

LAOS CARAVAN Training

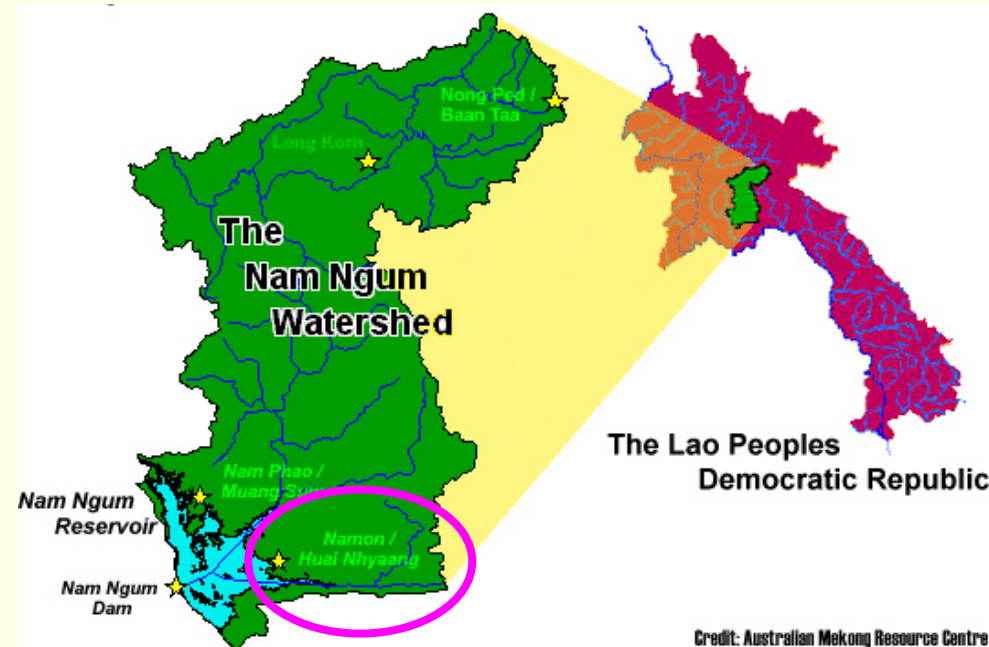
Case Study
29 Nov 2005

Watershed Management

- Objective:
 - Discuss watershed management aspect based on soil erosion
 - Land cover/use extraction, DEM creation, soil erosion and GIS analysis planning support for planner
 - Capacity building for local staffs on the use of GIS and Remote Sensing for watershed management

Study area

- NamNgum watershed
- NamNgum Dam have two main upstream as show in figure.
- Case study was based on the watershed loacted at of the Dam.



DATA



RS and GIS data

RS data

- Landsat
 - Path 128 Row 47 → 27 Dec 1999
- JERS OPS
 - Path 124 Row 269 → 27 Dec 1995
 - Path 124 Row 269 → 30 Oct 1996
 - Path 124 Row 269 → 24 Apr 1997

GIS Data

- Layers
 - Land use 1993 and 1997
 - River network
 - Road network
 - Villages with population data (spreadsheet)
 - Contour
 - Province boundary and
 - District boundary

Using RS & GIS

- Update landuse
- Extract watershed boundary
- Create terrain data: elevation, surface
- Generate the drainage network
- Evaluate the soil erosion in watershed area
- Carry out Spatial analysis

Hands-On Content

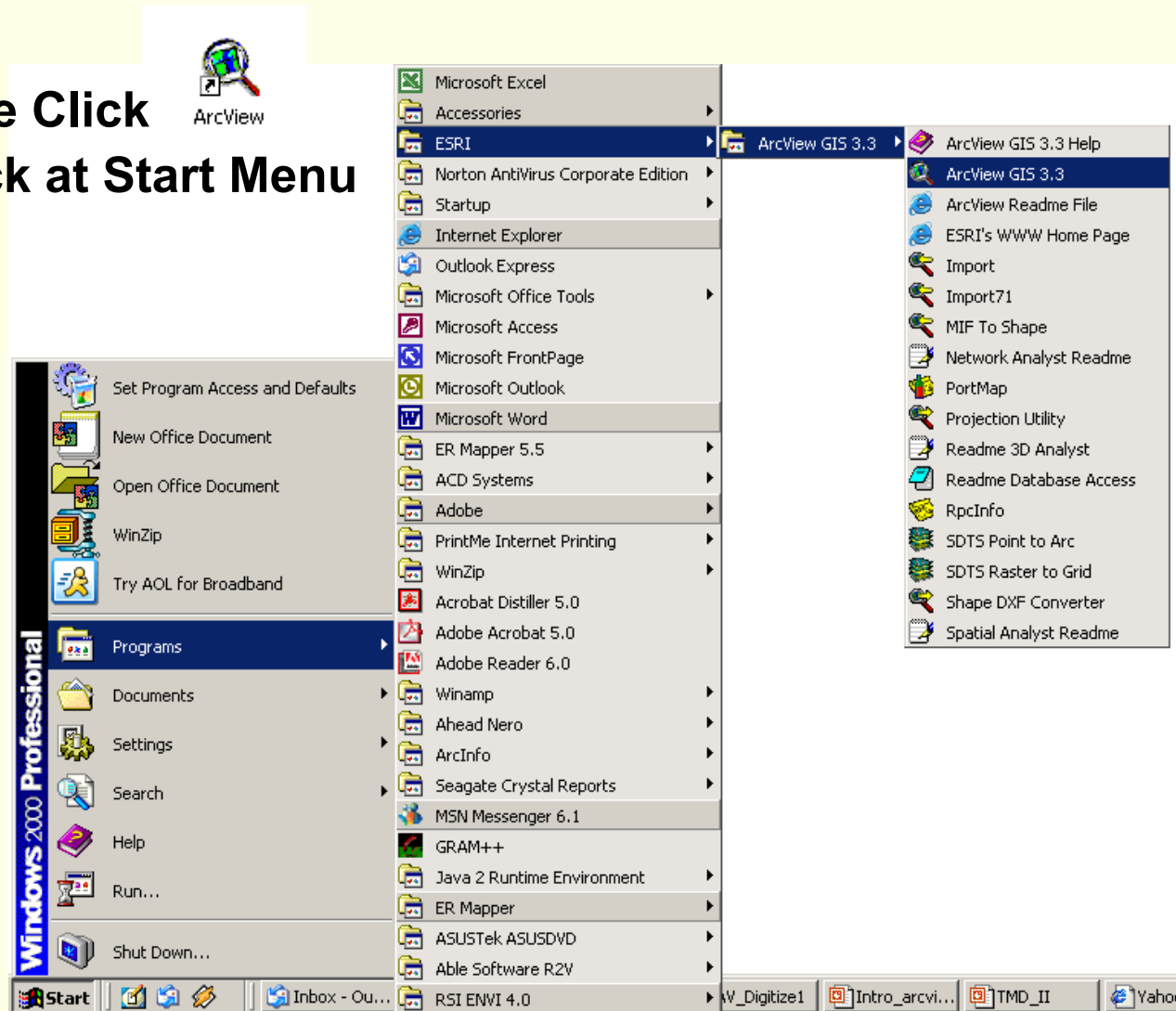
- Introduction ArcGIS and Data Creation/Handling
- Landuse Classification: Visual Screen Editing
- Watershed Extraction
- GIS Analysis
 - 3 D analyst and Spatial Analyst
- Applying Parameters
 - Landuse, Slope and Transportation
- Case study area extraction

Introduction ArcView

Data Creation/Handling

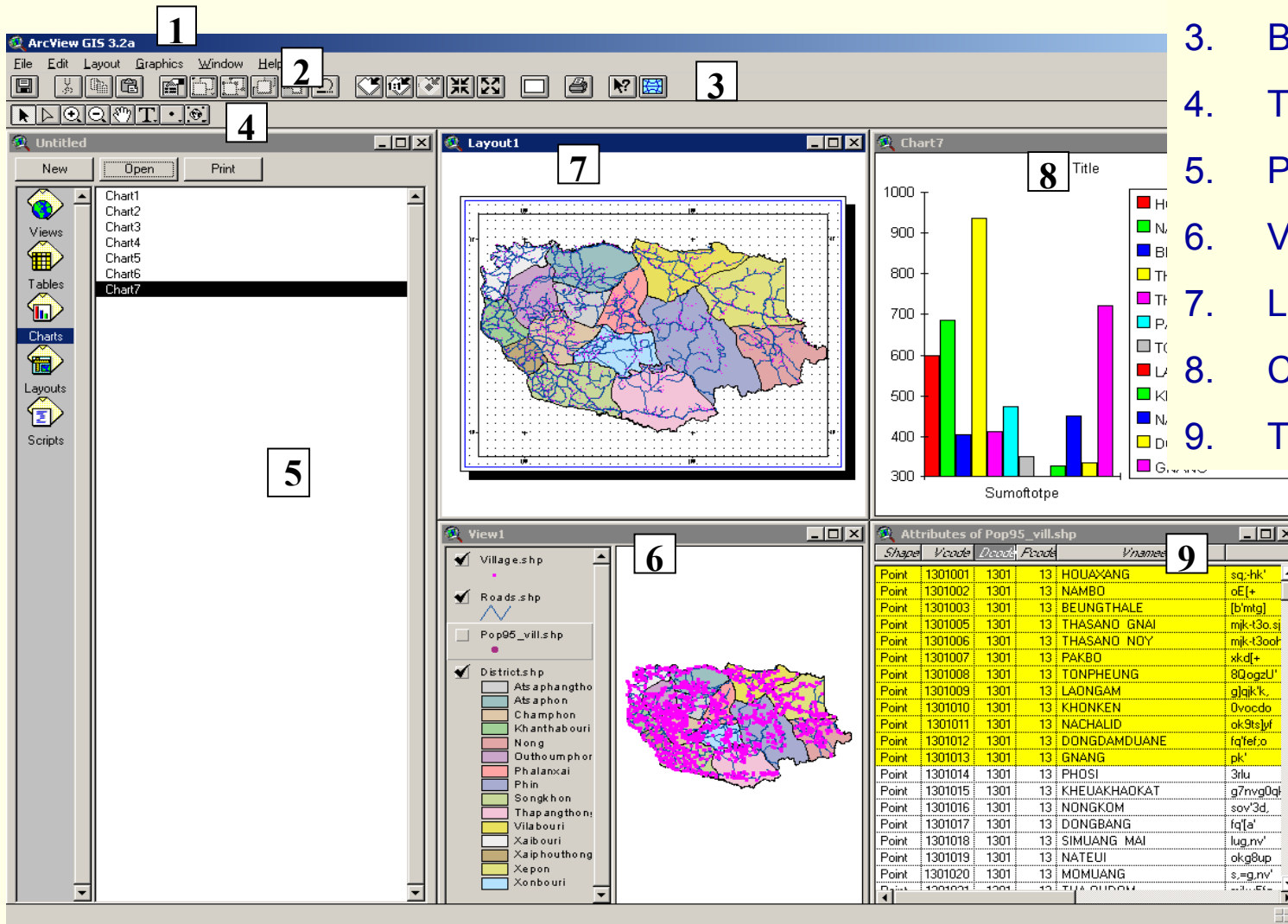
I. Overview of Arcview Software

- Double Click 
- Or click at Start Menu

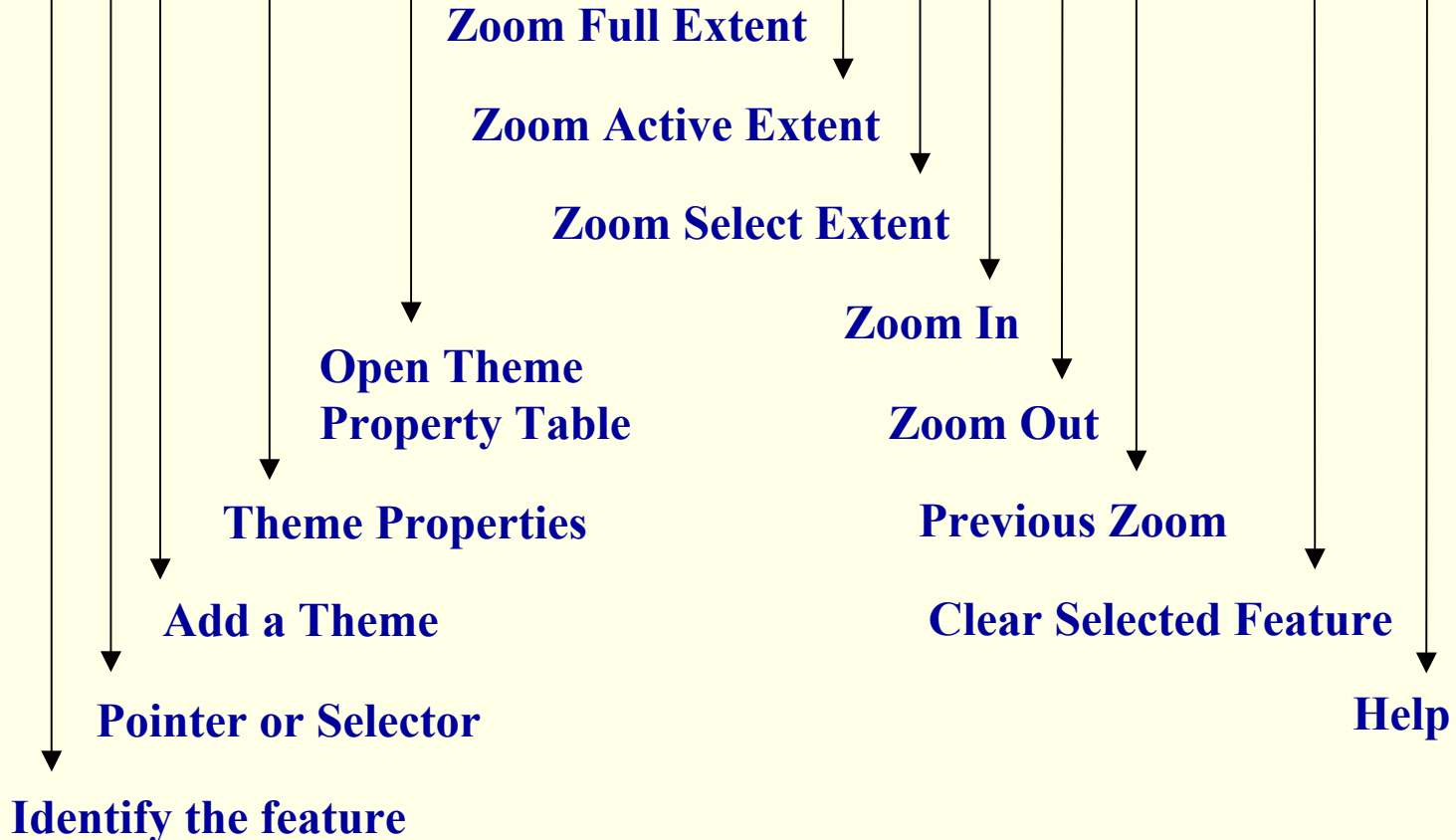
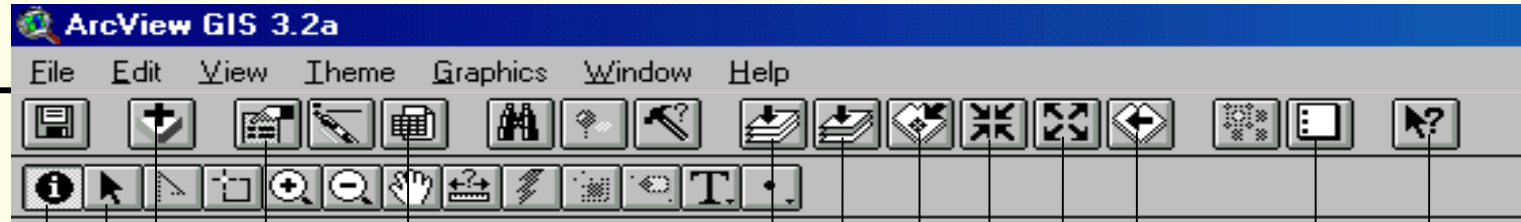


1.1 Arcview Components

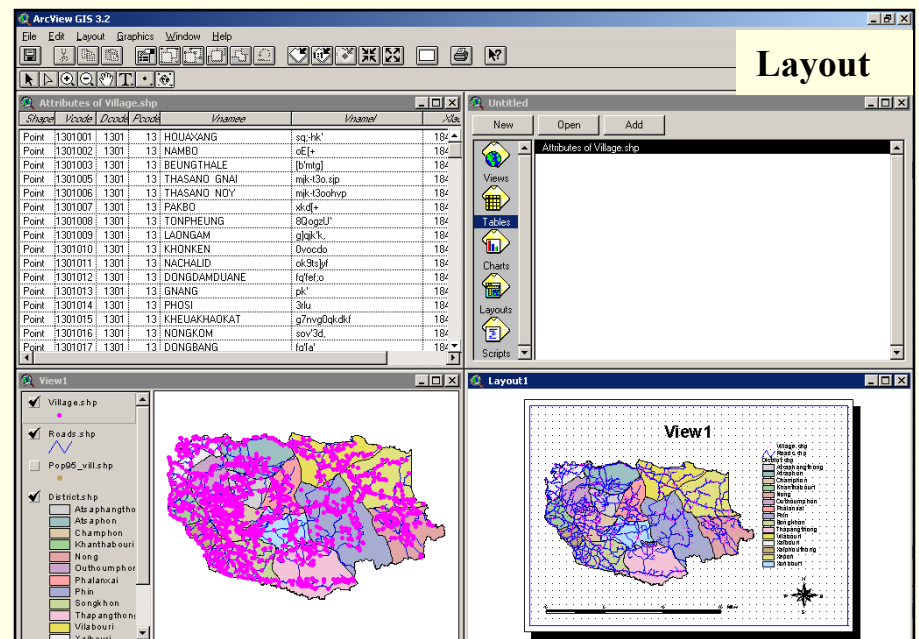
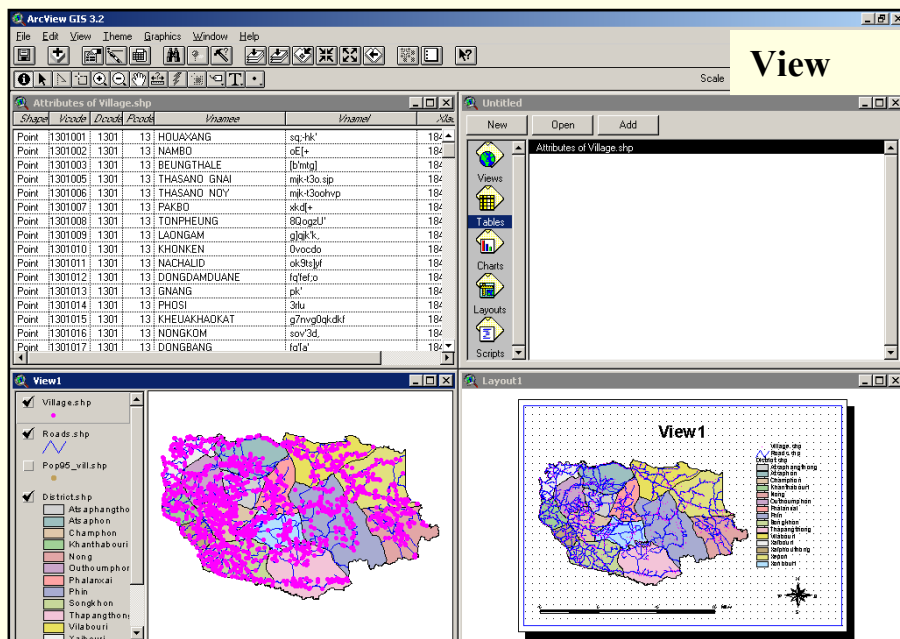
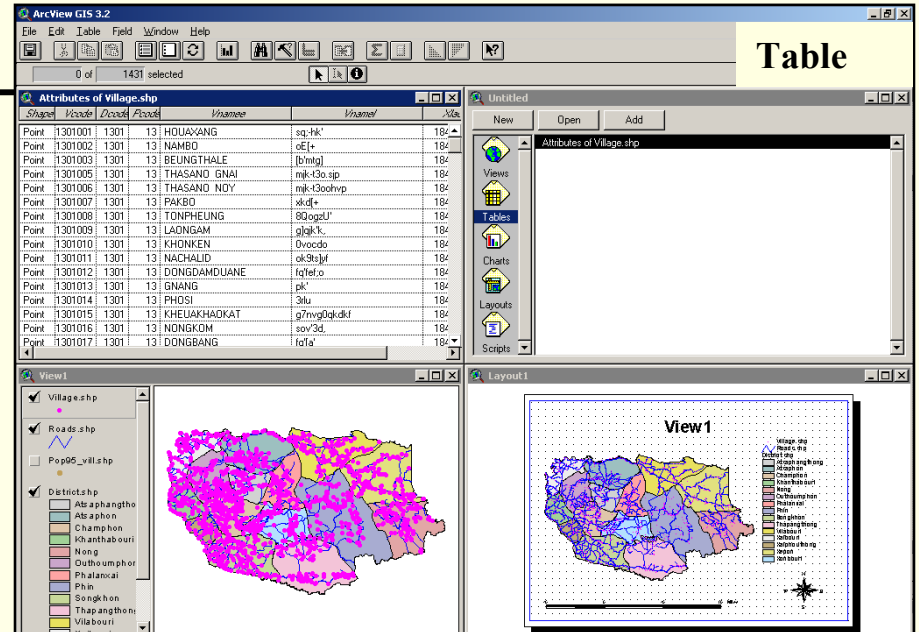
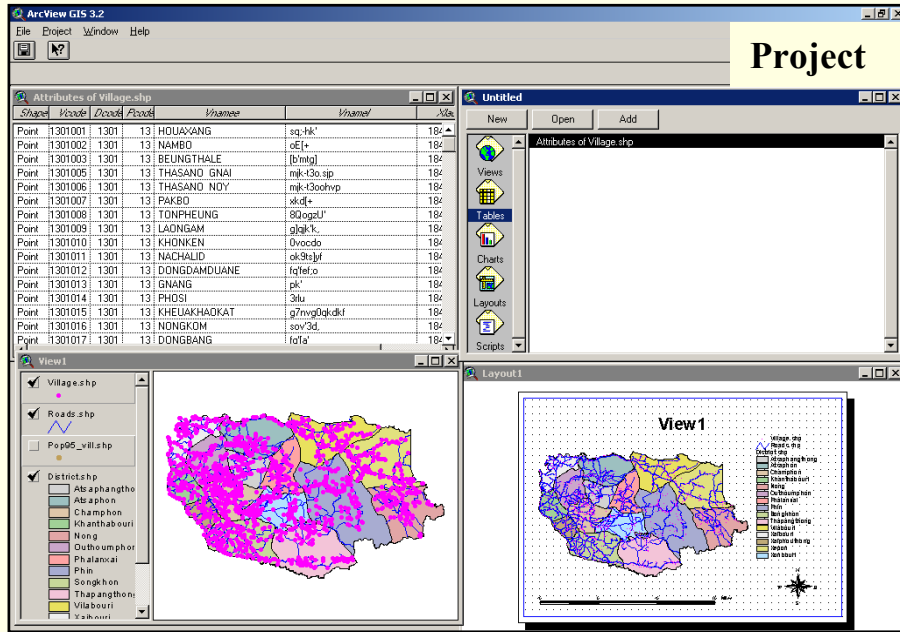
1. Application Window
2. Menu Bar
3. Button Bar
4. Tool Bar
5. Project Window
6. View Window
7. Layout Window
8. Chart Window
9. Table



1.2 Graphical User Interface (GUI) for View

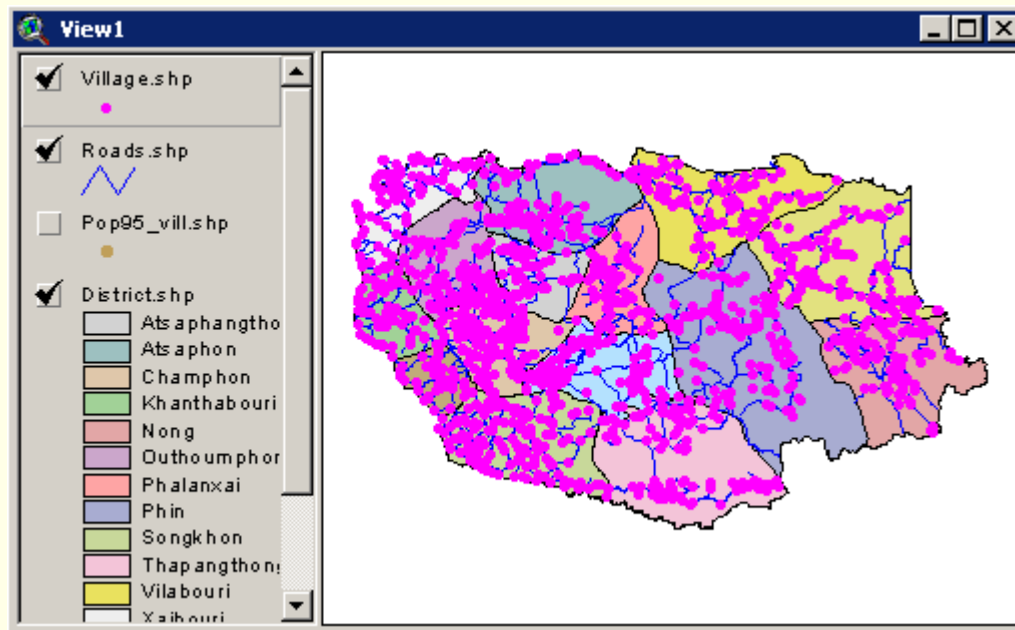
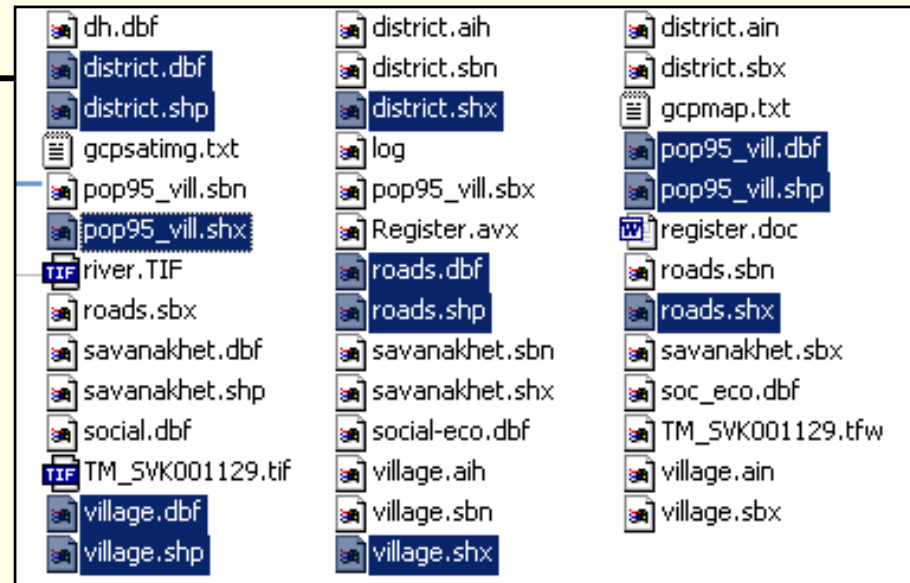


Different GUIs for different windows



1.3 Format of ArcView Data

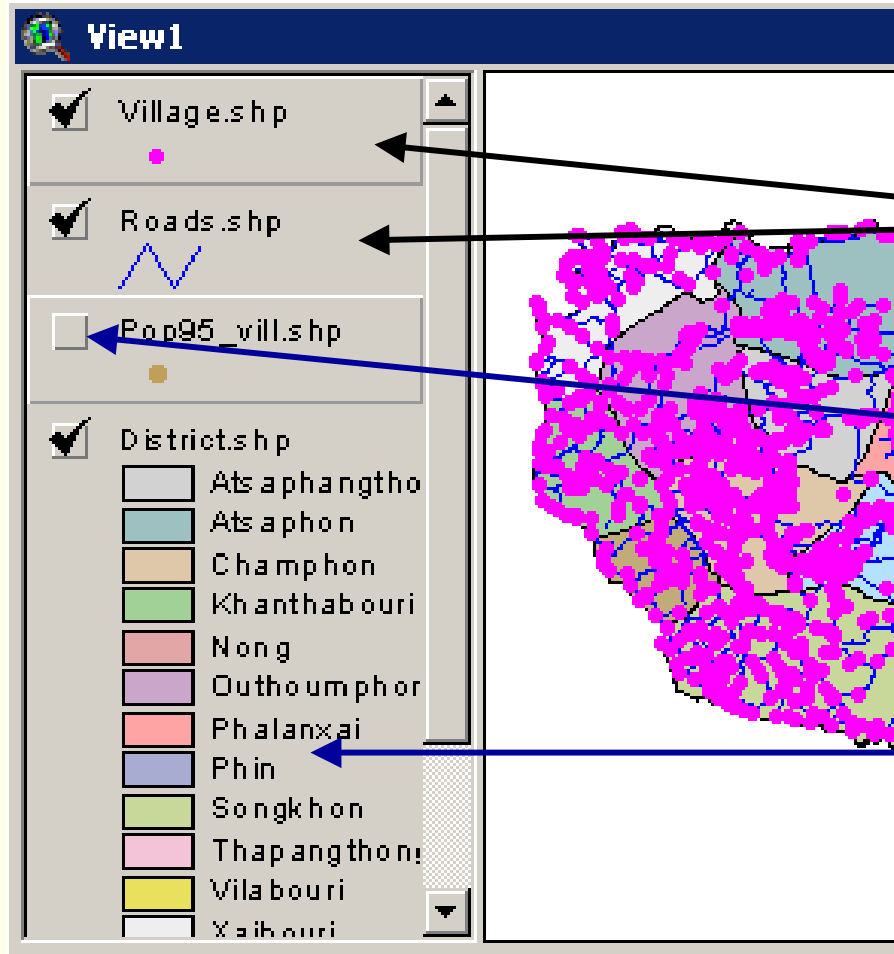
- Data Layer is called Theme in ArcView
- One theme in ArcView will have at least 3 physical files with extension
 - *.dbf (table data)
 - *.shp (spatial data)
 - *.shx (relations)



District.shp

- District.dbf* (table data)
- District.shp* (spatial data)
- District.shx* (relations)

1.4 Themes



Theme has properties as

Active/NonActive

Visible/Invisible

Legends

1.5 Data Display and Overlay



Add theme or themes

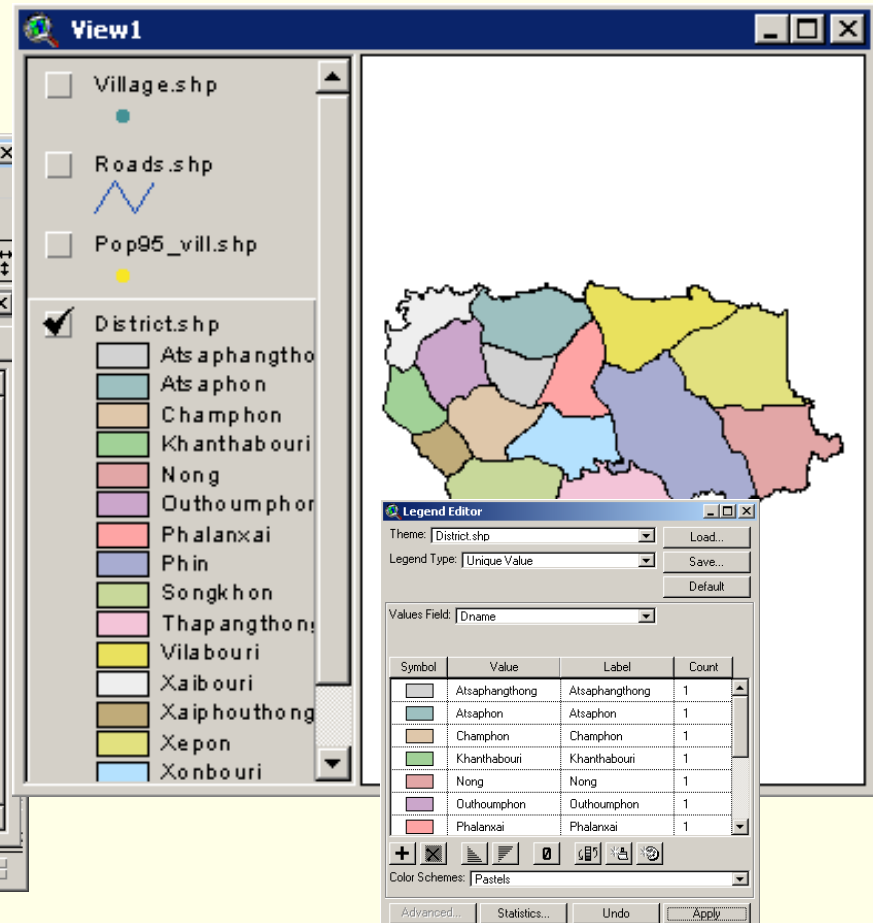
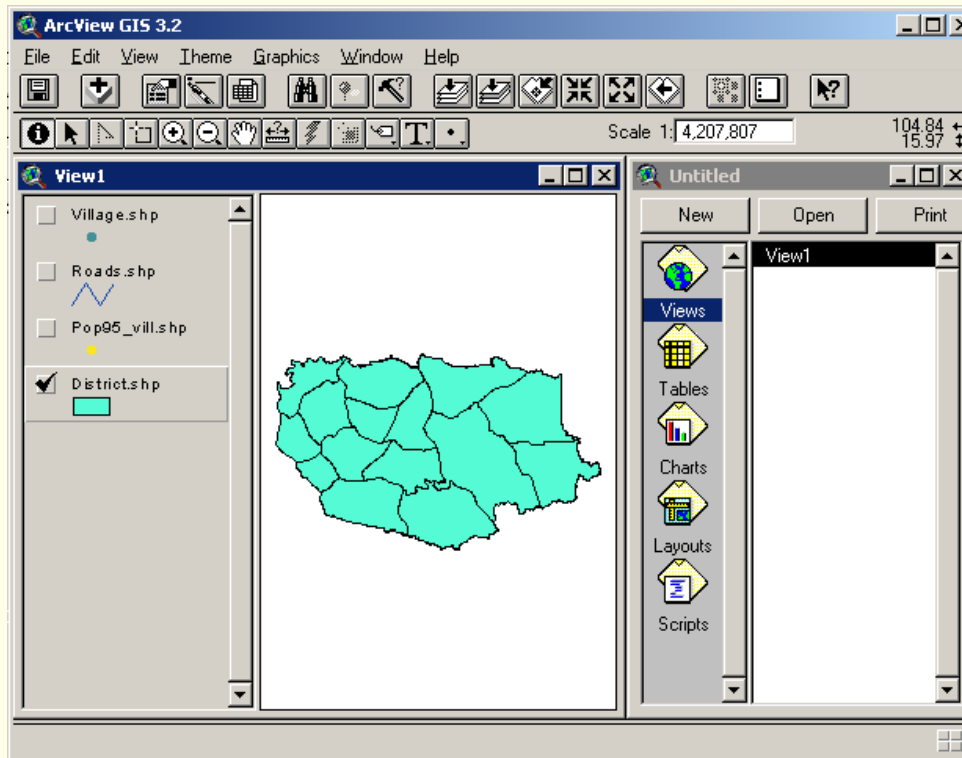
Check box to visible a theme: *district.shp*

Double click on theme for legend display: *district.shp*

Select Legend type: *Unique Value*

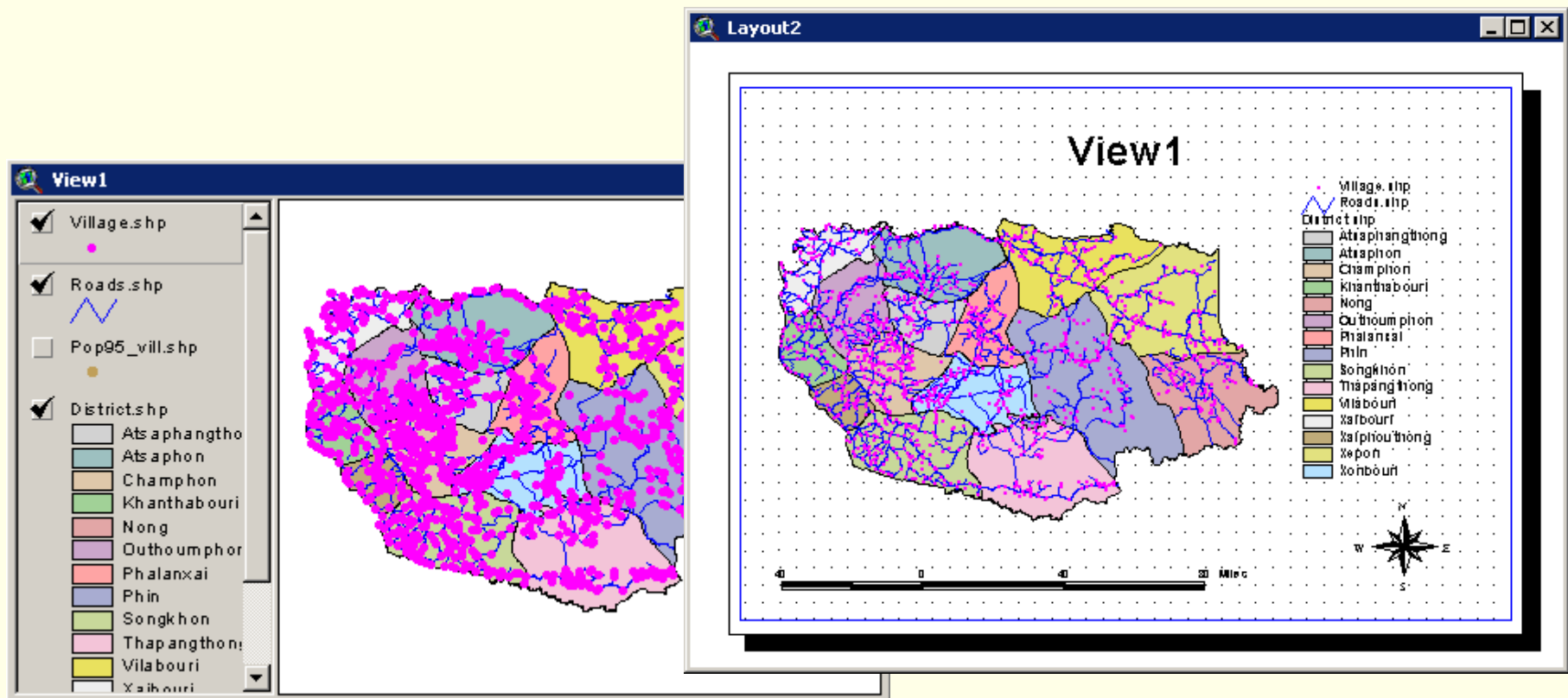
Values Field: *Dname*

Arrange for theme order: drag and drop



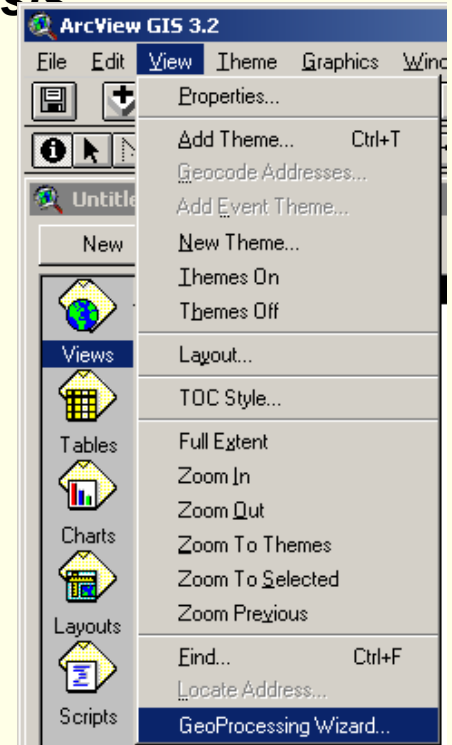
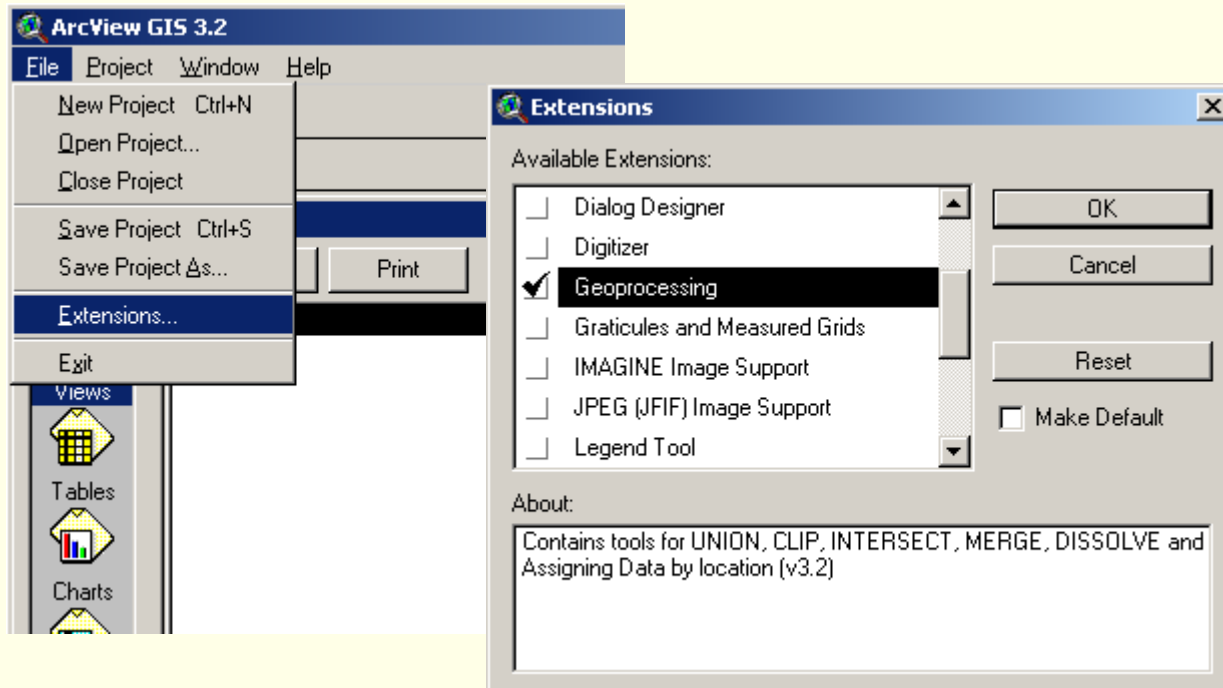
1.6 Layout for printing map

- Activate View window
- Select View/Layout...
- Select one paper style on Landscape Manager (portrait or landscape)
- Choose <New Layout>, Try edit with objects on the layout.



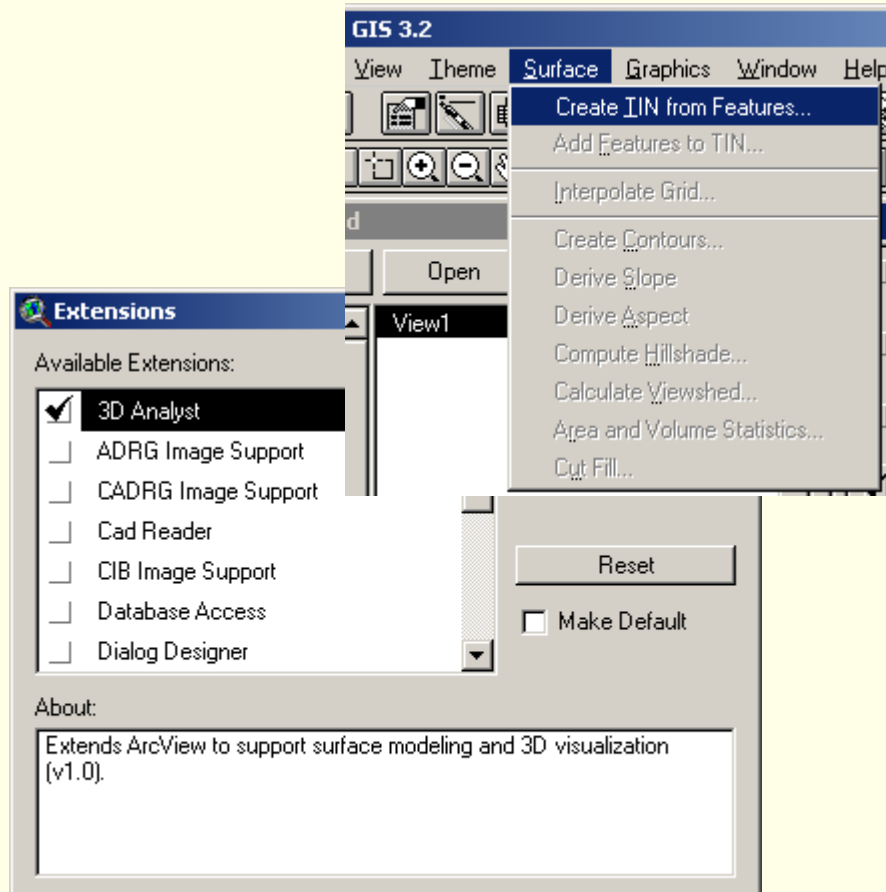
1.7 Extension of ArcView

- Activate the *project windows*
- Select *File\Extension*
- Select extension program (*Geoprocessing*)
- Extension program will occur in menu, button or tools in individual interface (*View Windows, menu View\Geoprocessing*)
- Try with another extension, *Spatial Analysis and 3D Analysis*

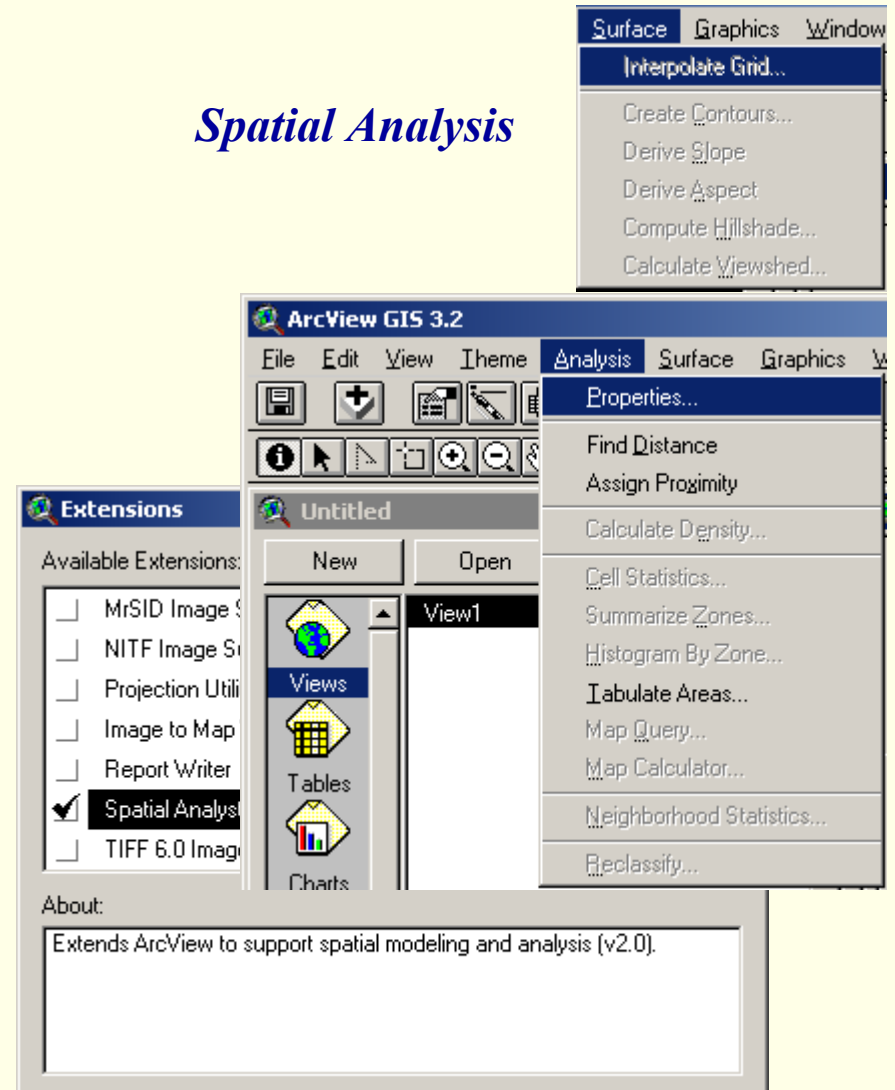


Extension of ArcView

3D Analysis



Spatial Analysis



Landuse Classification

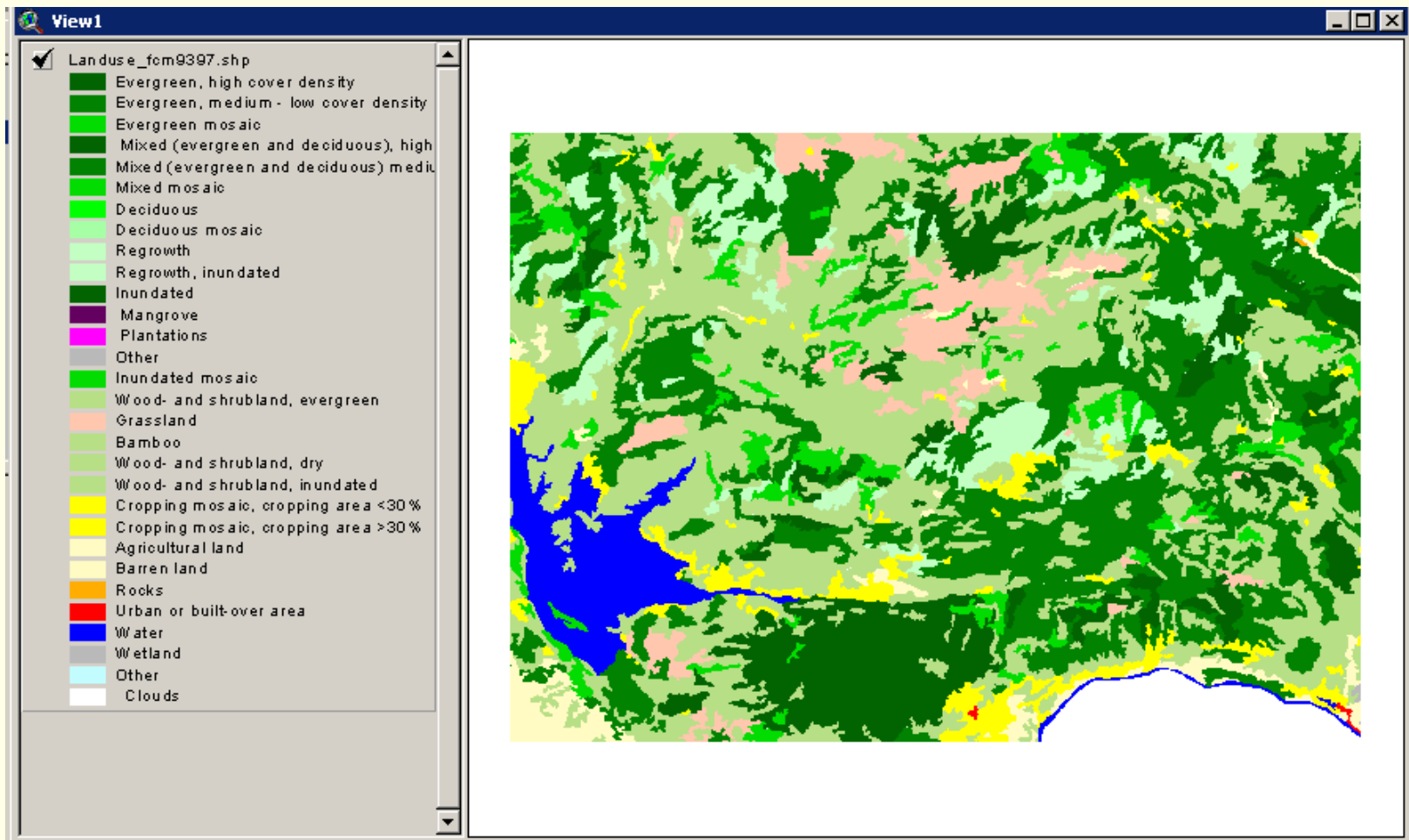
Visual Screen Editing

Steps

- Landuse 1997
- Regroup
- Overlay with Landsat image
- Update landuse

Landuse 1997

- Add theme  “Landuse_fcm9397”



Look up table Landuse code

- Add Table “mrc_fclc_type” (Forest/Land cover type)

The screenshot shows a GIS software interface with two main windows. The top window, titled 'mrc_fclc_type.dbf', displays a table with three columns: 'Fclc_code', 'Type', and 'Fclc'. The table contains 20 rows of data, each representing a different land cover type. The bottom window, titled 'Add Table', is a dialog box for adding a new table. It shows the file name 'mrc_fclc_type.dbf' and a list of files in the directory 'd:\training2005\laos_caravan\lao_data'. The file 'mrc_fclc_type.dbf' is selected in the list. The 'List Files of Type' is set to 'dBASE (*.dbf)' and the 'Drives' dropdown is set to 'd:'.

Fclc_code	Type	Fclc
11	forest	evergreen, high cover density
12	forest	evergreen, medium-low cover density
13	forest	evergreen mosaic
17	forest	mixed (evergreen and deciduous), high cover density
18	forest	mixed (evergreen and deciduous) medium-low cover
19	forest	mixed mosaic
20	forest	deciduous
22	forest	deciduous mosaic
40	forest	regrowth
41	forest	regrowth, inundated
52	forest	inundated
53	forest	mangrove
54	forest	plantations
55	forest	other
56	forest	inundated mosaic
61	non-forest	wood and shrub land, evergreen
62	non-forest	grassland
63	non-forest	bamboo
64	non-forest	wood and shrub land, dry
65	non-forest	wood and shrub land, inundated
81	non-forest	cropping mosaic, cropping area <30%
82	non-forest	cropping mosaic, cropping area >30%
91	non-forest	agriculture land
92	non-forest	barren land
93	non-forest	rocks
94	non-forest	urban or built-over area
95	non-forest	water
96	non-forest	wetland
97	non-forest	other
99	non-forest	clouds

Join attribute table



Open attribute table

of “Landuse_fcm9397”

Click field name

“Fclc_code” in

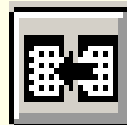
“mrc_fclc_type” table

Click field name “F97” in

“Landuse_fcm9397”

table

Press Join button



Attributes of Landuse_fcm9397.shp

Shape	Area	Perimeter	F_fcm9397	F_fcm9397	F93	F97
Polygon	1485684864.0	1306147.750	10542	10542	61	61
Polygon	1485684864.0	1306147.750	10542	10542	61	61
Polygon	1485684864.0	1306147.750	10542	10542	61	61
Polygon	1485684864.0	1306147.750	10542	10542	61	61
Polygon	1485684864.0	1306147.750	10542	10542	61	61
Polygon	1485684864.0	1306147.750	10542	10542	61	61
Polygon	1485684864.0	1306147.750	10542	10542	61	61
Polygon	1218690944.0	1429004.125	11373	11373	61	61
Polygon	261452128.00	266472.031	11547	11547	62	62
Polygon	261452128.00	266472.031	11547	11547	62	62
Polygon	261452128.00	266472.031	11547	11547	62	62
Polygon	261452128.00	266472.031	11547	11547	62	62
Polygon	363208192.00	383236.969	11602	11602	61	61
Polygon	363208192.00	383236.969	11602	11602	61	61
Polygon	363208192.00	383236.969	11602	11602	61	61
Polygon	91667240.000	181989.266	11782	11782	61	61
Polygon	70760376.000	80667.219	11805	11805	62	62
Polygon	74623400.000	61216.586	11866	11866	40	40

mrc_fclc_type.dbf

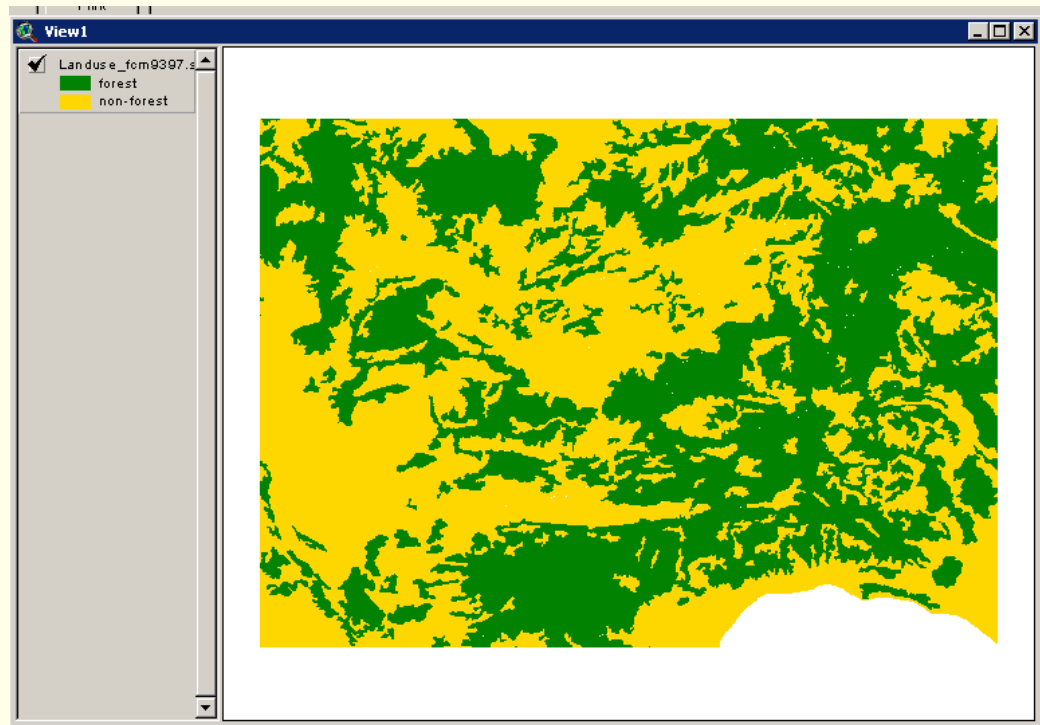
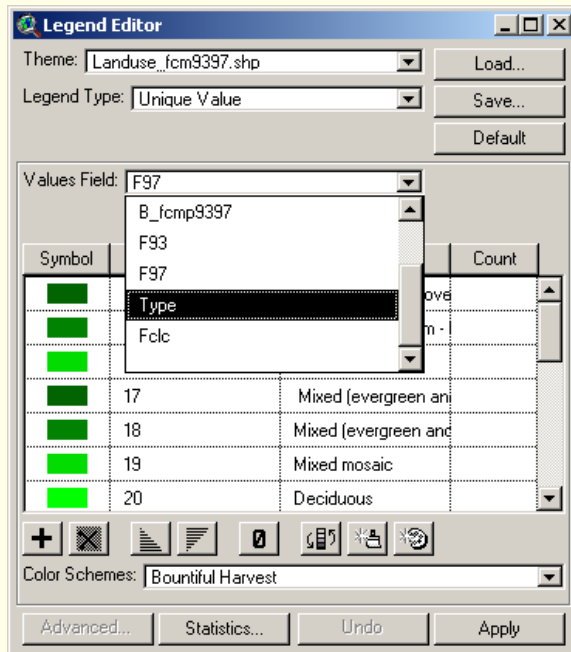
Fclc_code	Type	Fclc
11	forest	evergreen, high cover density
12	forest	evergreen, medium-low cover density
13	forest	evergreen mosaic
17	forest	mixed (evergreen and deciduous), high cover density
18	forest	mixed (evergreen and deciduous) medium-low cover
19	forest	mixed mosaic
20	forest	deciduous
22	forest	deciduous mosaic

Display Landuse type

- In Legend editor, change Value Field as “Type”
- Click Apply button and change Symbol color

Attributes of Landuse_fcm9397.shp

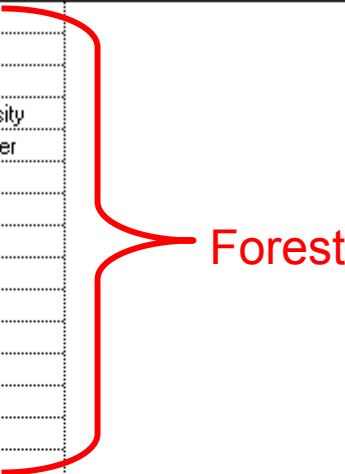
B_fcm9397	F93	F97	Type	Fclc
10542	61	61	non-forest	wood and shrub land, evergreen
10542	61	61	non-forest	wood and shrub land, evergreen
10542	61	61	non-forest	wood and shrub land, evergreen
10542	61	61	non-forest	wood and shrub land, evergreen
10542	61	61	non-forest	wood and shrub land, evergreen
10542	61	61	non-forest	wood and shrub land, evergreen
10542	61	61	non-forest	wood and shrub land, evergreen
11373	61	61	non-forest	wood and shrub land, evergreen
11547	62	62	non-forest	grassland
11547	62	62	non-forest	grassland
11547	62	62	non-forest	grassland
11547	62	62	non-forest	grassland



Re-class Landuse type

- In order to make the landuse class to simply landuse classes, the landuse type can be group into forest and other landuse

<i>Folz_code</i>	<i>Type</i>	<i>Folz</i>
11	forest	evergreen, high cover density
12	forest	evergreen, medium-low cover density
13	forest	evergreen mosaic
17	forest	mixed (evergreen and deciduous), high cover density
18	forest	mixed (evergreen and deciduous) medium-low cover
19	forest	mixed mosaic
20	forest	deciduous
22	forest	deciduous mosaic
40	forest	regrowth
41	forest	regrowth, inundated
52	forest	inundated
53	forest	mangrove
54	forest	plantations
55	forest	other
56	forest	inundated mosaic
61	non-forest	wood and shrub land, evergreen
62	non-forest	grassland
63	non-forest	bamboo
64	non-forest	wood and shrub land, dry
65	non-forest	wood and shrub land, inundated
81	non-forest	cropping mosaic, cropping area <30%
82	non-forest	cropping mosaic, cropping area >30%
91	non-forest	agriculture land
92	non-forest	barren land
93	non-forest	rocks
94	non-forest	urban or built-over area
95	non-forest	water
96	non-forest	wetland
97	non-forest	other
99	non-forest	clouds




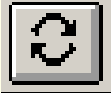
Edit table / Add field

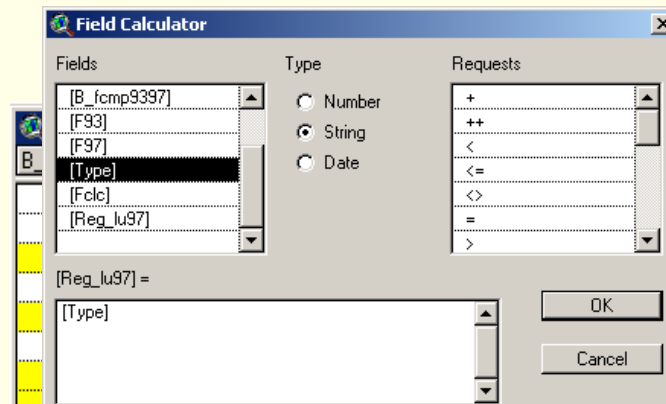
- Start Editing table, add new field, Set field definition
- Then query [Type] = "forest"

The process is shown in several steps:

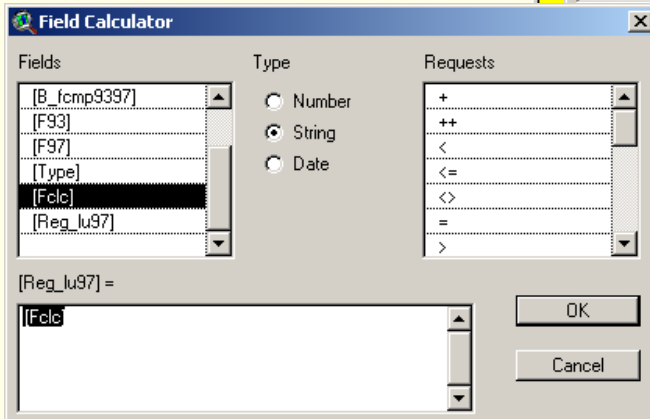
- ArcView GIS 3.3 Main Menu:** The 'Table' menu is open, and 'Start Editing' is selected.
- Field Definition Dialog:** A dialog box titled 'Field Definition' is shown with 'Name: Reg_lu97', 'Type: String', and 'Width: 50'.
- Attributes of Landuse_fcm9397.shp Table:** The table view shows columns for 'Type' and 'Fctc'. The 'Type' column contains values like 'forest' and 'non-forest'.
- Field Definition Dialog (Query):** The 'Field Definition' dialog is shown again, but with a query entered: '([Type] = "forest")'. The 'Values' list contains '"forest"' and '"non-forest"'. The 'Update Values' checkbox is checked.

Input new re-group landuse

- Copy Type “Forest” into “Reg_lu97” field using calculator button 
- Click  switch selection button select the remaining landuse type
- Copy other landuse into “Reg_lu97” field click [Reg_lu97] = [Fclc] in calculator tool
- Stop Editing
When finish.

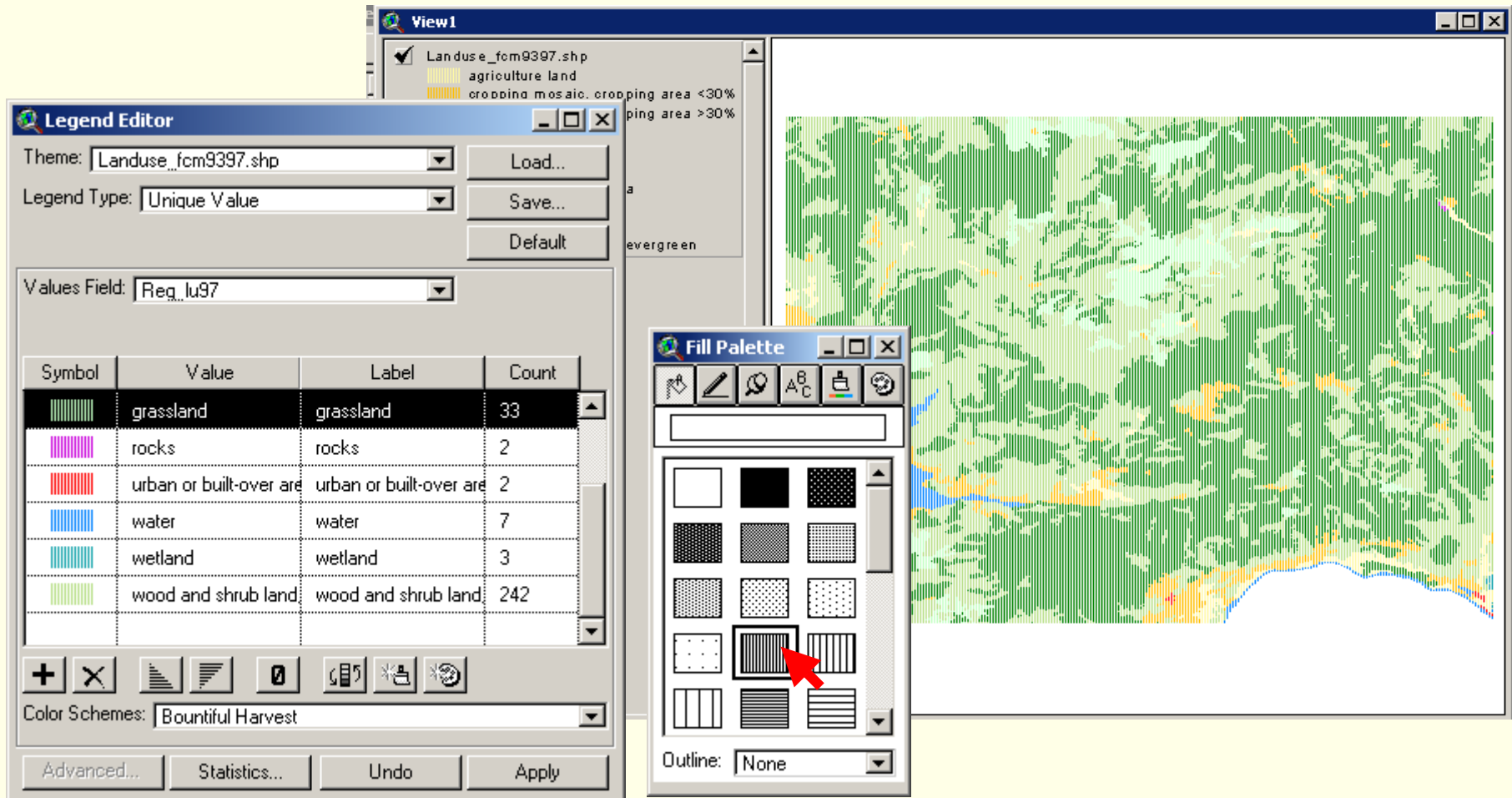


	Fclc	Reg_lu97
	evergreen, medium-low cover density	forest
	evergreen, medium-low cover density	forest
	wood and shrub land, evergreen	wood and shrub land, evergreen
	evergreen, medium-low cover density	forest
	wood and shrub land, evergreen	wood and shrub land, evergreen
	evergreen, medium-low cover density	forest
	wood and shrub land, evergreen	wood and shrub land, evergreen
	cropping mosaic, cropping area <30%	cropping mosaic, cropping area
12236	12 forest	evergreen, medium-low cover density forest
12240	12 forest	evergreen, medium-low cover density forest
12240	12 forest	evergreen, medium-low cover density forest
12247	61 non-forest	wood and shrub land, evergreen
12248		evergreen, high cover density forest
12249		evergreen, medium-low cover density forest
12250		wood and shrub land, evergreen
12253		grassland
12255		cropping mosaic, cropping area <30%
12258		regrowth forest
12262		cropping mosaic, cropping area >30%
12264		wood and shrub land, evergreen
12268		evergreen, medium-low cover density forest



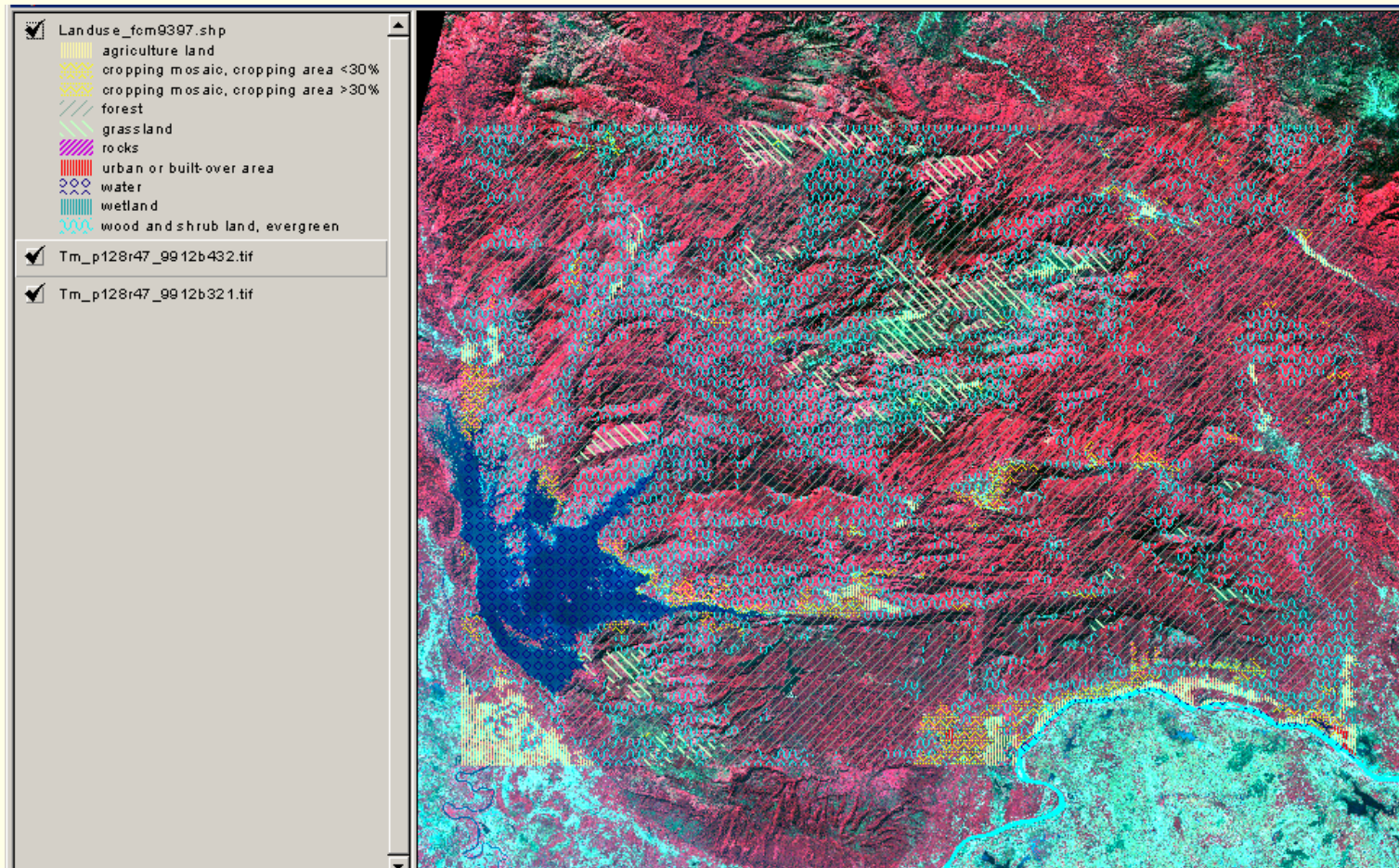
Display new re-class landuse

- Change color in Legend Editor according to new re-classed landuse (Field “Reg_lu97”)

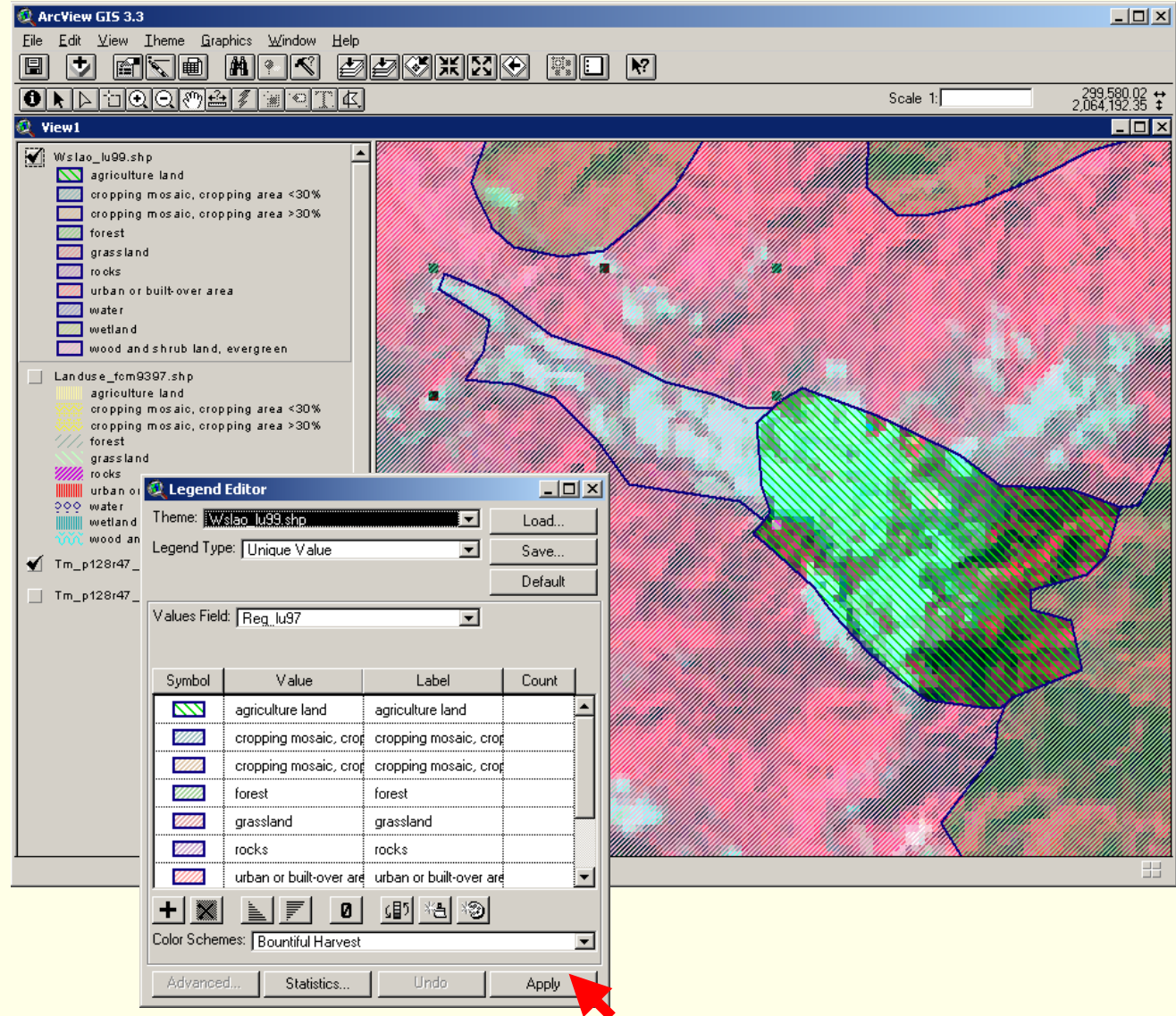
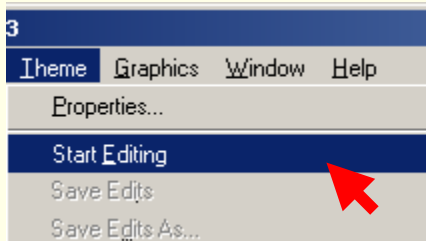


Open image and compare with landuse

- Add image theme name “Tm_p128r47_9912b432.tiff” and “Tm_p128r47_9912b321.tiff”



Edit/Update Landuse theme



- Convert landuse To new file name
- Change legend color and Start Editing in Theme menu

Using Edit Feature Tool

The image illustrates the workflow for editing a feature in ArcView GIS 3.3. It shows the 'Edit' menu with 'Union Features' selected, the 'Attributes of Wslao_lu99.shp' table, and a map view with a polygon being edited. Red arrows point to the 'Union Features' menu item and the 'Draw Line' tool in the toolbar. Blue arrows point from the attribute table to the corresponding polygon on the map.

Attributes of Wslao_lu99.shp

Type	Fcfc	Reg_lu97
non-forest	agriculture land	agriculture land
non-forest	wood and shrub land, evergreen	wood and shrub land, evergreen
non-forest	wood and shrub land, evergreen	wood and shrub land, evergreen
non-forest	wood and shrub land, evergreen	wood and shrub land, evergreen
non-forest	wood and shrub land, evergreen	wood and shrub land, evergreen

Attributes of Wslao_lu99.shp

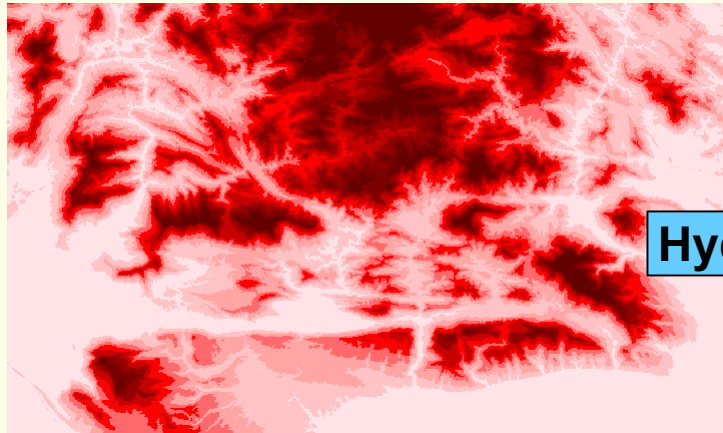
Type	Fcfc	Reg_lu97
non-forest	agriculture land	agriculture land
non-forest	wood and shrub land, evergreen	wood and shrub land, evergreen
non-forest	wood and shrub land, evergreen	wood and shrub land, evergreen
non-forest	wood and shrub land, evergreen	wood and shrub land, evergreen
non-forest	wood and shrub land, evergreen	wood and shrub land, evergreen
non-forest	wood and shrub land, evergreen	wood and shrub land, evergreen

- Use Vertex Edit tool or Draw Line to Split Polygon tool
- Edit attribute table for landuse type
- Save and Stop Editing when finish

Watershed Extraction

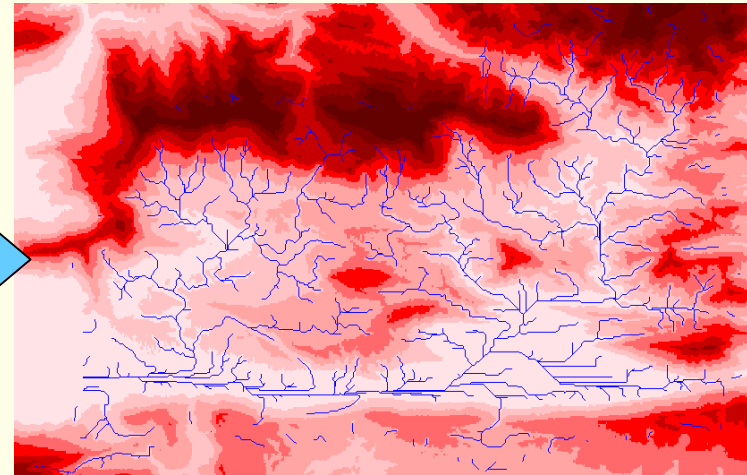
How to defined watershed boundary?

From which data WS can extract



SRTM-DEM

Hydrologic



Stream Network

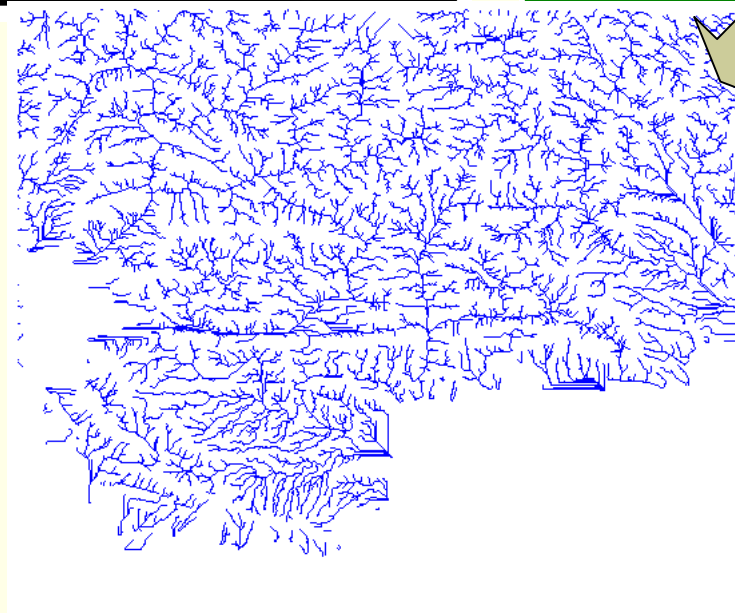
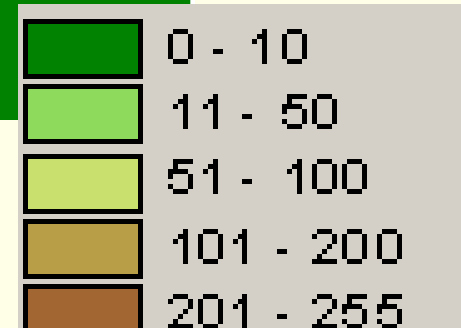
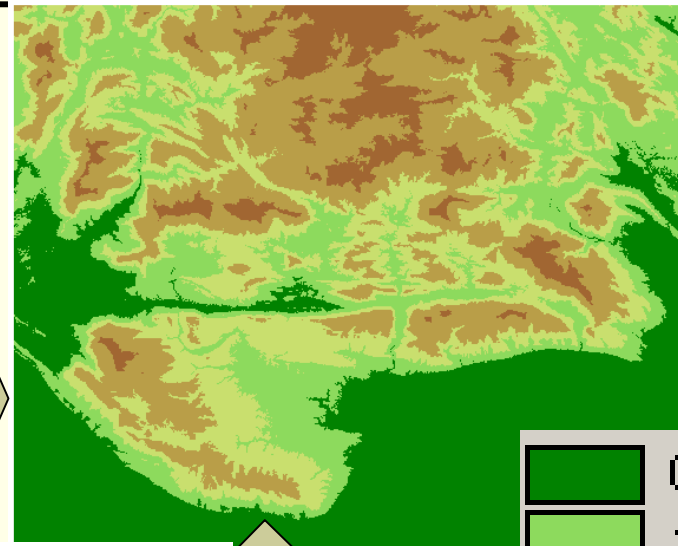
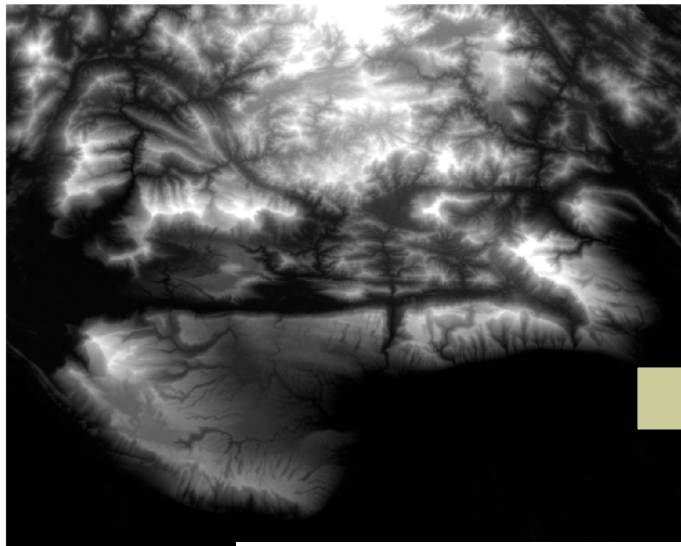


Satellite Image



GIS data-River

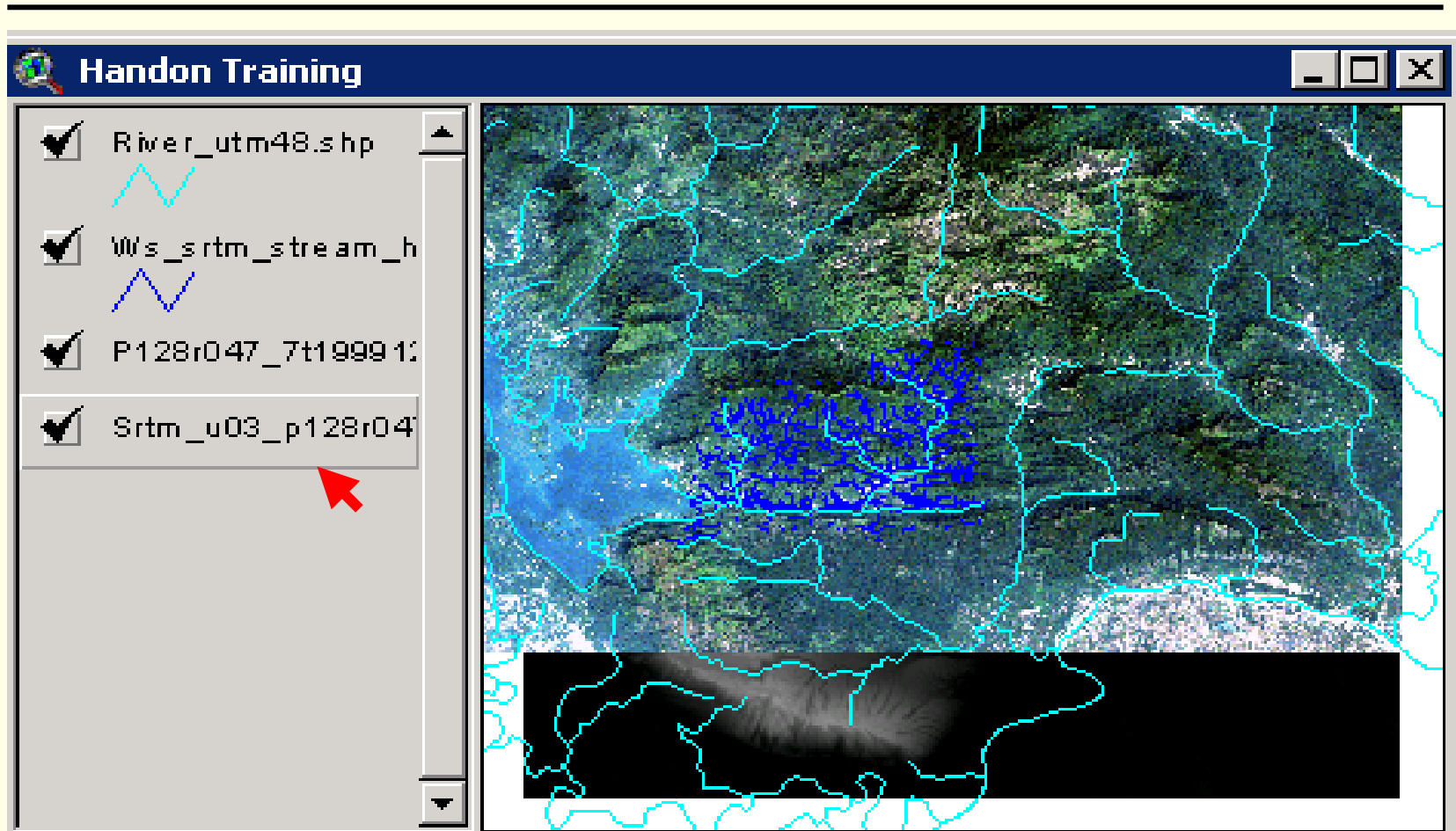
SRTM-DEM → STREAM Network



How can defined Watershed?

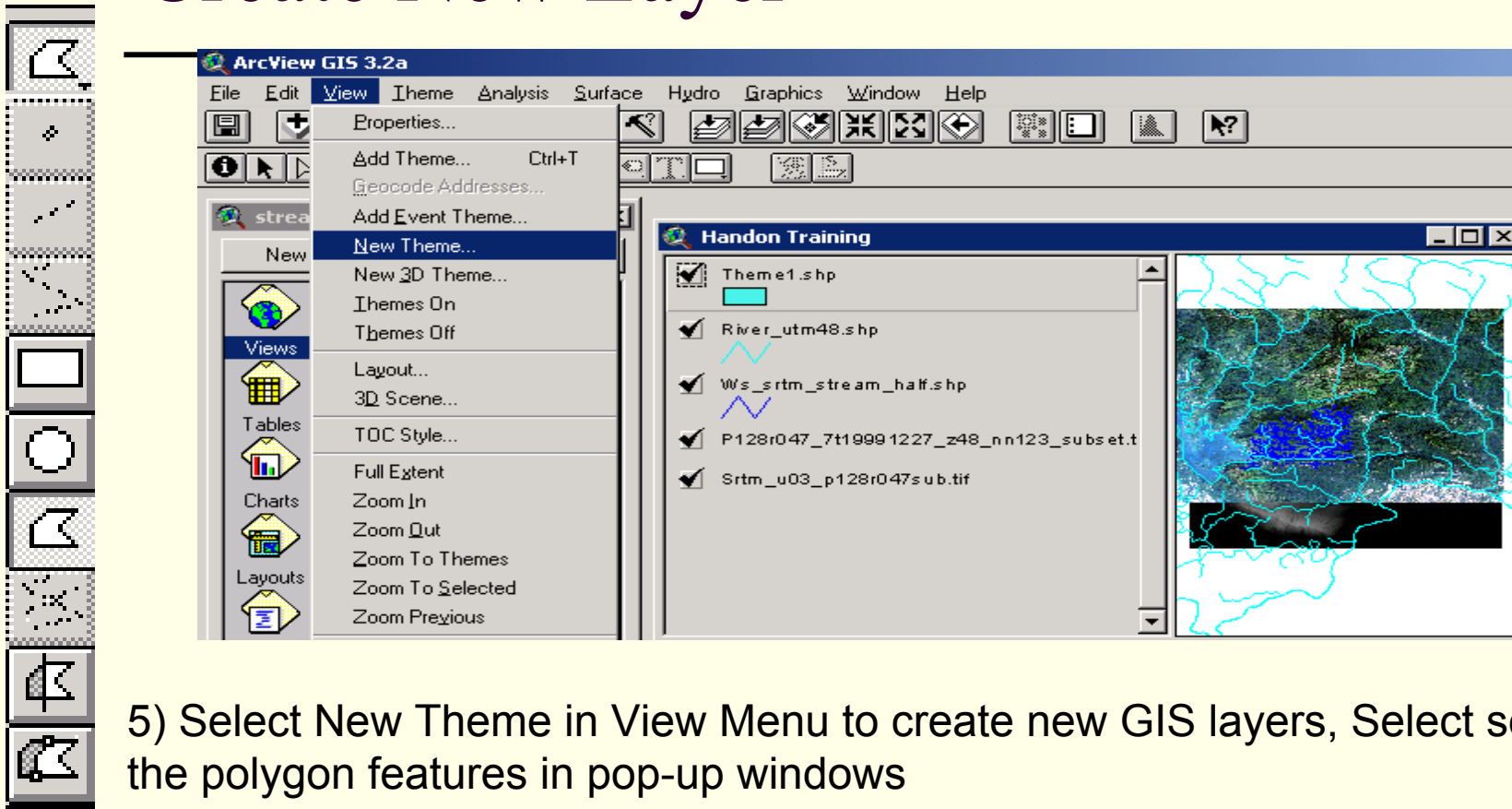
- 1) Boundary between rivers or river systems
- 2) Range between valleys or long depressions in the surface of the land
- 3) Major river catchments should be covered

Add Data Layers



- Add GIS layers and satellite imageries (river_utm48.shp, srtm_stream.shp, p128r047_7t19991227_z48_nn123_subset.tiff and srtm_u03_p128r047sub.tif)

Create New Layer



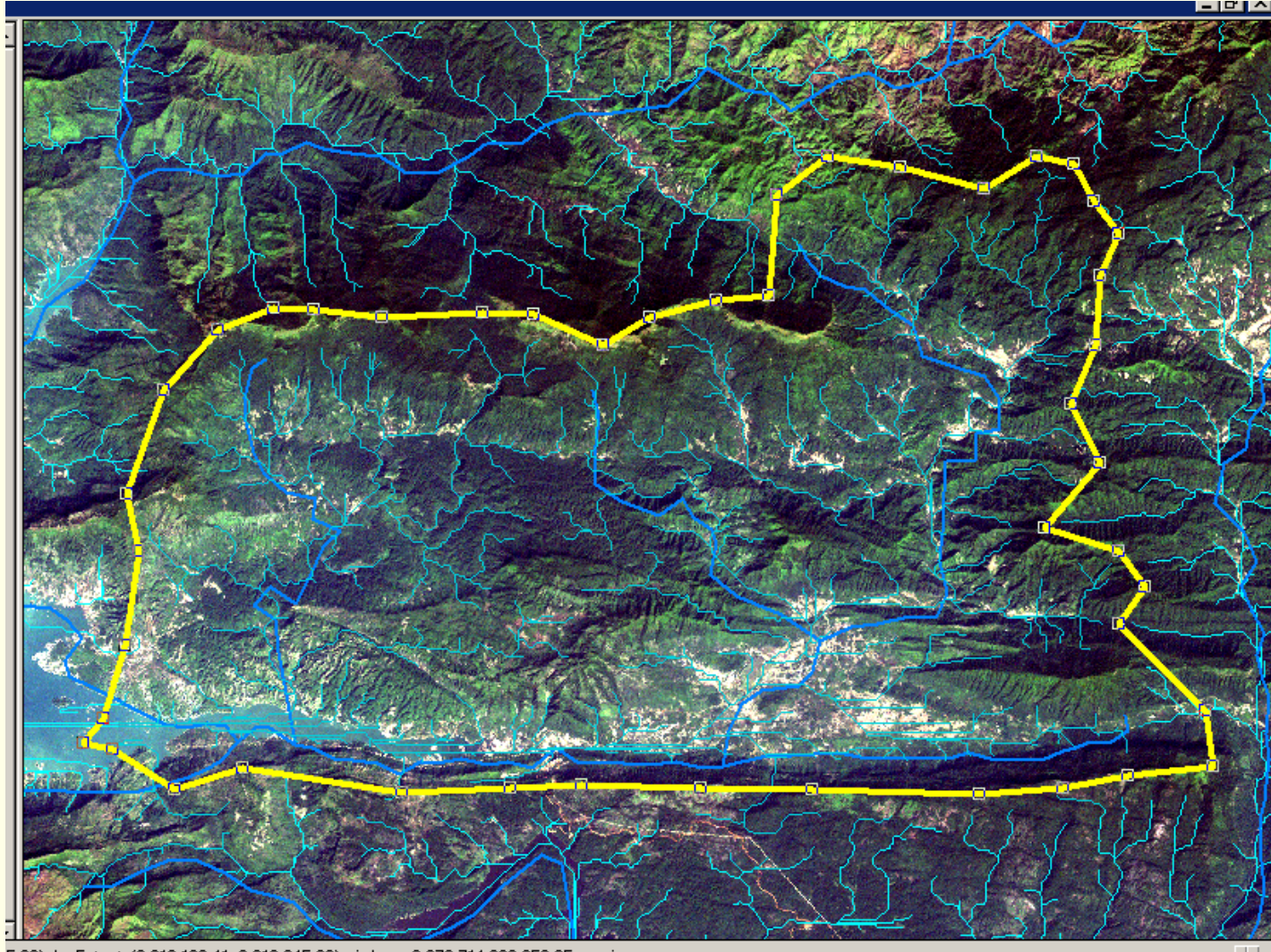
5) Select New Theme in View Menu to create new GIS layers, Select select the polygon features in pop-up windows

6) Then guide to the folder where new data file have to store and give name as **watershed.shp**

7) The watershed.shp file will be appear in the theme list

8) Use Draw Polygon Tool to digitize on screen to create watershed polygon

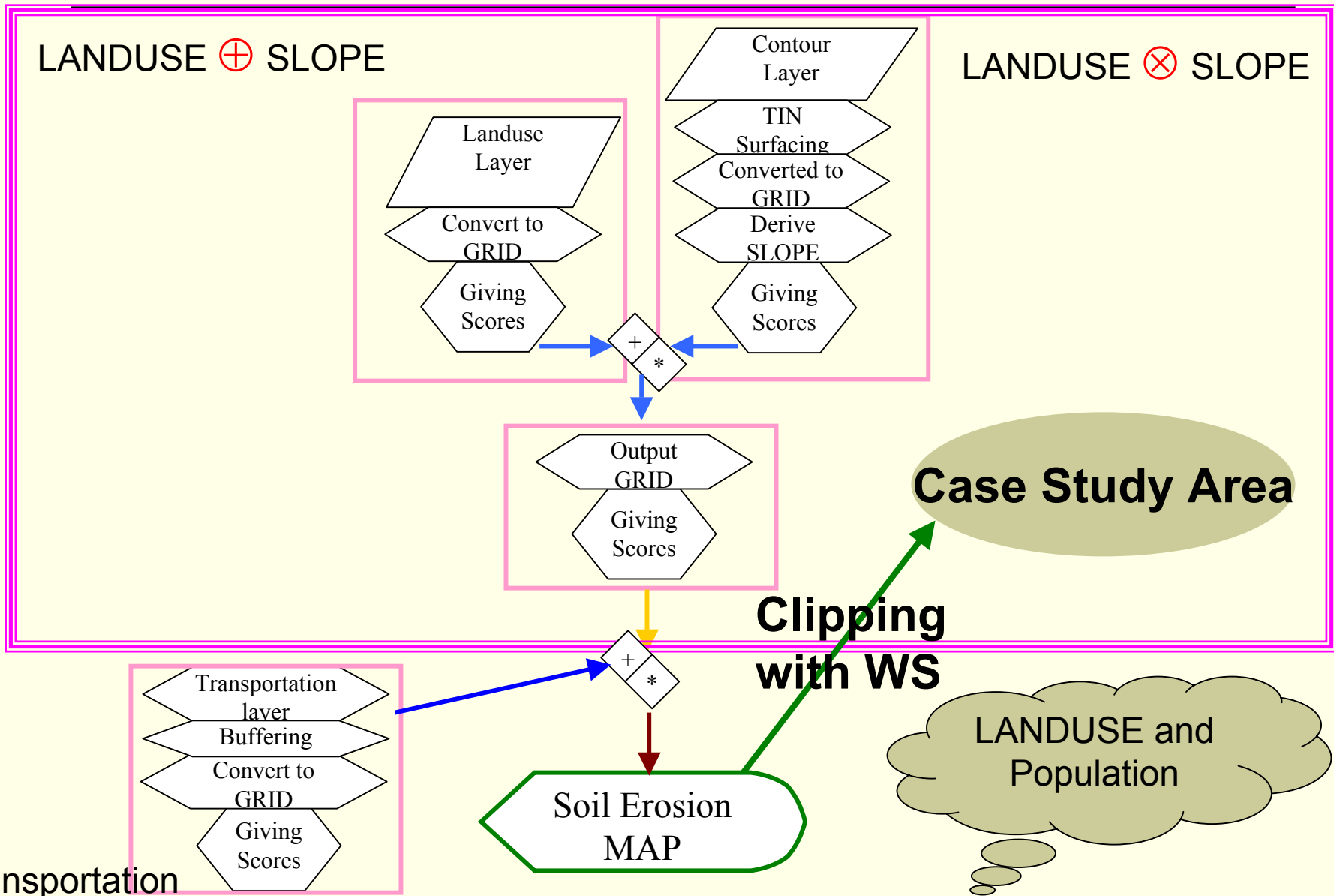
Watershed Boundary



GIS analysis and Parameters

- 3 D Analyst and Spatial Analyst
- Landuse
 - 1997
- Slope
 - Contour
- Transportation
 - Road and Stream

GIS analysis



ArcView GIS Analysis

- There are two main ArcView GIS Analyst software extensions will be used in this case study.
- They are:
 1. 3 D Analyst
 2. Spatial Analyst

3 D Analyst

- Support for **3D shapes, surface modeling, and real-time perspective viewing** to ArcView.
 - *3D shape* - store z coordinates, in addition to x and y, for every point used to define a feature.
 - Two types of *surface models* are available - grids and triangulated irregular networks (TINs).
 - *3D Scene Document* provides an interactive viewer that puts your data in a new perspective.

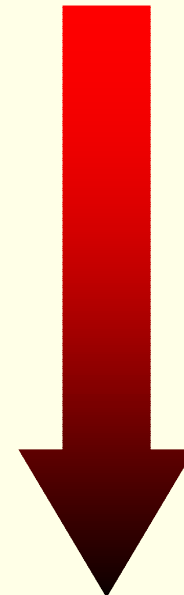
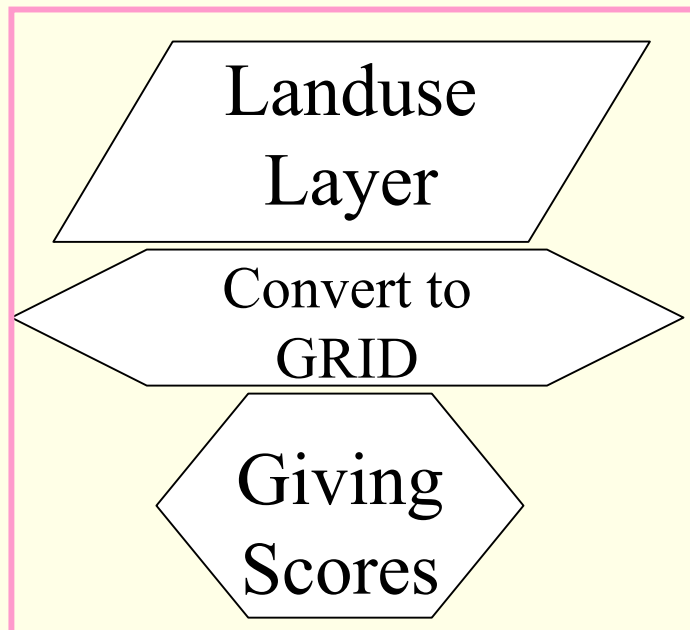
Spatial Analyst

- The main component of the Spatial Analyst is the grid theme. The grid theme is the raster equivalent of the feature theme.
- The Spatial Analyst also presents generic spatial analysis functionality on grid and feature themes.
- Main available function are: Find Distance, Assign Proximity, Calculate Density, Cell Statistics, Summarize Zones, Histogram By Zone, Tabulate Areas, Map Query, **Map Calculator**, Neighborhood Statistics, **Reclassify**, Interpolate Grid, Create Contour, **Derive Slope**, Derive Aspect, Compute Hillshade, Calculate Viewshed, Convert to Shapefile (not added, but modified to work with grid themes), **Convert to Grid**, Save Data Set, Edit Theme Expression, Manage Data Sources, Import Data Source, Export Data Source

Semi-quantitative method Parameters

- Parameters
 - Landuse
 - Slope and
 - Transportation

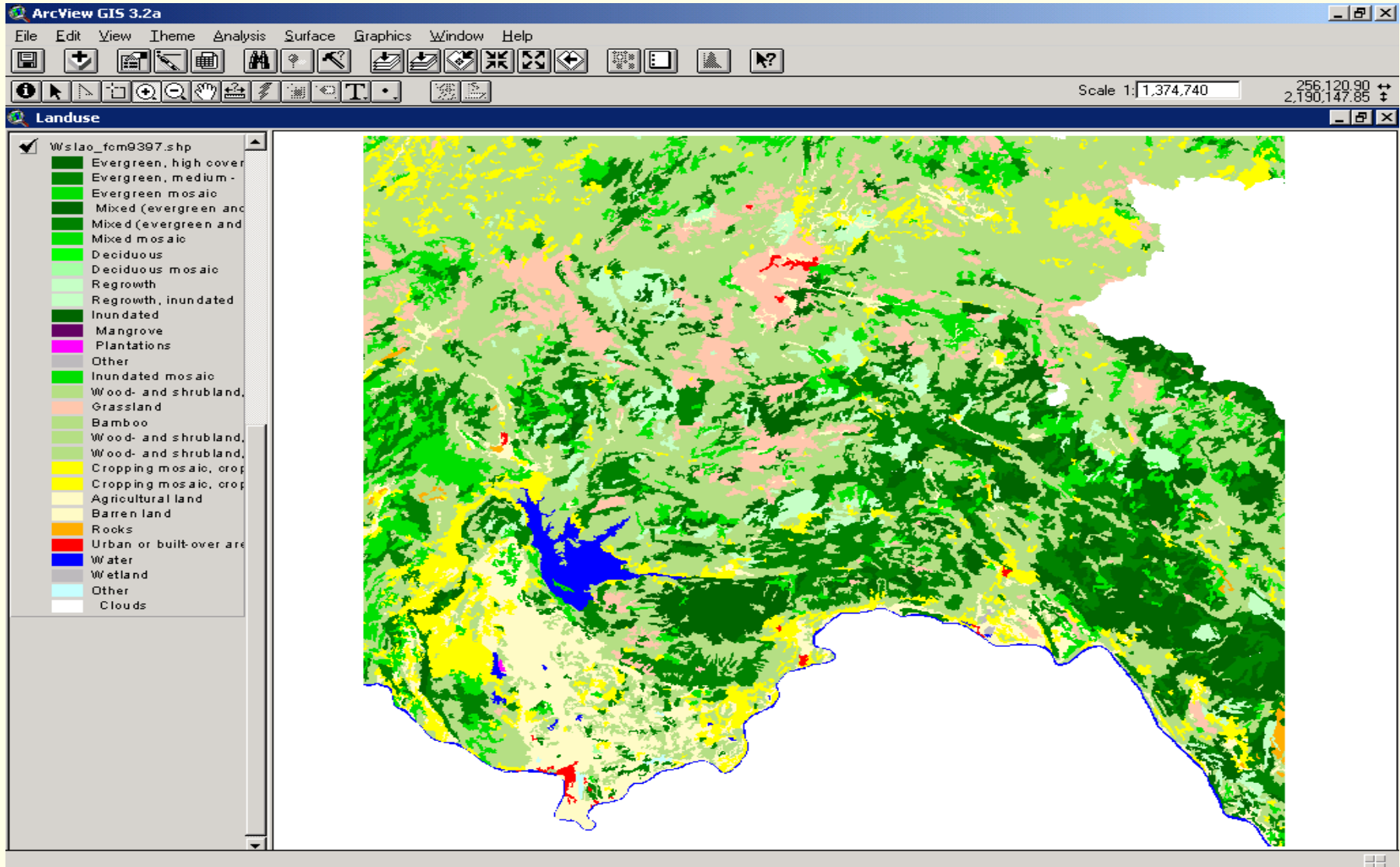
LANDUSE Parameter



Scoring Landuse Parameter

- Defined four scores based on forest types
 - **Score 0** has no erosion potential such as **water body, wetland, Rock**
 - **Score 1** has less erosion potential such as **evergreen/deciduous forest,**
 - **Score 2** has high erosion potential such as **Grassland, Shrub and Urban, low cover forest**
 - **Score 3** has very high erosion potential such as **barren land, agriculture land**
- Erosion Experts can be defined with his/her experience on landcover/landuse

Landuse 1997



Forest Types

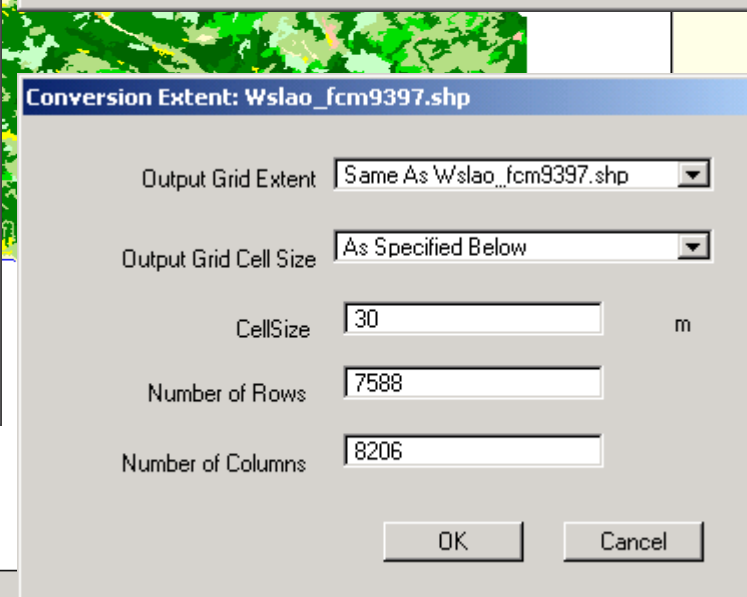
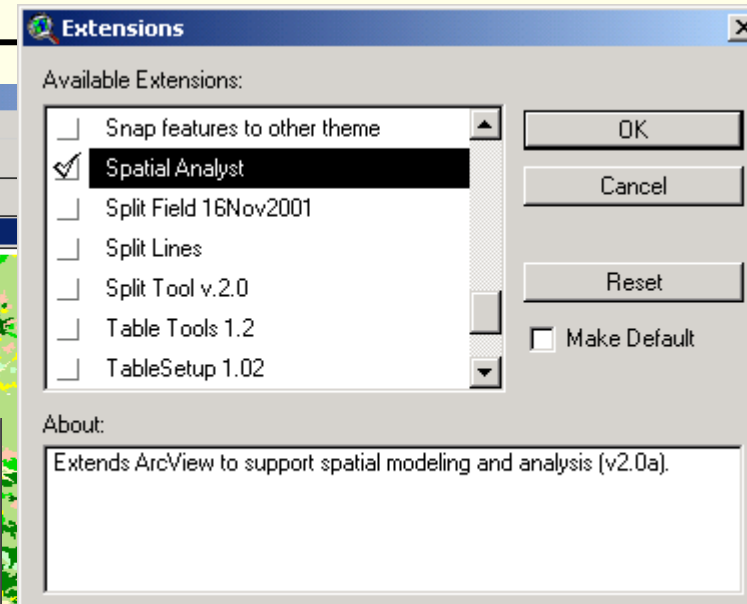
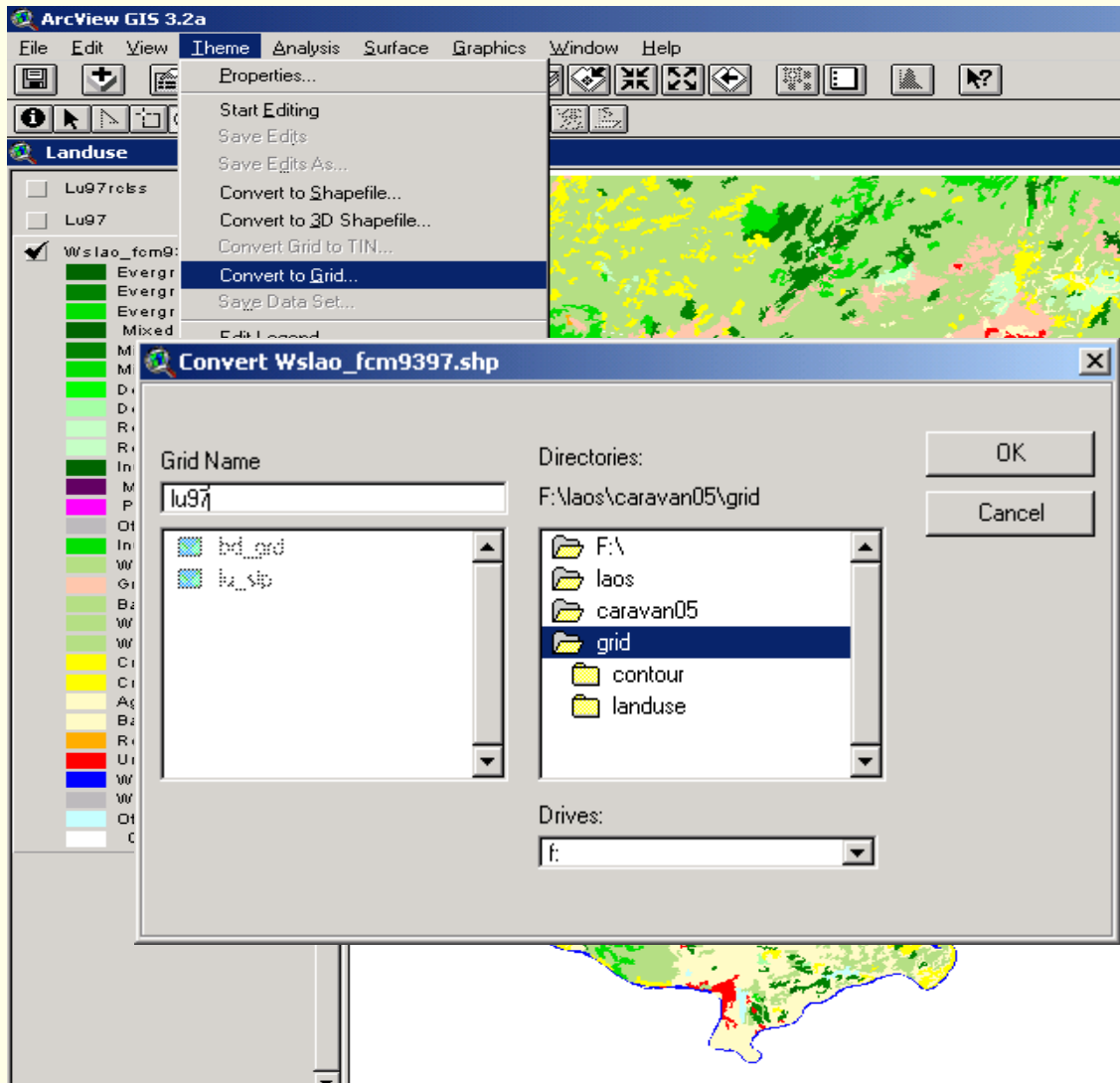
NO	Reclass (Score)	Code	Name
1	0	93	Rocks
2	0	95	Water
3	0	96	Wetland
4	1	11	Evergreen, high cover density
5	1	12	Evergreen, medium - low cover density
6	1	17	Mixed (evergreen and deciduous), high cover density
7	1	18	Mixed (evergreen and deciduous) medium - low cover density
8	1	40	Regrowth
9	2	13	Evergreen mosaic
10	2	19	Mixed mosaic
11	2	61	Wood- and shrub land, evergreen
12	2	62	Grassland
13	2	94	Urban or built-over area
14	3	81	Cropping mosaic, cropping area <30%
15	3	82	Cropping mosaic, cropping area >30%
16	3	92	Barren land

Landuse Scoring

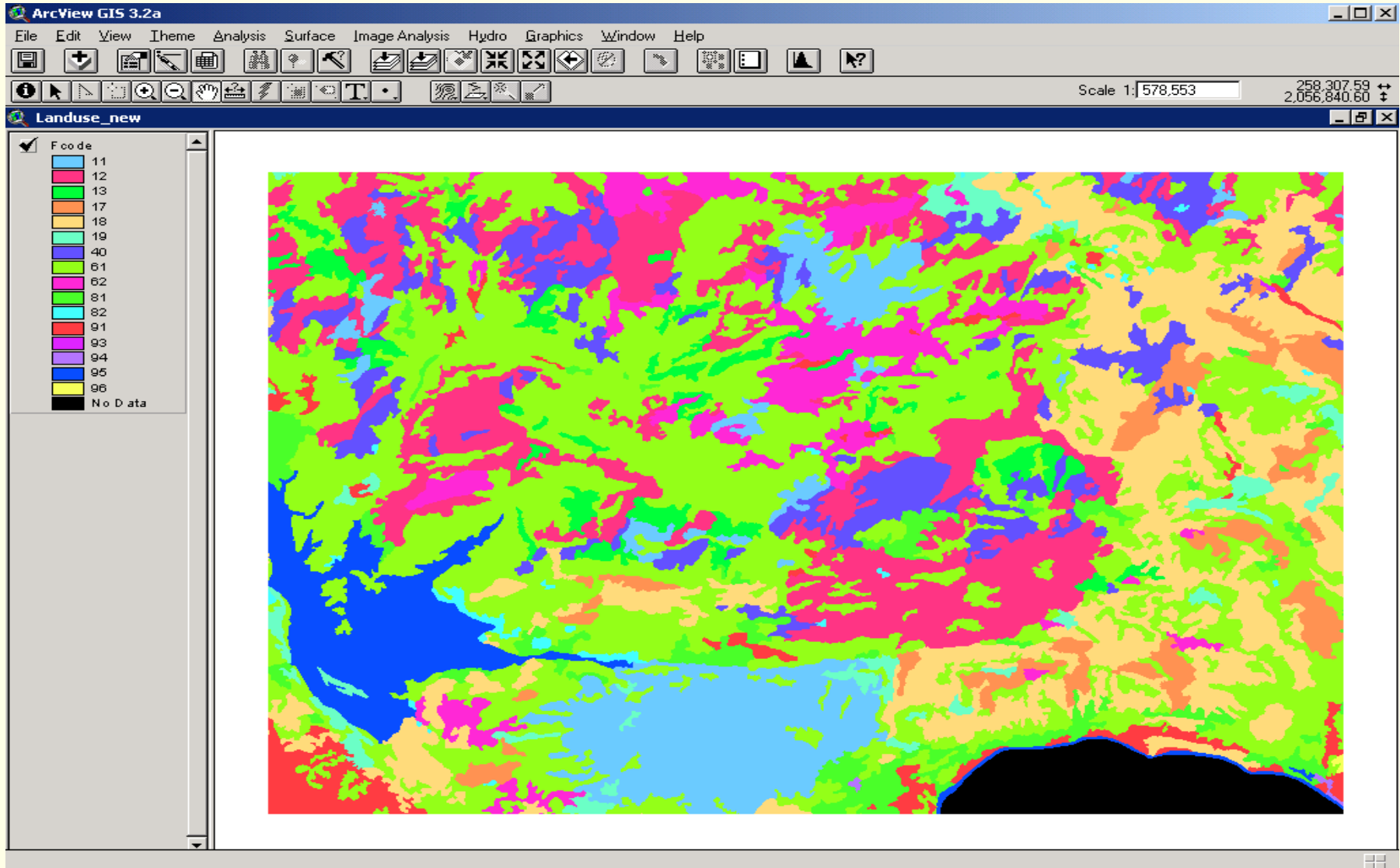
- **Converted -Landuse layers to Grid with pixel size 30**
- **Reclassification**
- **Score Landuse type**
 - 0 = 96, 95, 93
 - 1 = 11, 12, 17, 18, 40
 - 2 = 13, 19, 61, 62, 94
 - 3 = 81, 82, 91, 92

Find erosion values from internet

Landuse 1997 Grid conversion



Landuse GRID



Landuse GRID

Reclassify Values

Classification Field: Value

Classify... Unique

Old Values

11	
12	
13	
14 - 17	
18	
19	6
20 - 40	7

Classification

Type: Natural Breaks

Number of classes: 4

Round values at: 0

OK Cancel

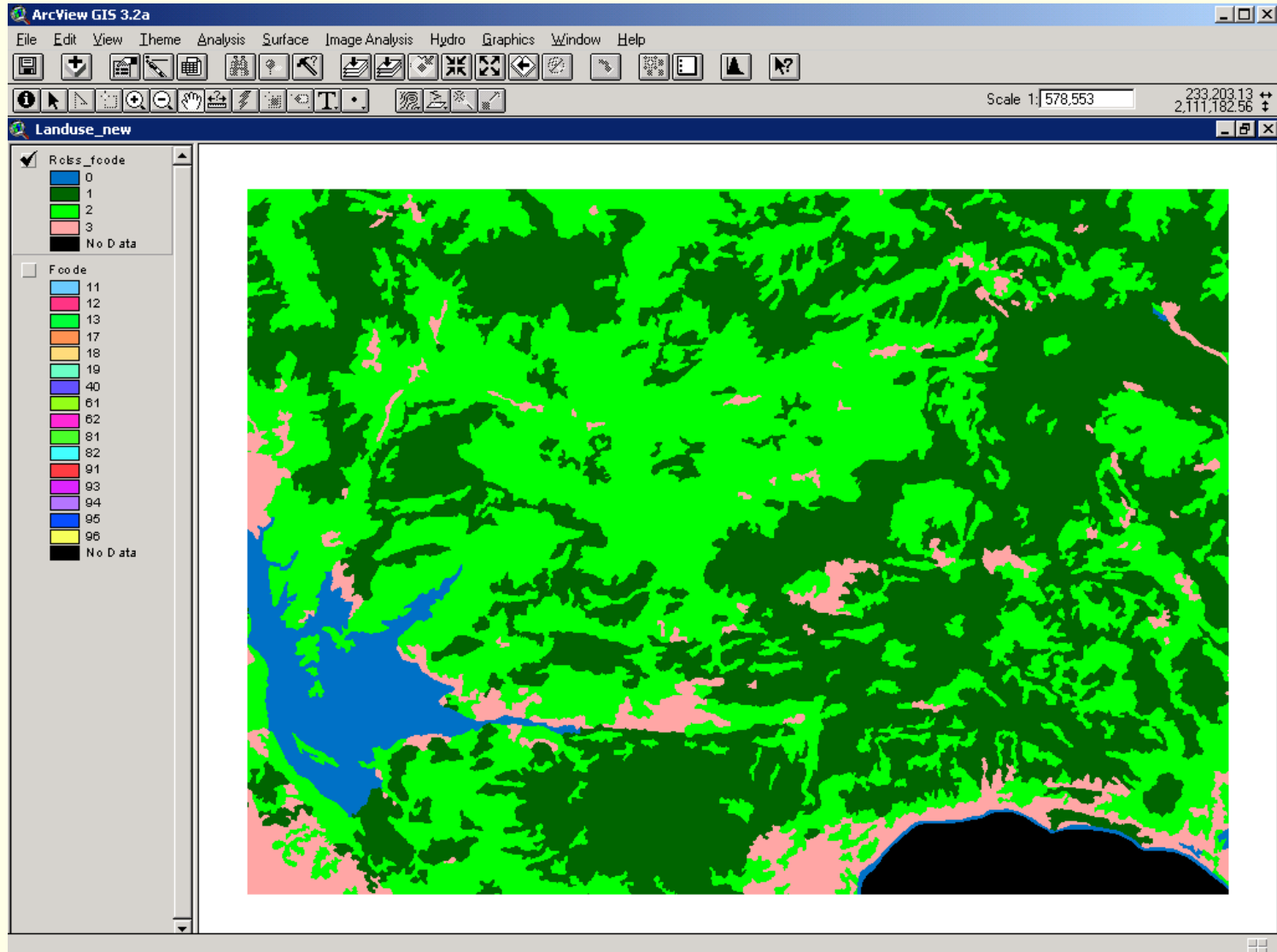
Old Values New Value

11, 12, 17, 18, 40	1
13, 19, 61, 62, 94	2
81, 82, 91	3
96, 95, 93	0
No Data	No Data

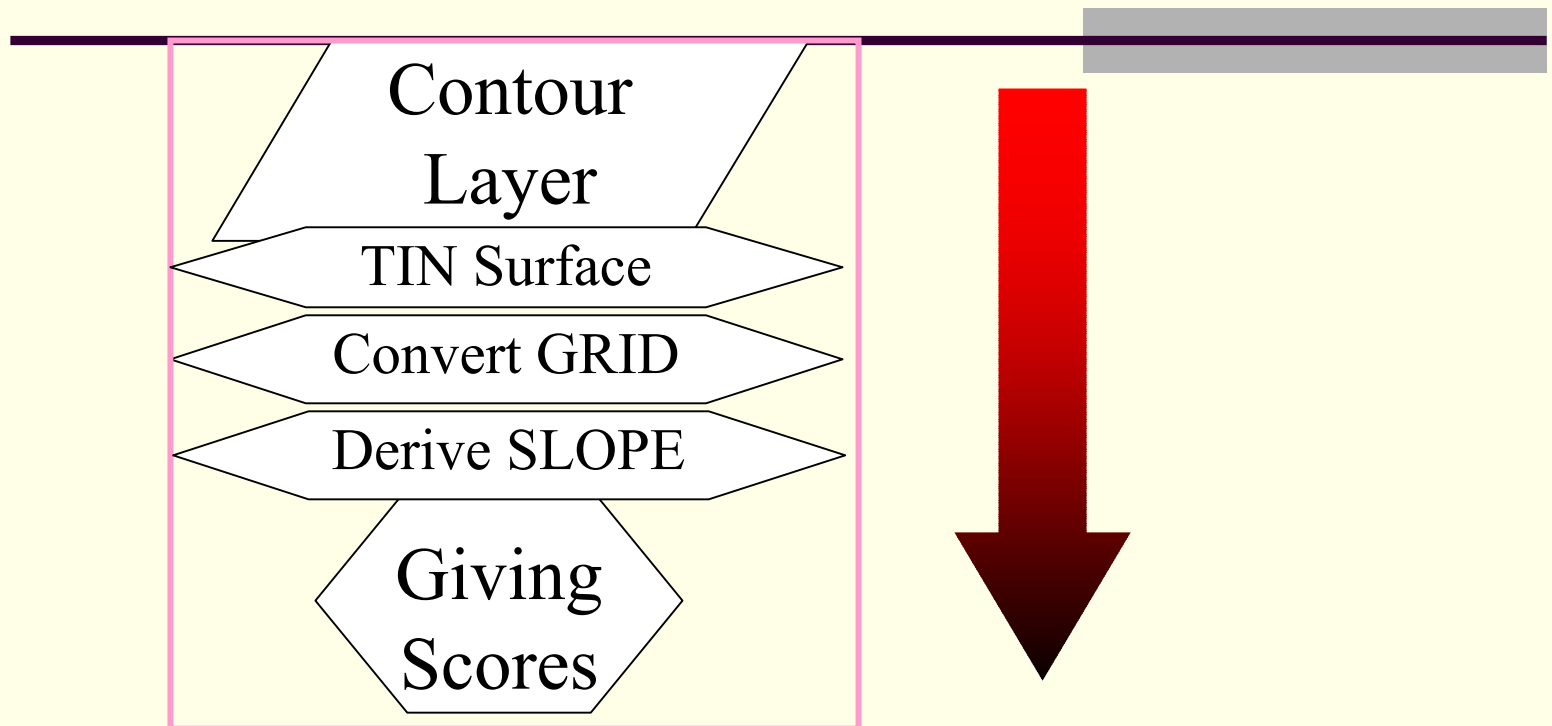
+ × Load Save OK Cancel

Reclassifies the values in a grid theme

Scoring Landuse 1997



CONTOUR Parameter



Scoring Slope Parameter

- Defined four scores based on slope degree
 - If the slope is $0^\circ - 7^\circ$, we defined score 1 and has Less erosion potential
 - If the slope is $7^\circ - 15^\circ$, we defined score 2 has medium erosion potential
 - If the slope is $> 15^\circ$, we defined score 3 has high erosion potential
- Score can adjust based on regional elevation.
- In this case study, area is mostly undulated land.

Select layers for Slope Scoring

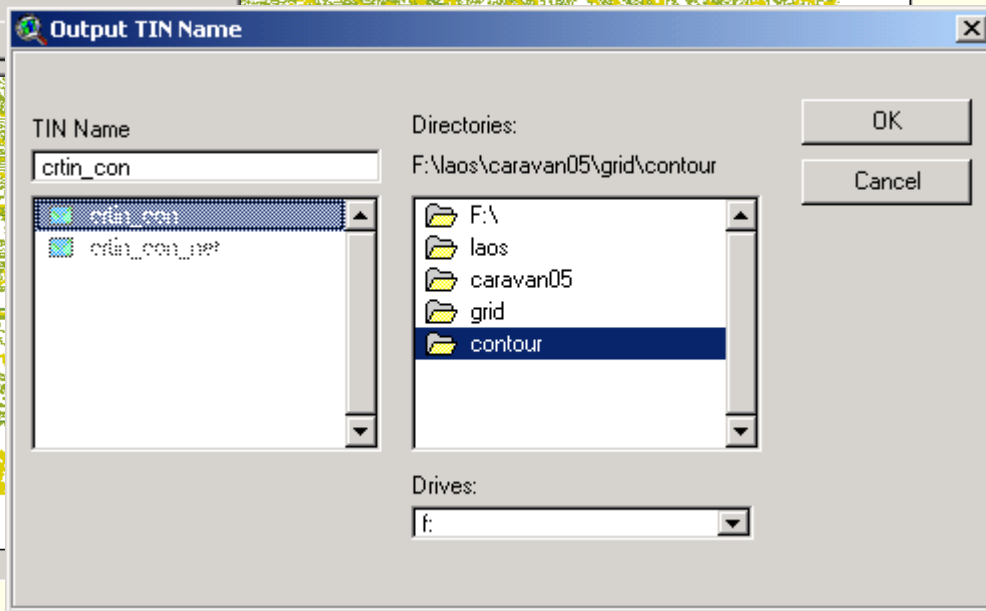
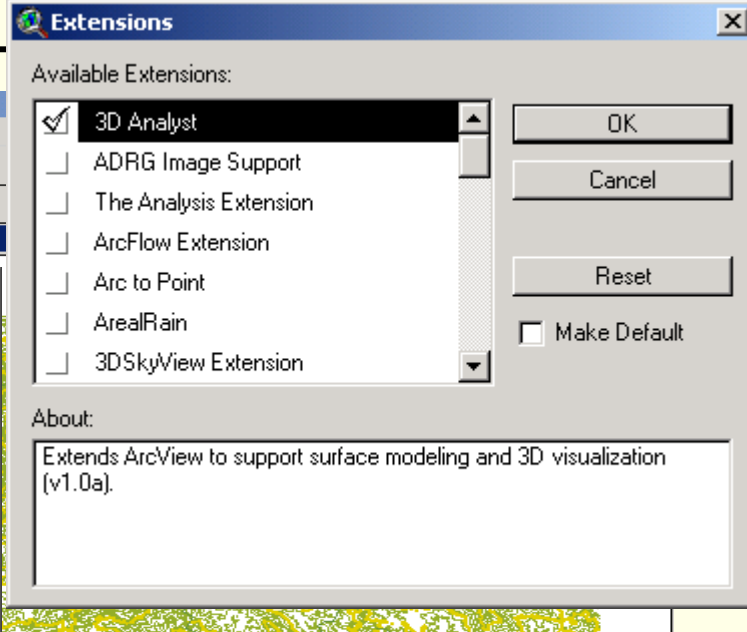
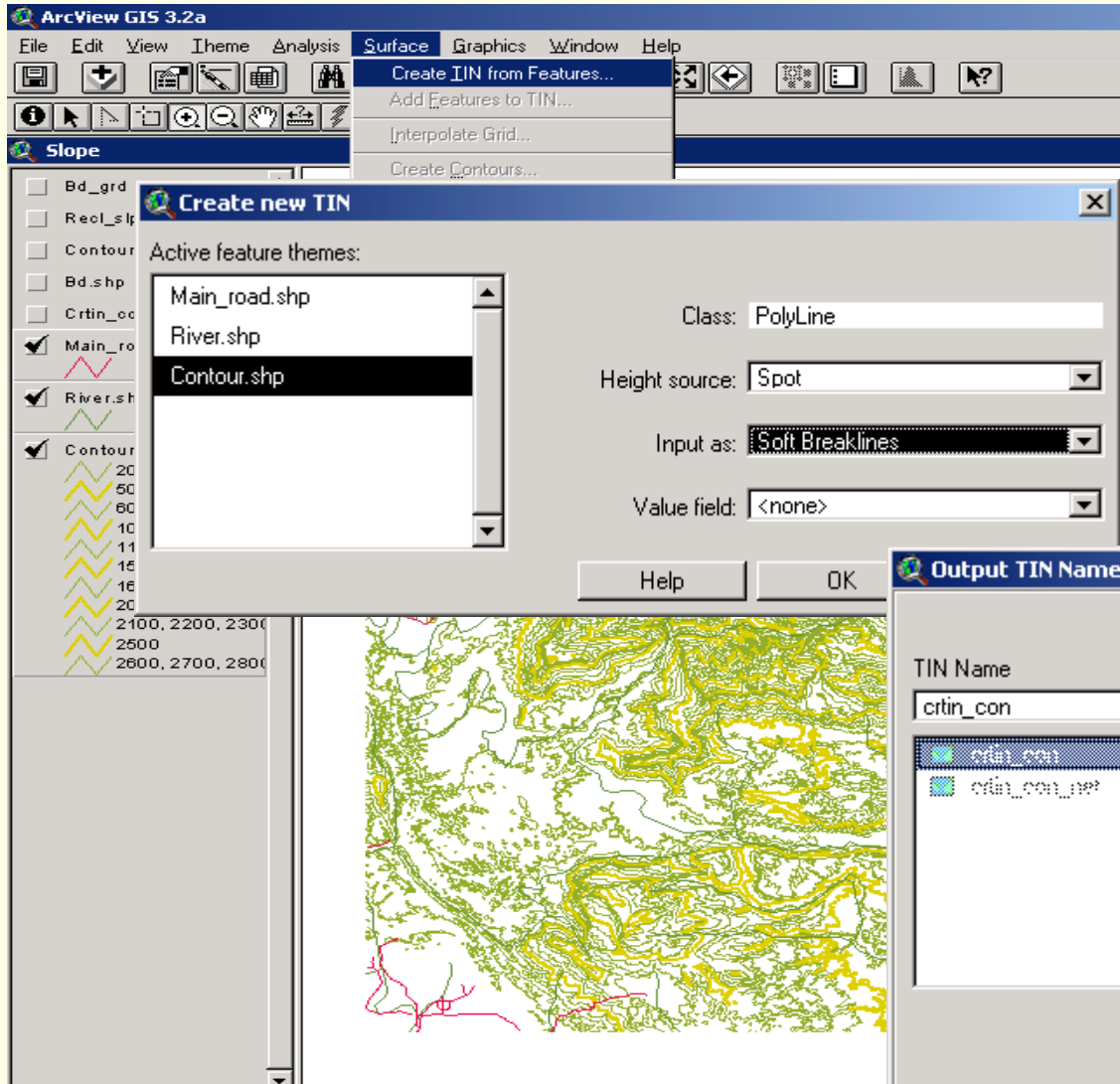
The screenshot shows the ArcView GIS 3.2a interface. The 'Slope' layer is active, displaying a map with a yellow-green color gradient representing slope values. The 'Layers' panel on the left is highlighted with a red box, showing the following layers and their status:

- Bd_grd
- Recl_slp
- Contour
- Bd.shp
- Crtin_con_net
- Main_road.shp
- River.shp
- Contour.shp
 - 200, 300, 400
 - 500
 - 600, 700, 800, 900
 - 1000
 - 1100, 1200, 1300
 - 1500
 - 1600, 1700, 1800
 - 2000
 - 2100, 2200, 2300
 - 2500
 - 2600, 2700, 2800

The map displays a network of roads (red lines), rivers (green lines), and contour lines (yellow lines) overlaid on a slope map (yellow-green background). The scale is 1:589,430. The coordinates are 335,202.44 Easting and 2,048,734.69 Northing.

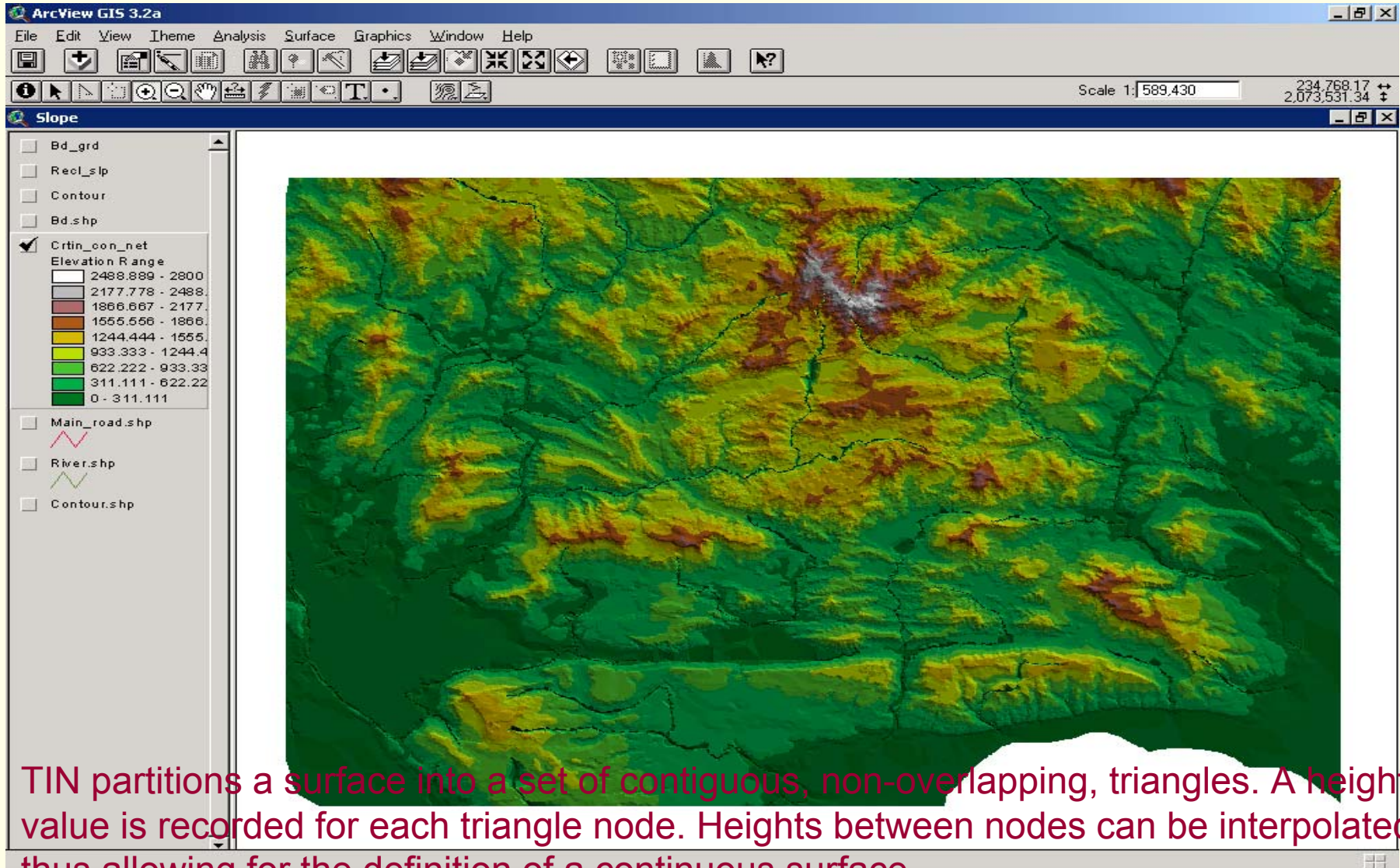
- Road Network
- River Network
- Contour

Create TIN from Contour

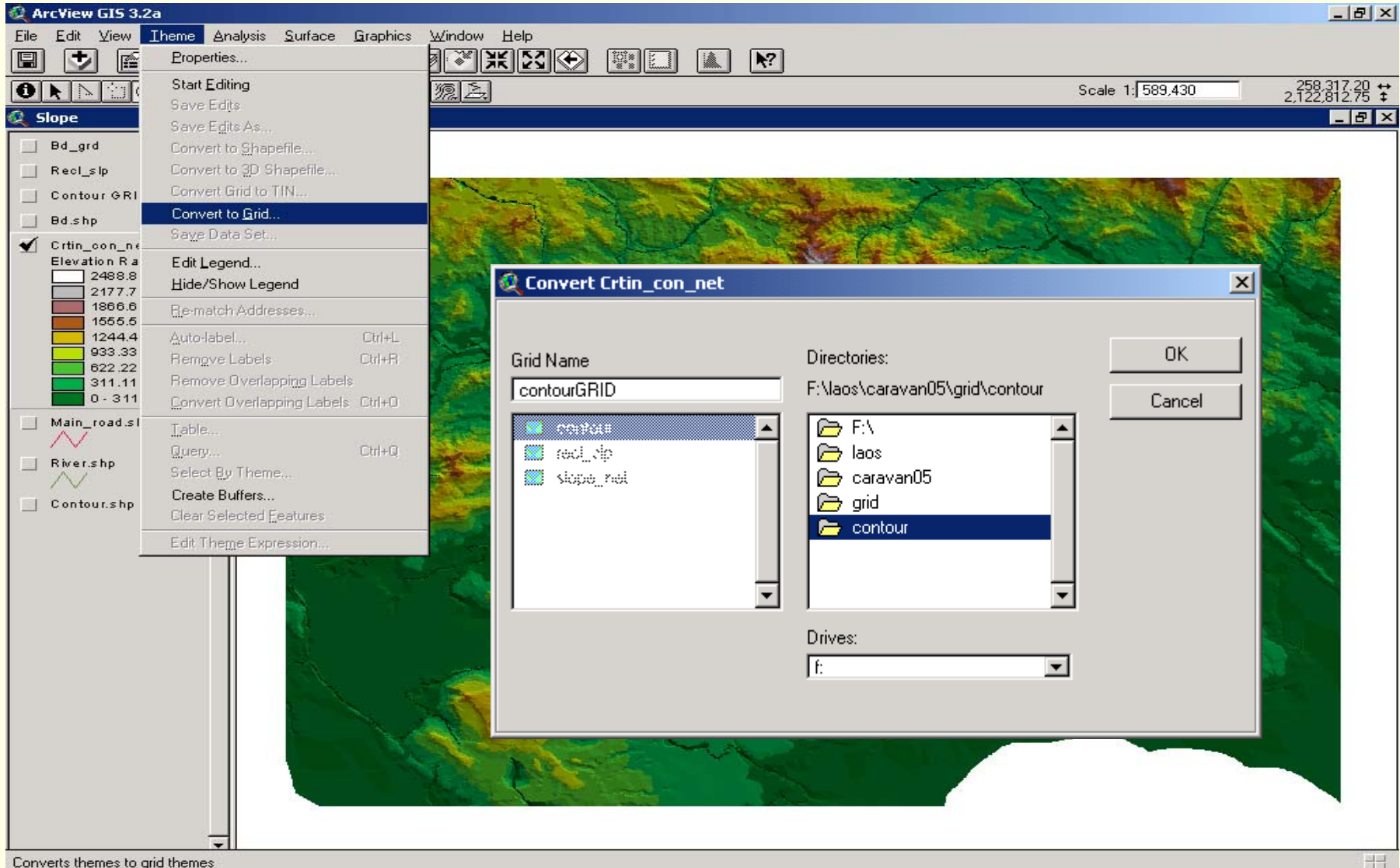


Build TIN using selected features in active feature themes

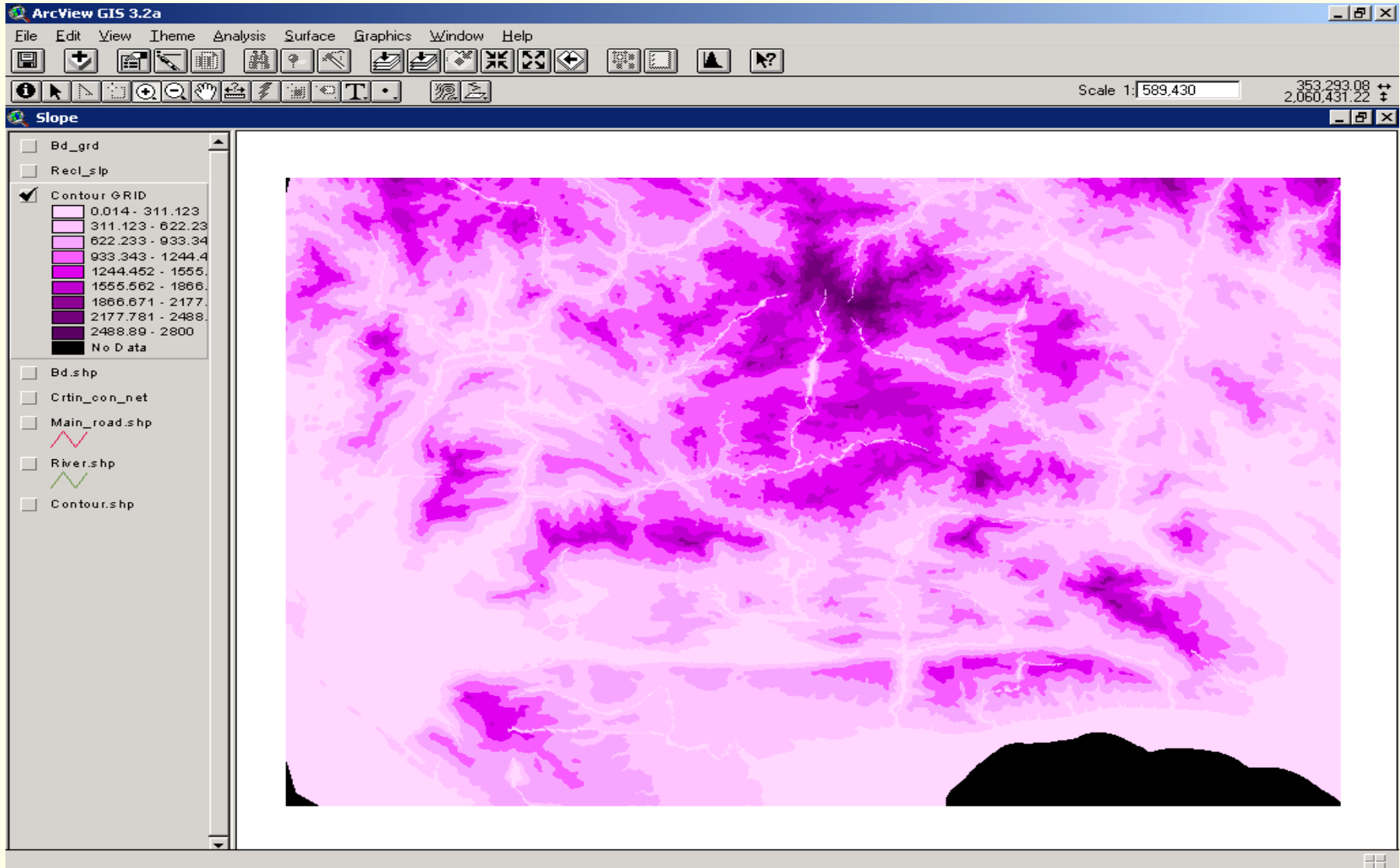
TIN (Triangulated Irregular Network)



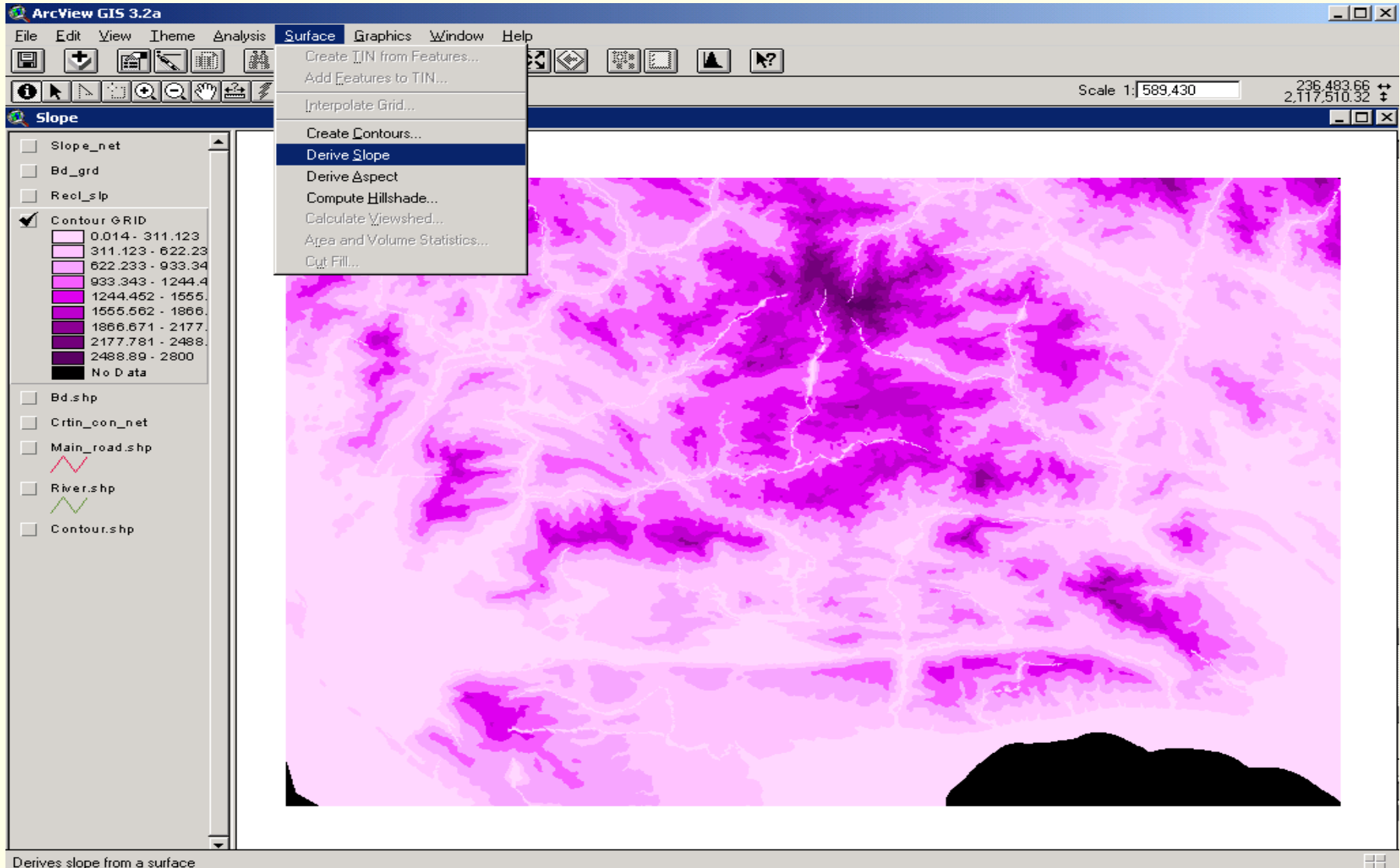
TIN to GRID



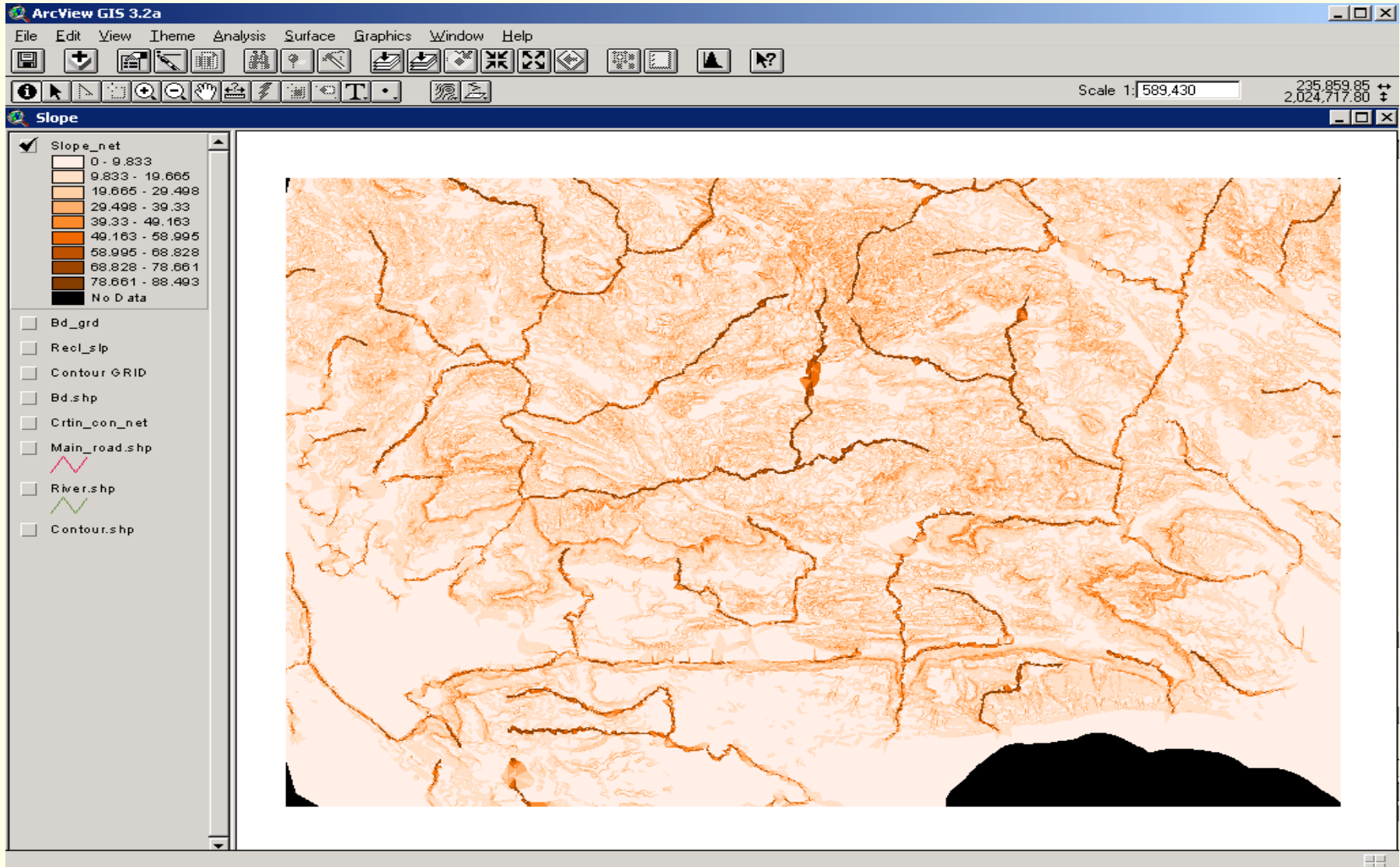
GRID from Contour



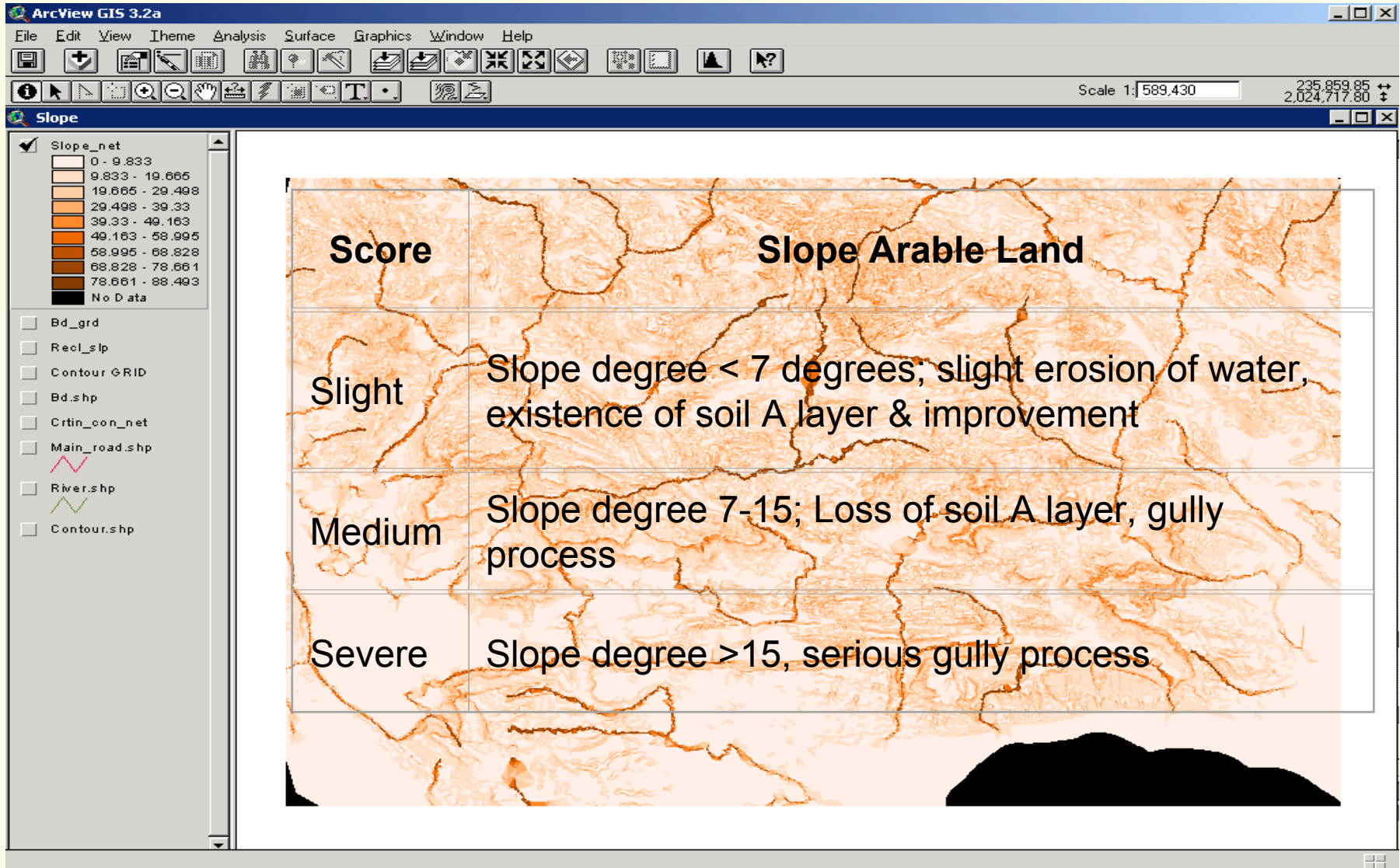
Derive Slope from GRID



Slope



Scoring Slope



Scoring Slope Grid

The screenshot shows the ArcView GIS 3.2a interface. The 'Analysis' menu is open, showing options like 'Properties...', 'Find Distance', 'Assign Proximity', 'Calculate Density...', 'Cell Statistics...', 'Summarize Zones...', 'Histogram By Zone...', 'Tabulate Areas...', 'Map Query...', 'Map Calculator...', 'Neighborhood Statistics...', and 'Reclassify...'. The 'Reclassify...' option is selected.

Two 'Reclassify Values' dialog boxes are open. The left dialog box shows the 'Classification Field' set to 'Value' and a table of old values and new values. The right dialog box shows the 'Classification Field' set to 'Value' and a table of old values and new values.

The background map shows a slope grid with a color scale from 0 to 88.493. The legend on the left lists the following ranges:

- 0 - 9.833
- 9.833 - 19.665
- 19.665 - 29.498
- 29.498 - 39.33
- 39.33 - 49.163
- 49.163 - 58.995
- 58.995 - 68.828
- 68.828 - 78.661
- 78.661 - 88.493
- No Data

The 'Reclassify Values' dialog boxes show the following tables:

Left Dialog Box:

Old Values	New Value
0 - 9.833	1
9.833 - 19.665	2
19.665 - 29.498	3
29.498 - 39.33	4
39.33 - 49.163	5
49.163 - 58.995	6
58.995 - 68.828	7

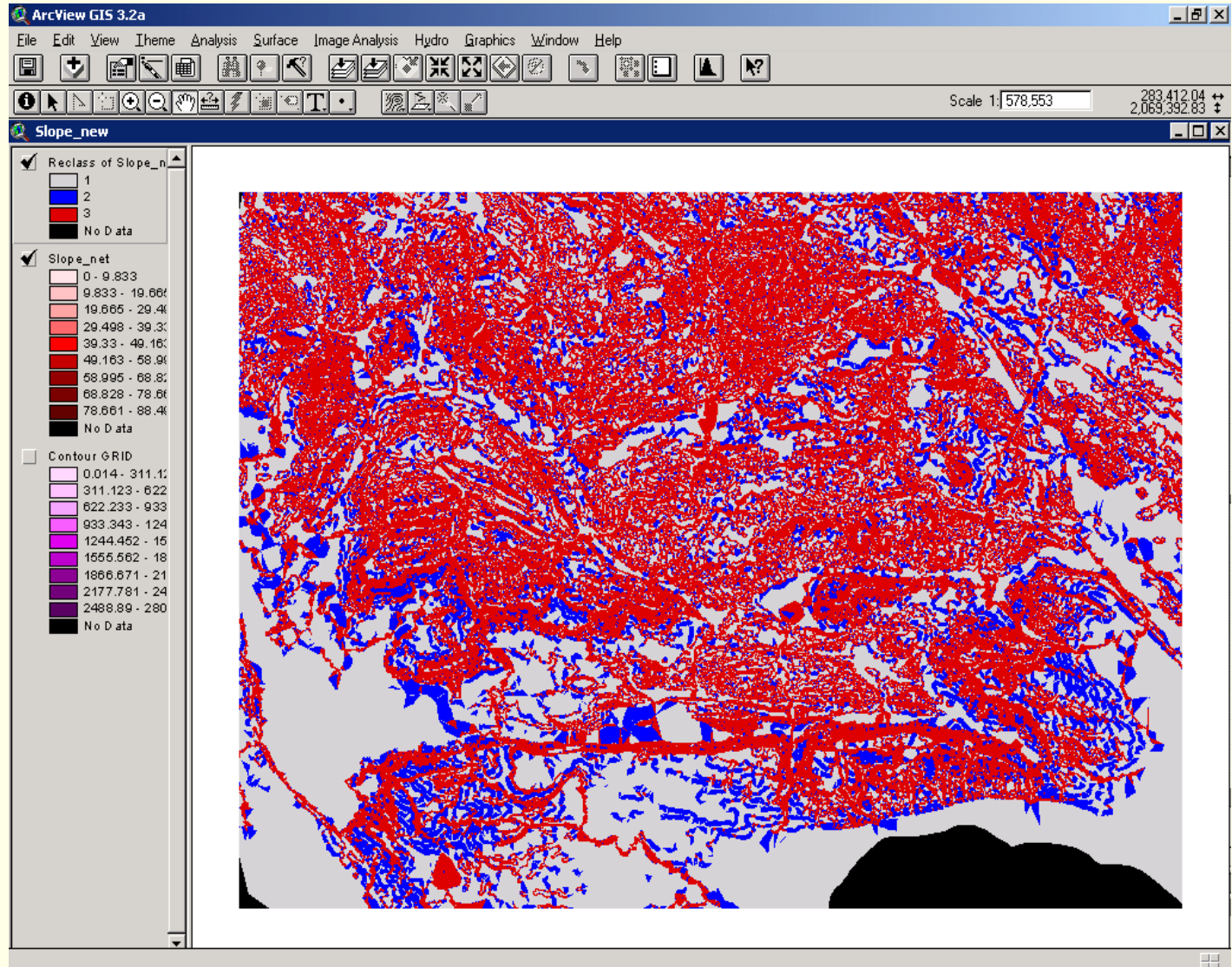
Right Dialog Box:

Old Values	New Value
0 - 7	1
7 - 15	2
15 - 88	3
No Data	No Data

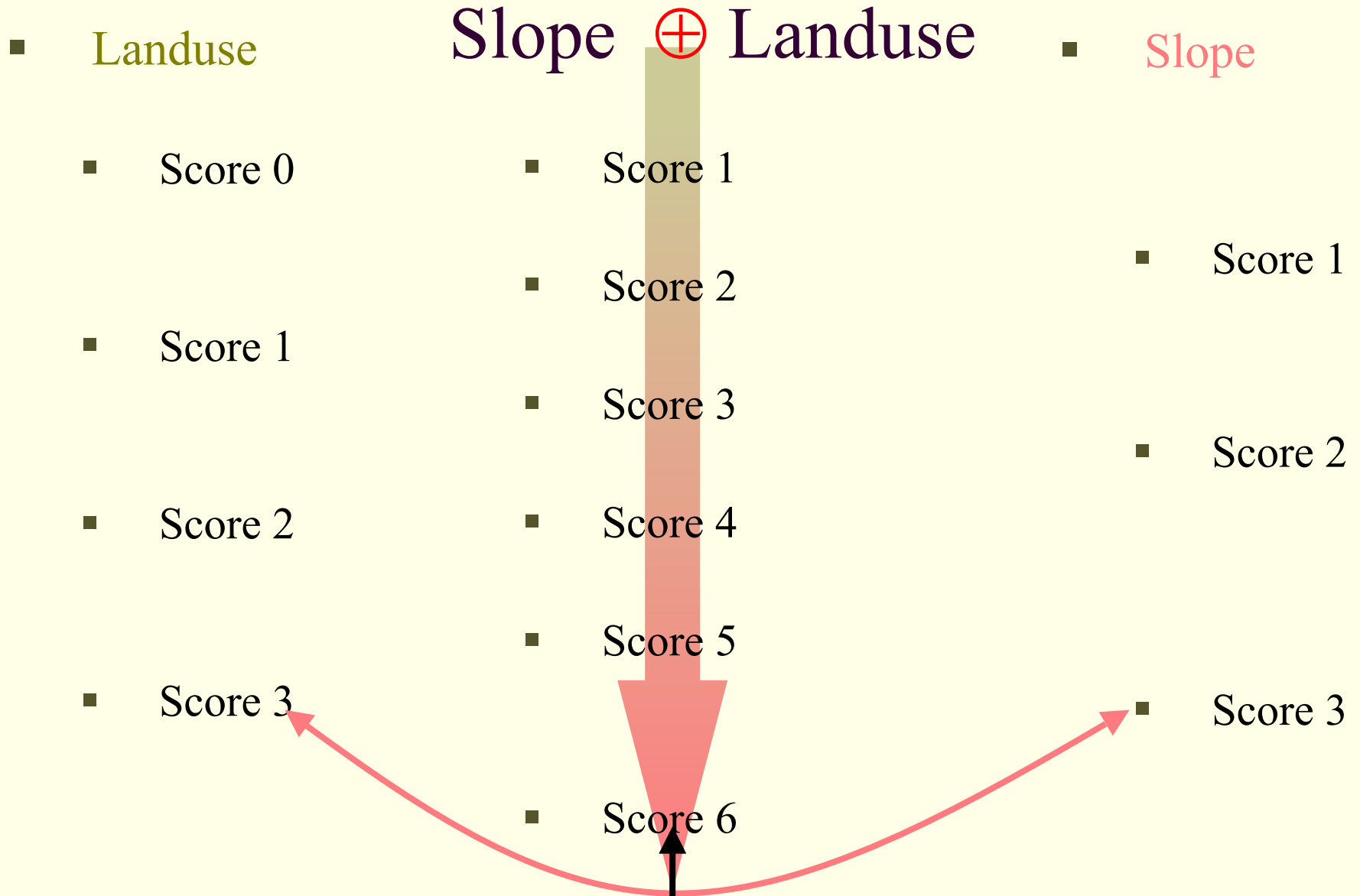
The 'Classification' dialog box shows 'Type: Equal Interval', 'Number of classes: 3', and 'Round values at: d'. The 'OK' button is highlighted.

At the bottom left, a status bar reads: 'Reclassifies the values in a grid theme'.

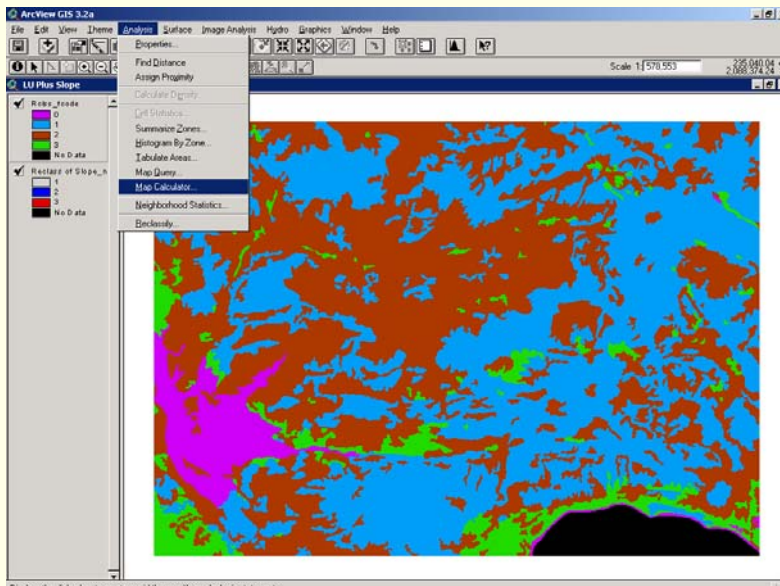
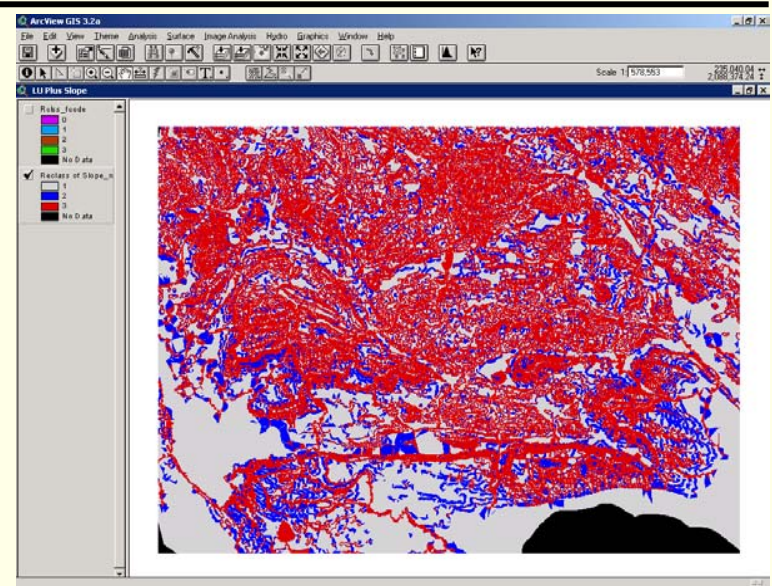
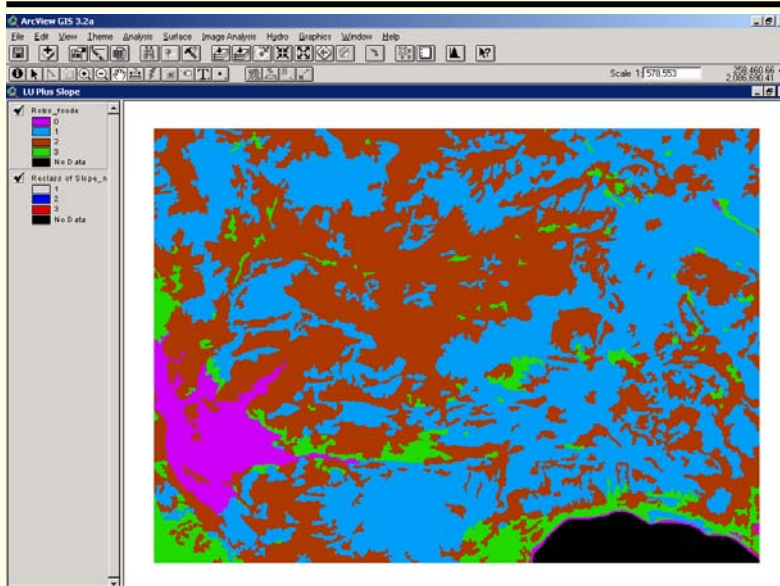
Scores of Slope



Logically way of Thought



Slope & Landuse



Map Calculation 1

Logarithms

Layers

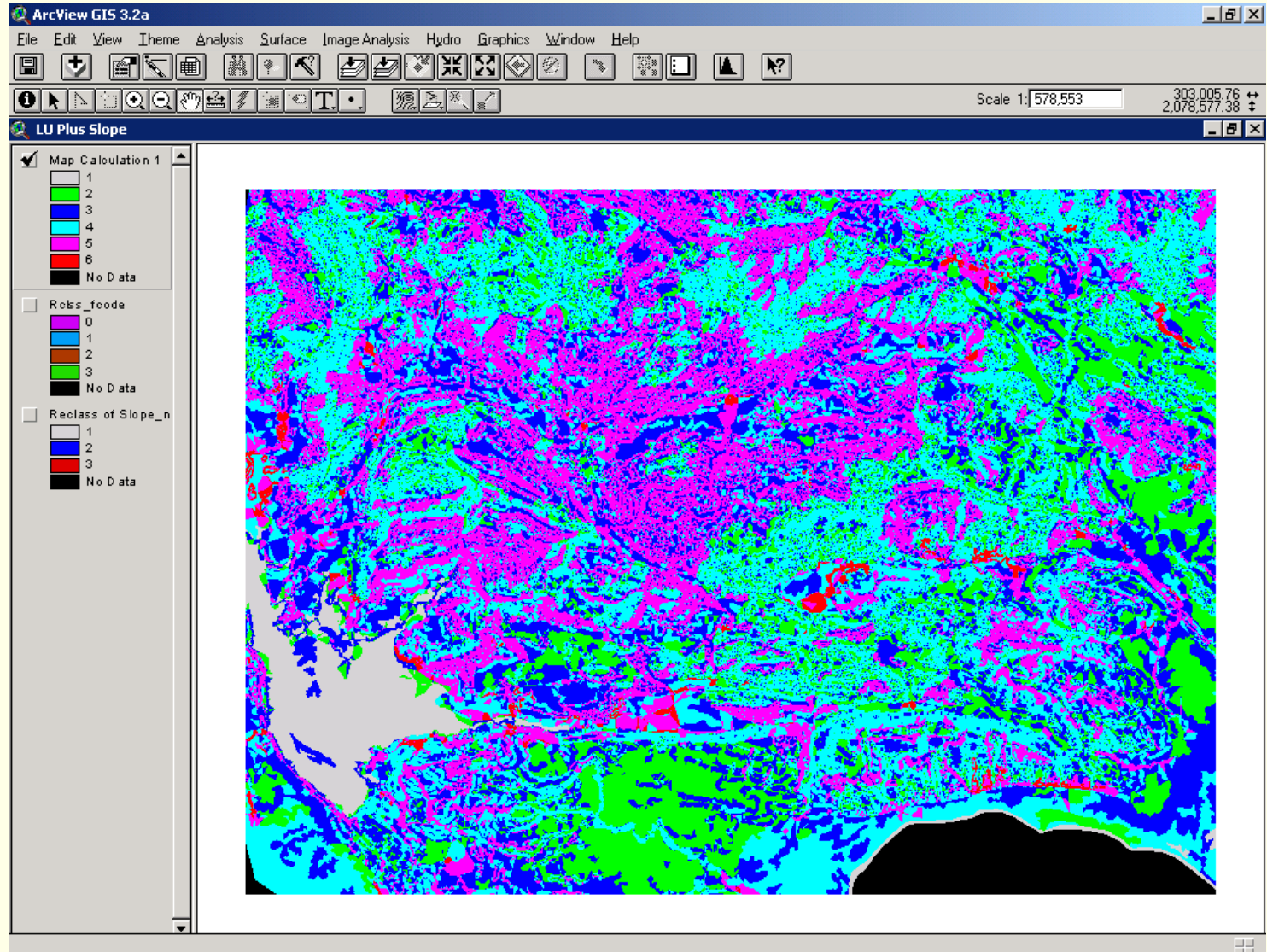
- [Rclss_fcodes]
- [Rclss_fcodes . Cou]
- [Reclass of Slope_net]
- [Reclass of Slope_net]

AsGrid

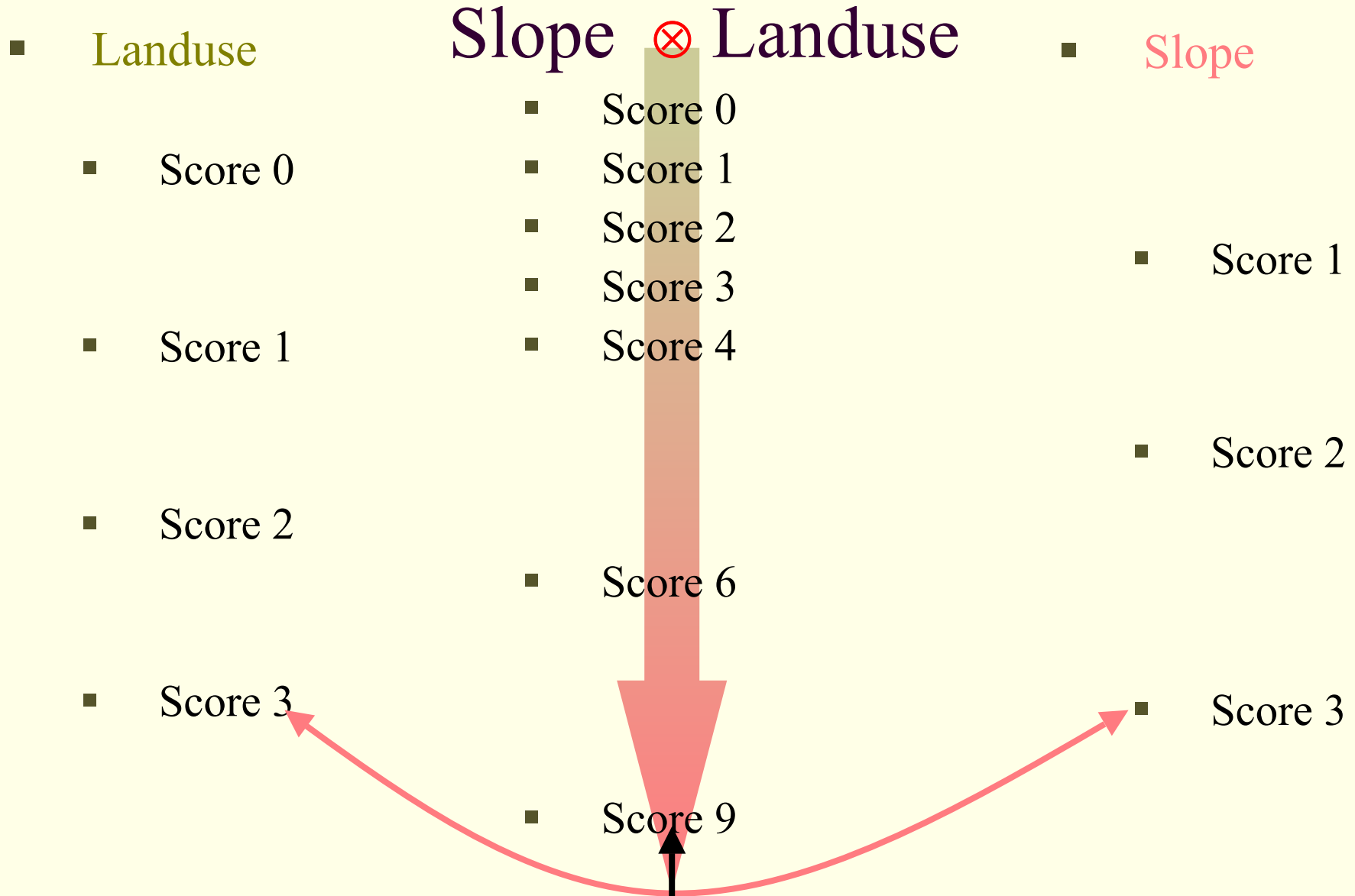
[(Rclss_fcodes) + (Reclass of Slope_net)]

Evaluate

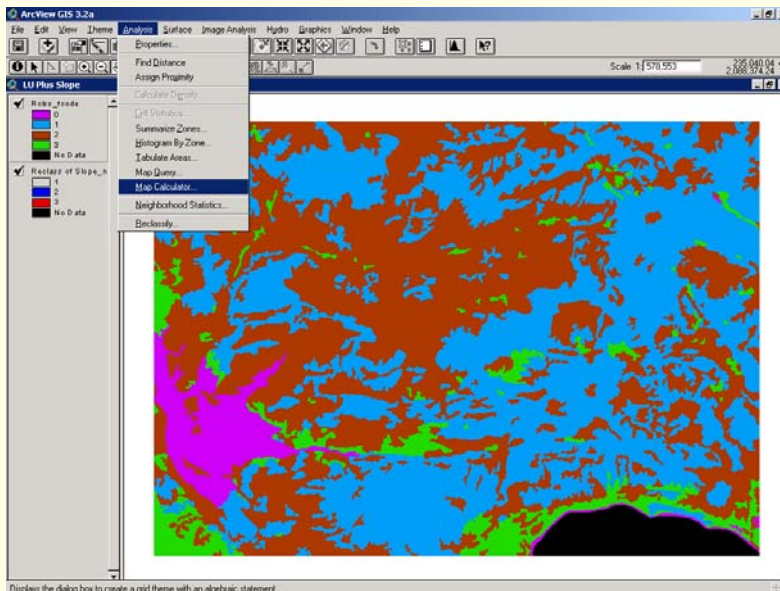
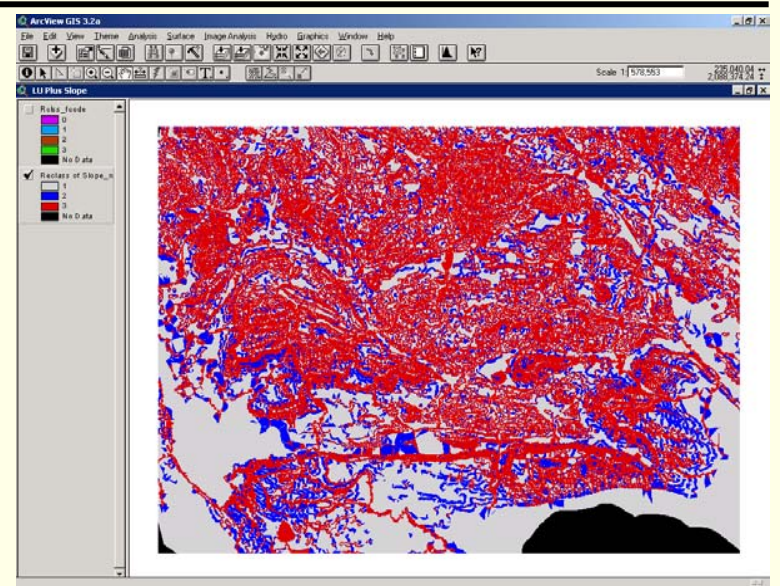
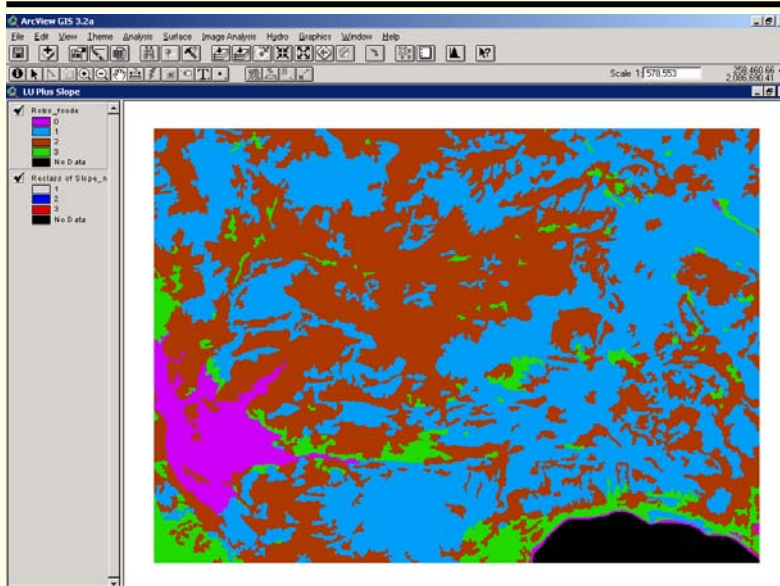
Slope ⊕ Landuse



Logically way of Thought



Slope & Landuse



Map Calculation 1

Logarithms

Layers

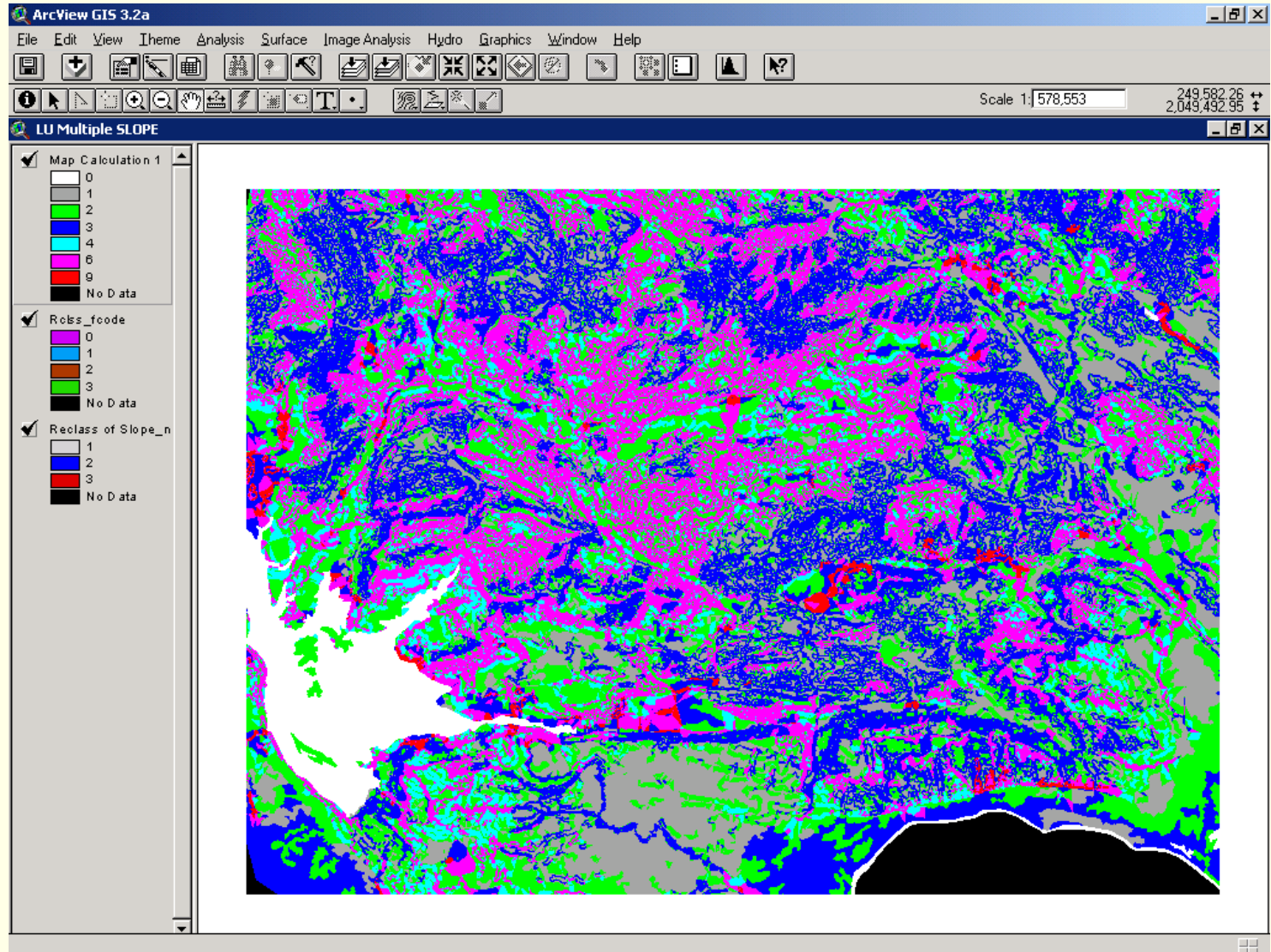
- [Reclass_fcode]
- [Reclass_fcode.Cou]
- [Reclass of Slope_n]
- [Reclass of Slope_n]

Calculator interface with buttons for mathematical operations: *, /, +, -, =, <>, and, >, >=, or, <, <=, xor, (), not, Exp, Log, Exp2, Log2, Exp10, Log10, AsGrid.

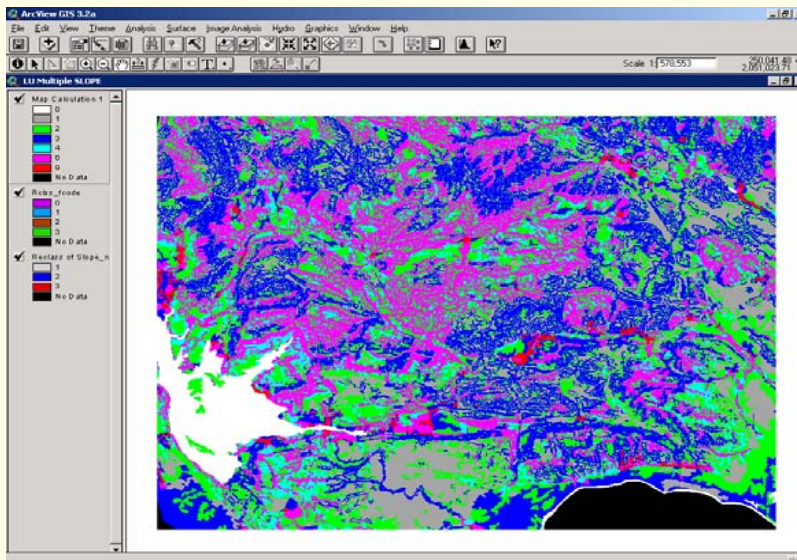
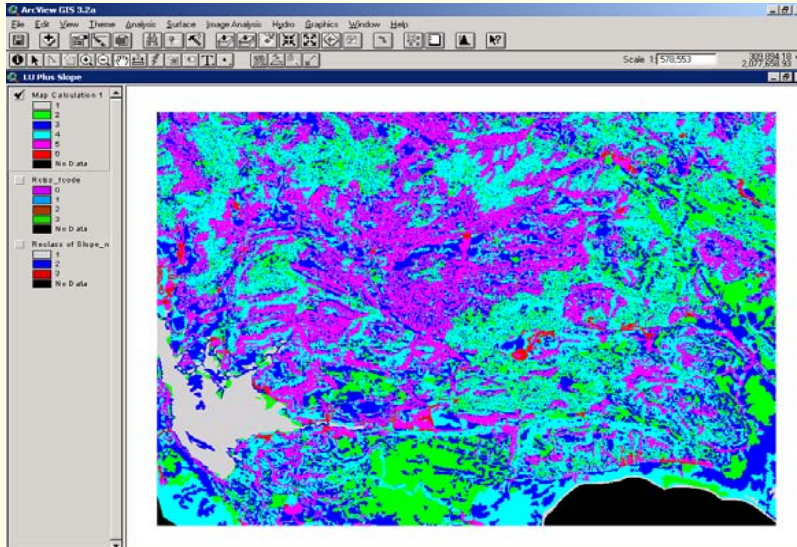
Expression field:
$$([Reclass_fcode] * [Reclass\ of\ Slope_net])$$

Evaluate

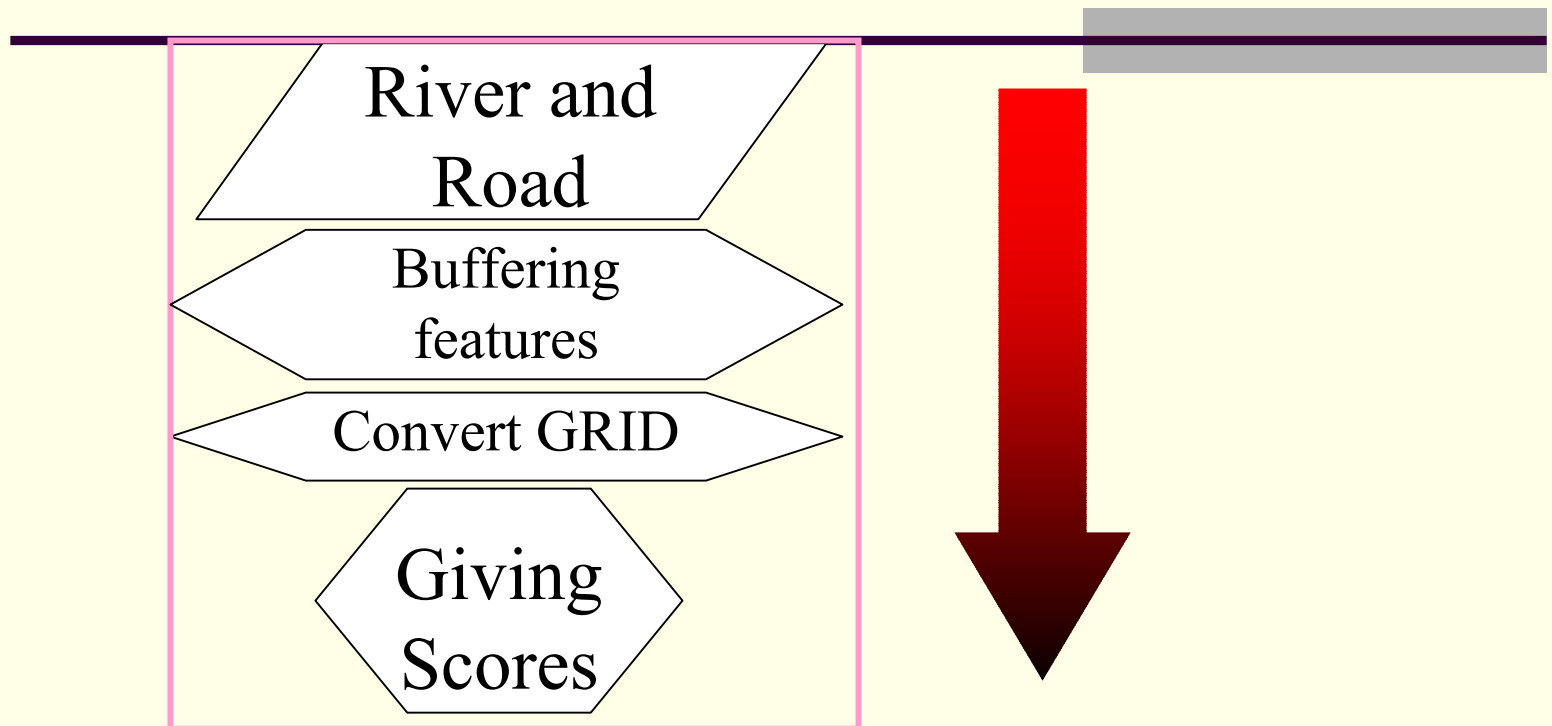
Slope ⊗ Landuse



Comparison Adding and Multiplying



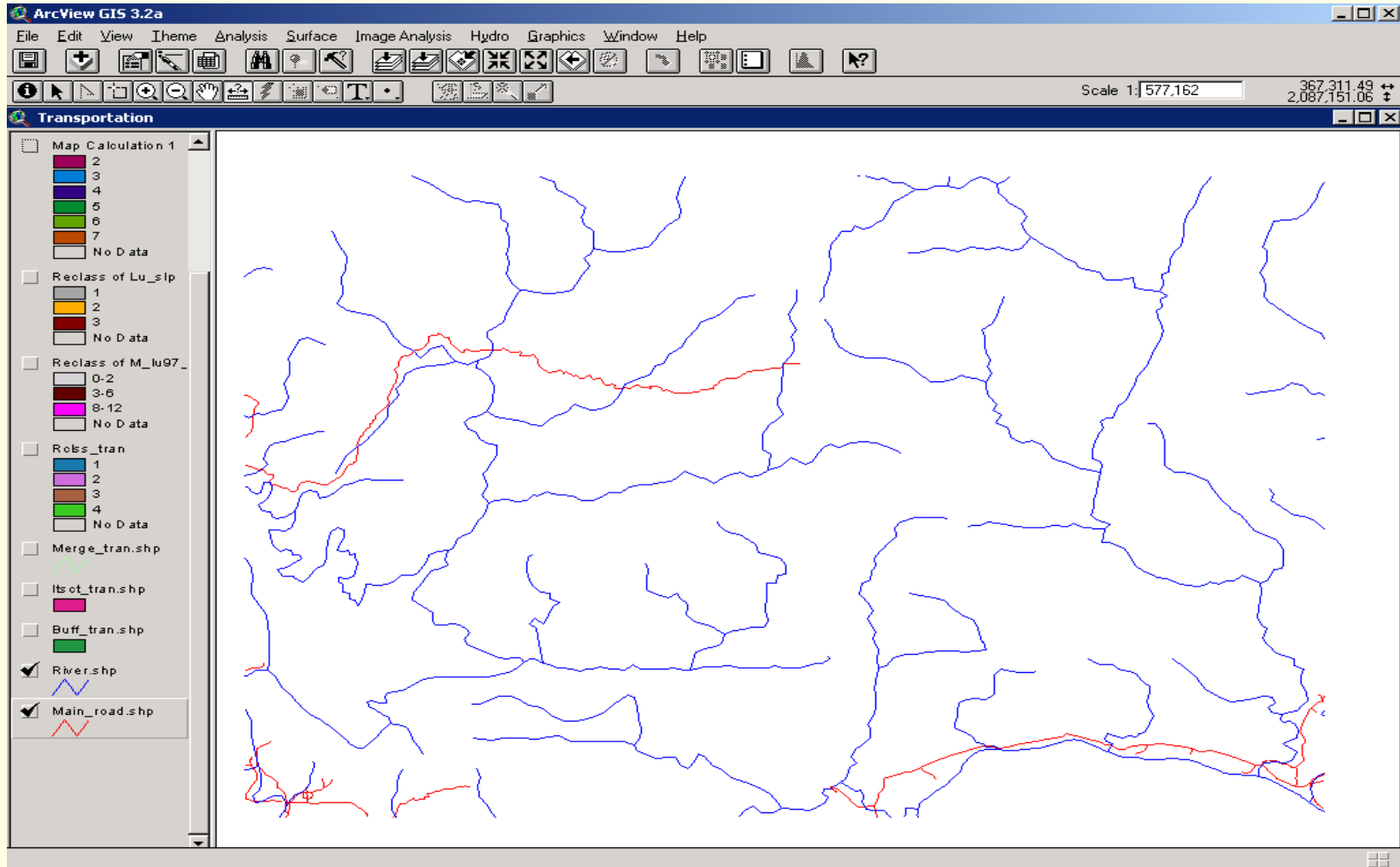
TRANSPORTATION Parameter



Scoring Transportation Parameter

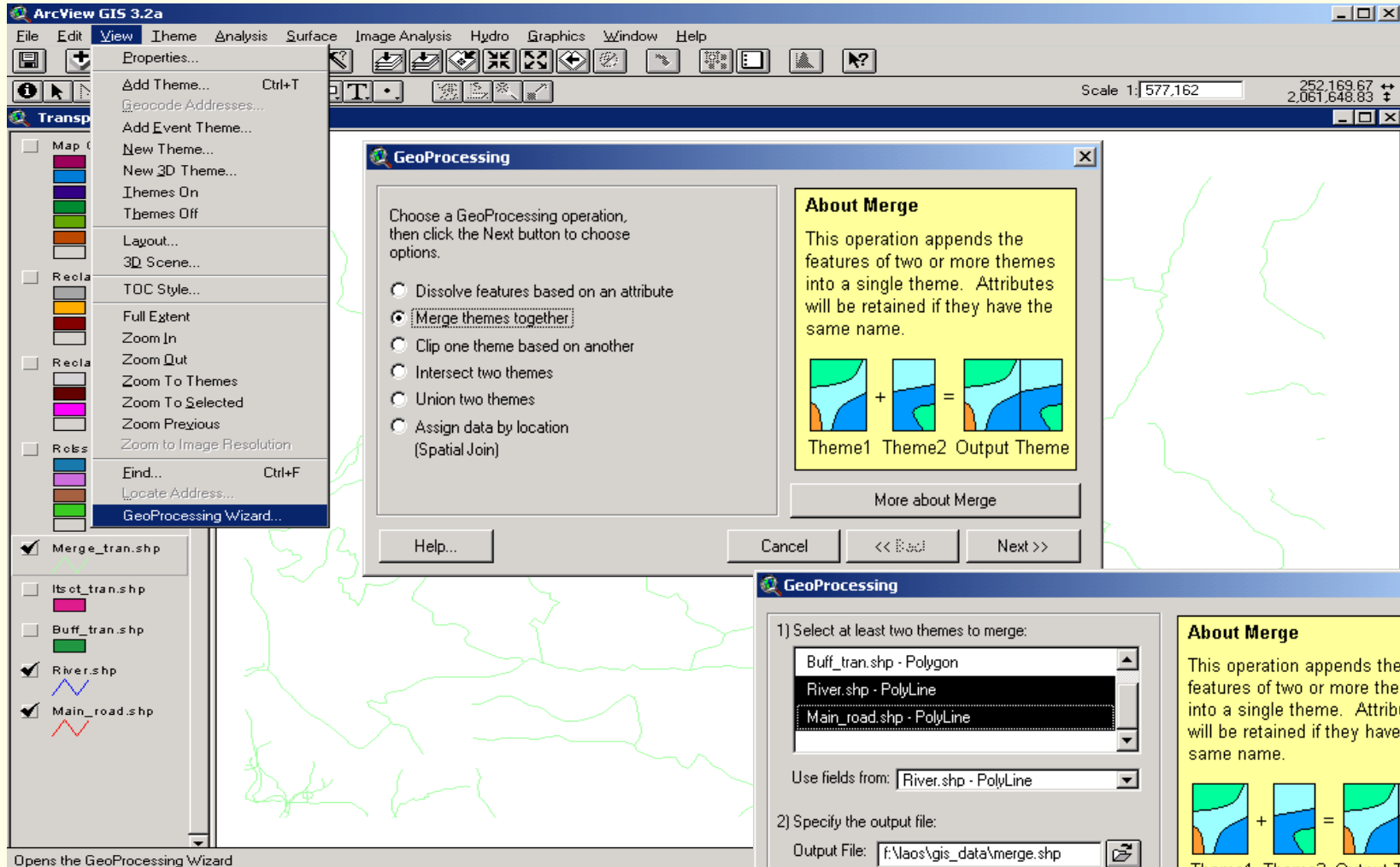
- Defined four scores based on how far from Transportation Route (River and Road)
 - **Score 1** has very less erosion potential areas where **the places located within 4 Kilometers far from Transportation route**
 - **Score 2** has less erosion potential areas where **the places located within 3 Kilometers far from Transportation route**
 - **Score 3** has high erosion potential areas where **the places located within 2 Kilometers far from Transportation route**
 - **Score 4** has very high erosion potential where **the places located within 1 Kilometers far from Transportation route**

Transportation



Included Road network and River network

Merged Layers



Road layer and River layer

Buffering

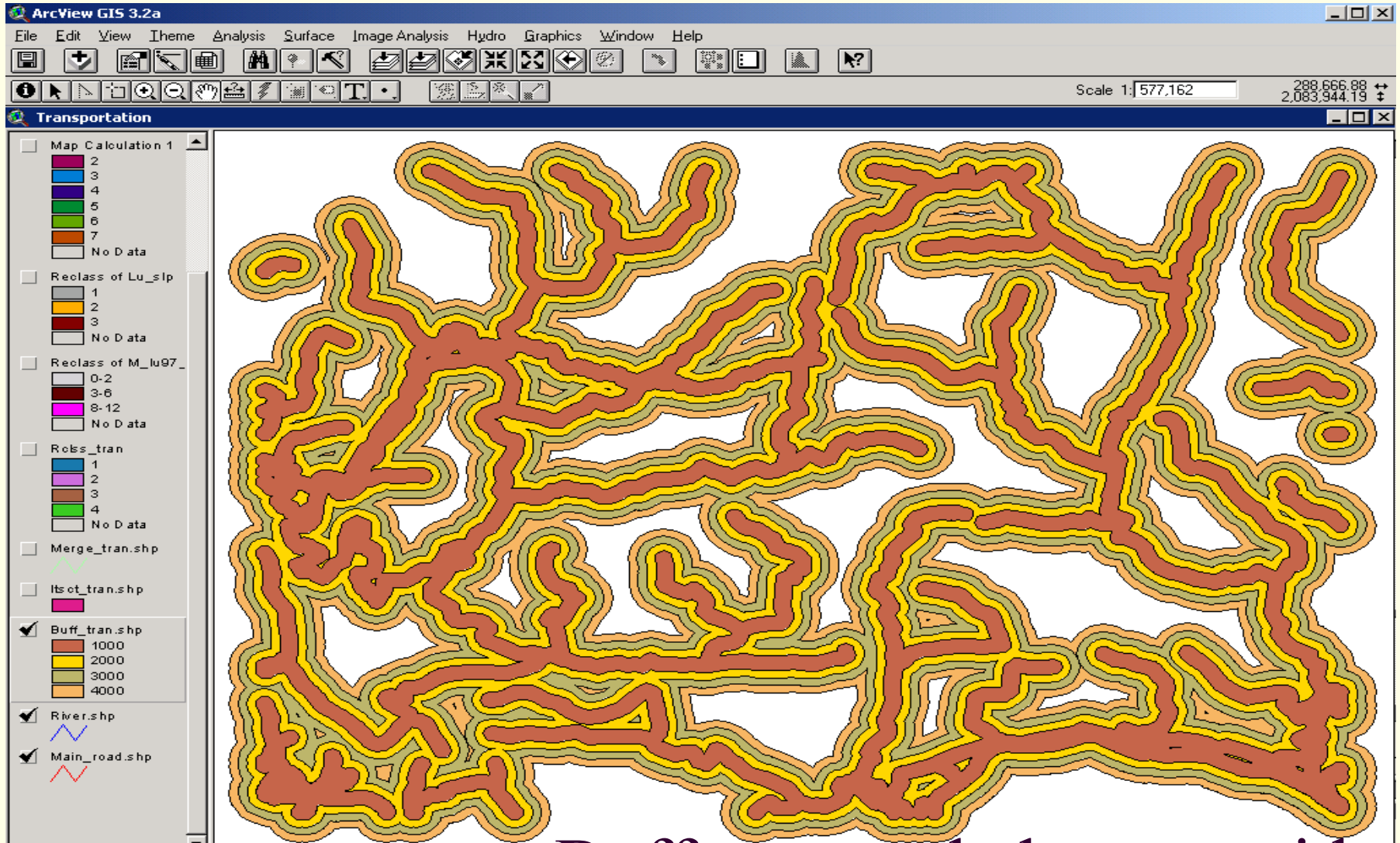
The screenshot displays the ArcView GIS 3.2a interface. The main window shows a map with green lines representing roads. A 'Create Buffers' dialog box is open, with the following settings:

- What do you want to buffer?: The features of a theme (Merge_tran.shp)
- How do you want to create buffers?: At a specified distance (500)
- At a distance from an attribute field (Length)
- As multiple rings (number of rings: 4, distance between rings: 1000)
- Distance units are: Meters

An 'About buffers' window is also visible, explaining that buffers are rings drawn around features at a specified distance. A 'New Theme' dialog box is also open, showing the file name 'buff.shp' and the directory 'F:\aos\gis_data'. The 'gis_data' directory contains subfolders like 'contour_grid', 'from_nah', 'info', and 'tables'.

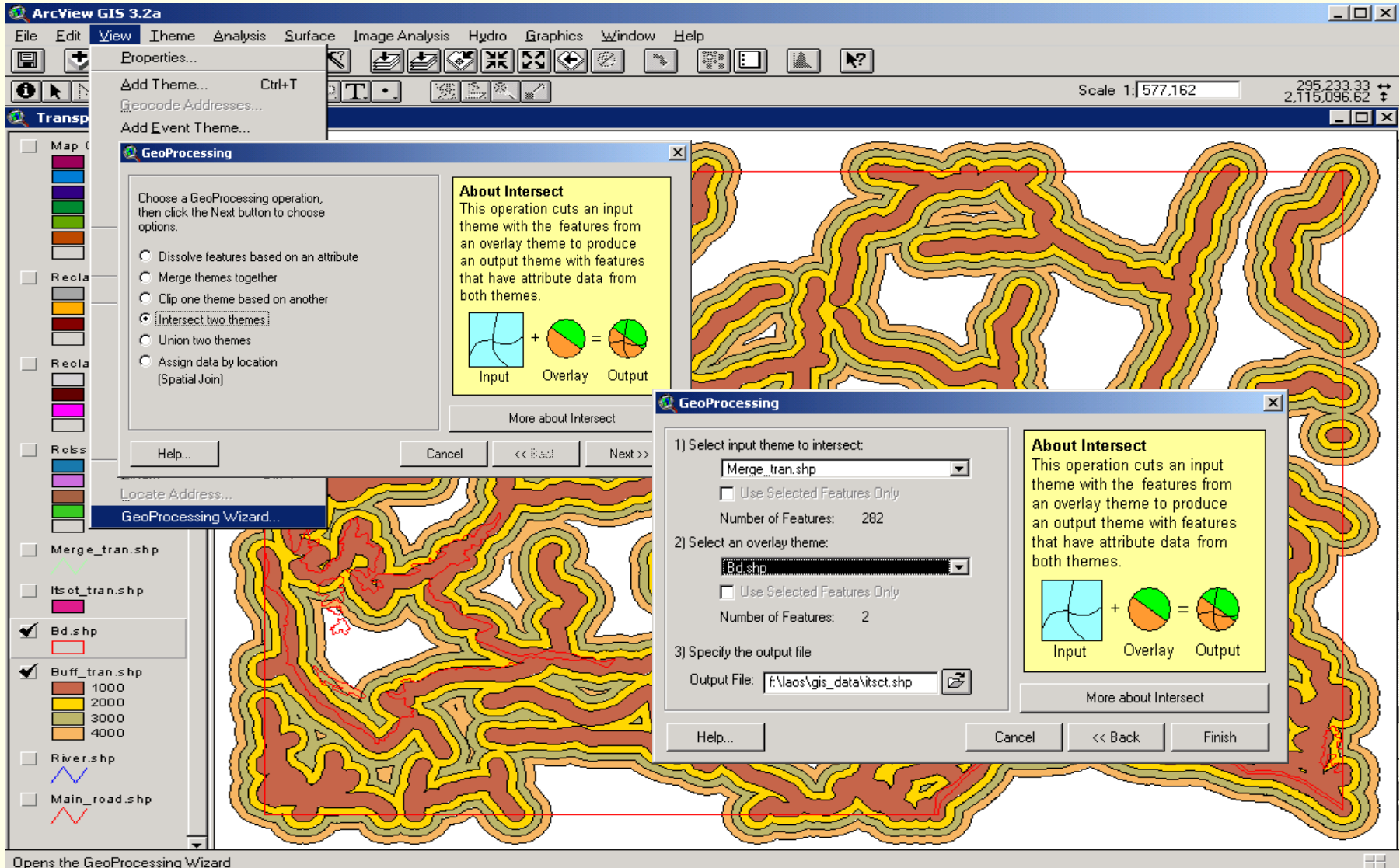
How far People can walk?

Buffering



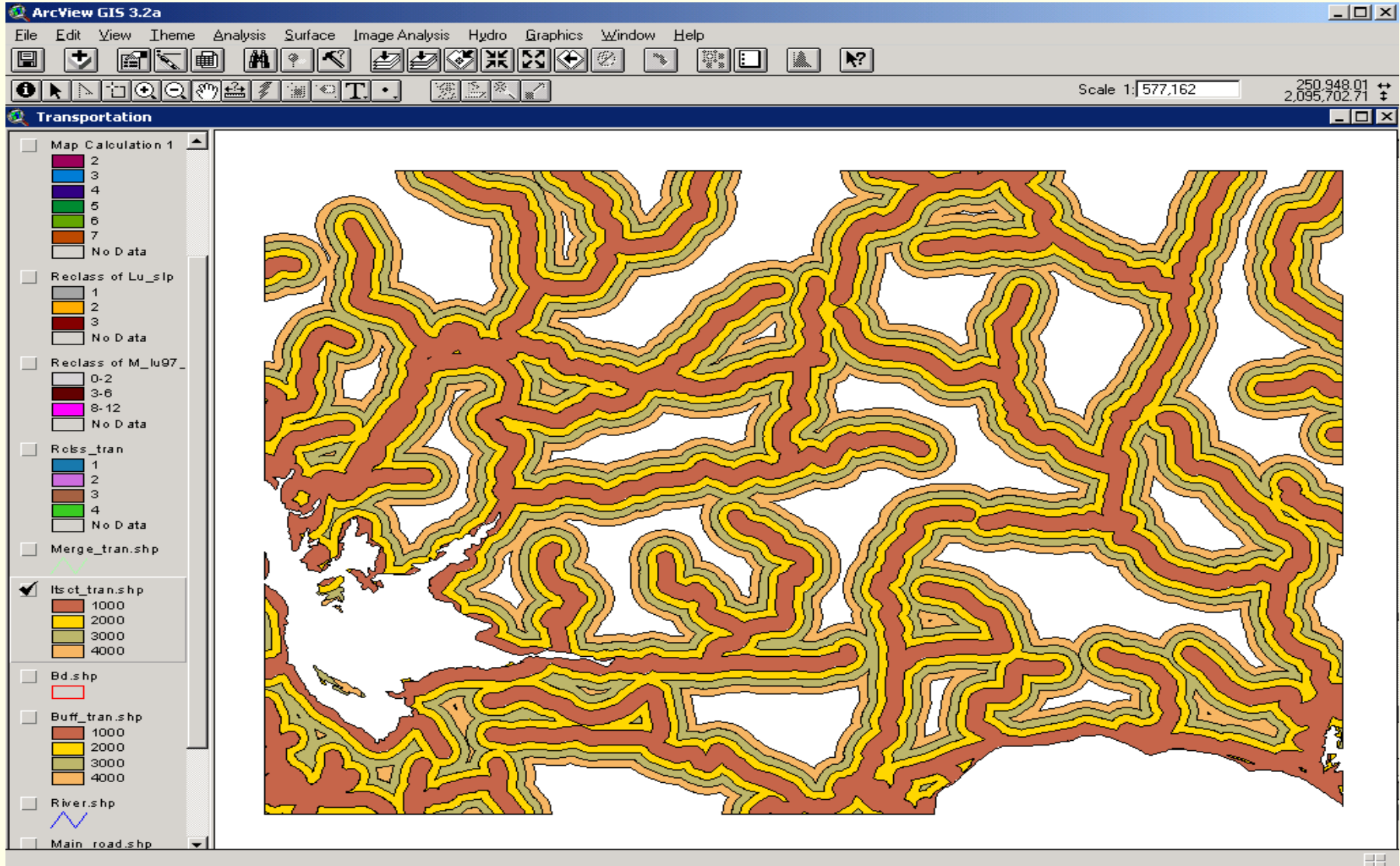
Buffer extended to two sides

Intersecting with Boundary



Opens the GeoProcessing Wizard

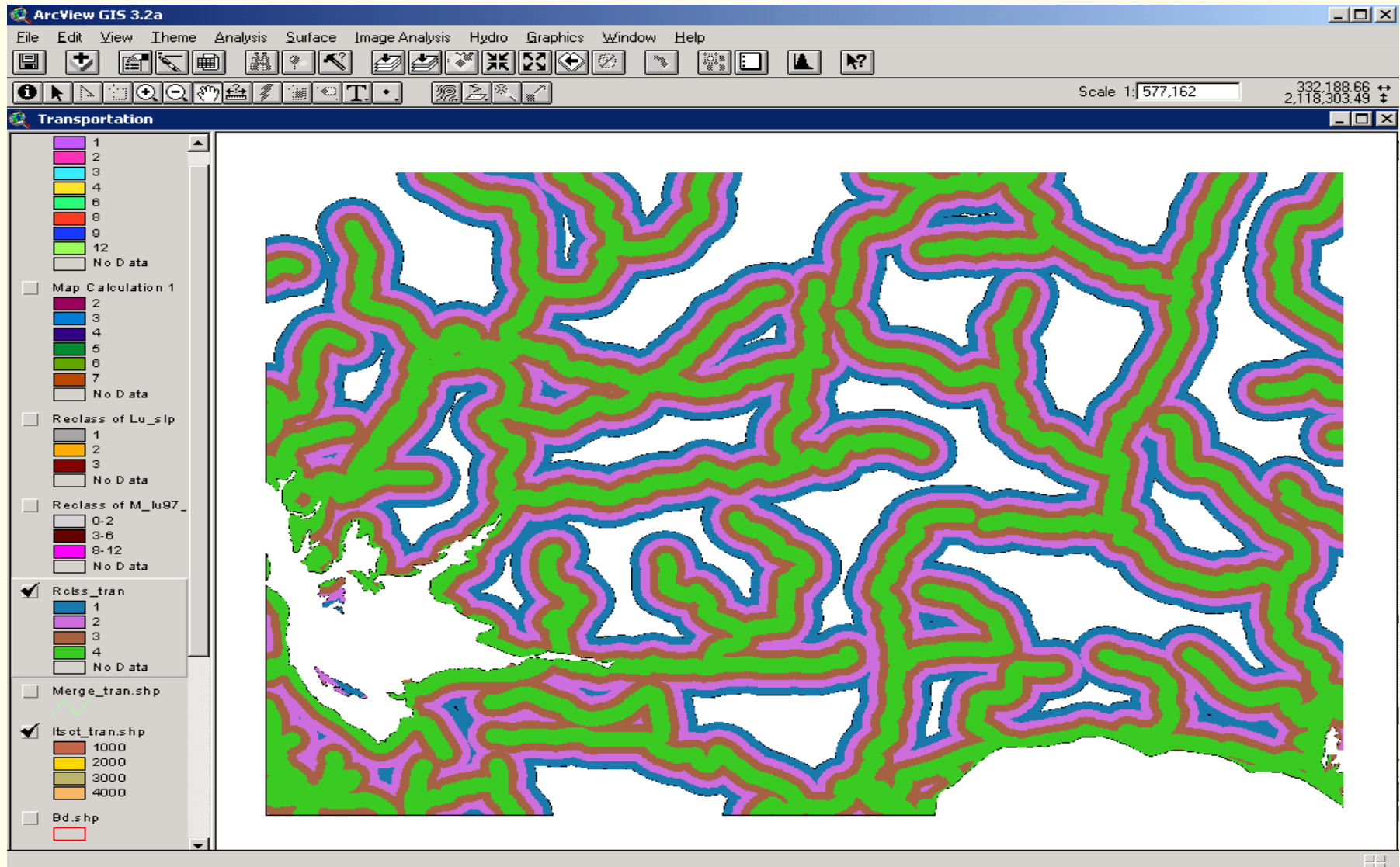
Intersecting with Boundary



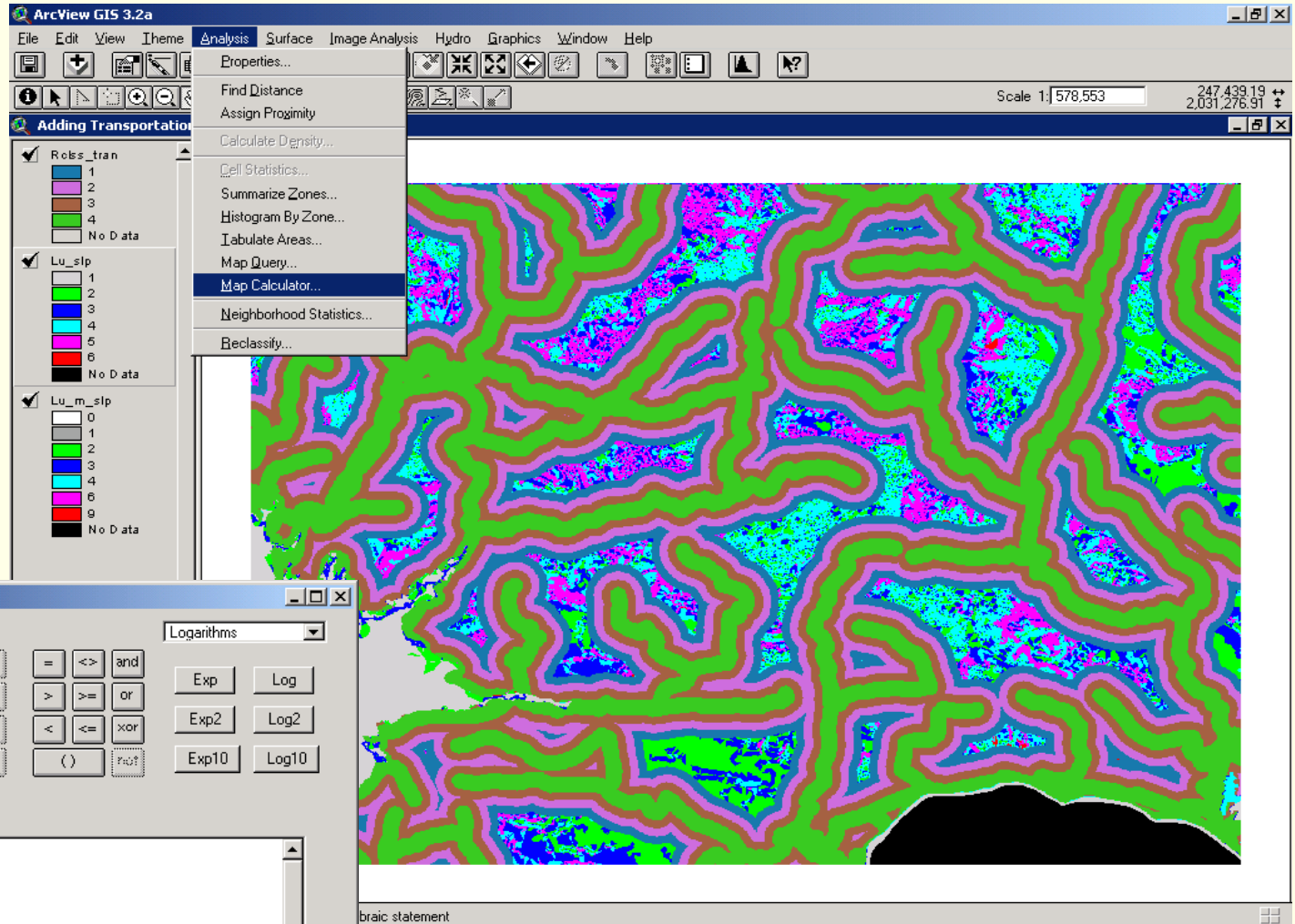
Transportation Scoring

- **Score** **Buffered distance**
 - 1 = 3 to 4 Kilometers
 - 2 = 2 to 3 Kilometers
 - 3 = 1 to 2 Kilometers
 - 4 = Feature to 1 Kilometers

Converted GRID with Scores



Landuse ⊕ Slope ⊕ Transportation



Map Calculation 1

Layers

- [Rclss_tran]
- [Rclss_tran . Count]
- [Lu_slp]
- [Lu_slp . Count]
- [Lu_m_slp]
- [Lu_m_slp . Count]

Logarithms

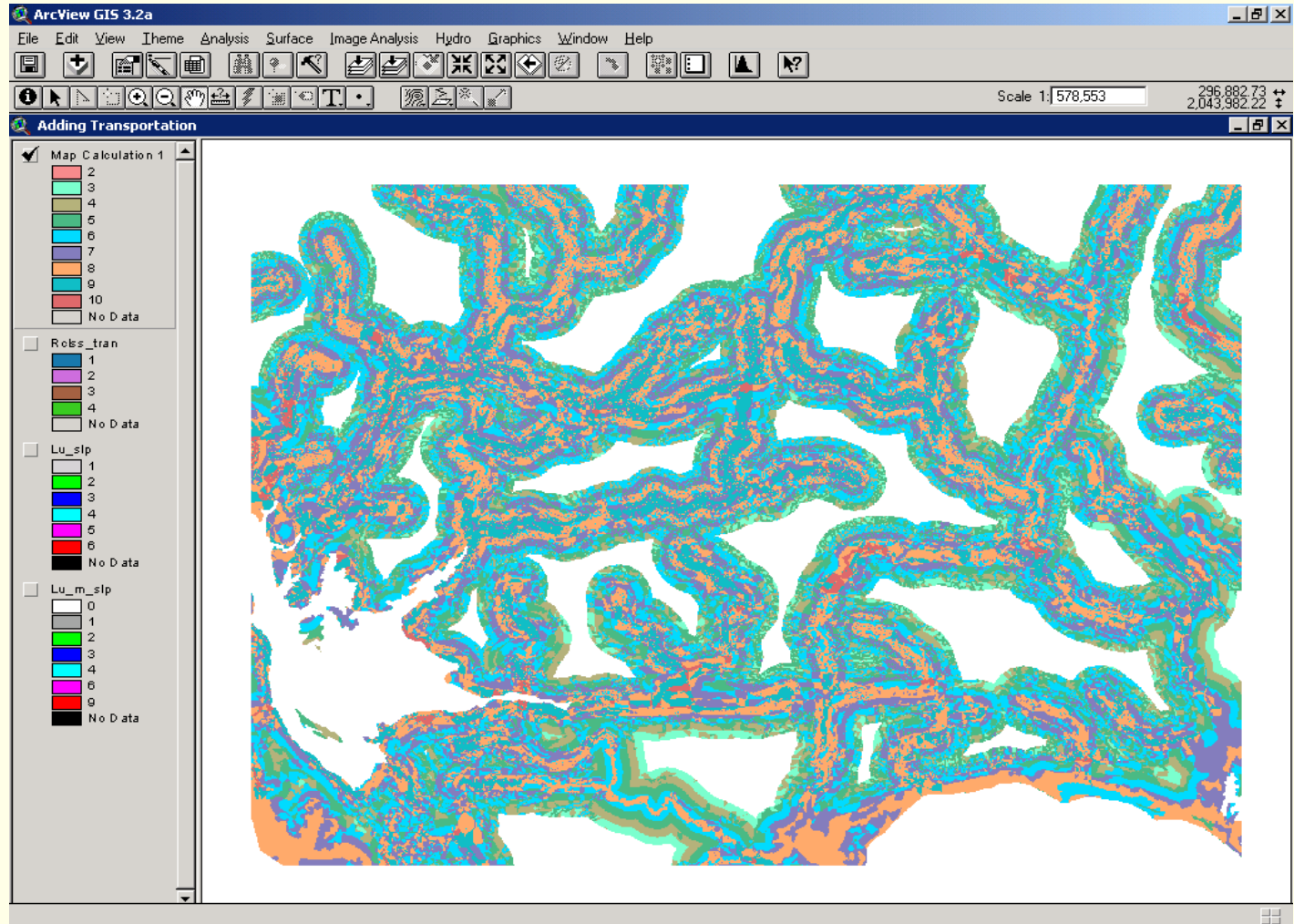
Exp Log
Exp2 Log2
Exp10 Log10

AsGrid

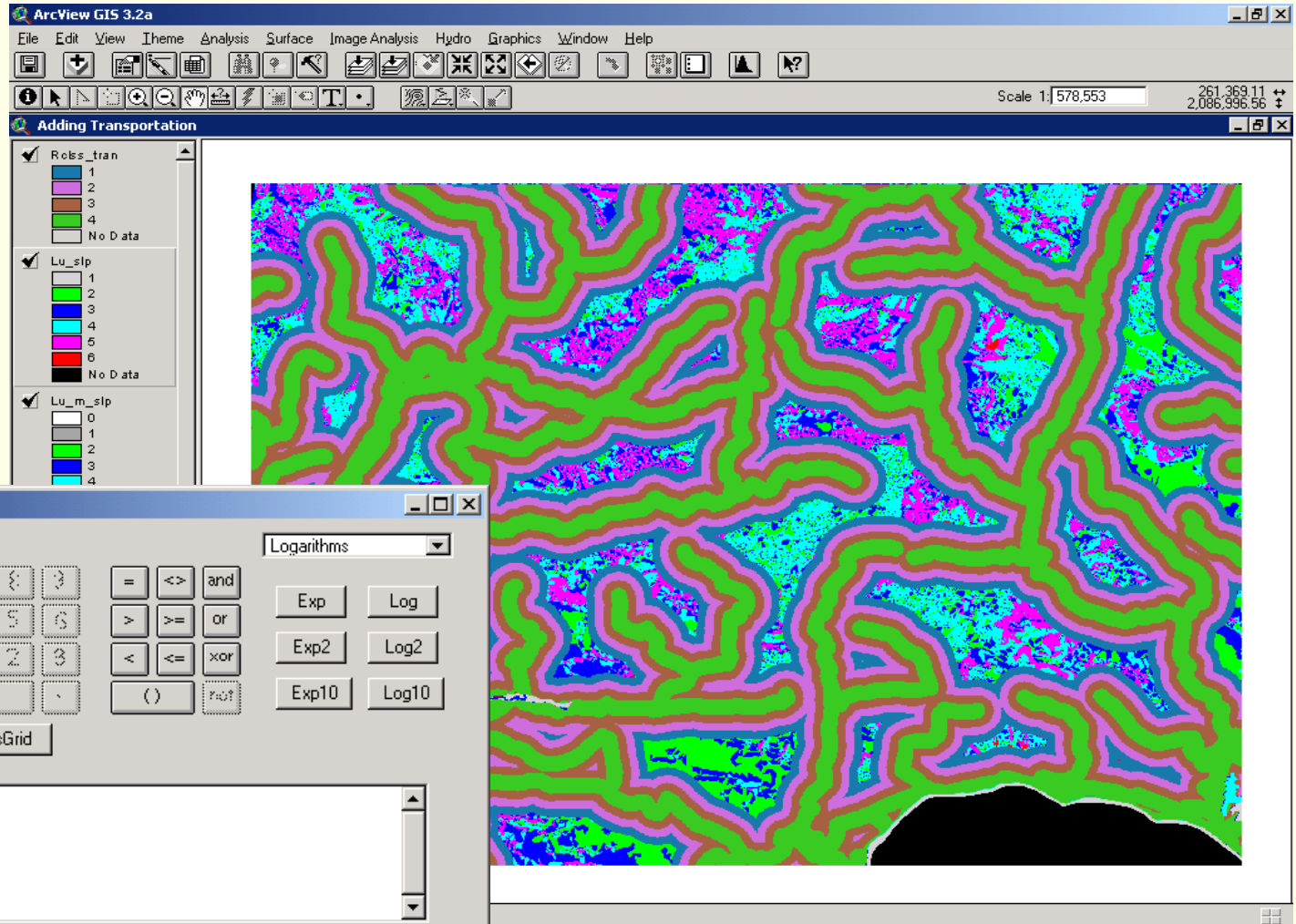
([Lu_slp] + [Rclss_tran])

Evaluate

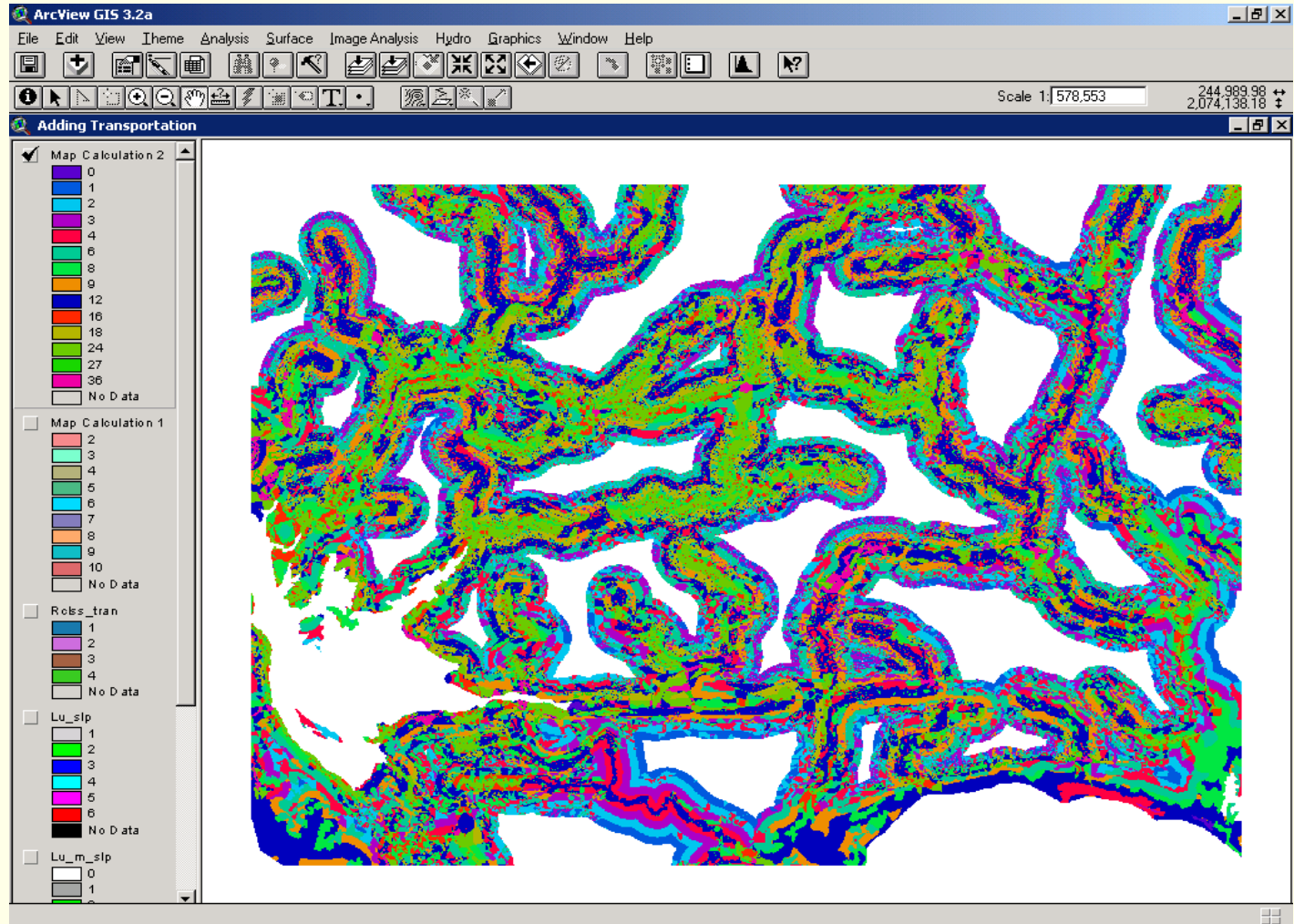
Landuse ⊕ Slope ⊕ Transportation



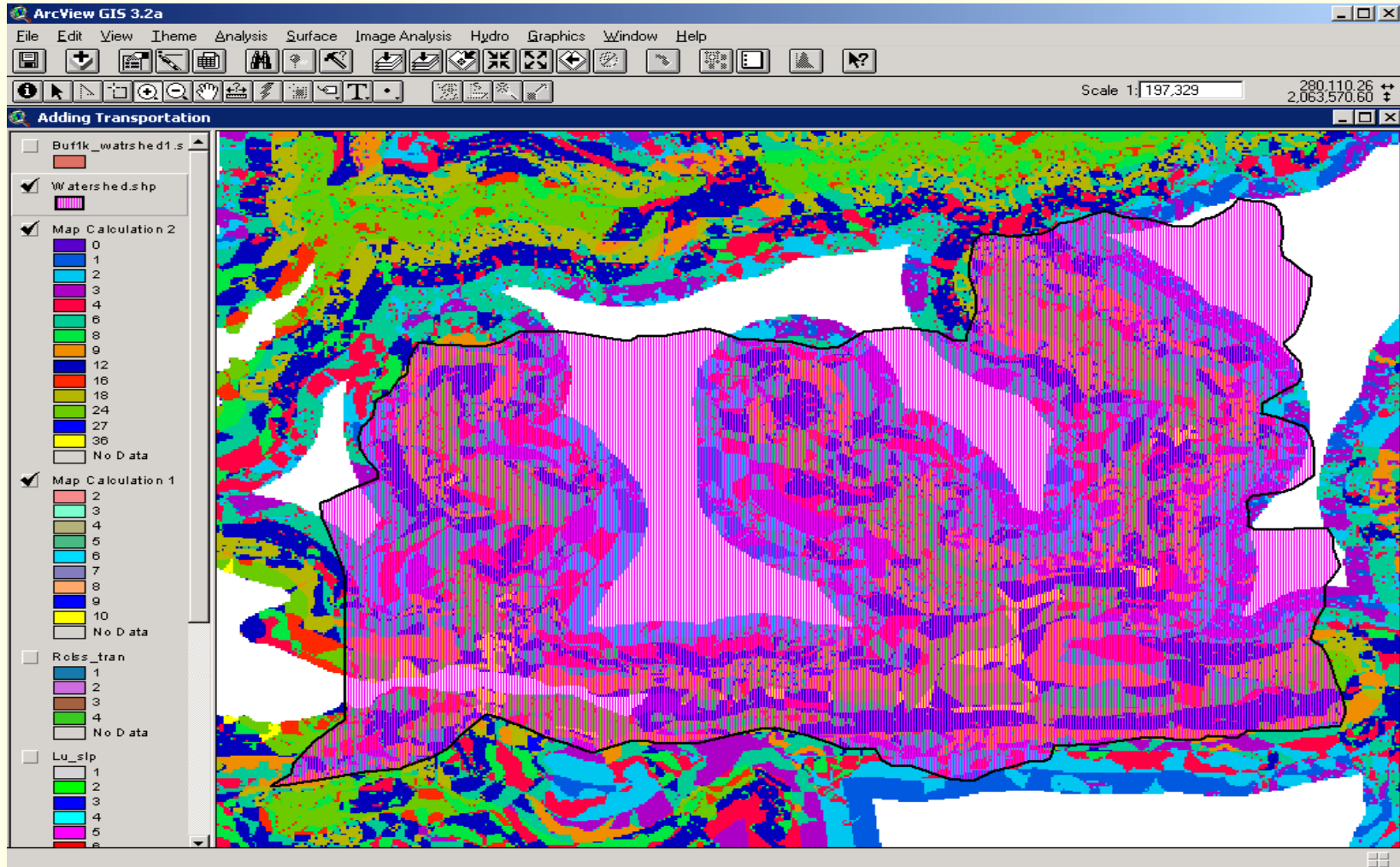
Landuse \otimes Slope \otimes Transportation



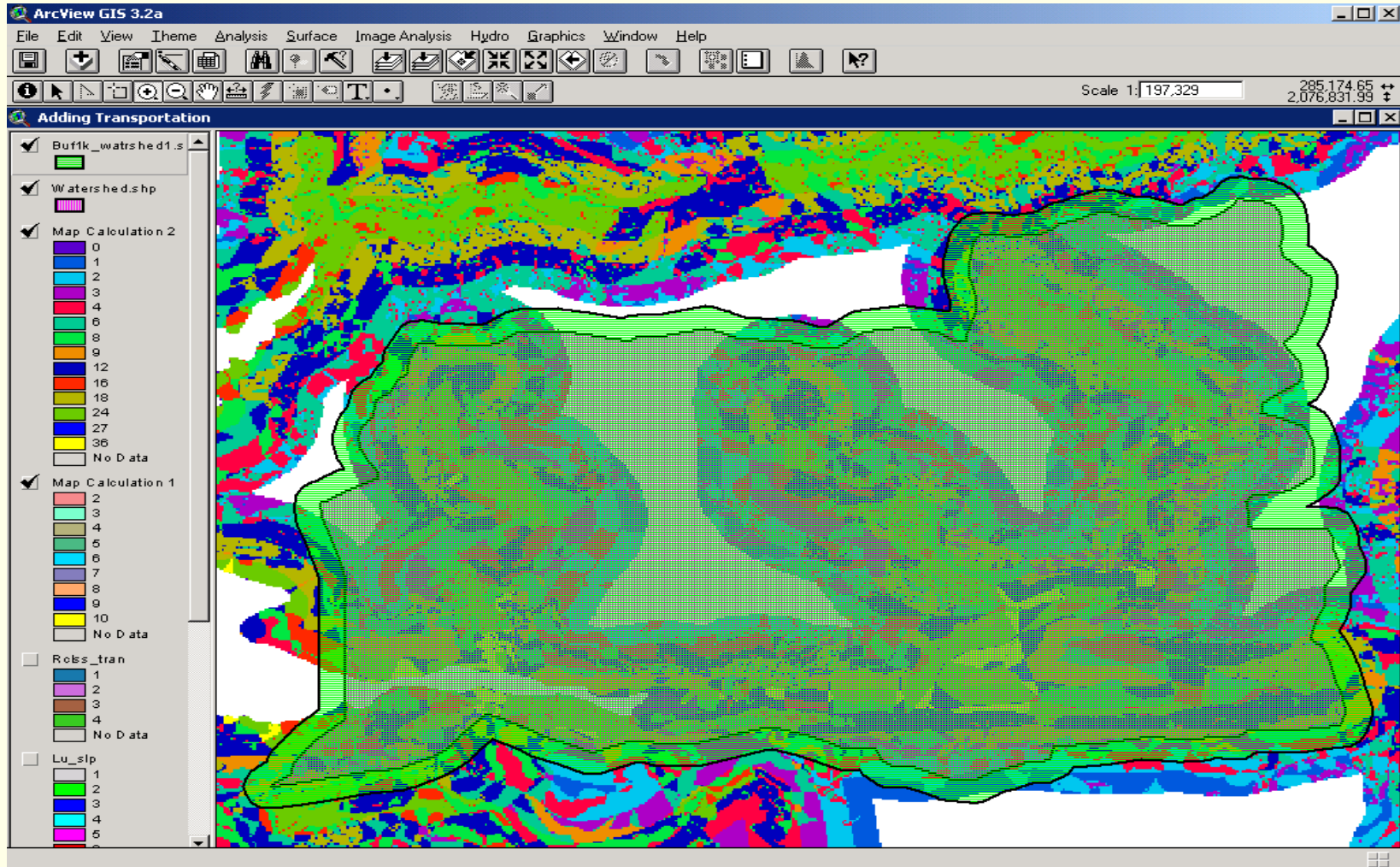
Landuse \otimes Slope \otimes Transportation



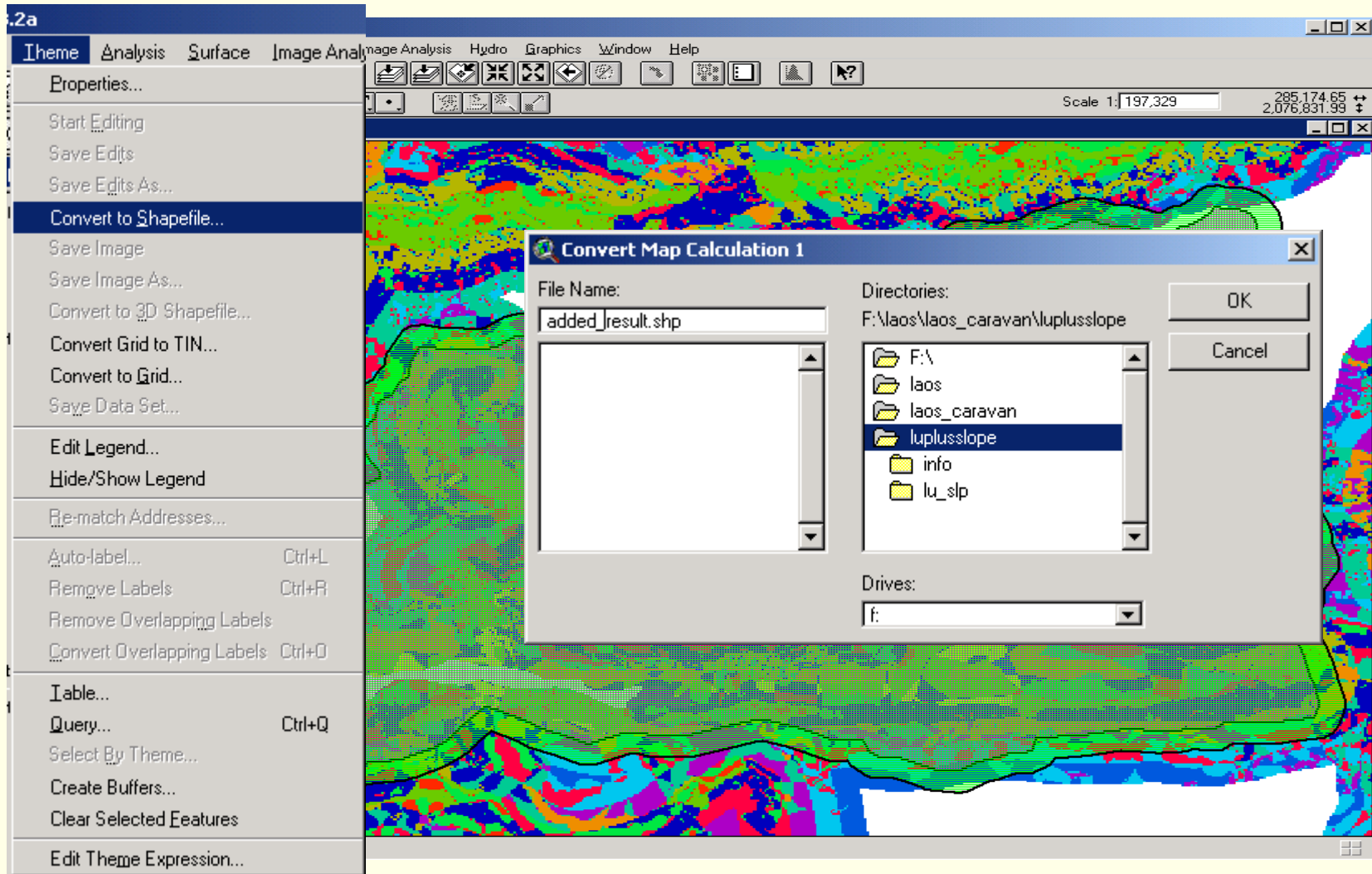
Overlaid Watershed



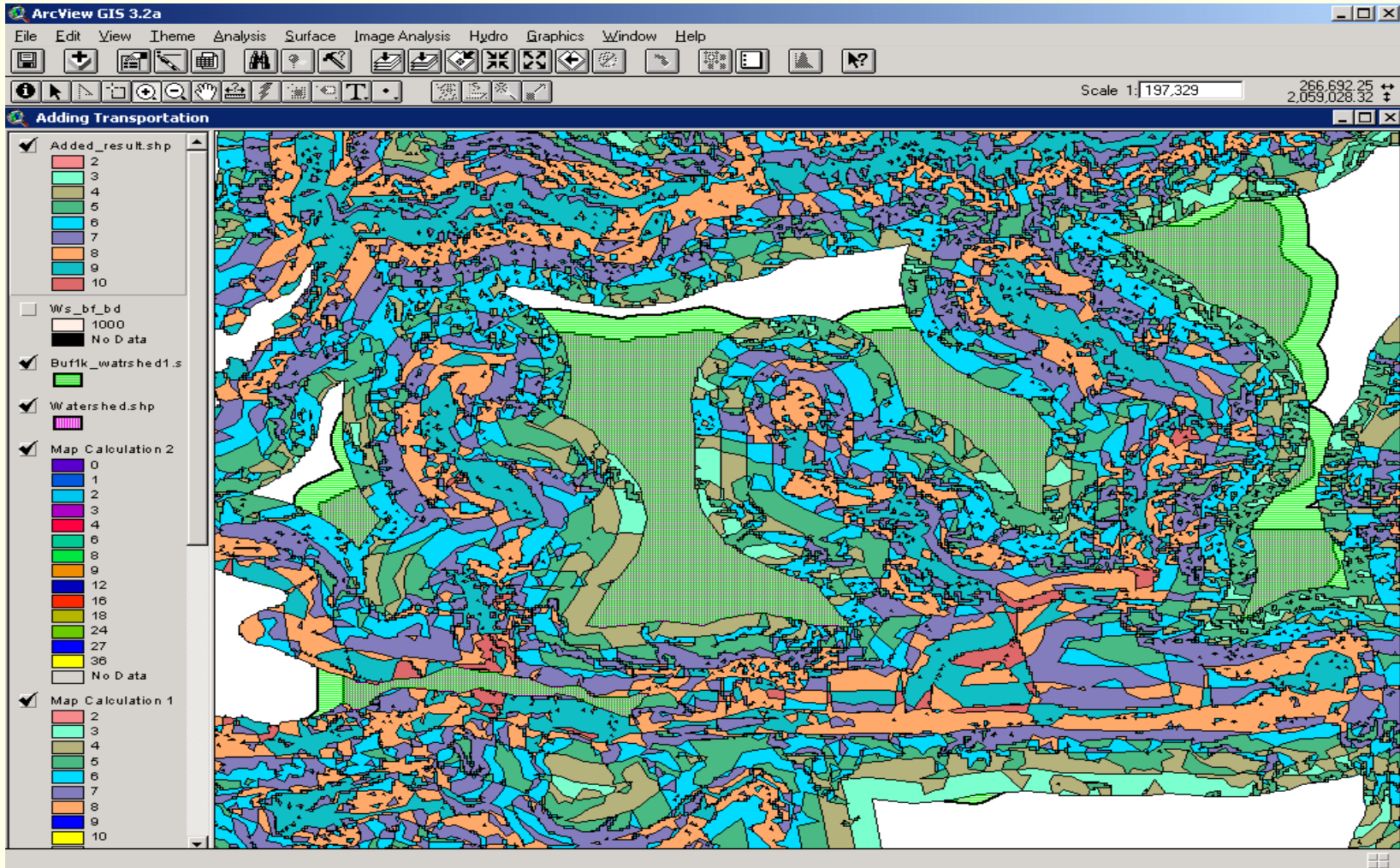
1 km Buffered Watershed



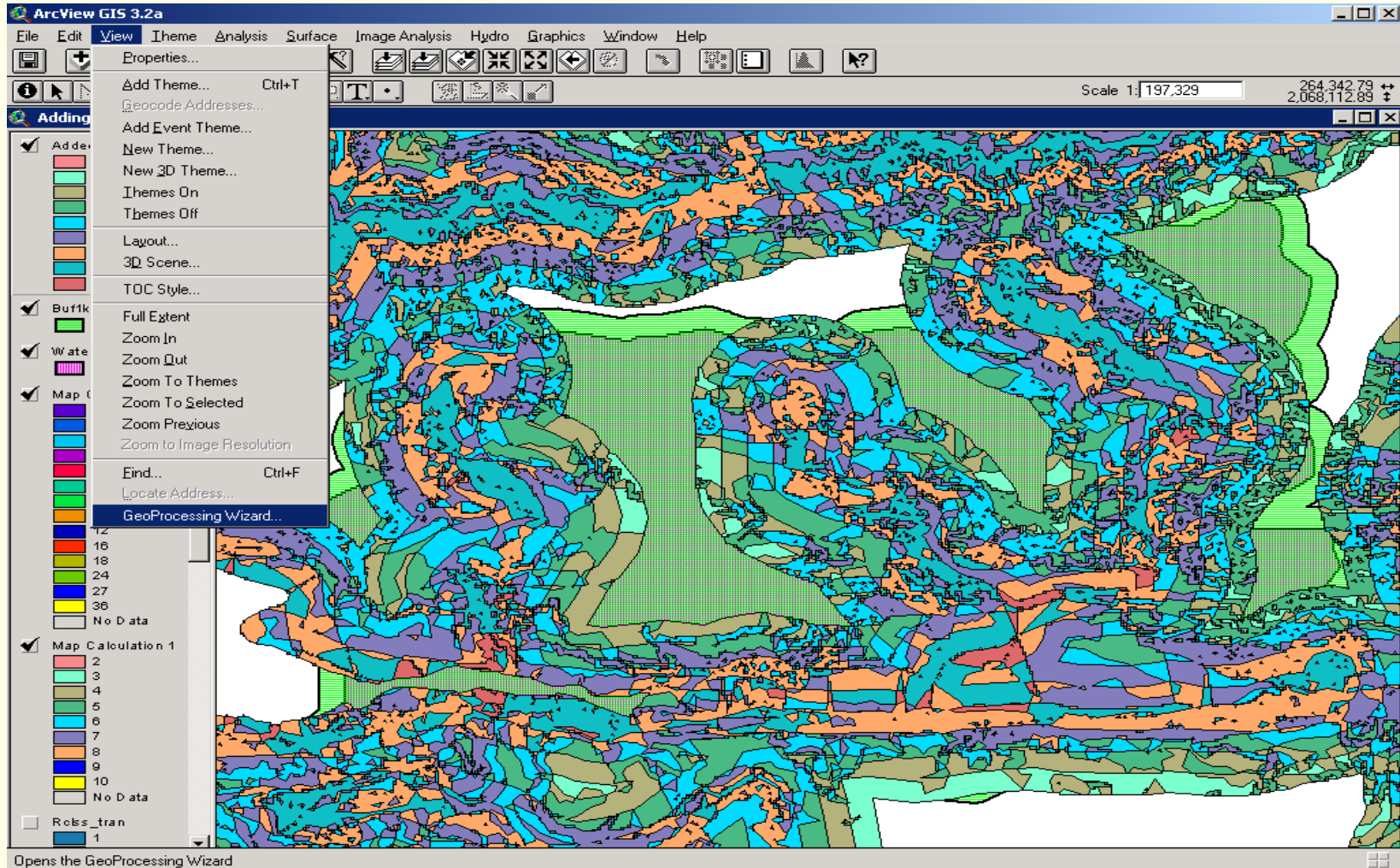
Raster to Vector



Raster to Vector



Extracting Case study area



Extracting Case study area

ArcView GIS 3.2a

File Edit View Theme Analysis Surface Image Analysis Hydro Graphics Window Help

Scale 1:197,329 264,342.79 2,068,112.89

GeoProcessing

Choose a GeoProcessing operation, then click the Next button to choose options.

- Dissolve features based on an attribute
- Merge themes together
- Clip one theme based on another**
- Intersect two themes
- Union two themes
- Assign data by location (Spatial Join)

Help...

About Clip

This operation uses a clip theme like a cookie cutter on your input theme. The input theme's attributes are not altered.

Input + Clip = Result

GeoProcessing

1) Select input theme to clip:

 Use Selected Features Only
 Number of Features: 55866

2) Select a polygon overlay theme:

 Use Selected Features Only
 Number of Features: 1

3) Specify the output file
 Output File: f:\laos\laos_caravan\luplussi

Help... Cancel << Back Finish

About Clip

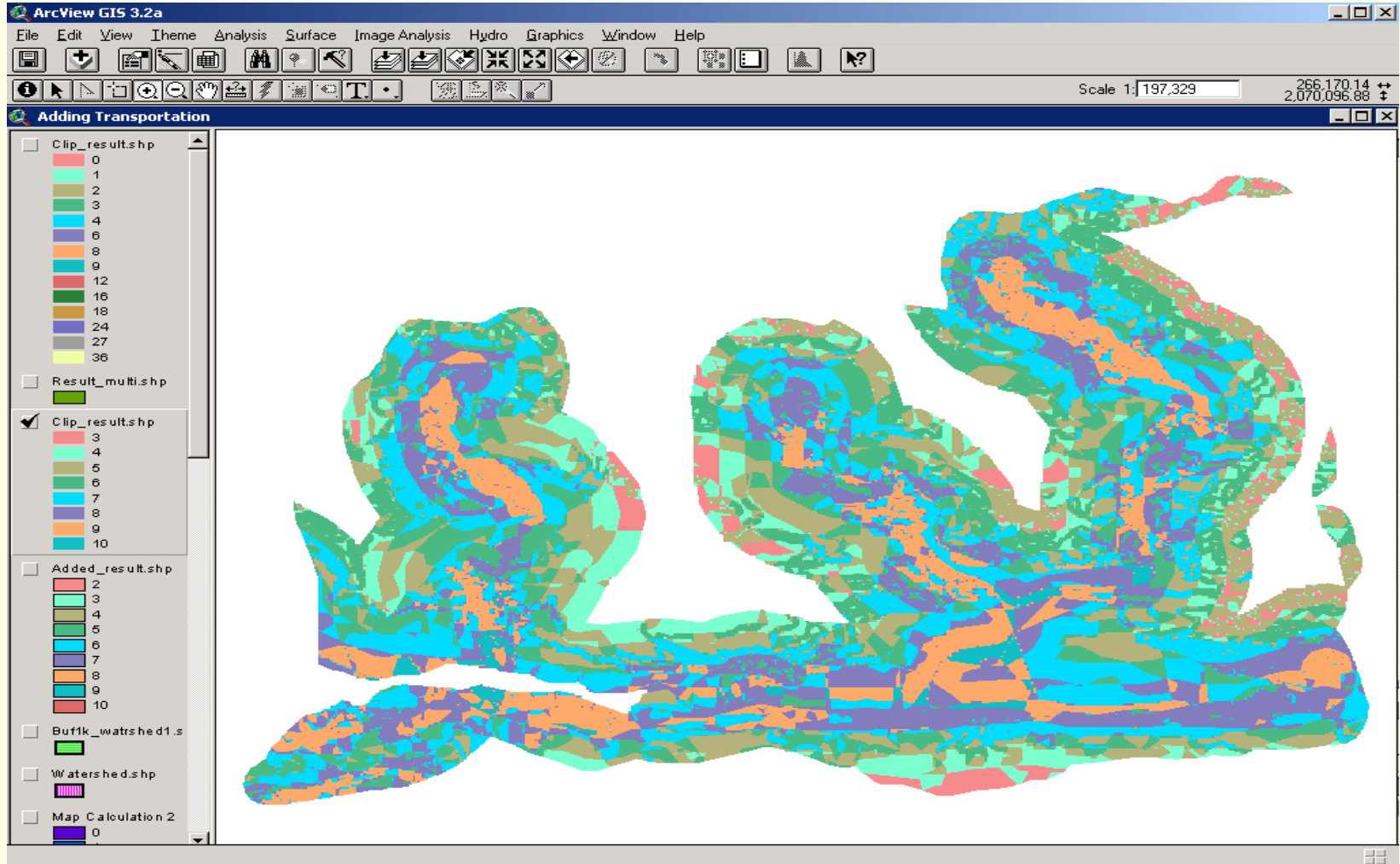
This operation uses a clip theme like a cookie cutter on your input theme. The input theme's attributes are not altered.

Input Theme + Clip Theme = Result Theme

More about Clip

Opens the GeoProcessing Wizard

Semi-Quantitative Watershed by Adding



Semi-Quantitative Watershed by Multiplying

