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SUSTAINABLE FISHERIES MANAGEMENT PROJECT (SFMP)

Manual for GIS Training of Central Regional TCPD Officers

2017

THE UNIVERSITY OF RHODE ISLAND GRADUATE SCHOOL OF OCEANOGRAPHY | CRC COASTAL RESOURCES CENTER

SpS SPATIAL SOLUTIONS

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ACRONYMS

CRS	Coordinate Reference System
ESPG	European Petroleum Search Group
ESRI	Environmental Sciences Research Institute
GDAL	Geospatial Data Abstraction Library
GIS	Geographic Information System
GPS	Global Positioning System
GUI	Graphical User Interface
ICFG	Integrated Coastal and Fisheries Governance
IGNF	Institut Geographique National de France
OGR	OpenGIS Simple Features Reference Implementation
QGIS	Quantum GIS
SFMP	Sustainable Fisheries Management Program
TCPD	Town and Country Planning Department
USAID	United States Agency for International Development

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INTRODUCTION

The USAID-Ghana Sustainable Fisheries Management Project (SFMP) is committed to the capacity building of Town and Country Planning Department. The project recognizes the important role the department plays in the planning of the limited coastal land and beach fronts in the face of rapid coastal erosion and the influx of infrastructure to accommodate the burgeoning population in coastal communities. The Sustainable Fisheries Management Project is working to build the capacity of the region's Town and Country Planning Department (TCPD) through state-of-the-art facilities and regular trainings aimed at encouraging coastal resource management in physical planning.

Objectives

The GIS training is one of the activities aimed at activating the Central region GIS Data Hub to function as the model training center, not only for TCPD staff, but other sister land agencies and departments. The specific objectives for the training were:

- To activate the GIS Data Hub as the data clearinghouse and training center for the region.
- To introduce the use of Quantum GIS, GPS and Google earth for basic data collection and mapping purposes.
  This document is the training manual used

BASIC GIS AND FILE MANAGEMENT

Organizing the Working Directory

You can easily manage your files and folders using **File/Windows Explorer** on a Windows computer.

The File/Windows Explorer allows you to open, access, and rearrange your files and folders in Desktop view. It also allows you to create directories (folders) and sub directories for your project

1. Click the **folder icon** on the taskbar in Desktop view to open File/Windows Explorer.

2. Browse to the disc you want to organize your project in.

3. Click the 'New Folder' buttons and rename the folder.

4. Open the Folder and create new sub folders to reflect the structure of the project file organization

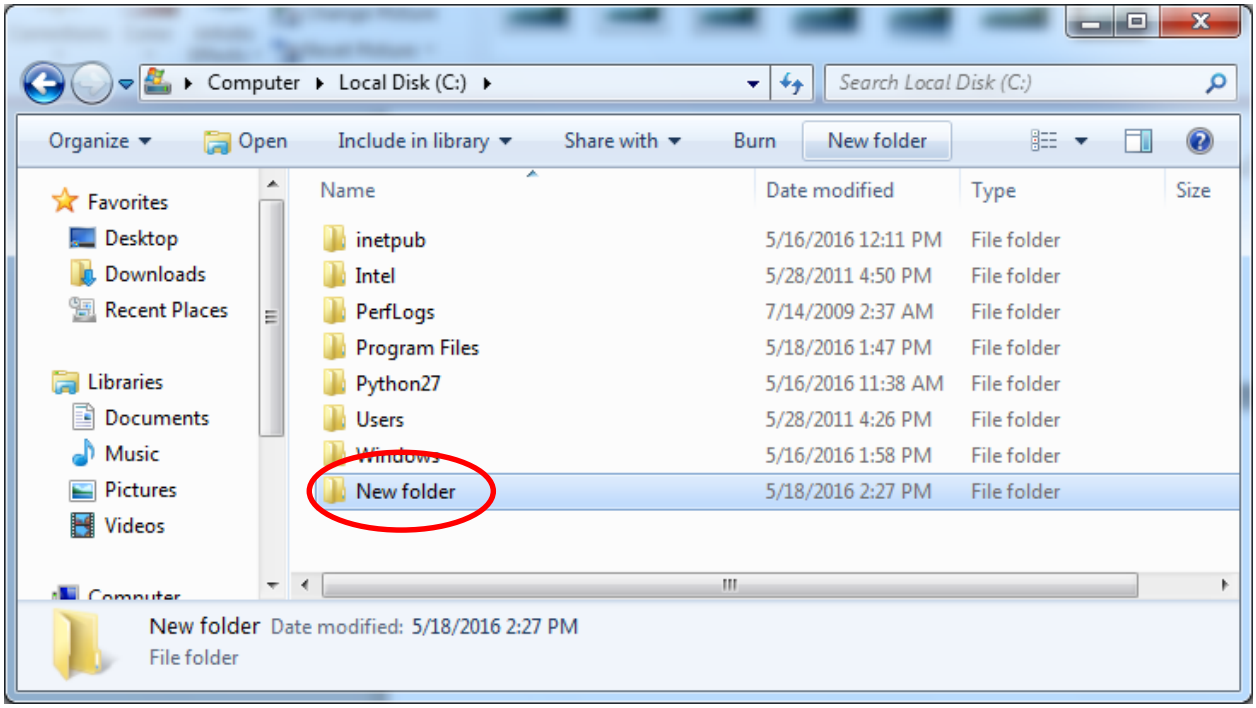

Figure 1 Create file folder

QGIS interface

Download and install Quantum GIS from https://www.qgis.org/en/site/forusers/download.html.

Once QGIS is installed and launched, you are presented with the GUI as shown in Figure 1.

The QGIS GUI is divided into five areas:

1. Menu Bar: The menu bar provides access to various QGIS features using a standard hierarchical menu.

2. Tool Bar: The toolbar provides access to most of the same functions as the menus, plus additional tools for interacting with the map. Each toolbar item has pop-up help available. Hold your mouse over the item and a short description of the tool's purpose will be displayed. Every menu bar can be moved around according to your needs. Additionally, every menu bar can be switched off using your right mouse button context menu, holding the mouse over the toolbars.

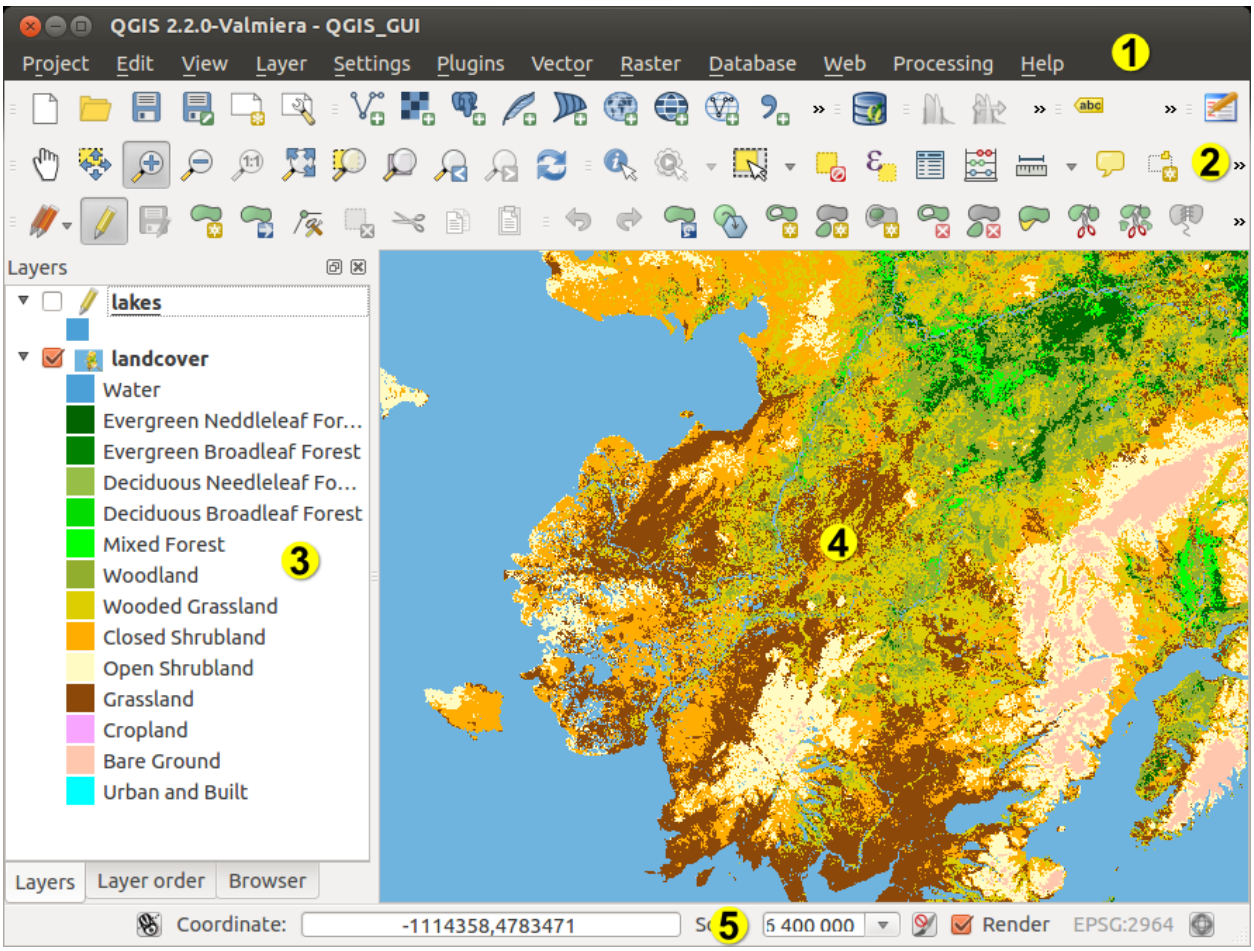

Figure 2 The QGIS Graphical User Interface

Tip: Restoring toolbars If you have accidentally hidden all your toolbars, you can get them back by choosing menu option Settings → Toolbars →.

3. Map Legend: The map legend area lists all the layers in the project. The checkbox in each legend entry can be used to show or hide the layer. A layer can be selected and dragged up or down in the legend to change the Z-ordering. Z-ordering means that layers listed nearer the top of the legend are drawn over layers listed lower down in the legend.

4. Map View: Maps are displayed in this area. The map displayed in this window will depend on the vector and raster layers you have chosen to load. The map view can be panned, shifting the focus of the map display to another region, and it can be zoomed in and out. Various other operations can be performed on the map as described in the toolbar description above. The map view and the legend are tightly bound to each other — the maps in view reflect changes you make in the legend area.

5. Status Bar: The status bar shows you your current position in map coordinates (e.g., meters or decimal degrees) as the mouse pointer is moved across the map view. To the left of the coordinate display in the status bar is a small button that will toggle between showing coordinate position or the view extents of the map view as you pan and zoom in and out. Next to the coordinate display you will find the scale display. It shows the scale of the map view. If you zoom in or out, QGIS shows you the current scale.

Adding a Vector Layer

The standard vector file format used in QGIS is the ESRI shapefile. A shapefile actually consists of several files. The following three are required:

- .shp file containing the feature geometries
- .dbf file containing the attributes in dBase format
- .shx index file

Shapefiles also can include a file with a .prj suffix, which contains the projection information. While it is very useful to have a projection file, it is not mandatory. A shapefile dataset can contain additional files.

Loading a Shapefile

To load a shapefile, click on the Add Vector Layer toolbar button or by select the Layer → Add Vector Layer menu option. This will bring up a new window

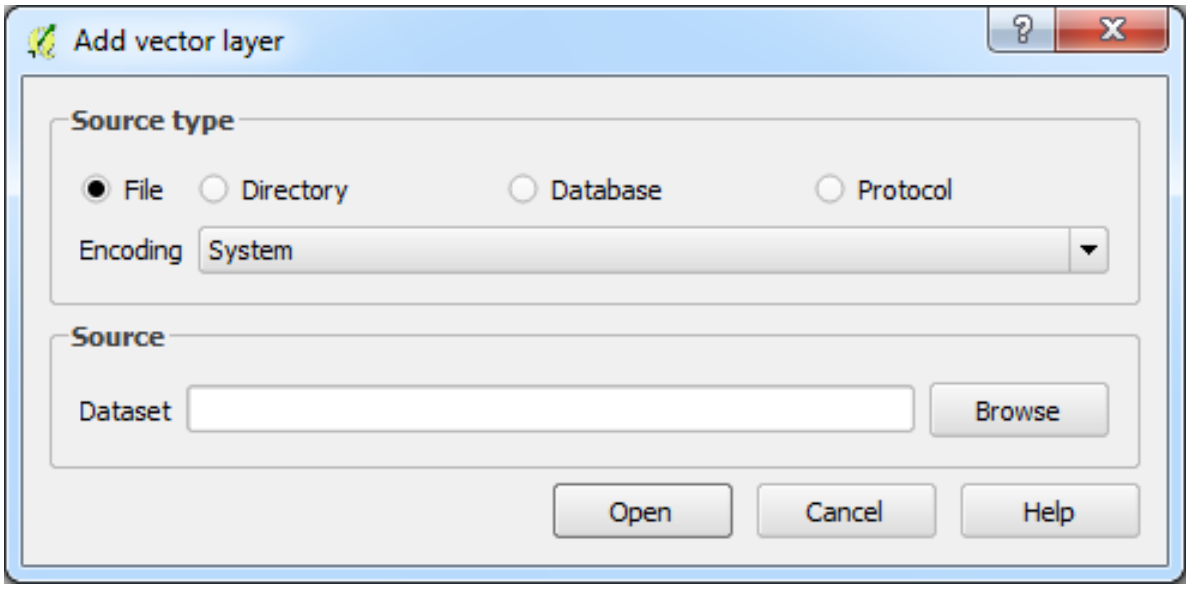

Figure 3 Add Vector Layer menu option

From the available options check File.

Click on 'Browse'. That will bring up a standard open file dialog which allows you to navigate the file system and load a shapefile or other supported data source.

The selection box Filter allows you to preselect some OGR-supported file formats. More than one layer can be loaded at the same time by holding down the Ctrl or Shift key and clicking on multiple items.

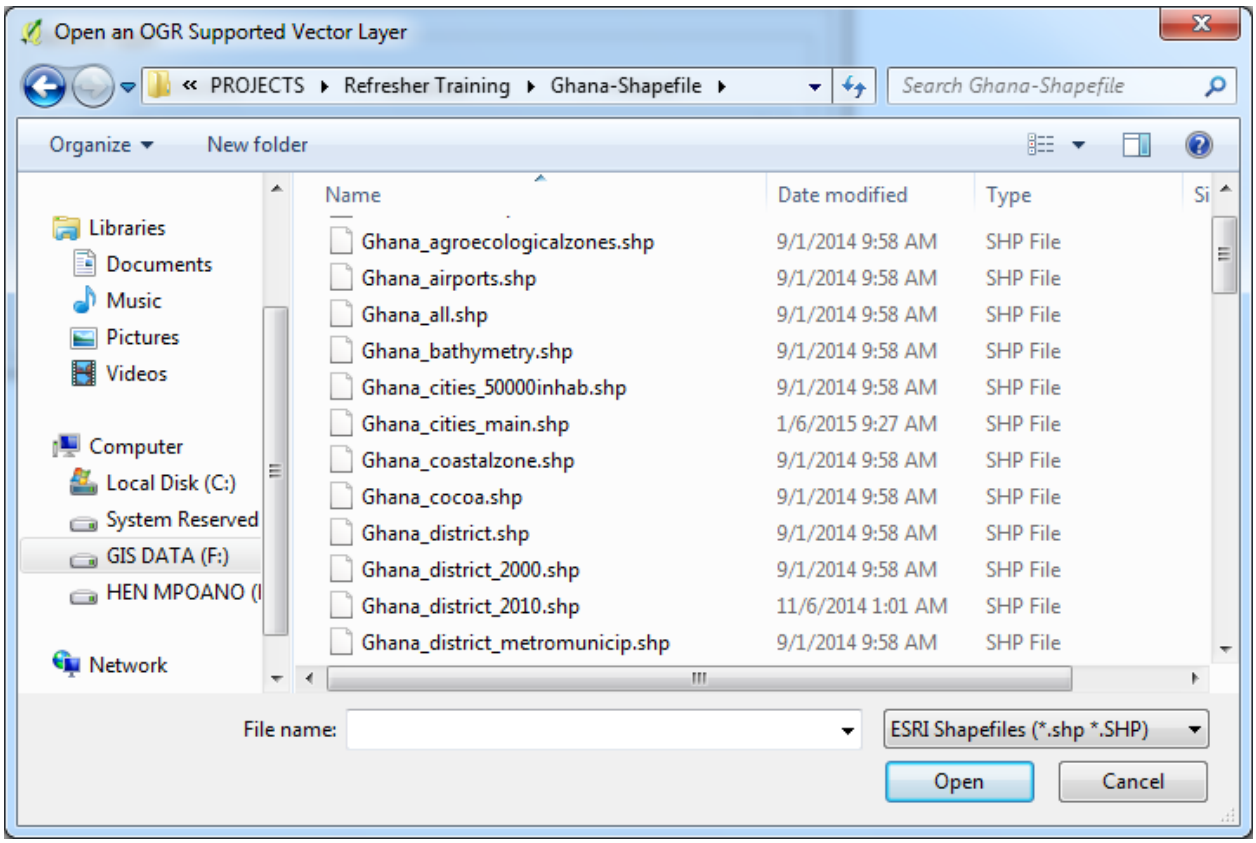

Figure 4 Selecting a shapefile from the list and clicking 'Open' loads it into QGIS

Selecting a shapefile from the list and clicking 'Open' loads it into QGIS.

Tip: Layer Colors

When you add a layer to the map, it is assigned a random color. When adding more than one layer at a time, different colors are assigned to each layer.

Once a shapefile is loaded, you can zoom around it using the map navigation tools. To change the style of a layer, open the Layer Properties dialog by double clicking on the layer name or by right-clicking on the name in the legend and choosing Properties from the context menu (Refer to Symbology for more on styling layers).

Adding Raster data in QGIS

Raster layers are loaded either by clicking on the Add Raster Layer icon or by selecting the Layer → Add Raster Layer menu option. More than one layer can be loaded at the same time by holding down the Ctrl or Shift key and clicking on multiple items in the Open a GDAL Supported Raster Data Source dialog.

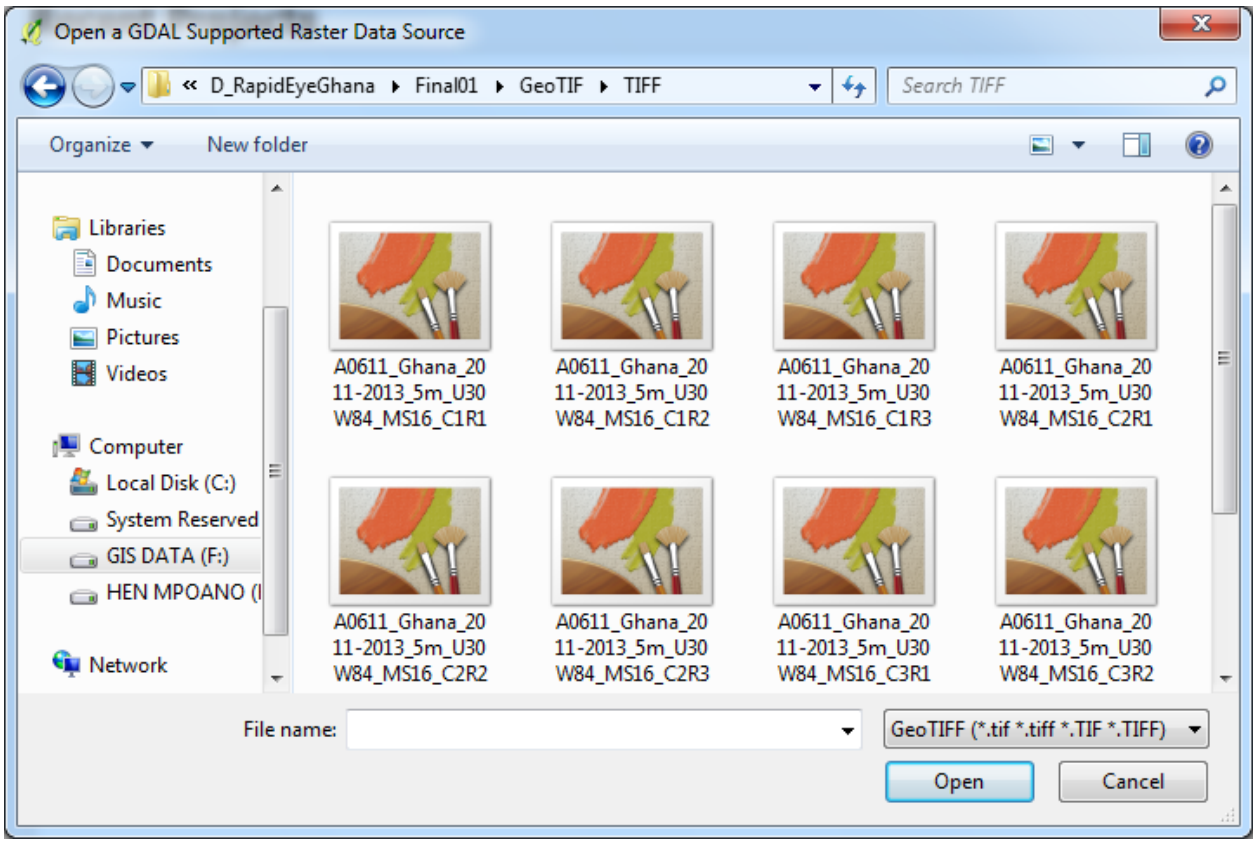

Figure 5 Open a GDAL Supported Raster Data Source dialog.

Symbology

The symbology of a layer is its visual appearance on the map. The basic strength of GIS over other ways of representing data with spatial aspects is that with GIS, you have a dynamic visual representation of the data you're working with.

Changing Colors

To change a vector layer's symbology;

- Select the menu item 'Properties' in the menu that appears. you can also access a layer's properties by double-clicking on the layer in the Layers list
- In the 'Properties' window, select the 'Style' tab at the extreme left:

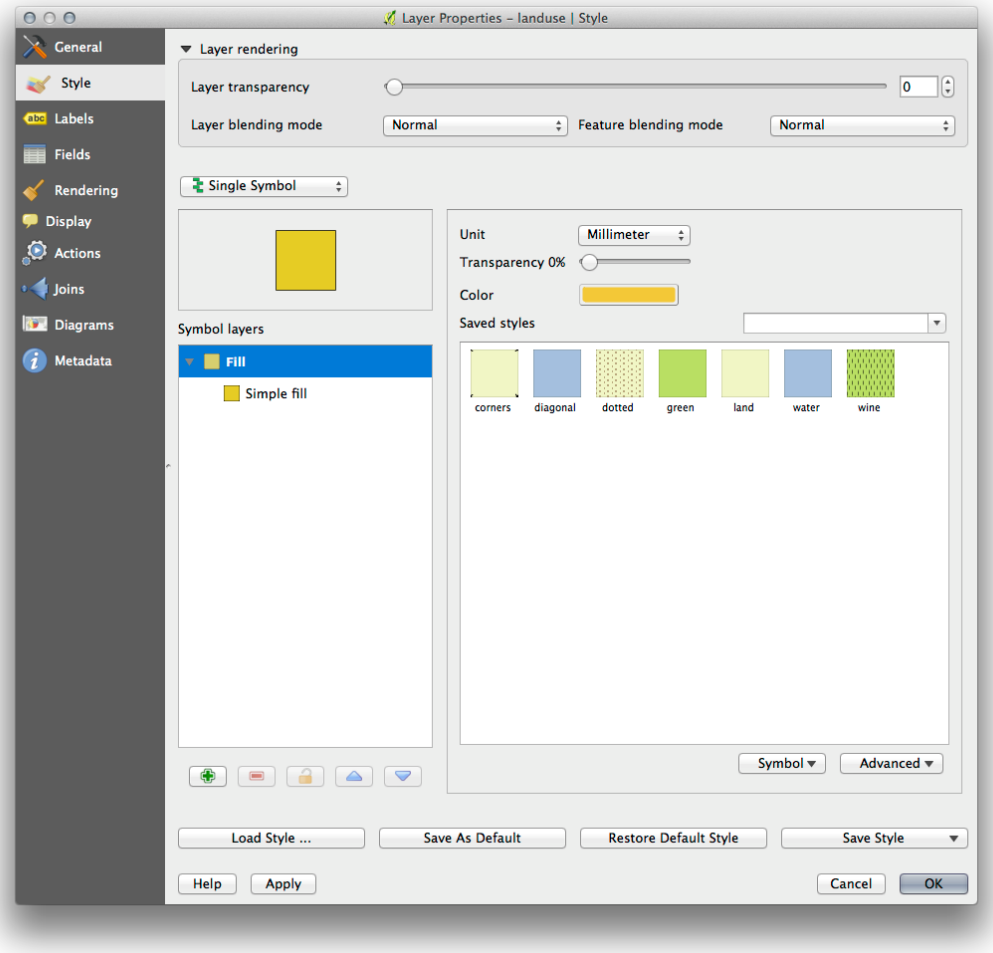

Figure 6 In the 'Properties' window, select the 'Style' tab at the extreme left

- Click the color select button next to the 'color' label.

A standard color dialog will appear.

- Choose a color and click 'OK'
- Click 'OK' again in the 'Layer Properties' window, and you will see the color change being applied to the layer.

Changing Symbol Structure

- Open the 'Layer Properties' window for the layer.
- In the 'Symbol Layer' panel under the 'Style' tab, expand the 'fill' dropdown (if necessary) and select the 'simple fill' option:

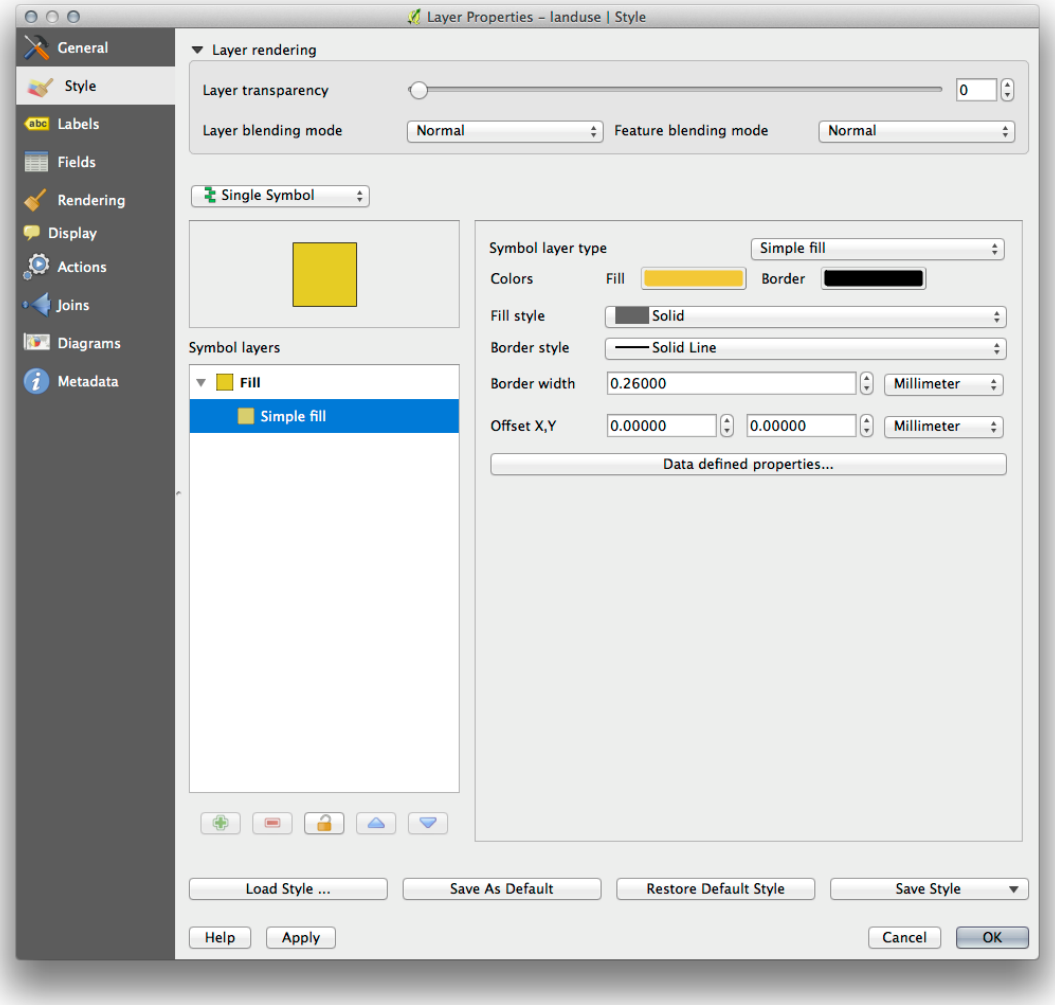

Figure 7 Open the'Layer Properties' window for the layer

- Click on the 'Border style' dropdown and change the style to you specification.
- Click 'OK'.

DATA ACQUISITION (PRIMARY AND SECONDARY SOURCES)

One major component of GIS is geospatial data. There are 2 main sources of all geospatial data- Primary and secondary sources. Primary data are collected on the ground with surveying instruments or GPS receivers. Another way Planners acquire data is retrieving needed information from existing data like aerial photos, scanned topographic maps, scanned sector layouts, etc.

Using GPS data

Loading GPS data from a file

There are dozens of different file formats for storing GPS data. The format that QGIS uses is called GPX (GPS eXchange format), which is a standard interchange format that can contain any number of waypoints, routes and tracks in the same file.

To load a GPX file, you first need to load the plugin.

Plugins→ Plugin Manager... opens the Plugin Manager Dialog. Activate the GPS Tools checkbox. When this plugin is loaded, two buttons with a small handheld GPS device will show up in the toolbar:

- Create new GPX Layer
- GPS Tools

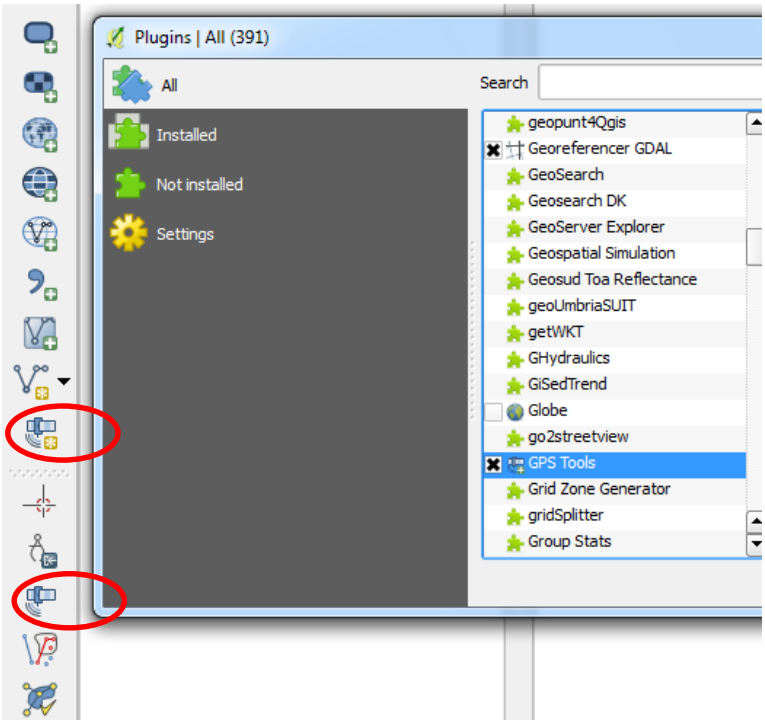

Figure 8 To load a GPX file, you first need to load the plugin

1. Select Vector→GPS→GPS Tools or click the 'GPS Tools' icon in the toolbar and open the 'Load GPX file' tab.

2. Browse to the folder containing the GPX file. Select the file and click 'Open'.

Use the 'Browse' button to select the GPX file, and then use the checkboxes to select the feature types you want to load from that GPX file. Each feature type will be loaded in a separate layer when you click 'OK'.

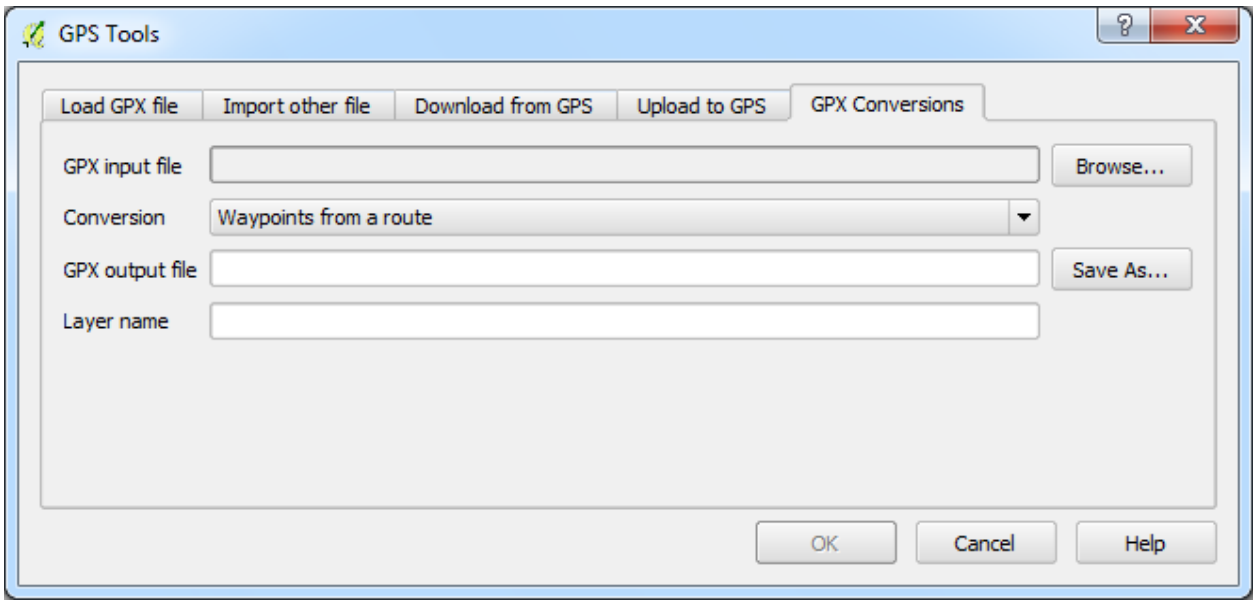

Figure 9 Browse to the folder containing the GPX file

Digitizing

Creating an empty shapefile

Digitization in GIS is the process of converting information from imagery, scanned maps, etc. into a digital (vector) format Before you can create a new vector layer (which will be stored in a shapefile), you need know what the geometry of that layer will be (point, polyline or polygon), and you need to know what the attributes of that layer will be.

Once you have planned what features you want to capture into the GIS, and the geometry type and attributes that each feature should have, you can move on to the next step of creating an empty shapefile.

The process usually starts with choosing the 'new vector layer' option and then selecting a geometry type.

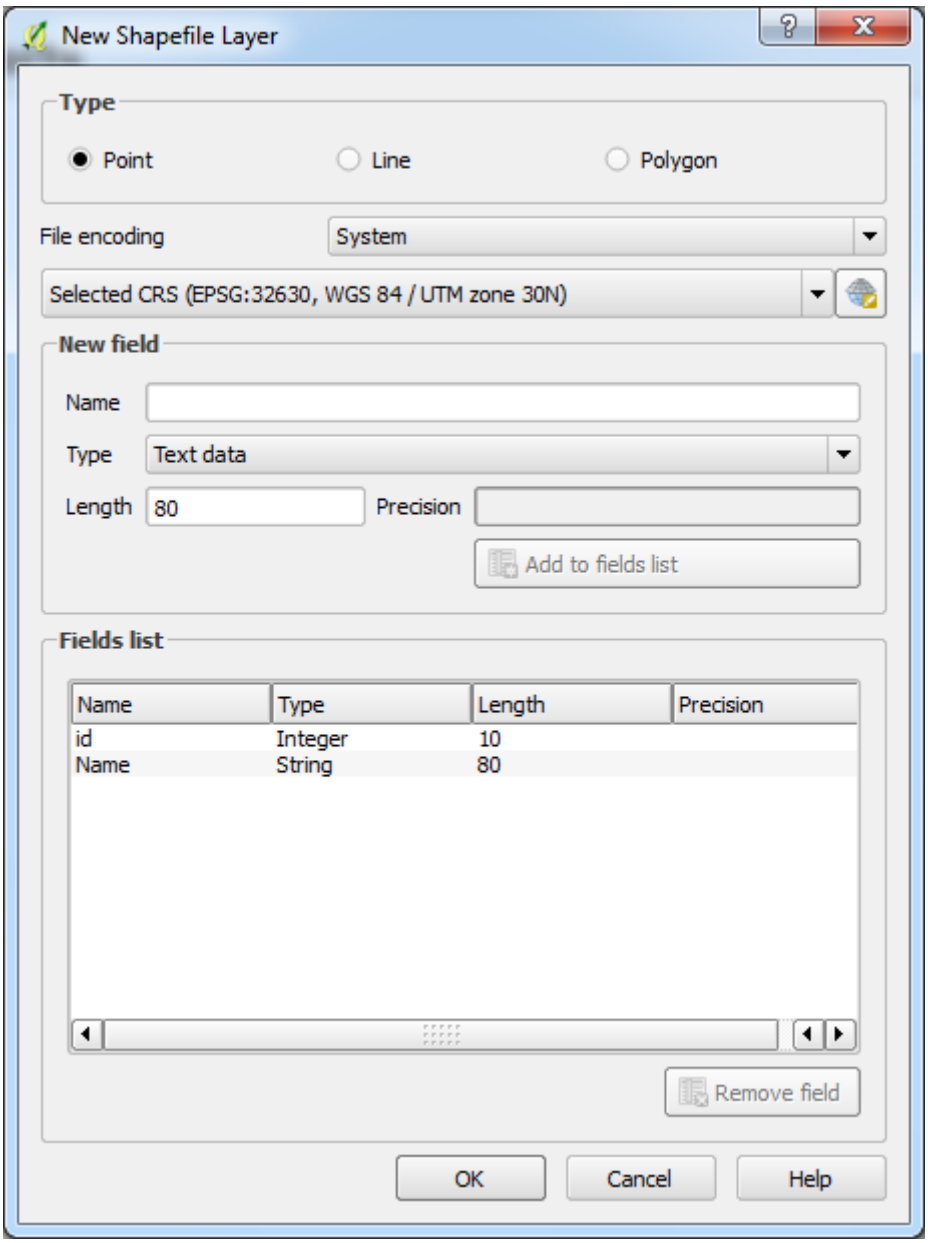

Figure 10 New shapefile Layer

Next you will add fields to the attribute table. Normally we give field names that are short, have no spaces and indicate what type of information is being stored in that field. Example field names may be 'pH', 'RoofColour', 'RoadType' and so on. As well as choosing a name for each field, you need to indicate how the information should be stored in that field — i.e. is it a number, a word or a sentence, or a date?

Computer programs usually call information that is made up of words or sentences '**strings**', so if you need to store something like a street name or the name of a river, you should use 'String' for the field type.

The shapefile format allows you to store the numeric field information as either a whole number (**integer**) or a decimal number (**floating point**) — so you need to think beforehand whether the numeric data you are going to capture will have decimal places or not.

The final step for creating a shapefile is to give it a name and a place on the computer hard disk where it should be created. Once again it is a good idea to give the shapefile a short and meaningful name.

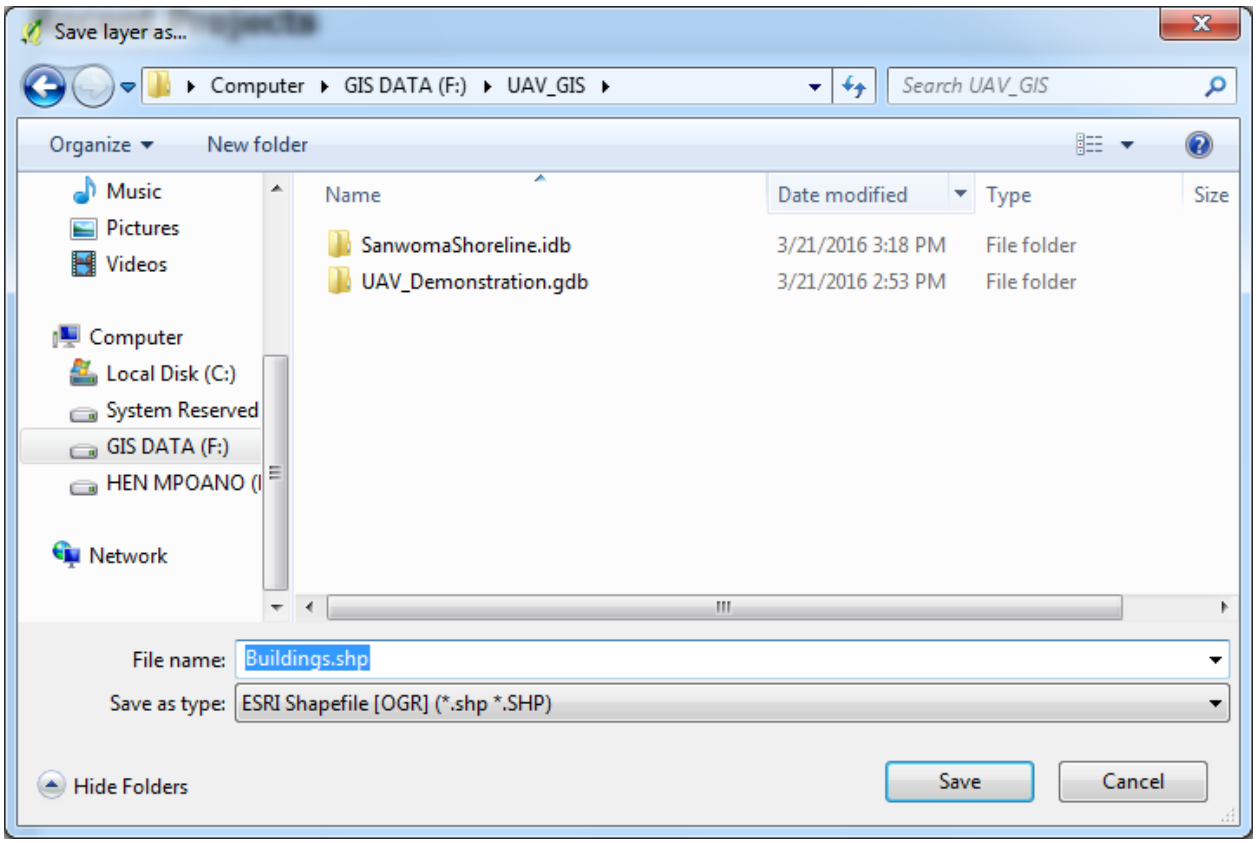

Figure 11 Give the shapefile a short and meaningful name

Adding data to your shapefile

So far we have only created an empty shapefile. Now we need to enable editing in the shapefile using the 'enable editing' menu option or tool bar icon. Next we need to start adding data. There are two steps we need to complete for each record we add to the shapefile:

- Capturing geometry
- Entering attributes

The process of capturing geometry is different for points, polylines and polygons.

To capture a point, you first use the map pan and zoom tools to get to the correct geographical area that you are going to be recording data for. Next you will need to enable the point capture tool. Having done that, the next place you click with the left mouse button in the map view, is where you want your new point geometry to appear. After you click on the map, a window will appear and you can enter all of the attribute data for that point.

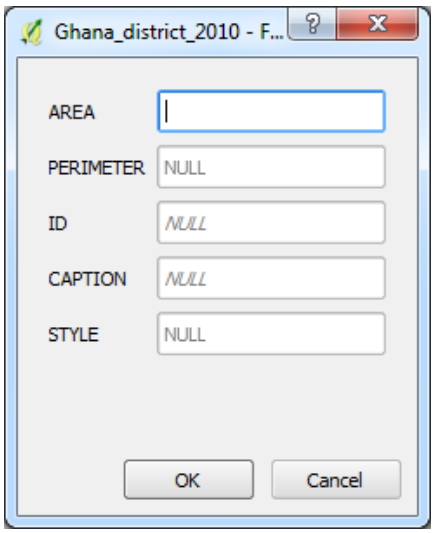

Figure 12 After you click on the map, a window will appear and you can enter all of the attribute data for that point

To capture a polyline the process is similar to that of a point, in that you need to first use the pan and zoom tools to move the map in the map view to the correct geographical area. You should be zoomed in enough so that your new vector polyline feature will have an appropriate scale. When you are ready, you can click the polyline capture icon in the tool bar and then start drawing your line by clicking on the map. After you make your first click, you will notice that the line stretches like an elastic band to follow the mouse cursor around as you move it. Each time you click with the left mouse button, a new vertex will be added to the map.

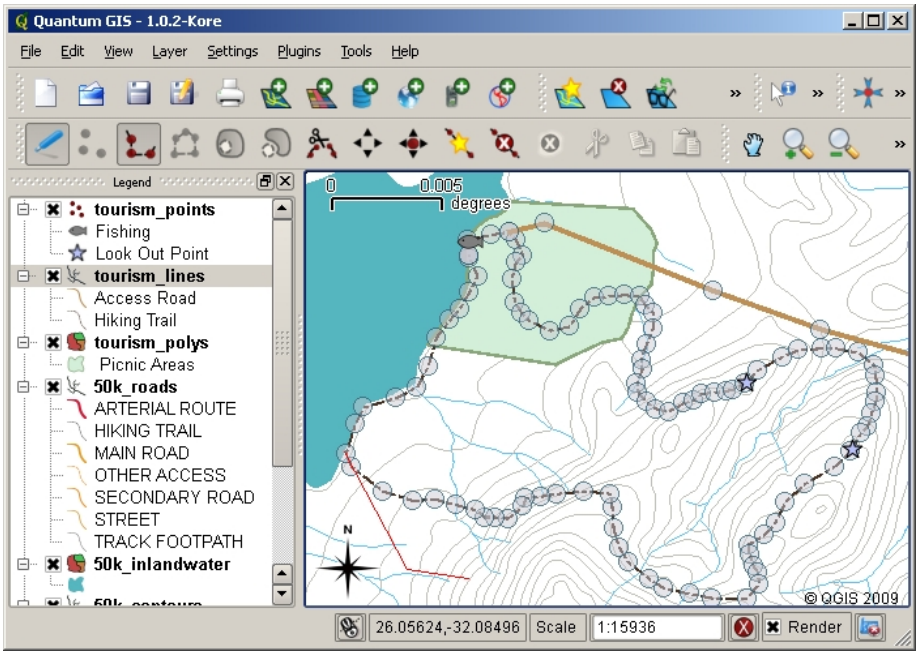

Figure 13 The line stretches like an elastic band to follow the mouse cursor around as you move it.

When you have finished defining your line, use the right mouse button to tell the GIS Application that you have completed your edits. As with the procedure for capturing a point feature, you will then be asked to enter in the attribute data for your new polyline feature.

The process for capturing a polygon is almost the same as capturing a polyline except that you need to use the polygon capture tool in the toolbar. Also, you will notice that when you draw your geometry on the screen, the GIS Application always creates an enclosed area.

To add a new feature after you have created your first one, you can simply click again on the map with the point, polyline or polygon capture tool active and start to draw your next feature.

When you have no more features to add, always be sure to click the ‘allow editing’ icon to toggle it off. The GIS Application will then save your newly created layer to the hard disk.

DATA FORMATS AND DATA INTEROPERABILITY

Supported Data Formats

Vector Data Formats

QGIS uses the OGR library to read and write vector data formats, including ESRI shapefiles, MapInfo and Micro-Station file formats, AutoCAD DXF, PostGIS, SpatiaLite, Oracle Spatial and MSSQL Spatial databases, and many more. GRASS vector and PostgreSQL support is supplied by native QGIS data provider plugins. Vector data can also be loaded in read mode from zip and gzip archives into QGIS

Raster Data formats

QGIS uses the GDAL library to read and write raster data formats, including ArcInfo Binary Grid, ArcInfo ASCII Grid, GeoTIFF, ERDAS IMAGINE, and many more. GRASS raster support is supplied by a native QGIS data provider plugin. The raster data can also be loaded in read mode from zip and gzip archives into QGIS.

Coordinate Systems and data Projections

QGIS has support for approximately 2,700 known CRSs. Definitions for each CRS are stored in a SQLite database that is installed with QGIS. Normally, you do not need to manipulate the database directly. In fact, doing so may cause projection support to fail. Custom CRSs are stored in a user database.

The CRSs available in QGIS are based on those defined by the European Petroleum Search Group (EPSG) and the Institut Geographique National de France (IGNF) and are largely abstracted from the spatial reference tables used in GDAL. EPSG identifiers are present in the database and can be used to specify a CRS in QGIS.

PRACTICAL EXERCISE

Capturing data from Google Earth into QGIS for georeferencing

1. Download Google Earth Pro (www.google.com/earth/download/gep/agree.html)
2. Log in (Using a google account and GETFREE as the password)

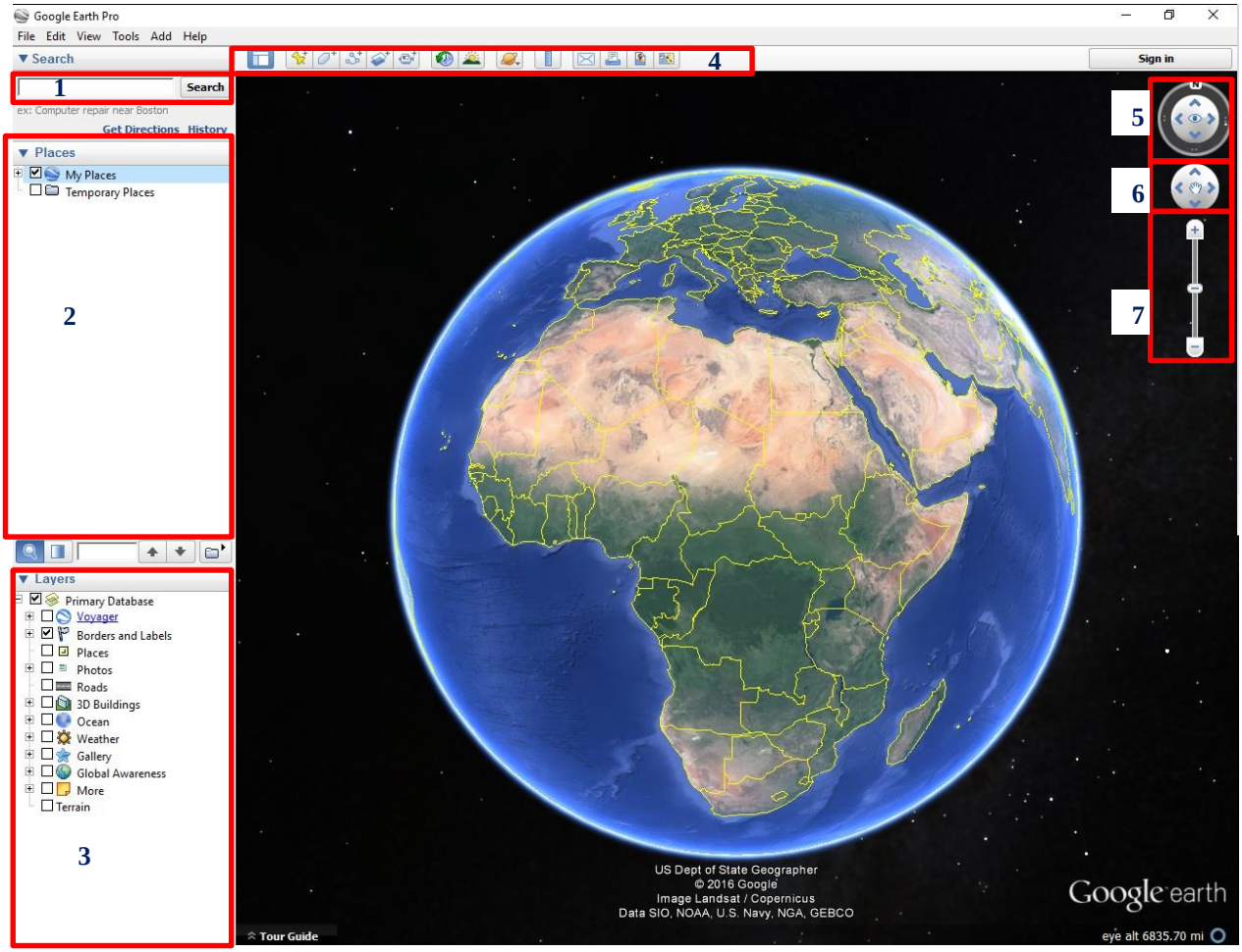

Figure 14 Capturing data from Google Earth into QGIS for georeferencing

Parts of the interface 1 (Search box: Querying for location/places), 2 (My place: Organisation of mapped data), 3(Layers: Displays the tiles and data on google earth), 4(Tools), 5(Orientation: Direction), 6(Panning), 7 (Zooming In+ and zooming out-).

3. Zoom to area of interest (Search using your search box)

- (Example: Search for Elmina)

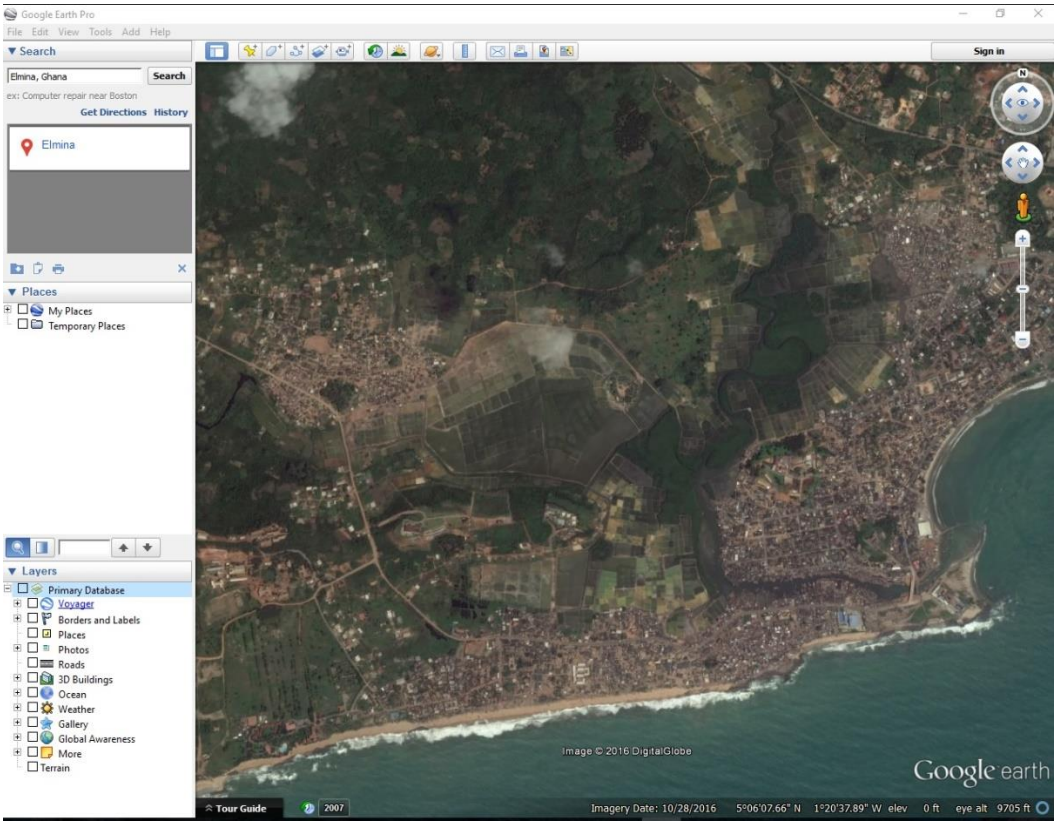

Figure 15 Search for Elmina

- Explore the image using 6 (Panning), 7 (Zooming) and 5 (Orientation –make sure the North point is always facing up)
-

4. Generate control points (which will serve as reference for georeferencing image).
    a. Create a folder under My Places (2): Right click on **My Places**, select **Add** and select **Folder** (Name the folder:Elmina)
    b. Right click on the folder created and select **Placemark**

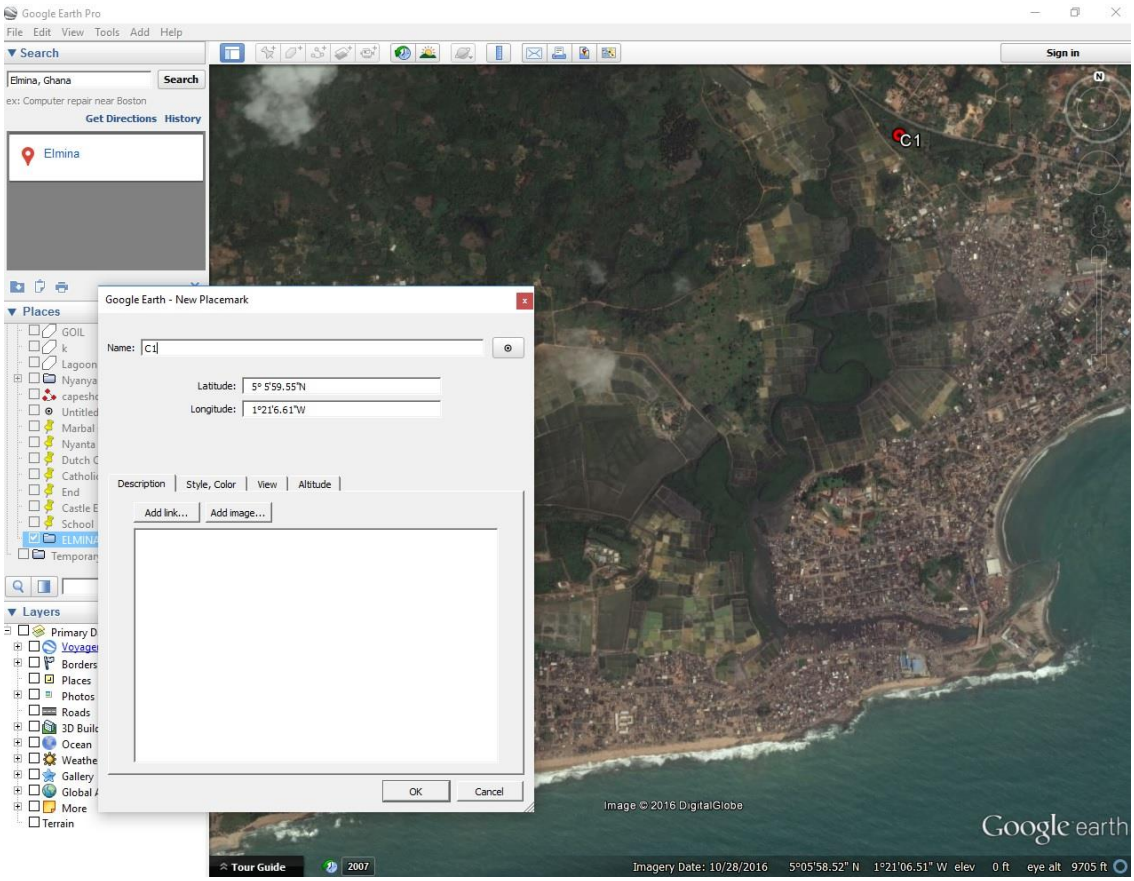

Figure 16 Generate control points

-Type name of point - Change the symbol - Point on photo (Use pan tool to move the point to the desired location)

c. Repeat, process [b] until you get a minimum of 4 points

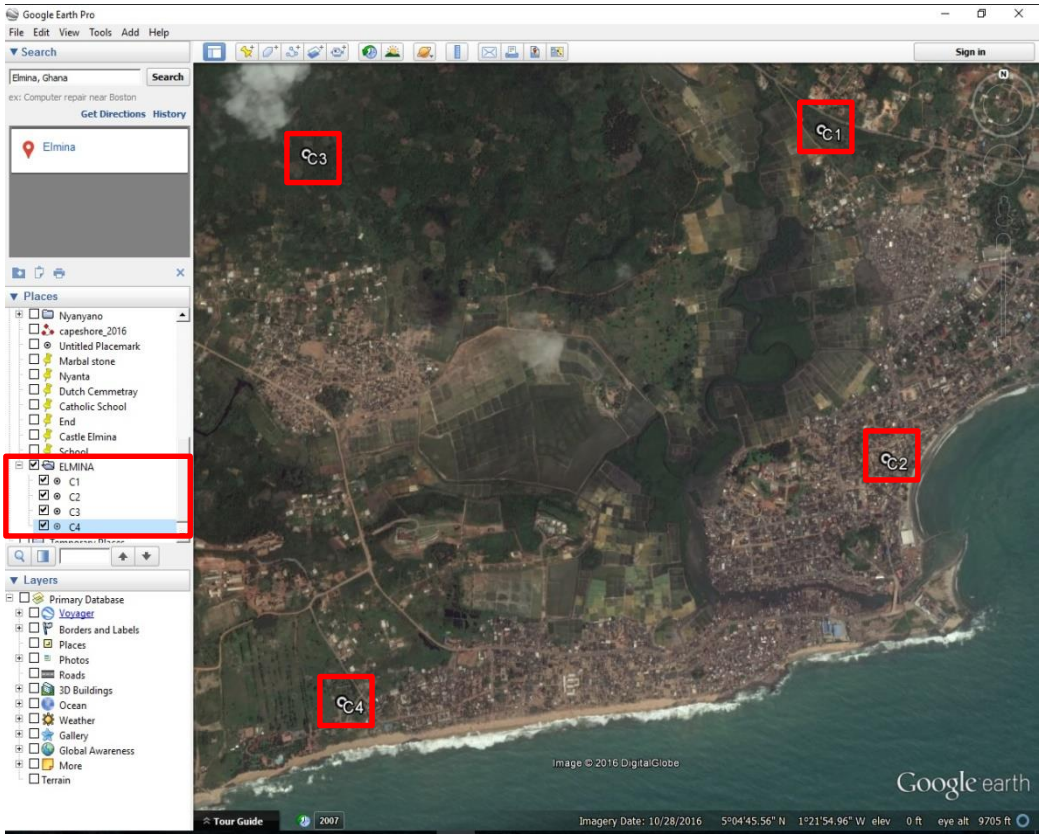

Figure 17 Control points

d. Points should be well over the area of interest (Should be shown on the map and within your folder [**Elmina**] under **My Places.**

5. Save the control points and image
    a. Right click on the folder Elmina and select **Save Place As**
    b. Locate a working folder or create one to save the points
6. Save Image
    a. Click on **File**, select **Save** and select **Save Image**

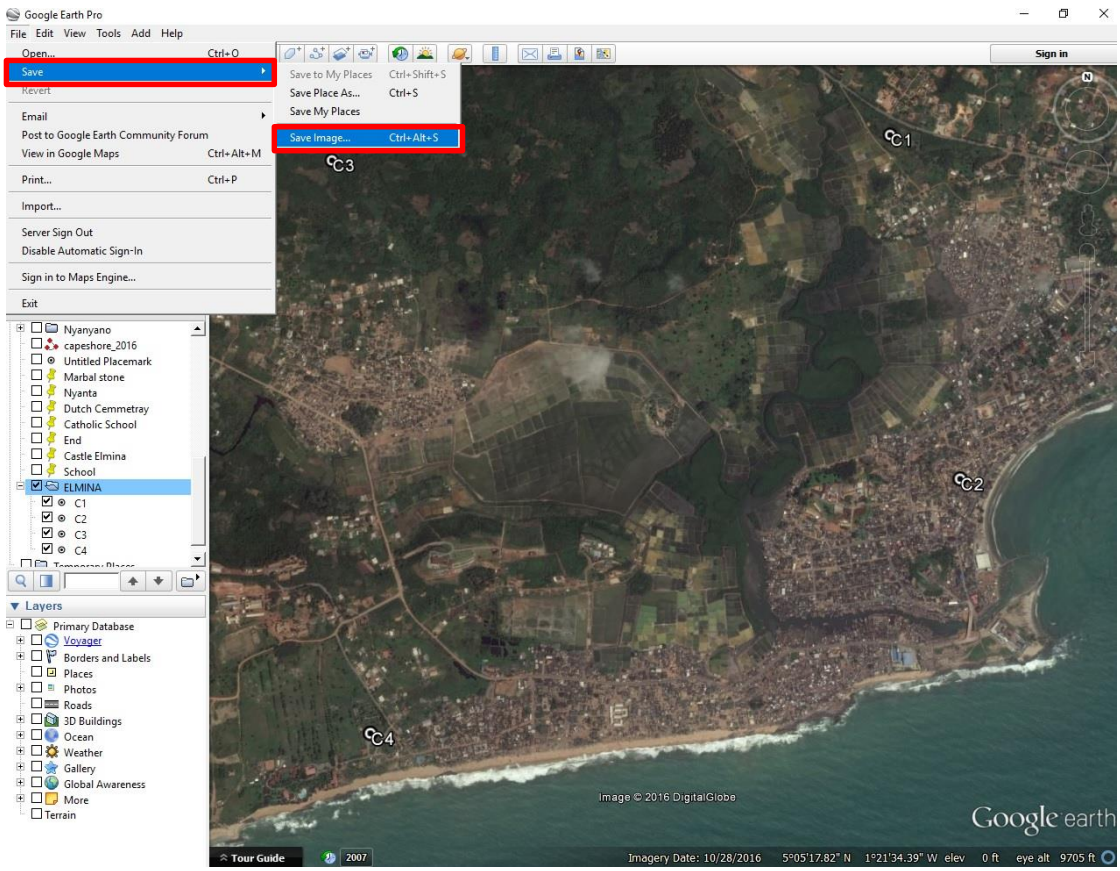

Figure 18 Save the control points and image

b. Select the highest resolution (Maximum 4800*4074) beside **Map Options**
c. Click on **Save Image** (Elmina) and locate a working folder

7. Georeferencing data in QGIS software
   a. Open QGIS software
   b. Load set the spatial reference of the software environment (Select **Settings**, then **Options** and make sure the coordinate is in the coordinate of the source data-in this case is World Geodetic Systems **WGS1984)**

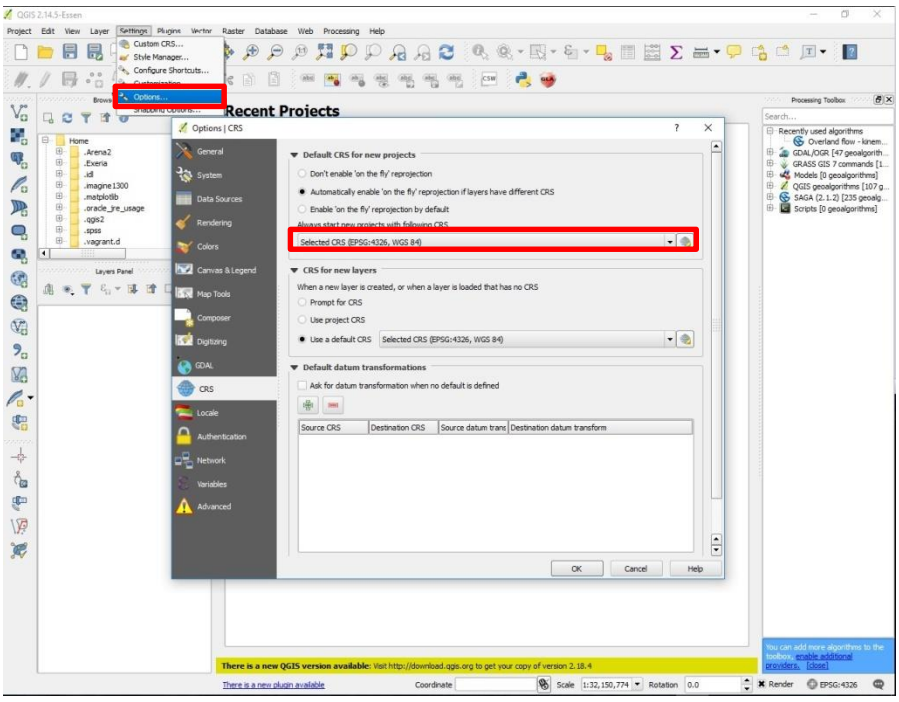

Figure 19. Load the Control Points saved from Google Earth

c. Load the **Control Points** saved from Google Earth

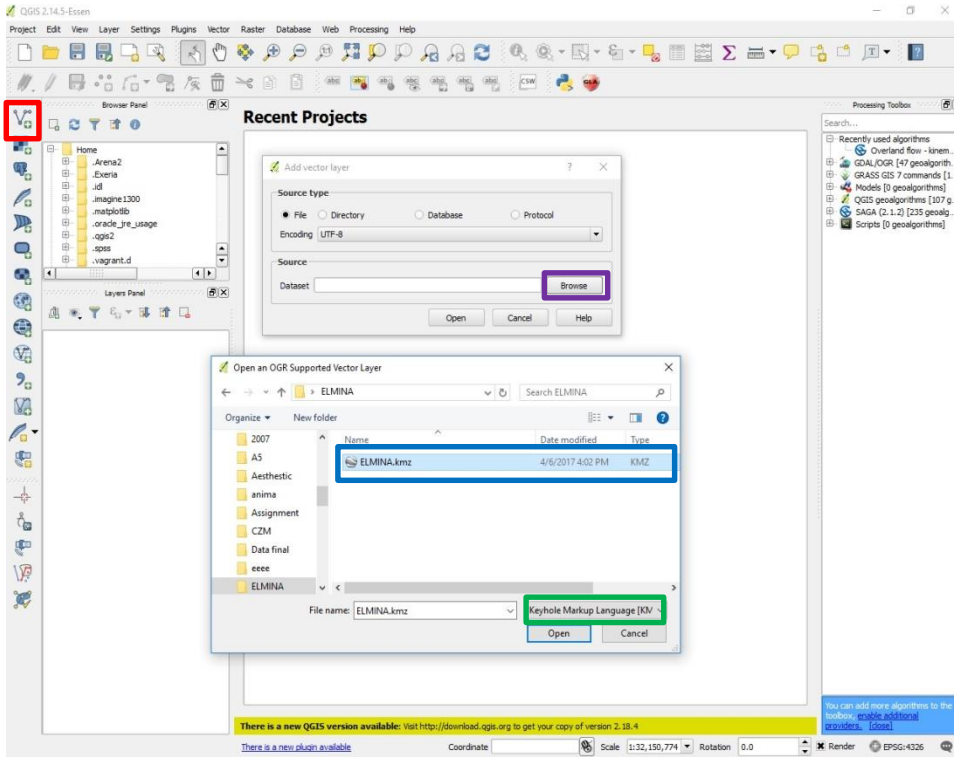

Figure 20 Adding vector

Click **Add Vector** Click on **Browse** to locate your add

Change data format to Keyholemarkup Language (Kml)

Select the data **(Elmina)**

d. Vector data displayed

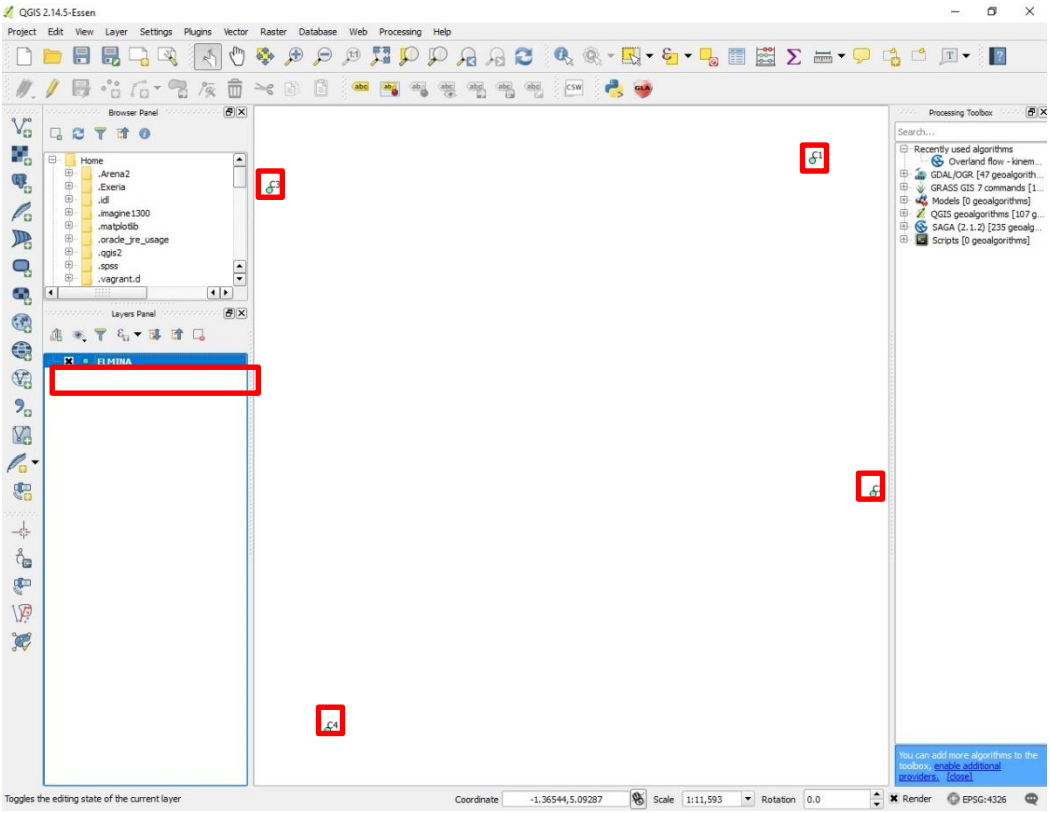

Figure 21 Vector data displayed

e. Load the image saved (**ElminaJpg**) into Georeferencer

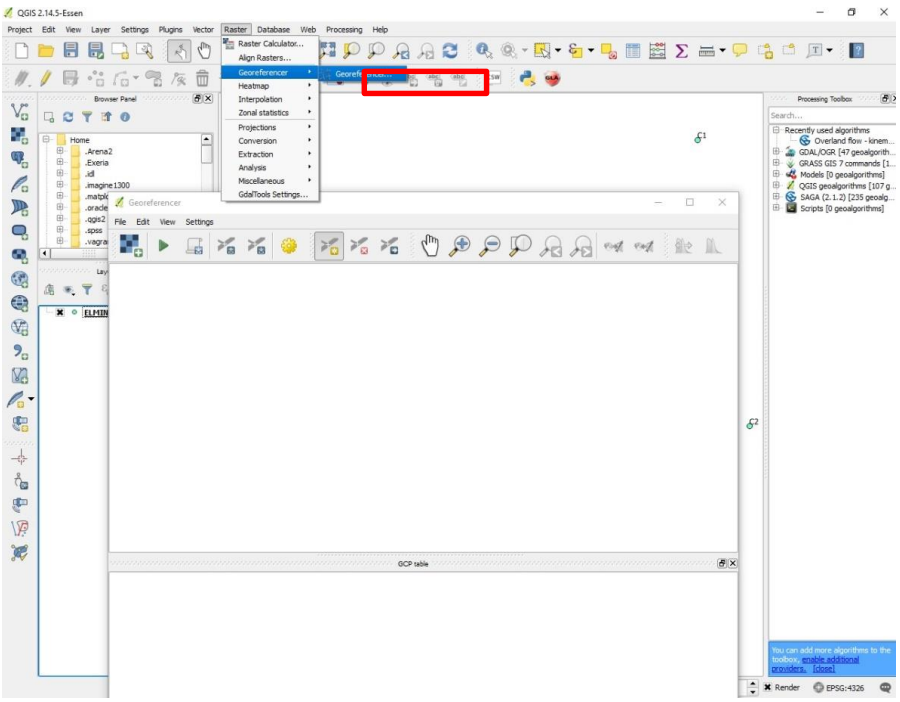

Figure 22 Load the image saved (ElminaJpg) into Georeferencer

f. Select **Raster** on the File Menu, and then **Geo-referencer**
g. Load the image by selecting the **Raster** and locating the image **Elmina**

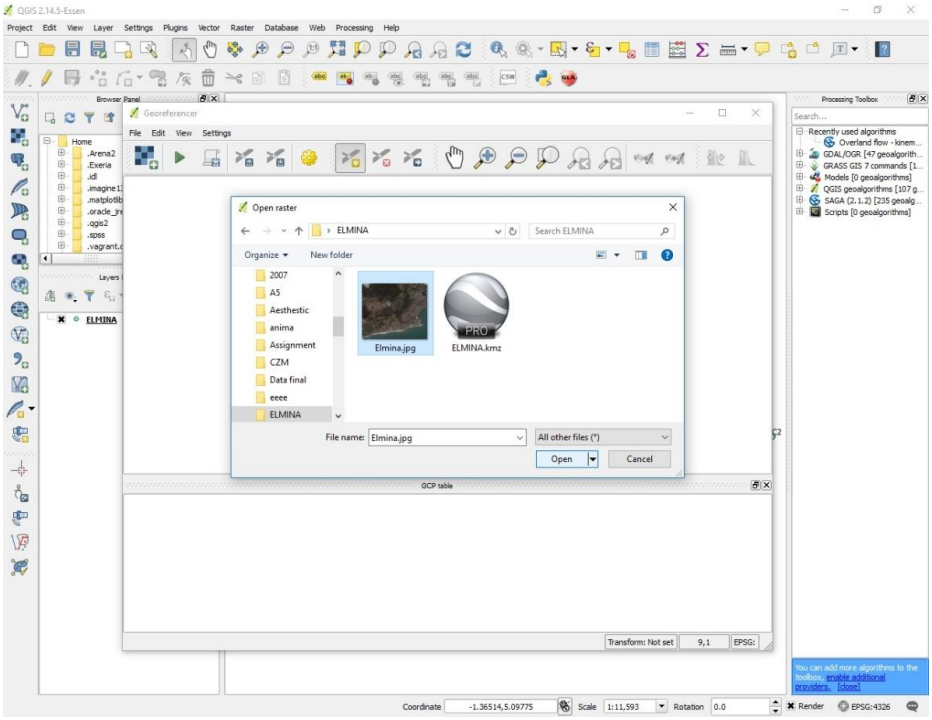

Figure 23 Load the image by selecting the Raster and locating the image Elmina

- Click on Raster tool ▭ Select the image ▭

h. Start Georeferencing by adding control points

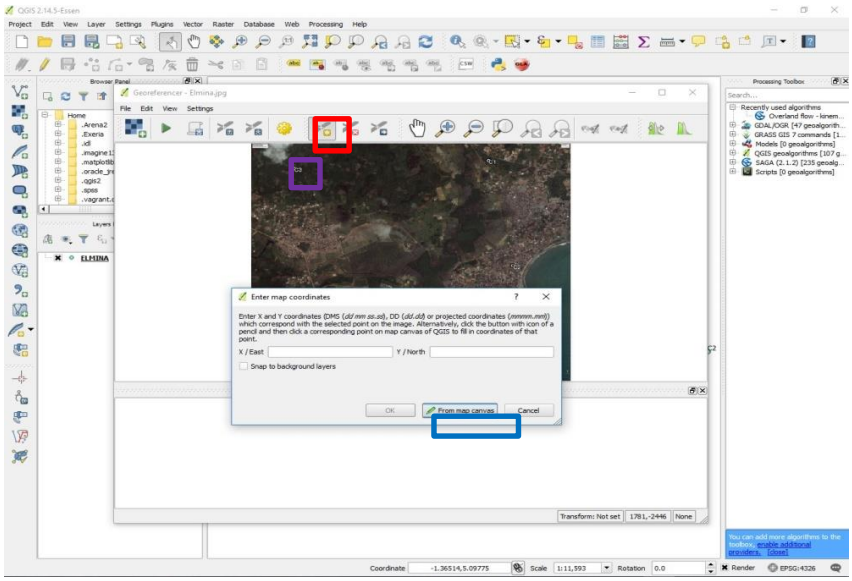

Figure 24 Start Georeferencing by adding control points

▭ Select **Add** button ▭ Click on the point on the image ▭ Select **From map Canvas**

i. Select the corresponding point (c3) in the QGIS Data view

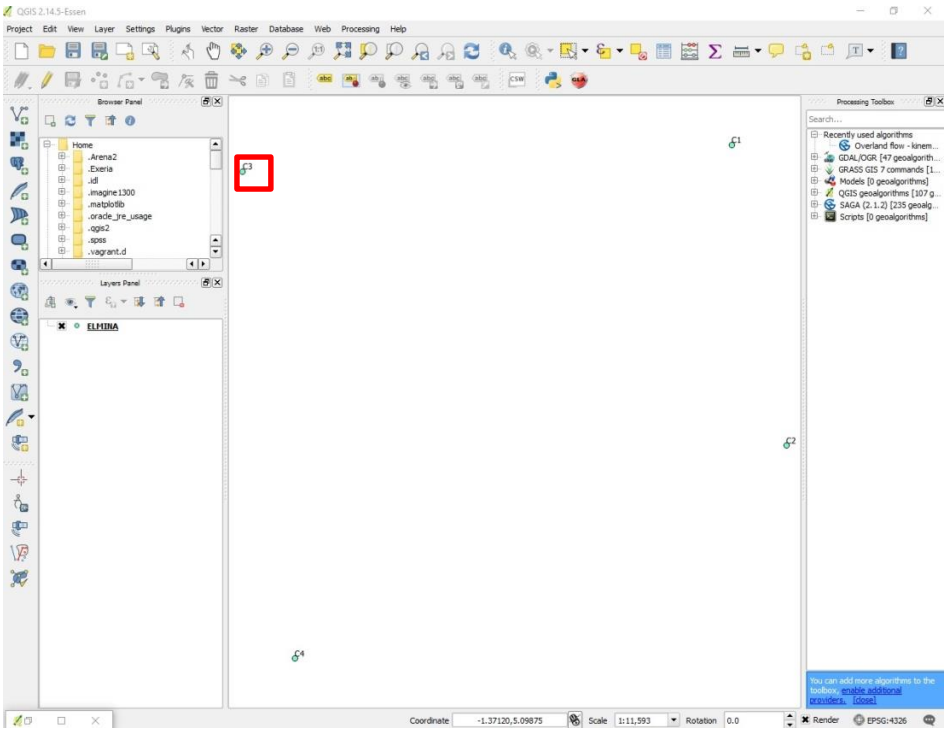

Figure 25 Select the corresponding point (c3) in the QGIS Data view

j. Ok it on the Enter map Coordinate window. Repeat h and j until all the points have coordinates

k. Select on settings once all control points on the image has been corresponded with its vector in the QGIS data view

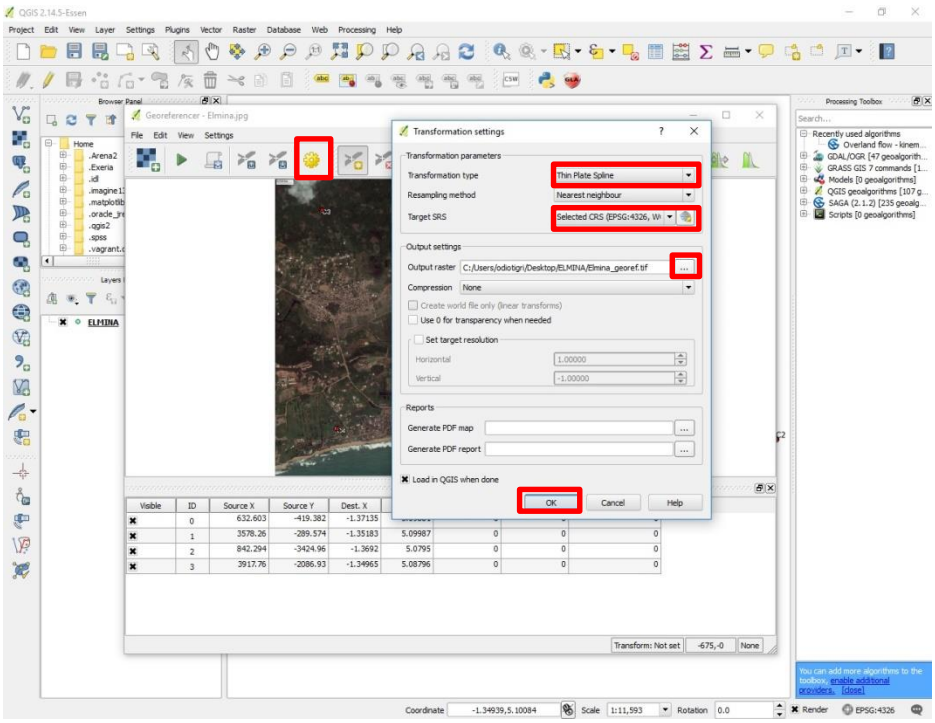

Figure 26 Click on Play or Run for georeferencing to be effected

l. Click on Play or Run for georeferencing to be effected. (Image is now georeferenced and it will over lay with the vector data

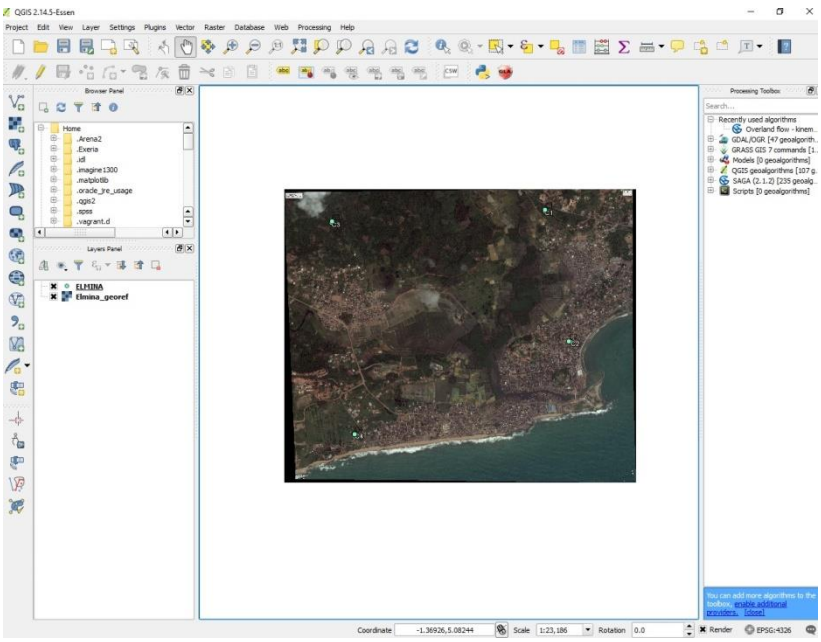

Figure 27 Drag the vector data Elmina on top of Elmina_georef

m. Drag the vector data **Elmina** on top of **Elmina_georef** (Image is georeferenced and can now be worked with spatially)**.**