UNIVERSITY OF MUMBAI

Teacher's Reference Manual

USIT6P4

(Discipline Specific Elective Practical)

Principles of Geographic Information Systems Practical

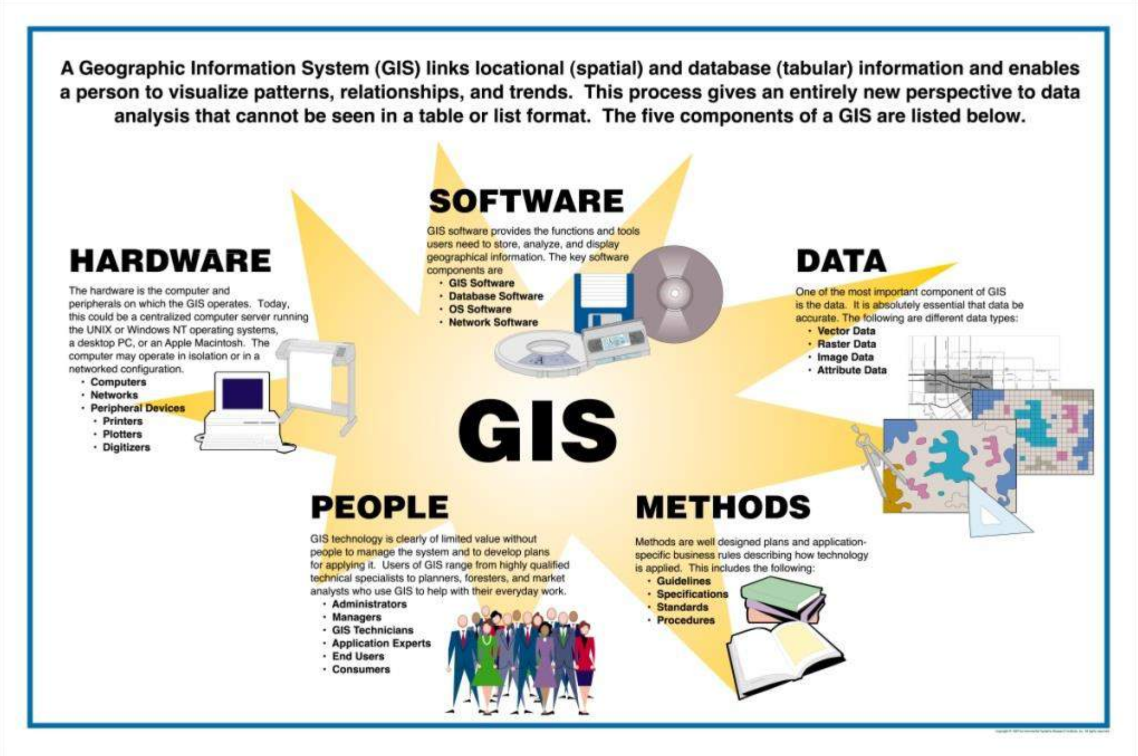
with effect from the academic year

2018 – 2019

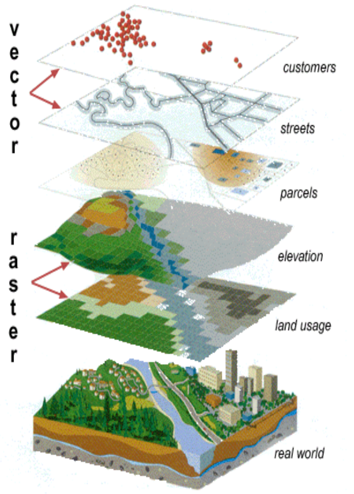
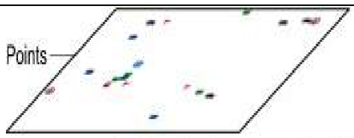
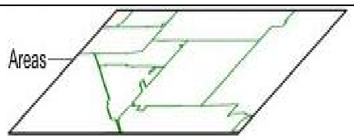
Prerequisites to GIS Practical

What is a Geographic Information System (GIS)?

A Geographical Information System (GIS) is an organized collection of computer **hardware**, **software** and **data** used to link, analyze and display geographically referenced information.



The foundation of GIS is the ability to locate objects and events (streams, villages, disease cases) and link them with appropriate information in order to identify patterns and provide a basis for map making and analysis. Key types of geographical data, represented as separate map layers in a GIS, are outlined in the table below.

Sr. No	Data Type	Example	Layer on Map	
1	POINT	Building, Hospital, City, Well.		
2	LINE	River, Road		
3	POLYGON	Administrative Boundaries, Census tacts.		
4	RASTER	Pixel or grid data		

Vector data: A representation of the world using points, lines, and polygons. Vector models are useful for storing data that has discrete boundaries, such as country borders, land parcels, and streets.

Point features: A map feature that has neither length nor area at a given scale, such as a city on a world map or a building on a city map.

Line features: A map feature that has length but not area at a given scale, such as a river on a world map or a street on a city map.

Polygon features: A map feature that bounds an area at a given scale, such as a country on a world map or a district on a city map.

Raster data. A representation of the world as a surface divided into a regular grid of cells. Raster models are useful for storing data that varies continuously, as in an aerial photograph, a satellite image, a surface of chemical concentrations, or an elevation surface.

With a GIS application you can open digital maps on your computer, create new spatial information to add to a map, create printed maps customised to your needs and perform spatial analysis.

Understanding QGIS

What is Quantum GIS?

Quantum GIS (QGIS) is a user friendly Open Source GIS application licensed under the GNU General Public License. QGIS is an official project of the Open Source Geospatial Foundation (OSGeo). It runs on Linux, Unix, Mac OSX, Windows and Android and supports numerous vector, raster, and database formats and functionalities.

Like all GIS applications, QGIS provides a graphical user interface allowing display of map layers and manipulation of data for analyses and map-making.

A Geographical Information System (GIS)1 is a collection of software that allows you to create, visualize, query and analyze geospatial data. Geospatial data refers to information about the geographic location of an entity. This often involves the use of a geographic coordinate, like a latitude or longitude value. Spatial data is another commonly used term, as are: geographic data, GIS data, map data, location data, coordinate data and spatial geometry data. Applications using geospatial data perform a variety of functions. Map production is the most easily understood function of geospatial applications. Mapping programs take geospatial data and render it in a form that is viewable, usually on a computer screen or printed page. Applications can present static maps(a simple image) or dynamic maps that are customized by the person viewing the map through a desktop program or a web page.

Many people mistakenly assume that geospatial applications just produce maps, but geospatial data analysis is another primary function of geospatial applications. Some typical types of analysis include computing:

1. Distances between geographic locations
2. The amount of area (e.g., square meters) within a certain geographic region
3. What geographic features overlap other features?
4. The amount of overlap between features
5. The number of locations within a certain distance of another
6. and so on...

These may seem simplistic, but can be applied in all sorts of ways across many disciplines. The results of analysis may be shown on a map, but are often tabulated into a report to support management decisions. The recent phenomena of location-based services promises to introduce all sorts of other features, but many will be based on a combination of maps and analysis. For example, you have a cell phone that tracks your geographic location. If you have the right software, your phone can tell you what kinds of restaurants are within walking distance. While this is a novel application of geospatial technology, it is essentially doing geospatial data analysis and listing the results for you.

System Requirements

Windows OS:

Minimum: Pentium III / 256 MB RAM.

Recommended: 1 GB of RAM and 1.6 GHz processor.

Operation System: Platforms Windows and Linux (Win XP or newer, Linux Suse 8.2/9.0/9.2, Linux Debian (Lliurex))

MAC OS:

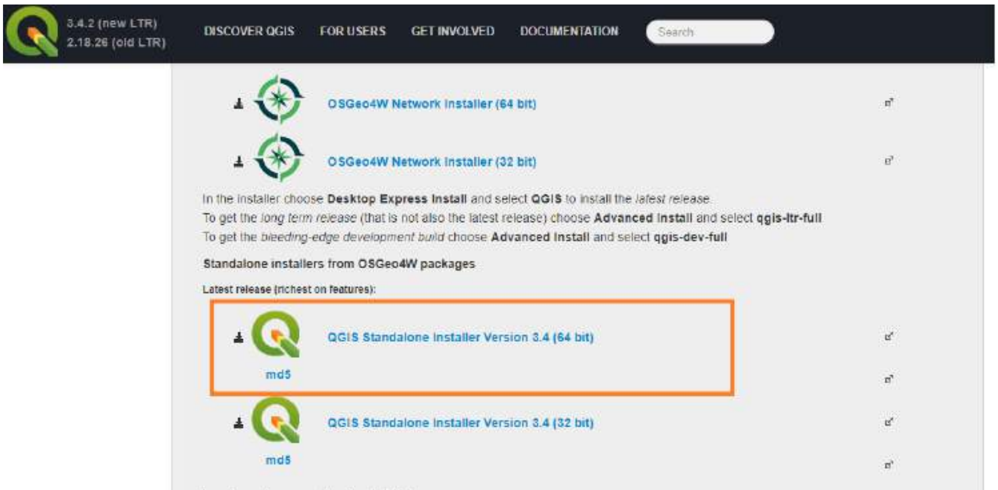
PC/Desktop with at least Pentium IV

Tiger OS, Leopard OS.

Installation of QGIS

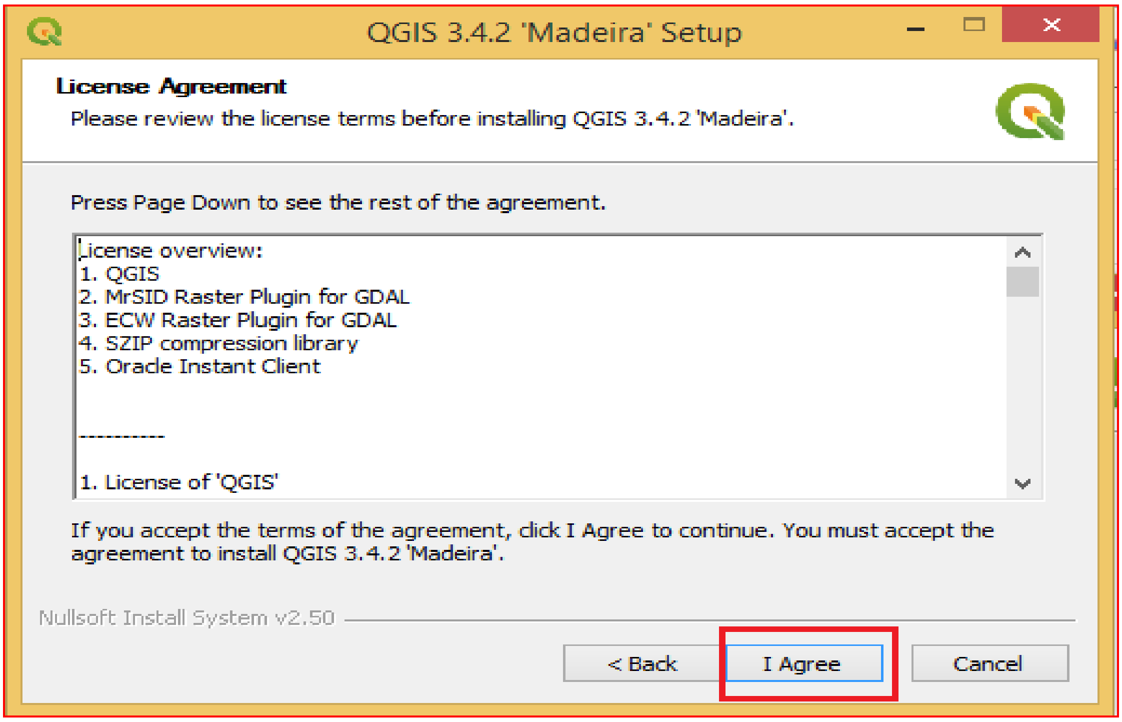
Step By step procedure

1) Create a folder on your D:/ drive on your computer called QGISlab by right clicking on the D: drive and navigating down to the New / Folder.
2) Go to the QGIS download page and download the latest 64bit version of QGIS for windows which is QGIS 3.4 'Madeira' by clicking once.
3) If you have a 32 bit machine or using another operating system search the bottom of the page for your operating system and download the correct operating system version of QGIS.
   http://www.qgis.org/en/site/forusers/download.html

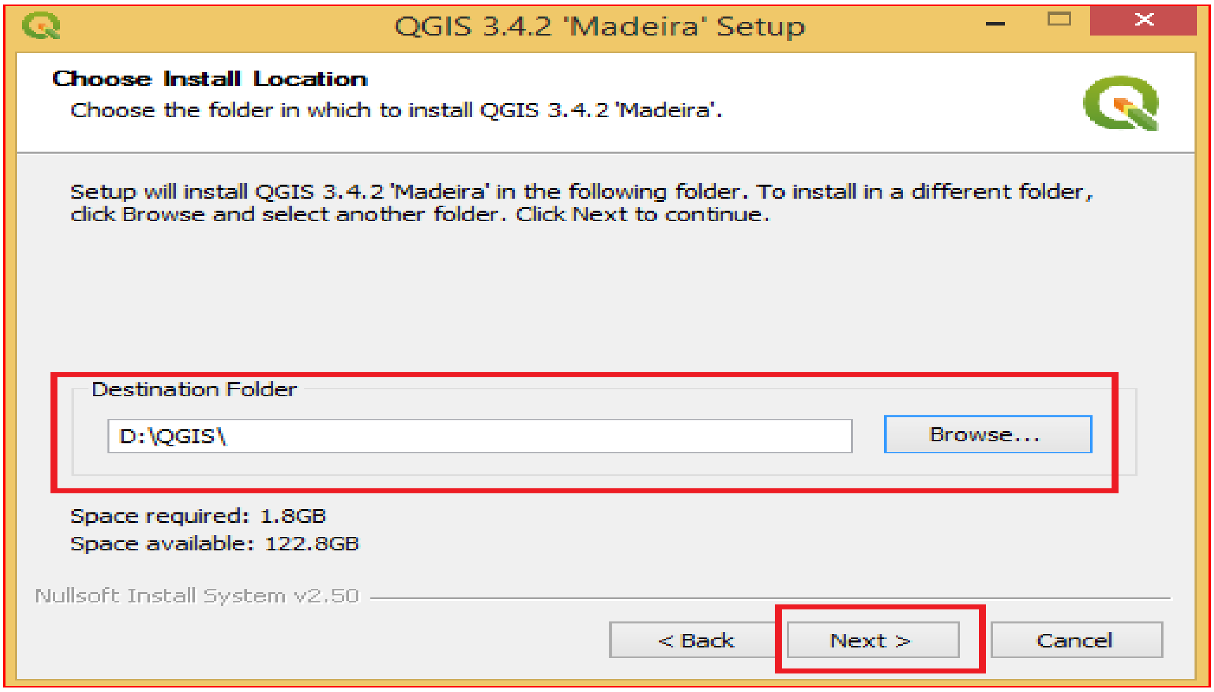


4) You browser will download the file to the browsers default download directory. By pressing the control key and the letter J at the same time a popup window will show you the folder where the QGIS file has been downloaded. The QGIS file will be called:
   QGIS-OSGeo4W-3.4.2-1-Setup-x86.exe
5) Move or copy the above file to your C:/QGISlab folder and double click on the file. You will get a popup window with a security warning.
6) Hit the run button to start the installation process and follow the prompts. There is no need to install the data sets suggested by QGIS.

7) From the above window, click Next button and continue with the installation.
8) Please go through the license agreement and click on the button> I agree and proceed with the installation as shown in the screen.

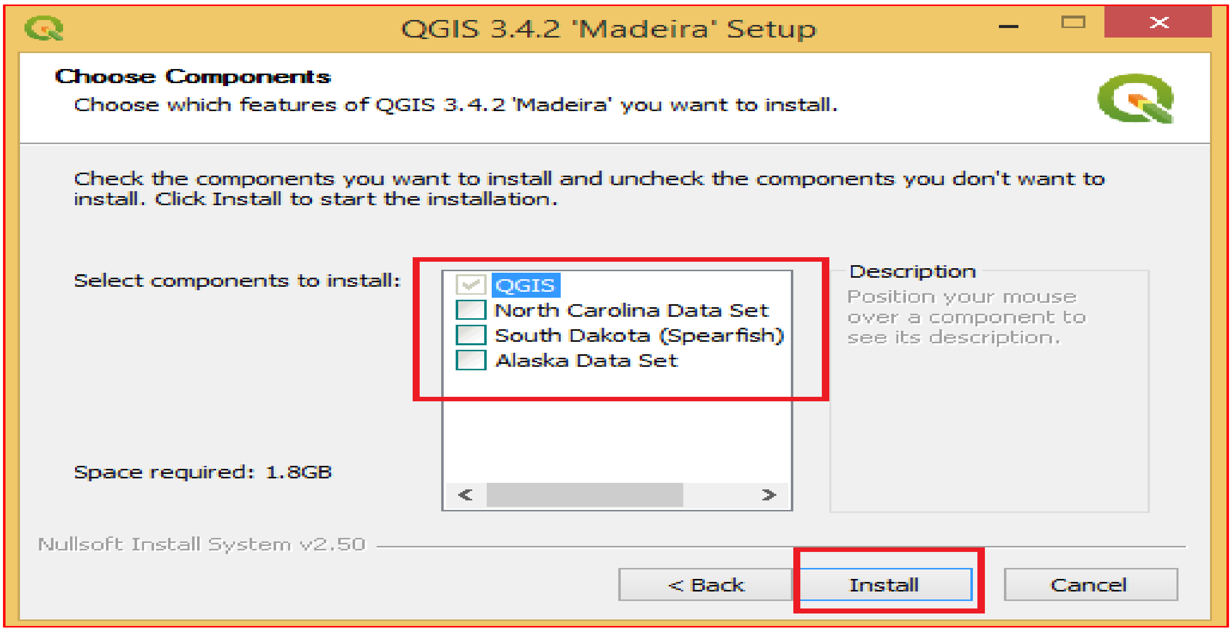


9) As the software is very heavy it is advisable to install it in the different drive other than the windows drive. As per our example, we will be installing in QGIS folder on D:\ drive.

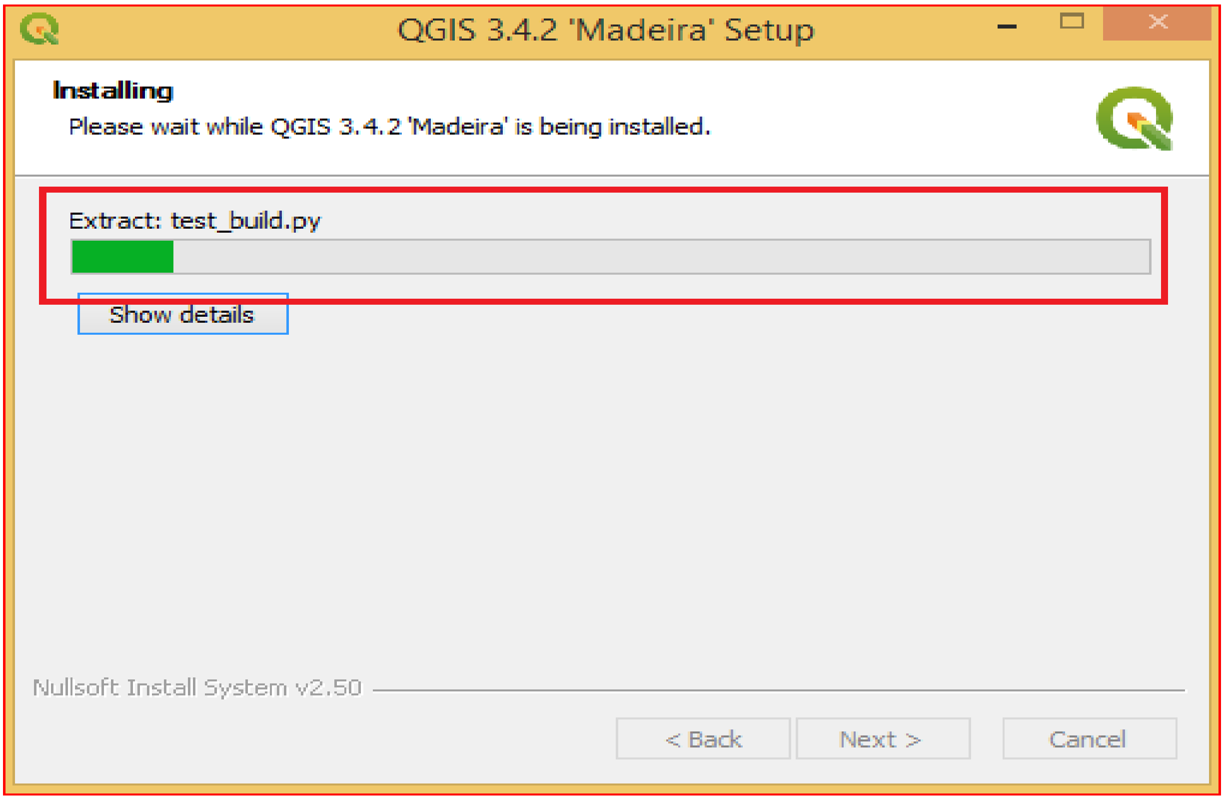


10) After browsing the folder click the Next button and proceed with the installation as shown in above figure.

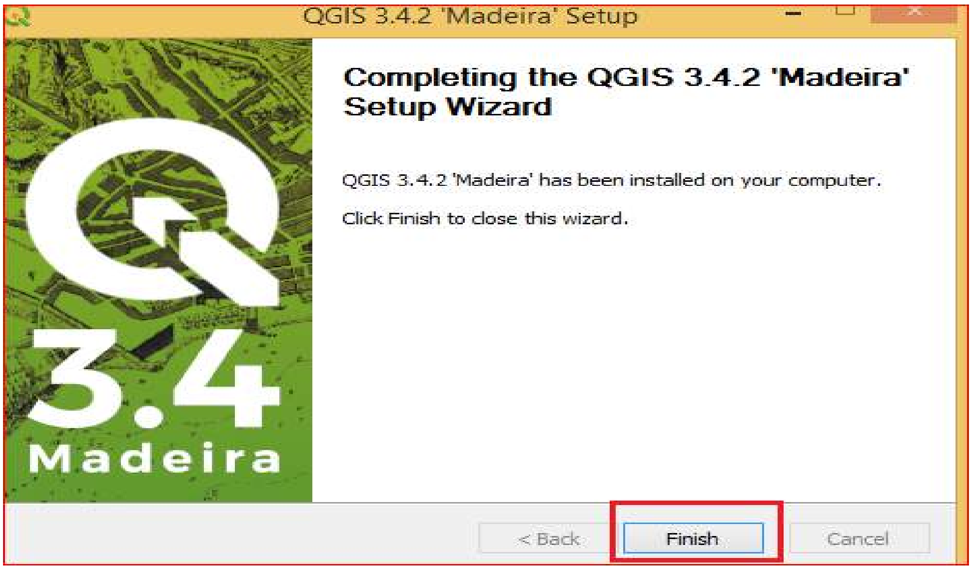
11) By default QGIS component is selected. Do not install any other data set at this point. Click Install to proceed with installation.



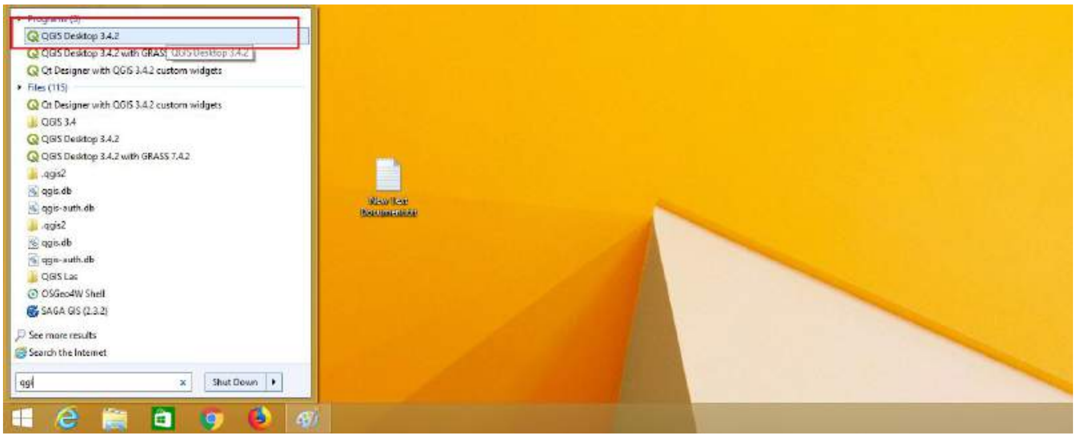
12) You will see the progress of the installation on the screen.



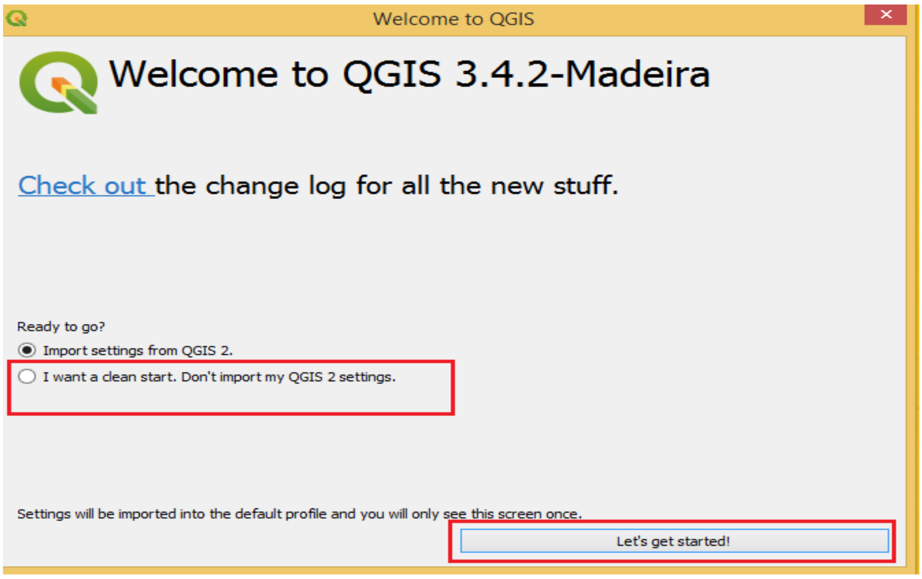
13) Please reboot your machine once the installation is completed. Click finish to complete the installation.



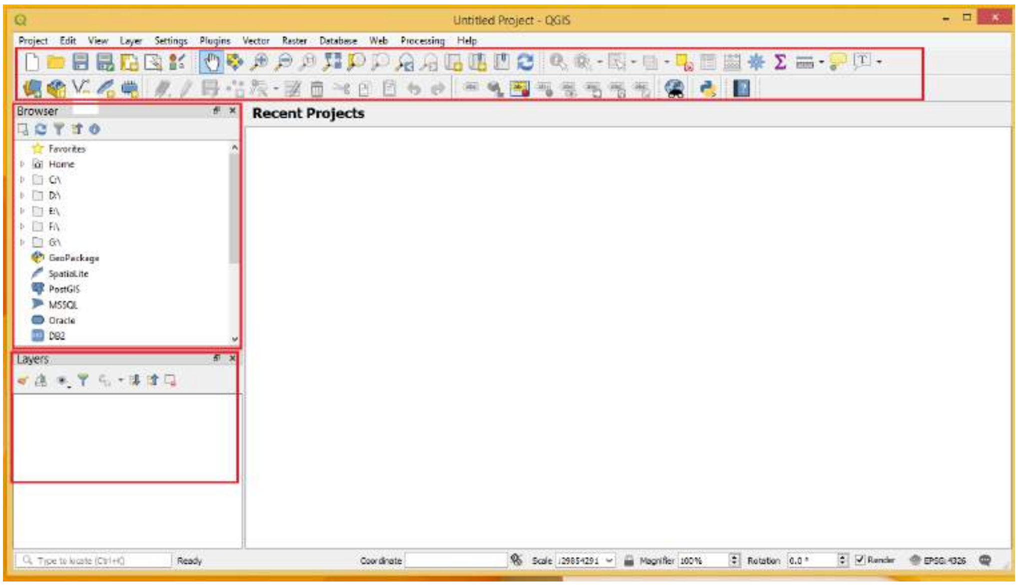
14) After machine is restarted, type QGIS on Run and open QGIS Desktop 3.4.2.



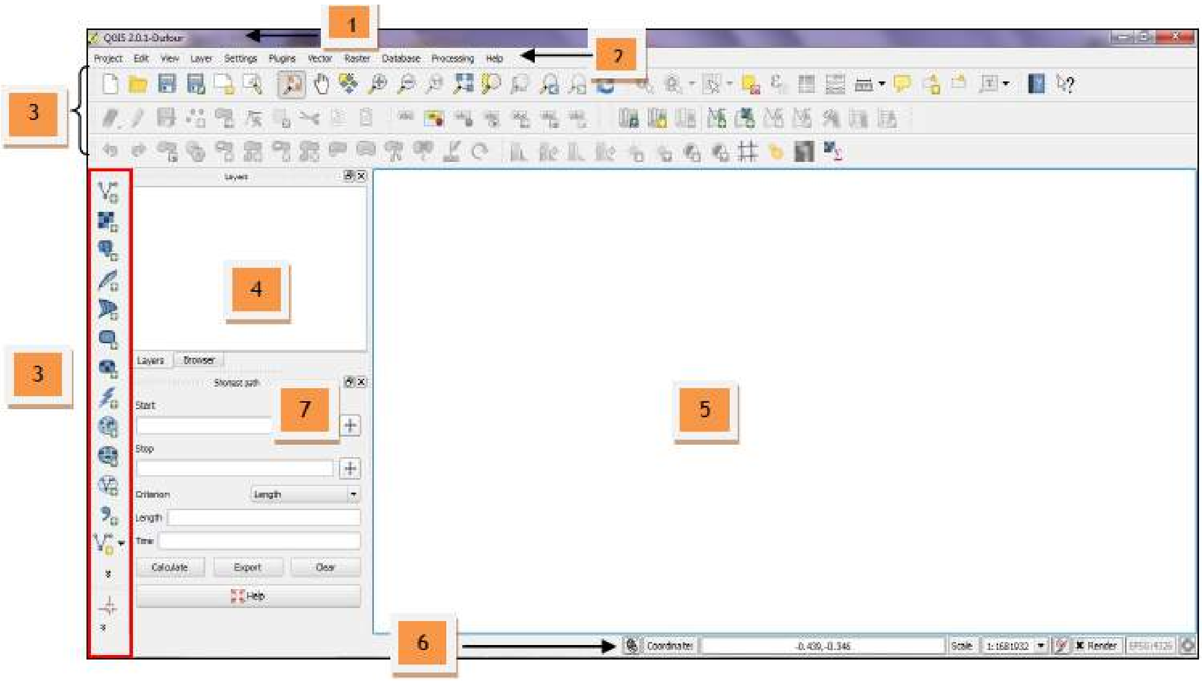
15) It will open a new wizard for the first time after installation as shown in the figure below.



16) Select I want a clean start. Don't import my QGIs 2 settings and click on let's get started button. You will be redirected now to the home screen of QGIS Desktop.



Understanding QGIS Desktop Environment.

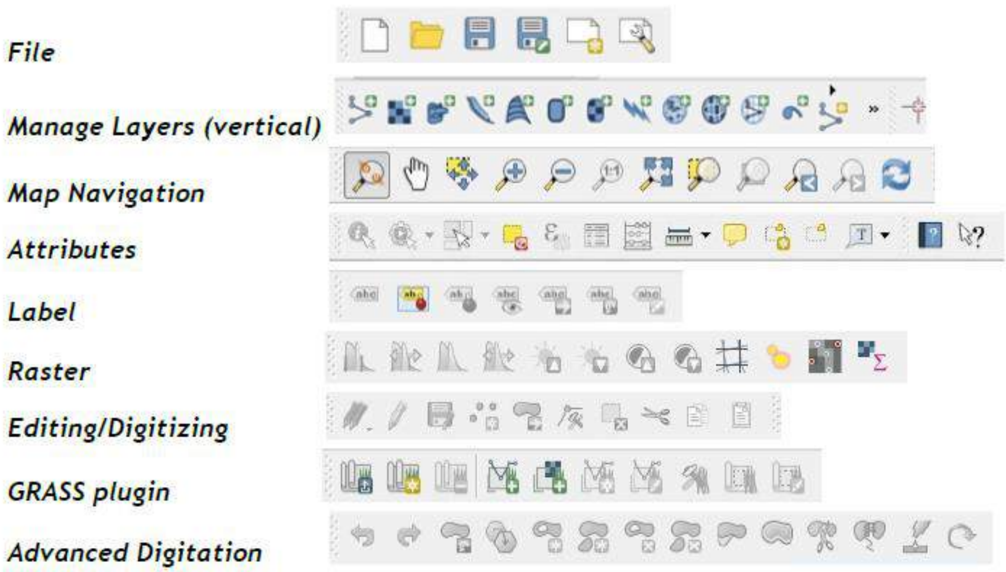


Quantum GIS interfaces change from one project to another depending on the required interface of the project. Below are the basic menus that you will encounter in Quantum GIS during the practicals.

1. ***Title of the Project*** - Shows the title of project that you are going to view.
2. ***Menu Bar*** – This provides access to various Quantum GIS features using a standard hierarchical menu.
3. ***Toolbars*** **–** These provide access to most of the same functions as the menus, plus additional tools for interacting with the map. It shows the command for zoom in, zoom out, pan, back to original view, go back to previous extent, go to next extent, object-information, coordinate read-out, measure, print and help.
4. ***Table of Contents/Map Legend*** **(TOC)** - Shows the layers that can be turned on or off and the legend, attributes symbols and query symbols available for the corresponding project.
5. ***Display Window*** - Shows the feature/s that you have turn on from the TOC.
6. ***Status Bar*** - Shows you your current position in map coordinates (e.g. metres 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.
7. ***Data sources browser*** – In previous versions, QGIS browser was only provided as an external application which enables us to explore our spatial data sets. In QGIS 2.0.1-*Dufour* this application is also integrated in the QGIS framework as an additional panel just below the Table of Contents.

Quantum GIS toolbars and some other components

Toolbars are divided by thematic (greyed icons means they are inactive because the appropriate conditions to use them are not fulfilled). Some of them are included by default in QGIS and others can be added/removed from the interface:



Key functions:

Here, you will learn how to QGIS" different mapping tools and other components that you"ll be using in this practical.

File Options

New Project
Enables you to create a new project.

Open Project
Tool use to open an existing/previous project created in Quantum GIS.

Save Project
Enables you to save the project.

Save Project As
Enables you to save the project in another format.

New Print Composer
Enables you to print the map/layers including the title, TOC, map overview, scale bar, graph/attributes present in the layer, author and map information, logo, toolbar, and other components present in the main page of the project.

Composer Manager
Enables you to access to the different composition in progress and manage them; showing, removing, closing, and so on.

Displaying Layers

Add Vector Layer
Enables you to add any readable existing vector format layer.

Add Raster Layer
Enables you to add any readable existing raster format layer.

Table of Contents. Menu
Turns layer on or off Click the box to turn on ☒ or off ☐ the layer/s.
Folder icon in the TOC This represents a group of layers in the TOC. Grayed colour means only selected layers are visible in the group of layers.
Navigation toolbars
Zoom in Click once in the map to zoom in or drag a box over the particular area.
Zoom out Click once in the map.
Panning Click in the map, hold down the mouse button, and drag in any direction.
Zoom to Full Click to return to default view or view the full map layer/s.
Zoom to Selection Click to view the selected part of map layer/s.
Zoom to Layer Click to view a particular map layer.
Object Information
Identify Features Click to activate and point to the layers you want to view the information.
Open Attribute Table Click to open the attribute table of a layer.

Principles of GIS T. Y. B. Sc. IT Semester VI

List of Sample/Data files used for Practical session

Practical No.	Data set Name
1D	IND_rails.zip IND_adm0.zip
2A	gl_gpwv3_pdens_00_ascii_one.zip gl_gpwv3_pdens_90_ascii_one.zip
2C	FAS_India1.2018349.terra.367.2km.tif FAS_India2.2018349.terra.367.2km.tif FAS_India3.2018349.terra.367.2km.tif FAS_India4.2018349.terra.367.2km.tif
3B	Sample.csv
4A	ne_10m_populated_places_simple.zip
4B	GMTED2010N10E060_300.zip

5A	ne_10m_populated_places_simple.zip
6A	IND_adm0.zip Bombay_1990.jpg
6B	GateWay_Aerial_Imagery.tif
6C	Christchurch Topo50 map.tif
7A	tl_2013_06_tract.zip ca_tracts_pop.csv
7B	OEM_NursingHomes_001.zip nybb_12c.zip
7C	EarthQuakeDatabase.txt ne_10m_admin_0_countries.zip ne_10m_populated_places_simple.zip
7D	ne_10m_populated_places_simple.zip ne_10m_rivers_lake_centerlines.zip
8A	ca_tracts_pop.csv EarthQuakeDatabase.txt ne_10m_populated_places_simple.zip tl_2013_06_tract.zip
10	Kenya admin.shp Kenya_epidemiological_data.xls Kenya_epidemiological_dict.xlsx Kenya_school_dict.xlsx Kenya_school_location.csv

PRACTICAL - 1

A. AIM : - Creating and Managing Vector Data:

a) Adding vector layer

b) Setting properties

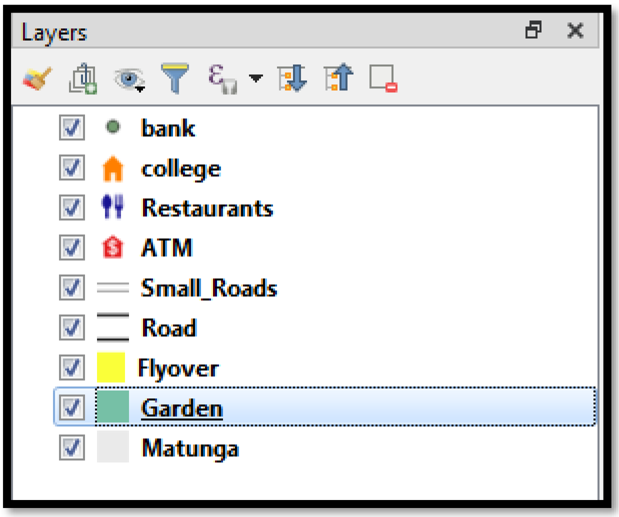
c) Vector Layer Formatting

<u>Procedure:</u>

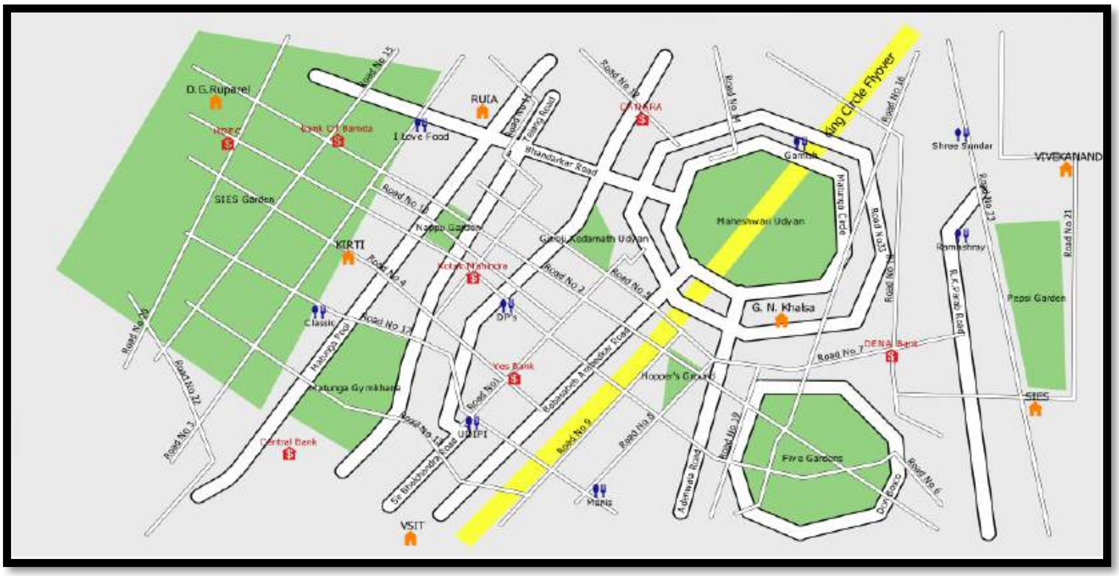
a. Adding vector layers (Polygon, Line, Points)

- Polygon layers (We have taken **2** layers Matunga, Garden)
- Line layers (We have taken **3** layers Small_Roads, Road, Flyover)
- Point layers (We have taken **4** layers bank,college,Restaurants,ATM)

b. Setting properties (Labeling, Symbolism)

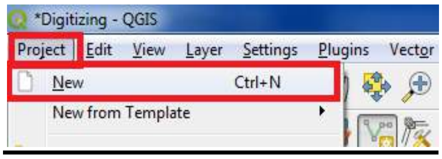


- **Our aim is to create map representing a location and its surrounding as follows:**

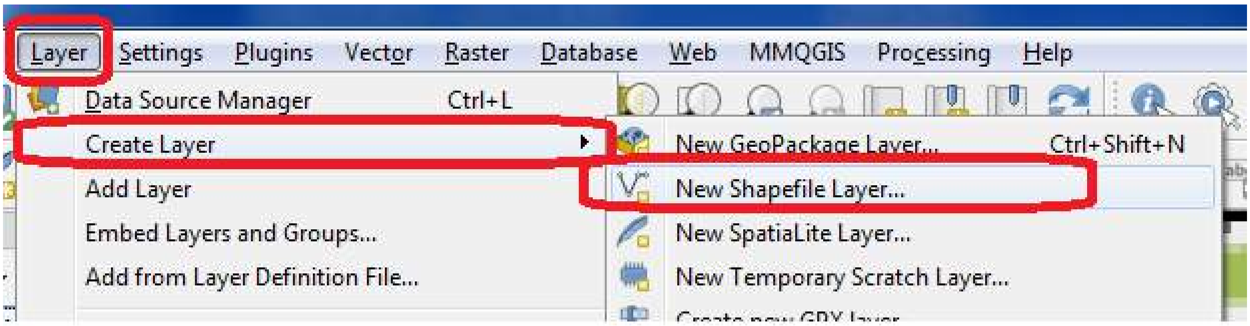


a) <u>Creating Polygon vector layer</u>

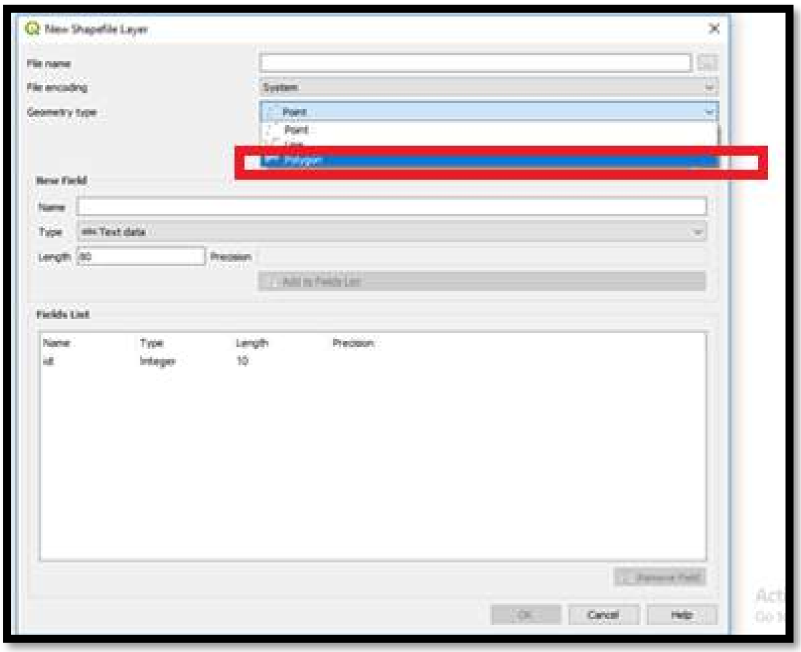
- Select **Project→New**



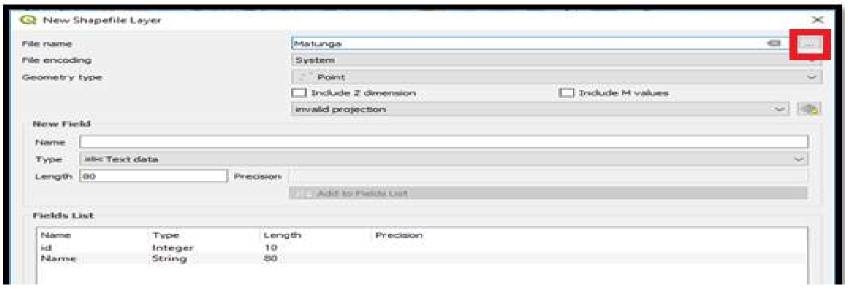
- Select **Layer→Create Layer→New Shapefile Layer**

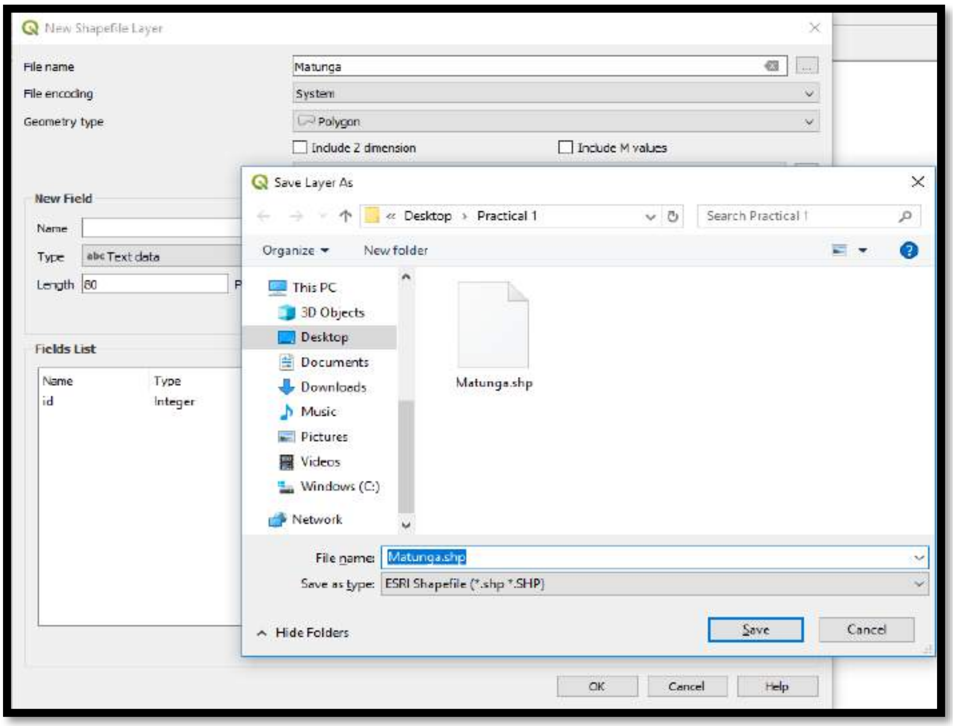


- Following dialog box will appear on the screen. Select Polygon option from Geometry type.



- Fill the appropriate information in each text box.
  - File name :
    - By default the file will be saved in bin folder.
    - To avoid it click on following button to change the location of file.

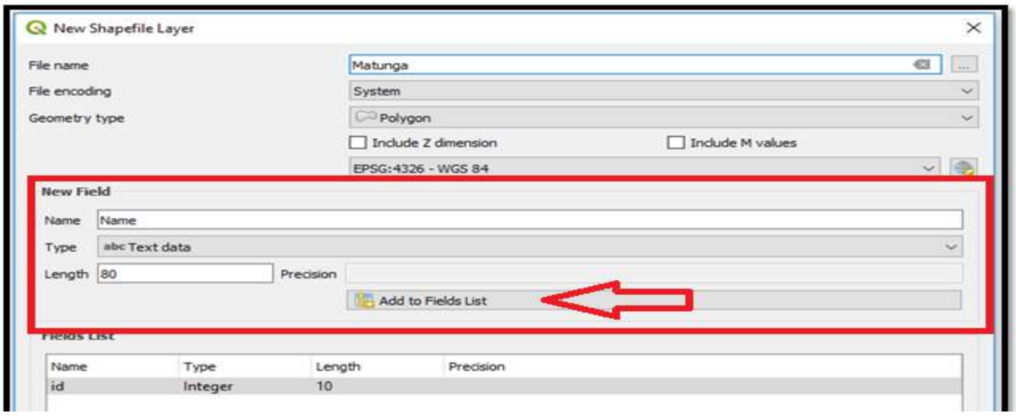




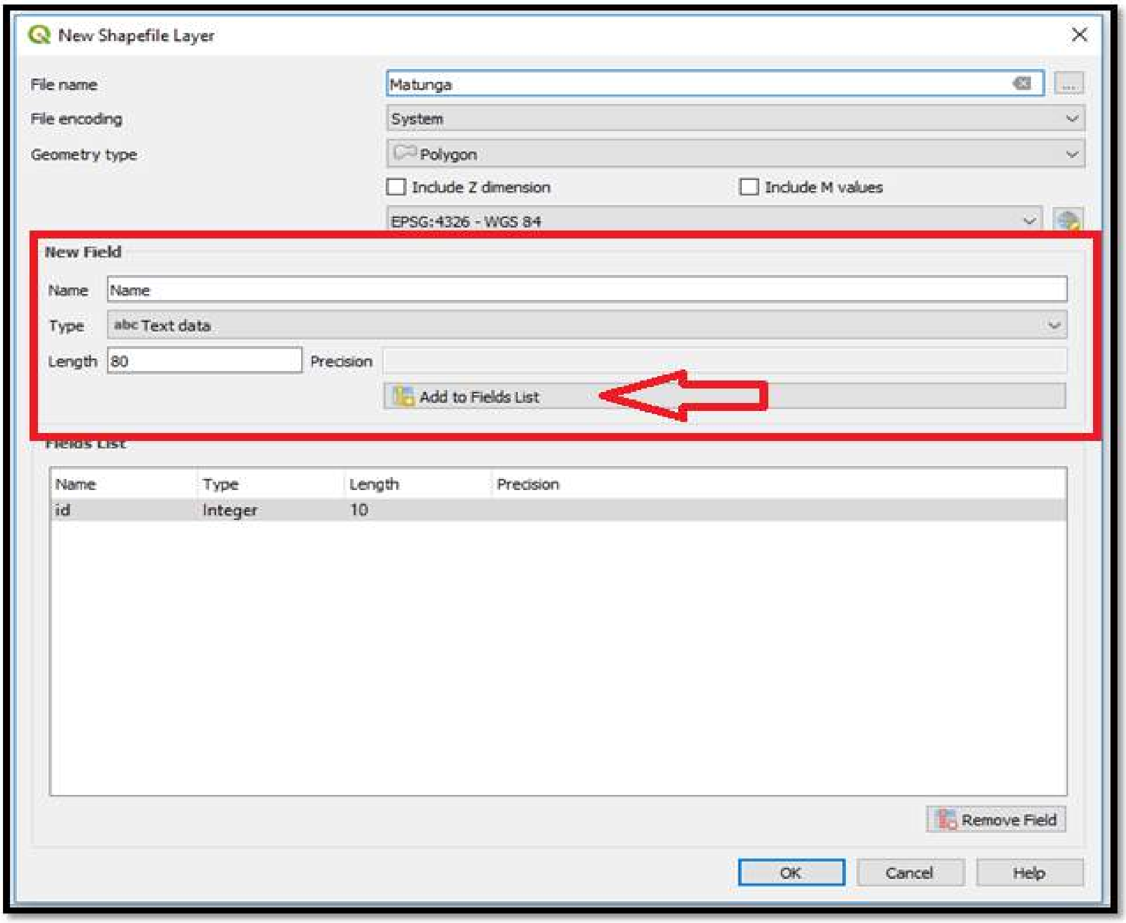
- **Field Panel**
  - Add the **Attribute** you want to show. (**Column Name** for Table)

  b. Specify **Type (DataType:**Text Data/Decimal Data/Whole Number/Date**)** of Attribute

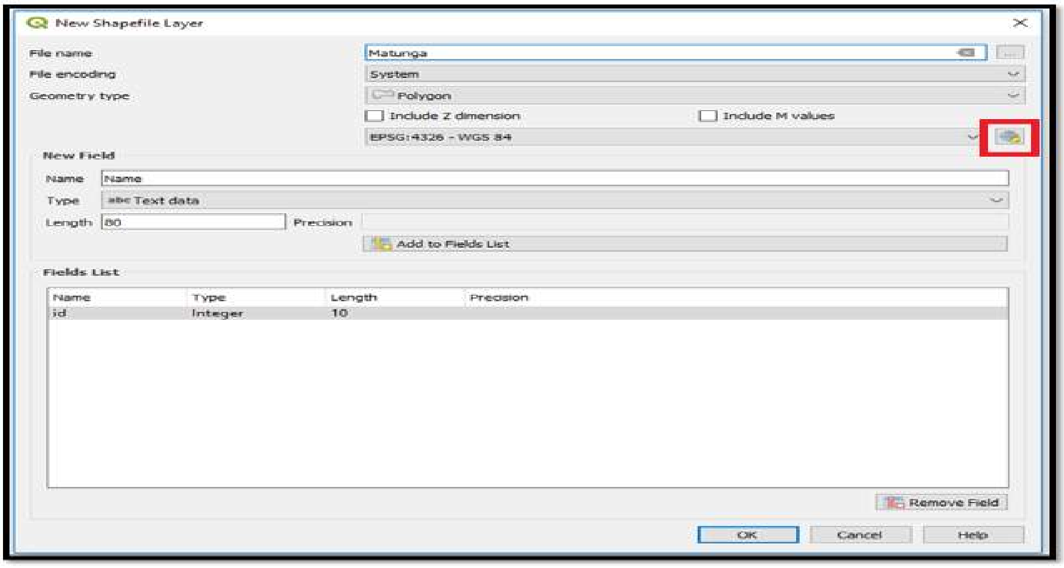
  c. Specify the **Length** of the Attribute. Specify **Precision** (If **Data Type** is **Decimal**)



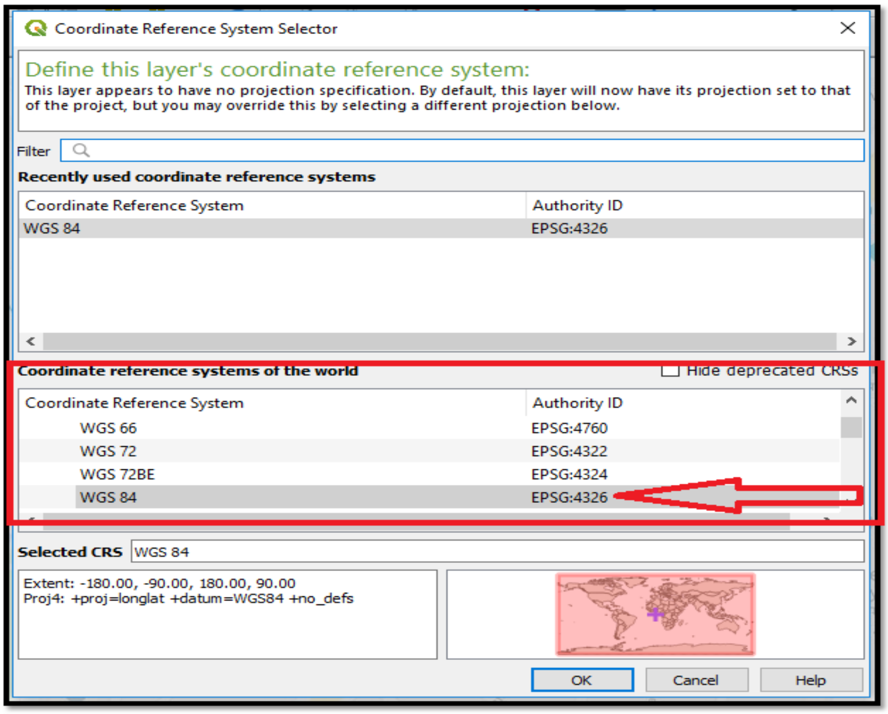
- Click on **Add to Field List** Button**.**
- You can add as many **fields (Column Name)** as you want for the layer.



- Select Geometry Type as follows
  - Click on the following button

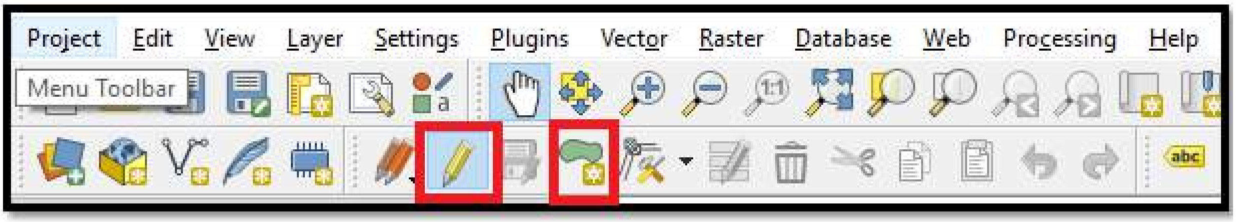


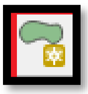
- The CRS dialog box will appear on screen. Click on the WGS84 option and it will be selected as follows. click on **OK**

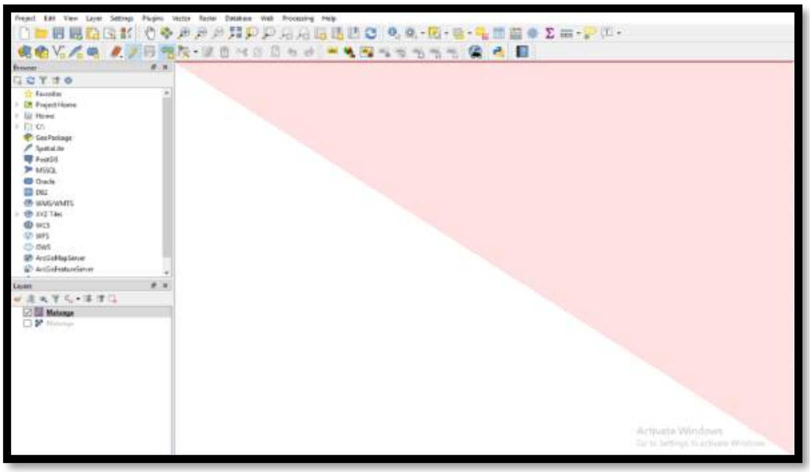


a) Follow the steps to plot **Polygon features.**

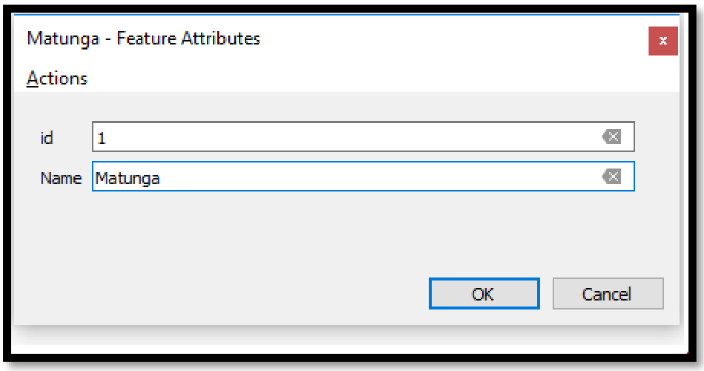
➢ Select the **Polygon Feature(** In our case it is **Matunga** for **background)** from layer panel



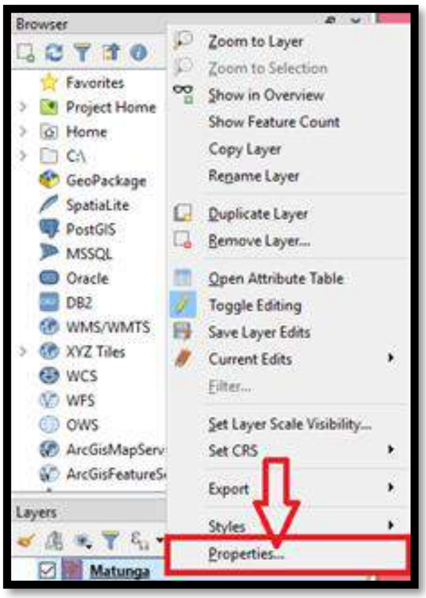
➢ Click **Toggle Editing Button**  → Click on **Add Polygon**  →Now place the cursor at the location where you want to place the polygon. for **polygon** layer **minimum 3 points** should be selected



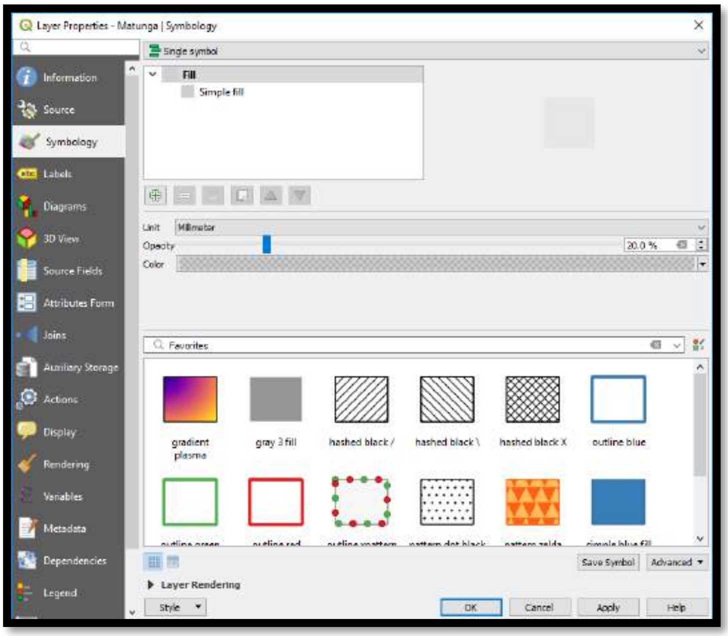
➢ Save the newly added polygon as follows.



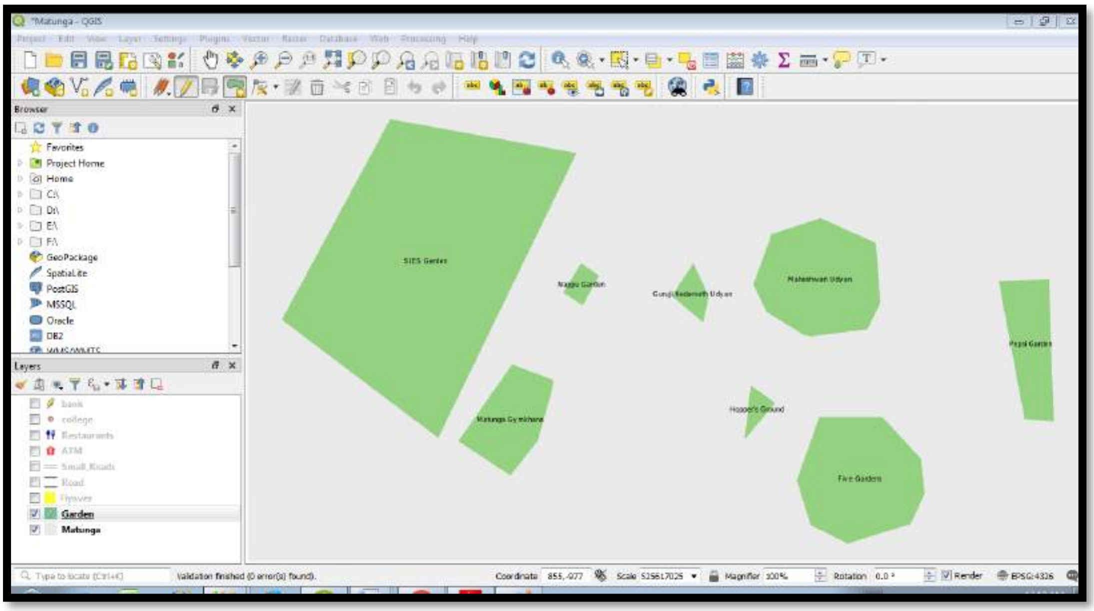
- Set **style** for polygon by using property window(**Right click** on Matunga Layer)



- Following screen will appear on the screen. Select **pattern** as you want and **click** on **OK**.

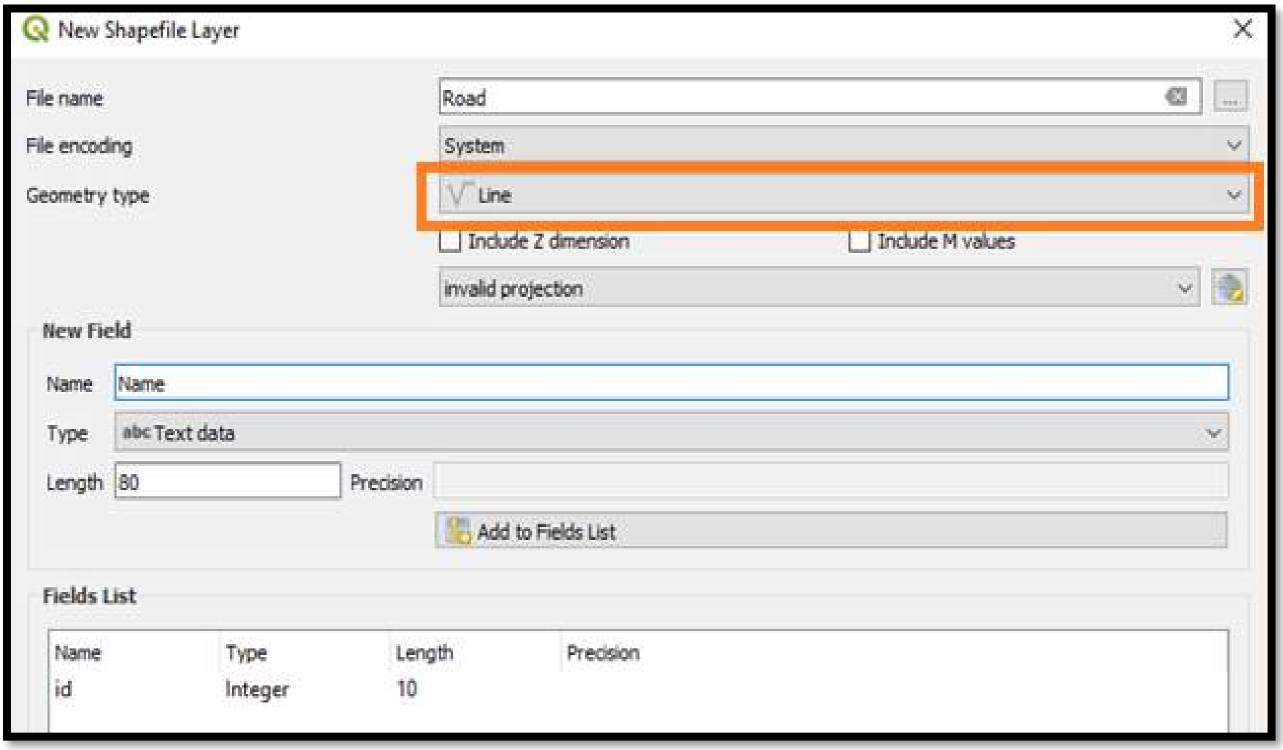


- Same way we can add one more polygon layer for Gardens.



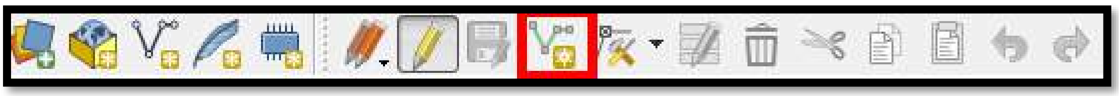
b) <u>Creating Line vector layer</u>

- Repeat the same steps as we have done for polygon layer.
- Select geometry type Line.

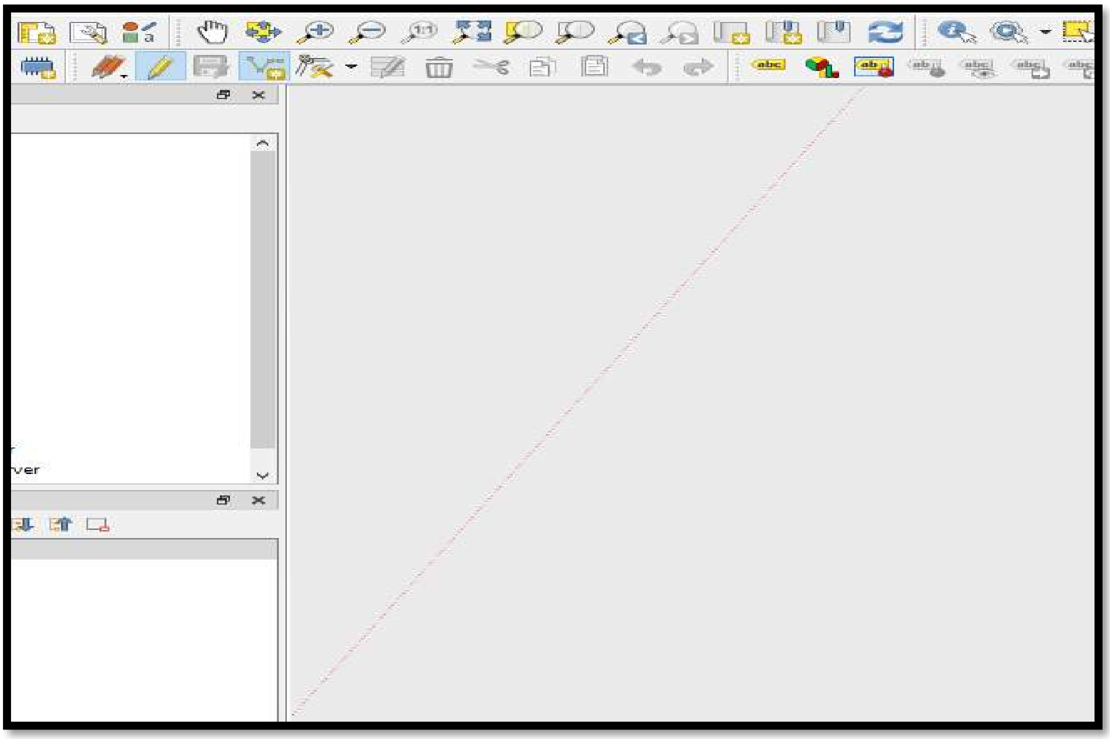


- **<u>Road layer</u> :**

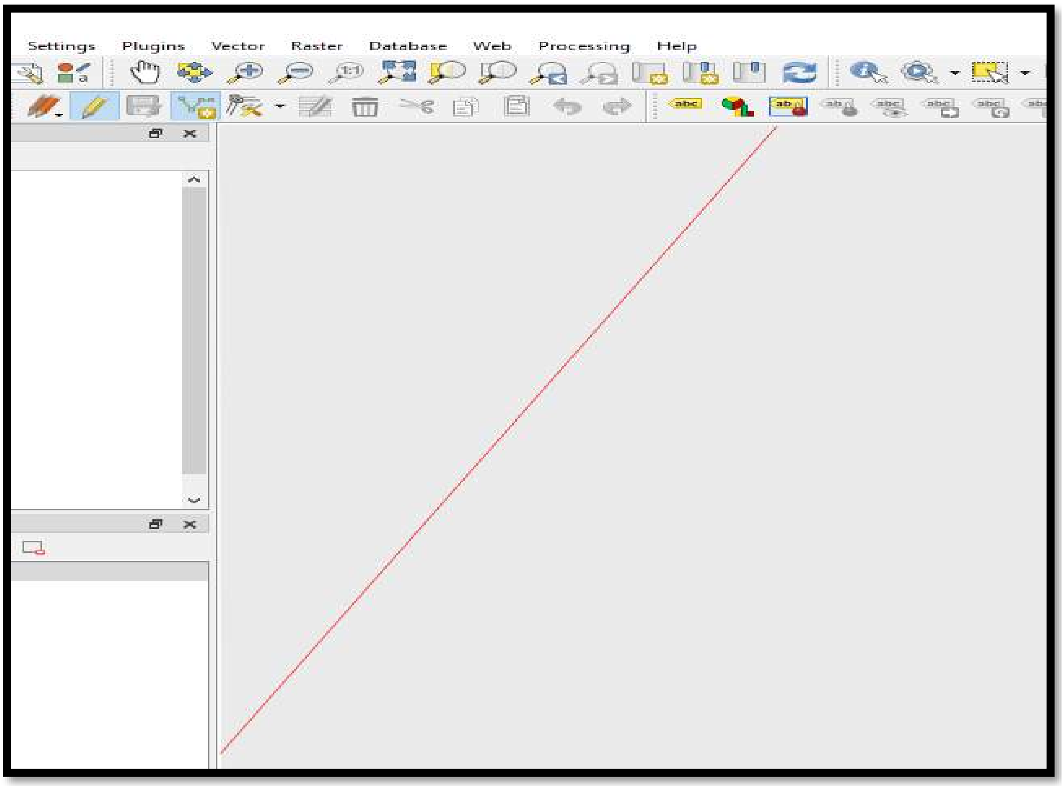
  - To plot road **click** on **Add Line Feature**.



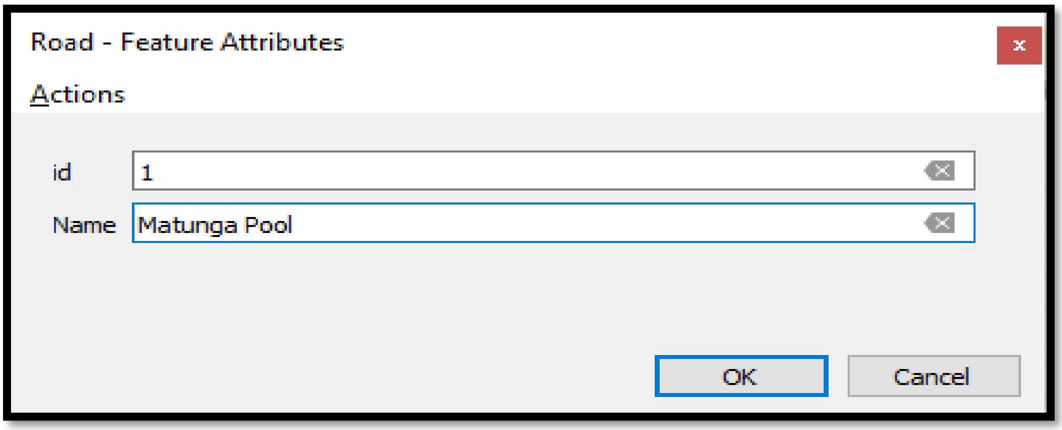
- Click on the map where you want to draw line.



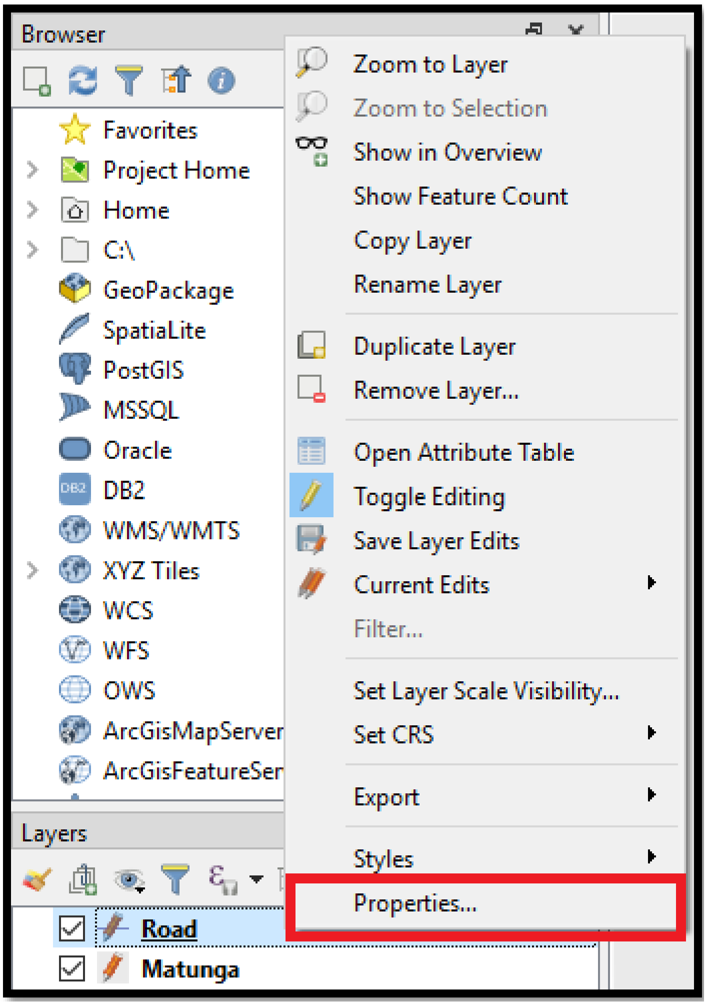
- Once you are done then **right click** on map (**Dotted line** turn into **solid line**)

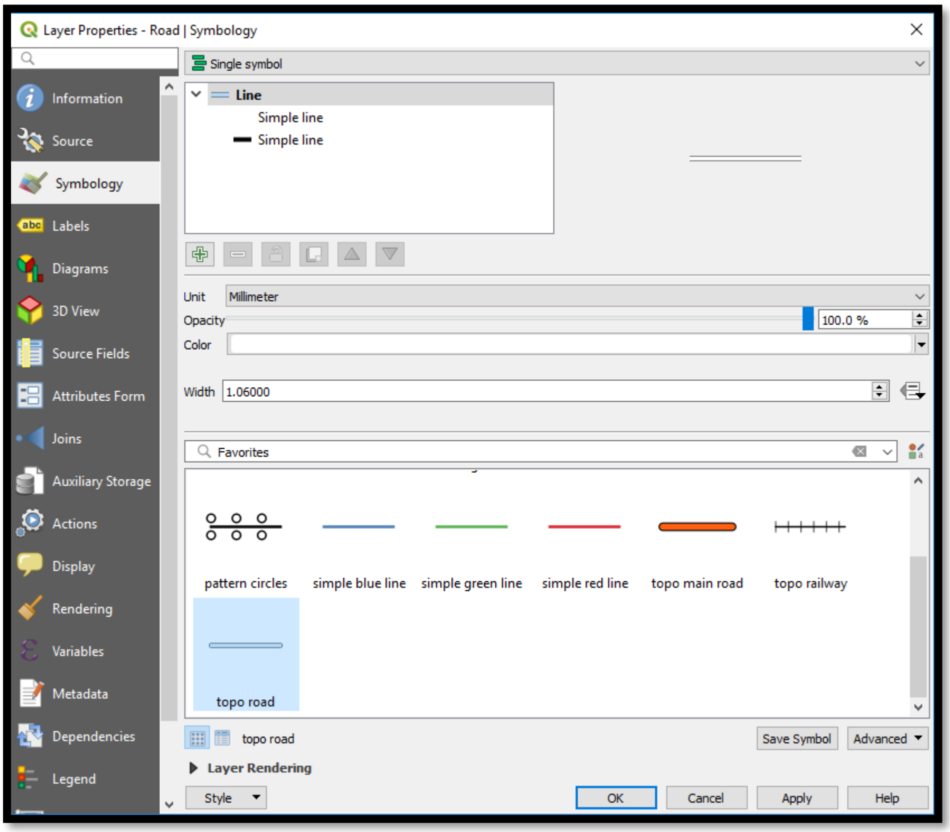


- **save** your data

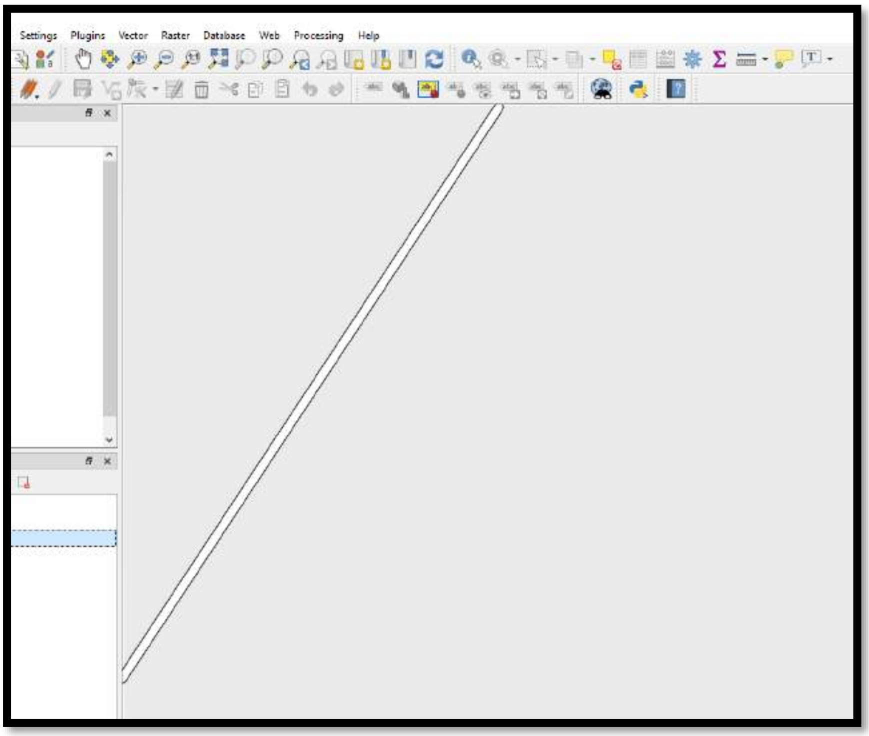


- set **style** for Roads in the same way as we have done for polygon

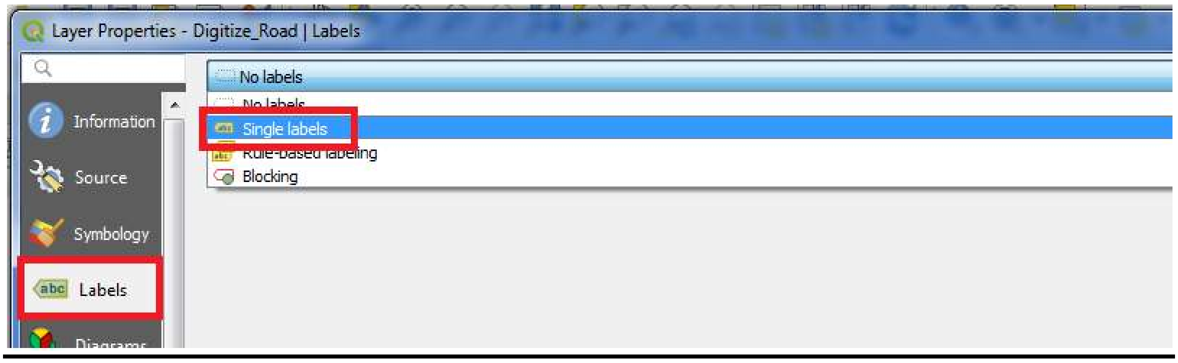




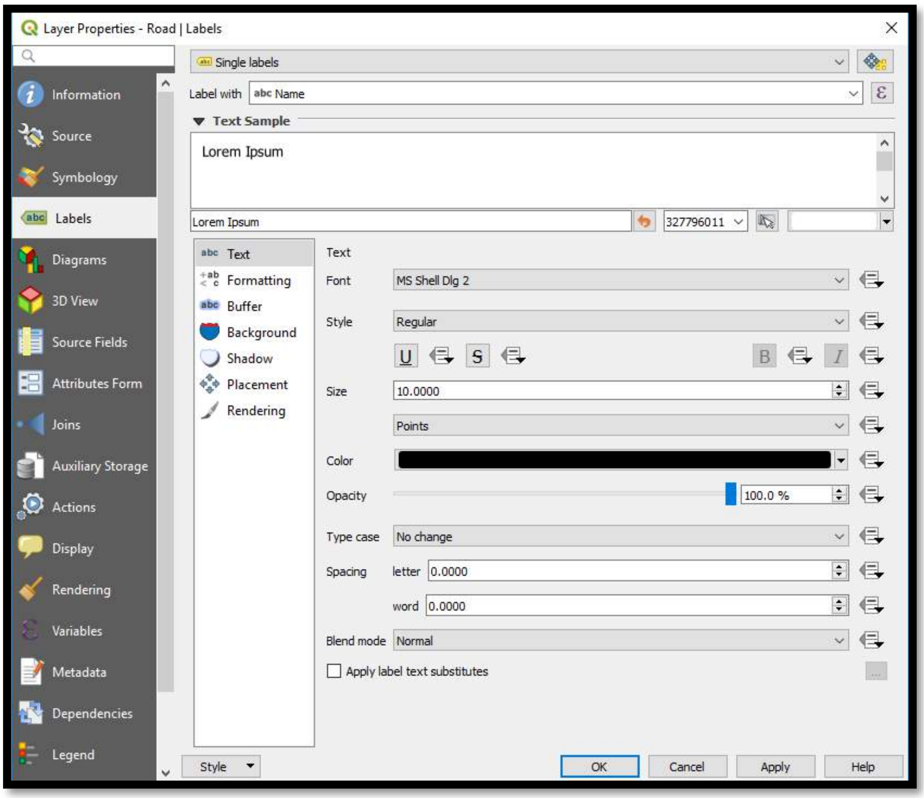
➢ Road will look as below



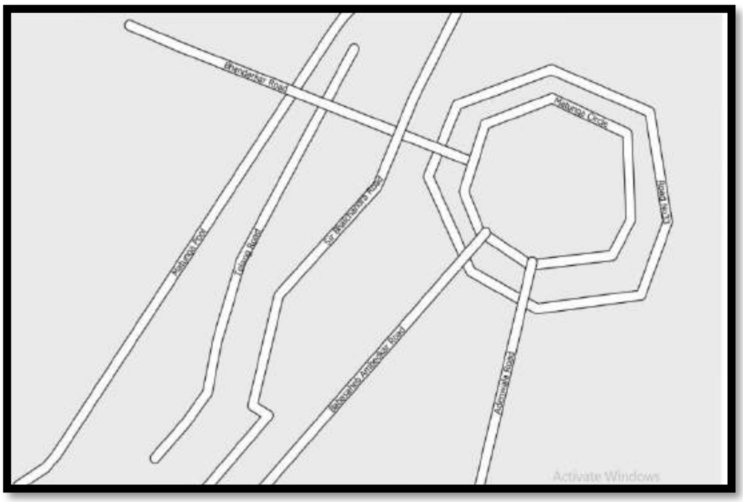
➢ To label your roads **Right click** on **Road layer** .Go to **properties** window then select label and set single **label property**



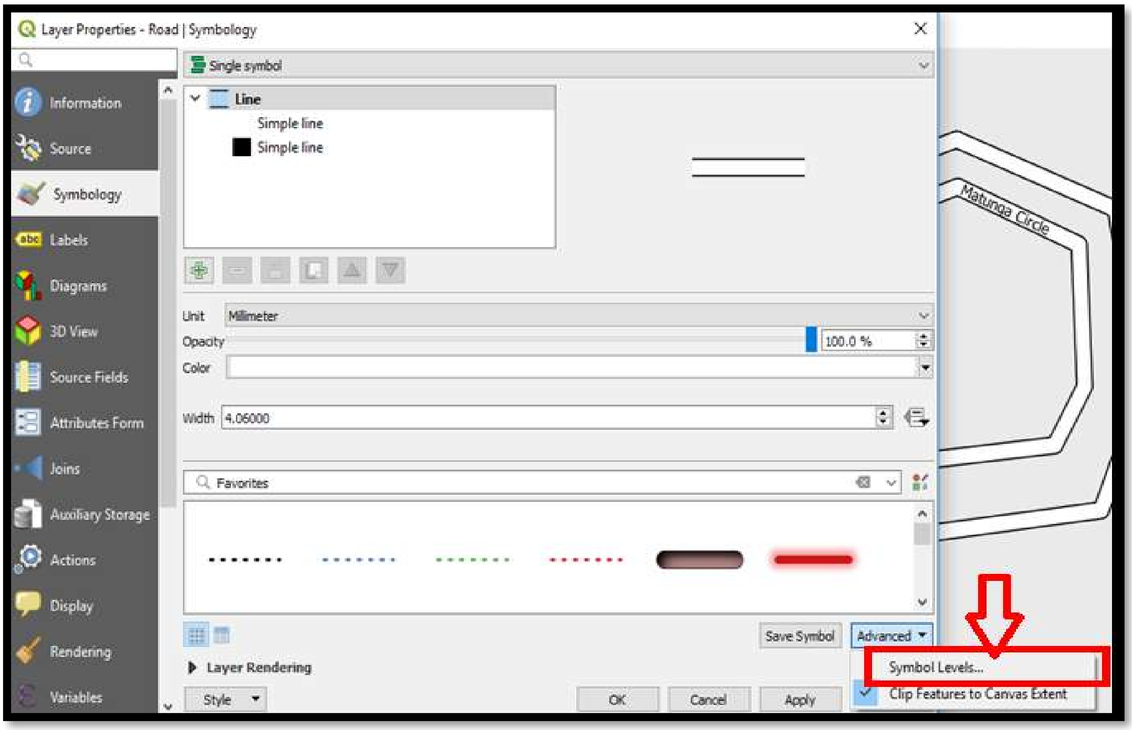
➢ Following window will appear on the screen



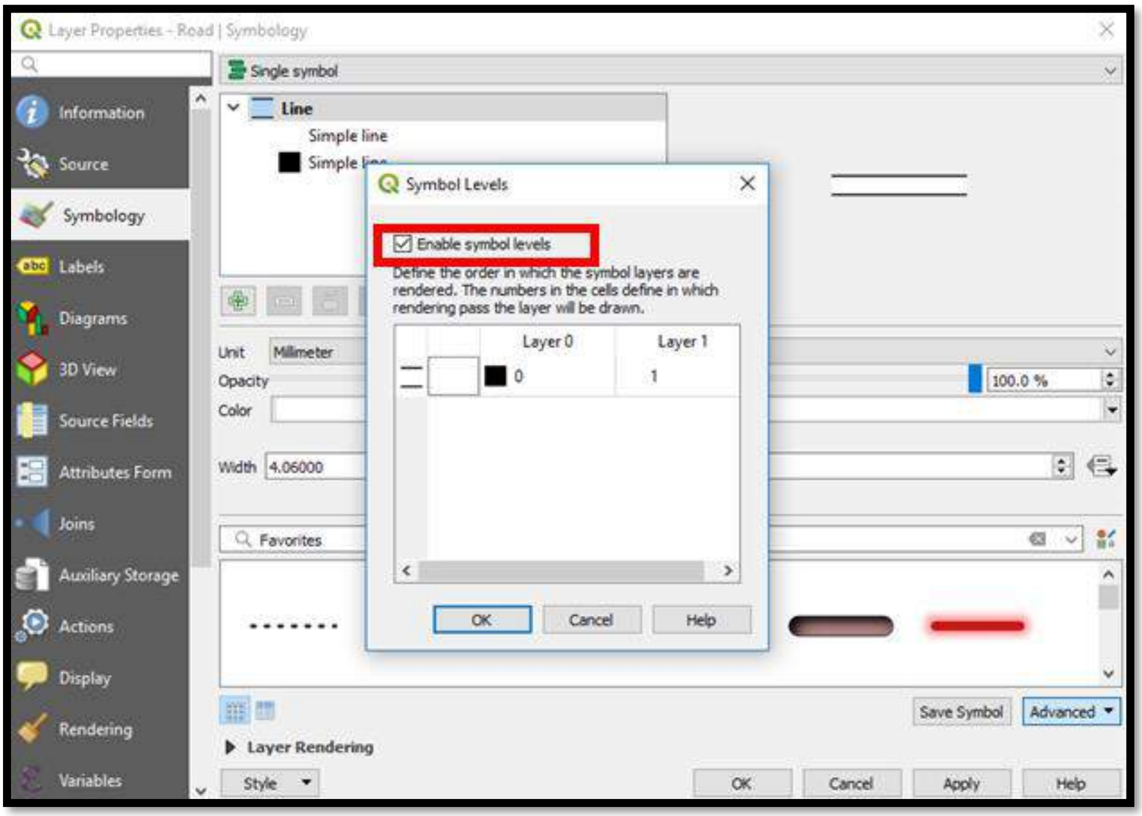
➢ Roads will look like these



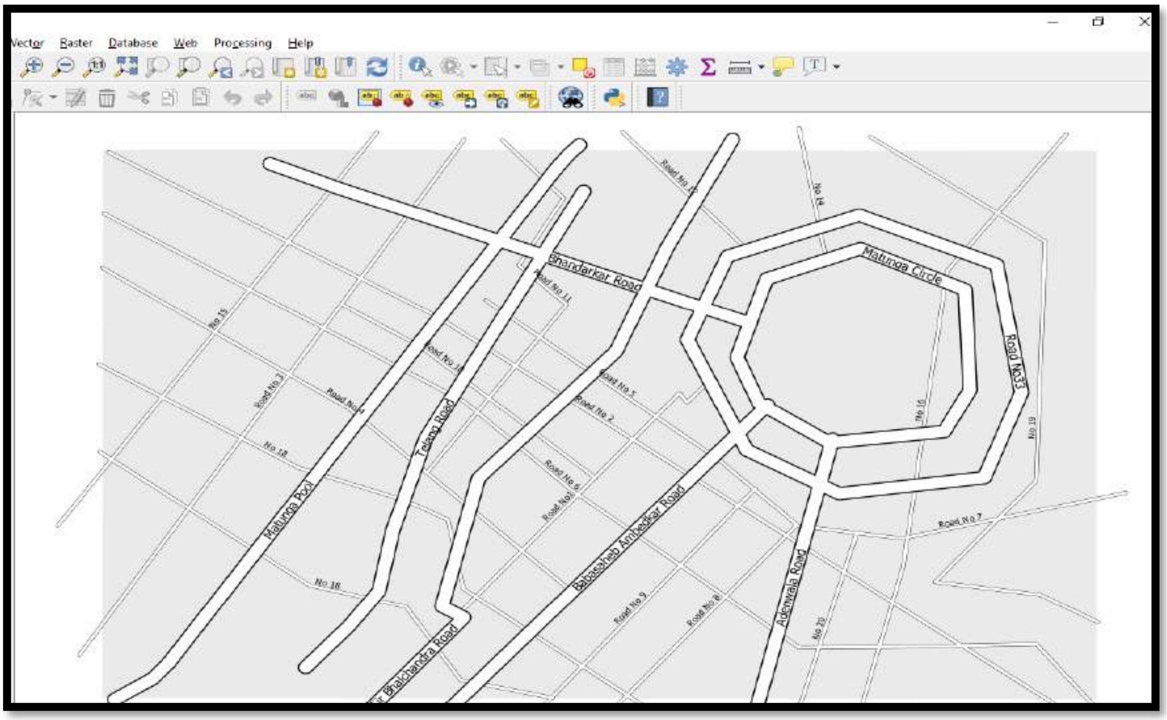
- To merge roads
  - Go to **properties** of road then select **symbology**. click on **Advanced button** select Symbol levels.



- Check **Enable symbol levels** option

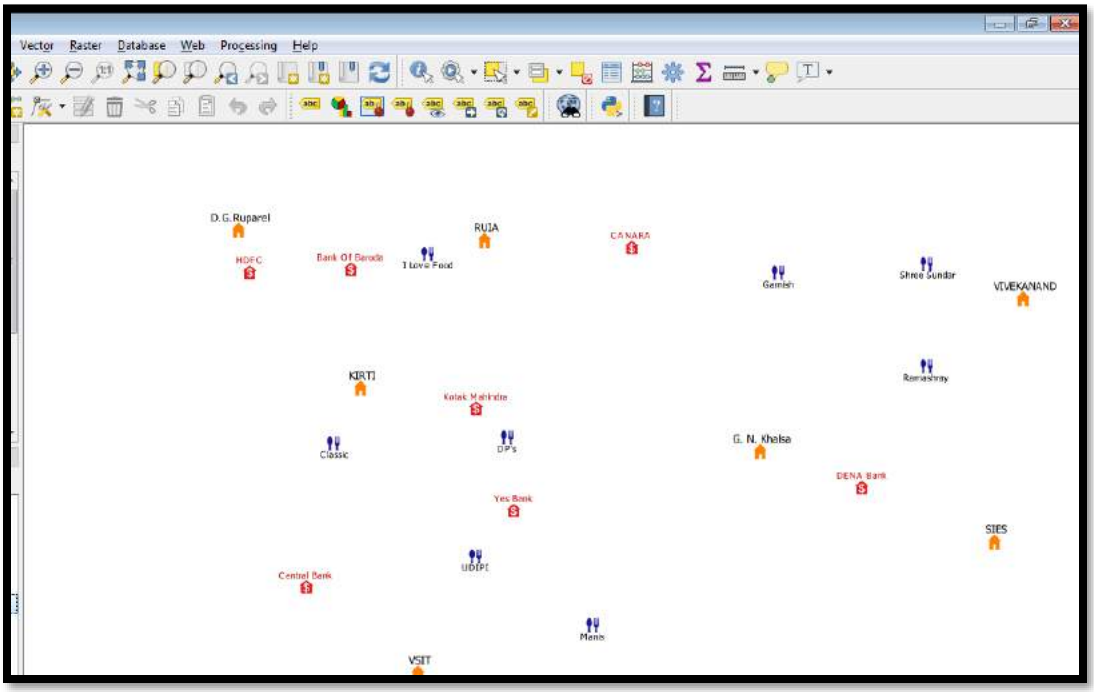


- Click ok & Road will appear as follows

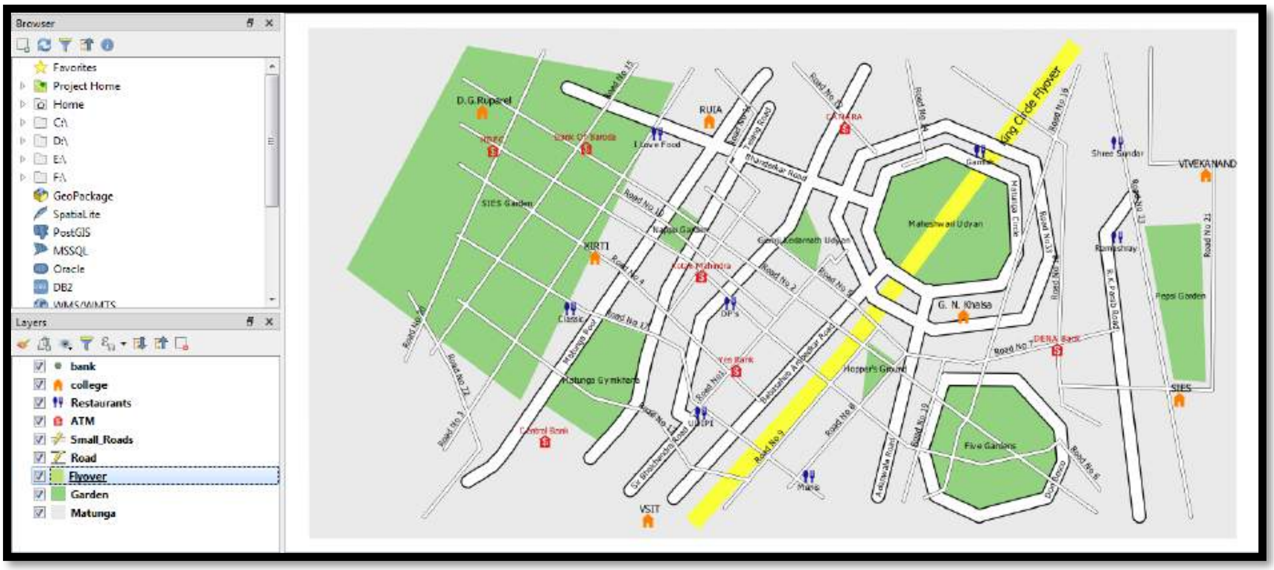


C. Create Point vector layer

- Repeat same steps to add point layers as we have done in previous layers.(For ATM, Restaurants, Banks, Bus Stops etc)

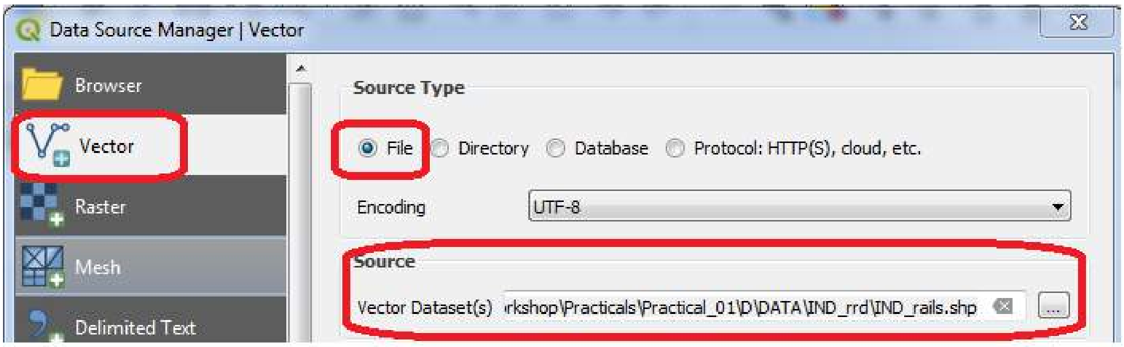


Final output:


Browser
Favorites
Project Home
Home
C:\
D:\
E:\
F:\
GeoPackage
SpatiaLite
PostGIS
MSSQL
Oracle
DB2
Layers
bank
college
Restaurants
ATM
Small_Roads
Road
Flyover
Garden
Matunga
King Circle Flyover
D.G.Ruparel
RUIA
SIES Garden
KIRTI
Mateshwari Udyan
G. N. Khalsa
VIVEKANAND
SIES
VSIT
Five Gardens
Matunga Gymkhana
Hopper's Ground
Pepsi Garden
Shree Sundar
Classic
Matunga Road
Bhandarkar Road

d) Calculating line lengths and statistics

- Go to Layer → Add Layer → Add Vector Layer
- Add the following file to project

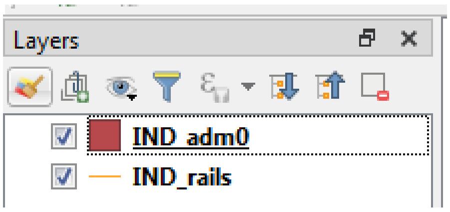


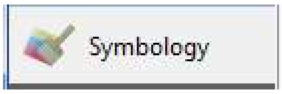
"\GIS_Workshop\Practicals\Practical_01\D\DATA\IND_rrd\IND_rails.shp"
Press "ADD"

- Also add India Administrative Map

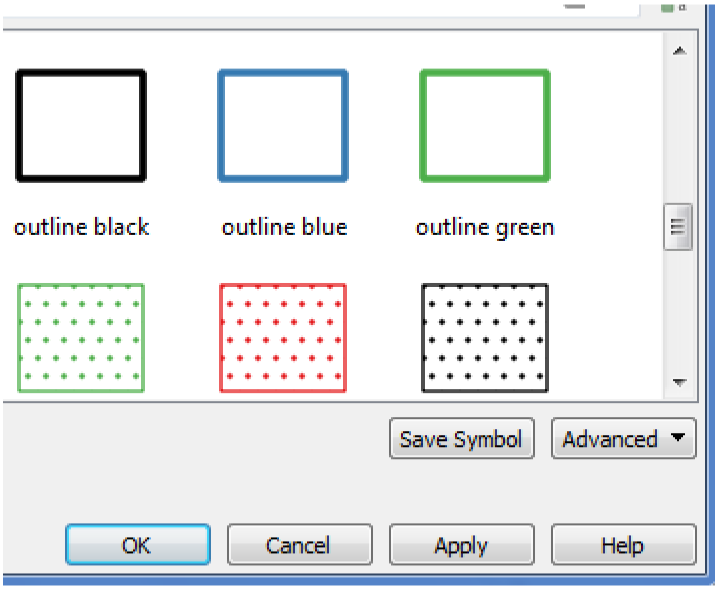
"GIS_Workshop\Practicals\Practical_01\D\DATA\IND_adm\IND_adm0.shp"

- Double Click on IND_adm0



Select 

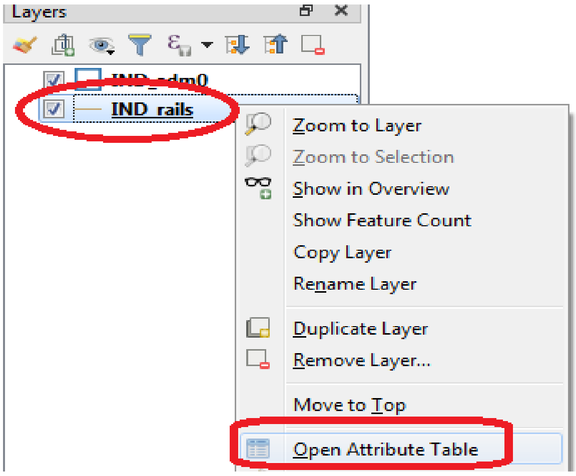
→ Select any outline style from below given options.

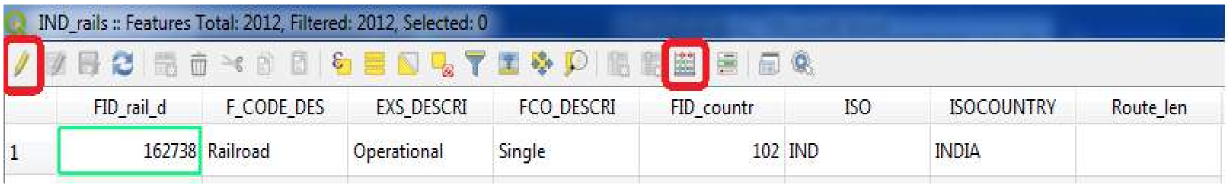


Press OK

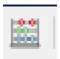
- The display window will appear like

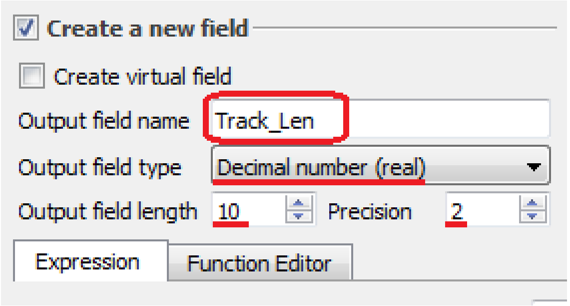
- In Layer Pane, Right click on IND_rails → Open Attribute Table



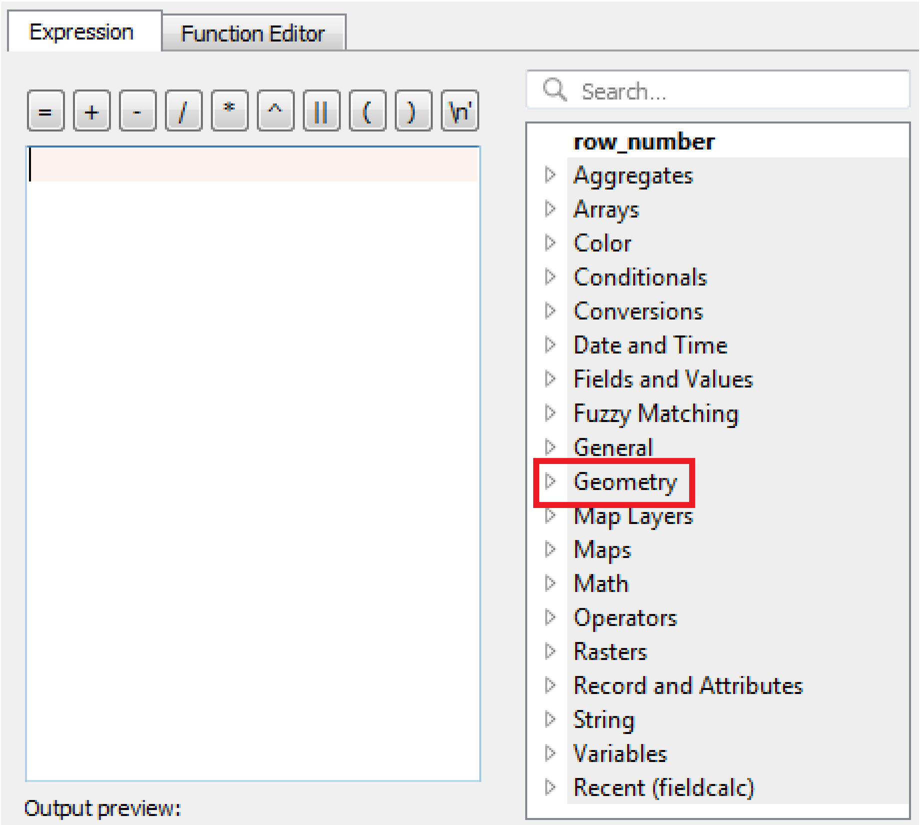


- Press Toggle Editing button using  button, on Attribute table window toolbar.

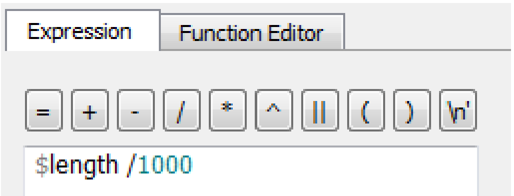
- Press Open Field Calculator using  button.
- Set the output field as “Track_Len”, field type to “Decimal Number”.



- From Function List search $length or go to Geometry → Select $length

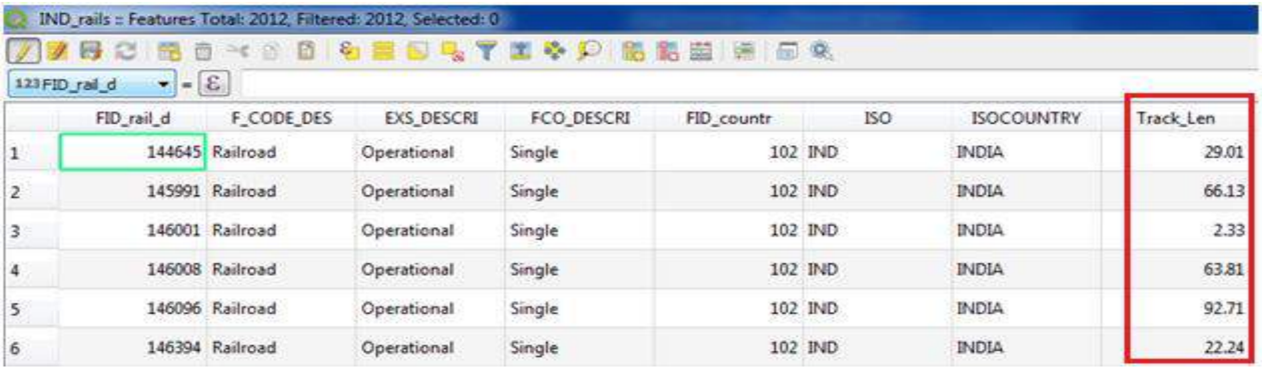


- Set expression as



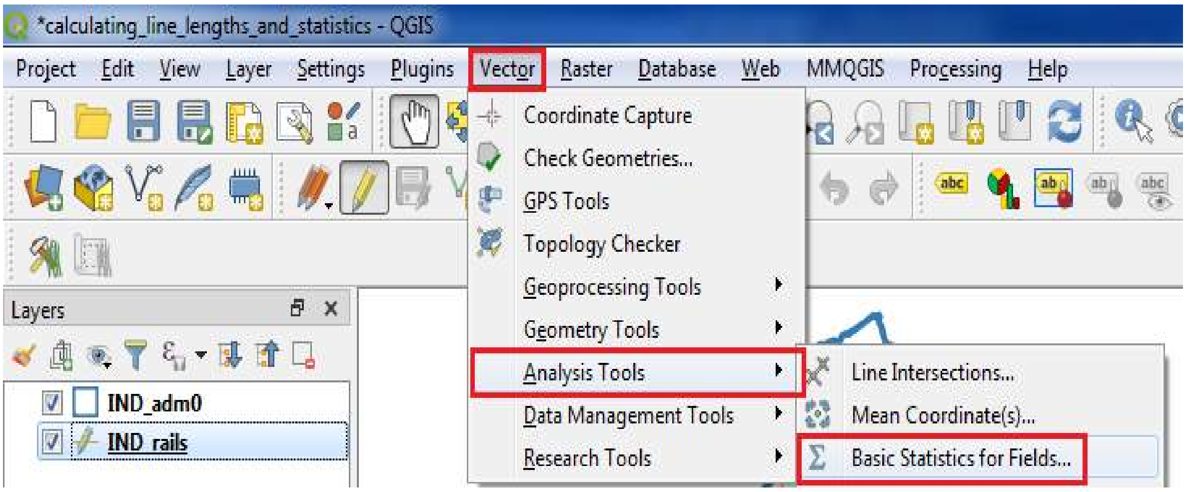
Press “OK”

- A new column is added to the attribute table with value representing the length of track in KM.

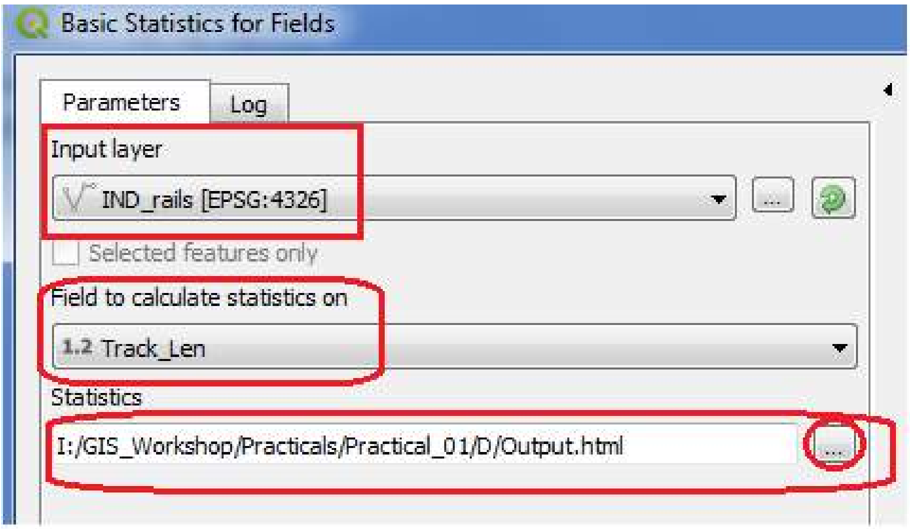


	FID_rail_d	F_CODE_DES	EXS_DESCRI	FCO_DESCRI	FID_countr	ISO	ISOCOUNTRY	Track_Len
1	144645	Railroad	Operational	Single	102	IND	INDIA	29.01
2	145991	Railroad	Operational	Single	102	IND	INDIA	66.13
3	146001	Railroad	Operational	Single	102	IND	INDIA	2.33
4	146008	Railroad	Operational	Single	102	IND	INDIA	63.81
5	146096	Railroad	Operational	Single	102	IND	INDIA	92.71
6	146394	Railroad	Operational	Single	102	IND	INDIA	22.24

- Press CTRL+S or click on Save Edits option on tool bar
- Close the attribute table window.
- For calculating the total length of Railway tracks in India.
- Select Vector→ Analysis Tools→ Basic Statics for Fields

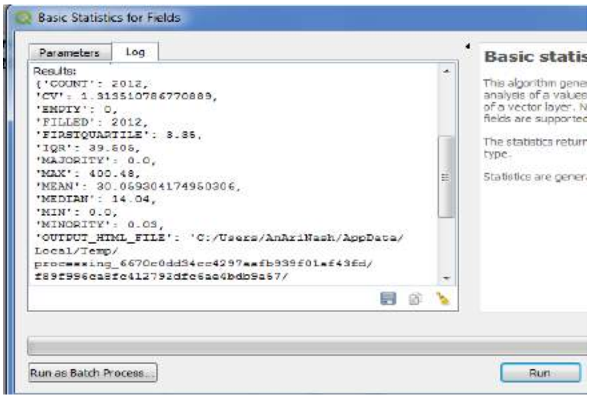


- Select IND_rails layer from input layer. And select Track_Len in “Field to Calculate statistics on”



- Press RUN

- The Result is



- Open the “**output.html**” file to get the field statistics.

  Analyzed field: Track_Len
  Count: 2012
  Unique values: 1608
  NULL (missing) values: 0
  Minimum value: 0.0
  Maximum value: 400.48
  Range: 400.48
  Sum: 60479.320000000014
  Mean value: 30.0593041749503O6
  Median value: 14.04
  Standard deviation: 39.483220276624444
  Coefficient of Variation: 1.313510786770889
  Minority (rarest occurring value): 0.03
  Majority (most frequently occurring value): 0.0
  First quartile: 3.35
  Third quartile: 42.855000000000004
  Interquartile Range (IQR): 39.505

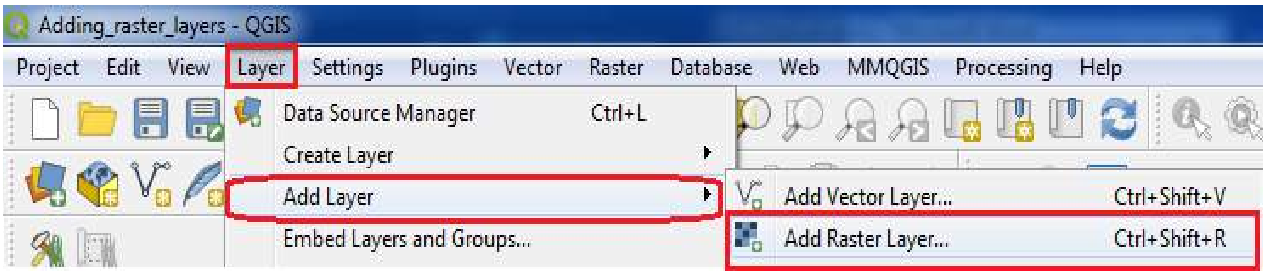
- The above statistics show that the total length of Railway track in India is **60,479.32 KM**.

PRACTICAL - 2

Exploring and Managing Raster data:

a) Adding raster layers

- From menu bar select Layer → Add Layer → Add Raster Layer

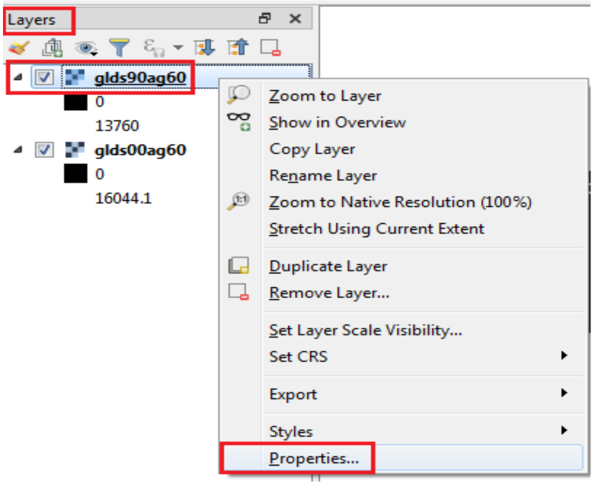


- Select Gridded Population of the World (GPW) v3 dataset from Columbia University, Population Density Grid for the entire globe in ASCII format and for the year 1990 and 2000.
"\GIS_Workshop\Practicals\Practical_02\A\Data\gl_gpwv3_pdens_90_ascii_one\glds90ag60.asc"
"\GIS_Workshop\Practicals\Practical_02\A\Data\gl_gpwv3_pdens_90_ascii_one\glds00ag60.asc"

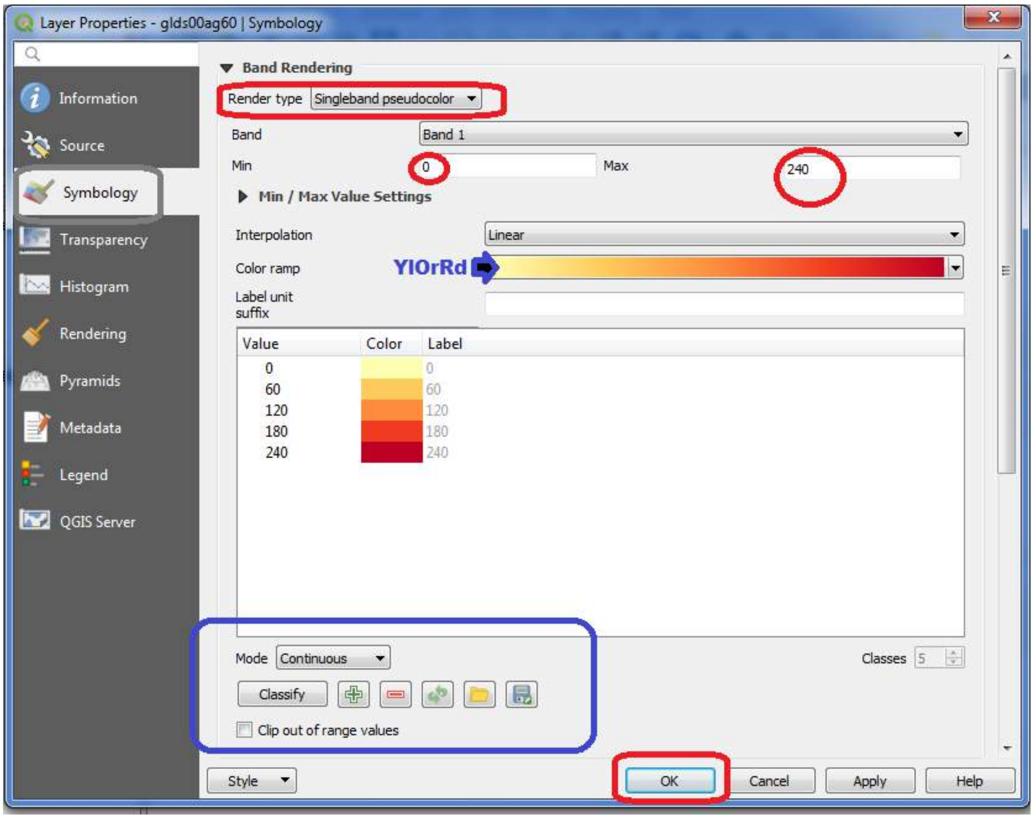
- Go to Project → Properties OR Press the Set CRS option on bottom right corner.
Select WGS 84 EPSG: 4326 and Press OK

b) Raster Styling and Analysis

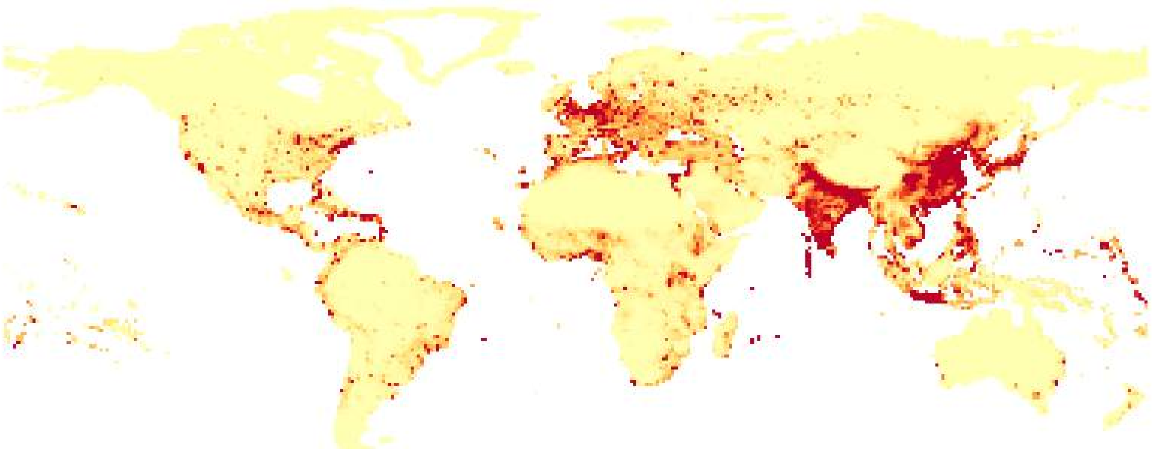
- To start with analysis of population data, convert the pixel from grayscale to Color.
- Select "glds90ag60.asc" Layer form layer Pane → select property OR double click on it.



- Select 

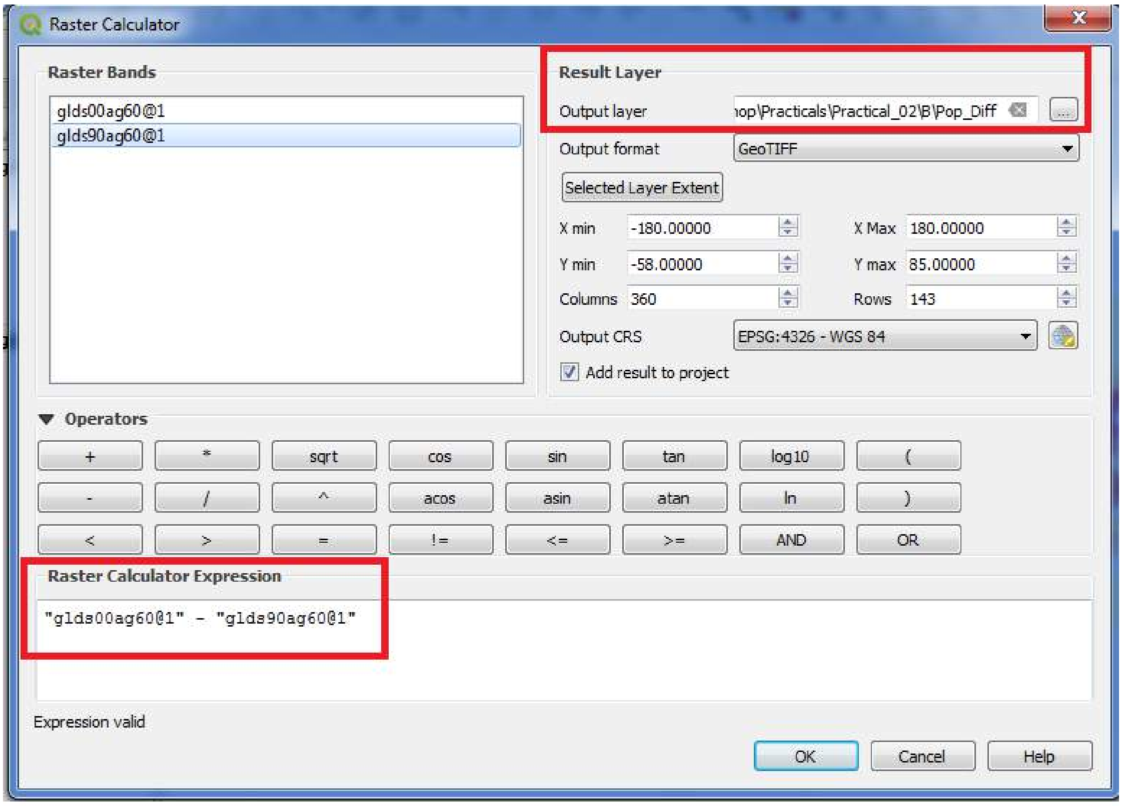


- Press "APPLY"
- Repeat the same for "glds00ag60.asc" Layer



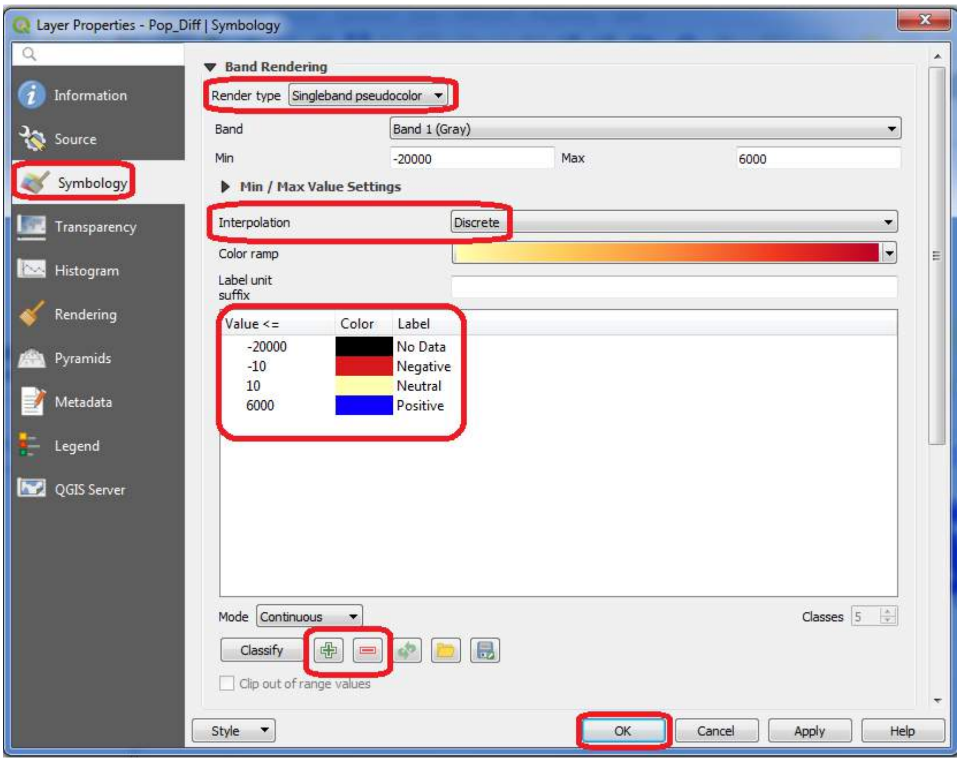
Layout output after applying style.

- The objective this experiment is to analyze raster data, as an example we will find areas with largest population change between 1990 and 2000, by calculating the difference between each pixel values.
- Go to Raster → Raster Calculator

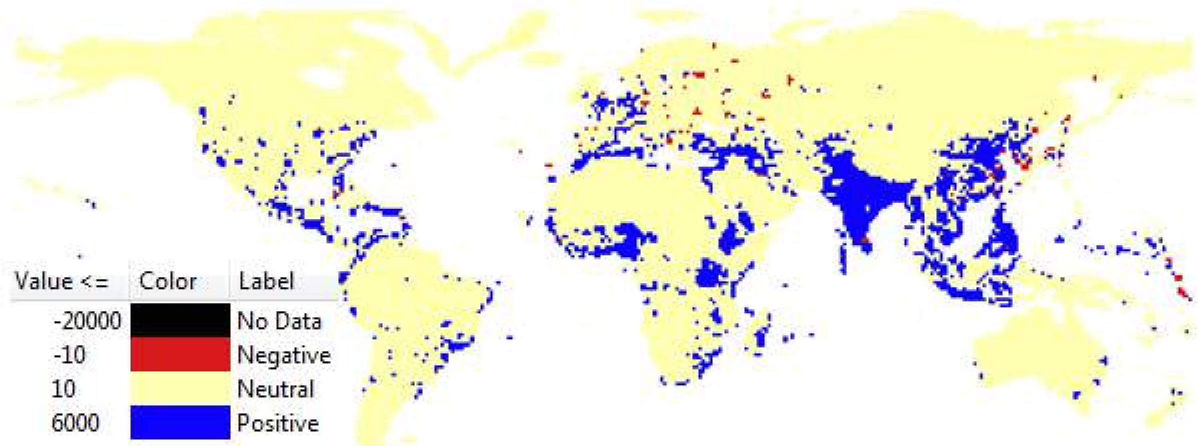


- Put the expression "glds00ag60@1" - "glds90ag60@1"
- Select the output file location & name and Press OK.

- Remove the other two layers i.e. glds00ag60.asc and glds90ag60.asc
- Double click on pop_diff layer.
- Select 



- Set Render Type to "Single band Pseudo color", Interpolation as Discrete, and remove all classification and add as shown in figure above using  button. After all settings press "OK".
- Layer will appear like

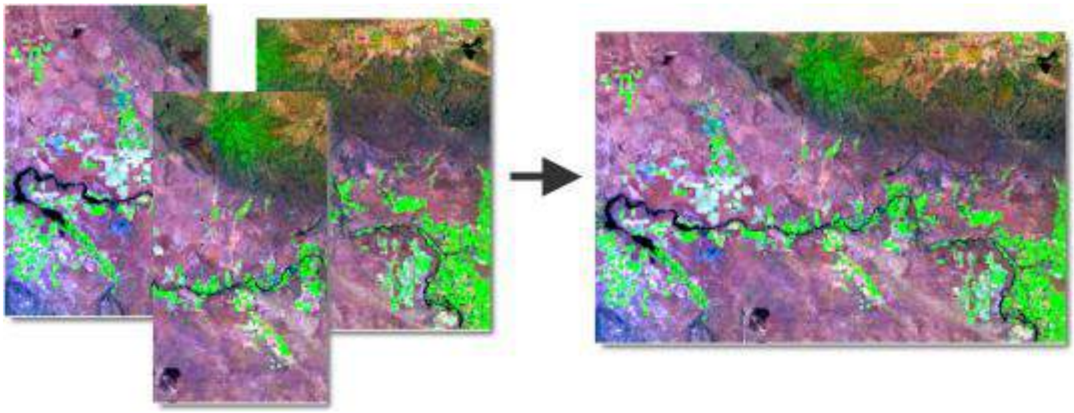


- Explore an area of your choice and check the raster band value using  to verify the classification rule.
- The red pixel shows negative changes and blue shows positive changes.

c) Raster Mosaicking and Clipping

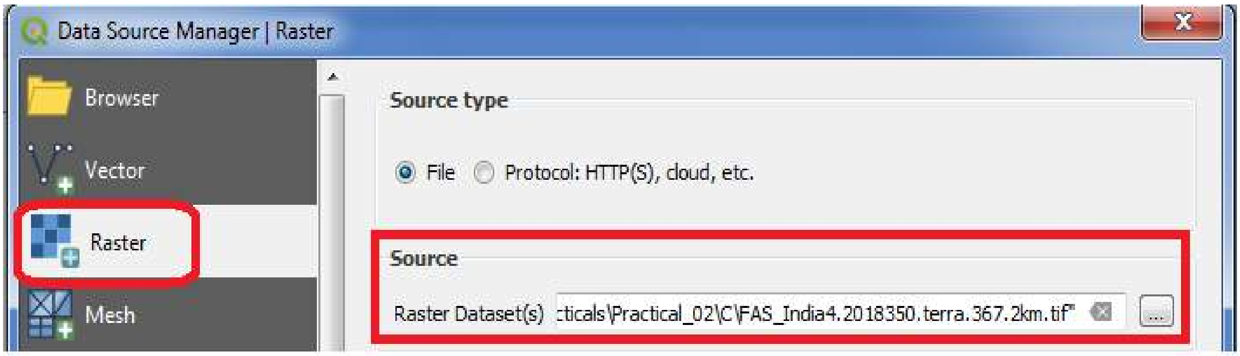
A **mosaic** is a combination or merge of two or more images.
In GIS, a single raster dataset can be created from multiple raster datasets by mosaicking them together.

In many cases, there will be some overlap of the raster dataset edges that are being mosaicked together, as shown below.

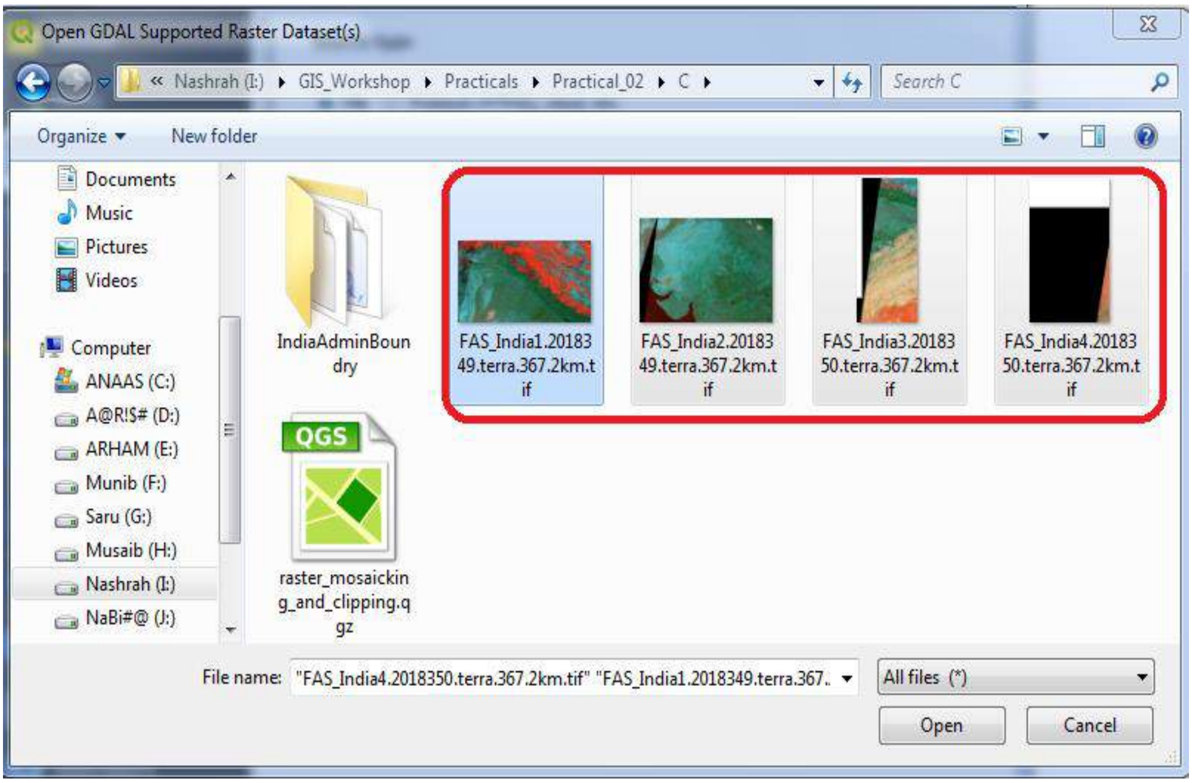


These overlapping areas can be handled in several ways; for example, you can choose to only keep raster data from the first or last dataset, you can blend the overlapping cell values using a weight-based algorithm, you can take the mean of the overlapping cell values, or you can take the minimum or maximum value. When mosaicking discrete data, the First, Minimum, or Maximum options give the most meaningful results. The Blend and Mean options are best suited for continuous data. If any of the input rasters are floating point, the output is floating point. If all the inputs are integer and First, Minimum, or Maximum is used, the output is integer.

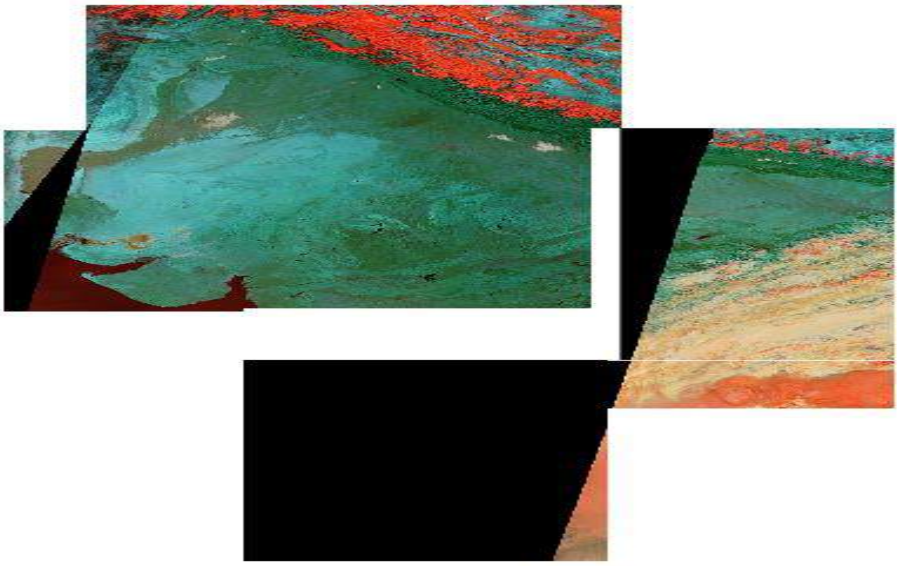
- Go to Layer → Add Layer → Add Raster Layer.



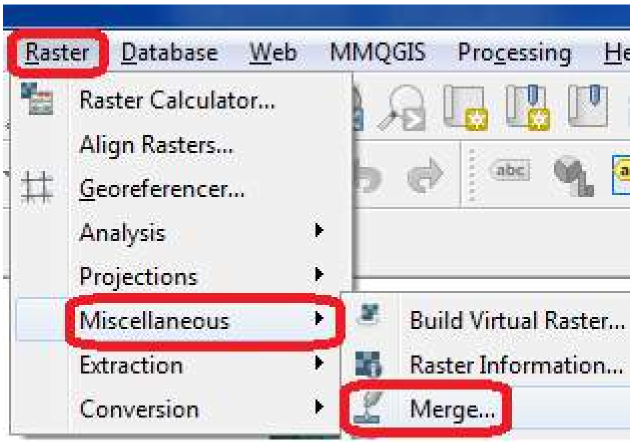
- Select the following "**.tif**" raster images for India from data folder.
  FAS_India1.2018349.terra.367.2km.tif
  FAS_India2.2018349.terra.367.2km.tif
  FAS_India3.2018349.terra.367.2km.tif
  FAS_India4.2018349.terra.367.2km.tif



- Press open
- In data source manager | Raster window click Add.

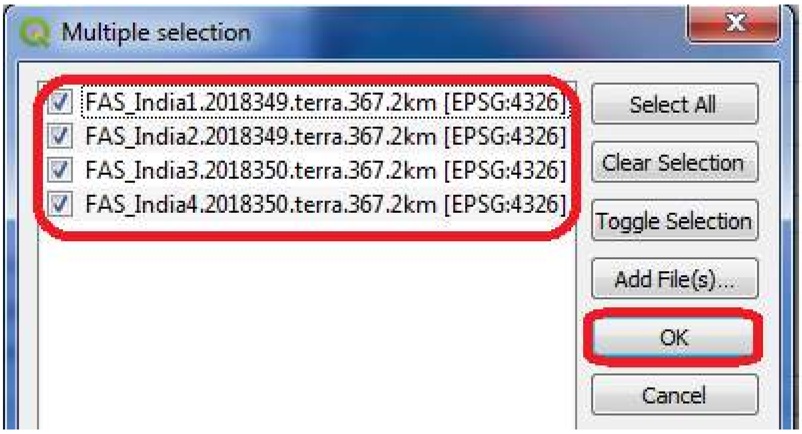


- Go to Raster → Miscellaneous → Merge

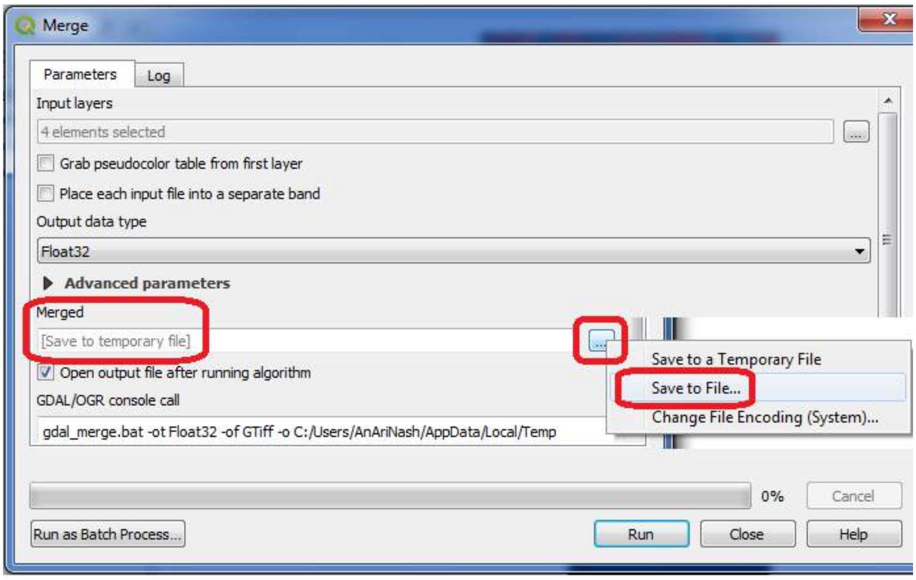


- ➢ In the Merge dialog window

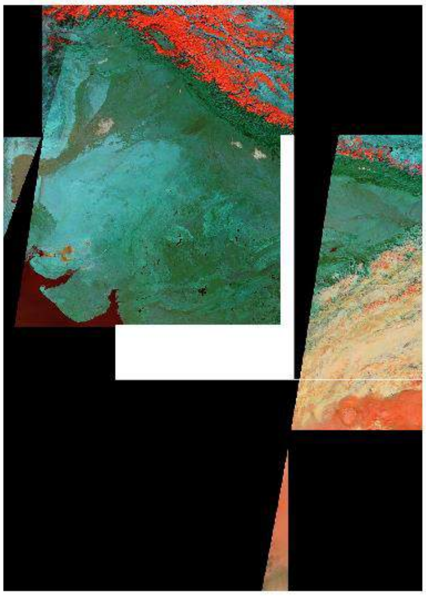
- ➢ Select all layers and Press OK.



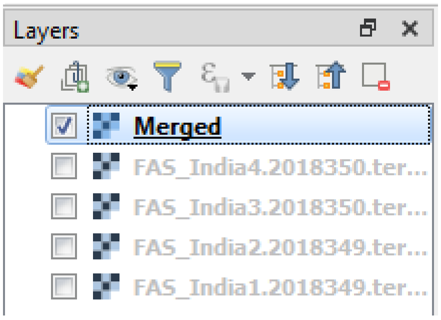
- ➢ In Merge dialog window select a file name and location to save merged images.



- Save the file to "GIS_Workshop/Practicals/Practical_02/C/" location with the name as Merge_Files.tif
- Press Run and after completion of operation close the Merge window dialog box.

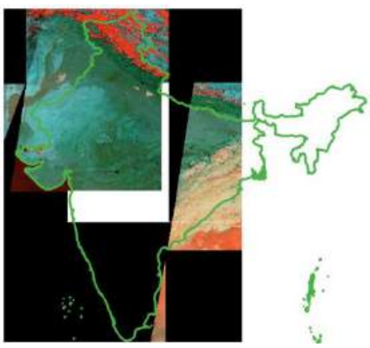


- You can now deselect individual layers from layer pane and only keep the merged raster file.

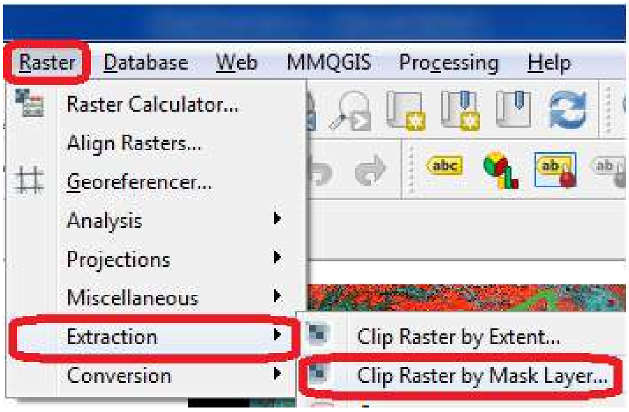


- Go to Layer→ Add Vector Layer → Select \GIS_Workshop\Practicals\Practical_02\C\IndiaAdminBoundry\IND_adm0.shp file.
- From layer properties → select  → select any one of the following

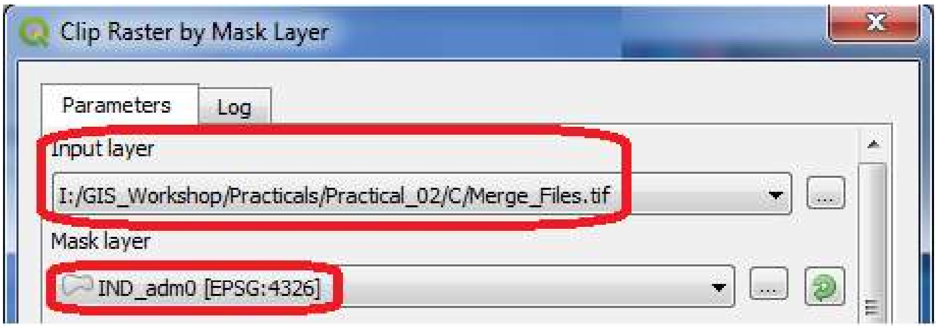
- The result will be



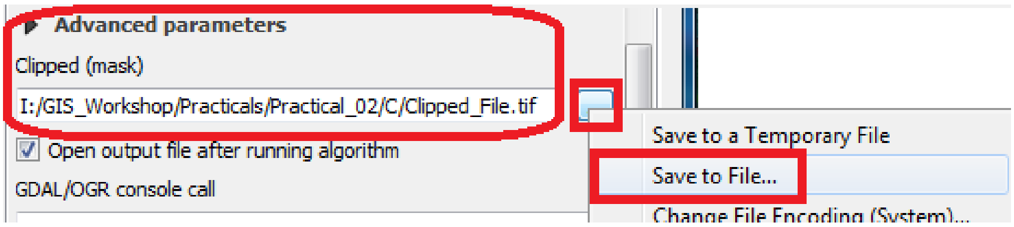
- Go to Raster → Extraction → Clip Raster by Mask Layer



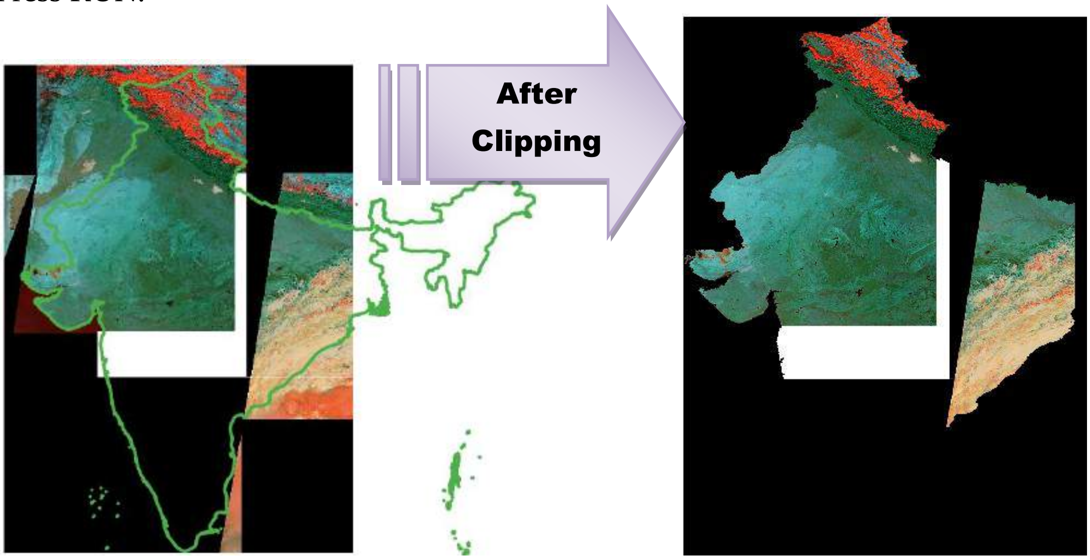
- Select the merge raster image as input and Ind_adm0 as mask layer.



- Select a file name and location for clipped raster as /Practical_02/C/Clipped_File.tif.



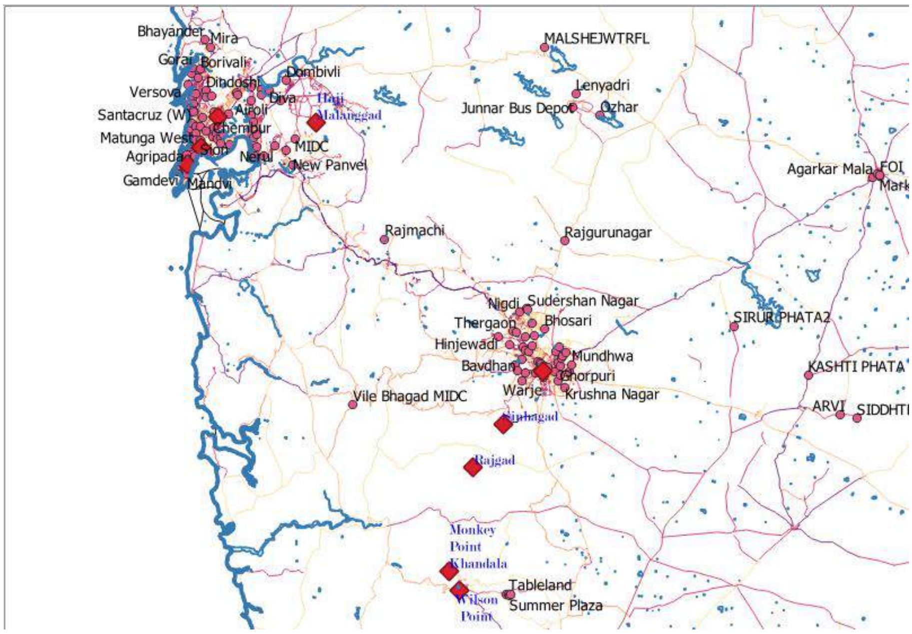
- Press RUN.



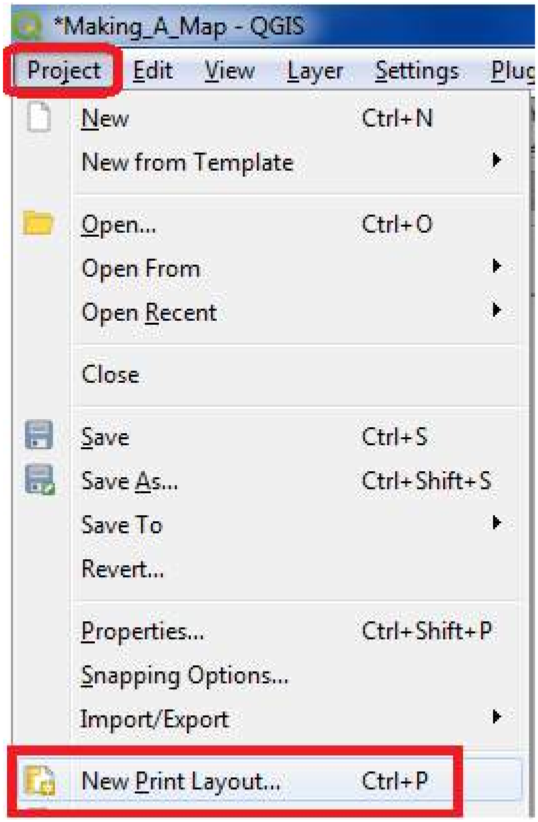
PRACTICAL - 3

a) Making a Map

- Create a new Thematic Map or open and existing one
- Consider the following map as an example map

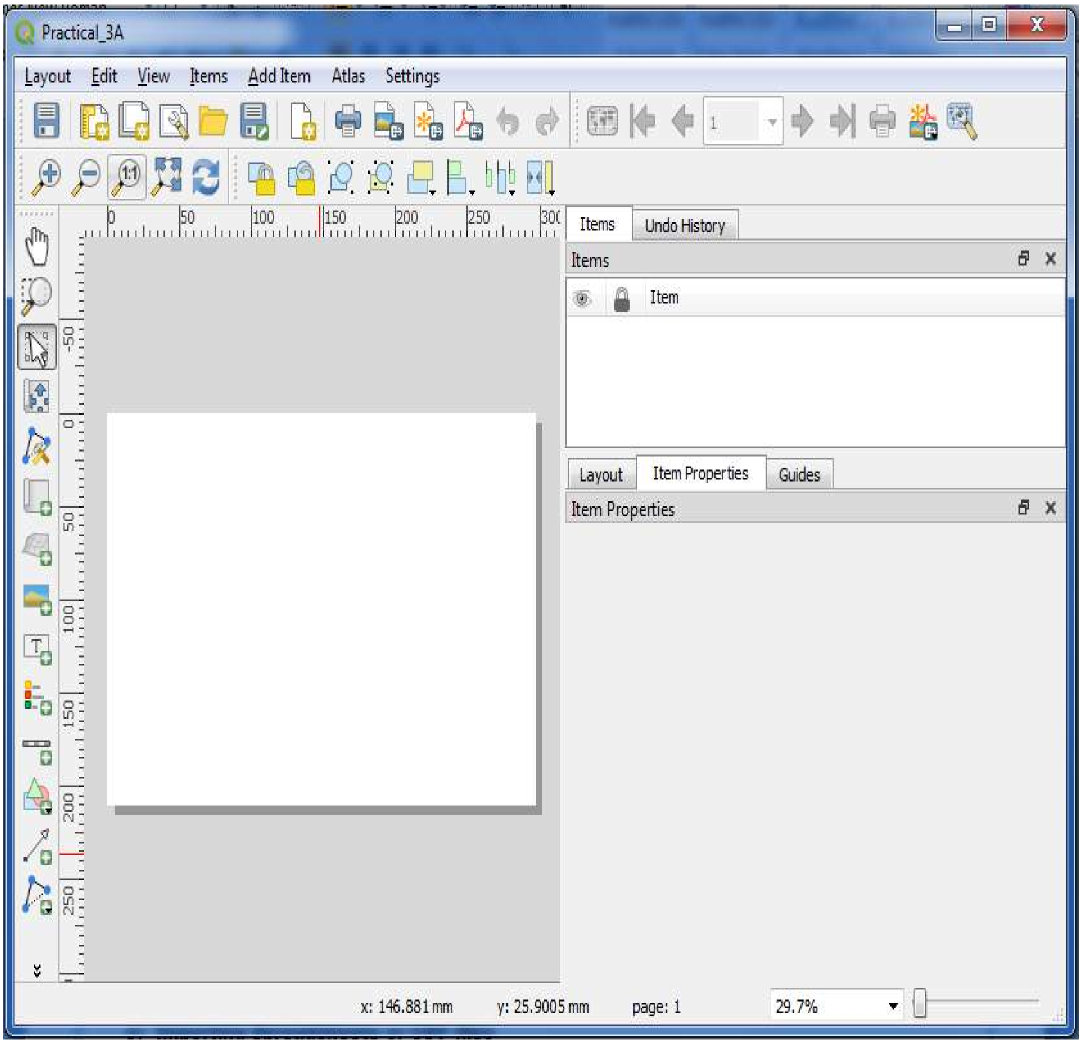


- Go to Project → New PrintLayout

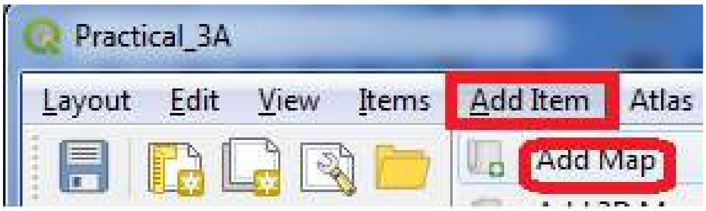


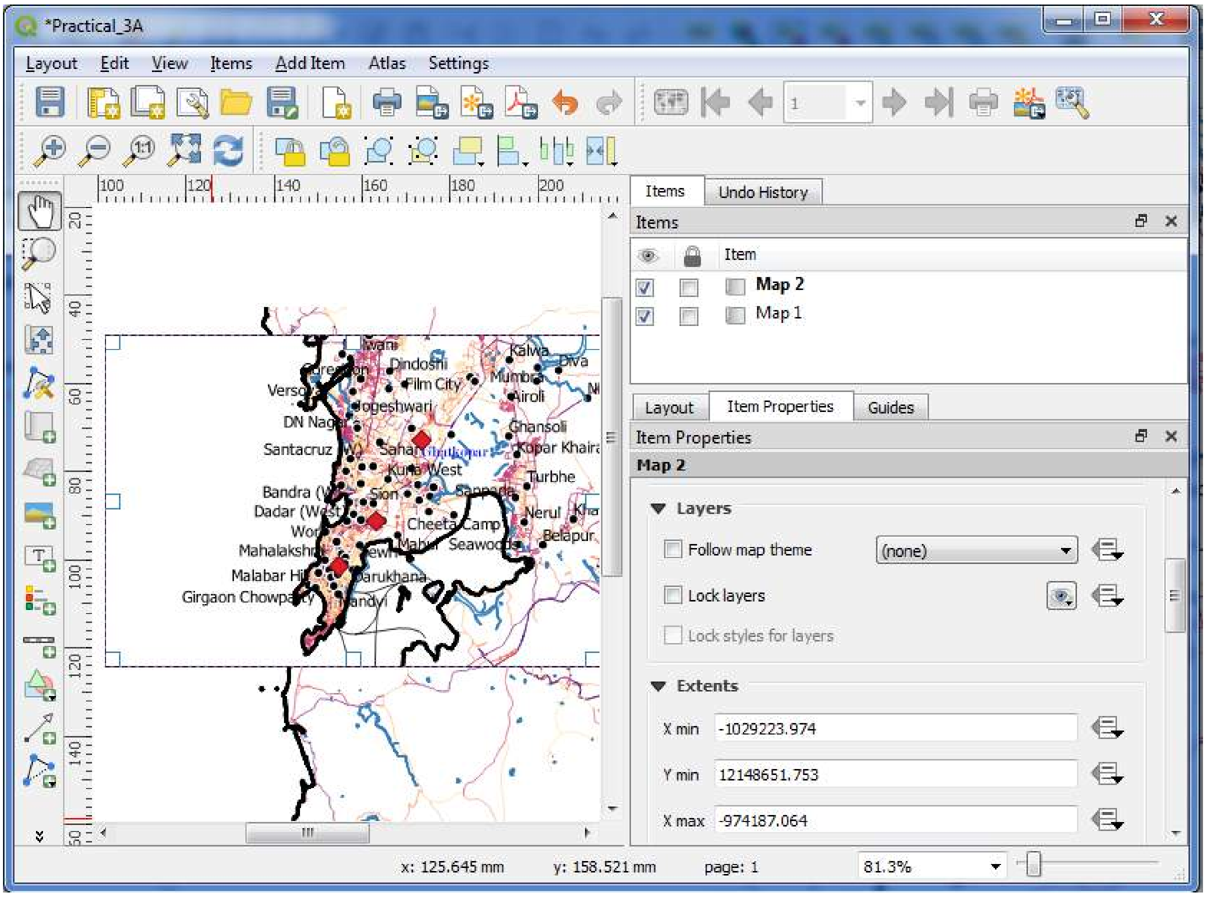
- Insert a suitable title and press “OK”.

➢ A new Print Layout window will open

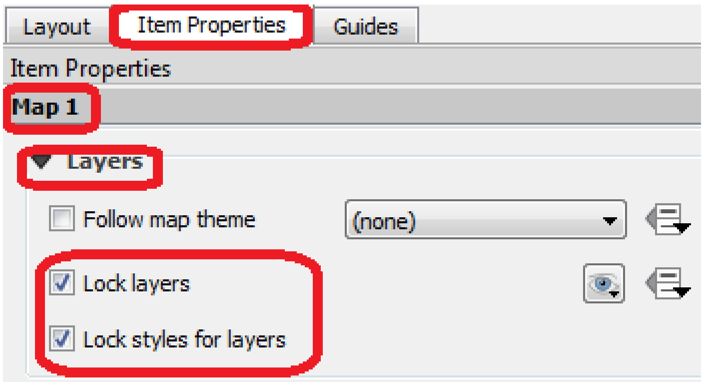


➢ Select Add Item → Add Map



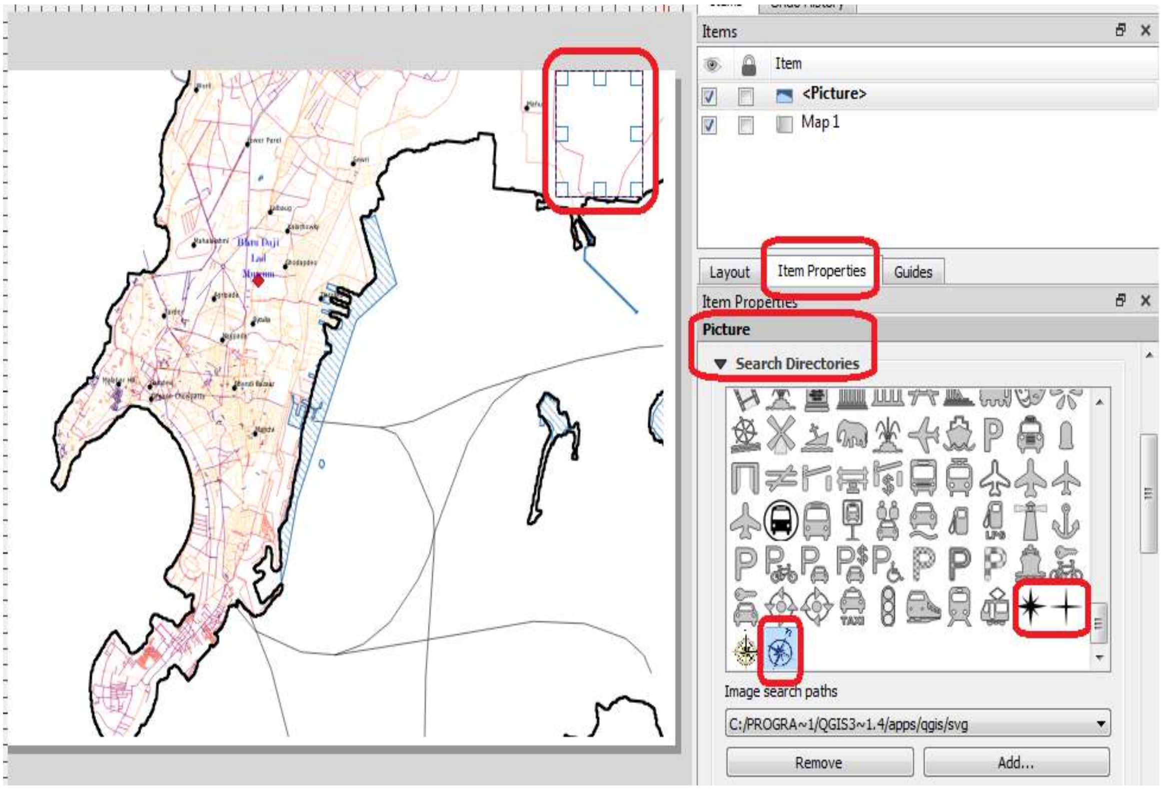


- After adding map go to ItemProperties → Map1→ Layers
  Check on Lock Layers and Lock Styles for Layers

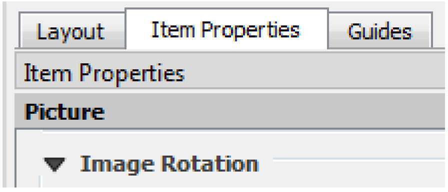


This will ensure that if any change in layers or change their styles, the Print Layout view will not change.

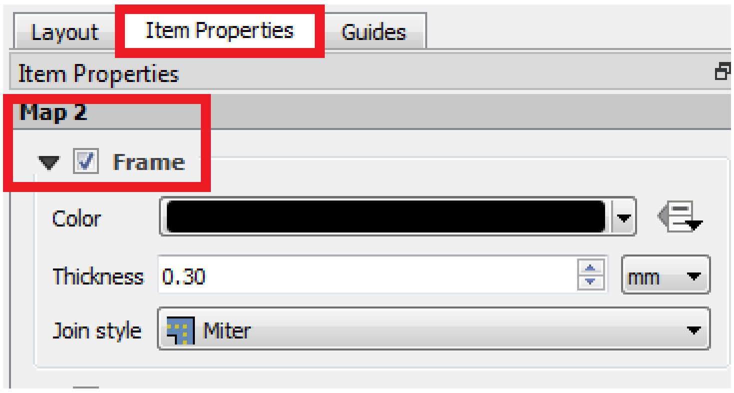
- Go to Add Item → Add Picture → Place a picture box at appropriate location.



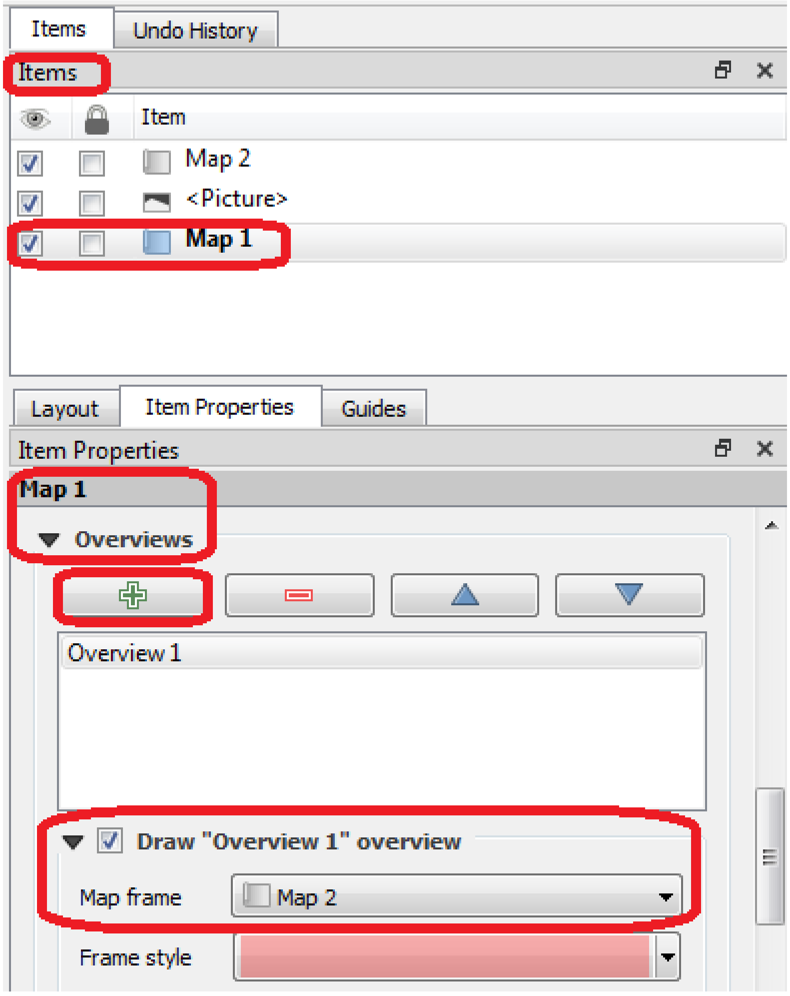
- ➢ Also adjust Image Rotation to its appropriate value.
- ➢ Item Properties → Image Rotation



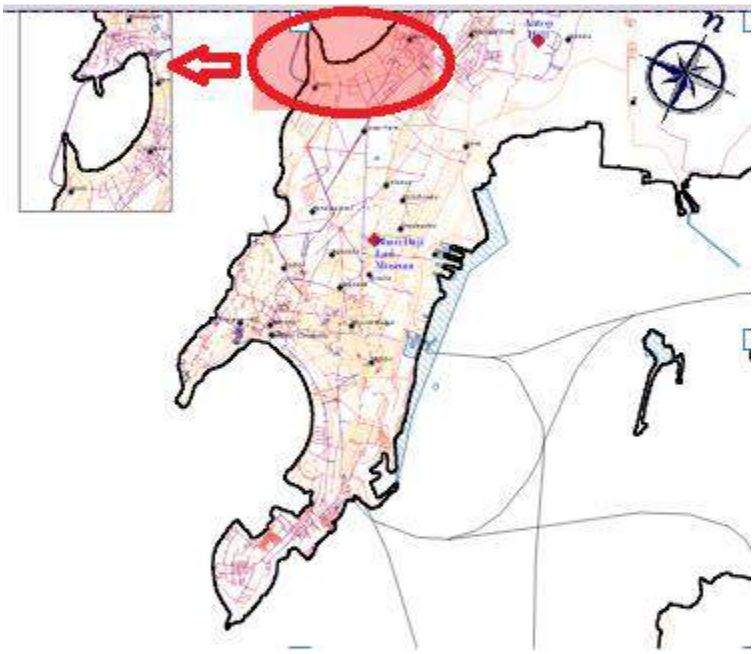
- ➢ Add an inset Using Add Item → Add Picture → Select an area to be highlighted on main Map.
- ➢ Set a frame for Inset by enabling the check box for Frame.



- ➢ To highlight the area shown in Inset
- ➢ Select the Picture representing main Map from Items pane.
- ➢ In Item Properties → Overviews → using  icon add an overview.
- ➢ Select the checkbox Draw Overview
- ➢ Name the Picture object representing inset (Map1 in our case).

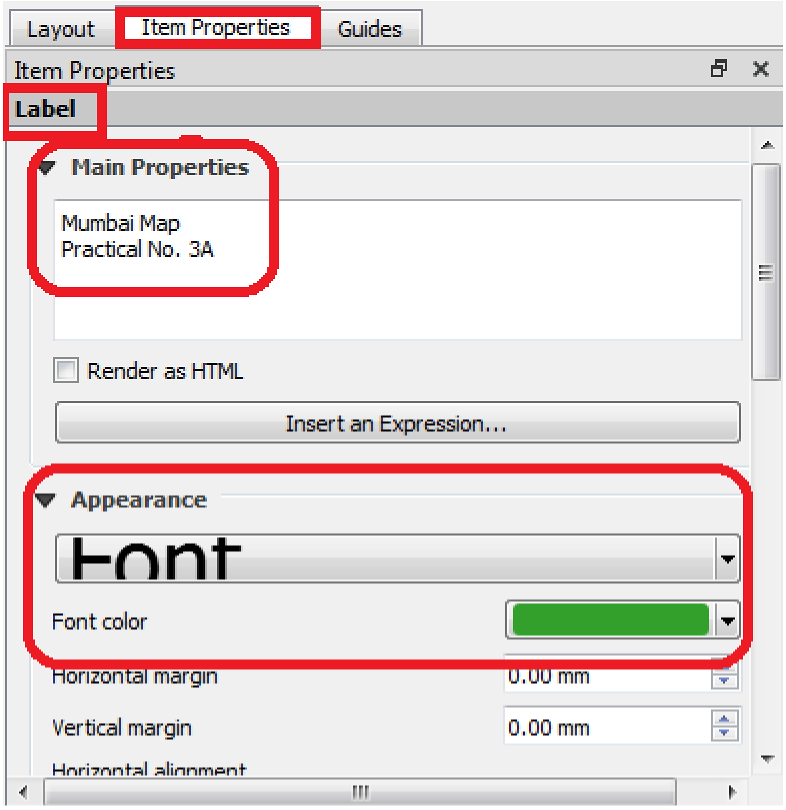


- The Print Layout will appear like

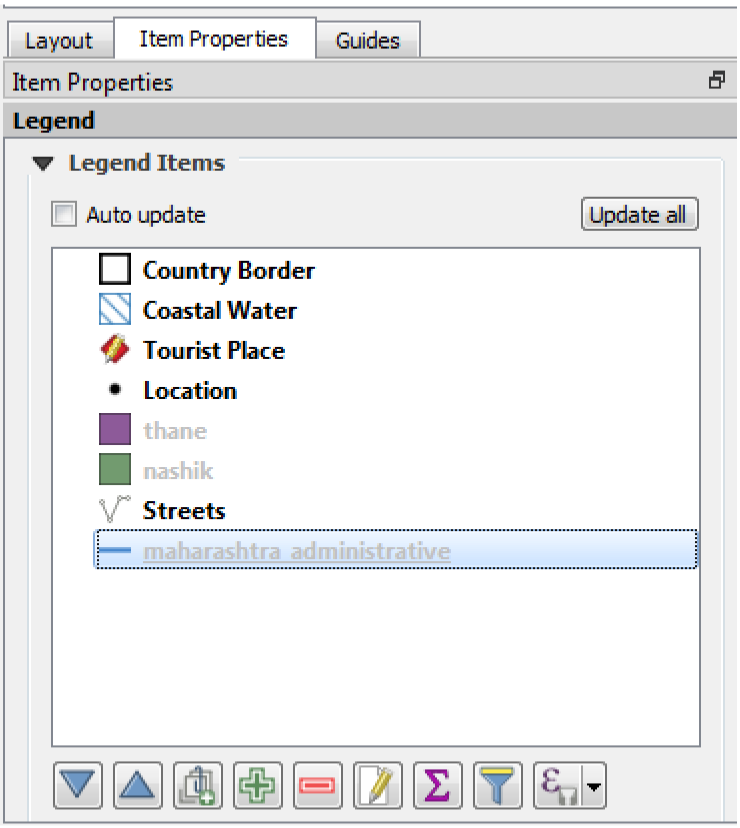


- Add Item → Add Label

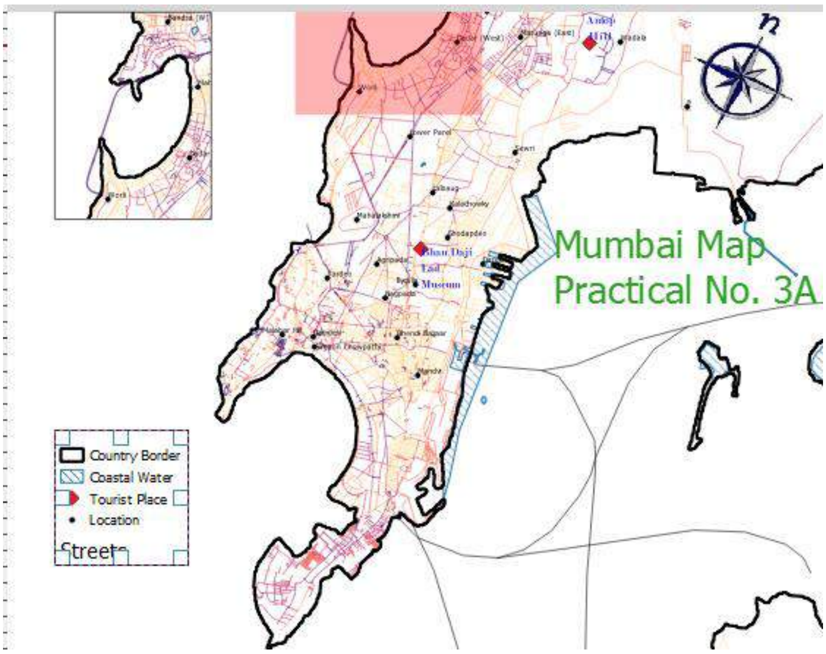
- Change the Label text To "Mumbai Map", Set appropriate font size and color using Item Properties→ Main Properties.



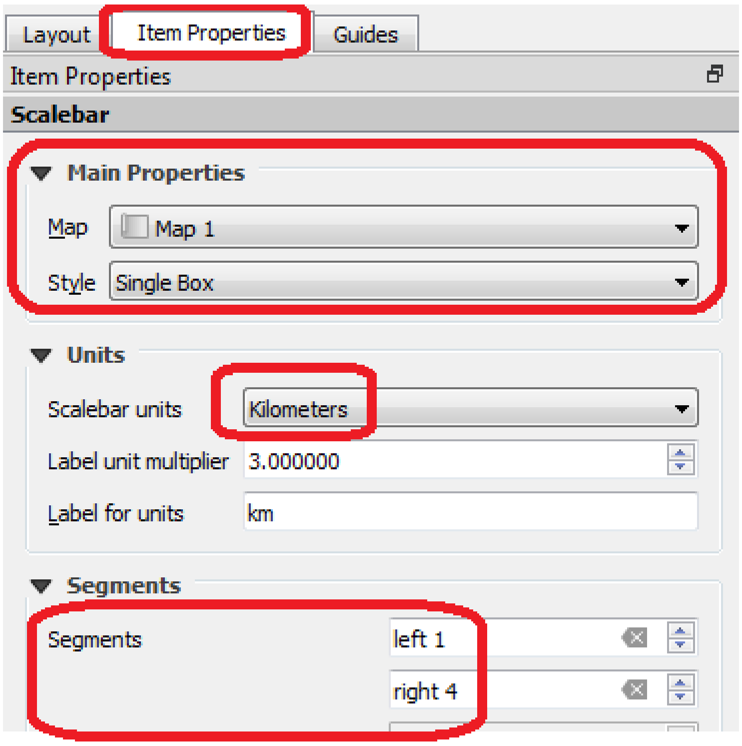
- Add Item → Add Legend→ Place the legend indicator at appropriate location.
- Uncheck auto update and use suitable legend indicator label.



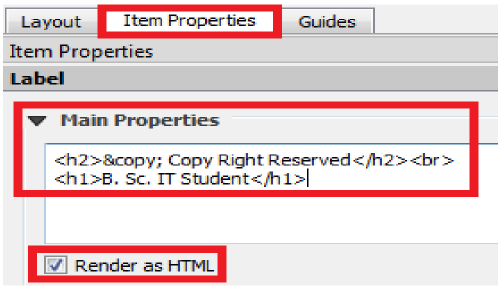
➢ The Print Layout will appear



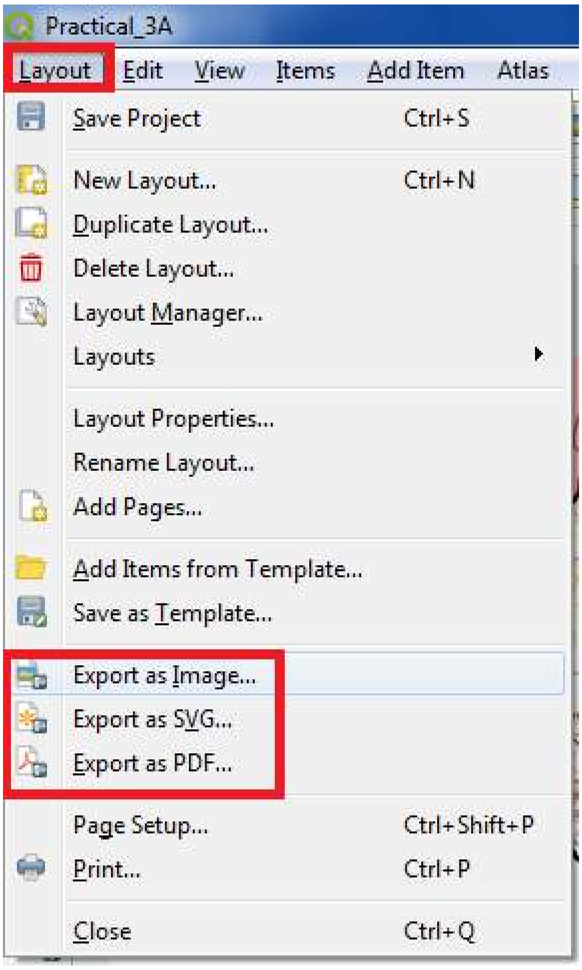
➢ Add Item → Add Scale Bar



➢ Add Item → Add Label→Add a Label using HTML rendering

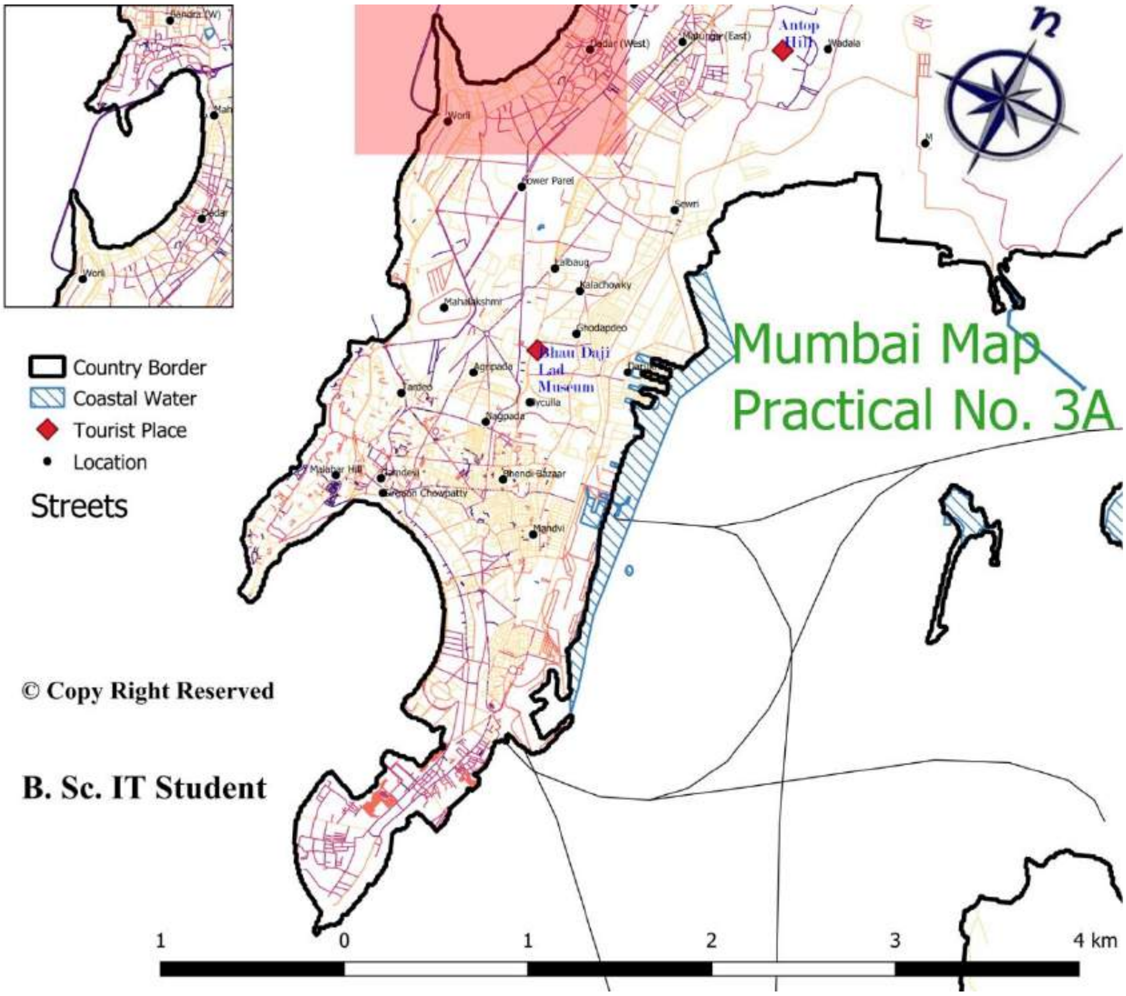


- A Map can be saved in Image or PDF using Layout → Export as Image / Export as PDF



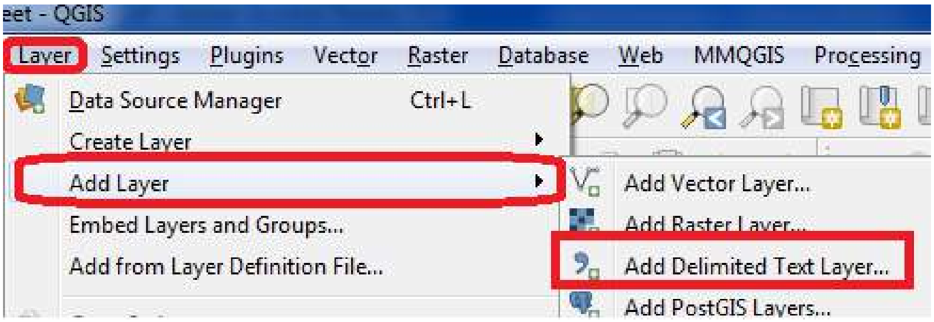
- Save the Map to a location appropriate location as PDF or Image.

- Open the PDF or Image from location.

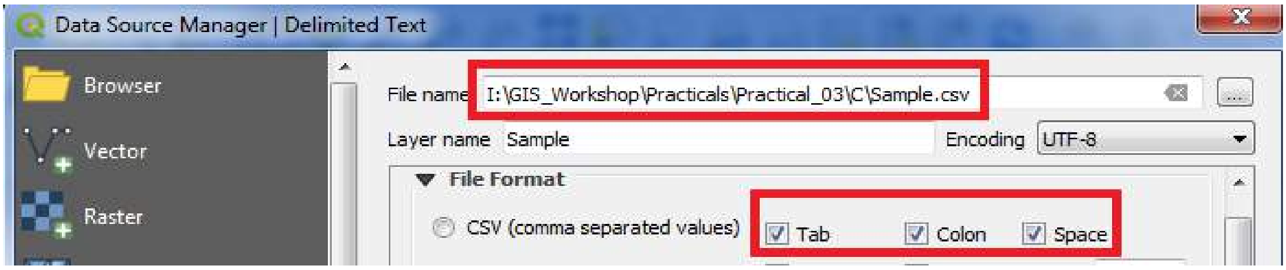


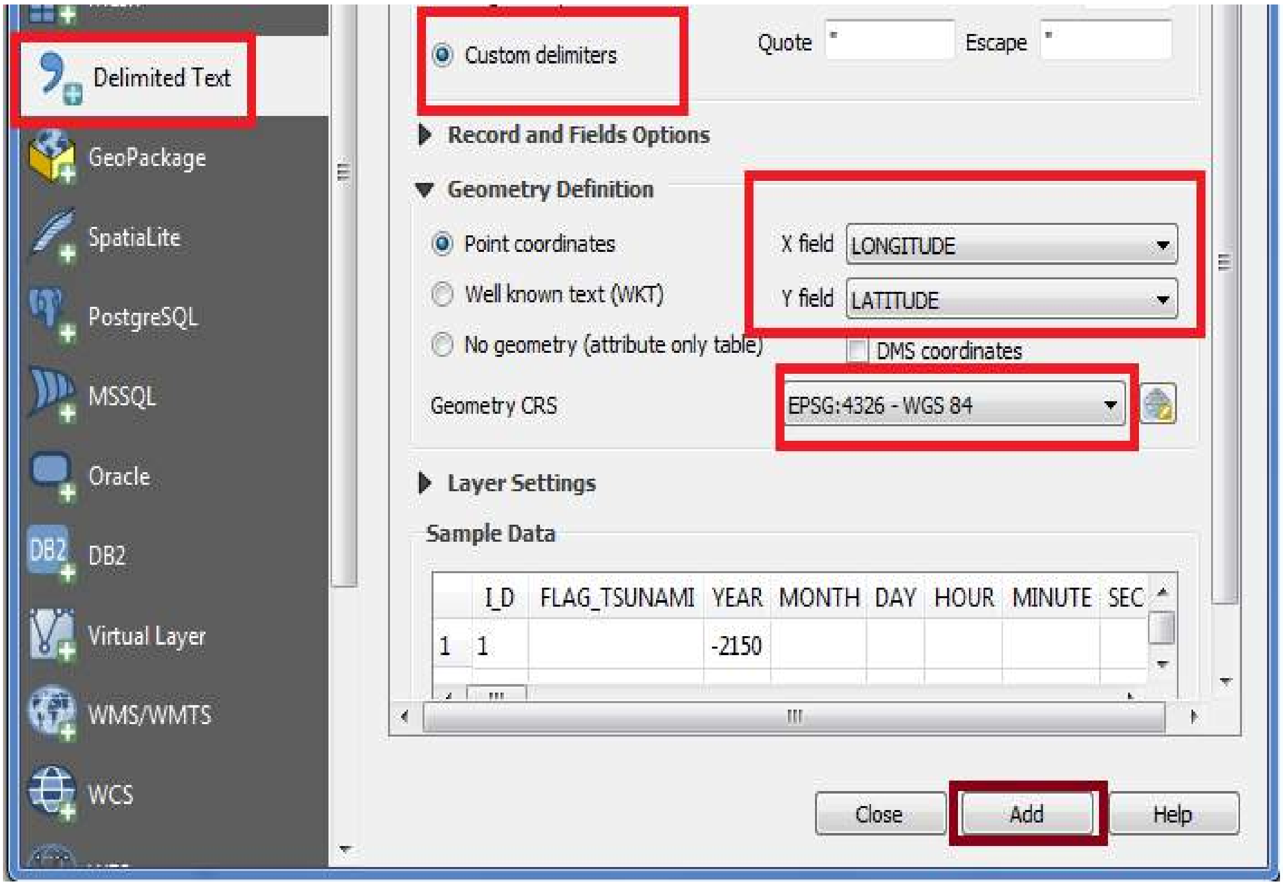
b) Importing Spreadsheets or CSV files

- Many times the GIS data comes in a table or an Excel spreadsheet or a list lat/long coordinates, therefore it has to be imported in a GIS project.
- Sample file for Earthquake data will be used in this practical.
- Go to Layer → Add Layer → Add Delimited text Layer



- Data Source Manager | Delimited Text window will appear
- Select the \GIS_Workshop\Practicals\Practical_03\C\Sample.csv file from data folder.

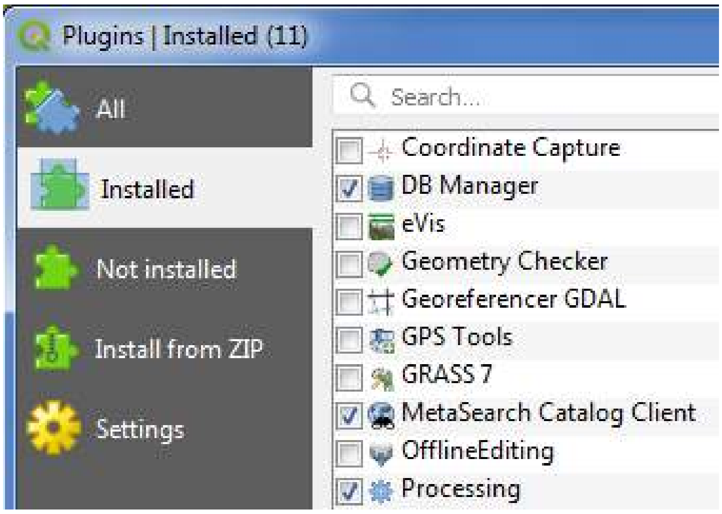




- Press ADD and close the window.
- Output:

c) Using Plugins

- Core plugins are already part of the standard QGIS installation. To use these, just enable them.
- Open QGIS. Click on Plugins → Manage and Install Plugins....



- **To enable a plugin**, check on the checkbox next to Plugin. This will enable the plugin to use it.
- **External plugins** are available in the QGIS Plugins Repository and need to be installed by the users before using them.
- Click on Not Installed or Install from ZIP.
- Once the plugin is downloaded and installed, you will see a confirmation dialog.
- Click on Plugins → <<new Plugin Name>>
- The Plugin if marked **Experimental plugin** can be installed, from Setting→ check on

or

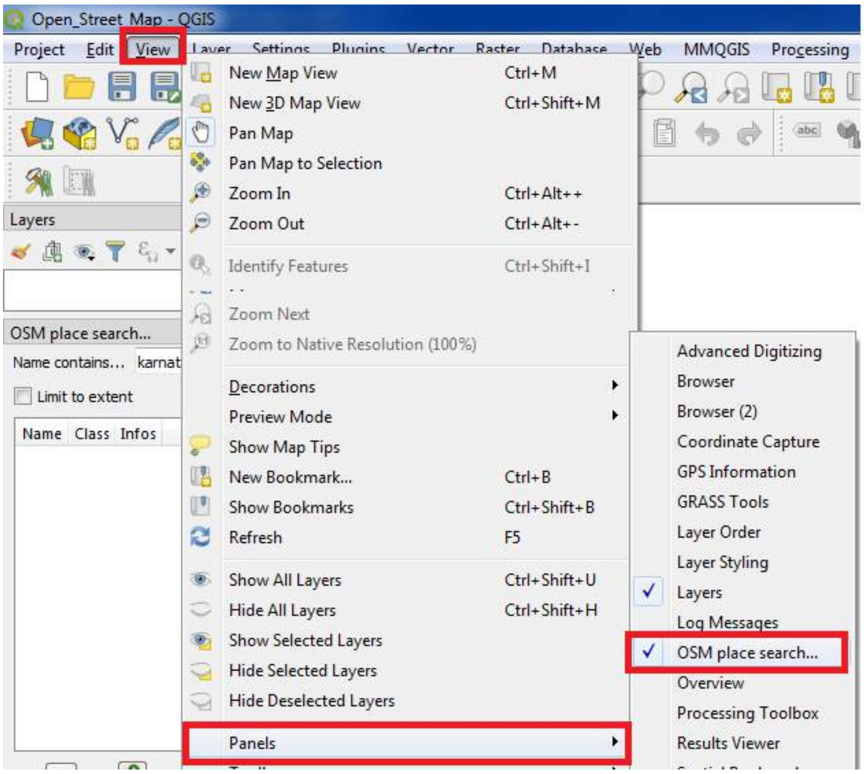
- A 

 tab will be added to Plugin Manager Window.
- Click on a plugin name and Click Install.

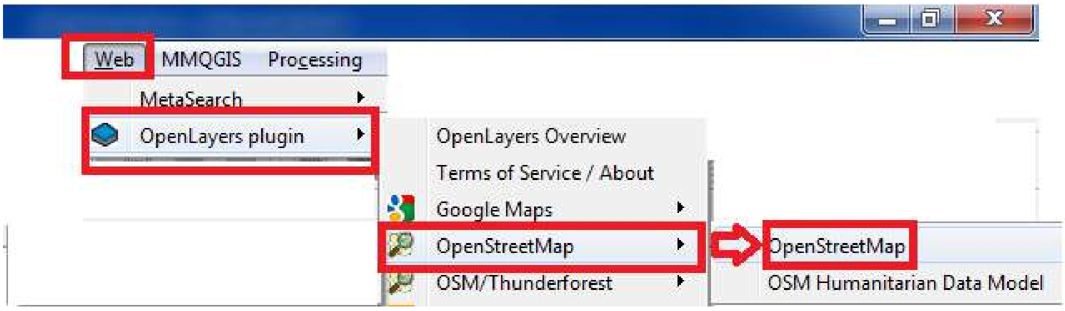
d) Searching and Downloading OpenStreetMap Data

OpenStreetMap (**OSM**) created by Steve Coast in the UK in 2004 is a collaborative project to create a free editable map of the world. Rather than the map itself, the data generated by the project is considered its primary output. The creation and growth of OSM has been motivated by restrictions on use or availability of map information across much of the world, and the advent of inexpensive portable satellite navigation devices.

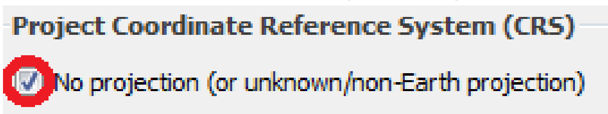
- Add "**Open Layer**" and "**OSM Search**" Plugin from Not Installed option from Plugin Manager Dialog Box.
- The **OSM Place Search** plugin will install itself as a *Panel* in QGIS, if not go to View → Panels → select OSM Place Search.

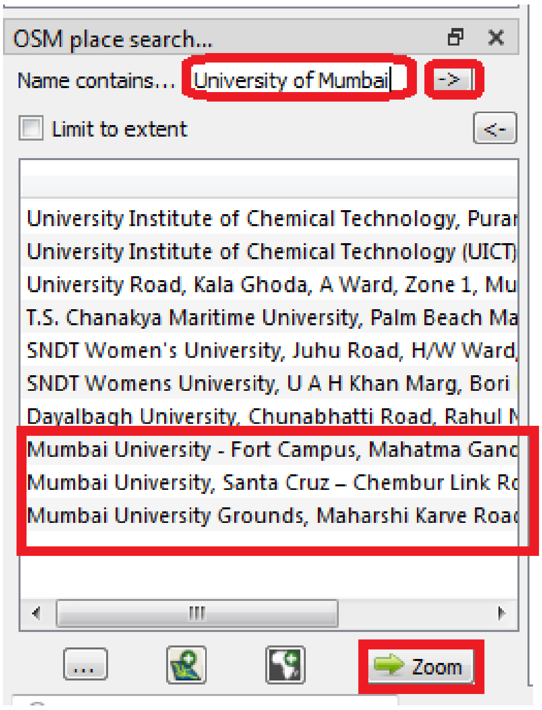


- Go to Web → OpenLayer Plugin and select Open Street Map



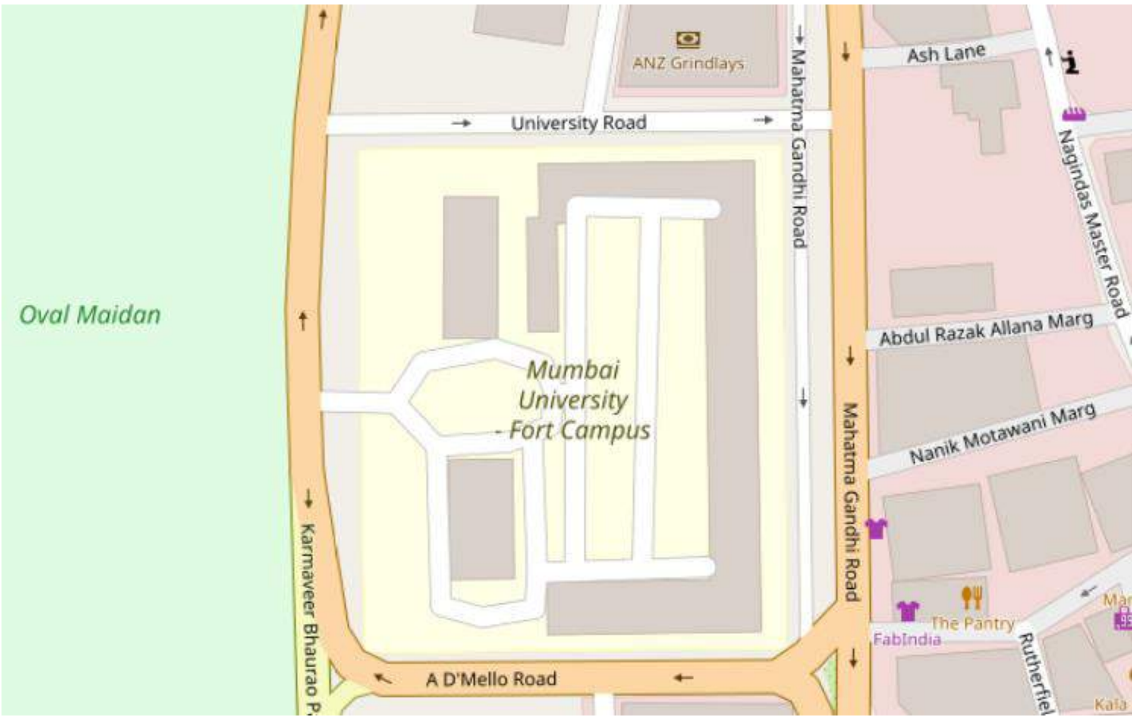
- A World map will appear on screen.
- If an error occurs in loading maps, go to project properties → CRS →





- ➢ In OSM Place search Pane → Enter Mumbai or any place name to search
- ➢ Double click on the desired place in OSM Place search Panel or Click and press 

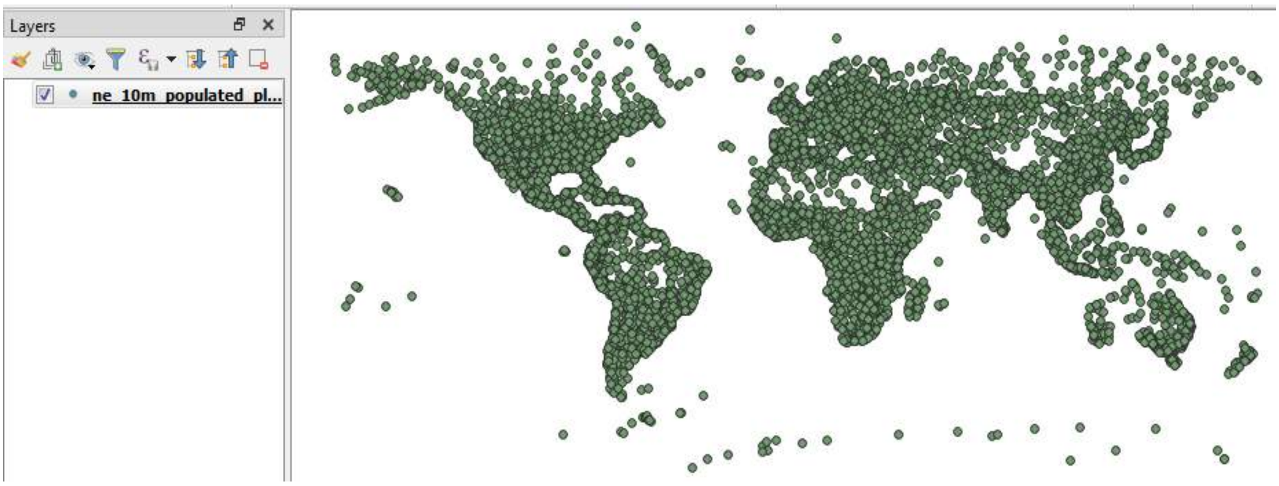
Output:



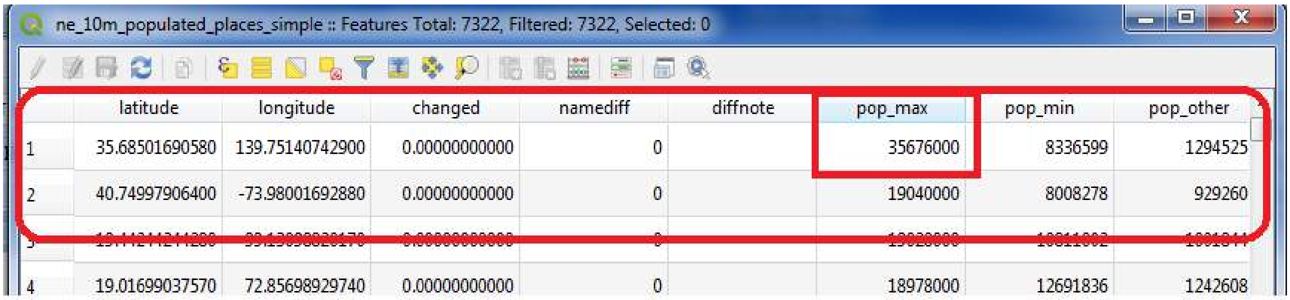
PRACTICAL - 4

A. Working with attributes

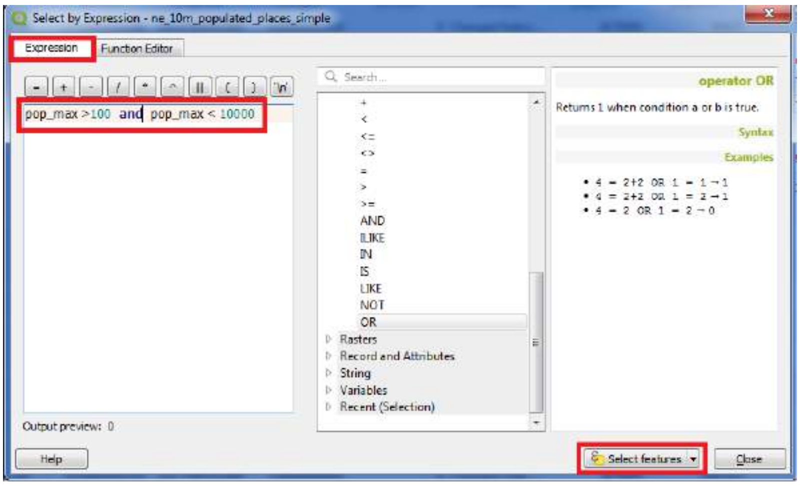
- ➢ Start a new project.
- ➢ Go to Layer → Add Layer → Add Vector Layer
- ➢ Select "\GIS_Workshop\Practicals\Practical_04\A\Data\ne_10m_populated_places_simple.zip"

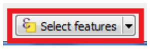


- ➢ Right click on Layer in Layer Panel → Open Attribute Table.
- ➢ Explore various attributes and their values in the Attribute table.
- ➢ To find the Place with maximum population click on **"pop_max"** file

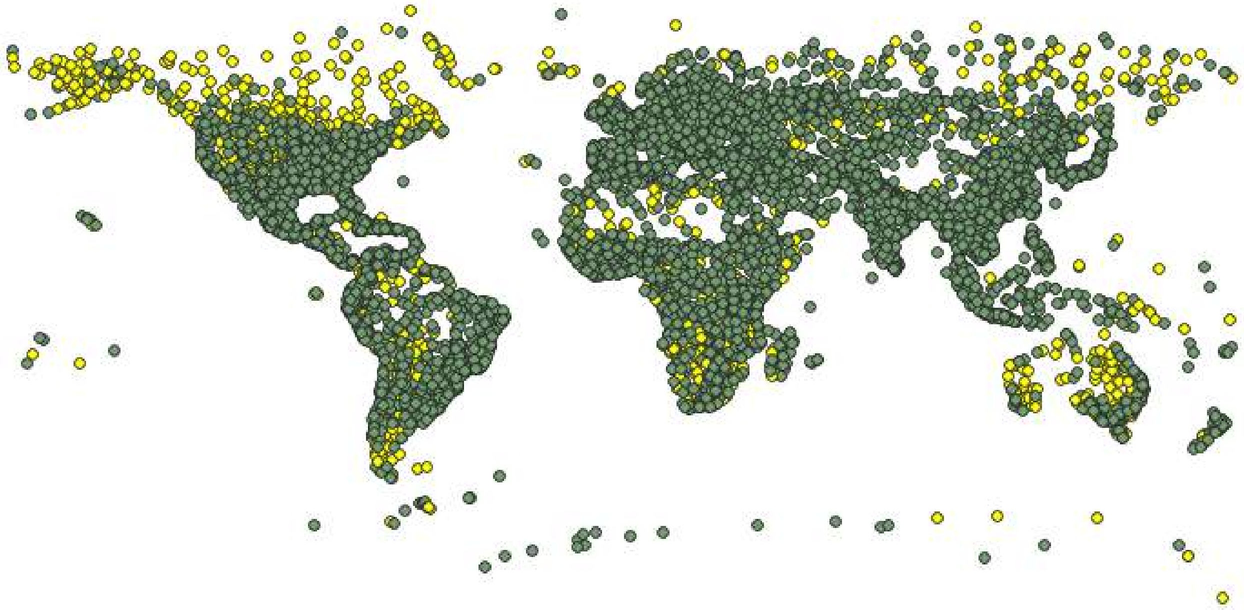


- ➢ On clicking the Select feature using expression  button the following window will appear.

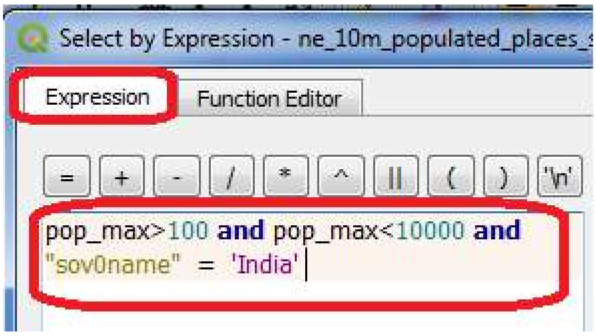


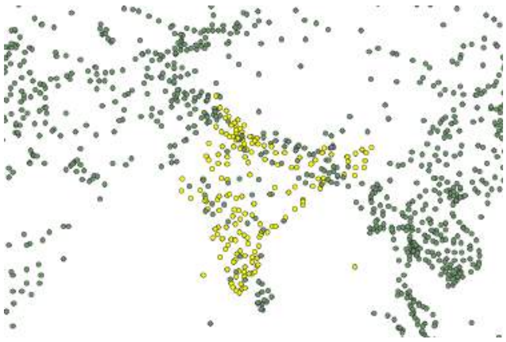
- ➢ Enter pop_max>100 and pop_max<10000 and click  button to get all the places with population between 100 and 10000.

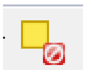
- The places matching the criteria will appear in different color.



- Different queries can be performed using the dataset.
- Try this

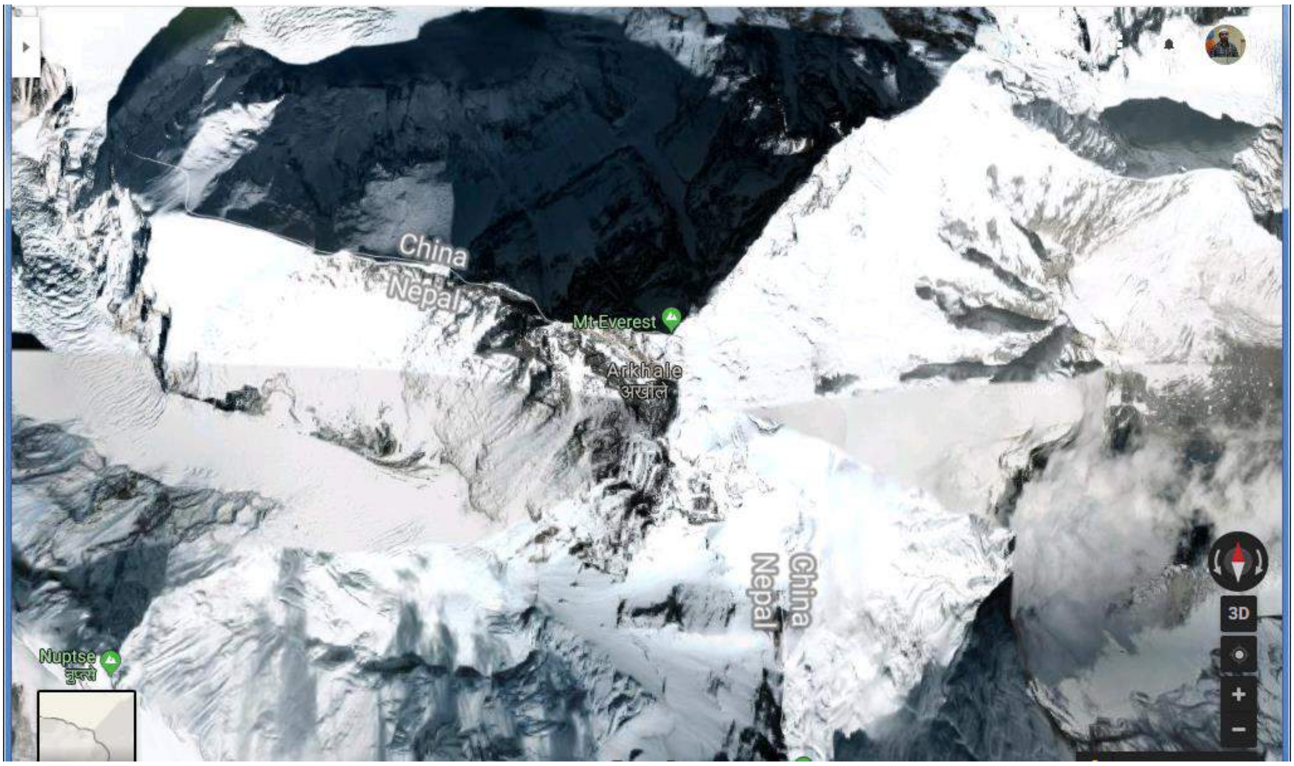


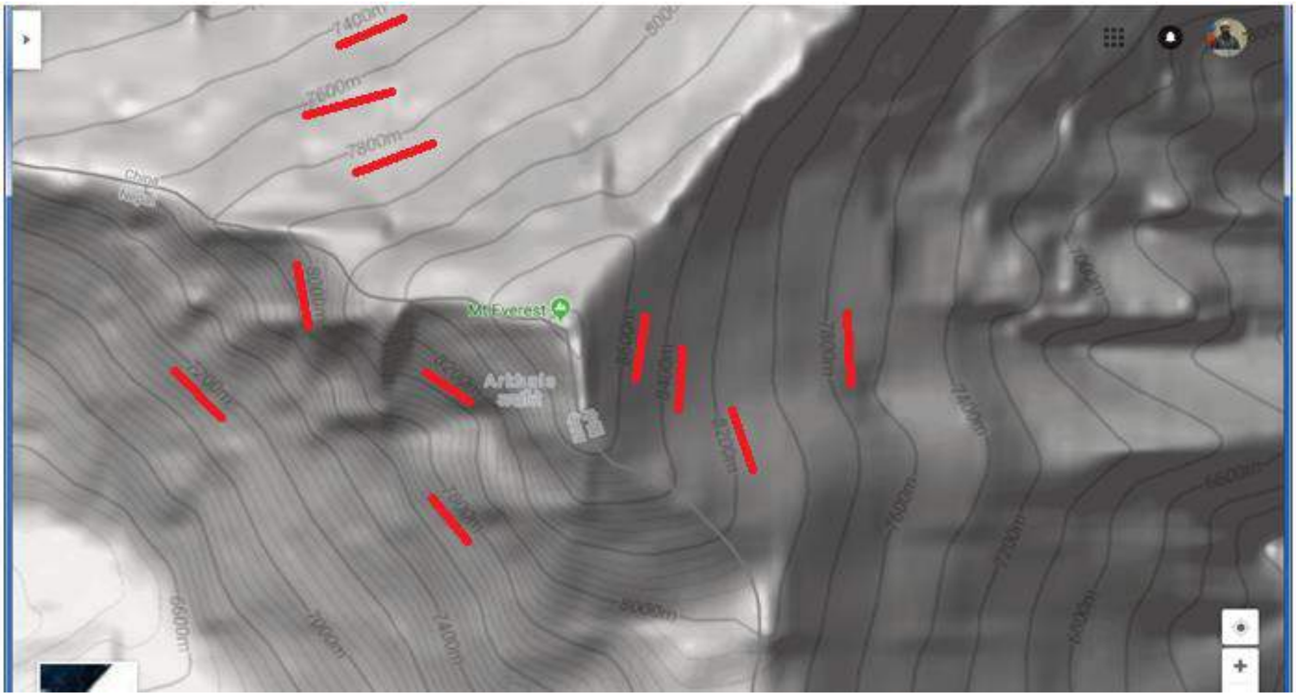
Will give 

- Use the deselect button  to deselect the feature to be rendered in original color.

B. Terrain Data

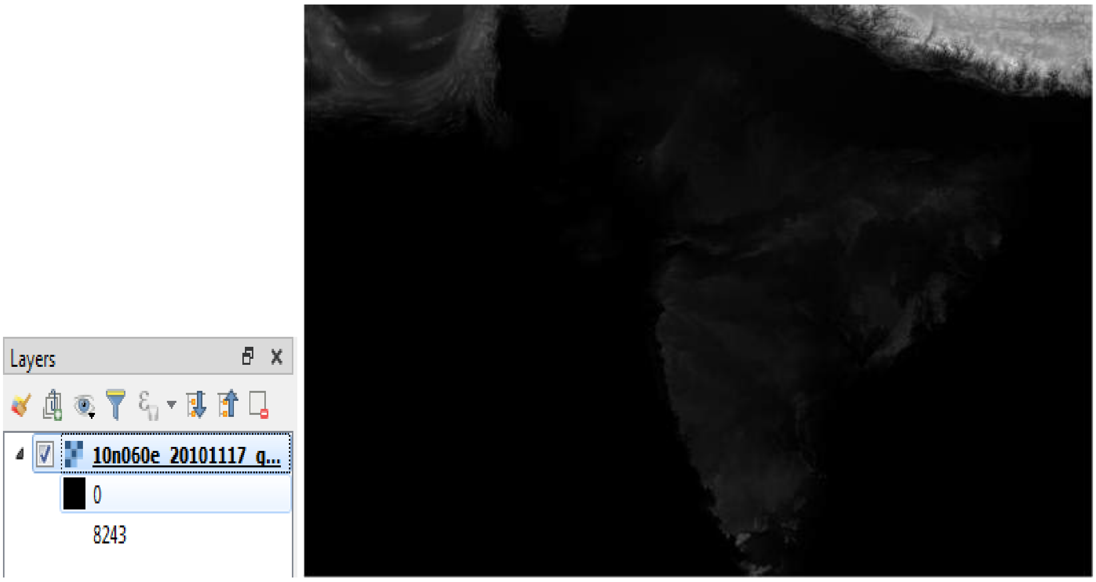
A terrain dataset is a multiresolution, TIN-based surface built from measurements stored as features in a geodatabase. Terrain or elevation data is useful for many GIS Analysis like, to generate various products from elevation data such as contours, hillshade etc.





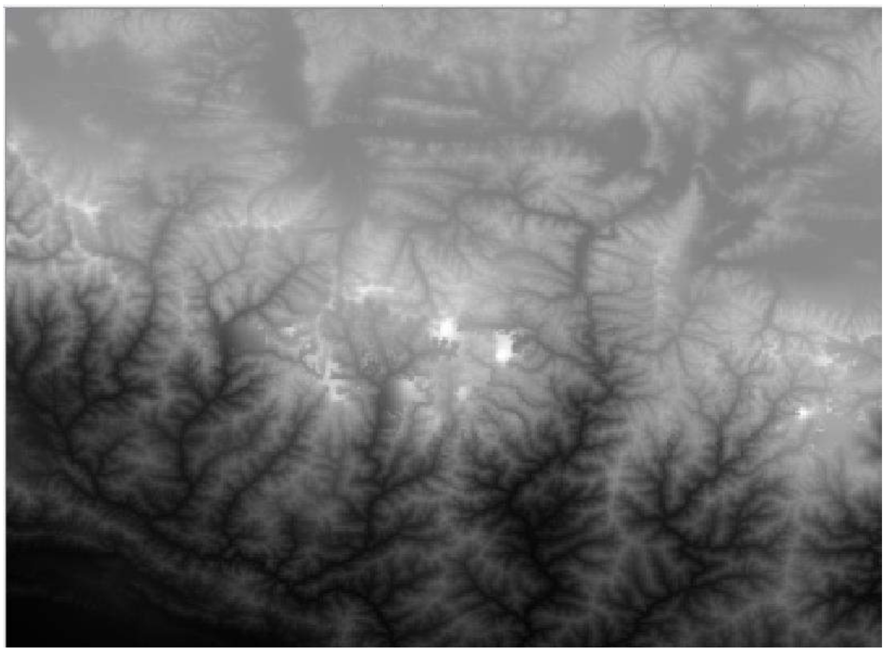
https://www.google.com/maps/@27.9857765,86.9285378,14.75z/data=!5m1!1e4?hl=en-US

- Go to Layer → Add Raster Layer → select "10n060e_20101117_gmted_mea300.tif", from Data folder

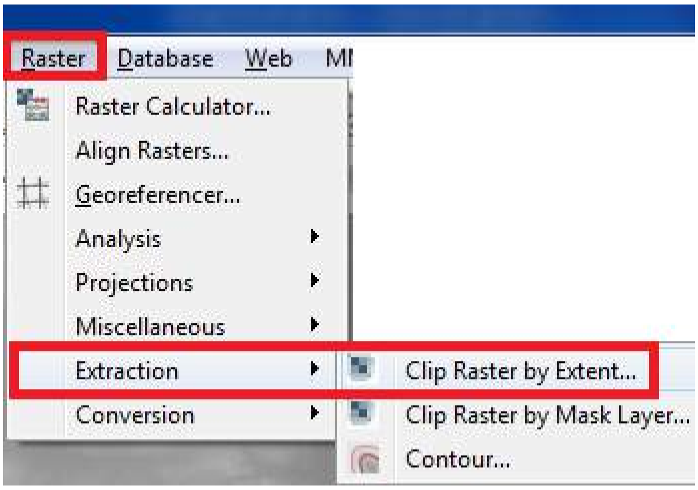


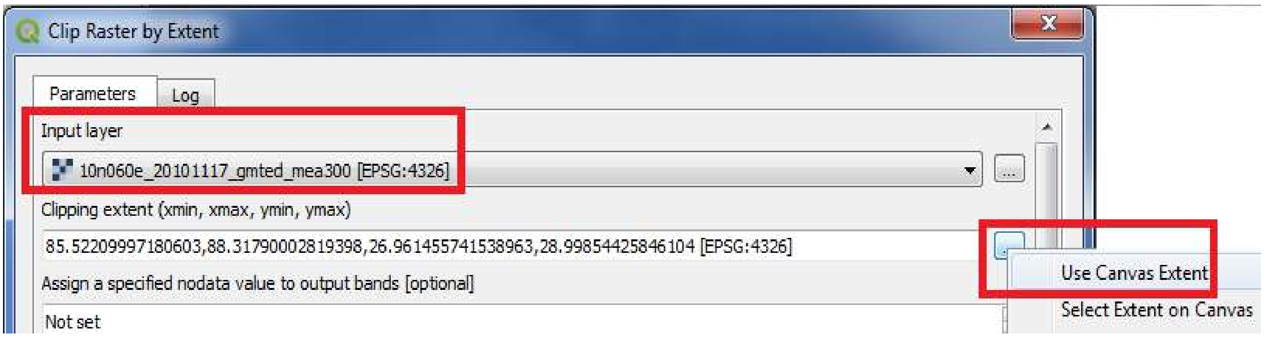
- The Lower altitude regions are shown using dark color and higher using light shade as seen on top region containing Himalaya and Mt Everest.
- Mt. Everest - is located at the coordinates 27.9881° N, 86.9253° E.
- Enter 86.92, 27.98 in the coordinate field, Scale 900000 and Magnifier 100% at the bottom of QGIS.

- Press enter the view port will be centered on Himalaya Region.

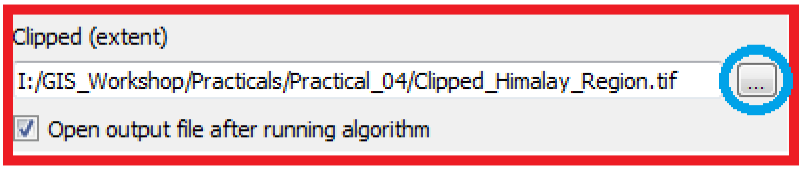


- Crop the raster layer only for the region under study.
- Go to Raster → Extraction→ Clip Raster by Extent

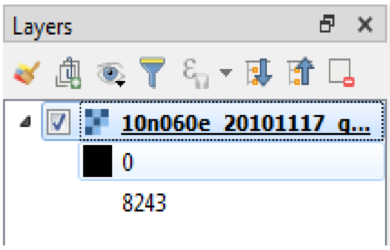




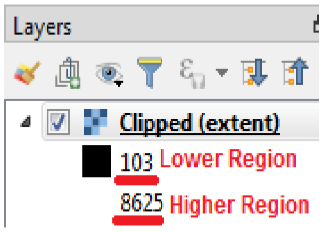
- Select the raster layer *(if project contains multiple layers)*.
- Select the clipping area by selecting the option **Use Canvas Extends** if the visible part of map is to be selected or manually select an area on canvas by using **Select Extent on Canvas**.
- Select the location and file name for storing clipped raster layer.



- Press RUN.
- Deselect the original layer and keep the clipped one.
- The Clipped raster layer is representing altitude are from 103 Meters.

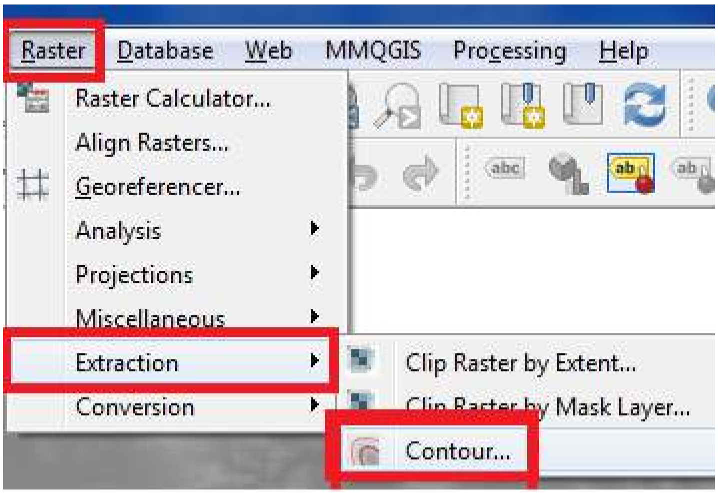


Original Raster

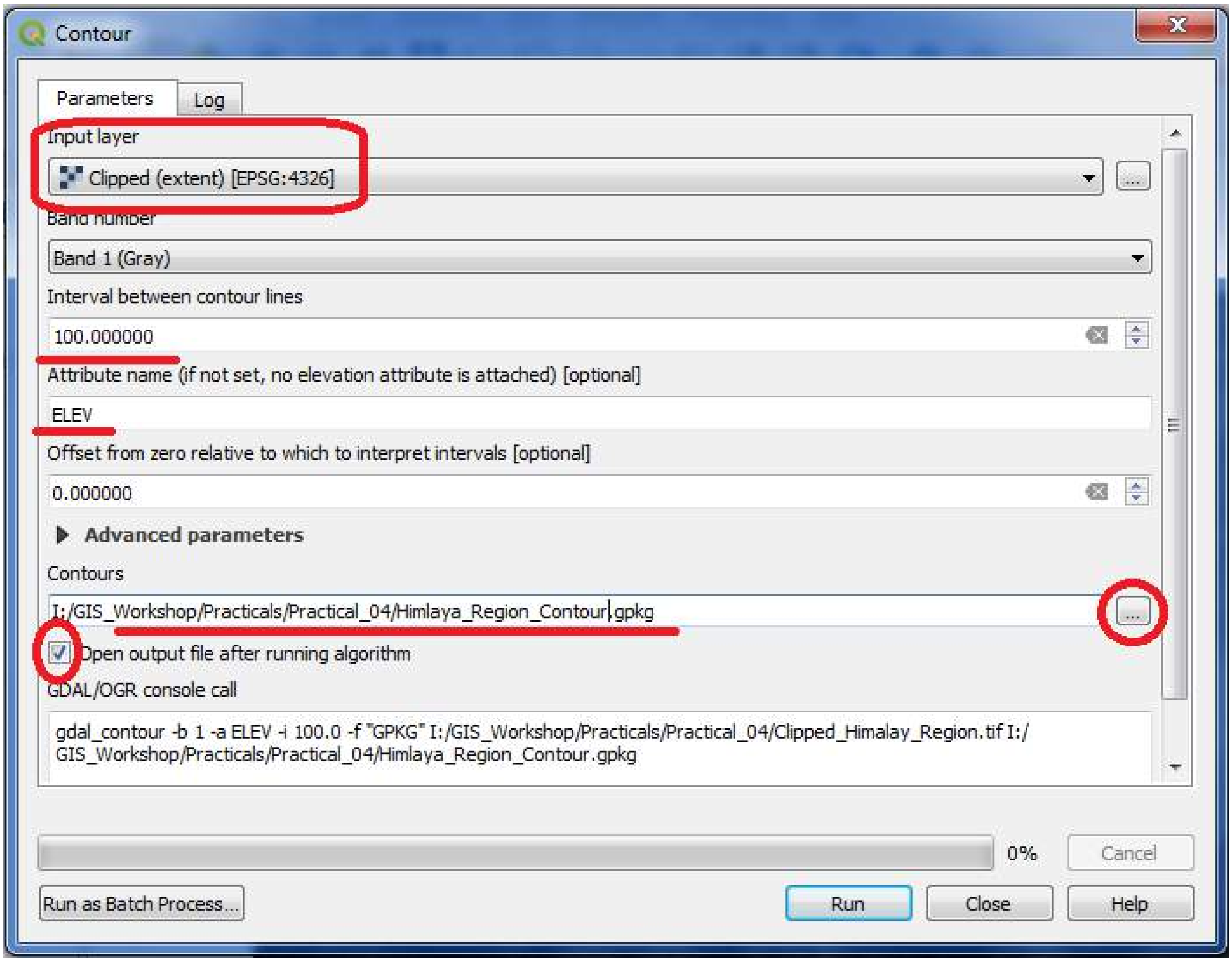


Clipped Raster

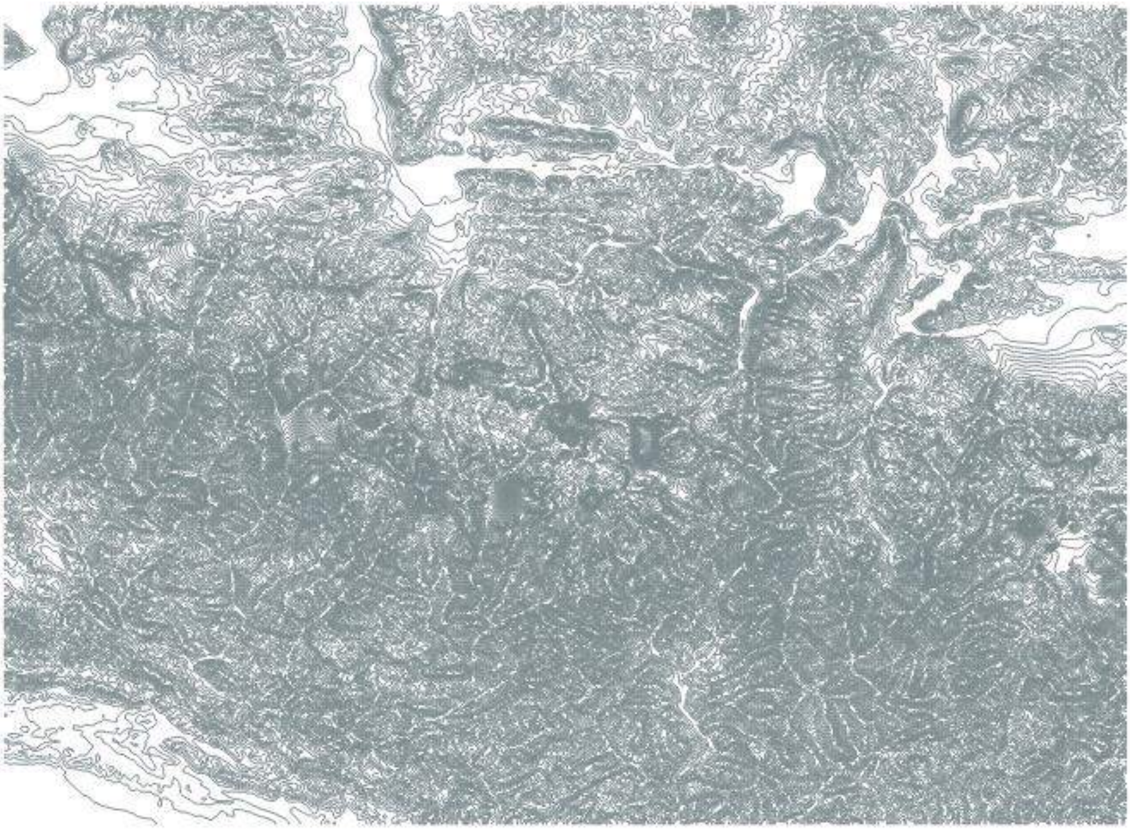
- Counter lines are the lines on a map joining points of equal height above or below sea level. A **contour interval** in surveying is the vertical distance or the difference in the elevation between the two **contour** lines in a topographical map.
- To derive counter lines from given raster.
- Go to Raster → Extraction→ Contour



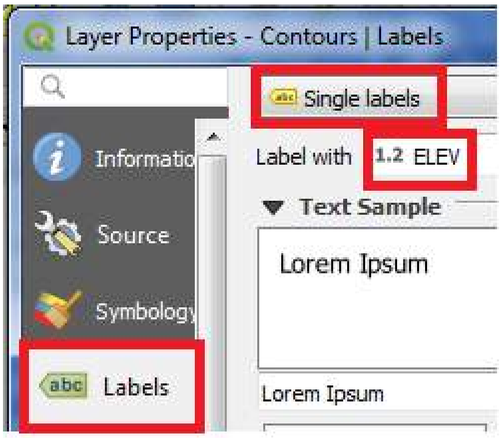
- The Contour configuration window will appear

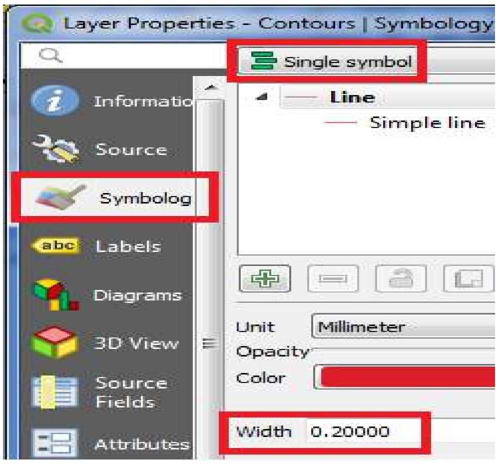


- Select the input raster layer name. Set contour interval 100.00 meters, select the output file name & location and check the option to add output file to project after processing.
- Press "RUN".
- The contour layer will appear like this

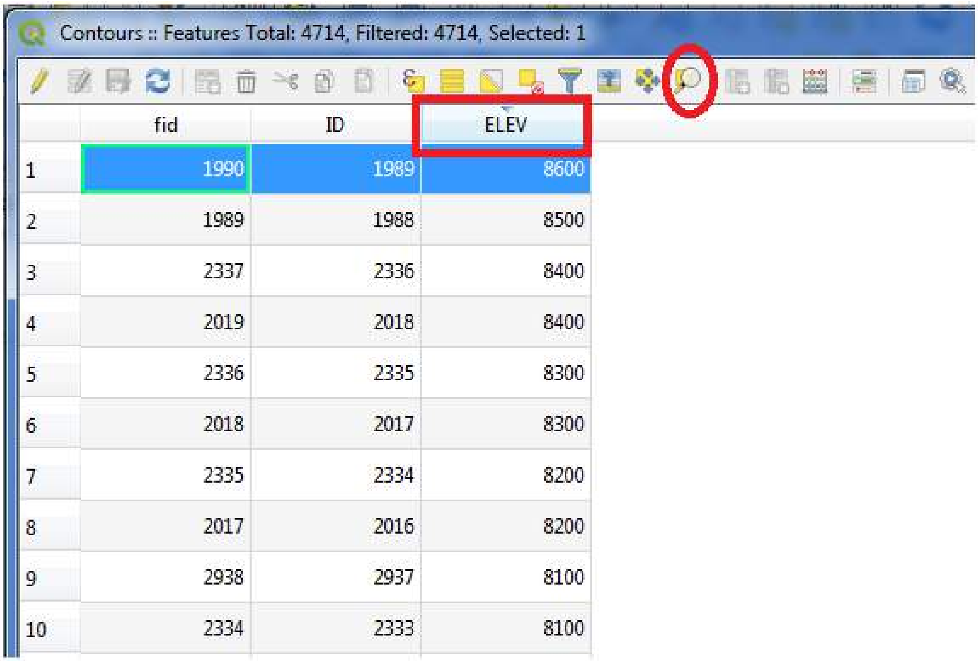


- Label the layer using "ELEVˮ field and set appropriate symbols for line.



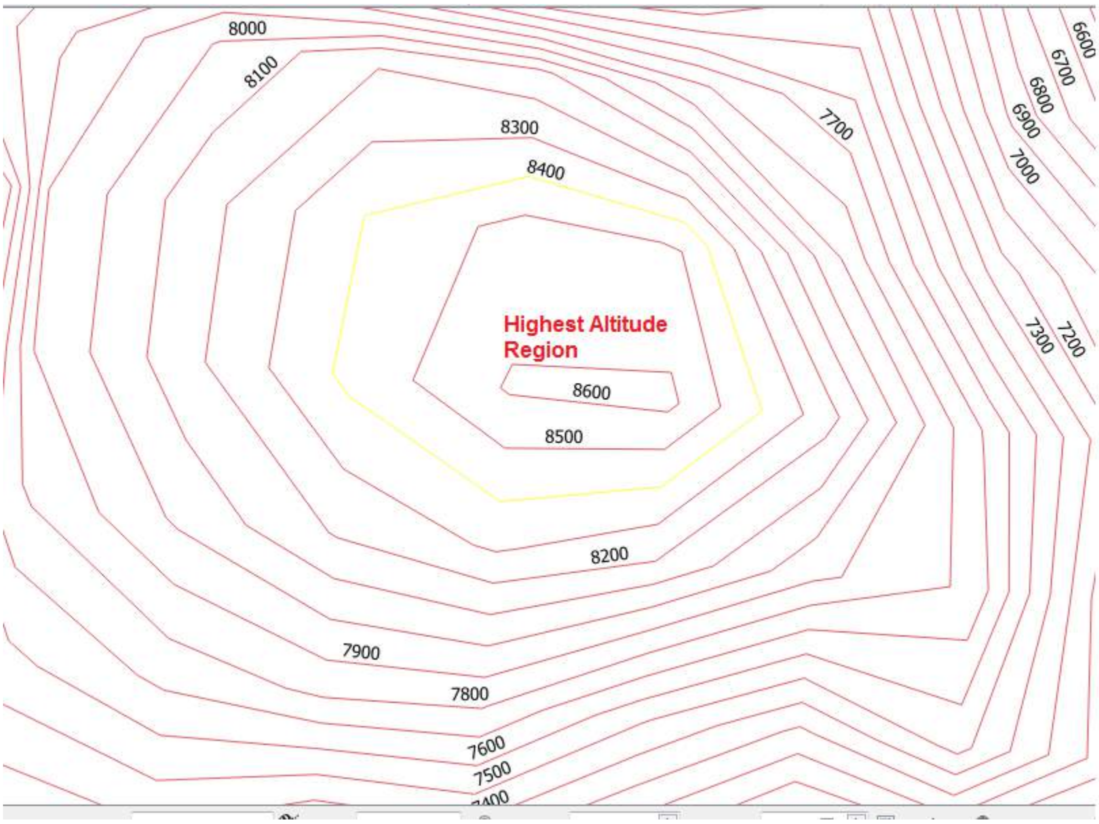


- In the Layer panel right click on Contour Raster Layer and select "**Open Attribute table**",
- Arrange the table in descending order based on the value of "ELEV" column.
-



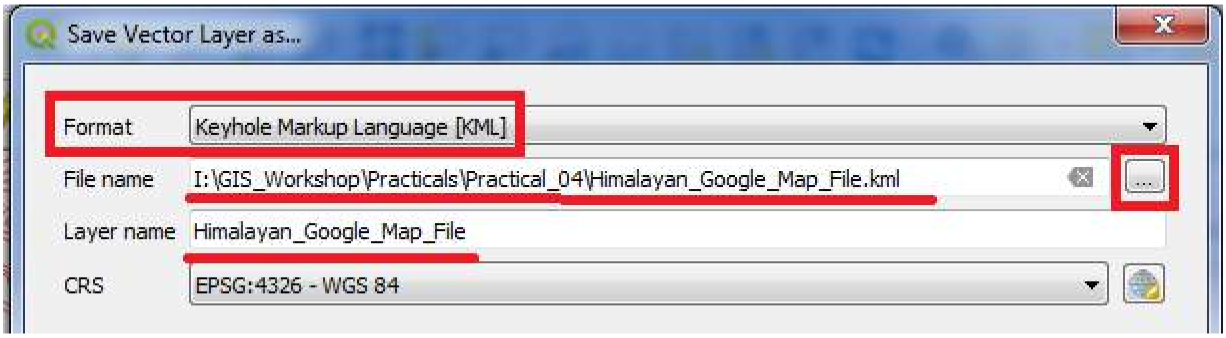
Contours :: Features Total: 4714, Filtered: 4714, Selected: 1

	fid	ID	ELEV
1	1990	1989	8600
2	1989	1988	8500
3	2337	2336	8400
4	2019	2018	8400
5	2336	2335	8300
6	2018	2017	8300
7	2335	2334	8200
8	2017	2016	8200
9	2938	2937	8100
10	2334	2333	8100



Compare the above counter line raster layer with the previous Google map image or visit
https://www.google.com/maps/@27.9857765,86.9285378,14.75z/data=!5m1!1e4?hl=en-US

- To verify the above contour files using Google Map
- Make a copy of Contour Layer, Go to Layer →Save As
- Select file format as “Keyhole Markup Language”, set file name, location and Layer Name.
- Also set CRS to WGS 84 EPSG:4326



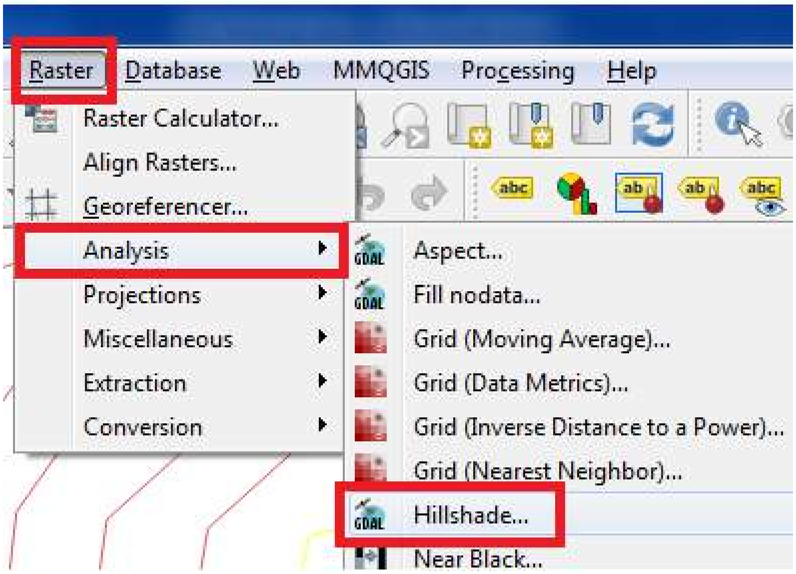
➢ Go to the stored location on Hard Disk and open the "Himalayan_Google_Map_File.kml" with Google Map.\

A **Hillshade** is a grayscale 3D representation of the surface, showing the topographical shape of hills and mountains using shading (levels of gray) on a map, just to indicate relative slopes, mountain ridges, not absolute height.

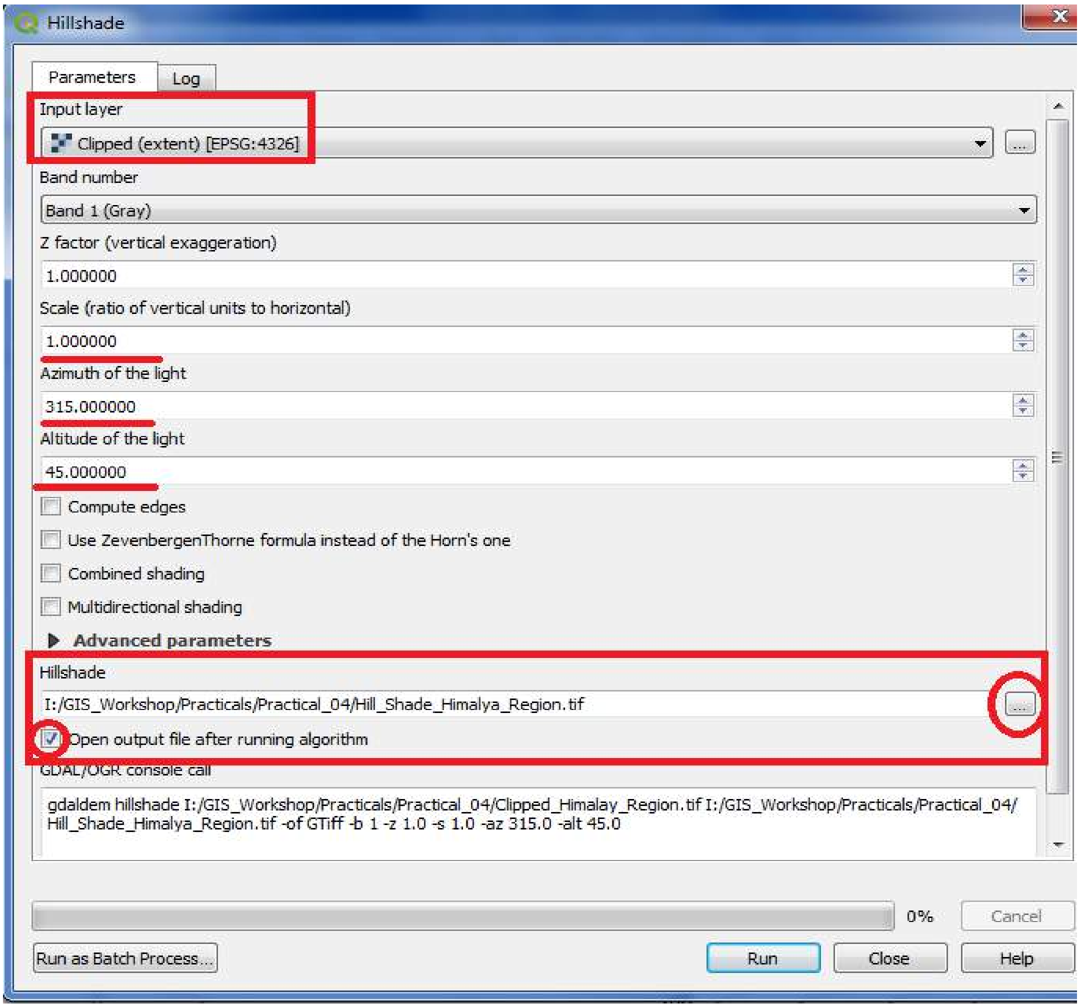
➢ For Hill Shade surface analysis

➢ Go to Plugin → Install Georeferencer GADL.

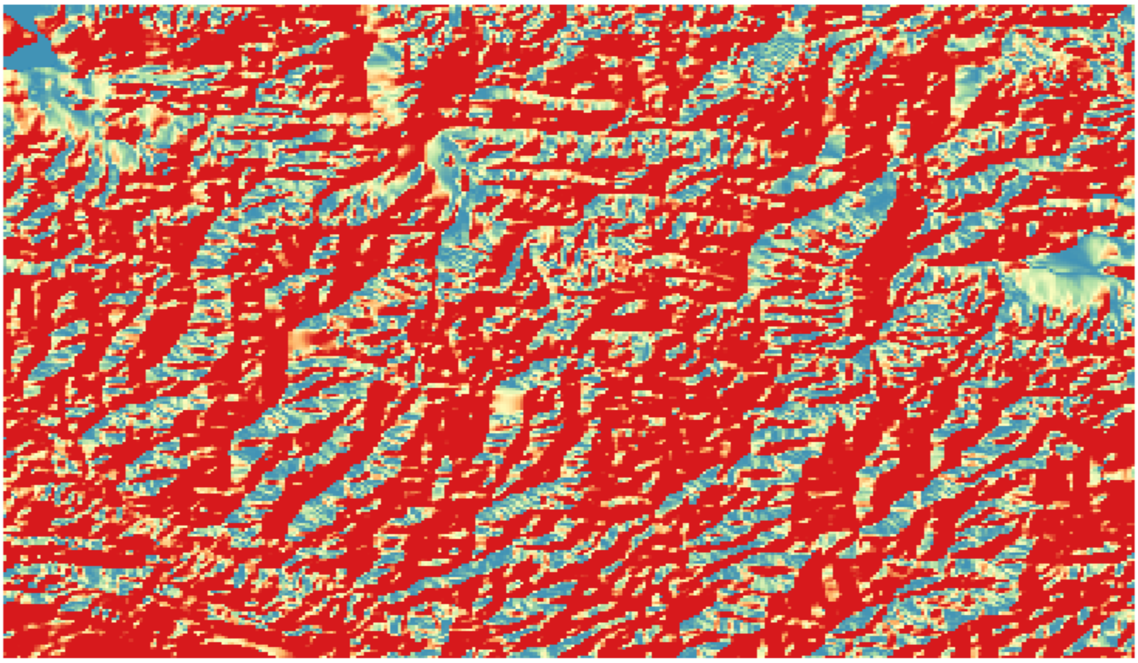
➢ After successful installation of plugin Go to Raster → Analysis → Hill Shade



➢ Select the input raster layer, select file name and location for storing Hill Shade output file.



- Press "RUN" and Close the Hill Shape Dialog window.
- After Raster styling the Output will appear like this.

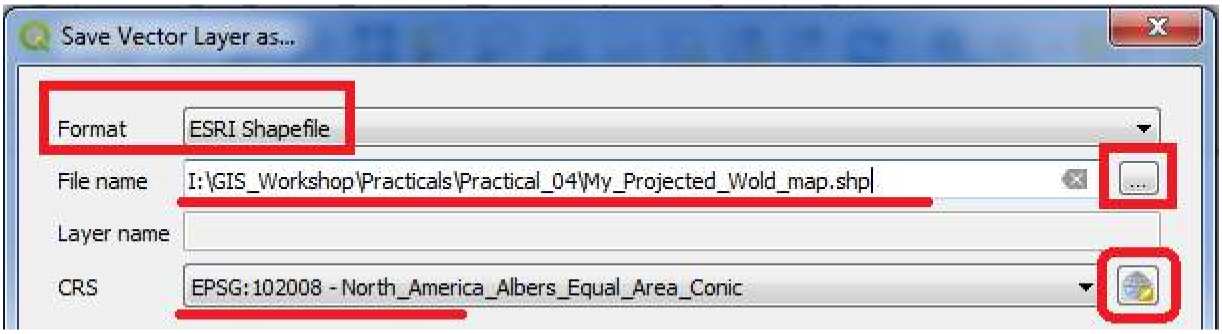


PRACTICAL - 5

A. Working with Projections and WMS Data

A **Web Map Service** (**WMS**) is a standard protocol developed by the Open Geospatial Consortium in 1999 for serving georeferenced map images over the Internet. These images are typically produced by a map server from data provided by a GIS database

- Start a new Project.
- Layer → Add Layer →Vector Layer
- Select "ne_10m_admin_0_countries.zip" Layer from data folder.
- Go to Layer → Save As
  Select format as ESRI Shape File
  Select folder location and file name
  Set CRS North_America_Albers_Equal_Area_Conic EPSG: 102008

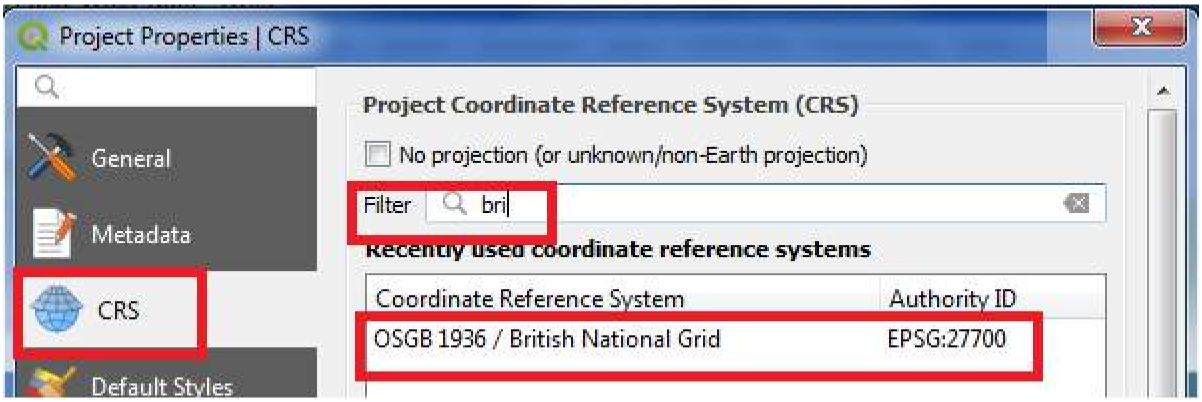


- Press "OK".
- Deselect the original Image and keep the projected layer visible.

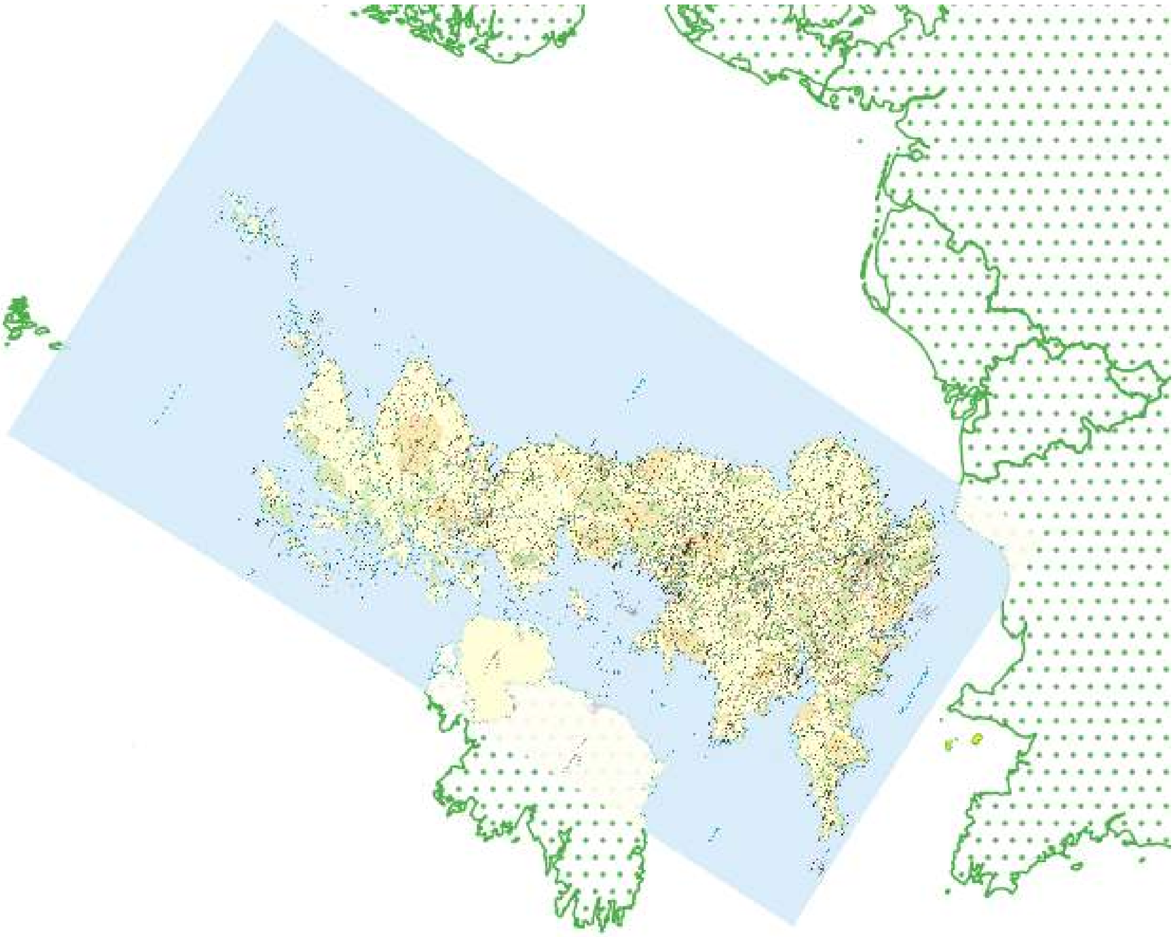
- Select Layer → Add Layer → Add Raster Layer → Select MiniScale_(standard)_R17.tif from Location

"GIS_Workshop\Practicals\Practical_05\DATA\minisc_gb\minisc_gb\data\RGB_TIF_compressed\MiniScale_(standard)_R17.tif"

- The Layer appears on a different location than the location where Great Britain is shown on Map.



- Open Layer Properties→CRS → Search bri → select British National Grid EPSG 27700.
- Processing may take some time.
- Locate United Kingdom on Layer; the vector layer exactly coincides by the raster layer covering United Kingdom.

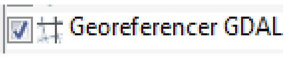


PRACTICAL - 6

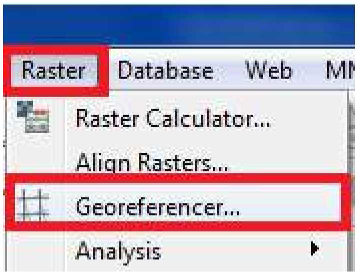
A. Georeferencing

a) Georeferencing Topo Sheets and Scanned Maps

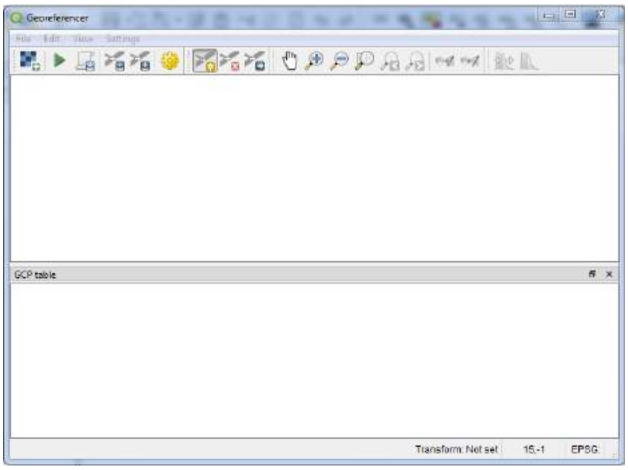
- Start a new project
- Go to Layers → Add Layer → Add vector Layer
- Select GIS_Workshop\Manual\Prac06\IND_adm0.shp
- Zoom in to Mumbai region in the layer.

- Go to Plugins→ Manage and Install Plugins
- Ensure that 

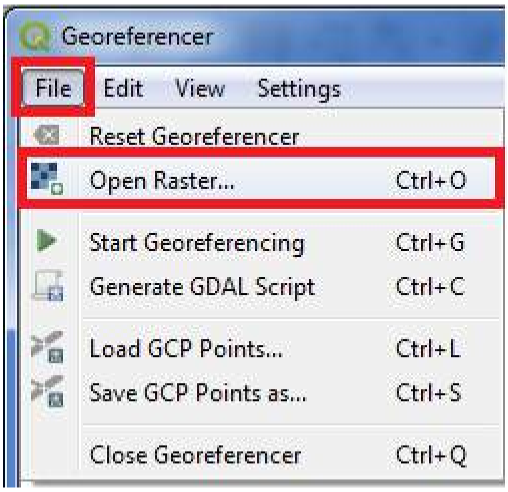
is checked, if not install Georeferencer GDAL plugin.
- Go to Raster → Georefrencer



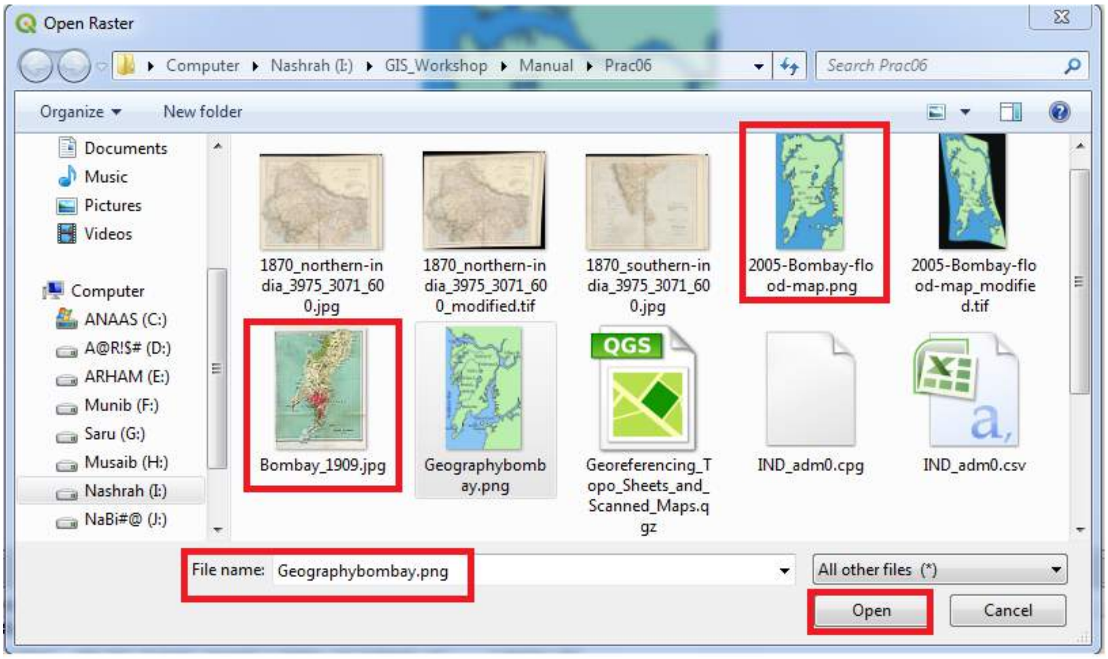
- A new Georeferencer window will open



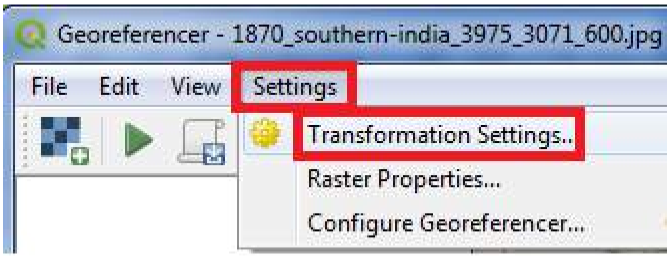
- File → Open Raster



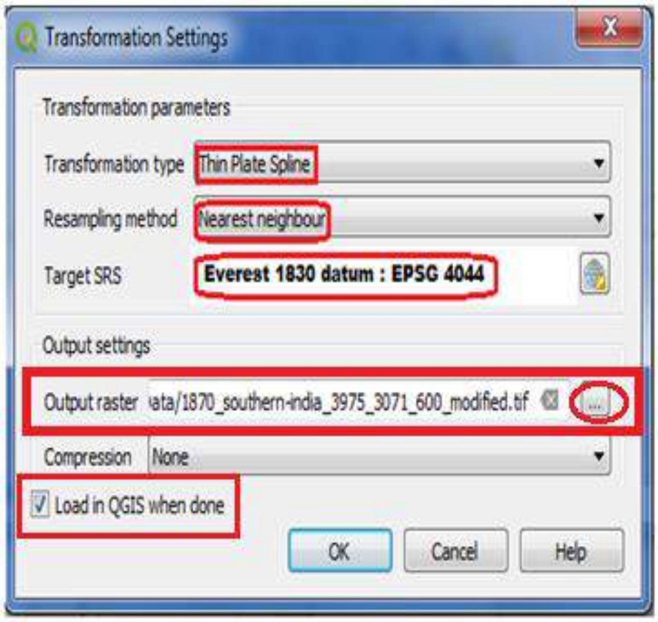
- ➢ Select file "1870_southern-india_3975_3071_600.jpg" from project data folder



- ➢ Go to Settings →Transformation Settings

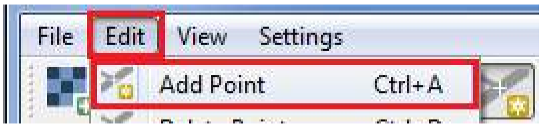


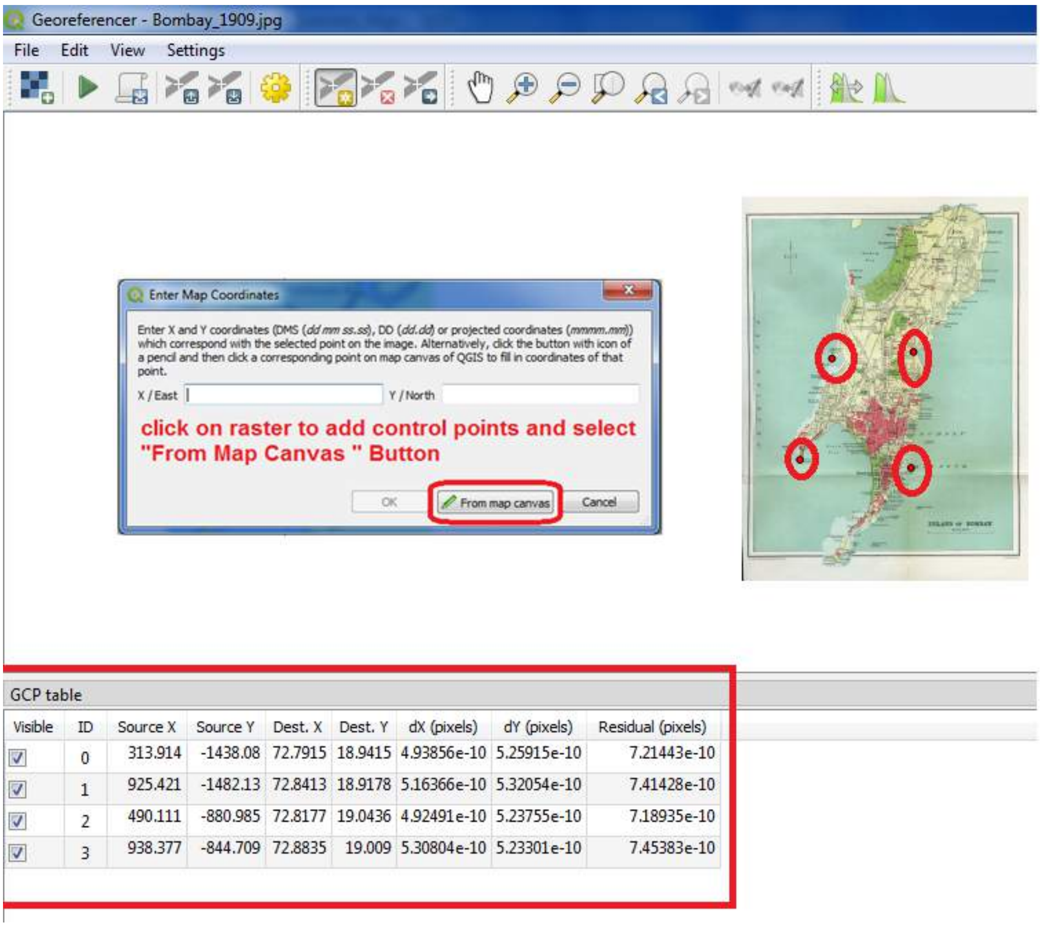
- ➢ In the Transformation Settings window



- Select Transformation type → Thin Plate Spline
- Re-sampling Method → Nearest Neighbour
- Target TRS → Everest 1830 datum: EPSG 4044
- Select Output Raster Name and Location
- Check the Load in QGIS When Done Option
- Press "OK".

➢ In Georeferencer window Go to Edit → Add Points

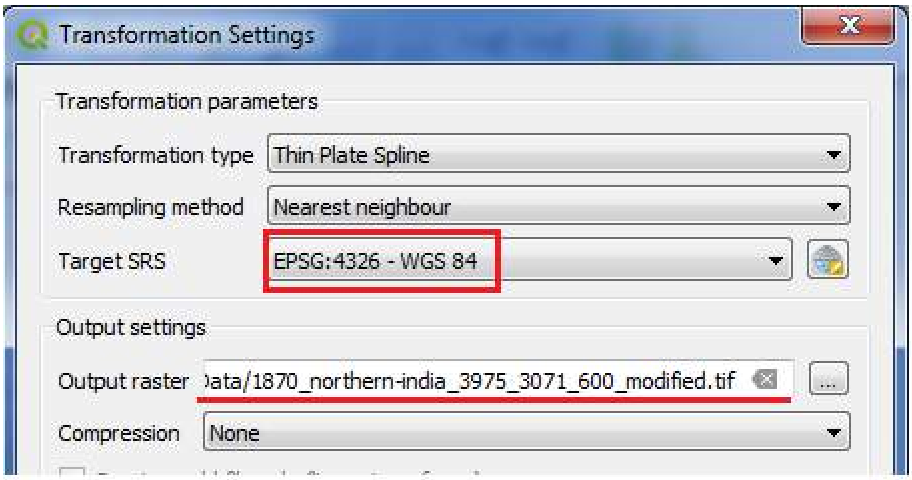




Visible	ID	Source X	Source Y	Dest. X	Dest. Y	dX (pixels)	dY (pixels)	Residual (pixels)
☑	0	313.914	-1438.08	72.7915	18.9415	4.93856e-10	5.25915e-10	7.21443e-10
☑	1	925.421	-1482.13	72.8413	18.9178	5.16366e-10	5.32054e-10	7.41428e-10
☑	2	490.111	-880.985	72.8177	19.0436	4.92491e-10	5.23755e-10	7.18935e-10
☑	3	938.377	-844.709	72.8835	19.009	5.30804e-10	5.23301e-10	7.45383e-10

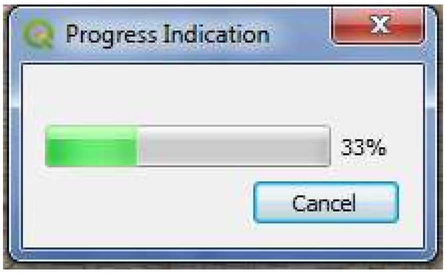
➢ Select the set of control points.

➢ Go to, Setting → transformation settings.

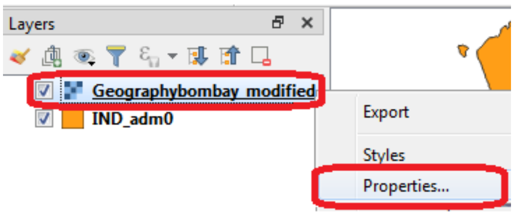


- Press "RUN"
- In Georeferencing window go to → File → Start Georeferencing

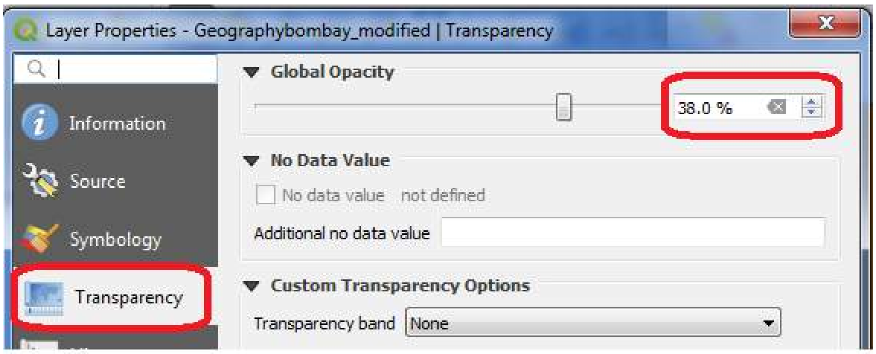
- The progress indicator will appear



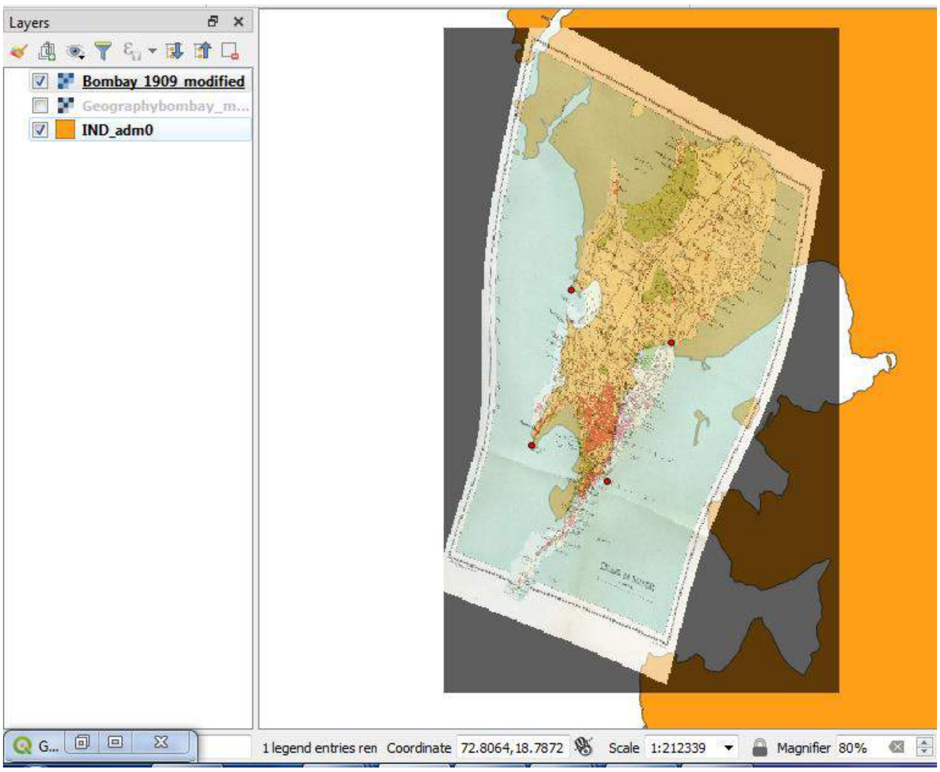
- The canvas area will now have the scanned map of Mumbai referenced with control points.
- Select the newly added layer in Layer Panel Right click and go to property.



- Set Transparency level of raster layer to appropriate level.



Output:

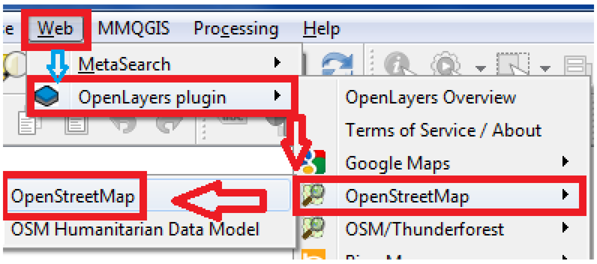


- The Scanned Image map coincides with the existing map.

b) Georeferencing Aerial Imagery

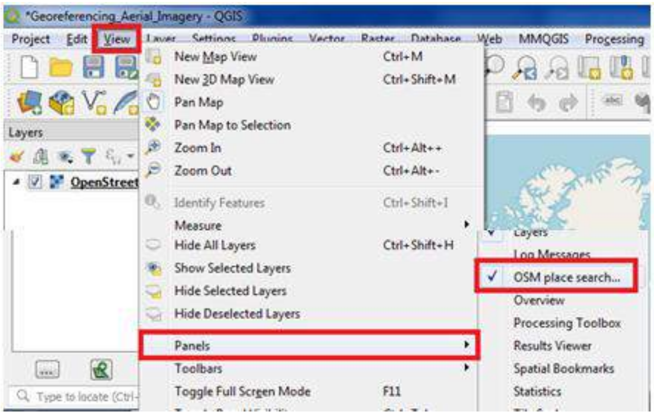
B. Install plugin OpenStreetMap

C. Go to Web Menu → OpenLayerPlugin → OpenStreetMap→ OpenStreetMap



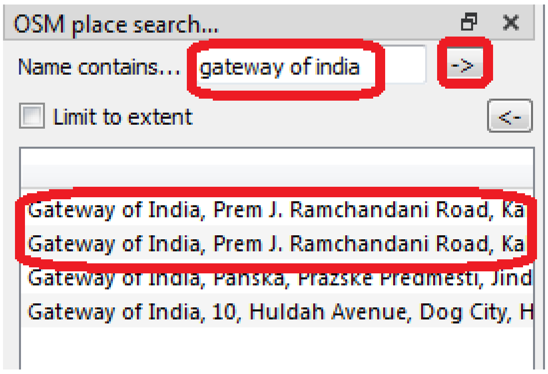
D. Go to Project → Properties → Set CRS to EPSG 3857

E. Go to View → Panels → select OSM Place search



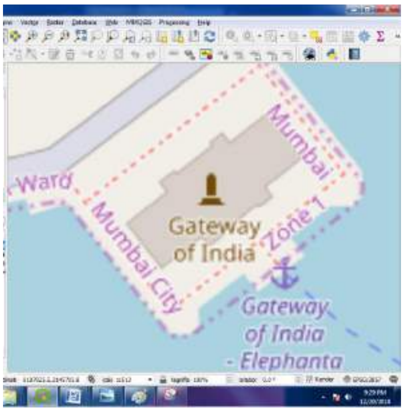
F. The Gateway of India, Mumbai is located at 18.92°N 72.83°E

G. Search Gateway of India in OSM Search Panel

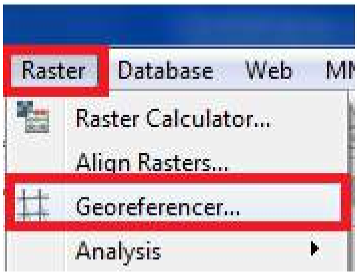


H. Zoom in to appropriate level.

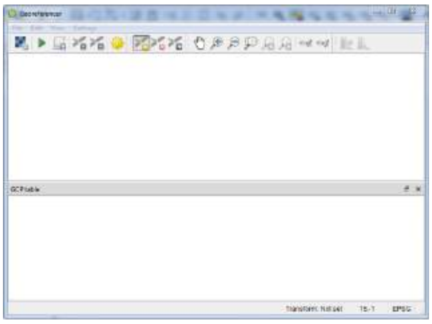
I. The map will appear like this



J. Go to Raster → Georefrencer

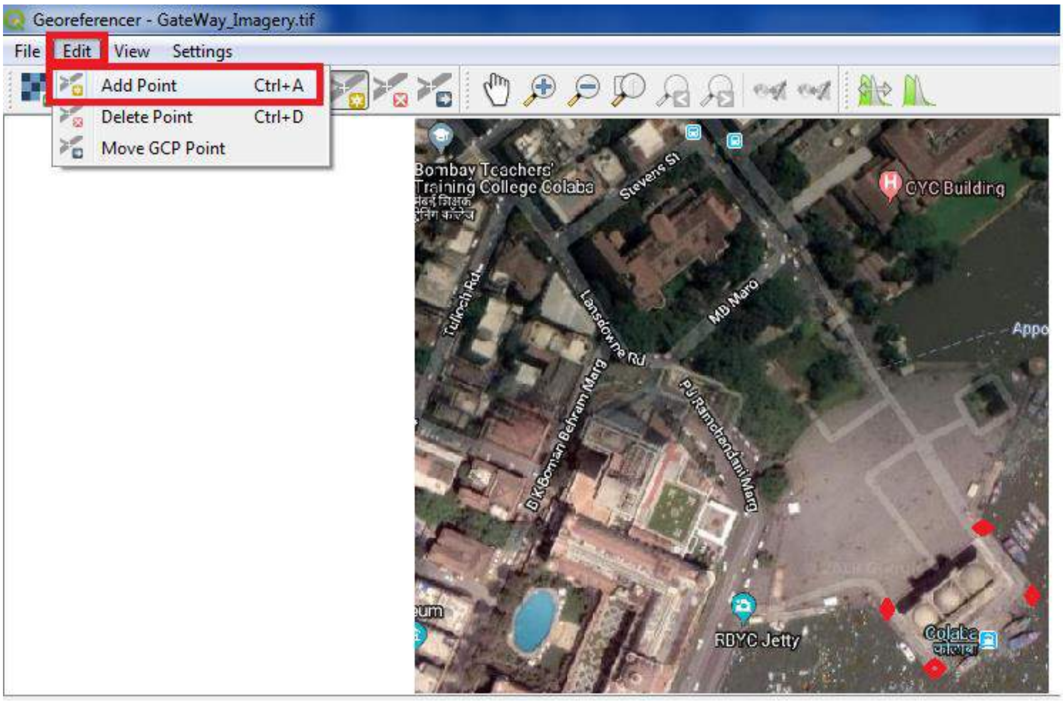


K. A new Georeferencer window will open



L. File → Open Raster

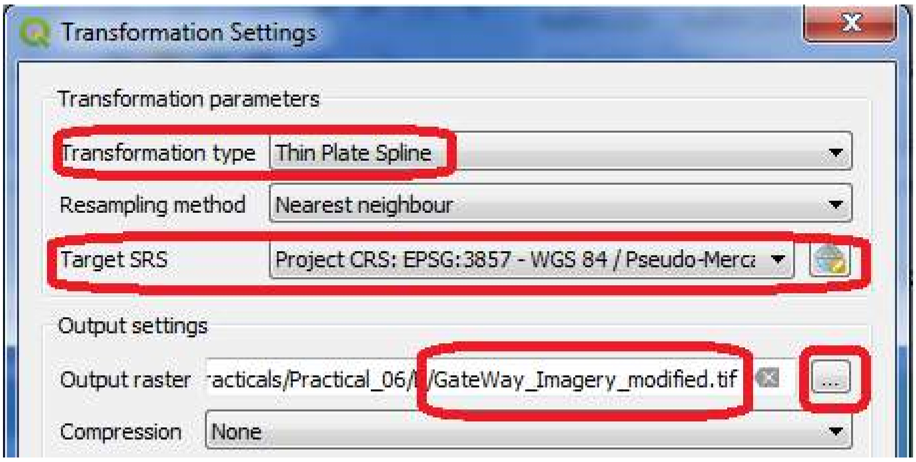
M. Select file "Gateway_Imagery.tif" from project data folder

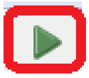


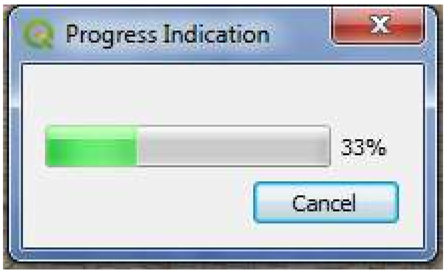
N. Go to Edit → Add Point

O. Select control points from map (Indicated in red color).

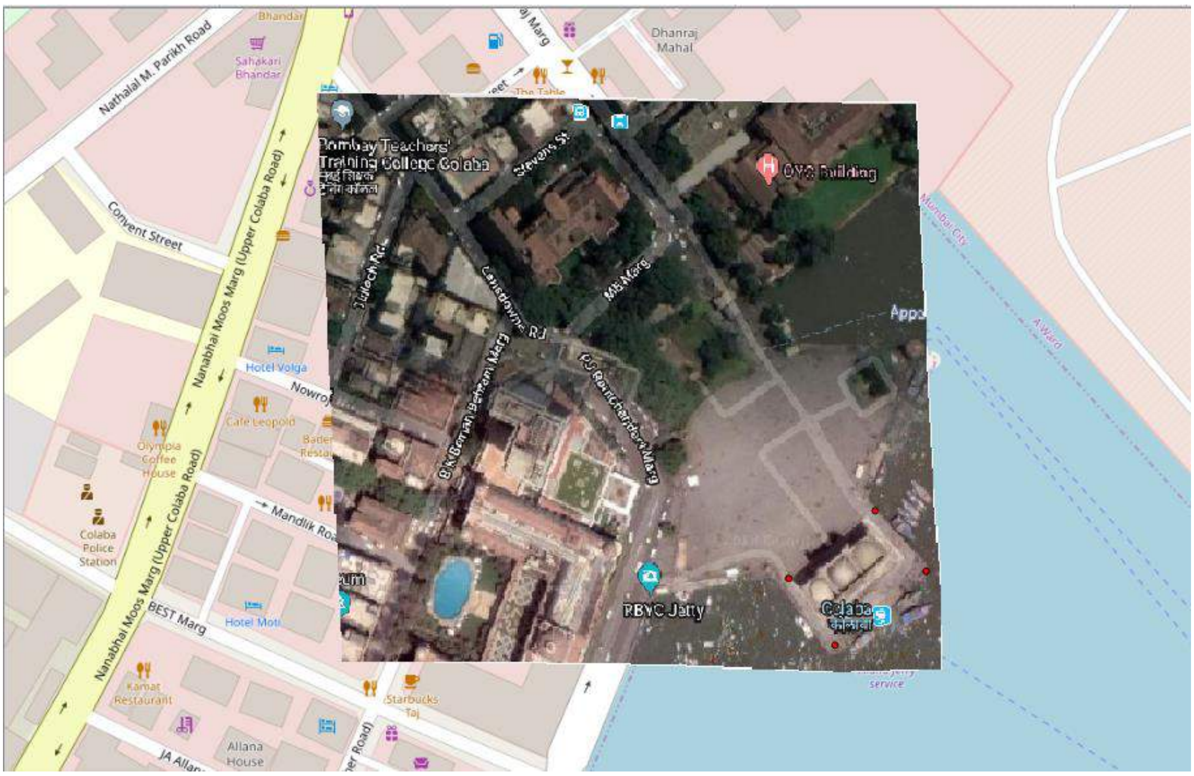
- Go to Setting → Transformation Setting



- Go to File → Start Georeferencing or Press the  button in Georegerencing Window.
- The progress indicator will appear



➢ Observe that the aerial image of the Gateway of India is georeferenced on OSM in the map canvas.

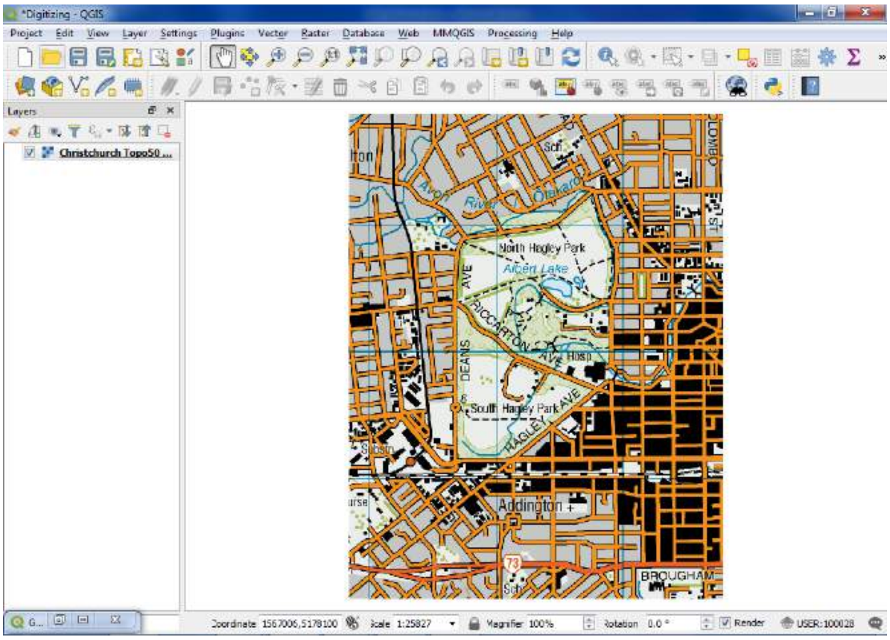


a) Digitizing Map Data

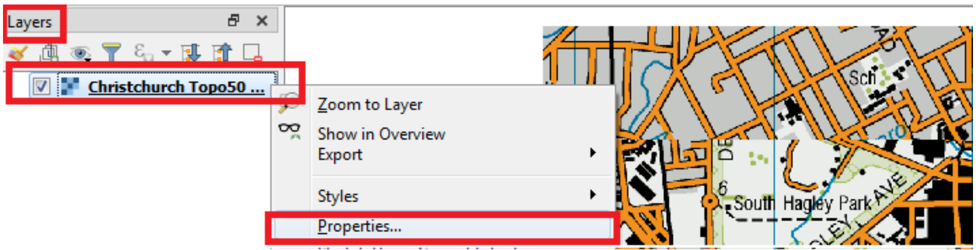
Spatialite is an open database format similar to ESRI's geodatabase format. Spatialite database is contained within a single file on your hard drive and can contain diferent types of spatial (point, line, polygon) as well as non-spatial layers. This makes is much easier to move it around instead of a bunch of shapefiles.

Digitizing Map Data

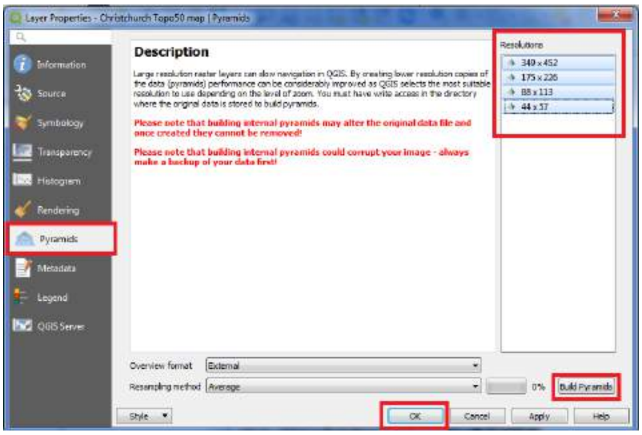
➢ Go to Layer ‣ Add Raster→ Select “Christchurch Topo50 map.tif” from project Folder.



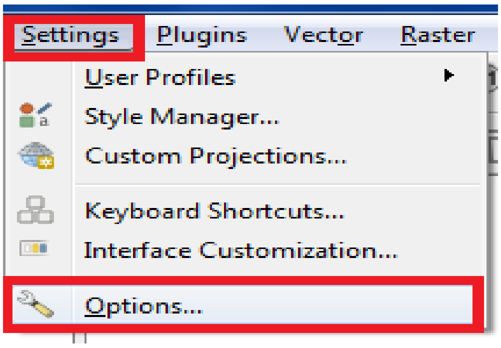
- QGIS offers a simple solution to make raster load much faster by using **Image Pyramids**.
- Right-click the Christchurch Topo50 map.tif layer and select Properties.



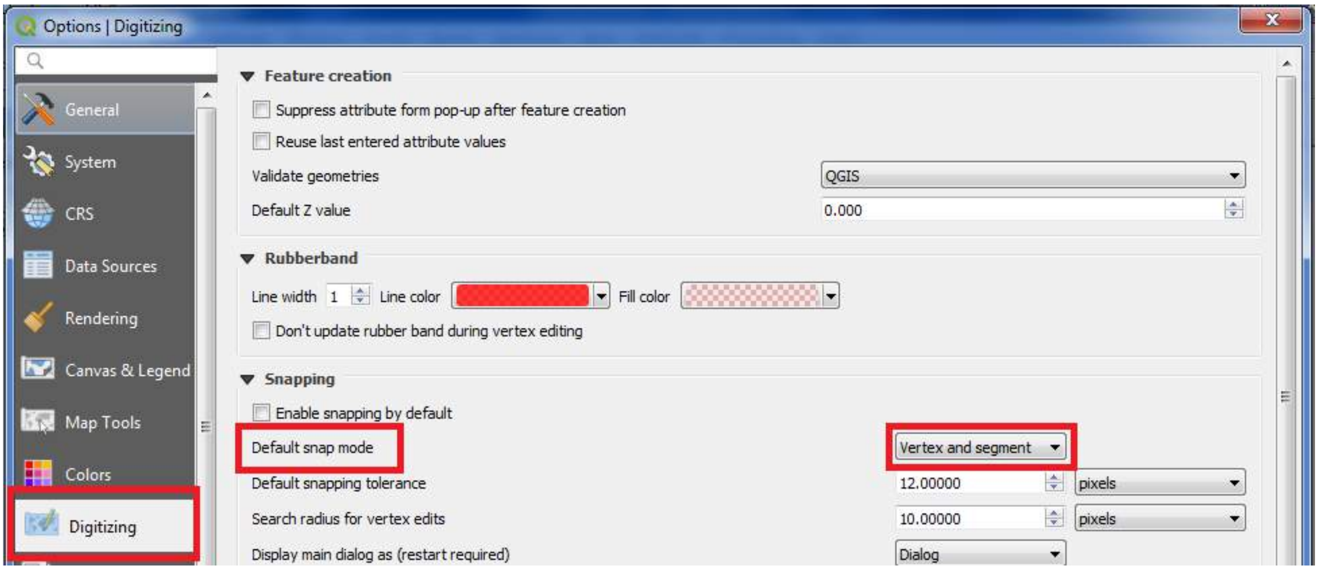
- Choose the Pyramids tab. Hold the Ctrl key and select all the resolutions offered in the Resolutions panel.



- Click Build pyramids. Then click OK.
- Go to Settings →Options.... Select the Digitizing tab in the Options dialog.

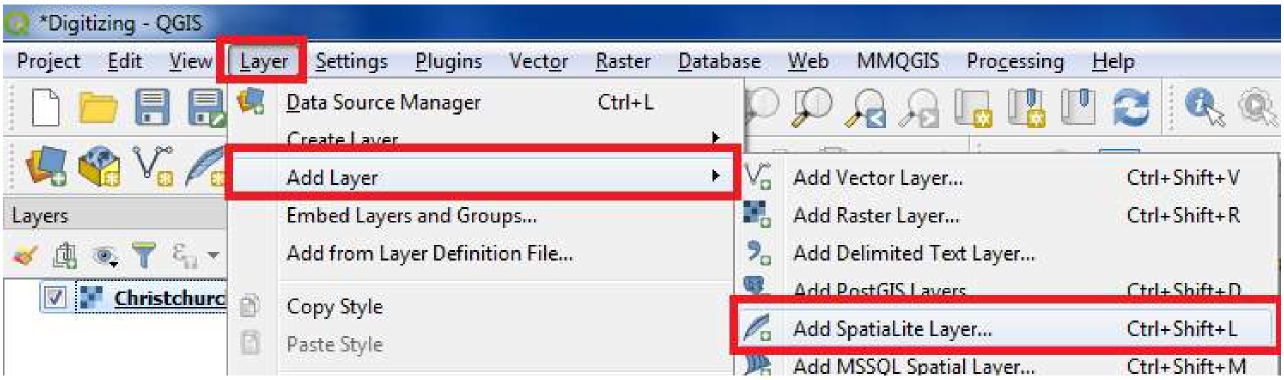


- Set the Default snap mode to vertex and segment.

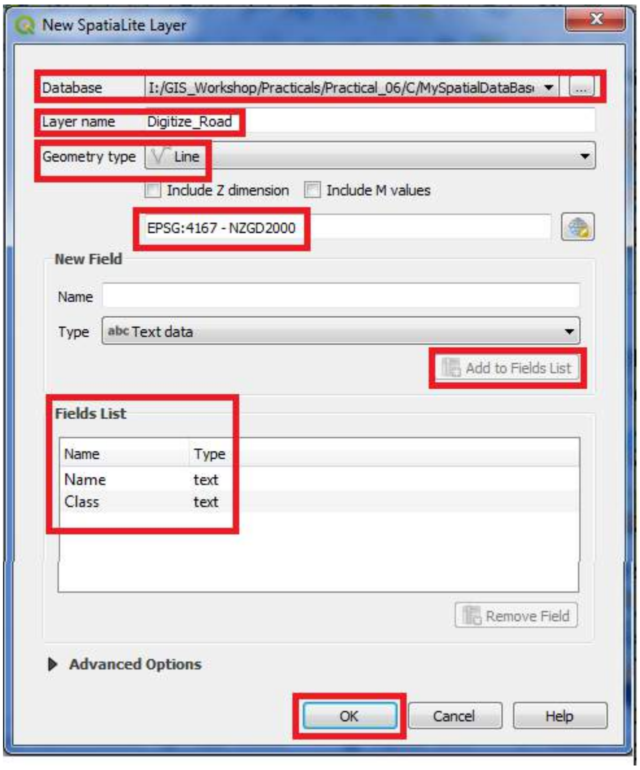


- Press OK.

- Go to Layer → Add Layer → Add Spatialite Layer.



- Select the name and location for Spatial database eg: "GIS_Workshop\Practicals\Practical_06\C\MySpatialDataBase.sqlite".
- Name the Layer as "Digitized_Road
- Set Geometry type as "Line"
- Set CRS EPSG:4167 – NZGD2000

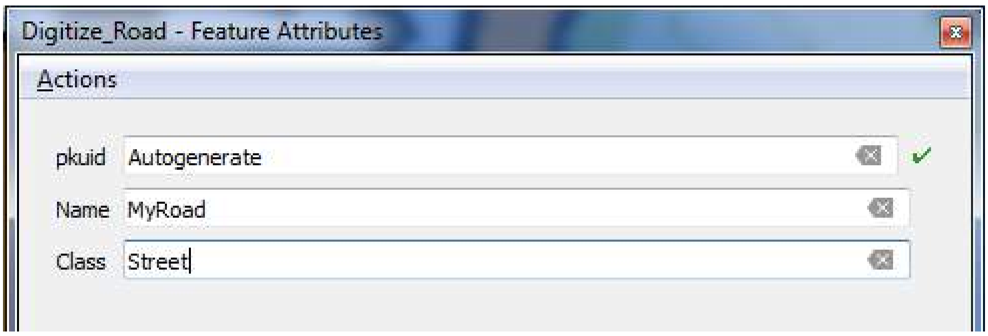


- Add "Name" and "Class" fields using "Add to Fields List".

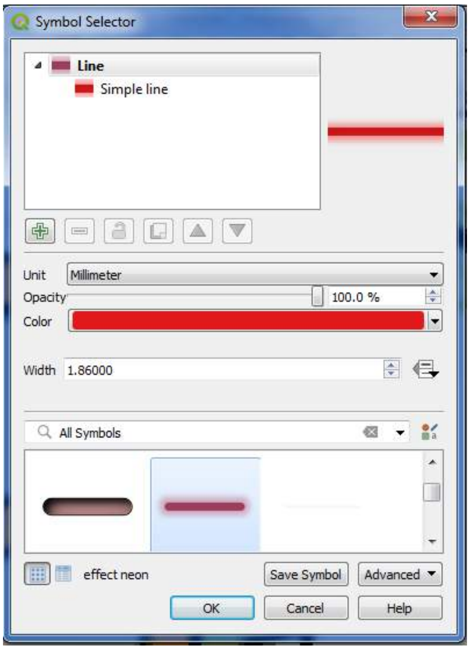
- Once the layer is loaded, click the Toggle Editing button to put the layer in editing mode.

- Click the 

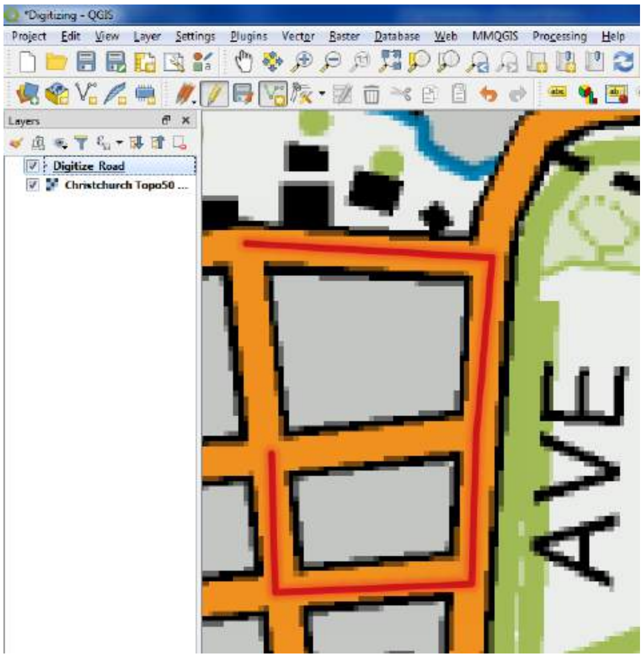
Add feature button. Click on the map canvas to add a new vertex. Add new vertices along the road feature. Once you have digitized a road segment, right-click to end the feature.



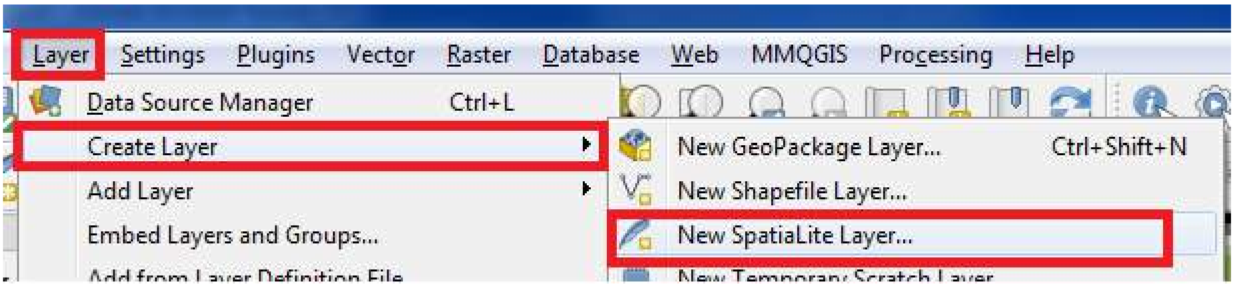
- On Layer Panel Right Click on Digitze_Road, Select the Style tab in the Layer Properties dialog.

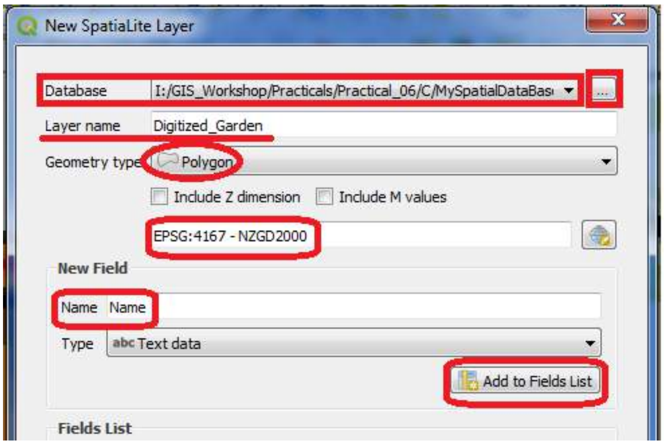


Result

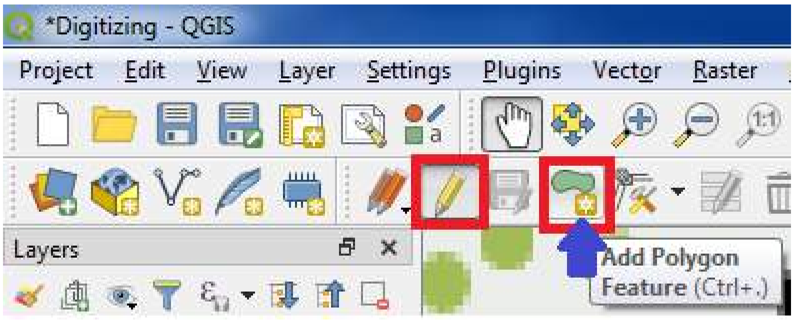


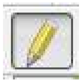
➢ Select appropriate style to see the digitized road feature clearly.

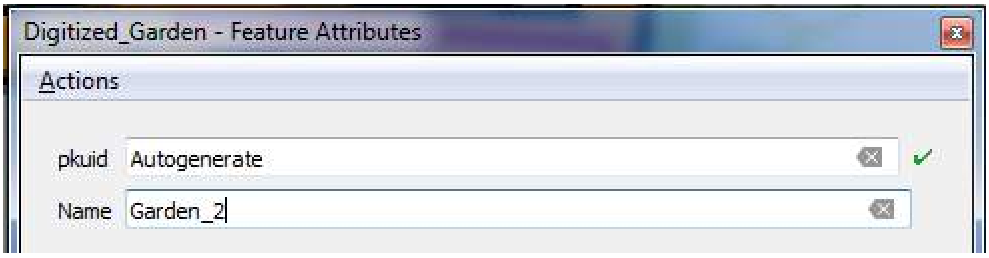




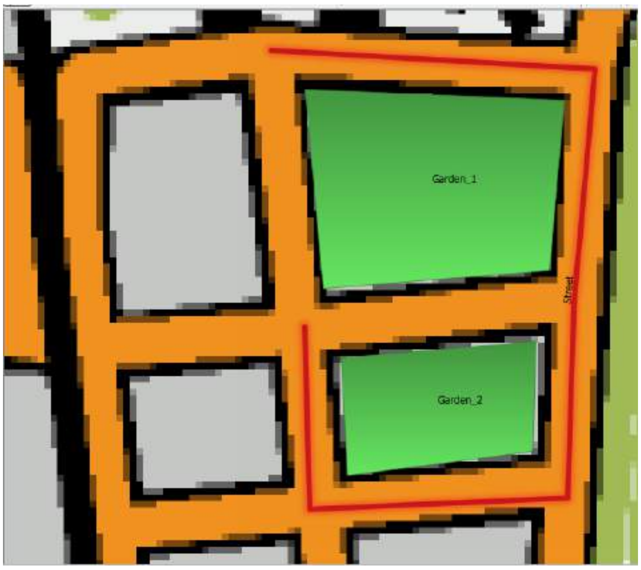
➢ After creating a new Spatialite layer



- Select Digitized_Garden layer in Layer Panel and click on Toggle Editing  button and then Add Polygon Feature  button on Tool bar.
- Add two gardens to the region by adding polygon.



- The Layer will appear on map canvas



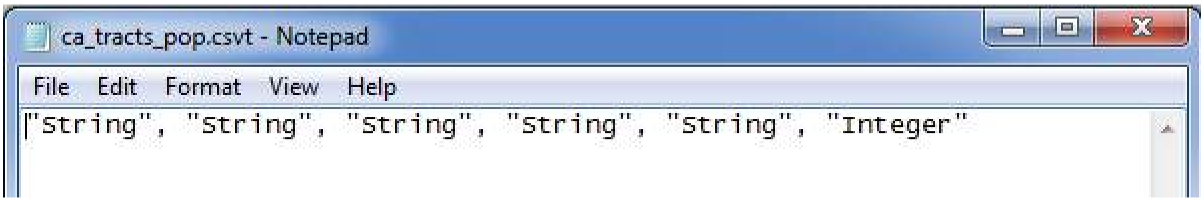
- Using the above procedure a point feature can also be digitized.
- The digitizing task is now complete. You can play with the styling and labeling options in layer properties to create a nice looking map from the data you created.

PRACTICAL - 7

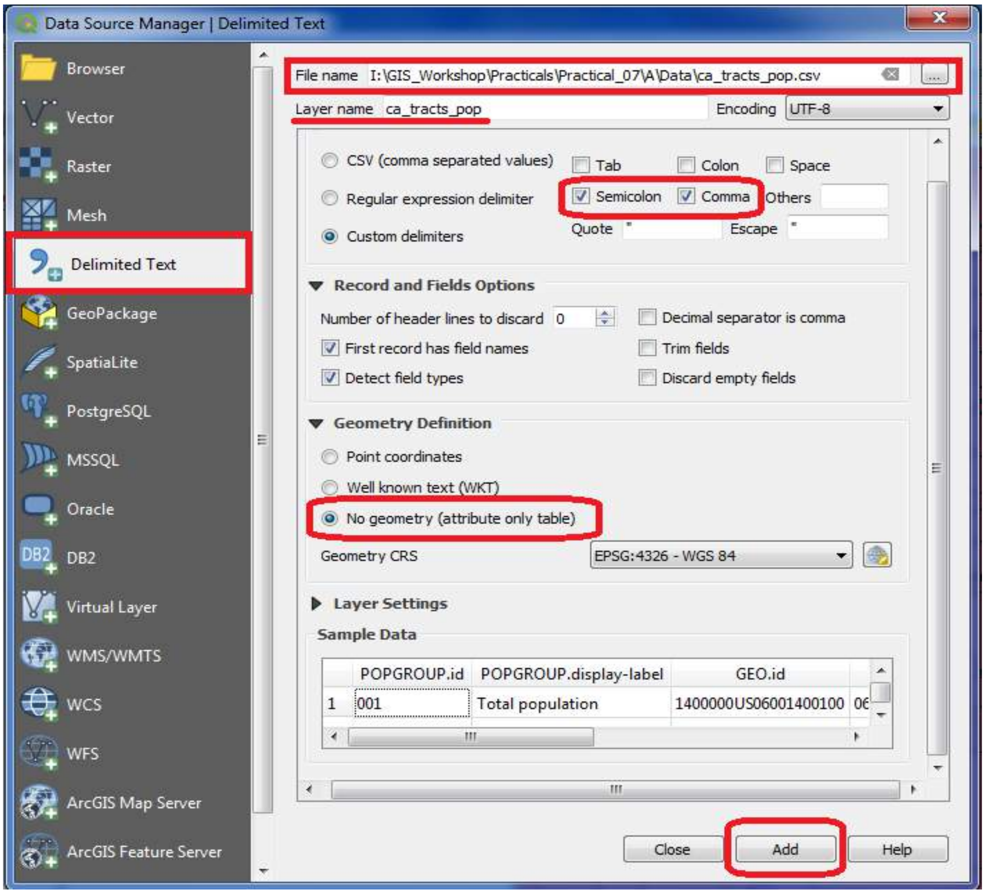
Managing Data Tables and Saptial data Sets:

a) Table joins

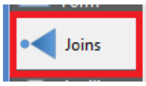
- Start a new project
- Go to Layer → Add Layer → Add new Vector Layer
  “I:\GIS_Workshop\Practicals\Practical_07\A\Data\tl_2013_06_tract.zip”
- We could import this csv file without any further action and it would be imported. But, the default type of each column would be a *String* (text). That is ok except for the *D001* field which contains numbers for the population. Having those imported as text would not allow us to run any mathematical operations on this column. To tell QGIS to import the field as a number, we need to create a *sidecar* file with a *.csvt* extension.



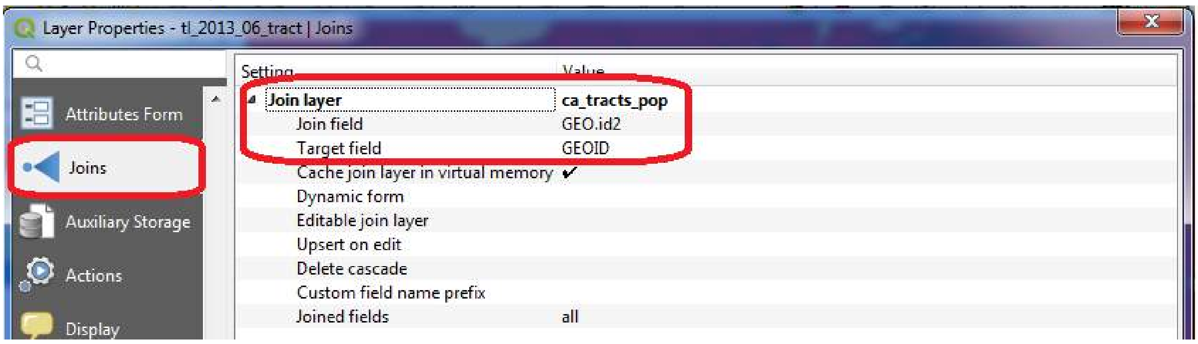
- This file will have only 1 row specifying data types for each column. Save this file as ca_tracts_pop.csvt in the same directory as the original *.csv* file.
- Go to Layer → Add Layer → Add Delimited Text Layer
  And add I:\GIS_Workshop\Practicals\Practical_07\A\Data\ca_tacts_pop.csv”



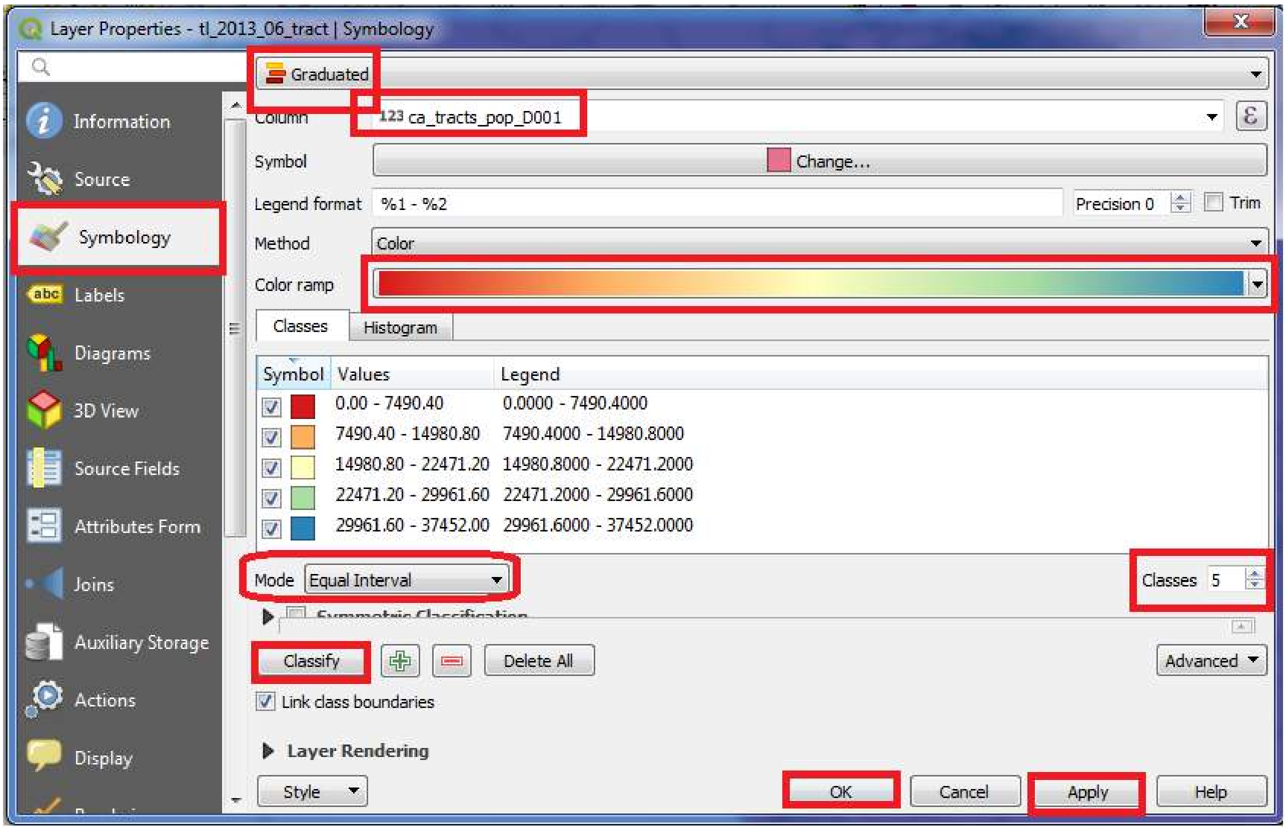
- In the layer panel, Right click on “tl_2013_06_tract”, layer and select Properties

- Select the  option in Properties, and click on  button to add new table join.
- In the Add Vector Join window set the following properties and click OK.

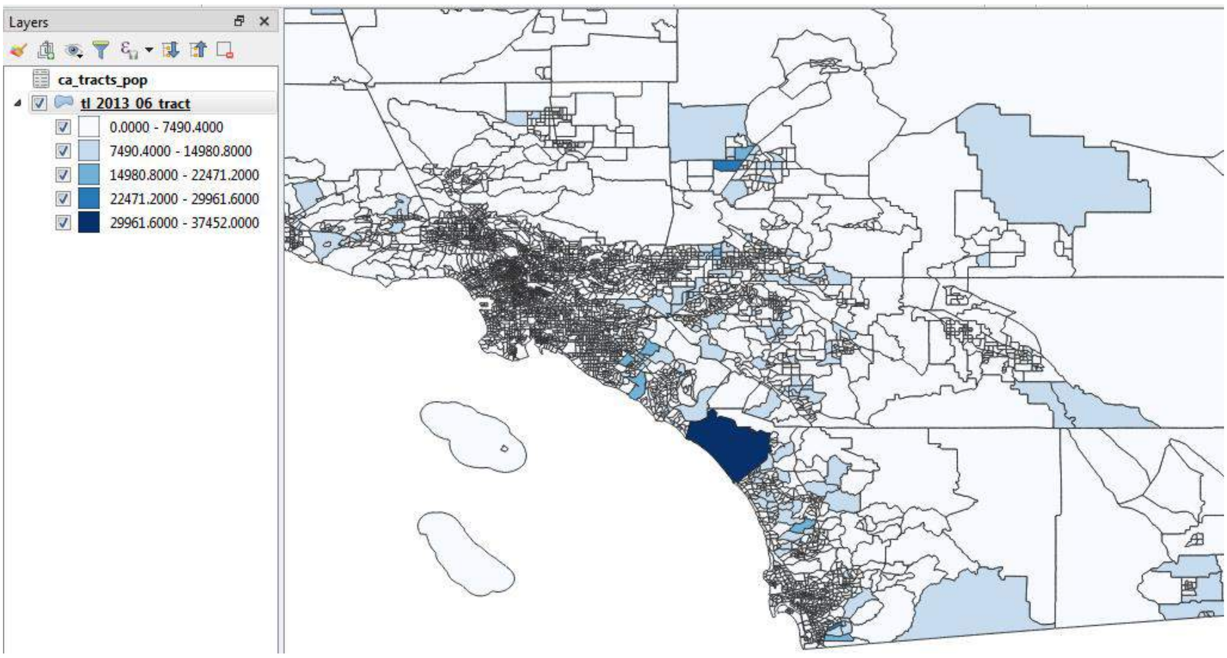
- After performing join



- For more clear output, select "tl_2013_06_tact" from Layer Panel, right click and select properties. Go to Symbology and set the following properties.

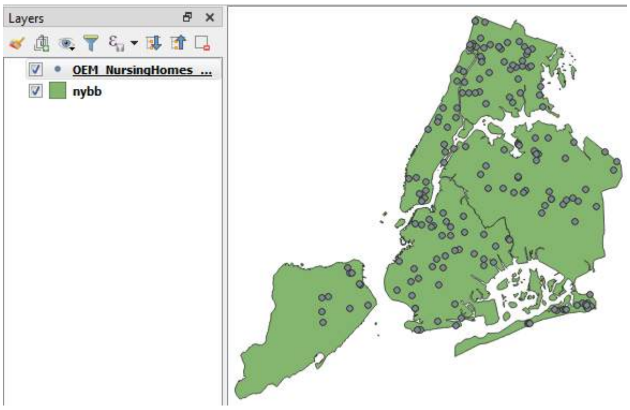


➢ A detailed and accurate population map of California can be seen as the result. Same technique can be used to create maps based on variety of census data.

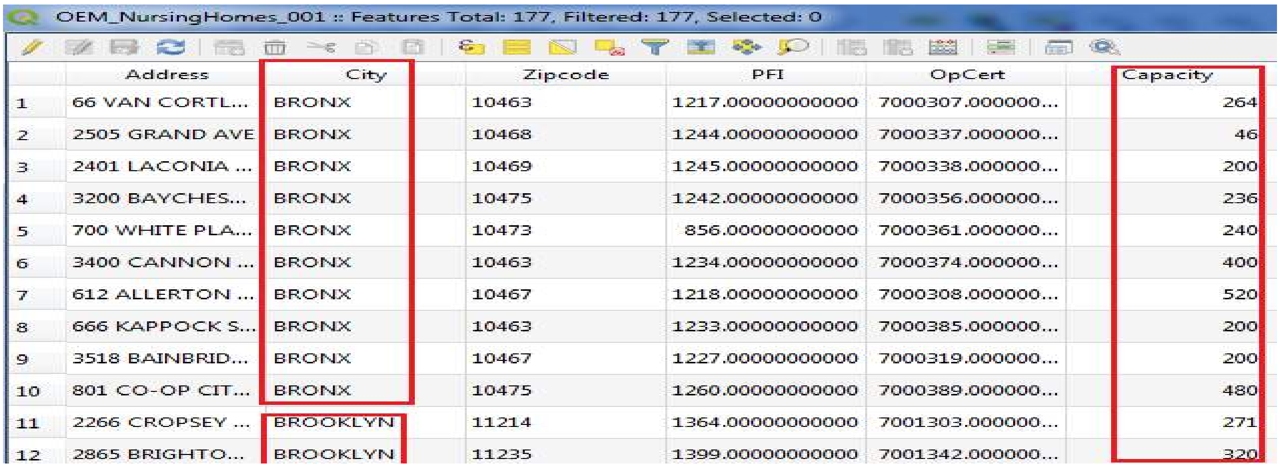


b) spatial joins

- Go to Layer → Add Layer → Add Vector Layer → Select "I:\GIS_Workshop\Practicals\Practical_07\B\Data\nybb_12c\nybb_13c_av\nybb.shp" and "I:\GIS_Workshop\Practicals\Practical_07\B\Data\OEM_NursingHomes_001\OEM_NursingHomes_001.shp", from data folder.



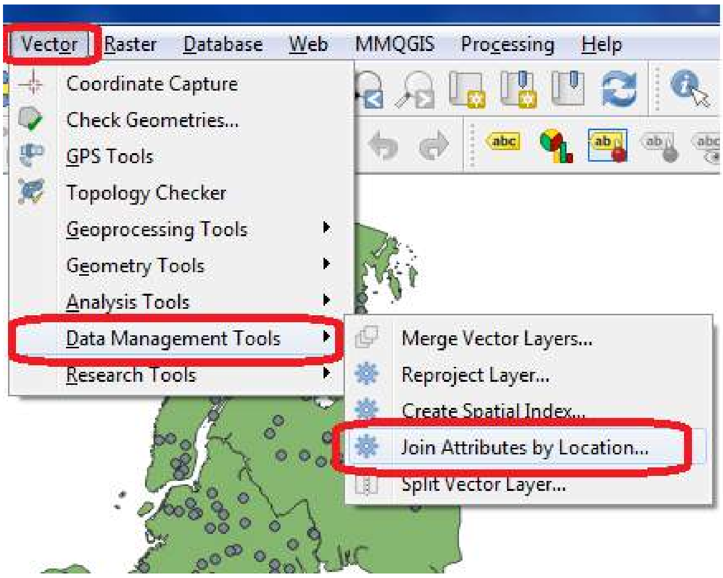
- Go to attribute table and observe the data.
- Table before performing Join

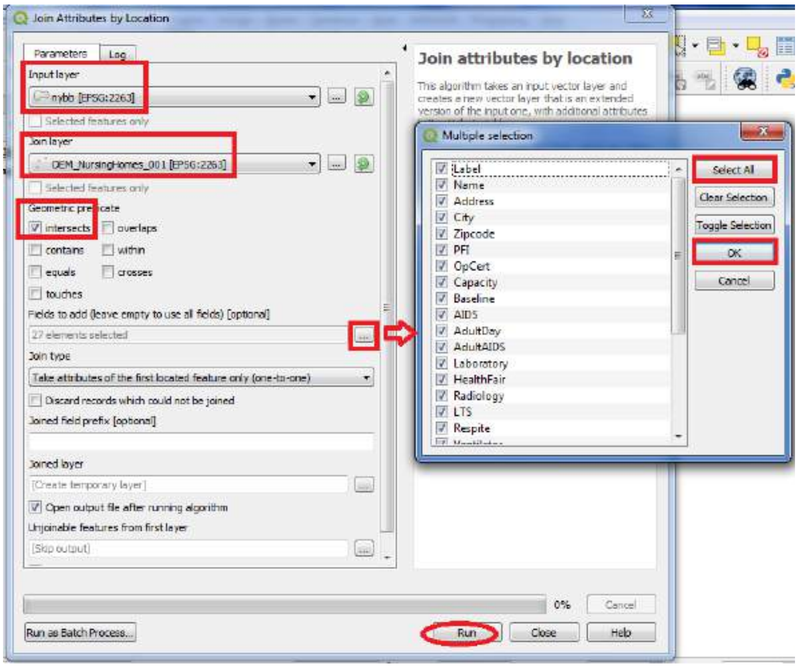


OEM_NursingHomes_001 :: Features Total: 177, Filtered: 177, Selected: 0

	Address	City	Zipcode	PFI	OpCert	Capacity
1	66 VAN CORTL...	BRONX	10463	1217.00000000000	7000307.000000...	264
2	2505 GRAND AVE	BRONX	10468	1244.00000000000	7000337.000000...	46
3	2401 LACONIA ...	BRONX	10469	1245.00000000000	7000338.000000...	200
4	3200 BAYCHES...	BRONX	10475	1242.00000000000	7000356.000000...	236
5	700 WHITE PLA...	BRONX	10473	856.00000000000	7000361.000000...	240
6	3400 CANNON ...	BRONX	10463	1234.00000000000	7000374.000000...	400
7	612 ALLERTON ...	BRONX	10467	1218.00000000000	7000308.000000...	520
8	666 KAPPOCK S...	BRONX	10463	1233.00000000000	7000385.000000...	200
9	3518 BAINBRID...	BRONX	10467	1227.00000000000	7000319.000000...	200
10	801 CO-OP CIT...	BRONX	10475	1260.00000000000	7000389.000000...	480
11	2266 CROPSEY ...	BROOKLYN	11214	1364.00000000000	7001303.000000...	271
12	2865 BRIGHTO...	BROOKLYN	11235	1399.00000000000	7001342.000000...	320

- Go to Vector → Data Management Tools → Join Attributes by Location



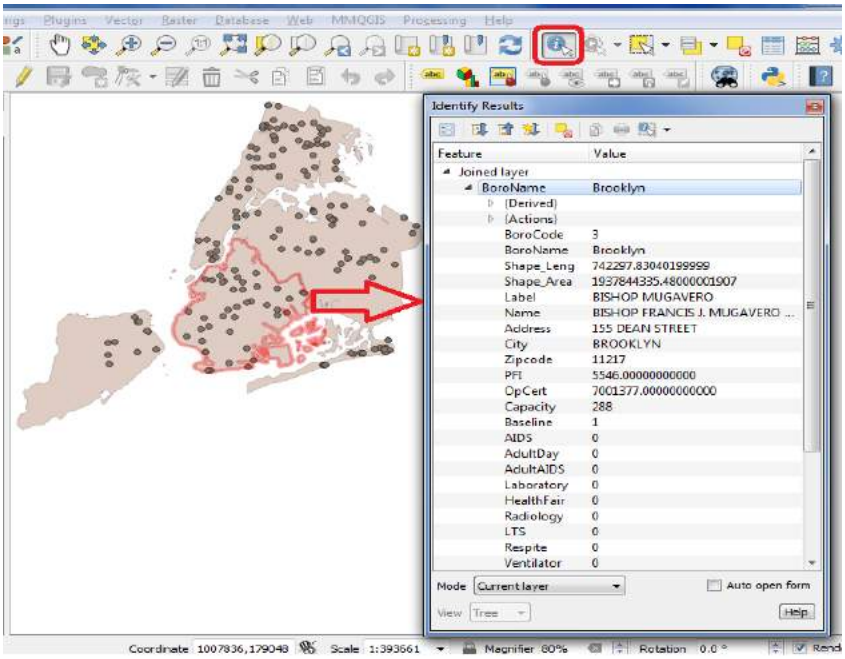


➢ Attribute table after join

City	Zipcode	PFI	OpCert	Capacity
ASTORIA	11102	6384.00000000000	7003405.000000...	280
BROOKLYN	11217	5546.00000000000	7001377.000000...	288
BRONX	10472	1251.00000000000	7000381.000000...	200
STATEN ISLAND	10304	1755.00000000000	7004310.000000...	300
NEW YORK	10003	4807.00000000000	7002351.000000...	28

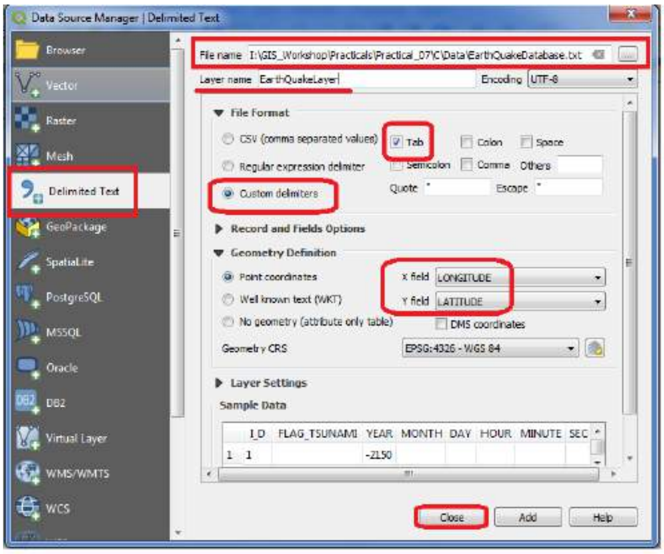
➢ Use the Identify Feature  Button to select a region to view join data on map Layer.

➢ Output

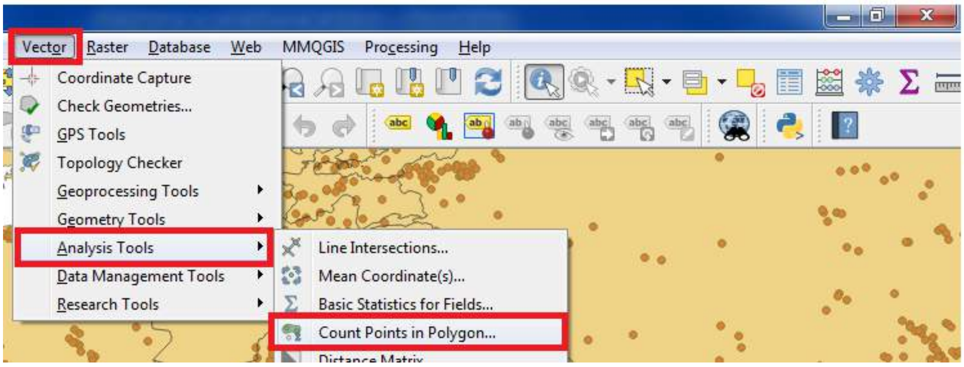


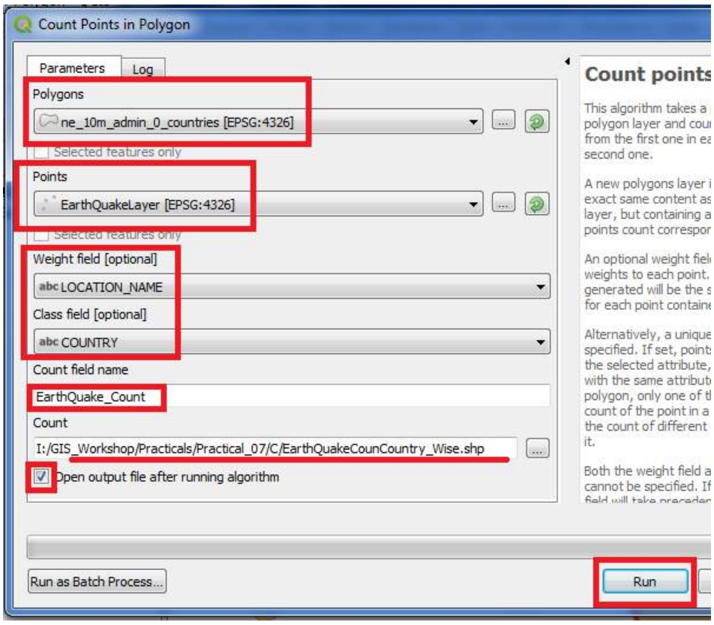
c) Points in polygon analysis

- Go to Layer → Add Layer → Add Delimited Text Layer
  Select "EarthQuakeDatabase.txt"

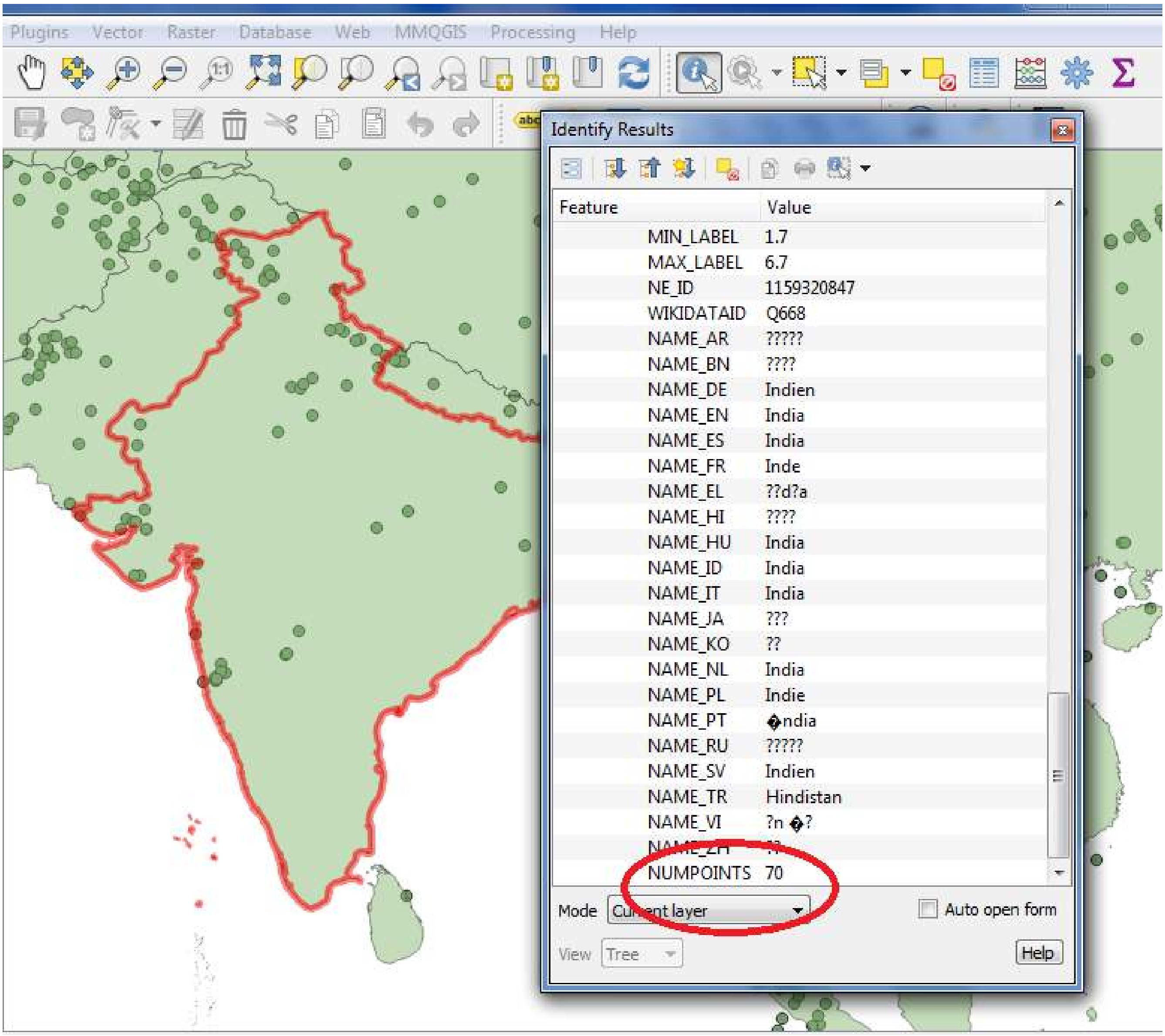


- Go to Layer → Add Layer → Add Delimited Text Layer
  "I:\GIS_Workshop\Practicals\Practical_07\C\Data\ne_10m_admin_0_countries.zip"





- Use the select Feature  button to check country wise counting of Earthquakes.

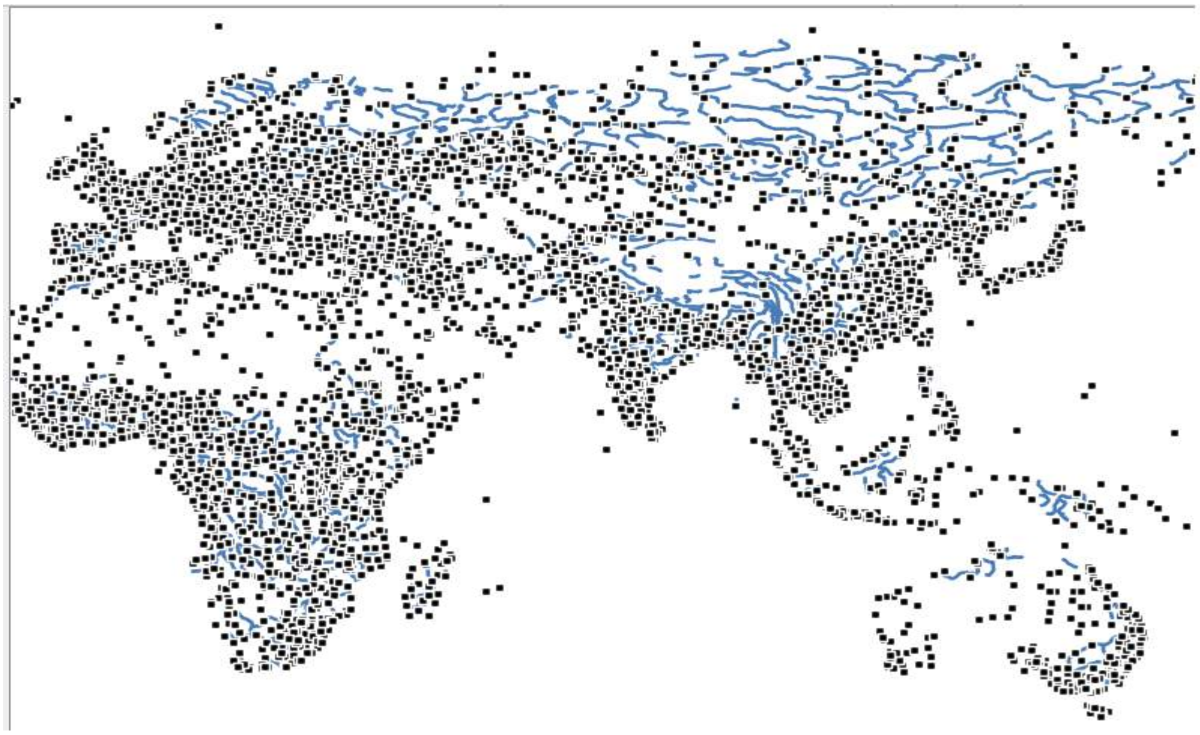


- Also a new column is added to attribute table "NumPoints" indicating number of earth quake points in each country.

NUMPOINTS
0
64
53
13
0
9
0
10
5
57
0
12
4
0
2
5
8
152
0

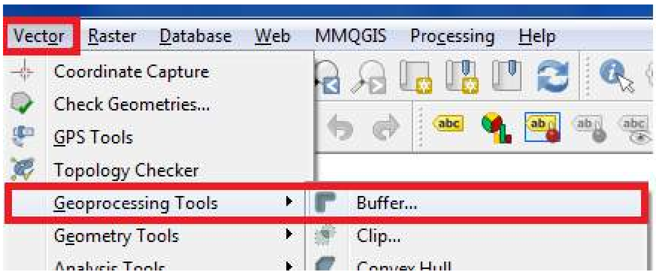
d) performing spatial queries

- Go to Layer → Add Layer → Add Vector Layer and load "\GIS_Workshop\Practicals\Practical_07\D\Data\ne_10m_populated_places_simple(2)\ne_10m_populated_places_simple.shp" and "I:\GIS_Workshop\Practicals\Practical_07\D\Data\ne_10m_rivers_lake_centerlines\ne_10m_rivers_lake_centerlines.shp" from project data folder.

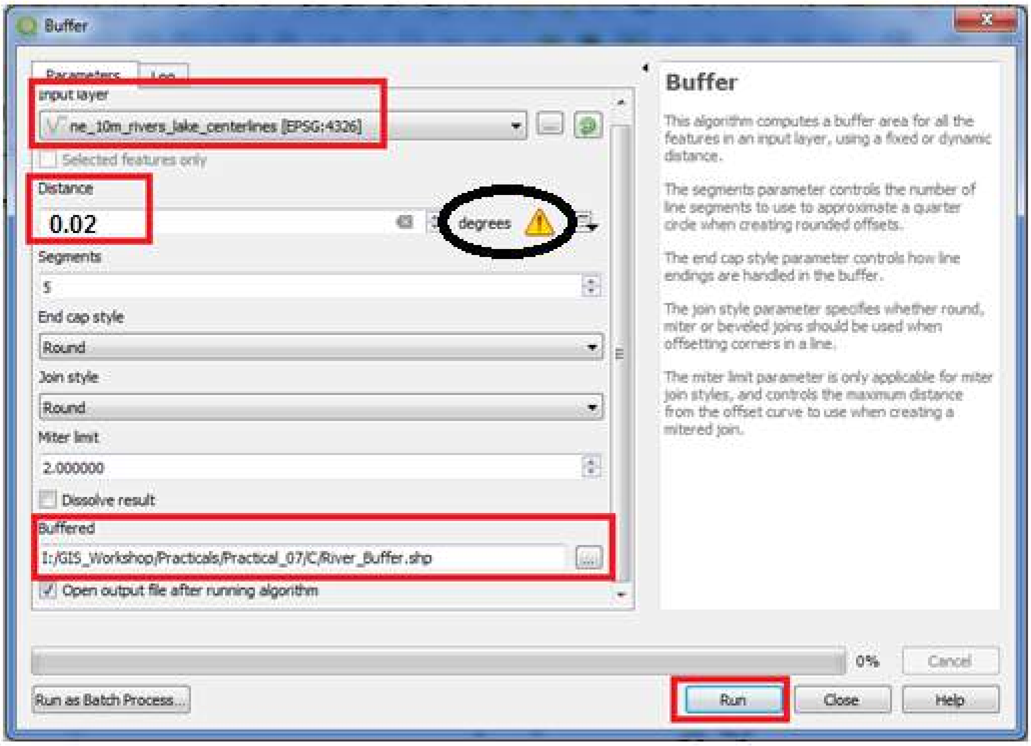


- Open project Properties → Set CRS "World_Azimuthal_Equidistant EPSG 54032" . The map will be re-projected as

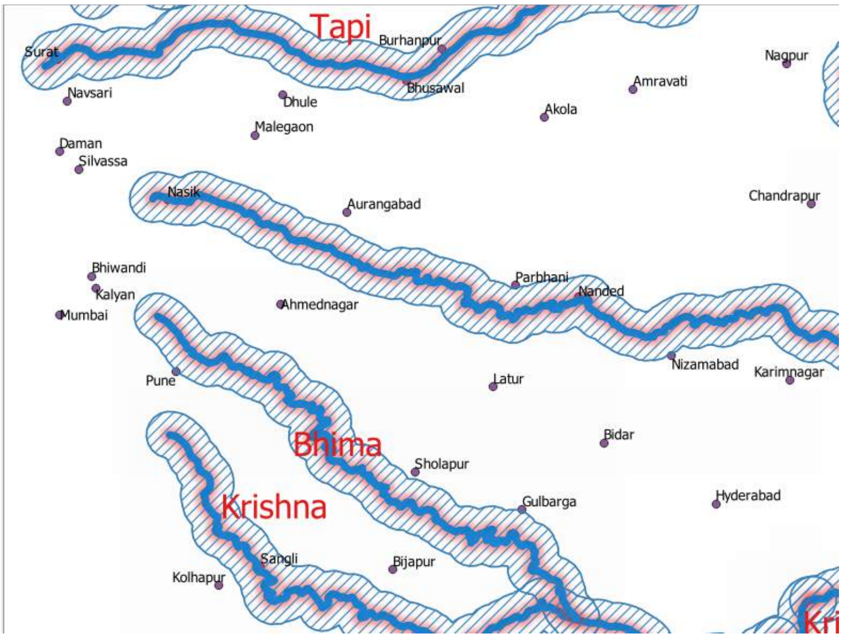
- Go to Vector → Geoprocessing Tool → Buffer



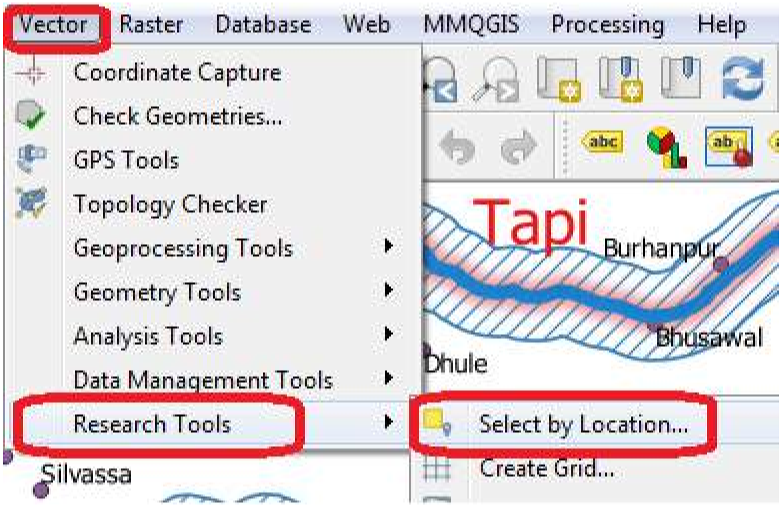
- Repeat the step to create River Buffer

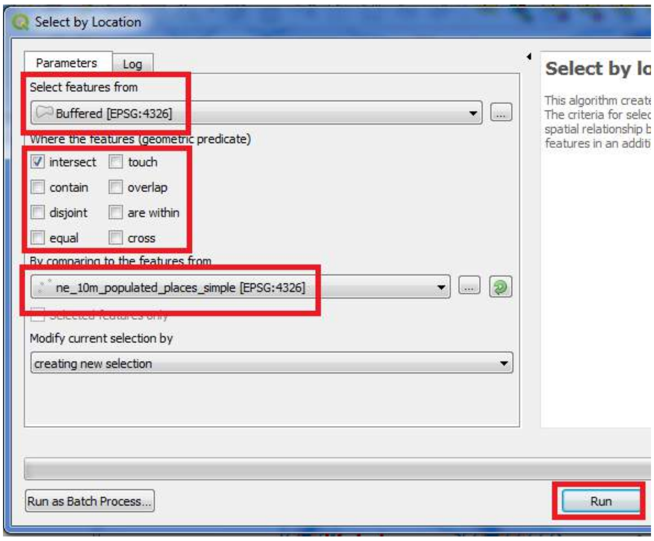


- Create a buffer for River

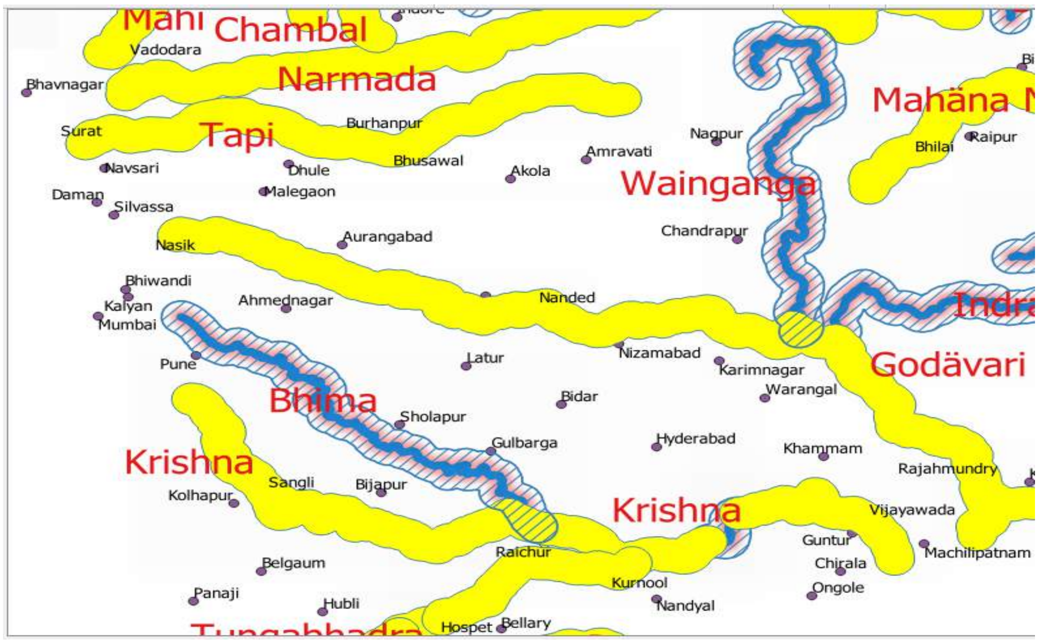


- Go to Vector → Research Tool → Select By Location





- This will highlight only those rivers containing a populated place within 2 KM

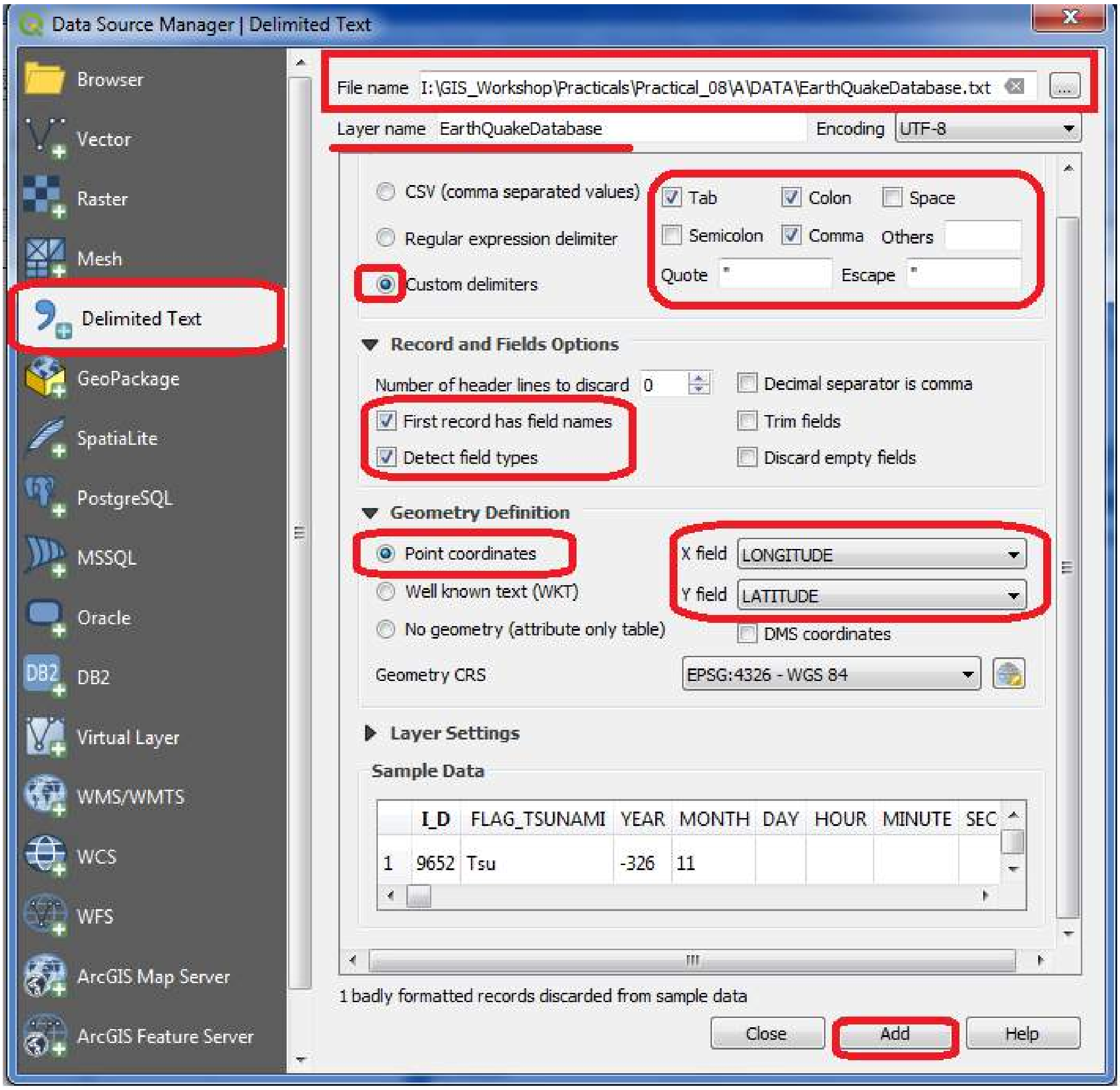


PRACTICAL - 8

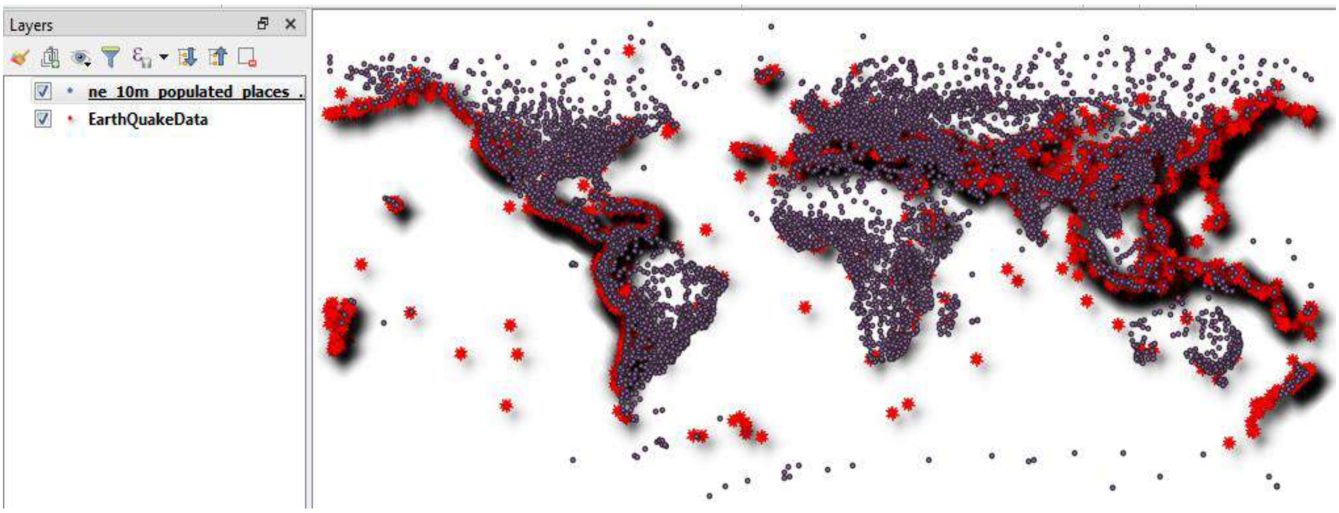
Advanced GIS Operations 1:

a) Nearest Neighbor Analysis

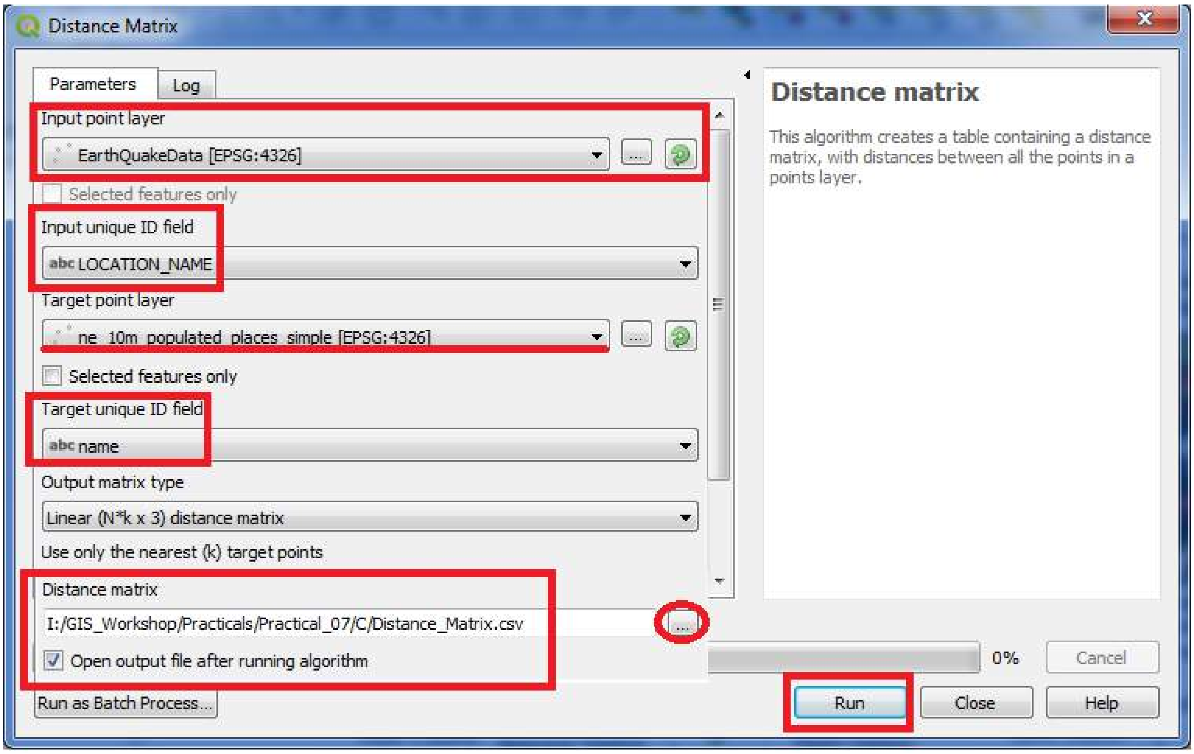
- Go to Layer → add Layer → add Delimited Text Layer and load "signif.txt" from data file.



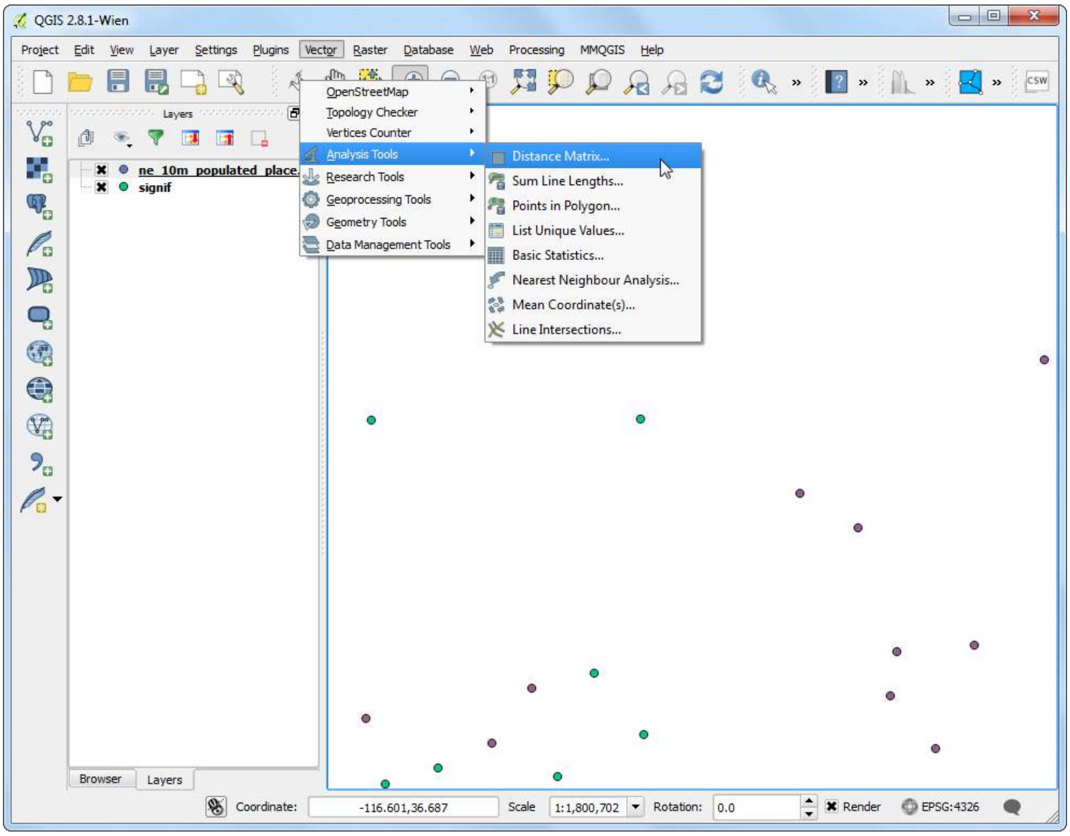
- Go to Layer → Add Layer → Add vector Layer and from data folder "\GIS_Workshop\Practicals\Practical_08\A\DATA\ne_10m_populated_places_simple.zip" load the layer to the project and remove all rows from attribute table other than India.



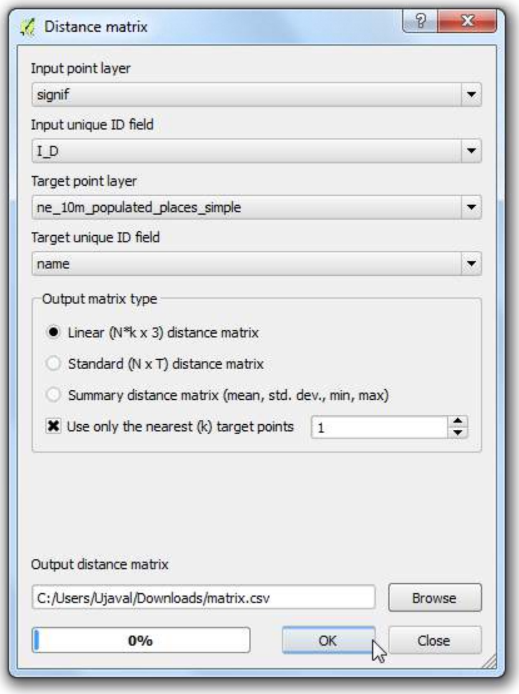
- Go to Vector→ Analysis tool → Distance Matrix



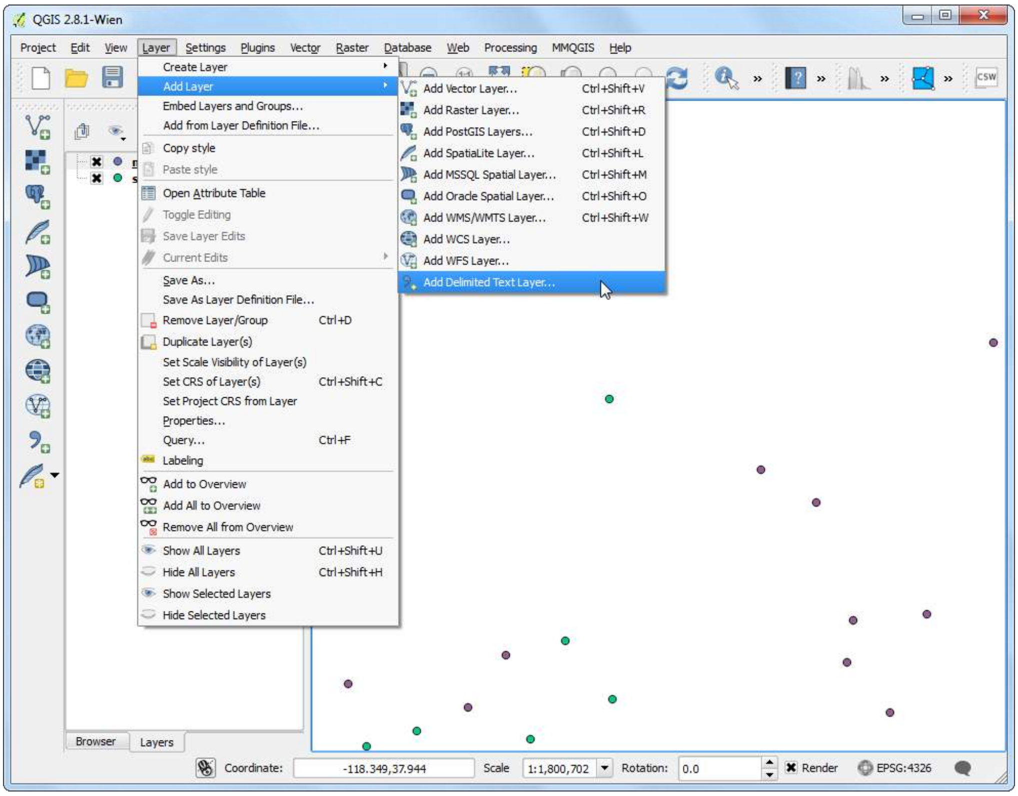
- Calculate the Distance matrix and perform Nearest Neighbor Analysis
- Now you will be able to see the content of our results. The InputID field contains the field name from the Earthquake layer. The TargetID field contains the name of the feature from the Populated Places layer that was the closest to the earthquake point. The Distance field is the distance between the 2 points.



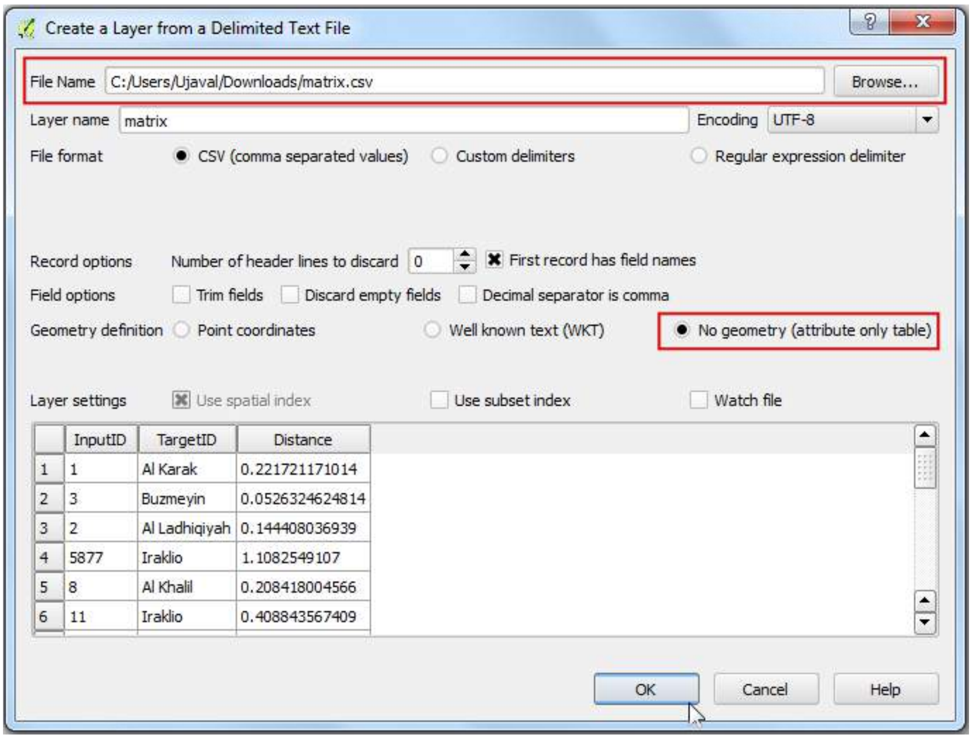
7. Here select the earthquake layer signif as the Input point layer and the populated places ne_10m_populated_places_simpleas the target layer. You also need to select a unique field from each of these layers which is how your results will be displayed. In this analysis, we are looking to get only 1 nearest point, so check the Use only the nearest(k) target points, and enter 1. Name your output file matrix.csv, and click OK. Once the processing finishes, click Close.



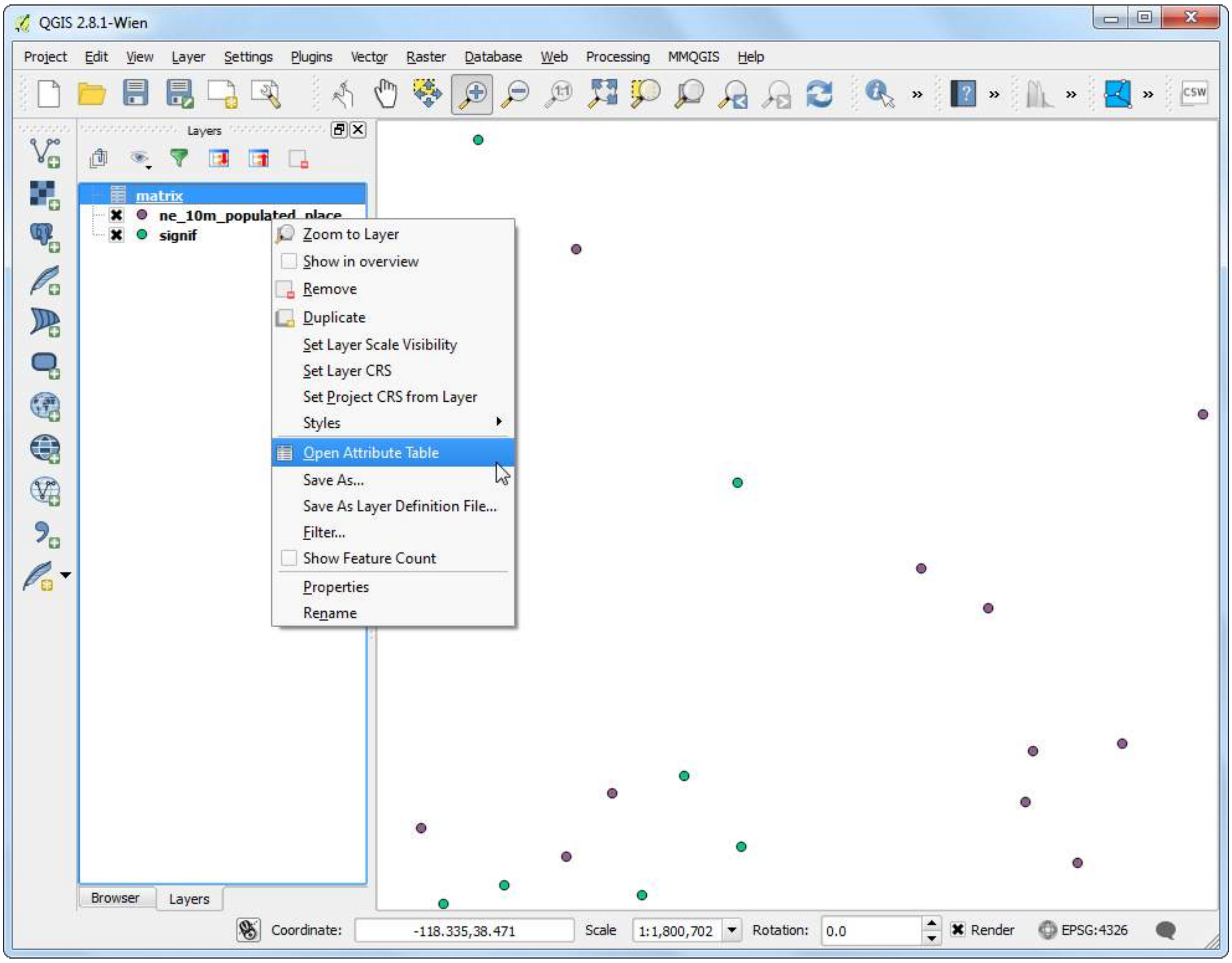
8. Once the processing finishes, click the Close button in the Distance Matrix dialog. You can now view the matrix.csv file in Notepad or any text editor. QGIS can import CSV files as well, so we will add it to QGIS and view it there. Go to Layer □Add Layer □Add Delimited Text Layer....



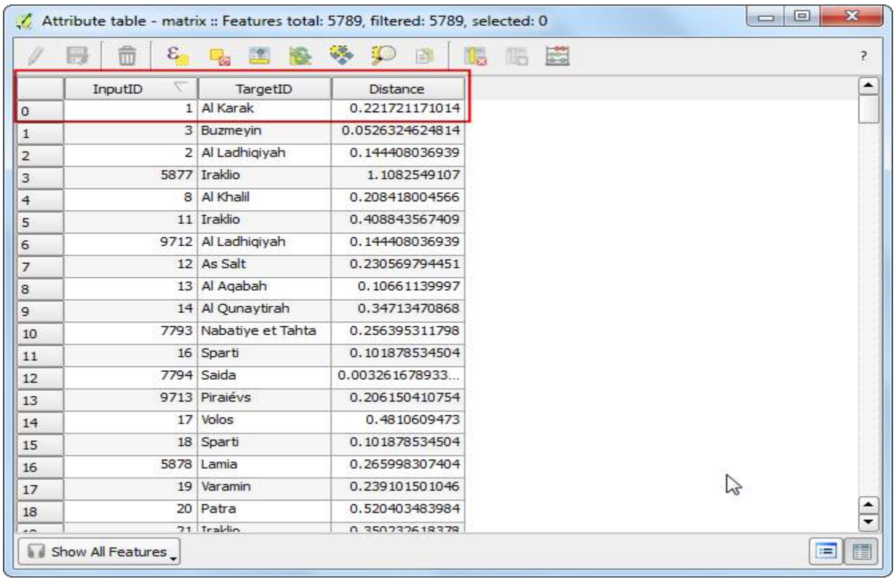
9. Browse to the newly created matrix.csv file. Since this file is just text columns, select No geometry (attribute only table) as theGeometry definition. Click OK.



10. You will see the CSV file loaded as a table. Right-click on the table layer and select Open Attribute Table.

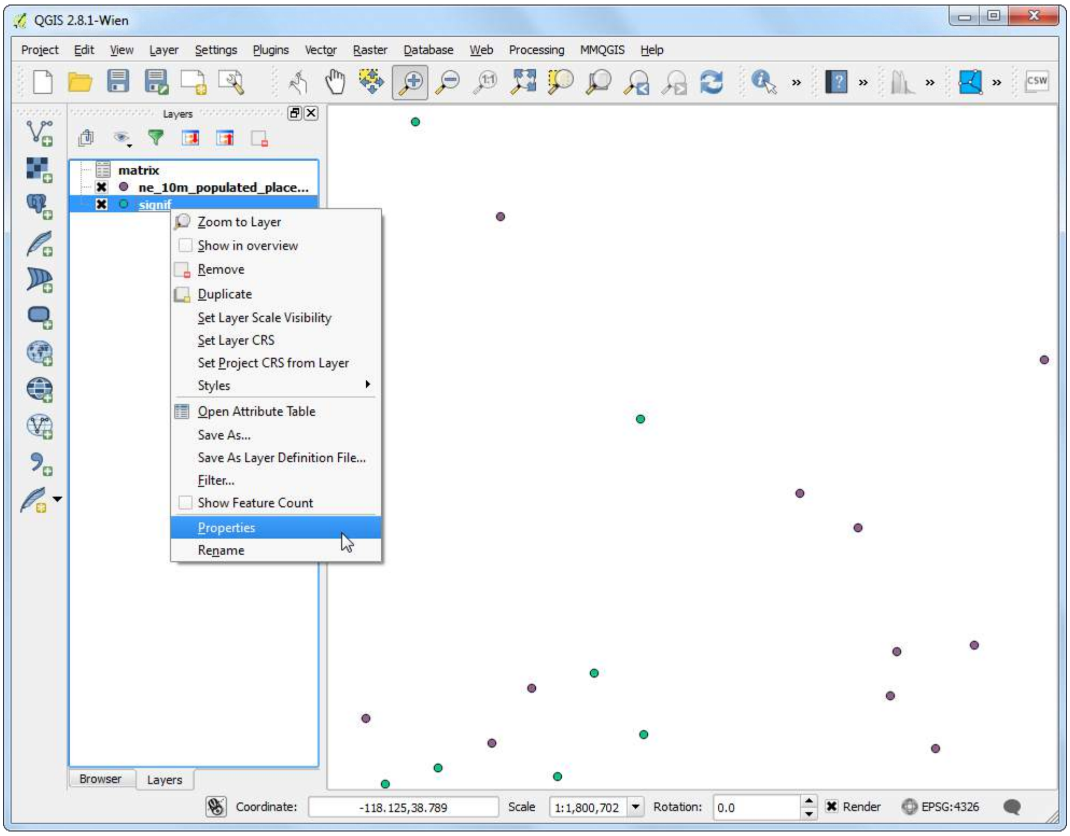


11. Now you will be able to see the content of our results. The InputID field contains the field name from the Earthquake layer. The TargetID field contains the name of the feature from the Populated Places layer that was the closest to the earthquake point. The Distance field is the distance between the 2 points.



	InputID	TargetID	Distance
0	1	Al Karak	0.221721171014
1	3	Buzmeyin	0.0526324624814
2	2	Al Ladhiqiyah	0.144408036939
3	5877	Iraklio	1.1082549107
4	8	Al Khalil	0.208418004566
5	11	Iraklio	0.408843567409
6	9712	Al Ladhiqiyah	0.144408036939
7	12	As Salt	0.230569794451
8	13	Al Aqabah	0.10661139997
9	14	Al Qunaytirah	0.34713470868
10	7793	Nabatiye et Tahta	0.256395311798
11	16	Sparti	0.101878534504
12	7794	Saida	0.003261678933...
13	9713	Piraiévs	0.206150410754
14	17	Volos	0.4810609473
15	18	Sparti	0.101878534504
16	5878	Lamia	0.265998307404
17	19	Varamin	0.239101501046
18	20	Patra	0.520403483984

12. This is very close to the result we were looking for. For some users, this table would be sufficient. However, we can also integrate this results in our original Earthquake layer using a Table Join. Right-click on the Earthquake layer, and select Properties.

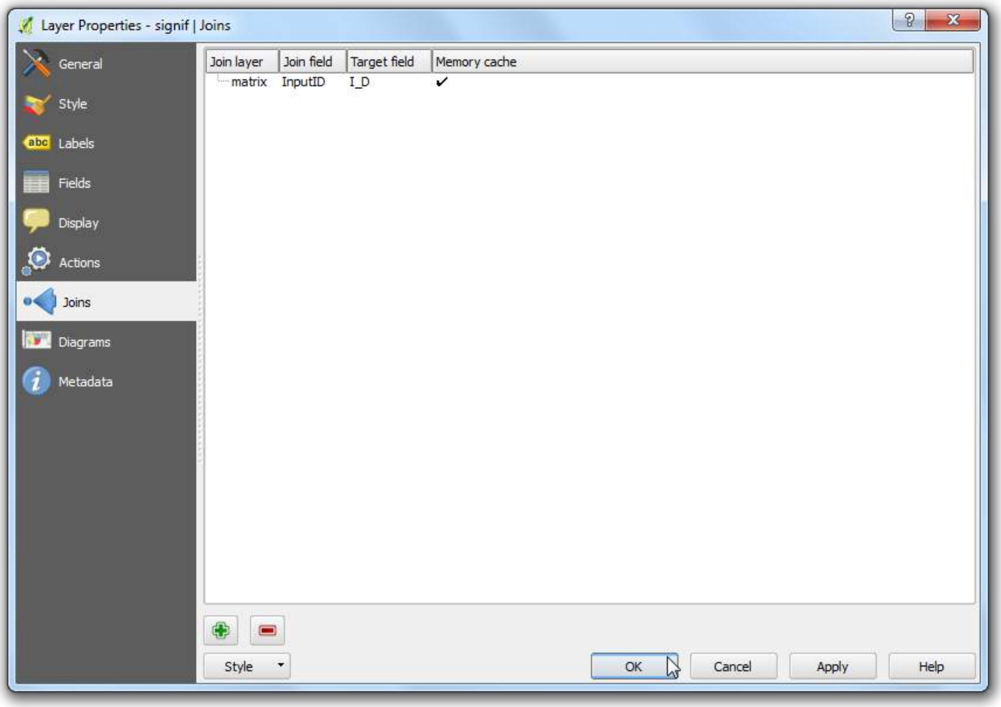


13. Go to the Joins tab and click on the + button.

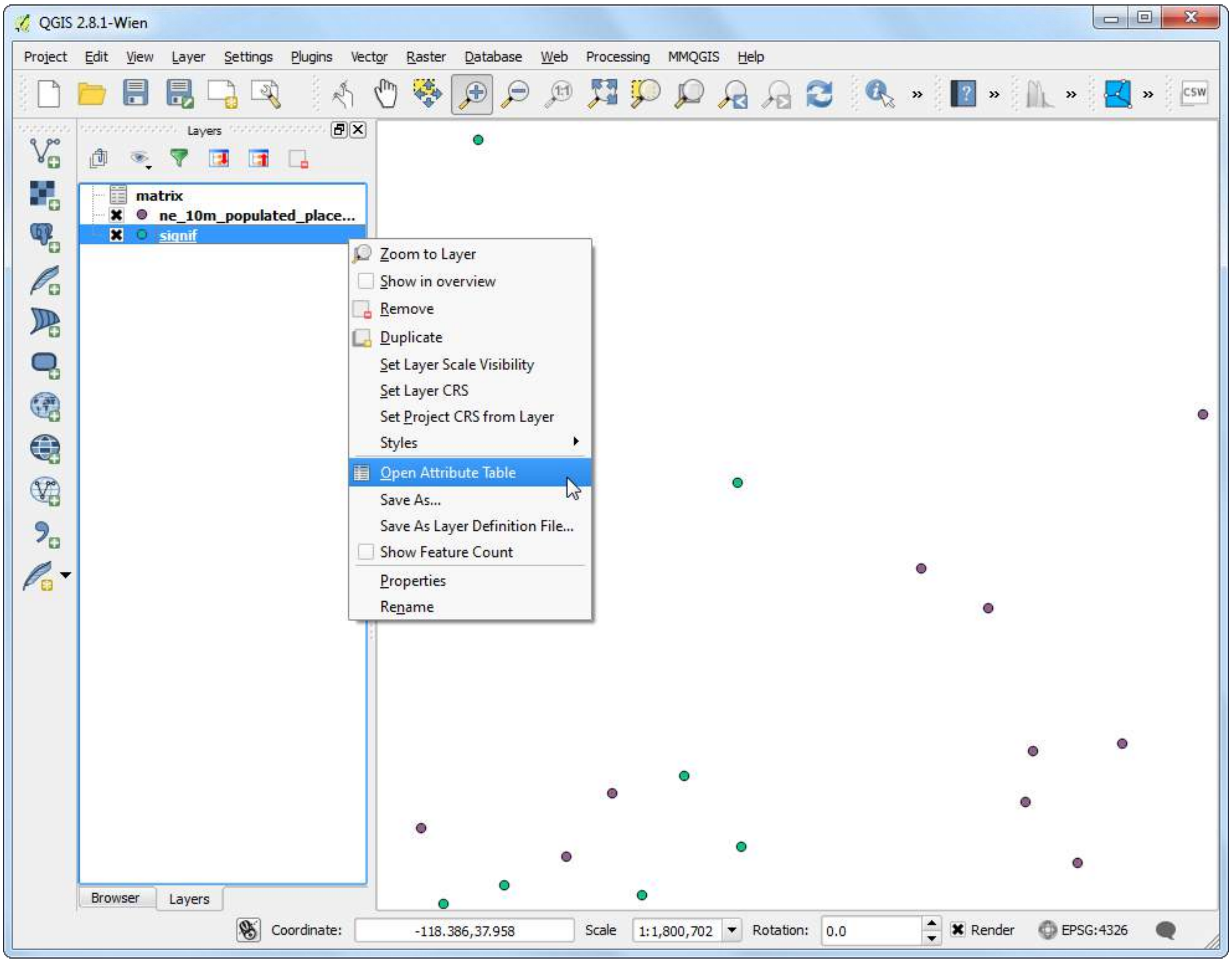
14. We want to join the data from our analysis result to this layer. We need to select a field from each of the layers that has the same values. Select matrix as the Join layer` and InputID as

the Join field. The Target field would be I_D. Leave other options to their default values and click OK.

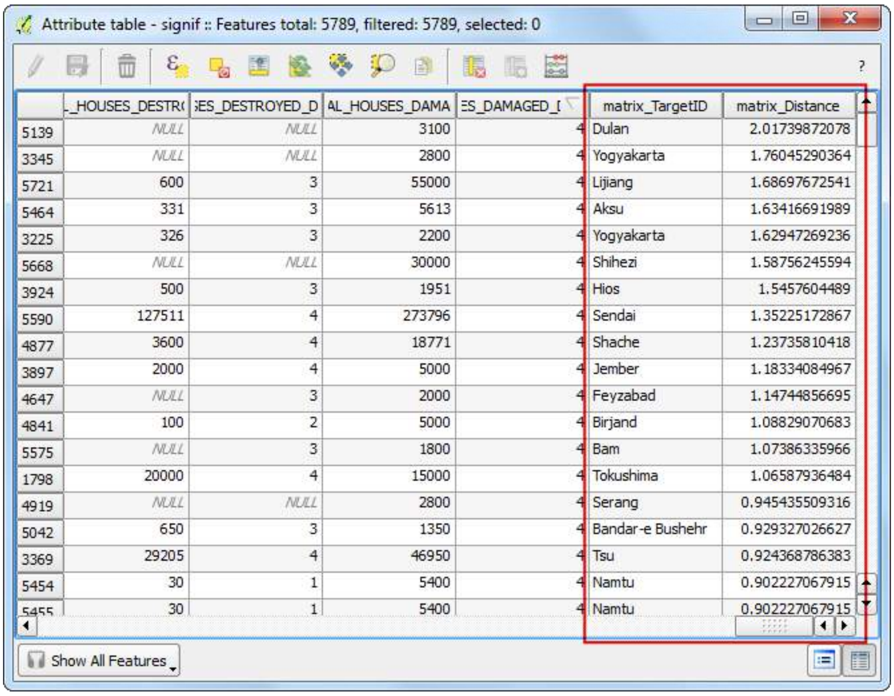
15. You will see the join appear in the Joins tab. Click OK.



16. Now open the attribute table of the signif layer by right-clicking and selecting Open Attribute Table.



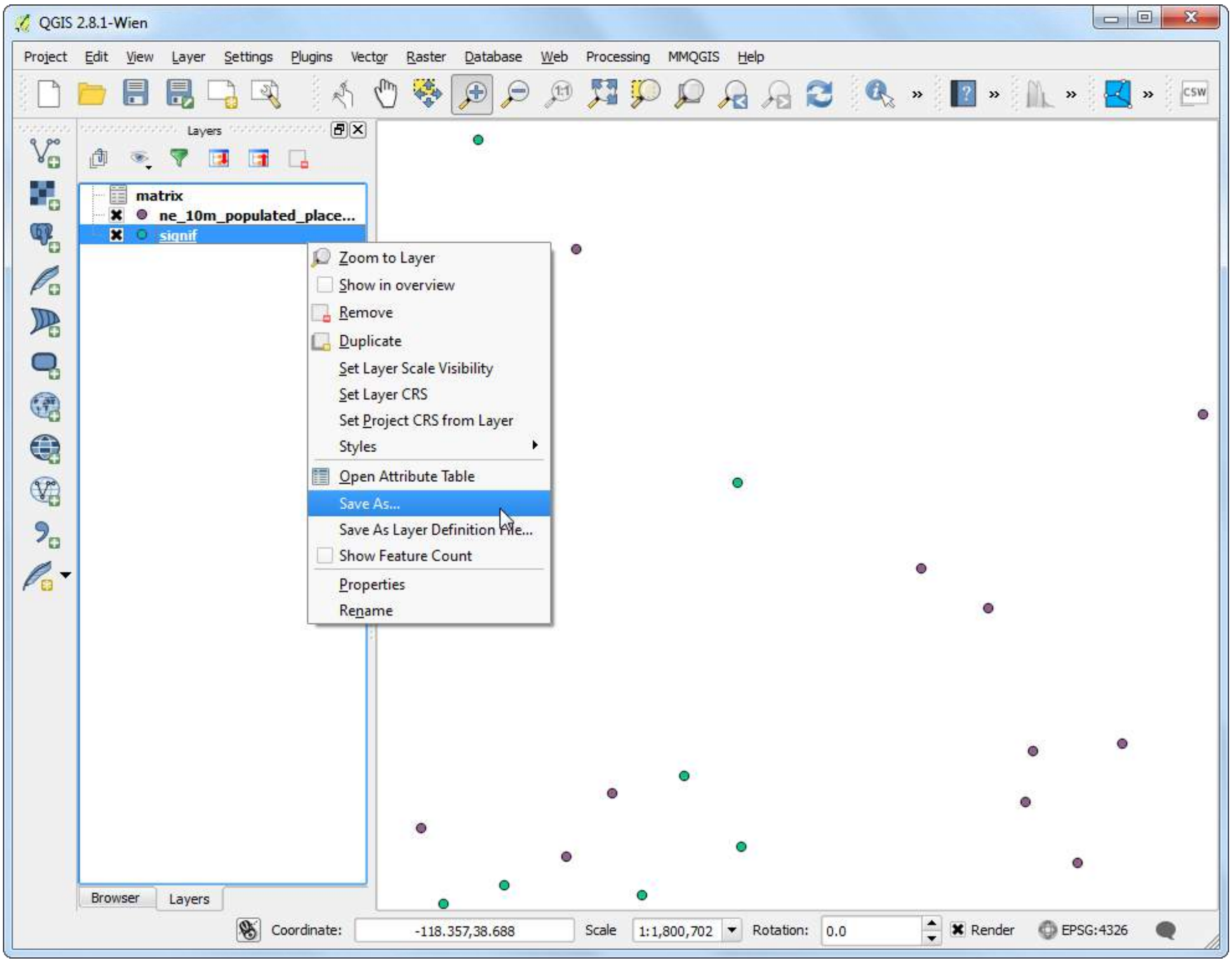
17. You will see that for every Earthquake feature, we now have an attribute which is the nearest neighbor (closest populated place) and the distance to the nearest neighbor.


Attribute table - signif :: Features total: 5789, filtered: 5789, selected: 0

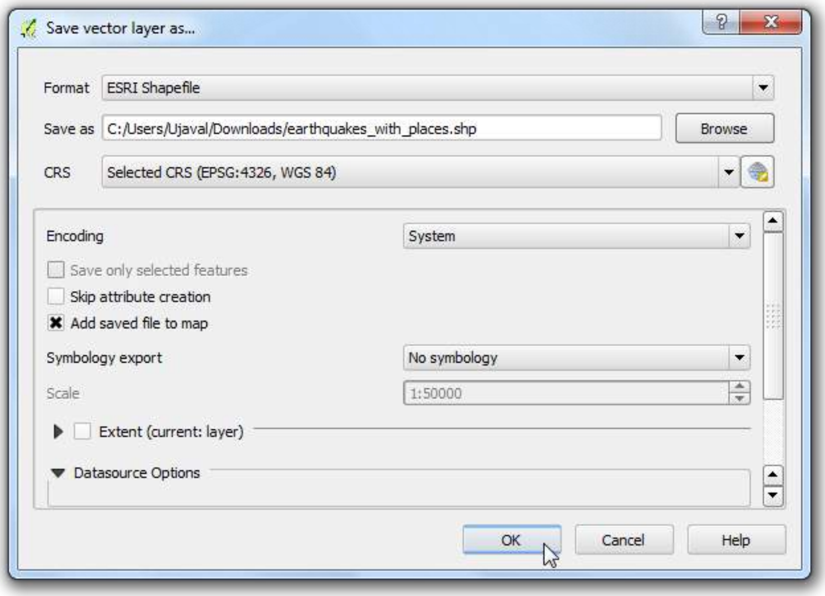
	_HOUSES_DESTR(	ES_DESTROYED_D	AL_HOUSES_DAMA	ES_DAMAGED_I	matrix_TargetID	matrix_Distance
5139	NULL	NULL	3100	4	Dulan	2.01739872078
3345	NULL	NULL	2800	4	Yogyakarta	1.76045290364
5721	600	3	55000	4	Lijiang	1.68697672541
5464	331	3	5613	4	Aksu	1.63416691989
3225	326	3	2200	4	Yogyakarta	1.62947269236
5668	NULL	NULL	30000	4	Shihezi	1.58756245594
3924	500	3	1951	4	Hios	1.5457604489
5590	127511	4	273796	4	Sendai	1.35225172867
4877	3600	4	18771	4	Shache	1.23735810418
3897	2000	4	5000	4	Jember	1.18334084967
4647	NULL	3	2000	4	Feyzabad	1.14744856695
4841	100	2	5000	4	Birjand	1.08829070683
5575	NULL	3	1800	4	Bam	1.07386335966
1798	20000	4	15000	4	Tokushima	1.06587936484
4919	NULL	NULL	2800	4	Serang	0.945435509316
5042	650	3	1350	4	Bandar-e Bushehr	0.929327026627
3369	29205	4	46950	4	Tsu	0.924368786383
5454	30	1	5400	4	Namtu	0.902227067915
5455	30	1	5400	4	Namtu	0.902227067915

Show All Features

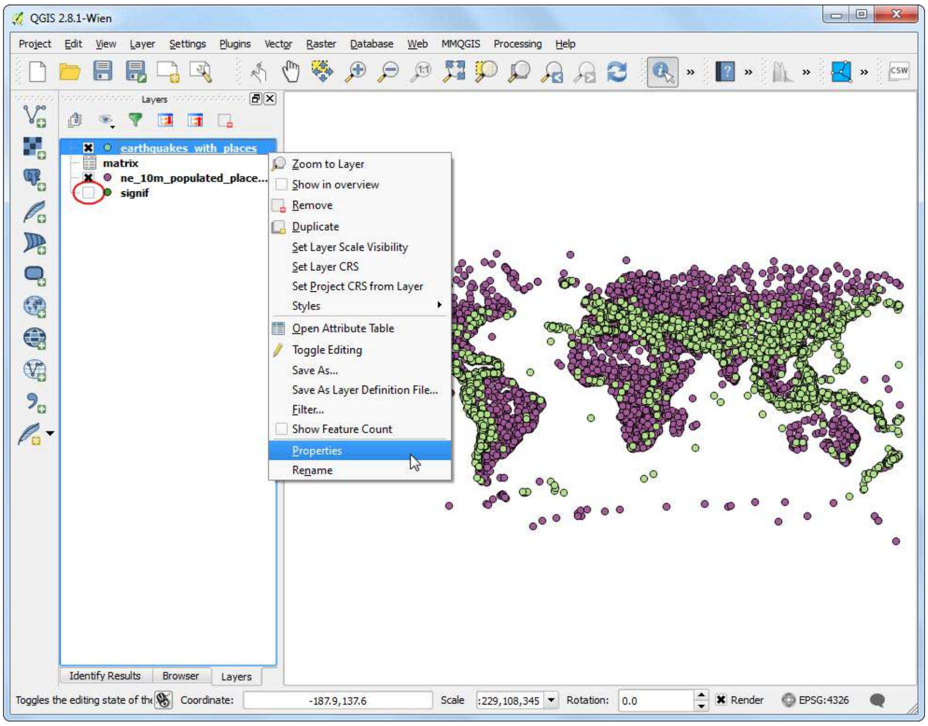
18. We will now explore a way to visualize these results. First, we need to make the table join permanent by saving it to a new layer. Right-click the signif layer and select Save As....



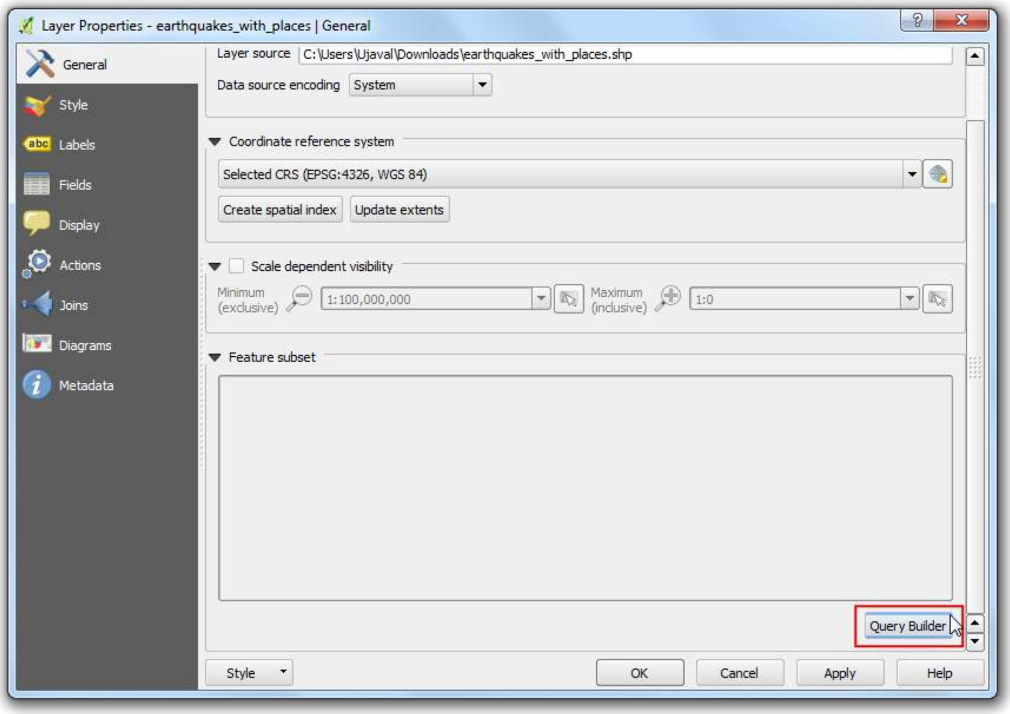
19. Click the Browse button next to Save as label and name the output layer as earthquake_with_places.shp. Make sure the Add saved file to map box is checked and click OK.



20. Once the new layer is loaded, you can turn off the visibility of the signif layer. As our dataset is quite large, we can run our visualization analysis on a subset of the data. QGIS has a neat feature where you can load a subset of features from a layer without having to export it to a new layer. Right-click the earthquake_with_places layer and select Properties.

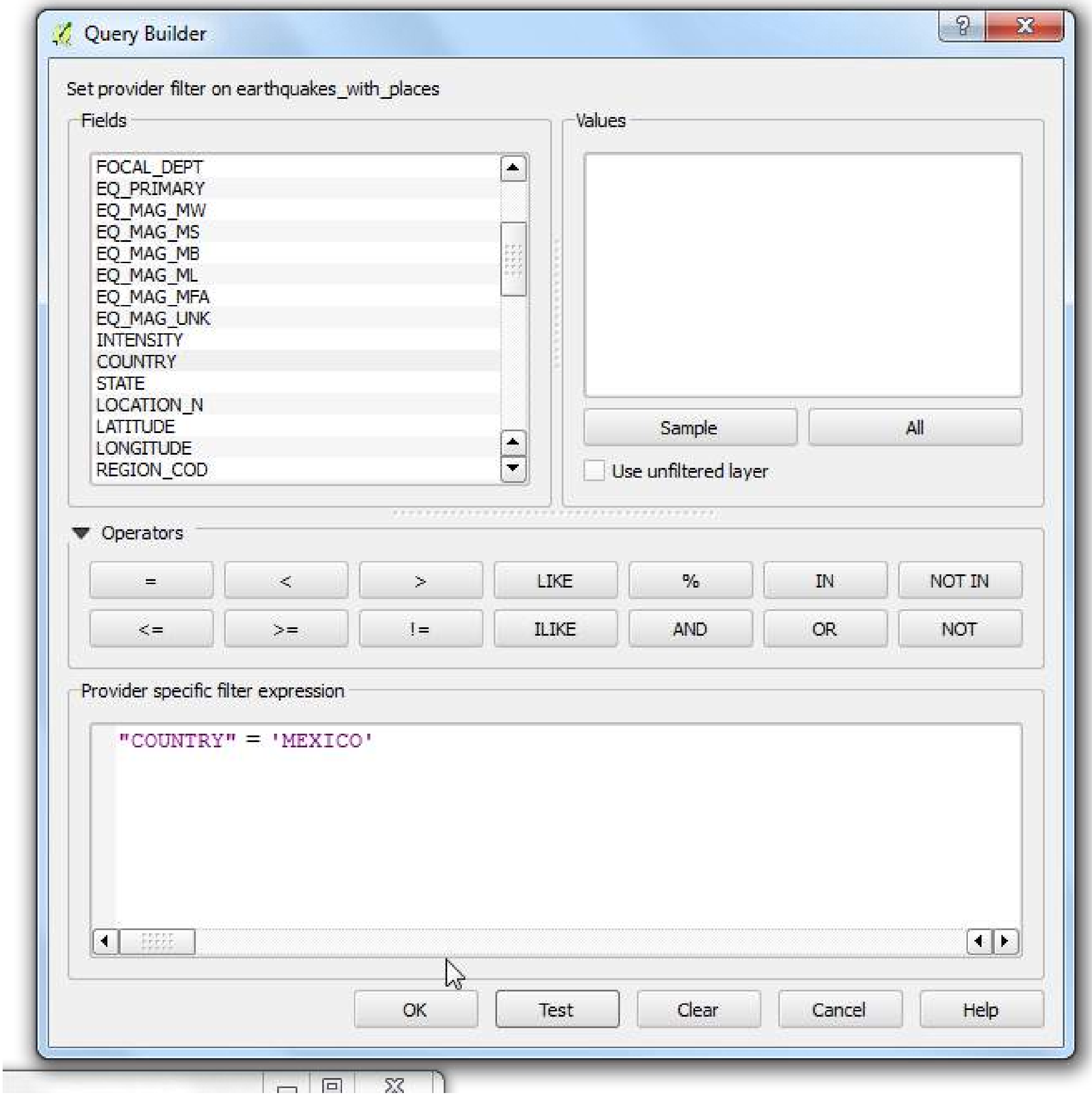


21. In the General tab, scroll down to the Feature subset section. Click Query Builder.

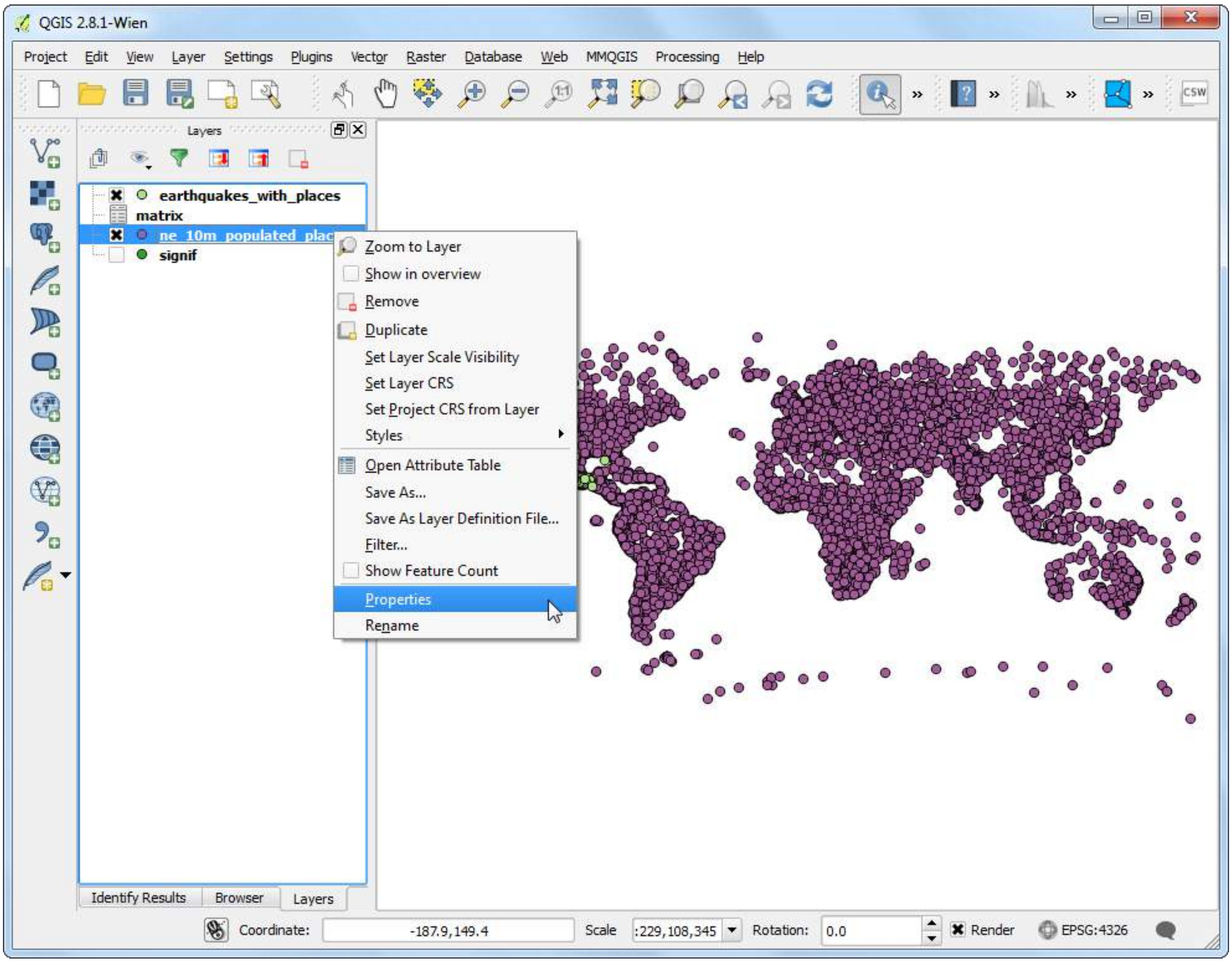


22. For this tutorial, we will visualize the earthquakes and their nearest populated places for Mexico. Enter the following expression in the Query Builder dialog.

"COUNTRY" = 'MEXICO'

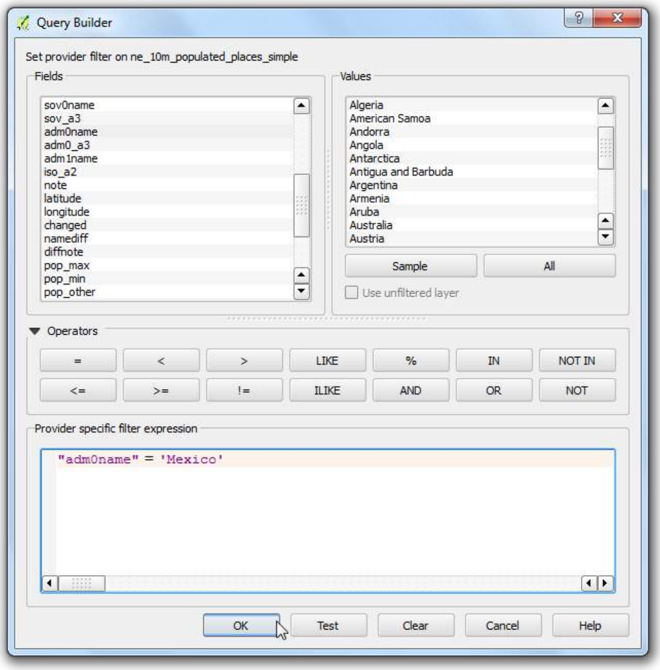


23. You will see that only the points falling within Mexico will be visible in the canvas. Let's do the same for the populated places layer. Right-click on the ne_10m_populated_places_simple layer and select Properties.

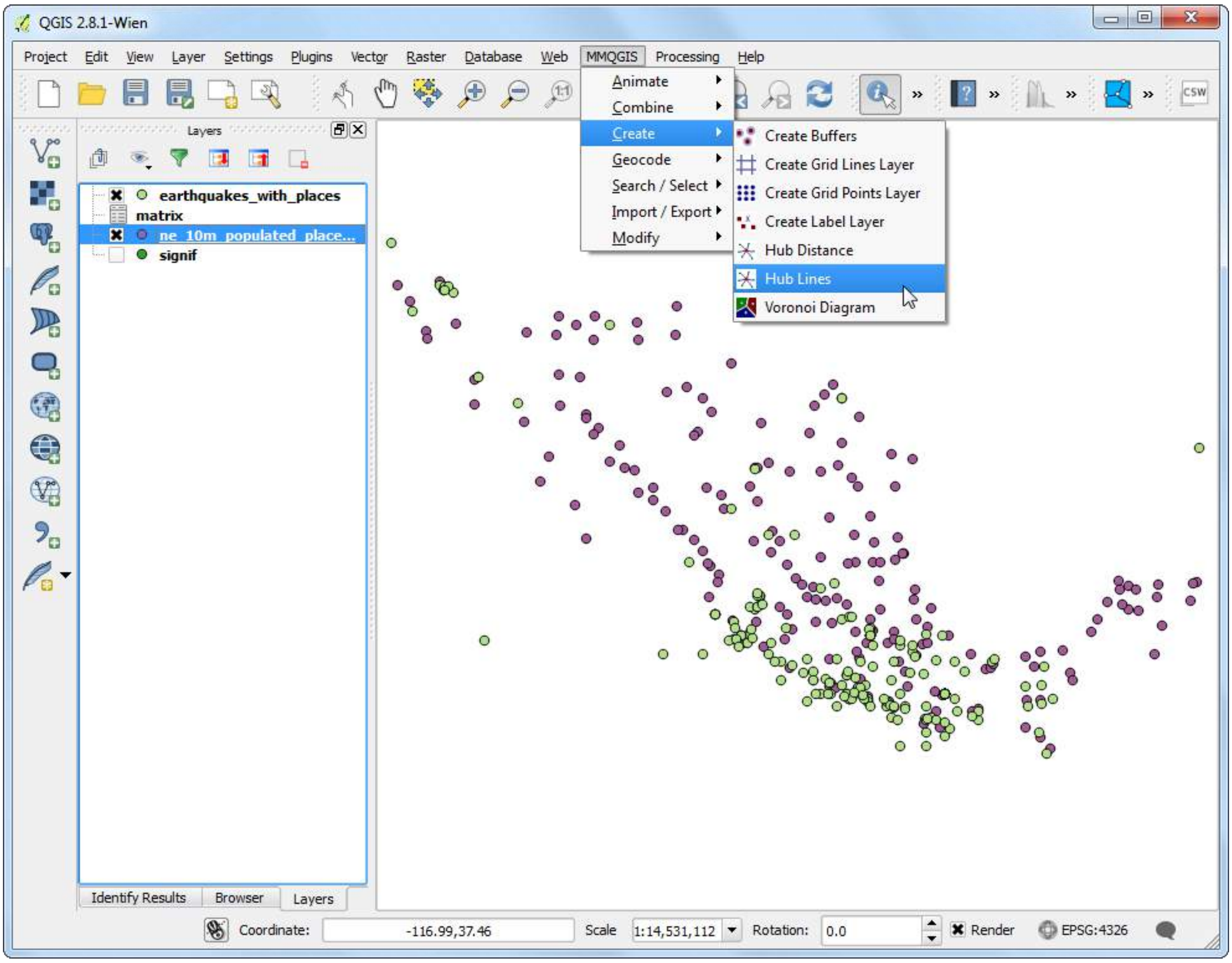


24. Open the Query Builder dialog from the General tab. Enter the following expression.

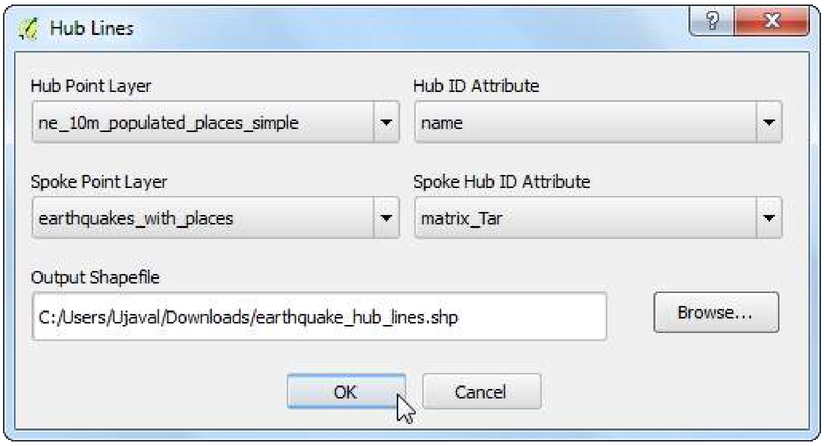
"adm0name" = 'Mexico'



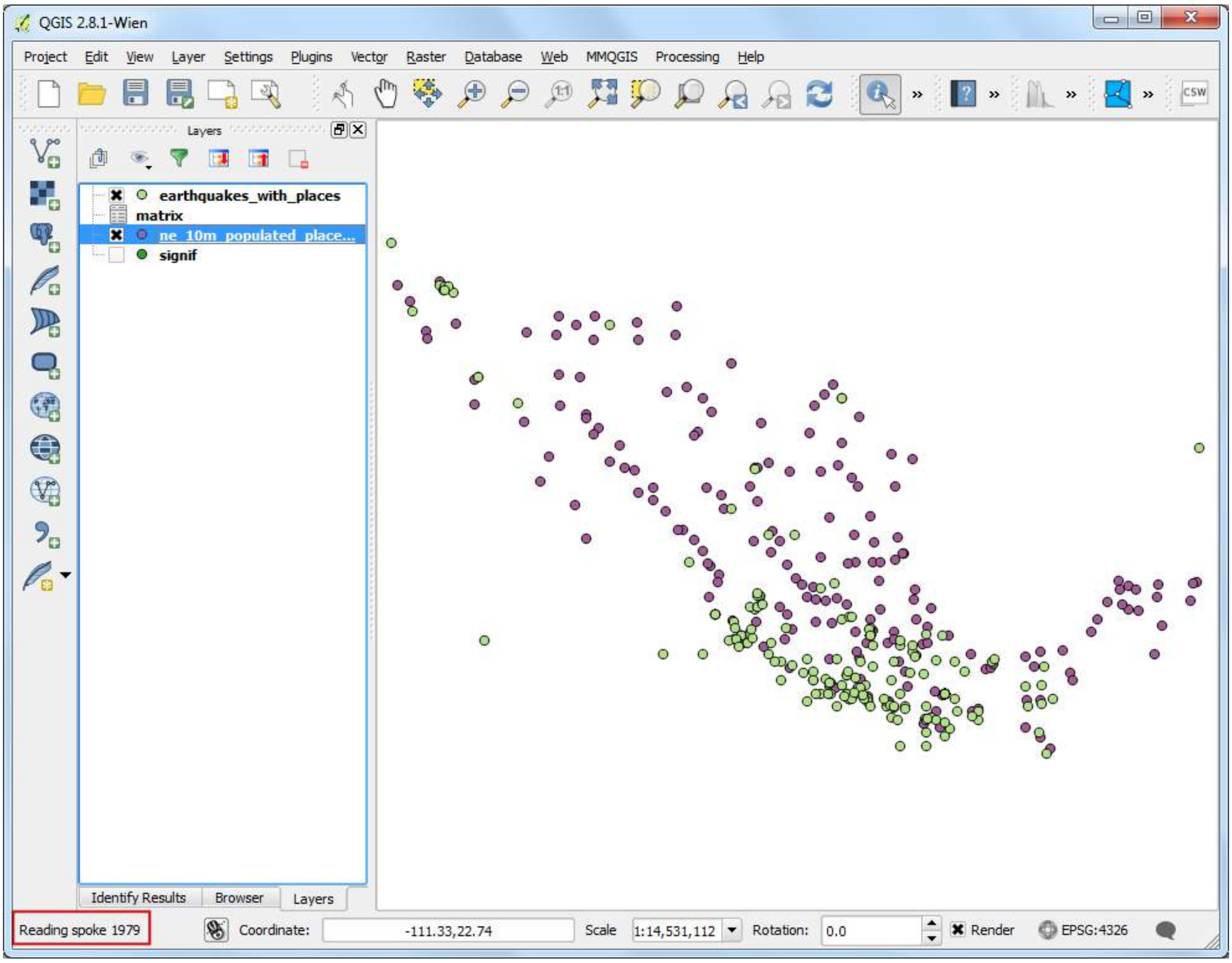
25. Now we are ready to create our visualization. We will use a plugin named MMQGIS. Find and install the plugin. See Using Pluginsfor more details on how to work with plugins. Once you have the plugin installed, go to MMQGIS □Create □Hub Lines.



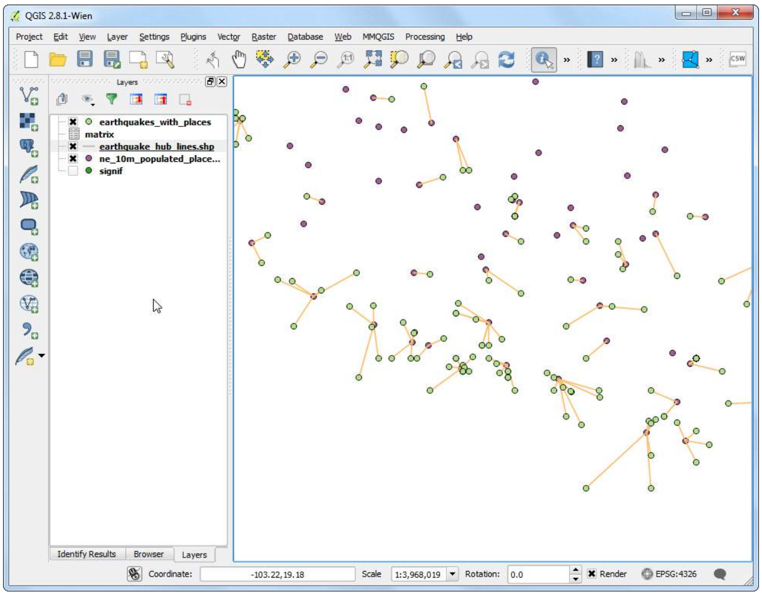
26. Select ne_10m_populated_places_simple as the Hub Point Layer and name as the Hub ID Attribute. Similarly, selectearthquake_with_places as the Spoke Point Layer and matrix_Tar as the Spoke Hub ID Attribute. The hub lines algorithm will go through each of earthquake points and create a line that will join it to the populated place which matches the attribute we specified. Click Browse and name the Output Shapefile as earthquake_hub_lines.shp. Click OK to start the processing.



27. The processing may take a few minutes. You can see the progress on the bottom-left corner of the QGIS window.



28. Once the processing is done, you will see the earthquake_hub_lines layer loaded in QGIS. You can see that each earthquake point now has a line that connects it to the nearest populated place.



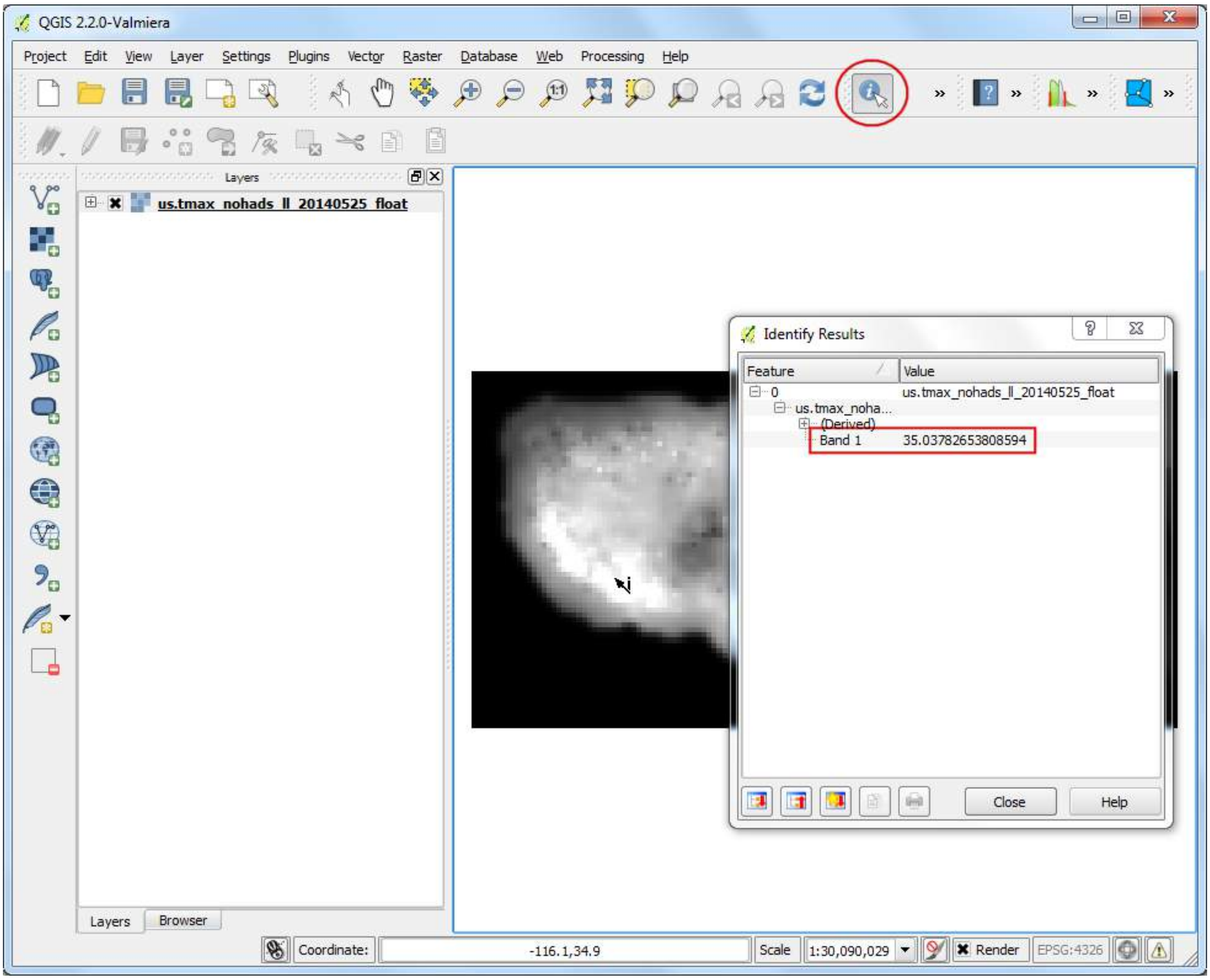
B) Sampling Raster Data using Points or Polygons

Many scientific and environmental datasets come as gridded rasters. Elevation data (DEM) is also distributed as raster files. In these raster files, the parameter that is being represented is encoded as the pixel values of the raster. Often, one needs to extract the pixel values at certain locations or aggregate them over some area. This functionality is available in QGIS via two plugins - Point SamplingTool and Zonal Statistics plugin.

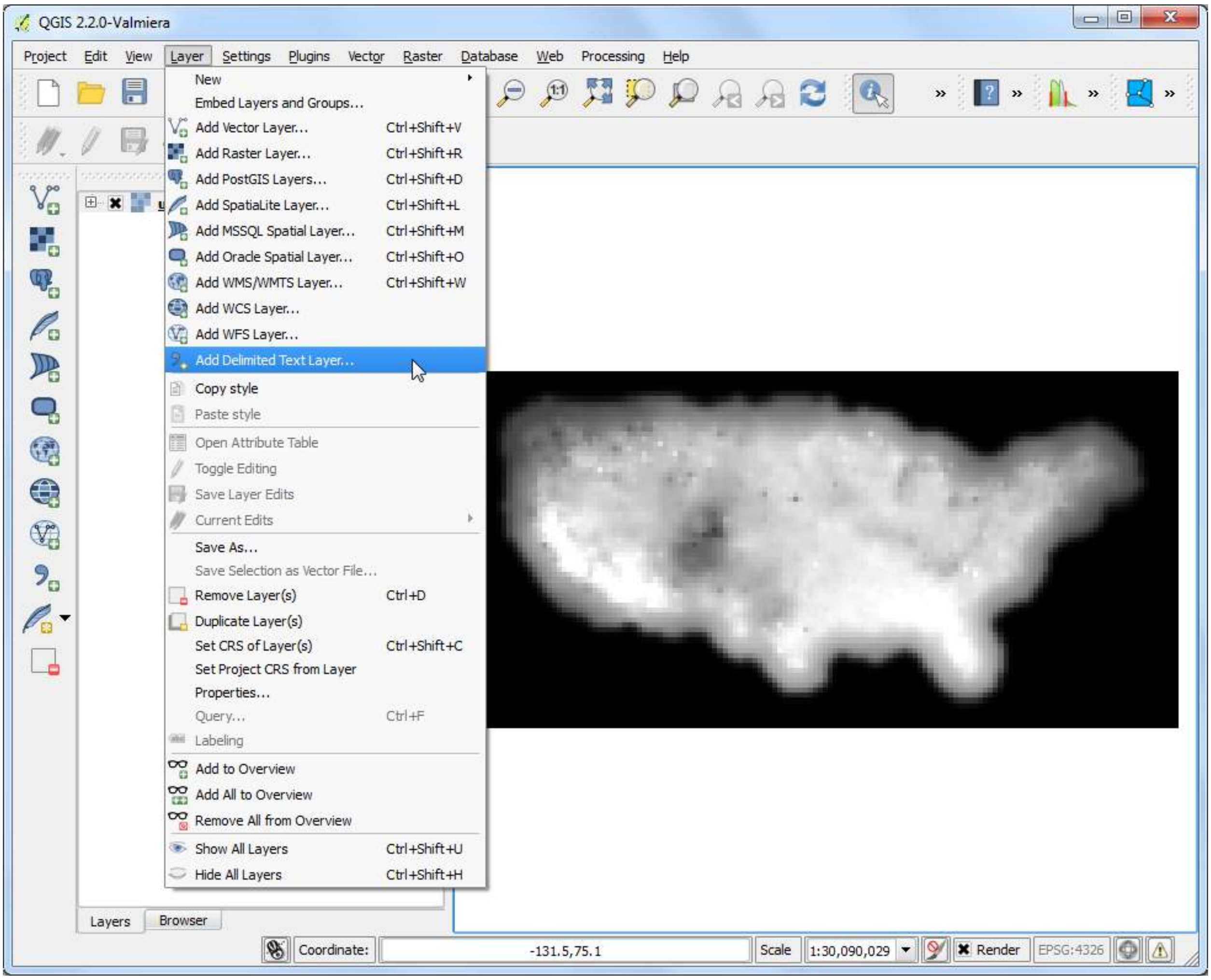
Procedure

1. Go to Layer □Add Raster Layer and browse to the downloaded us.tmax_nohads_ll_{YYYYMMDD}_float.tif file and click Open.

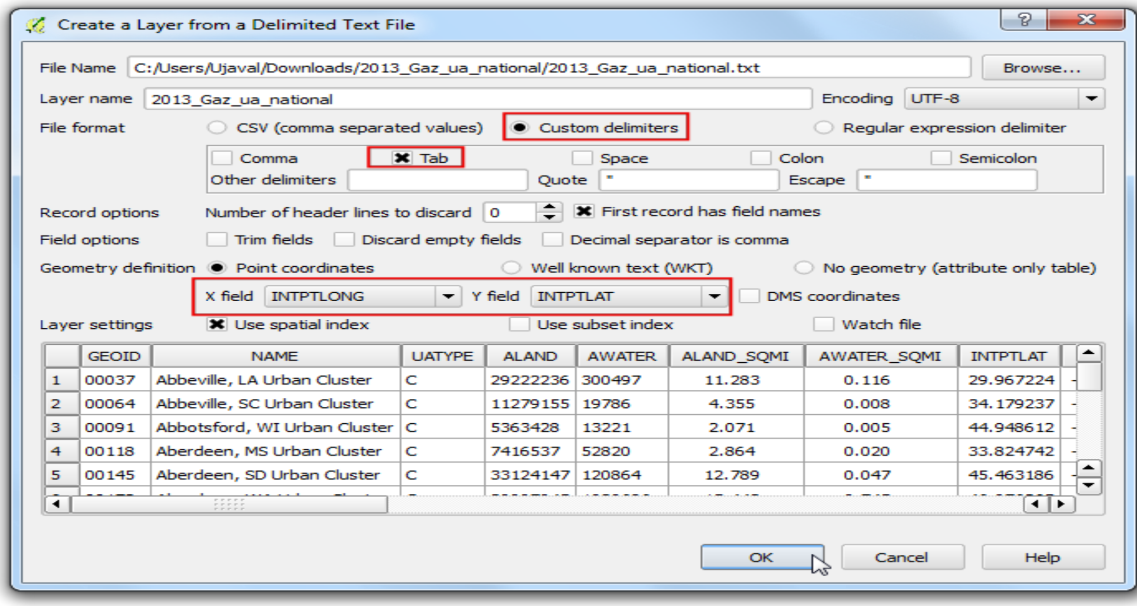
2. Once the layer is loaded, select the Identify tool and click anywhere on the layer. You will see the temperature value in celsius as the value or Band 1 at that location.



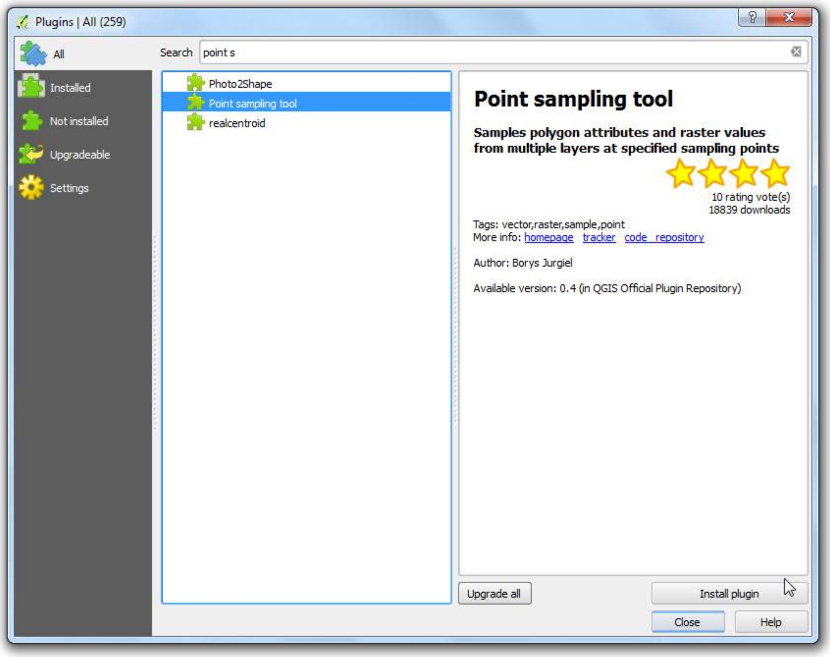
3. Now unzip the downloaded 2013_Gaz_ua_national.zip file and extract the 2013_Gaz_ua_national.txt file on your disk. Go to Layer □Add Delimited Text Layer.



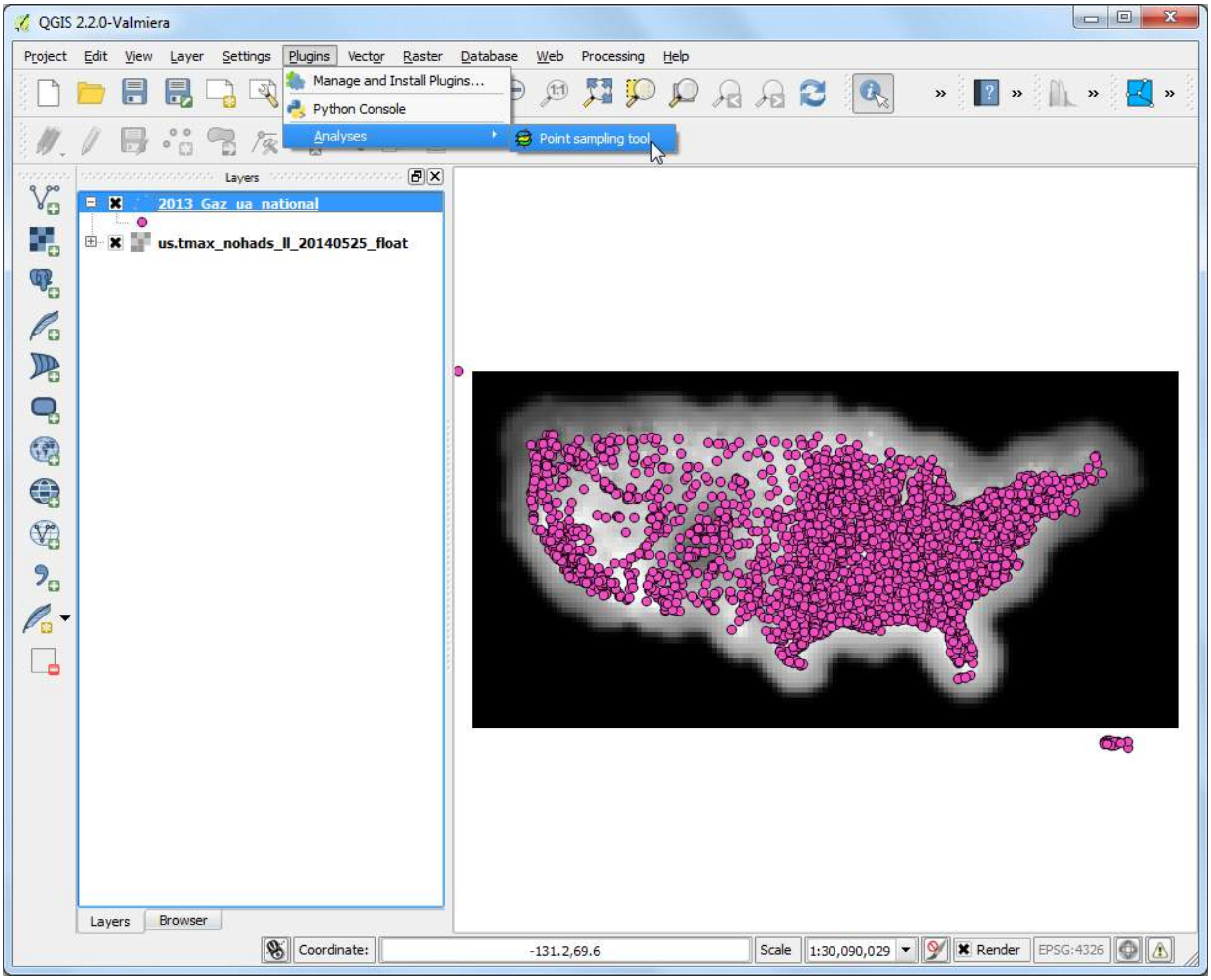
4. In the Create a Layer from Delimited Text File dialog, click Browse and open 2013_Gaz_ua_national.txt. Choose Tab under Custom delimiters. The point coordinates are in Latitude and Longitude, so select INTPTLONG as X field and INTPTLAT as Y field. Check the Use spatial index box and click OK.



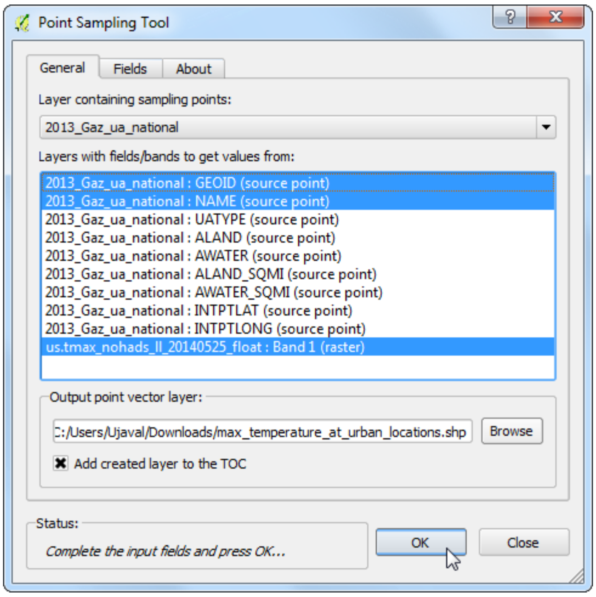
5. Now we are ready to extract the temperature values from the raster layer. Install the Point Sampling Tool plugin. See *Using Plugins* for details on how to install plugins.



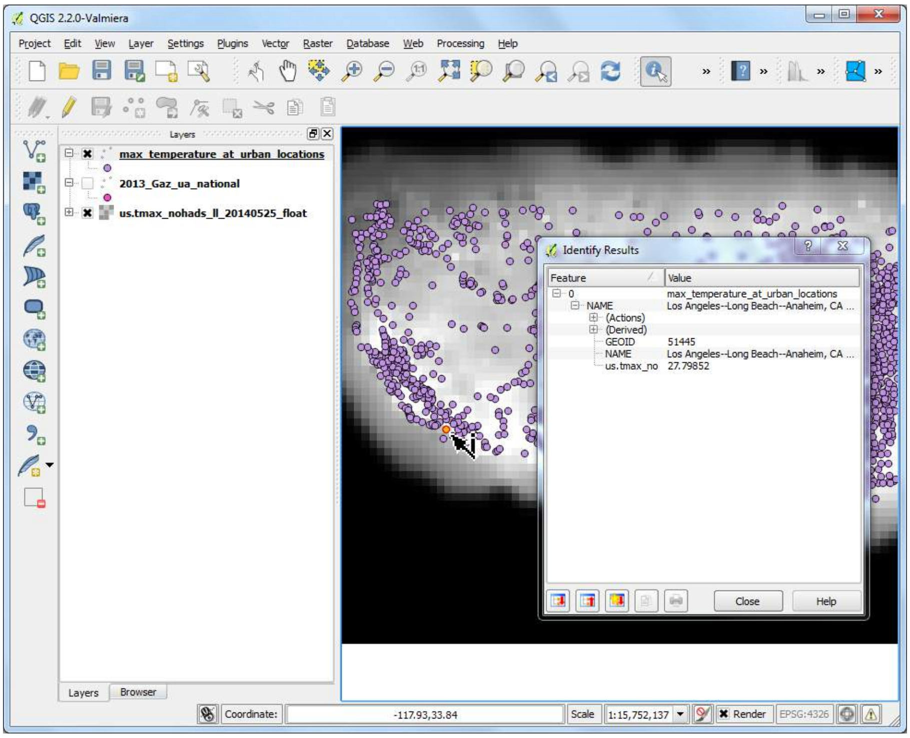
6. Open the plugin dialog from Plugins □Analyses □Point sampling tool.



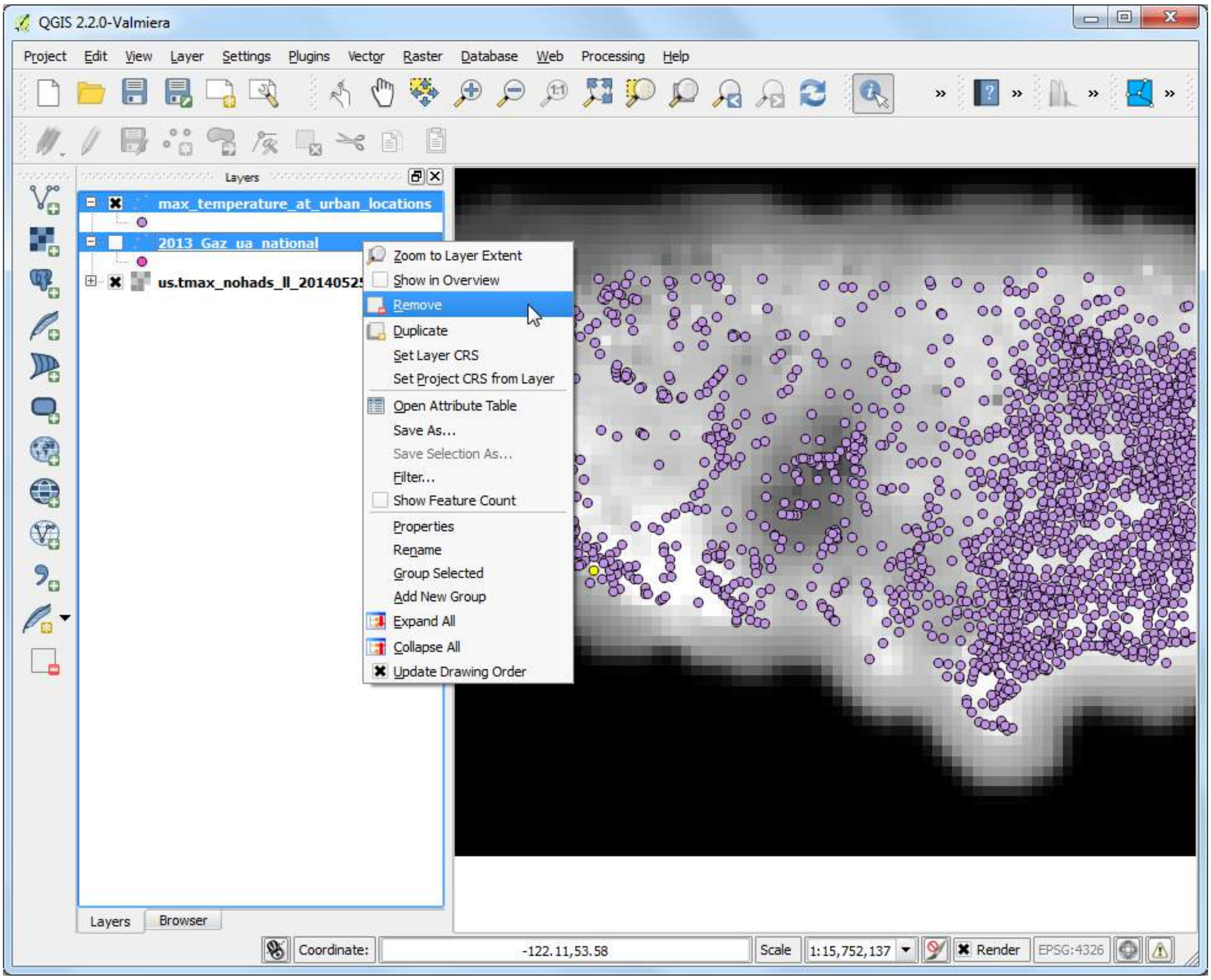
7. In the Point Sampling Tool dialog, select 2013_Gaz_ua_national as the Layer containing sampling points. We must explicitely pick the fields from the input layer that we want in the output layer. Choose GEOID and NAME fields from the2013_Gaz_ua_national layer. We can sample values from multiple raster band at once, but since our raster has only 1 band, choose the us.tmax_nohads_ll_{YYYYMMDD}_float: Band 1. Name the output vector layer as max_temparature_at_urban_locations.shp. Click the OK to start the sampling process. Click Close once the process finishes.



8. You will see a new layer max_temparature_at_urban_locations loaded in QGIS. Use the Identify tool to click on any point to see the attributes. You will see the us.tmax_no field - which contains the raster pixel value at the location of the point.



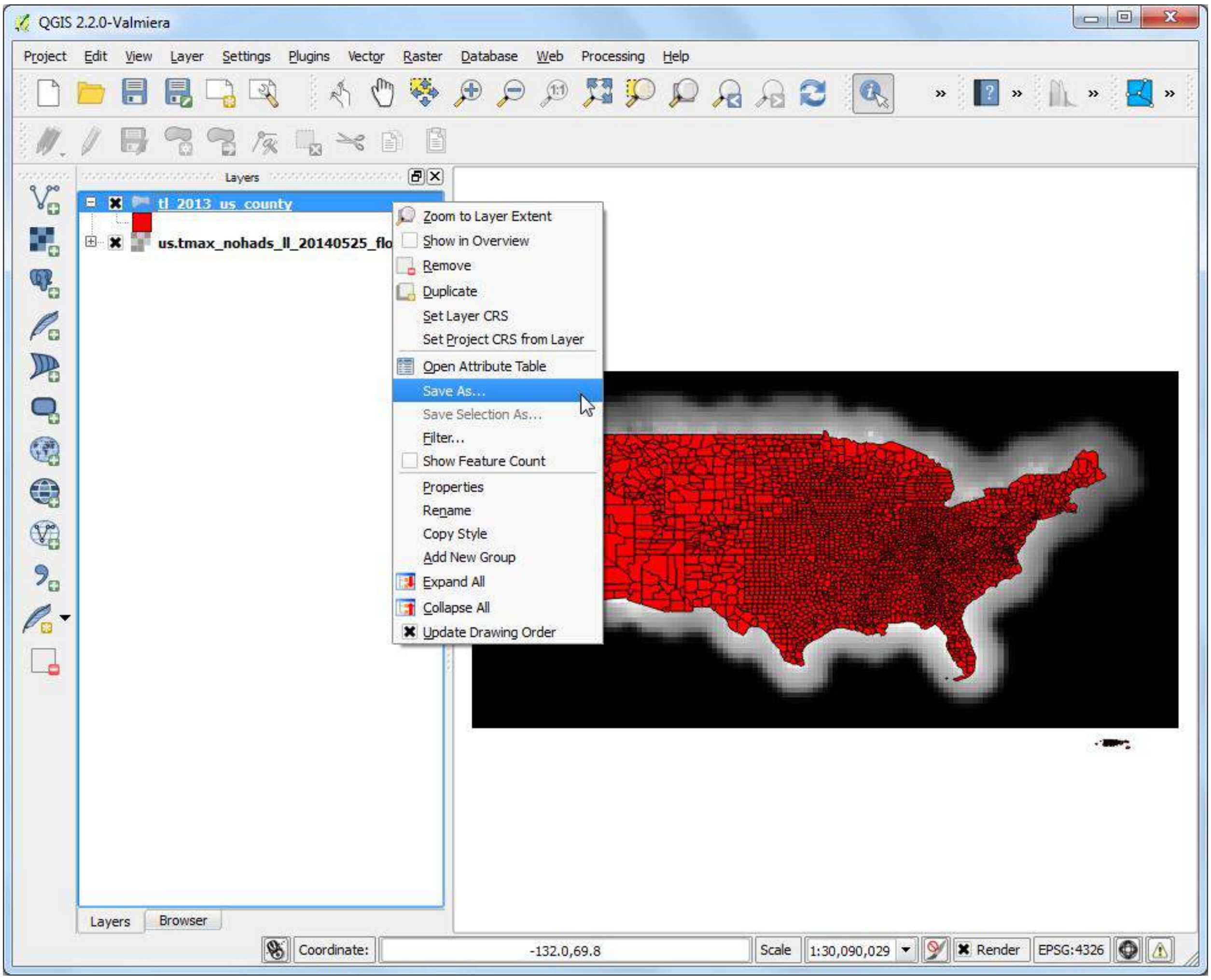
9. First part of our analysis is over. Let's remove the unnecessary layers. Hold the Shift key and select max_temparature_at_urban_locations and 2013_Gaz_ua_national layers. Right-click and select Remove to remove them from QGIS TOC.



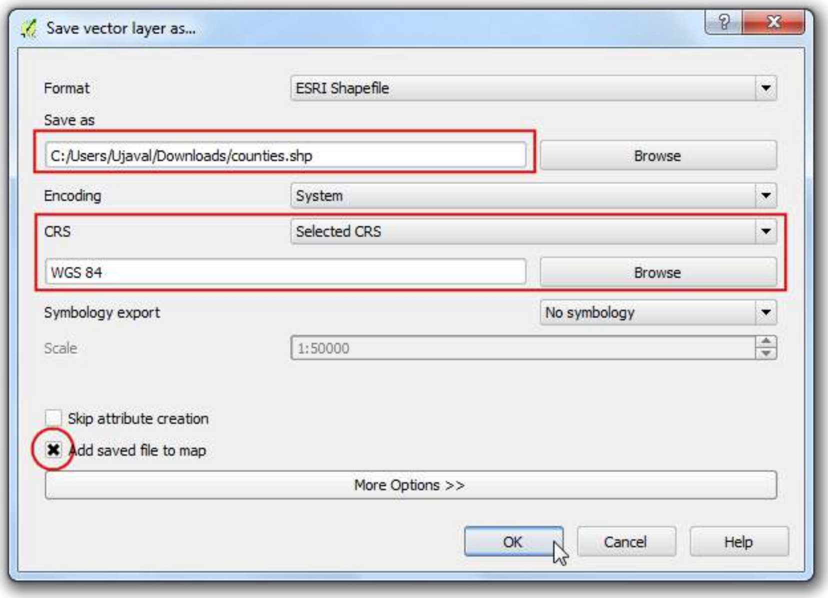
10. Go to Layer Add Vector Layer. Browse to the downloaded tl_2013_us_county.zip file and click Open. Select thetl_2013_us_county.shp as the layer and click OK.

11. The tl_2013_us_county will be added to QGIS. This layer is in EPSG:4269 NAD83 projection. This doesn't match the projection of the raster layer. We will re-project this layer to EPSG:4326 WGS84 projection.

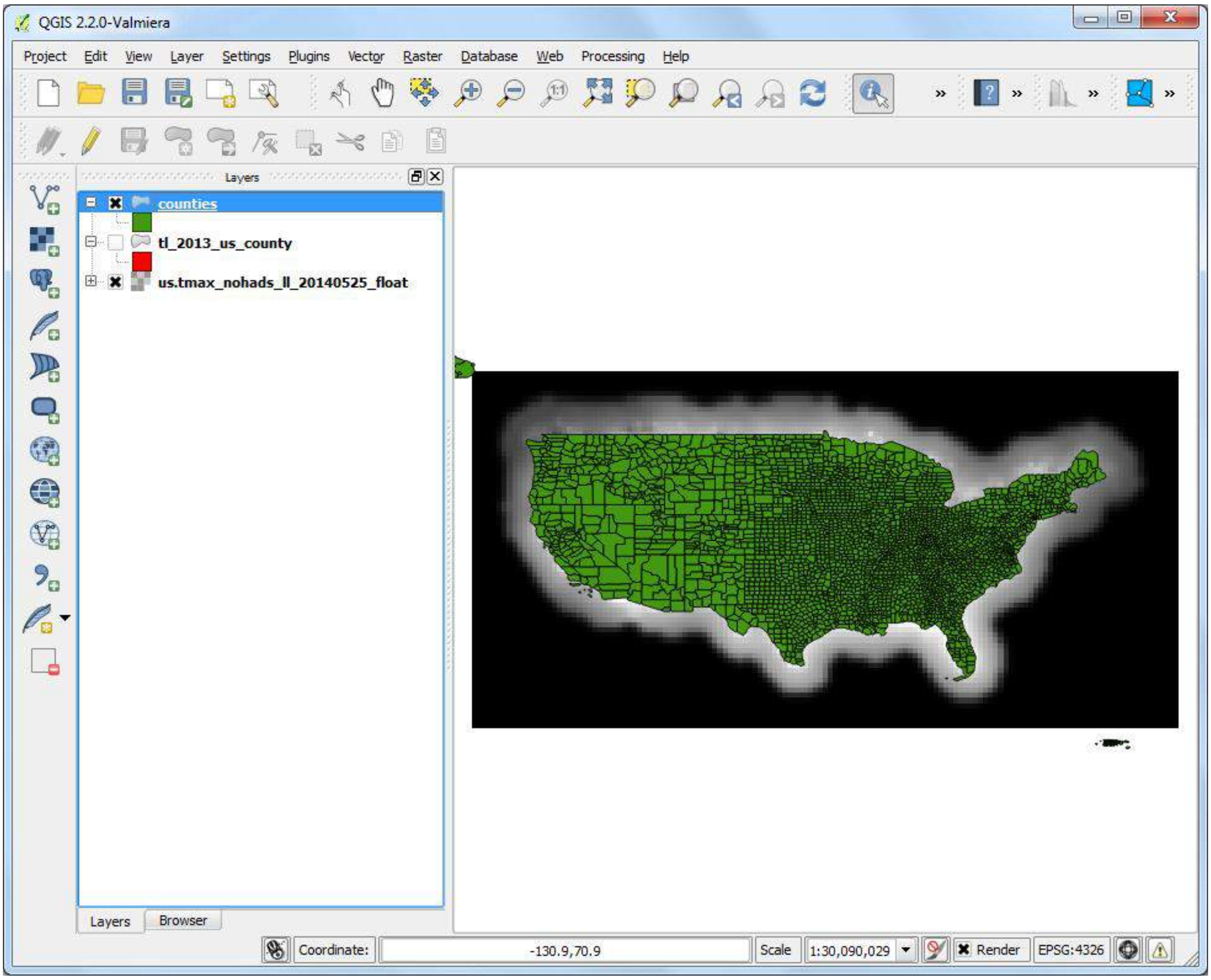
12. Right-click the tl_2013_us_county layer and select Save As...



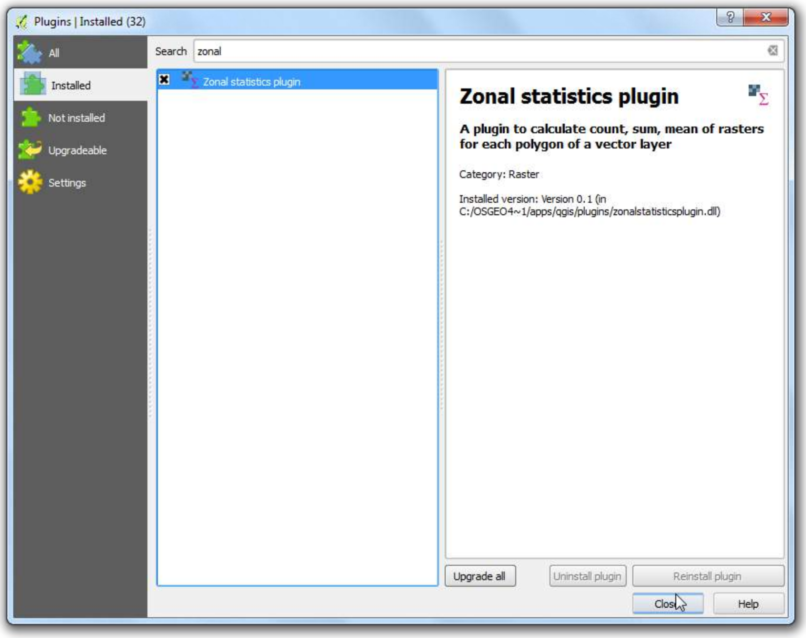
13. In the Save Vector layer as.. dialog, click Browse and name the output file as counties.shp. Choose Selected CRS from the CRS dropdown menu. Click Browse and select WGS 84 as the CRS. Check the Add saved file to map and click OK.



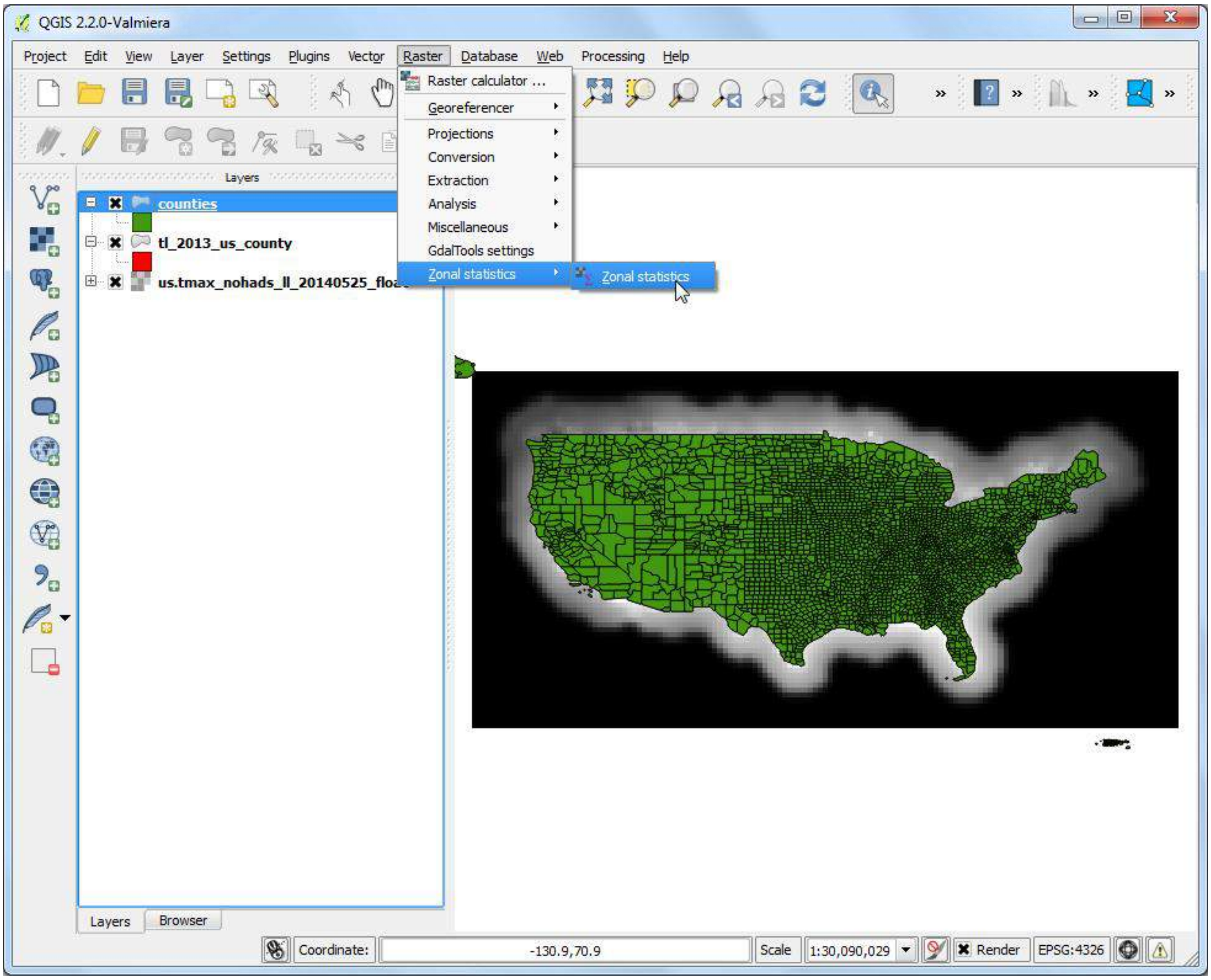
14. A new layer named counties will be add to QGIS.



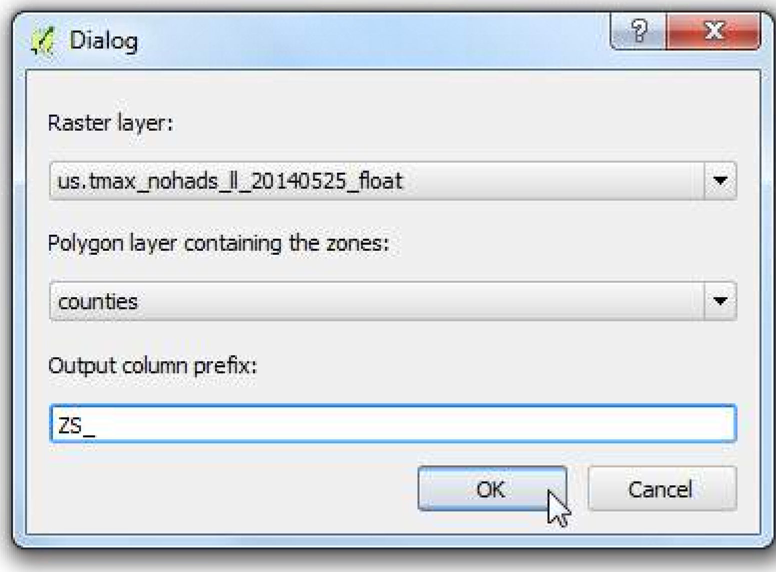
15. Enable the Zonal Statistics Plugins. This is a core plugin so it is already installed. See *Using Plugins* to know to how enable core plugins.



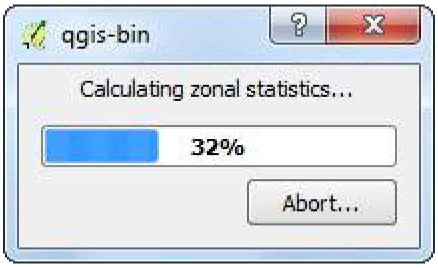
16. Go to Raster □Zonal statistics □Zonal statistics.



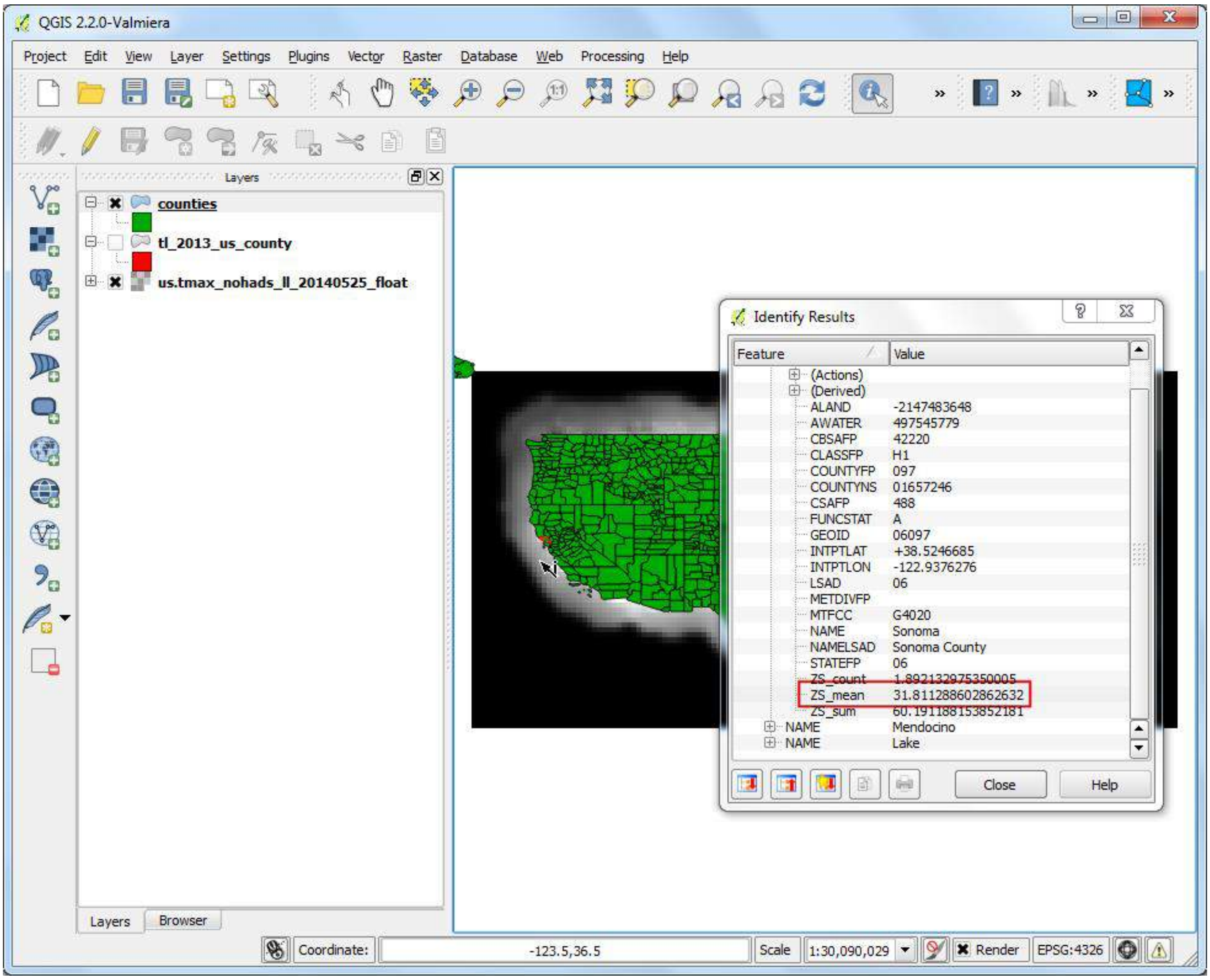
17. Select us.tmax_nohads_ll_{YYYYMMDD}_float as the Raster layer and counties as the Polygon layer containing the zones. Enter ZS_ as the Output column prefix. Click OK.



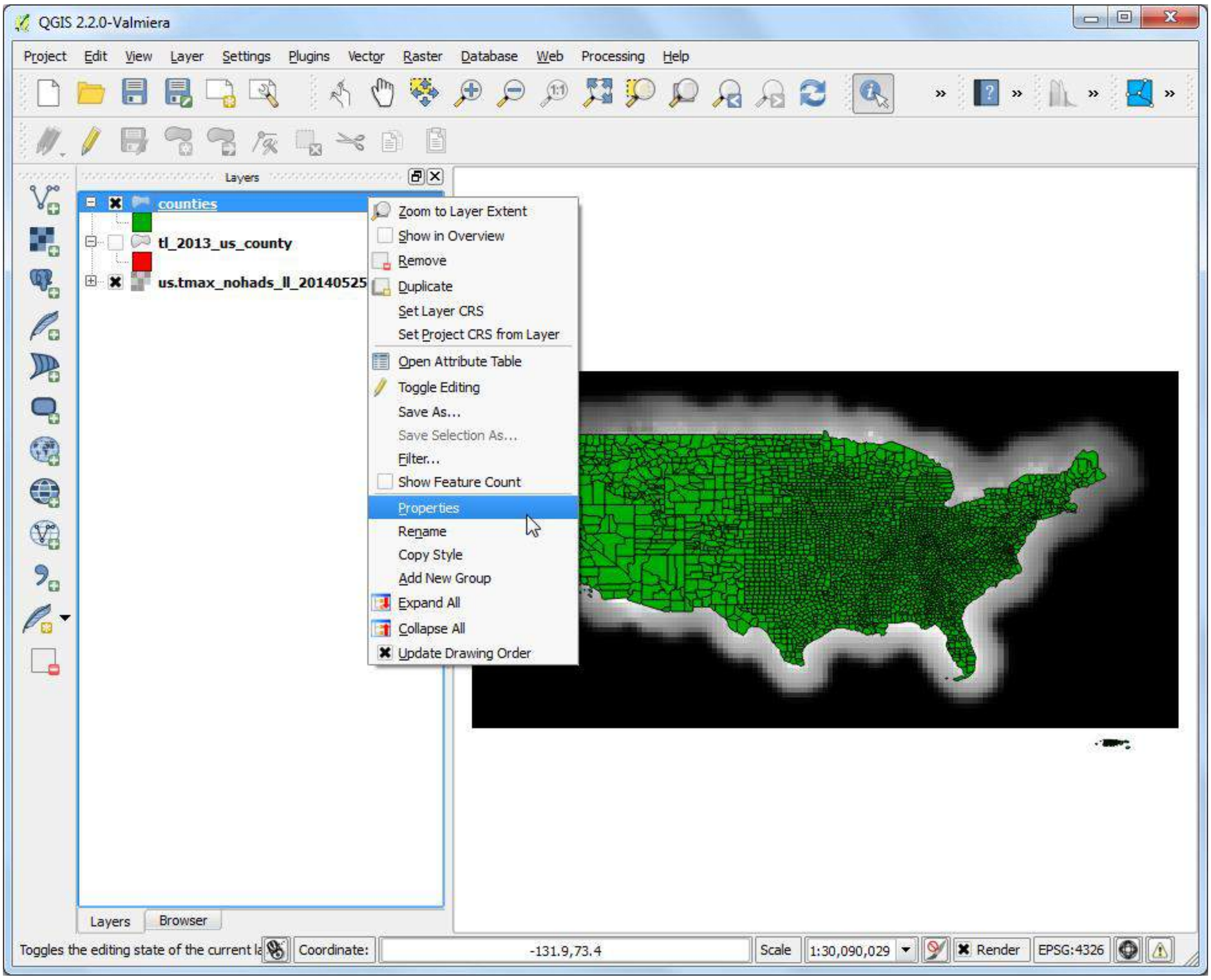
18. The analysis may take some time depending on the size of the dataset.



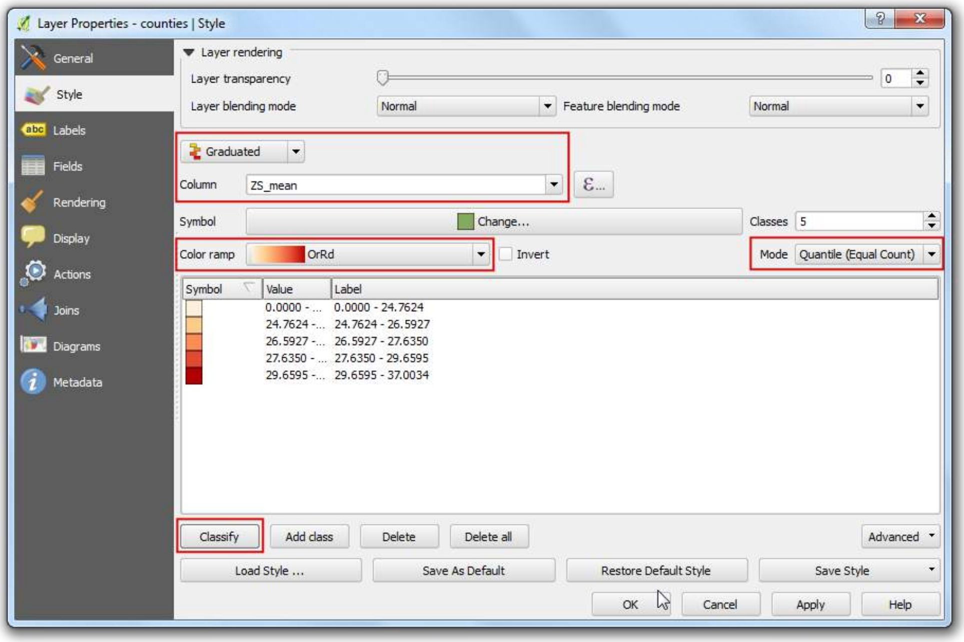
19. Once the processing finishes, select the counties layer. Use the Identify tool and click on any county polygon. You will see three new attributes added to the layer: ZS_count, ZS_mean and ZS_sum. These attributes contain the count of raster pixels, mean of raster pixel values and sum of raster pixel values respectively. Since we are interested in average temperature, the ZS_meanfield will be the one to use.



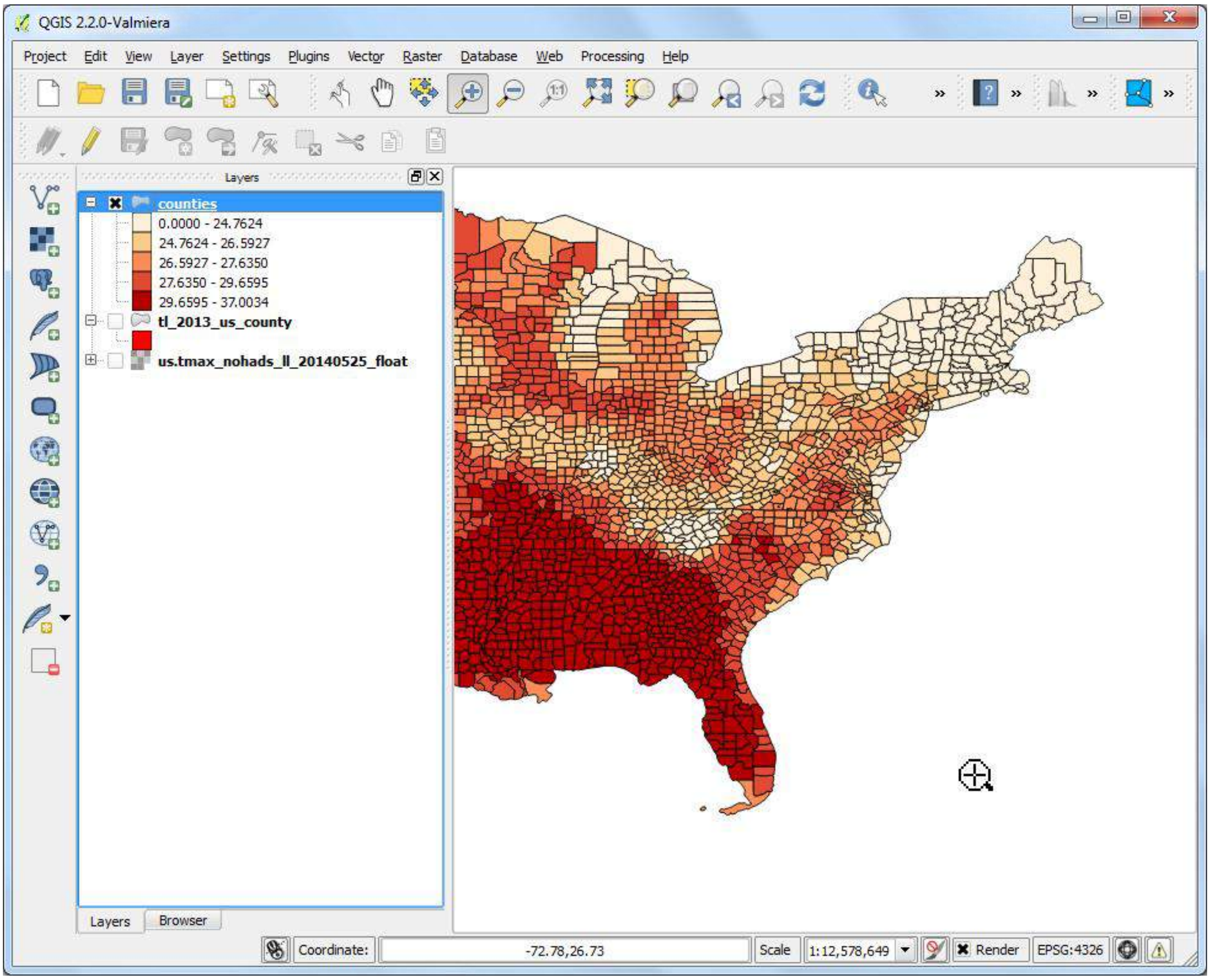
20. Let’s style this layer to create a temperature map. Right-click the counties layer and select Properties.



21. Switch to the Style tab. Choose Graduated style and select ZS_mean as the Column. Choose a Color Ramp and Mode of your chose. Click Classify to create the classes. Click OK. (See *Basic Vector Styling* for more details on styling.)



22. You will see the county polygons styled using average maximum temperature extracted from the raster grid.



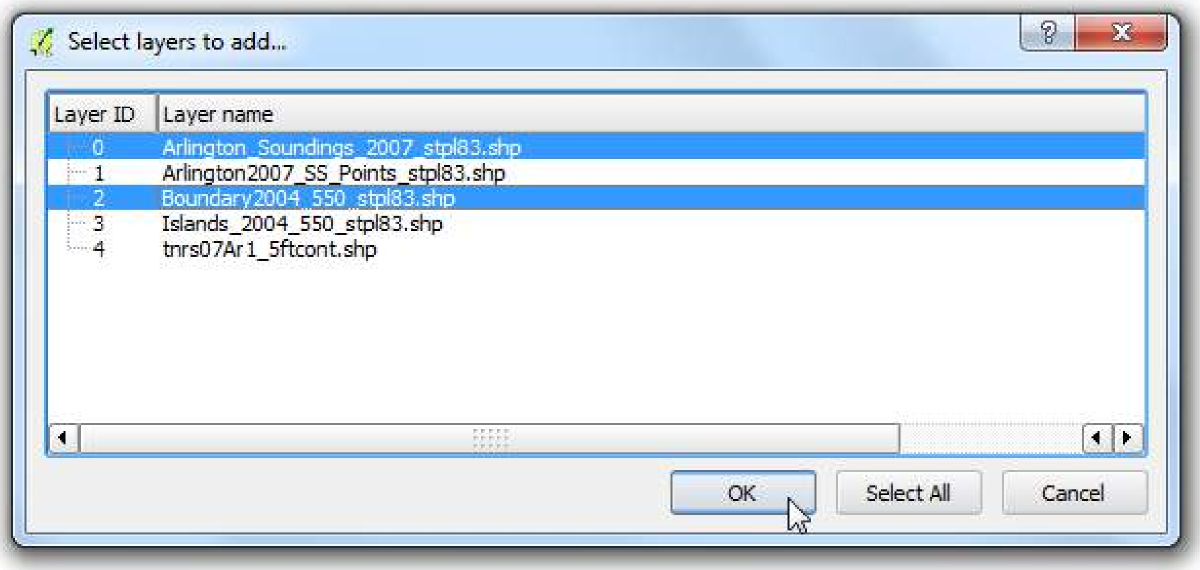
c) Interpolating Point Data

Procedure

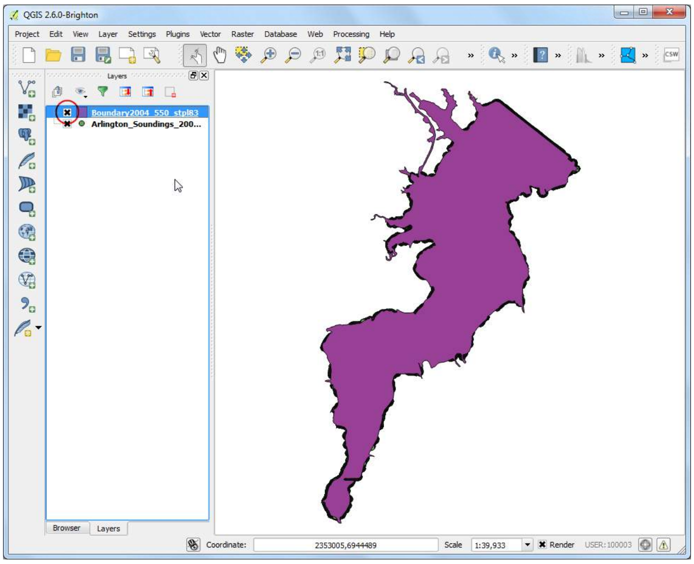
1. Open QGIS. Go to Layer Add Layer Add Vector Layer..

2. Browse to the downloaded `Shapefiles.zip` file and select it. Click Open.

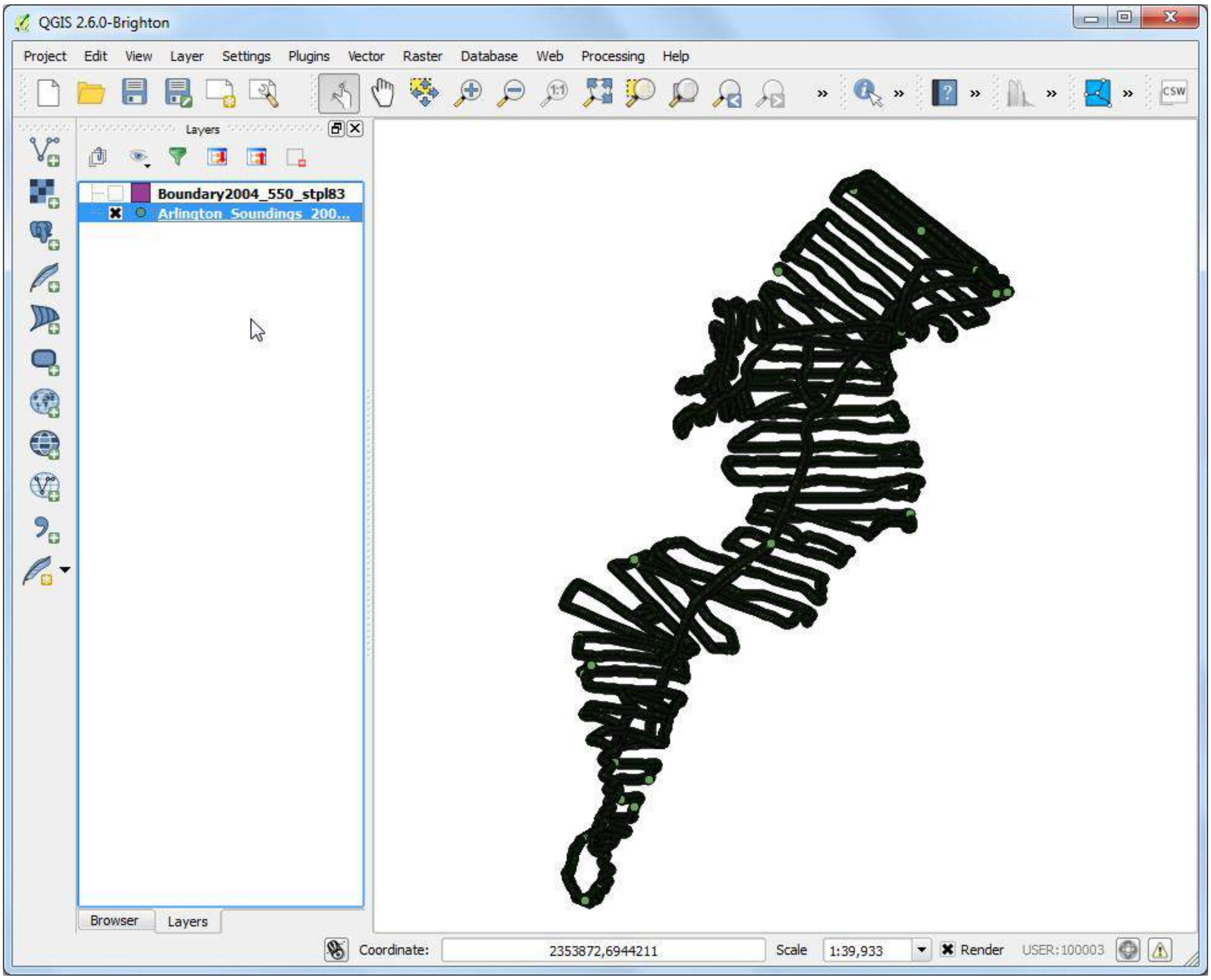
3. In the Select layers to add... dialog, hold the `Shift` key and select `Arlington_Soundings_2007_stpl83.shp` and`Boundary2004_550_stpl83.shp` layers. Click OK.



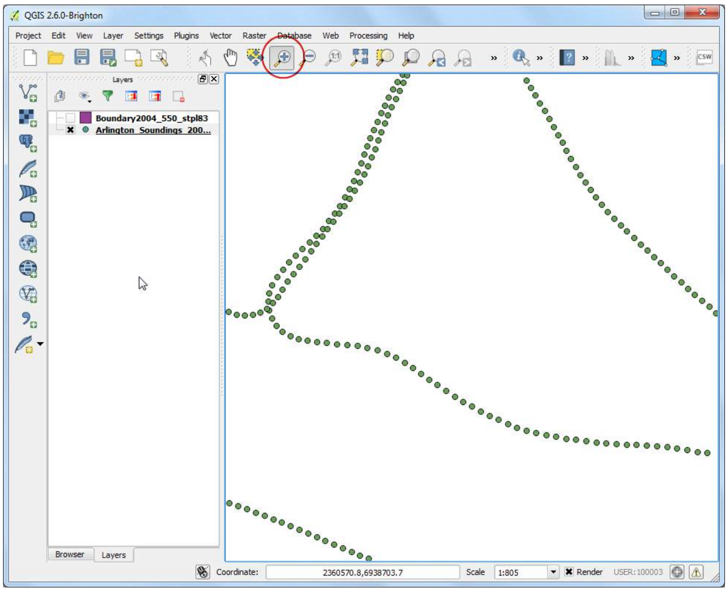
4. You will see the 2 layers loaded in QGIS. The `Boundary2004_550_stpl83` layer represents the boundary of the lake. Un-check the box next to it in the Table of Contents.



5. This will reveal the data from the second layer `Arlington_Soundings_2007_stpl83`. Though the data looks like lines, it is a series of points that are very close.

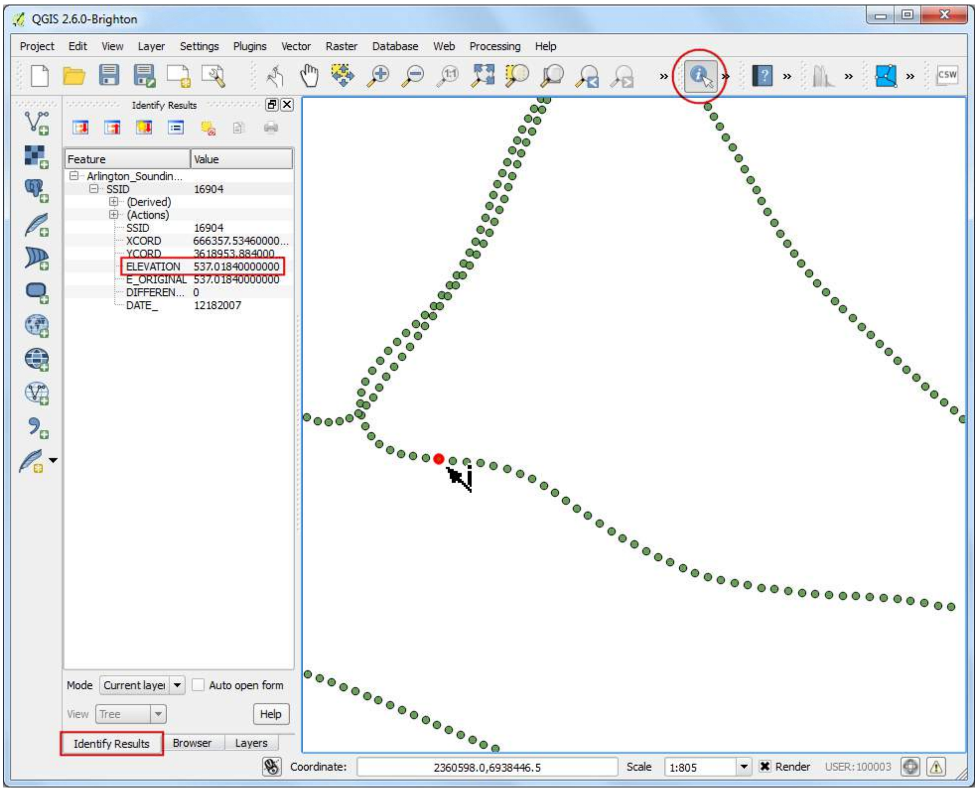


6. Click the Zoom icon and select a small area on the screen. As you zoom closer, you will see the points. Each point represents a reading taken by a *Depth Sounder* at the location recorded by a *DGPS* equipment.

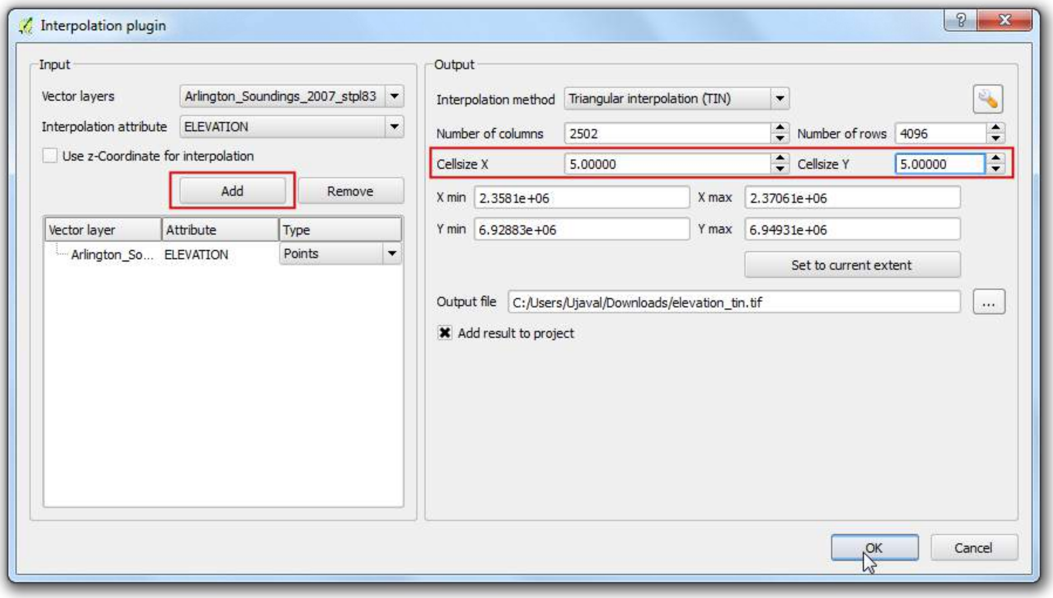


7. Select the Identify tool and click on a point. You will see the Identify Results panel show up on the left with the attribute value of the point. In this case, the `ELEVATION` attribute contains the depth of

the lake at the location. As our task is to create a depth profile and elevation contours, we will use this values as input for the interpolation.

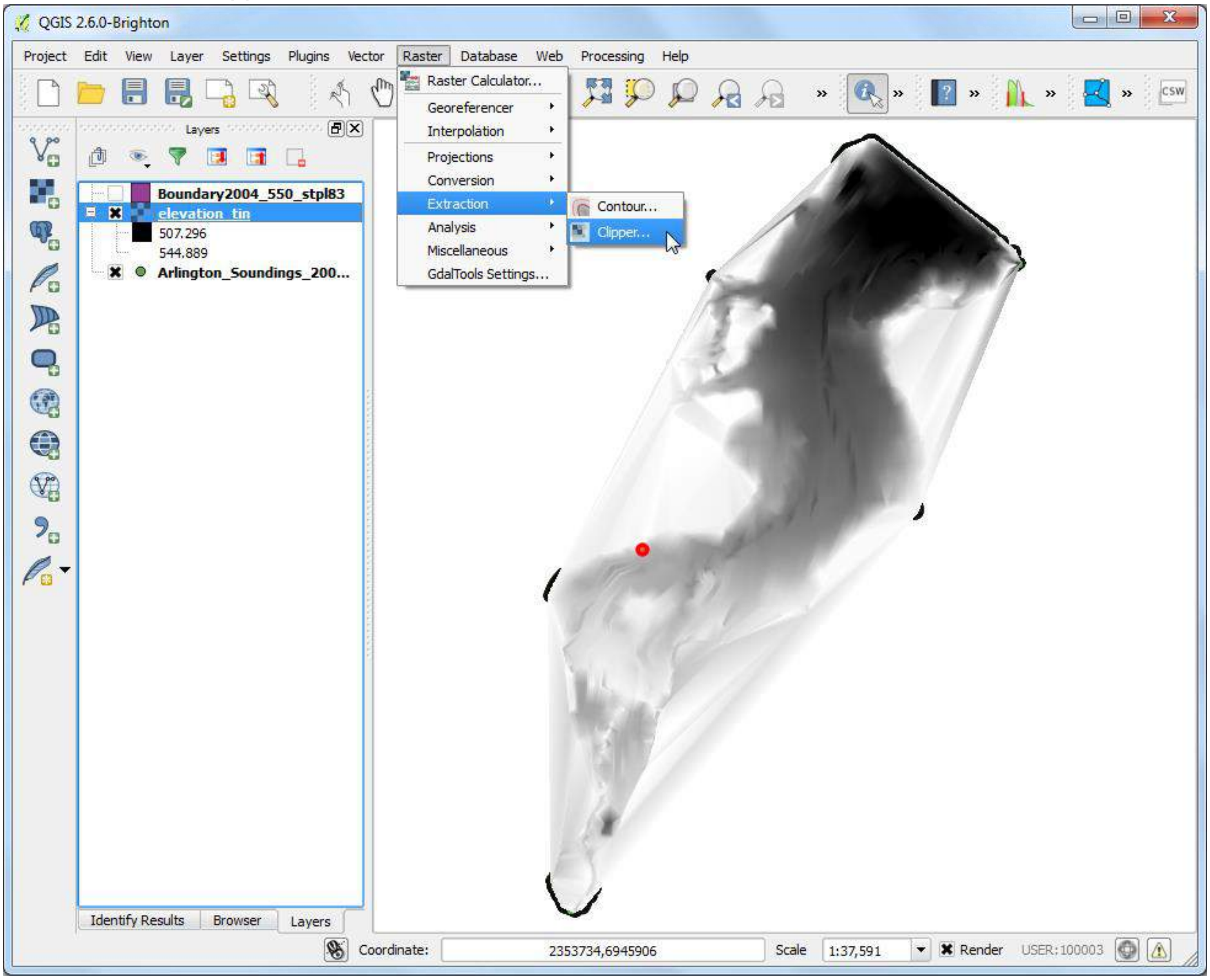


8. Make sure you have the `Interpolation plugin` enabled. See *Using Plugins* for how to enable plugins. Once enabled, go toRaster□Interpolation □Interpolation.
9. In the Interpolation dialog, select `Arlington_Soundings_2007_stpl83` as the Vector layers in the Input panel. Select `ELEVATION` as the Interpolation attribute. Click Add. Change the Cellsize X and Cellsize Y values to `5`. This value is the size of each pixel in the output grid. Since our source data is in a projected CRS with **Feet-US** as units, based on our selection, the grid size will be **5 feet**. Click on the … button next to Output file and name the output file as `elevation_tin.tif`. CLick OK.

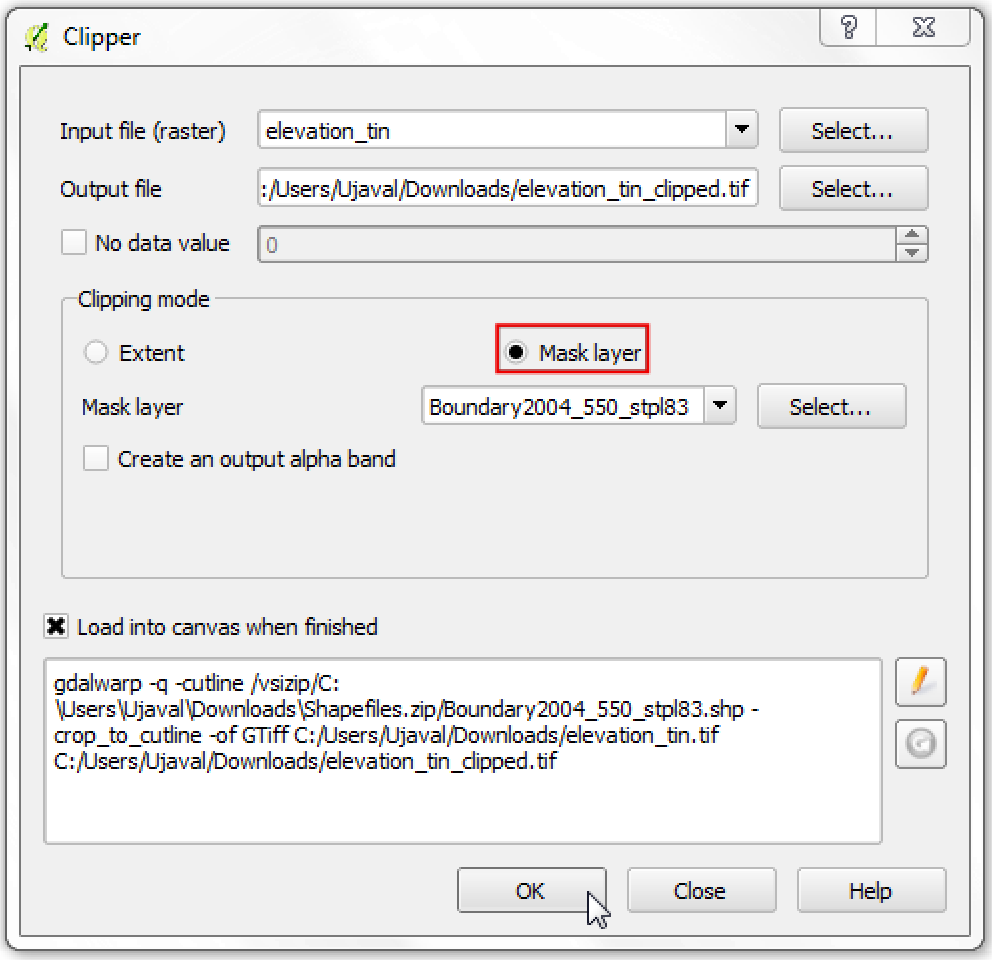


10. You will see the new later `elevation_tin` loaded in QGIS. Right-click the layer and select Zoom to layer.

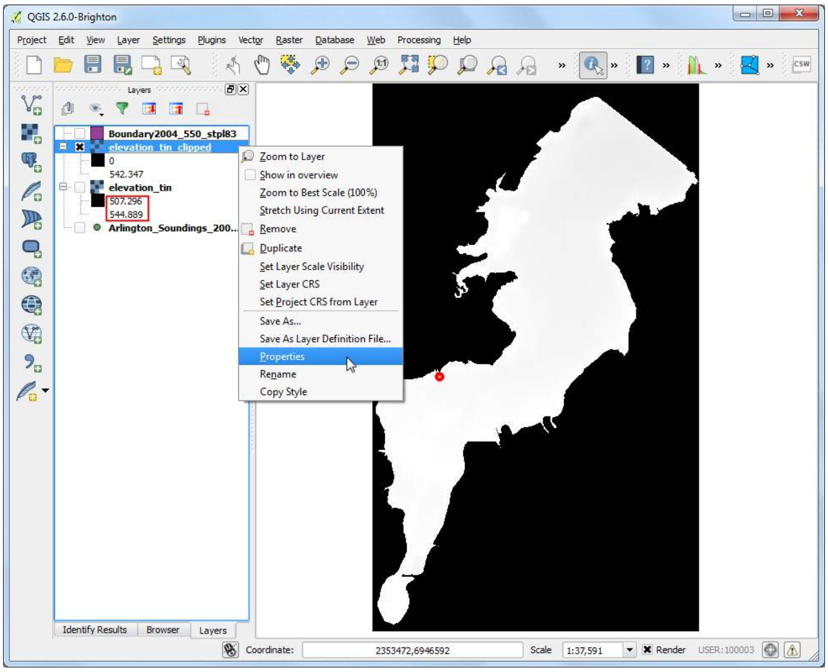
11. Now you will see the full extent of the created surface. Interpolation does not give accurate results outside the collection area. Let's clip the resulting surface with the lake boundary. Go to Raster □ Extraction □Clipper.



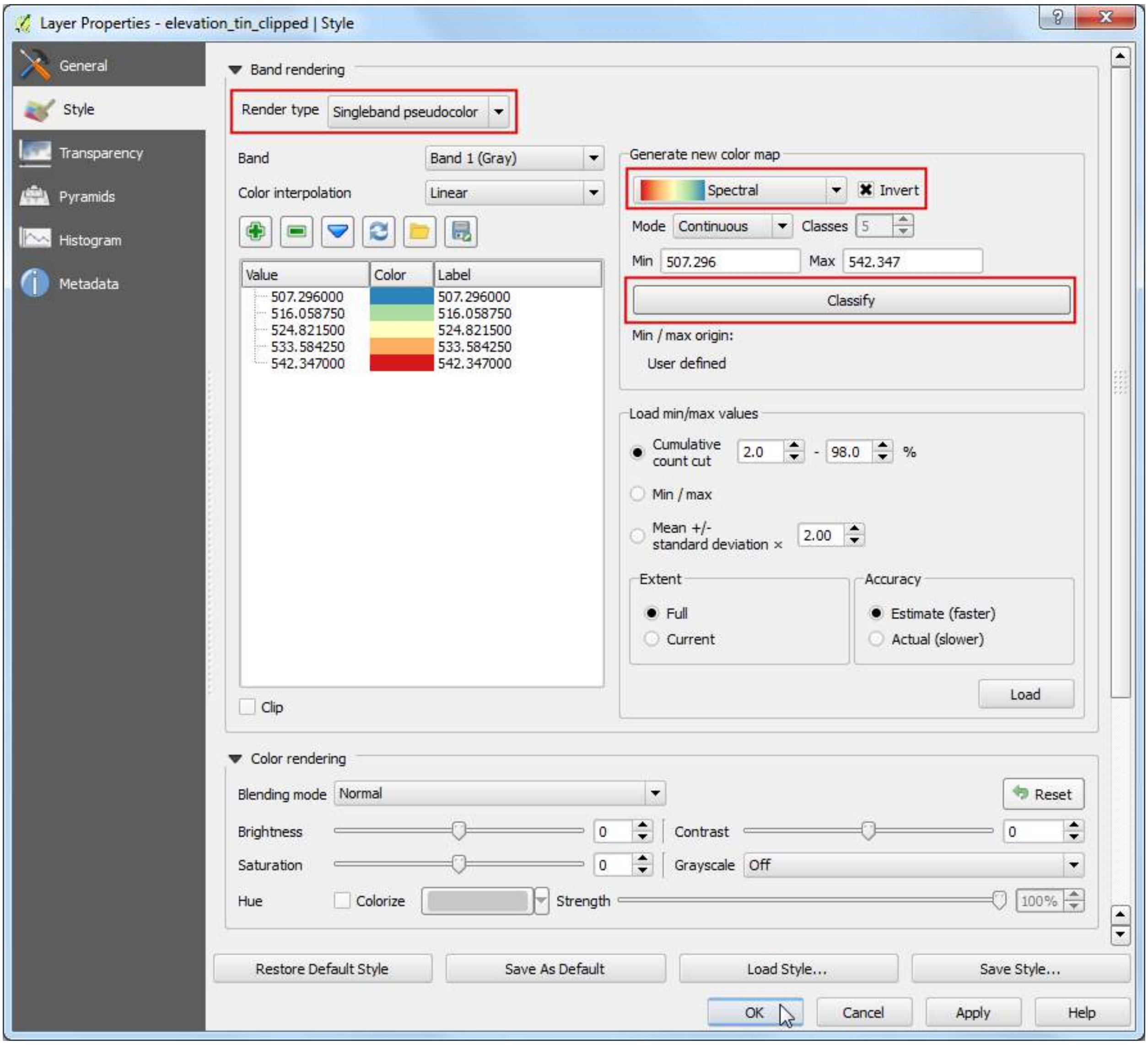
12. Name the Output file as `elevation_tin_clipped.tif`. Select the Cliiped mode as Mask layer. Select `Boundary2004_550_stpl83` as the Mask layer`. Click OK.



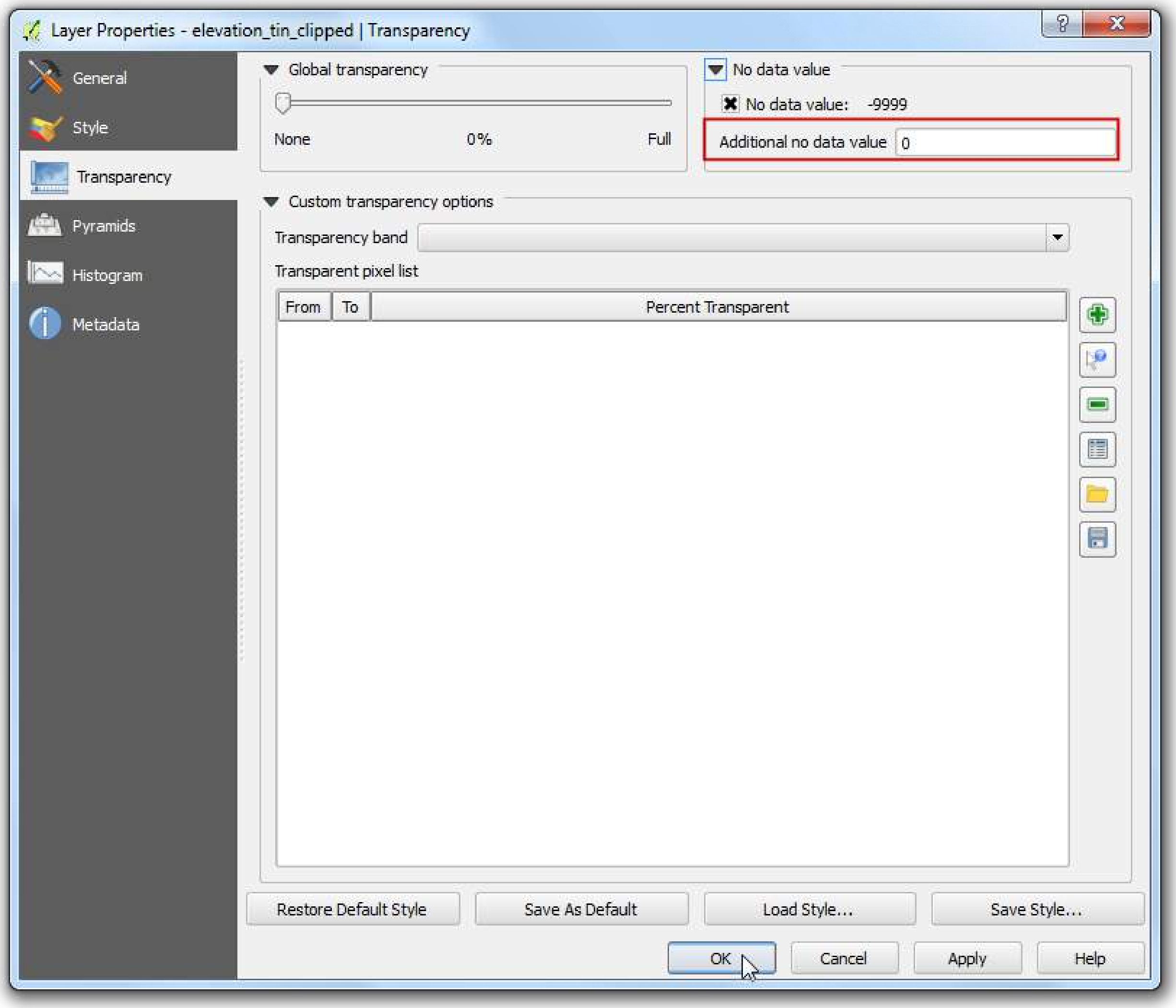
13. A new raster `elevation_tin_clipped` will be loaded in QGIS. We will now style this layer to show the difference in elevations. Note the min and max elevation values from the `elevation_tin` layer. Right-click the `elevation_tin_clipped` layer and select Properties.



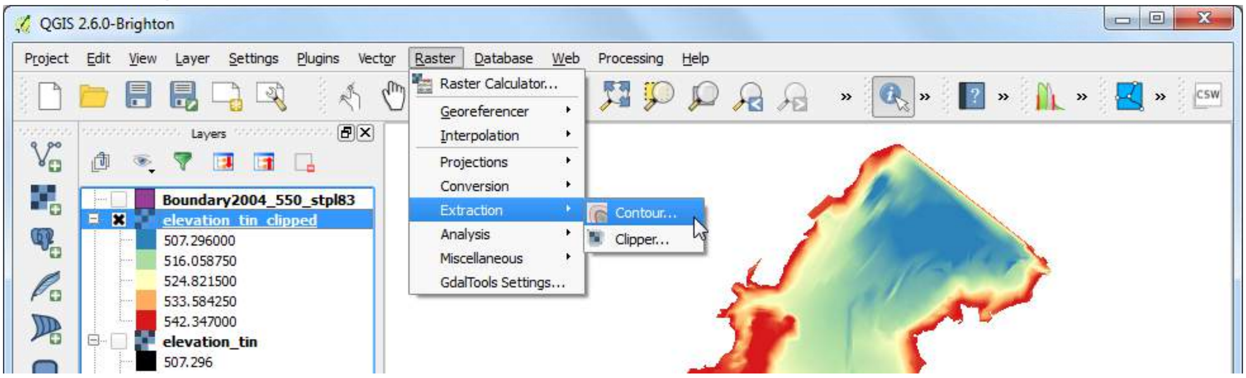
14. Go to the Style tab. Select Render type as `Singleband pseudocolor`. In the Generate new color map panel, select `Spectral`color ramp. As we want to create a depth-map as opposed to a height-map, check the Invert box. This will assign blues to deep areas and reds to shallow areas. Click Classify.



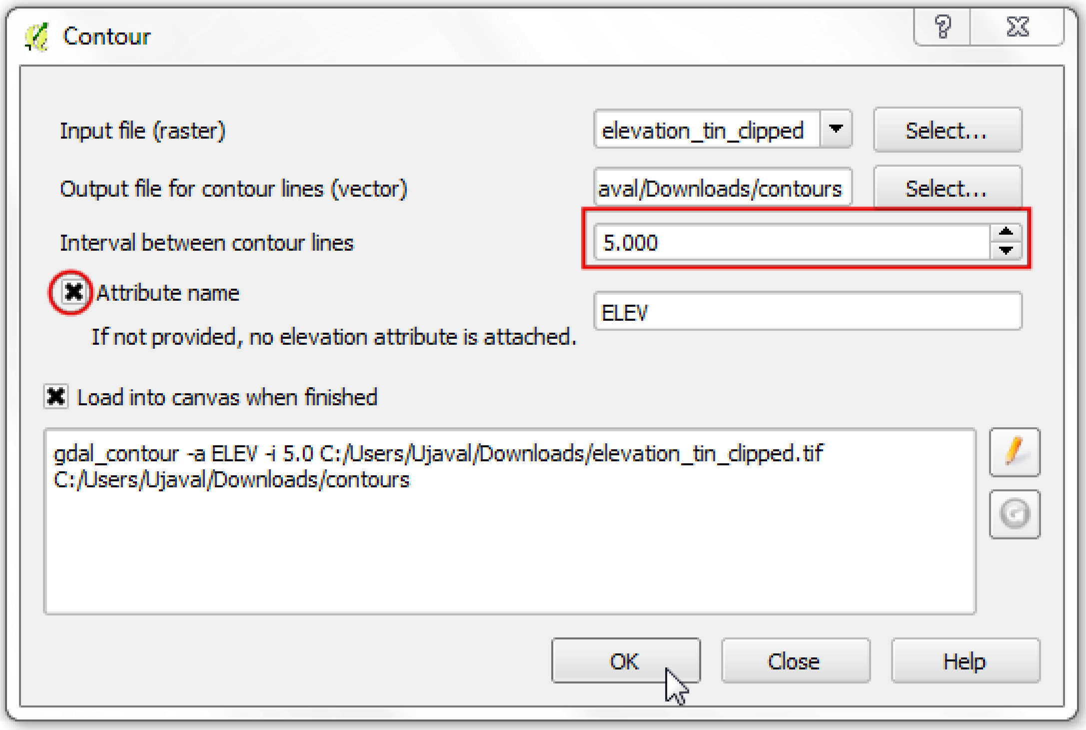
15. Switch to the Tranparency tab. We want to remove the black-pixels from our output. Enter `0` as the Additional no data value. Click OK.



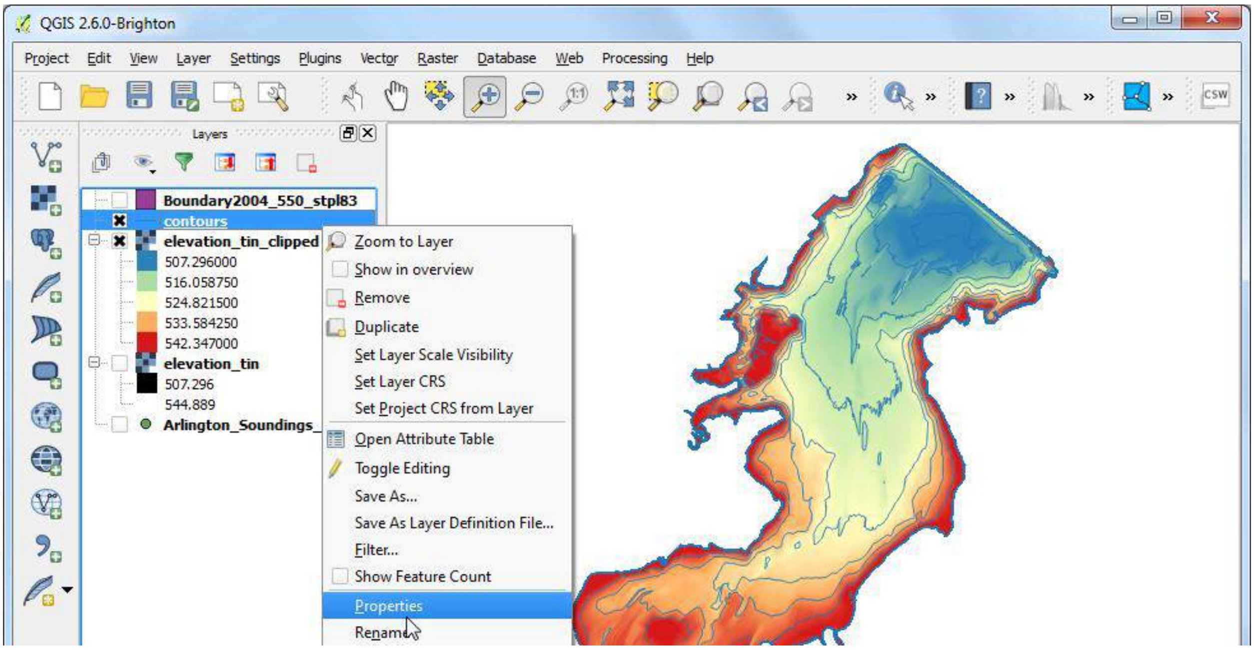
16. Now you have a elevation relief map for the lake generated from the individual depth readings. Let's generate contours now. Go to Raster Extraction Contours.



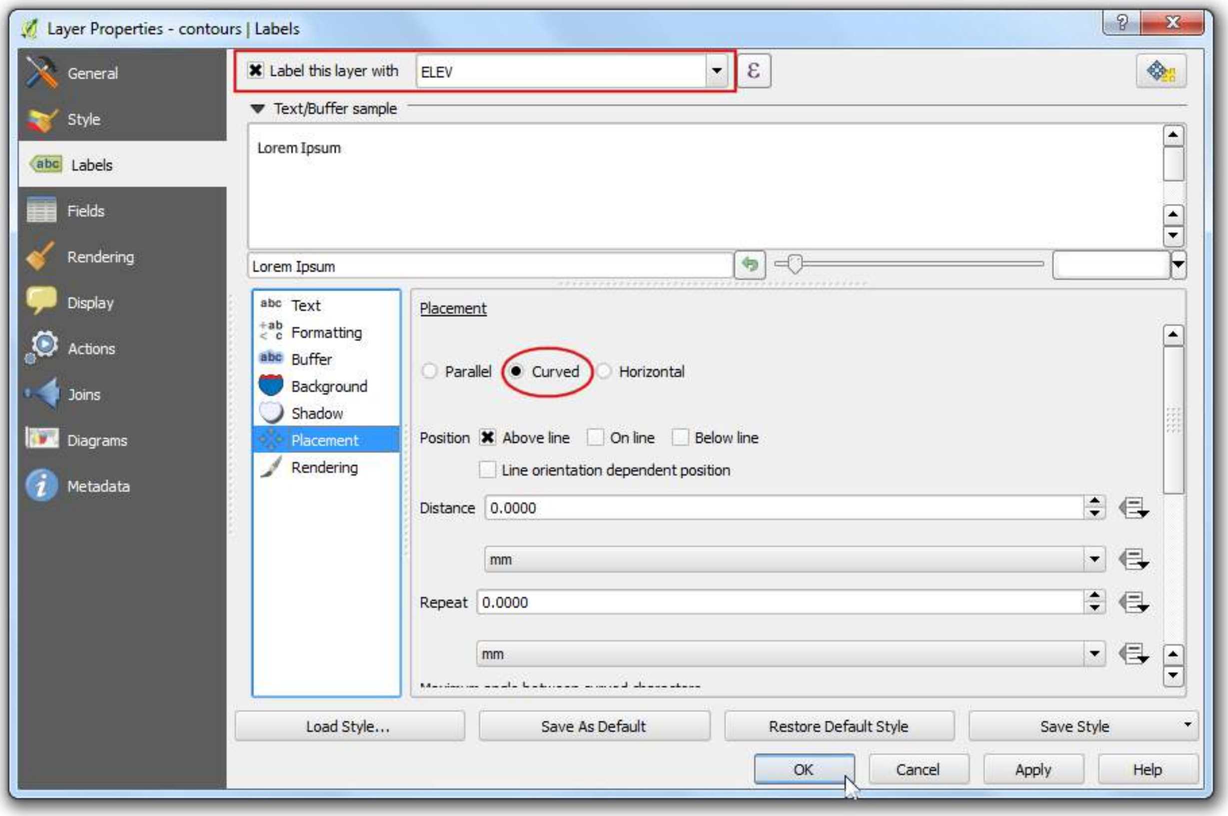
17. In the Contour dialog, enter `contours` as the Output file for contour lines. We will generate contour lines at 5ft intervals, so enter `5.00` as the Interval between contour lines. Check the Attribute name box. Click OK.



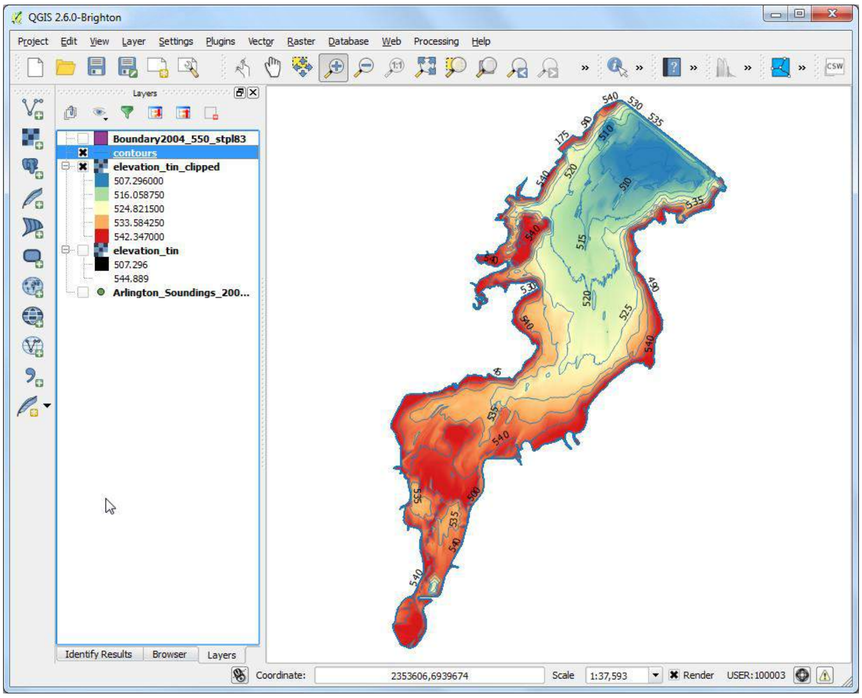
18. The contour lines will be loaded as `contours` layer once the processing is finished. Right-click the layer and select Properties.



19. Go to the Labels tab. Check the Label this layer with box and select `ELEV` as the field. Select `Curved` as the Placement type and click OK.



20. You will see that each contour line will be appropriately labeled with the elevation along the line.



Practical 9

Advance GIS Operations 2:

a) **Batch Processing using Processing Framework**

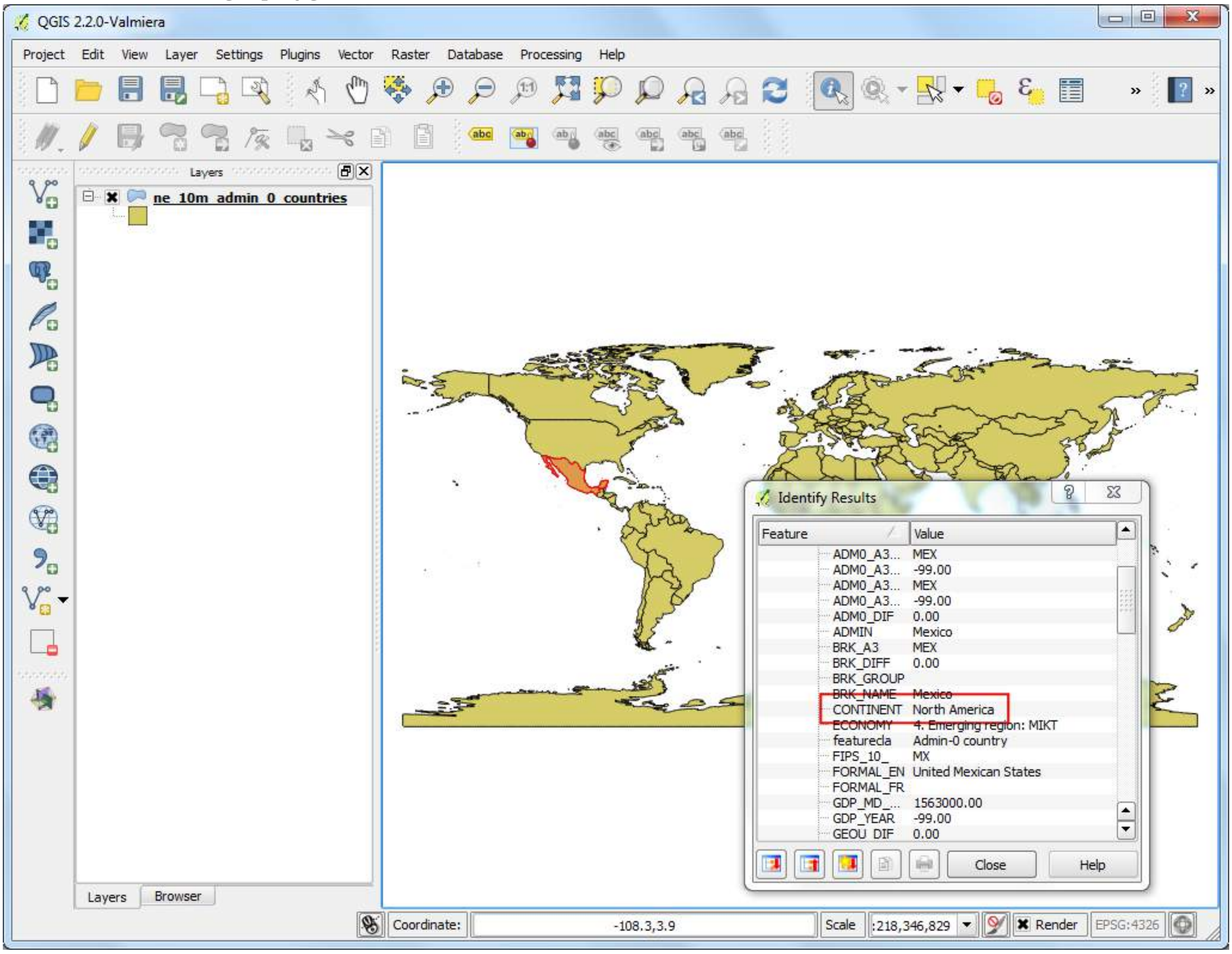
b) **Automating Complex Workflows using Processing Modeler**

c) **Automating Map Creation withPrint Composer Atlas**

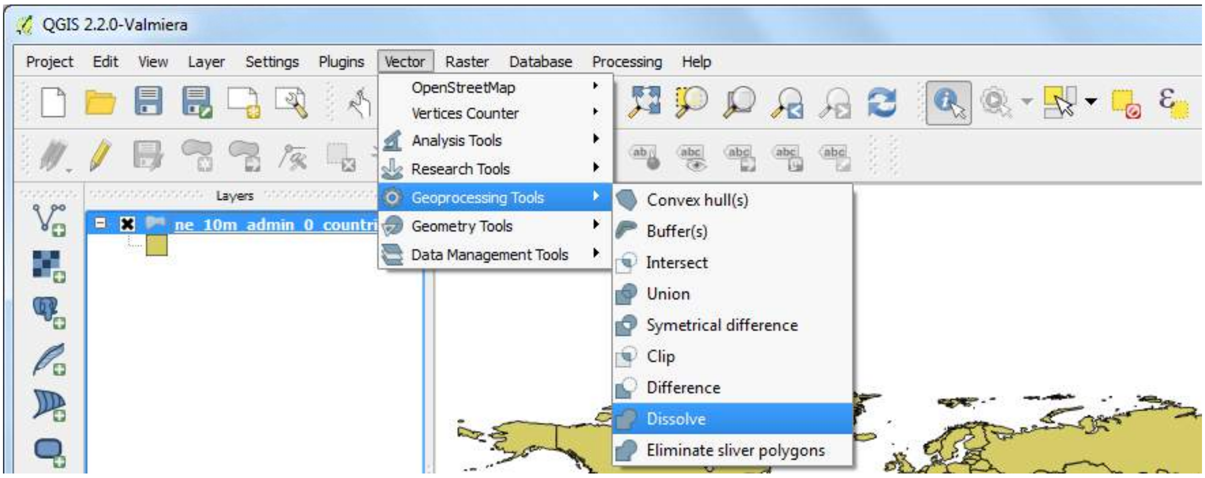
(a) Batch Processing using Processing Framework

Procedure

1. Go to Layer ‣ Add Vector Layer.
2. Browse to the downloaded Admin 0 Countries shapefile ne_10m_admin_0_countries.shp and click Open.
3. As our task is to clip the global layers to the boundary of Africa, we need to first prepare a layer containg a polygon for the entire continent. The countries layer has an attribute called **CONTINENT**. We can use a geoprocessing concept called *Dissolve* to merge all countries that have the same continent value and merge them to a single polygon.



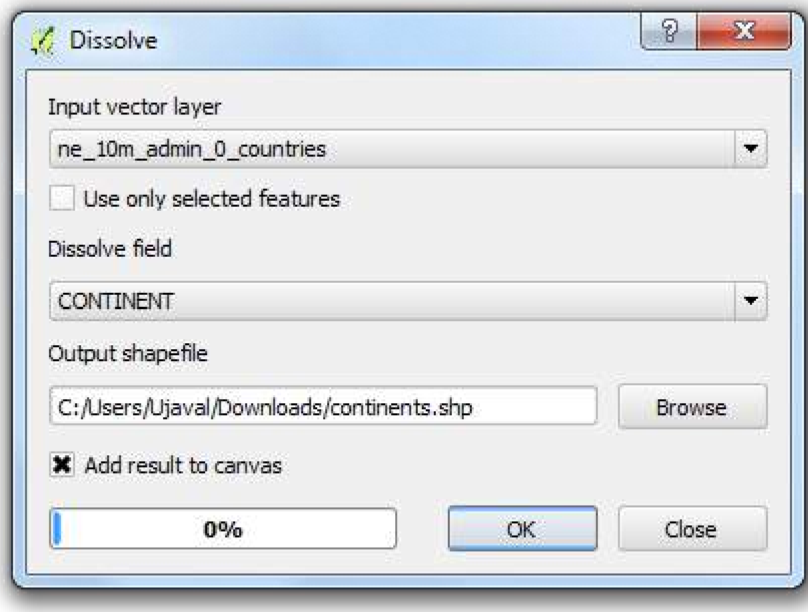
4. Open the Dissolve tool from Vector ‣ Geoprocessing Tools ‣ Dissolve.



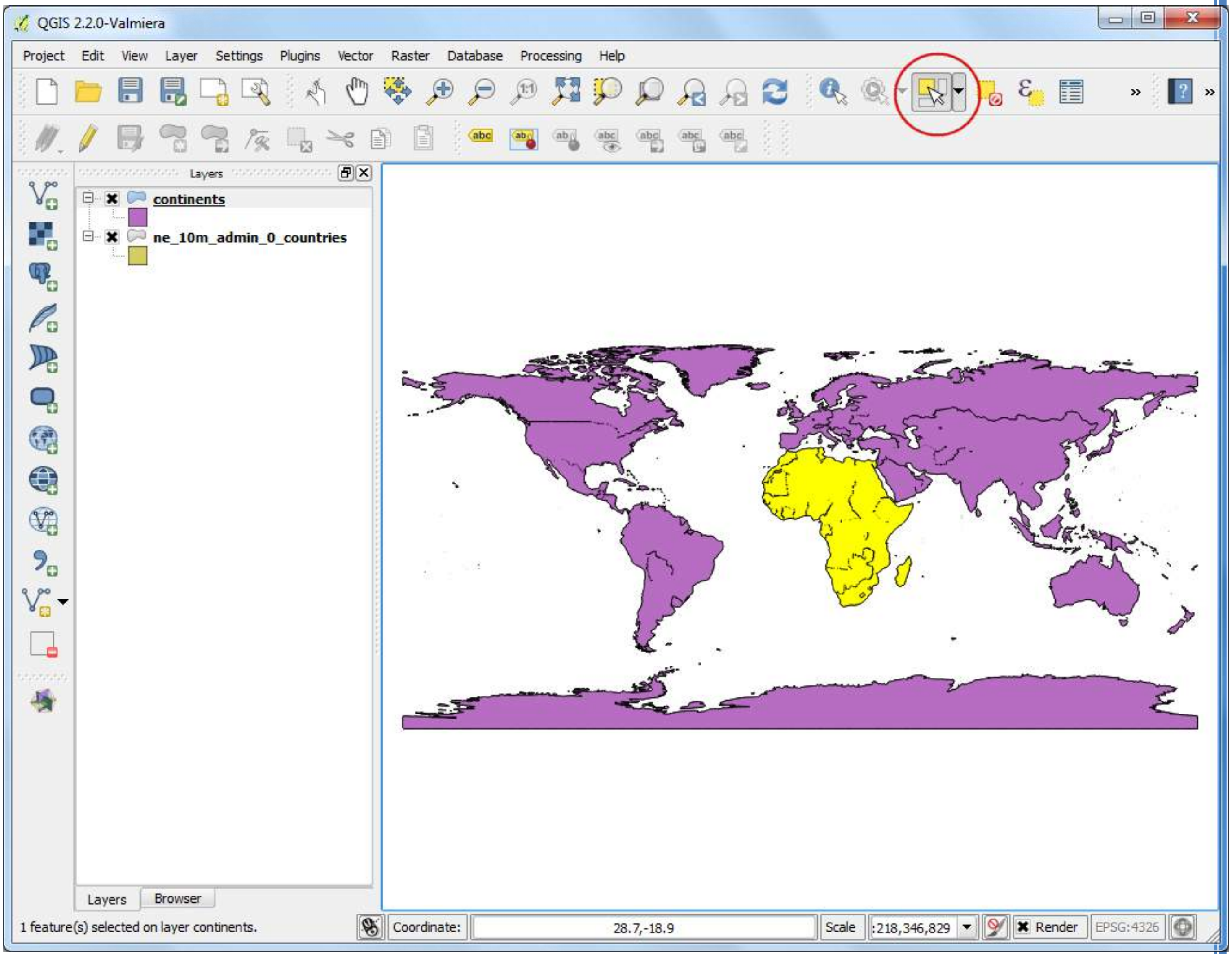
5. Select ne_10m_admin_0_countries as the Input vector layer. The Dissolve field would be CONTINENT. Name the output file as continents.shp and check the box next to Add result to convas.

Note

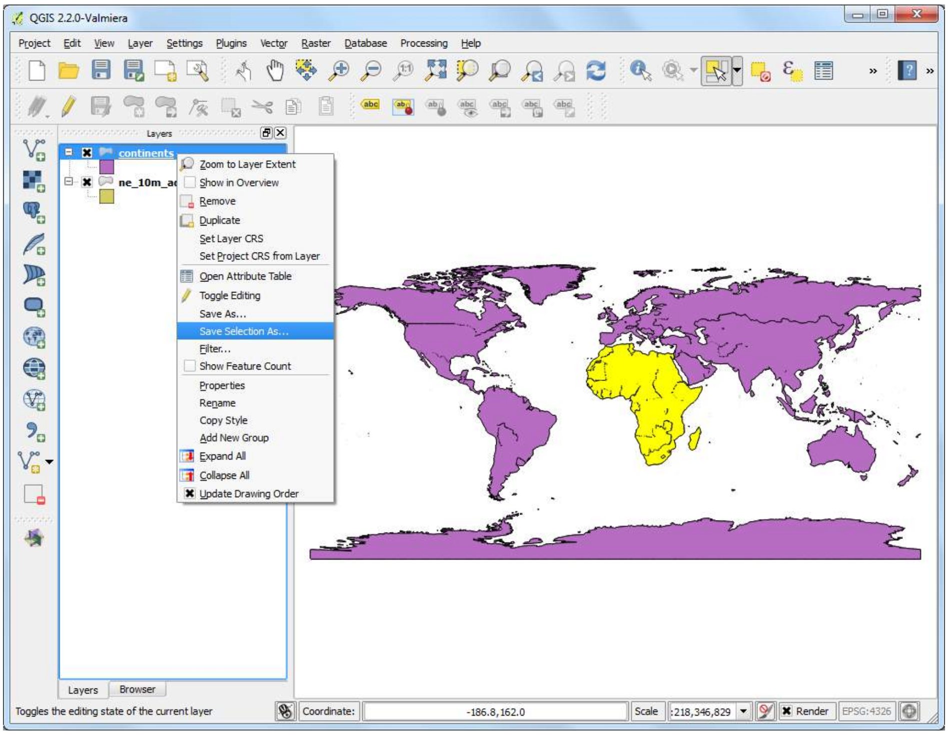
If you want to merge **ALL** polygons regardless of their attributes, you can select – Dissolve All – as the Dissolve field. This will combine all polygons in the layer and give you a single aggregate polygon.



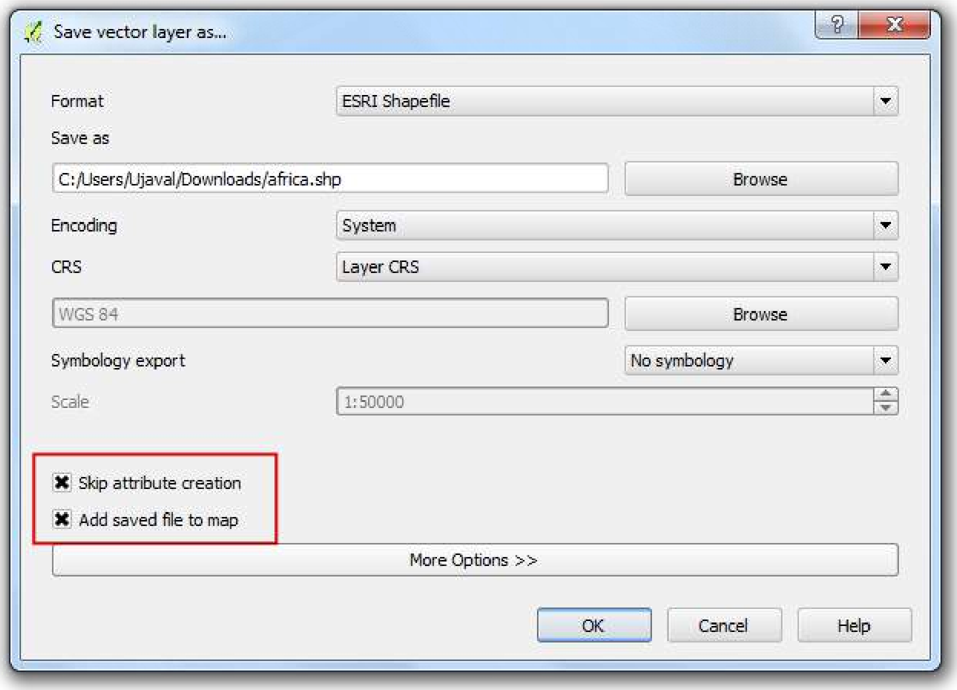
6. The dissolve processing may take a while. Once the process finishes, you will see the new continent layer added to QGIS. Use the Select Single Feature tool from the toolbar and click on Africa to select the polygon representing the continent.



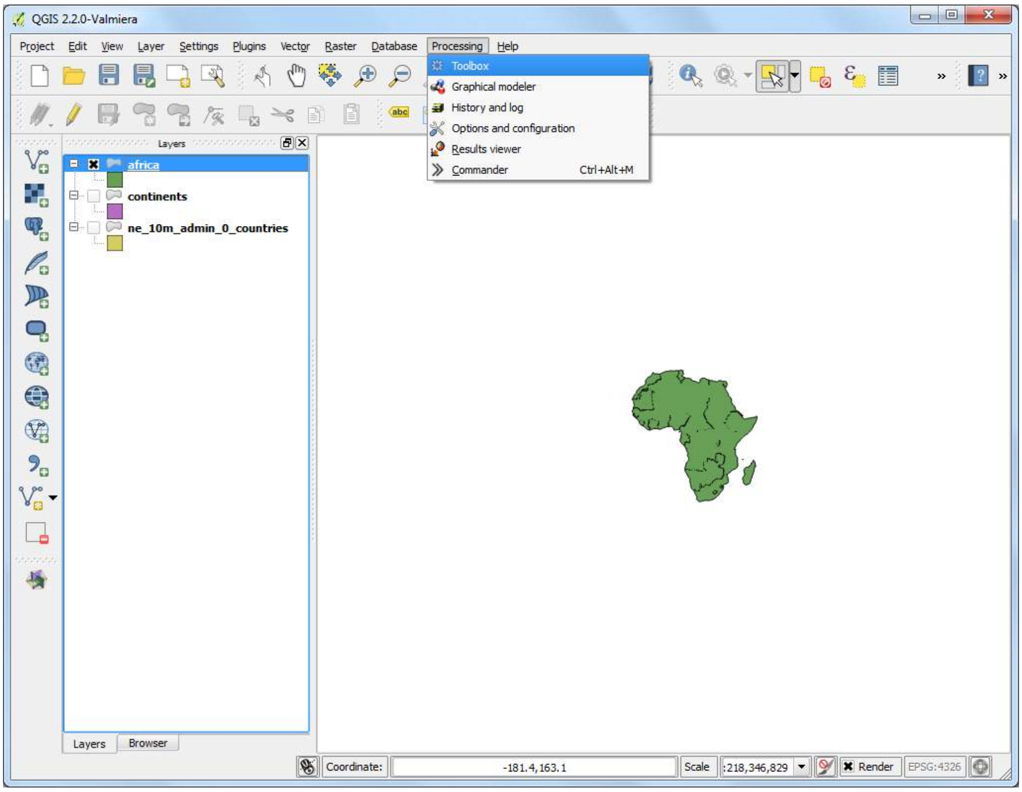
7. Right-click the continents layer and select Save Selection As....



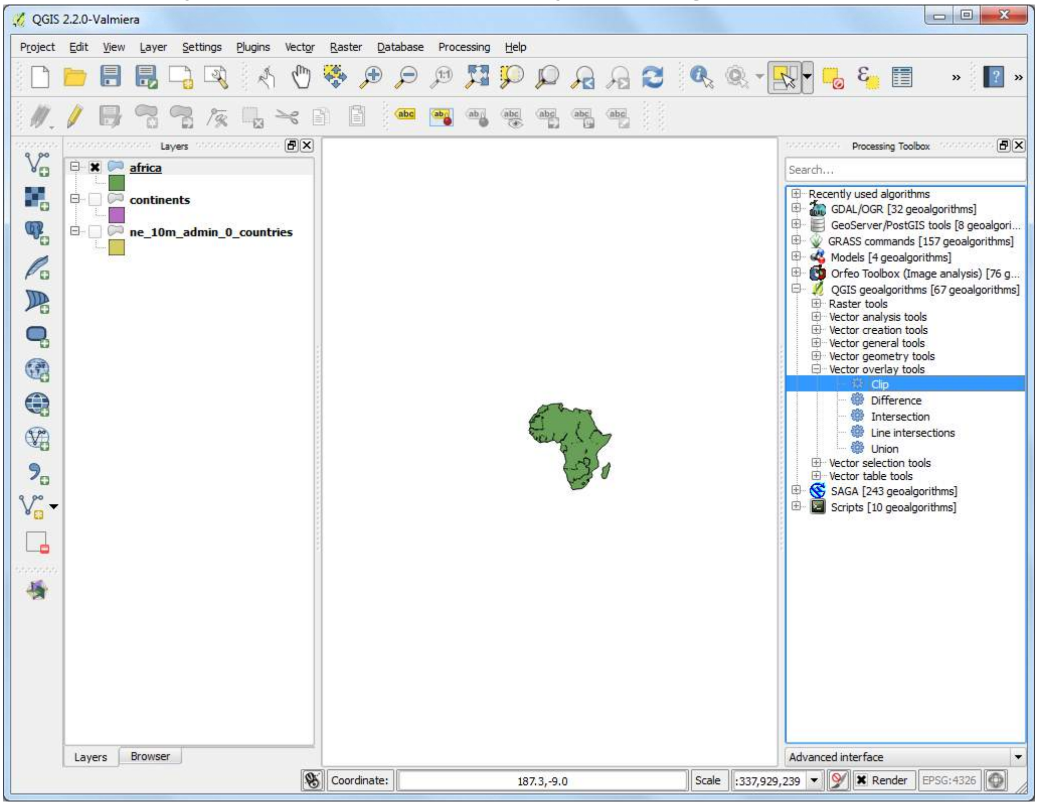
8. Name the output file as africa.shp. Since we are only interested in the shape of the continent and not any attributes, you may check the Skip attribute creation. Make sure the Add saved file to map box is checked and click OK.



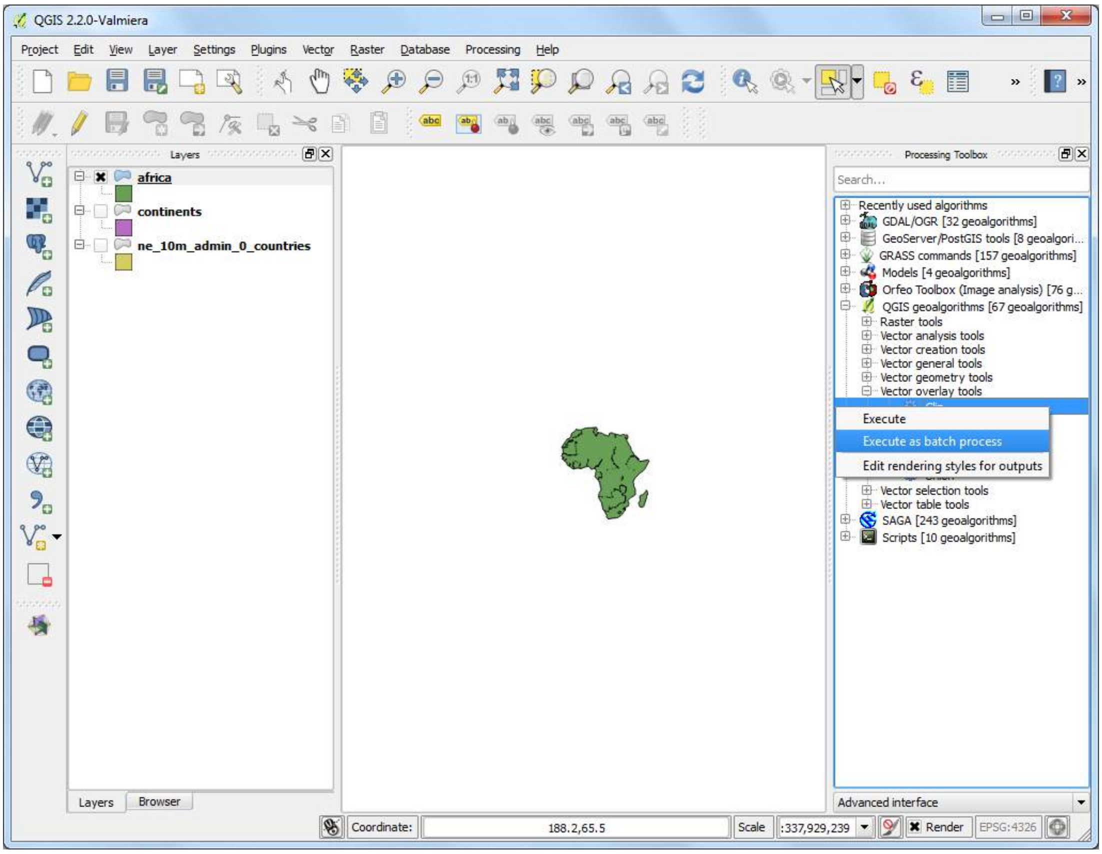
9. Now you will have the africa layer loaded in QGIS containing a single polygon for the entire continent. Now, it's time to start our batch clip process. Open Processing ‣ Toolbox.



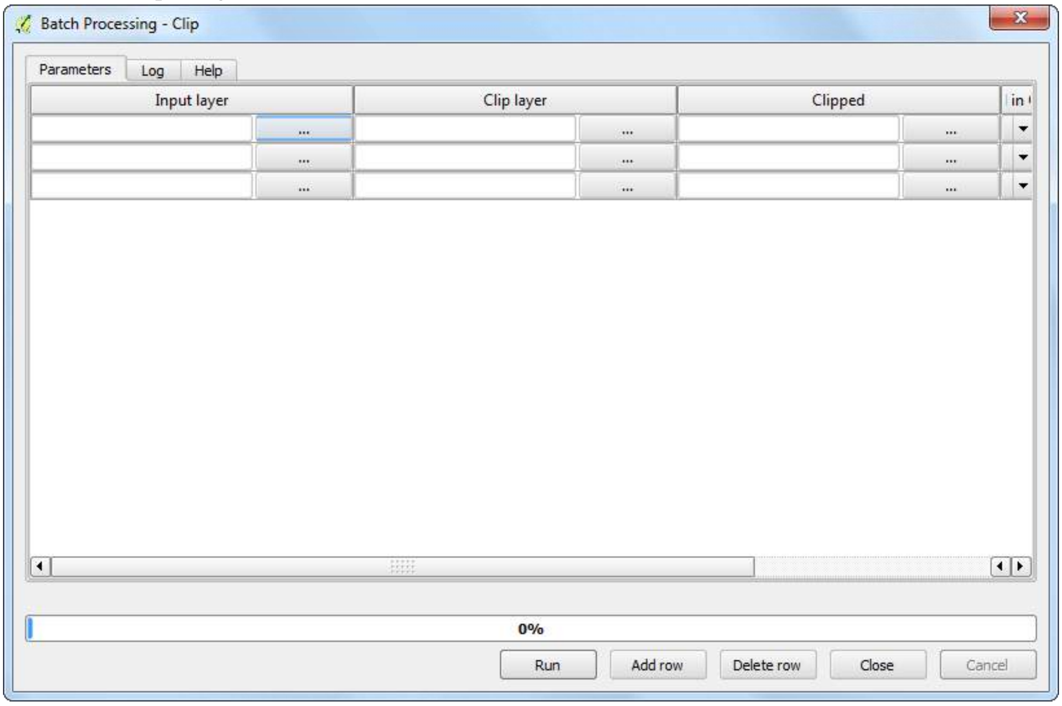
10. Browse all available algorithms and find the Clip tool from QGIS geoalgorithms ‣ Vector overlay tools ‣ Clip. You may also use the Search box to easily find the algorithm as well.



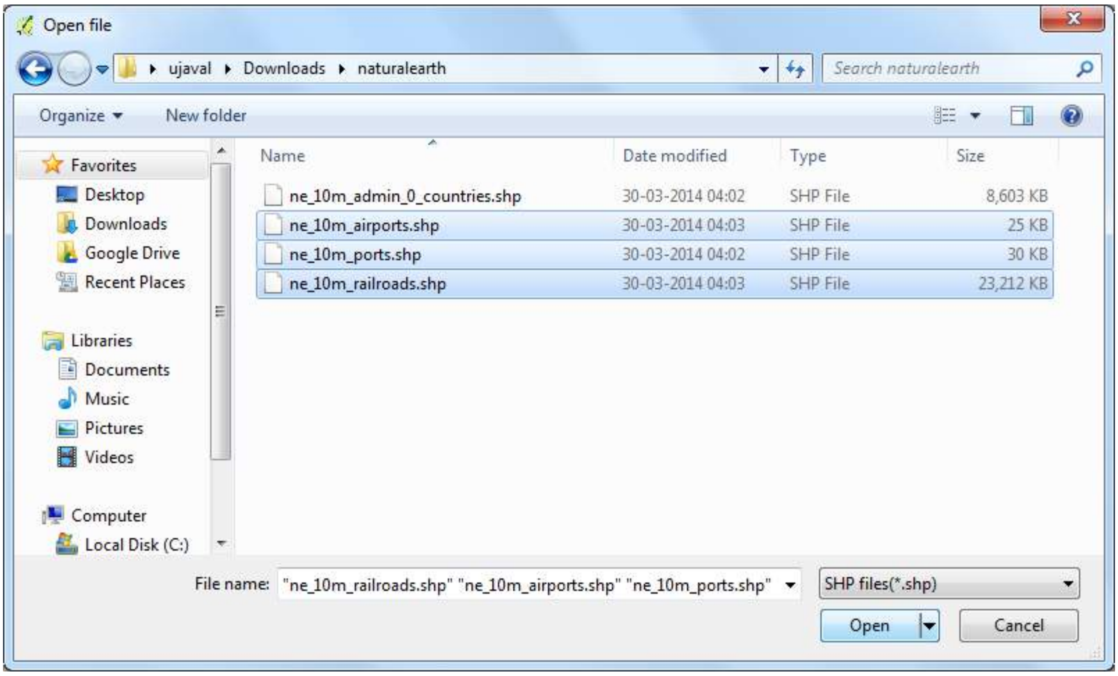
11. Right-click the Clip algorithm and select Execure as batch process.



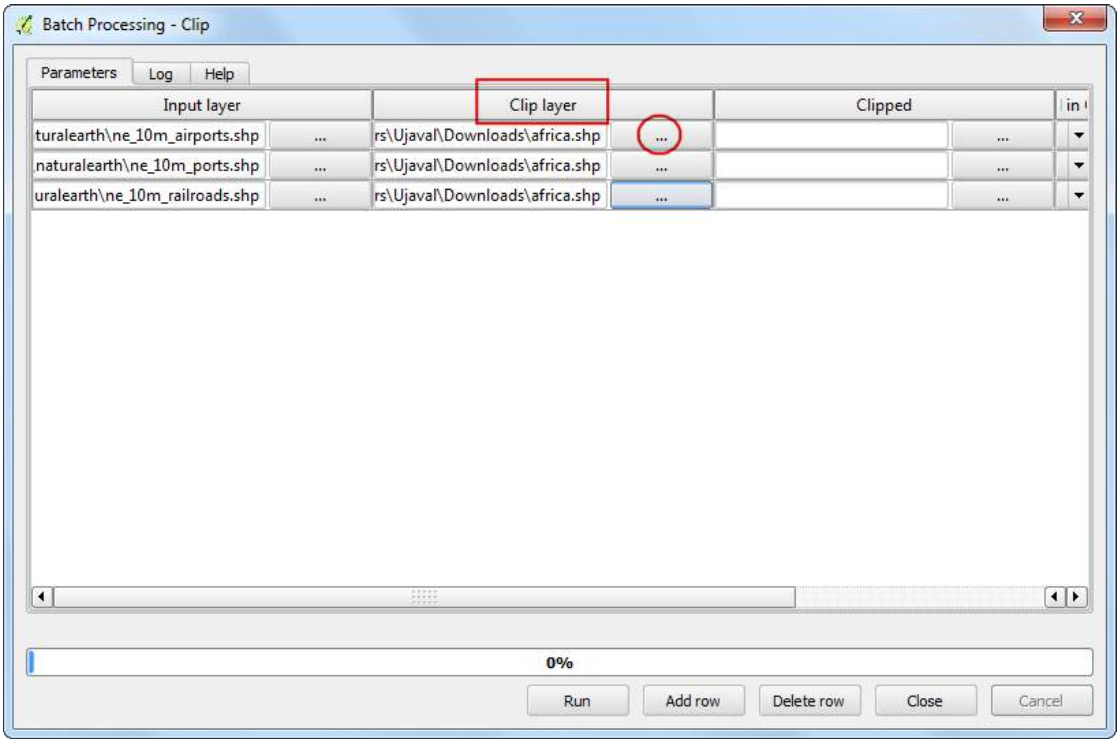
12. In the Batch Processing dialog, the first tab is Parameters where we define out inputs. Click the ... next to the first row in the Input layer column.



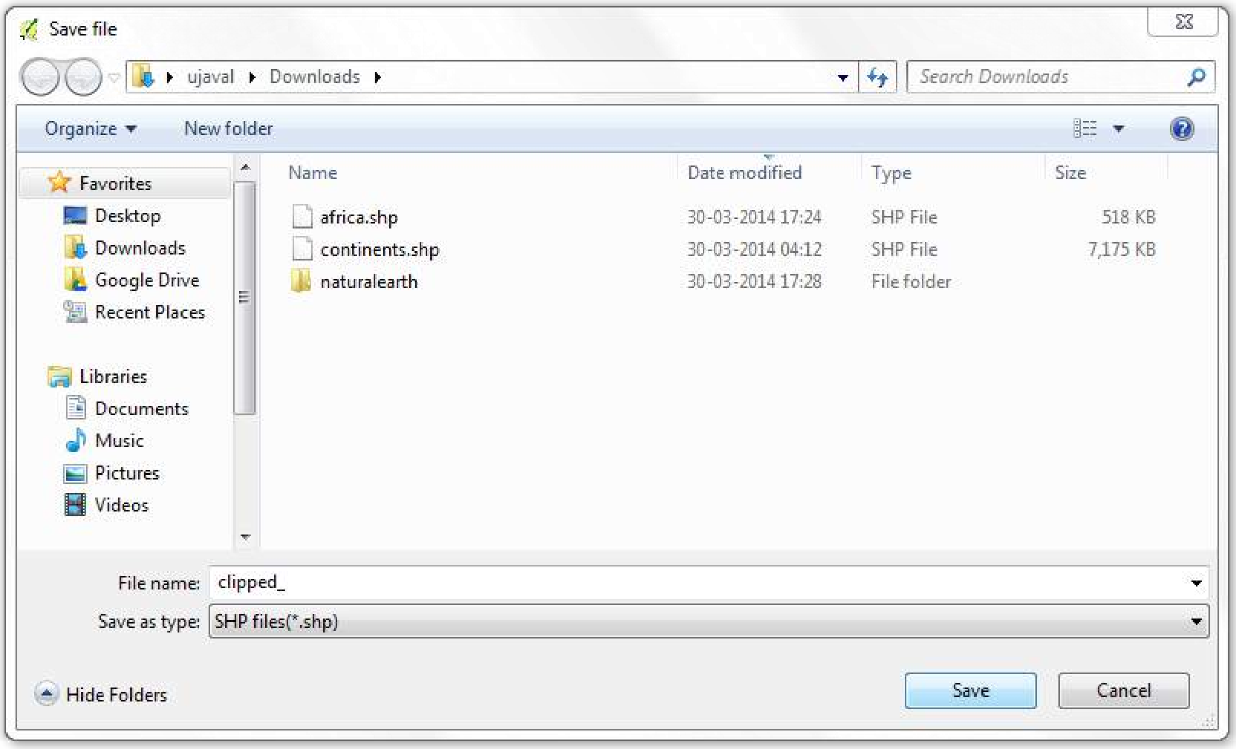
13. Browse to the directory containing the global transportation layers that you had downloaded. Hold the Ctrl key and select all the layers that you want to clip. You may also use Shift or Ctrl-A to make multiple selection. Click Open.



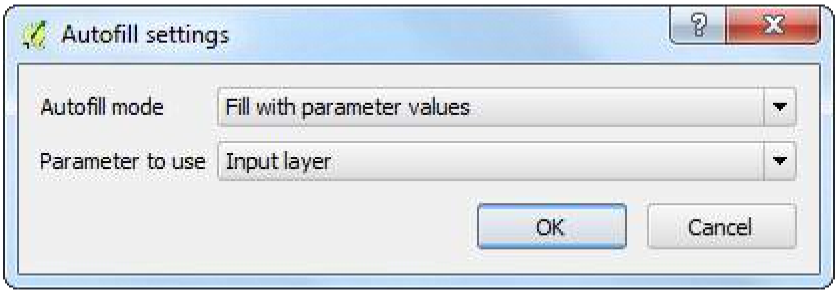
14. You will notice that the Input layer columns will be auto-populated with all layers you had selected. You may use Add row button to add more rows and define more inputs. Next, we need to select the layer containing the boundary to clip our input layers. Click the ... button for the first row and add the africa.shp Clip layer. Since the clip layer is the same for all our inputs, you can double-click the column header Clip layer and the same layer will be auto-filled for all the rows. Next, we need to define our outputs. Click the ... buton next to the first row in the Clipped column.



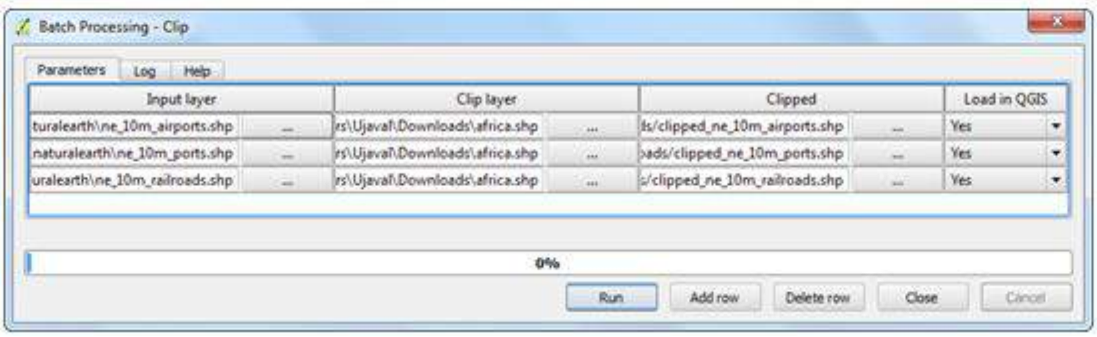
15. Browse the the directory where you want your output layers. Type the filename as clipped_ and click Save.



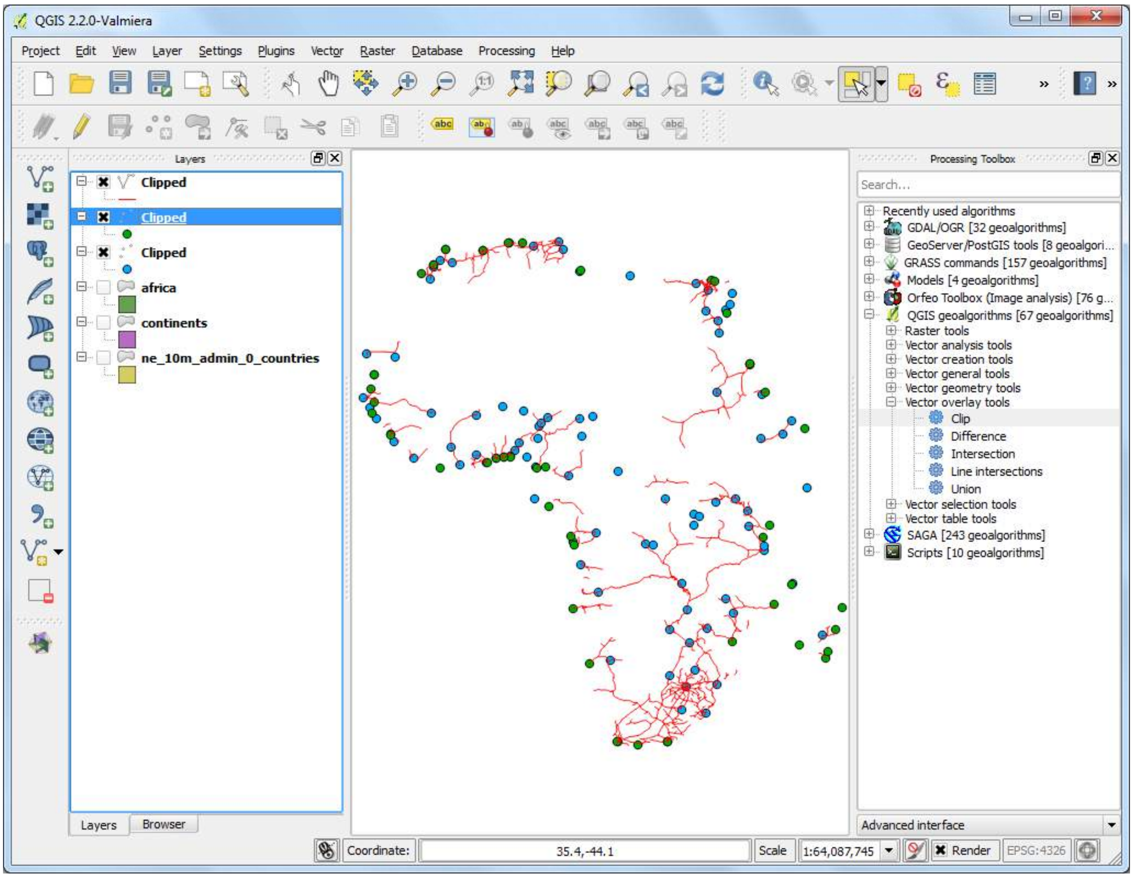
16. You will see a new Autofill settings dialog pop up. Select Fill with parameter values as the Autofill mode. Select Parameter to useas Input layer. This setting will add the input file name to the output along with the specified output_ filename. This is important to ensure all the output files have unique names and they do not overwrite each other.



17. Now we are ready to start the batch procesing. Click Run.



18. The clip algorithm will run for each of the inputs and create output files are we have specified. Once the batch process finishes, you will see the layers added to QGIS canvas. As you will notice, all the global layers are properly clipped to the continent boundary that we had specified.


QGIS 2.2.0-Valmiera
Project Edit View Layer Settings Plugins Vector Raster Database Processing Help
Layers
Clipped
Clipped
Clipped
africa
continents
ne_10m_admin_0_countries
Layers Browser
Processing Toolbox
Search...
Recently used algorithms
GDAL/OGR [32 geoalgorithms]
GeoServer/PostGIS tools [8 geoalgori...
GRASS commands [157 geoalgorithms]
Models [4 geoalgorithms]
Orfeo Toolbox (Image analysis) [76 g...
QGIS geoalgorithms [67 geoalgorithms]
Raster tools
Vector analysis tools
Vector creation tools
Vector general tools
Vector geometry tools
Vector overlay tools
Clip
Difference
Intersection
Line intersections
Union
Vector selection tools
Vector table tools
SAGA [243 geoalgorithms]
Scripts [10 geoalgorithms]
Advanced interface
Coordinate: 35.4,-44.1
Scale 1:64,087,745
Render
EPSG:4326

(B)

Automating Complex Workflows using Processing Modeler

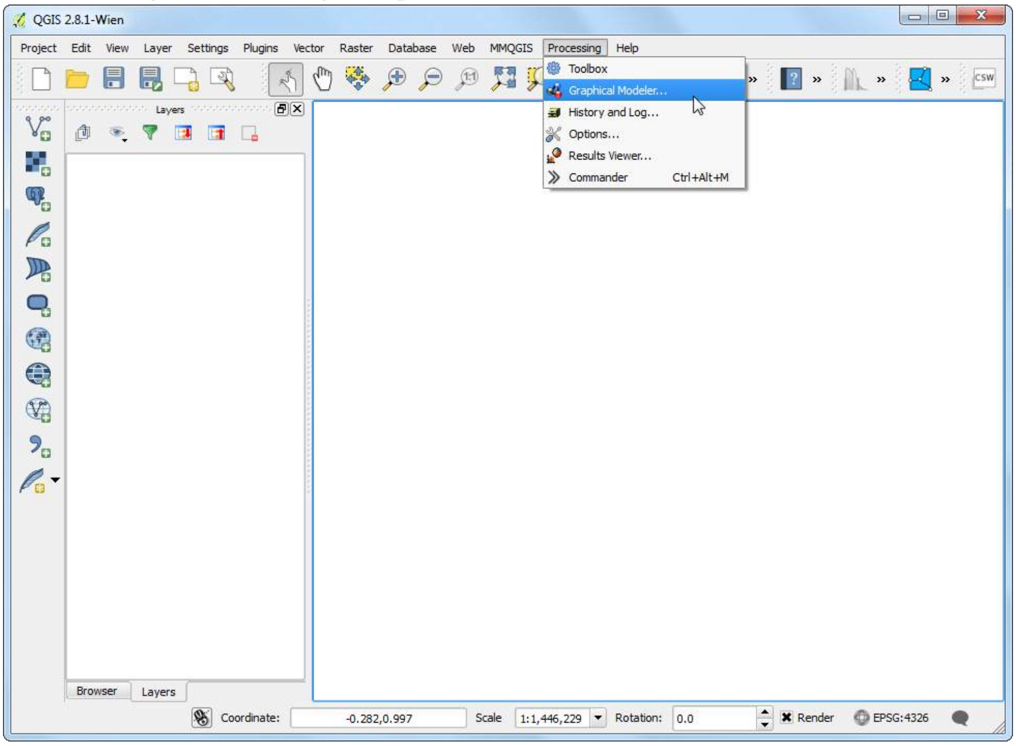
Procedure

Our workflow for this exercise will have the following steps.

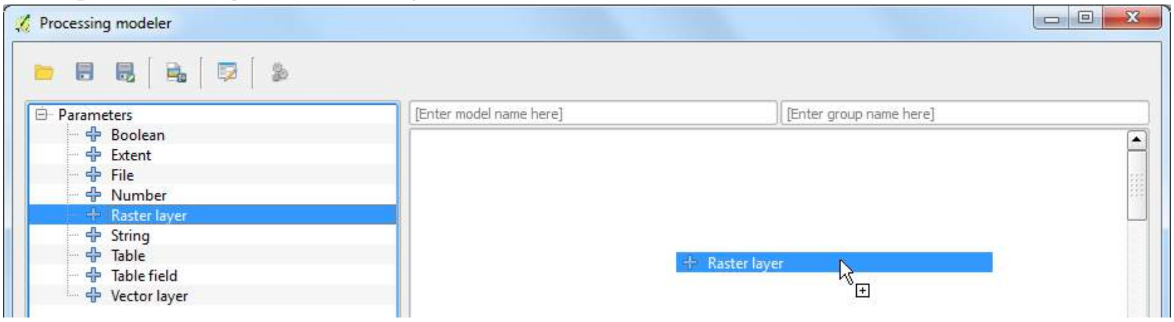
- Apply a Majority Filter algorithm to the input landcover raster. This will reduce noise in our output by eliminating isolated pixels.
- Convert the resulting raster to a polygon layer.
- Query for a class value from the attribute table of the polygon layer and create a vector layer for that class.

The following steps outline the process to code the above process into a model and run it on the downloaded datasets.

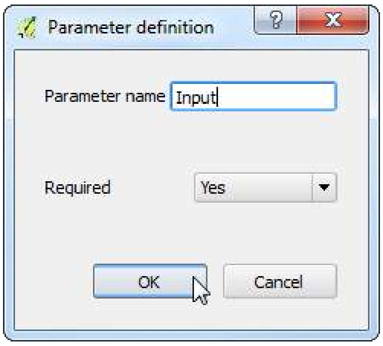
1. Launch QGIS and go to Processing ‣ Graphical Modeler....



2. The Processing modeler dialog contains a left-hand panel and a main canvas. Select the Inputs tab in the left-hand panel and drag the + Raster layer to the canvas.



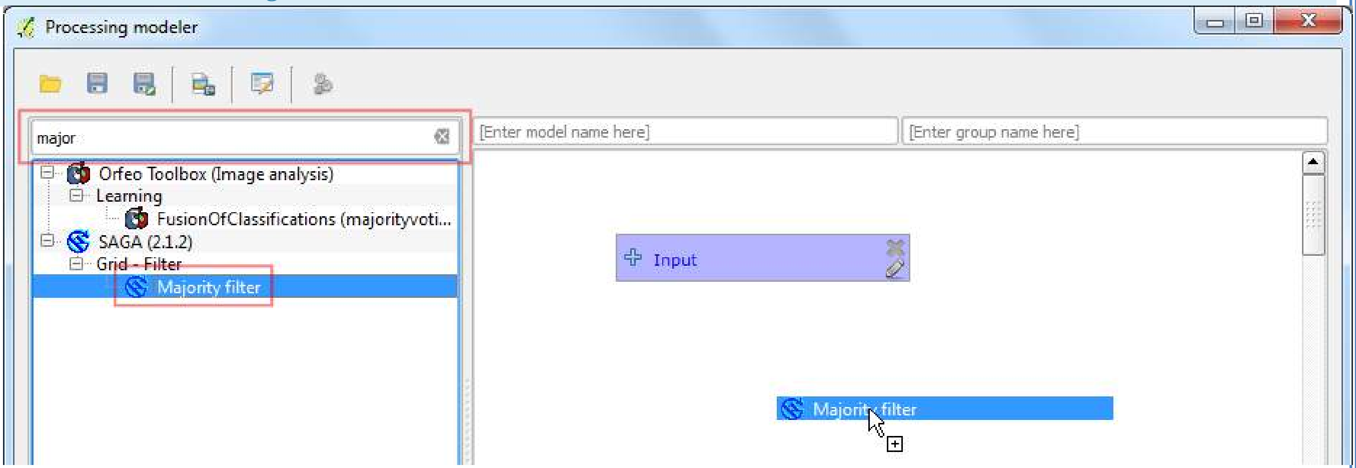
3. A Parameter definition dialog will pop-up. Enter Input as the Parameter name and mark Yes to Required. Click OK.



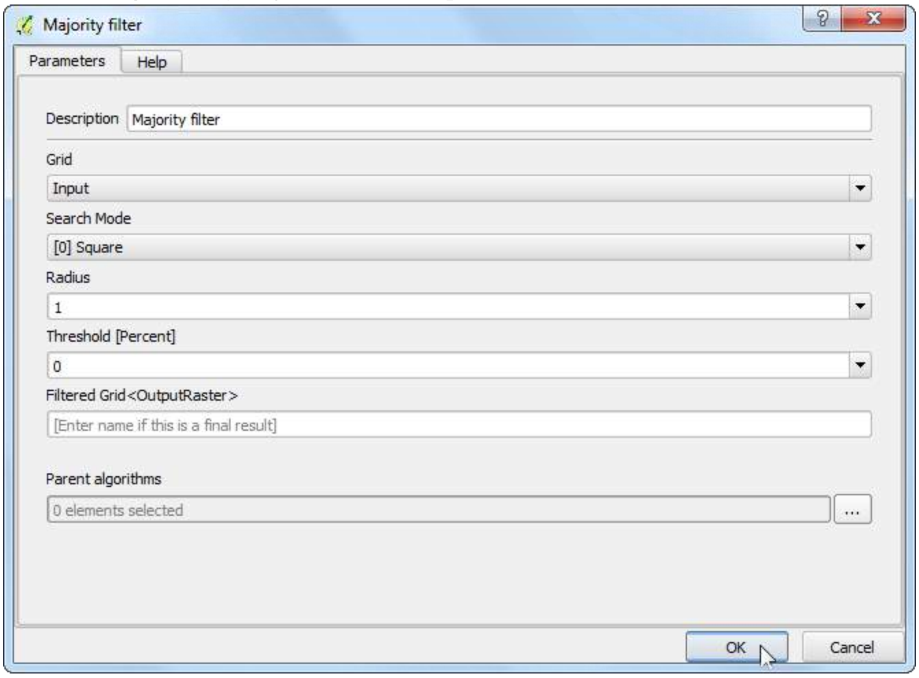
4. You will see a box with the name Input appear in the canvas. This represents the landcover raster that we will use as input. Next step is to apply a Majority filter algorithm. Switch to the Algorithm tab from the bottom-left corner. Search for the algorithm and you will find it listed under SAGA provider. Drag it to the canvas.

Note

If you do not see this algorithm or any of the subsequent algorithms mentioned in thi tutorial, you may be using the Simplified Interface of the Processing Toolbox. Switch to the Advanced Interface by using the dropdown at the bottom of the Processing Toolbox in the main QGIS window.



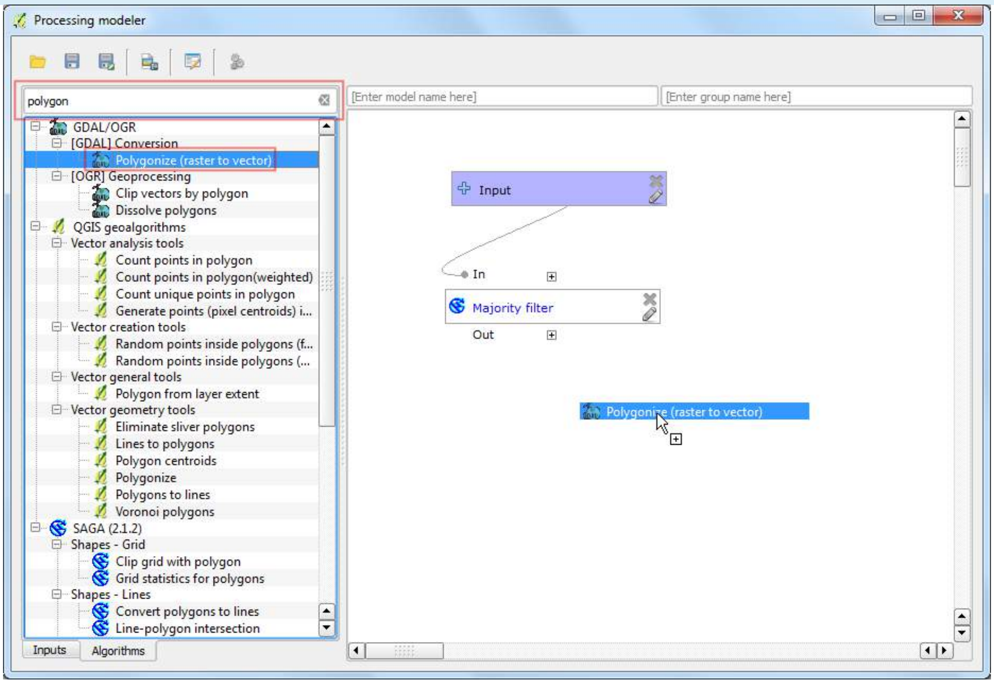
5. A configuration dialog for Majority Filter will be presented. Leave the values to their default and click OK.



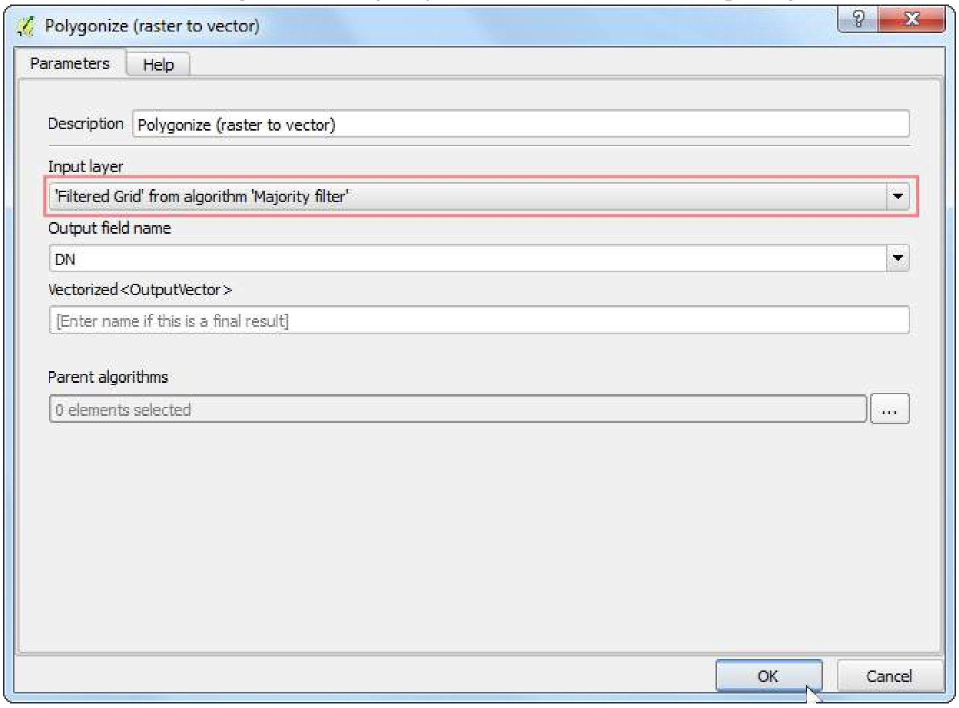
6. You will note that there is now a new box named Majority Filter in the canvas and it is connected to the Input box. This is because the Majority Filter algorithm uses the Input raster as its input. The next step in our workflow is to convert the output of majority filter to vector. Find the Polygonize (raster to vector) algorithm and drag it to the canvas.

Note

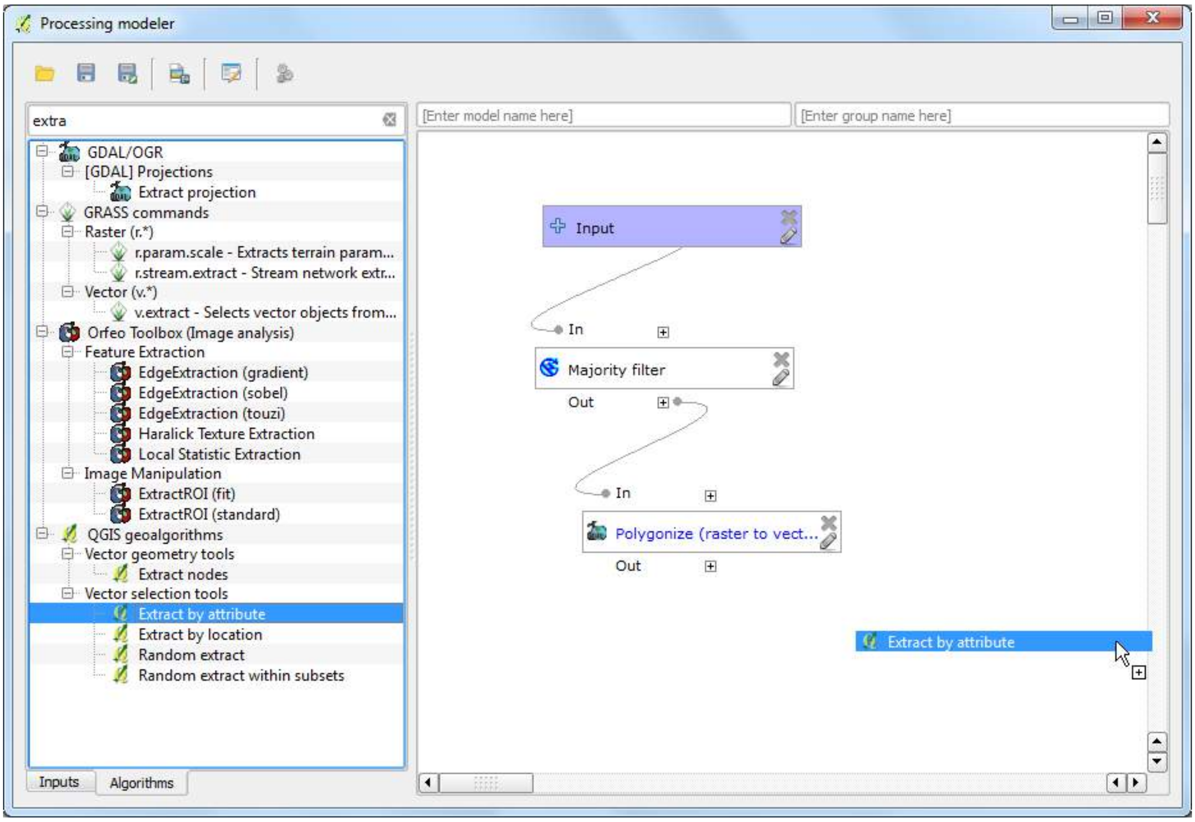
The boxes can be moved and arranged by clicking on it and dragging it while holding the left mouse button. You can also use the scroll-wheel to zoom in and out in the model canvas.



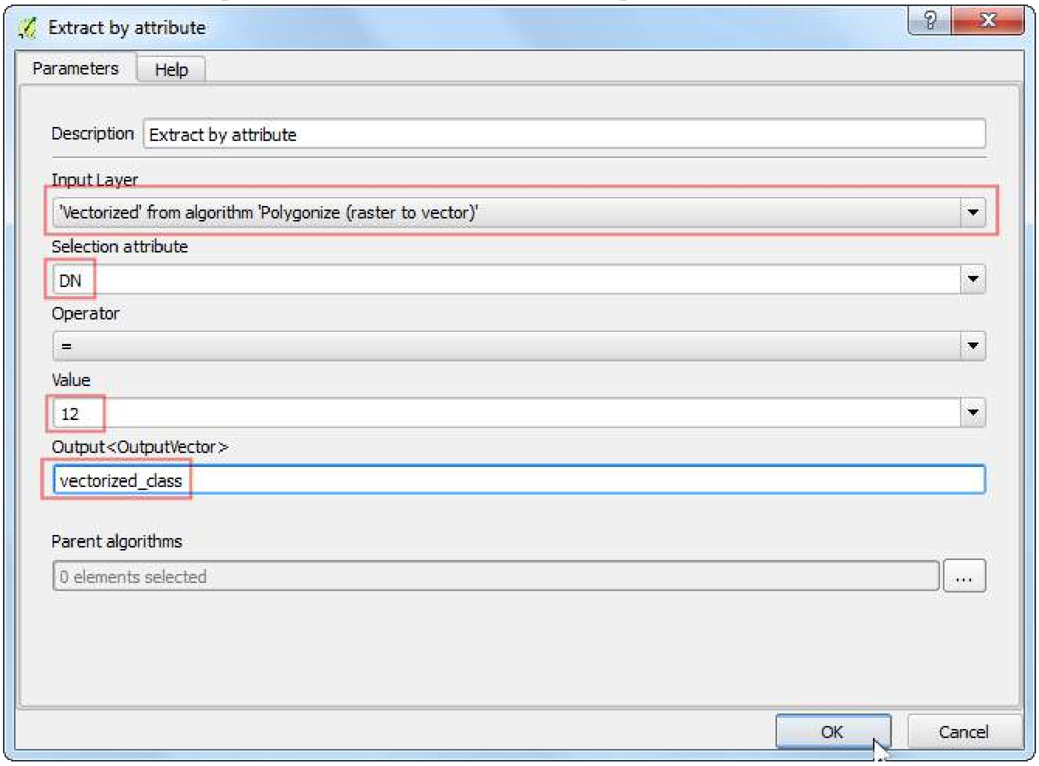
7. Select 'Filtered Grid' from algorithm 'Majority Filter' as the value for Input layer. Click OK.



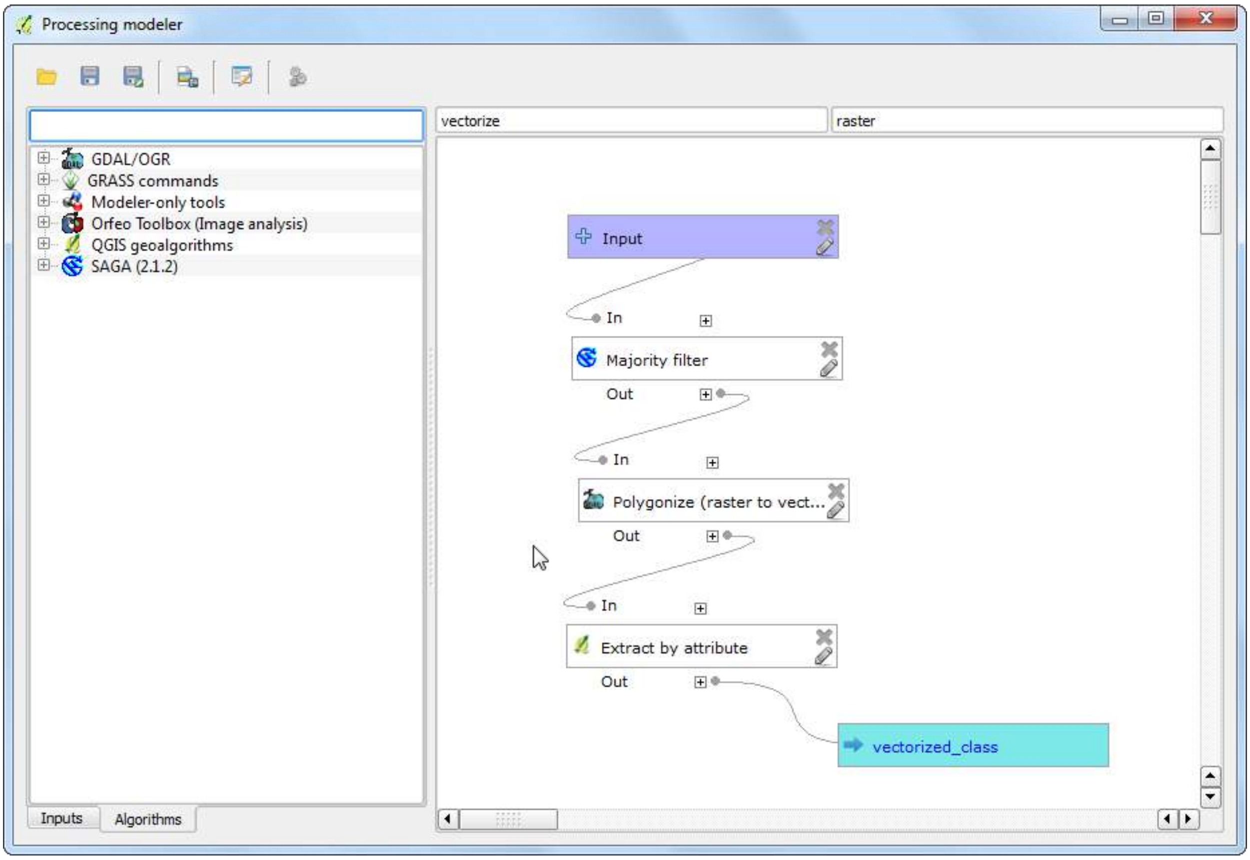
8. The final step in the workflow is to query for a class value and create a new layer from the matching features. Search for the Extract by attribute algorithm and drag it the canvas.



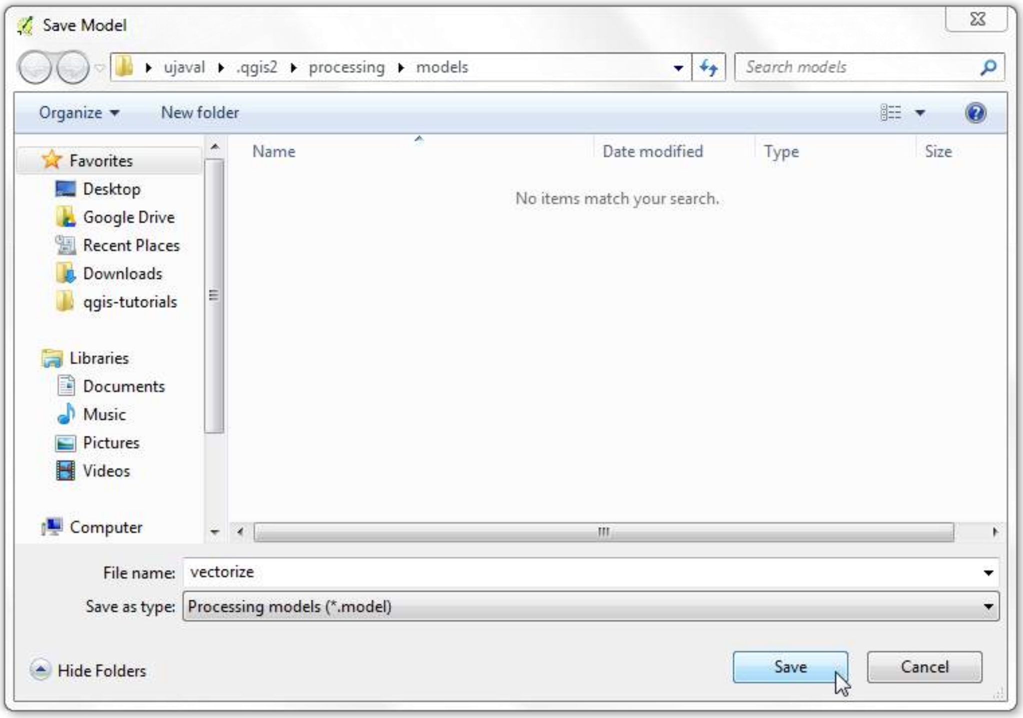
9. Select ‘Vectorized’ from algorithm ‘Polygonize (raster to vector) as the Input Layer. We want to extract the pixels that represent Croplands. The corresponding pixel value for this class will be 12. (see Code Values). Enter DN as the Selection attribute and 12as the value. As the output of this operation will be the final result, we need to name the output. Enter vectorized class as the Output.



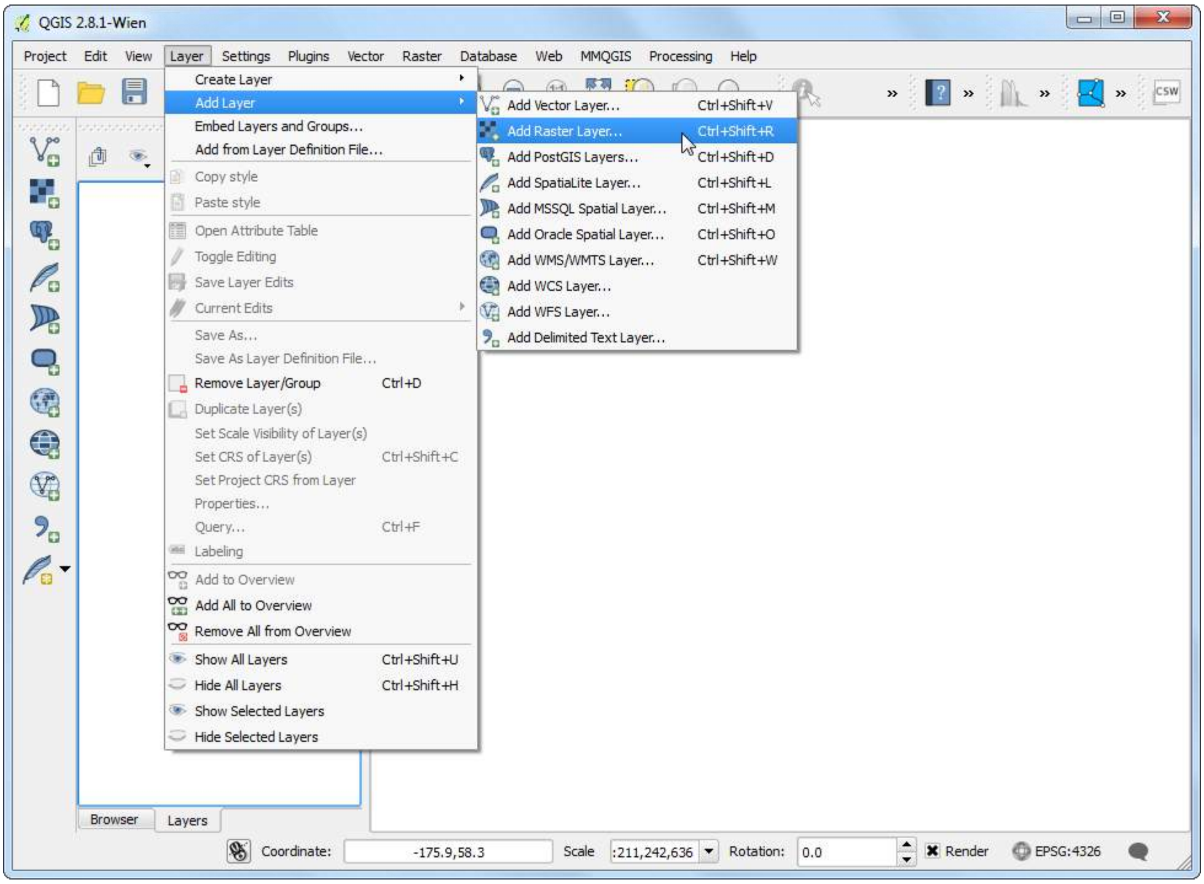
10. Enter the Model name as vectorize and Group name as raster. Click the Save button.



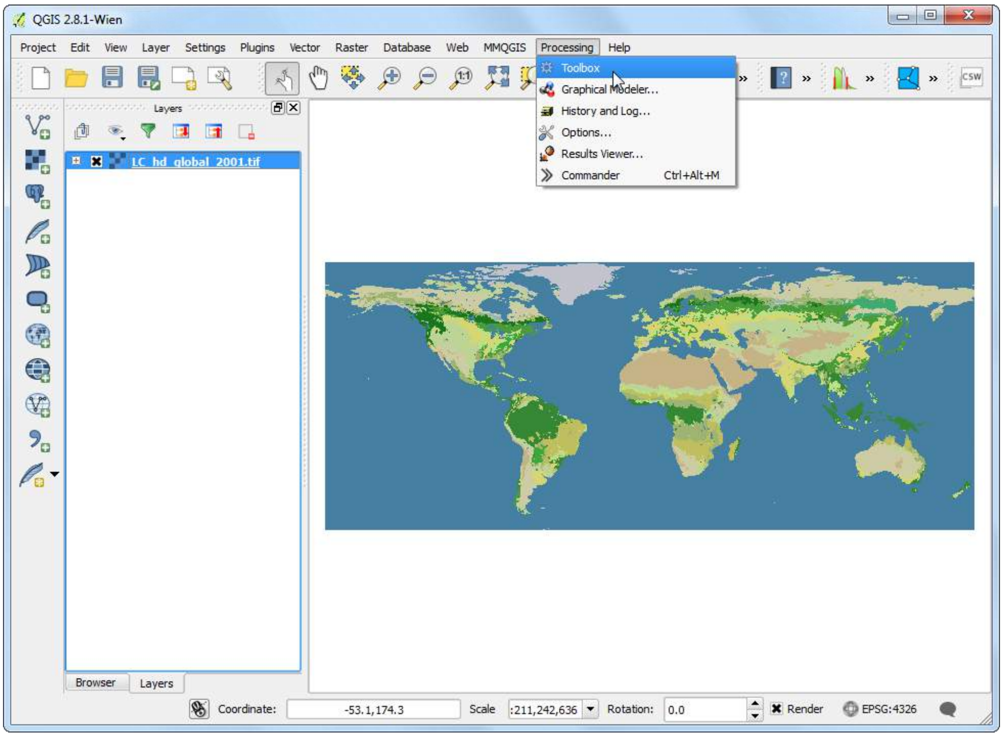
11. Name the model vectorize and click Save.



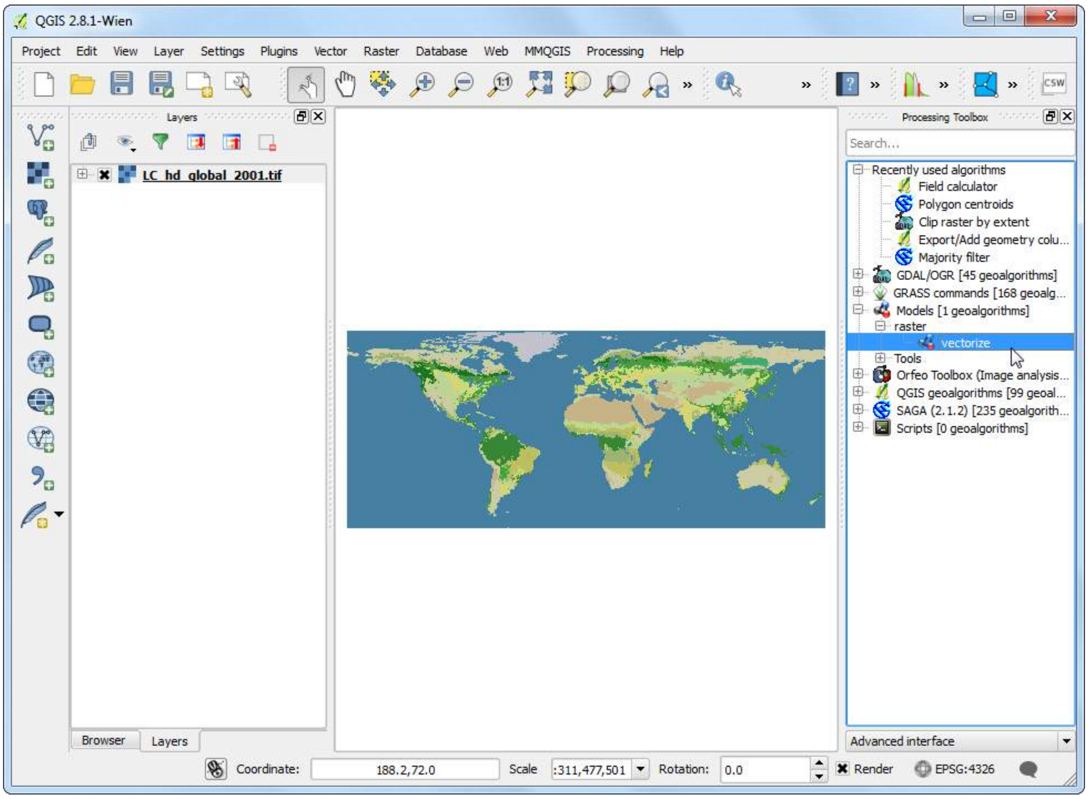
12. Now it is time to test our model. Close the modeler and switch to the main QGIS window. Go to Layer ‣ Add Layer ‣ Add Raster Layer....



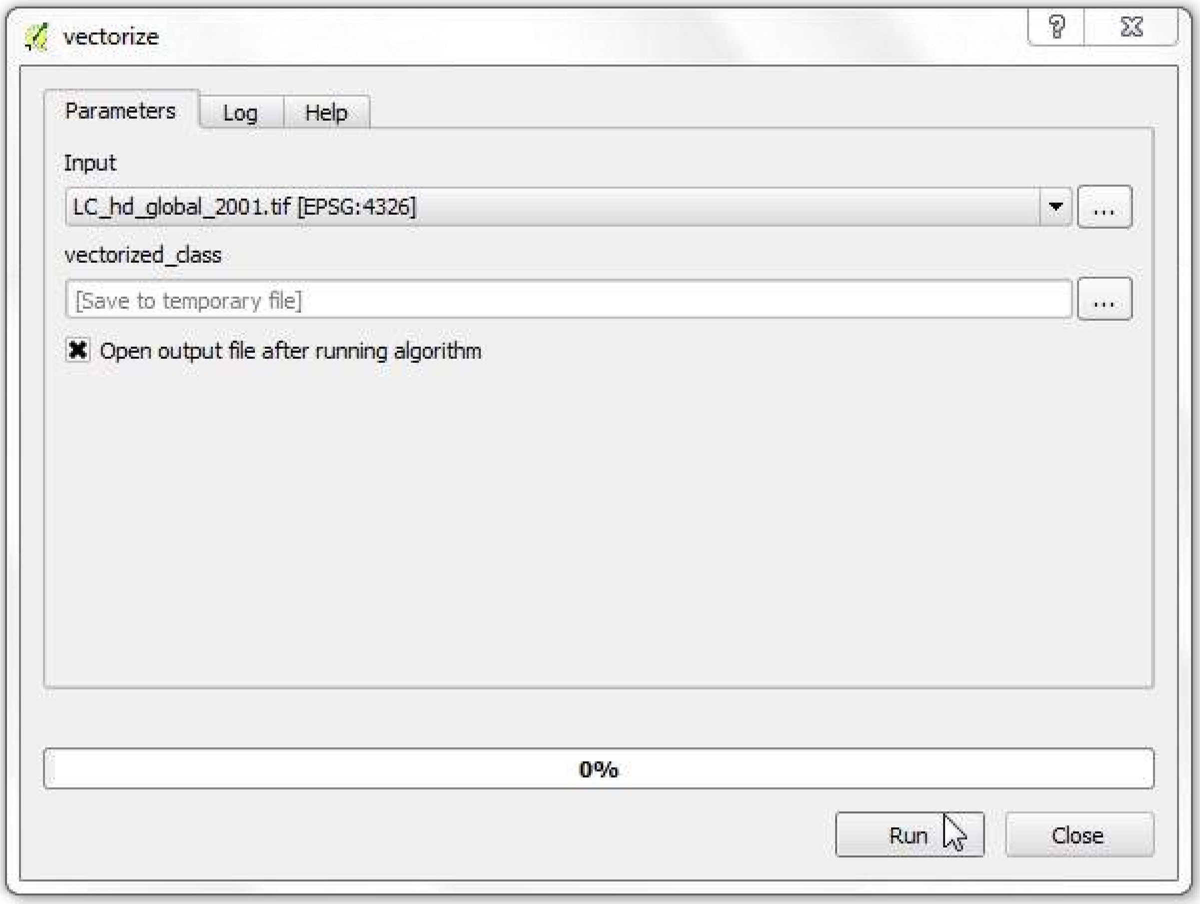
13. Browse to the downloaded LC_hd_global_2001.tif.gz file and click Open. Once the raster is loaded, go to Processing ‣ Toolbox.



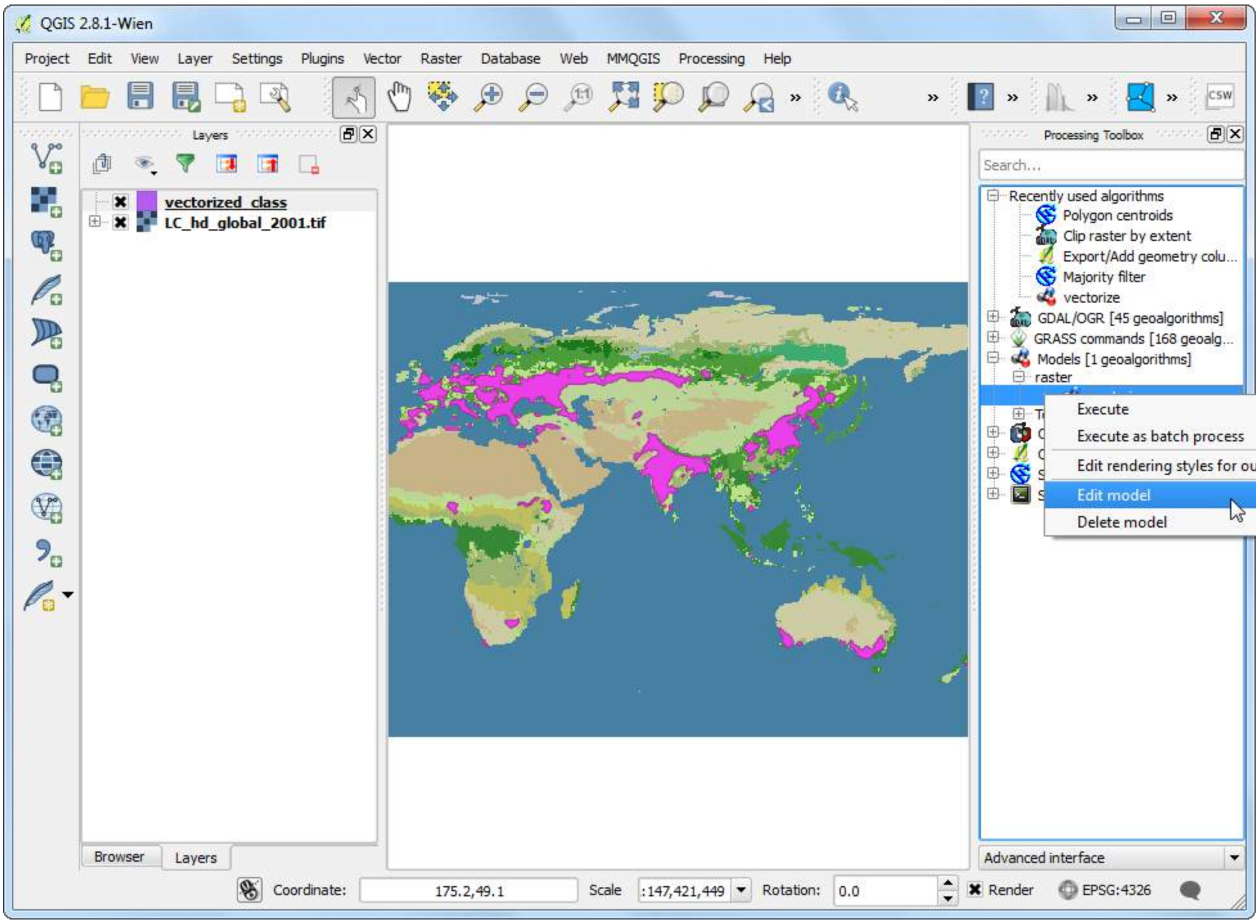
14. Find the newly created model under Models ‣ raster ‣ vectorize. Double-click to launch the model.



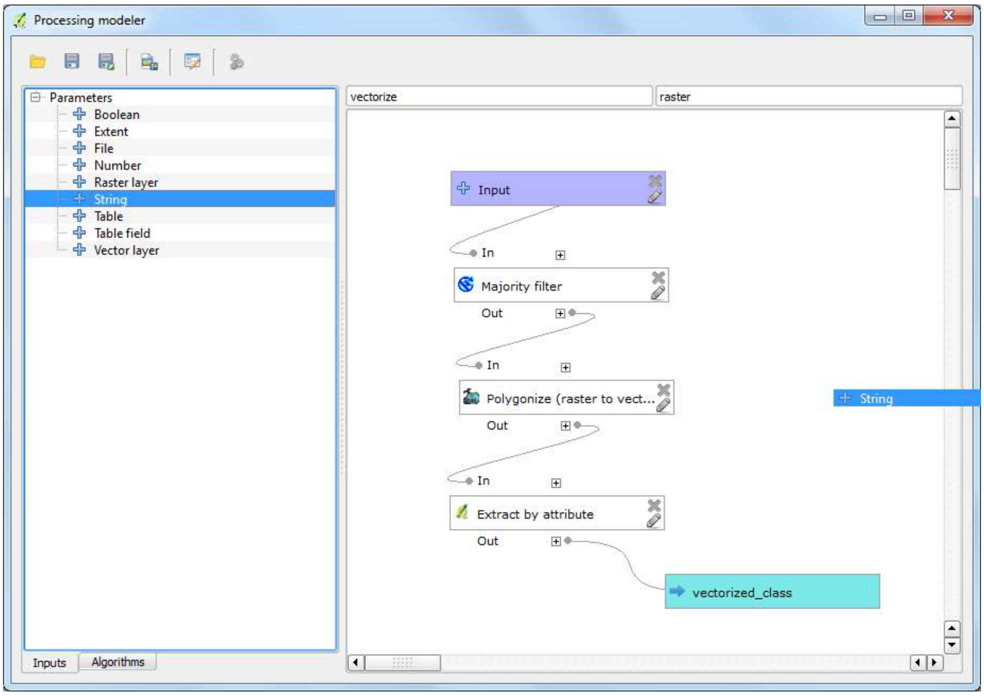
15. Select LC_hd_global_2001 as the Input and click Run.



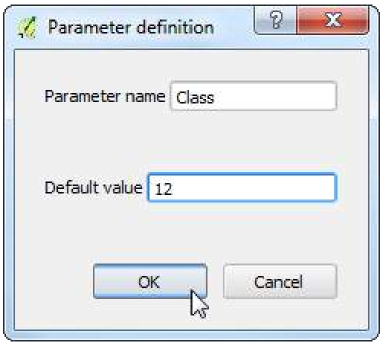
16. You will see all the steps being executed without any user input. Once the processing finishes, a new layer vectorized_classwill be added to QGIS. Let's improve the model a little bit. Right-click on the vectorize model and select Edit model.



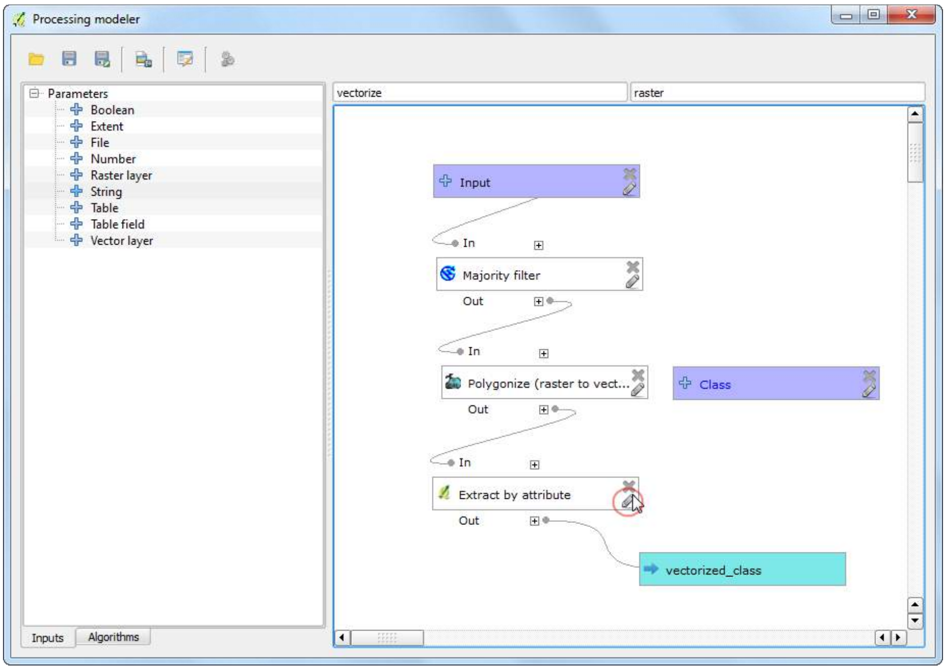
17. In Step 12, we hard-coded the value 12 as the class value. Instead, we can specify it as a input parameter which the user can change. To add this, switch to the Inputs tab and drag the + String to the model.



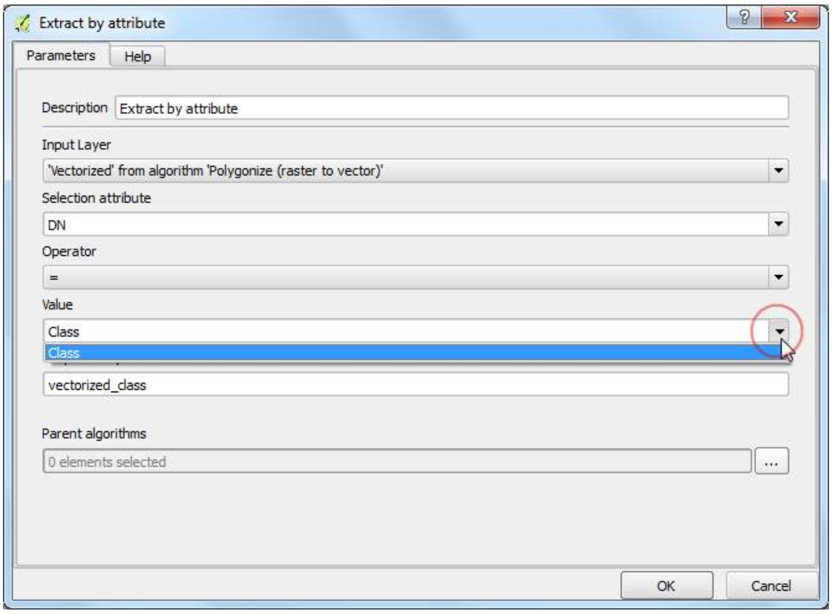
18. Enter the Parameter Name as Class. Enter 12 as the Default value.



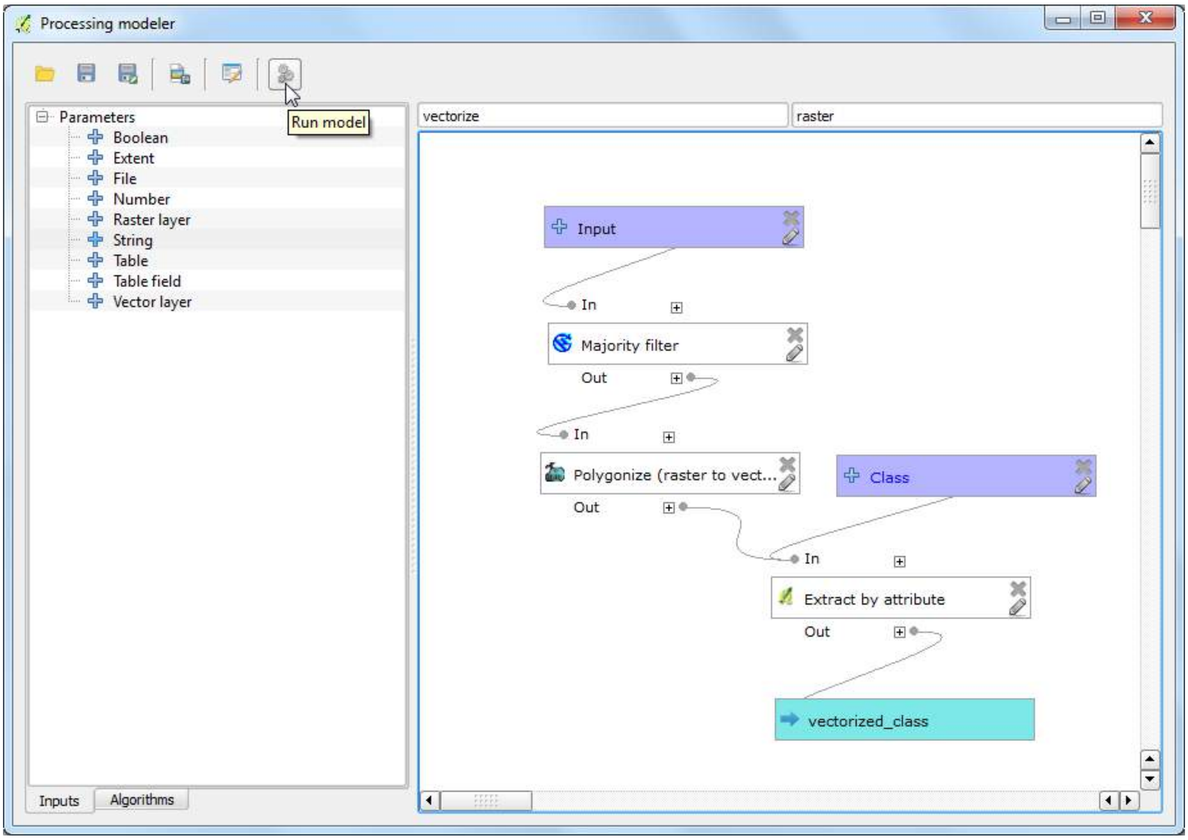
19. We will now change the Extract by attribute algorithm to use this input instead of the hard-coded value. Click the Editbutton next to the Extract by attribute box.



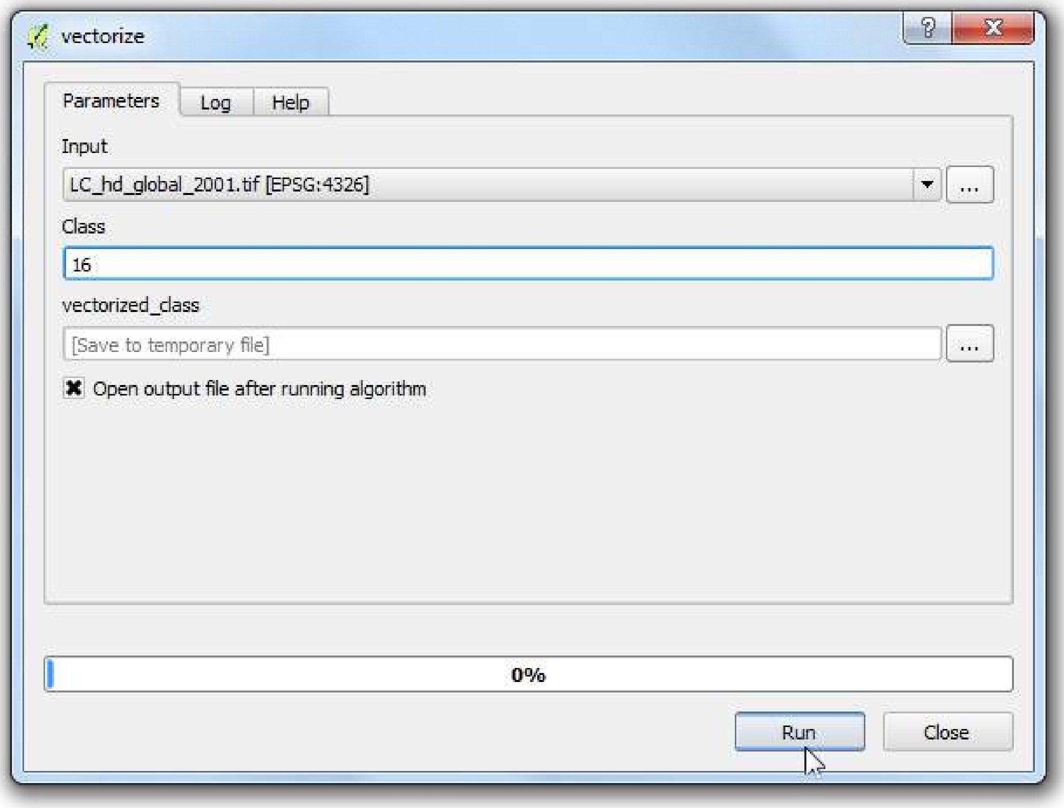
20. Click the dropdown arrow for Value and select Class. Click OK.



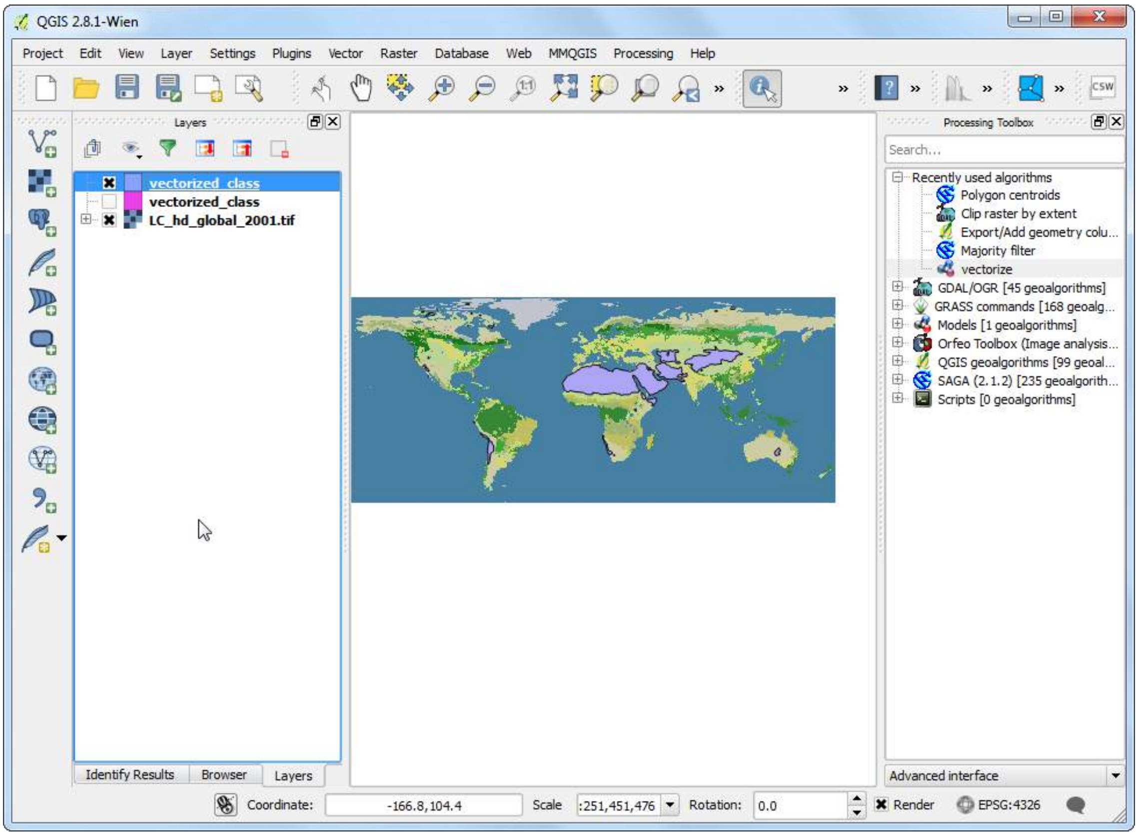
21. You will see from the model diagram that the Extract by attribute algorithm now uses 2 inputs. The modeler has a shortcut to launch the model and test it. Click the Run button from the toolbar.



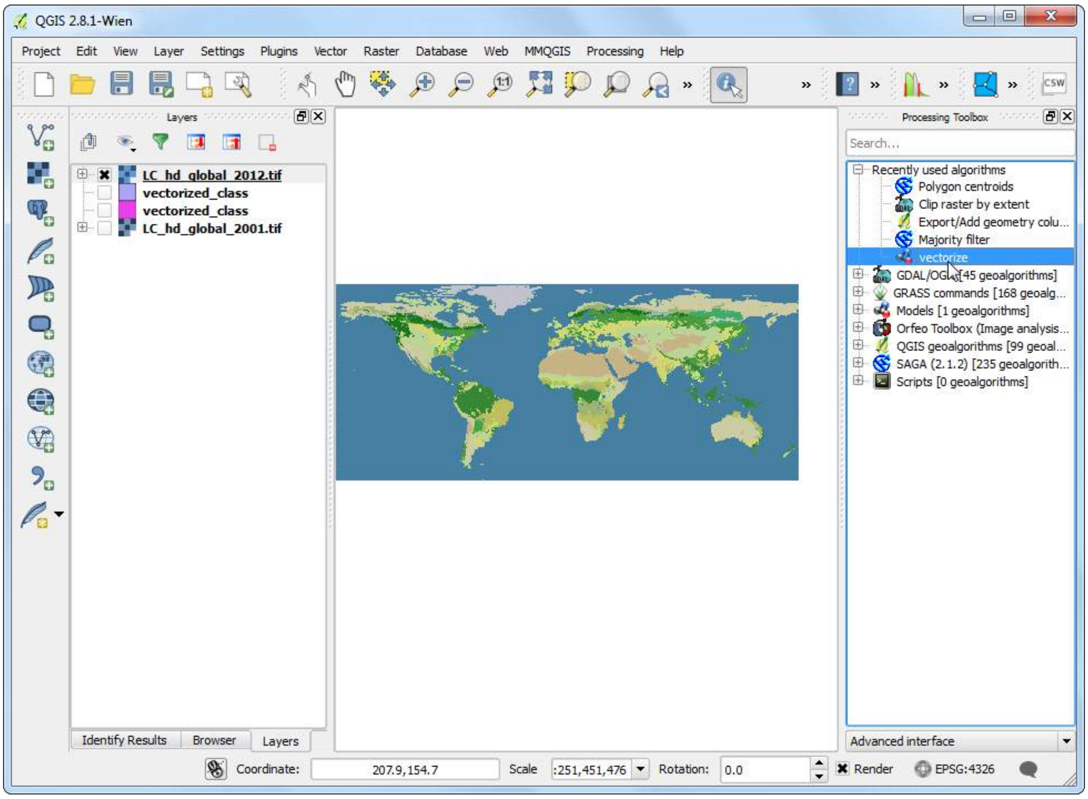
22. Notice that the model dialog has a new editable field called Class. Enter 16 as the Class value and click Run.



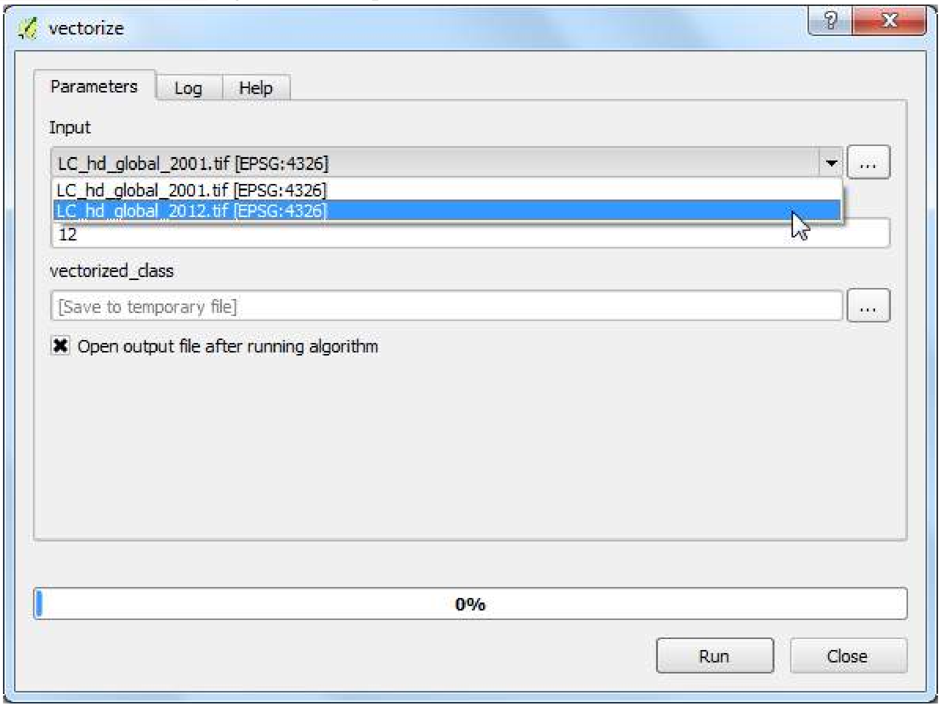
23. Once the processing finishes, you will see that with just a click of a button we were able to run a complex workflow and extract the area for class 16.



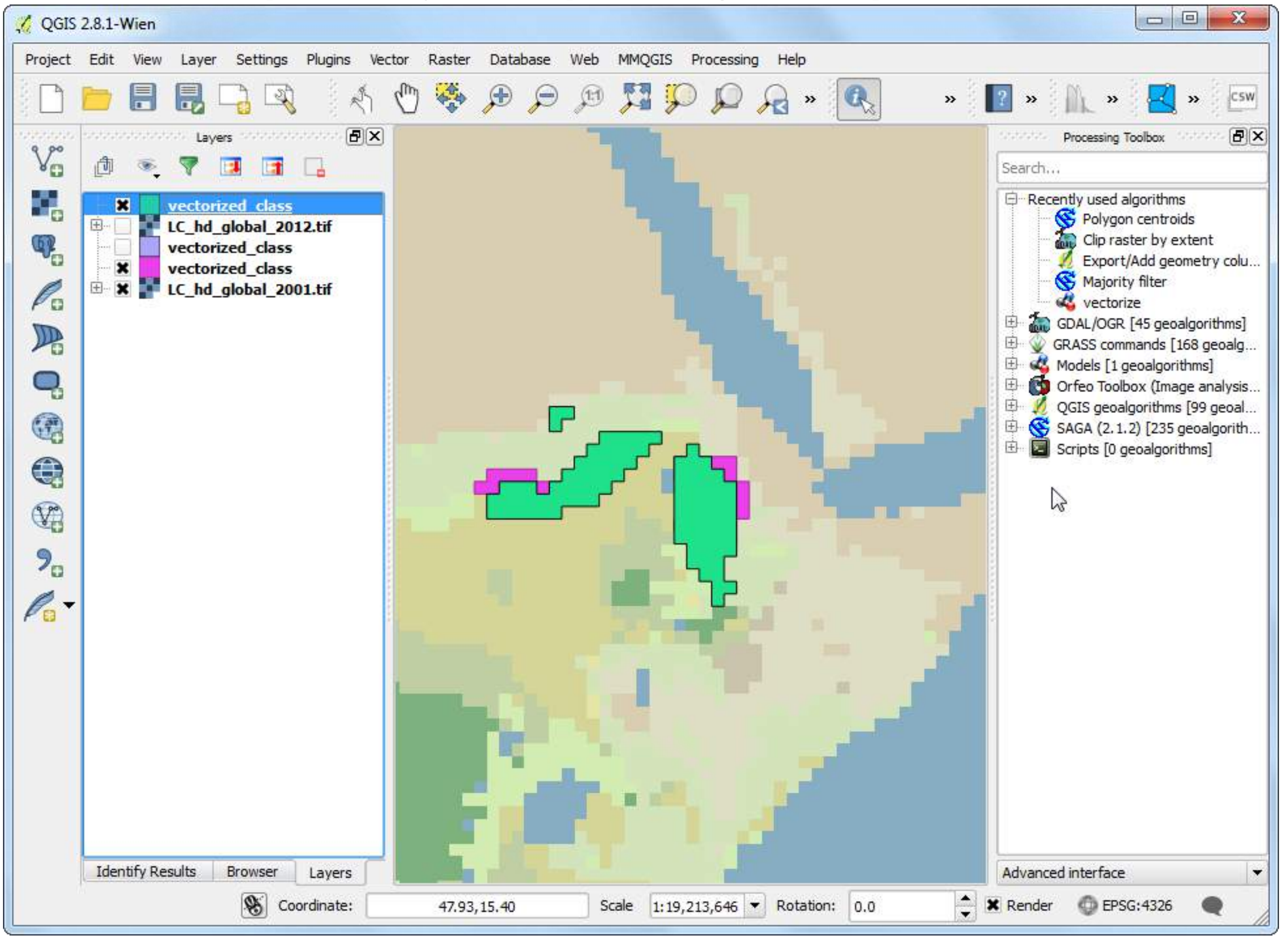
24. Now that our model is ready, we can run it just as easily on a new raster layer. Load the LC_hd_global_2012.tif.gz file by going to Layer ‣ Add Layer ‣ Add Raster Layer.... Click the vectorize` model from the Processing Toolbox panel.



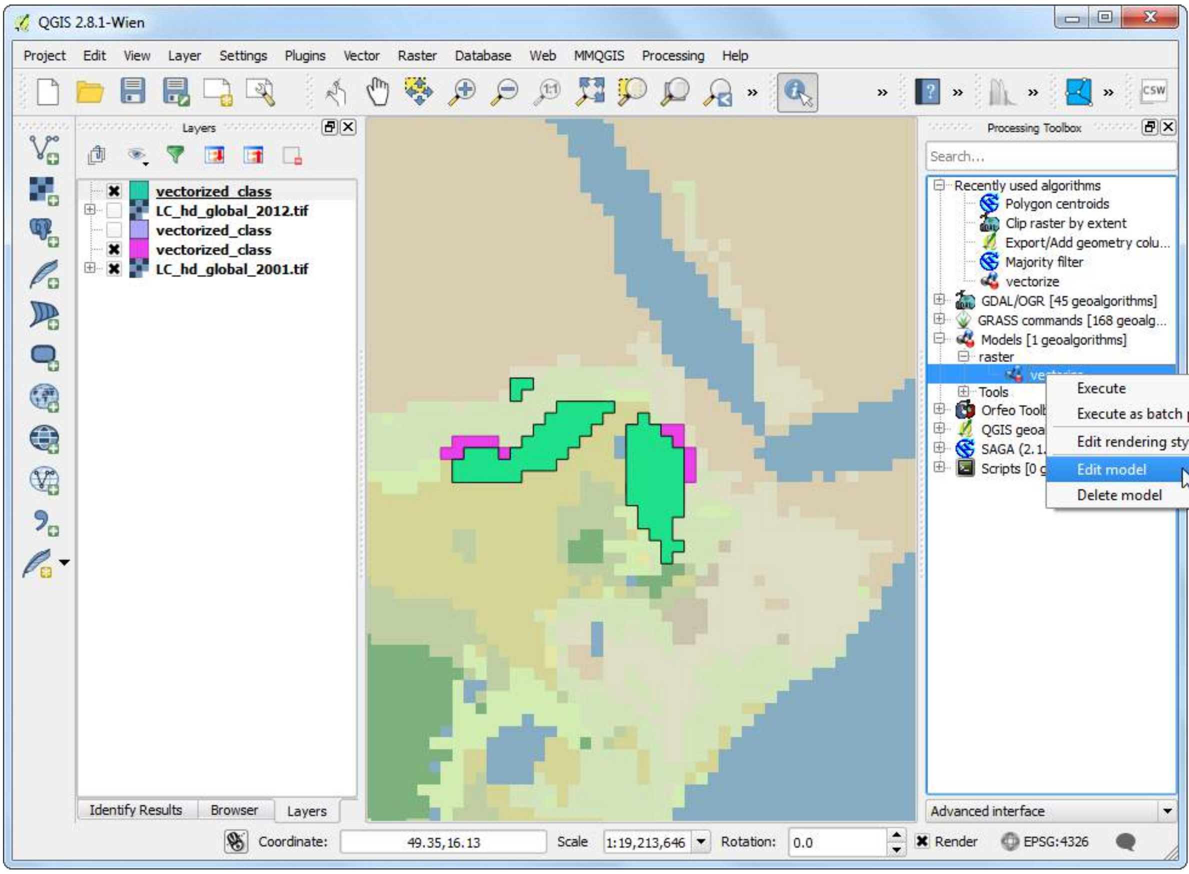
25. Pick the LC_hd_global_2012 layer as the Input and click Run.



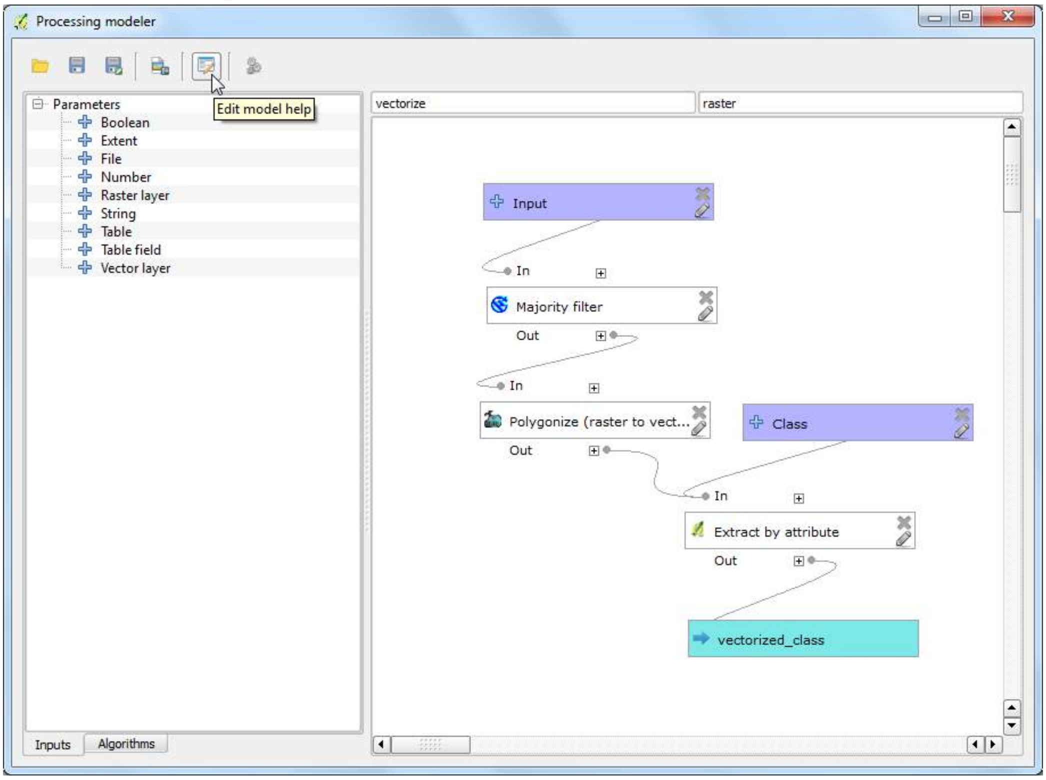
26. Once the new output is loaded, you can compare the changes in the Croplands from 2001 to 2012.



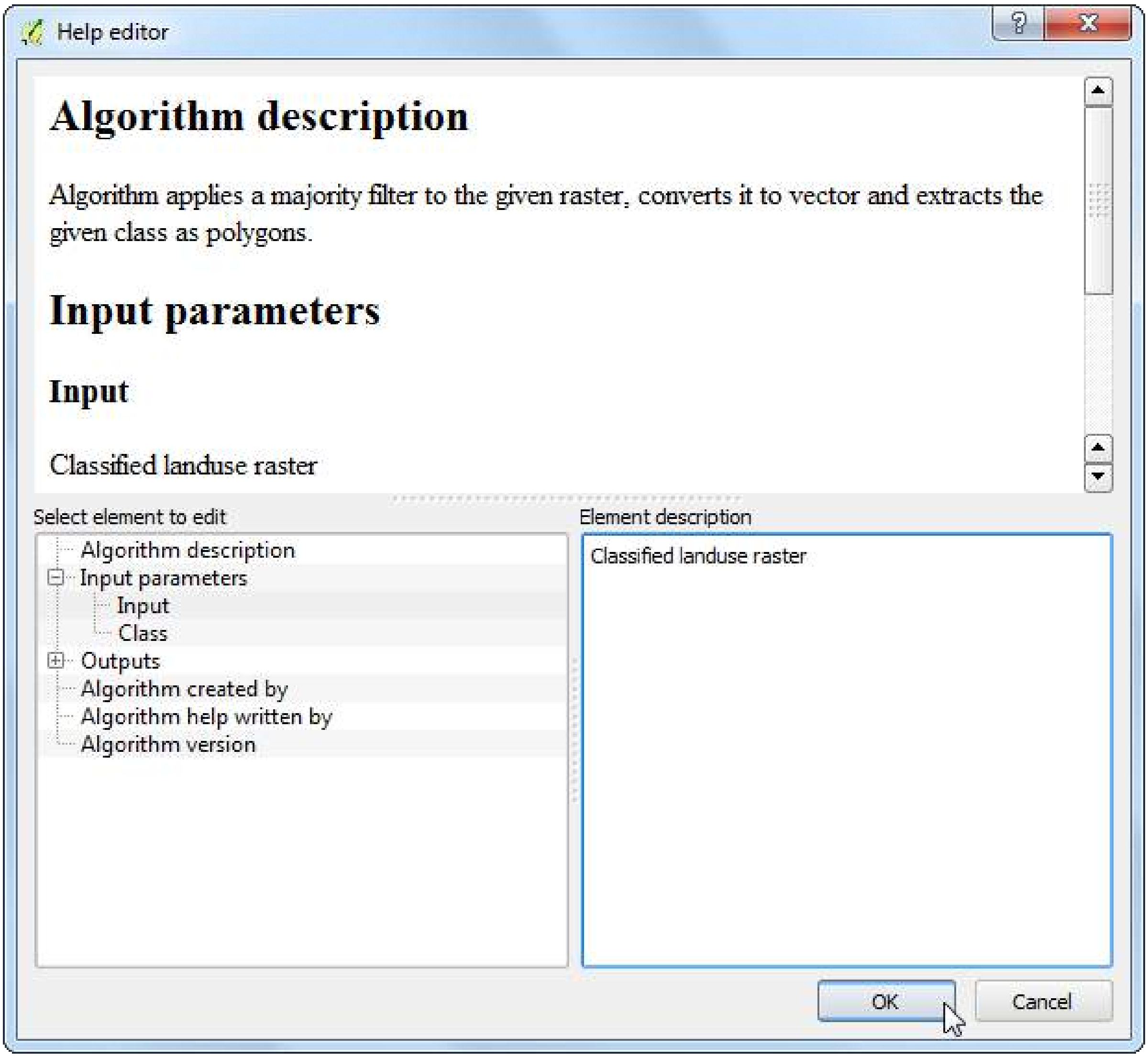
27. It is always a good idea to add documentation to your model. The modeler has a built-in Help editor that allows you to embed help directly in the model. Right-click the vectorize model and select Edit model.



28. Click the Edit model help button from the toolbar.



29. In the Help editor dialog, select any item from the Select element to edit panel and enter the help text in Element description. Click OK. This help will be available in the Help tab when you launch the model to run.

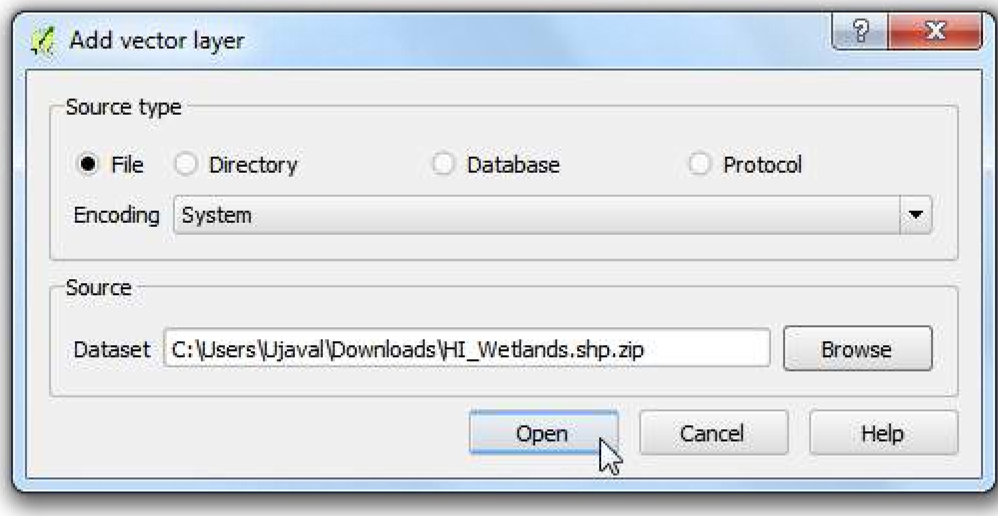

Help editor
Algorithm description
Algorithm applies a majority filter to the given raster, converts it to vector and extracts the given class as polygons.
Input parameters
Input
Classified landuse raster
Select element to edit
Algorithm description
Input parameters
Input
Class
Outputs
Algorithm created by
Algorithm help written by
Algorithm version
Element description
Classified landuse raster
OK
Cancel

(c) Automating Map Creation with Print Composer Atlas

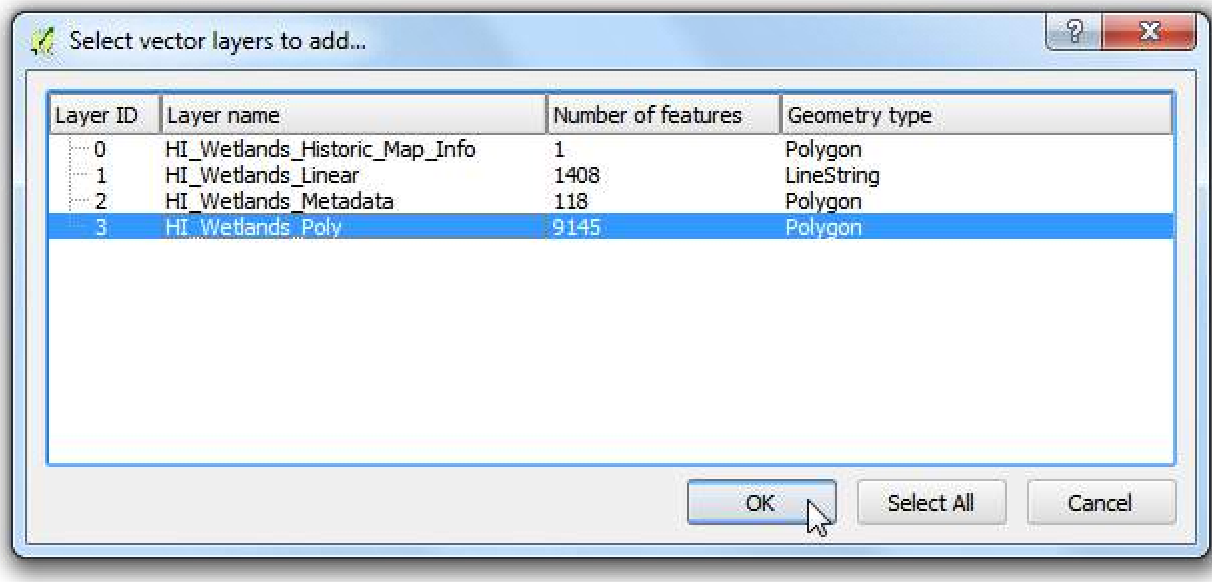
Procedure

1. Launch QGIS and go to Layer ‣ Add Layer ‣ Add Vector Layer.

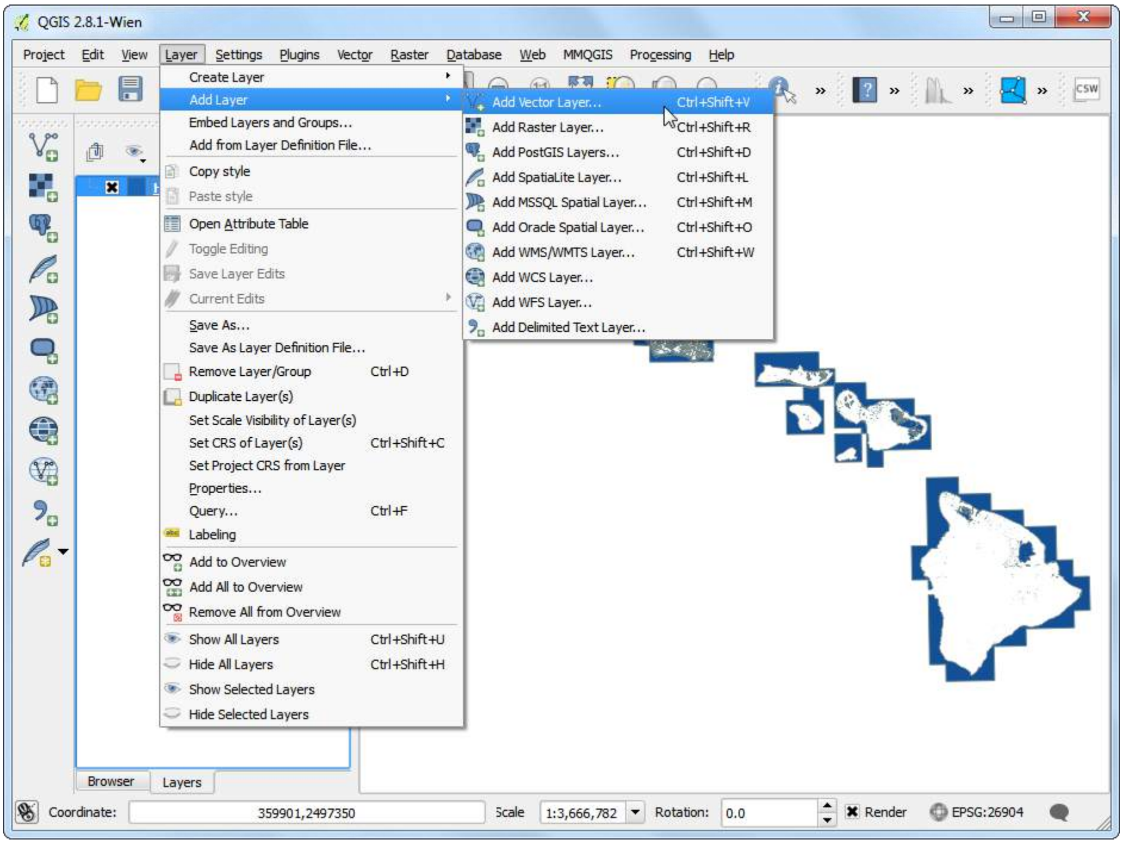
2. Browse to the HI_Wetlands.shp.zip file and click Open.



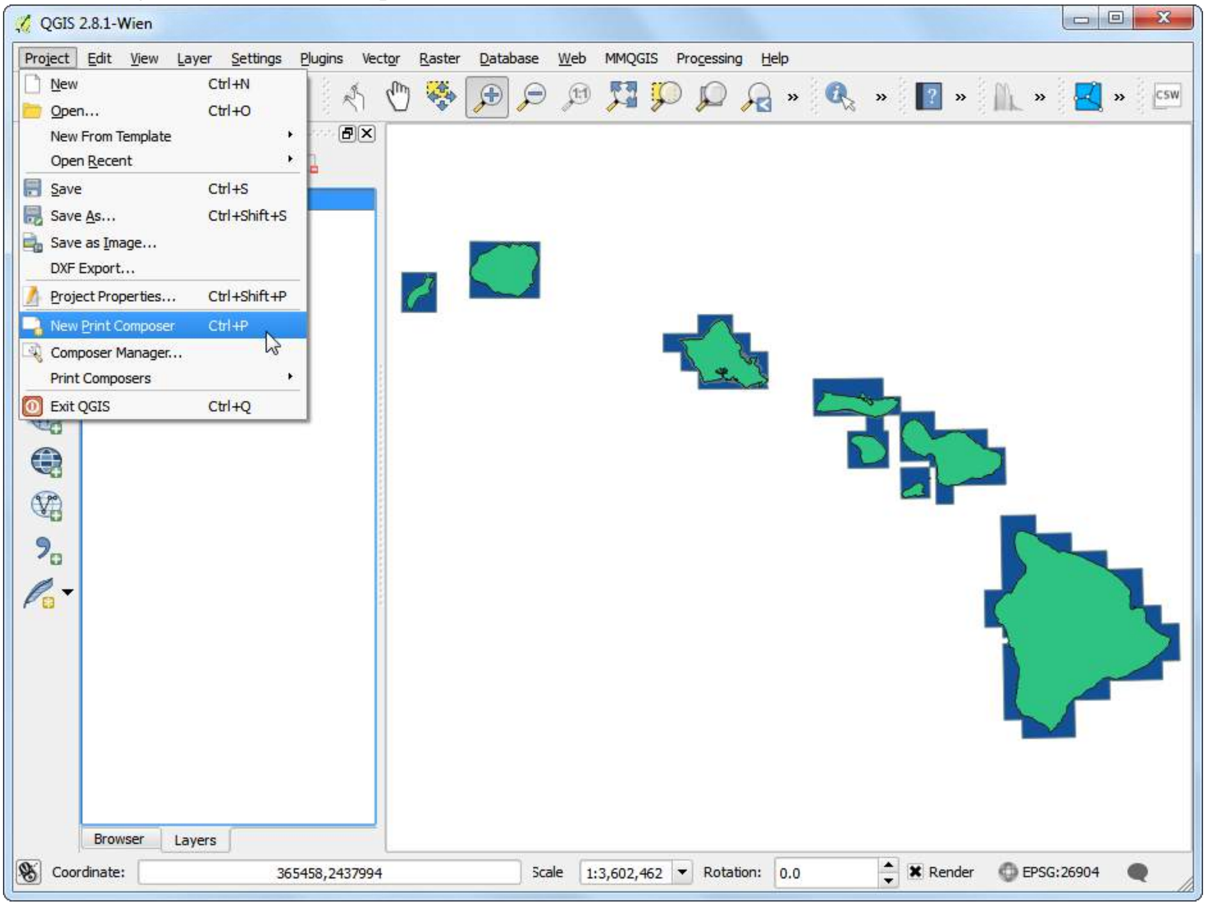
3. Select the HI_Wetlands_Poly layer and click OK.



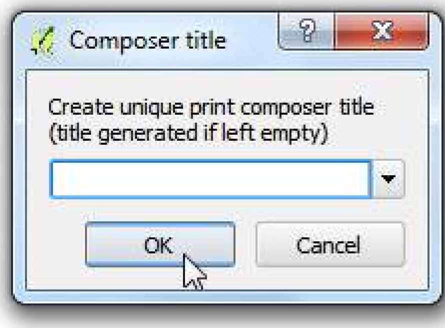
4. You will see the polygons representing the wetlands in the entire state of Hawaii. Since we want to make separate wetlands map for each county in the state, we will need the county boundaries layer. Go to Layer ‣ Add Layer ‣ Add Vector Layer and browse to the county10.shp.zip file. Click Open.



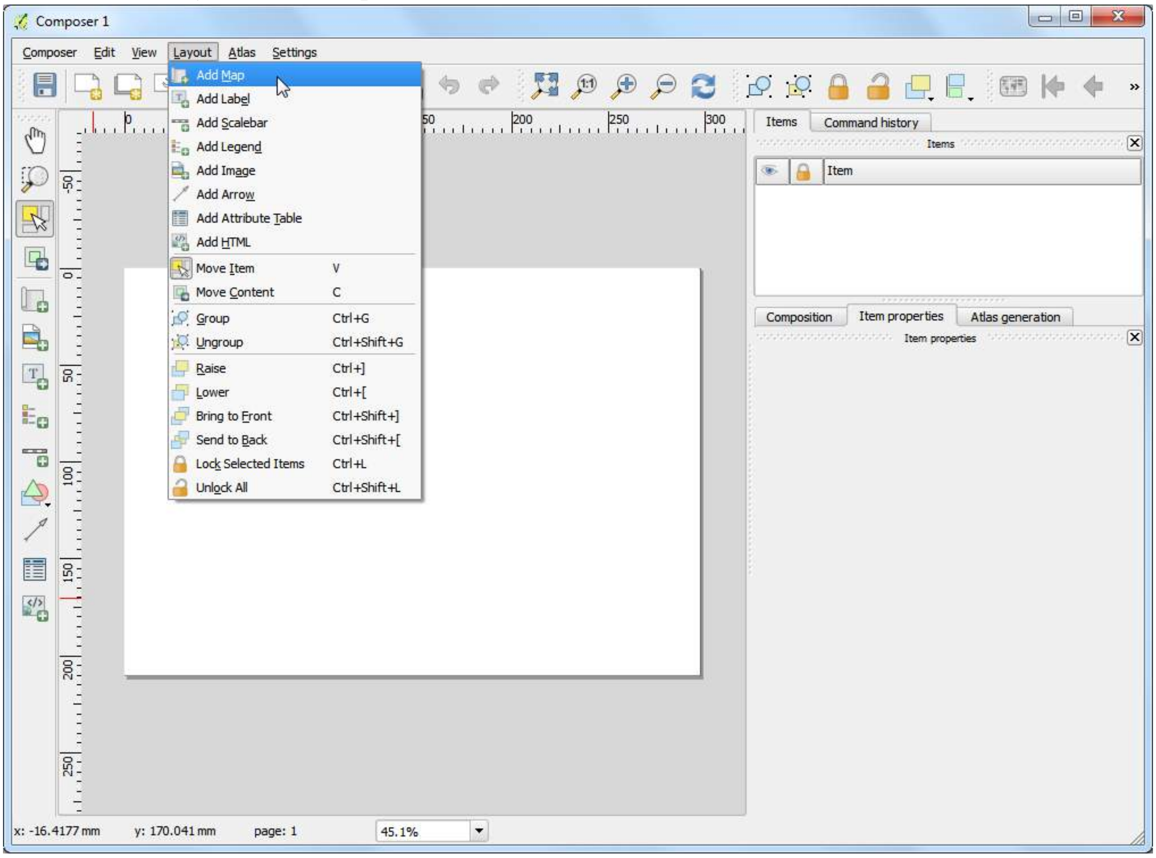
5. Go to Project ‣ New Print Composer.



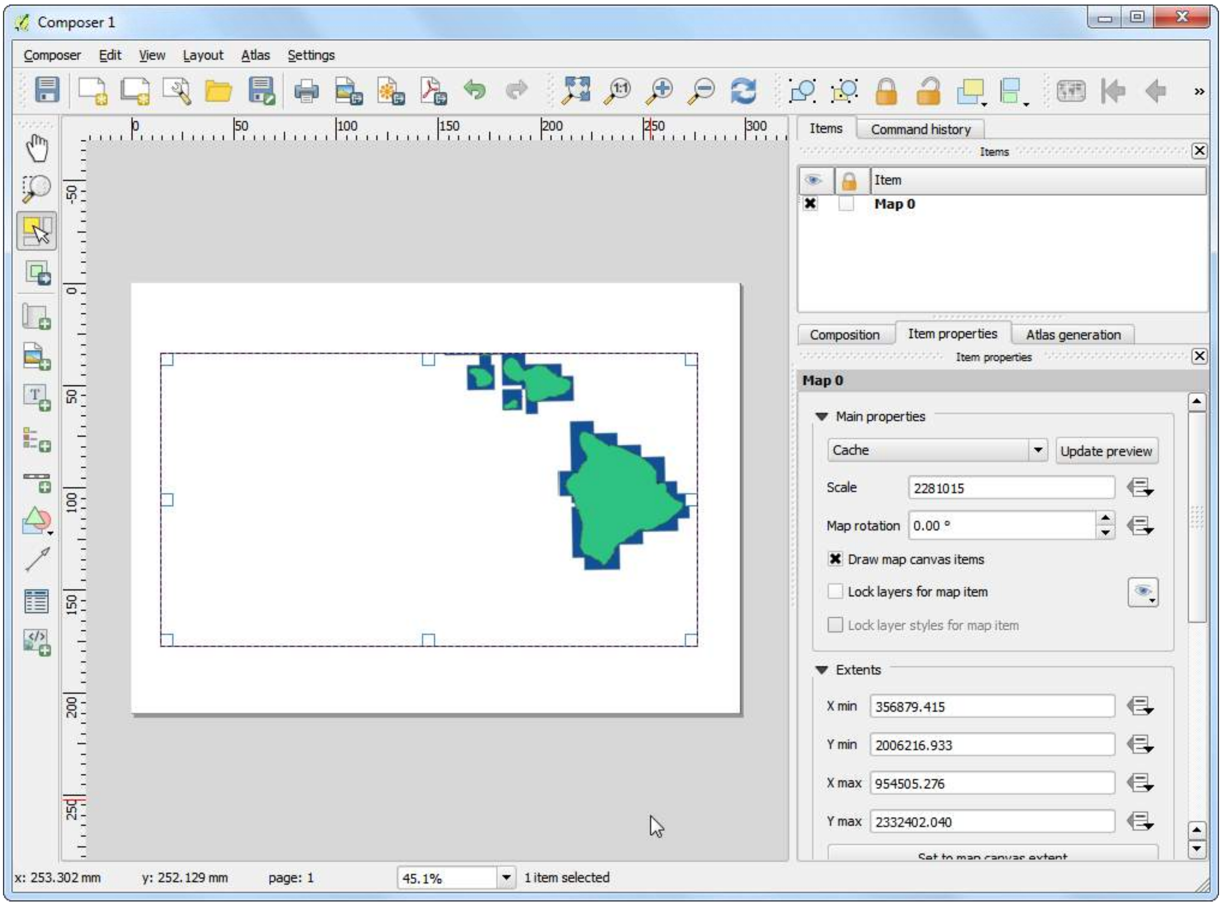
6. Leave the composer title field empty and click OK.



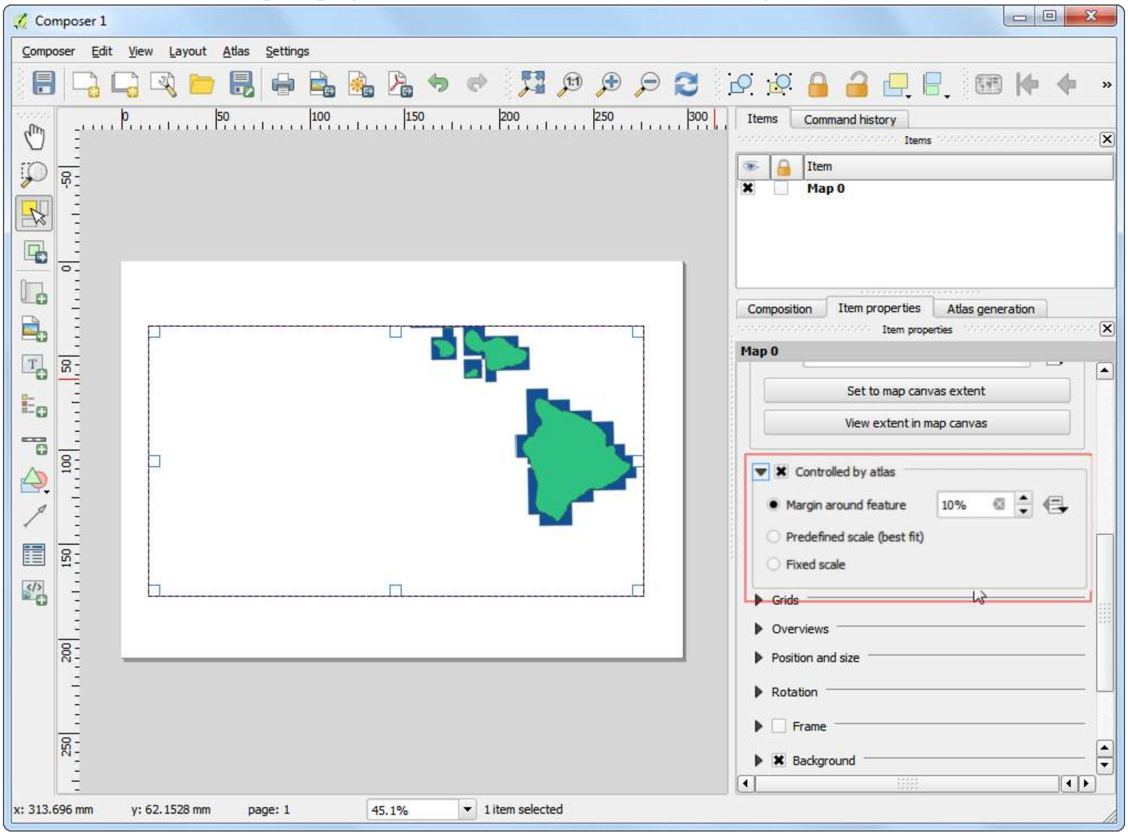
7. Go to Layout ‣ Add Map.



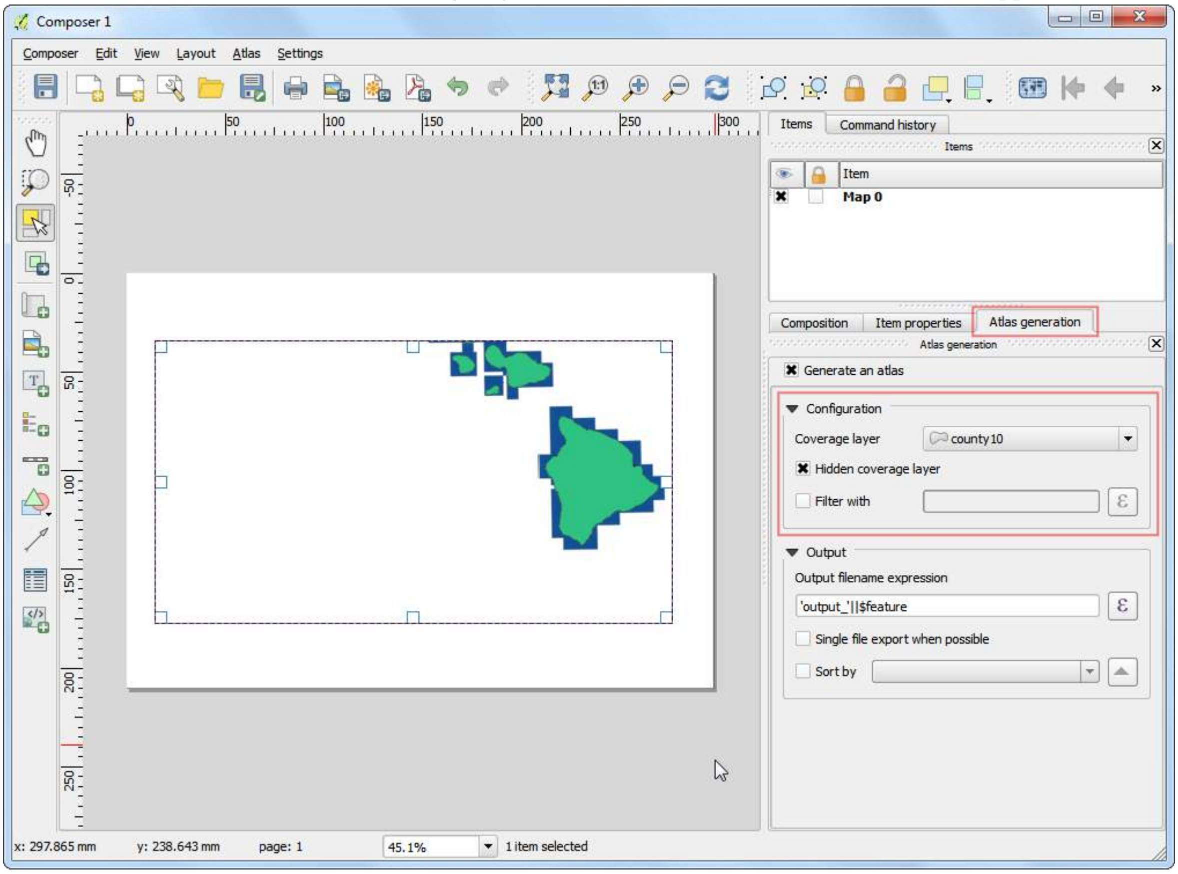
8. Drag a rectangle while holding the left mouse button where you would like to insert the map.



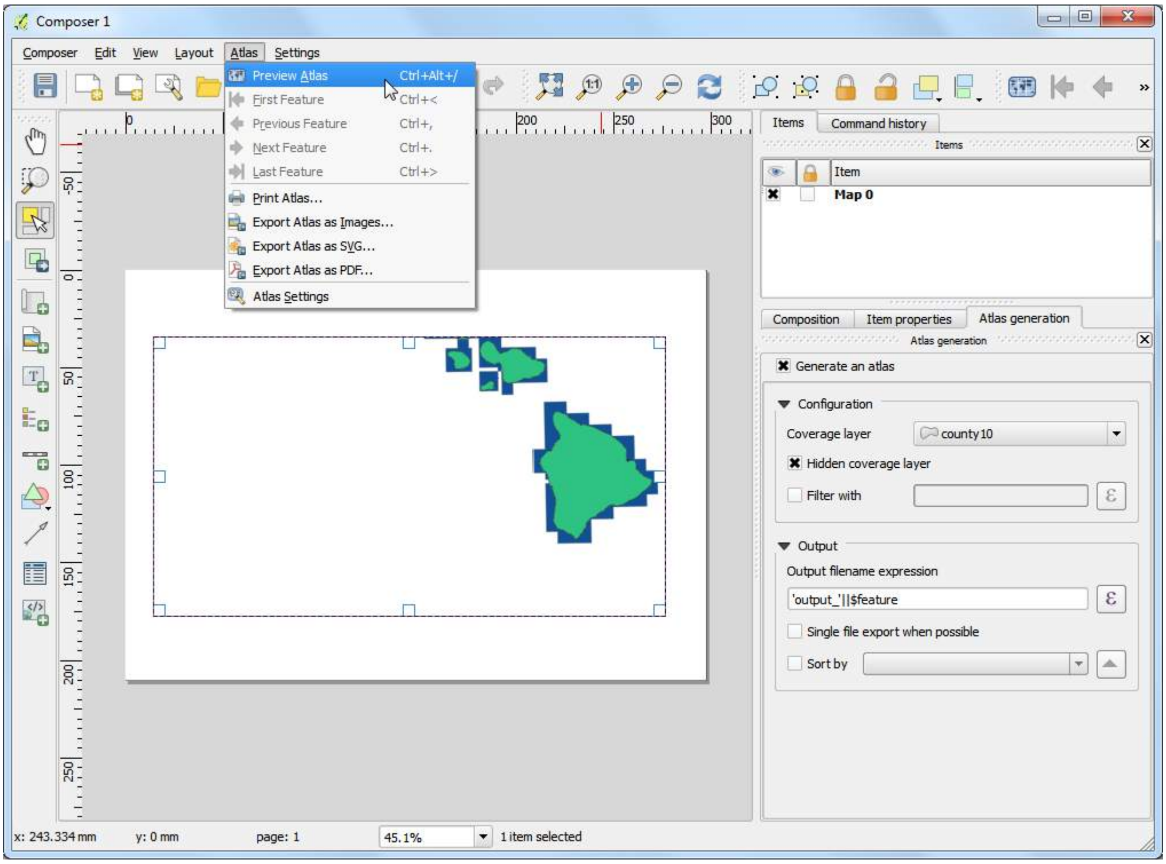
9. Scroll down in the Item Properties tab and check the Controlled by atlas box. This will indicate the composer that the extent of the map displayed in this item will be determined by the Atlas tool.



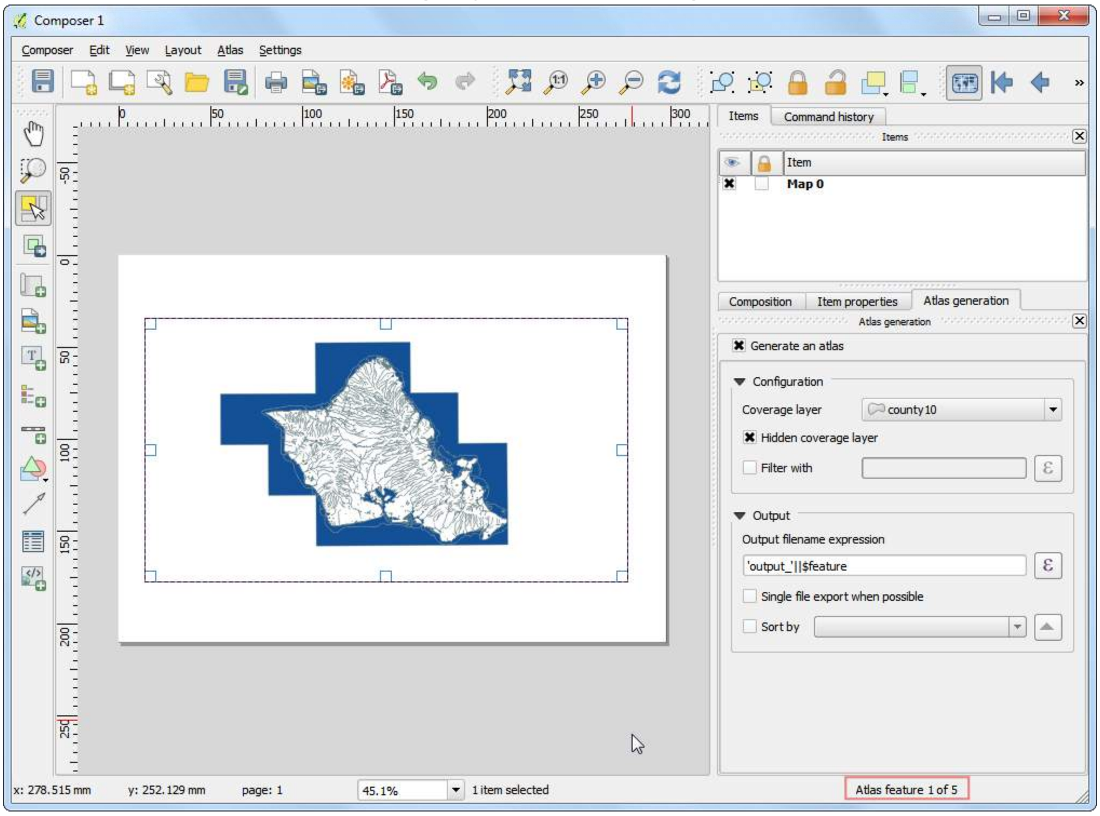
10. Switch to the Atlas generation tab. Check the Generate an atlas box. Select the county10 as the Coverage layer. This will indicate that we want to create 1 map each for every polygon feature in the county10 layer. You can also check the Hidden coverage layer so that the features themselves will not appear on the map.



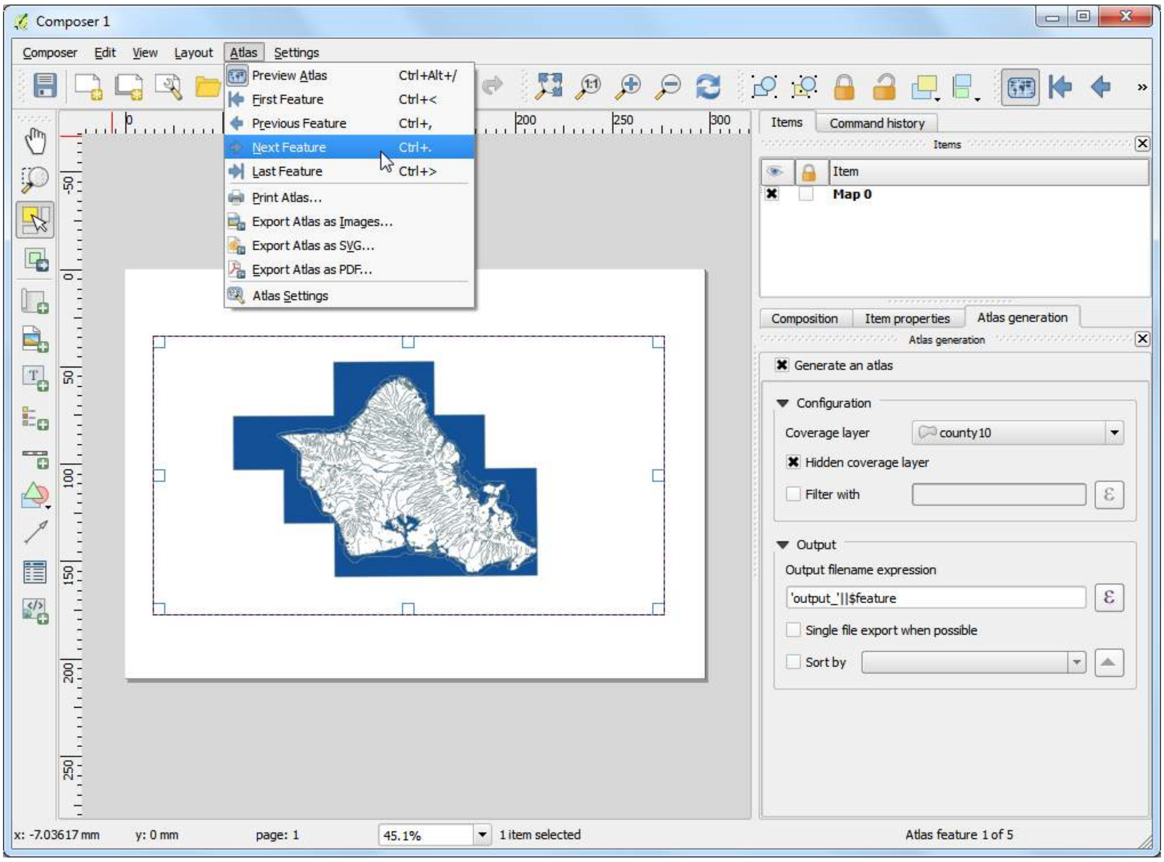
11. You will notice that the map image does not change after configuring the Atlas settings. Go to Atlas ‣ Preview Atlas.



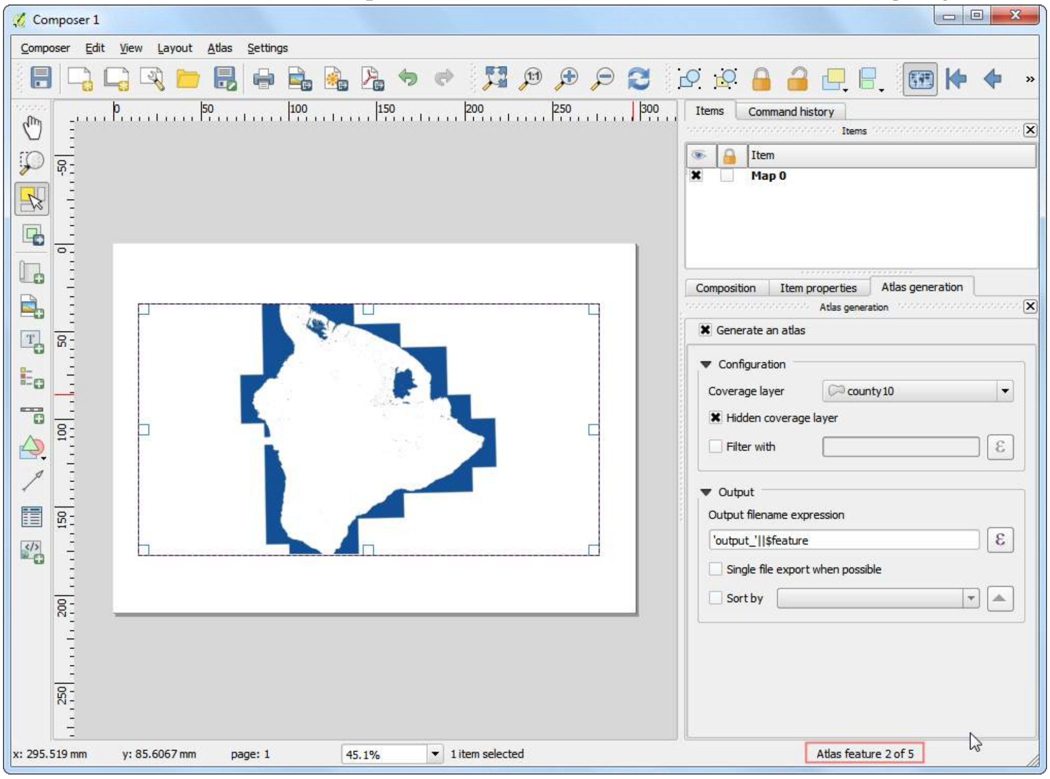
12. Now you will see the map refresh and show how individual map will look like. Notice that it shows the current feature number from the coverage layer at the bottom right.



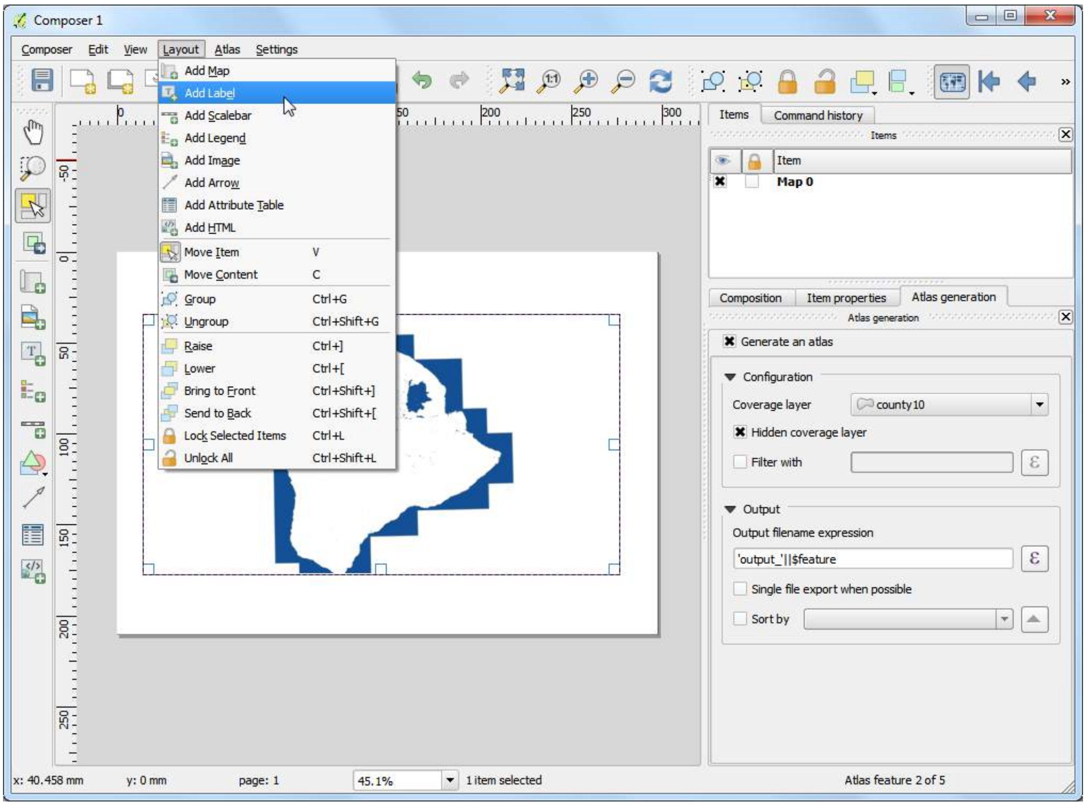
13. You can preview how the map will look for each of the county polygons. Go to Atlas ‣ Next Feature.



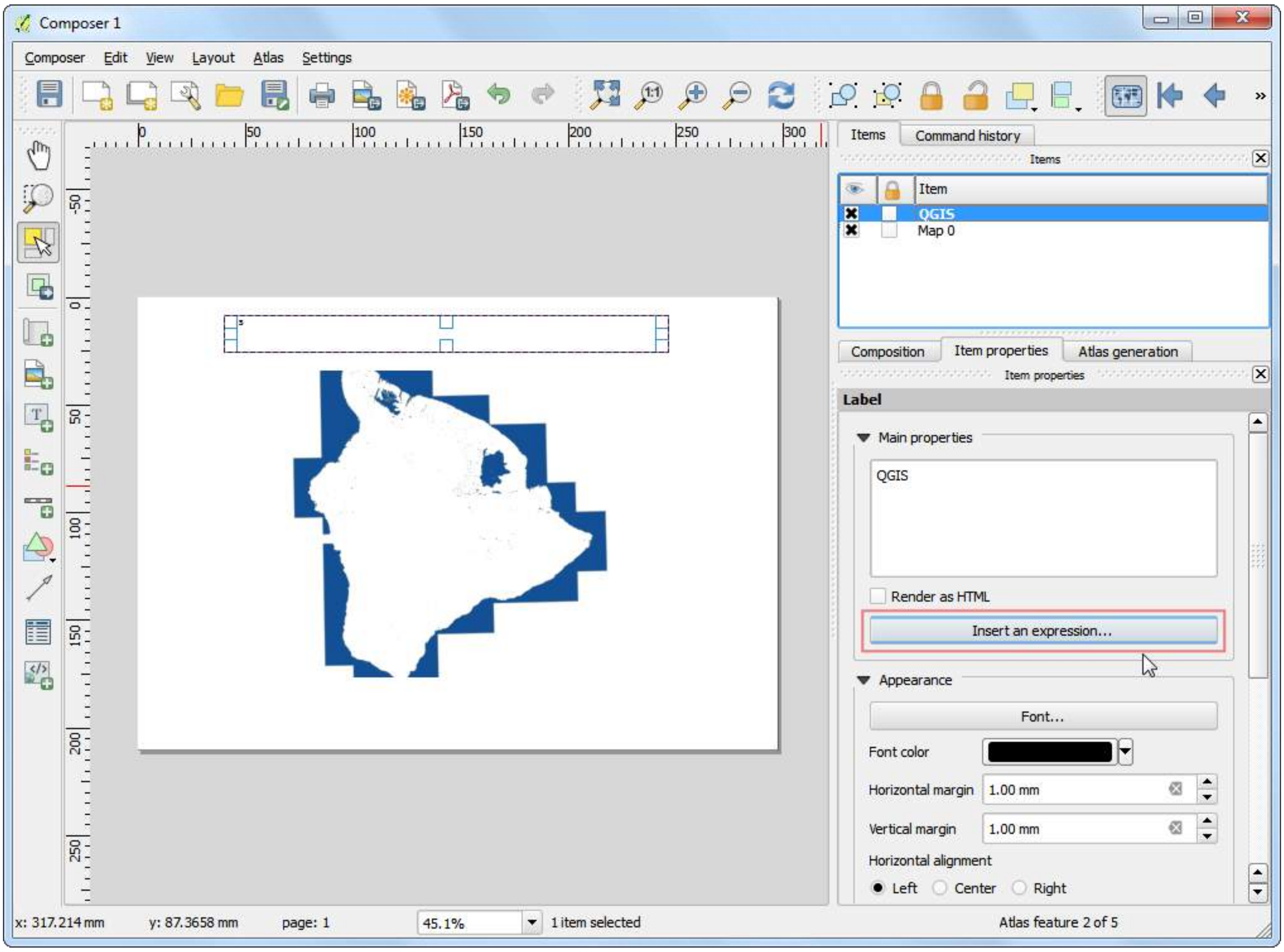
14. Atlas will render the map to the extent of the next feature in the coverage layer.



15. Let’s add a label to the map. Go to Layout ‣ Add Label.



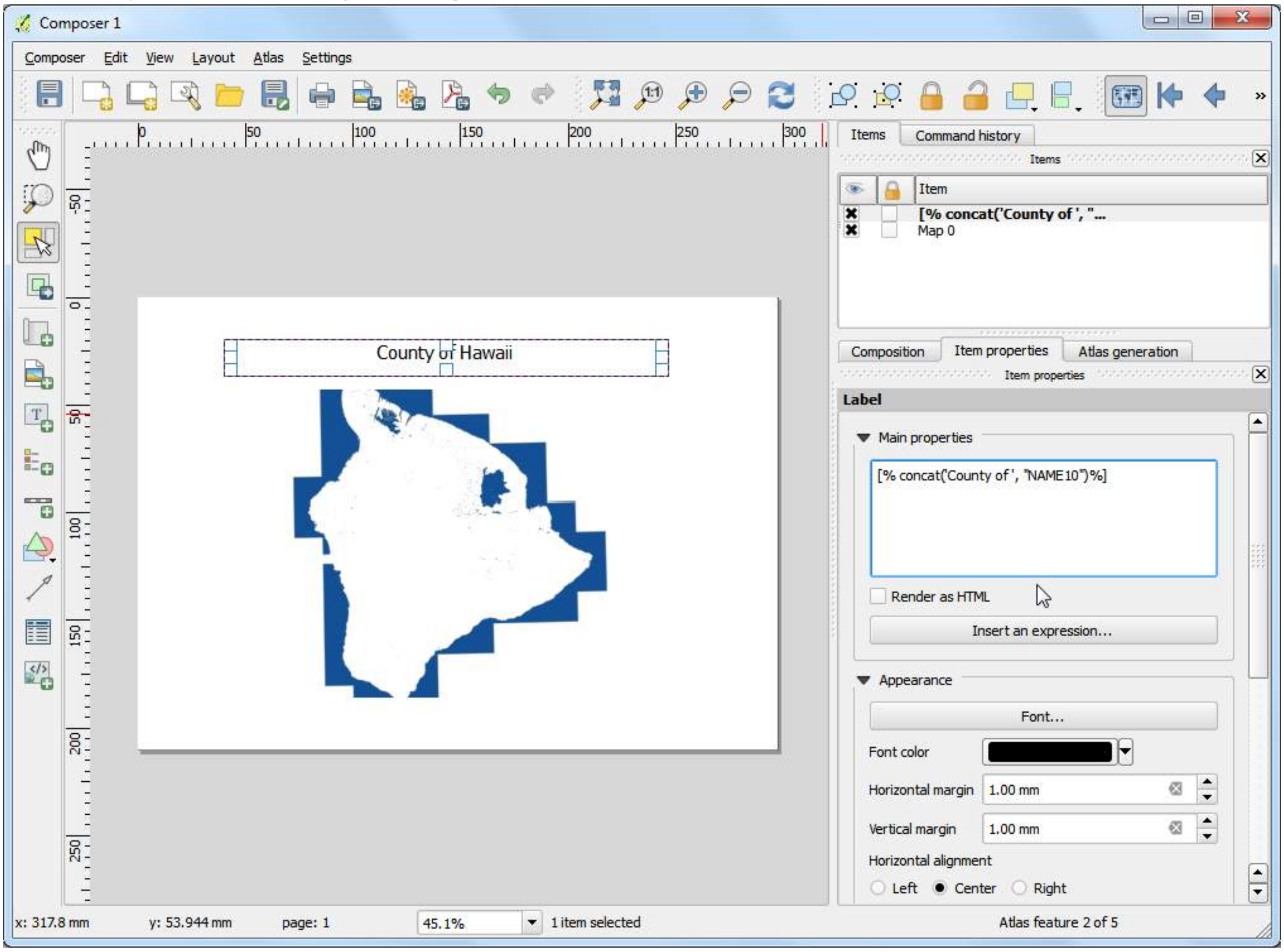
16. Under the Item properties tab, click Insert an expression... button.



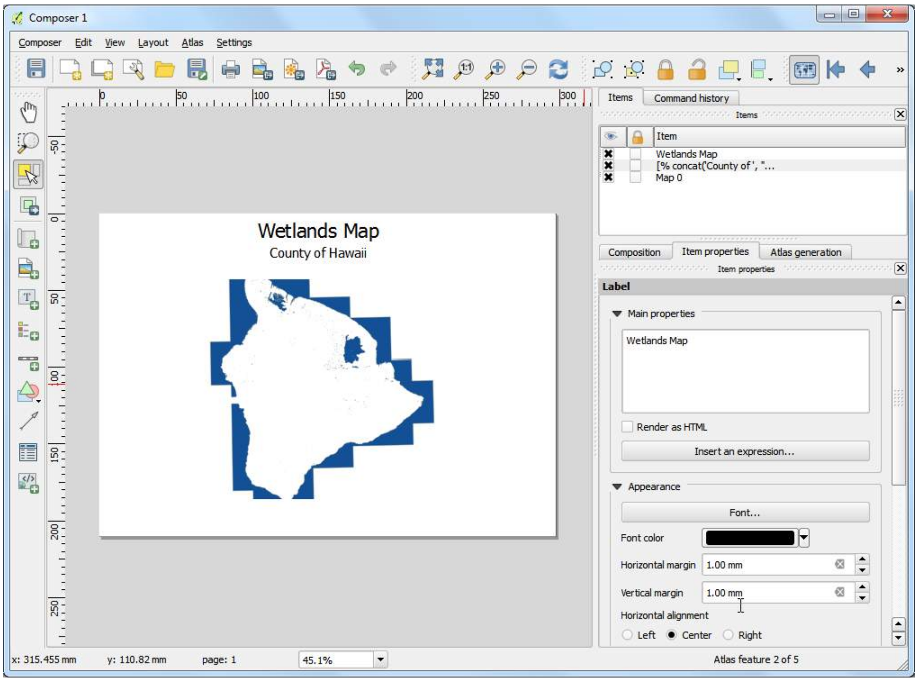
17. The label of the map can use the attributes from the coverage layer.he concat function is used to join multiple text items into a single text item. In this case we will join the value of the NAME10 attribute of the county10 layer with the text County of. Add an expression like below and click OK.

```
concat('County of ', "NAME10")
```

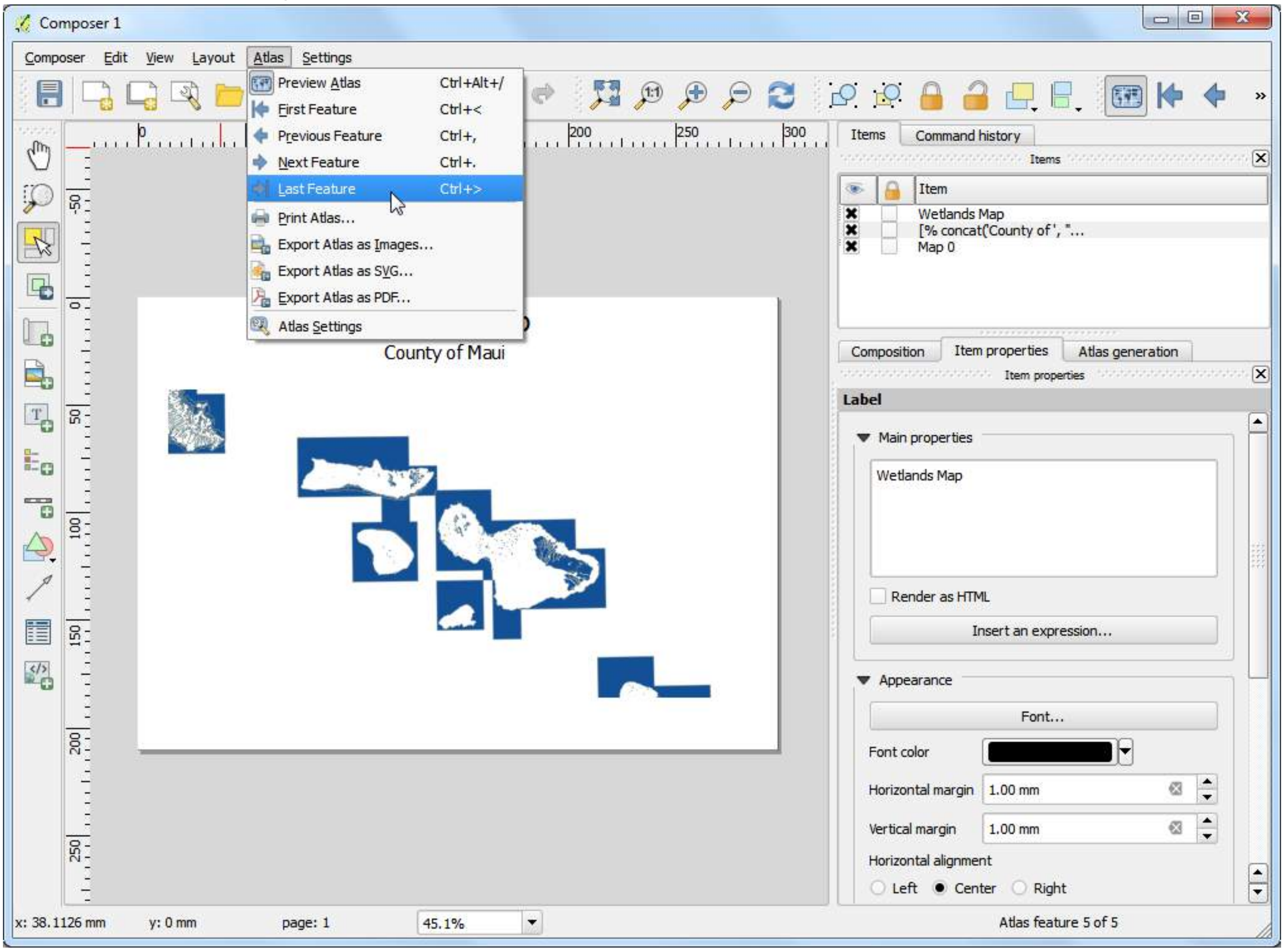
18. Adjust the font size to your liking.



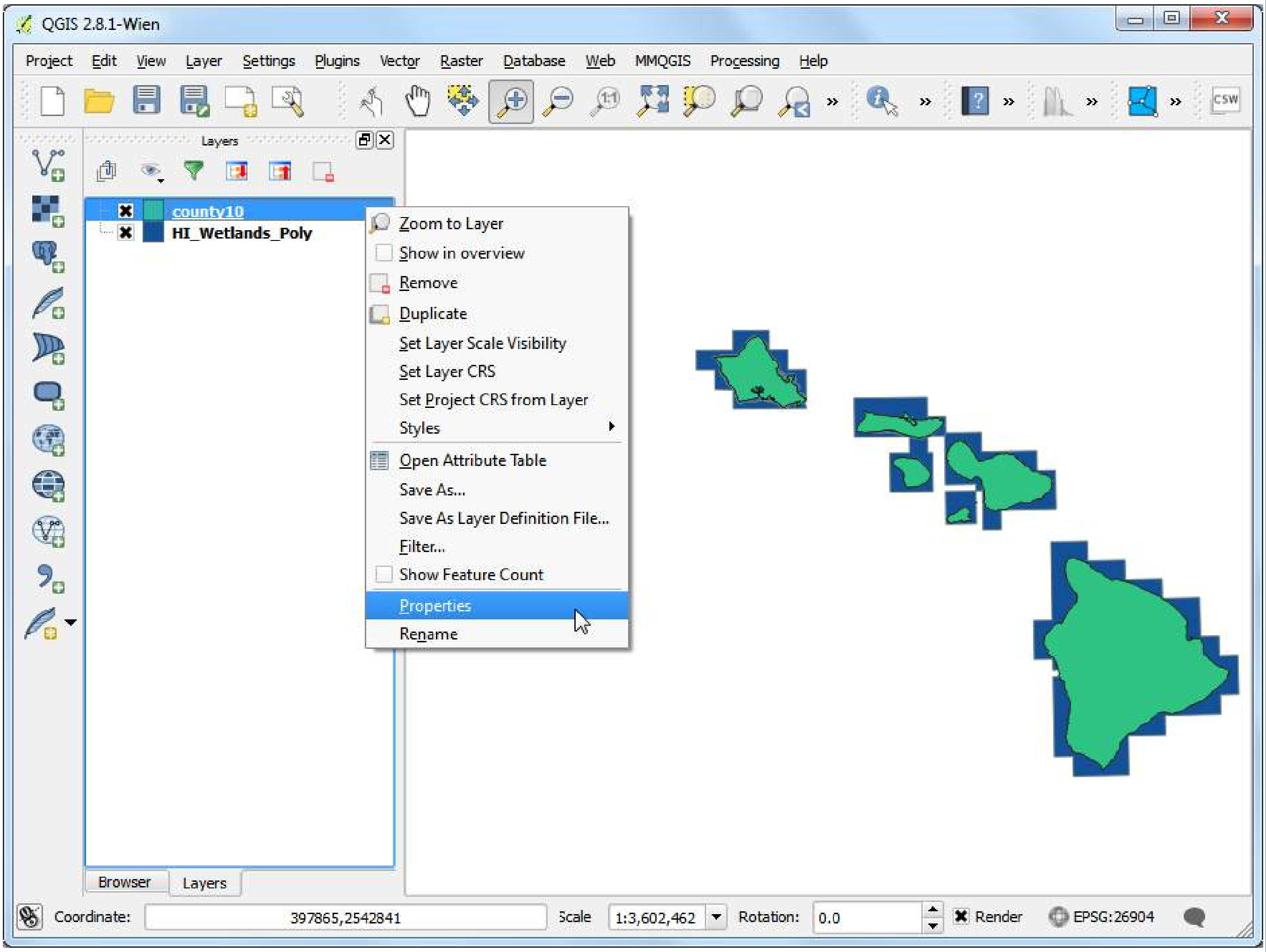
19. Add another label and enter Wetlands Map under the Main properties. Since there is no expression here, this text will remain the same on all maps.



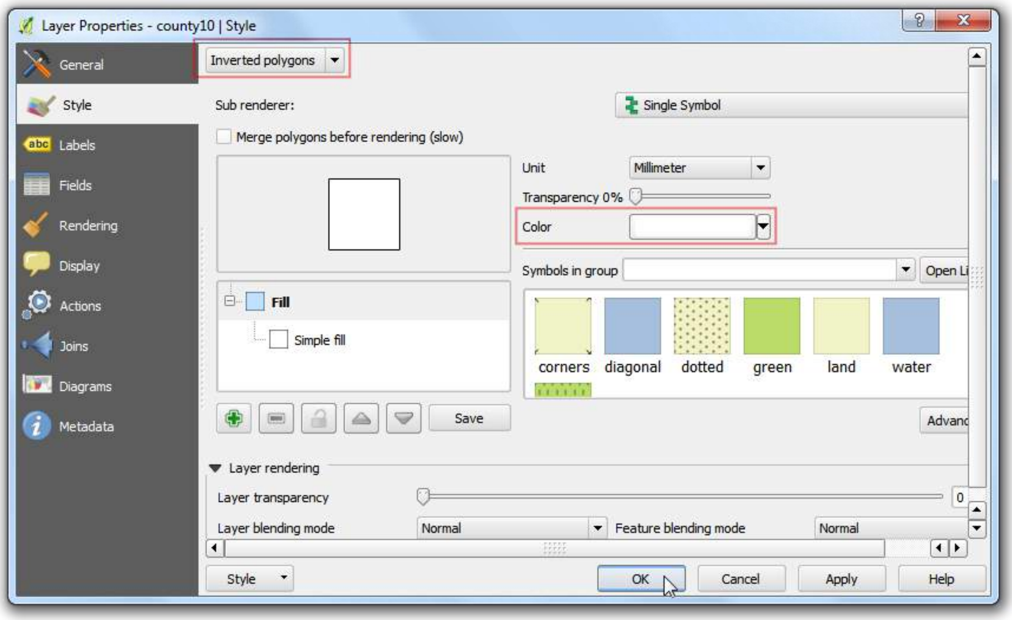
20. Go to Atlas ‣ Last Feature and verify that the map labels do work as intended. You will notice that the wetland map has polygons extending out in the ocean that looks ugly. We can change the style to that areas outside the county boundaries are hidden.



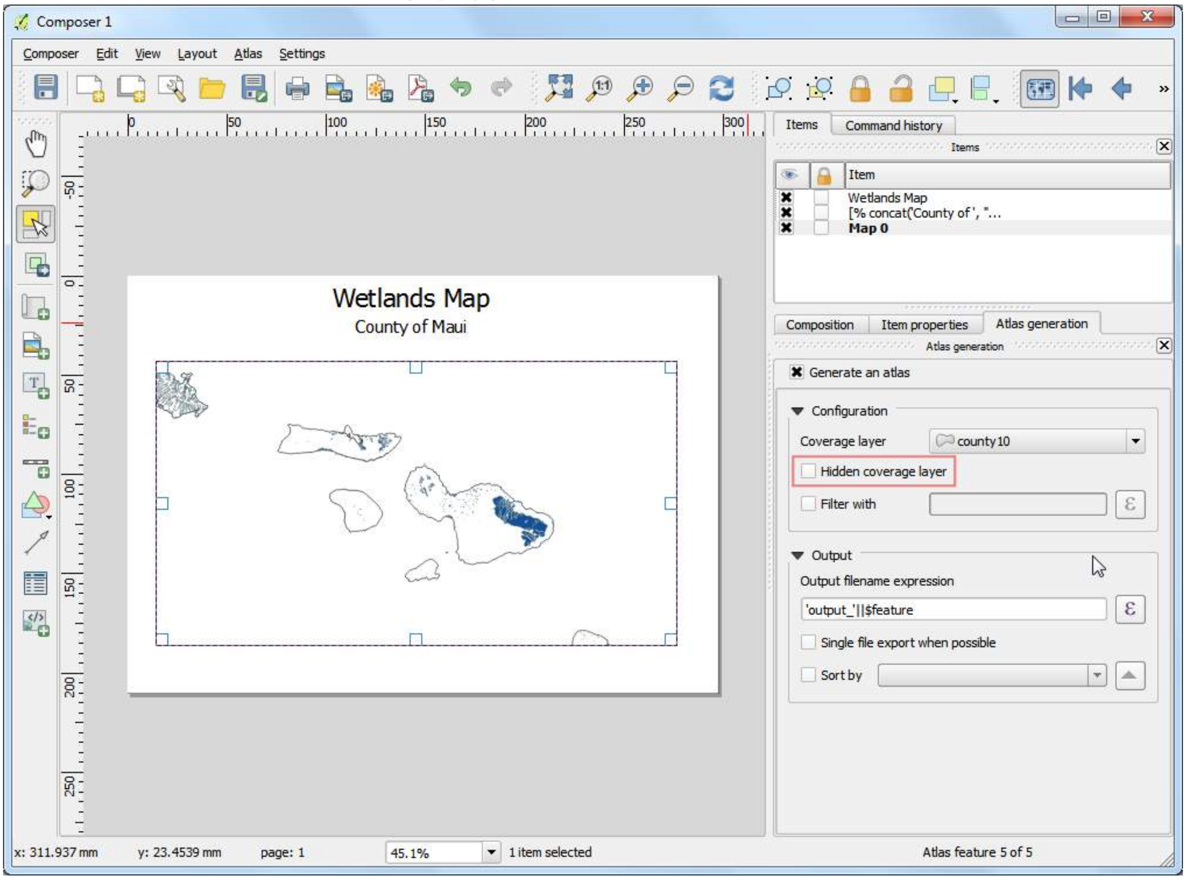
21. Switch to the main QGIS window. Right-click the county10 layer and select Properties.



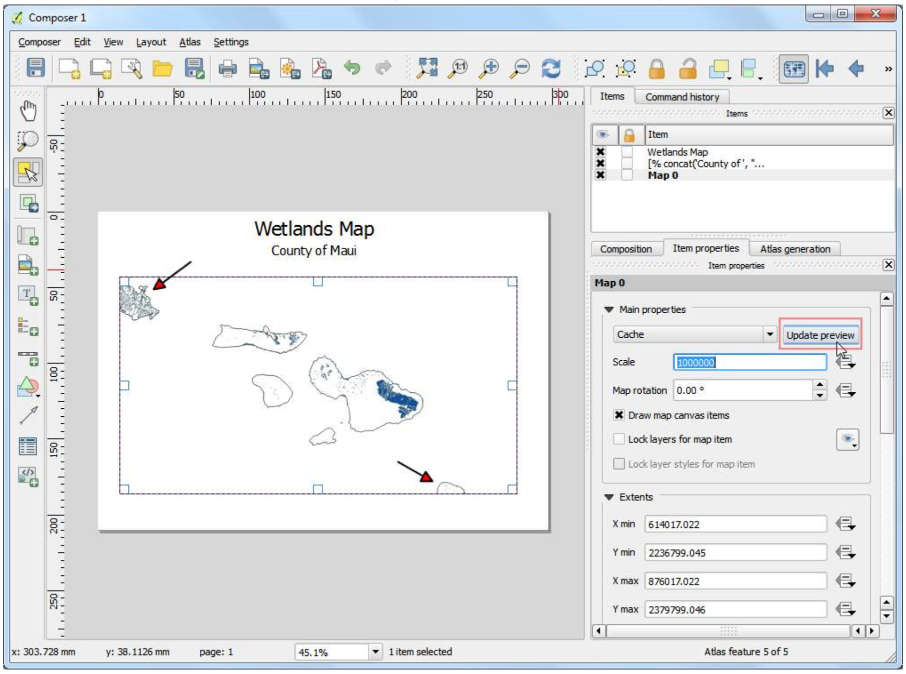
22. In the Style tab, select the Inverted polygons renderer. This renderer styles the *outside* of the polygon - not inside. Select white as the fill color and click OK.



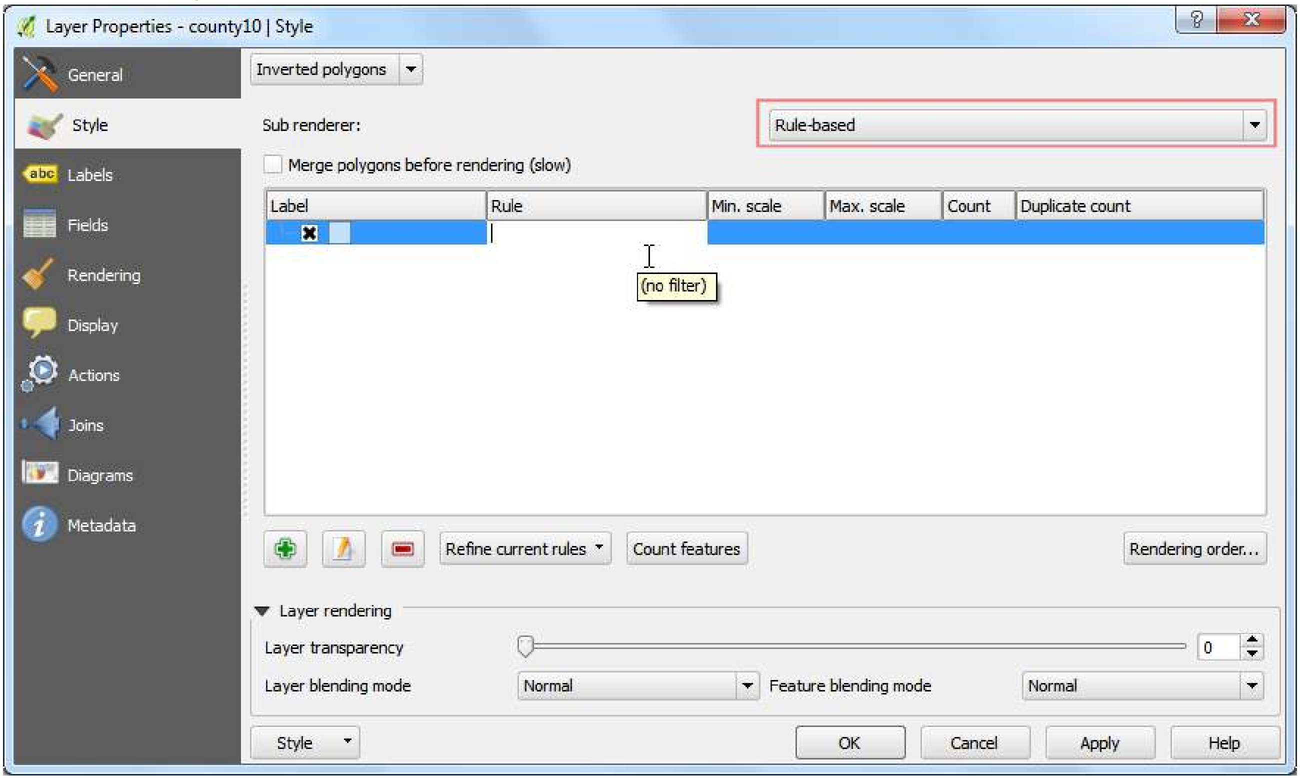
23. Switch to the Print Composer window. If we want the effect of the inverted polygons to show, we need to uncheck the Hidden coverage layer box under Atlas generation. You will now see that the rendered image is clean and areas outside the coverage polygon is not visible.



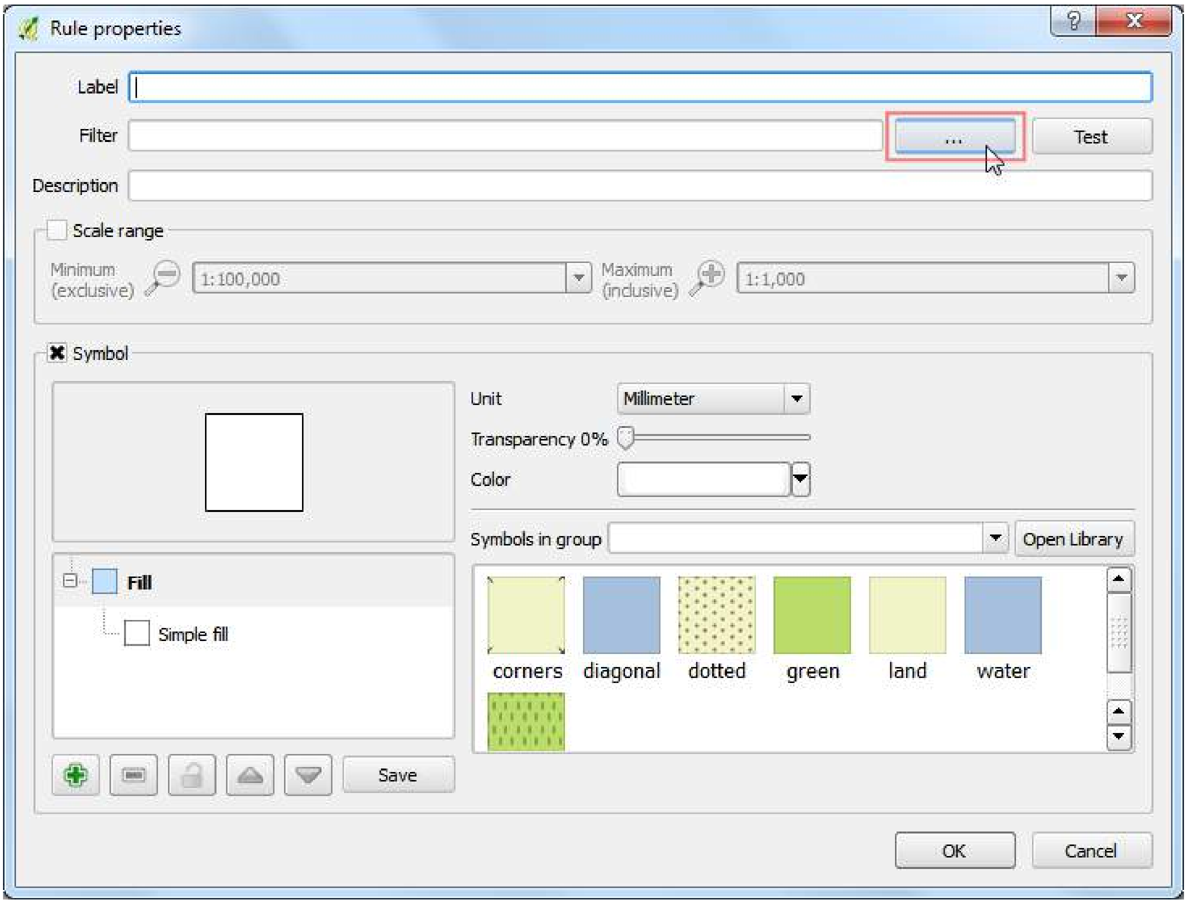
24. There is one problem though. You can see areas of the map that are outside the coverage layer boundary but still visible. This is because Atlas doesn't automatically hide other features. This can be useful in some cases, but for our purpose, we only want to show wetlands of the county whose map is being generated. To fix this, switch back to the main QGIS window and right-click the county10 layer and select Properties.



25. In the Style tab, select Rule-based renderer as the Sub renderer. Double-click the area under Rule.

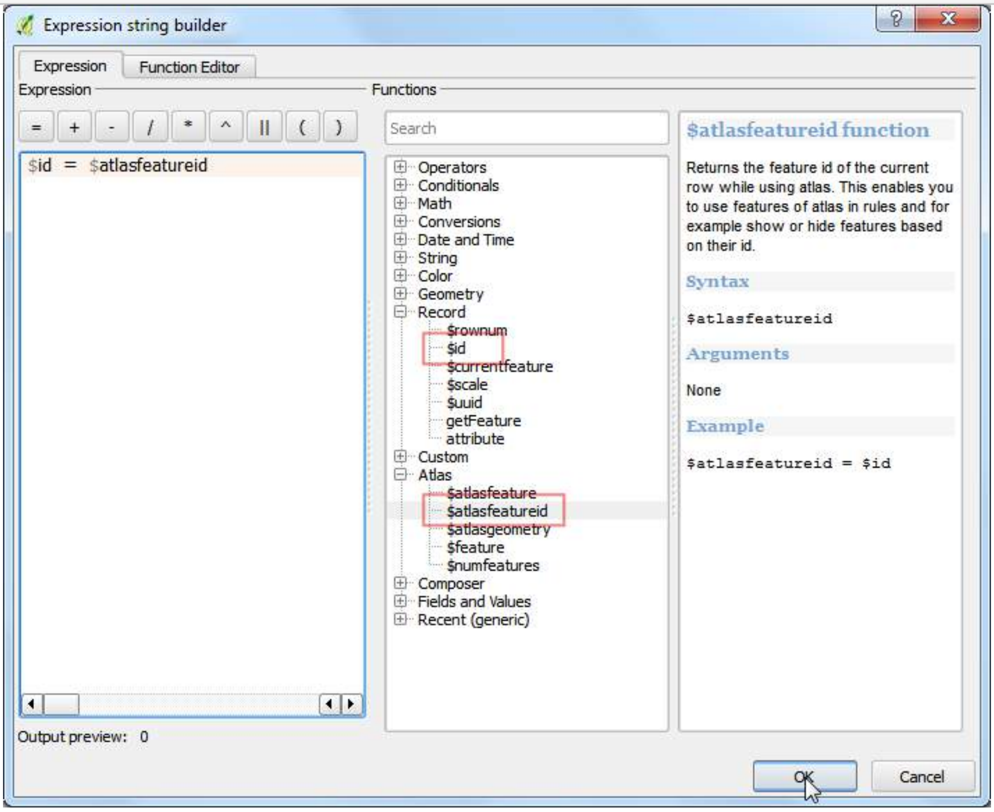


26. Click the ... button next to Filter.

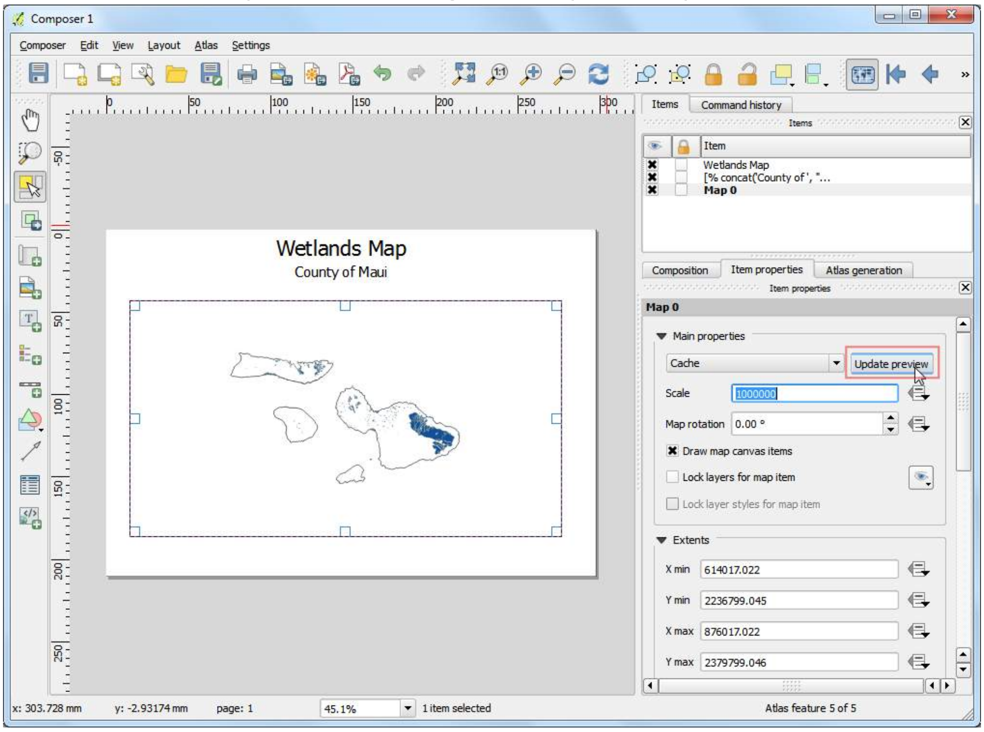


27. In the Expression string builder, expand the Atlas group of functions. The $atlasfeatureid function will return the currently selected feature. We will construct an expression that will select only the currently selected Atlas feature. Enter the expression as below:

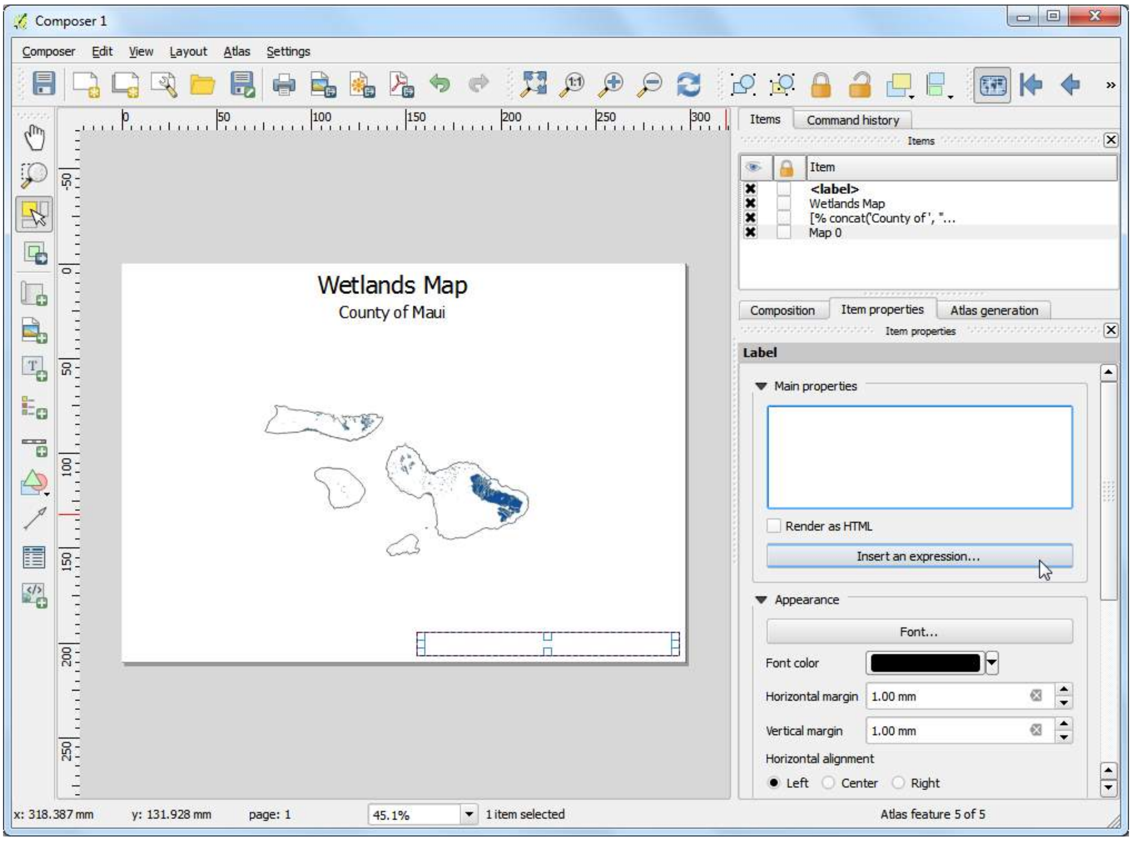
```
$id = $atlasfeatureid
```



28. Back in the Print Composer window, click the Update preview button under Item properties tab to see the changes. Notice that now only the area covering the county boundary is shown.

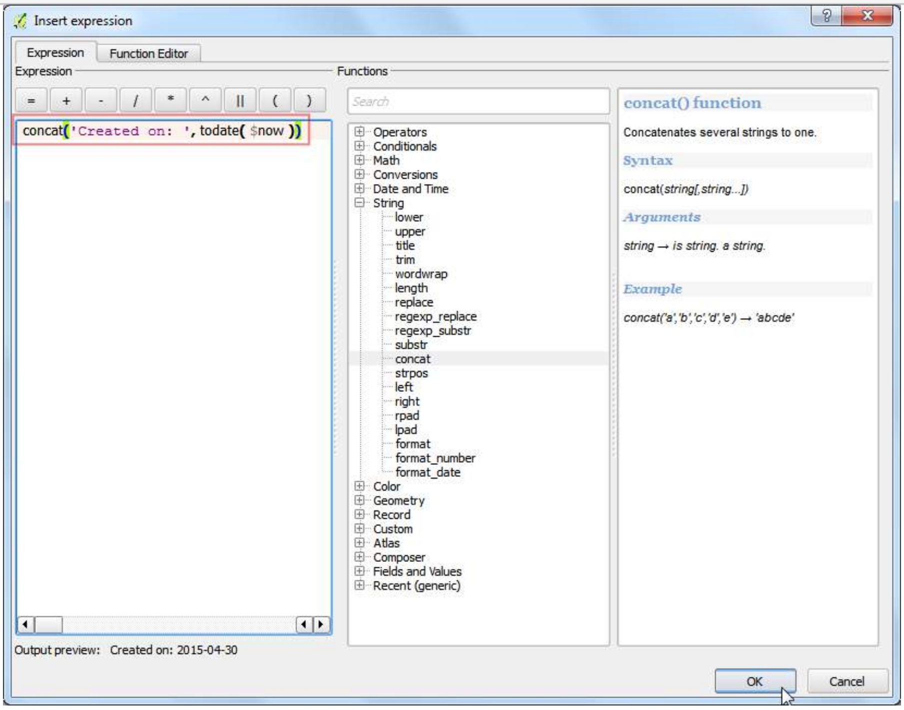


29. We will now add another dynamic label to show the current date. Go to Layout ‣ Add Label and select the area on the map. ClickInsert an expression button.

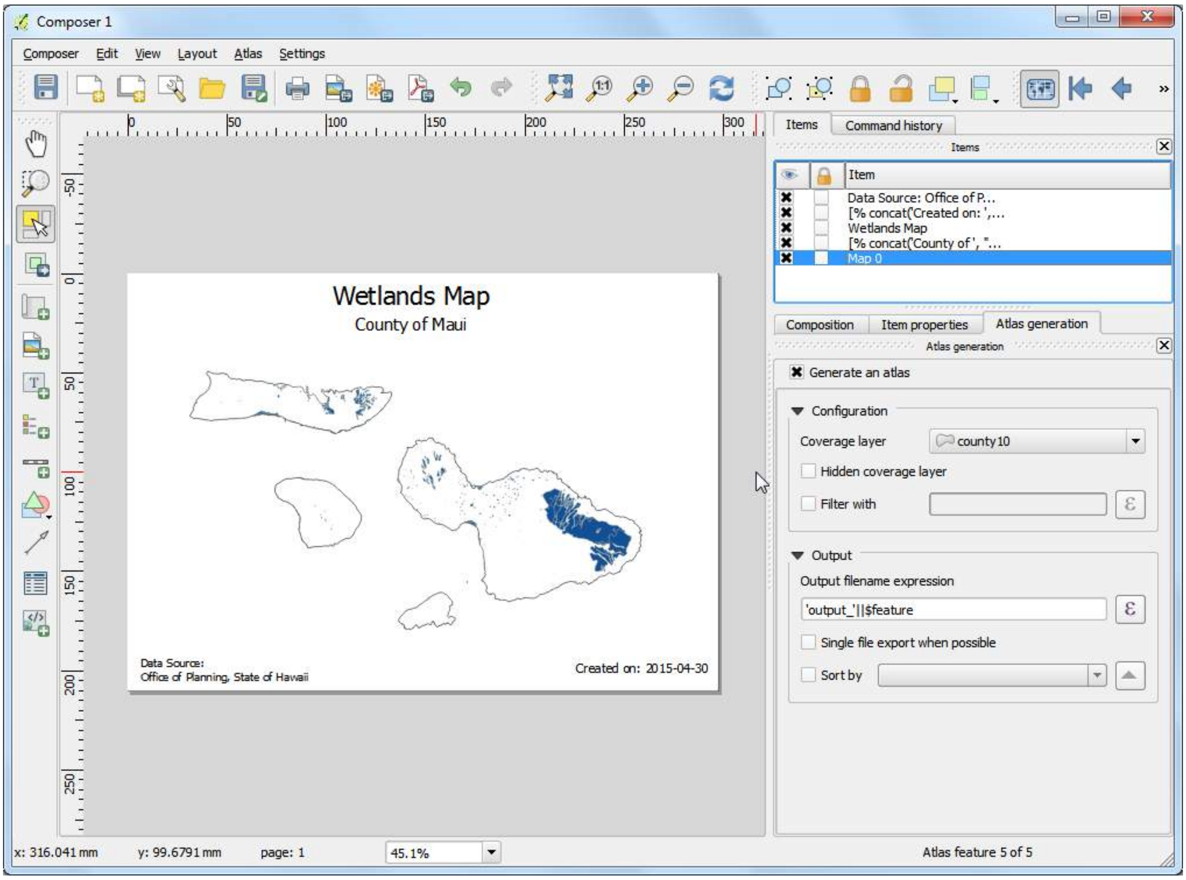


30. Expand the Date and Time functions group and you will find the $now function. This holds the current system time. The function todate() will convert this to a date string. Enter the expression as below:

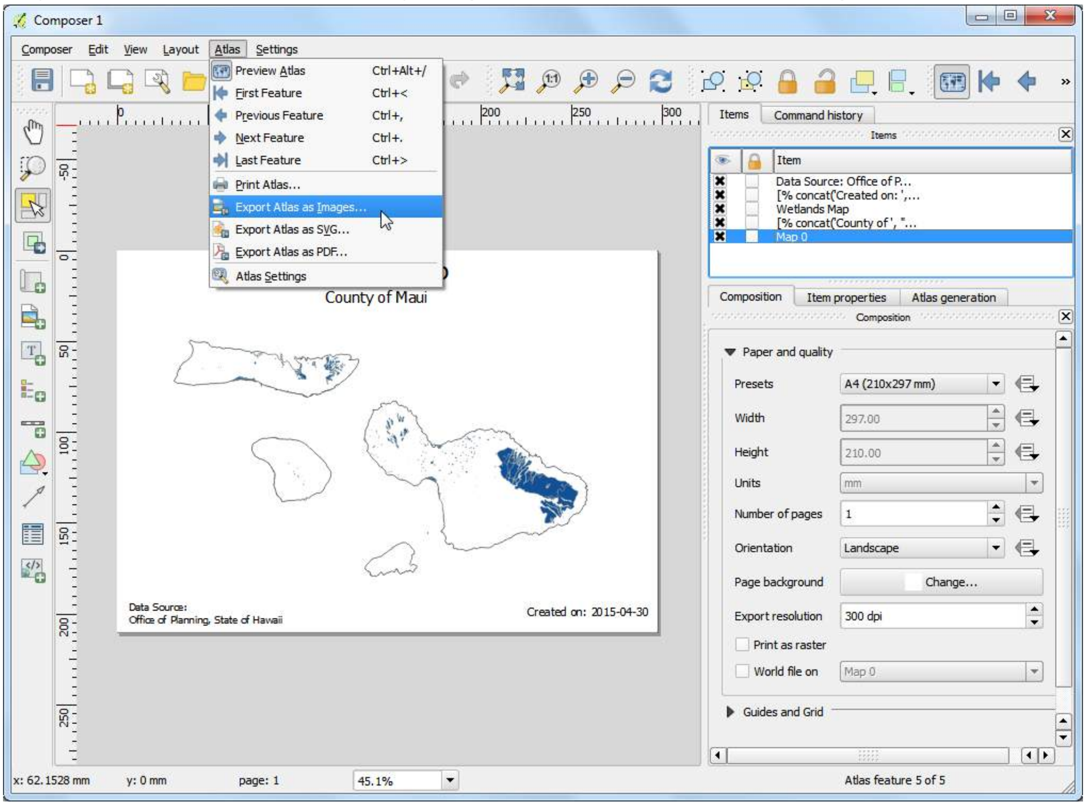
```
concat('Created on: ', todate($now))
```



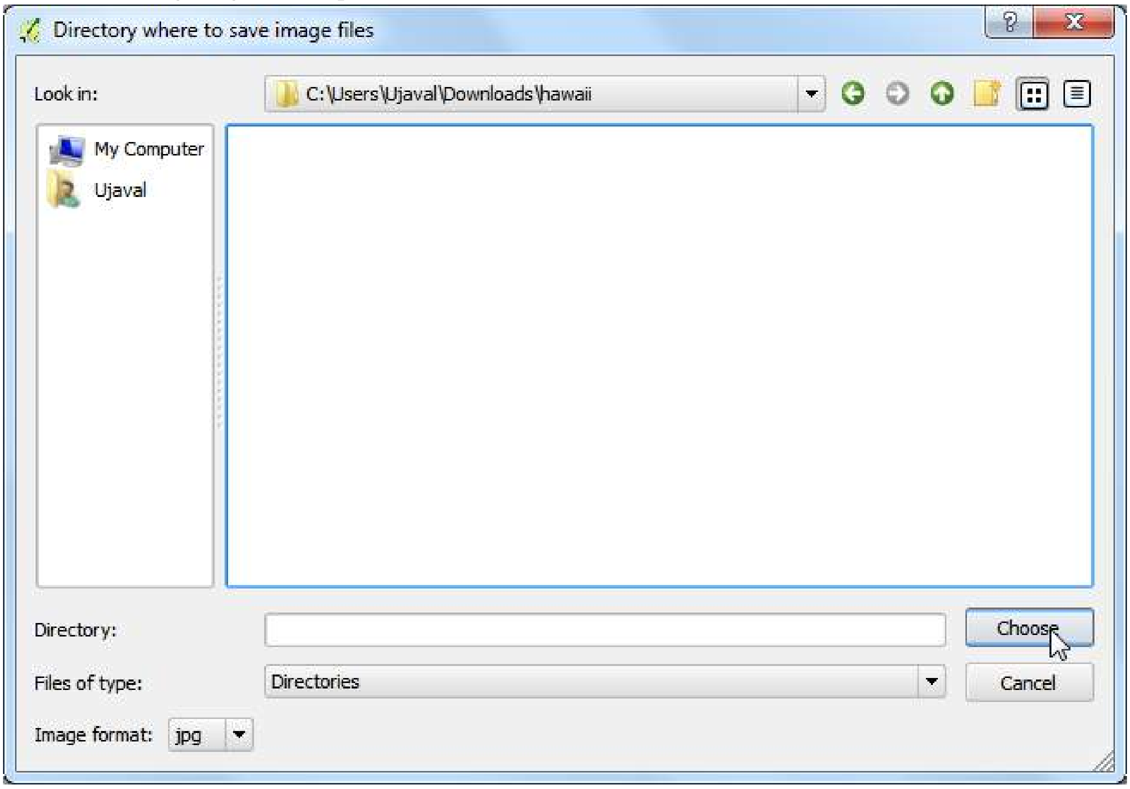
31. Add another label citing the data source. You may also add other map elements such as a north arrow, scalebar etc. as described in *Making a Map* tutorial.



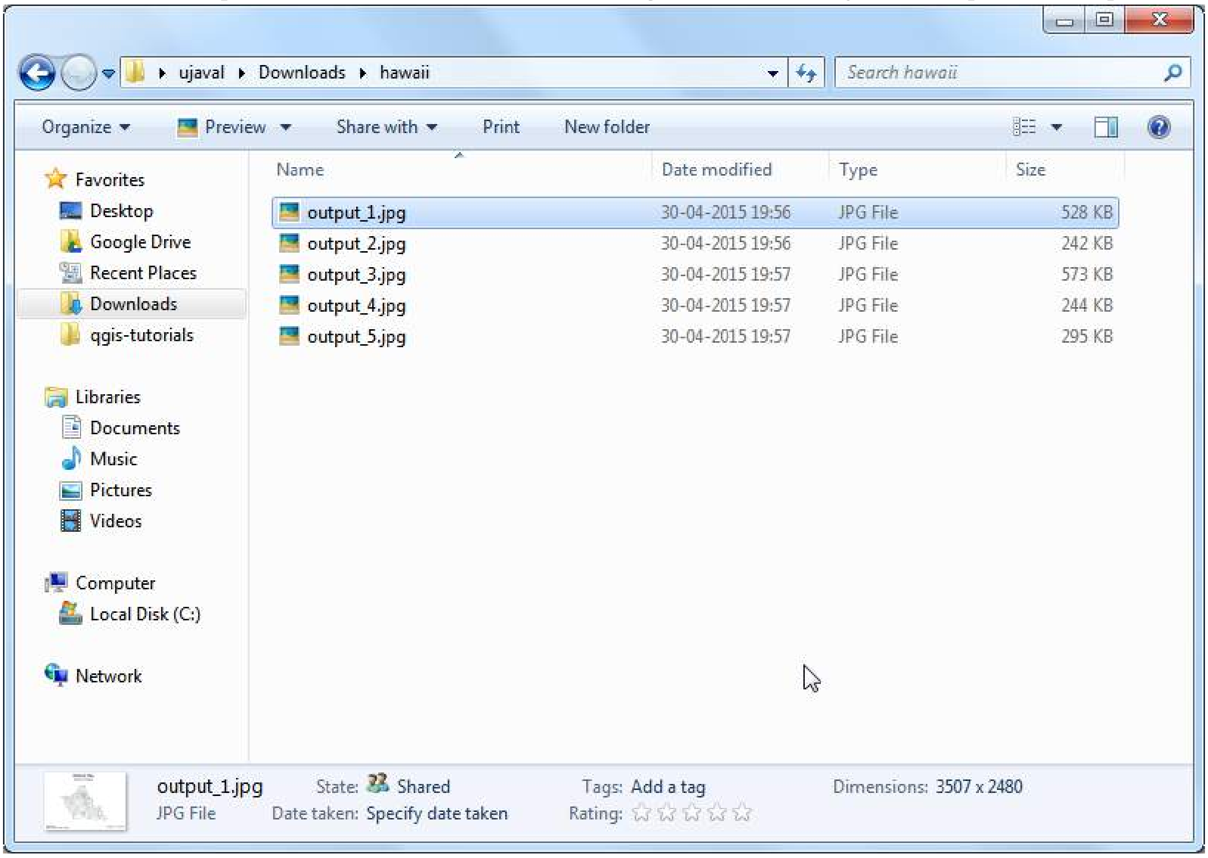
32. Once you are satisfied with the map layout, go to Atlas ‣ Export Atlas as Images.



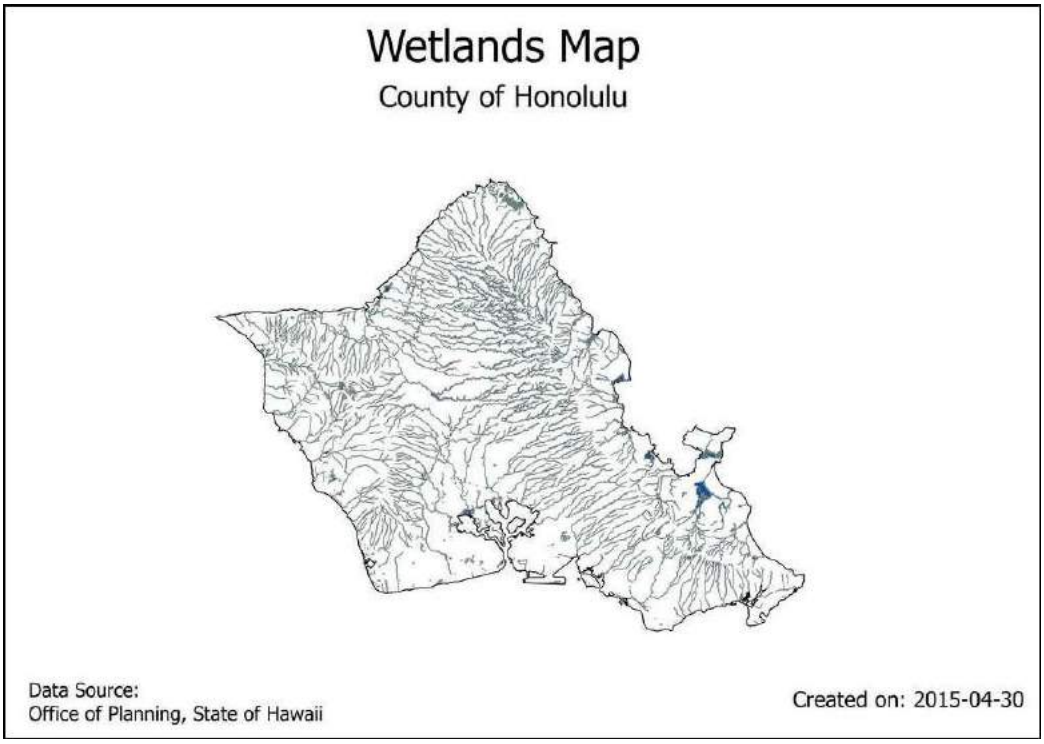
33. Select a directory on your computer and click Choose.

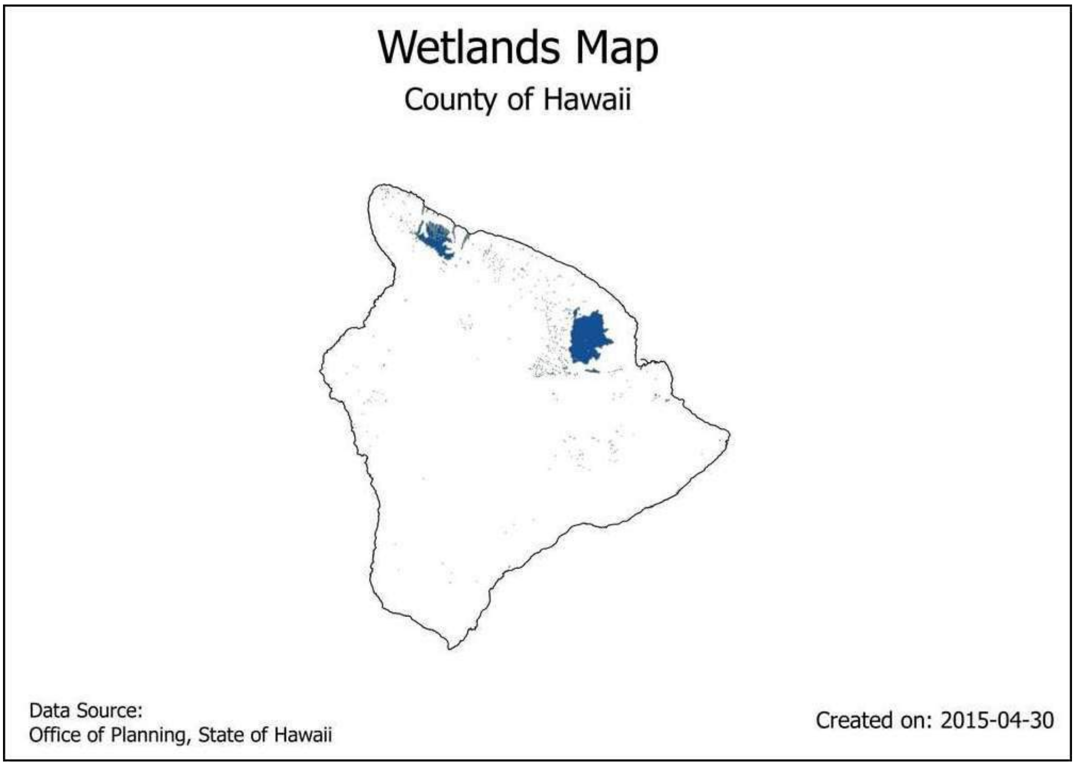


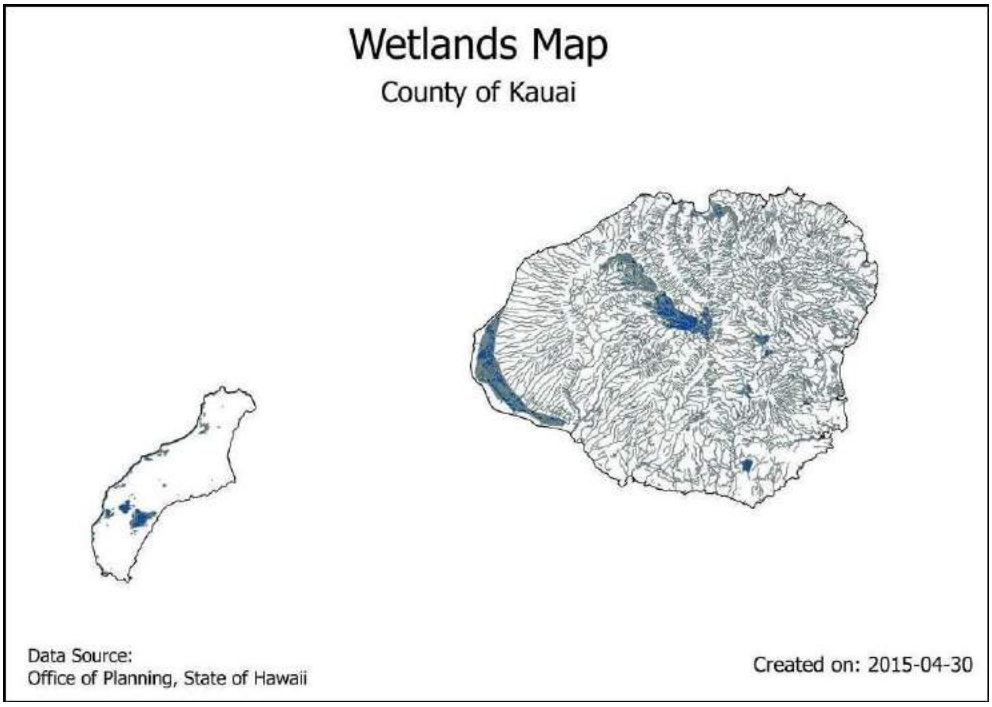
34. The Atlas tool will now iterate through each feature in the coverage layer and create a separate map image based on the template we created. You can see the images in the directory once the process completes.

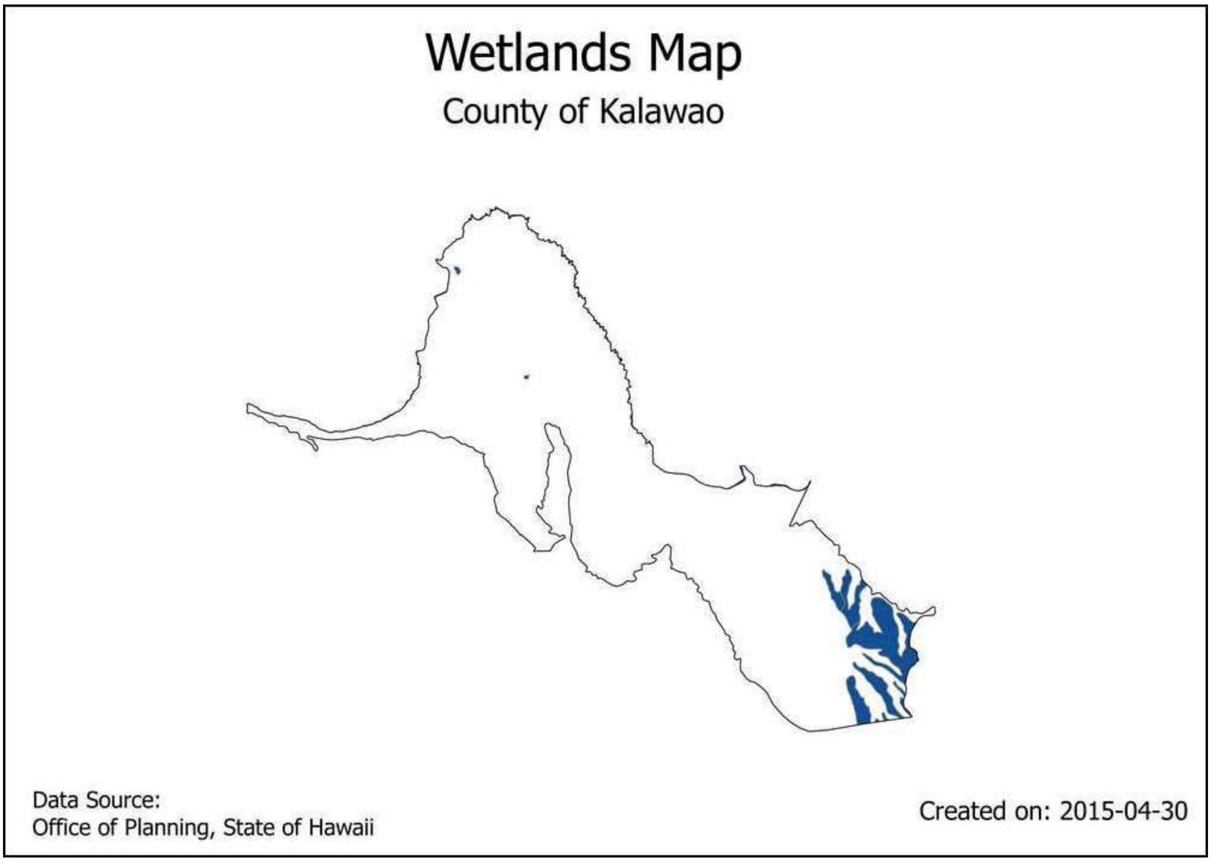


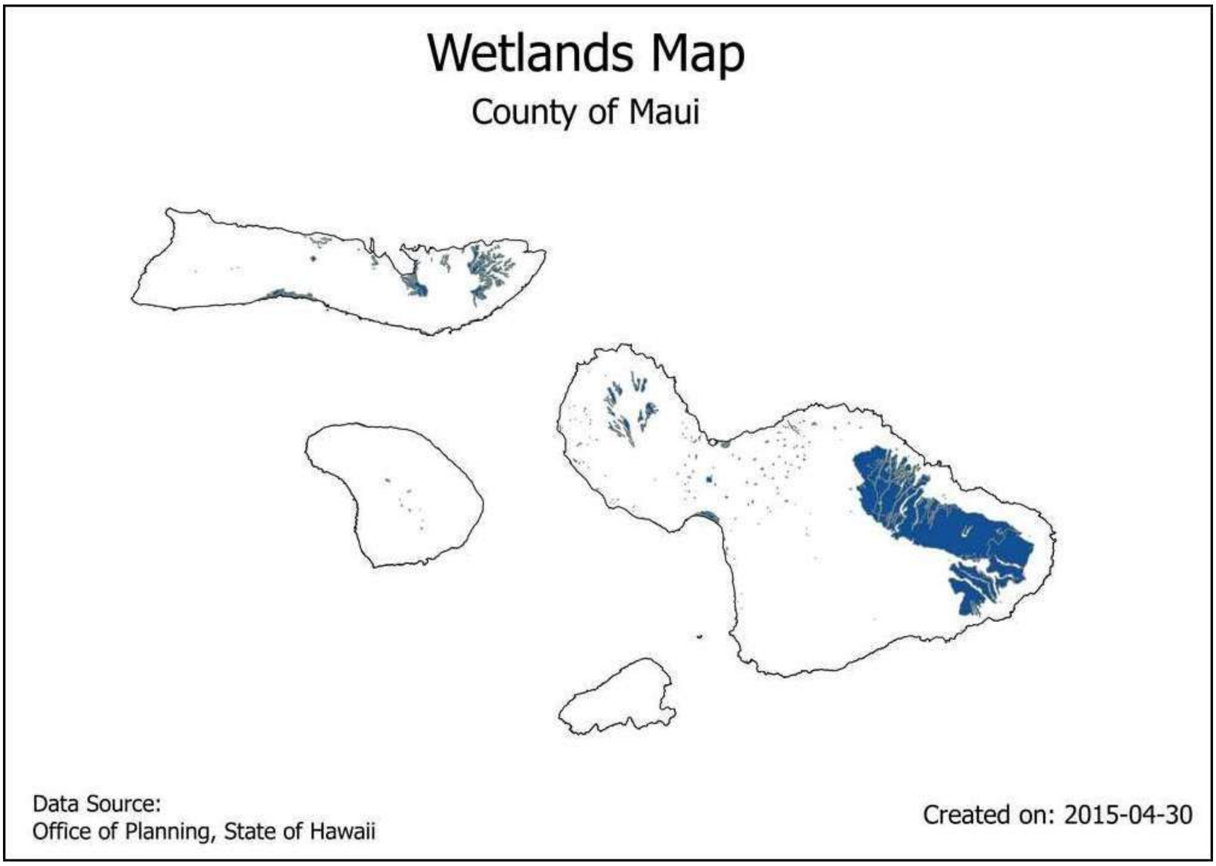
35. Here are the map images for refeence.


Wetlands Map
County of Honolulu
Data Source:
Office of Planning, State of Hawaii
Created on: 2015-04-30


Wetlands Map
County of Hawaii
Data Source:
Office of Planning, State of Hawaii
Created on: 2015-04-30


Wetlands Map
County of Kauai
Data Source:
Office of Planning, State of Hawaii
Created on: 2015-04-30


Wetlands Map
County of Kalawao
Data Source:
Office of Planning, State of Hawaii
Created on: 2015-04-30


Wetlands Map
County of Maui
Data Source:
Office of Planning, State of Hawaii
Created on: 2015-04-30

PRACTICAL - 10

B. Validating map data.

AIM: To validate Map data using Excel and QGIS.

Software Used: QGIS Desktop 3.4.2 and Microsoft Excel 2013.

Datasets Used: The following datasets are used

1. Kenya_epidemiological_data.xls
2. Kenya_epidemiological_dict.xls

Shape Files used: Kenya admin.

Theory

The aim of this practical is to focus on the validation steps that should be performed during data cleaning. These include three types of checks:

1. Structural checks: e.g. unique ID, duplicates, format
2. Validation of plausibility - possible range of values e.g. min/max expected age
3. Logical checks - inconsistencies in answers e.g. occupation/age

The practical will be conducted using Microsoft Excel and QGIS software. The practical will be performed in the following stages

1. **Developing a data cleaning plan**
2. **Performing Structural data checks**
3. **Verifying the plausibility of data**
4. **Performing Logical data checks**
5. **Verifying coordinates of mapping data**
6. **Preparing data for mapping.**

Procedure

The following steps we need to perform in the Stage I of developing a data cleaning plan

1. Open the "Kenya_epidemiological_data.xls" in Microsoft Excel. Additionally open the corresponding dictionary "Kenya_epidemiological_dict.xls", which contains a description of all variables and information about their coding.
2. You should make note of the number of entries in your database, as you will need to keep track of any changes e.g. when you remove duplicates at a later stage.

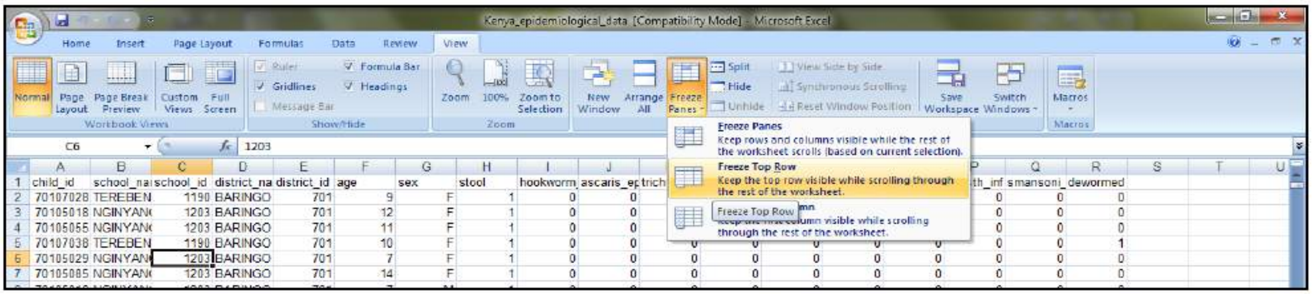
The following steps we need to perform in the Stage II of performing Structural Data checks

A. Format of the Database
B. Removing Duplicates
C. Coding of variables

2A Format of the database

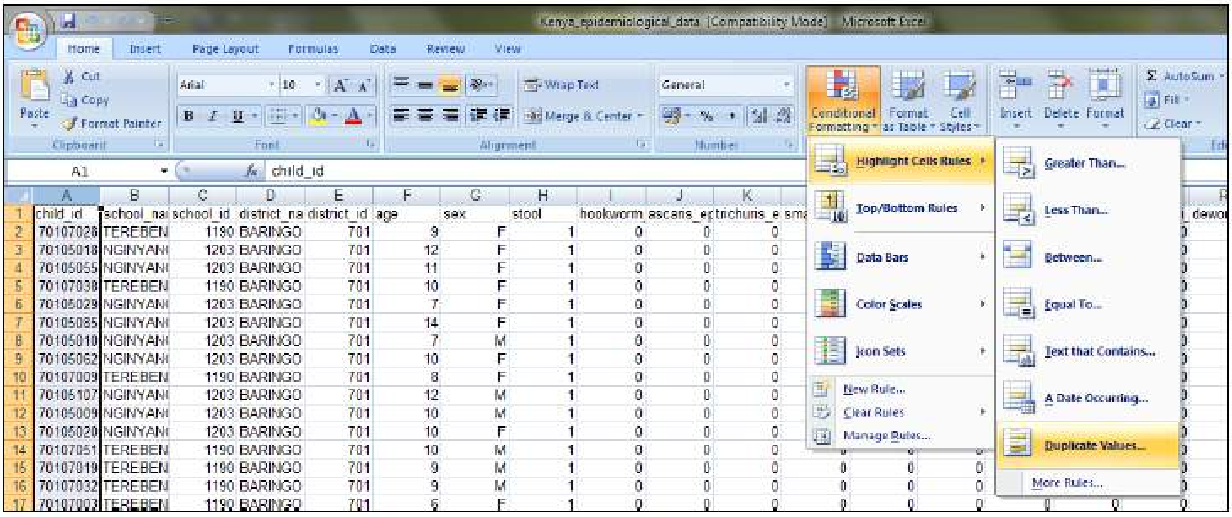
Open *Kenya_epidemiological_data.xls in excel.*

*Go to the **View** tab, click **Freeze Panes** and choose **Freeze Top Row**.*

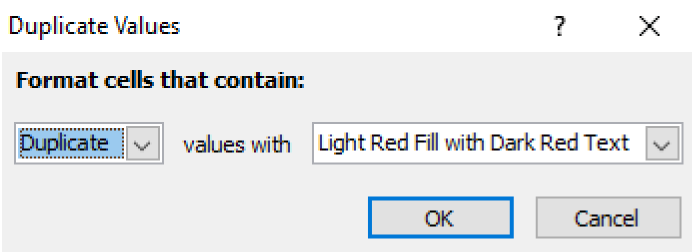


select the entire "child_id" column(first column),

Under Home Tab, click on ***Conditional formatting*** *>* ***Highlight Cell Rules*** *> Select* ***Duplicate values***



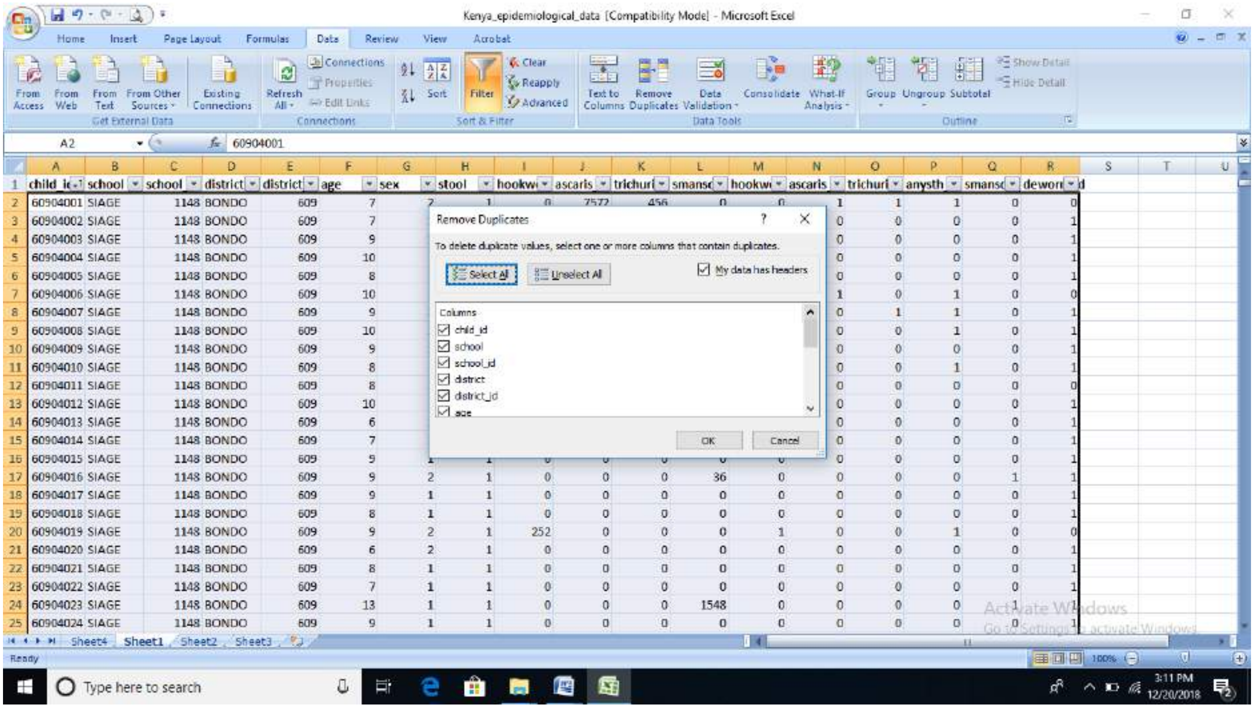
Now select the first combo box and select ***Duplicate*** *and select* ***Light red fill with Dark red text*** *in the next combo box as shown in figure*



2B Removing Duplicates

Select all the columns of existing worksheet

Now go to Data Tab and select Remove Duplicates



2C Coding of variables

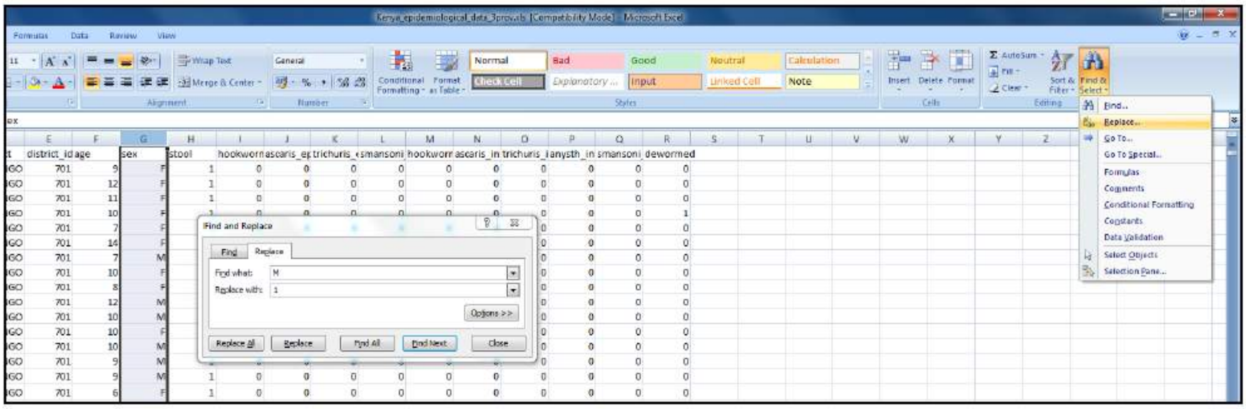
In the current worksheet, select the sex column.

Now type Ctrl+F and use Replace Function and Replace as follows

M-1

F-2

Please keep track of how many values are getting replace.



Step 3 Verifying the plausibility of data

In this step, we perform two basic operations

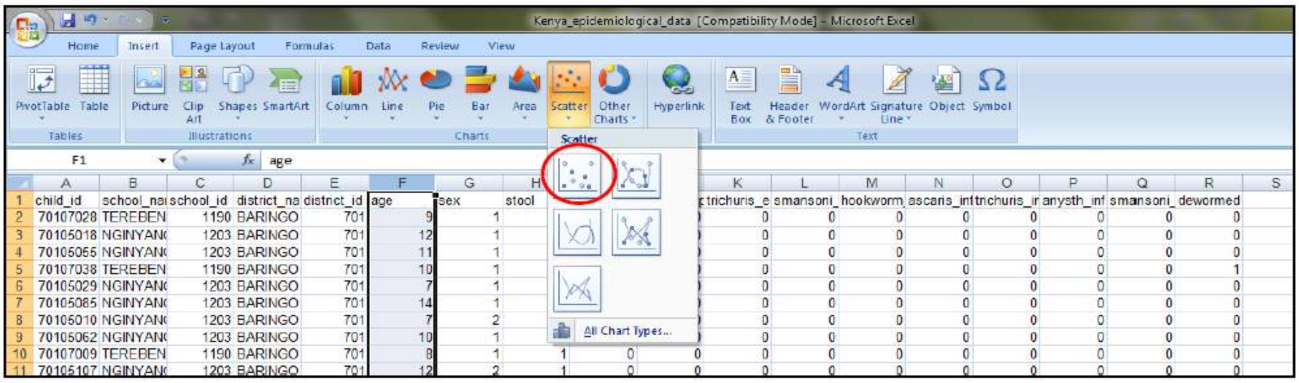
A. Coding of variables

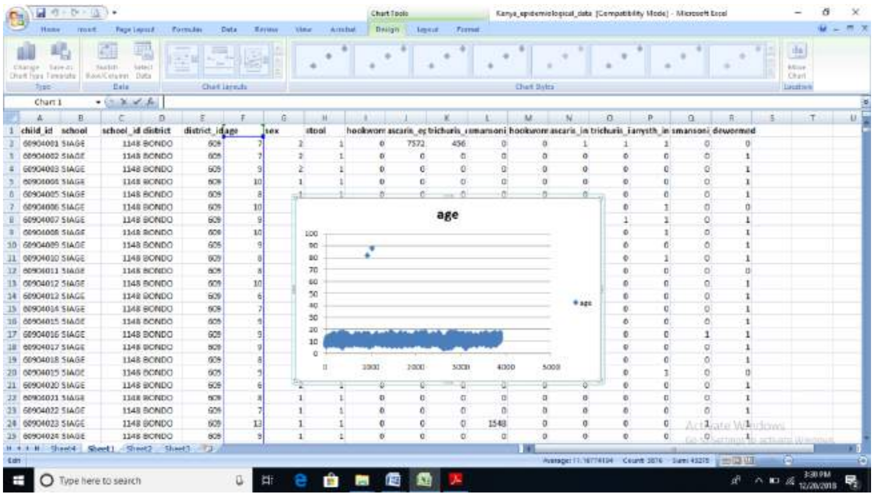
B. Using a filter to detect outliners

3A Coding of variables

Select the age column in the existing worksheet.

Now go to Insert tab and select Scatter. You will set chart as shown below

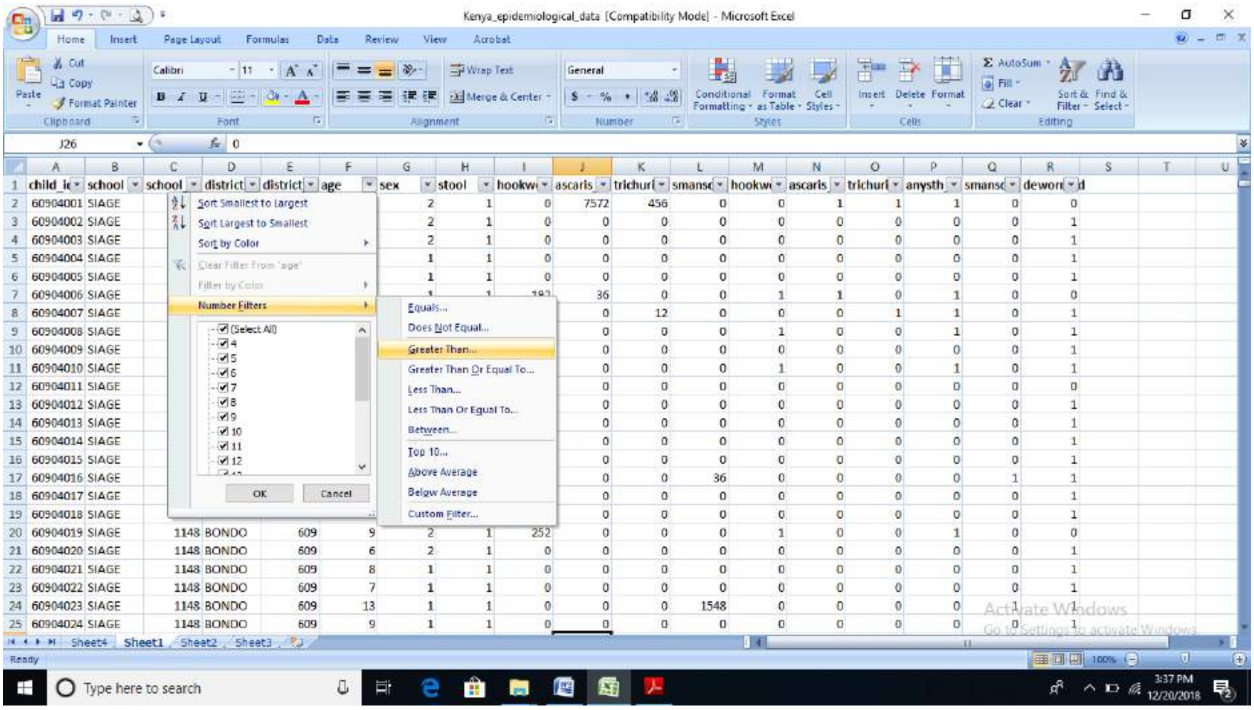


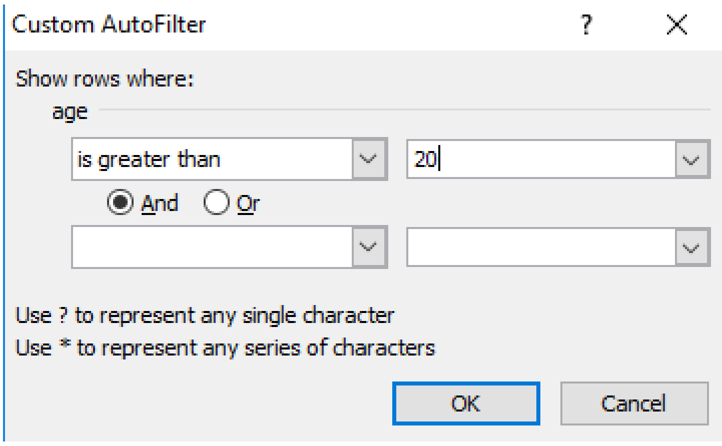


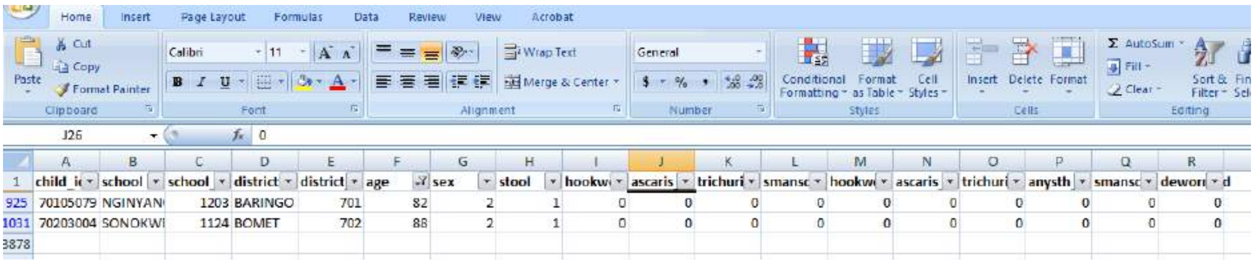
3B Using a filter to detect outliners

First go to the Home Tab>Sort and Filter>Filter. Click and apply the filter to all the columns of the worksheet.

Now click on age filter and click on Number Filter> Greater Than option and type the value 20 in greater than field.







Step 4: Logical Data checks

In this step, we perform two basic operations

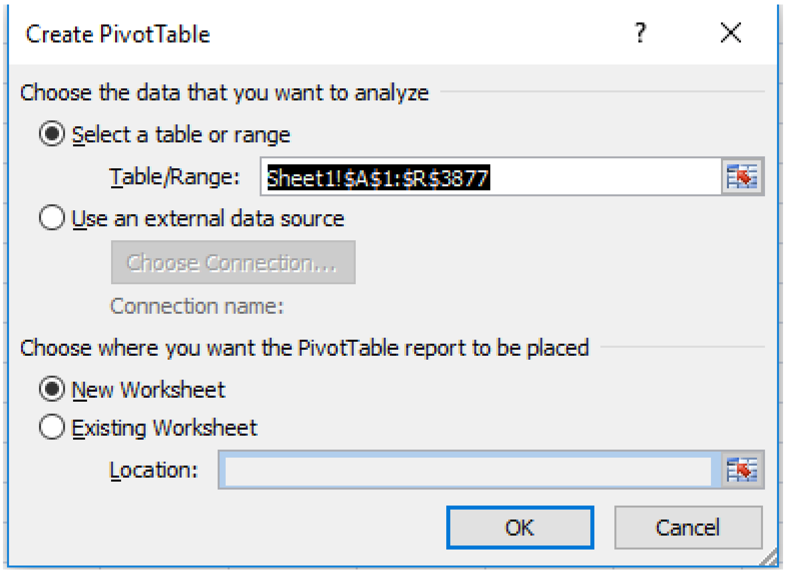
A. Cross Tabulations

B. Formulas

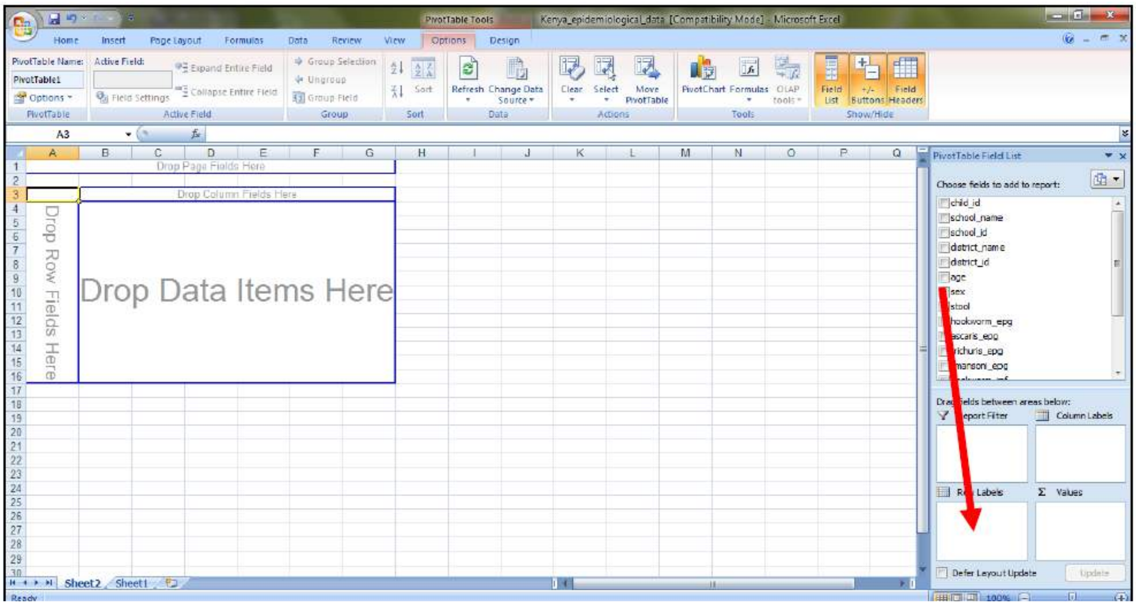
4A. Cross Tabulations

Open the existing worksheet. Now go to Insert Tab and select Pivot table function.

Select New Worksheet and click OK(refer the figure below)



An empty table is inserted in a new sheet and a window will open on the right hand side named PIVOT TABLE FIELD LIST.



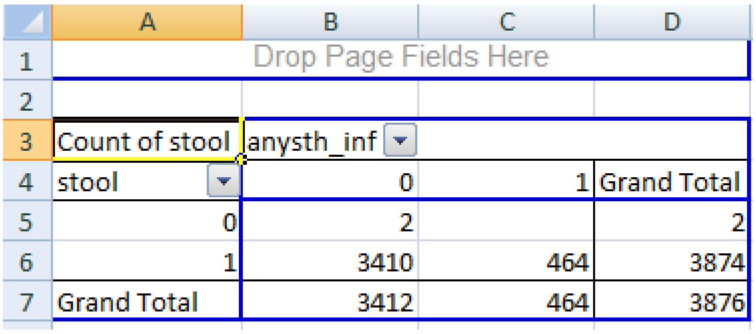
From the PivotTable Field List, drag the “stool” item and drop it into the “Row Label” field as show above.

Similarly, Click on *anysth_inf* and draw it into the “Column labels” and “Σ Values” field.

To include the count of observations in the table you might need to change the value field settings to count.

Click on the combo box Sum of stools and Click on Value Field Settings.

Change the value in Summarize value filed by to Count and click OK. Table is updated with count values as shown below



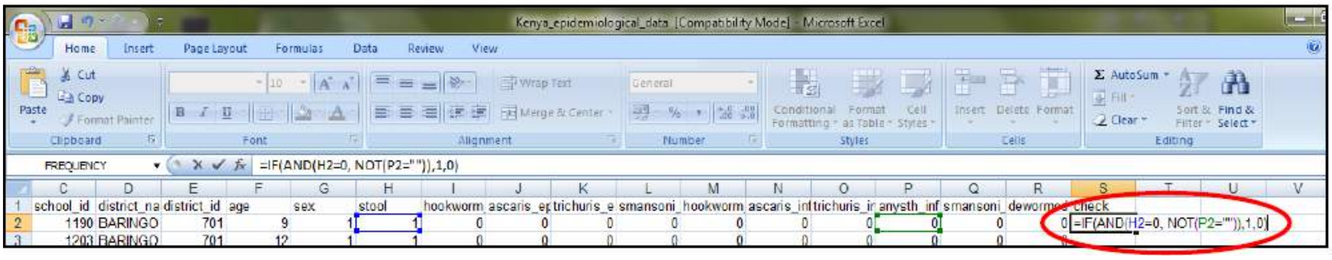
	A	B	C	D
1	Drop Page Fields Here			
2				
3	Count of stool	anysth_inf		
4	stool	0	1	Grand Total
5	0	2		2
6	1	3410	464	3874
7	Grand Total	3412	464	3876

4B Formulas

Open the existing worksheet

Create a new column with the variable called check

Type the following formula in S2 column of worksheet =IF(AND(H2=0, NOT(P2="")),1,0)



Now copy the formula to all other cells (ensure that the formula is copied to all rows in your dataset)

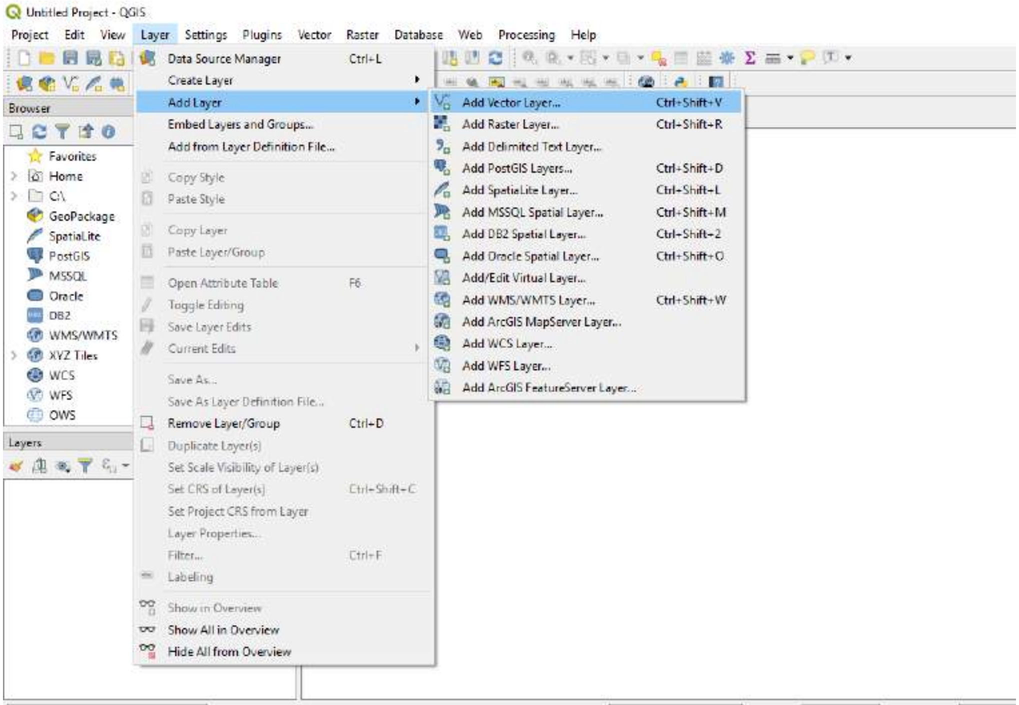
Now use the filter to show only entries with a check value of 1.

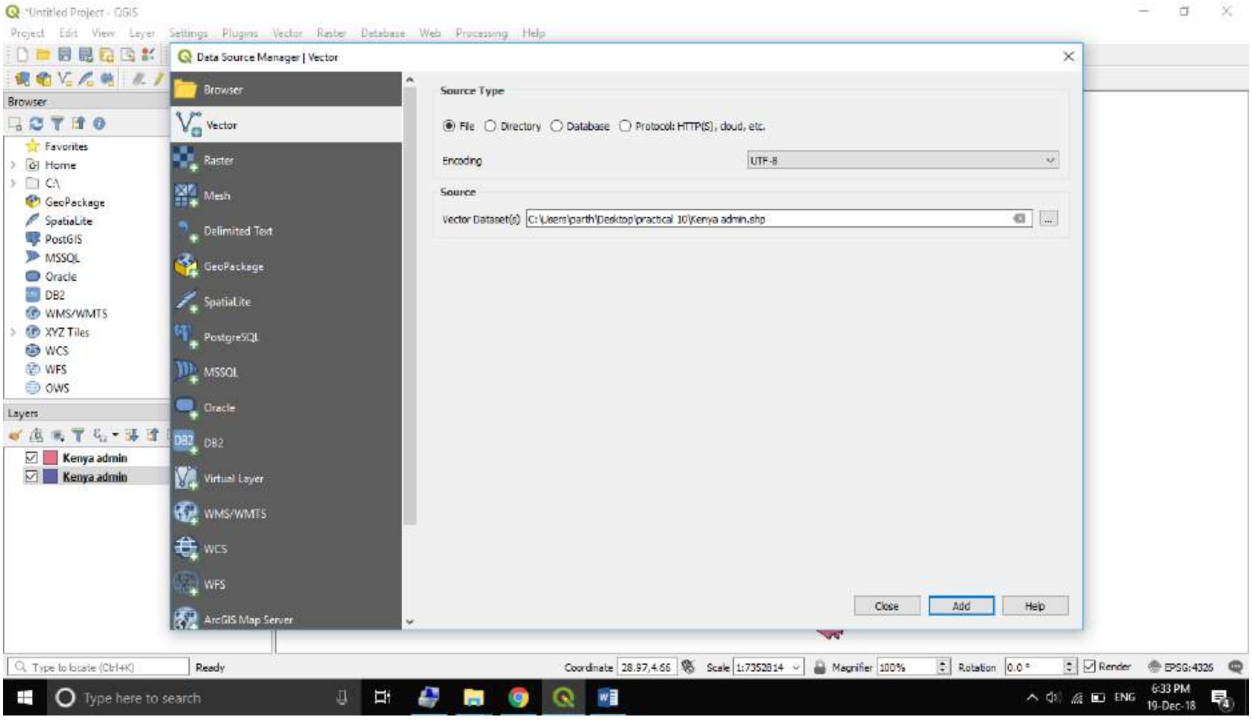
Step 5: Verifying the coordinates of mapping data

Create a New Project in QGIS Desktop 3.4.2.

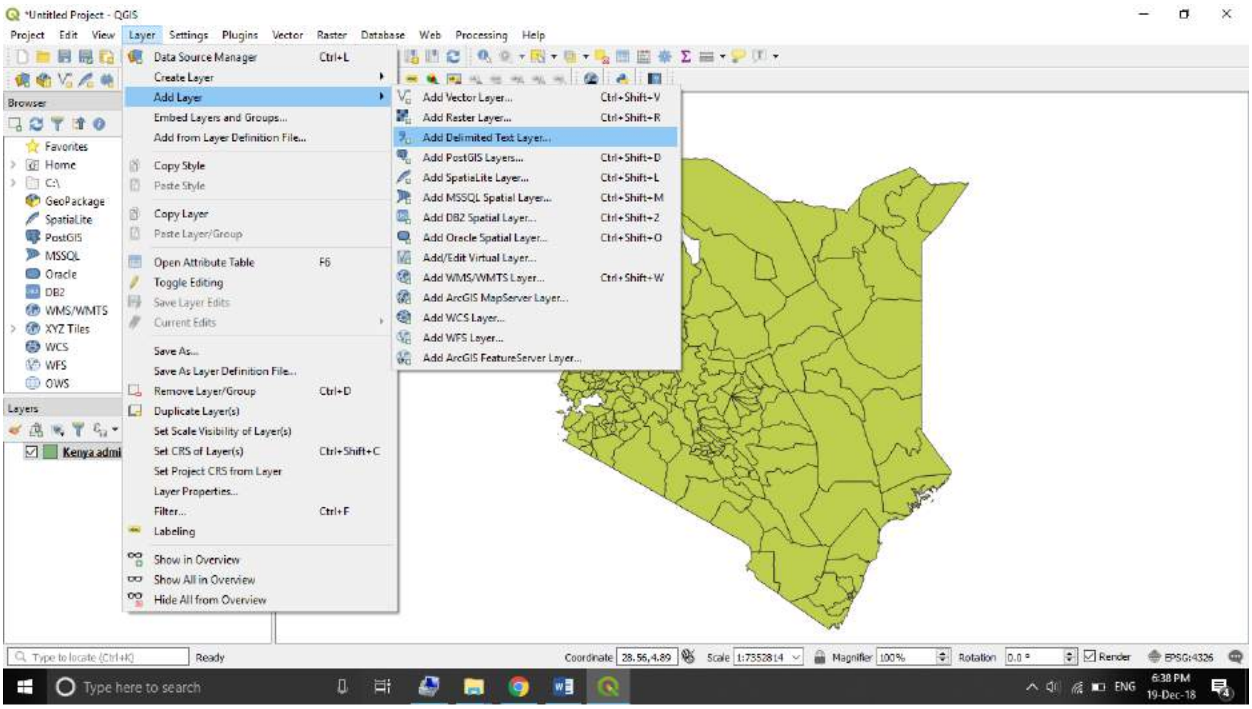
Let’s add the files!

Navigate to **Add Vector Layer** and add file: **Kenya_admin.shp**



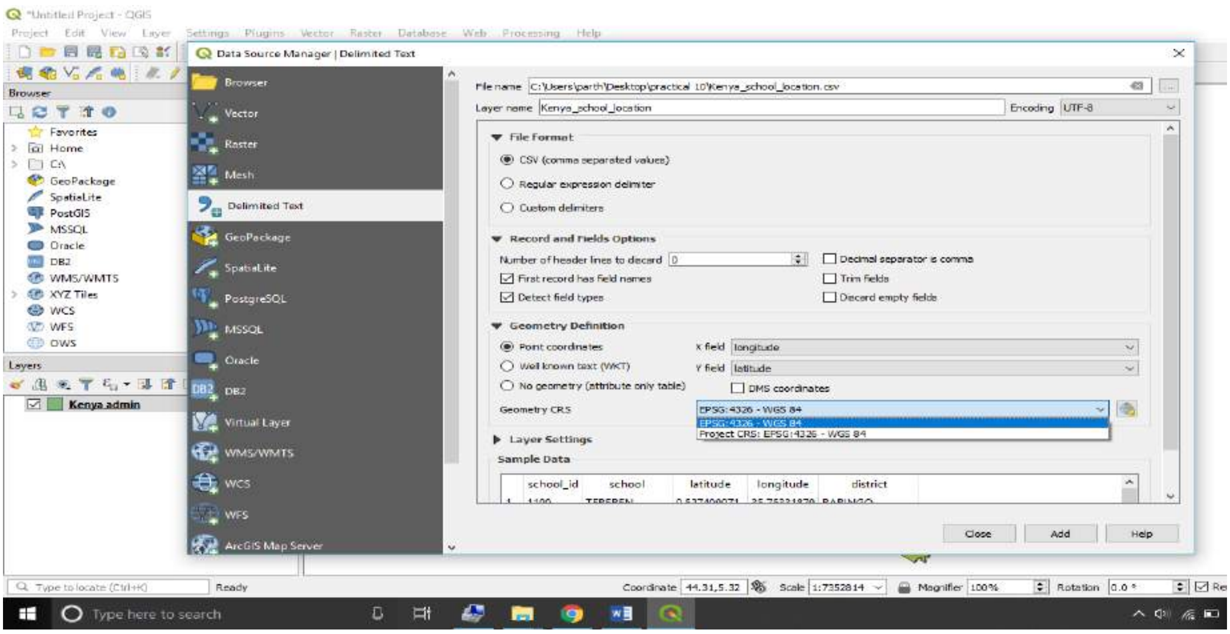


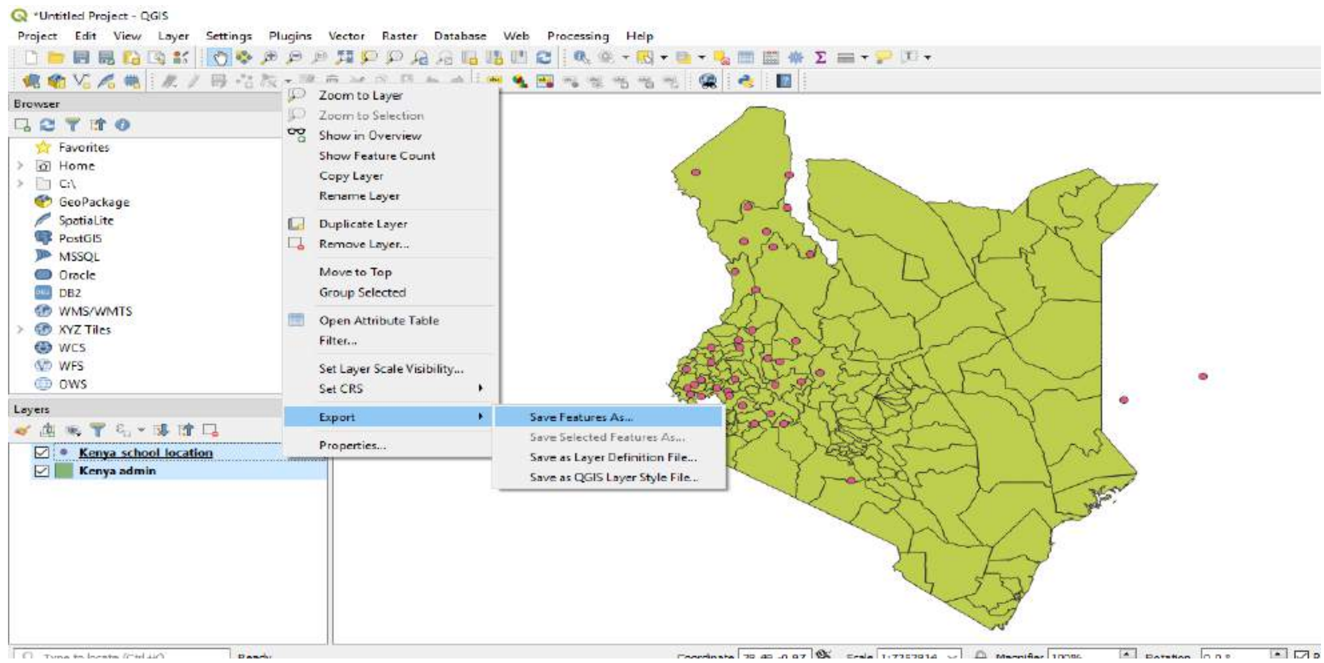
Similarly, navigate to **Add Delimited Text Layer.**



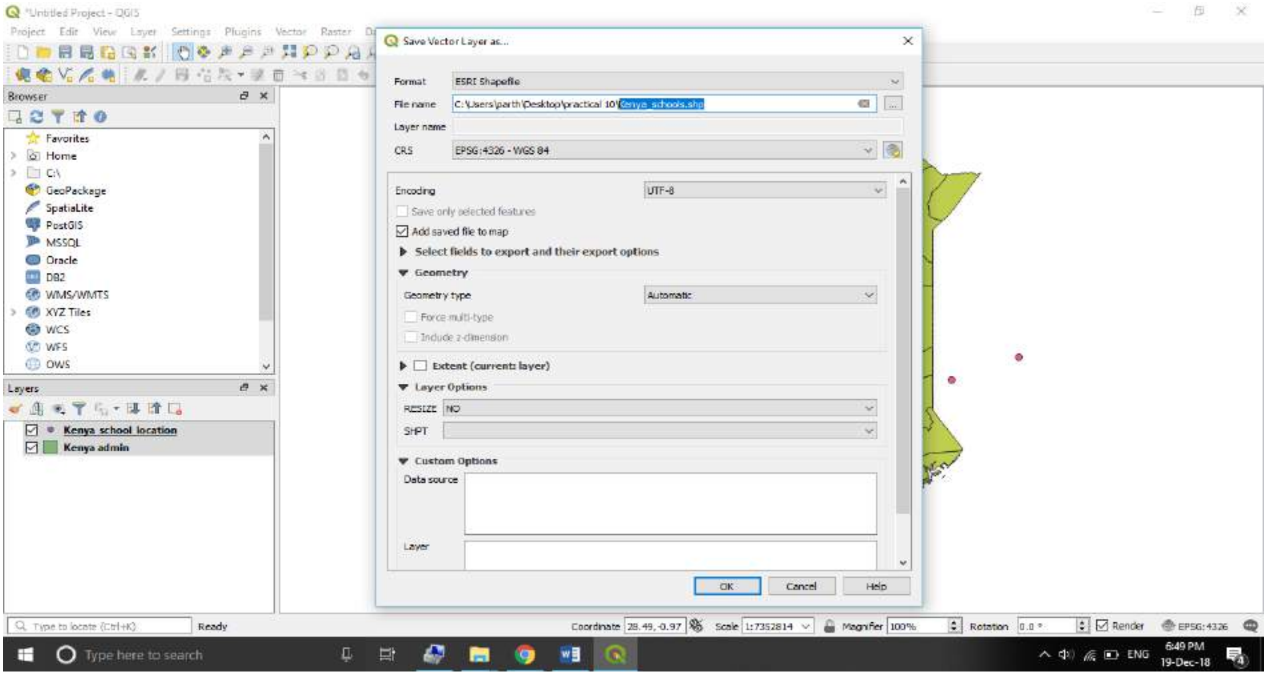
Here we have to add file: **Kenya_school_location.csv**. In **the Geometry Definition section**, there is a field called **Geometry CRS**, in that we have to select **WGS84** as coordinate system.

As you can see 2 points are not on the map.
To examine this, we need to save these layers as a Shapefile, to do that select both the layers **Kenya_school_location** and **Kenya admin**, then right click on them and choose **Save Features As…**

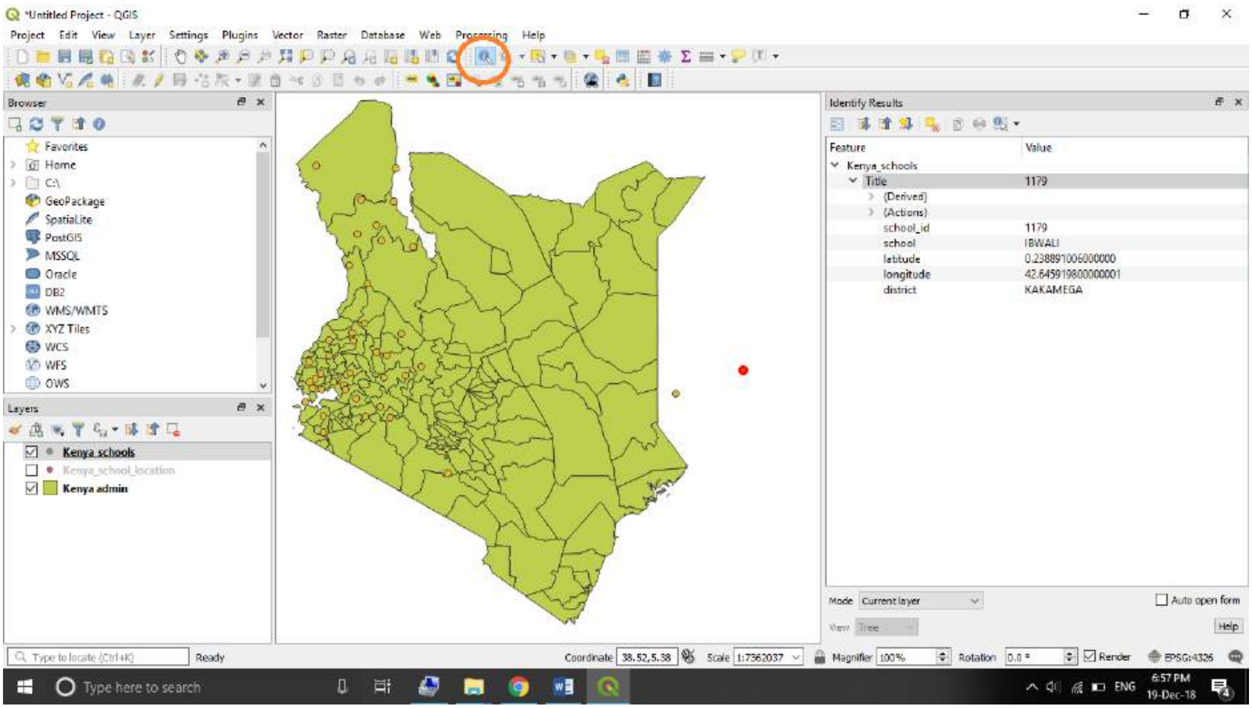




In the menu that comes up, set **Format** as **ESRI Shapefile** and put **File Name** as **Kenya_schools.shp**
After this is done you can uncheck the Kenya_school_location in the layers section.

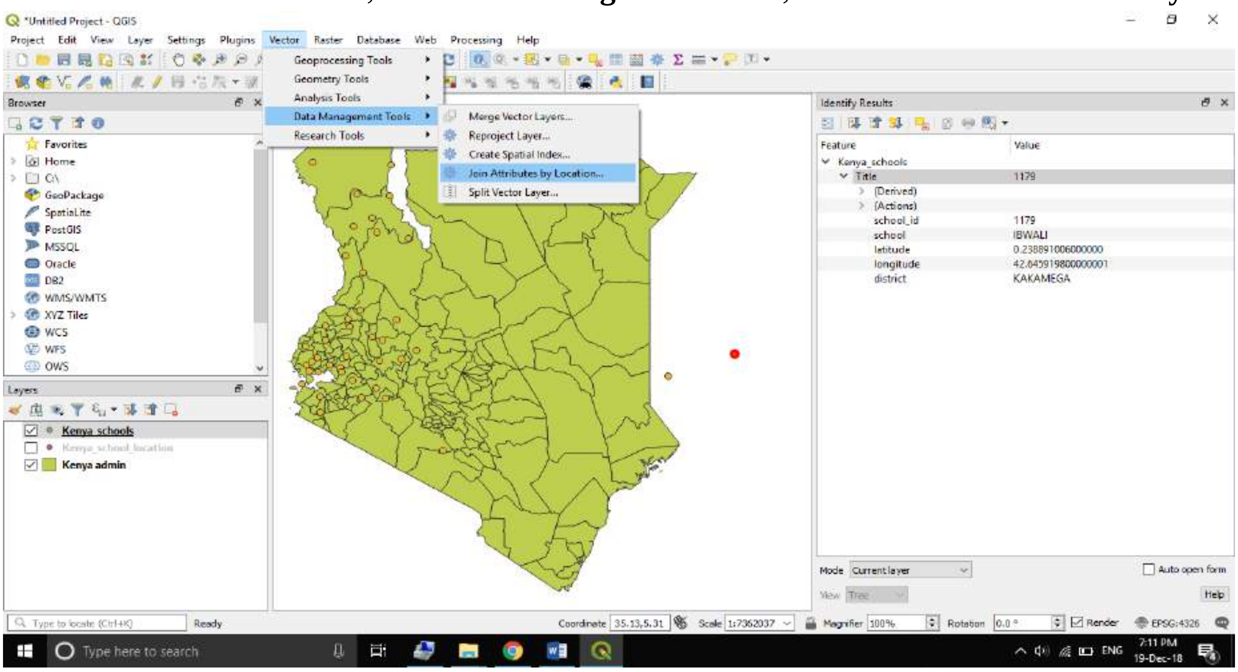


Let's try and get the details of these 2 points that are not on the map, select the **Kenya_schools** layer, click on the **Identify Features Tool** button and then click on the points outside of Kenya to get their details.

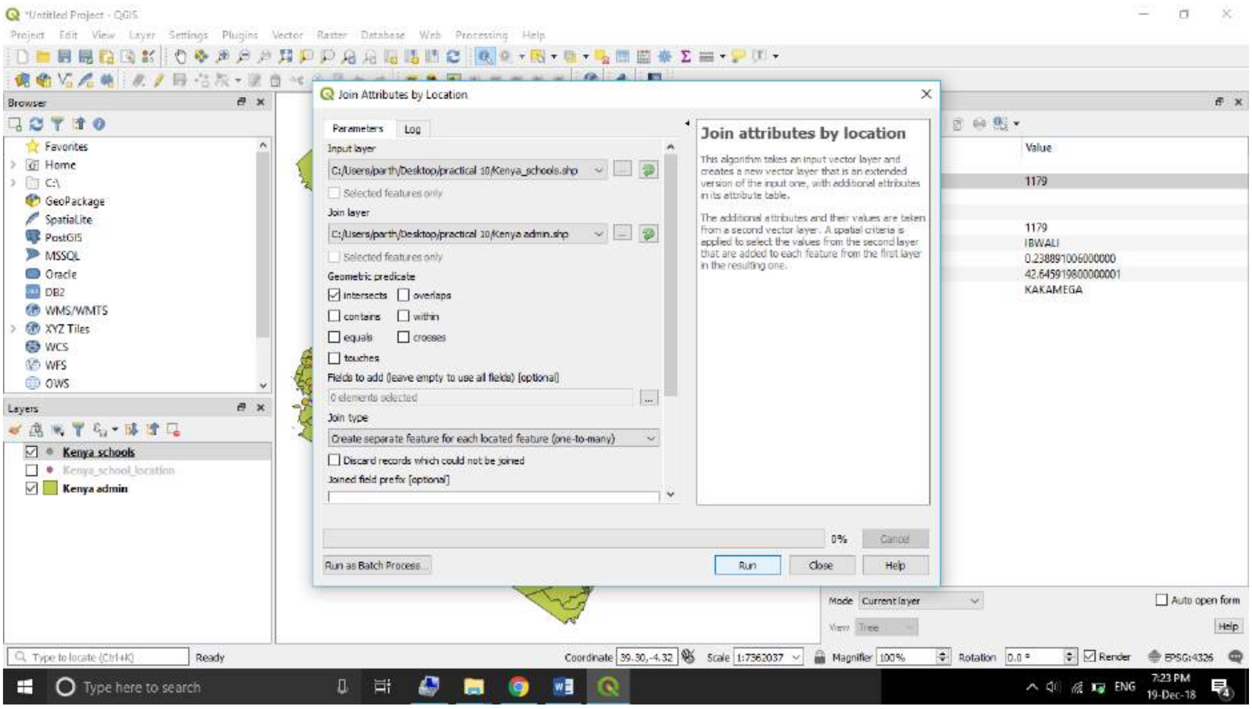


Now we want to add the district information to the map. Therefore, we will join information based on the geographical localization.

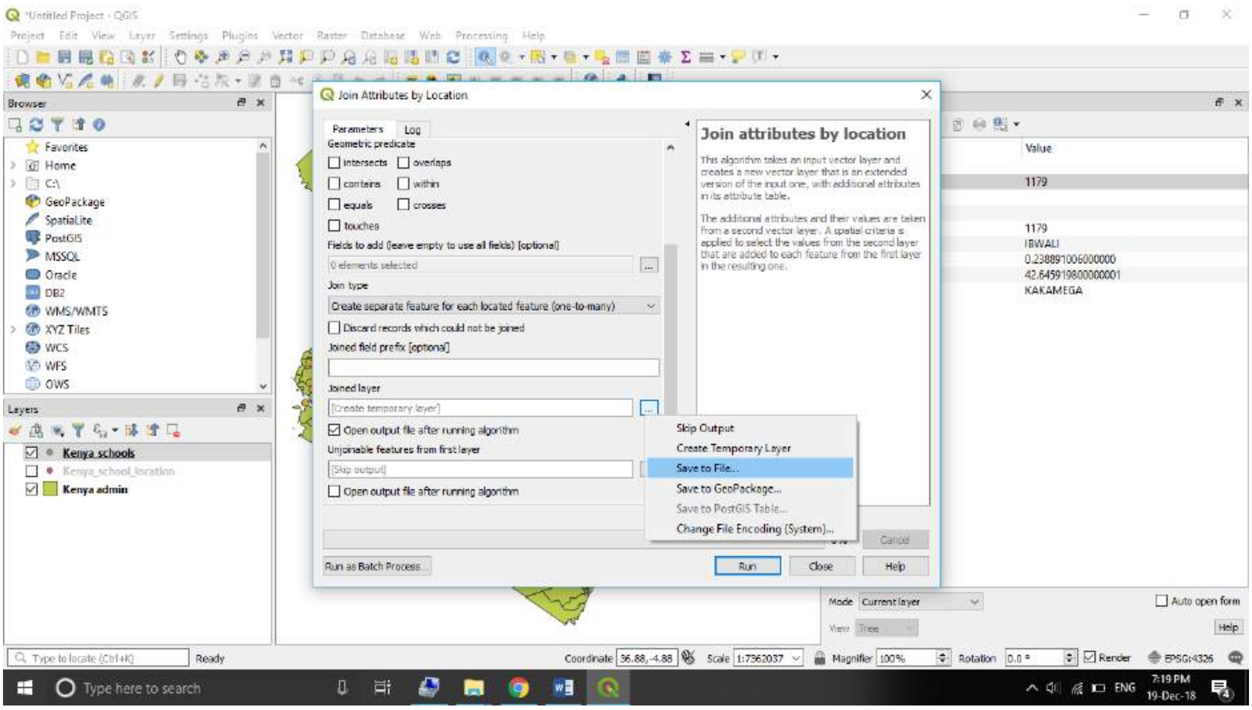
In the menu click on **Vector**, then **Data Management Tools**, then select **Join attributes by location.**



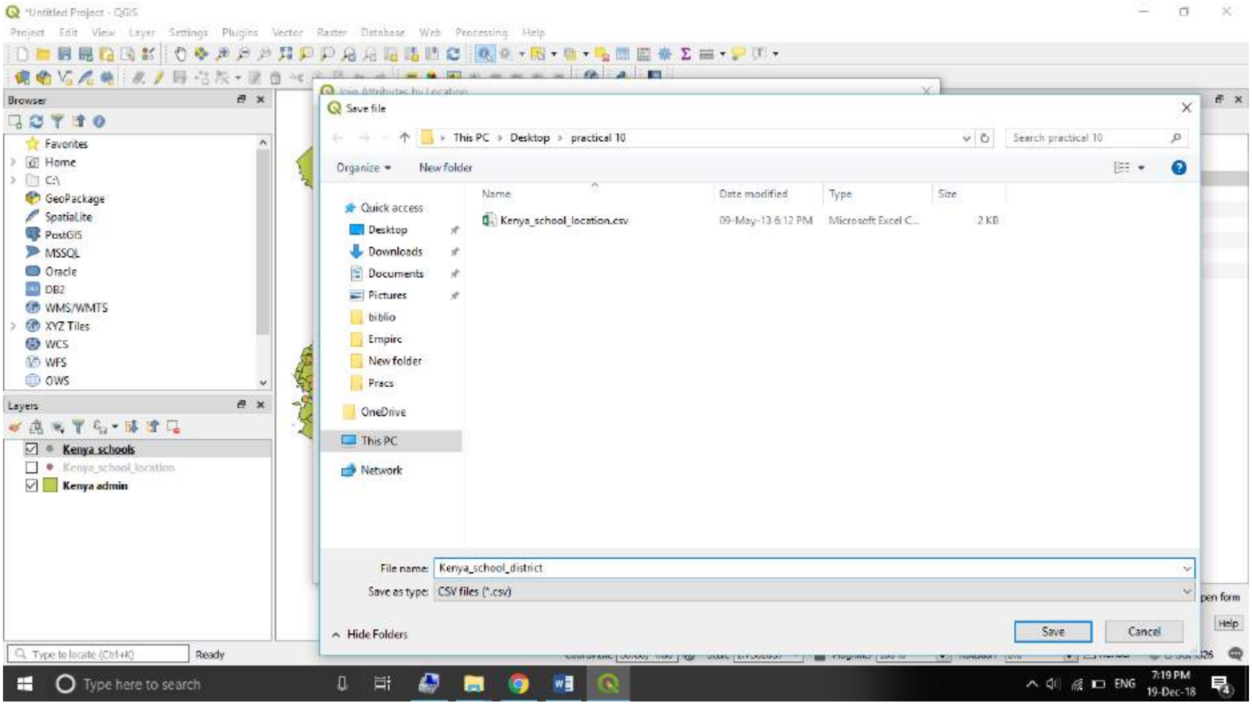
Then select **Kenya_schools** as **Input layer** and **Kenya_admin** as **Join layer**.



We also need to save the output so in **Joined Layer,** click "…"button to Browse location.



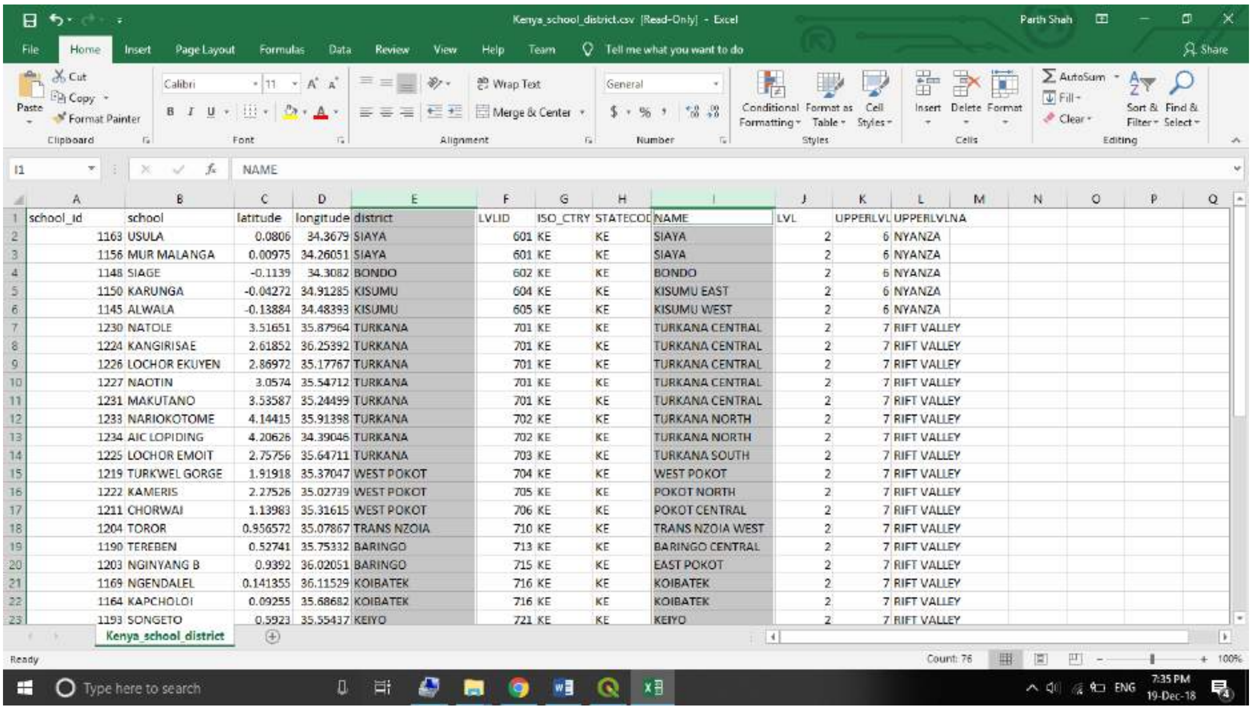
Save as **Kenya_school_district.csv**



And then click run.

After it is done…

Navigate to the location of saved file **Kenya_school_district.csv**and open it, you should now be able to compare both **district** and **Name** for discrepancies.

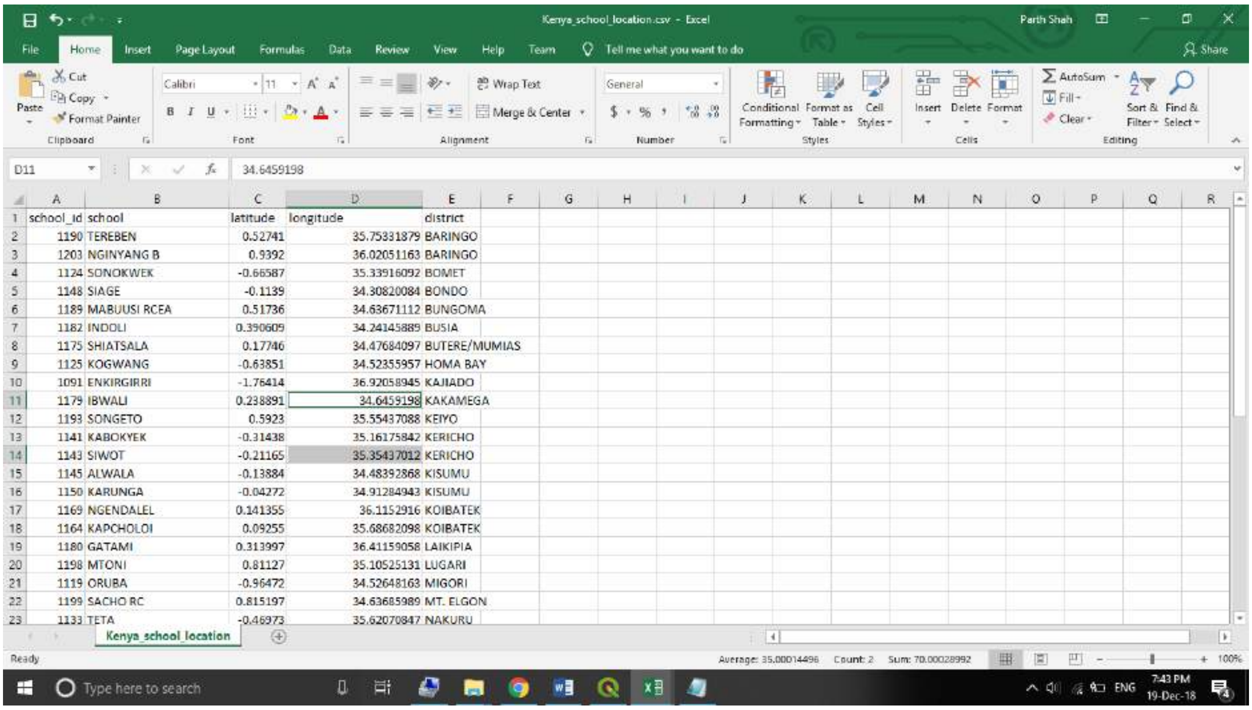


school_id	school	latitude	longitude	district	LVLID	ISO_CTRY	STATECOD	NAME	LVL	UPPERLVL	UPPERLVLNA
1163	USULA	0.0806	34.3679	SIAYA	601	KE	KE	SIAYA	2	6	NYANZA
1156	MUR MALANGA	0.00975	34.26051	SIAYA	601	KE	KE	SIAYA	2	6	NYANZA
1148	SIAGE	-0.1139	34.3082	BONDO	602	KE	KE	BONDO	2	6	NYANZA
1150	KARUNGA	-0.04272	34.91285	KISUMU	604	KE	KE	KISUMU EAST	2	6	NYANZA
1145	ALWALA	-0.13884	34.48393	KISUMU	605	KE	KE	KISUMU WEST	2	6	NYANZA
1230	NATOLE	3.51651	35.87964	TURKANA	701	KE	KE	TURKANA CENTRAL	2	7	RIFT VALLEY
1224	KANGIRISAE	2.61852	36.25392	TURKANA	701	KE	KE	TURKANA CENTRAL	2	7	RIFT VALLEY
1226	LOCHOR EKUYEN	2.86972	35.17767	TURKANA	701	KE	KE	TURKANA CENTRAL	2	7	RIFT VALLEY
1227	NAOTIN	3.0574	35.54712	TURKANA	701	KE	KE	TURKANA CENTRAL	2	7	RIFT VALLEY
1231	MAKUTANO	3.53587	35.24499	TURKANA	701	KE	KE	TURKANA CENTRAL	2	7	RIFT VALLEY
1233	NARIOKOTOME	4.14415	35.91398	TURKANA	702	KE	KE	TURKANA NORTH	2	7	RIFT VALLEY
1234	AIC LOPIDING	4.20626	34.39046	TURKANA	702	KE	KE	TURKANA NORTH	2	7	RIFT VALLEY
1225	LOCHOR EMOIT	2.75756	35.64711	TURKANA	703	KE	KE	TURKANA SOUTH	2	7	RIFT VALLEY
1219	TURKWEL GORGE	1.91918	35.37047	WEST POKOT	704	KE	KE	WEST POKOT	2	7	RIFT VALLEY
1222	KAMERIS	2.27526	35.02739	WEST POKOT	705	KE	KE	POKOT NORTH	2	7	RIFT VALLEY
1211	CHORWAI	1.13983	35.31615	WEST POKOT	706	KE	KE	POKOT CENTRAL	2	7	RIFT VALLEY
1204	TOROR	0.956572	35.07867	TRANS NZOIA	710	KE	KE	TRANS NZOIA WEST	2	7	RIFT VALLEY
1190	TEREBEN	0.52741	35.75332	BARINGO	713	KE	KE	BARINGO CENTRAL	2	7	RIFT VALLEY
1203	NGINYANG B	0.9392	36.02051	BARINGO	715	KE	KE	EAST POKOT	2	7	RIFT VALLEY
1169	NGENDALEL	0.141355	36.11529	KOIBATEK	716	KE	KE	KOIBATEK	2	7	RIFT VALLEY
1164	KAPCHOLOI	0.09255	35.68682	KOIBATEK	716	KE	KE	KOIBATEK	2	7	RIFT VALLEY
1193	SONGETO	0.5923	35.55437	KEIYO	721	KE	KE	KEIYO	2	7	RIFT VALLEY

We need to change the co-ordinate of those 2 points which were not on the map. So, open the file **Kenya_school_location.csv** and make the following changes, set:

IBWALI: Longitude 34.6459198

SIWOT: Longitude 35.35437012

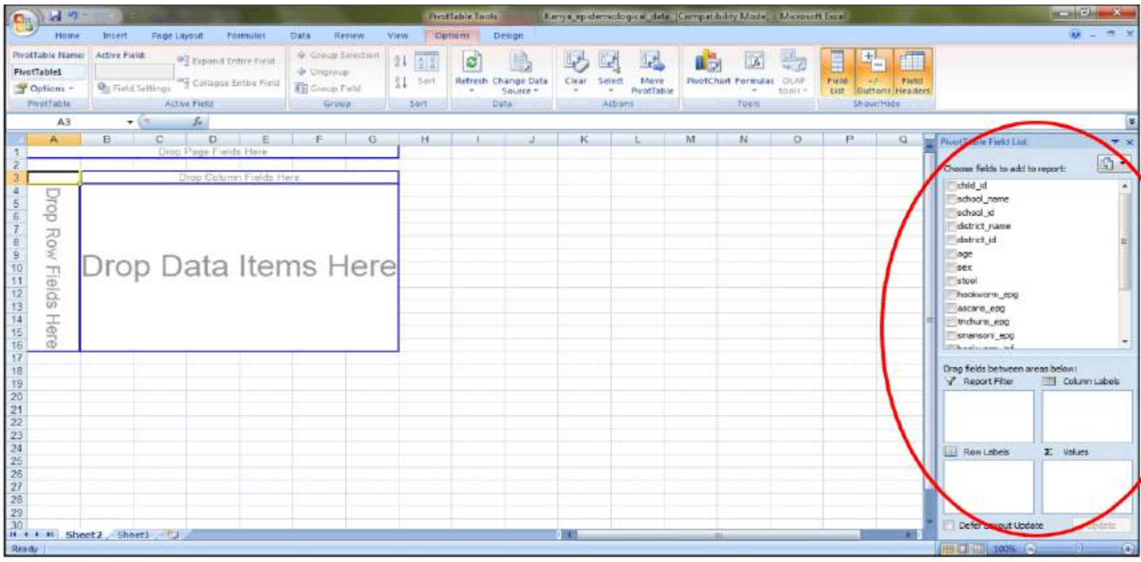


Save the file as: Kenya_school_location2.csv.

Step 6: Preparing data for mapping

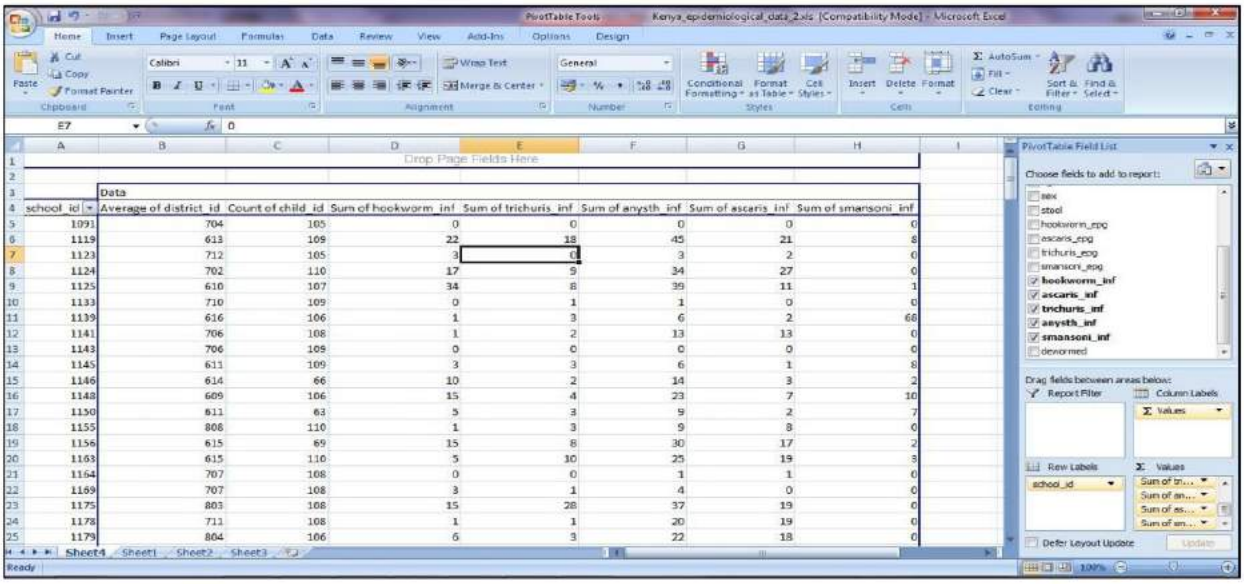
Open **Kenya_epidemiological_data_2.xls**, **select the entire sheet**, go to **Insert tab** to create new **Pivot Table.**

Tick New Worksheet to tell Excel that you want to place the table in a new sheet.



Now click on **school_id**todragand drop it in the **"Row labels"** field at the bottom.

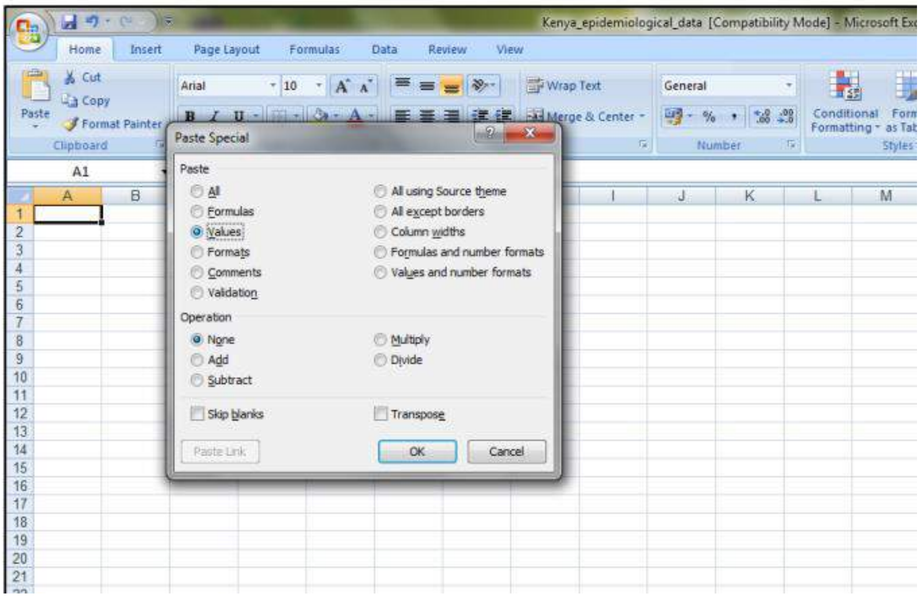
Add **district_id** to**"Σ Values"**and click on it, a drop down list will open, click on **Value Field Settings**. Choose **Average** as type of calculation, because all children in the same school will have same district_id.



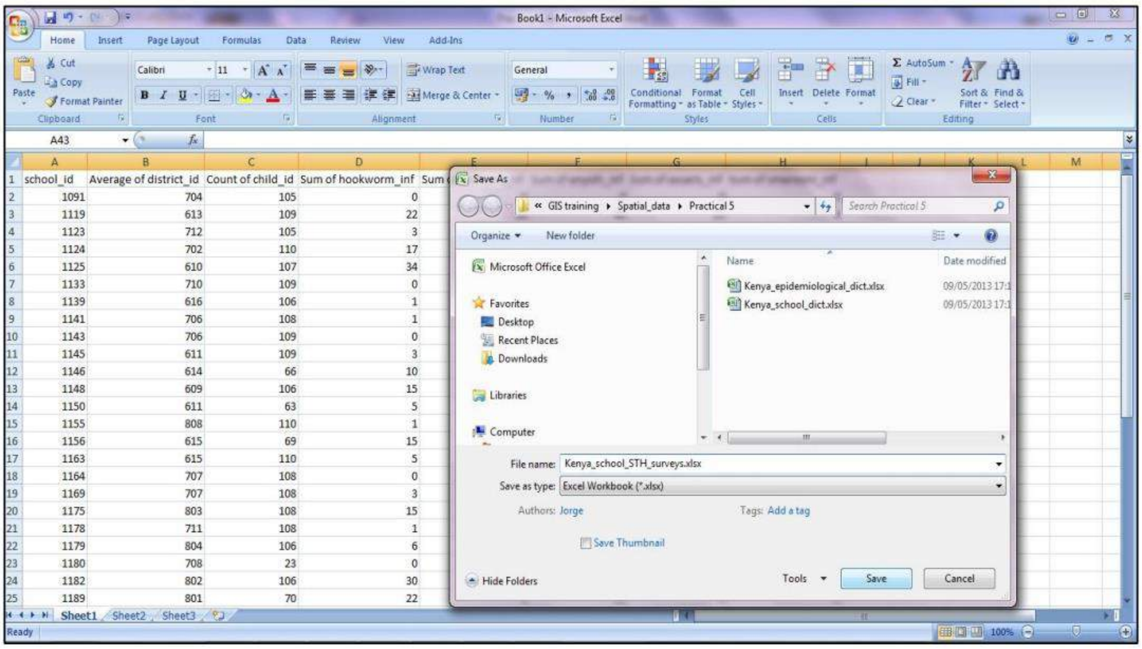
Now drag and drop**child_id** into the **"Σ Values"** field, click on **Value Field Settings** and choose **Count** to summarize the results. So, we come to know how many children per school are infected. Similarly, Drag and drop**anysth_inf** into the field, click on **Value Field Settings**and choose **Sum**. As, infected is 1 and not affected is 0, the sum will give us the total number of infected children.

Now **copy the table**, open a new Excel file and paste the values into the new spreadsheet. Therefore, click Paste in the Home tab, then choose **Paste special** and paste only the **values.**

Remove the last row which has Grand Total and other values.



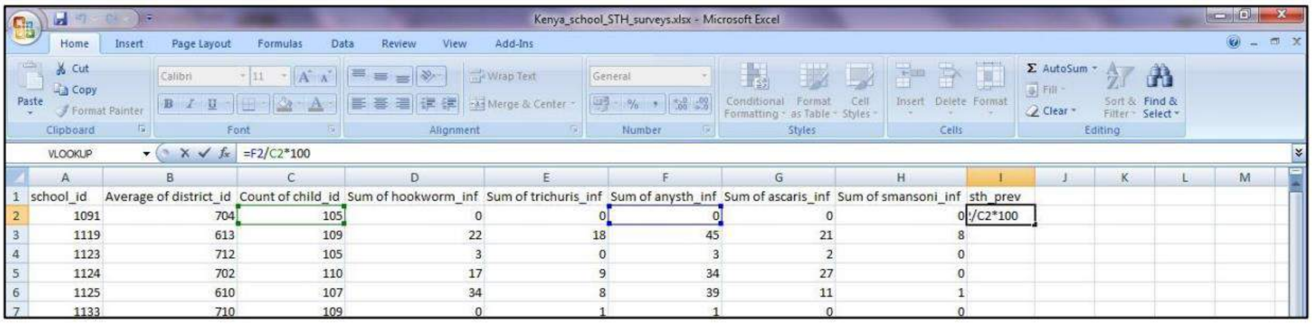
Save this new data table as **Kenya_school_STH_surveys.xlsx**



Now we need to know the total count of infected children, that is, the prevalence of STH.

So, w e**create a new column:sth_prev**in which we are going to be dividing the number of infected children by the number of children and multiplying by hundred to obtain a value in percent (%).

In the first cell under the heading type **=F2/C2*100** (this assumes that your number of children is in row C and the number of infected children in row F; you will need to **<u>adjust the column label accordingly</u>**); then copy the formula to the other cells in the column.



Additionally, you could calculate the 95% confidence interval (CI) of your prevalence.

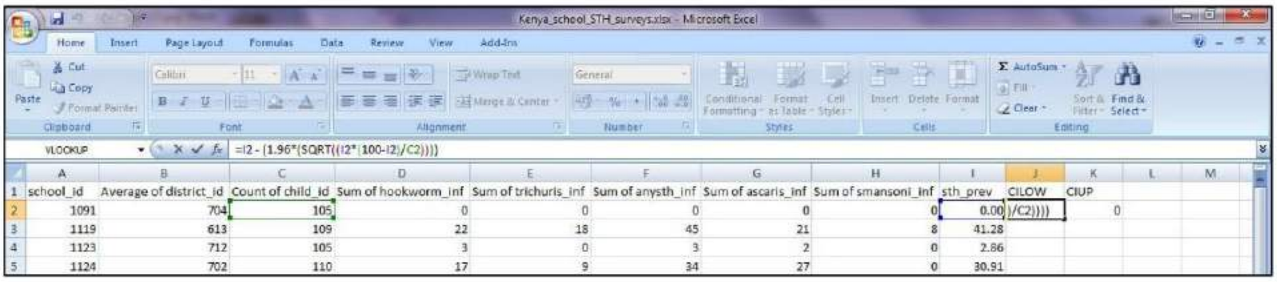
You will have to create a new column called **"CIlow"** (lower confidence limit) and **"CIup"**(upper confidence limit)

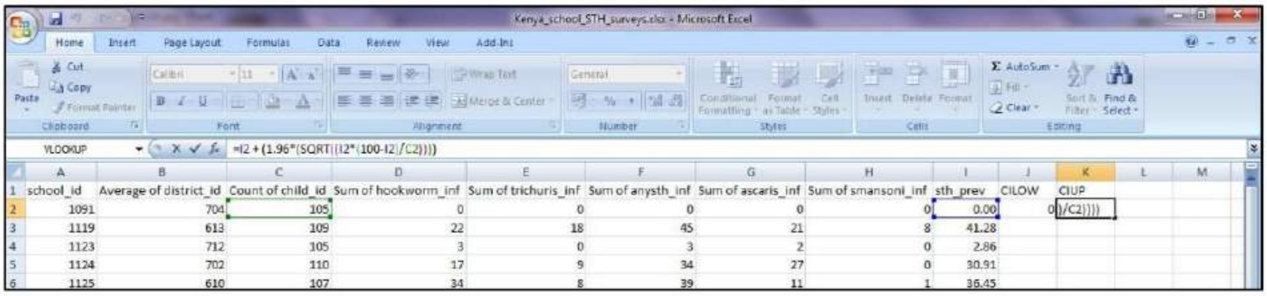
You can calculate the limits by typing the formulas as follows and then copying to the other cells:

For CIlow: =I2 - (1.96*(SQRT((I2*(100-I2)/C2))))

For CIup: =I2 + (1.96*(SQRT((I2*(100-I2)/C2))))

Assuming I2 as **sth_prev** and C2 as **Count of child_id, <u>adjust accordingly.</u>**



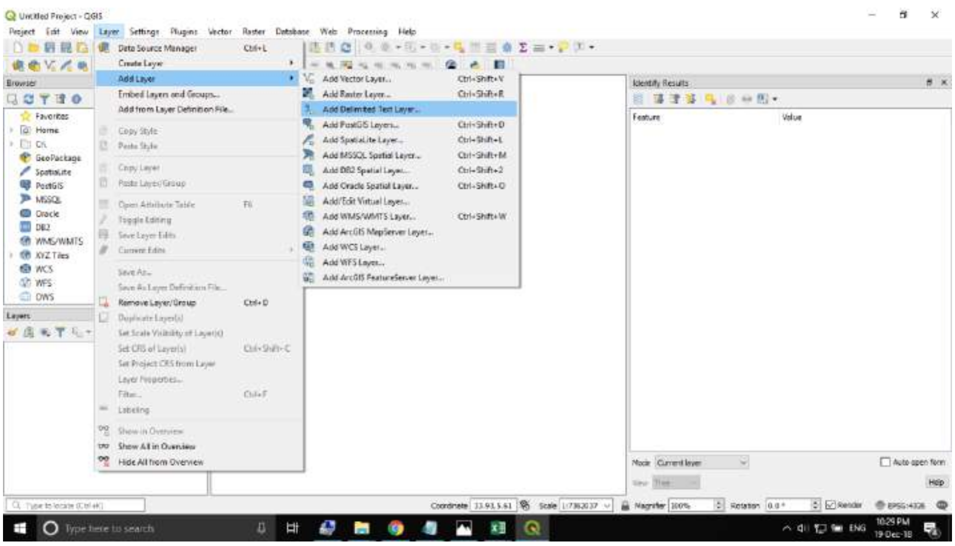


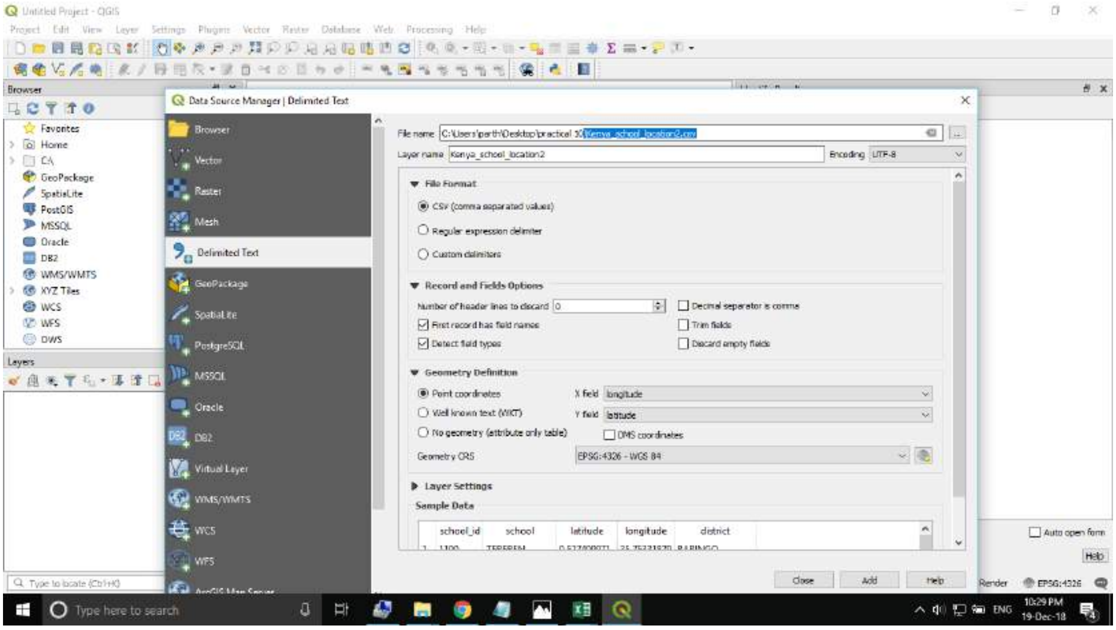
Save this file as **Kenya_epidemiological_school.csv**

Now that all the datasets are ready, let's add them.

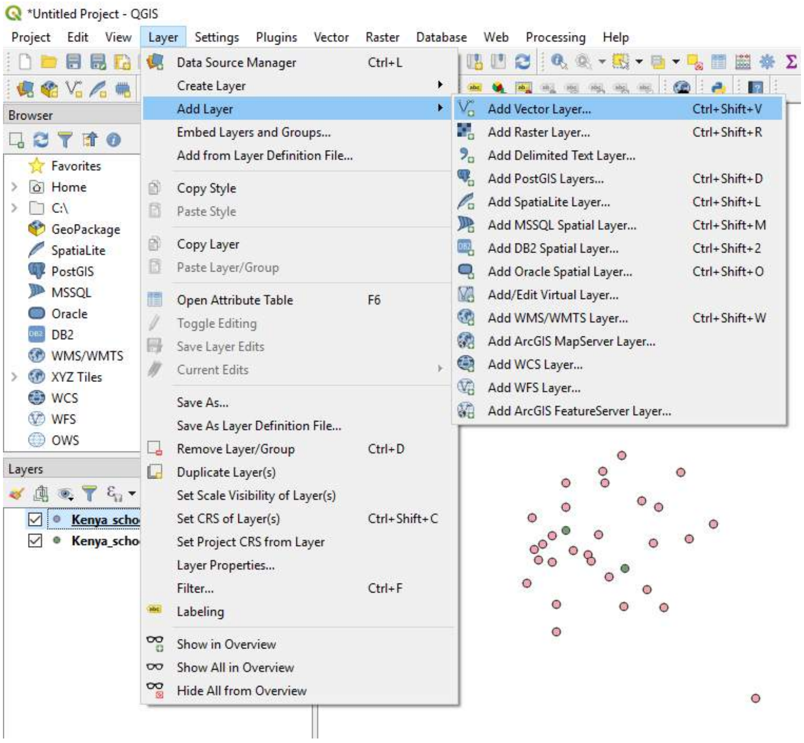
Open a new QGIS project.

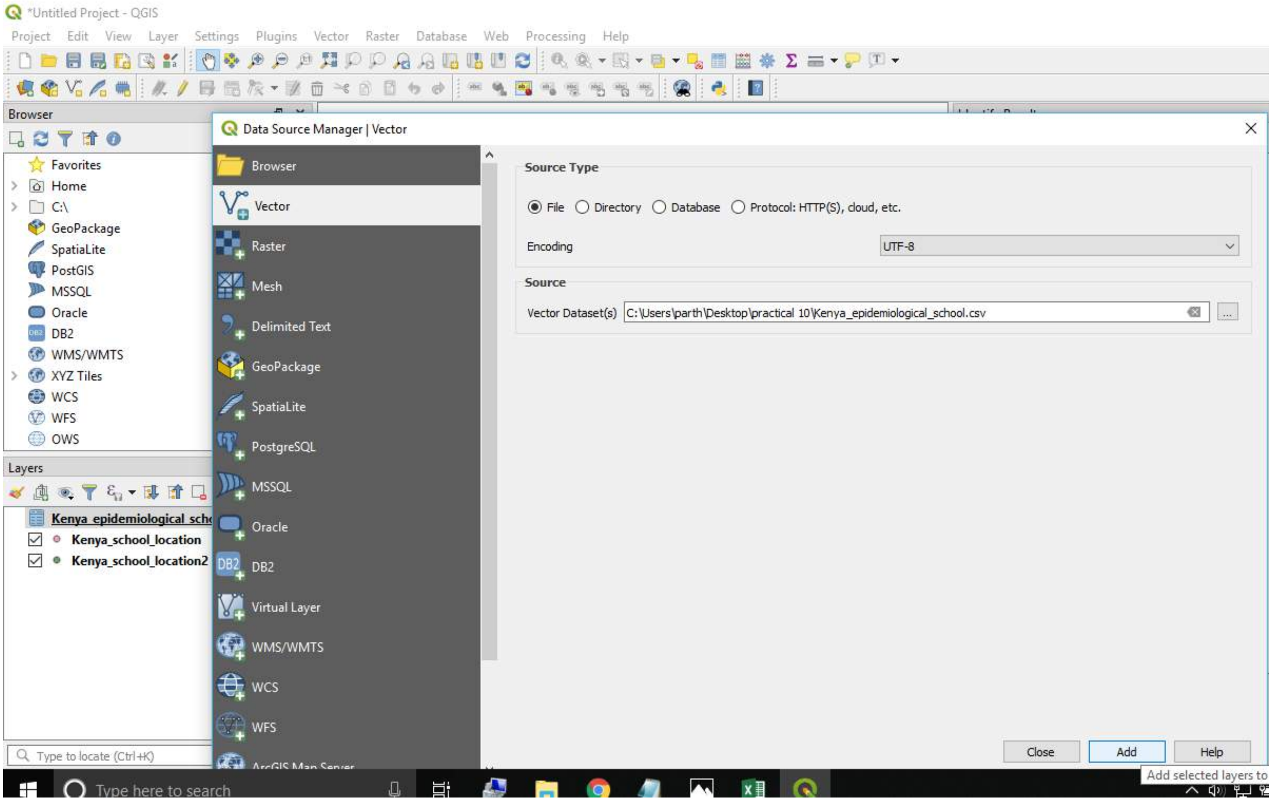
First, add **Kenya_school_location2.csv** to the project. Click on **Add Delimited text** layer in the menu, and browse to select the file.





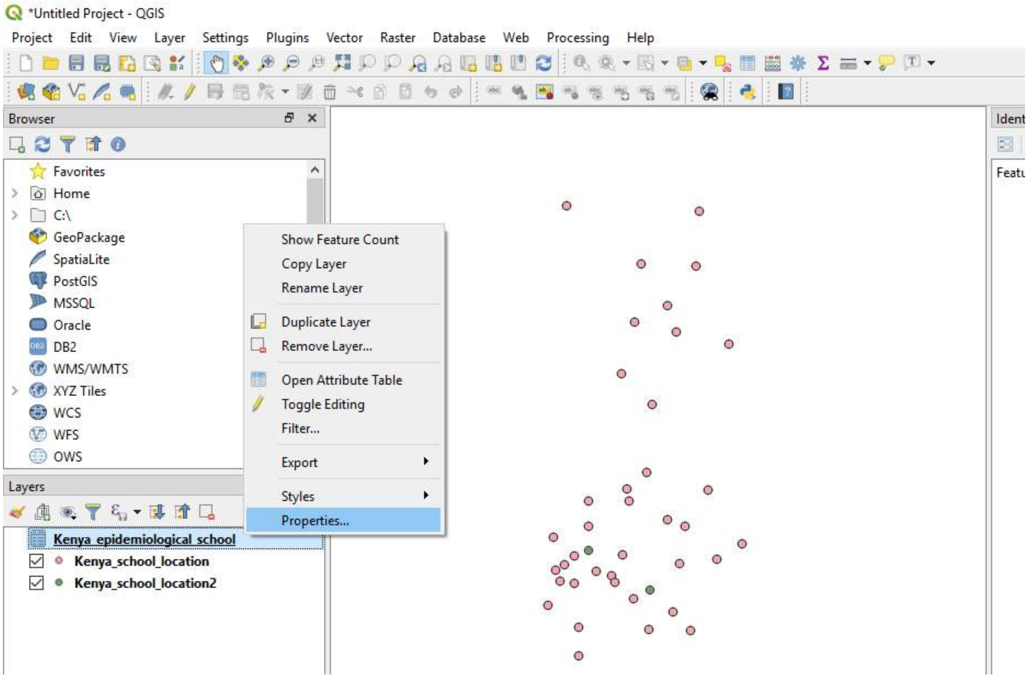
Similarly,**Add Vector Layer** and add **Kenya_ epidemiological_school.csv**



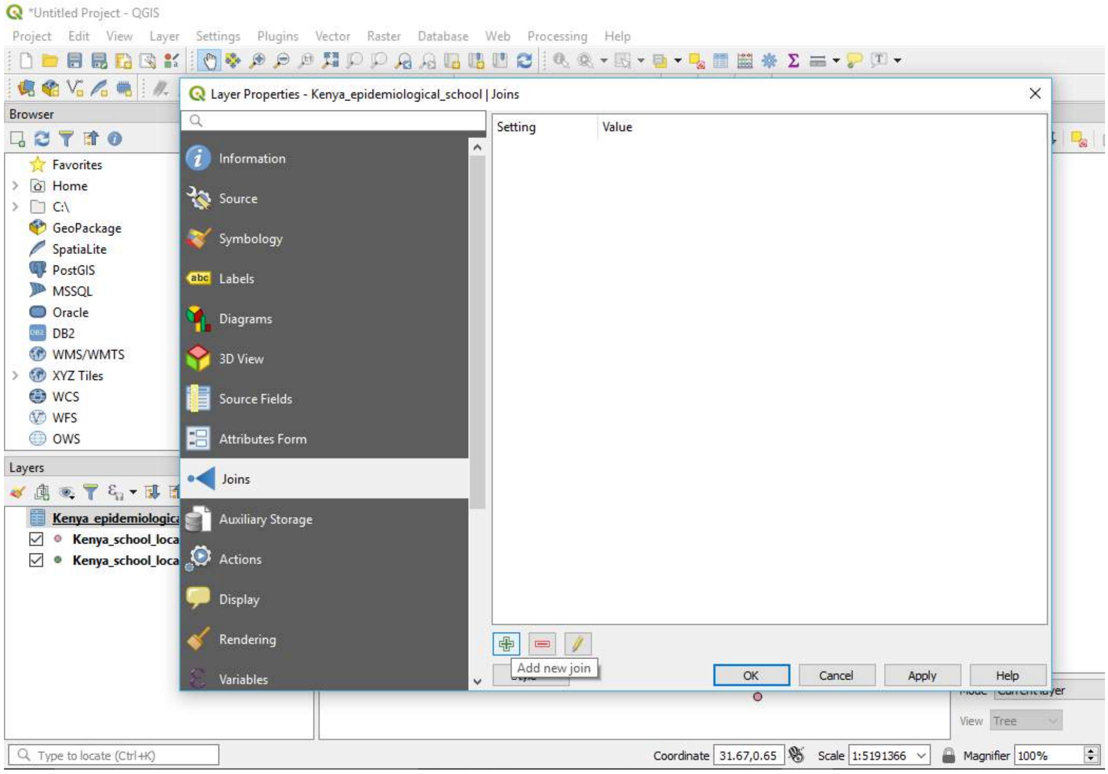


Now we'll join the data.

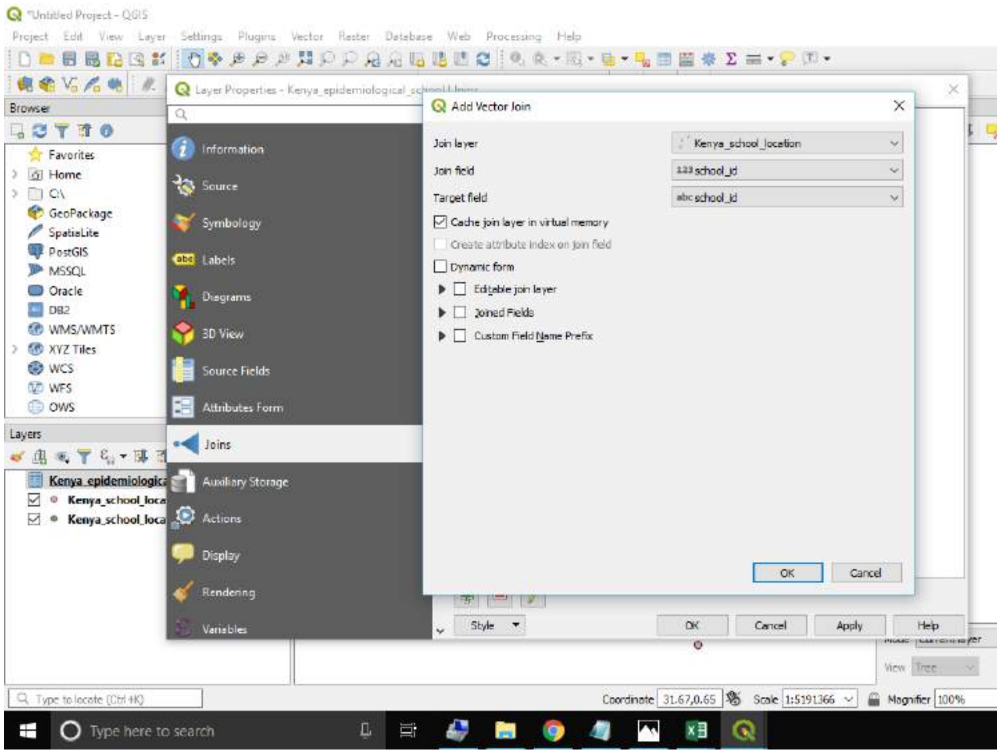
Right click on **Kenya _school_location2** layer and click on **Properties**



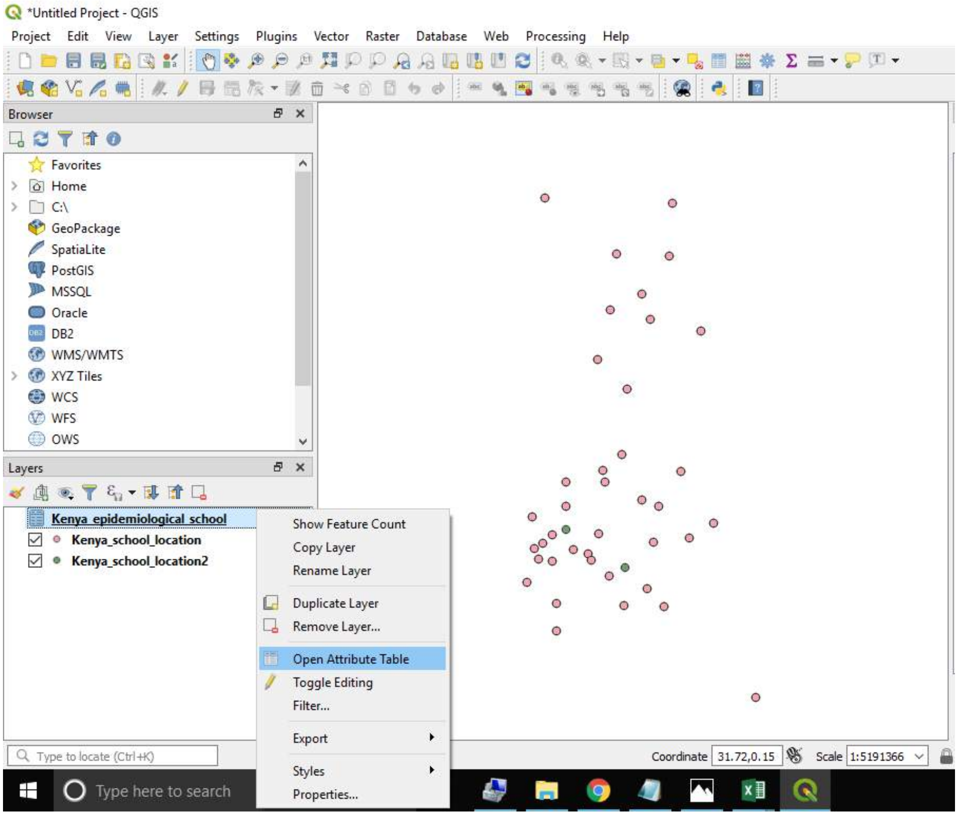
Go to the **Joins** section and click on the plus(+) button at the bottom



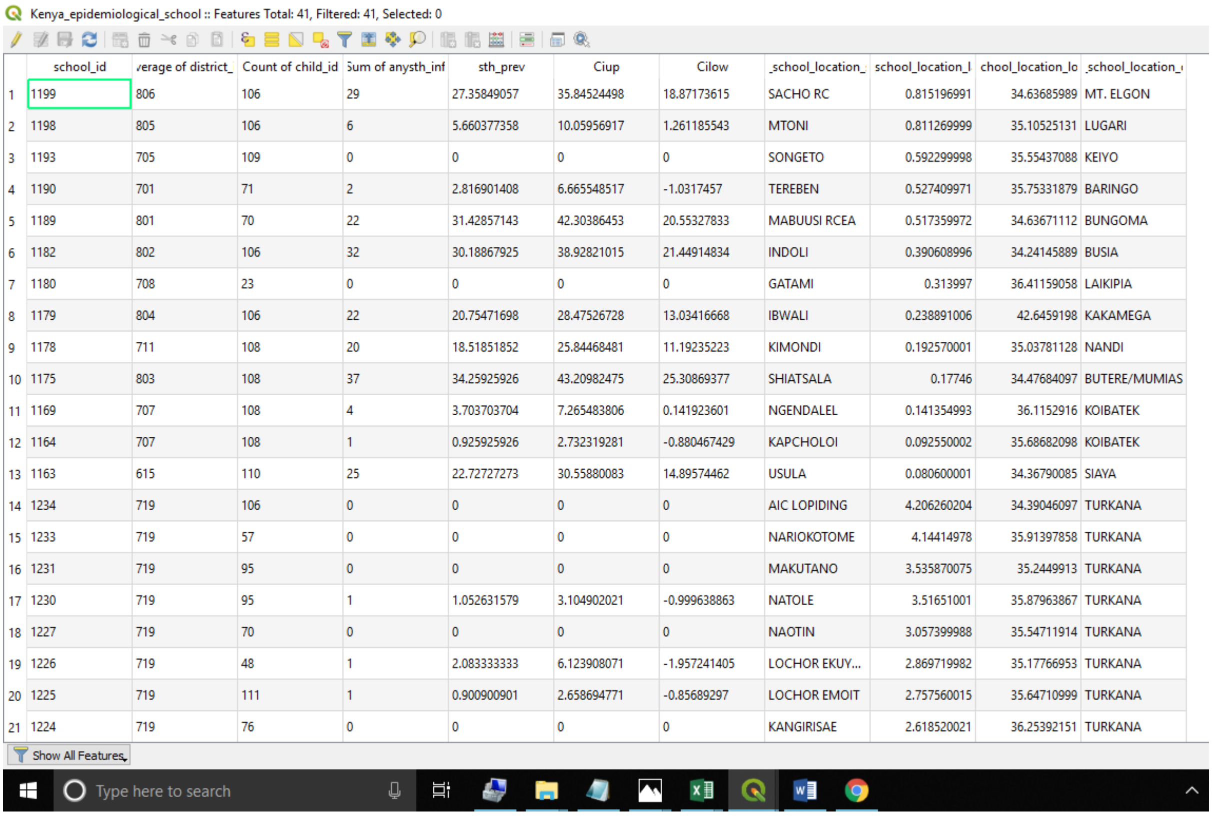
For "Join layer" choose**Kenya_epidemiological_school** and for"Join field" and "Target field" choose **school_id.** Then click on OK.



Right click on **Kenya_school_location2** layer and select **Open Attribute Table.**



You will see that the epidemiological variables are included.



Kenya_epidemiological_school :: Features Total: 41, Filtered: 41, Selected: 0

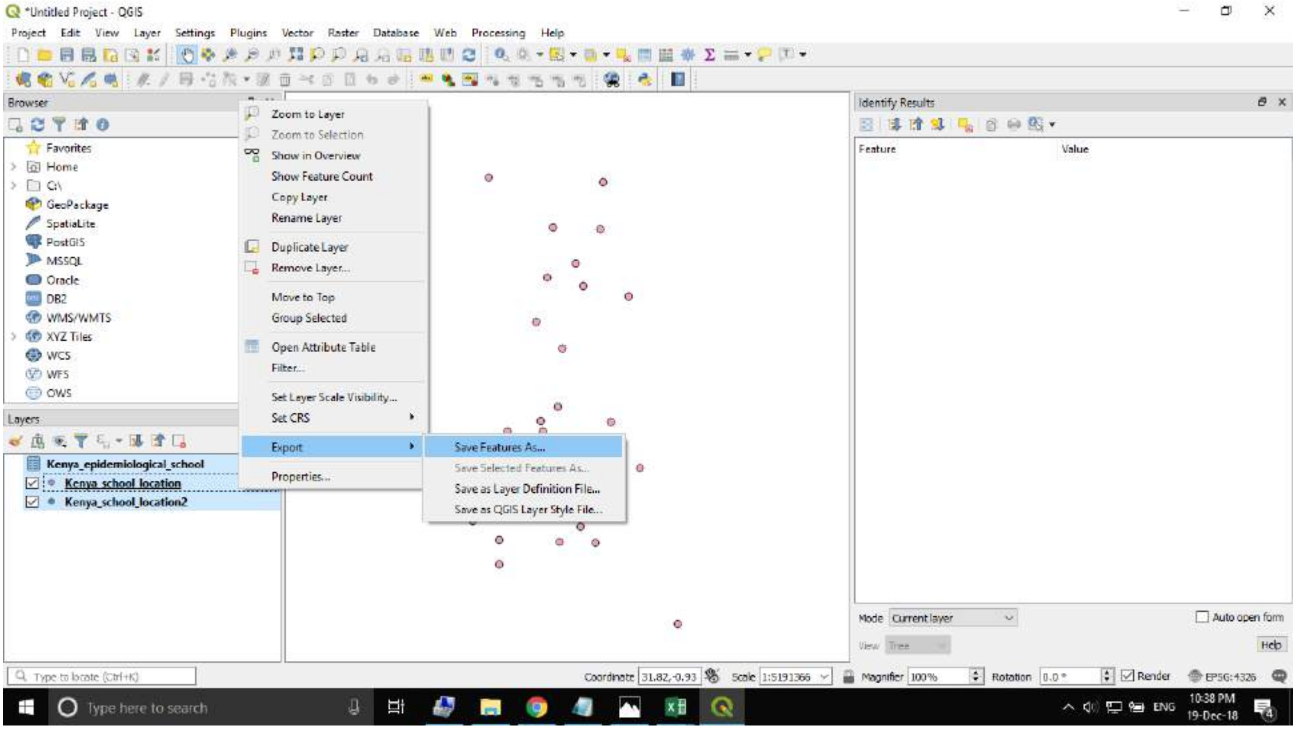
	school_id	verage of district_	Count of child_id	Sum of anysth_inf	sth_prev	Ciup	Cilow	_school_location_	school_location_l	chool_location_lo	_school_location_(
1	1199	806	106	29	27.35849057	35.84524498	18.87173615	SACHO RC	0.815196991	34.63685989	MT. ELGON
2	1198	805	106	6	5.660377358	10.05956917	1.261185543	MTONI	0.811269999	35.10525131	LUGARI
3	1193	705	109	0	0	0	0	SONGETO	0.592299998	35.55437088	KEIYO
4	1190	701	71	2	2.816901408	6.665548517	-1.0317457	TEREBEN	0.527409971	35.75331879	BARINGO
5	1189	801	70	22	31.42857143	42.30386453	20.55327833	MABUUSI RCEA	0.517359972	34.63671112	BUNGOMA
6	1182	802	106	32	30.18867925	38.92821015	21.44914834	INDOLI	0.390608996	34.24145889	BUSIA
7	1180	708	23	0	0	0	0	GATAMI	0.313997	36.41159058	LAIKIPIA
8	1179	804	106	22	20.75471698	28.47526728	13.03416668	IBWALI	0.238891006	42.6459198	KAKAMEGA
9	1178	711	108	20	18.51851852	25.84468481	11.19235223	KIMONDI	0.192570001	35.03781128	NANDI
10	1175	803	108	37	34.25925926	43.20982475	25.30869377	SHIATSALA	0.17746	34.47684097	BUTERE/MUMIAS
11	1169	707	108	4	3.703703704	7.265483806	0.141923601	NGENDALEL	0.141354993	36.1152916	KOIBATEK
12	1164	707	108	1	0.925925926	2.732319281	-0.880467429	KAPCHOLOI	0.092550002	35.68682098	KOIBATEK
13	1163	615	110	25	22.72727273	30.55880083	14.89574462	USULA	0.080600001	34.36790085	SIAYA
14	1234	719	106	0	0	0	0	AIC LOPIDING	4.206260204	34.39046097	TURKANA
15	1233	719	57	0	0	0	0	NARIOKOTOME	4.14414978	35.91397858	TURKANA
16	1231	719	95	0	0	0	0	MAKUTANO	3.535870075	35.2449913	TURKANA
17	1230	719	95	1	1.052631579	3.104902021	-0.999638863	NATOLE	3.51651001	35.87963867	TURKANA
18	1227	719	70	0	0	0	0	NAOTIN	3.057399988	35.54711914	TURKANA
19	1226	719	48	1	2.083333333	6.123908071	-1.957241405	LOCHOR EKUY...	2.869719982	35.17766953	TURKANA
20	1225	719	111	1	0.900900901	2.658694771	-0.85689297	LOCHOR EMOIT	2.757560015	35.64710999	TURKANA
21	1224	719	76	0	0	0	0	KANGIRISAE	2.618520021	36.25392151	TURKANA

Show All Features

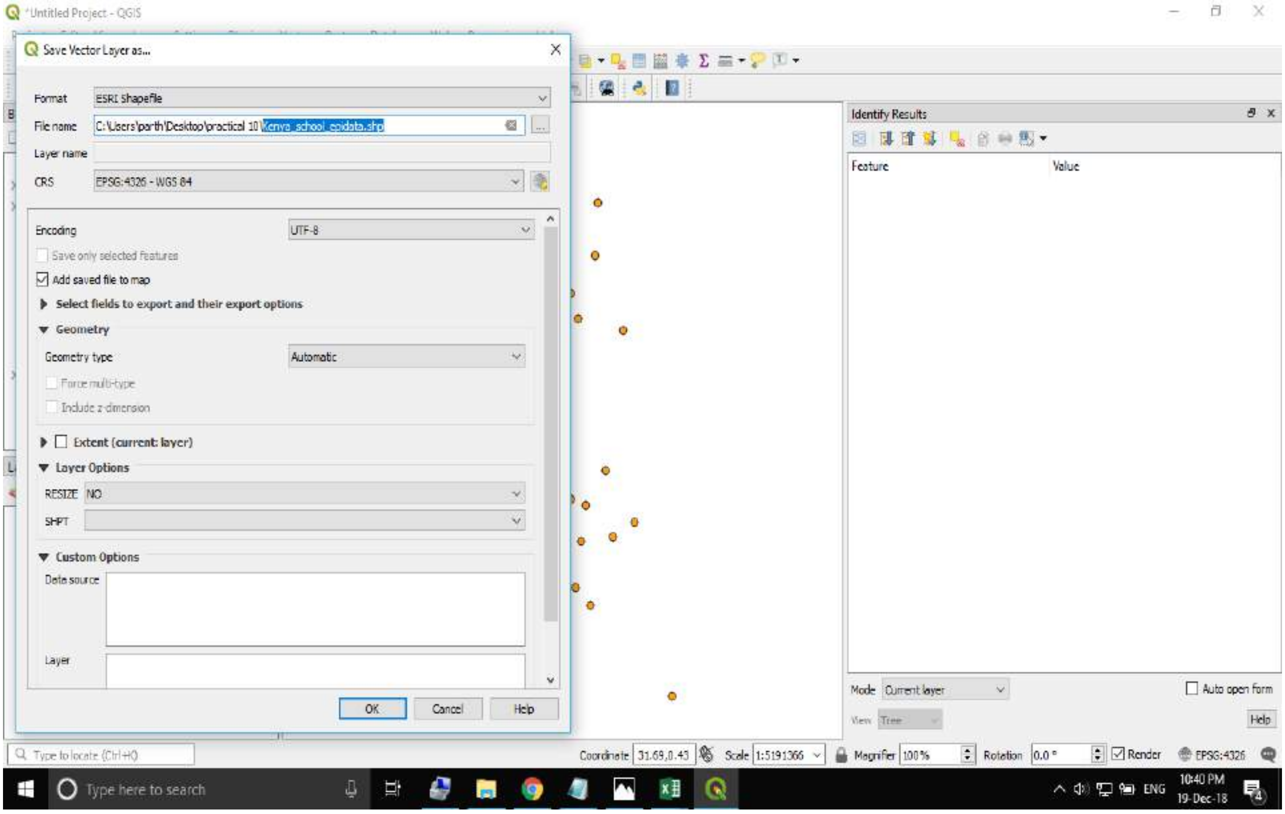
Type here to search

We are finally done, now we just have to save the files!!

Select all the layers, right-click on them and in Export select **Save Features As..**



Select **Format** as **ESRI Shapefile** and **File Name** as: **Kenya_school_epidata.shp**



Links for Datasets

1. **For Multiple data sets : https://www.gadm.org/download_country_v3.html**
2. **For Multiple data sets : https://urs.earthdata.nasa.gov**
3. **Geological survey data : https://ers.cr.usgs.gov/register**
4. **Raster Mosaic: https://lance-modis.eosdis.nasa.gov/imagery/subsets/?project=fas**
5. **https://www.gadm.org/download_world.html**
6. **https://github.com/datameet/maps/tree/master/Survey-of-India-Index-Maps**
7. **https://bhuvan.nrsc.gov.in**
8. **For DEM :**
   http://viewfinderpanoramas.org/Coverage%20map%20viewfinderpanoramas_org3.htm

Dear Teacher, please send your valuable feedback and contribution to make this manual more effective.
Please send on dandhiren@yahoo.co.in and/or shaikh.aa@rediffmail.com