

TRAINING MODULE ON

GROUNDWATER INTERVENTION MANAGEMENT PLAN FOR SUSTAINABLE DEVELOPMENT OF GROUND WATER RESOURCE IN MADHYA PRADESH

DAY 2- DEVELOPING GEO-SPATIAL LAYERS FOR GROUND WATER INTERVENTION PLAN

ORGANISED BY
**STATE EMPLOYMENT GUARANTEE
COUNCIL**



TECHNICAL SUPPORT

BY

**GIZ-India (Water Security and Climate Adaptation in Rural India) &
AMAY Environmental Consultancies**



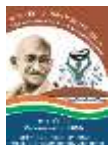
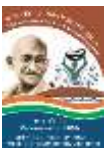


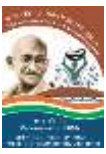
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Chapter-1

**Installation process of the software's
And Data Downloading
Duration: 30 Minutes**



System/Hardware Requirements

	Minimum	Recommended
Processor-CPU	Corei32.7Ghz	Corei73.5Ghz
Memory RAM	2Gb	8Gb or more
Hard Disk	500 Gb SATA	SSD de128Gb or 500 Gb SATA
Graphic card	1GbRAM	2Gb RAM (NVIDIA Geforce)
Operating System	Windows 10 Mac/Linux(Various) Android	Windows 10 Mac/Linux (Various)Android

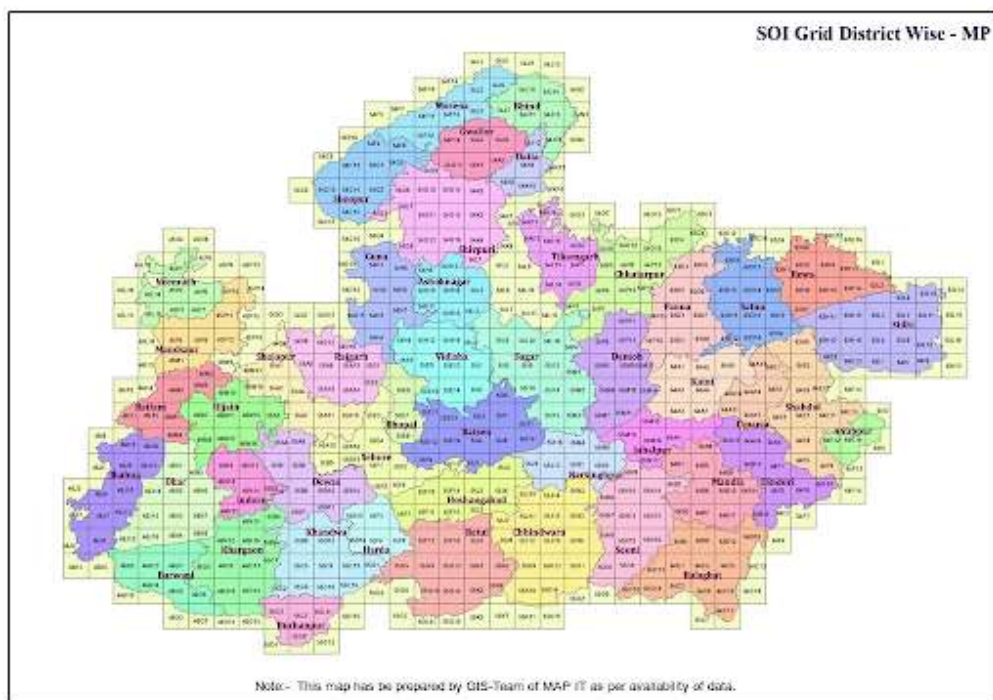
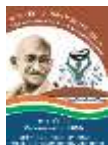
(1) Download QGIS software 3.16.5 version from below link

<https://qgis.org/en/site/forusers/download.html>
<https://www.download.qgis.org/>

(2) Download Topo sheet (scale 1:50000) from Survey of India Website

<https://onlinemaps.surveyofindia.gov.in/FreeMapSpecification.aspx>

Open Survey of India Website, then Map services, online maps portal section. Identify your Toposheet number of areas using following Index Map and shapefile.



(3) Open Geological Survey of India website from below link.

<http://www.gsi.gov.in>

(4) Download block boundaries of Indian States from below link.

<https://www.diva-gis.org/gdata>

(5) Download lineament map from below link.

<http://www.mpphd.gov.in/hgm.html>

(6) For downloading SRTM elevation data: Create UserID & Password with EarthData website from below link.

<https://urs.earthdata.nasa.gov/users/new>

EARTHDATA LOGIN

Register for an Earthdata Login Profile

Profile Information

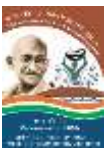
Username: *

Password: *

* Required field

Username must:

- Be a Minimum of 4 characters
- Be a Maximum of 30 characters
- Use letters, numbers, periods and underscores.

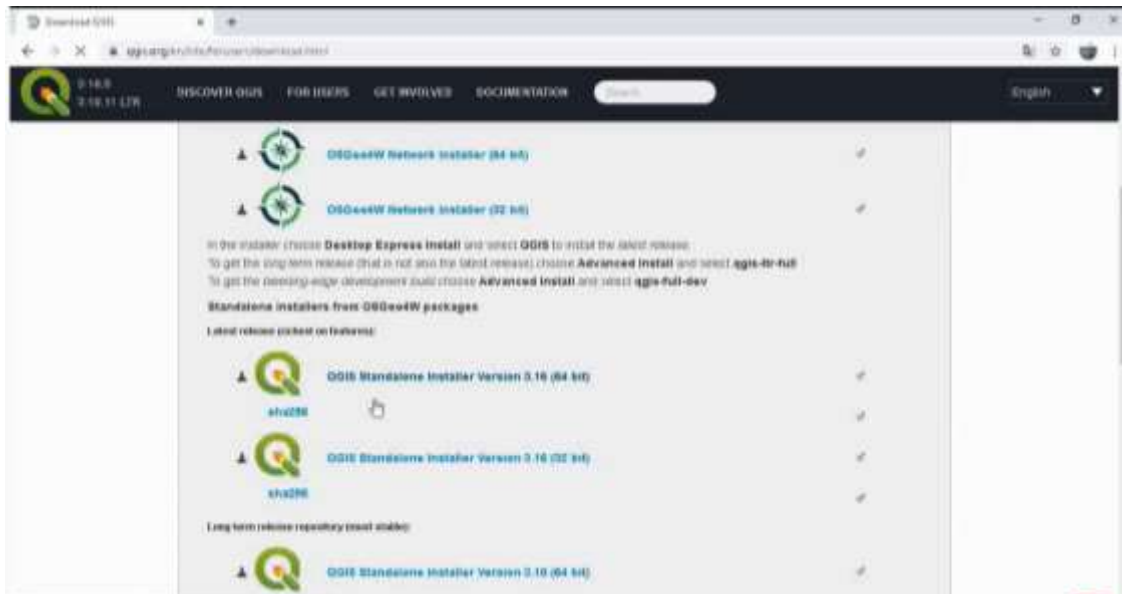
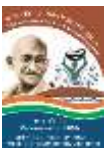


1. Introduction of QGIS (Quantum GIS)

Quantum GIS (QGIS) is an open-source Geographic Information System is available via Internet. The initial objective of the project was to provide a GIS data viewer. QGIS has reached a point in its evolution where it is being used by many, both individuals and corporations to meet their daily needs for viewing, analysis and management of GIS data. QGIS provides a growing range of skills through basic and complementary roles. You can view, manage, edit, analyze data and design maps which can be printed indifferent formats.

1.1 Installation of QGIS

Step1. To install the software QGIS must choose the web browser of your choice on your computer (for demonstration we are using Google Chrome) and select the installer, note that this software is free and open source. The web address where the installer is as follows:www.qgis.org , after selecting the executable file downloaded the application. Check the system configuration before downloading the .exe file (32 bit or 64 bit).

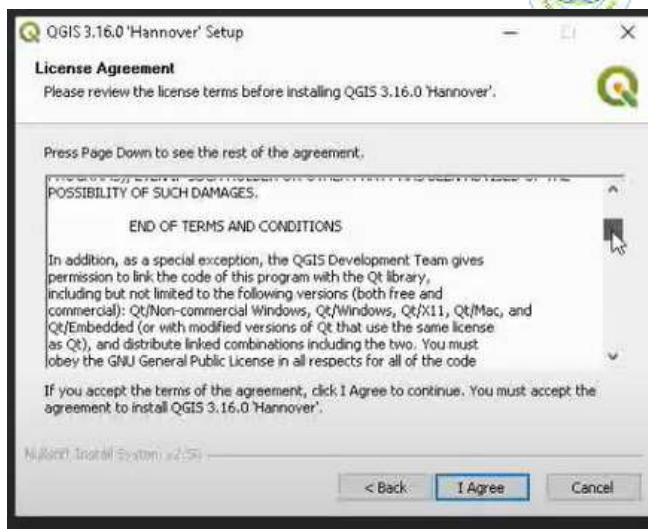
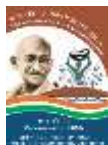


Step2.After the download proceed with terminal select the installer (.exe) and follow step by step installation the instructions below. Double click on " QGIS-OSGeo4W-3.16.0-Setup-x86_64.exe. This is the welcome interface software that appears when you start the installation, in this step click on "Next".

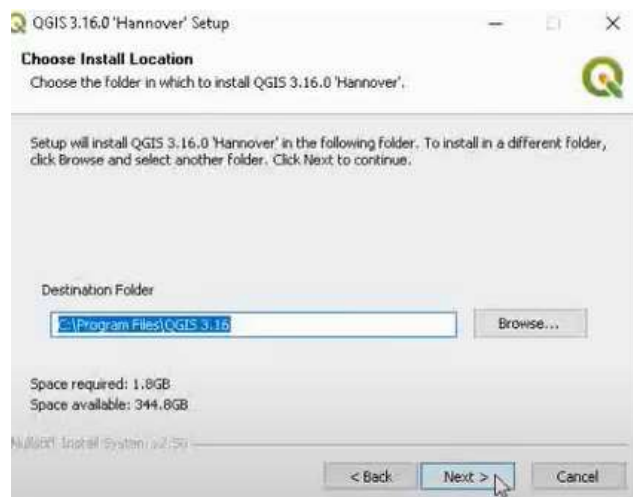


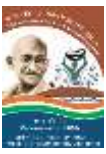
Welcome message window

Step3.The following illustration shows the license information and the terms, if we agree click "I Agree".



Step4. The following illustration shows their commended destination which can be changed to our preference, we just press the button "Next".



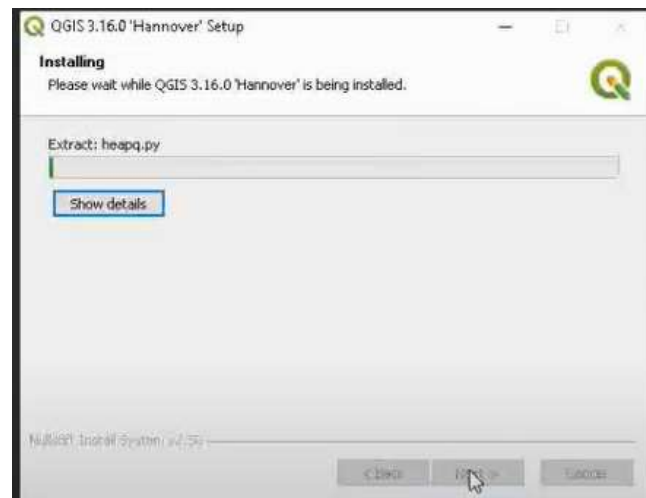


Note: we must note that the program requires a minimum of 1.5GB of hard disk space to be installed, otherwise it cannot be made the installation disk.

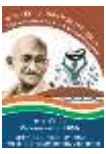
Step5.The following illustration shows and asked to select the components, usually just leave it and press the button "Install".



Step6.The following illustration shows the process of installing the software, just wait.



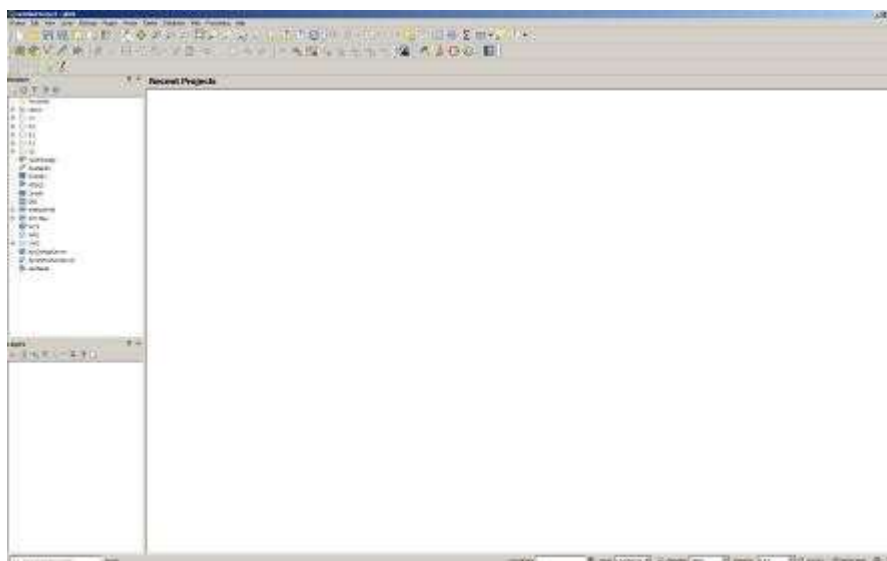
Step7.After the installation process is finished, click the button "Finish" and the software will be installed in your computer and can be proceeded to initiate work.

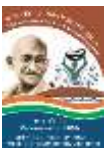


Step8.Go to start tool of your bottom left windows tool select QGIS3.16.5 installed folder and select QGIS Desktop3.16.5 with GRASS7.4.2 as shown below.



Step9.QGIS3.16.5 desktop application opens as shown below

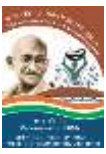




Chapter 2

Introduction to QGIS

Duration: 15 Minutes



2.1 What is Geographic Information System (GIS)?

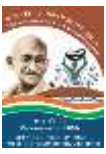
- A **GIS** is a system of computer hardware, computer software and geographical data.
- A **GIS Application** allows you to view geographical data and is an important part of the GIS.
- A GIS Application normally consists of a **menu bar**, **toolbars**, a **map view** and a **legend**.
- **Vector** and **Raster** data are geographical data used in a GIS application.
- **Geographical** data can have associated **non-geographical** data.
- GIS Applications or Software's are normally programs with a graphical user interface that can be manipulated using the mouse and keyboard.

2.2 What is QGIS (Quantum GIS)?

- QGIS is an open-source Geographic information system software which you can use for free.
- It's an Open-Source Application which provides Functionality and plugins to View, Edit, Store and analyze geospatial data.
- With the help of Quantum GIS (QGIS), users can create Awesome Maps.
- It's available to Windows, MAC, Linux, BSD and as well for Android for free.

2.2.1 What is Open source?

1. It's free.
2. Frequent update
3. Participate in development
4. Multi-platform
5. QGIS is a free and open-source cross-platform desktop geographic information system application that supports viewing, editing, and analysis of geospatial data.
6. QGIS functions as Geographic Information System (GIS) software, allowing users to analyze and edit spatial information, in addition to composing and exporting graphical maps.
7. QGIS supports both raster and vector layers.
8. Vector data is stored as either point, line, or polygon features.
9. Multiple formats of raster images are supported, and the software can georeferenced images.
10. QGIS supports shapefiles, coverages, personal geodatabases, MapInfo, PostGIS, and other formats. Web services, WMS (Web Map Services) and (Web Feature Service), are also supported to allow use of data from external sources.



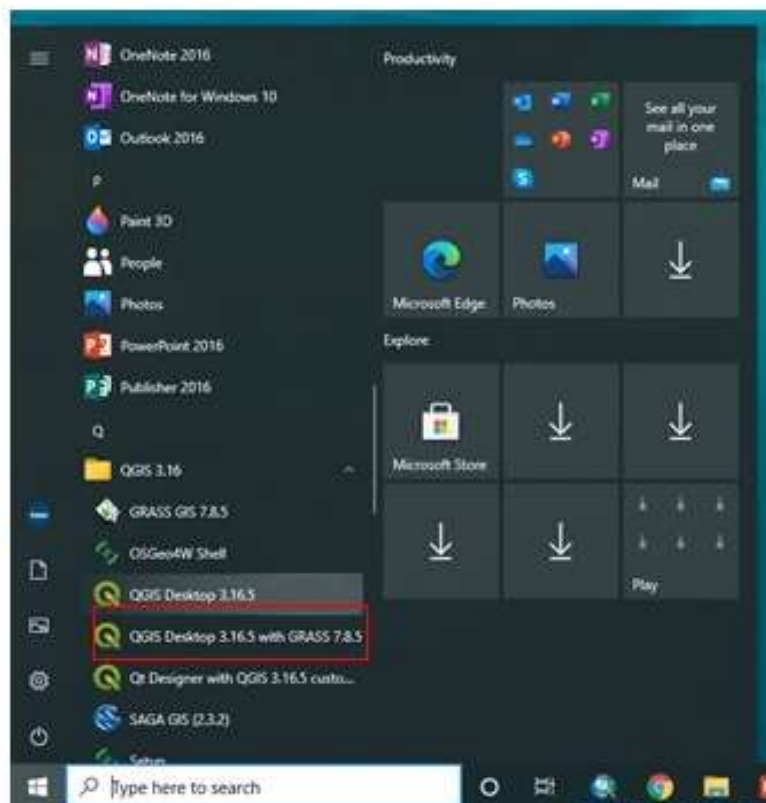
11. QGIS integrates with other open-source GIS packages.

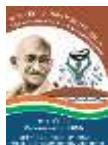
2.2.2 QGIS is Useful for

1. **For Developers** - adapt or extend libraries and programs already written, to meet your own needs
2. **For Users** – reduce acquisition costs – make your own customizations – enjoy a completely different support and maintenance model
3. **For Students** – learn from the code already out there, don't reinvent the wheel

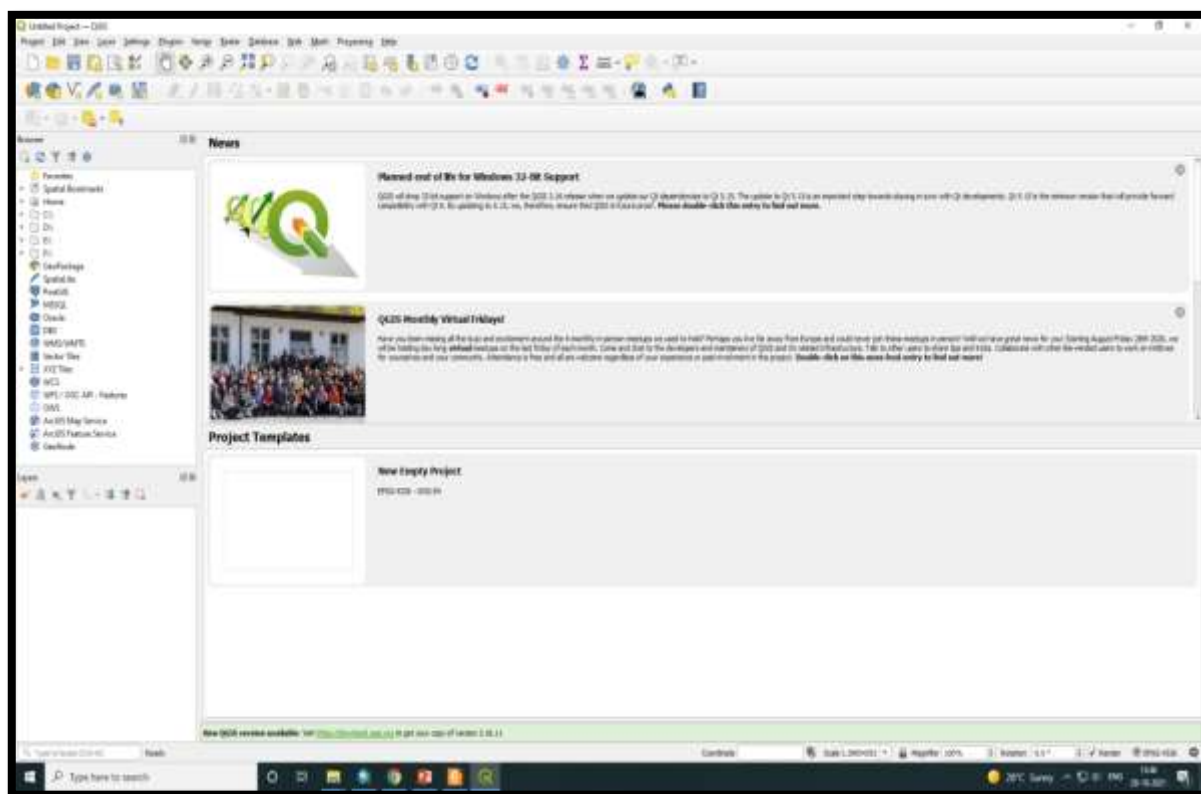
Open Start Menu click on QGIS DEKSTOP

Basics of QGIS (Quantum GIS)

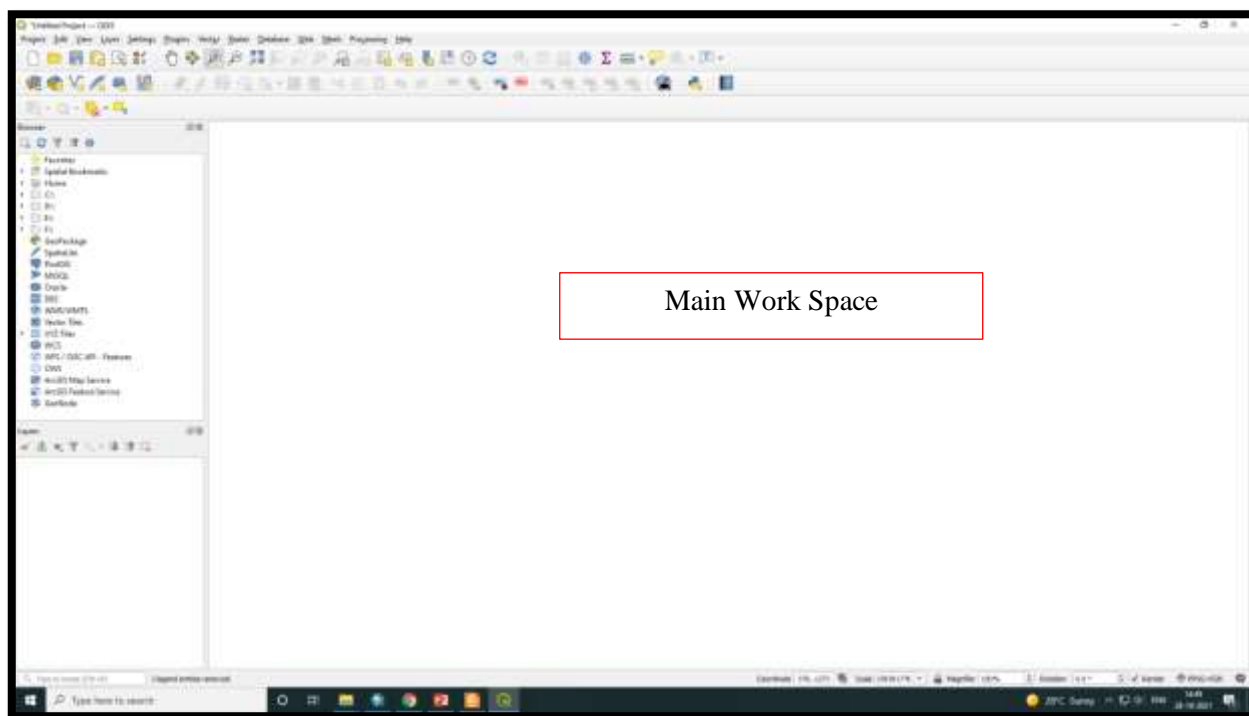


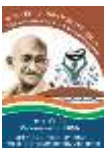


QGIS Main frame view



Main work Space area of QGIS

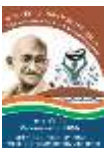




Chapter 3

Downloading data: Toposheet, Ground Water Prospect, Elevation data, Geology and Geomorphology data

Duration: 1 hr 15 Minutes



3.1 What is a Topographic Map?

A topographic map is a detailed and accurate illustration of man-made and natural features on the ground such as roads, railways, power transmission lines, contours, elevations, rivers, lakes and geographical names. The topographic map is a two-dimensional representation of the Earth's three-dimensional landscape. Available toposheet on scale of 1:50000 (2 cm=1000m. (1 km))

3.1.1 What information is on a topographic map?

Topographic maps identify numerous ground features, which can be grouped into the following categories:

Relief: mountains, valleys, slopes, depressions as defined by contours

Hydrography: lakes, rivers, streams, swamps, rapids, falls

Vegetation: wooded areas

Transportation: roads, trails, railways, bridges, airports/airfield, seaplane anchorages

Culture: buildings, urban development, power transmission line, pipelines, towers

Boundaries: international, provincial/territorial, administrative, recreational, geographical

Toponymy: place names, water feature names, landform names, boundary names

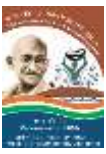
Refer to the map legend for a complete listing of all features and their corresponding symbols.

Information along the map borders provides valuable details to help you understand and use a topographic map. For example, here you will find the map scale and other important information about the map such as the year, the edition and information pertaining to the map data.

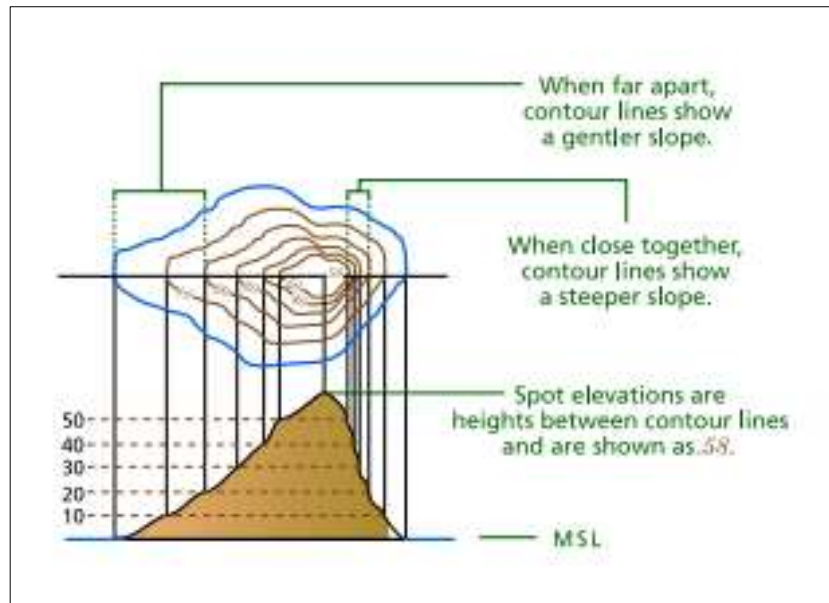
Topographic maps show contours, elevation, forest cover, marsh, pipelines, power transmission lines, buildings and various types of boundary lines such as international, provincial and administrative, and many others. Topographic maps show a universal transverse Mercator (UTM) grid, allowing the user to determine precise positions. In basic terms, topographic maps allow the user to see a three-dimensional landscape on a two-dimensional surface.

3.1.2 What do the colours mean?

A variety of colours can be found on a map, each relating to different types of features. Black shows cultural features such as buildings, railways and power transmission lines. It is also used to show geographical names (toponymy), certain symbols, geographic coordinates and precise elevations. Blue represents water features, such as lakes, rivers, falls, rapids, swamps and marshes. The names of water bodies and water courses are also shown in blue, as are magnetic declination and UTM grid information. Green indicates vegetation such as wooded areas,



orchards and vineyards. Some northern areas of Canada are mapped in black and white (monochrome). What are contour lines? Contour lines connect a series of points of equal elevation and are used to illustrate relief on a map. They show the height of ground above mean sea level (MSL) either in meters or feet, and can be drawn at any desired interval. For example, numerous contour lines that are close to one another indicate hilly or mountainous terrain; when further apart they indicate a gentler slope; and when far apart they indicate flat terrain.



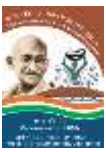
3.1.3 What is scale?

Maps are made to scale. In each case, the scale represents the ratio of a distance on the map to the actual distance on the ground. A standard Canadian topographic map is produced at 1:50 000, where 2 cm on the map represents 1 km on the ground.

$$\frac{\text{MAP DISTANCE}}{\text{GROUND DISTANCE}} = \frac{2 \text{ cm}}{1 \text{ km}} = \frac{2 \text{ cm}}{100\,000 \text{ cm}} = \frac{1}{50\,000}$$

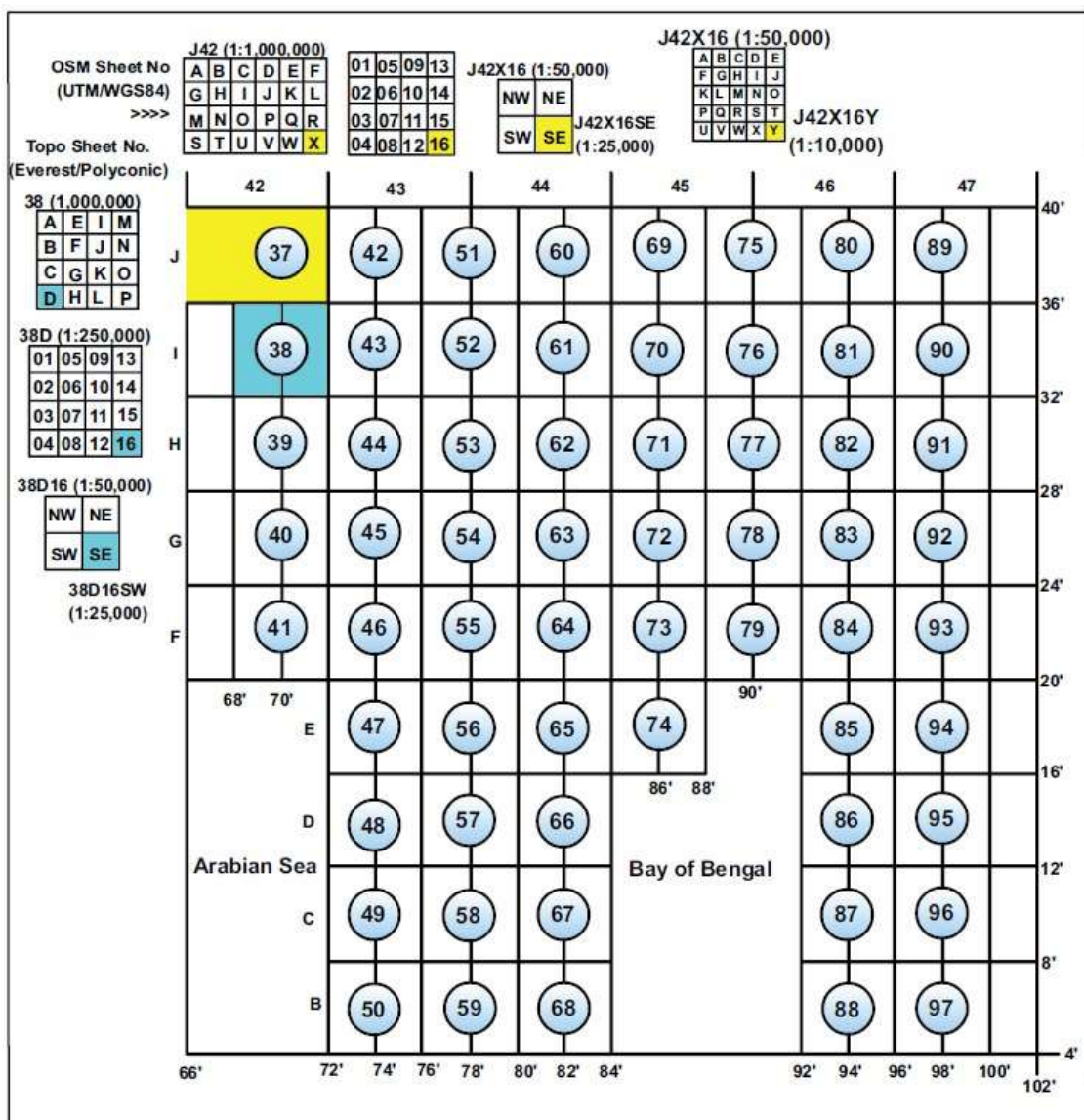
SCALE \longrightarrow 1:50 000

Medium-scale maps (e.g. 1:50 000) cover smaller areas in greater detail, whereas small-scale maps (e.g. 1:250 000) cover large areas in less detail. A 1:250 000 scale national topographic system (NTS) map covers the same area as sixteen 1:50 000 scale NTS maps.

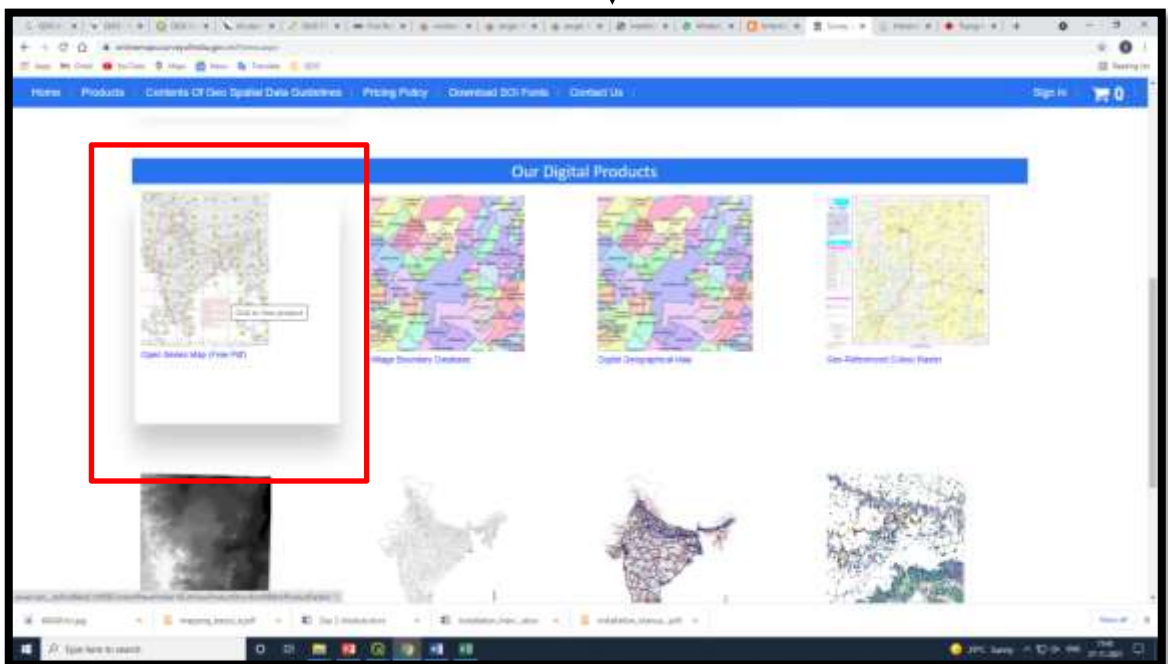
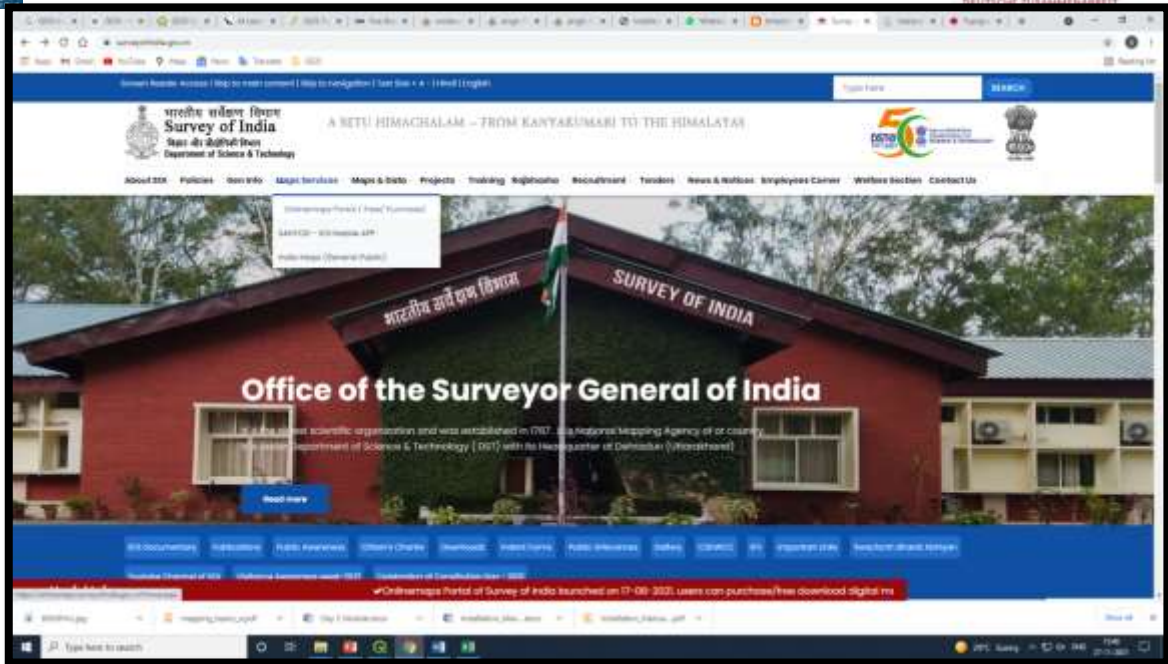
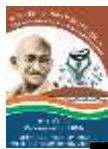


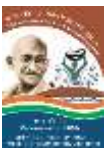
3.1.4 What is a grid?

A grid is a regular pattern of parallel lines intersecting at right angles and forming squares; it is used to identify precise positions. To help you locate your position accurately on the surface of the Earth (or map sheet), topographic maps have two kinds of referencing systems: • universal transverse Mercator (UTM) projection (easting/northing) • geographic: degrees and minutes (longitude/latitude) The projection used for topographic maps is UTM. The UTM grid is a square grid system of lines depicted on maps and based on the transverse Mercator projection. It can be used to accurately locate the position of features on the map by distance or direction.



Index for conversion of Topo Sheet No. to OSK sheet No.





3.2.1 Study of toposheet and Base Map Preparation

(a) Demarcation of study area in block boundary

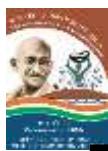
(b) Identification of catchment/ Watershed

- Digitize drainage from ridge to valley
- Demarcation of Watershed area
- Development of various order of drainage and its intercept at slope of the area
- Location of village/Road/Waterbodies
- Triangulation Elevation in Survey of India Toposheet

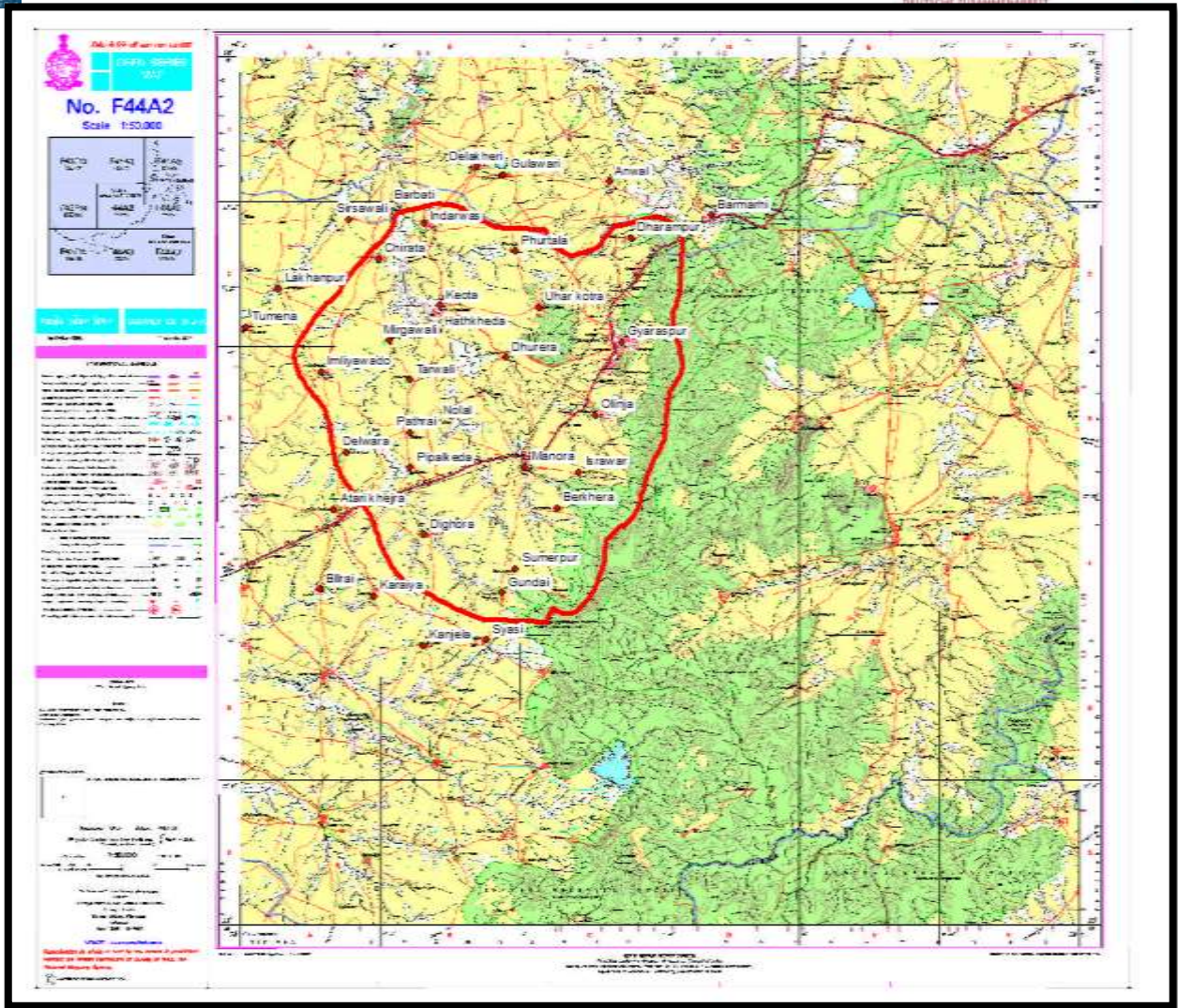
(c) Study of 20 meter contour elevation of Topo sheet in its variation for landscapes

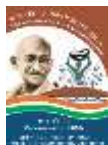
identification of high ridges, valley slope, intercept at drainage order

(d) Identification of the Forest boundary (Green color)



giz





3.3 Downloading Geology Map

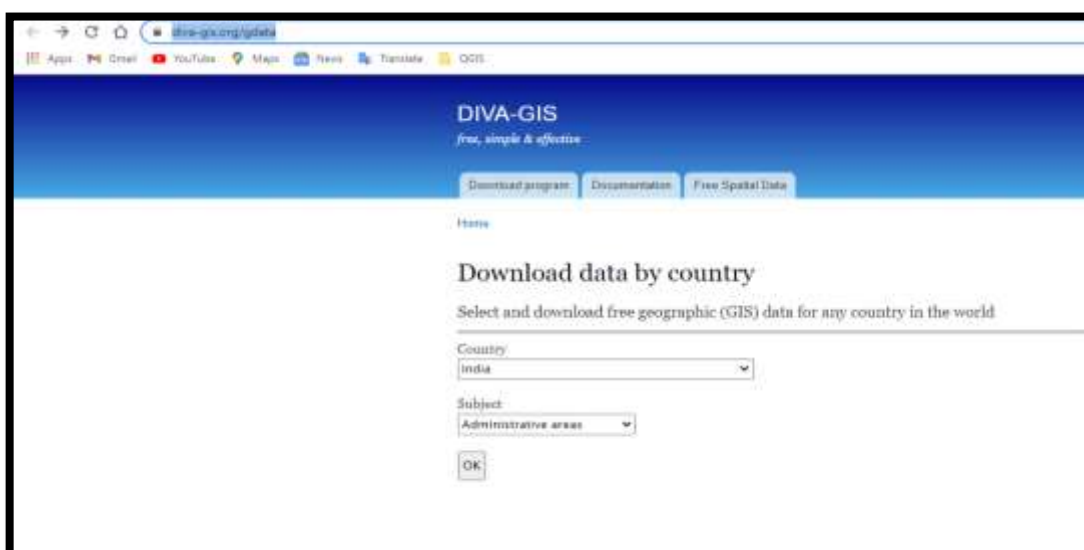
Hands on Training - Generation of Geology and Geomorphology of the study area.

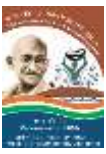
Step 1: Open Geological Survey of India website



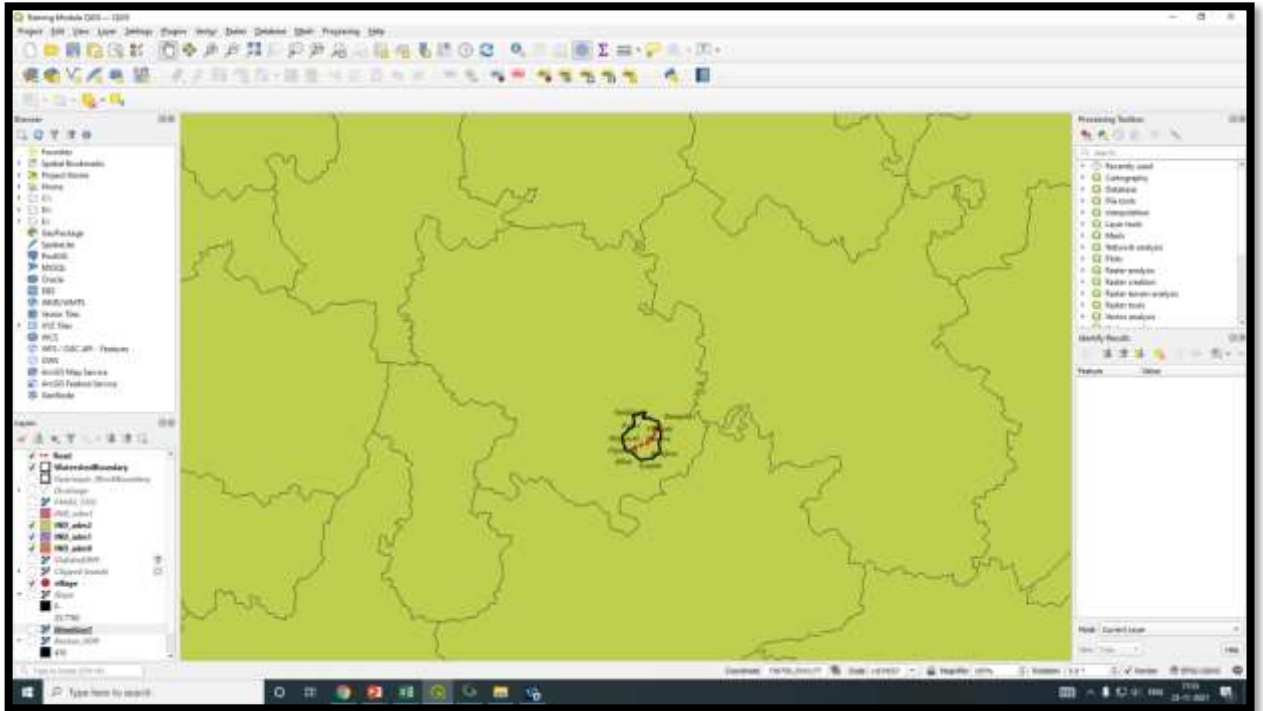
✓ Download Block Boundaries

- Download block boundaries of Indian States from below link
- <https://www.diva-gis.org/gdata>



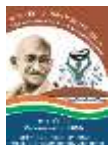


✓ Check the state and Block boundary



Step 2: Open Geological Survey of India Website, Maps, and then Map series. In this series you can search your data with State name and DRM data. This data will download in ZIP file. The zip file extract in the specified location. These files are in PDF format, we have to convert these files into JPG format for further use or extracting data.





Map Series

Search
Match All Any

Map Type: Published Paper Map
Map Sub-Type: --Please Select--
Map Title:
Map Region: --Please Select--
State: Madhya Pradesh
District: Bhopal

List of Maps

Restricted	Map Sub-Type	Map Title
Free Map	Geological Quadrangle Map	Geological Quadrangle
Restricted Map	Geological Quadrangle Map	Surat Quadrangle
Restricted Map	Geological Quadrangle Map	Partakimbi Quadrangle
Free Map	Mineral Belt Map	Geological and Mineral Map of Singhthum Keonjhar Sumbargarh Iron Co
Free Map	Mineral Belt Map	Geological and Mineral Belt Map of Bhojpur Mandla Ujjain District, Central

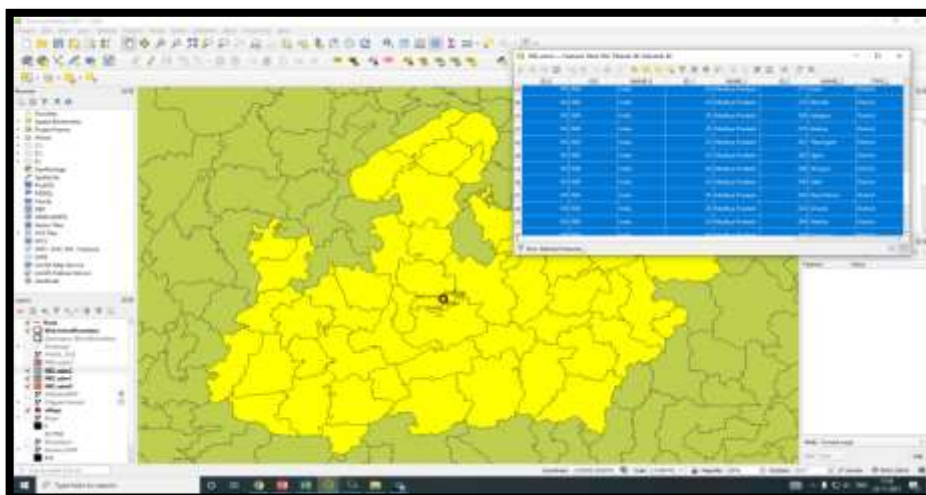
Map Series

Search
Match All Any

Map Type: Published Paper Map
Map Sub-Type: --Please Select--
Map Title:
Map Region: --Please Select--
State: Madhya Pradesh
District: Bhopal

List of Maps

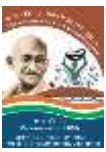
Restricted	Map Sub-Type	Map Title	Map Region	State	District	Stock Pages	Year of Publication
Free Map	District Resource Map	MP	MP	Madhya Pradesh	Bhopal	01	2011
Free Map	State Resource Map	State Resource Map of MP/MP	MP	Madhya Pradesh	Bhopal	01	2011



3.4 Downloading Lineament Map

Download Lineament Map from

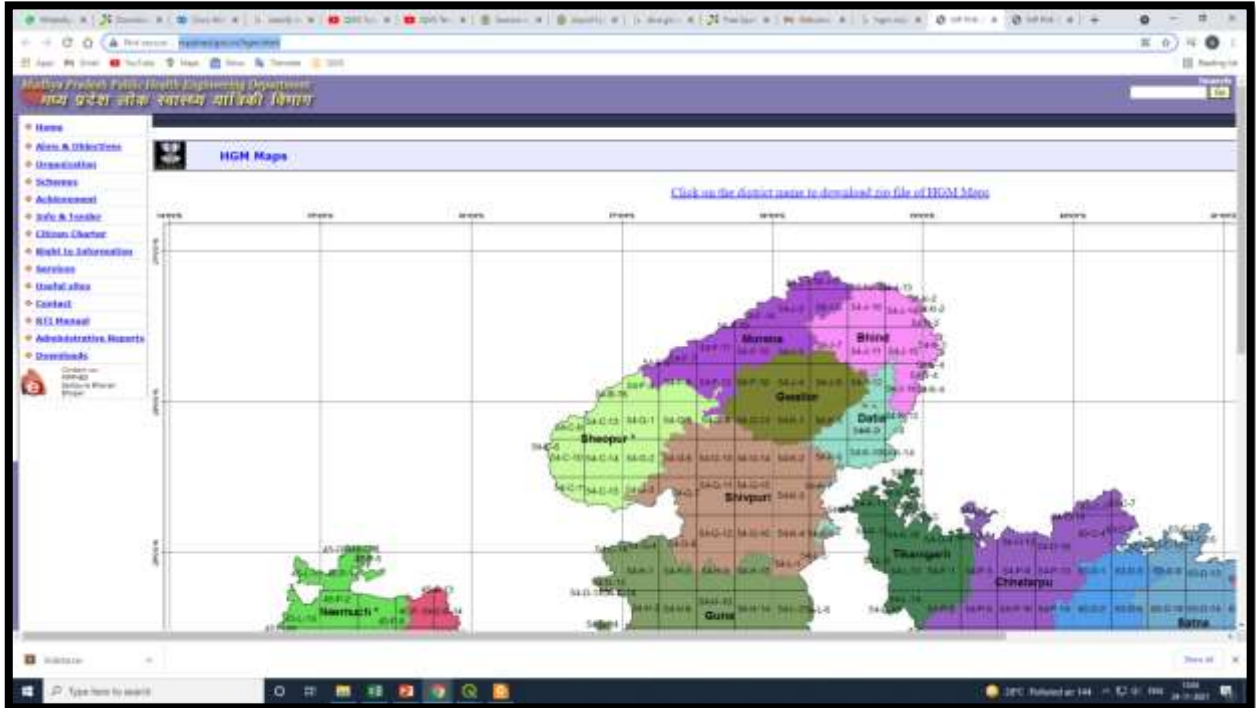
- link to Download map:
- <http://www.mpphed.gov.in/hgm.html>



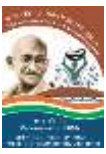
Steps:

- ✓ Just click on the district for download lineament Map.
- ✓ The **District.rar** will be downloaded by the user.
- ✓ Extract that file and many pdf files will open.

These pdf file names are divided on the basis of Toposheet number of the area. Convert these pdf files into JPG format for georeferencing by [ilovepdf online converter](#).



Name	Date modified	Type	Size
gwm54n07.pdf	21-10-2010 10:45	Font PDF Reader ...	2,973 KB
gwm54n8.pdf	21-10-2010 10:45	Font PDF Reader ...	3,224 KB
gwm54n11.pdf	21-10-2010 10:45	Font PDF Reader ...	3,515 KB
gwm54n12.pdf	21-10-2010 10:45	Font PDF Reader ...	3,883 KB
gwm54n13.pdf	21-10-2010 10:45	Font PDF Reader ...	3 KB
gwm54n16.pdf	21-10-2010 10:45	Font PDF Reader ...	2,405 KB
gwm54n4.pdf	21-10-2010 10:47	Font PDF Reader ...	2,638 KB
gwm54n8.pdf	21-10-2010 10:47	Font PDF Reader ...	2,544 KB
gwm55e13.pdf	21-10-2010 10:49	Font PDF Reader ...	2,500 KB
gwm55e14.pdf	21-10-2010 10:49	Font PDF Reader ...	2,447 KB
gwm55e15.pdf	21-10-2010 10:50	Font PDF Reader ...	2,238 KB



Chapter 4

Hands on Training- Process of Georeferencing

Duration: 1 hr 45 minutes

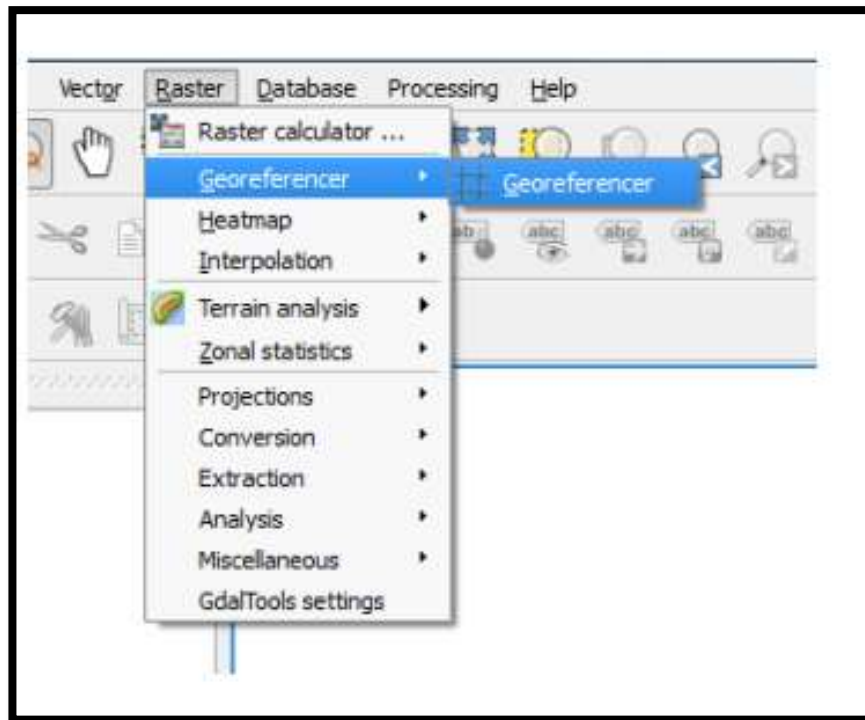
4.1 Geo-Referencing in QGIS

• Georeferencing is a process of establish a mathematical relationship between the image coordinate system and the world spatial coordinate system.

Step 1: First, open Quantum GIS (QGIS) software

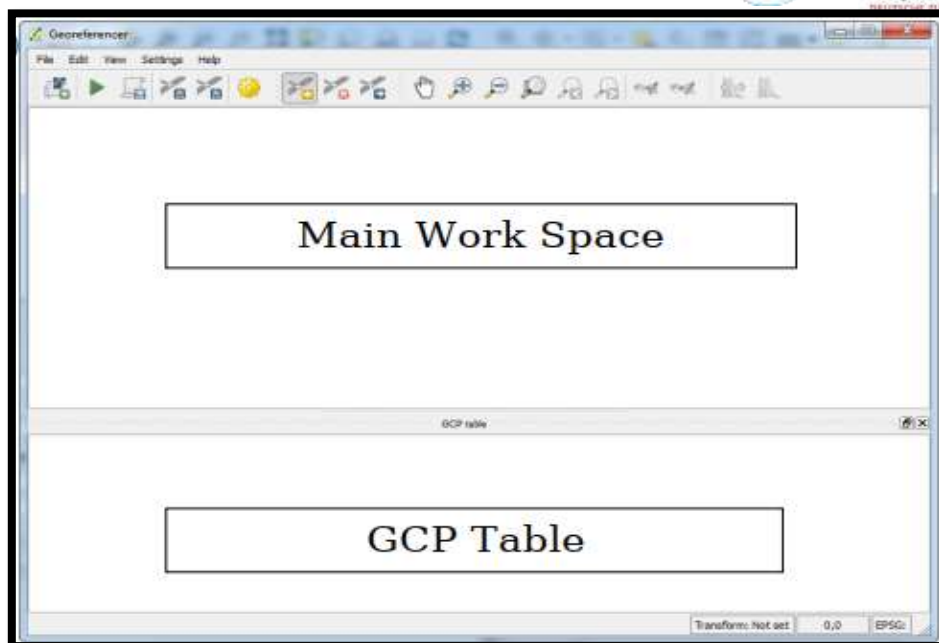
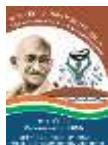
- Start All programs QGIS-Desktop QGIS

Step 2: Open QGIS Georeferencer (Raster → Georeferencer → Georeferencer).



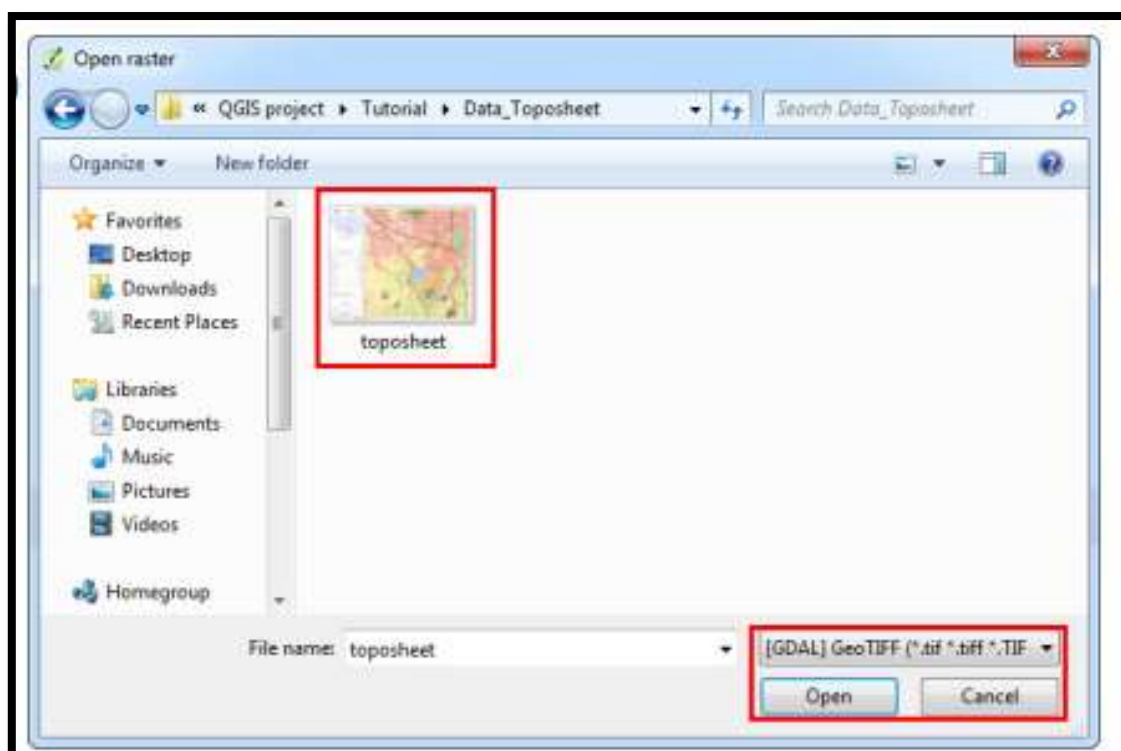
Step 3: The Georeferencer is in the form of a window with two parts to it.

- The upper part is called as 'main Work Space' dedicated to display the Raster Map to be georeferenced and it allows the user to input the geographic or projected coordinates of control points.
- The lower part, titled 'GCP table', is where the Ground Control Point data and residuals will be displayed.

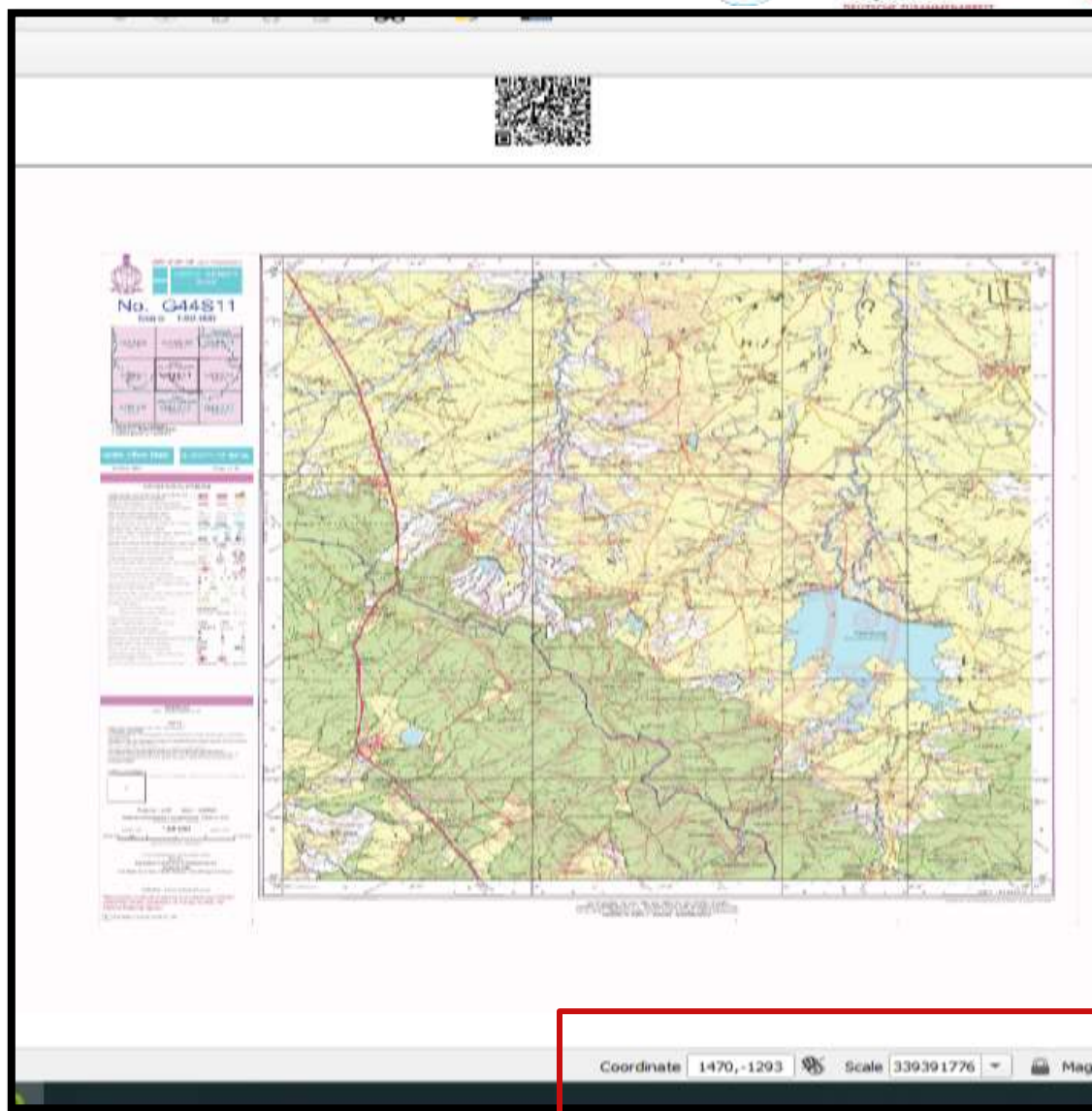
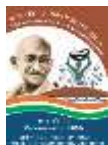


Step 4: Add the toposheet to the Georeferencer by clicking on the Open Raster button or from the File menu (File → Open Raster).

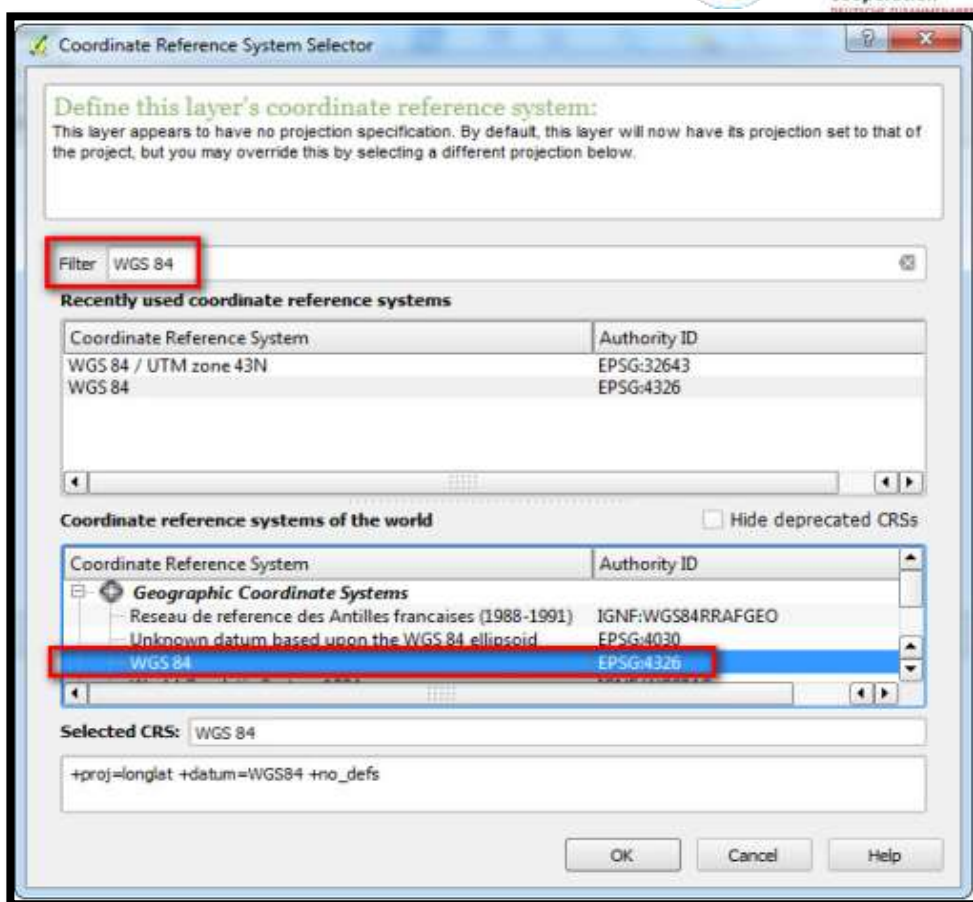
Step 5: Click on the drop-down menu right to the 'File name' and select '[GeoTIFF]'. Now select the 'toposheet.tif' and click 'Open'.



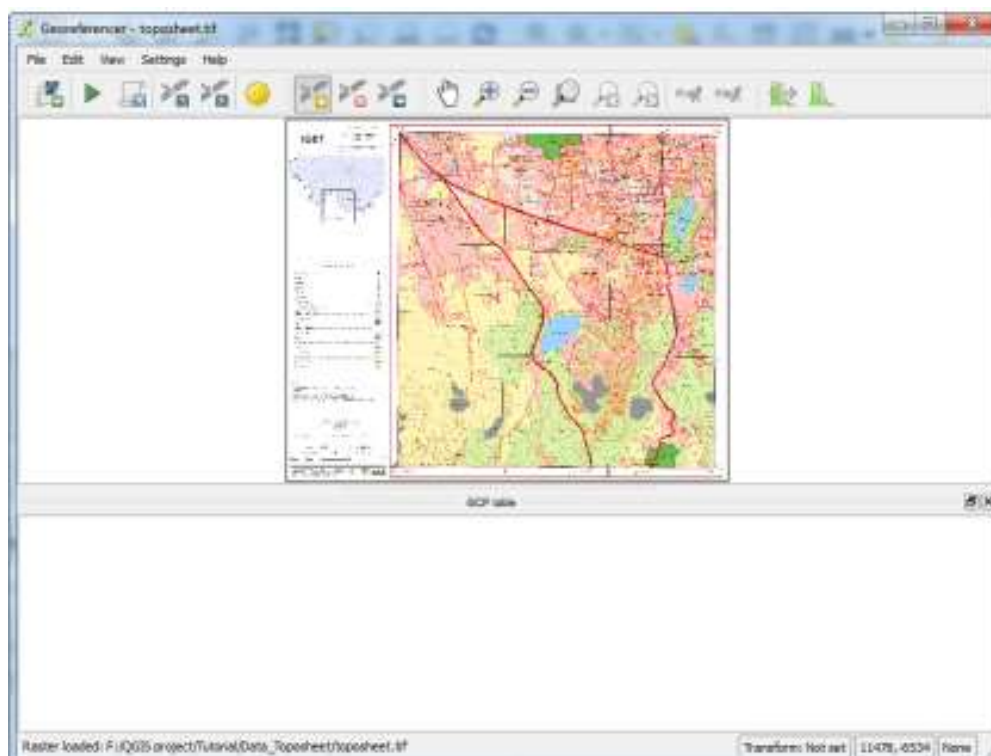
Check the coordinates. This is not georeferenced so it will not give any real coordinate information.

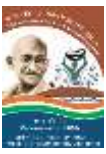


Step 6: You will then be presented with the ‘Coordinate Reference System Selector’ window from which we will select the ‘WGS 84’ under Coordinate reference system of the world section.



Step 7: The toposheet will be loaded in the Georeferencer window.





Step 8: To georeference an image we use Ground control points (GCPs). GCP is a location on the earth's surface with known coordinates on both earth and Toposheet/imagery, i.e. geographic and pixel coordinates respectively.

Step 9: To start adding GCPs to our map, we first zoom to a corner of the map where we can easily identify the intersection of the latitude and longitude.

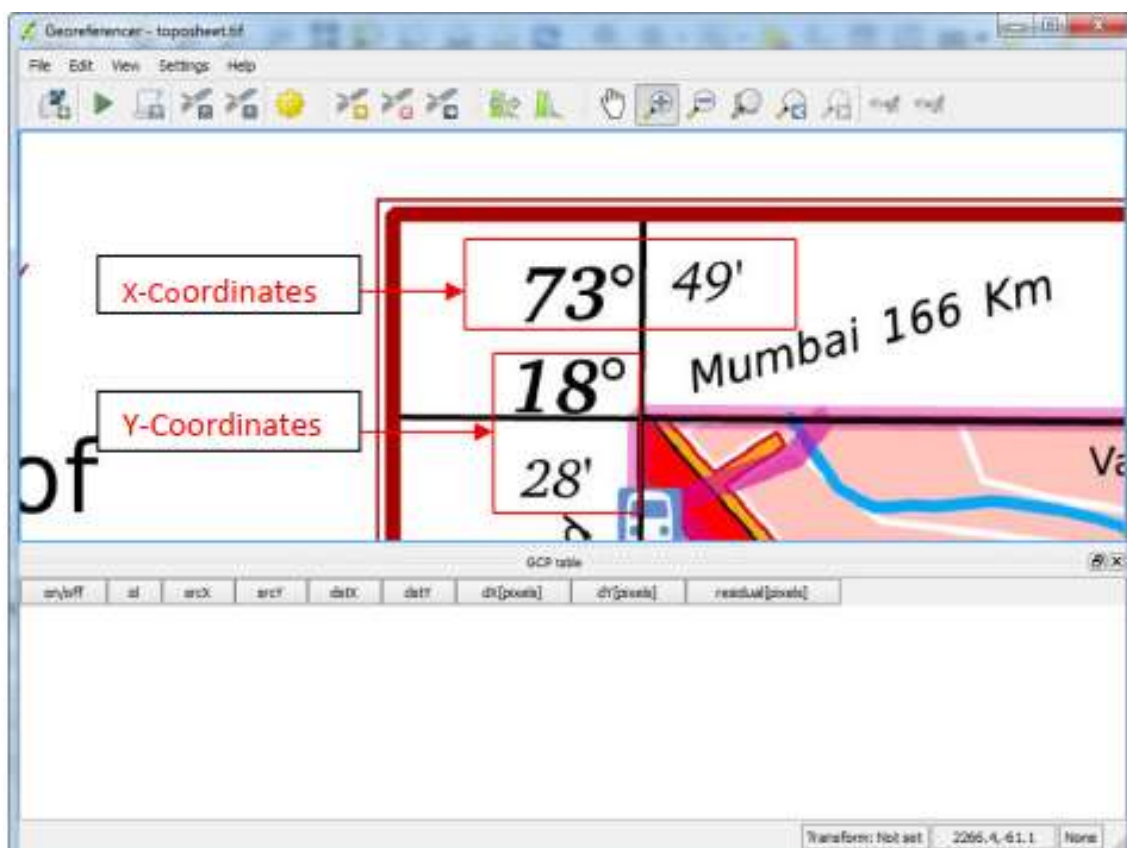
Step 10. To add a GCP click on the 'Add point' button, or go via menu (Edit-Add Point).

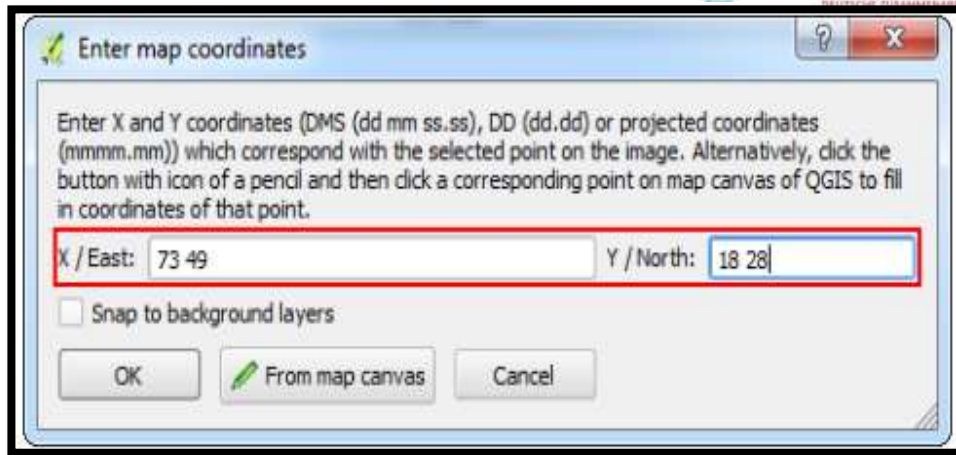
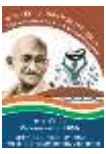
The mouse will transform into a '+' sign, which we use to click on the center of the intersection. Use 'view tool' when needed.



Step 11: A window 'Enter map coordinates' will pop up where we enter the coordinates of the point which we take from the map.

Always enter 'Longitude or Easting' in X field and 'Latitude or Northing; in Y field. Use same procedure for marking six more points.



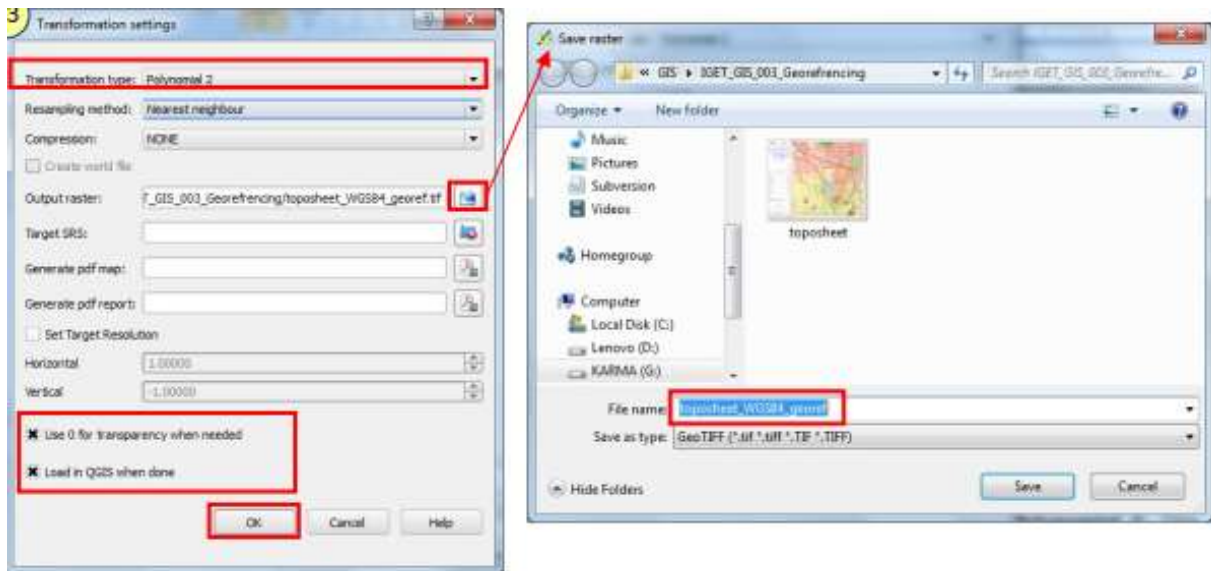


Step 12: We now set the spatial reference settings for the toposheet by clicking on the ‘Transformation Settings’ button.

The ‘Transformation Settings’ window pops up in which we will enter the spatial information of our map.

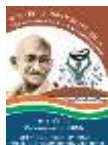
Step 13: Click on the ‘Transformation type’ drop-down menu and select ‘Polynomial 2’. This means we will be using a second order polynomial transformation.

Step 14: Click on the button next to ‘output Raster’. A dialogue box will appear in which we enter the name of our output file. It is recommended to include the name of the original file.



Step 15: ‘Check’ the check box ‘Load in QGIS when done’ and ‘Use 0 for transparency when needed’, leave the rest of the values as default and click ‘OK’.

Step 16: After Click ‘OK’ the last column ‘residual [Pixels]’ displays some values. These are the error values associated with the GCPs. An error value of 1 or less would be satisfactory.



17

GCP table

on/off	id	srcX	srcY	dstX	dstY	dX[pixels]	dY[pixels]	residual[pixels]
<input checked="" type="checkbox"/>	0	2239.98	-274.97	73.82	18.47	0.01	-0.00	0.01
<input checked="" type="checkbox"/>	1	8479.98	-315.04	73.87	18.47	-0.06	-0.10	0.11
<input checked="" type="checkbox"/>	2	8439.00	-6853.96	73.87	18.42	-0.01	0.00	0.01
<input checked="" type="checkbox"/>	3	2197.00	-6813.99	73.82	18.42	0.06	0.10	0.11
<input checked="" type="checkbox"/>	4	4306.02	-2467.98	73.83	18.45	-0.05	0.02	0.05
<input checked="" type="checkbox"/>	5	6385.97	-2481.03	73.85	18.45	0.20	0.28	0.35
<input checked="" type="checkbox"/>	6	4292.03	-4648.00	73.83	18.43	-0.14	-0.30	0.34

Transform: Polynomial 2 Mean error: 0.510613 4285.50,-4650.05 None

Step 18: Double check and adjust the GCP locations if the value is greater than 1. To adjust a point, click on the ‘Move GCP point’ button, and then click and drag the point to the desired location.

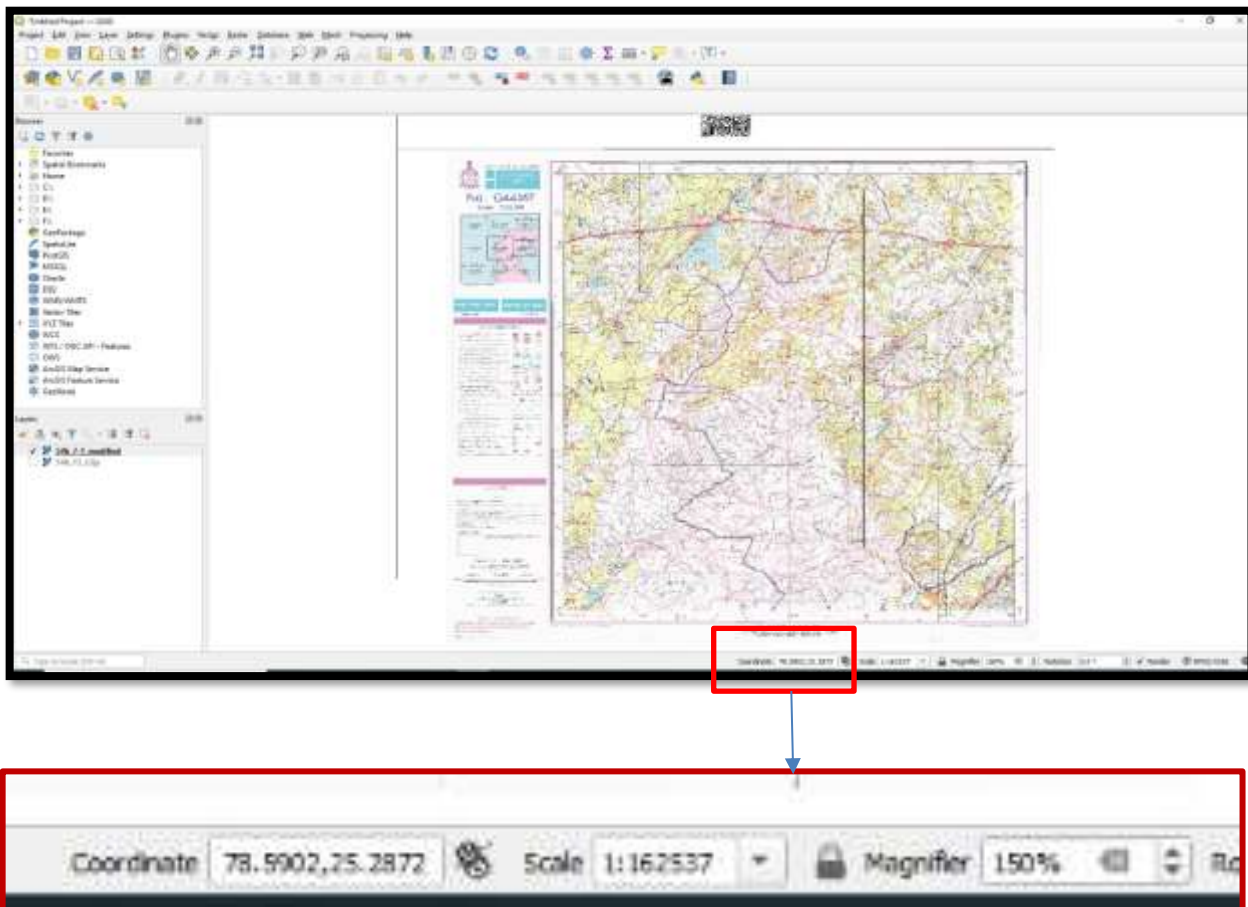
Use ‘Delete Point’ button to delete an erroneous GCP. We can also enable and disable the GCPs by using check boxes under ‘on/off’ column in ‘GCP Table’.

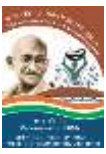
Step 19: Once the error is around or below 1, click the ‘Start Georeferencing’ Button.

The processing will take at about 2 minutes.

The georeferenced image will be found at the location specified for the ‘Output File’. The output file will have loaded in the canvas also.

Output georeferenced Toposheet

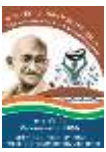




Chapter 5

Hands on Training- Process of Generating Vector Layers in QGIS

Duration: 1 hr 30 Minutes



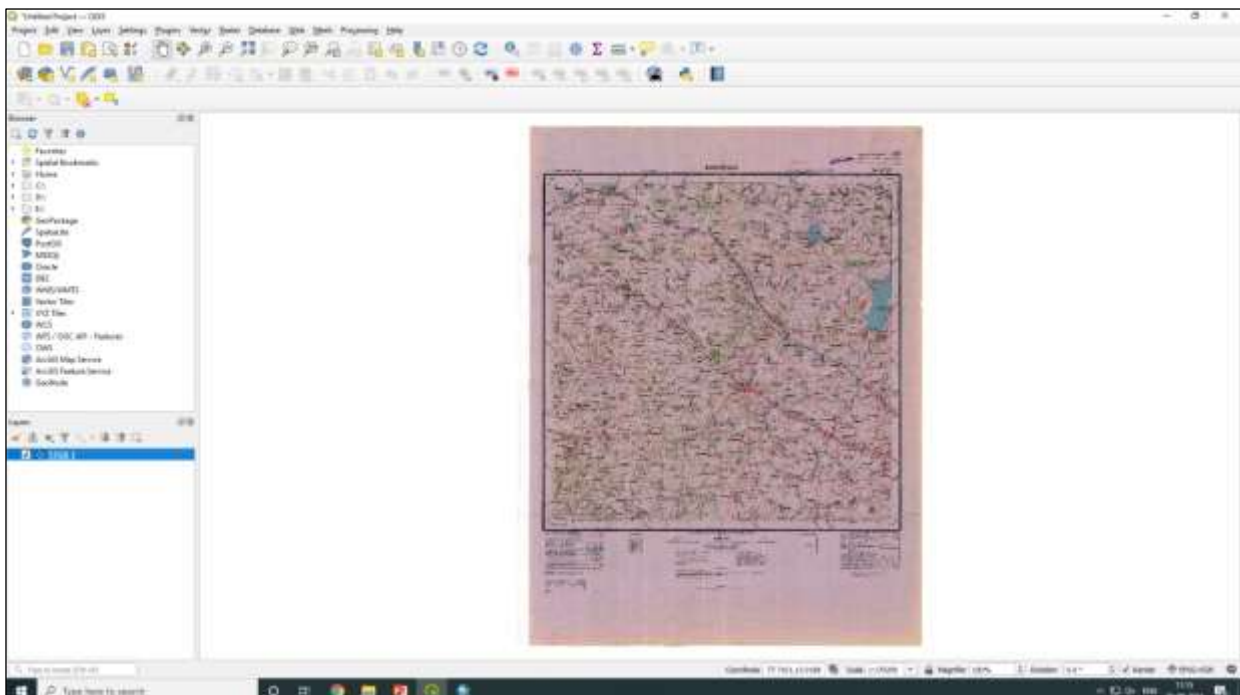
5.1 PROCESS OF EXTRACTING DATA MAP CREATION (MAPPING QGIS)

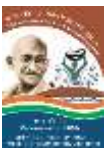
Digitization

- Digitization refers to creating a digital representation of physical objects or attributes.
- QGIS has powerful on-screen digitizing and editing capabilities that we will explore. Go to.

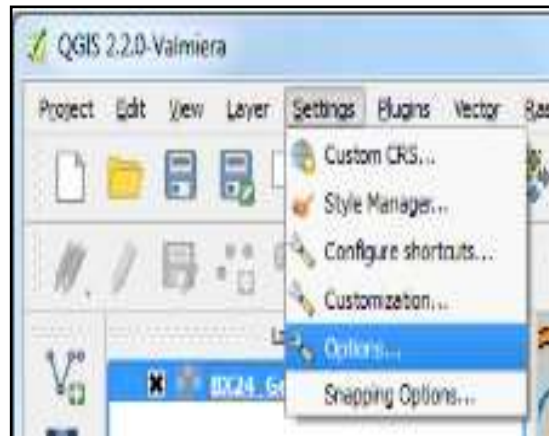


Add Georeferenced Toposheet

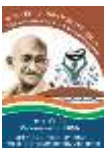




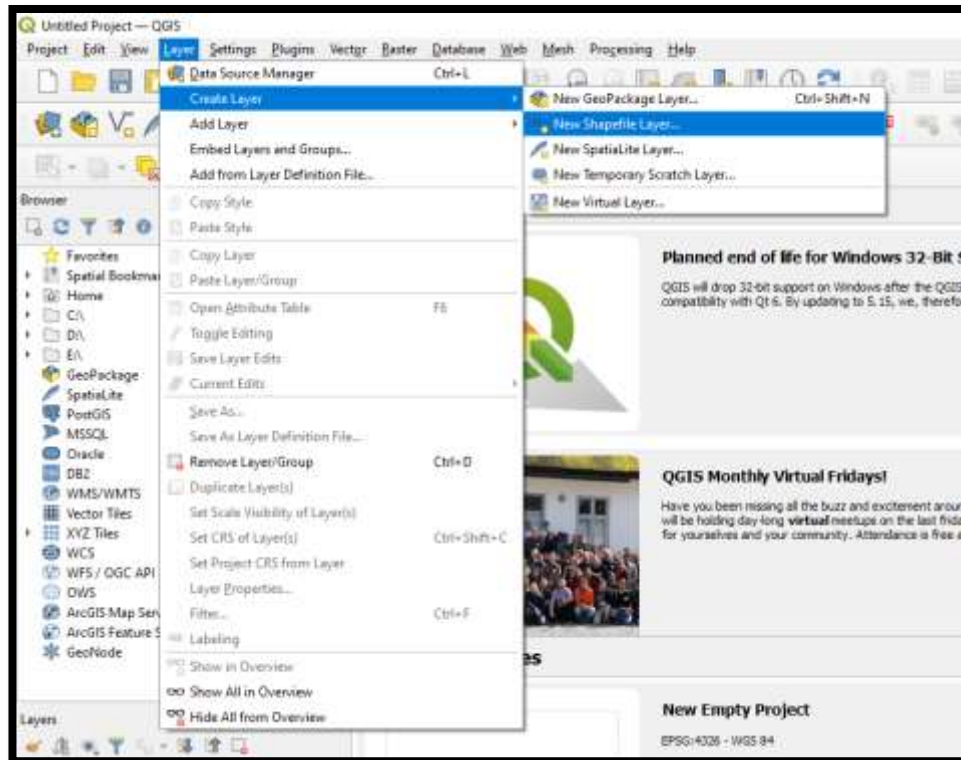
Before we start, we need to set default Digitizing Options. Go to Settings ▸ Options....



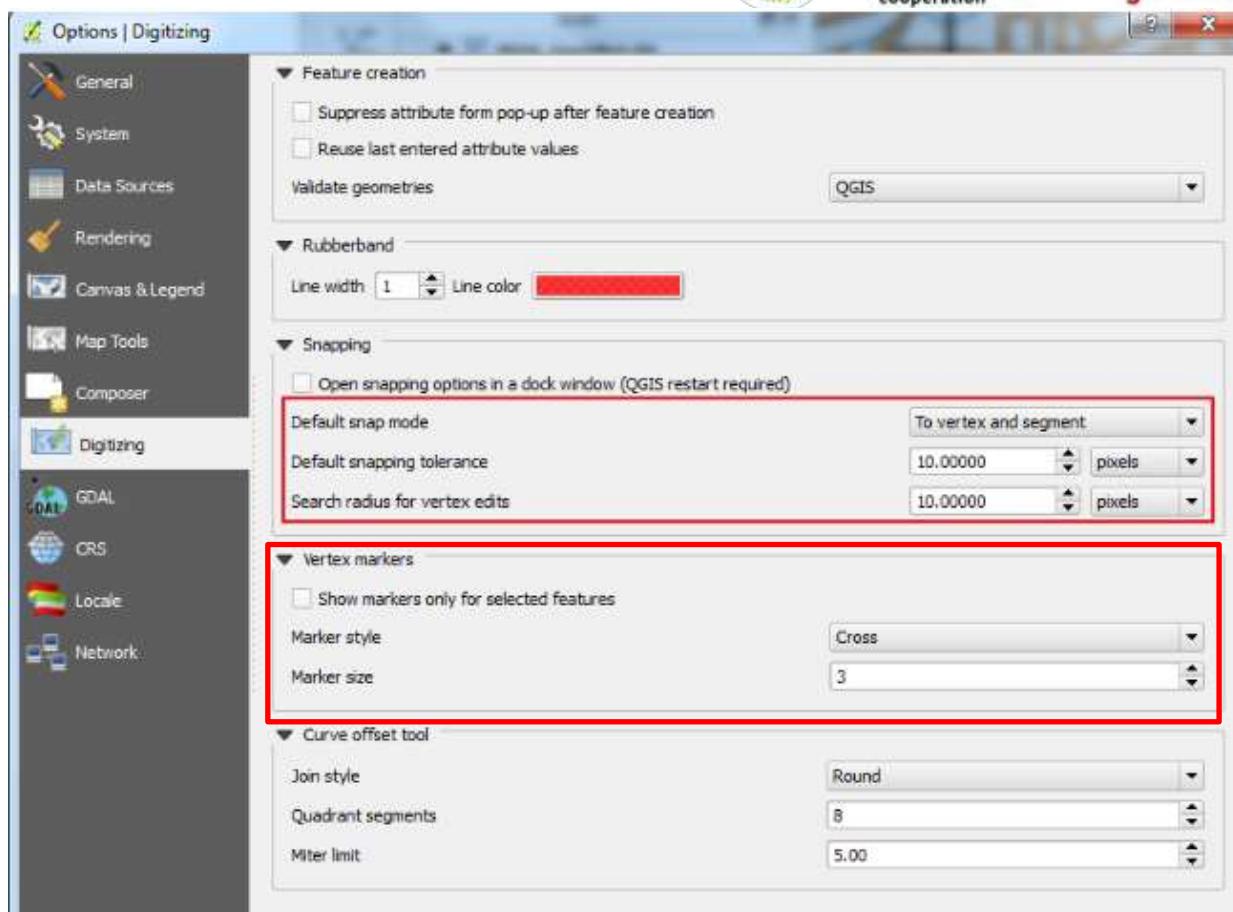
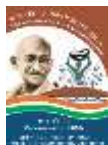
- Select the Digitizing tab in the Options dialog.
- Set the Default snap mode to vertex and segment.
- This will allow you to snap to the nearest vertex or line segment. Prefer to set the Default snapping tolerance and Search radius for vertex edits in pixels instead of map units.
- This will ensure that the snapping distance remains constant regardless of zoom level.
- Depending on your computer screen resolution, you may choose an appropriate value. Click OK.



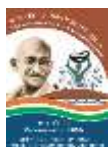
Creating a New Shapefile Layer



- Now we are ready to start digitizing.
- We will first create a roads layer and digitize the roads around the park area.
- Select **Layer** ▶ **New** ▶ **New Shapefile Layer...**
- We are creating a couple of polygon layers and a line layer.



The new shapefile layer dialog box opens, then we select the type of geometry, and add to the attribute list, and then click on OK.



New Spatialite Layer

Database: C:/Users/Ujaval/Downloads/nztopo.sqlite

Layer name: Roads

Geometry column: geometry

Type: Line

CRS: EPSG:2193 - NZGD2000 / New Zealand Transverse Mercator 2000

Create an autoincrementing primary key

New attribute:

Name: Name

Type: Text data

Add to attributes list

Name	Type
Name	text

Name: [text box]

Type: Text data

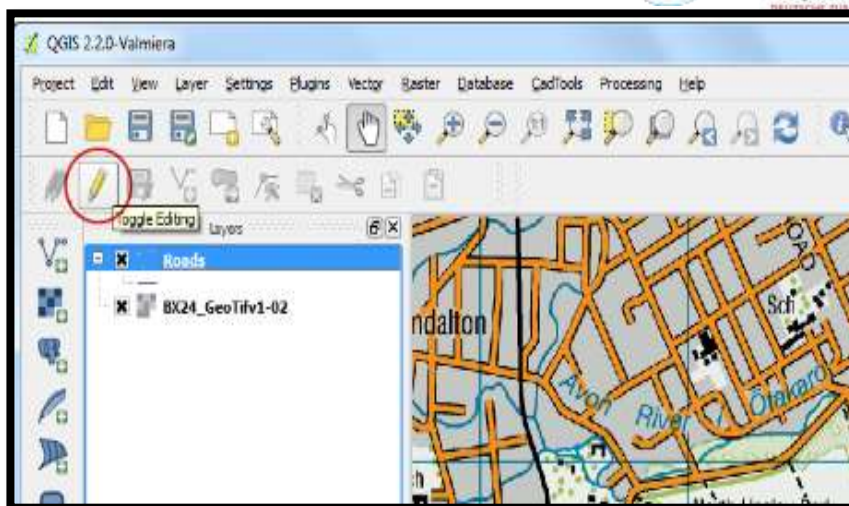
Add to attributes list

Name	Type
Name	text
Name	text
Class	text

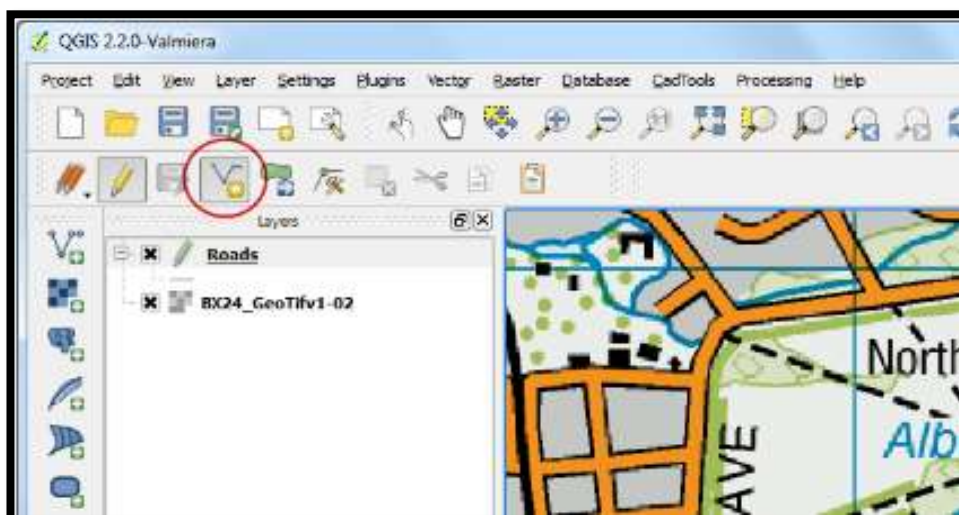
Remove attribute

OK Cancel Help

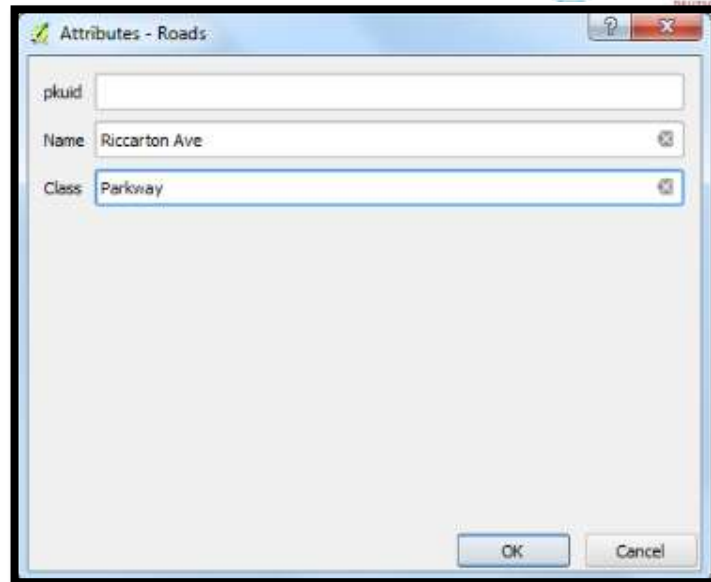
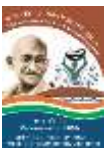
- Once the layer is loaded, click the Toggle Editing button to put the layer in editing mode.



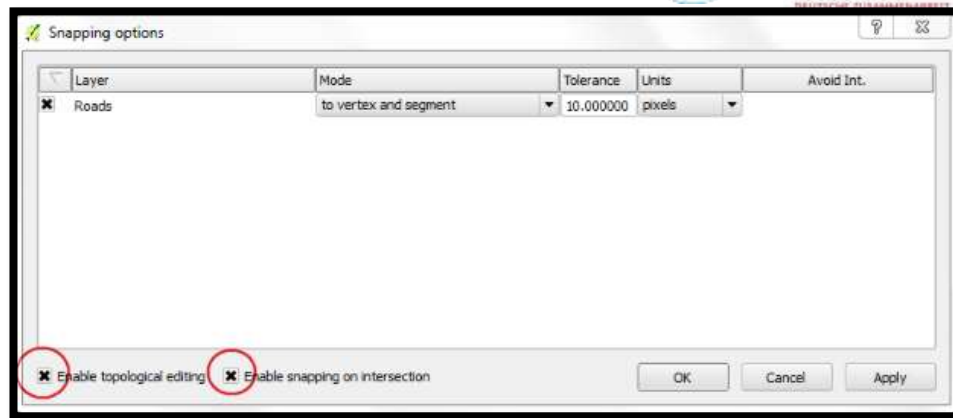
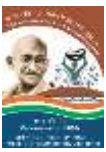
- Click the Add feature button. Click on the map canvas to add a new vertex.
- Add new vertices along the road feature. Once you have digitized a road segment, right-click to end the feature.



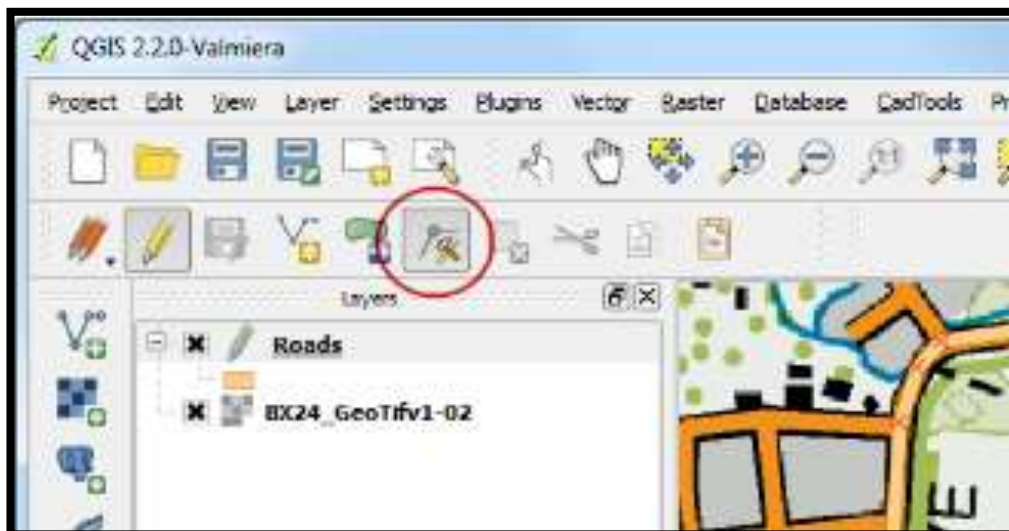
- After one right-click to end the feature, you will get a pop-up dialog called Attributes.
- Here one can enter attributes of the newly created feature.
- Since the ID is an auto-incrementing field.
- Leave it blank and enter the road name as it appears on the topo map.
- Optionally, assign a Road Class value as well. Click OK.



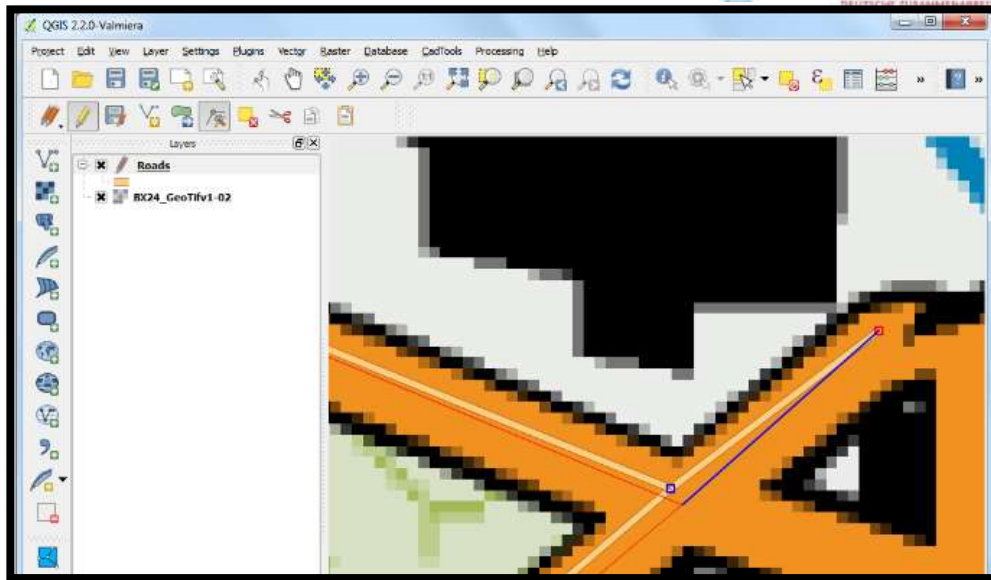
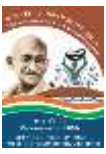
- The default style of the new line layer is a thin line. Let's change it so we can better see the digitized features on the canvas.
- Right click the Roads layer and select Properties.
- Select the Style tab in the Layer Properties dialog.
- Choose a thicker line style such as Primary from the predefined styles. Click OK.
- Now you will see the digitized road feature clearly.
- Click Save Layer Edits to commit the new feature to disk.
- Before we digitize remaining roads, it is important to update some other settings that are important to create an error free layer.
- Go to Settings ▸ Snapping Options...
- In the Snapping Options dialog, check the **Enable Topological Editing**.
- This option will ensure that the common boundaries are maintained correctly in polygon layers.
- Also check the Enable snapping on intersection which allows you to snap on an intersection of a background layer.



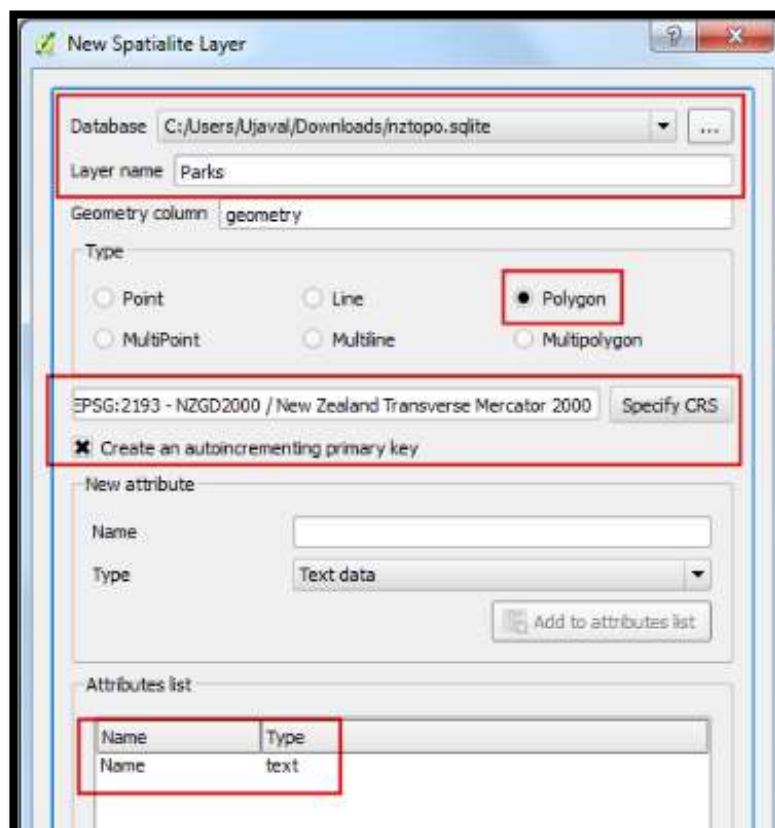
- Now you can click Add feature button and digitize other roads around the park.
- Make sure to click Save Edits after you add a new feature to save your work.
- A useful tool to help you with digitizing is the **Node Tool**.
- Click the Node Tool button.

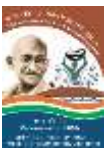


- Once the node tool is activated, click on any feature to show the vertices.
- Click on any vertex to select it.
- The vertex will change the colour once it is selected.
- Now you can click and drag your mouse to move the vertex.
- This is useful when you want to make adjustments after the feature is created.
- You can also delete a selected vertex by clicking the Delete key.
- Once you have finished digitizing all the roads, click the Toggle Editing button.

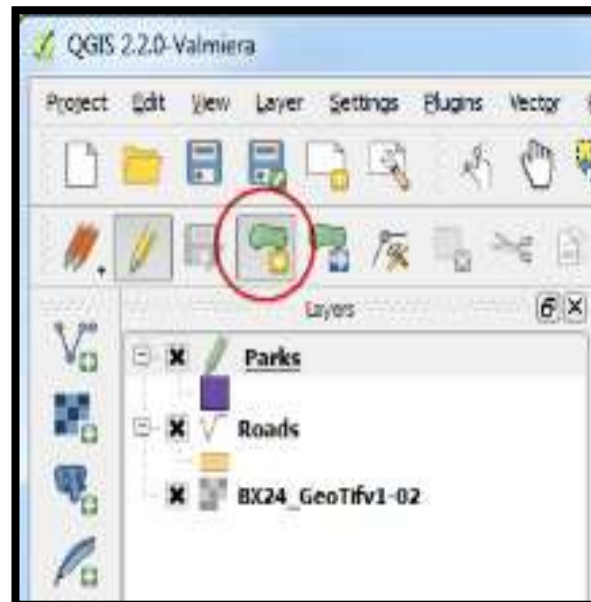


- Now we will create a polygon layer representing the park boundaries.
- Go to Layer ▶ New ▶ New Shapefile Layer.... Select the nztopo.sqlite database from the dropdown list.
- Name the new layer as Parks. Select Polygon as the Type. Create a new attribute called Name. Click OK.

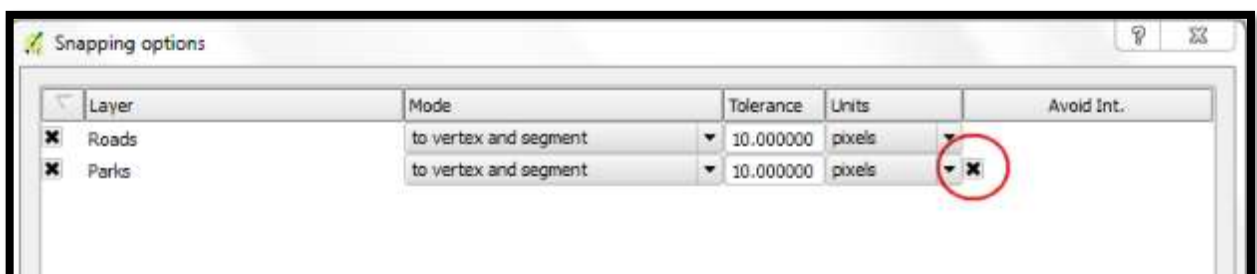




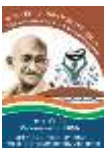
- Click the Add feature button and click on the map canvas to add a polygon vertex.
- Digitize the polygon representing the park. Make sure you snap to the roads vertices so there are no gaps between the park polygons and road lines.
- Right-click to finish the polygon.
- Enter the park name in the Attributes pop-up.



- Polygon layers offer another very useful setting called Avoid intersections of new polygons.
- Go to Settings > Snapping Options.... Check the box in the Avoid Int column in the row for the Parks layer. Click OK.
- Now click on Add feature to add a polygon. With the Avoid intersections of new polygons, you will be able quickly digitize a new polygon without worrying about snapping exactly to the neighboring polygons.



- Right-click to finish the polygon and enter the attributes.
- Magically the new polygon is shrunk and snapped exactly to the boundary of the neighboring polygons.

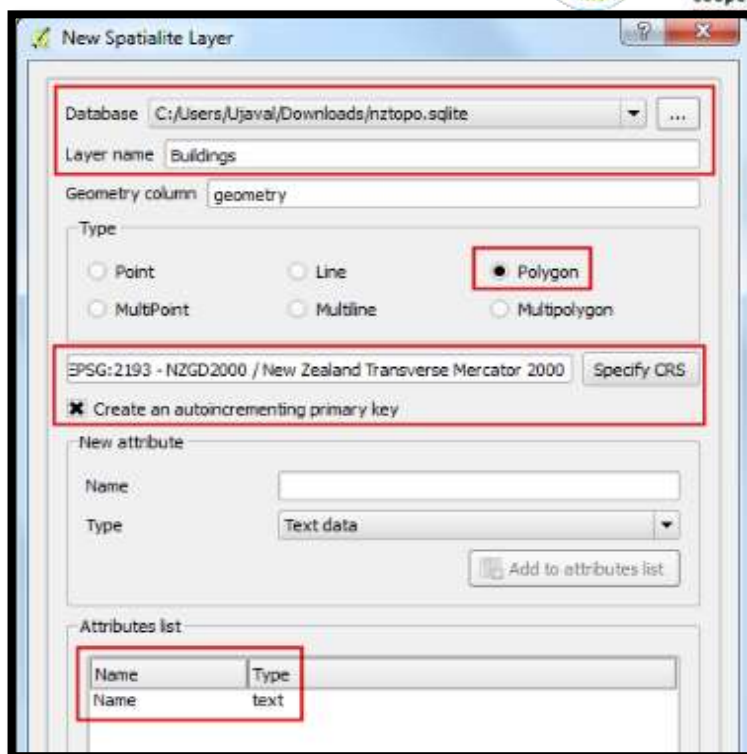
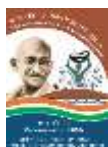


- This is very useful when digitizing complex boundaries where you need not be very precise and still have topologically correct polygon.
- Click Toggle Editing to finish editing the layer.

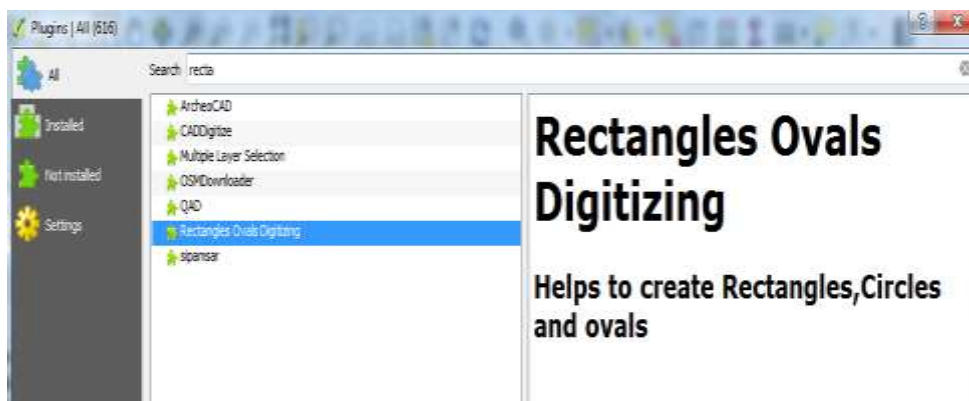


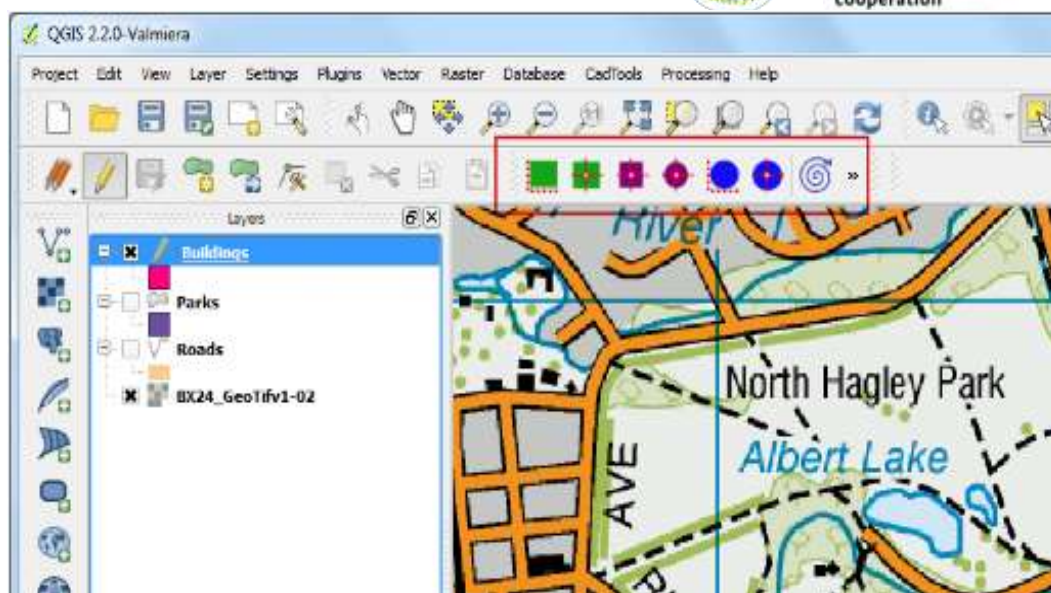
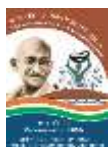
Creating Polygon

- Now it is time to digitize a buildings layer.
- Create a new polygon layer named Buildings by going to
- Layer ▸ New ▸ New Shapefile Layer.
- Once the building layer is added, turn off the Parks and Roads layer so the base topo map is visible.
- Select the Buildings layer and click Toggle Editing.



- Digitizing buildings can be a difficult task.
- Also it is difficult to add vertices manually so that the edges are perpendicular and form a rectangle.
- We will use a plugin called **Rectangles Ovals Digitizing** to help with this task.
- Once the **Rectangles Ovals Digitizing** plugin is installed, you will see a new toolbar appear above the canvas.

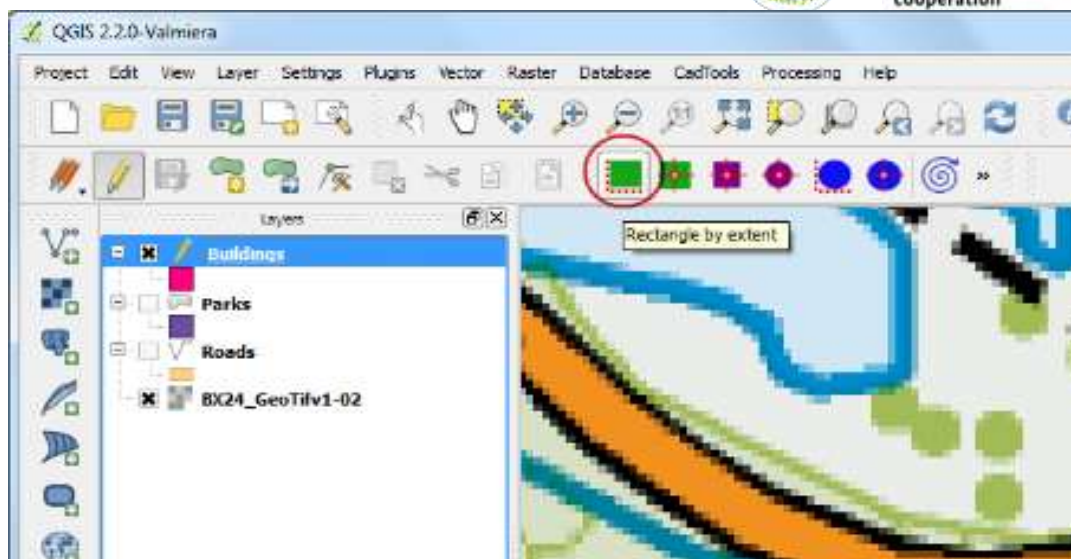
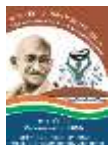




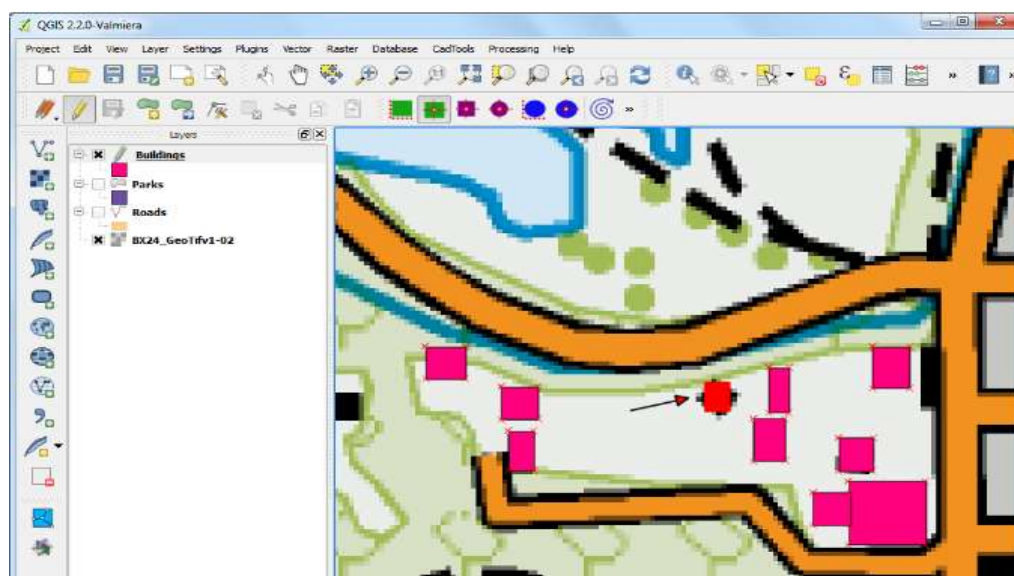
- You will notice that some buildings are not vertical. We will need to draw a rectangle at an angle to match the building footprint. Click the Rectangle from center.



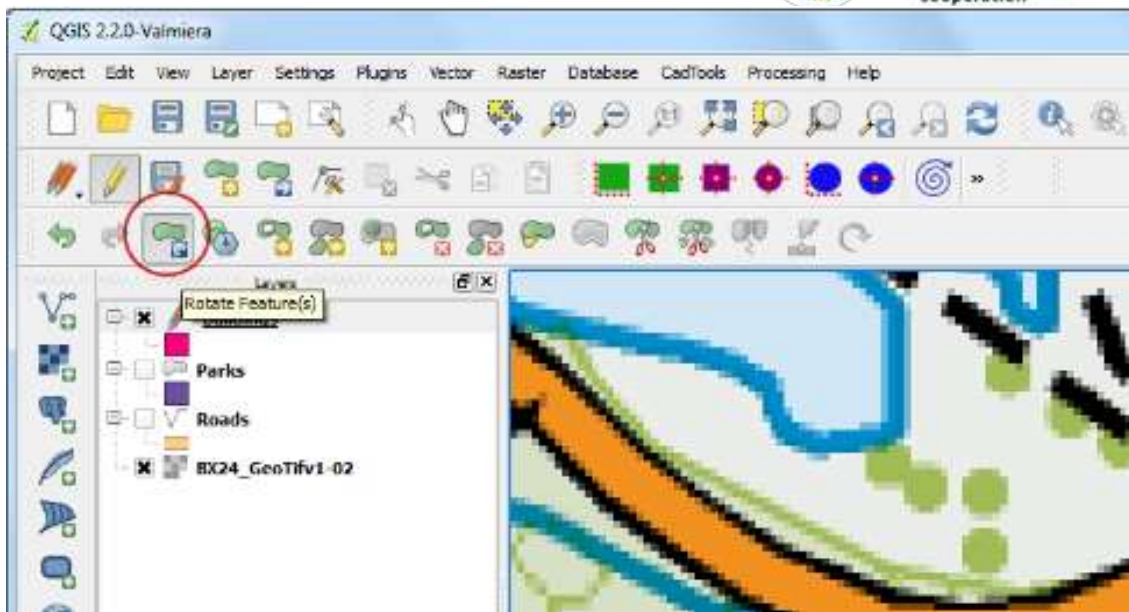
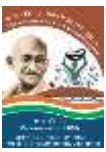
- Zoom to an area with the buildings and click Rectangle by Extent button.
- Click and drag the mouse to draw a perfect rectangle. Similarly, add remaining buildings.



- Click at the center of the building and drag the mouse to draw a vertical rectangle.



- We need to rotate this rectangle to match the image on the topo map.
- The **rotate tool** is available in the **Advanced Digitizing** toolbar.
- Right-click on an empty area on the toolbar section and enable the Advanced Digitizing toolbar.
- Click the Rotate Feature(s) button.



- Use the Select Single feature tool to select the polygon that you want to rotate.
- Once the Rotate Feature(s) tool is activated, you will see crosshairs at the center of the polygon.
- Click exactly on that crosshairs and drag the mouse while holding the left-click button.
- A preview of the rotated feature will appear.
- Let go of the mouse button when the polygon aligns with the building footprint.

Point Layer Creation

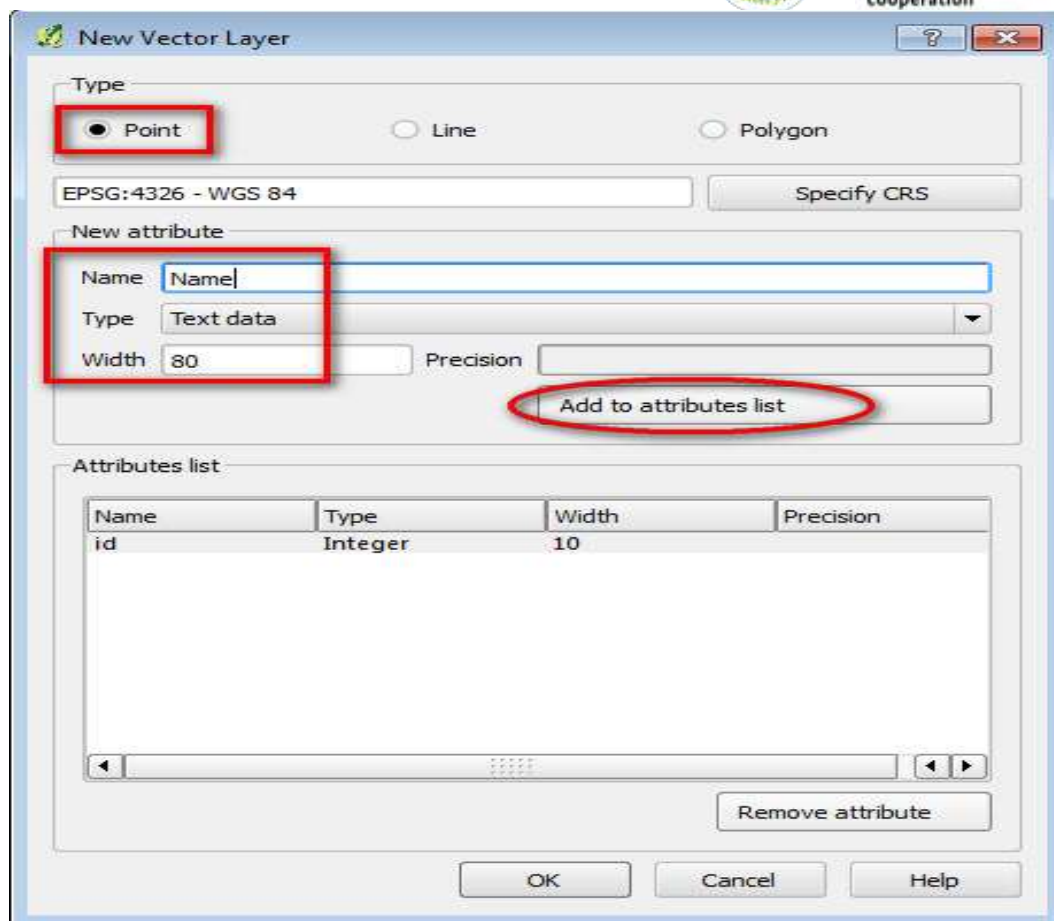
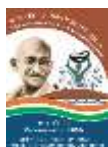
To create new point layer, go to main menu bar in QGIS interface and select 'Layer' 'New' 'New Shapefile Layer'.

2. Now the 'New vector Layer' windows will popup. Select 'Type' as 'Point' as we are interested in creating a point layer.

3. Specify CRS same as original layer, i.e., as 'EPSG:4326 - WGS 84'. To do this click on 'Specify CRS' Select the 'WGS 84' under Coordinate reference system of the world Click on 'OK'.

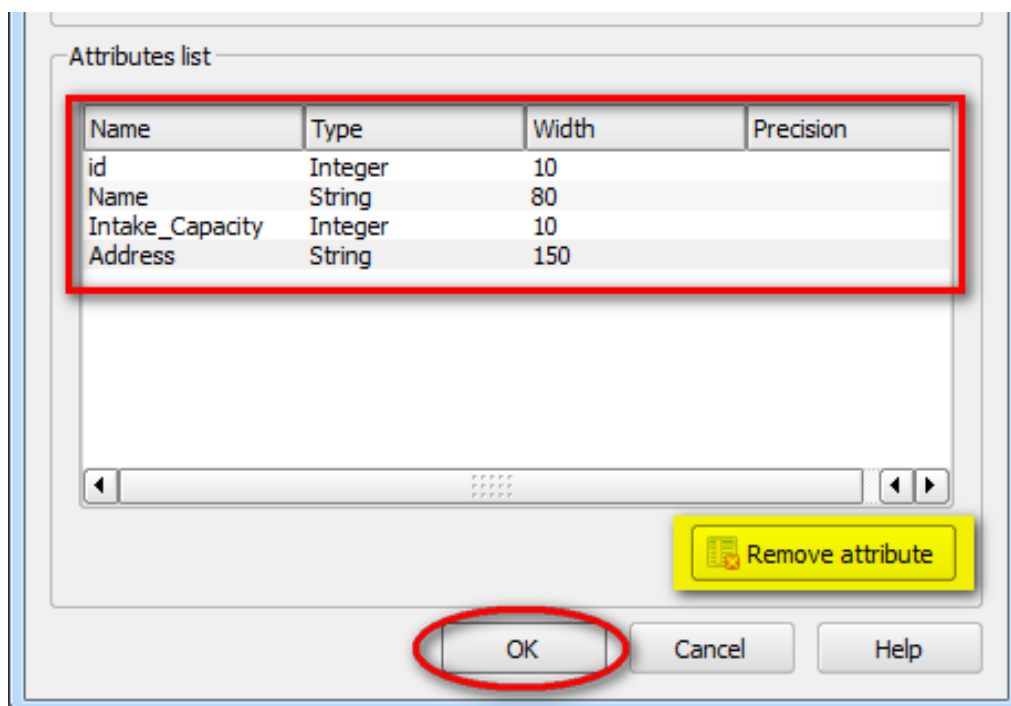
4. We can add new required attribute fields to the vector layer that we have created.

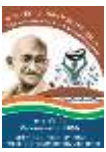
For example, if we are creating point vector layer of all hospitals we can add 'Name' of the hospital as new field and 'intake capacity', 'Address' etc. as other fields.



5. For Each New attribute added, an appropriate name, type of the variable (like text, whole number, decimal number and date) and width must be selected.

6. Click on 'Add to attribute List' and the attribute will be added to the list. Now add the attributes details shown in the below figure.





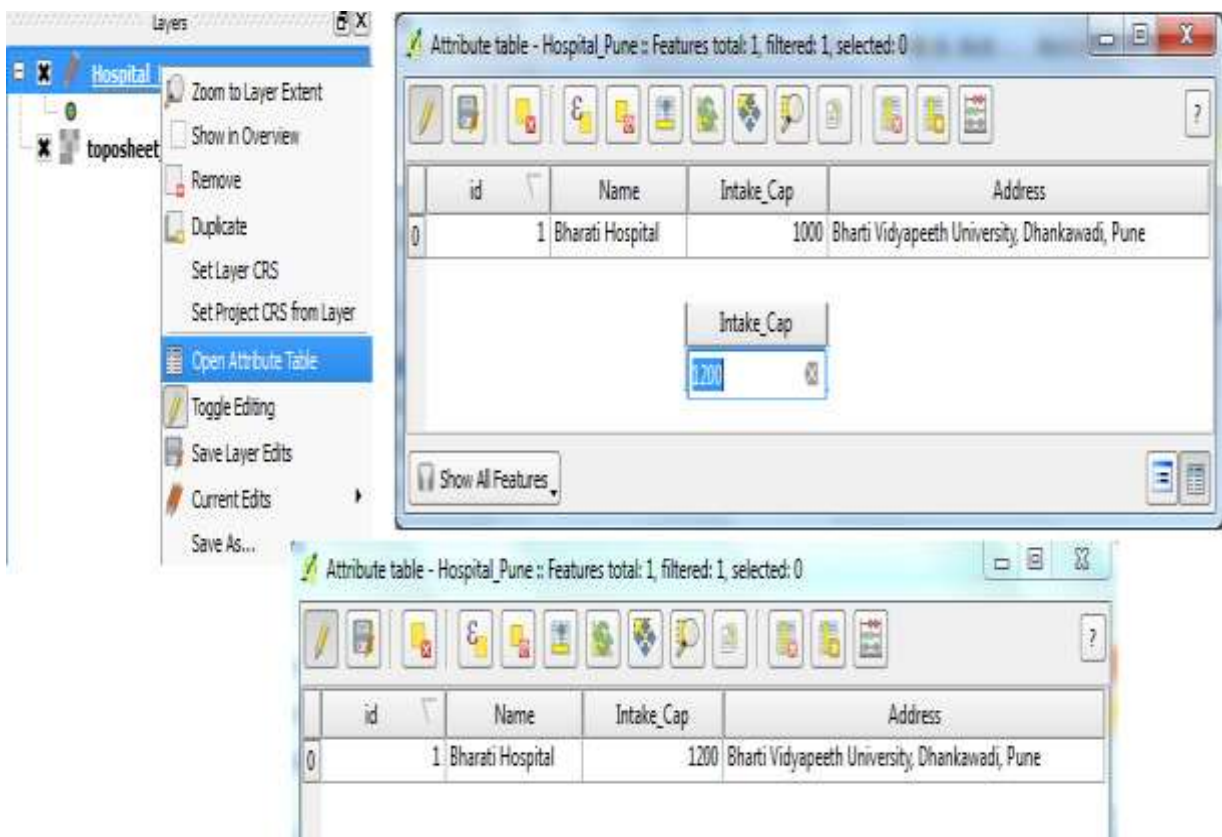
7. Now you will be presented with 'Save As' window, save the file in appropriate drive with appropriate name for example: Hospitals_Pune.shp. Once the layer is saved it opens up as point data layer under map legend.

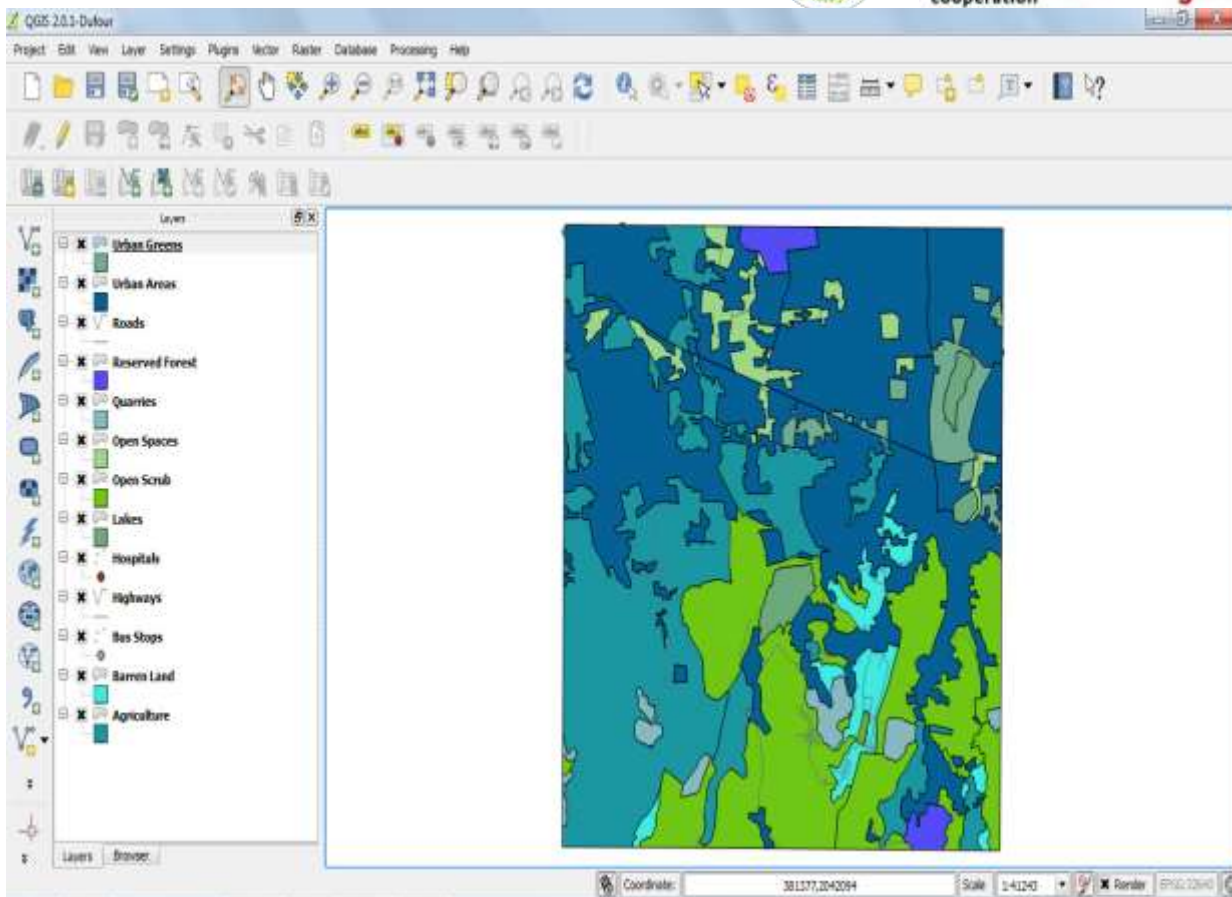
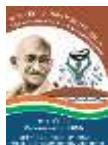
8. To start digitization, we have to enable the editing mode of the corresponding vector layer. Right click on 'Hospital_Pune.shp' point layer and click on 'Toggle Editing' or select the layer and click on icon from 'Digitizing' toolbar.

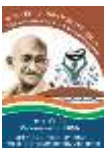
9. The point will be created with the specified attributes at the specified location. Now open the attribute table of 'Hospital_Pune.shp' by right clicking on the hospital layer and selecting 'Open Attribute Table'.

If you want to change any details, then simply select the attribute by double click and edit it.

For example, change the intake capacity of Bharati Hospital from 1000 to 1200.



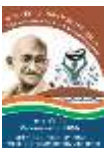




Chapter 6

Hands on Training –Process of Digitization of Drainage and

Duration: 1 hr.

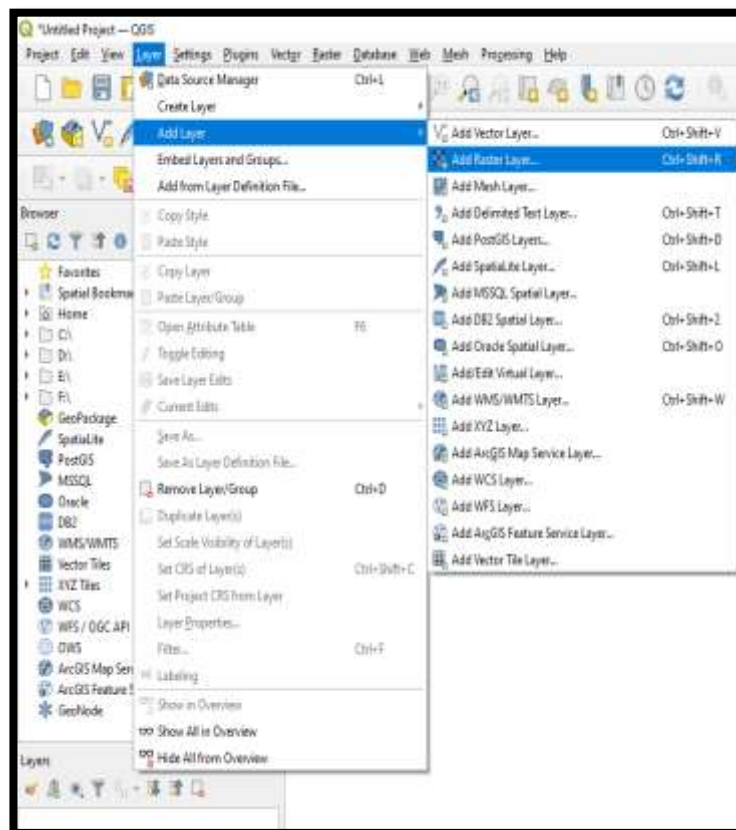


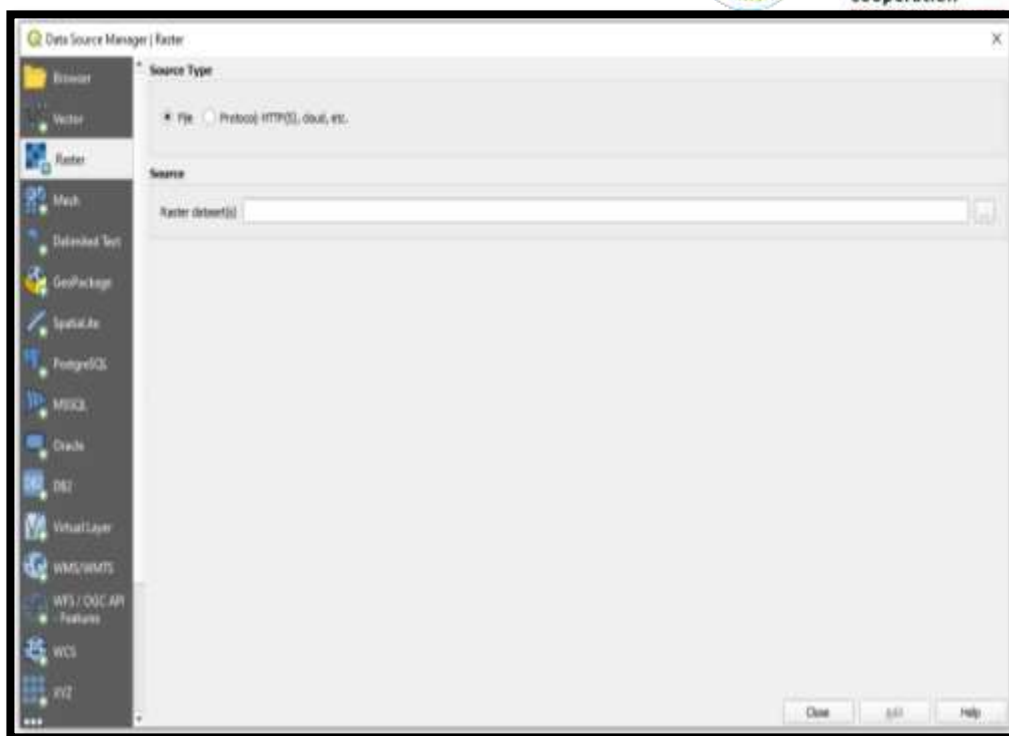
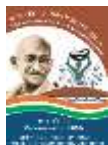
6.1 Drainage

- **Drainage:**
 - The flow of water through well-defined channels is known as ‘drainage’ and the network of such channels is called a ‘drainage system’.
- **Drainage Pattern:**
 - It refers to the system of flow of surface water mainly through the forms of rivers and basins.
 - The drainage system depends upon factors such as slope of land, geological structure, amount of volume of water and velocity of water.

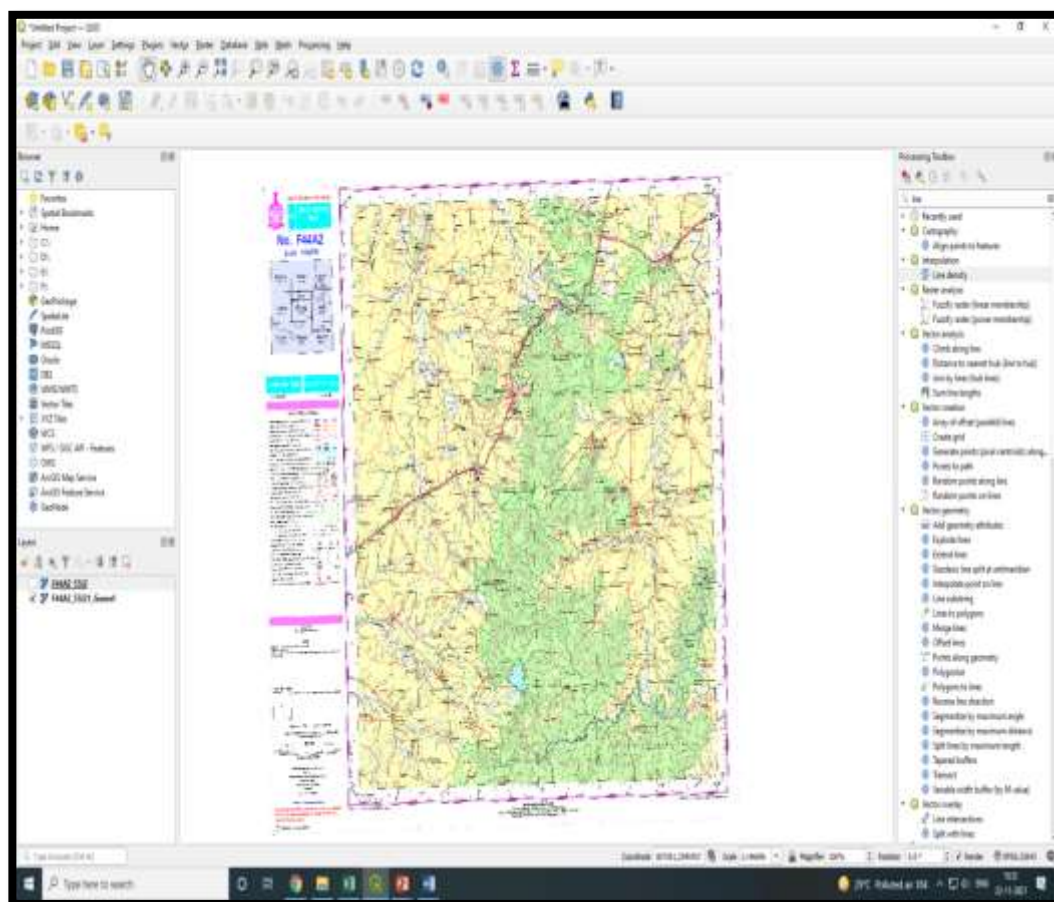
Digitization of Drainage or Preparation of Drainage Map

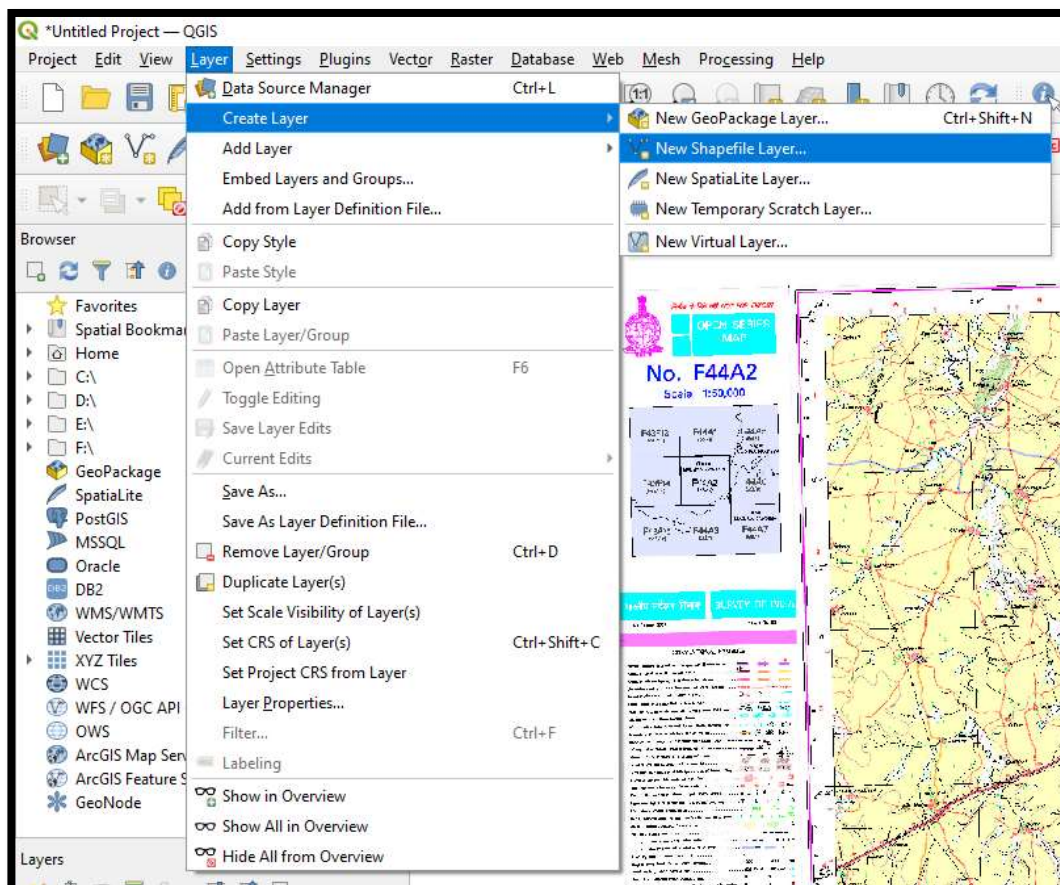
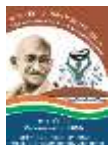
1. Add Georeferenced Topo-sheet Map on QGIS Main Panel.
2. Click on Layer, Add layer and then Add Raster Layer



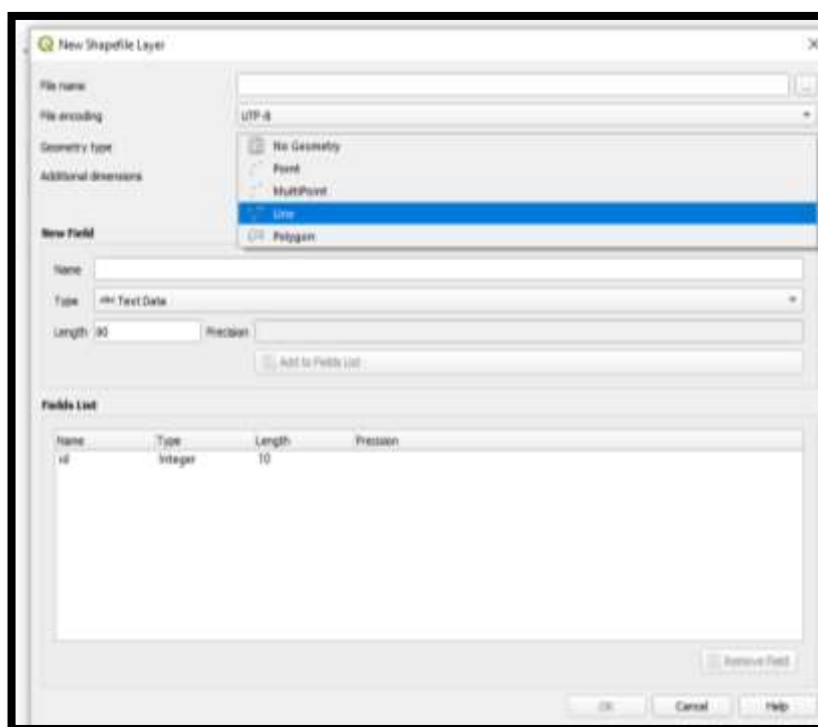


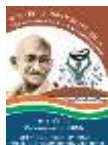
. After adding raster map create shapefile with linear feature type.





➤ Steps for creation of Shapefile





New Shapefile Layer

File name: Drainage_Block

File encoding: UTF-8

Geometry type: Polygon

Additional dimensions: None (selected), 2 (+ M values), M values

Project CRS: EPSG:32643 - WGS 84 / UTM zone 43N

New Field

Name: Order

Type: Text Data (selected)

Length: 0 (selected), Whole Number, 1..2 Decimal Number, Date

Fields List

Name	Type	Length	Precision
id	Integer	10	

Remove Field

OK Cancel Help

New Shapefile Layer

File name: Drainage_Block

File encoding: UTF-8

Geometry type: Polygon

Additional dimensions: None (selected), 2 (+ M values), M values

Project CRS: EPSG:32643 - WGS 84 / UTM zone 43N

New Field

Name: Length

Type: 1..2 Decimal Number

Length: 20 Precision: 0

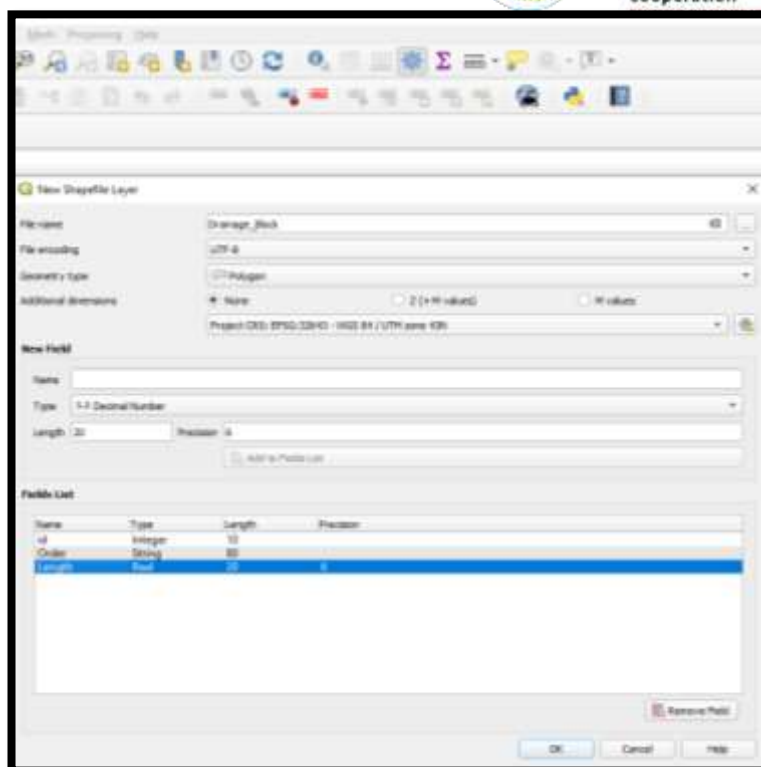
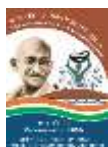
Add to Fields List

Fields List

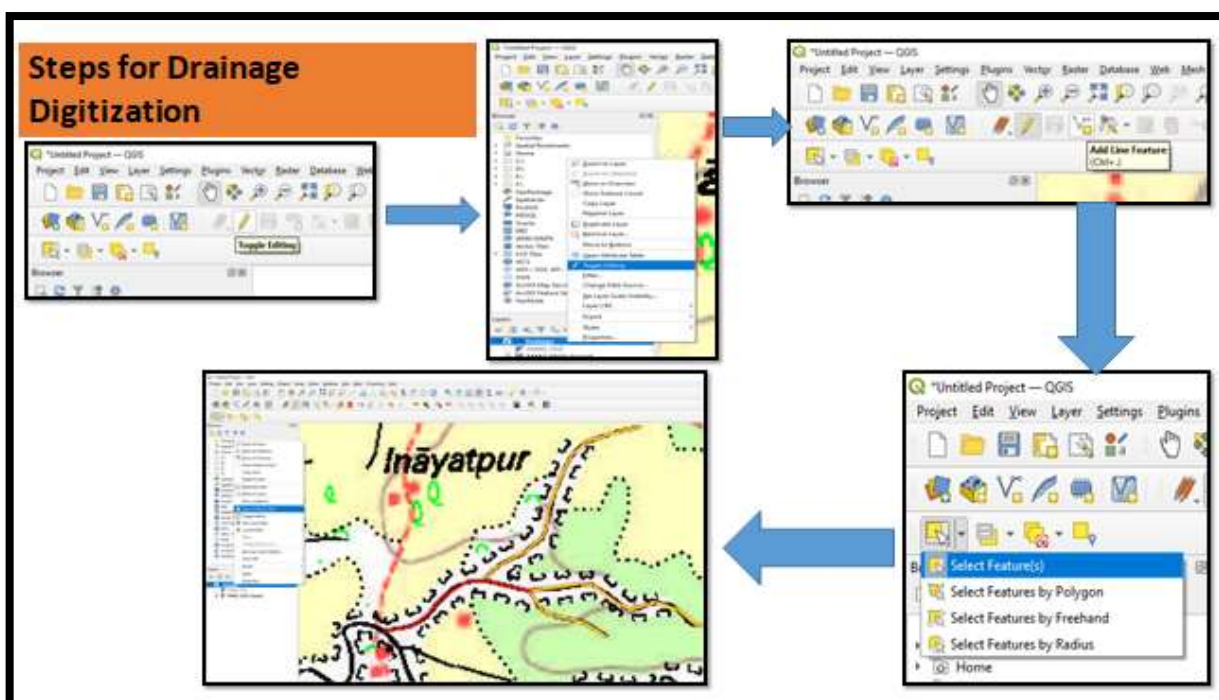
Name	Type	Length	Precision
id	Integer	10	
Order	String	80	

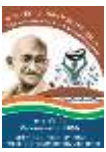
Remove Field

OK Cancel Help

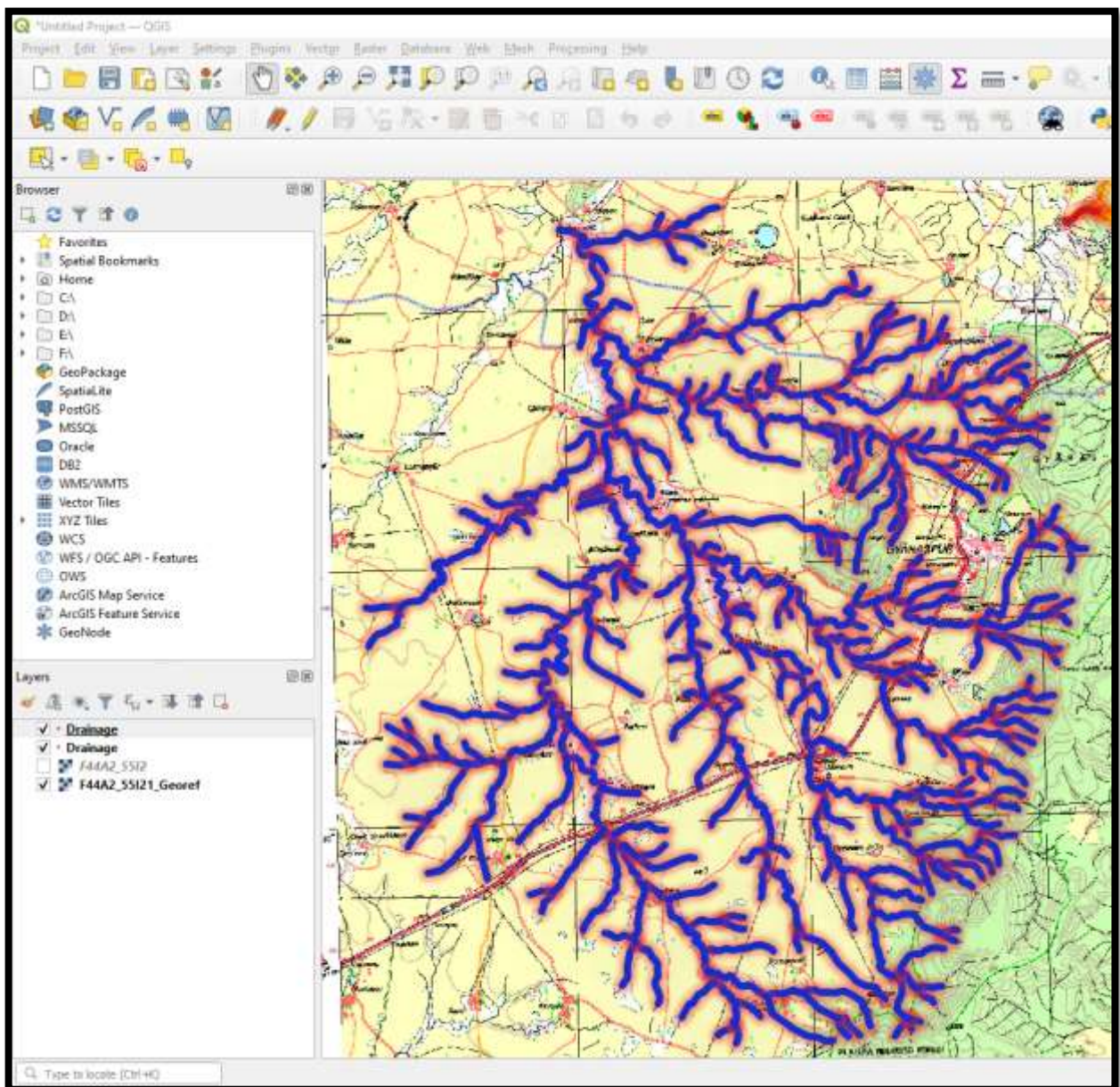


➤ Steps for Drainage Digitization



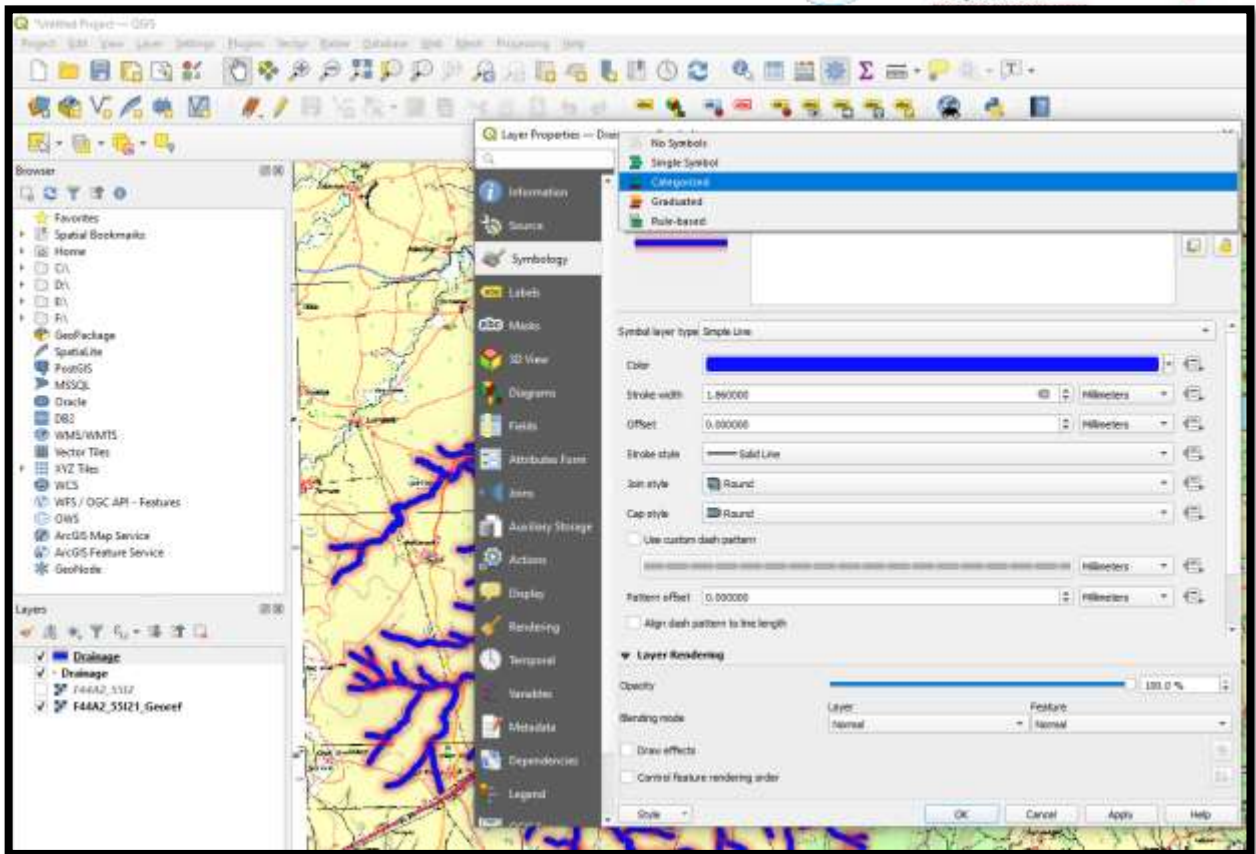
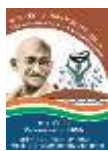


➤ Final Digitized Drainage Map

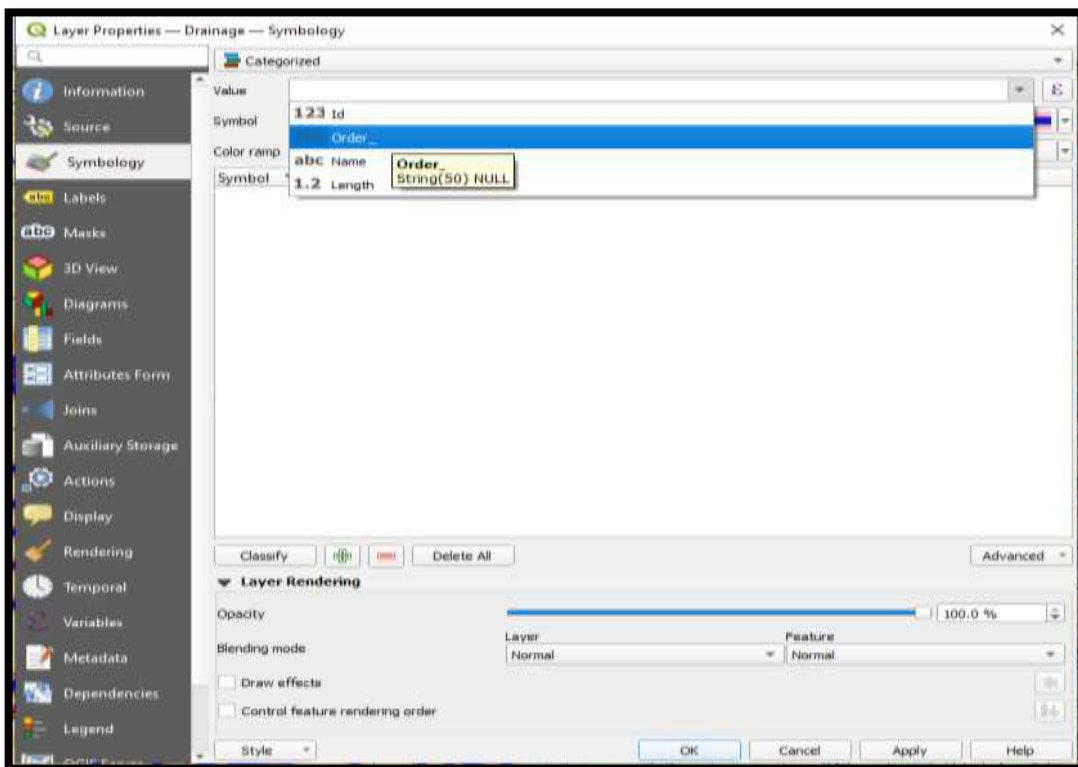


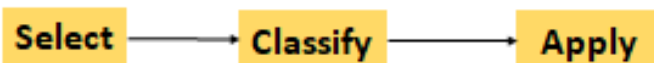
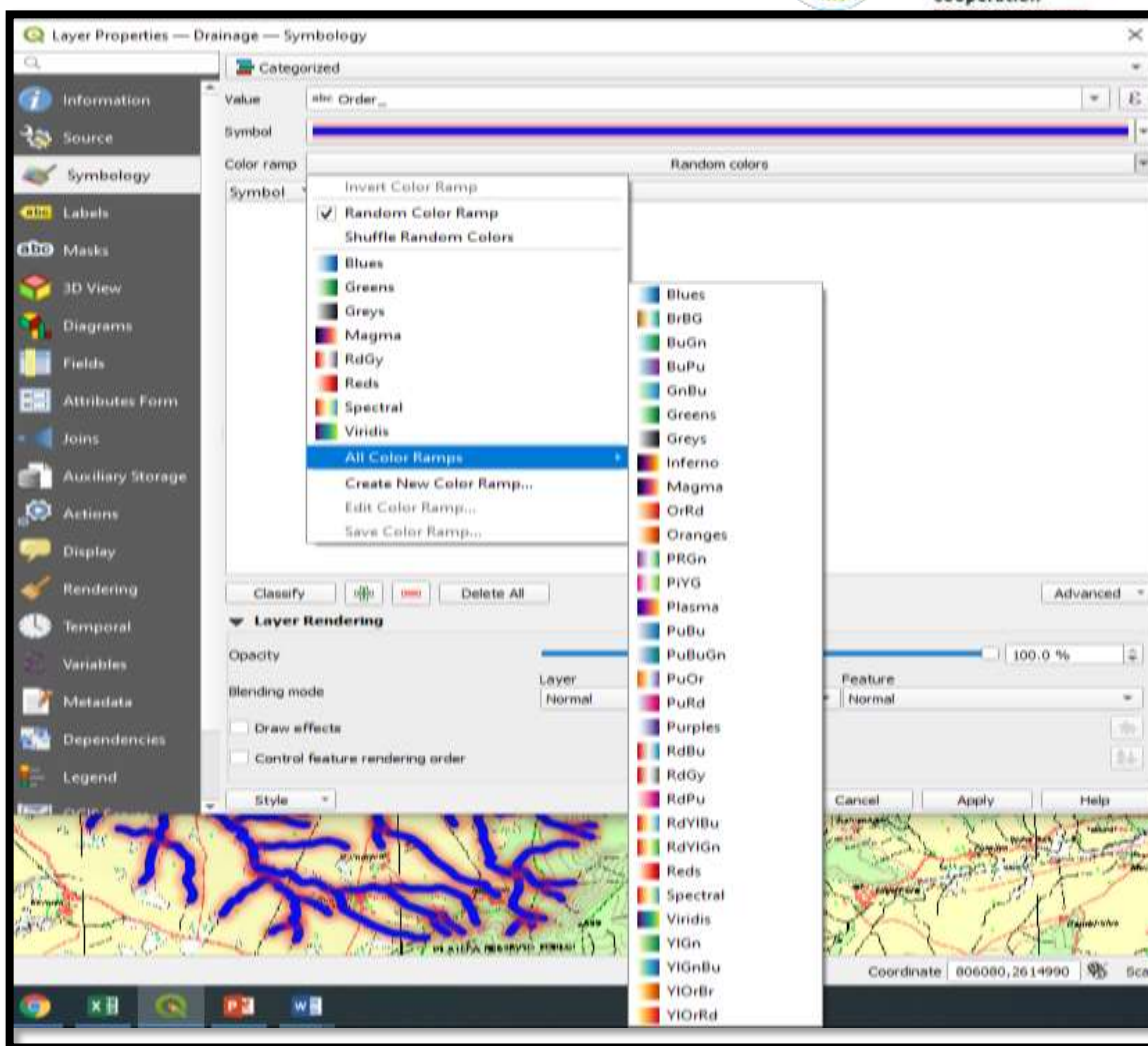
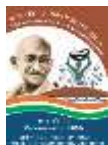
➤ How to Categorize Different Orders of Drainages

- Right click on layer and click on categorized drop down button.
- Choose nay symbol layer type and the color symbology and line width or style of the layer then OK

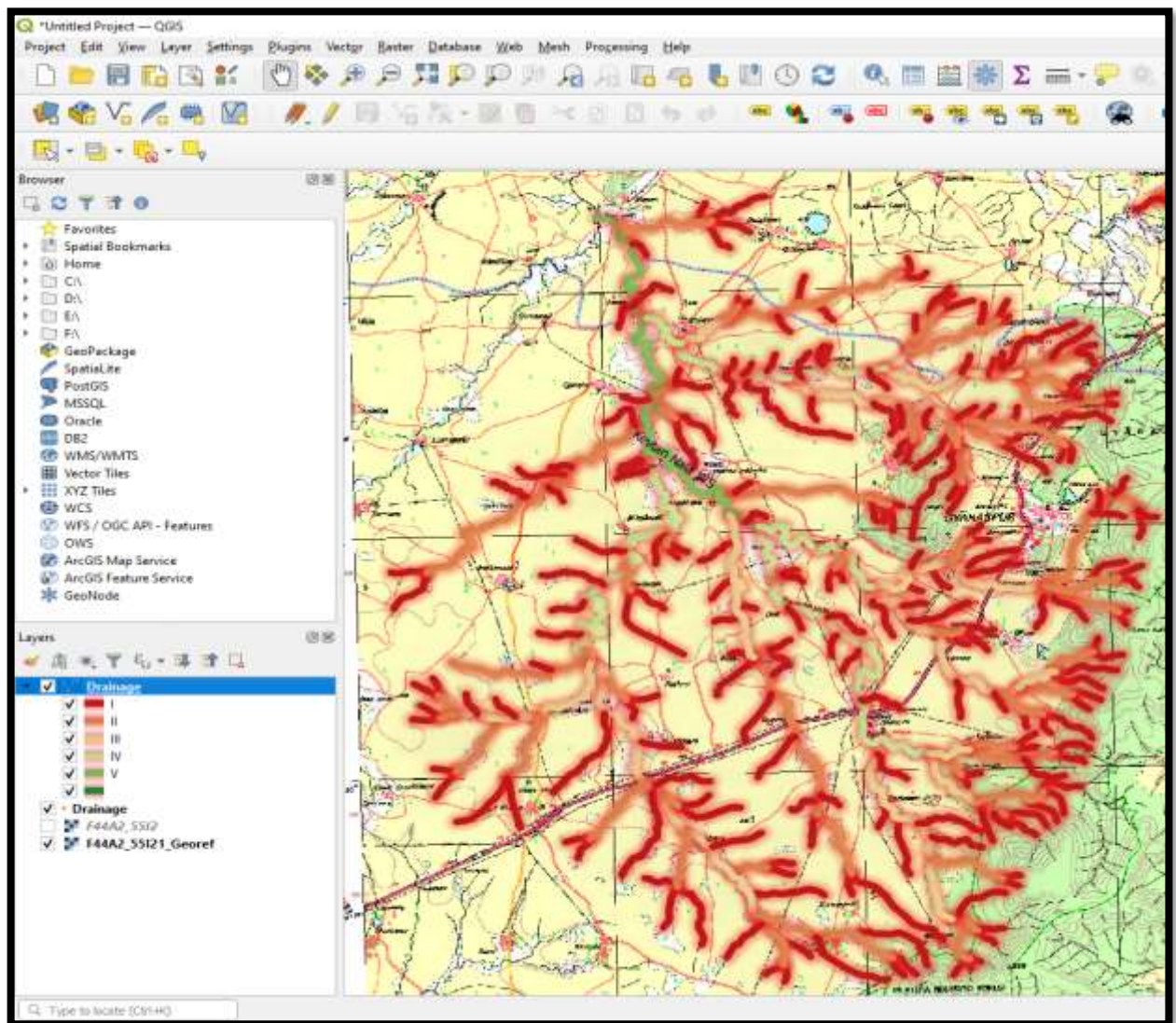
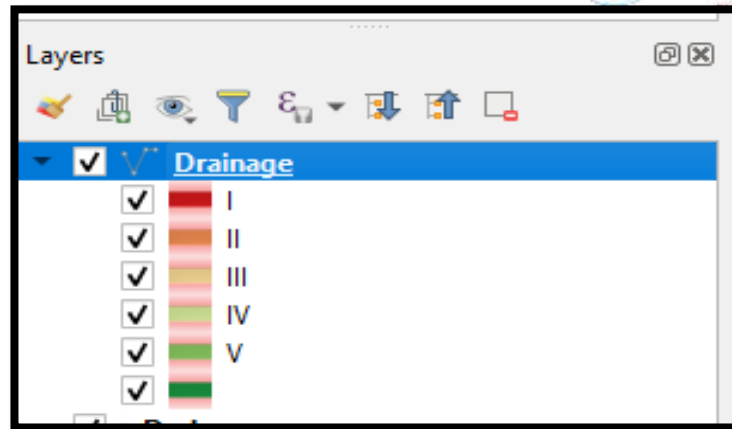


➤ Categorize Drainage On the basis of Attribute or Order

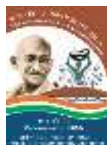




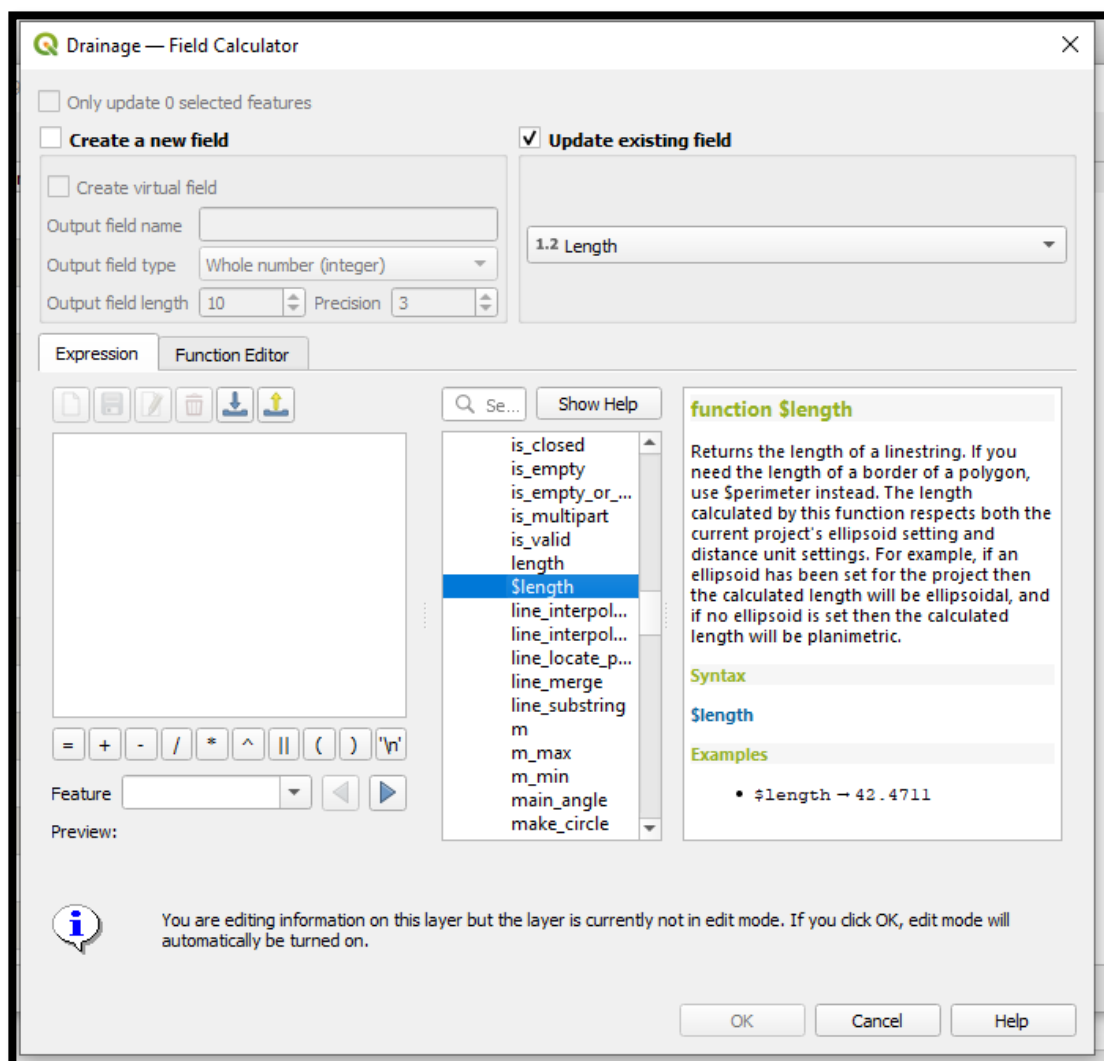
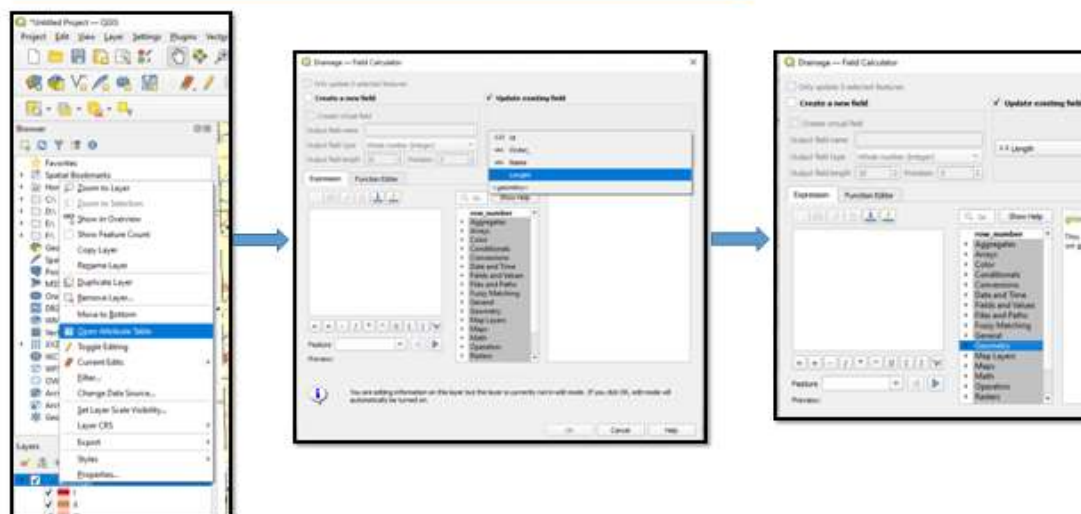
- **Classified Labelled Map of Drainage**
- Drainages are classified in low to highest
- Order with color symbology.

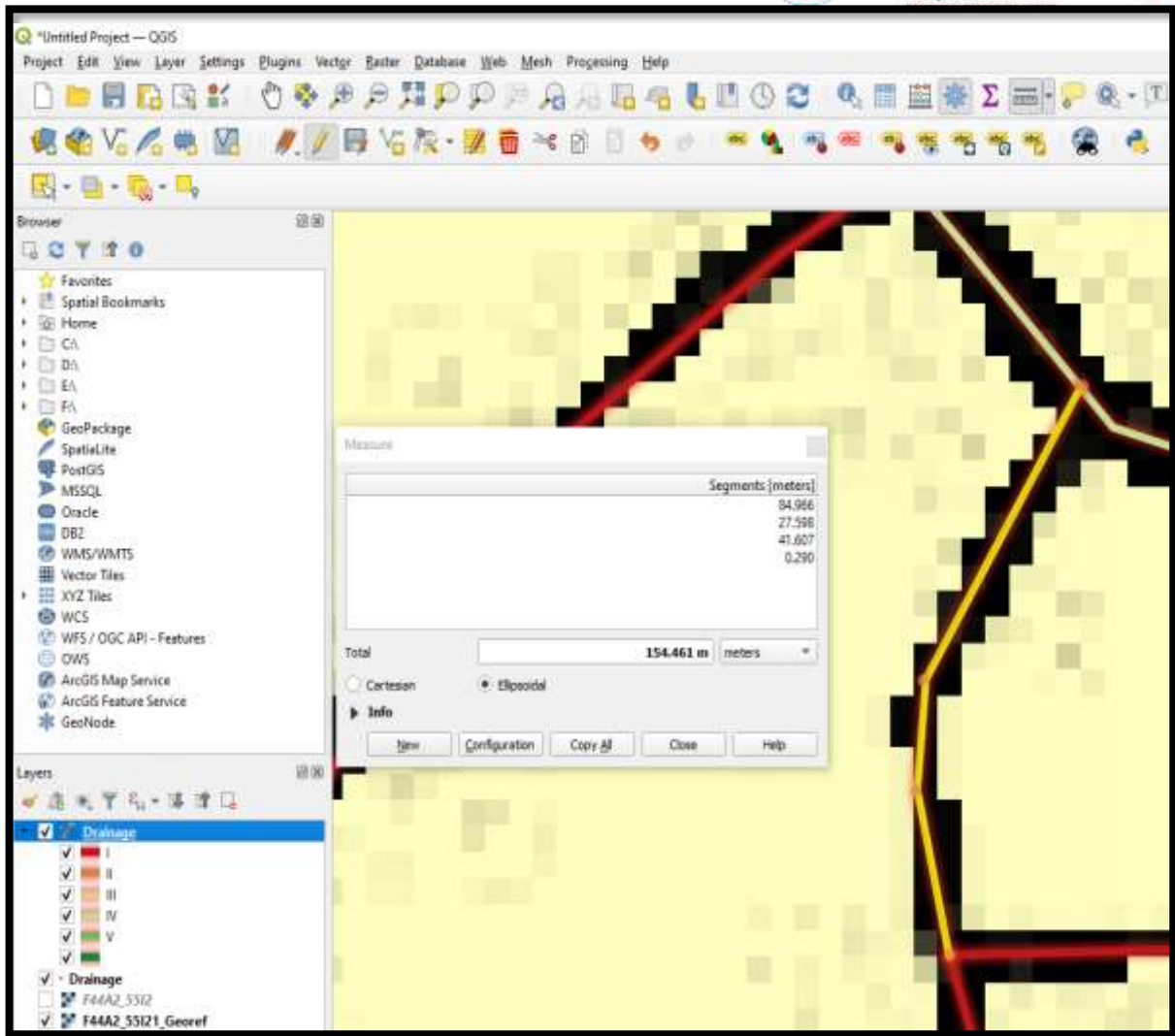
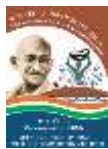


➤ How to calculate Length of the Stream?

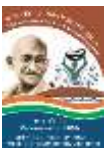


How to calculate Length of the Stream





Note: Drainage length unit is meter by default or on the basis of Map units.

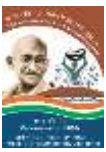


Chapter- 7

Clipping Tool & KML Creation

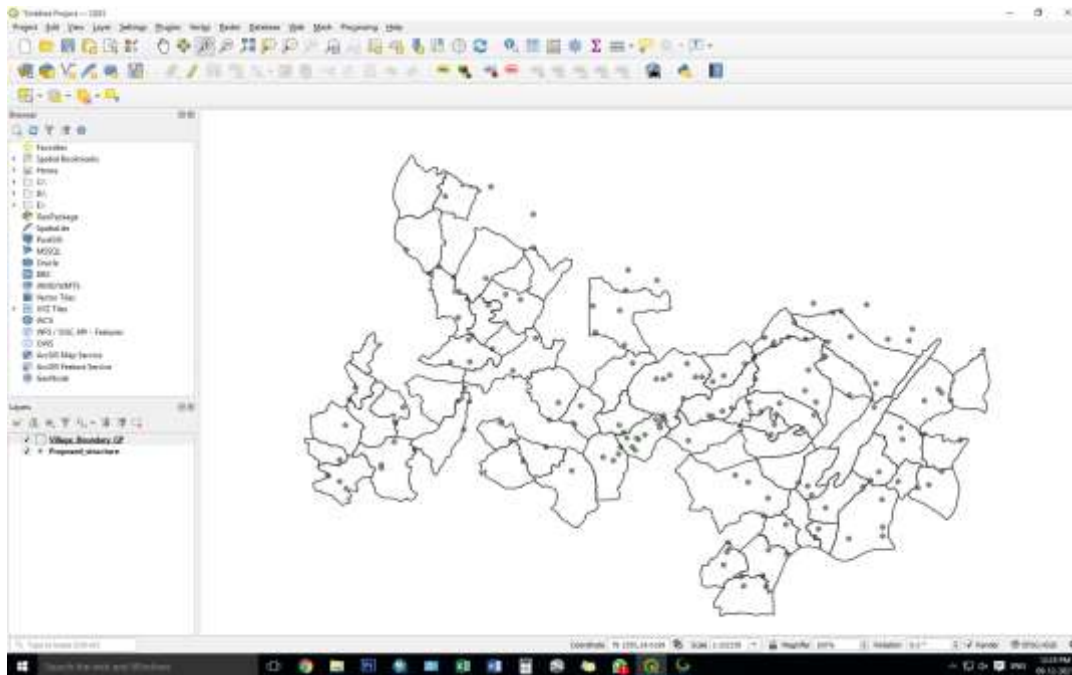
using QGIS

Duration: 30 minutes

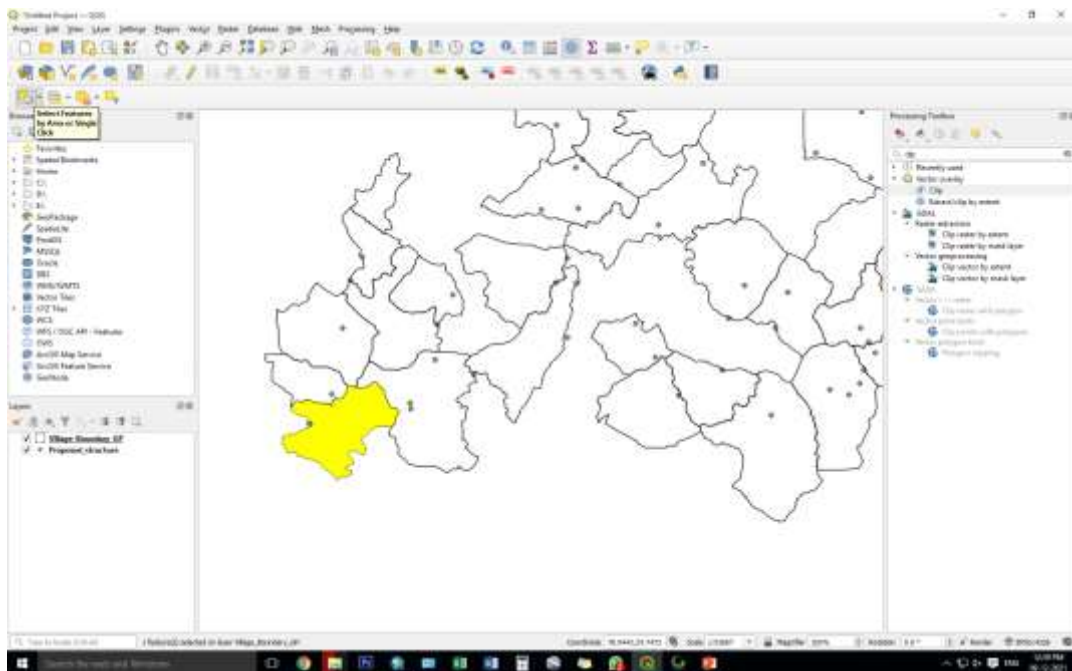


1. Clipping Tool in QGIS

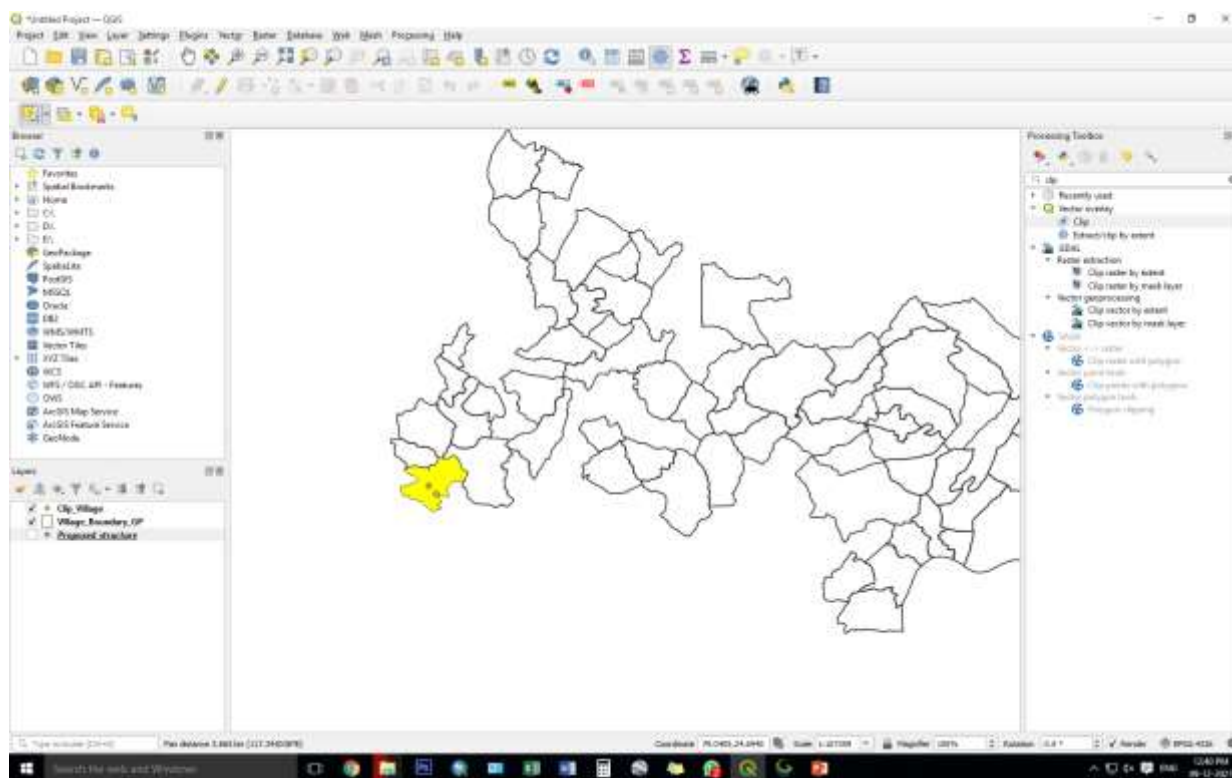
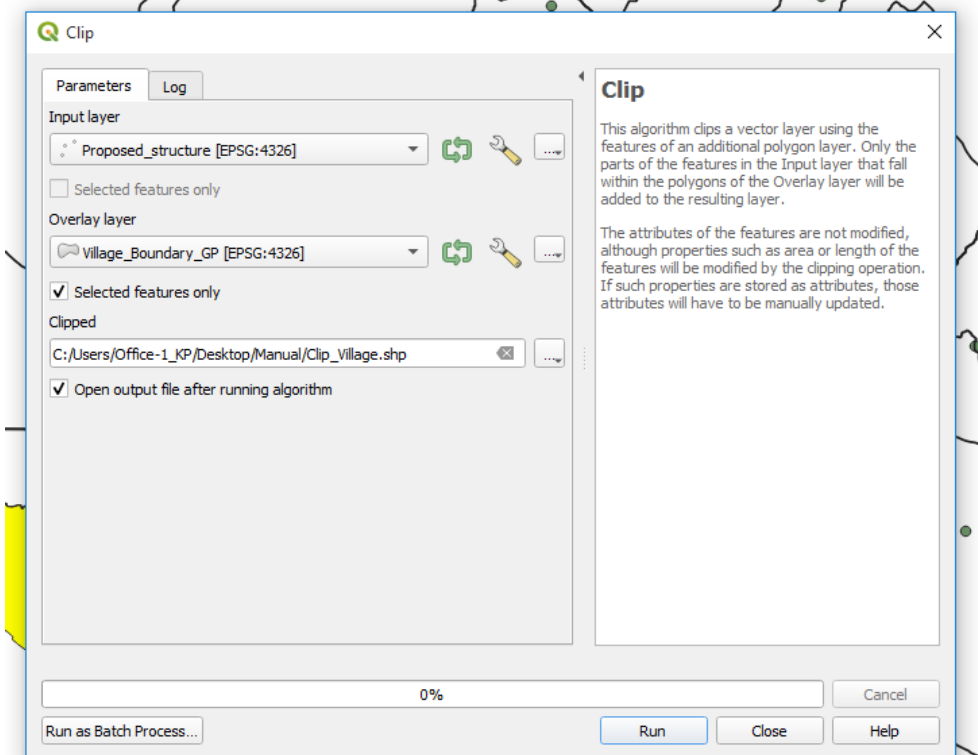
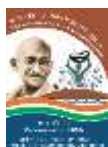
In this section we clip village boundary and proposed structure.

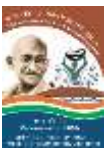


In this, select desire village boundary.



Search Clip Tool in toolbox window present in processing toolbox window.



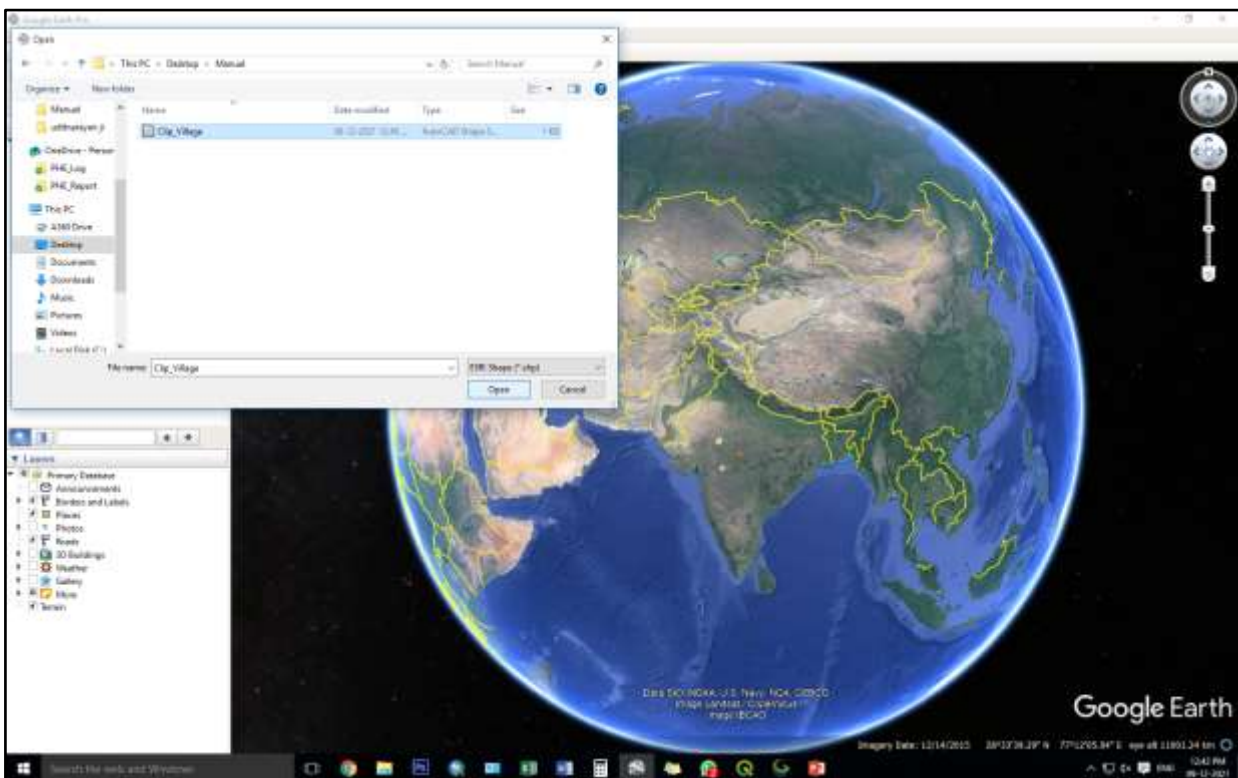


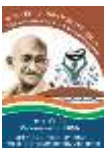
1. Create KML in QGIS

Open Google Earth Platform

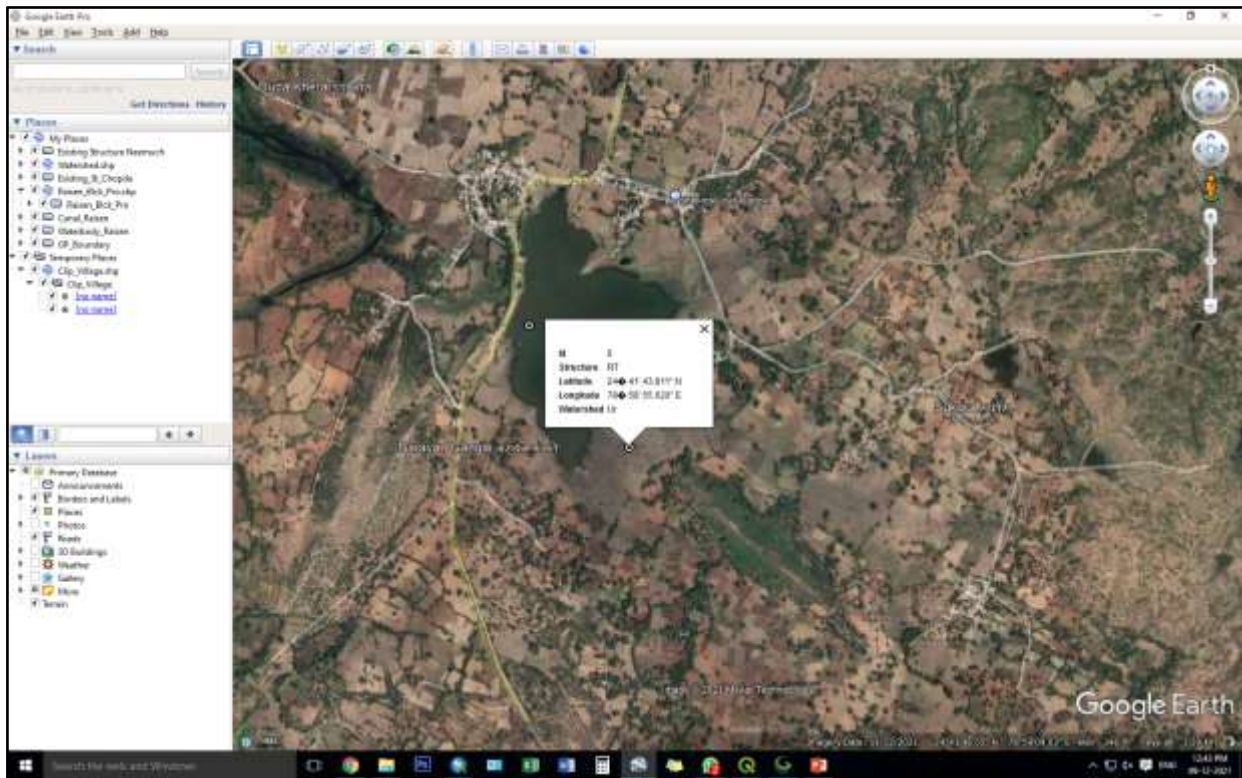


Open your saved shapefile





Final output of KML



Glossary

Topographic terminology

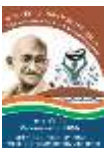
Bearing: The horizontal angle at a given point, measured clockwise from magnetic north or true north to a second point.

Classified roads: Roads for which surface type, width and use are identified.

Unclassified roads: Roads for which the surface is unidentified.

Contour lines: Lines on a map connecting points of equal elevation above mean sea level; using contour lines, relief features can be profiled into a three-dimensional perspective.

Elevation: Vertical distance from a datum (usually mean sea level) to a point or object on the Earth's surface.



Legend: A description, explanation table of symbols, or other information, on a map or chart to provide a better understanding and interpretation of it.

Magnetic north: Direction to which a compass needle point.

Mean sea level: The average height of the surface of the sea for all stages of tide, used as a reference surface from which elevations are measured.

National Topographic System: An orderly index system suitable for a series of maps of different scales for the coverage of Canada.

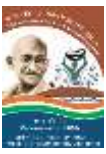
Projection: Geometric representation of the curved surface of the Earth on a flat sheet of paper.

Relief: The physical configuration of the Earth's surface, depicted on a topographic map by contour lines and spot heights.

Spot elevation: A point on a map where height above mean sea level is noted, usually by a dot and elevation value; it is shown wherever practical (road intersections, summits, lakes, large flat areas and depressions).

Symbols: A diagram, design, letter or abbreviations, placed on maps, that (by convention, usage or reference to a legend) is understood to stand for or represent a specific feature or object.

Topography: Surface features both natural and man-made, collectively depicted on topographic maps.



References

- 1) https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/topo101/pdf/mapping_basics_e.pdf.
- 2) <https://qgis.org/en/site/index.html>
- 3) <https://surveyofindia.gov.in/>
- 4) <https://www.blumarblegeo.com/global-mapper/>