Analysis of Texas Fatal Traffic Crashes
Final Report

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ABSTRACT

In 2007, the state of Texas exceeded the national average for the number of traffic related fatalities, which accounted for the death of 3,363 people (National Highway Traffic and Safety Administration). This research project identifies spatial trends and patterns of fatal traffic crashes in the state of Texas for 2008 by looking at several different factors specific to vehicle drivers, driver age groups, roadway conditions, roadway types, various driver factors and other related issues involved in the fatal crashes. The study focuses on using geographic analysis through the use of Geographic Information Systems in conjunction with various traffic crash data sets in order to draw conclusions and provide a spatial visualization of the fatal crashes and the factors involved. The project is intended to provide helpful information and analysis to public and private sectors in order to gain a better understanding of fatal traffic crashes and the factors involved in the crashes. Along with the tragic loss of lives it is also important to study and analyze fatal crashes because of the annual cost to the state of Texas. This study identifies some problem areas and factors that can be looked at in order to aid in the development of preventative measures and policy-making decisions. Although this project provides a thorough review of fatal crashes in Texas for 2008, there still remain many possibilities for future studies that can be developed with the data sets.

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1. INTRODUCTION

1.1 PURPOSE

The Texas Department of Transportation (TxDot) maintains over 79,000 miles of roadway, a number higher than any other state in the nation, with drivers averaging 600 million miles driven on these roadways daily ("Accidents due to poor road maintenance, Adler and Associates, 2009). A study released July 2009 by the Pacific Institute for Research and Evaluation (PIRE) found that more than half of roadway fatalities in the U.S. are related to deficient roadway conditions, a percentage larger than both the impacts of drunk driving and speeding in the number of fatalities produced (Miller & Zaloshnja, 2009). Deficient roadway conditions have led to 22,000 fatalities in the U.S. and have cost the nation on average $217 billion (Miller & Zaloshnja, 2009). Texas roadways are some of the deadliest in the country. As compared with the national average when examining the number of traffic fatalities per 100,000 people in 2004, Texas averaged 16.50 deaths as opposed to the national average of 14.63. By 2007, the national average had fallen to 13.69 traffic fatalities per 100,000 people, but the number of traffic fatalities in Texas, although it too fell to a rate of 14.54 deaths per 100,000 people, still exceeded the national average. It is important that the issue of high automobile fatality rates be examined so as to pinpoint the significant problem areas throughout the state and identify related factors involved in fatal crashes, so proper action can be taken to address these issues.

The goal of this project is to identify spatial trends and patterns of fatal traffic crashes in the state of Texas for 2008 by evaluating several different factors specific to vehicle drivers, driver age groups, roadway conditions, roadway types, various driver factors, and other related issues. After this goal was realized and accomplished, we set forth to identify significant factors and findings of trends and patterns that could be observed in the development of traffic safety preventative measures and policy-making decisions. In addition, we set out to pinpoint significant geographic problem areas on both a statewide and county specific level that would benefit the most from an increased amount of attention.

Traffic Accident Geospatial Solutions (T.A.G.S) has implemented the use of two data sets in this project. T.A.G.S used the Fatality Analysis Reporting System (FARS), which contains data on the nation's auto crashes occurring from 1994 to 2008, in order to create static maps that illustrate which counties in Texas for 2008 had the highest number of fatal traffic crashes and which roadway types, conditions, age groups, and driver factor scenarios (such as driving under the influence of alcohol and failing to yield the right of way) were involved in the fatal crashes. To a lesser degree T.A.G.S incorporated the Crash Records Information System (CRIS) produced by TxDot, which contains a more detailed record of roadway fatal crashes for the state. The CRIS data set was used in order to provide a more localized study and analysis of some problem areas. We believe the use of Geographic Information Systems (GIS) is an excellent method to utilize these data sets because it allows the viewer to readily comprehend the data statistics in a visual format that highlights areas that exhibit levels of fatal traffic crash related significance. T.A.G.S has chosen to use a graduated color scheme to display the data statistics and the differing rates and counts of fatal traffic crashes at a county by county level. In addition, specific counties were analyzed to further understand the actual spatial distribution of the fatal crashes.

By focusing on the development of effective countermeasures to combat the high number of fatal traffic crashes that are occurring in specific areas of Texas, T.A.G.S believes that there will be a significant reduction in the number of fatalities occurring on Texas roadways annually. T.A.G.S also believes that this will tremendously decrease the amount of money being spent on traffic fatality related expenditures (i.e. the funding of cleanup crews, the costs related to ambulance assistance, roadway closures and maintenance.)

1.2 SCOPE

All counties in Texas, Figure 1, were chosen to be included as part of the study area so that a true spatial distribution of the fatal traffic crashes could be represented using GIS. Using the CRIS data, T.A.G.S not only accessed the fatal traffic crashes on a statewide distribution, but also looked into major "hot spot" areas that showed evidence of a significant number of fatal crashes. This was done in order to try to access what it was about these areas that made for ideal fatal traffic crash locations. Data from the fatal traffic crashes occurring only in the year 2008 were combined with the estimated 2008 Census Data to create all maps produced in the course of this study.

Figure 1. State of Texas County Map
Source: http://www.breckenridgeisd.org

2. LITERATURE REVIEW

T.A.G.S found it appropriate to engage in an extensive review of scholarly journals and articles to better understand what factors would be most beneficial in examining as being the leading contributors to the occurrence of fatal traffic crashes. In addition to addressing the specific factors as laid out within the Request for Proposal presented to T.A.G.S at the beginning of our research process, T.A.G.S placed focus on examining specific incidences of Texas fatal traffic crashes in order to better understand what specific factors led to their creation, in an effort to find specific correlations that might have otherwise gone unaddressed. T.A.G.S also further researched both the FARS and CRIS data sets in order to better understand how to most effectively extract and use the plethora of data both data sets contained to create informative maps.

2.1 CRASHES DUE TO POOR ROAD MAINTENANCE

A study conducted by *Better Roads*, a national publication for government and contractor information pertaining to road construction, found that drivers rank road maintenance as one of the top five traffic safety hazards. The TxDot maintains more roadways than any other state in the country. Poor road maintenance leads to many catastrophic and fatal crashes every year. In 2003, 144 fatal traffic crashes in Texas took place within construction and maintenance zones. However, in May 2005, TxDot reported 270 ‘roadway conditions’ including construction zones and road closures throughout the state. Every one of these ‘conditions’ has the potential to cause crashes that lead to severe or even fatal injuries.

2.2 CRASHES DUE TO WORK ZONES

In 2003, there were 1,028 work zone fatalities across the U.S. including 161 in Texas alone. When numbers are adjusted to population, Texas has more than twice the fatality rates of New York and Pennsylvania, and six times that of Ohio. The most common causes of work zone crashes are due to speeding, inattention, and failure to yield right of way.

Transportation agencies are challenged to balance the increasing need for work zones with mobility and safety concerns expressed by the public and government agencies. Full road closure is one method that transportation agencies are giving increased consideration to during project planning and design, as a potential way to balance these conflicting needs. The researchers studied six road works projects done using the full road closure method, and showed many positive signs. All six projects were completed faster than normal, and two of the projects showed significant cost savings. Productivity improved, both because there was more room to work and because there were fewer distractions from traffic. Five of the six projects reported that worker and traveler safety was one of the benefits of the system. Roadwork continues to increase across the country. That impact is felt most in Texas, the state with the largest number of highway miles.

2.3 SEASONAL TRAFFIC HAZARDS

Fall is a peak time for deer-vehicle crashes. There are about 150 deaths and 1.6 million collisions with deer in the U.S. every year. Storms, rain, snow, dust, ice, sleet, hail, fog, fires and rush-hour traffic are seasonal hazards that also affect your driving. They all require slower speeds, no matter what the posted speed limits may say, and greater attention to the environment. While many fires and floods are in remote locations, some occur next to or on public roads and highways and have required detours or closing of the roadways. It is essential that motorists follow the directions of the detours or highway closures. Motorists are also urged to not drive through fire areas that have created smoke or flame hazards on the highway, and to not drive through water flowing on a highway even if authorities have not closed the roadway.

2.4 PEDESTRIAN AUTOMOBILE CRASH RELATED FATALITIES

Walking is very healthy exercise, but the sad fact is that walking also can be very dangerous, especially on or near streets and roads. Houston is one of the worst cities for pedestrian fatalities. A recent Transportation for America study puts Houston among the 10 most dangerous U.S. cities for walking. Houston, Sugar Land and Baytown, in fact, ranked collectively as eighth in the survey. Transportation for America reports that 76,000 Americans have been killed while crossing or walking near streets in the past 15 years. Many streets and through fares were designed strictly for speeding cars, and make little if any concession to the very real fact that people on foot, on bicycles or in wheelchairs also must cross them, or at least proceed alongside them. Failing to factor this into a street's design leads to deadly car crashes and pedestrian fatalities every day.

2.5 OLDER DRIVER CRASHES

Specific driving maneuvers are problematic for older drivers. This includes left turns across traffic, high-speed roads, lane changes, and navigating intersections. Twenty percent of two-vehicle crashes for drivers 70 to 79 and 32% of two-vehicle crashes for drivers age 80 and above involved in a left turn. In contrast, only 11% of two-vehicle crashes for drivers 60 to 69 involved a left turn. In two-vehicle crashes, those 60 and older were more likely to have received citations for failure to yield. Drivers 80 and older were especially vulnerable to right-side impacts, a situation that can occur when turning left at a stop sign. One of the most risky situations for older drivers was turning left at a signal-controlled intersection. Older drivers were less likely than other drivers to be involved in some other types of crashes. Drivers 60 and older were less likely to be involved in alcohol-related, speed-related, or nighttime crashes. Older drivers were less likely to be involved in crashes related to poor weather, such as rain or snow.

2.6 FARS DOCUMENTS AND LITERATURE

Throughout the data collection process T.A.G.S referred to many different types of literature to learn, study, and verify information for the project. There are many ways that the FARS data can be queried and analyzed. T.A.G.S reviewed past reports, NHTSA previous studies, FARS term definitions, manuals, forms, exercise examples, and guides in order to properly query and analyze the data to obtain the information desired for the project. This also helped verify the quality of the data obtained.

3. DATA

This section of the report will explain the data used in the project. The data used this project was as follows:

1) Counties.shp – This data was extracted from the Texas General Land Office's website. In order to spatially represent our crash data, we needed data to represent the scope of our study. The Counties shapefile is a graphic representation of Texas subdivided into its counties.

2) Roads.shp – This data was also extracted from the Texas General Land Office. Since some of the data we analyzed in our project contained x and y coordinates, this shapefile would help give visual reference to the location of the crashes within the Texas counties. This shapefile contained the major highways and roads used by the US Department of Transportation.

3) Estimated 2008 Census Data – The crash data we analyzed in our project was from the year 2008. Since the census of the United States is taken every ten years we could not use absolute figures. We used the projected 2008 census data provided by the US Census Bureau in order to calculate the rates of crashes to the population of each county.

4) FARS Data – The data we extracted from FARS was fatal crash data from the year 2008. This crash data is reported by NCSA (National Center for Statistics and Analysis). We

extracted this data from the FARS website through a multiple set of queries based on different factors involved in the crashes. The FARS database was designed as an aid to help increase traffic safety. This data was the center point for our study of fatal crashes in Texas.

5) CRIS Data – This data, like the FARS data, is traffic crash data. This data was compiled by the Texas Department of Transportation and delivered to T.A.G.S via hand delivery by our client. While this data is very similar to the FARS data, it provided detailed descriptions of factors contributing to each crash that happened in 2008. This data also contained x and y coordinates of each crash allowing us to further our studies by examining counties that had high frequencies of crashes on a smaller scope.

4. METHODOLOGY

4.1 SUPPLEMENTARY DATA

We began our study by gathering the framework of our data. The counties and roads shapefiles provided by the Texas General Land Office were the cornerstone of our project. Using this data, we could essentially “attach” our analyzed crash data to each county and visually represent it.

Since the data we were analyzing was from 2008, we needed to base our rate calculations on 2008 population data. The US Census Bureau offers an estimated population count for each state. We queried this data for the state of Texas, subdivided it by county, and received it via the Census Bureau’s website.

4.2 FATALITY ANALYSIS REPORTING SYSTEM (FARS) DATA METHODS

Next, we needed to acquire the fatal crash data provided by the FARS database. This would be done by a multiple set of queries of the website. By selecting the crash criteria we wanted displayed such as driver age groups, driver factors, roadway types, etc. the system would query and display the results. The displayed results showed the number of crashes by county in a table format. We extracted this data in a .csv file format made available by the FARS website. By using this file format, we were able to open the data in a spreadsheet, manipulate, and organize it. Figure 2 shows how this process was achieved.

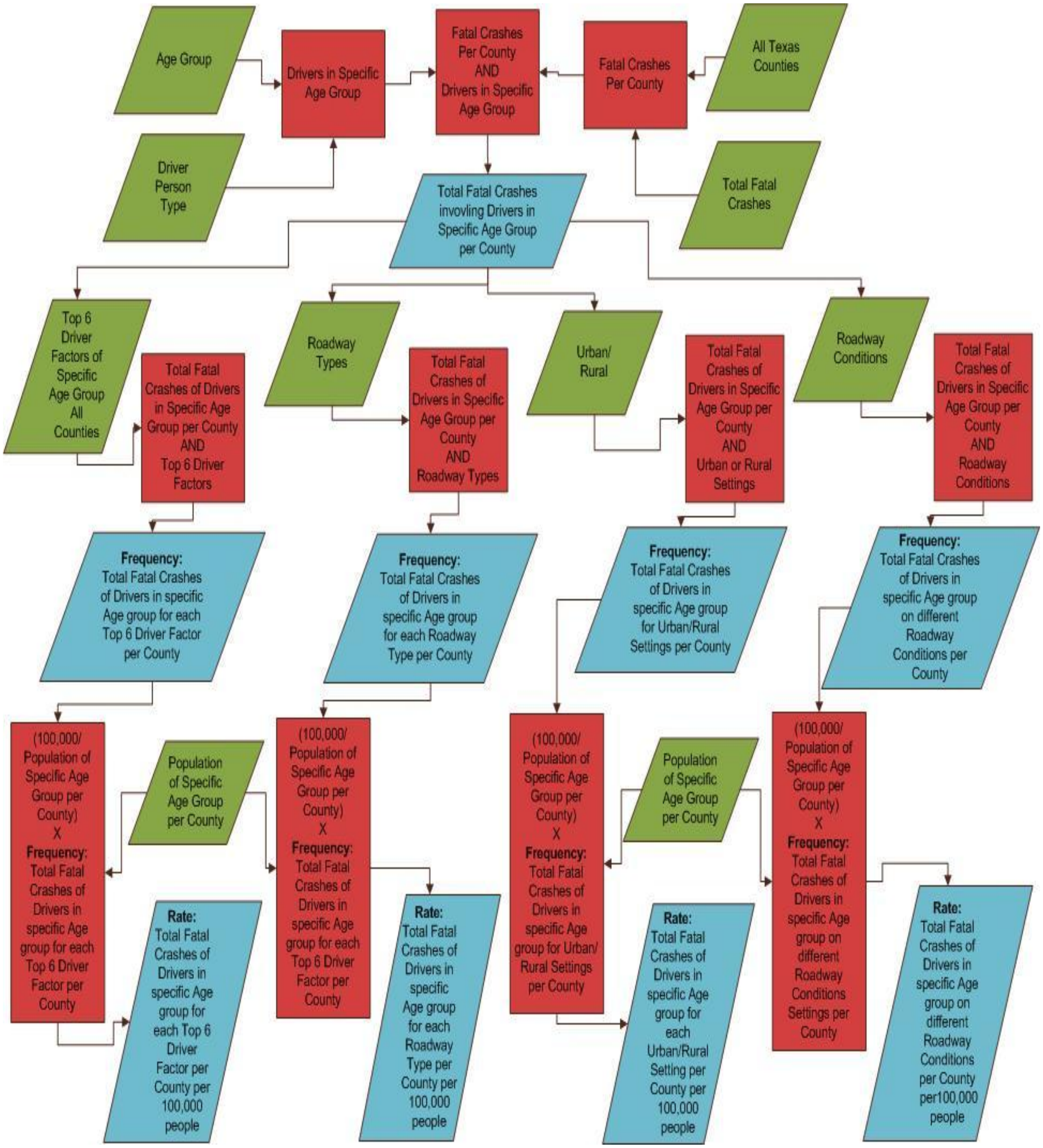

Figure 2. FARS data compilation.

We decided to create three different data sets. Since part of the study focuses on the age group of drivers and fatal crashes, we queried and grouped our data accordingly. This would allow us to subdivide each age group by population, contributing crash factor, road type, road condition, and rural/urban settings. After we extracted the data, we analyzed it and performed a multiple series of quality checks for each assigned age group.

In order to produce data for the roadway types and urban/rural settings studies we needed to manipulate some of the FARS data. Both studies were produced by querying the same data from the FARS called “Roadway Function Class.” When the data displays in the FARS it separates Roadway Function Class by roadway types (i.e. Interstate, Local, etc) and further into rural and urban for each roadway type. For example, Roadway Function Class “Local” would display as Rural Local and Urban Local and give a fatal crash count for both. In order to achieve our goal of having an urban/rural setting study of fatal crashes and roadway type study of fatal crashes we decided to manipulate the data. Table 1 shows a break down on how we manipulated the data in order extrapolate the data we needed for the studies. It should also be noted that Table 7 in Appendix II shows the definitions of each Roadway Types according to the FARS Terms.

Table 1. Roadway types and urban/rural setting method

Roadway Types	Roadway Function Class		Roadway Function Class
Minor Arterial	Rural Minor Arterial	+	Urban Minor Arterial
	+		+
Collector Arterial	Rural Major Collector + Rural Minor Collector	+	Urban Collector
	+		+
Local	Rural Local Road or Street	+	Urban Local Road or Street
	+		+
Freeway and Expressway	None	+	Urban Principal Arterial / Other Freeways or Expressways
	+		+
Interstate	Rural Principal Arterial Interstate	+	Urban Principal Arterial Interstate
	+		+
Unknown	Unknown Rural	+	Unknown Urban
	+		+
Other	Rural Principal Other	+	Urban Other Principal Arterial
	Rural Setting		Urban Setting

In order to visualize the data, our team needed to create a unique way to assign the number of crashes and the involving factors to our county shapefile. We created a unique coding system in which we numbered the Texas counties from 1-254, and placed these corresponding numbers into the attribute table of the county shapefile. In doing so we were able to standardize our data based on the number ID's rather than the specific county names. We found by using this method of numbering the counties we could easily join our data sets to the county shapefiles. This method would also prove to be efficient by avoiding misspelled words or spaces that would normally cause a join operation to fail in ArcGIS. Up until this point in our study, most of our work had been done in a spreadsheet format. Querying, extracting, analyzing, and manipulating the crash data in Excel proved to take up most of our time, followed by multiple quality assurance checks.

Our next step was to implement and visualize the crash data into a GIS. We proceeded to use ESRI's ArcGIS to visualize our analyzed data. Through a series of operations, we were able to merge the counties shapefile with our crash data based on the unique numbering of the counties. By merging these files, it essentially created one file from two. This allowed us to visualize the numbers of crashes by displaying them in a graduated color scheme. We used a natural breaks method in order to classify the numbering system. This would allow for an even number of colors to be displayed while avoiding overcrowding of the groups of numbers themselves.

We created separate maps for each set of age groups, subdividing each by the specific factors that were involved in the fatal crashes. Each map created displays two subjects. One side of the map displays the frequency of the crash occurring. The other side of the map displays the rate of the fatal crashes to the population of its corresponding county. Since the counties contain varying populations, we needed to normalize the states countywide population. In order to do so, we used the following formula (Figure 3):

County's Fatal Crashes x (100,000/County Population).

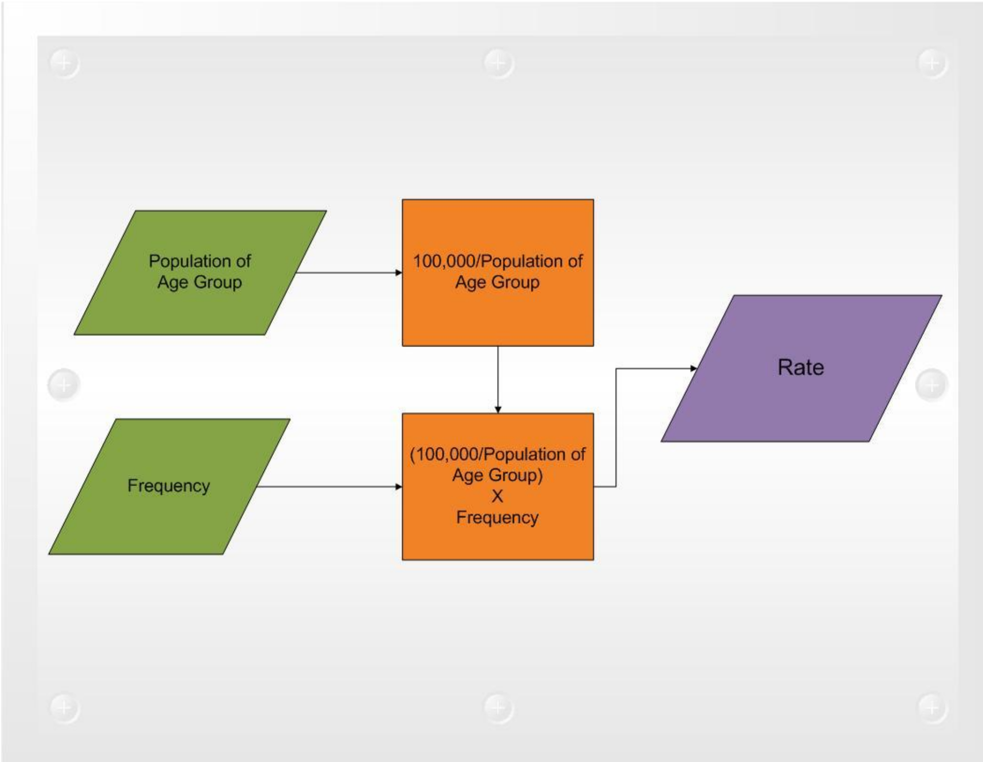

Figure 3. Rate calculation.

Each team member was assigned different age groups and/or specific factors to map. We created a map template for each team member to create their map by so that there would be uniformity among the produced maps. After creating all the maps for each age group, each map was visually checked for errors by multiple team members in order to ensure that they were all of good quality.

4.3 CRASH RECORDS INFORMATION SYSTEM DATA METHODS

Our next task was to analyze and map a separate data set from the CRIS database. Although very similar to the FARS data, this data was different in that it provided much more detail of the factors contributing to the fatal crashes. This data also provides precise locations of each fatal crash by containing the X and Y geographic coordinates of each crash.

Our team was able to decipher, analyze, and combine the CRIS data sets in order to create our own separate data set. The CRIS data sets were given to us in three separate Excel files, all in massive proportions. Much of the time our computers were unable to process the amount of data contained in the files. The CRIS data sets contained detailed information on every crash that occurred in 2008, fatal or not. By isolating the fatal crashes this greatly reduced the size of the files and made them workable.

The new CRIS data set contained only major crash attribute information along with the X and Y coordinates. We were able to project these crashes and proceed to analyze the crashes using a narrower scope. By separating the crashes based on different contributing factors, we could now begin to see trends of crashes. In order to better understand the crash trends, we produced different maps based on different analysis. Using a spatial join we were able connect the crash location to the road the crash occurred on. This allowed us to analyze and find the roads with the most crashes occurring on them. We also produced maps based on the density of the crashes. By doing this, we could identify "hotspots" where the most crashes are happening in the urban areas of Texas. Further studies were made on specific attributes of the crashes. For example, a map was made with the findings of the areas in Texas with the most fatal crashes occurring at night. Another study found a high rate of crashes occurring in construction zones. Using the CRIS data allowed us to study and produce detailed maps on a specific county and broad statewide scope. Figure 4 shows the methods of using the CRIS data set.

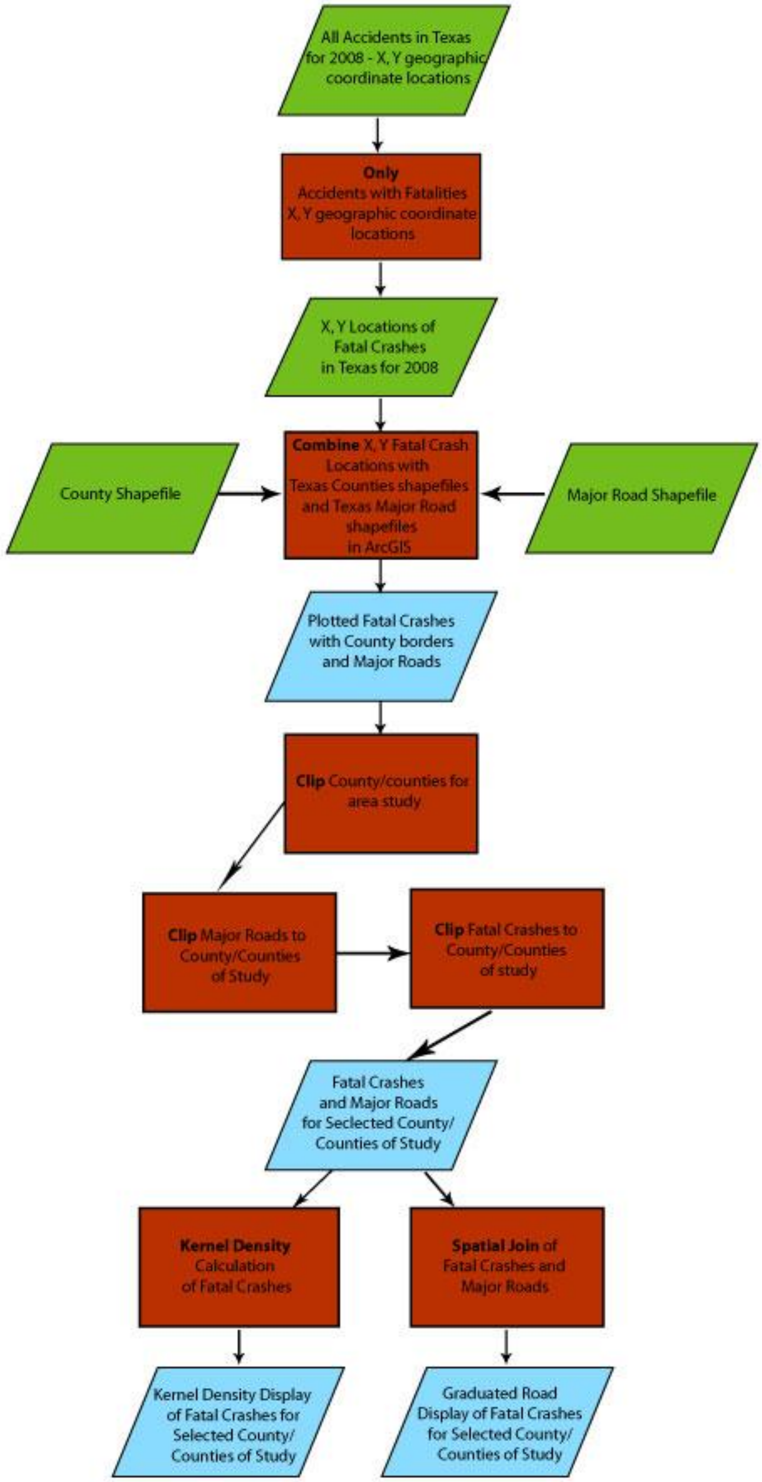

Figure 4. CRIS Data Methodology

5. RESULTS

5.1 FARS DATA ANALYSIS

The descriptive results are based on the 2008 FARS data as it relates to the driver of vehicles that were involved in a traffic crash in which a fatality occurred. This study examines the drivers within three separate age groups: ages 70 and over, under 70, and 15-24. Each age group was examined according to three general categories: specific driver related factors (FARS - Driver Related Factors), roadway condition (FARS - Roadway Surface Conditions), and roadway types (FARS - Roadway Function Class).

The following material includes both a list and a map to identify key findings with respect to selected parameters within each category for the age group being considered. The maps identify both a frequency of occurrence and a standardized rate which was described previously in section 4.2.

5.1.1 Fatal Crashes within Age Groups

When looking at Figures 5 and 6, the total fatal crashes in the 70 and over age group are concentrated in the more highly populated counties of Harris, Dallas, Bexar, Jefferson, and Hardin. The highest rate of occurrence within this age group, however, are in the less populated counties of Terrell, Oldham, Dallam, Hemphill, Donley, Stonewall, and Blanco.

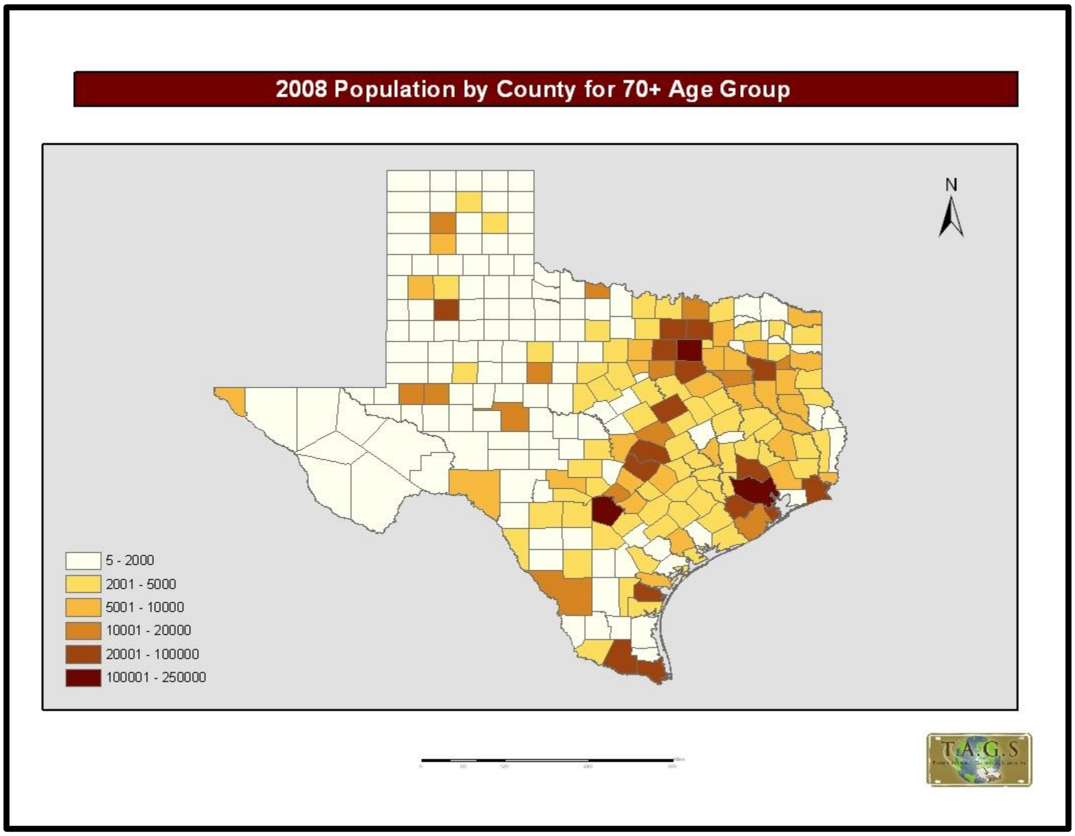

Figure 5. 70 and over population distribution

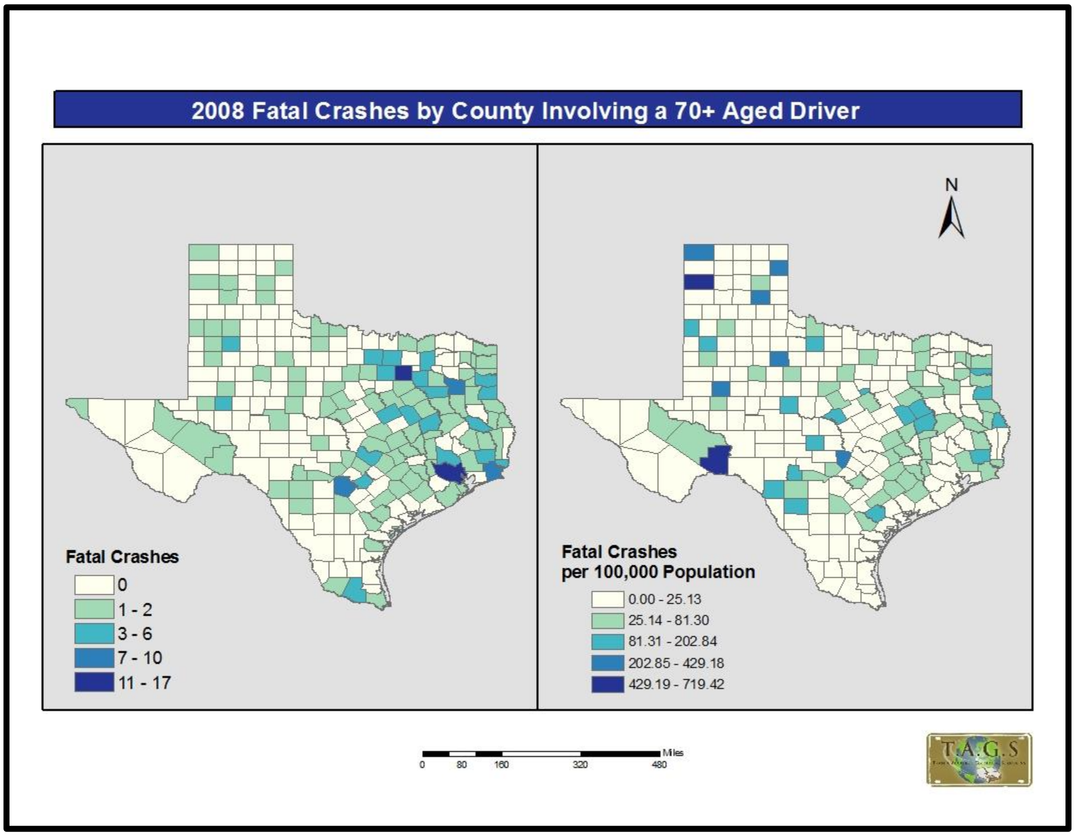

Figure 6. Fatal crashes involving a 70 and over aged driver.

5.1.2 Driver Related Factors

The top six driver related factors within each age group were identified in Tables 2, 3, and 4. As shown, "Failure to remain in the proper lane" was the leading driver related factor in fatal crashes for both the 15-24 and the under 70 age groups, and was the second leading driver related factor for the 70 and over age group. As can be seen in Figures 7, 8, and 9, the fatal crash frequencies in all age groups are primarily distributed in the major metropolitan areas and surrounding counties in the eastern half and far western parts of the state, but the higher rates occur in the central region of the state, from the western panhandle to south Texas. Stonewall

County exhibits the highest rate of occurrence among the 70 and over age group and shows a significant rate in the under 70 age group as well.

Table 2. Top six driver factors in fatal crashes for the 15-24 aged drivers.

Ranking	**Driver Related Factor**	**Frequency**
1	(28) Failure to keep in Proper Lane	1112
2	(5) Under the Influence of Alcohol, Drugs or Medication	998
3	(44) Driving In Excess of Posted Maximum	906
4	(58) Over Correcting	382
5	(43) Driving Too Fast for Conditions	318
6	(6) Operating the Vehicle in Careless or Inattentive Manner	335

Table 3. Top six driver factors in fatal crashes for the under 70 aged drivers.

Ranking	**Driver Related Factor**	**Frequency**
1	(28) Failure to keep in Proper Lane	361
2	(44) Driving In Excess of Posted Maximum	353
3	(5) Under the Influence of Alcohol, Drugs or Medication	307
4	(58) Over Correcting	133
5	(6) Operating the Vehicle in Careless or Inattentive Manner	115
6	(43) Driving Too Fast for Conditions	83

Table 4. Top six driver related factors in fatal crashes for the 70 and over age driver.

Ranking	**Driver Related Factor**	**Frequency**
1	(38) Failure to Yield Right of Way	57
2	(28) Failure to keep in Proper Lane	47
3	(44) Driving In Excess of Posted Maximum	24
4	(6) Operating the Vehicle in Careless or Inattentive Manner	24
5	(39) Failure to Obey Actual Traffic Sign, Traffic Control Devices or Traffic Officers; Failure to Obey Safety Zone Traffic Laws	23
6	(5) Under the Influence of Alcohol, Drugs or Medication	7

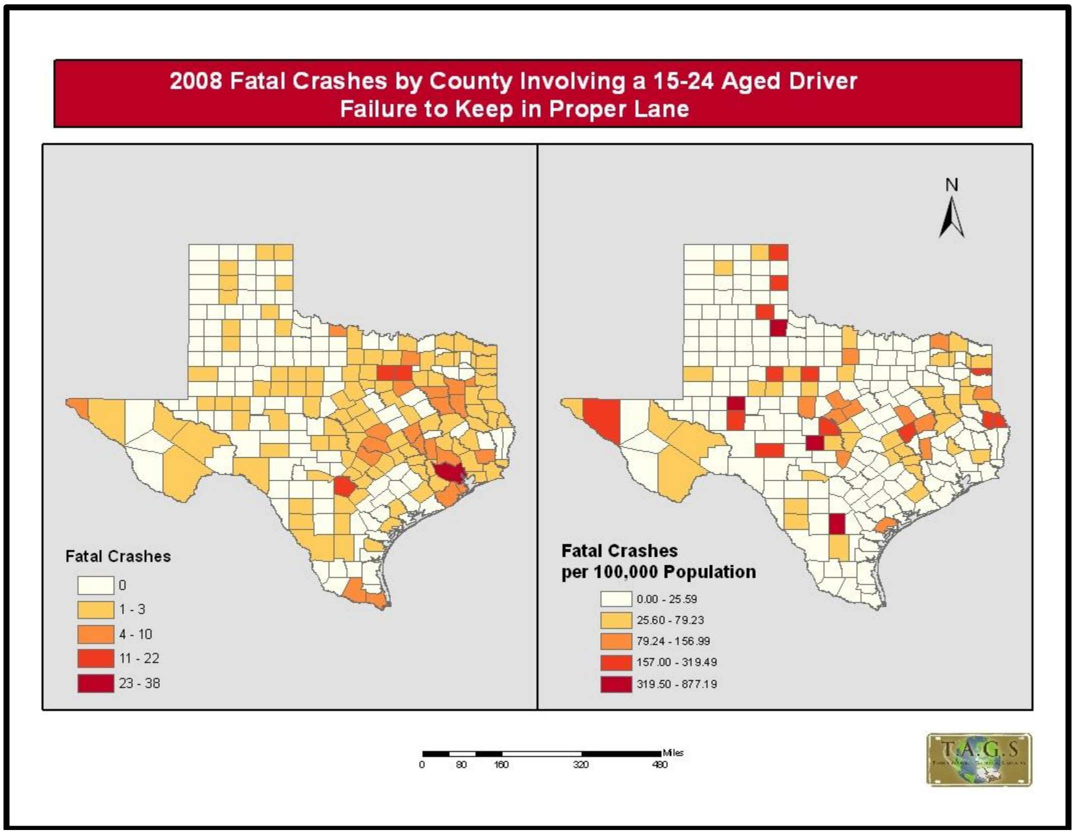

Figure 7. "Failure to keep in proper lane" for a 15-24 aged driver.

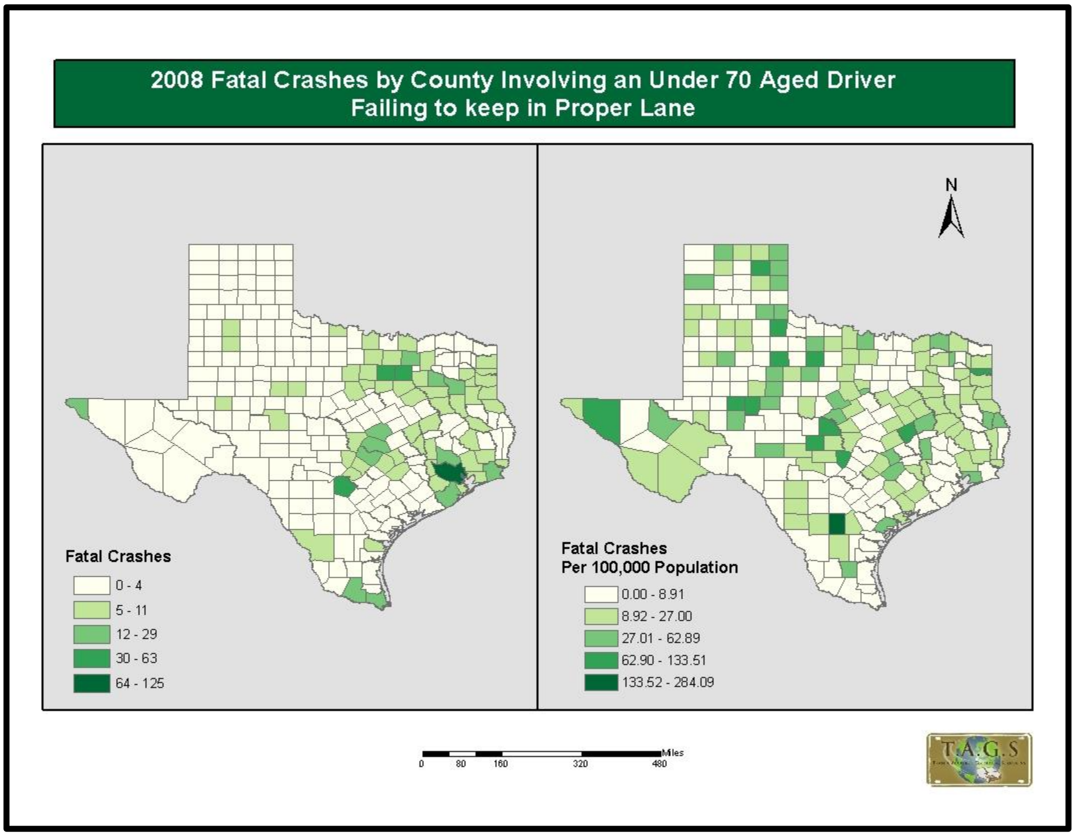

Figure 8. "Failure to keep in proper lane" for an under 70 aged driver.

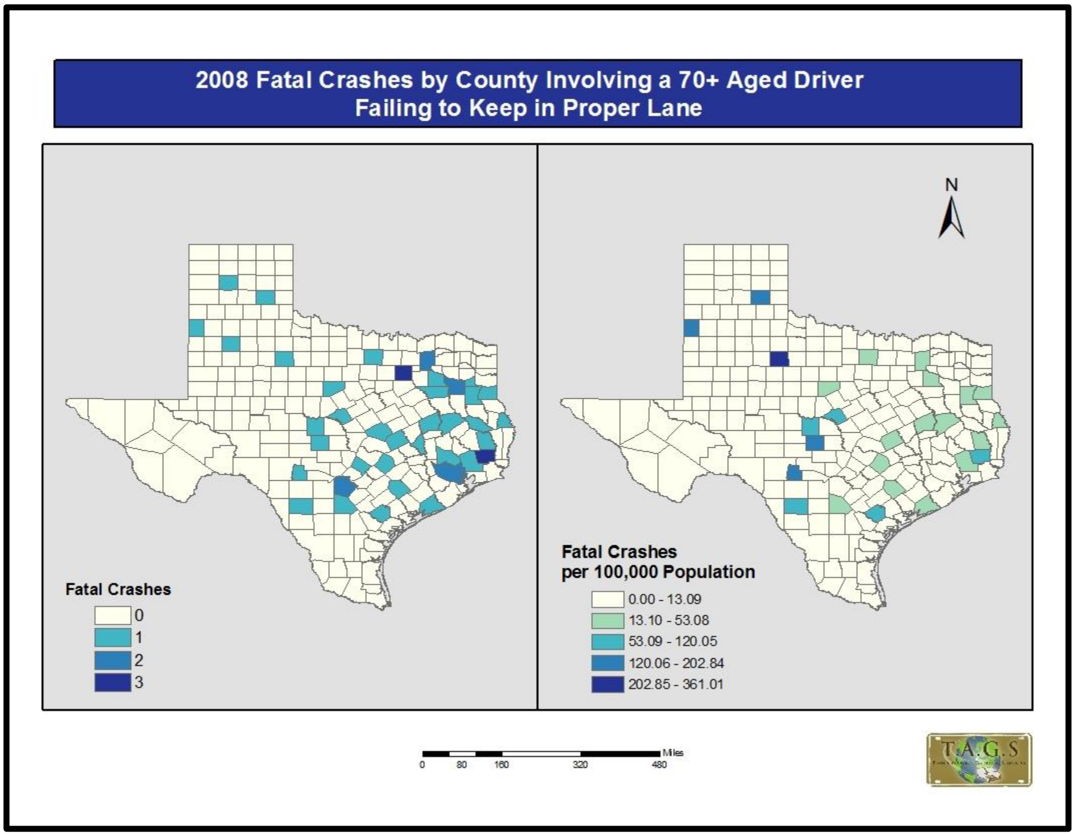

Figure 9. "Failure to keep in proper lane" for a 70 and over aged driver

Additionally, as shown in Table 5, the influence of alcohol, drugs, or medication was over 140 times more frequent in the under 70 age group fatal crashes than in the 70 and over age group. This is despite the fact that the total number of fatal crashes for the under 70 age group is only 10 times more than the 70 and over age group. As seen in Figures 10 and 11, the frequency distribution in the under 70 age group occurred in the major metropolitan areas of east and southeast Texas, however, the rate of occurrences was widely distributed throughout the state.

Table 5. Under 70 and 70 and over alcohol, drugs, or medication comparison

Age Group	Total Statewide Fatal Crashes	Frequency
Under 70	2887	998
70 and over	251	7

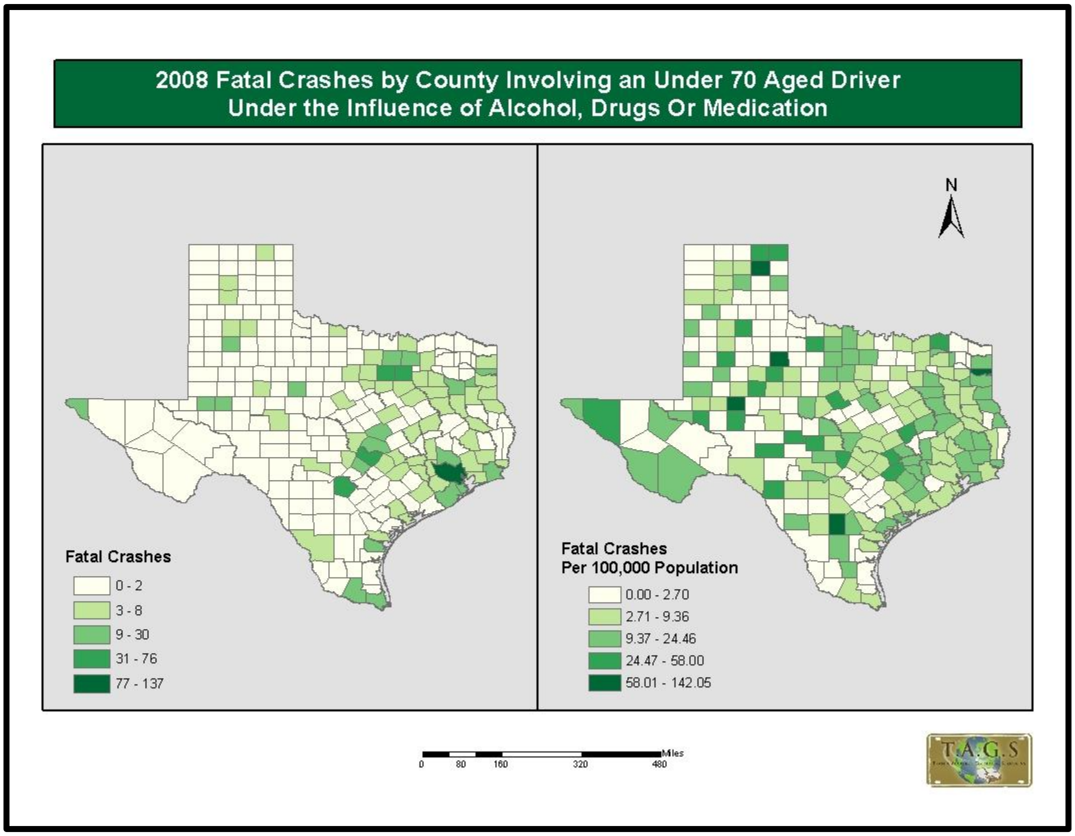

Figure 10. "Under the influence of alcohol, drugs, or Medication" for an under 70 aged driver.

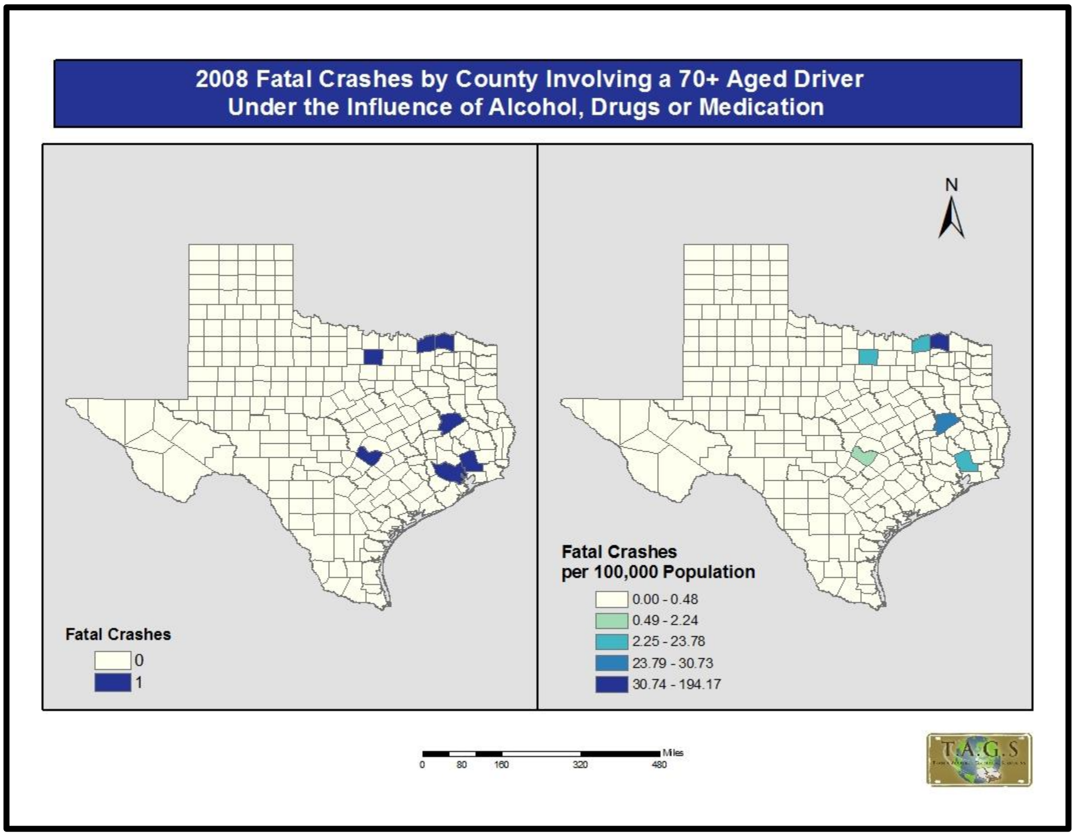

Figure 11. "Under the influence of alcohol, drugs, or Medication" for a 70 and over aged driver.

5.1.3 Roadway Conditions

As seen in Table 6, the frequency of fatal crashes was approximately 10 times greater in dry roadway conditions than wet conditions for the under 70 age group. However, in looking at Figures 12 and 13, many counties in East Texas have high fatality rates in both conditions.

Table 6. Top two road conditions in fatal crashes for an under 70 age driver

Roadway Condition	Frequency
Dry	2750
Wet	257

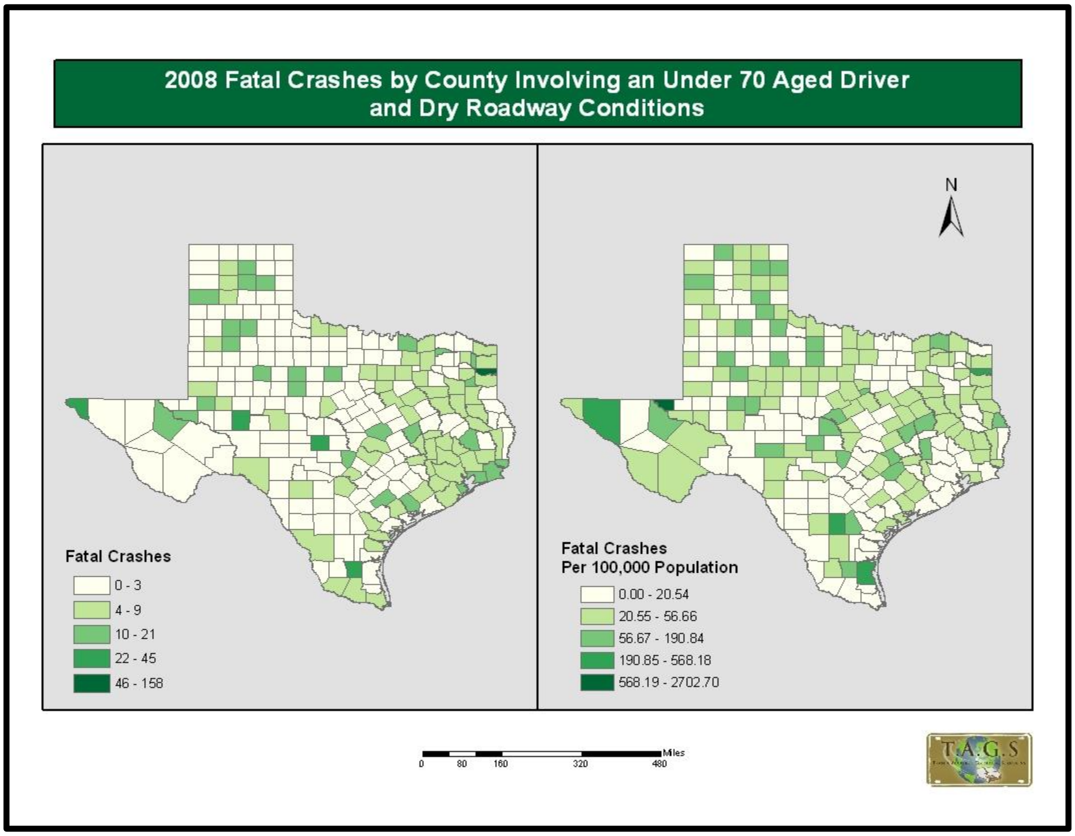

Figure 12. Dry roadway conditions for the under 70 aged driver.

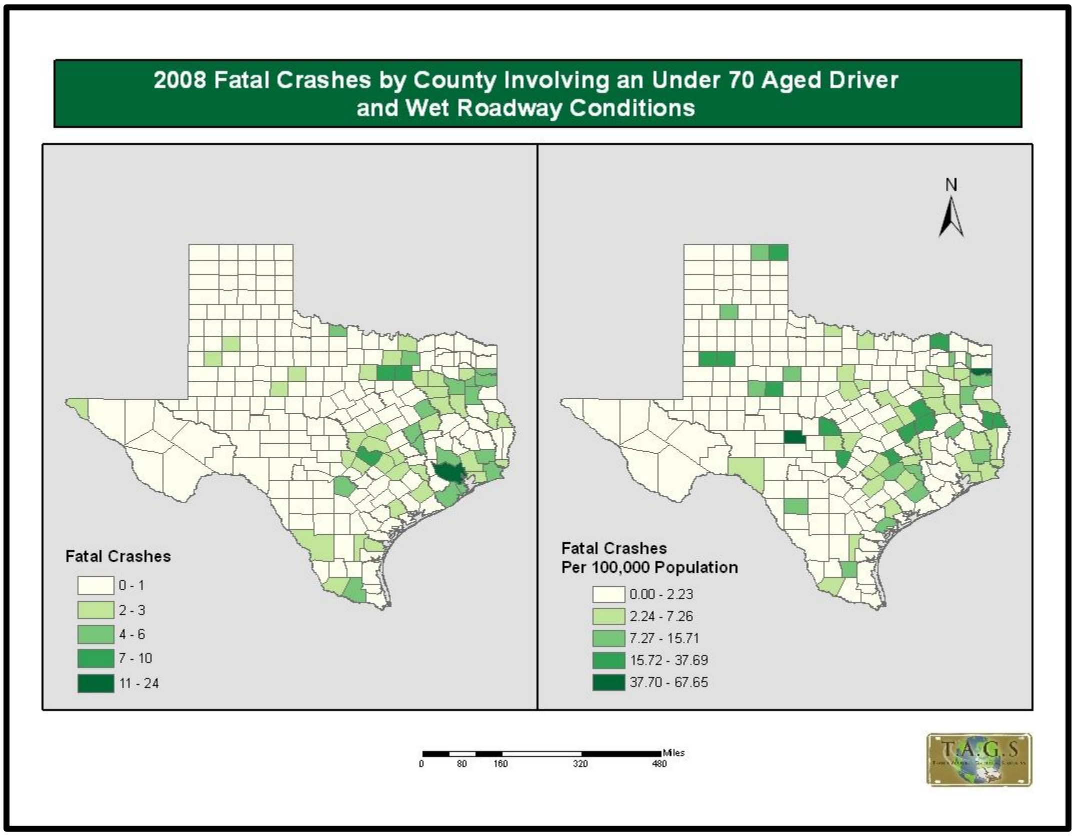

Figure 13. Wet roadway conditions for the under 70 aged driver.

5.1.4 Roadway Types

In Figures 14 and 15, as one might expect, most urban roadway types have a higher frequency of fatal crashes than rural roadway types for both the under 70 and 70 over age groups. However, the rural roadway types have a significantly higher rate of occurrence than do the urban areas as shown in Figures 16 and 17.

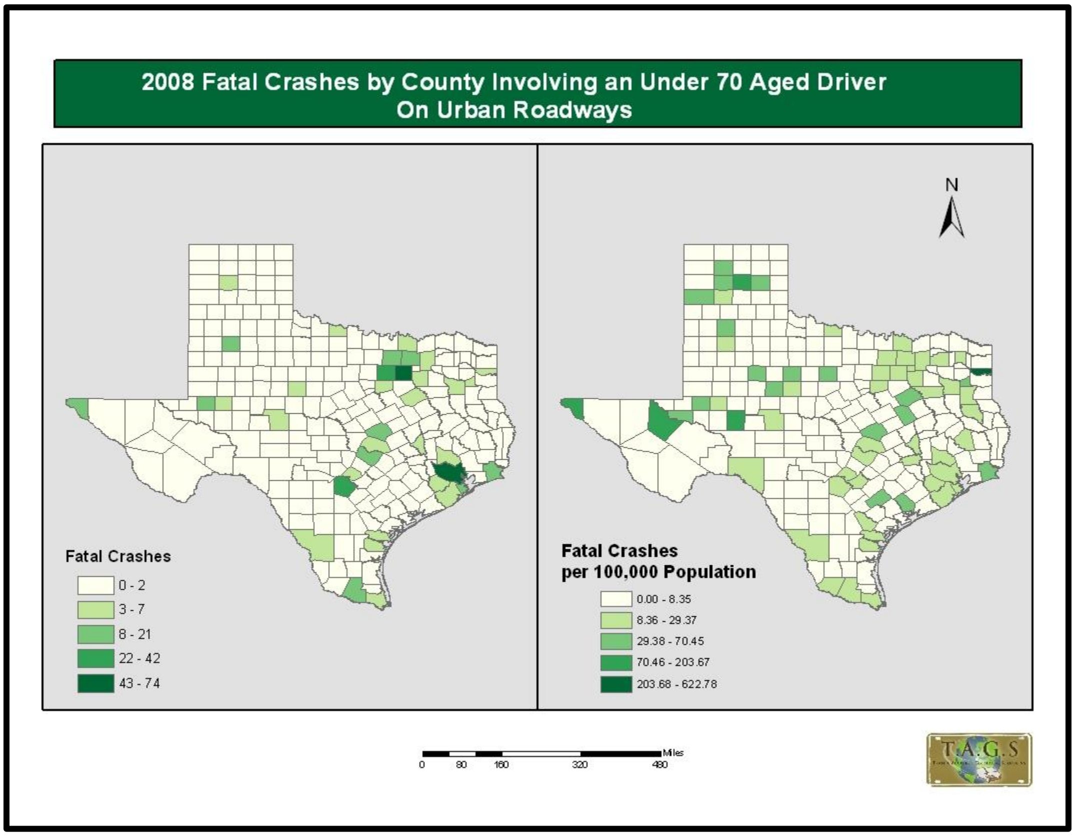

Figure 14. Urban roadway types for the under 70 aged driver.

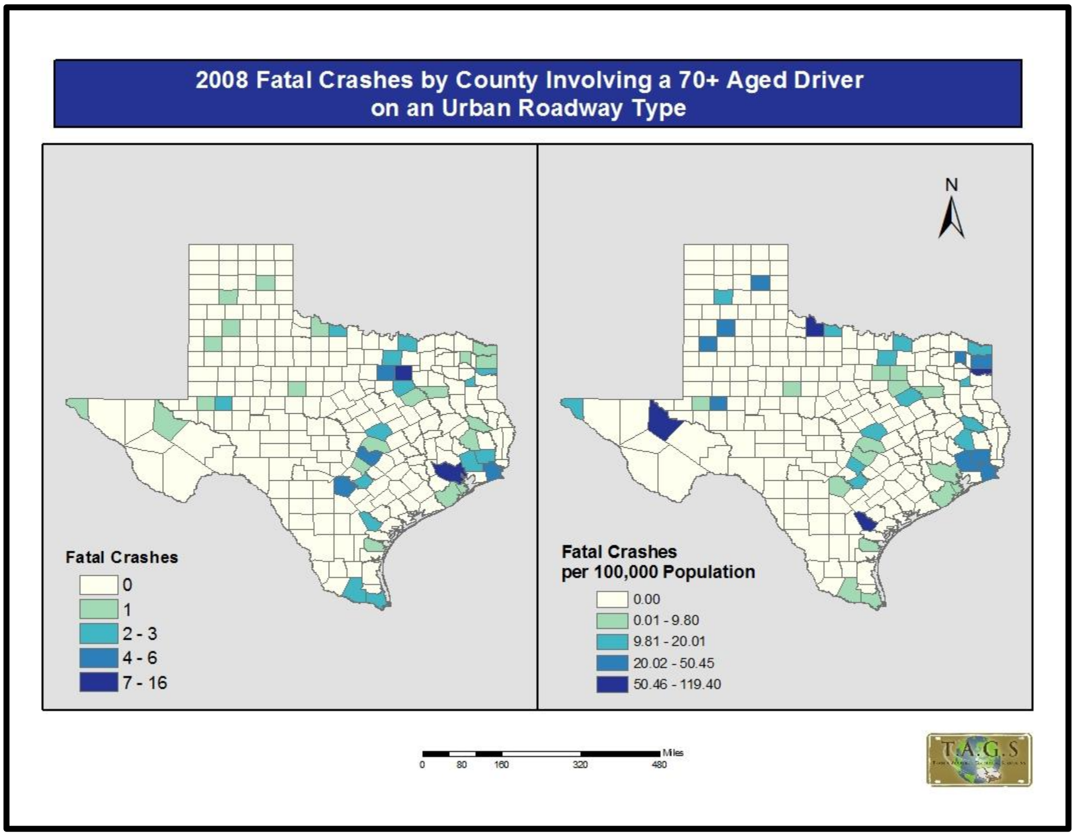

Figure 15. Urban roadway types for the 70 and over aged driver.

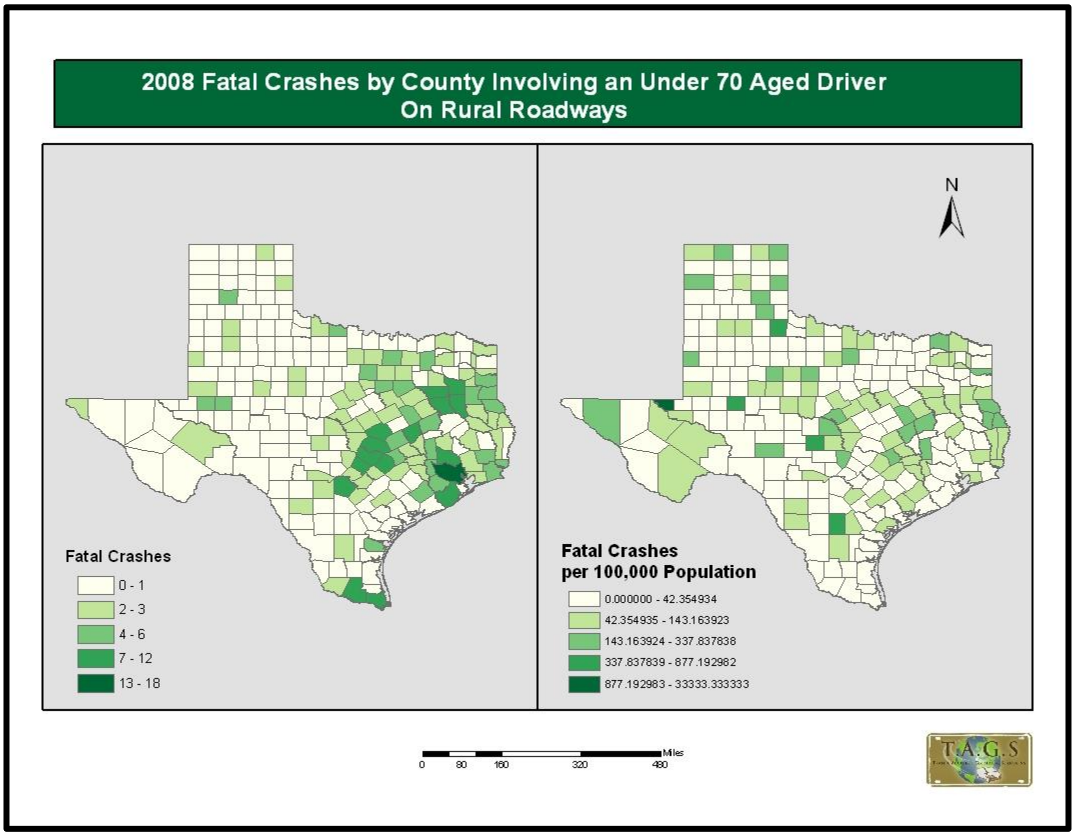

Figure 16. Rural roadway types for the under 70 aged driver.

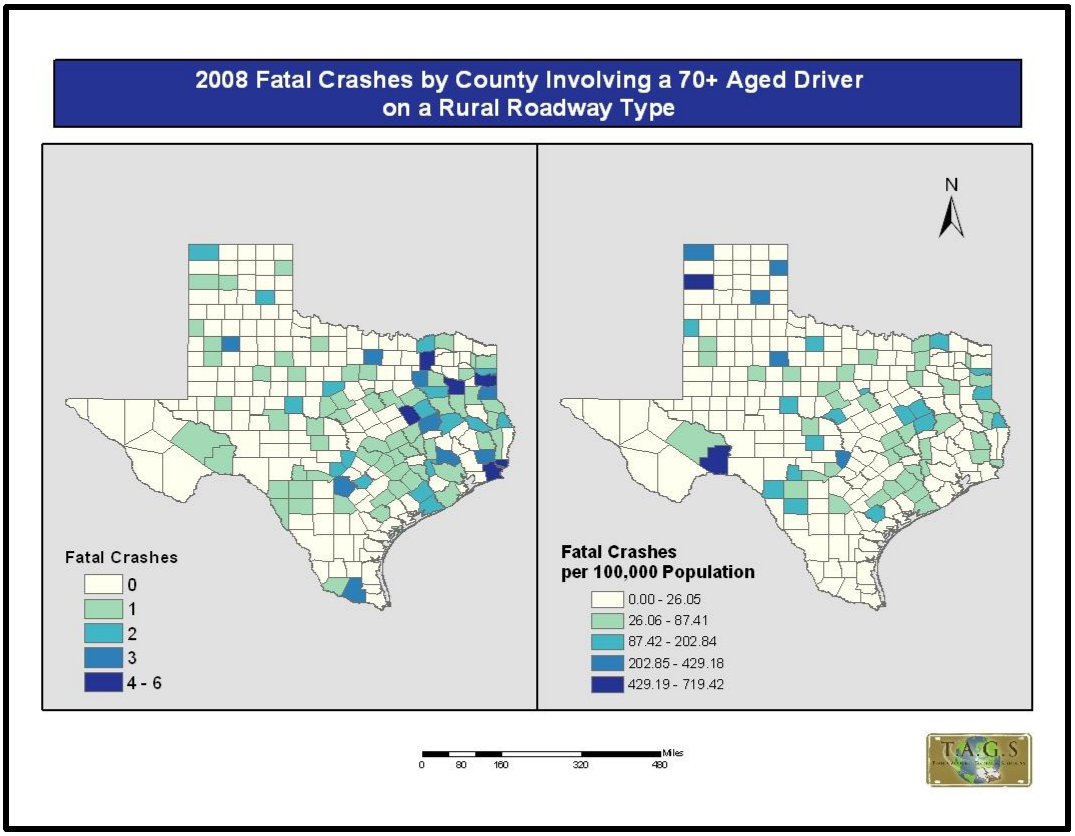

Figure 17. Rural roadway types for the 70 and over aged driver.

Within the 15-24 age group, the frequency of fatal crashes on interstate, highway, and local roads (local roads beings streets whose primary purpose is feeding higher order systems, providing direct access with little or no through traffic) are in the Houston, Dallas, Austin, and San Antonio areas, but as shown in Figures 18, none of these counties have high fatal crash rates for this particular age group. Figure 19 and 20 show the distribution of fatal crashes for 15-24 aged drivers and under 70 aged drivers on local roadway types. Figure 21 shows that these are the most problematic roadway types for fatal crashes in those age groups.

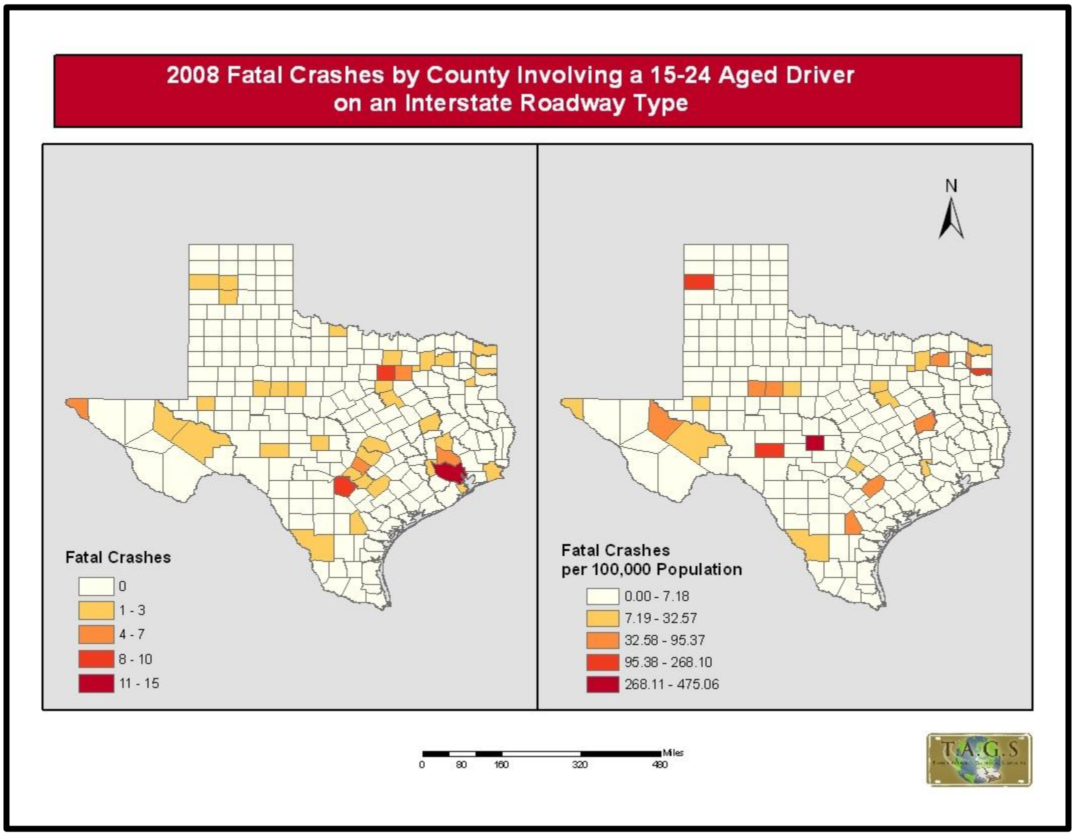

Figure 18. Interstate roadway type for a 15-24 aged driver.

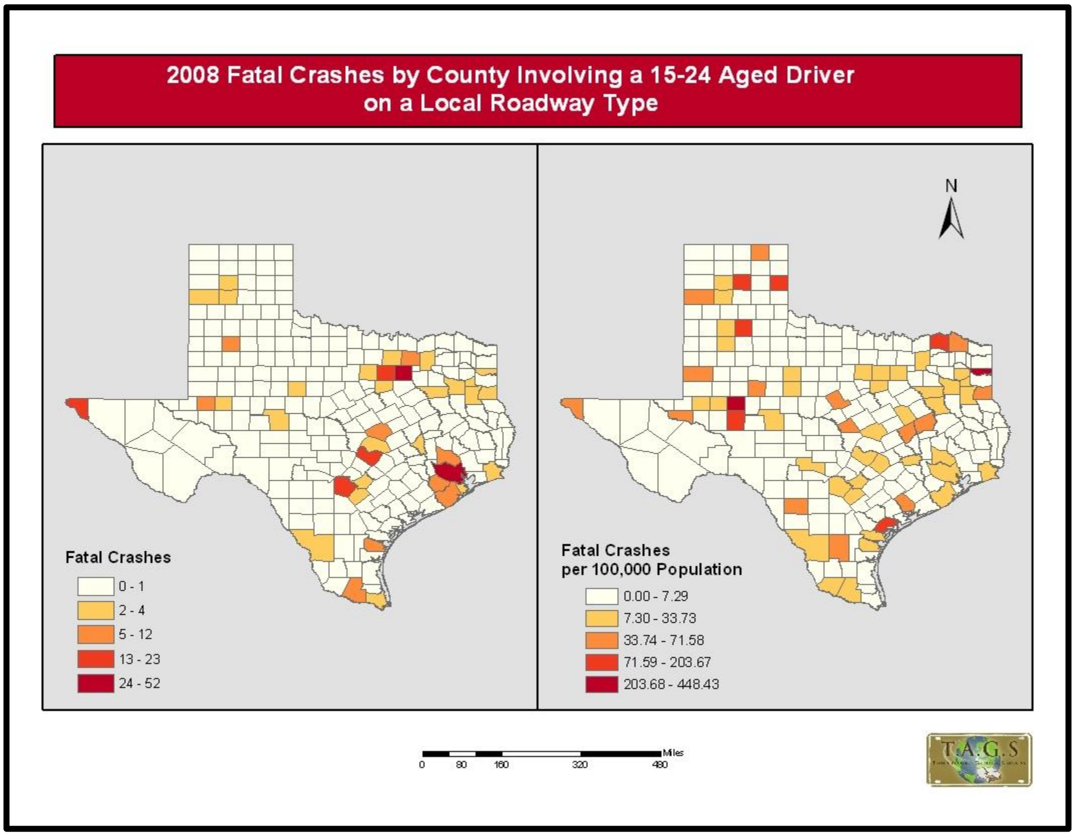

Figure 19. Local roadway type for a 15-24 aged driver.

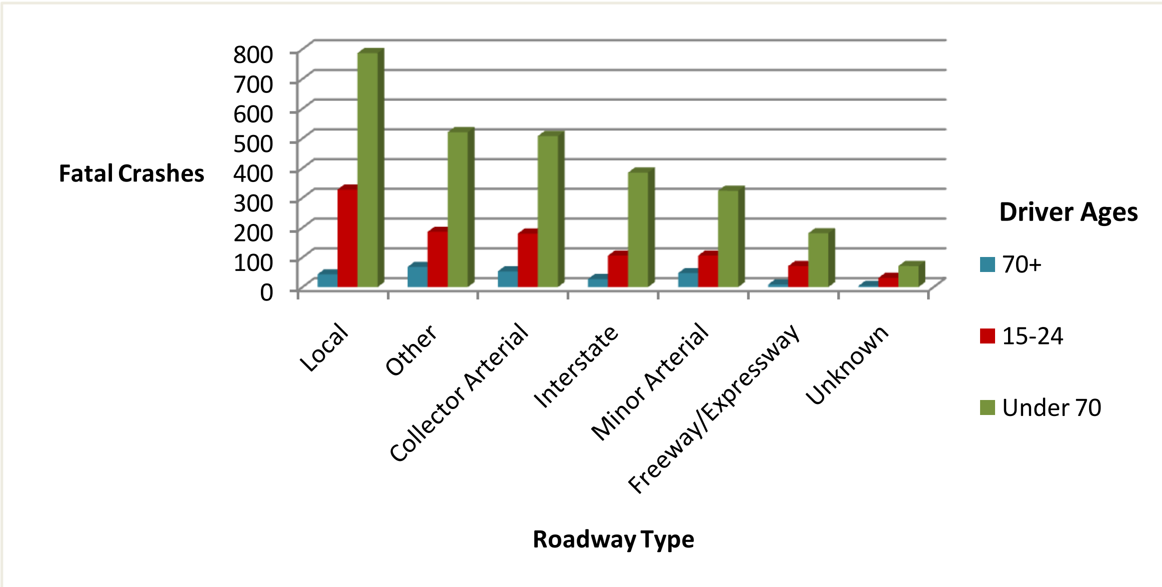

Figure 20. Fatal Crashes by Driver Age Groups on Different Roadway Types

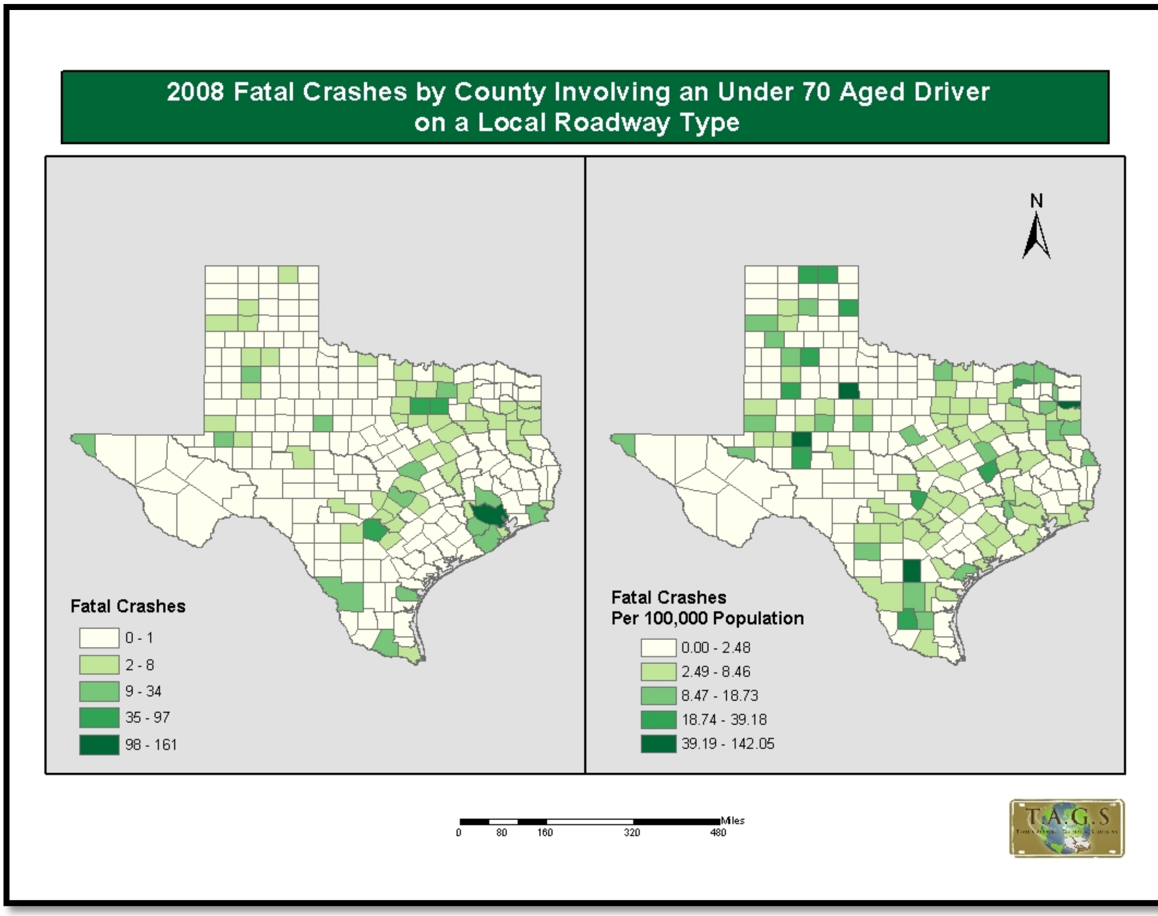

Figure 21. Local roadway type for under 70 aged drivers

5.2 CRIS DATA ANALYSIS

The descriptive results are based on the 2008 CRIS data as it relates to the driver of vehicles that were involved in a traffic crash in which a fatality occurred and to the location of each fatal crash. This study examines both on a statewide and county specific scope, a more specific location oriented analysis of various factors.

5.2.1 Construction Zone Analysis

We identified a pattern in the moderately populated county of Henderson, Figure 22. There were many fatal crashes in construction zones or maintenance areas. This is important because they were fairly close in distance from each other and Henderson county is not a heavily populated county.

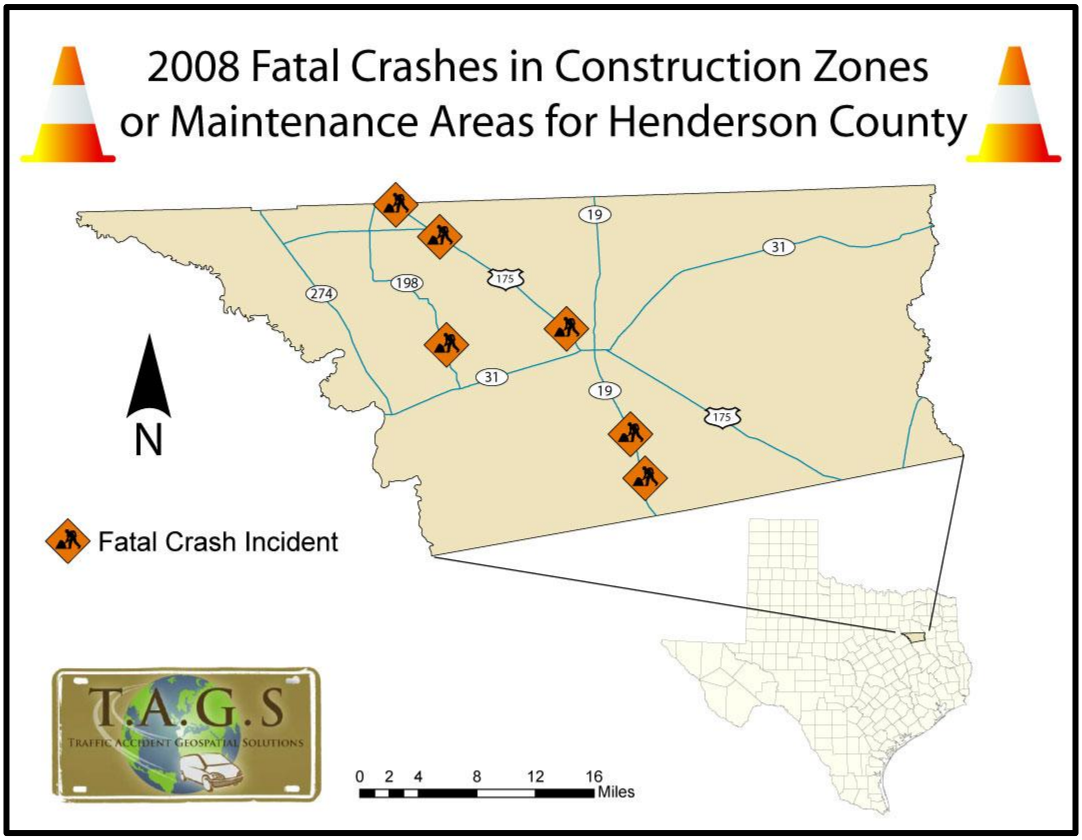

Figure 22. Construction zone fatalities within Henderson County

5.2.2 Density Studies

Many problem areas have been identified in higher populated areas. These can be seen on the fatal crash density maps for Travis and Harris counties. As is shown in Figure 23 and

Figure 24, high density fatal crash clusters are grouped around major highway within the counties. For example, in Figure 23, there are numerous high density clusters within Travis County along Interstate 35, Highway 183, and Highway 290. All of these highways are major arteries for both daily commuter and through traffic. In Figure 23, Harris County shows a high density cluster of fatal crashes occurring at the interchange area of Interstate 45 and Interstate 610 and along Highway 59 at the Jensen Road interchange.

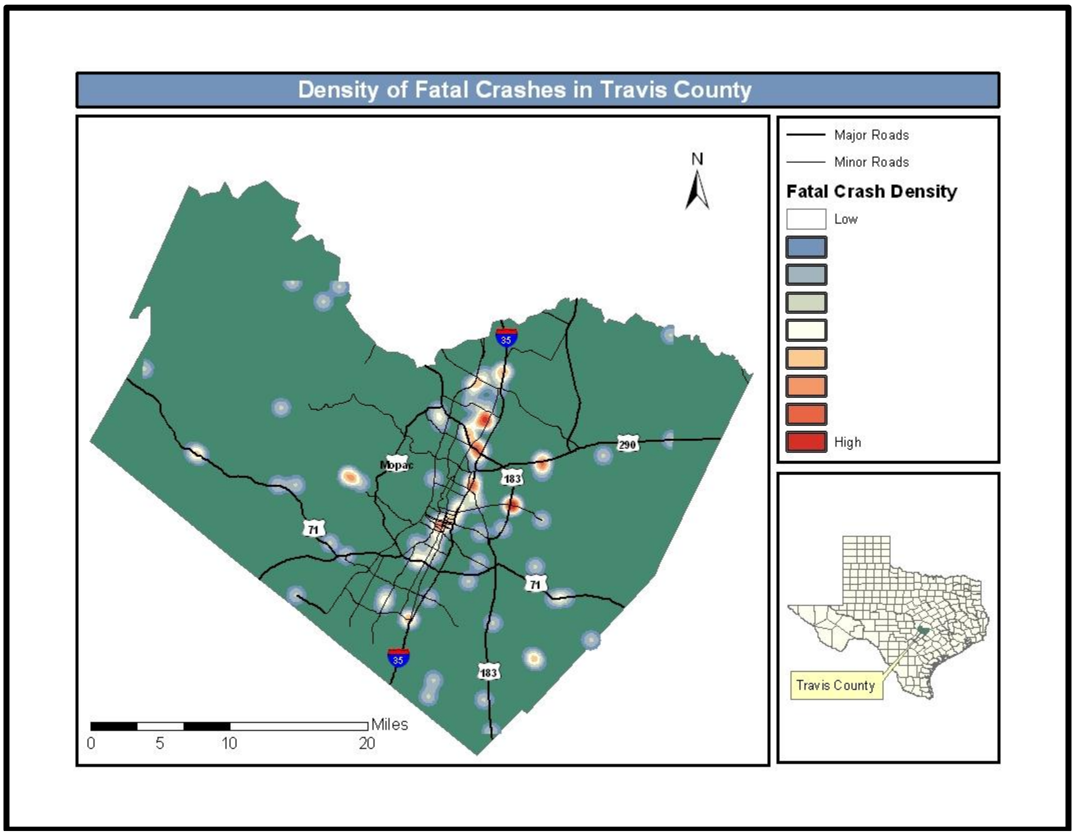

Figure 23. Fatal crash density in Travis County

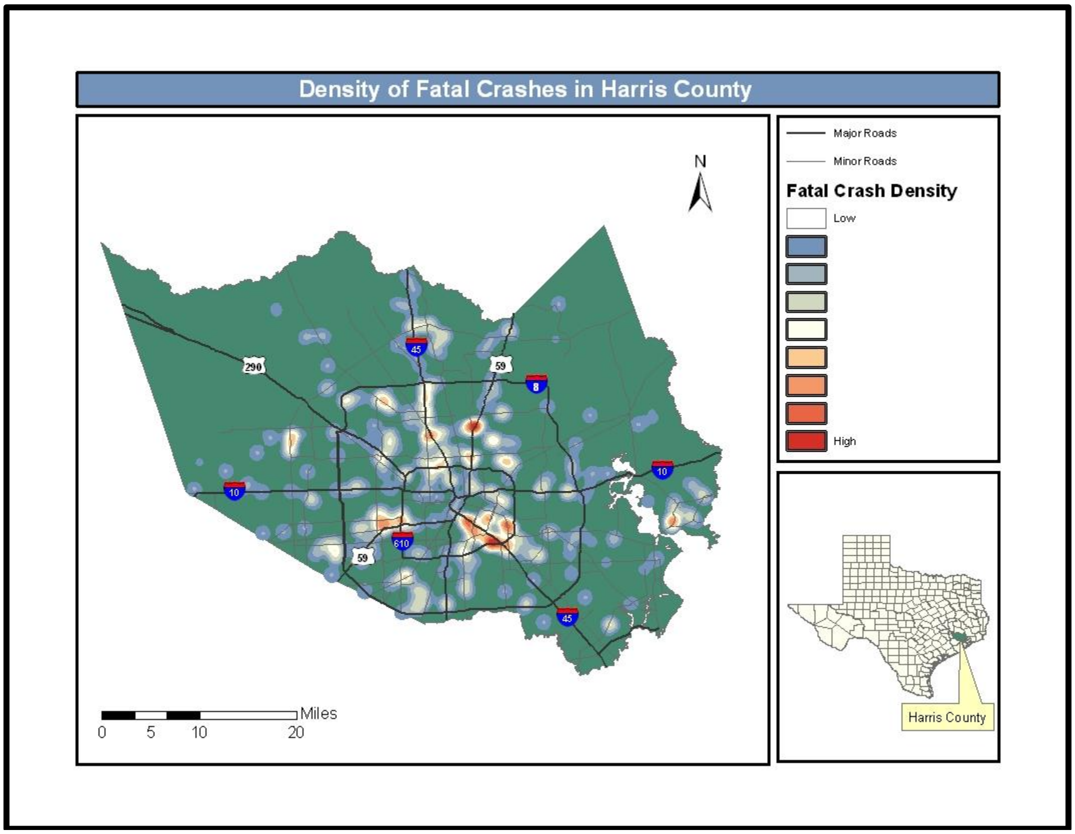

Figure 24. Fatal crash density in Harris County

5.2.3 Lighting Study

Figures 25 and 26 display the difference in the spatial distribution of fatal crashes observed when examining lit and unlit roadways during evening hours. There is a significant increase in the number of fatal crashes that occur in evening hours on unlit roadways (919) as opposed to lit roadways (658), especially in the corridor counties that connect the Austin area with the Houston area.

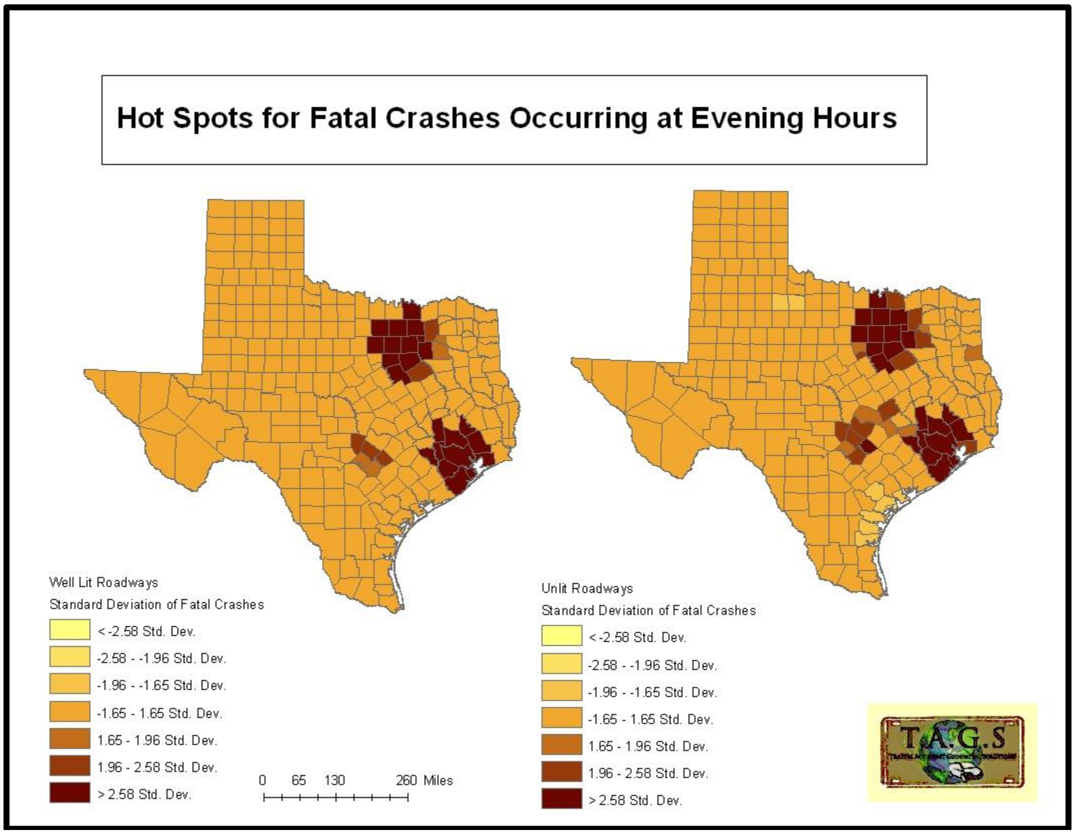

Figure 25. Fatal crash evening hour “hot spots” within Texas

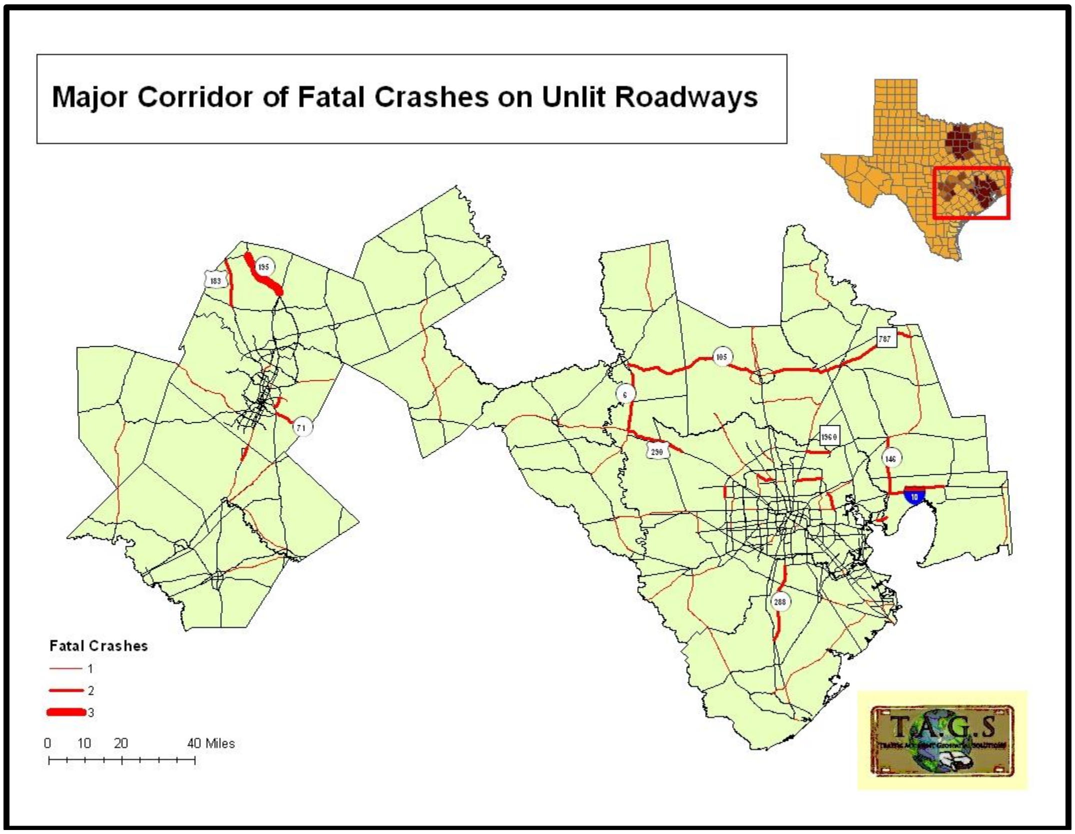

Figure 26. Fatal crashes on unlit roadways within the Central Texas and Houston Corridor.

6. DISCUSSION

We believe the results and findings are significant in tackling the problem of high fatal crashes in the state of Texas. The results prove that using spatial analysis through the use of GIS can be very beneficial when attempting to identify problems relating to traffic crashes. With the FARS data we analyzed we were able to pinpoint problem areas by county and provide a geographic visualization of both the frequencies and rates of the counties. This can further help governments identify which counties are having problems with particular issues and take the action to address the issues.

Although the FARS data and analysis is highly useful and has potential for many more significant spatial studies we believe the CRIS data has potential for being utilized at a much more localized level. This is because of the specific geographic location of crashes and the information attached to the crashes in the data set. With the FARS data we were able to observe general statewide trends in fatal crashes involving many different factors. However, for some issues to be addressed, it will be important to find the specific areas of problems. The CRIS data set helps the later come to light. For example, from the FARS we learned that local roadways observed many fatal crashes in several counties. With that being known, the CRIS data can be used to further find out what local roadways are the problems in those counties. The density calculation available in ArcGIS is highly useful tool for analyzing point location data like the data in the CRIS data set. As shown in this study on some maps it shows areas in particular counties with a high density of fatal crashes. When patterns like this are discovered it can be very useful for governments to realize where attention is needed.

The FARS data might have been as useful if we had had a better access method to the data. The online web interface only allowed for queries which represented "and" conditions, and thus, limited the types of queries that could be made. In the future, access to the FARS database should be provided through the Statistical Analysis System (SAS) software interface, which would allow for a more robust data analysis. Access of this type would allow researchers to utilize a more sophisticated set of queries providing a deeper and more complete analysis of the FARS database.

The FARS frequency of fatal crashes analysis was very effective in revealing a statewide view of the factors that are affecting Texas Counties. The rate calculation was extremely useful in identifying counties with higher fatal crash frequencies, but had much lower rates because of their larger age group populations. In some instances, the high rates can be deceiving. Counties that showed a high rate of fatal crashes for a given age group were, in some instances, because the county had a lower age group population even one fatal crash could produce a high rate.

Another approach in determining fatal crash rates would be to use fatal crashes per vehicle miles travel. This would provide a different rate representation which includes in the rate both the driver and vehicle combination and the miles traveled versus relating fatal crashes to the population which can include non-drivers. This method would eliminate the dependence on age group populations and remove the restriction that the driver was a citizen of the county in which the fatal crash occurred.

Since the focus on this project was to deliver maps and spatial analysis of the FARS data set we did not spend as much time with the CRIS data. If more time were available we would focus more resources on the CRIS data set. One issue that came up with the data set was that the data was in multiple spreadsheets and not connected in any way. We had to spend some time finding out how to merge the data. If the data were in a database form it would be easier to access and therefore easier to use.

The CRIS data set is very useful and has a vast amount of information. Because of time constraints T.A.G.S was only able to perform analysis on a small part of the CRIS data. If T.A.G.S had more time to analyze the CRIS data set the following illustrates only a few things that could be accomplished with the data and GIS analysis.

Driving "Under the Influence (DUI)" is a potential health hazard common across the country. The CRIS data notes in each crash record if DUI was involved in the crashes. These can be plotted on roadway maps in order to look for spatial trends and problem areas. Police Enforcement might find this useful if an area is discovered that has many crashes involving DUI crashes. A further analysis of the data could reveal proximity of crashes to areas of relevance such as bars or nightclubs.

Another example of a study that could be completed with the CRIS data set is observing where fatal crashes occur during rush hours for metropolitan areas. Since the data provides times for each crash, potential patterns can be discovered during rush hour times. This might aid governments in realizing where a High Occupancy Vehicle lane could be beneficial or where road attention is needed.

7. CONCLUSION

T.A.G.S feels that the use of GIS to create geographic visualizations of both the FARS and CRIS data sets proved to be highly successful. By using GIS and the abundant amount of data contained in spreadsheet form within both data sets, T.A.G.S was able to compile maps into an easily referenced map album. By placing the data into maps, the information regarding the locations of fatal traffic crashes and the involved factors, in association with their occurrences, became readily accessible to the reader. The maps were able to highlight in a visually comprehensible way the areas in greatest need of attention, and the areas where funding might be capable of being shifted away from so as to be spent more beneficially by being focused elsewhere. The results of the study have created a collection of maps that T.A.G.S believes will help in the development of additional investigations that will only further lead to the reduction of fatal traffic crashes occurring on Texas roadways in subsequent years to come.

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APPENDIX I. METADATA

Counties.shp

How should this dataset be cited?

1. Origin – Texas General Land Office
2. Title – Counties.shp

Who published this dataset?

1. Published by – Texas Commission on Environmental Quality
2. Published at – Austin, TX

Dataset description

1. Abstract – Boundaries and names of the 254 Texas counties.
2. Purpose – Digital boundaries provided by the Texas Commission on Environmental Quality (TCEQ).

When is the dataset relevant?

1. Date of dataset – 2009
2. Progress of data – Complete
3. Data currency – None
4. Update frequency – None Planned

What are the spatial extents of the dataset?

1. North – 36.53
2. South – 25.70
3. East – -93.11
4. West – -106.97

Are there dataset constraints?

1. Access – Anyone
2. Use – None
3. Security classification – None. Acknowledgement of the EPA is appreciated.

TxDotRoads.shp

How should this dataset be cited?

1. Origin – Texas General Land Office
2. Title – TxDotRoads.shp

Who published this dataset?

1. Published by – TxDot
2. Published at – Austin, TX

Dataset description

1. Abstract – TxDOT roads, streets and street types for all Texas counties
2. Purpose – TxDOT roads, streets and street types for all Texas counties

When is the dataset relevant?

1. Date of dataset - 2009
2. Progress of data – Current
3. Data currency – none
4. Update Frequency – Update as needed

What are the spatial extents of the dataset?

1. North – 36.51
2. South – 25.85
3. East – -93.51
4. West – -106.64

Are there dataset constraints?

1. Access – Anyone
2. Use – None
3. Security classification – None

15-24 FARS Data

How should this dataset be cited?

1. Origin – NHTSA
2. Title – Fatality Analysis Reporting System

Who published this dataset?

1. Published by – T.A.G.S
2. Published at – Texas State University - San Marcos, Tx

Dataset description

1. Abstract – Fatality information is derived from the Fatality Analysis Reporting System (FARS). FARS includes motor vehicle traffic crashes that result in fatality to a vehicle occupant or nonmotorist, from injuries resulting from a traffic crash, that occur within 30 days of the crash.
2. Purpose – FARS data can be used to answer many questions on the safety of vehicles, drivers, traffic situations, and roadways. FARS data can also be accessed at the state level by the FARS analyst to respond to state safety issues. To protect individual privacy, no personal information, such as names, addresses, or specific crash locations, is coded.

When is the dataset relevant?

1. Date of dataset - 2008
2. Progress of data - Complete
3. Data Currency - None
4. Update frequency – None planned

What are the spatial extents of the dataset?

1. North – 36.51
2. South – 25.85
3. East – -93.51
4. West – -106.64

Are there dataset constraints?

1. Access – Anyone
2. Use – None
3. Security classification – None

-70 FARS Data

How should this dataset be cited?

1. Origin – NHTSA

2. Title – Fatality Analysis Reporting System

Who published this dataset?

1. Publisher – T.A.G.S
2. Published at – Texas State University - San Marcos, Tx

Dataset description

1. Abstract – Fatality information is derived from the Fatality Analysis Reporting System (FARS). FARS includes motor vehicle traffic crashes that result in fatality to a vehicle occupant or nonmotorist, from injuries resulting from a traffic crash, that occur within 30 days of the crash.
2. Purpose – FARS data can be used to answer many questions on the safety of vehicles, drivers, traffic situations, and roadways. FARS data can also be accessed at the state level by the FARS analyst to respond to state safety issues. To protect individual privacy, no personal information, such as names, addresses, or specific crash locations, is coded.

When is the dataset relevant?

1. Date of dataset - 2008
2. Progress of data - Complete
3. Data currency - None
4. Update frequency – None planned

What are the spatial extents of the dataset?

1. North – 36.51
2. South – 25.85
3. East – -93.51
4. West – -106.64

Are there dataset constraints?

1. Access – Anyone
2. Use – None
3. Security classification – None

70+ FARS Data

How should this dataset be cited?

1. Origin – NHTSA
2. Title – Fatality Analysis Reporting System

Who published this dataset?

1. Publisher – T.A.G.S
2. Published at – Texas State University - San Marcos, Tx

Dataset description

1. Abstract – Fatality information is derived from the Fatality Analysis Reporting System (FARS). FARS includes motor vehicle traffic crashes that result in fatality to a vehicle occupant or nonmotorist, from injuries resulting from a traffic crash, that occur within 30 days of the crash.
2. Purpose – FARS data can be used to answer many questions on the safety of vehicles, drivers, traffic situations, and roadways. FARS data can also be accessed at the state level by the FARS analyst to respond to state safety issues. To protect individual privacy, no personal information, such as names, addresses, or specific crash locations, is coded.

When is the dataset relevant?

1. Date of dataset – 2008
2. Progress of dataset – Complete
3. Data currency – None
4. Update frequency – None planned

What are the spatial extents of the dataset?

1. North – 36.51
2. South – 25.85
3. East – -93.51
4. West – -106.64

Are there dataset constraints?

1. Access – Anyone
2. Use – None
3. Security classification – None

CRIS Data

How should this dataset be cited?

1. Origin – TxDOT & DPS
2. Title – Crash Records Information System

Who published this dataset?

1. Publisher – Texas Department of Public Safety
2. Published at – Austin, Tx

Dataset description

1. Abstract – Accurate and timely collection of crash data is critical to the success of the following functions: State and local transportation project planning and prioritization.
   Highway and railroad-crossing safety evaluations.
   TxDOT and private traffic safety studies.
2. Purpose – Mission – implement system that will provide enhanced efficiencies to capture, manage and deliver timely and accurate data to improve safety of Texas roadways

When is the dataset relevant?

1. Date of dataset – 2008
2. Progress of dataset – Complete
3. Data currency –None
4. Update frequency –None Planned

What are the spatial extents of the dataset?

1. North – 36.51
2. South – 25.85
3. East – -93.51
4. West – -106.64

Are there dataset constraints?

1. Access – Anyone
2. Use – None
3. Security classification – None

APPENDIX II. DEFINITIONS

Table 7. FARS Definitions (source: http://www-fars.nhtsa.dot.gov/Help/Terms.aspx)

Collectors	In Rural Areas, Routes Serving Intra-county, Rather Than Statewide Travel. In Urban Areas, Streets Providing Direct Access To Neighborhoods As Well As Direct Access To Arterials.
Construction/ Maintenance Zone	An Area, Usually Marked By Signs, Barricades, Or Other Devices Indicating That Highway Construction Or Highway Maintenance Activities Are Ongoing.
Crash	An Event That Produces Injury And/or Property Damage, Involves A Motor Vehicle In Transport, And Occurs On A Traffic way Or While The Vehicle Is Still In Motion After Running Off The Traffic way.
Driver	An Occupant Of A Vehicle Who Is In Physical Control Of A Motor Vehicle In Transport, Or For An Out-of-control Vehicle, An Occupant Who Was In Control Until Control Was Lost.
Fatal Crash	A Police-reported Crash Involving A Motor Vehicle In Transport On A Traffic way In Which At Least One Person Dies Within 30 Days Of The Crash.
Interstates	Limited Access Divided Facilities Of At Least Four Lanes Designated By The Federal Highway Administration As Part Of The Interstate System.
Local Streets And Roads	Streets Whose Primary Purpose Is Feeding Higher Order Systems, Providing Direct Access With Little Or No Through Traffic.
Minor Arterials	Streets And Highways Linking Cities And Larger Towns In Rural Areas In Distributing Trips To Small Geographic Areas In Urban Areas (not Penetrating Identifiable Neighborhoods).
Freeways And Expressways	All Urban Principal Arterial With Limited Control Of Access Not On The Interstate System.
Principal Arterials	Major Streets Or Highways, Many With Multi-lane Or Freeway Design, Serving High-volume Traffic Corridor Movements That Connect Major Generators Of Travel.
Roadway	That Part Of A Traffic way Designed, Improved, And Ordinarily Used For Motor Vehicle Travel.
Roadway Function Class	The Classification Describing The Character Of Service The Street Or Highway Is Intended To Provide.

APPENDIX III. TEAM MEMBER CONTRIBUTION

Team Name – All team members contributed and provided input

Logo Design – All team members provided input and ideas on logo. Final logo and design by Mark Poitras

Proposal

- *Summary* **–** Catherine Perille, Larissa Matin, Mark Poitras
- *Purpose* **-** Catherine Perille, Larissa Matin, Mark Poitras
- Scope – Larissa Matin
- *Data* – Paul Head
- *Methodology* – Paul Head
- *Implications* – Catherine Perille, Mark Poitras, Larissa Matin
- *Timeline* – Frank Martin
- *Budget* – Catherine Perille, Frank Martin
- *Final Deliverables* – Catherine Perille
- *Presentation* – All team members contributed, design by Frank Martin

Data for Project

- *Supplementary Data Acquisition* – Catherine Perille, Paul Head
- *FARS Data Exploration* – Mark Poitras, Frank Martin
- *FARS Data Collection* - All team members contributed (see Table 8)
- *FARS Data Quality Checks* – All team members contributed (see Table 8)
- *FARS Literature Review* – Frank Martin, Mark Poitras
- *FARS Database Design* – Mark Poitras, Frank Martin

- *FARS Data Processing* – All team members contributed
- *CRIS Data Exploration* – Mark Poitras, Paul Head, Frank Martin
- *CRIS Data Processing* – Mark Poitras, Frank Martin

GIS Implementation and Map Making

- *FARS Map Template Design* – Paul Head, Frank Martin
- *FARS Map Making and Spatial Data Processing* - Paul Head, Frank Martin, Larissa Matin, Catherine Perille (see Table 9)
- *Imported X, Y CRIS point data to GIS* – Mark Poitras, Paul Head
- *Merged CRIS data sets* – Frank Martin
- *Projected CRIS data sets* – Mark Poitras
- *Designed CRIS GIS Template with all data* – Mark Poitras
- *Explored Different spatial studies (Spatial Joins, Kernel Density, etc)* – Mark Poitras
- *Created Henderson County Map* – Mark Poitras
- *Created Bexar County (graduated road) Map* – Mark Poitras
- *70+ Driver Factor Comparison Maps for all 3 age groups* – Frank Martin
- *County Density Maps* – Paul Head
- *Unlit Road study CRIS map creation and analysis* – Larissa Matin
- *Hot Spots CRIS Study map creation and analysis* – Larissa Matin

Progress Report

- *Introduction* – Larissa Matin

- *Project Description* – Larissa Matin
- *Summary* – Mark Poitras
- *Scope* – Larissa Matin
- *Literature Review* – Mark Poitras
- *Current Work Section* – Mark Poitras
- *Query Process* – Catherine Perille
- *Quality Assurance* – Catherine Perille
- *Challenges* – Frank Martin
- *Future Work Section* – Frank Martin
- *Rate Calculation Flowchart* – Mark Poitras
- *Map Creation* – Paul Head
- *Pilot Study* – Paul Head
- *Overall Project Assessment* – Larissa Matin
- *Slideshow* – All team members

Website

- *Design* – Mark Poitras

Poster

- *Design* – Frank Martin, Mark Poitras
- *Introduction* – Larissa Matin
- *Purpose* – Mark Poitras, Larissa Matin
- *Methodology* – Frank Martin, Paul Head
- *Results and Findings* – Mark Poitras, Frank Martin

- *Conclusion* – Frank Martin, Mark Poitras, Larissa Matin
- *Chart* – Mark Poitras

Final Report

- *Abstract* – Mark Poitras
- *Introduction* – Larissa Matin, Mark Poitras
- *Literature Review*- Catherine Perille, Larissa Matin (intro paragraph, one review), Mark Poitras (paragraph about FARS)
- *Data* – Paul Head
- *Methodology* – Paul Head, Mark Poitras (Charts and Paragraph about Roadway types)
- *Results* – Frank Martin
- *Discussion* – Frank Martin, Mark Poitras (paragraphs about CRIS)
- *Conclusion* – Larissa Matin
- *References* – Catherine Perille
- *Book of Maps* – Frank Martin, Paul Head, Mark Poitras
- *Metadata* – Paul Head
- *Editing* – Frank Martin, Larissa Matin, Mark Poitras

Table 8. FARS Data collection work division.

70+ Age Driver Group	Number of Maps	Scope	Person	Started	Complete	Checked
Frequency of Fatal Crashes	1 Map		Mark	✓	✓	FM
Rate of Fatal Crashes	1 Map		Frank	✓	✓	MP
Frequency of Fatal Crashes for each top 6 Major Driver Factors	6 Maps - 1 for each driver factor		Frank	✓	✓	MP
Rate Fatal Crashes for each top 6 Major Driver Factors	6 Maps - 1 for each driver factor		Frank	✓	✓	MP
Frequency of Fatal Crashes for Roadway Types (Roadway Function Class)***	5-6 Maps - 1 for each roadway type	All Counties	Cat	✓	✓	FM
Rate of Fatal Crashes for Roadway Types (Roadway Function Class)	5-6 Maps - 1 for each roadway type		Frank	✓	✓	MP
Frequency of Fatal Crashes for Urban/Rural (Roadway Function Class)*	1 map for Urban / 1 map for rural		Larissa	✓	✓	PH
Rate of Fatal Crashes for Urban/Rural (Roadway Function Class)	1 map for Urban / 1 map for rural		Frank	✓	✓	MP
Frequency Fatal Crashes and Roadway Conditions	** # of Maps will vary		Paul	✓	✓	MP
Rate of Fatal Crashes and Roadway Conditions	** # of Maps will vary		Frank	✓	✓	MP
<70 Age Driver Group						
Frequency of Fatal Crashes	1 Map		Mark	✓	✓	FM
Rate of Fatal Crashes	1 Map		Paul	✓	✓	FM
Frequency of Fatal Crashes for each top 6 Major Driver Factors	6 Maps - 1 for each driver factor		Mark	✓	✓	PH
Rate Fatal Crashes for each top 6 Major Driver Factors	6 Maps - 1 for each driver factor		Paul	✓	✓	FM
Frequency of Fatal Crashes for Roadway Types (Roadway Function Class)***	5-6 Maps - 1 for each roadway type	All Counties	Cat	✓	✓	FM
Rate of Fatal Crashes for Roadway Types (Roadway Function Class)	5-6 Maps - 1 for each roadway type		Frank	✓	✓	MP
Frequency of Fatal Crashes for Urban/Rural (Roadway Function Class)*	1 map for Urban / 1 map for rural		Paul	✓	✓	MP
Rate of Fatal Crashes for Urban/Rural (Roadway Function Class)	1 map for Urban / 1 map for rural		Paul	✓	✓	FM
Frequency Fatal Crashes and Roadway Conditions	** # of Maps will vary		Paul	✓	✓	MP
Rate of Fatal Crashes and Roadway Conditions	** # of Maps will vary		Paul	✓	✓	FM
15-24 Age Driver Group						
Frequency of Fatal Crashes	1 Map		Mark	✓	✓	PH
Rate of Fatal Crashes	1 Map		Mark	✓	✓	PH
Frequency of Fatal Crashes for each top 6 Major Driver Factors	6 Maps - 1 for each driver factor		Larissa	✓	✓	MP
Rate Fatal Crashes for each top 6 Major Driver Factors	6 Maps - 1 for each driver factor		Mark	✓	✓	PH
Frequency of Fatal Crashes for Roadway Types (Roadway Function Class)***	5-6 Maps - 1 for each roadway type	All Counties	Cat	✓	✓	LM & MP
Rate of Fatal Crashes for Roadway Types (Roadway Function Class)	5-6 Maps - 1 for each roadway type		Mark	✓	✓	LM
Frequency of Fatal Crashes for Urban/Rural (Roadway Function Class)*	1 map for Urban / 1 map for rural		Larissa	✓	✓	PH
Rate of Fatal Crashes for Urban/Rural (Roadway Function Class)	1 map for Urban / 1 map for rural		Mark	✓	✓	LM
Frequency Fatal Crashes and Roadway Conditions	** # of Maps will vary		Larissa	✓	✓	MP
Rate of Fatal Crashes and Roadway Conditions	** # of Maps will vary		Mark	✓	✓	LM

Table 9. FARS Mapping creation division.

70+ Age Driver Group	Number of Maps	Scope	Person	Started	Complete
Frequency of Fatal Crashes	1 Map	All Counties	Frank	✓	✓
Rate of Fatal Crashes	1 Map		Frank	✓	✓
Frequency of Fatal Crashes for each top 6 Major Driver Factors	6 Maps - 1 for each driver factor		Frank	✓	✓
Rate Fatal Crashes for each top 6 Major Driver Factors	6 Maps - 1 for each driver factor		Frank	✓	✓
Frequency of Fatal Crashes for Roadway Types (Roadway Function Class)***	5-6 Maps - 1 for each roadway type		Paul	✓	✓
Rate of Fatal Crashes for Roadway Types (Roadway Function Class)	5-6 Maps - 1 for each roadway type		Paul	✓	✓
Frequency of Fatal Crashes for Urban/Rural (Roadway Function Class)*	1 map for Urban / 1 map for rural		Paul	✓	✓
Rate of Fatal Crashes for Urban/Rural (Roadway Function Class)	1 map for Urban / 1 map for rural		Paul	✓	✓
Frequency Fatal Crashes and Roadway Conditions	** # of Maps will vary		Frank	✓	✓
Rate of Fatal Crashes and Roadway Conditions	** # of Maps will vary		Frank	✓	✓
<70 Age Driver Group					
Frequency of Fatal Crashes	1 Map	All Counties	Paul	✓	✓
Rate of Fatal Crashes	1 Map		Paul	✓	✓
Frequency of Fatal Crashes for each top 6 Major Driver Factors	6 Maps - 1 for each driver factor		Paul	✓	✓
Rate Fatal Crashes for each top 6 Major Driver Factors	6 Maps - 1 for each driver factor		Paul	✓	✓
Frequency of Fatal Crashes for Roadway Types (Roadway Function Class)***	5-6 Maps - 1 for each roadway type		Paul	✓	✓
Rate of Fatal Crashes for Roadway Types (Roadway Function Class)	5-6 Maps - 1 for each roadway type		Paul	✓	✓
Frequency of Fatal Crashes for Urban/Rural (Roadway Function Class)*	1 map for Urban / 1 map for rural		Cat	✓	✓
Rate of Fatal Crashes for Urban/Rural (Roadway Function Class)	1 map for Urban / 1 map for rural		Cat	✓	✓
Frequency Fatal Crashes and Roadway Conditions	** # of Maps will vary		Paul	✓	✓
Rate of Fatal Crashes and Roadway Conditions	** # of Maps will vary		Paul	✓	✓
15-24 Age Driver Group					
Frequency of Fatal Crashes	1 Map	All Counties	Cat	✓	✓
Rate of Fatal Crashes	1 Map		Cat	✓	✓
Frequency of Fatal Crashes for each top 6 Major Driver Factors	6 Maps - 1 for each driver factor		Cat	✓	✓
Rate Fatal Crashes for each top 6 Major Driver Factors	6 Maps - 1 for each driver factor		Cat	✓	✓
Frequency of Fatal Crashes for Roadway Types (Roadway Function Class)***	5-6 Maps - 1 for each roadway type		Larissa	✓	✓
Rate of Fatal Crashes for Roadway Types (Roadway Function Class)	5-6 Maps - 1 for each roadway type		Larissa	✓	✓
Frequency of Fatal Crashes for Urban/Rural (Roadway Function Class)*	1 map for Urban / 1 map for rural		Larissa	✓	✓
Rate of Fatal Crashes for Urban/Rural (Roadway Function Class)	1 map for Urban / 1 map for rural		Larissa	✓	✓
Frequency Fatal Crashes and Roadway Conditions	** # of Maps will vary		Larissa	✓	✓
Rate of Fatal Crashes and Roadway Conditions	** # of Maps will vary		Larissa	✓	✓