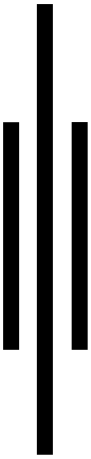
# A
# Practical Manual
# *of*
# GIS Training
# *For*
# GIS Training for Civil/Agriculture Engineers, Science/Applied Science Professionals, and Architects




**Prepared by**
Er. Sadhuram Lamichhane
Remote Sensing and GIS Expert
MD Latitude Engineering Pvt. Ltd Pulchwok-04, Lalitpur
Lecturer Universal Engineering and Science College Chakupat, Lalitpur
Ph: 9851142018
Email: shadowskalpit@gmail.com
Blog: http://revsrl.blogspot.com/
Facebook: https://www.facebook.com/sadhuram.lamichhane/
Linkedin: https://www.linkedin.com/in/sadhuram-lamichhane-93277213b/



June, 2021

# Introduction

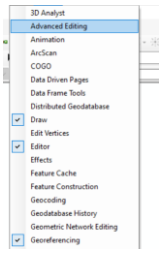
GIS as a powerful set of tools for collecting, storing and retrieving at will, transforming and displaying spatial data from the real world. The convergence of GIS with allied technologies, those of surveying, remote sensing, air photography, the global positioning system (GPS), and mobile computing and communications has fed a spectacular growth of these technologies. Application of Geo-information technology has been seen in the disaster management and irrigation sectors. Hydrologic parameters are easily handled by GIS. Information is processed in a GIS environment to visualize a simulated flood. Essentially, spatial data handling in an articulated way needs knowledge of advanced GIS on the part of the user. For this, an advanced integrated technique is proposed to be learned through advanced level training in GIS. A system which is also known as GIS is a computer-based system of data acquiring, data storage, data management, analysis, and display of geographic data in relation to the real world. Remote sensing is a technology of assessing an object without physical contact. Based on the platform and sensors used, remote sensing can be classified as Aerial and Satellite data and based on the sensors and EMR used.

ArcGIS Desktop consists of several integrated applications, including ArcMap, ArcCatalog, ArcToolbox, ArcScene, ArcGlobe, and ArcGIS Pro. ArcCatalog is a data management application, used to browse datasets and files on one's computer, database, or other sources. In addition to showing what data is available, ArcCatalog also allows users to preview the data on a map. ArcCatalog also provides the ability to view and manage metadata for spatial datasets. ArcMap is the application used to view, edit and query geospatial data, and create maps. The ArcMap interface has two main sections, including a table of contents on the left and the data frames that display the map. Items in the table of contents correspond with layers on the map. ArcToolbox contains geoprocessing, data conversion, and analysis tools, along with much of the functionality in ArcInfo. It is also possible to use batch processing with ArcToolbox, for frequently repeated tasks. ArcScene is an application that allows the user to view their GIS data in 3-D and is available with the 3D Analyst License.

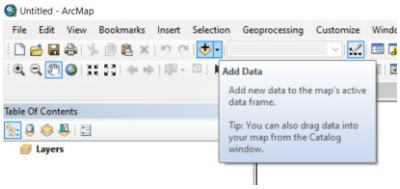
QGIS functions as geographic information system (GIS) software, allowing users to analyze and edit spatial information, in addition to composing and exporting graphical maps. QGIS supports both raster and vector layers; vector data is stored as either point, line, or polygon features. Multiple formats of raster images are supported, and the software can georeference images. QGIS supports shapefiles, coverages, personal geodatabases, dxf, MapInfo, PostGIS, and other formats. Web services, including Web Map Service and Web Feature Service, are also supported to allow the use of data from external sources. QGIS integrates with other open-source GIS packages, including PostGIS, GRASS GIS, and MapServer. Plugins written in Python or C++ extend QGIS's capabilities. Plugins can geocode using the Google Geocoding API, perform geoprocessing functions similar to those of the standard tools found in ArcGIS, and interface with PostgreSQL/PostGIS, SpatiaLite, and MySQL databases.

About ArcMap

- Go to Desktop and search button and click on ArcMap icon. (For easy access of ArcMap)
- Click on the radio button (Left side of the ArcMap Window) File>>New>>Blank Map>>Save to destination folder.
- Right Click on blank space of main menu and add different tools such as Editor tools, Spatial analyst etc.




- On the Standard toolbar, click the Add Data button



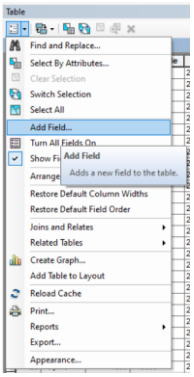

- In the Add Data dialog, navigate to "Local Unit" folder. Select all the datasets and layers of "Local Unit.shp" and click Add.
- Explore where you have copied "Local Unit" folder from ArcCatalog.
- Performing data layers management and Managing data frames
- Turn the layers on and off by using check boxes
- Display/hide layer's legends
- Display the layer data by maintaining the hierarchy
- Play with different buttons on tools
- Managing Data Frames
- Setting scale
- Add desired scale in scale box on the Standard toolbar.

Using the Local Unit

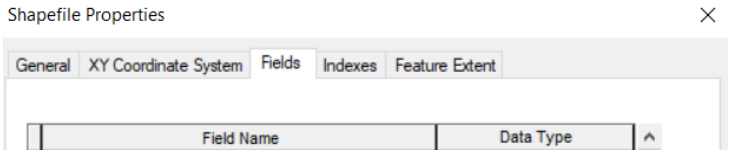
- Click on Display, Source and Selection tabs in Table of Contents and get information.
- Try to change colors, symbols of different features from symbology and scale of map, fix scale as well of the desired Data Frame.
- Label layer from properties/label. Try to label with different attributes (from Labels tab of Layer Properties dialogue box, select desired attribute in Label Field).
- Identify and locating feature using identify tool.
- To locate feature using edit menu we can then flash it on the map and zoom to the feature.

Working with Attributes

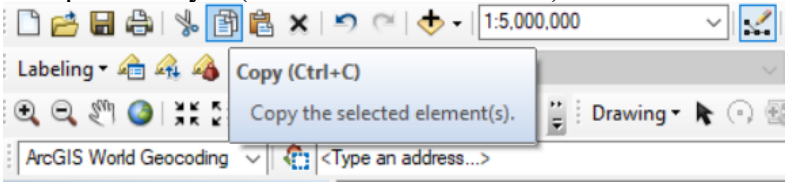
- Layer>>Right Click>>Open attribute table>>Reading the attributes
- Adding new field in attribute table: Table options>>Add field>>Create new field.




- Definition query: Layer>>Properties>>Definition Query>>Write Query>>Export required features from layers.
- Selection of attributes by queries: Layer>>Attribute table>>Select by attribute>>queries.
- Deletion of rows/columns: Layer>>Attribute Table>>Select Rows and Column>>Delete
- Addition of multiple fields in Layers: ArcCatalog>>Dataset>>Properties>>Add Multiple fields>>Assign the respective data types




- Geometrical and Statistical Calculation for attributes: Field calculator, Summary, Statistics, Calculate Geometry, turn on/off fields, Freeze/unfreeze attributes.
- For copying the location and attribute >> select the data from a layer >> copy the data >> paste the data in respective layer (Note: editor must be on).




**About ArcCatalog**

- Start ArcCatalog>> Connect to the folder: Connect to Folder button>>Click OK>> expand the folder to view data sets. (+/– sign).
- Click Catalog tree>>Click content>>Click Preview>>Click Description>>See result.
- Create personal geodatabase and save the database into respective folder.

**Geoprocessing Tools**

Dissolve: Geoprocessing tools>>Dissolve>>Input features>>Output feature class>>Dissolve field>>ok

Clip: Geoprocessing tools>>Clip>>Input features>>Clip features>>Output features class>>ok

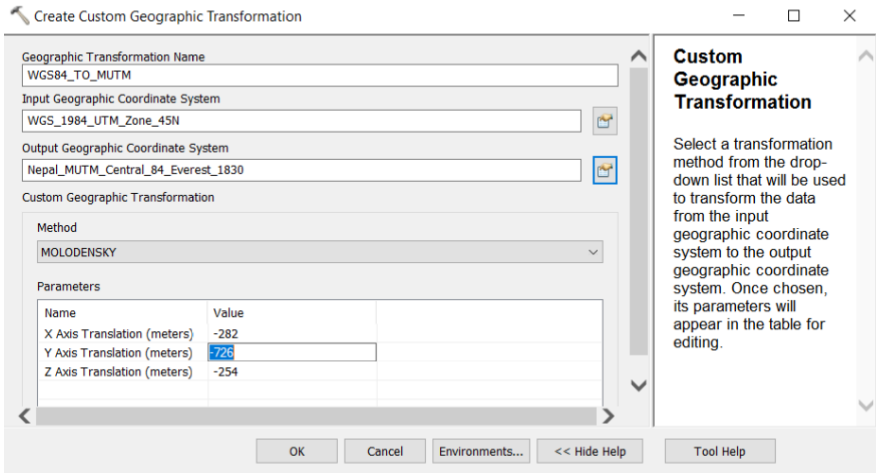
Buffer: Geoprocessing tools>>Buffer>>Input Features>>Output Features class>>Distance [Value]>>ok

## Model builder in ArcMap

- Catalog>>Toolboxes>>My Toolboxes>>Create New Toolboxes>>Save>>Create new model

## Coordinate Transformation

- Coordinate transformations are mandatory if two layers are having different coordinate system are in same ArcMap Window.
- For different spheroid: Data management tools>>Projection and Transformations>>Create custom geographic transformation. Example: For WGS84 To Everest 1830 Transformation translation parameters are: dx= -282, dy= -726, dz= -254 and For Everest 1830 Spheroid to WGS84 translation parameters are: dx= 282, dy= 726, dz= 254. For transformation betwwen same spheroid Data management tools>>Projection and Transformations>>Project>>Input dataset or feature class>>Input CRS>>Output dataset or feature class>>Output CRS>>ok




## Working with Google Earth Pro

- Installing Google Earth Pro in Desktop/PC.
- Adding placemark, path and polygon.


- For placemark 
- For Path 
- For Polygon 
- For tour recording 
- Adding excel data in Google earth Pro: File>>Import>>File>>Change File extension (if required); you can see the window of data import wizard and change some details and finish the excel data import process.
- Click and display historical imagery, image overlay, switching the google earth google sky, moon and mars.
- Creating Video in Google earth

- We can make a video by using tour recording tool
- Also, we can make a video by importing GPS track in Google earth >>Expand Points>>Select required segment of route>>Turn off the track layer>>Copy the points as track>>Paste in destination folder>> and click >>The icon moves with the defined speed>>Save the tour>>Tools>>Movie Maker>>Save video in your desktop/PC.

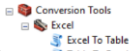
Symbolizing raster and Vector data

- Import shapefile>>Layer>Properties>>Symbology>>Categories>>Add all values>>Select suitable color ramp>>See result

Labelling raster and Vector data

- Layer>>Properties>>Label>>Label features>>label style>>Choose appropriate label size>>See result.

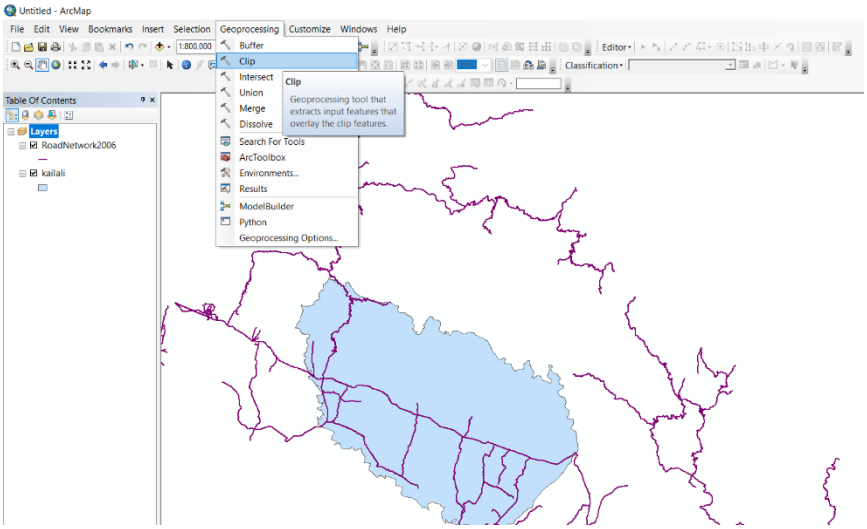
Exporting Attribute table into Excel data

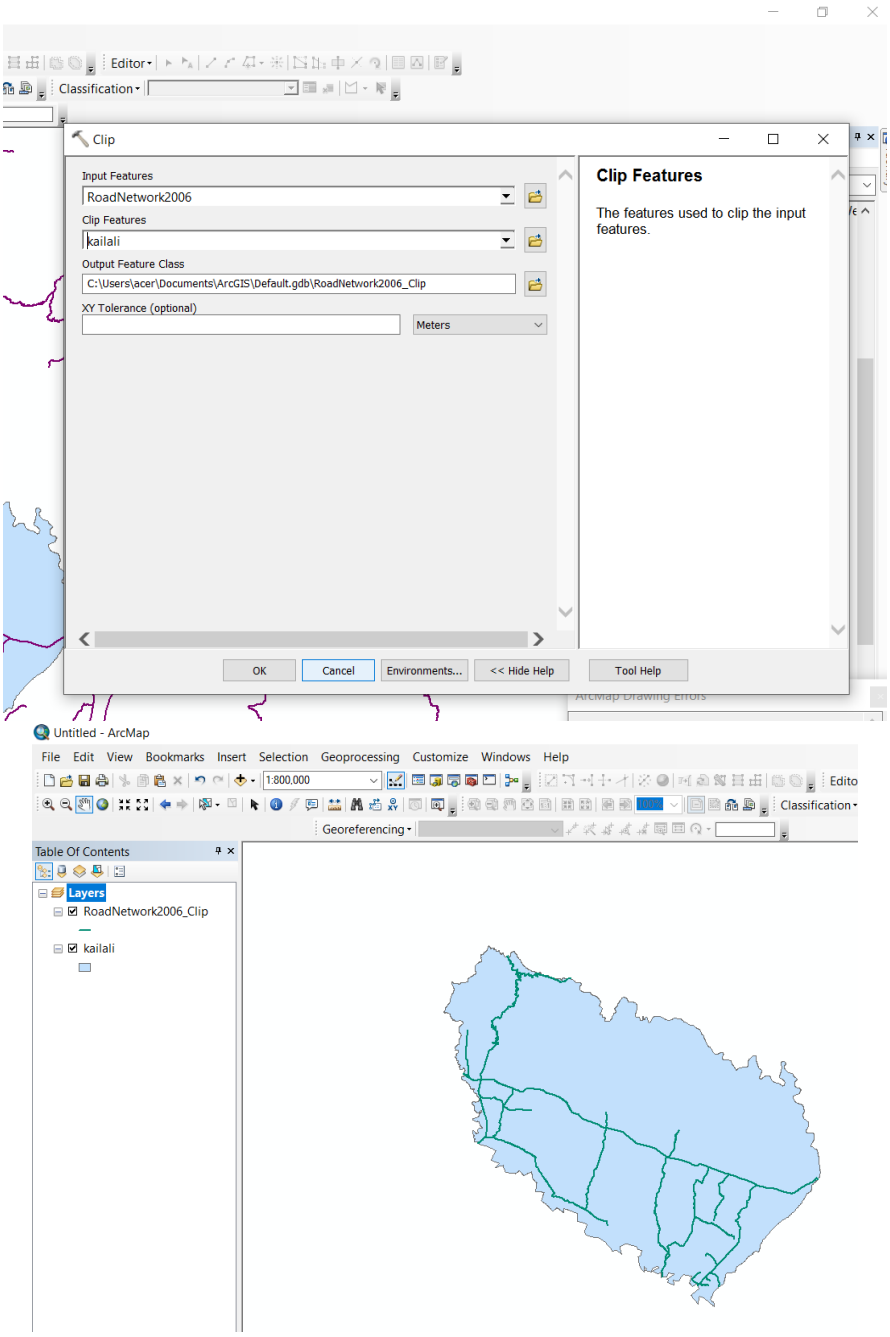
- Conversion tools>> 

>>Table to excel>>Save to destination folder

**CLIP**

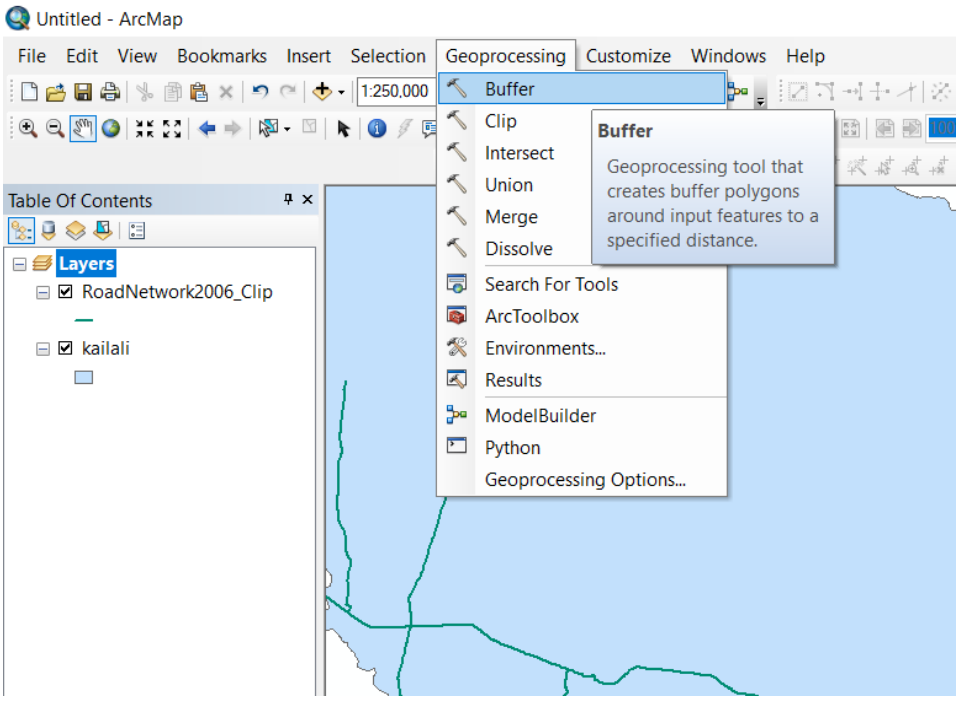
- Open “Kailali” shape file and “road network 2006” shape file (.shp)
- Geopreocessing>> clip >> Input the data >> ok

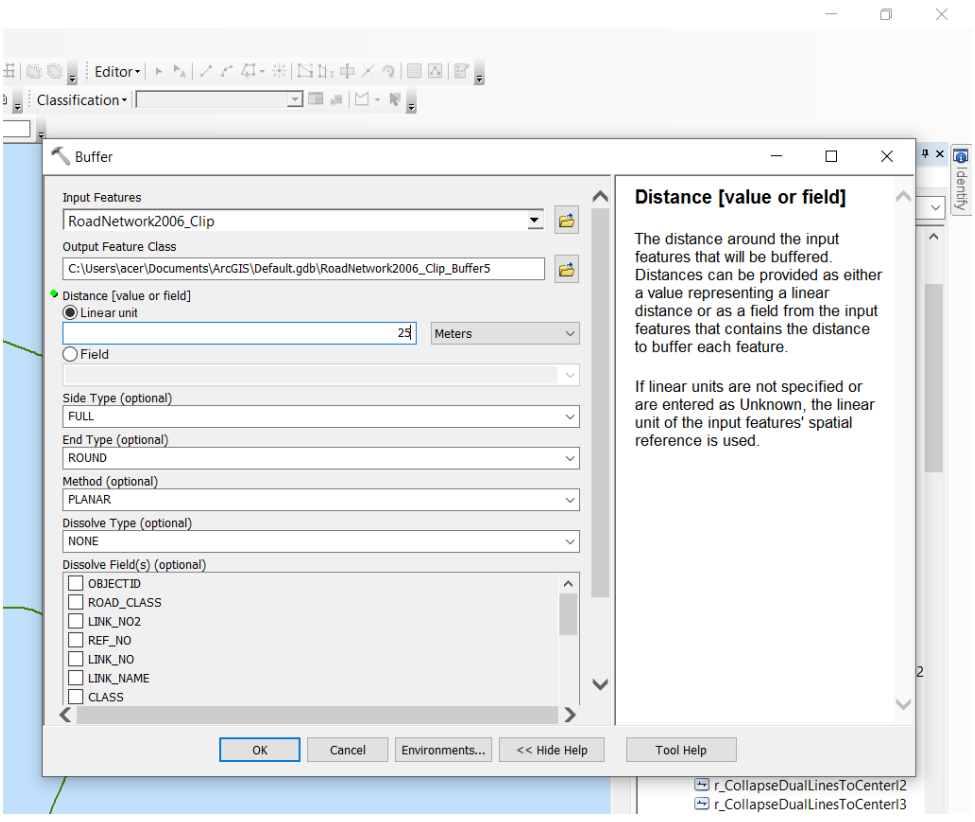


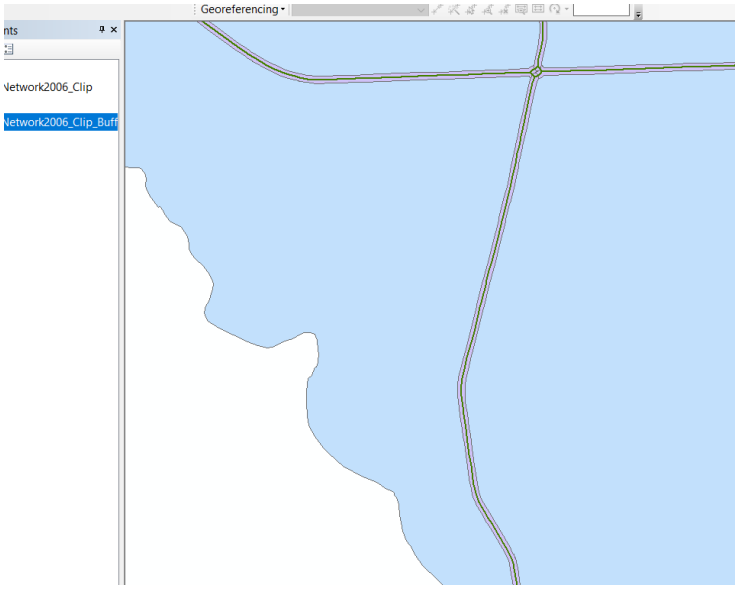



**BUFFER**

- Open “Kailali” shape file and “road network 2006” shape file (.shp)
- Geoprocessing >>Buffer >>Input the layers >> ok






Dissolve

- Import the file local unit.shp>>Geoprocessing>>Import file>>Output folder>>Dissolve field>>See result.

Intersect

- Intersect>>Input two same features like: polygon and polygon, line and polygon.

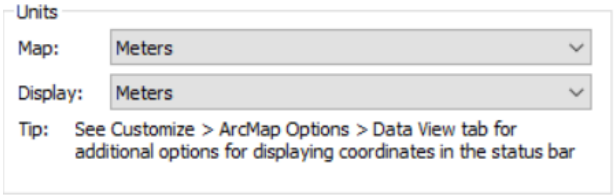
Merge

- Merge>>Input features>>Merge feature>>Save output in destination folder.

# Georeferencing

**Method: 1**
**Georeferencing a raster image/Scanned map**

- Add, "Topo" to Arc Map>>Right click on Layers and click on Data Frame Properties>>Click on General tab, set Map, and Display units as Meters.



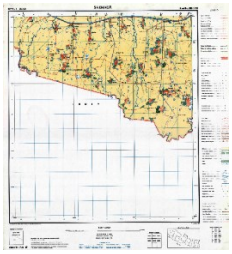

- Main menu>>Click auto adjust>>See result
- Use following coordinates of the four corners of the scanned map:

| Corner | X | Y |
|---|---|---|
| 1 | 563086.34 | 3089928.74 |
| 2 | 563306.38 | 3089928.74 |
| 3 | 563306.38 | 3089657.17 |
| 4 | 563086.34 | 3089657.17 |

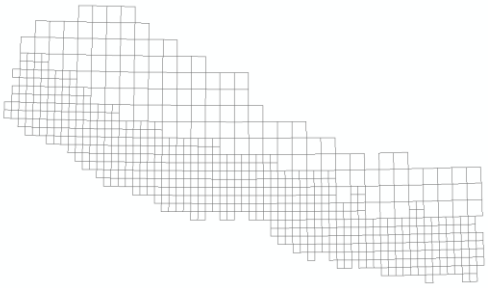
- Click on Add Control Points button and click on corner of the sheet.
- Right click on that point, click Put X and Y Coordinates
- Enter Coordinates and click OK.
- Similarly, put coordinates of rest corners.
- Click on and Check Total RMS error
- Tick on Adjust coordinates.
- Rectify image and Save.
- Open georeferenced map and inspect coordinates.

**Method 2:**
**Image to Map Transformation**
**(Data: Georeferencing)**
**Requirements:**

- Grid map of Nepal (which is a referenced Map)
- Toposheet (which needs to be rectified)
- **Insert** the topomap that needs to be georeferenced



- Insert the grid from the files to ArcMap.



- Go to the **Attribute Table** of gridmap and search the toposheet number that you will reference and select it:

| | | | | |
|---|---|---|---|---|
| 55 | Polygon | 2686 11A | 11A | |
| 56 | Polygon | 2686 11B | 11B | |
| 57 | Polygon | 2686 12A | 12A | |
| 58 | Polygon | 2686 12B | 12B | |
| 59 | Polygon | 2687 01A | 01A | |
| 60 | Polygon | 2687 01B | 01B | |
| 61 | Polygon | 2687 01C | 01C | |
| 62 | Polygon | 2687 01D | 01D | |
| 63 | Polygon | 2687 02A | 02A | |
| 64 | Polygon | 2687 02B | 02B | |
| 65 | Polygon | 2687 02C | 02C | |
| 66 | Polygon | 2687 02D | 02D | |
| 67 | Polygon | 2687 03A | 03A | |
| 68 | Polygon | 2687 03B | 03B | |
| 69 | Polygon | 2687 03C | 03C | |
| 70 | Polygon | 2687 03D | 03D | |
| 71 | Polygon | 2687 04A | 04A | |
| 72 | Polygon | 2687 04B | 04B | |
| 73 | Polygon | 2687 04C | 04C | |
| 74 | Polygon | 2687 04D | 04D | |
| 75 | Polygon | 2687 05A | 05A | |
| 76 | Polygon | 2687 05B | 05B | |
| 77 | Polygon | 2687 05C | 05C | |
| 78 | Polygon | 2687 05D | 05D | |
| 79 | Polygon | 2687 06A | 06A | |
| 80 | Polygon | 2687 06B | 06B | |
| 81 | Polygon | 2687 06C | 06C | |
| 82 | Polygon | 2687 06D | 06D | |
| 83 | Polygon | 2687 07A | 07A | |

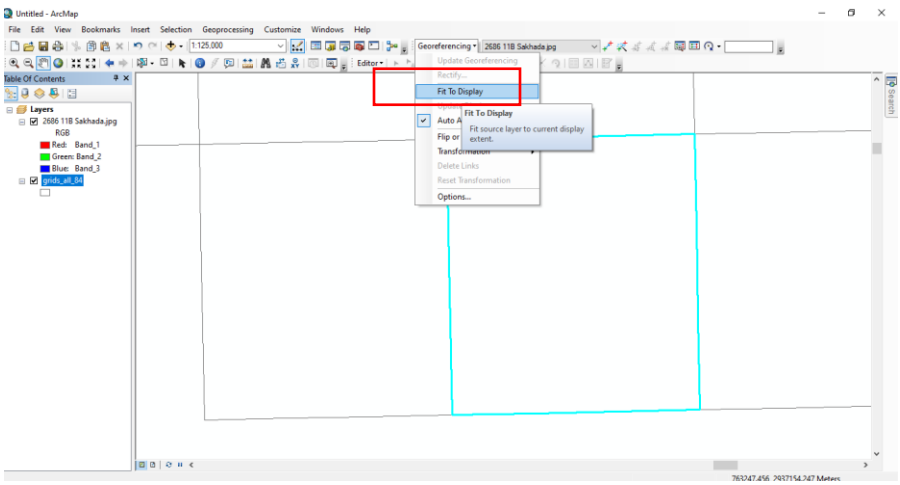
57 (1 out of 678 Selected)

grids_all_84

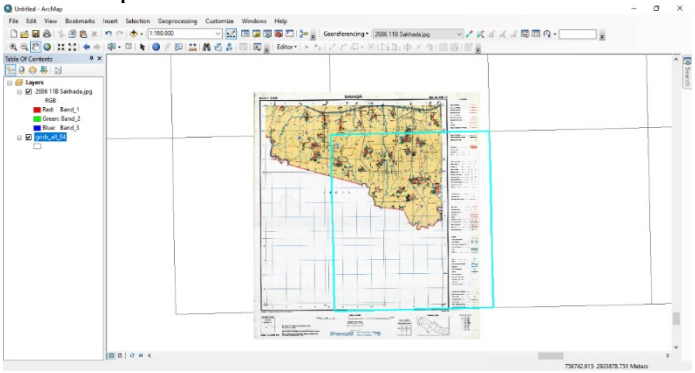
Selection of toposheet number from attribute table

Now, the toposheet number that is selected is displayed in the grid map

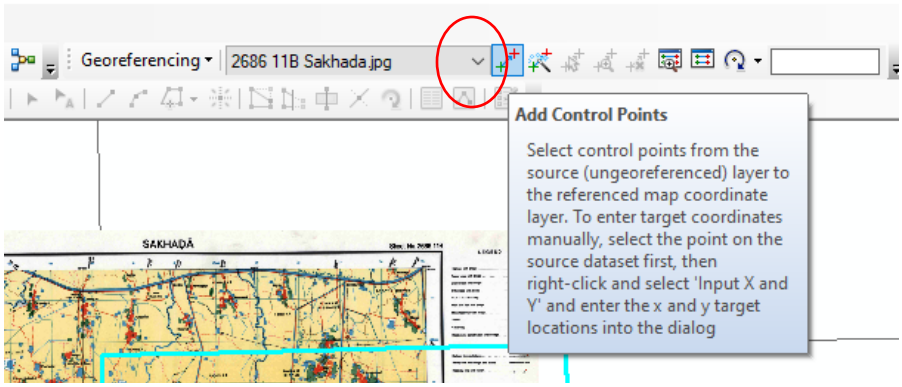
- Zoom the selected grid
- Go to georeferencing tool and select fit to display



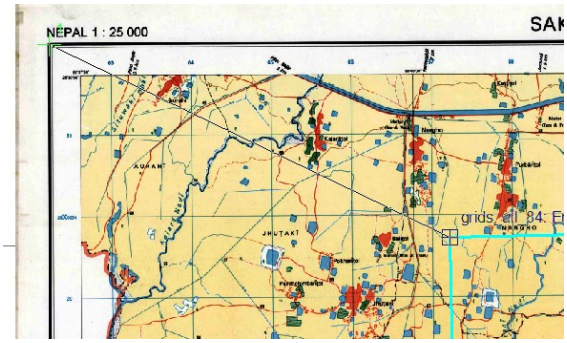

Both the selected grid and toposheet will be seen in the screen at the same time



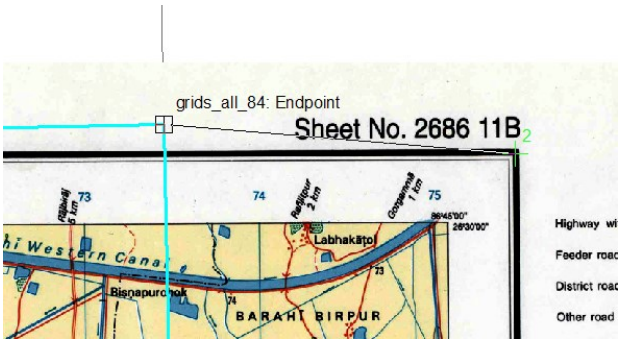
- Now, select the add control points tool



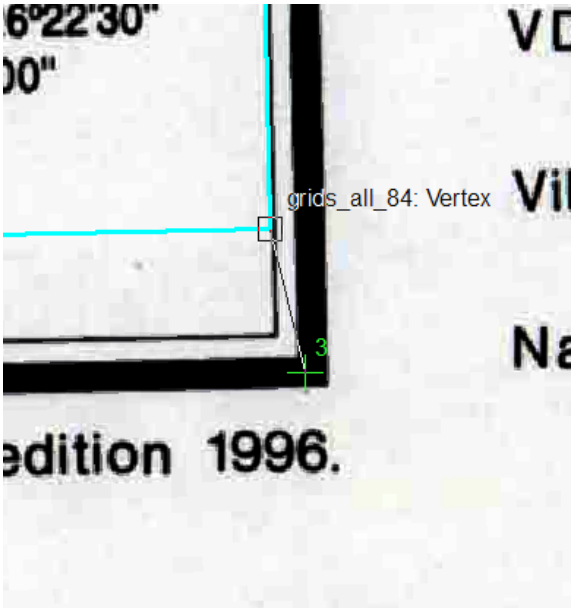

- Know the four points of the toposheets that needs to be referenced from the grid map, and start selecting them



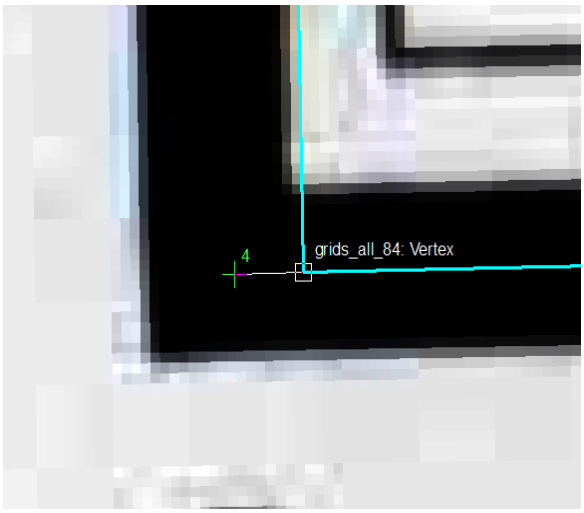

After first selection




After Second Selection

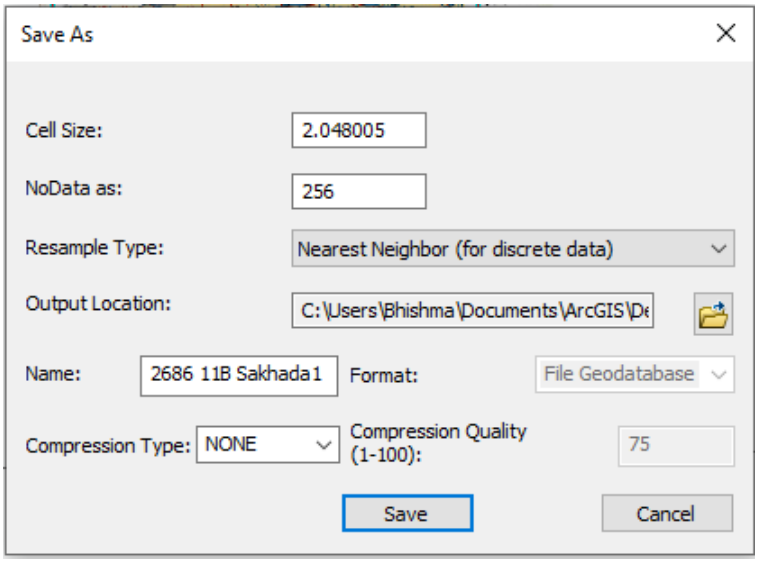



After third selection




After fourth selection

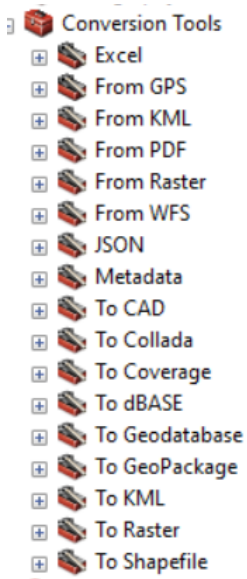
- Now the toposheet is referenced but it needs to be rectified for future use
- Select the topomap layer and then go to the georeferencing tool and select rectify, following dialogue box will appear




- Select the output location
- Change the name of the rectified toposheet and save
- Now the map is georeferenced.

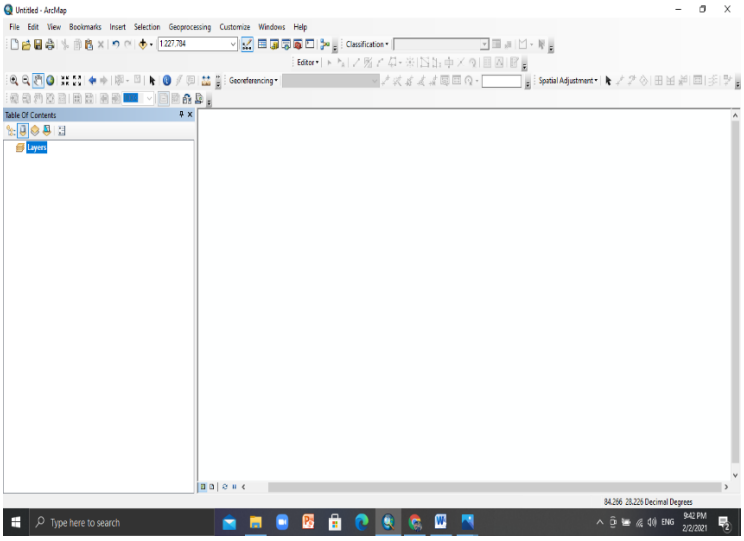
# Conversion Tools

ArcToolbox>>Conversion tools

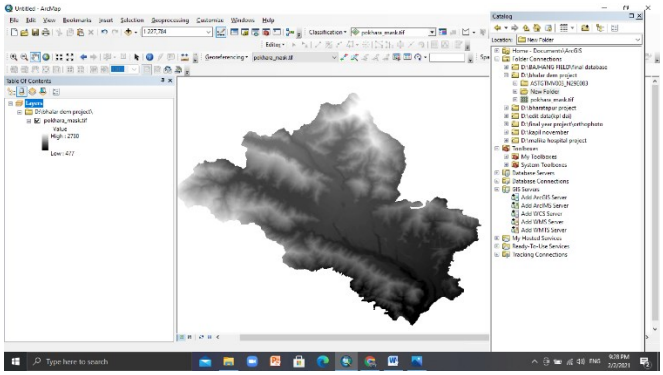


# Geospatial Analysis

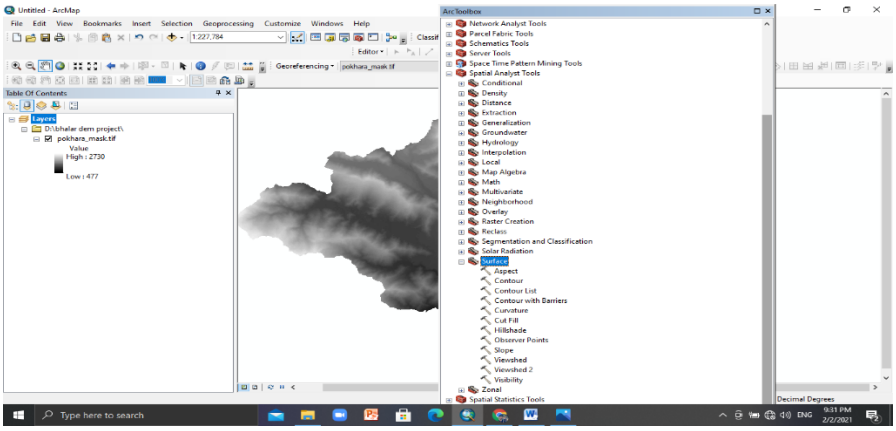
1) Open ArcMap



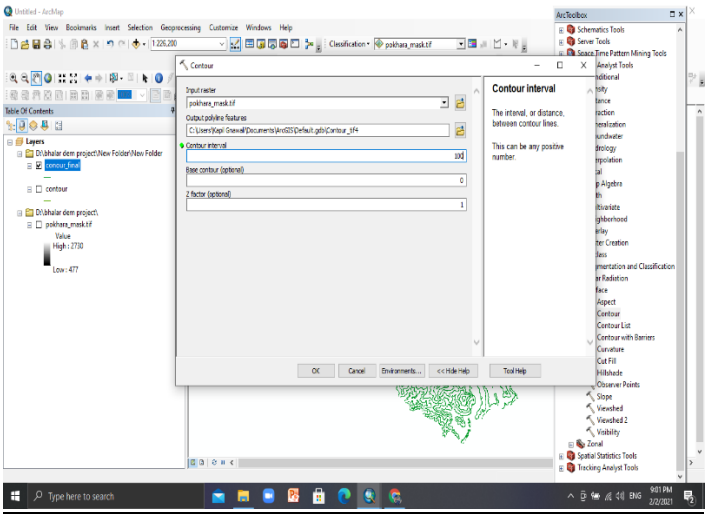
2) Load the DEM data

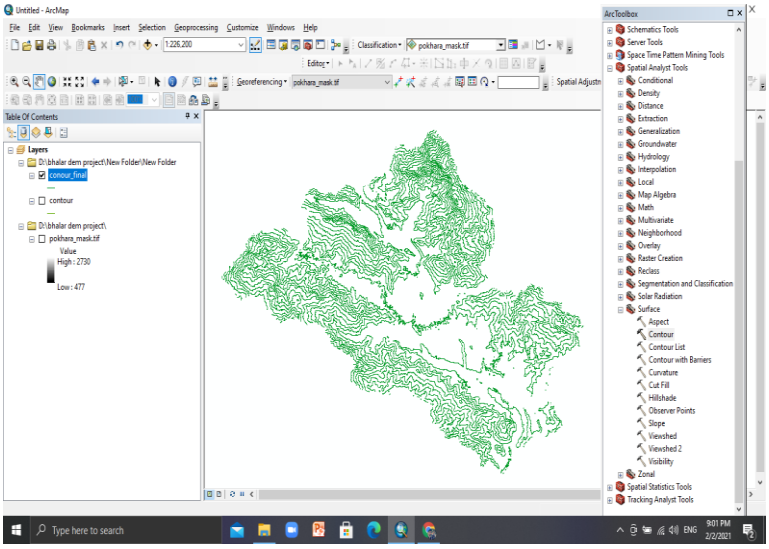


3)Go to ArcToolbox

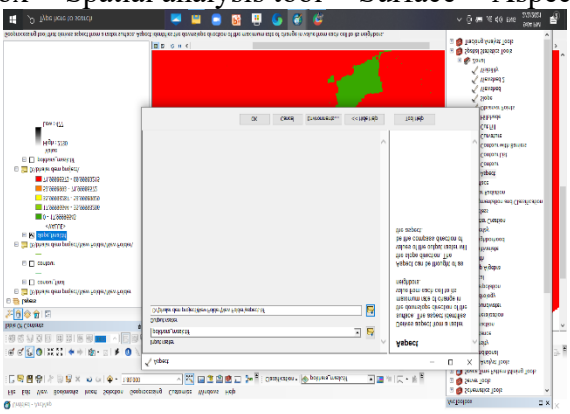


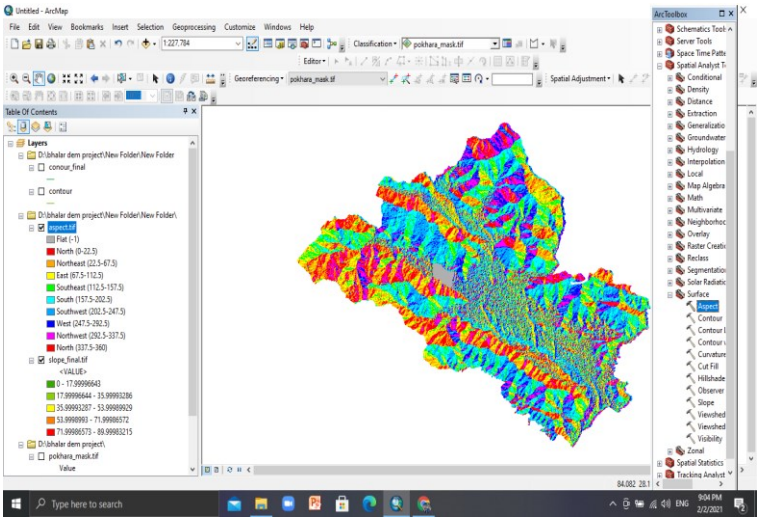
Contour>>ArcToolbox>>Spatial analysis tool>>Surface>>Contour



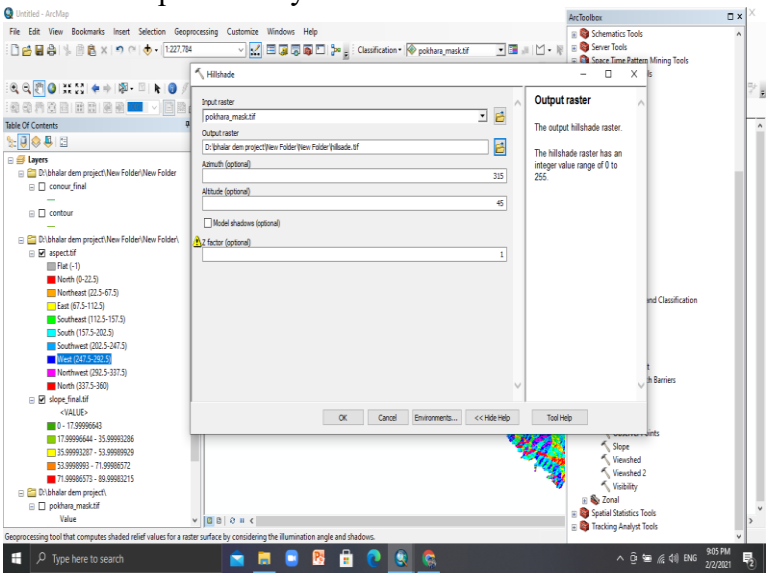


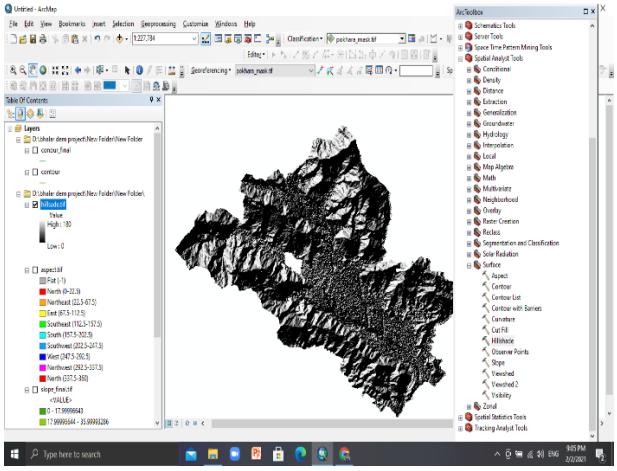
Aspect>>ArcToolbox>>Spatial analysis tool>>Surface>>Aspect



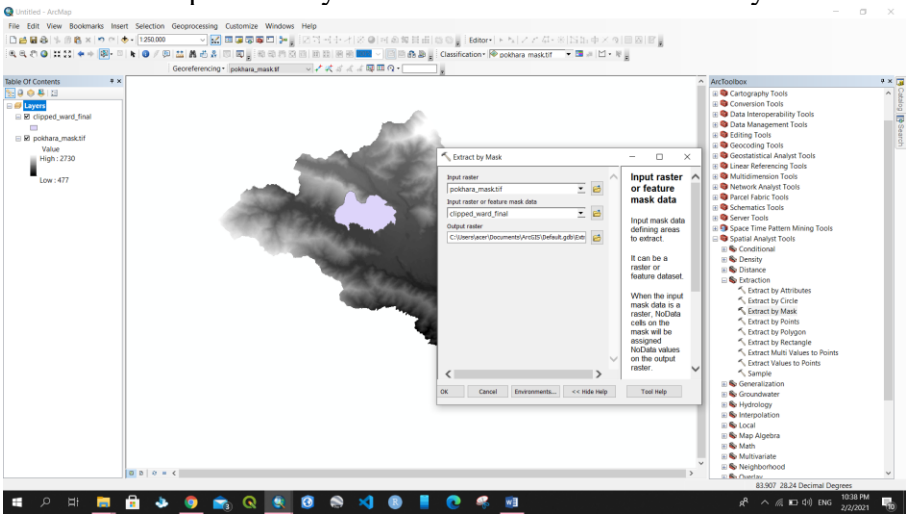


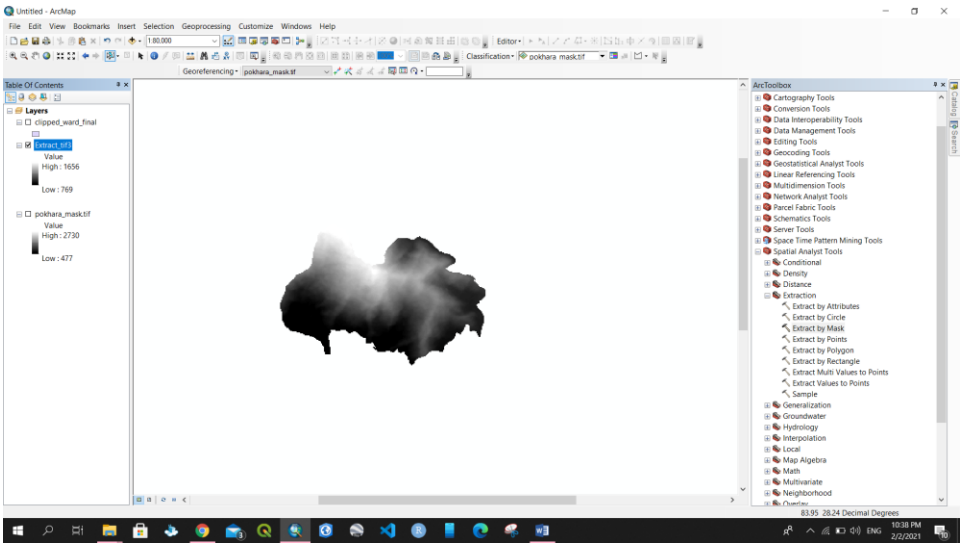
Hillshade>>ArcToolbox>>Spatial analysis tool>>Surface>>Hillshade





Mask>>ArcToolbox >>Spatial analysis tool>>Extraction>>Extract by Mask

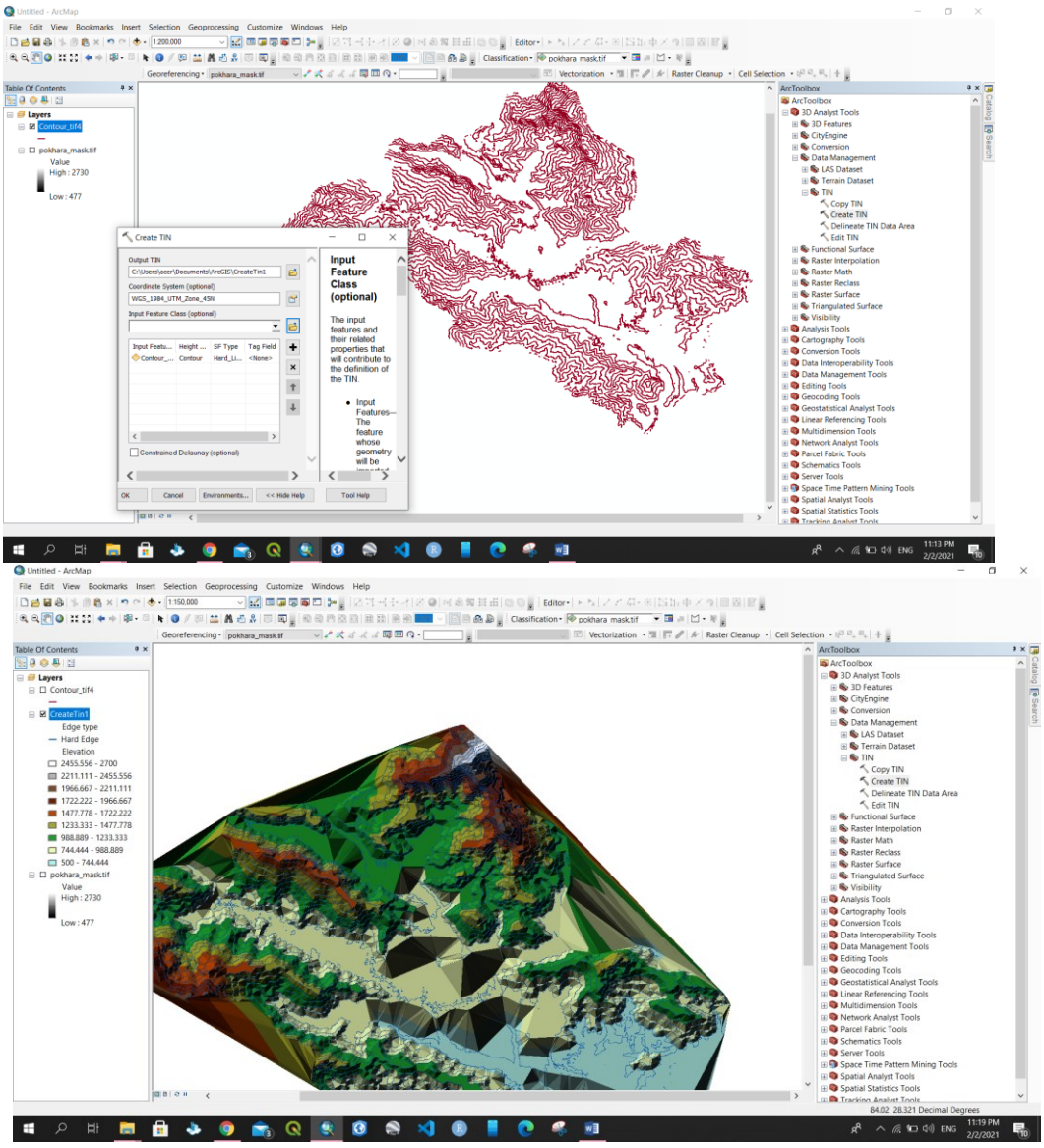




TIN

Add contour data >> arctoolbox >> 3d analysis tool >> data management tool >> TIN >>

- Output file location
- Import Projection System
- Input file class contour



# Watershed Boundary Delineation in ArcGIS

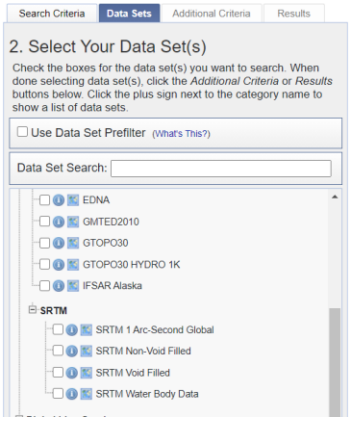
Introduction

Watershed is a land area that drains surface water to a common outlet. Watersheds, also known as basins or catchments, are physically delineated by the area upstream from a specified outlet point. Watersheds can be delineated manually using paper maps, or digitally in a GIS environment. The process outlined in this document includes steps for delineating watersheds in ESRI's ArcGIS Desktop 10.5 software.

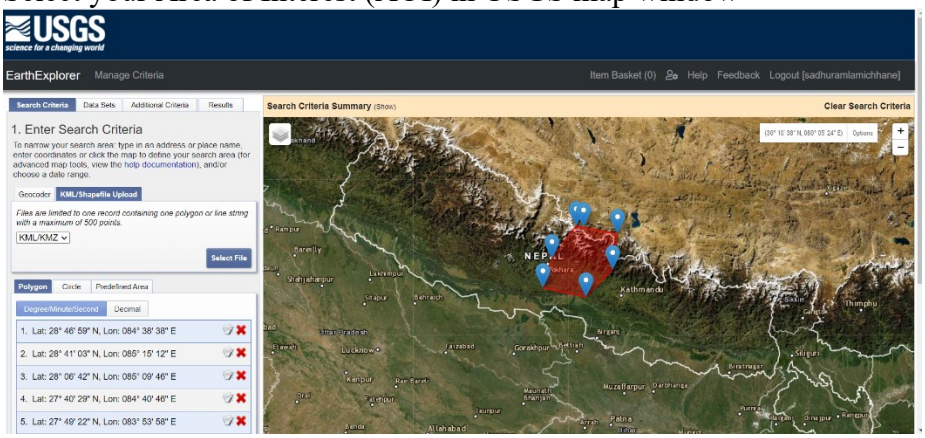
Steps to download DEM from https://earthexplorer.usgs.gov/

- Create login credentials by filling form provided by USGS

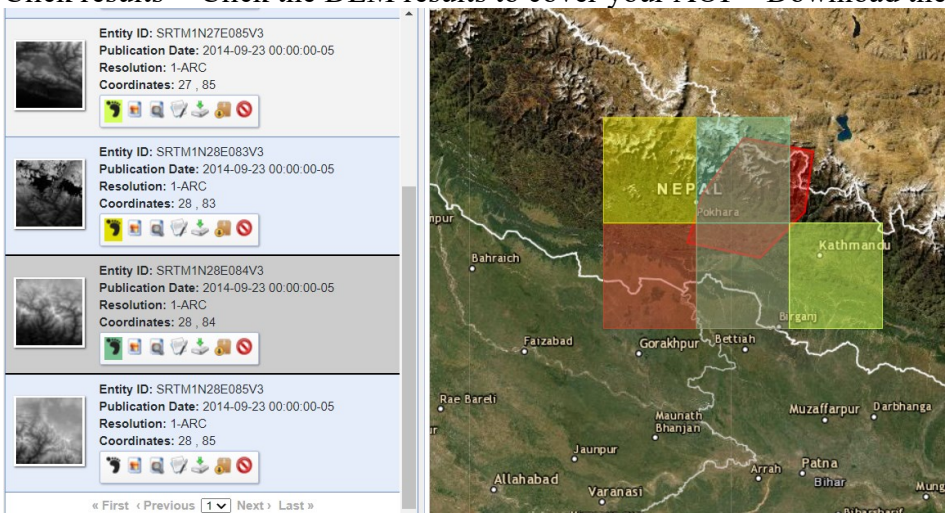
- Visualize USGS web portals and click search criteria and fill some information if necessary
- Click datasets>>Click Digital elevation>>SRTM>>SRTM 1 Arc Second Global




- Select your Area of Interest (AOI) in USGS map window




- Click results>>Click the DEM results to cover your AOI>>Download the DEM

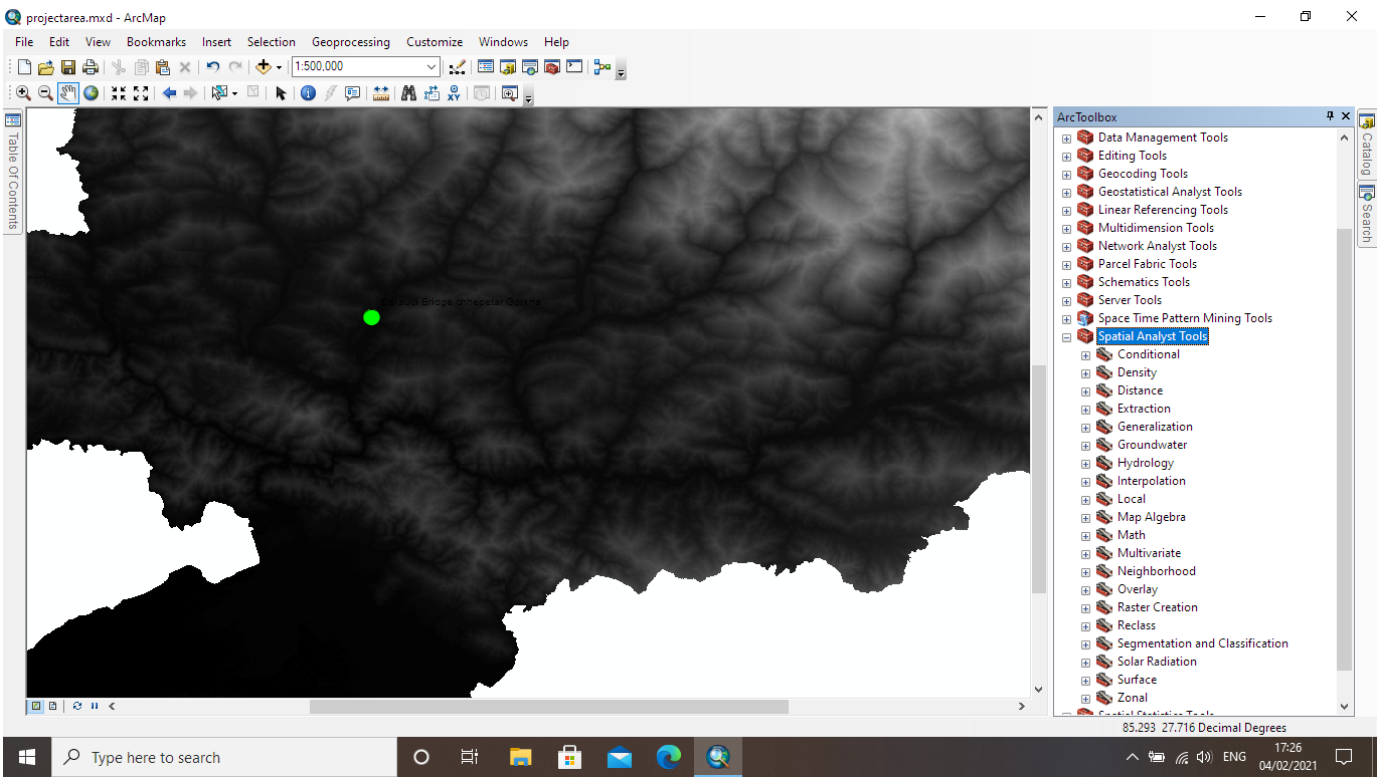


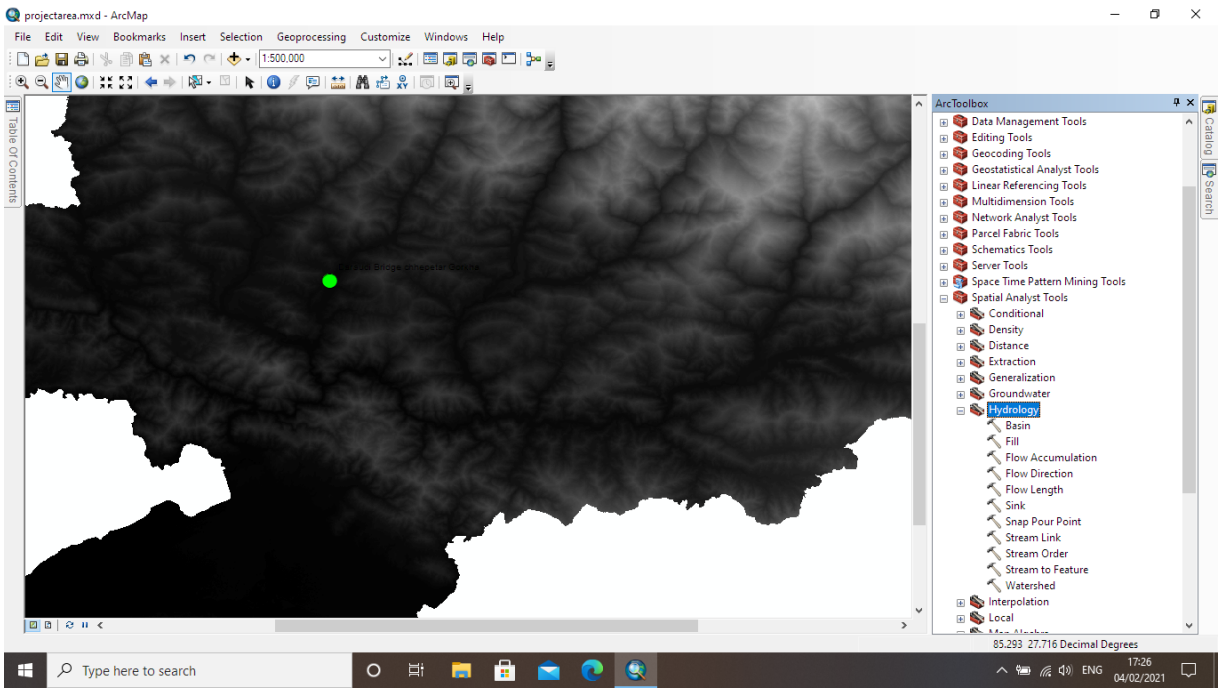
**Step 1 Set up your work environment**

Use the steps below to set up your map document and establish the working directory you will be using throughout the watershed delineation process.

1. Open ArcMap and create a new, blank map document. Use the *Add Data* button to add the DEM for your area of interest to the map.

2. Browse to *Geoprocessing> Environments*. Under *Workspace*, set the variables for *Current Workspace* and *Scratch Workspace* to the directory where you wish to save your results. It is a good idea to create an empty file geodatabase for this purpose. Further information about the file geodatabase format can be found.
3. Browse to *Environment Settings* > *Raster Analysis* and use the drop down arrow to set the *Cell Size* property to be the same as the DEM layer. Click *OK* to accept the changes.
4. If necessary, enable the Spatial Analyst extension (*Customize* > *Extensions* > *Spatial Analyst*).
5. Open *ArcToolbox* from the main menu and expand the *Spatial Analysis Tools* > *Hydrology* toolbox to view its contents.

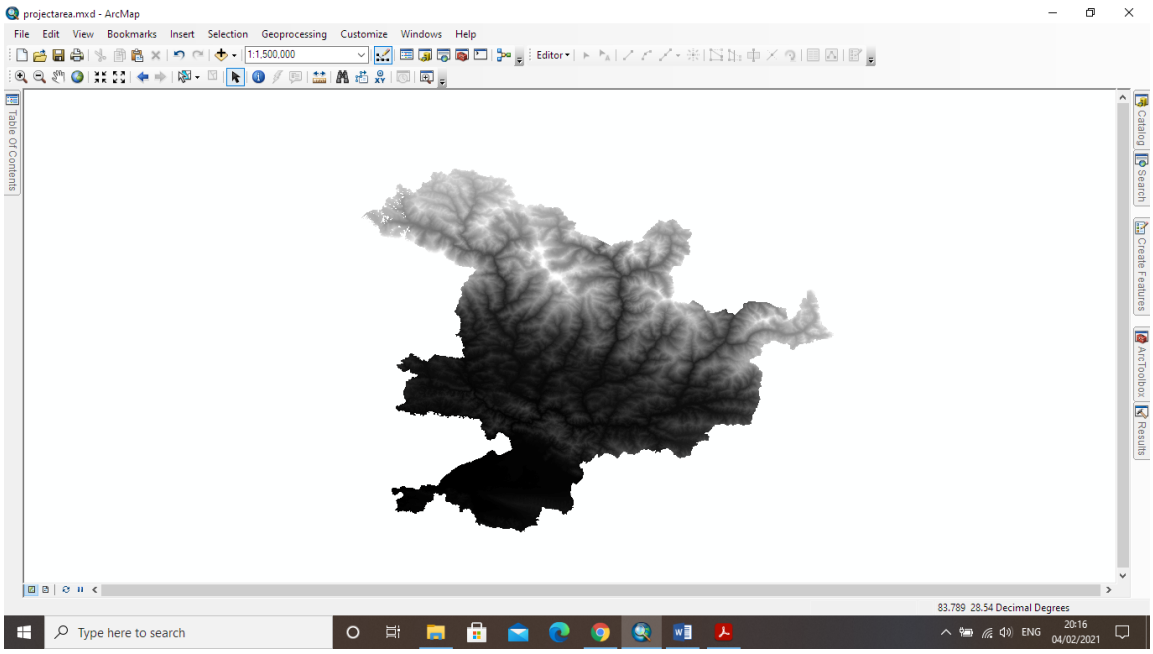





6. Save your map document (*File* > *Save*).

**Step 2 Create a depression less DEM**

1. Double click the *Fill* tool to open its dialog and enter the following parameters.
2. Set the DEM grid as the *Input surface raster*. [Screen shot]
3. If necessary, set the *Output surface raster* to your working directory and provide a descriptive name for the output.
4. Accept all other defaults and click *OK* to run the tool. This process can be resource-intensive, and may take some time to complete depending on the processing power available to the software.




***Note**: The Show Help option at the bottom of the tool dialog provides help documentation for each parameter. In this case, the optional input of Z limit has been left blank; but it is important that you make your own decisions regarding optional parameters, as every analysis is different and dependent on the data that is being used.*

When the fill process is complete, a new grid will be added to the data frame of your map document. There should be a difference in the lowest elevation value between the original DEM and the filled DEM.

You can now remove the original DEM layer from the map view (right-click > *Remove*) and save your map document.

**Step 3 Create a flow direction grid**

A flow direction grid assigns a value to each cell to indicate the direction of flow –that is, the direction that water will flow from that particular cell based on the underlying topography of the landscape. This is a crucial step in hydrological modelling, as the direction of flow will determine the ultimate destination of the water flowing across the surface of the land.

Flow direction grids are created using the Flow Direction tool. For every 3x3 cell neighbourhood, the grid processor finds the lowest neighbouring cell from the centre. Each number in the matrix below corresponds to a flow direction –that is, if the centre cell flows due north, its value will be 64; if it flows northeast, its value will be 128, etc. These numbers have no numeric meaning –they are simply codes that define a specific directional value, and are determined using the elevation values from the underlying DEM.

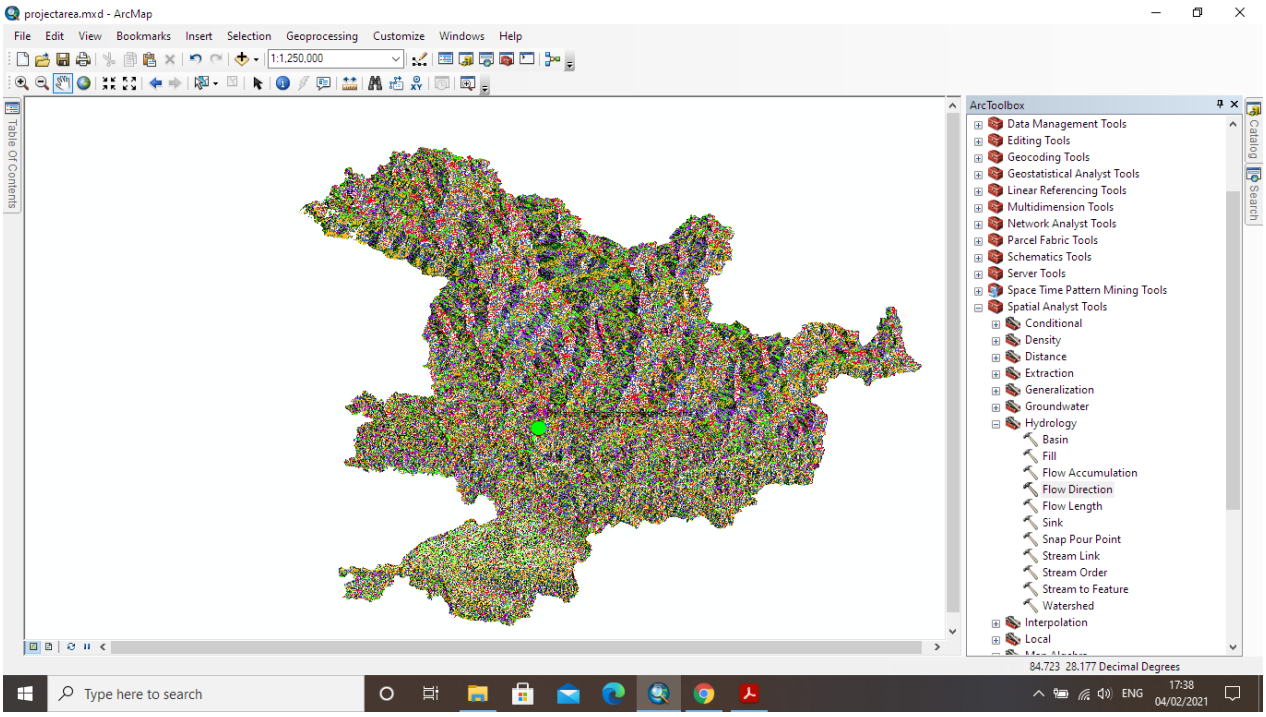
Double-click the *Flow Direction* tool to open the tool dialog and input the following parameters.

1. Set the *Input surface raster* to the filled DEM created in the Step 2.

2. If necessary, set the *Output flow direction raster* to your working directory and provide a descriptive name for the output file.

3. Browse to *Environment Settings* > *Raster Analysis* and confirm that the *Cell Size* parameter is set to the same as your filled DEM. Click *OK* to run the tool.

This process may take quite some time to run through to completion. When the tool has finished, the new flow direction grid will be added to the map document.




**Step 4 Create a flow accumulation grid**

The *Flow Accumulation* tool calculates the flow into each cell by identifying the upstream cells that flow into each downslope cell. In other words, each cell's flow accumulation value is determined by the number of upstream cells flowing into it based on landscape topography.
Double-click the *Flow Accumulation* tool to open the tool dialog and input the following parameters.

1. Set the *Input flow direction raster* to the flow direction grid created in Step 3.

2. If necessary, set the *Output accumulation raster* to your working directory and provide a descriptive name for the output.

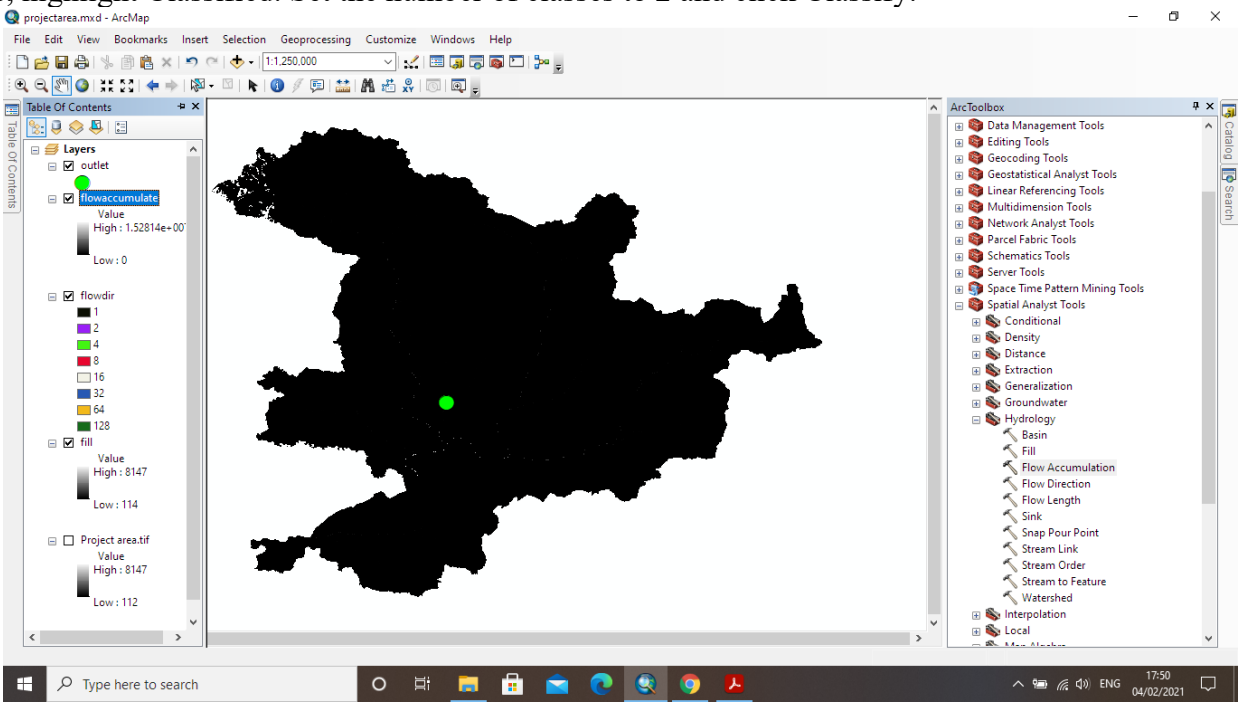
3. Browse to *Environment Settings* > *Raster Analysis* and confirm that the *Cell Size* parameter is set to the same as your filled DEM. Click *OK* to run the tool.

The new flow accumulation raster will be added to your map document. Each cell in the grid contains a value that represents the number of cells upstream from that particular cell. Cells with

higher flow accumulation values should be located in areas of lower elevation, such as valleys or drainage channels where water flows naturally while it is following the landscape.

If the flow accumulation raster appears dark and the cell values are difficult to visualize then it will be necessary to alter the layer symbology.

Right-click the layer name in the table of contents and select Properties > Symbology. In the left pane, highlight Classified. Set the number of classes to 2 and click Classify.

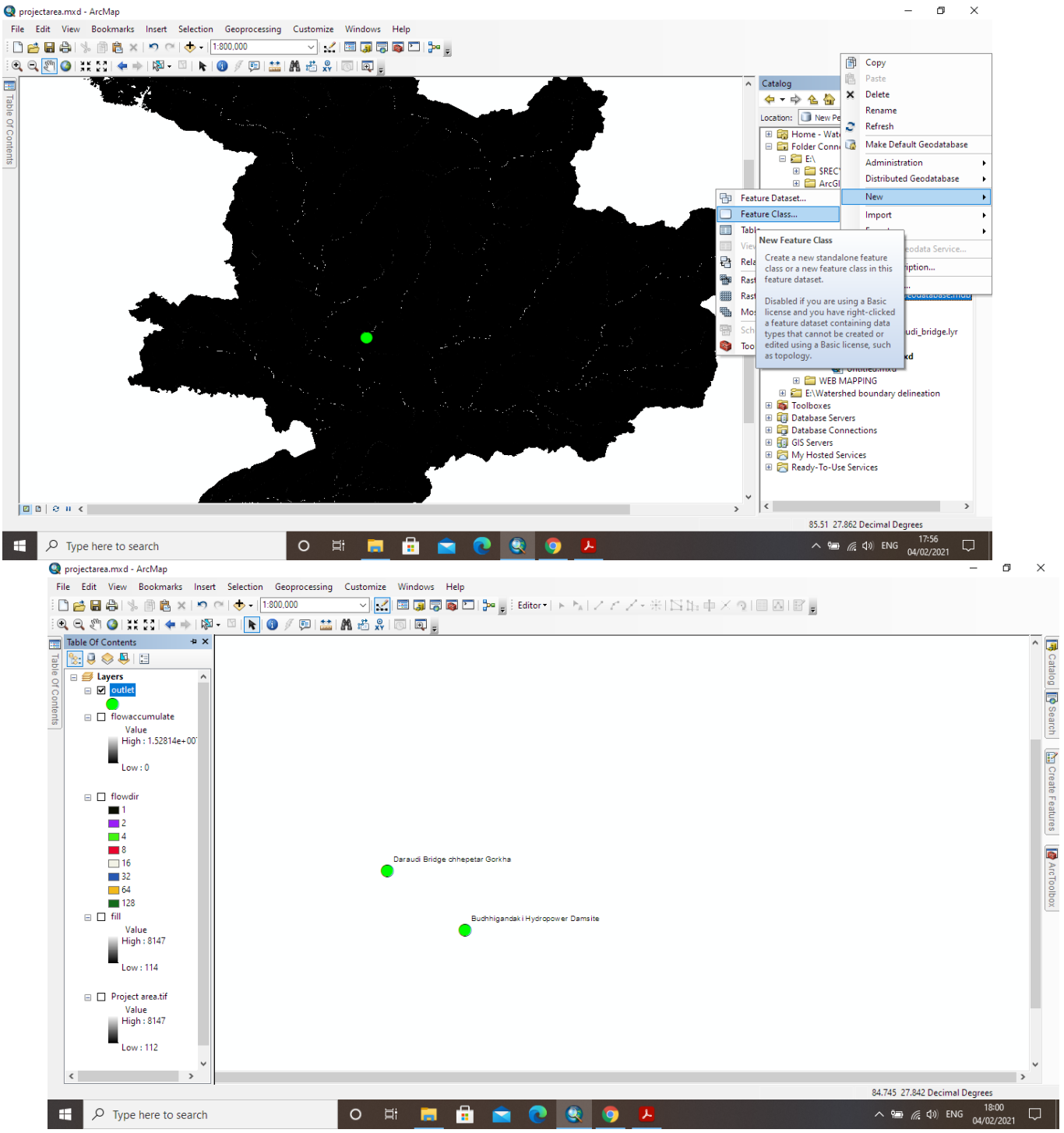



**Step 5 Create outlet (pour) points.**

Pour point placement is an important step in the process of watershed delineation. A pour point should exist within an area of high flow accumulation because it is used to calculate the total contributing water flow to that given point. In many cases you will already have a file containing the locations of your pour points, whether they are sampling sites, hydrometric stations, or another data source. However, in some cases, it may be necessary or preferable to create pour points manually. Instructions have been provided for both cases below.

a. ***Loading pour points from an existing file*** Add the point file containing pour point locations to your map document along with the flow accumulation grid created in Step 4. Zoom in to each point (or a random sample of points) to determine if they fall on a path of high flow accumulation. As mentioned, if the pour points are not situated in cells of high flow accumulation then the resulting watersheds will be excessively small. Assuming that your pour points are situated correctly, move on to Step 6.

b. ***Creating pour points through visual inspection*** Open the ArcCatalog window and create a new point file in your working directory (right-click the directory in the Catalog tree and select *New* > *Feature Class* if you are working from a geodatabase, or *New* > *Shapefile* you are working from a folder). Give the file a descriptive name and apply the appropriate coordinate system for your data. Click OK to add the new point layer to the map document.




## Step 6 Snapping pour points

The *Snap Pour Point* tool accomplishes two things; it snaps the pour point/s created in Step 5 to the closest cell of high flow accumulation to account for any error during placement, and it converts the pour points to raster format for input to the *Watershed* tool.
Double click the *Snap Pour Point* tool to open its dialog and enter the following parameters.
1. Set the *Input raster or feature pour point data* to the pour point layer created or loaded in Step 5.

2. Set the *Pour Point Field* to the UNIQUEID field created in Step 5 (only applicable when delineating multiple watersheds).

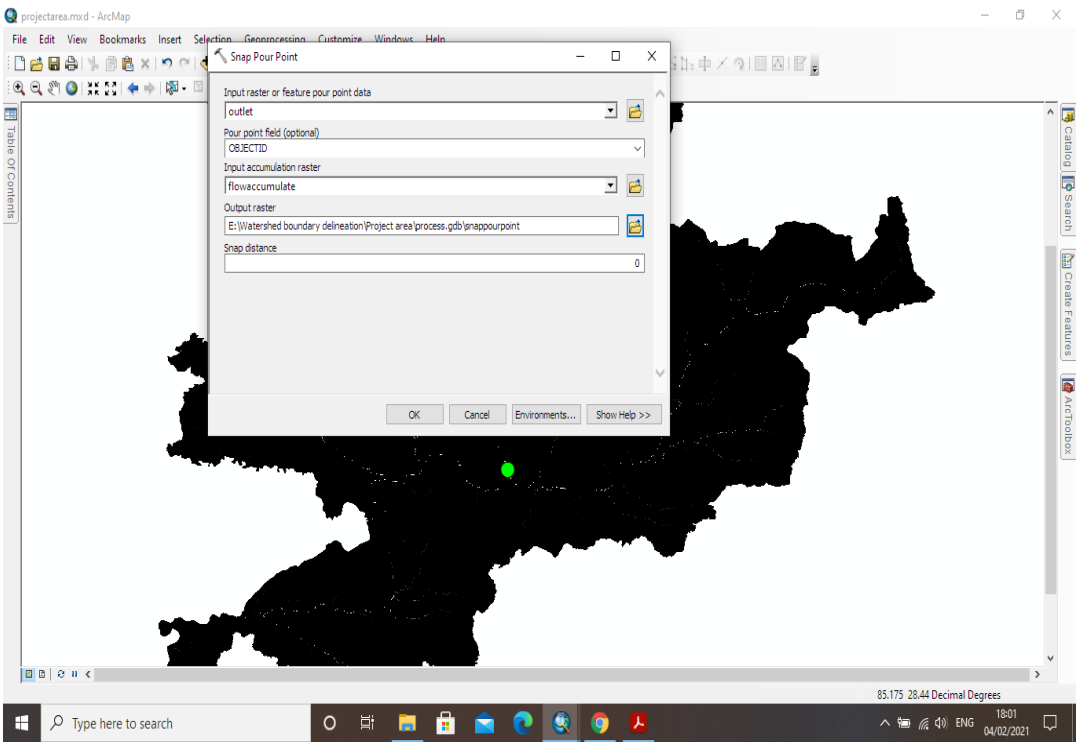
3. Set the *Input accumulation raster* to your flow accumulation grid created in Step 4.

4. Set the *Output raster* to your working directory and give the output a descriptive name.

5. The *Snap Distance*s the specified distance (in map units) that the tool will use to search around your pour points for the cell with the highest flow accumulation value. The snap distance should be based on the resolution of your data; it may require some trial and error to determine the best value. If your pour point is not located on a high flow pathway, the tool will move it to the cell within the search radius with the highest accumulation value. If your pour point is already located on the high flow pathway, then the tool will move the point to a downstream cell within the search radius. If it is important that your points remain at the exact cell location of initial placement, then run the tool with a snap distance of 0.

6. Browse to *Environment Settings* > *Raster Analysis Settings* > *Cell Size* and ensure that the cell size is set to the same as your flow accumulation layer.

Click OK to run the tool. The output will yield raster file of pour points that will be added to the map document.




**Step 7 Delineate watersheds**

Double-click the *Watershed* tool to open the tool dialog and set the parameters as follows.

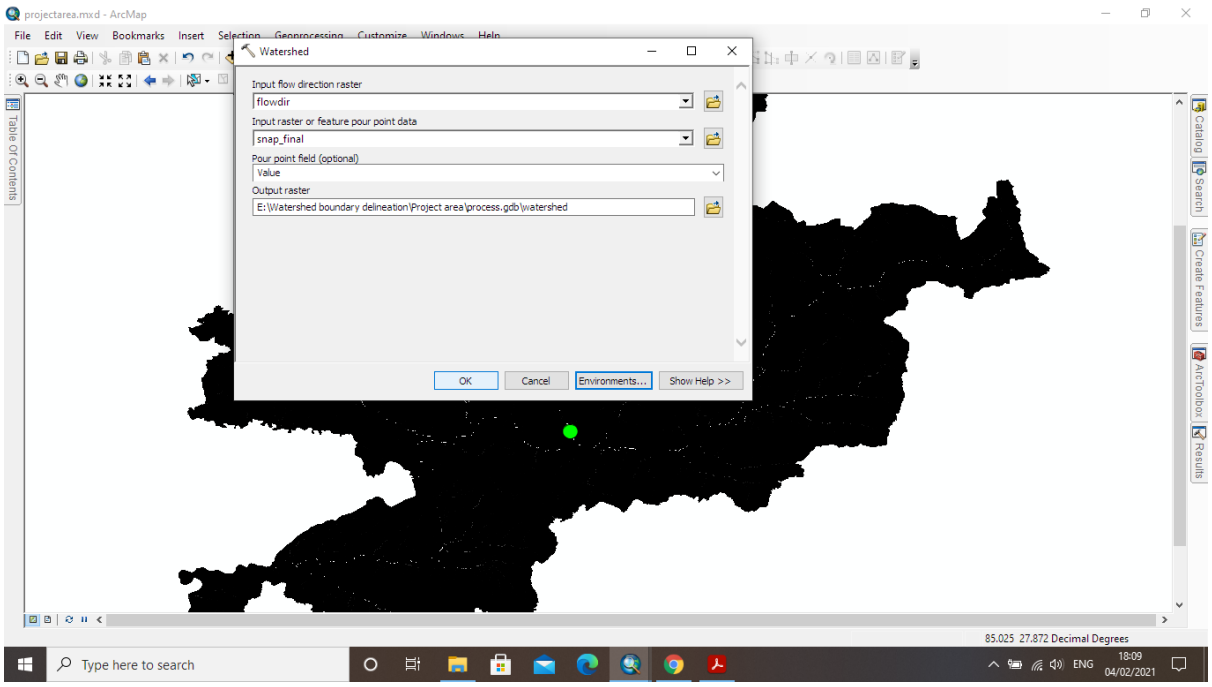
1. The *Input flow direction raster* is the flow direction raster output in Step 3, or the enhanced flow direction grid provided with the OMNRF data package.

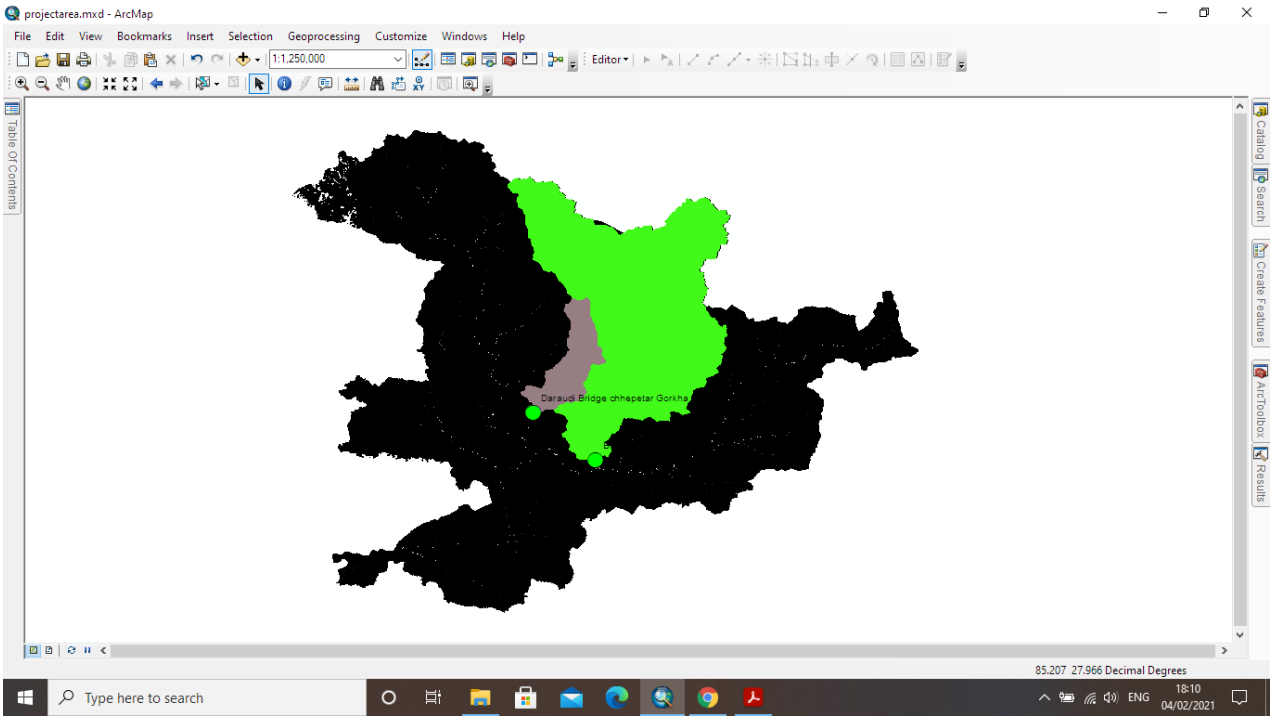
2. The *Input raster or feature pour point data* is the raster pour point file created in Step 6.

3. The *Pour point field* can be left as default, or optionally you may choose to select the UNIQUEID field created in Step 5.

4. If necessary, set the *Output raster* to your working directory and provide a descriptive name for the output file.

Click OK to run the tool. Upon completion, a new watershed raster will be added to your map document.




## Step 8 Convert watershed rasters to polygons

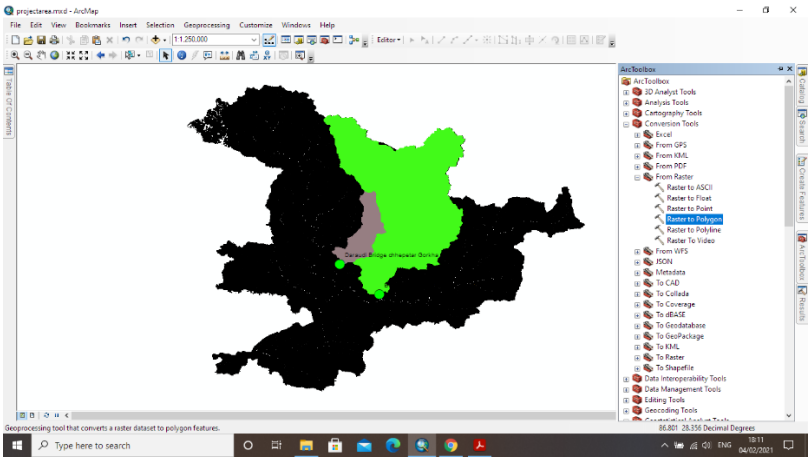
Most users will find vector watersheds more useful than raster files in order to run further geoprocessing and analyses. Raster files can be converted to vector format using the *Raster to*

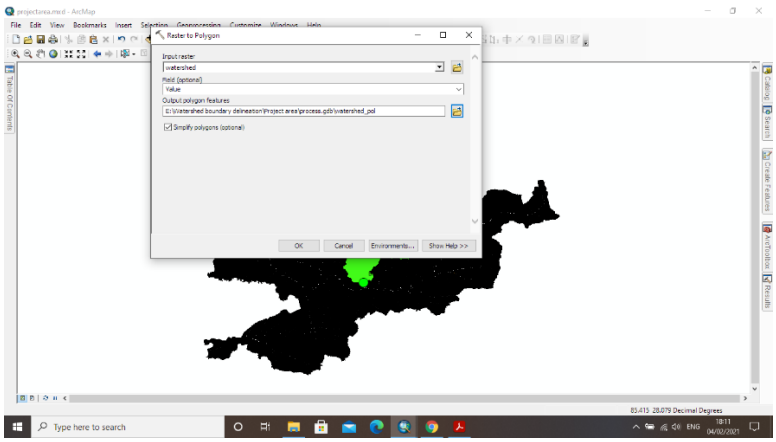
*Polygon* tool (*ArcToolbox* > *Conversion* > *From Raster*). Double-click the tool to open its dialog and enter the parameters as follows.

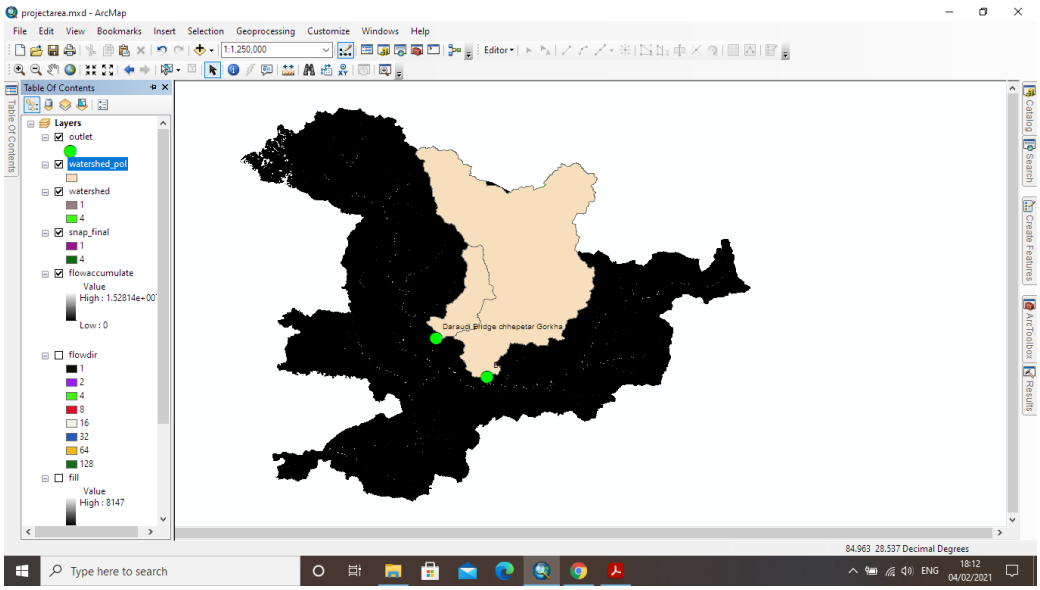
1. Set the *Input raster* to the watershed raster file created in Step 7.

2. If necessary, set the *Output polygon features* to your working directory and give the output a descriptive name.

Leave all other defaults and click *OK* to run the tool. A new polygon file displaying your watersheds will be added to the map document.





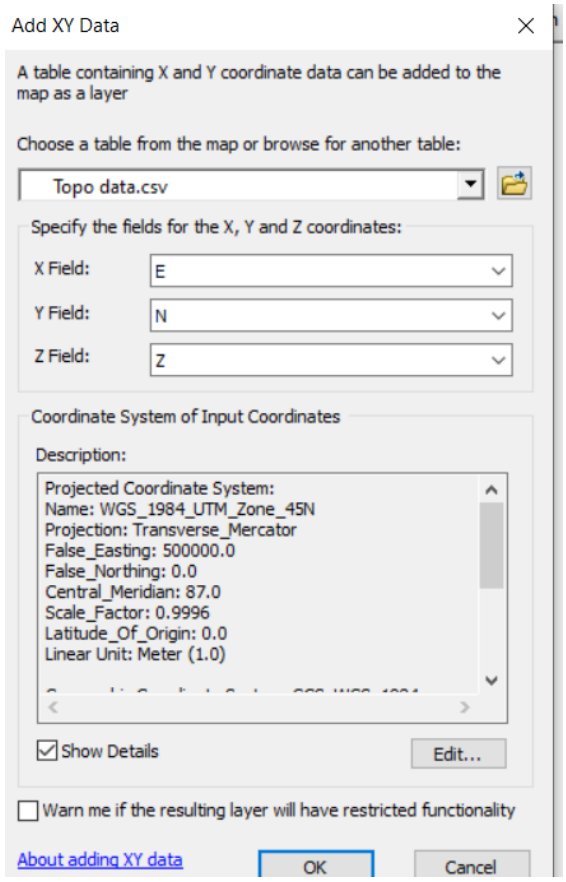



**Note: Calculate watershed area**

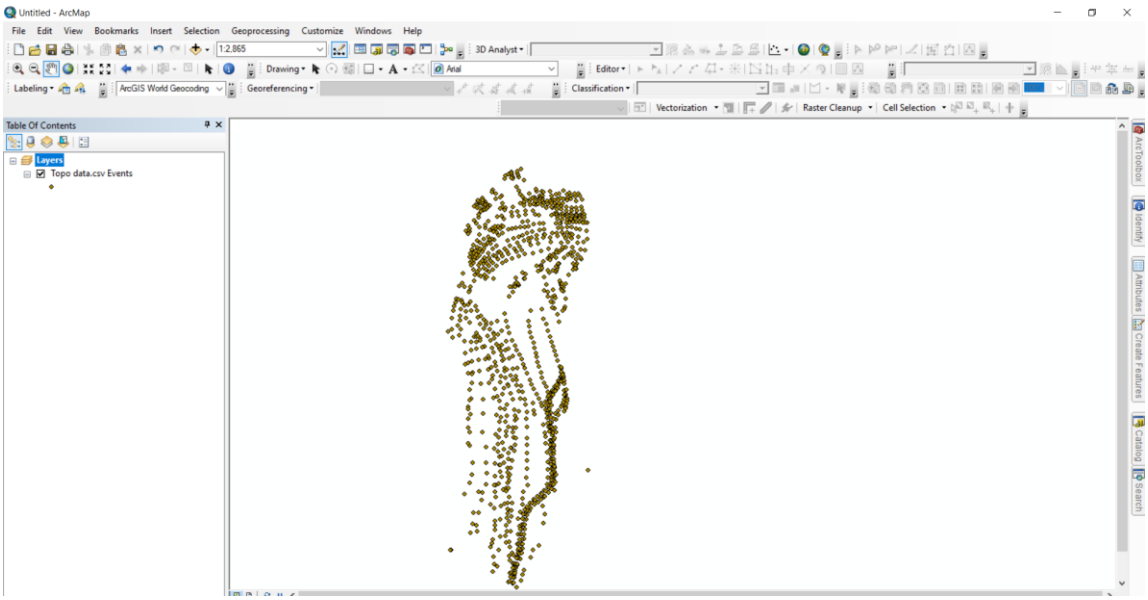
**To calculate drainage area, at first, project the polygon layer of watershed into projected coordinate system. Then, add a field named *Drainage_area* of type *long* in attribute table of the layer. Then, right click on the field named *Drainage_area* and calculate geometry in desired units as Sq. m or Sq.km or Sq. miles or other.**

## Map Layout and Map presentation

- Open Topo Map folder>>Open Topo data.csv file and check your data formats
- Open blank map in ArcMap window>>File>>Add data>>Add XY data>>Select Topo data.csv file
  X field: E
  Y field: N
  Z field: Z




- Select suitable coordinate system: For this data select **Projected Coordinate System**: WGS_1984_UTM_Zone_45N; **Geographic Coordinate System**: GCS_WGS_1984.
- Follow the path: Edit>>Projected Coordinate system>>UTM>>WGS1984>>Northern Hemisphere>> WGS_1984_UTM_Zone_45N.



- Click catalog>>Connect your folder>>Create personal geodatabase>>Create feature dataset and class if necessary.
- Layer>> Click Topodata.csv events>>Right Click>>Data>>Export Data>>Save the layer in your database.
- Click editor>>Start editing >>by clicking create features you can create the features.
- Create raster surfaces by: Data management tools>>Raster interpolation>>Topo to raster…..>> ok
- Create Contour from interpolated raster surface>> Data management tools>>Raster surface>>Contour>>Contour Interval>>Base Contour>> ok
- Smooth contour by smoothing tools: ArcToolbox>>Cartography Tools>>Generalization>>Smooth line>>ok
- Observe the contour difference between the original and the smoothen.
- Also, smooth contour using different Smoothing Tolerance and observe the difference.
- Try different color ramp to visualize height.
- Use clip tool to clip contours inside the boundary
- Observe the contour difference between the original and the smoothen one.
- Also, smooth contour using different Smoothing Tolerance and observe the difference.
- Try different color ramp to visualize height.
- Use clip tool to clip contours inside the boundary.
- Creating Layout and printing map

**For Layout**

- Right click on screen and data frame properties>>Click on data frame and click on fixed scale, define required scale and click on Apply ok.
- Click on layout view>>Click on ***Insert*** and add title, legend, north arrow, scale bar etc.
- Design appropriate layout for your map.
- Export map: Main menu>>Export Map pdf/jpeg format.

Map Elements