

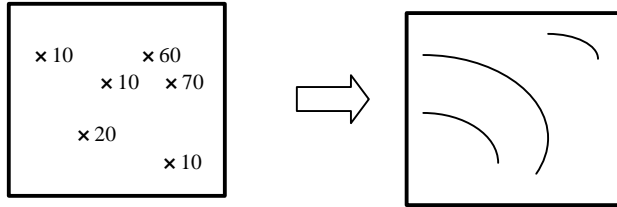
6. Specific Analysis

A. Working with Digital Elevation Models

Making contours by using point height data

Spatial Analyst is necessary to use this Function

1) Explain



A theme containing spot heights (survey field or photogrammetric work) can be used to derive contour lines.

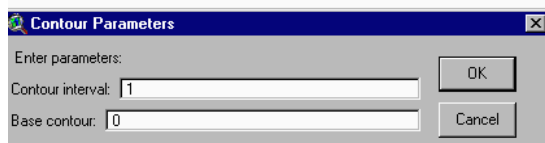
2) Operate

Add Point Theme, containing Elevation Information. The Program will first generate a temporary grid file containing the elevation and then will interpolate the contours.

DTM Grid Specifications (Explained Before in the data conversion)

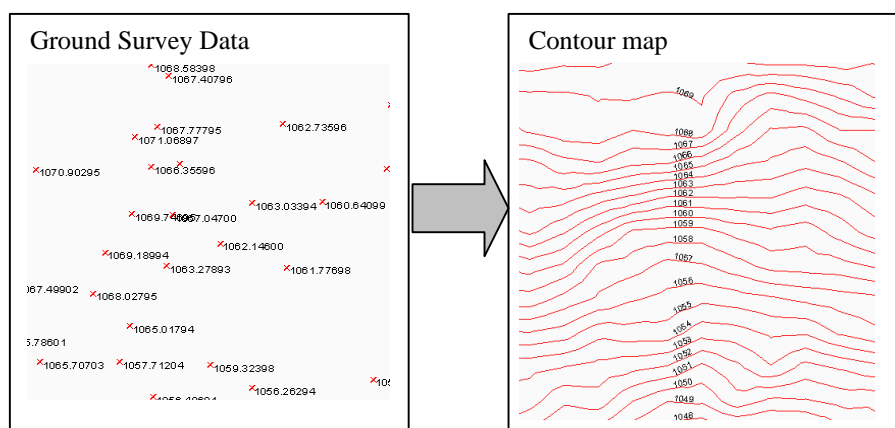
Interpolation Method:
IDW
Inverse Distance
Weighting

Enter the contours shapfile (to be created) properties.



The Inverse Distance Weighted (IDW) interpolator assumes that each input point has a local influence that diminishes with distance. It weights the points closer to the processing cell greater than those farther away.
Z Field: Must direct to the numerical field which contains the elevation value.

3) Sample: Contour generation (1 m interval) from the Field Data Surveyed Points.



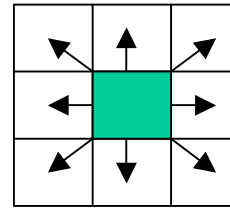
Calculating Slope and Aspect

1) Explain

Make slope and aspect data from elevation grid data.

Slope : Max slope in 8 directions

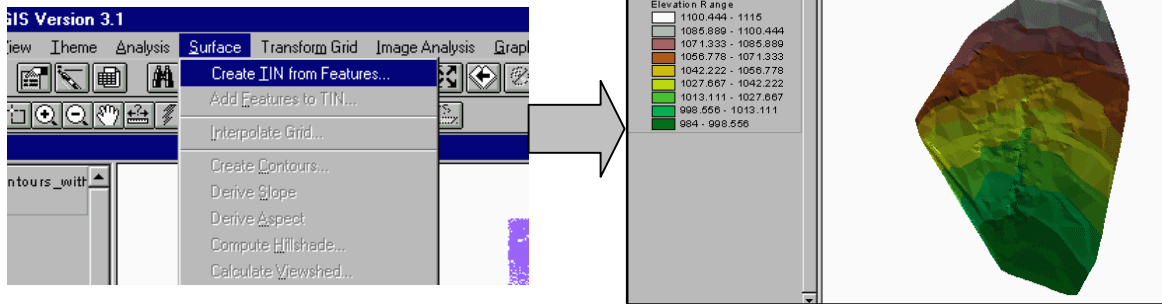
Aspect : Max direction



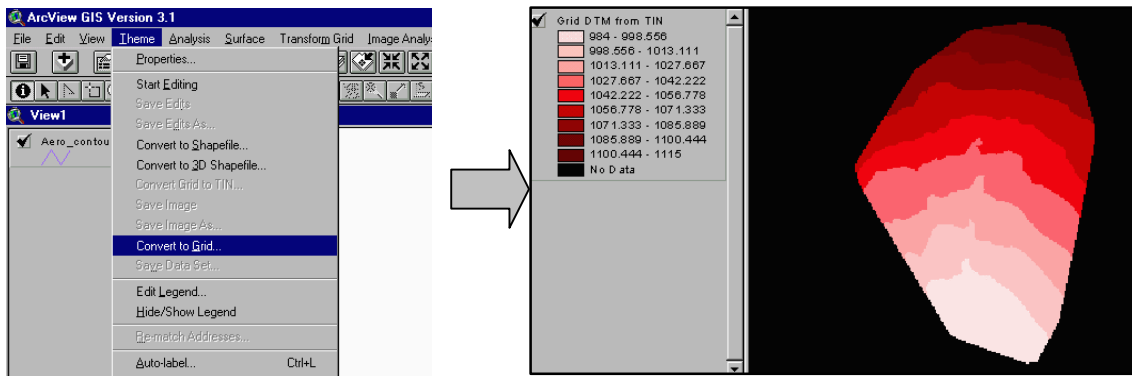
2) Operate

1. Add a point or line theme containing elevation values
2. Convert it to TIN (Must have 3D Analyst extension activated).
3. Convert the TIN to GRID = (DEM : Continuosly Digital Elevation Model)
4. Specify New Grid Parameters
5. DTM Ready
6. Derive Aspect from DTM
7. Derive Slope from DTM

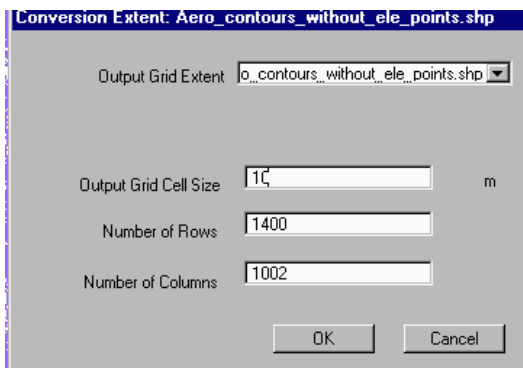
3) Conversion to TIN



4) Convert the TIN to GRID = (DEM : Continuosly Digital Elevation Model)

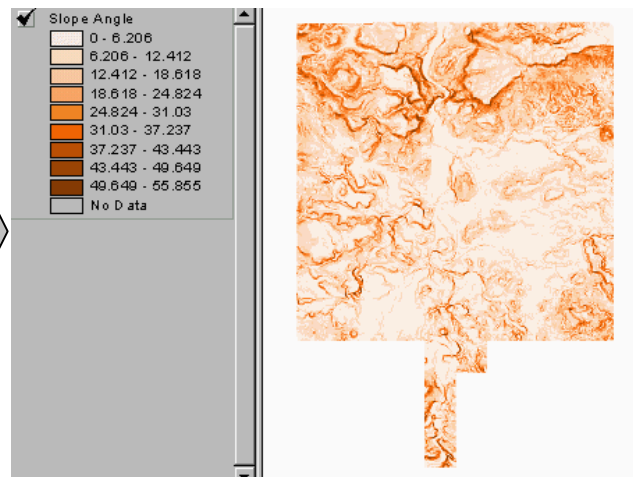
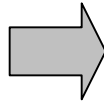
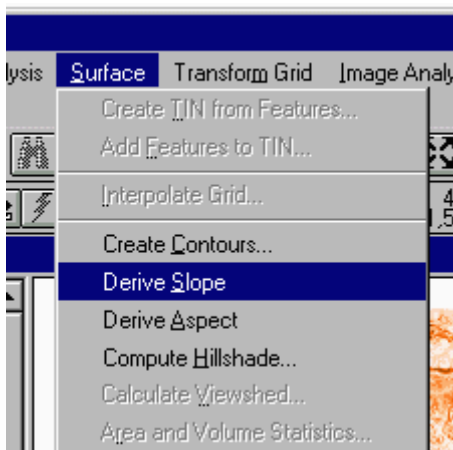
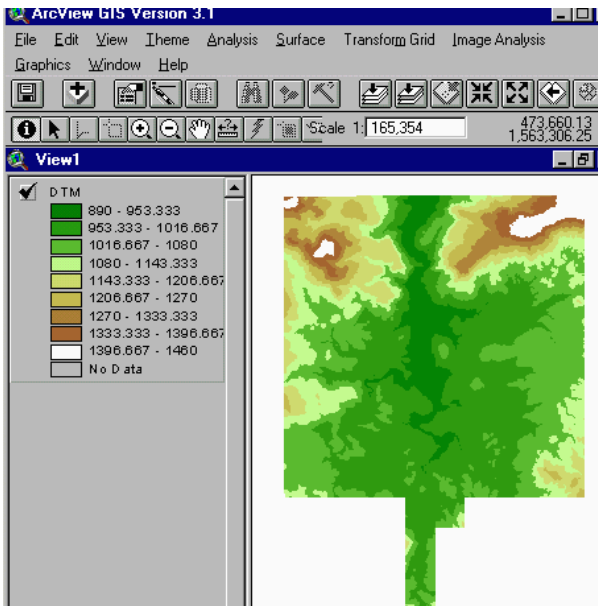


5) Specify New Grid Parameters

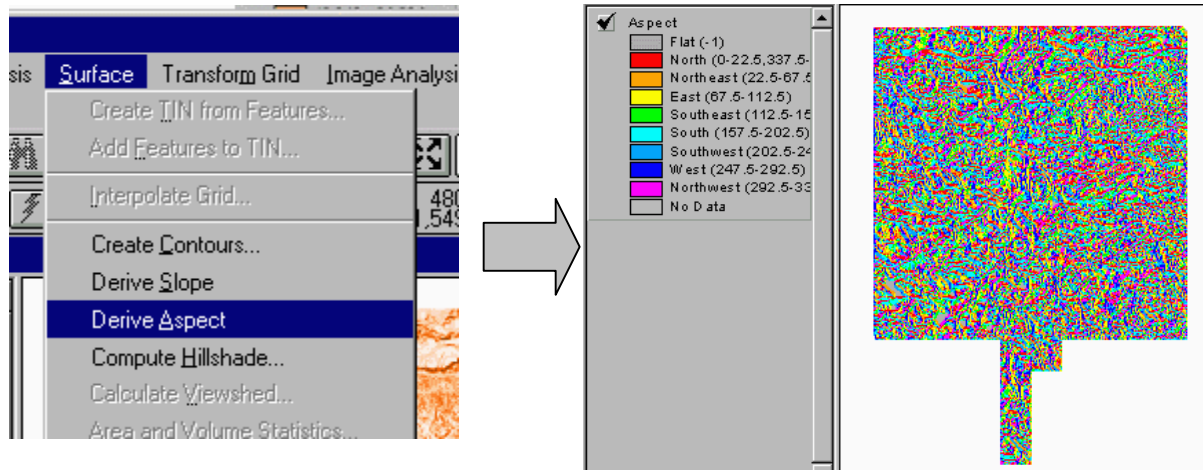


DTM Grid Specifications (Explained Before in the data conversion)

6) Sample: Generation of Slope and Aspect from a previously prepared DTM



Derive Slope identifies the slope, or maximum rate of change, from each cell to its neighbors. The output slope grid theme represents the degree of slope (e.g., 10 degree slope) for each cell location.



Derive Aspect identifies the steepest down-slope direction from each cell to its neighbors. The values of the output grid theme represent the compass direction of the aspect; 0 is true north, a 90 degree aspect is to the east, and so forth.

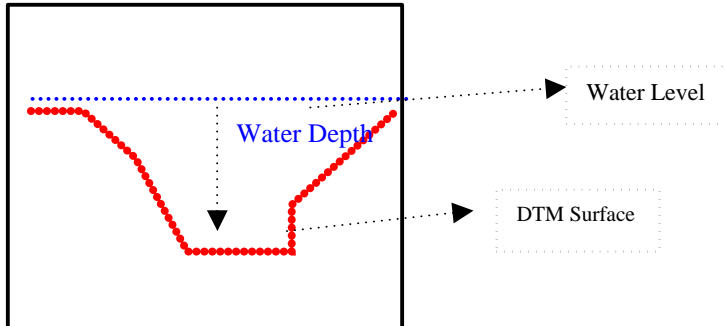
A legend representing the 8 cardinal directions is assigned to the output grid theme (e.g., east [67.5 - 112.5 degrees], southeast [112.5 - 157.5]).

B. Analyzing Flood Prevention Data

Calculating Flood Water Depth

1) Explain

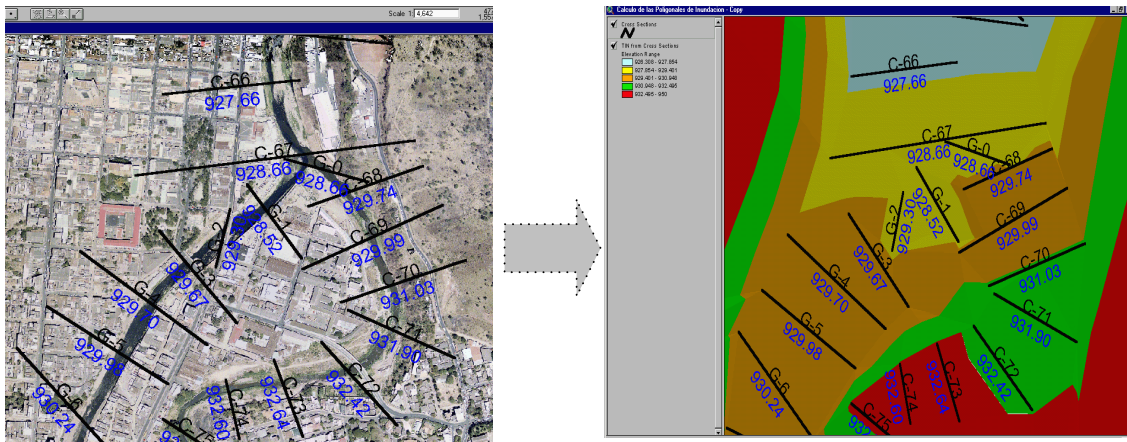
Subtracting the flood water level surface (Grid Data) from the Digital Elevation Model (Grid Data) can generate a grid theme identifying the water depths for the different flooding scenarios.



2) Operate

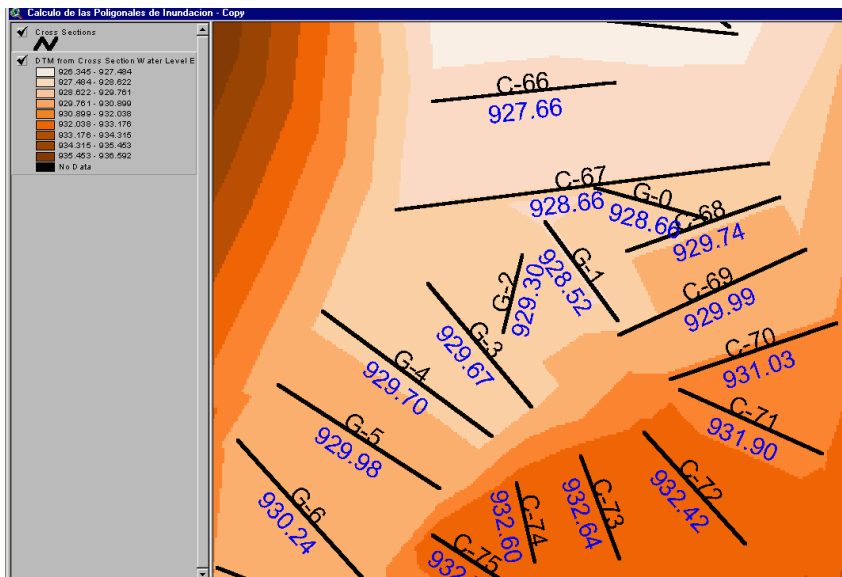
A. Generate the Flood Water Level Surface

From the Flood Simulation Software, the water level for each cross section is obtained which may be used as an elevation input required to build a TIN.



Triangle Irregular Network, generated from the elevation input. See “How to calculate slope and aspect.”

Convert the TIN to GRID (Water Level Surface)



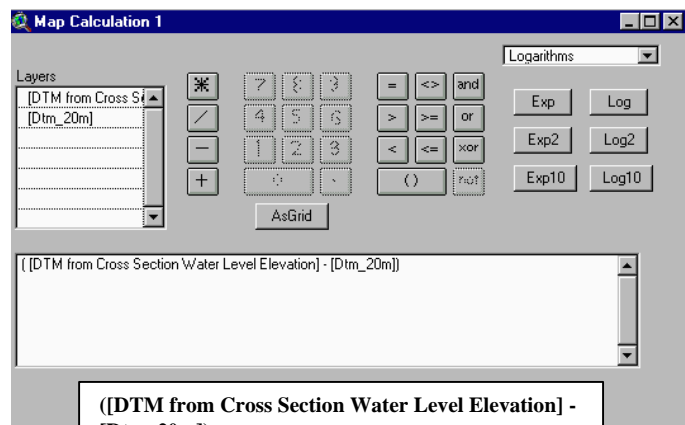
B. Subtract the DTM (Actual Terrain Elevation) from the Water Level Surface

Add the DTM to the view

From the Analysis Menu, choose Map Calculator

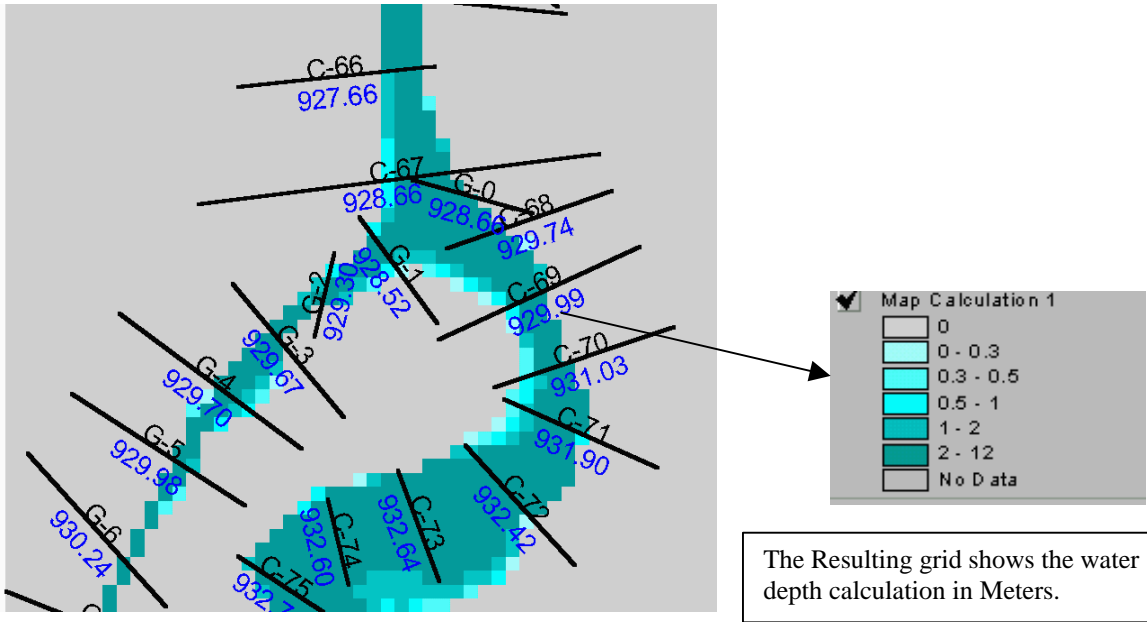


Write the formula needed, In this case:



(DTM from Cross Section Water Level Elevation) - [Dtm_20m]

The calculation criteria in the Map Calculator Box Input complies with the Settings regulations expressed before in the Query Box.



C. Slope Failure Dangerous Area Analysis

1) Explain

The dangerous areas designated from the slope failures were obtained by overlaying the geological map (specific geology rocks) with the slope map, specially the areas designated as steep. The occurrence probability (Ranks A & B) of these dangerous areas was calculated in accordance to the different combinations in the database output.

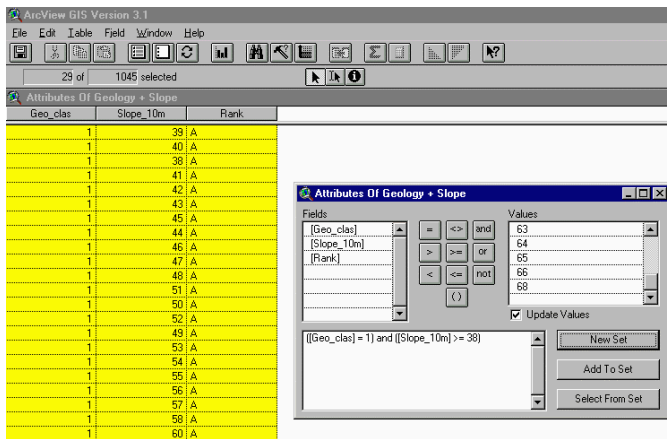
Further explanation of the methodology concepts and hazard ranges definitions must be consulted from the Geology and hazard map Report.

2) Operate

A. Overlaying the Geology Map with the Slope Range.

Using the Combine function from the Grid Transformation Tools. (Explained in the Overlaying Grid Data)

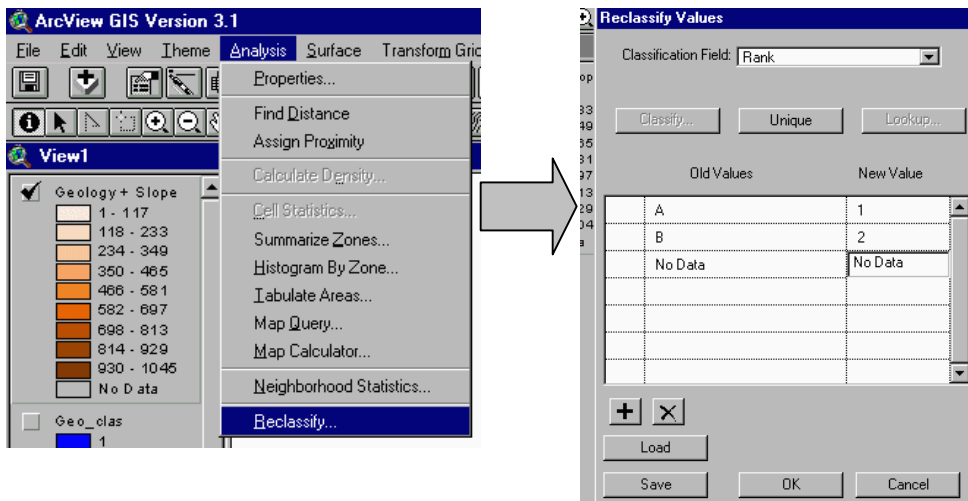
B. Arranging the output database into occurrence probability ranks



Having the fields of geology rock and slope range in just one database set, we can assign new values for Rank A or Rank B, depending upon the combination.

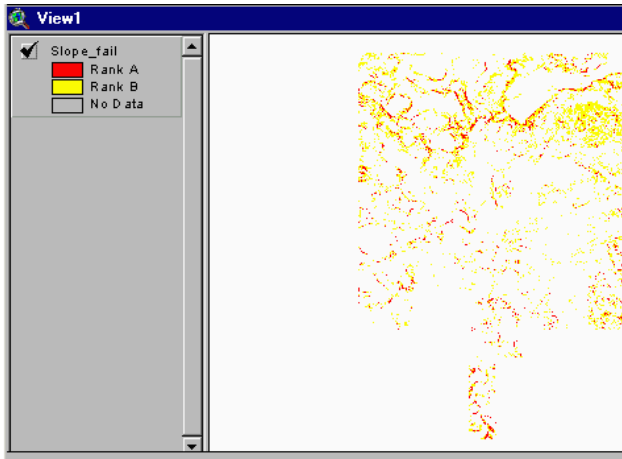
Example: (Explained before in the Querying database sources)
 Geo_clas = 1 and Slope_10m > 38 = Rank A
 Geo_clas = 1 and Slope_10m > 34 < 38 = Rank B

C. Reclassify the Combined Grid in a new Grid Containing only the Rank Value



Parameter Setting Box:

The classification field must be defined so that we have a new grid with the values we need. Coming from the arrangement of the database into Ranks.

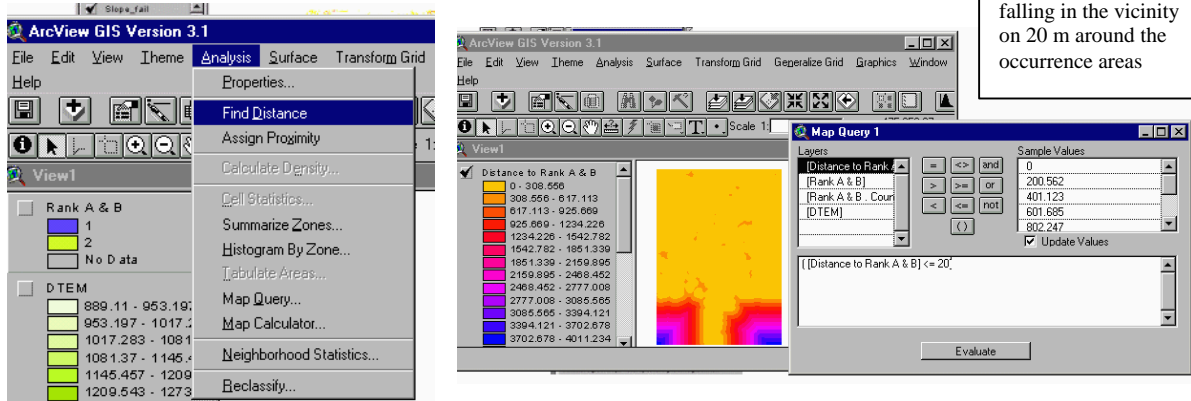


Resulting Occurrence Rank A & B Grid.

D. Calculation of the Affected Areas

D.1. Generating a buffer zone of 20 meters around the occurrence areas

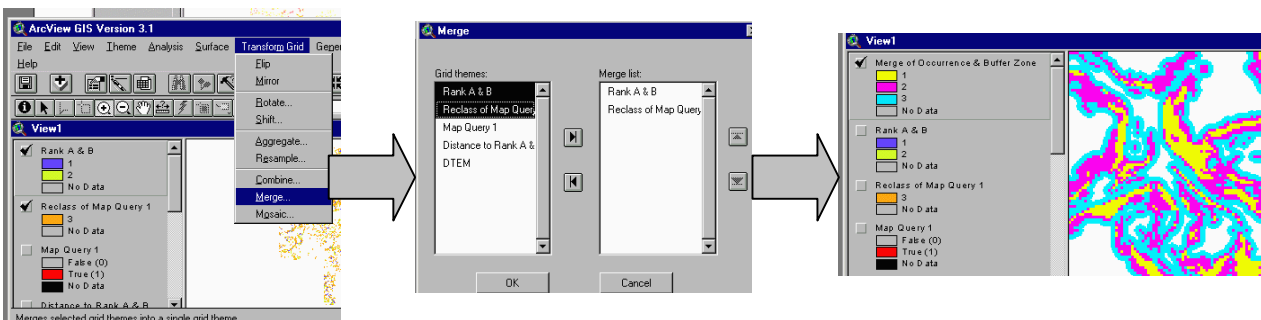
Using the map query to find the areas falling in the vicinity on 20 m around the occurrence areas



The resulting **True Value 1** grid must be reclassified (explain before) as value 3. So that we can merge it with the occurrence A & B Grid; therefore, having a new grid with 3 values:

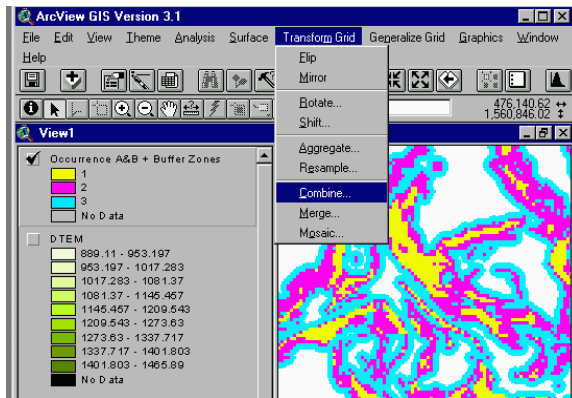
- 1: Occurrence Rank A
- 2: Occurrence Rank B
- 3: Buffer Areas surrounding 20 meters around zones 1 & 2.

Merge Process:

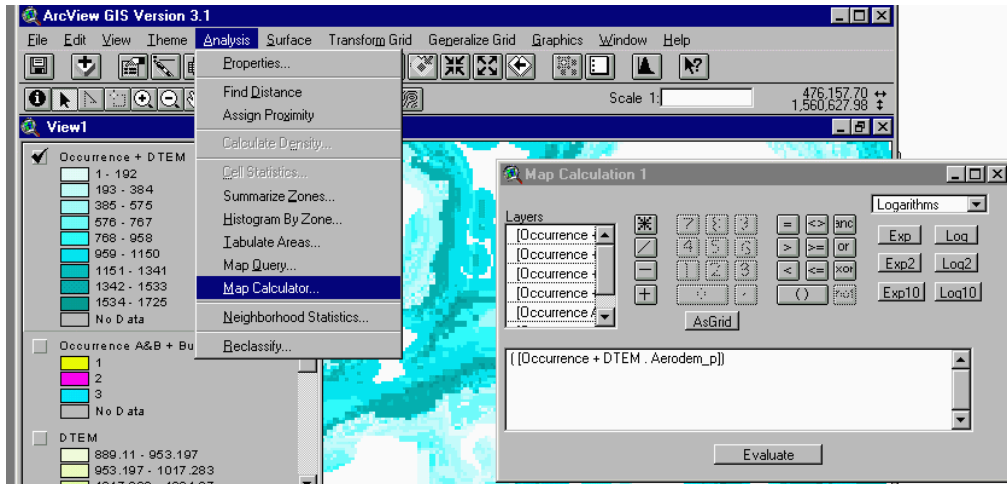


Remember to save the resulting grid, as all the grids coming from different processes are temporary datasets.

D.2. Extracting the DTEM of Ranks A & B & Buffer Zone Coverage Areas



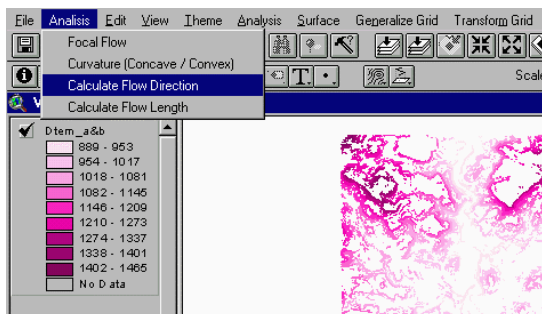
- Using the Combine function from the Grid Transformation Tools. (Explained in the Overlaying Grid Data)
- Reclassify the resulting grid by the Height Value (coming from the DTEM) in the database. Because there are many height values, we should use the map calculator option, as follow:



The Result is the DTEM of the Occurrence Areas + Buffer Zones. Remember to Save the DataSet.

D.3. Calculating The Flow Direction of the DTEM

- Open the Arcview Project: " Slope Failure Analysis "
- Add the resulting DTEM grid
- Calculate the Flow Direction



The FlowDirection request calculates the direction of flow out of each cell into one of its eight neighbors. The output is an integer Grid whose values range from 1 to 255. The values for each direction from the center are:

```
32 64 128
16 X 1
8 4 2
```

For example, if the direction of steepest drop was to the left of the current processing cell, its flow direction would be coded as 16. The direction of flow is determined by finding the direction of steepest descent from each cell. This is calculated as $\text{drop} = \text{change in } z \text{ value} / \text{distance} * 100$

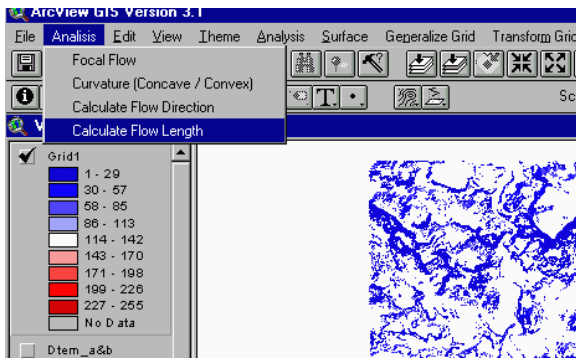
78	72	69	71	58	44	2	2	2	4	4	8
74	67	56	49	46	51	2	2	2	4	4	8
69	53	44	37	31	41	1	1	2	4	8	4
64	58	55	22	31	24	128	128	1	2	4	8
68	61	47	21	16	13	2	2	2	1	4	4
74	53	34	12	11	12	1	1	1	1	4	16

=

2	2	2	4	4	8
2	2	2	4	4	8
1	1	2	4	8	4
128	128	1	2	4	8
2	2	2	1	4	4
1	1	1	1	4	16

FlowGrid FlowGrid

D.4. Obtaining the Flow Length to the Upstream Areas



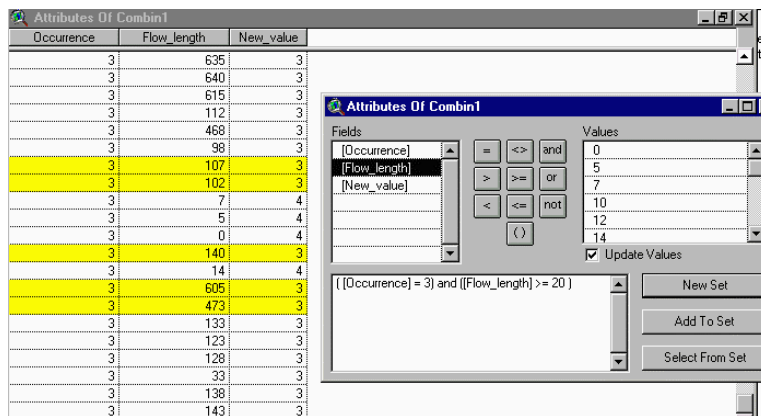
The FlowLength request calculates upstream or downstream distance along a flow path for each cell. A primary use of the request is to calculate the length of the longest flow path within a drainage basin or watershed. This measure is often used to calculate the time of concentration of a basin. Flow length can also be used to create distance-area diagrams of hypothetical rainfall/runoff events using the weightGrid argument as an impedance to movement downslope. **The input grid must be a Flow Direction Grid**

D.5. Finding the Affected Areas of Occurrence A&B Ranks

The former grid result contains the flow length; necessary to discriminate those portions allocated within the 20 meters surrounding areas of the occurrence A&B Ranks, which **must** fulfill the requirement of being located **downstream** of the occurrence zones.

The Flow length grid must be combined (explained before) with the occurrence A&B Ranks + Buffer Zones Grid.

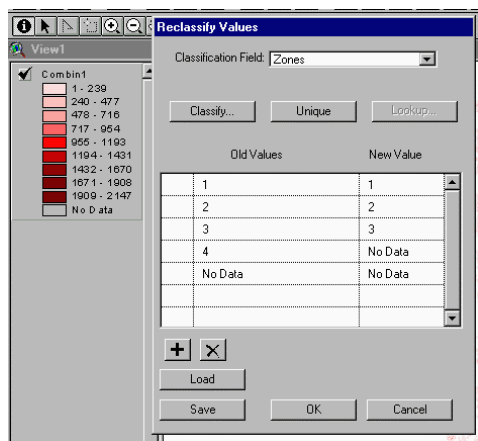
The Resulting database should look like this:



Steps:

1. The Occurrence Values of 1 & 2 do not change, thus must be calculated exactly in the new value field.
2. The database must be queried to find those cells with an occurrence value of 3 but having a Flow_Length value higher than 20. These will have a value of 3 in the new value field.
3. The occurrence value of 3 having a Flow_Length value of less than 20 are portions to be discarded, because these zones are located **upstream** of the occurrence zones. Thus, we can assign a value of 4 or whatever.

This Grid must be reclassify (explained before) according to the new_value field, assigning a value of No Data to the value of 4, since these portions are useless.



The final grid dataset contains the values of:

1. Occurrence Rank A Zone
2. Occurrence Rank B Zone
3. Affected Areas

D. Watershed Management (Potential Erosion Analysis)

1) Explain

The Study area comprises 819.65 Km² of the upper catchment zones of the Choluteca River. As the prime objective of this study is to propose a master plan for the flood control and landslides prevention, the watershed management purpose aims mainly in the calculation of potential erosion, being this phenomenon one of the most influencing factors in the weakening of the rivers ' drainage capacity.

The Universal Soil Loss Equation (USLE) was used in this study and the GIS application for its calculation will be explained lately.

The USLE is defined as:

$$E = R \times K \times LS \times C \times P$$

Where:

E: Annual soil loss amount (ton/acre/year or ton/ha/year)

R: Rainfall and runoff factor (100 ft × ton/acre × in/hr or 100 m × ton/ha × cm/hr)

K: Soil erodibility factor (ton/acre or ton/ha, per unit of R)

LS: Slope length - steepness factor, dimensionless

C: Cover and management factor, dimensionless

Further explanation of the methodology concepts and each factor's definitions must be consulted from the watershed management: soil erosion and sedimentation Report.