

# Using GIS to Identify Sites for New Emergency Telephone Locations at Furman Campus

## Abstract

Geographic Information Systems (GIS) are frequently used by a wide range of professionals in business, government, and industry to visualize and analyze geographical data. Law enforcement agencies may use GIS to analyze crime patterns in order to improve their services. This project used GIS to analyze several variables related to Furman University in order to propose new sites for "Code Blue" emergency telephones. The maps produced through this analysis revealed nine poorly lit, high crime areas that were relatively far from current Code Blue emergency telephones and that met electricity and telephone line considerations. These nine locations are proposed as sites for new Code Blue emergency telephones. Adding some or all of the proposed phones would vastly improve access to Code Blue emergency telephones on campus.

## Introduction

GIS are used by a variety of professionals in both the public and private sector to accomplish very diverse goals. Analyzing variables that may influence crime patterns is an important component of law enforcement's efforts to respond to or prevent crime (Hirschfield et al. 1995). GIS are well-suited to crime analysis (Hirschfield et al. 1995).

Emergency telephones, including outdoor Code Blue telephones, are one way that Furman's Public Safety Department and many other university police departments increase security on campus (Wray 2002). Furman's Public Safety Department maintains emergency telephones in card access entrances to residence halls, all elevators, and a few parking lots and walkways around campus (Public Safety Dept. 2007).

Furman currently has eight Code Blue emergency telephones scattered throughout the campus. In the fall of 2007, Public Safety secured funding for two additional telephones to be placed on campus this year. On September 21, 2007, Bob Miller, Director of Public Safety, informed the Sexual Harassment and Rape Prevention (SHARP) Committee that he would be determining locations for the new emergency telephones.

The objective of this project is to use GIS to analyze data on crime reports, current "Code Blue" emergency telephone locations, streetlight density, electricity and phone line limitations, and common campus pathways to suggest ideal locations for new Code Blue emergency telephones on the Furman campus.

## Methodology

### Streetlights and Current Code Blue Emergency Phone Locations

>Georeferencing and Projection: A PDF file containing the layout of buildings, athletic fields, streetlights, and the current Code Blue emergency telephones was converted to JPEG format and then georeferenced to an aerial photo of Furman's campus.

>Digitization: Once georeferenced, new layers were created upon which each streetlight and each existing Code Blue telephone were digitized manually.

>Analysis of Streetlights: A Point Density analysis was performed to determine the number of streetlights per acre for the campus (Fig. 3).

>Analysis of Current Emergency Phones: A Buffer analysis of each of the current emergency phone locations revealed zones that were relatively near the current emergency telephones (Fig. 2).

### Crime Data (Public Safety Reports)

>Reclassification: The original crime data from Public Safety categorized the 472 total reports based on type of report (e.g. larceny) and by area on campus where the report occurred (e.g. Administration Building). The report types were reclassified into 7 broader types: Crimes vs. Property, Crimes vs. People, Individual Conduct Violations, Traffic or Vehicle Related, Informational Reports, Medical Assistance, and Must Exclude. (For more information on the Must Exclude category, see the Note on Fig. 4.) The name of the 103 areas of campus and the total number of each type of report that occurred at a particular area was then entered into a table.

>Georeferencing and Projection: Midpoint coordinates for each of the 103 areas of campus mentioned in the Public Safety report were estimated using Google Earth. These coordinates and their associated crime data were then georeferenced to an aerial photo of Furman's campus.

>Interpolation: Each of the 7 categories of Public Safety Reports were interpolated individually using an Inverse Distance Weighted technique. This resulted in 7 different "crime" layers (not pictured).

>Analysis: The interpolated Crimes vs. Property, Crimes vs. People, Individual Conduct Violations, Informational Reports, and Medical Assistance layers were analyzed using a Weighted Sum to produce a "Crime Hot Spots" layer (Fig. 4).

### Poorly Lit, High Crime Areas

>Analysis: An Overlay of the Crime Hot Spots layer and the Streetlight Density layer was used to reveal poorly lit, high crime areas (Fig. 5).

### Campus Features Shapefiles

>Description: These shapefiles represented campus buildings, athletic fields, roadways, some parking lots, and some pathways. These shapefiles were already georeferenced to the aerial photo. You can see them used throughout my project as either solid shapes or outlines of campus features. As these were from 2003, some campus features have changed.

>Analysis: The shapefile containing campus buildings was Buffered at 200 feet to create a Building Buffer layer. This layer was considered when making recommendations on locations for new Code Blue emergency telephones, but was not pictured in Figure 6 because it obscured the other layers.

### Proposed New Code Blue Emergency Telephone Locations

>Analysis: When proposing locations for new Code Blue emergency telephones, consideration was given to current emergency phone locations (Fig. 2), poorly lit, high crime areas (Fig. 5), a building buffer layer (not pictured), and common pathways (visible as white lines in each figure).

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### Results

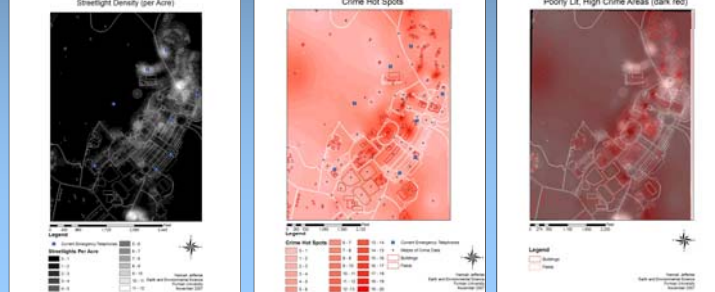
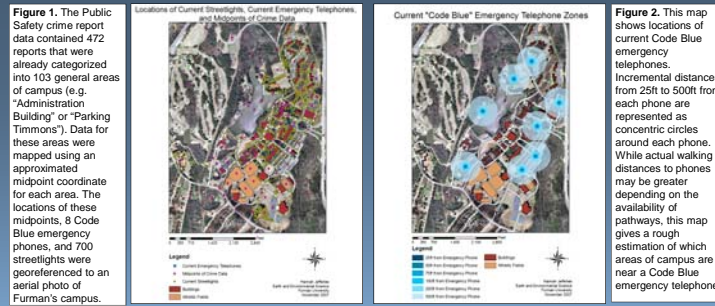


Figure 3. This map demonstrates how poorly or how well particular areas of campus are lit based on the number of streetlights per acre. Current emergency telephones, campus pathways, buildings, and athletic fields are marked. Actual lighting in certain areas may vary based on the strength of the different types of bulbs used in streetlights around campus.

Figure 4. This map rendering was created by interpolating data from the midpoints (yellow dots) of the crime areas. The crimes vs. property, crimes vs. people, individual conduct violations, medical assistance requests, and informational reports categories were added via a weighted sum to determine the Crime Hot Spots. Medical assistance requests were given a weight of 1 while the other categories were given a weight of 2. Darker areas indicate higher levels of crime.

Figure 5. This map is an overlay of the crime map and the streetlight density map. Darker areas indicate poorly lit, higher crime areas.

Note on Fig. 4: Public Safety reports (N=472) categorized as traffic-related (N=44) or "Must Exclude" (N=100) were not used when determining the Crime Hot Spots. (The "Must Exclude" category included damages which may or may not have been accidental, alarms, fires, etc. The items in the "Must Exclude" category were excluded based on the recommendations of Bob Miller of Public Safety.)

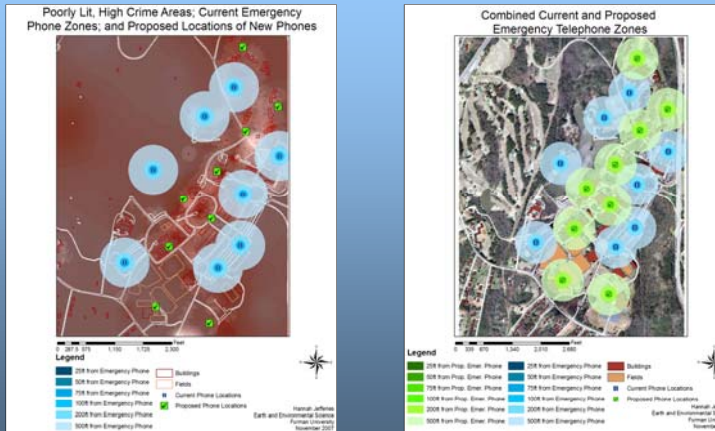


Figure 6. This map combines the three primary data layers (e.g. streetlight density, crime hot spots, and current emergency telephone zones). It also contains the proposed locations for new emergency telephones. The proposed new locations all lie within 200 feet of a building, which will allow Facilities Services to run power and phone lines to these locations.

Figure 7. This map combines the pre-existing Code Blue emergency telephone locations with the nine proposed locations for new Code Blue emergency telephones. Concentric circles around the existing and the proposed Code Blue emergency telephone locations represent incremental distances of 25ft to 500ft from the phones.

Geographic Coordinate System: GCS North American 1983  
Projection: Lambert Conformal Conic  
Datum: D North American 1983  
Central Meridian: -81.000000  
Latitude of Origin: 31.833333  
Linear Unit: Foot

## Discussion

**Current Code Blue Phone Zones** The current Code Blue emergency telephones serve the Athletic Building, South Housing Parking Lots, Chapel Parking Lots, Chapel, Furman Mall, Administration Building, Hartness Welcome Center, Furman Hall, McAlister Parking Lot, FULLR Building, Theatre Playhouse, NV-G, NV-D, NV-E, Amphitheatre, Intramural Fields, and Lake Restrooms relatively well.

**Well Lit Areas** The Younts Conference Center, Cherrylade Alumni House, Younts Parking Lot, Amphitheatre, road to the Amphitheatre, NV-G Parking Lot, Estridge Commons (Housing Office) Parking Lot, Johns Hall Courtyard, and Rose Garden all have relatively high numbers of lights per acre.

**Poorly Lit Areas** Areas with low numbers of streetlights per acre include most of the athletic fields (southwest of the PAC), behind the Lake, Furman Mall, Milford Mall, McAlister Circle, Bell Tower Housing, the path between the Bell Tower and the Amphitheatre, the eastern side of the Lakeside Housing Complex, and the center of the South Housing Complex. (Actual lighting may vary based on the strength of the different types of bulbs used in the lights.)

**Crime Hot Spots** The raw data indicated that the Infirmary, the PAC, Judson, Gambrell, Furman Hall, Timmons Arena, NV-A, the Library, Geer, and NV-F had the highest number of Public Safety Reports (9 or more). The infirmary had the highest number of Public Safety reports (N=18); unsurprisingly, 17 of these were medical. Interpolation with a weighted sum also indicated hot spots near Furman Hall, NV-A, NV-F, NV-K, and Manly.

**Poorly Lit, High Crime Areas** Areas meeting this description appear near NV-A, NV-K, Gambrell, the Lakeside Patio, behind the Dining Hall (lake side), behind the University Center (lake side), the Library, Geer, Manly, the PAC, the Chapel South Parking Lot, Paladín Stadium, and Timmons Arena.

**Other Findings** Interestingly, it would appear that all of the current Code Blue emergency telephones are situated in areas with relatively low levels of crime. Half of the current Code Blue Phones are in well lit areas (NV-G Pavilion, Amphitheatre Restrooms, McAlister Parking Lot, Administration Building) while half are in darker areas (Lake Restrooms, Athletic Building Parking Lot, Chapel South Parking Lot near Fieldhouse, and Chapel South Parking Lot Adjacent to the Chapel).

**Study Limitations** There were several limitations to the present research. Most notably, the Public Safety reports were necessarily vague in terms of the location where the report occurred and the circumstances pertaining to each report. For the most accurate analysis, each report would have its own spatially-referenced coordinate location linked to the associated attributes of that report. Additionally, statistical analyses would contribute to a greater understanding about the degree of importance of each variable examined in the study. Concrete data related to population density and common travel paths, which were unavailable for the present study, would likely improve understanding as well.

## Conclusion

GIS analysis revealed several areas of interest related to crime, lighting, and current Code Blue emergency phone placement. These areas of interest formed the basis for recommendations on placement for 9 new Code Blue emergency telephones. The 9 proposed sites have been prioritized into 4 tiers with Tier 1 being the most urgent and Tier 4 being the least urgent. For a detailed justification of Tier placement, see accompanying handout.

- Tier 1
  - On Milford Mall across from the Library Patio.
  - Northeastern side of the Mickel Tennis Center.
  - Parking Lot of Timmons Arena and Paladín Stadium.
- Tier 2
  - Slightly northwest of the Rose Garden (on the lake side).
  - East of Roe Ford Road, slightly south of junction with Bell Tower road.
- Tier 3
  - NV-K Parking Lot near NV-H and NV-I Parking Lots.
  - Parking Lot of NV-B/NV-C.
- Tier 4
  - Slightly west of Lakeside Patio.
  - Near center of South Housing Complex.

Installation of each of the 9 proposed Code Blue emergency telephones would cause most places on campus to be within 500 feet of a Code Blue emergency telephone. Once this has been accomplished, it is recommended that Code Blue telephones continue to be installed until most areas of campus are within 200 feet of a Code Blue telephone.

## Data Sources

"Crimes by Location from Oct 24 2006 to Oct 23 2007." Public Safety Dept., Furman Univ. 23 Oct. 2007.  
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Georeferenced building, athletic field, parking lot, and road/path shapefiles. Facilities Services, Furman Univ. 2004.  
Aerial photo of Furman campus. Greenville County GIS, 2003.

## References

Hirschfield, Alexander, Peter Brown, and Peter Todd. "GIS and the analysis of spatially-referenced crime data: Experiences in Merseyside, U.K." *International Journal of Geographical Information Science* (01 March 1995). 24 Nov. 2007. <http://www.informaworld.com/lempj115k7c0ctent1713593799>  
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Wray, John. "Upgraded Emergency System Promotes Campus Safety." *Advantage on the Web*. University of Connecticut. 18 Feb. 2002. <http://advantage.uconn.edu/2002/02/21/02021814.htm> 24 Nov. 2007.

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