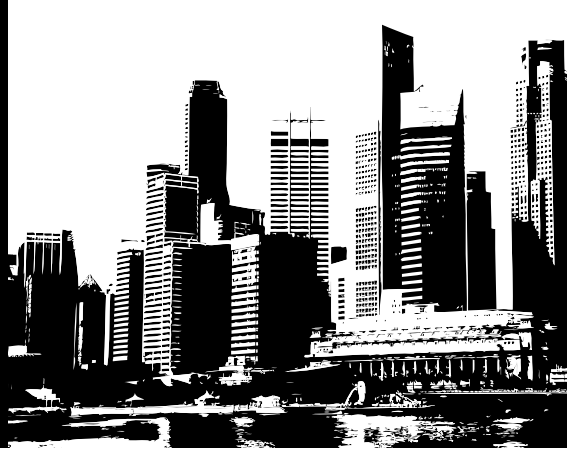
Geography & Public Safety



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On Traffic Safety and Law Enforcement

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Traffic safety education and enforcement are unappreciated and undervalued aspects of modern policing. The vast majority of crashes are caused by driver behavior; yet, these issues are not often given a prominent position in an agency's hierarchy or featured prominently in the image the agency projects to the public. Even a cursory examination of public safety statistics shows its importance:

- The number of traffic crashes in the United States is almost equal to the number of total reported crimes. In 2005, 10.7 million crashes and 11.6 million crimes were reported. (National Safety Council, 2007; Federal Bureau of Investigation, 2006).
- The number of fatalities from drunk driving crashes is almost equal to the number of homicides. In 2006, 15,827 persons were killed in crashes in which one or more drivers had been drinking and 17,034 persons were killed from murder or nonnegligent manslaughter (National Highway Traffic Safety Administration, 2008; Federal Bureau of Investigation, 2006).

Law enforcement officers devote significant time and energy to dealing with traffic safety—from managing crash scenes and filling out crash reports to creating strategies to reduce crash rates. While federal, state, and local governments regularly place their resources in roadway engineering and in emergency services, they devote fewer resources and less time on public outreach to promote traffic safety education and enforcement.

Drunk driving is the most important safety problem for officers to target. In 2006, about 37 percent of all motor vehicle fatalities in the U.S. were caused by crashes in which one or more drivers had been drinking (National Highway Traffic Safety Administration, 2008). Excessive speeding also causes many crashes—close to 30 percent of all motor vehicle fatalities in 2005 were associated with speeding (National Safety Council, 2007). Young drivers are also represented disproportionately in motor vehicle crashes. After these principal safety problems come others including red light running, truck safety, distracted driving, and aggressive driving. Law enforcement plays a critical role in combating these problems, by enforcing traffic safety and supporting other activities to improve safety on the roads.

Geographic information systems (GIS) and other information technologies can help police enforce traffic safety. While police departments have long used GIS for crime mapping, few departments in the United States use it for law enforcement. Articles in this issue of *Geography and Public Safety* discuss how GIS technologies can be used for traffic safety analysis. Tom Beretich discusses how maps have been used to examine drunk driving in Albuquerque, New Mexico, and provides an important example of how well-designed maps can influence public policy. Jeff Kaufman examines a GIS-based spatial information

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system that was developed in Houston, Texas, by the regional transportation planning agency to identify crash hot spots, initiate safety engineering projects, and develop law enforcement strategies. Another article describes how an Idaho center used statistical analysis to advise state patrolling practices, and a technical piece assists GIS users with common tasks.

Law enforcement plays a critical role in supporting traffic safety. I hope that this issue will facilitate law enforcement's and other agencies' interest in focusing analyses on traffic safety issues.

References

Federal Bureau of Investigation. *Crime in the United States, 2006*. Washington, D.C.: Department of Justice, Federal Bureau of Investigation, 2007. www.fbi.gov/ucr/cius2006/data/table_01.html

National Highway Traffic Safety Administration. *Traffic Safety Facts 2006 Data: Alcohol-Impaired Driving.* Washington, D.C.: National Highway Traffic Safety Administration, 2008.

National Safety Council, *Injury Facts: 2007 Edition,* Itasca, Illinois: National Safety Council, 2007, pp. 86–90.

Creating a Safer Houston through Crash Mapping

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Houston, Texas

The Need for Crash Mapping

Traffic safety is often overlooked in the United States. In 2006, police reported nearly 6 million motor vehicle crashes nationwide. These crashes resulted in 2.6 million injuries and more than 40,000 deaths. In addition, 4.2 million crashes resulted in property damage.[1] Each year, motor vehicle crashes kill 2.5 times as many people as murder and nonnegligent manslaughter.[2] These numbers should be considered an epidemic, and it is necessary that researchers investigate why they happen and find ways to remedy the problem.

Federal transportation law requires states to collect data on motor vehicle accidents (crash data) to identify safety problems and determine appropriate solutions.[3] Once those data have been collected, however, researchers often disagree about the most effective way to use the data. For instance, the Houston, Texas, metropolitan area averages approximately 100,000 serious crashes a year. Trying to analyze this quantity of data in a strictly tabular database (such as Microsoft Access) is a daunting task, even for the simplest of queries. But a process called "crash mapping" can make it simpler. By determining geographic locations of crashes (i.e., mapping crashes), the time needed to conduct safety analyses can be reduced from days to minutes.

The Benefits of Crash Mapping

Crash mapping allows officers to visualize where traffic safety improvements are needed. Safety planners, engineers, and police can use mapping to pinpoint locations where crashes occur most frequently and target their efforts to mitigate the problem. With the use of geospatial analysis tools such as CrimeStat[4], researchers can aggregate crashes on a map to identify potential hot spots or larger areas with a high crash incidence.

Road intersections tend to be prime locations for motor vehicle collisions, so identifying intersections with a high crash incidence becomes essential for traffic safety analysts. Mapping crash data and using a geographic information system allow analysts to identify and select crashes that have taken place in a certain intersection. This selection becomes important when analysts work with intersection-related crashes that are recorded not at the intersection of two streets but at a nearby address. A tabular search would fail to identify those crashes.

According to the National Highway Traffic Safety Administration, however, the

overwhelming majority of fatal crashes occur not at the intersection of two roads but somewhere along a roadway, especially on heavily traveled freeways. Entire roadways can be analyzed through a geographic information system. Urban roads, especially those with a large commercial presence, will have multiple access points without any associated traffic control devices. They create many opportunities for crashes because of the high volume of traffic entering and exiting at these points. Using geospatial crash data allows analysts to assess what factors contribute to crashes and examine highway layout.

Safety problems may not be restricted to a single location or stretch of road but may involve an entire neighborhood or commercial district. These hot spots are small areas where crashes are concentrated. Hot spots may indicate a larger problem. A simple geographic information system may not analyze hot spots effectively because it cannot differentiate among multiple crashes that occur at a single location. A program like CrimeStat allows analysts to count and aggregate geographic data and identify those locations.

DUI Hot Spots—Houston Galleria and Adjacent Areas, 1999–2001

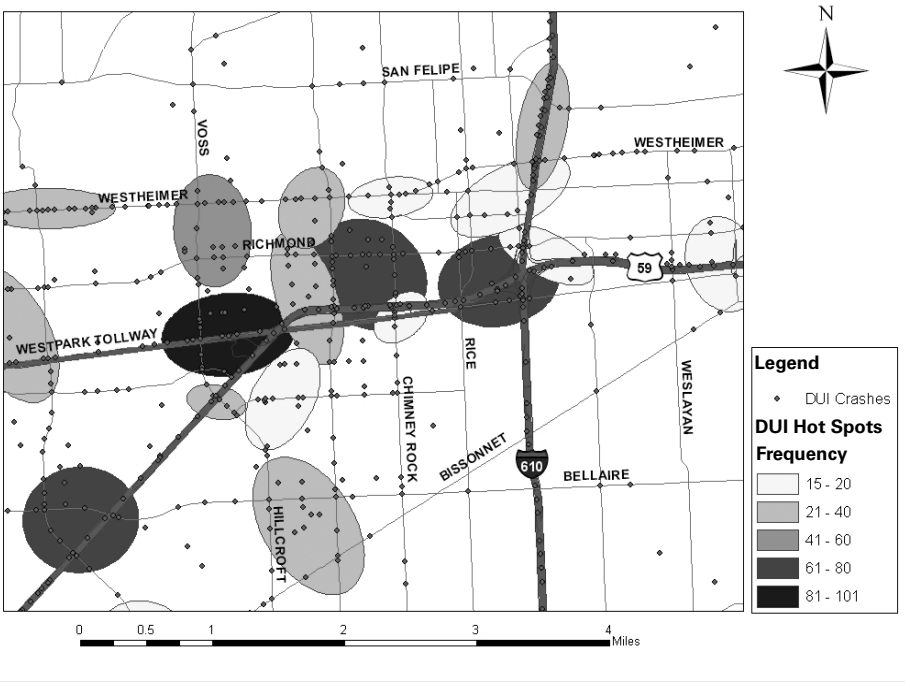

Figure 1: Approximately 420 DUI-related serious crashes occurred in a 3-year period in the area around Houston's Galleria. Many restaurants, sports bars, and adult entertainment establishments in the Galleria area serve alcohol, which may contribute to the high incidence of crashes. The figure shows DUI hot spots generated from an analysis.

The Houston Traffic Safety Program

Transportation planning in the Houston, Texas, metropolitan area is the task of the Houston-Galveston Area Council (H–GAC). The H–GAC began the development of a geographic information system-based crash information system in 2001. Before then, Houston, like other areas in Texas, used a tabular database containing crash records from the Crash Records Bureau of the Texas Department of Public Safety. This tabular system required officers to abbreviate the locations of crashes because of space limitations in the database.

When developing the geographic information system, officers translated these abbreviated location names into identifiable descriptions that could then be geocoded. The effort resulted in an 81 percent geocoding rate for more than 330,000 records between 1998 and 2001. As a result of this geocoding effort, the H–GAC was able to establish a regional traffic safety program to address transportation-related safety issues within its jurisdiction. The program set three goals:

1. **Identify and monitor safety.** At the time of the Houston traffic safety program's conception, little attention was paid to transportation safety issues in the region. The local governments could not identify local safety problems. Although the Texas Department of Transportation (TxDOT) monitored the roads under its jurisdiction, this represented only a fraction of the region's road system. The geocoding effort allowed the H–GAC to work with communities to identify problem locations and analyze causes.

2. **Implement safety improvements at hazardous locations.** Upon identifying locations where crashes frequently occurred, the H–GAC met with local governments and residents to develop solutions, including the following:

   - Conducted preliminary engineering studies of high-accident intersections in Houston, Pasadena, Galveston, and Sugar Land. These studies helped communities review how well intersections were laid out, whether traffic signals functioned properly, how well traffic signs were used, and other intersection issues. The studies also provided suggestions for improvements.
   - Conducted access management studies with TxDOT and communities near roadways where a high incidence of crashes took place. These studies examined issues such as land use, travel speeds, driveway access, turning options, and the functioning of traffic signals. Researchers wanted to find ways to lower the number of locations where crashes might occur.[5]

Red-Light Running Crashes, 1999–2001

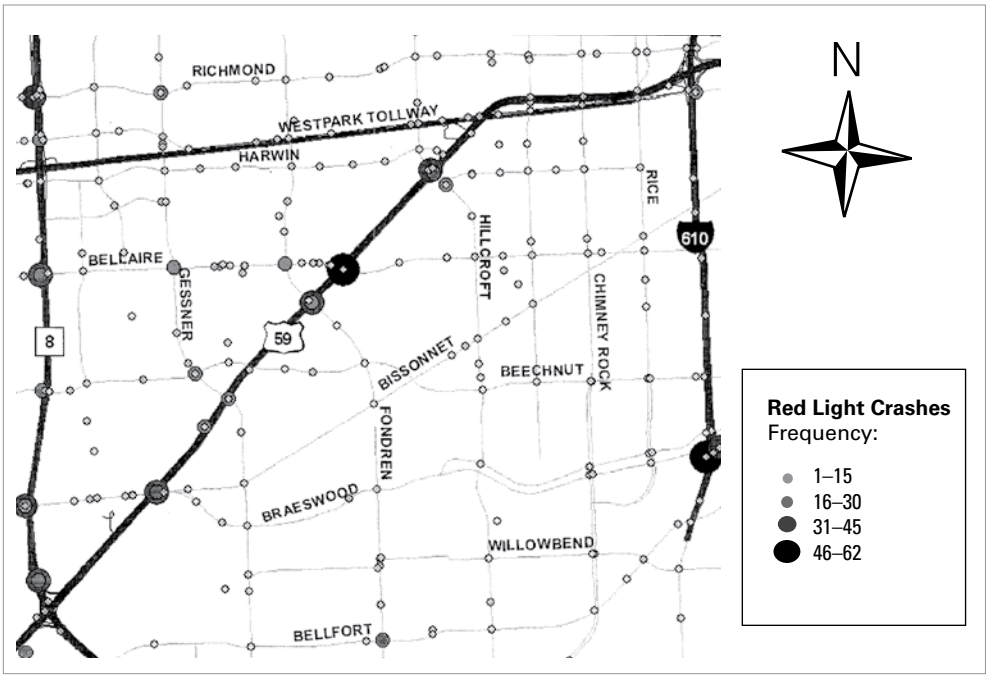

Figure 2. A crash analysis map of locations where drivers commonly run red lights. The Houston Police Department used the map when installing red-light cameras.

- Worked with the Houston Police Department (HPD) to identify locations with a high incidence of red-light running. These studies helped determine the placement of red-light enforcement cameras.

3. **Support other safety efforts.** Many people view traffic safety as a road engineering problem—solutions may focus on roadway design issues such as lane widths or medians, or traffic signal problems (e.g., yellow lights that are timed too short, or a lack of traffic signs to warn drivers.) Crash analysis, however, shows that the majority of crashes have a behavioral component that engineering cannot fix. For instance, the H–GAC's analysis showed the following:

   - 39 percent of crashes in the region were speed related (i.e., involved excessive speed or a failure to control speed).
   - 20 percent of crashes involved a failure to yield.
   - 19 percent of crashes involved running a stop sign or a red light.
   - 21 percent of crashes involved inexperienced teen drivers.
   - 7 percent of crashes involved driving under the influence (DUI).
   - Nearly 50 percent of the region's auto fatalities were due to DUI.

In light of these statistics, officers recognized that a comprehensive approach was needed to combat the traffic safety problem. They realized that this approach should include not only engineers but law enforcement, the medical community, advocacy groups, the trucking sector, bicycle and pedestrian planners, and researchers.

Creating the Houston Regional Safety Council

In February 2006, the H–GAC launched a Regional Safety Council to provide a forum for practitioners to take an interdisciplinary approach to traffic safety issues. Based in part on crash data analysis, the council created five areas of focus and established a subcommittee for each: aggressive driving, reducing DUI crashes, freight safety, bicycle/pedestrian/child safety, and safety information systems. These subcommittees

have developed approaches to help increase traffic safety in Houston.

Examples of these initiatives include the following:

- Develop an urban safety corridor, an approach to improve safety on roadways with a history of significant collisions through low-cost engineering improvements (e.g., lane restriping, traffic signs, traffic signal optimization) and increased traffic enforcement.
- Create a NO–ZONE campaign to inform drivers of blind spots on trucks.
- Create a program to allow drivers to dial *DWI on cell phones to report suspected drunk drivers.
- Start a bilingual commercial driver's license educational outreach program.
- Host two regional safety conferences and develop a statewide conference.

Although these initiatives are still in development, the council's presence has created a critical dialog on traffic safety.

Author's Note

Geographic information systems provide an efficient, visual approach to analyzing traffic safety. Traffic data can be compared with information about high-travel times, roadway configurations, or nearby liquor establishments. Analysts can use this information to target areas for safety projects or identify hazards that lead to certain types of crashes. In addition, the visual displays created by geographic information systems allow decision-makers and the general public to see and understand the problem, giving officers the consent they need to take action.

Currently, Houston is one of only a few metropolitan areas in the United States taking this approach to traffic safety. For more information about the H–GAC's Traffic Safety Program, see: http://www.h-gac.com/trafficsafety.

Notes

[1] National Center for Statistics and Analysis. *Traffic Safety Facts, 2006 Data*. Washington, D.C.: National Highway Transportation Safety Administration, March 2008.

[2] Federal Bureau of Investigation. *Crime in the United States, 2006*. Washington, D.C.: Federal Bureau of Investigation, September 2007.

[3] Highway Safety Improvement Program (HSIP), 23 U.S.C. § 148.

[4] Ned Levine & Associates. *CrimeStat: A Spatial Statistics Program for the Analysis of Crime Incident Locations* (v 3, 1). Houston, Texas: Ned Levine & Associates; Washington, D.C.: National Institute of Justice, March 2007.

[5] Solutions may include eliminating multiple driveways that lead to a property, constructing medians, and preventing left turns at certain locations.

[6] Houston-Galveston Area Council. *State of Safety in the Region: Report of the Regional Safety Council 2007*. Houston, Texas: Houston-Galveston Area Council, February 2007.

Mapping Programs Target Alcohol-Impaired Driving

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Motor vehicle accidents continue to be the leading cause of death for Americans between ages 1 and 44, and alcohol plays a large role in many of these fatalities.[1] In 2005, 39 percent of all motor vehicle fatalities were alcohol related, making impaired driving the most frequently committed violent crime in the United States.[2]

Stopping drunk driving requires a community policing effort with local solutions and cooperation among many community members, including law enforcement, public officials, liquor compliance agencies, judges, and community activists. Many metropolitan law enforcement agencies designate personnel to address impaired driving, and most urban agencies have used geospatial analysis tools for crime mapping, but few agencies of any size are applying geographical principles to preventing driving while intoxicated (DWI). Providing local law enforcement agencies with visual tools to identify and analyze DWI hot spots can help agencies allocate resources and significantly influence traffic safety policy decisions.

Using Crime Mapping As a Public Awareness Tool

The DWI Resource Center in Albuquerque, New Mexico, was formed to reduce the social and economic impact of drunk driving through research, public awareness, education, and prevention programs. In November 2005, the center conducted a survey of Albuquerque neighborhood associations to determine the general public's awareness of local DWI issues. The survey results were surprising—most citizens identified DWI as a significant problem in Albuquerque, but few believed it was a problem in their own neighborhood.

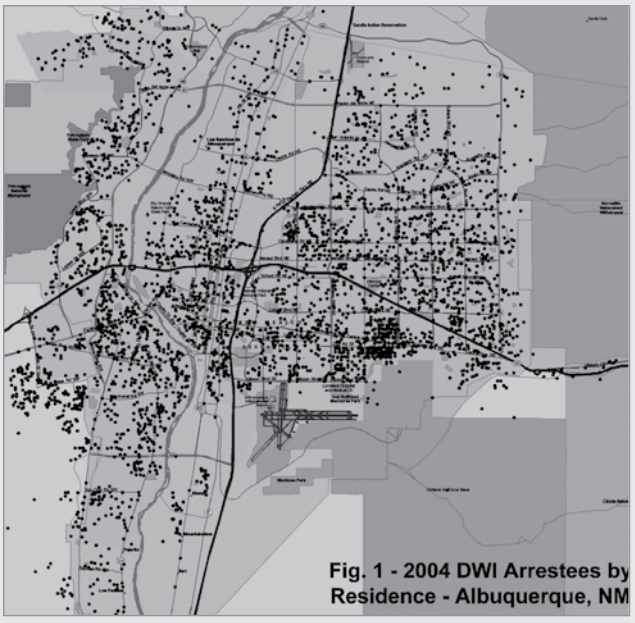
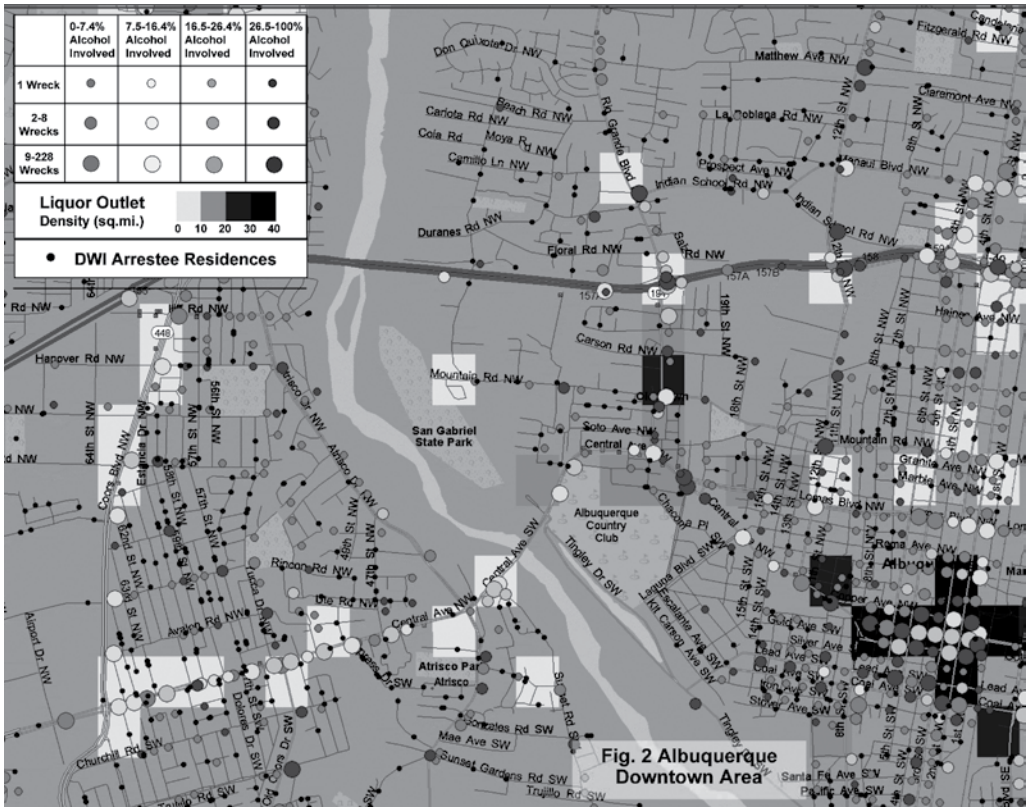


Fig. 1 - 2004 DWI Arrestees by Residence - Albuquerque, NM



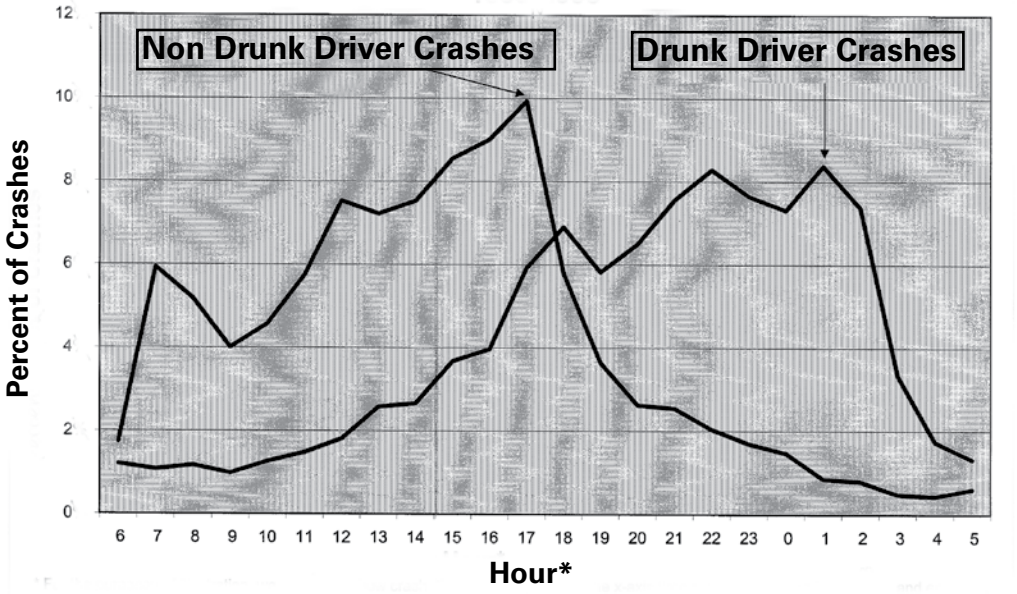
To counter inaccurate public perceptions, the center created a series of maps that showed the location of alcohol-involved crashes, liquor outlets, and where DWI offenders reside in each neighborhood (Figures 1 and 2). The maps caught the attention of both citizens and the media and changed public awareness. As a result, the center began to develop maps for local law enforcement agencies and public policy planners to use as decision-making tools. The center surveyed agencies to understand the best way to develop the maps and learned the following:

- Tools should help agencies deploy their limited law enforcement resources more efficiently.
- Officers need data to support their street knowledge.
- Agencies must follow guidelines (*City of Las Cruces* v. *Betancourt*) when determining locations of sobriety checkpoints.[3]

Resource Center Advances Mapmaking Methods

Traditional maps had limitations. Most either showed alcohol-related crash fatalities or DWI crash locations. These maps were statistically limited, and did not consider alternative factors that may have contributed to crash rates, such as traffic volume or road conditions. The center's new maps examined DWI hot spots relative to overall accident hot spots and highlighted how alcohol-involved crashes at different intersections contributed to total crash volume. Additionally, the size and shape of the distribution curve (see Figure 3) for alcohol-involved crashes differed significantly from that of total crashes during a 24-hour period. The maps charted crashes that occurred between 7 p.m. and 5:59 a.m., when 64 percent of alcohol-involved crashes occur.[4]

Figure 3. Hourly Distributions of Crashes—Bernalillo County 1998–2005.



*For the purpose of illustration ,we chose to show crash distributions by shifting the x-axis time scale and starting from 6:00 a.m. and ending at 5:59 a.m. the next day. This reflects actual driving schedules more closely than a simple 0–23 hourly time scale.

Crash data on the map were color coded. Green represented a low percentage of alcohol-involved crashes as a percentage of total crashes; yellow, a low-to-medium percentage of alcohol-involved crashes; orange, a medium-to-high percentage of alcohol-involved crashes, and red represented a high percentage of alcohol-involved crashes as a percentage of total crashes. In addition to the color scheme, the maps identified intersections with small, medium, and large numbers of crashes, illustrated by increasing dot size. Maps also showed licensed liquor outlets by both density and location. During the mapping process, the center's staff noticed a visual correlation between DWI crashes at hot spot intersections and clusters of DWI offenders living near those hot spots. For this reason, they began to include offender residences on the map.

Are the Maps Useful?

The DWI crash maps served as an effective tool for law enforcement agencies and public policy planners. Feedback from law enforcement agencies shows that they use the maps to more effectively deploy limited personnel resources. Law enforcement agencies in Bernalillo, McKinley, and Rio Arriba Counties in New Mexico reported positive results when they deployed personnel to map locations with high numbers of alcohol-involved crashes, residences of DWI offenders, and liquor outlet clusters. Although these deployment strategies are not new, the ability to visualize these variables coherently and concurrently on a single map has allowed law enforcement to make decisions much more rapidly. As a result, the DWI Resource Center, funded under a grant from the Office of Community Oriented Policing Services (the COPS Office), will build a web-based resource deployment tool. The tool will provide options for law enforcement shifts at priority locations throughout the day, taking into account staff numbers and work hours. In addition, the web-based tool will create color-coded maps, updated by the hour to display crash probabilities.

The center's crash maps have also assisted law enforcement agencies in court by providing documentation that locations selected for sobriety checkpoints meet the standard established in the New Mexico Supreme Court decision *City of Las Cruces* v. *Betancourt*.[5] The ruling establishes eight guidelines to determine the "reasonableness" of a checkpoint, including location and time, two data points provided by the center's maps.[6] Because the center's maps are based on data provided through the New Mexico Traffic Safety Bureau, the court views the data as reliable and officers are better equipped to justify both the location and time of sobriety checkpoints.

Implications for Public Policy

The DWI crash maps have significant public policy implications. For example, when the center furnished the city of Albuquerque's mayor's office with maps illustrating the top five intersections in the city where DWI-related deaths and property damage occur, the mayor's office was able to refine its resource allocation strategy. The strategy included potential public safety infrastructure investments at each intersection, including speed cameras, traffic

controls, and possible public transportation improvements. The city also launched a public awareness campaign to notify businesses and schools within a 1-mile radius of these high-crash intersections.

The crash maps also helped citizens and policymakers in liquor license hearings illustrate how a proposed new license may affect alcohol-involved crashes in the area. Maps gave policymakers a visual representation of the correlation between alcohol-involved crashes and liquor outlet density throughout the city, and allowed them to weigh public safety concerns against business interests. In at least one hearing, the map presentation strongly influenced the denial of a liquor license transfer.

The center learned several valuable lessons while creating DWI crash maps. Law enforcement agencies value data integrity and analytical precision, so the center chose not to overly modify data that went into the final product. The data points on the map primarily represent the latitude and longitude values where crashes occurred. Advanced statistical techniques and measures could have provided information about hot spots and other areas of interest to law enforcement, but the center chose to allow law enforcement agencies to make their own inferences and deployment decisions based on their visual interpretation of the maps.

Portraying data in this manner allows the map user to make decisions by drawing on personal and group experience—variables that cannot be accounted for with statistical techniques. For example, law enforcement officers might be aware of secondary "escape" routes or side roads in residential areas that impaired drivers used to avoid officers or sobriety checkpoints.

Conclusion

Crash maps help facilitate deployment decisions without providing so much statistical information that officers would find them difficult to use. They allow officers to use their experience to interpret the maps and create solutions. In New Mexico, these maps have helped law enforcement and policymakers craft data-based solutions to reduce DWI deaths and injuries.

The COPS Office is funding the development of a web-based application to help police fight drunk driving in New Mexico.[7] This application will be used in conjunction with the center's crash maps. It will allow users to analyze DWI data most vital to their needs, providing a list of dangerous intersections or road segments based on the parameters they input into the application. These mapping technologies have long-term, significant public policy implications for stopping drunk driving in communities nationwide.

For more information about the DWI Resource Center, see http://www.dwiresourcecenter.org/.

Notes

[1]U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, *National Vital Statistic Reports*, Vol. 54, No. 19, June 28, 2006. This is the most recent year for which data are available.

[2]National Highway Traffic Safety Administration, *Traffic Safety Facts: Laws*, DOT HS 810 721W, February 2007.

[3]These checkpoints were established by a New Mexico Supreme Court decision (*City of Las Cruces* v. *Betancourt*, 105 N.M. 655, 735 P.2d 1161 (1987).

[4]For the area and years in question, 5.6 percent of all crashes involved alcohol.

[5]105 N.M. 655, 735 P.2d 1161 (1987).

[6]Ibid.

[7]For more information, see the related article on the Operational Deployment and Reporting Application.

COPS Office Funds a Web-Based Application to Examine Drunk Driving

Community policing efforts can help reduce car crashes that happen because of drunk driving. In an effort to prevent alcohol-related traffic fatalities, the Office of Community Oriented Policing Services is funding the development of a web-based application that law enforcement agencies and public officials can use to examine local incidents of drunk driving.

The application, called the Operational Deployment and Reporting Application (ODRA), will provide analysis of driving while intoxicated (DWI) data specific to the needs of individual stakeholders and local jurisdictions. Users can select parameters—including the jurisdiction and the date and time of crashes—and ODRA will create a list of the most

dangerous intersections and road segments in the jurisdiction, ranked by the number of alcohol-involved crashes. Officers can use the application to find DWI hot spots, which will help them develop tactics and deploy resources to stop drunk drivers before they cause crashes.

Initially, ODRA will be developed and tested in New Mexico. The source code and application will be free and available online when testing is complete.

Creating Base Maps and Layer Files for Cartographic Consistency

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Crime analysts create maps that focus on a specific problem. An analyst's goal in creating a map should be to show how the data that matter to the audience are significant. He or she accomplishes this by establishing cartographic standards that officers can follow to understand the geographic elements of the problem in question.

As time passes, data will change. Consequently, a geographic representation of the problem will change. The way the problem is represented should be consistent. This article will discuss how to create consistent standards when making a map. It includes instructions for creating layer files, describes base map production, and provides useful tips for making maps.

Before Creating a Map

Analysts must carefully think about how to construct a map before beginning the process. Requests may come from inexperienced clients who are unsure what they are asking for and how to ask for what they want. Analysts should be able to clear up any misconceptions so the clients get what they want or understand what is possible.

Analysts may wish work with a client to develop the map's mission statement. To accomplish this, they should consider the following:

- **The audience.** Will this map be shown to the public?
- **The decisions the map will influence.** Will this map support short-term decisions or long-term goals?
- **The data at the analyst's disposal.** Will aerial photography, building outlines, or census data enhance the product or distract the viewer?
- **The data the analyst has not yet gathered.** Supporting data should be collected and made a constant for each specific problem. For example, knowing streetlight locations will affect an officer's understanding of night vehicle burglaries.

Take into account what the map should accomplish and construct a solid statement that clearly communicates this. List the data used and dates when the crime took place. Send the statement to the client for verification.

Developing a Base Map

If an analyst takes the time to develop a clear base map, it will reduce the time it takes to create related maps in the future. A base map contains crucial information that allows a map's user to immediately identify geographic regions within a city.

A clear base map will have subdued coloration (color choices), to emphasize the incidents or focus of the map. An analyst should test the base map's appearance in grayscale. The analyst should match the audience's mental map as much as possible and think about the cartographic representation of main transportation routes and landmarks. Landmarks should include school parcels,[1] parks, stations, substations, and other government facilities. Parcels, building outlines, and light poles may be useful to display on large-scale maps for tactical planning.

Frequently, analysts will support tactical operations that focus on a problem in a small area. The base map document should utilize scale levels (for example, the area and level of detail displayed on a map, the zoom level). This can help determine on which scale certain layers will be visible and which predefined labels show. It reduces production time if, when analysts zoom to the focus on a certain part of the map, they know that the base map will turn layers off and on and label accordingly. A region's size may vary, but four or five scale levels should be able to clearly facilitate the needs of most requests. See Figures 1, 2, and 3.

Scale Levels with Base Maps

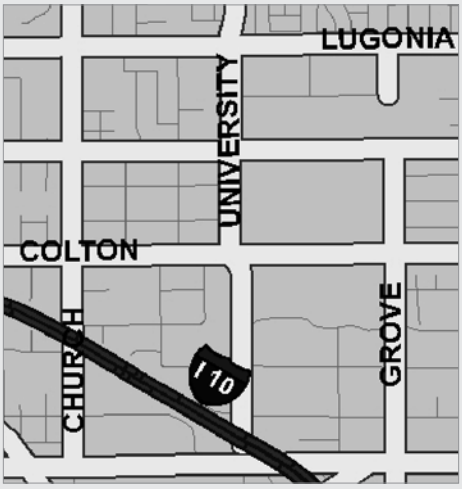

Figure 1.1:40000 scale. Major streets are larger and labeled. Smaller streets are subdued and not labeled.

Figure 2. 1:50000 scale. All streets are labeled and symbolized equally. Building outlines and parcels are visible. Address numbers are labeled.

Figure 3. Scale ranges can be set in the mapping program ArcMap[2] by right-clicking the layer and selecting "Visible Scale Range." Zoom in to the point where symbols in the layer should become invisible if the map's user zooms farther, and select "Set Maximum Scale."

Using Layer Files

Layer files are files that enable crime analysts to save a query without filling a computer's hard drive with shapefiles (for example, files that contain the GIS-linked database information about crime and public safety incidents in an area). Problems often arise when analysts query the master incident data source (the complete database) and then export the relevant data, making these data a separate shapefile mapped with separate symbols on the resulting map. This causes three problems that can be averted by creating layer files in ArcMap:

Problem 1. For every map project, an analyst creates a backlog of files that must be supported and sustained. Depending on the map document and the request, this could result in 5 or 10 extra megabytes of data that must be stored and rarely retrieved. Considering that most analysts fill multiple requests daily, this can fill their hard drives in a short time. Hard drive cleaning can be a tricky process because it can be difficult to tell which data are vitally important.

Problem 2. An analyst can squeeze only a small amount of information into a file name. Complex queries involving date, time, offense type, geography, and a host of other variables can not be documented easily within a file name. Referencing shapefiles from previous maps and queries introduces uncertainty into the product.

Problem 3. Incident databases change. New streets require new geocoding. Records departments recode offense types. Reports may take longer to arrive into the incident database than the previous query allowed. A shapefile exported from the master incident database does not account for retroactive changes to the main incident database.

Layer files in ArcMap (.lyr) are small in size (less than 20 kilobytes) and serve as a combination of a saved query, the symbols used to denote incidents on the map (the symbology), and the label classification (for example, zoom level, font type). A layer file references a master incident data source by the stored query. Each query can be changed to include different types of crime or different dates and times when crime was committed.

By referencing the master incident data source, the layer file acts as a dynamic query[3] that will allow for naturally occurring changes in the data source. For instance, say an officer wants to know where traffic accidents occurred in September. If after creating the query, the master incident data source is updated to

include extra incidents, the layer file acts as a dynamic query and can incorporate the new data into the resulting map.

Analysts can find information about the initial query and the data source being referenced under the layer's properties tab. Checking these parameters removes the guesswork involved in saving and sharing layer files within a crime analysis unit. Analysts should use consistent symbologies (symbols) when creating maps, so that officers can quickly understand the problems displayed.

Creating Layer Files for Hot Spot Data

Spatial Analyst, an extension of the Environmental Systems Research Institute's[4] ArcGIS software, produces a Kernel density estimation (KDE) raster file, a spatial analysis technique that groups crime incidents and shows crime hot spots. When creating layer files, a crime analysis unit must establish standards for the KDE's search radius and grid cell size, or the result is visual ambiguity. Hot spots will vary too much in size and density value when different search radii are used.[5]

The symbology of this raster file is often created by using a classified schema, a program function that will automatically produce color values. These color values are classified using a statistical model, known as natural (Jenks) breaks.[6] The areas of higher crime density are automatically colored with a darker hue and an analyst typically displays the crime hot spots illustrated by the natural breaks model. This process helps show where certain incidents are occurring in higher density at a given time, but does not allow analysts to consistently symbolize incident densities from two different time periods.

For example, assume that in September, a total of 62 vehicle crimes took place in a given area, while in October, 44 crimes occurred in the same area. Fifteen vehicle crimes occurred on a single street in September, whereas in October, nine vehicle crimes occurred in a single parking lot. Using the values given automatically from the natural (Jenks) breaks for both densities, the analyst might depict the hot spots as equally dense from September to October. The officer, seeing the darkest hue of the hot spot, thinks that the parking lot in October is just as bad as the street in September.

To create a map that can compare data from different time periods, follow these steps:

- Pick the KDE raster that will give the highest density values. For example, if September has the highest number of vehicle crimes, use September's density raster.
- Use the automatic natural breaks to separate the highest-value density. Make sure the lowest density values will not symbolize single crime events, and add a higher range of values to allow for time periods that may have higher densities of crime. Save the layer file.
- Use this layer file as a standard for creating other density rasters of the same crime type and time period (for example, monthly vehicle crimes). Import this layer file into maps made from other density rasters.

Conclusion

Producing consistent cartographic products will allow a map's user to develop familiarity with the way information is portrayed. Using layer files and base maps not only ensures that information is portrayed consistently, but saves valuable production time.

Notes

[1]Consider displaying the 1,000-ft. buffer of schools, depending on laws regarding enhancing drug charges near schools.

[2]ArcMap is a component of Environmental Systems Research Institute's Geographic Information System software.

[3]A layer file acts as a dynamic query if an analyst creates a definition query for the layer file (using the properties tab).

[4]See the Environmental Systems Research Institute web site: www.esri.com.

[5]See www.eastvalleycompass.org/radiustest.html to learn how about different types of displays for search radius sizes.

[6]"Natural (Jenks) breaks" is a statistical model for determining the best arrangement of values into classes.

Idaho's Statistical Analysis Center Helps State Police Solve Personnel Allocation Problem

Janeena Wing
Idaho State Police
Meridian, Idaho

When the Idaho State Police needed to know how many troopers should patrol state roads, the Idaho Statistical Analysis Center (ISAC) used geographic mapping technologies and collaborative data to answer the question.

Statistical Analysis Centers (SAC) collect and distribute criminal justice data and research and evaluate statewide policy issues. The U.S. Bureau of Justice Statistics offers grant funds to encourage SACs to analyze topics of concern, such as human trafficking, cybercrime, domestic violence, and emerging drug trends. Many SACs also help maintain national data sets, including National Incident-Based Reporting System (NIBRS) data and state crime victimization research.

Currently, 53 states and territories have SACs. Each state's governor decides where to locate the SAC. The governor may choose to place the SAC in the governor's office, the state highway patrol, the state department of corrections, or a university.

The Idaho Statistical Analysis Center

Since its inception in 1978, the ISAC has been housed in the Idaho Department of Law Enforcement, which became the Idaho State Police in July 2000. ISAC provides statistical support, data analysis, program planning, evaluation research, and technical support to local, state, and national criminal justice agencies.

ISAC is currently working on several projects, including evaluations of B/JAG[1] and STOP[2] grant programs, a state victimization study, and projects that analyze NIBRS data to gain a better understanding of Idaho crime trends.

Patrolling Idaho's Interstates and Highways—How Many Troopers Are Needed?

The Idaho State Police wanted to determine how many troopers would be needed if a trooper were to pass every mile of the state's interstates and highways once a day. They also wanted to know the number of troopers needed to provide adequate coverage for calls for service and interagency assistance in each region of the state. To answer the Idaho State Police's questions, ISAC began a police allocation study in March 2007.

ISAC collected information on state and federal roadways in Idaho from a variety of sources, including the following:

- Idaho Department of Transportation data on crashes and average traffic for each milepost for 2004 through 2006.
- Idaho State Police computer-aided dispatch system information on calls for service for each milepost for 2004 through 2006.

ISAC used the information to categorize roads by frequency of traffic, crashes, and calls for service, using three tiers (high [1], medium [2], and low [3]). Data were analyzed using Statistical Package for the Social Sciences software, then plotted geographically using Geographic Information Systems software, as shown in Figure 1.

The ISAC analysis determined that Tier 1 roads needed a trooper to pass by each milepost once every 4 to 6 hours. Tier 2 roads needed a trooper to pass by each milepost every 8 to 12 hours. Tier 3 roads needed a trooper to pass by each milepost once every 24 hours.

After establishing the number of times troopers needed to travel between distant points, ISAC estimated the average patrol speed possible through all rural and urban areas. The geography of each area played an important role in understanding how fast a trooper could travel between distant points on Idaho roadways—rural roads might wind through

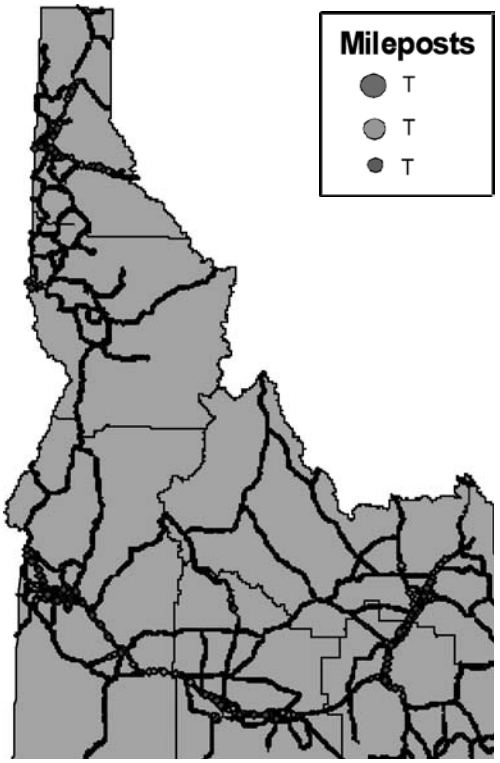

Figure 1: Tiered Mileposts on State and Federal Roads in Idaho.

narrow river canyons and high mountain passes, and officers on urban roads might encounter heavy traffic. ISAC calculated the optimum average speed for each milepost and determined the best possible routes troopers could take to ensure that all mileposts were passed at least once a day.

Based on geography and traffic flow, Tier 1 roads had an average patrol speed of 10 miles per hour, Tier 2 roads had an average patrol speed of approximately 35 miles per hour, and Tier 3 roads had an average patrol speed of 55 miles per hour.

A mathematical equation incorporating average patrol speeds and the number of patrols per day allowed ISAC to determine how many troopers were needed to patrol each mile of freeway. Figure 2 shows this equation, which was developed by Northwestern University.

$$N = \frac{HM \times HC}{7 \times PS \times SH \times PI}$$

N = Number of Troopers
HM = Highway Miles
HC = Hours of Coverage Per Week
PS = Average Patrol Speed (includes stationary patrol
SH = Shift Length
PI = Performance Objective Patrol Interval

Figure 2: Equation to Determine the Number of Troopers Needed per Highway Mile.

Using this equation, ISAC estimated that the Idaho State Police would need to hire 88 additional troopers. Idaho would then have 231 state troopers, up from the 143 mandated by the state legislature.

Conclusion

State SACs actively work to establish national and state networking relationships and research partnerships. The Idaho study was possible because of the collaborative opportunities available to ISAC. Combining criminal justice data sets with geographic mapping systems can provide meaningful research that effectively influences policy and practice.

The Edward Byrne Memorial Justice Assistance Grant (JAG) Program (42 U.S.C. 3751 (a)) is the primary provider of federal criminal justice funding to state and local jurisdictions. JAG funds support all components of the criminal justice system, including multijurisdictional drug and gang task forces; crime-prevention and domestic violence programs; and courts, corrections, treatment, and justice information sharing initiatives.

The Services, Training, Officers and Prosecutors (STOP) Violence Against Women formula grant program provides federal financial assistance to states to develop and strengthen law enforcement activities, prosecution strategies, and victim services in cases involving violent crimes against women.

Notes

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NEWS BRIEFS

Web Site Maps Crime and Public Safety Information in Chicago, New York, and San Francisco

If Chicago residents want to know what neighborhoods are safe to stroll in at night, they may want to check out everyblock.com. The web site, launched in January 2008, provides city maps that track crime incidents and neighborhood safety information, including restaurant inspections and liquor licenses. This information is free for use by officers, city officials, and the general public. Everyblock.com expands on the concept of chicagocrime.org, providing crime and public safety information for Chicago, San Francisco, and New York City.

The idea for such "mashup" sites began in 2005, when a number of web developers customized Google Maps to include other types of information. At this time, a programmer named Adrian Holovaty designed chicagocrime.org, a site that fused map data with crime data from the Chicago Police Department. Users could find where crime occurred and search for specific locations or types of incidents. In January 2008, Holovaty replaced the chicagocrime.org site with everyblock.com. The new site has an improved crime mapping interface and provides information that includes building code violations, graffiti cleanup, restaurant inspections, and more.

Holovaty's chicagocrime.org has inspired numerous other mashup web sites that provide crime data and public safety information. Some of these sites also provide information about traffic incidents and construction, which allows motorists to plan their daily commutes. For example, a site called DalTrans provides information about traffic, construction, and accidents in and around Dallas. Another site, CrashStat, maps dangerous intersections in New York City. This information can help city officials decide where and when to change traffic patterns or erect signs.

Mashup sites have proliferated, partly because of how easily they can be developed. Police departments now often use mashups to make crime information available to the public.

For more information, see www.everyblock.com, www.crashstat.org, and http://dfwtraffic.dot.state.tx.us/dfwweb/.

Police Departments Partner With Crime Mapping Web Site

Public Engines, Inc., has integrated Google Maps into its crimereports.com site, which creates maps of crime incident data from participating jurisdictions and makes them available to the public. So far, 40 police jurisdictions have partnered with Public Engines, Inc. The web site provides police departments with an easy-to-use web service for publishing and sharing crime data. Maps are available at www.crimereports.com.

Intelligent Communication Systems Target Road Hazards and Bad Weather

Intelligent technology can warn drivers of hazards on the road. A consortium of European automotive companies, public authorities, and research institutes are working together to develop an intelligent transportation system that tells drivers where hazards may occur and increases their spatial awareness of the roads on which they are driving.

The system will use global positioning systems technology, wireless communication systems, and sensors to warn drivers about hazards outside their field of vision. Collaborators hope it can help reduce the risk of automobile collisions and stop multivehicle pileups.

For more information, see www.prevent-ip.org.

Boston Police Change Protocol for Handling 911 Calls

When someone calls 911 and requests help, officers may find that more than one location on their maps match a given address because streets in different parts of the city have the same name. To help deal with the problem, Boston police officers have begun sending officers to all locations that come up as matches. This helps them prevent mix-ups and ensures that all calls receive a prompt response.

Cell Phones Help Detectives Locate Crime Suspects and Victims

On June 5, 1998, Denise Murray's daughter Stephanie was impaled with a metal rod on Interstate 95 in southern Florida. Her daughter survived the incident, but emergency dispatchers had to ask for her location 23 times before they were able to locate her.

Today, global positioning system tracking technology is commonly available on cell phones, a feature that would have made it possible for Florida officers to track Murray's location more quickly. This technology can also be used by law enforcement to track criminals in investigations or find missing persons.

For more information, see http://www.topix.com/content/trb/2008/03/cell-phones-become-tools-for-helping-detectives-find-crime-suspects.

Resources: Traffic Safety and Law Enforcement

Major Safety Organizations

National Highway Traffic Safety Administration, Traffic Safety Program
Documents fatalities and injuries and addresses behavioral and educational aspects of traffic safety. Issues include child passenger safety, seat belt use, impaired driving, teenage drivers, motorcycle safety, and new drivers. http://www.nhtsa.dot.gov/portal/site/nhtsa/menuitem.5928da45f995923816010 31046108a0c.

Federal Highway Administration, Safety Division
Funds programs on intersection safety, roadway safety, pedestrians, bicyclists, child safety (safe routes to school), older drivers, and many other issues. http://safety.fhwa.dot.gov.

National Safety Council
Nonprofit organization that compiles annual statistics on motor vehicle safety and constructs annual estimates of the cost of motor vehicle fatalities, injuries, and property damage. It produces an annual report called *Injury Facts*. http://www.nsc.org.

American Association of State Highway and Transportation Officials, Standing Committee on Highway Traffic Safety
Nonprofit organization that is involved in setting national roadway safety engineering standards, which are accepted by most states. http://www.transportation.org/?siteid=35&pageid=2331.

Transportation Research Board
Part of the National Academies of Science, the board sponsors many studies on traffic safety. http://www.trb.org.

AAA Foundation for Traffic Safety
Nonprofit organization that produces reports on various aspects of safety including child safety, bicycle safety, driver education, young drivers, aggressive driving, safety 'culture,' and many other topics. http://www.aaafoundation.org.

Governors Highway Safety Administration
Nonprofit organization that represents the highway safety offices. It produces publications on various policy-oriented safety topics including community guidebooks and countermeasures that work. http://www.ghsa.org.

Insurance Institute for Highway Safety
Nonprofit organization that conducts studies for the insurance industry including crashworthiness, red-light running, impaired driving, motorcycle safety, and teenage drivers. http://www.iihs.org.

International Association of Chiefs of Police, Traffic Safety Management Program
The IACP technology clearinghouse has many publications dealing with traffic safety including red-light running enforcement, road safety audits, work zone safety, and other topics. http://www.iacptechnology.org/TrafficSafety.html.

Most states have offices that specialize in safety. The offices are located either in the state police or in the state's transportation department (or both). See the URL for the individual state.

Major Publications Relevant for Traffic Safety Best Practices

AECOM Consulting Transportation Group, Bellomo-McGee, and Ned Levine & Associates. *Considering Safety in the Transportation Planning Process*. Washington, D.C.: Federal Highway Administration, U.S. Department of Transportation, 2002. http://tmip.fhwa.dot.gov/clearinghouse/docs/safety/.

Federal Highway Administration
Highway-Railroad Grade Crossing. Washington, D.C.: FHWA Safety Division, U.S. Department of Transportation, 2006. http://safety.fhwa.dot.gov/xings/index.htm

Federal Motor Carrier Safety Administration
Report to Congress on the Large Truck Crash Causation Study. MC-R/MC-RIA. Washington, D.C.: March 2006.

International Association of Chiefs of Police
IACP Technology Clearinghouse. Alexandria, Virginia: International Association of Chiefs of Police, 2006. http://www.iacptechnology.org/TrafficSafety.html.

National Cooperative Highway Research Program
Crash Records Systems: A Synthesis of Highway Practice. Washington, D.C.: NCHRP Synthesis 350, Transportation Research Board, 2005 http://www.trb.org/news/blurb_detail.asp?id=5840.

National Cooperative Highway Research Program
Guide for Reducing Aggressive Driving Collisions. 2003. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_500v1.pdf.

National Highway Traffic Safety Administration
Strategies for Aggressive Driver Enforcement. 2001.
http://www.nhtsa.dot.gov/people/injury/enforce/aggressdrivers/toc.html.

National Highway Traffic Safety Administration
Studies on Aggressive Driving. Multiple years.
http://www.nhtsa.dot.gov/people/injury/enforce/aggredriver.html.

National Highway Traffic Safety Administration.
National Survey of Speeding and Other Unsafe Driving Actions:
Volume I: Methodology.
Volume II: Driver Attitudes & Behavior.
Volume III: Countermeasures.
Washington, D.C.: National Highway Traffic Safety Administration,
U.S. Department of Transportation, 1998.
http://www.nhtsa.dot.gov/people/injury/aggressive/unsafe/

National Highway Traffic Safety Administration
Initiatives to Address Impaired Driving. December 2003.
http://trb.org/news/blurb_detail.asp?id=2163.

National Highway Traffic Safety Administration
4313FA Crash Outcome Data Evaluation System (CODES). Washington, D.C.: National Highway Traffic Safety Administration, U. S. Department of Transportation, 1997.

Case Studies of GIS-Based Traffic Safety Information Systems

1. Houston-Galveston Area Council traffic safety planning program. http://www.h-gac.com/taq/planning/default.aspx.
2. Southeast Michigan Council of Governments traffic safety planning program. http://www.semcog.org/Safety.aspx.

Crime News Events 2008

Dealing with crime problems in a local law enforcement agency sometimes means reaching out to other local agencies (e.g., city planning) to come up with a solution. The events listed here are good opportunities to learn what mapping professionals and those in related areas are doing, get new ideas, and present your work.

NIJ Conference 2008
July 21–23, 2008 in Washington, D.C.
http://www.ojp.usdoj.gov/nij/events/nij_conference/welcome.htm

GeoWeb 2008 Conference
July 21–25, 2008 in Vancouver, B.C., Canada
http://www.geoweb.org/

2008 ESRI International User Conference
August 4–8, 2008 in San Diego, California
http://www.esri.com/events/uc/index.html

NSGIC 2008 Annual Conference
September 7–11, 2008 in Keystone, Colorado
http://www.nsgic.org/events/2008_conference.cfm

GIScience 2008
September 23–26, 2008 in Park City, Utah
http://www.giscience.org/

2008 California Crime and Intelligence Analysts Association Training Conference
September 23–26, 2008 in Pleasanton, California
http://www.baciaa.org/2008ConferencePage.htm

Urban and Regional Information Systems Association (URISA) 46th Annual Conference
October 7–10, 2008 in New Orleans, Louisiana
http://www.urisa.org/conferences/aboutannual

24th Annual New York State GIS Conference
October 6–7, 2008 in Liverpool, New York
http://www.esf.edu/nysgisconf/default.htm

2008 IACA/FCIAA Conference
October 13–16, 2008 in St. Pete Beach, Florida
http://www.iaca.net/Conference2008.asp

Applied Geography Conference
October 15–18, 2008 in Wilmington, Delaware
http://appliedgeog.binghamton.edu/

Tenth Crime Mapping Research Conference
August 2009 in New Orleans, Louisiana
http://www.ojp.usdoj.gov/nij/maps/

The NIJ Conference 2008

July 21–23, 2008
Crystal Gateway Marriott
Arlington, Virginia

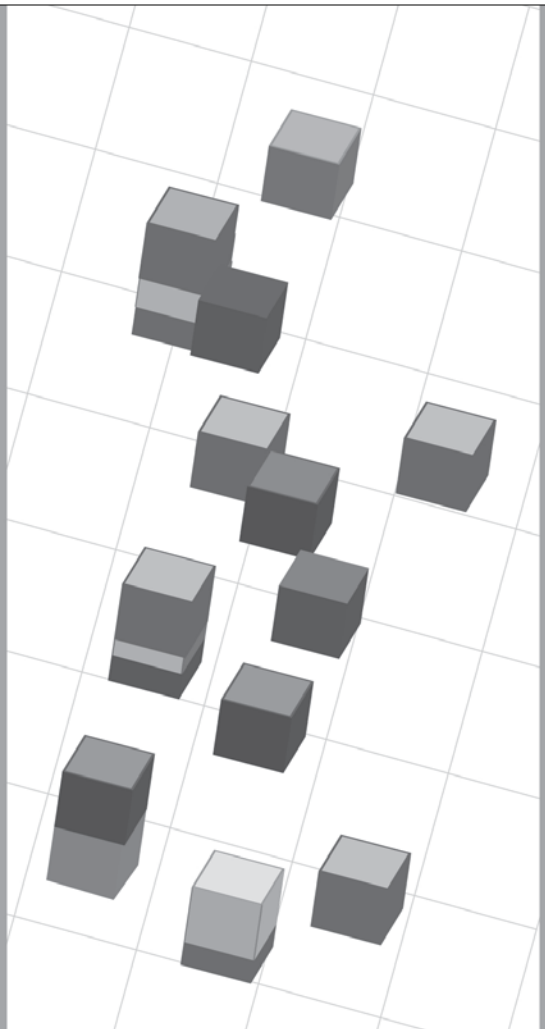
For more information, visit
www.ojp.usdoj.gov/nij/2008.htm

Featuring the plenary panel
"Making Smarter Decisions:
Connecting Crime Mapping with City Officials"

Mapping & Analysis for Public Safety (MAPS)

The Tenth Crime Mapping Research Conference:

Solving Problems With Geography and Technology



August 2009

Sheraton New Orleans Hotel

National Institute of Justice
The Tenth
Crime Mapping Research Conference

COPS Grant Information at your fingertips

The COPS Office Response Center provides information on the following:

- COPS Grants
- Grant Applications
- Grant Management
- COPS Online, passwords, financial status reports, etc.
- Community policing training available from the Regional Community Policing Institutes
- COPS Publications
- Contacting your state Grant Program Specialist or Staff Accountant

To contact the COPS Office Response Center:

Phone: 800.421.6770

Fax: 202.616.8594

E-mail: askcopsrc@usdoj.gov

Mailing address:
COPS Office Response Center
1100 Vermont Avenue, N.W.
Washington, DC 20530

Hours of Operation:

Monday to Friday, 9:00–5:00 Eastern Time

After-hours voicemail—call returned next business day

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Ask us for materials to address a specific problem in your community.

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