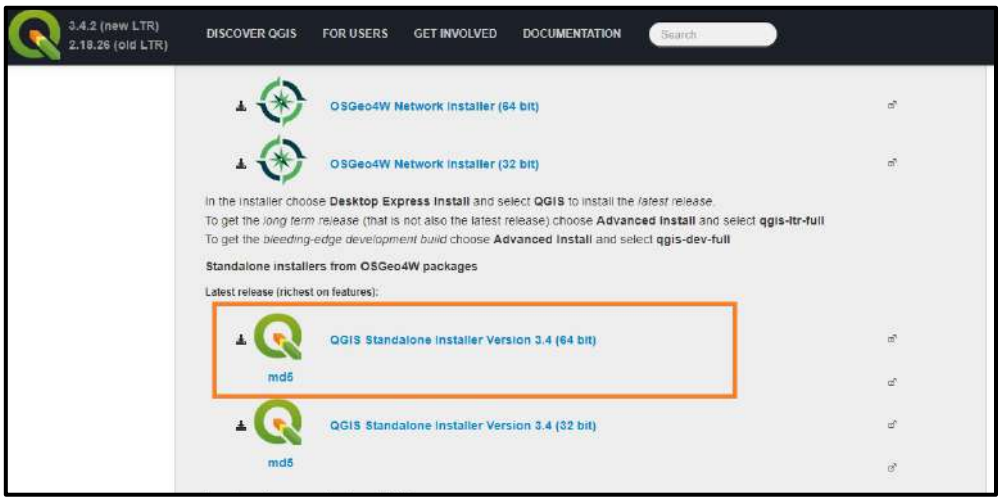
Practical 1

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

1) Create a folder on your D:/ drive on your computer called QGISlab by right clicking on the D: drive and navigating down to the New / Folder.

2) Go to the QGIS download page and download the latest 64bit version of QGIS for windows which is QGIS 3.4 'Madeira' by clicking once.

3) If you have a 32 bit machine or using another operating system search the bottom of the page for your operating system and download the correct operating system version of QGIS. http://www.qgis.org/en/site/forusers/download.html



4) You browser will download the file to the browsers default download directory. By pressing the control key and the letter J at the same time a popup window will show you the folder where the QGIS file has been downloaded. The QGIS file will be called:

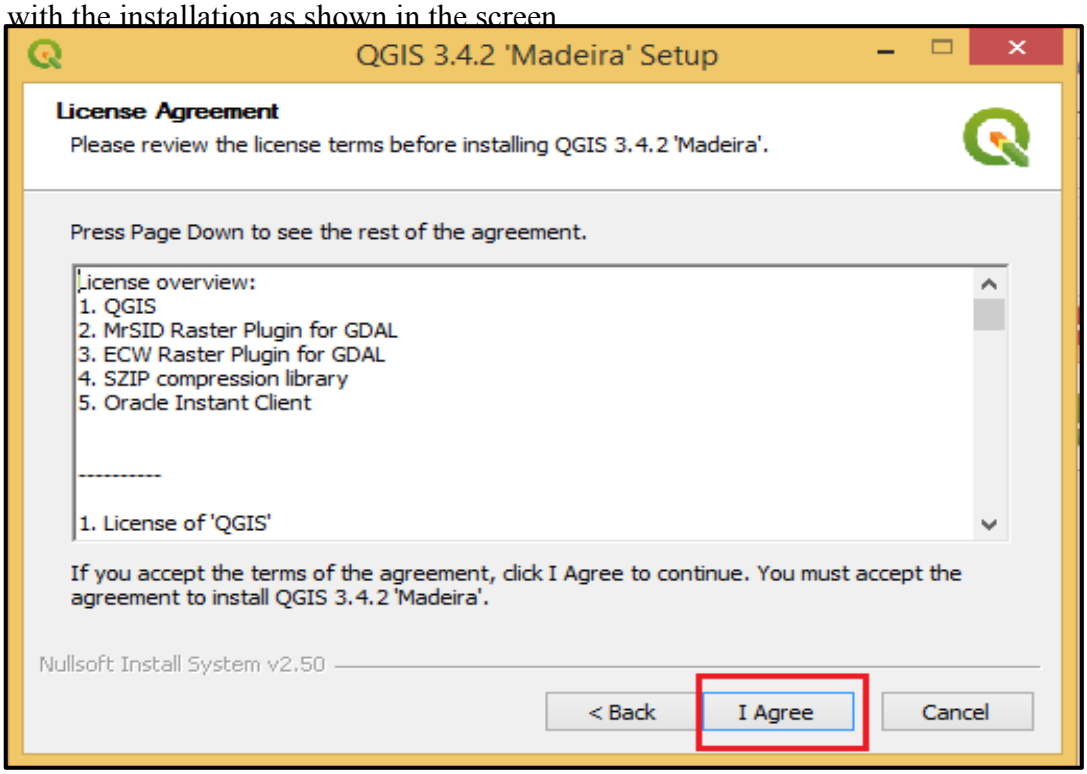
"QGIS-OSGeo4W-3.4.2-1-Setup-x86.exe"

5) Move or copy the above file to your C:/QGISlab folder and double click on the file. You will get a popup window with a security warning.

6) Hit the run button to start the installation process and follow the prompts. There is no need to install the data sets suggested by QGIS.

7) From the above window, click Next button and continue with the installation.

8) Please go through the license agreement and click on the button> I agree and proceed with the installation as shown in the screen



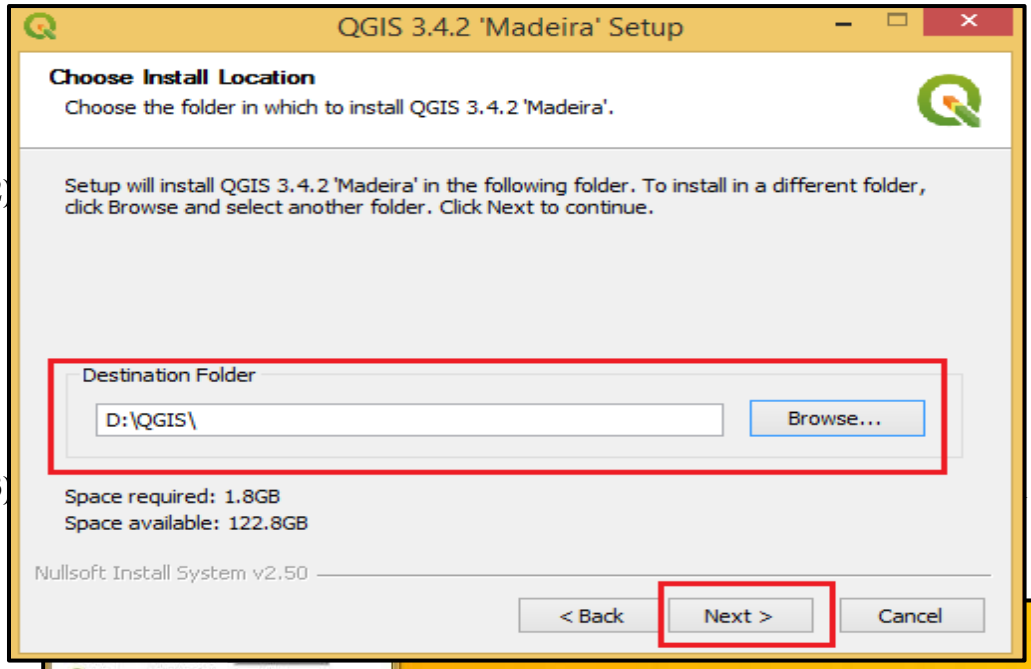
9) As the software is very heavy it is advisable to install it in the different drive other than the windows drive. As per our example, we will be installing in QGIS folder on D:\ drive.

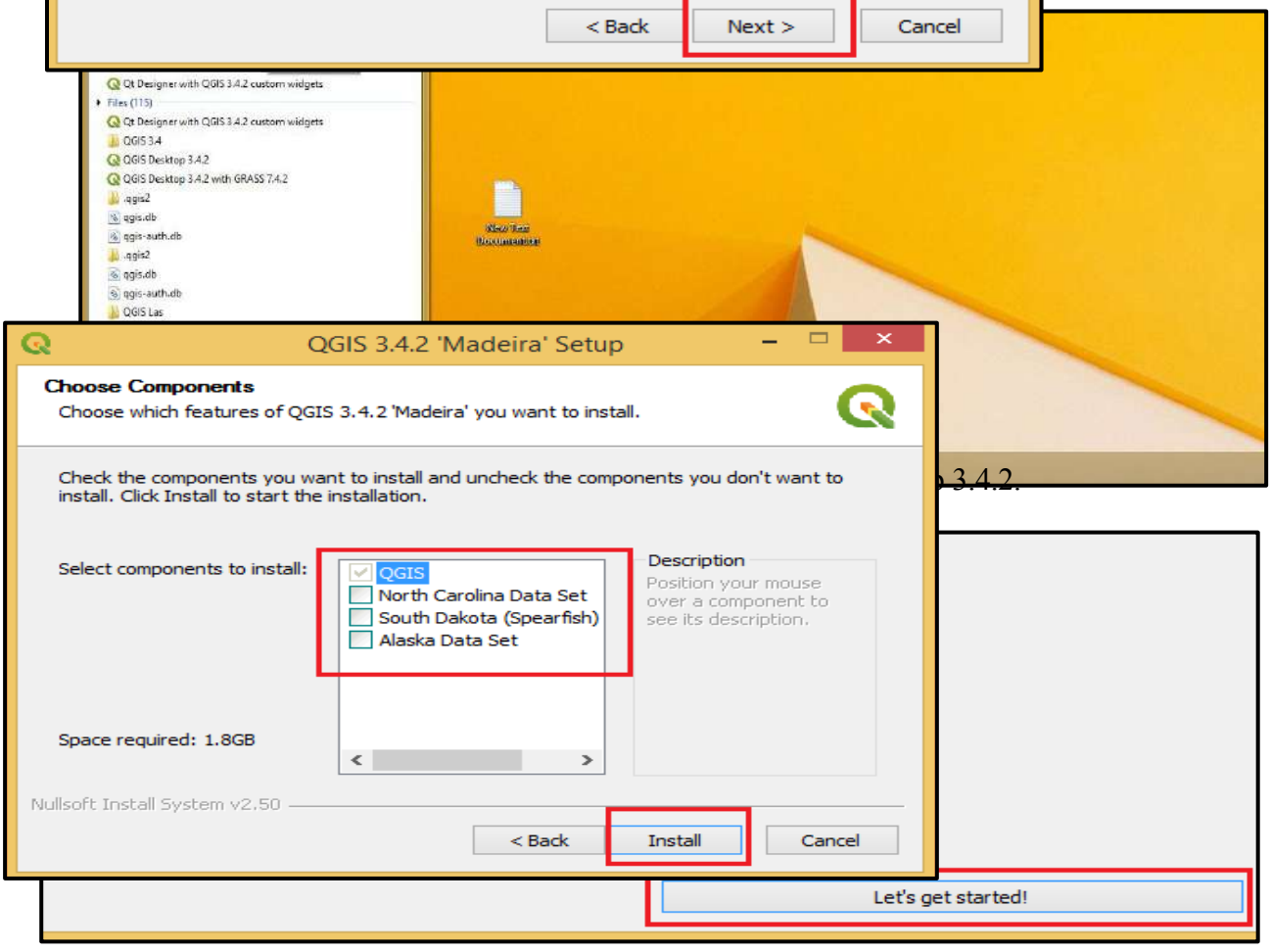
10) After browsing the folder click the Next button and proceed with the installation as shown in above figure.

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

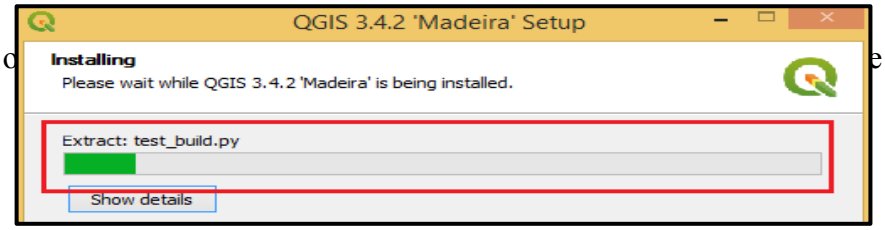
12)

13) to





15) It will o



e figure below.

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

Part 2: Working with Datasets (Vector & Raster)

1. Understanding Vector and Raster Data

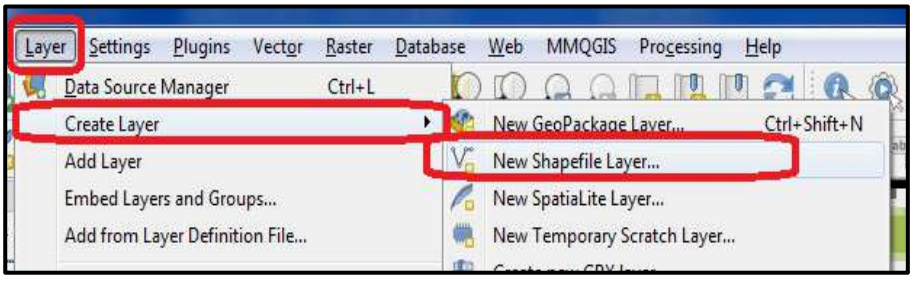
- **Vector Data:** Represents features using points, lines, and polygons (e.g., roads, rivers, land boundaries).
- **Raster Data:** Represents data as a grid of pixels (e.g., satellite images, elevation models).

2. Downloading Sample Datasets

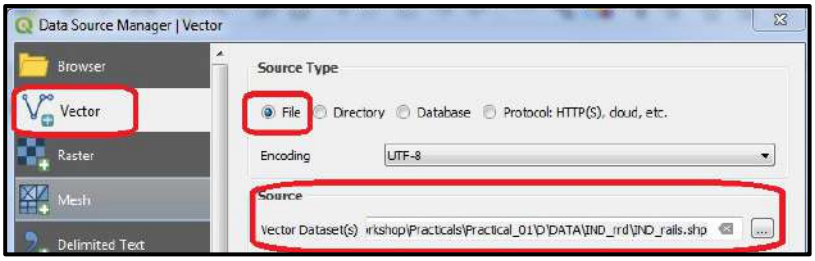
- You can find free datasets from:
  - **Natural Earth** (https://www.naturalearthdata.com/)
  - **OpenStreetMap (OSM) Extracts** (https://download.geofabrik.de/)
  - **USGS Earth Explorer** (https://earthexplorer.usgs.gov/)
- Or you can use your own given dataset

3. Loading Vector Data in QGIS

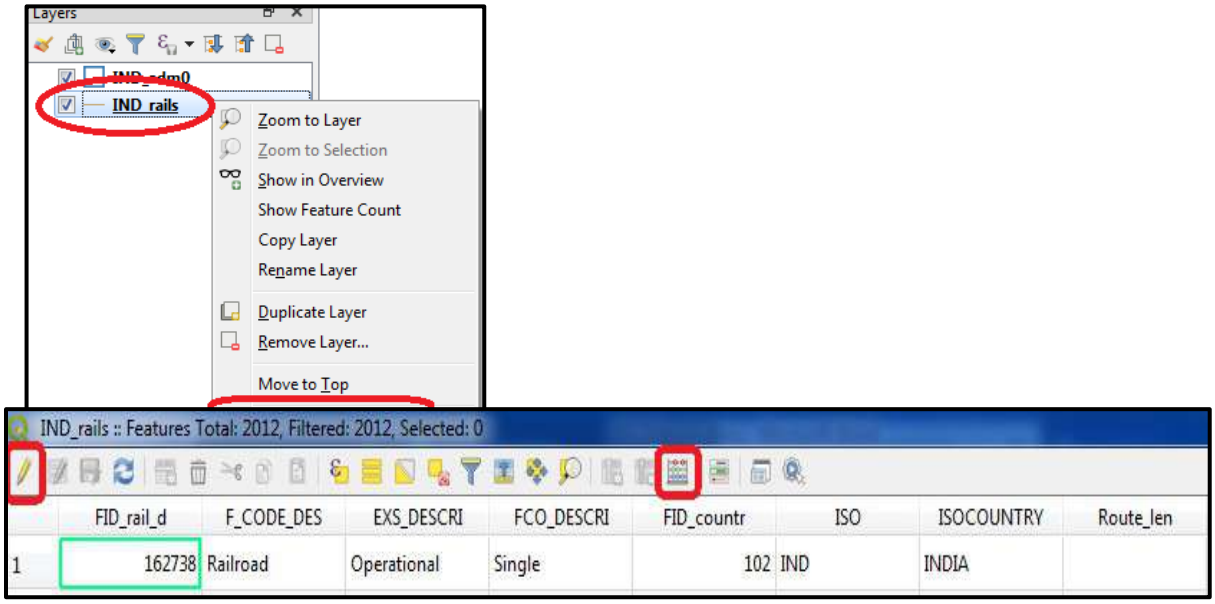
1. Click on **Layer → Add Layer → Add Vector Layer**.



2. Click **Browse**, select the downloaded **.shp** file, and click **Open**.

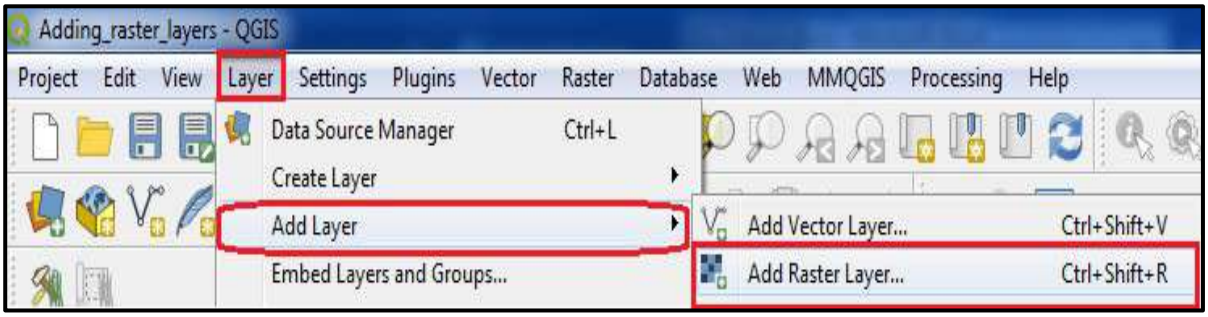


3. The vector dataset will now appear on your map.

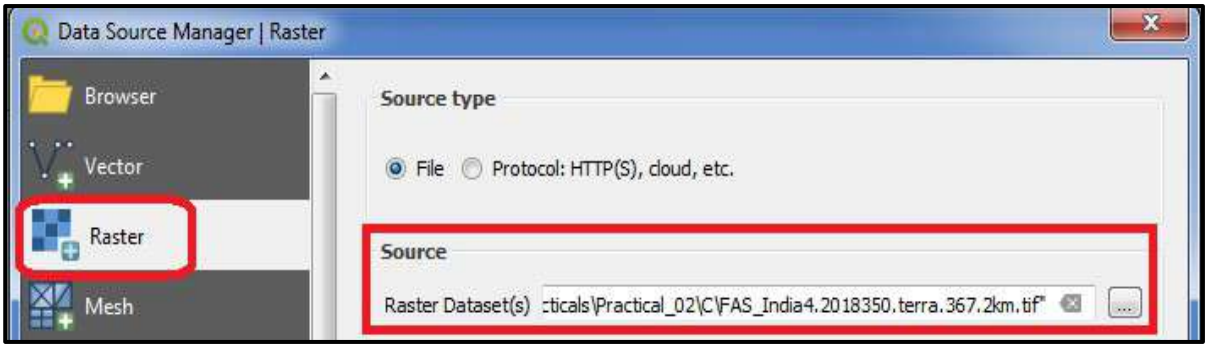


4. Loading Raster Data in QGIS

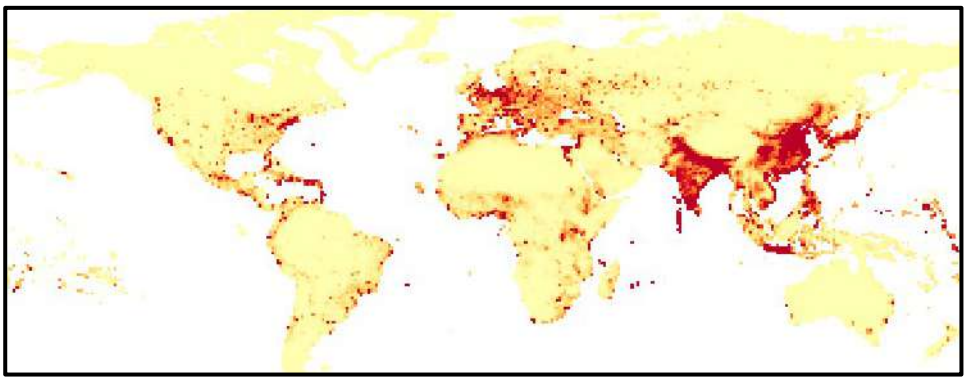
1. Click on **Layer → Add Layer → Add Raster Layer**.



2. Browse for a **.tif** file and click **Open**.



3. The raster image will load onto the map.



5. Adding a Simple Map in QGIS

1. Go to **Project → New Print Layout** → Give it a name and click OK.
2. Click **Add Map**, then drag and draw a rectangle to create a map.
3. Add **Legend, Scale Bar, and Title** using the "Add Item" menu.
4. Click **Layout → Export as PDF/PNG** to save your map.

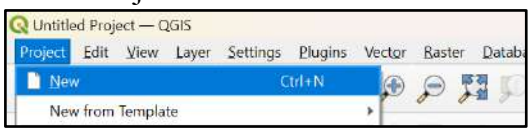
Practical 2

<u>Creating and Managing Vector Data:</u>

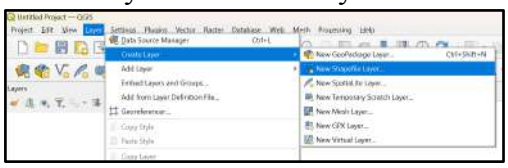
Adding vector layers, setting properties, formatting, calculating line lengths and statistics.

a. Creating Polygon vector layer

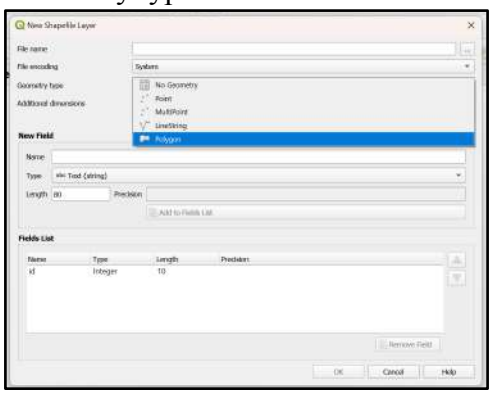
➢ Select Project→New



➢ Select Layer → Create Layer → New Shapefile Layer



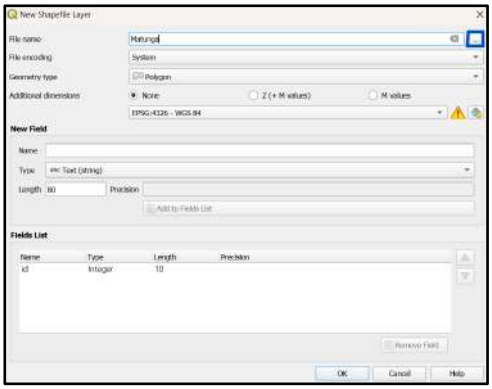
➢ Following dialog box will appear on the screen. Select Polygon option from Geometry type.

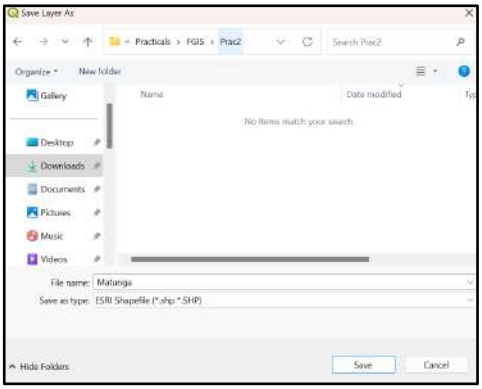


➢ Fill the appropriate information in each text box.

➢ 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.

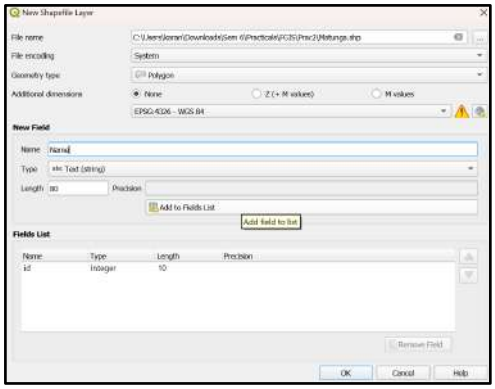




➢ Field Panel

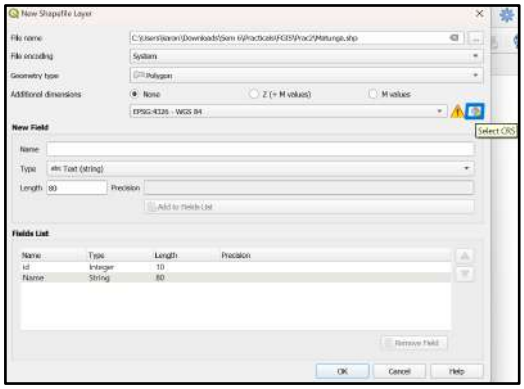
- Add the Attribute you want to show. (Column Name for Table)
- Specify Type (DataType:Text Data/Decimal Data/Whole Number/Date) of Attribute
- Specify the Length of the Attribute. Specify Precision (If Data Type is Decimal)

➢ Click on Add to Field List Button.

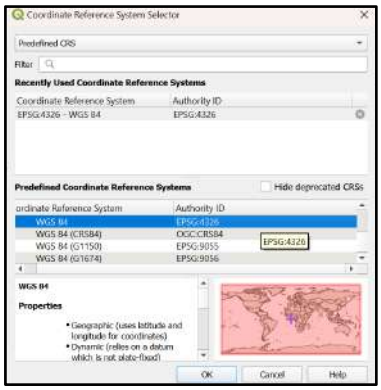


➢ You can add as many fields (Column Name) as you want for the layer.

➢ Select Geometry Type as follows
Click on the following button:



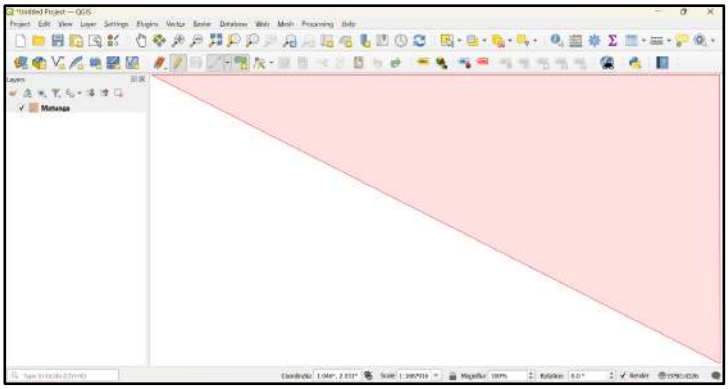
➢ The CRS dialog box will appear on screen. Click on the WGS84 option and it will be selected as follows. Click on OK.



➢ <u>Follow the steps to plot Polygon features.</u>

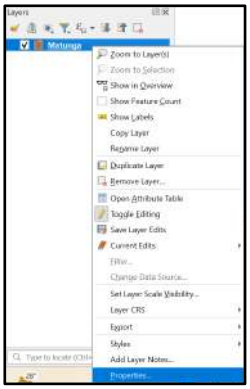
- Select the Polygon Feature(In our case it is Matunga for background) from layer panel.

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

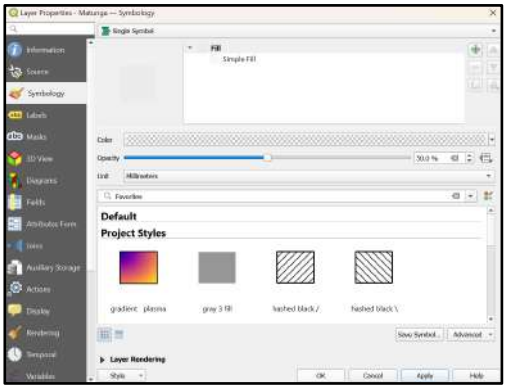


- Save the newly added polygon as follows.

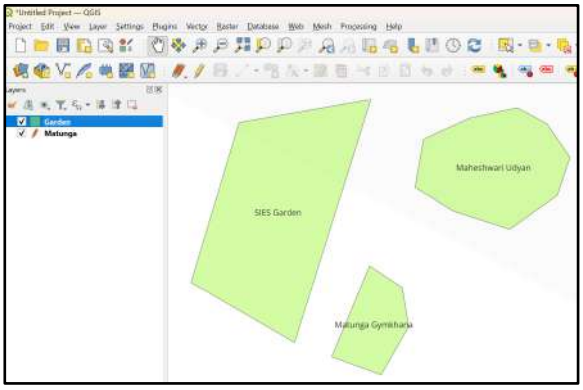
- Set style for polygon by using property window(Right click on Matunga Layer)



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



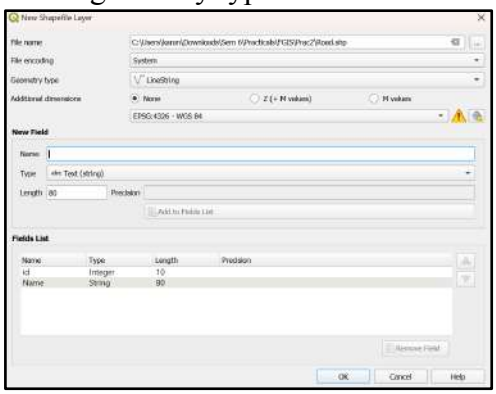
- Same way we can add one more polygon layer for Gardens.



b. Creating Line vector layer

➢ Repeat the same steps as we have done for polygon layer.

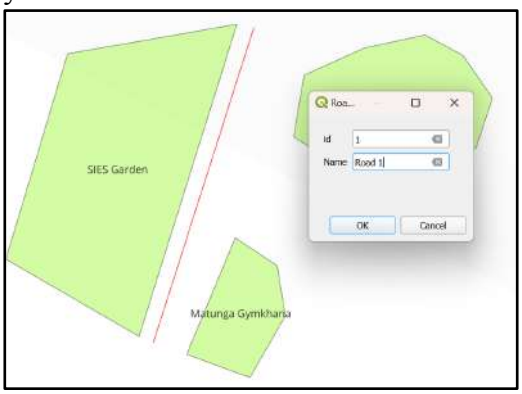
➢ Select geometry type Line.



➢ <u>Road layer:</u>

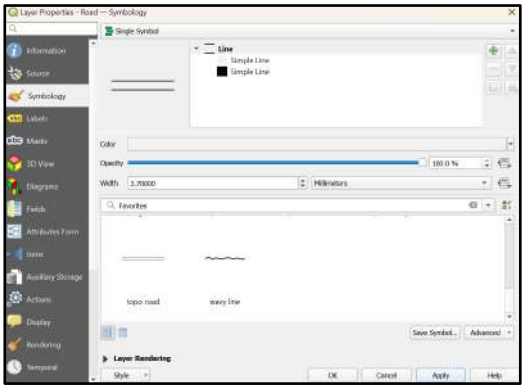
- To plot road click on Add Line Feature.

- Click on the map where you want to draw line.
- Once you are done then right click on map (Dotted line turn into solid line) save your data .



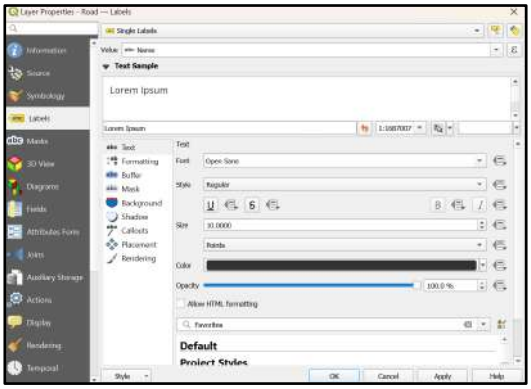
- Set style for Roads in the same way as we have done for polygon.

- Road will look as below.

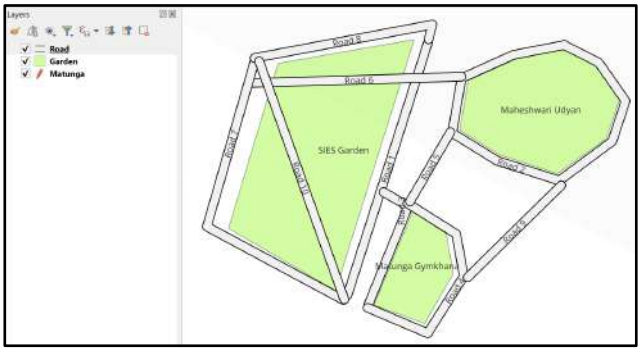


- To label your roads Right click on Road layer → Go to properties window then select label and set single label property

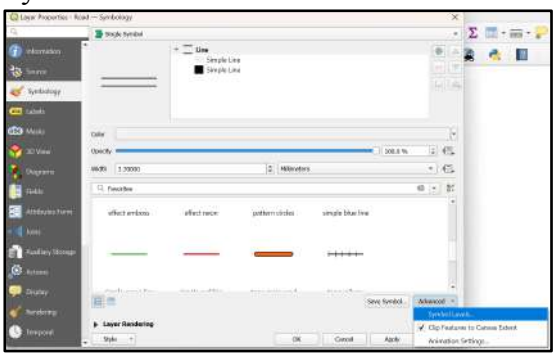
- Following window will appear on the screen



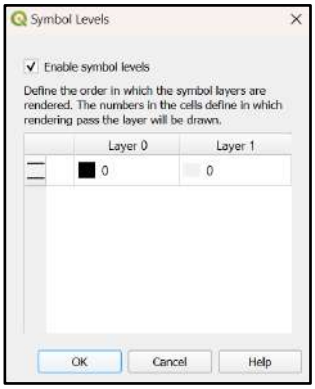
- Roads will look like these



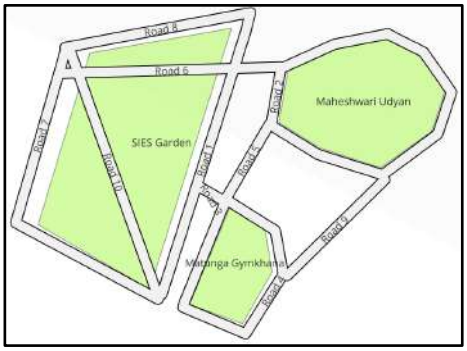
- To merge roads
  Go to properties of road then select symbology. Click on Advanced button select Symbol levels.



- Check Enable symbol levels option

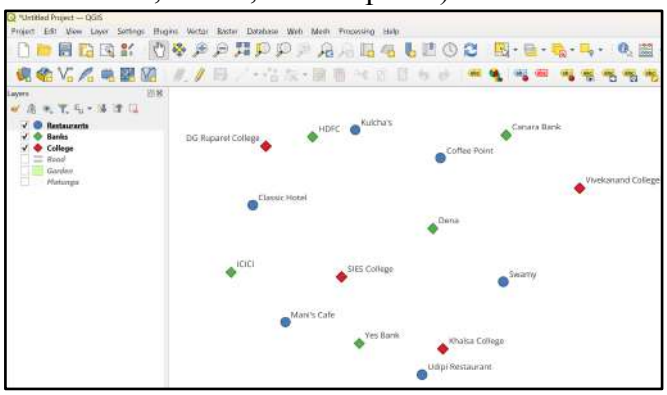


- Click ok & Road will appear as follows

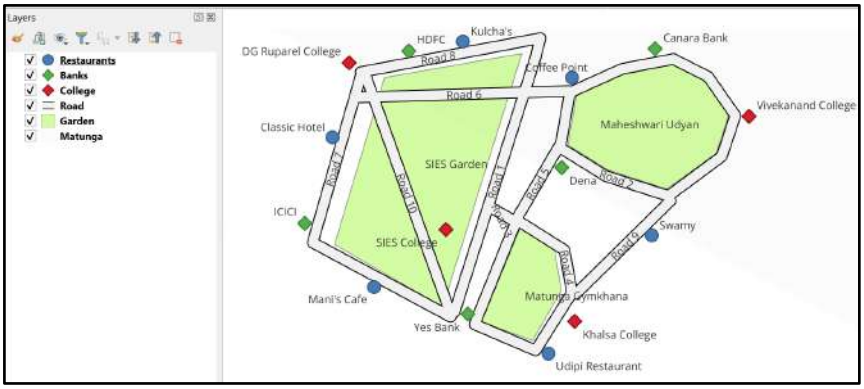


c. Create Point vector layer

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

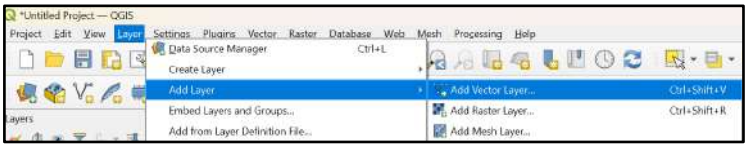


➢ Final output:



d. **Calculating line lengths and statistics**

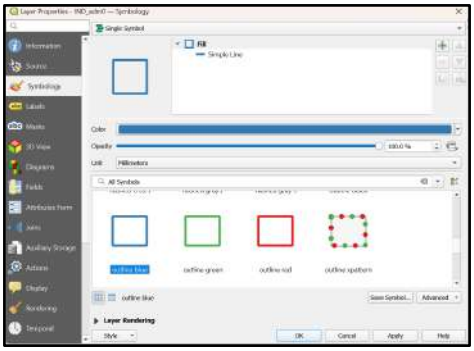
➢ Go to Layer → Add Layer → Add Vector Layer



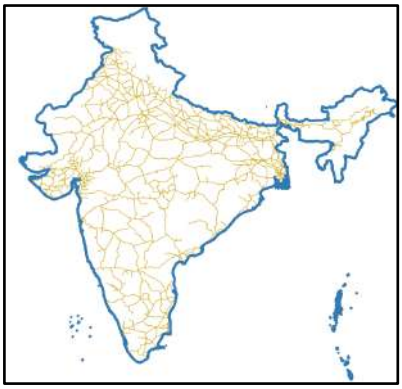
➢ Add the following file to project
"C:\PGIS\Practical_01\IND_rrd IND_rails.shp". Press "ADD"
Also add India Administrative Map
"GIS_Workshop\Practicals\Practical_01\D\DATA\IND_adm\IND_adm0.shp"

➢ Double Click on IND_adm0

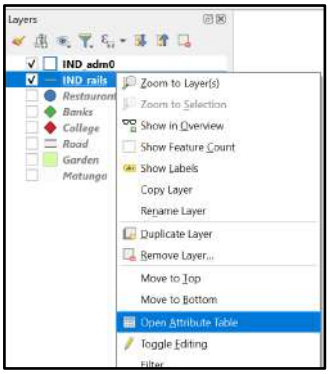
➢ Select Symbology → Select any outline style from below given options.



➢ Press OK. The display window will appear like:

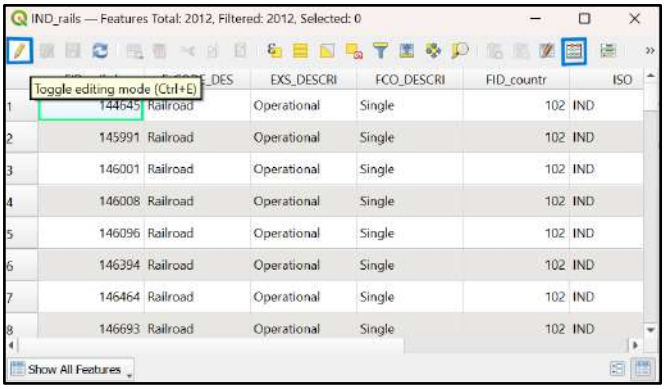


➢ In Layer Pane, Right click on IND_rails → Open Attribute Table

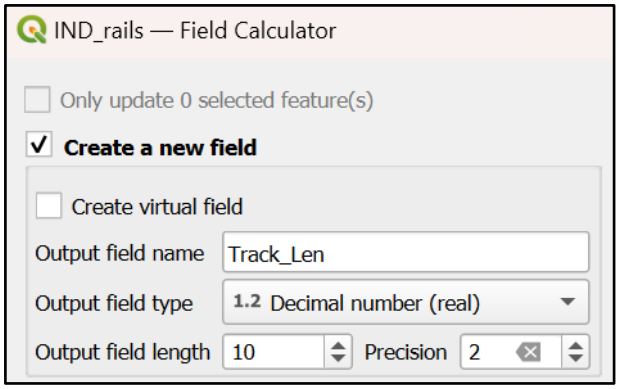


➢ Press Toggle Editing button using button, on Attribute table window toolbar.

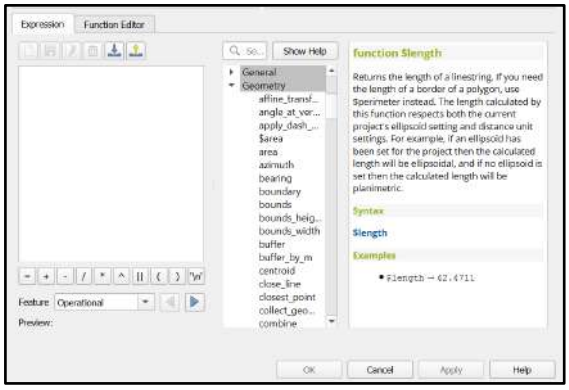
➢ Press Open Field Calculator using button.



➢ Set the output field as “Track_Len”, field type to “Decimal Number”.



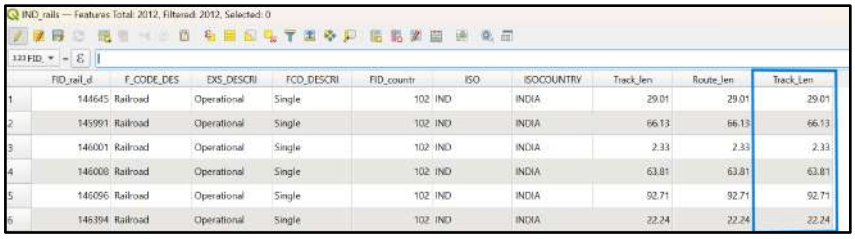
➢ From Function List search $length or go to Geometry → Select $length



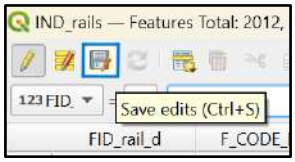
➢ Set expression as

➢ Press "OK"

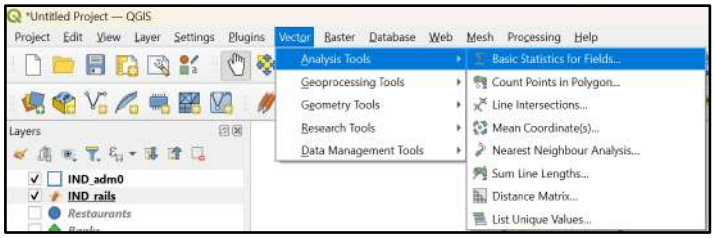
➢ A new column is added to the attribute table with value representing the length of track in KM.



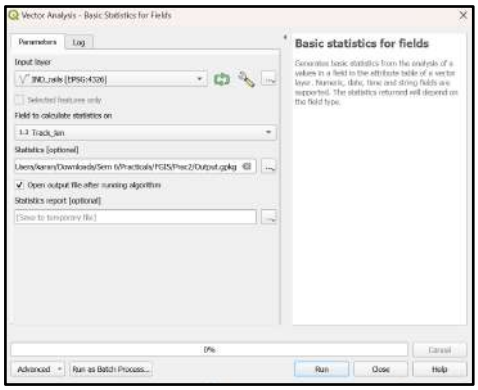
➢ Press CTRL+S or click on Save Edits option on tool bar



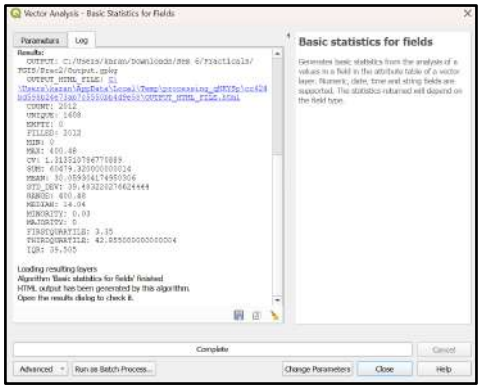
- Close the attribute table window.
- For calculating the total length of Railway tracks in India.
- Select Vector→ Analysis Tools→ Basic Statics for Fields



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



- Press RUN
- The Result is



- Open the "output.html" file to get the field statistics.

  Analyzed field: Track_Len
  Count: 2012
  Unique values: 1608
  NULL (missing) values: 0
  Minimum value: 0.0
  Maximum value: 400.48
  Range: 400.48

Sum: 60479.320000000014
Mean value: 30.059304174950306
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
First quartile: 3.35
Third quartile: 42.855000000000004
Interquartile Range (IQR): 39.505

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

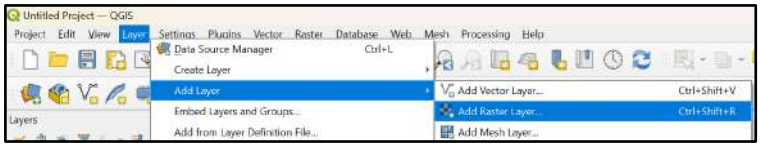
Practical 3

Exploring and Managing Raster data:

Adding raster layers, raster styling and analysis, raster mosaicking and clipping.

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\glds

90ag60.asc"
"\GIS_Workshop\Practicals\Practical_02\A\Data\gl_gpwv3_pdens_90_ascii_one\glds00ag60.asc"

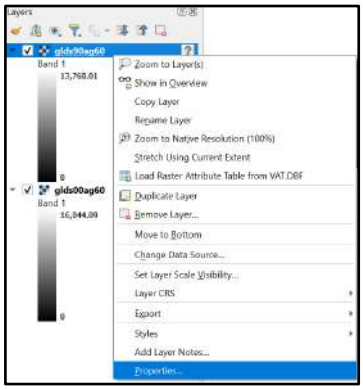
➢ Go to Project → Properties OR Press the 

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

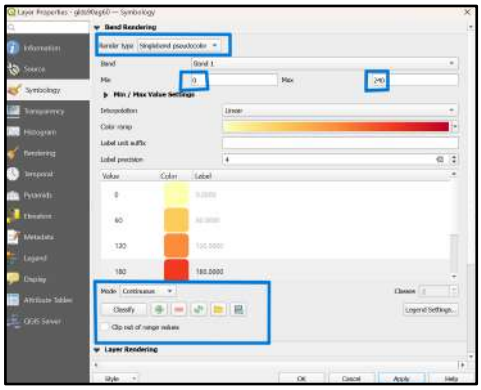
b. Raster Styling and Analysis

➢ To start with analysis of population data, convert the pixel from grayscale to Color.

➢ Select "glds90ag60.asc" Layer form layer Pane → select property OR double click on it.



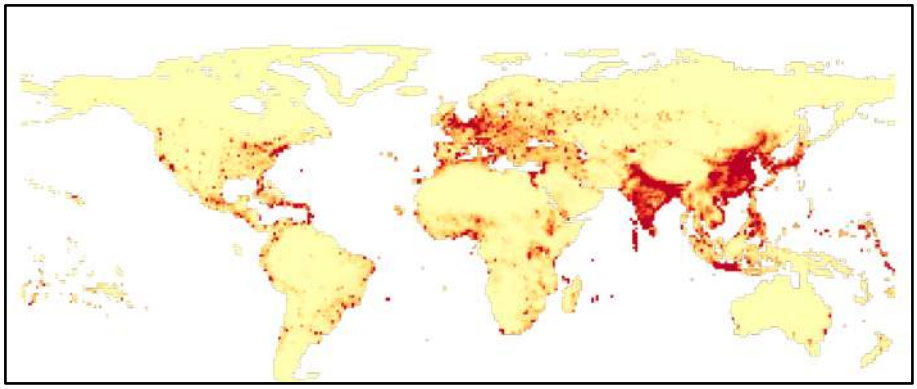
➢ Select Symbology. Color Ramp : YIOrRd



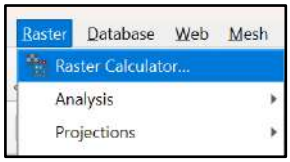
➢ Press "APPLY"

➢ Repeat the same for "glds00ag60.asc" Layer.

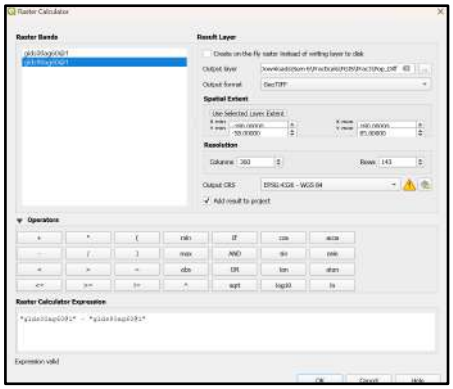
➢ Layer output after applying style.



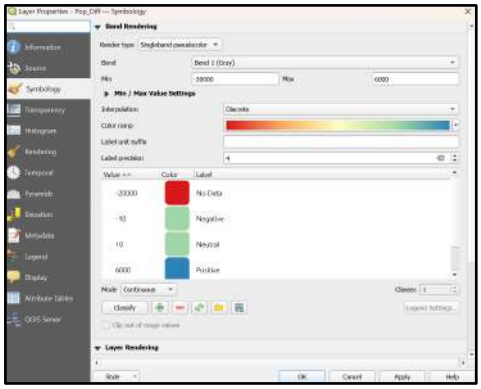
- The objective this experiment is to analyze raster data, as an example we will find areas with largest population change between 1990 and 2000, by calculating the difference between each pixel values.
- Go to Raster → Raster Calculator



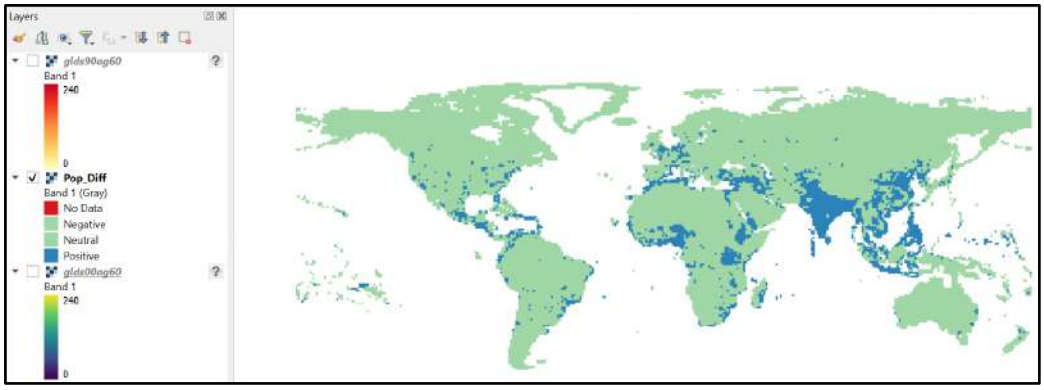
- Put the expression "glds00ag60@1" - "glds90ag60@1"
- Select the output file location & name and Press OK.



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



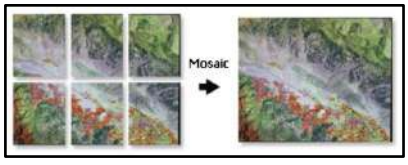
➢ Explore an area of your choice and check the raster band value using  to verify the classification rule.

➢ The light green pixel shows negative changes and blue shows positive changes.

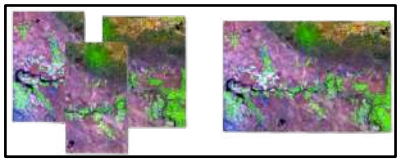
c. Raster Mosaicking and Clipping

A mosaic is a combination or merge of two or more images.

In GIS, a single raster dataset can be created from multiple raster datasets by mosaicking them together.

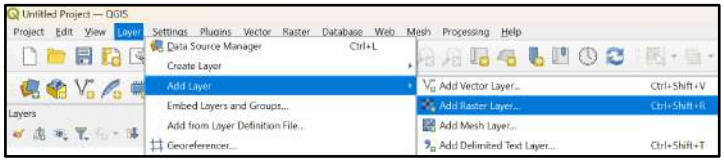


In many cases, there will be some overlap of the raster dataset edges that are being mosaicked together, as shown below.

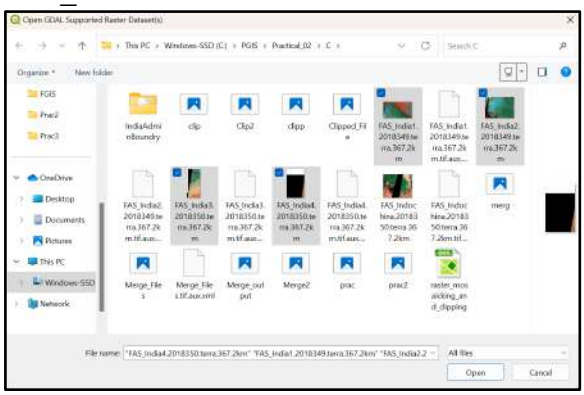


These overlapping areas can be handled in several ways; for example, you can choose to only keep raster data from the first or last dataset, you can blend the overlapping cell values using a weight based algorithm, you can take the mean of the overlapping cell values, or you can take the minimum or maximum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

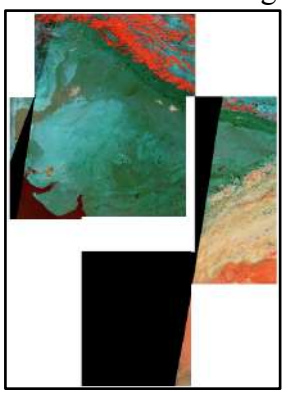
➢ Go to Layer → Add Layer → Add Raster Layer.



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

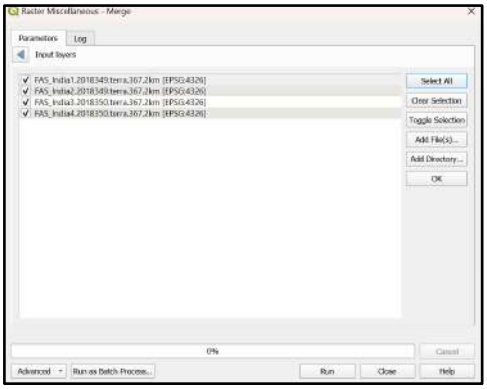


➢ Press open
➢ In data source manager | Raster window click Add.

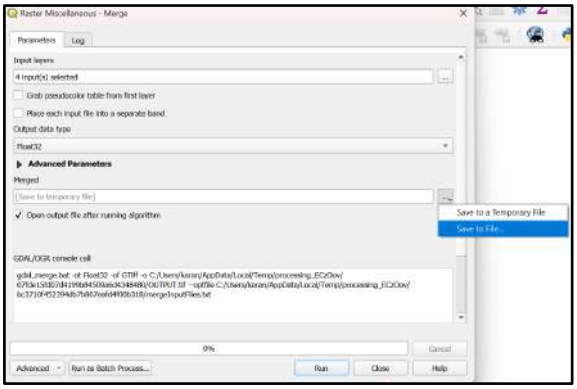


➢ Go to Raster → Miscellaneous → Merge

➢ In the Merge dialog window, select all layers and Press OK.

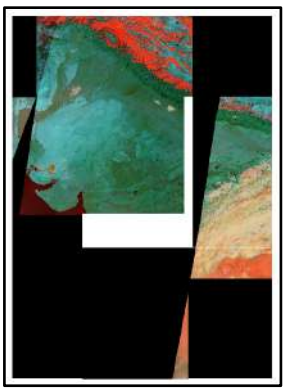


➢ In Merge dialog window select a file name and location to save merged images.

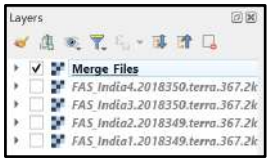


➢ Save the file to “C:\Users\karan\Downloads\Sem 6\Practicals\FGIS\Prac3” location with the name as Merge_Files.tif

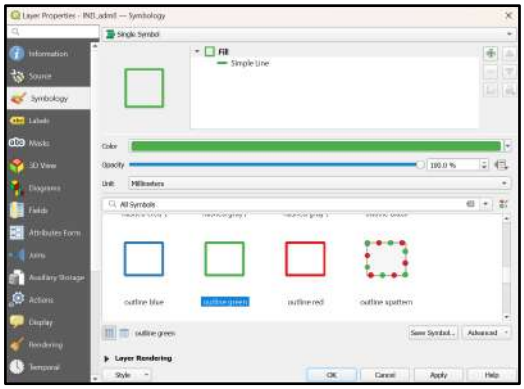
➢ Press Run and after completion of operation close the Merge window dialog box.



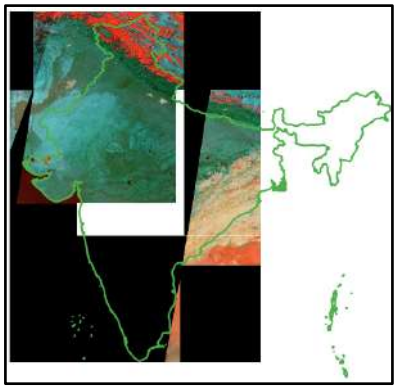
➢ You can now deselect individual layers from layer pane and only keep the merged raster file.



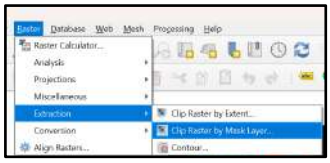
- Go to Layer→ Add Vector Layer → Select C: \PGIS\Practical_02\C\IndiaAdminBoundry\IND_adm0.shp file.
- From layer properties → Select Symbology → select any one of the following



- The result will be

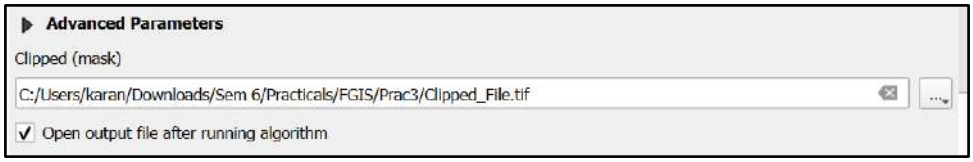


- Go to Raster → Extraction → Clip Raster by Mask Layer

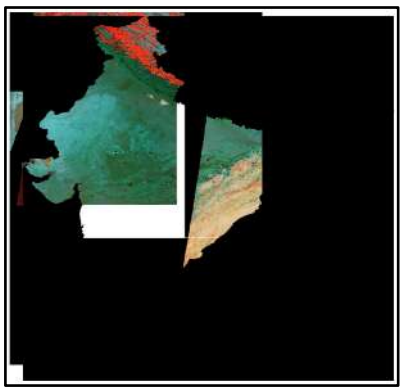


- Select the merge raster image as input and Ind_adm0 as mask layer.

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



➢ Press RUN.

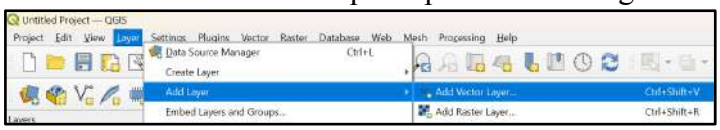


Practical 4

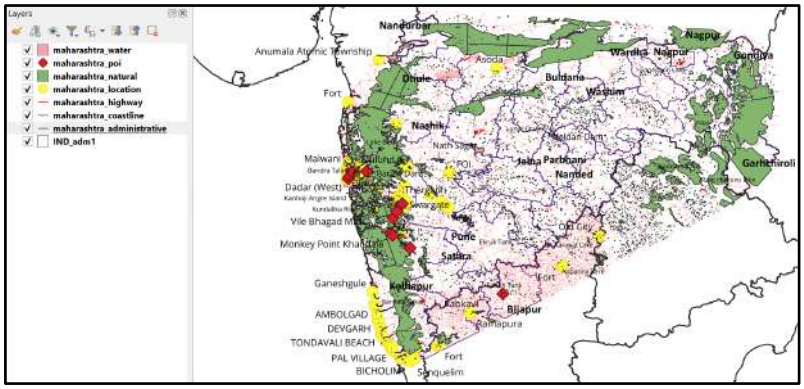
Making a Map, Working with Attributes, Importing Spreadsheets or CSV files Using Plugins, Searching and Downloading OpenStreetMap Data

a. Making a Map

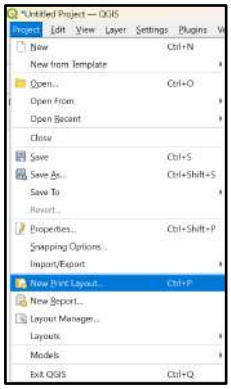
➢ Create a new Thematic Map or open and existing one



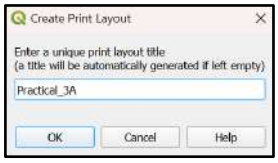
➢ Consider the following map as an example map



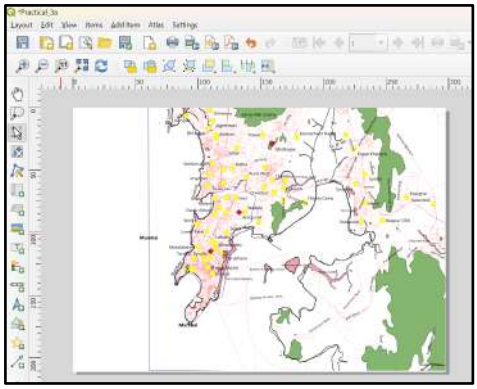
➢ Go to Project → New PrintLayout



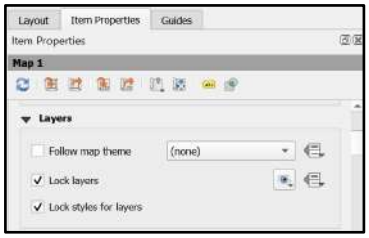
➢ Insert a suitable title and press “OK”.



➢ A new Print Layout window will openSelect Add Item → Add Map

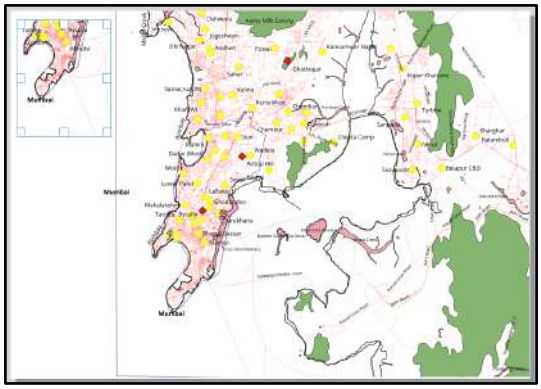


➢ After adding map go to ItemProperties → Map1→ Layers
Check on Lock Layers and Lock Styles for Layers.



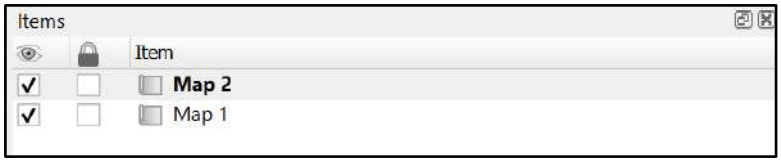
This will ensure that if any change in layers or change their styles, the Print Layout view will not change.

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

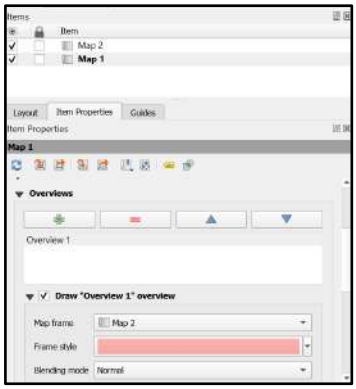


➢ Also adjust Image Rotation to its appropriate value.
➢ Item Properties → Image Rotation

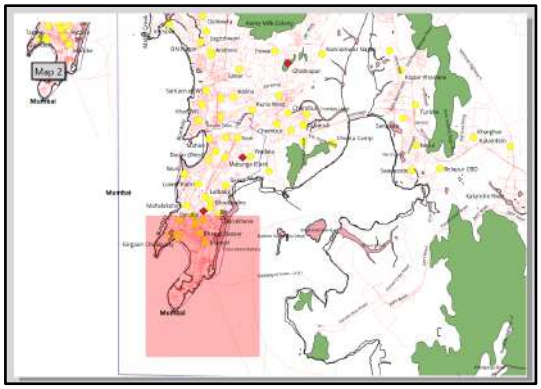
➢ Add an inset Using Add Item → Add Picture → Select an area to be highlighted on main Map.
➢ Set a frame for Inset by enabling the check box for Frame.



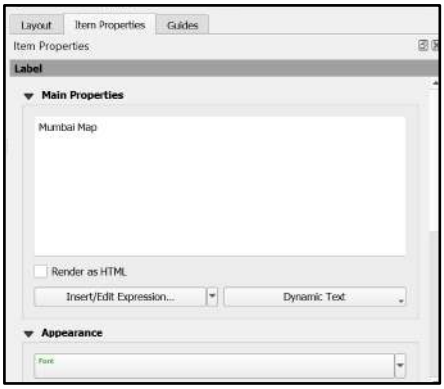
- To highlight the area shown in Inset
- Select the Picture representing main Map from Items pane.
- In Item Properties → Overviews → using  icon add an overview.
- Select the checkbox Draw Overview
- Name the Picture object representing inset (Map2 in our case).

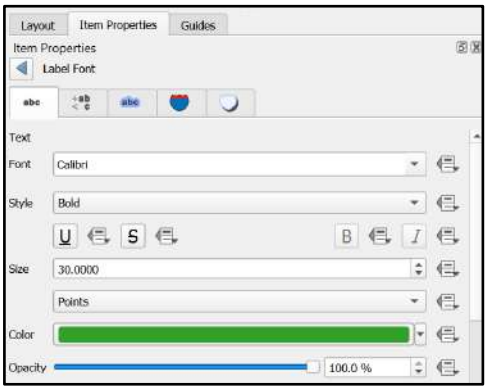


- The Print Layout will appear like



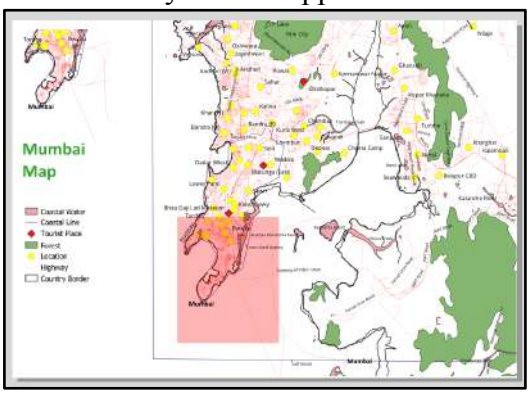
- Add Item → Add Label
- Change the Label text To “Mumbai Map”, Set appropriate font size and color using Item Properties→ Main Properties.



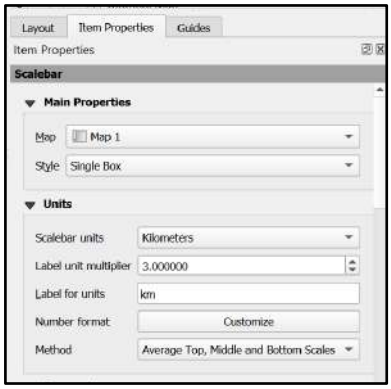


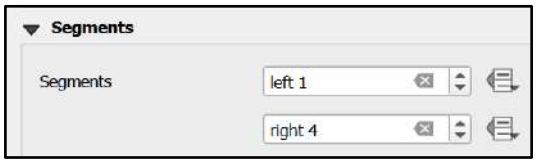
- Add Item → Add Legend→ Place the legend indicator at appropriate location.
- Uncheck auto update and use suitable legend indicator label.

- The Print Layout will appear

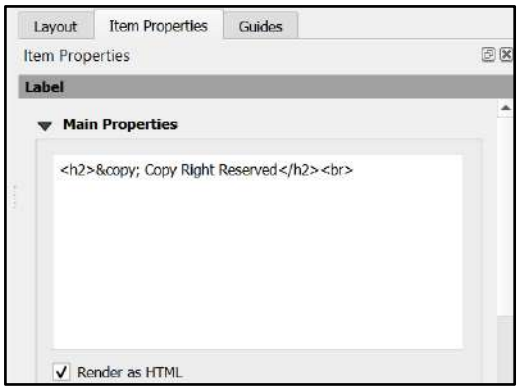


➢ Add Item → Add Scale Bar

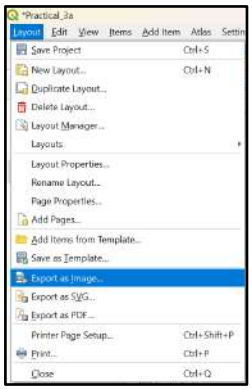




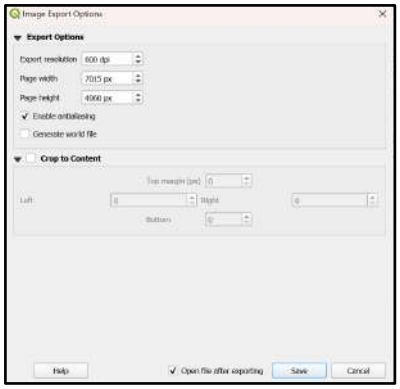
➢ Add Item → Add Label → Add a Label using HTML rendering



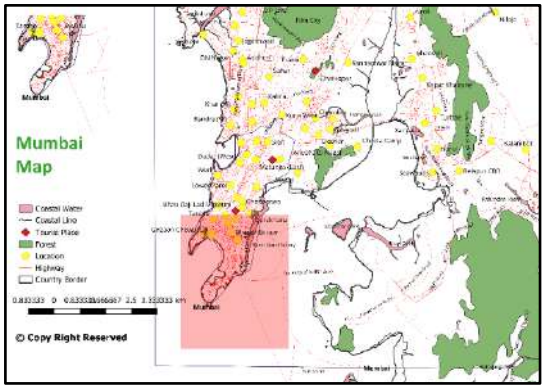
➢ A Map can be saved in Image or PDF using Layout → Export as Image / Export as PDF



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



➢ Open the PDF or Image from location.

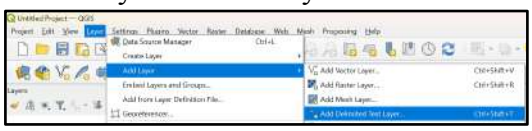


b. Importing Spreadsheets or CSV files

➢ Many times the GIS data comes in a table or an Excel spreadsheet or a list lat/long coordinates, therefore it has to be imported in a GIS project.

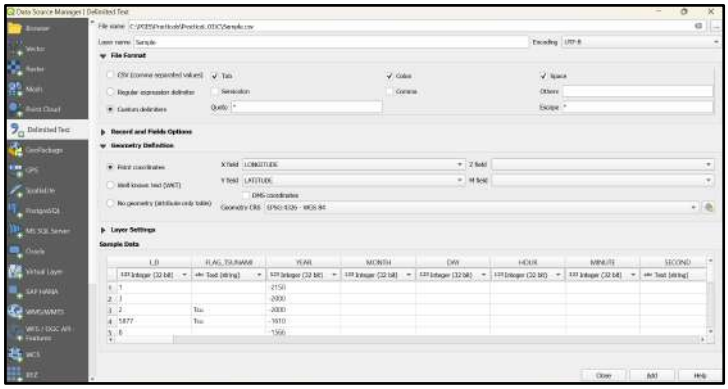
➢ Sample file for Earthquake data will be used in this practical.

➢ Go to Layer → Add Layer → Add Delimited text Layer

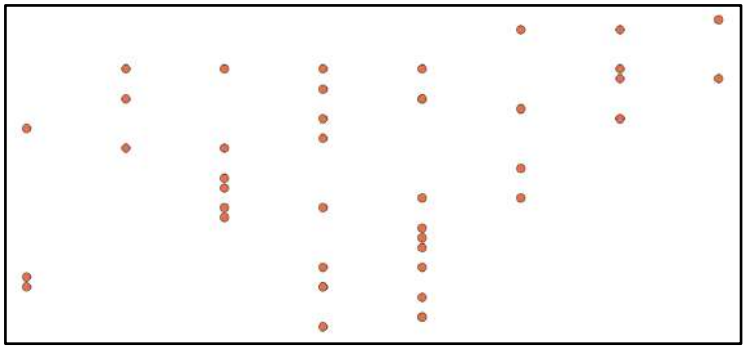


➢ Data Source Manager | Delimited Text window will appear

➢ Select the \GIS_Workshop\Practicals\Practical_03\C\Sample.csv file from data folder.

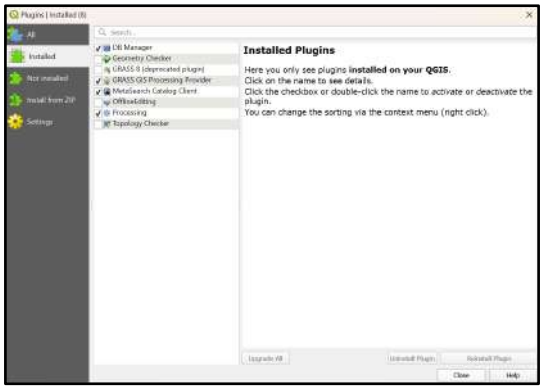


- Press ADD and close the window.
- Output:



c. Using Plugins

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



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

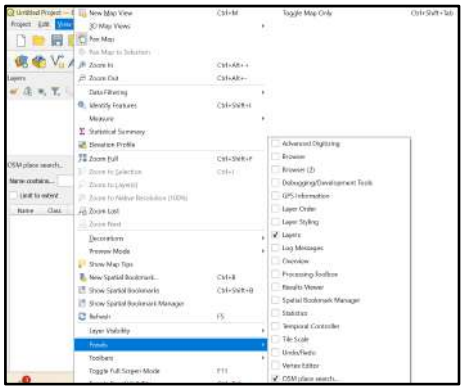
OR

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

d. Searching and Downloading OpenStreetMap Data

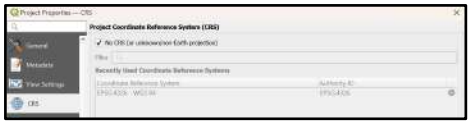
OpenStreetMap (OSM) created by Steve Coast in the UK in 2004 is a collaborative project to create a free editable map of the world. Rather than the map itself, the data generated by the project is considered its primary output. The creation and growth of OSM has been motivated by restrictions on use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

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

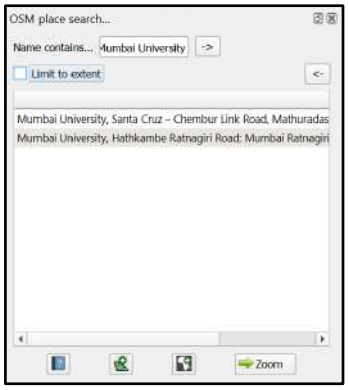


- Go to Web → OpenLayer Plugin and select Open Street Map

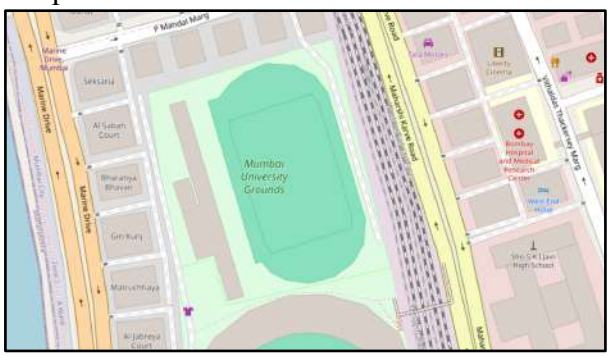
- A World map will appear on screen.
- If an error occurs in loading maps, go to project properties → CRS →



- In OSM Place search Pane → Enter Mumbai or any place name to search



- Double click on the desired place in OSM Place search Panel or Click and press
- Output:

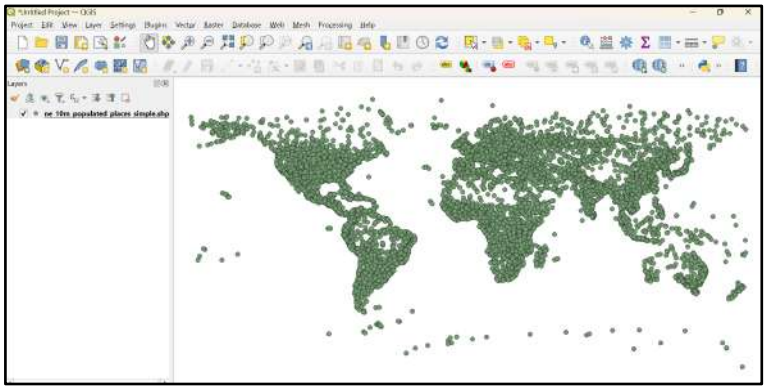


Practical 5

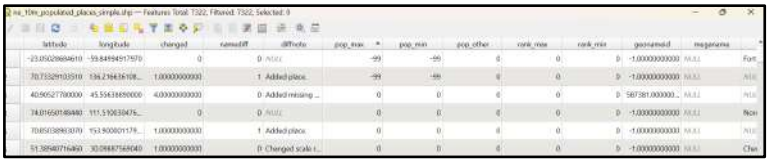
Working with attributes, terrain Data

a. Working with attributes

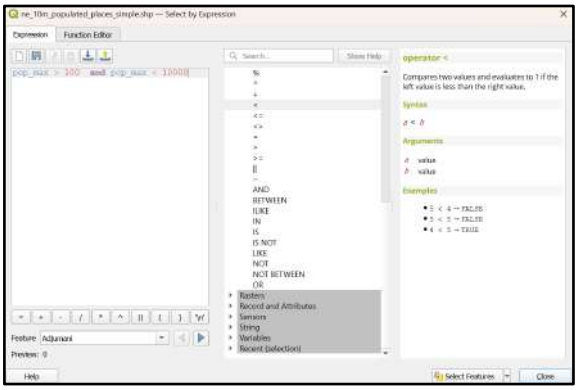
- Start a new project.
- Go to Layer → Add Layer → Add Vector Layer
- Select"\GIS_Workshop\Practicals\Practical_04\A\Data\ne_10m_populated_places_simple.zip"



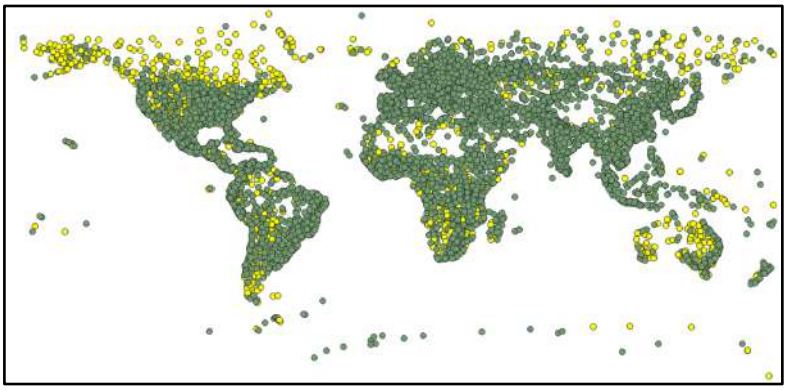
- ➢ Right click on Layer in Layer Panel → Open Attribute Table.
- ➢ Explore various attributes and their values in the Attribute table.
- ➢ To find the Place with maximum population click on “pop_max” file



- ➢ On clicking the Select feature using expression button the following window will appear.
- ➢ Enter pop_max>100 and pop_max<10000 and click Select Features button to get all the places with population between 100 and 10000.



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

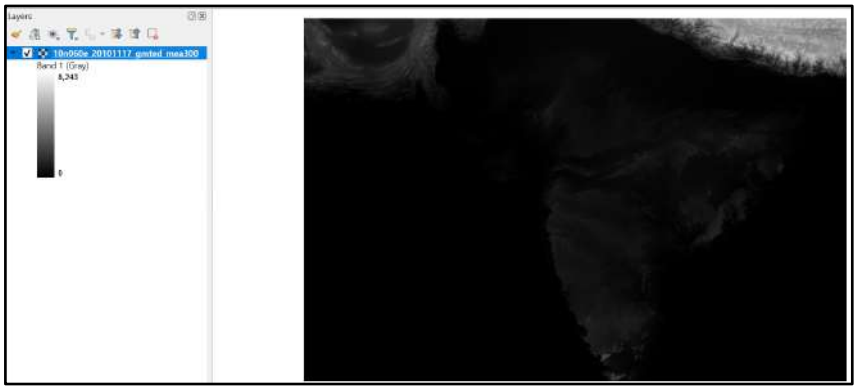


- ➢ Different queries can be performed using the dataset.
- ➢ Use the deselect button to deselect the feature to be rendered in original color.

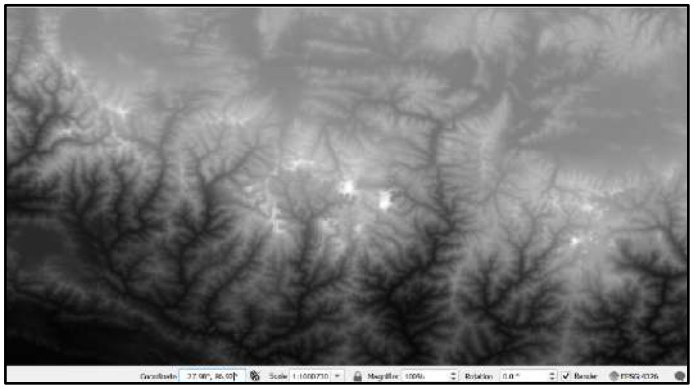
b. Terrain Data and Hill shade analysis

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

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

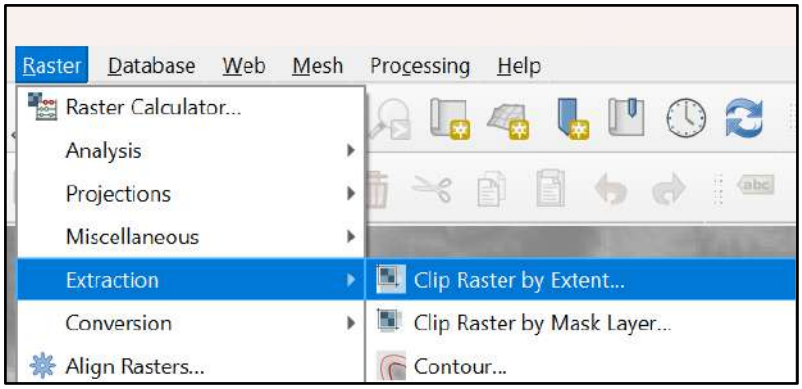


- The Lower altitude regions are shown using dark color and higher using light shade as seen on top region containing Himalaya and Mt Everest.
- Mt. Everest - is located at the coordinates 27.9881° N, 86.9253° E.
- Enter 86.92, 27.98 in the coordinate field, Scale 900000 and Magnifier 100% at the bottom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

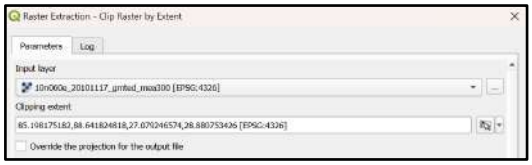


27.98, 86.92

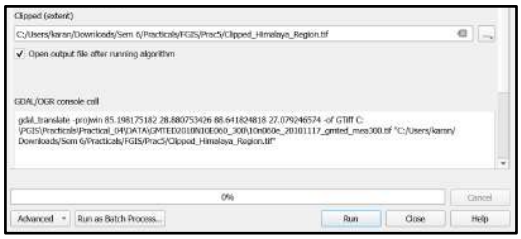
- Crop the raster layer only for the region under study.
- Go to Raster → Extraction→ Clip Raster by Extent



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

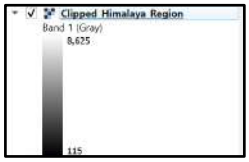


- Select the location and file name for storing clipped raster layer.



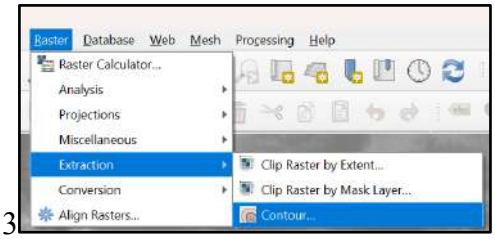
- Press RUN.
- Deselect the original layer and keep the clipped one.
- The Clipped raster layer is representing altitude are from 103 Meters.

Original Raster

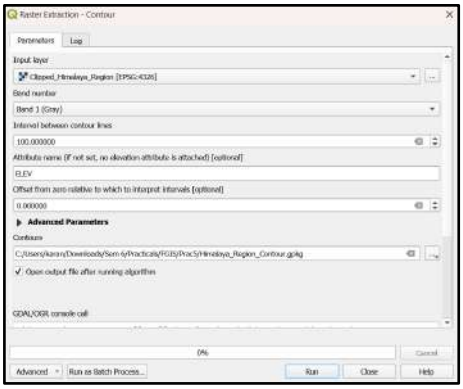


Clipped Raster

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

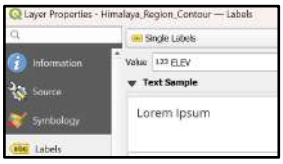
3 

- The Contour configuration window will appear
- Select the input raster layer name. Set contour interval 100.00 meters, select the output file name & location and check the option to add output file to project after processing.

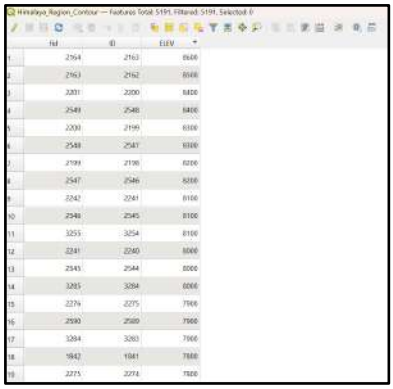


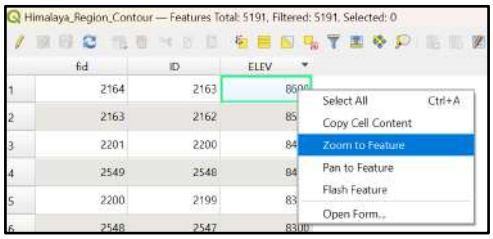
- Press “RUN”.
- The contour layer will appear like this

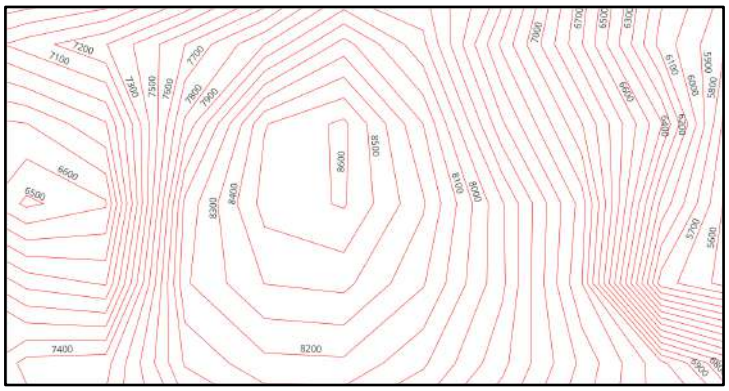
- Label the layer using “ELEV” field and set appropriate symbols for line.



- 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.

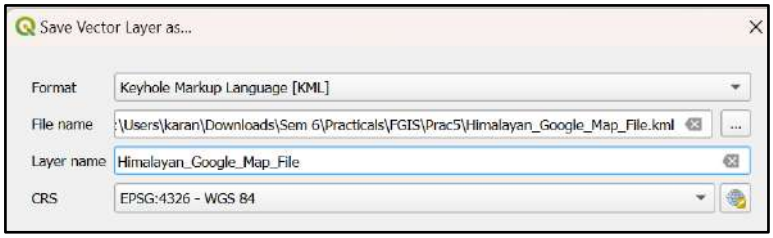






Compare the above counter line raster layer with the previous Google map image or visit https://www.google.com/maps/@27.9857765,86.9285378,14.75z/data=!5m1!1e4?hl=en-US

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



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

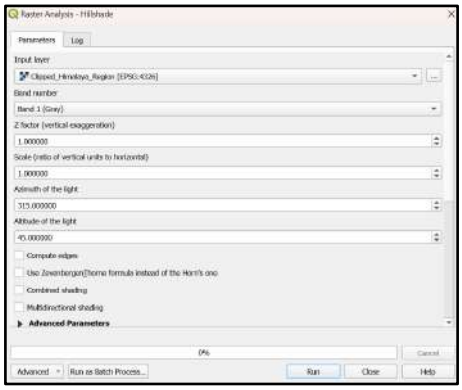
A Hillshade is a grayscale 3D representation of the surface, showing the topographical shape of hills and mountains using shading (levels of gray) on a map, just to indicate relative slopes, mountain ridges, not absolute height.

➢ For Hill Shade surface analysis

➢ Go to Plugin → Install Georeferencer GADL.

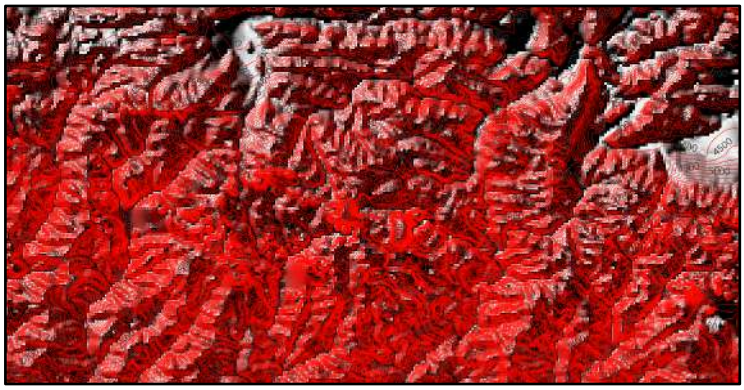
➢ After successful installation of plugin Go to Raster → Analysis → Hill Shade

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



➢ Press "RUN" and Close the Hill Shape Dialog window.

➢ After Raster styling the Output will appear like this.



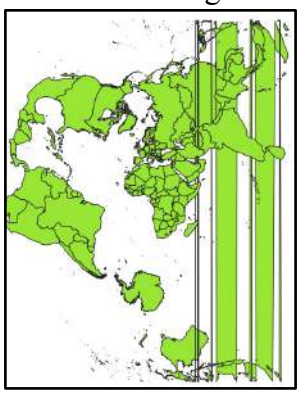
Practical 6

Working with Projections and WMS Data

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

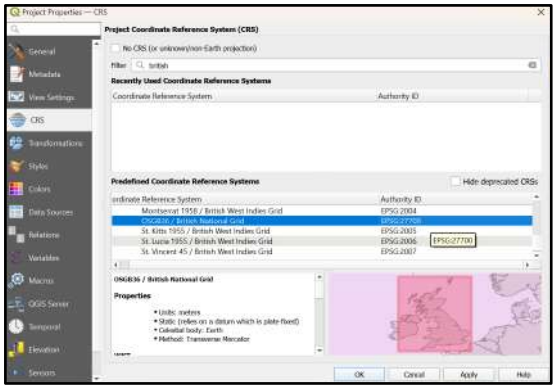
- ➢ Start a new Project.
- ➢ Layer → Add Layer →Vector Layer
- ➢ Select "ne_10m_admin_0_countries.zip" Layer from data folder.
- ➢ Go to Layer → Save As
  Select format as ESRI Shape File
  Select folder location and file name
  Set CRS North_America_Albers_Equal_Area_Conic EPSG: 102008

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

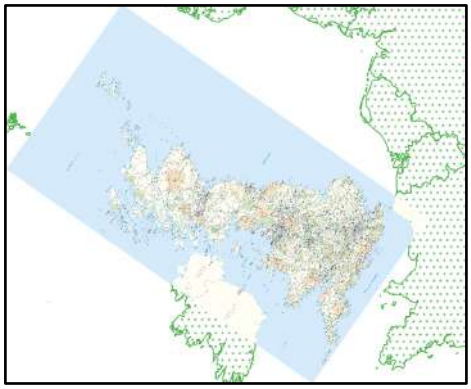


- ➢ Select Layer → Add Layer → Add Raster Layer → Select MiniScale_(standard)_R17.tif from Location "GIS_Workshop\Practicals\Practical_05\DATA\minisc_gb\minisc_gb\data\RGB_TIF_compressed\MiniScale_(standard)_R17.tif"

- ➢ The Layer appears on a different location than the location where Great Britain is shown on Map.
- ➢ Open Layer Properties→CRS → Search bri → select British National Grid EPSG 27700. Processing may take some time.



➢ Locate United Kingdom on Layer; the vector layer exactly coincides by the raster layer covering United Kingdom.

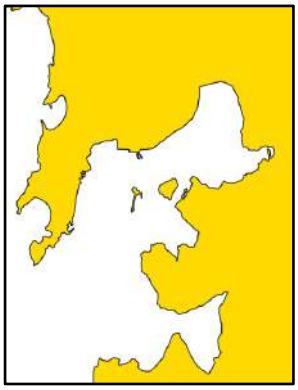


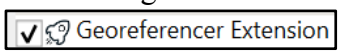
Practical 7

a. **Georeferencing Topo Sheets and Scanned Maps**
b. **Georeferencing Aerial Imagery**
c. **Digitizing Map Data**

a. Georeferencing Topo Sheets and Scanned Maps

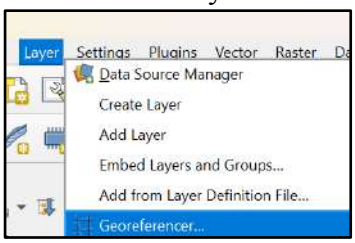
- Start a new project
- Go to Layers → Add Layer → Add vector Layer
- Select GIS_Workshop\Manual\Prac06\IND_adm0.shp
- Zoom in to Mumbai region in the layer.



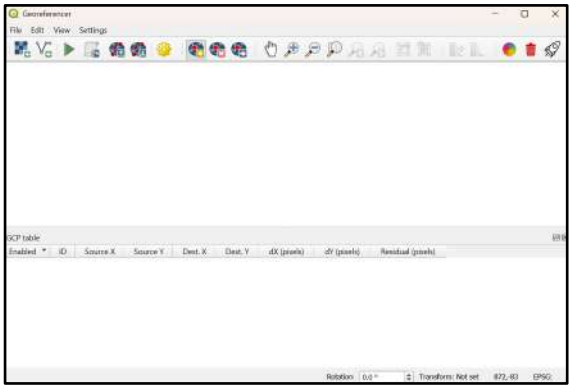
- Go to Plugins→ Manage and Install Plugins
- Ensure that 

is checked, if not install Georeferencer GDAL plugin.

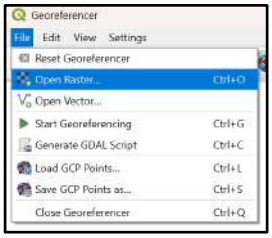
- Go to Raster/Layer → Georeferencer



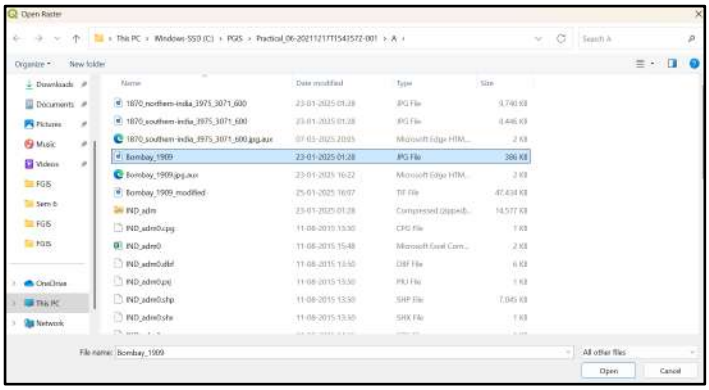
- A new Georeferencer window will open



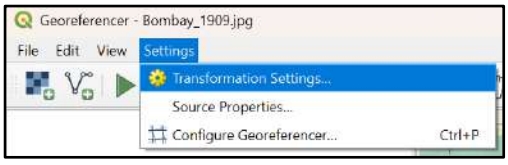
➢ File → Open Raster



➢ Select file “Bombay_1909.jpg” from project data folder

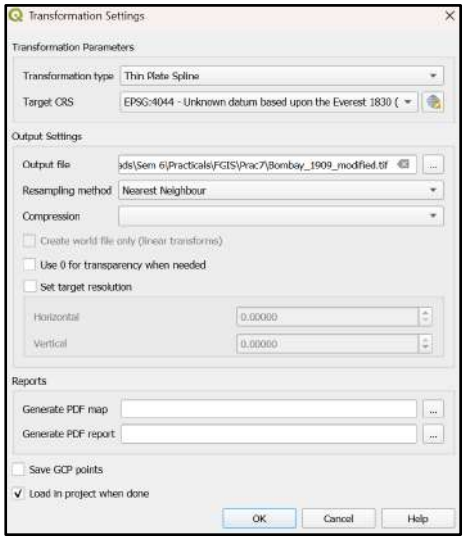


➢ Go to Settings →Transformation Settings

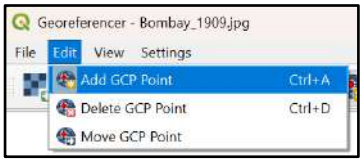


➢ In the Transformation Settings window

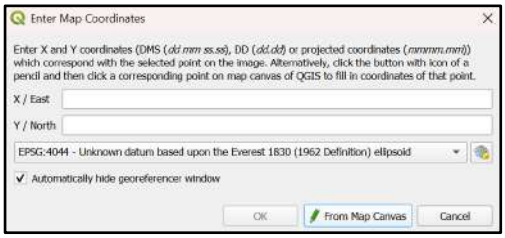
- Select Transformation type → Thin Plate Spline
- Re-sampling Method → Nearest Neighbour
- Target TRS → Everest 1830 datum: EPSG 4044
- Select Output Raster Name and Location
- Check the Load in QGIS When Done Option
- Press “OK”.



➢ In Georeferencer window Go to Edit → Add Points



Click on the raster to add control points and select “From Map Canvas” Button.



GCP table

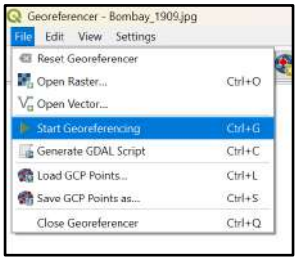
Enabled	ID	Source X	Source Y	Dest. X	Dest. Y	dX (pixels)	dY (pixels)	Residual (pixels)
✓	0	535.825333	-897.706667	72.810520	18.983515	-0.000000	0.000000	0.000000
✓	1	322.620000	-1475.6053	72.793434	18.936436	-0.000000	0.000000	0.000000
✓	2	939.793333	-1469.9947	72.848866	18.936436	-0.000000	0.000000	0.000000
✓	3	973.457333	-841.600000	72.858738	18.991867	-0.000000	0.000000	0.000000

➢ Select the set of control points.

➢ Go to, Setting → transformation settings.

➢ Press “RUN”

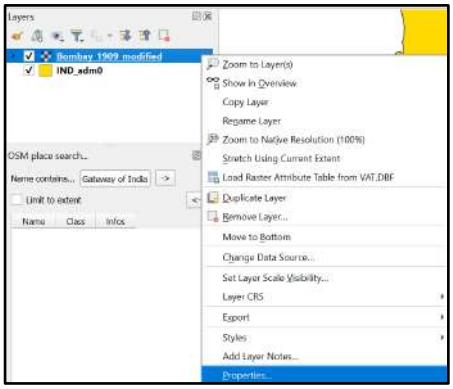
➢ In Georeferencing window go to → File → Start Georeferencing



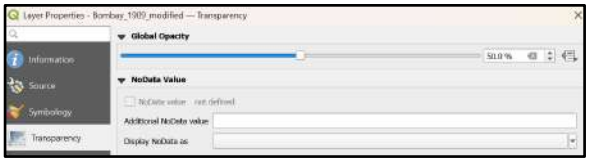
➢ The progress indicator will appear.

➢ The canvas area will now have the scanned map of Mumbai referenced with control points.

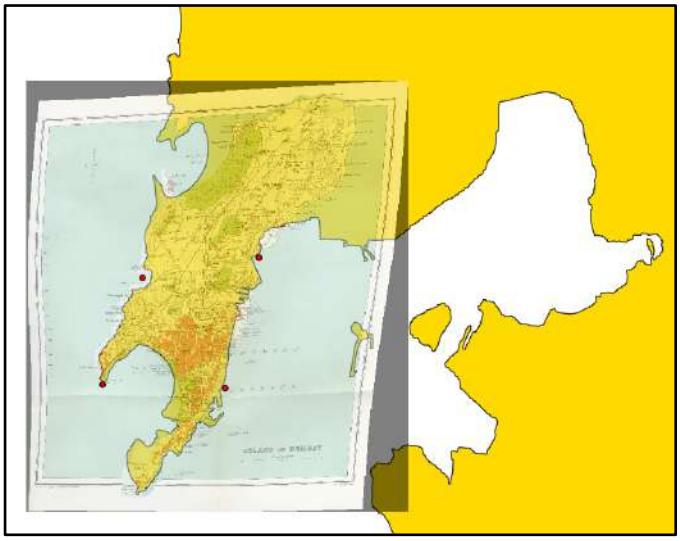
➢ Select the newly added layer in Layer Panel Right click and go to property.



➢ Set Transparency level of raster layer to appropriate level.



➢ Output:

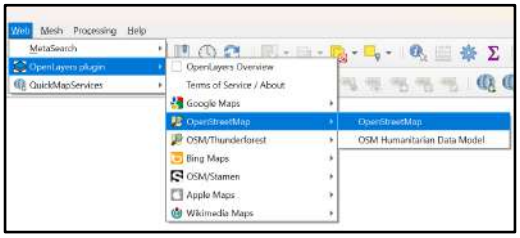


➢ The Scanned Image map coincides with the existing map.

b. Georeferencing Aerial I magery

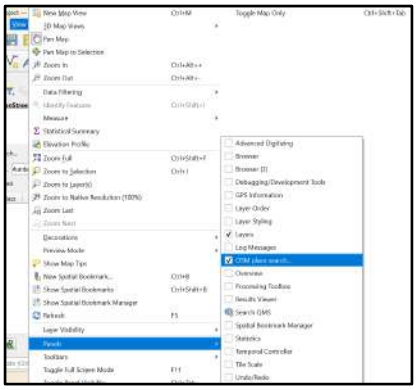
➢ Install plugin OpenStreetMap

➢ 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

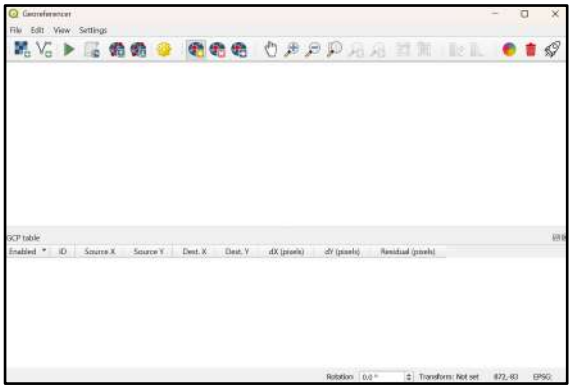
➢ Search Gateway of India in OSM Search Panel

➢ Zoom in to appropriate level.

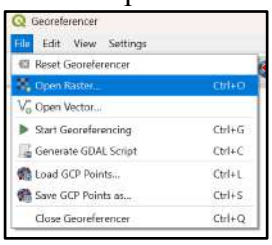
➢ The map will appear like this

➢ Go to Raster/Layer → Georeferencer

➢ A new Georeferencer window will open

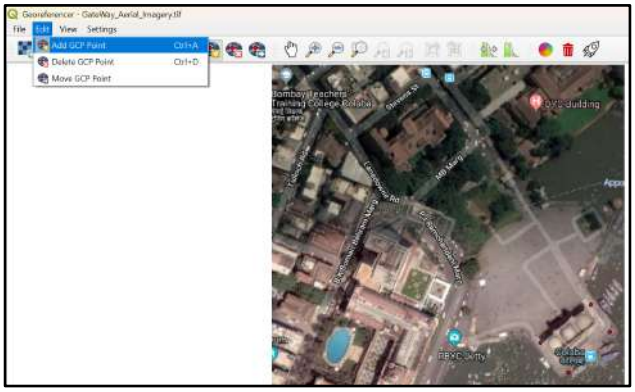


➢ File → Open Raster

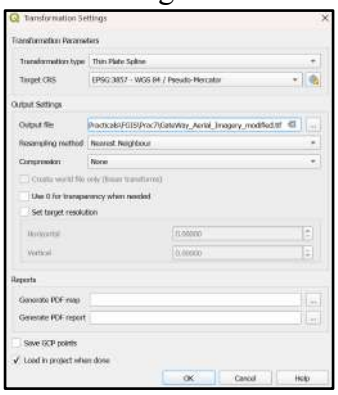


➢ Select file “Gateway_Imagery.tif” from project data folder

➢ Go to Edit → Add Point



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



- Go to File → Start Georeferencing or Press the  button in Georeferencing Window.

- The progress indicator will appear.

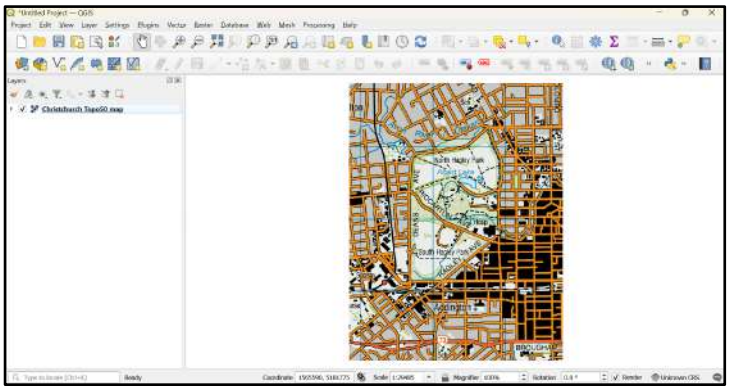
- Observe that the aerial image of the Gateway of India is georeferenced on OSM in the map canvas.

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 diferent types of spatial (point, line, polygon) as well as non-spatial layers. This makes is much easier to move it around instead of a bunch of shapefiles.

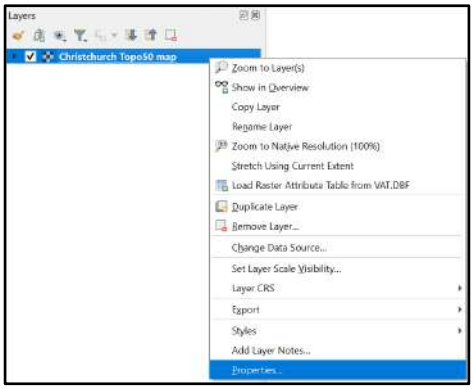
Digitizing Map Data

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

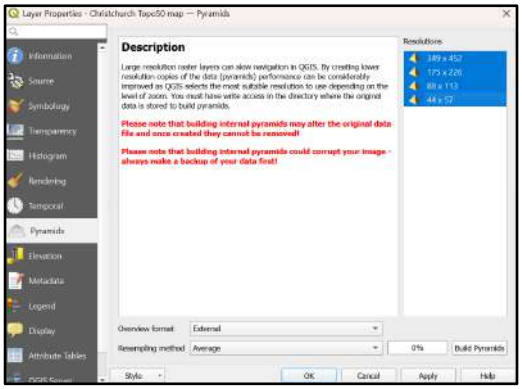


➢ QGIS offers a simple solution to make raster load much faster by using Image Pyramids.

➢ Right-click the Christchurch Topo50 map.tif layer and select Properties.

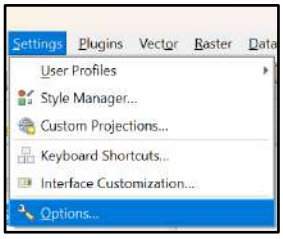


➢ Choose the Pyramids tab. Hold the Ctrl key and select all the resolutions offered in the Resolutions panel.

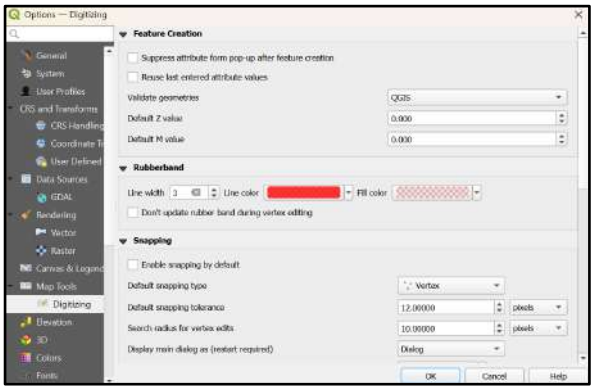


➢ Click Build pyramids. Then click OK.

➢ Go to Settings → Options. Select the Digitizing tab in the Options dialog.

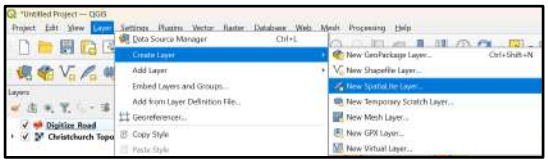


➢ Set the Default snap mode to vertex and segment.



➢ Press OK.

➢ Go to Layer → Create Layer → Add Spatialite Layer.



➢ Select the name and location for Spatial database eg: “GIS_Workshop\Practicals\Practical_06\C\MySpatialDataBase.sqlite”.

➢ Name the Layer as “Digitized_Road

➢ Set Geometry type as “Line”

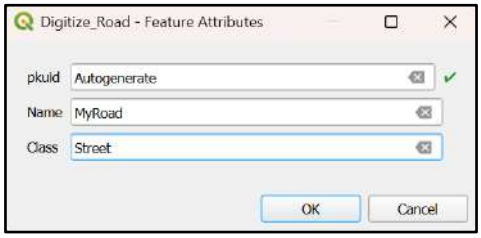
➢ Set CRS EPSG:4167 – NZGD2000 76

➢ Add “Name” and “Class” fields using “Add to Fields List”.

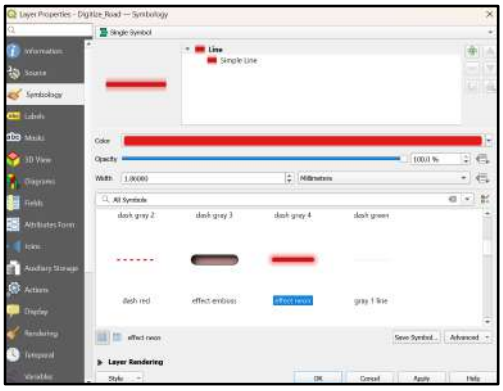
➢ Once the layer is loaded, click the Toggle Editing button  to put the layer in editing mode.

➢ Click the 

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



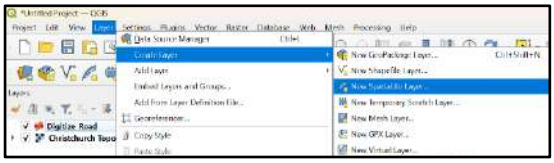
➢ On Layer Panel Right Click on Digitze_Road, Select the Style tab in the Layer Properties dialog.



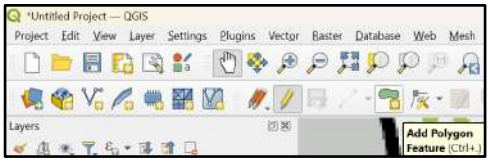
➢ Result

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

➢ Create a new Spatialite layer

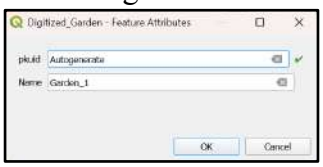


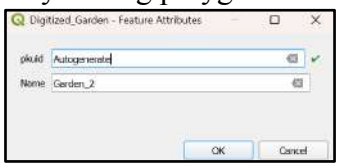
➢ After creating a new Spatialite layer



➢ Select Digitized_Garden layer in Layer Panel and click on Toggle Editing button and then Add Polygon Feature button on Tool bar.

➢ Add two gardens to the region by adding polygon.





➢ The Layer will appear on map canvas

➢ Using the above procedure a point feature can also be digitized.

➢ The digitizing task is now complete. You can play with the styling and labeling options in layer properties to create a nice looking map from the data you created.

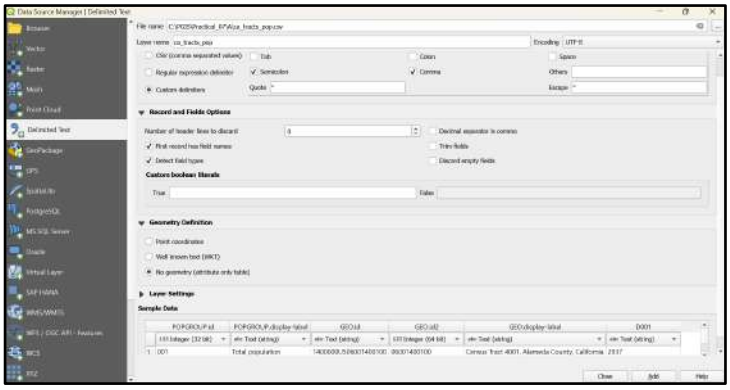
Practical 8

<u>Managing Data Tables and Spatial data Sets:</u>
Table joins, spatial joins, points in polygon analysis, performing spatial queries

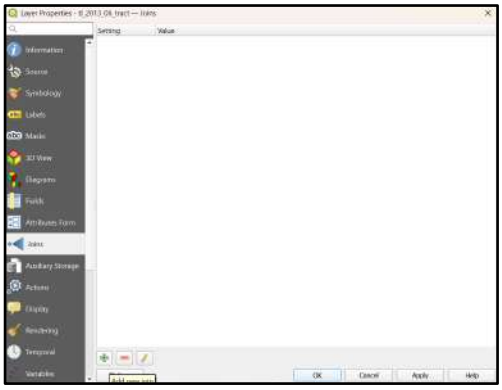
a. Table joins

- ➢ Start a new project
- ➢ Go to Layer → Add Layer → Add new Vector Layer "I: \GIS_Workshop\Practicals\Practical_07\A\Data\tl_2013_06_tract.zip"
- ➢ We could import this csv file without any further action and it would be imported. But, the default type of each column would be a String (text). That is ok except for the D001 field which contains numbers for the population. Having those imported as text would not allow us to run any mathematical operations on this column. To tell QGIS to import the field as a number, we need to create a sidecar file with a .csvt extension.
- ➢ This file will have only 1 row specifying data types for each column. Save this file as ca_tracts_pop.csvt in the same directory as the original .csv file.

- ➢ Go to Layer → Add Layer → Add Delimited Text Layer And add I: \GIS_Workshop\Practicals\Practical_07\A\Data\ca_tacts_pop.csv"



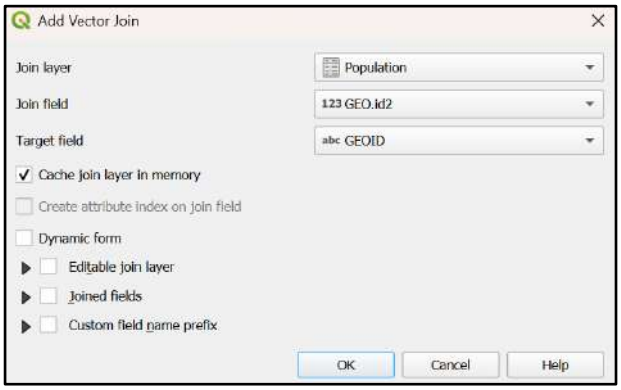
- ➢ In the layer panel, Right click on "tl_2013_06_tract", layer and select Properties



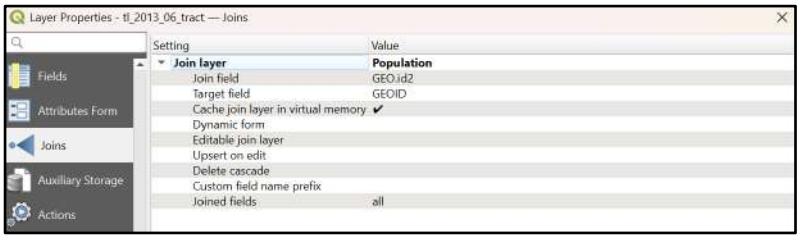
➢ Select the option 

in Properties, and click on  button to add new table join.

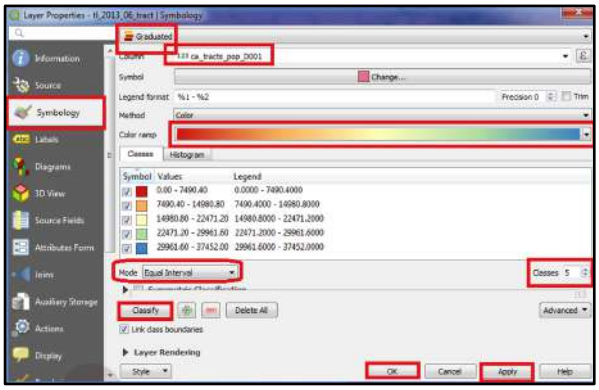
➢ In the Add Vector Join window set the following properties and click OK.



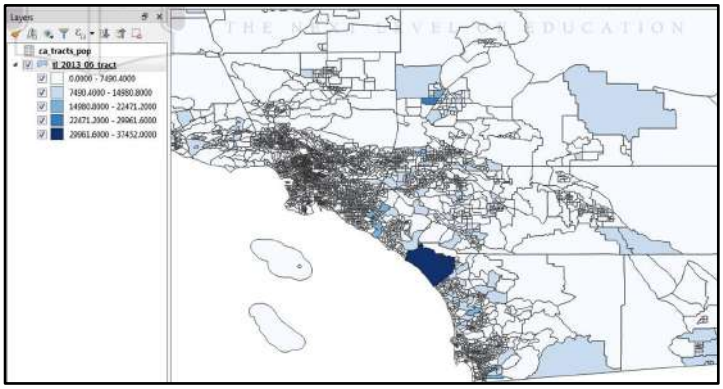
➢ After performing join



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

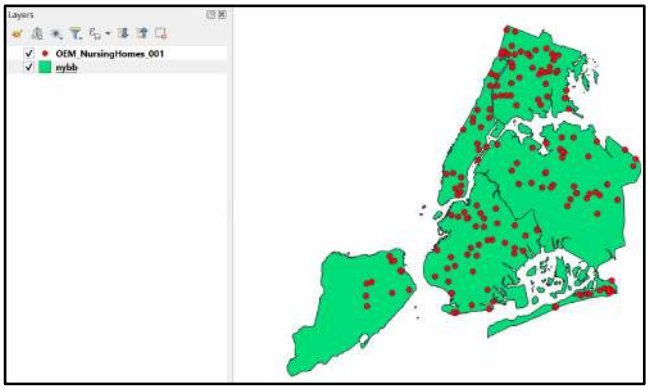


➢ A detailed and accurate population map of California can be seen as the result. Same technique can be used to create maps based on variety of census data.



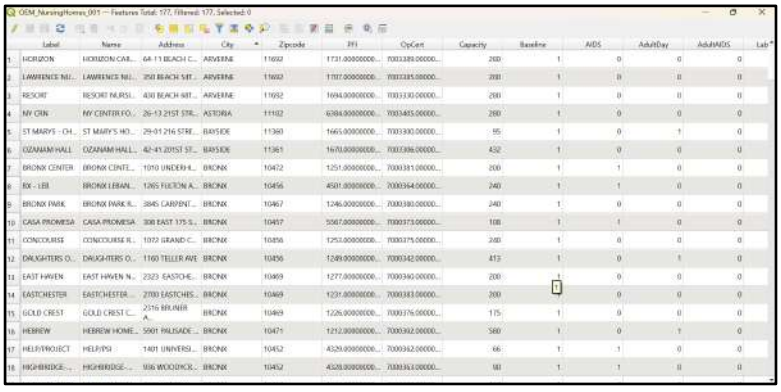
b. Spatial Joins

➢ Go to Layer → Add Layer → Add Vector Layer → Select "I: \GIS_Workshop\Practicals\Practical_07\B\Data\nybb_12c\nybb_13c_av\nybb.shp" and "I: \GIS_Workshop\Practicals\Practical_07\B\Data\OEM_NursingHomes_001\OEM_NursingHo mes_001.shp", from data folder.

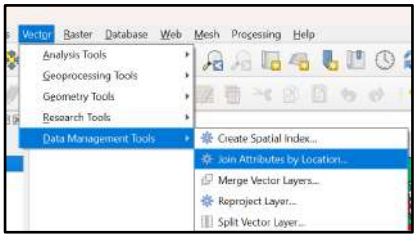


➢ Go to attribute table and observe the data.

➢ Table before performing Join



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

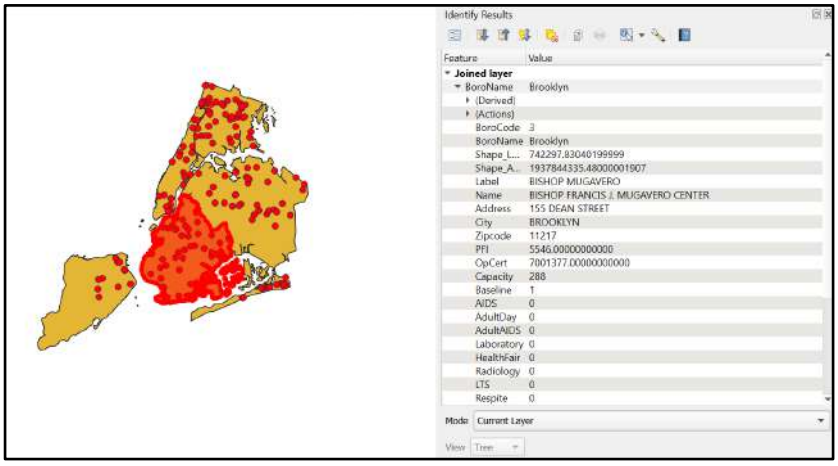


➢ Attribute table after join

City	Zipcode	PFI	OpCert	Capacity
STATEN ISLAND	10304	1755.00000000000	7004310.00000000000	300
NEW YORK	10003	4807.00000000000	7002351.00000000000	28
BRONX	10472	1251.00000000000	7000381.00000000000	200
BROOKLYN	11217	5546.00000000000	7001377.00000000000	288
ASTORIA	11102	6384.00000000000	7003405.00000000000	280

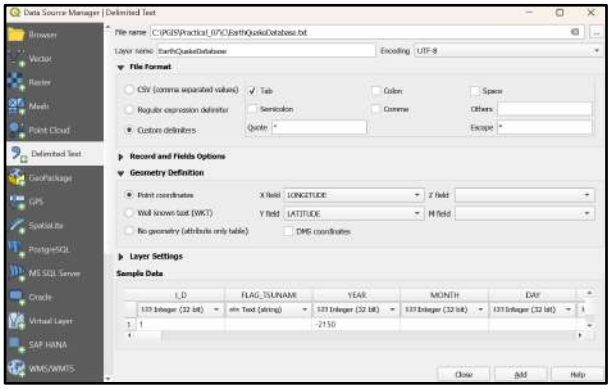
➢ Use the Identify Feature Button to select a region to view join data on map Layer.

➢ Output:

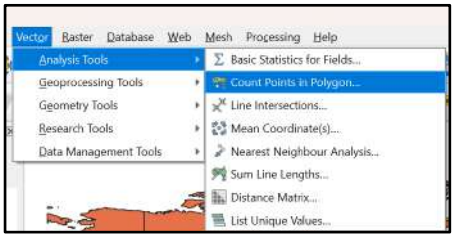


c. Points in polygon analysis

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

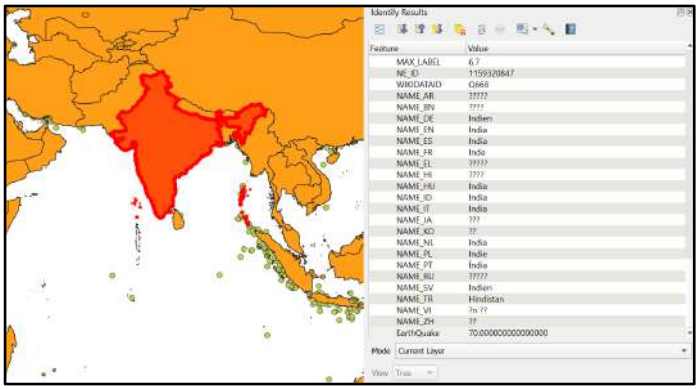


➢ Go to Layer → Add Layer → Add Vector Layer "I: \GIS_Workshop\Practicals\Practical_07\C\Data\ne_10m_admin_0_countries.zip"



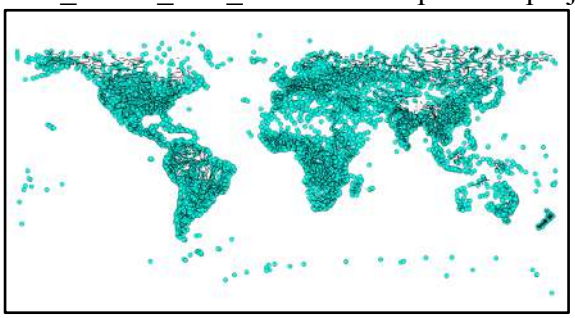
➢ Use the Select Feature button to check country wise counting of Earthquakes.

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

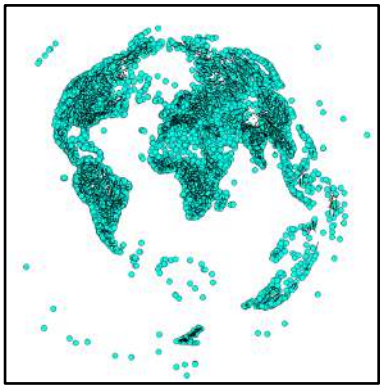


d. Performing spatial queries

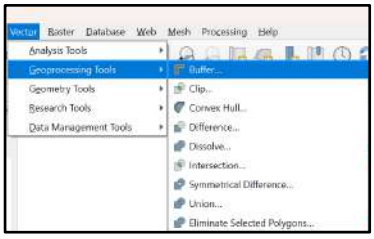
➢ Go to Layer → Add Layer → Add Vector Layer and load “\GIS_Workshop\Practicals\Practical_07\D\Data\ne_10m_populated_places_simple\ ne_10m_popul ated_places_simple.shp” and “I: \GIS_Workshop\Practicals\Practical_07\D\Data\ne_10m_rivers_lake_centerlines\ne_ 10m_rivers _lake_centerlines.shp” from project data folder.



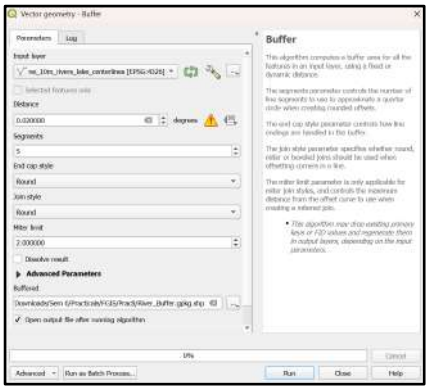
➢ Open project Properties → Set CRS “World_Azimuthal_Equidistant EPSG 54032” . The map will be re-projected as



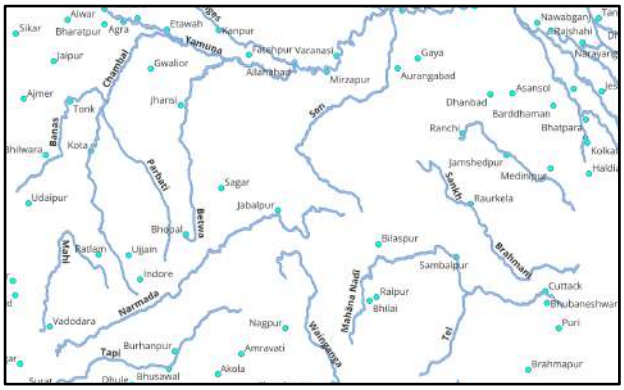
➢ Go to Vector → Geoprocessing Tool → Buffer



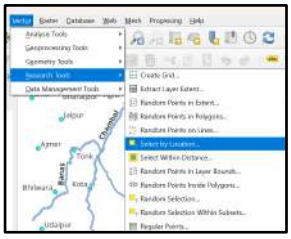
➢ Repeat the step to create River Buffer

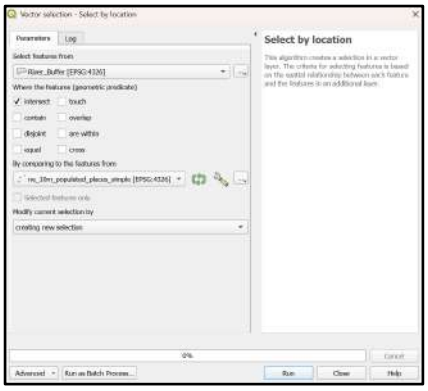


➢ Create a buffer for River

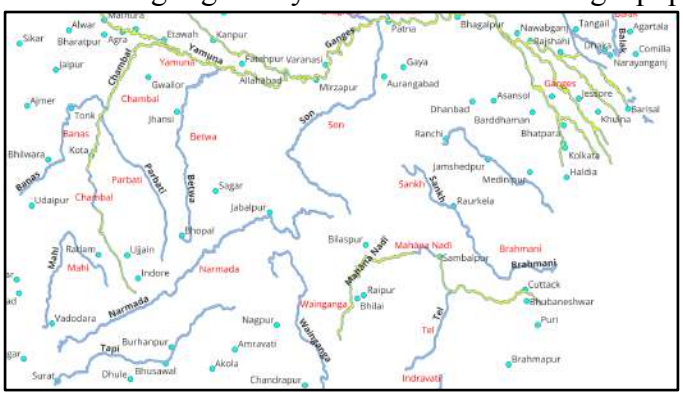


➢ Go to Vector → Research Tool → Select By Location





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



Practical 9

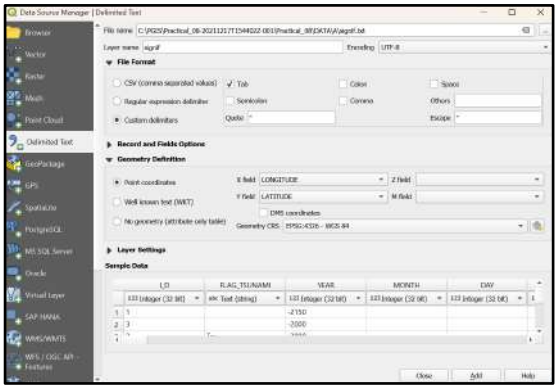
<u>Advanced GIS Operations 1:</u>

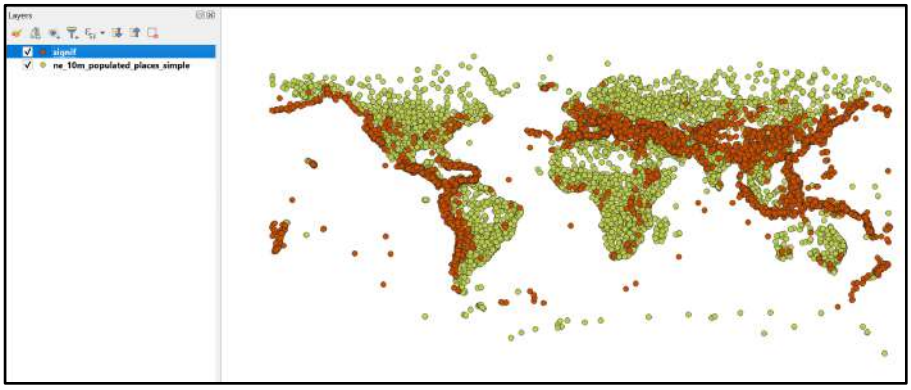
Nearest Neighbor Analysis, Sampling Raster Data using Points or Polygons, Interpolating Point Data

A. Nearest Neighbor Analysis

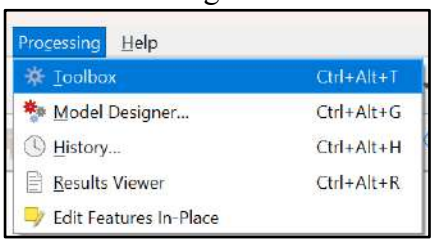
➢ Open QGIS and go to Layer → Add Layer → Add Vector Layer C:\PGIS\Practical_08\Practical_08\DATA\A\ne_10m_populated_places_simple

➢ Open QGIS and go to Layer → Add Layer → Add Delimited Text Layer C:\PGIS\Practical_08\Practical_08\DATA\A\signif.txt

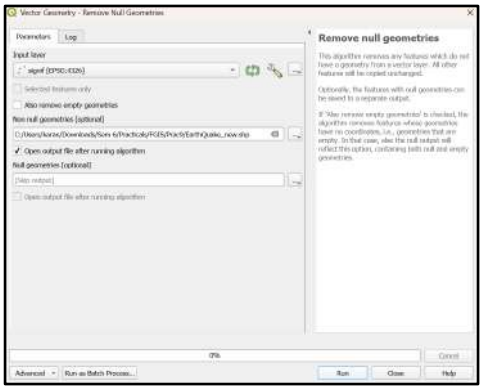




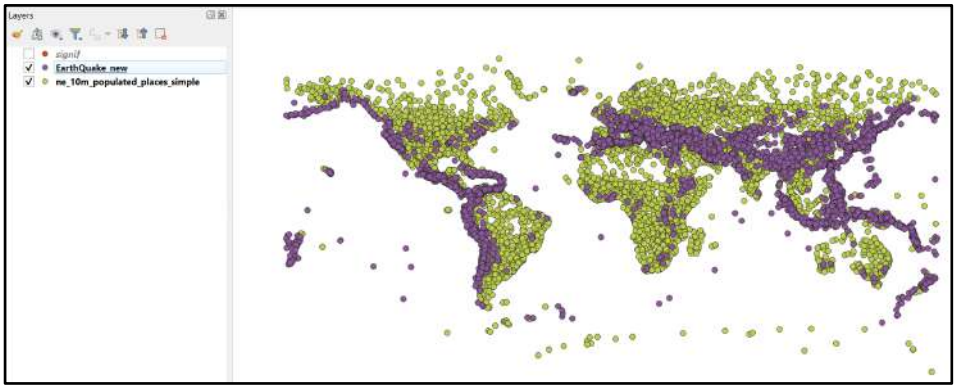
➢ Click Processing → Toolbox



➢ In Vector Geometry, double click on Remove null geometries.

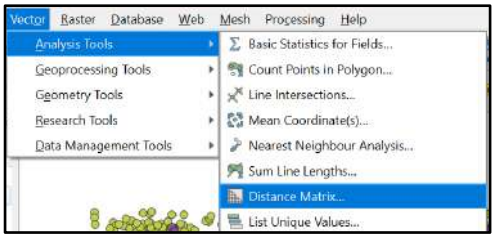


➢ Click on Run.

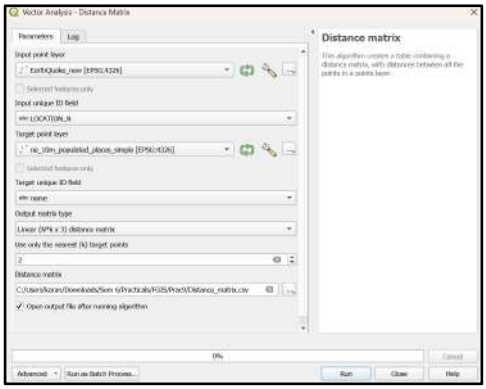


All null values have been removed from the attribute table.

- ➢ 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.

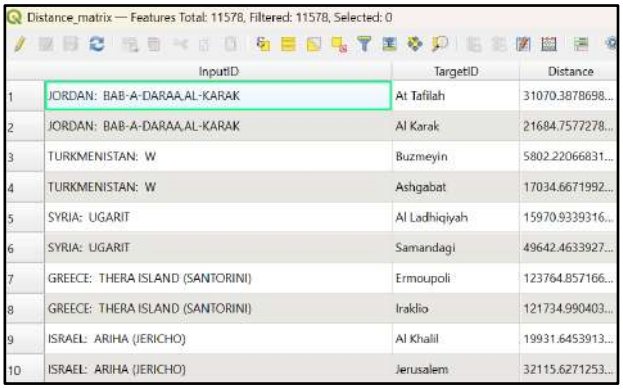


- ➢ Here select the earthquake layer signif as the Input point layer and the populated places ne_10m_populated_places_simpleas the target layer. You also need to select a unique field from each of these layers which is how your results will be displayed. In this analysis, we are looking to get only 1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



- ➢ Click Close, and the table will be added as a layer.
  Right-click on the table layer (Distance_matrix.csv) and select Open Attribute Table. The table will display:
  - **InputID:** The field name from the earthquake layer.

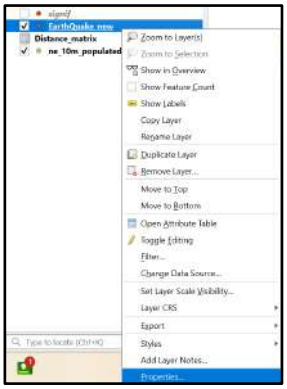
- **TargetID:** The closest populated place.
- **Distance:** The distance between the two points.



	InputID	TargetID	Distance
1	JORDAN: BAB-A-DARAA,AL-KARAK	At Tafilah	31070.3878698...
2	JORDAN: BAB-A-DARAA,AL-KARAK	Al Karak	21684.7577278...
3	TURKMENISTAN: W	Buzmeyin	5802.22066831...
4	TURKMENISTAN: W	Ashgabat	17034.6671992...
5	SYRIA: UGARIT	Al Ladhiqiyah	15970.9339316...
6	SYRIA: UGARIT	Samandagi	49642.4633927...
7	GREECE: THERA ISLAND (SANTORINI)	Ermoupoli	123764.857166...
8	GREECE: THERA ISLAND (SANTORINI)	Iraklio	121734.990403...
9	ISRAEL: ARIHA (JERICHO)	Al Khalil	19931.6453913...
10	ISRAEL: ARIHA (JERICHO)	Jerusalem	32115.6271253...

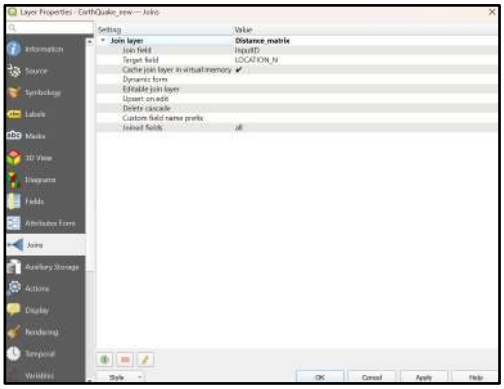
➢ To link the results to the Earthquake_new layer:

- Right-click on the Earthquake_new layer and select **Properties**.



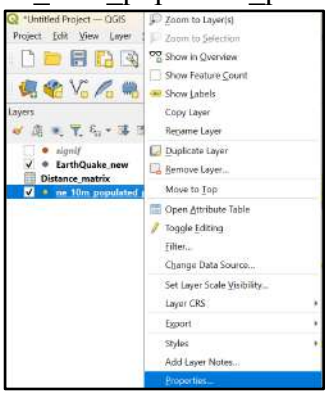
- Go to the **Joins tab** and click  .
- Select Distance_matrix.csv as the **Join Layer**, **InputID** as the **Join Field, and Location as the Target Field**.

- Click OK.

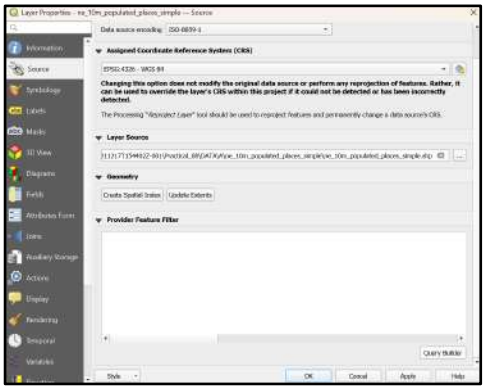


- Click Apply and the click **OK**, and the table will be joined to the earthquake layer.
- Open the **earthquake layer's attribute table** to confirm that the **nearest populated place** and **distance field** have been added.

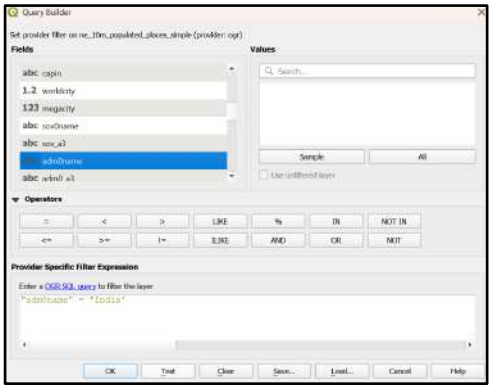
➢ As our dataset is quite large, we can run our visualization analysis on a subset of the data. QGIS has a neat feature where you can load a subset of features from a layer without having to export it to a new layer. Right-click the ne_10m_populated_places_simple layer and select Properties.



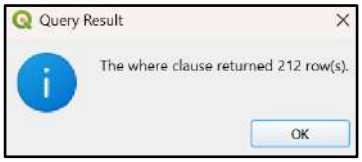
➢ In the Source tab, scroll down to the Feature subset section. Click Query Builder.



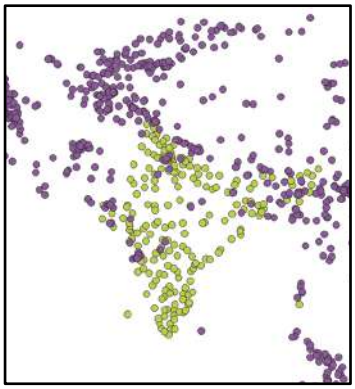
➢ For this tutorial, we will visualize the earthquakes and their nearest populated places for India. Enter the following expression. "adm0name" = 'India'.



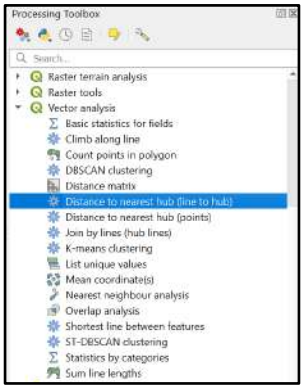
➢ Click on Test, it returns the result of the query.



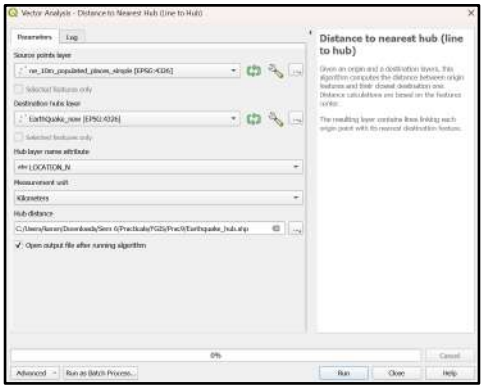
➢ Now, zoom to the part where India is highlighted.



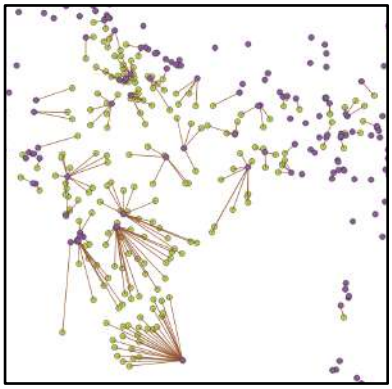
➢ Click Processing → Toolbox. In Vector analysis, double click on ‘Distance to nearest hub (line to hub)’ option.



➢ Select the following options and click on run.



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

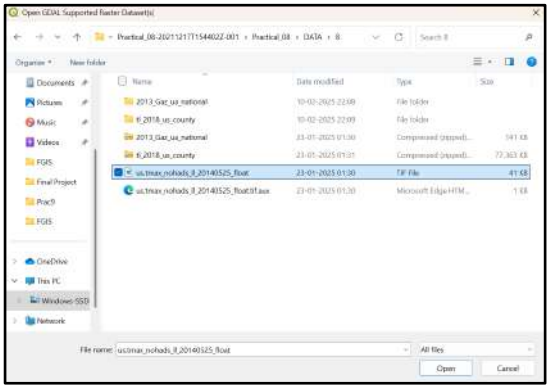


B. Sampling Raster Data using Points or Polygons

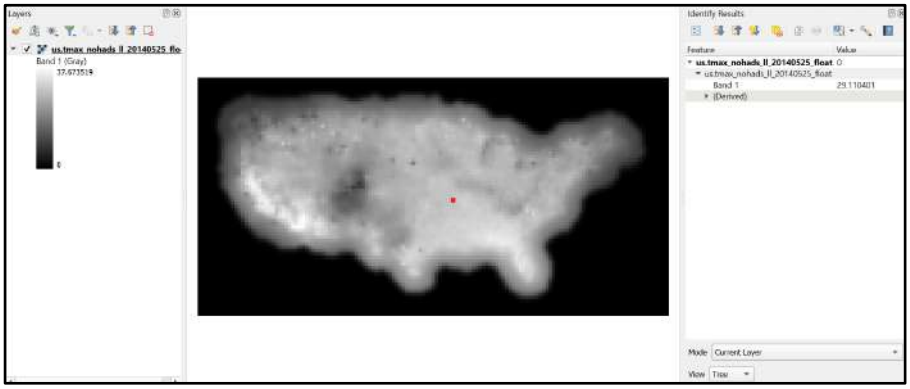
Many scientific and environmental datasets come as gridded rasters. Elevation data (DEM) is also distributed as raster files. In these raster files, the parameter that is being represented is encoded as the pixel values of the raster. Often, one needs to extract the pixel values at certain locations or aggregate them over some area. This functionality is available in QGIS via two plugins - Point Sampling Tool and Zonal Statistics plugin.
In this practical we will extract the temperature of a point layer of all the urban areas and calculate the average temperature for a polygon layer of each country in the US.

Procedure

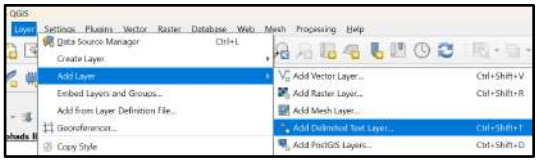
- Go to Layer → Add Layer → Add Raster Layer and browse to the downloaded us.tmax_nohads_ll_{YYYYMMDD}_float.tif file and click Open.



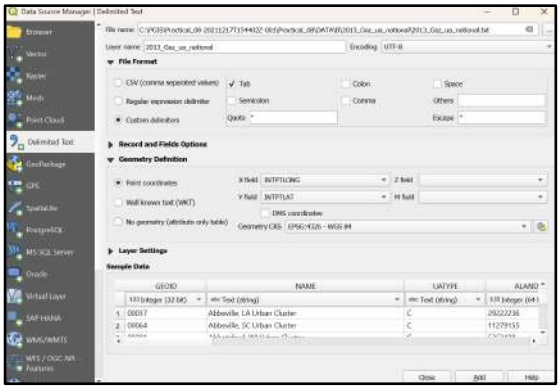
- Once the layer is loaded, select the Identify tool and click anywhere on the layer. You will see the temperature value in celsius as the value or Band 1 at that location.



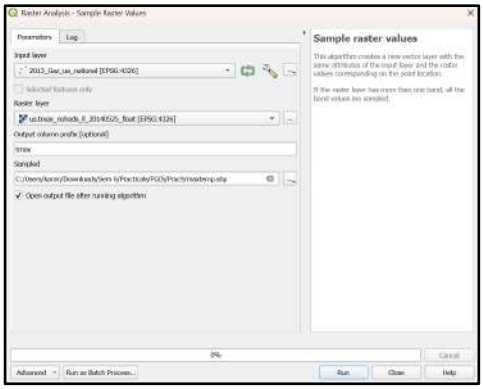
- Now unzip the downloaded 2013_Gaz_ua_national.zip file and extract the 2013_Gaz_ua_national.txt file on your disk. Go to Layer → Add Delimited Text Layer.



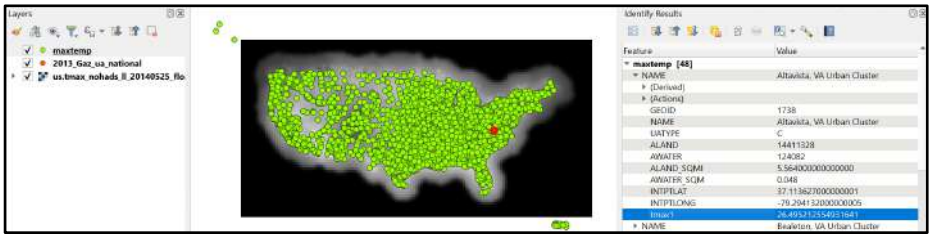
➢ In the Create a Layer from Delimited Text File dialog, click Browse and open 2013_Gaz_ua_national.txt. Choose Tab under Custom delimiters. The point coordinates are in Latitude and Longitude, so select INTPTLONG as X field and INTPTLAT as Y field. Check the Use spatial index box and click OK.



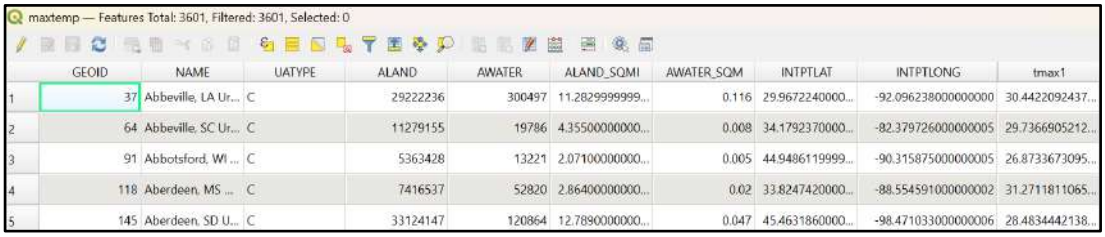
➢ Click Processing → Toolbox. In Raster analysis, double click on Sample raster values. Select the following parameters and click on Run.



➢ You will see a new layer ‘maxtemp’ 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.



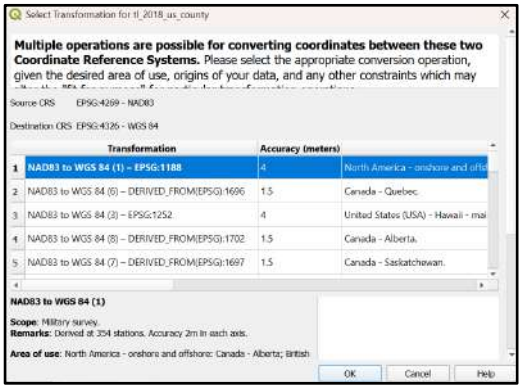
➢ You can also check the Attribute table for the ‘maxtemp’ layer to verify if the ‘tmax’ column has been added.

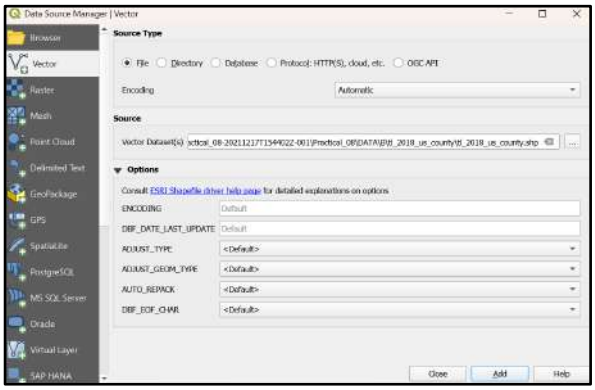


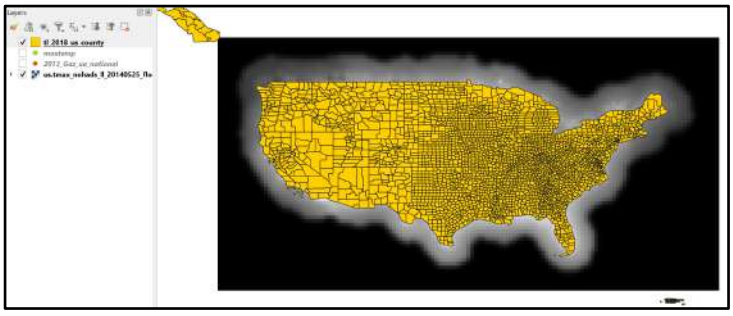
	GEOID	NAME	UATYPE	ALAND	AWATER	ALAND_SQMI	AWATER_SQM	INTPTLAT	INTPTLONG	tmax1
1	37	Abbeville, LA Ur...	C	29222236	300497	11.2829999999...	0.116	29.9672240000...	-92.096238000000000	30.4422092437...
2	64	Abbeville, SC Ur...	C	11279155	19786	4.35500000000...	0.008	34.1792370000...	-82.379726000000005	29.7366905212...
3	91	Abbotsford, WI ...	C	5363428	13221	2.07100000000...	0.005	44.9486119999...	-90.315875000000005	26.8733673095...
4	118	Aberdeen, MS ...	C	7416537	52820	2.86400000000...	0.02	33.8247420000...	-88.554591000000002	31.2711811065...
5	145	Aberdeen, SD U...	C	33124147	120864	12.7890000000...	0.047	45.4631860000...	-98.471033000000006	28.4834442138...

➢ Now, remove or deselect the ‘maxtemp’ and ‘2013_Gaz_ua_national’ layers.

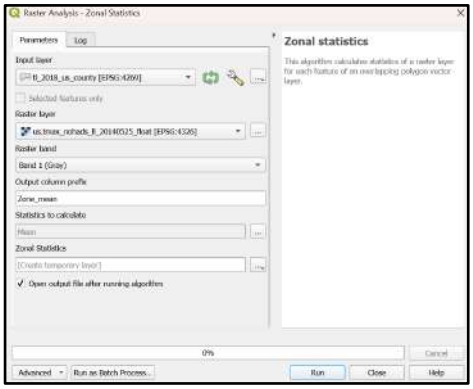
➢ Go to Layer → Add Layer → Add Vector Layer.
Browse to the downloaded tl_2013_us_county.zip file and click Open. Select thetl_2013_us_county.shp as the layer and click OK.



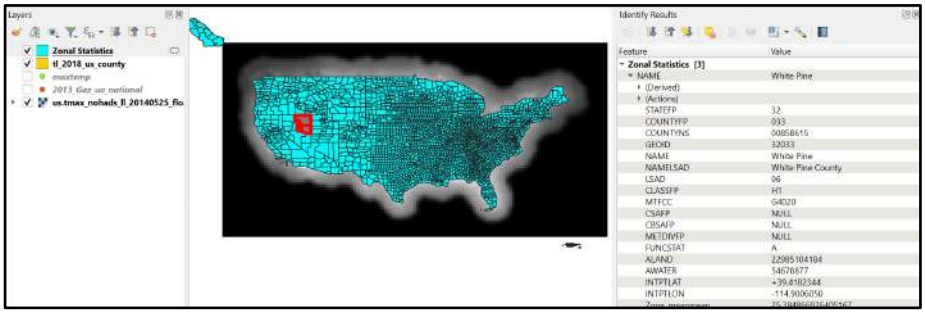




➢ Click Processing → Toolbox. In Raster analysis, double click on Zonal Statistics. Select the following parameters and click on Run.

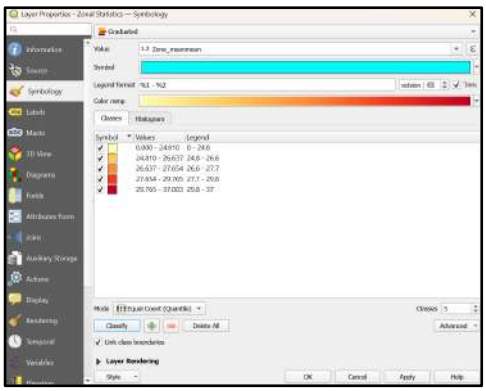


➢ Once the processing finishes, select the ‘Zonal statistics’ layer. Use the Identify tool and click on any county polygon. You will see the new attribute added to the layer: Zone_mean and, it contains the mean of raster pixel values.

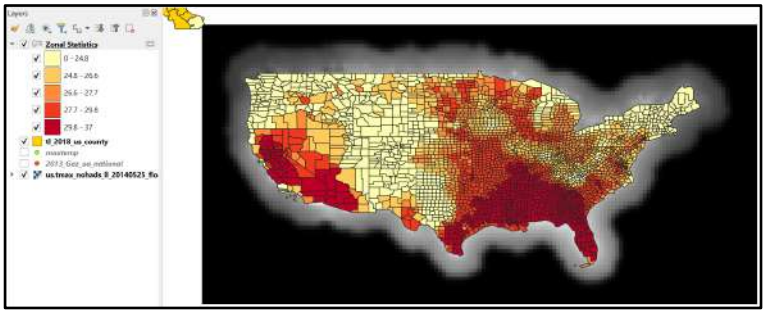


➢ Let’s style this layer to create a temperature map. Right-click the ‘Zonal statistics’ layer and select Properties.

➢ Switch to the Symbology tab. Choose Graduated style and select Zone_mean as the Column. Choose a Color Ramp and Mode of your choice. Click Classify to create the classes. Click OK.



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



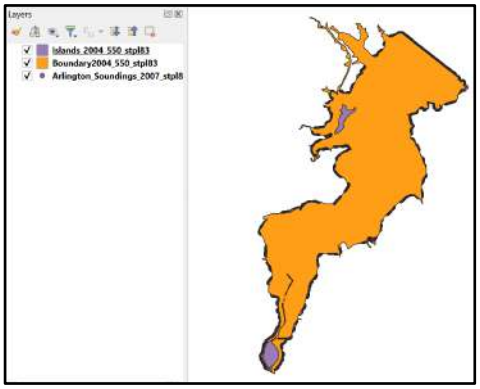
C. Interpolating Point Data Procedure

➢ Open QGIS. Go to Layer → Add Layer → Add Vector Layer..

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

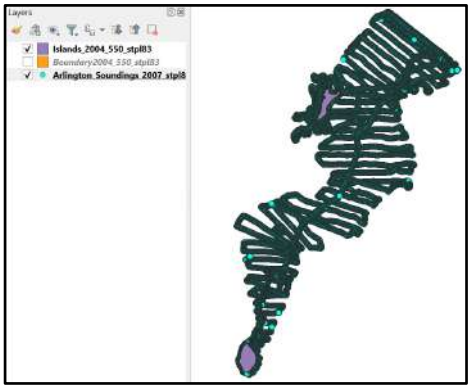
➢ In the Select layers to add... dialog, hold the Shift key and select Arlington_Soundings_2007_stpl83.shp, Boundary2004_550_stpl83.shp and Islands_2004_550_stpl83.shp layers. Click OK.

➢ You will see the 3 layers loaded in QGIS.

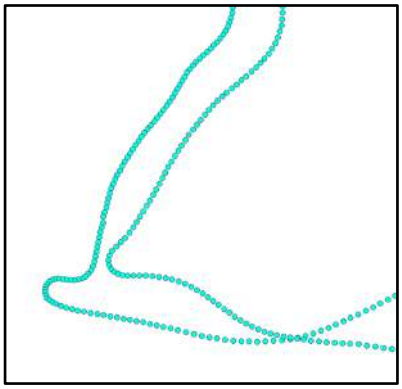


➢ The Boundary2004_550_stpl83 layer represents the boundary of the lake. Un-check the box next to it in the Table of Contents.

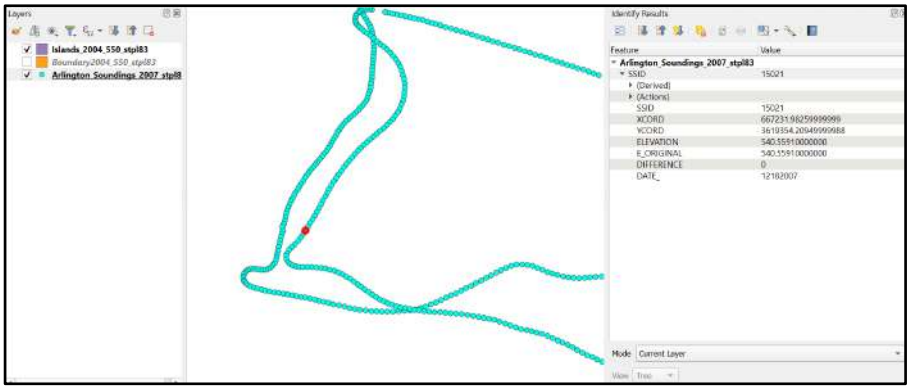
➢ This will reveal the data from the second layer Arlington_Soundings_2007_stpl83. Though the data looks like lines, it is a series of points that are very close.



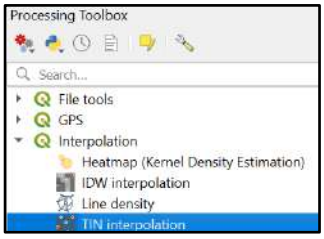
➢ Click the Zoom icon and select a small area on the screen. As you zoom closer, you will see the points. Each point represents a reading taken by a Depth Sounder at the location recorded by a DGPS equipment.



➢ 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.

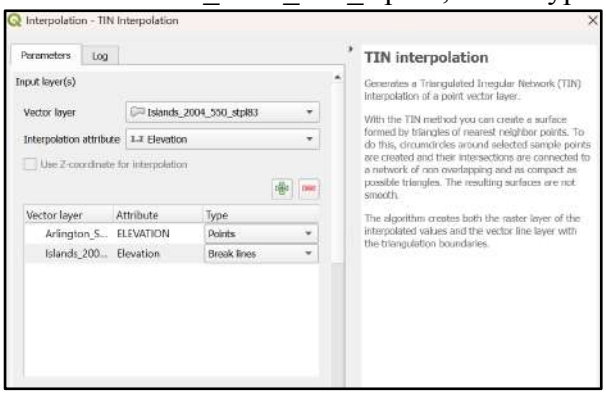


➢ Click Processing → Toolbox. In Interpolation, double click on TIN interpolation.

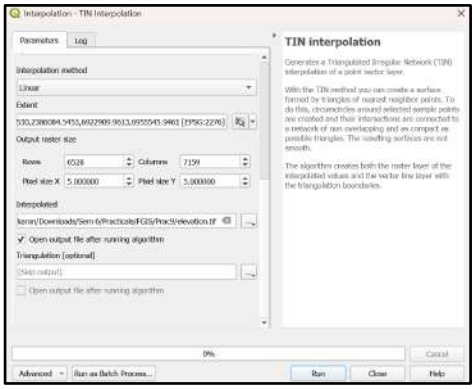


- Select Parameters as follows:
  Vector Layer : Arlington_Soundings_2007_stpl83
  Interpolation attribute : ELEVATION
  Then click on 

- Again select Parameters as follows:
  Vector Layer : Islands_2004_550_stpl83
  Interpolation attribute : Elevation
  Then click on 
  For Islands_2004_550_stpl83, select type as Break Lines



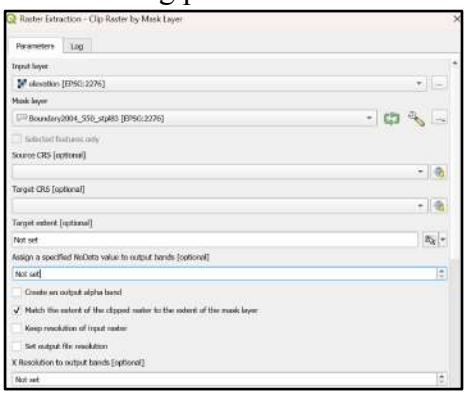
- Interpolation method : Linear
- For Extent, click on this button 
- In Output Raster size, change Pixel size X to 5.
- Save the Interpolated file and click on Run.

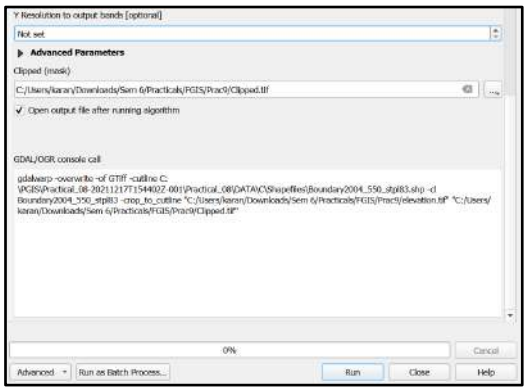


➢ You will see the new layer named ‘elevation’ loaded in QGIS. Deselect the other layers.

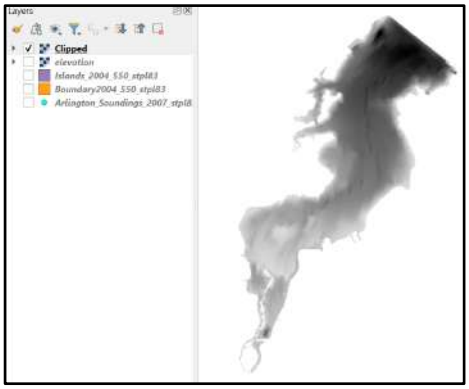
➢ Now you will see the full extent of the created surface. Interpolation does not give accurate results outside the collection area. Let’s clip the resulting surface with the lake boundary.

➢ Click Processing → Toolbox.
Go to GDAL → Raster extraction, double click on Clip raster by mask layer. Select the following parameters and click on Run.

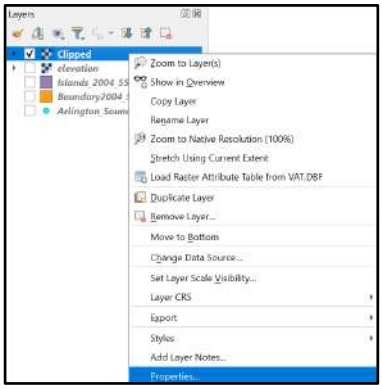




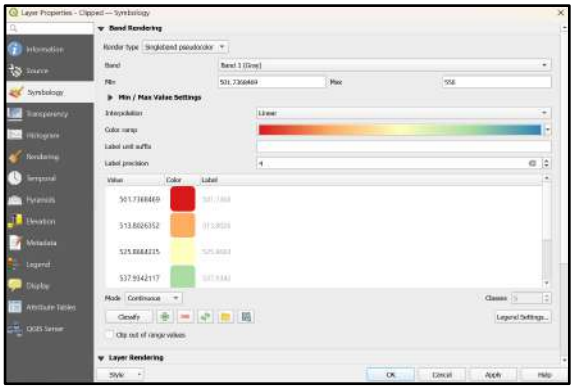
➢ A new raster named ‘Clipped’ will be loaded in QGIS. Deselect the other layers.



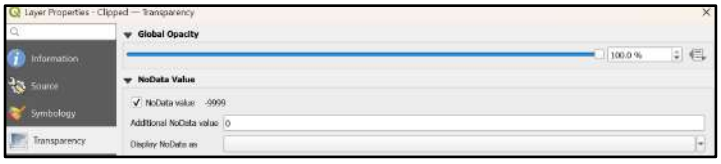
➢ We will now style this layer to show the difference in elevations.
Note the min and max elevation values from the elevation layer. Right-click the Clipped layer and select Properties.



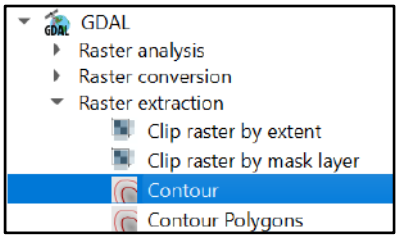
➢ Go to the Symbology tab. Select Render type as Singleband pseudocolor. In the Generate new color map panel, select Spectralcolor ramp. As we want to create a depth-map as opposed to a height map, check the Invert box. This will assign blues to deep areas and reds to shallow areas. Click Classify.



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

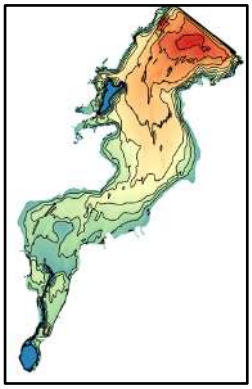


➢ Now you have a elevation relief map for the lake generated from the individual depth readings. Let's generate contours now.
Click Processing → Toolbox.
Go to GDAL → Raster extraction, double click on Contour.



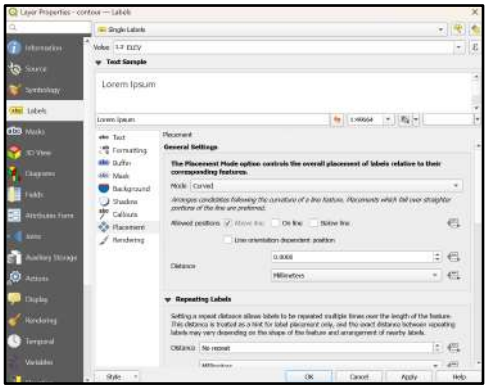
Select the following parameters and click on Run.

➢ The contour lines will be loaded as contours layer once the processing is finished.

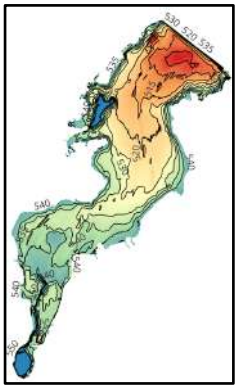


➢ Right-click the layer and select Properties.

➢ 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.



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



Practical 10

<u>Advance GIS Operations 2:</u> Batch Processing using Processing Framework

a. **Automating Complex Workflows using Processing Modeler**
b. **Automating Map Creation with Print Composer Atlas**
c. **Validating Map data**