

## **Chapter 3. RECOVERY SOFTWARE USERS' GUIDE**

### **Introduction**

This chapter gives an introduction and step-by-step instructions on how to use the hurricane recovery software. It will also provide several useful examples to walk the user through the tool and some helpful hints and suggestions that will make the software easier to use and the output more meaningful. The organization of this chapter is as follows:

- (1) A discussion of where the data come from and how it was put into the software, with the intent that the user if necessary could repeat the process.
- (2) A discussion of how to select road types and critical facility categories.
- (3) A thorough description of the summary worksheet in the software, including how to manipulate it and how to interpret the results.
- (4) A few practical examples for demonstration.
- (5) A list of several potential models that will make sense for short, medium, and long-term recovery.

### **Data Gathering**

Three types of data were gathered for this project: critical facilities, population, and road mileage. Critical facility data was divided among eight categories, and there are four type of roads for which mileage was tabulated. Population is a single category, so that creates 13 sheets if raw data in the spreadsheet. There are three more sheets where the user may enter any data they wish. Since the critical facilities category has eight separate sheets of raw data, they are compiled on the “Facilities” sheet. The road mileage category has the same type of compilation sheet. Finally, everything comes together in the summary sheet, where the prioritization calculations are done and the output is displayed.

The raw data was gathered using the Arcview GIS program, which displays spatial data and tallies attribute data for analysis. A large project was created containing all of the data mentioned above, and set up to import the data into Excel. There were several sources for the GIS data.

One piece of GIS data came from VDOT. The “Network Level Basemap” contains GIS data files detailing roads in the Commonwealth of Virginia. This set of data mapped roads throughout the state, but in populated areas did not map the secondary state routes. It also did not have street address information, identifying each road only by it’s route number. While it is considered more accurate than the other road data used in this project, the lack of secondary routes was a real problem.

The other road data obtained for this effort came from the United States Census Bureau. This road data is not considered to be as accurate as the previously mentioned VDOT data, but it contained all of the roads in the state down to the secondary state and local roads. In addition, this data identified each road by street name and block number, which allows for houses and

other buildings to be located automatically using the geocoding process. Geocoding comes in very handy when locating critical facilities by their addresses. These two factors made the Census data (called “TIGER” maps) the better choice for road data.

Population data also came from the Census Bureau. The population data, measured in block groups (the smallest breakdown compiled). Mr. Mike Furlough of the Geostat Center at the University of Virginia compiled both the TIGER maps and the population data, and he created numerous shape files for this effort. The VDOT data came already compiled on CD-ROM, and it was ready for manipulation right away.

The gross resource allocation problem called for a way to break the land into zones, instead of prioritizing each individual road. The most sensible way to do that was using a grid, and making each zone exactly the same size. A grid fit very well with using Microsoft Excel, so a grid was drawn in Arcview to match the map grid that already existed in Excel. With the same grid data was gathered in Arcview and sent to Excel with little difficulty.

### **Population Data**

The population data was straightforward to gather. Once the grid was established, the goal was to find the number of people in each grid cell. Population blocks are very small in size, usually between 20 and 150 people living in one, in both rural and urban areas (that makes them very small in land area in urban areas). The GIS data consisted of the blocks drawn out (with the number of people from the census as attribute data for each block). In addition, the location of the geographic center of the block was included as attribute data. So to collect the population data, the blocks whose centers were contained within a grid cell were counted for that grid cell. This makes collecting data much easier, it really would have been impossible to try and match up uneven borders with square grid cells. This is also not a bad assumption because the grid cell is significantly larger than the block size so it really didn't make all that much difference (discrepancies balanced out). It should be noted that the population data in Excel is in units of 100 people, so for example if the spreadsheet has 18.41 in a cell then 1,841 people live in that grid cell. It should also be noted that the data is from the 1990 census, and the data from the 2000 census will be available very soon to the public and this project will be updated with the new data at that point.

### **Highway Mileage Data**

The road mileage data was a little bit more difficult to collect, because the road segments are not points, the mileage of road doesn't tabulate as easily as people counts do, and there are four categories of roads for which data is compiled. For each cell, a road segment was counted if the center of the segment lied within the cell, and again this was not a bad assumption because of the relative size of the grid to the streets. The type of road was already recorded as attribute data so it was easy to distinguish between Interstates, US highways, primary state routes, and secondary state and local routes. It should be noted that the units are unknown on the road length data; they appear to be close to miles but no actual units have been found yet. For now they are called miles because they are somewhat close to miles and the absolute distance is not nearly important to this problem as the relative distances.

## Critical Facility Data

The critical facilities were the most difficult to gather, but the great majority of them came from Internet searches, particularly on the Yahoo! Site. As stated above, the geocoding process allows for locating and plotting facilities automatically (in large batches) by using only a street address. To find the addresses numerous sources were consulted, but the best one found by far was Yahoo! Maps, and Internet site that publishes the address and phone number for businesses of all types. The businesses are broken down by category and include virtually all government buildings and facilities in addition to private companies. Every category of critical facility was included.

The geocoding function was very successful with the addresses provided. In previous runs roughly 65% of the facilities were matched, leaving quite a bit of work to locate the remaining 35%. This time, by manipulating the geocoding controls and criteria, the results were closer to 90 or 95% matches. Each unmatched facility needs to be investigated and if the address is correct (some are addresses that do not exist) than the data can be modified to get it to match. Once all the facilities are located in Arcview, the exact same technique that was been used twice before is used to port the number of facilities per cell to Excel. This time there are eight calculations per cell (eight categories of critical facilities).

## Sample Model

Once all of the data is in Excel the analysis can begin. There are thousands of models that the user can choose, but not all make sense and not all will produce good results. In order to get good results the user must create models that make sense and mimic their own ideas of what is most important for the present stage of the recovery. Examples will be given of possible models, but they are only suggestions. One of the strengths of the way the model is set up is that a new model can be formulated in just a few seconds, so it is possible to look at many, many models before deciding which is the best.

In order to demonstrate the usage of the software a sample model will be used for the rest of this chapter. This is a very practical model, does not use any user inputs, and intuitively makes a lot of sense. The model is as follows:

$$\frac{(\text{Emergency, Commercial, Operations, and Military facilities}) * (\text{Population})}{\text{Interstate Mileage}} ? \text{ Score}$$

This model makes sense for short-term recovery problems. The emergency facilities are very important to saving lives and homes right after a storm. Operations facilities (power company, natural gas, etc.) are also very important following a disaster. Military facilities are important to maintain, and the National Guard may be called in if there was a major disaster. And commercial facilities (grocery stores, gas stations, etc.) are extremely important because people need to get food and supplies. Since it is a short-term recovery problem I only look at Interstate mileage. Population is in there because getting people where they need to go is the ultimate mission, so knowing where the people are is important.

It is important to note here that while using several types of facilities in a model is perfectly acceptable, but only one type of road can be used at a time. Facilities all carry the same units. In the past there was talk of assigning weights to the facility categories, but it was decided that weights would provide inaccurate information that really did not mean anything. Then when several facility categories are added together, the units stay the same – number of facilities. It is incorrect to add road mileage together because one mile of Interstate is such a totally different thing than a mile of secondary route (side streets). They are not comparable at all.

### Manipulating the Data

In order to implement the model above, follow these simple instructions. It should be very simple to learn how to create your own models after this brief tutorial. Detailed instructions are also provided in the software in the “Instructions” tab. Note that in the spreadsheet the user should only make entries into cells shaded yellow.

#### Step 1: “Facilities” Tab

Since the model being implemented uses facilities, the user must go to the facilities tab and enter which facilities to include in the model. Look for the eight yellow boxes in a column on the left, each one corresponding to a facility category. To include that category of facilities, enter a “1”. To not include that category, enter a “0”. Then proceed to the “Roads” tab.

**Facilities**


For ease of viewing, zoom out or zoom in as desired  
 In the Input Boxes, the units represent the mileage of Highway roadway for the grid box in question.

Category Definition Table					
Priority	Percentile Range		Numerical Range		Color Designation
	Lower	Upper	Lower	Upper	
High	75.0%	100.0%	2	34	Red
Medium	50.0%	75.0%	0	2	Yellow
Low	0.0%	50.0%	0	0	Green

Facility Type	Enter 1 to Include in Analysis, 0 to Exclude
Education	0
Government	0
Military	1
Emergency	1
Operations	1
Commerce	1
Communications	0
Transport	0

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**Figure 3.1** Entering facilities into the model

#### Step 2: “Roads” Tab

The next step, inputting the type of roads to include in the mileage calculations, is pretty much the exact same thing. Go to the “Roads” tab and look for the four yellow cells in the upper left, each corresponding to a different road type. Again, enter a “1” to include interstate and a “0” to

not include US Highway, Primary route, and Secondary Routes. Anything other than a one or a zero is an error, and in this case more than one “1” is also an error. Then proceed onto the “Summary” tab.

**Roads**

For ease of viewing, zoom out or zoom in as desired  
 In the Input Boxes, the units represent the mileage of Highway roadway for the grid box in question.

Category Definition Table					
Priority	Percentile Range		Numerical Range		Color Designation
	Lower	Upper	Lower	Upper	
High	75.0%	100.0%	0	8.629	Red
Medium	50.0%	75.0%	0	0	Yellow
Low	0.0%	50.0%	0	0	Green

Road Type	Enter 1 to Include in Analysis, 0 to Exclude
Interstate	1
US Highway	0
Primary Route	0
Secondary Route	0

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**Figure 3.2** Entering roads in the model

### Step 3: “Summary” Tab

The final step to completing this model is in the “Summary” tab. All that is required here is to enter the numerator and denominator into the model and it will be done. The model from above contains facilities and population in the numerator of the equation, and the road mileage is in the denominator. None of the user inputs are used. Looking at the upper left of this screen, look for the yellow blocks two rows high and six columns wide. The six columns are for the six data types (critical facilities, population, road mileage, and user inputs #1, #2, and #3). The two rows are for the numerator and the denominator. If the model calls for the data type in the numerator, put a “1” in the top box and a “0” in the bottom. Likewise, if the model calls for a data type in the denominator, put a “0” in the top box and a “1” in the bottom. If the model does not use the data type, then a “0” should be placed in both boxes. So for Facilities and Population enter a “1” on top and a “0” down below, for Roads put a “0” on top and a “1” below, and for User Input #1, #2, and #3 put “0” in both spaces.

Note that if a data type is placed in the numerator, than a higher value in that data leads to a higher priority. If the data were placed in the denominator, a higher value in the data would receive a lower priority.

**Summary**

For ease of viewing, zoom out or zoom in as desired

Category Definition Table					
Priority	Percentile Range		Numerical Range		Color Designation
	Lower	Upper	Lower	Upper	
High	80.0%	100.0%	146.30168	13438	Red
Medium	20.0%	80.0%	16.374691	146.30168	Yellow
Low	0.0%	20.0%	0.1808954	16.374691	Green

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Enter a 1 in the below table to include that factor in the prioritization score, otherwise leave it blank or enter a 0 for the factors that aren't needed in the final

	Facilities	Population	Roads	User Input #1	User Input #2	User Input #3
Numerator	1	1	0	0	0	0
Denominator	0	0	1	0	0	0

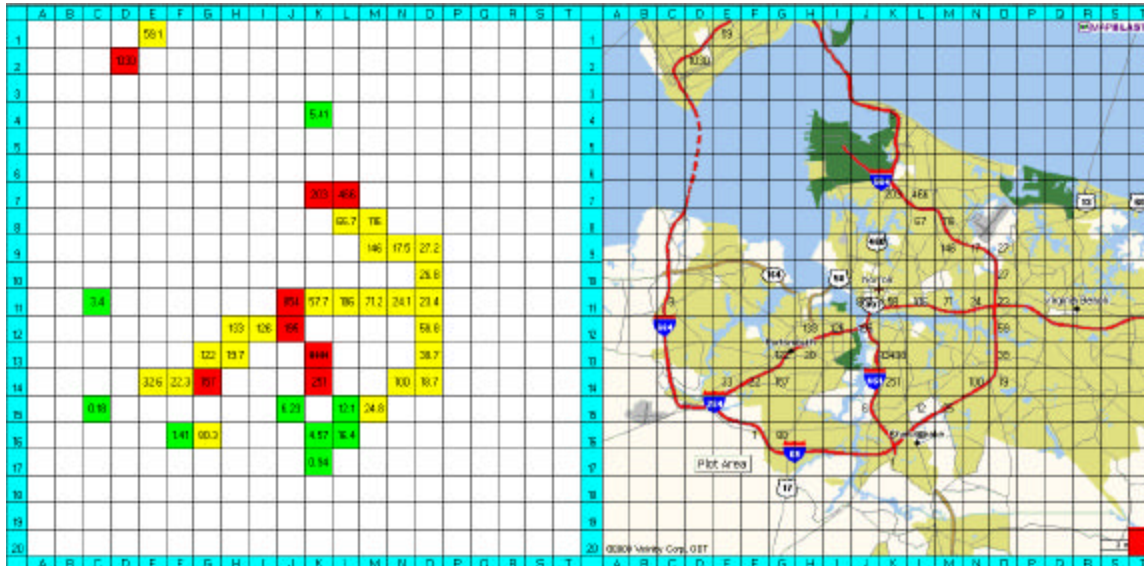
The formula is as follows:

Facilities	x	Population	x	1	x	1	x	1	x	1
1	x	1	x	Roads	x	1	x	1	x	1

\*Note: If numerator or denominator is left empty, then the resultant fraction will be one by default

**Figure 3.3** Summary worksheet

The output, shown in Figure 3.4, gives priorities for this model. Most of the cells are white because of no data in those cells – meaning there are no Interstate highways passing through those cells. Of the cells that do have data, we see high priorities in Red, medium in yellow, and low in green. In this setup, the top 20% of cells with data get red, the bottom 20% get green, and the middle 60% get yellow. Looking back at Figure 3.3 shows how to change those distributions. Look to the upper left, and remember to only change cells shaded yellow. You can adjust the lower bounds (bottom always stays at 0.0%) to change how the output is perceived. The right side shows the numbers from the left with the map in the background. The colors don't show through but the numbers can still be examined and it really helps to locate the roads beneath the numbers.



**Figure 3.4** Output of the sample prioritization model

To get a good feeling of what this model can do, the user needs to run many, many different models and examine the outputs. The user should experiment with combinations that might not originally make sense. The user really wants to know what spots are continually hot spots and what spots rarely if ever are high on the priority lists. If certain cells continually stay as vitally important then the model is producing a robust answer, but if it changes all the time then the model is not a robust solution.

### Sample Models

There are literally thousands of different combinations of models that could be used as criteria for the prioritization. There are various combinations of facilities, road types, and whether or not to include population and the various user inputs, which could be anything. One of the objectives for this project is to prioritize disaster recovery on a short, medium, and long-term basis. The table below contains several suggestions for short-term, medium-term and long-term recovery models.

**Table 3.1** Sample models

Time domain	Example priority setting model
Short-term	1) Emergency facilities * population / interstate mile 2) (Ops. + Trans. + Mil.) / primary route mile 3) Schools (Evac. Shelters) * population / interstate mile
Medium-term	1) Schools * population / US highway mile 2) (Comm. + Trans.) * population / primary route mile 3) (Emerg. + Ops. + Mil.) * User Input [damage indicator]
Long-term	1) Commercial * population / primary route mile 2) (All facilities) * population / User Input [recovery cost] 3) (All facilities) * population / secondary mile

The models shown in Table 3.1 are only samples, though they are all practical models. The point of Table 3.1 is to show examples of how the user can go about creating models and also how many possible models exist.