Hillsborough County, Florida, Roadway Lighting Plan

Lighting the Way to Safer Roads

By Marc J. Rogoff, Ph.D., SCS Engineers; Marina Ostapenko, Ayres Associates; and Buz Barbour, Hillsborough Traffic Division

Hillsborough County, which is located on the west coast of Florida, has grown dramatically in recent decades, resulting in rapid growth of automobile and pedestrian traffic along the county's arterial and collector roads. Given the increasing urbanization of the county, it is not surprising that the public has expressed a strong desire for expanded traffic programs, such as traffic calming, i.e., reducing vehicle speeds and improving safety, crosswalks and pavement markings, signalization, traffic signage, school safety, and roadway lighting. Hillsborough County is aggressively implementing programs and countermeasures to reduce fatalities on county roadways.

How do transportation and traffic services managers make informed decisions about roadway lighting needs? With increased demands for public funding of such projects, GIS offers enhanced means to graphically illustrate for decision makers where traffic countermeasures would provide the most benefits. Buz Barbour, the county's manager of Traffic Programs, says, "Without GIS, there is no way we can make accurate and timely decisions as rapidly as we are able to now by viewing the graphic representations of data GIS provides."

The county engaged the team of Ayres Associates, an ESRI Business Partner, and SCS Engineers to develop a comprehensive analysis of the needs for the program, benchmark similar roadway lighting programs, prioritize roadway lighting needs countywide, calculate the construction and operating costs for roadway lighting, and evaluate feasible funding options for the program.

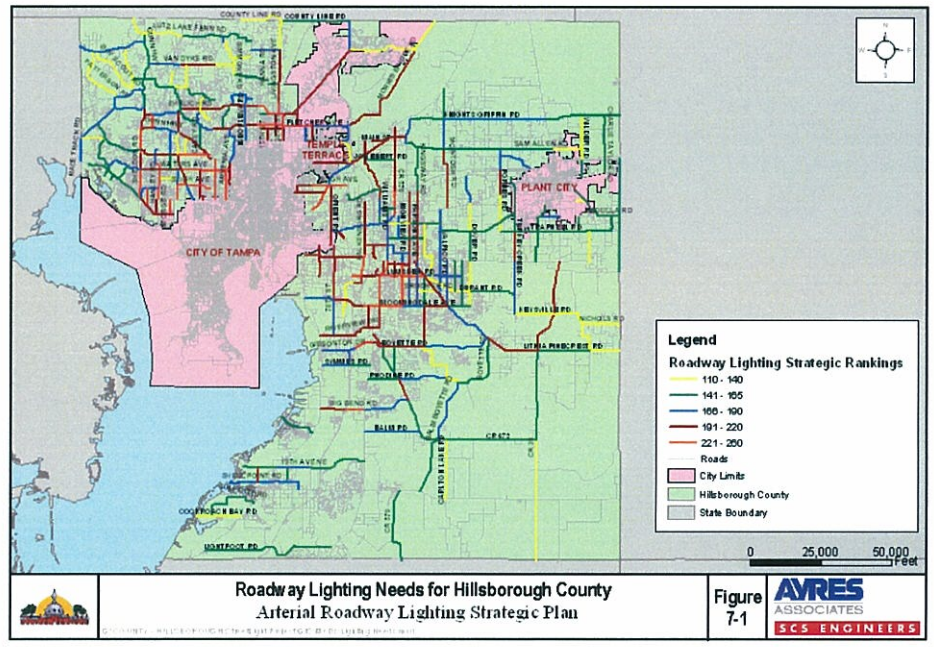
Numerous studies have demonstrated that the implementation of roadway countermeasures saves lives and reduces property damage. Improved illumination yields the greatest benefit relative to cost with the overall benefit of roadway lighting calculated to be 26.8 times its cost for every dollar invested. This is critical because national studies by the Highway Safety Administration suggest that more than one-half of crash-related fatalities occur at night, though only 25 percent of the vehicle miles traveled occur at night.

In general, the most widely used methods of evaluating roadway lighting needs are based on scores, weights, or thresholds, which are based on assumptions that have not been revisited by the traffic engineering profession for decades. These standards primarily were developed with an emphasis on crash history and roadway geometry. However, these national standards do not take into account important factors, such as tourism, elderly drivers, total traffic volume, crime, and levels of urbanization. As such, some observers have concluded that the current lighting warrants underestimate roadway lighting needs, putting drivers at risk for fatal accidents and serious injuries.

For the purpose of this study, the county developed a methodology for prioritizing county roadway lighting needs. The goal of the project was to develop a roadway layer composed of a number of segments and prioritize those segments based on a number of criteria/classification factors. The criteria included traffic factors, roadway geometry, and lighting design but also lighting's effect on crime, nighttime accidents, and evening community functions. Weighting for each of the factors enabled us to calculate a weighted score for each roadway segment that would signify the relative priority each segment would have. Cost information provided by the local electric utility enabled us to quantify the financial costs and prioritize the order in which these roadways would be lighted.

A database was constructed using ArcView, while the specific roadway lighting criteria were obtained from the Hillsborough County specialized geodatabases and existing and newly created shapefiles. A 200-foot buffer layer was created around the master county roadway layer for the county's major arterial and collector roads. All data used for this project was clipped and analyzed within the boundary of the buffer layer.

Traffic-related data (number of lanes, road type [divided/undivided], speed limits, and traffic volume annual average daily traffic, or AADT]) was obtained and manually entered for each segment along with point and polygon coverages for the major public facilities in the county that operate during nighttime hours (fire stations, hospitals, parks, schools, religious centers, etc.). Information pertaining to car accident locations, as well as detailed information about each accident (time of day, vehicles involved, number of fatalities, etc.) that occurred within Hillsborough County over the past five years, was obtained from the Hillsborough County Crash Geodatabase. This geodatabase utilizes a number of joins and intersection functions that allow users to obtain detailed information about specified types of car accidents. For the purpose of this project, a shapefile representing locations of all accidents within Hillsborough County for the past five years was clipped to the 200-foot buffer of the county roadway layer. Using several ArcView functions, the extracted nodes were joined with detailed information regarding each accident, specifically the time of day and the number of fatalities involved in each accident.



County roadway lighting needs mapped using our numerical scoring methodology.

One of the complicated tasks of the project involved assigning crime data from the county Sheriff's Department from polygon features (census tracts) to line features (roadway segments) to ensure that a crime statistic was calculated for every roadway segment in the county roads layer. Depending on the location of the roadway segment (whether it was completely enclosed within a single census tract, split between a number of tracts, or followed the boundary between two tracts), a different algorithm was used in each case in order to assign the crime statistic data to individual roadway segments.

By the end of the project, the team had developed a matrix using GIS software and various spreadsheet applications that correlated classification factors described above to each individual roadway layer. Using this matrix, rating scores and the annual price of lighting installation were calculated for each roadway segment. The results were color coded and displayed on the map, which allows planners to prioritize locations in need of streetlight programs within the county. As a result of this successful GIS project, the County Traffic Services Division is currently initiating plans to gain approval for implementation of the Roadway Lighting Capital Improvement Program from the Board of County Commissioners.

About the Authors

Dr. Rogoff has more than 25 years of consulting experience applying spatial data for public policy decision-making in areas of solid waste management and transportation planning. Marina Ostapenko is an environmental scientist/GIS analyst working with a variety of spatial data for stormwater, transportation, and asset management planning. Buz Barbour manages the Department's Data Management Section has more than 20 years of data management experience.

More Information

For more information on this project, contact Marc Rogoff, Ph.D., project director, SCS Engineers (e-mail: mrogoff@scsengineers.com, tel.: 813-621-0080); Marina Ostapenko, environmental scientist, Ayres Associates (e-mail: ostapenko@ayresassociates.com, tel.: 813-978-8688); and Buz Barbour, general manager III, Hillsborough County Traffic Division (e-mail: barbourb@hillsboroughcounty.org, tel.: 813-307-1833).

Classification Factor	Rating 1	2	3	4	5	Assigned Rating	Weight	Rating x Weight
Activity Centers per Mile: Fire Stations, Hospitals, Libraries, Parks, Schools, School Bus Stops, Religious Centers, Bus Routes	0	0–0.62	0.63–1.05	1.06–1.72	1.73+		10	
Number of Lanes/Road Type	2 Lanes Divided	2 Lanes Undivided	4 Lanes Divided	4 Lanes Undivided	6+		5	
Speed Limit	<25	30	35	40	>45		5	
Traffic Volumes (AADT)	0–5,000	5,001–8,000	8,001–15,000	15,001–18,000	18,000 +		5	
Total Number of Accidents per Segment	0–56	57–112	113–212	213–359	360 +		10	
Night/Day Accident Ratio	<1	1–1.2	1.21–1.5	1.51–2	>2.1		10	
Existing Streetlights per Mile	23.1–84	14.9–23	7.2–14.8	1.51–7.1	0–1.5		10	
Crime Rate Data	0–111	111.1–167	167.1–236	236.1–320	320.1 +		10	
							TOTAL	

This table illustrates the criteria and ranking criteria used by the county to prioritize roadway lighting needs. As shown, each criterion was further subdivided into five ranking classifications (1 through 5) based on potential impact on lighting needs.