

A collection of items including a chessboard, medals, a compass, and glasses. The chessboard is in the top left, with several pieces visible. Below it are two medals: one with a red ribbon and a white star, and another with a blue ribbon and a white star. A compass is in the bottom left. A pair of glasses is in the center. The background is a light-colored, textured surface.

# Introduction to GIS

By

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# Geographical Information System

- ◆ GIS is defined as set of powerful tools for **collecting**, **storing**, retrieving at will, **transforming** and displaying spatial and non-spatial data from the real world for a particular set of purposes.
- ◆ GIS allows to view, understand, question, interpret, and visualize data in many ways that helps to understand the relationships, patterns, and trends in the form of maps, globes, reports, and charts







# Geographic Information System (GIS)

## ◆ Questions a GIS can answer

- ◆ **Location**-Where are Particular Features found?
- ◆ **Patterns** - What geographical pattern exist
- ◆ **Trends** - What has changed since...?
- ◆ **Conditions** - where do certain conditions apply?
- ◆ **Implications**-what are spatial implications if...?



# VERY FIRST USE OF GIS





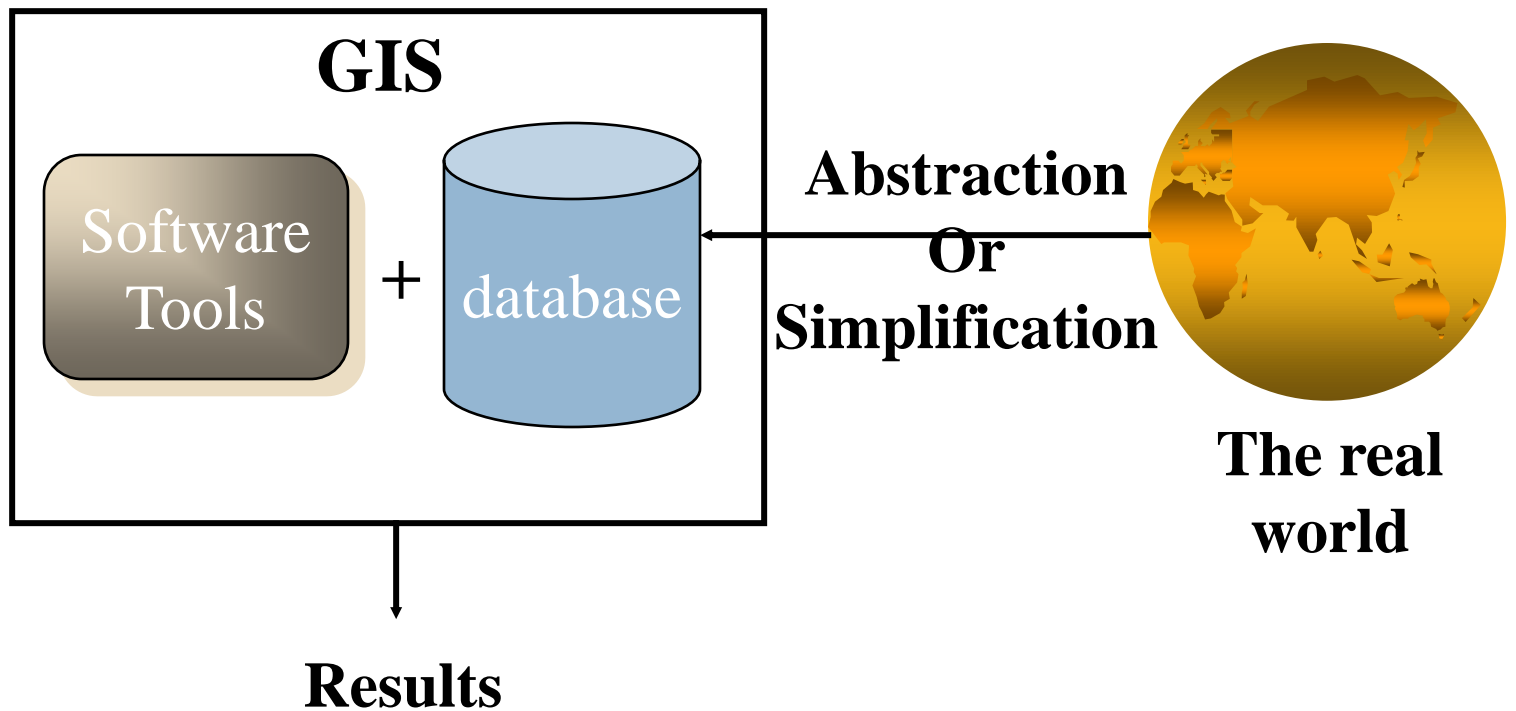
# The GIS

- **Digital Data**  
The geographical information that you will view and analyse using computer hardware and software.
- **Computer Hardware**  
Computers used for storing data, displaying graphics and processing data.
- **Computer Software**  
Computer programs that run on the computer hardware and allow you to work with digital data.





# The GIS

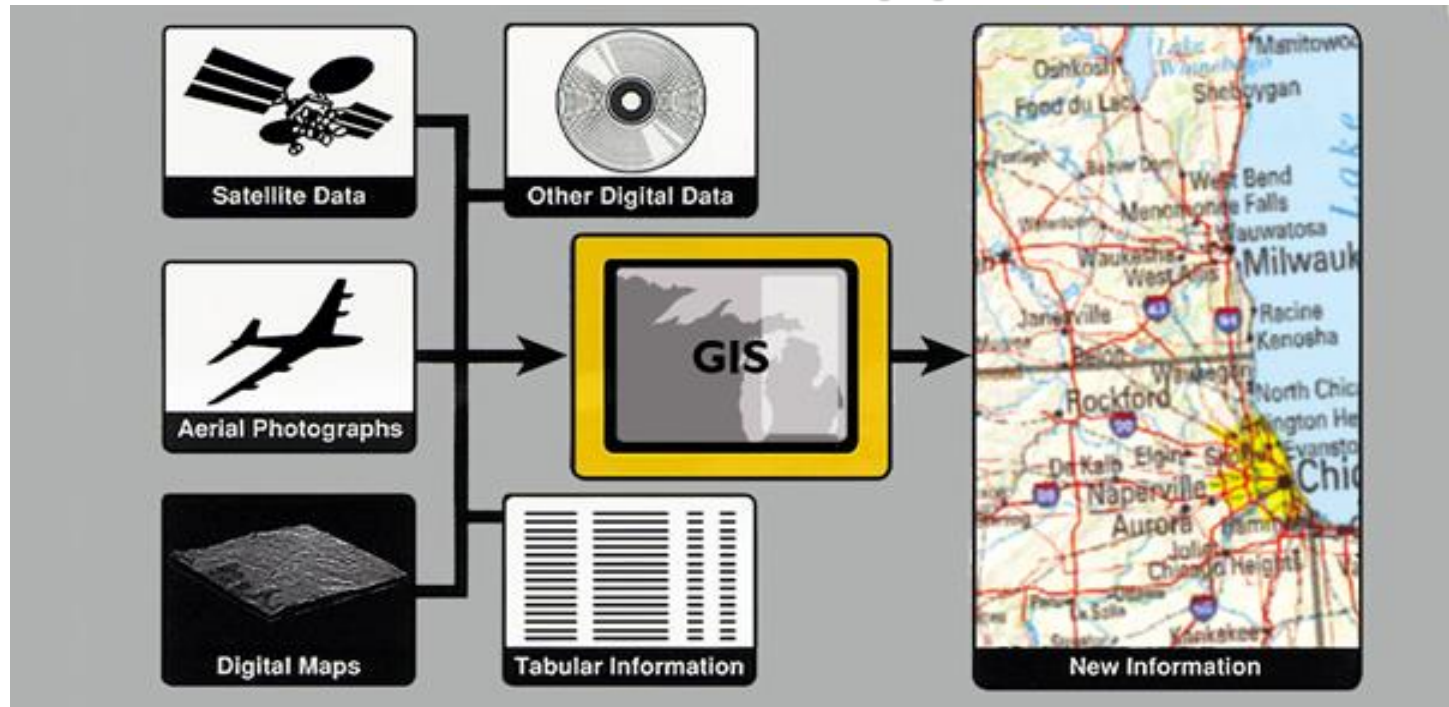


# GIS Database ?

- ◆ **A database containing**
  - **Spatial data (Geographical Data )..Where?**
    - **Lat Long information**
    - **Geometry**
    - **Position**
    - **connections**
  - **Attribute data (Properties data)....What?**
    - **Name**
    - **Length**
    - **Area**
    - **Type etc**



# Data for GIS Application

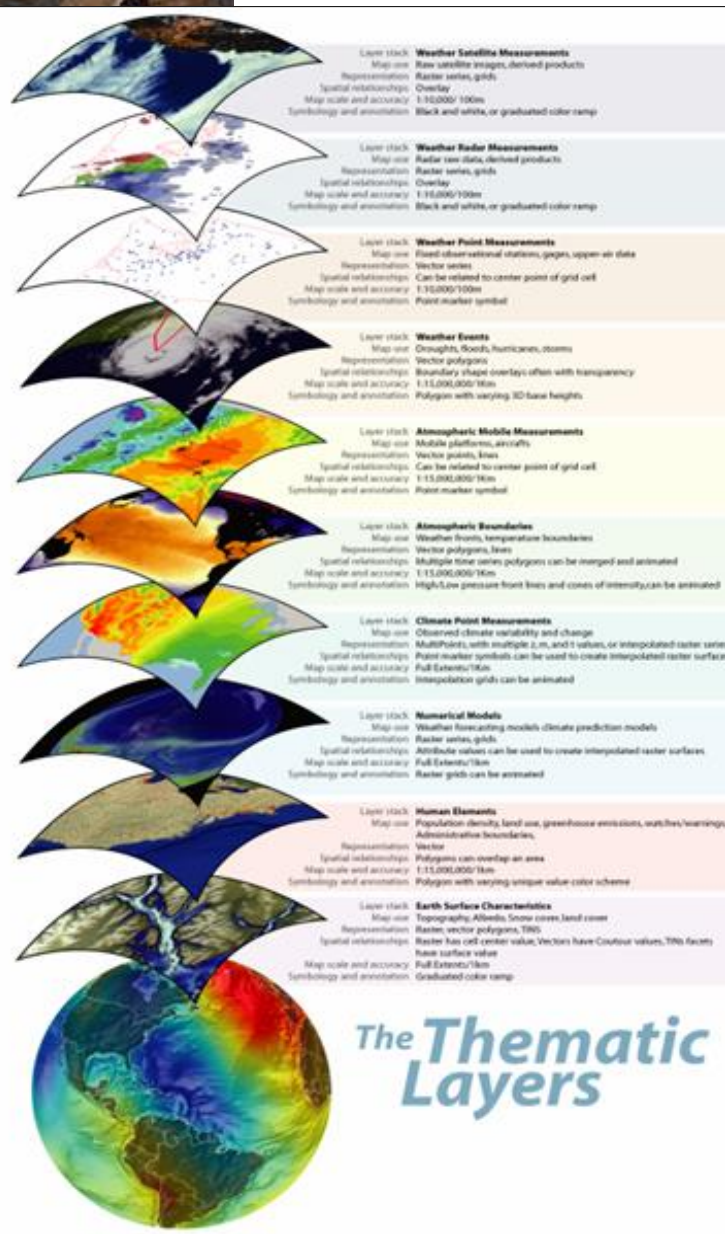


- Digitized and scanned maps
- Databases - table of data
- Field sampling
- Remote sensing and aerial photographs





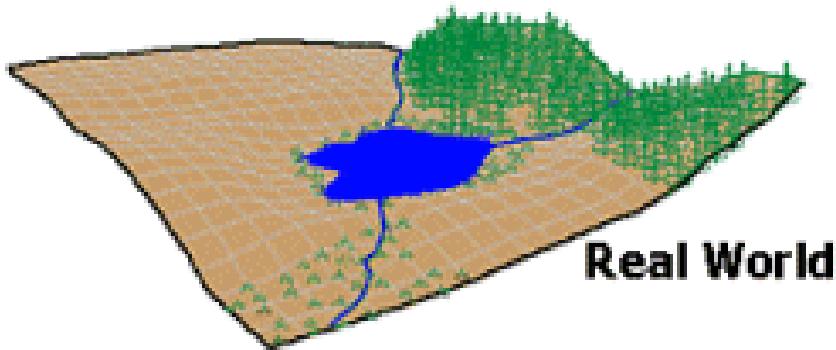
# GIS Layers



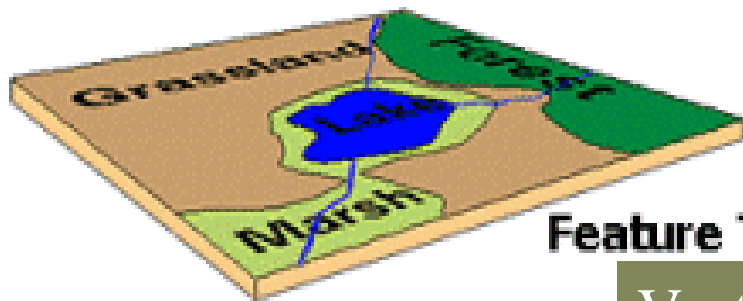
- GIS allows multiple layers of information to be displayed on a single map (eg. Landuse, soil type, Thiessen polygon).
- One of the main features of contemporary GIS
- Layers facilitates representation of real world.



# GIS – Data Model

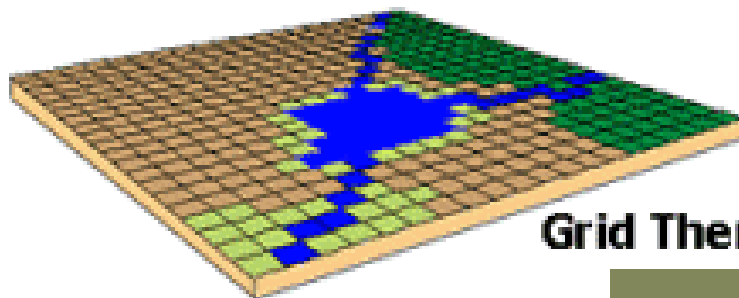


**Real World**



**Feature Theme**

Vector



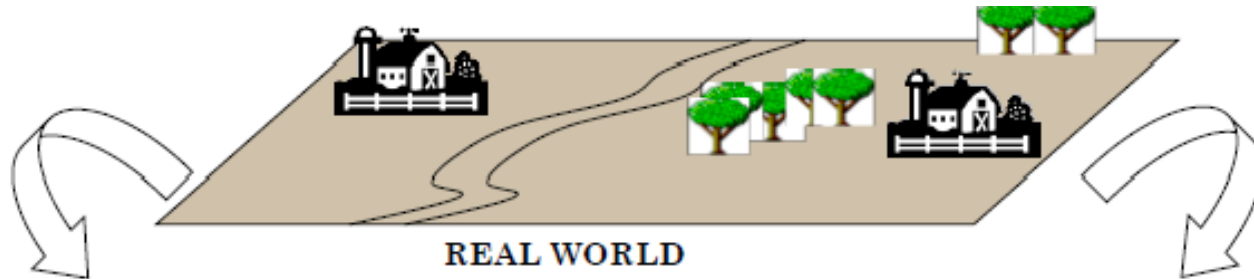
**Grid Theme**

Raster

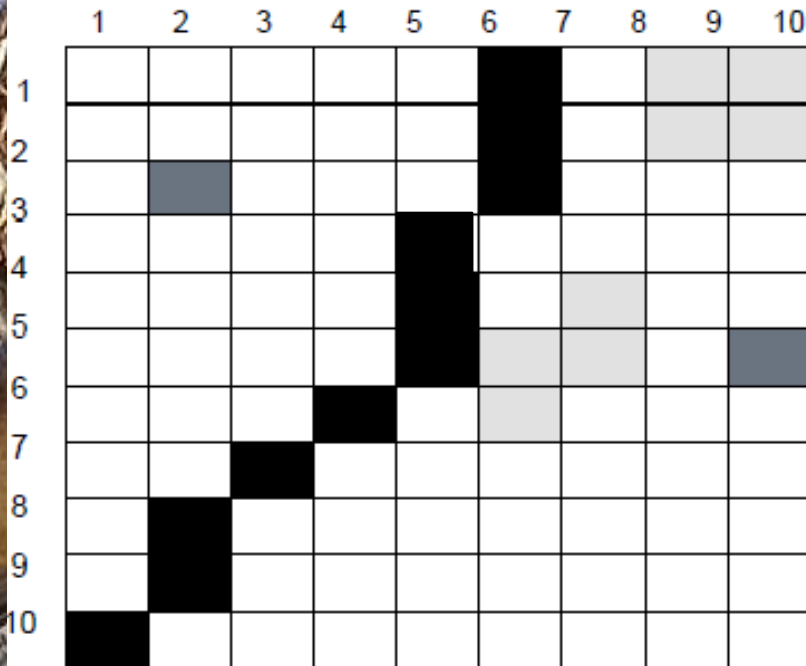
Attributes of Rain25used.txt					
Shape	rainfalls for site	Easting	Northing	Alt	Rain (mm)
Point	999	2411300	5901700	334	2592.200
Point	211302	2372144	5899615	4	2658.491
Point	211802	2416286	5898496	198	1833.954
Point	213810	2410022	5872000	183	2131.642
Point	214202	2361986	5858663	20	2551.988
Point	214301	2370172	5860685	12	3234.292
Point	214710	2405600	5862900	117	2424.000
Point	215102	2359367	5853050	11	2773.110
Point	215302	2375764	5855241	143	3394.845
Point	215401	2379943	5851617	75	3146.148
Point	215702	2406013	5848356	175	3068.048
Point	216401	2382989	5835007	116	5119.652
Point	216503	2392487	5838880	107	3696.638
Point	216510	2384400	5846800	90	2683.821
Point	217411	2379300	5826800	126	4308.232
Point	218910	2416759	5827584	1418	5025.104
Point	220201	2447921	5906255	380	1826.003
Point	223101	2442708	5874733	421	2236.851
Point	224001	2429123	5861627	368	2888.288



# Types of GIS Data



REAL WORLD



GRID RASTER

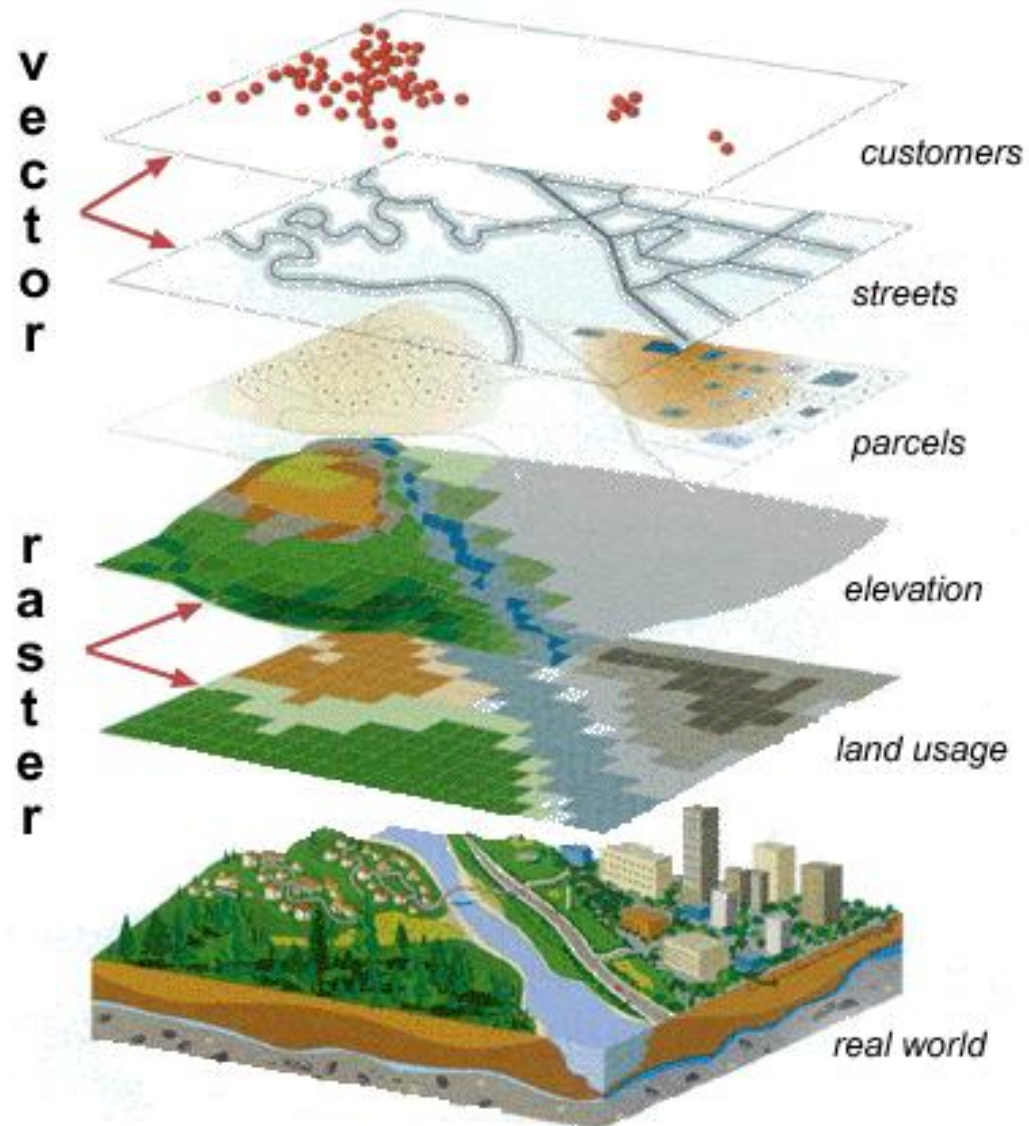


VECTOR



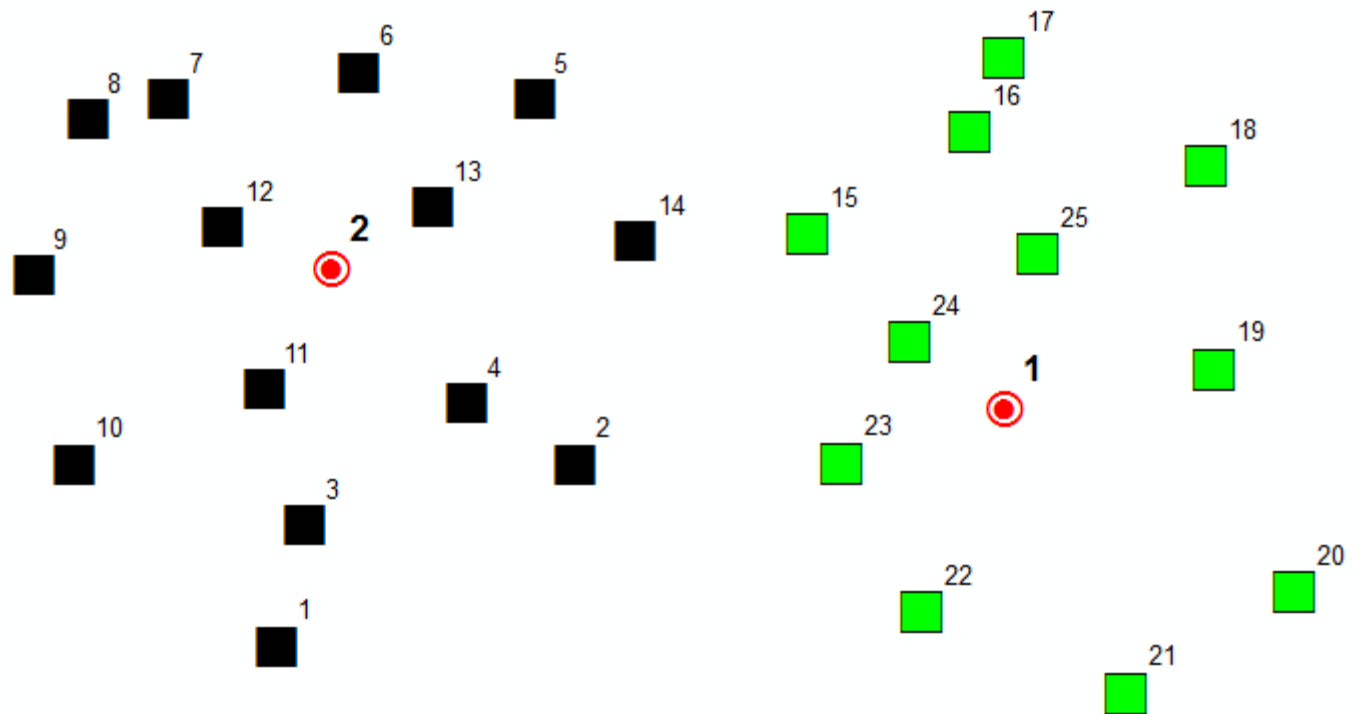


# The GIS



# GIS – Map Features

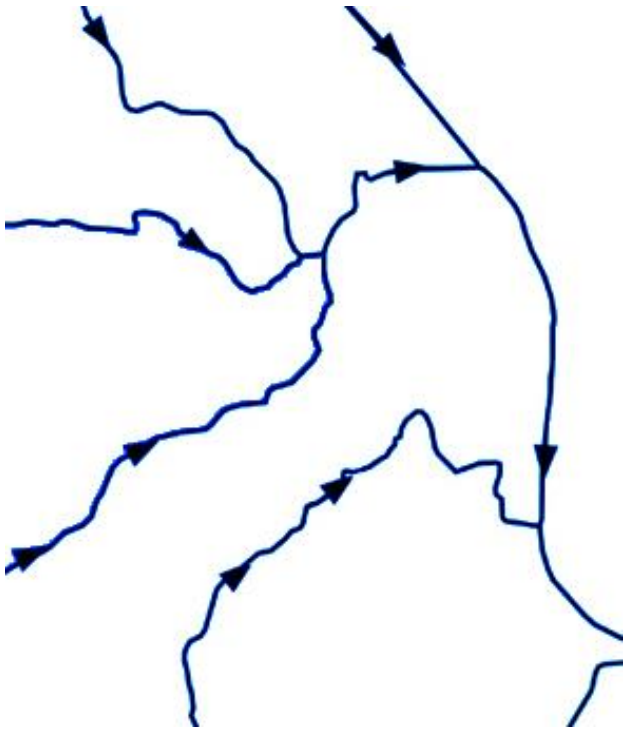
**Point Feature:** Represents a single point location (eg. location of rain gauge, flow-gauge, manholes)



# GIS – Map Features

**Line Features:** Lines are used to represent the shape and location of geographic objects, too narrow to depict as areas.

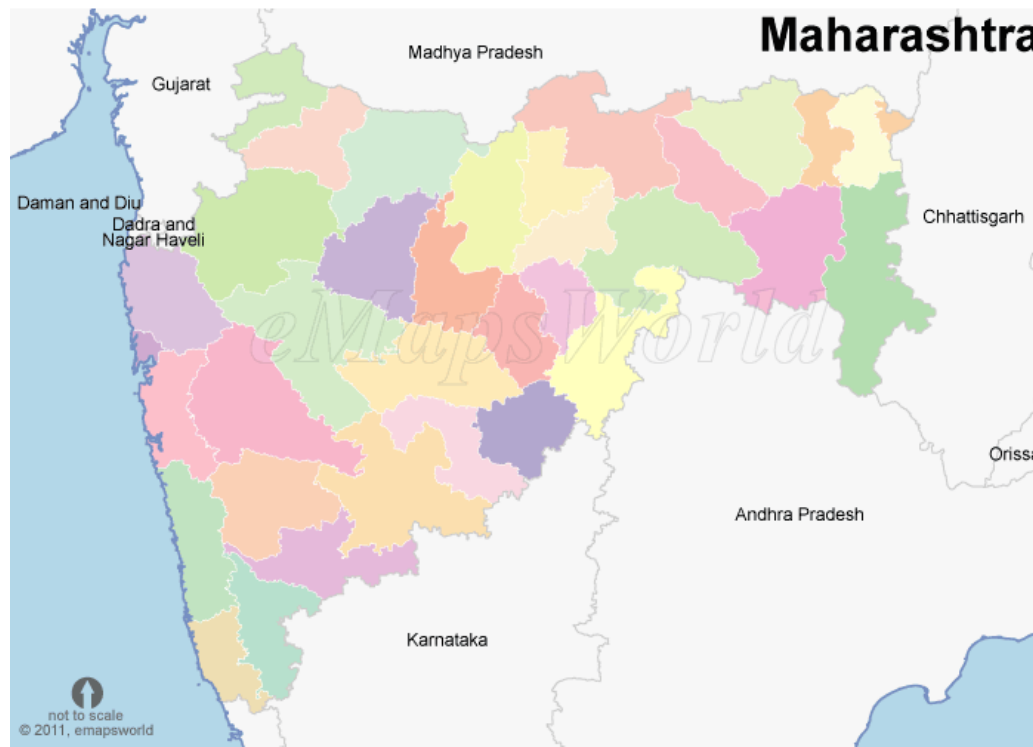
(eg. Streams, Rivers, Canals)



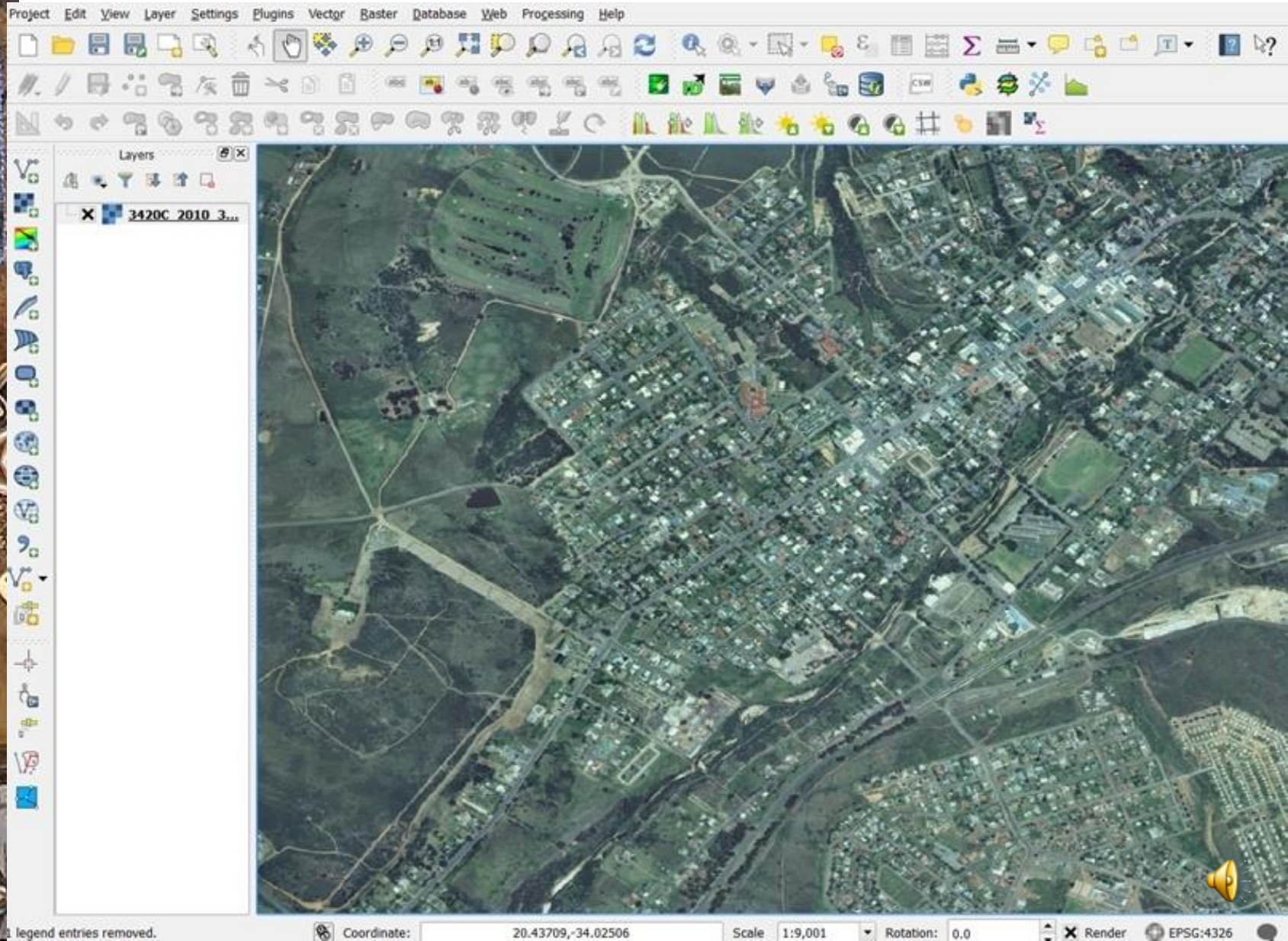


# GIS – Map Features

**Polygon Features:** Polygon is used to represent a shape, set of connected, ordered coordinates forming an area  
(eg. Watersheds, catchments, water bodies etc.)

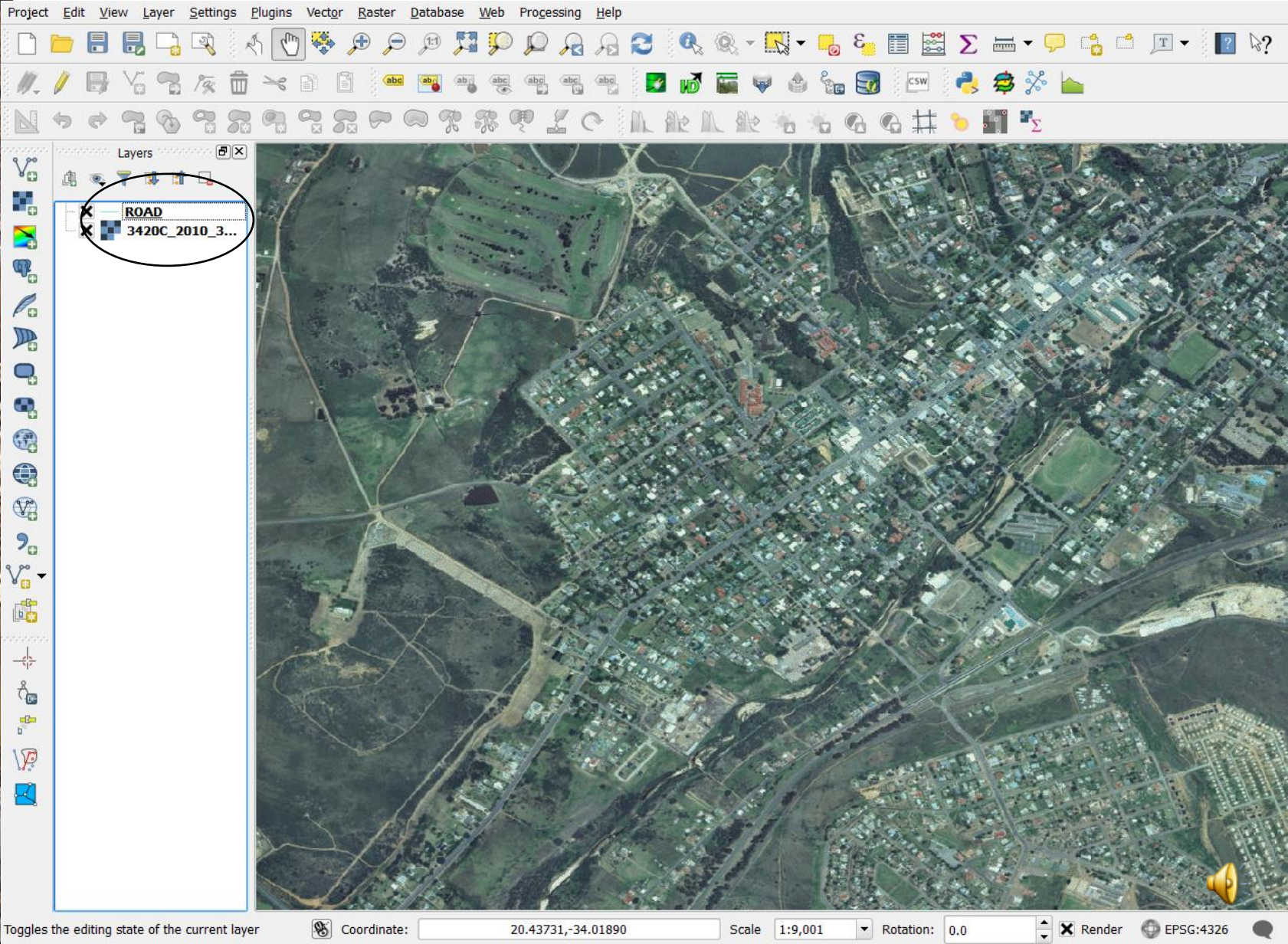


# Creation of spatial layers - GIS software



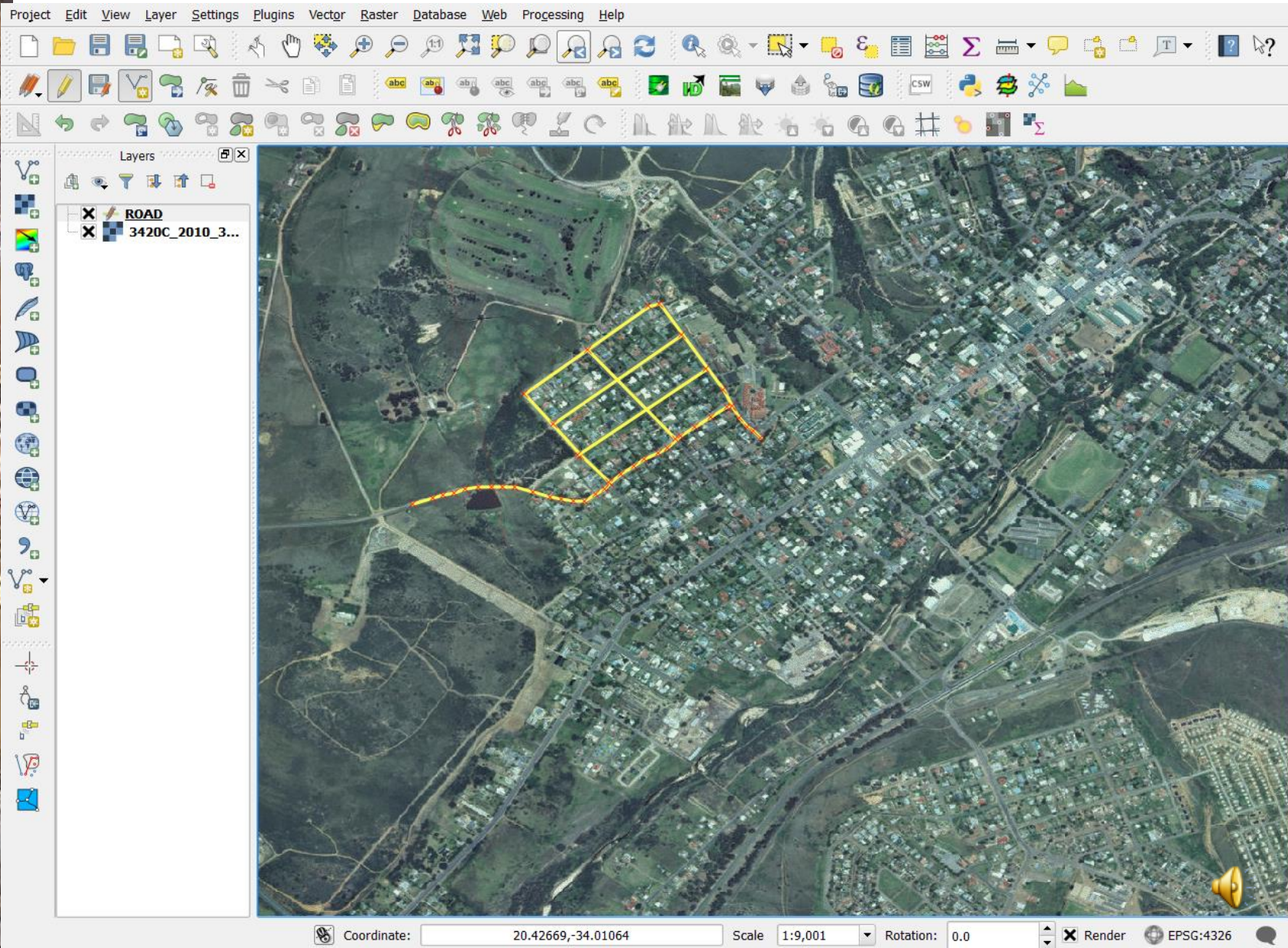


# Creation of spatial layers - GIS software





# Creation of spatial layers - GIS software





# Creation of spatial layers - GIS software

The screenshot displays a GIS software interface with a menu bar (Project, Edit, View, Layer, Settings, Plugins, Vector, Raster, Database, Web, Processing, Help) and a toolbar. The main map area shows an aerial view of a city with a network of yellow lines representing roads. On the left, a 'Layers' panel lists two layers: 'roads' and '3420C\_2010\_3...'. The bottom status bar shows the coordinate '20.43850,-34.02881', a scale of '1:9,001', a rotation of '0.0', and the projection 'EPSG:4326'. A small tooltip at the bottom left reads 'Toggles the editing state of the current layer'.



# Creation of spatial layers - GIS software

The screenshot displays the QGIS interface. The main map area shows an aerial view with buildings outlined in yellow. The 'Layers' panel on the left lists several layers, including 'places', 'buildings', 'roads', 'rivers', 'water', 'landuse', and '3420C\_2010\_327\_RGB...'. The 'Attribute table - buildings' window is open, showing a table with 30 rows of data. The table columns are 'osm\_id', 'osm\_way\_id', 'name', 'type', and 'aeroway'. The first row is selected, showing 'osm\_id' 2631392 and 'type' multipolygon.

	osm_id	osm_way_id	name	type	aeroway
0	2631392	NULL	Swellendam ...	multipolygon	NULL
7	NULL	190725246	Buirski Plein	NULL	NULL
8	NULL	190725247	Buirski Plein	NULL	NULL
9	NULL	190725248	Buirski Plein	NULL	NULL
10	NULL	190726002	Drostdy	NULL	NULL
11	NULL	190726003	Mayville drost...	NULL	NULL
12	NULL	191530924	Nedbank	NULL	NULL
22	NULL	194620469	Boshoff Visser	NULL	NULL
29	NULL	194655560	ABSA	NULL	ba
31	NULL	194663589	La Pop Interiors	NULL	NULL
39	NULL	194740668	Swellendam ...	NULL	NULL
47	NULL	194741835	Powell House ...	NULL	NULL
279	NULL	195204796	Aan de Drostdy	NULL	NULL
280	NULL	195204798	Aan de Drostdy	NULL	NULL
281	NULL	195204799	Auld House	NULL	NULL
282	NULL	195204800	Barry House	NULL	NULL
283	NULL	195204801	Herberg Roos...	NULL	NULL
285	NULL	195204803	The Pennant...	NULL	NULL
286	NULL	195204804	Herberg Roos...	NULL	NULL
289	NULL	195204809	Lekker-Bly Sel...	NULL	NULL
290	NULL	195204810	Seeff Properties	NULL	NULL

Coordinate: 20.43429,-34.03458 Scale: 1:15,739 Rotation: 0.0 Render EPSG:4326



# Creation of spatial layers - GIS software

The screenshot displays the QGIS GIS software interface. The main window shows a satellite-style map of a town with a river. A blue line representing a river layer is overlaid on the map. The 'Layers' panel on the left lists several layers: 'landuse' (purple), 'buildings' (blue), 'area1' (green), 'school property' (cyan), 'river\_33s' (blue line), and '3420C\_2010\_3...' (blue grid). The status bar at the bottom shows the coordinate '20.42348,-34.01801', a scale of '1:9,001', a rotation of '0.0', and the projection 'EPSG:4326 (OTF)'. A notification in the bottom left corner states '1 legend entries removed.'

Project Edit View Layer Settings Plugins Vector Raster Database Web Processing Help

Layers

- landuse
- buildings
- area1
- school property
- X river\_33s
- X 3420C\_2010\_3...

1 legend entries removed.

Coordinate: 20.42348,-34.01801 Scale 1:9,001 Rotation: 0.0 Render EPSG:4326 (OTF)



# Creation of spatial layers - GIS software

The screenshot displays the QGIS GIS software interface. The main window shows an aerial photograph of a city area with several rectangular areas highlighted in cyan. The interface includes a menu bar at the top with options: Project, Edit, View, Layer, Settings, Plugins, Vector, Raster, Database, Web, Processing, and Help. Below the menu bar is a toolbar with various icons for map navigation and editing. On the left side, there is a Layers panel with a legend. The legend lists the following layers:

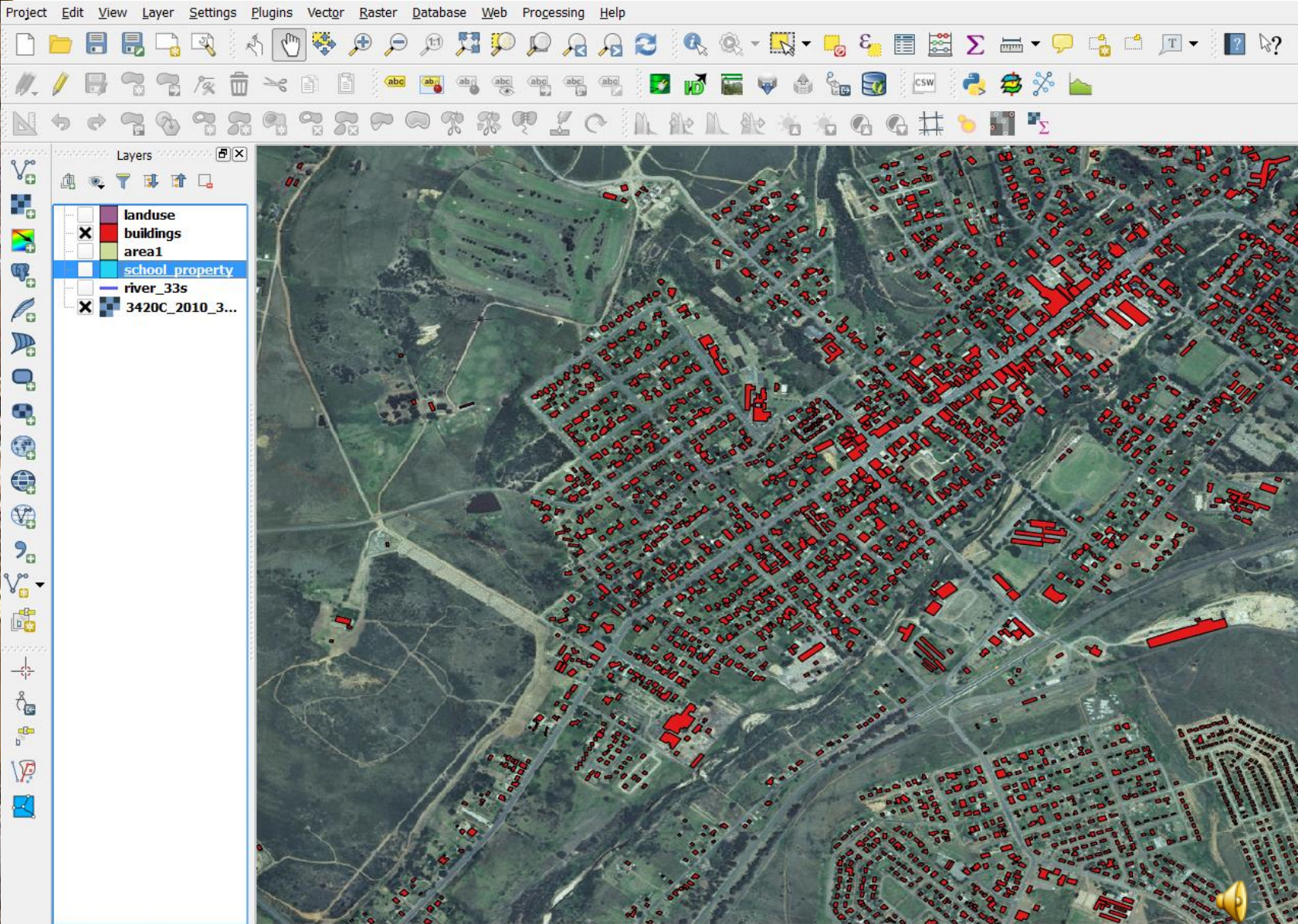
- landuse
- buildings
- area1
- school\_property
- river\_33s
- 3420C\_2010\_3...

The status bar at the bottom of the window shows the following information:

- 1 legend entries removed.
- Coordinate: 20.42563,-34.02680
- Scale: 1:9,001
- Rotation: 0.0
- Render
- EPSG:4326 (OTF)



# Creation of spatial layers - GIS software



1 legend entries removed.

Coordinate: 20.42519, -34.02080 Scale: 1:9,001 Rotation: 0.0 Render EPSG:4326 (OTF)



# Creation of spatial layers - GIS software

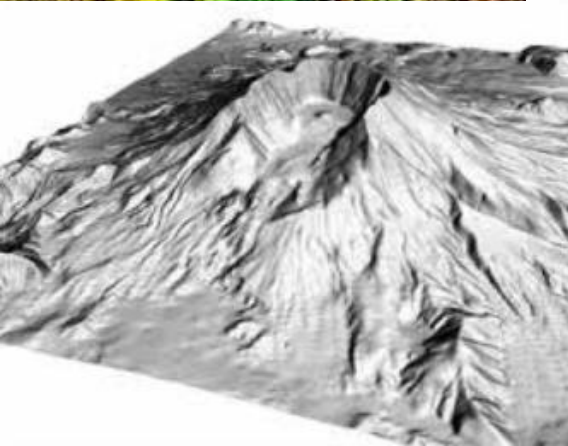
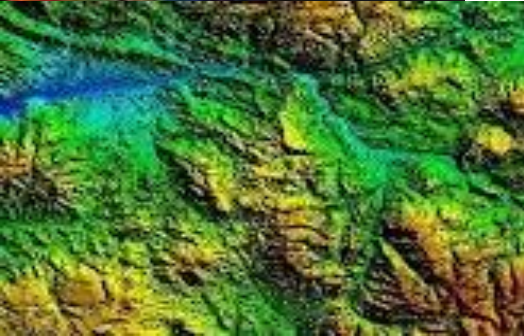
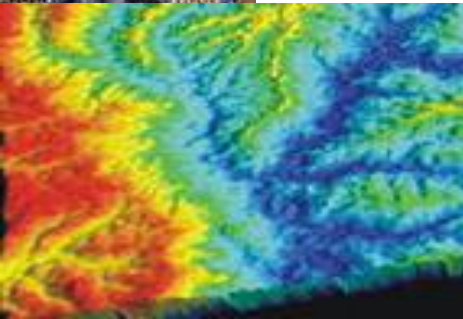
The screenshot displays the QGIS desktop environment. The main map area shows a vector-style map of Swellendam and Railton, with buildings in black, roads in yellow, water in blue, and landuse in light green. The 'Layers' panel on the left is circled and contains the following list:

- places
- buildings
- roads
- rivers
- water
- landuse

The top menu bar includes: Project, Edit, View, Layer, Settings, Plugins, Vector, Raster, Database, Web, Processing, Help. The status bar at the bottom shows: Coordinate: 20.44950,-34.03316, Scale: 1:14,984, Rotation: 0.0, Render, and EPSG:4326.

# Digital Elevation Model

- ◆ DEM is a digital model or 3D representation of a terrain's surface
  - Raster (a grid of squares, also known as a heightmap when representing elevation)
  - Vector-based triangular irregular network (TIN).
  - Acquired through techniques such as photogrammetry, lidar, land surveying, etc. i.e. remote sensing techniques





# Digital Elevation Model

◆ TIN

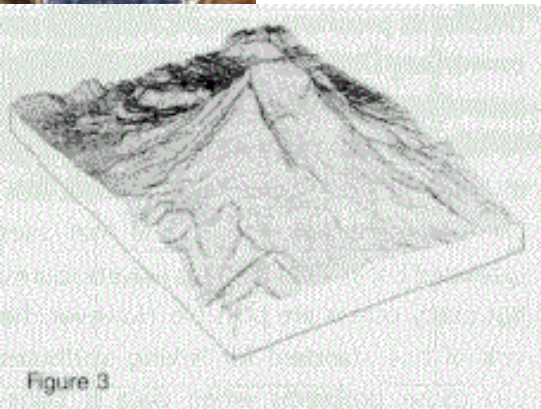
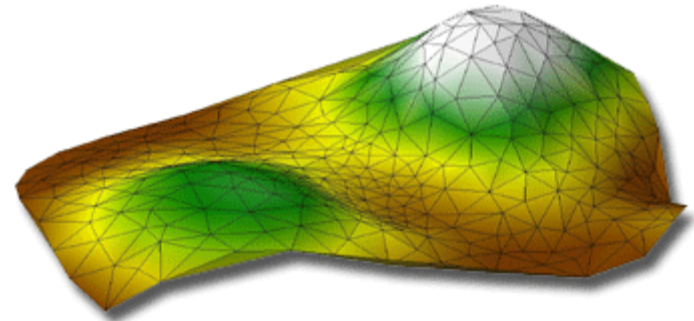
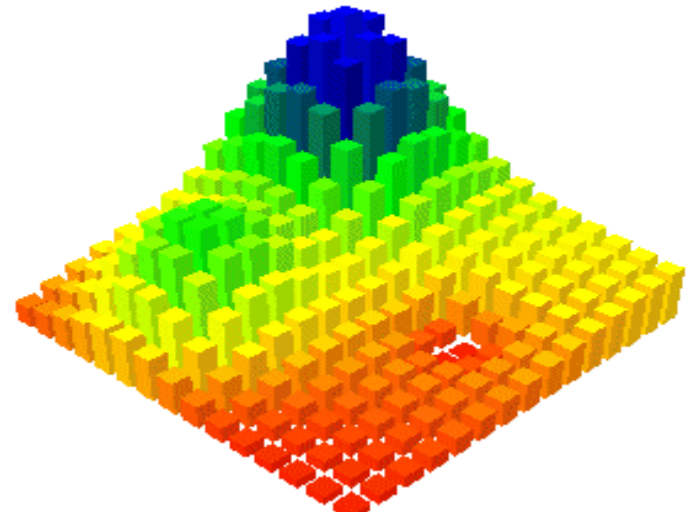


Figure 3

◆ GRID



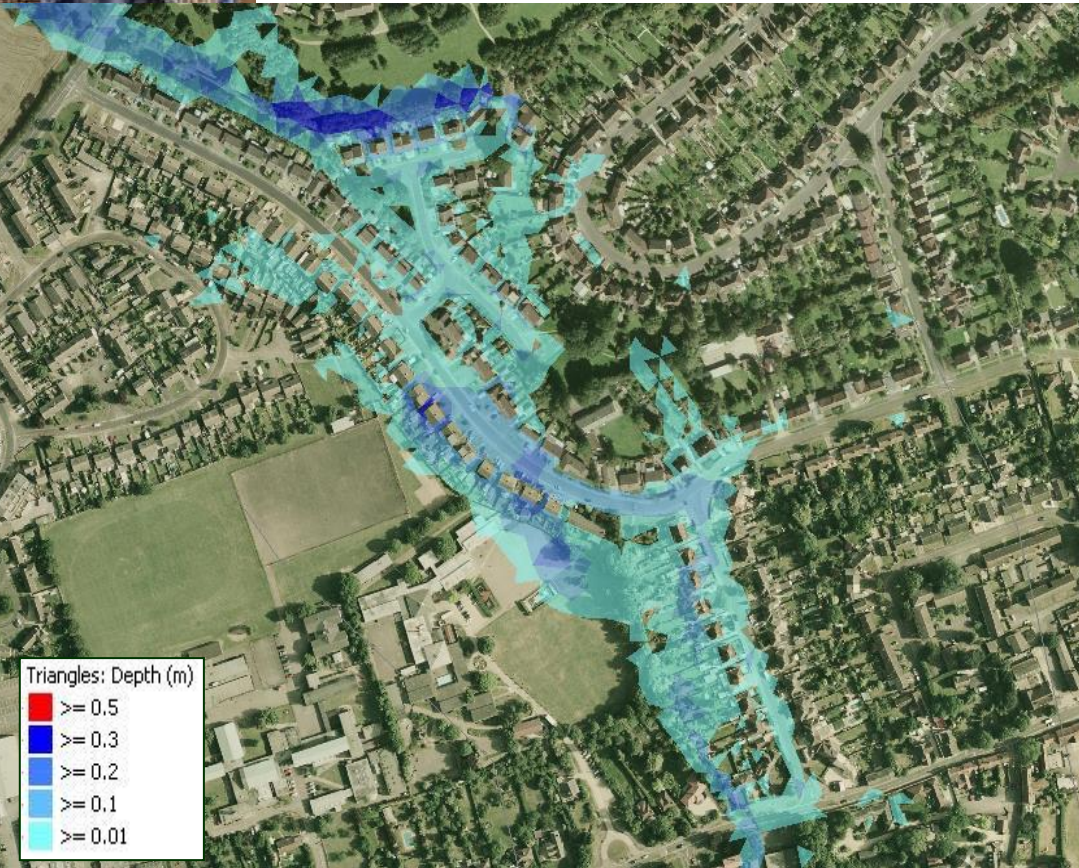


# GIS - Analysis

- **Querying**
- **Measurement**
- **Routing and Minimum path**
- **Buffering**
- **Overlay**
- **Distance, Adjacency and Proximity analysis**
- **Misc. analysis likes neighbourhood analysis, network analysis, 3D Analysis etc.**
- **Interpolation**



# Overlay Analysis



Superimposing two or more maps registered to a common coordinate system, to show relationships between features in the same study area.





# Uses of GIS

- River Basin Management
- Crop Water Requirement & Scheduling
- Irrigation Water Management
- Ground Water Investigations
- Watershed Management
- Soil Erosion Modelling
- Land Use Change Detection
- Flood Management
- Environmental Modeling
- Sedimentation Studies Etc







THANK YOU

