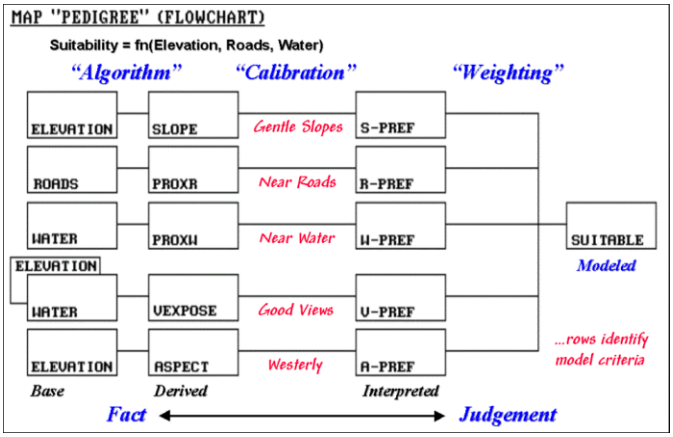
Applying Map Analysis

Identifying Campground Suitability: *A recreation specialist needs to generate a map that identifies the relative suitability for locating a campground. In an initial planning session it was determined that the best locations for the campground is on gently sloping terrain, near existing roads, near flowing water, with good views of surface water and oriented toward the west.*

<click here> for a printer friendly version (.pdf)

Processing Flow.



Campground Suitability—Model Logic

All GIS models can be expressed as a flowchart of processing steps. In this example, SLOPE is derived from a base map of ELEVATION. In turn, the SLOPE map is interpreted for areas of "relative goodness" in terms of terrain steepness and stored as the S_PREF map.

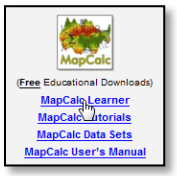
The each row in the flowchart is evaluated to reflect preferences for locating a campground—

gentle slopes ● near roads ● near water ● good views of water ● and westerly oriented

The final step combines the maps of the five criteria for a map of the overall suitability (SUITABLE). Note that the columns in the flowchart reflect increasing abstraction from *Base* maps of physical features, to *Derived* maps of spatial context, to *Interpreted maps* of relative goodness, and finally to a *Modeled* map of suitability. The movement from maps of physical *Fact* to decision *Judgment* involves a logical sequencing of map analysis operations.

You can take a hands-on "guided tour" of this model using the MapCalc Learner software…

Download and Install MapCalc Learner



…from www.innovativegis.com/basis, "Software" item at the bottom.

Accessing a MapCalc Database

To begin a **MapCalc** session—

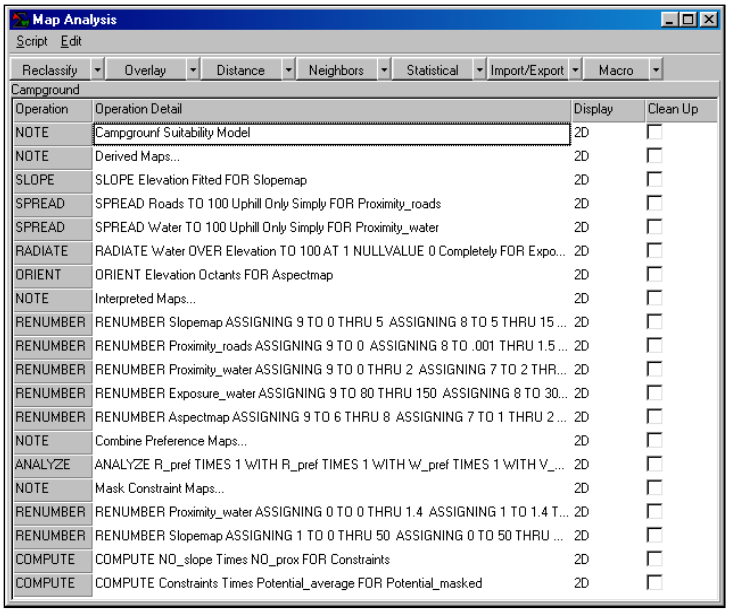
1. Click on the Windows **Start** button.
2. Navigate to **Programs→ Red Hen→ MapCalc** and click on the **MapCalc** icon.

3. Choose **Open existing map set** from the MapCalc Quick Start menu and open the **Tutor25.rgs** database. The database will be accessed, several of the base maps will be opened and a 2-D display of the Elevation map will be maximized.

Accessing a Stored Script

Now open the command macro for *Campground Suitability*—

1. Access the Grid Analysis module by pressing the **Grid Analysis** button on the Main Toolbar 
2. Select **Script→ Open** from the Map Analysis menu
3. Navigate to the **C:\Program Files\Red Hen Systems\MapCalc\MapCalc Data\Scripts** folder open the **Campground.scr** script

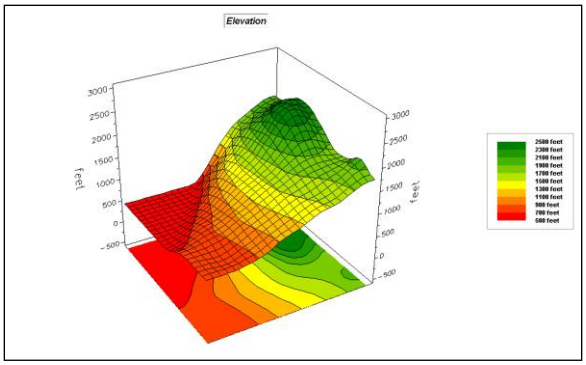


Operation	Operation Detail	Display	Clean Up
NOTE	Campgrount Suitability Model	2D	
NOTE	Derived Maps...	2D	
SLOPE	SLOPE Elevation Fitted FOR Slopemap	2D	
SPREAD	SPREAD Roads TO 100 Uphill Only Simply FOR Proximity_roads	2D	
SPREAD	SPREAD Water TO 100 Uphill Only Simply FOR Proximity_water	2D	
RADIATE	RADIATE Water OVER Elevation TO 100 AT 1 NULLVALUE 0 Completely FOR Expo...	2D	
ORIENT	ORIENT Elevation Octants FOR Aspectmap	2D	
NOTE	Interpreted Maps...	2D	
RENUMBER	RENUMBER Slopemap ASSIGNING 9 TO 0 THRU 5 ASSIGNING 8 TO 5 THRU 15 ...	2D	
RENUMBER	RENUMBER Proximity_roads ASSIGNING 9 TO 0 ASSIGNING 8 TO .001 THRU 1.5 ...	2D	
RENUMBER	RENUMBER Proximity_water ASSIGNING 9 TO 0 THRU 2 ASSIGNING 7 TO 2 THR...	2D	
RENUMBER	RENUMBER Exposure_water ASSIGNING 9 TO 80 THRU 150 ASSIGNING 8 TO 30...	2D	
RENUMBER	RENUMBER Aspectmap ASSIGNING 9 TO 6 THRU 8 ASSIGNING 7 TO 1 THRU 2 ...	2D	
NOTE	Combine Preference Maps...	2D	
ANALYZE	ANALYZE R_pref TIMES 1 WITH R_pref TIMES 1 WITH W_pref TIMES 1 WITH V_...	2D	
NOTE	Mask Constraint Maps...	2D	
RENUMBER	RENUMBER Proximity_water ASSIGNING 0 TO 0 THRU 1.4 ASSIGNING 1 TO 1.4 T...	2D	
RENUMBER	RENUMBER Slopemap ASSIGNING 1 TO 0 THRU 50 ASSIGNING 0 TO 50 THRU ...	2D	
COMPUTE	COMPUTE NO_slope Times NO_prox FOR Constraints	2D	
COMPUTE	COMPUTE Constraints Times Potential_average FOR Potential_masked	2D	

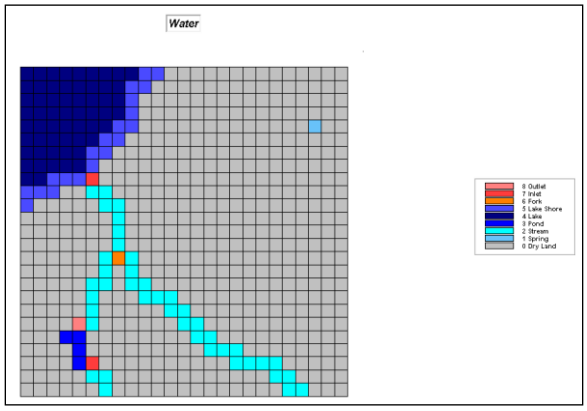
Script Procedures

Each line of the script contains an individual Map Analysis command. The command lines are executed in their listed order (top to bottom). You can view a command's specifications by double-clicking on a command line, then click "OK" to execute the command and display the derived map. In many instances the default map displays are modified for the ones shown below using the procedures described in Tutorial Lessons 1 through 6.

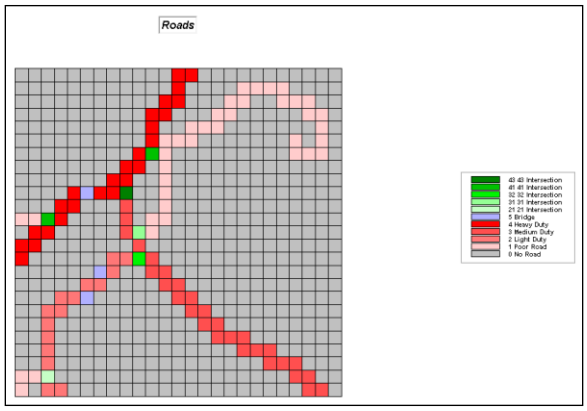
Base Maps. The *Base Maps* needed include:



Elevation Map. Each grid cell value identifies its elevation forming a continuous terrain gradient.

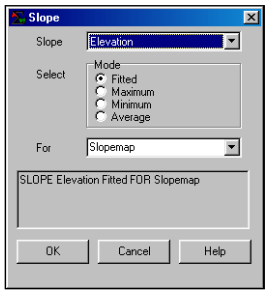


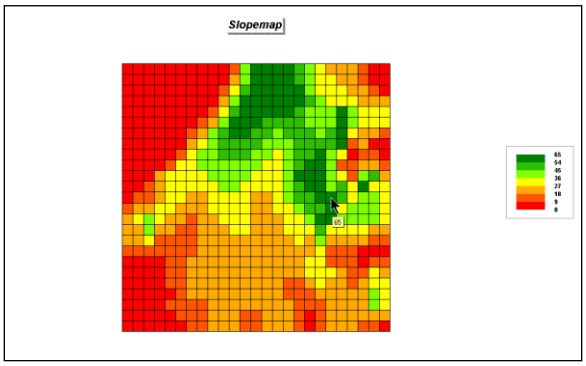
Water Map. Each grid cell value identifies surface water present.



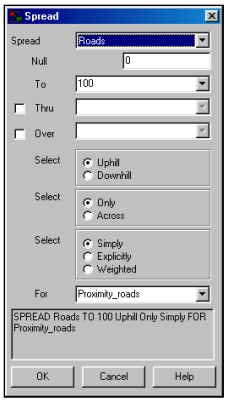
Roads Map. Each grid cell value identifies the type of road present.

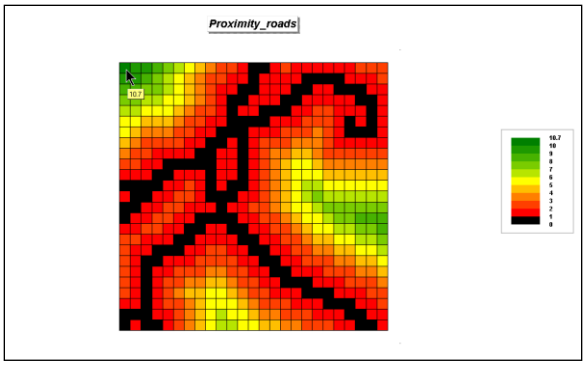
<u>Step 1</u>, Derived Maps.



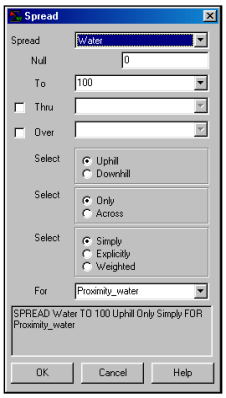


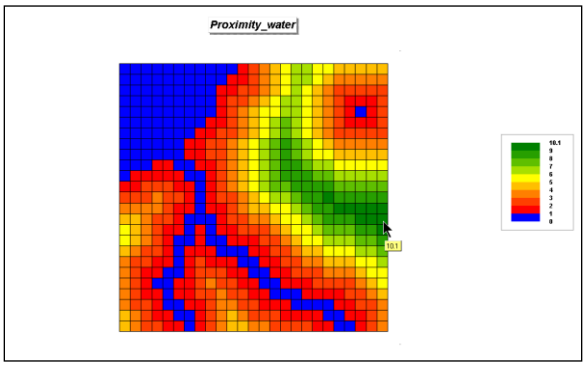
Slopemap. *The terrain steepness varies from 0% to 65% slope.*



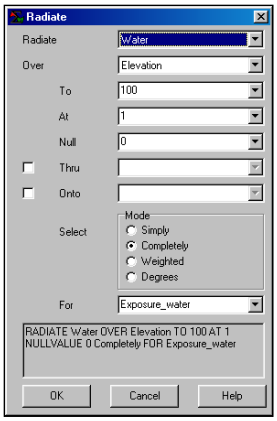


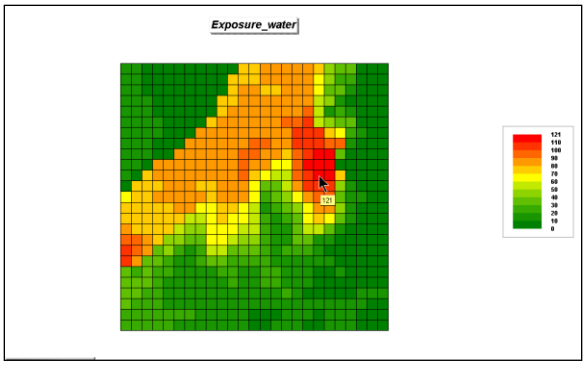
Proximity_roads. *The distance from roads varies from 0 (road present) to 10.7 cells away. Since each cell is 100 meters (328 feet), the farthest location in the northeast corner is 1.07 kilometers (10.7*328=3509.6/5280= .665 miles) away from the nearest road location. For this display, the "Shading Manager" was set to Equal Ranges, number of ranges to 11, black assigned to range 0-1, red to range 1-2, yellow to range 5-6 and green to range 10-10.7.*





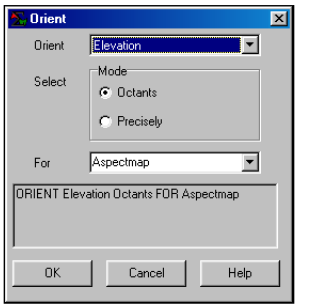
Proximity_water. *The distance from water varies from 0 (water present) to 10.1 cells away. For more information on how distance is measured, see "Determining Proximity" application scenario.*

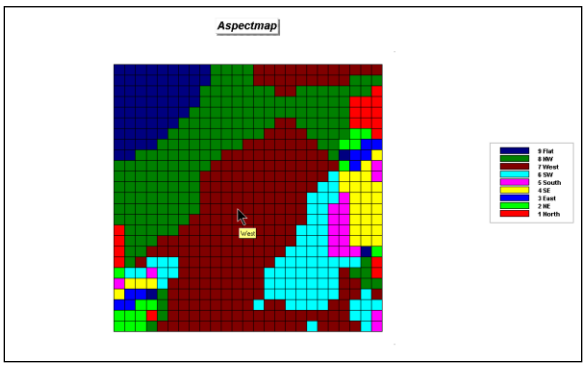




Exposure_water. *The relative exposure to water varies from 0 (not seen) to 121 water cells seen from the location indicated in the figure. Since there is 128 cells with water present (blue area in the Proximity_water map above), a location that is visually connected to 121 cells "sees" a lot*

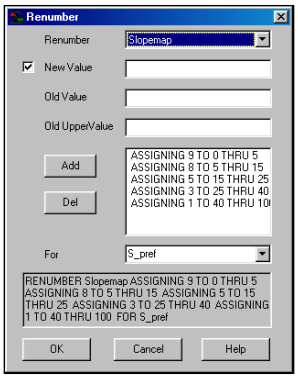
of water (121.128= 95% of the water area). For more information on how visual exposure is measured, see "Determining Visual Exposure" application scenario.

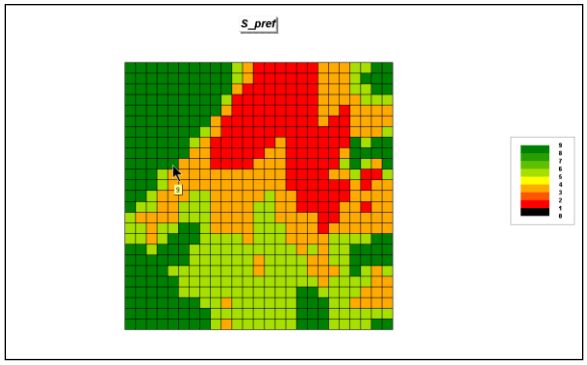




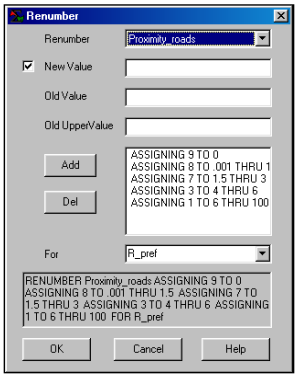
Aspectmap. *The dominant terrain orientation is West (7= West) and Northwest (8= NW). The large flat area (no aspect) in the upper left corner is a lake (blue area in the Proximity_water map above).*

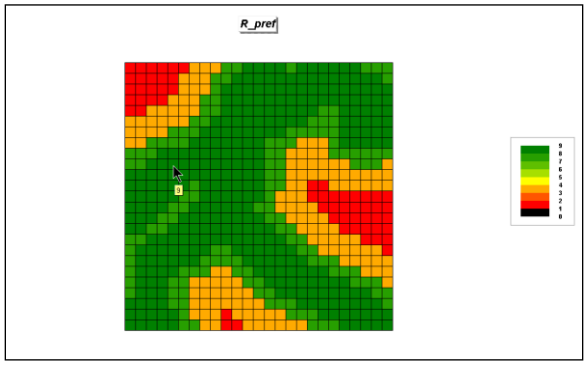
<u>Step 2</u>, Interpreted Maps.



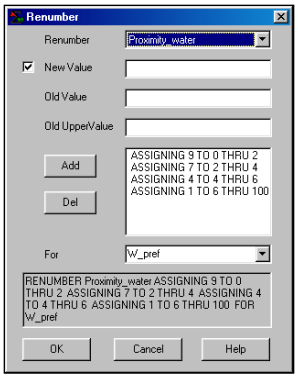


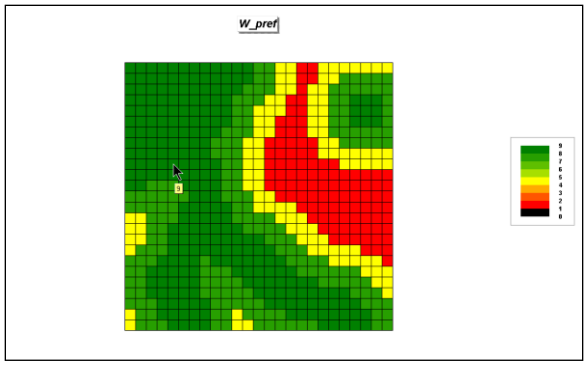
S_pref. *The "Slopemap" is calibrated to a 1 (worst) to 9 (excellent) scale of campground suitability with gently sloped areas rated the best (green tones).*



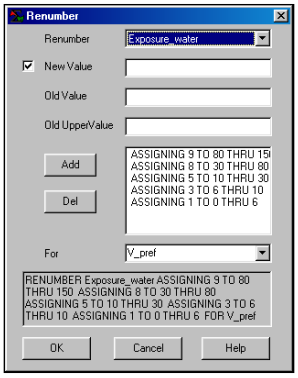


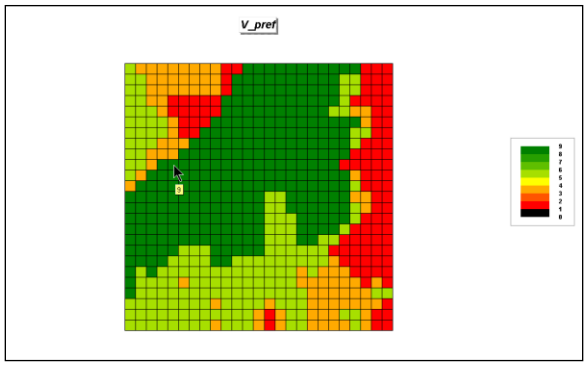
R_pref. *The "Road_proximity" map is calibrated to a 1 (worst) to 9 (excellent) scale of campground suitability with areas close to a road rated the best (green tones).*



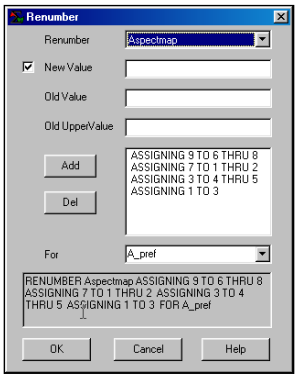


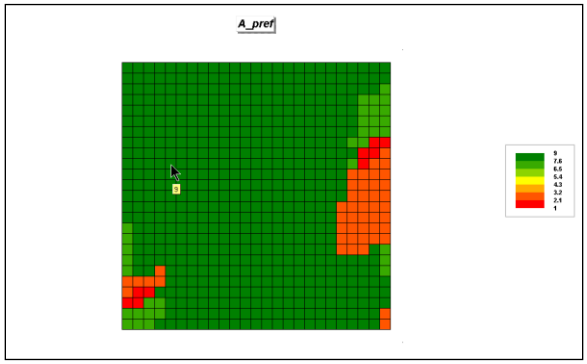
W_pref. *The "Water_proximity" map is calibrated to a 1 (worst) to 9 (excellent) scale of campground suitability with areas close to water rated the best (green tones).*





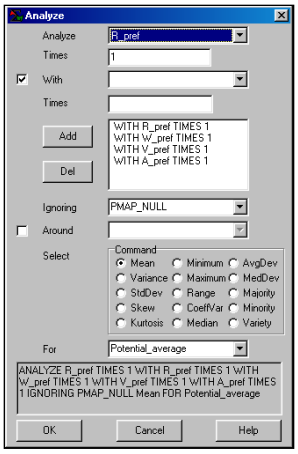
V_pref. *The "Exposure_water" map is calibrated to a 1 (worst) to 9 (excellent) scale of campground suitability with areas "seeing" a lot of water rated the best (green tones).*

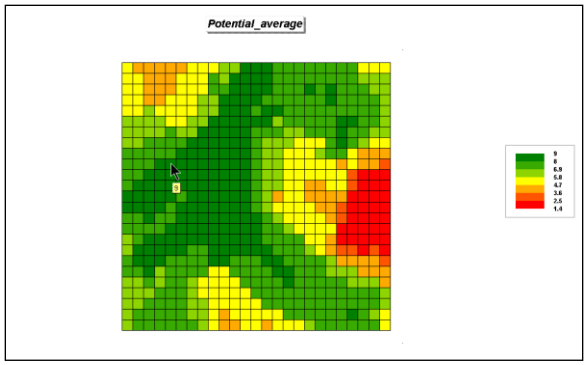




A_pref. *The "Aspectmap" is calibrated to a 1 (worst) to 9 (excellent) scale of campground suitability with westerly oriented terrain rated the best (greentones).*

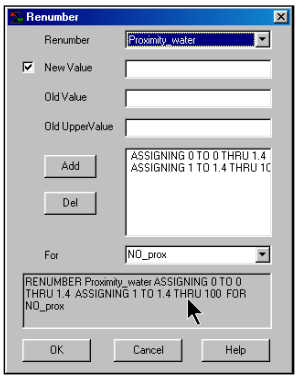
Step 3, Combine Preference Maps.

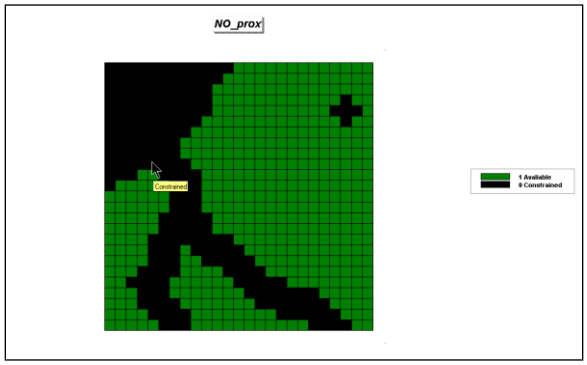




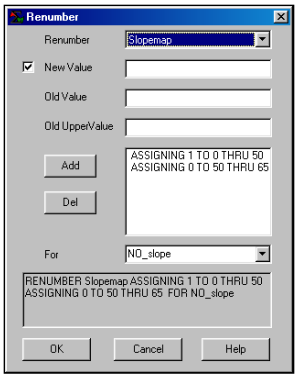
Potential_average. *An overall suitability map is generated by calculating the average of the individual preference maps. Areas with higher average suitability (green tones) are the best areas "overall."*

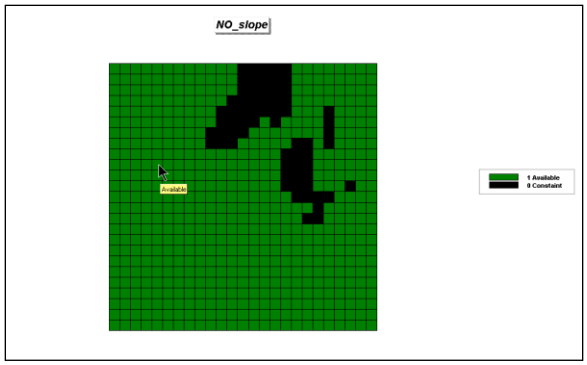
Step 4, Mask Constraint Maps.



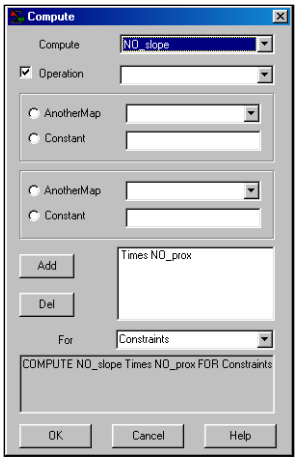


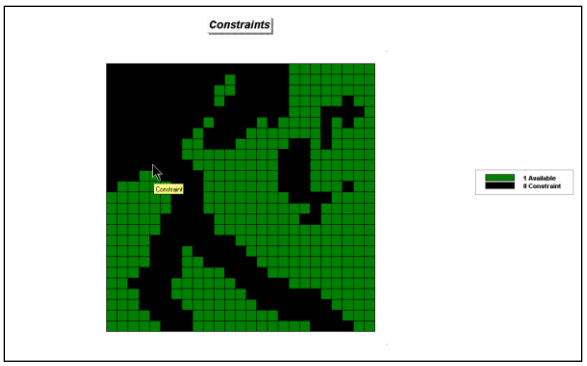
No_prox. *Areas too close to water (0 to 1.4 cells) are legally constrained and are not available for locating a campground (black areas).*



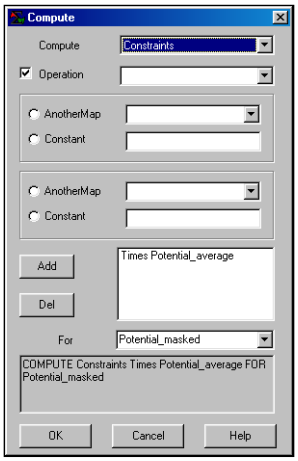


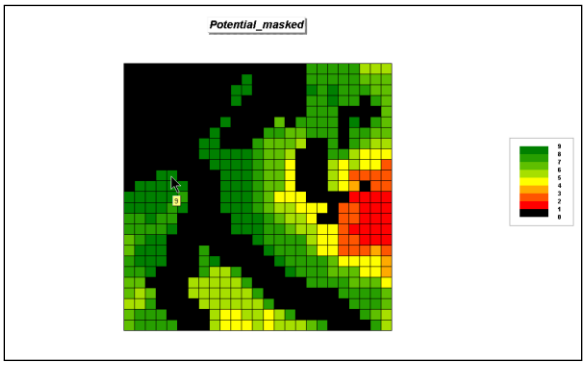
No_slope. *Areas steep (greater than 50% slope) are legally constrained and are not available for locating a campground (black areas).*





Constraints. *The two individual constraint maps are multiplied together for an overall map of constraints (black areas)— 0*1, 1* 0 or 0*0. Only areas that are available on both maps are identified as available overall— 1*1.*





Potential_masked. *The same binary masking procedure is used by multiplying the "Constraints" map by the "Potential_average" map. The result is a map with 0 indicating unavailable areas and higher values indicting the best areas.*

Summary. The simple Campground Suitability model identifies the "relative goodness" of each map location for a campground. This suitability map can be used to narrow field work and serve as a starting palace for further map analysis.

Extensions. The model can be extended in two ways. First, the logic can be enhanced to include other factors, such as "being in or near forested areas" as best…

SPREAD Forests TO 100 Simply FOR Forest_prox
RENUMBER Forest_prox ASSIGNING 9 TO 0 ASSIGNING 7 TO 1 THRU 2 ASSIGNING 3 TO 1.01 THRU 4 ASSIGNING 1 TO 4 THRU 100 FOR F_pref

Also, the model's parameters and weights can be changed to reflect different interpretations, such as proximity to water more important than terrain steepness…

ANALYZE S_pref TIMES 1 WITH R_pref TIMES 10 WITH W_pref TIMES 5 WITH V_pref TIMES 5 WITH A_pref TIMES 5 WITH F_pref TIMES 5 IGNORING PMAP_NULL Mean FOR Potential_average2
COMPUTE Constraints Times Potential_average2 FOR Potential_masked2

Give the extensions a try on your own. You can compare the two results by…

COMPUTE Potential_masked Minus Potential_masked2 FOR Difference

…areas with 0 assigned indicate no change; sign of the values indicate type of change (positive means original rating higher); and magnitude of the value indicates the amount of change (large values indicate a lot of change).