



**SHRI G.P.M. DEGREE COLLEGE OF SCIENCE & COMMERCE**

**Department of Computer**

Affiliated to University of Mumbai

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## **Experiment No.—1:**

**Aim:** Familiarizing Quantum GIS: Installation of QGIS, datasets for both Vector and Raster data, Maps.

**Tools & Technologies used:** QGIS

**Learning Objectives:**

1. Install QGIS software and datasets.
2. Understand vector and raster data

### **Theory-1: Introduction to Quantum GIS**

#### **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) 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

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.



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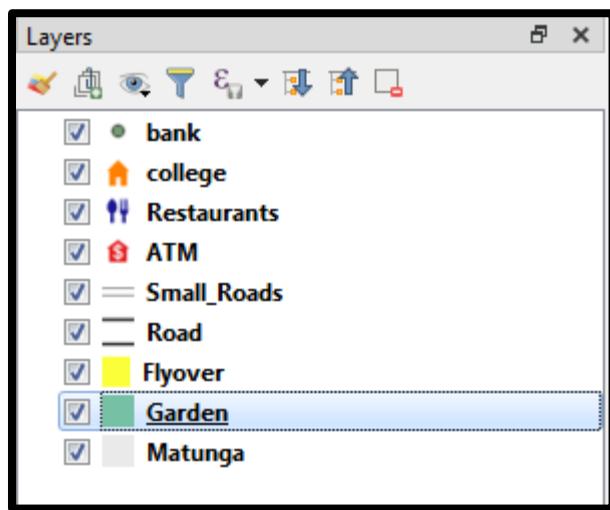
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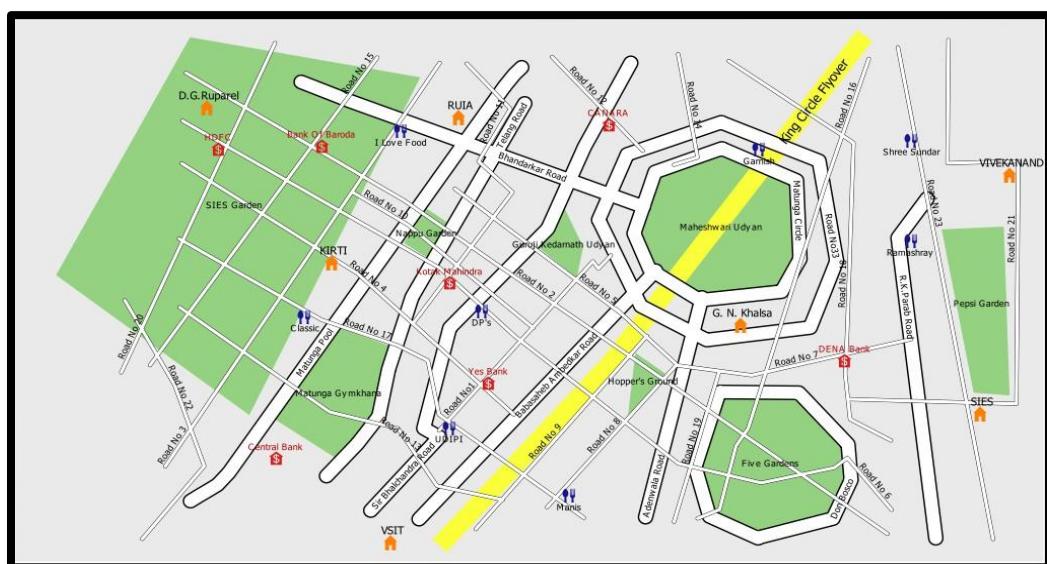
## Step:-

### Procedure:

- 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:





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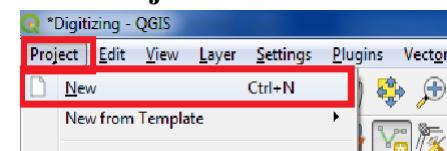
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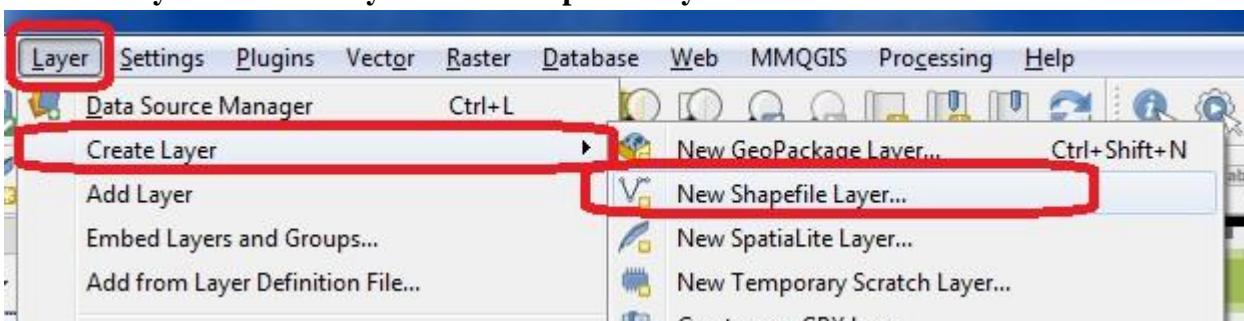
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a) Creating Polygon vector layer

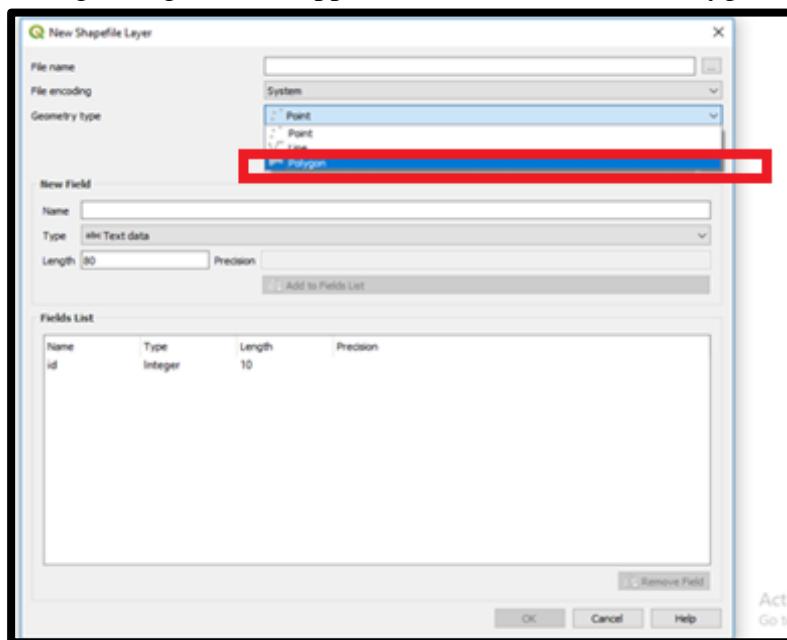
- Select Project→New



- 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.

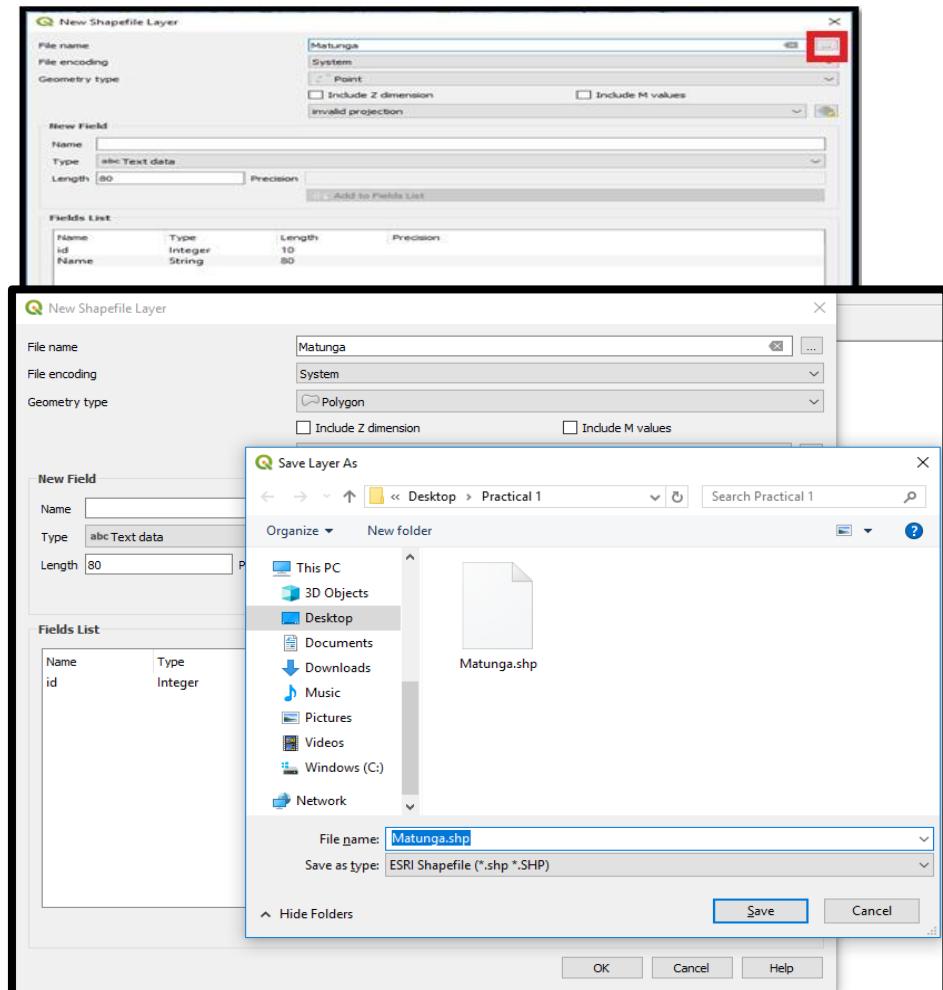


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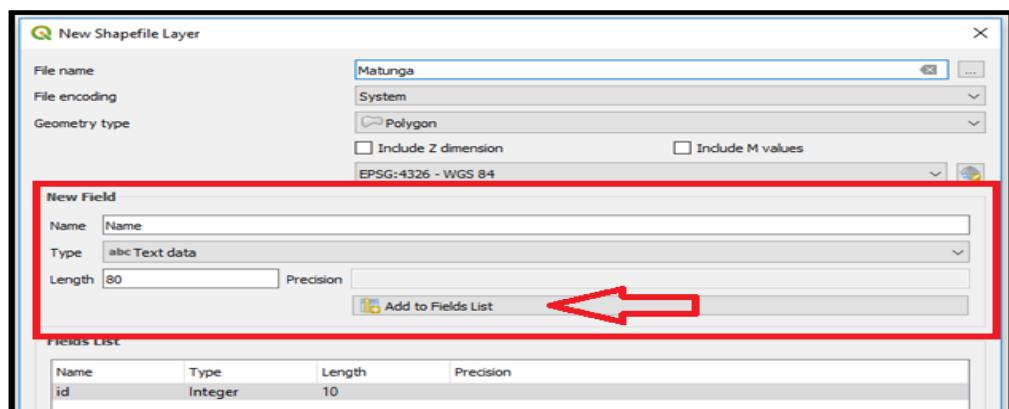
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#### ➤ Field Panel

- Add the **Attribute** you want to show. (**Column Name** for Table)
- b. Specify **Type** (**Data Type**: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.

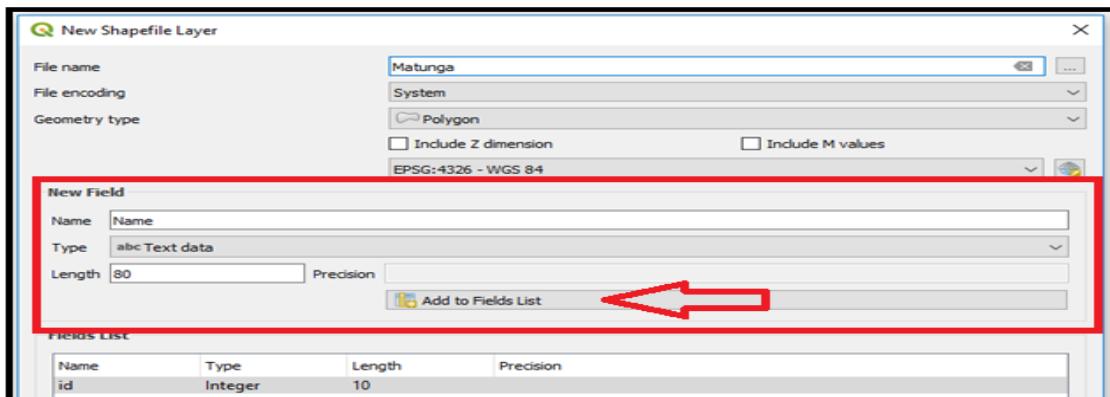


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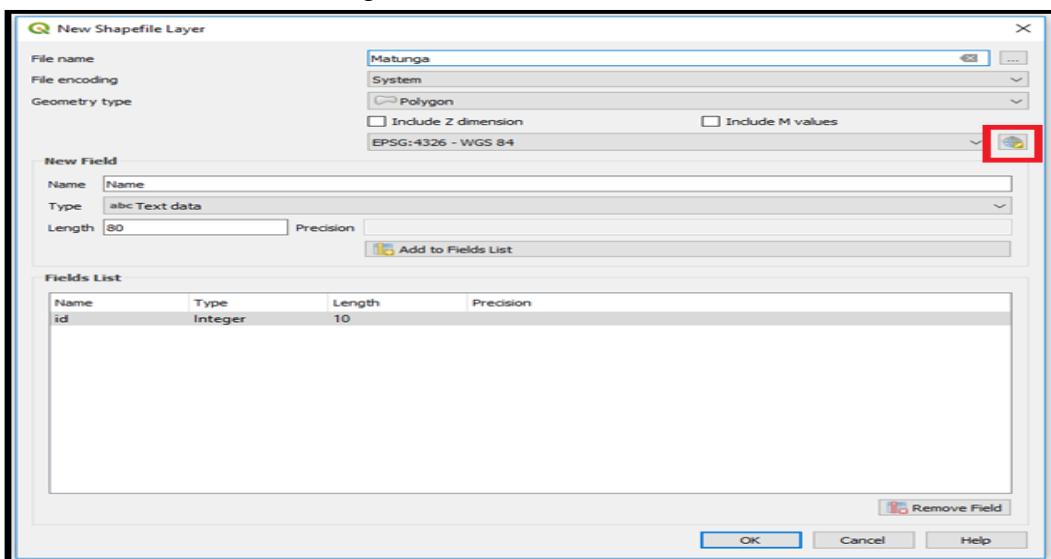
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- Select Geometry Type as follows
  - Click on the following button



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

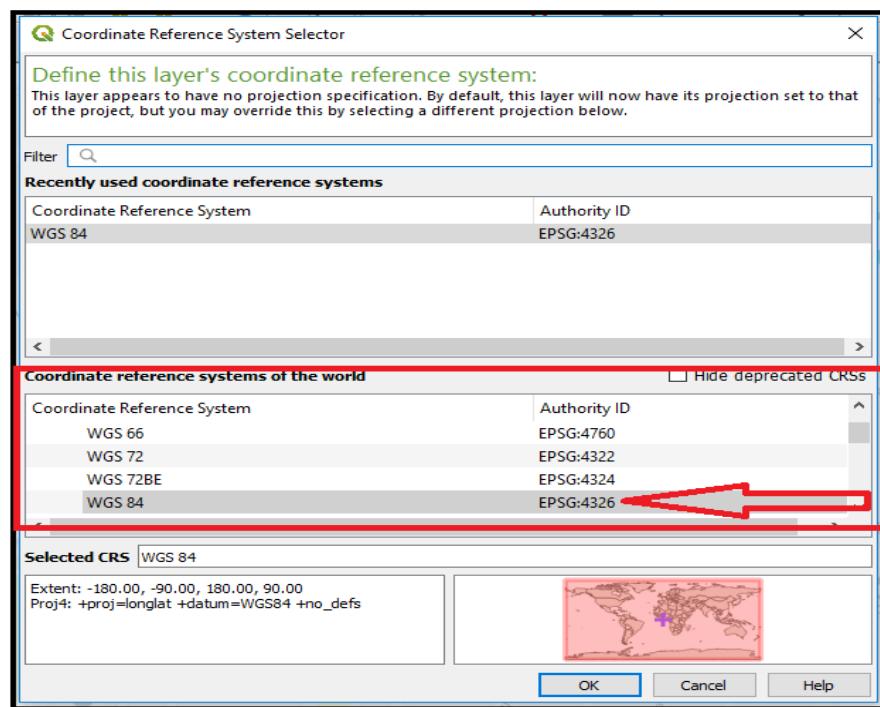


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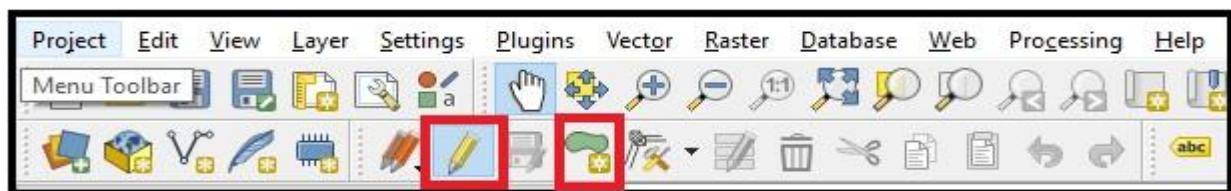
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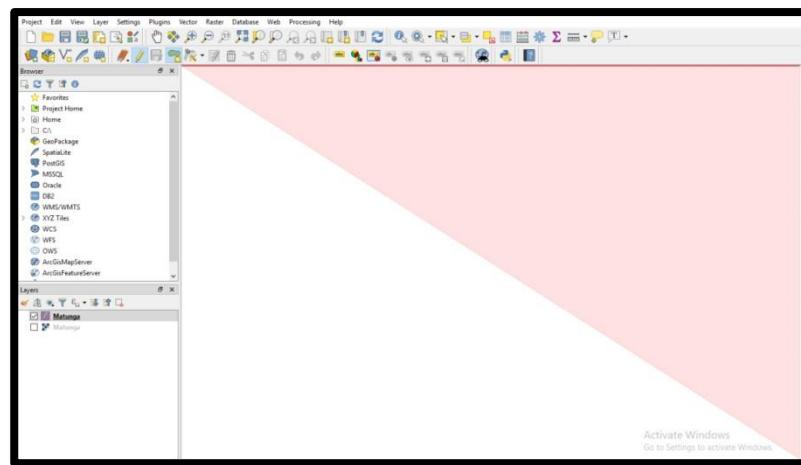


- a) Follow the steps to plot Polygon features.

- 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





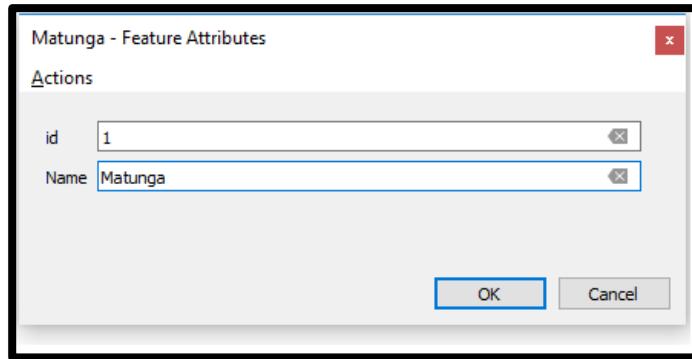
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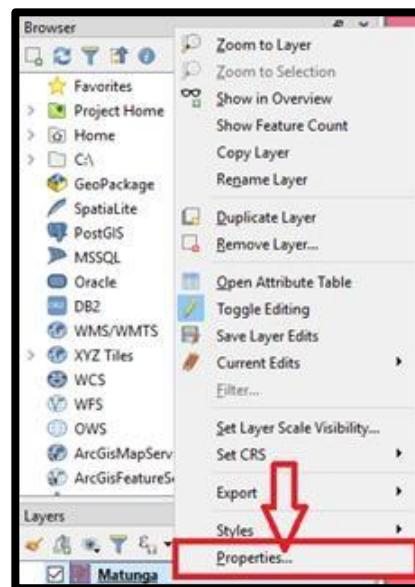
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- Save the newly added polygon as follows.



- 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**.

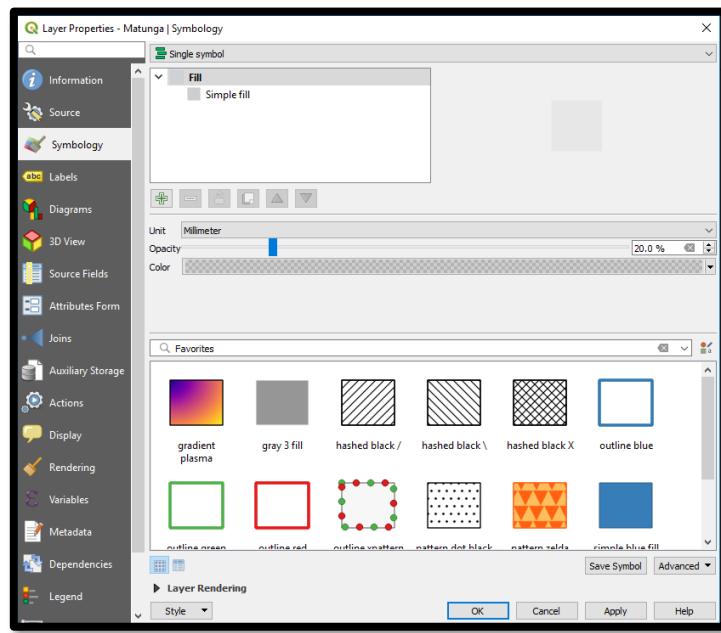


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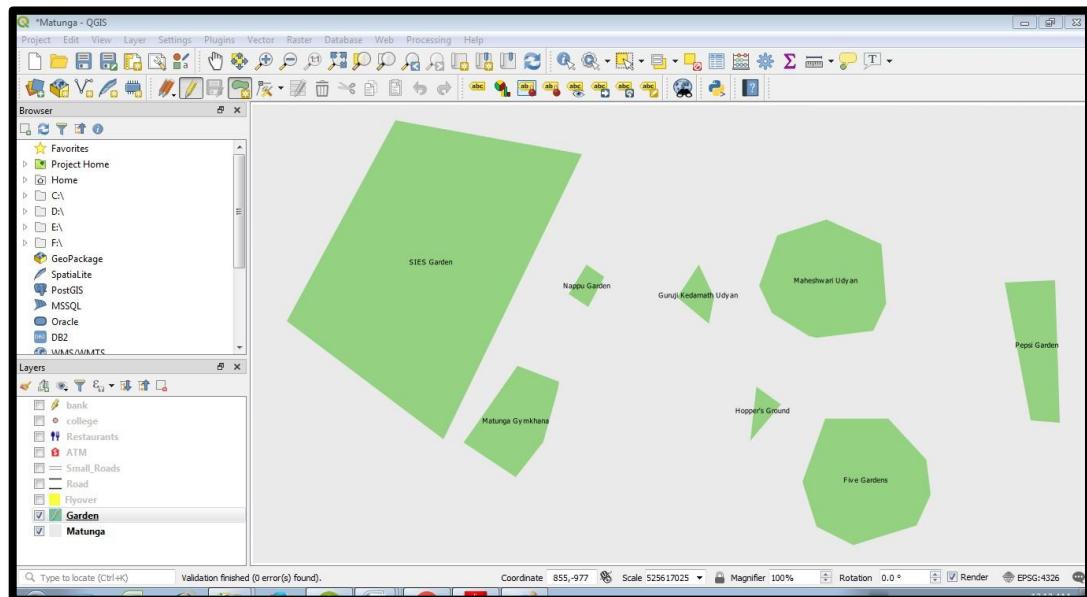
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- Same way we can add one more polygon layer for Gardens.



**b) Creating Line vector layer**

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

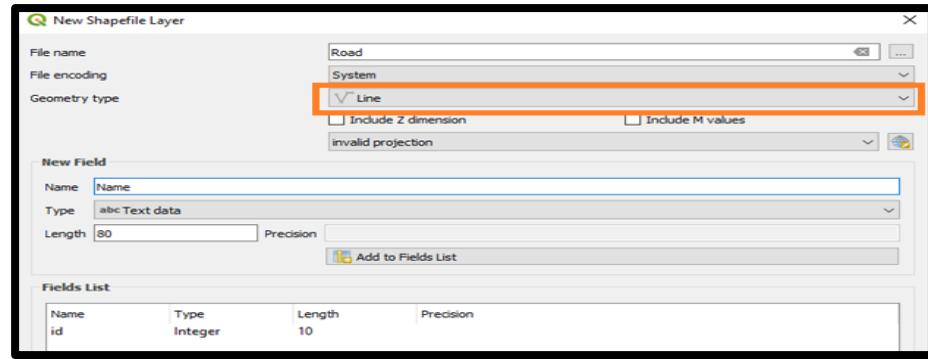


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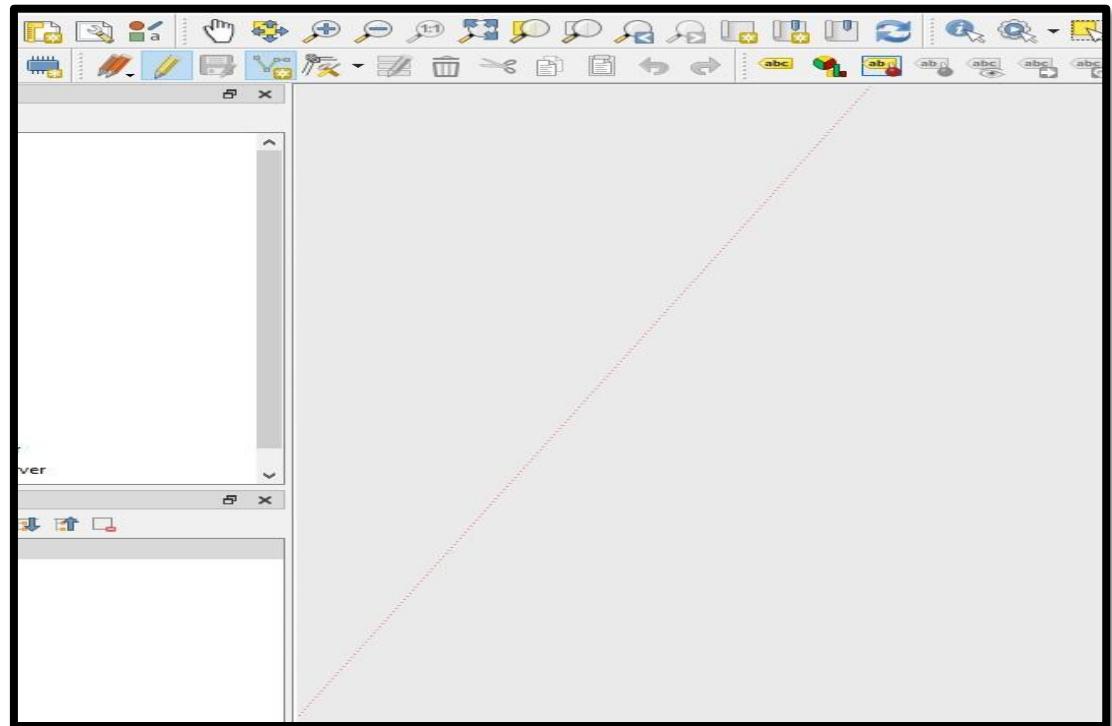


➤ **Road layer :**

- 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**)

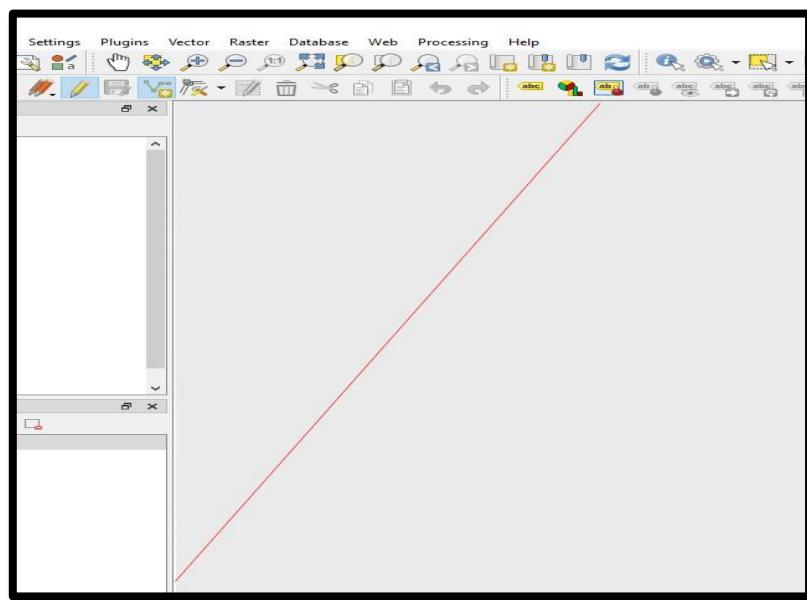


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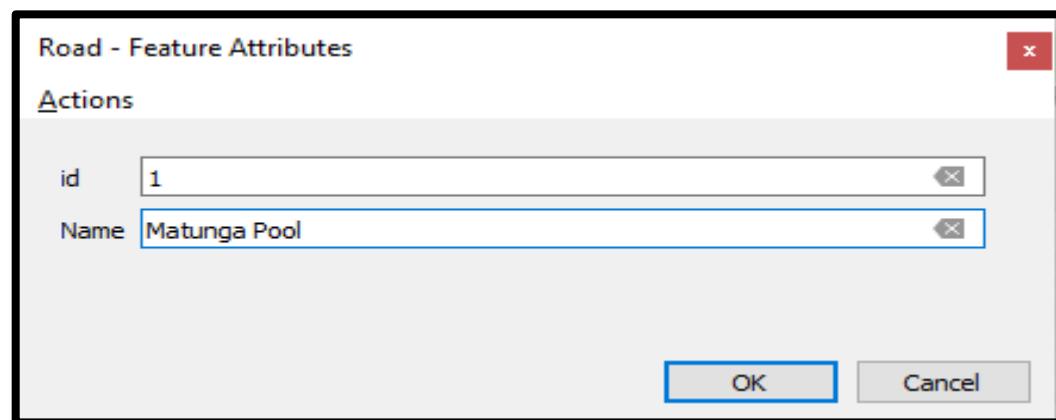
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- save your data



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

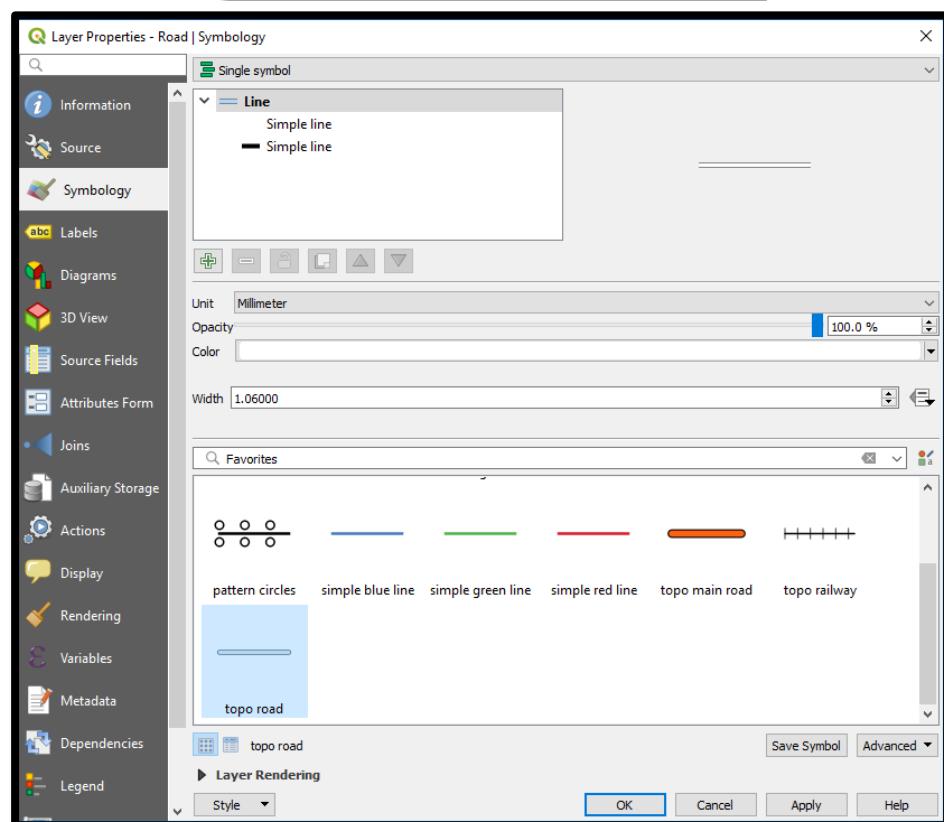
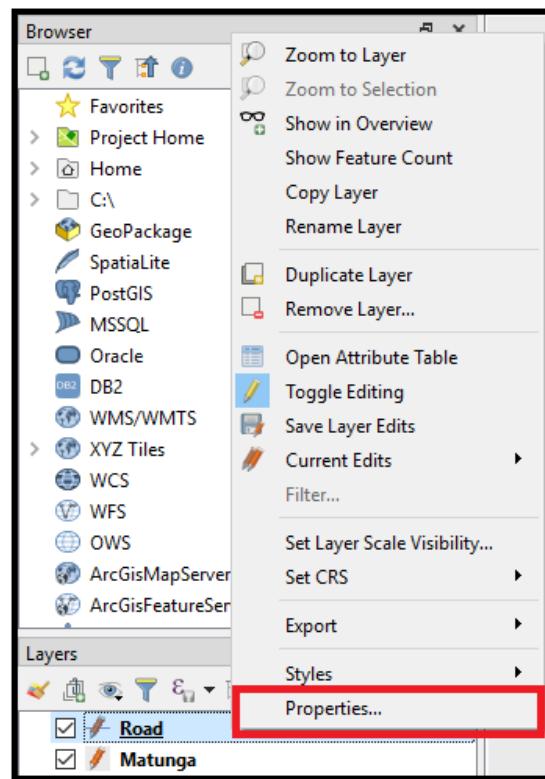


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- Road will look as below

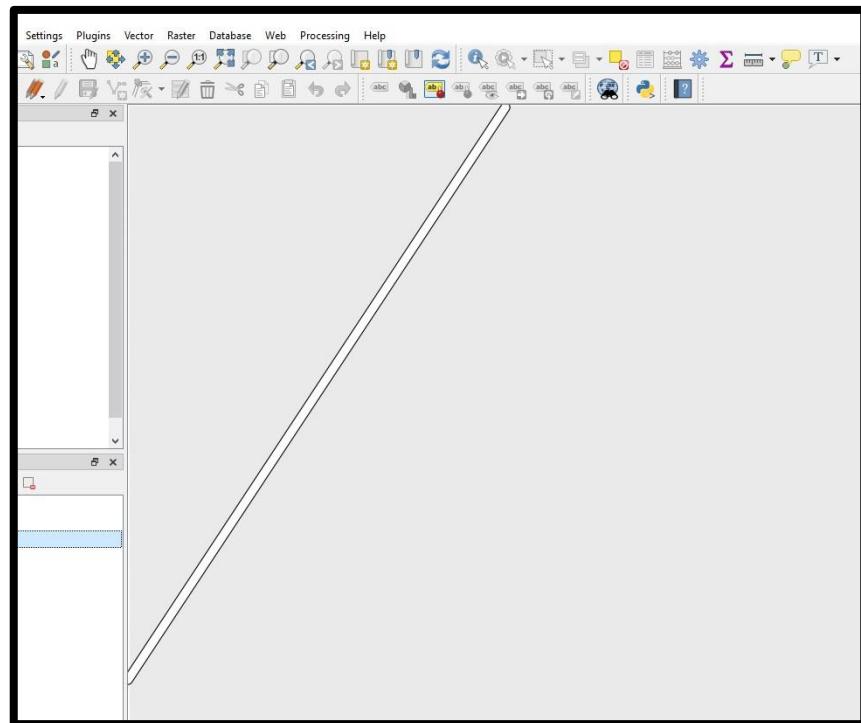


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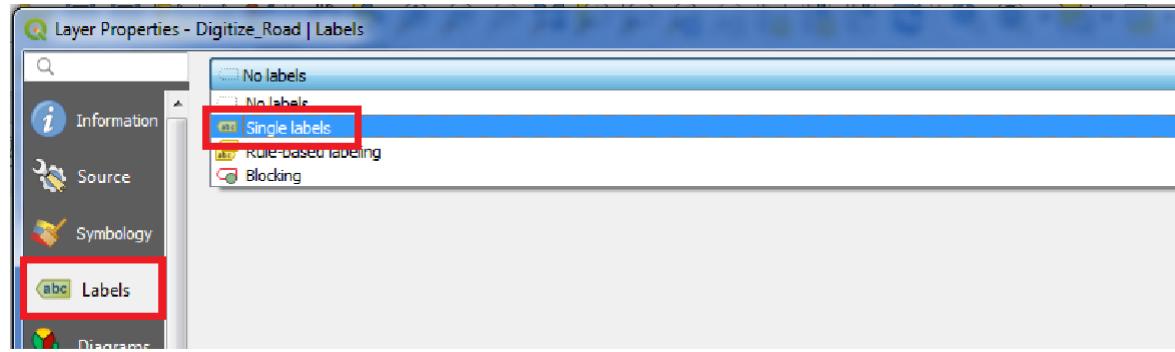
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- To label your roads **Right click on Road layer**. Go to **properties** window then select label and set single **label property**



- Following window will appear on the screen

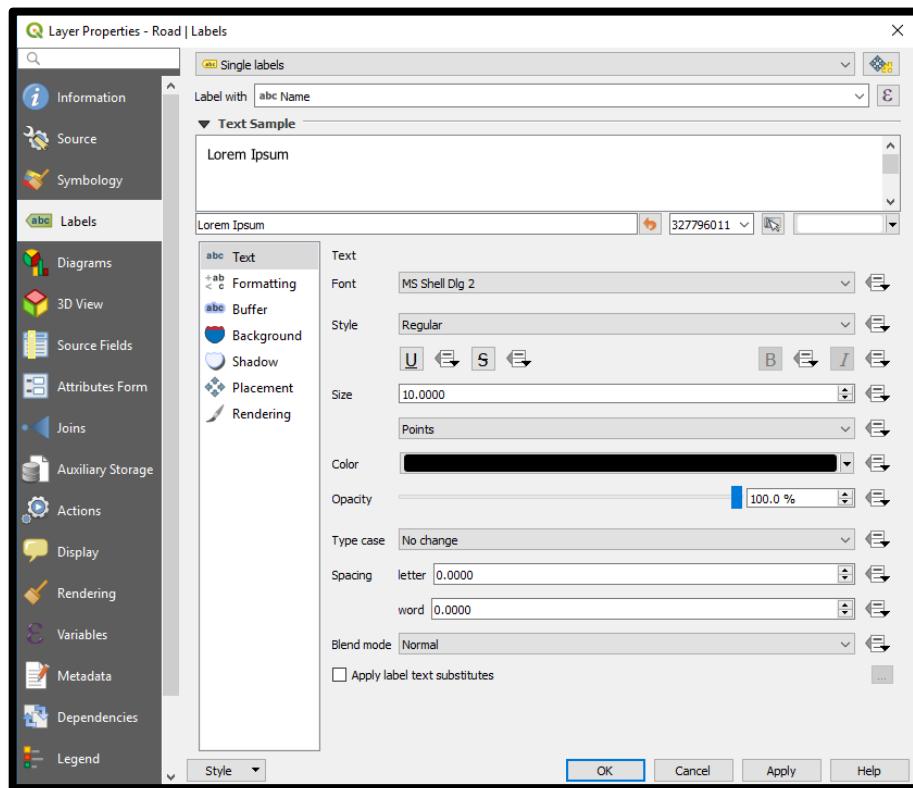


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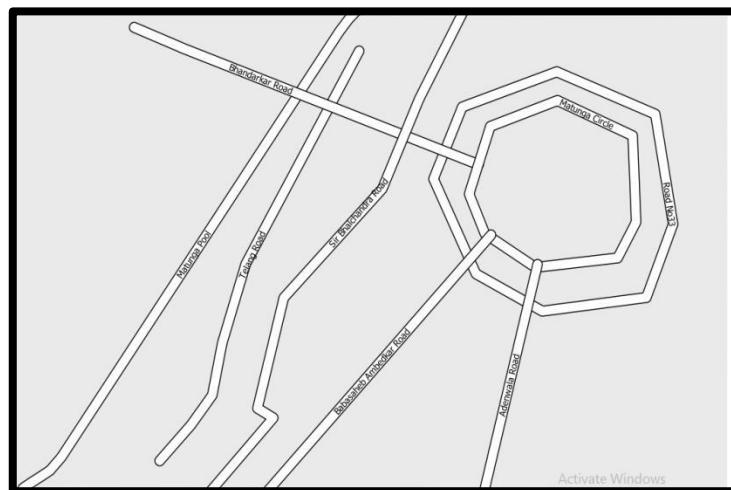
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- Roads will look like these



- To merge roads

- Go to **properties** of road then select **symbology**. Click on **Advanced** button select Symbol levels.

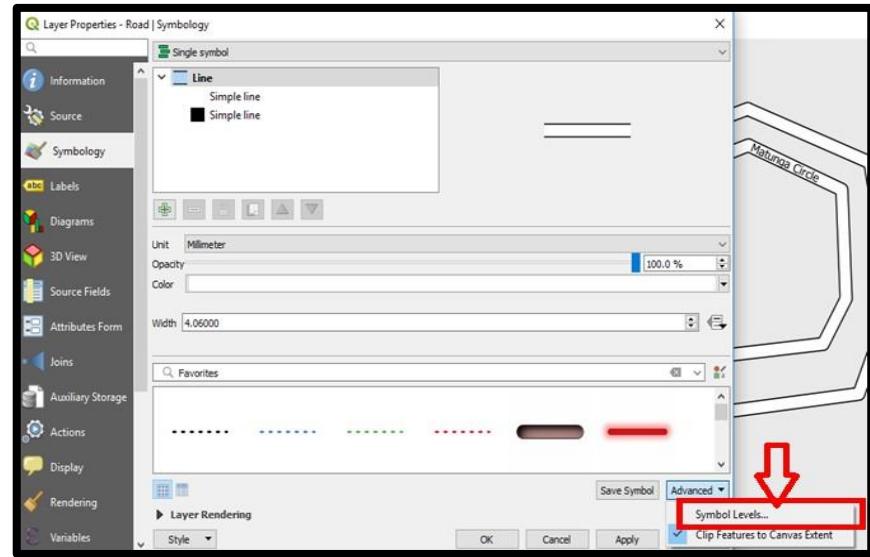


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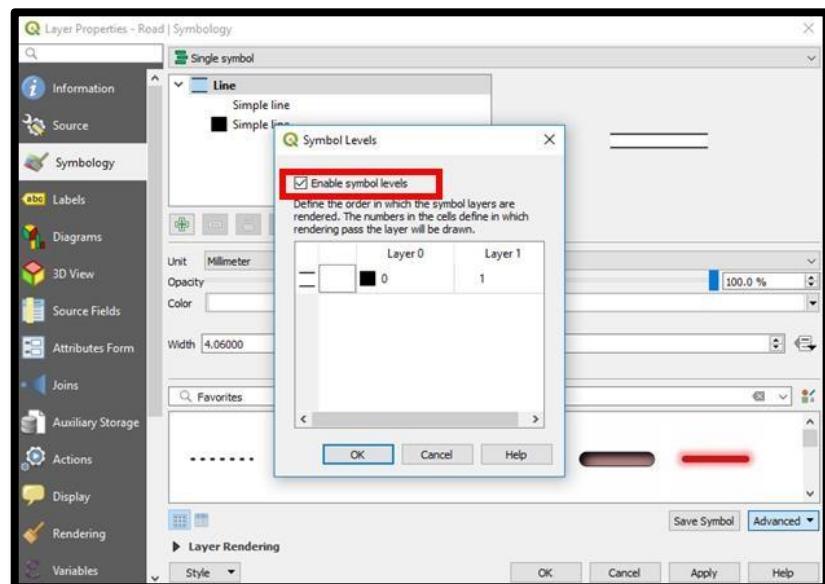
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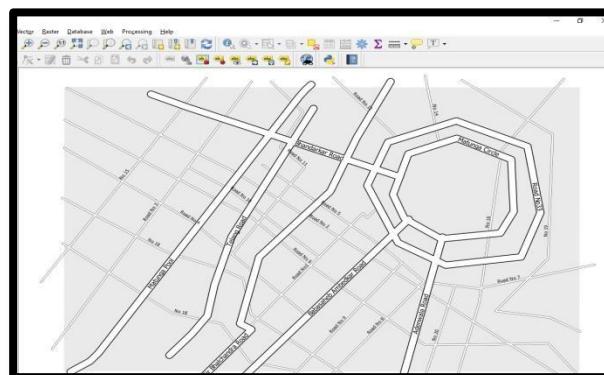
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- Check Enable symbol levels option



- Click ok & Road will appear as follows





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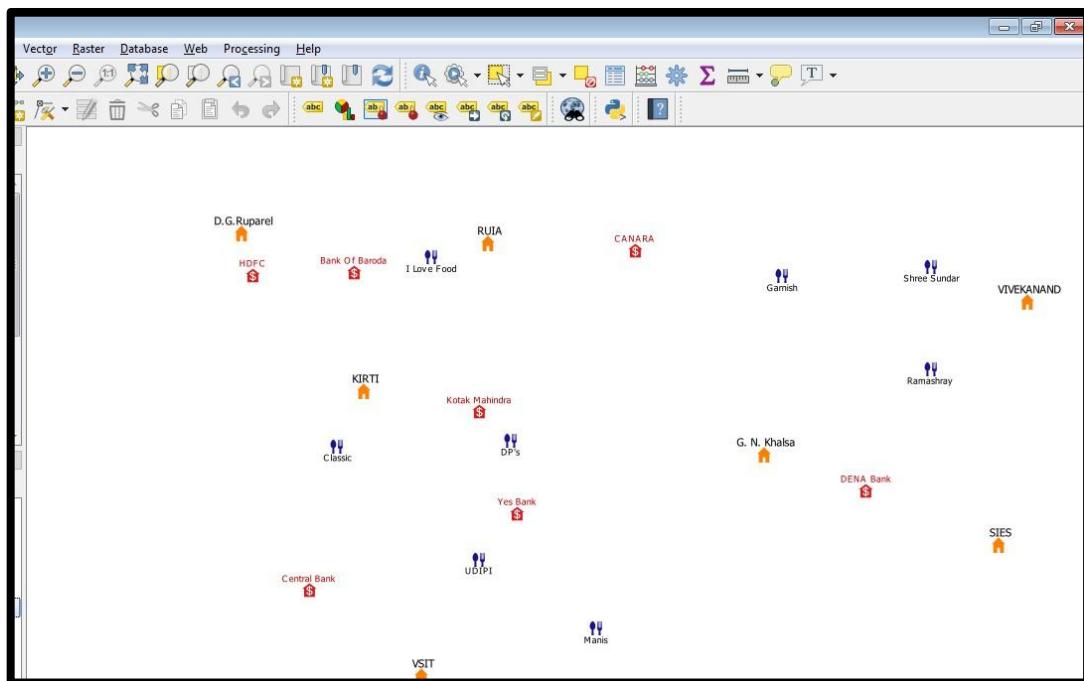
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### C. Create Point vector layer

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



**Final output:**



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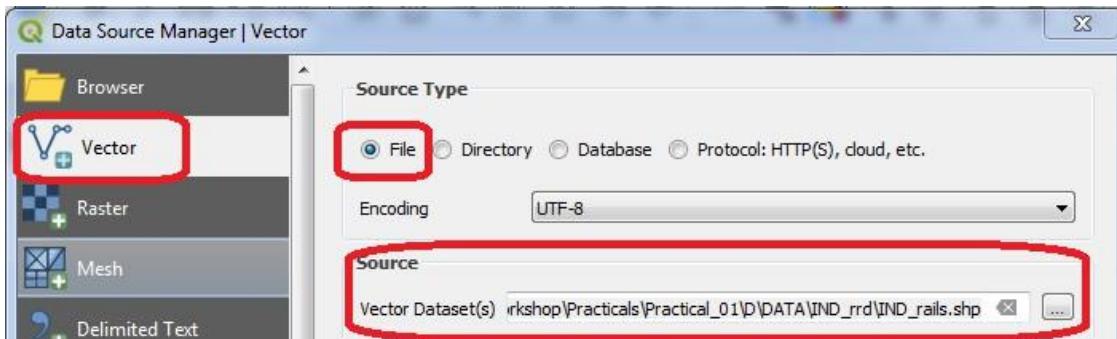
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#### d) Calculating line lengths and statistics

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



"\GIS\_Workshop\Practicals\Practical\_01\DATA\IND\_rrd\IND\_rails.shp"

Press “ADD”

- Also add India Administrative Map

“GIS\_Workshop\Practicals\Practical\_01\DATA\IND\_adm\IND\_adm0.shp”

- Double Click on IND\_adm0

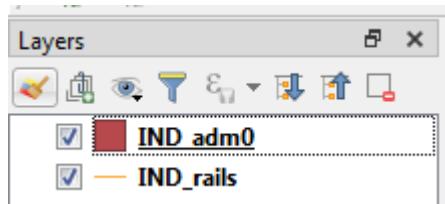


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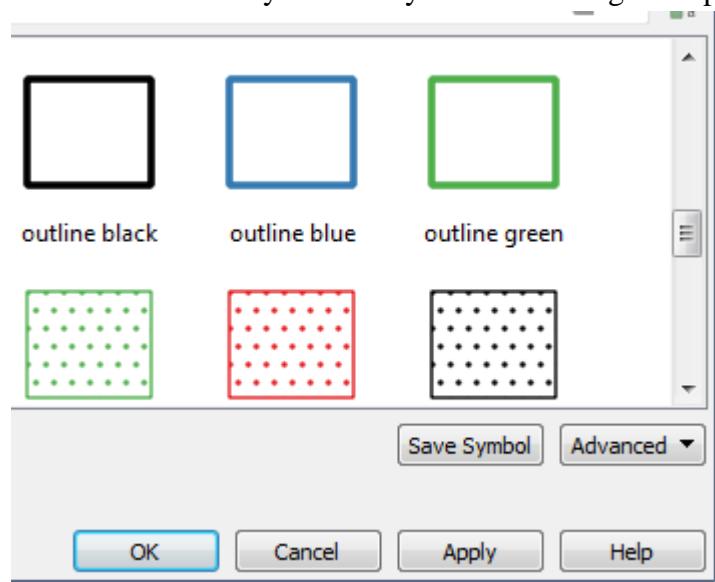
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Select → Select any outline style from below given options.



Press OK

- The display window will appear like



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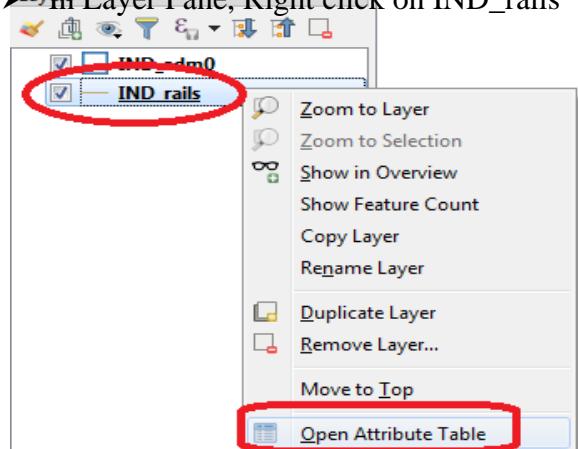
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In Layer Pane, Right-click on IND\_rails → Open Attribute Table





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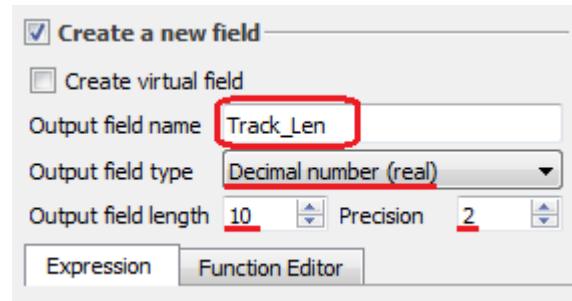
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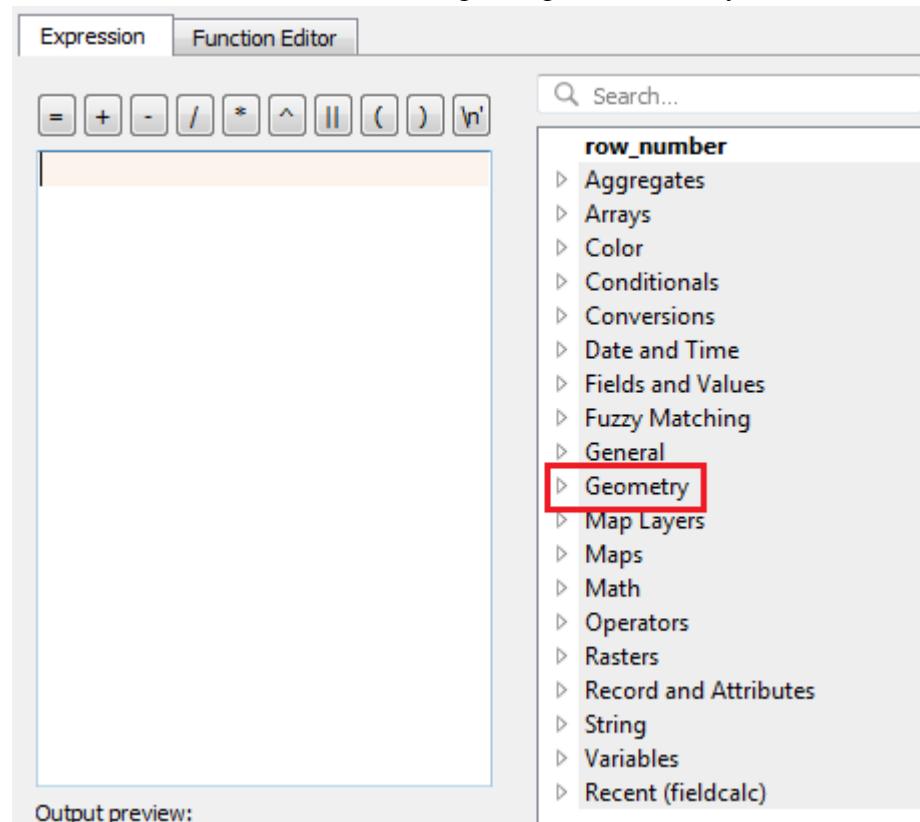
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IND_rails :: Features Total: 2012, Filtered: 2012, Selected: 0								
	FID_rail_d	F_CODE_DES	EXS_DESCRI	FCO_DESCRI	FID_countr	ISO	ISOCOUNTRY	Route_len
1	162738	Railroad	Operational	Single	102	IND	INDIA	

- 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



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The screenshot shows a function editor window with two tabs: "Expression" and "Function Editor". The "Expression" tab is active, displaying the mathematical expression  $\$length / 1000$ . Below the expression are several small icons representing different operators and functions.

Press “OK”

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

The screenshot shows the attribute table for the "IND\_rails" layer in QGIS. The table includes columns for FID\_rail\_d, F\_CODE\_DESC, EXS\_DESCRI, FCO\_DESCRI, FID\_countr, ISO, ISOCOUNTRY, and Track\_Len. The "Track\_Len" column is highlighted with a red border. The values in this column represent the length of each railway track in kilometers. The first few rows of data are as follows:

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

The screenshot shows the QGIS application interface with the "Vector" menu selected. Under the "Analysis Tools" submenu, the "Basic Statistics for Fields..." option is highlighted with a red border. The "Layers" panel on the left shows the "IND\_rails" layer selected.

- Select IND\_rails layer from input layer. And select Track\_Len in “Field to Calculate statistics on”

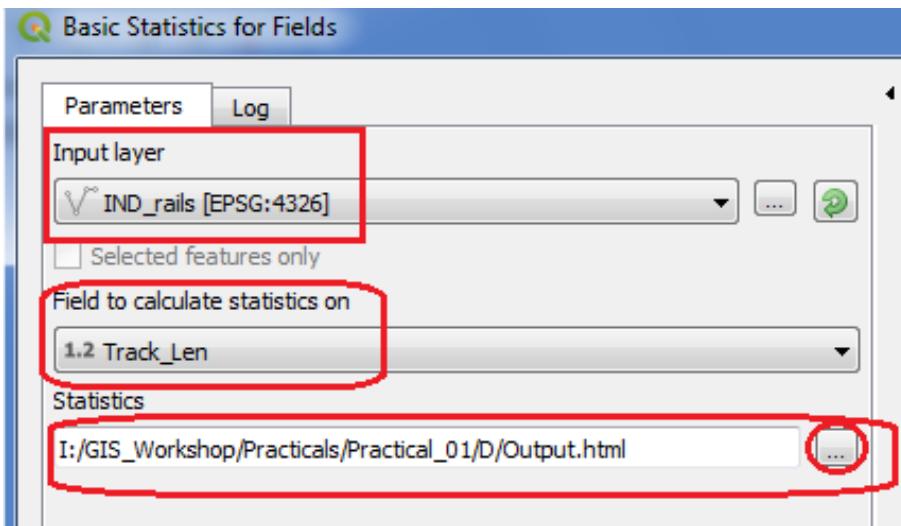


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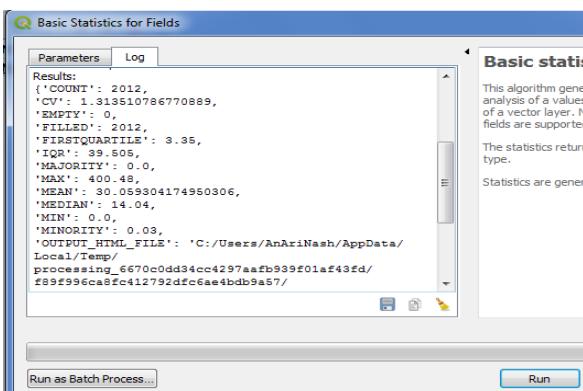
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- Press RUN
- The Result is



- 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: 30.059304174950306

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



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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.**



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**Learning Outcome:**

1. Explore QGIS interface and tools.
2. Visualize and analyze spatial data.

**Course Outcome:**

1. Perform geospatial analysis with QGIS.
2. Work with both vector and raster formats.

**Conclusion:**

**Viva Questions:**

1. What does QGIS stand for?
2. What data format represents points, lines, and polygons?
3. Which QGIS format represents continuous data?

Correction Parameter	Formative Assessment [ ]	Timely Completion of practical	Attendance Learning Attendance [ ]



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### Experiment No.—2:

**Aim:** Creating and Managing Vector Data: Adding vector layers, setting properties, formatting, calculating line lengths and statistics

**Tools & Technologies used:** QGIS

#### Learning Objectives:

1. Add and manage vector layers
2. Calculate statistics and line lengths

## Theory-2: Introduction to Vector Data.

Vector data structures represent specific features on the Earth's surface, and assign attributes to those features. Vectors are composed of discrete geometric locations (x, y values) known as vertices that define the shape of the spatial object. The organization of the vertices determines the type of vector that we are working with: point, line or polygon.

**Vector** data provide a way to represent real world **features** within the GIS environment. A feature is anything you can see on the landscape. Imagine you are standing on the top of a hill. Looking down you can see houses, roads, trees, rivers, and so on . Each one of these things would be a **feature** when we represent them in a GIS Application. Vector features have **attributes**, which consist of text or numerical information that **describe** the features.

Vector data has some important advantages:

- The geometry itself contains information about what the dataset creator thought was important
- The geometry structures hold information in themselves - why choose point over polygon, for instance?
- Each geometry feature can carry multiple attributes instead of just one, e.g. a database of cities can have attributes for name, country, population, etc
- Data storage can be very efficient compared to rasters The

downsides of vector data include:

- potential loss of detail compared to raster
- potential bias in datasets - what didn't get recorded?
- Calculations involving multiple vector layers need to do math on the geometry as well as the attributes, so can be slow compared to raster mat

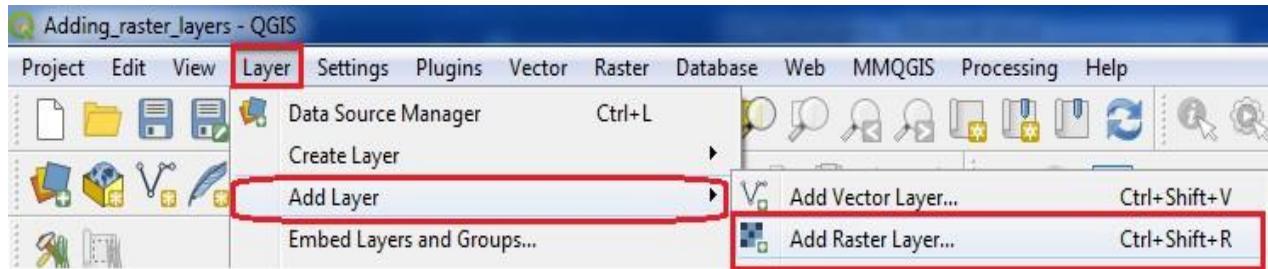


## Step:-

### **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 right corner. Set CRS option on bottom  
Select WGS 84 EPSG: 4326 and Press OK



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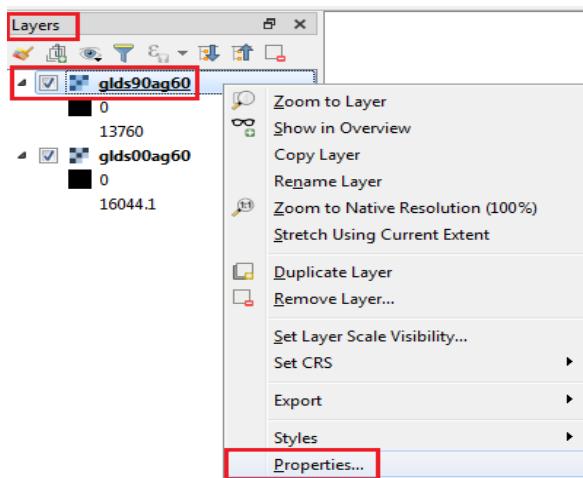
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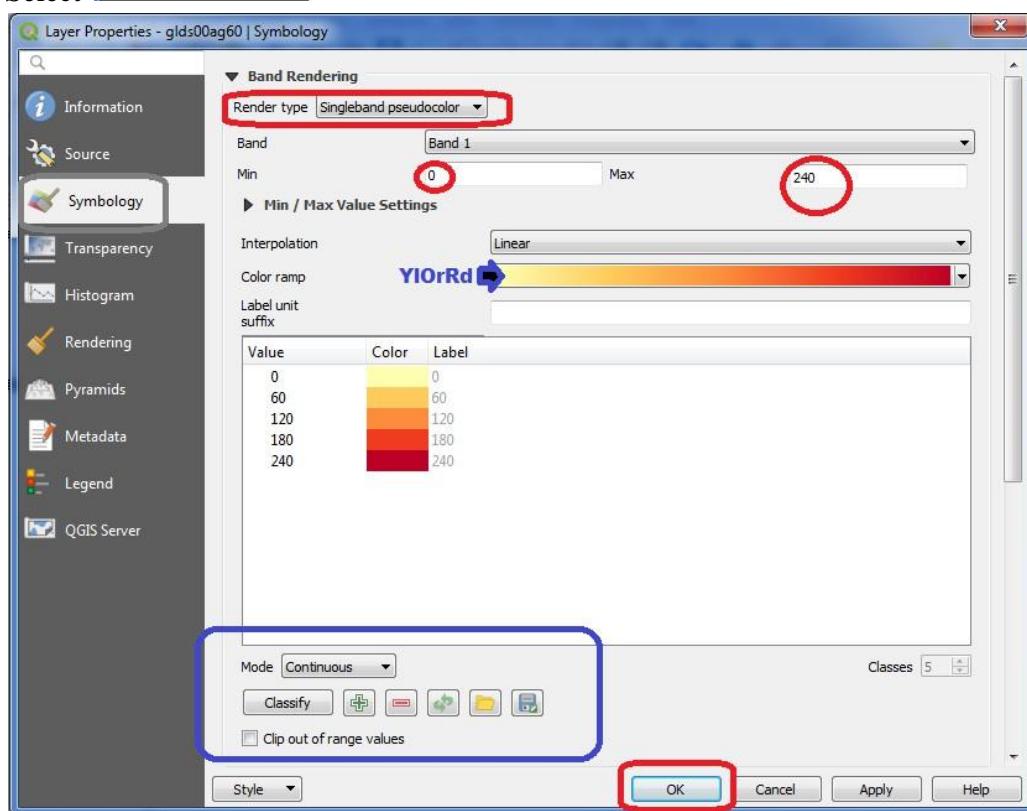
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### b) Raster Styling and Analysis

- 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

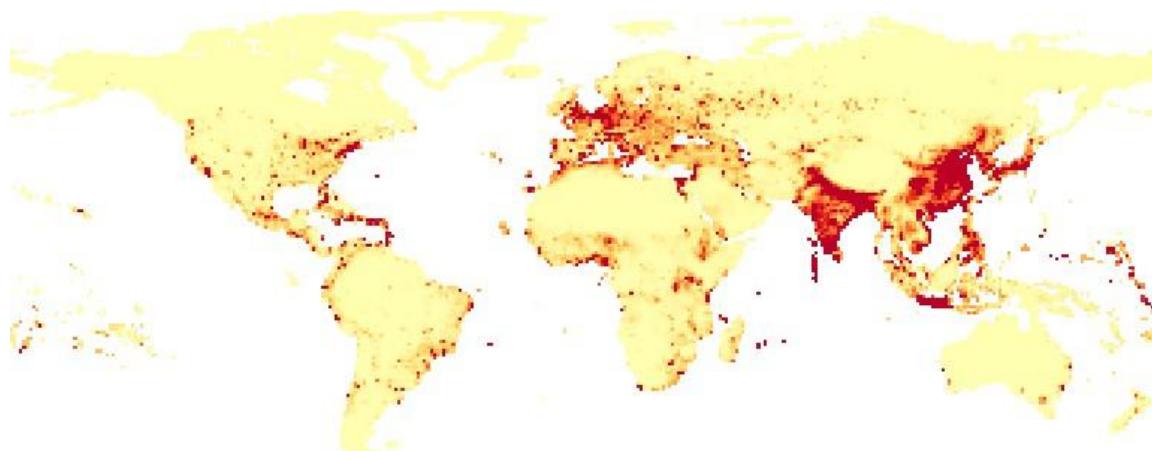


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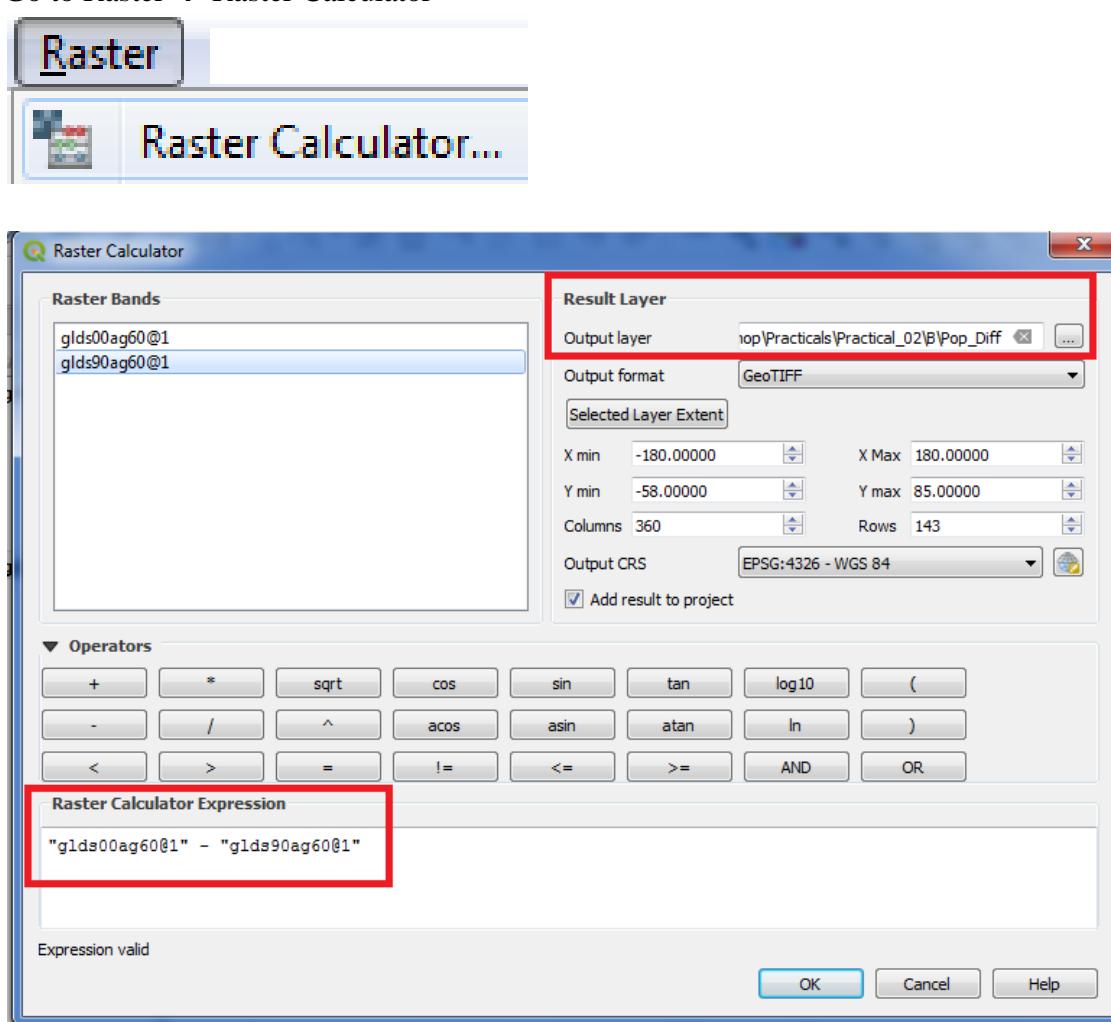
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Layer output after applying style.

- 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





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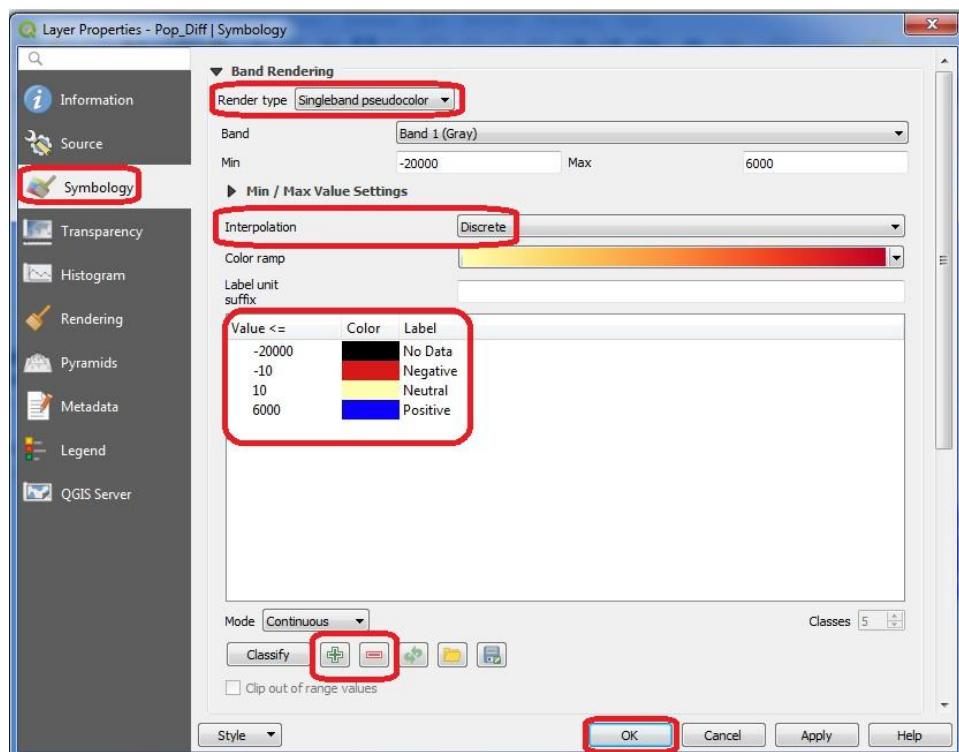
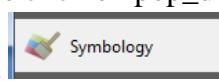
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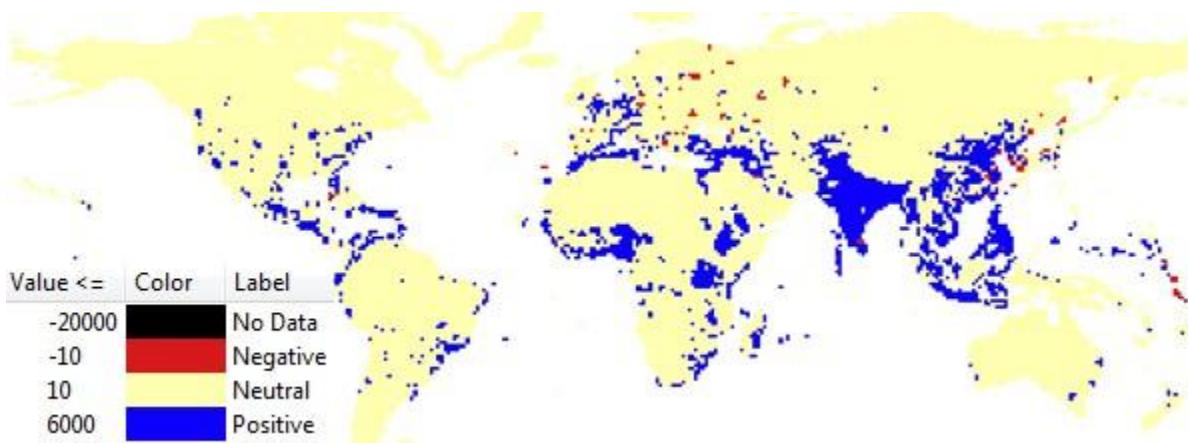
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- Put the expression "glds00ag60@1" - "glds90ag60@1"
- Select the output file location & name and Press OK.
- Remove the other two layers i.e. glds00ag60.asc and glds90ag60.asc
- Double click on pop\_diff layer.

- 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



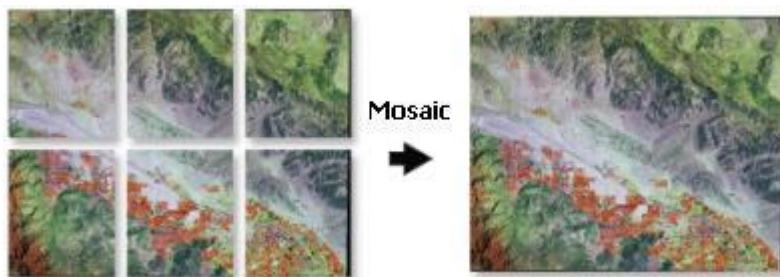


- Explore an area of your choice and check the raster band value using  to verify the classification rule.
- The red pixel shows negative changes and blue shows positive changes.

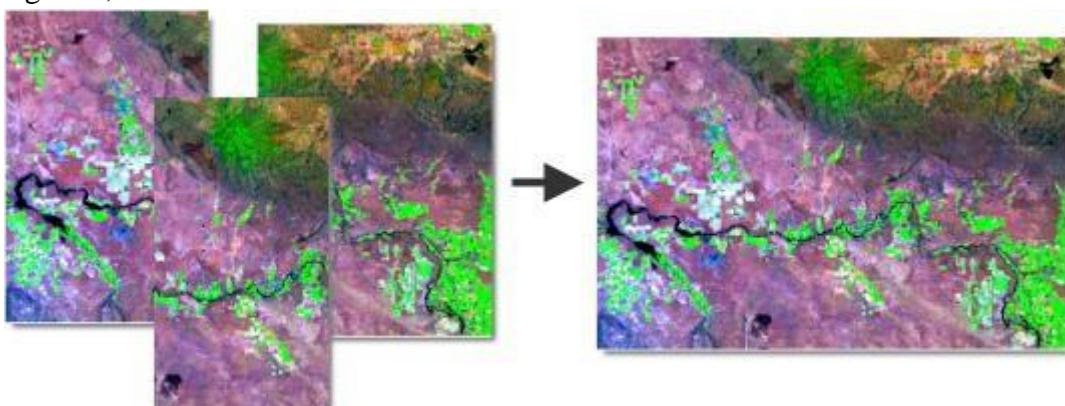
### c) Raster Mosaicking and Clipping

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.

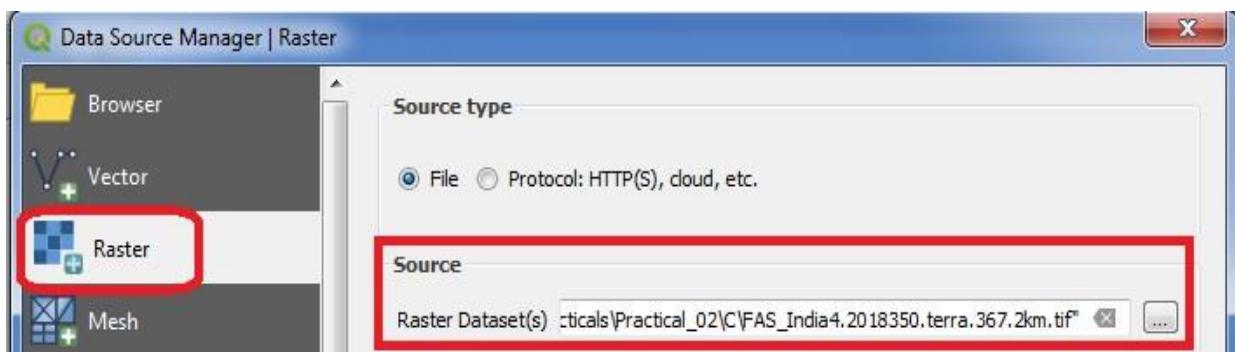


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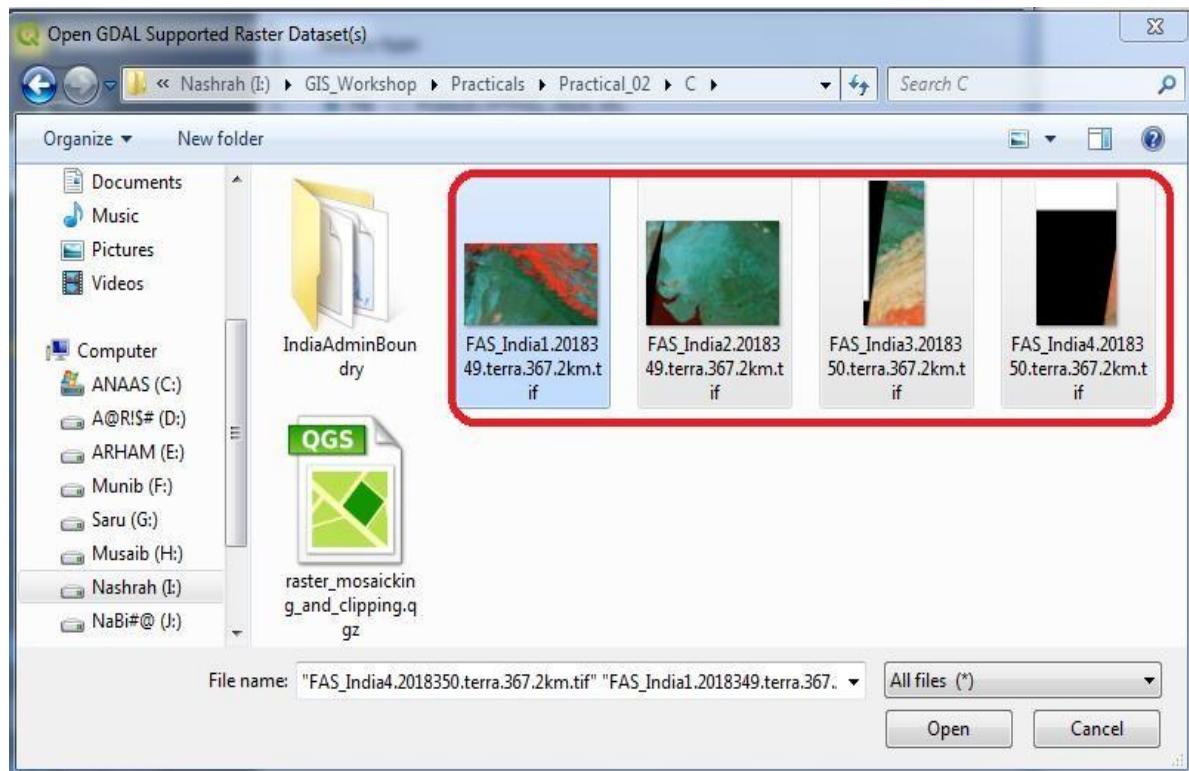
- Select the following “.tif” raster images for India from data folder.

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.

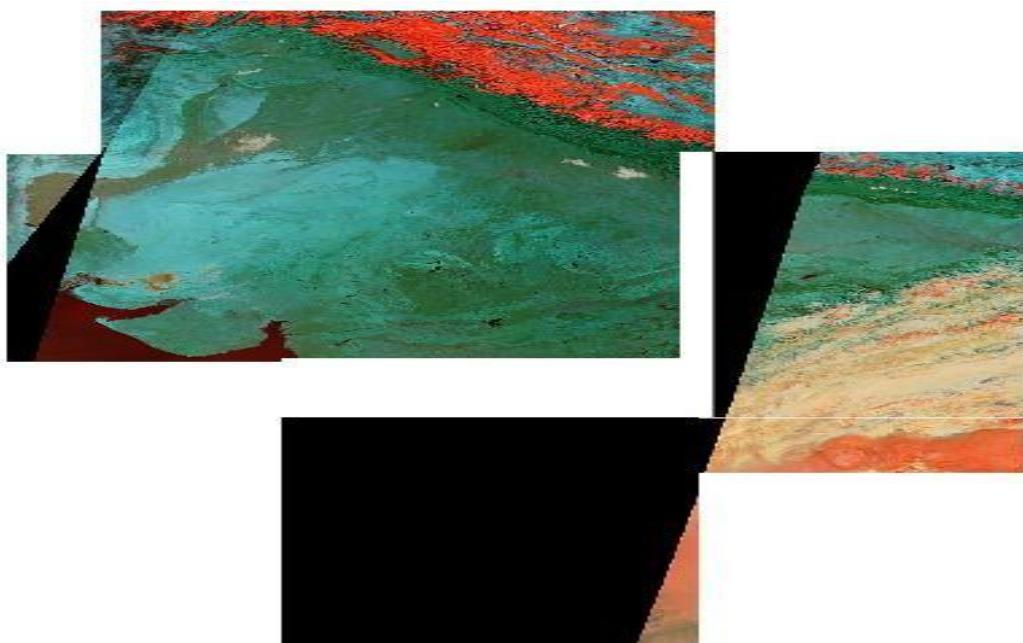


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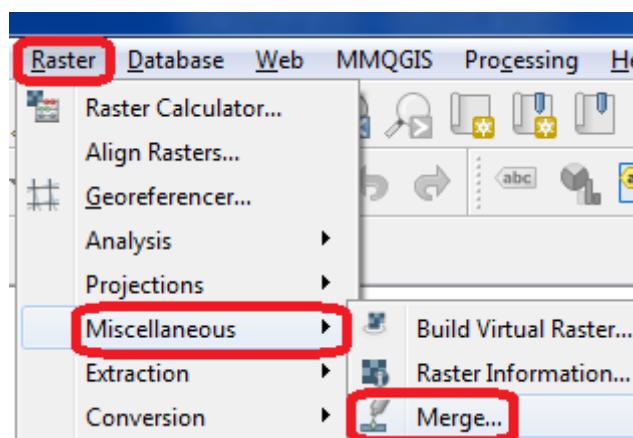
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- Go to Raster → Miscellaneous → Merge



- In the Merge dialog window



- Select all layers and Press OK.

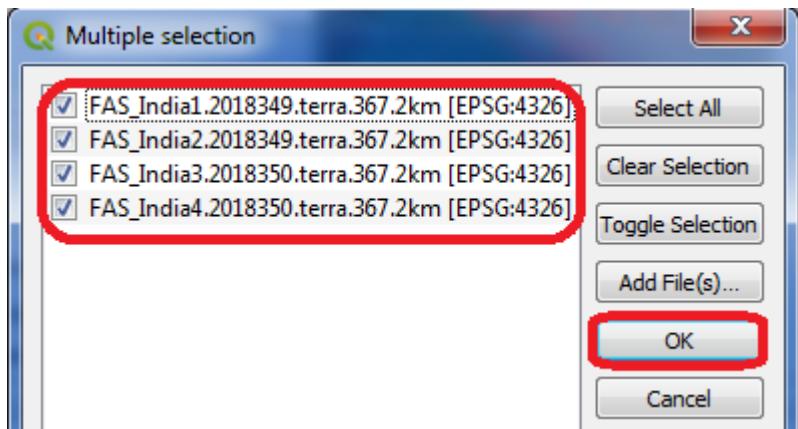


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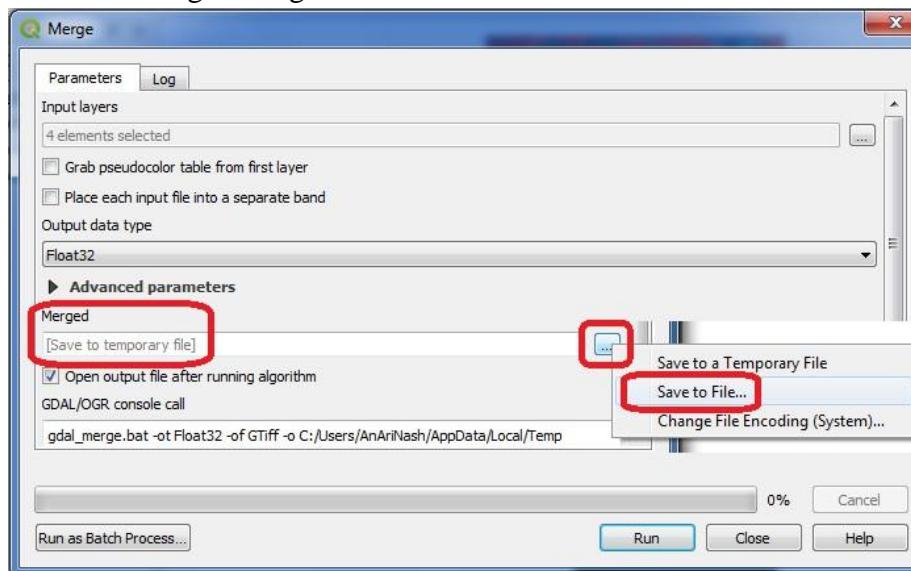
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- In Merge dialog window select a file name and location to save merged images.



- 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.

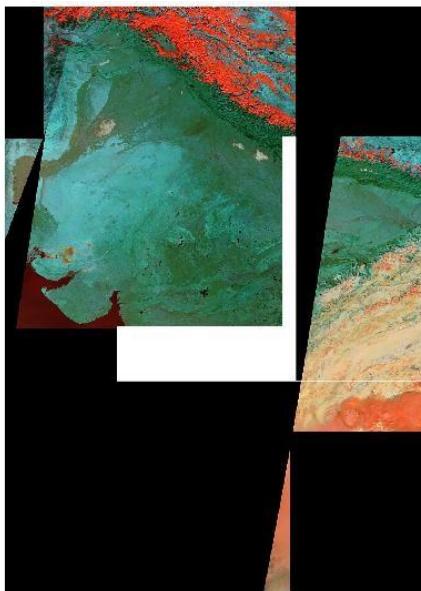


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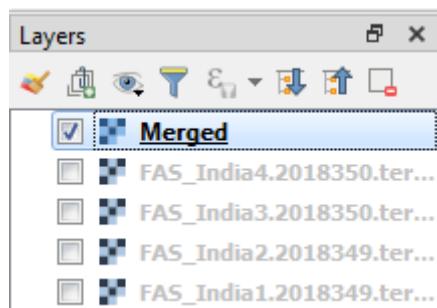
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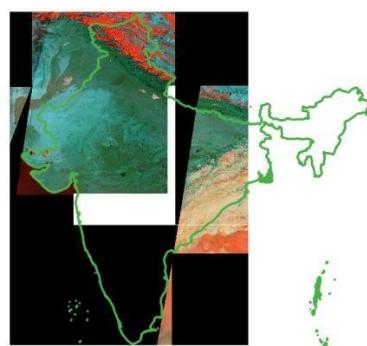
- You can now deselect individual layers from layer pane and only keep the merged raster file.



- Go to Layer → Add Vector Layer → Select  
|GIS\_Workshop\Practicals\Practical\_02\C\IndiaAdminBoundary\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

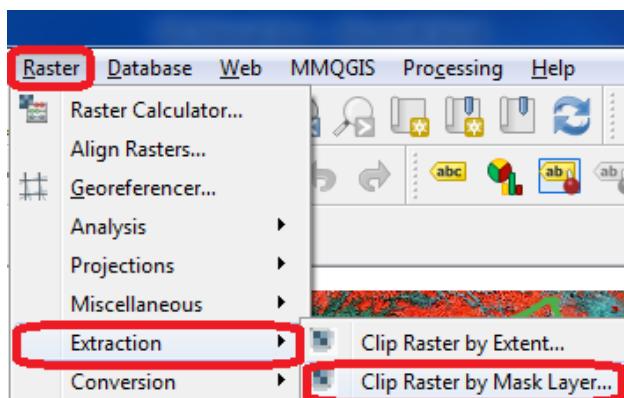


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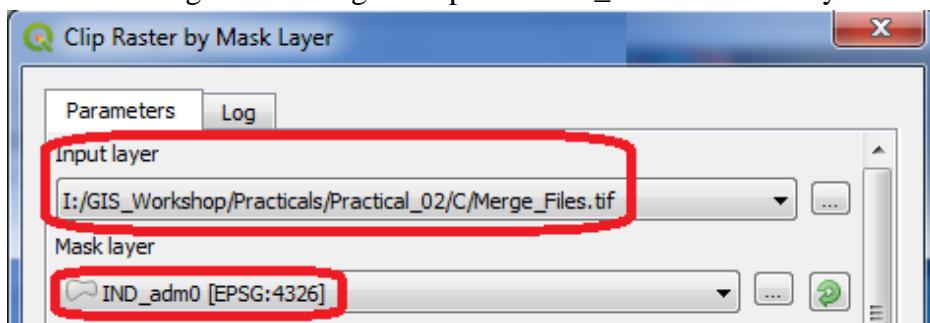
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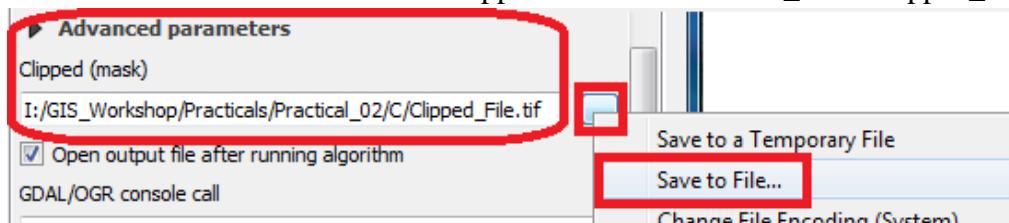
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- Select the merge raster image as input and Ind\_adm0 as mask layer.



- Select a file name and location for clipped raster as /Practical\_02/C/Clipped\_File.tif.



- Press RUN.

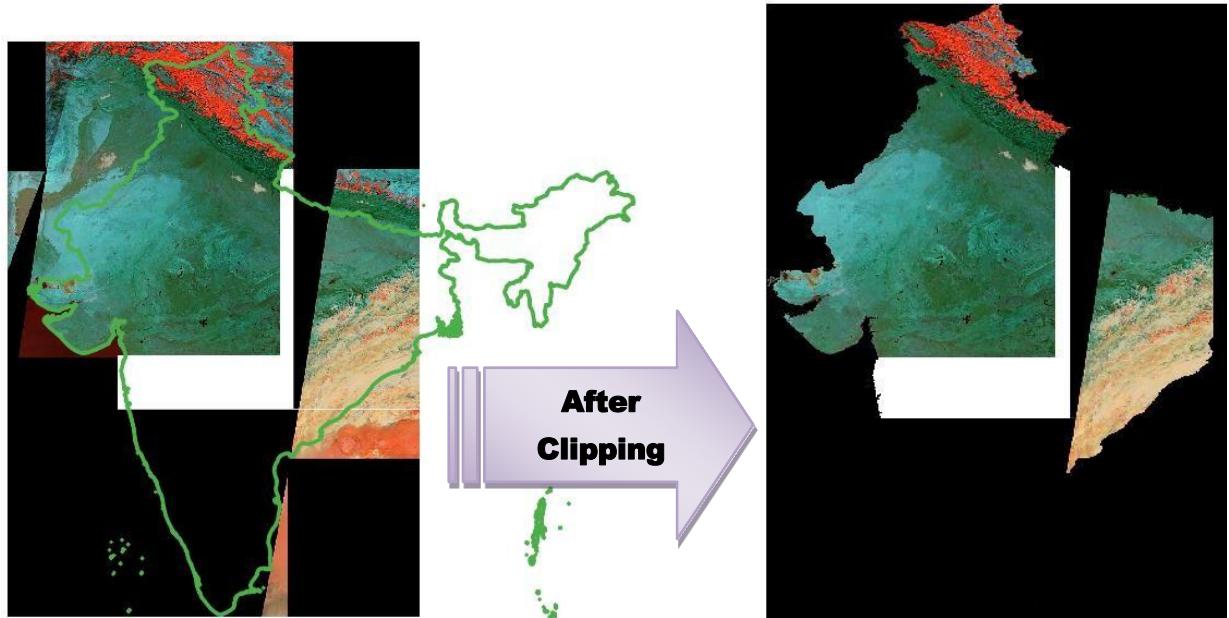


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**Learning Outcome:**

- 1 Understand vector layer properties
- 2 Format and calculate spatial data

**Course Outcome:**

- 1 Create and manage vector data
- 2 Analyze vector data for insights

**Conclusion:**

**Viva Questions:**

- 1 What are vector layers?
- 2 How to calculate line length?
- 3 What is data formatting?

Correction Parameter	Formative Assessment [ ]	Timely Completion of practical	Attendance Learning Attendance [ ]



**Experiment No.—3:**

**Aim:** Exploring and Managing Raster data: Adding raster layers, raster styling and analysis, raster mosaicking and clipping

**Tools & Technologies used:** QGIS

**Learning Objectives:**

1. Add and manage raster layers
2. Perform raster analysis and styling

## **Theory: Introduction to Raster Data.**

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

Data stored in a raster format represents real-world phenomena:

- Thematic data (also known as discrete) represents features such as land-use or soils data.
- Continuous data represents phenomena such as temperature, elevation, or spectral data such as satellite images and aerial photographs.
- Pictures include scanned maps or drawings and building photographs.

Thematic and continuous rasters may be displayed as data layers along with other geographic data on your map but are often used as the source data for spatial analysis with the ArcGIS Spatial Analyst extension. Picture rasters are often used as attributes in tables—they can be displayed with your geographic data and are used to convey additional information about map features.

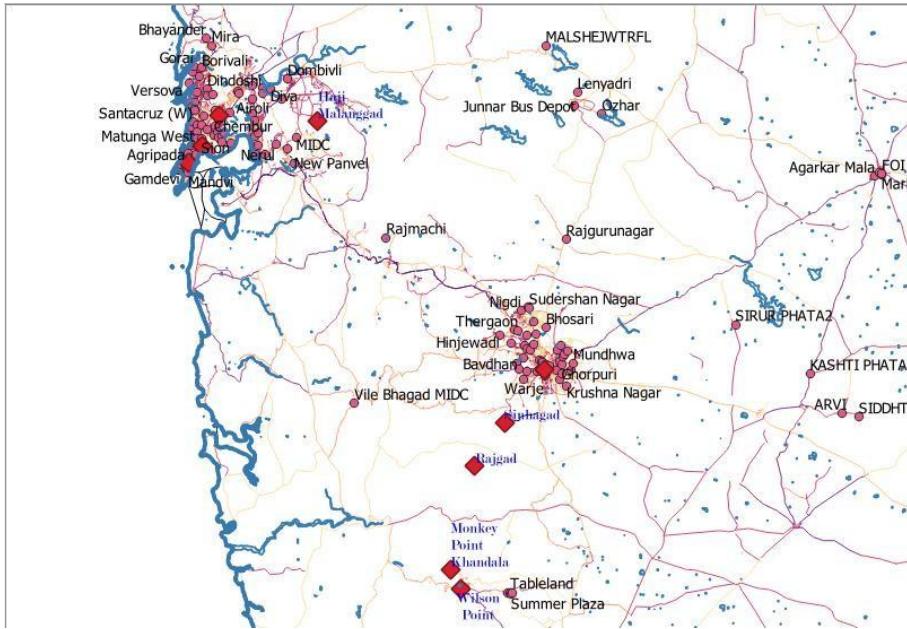
A common use of raster data in a GIS is as a background display for other feature layers. For example, orthophotos displayed underneath other layers provide the map user with confidence that map layers are spatially aligned and represent real objects, as well as additional information. Three main sources of raster basemaps are orthophotos from aerial photography, satellite imagery, and scanned maps. Raster data is any pixelated (or gridded) data where each pixel is associated with a specific geographical location. The value of a pixel can be continuous (e.g. elevation) or categorical (e.g. land use). If this sounds familiar, it is because this data structure is very common: it's how we represent any digital image. A geospatial raster is only different from a digital photo in that it is accompanied by spatial information that connects the data to a particular location. This includes the raster's extent and cell size, the number of rows and columns, and its coordinate reference system (or CRS).



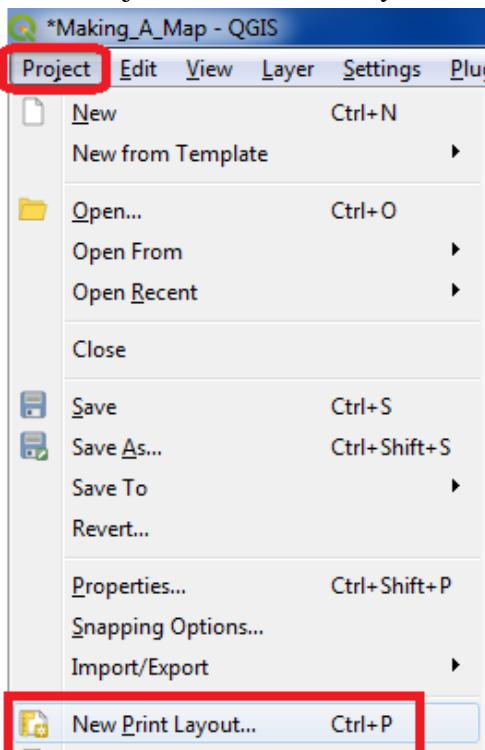
## Step:-

### 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".



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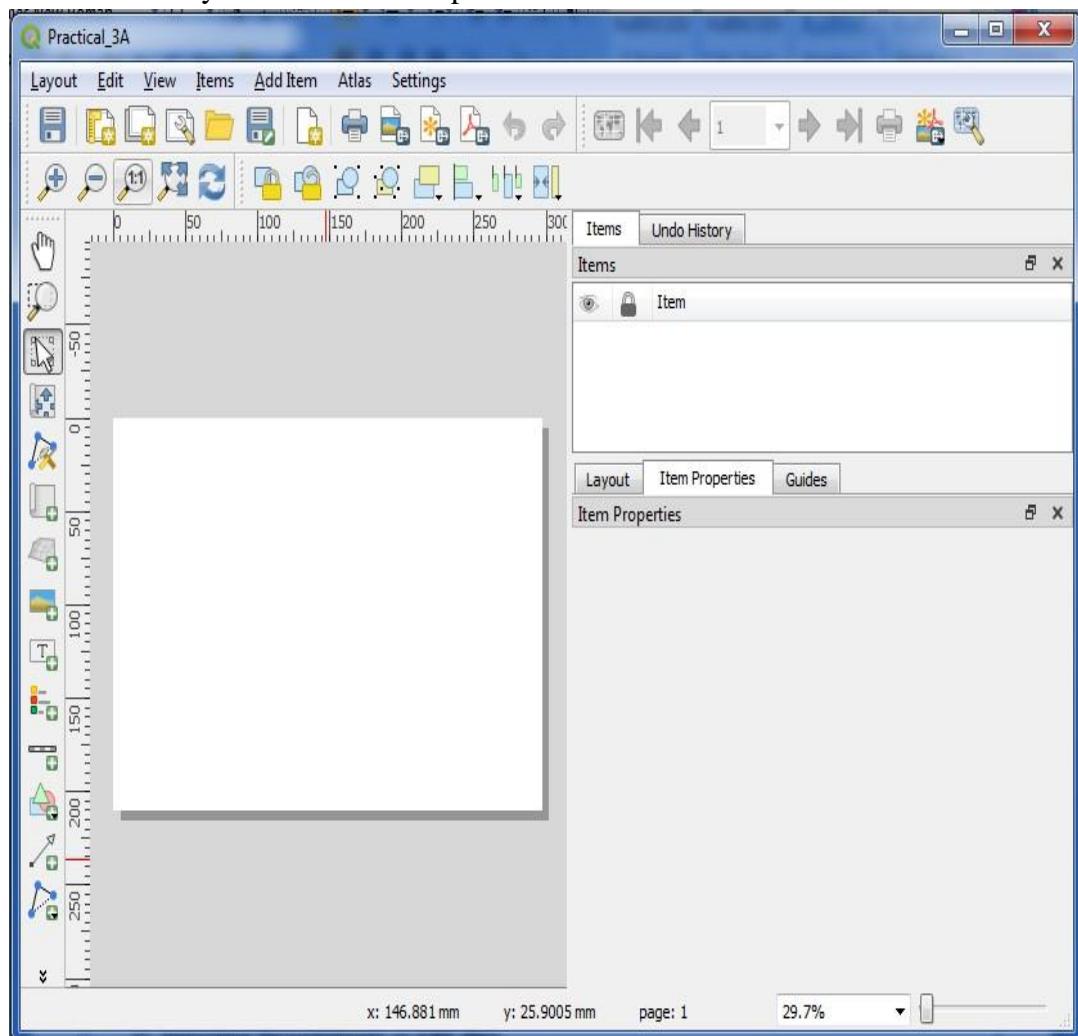
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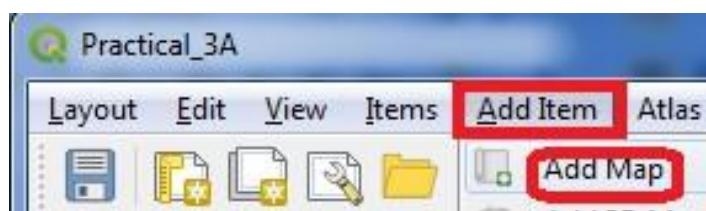
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- A new Print Layout window will open



- Select Add Item → Add Map



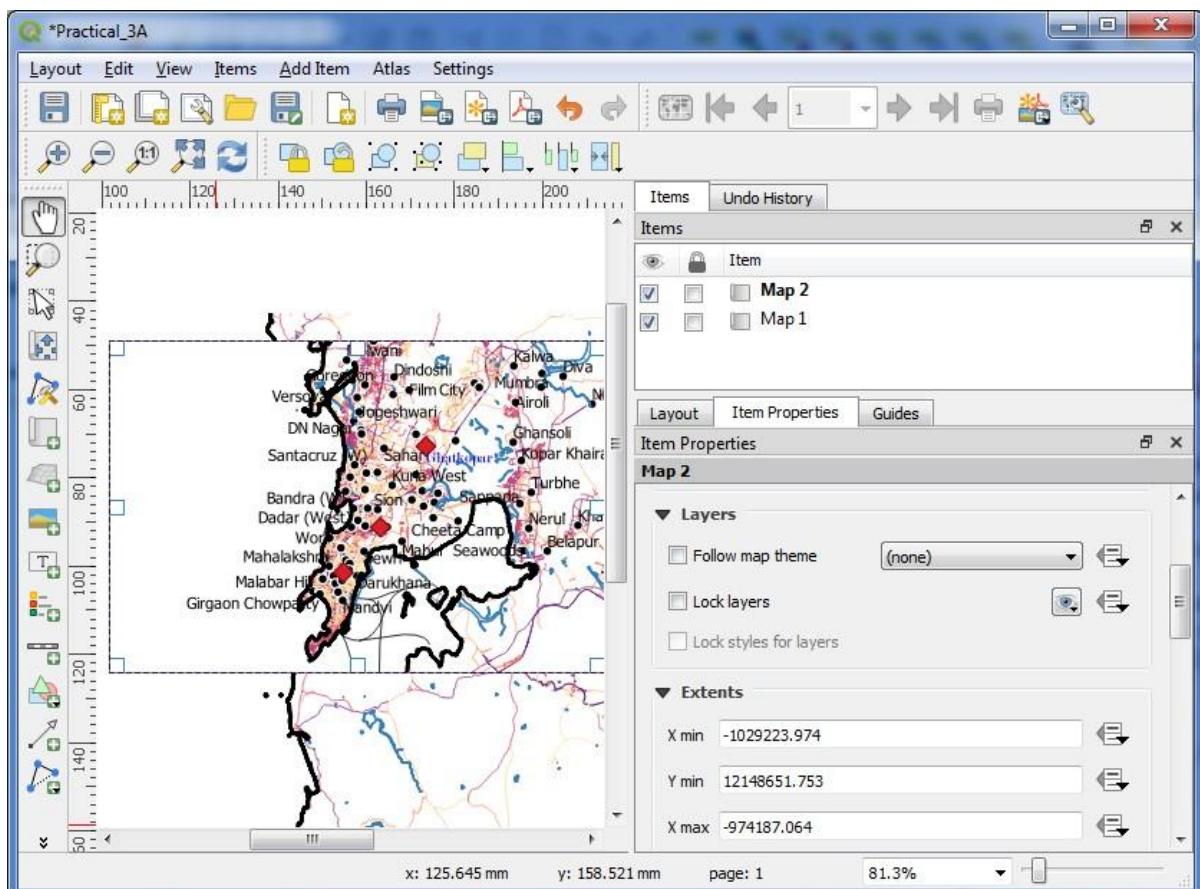


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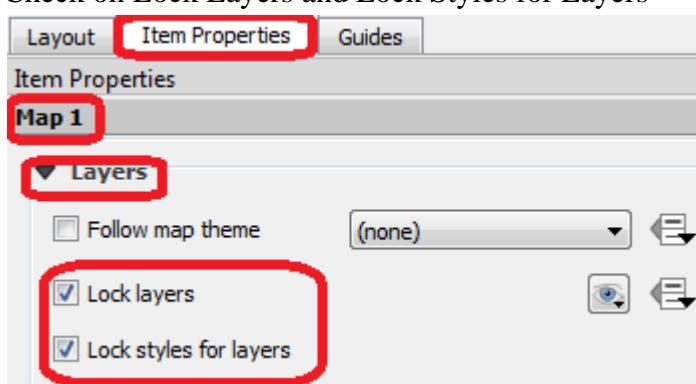
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- After adding map go to ItemProperties → Map1→ Layers  
Check on Lock Layers and Lock Styles for Layers



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.

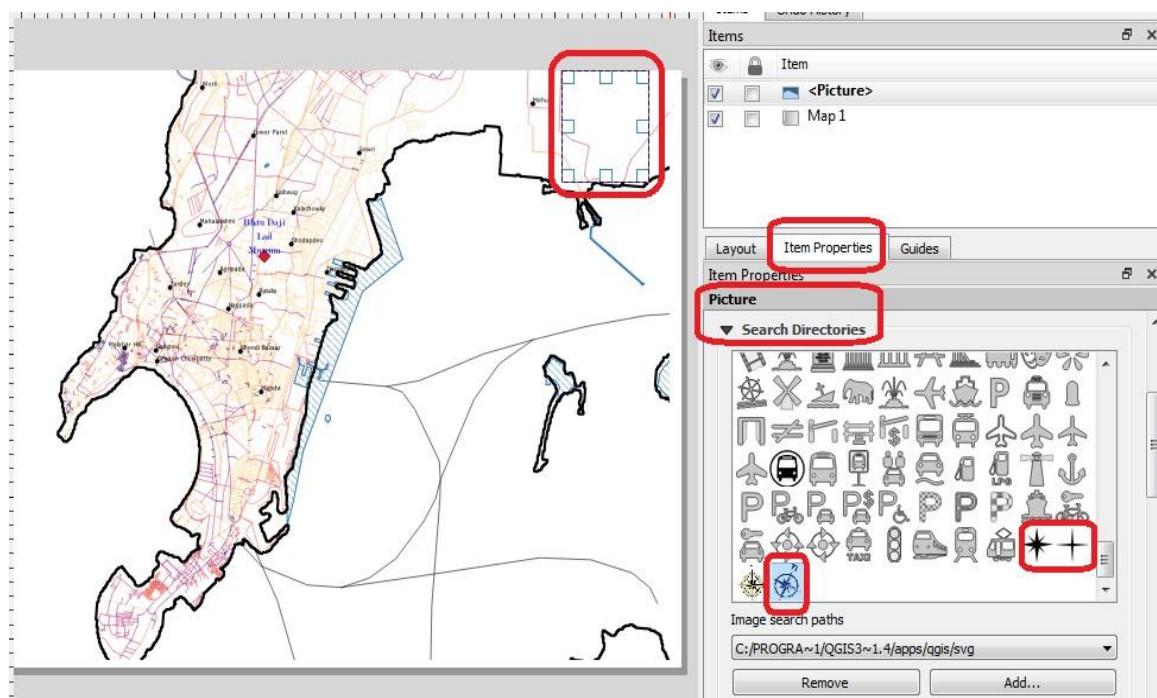


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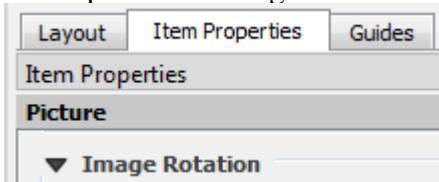
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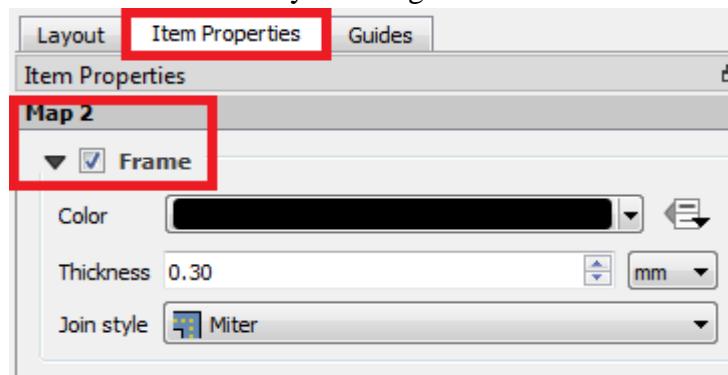
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- Also adjust Image Rotation to its appropriate value.
- Item Properties → Image Rotation



- 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.



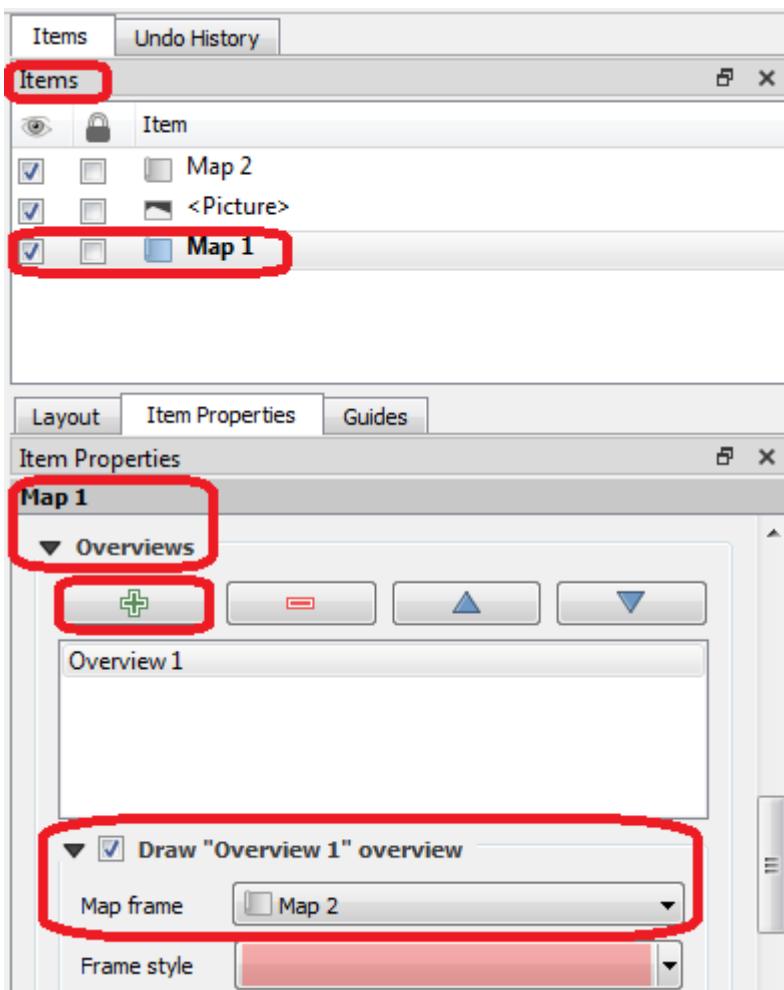
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- Select the checkbox Draw Overview
- Name the Picture object representing inset (Map1 in our case).



- The Print Layout will appear like

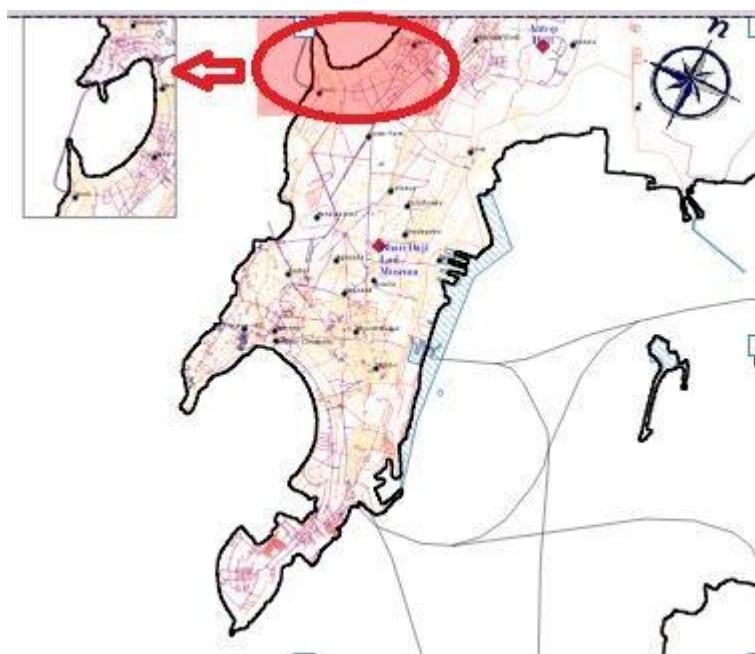


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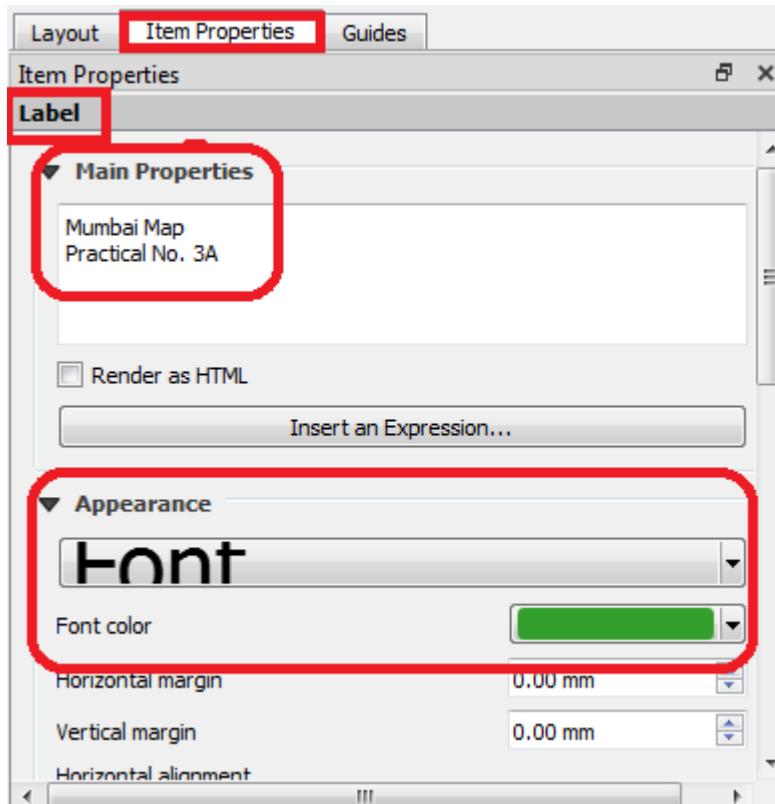
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- Add Item → Add Label
- Change the Label text To “Mumbai Map”, Set appropriate font size and color using Item Properties→ Main Properties.



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

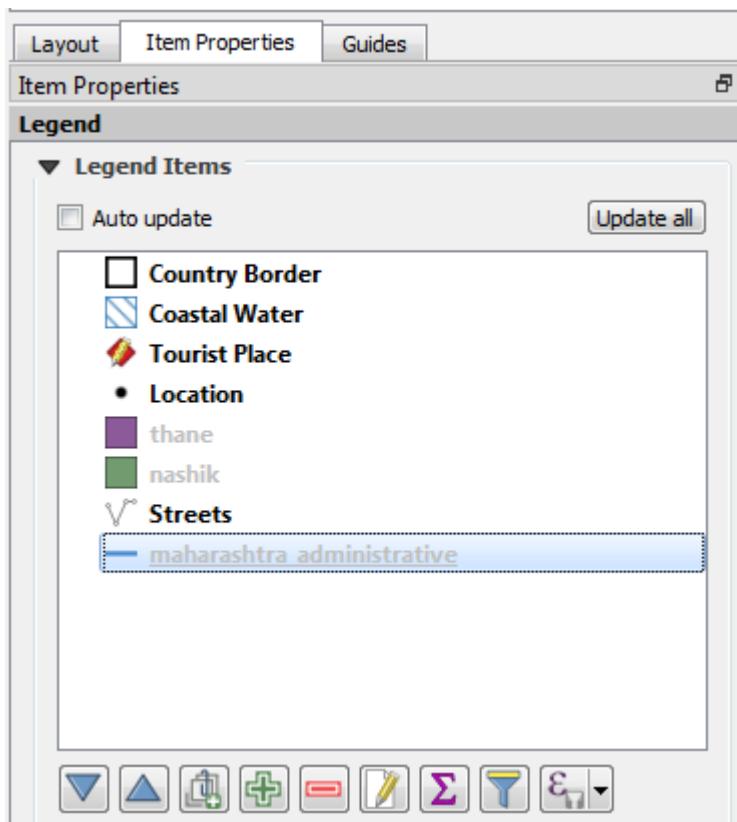


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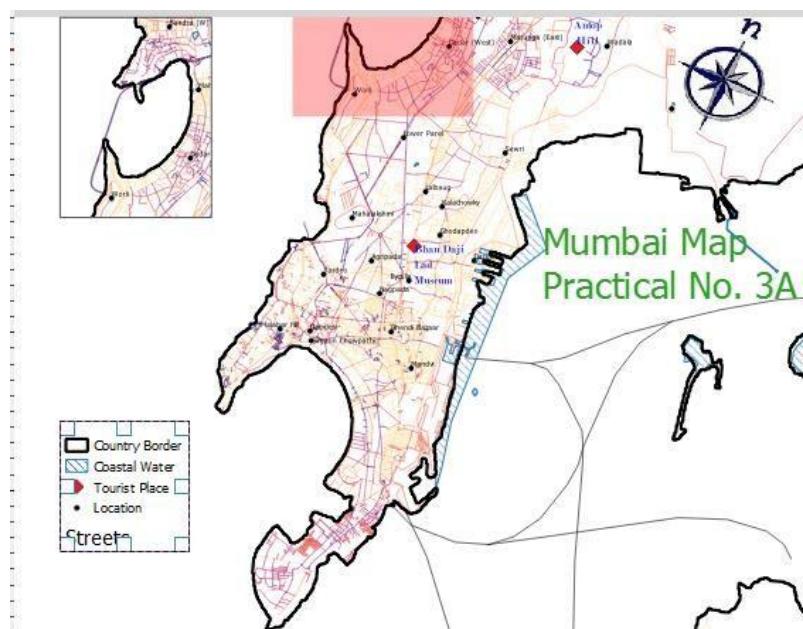
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- The Print Layout will appear



- Add Item → Add Scale Bar



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Layout   **Item Properties**   Guides

Item Properties

Scalebar

▼ Main Properties

Map

Style

▼ Units

Scalebar units

Label unit multiplier

Label for units km

▼ Segments

Segments left 1   right 4

The entire 'Main Properties' and 'Segments' sections are highlighted with a red box.

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

Layout   **Item Properties**   Guides

Item Properties

Label

▼ Main Properties

<h2>&copy; Copy Right Reserved</h2><br><h1>B. Sc. IT Student</h1>

Render as HTML

The 'Main Properties' section containing the HTML code and the 'Render as HTML' checkbox are highlighted with a red box.

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

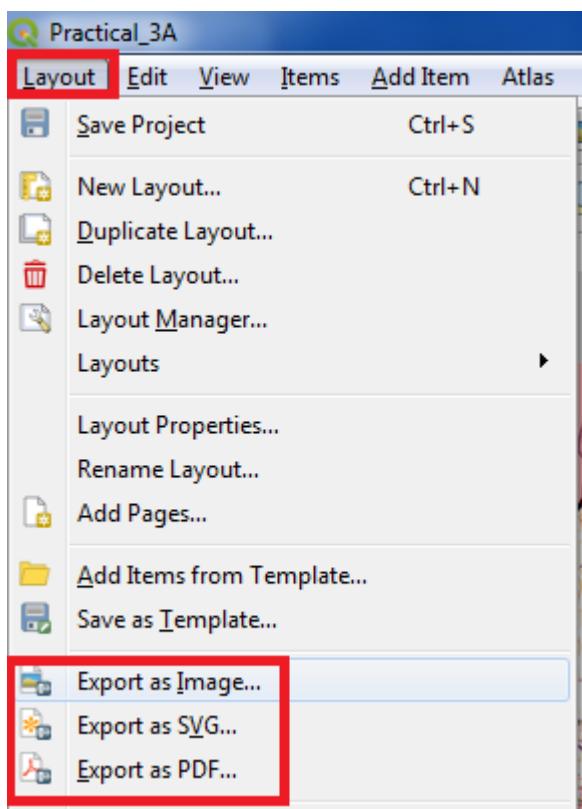


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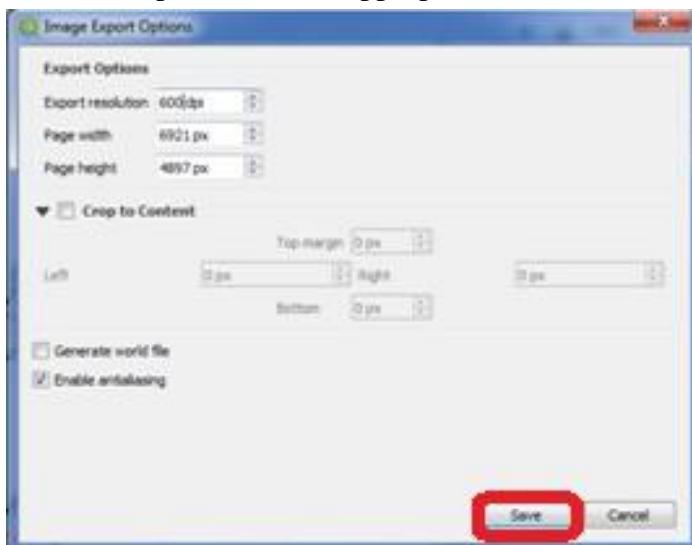
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- Save the Map to a location appropriate location as PDF or Image.



- Open the PDF or Image from location.



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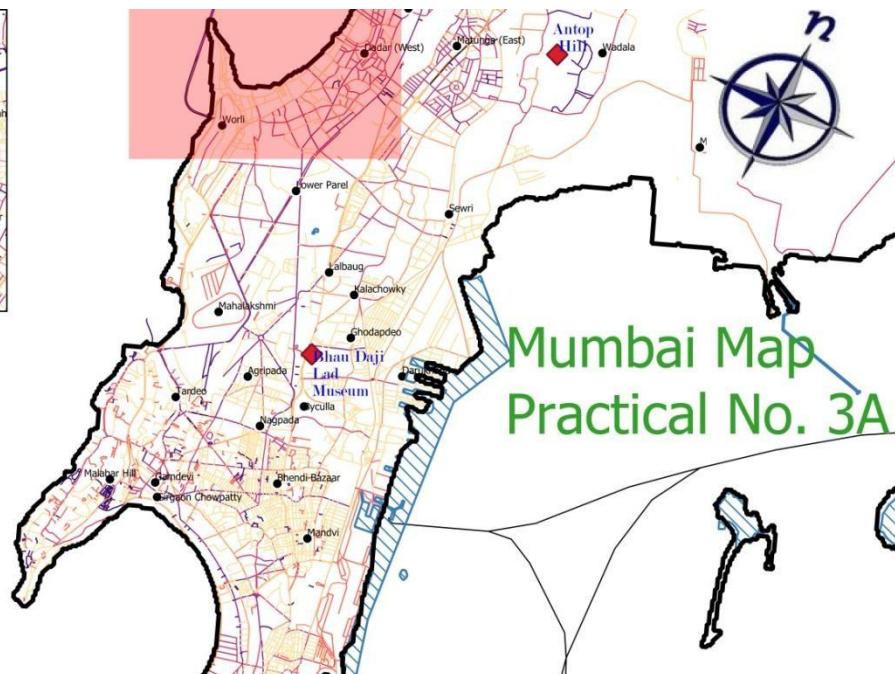
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- Country Border
- Coastal Water
- ◆ Tourist Place
- Location

Streets



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1 0 1 2 3 4 km



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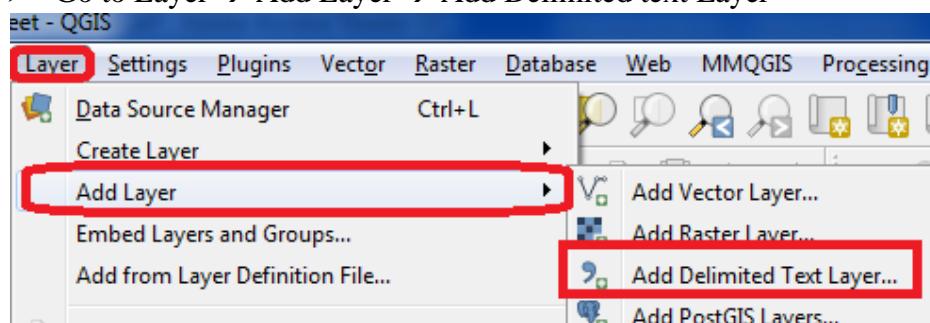
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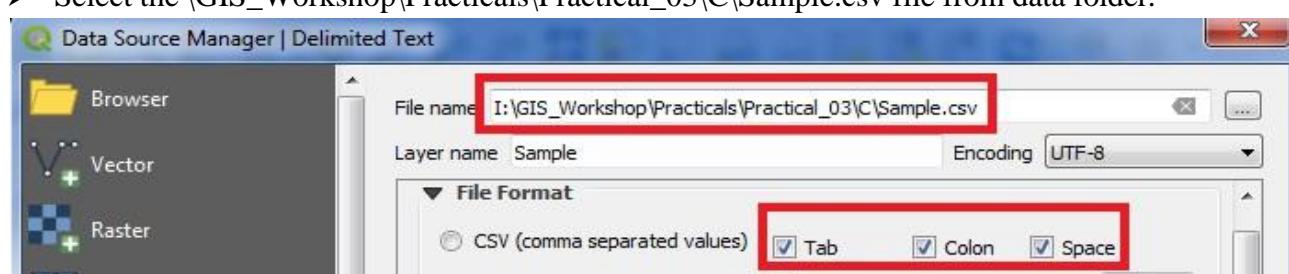
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**b) Importing Spreadsheets or CSV files**

- 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.





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The screenshot shows the 'Add Layer' dialog in QGIS. On the left, a sidebar lists various data sources: Delimited Text (selected and highlighted with a red box), GeoPackage, SpatialLite, PostgreSQL, MSSQL, Oracle, DB2, Virtual Layer, WMS/WMTS, and WCS. The main configuration area includes:

- Custom delimiters** (radio button selected, highlighted with a red box).
- Record and Fields Options** (button).
- Geometry Definition** (button):
  - Point coordinates** (radio button selected, highlighted with a red box).
  - Well known text (WKT)** (radio button).
  - No geometry (attribute only table)** (radio button).
  - DMS coordinates** (checkbox).
  - X field**: LONGITUDE (highlighted with a red box).
  - Y field**: LATITUDE (highlighted with a red box).
  - Geometry CRS**: EPSG:4326 - WGS 84 (highlighted with a red box).
- Layer Settings** (button).
- Sample Data** (table):

I_D	FLAG_TSUNAMI	YEAR	MONTH	DAY	HOUR	MINUTE	SEC
1	1		-2150				

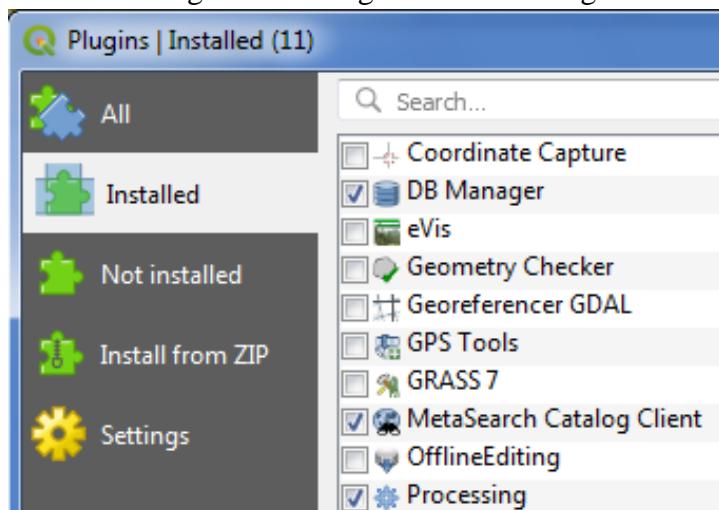
At the bottom right are buttons: Close, Add (highlighted with a red box), and Help.

- Press ADD and close the window.
- Output:

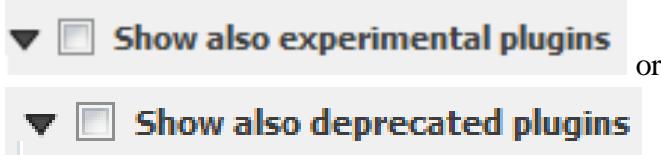


**c) Using Plugins**

- 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

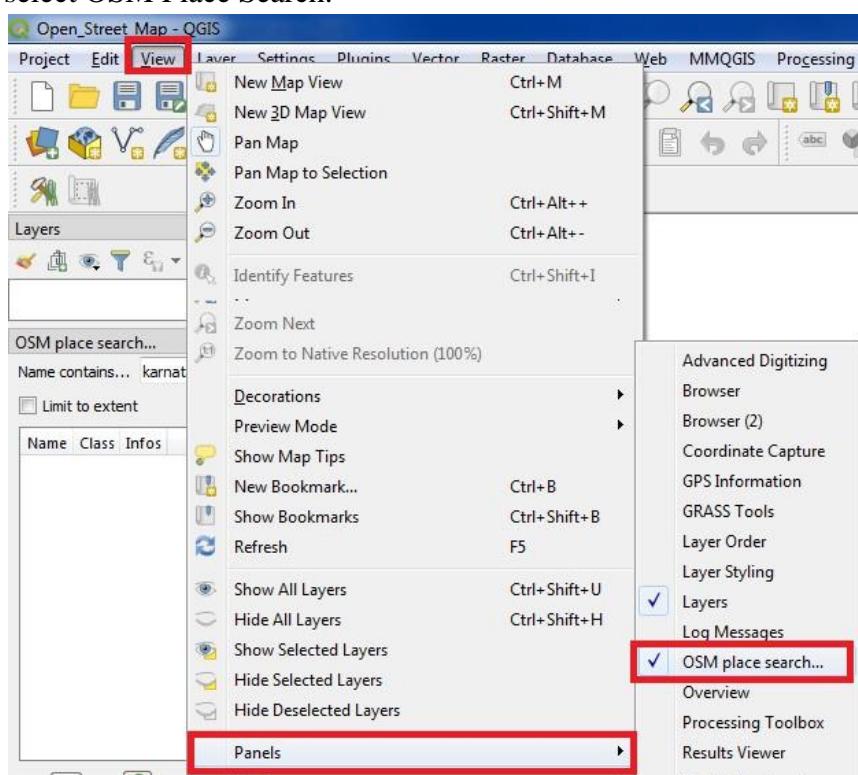


- A  tab will be added to Plugin Manager Window.
- Click on a plugin name and Click Install.

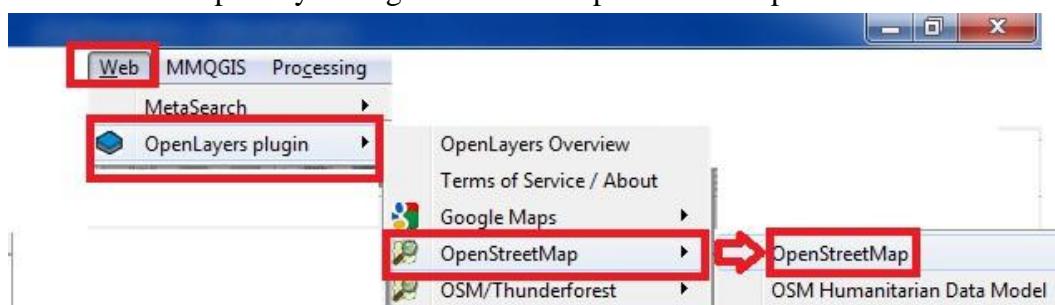
**d) Searching and Downloading OpenStreetMap Data**

**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.



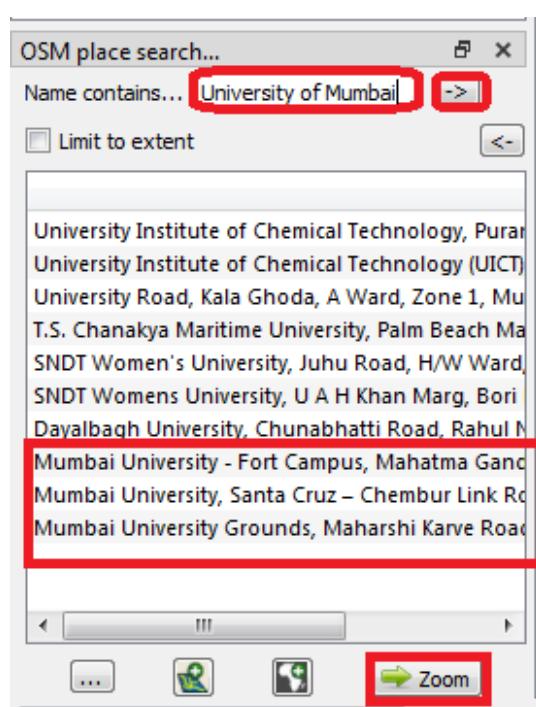
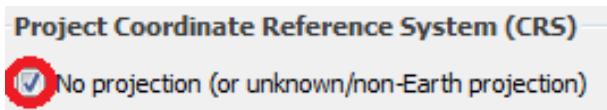
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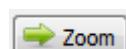
- If an error occurs in loading maps, go to project properties → CRS →



- 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:**



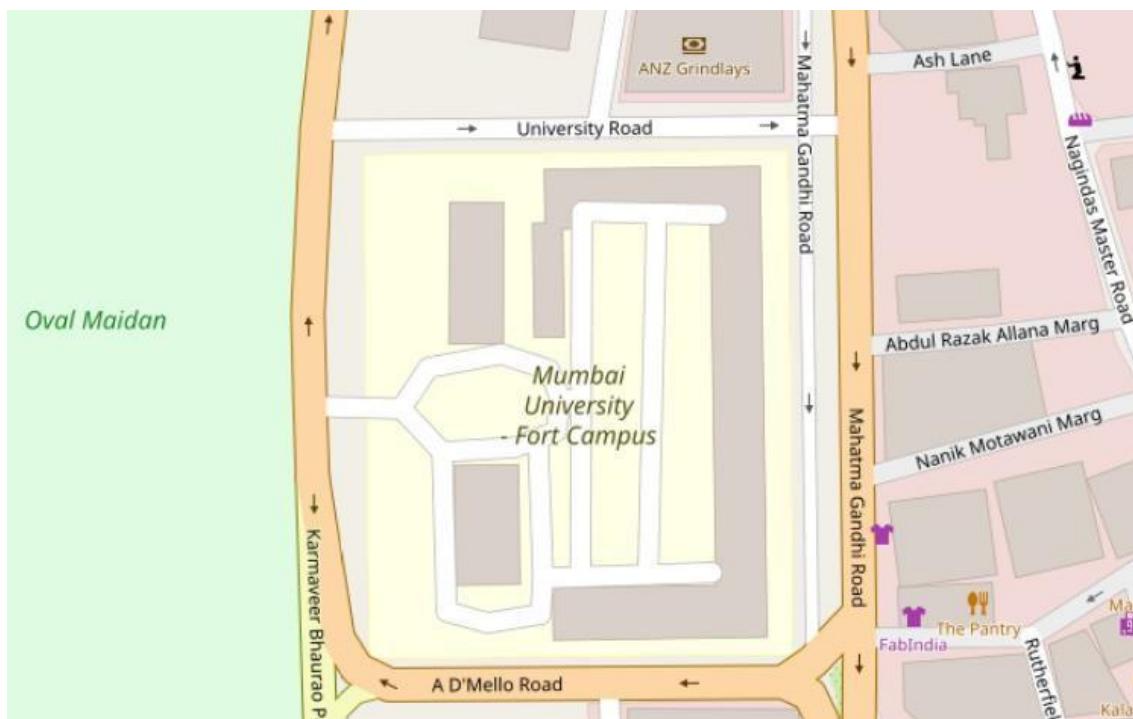


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**Learning Outcome:**

- 1.Understand raster data properties
- 2.Apply raster mosaicking and clipping

**Course Outcome:**

- 1.Analyze and visualize raster data
- 2.Manage raster layers for insights

**Conclusion:**

**Viva Questions:**

- 1.What is raster mosaicking?
- 2.How to style raster layers?
- 3.What is raster clipping?

Correction Parameter	Formative Assessment [ ]	Timely Completion of practical	Attendance Learning Attendance [ ]



**Experiment No.—4:**

**Aim:** Making a Map, Working with Attributes, Importing Spreadsheets or CSV files Using Plugins, Searching and Downloading OpenStreetMap Data

**Tools & Technologies used:** QGIS

**Learning Objectives:**

1. Create and design interactive maps
2. Import and manage CSV/spreadsheet data

**Theory: Introduction to Maps, Spreadsheets.**

Maps are the visual representation of where events happen. As such, maps and stories complement each other, but until recently they have existed more as side-by-side products and not as one integrated presentation.

Maps are the geographic container for the data layers and analytics you want to work with. GIS maps are easily shared and embedded in apps, and accessible by virtually everyone, everywhere.

A mapping spreadsheet can be used to explicitly document mappings from data requirements to properties and types in NIEM. It can also be used to model extensions for requirements that do not exist in NIEM.

This is the same template that can be used to submit change requests for NIEM release content. There are additional tabs and columns to support this level of detail, but to just use this spreadsheet for mappings, focus on the “Property” tab. Customize the spreadsheet by hiding column and tabs that aren’t being used.

Note that at this time, this spreadsheet is for documentation purposes only. There currently is no automated support for generating a NIEM subset or building extension schemas from a mapping spreadsheet.

There are a number of options for mapping spreadsheet data - some free, some premium. Most deliver adequate results, but all too often your data won't quite fit into the preset systems, so it's common to find records missing from your mapped data. One way to validate geospatial data in QGIS is to compare it with data from other sources. For example, you can compare the data with data from other government agencies, open data sources, or commercial providers. By comparing the data, you can identify any discrepancies and make corrections as needed. This is an important step in ensuring the accuracy and consistency of the data. It is also a good way to find errors that may have been introduced during the data collection or processing process. Map charts are graphical representations that employ geographical maps as a visual backdrop to display data points or statistical information associated with specific geographic locations. These charts utilize various visual elements such as colors, symbols, or shading to convey data trends, patterns, or relationships across different regions or coordinates.

They are invaluable tools for organizations, enabling them to harness spatial context's power to present data and uncover intricate relationships. These charts are adept at anchoring data points within a geographic framework, a capability that lends itself to many applications.



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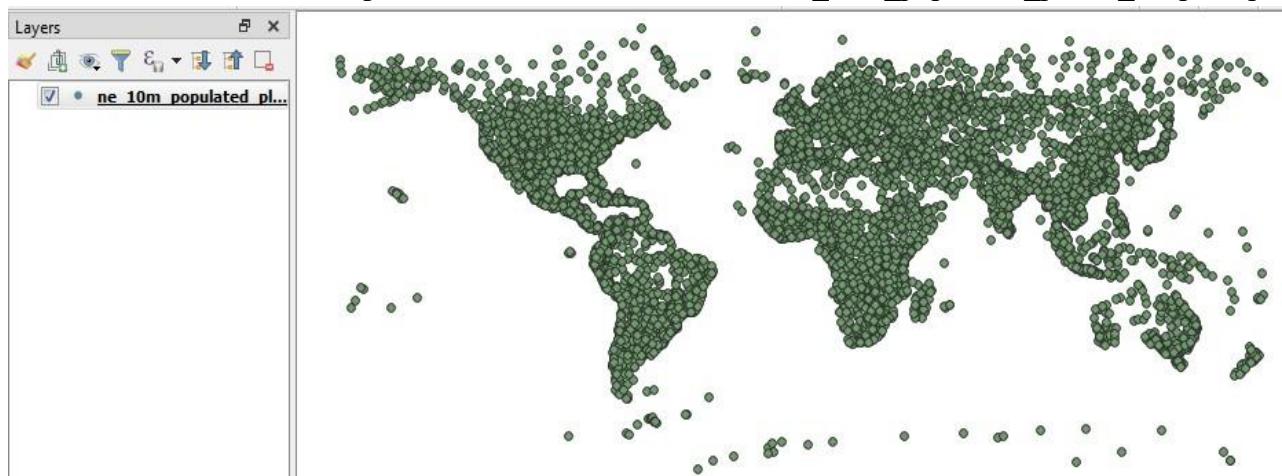
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## Step:-

### A. Working with attributes

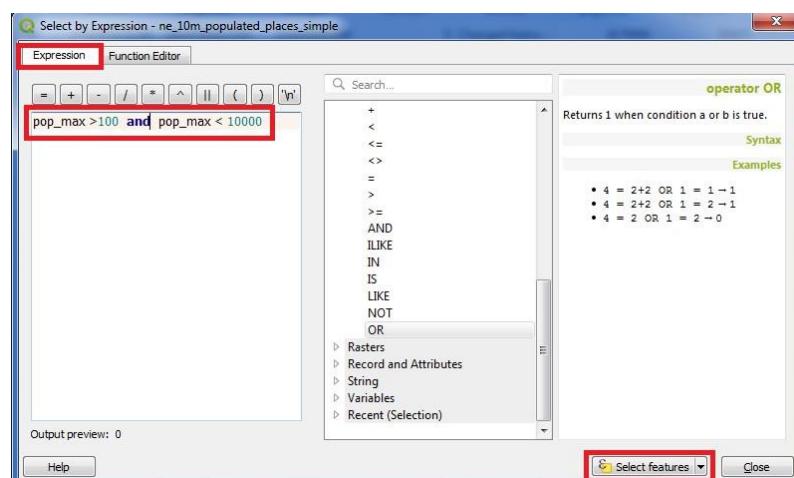
- Start a new project.
- Go to Layer → Add Layer → Add Vector Layer
- Select “\GIS\_Workshop\Practicals\Practical\_04\A\Data\ne\_10m\_populated\_places\_simple.zip”



- 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

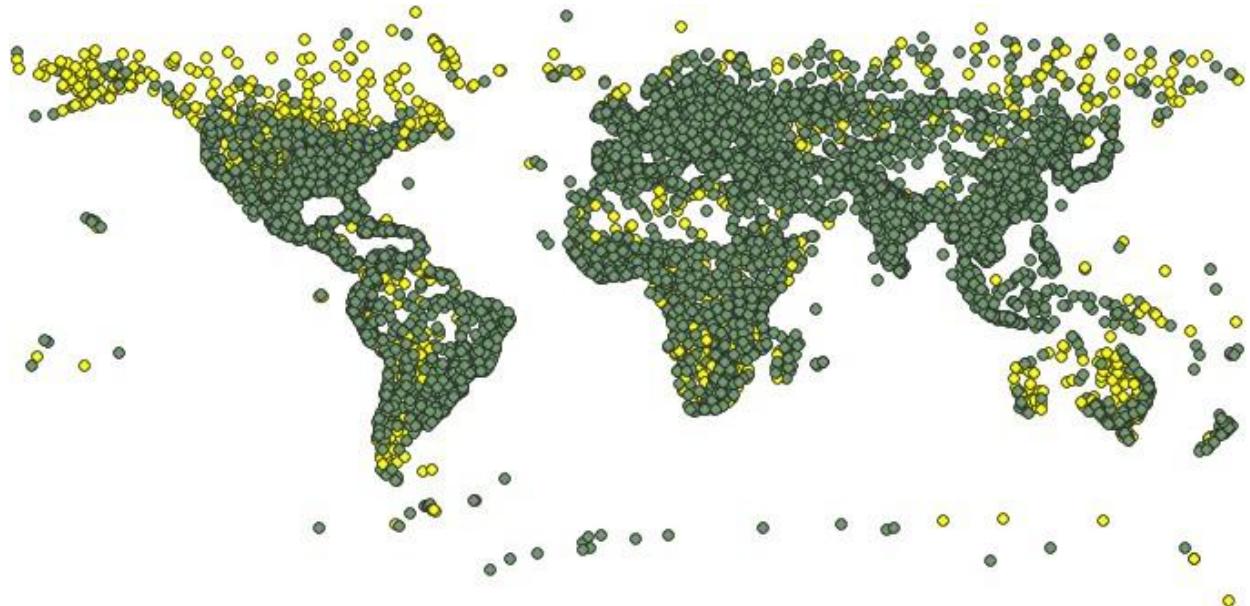
	latitude	longitude	changed	namediff	diffnote	pop_max	pop_min	pop_other
1	35.68501690580	139.75140742900	0.00000000000	0		35676000	8336599	1294525
2	40.74997906400	-73.98001692880	0.00000000000	0		19040000	8008278	929260
3	19.11214241200	99.120000020170	0.00000000000	0		19020000	10011002	1001011
4	19.01699037570	72.85698929740	0.00000000000	0		18978000	12691836	1242608

- 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

Select by Expression - ne\_10m\_populated\_places\_simple

Expression      Function Editor

= + - / \* ^ || ( ) '\n'

`pop_max>100 and pop_max<10000 and  
"sov0name" = 'India'`

Will give

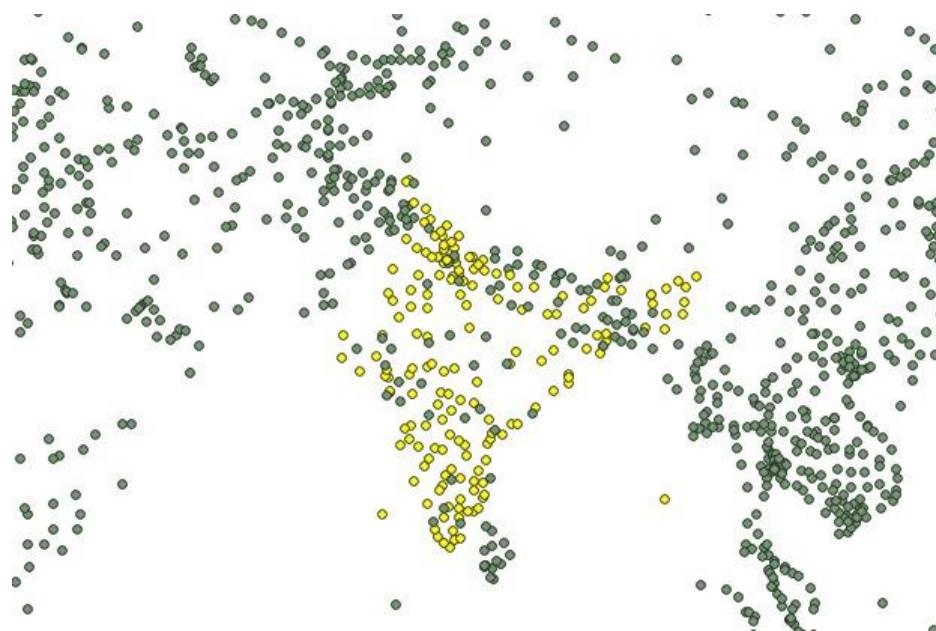


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- Use the deselect button  to deselect the feature to be rendered in original color.



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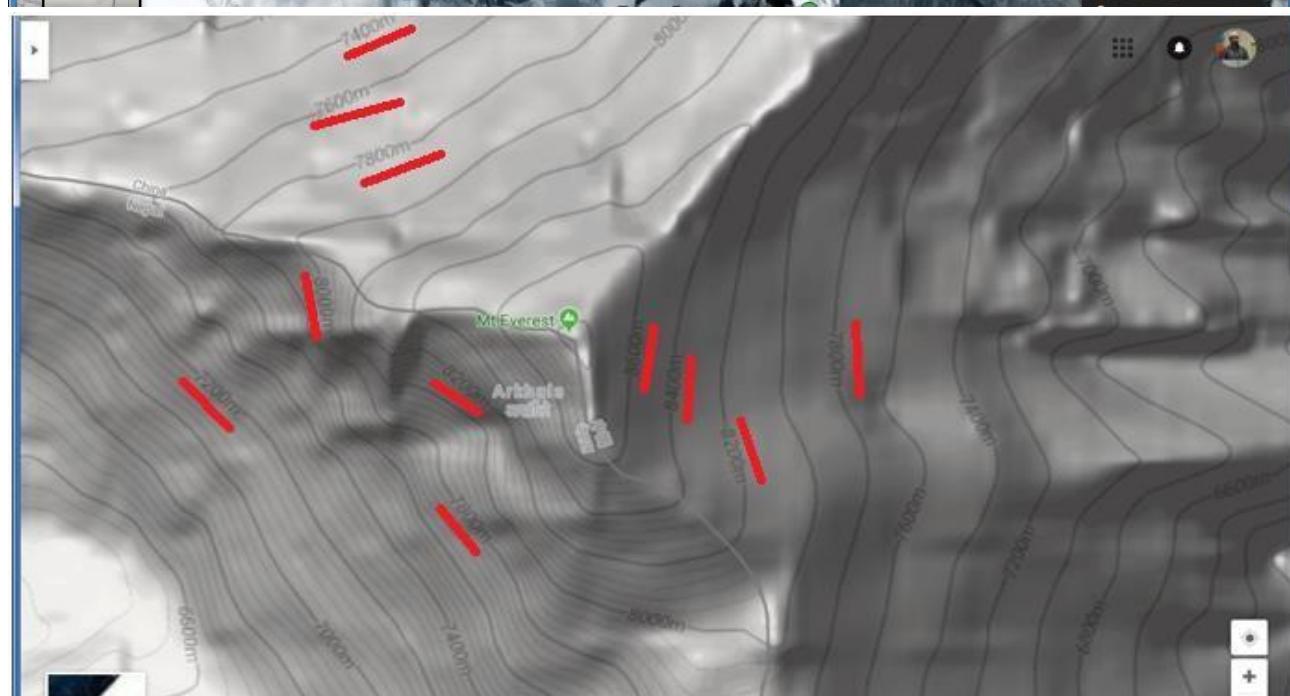
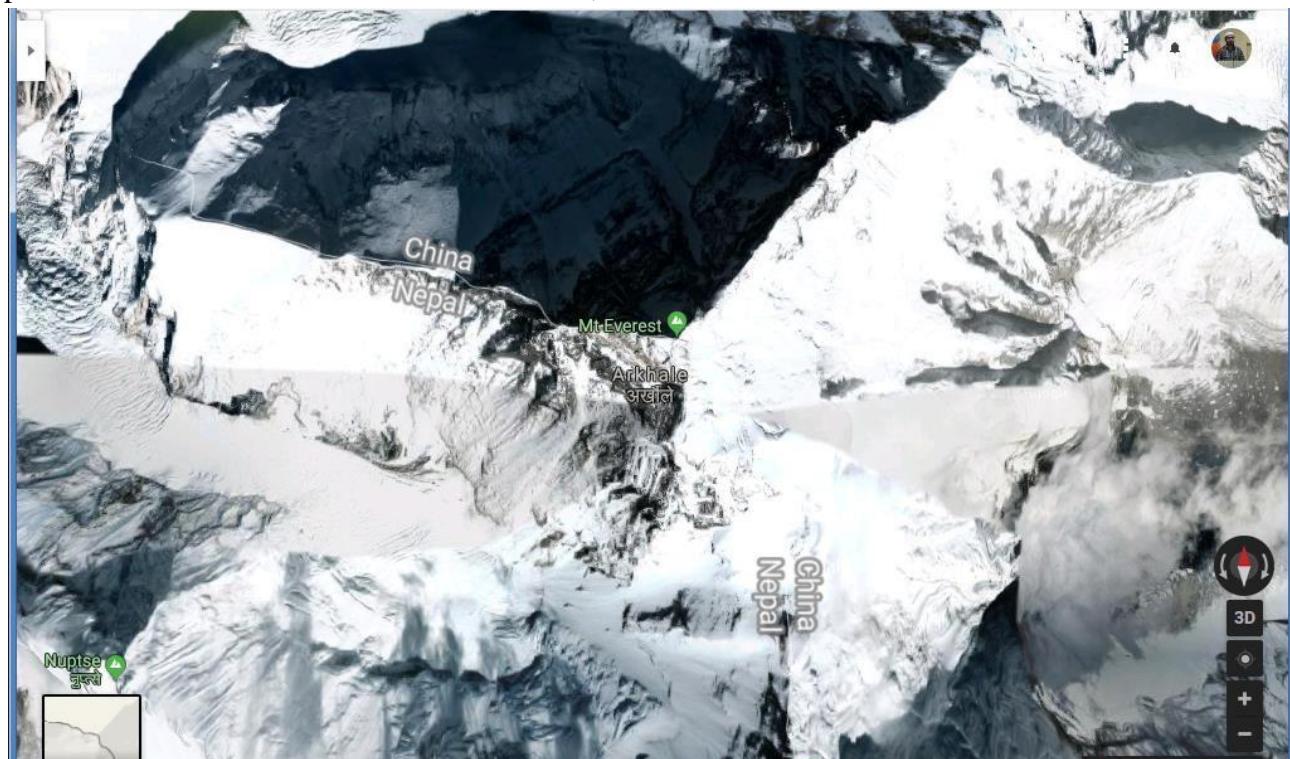
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**b) Terrain Data and Hill shade analysis**

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>



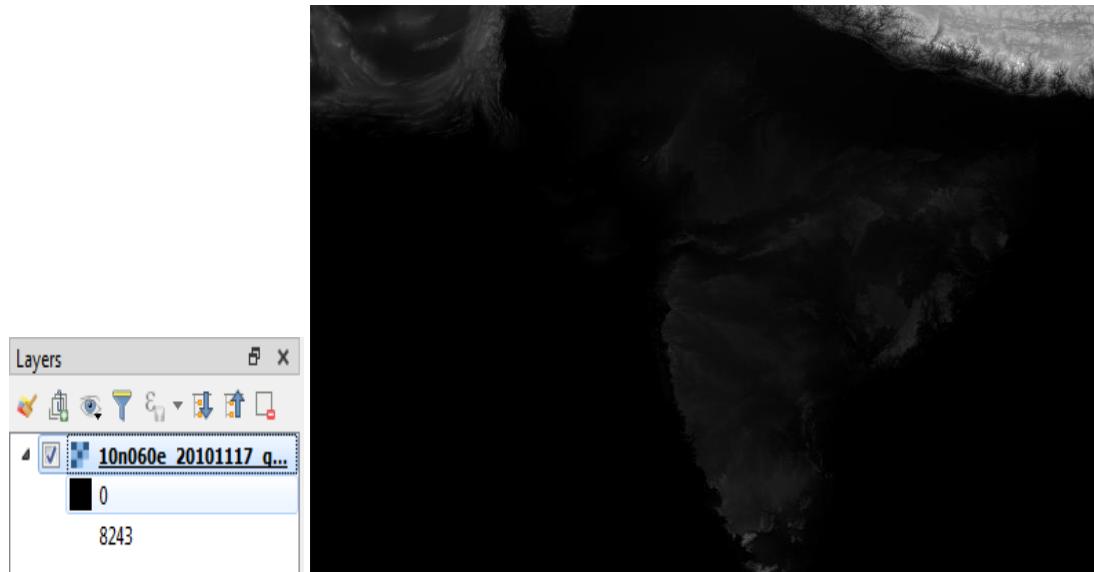
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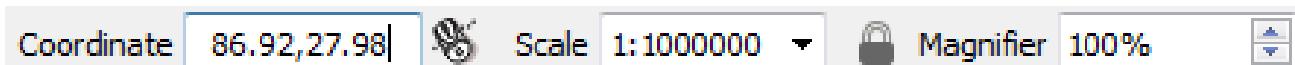
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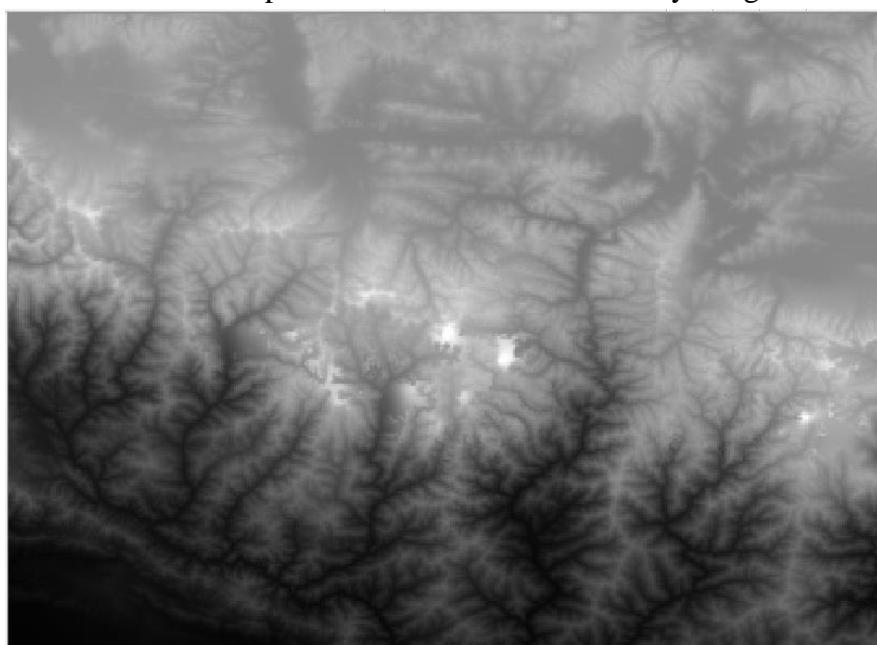
- Go to Layer → Add Raster Layer → select “10n060e\_20101117\_gmted\_mea300.tif”, from Data folder



- 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  $27.9881^{\circ}$  N,  $86.9253^{\circ}$  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.





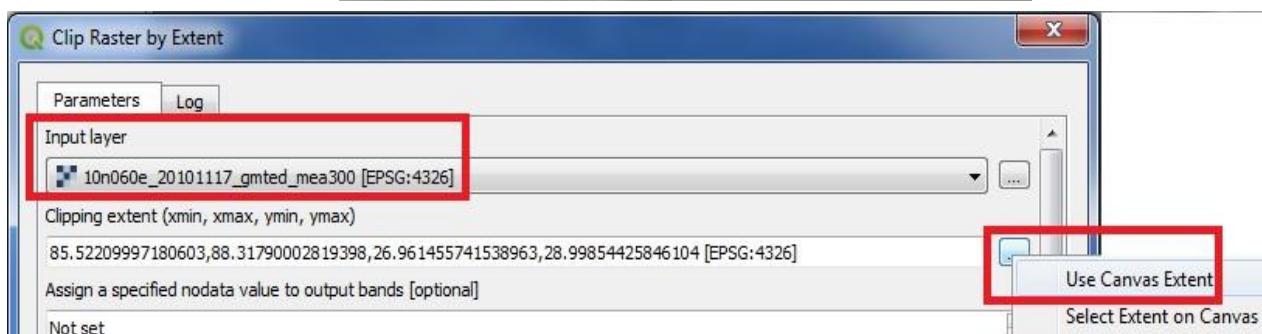
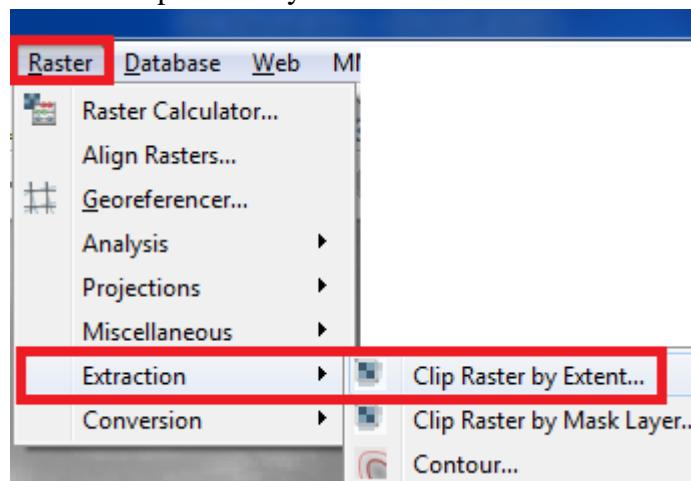
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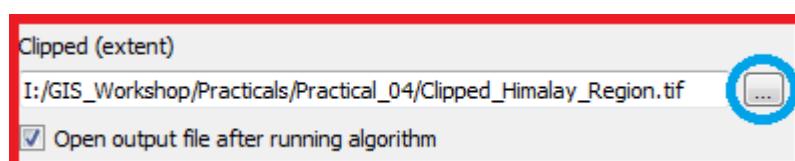
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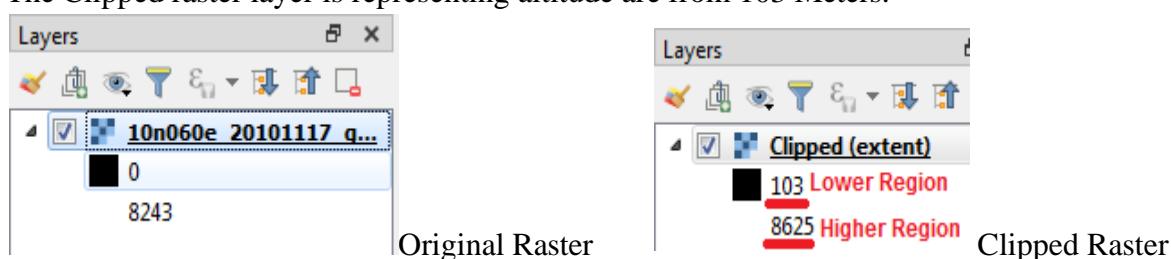
- Crop the raster layer only for the region under study.
- Go to Raster → Extraction → Clip Raster by Extent



- 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.

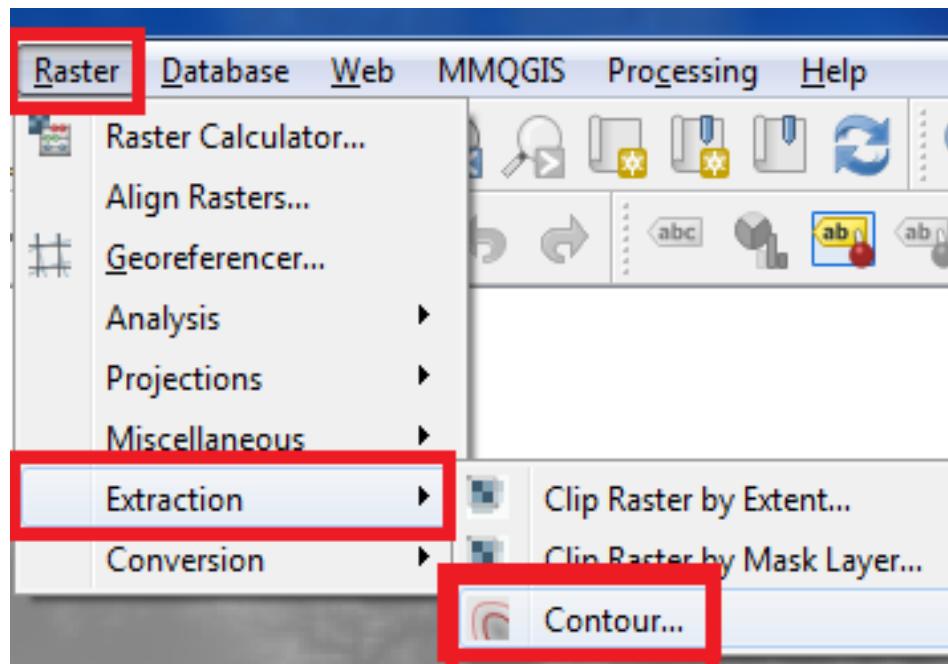


- Press RUN.
- Deselect the original layer and keep the clipped one.
- The Clipped raster layer is representing altitude are from 103 Meters.





- 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

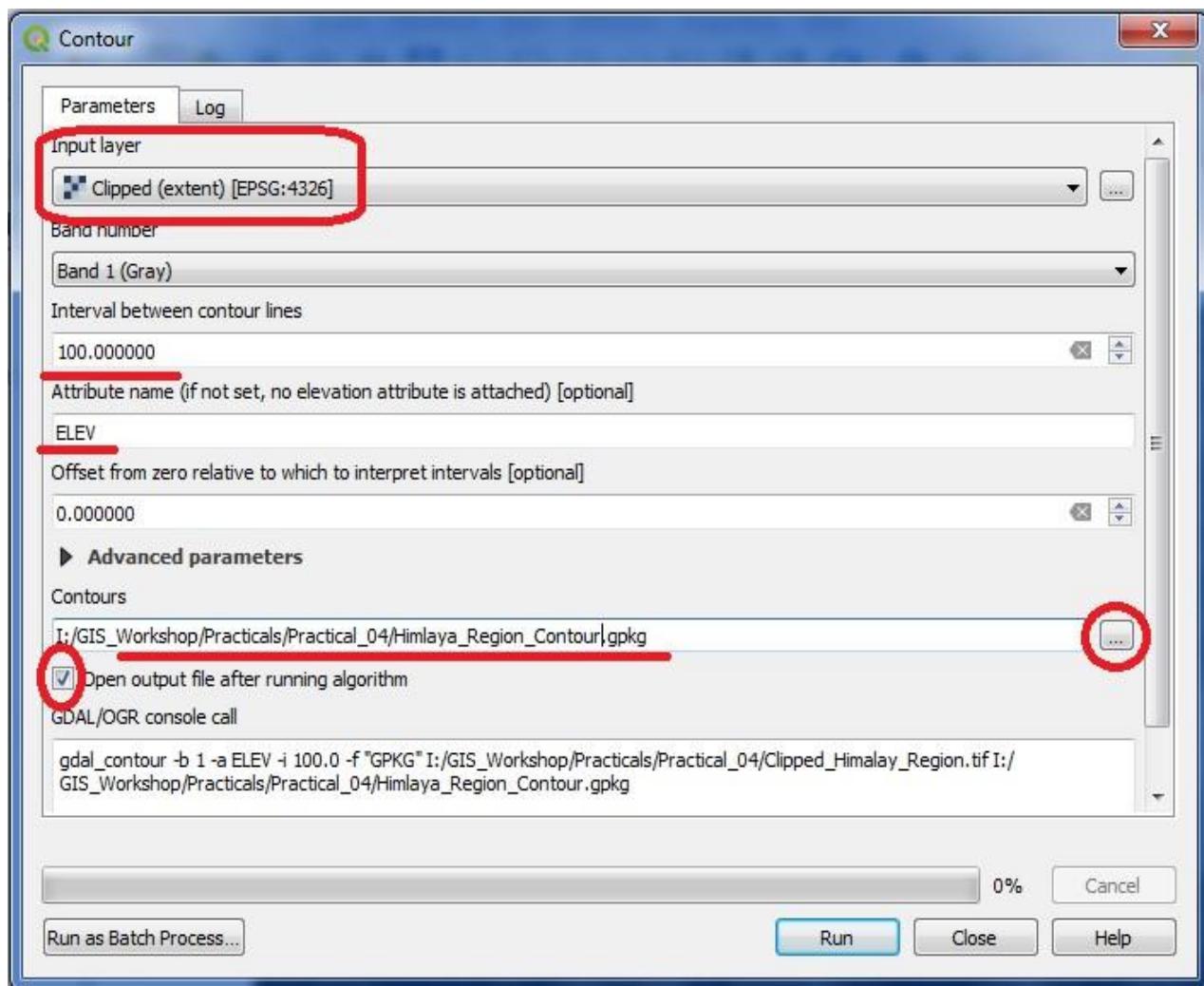


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- Select the input raster layer name. Set contour interval 100.00 meters, select the output file name & location and check the option to add output file to project after processing.
- Press “RUN”.
- The contour layer will appear like this

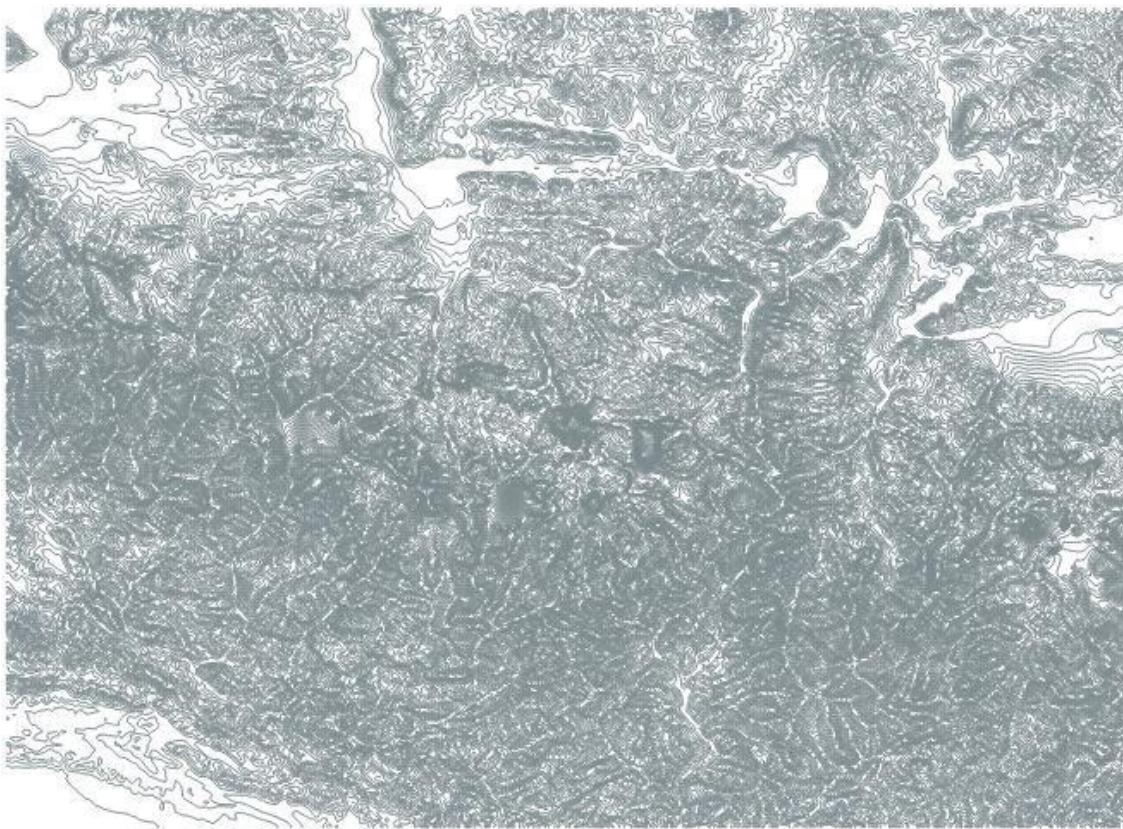


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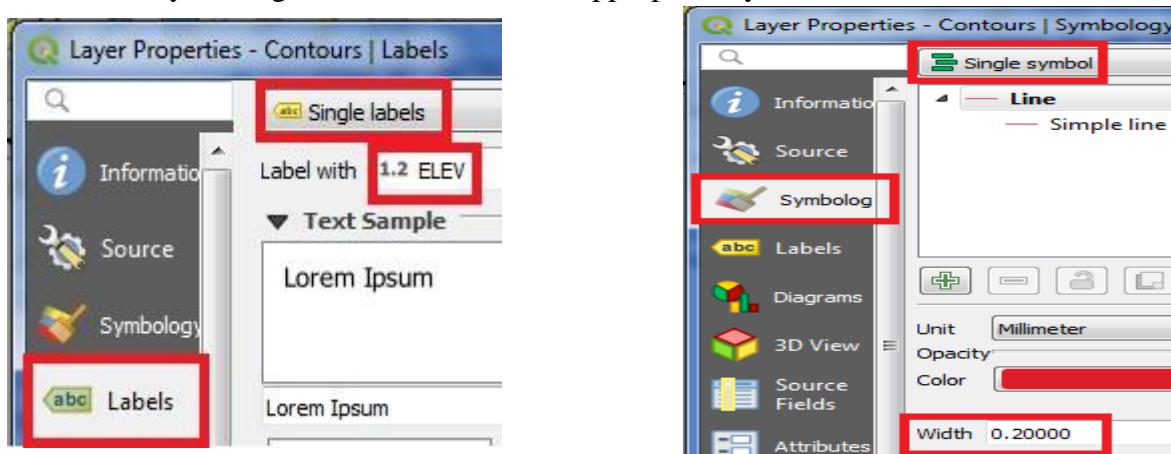
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- Label the layer using “ELEV” field and set appropriate symbols for line.



- 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.
-

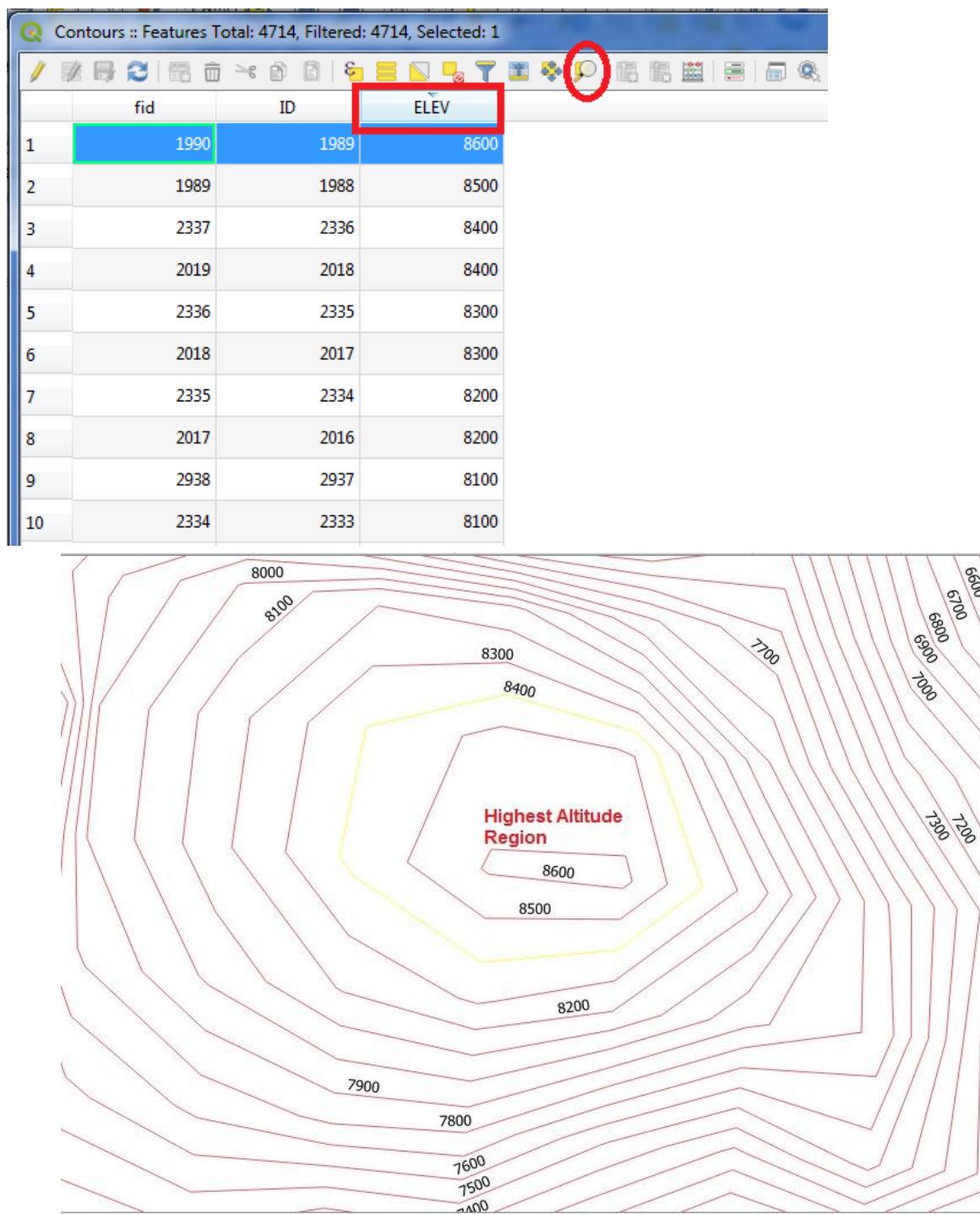


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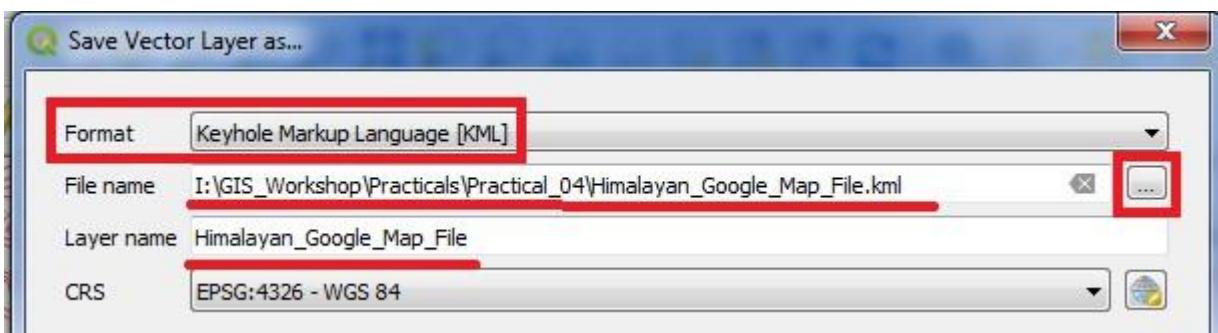
Compare the above counter line raster layer with the previous Google map image or visit

<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.



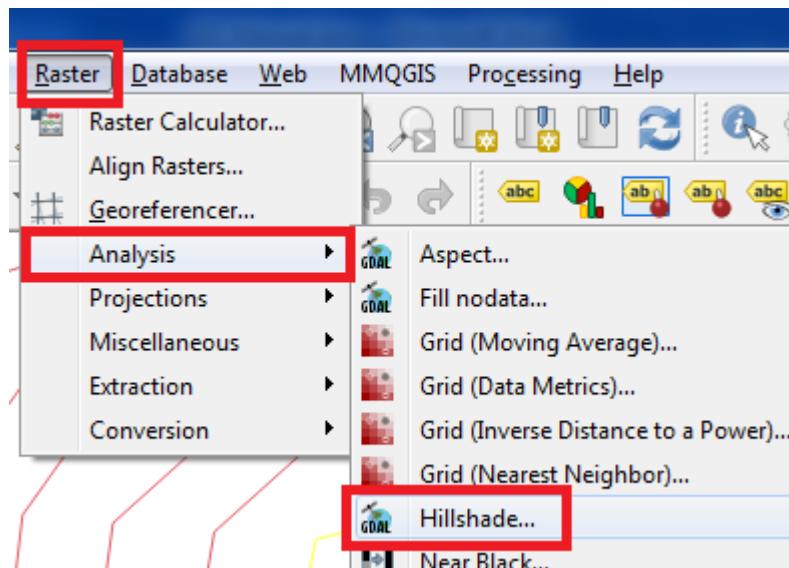
- Also set CRS to WGS 84 EPSG:4326



- 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.

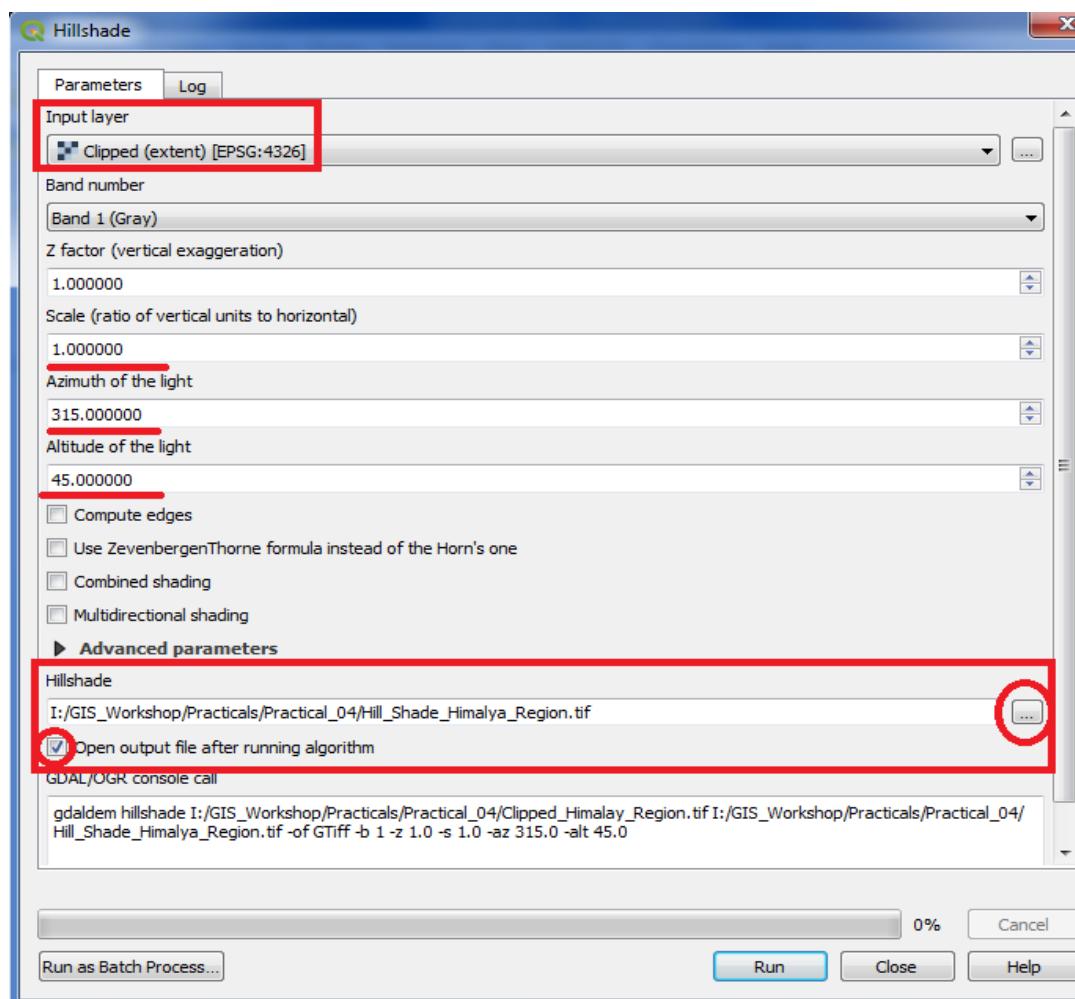


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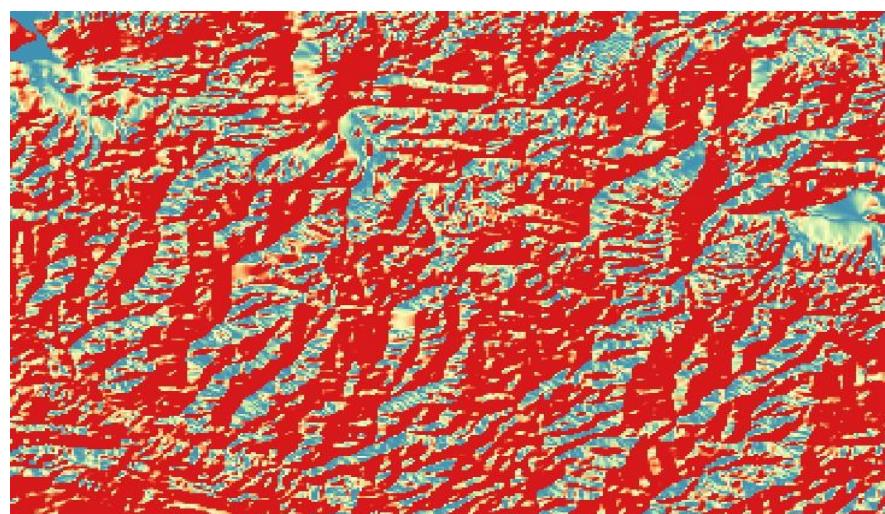
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- Press “RUN” and Close the Hill Shape Dialog window.
- After Raster styling the Output will appear like this.





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**Learning Outcome:**

1. Work with attribute data effectively
2. Use plugins for data import/export

**Course Outcome:**

1. Design maps with attribute data
2. Download and utilize OpenStreetMap data

**Conclusion:**

**Viva Questions:**

1. What are attribute data types?
2. How to import CSV files?
3. What is OpenStreetMap used for?

Correction Parameter	Formative Assessment [ ]	Timely Completion of practical	Attendance Learning Attendance [ ]



**Experiment No.—5:**

**Aim:** Working with attributes, terrain Data

**Tools & Technologies used:** QGIS

**Learning Objectives:**

1. Manage and edit attribute data
2. Analyze and visualize terrain data

**Theory: Introduction to Attributes and Terrain Data.**

Attribute data have been discussed only indirectly during the course of the previous four chapters because of their concentration on spatial data. However, it is important to pay attention also to the descriptive information for places or facilities or landscapes, as probably most uses of spatial information systems pertain to the thematic information. There are three situations:

1. Actions requiring no spatial properties.
2. Actions using only spatial properties.

Tasks that involve combinations of spatial and attribute data include tasks like finding the number of students who live within areas demarcated by no more than thirty minutes driving time on a school bus by the fastest routes to particular schools, or measuring the area of damaged property on coastal barrier islands that have recently suffered storms. Terrain data, such as information about elevation, slope, and aspect, can play an integral part in many land change and management studies. These data are particularly useful in the form of digital elevation models (DEMs). Most simply, DEMs can be used to create 3-dimensional data visualizations, which provide an insightful perspective on landscapes. For more complex studies, DEMs can be used to map hazardous terrain, to calculate topographical features such as slope and aspect, and as an input variable for modelling landslides or snowmelt. Digital elevation data can be created from many different sources. A terrain dataset is a multiresolution, TIN-based surface built from measurements stored as features in a geodatabase. They're typically made from lidar, sonar, and photogrammetric sources. Terrains reside in the geodatabase, inside feature datasets with the features used to construct them.

Terrains have participating feature classes and rules, similar to topologies. Common feature classes that act as data sources for terrains include the following:

- Multipoint feature classes of 3D mass points created from a data source such as lidar or sonar
- 3D point and line feature classes created on photogrammetric workstations using stereo imagery
- Study area boundaries used to define the bounds of the terrain dataset

The terrain dataset's rules control how features are used to define a surface. For example, a feature class containing edge of pavement lines for roads could participate with the rule that its features be used as hard breaklines.



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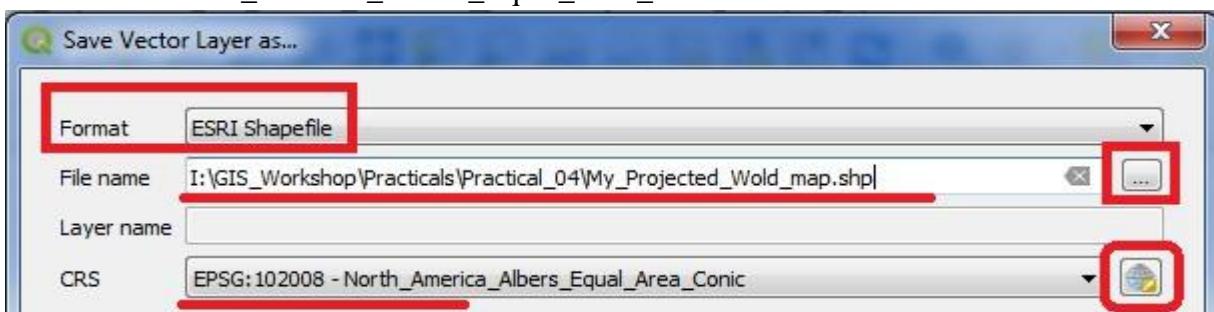
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## Step:-

### **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



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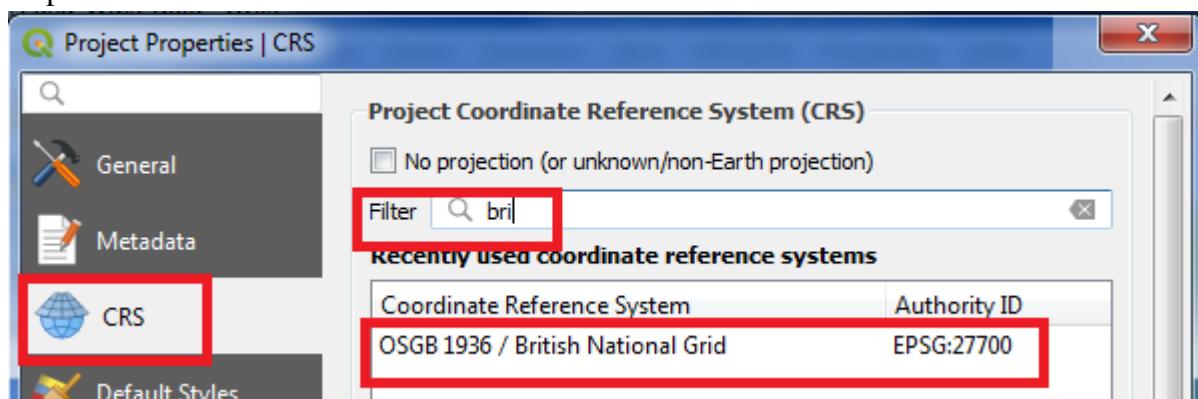
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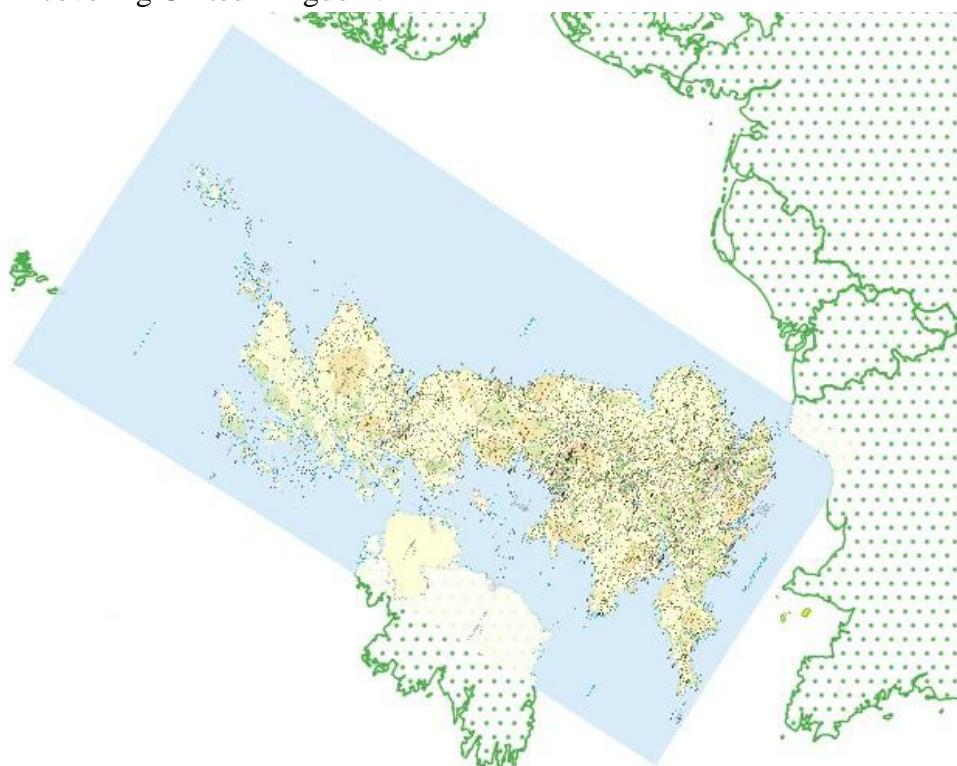
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“GIS\_Workshop\Practicals\Practical\_05\DATA\minisc\_gb\minisc\_gb\data\RGB\_TIF\_compressed\MiniScale\_(standard)\_R17.tif”

- 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.





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**Learning Outcome:**

- 1 Understand attributes in spatial data
- 2 Interpret terrain data for analysis

**Course Outcome:**

- 1 Work with and manipulate attribute data
- 2 Apply terrain data in mapping projects

**Conclusion:**

**We have successfully executed the program**

**Viva Questions:**

- 1 What is attribute data?
- 2 How to analyze terrain data?
- 3 What is terrain modeling?

Correction Parameter	Formative Assessment [ ]	Timely Completion of practical	Attendance Learning Attendance [ ]



### Experiment No.—6:

**Aim:** Working with Projections and WMS Data

**Tools & Technologies used:** QGIS

#### Learning Objectives:

1. Understand and apply projections
2. Work with WMS data layers

## Theory: Introduction to Projections.

A three-dimensional object can be represented in a single plane, such as on a sheet of paper, using projecting lines and planes. All projection theory is based on two variables: *line of sight* (projecting lines) and *plane of projection*. A line of sight (LOS) is an imaginary line between an observer's eye and an object. A plane of projection (i.e., an image or picture plane) is an imaginary flat plane upon which the image is projected. The projection is produced by connecting the points where the lines of sight pierce the projection plane. As a result, the 3D object is transformed into a 2D view.

If the distance from the observer to the object is infinite, then the projection lines are assumed to be parallel, and the projection is called a parallel projection. Parallel projection is *orthographic* if the plane of projection is placed between the observer and the object, and the plane is perpendicular to the parallel lines of sight.

1. In multiview orthographic projection (see details below), the object surface and the projection plane are parallel, and you can see only two dimensions.
2. In isometric view (orthographic) the surface is no longer parallel to the projection plane, but the latter is perpendicular to the lines of sight, with three dimensions being seen.
3. In oblique projection (non-orthographic) the object surface and the projection plane are also parallel, but the lines of sights are not perpendicular to the projection plane, and you can see again three dimensions.

If the distance from the observer to the object is finite, then the projection lines are not parallel (since all lines of sight start at a single point), and the drawing is classified as a *perspective projection*. In perspective view the object surface and projection plane can be also parallel.

#### Multiview projection

By changing position of the object relative to the line of sight you can create different views of the same object. Drawing more than one face of an object by rotating the object relative to your line of sight helps in understanding the 3D form. Having several views on one drawing you use the concept of multi-view projection, which is based on the orthographic (parallel) projection technique where



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- the plane of projection is positioned between the observer and the object,
- the plane of projection is perpendicular to the parallel lines of sight, and
- the object is oriented such that only two of its dimensions are shown.



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### Step:-

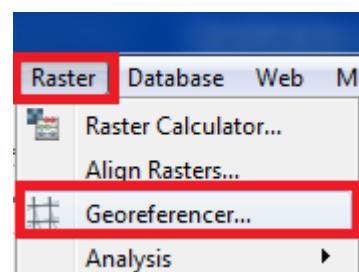
#### ➤ **Georeferencing**

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



- A new Georeferencer window will open



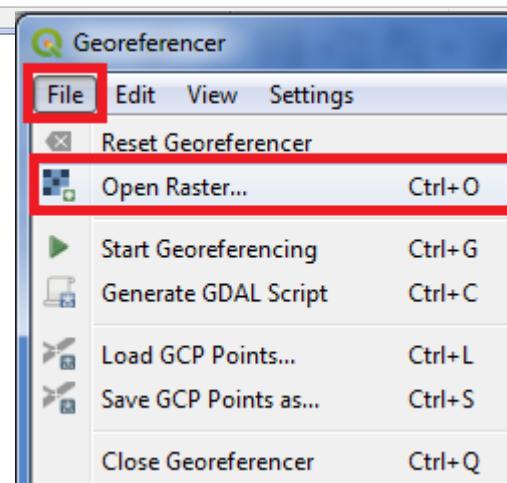
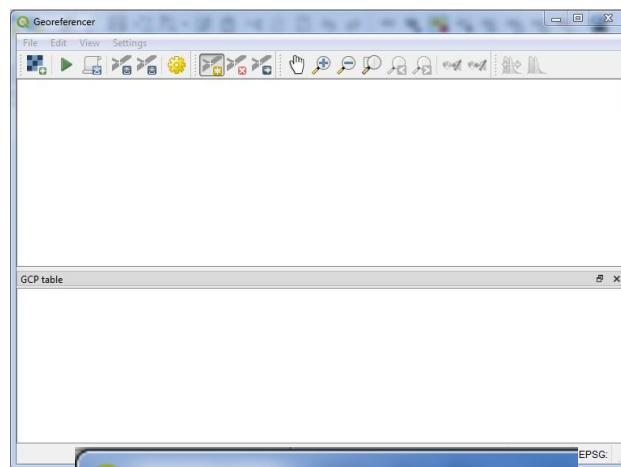
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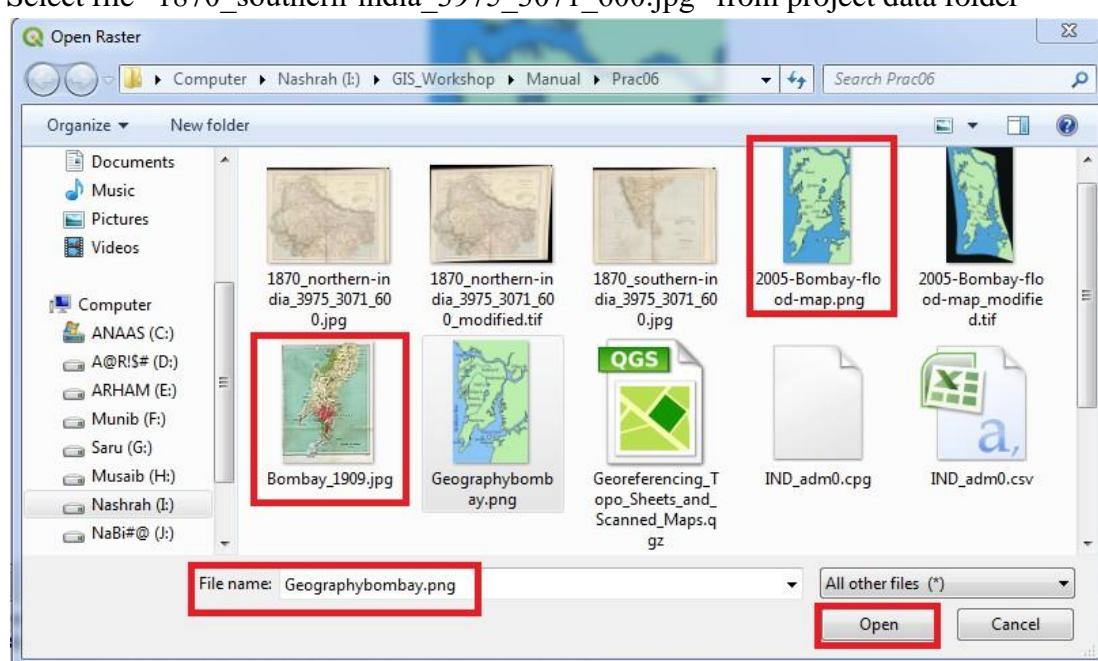
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File → Open Raster



- Select file “1870\_southern-india\_3975\_3071\_600.jpg” from project data folder





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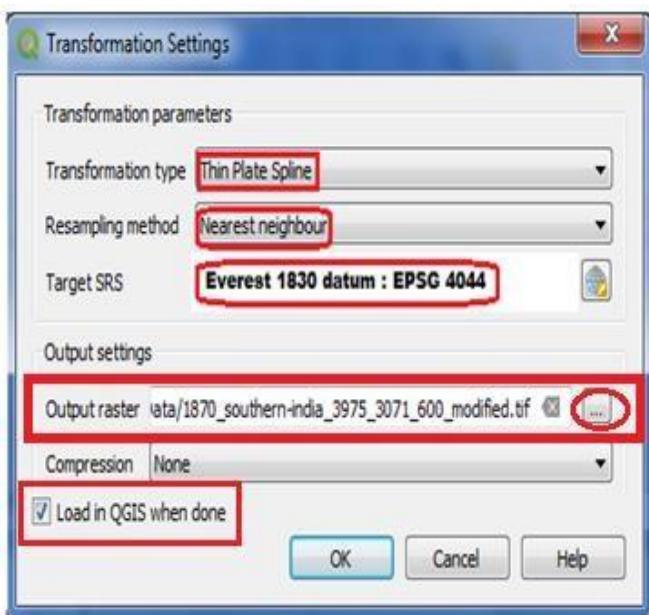
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- Go to Settings → Transformation Settings

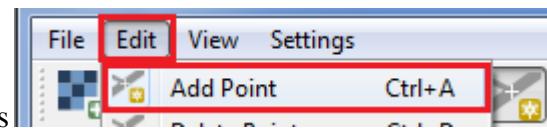


- In the Transformation Settings window



- 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





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The screenshot shows the QGIS Georeferencer interface. On the left, there is a toolbar with various icons. In the center, a dialog box titled "Enter Map Coordinates" is open, instructing the user to click on raster to add control points and select "From map canvas" button. Below this dialog, a "GCP table" is displayed with four entries:

Visible	ID	Source X	Source Y	Dest. X	Dest. Y	dX (pixels)	dY (pixels)	Residual (pixels)
<input checked="" type="checkbox"/>	0	313.914	-1438.08	72.7915	18.9415	4.93856e-10	5.25915e-10	7.21443e-10
<input checked="" type="checkbox"/>	1	925.421	-1482.13	72.8413	18.9178	5.16366e-10	5.32054e-10	7.41428e-10
<input checked="" type="checkbox"/>	2	490.111	-880.985	72.8177	19.0436	4.92491e-10	5.23755e-10	7.18935e-10
<input checked="" type="checkbox"/>	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.

The screenshot shows the "Transformation Settings" dialog box. Under "Transformation parameters", the "Transformation type" is set to "Thin Plate Spline", "Resampling method" to "Nearest neighbour", and "Target SRS" to "EPSG:4326 - WGS 84". Under "Output settings", the "Output raster" is set to "data/1870\_northern-india\_3975\_3071\_600\_modified.tif" and "Compression" is set to "None". The "Target SRS" field is highlighted with a red box.

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



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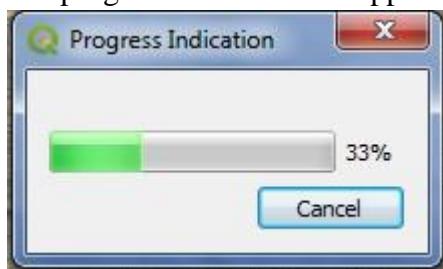
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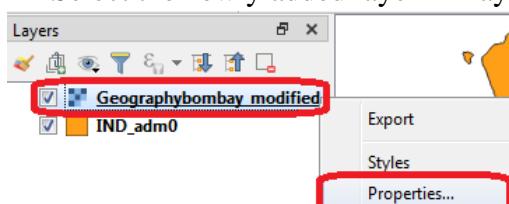
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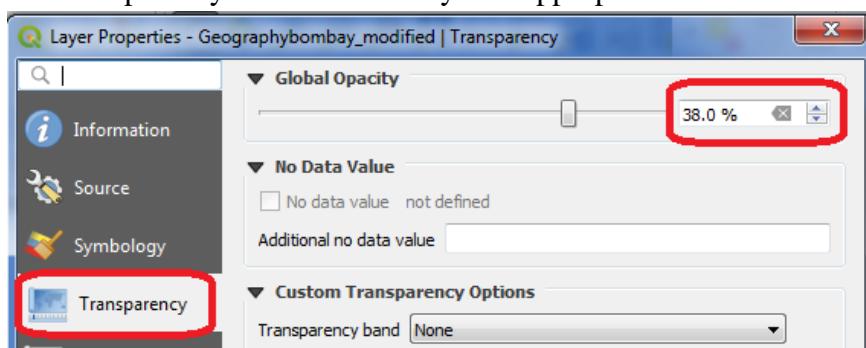
- The progress indicator will appear



- 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:**

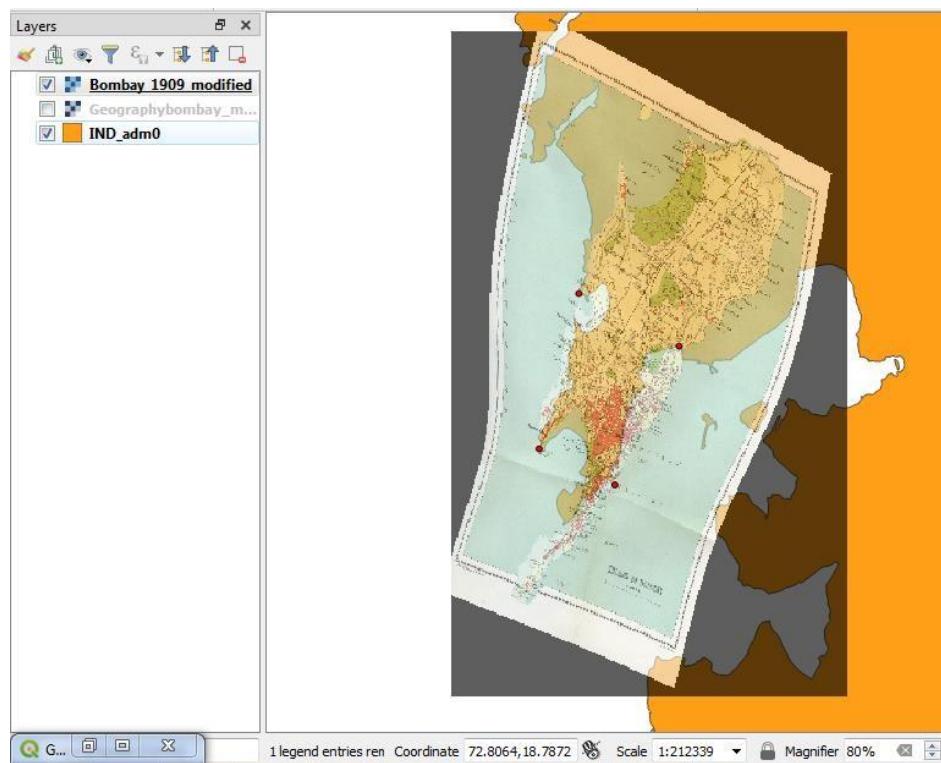


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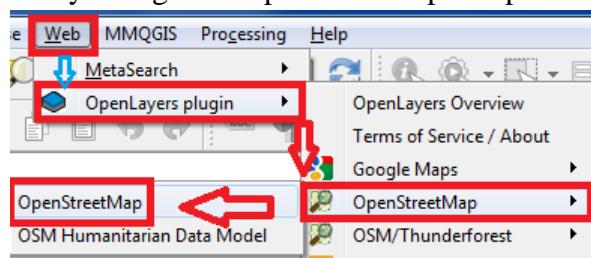
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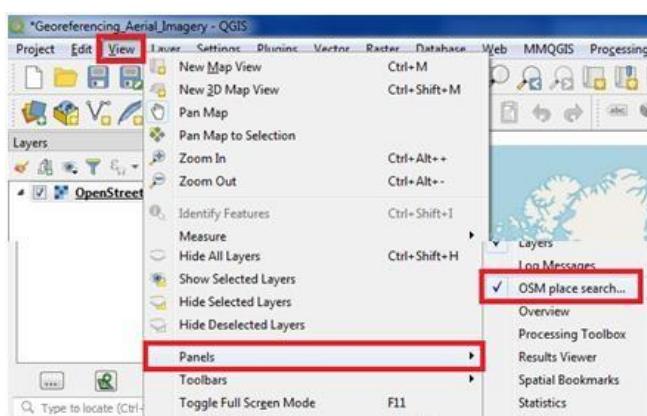


**B. Georeferencing Aerial Imagery**

- Install plugin OpenStreetMap
- Go to Web Menu → OpenLayerPlugin → OpenStreetMap → OpenStreetMap



- Go to Project → Properties → Set CRS to EPSG 3857
- Go to View → Panels → select OSM Place search



- The Gateway of India, Mumbai is located at 18.92°N 72.83°E
- Search Gateway of India in OSM Search Panel



- Zoom in to appropriate level.
- The map will appear like this

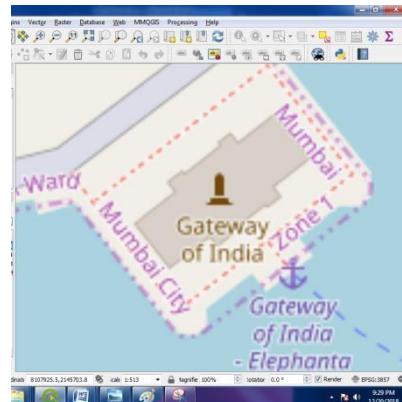


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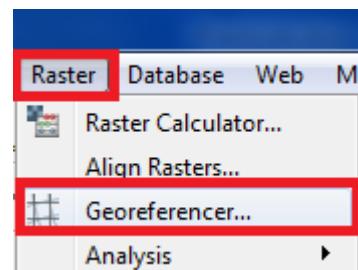
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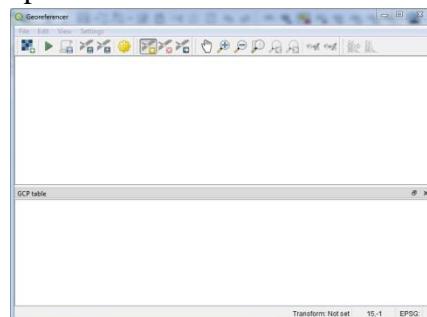
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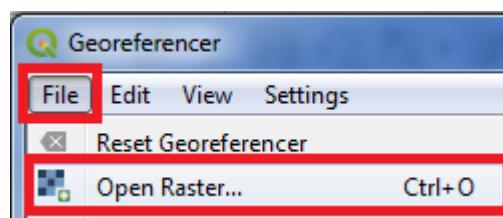
- Go to Raster → Georeferencer



- A new Georeferencer window will open



- File → Open Raster



- Select file "Gateway\_Imagery.tif" from project data folder

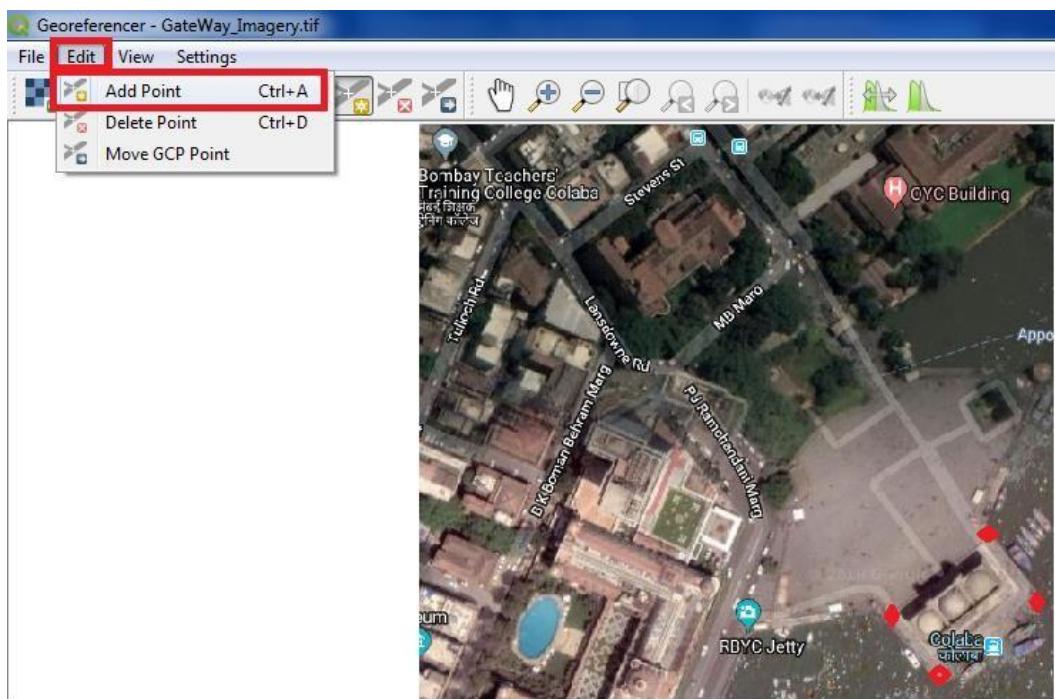


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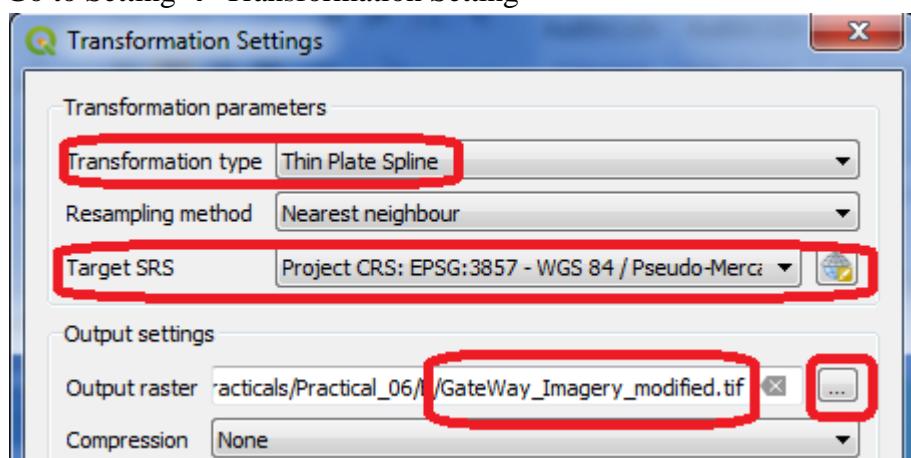
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- Go to Edit → Add Point
- Select control points from map (Indicated in red color).
  
- Go to Setting → Transformation Setting



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



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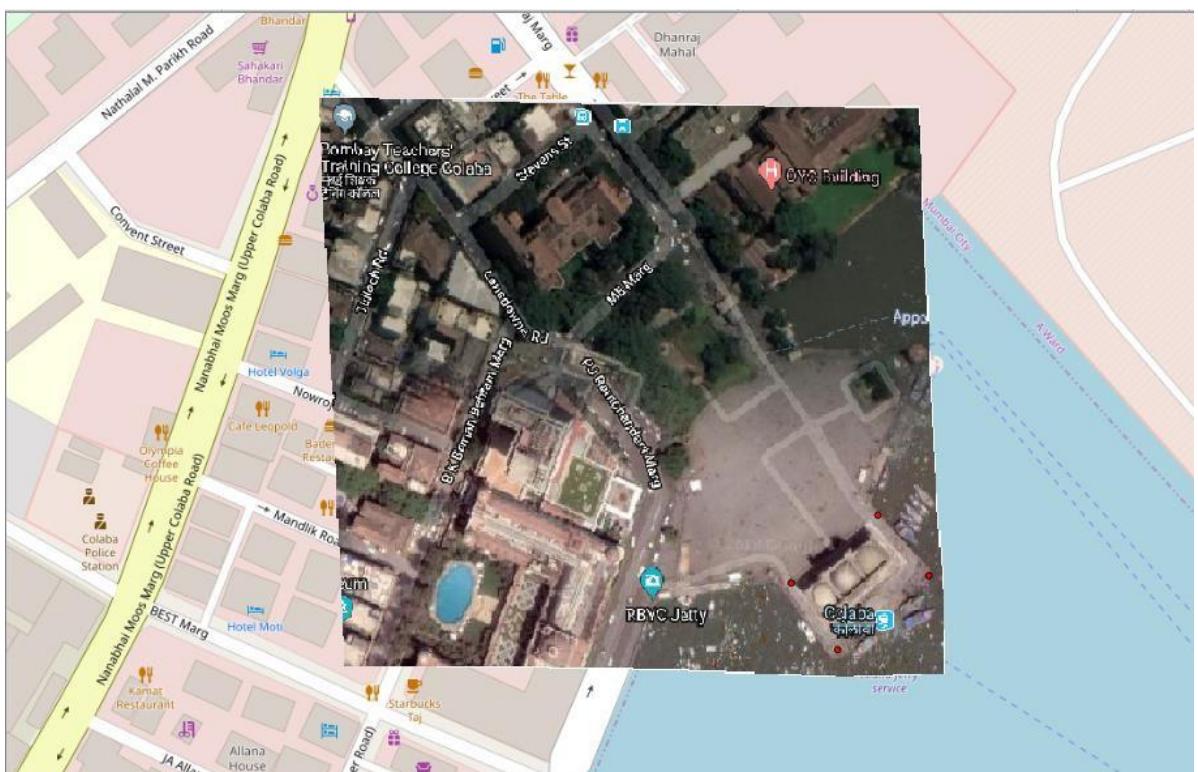
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- Observe that the aerial image of the Gateway of India is georeferenced on OSM in the map canvas.





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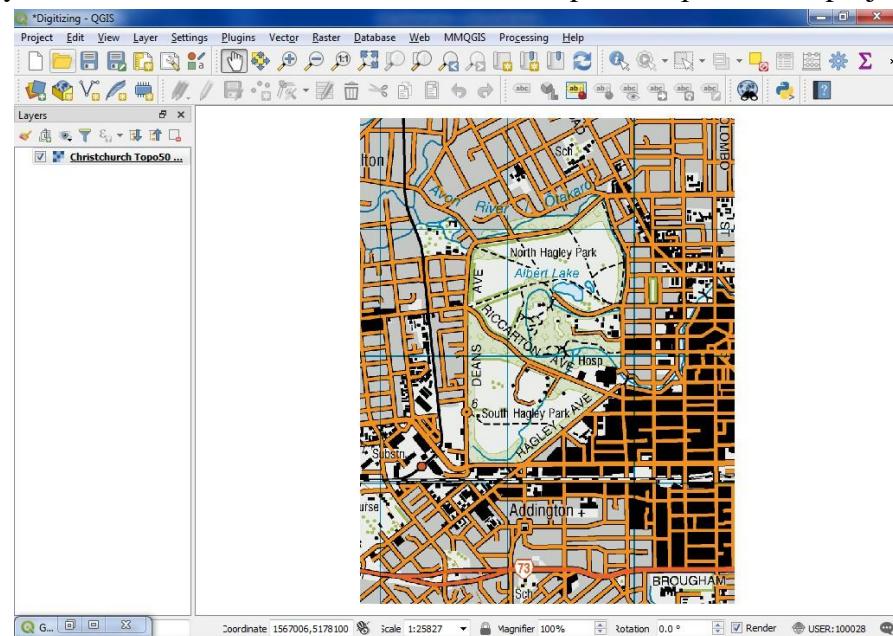
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### C. Digitizing Map Data

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 different types of spatial (point, line, polygon) as well as non-spatial layers. This makes it 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 layer and select Properties.



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

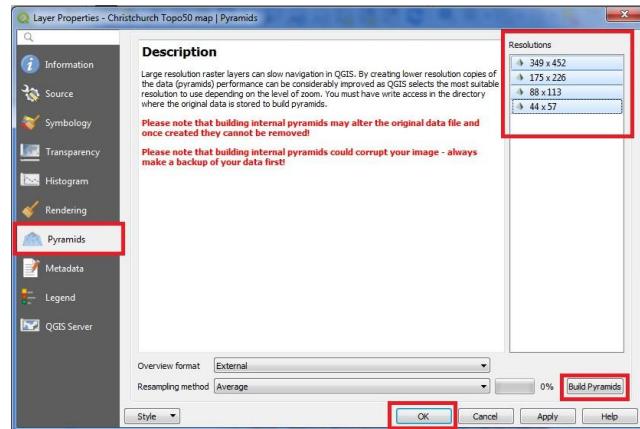


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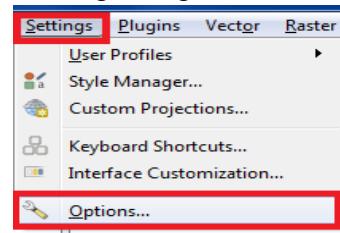
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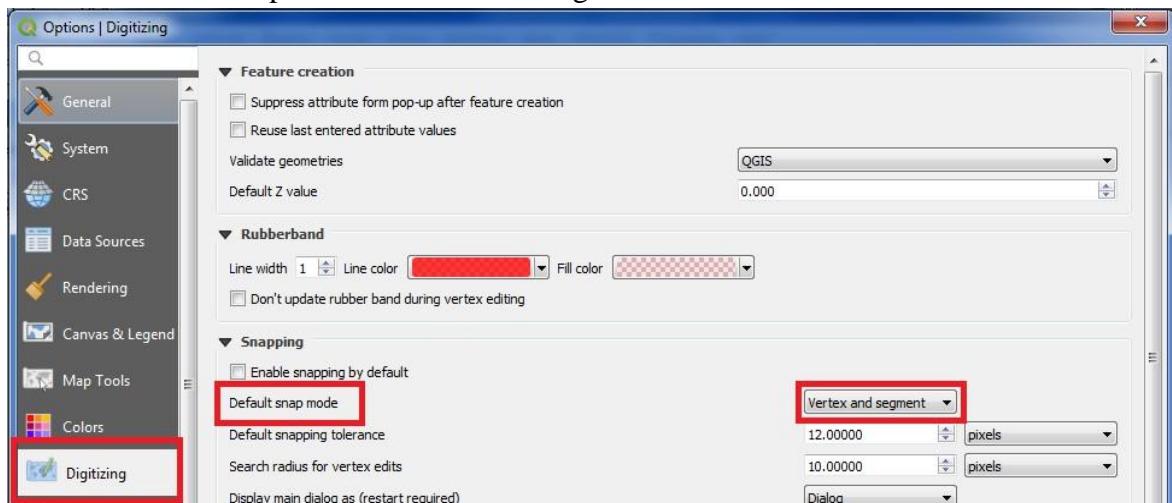
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- Click Build pyramids. Then click OK.
- Go to Settings → Options .... Select the Digitizing tab in the Options dialog.



- Set the Default snap mode to vertex and segment.



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

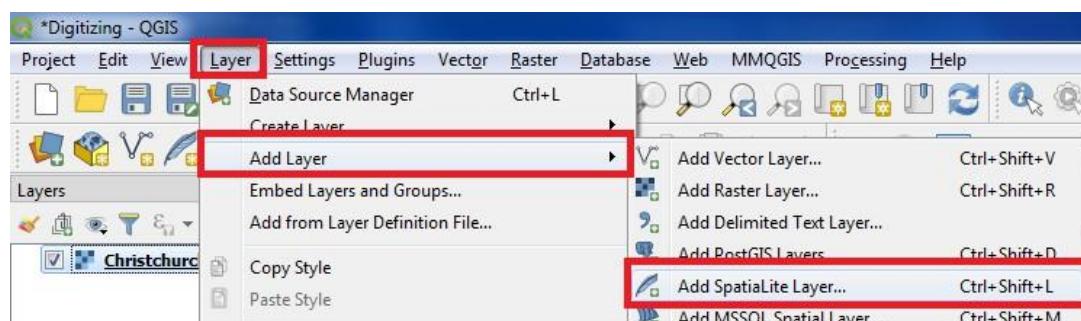


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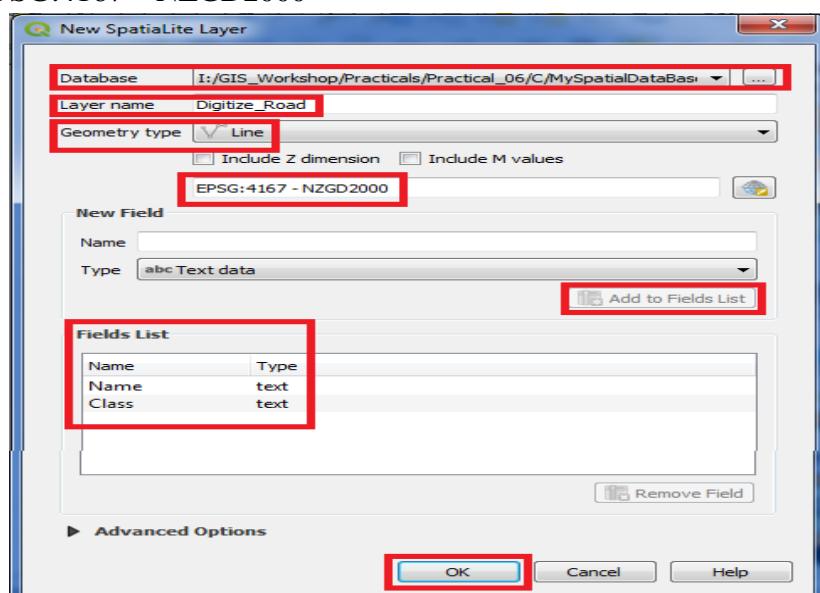
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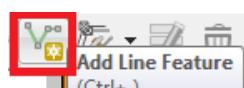
- Select the name and location for Spatial database eg: "GIS\_Workshop\Practicals\Practical\_06\C\MySpatialDataBase.sqlite".
- Name the Layer as "Digitized\_Road"
- Set Geometry type as "Line"
- Set CRS EPSG:4167 – NZGD2000

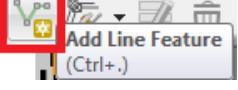


- Add "Name" and "Class" fields using "Add to Fields List".



- 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.

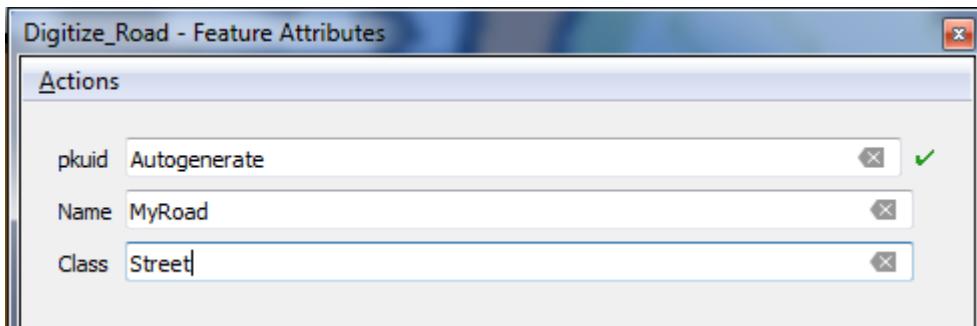


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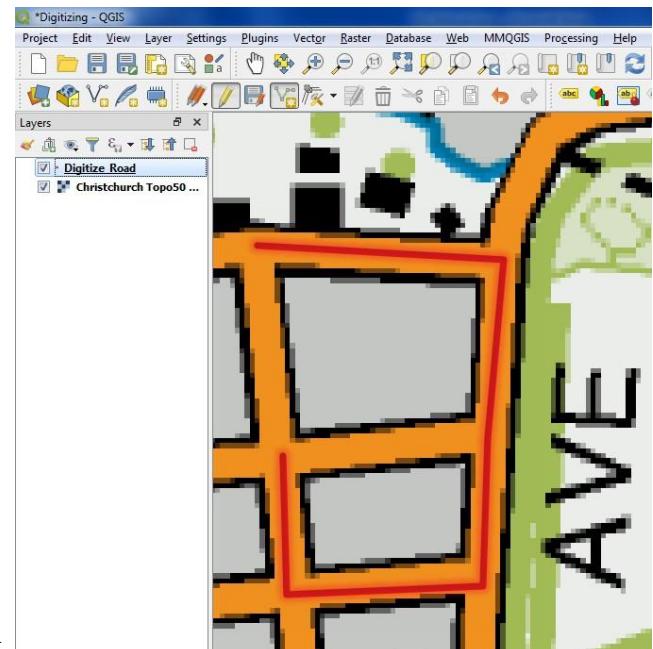
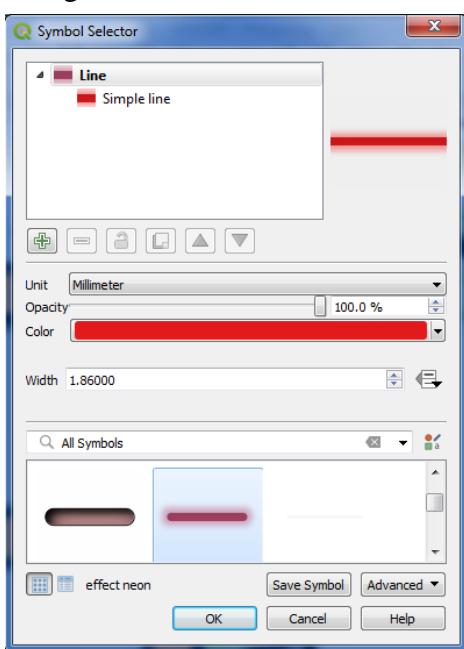
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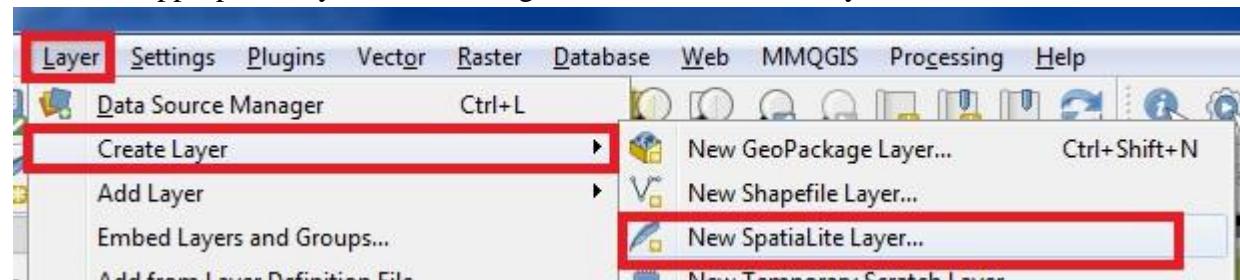


- On Layer Panel Right Click on Digitize\_Road, Select the Style tab in the Layer Properties dialog.



Result

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



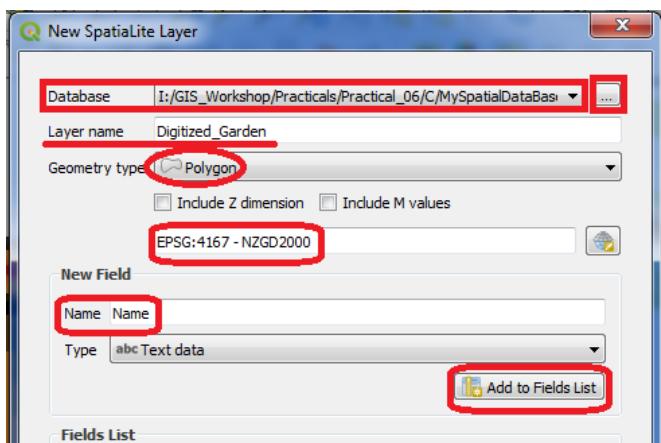


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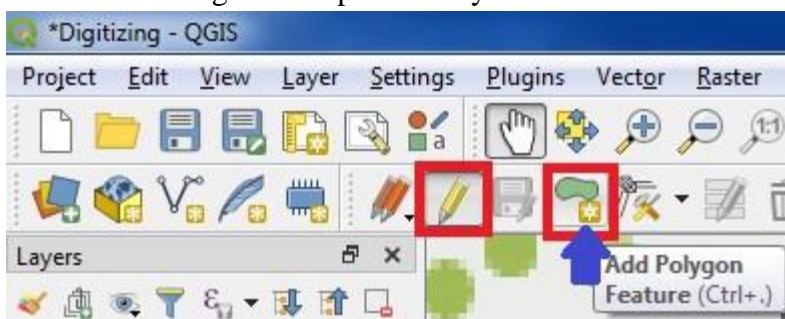
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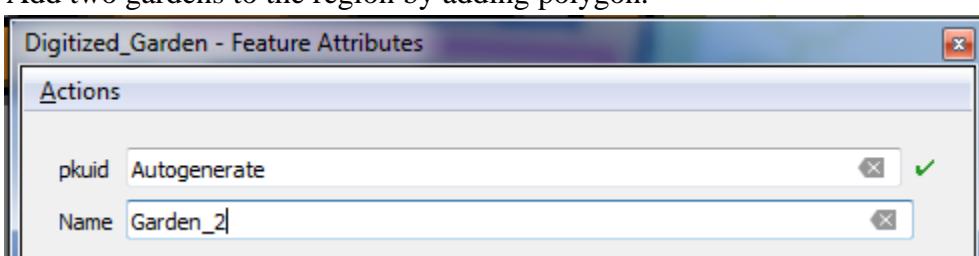
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- After creating a new Spatialite layer



- 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

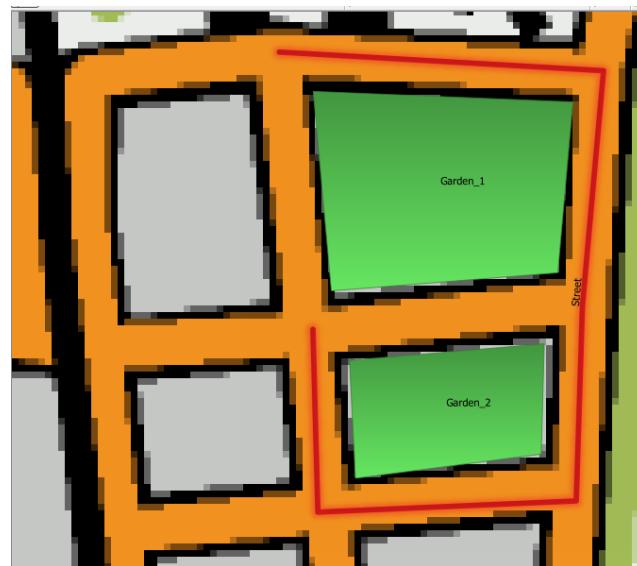


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- Using the above procedure a point feature can also be digitized.
- The digitizing task is now complete. You can play with the styling and labeling options in layer properties to create a nice looking map from the data you created.



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**Learning Outcome:**

- 1 Use different map projections effectively
- 2 Integrate and visualize WMS data

**Course Outcome:**

- 1 Apply projections in spatial analysis
- 2 Use WMS data in mapping projects

**Conclusion:**

**Viva Questions:**

- 1 What is a map projection?
- 2 How to use WMS data?
- 3 What is WMS in GIS?

Correction Parameter	Formative Assessment [ ]	Timely Completion of practical	Attendance Learning Attendance [ ]



**Experiment No.—7:**

**Aim: Georeferencing Topo Sheets and Scanned Maps Georeferencing Aerial Imagery Digitizing Map Data**

**Tools & Technologies used: QGIS**

**Learning Objectives:**

- 1. Georeference topo sheets and scanned maps**
- 2. Digitize map data from imagery**

**Theory : Introduction of Topo sheets and Scanned maps.**

In modern mapping, a topographic map or topographic sheet is a type of map characterized by large-scale detail and quantitative representation of relief features, usually using contour lines (connecting points of equal elevation), but historically using a variety of methods. Traditional definitions require a topographic map to show both natural and artificial features. A topographic survey is typically based upon a systematic observation and published as a map series, made up of two or more map sheets that combine to form the whole map .A topographic map series uses a common specification that includes the range of cartographic symbols employed, as well as a standard geodetic framework that defines the map projection, coordinate system, ellipsoid and geodetic datum. Official topographic maps also adopt a national grid referencing system. Topographic maps are based on topographical surveys. Performed at large scales, these surveys are called topographical in the old sense of topography, showing a variety of elevations and landforms. This is in contrast to older cadastral surveys, which primarily show property and governmental boundaries.

Topographic surveys were prepared by the military to assist in planning for battle and for defensive emplacements

The various features shown on the map are represented by conventional signs or symbols. For example, colors can be used to indicate a classification of roads. These signs are usually explained in the margin of the map, or on a separately published characteristic sheet.Topographic maps are also commonly called *contour maps* or *topo maps*. In the United States, where the primary national series is organized by a strict 7.5-minute grid, they are often called or *quads* or quadrangles.Topographic maps conventionally show topography, or land contours, by means of contour lines. Contour lines are curves that connect contiguous points of the same altitude (isohypse). In other words, every point on the marked line of 100 m elevation is 100 m above mean sea level.

These maps usually show not only the contours, but also any significant streams or other bodies of water, forest cover, built-up areas or individual buildings (depending on scale), and other features and points of interest such as what direction those streams are flowing.Most topographic maps were prepared using photogrammetric interpretation of aerial photography using a stereoplotter. Modern mapping also employs lidar and other Remotesensing techniques. Older topographic maps were prepared using traditional surveying instruments.



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## Step:-

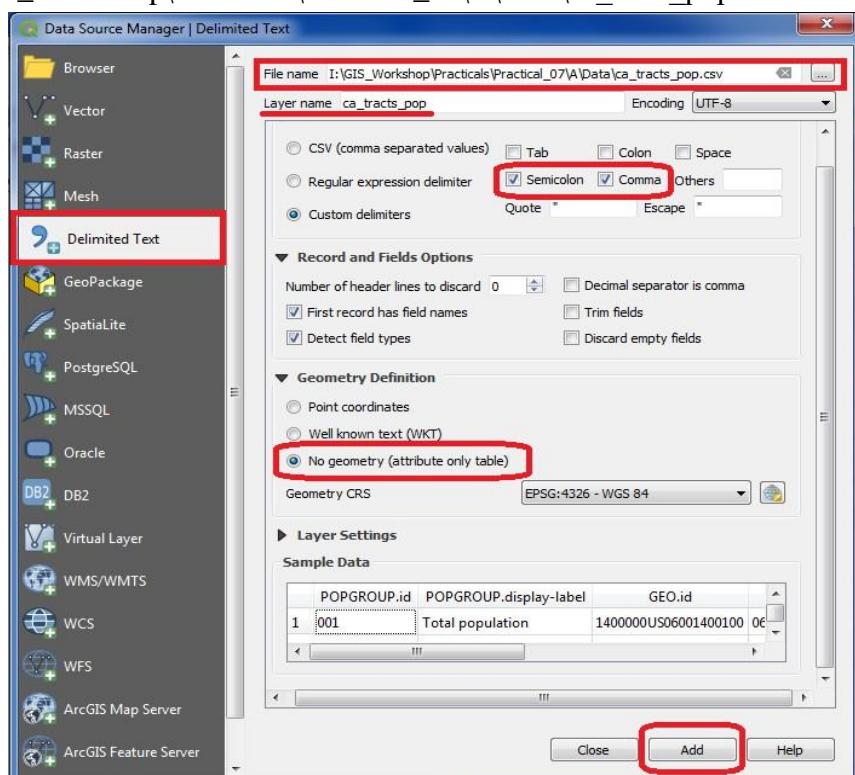
### Managing Data Tables and Saptial data Sets:

#### 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.

The screenshot shows a Windows Notepad window titled "ca\_tracts\_pop.csvt - Notepad". The content of the file is a single row of text: `"String", "string", "string", "string", "string", "Integer"`. This file serves as a sidecar file to define data types for each column in the CSV file.

- 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

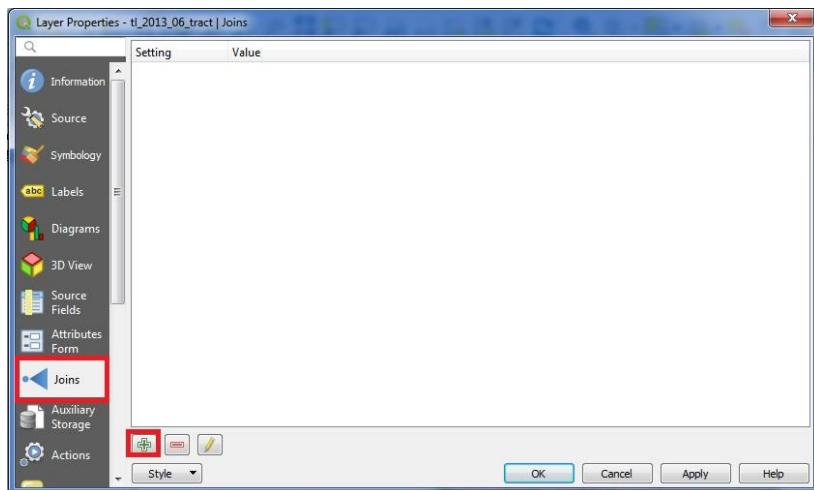


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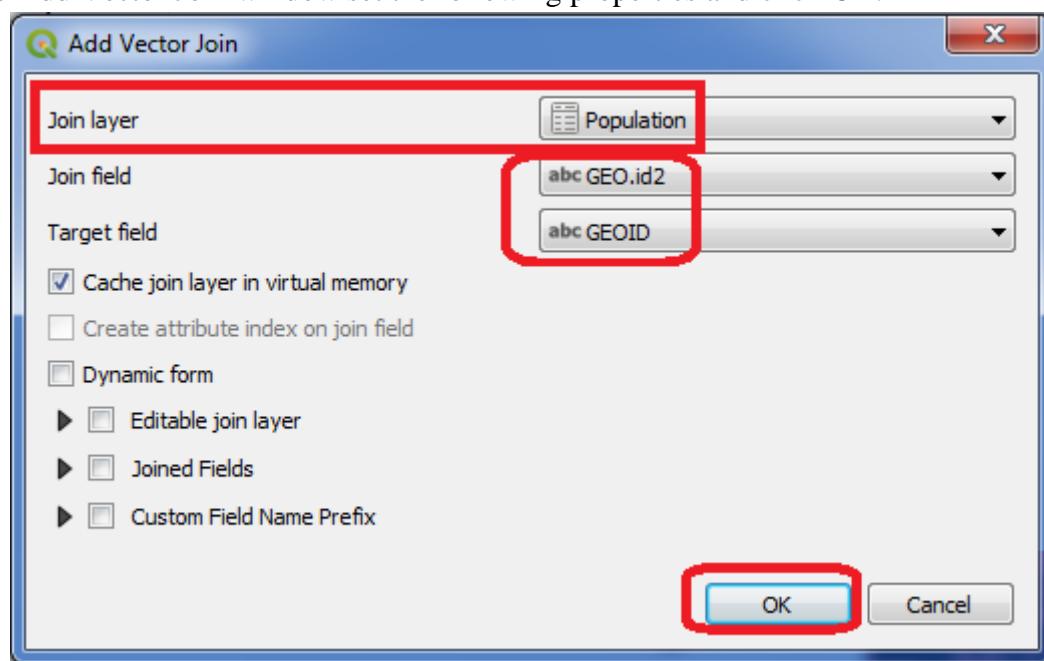
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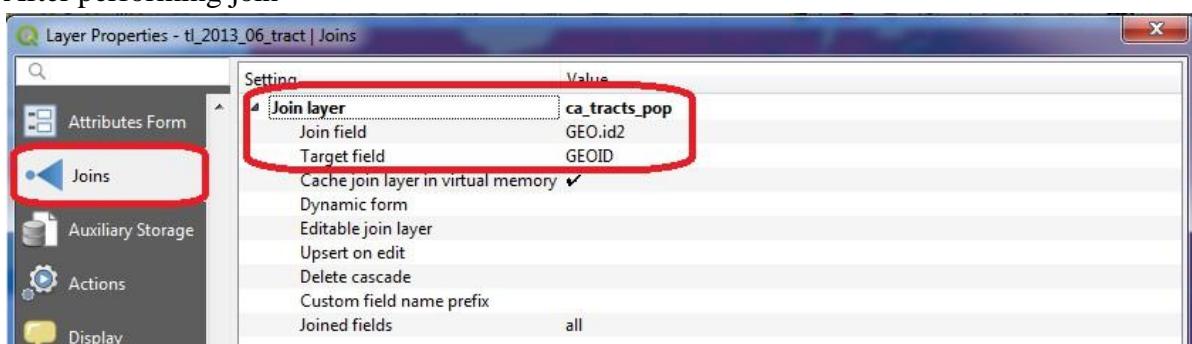
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- Select the option in Properties, and click on button to add new table join.
- In the Add Vector Join window set the following properties and click OK.



- After performing join





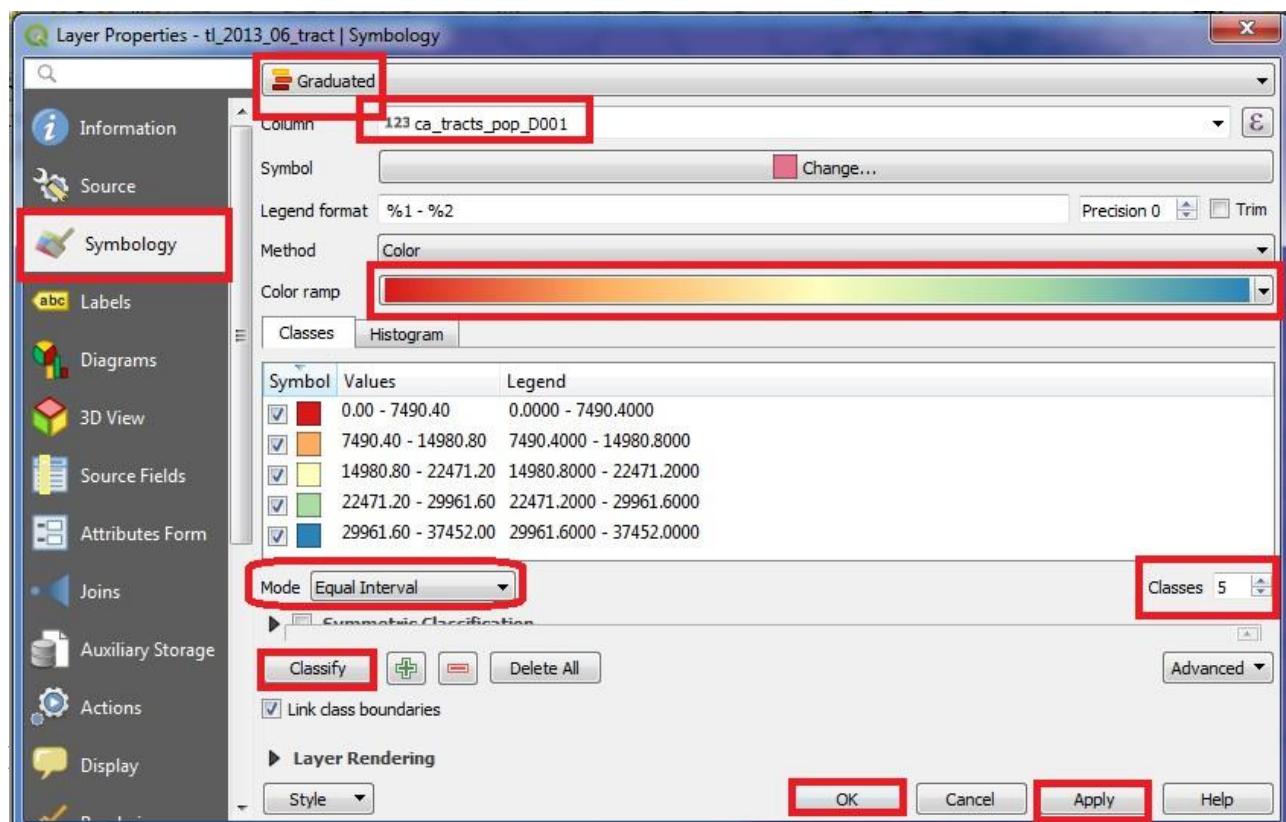
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- For more clear output, select “tl\_2013\_06\_tact” from Layer Panel, right click and select properties. Go to Symbology and set the following properties.



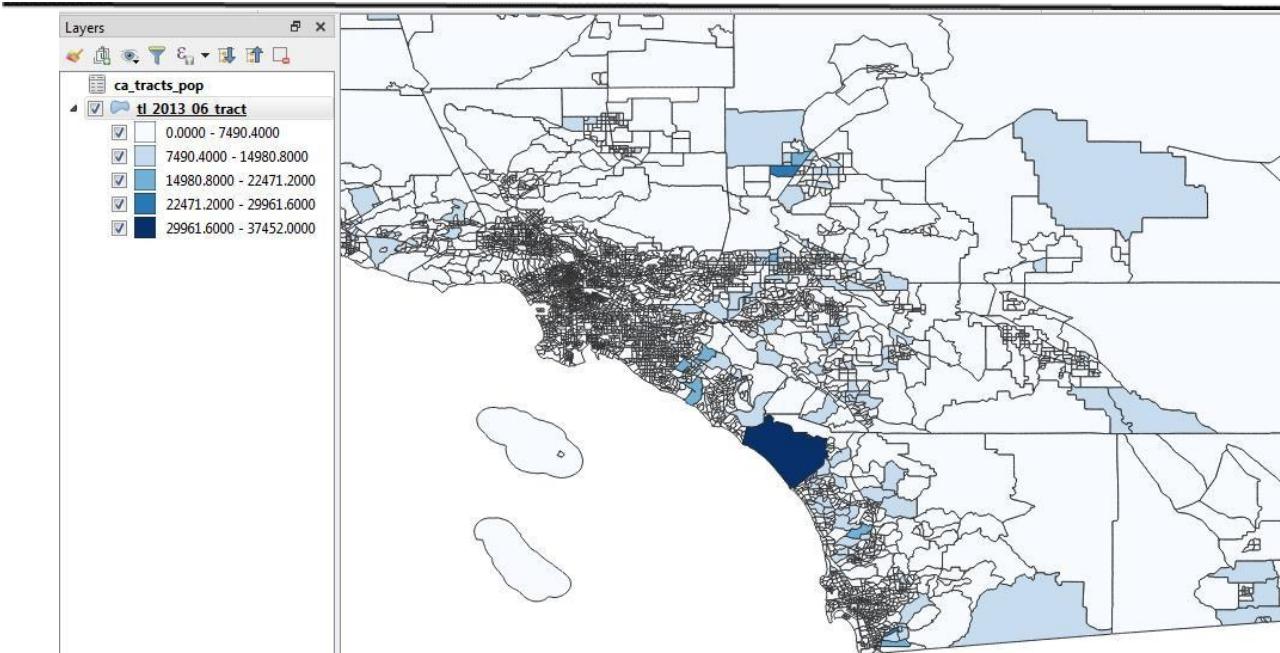


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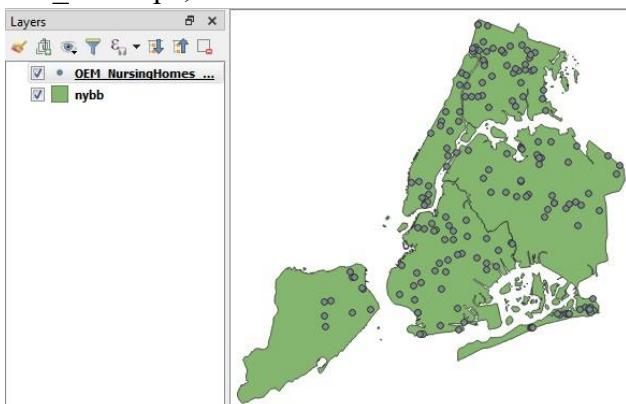
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### b) spatial joins

- 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	1217.000000000000	7000307.000000...	264
2	2505 GRAND AVE	BRONX	10468	1244.000000000000	7000337.000000...	46
3	2401 LACONIA ...	BRONX	10469	1245.000000000000	7000338.000000...	200
4	3200 BAYCHES...	BRONX	10475	1242.000000000000	7000356.000000...	236
5	700 WHITE PLA...	BRONX	10473	856.000000000000	7000361.000000...	240
6	3400 CANNON ...	BRONX	10463	1234.000000000000	7000374.000000...	400
7	612 ALLERTON ...	BRONX	10467	1218.000000000000	7000308.000000...	520
8	666 KAPPOCK S...	BRONX	10463	1233.000000000000	7000385.000000...	200
9	3518 BAINBRID...	BRONX	10467	1227.000000000000	7000319.000000...	200
10	801 CO-OP CIT...	BRONX	10475	1260.000000000000	7000389.000000...	480
11	2266 CROPSEY ...	BROOKLYN	11214	1364.000000000000	7001303.000000...	271
12	2865 BRIGHTO...	BROOKLYN	11235	1399.000000000000	7001342.000000...	320

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

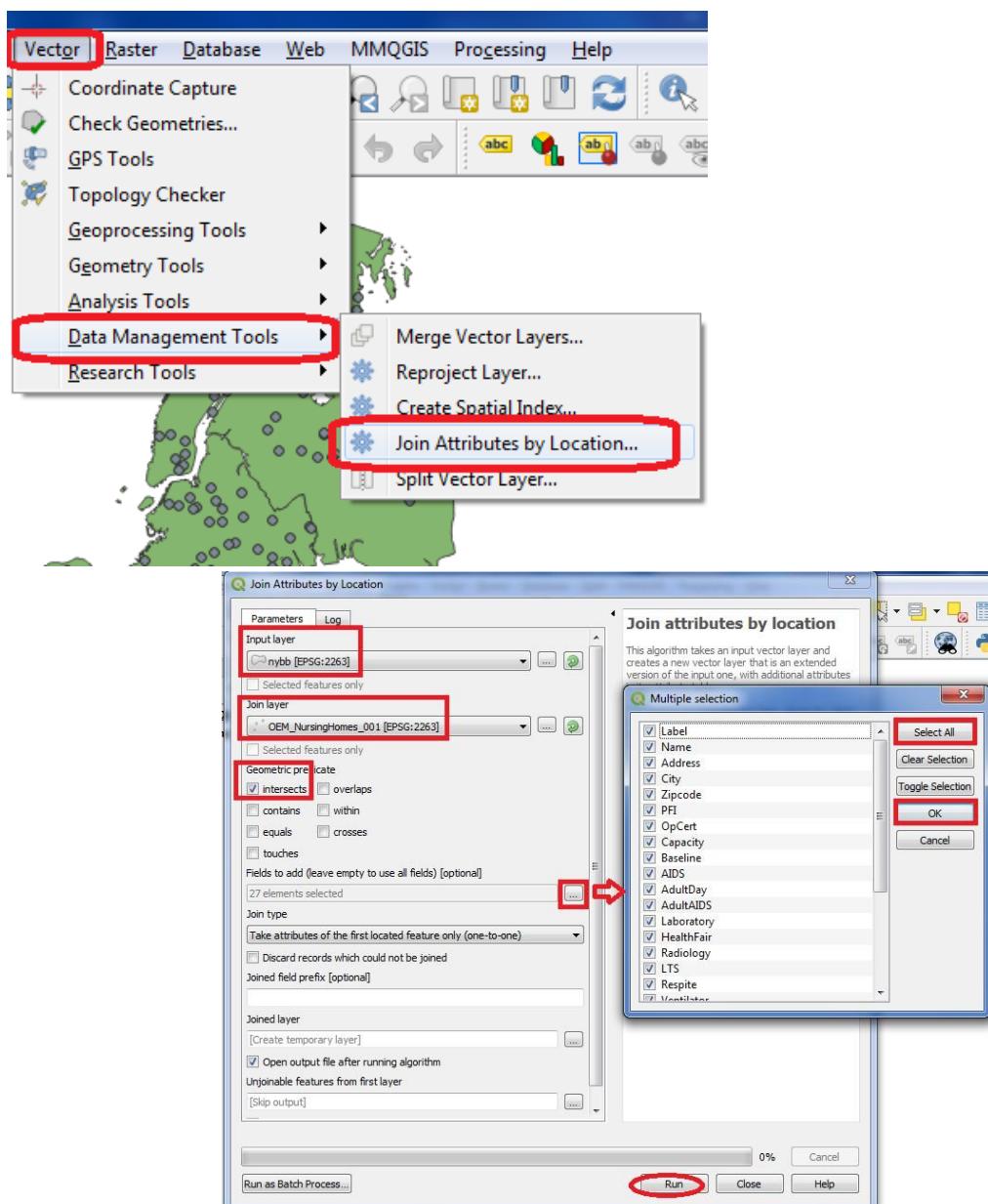


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➤ Attribute table after join

City	Zipcode	PFI	OpCert	Capacity
ASTORIA	11102	6384.000000000000	7003405.000000...	280
BROOKLYN	11217	5546.000000000000	7001377.000000...	288
BRONX	10472	1251.000000000000	7000381.000000...	200
STATEN ISLAND	10304	1755.000000000000	7004310.000000...	300
NEW YORK	10003	4807.000000000000	7002351.000000...	28

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

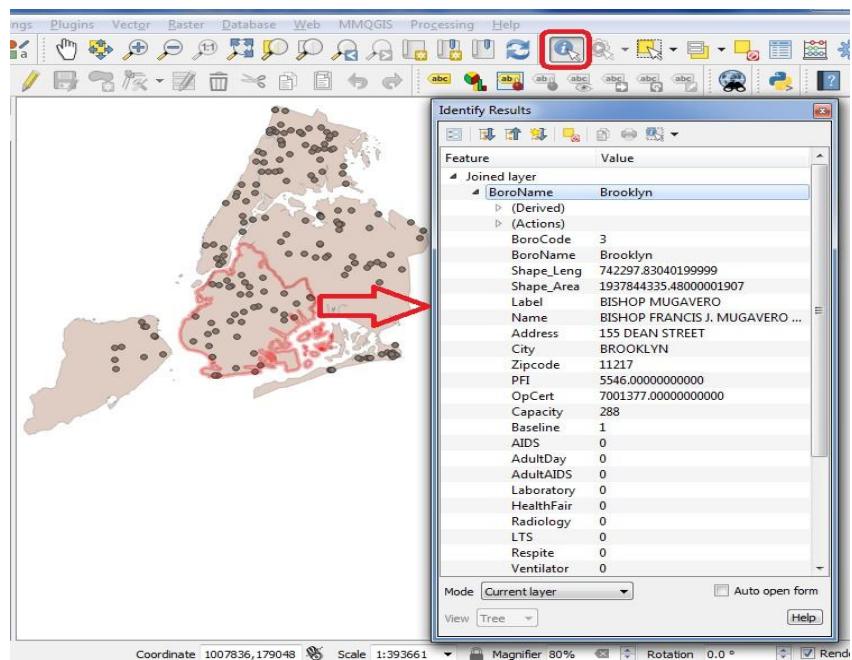


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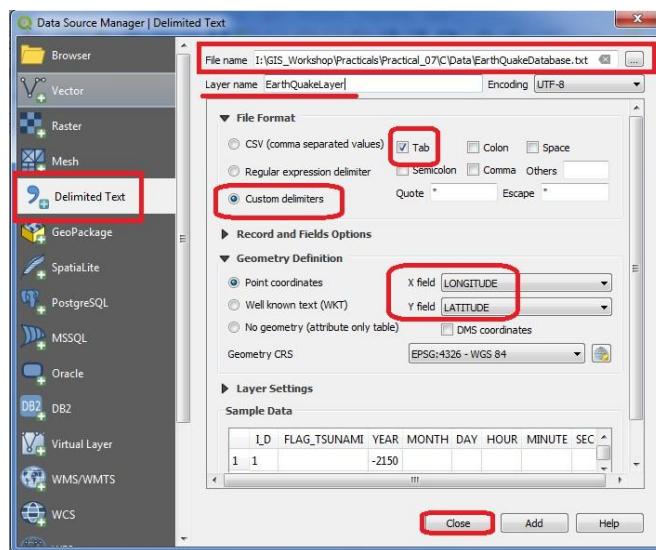
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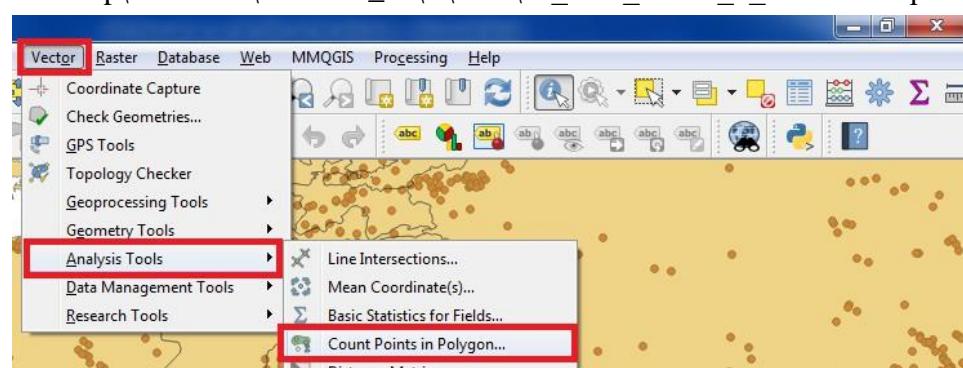
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### c) Points in polygon analysis

- 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”



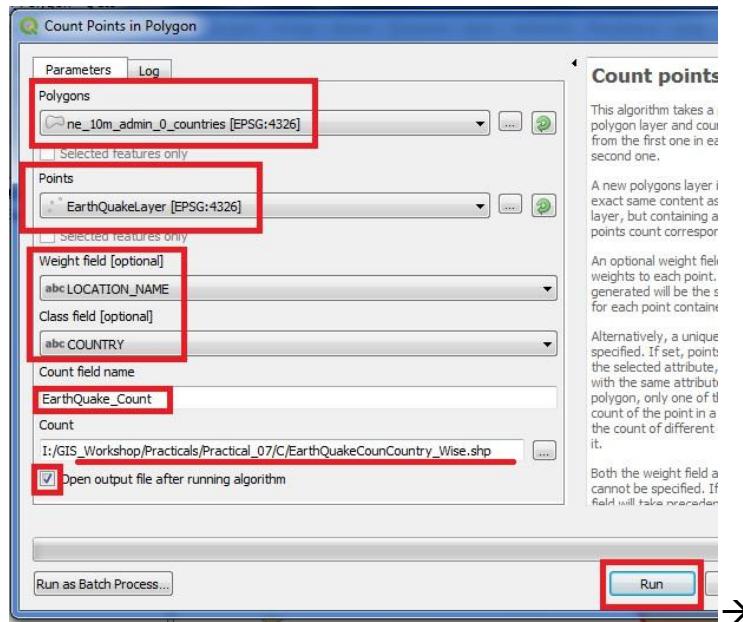


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- Use the select Feature  button to check country wise counting of Earthquakes.

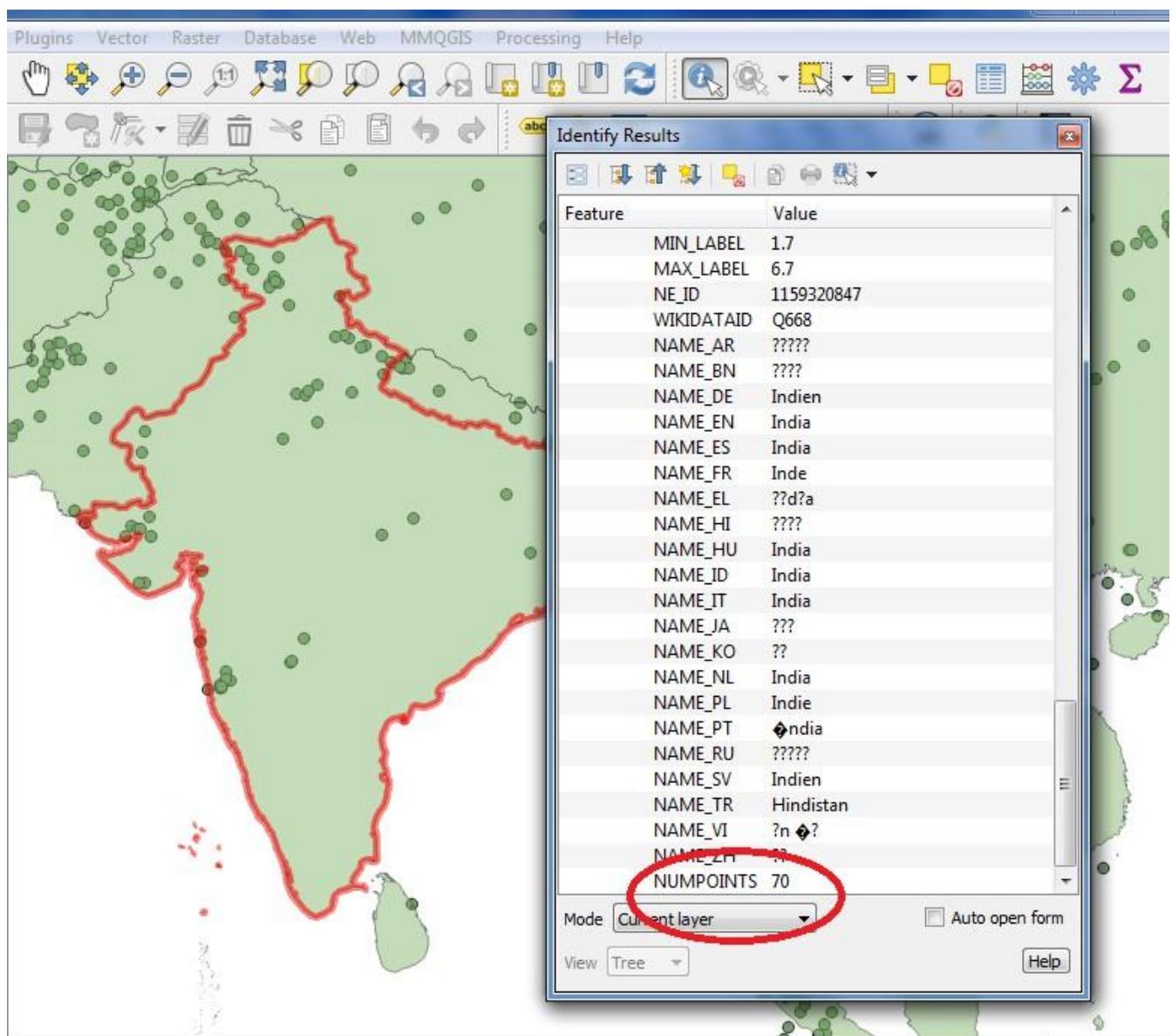


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- Also a new column is added to attribute table “NumPoints” indicating number of earth quake points in each country.

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



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**d) Performing spatial queries**

- Go to Layer → Add Layer → Add Vector Layer and load “\GIS\_Workshop\Practicals\Practical\_07\Datas\ne\_10m\_populated\_places\_simple\ne\_10m\_populated\_places\_simple.shp” and “I:\GIS\_Workshop\Practicals\Practical\_07\Datas\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

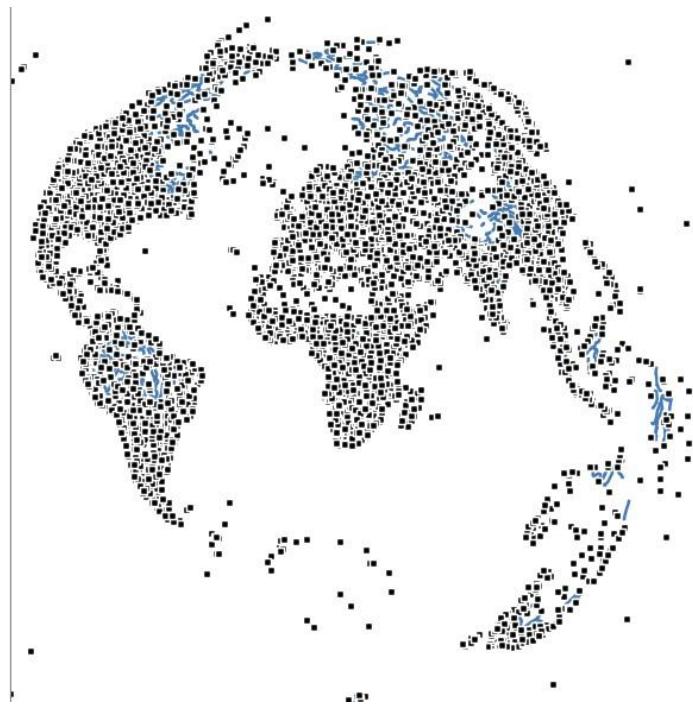


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- Go to Vector → Geoprocessing Tool → Buffer
- 

- Repeat the step to create River Buffer

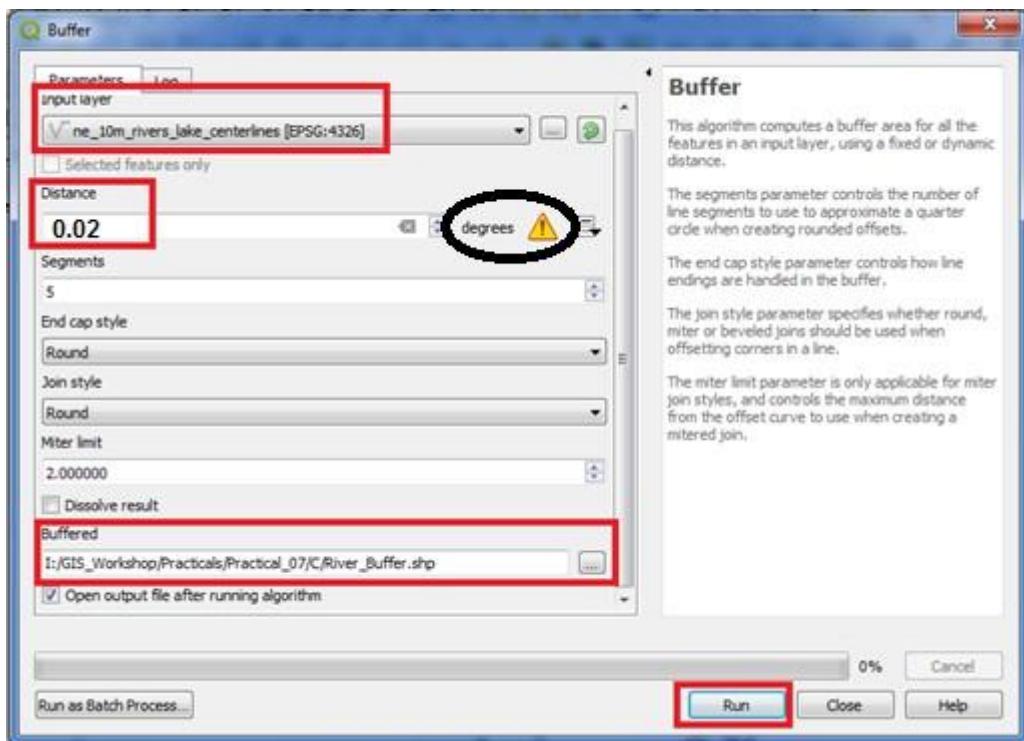


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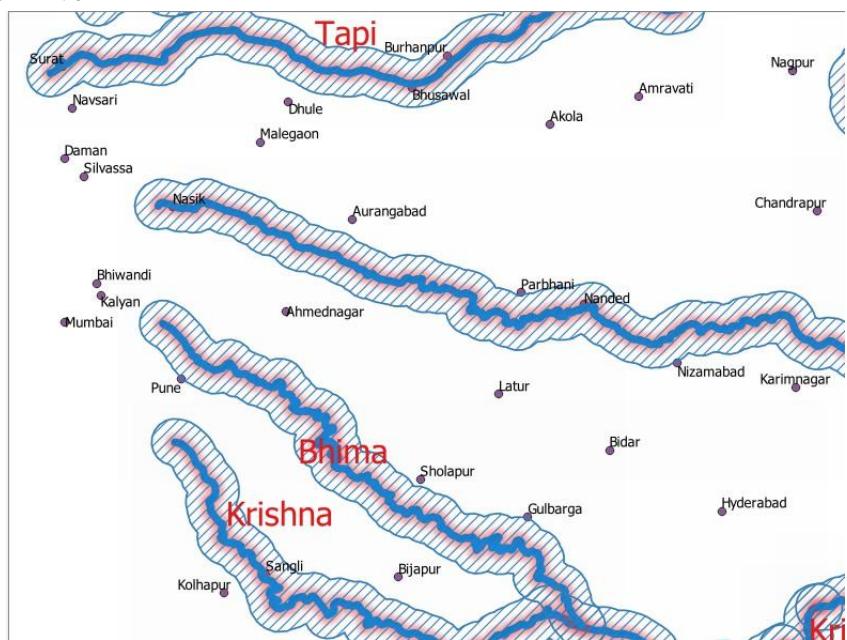
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➤ Create a buffer for River



➤ Go to Vector → Research Tool → Select By Location

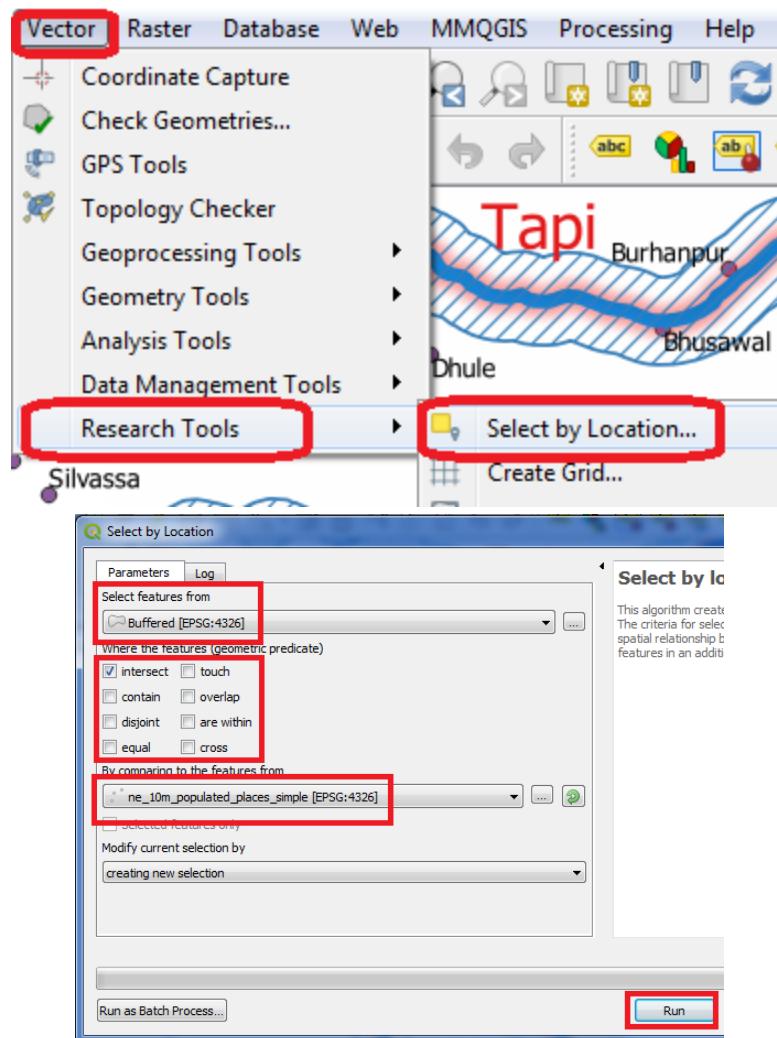


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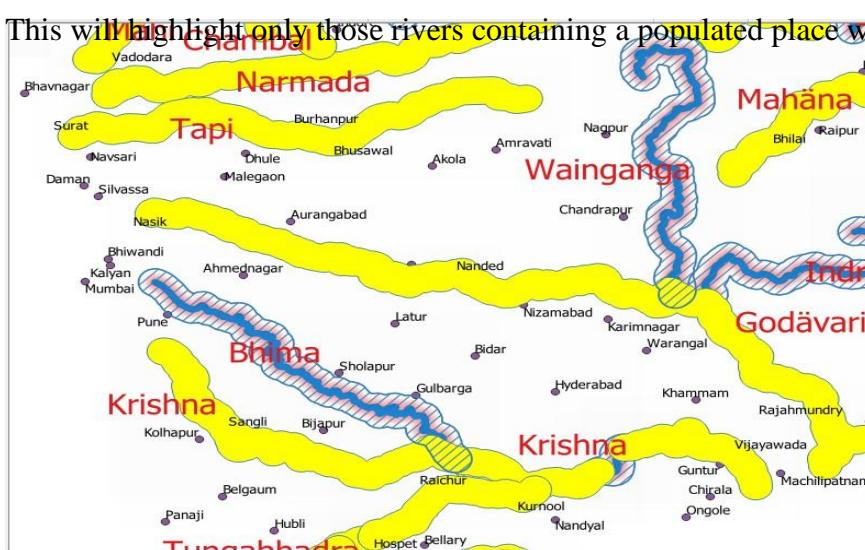
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- This will highlight only those rivers containing a populated place within 2 KM





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**Learning Outcome:**

- 1 Align scanned maps with real-world coordinates
- 2 Convert aerial imagery to digital data

**Course Outcome:**

- 1 Perform georeferencing on various map types
- 2 Digitize and edit spatial data effectively

**Conclusion:**

**Viva Questions:**

- 1 What is georeferencing?
- 2 How to digitize map data?
- 3 What is aerial imagery used for?

Correction Parameter	Formative Assessment [ ]	Timely Completion of practical	Attendance Learning Attendance [ ]



**Experiment No.—8:**

**Aim:** Managing Data Tables and Spatial data Sets: Table joins, spatial joins, points in polygon analysis, performing spatial queries

**Tools & Technologies used:** QGIS

**Learning Objectives:**

1. Perform table and spatial joins
2. Conduct points-in-polygon analysis

**Theory: Introduction to data tables and spatial data sets.**

Spatial data is any type of data that directly or indirectly references a specific geographical area or location. It is most commonly processed and analyzed by geographical information systems (GISes) to enable users in a wide range of industries to understand geographic context, patterns and relationships for further analysis, communications and decision-making. Sometimes called *geospatial data* or *geographic information*, spatial data most often numerically represents a physical object (natural or manmade) in a geographic coordinate system. The system uses two-dimensional (2D) geographic coordinates known as Cartesian or x and y coordinates. However, spatial data is much more than geographic coordinates represented on a 2D map. Spatial information can also include geometric shapes like lines or polygons, descriptions of a particular geographic feature, as well as images presented in the form of rasters (a grid of pixels). Since spatial data contains more than location-specific data, different types of data can be saved in different formats. Capturing and analyzing spatial data provides a better understanding of how each variable in a geographic space impacts individuals, communities, populations, etc.

Spatial data might be collected by ground surveys or census studies, from land records and via satellite images, aerial photographs or Global Positioning System (GPS) receivers. Increasingly, drones and wireless sensors are also used to capture spatial data. A data table, also known as a database table or simply a table, is a structured collection of related data organized in rows and columns. Each row in a data table represents a unique record, while each column represents a specific attribute or characteristic of that record. Data tables are commonly used in databases to store large amounts of structured data. They allow for easy access, searching, and sorting of data, depending on the requirements of the application or process using them. Data tables can also be linked or joined with other tables in a database using database relations, enabling complex queries and data analysis. Overall, data tables provide a flexible and efficient way to store and manage large amounts of information in a structured and organized manner.

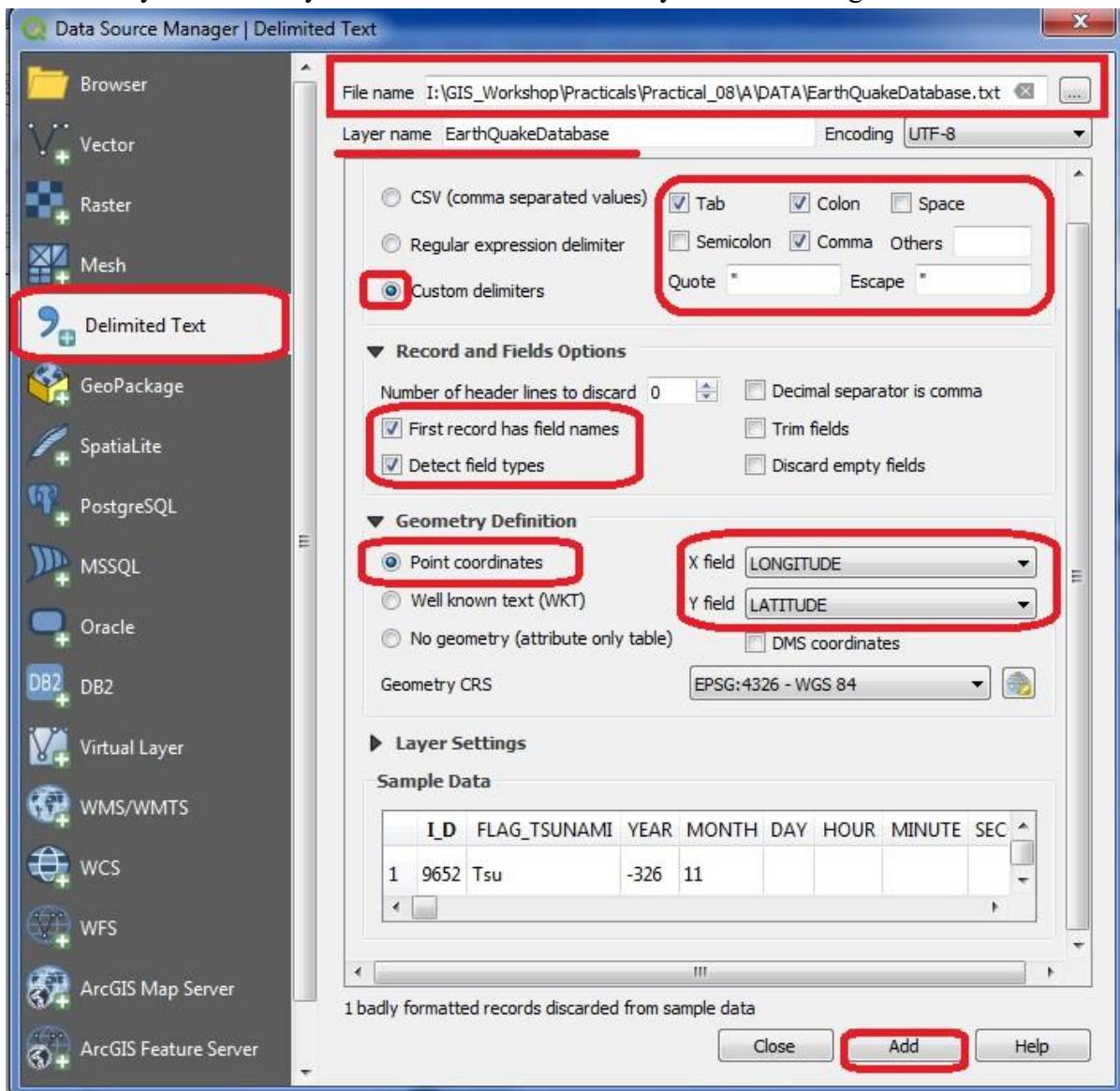


## Step:-

### 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.

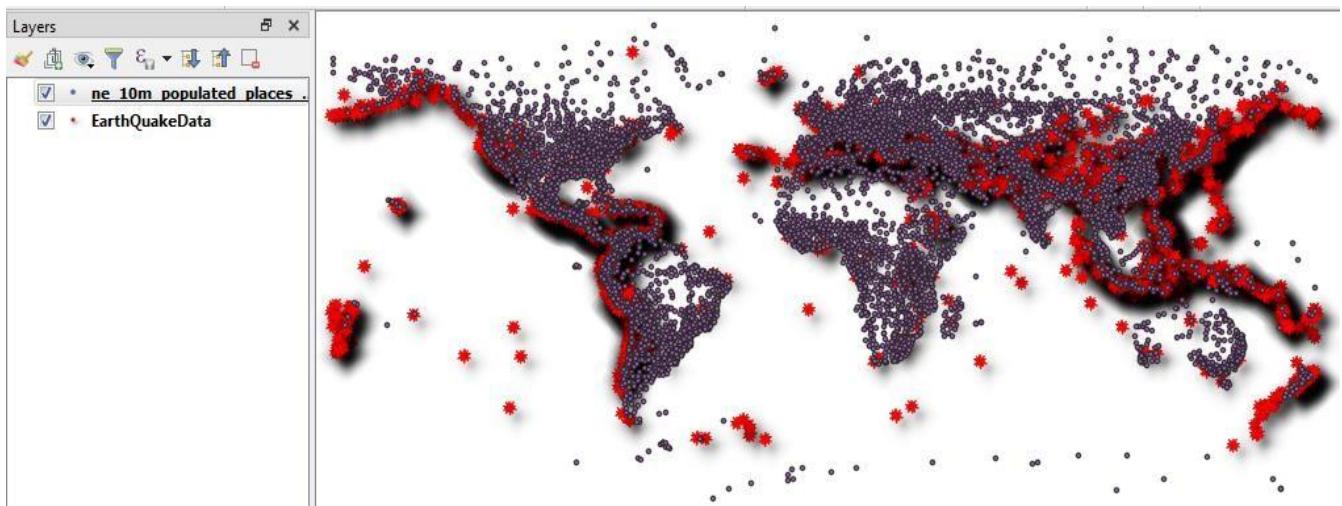


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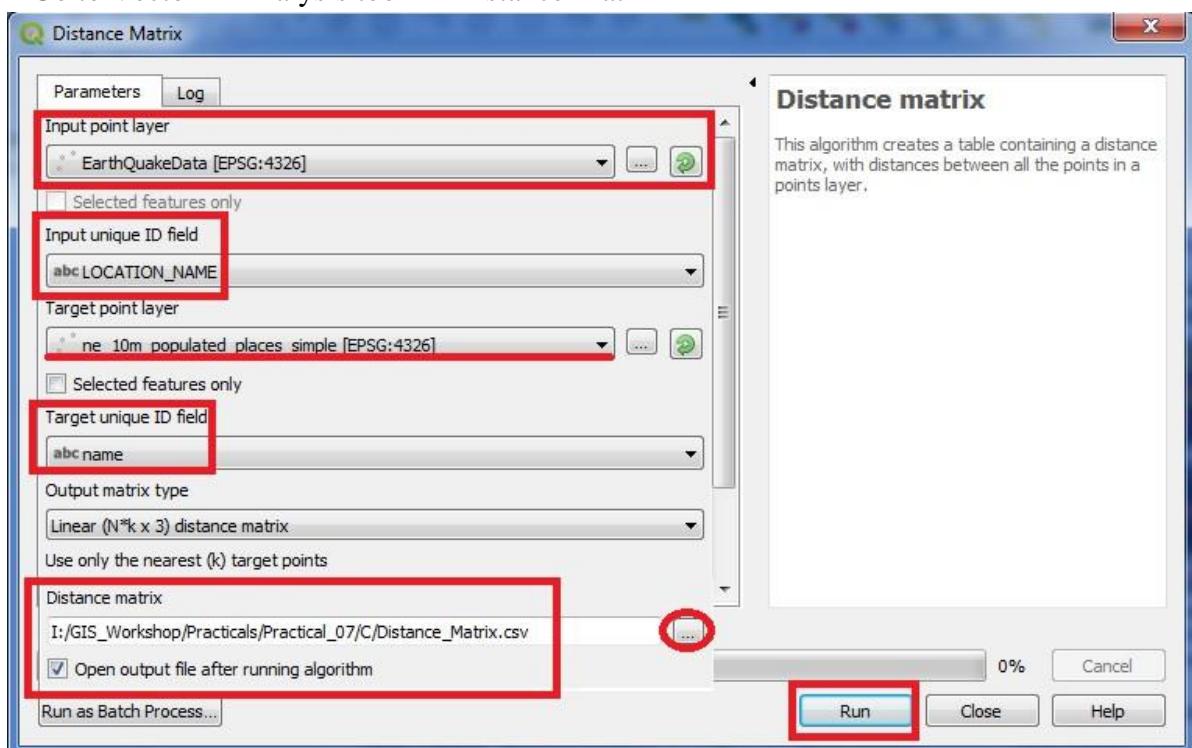
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- Go to Vector → Analysis tool → Distance Matrix



- 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.

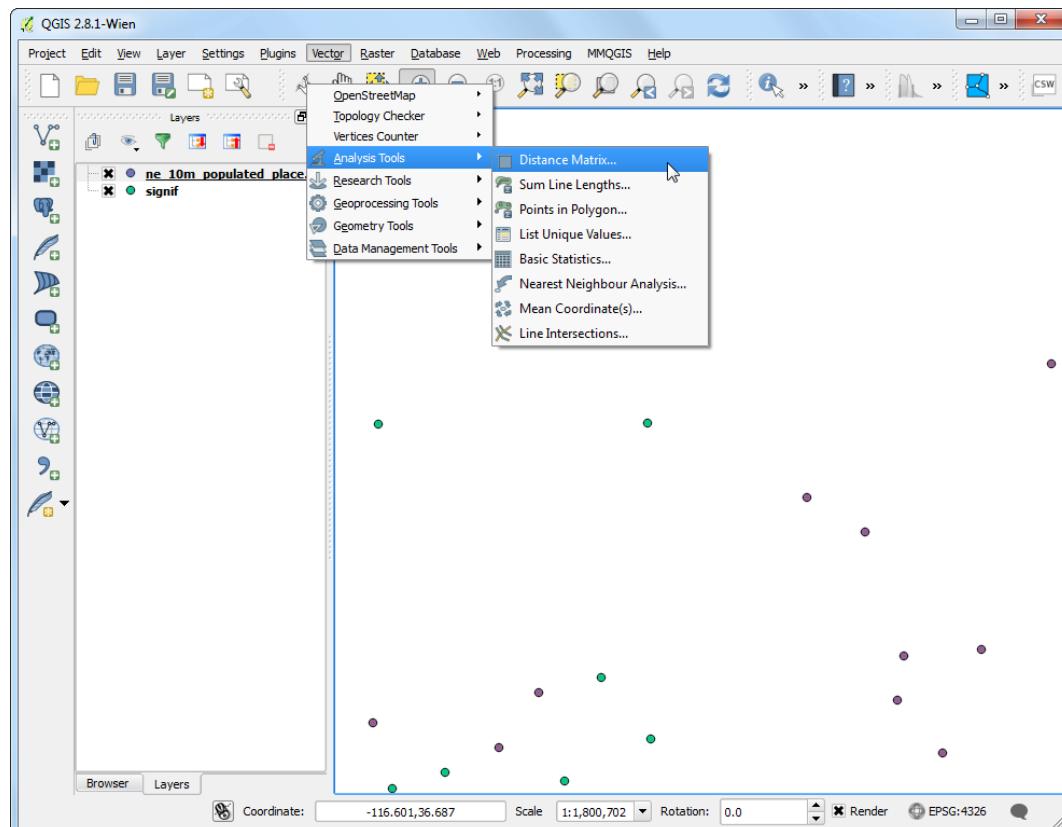


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7. Here select the earthquake layer signif as the Input point layer and the populated places ne\_10m\_populated\_places\_simpleas the target layer. You also need to select a unique field from each of these layers which is how your results will be displayed. 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.

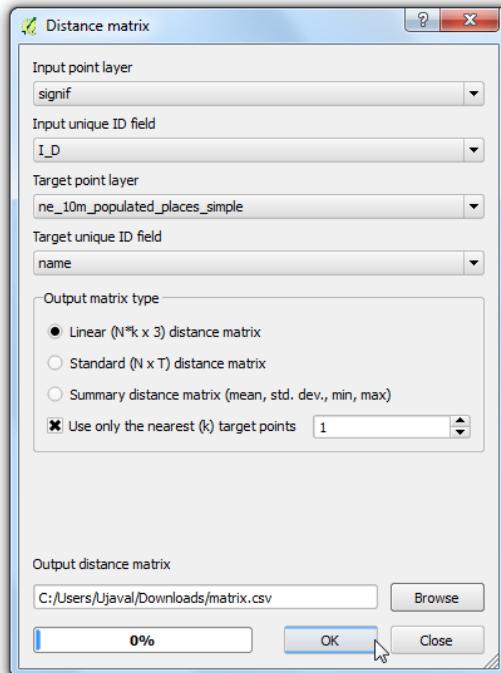


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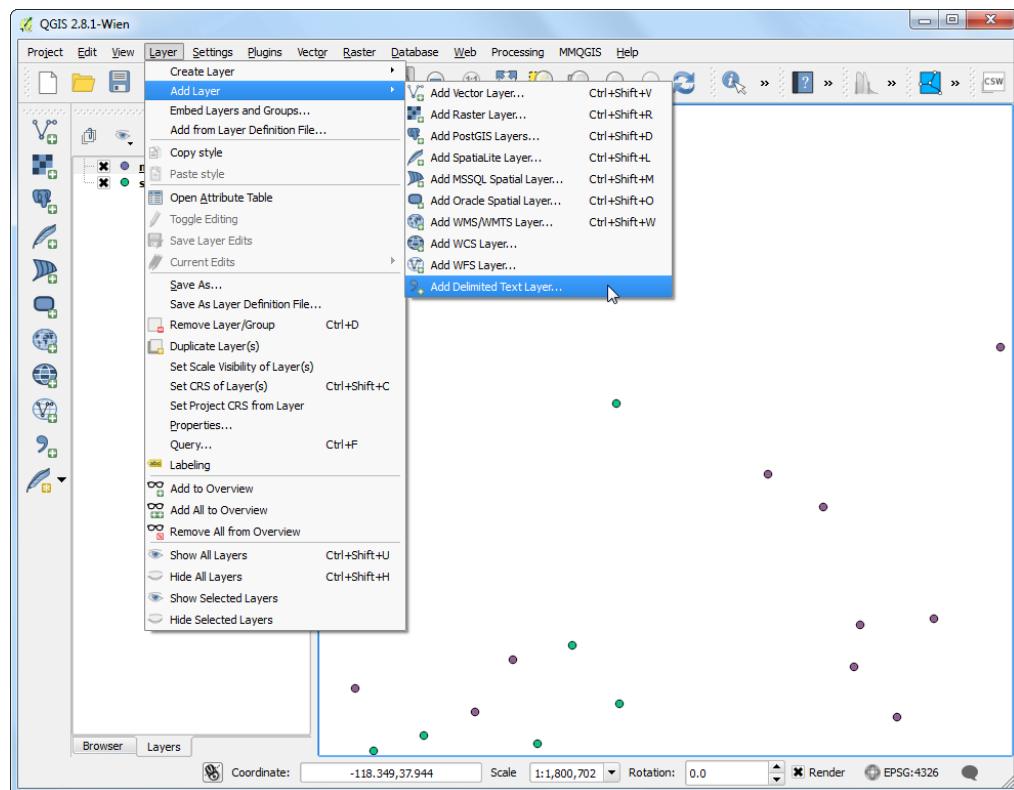
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- Once the processing finishes, click the Close button in the Distance Matrix dialog. You can now view the matrix.csv file in Notepad or any text editor. QGIS can import CSV files as well, so we will add it to QGIS and view it there. Go to Layer >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





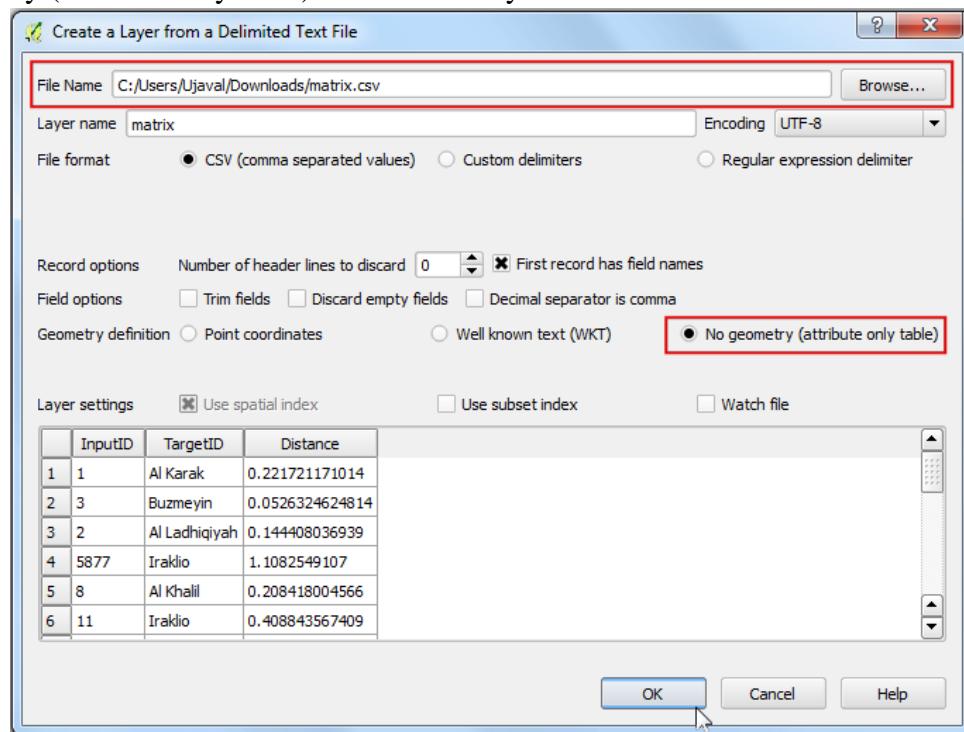
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9. Browse to the newly created matrix.csv file. Since this file is just text columns, select No geometry (attribute only table) as theGeometry definition. Click OK.



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

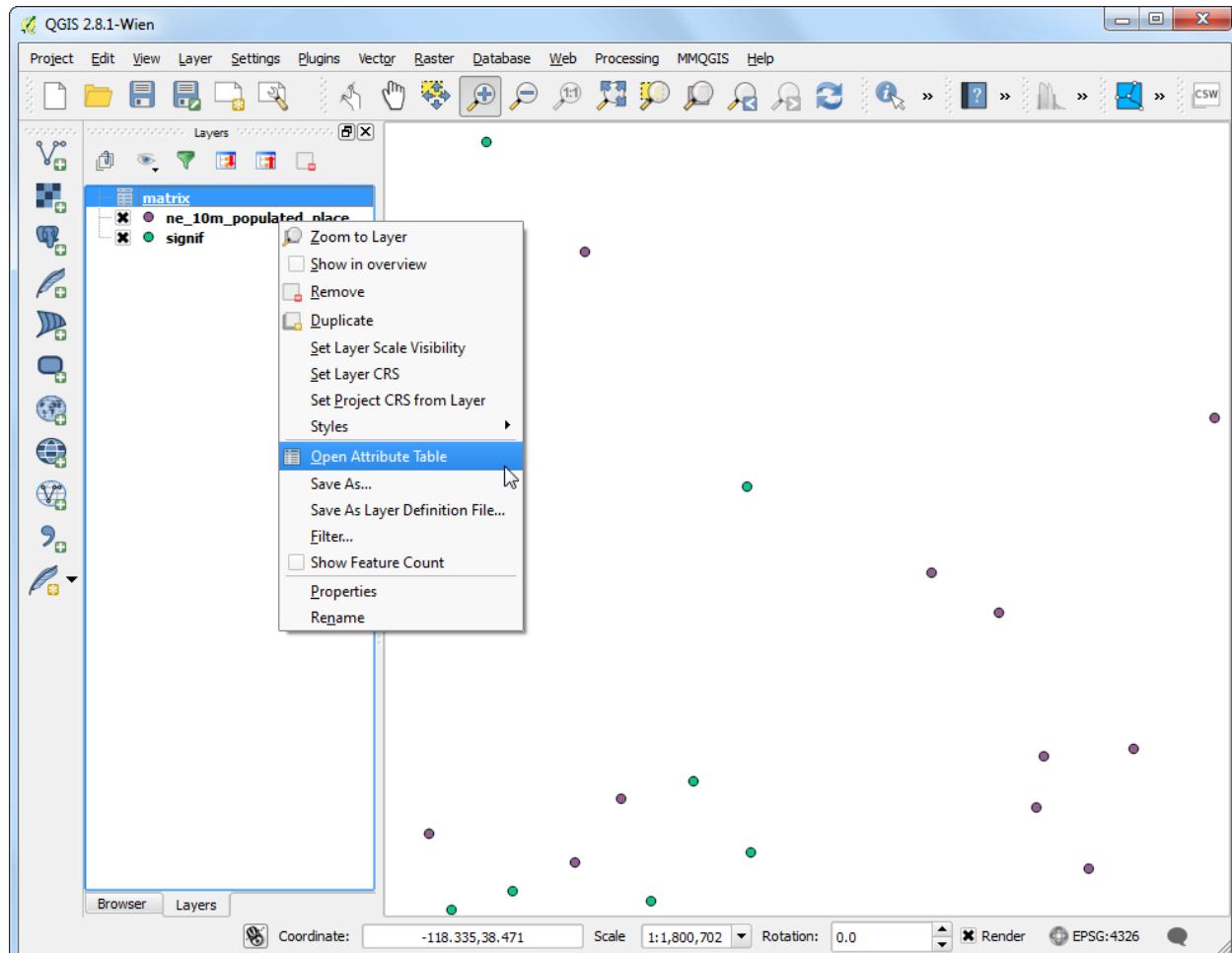


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11. Now you will be able to see the content of our results. The InputID field contains the field name from the Earthquake layer. The TargetID field contains the name of the feature from the Populated Places layer that was the closest to the earthquake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



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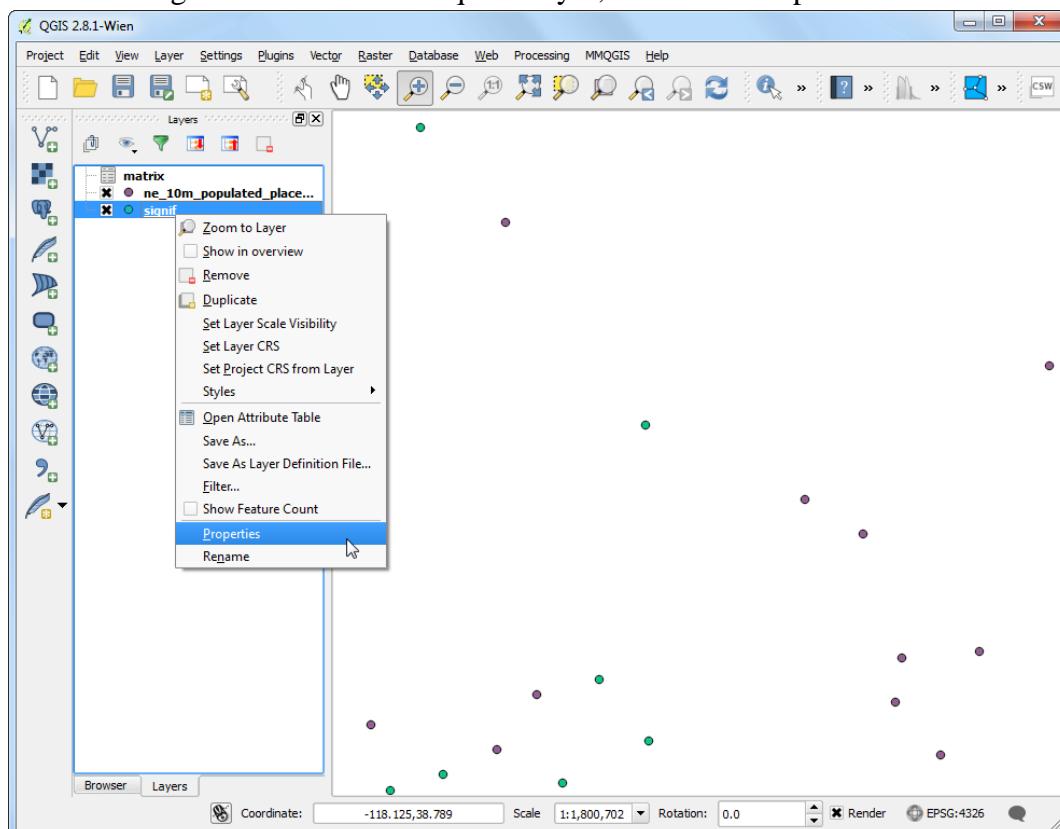
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	InputID	TargetID	Distance
0		1 Al Karak	0.221721171014
1		3 Buzmeyin	0.0526324624814
2		2 Al Ladhiqiyah	0.144408036939
3	5877	Iraklio	1.1082549107
4		8 Al Khalil	0.208418004566
5		11 Iraklio	0.408843567409
6	9712	Al Ladhiqiyah	0.144408036939
7		12 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	Piraliévs	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
19	71	Trakia	0.360772618378

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.

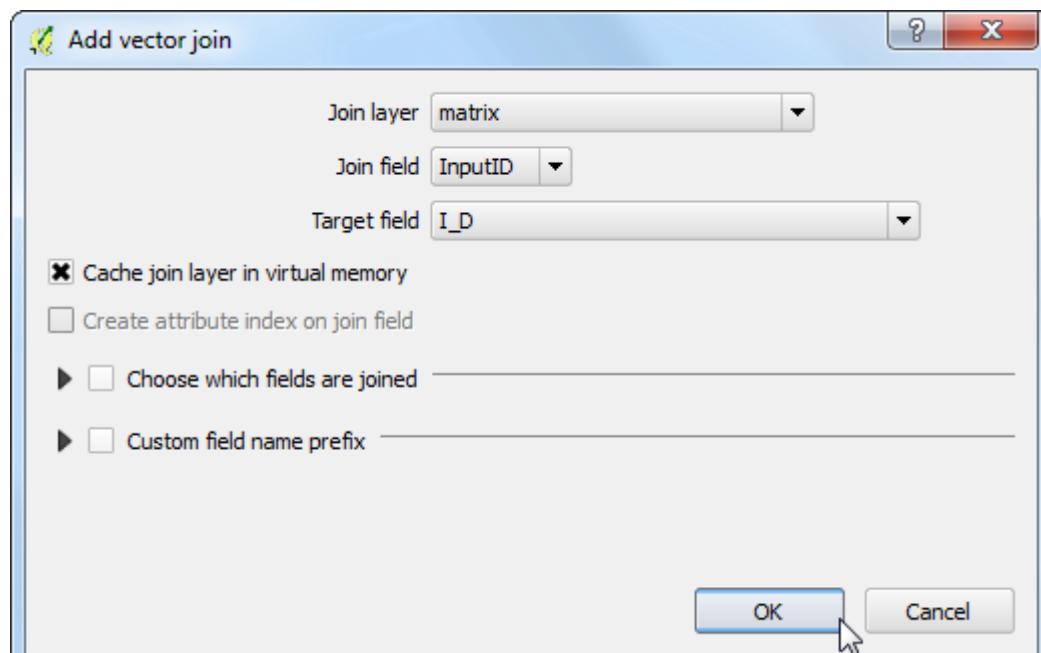


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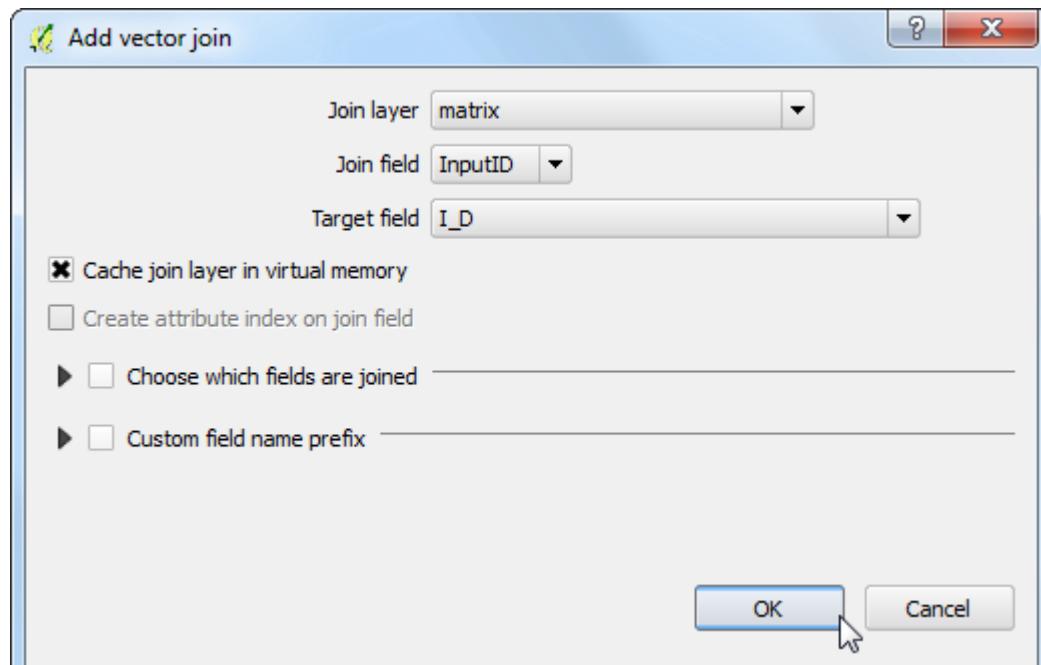
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14. We want to join the data from our analysis result to this layer. We need to select a field from each of the layers that has the same values. Select matrix as the Join layer` and InputID as the Join field. The Target field would be I\_D. Leave other options to their default values and click OK.



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

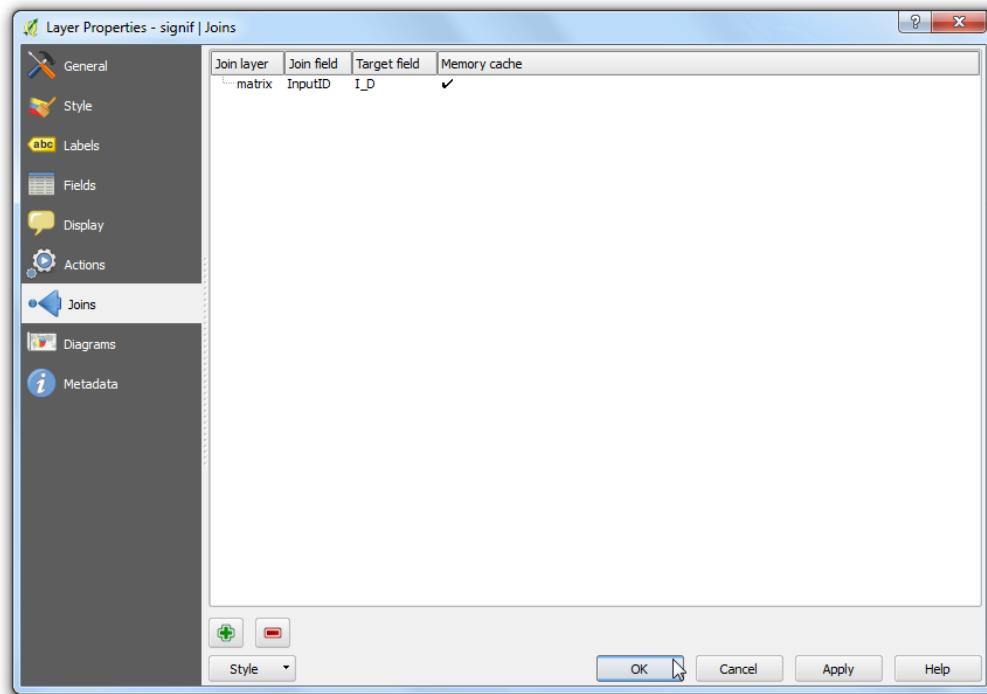


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16. Now open the attribute table of the signif layer by right-clicking and selecting Open Attribute Table.

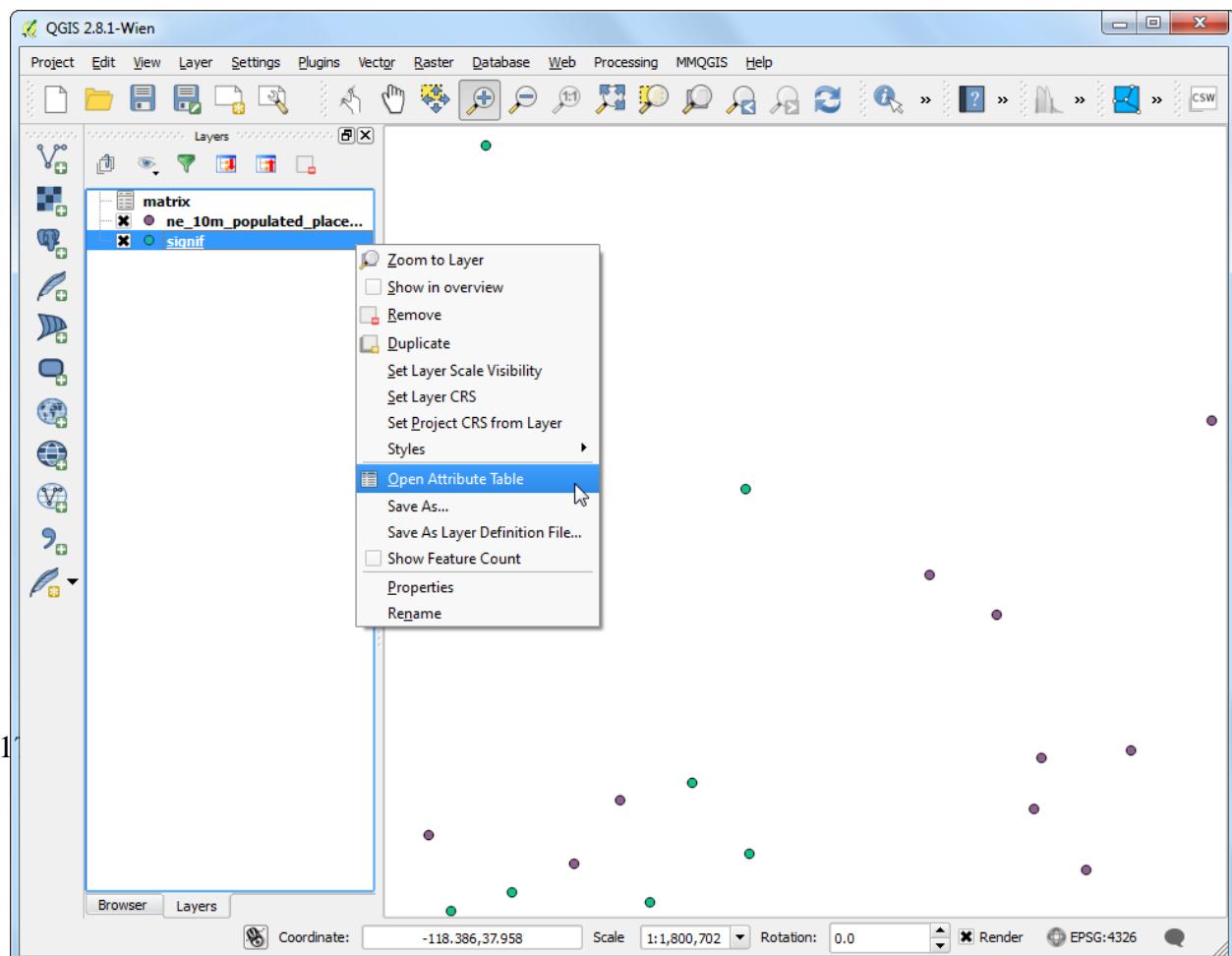


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Attribute table - signif :: Features total: 5789, filtered: 5789, selected: 0

	_HOUSES_DESTROYED	ES_DESTROYED_D	AL_HOUSES_DAMAGE	ES_DAMAGE_I	matrix_TargetID	matrix_Distance
5139	NULL	NULL	3100		4	Dulan
3345	NULL	NULL	2800		4	Yogyakarta
5721	600	3	55000		4	Lijiang
5464	331	3	5613		4	Aksu
3225	326	3	2200		4	Yogyakarta
5668	NULL	NULL	30000		4	Shihezi
3924	500	3	1951		4	Hios
5590	127511	4	273796		4	Sendai
4877	3600	4	18771		4	Shache
3897	2000	4	5000		4	Jember
4647	NULL	3	2000		4	Feyzabad
4841	100	2	5000		4	Birjand
5575	NULL	3	1800		4	Bam
1798	20000	4	15000		4	Tokushima
4919	NULL	NULL	2800		4	Serang
5042	650	3	1350		4	Bandar-e Bushehr
3369	29205	4	46950		4	Tsu
5454	30	1	5400		4	Nantu
5455	30	1	5400		4	Nantu

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....

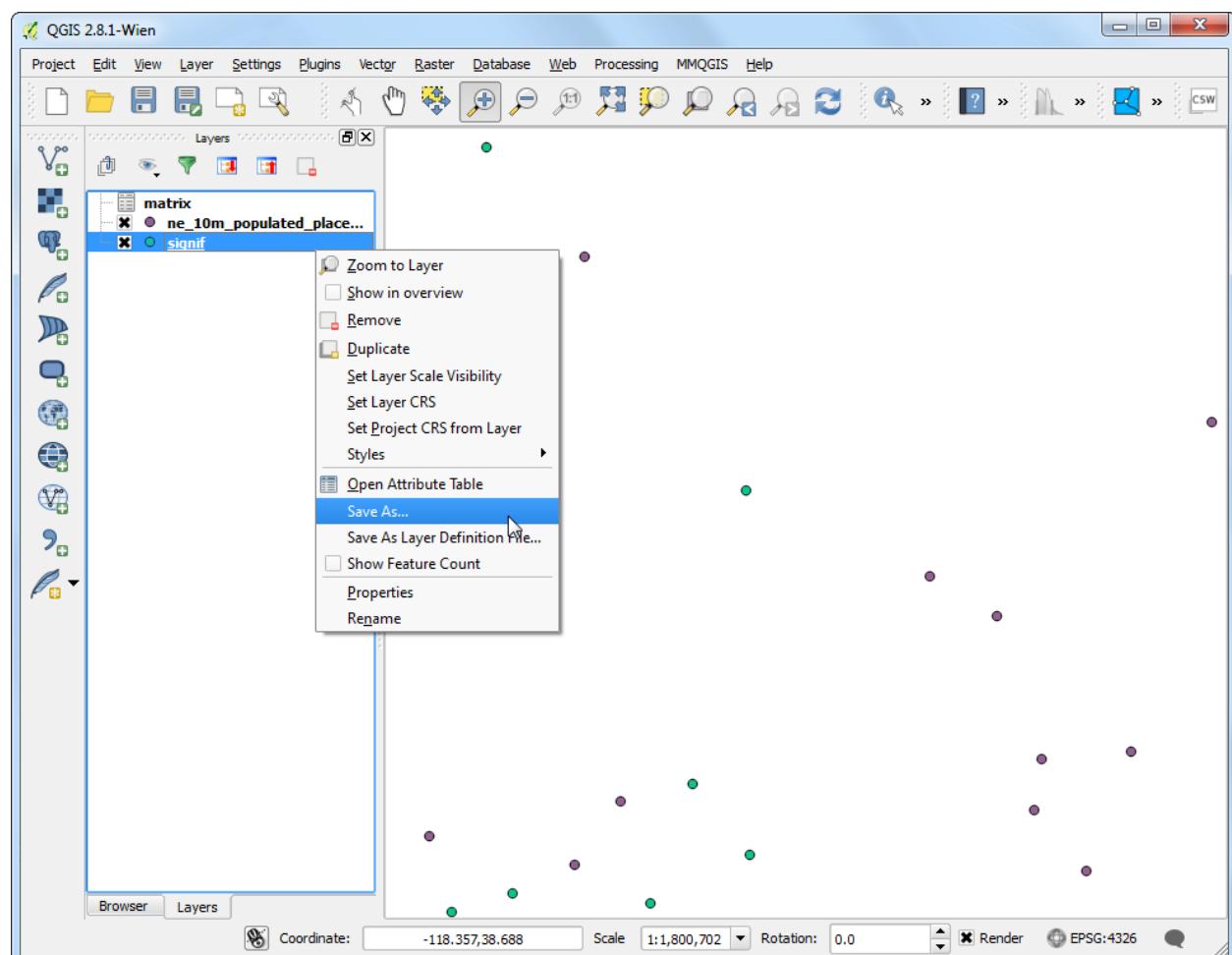


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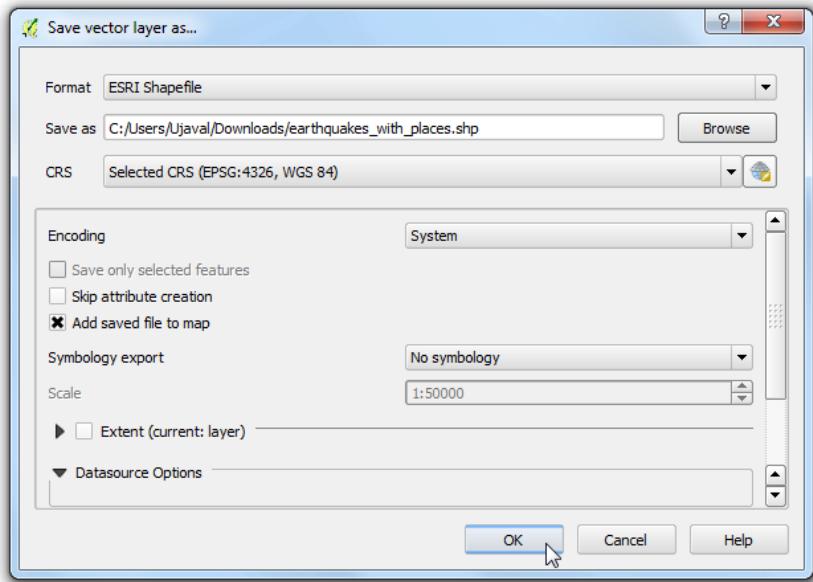


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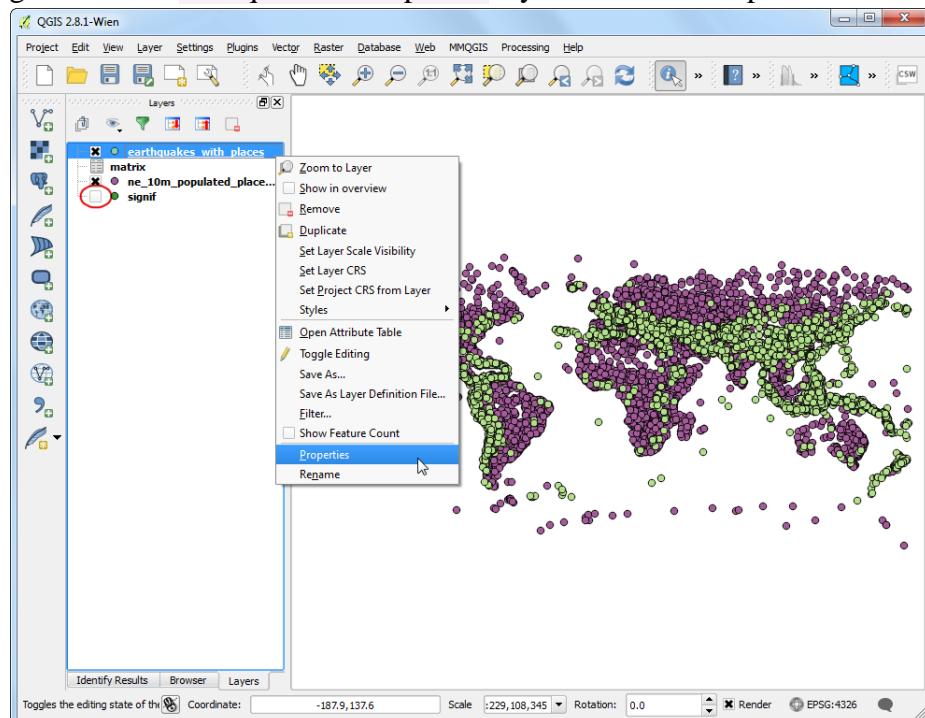
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20. Once the new layer is loaded, you can turn off the visibility of the signif layer. As our dataset is quite large, we can run our visualization analysis on a subset of the data. QGIS has a neat feature where you can load a subset of features from 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.

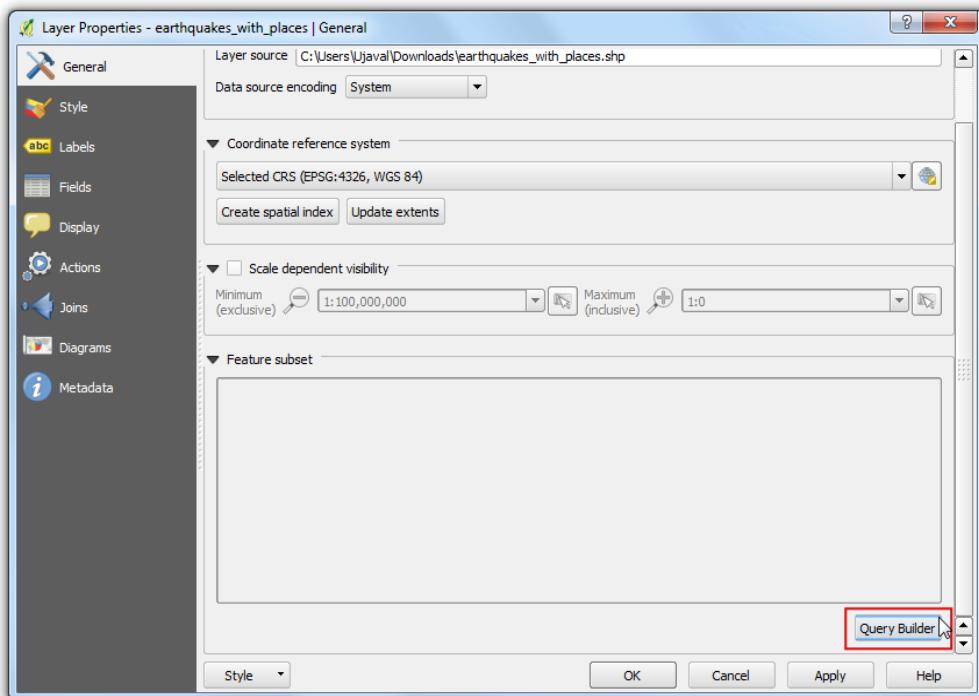


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22. For this tutorial, we will visualize the earthquakes and their nearest populated places for Mexico. Enter the following expression in the Query Builder dialog.

"COUNTRY" = 'MEXICO'

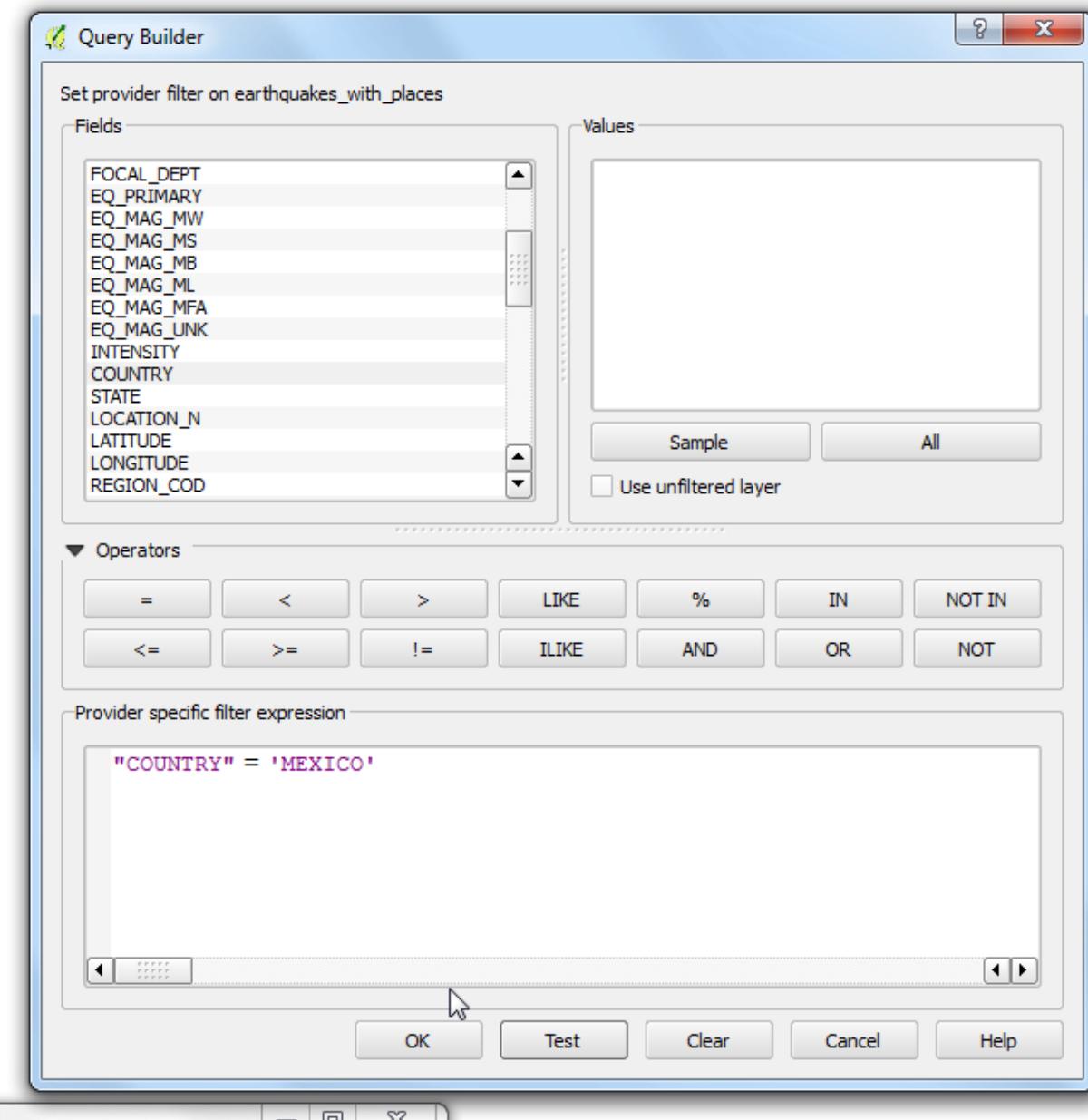


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23. You will see that only the points falling within Mexico will be visible in the canvas. Let's do the same for the populated places layer. Right-click on the ne\_10m\_populated\_places\_simple layer and select Properties.

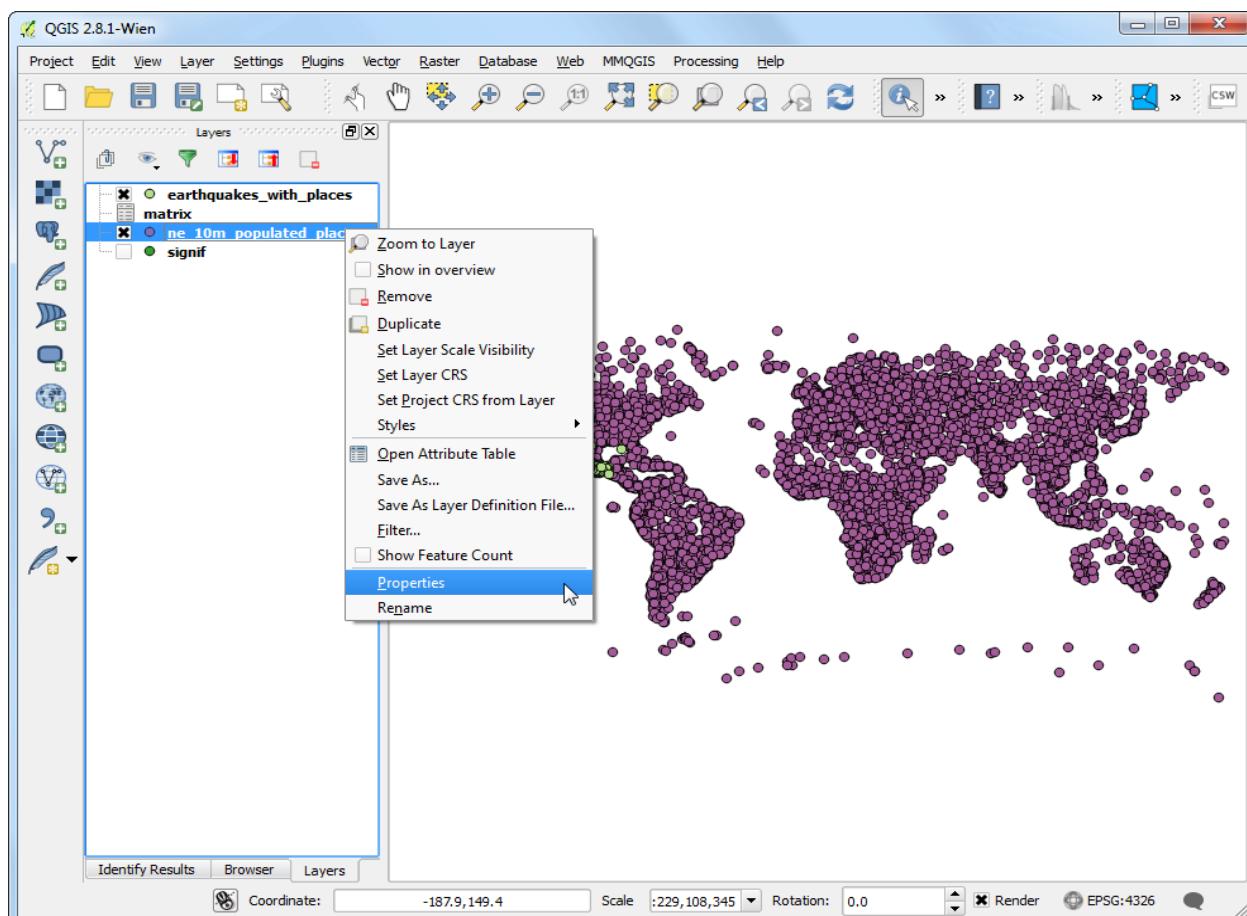


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24. Open the Query Builder dialog from the General tab. Enter the following expression.

"adm0name" = 'Mexico'

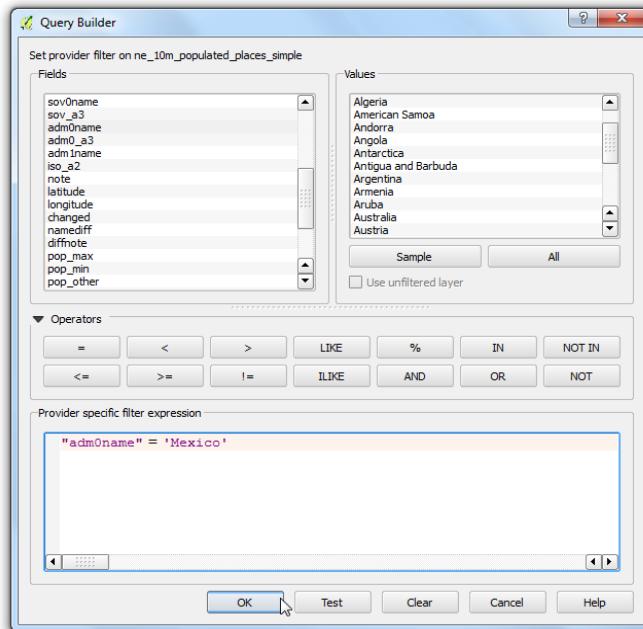


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25. Now we are ready to create our visualization. We will use a plugin named MMQGIS. Find and install the plugin. See Using Plugins for more details on how to work with plugins. Once you have the plugin installed, go to MMQGIS ▶ Create ▶ Hub Lines.

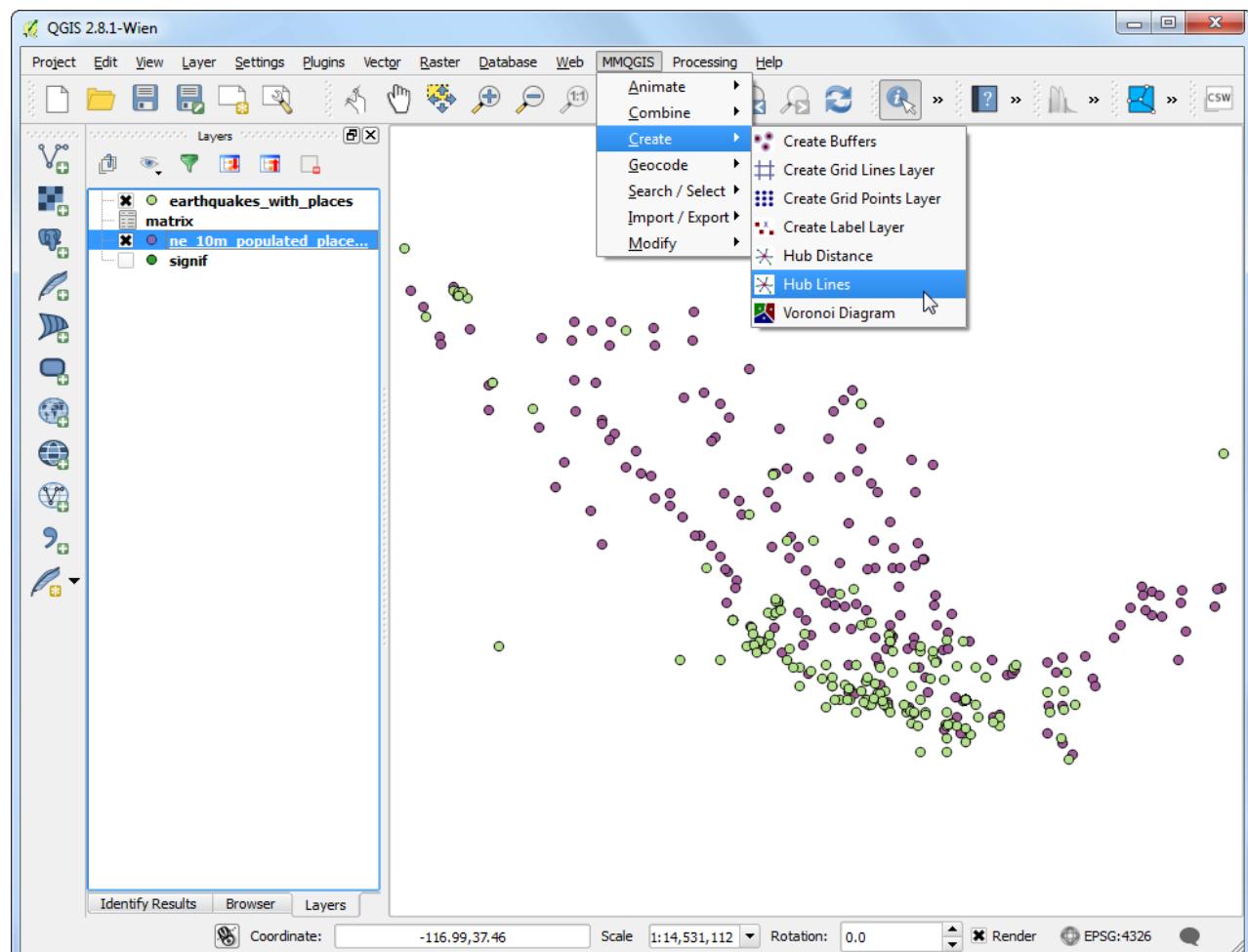


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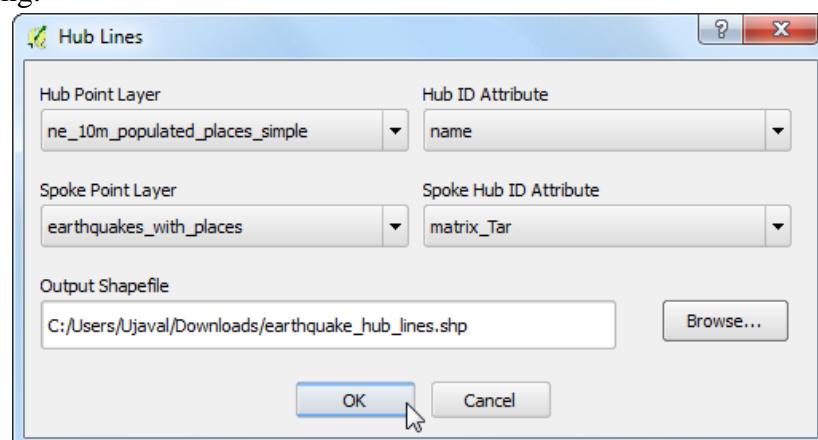
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26. Select ne\_10m\_populated\_places\_simple as the Hub Point Layer and name as the Hub ID Attribute. Similarly, select earthquake\_with\_places as the Spoke Point Layer and matrix\_Tar as the Spoke Hub ID Attribute. The hub lines algorithm will go 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.





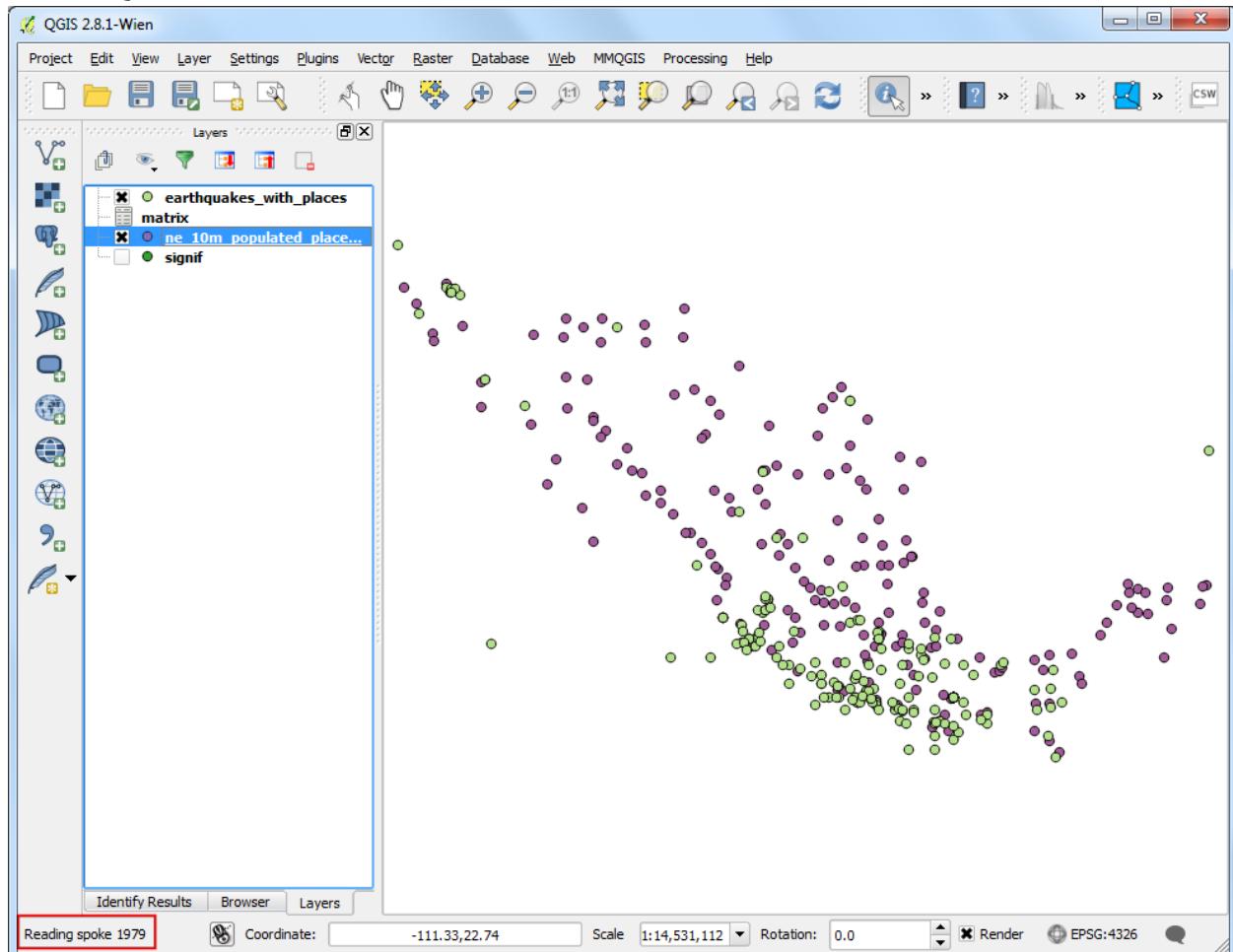
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27. The processing may take a few minutes. You can see the progress on the bottom-left corner of the QGIS window.



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.

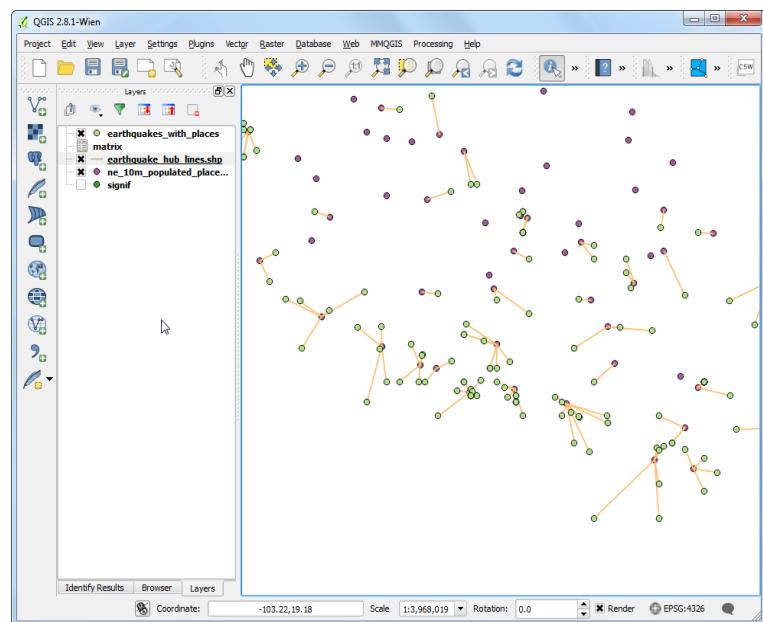


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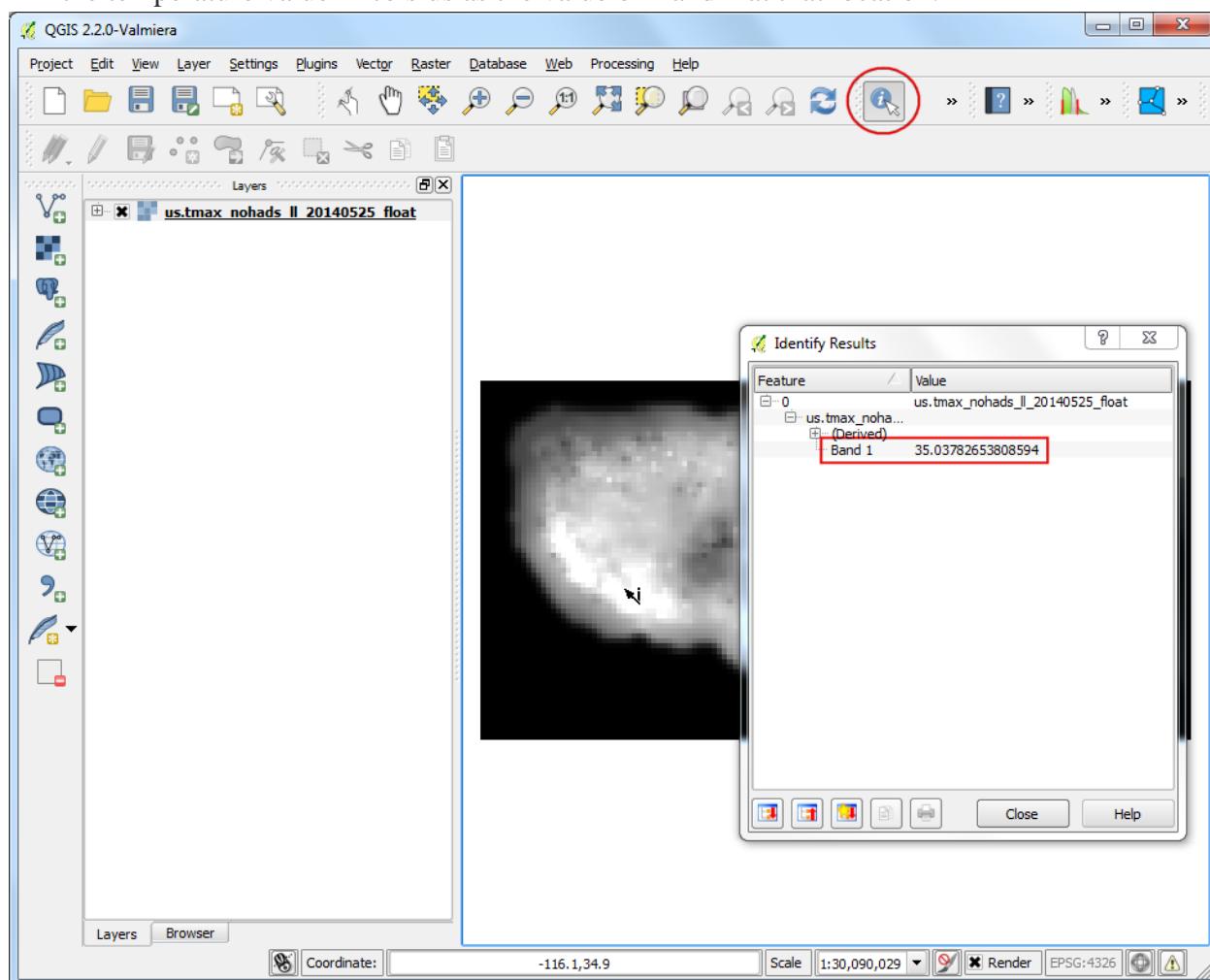


## B) Sampling Raster Data using Points or Polygons

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\_noahds\_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 of Band 1 at that location.





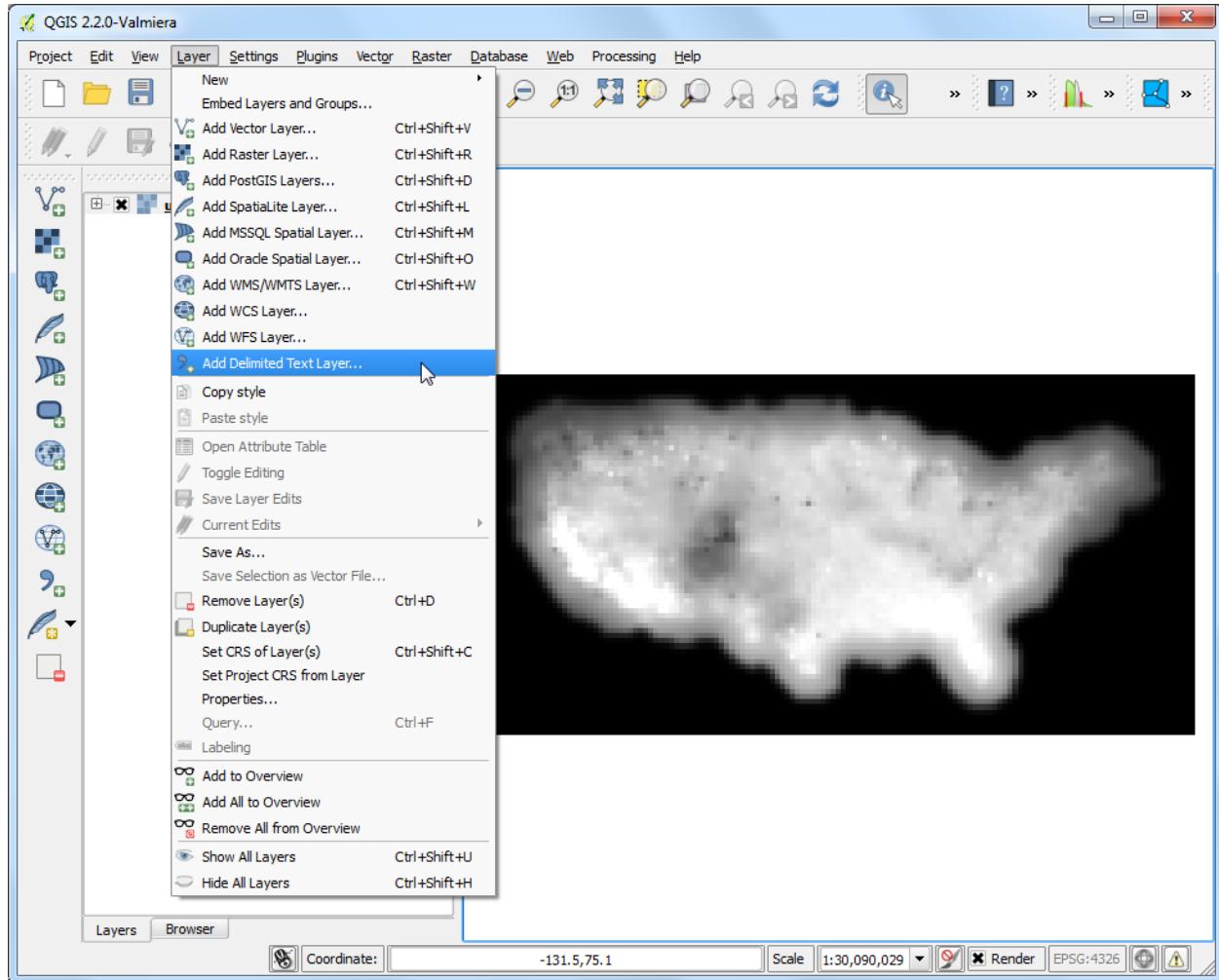
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3. Now unzip the downloaded [2013\\_Gaz\\_ua\\_national.zip](#) file and extract the [2013\\_Gaz\\_ua\\_national.txt](#) file on your disk. Go to Layer ▶ Add Delimited Text Layer.



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.

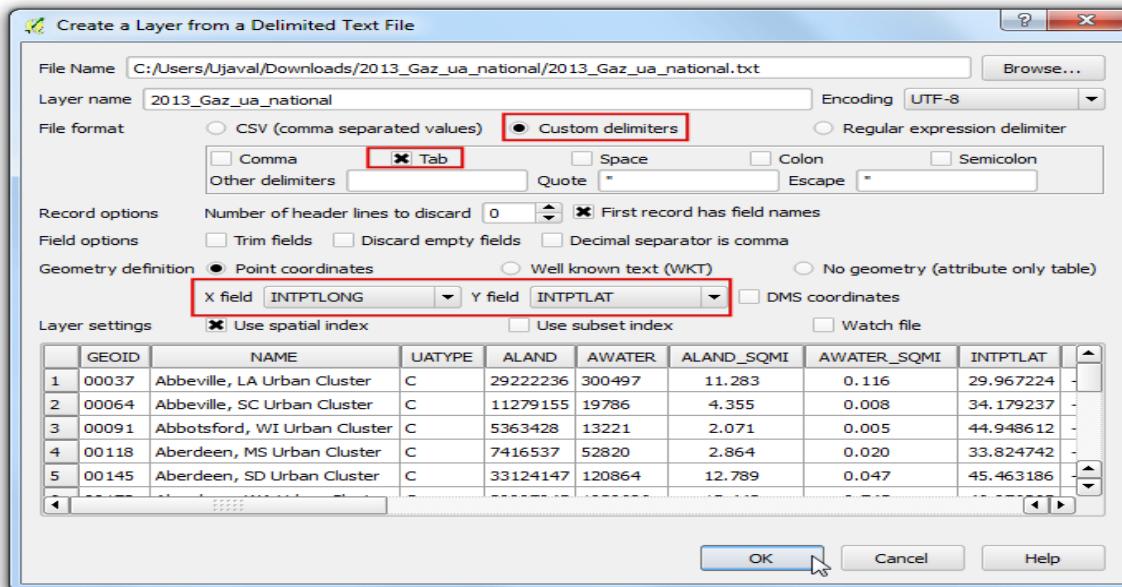


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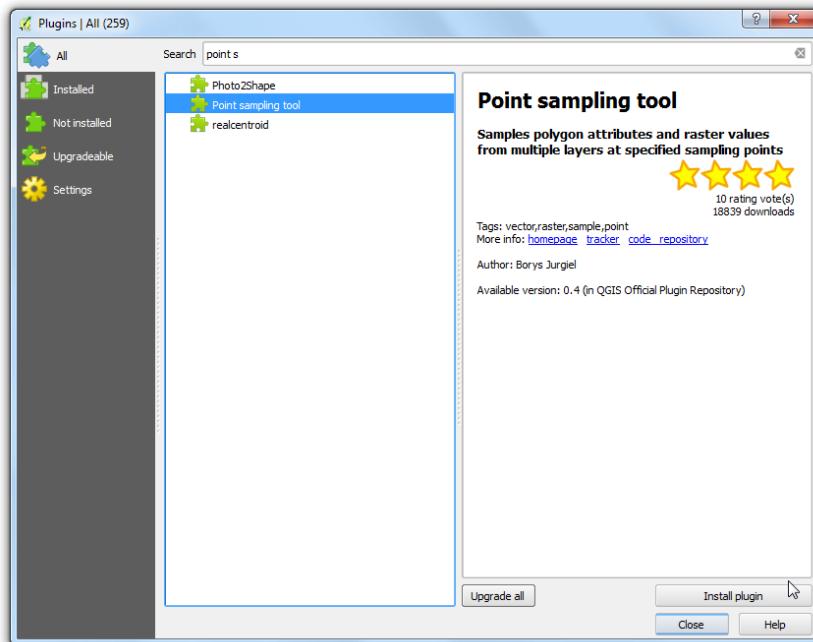
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- Now we are ready to extract the temperature values from the raster layer. Install the **Point Sampling Tool** plugin. See *Using Plugins* for details on how to install plugins.



- Open the plugin dialog from Plugins ▶ Analyses ▶ Point sampling tool.

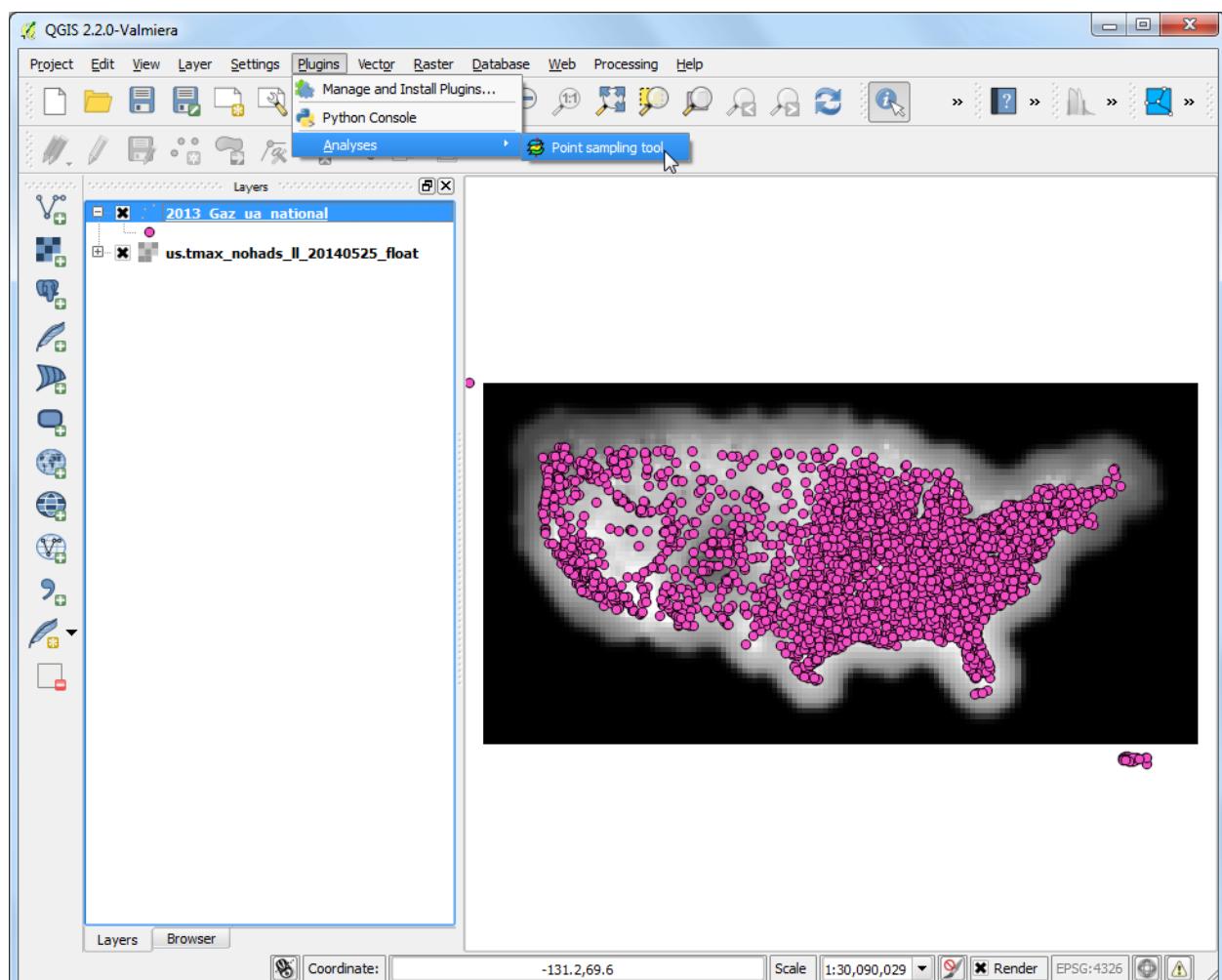


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7. In the Point Sampling Tool dialog, select **2013\_Gaz\_ua\_national** as the Layer containing sampling points. We must explicitly pick the fields from the input layer that we want in the output layer. Choose **GEOID** and **NAME** fields from the **2013\_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\_noahds\_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.

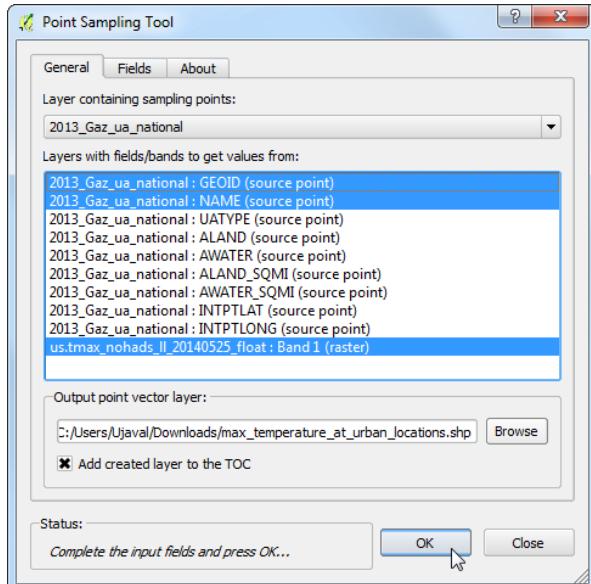


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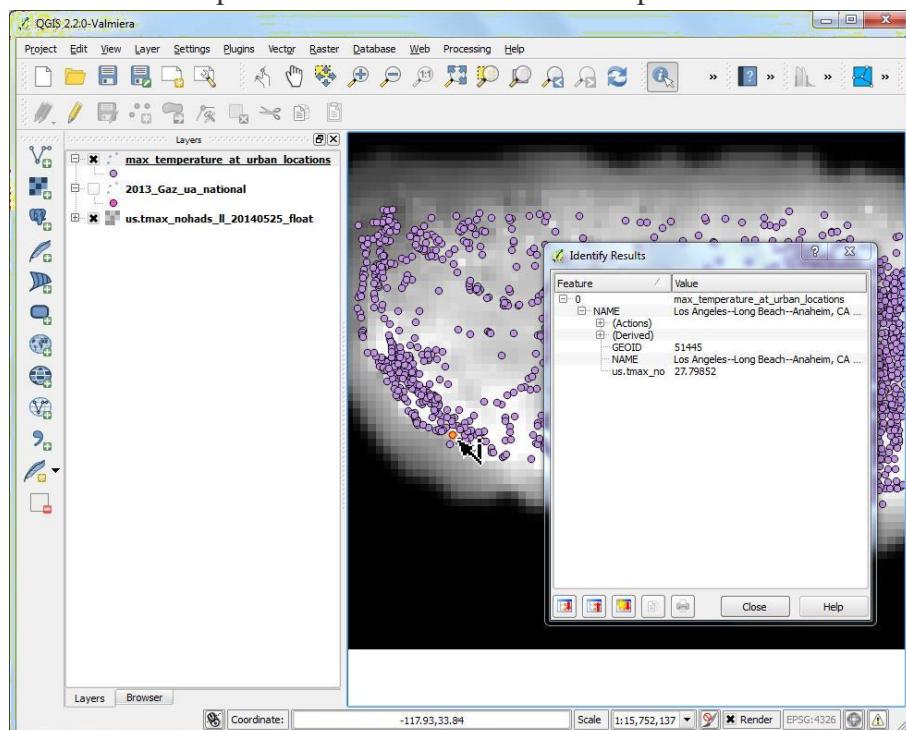
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8. You will see a new layer **max\_temparature\_at\_urban\_locations** loaded in QGIS. Use the Identify tool to click on any point to see the attributes. You will see the **us.tmax\_no** field - which contains the raster pixel value at the location 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.

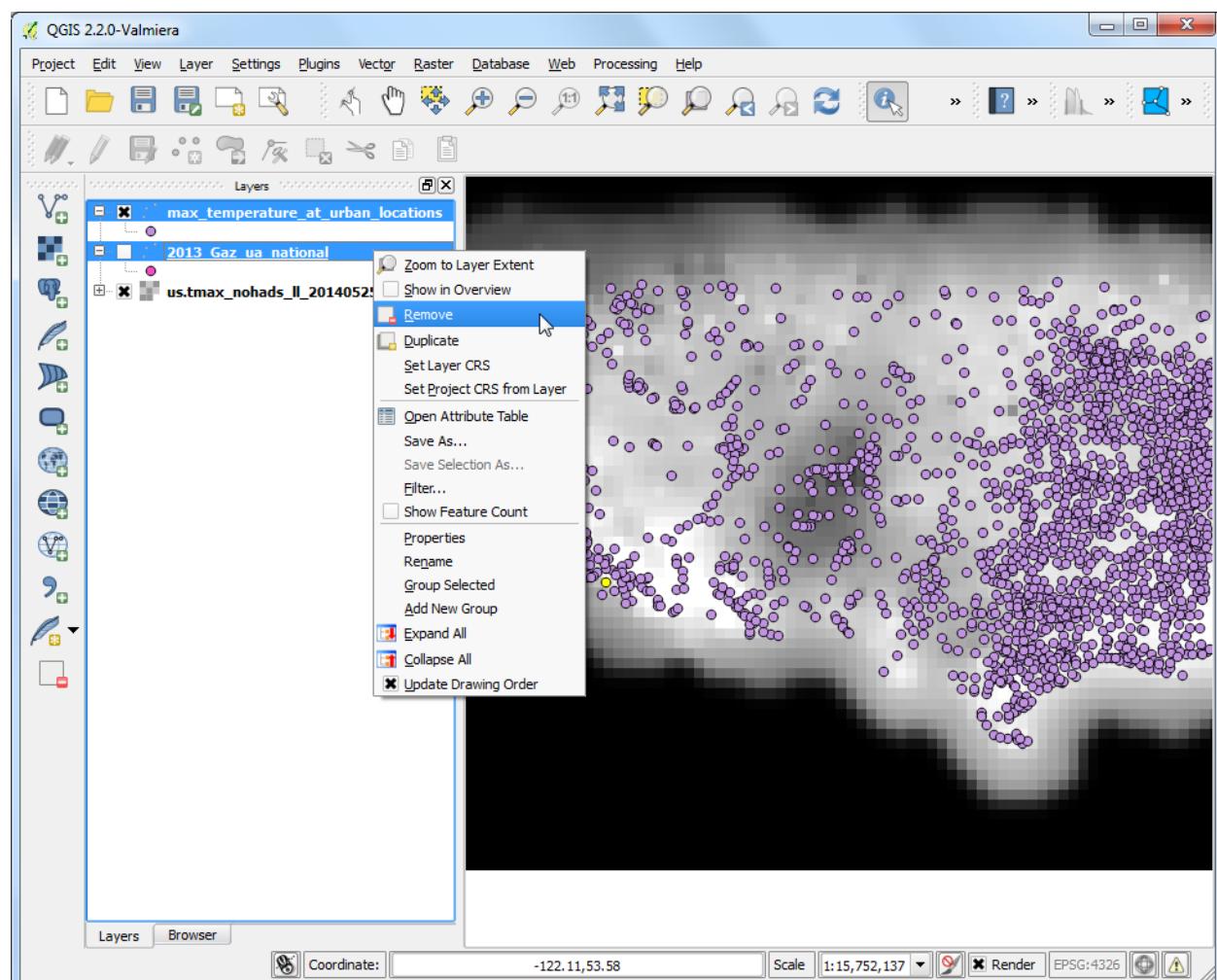


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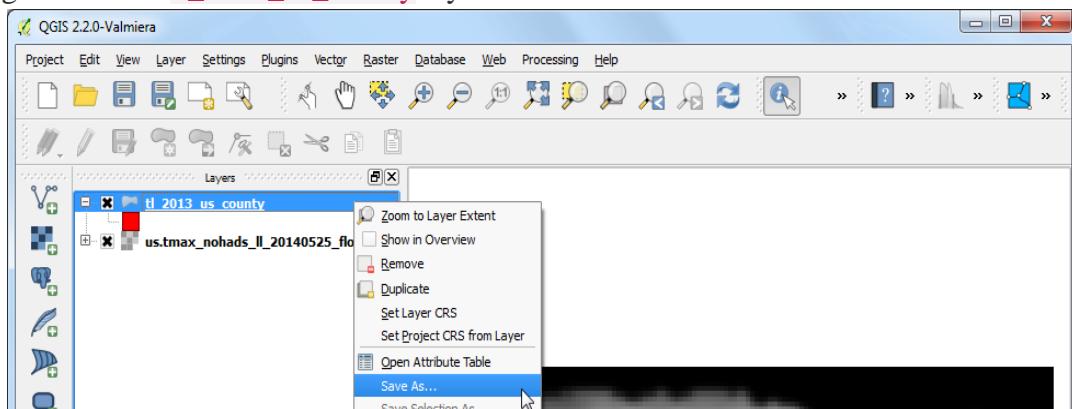
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10. Go to Layer ▶ Add Vector Layer. Browse to the downloaded [tl\\_2013\\_us\\_county.zip](#) file and click Open. Select the [tl\\_2013\\_us\\_county.shp](#) as the layer and click OK.
11. The [tl\\_2013\\_us\\_county](#) will be added to QGIS. This 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...





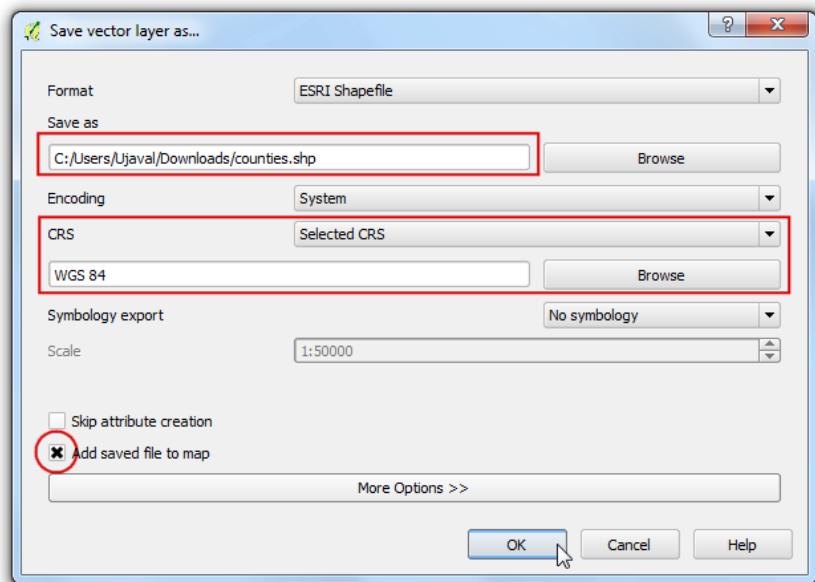
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13. In the Save Vector layer as.. dialog, click Browse and name the output file as **counties.shp**. Choose Selected CRS from the CRS dropdown menu. Click Browse and select **WGS 84** as the CRS. Check the Add saved file to map and click OK.



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

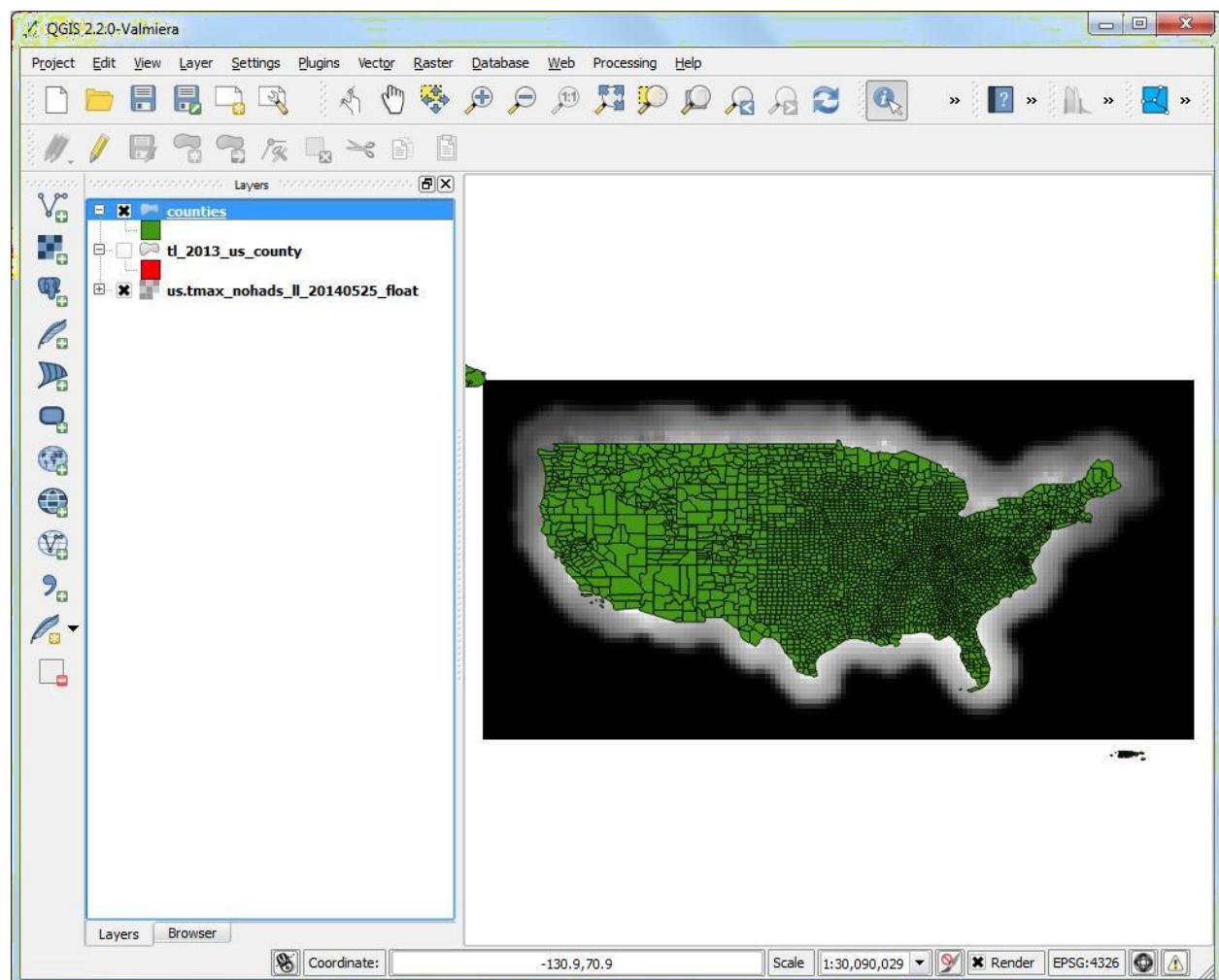


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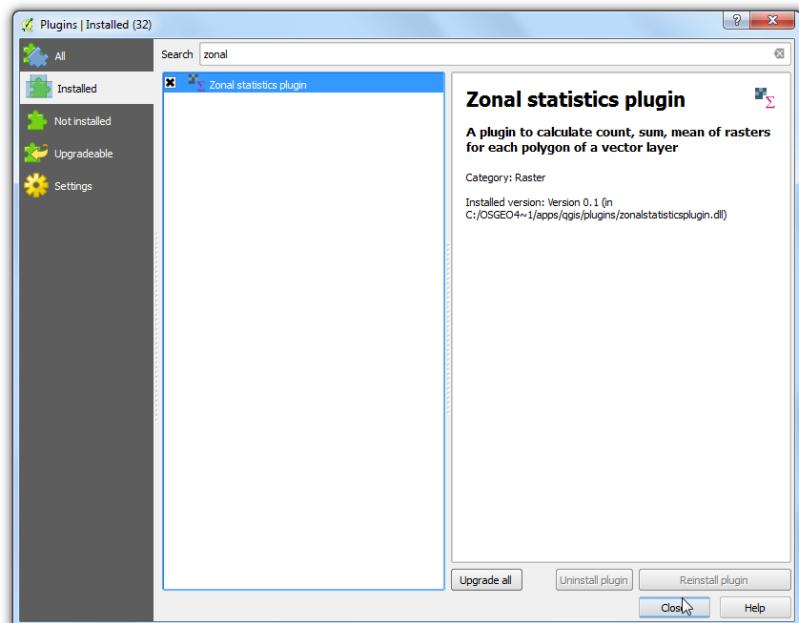


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16. Go to Raster ▶ Zonal statistics ▶ Zonal statistics.

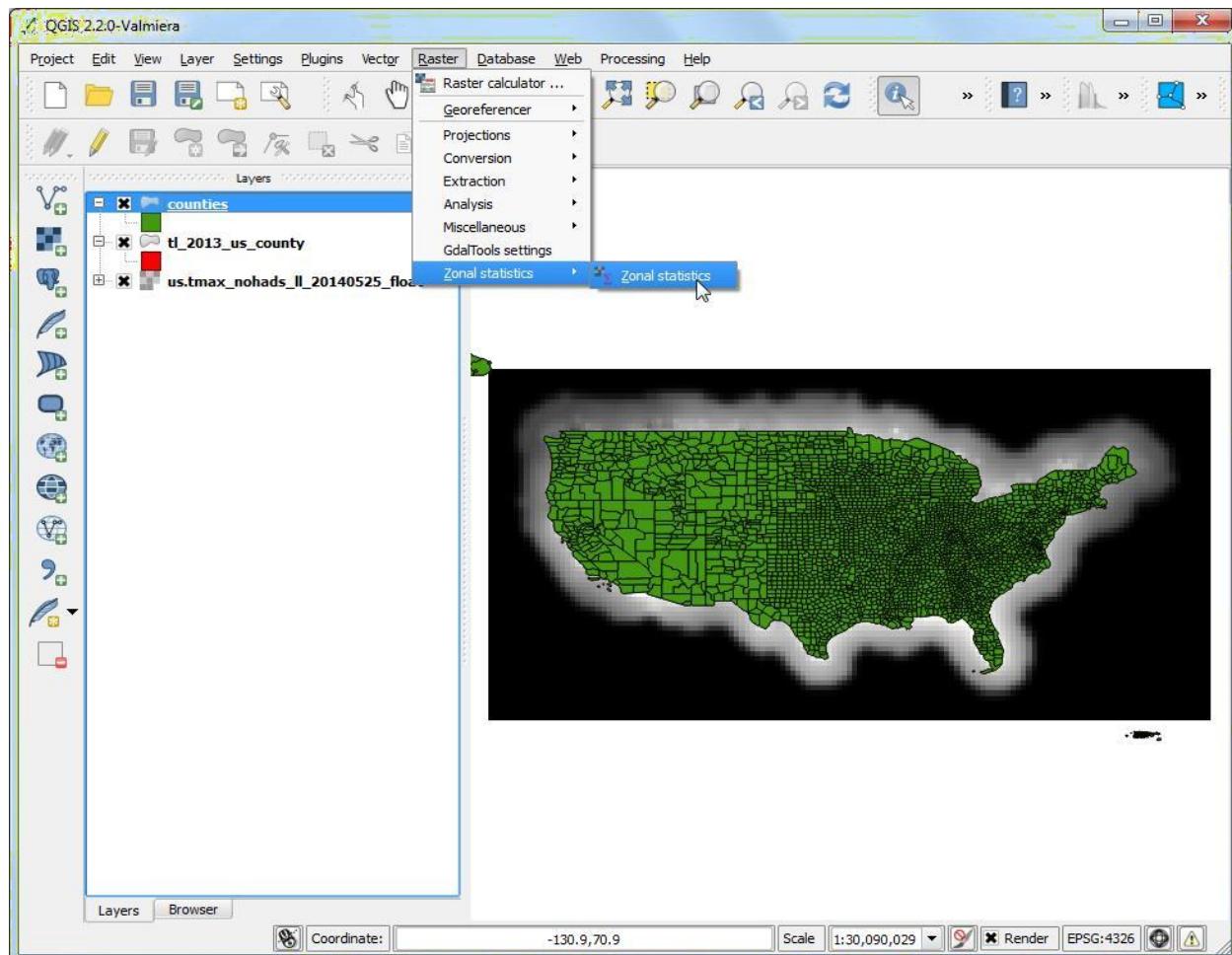


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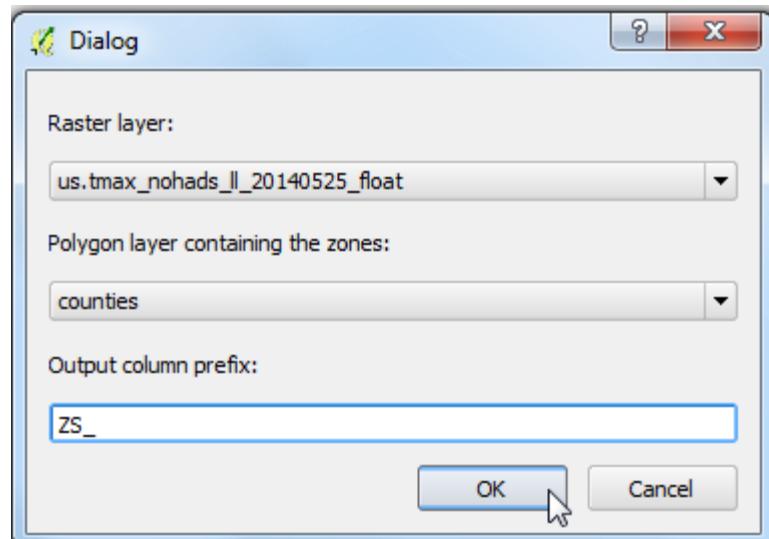
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17. Select `us.tmax_noahds_ll_{YYYYMMDD}_float` as the Raster layer and `counties` as the Polygon layer containing the zones. Enter `ZS_` as the Output column prefix. Click OK.



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

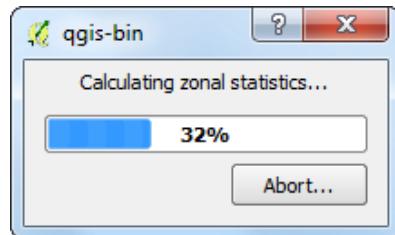


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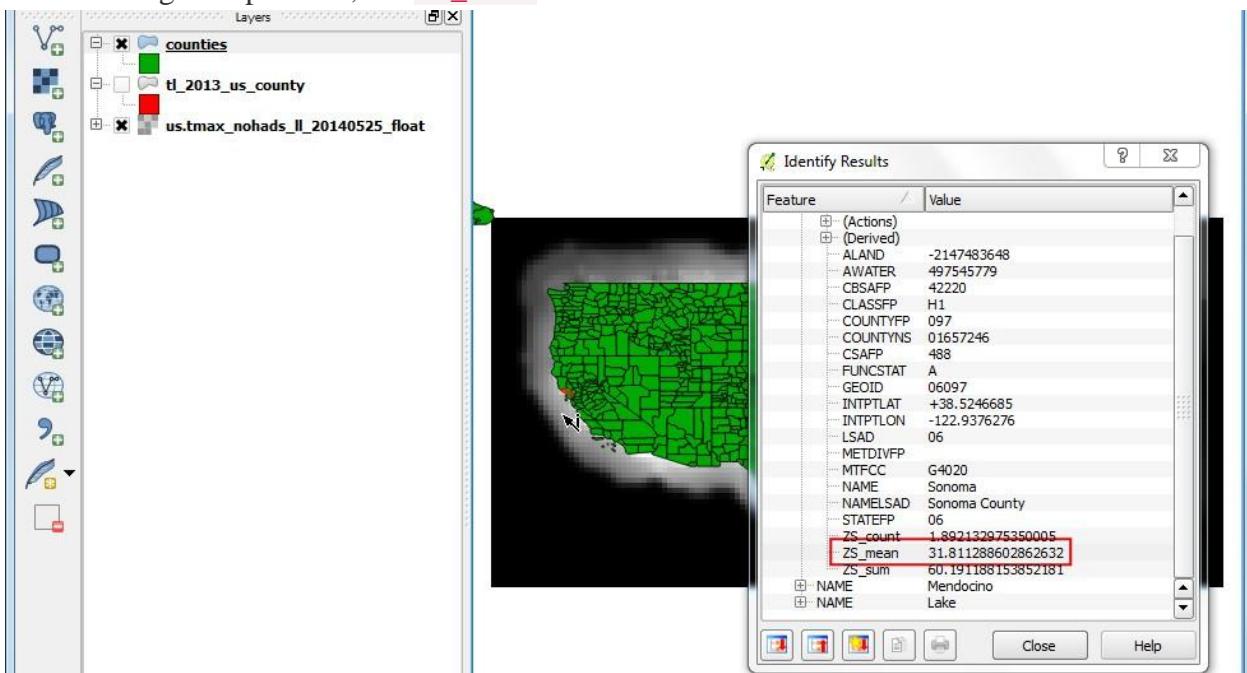
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19. Once the processing finishes, select the **counties** layer. Use the Identify tool and click on any county polygon. You will see three new attributes added to the layer: **ZS\_count**, **ZS\_mean** and **ZS\_sum**. These attributes contain the 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\_mean** field 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.

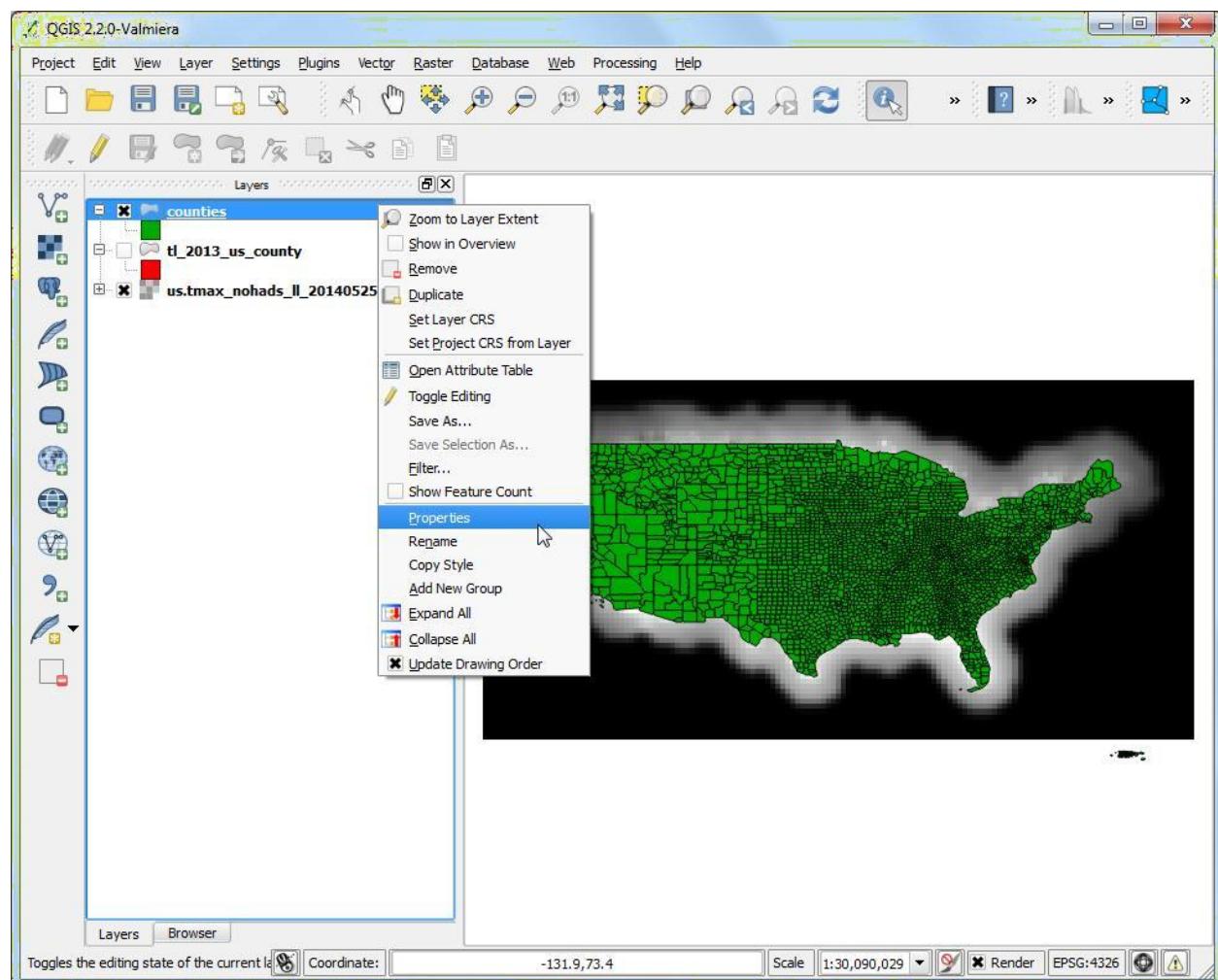


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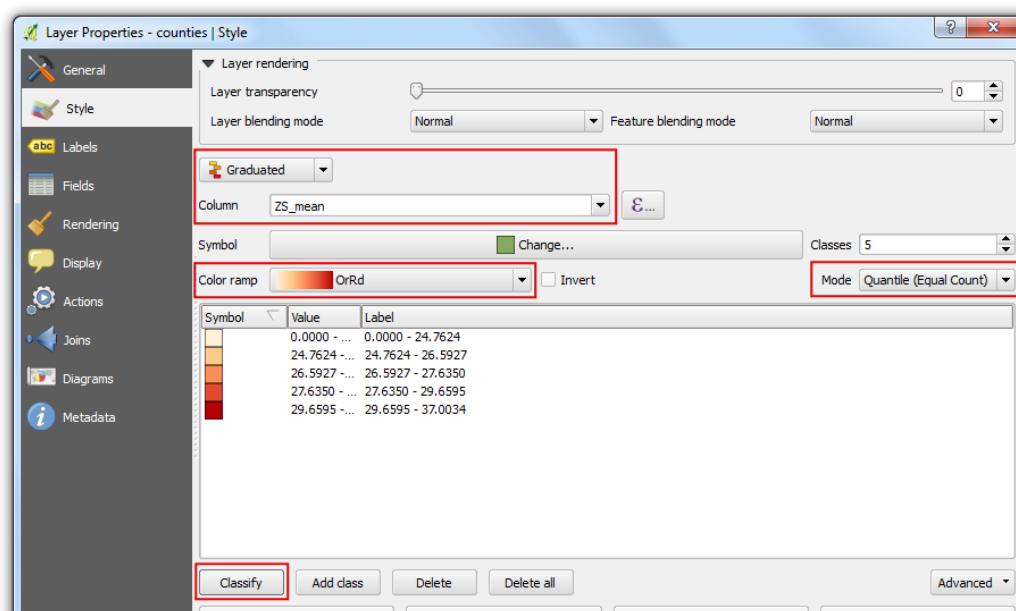
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21. Switch to the Style tab. Choose Graduated style and select **ZS\_mean** as the Column. Choose a Color Ramp and Mode of your chose. Click Classify to create the classes. Click OK.



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

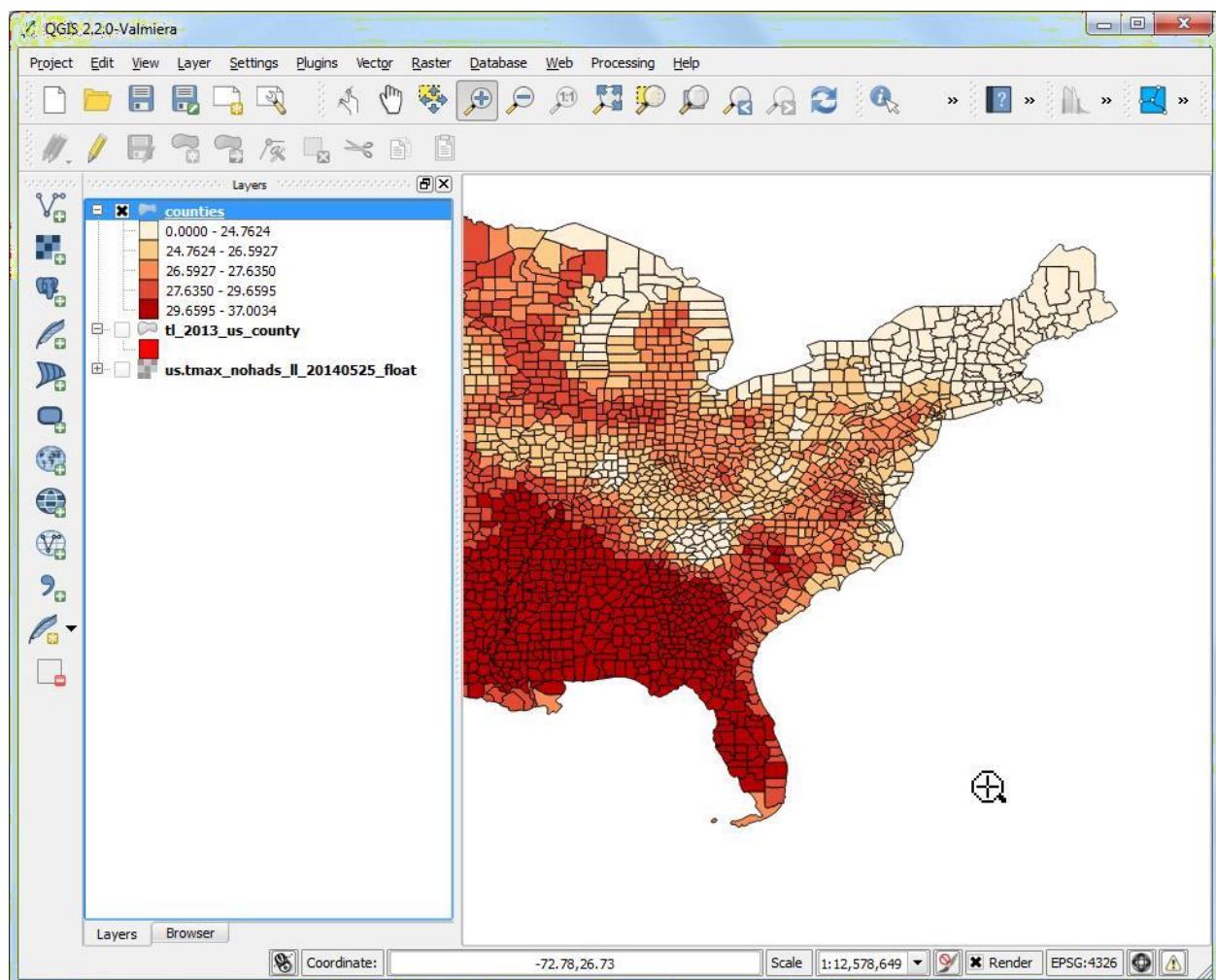


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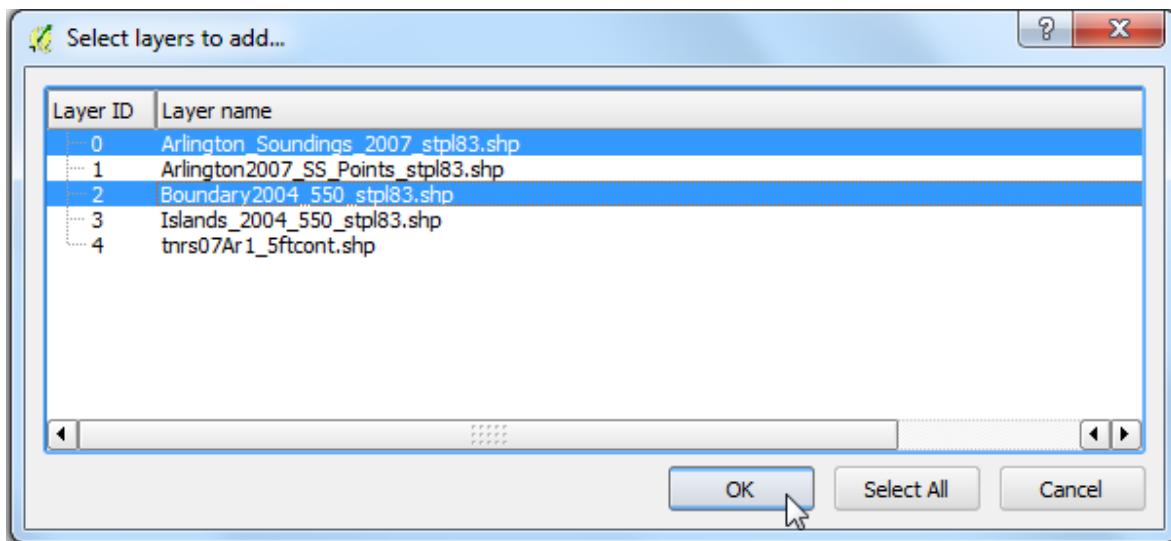
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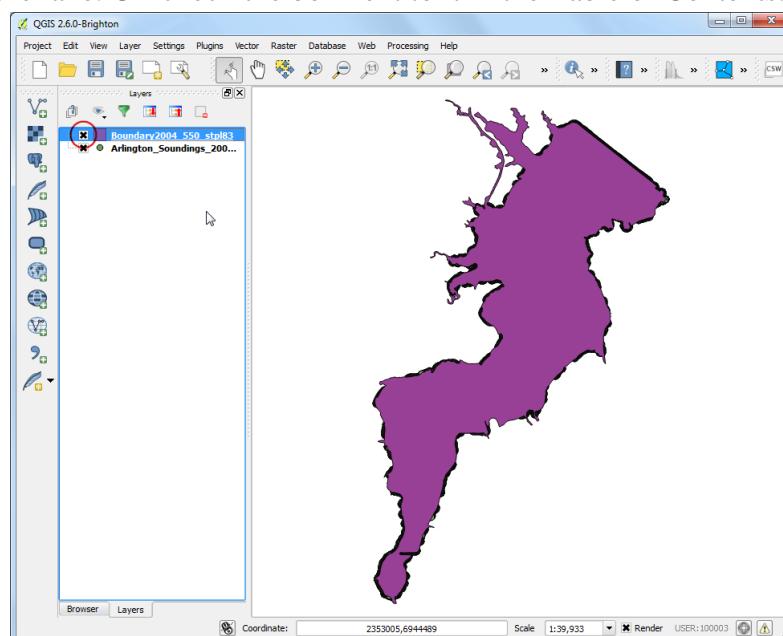
### c) Interpolating Point Data

## 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.





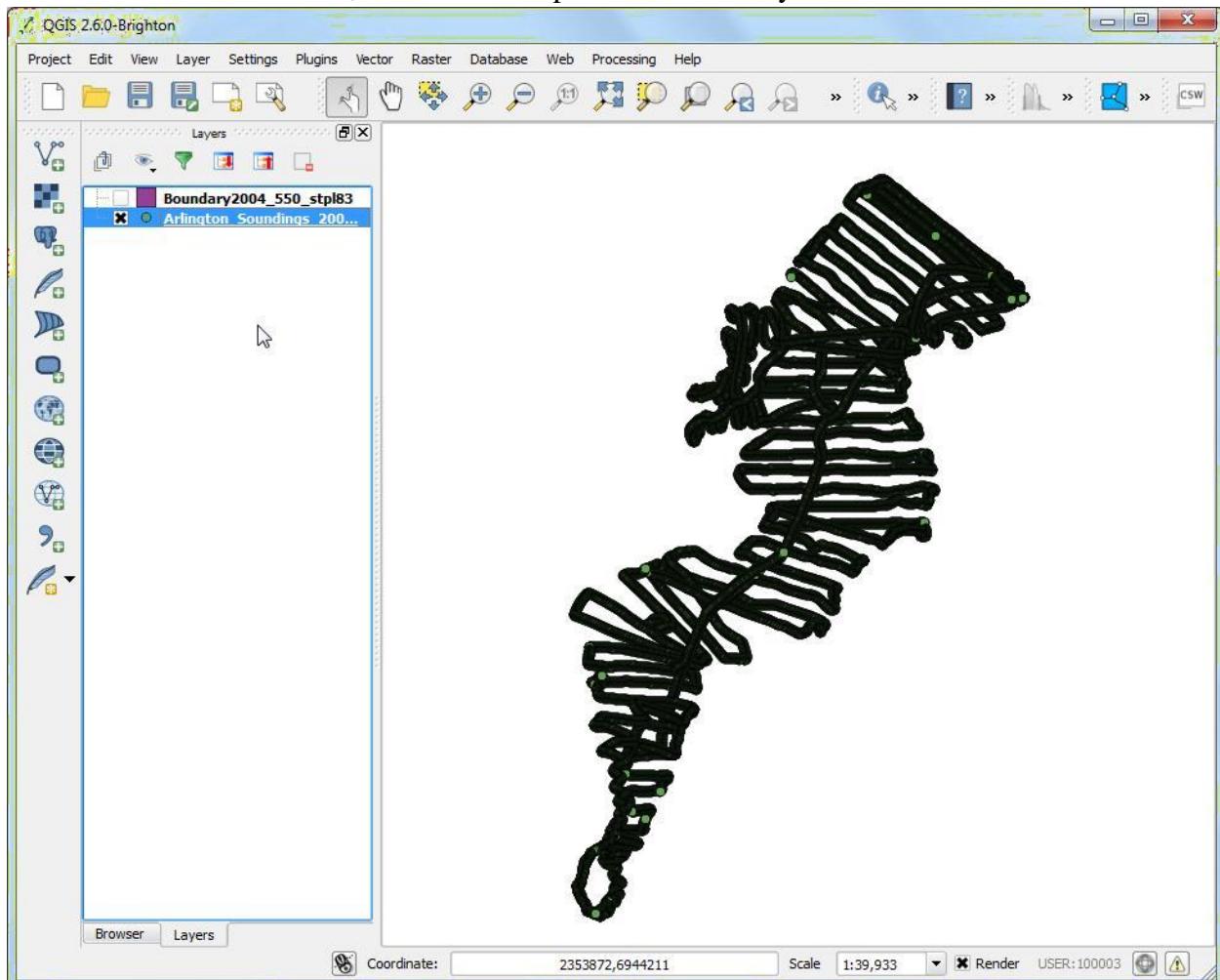
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5. This will reveal the data from the second layer Arlington\_Soundings\_2007\_stpl83. Though the data looks like lines, it is a series of points that are very close.



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.

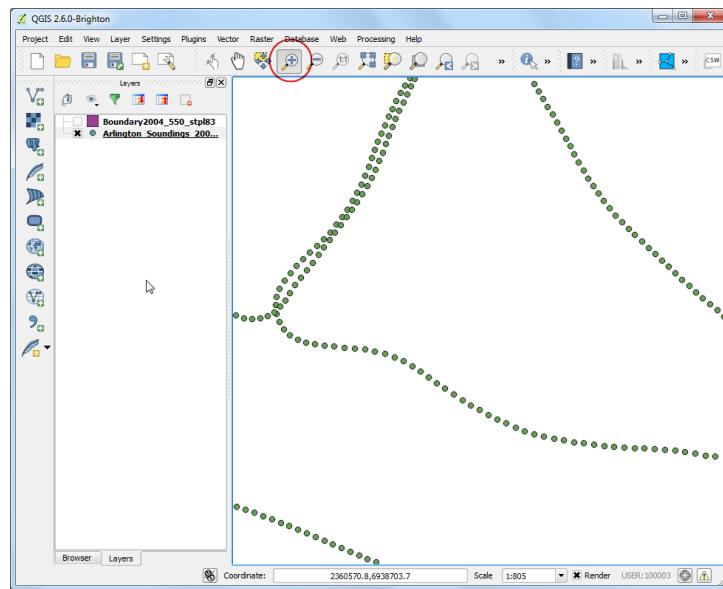


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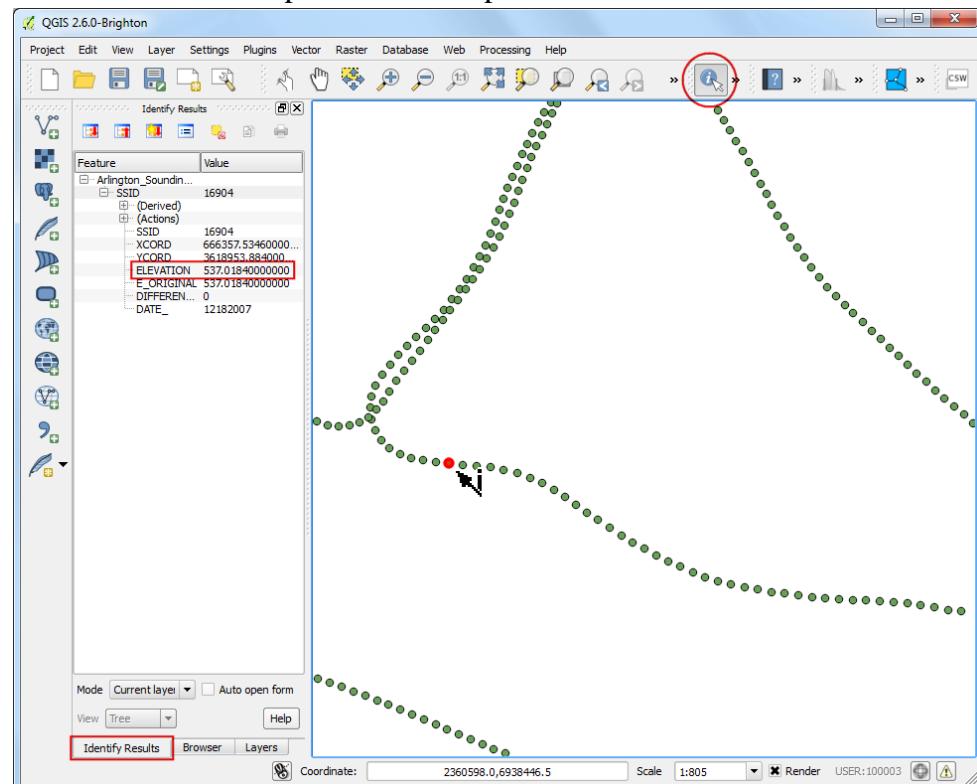
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7. Select the Identify tool and click on a point. You will see the Identify Results panel show up on the left with the attribute value of the point. In this case, the ELEVATION attribute contains the depth of the lake at the location. As our task is 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 to Raster > Interpolation > Interpolation.



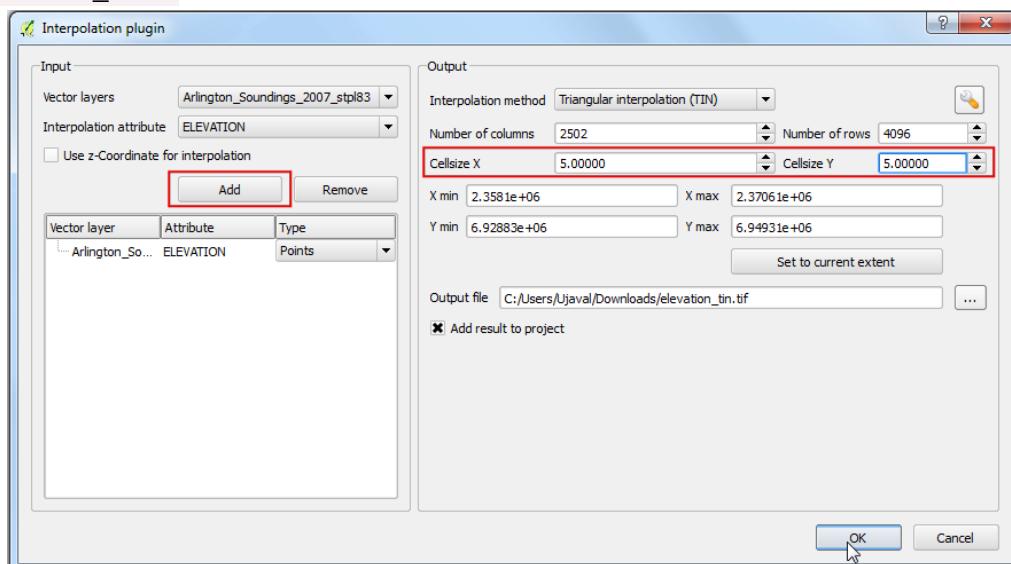
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- In the Interpolation dialog, select `Arlington_Soundings_2007_stpl83` as the Vector layers in the Input panel. Select `ELEVATION` as the Interpolation attribute. Click Add. Change the Cellsize X and Cellsize Y values to `5`. This value is the size 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.



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

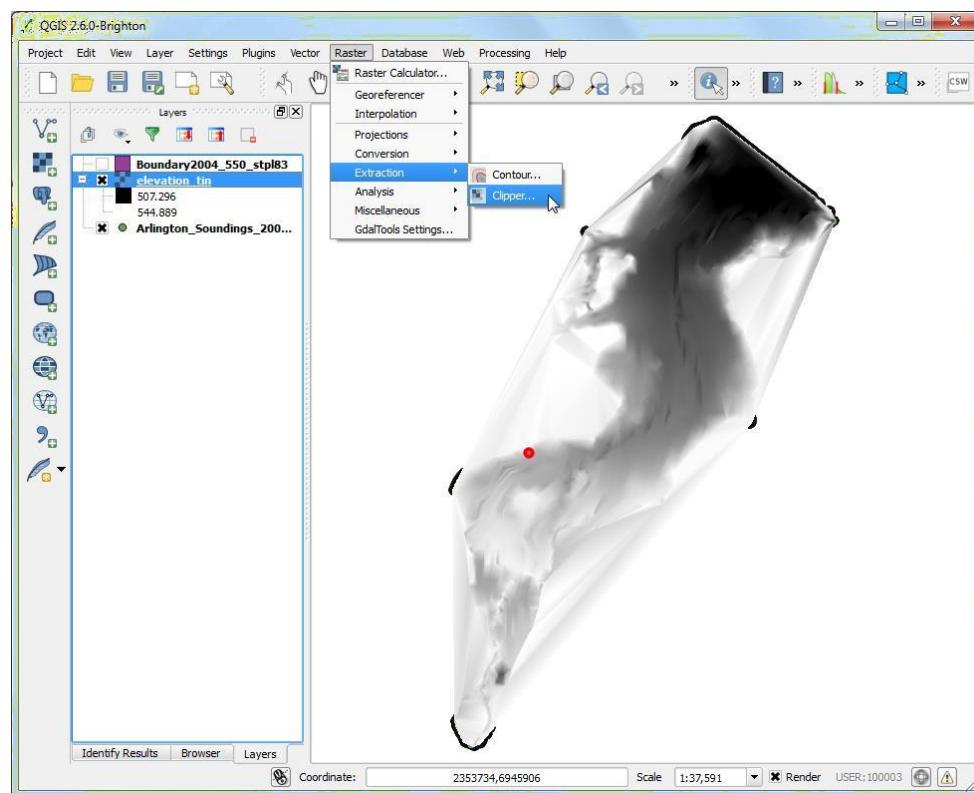


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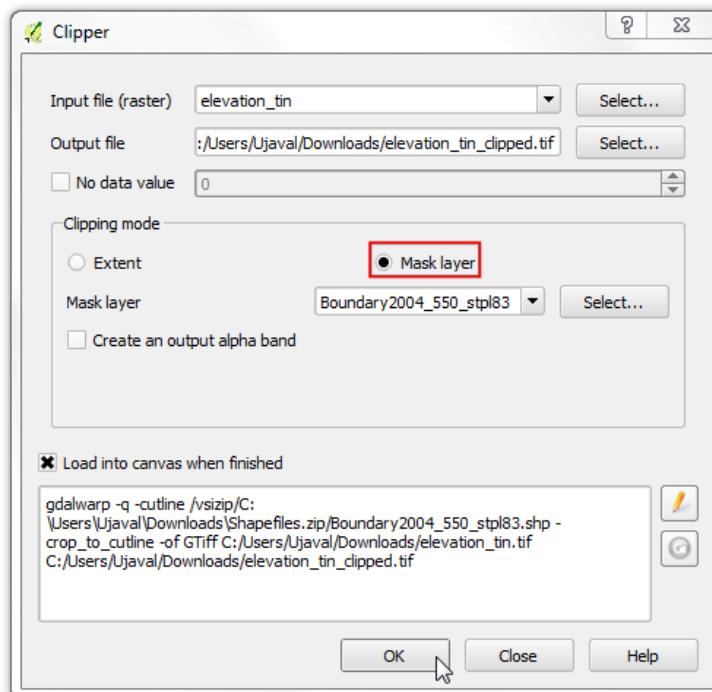
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12. Name the Output file as `elevation_tin_clipped.tif`. Select the Clipped mode as Mask layer.  
Select `Boundary2004_550_stpl83` as the Mask layer. Click OK.





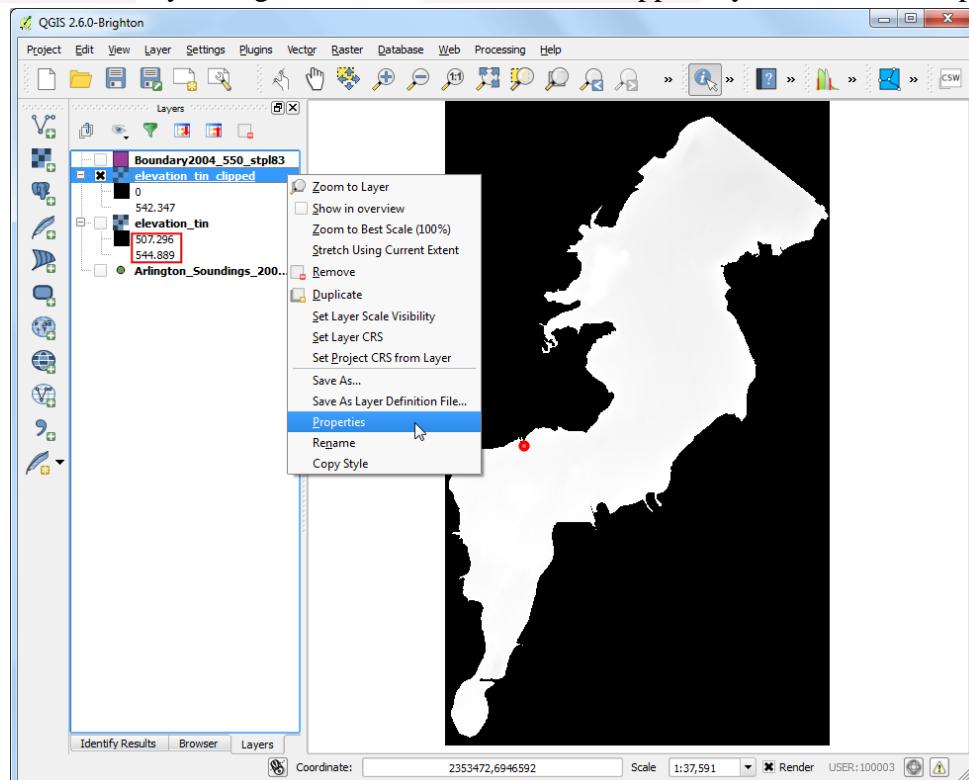
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13. A new raster elevation\_tin\_clipped will be loaded in QGIS. We will now style this layer to show the difference in elevations. Note the min and max elevation values from the elevation\_tin layer. Right-click the elevation\_tin\_clipped layer and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



14. Go to the Style tab. Select Render type as Singleband pseudocolor. In the Generate new color map panel, select Spectralcolor 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.

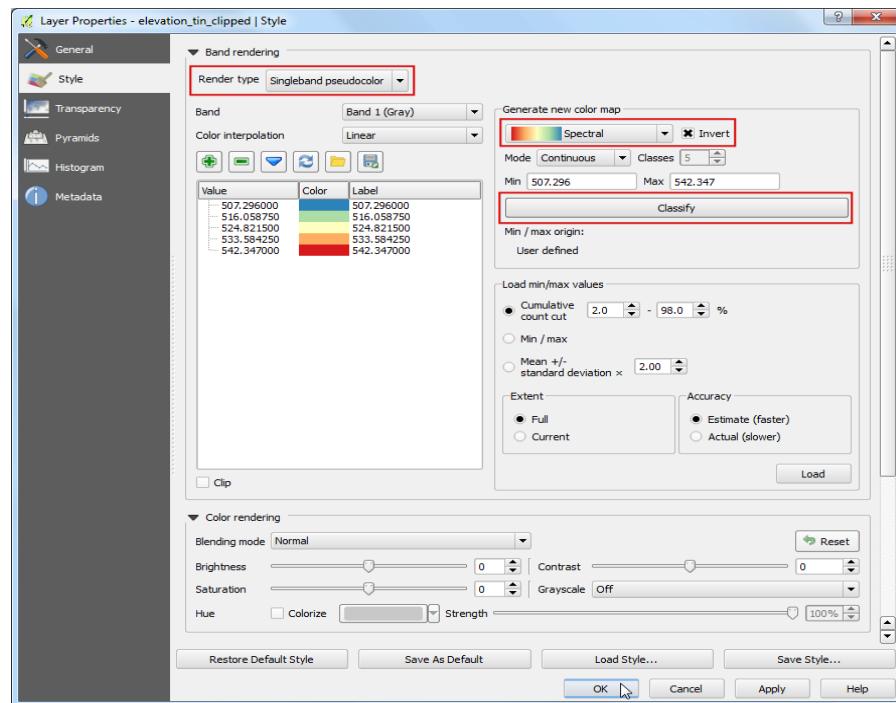


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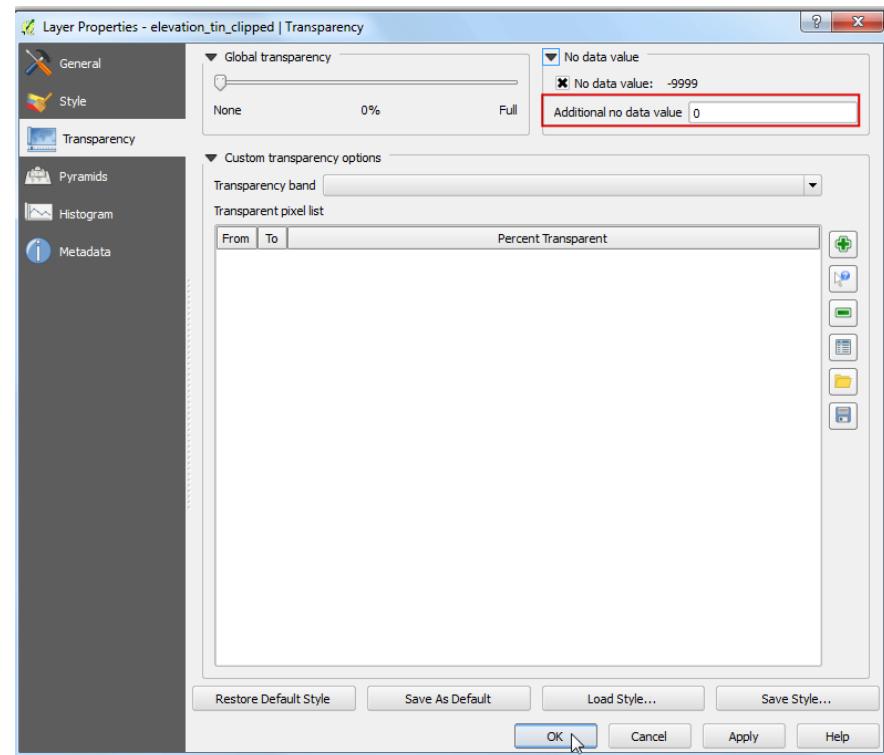
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15. Switch to the Transparency tab. We want to remove the black-pixels from our output. Enter 0 as the Additional no data value. Click OK.



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.

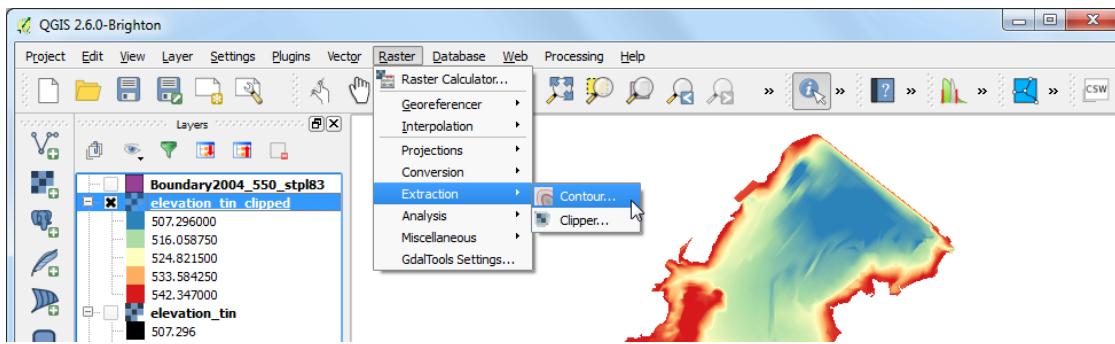


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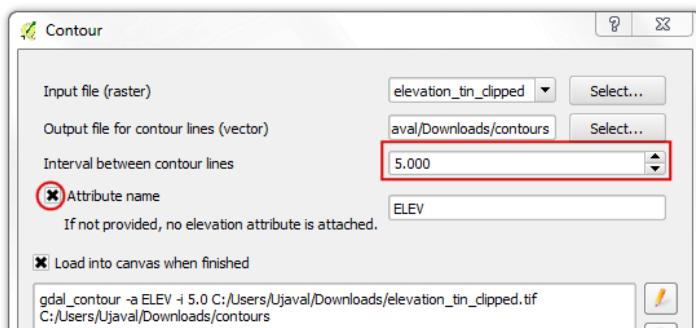
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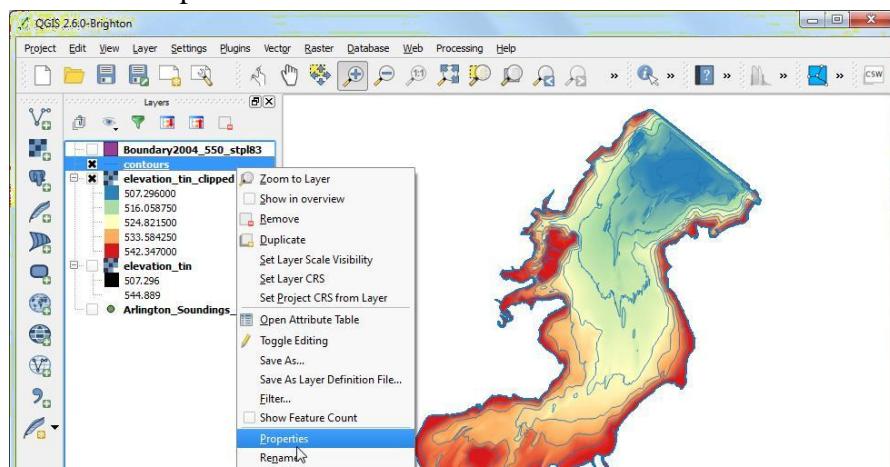
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17. In the Contour dialog, enter contours as the Output file for contour lines. We will generate contour lines at 5ft intervals, so enter 5.00 as the Interval between contour lines. Check the Attribute name box. Click OK.



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.

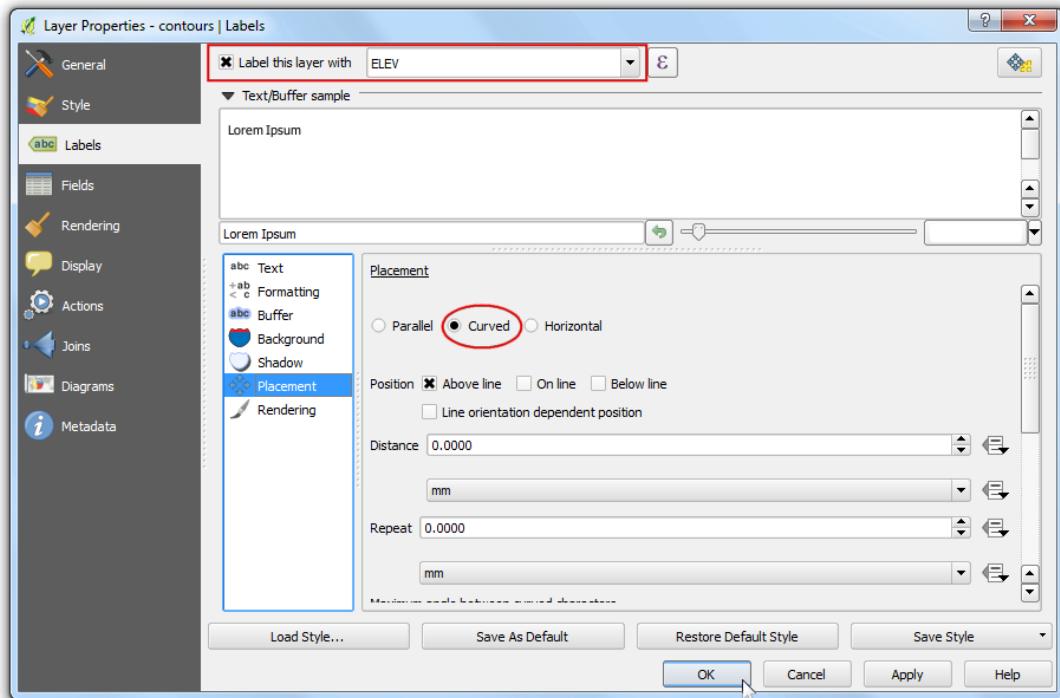


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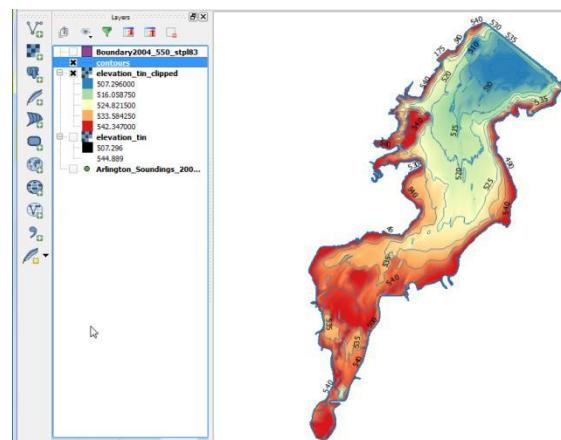
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20. You will see that each contour line will be appropriately labeled with the elevation along the line.





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**Learning Outcome:**

- 1 Understand and apply table joins
- 2 Perform spatial queries and analysis

**Course Outcome:**

- 1 Manage and analyze spatial data sets
- 2 Use spatial queries for data insights

**Conclusion:**

**Viva Questions:**

- 1 What is a spatial join?
- 2 How to perform table joins?
- 3 What is points-in-polygon analysis?

Correction Parameter	Formative Assessment [ ]	Timely Completion of practical	Attendance Learning Attendance [ ]



**Experiment No.—9:**

**Aim: Advanced GIS Operations 1: Nearest Neighbor Analysis, Sampling Raster Data using Points or Polygons, Interpolating Point Data**

**Tools & Technologies used: QGIS**

**Learning Objectives:**

1. Perform nearest neighbor analysis
2. Sample and interpolate raster data

**Theory: Introduction to GIS operations.**

**Proximity Analysis**

Proximity Analysis is an analytical technique used to determine the relationship between a selected point and its neighbors. The distance between point A and point B may be measured as a straight line or by following a networked path, such as a street network.

Proximity tools can be divided into two categories depending on the type of input the tool accepts: features or rasters. The feature-based tools vary in the types of output they produce. For example, the Buffer tool outputs polygon features, which can then be used as input to overlay or spatial selection tools such as Select Layer By Location.

**Network Analysis**

Network analysis is an operation in GIS which analyses the datasets of geographic network or real world network. This kind of advanced GIS analysis involves examining the properties of natural and man-made network to gain an understanding of the behavior of flows within and around such networks and locational analysis.

Network analysis as part of advanced GIS analysis primarily includes analyzing a set of connected lines, representing railways, streams, roads, waterlines, pipelines, telecommunication lines etc. Network analysis helps in analyzing movement of people, connectivity and accessibility of railway, roads, pipelines and telecommunications, flow of matter and energy and movement of goods and services. Network analysis in GIS helps in planning, development and accessibility.

**Hillshading Analysis**

Hillshading in GIS is used for creating relief maps, which indicate the topographical shape of hills and mountains using shading (levels of gray) on a map. This technique is used to indicate relative slopes, mountain ridges, and not absolute height.



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In Hillshading analysis, the terrain is illuminated with a hypothetical light source and visualized as a shaded relief. The illumination value for each raster cell is determined by its orientation to the light source, which is based on slope and aspect.



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## Step:-

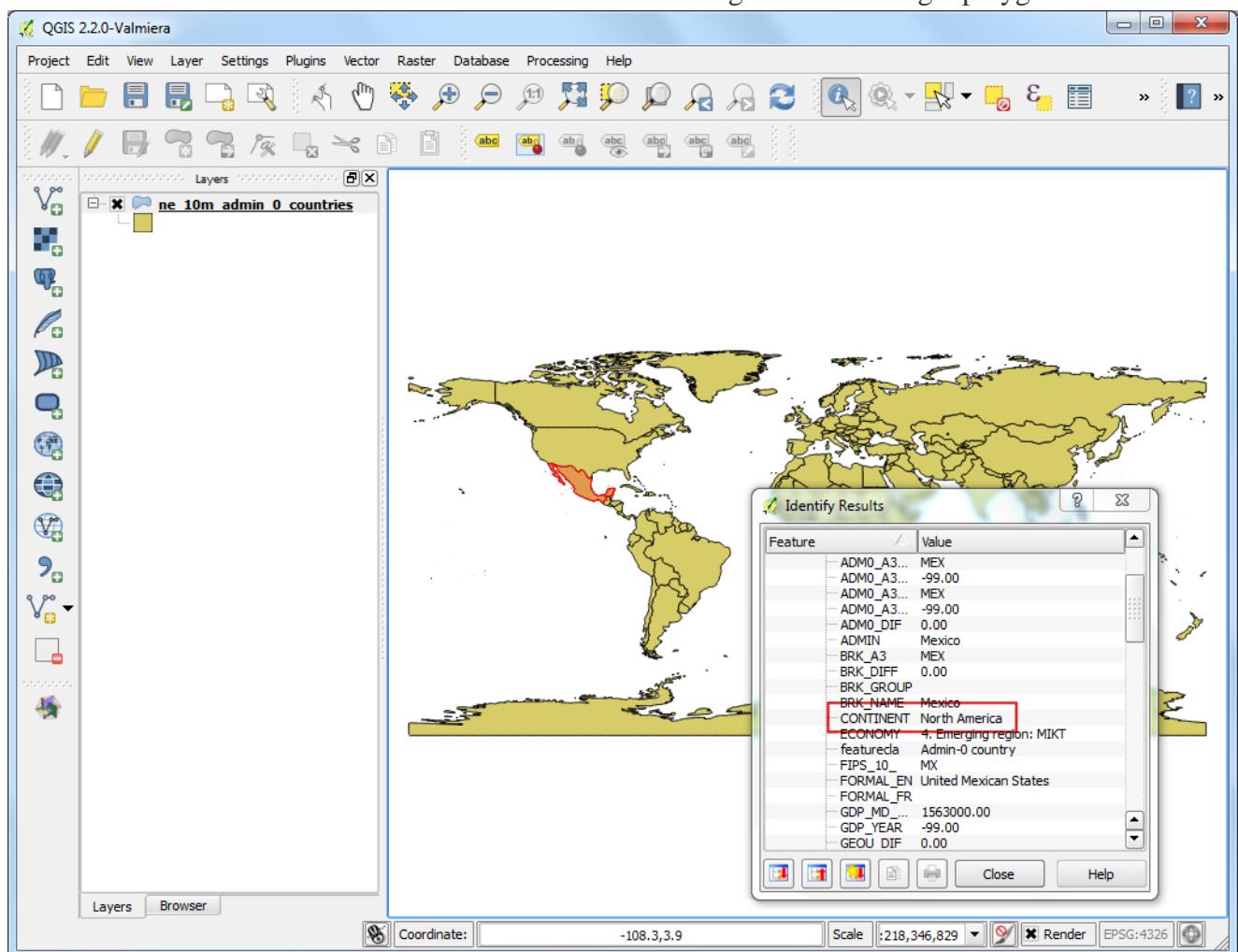
Advance GIS Operations 2:

- a) Batch Processing using Processing Framework
- b) Automating Complex Workflows using Processing Modeler
- c) Automating Map Creation with Print 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 containing 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.

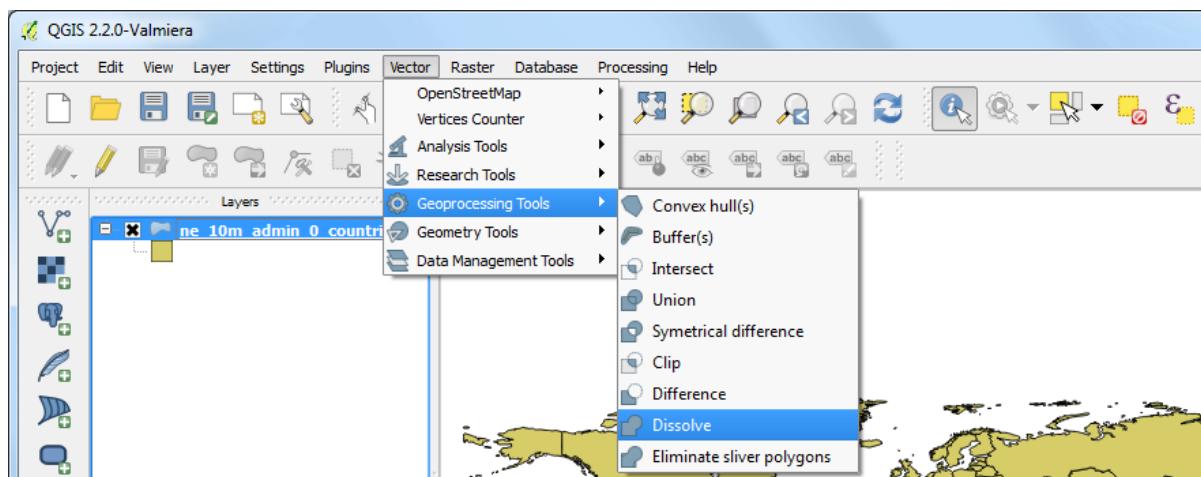


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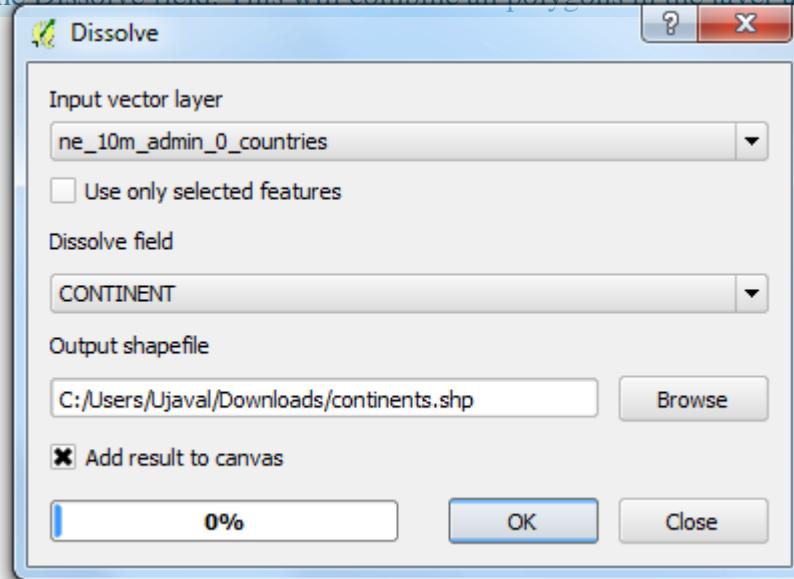
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5. Select **ne\_10m\_admin\_0\_countries** as the Input vector layer. The Dissolve field would be **CONTINENT**. Name the output file as **continents.shp** and check the box next to Add result to canvas.

#### 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.

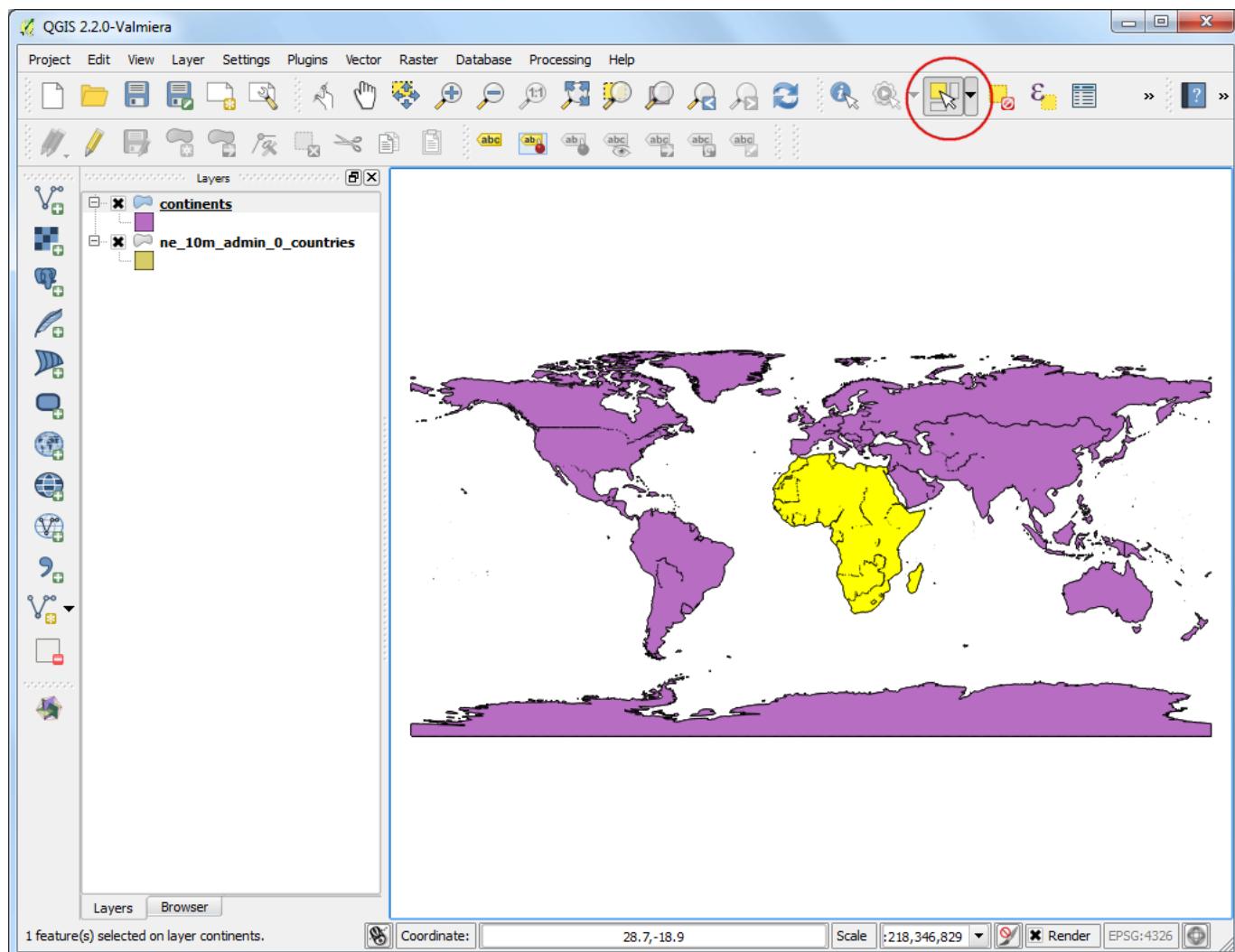


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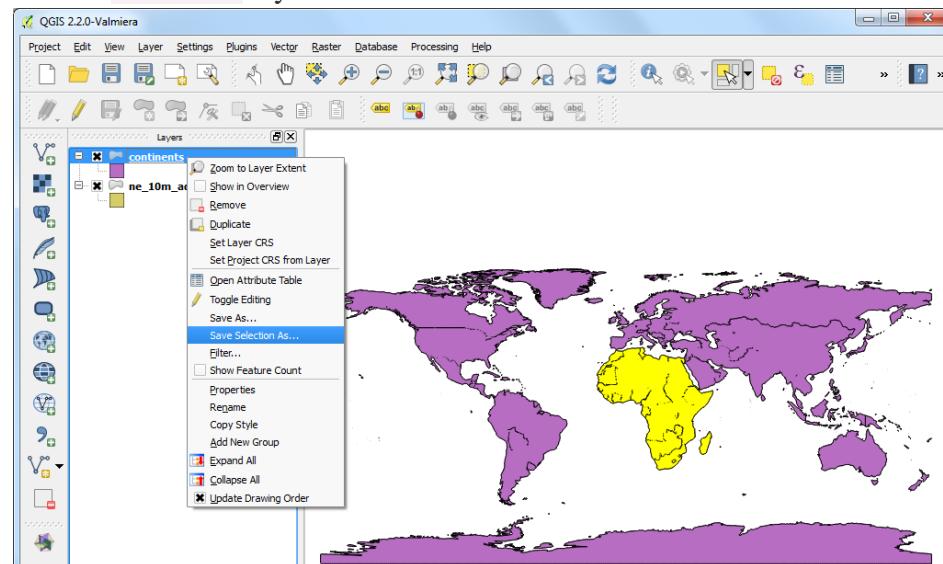
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7. Right-click the continents layer and select Save Selection As....





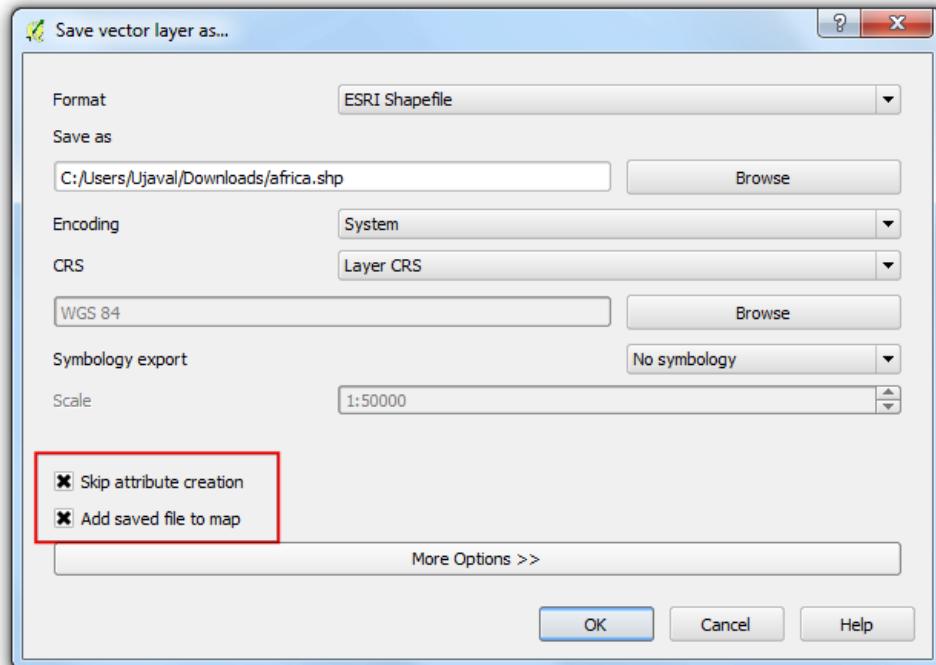
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8. Name the output file as **africa.shp**. Since we are only interested in the shape of the continent and not any attributes, you may check the Skip attribute creation. Make sure the Add saved file to map box is checked and click OK.



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.

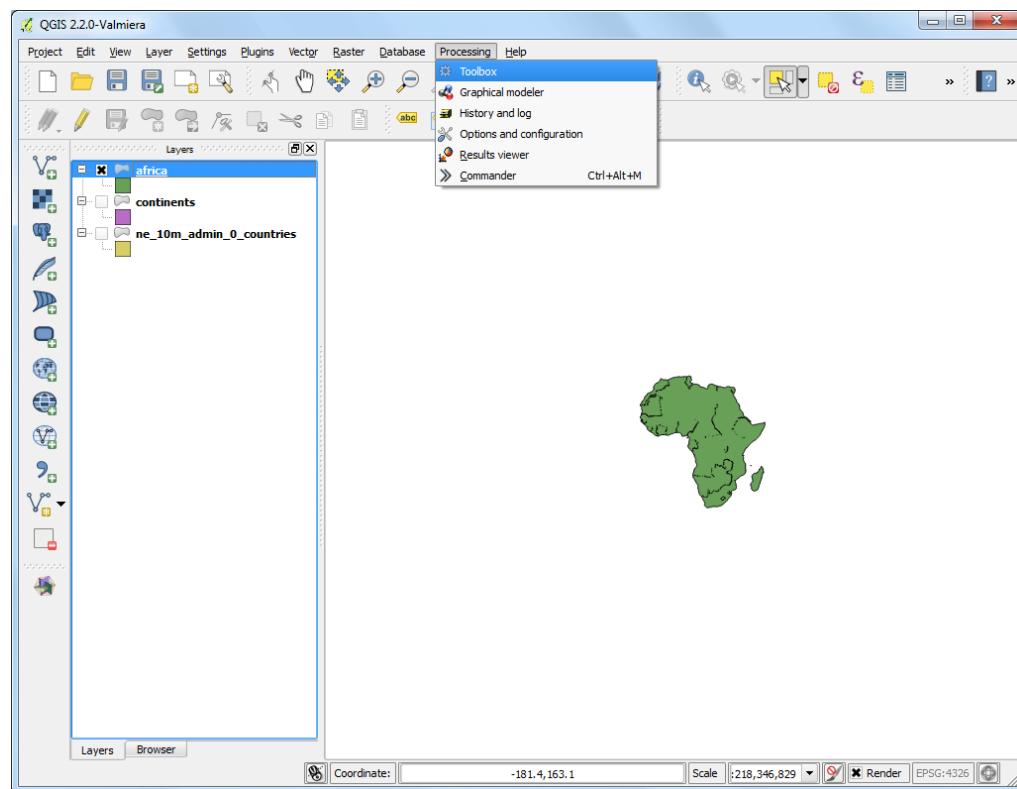


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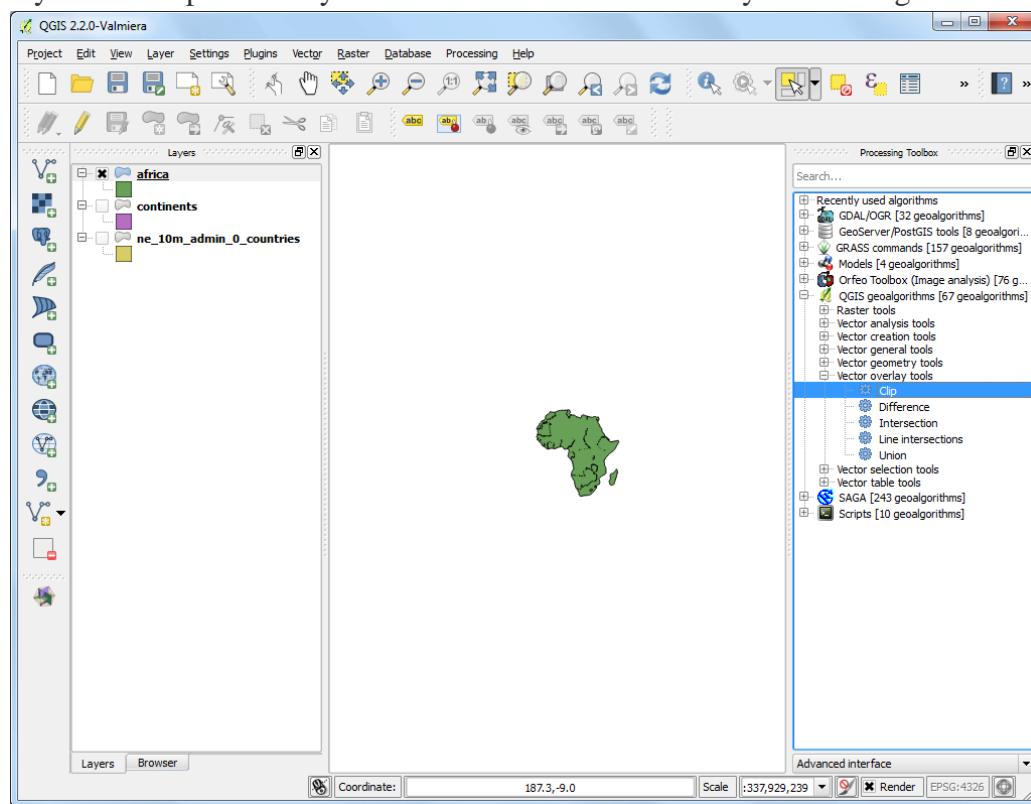
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10. Browse all available algorithms and find the Clip tool from QGIS geoalgorithms ▸ Vector overlay tools ▸ Clip. You may also use the Search box to easily find the algorithm as well.





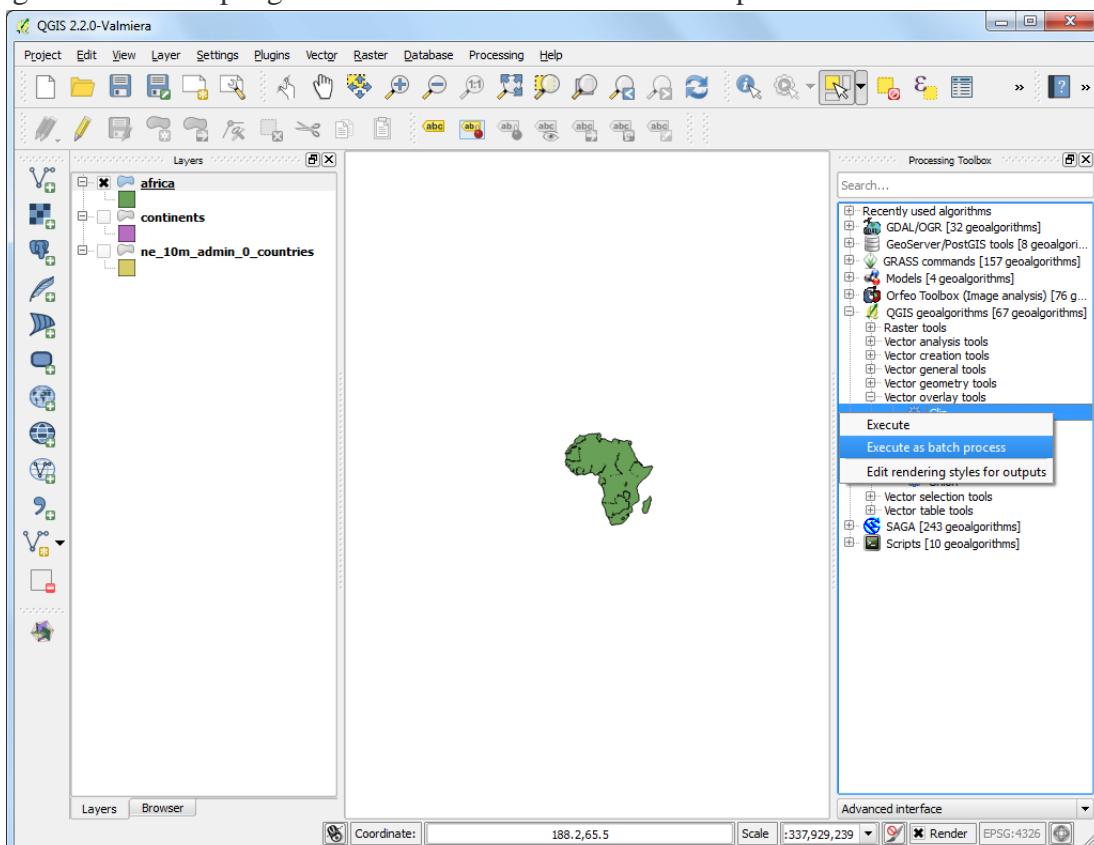
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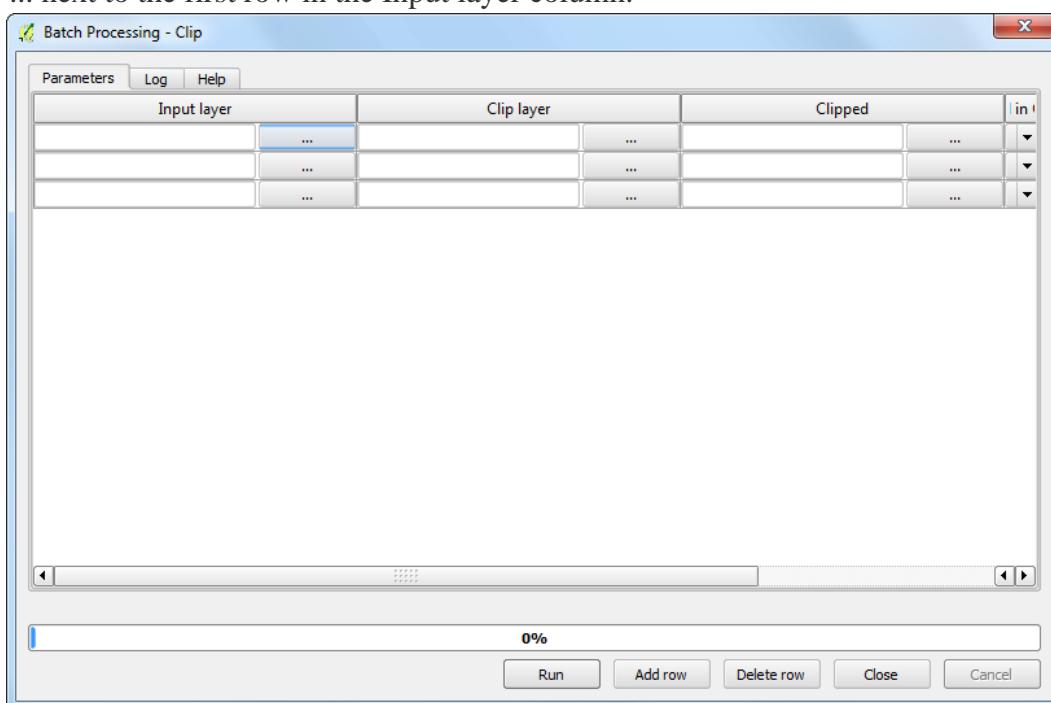
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11. Right-click the Clip algorithm and select Execute as batch process.



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





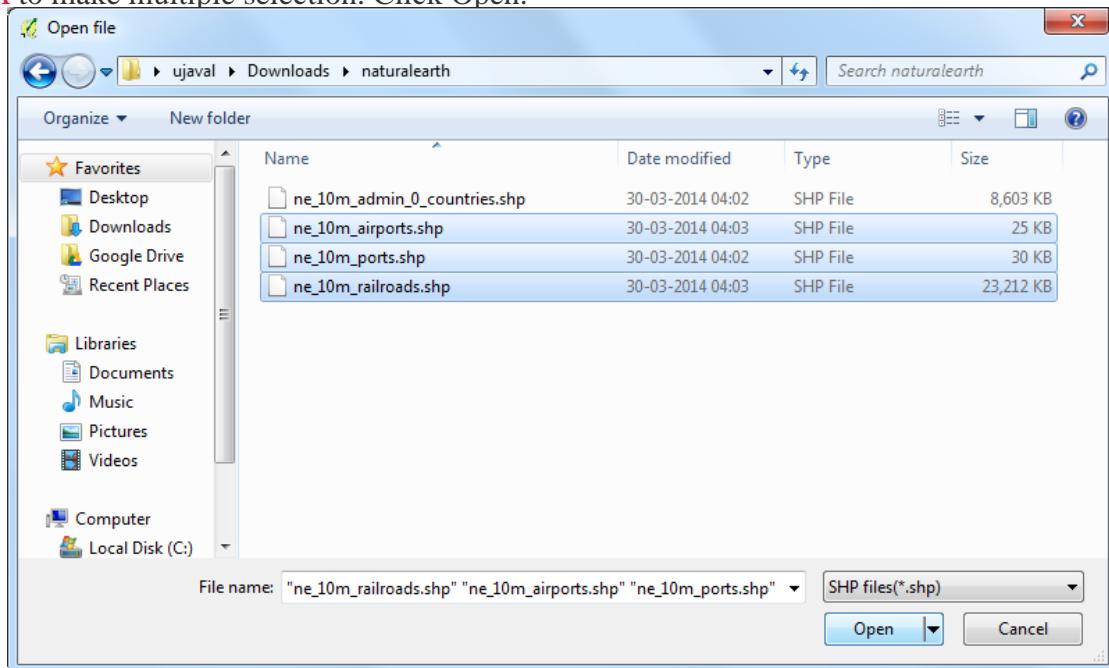
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13. Browse to the directory containing the global transportation layers that you had downloaded. Hold the **Ctrl** key and select all the layers that you want to clip. You may also use **Shift** or **Ctrl-A** to make multiple selection. Click Open.



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 ... button next to the first row in the Clipped column.

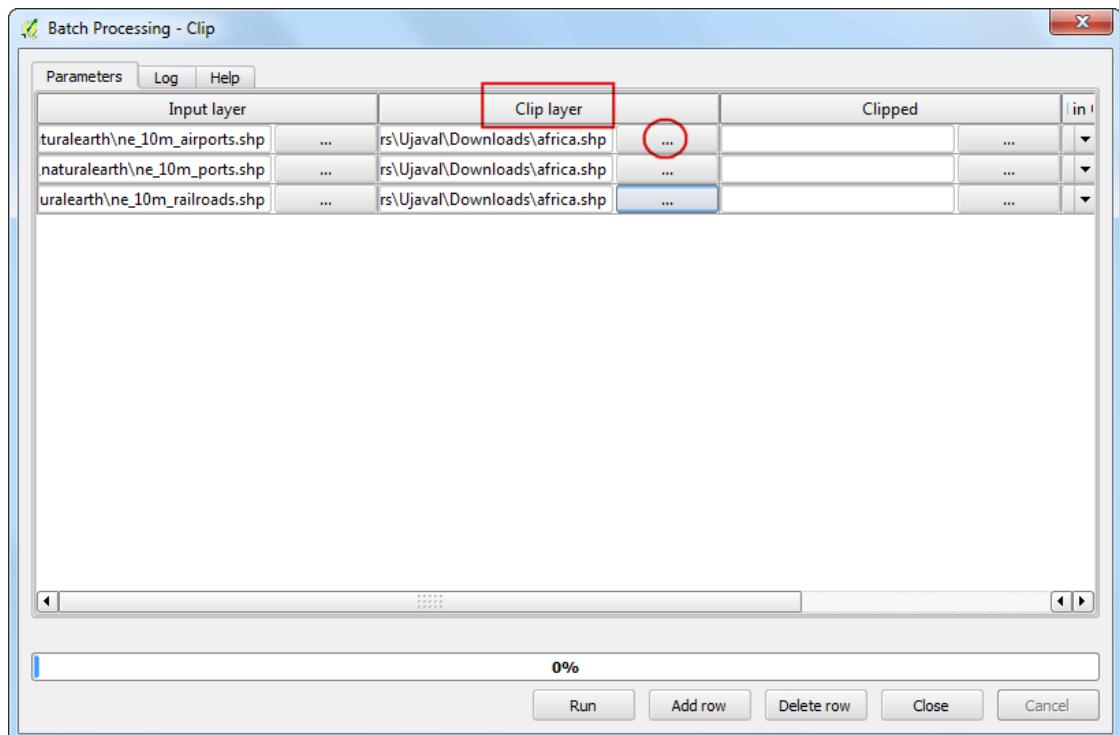


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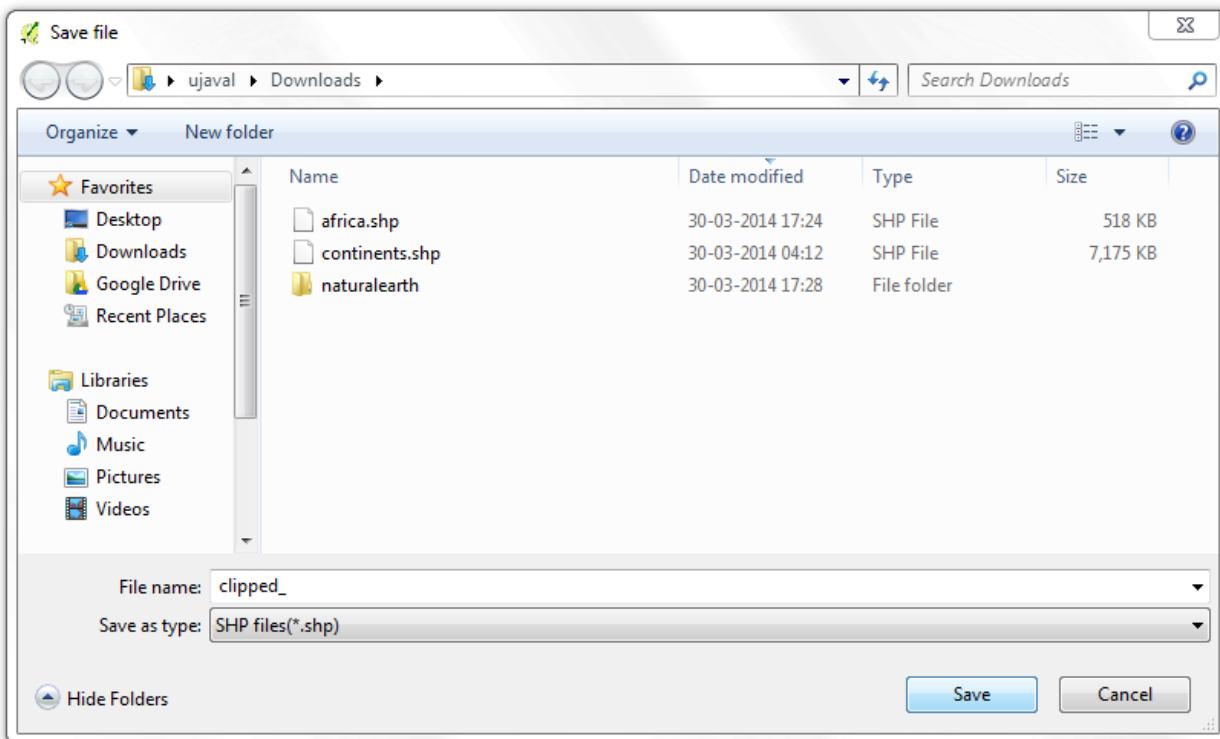
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15. Browse the the directory where you want your output layers. Type the filename as **clipped\_** and click Save.



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



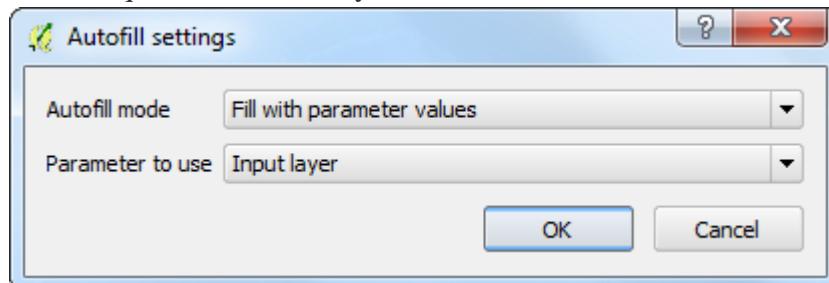
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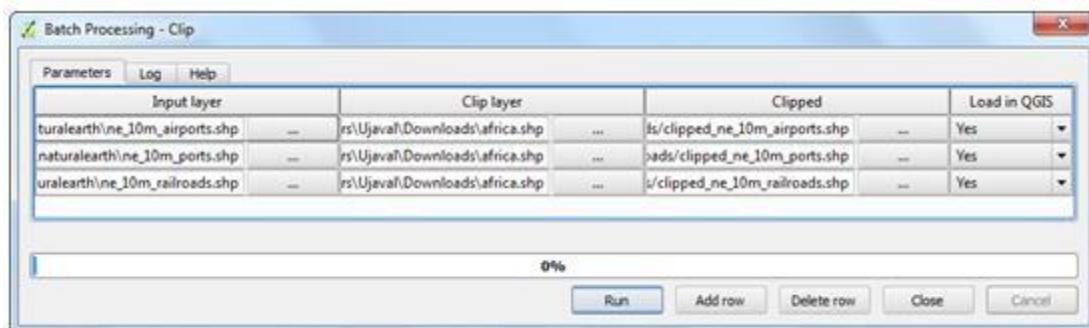
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name to the output along with the specified **output** filename. This is important to ensure all the output files have unique names and they do not overwrite each other.



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



18. The clip algorithm will run for each of the inputs and create output files as 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.

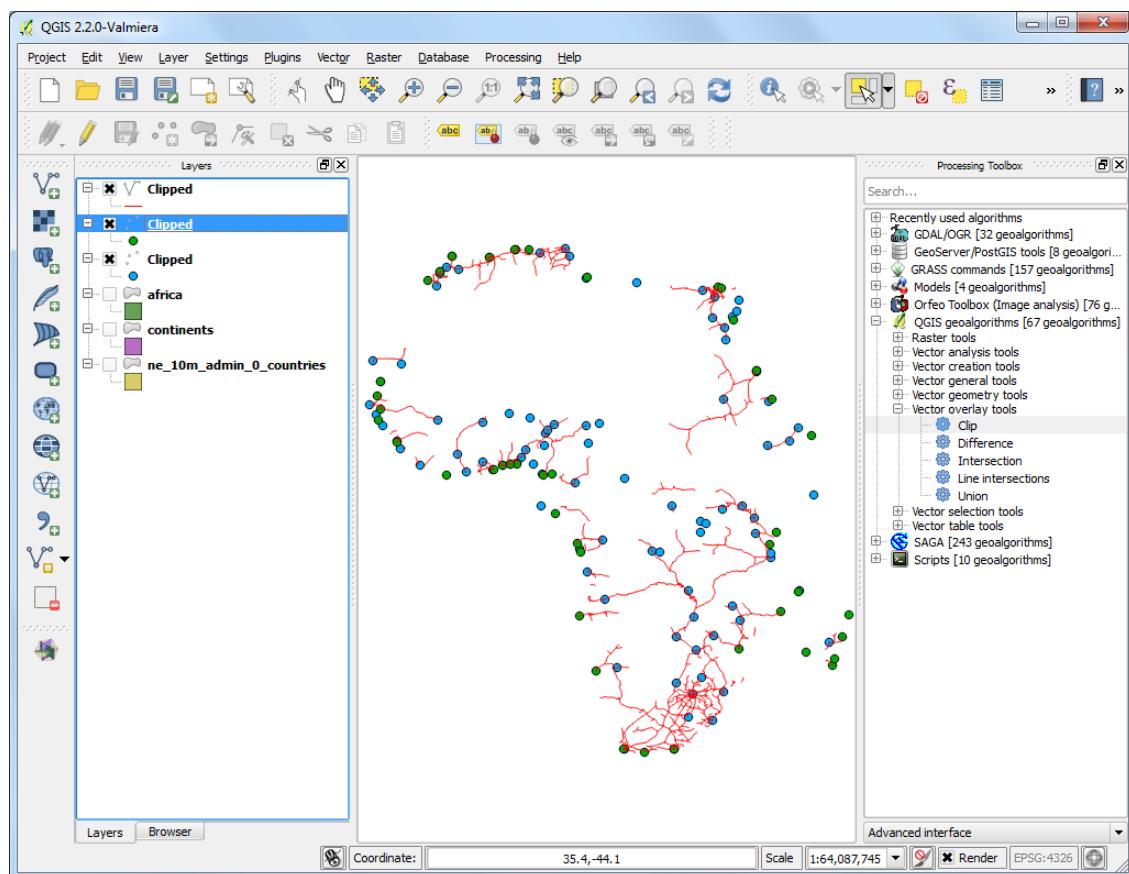


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(B)

## Automating Complex Workflows using Processing Modeler

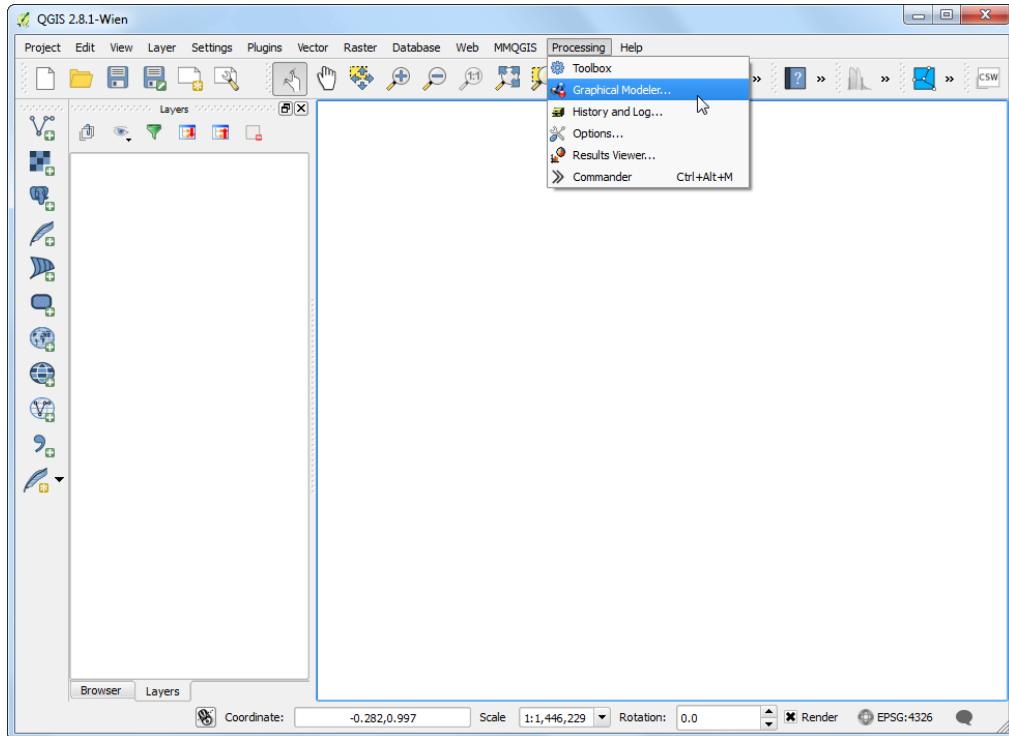
### Procedure

Our workflow for this exercise will have the following steps.

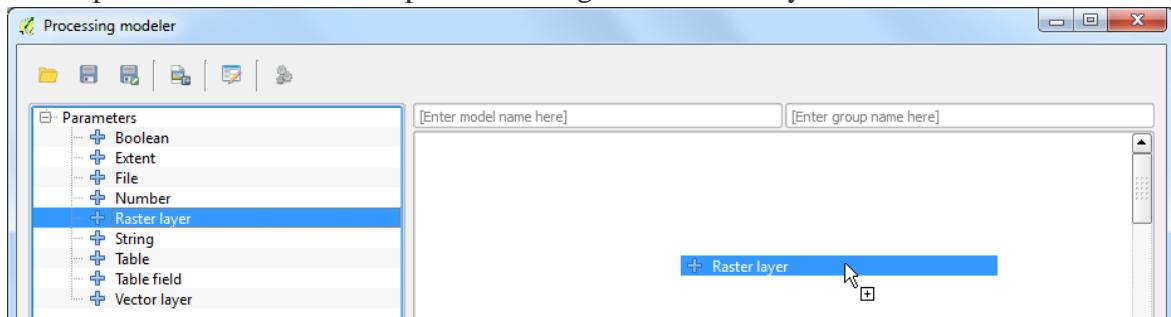
- Apply a **Majority Filter** algorithm to the input landcover raster. This will reduce noise in our output by eliminating isolated pixels.
- Convert the resulting raster to a polygon layer.
- Query for a class value from the attribute table of the polygon layer and create a vector layer for that class.

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.





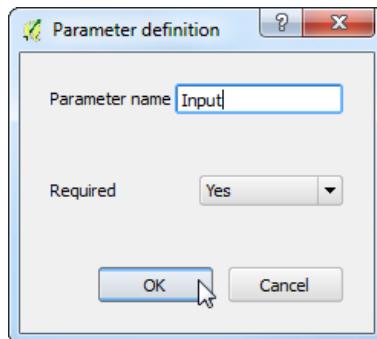
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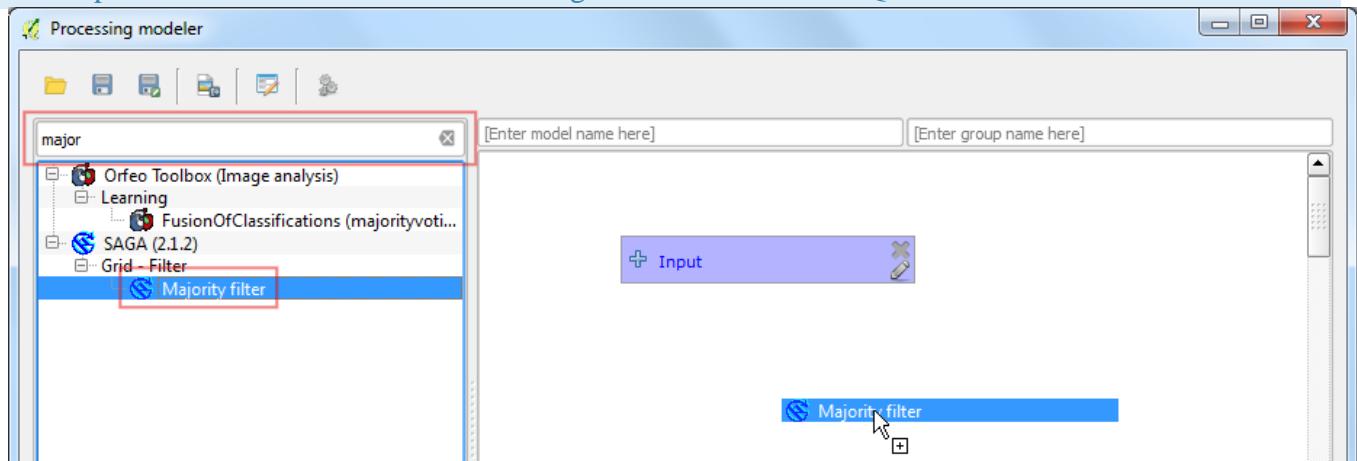
3. A Parameter definition dialog will pop-up. Enter **Input** as the Parameter name and mark **Yes** to Required. Click OK.



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.

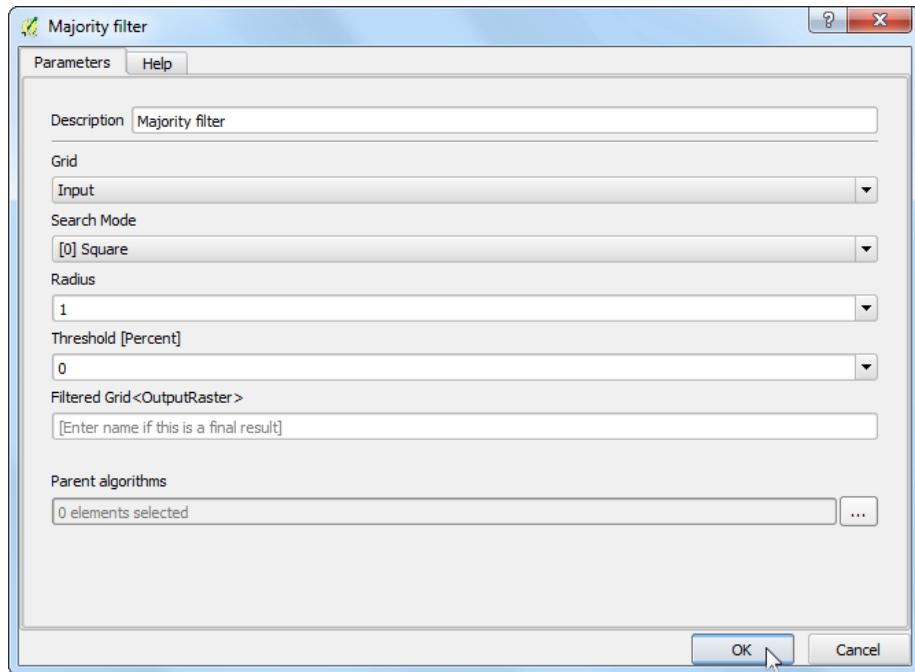


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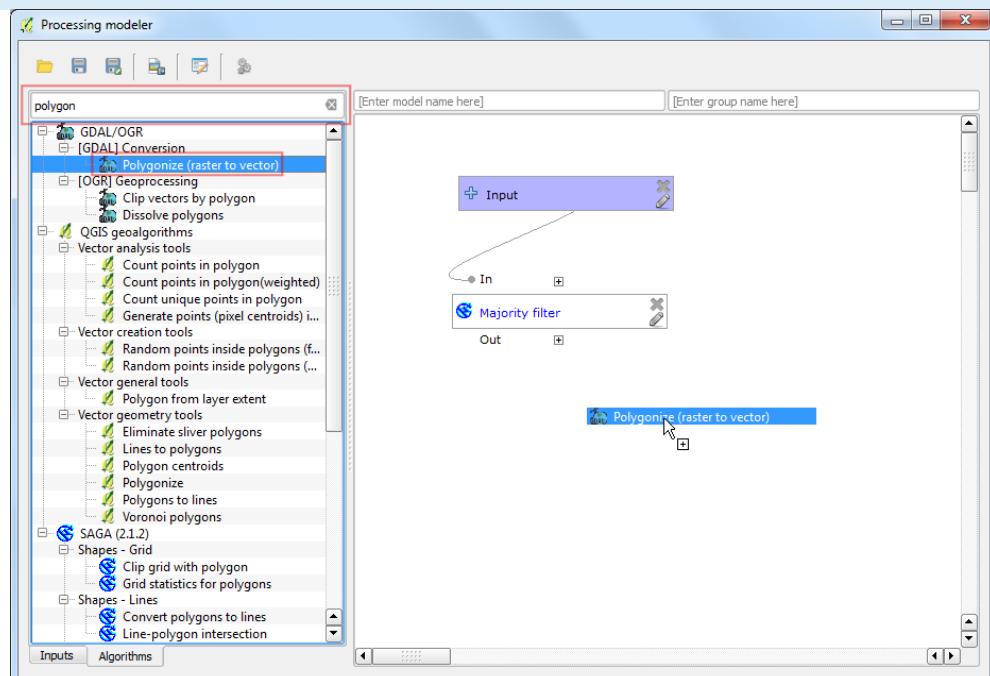
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6. You will note that there is now a new box named Majority Filter in the canvas and it is connected to the Input box. This is because the Majority Filter algorithm uses the Input raster as its input. The next step in our workflow is to convert the 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.

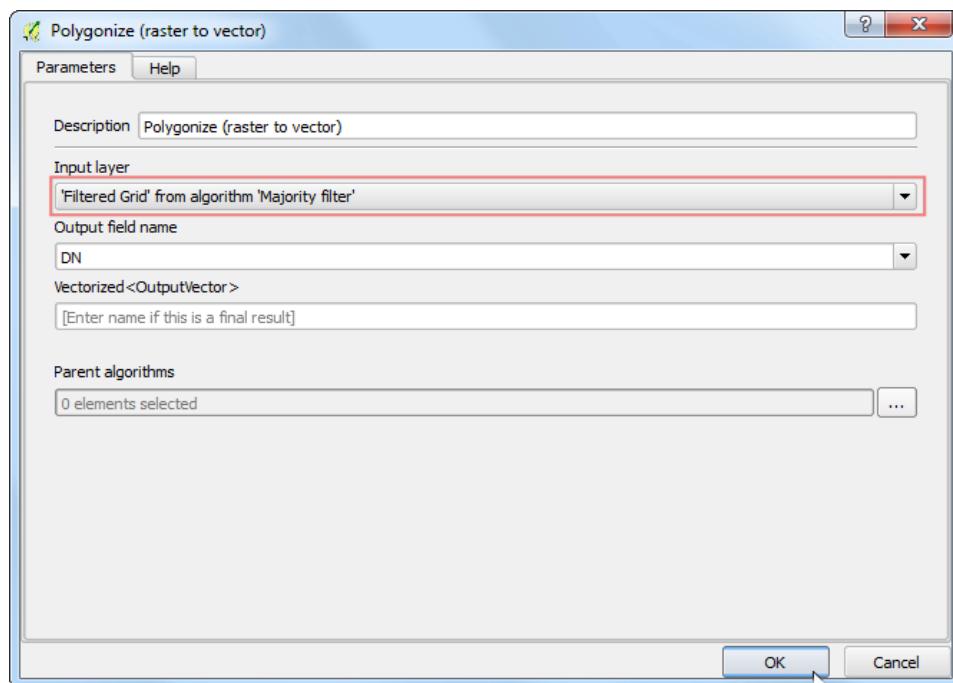


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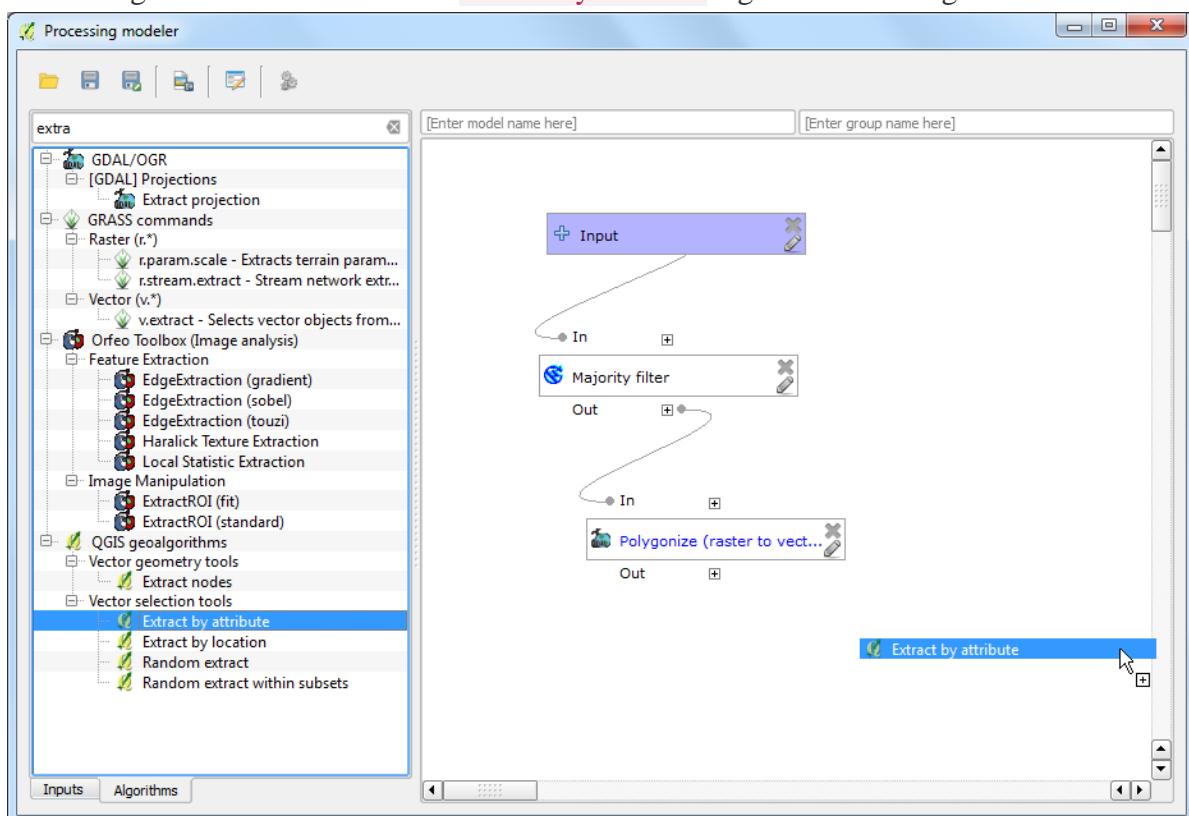
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8. The final step in the workflow is to query for a class value and create a new layer from the matching features. Search for the **Extract by attribute** algorithm and drag it to the canvas.



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



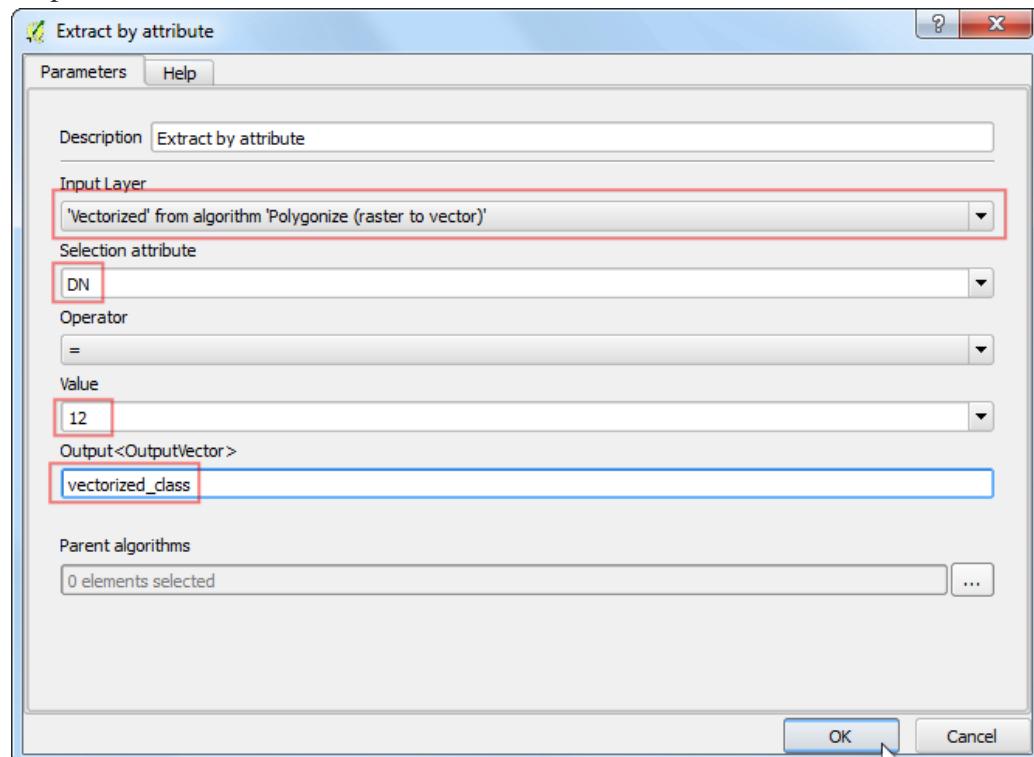
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be 12. (see [Code Values](#)). Enter **DN** as the Selection attribute and **12** as the value. As the output of this operation will be the final result, we need to name the output. Enter **vectorized class** as the Output.



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

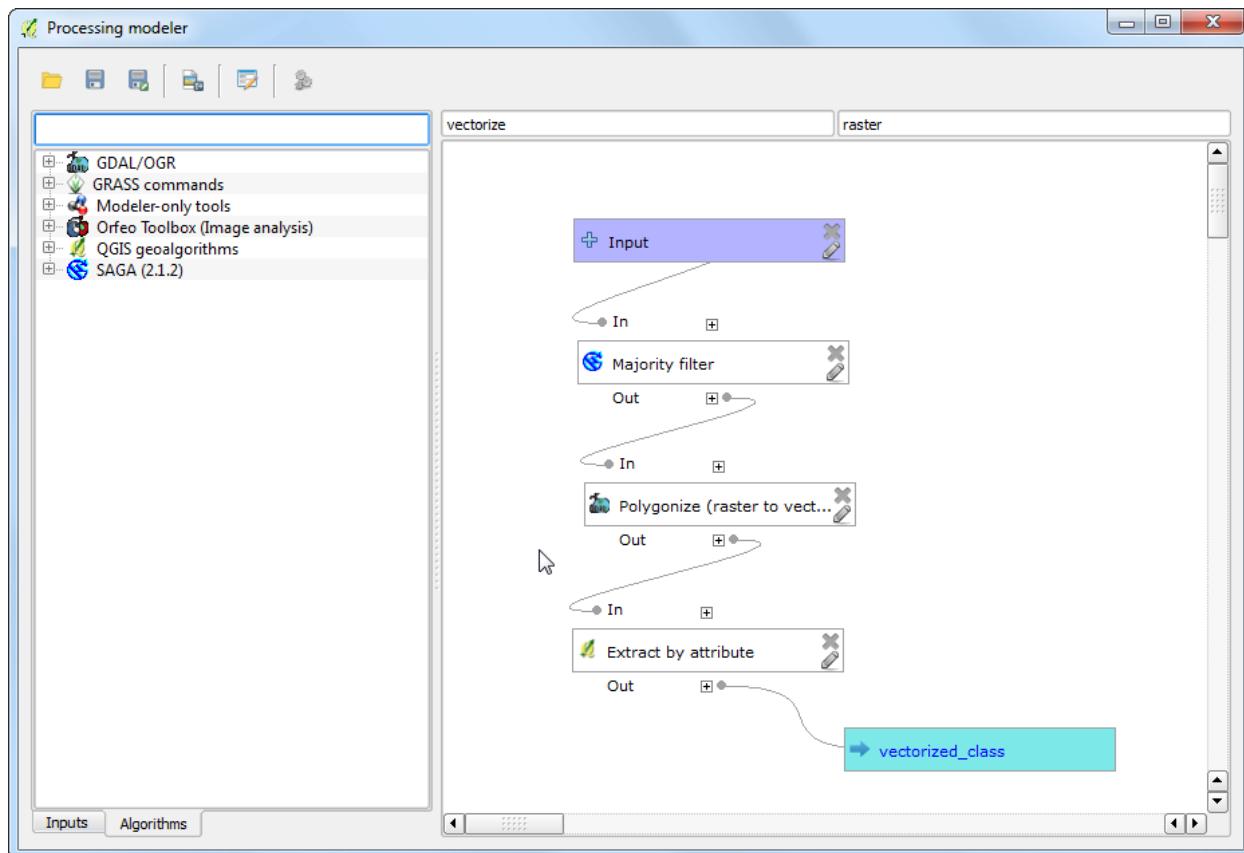


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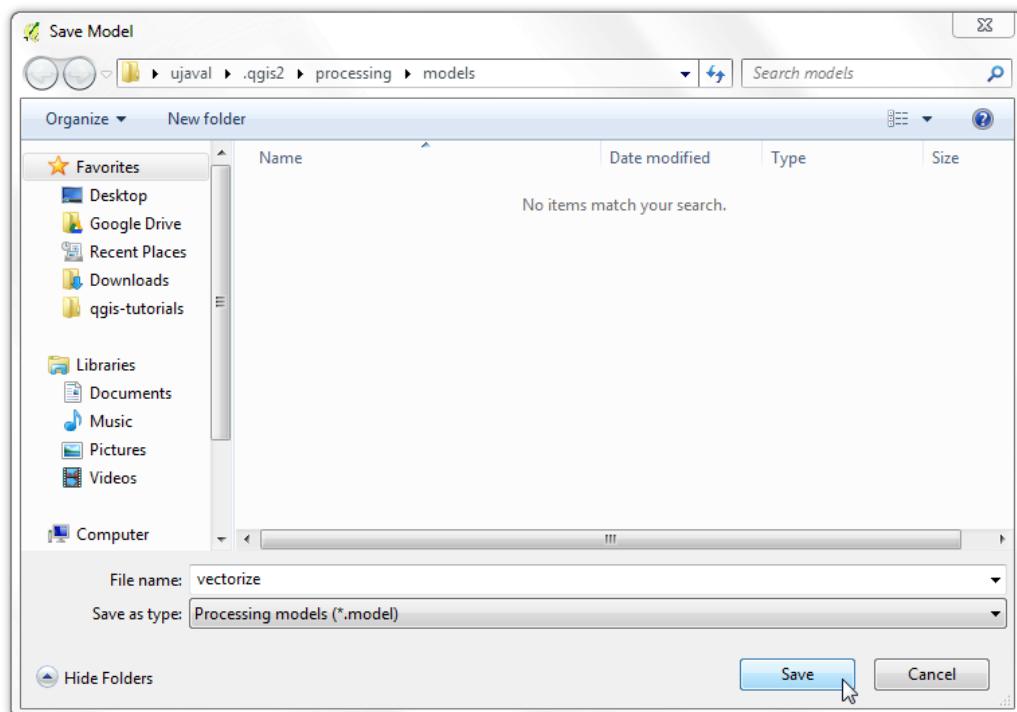
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11. Name the model **vectorize** and click Save.





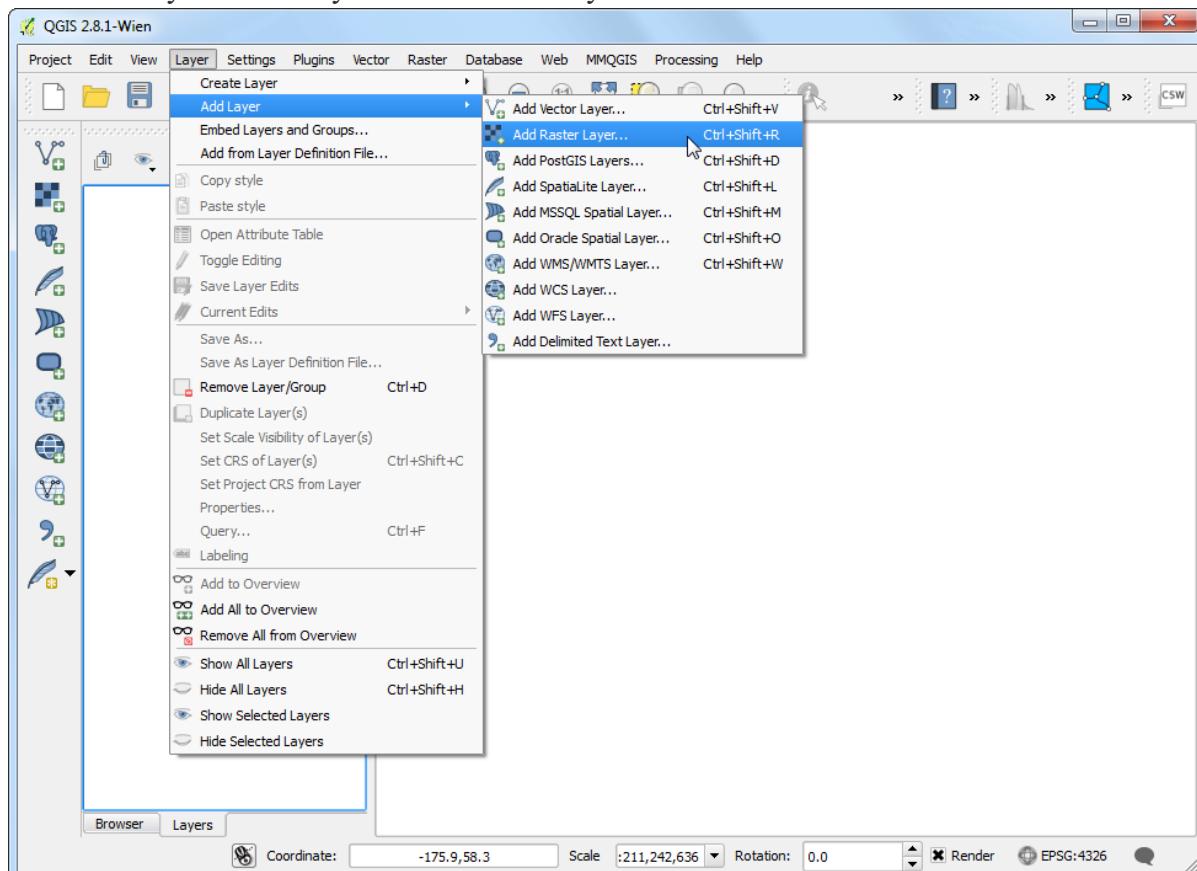
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12. Now it is time to test our model. Close the modeler and switch to the main QGIS window. Go to Layer ▶ Add Layer ▶ Add Raster Layer....



13. Browse to the downloaded **LC\_hd\_global\_2001.tif.gz** file and click Open. Once the raster is loaded, go to Processing ▶ Toolbox.

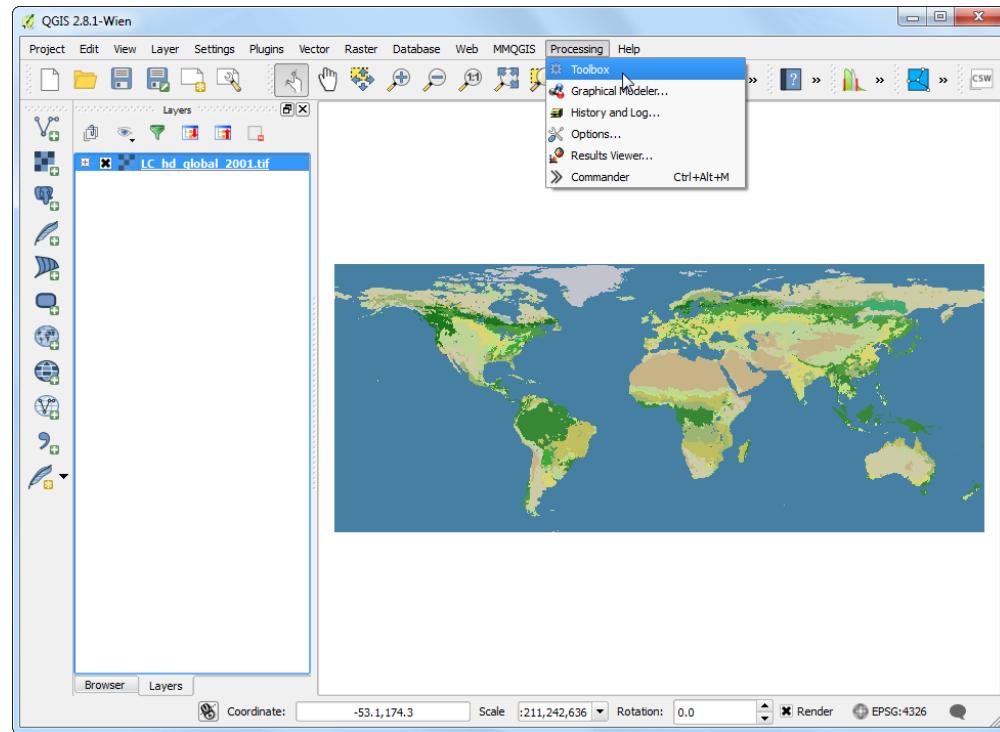


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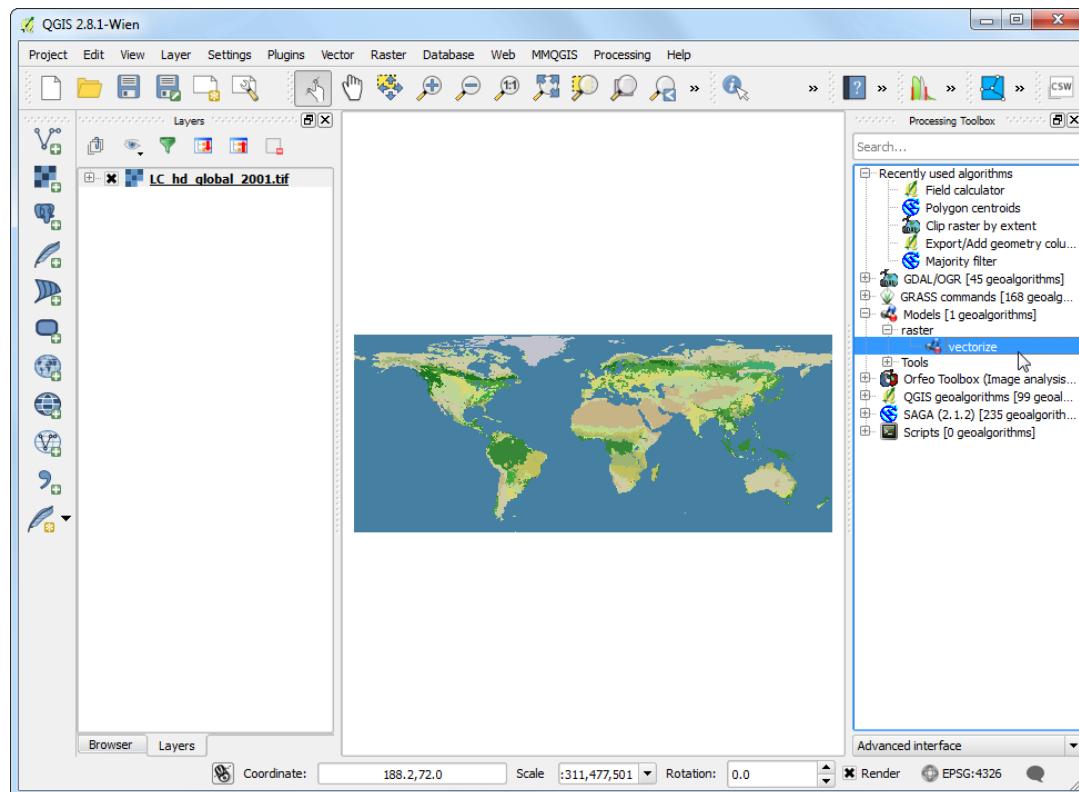
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14. Find the newly created model under Models > raster > vectorize. Double-click to launch the model.



15. Select LC\_hd\_global\_2001 as the Input and click Run.

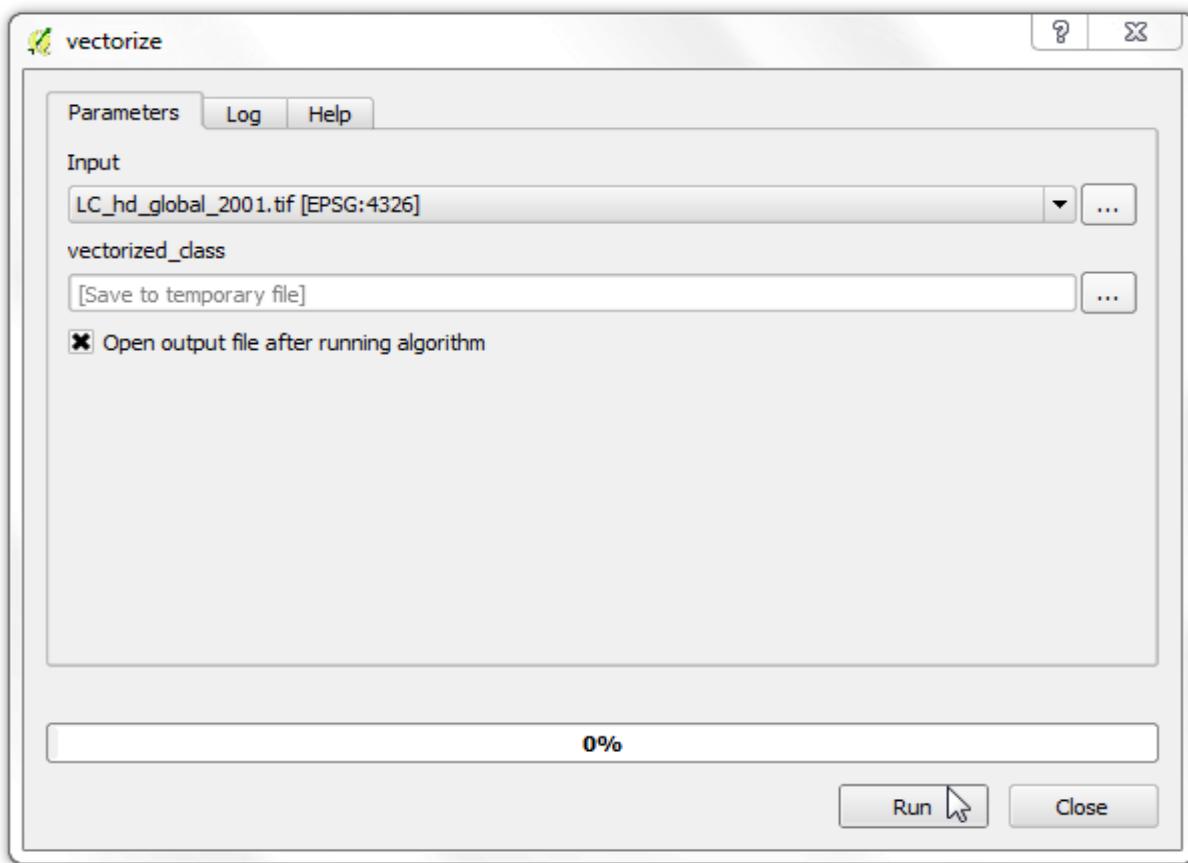


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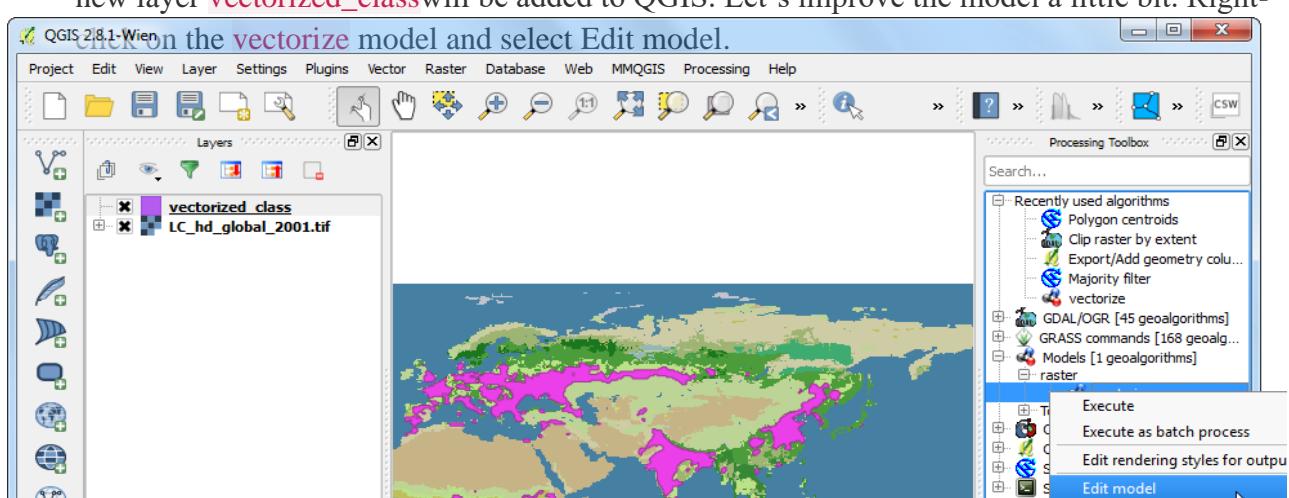
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16. You will see all the steps being executed without any user input. Once the processing finishes, a new layer **vectorized\_class** will be added to QGIS. Let's improve the model a little bit. Right-click on the **vectorize** model and select Edit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



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

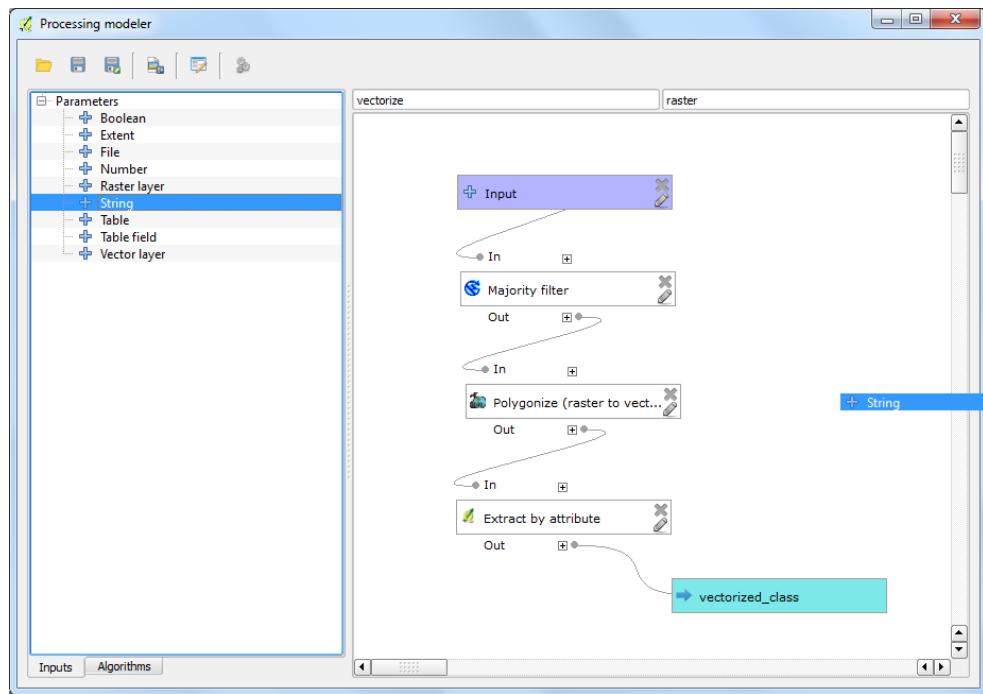


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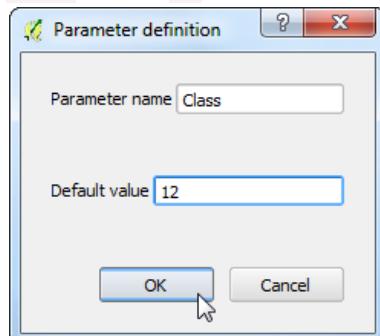
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18. Enter the Parameter Name as **Class**. Enter **12** as the Default value.



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

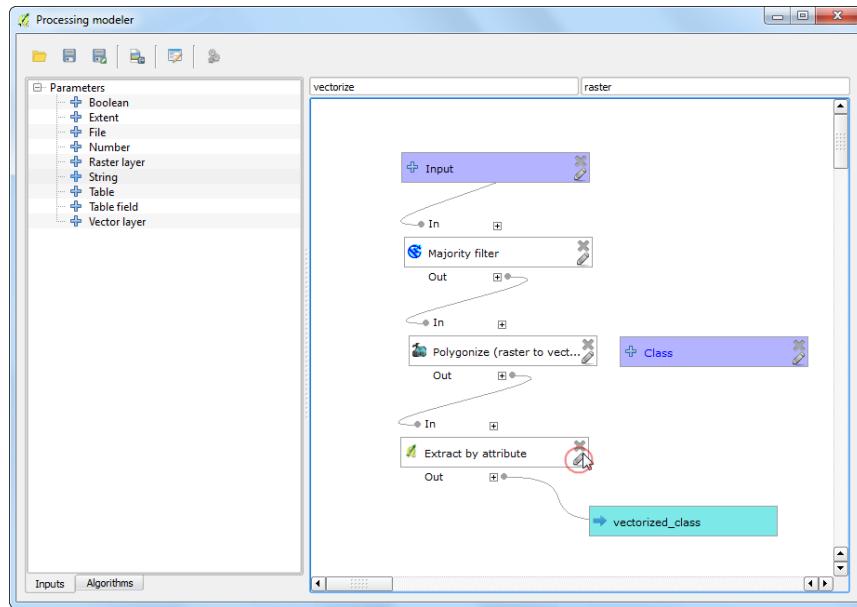


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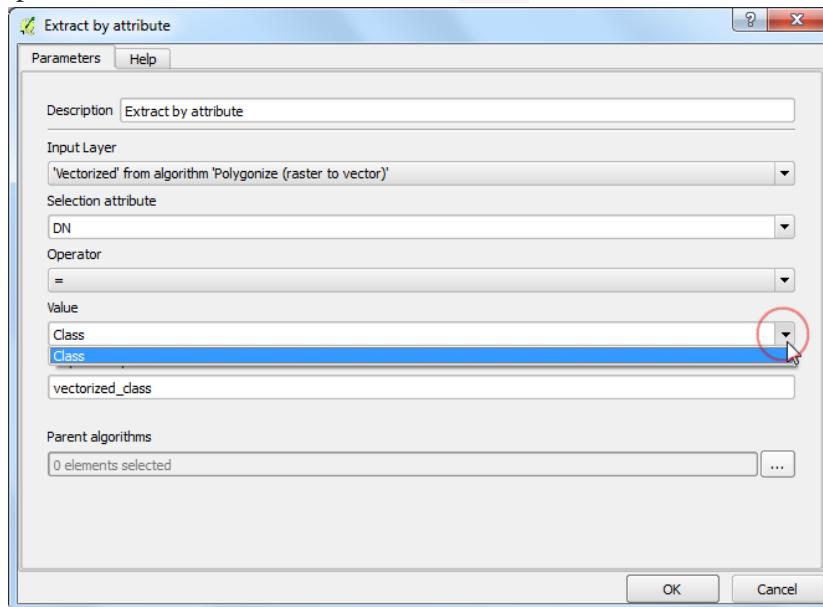
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20. Click the dropdown arrow for Value and select **Class**. Click OK.



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.

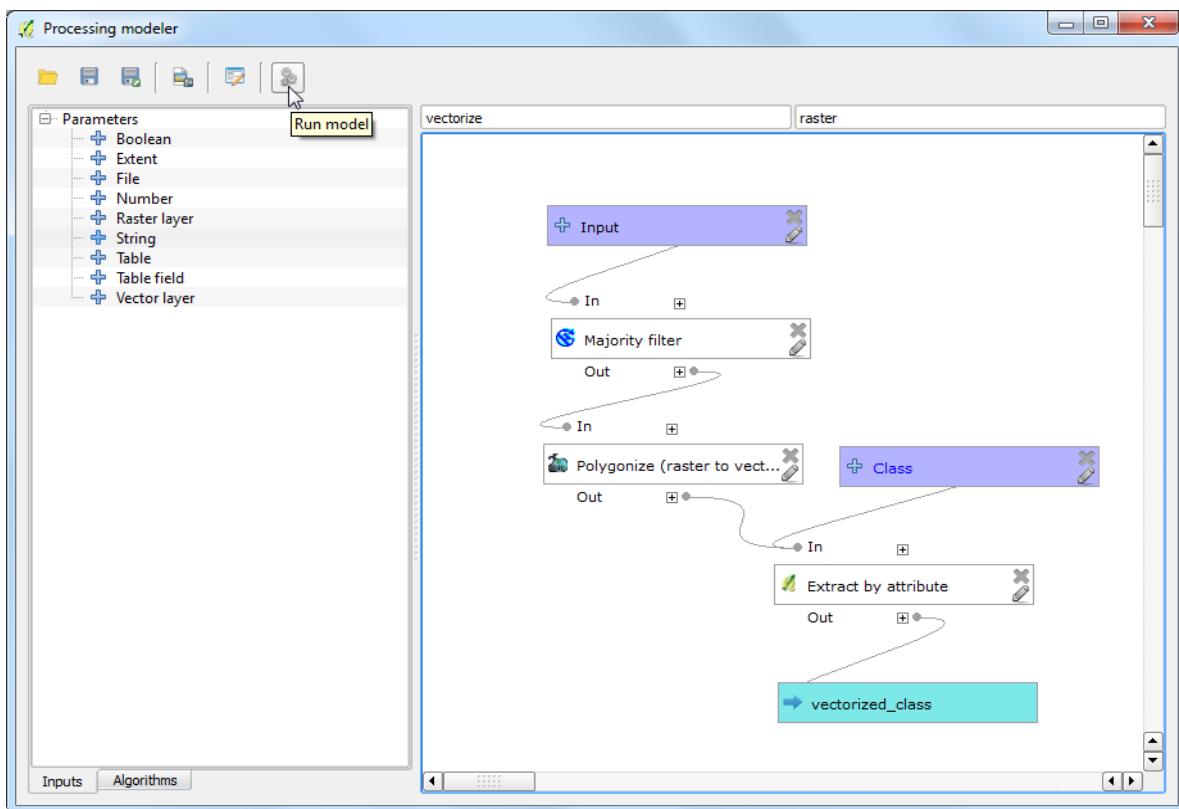


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22. Notice that the model dialog has a new editable field called Class. Enter **16** as the Class value and click Run.

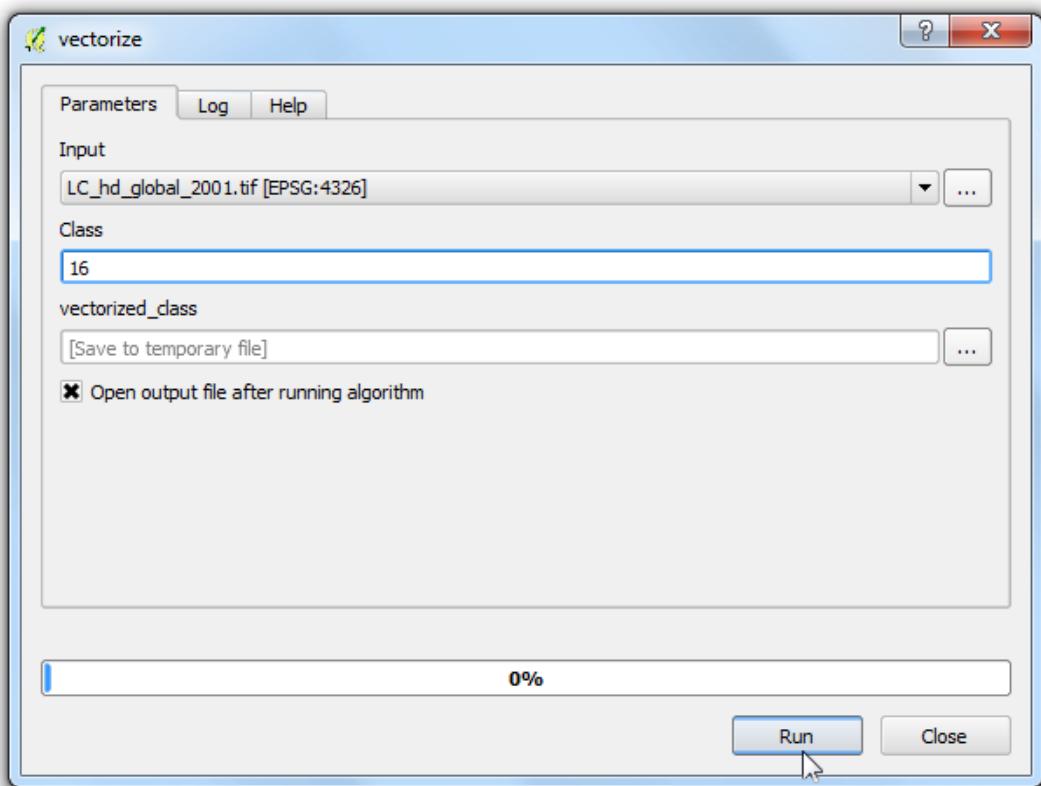


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23. Once the processing finishes, you will see that with just a click of a button we were able to run a complex workflow and extract the area for class 16.

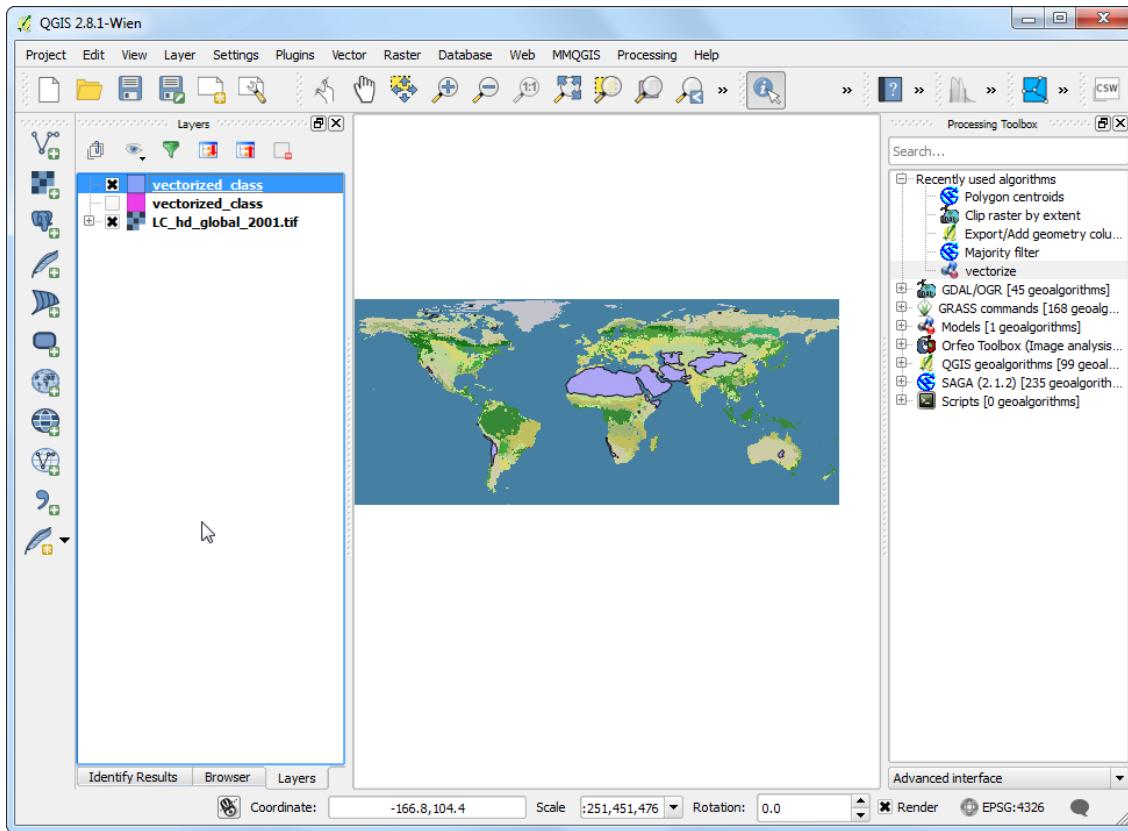


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24. Now that our model is ready, we can run it just as easily on a new raster layer. Load the [LC\\_hd\\_global\\_2012.tif.gz](#) file by going to Layer ▶ Add Layer ▶ Add Raster Layer.....Click the vectorize` model from the Processing Toolbox panel.

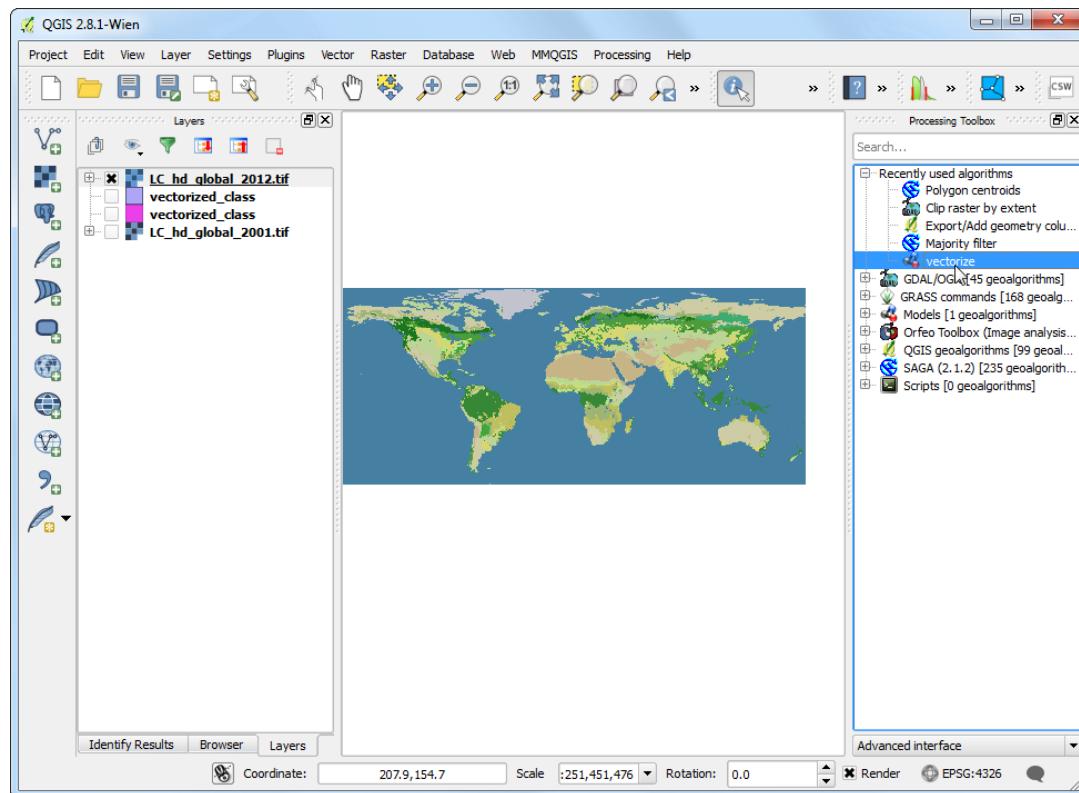


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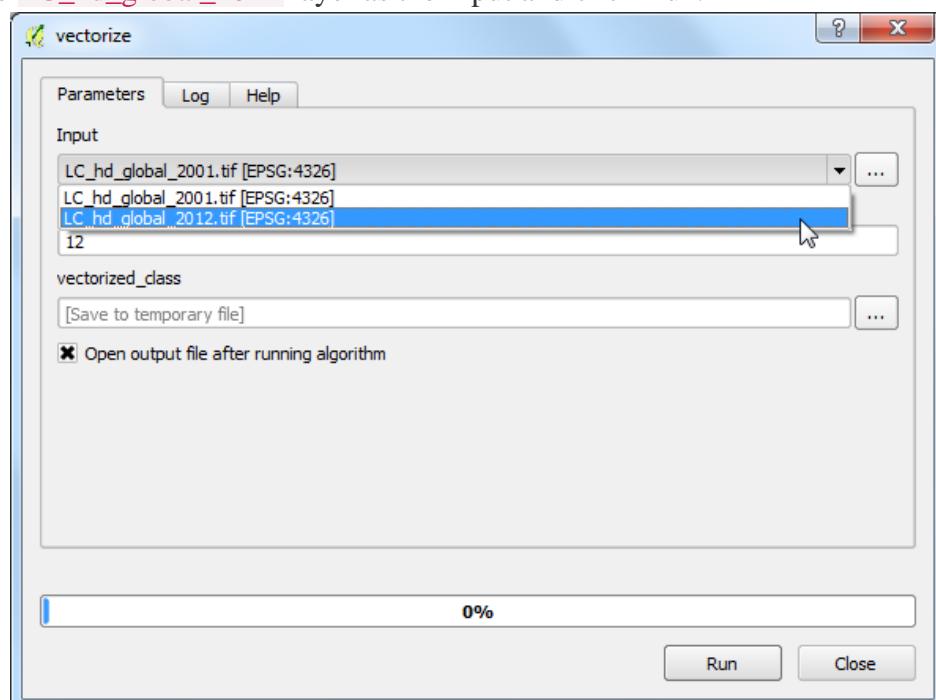
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25. Pick the **LC\_hd\_global\_2012** layer as the Input and click Run.



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

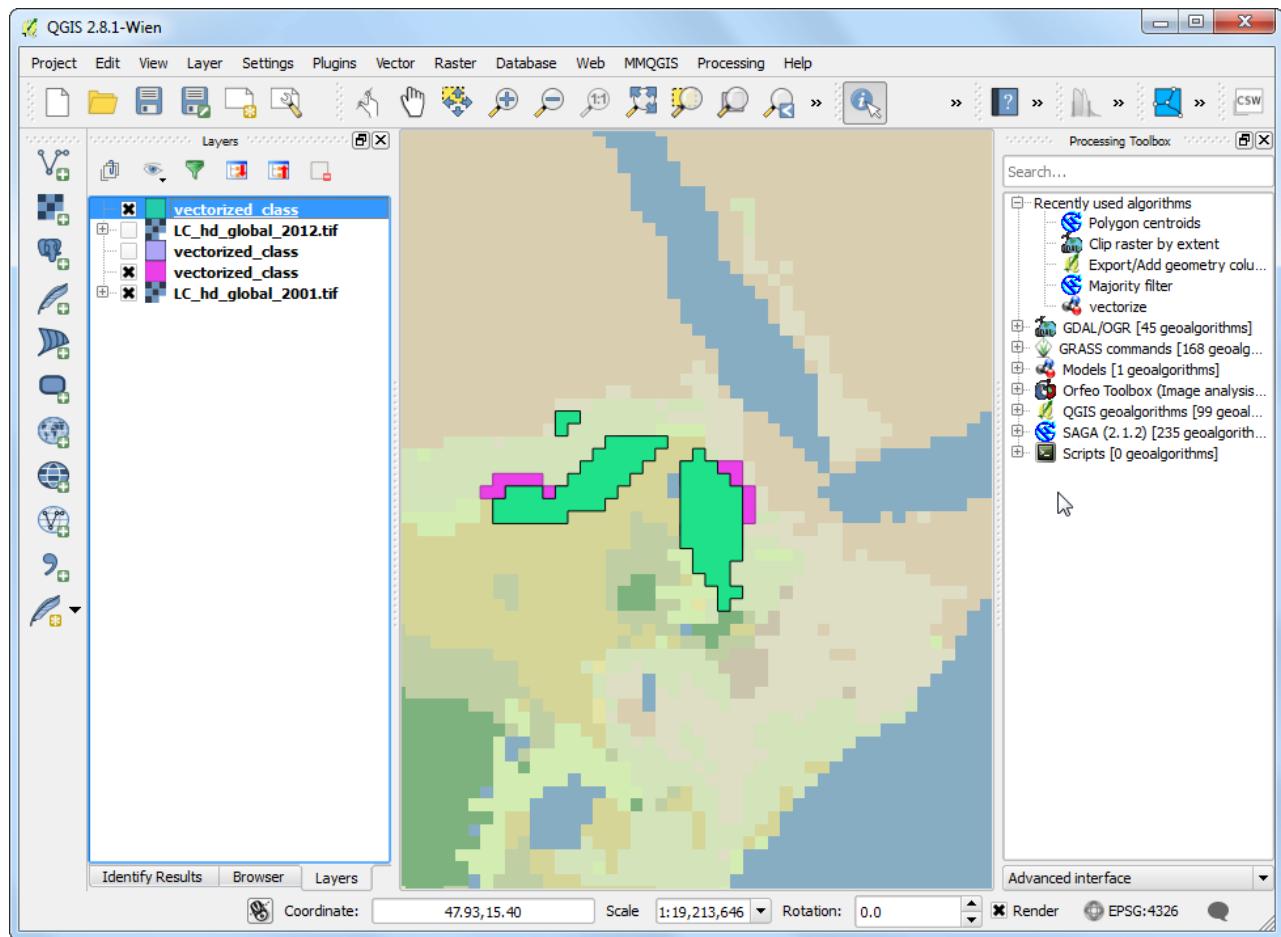


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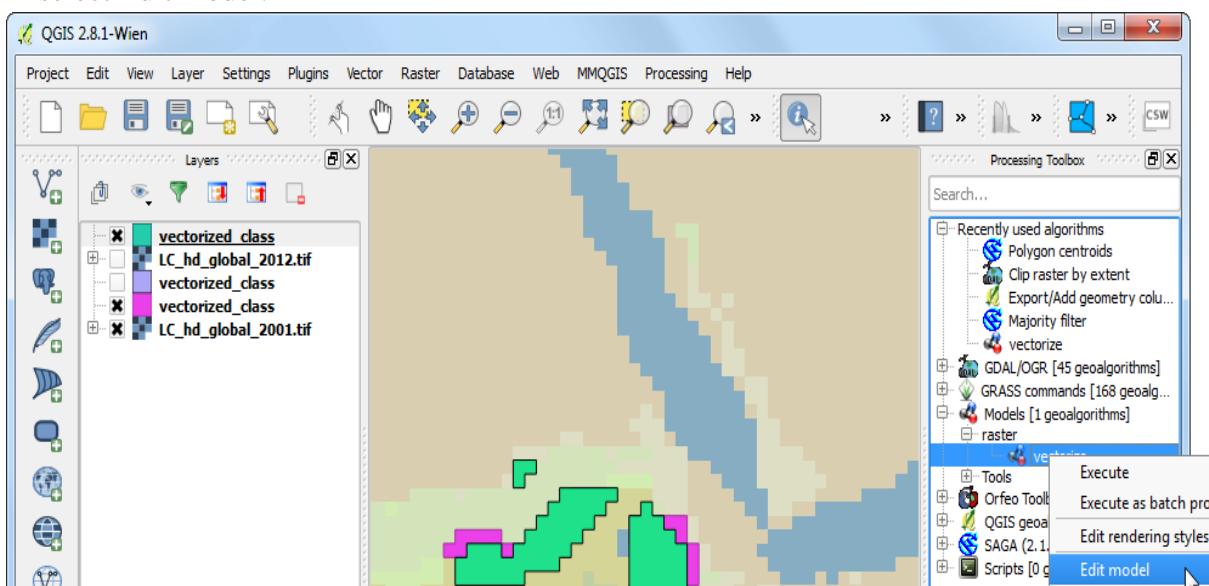
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27. It is always a good idea to add documentation to your model. The modeler has a built-in Help editor that allows you to embed help directly in the model. Right-click the **vectorize** model and select Edit model.



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

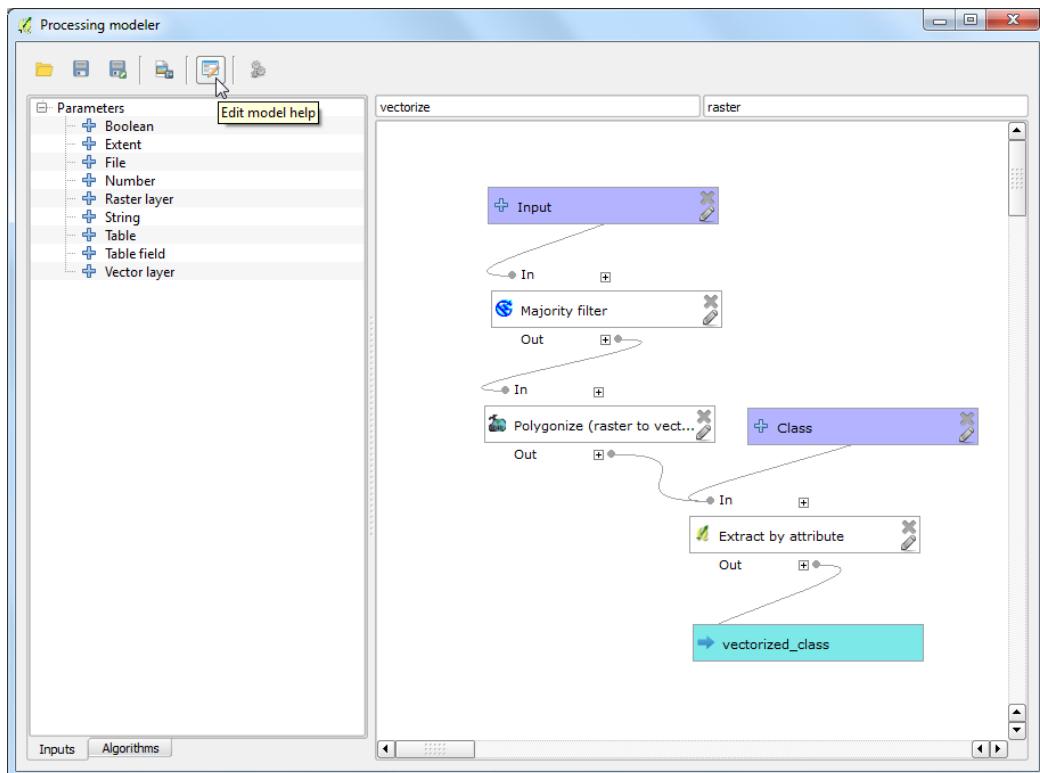


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29. In the Help editor dialog, select any item from the Select element to edit panel and enter the help text in Element description. Click OK. This help will be available in the Help tab when you launch the model to run.

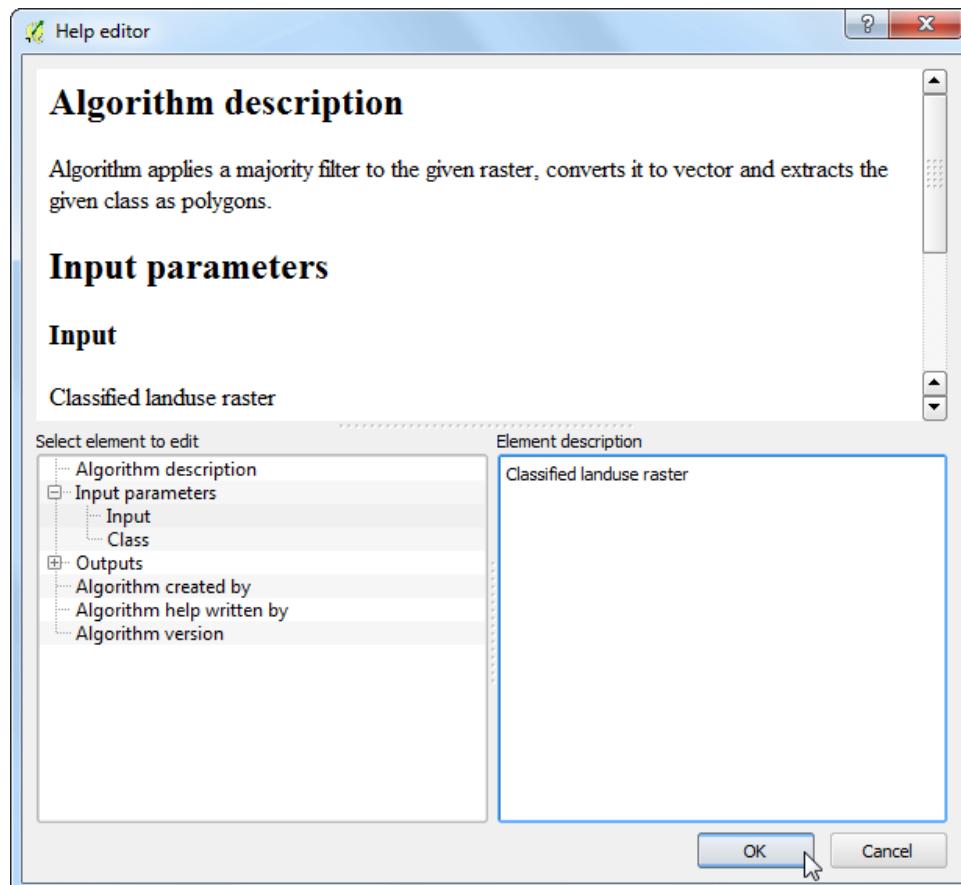


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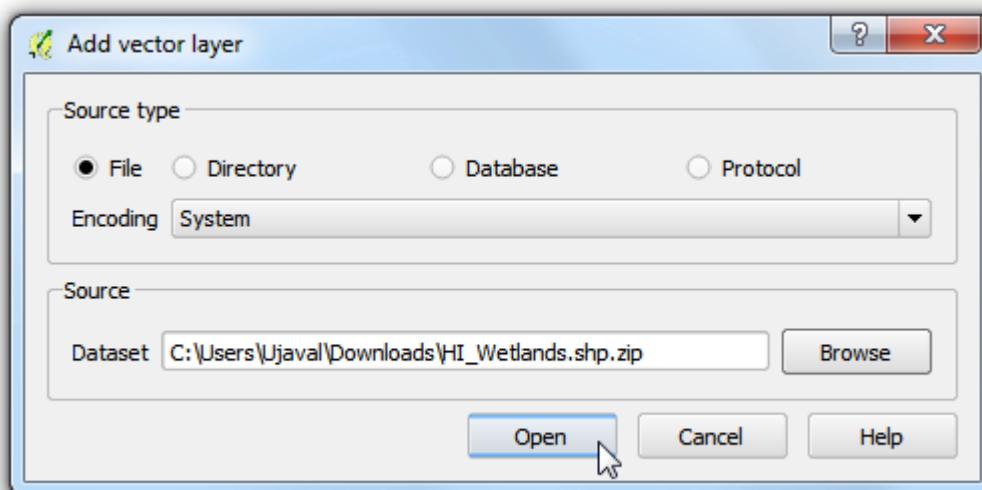
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## (c) Automating Map Creation with Print Composer Atlas

### Procedure

1. Launch QGIS and go to Layer ▶ Add Layer ▶ Add Vector Layer.
2. Browse to the **HI\_Wetlands.zip** file and click Open.



3. Select the **HI\_Wetlands\_Poly** layer and click OK.

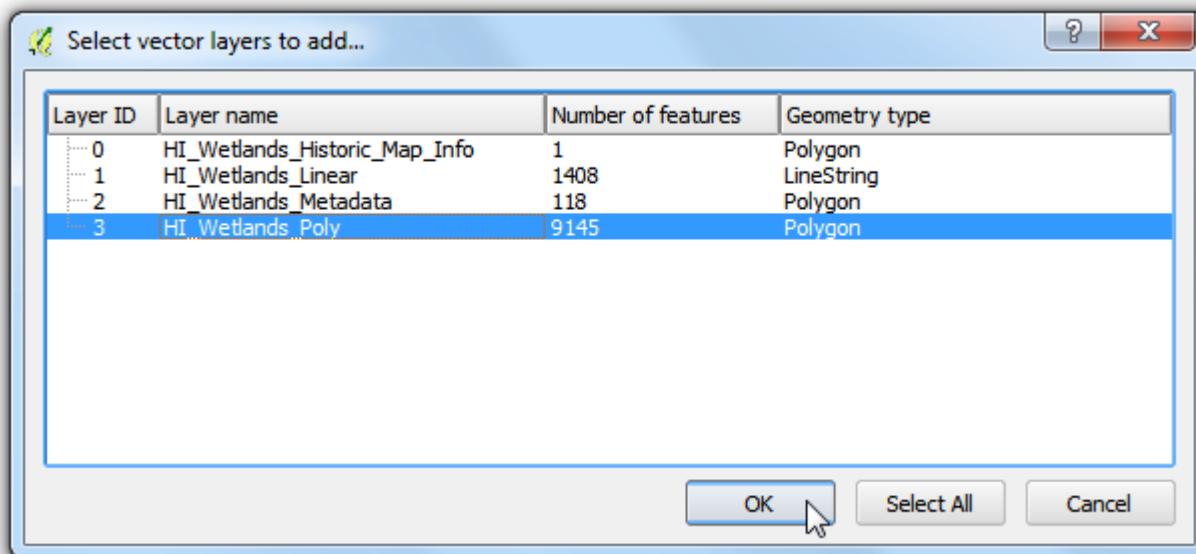


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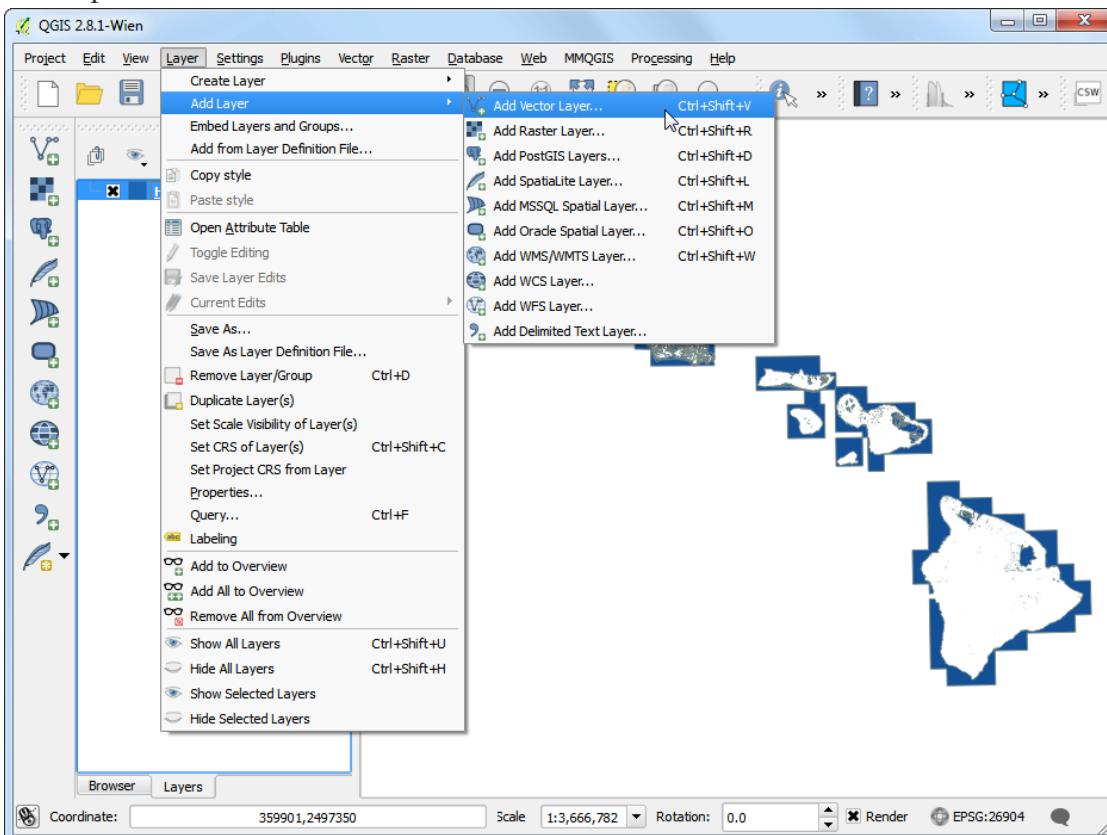
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4. You will see the polygons representing the wetlands in the entire state of Hawaii. Since we want to make separate wetlands map for each county in the state, we will need the county boundaries layer. Go to Layer ▶ Add Layer ▶ Add Vector Layer and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



5. Go to Project ▶ New Print Composer.

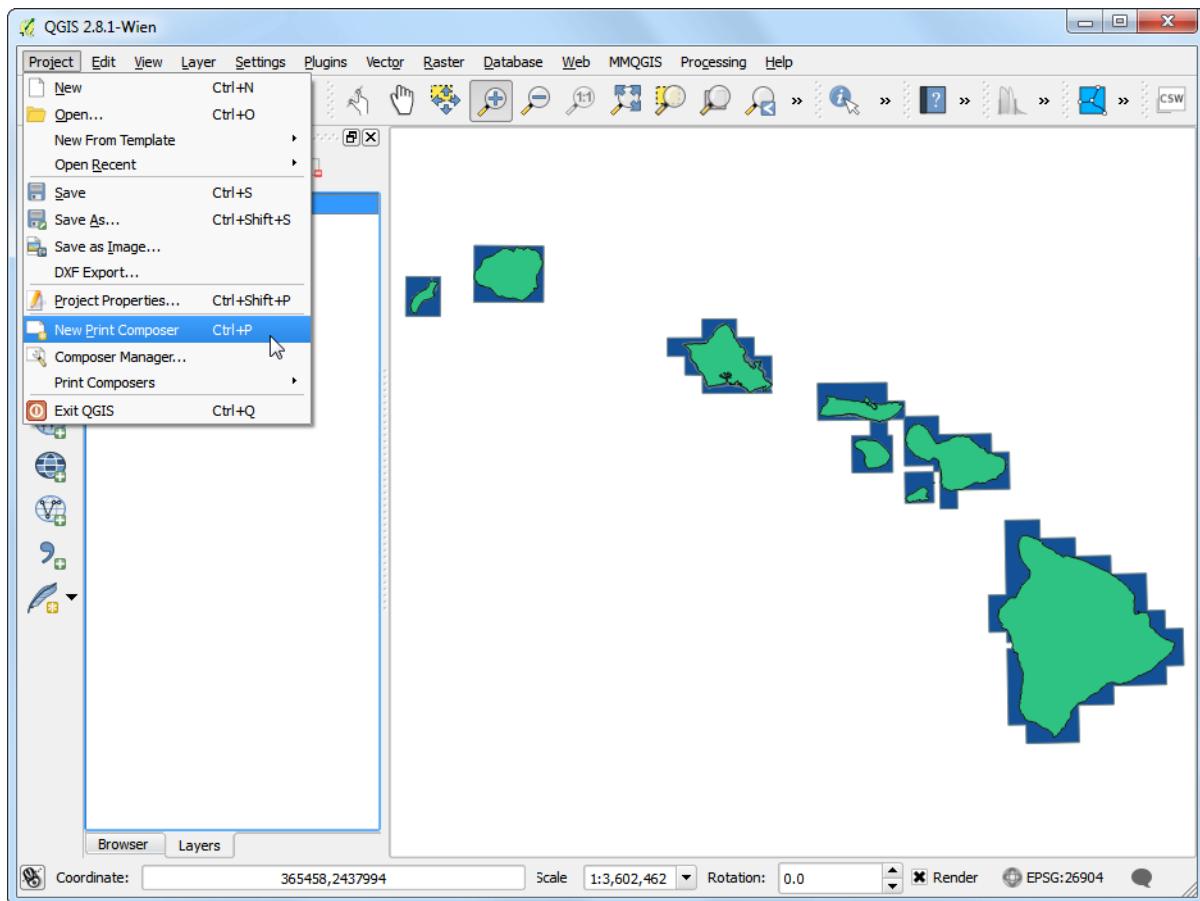


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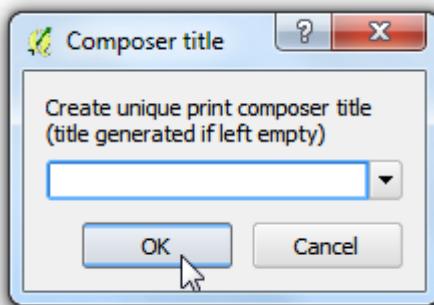
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6. Leave the composer title field empty and click OK.



7. Go to Layout ▶ Add Map.

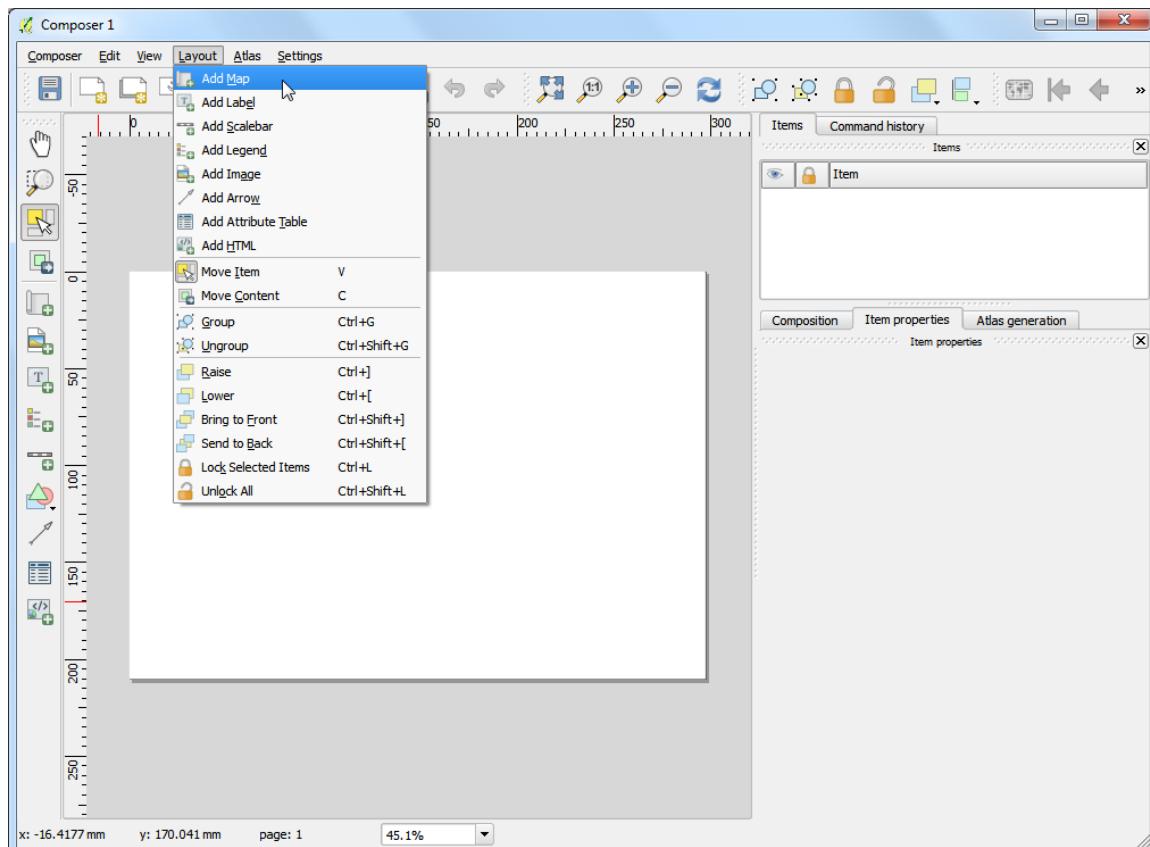


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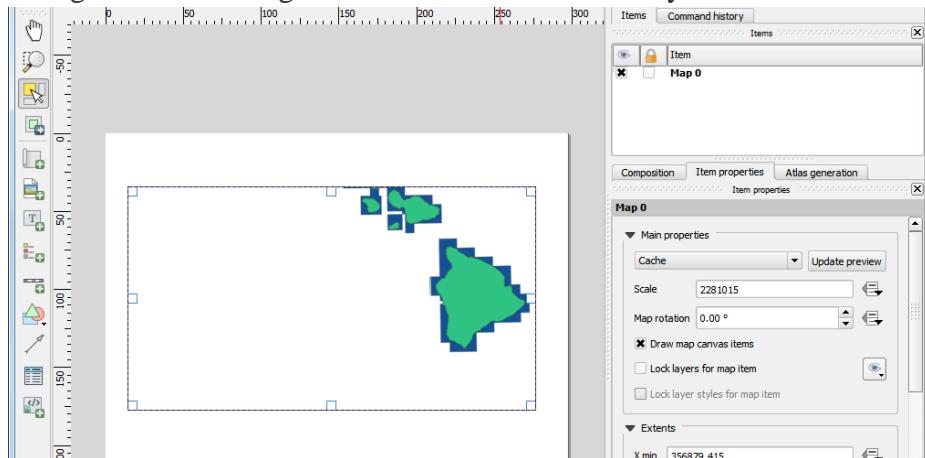
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- Drag a rectangle while holding the left mouse button where you would like to insert the map.



- 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.

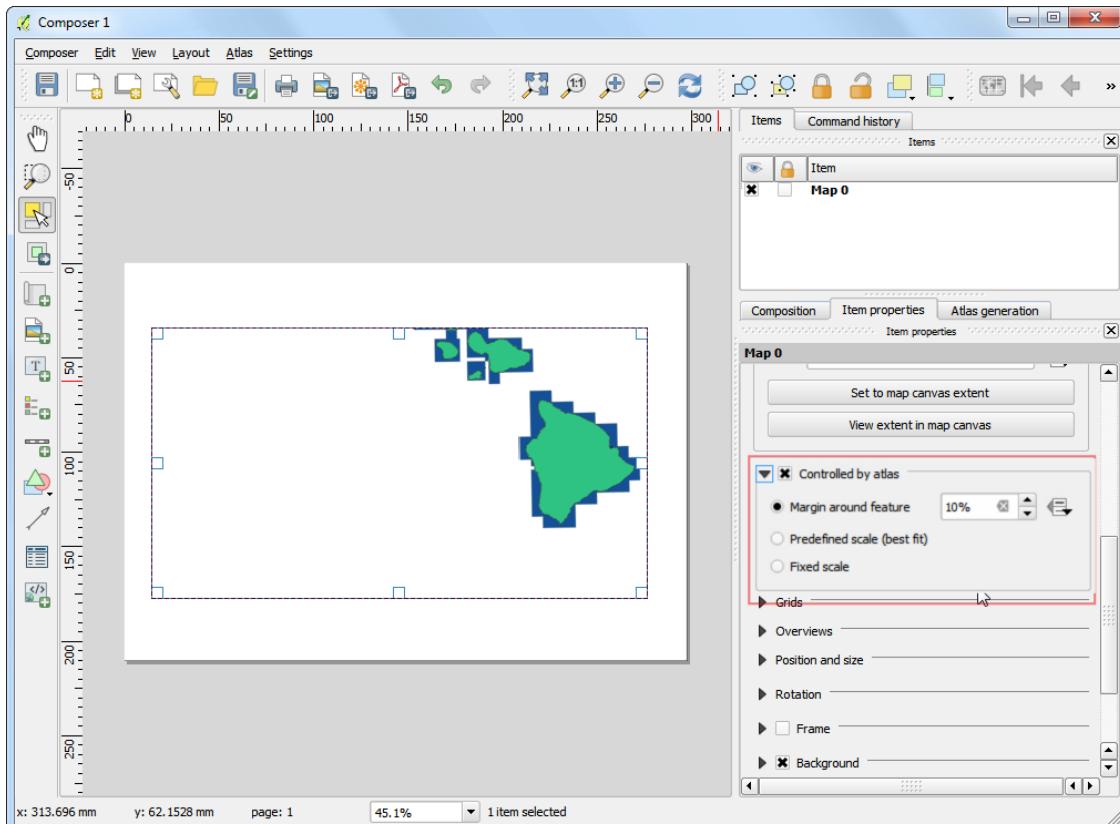


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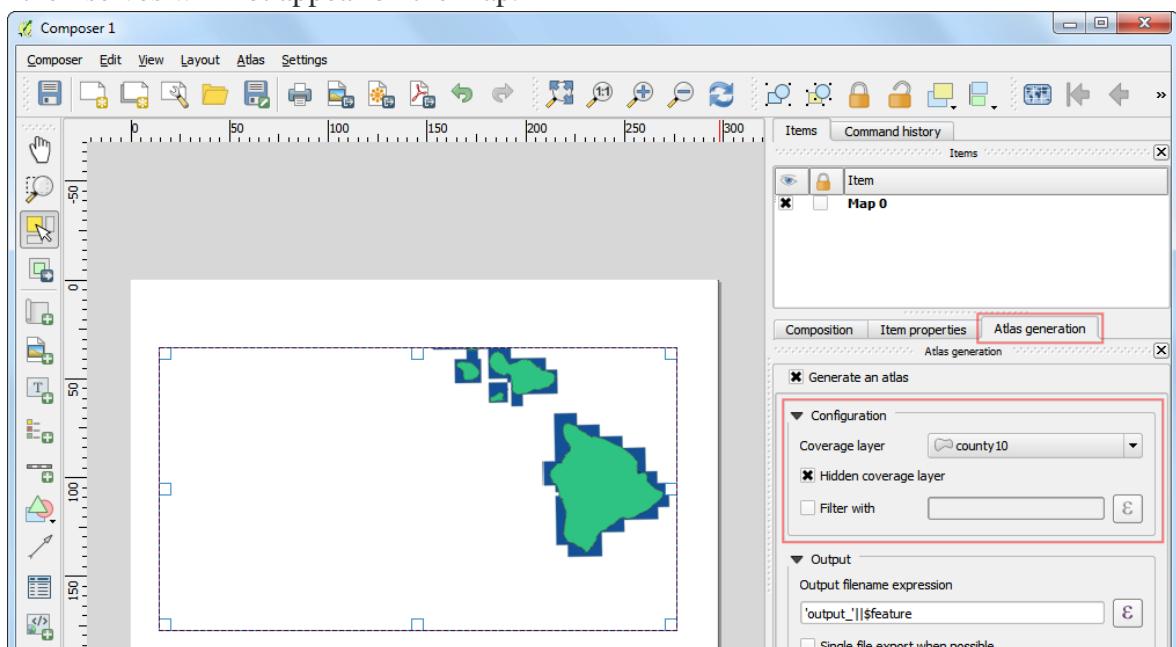
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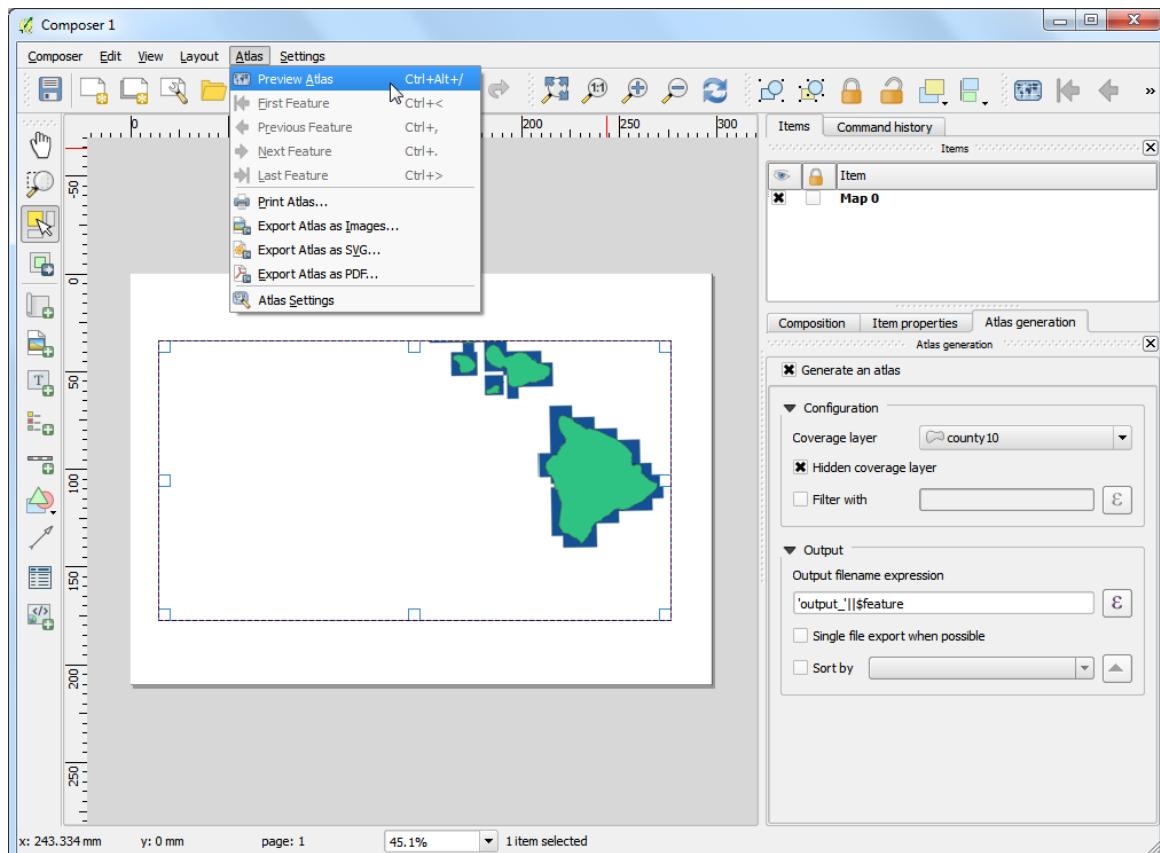


10. Switch to the Atlas generation tab. Check the Generate an atlas box. Select the **county10** as the Coverage layer. You can also check the Hidden coverage layer so that the features themselves will not appear on the map.

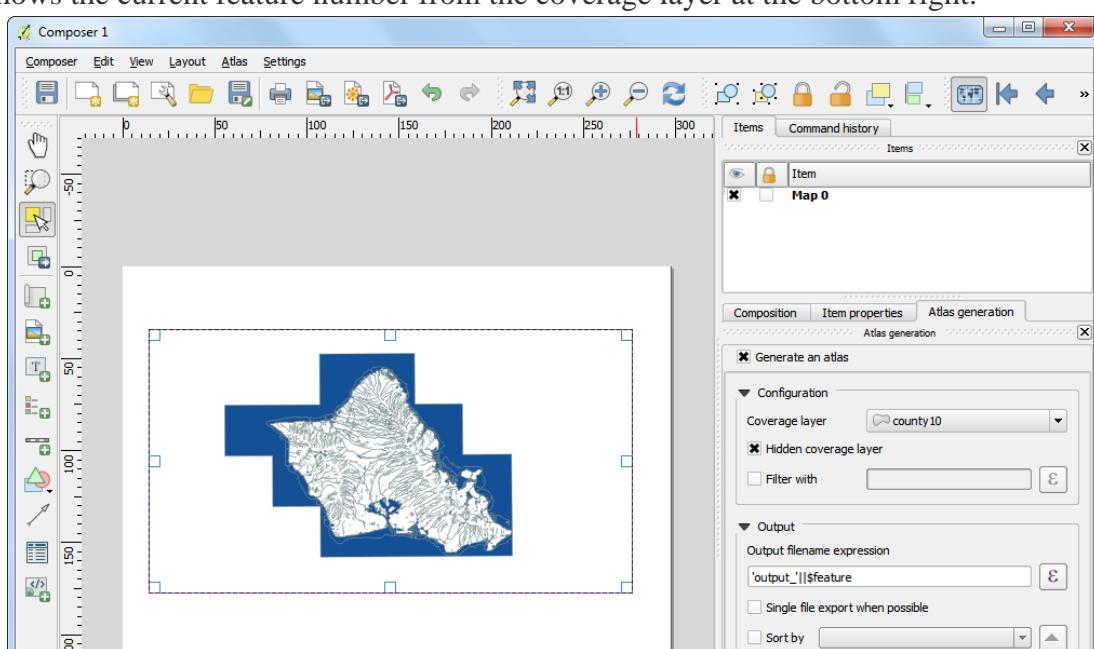




11. You will notice that the map image does not change after configuring the Atlas settings. Go to **Atlas > Preview Atlas**.

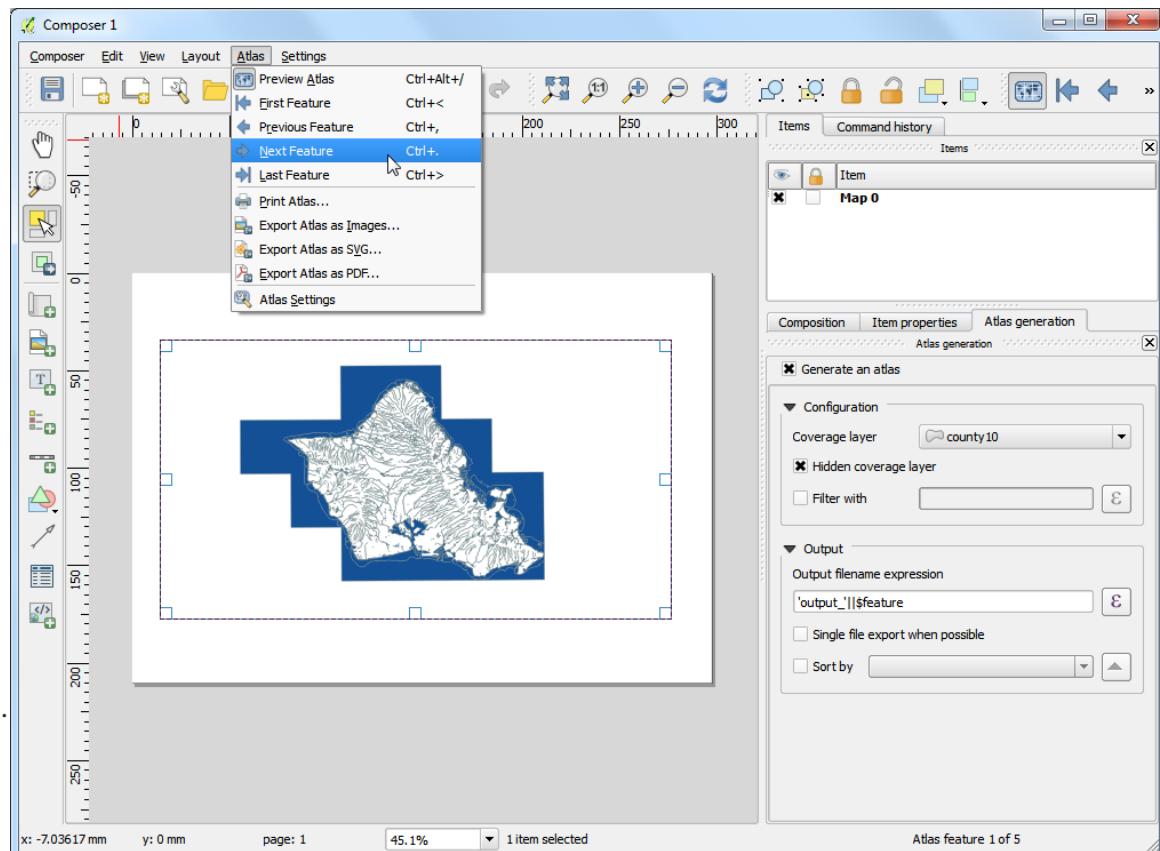


12. Now you will see the map refresh and show how individual map will look like. Notice that it shows the current feature number from the coverage layer at the bottom right.





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



14.

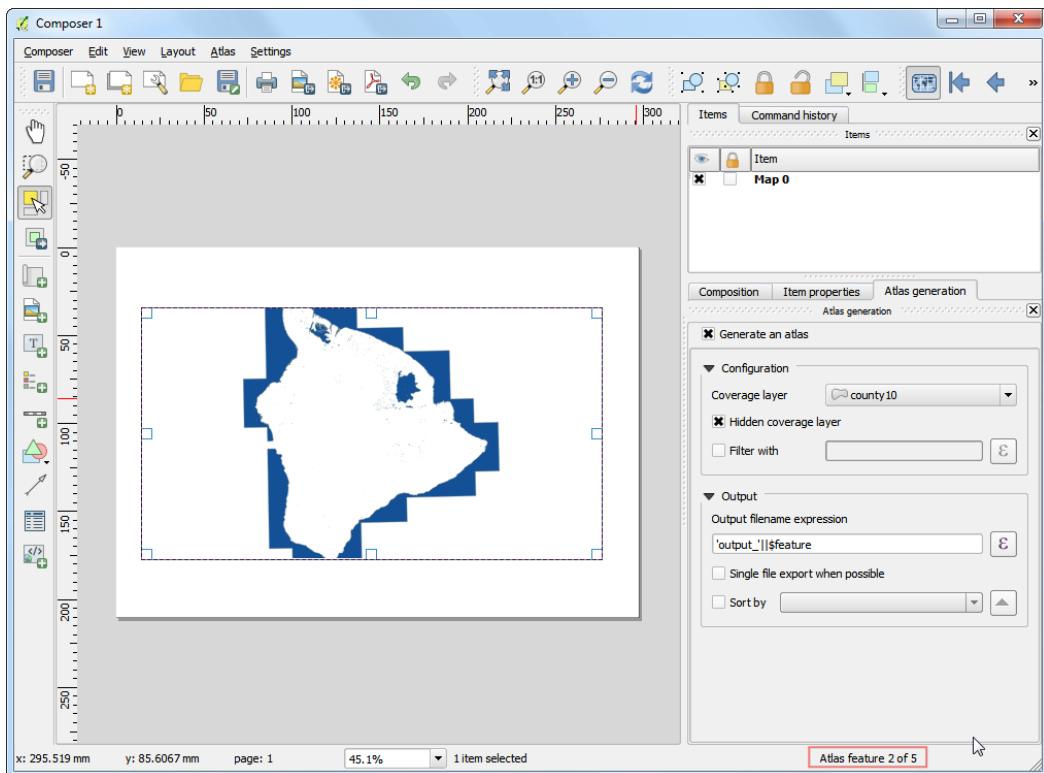


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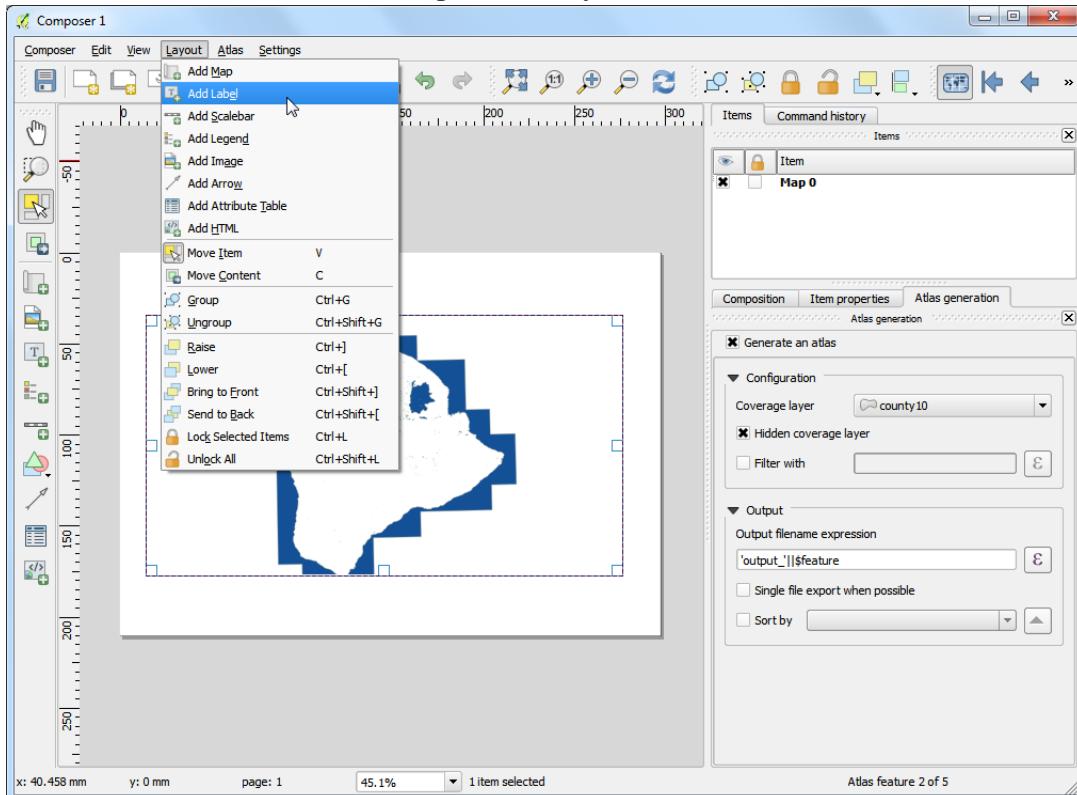
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15. Let's add a label to the map. Go to Layout ▶ Add Label.



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

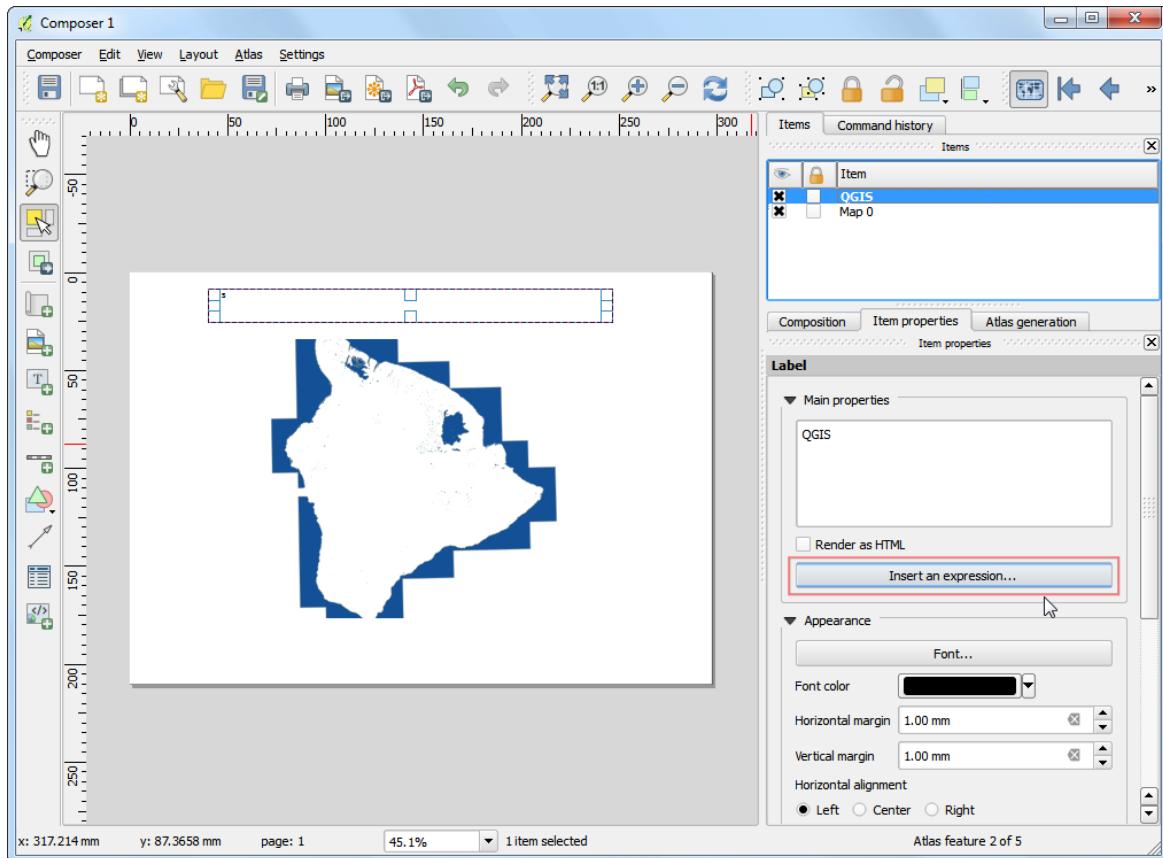


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17. The label of the map can use the attributes from the coverage layer. The **concat** function is used to join multiple text items into a single text item. In this case we will join the value of the **NAME10** attribute of the **county10** layer 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.

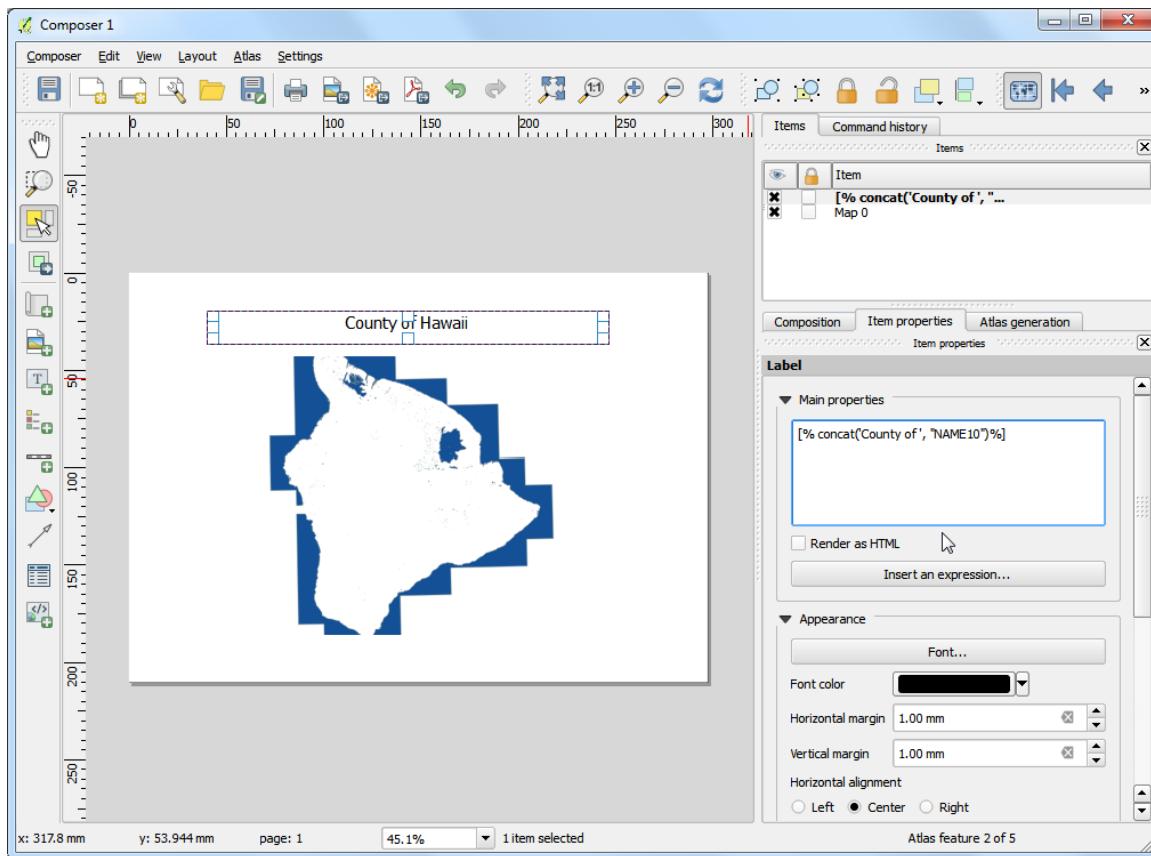


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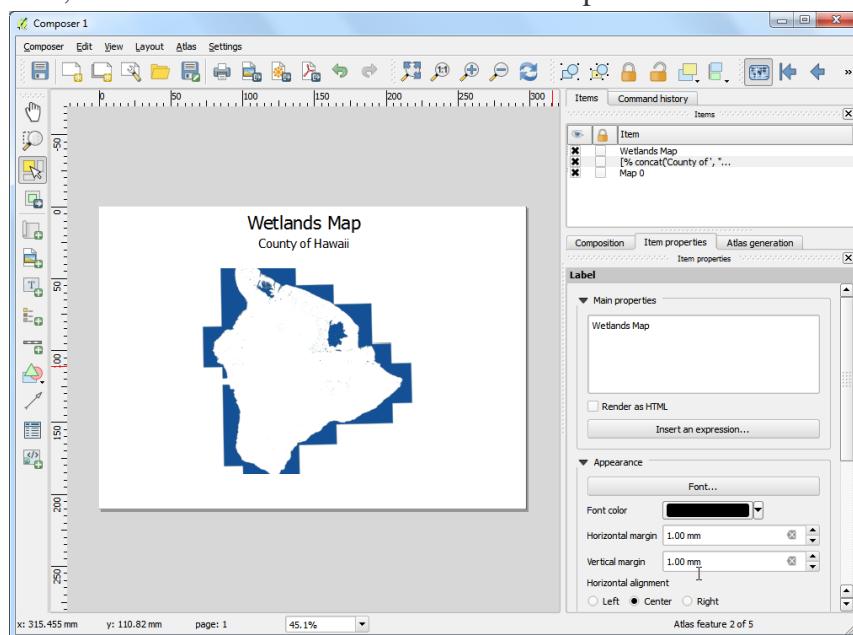
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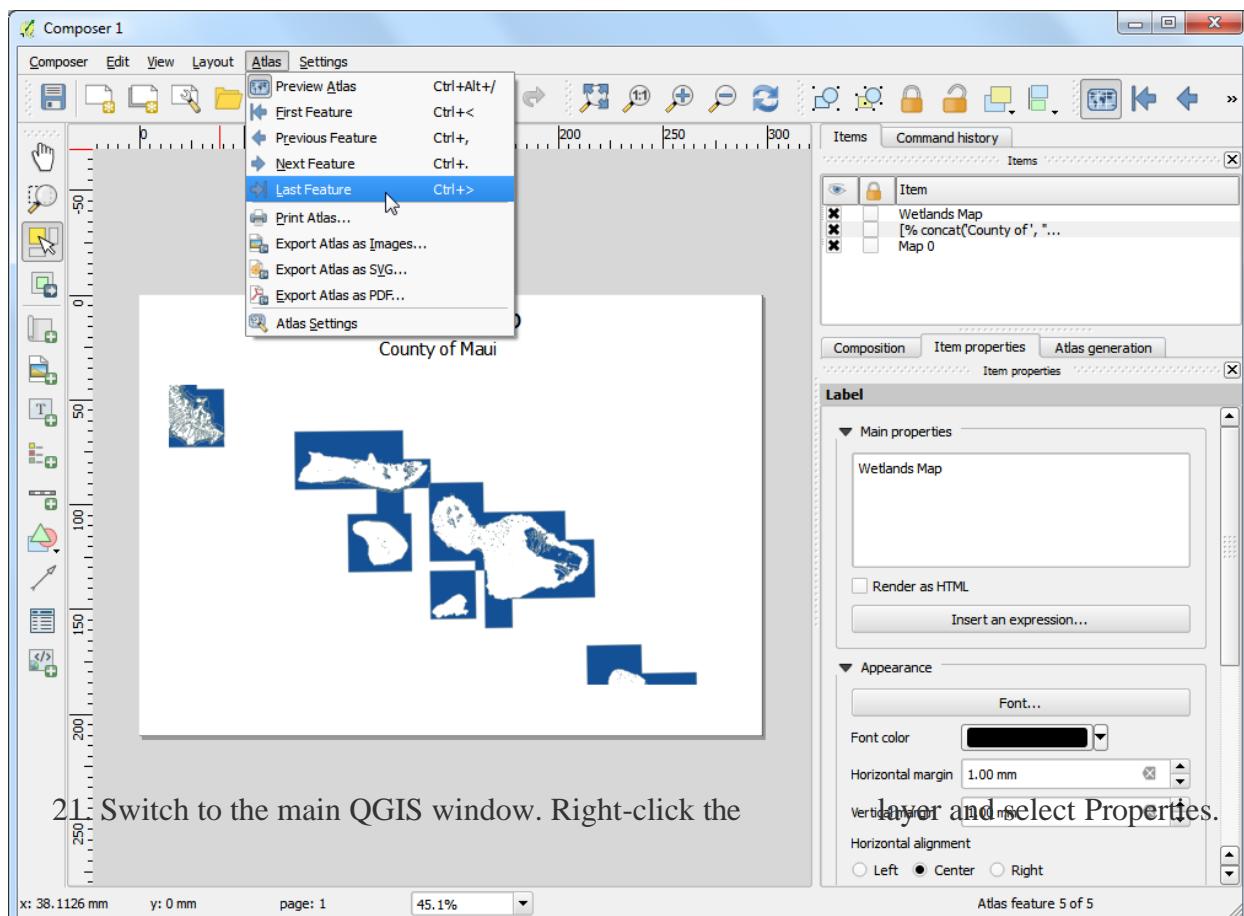


19. Add another label and enter **Wetlands Map** under the Main properties. Since there is no expression here, this text will remain the same on all maps.

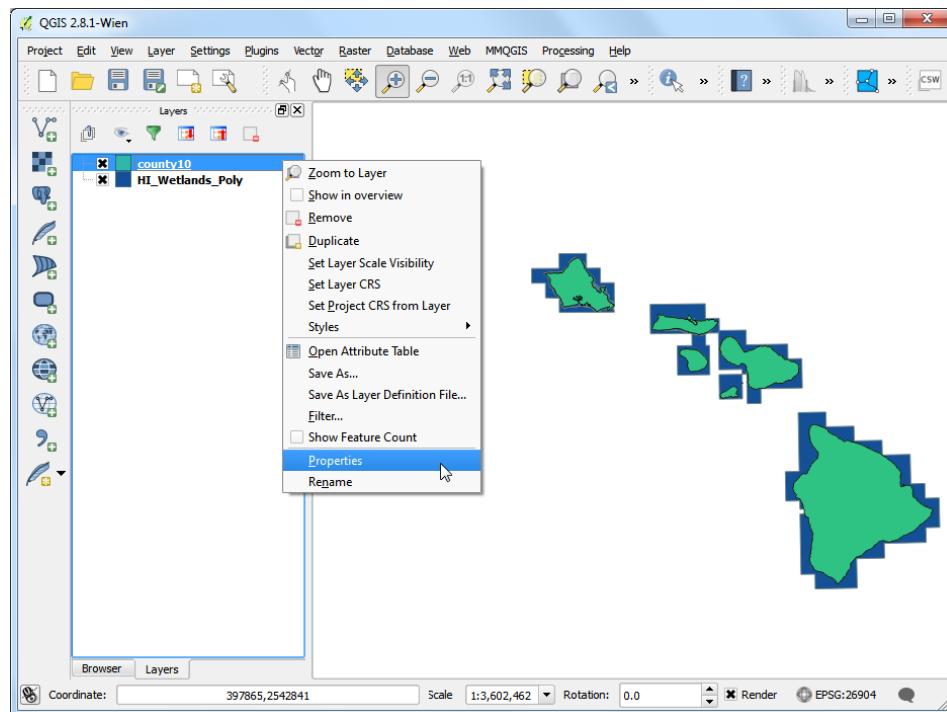




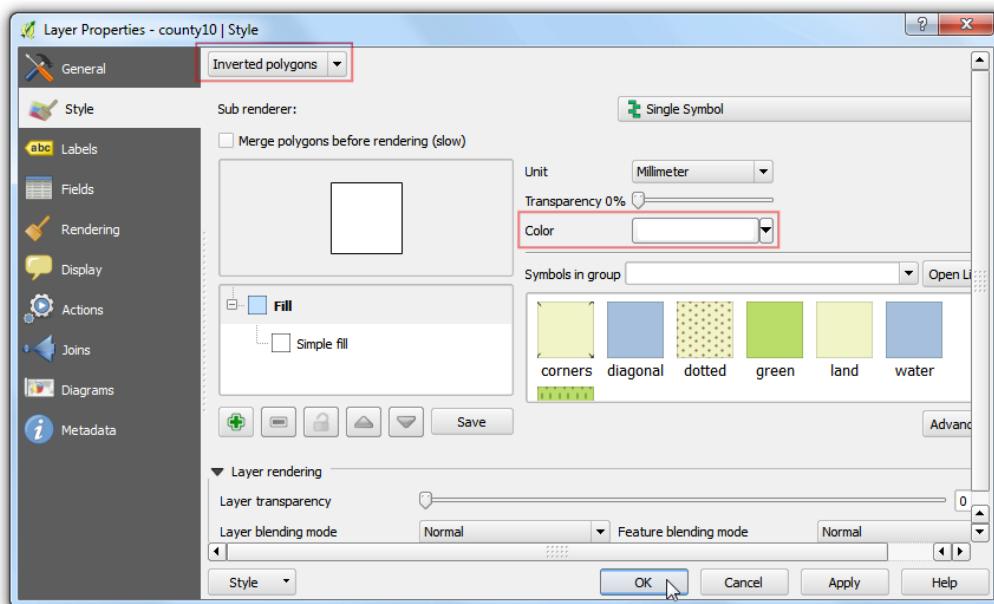
20. Go to Atlas ▶ Last Feature and verify that the map labels do work as intended. You will notice that the wetland map has polygons extending out in the ocean that looks ugly. We can change the style to that areas outside the county boundaries are hidden.



21. Switch to the main QGIS window. Right-click the 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.

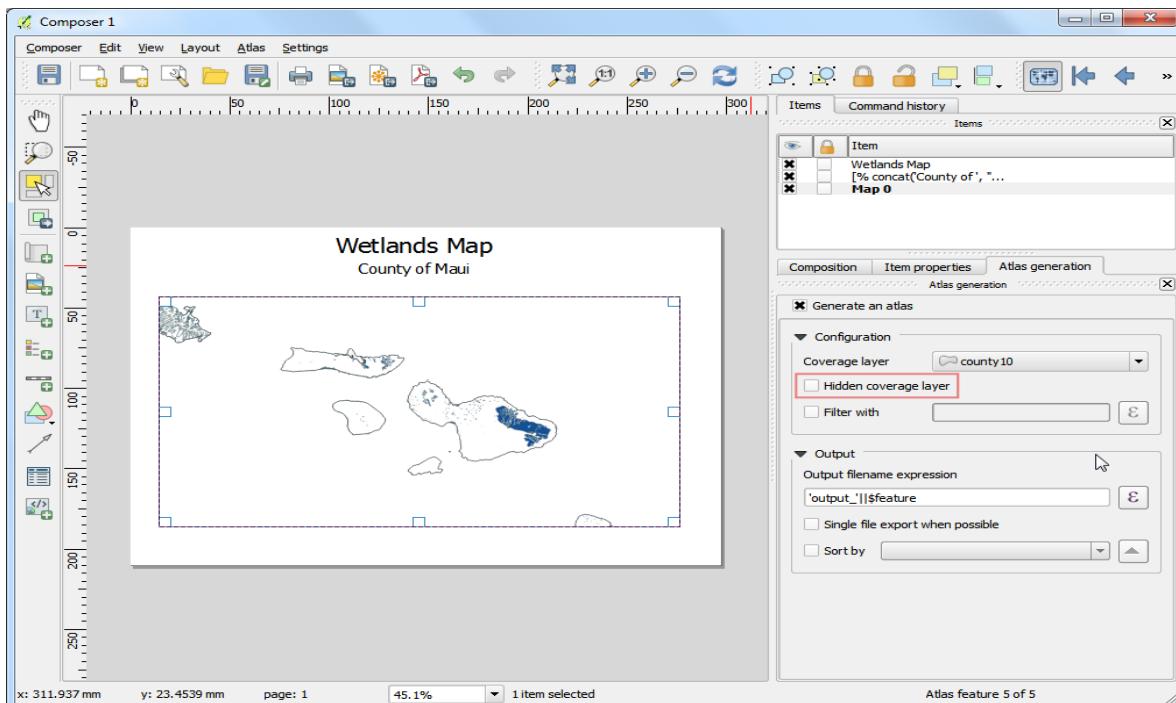


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24. There is one problem though. You can see areas of the map that are outside the coverage layer boundary but still visible. This is because Atlas doesn't automatically hide other features. This can be useful in some cases, but for our purpose, we 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.

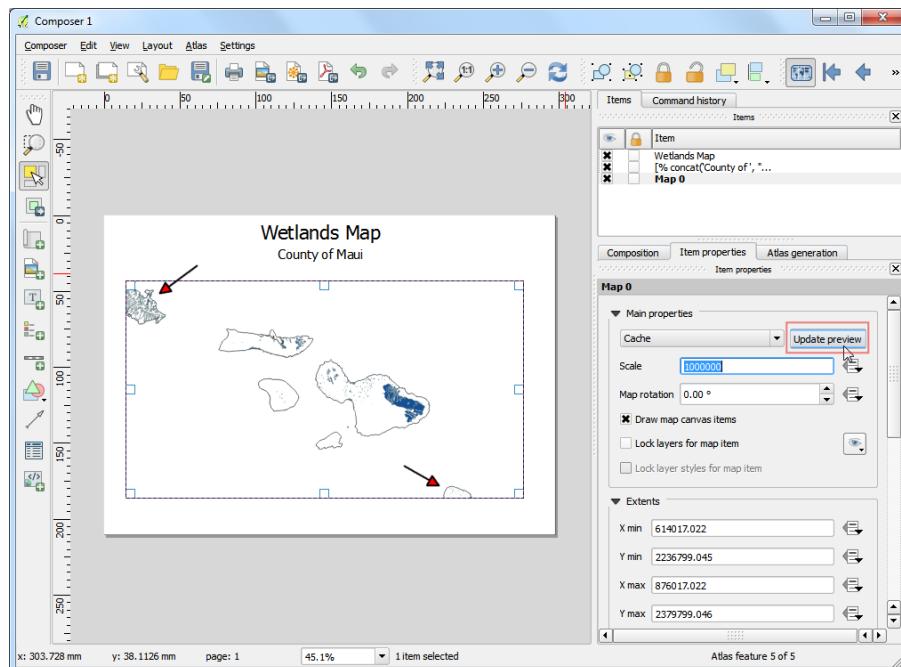


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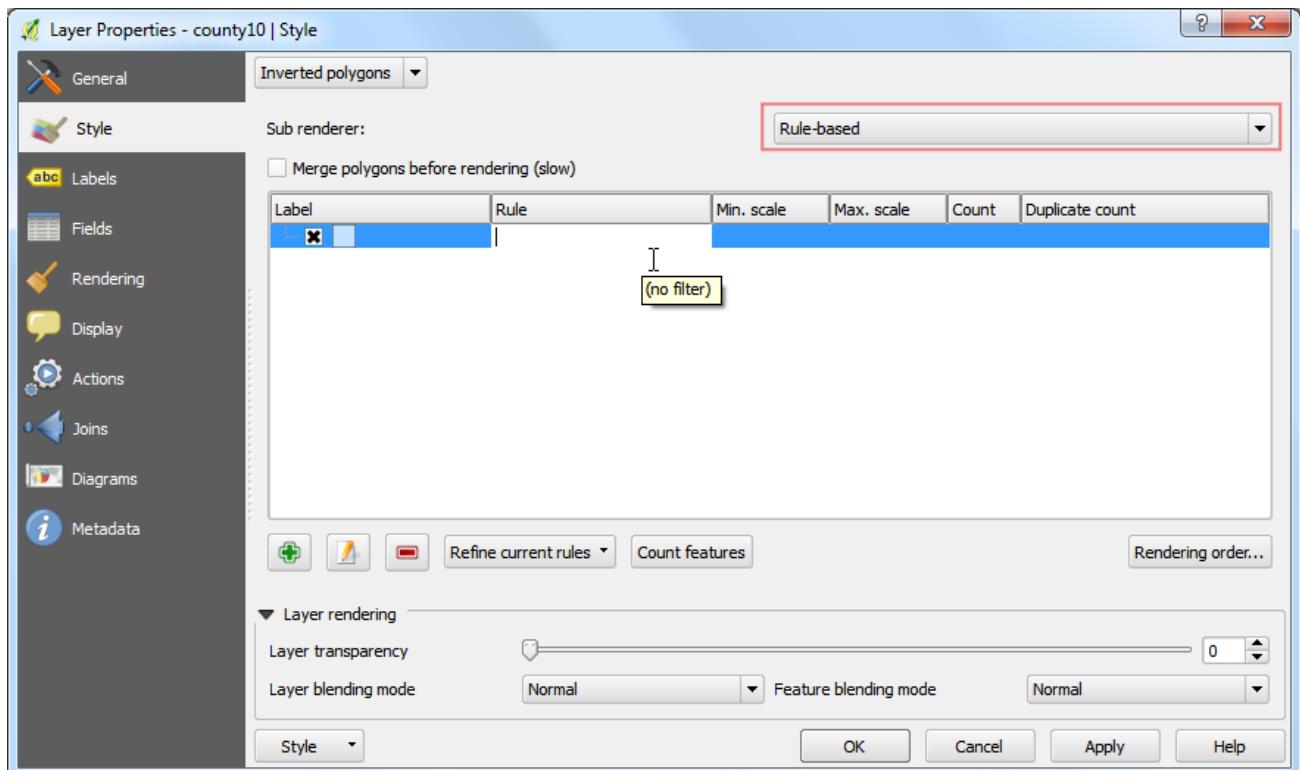
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25. In the Style tab, select Rule-based renderer as the Sub renderer. Double-click the area under Rule.



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

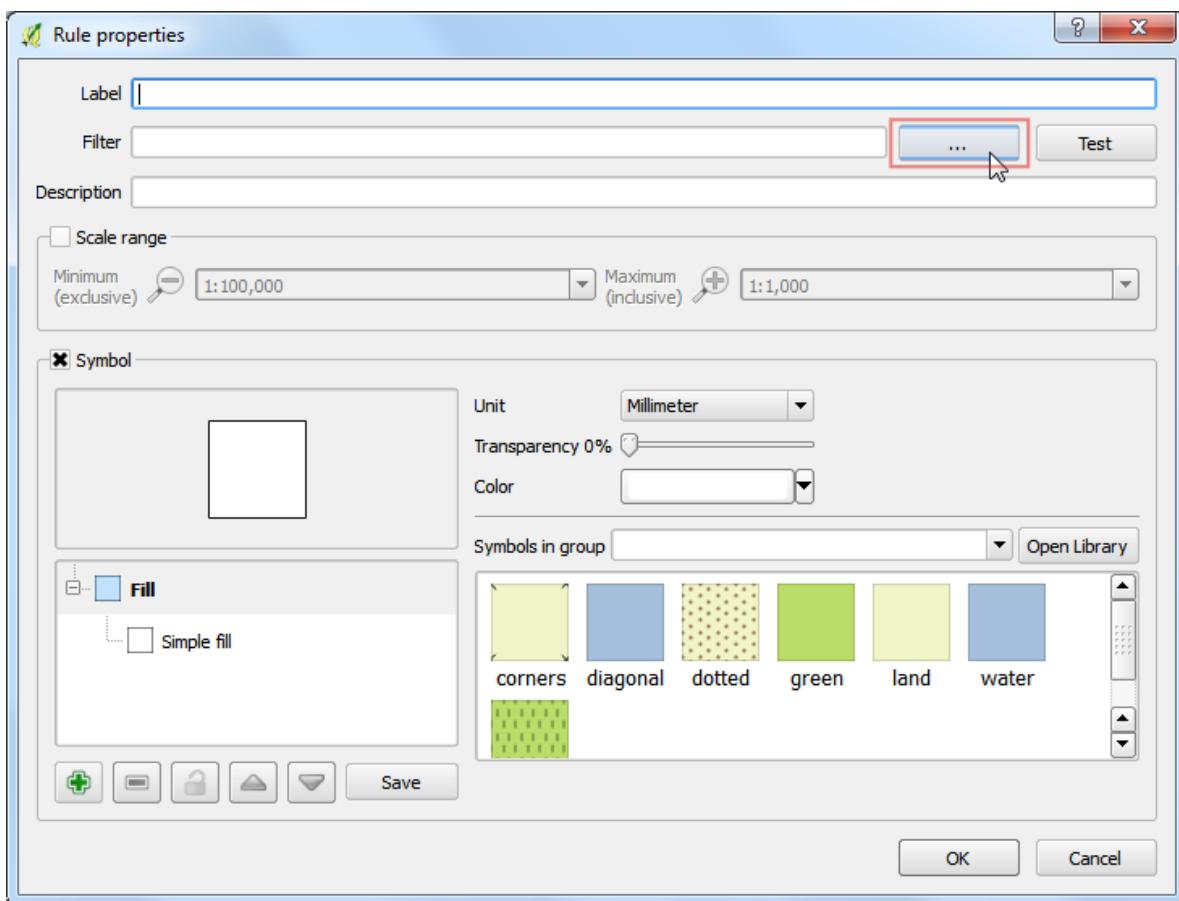


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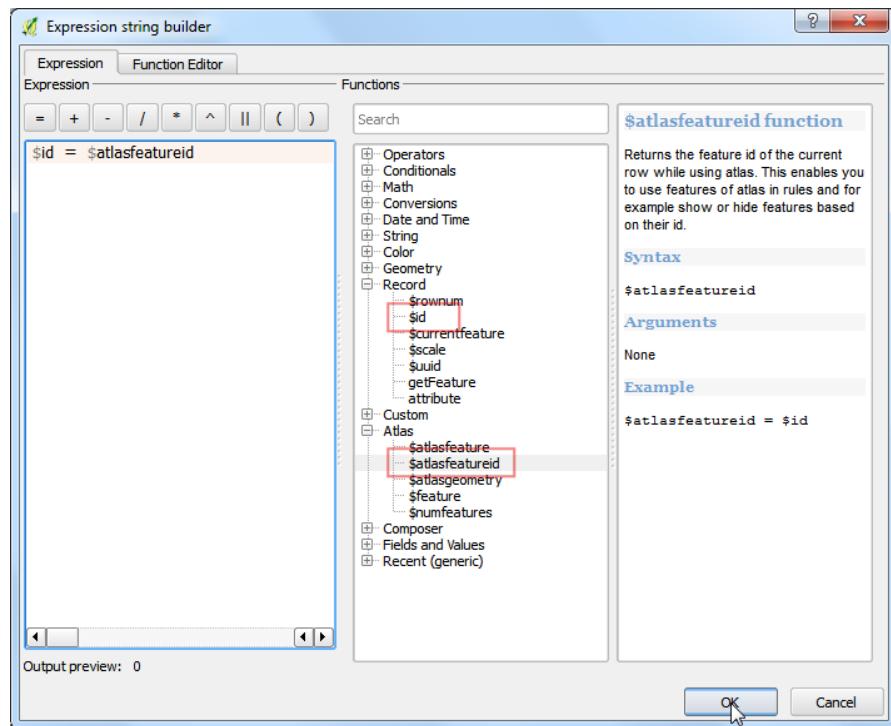


27. In the Expression string builder, expand the **Atlas** group of functions.

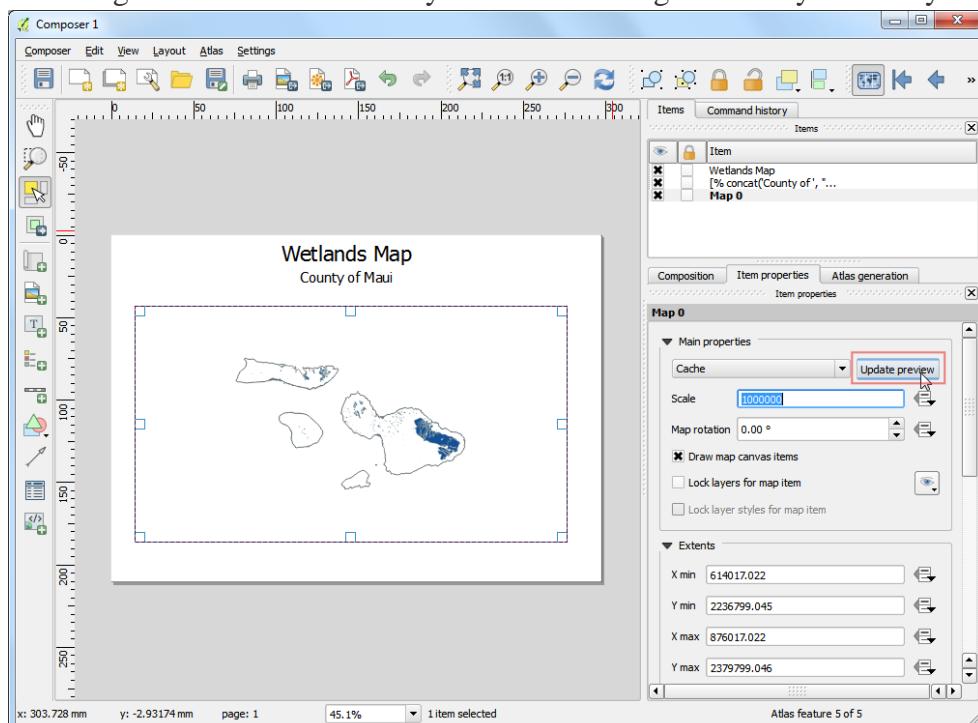
The function will return the currently selected feature. We will construct an expression that will ~~\$atlasfeatureid~~ currently selected Atlas feature. Enter the expression as

\$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. Click Insert an expression button.

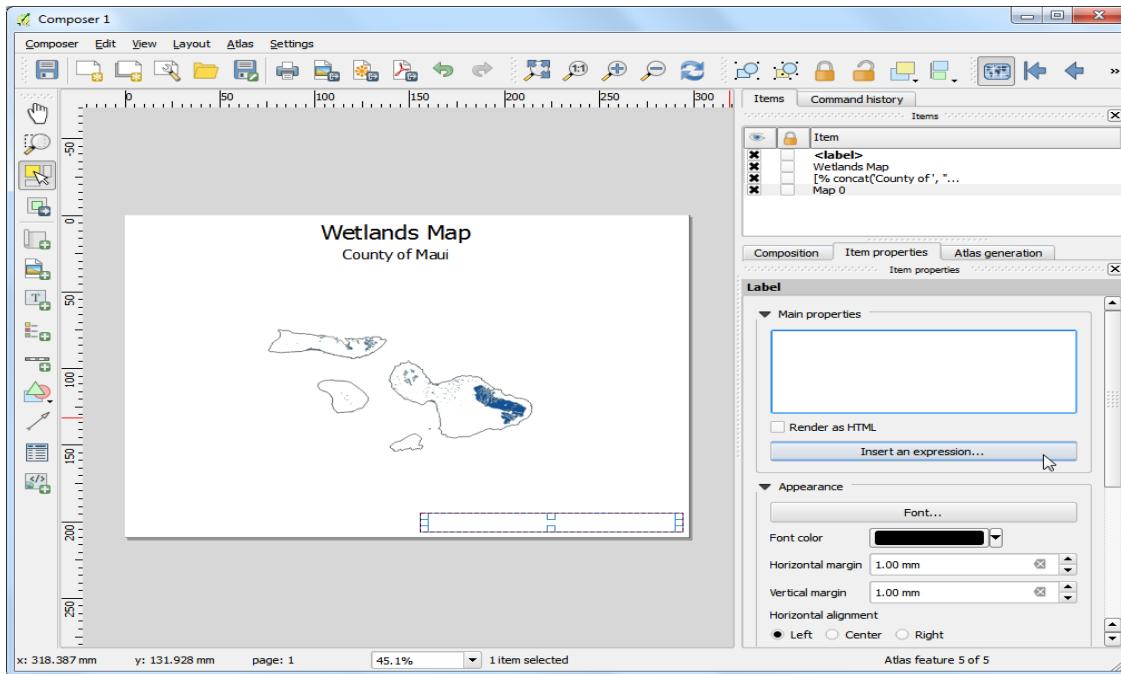


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30. Expand the Date and Time functions group and you will find the `$now` function. This holds the current system time. The function `todate()` will convert this to a date string. Enter the expression as below:

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

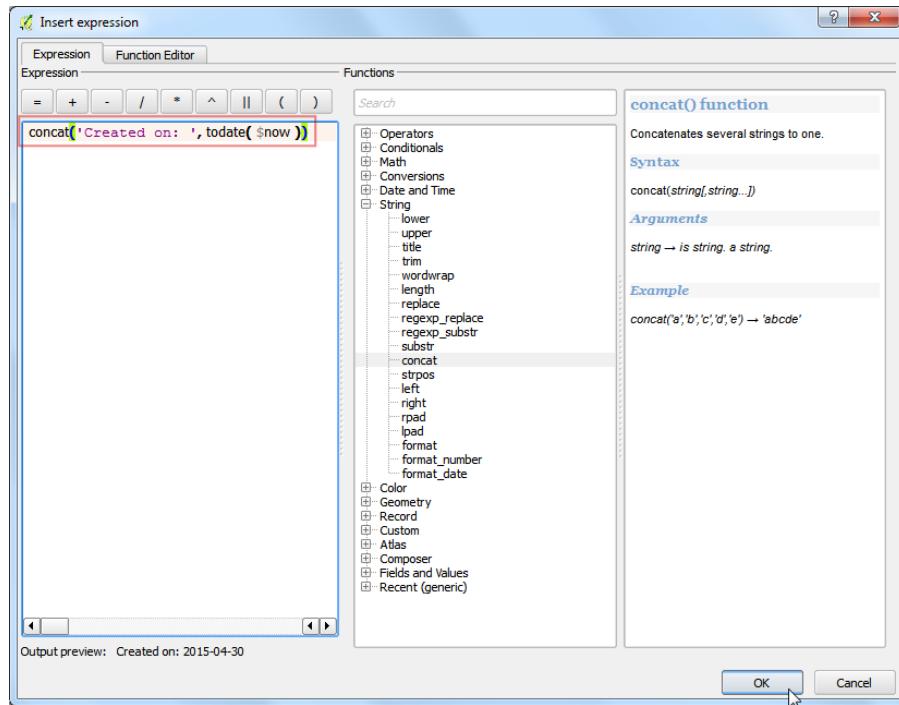


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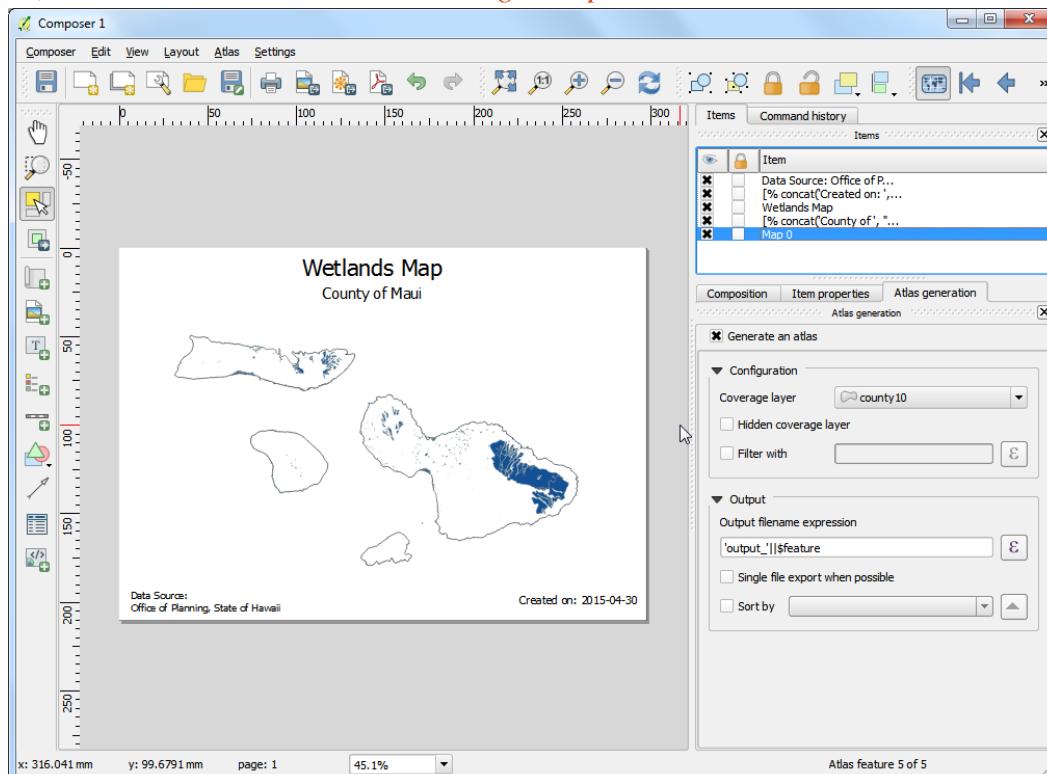
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31. Add another label citing the data source. You may also add other map elements such as a north arrow, scalebar etc. as described in *Making a Map* tutorial.



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

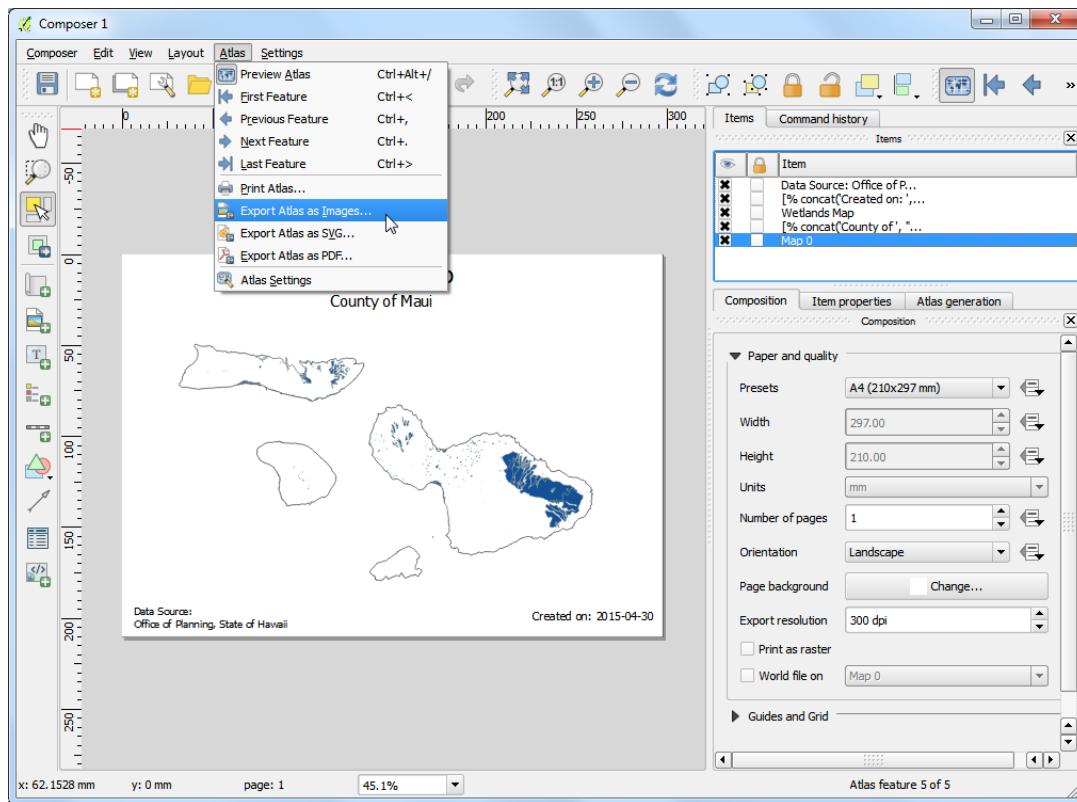


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33. Select a directory on your computer and click Choose.
34. The Atlas tool will now iterate through each feature in the coverage layer and create a separate map image based on the template we created. You can see the images in the directory once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

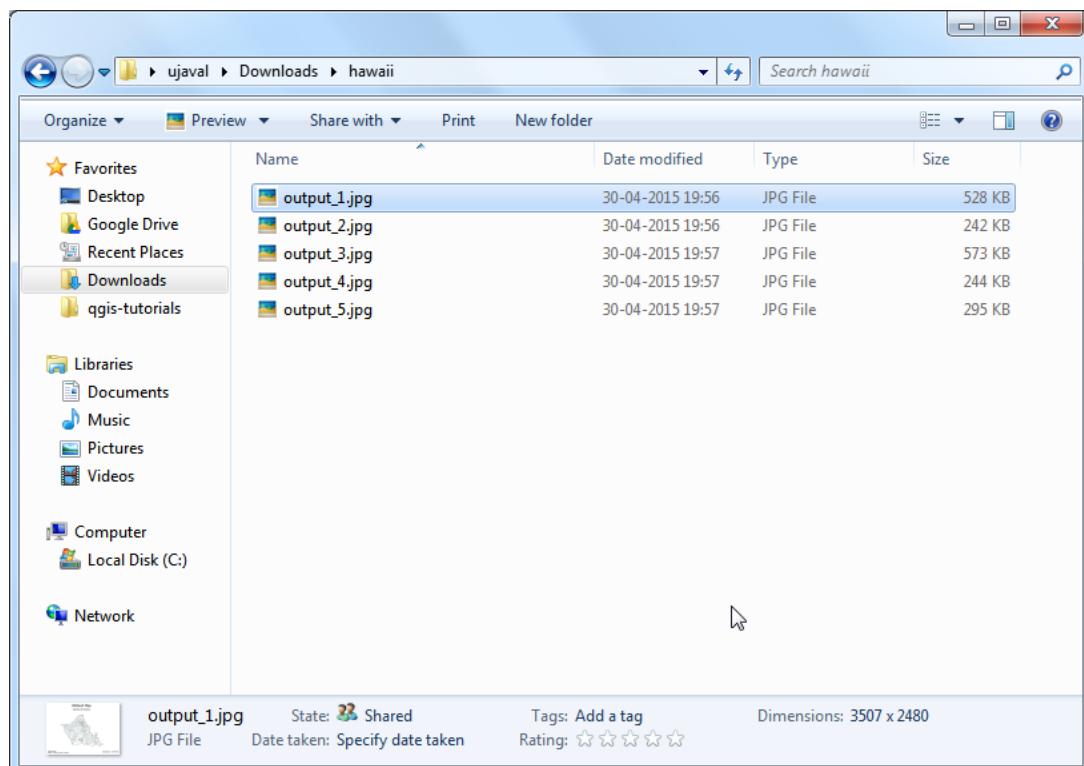


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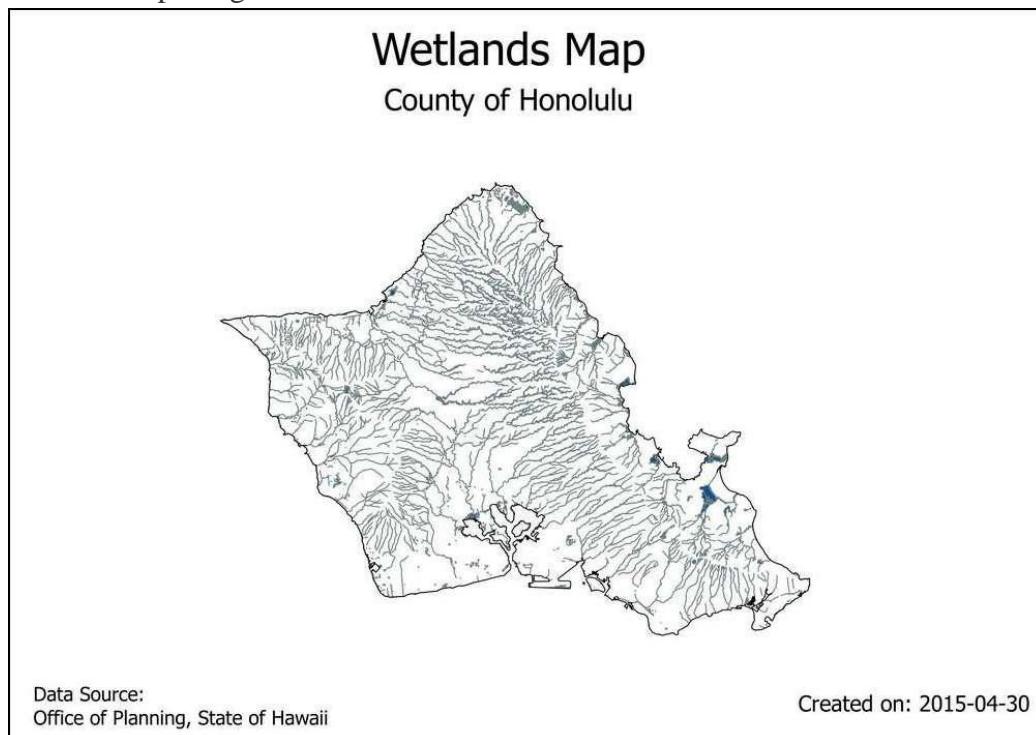
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35. Here are the map images for reference.





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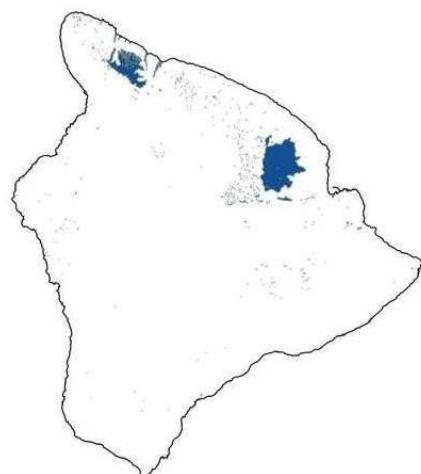
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## Wetlands Map

County of Hawaii

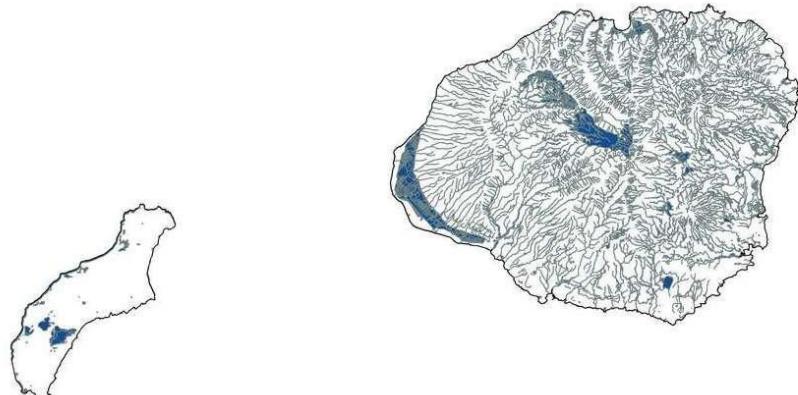


Data Source:  
Office of Planning, State of Hawaii

Created on: 2015-04-30

## Wetlands Map

County of Kauai



Data Source:  
Office of Planning, State of Hawaii

Created on: 2015-04-30



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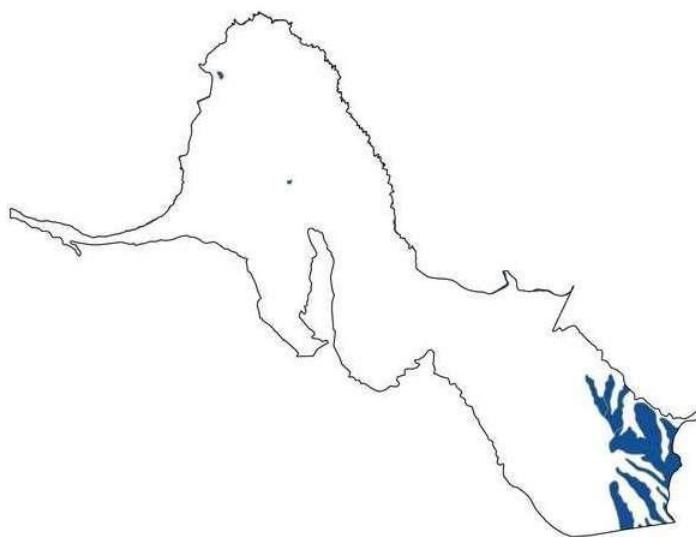
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## Wetlands Map

County of Kalawao



Data Source:  
Office of Planning, State of Hawaii

Created on: 2015-04-30



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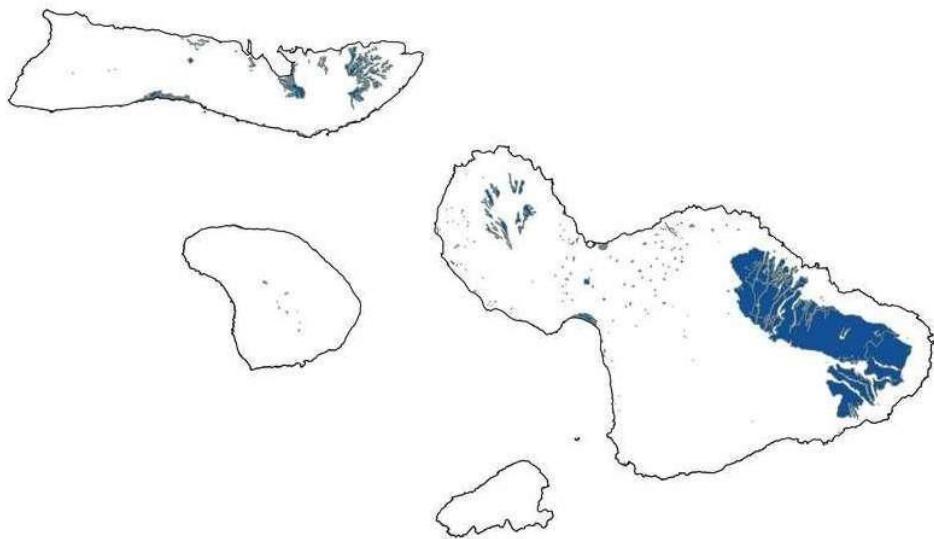
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## Wetlands Map

County of Maui



Data Source:  
Office of Planning, State of Hawaii

Created on: 2015-04-30



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**Learning Outcome:**

- 1 Analyze proximity using nearest neighbor
- 2 Interpolate and sample raster data

**Course Outcome:**

- 1 Apply advanced GIS analysis techniques
- 2 Understand interpolation and sampling methods

**Conclusion:**

**Viva Questions:**

- 1 What is nearest neighbor analysis?
- 2 How to sample raster data?
- 3 What is data interpolation?

<b>Correction Parameter</b>	<b>Formative Assessment [ ]</b>	<b>Timely Completion of practical</b>	<b>Attendance Learning Attendance [ ]</b>



**Experiment No.—10:**

**Aim:** Advance GIS Operations 2: Batch Processing using Processing Framework Automating Complex Workflows using Processing Modeler Automating Map Creation with Print Composer Atlas Validating Map data

**Tools & Technologies used:** QGIS

**Learning Objectives:**

1. Automate complex workflows using Processing Modeler.
2. Validate map data for consistency and accuracy.

**Theory: Introduction to Validation of map data.**

Data mapping is the process of defining how data from one source is transformed and transferred to another destination, such as a database, a file, or an application. Data mapping validation is the step of verifying that the data mapping rules are correct, consistent, and complete, and that the data quality and integrity are maintained throughout the data migration or integration process. Data mapping validation is essential for ensuring that the data mapping objectives are met, that the data is accurate and reliable, and that the data migration or integration project is successful.

**Benefits of data mapping validation**

Data mapping validation can bring many benefits to your data migration or integration project, such as reducing errors and risks, improving efficiency and performance, and enhancing user satisfaction and trust. By validating the data mapping rules, you can identify and fix any issues or discrepancies before they affect the data quality and integrity. This can also help optimize the data transformation and transfer process, reduce the time and resources required for data testing and debugging, and ensure that the data is reliable and secure. Ultimately, validating the data mapping rules can ensure that the data meets the expectations of end-users and stakeholders, as well as demonstrate that the project is of high quality and value.

**Types of data mapping validation**

Data mapping validation can be performed at different stages and levels of the data migration or integration process, depending on the complexity and scope of the data mapping rules. For example, source-to-target mapping validation checks that the data mapping rules correctly map the data elements from the source to the target destination, while data transformation validation verifies that the data mapping rules correctly apply the data transformation logic. Additionally, data quality validation ensures that the data mapping rules preserve or improve the data quality and integrity. These types of validation can be done by reviewing the data mapping specifications, using data mapping tools, measuring and monitoring the data quality indicators, or testing sample data sets. Data mapping validation is key in data migration/integration, comprising:

- Source-to-Target Mapping:** Ensures data elements correctly map from source to destination.
- Data Transformation Validation:** Verifies accurate application of transformation logic.



## **Step:-**

### **A. 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.*



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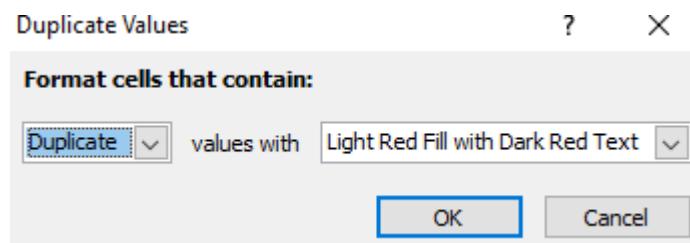
child_id	school_national_school_id	district_na	district_id	age	sex	stool	hookworm	ascaris_eg_trich	schistosomiasis	tb_inf	siamsoni	de wormed
2	70107028	TEREBEN	1190	BARINGO	701	9	F	1	0	0	0	0
3	70105018	NGINYANI	1203	BARINGO	701	12	F	1	0	0	0	0
4	70105055	NGINYANI	1203	BARINGO	701	11	F	1	0	0	0	0
5	70107038	TEREBEN	1190	BARINGO	701	10	F	1	0	0	0	0
6	70105029	NGINYANI	1203	BARINGO	701	7	F	1	0	0	0	0
7	70105085	NGINYANI	1203	BARINGO	701	14	F	1	0	0	0	0
8	70105010	NGINYANI	1203	BARINGO	701	7	M	1	0	0	0	0
9	70105062	NGINYANI	1203	BARINGO	701	10	F	1	0	0	0	0
10	70107009	TEREBEN	1190	BARINGO	701	8	F	1	0	0	0	0
11	70105107	NGINYANI	1203	BARINGO	701	12	M	1	0	0	0	0
12	70105009	NGINYANI	1203	BARINGO	701	10	M	1	0	0	0	0
13	70105020	NGINYANI	1203	BARINGO	701	10	F	1	0	0	0	0
14	70107051	TEREBEN	1190	BARINGO	701	10	M	1	0	0	0	0
15	70107019	TEREBEN	1190	BARINGO	701	9	M	1	0	0	0	0
16	70107032	TEREBEN	1190	BARINGO	701	9	M	1	0	0	0	0
17	70107003	TEREBEN	1190	BARINGO	701	6	F	1	0	0	0	0

select the entire "child\_id" column(first column),

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

child_id	school_national_school_id	district_na	district_id	age	sex	stool	hookworm	ascaris_eg_trich	schistosomiasis	tb_inf	siamsoni	de wormed
2	70107028	TEREBEN	1190	BARINGO	701	9	F	1	0	0	0	0
3	70105018	NGINYANI	1203	BARINGO	701	12	F	1	0	0	0	0
4	70105055	NGINYANI	1203	BARINGO	701	11	F	1	0	0	0	0
5	70107038	TEREBEN	1190	BARINGO	701	10	F	1	0	0	0	0

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



The screenshot shows a Microsoft Excel spreadsheet titled "Kenya\_epidemiological\_data [Compatibility Mode] - Microsoft Excel". The data is organized into several columns representing variables such as child\_id, school, district, sex, and various health outcomes. A "Remove Duplicates" dialog box is currently active, prompting the user to delete duplicate values from the data. The "My data has headers" checkbox is checked. The Excel ribbon is visible at the top, and the status bar at the bottom indicates the date and time.

## 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.

The screenshot shows a Microsoft Excel spreadsheet with the "Replace" dialog box open. The "Find what" field is set to "M" and the "Replace with" field is set to "F". The "Replace All" button is highlighted. The background shows a data table with columns for district\_id, age, sex, and various health metrics. The Excel ribbon is visible at the top, and the status bar at the bottom indicates the date and time.

Step 3

## Verifying the plausibility of data

In this step, we perform two basic operations

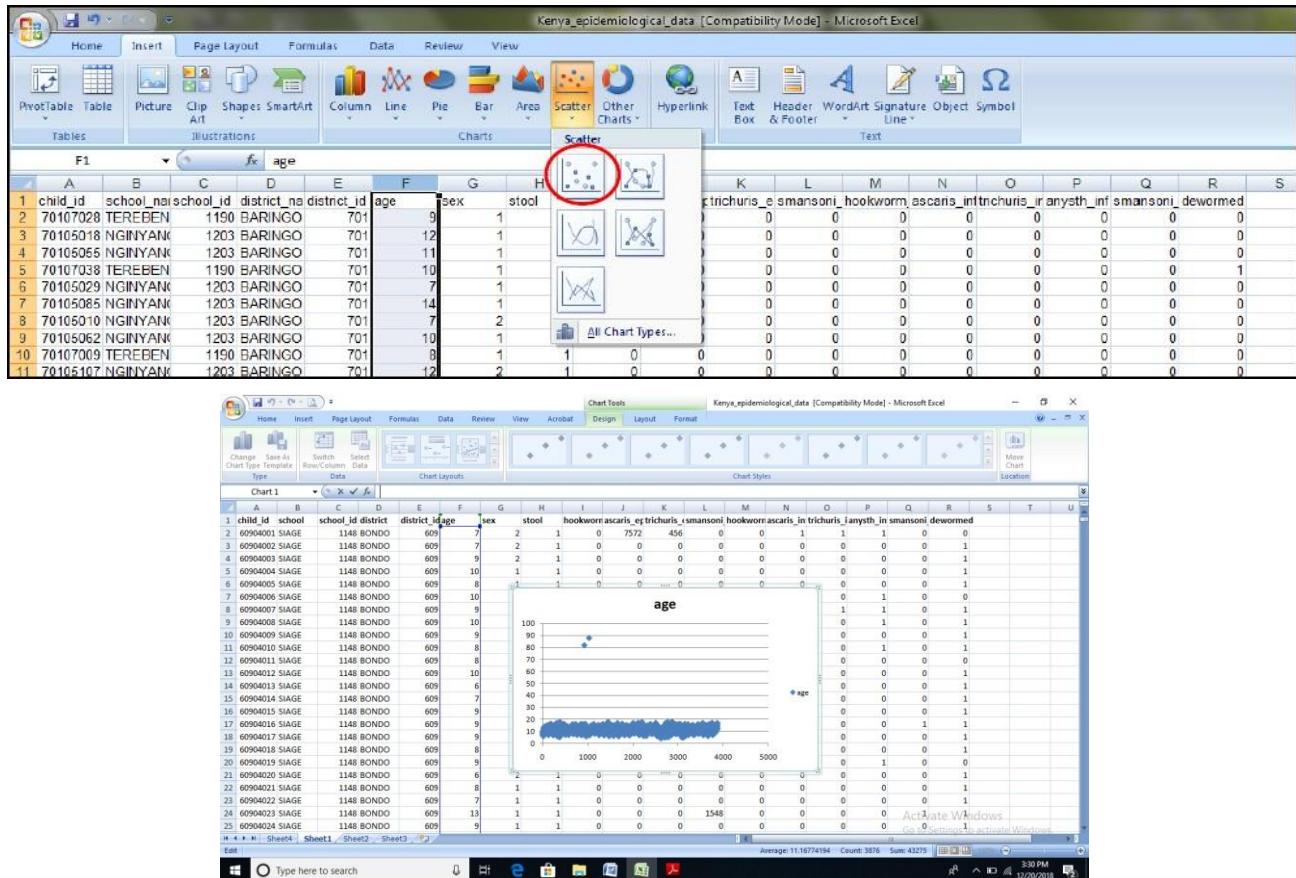
- A. Coding of variables
- B. Using a filter to detect outliers

## 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 outliers

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.



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Kenya\_epidemiological\_data [Compatibility Mode] - Microsoft Excel

Home Insert Page Layout Formulas Data Review View Acrobat

Font Alignment Number Styles Cells Editing

J26 fx 0

child_id	school	district	district	age	sex	stool	hookw	ascaris	trichuri	smansc	hookw	ascaris	trichuri	anysth	smansc	dewormed
1	60904001	SIAGE		2	1	0	7572	456	0	0	1	1	1	1	0	0
2	60904002	SIAGE		2	1	0	0	0	0	0	0	0	0	0	0	1
3	60904003	SIAGE		2	1	0	0	0	0	0	0	0	0	0	0	1
4	60904004	SIAGE		1	1	0	0	0	0	0	0	0	0	0	0	1
5	60904005	SIAGE		1	1	0	0	0	0	0	0	0	0	0	0	1
6	60904006	SIAGE		1	1	0	0	0	0	0	0	0	0	0	0	1
7	60904007	SIAGE		1	1	102	36	0	0	1	1	0	1	0	0	0
8	60904008	SIAGE														
9	60904009	SIAGE														
10	60904010	SIAGE														
11	60904011	SIAGE														
12	60904012	SIAGE														
13	60904013	SIAGE														
14	60904014	SIAGE														
15	60904015	SIAGE														
16	60904016	SIAGE														
17	60904017	SIAGE														
18	60904018	SIAGE														
19	60904019	SIAGE	1148	BONDO	609	9	2	1	252	0	0	0	1	0	0	0
20	60904020	SIAGE	1148	BONDO	609	6	2	1	0	0	0	0	0	0	0	1
21	60904021	SIAGE	1148	BONDO	609	8	1	1	0	0	0	0	0	0	0	1
22	60904022	SIAGE	1148	BONDO	609	7	1	1	0	0	0	0	0	0	0	1
23	60904023	SIAGE	1148	BONDO	609	13	1	1	0	0	0	1548	0	0	0	0
24	60904024	SIAGE	1148	BONDO	609	9	1	1	0	0	0	0	0	0	0	0
25																

Activate Windows  
Go to Settings to activate Windows.

Custom AutoFilter

Show rows where:

age

is greater than 20

And

OK Cancel

Home Insert Page Layout Formulas Data Review View Acrobat

Font Alignment Number Styles Cells Editing

J26 fx 0

child_id	school	district	district	age	sex	stool	hookw	ascaris	trichuri	smansc	hookw	ascaris	trichuri	anysth	smansc	dewormed
925	70105079	NGINYAN	1203	BARINGO	701	82	2	1	0	0	0	0	0	0	0	0
1031	70203004	SONOKWI	1124	BOMET	702	88	2	1	0	0	0	0	0	0	0	0
3878																

#### Step 4: Logical Data checks

In this step, we perform two basic operations

- Cross Tabulations
- Formulas

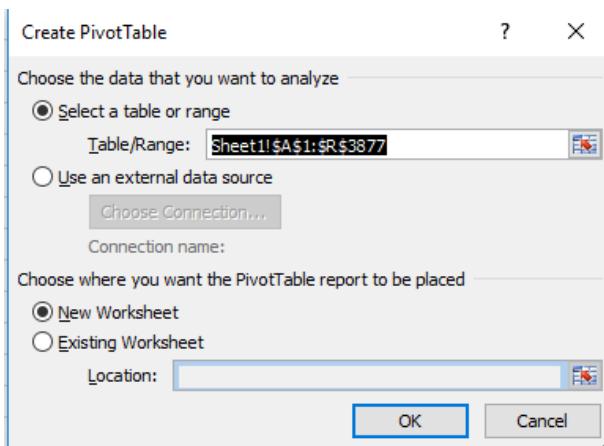


#### 4A. Cross Tabulations

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

The screenshot shows the Microsoft Excel ribbon with the "Insert" tab selected. In the "Tables" group of the ribbon, the "PivotTable" icon is highlighted. Below the ribbon, a portion of a data table is visible with columns labeled from A to P. The first few rows contain data such as "child\_id", "school\_name", "district\_na", "age", "sex", "stool", and various parasite counts like "hookworm", "ascaris\_eggs", etc.

Select New Worksheet and click OK



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

The screenshot shows the Microsoft Excel interface with a PivotTable created on a new sheet. The PivotTable Field List is open on the right side of the screen. A red arrow points from the "stool" item in the list to the "Row Labels" field in the PivotTable grid. Another red arrow points from the "anysth\_inf" item in the list to the "Column labels" and "Σ Values" fields in the grid.

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 " $\Sigma$  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
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)

The screenshot shows a Microsoft Excel spreadsheet titled "Kenya\_epidemiological\_data". The formula `=IF(AND(H2=0, NOT(P2="")),1,0)` is being typed into cell S2. The formula bar at the top also displays this formula. The formula is circled in red.

C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	school_id	district_na	district_id	age	sex	stool	hookworm	ascaris	eg_trichuris	e_mansoni	hookworm	ascaris	inf_trichuris	in anysth	inf_mansoni	dewormed	check		
2	1190	BARINGO	701	9	1	1	0	0	0	0	0	0	0	0	0	0			
3	1200	BARINGO	701	12	1	1	0	0	0	0	0	0	0	0	0	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

The screenshot shows the QGIS desktop application. The menu bar is visible with "Layer" selected. A sub-menu under "Layer" shows "Add Layer" with "Add Vector Layer..." highlighted. The keyboard shortcut "Ctrl+Shift+V" is displayed next to it.

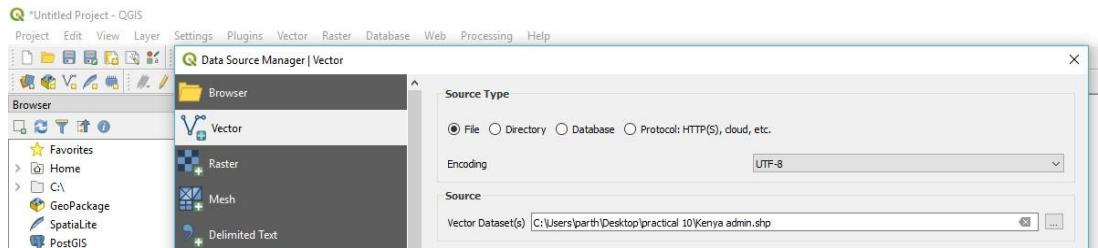


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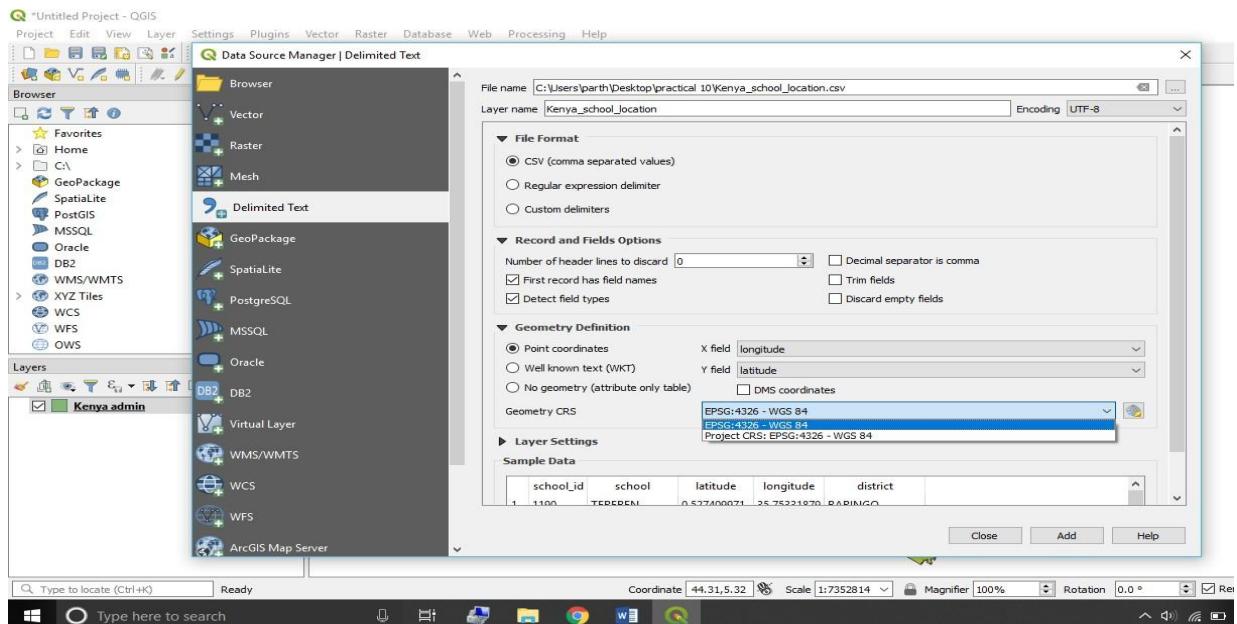
Similarly, navigate to Add Delimited Text Layer.



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...**



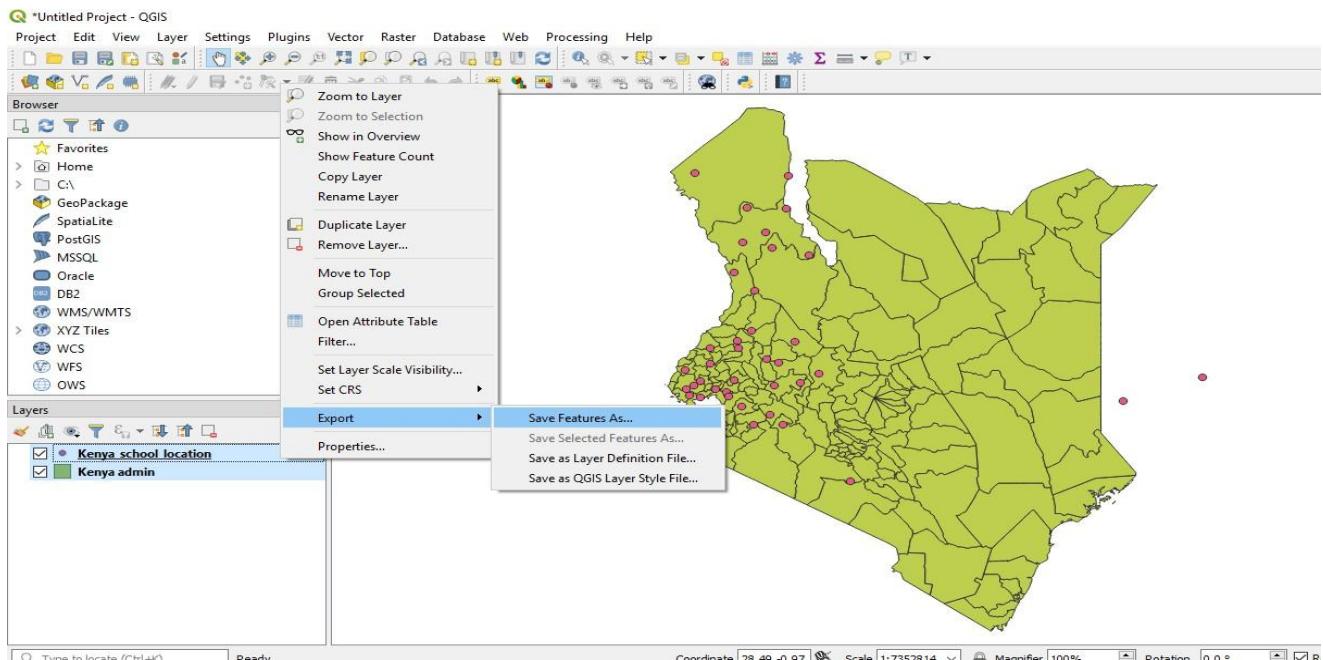


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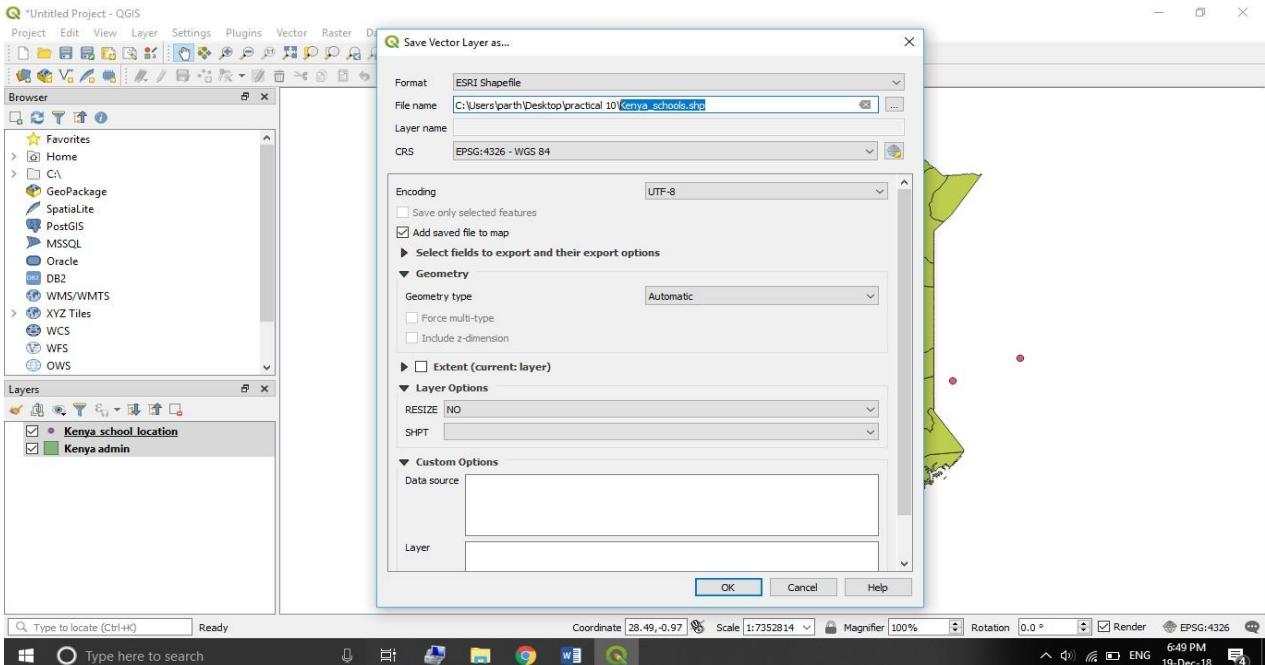
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In the menu that comes up, set Format as **ESRI Shapefile** and put File Name as **Kenya\_schools.shp**  
After this is done you can uncheck the **Kenya\_school\_location** in the layers section.



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.

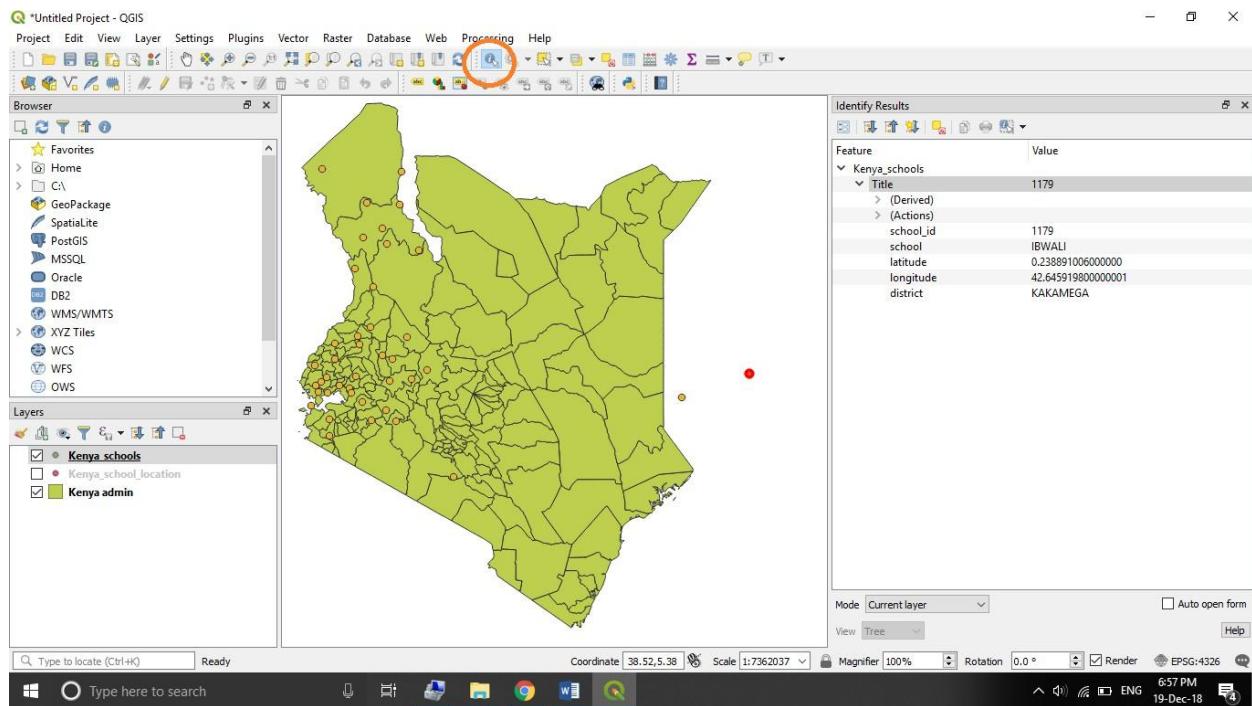


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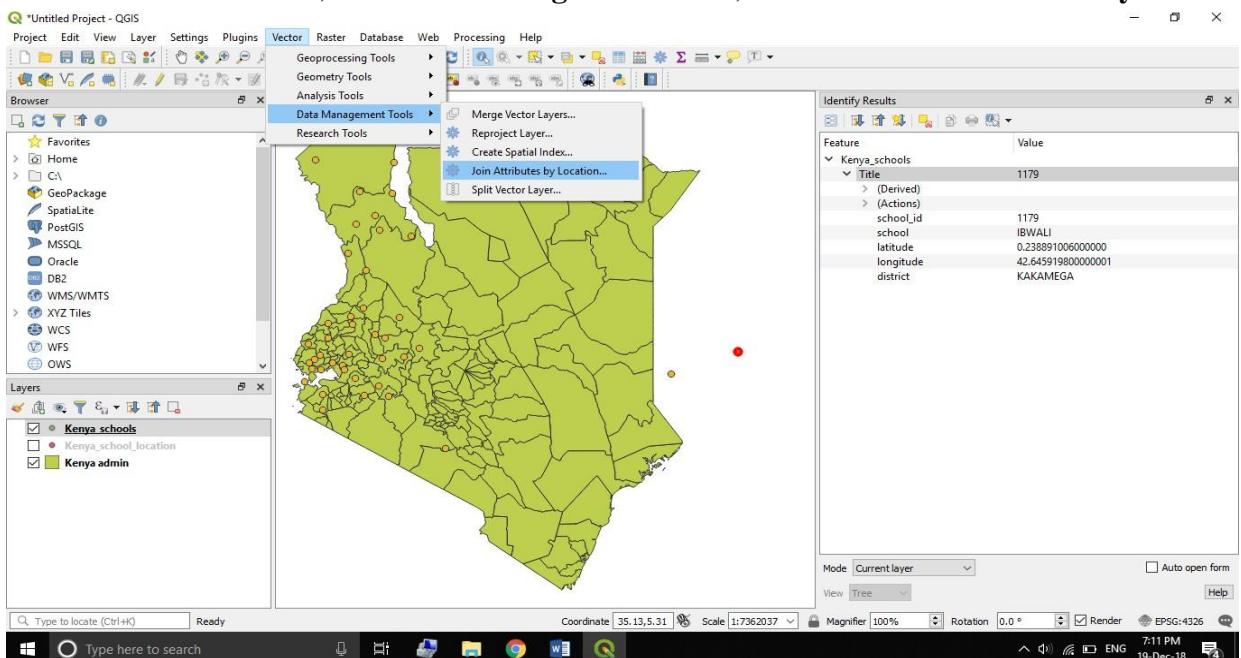
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Now we want to add the district information to the map. Therefore, we will join information based on the geographical localization.

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.

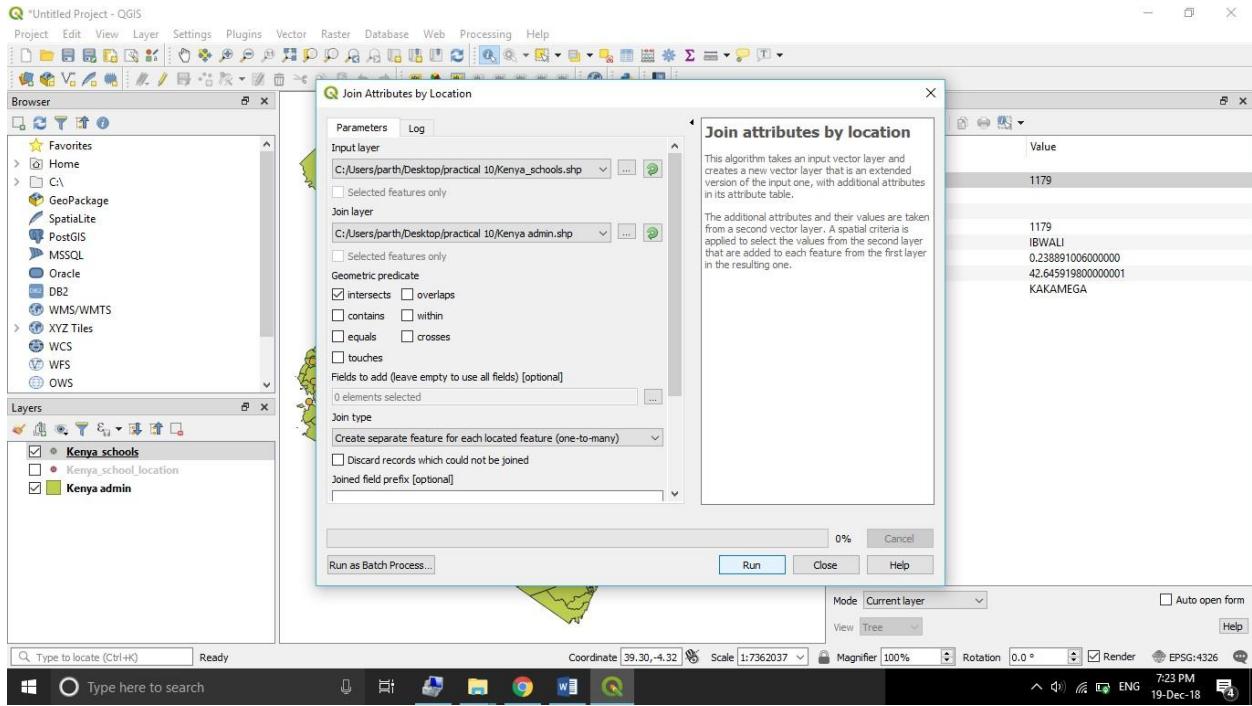


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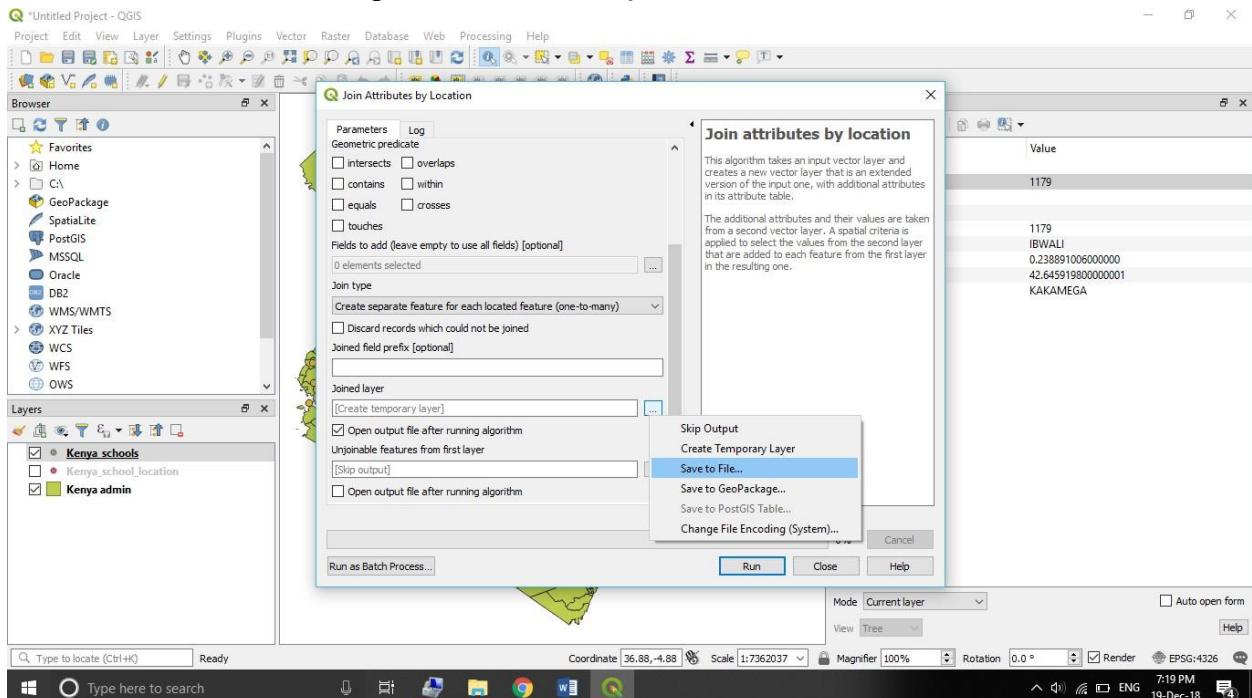
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We also need to save the output so in **Joined Layer**, click “...”button to Browse location.



Save as **Kenya\_school\_district.csv**

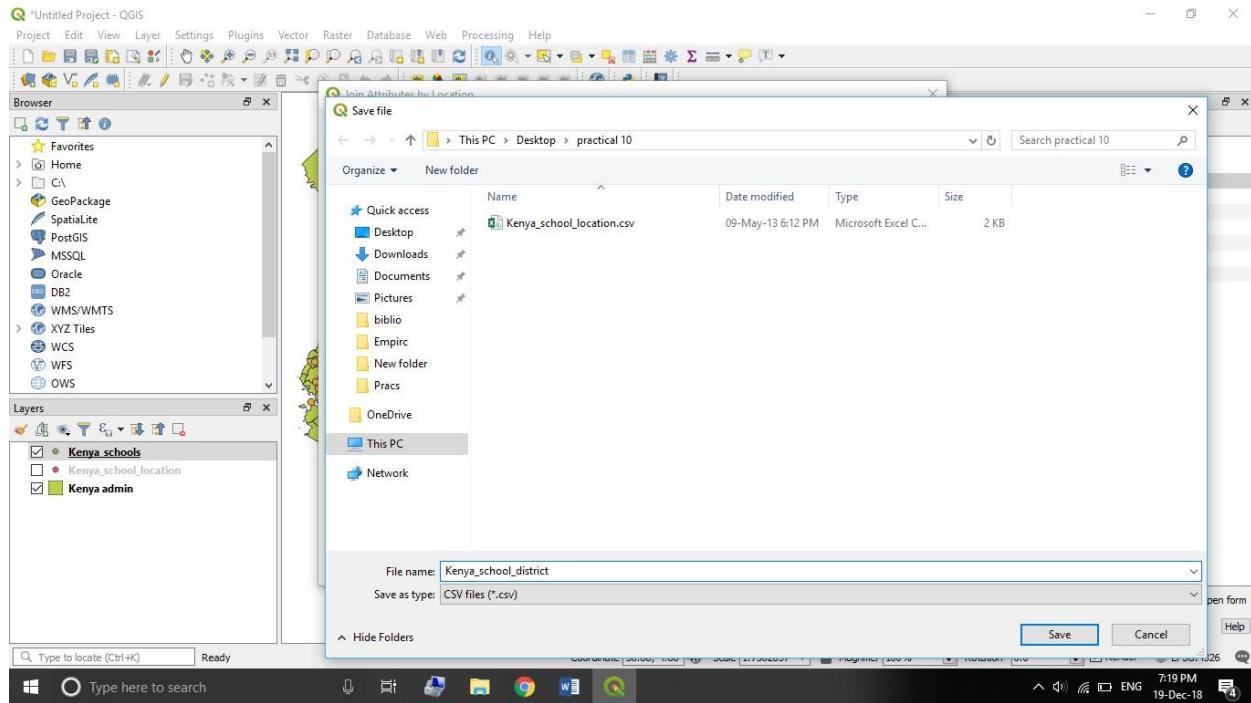


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And then click run.

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.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	school_id	school	latitude	longitude	district	LVLID	ISO_CTRY	STATECODE	NAME	LVL	UPPERLVL	UPPERLVNA					
2	1163 USULA		0.0806		SIAYA	601 KE	KE	SIAYA		2	6	NYANZA					
3	1156 MUR MALANGA		0.00975	34.26051	SIAYA	601 KE	KE	SIAYA		2	6	NYANZA					
4	1148 SIAGE		-0.1139	34.3082	BONDO	602 KE	KE	BONDO		2	6	NYANZA					
5	1150 KARUNGA		-0.04272	34.91285	KISUMU	604 KE	KE	KISUMU EAST		2	6	NYANZA					
6	1145 ALWALA		-0.13884	34.48393	KISUMU	605 KE	KE	KISUMU WEST		2	6	NYANZA					
7	1230 NATELO		3.16151	35.87964	TURKANA	701 KE	KE	TURKANA CENTRAL		2	7	RIFT VALLEY					
8	1224 KANGIRISAE		2.61852	36.25392	TURKANA	701 KE	KE	TURKANA CENTRAL		2	7	RIFT VALLEY					
9	1226 LOCHOR EKUYEN		2.86972	35.17767	TURKANA	701 KE	KE	TURKANA CENTRAL		2	7	RIFT VALLEY					
10	1227 NAOTIN		3.0574	35.54712	TURKANA	701 KE	KE	TURKANA CENTRAL		2	7	RIFT VALLEY					
11	1231 MAKUTANO		3.53587	35.24499	TURKANA	701 KE	KE	TURKANA CENTRAL		2	7	RIFT VALLEY					
12	1233 NARIOKOTOME		4.14415	35.91398	TURKANA	702 KE	KE	TURKANA NORTH		2	7	RIFT VALLEY					
13	1234 AIC LOPIDING		4.20626	34.39046	TURKANA	702 KE	KE	TURKANA NORTH		2	7	RIFT VALLEY					
14	1225 LOCHOR EMOIT		2.75756	35.64711	TURKANA	703 KE	KE	TURKANA SOUTH		2	7	RIFT VALLEY					
15	1219 TURKWEL GORGE		1.91918	35.37047	WEST POKOT	704 KE	KE	WEST POKOT		2	7	RIFT VALLEY					
16	1222 KAMERIS		2.27526	35.02739	WEST POKOT	705 KE	KE	POKOT NORTH		2	7	RIFT VALLEY					
17	1211 CHORWAI		1.13983	35.31615	WEST POKOT	706 KE	KE	POKOT CENTRAL		2	7	RIFT VALLEY					
18	1204 TOROR		0.956572	35.07867	TRANS NZOIA	710 KE	KE	TRANS NZOIA WEST		2	7	RIFT VALLEY					
19	1190 TEREBEN		0.52741	35.75332	BARINGO	713 KE	KE	BARINGO CENTRAL		2	7	RIFT VALLEY					
20	1203 NGINYANG B		0.9392	36.02051	BARINGO	715 KE	KE	EAST POKOT		2	7	RIFT VALLEY					
21	1169 NGENDALEL		0.141355	36.11529	KOIBATEK	716 KE	KE	KOIBATEK		2	7	RIFT VALLEY					
22	1164 KAPCHOLOI		0.09255	35.68682	KOIBATEK	716 KE	KE	KOIBATEK		2	7	RIFT VALLEY					
23	1193 SONGETO		0.5923	35.55437	KEIYO	721 KE	KE	KEIYO		2	7	RIFT VALLEY					



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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

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	school_id	school	latitude	longitude	district													
2	1190	TEREBEN	0.52741	35.75331879	BARINGO													
3	1203	NGINYANG B	0.9392	36.02051163	BARINGO													
4	1124	SONOKWEK	-0.66587	35.33916092	BOMET													
5	1148	SIAGE	-0.1139	34.30820084	BONDO													
6	1189	MABUUSI RCEA	0.51736	34.63671112	BUNGOMA													
7	1182	INDOLI	0.390609	34.24145889	BUSIA													
8	1175	SHIATSALA	0.17746	34.47684097	BUTERE/MUMIAS													
9	1125	KOGWANG	-0.63851	34.52355957	HOMA BAY													
10	1091	ENKIRGIRRI	-1.76414	36.92058945	KAJADIO													
11	1179	IBWALI	0.238891	34.6459198	KAKAMEGA													
12	1193	SONGETO	0.5923	35.55437088	KEIYO													
13	1141	KABOKYEK	-0.31438	35.16175842	KERICHO													
14	1143	SIWOT	-0.21165	35.35437012	KERICHO													
15	1145	ALWALA	-0.13884	34.48392868	KISUMU													
16	1150	KARUNGA	-0.04272	34.91284943	KISUMU													
17	1169	NGENDALEL	0.141355	36.1152916	KOIBATEK													
18	1164	KAPCHOLOI	0.09255	35.68682098	KOIBATEK													
19	1180	GATAMI	0.313997	36.41159058	LAikipia													
20	1198	MTONI	0.81127	35.10251131	LUGARI													
21	1119	ORUBA	-0.96472	34.52648163	MIGORI													
22	1199	SACHO RC	0.815197	34.63685889	MT. ELGON													
23	1133	TETA	-0.46973	35.62070847	NAKURU													

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.



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The screenshot shows a Microsoft Excel window with the 'PivotTable Tools' ribbon tab selected. The main area displays a blank PivotTable structure with placeholder text: 'Drop Row Fields Here' in row 3, 'Drop Column Fields Here' in column A, and 'Drop Data Items Here' in the main body. To the right, the 'PivotTable Field List' pane is open, listing various fields such as child\_id, school\_name, school\_id, district\_name, district\_id, sex, stool, hookworm\_egg, ascaris\_egg, trichuris\_egg, smansoni\_egg, and anysth\_inf. A red circle highlights this pane.

Now click on **school\_id** to drag and drop it in the “Row labels” field at the bottom.

Add **district\_id** to “ $\Sigma$  Values” and click on it, a drop down list will open, click on **Value Field Settings**.

**Settings.** Choose **Average** as type of calculation, because all children in the same school will have same **district\_id**.

The screenshot shows the same Microsoft Excel window after applying the changes. The 'Row Labels' field now contains 'school\_id'. The 'Σ Values' field contains 'Sum of district\_id'. The 'PivotTable Field List' pane shows several fields checked: sex, stool, hookworm\_egg, ascaris\_egg, trichuris\_egg, smansoni\_egg, hookworm\_inf, ascaris\_inf, trichuris\_inf, anysth\_inf, smansoni\_inf, and devormed. The data table below shows the average district\_id for each school\_id.

school_id	Average of district_id	Count of child_id	Sum of hookworm_inf	Sum of trichuris_inf	Sum of anysth_inf	Sum of ascaris_inf	Sum of smansoni_inf
1091	704	105	0	0	0	0	0
1119	613	109	22	18	45	21	8
1123	712	105	3	0	3	2	0
1124	702	110	17	9	34	27	0
1125	610	107	34	8	39	11	1
1133	710	109	0	1	1	0	0
1139	616	106	1	3	6	2	68
1141	706	108	1	2	13	13	0
1143	706	109	0	0	0	0	0
1145	611	109	3	3	6	1	8
1146	614	66	10	2	14	3	2
1148	609	106	15	4	23	7	10
1150	611	63	5	3	9	2	7
1155	808	110	1	3	9	8	0
1156	615	69	15	8	30	17	2
1163	615	110	5	10	25	19	3
1164	707	108	0	0	1	0	0
1169	707	108	3	1	4	0	0
1175	803	108	15	28	37	19	0
1178	711	108	1	1	20	19	0
1179	804	106	6	3	22	18	0

Now drag and drop **child\_id** into the “ $\Sigma$  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.

The screenshot shows the 'Kenya\_epidemiological\_data [Compatibility Mode] - Microsoft Excel' window. A 'Paste Special' dialog box is open over the spreadsheet. In the 'Paste' section, the radio button for 'Values' is selected. In the 'Operation' section, the radio button for 'None' is selected. At the bottom of the dialog box, the 'OK' button is highlighted with a red box. The main spreadsheet area shows columns I through M with some data entries.

Save this new data table as **Kenya\_school\_STH\_surveys.xlsx**

The screenshot shows the 'Book1 - Microsoft Excel' window with a data table in the background. An 'Save As' dialog box is open in the foreground. The 'File name:' field contains 'Kenya\_school\_STH\_surveys.xlsx'. The 'Save as type:' dropdown shows 'Excel Workbook (\*.xlsx)'. The 'Save' button at the bottom right of the dialog box is highlighted with a red box. The 'OK' button in the dialog box is also highlighted with a red box.

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

So, we create a new column: sth\_prev 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 adjust the column label accordingly); then copy the formula to the other cells in the column.

A	B	C	D	E	F	G	H	I	J	K	L	M
1	school_id	Average of district_id	Count of child_id	Sum of hookworm_inf	Sum of trichuris_inf	Sum of anysth_inf	Sum of ascaris_inf	Sum of smansoni_inf	sth_prev			
2	1091	704	105	0	0	0	0	0	0/C2*100			
3	1119	613	109	22	18	45	21	8				
4	1123	712	105	3	0	3	2	0				
5	1124	702	110	17	9	34	27	0				
6	1125	610	107	34	8	39	11	1				
7	1133	710	109	0	1	1	0	0				

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:  $=I2 - (1.96 * (\text{SQRT}((I2 * (100 - I2) / C2))))$

For CIup:  $=I2 + (1.96 * (\text{SQRT}((I2 * (100 - I2) / C2))))$

Assuming I2 as sth\_prev and C2 as Count of child\_id, adjust accordingly.

A	B	C	D	E	F	G	H	I	J	K	L	M
1	school_id	Average of district_id	Count of child_id	Sum of hookworm_inf	Sum of trichuris_inf	Sum of anysth_inf	Sum of ascaris_inf	Sum of smansoni_inf	sth_prev	CILOW	CIUP	
2	1091	704	105	0	0	0	0	0	0/0.00/(C2)))	0	0	
3	1119	613	109	22	18	45	21	8	41.28			
4	1123	712	105	3	0	3	2	0	2.86			
5	1124	702	110	17	9	34	27	0	30.91			

A	B	C	D	E	F	G	H	I	J	K	L	M
1	school_id	Average of district_id	Count of child_id	Sum of hookworm_inf	Sum of trichuris_inf	Sum of anysth_inf	Sum of ascaris_inf	Sum of smansoni_inf	sth_prev	CILOW	CIUP	
2	1091	704	105	0	0	0	0	0	0/0.00/(C2)))	0	0/0.00/(C2)))	
3	1119	613	109	22	18	45	21	8	41.28			
4	1123	712	105	3	0	3	2	0	2.86			
5	1124	702	110	17	9	34	27	0	30.91			
6	1125	610	107	34	8	39	11	1	36.45			

Save this file as Kenya\_epidemiological\_school.csv



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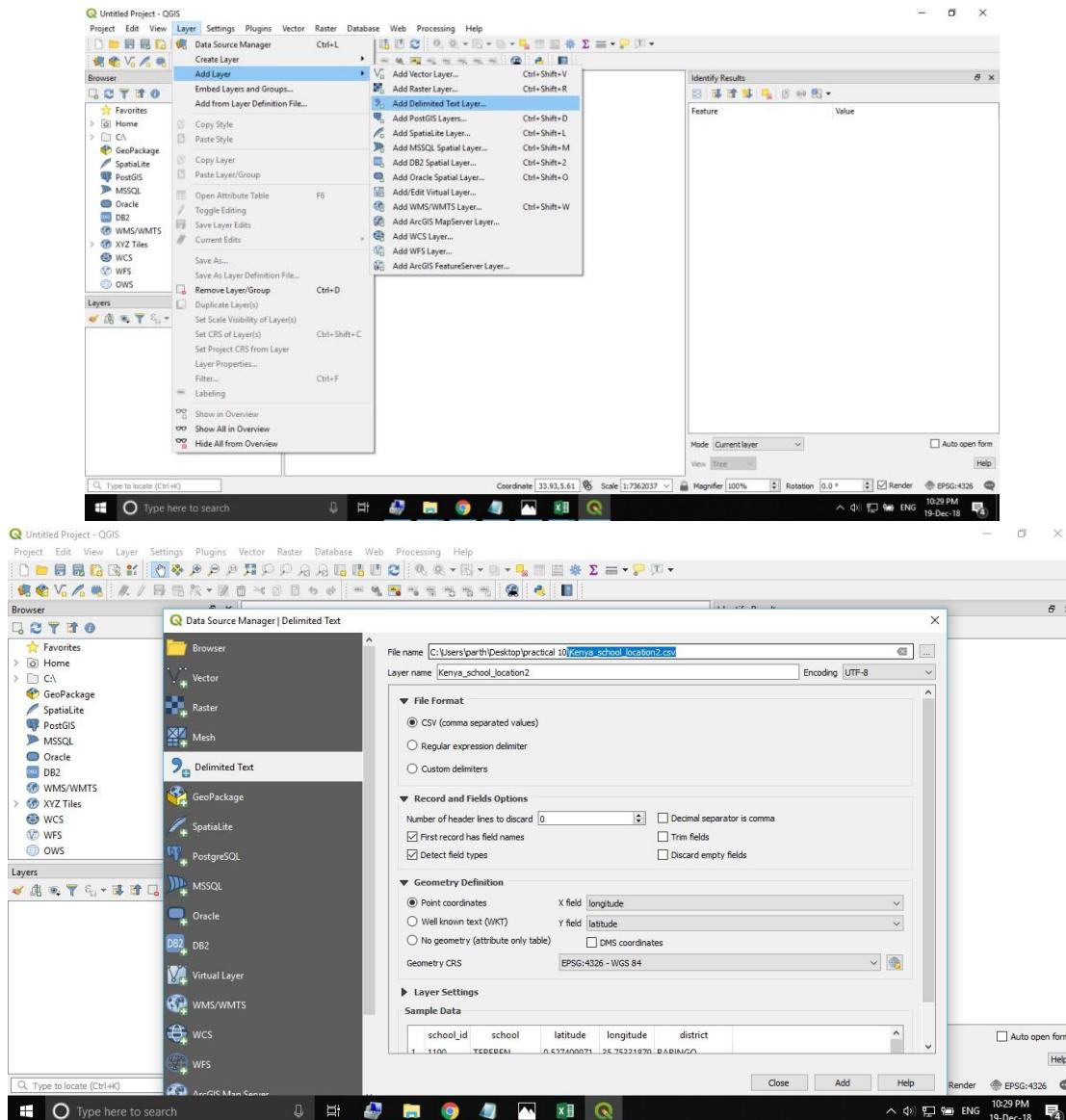
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Now that all the datasets are ready, let's add them.

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**



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The screenshot shows two instances of the QGIS application. The top instance displays a map view with several red circular points representing school locations. A context menu is open over one of these points, with the 'Add Layer' option highlighted. A sub-menu for 'Add Layer' is shown, listing various options for adding vector layers, such as 'Add Vector Layer...', 'Add Raster Layer...', and 'Add Delimited Text Layer...'. The bottom instance shows the 'Data Source Manager | Vector' dialog box. In the 'Source Type' section, the 'File' radio button is selected. The 'Source' field contains the path 'C:\Users\parth\Desktop\practical 10\Kenya\_epidemiological\_school.csv'. The 'Encoding' dropdown is set to 'UTF-8'. The 'Layers' panel on the left shows two layers: 'Kenya\_school\_location' and 'Kenya\_school\_location2'. The 'Browser' panel on the right lists various data sources including GeoPackage, Spatialite, PostGIS, MSSQL, Oracle, DB2, WMS/WMTS, XYZ Tiles, WCS, WFS, and OWS.

Now we'll join the data.

Right click on **Kenya\_school\_location2** layer and click on **Properties**

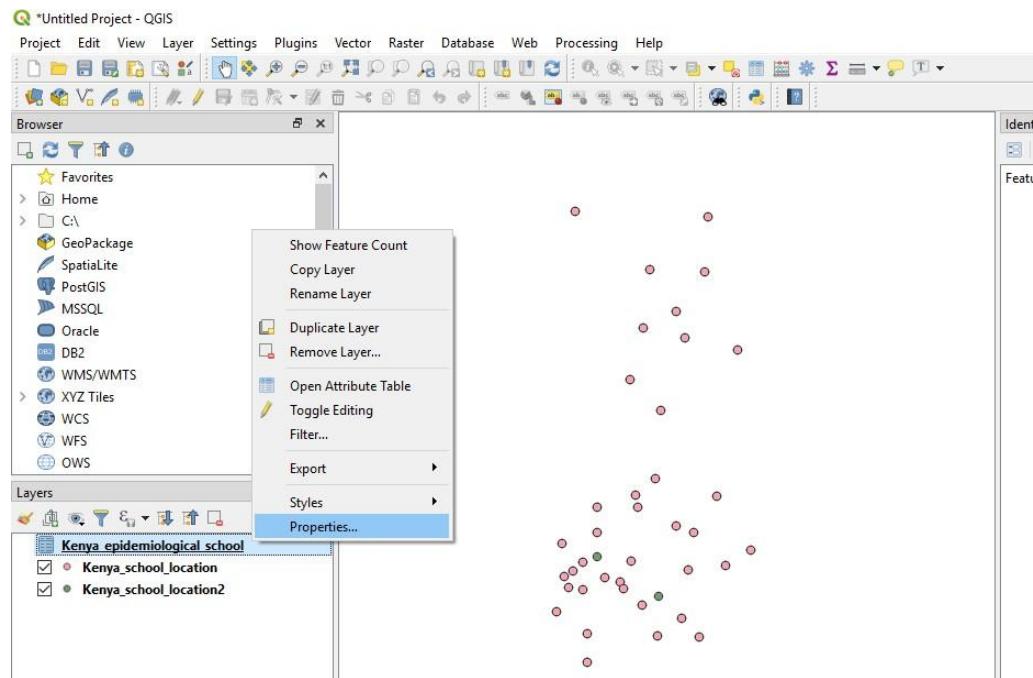


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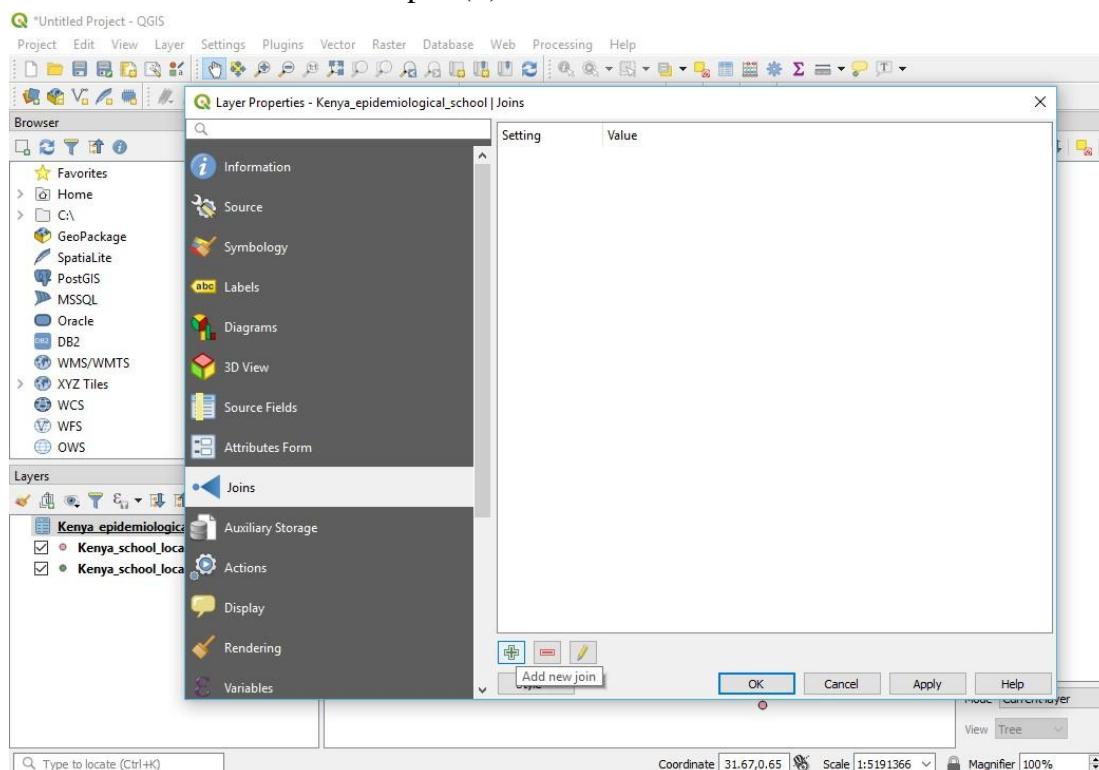
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Go to the **Joins** section and click on the plus(+) button at the bottom



For “Join layer” choose **Kenya\_epidemiological\_school** and for “Join field” and “Target field” choose **school\_id**. Then click on OK.

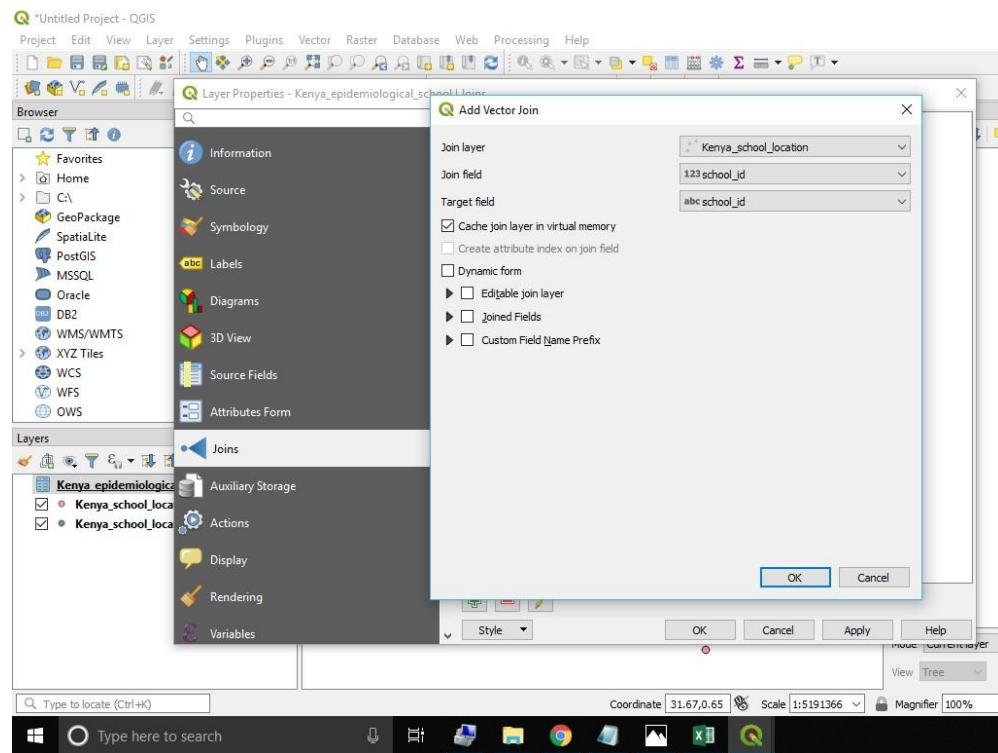


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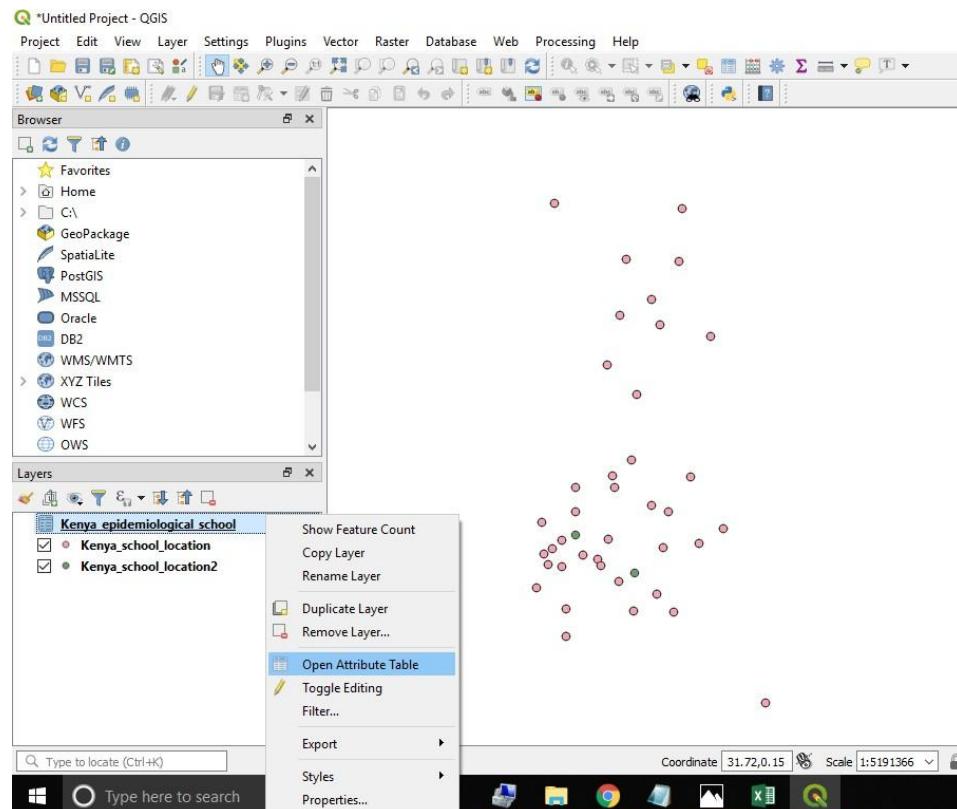
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Right click on Kenya\_school\_location2 layer and select Open Attribute Table.





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You will see that the epidemiological variables are included.

Q 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_I	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	KEIVO
4	1190	701	71	2	2.816901408	6.665548517	-1.0317457	TEREBEN	0.527409971	35.75331879	BARINGO
5	1189	801	70	22	31.42857143	42.3036453	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
								KANGIRISAE	2.618520021	36.25392151	TURKANA

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.



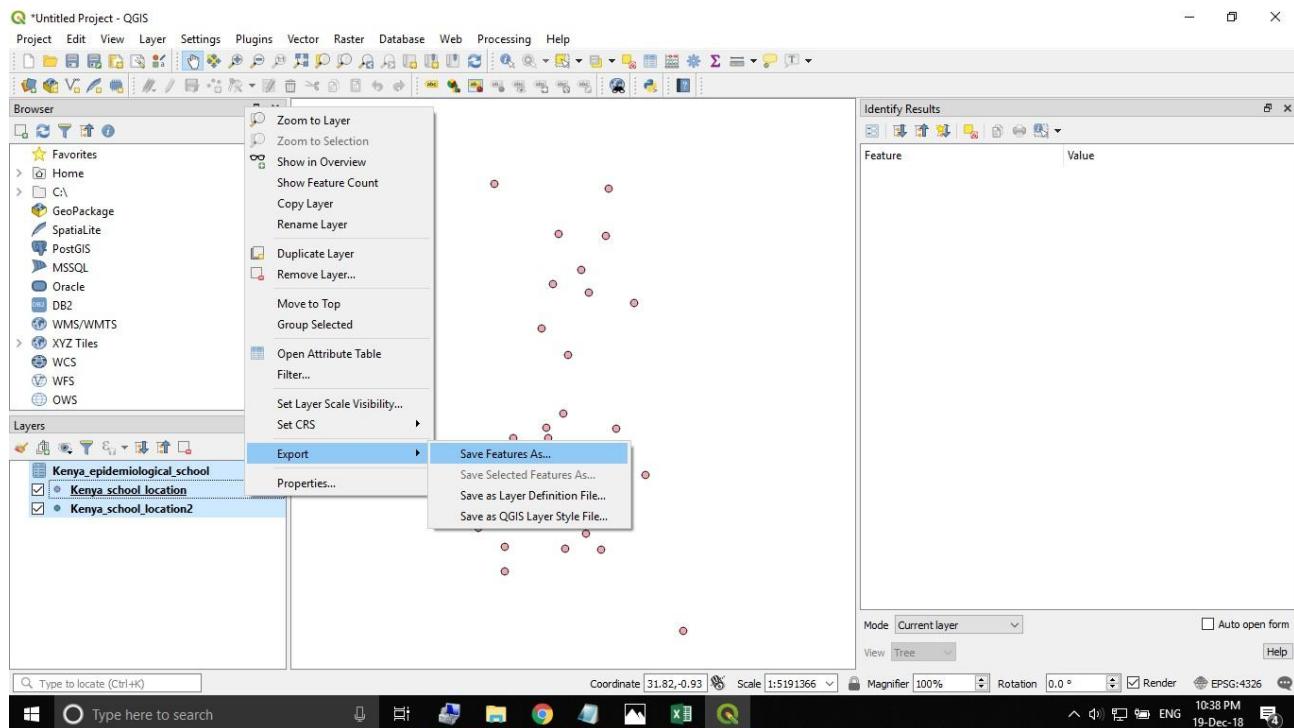


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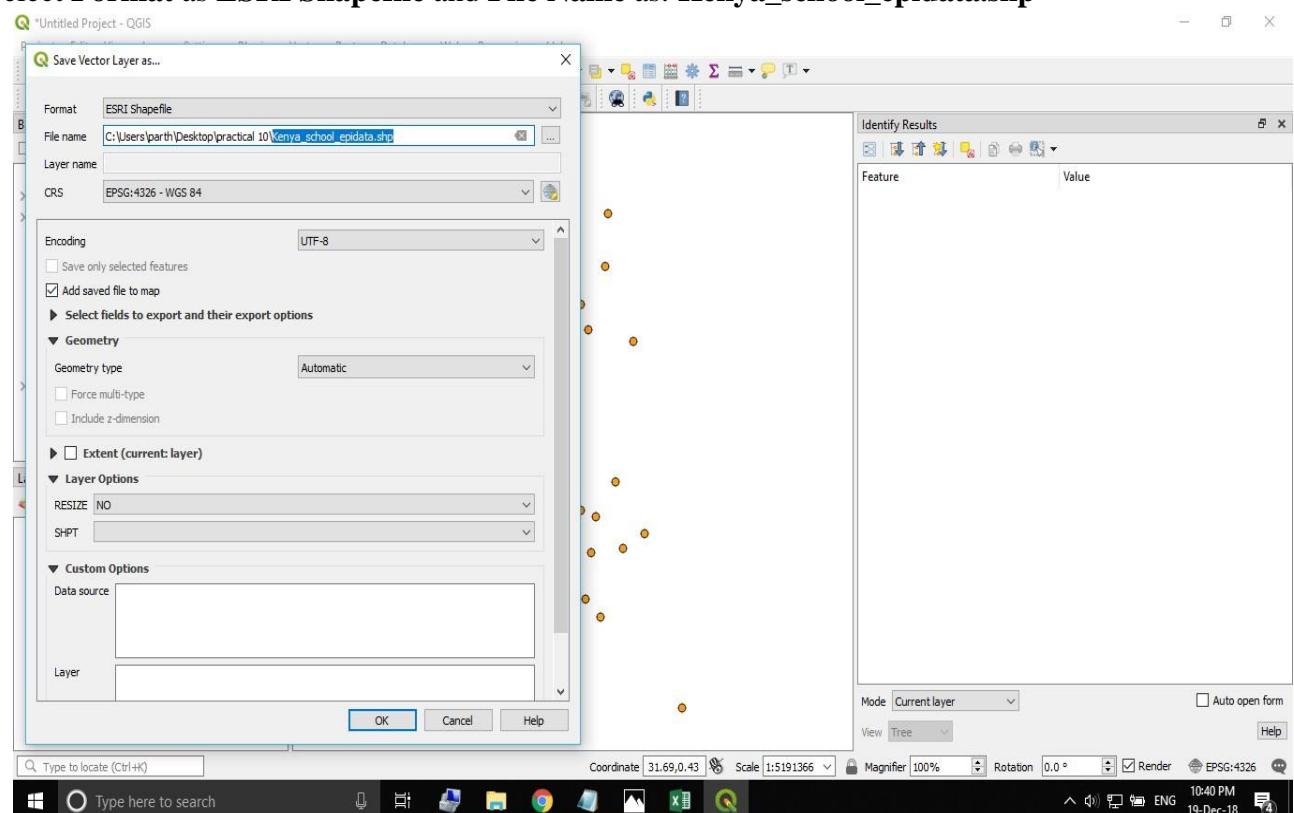
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Select Format as ESRI Shapefile and File Name as: Kenya\_school\_epidata.shp





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**Learning Outcome:**

Efficiently batch process GIS data tasks.

Create dynamic maps using Print Composer

**Course Outcome:**

- 1 Streamline GIS tasks with automation.
- 2 Produce validated, high-quality map outputs.

**Conclusion:**

**Viva Questions:**

- 1 What is the purpose of the Processing Modeler?
- 2 How do you automate map creation in QGIS?
- 3 Explain the significance of map data validation.

<b>Correction Parameter</b>	<b>Formative Assessment [ ]</b>	<b>Timely Completion of practical</b>	<b>Attendance Learning Attendance [ ]</b>

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<b>Prof. Name: Ms. Akanksha Mishra</b>	<b>Class / Sem: TYBsc.IT/ VI (2024-2025)</b>
<b>Course Code: USIT6P4</b>	<b>Subject Name: Fundamentals of GIS</b>

Sr. No.	Date	Index	Page	Sign
1.		Familiarizing Quantum GIS: Installation of QGIS, datasets for both Vector and Raster data, Maps.		
2.		Creating and Managing Vector Data: Adding vector layers, setting properties, formatting, calculating line lengths and statistics		
3.		Exploring and Managing Raster data: Adding raster layers, raster styling and analysis, raster mosaicking and clipping		
4.		Making a Map, Working with Attributes, Importing Spreadsheets or CSV files Using Plugins, Searching and Downloading OpenStreetMap Data		
5.		Working with attributes, terrain Data		
6.		Working with Projections and WMS Data		
7.		Georeferencing Topo Sheets and Scanned Maps Georeferencing Aerial Imagery Digitizing Map Data		
8.		Managing Data Tables and Spatial data Sets: Table joins, spatial joins, points in polygon analysis, performing spatial queries		
9.		Advanced GIS Operations 1: Nearest Neighbor Analysis, Sampling Raster Data using Points or Polygons, Interpolating Point Data		
10.		Advance GIS Operations 2: Batch Processing using Processing Framework Automating Complex Workflows using Processing Modeler Automating Map Creation with Print Composer Atlas Validating Map data		



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**2024 – 2025**

Name: \_\_\_\_\_

Department: \_\_\_\_\_

Class: \_\_\_\_\_

Roll No: \_\_\_\_\_



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**Rajarshi Sahu Maharaj Marg, Telli Galli, Andheri (E), Mumbai -400069,**  
**Tel.: 8928387199**

### CERTIFICATE

This is to certify that Mr/Ms. \_\_\_\_\_ - \_\_\_\_\_ a student of **T.Y.B.Sc IT** Roll No. \_\_\_\_\_ has completed the required number of practical in the subject of \_\_\_\_\_ as prescribed by the **UNIVERSITY OF MUMBAI** under my supervision during the academic year 2024-2025.

Signatories:

Subject In-charge (Name & Sign) : \_\_\_\_\_

Principal Sign (Name & Sign) : \_\_\_\_\_

External Examiner (Name & Sign) : \_\_\_\_\_

Date: \_\_\_\_\_

College Stamp