

Hot Spot Analysis of 911 Calls

Using ArcGIS Spatial Statistics Tools

1 Raw Data

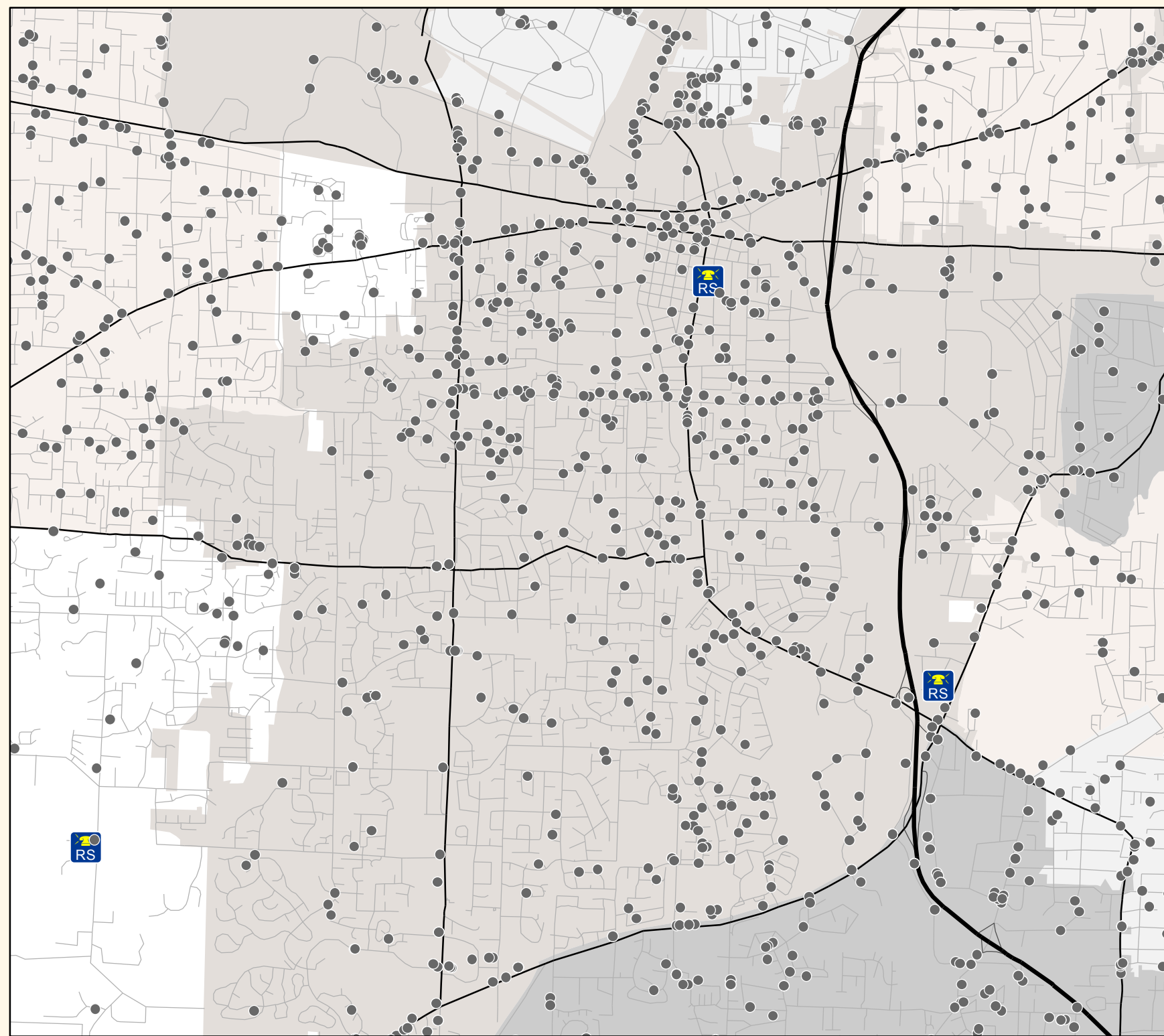
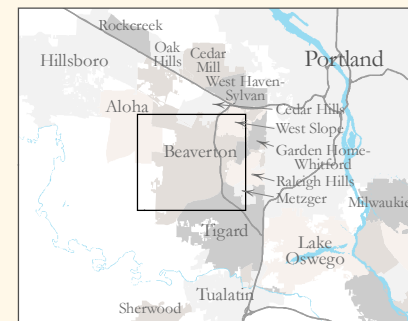


Figure 1. The raw data shows the geocoded locations where 911 calls were placed.

These data are a sample of 911 calls placed from within the Portland, Oregon metropolitan area. Each of the points represents a single call into a 911 response station. Using just visual analysis it is difficult to know whether and where clustering exists, or how strongly the calls are clustered. Some areas do appear to be clustered, but even with a truly random pattern contains some pockets of local clustering. Additionally, visual analysis cannot determine whether multiple calls have been made from the same location, such as an apartment building.



Raw Data for 911 Calls
 Call Response Station
 Major Highways
 Other Highways
 Major Streets
 Ramps
 Other Roads
 Scale: 1:35,000

Weighted Data

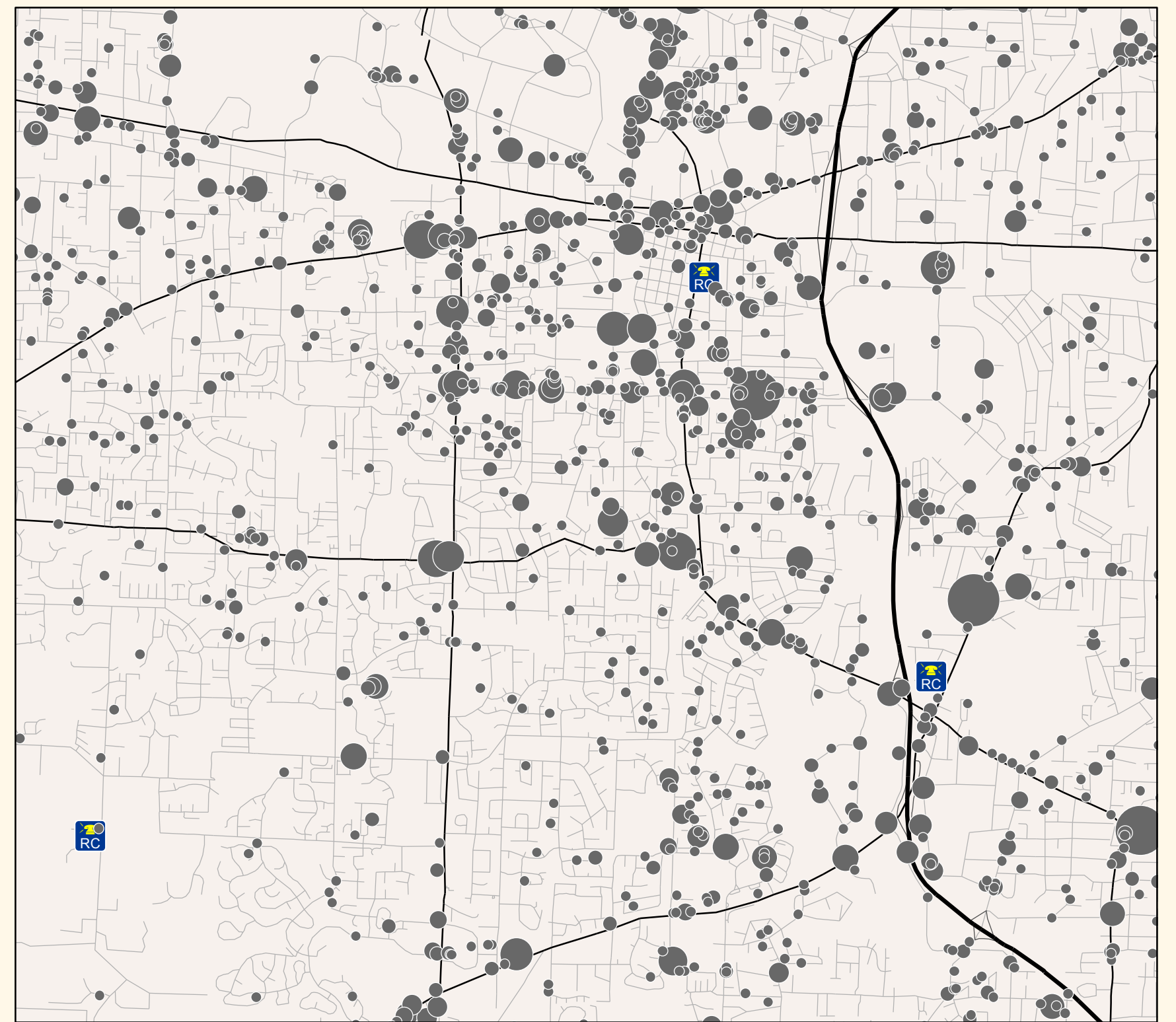


Figure 2. The weighted call data shows counts at each location, and is symbolized with proportional circles.

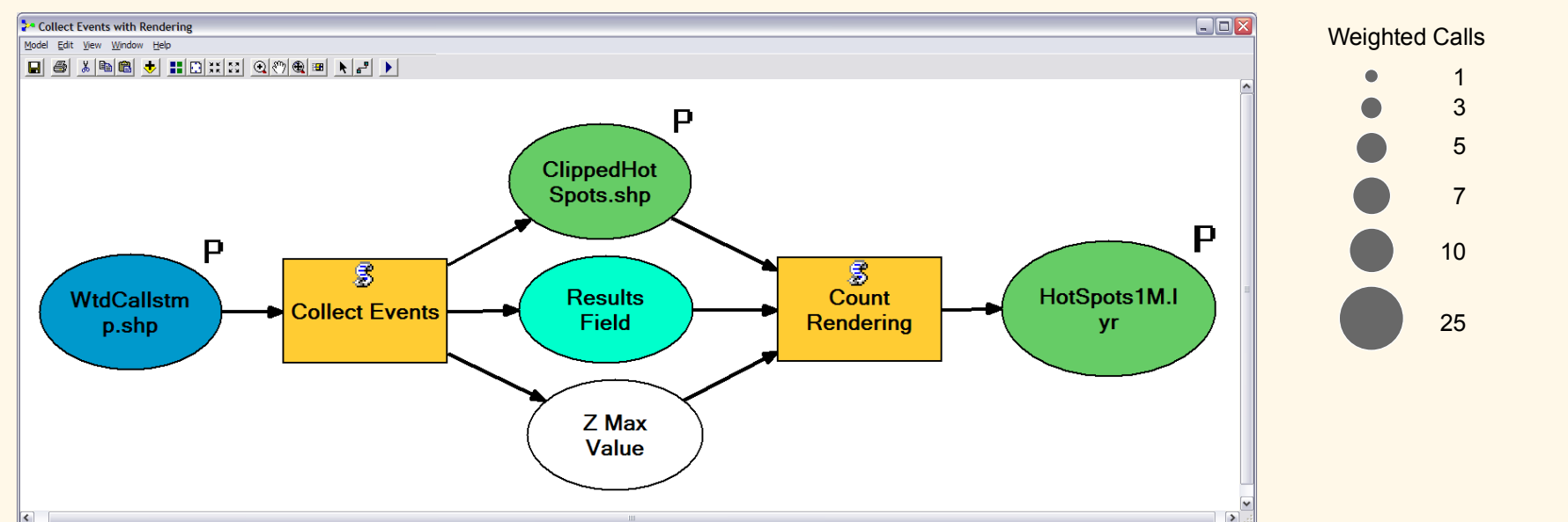


Figure 3. The Collect Events Model was used to create the data for Figure 2.

The Collect Events with Rendering Model was used to process the raw call data and produce a set of counts at each location. The weight is the number of 911 calls made from each location.

Now it is possible to see some clustering more clearly, like just above and to right of the center. The question remains, however, as to whether this cluster is statistically significant?

3 Z-Scores

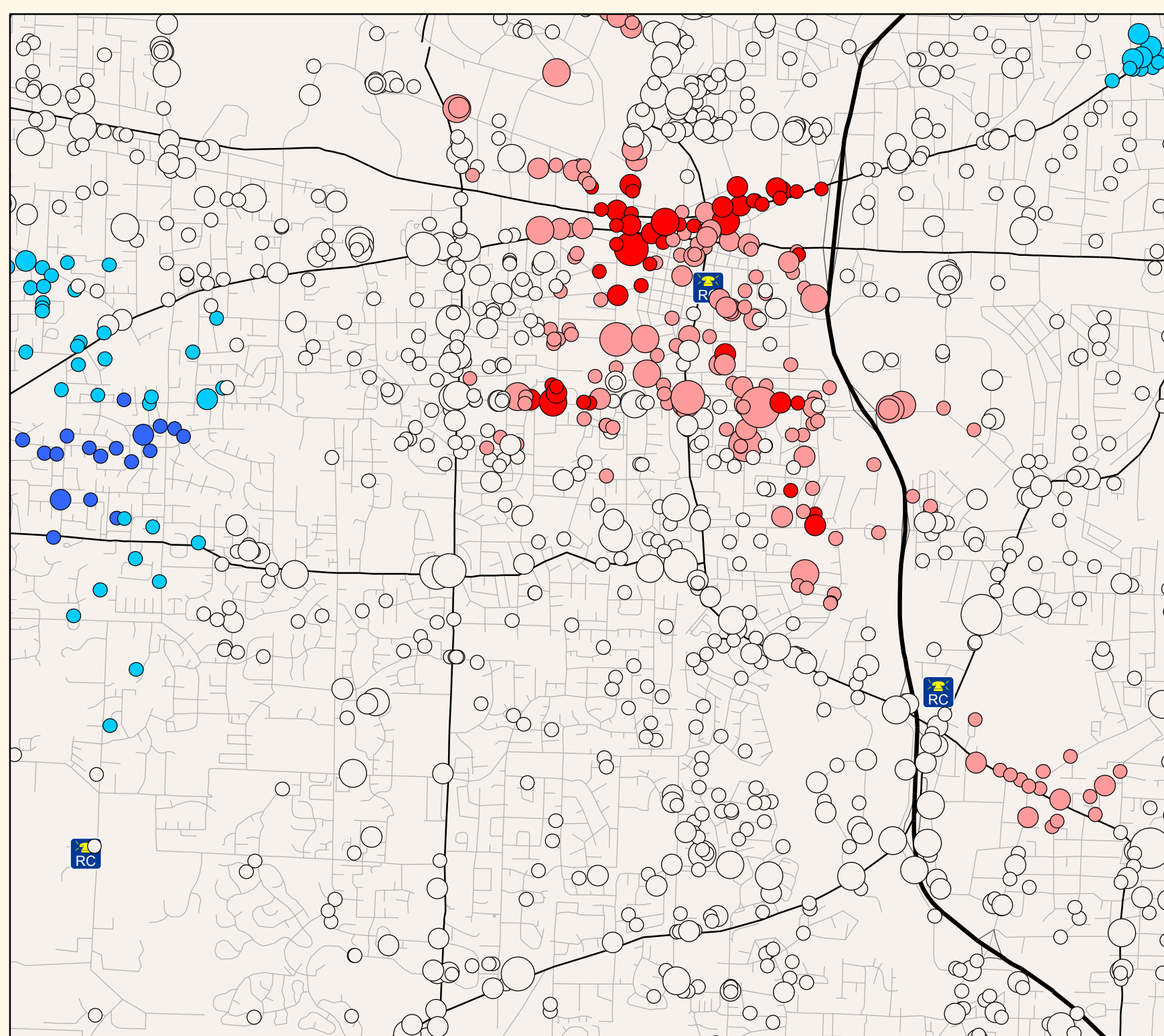


Figure 4. The Z-Scores of weighted 911 call data shows hot spots.

The goal of this analysis was to evaluate the spatial pattern of these 911 calls and to look for hot spots. We wanted to see where the calls were clustering together in space. The results of this analysis can be used either relocate emergency response stations or add a new emergency response station to better serve the needs of the people of this city.

lapperson, this mean, the tool determines where more calls than expected occur and where fewer calls than expected occur. Hot spot analysis determines how likely it is that there is a pattern like this one if the underlying processes are random.

The results are presented as the standard deviation z-scores. Once these have been calculated, we can immediately see the 911 call clustering. The red are hot, lots of calls. The blue spots are cold, that is given the overall region, these areas don't get very many calls.

The Hot Spot Analysis with Rendering tool was used to produce the data for figure 4. At the core of this tool is the Getis-Ord G_i* statistic. The tool evaluates the call data by comparing the local mean to the global mean and then determining whether the difference between them is statistically significant. To the

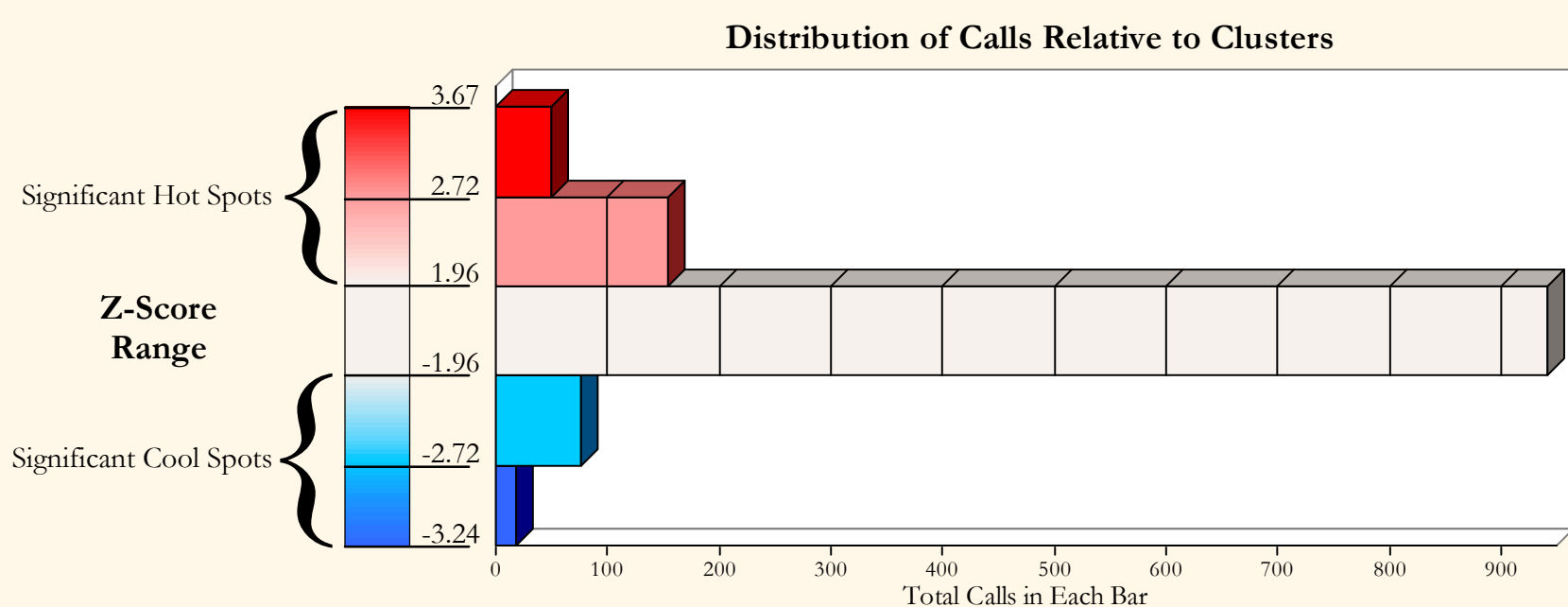


Figure 5. Distribution of Z-scores related to a graph using the same colors on the map.

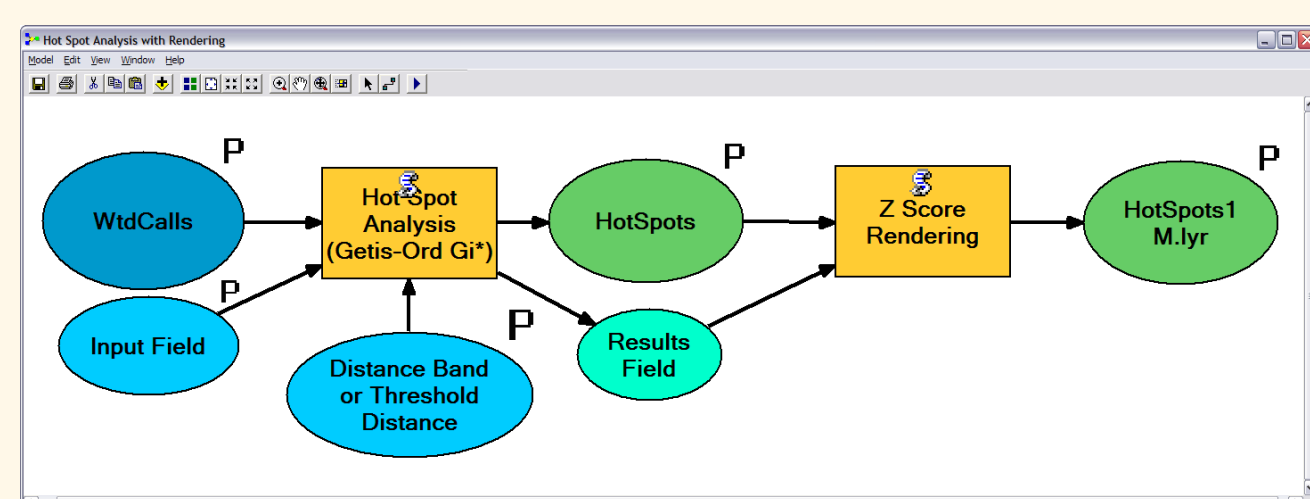


Figure 6. The Hot Spot Analysis with Rendering Model was used to create Figures 4 and 5.

4 Visualizing the Results

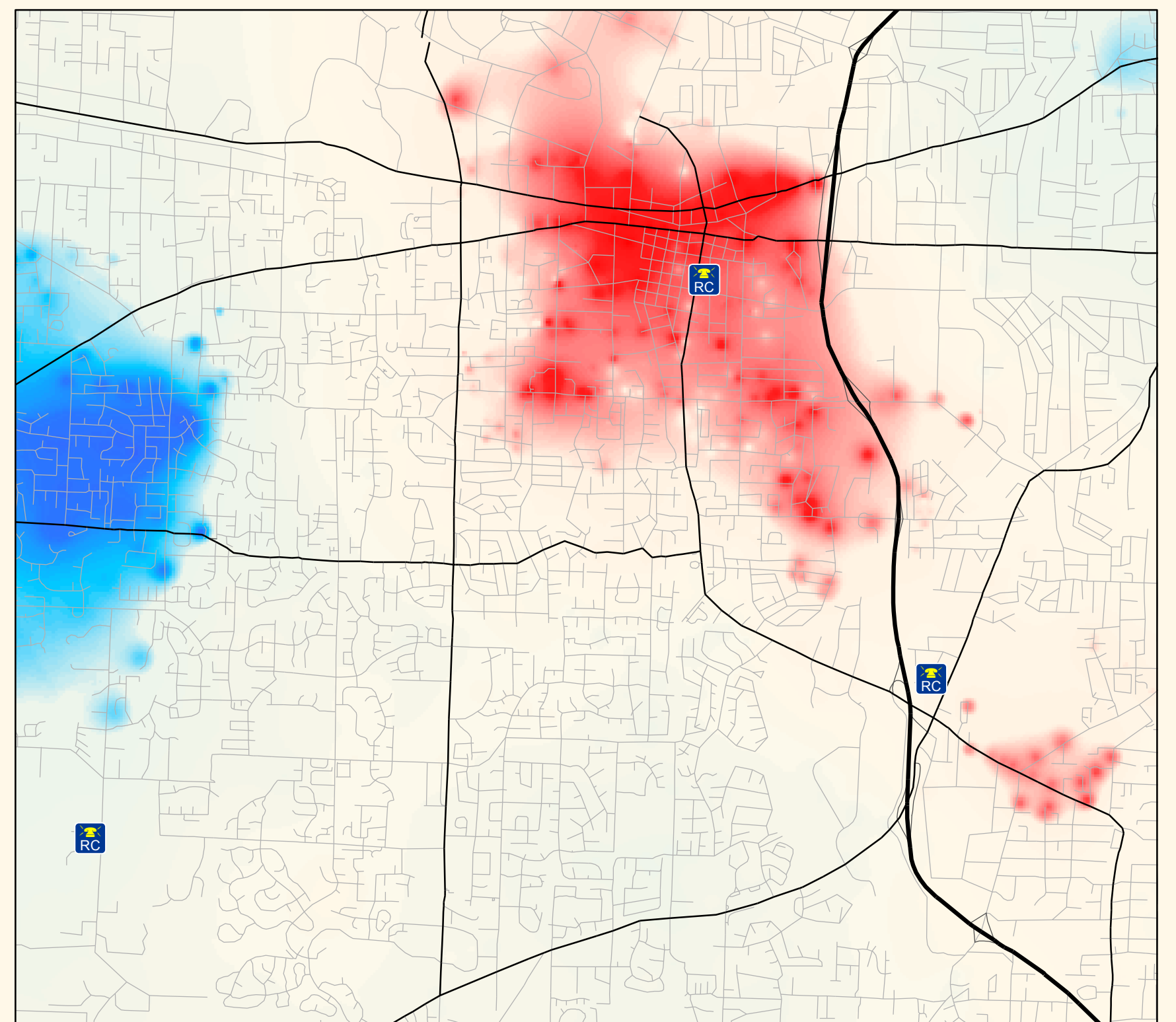


Figure 7. Hot spot analysis results can be shown as an interpolated surface.

The hot spot points were converted to a surface using the IDW tool from the Spatial Analyst extension to ArcGIS. By symbolizing that surface using the color ramp shown in the left part of figure 3, it is easier to quickly visualize how well the call

response stations are located. This analysis was performed on a small portion of the city, and therefore no inferences should be made about the effectiveness of the stations portrayed here.

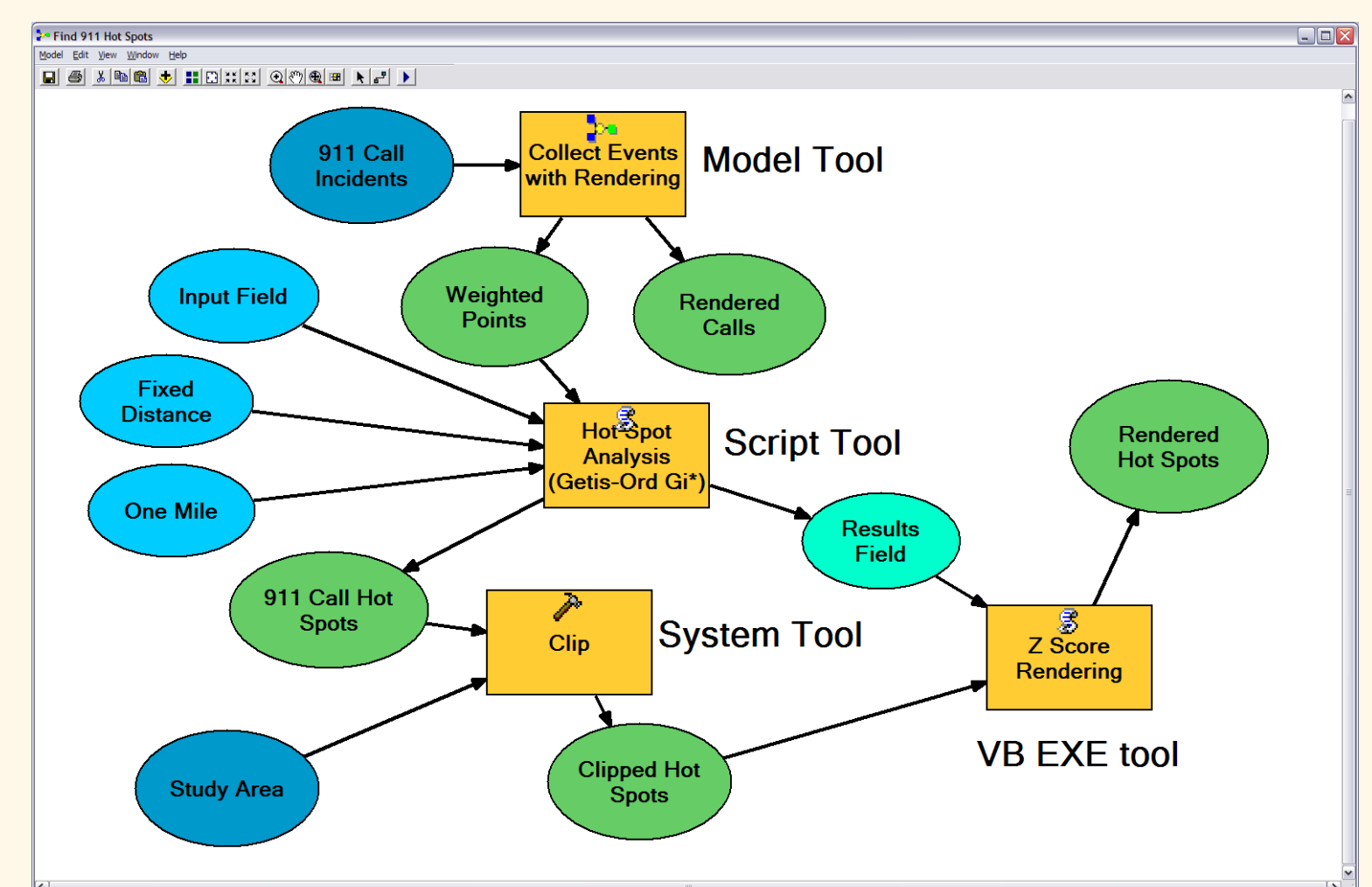


Figure 8. This model was used to automate parts 1, 2, & 3 in ArcGIS 9.0.