Final Report

Reducing Fatalities and Severe Injuries on Florida's High-Speed Multi-Lane Arterial Corridors

Part III
COUNTY LEVEL AND ROADWAY LEVEL GIS SAFETY ANALYSIS OF STATE MULTILANE CORRIDORS IN FLORIDA

BD-548-22

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This part of the study examines the locations of high trends of severe crashes (incapacitating and fatal crashes) on multilane corridors in the state of Florida at two levels, county level and roadway level. The Geographic Information System (GIS) tool, which is used frequently in traffic safety research, was utilized in this study to identify those locations. At the roadway level, seven counties were chosen for the analysis based on their high severe crash trends, metropolitan size and geographical location. Several GIS maps displaying the safety level of multilane corridors in the seven counties were generated. The GIS maps were based on a ranking methodology that we developed and which evaluated the safety condition of road segments and signalized intersections separately. The GIS maps were supported by tables which provided the milepoints of the most hazardous locations on the roadways. The results of the roadway level analysis found that the worst corridors were located in Pasco, Pinellas and Hillsborough counties.</td></tr>
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EXECUTIVE SUMMARY

This part of the study examines the locations of high trends of severe crashes (incapacitating and fatal crashes) on multilane corridors in the state of Florida at two levels, county level and roadway level. The Geographic Information System (GIS) tool, which is used frequently in traffic safety research, was utilized in this study to visually display and identify those locations.

There are 67 counties in the state of Florida. At the county level, several maps of crash trends were generated. It was found that counties with high population and big metropolitan areas tend to have more crash occurrences. It was also found that most severe crashes occurred in counties with more urban than rural roads. The neighboring counties of Pasco, Pinellas and Hillsborough had high severe crash rates per mile.

At the roadway level, seven counties were chosen for the analysis based on their high severe crash trends, metropolitan size and geographical location. Several GIS maps displaying the safety level of multilane corridors in the seven counties were generated. The GIS maps were based on a ranking methodology that we developed and which evaluated the safety condition of road segments and signalized intersections separately. The GIS maps were supported by tables which provided the milepoints of the most hazardous locations on the roadways. The results of the roadway level analysis found that the worst corridors were located in Pasco, Pinellas and Hillsborough counties.

We also developed a sliding window analysis that was conducted on the ten most hazardous corridors of the seven counties. The results of the sliding window analysis were graphs which located the most dangerous 0.5 miles on a corridor.

The results of this study provide the Florida Department of Transportation (FDOT) with specific information on where improvements should be implemented to achieve a reduction in severe crashes.

Disclaimer

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the State of Florida Department of Transportation.

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LIST OF ACRONYMS/ABBREVIATIONS

ADT	Average Daily Traffic
CAR	Crash Analysis Reporting System
FDOT	Florida Department of Transportation
FHWA	Federal Highway Administration
GIS	Geographic Information Systems
RCI	Roadway Characteristics Inventory
VMT	Vehicle Miles Traveled

CHAPTER 1. INTRODUCTION

Traffic safety is one of the most continuously researched topics in the field of transportation engineering. Traffic crashes lead to injuries, some of which can be fatal, and they also cause traffic congestion. An estimated 1.2 million people are killed, and as many as 50 million people are injured, in road crashes annually worldwide (Nambisan et. al, 2007). According to the National Highway Traffic Safety Administration (NHTSA), more than 42,600 people were killed in 2006 and about 2.6 million were injured in traffic-related crashes on the roads of the United States (NHTSA, 2006).

There were 256,200 traffic accidents in Florida in 2006; of which 3084 were fatal crashes which resulted in 3,365 deaths. The fatality rate on Florida roads is 1.65 deaths per 100 million vehicle miles traveled *(vmt)* which is higher than the national average of 1.42 deaths per 100 million *vmt* (FHSMV, 2006). Among different road types, principal and minor arterials account for 58% of total fatal crashes in Florida (NHTSA, 2004). The proportion and total number of fatal crashes on principal arterials (excluding freeways and toll roads) in Florida were the highest in the nation, compared to any other state, in 2003.

The U.S. congress passed the 1966 Highway Safety Act in order to improve highway safety requiring the state departments of transportation, to develop and implement safety improvement programs. The identification of hazardous locations based on crash history is one of the main cornerstones in the process of improving highway safety, guaranteeing efficient implementation of improvement programs.

The main aim of this study is to provide the Florida Department of Transportation (FDOT) the hazardous locations using the GIS tool. The study focuses specifically on Florida's state road system multilane corridors, mainly arterials. The mapping of those locations in GIS makes it easier to visually identify those locations. The GIS maps are supported by Microsoft Excel tables which provide more specific details about those locations.

The following are the steps followed to achieve the main objectives of this study:

1. Perform an exploratory district and county level GIS analysis of crash trends in Florida.
2. Identify and select counties with high trends of severe crashes.
3. Identify hazardous locations on the multilane corridors of the chosen counties.
4. Display those locations in GIS.
5. Provide tables that list details of those locations.

This report is organized as follows: Chapter 2 provides a review of previous studies that used GIS in assessing safety at county and roadway level. Chapter 3 describes the data collection process carried out for this study. Chapter 4 presents the methodology and findings of the district and county level GIS safety study (macro-GIS analysis). Chapter 5 presents the methodology and results of the roadway level GIS analysis (micro-GIS analysis). Chapter 6 describes a more detailed approach to roadway level safety analysis (sliding window analysis) and Chapter 7 provides the main conclusions of the study.

CHAPTER 2. LITERATURE REVIEW

2.1 County Level GIS Analysis

There are several published studies that used GIS analysis in order to evaluate crash trends. Aguero-Valverde et. al (2006) used county-level GIS mapping to display the distribution of severe crashes and fatal crash rates per *dvmt* (daily vehicle miles traveled) among the 67 counties of the state of Pennsylvania. The authors found that the highest frequency of severe crashes occurred in the biggest metropolitan areas of the state. It was also found that the highest rates of fatal crashes occurred in counties with low total number of crashes. This observation was attributed to the fact that fatal crashes rarely occur and a small increase in the number of those crashes tends to magnify the crash rate especially if those counties have low *dvmt* values.

Abdel-Aty and Radwan (1998) also used GIS to analyze crash trends at the county level in Florida. The study found that counties with high populations tend to have higher crash frequencies. The study also looked into the percentage of severe crashes to total crashes. The analysis concluded that rural counties tend to have higher severe crashes percentages than urban counties. Similar results were also found when the study looked at the distribution of drug and alcohol related crashes. The authors suggested that there might be a strong association between those two types of crashes.

GIS analysis has also been widely used to analyze crash types at county level. Khan et. al (2008) used GIS in order to select counties that displayed similar ice related crash rates in Wisconsin.

Kant (2005) analyzed the relationship between crash types and land-use in Florida using GIS. The study found that rear-end crashes and right turn crashes are more common on urban roads than on rural roads. This could be attributed to the fact that signalized intersections and traffic congestion are more common on urban roads than rural roads. The study also found that ran-off the road type of crashes were more common on rural roads than on urban roads.

2.2 Roadway Level GIS Analysis

The process of rating road safety using GIS involves the mapping of roads and visually displaying the varying safety conditions of road elements. This practice provides a helpful indicator to agencies on locations where improvements to the road are recommended in order to improve the safety condition. This is achieved by altering the size and the color of road elements, mainly road segments and signalized intersections, in GIS.

Kulikowski and Bejleri (2006) used color coding and thickness alteration to indicate varying safety conditions on a road network as seen in Figure 2-1 and Figure 2-2.

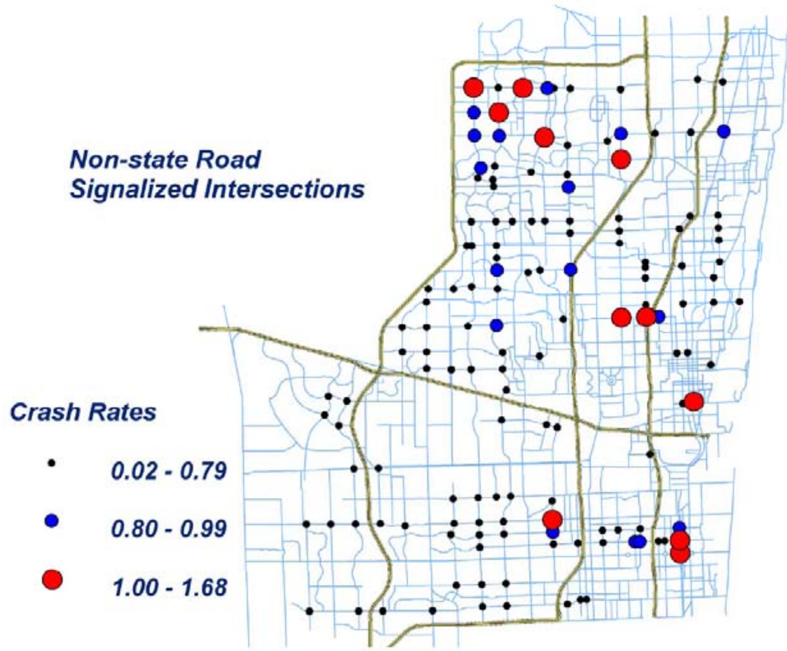

Figure 2-1: Example of Use of Color and Thickness in GIS

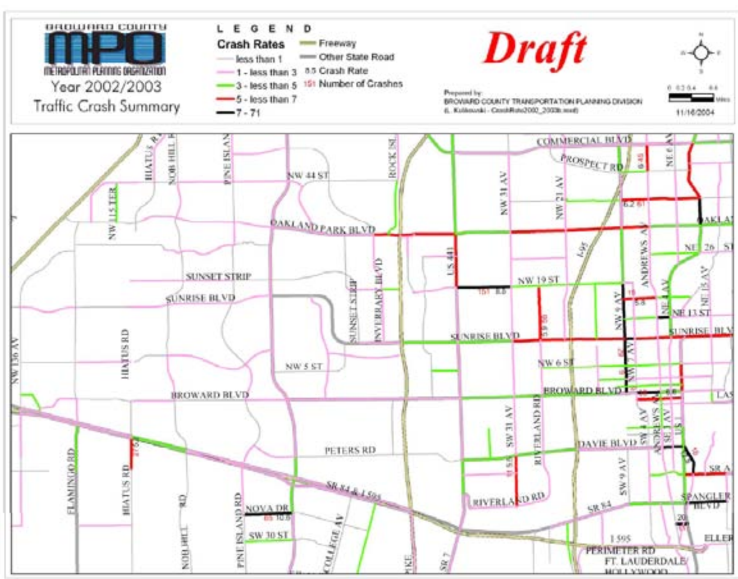

Figure 2-2: Another Example of Use of Color and Thickness in GIS

2.2.1 Methods of Rating the Safety of Roadway Elements

In order to be able to visually display the varying road safety condition, a methodology had to be devised to reflect the safety condition of a road element in comparison with another.

Kulikowski and Bejleri (2006) used a naive technique to rate the safety condition of road elements. The authors separated signalized intersections from road segments in a road network. Signalized intersections were ranked according to the rate of crashes per volume entering the intersection; the higher the rate, the higher the rank, the worse the intersection. Road segments were also ranked in a similar manner; the frequency of crashes on a road segment was normalized by the *vmt* of that particular road segment.

The Minnesota DOT (Hallmark et. al., 2002) also separated road segments from signalized intersections to evaluate the safety condition on roadway elements. Road segments and intersections were ranked according to each of the following criteria:

- Crashes per mile for road segments; total crashes for intersections
- Crash rate per *vmt* for road segments; crash rate per volume entering intersection
- Severity rate: an index similar to crash rate where fatal crashes have a weight of 10, injury crashes a weight of 4, and property damage have a weight of 1
- Crash cost: Each crash is multiplied by its monetary cost, and the total sum for all crashes is calculated. The final number is total cost for intersections and cost per mile for segments

The sum of the ranks of the criteria for each road segment and intersection were calculated;

the higher the ranking (lowest sum) the worse the safety condition.

Geurts et. al. (2003) proposed splitting a road corridor into equal 1-mile segments. This method did not separate a corridor's road segments from signalized intersections. The corridor was treated as a continuous entity. The 1-mile segments were ranked according to the frequency of the crashes within the 1-mile segments, with more weight given to severe crashes. This methodology, however, is biased towards intersections.

The Federal Highway Authority (FHWA) proposed the use of the sliding window analysis. In this type of analysis, the user defines an analysis window which *slides* along the road in an incremental fashion. The window that has the highest crash frequency is considered to be the most dangerous. The final output of this analysis is a table and a map indicating high crash locations. The FHWA provides a GIS add-on package that performs such type of analysis. The package is available for download on the FHWA website.

The safety rating methods that were discussed are widely used at many departments of transportations. However, this study focuses specifically on severe type crashes. Some methods for example, used the *vmt* in order to calculate crash rates. It is already well established that an increase in *vmt* tends to decrease the rate of severe crashes, which would mask the existence of a problem at a particular location of the road. This study will attempt at devising a ranking methodology for road safety rating that specifically targets severe crashes. The results of the ranking methodology will be displayed in GIS. A sliding window analysis will then be conducted on the most hazardous corridors to specify the exact high crashes location.

CHAPTER 3. DATA PREPARATION FOR THE ANALYSIS

There were three sets of data used in the GIS analysis; roadway data; crash data and GIS data. The roadway data was collected from the FDOT's Roadway Characteristics Inventory (RCI) repository. The crash data was obtained from the FDOT's Crash Analysis Resources (CAR) database available online. The GIS maps were also obtained online from the FDOT website.

3.1 Roadway Data

The FDOT's RCI database provides information and description of the state road system in Florida. The road characteristics from RCI that were used in the analysis are:

- County number: A unique number given to each of Florida's 67 counties
- Roadway ID: A unique seven or eight digit number given for a certain length of a state road. Each roadway ID is split into several small sections in the RCI database
- Beginning milepoint: The beginning milepoint of a section
- Ending milepoint: The ending milepoint of a section
- ADT: The average daily traffic of a section of the roadway
- Speed limit: The posted speed limit at a section of the roadway
- Number of lanes: The total number of through lanes in both directions

- Functional classification: The FDOT highway functional classification of the roadway; The functional classification factor also provides information on the land-use type of the road; whether it's rural or urban.

Table 3-1 provides a list of the highway functional classifications in RCI.

Table 3-1: FDOT Highway Classification

Functional Class	Description
1	Principal Arterial-Interstate RURAL
2	Principal Arterial-Other RURAL
6	Minor Arterial RURAL
7	Major Collector RURAL
8	Minor Collector RURAL
9	Local Roads RURAL
11	Principal Arterial-Interstate URBAN
12	Arterial-Freeways and Expressways URBAN
14	Other Principal Arterial URBAN
16	Minor Arterial URBAN
17	Collector URBAN
19	Local Roads URBAN

Table 3-2 is an example of the RCI data. It can be noticed how Roadway 75040002 is split into several small subsections. The *vmt* is not provided in RCI. It was calculated by multiplying the *adt* of the section by the length of the section. The product was then multiplied by 365, the number of days in a year.

Table 3-2: Example of RCI Data

County	Rdwy ID	Beg Mp	End MP	# of Lanes	ADT	Speed Limit	Section Length	VMT	Funclass
75	75040002	0	0.05	6	16300	45	0.05	297475	16
75	75040002	0.05	0.908	6	16300	45	0.858	5104671	16
75	75040002	0.908	1.288	6	16300	45	0.38	2260810	16
75	75040002	1.288	1.325	6	16300	45	0.037	220131.5	16
75	75040002	1.325	1.425	6	16300	45	0.1	594950	16
75	75040002	1.425	1.46	6	16300	45	0.035	208232.5	16
75	75040002	1.46	1.719	6	31100	45	0.259	2940039	16
75	75040002	1.719	1.819	6	31100	45	0.1	1135150	16
75	75040002	1.819	1.918	6	31100	45	0.099	1123799	16
75	75040002	1.918	2.398	6	31100	45	0.48	5448720	16
75	75040002	2.398	2.774	6	31100	45	0.376	4268164	16
75	75040002	2.774	3.52	6	31100	45	0.746	8468219	16
75	75040002	3.52	3.663	6	31100	45	0.143	1623265	16
75	75040002	3.663	3.821	6	31100	45	0.158	1793537	16

The GIS analysis focused specifically on state road multilane corridors. Only year 2006 data was used in the analysis since it was assumed that roadway characteristics do not significantly change over the span of two years. Only functional classes 2,6,7,8,14,16 and 17 were included in the analysis. Local roads, freeways and expressways were filtered out. Roads with posted speed limits of 40 mph and above and with at least four through lanes were retained for the analysis. The total centerline miles roadway length included in the analysis came out to be 3977 centerline miles, almost all of which are arterials with only 25 miles of collectors. The software that was used in the data extraction process is SAS version 9.1.

3.2 Crash Data

The FDOT's CAR database contains rich information and description about the crashes that occurred over several years on the roads of the state of Florida. Some of the crash characteristics used in the analysis include crash roadway ID, crash location milepoint, crash severity, crash type and functional classification of the roadway on which the crash occurred.

- Crash roadway ID: The crash roadway ID provides the RCI roadway ID of the road on which the crash occurs
- Milepoint: The milepoint location on the RCI roadway ID section at which the crash occurred (The milepoint is recorded as the distance measured from milepoint 0 of a certain roadway ID to the location of the crash on that same roadway ID.)
- Crash severity: The FDOT splits the severity of a crash into the following levels as seen in Table 3-3:

Table 3-3: FDOT Crash Severity Levels

Severity Level	Description
1	PDO (Property damage)
2	Possible Injury
3	Non-incapacitating
4	Incapacitating (Severe)
5	Fatal (within 30 days)
6	Non-traffic fatality

- Crash types: The type of the crash recorded in the CAR database such as rear-end crashes, angle crashes, turning movement crashes, sideswipe crashes and head-on crashes
- Functional classification: The functional classification of the roadway on which the crash occurred

There are many other crash characteristics in the CAR database, such as date and time of the crash, but they were not included in the GIS analysis.

Since the GIS analysis only involves multilane corridors, only crashes that occurred on multilane roadways which were extracted from the RCI data were considered. Each data entry in CAR has a milepoint where the crash occurred and the roadway ID corresponding to the crash location. Crash entries in the database which have the same roadway ID with one of the multilane corridor roadways in RCI and have a milepoint crash location within the range of the RCI beginning and ending milepoint of that same roadway ID are selected for the GIS analysis. The process of crash selection was achieved using the SAS 9.1 software. For the macro-GIS analysis (Chapter 4), only 2006 crashes were used in the analysis. For the micro-GIS analysis and sliding window analysis (Chapters 5 and 6), both 2006 and 2007 crashes were used to enrich the data since only severe crashes (severity levels 4 and 5) of seven Florida counties were included. The total number of crashes used in the analysis for multilane corridors came out to be 159493 crashes; 80558 in 2006 and 78935 in 2007. The total number of severe crashes was found to be 13132 (8.2% of total crashes); 6946 in 2006 and 6186 in 2007.

3.3 GIS Data

GIS, in its simplest form, provides information which relates to a specific location. GIS provides data which relates to geographic scales of measurement and which are referenced by a coordinate system to location on the surface of the earth. The data could be broad in nature, such as the location or boundaries of a country, or more detailed, such as the location of roads within a city network.

The GIS software used in this study is ArcMAP 9.2. The FDOT provides on its website several GIS maps of Florida related to geographical and transportation related factors. The maps are saved in compressed file format (.zip) and could be uploaded into GIS in layer file format (.lyr) once extracted. The maps that were used in this analysis were from the year 2006. The following is a list of the maps:

- District layer map (see Figure 3-1): This layer provides a map of Florida with the geographical boundaries and areas of the state's seven districts.

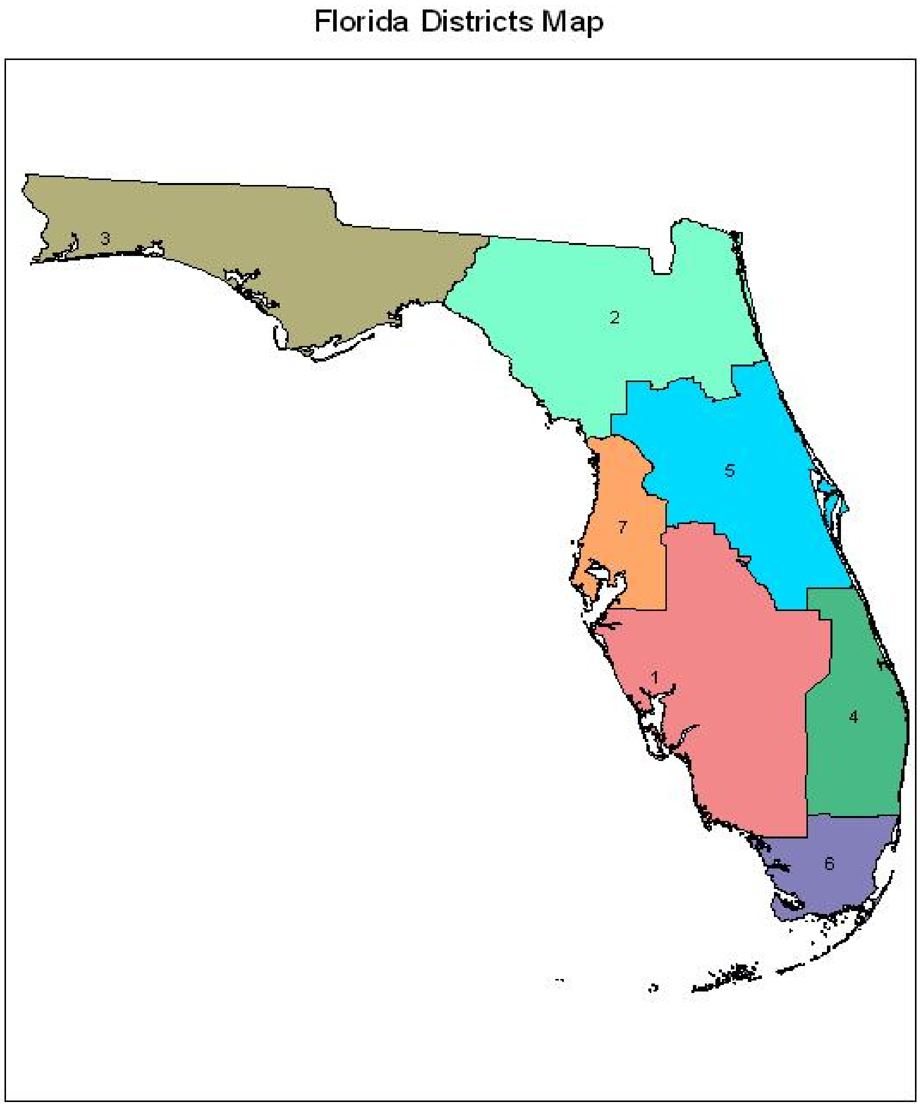

Figure 3-1: Florida Districts Map

- State road map (see Figure 3-2): This layer provides a map of the state road system within the state of Florida. The layer's attribute table also provides the beginning and ending milepoint of the state roadways and their corresponding roadway ID number.

Florida State Road Network

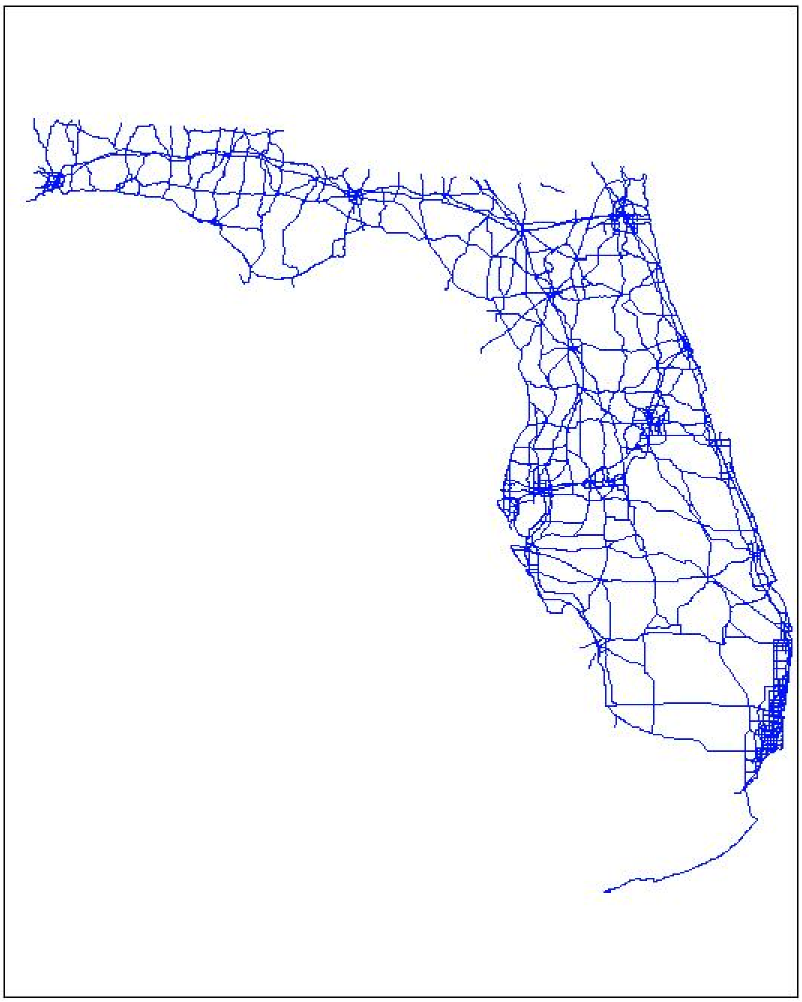

Figure 3-2: Florida State Road Network

Attributes of state_roads

OBJECTID *	Shape *	state_roads.ROADWAY	state_roads.RANK	state_roads.ROUTE	state_roads.RouteNum	state_roads.BEGIN_POST	state_roads.END_POST
719	Polyline	01010000	1	SR 45	45	15.214	25.946
720	Polyline	01010000	1	SR 45	45	13.247	15.214
721	Polyline	01010000	1	SR 45	45	0	13.247
718	Polyline	01010101	1	SR 45	45	0	2.042
717	Polyline	01030000	1	SR 31	31	0	18.337
715	Polyline	01040000	1	SR 35	35	1.532	6.399
716	Polyline	01040000	1	SR 35	35	0	1.532
714	Polyline	01040101	1	SR 35	35	0	1.668
713	Polyline	01040201	1	SR 35	35	0	4.425
712	Polyline	01050000	1	SR 776	776	2.237	17.549
711	Polyline	01060000	1	SR 776	776	9.23	10.385
710	Polyline	01075000	1	SR 93	93	0	22.008
703	Polyline	02010000	1	SR 45	45	13.177	30.039
704	Polyline	02010000	1	SR 45	45	13.136	13.177
705	Polyline	02010000	2	SR 45	45	12.72	13.136
706	Polyline	02010000	1	SR 44	44	12.72	13.136
707	Polyline	02010000	2	SR 45	45	12.198	12.502
708	Polyline	02010000	1	SR 44	44	12.198	12.502
709	Polyline	02010000	1	SR 45	45	0	12.198

Figure 3-3: Example of State Road Attributes Table

Figure 3-3 is a snapshot of the state road layer attribute table. The highlighted portion is the roadway ID while the last two columns denote the beginning and ending milepoints of the road.

- Signalized intersections map (see Figure 3-4): This layer provides a map of geo-coded signalized intersections on the roads of the state of Florida. The map's attributes table could be extracted into an excel table format and used in the analysis.

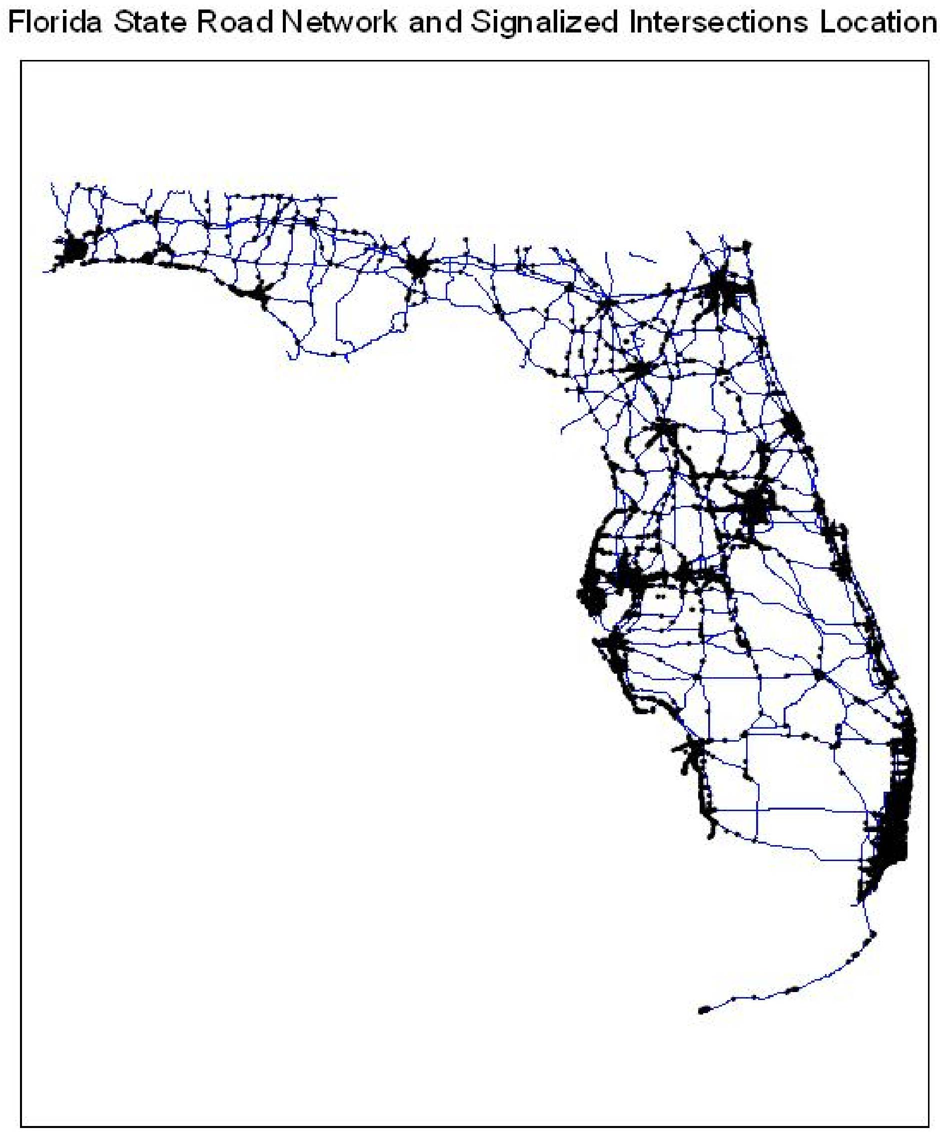

Figure 3-4: Florida Signzalized Intersection Map

- County layer map (see Figure 3-5): The FDOT does not provide a map of Florida's 67 counties. The map was obtained from another source online (FGDL).

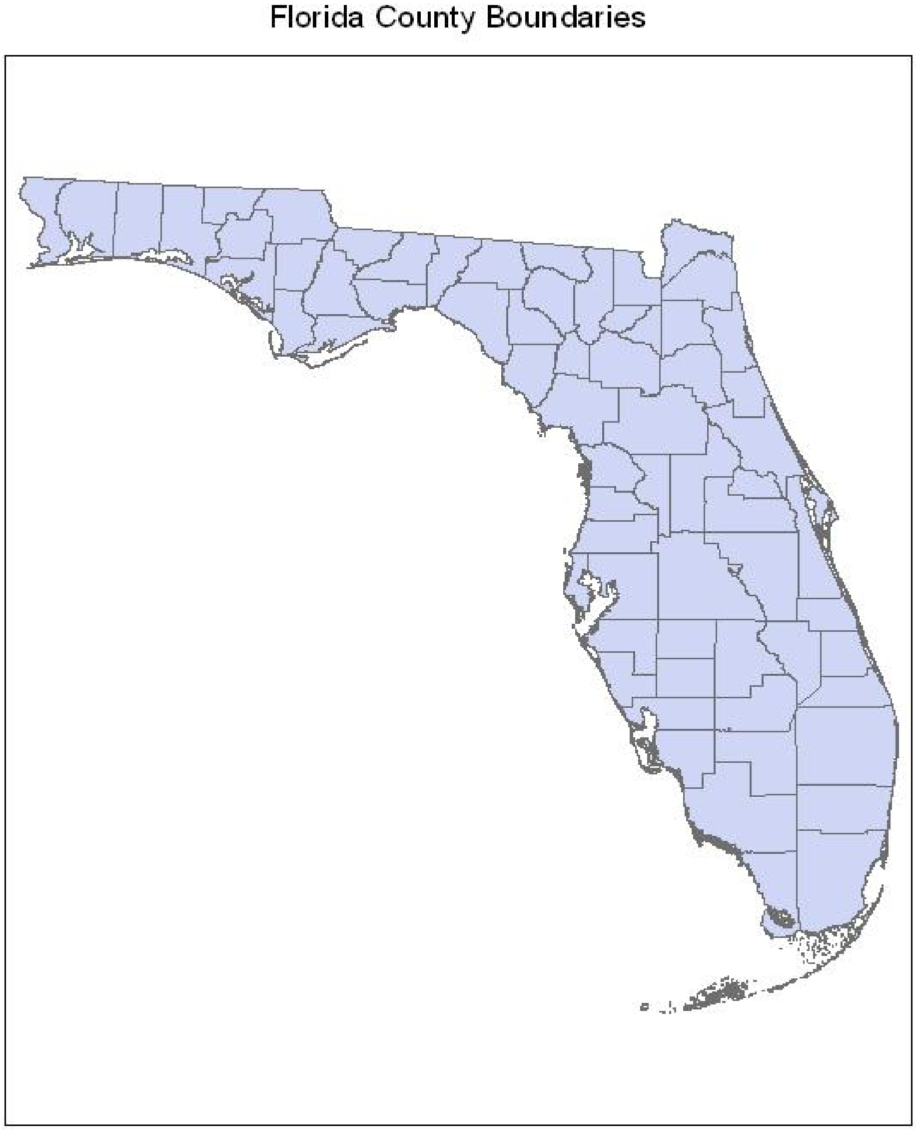

Figure 3-5: Florida Counties Map

The district and county map layers were mainly used in the exploratory macro-GIS analysis of this study. The state road map and intersection maps were used in the micro-GIS analysis. Only maps of state roads and intersections of multilane corridors were displayed in GIS. There are other several maps available from the FDOT website, such as maps of bridge locations and median types, however they were not included in the scope of this study.

CHAPTER 4. MACRO-GIS ANALYSIS: DISTRICT AND COUNTY LEVEL

At the macro level, the main objective of the GIS safety analysis is to provide exploratory maps of crash trends in the state of Florida at district and county level. The use of districts for analysis is too broad because of their large geographical area. The mapping of district crash trends in this study is purely exploratory in nature. The mapping of crash trends at the county levels provides a clear visual indication of counties with relatively unsafe roads. The use of map color degradation, from light to dark, displays variation in crash trends from county to county.

4.1 Methodology

Incorporating crash trends into GIS maps is very simple. For example, to display the rate of crashes per mile in each county, the total number of crashes in a county is divided by its total centerline miles of multilane corridors. The end result is an excel table with 67 rows (representing 67 counties in Florida) with the column headers being county name and rate of crashes per mile. The excel table is then saved in database file format (.dbf) which can be recognized by ArcMAP 9.2. Since the attributes table of the county layer map in ArcMAP 9.2 has also 67 entries, the newly created database table file is linked to the GIS attributes table.

4.2 Results

The district and county level maps generated for this study include the following:

- District crashes frequency
- District multilane corridors centerline miles
- District crash rate per mile
- County crashes frequency
- County multilane corridors centerline miles
- County crash rate per mile
- County crash rater per 1 million *vmt*
- County crash frequency vs. landuse distribution
- County severe crashes frequency vs. landuse distribution
- County severe crashes percentage from total crashes
- County severe crashes rate per mile
- County severe crashes rate per 1 million *vmt*

There were six counties that had no multilane corridors, hence no crash occurrences. The counties are Gilchrist, Hamilton, Lafayette, Union, Franklin and Wakulla.

4.2.1 District Crash Frequency

As observed in Figure 4-1, the district with the highest crash occurrences in 2006 was District 7 (17869 crashes).

District Crash Frequency

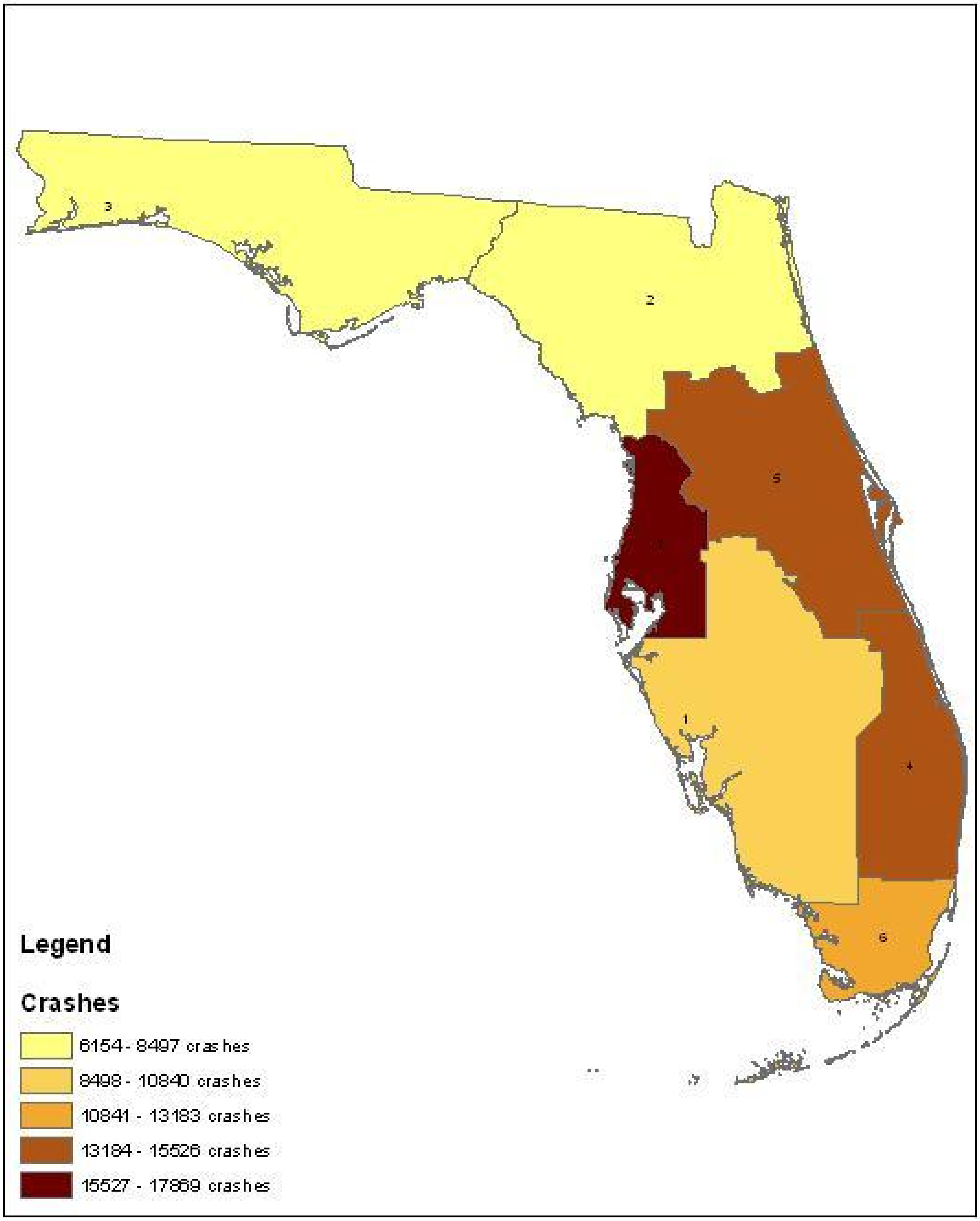

Figure 4-1: Districts Crash Frequency

4.2.2 District Multilane Corridors Centerline Miles

The district with the highest mileage of corridors in Florida is District 5 (869 miles), as shown in Figure 4-2.

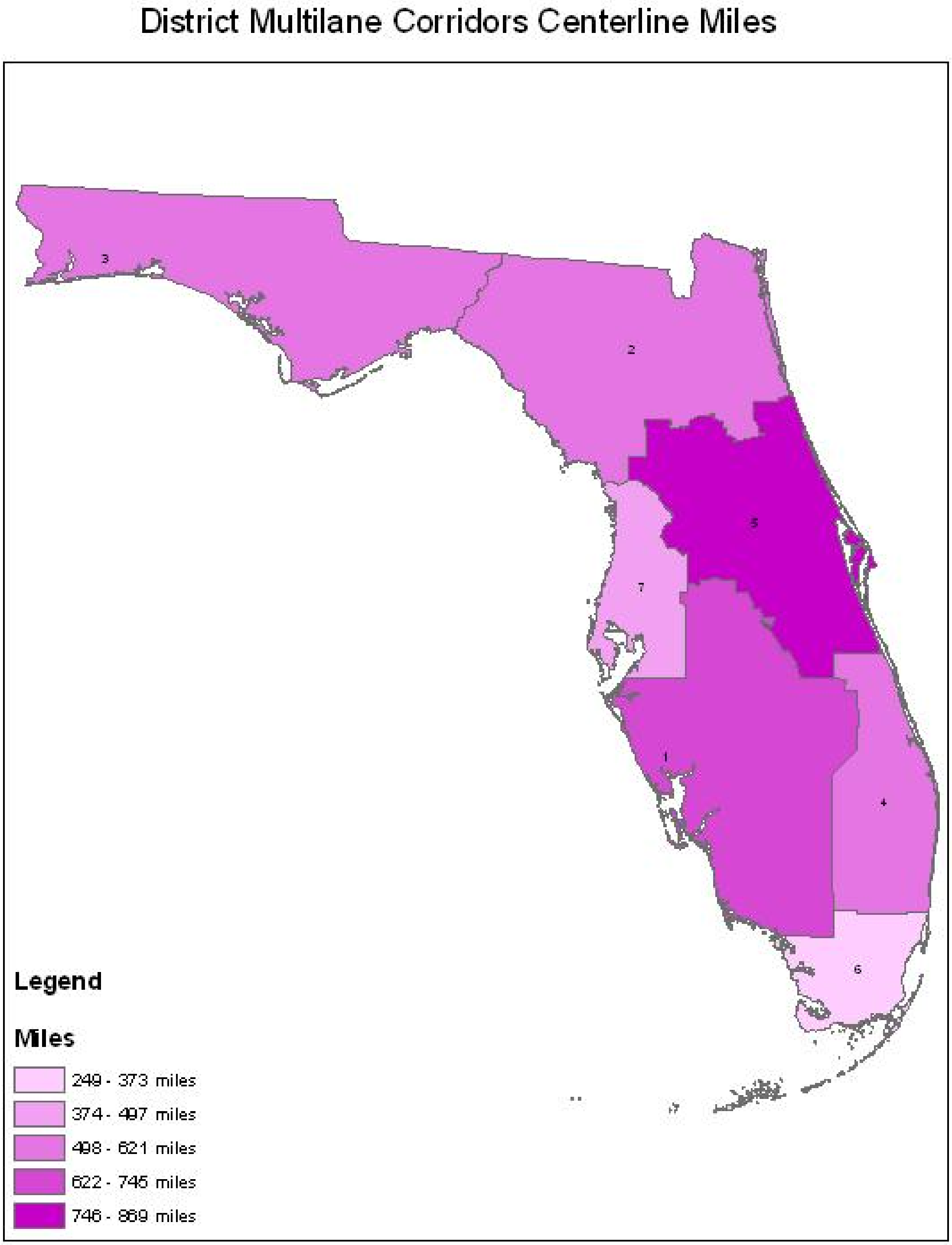

Figure 4-2: Districts Multilane Corridors Centerline Miles

4.2.3 District Crash Rate per Mile

As observed in Figure 4-3, the districts with the highest crash rates per mile are District 6 and District 7. This result makes sense since District 6 includes Miami-Dade County and District 7 includes Hillsborough County. Both counties have very high crash frequencies which probably are due to the high population levels there.

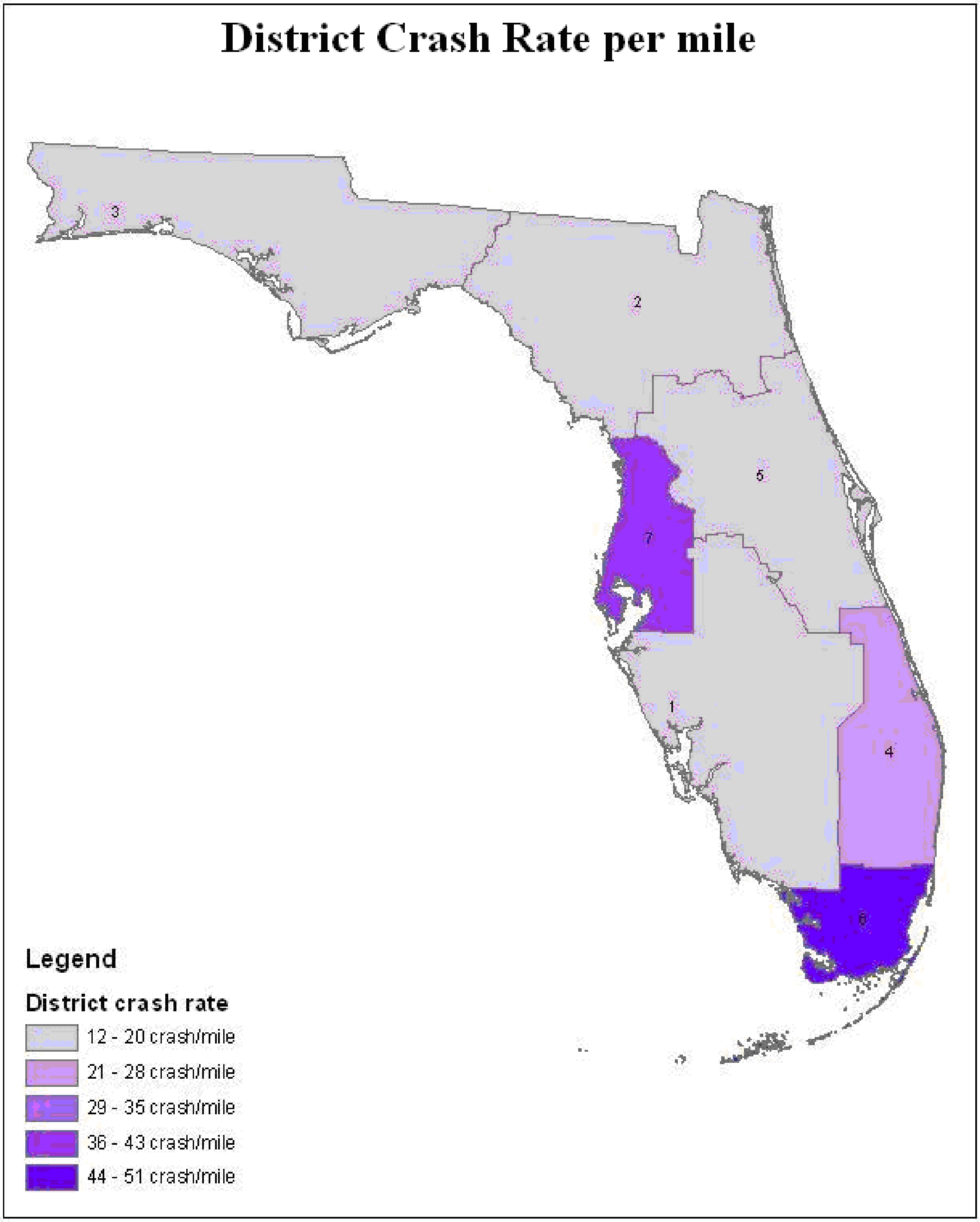

Figure 4-3: Districts Crash Rate per Mile

4.2.4 County Crash Frequency

As it was expected, the highest number of crashes in 2006 occurred in Miami-Dade County with 12,378 crashes. It is followed by Broward County, which includes the city of Fort-Lauderdale, with 9049, Hillsborough County, which includes the city of Tampa, with 9001 crashes and Pinellas, which includes the city of St. Petersburg, with 5744 crashes (see Figure 4-4). These findings are not surprising. The cities within those counties are heavily populated, and the counties have historically shown high crash frequencies.

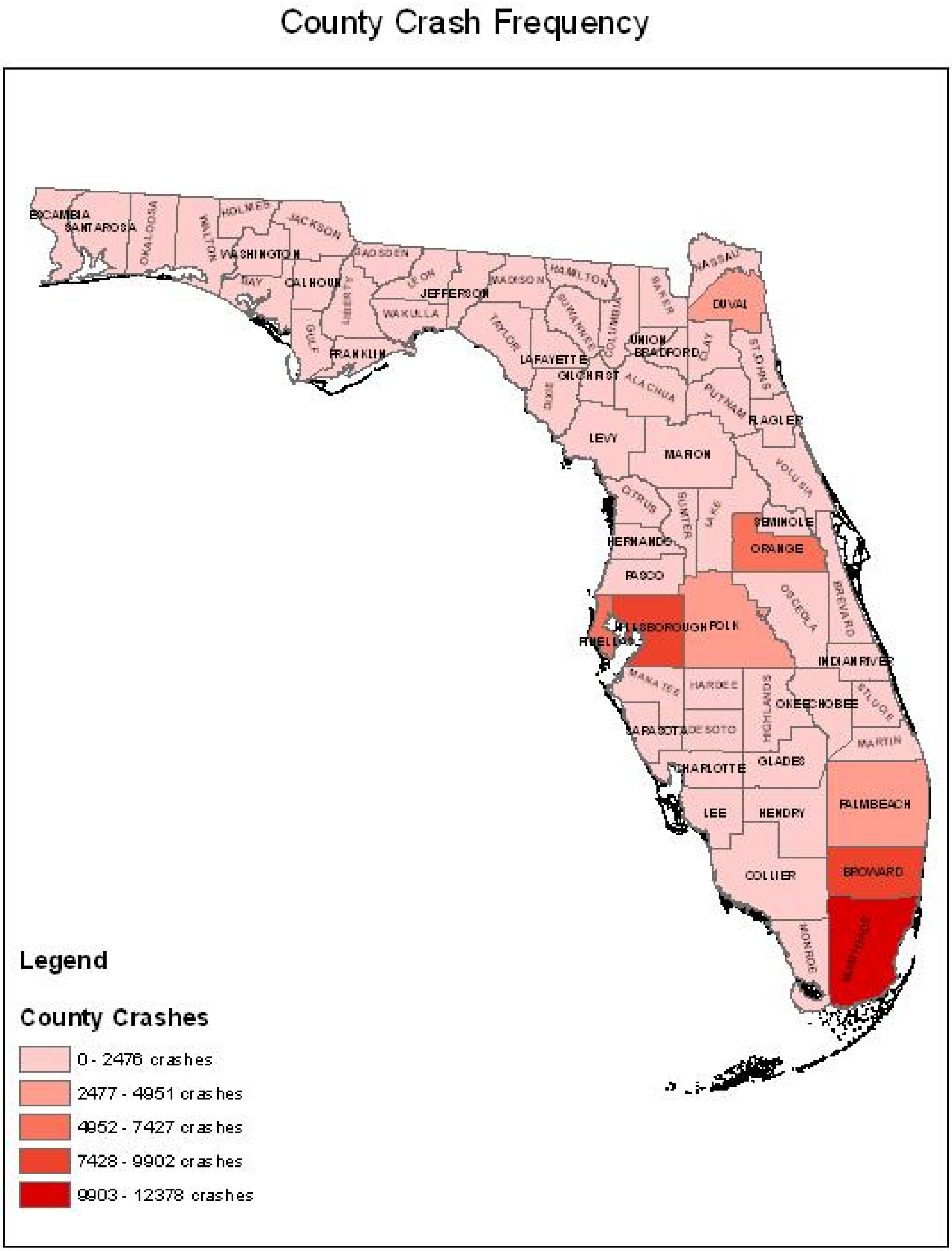

Figure 4-4: County Crash Frequency

4.2.5 County Multilane Corridor Centerline Miles

As seen in Figure 4-5, the counties with the highest multilane corridor miles are Polk County (215 miles) and the southern counties of Palm Beach (246 miles), Broward (227 miles) and Miami-Dade (224 miles).

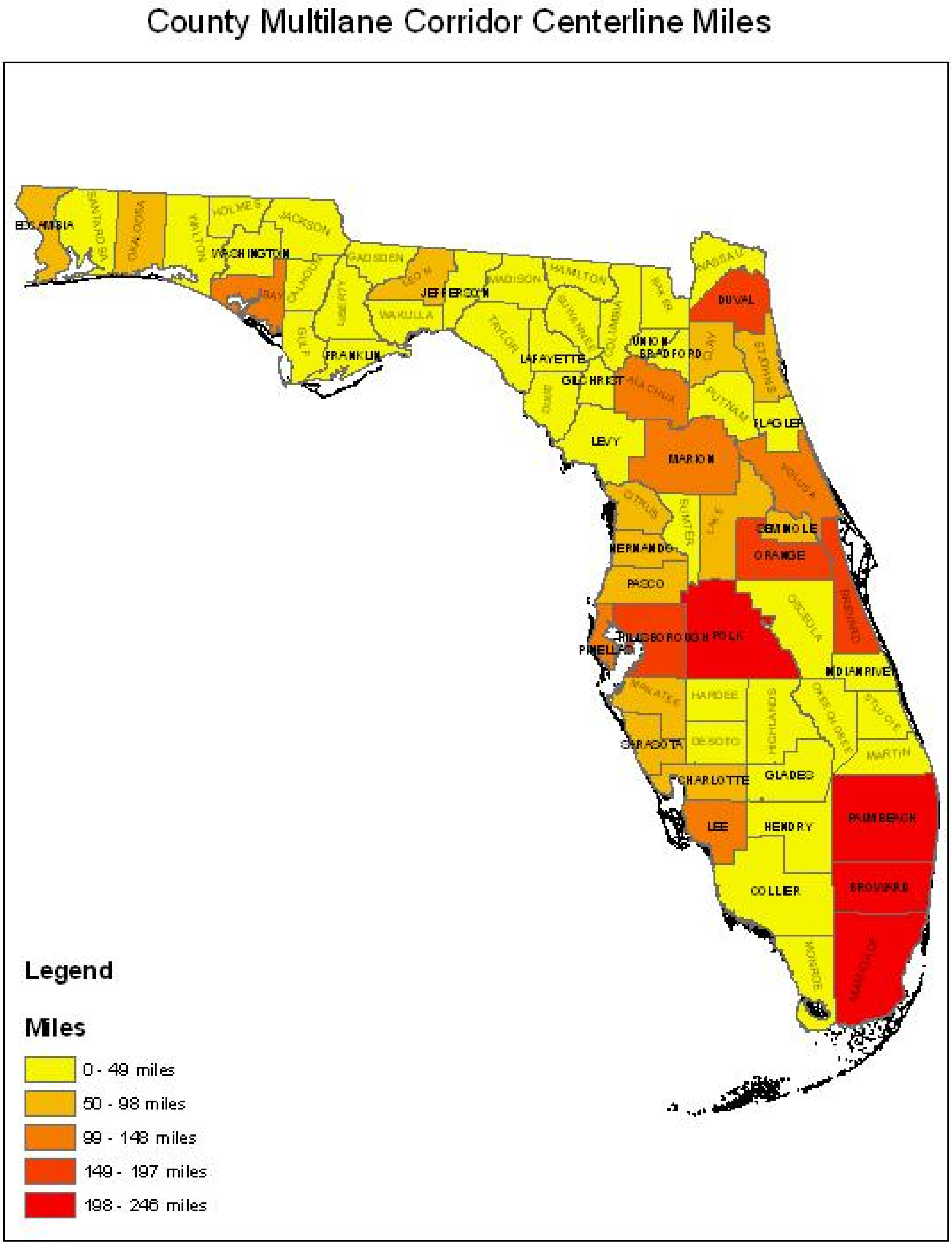

Figure 4-5: County Multilane Corridor Centerline Miles

4.2.6 County Crash Rate per Mile

The county with highest crash rate per mile was Miami-Dade with 55 crashes/mile. It was followed by Hillsborough County with 48 crashes/mile, Pinellas County with 43 crashes/mile and Broward County with a rate of 40 crashes/mile (see Figure 4-6).

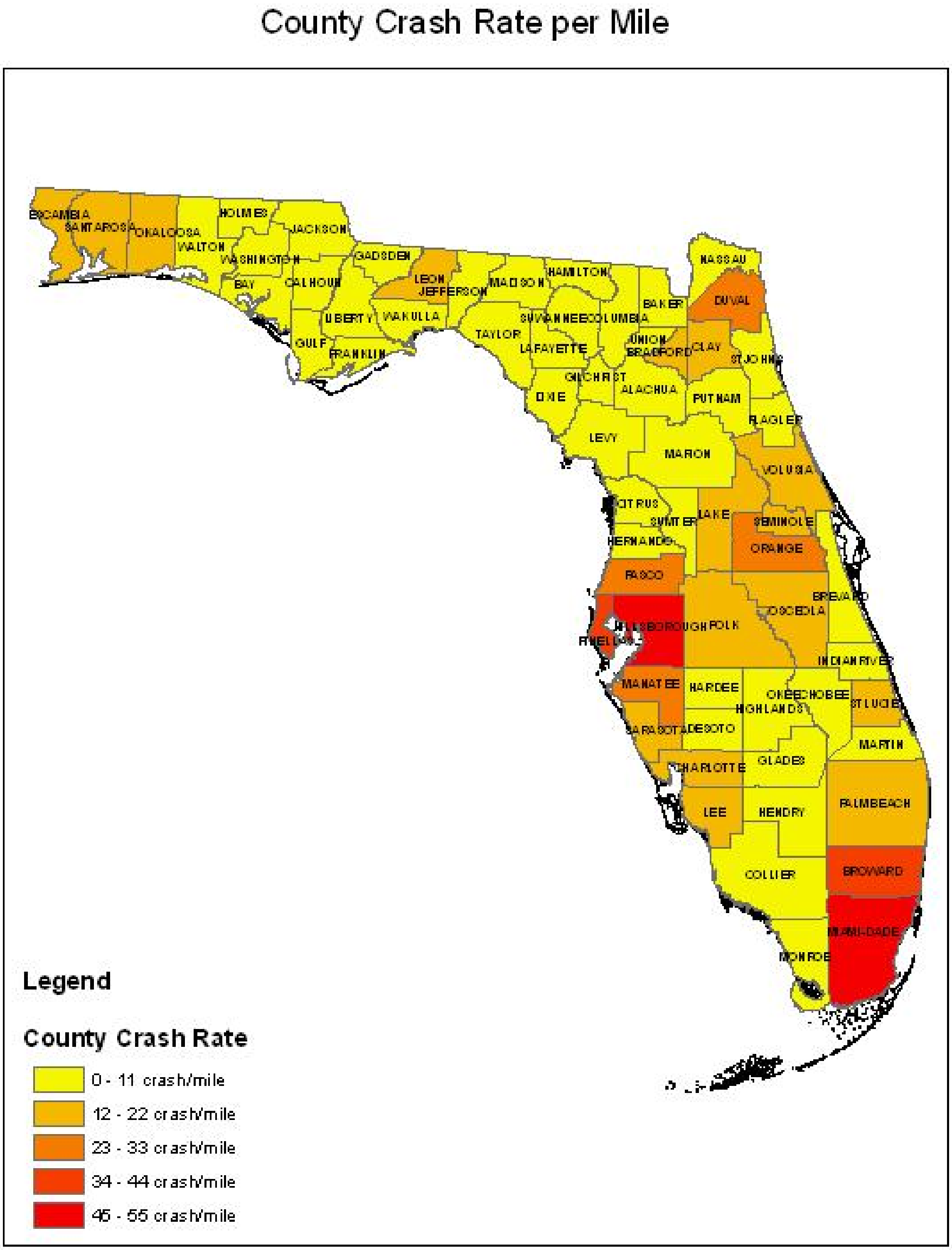

Figure 4-6: County Crash Rate per Mile

4.2.7 County Crashes per 1 million VMT

The counties with the highest crash rate per 1 million *vmt* were Hillsborough County (3.63), Miami-Dade County (3.49), Pinellas County (2.76) and Broward County (2.73) as seen in Figure 4-7.

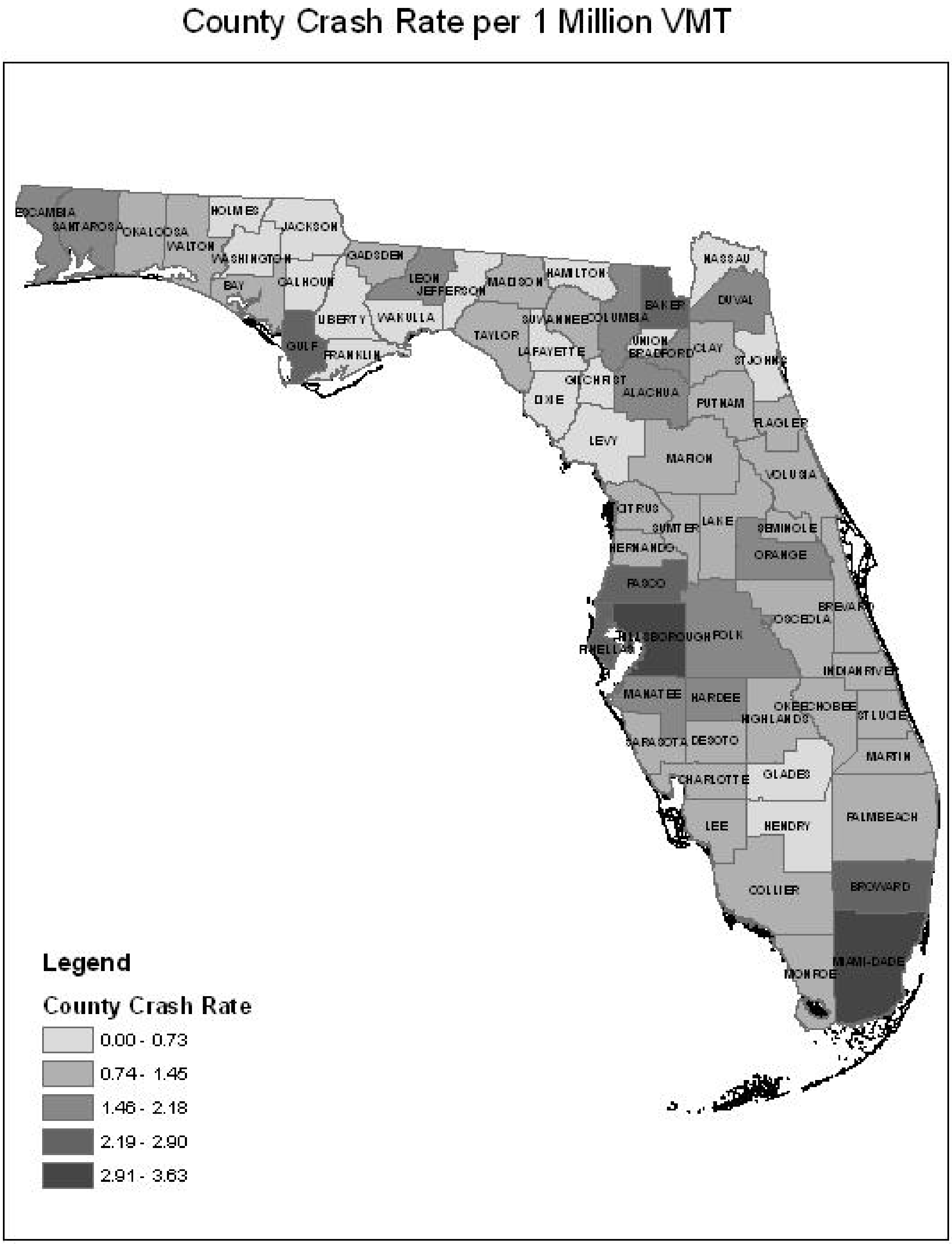

Figure 4-7: County Crash Rate per 1 Million VMT

4.2.8 County Crash Frequency vs. Landuse Distribution

It is interesting to note in Figure 4-8 that the counties that had high crash frequencies have a much higher ratio of urban roads to rural roads (Miami-Dade, Hillsborough, Broward, Orange). This is expected since urban roads are much more congested and have more intersections, which increase crash risk.

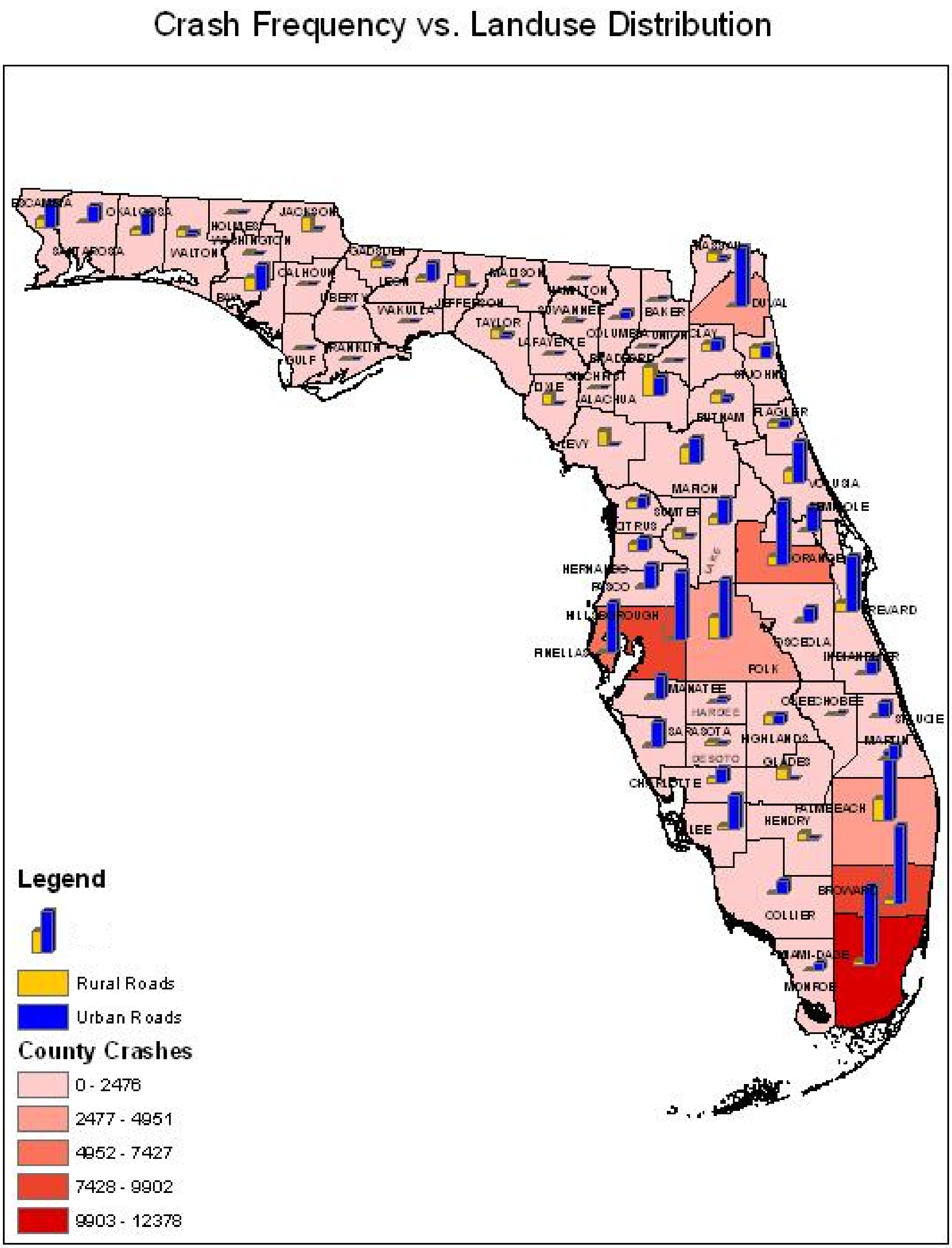

Figure 4-8: County Crash Frequency vs. Landuse Distribution

4.2.9 Severe Crashes Frequency vs. Landuse Distribution

As seen in Figure 4-9, the counties with the highest frequency of severe crashes are, Hillsborough (705 crashes), Broward (685 crashes), Miami-Dade (620 crashes) and Pinellas (497 crashes). The same four counties had the highest frequency of total crashes (Figure 4-4). It is also observed that counties with more urban roads have higher frequencies of severe crashes compared to counties with more urban roads. This is expected since the traffic volume on urban roads is higher than rural roads which increase the chances of the occurrence of an incapacitating or a fatal crash.

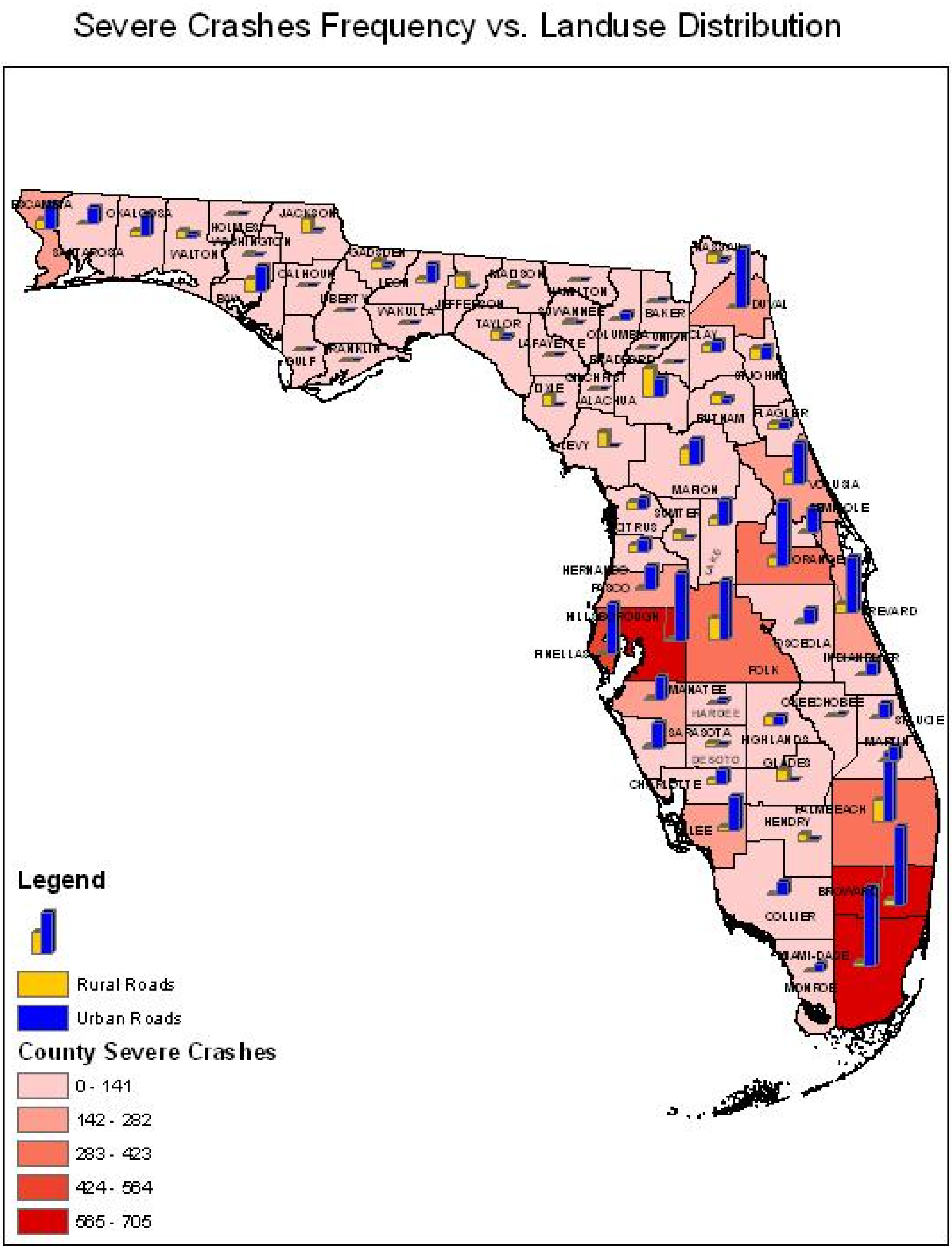

Figure 4-9: County Severe Crashes Frequency vs. Landuse Distribution

4.2.10 County Severe Crash Percentage

The counties with the highest percentage of severe crashes to total crashes were Madison County (31%), Jefferson County (31%), Flagler County (29%) and Hernando County (25%) as shown in Figure 4-10. It was found that counties with higher proportions of rural roads tend to have higher percentages due to their low total crash frequencies; thus a small increase of severe crashes translates into a large ratio. In addition, counties with high total number of crashes such as Miami-Dade and Hillsborough have highly congested road networks which lower the vehicle speeds. This phenomenon would result in much more higher numbers of non-severe crashes.

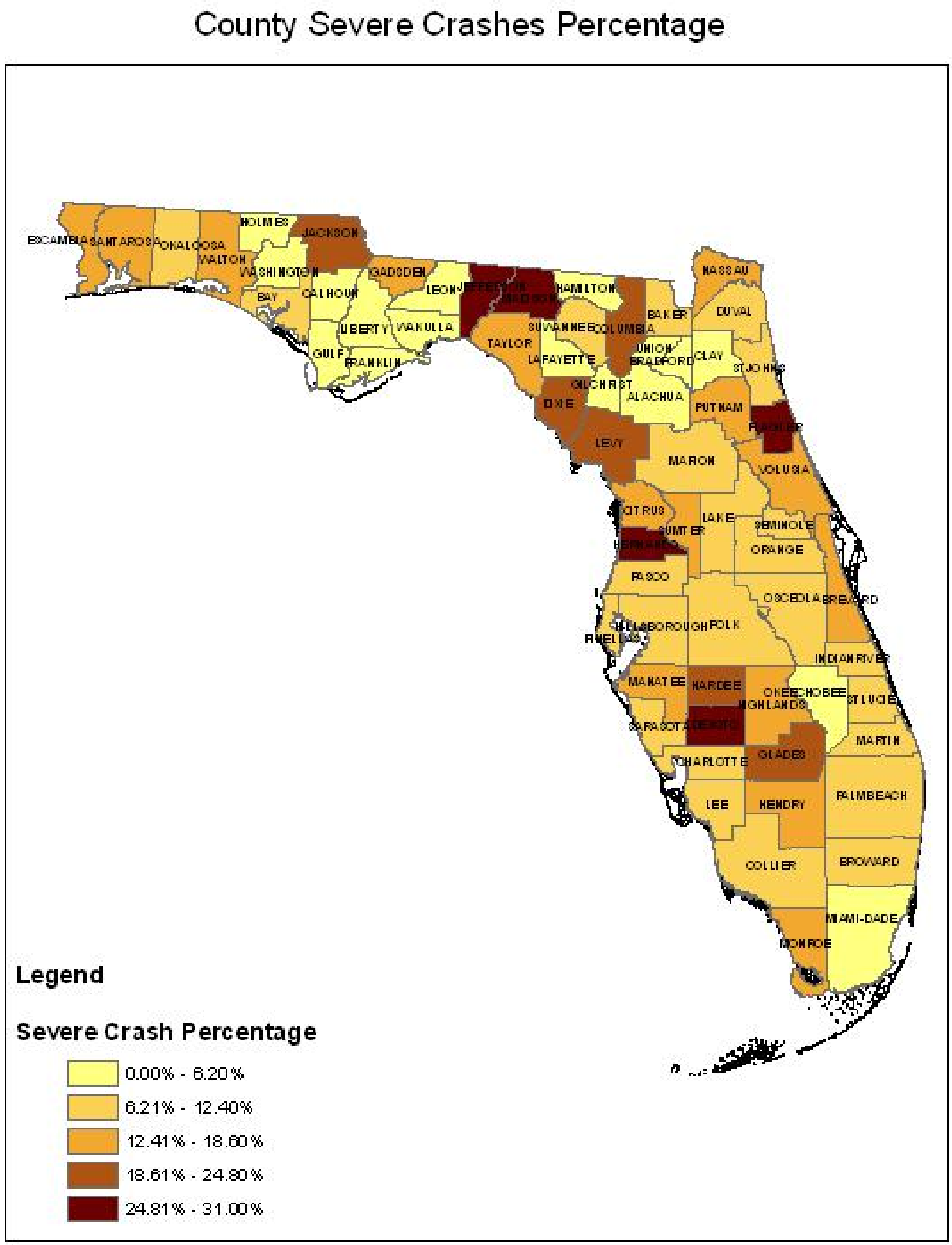

Figure 4-10: County Severe Crashes per Percentage

4.2.11 County Severe Crash Rate per Mile

The counties with highest rate of severe crashes per mile were Pinellas County (4.09 crashes per mile), Hillsborough County (3.74 crashes per mile) and Pasco County (3.69 crashes per mile) (see Figure 4-11). It is interesting to note that these 3 counties neighbor each other, which might imply similar crash patterns.

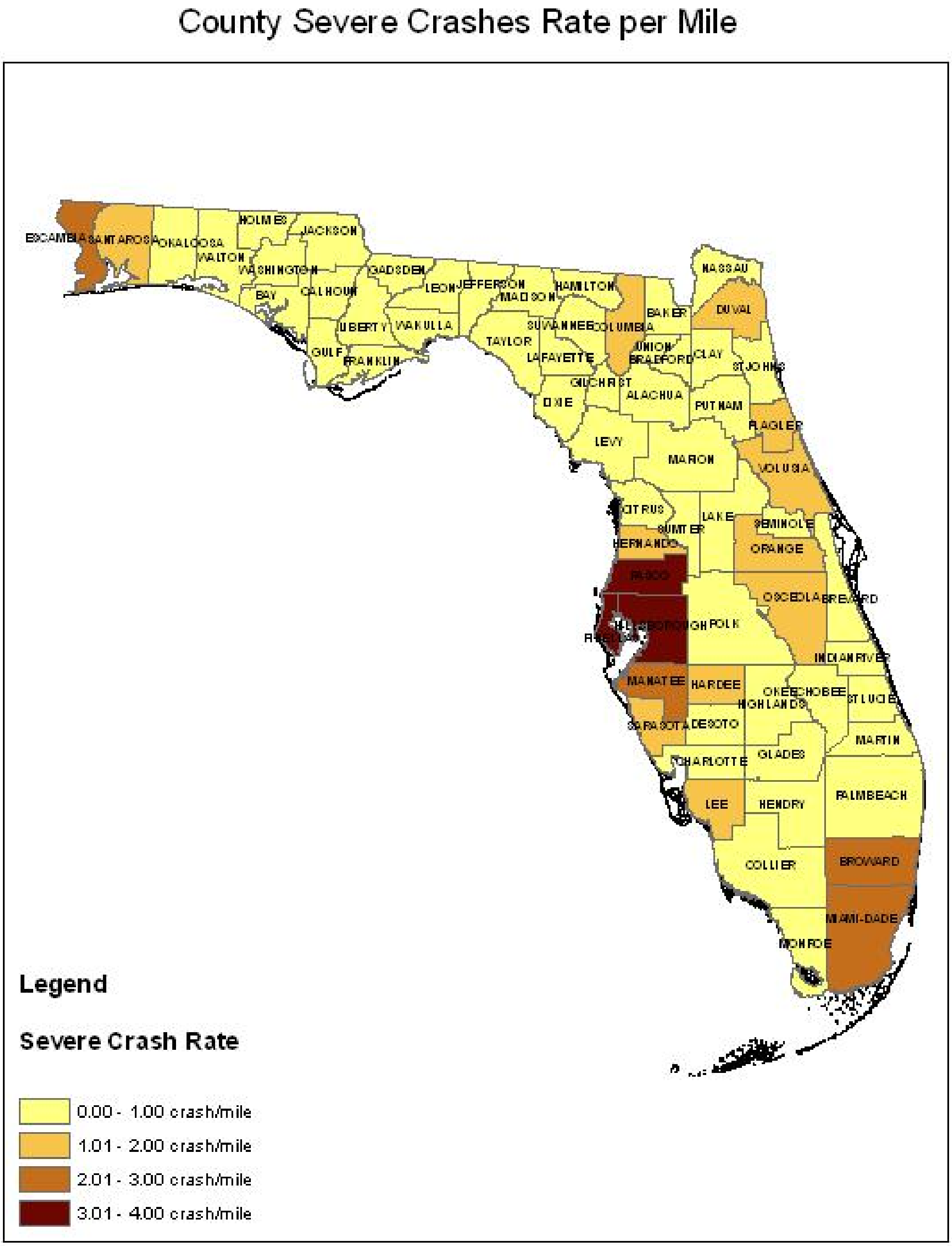

Figure 4-11: County Severe Crashes per Mile

4.2.12 County Severe Crash Rate per 10 million VMT

The counties with the highest rate of severe crashes per 10 million *vmt* were Hardee County (3.53), Escambia County (3.21), Flagler County (3.15) and Columbia County (3.03) as shown in Figure 4-12. With the exception of Escambia, the other 3 counties experience low total crash occurrences. The three counties have low *vmt* values, thus a small increase of one or two severe or fatal crashes tends to magnify the rate.

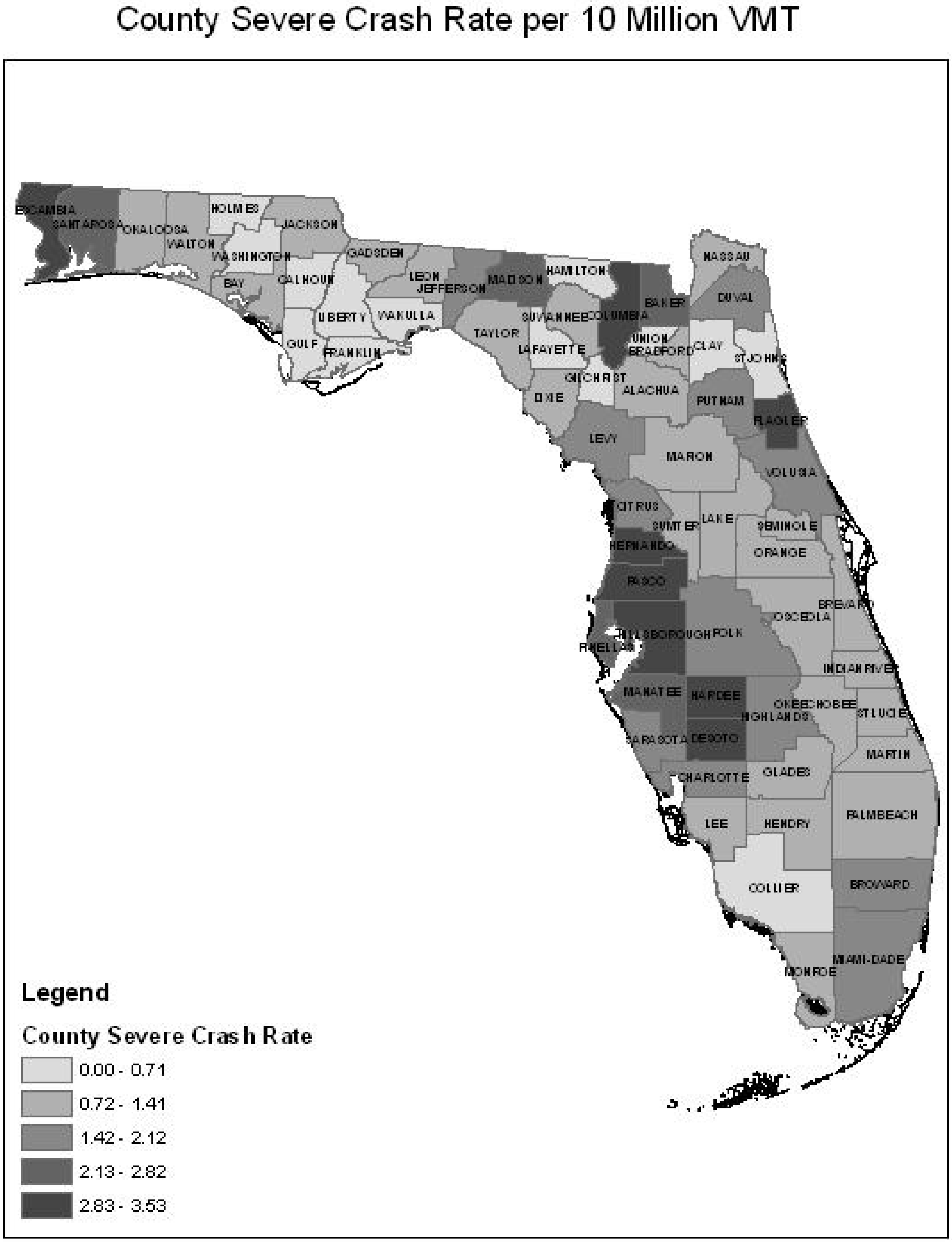

Figure 4-12: County Severe Crashes per 10 Million VMT

4.3 Summary

In summary, Miami-Dade, Broward, Palm Beach and Hillsborough counties had the highest number of total crash occurrences and crash rates in 2006. Counties with urban roads have higher frequencies of total crashes and severe type crashes than the ones with rural roads. Counties with more rural roads tend to have a higher percentage of severe crashes in comparison with urban counties; however this is mainly to low total number of crash occurrences. The neighboring counties of Pasco, Pinellas and Hillsborough have the highest rates of severe crashes per mile. Counties with low number of crash occurrences have higher severe crashes per 10 million *vmt* and this is mainly due to the low *vmt* values. Appendix A includes several other county level maps that were generated in GIS but were not included in the main report.

CHAPTER 5. MICRO-GIS ANALYSIS: ROADWAY LEVEL

The macro-GIS analysis focused primarily on the general trends of county crash distribution. The macro analysis was concluded by focusing on the distribution of severe crashes among the 67 counties of the state of Florida. The micro-GIS analysis zooms into specific counties and looks at the distribution of severe crashes on multilane corridors within a county. The main aim of this analysis is to be able to visually identify (using color-coding of road links and signalized intersections in GIS maps) certain sections of roadways within a county that experienced high trends of severe crashes for the years, 2006 and 2007.

The main objective of the micro-GIS analysis is to make it possible to visually identify certain spots on the roadways which have experienced high trends of severe crashes. These spots could be a roadway section or a signalized intersection area. It will also be possible to identify the beginning and ending mile points of those spots. The identification of the mile posting of those spots would help in determining specific locations where road improvements are required in order to have better safety conditions.

ArcMap 9.2, is a powerful tool that can display maps of county boundaries, roadway segments and intersection locations. By using the several graphical tools available in ArcMap 9.2, it becomes convenient to mark locations on the roadway by varying colors or altering the size or thicknesses of roadway segments or intersections to display the safety condition of that particular location. The less safe a segment or an intersection is, the darker in color and thicker in size it is drawn in GIS. Figure 5-1 is an ArcMap 9.2 snapshot presenting an example of the main visual objective of the micro-GIS analysis. As observed, the darker and thicker the lines or dots, the worse the safety condition of that particular location on the roadway.

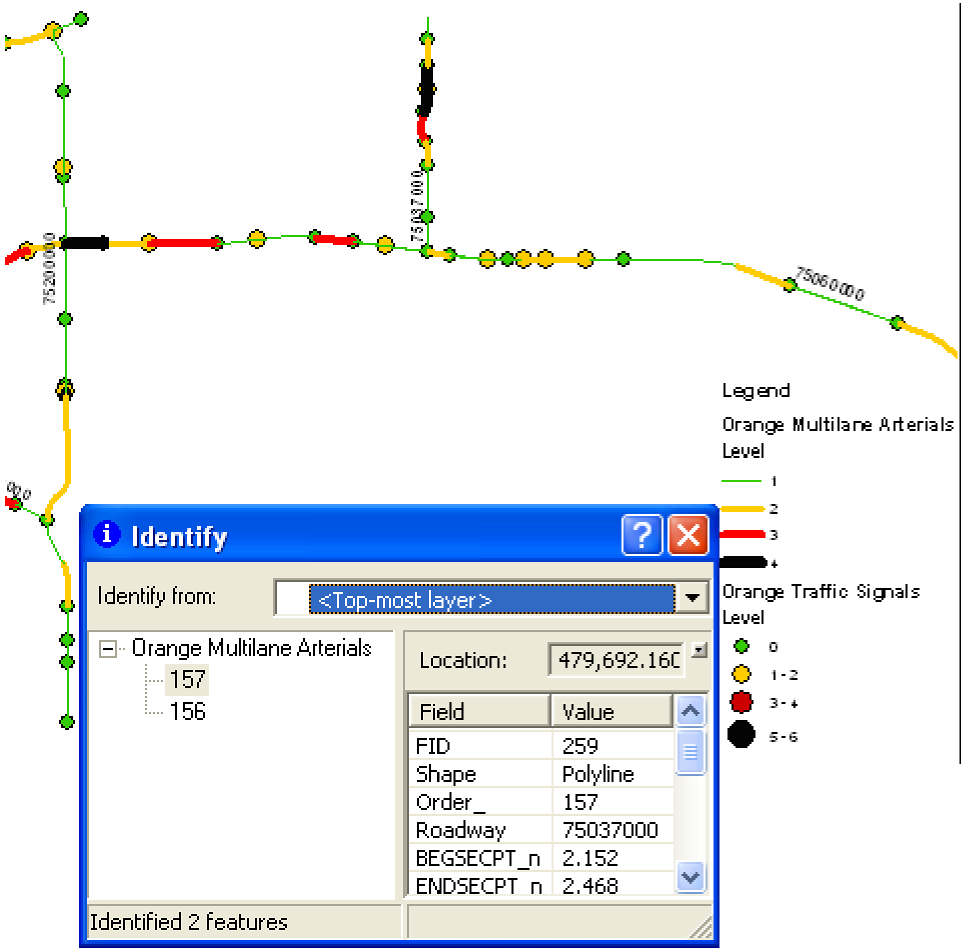

Figure 5-1: Example of Main Visual Objectives of GIS

However in order to achieve this objective, severe crash data and roadway data had to be properly analyzed in order to display the varying safety conditions on a map. Several roadway section ranking procedures were examined through the exploration of previous literature and scientific intuition until one consistent method to rank the roadway sections was achieved. The methodology section discusses the steps followed in order to achieve the proper ranking procedure.

5.1 Methodology

The following is a breakdown of the methodology followed in order to identify a proper way to rank roadway sections according to their safety performance with regards to their severe crash trends.

5.1.1 Selection of a County for Roadway Ranking Trials

The macro-GIS analysis identified several counties that exhibited alarming severe crash trends in 2006. These counties displayed relatively high frequencies and crash rates (per centerline mile and *vmt*) for such type of crashes. The counties chosen for the micro-GIS analysis were: Hillsborough, Miami-Dade, Duval, Pinellas, Escambia, Pasco and Orange. There were other counties that also displayed some high trends; however the aforementioned counties were chosen because they displayed high trends, spanned different geographic locations and had big metropolitan areas sizes within them. In addition several counties that ranked high in rates of severe crashes per mile and *vmt* had a low frequency of severe crashes. They simply ranked high because they had low centerline miles or low *vmt* figures. Table 5-1 summarizes the severe crash trends of the seven counties.

Table 5-1: Summary of Severe Crash Trends of Selected Counties

County	Geographical Location	Major City	Crash Frequency	Rank	crash/mile	Rank	Crashes per 10 million VMT	Rank
Escambia	Florida Panhandle	Pensacola	257	10	2.86	6	3.21	2
Hillsborough	South-West Florida	Tampa	705	1	3.74	2	2.84	8
Miami-Dade	South Florida	Miami	620	3	2.76	7	1.75	17
Orange	Central Florida	Orlando	357	5	1.87	13	1.37	26
Pinellas	South-West Florida	St. Petersburg	497	4	3.69	3	2.38	12
Pasco	West Florida	Dade City	278	8	4.09	1	2.98	6
Duval	North-East Florida	Jacksonville	260	9	1.62	16	1.47	21

Escambia County was chosen in order to test different ranking techniques. Escambia is a county located in the west most section of the Florida Panhandle. In 2006, Escambia experienced 257 severe crashes on its multilane arterials (10th highest) of which 10 were fatal (severity level 5). Most of Escambia's multilane roads are urban (67 miles out of a total of 89) and only 16 severe crashes occurred on rural roads. The 2007 severe crash data for the seven counties was not used in the ranking trial stage; it was only employed after finalizing a ranking methodology for the roadways.

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5.1.2 Testing Different Ranking Techniques

The first method tested to rank multilane corridors in Escambia was to use the frequency of severe crashes occurrence on road sections provided by the RCI data. However the roadway beginning and end milepoint segments provided by the raw RCI roadway data were found to be too small (see Table 3-2) and more than 90% of those small segments exhibited 0 crash occurrences. The method was found to be far too simplistic and visually unfriendly (see Figure 5-2). It does not provide a clear way to identify or display very unsafe spots. Thus it was concluded that the roadways had to be split into larger segments than the ones provided in the RCI data.

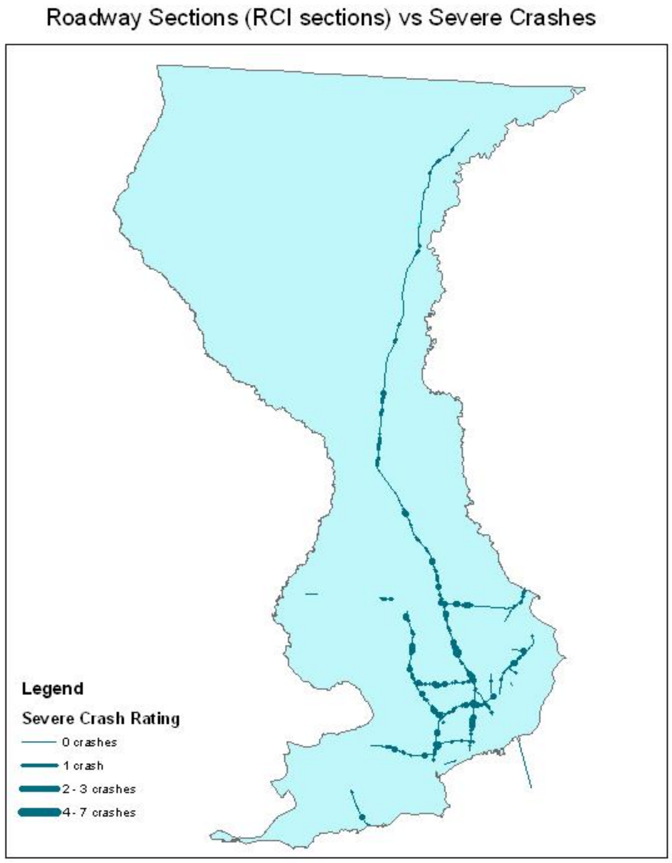

Figure 5-2: Use of RCI Sections for Ranking Methodology

Another ranking technique considered was splitting the roadways into equal 1-mile segments and then ranking them according to the frequency of severe crashes as recommended by Geurts et. al.(2003); however this methodology assumes the roadway to be a continuous entity without taking the existence of signalized intersections into account. The results would be biased towards intersection areas.

Another ranking technique tested is the one used by Kilkowski and Bejleri (2006) in which roadways are split into segments between signalized intersections. Signalized intersections would be analyzed separately by taking into account crashes within an intersection's physical boundary and its influence area, whereas road segment analysis take into account crashes that occurred on road sections between 2 consecutive intersection influence areas. However, because sections between traffic signals vary in length, the frequency of severe crashes had to be normalized, either by the length in miles or the *vmt* of that section or by using both.

It was finally decided to split roadways into segments between signalized intersections and to analyze those two elements of a corridor separately, which is similar to the procedure followed by the Minnesota DOT (Hallmark et. al., 2002), Idaho DOT (Hallmark et. al, 2002) and Kilkowski and Bejleri (2006). The frequency of crashes was divided by the centerline length of a segment.

The next step was to decide on a weight ratio for fatal to incapacitating crashes. Geurts et. al. used a 5:3 weight ratio in their study. The Iowa DOT proposed a 7:1 ratio. Illinois DOT used a 10:9 ratio whereas the Minnesota DOT used a 10:4 ratio. Those studies looked at severe crashes from several perspectives, which explains the different ratios used. From a monetary perspective for example, an incapacitating crash costs more than a fatal crash in medical bills. On the other hand, a fatal crash costs more in human value. A 2:1 ratio was chosen for this analysis as an approximate average of the ratios that were discussed previously. The road segment ranking formula used was:

Equation 5-1

Road Segment Severity Score=[2x(No. of crashes level 5)+1x(No. crashes level 4)]/segment length

As the score increases, the safety level of that road segment deteriorates which means a higher ranking. This is displayed in GIS with darker colors and thicker lines (denoting road segments). The longest allowable road segments analyzed were one mile long. If the distance between two signalized intersections exceeded one mile, then the segment was split into equal parts less than one mile long. Intersection influence areas were subtracted from the segment length in the calculation of road segment scores as shown in Tables 5-5 to 5-18.

As for signalized intersections, they were ranked according to the frequency of occurrence of severe crashes within an intersection's physical location and influence area with a (2:1) weighting given to fatal and incapacitating crashes respectively.

Equation 5-2

Signalized Intersection Severity Score=[2x(No. of crashes level 5)+1x(No. crashes level 4)]

As the score increases, the safety level of the intersection worsens. This is displayed in GIS with darker colors and thicker dots (denoting intersections). Most studies use a 250 ft radius as a default value for an intersection's influence area (250 ft upstream and downstream from the center of an intersection). However, a signalized intersection's influence radius should be varied according to the volume of traffic entering the intersection from the crossroad. Since information on intersection volumes is not available for all seven counties, the number of lanes of the cross road was used as a surrogate indicator of the length of the influence area.

Table 5-2: Signalized Intersection Influence Area

CrossRoad No. of Lanes	Influence Area
<=Two Lanes	150 ft
Three Lanes	200 ft
Four or more Lanes	250 ft

Crashes which occurred upstream of a signalized intersection, within its influence area and 50 ft downstream (to account for right turn crashes) were considered as intersection crashes. The influence area of an intersection was assumed to start from the intersection’s actual center. There are cases in which crash location mile points were measured with reference to an intersection’s stop bar, however it is extremely tedious to clarify such cases. Signalized intersections’ location milepoints and corresponding roadway IDs were identified using the GIS map provided by the FDOT. In some of the cases where multilane corridors intersected with non state roads, signalized intersections had to be identified using the Google Earth application since their corresponding roadway IDs were in reference to the non state roads.

Some studies ranked intersections according to the number of crashes divided by the volume of traffic entering the intersection. This approach is recommended for the analysis of intersection crash trends in general. However, similar to the case of using crash rates per *vmt* for ranking road segments, such a technique would dilute the problem of the existence of severe crashes.

5.2 Micro-GIS Analysis Results

After choosing a ranking methodology, the severe crash records of 2006 and 2007 were compiled together in order to calculate road segment and signalized intersection scores. Road segment scores and signalized intersection scores were pooled into two groups for all seven counties. Table 5-3 and Table 5-4 provide guidelines to the ranking of roads and intersections. The scores were split into 4 levels according to the 50th, 75th, 90th and 100th percentiles. Road segments of the seven counties, with their corresponding roadway IDs, beginning and ending milepoints and scores were placed in one excel table. A second excel table included the signalized intersections of the seven counties with their corresponding roadway IDs, milepoint locations and scores.

Table 5-3: Road Segment Severity Scores

Color in GIS	Score
Black	>17.094 (Rank 1)
Red	6.316-17.094 (Rank 2)
Yellow	2.060-6.315 (Rank 3)
Green	0-2.059 (Rank 4)

Table 5-4: Signalized Intersections Severity Score

Color in GIS	Score
Black	>5 (Rank 1)
Red	4 & 5 (Rank 2)
Yellow	2 & 3 (Rank 3)
Green	0 & 1 (Rank 4)

A new layer had to be created in order to generate a map of the road segments. This is accomplished by using the *Add Route Events* option in ArcMap 9.2. Since there already is a State-Road layer for Florida, the map of the road segments is created by referencing the road segments' excel table to the State-Road map. GIS then uses the roadway ID and beginning and ending milepoints of the road segments to generate the map. For visual purposes, the beginning and ending milepoints of segments used to draw the maps in GIS include intersection influence areas. This is required in order for road segments to appear continuous. For mapping signalized intersections in GIS, the procedure was much simpler. The signalized intersections of the 7 counties were extracted from their corresponding GIS layer (see Figure 3-4). A new map of the signalized intersections of the 7 counties was then created. Intersection scores were then appended to the signalized intersection attribute table of the newly created map in GIS. The results are shown in the following sections with the tables emphasizing on road segments and intersections that ranked 1 and 2. In the tables BegMp stands for beginning milepoint, EndMp stands for ending milepoint, IC stands for incapacitating crashes and FC stands for fatal crashes.

5.2.1 Escambia County

In Figure 5-3 and Figure 5-4, it can be seen that the most dangerous roadway segments and intersections occur in the southern region of the county. Roadway 48040000 has the highest number of dangerous road segments according to the analysis. (see Table 5-5).

Table 5-5: Escambia County Worst Road Segments

Roadway ID	State Road	Beg Mp	End Mp	Total Severe Crashes	IC	FC	Score	Rank
48003000	SR 289	4.053	4.183	1	1	0	7.692308	2
48003000	SR 289	4.586	4.671	4	4	0	47.05882	1
48004000	SR 295	7.131	7.748	3	2	1	6.482982	2
48004000	SR 295	6.871	7.075	3	3	0	14.70588	2
48004000	SR 295	8.341	8.527	3	3	0	16.12903	2
48004000	SR 295	7.804	8.285	8	8	0	16.63202	2
48004000	SR 727	5.989	6.108	6	6	0	50.42017	1
48010000	SR 10	6.589	7.491	6	4	2	8.86918	2
48010000	SR 10	10.431	10.621	3	3	0	15.78947	2
48010000	SR 10	11.098	11.295	4	4	0	20.30457	1
48010000	SR 10	10.265	10.375	3	3	0	27.27273	1
48012000	SR 296	1.456	2.26	8	6	2	12.43781	2
48012000	SR 296	0.653	1.456	10	9	1	13.69863	2
48012000	SR 296	0.028	0.597	11	11	0	19.33216	1
48020000	SR 10A	8.18	8.674	4	4	0	8.097166	2
48020000	SR 10A	10.923	10.98	1	1	0	17.54386	1
48020000	SR 10A	10.522	10.867	11	10	1	34.78261	1
48040000	SR 95	8.177	8.615	3	3	0	6.849315	2
48040000	SR 95	17.869	18.818	5	3	2	7.376185	2
48040000	SR 95	14.741	14.994	2	2	0	7.905138	2
48040000	SR 95	10.231	10.725	3	2	1	8.097166	2
48040000	SR 95	11.787	11.979	2	2	0	10.41667	2
48040000	SR 95	3.571	4.144	9	9	0	15.70681	2
48040000	SR 95	7.631	8.121	8	8	0	16.32653	2
48040000	SR 95	5.236	5.783	11	11	0	20.10969	1
48040000	SR 95	5.963	6.068	3	3	0	28.57143	1
48040000	SR 95	5.839	5.907	4	4	0	58.82353	1
48050000	SR 292	20.92	21.029	1	1	0	9.174312	2
48050000	SR 292	21.029	21.923	14	14	0	15.65996	2
48070000	SR 291	2.55	2.696	2	2	0	13.69863	2
48080000	SR 295	3.07	3.829	5	4	1	7.905138	2
48080000	SR 295	1.717	2.026	4	4	0	12.94498	2
48080000	SR 295	1.3	1.524	3	3	0	13.39286	2
48080060	SR 30	2.398	2.59	2	1	1	15.625	2
48080062	SR 295	0.354	0.482	2	2	0	15.625	2
48190000	SR 297	0.949	1.71	7	7	0	9.198423	2
48190000	SR 297	3.504	3.677	1	0	1	11.56069	2
48280000	SR 30	3.639	4.228	4	4	0	6.791171	2

Table 5-6: Escambia County Worst Signalized Intersections

Roadway ID	State Road	Signal Mp	Total Severe Crashes	IC	FC	Score	Rank
48004000	SR 727	6.136	5	5	0	5	2
48004000	SR 295	7.776	4	4	0	4	2
48004000	SR 295	9.647	5	5	0	5	2
48020000	SR 10A	7.788	7	7	0	7	1
48020000	SR 10A	8.702	11	11	0	11	1
48020000	SR 10A	11.095	4	4	0	4	2
48040000	SR 95	7.603	3	2	1	4	2
48040000	SR 95	9.709	4	4	0	4	2
48040000	SR 95	11.307	5	5	0	5	2
48080060	SR 30	0.434	6	6	0	6	1
48280000	SR 30	2.123	9	9	0	9	1
48280000	SR 30	5.46	5	5	0	5	2
48280000	SR30	3.611	5	4	1	6	1

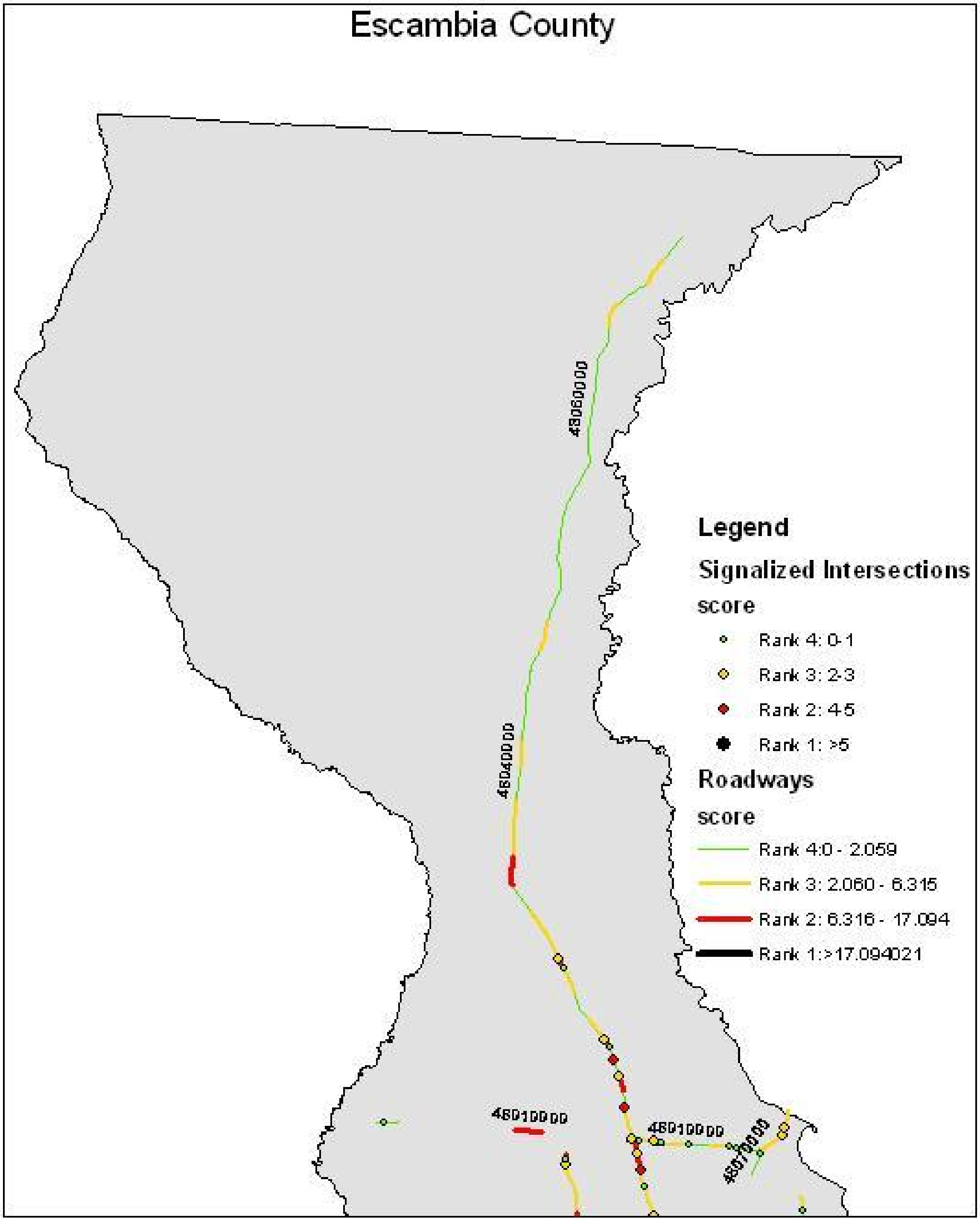

Figure 5-3: Escambia County (North)

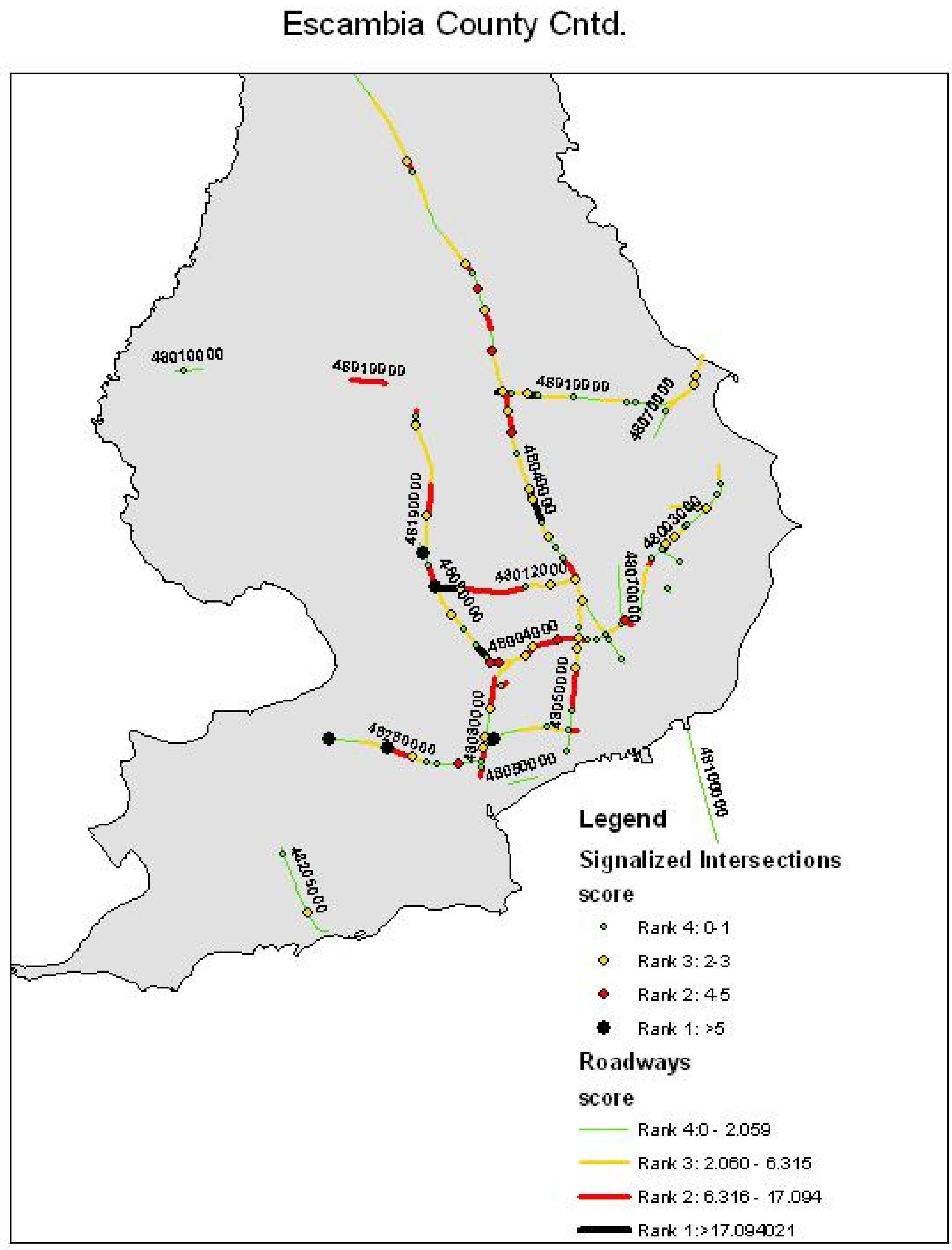

Figure 5-4: Escambia County (South)

5.2.2 Duval County

The most hazardous roadways are the ones located in the central region of the county, mainly Roadway 72100000 (Table 5-7 and Figure 5-5). There are very few dangerous signalized intersections in the county. Overall, Duval is the safest among the seven chosen counties.

Table 5-7: Duval County Worst Road Segments

Roadway ID	State Road	Beg Mp	End Mp	Total Severe Crashes	IC	FC	Score	Rank
72014000	SR 109	2.976	3.363	2	1	1	7.751938	2
72014000	SR 109	2.021	2.225	2	1	1	14.70588	2
72014000	SR 109	2.53	2.704	2	1	1	17.24138	1
72014000	SR 109	4.023	4.111	1	0	1	22.72727	1
72028000	SR 152	3.217	3.476	1	0	1	7.722008	2
72028000	SR 152	2.878	2.975	1	1	0	10.30928	2
72028000	SR 152	3.031	3.161	2	2	0	15.38462	2
72028000	SR 152	2.606	2.733	2	2	0	15.74803	2
72030000	SR 15	6.75	7.37	3	2	1	6.451613	2
72030000	SR 15	1.272	2.055	4	1	3	8.939974	2
72030000	SR 15	8.738	9.094	2	0	2	11.23596	2
72070000	SR 5	13.828	14.747	5	3	2	7.616975	2
72080000	SR 15	6.811	7.61	5	3	2	8.760951	2
72080000	SR 139	2.178	2.571	3	2	1	10.17812	2
72100000	SR 10	5.378	5.676	2	2	0	6.711409	2
72100000	SR 10	7.523	7.658	1	1	0	7.407407	2
72100000	SR 10	5.057	5.322	2	2	0	7.54717	2
72100000	SR 10	10.515	10.95	3	2	1	9.195402	2
72100000	SR 10	7.174	7.467	3	3	0	10.23891	2
72100000	SR 10	3.248	3.627	4	4	0	10.55409	2
72100000	SR 10	10.022	10.459	5	5	0	11.44165	2
72100000	SR 10	11.006	11.262	2	1	1	11.71875	2
72100000	SR 10	7.04	7.118	1	1	0	12.82051	2
72100000	SR 10	1.872	2.022	2	2	0	13.33333	2
72100000	SR 10	11.318	11.863	7	6	1	14.6789	2
72100000	SR 10	4.682	4.799	2	2	0	17.09402	1
72100000	SR 10	2.078	2.173	2	2	0	21.05263	1
72100000	SR 10	4.855	5.001	3	2	1	27.39726	1
72100000	SR 10	3.014	3.192	6	6	0	33.70787	1
72120000	SR 228	17.612	17.921	3	3	0	9.708738	2

Roadway ID	State Road	Beg Mp	End Mp	Total Severe Crashes	IC	FC	Score	Rank
72160000	SR 13	0	0.14	1	1	0	7.142857	2
72160000	SR 13	3.393	3.599	2	2	0	9.708738	2
72160000	SR 13	4.442	4.647	1	0	1	9.756098	2
72160000	SR 13	2.947	3.317	3	2	1	10.81081	2
72160000	SR 13	7.881	8.061	2	2	0	11.11111	2
72170000	SR 21	6.251	6.704	3	3	0	6.622517	2
72170000	SR 21	0	0.147	1	1	0	6.802721	2
72170000	SR 21	1.043	1.44	2	1	1	7.556675	2
72170000	SR 21	5.466	5.683	1	0	1	9.21659	2
72170000	SR 21	6.892	7.382	5	4	1	12.2449	2
72170000	SR 21	5.739	6.069	3	1	2	15.15152	2
72170000	SR 21	0.32	0.665	5	4	1	17.3913	1
72190000	SR 212	7.413	7.716	2	2	0	6.60066	2
72190000	SR 212	8.848	9.622	6	5	1	9.043928	2
72190000	SR 212	4.962	5.047	1	1	0	11.76471	2
72190000	SR 212	11.479	12.056	5	3	2	12.13172	2
72190000	SR 212	6.383	6.671	4	4	0	13.88889	2
72190000	SR 212	6.727	6.795	1	1	0	14.70588	2
72190000	SR 212	5.742	5.998	3	2	1	15.625	2
72190000	SR 212	6.851	7.357	6	4	2	15.81028	2
72220000	SR 134	7.782	8.012	3	3	0	13.04348	2
72220000	SR 134	6.39	6.841	5	4	1	13.30377	2
72220000	SR 134	8.214	8.662	7	4	3	22.32143	1
72220000	SR 134	8.068	8.088	1	1	0	50	1
72220000	SR 134	8.144	8.158	3	3	0	214.2857	1
72230000	SR A1A	2.158	2.272	1	1	0	8.77193	2
72250000	SR 105	0.437	1.323	5	4	1	6.772009	2
72250000	SR 105	6.003	6.32	4	3	1	15.77287	2
72291000	SR 111	5.201	5.89	4	3	1	7.256894	2

Table 5-8: Duval County Worst Signalized Intersections

Roadway ID	State Road	Signal Mp	Total Severe Crashes	IC	FC	Score	Rank
72010000	SR 10	20.213	4	4	0	4	2
72012000	SR 103	0	3	2	1	4	2
72030000	SR 15	0.46	4	4	0	4	2
72160000	SR 13	0.168	2	0	2	4	2
72170000	SR 21	0.693	3	2	1	4	2
72190000	SR 212	6.823	6	4	2	8	1
72190000	SR 212	6.355	3	2	1	4	2
72190000	SR 212	5.075	3	2	1	4	2
72220000	SR 134	6.869	4	4	0	4	2
72230000	SR A1A	2.3	4	4	0	4	2

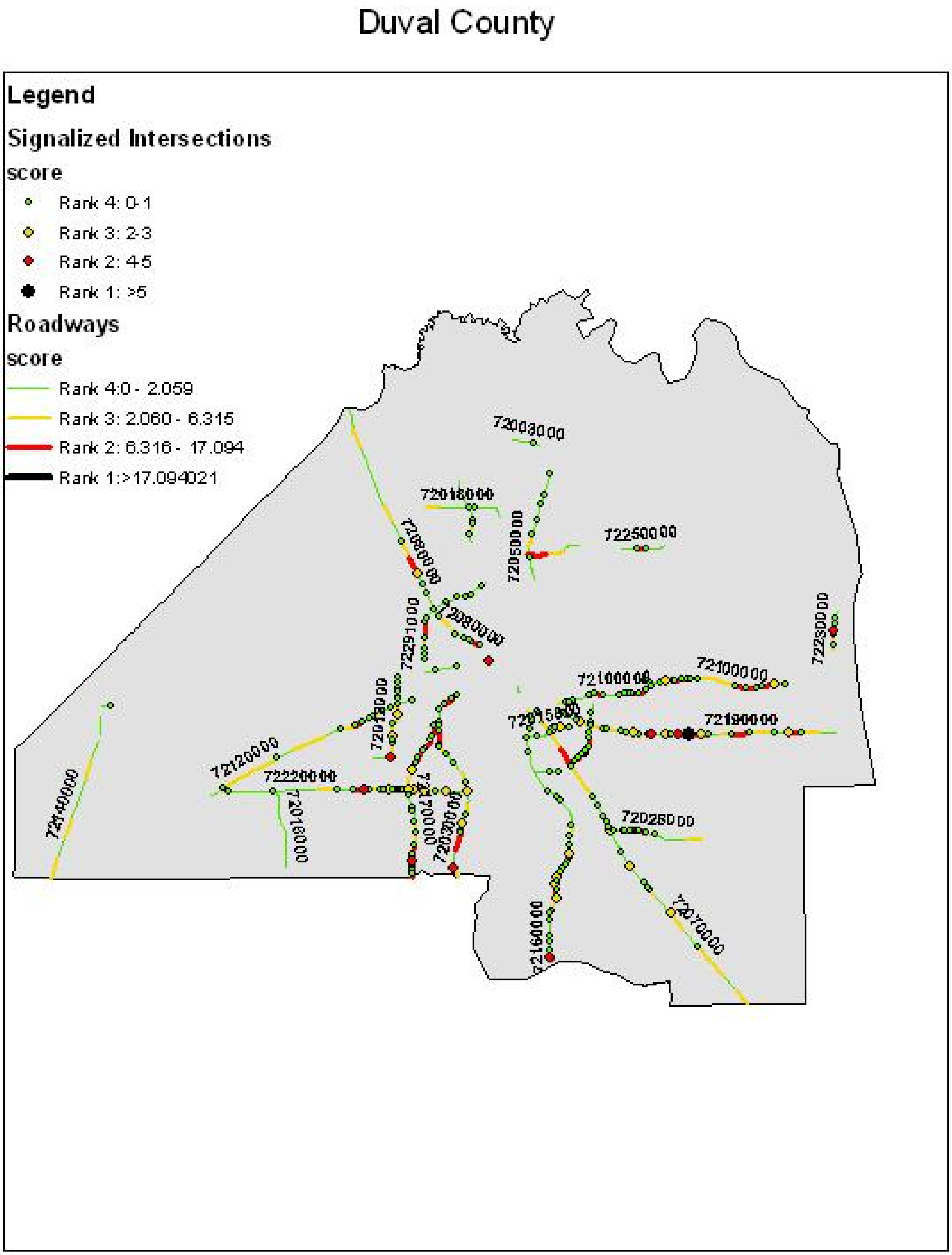

Figure 5-5: Duval County

5.2.3 Orange County

From the tables (Table 5-9 and Table 5-10) and figures (Figure 5-6 and Figure 5-7), it can be clearly observed that the roadways with the most dangerous road segments and intersections are Roadway 75003000, Roadway 75050000 and Roadway 75060000.

Table 5-9: Orange County Worst Road Segments

Roadway ID	State Road	Beg Mp	End Mp	Total Severe Crashes	IC	FC	Score	Rank
75002000	SR 482	1.261	1.828	4	4	0	7.054674	2
75002000	SR 482	4.447	4.764	3	3	0	9.463722	2
75002000	SR 482	3.009	3.635	5	3	2	11.18211	2
75002000	SR 482	4.82	5.017	2	1	1	15.22843	2
75003000	SR 436	9.636	10.079	3	3	0	6.772009	2
75003000	SR 436	2.076	2.326	1	0	1	8	2
75003000	SR 436	6.554	7.033	3	2	1	8.350731	2
75003000	SR 436	8.57	8.799	2	2	0	8.733624	2
75003000	SR 436	5.302	5.629	2	1	1	9.174312	2
75003000	SR 436	8.855	9.58	5	3	2	9.655172	2
75003000	SR 436	3.8	4.352	4	2	2	10.86957	2
75003000	SR 436	5.685	6.021	3	2	1	11.90476	2
75003000	SR 436	5.023	5.246	2	1	1	13.45291	2
75003000	SR 436	7.512	7.583	2	2	0	28.16901	1
75010000	SR 500	6.411	6.549	1	1	0	7.246377	2
75010000	SR 500	10.811	11.065	2	2	0	7.874016	2
75010000	SR 500	8.01	8.106	1	1	0	10.41667	2
75010000	SR 500	8.666	9.412	4	0	4	10.72386	2
75010000	SR 500	2.97	3.39	5	4	1	14.28571	2
75010000	SR 500	9.468	10.117	9	5	4	20.03082	1
75010000	SR 500	10.173	10.755	12	10	2	24.05498	1
75012000	SR 552	1.841	2.148	2	2	0	6.514658	2
75012000	SR 552	1.029	1.224	1	0	1	10.25641	2
75012000	SR 552	0.17	0.35	2	1	1	16.66667	2
75020000	SR 500	10.359	10.514	1	1	0	6.451613	2
75020000	SR 500	20.269	21.116	4	1	3	8.264463	2
75020000	SR 500	1.973	2.668	5	2	3	11.51079	2
75020000	SR 500	11.76	12.251	4	2	2	12.21996	2
75035000	SR 535	0	0.098	1	1	0	10.20408	2
75035001	SR 535	1.796	1.875	1	1	0	12.65823	2
75037000	SR 434	0.475	1.1	3	1	2	8	2

Roadway ID	State Road	Beg Mp	End Mp	Total Severe Crashes	IC	FC	Score	Rank
75037000	SR 434	2.19	2.44	2	2	0	8	2
75037000	SR 434	1.476	1.827	2	1	1	8.547009	2
75037000	SR 434	1.156	1.42	2	1	1	11.36364	2
75037000	SR 434	1.883	2.114	3	2	1	17.31602	1
75050000	SR 50	8.793	9.31	2	0	2	7.736944	2
75050000	SR 50	11.817	12.075	1	0	1	7.751938	2
75050000	SR 50	15.086	15.329	2	2	0	8.230453	2
75050000	SR 50	8.427	8.737	2	1	1	9.677419	2
75050000	SR 50	14.523	14.831	3	3	0	9.74026	2
75050000	SR 50	12.853	13.335	4	3	1	10.37344	2
75050000	SR 50	12.615	12.797	2	2	0	10.98901	2
75050000	SR 50	11.129	11.578	4	3	1	11.13586	2
75050000	SR 50	6.028	6.11	1	1	0	12.19512	2
75050000	SR 50	11.634	11.761	2	2	0	15.74803	2
75060000	SR 50	13.31	13.772	2	1	1	6.493506	2
75060000	SR 50	13.828	14.265	3	3	0	6.864989	2
75060000	SR 50	18.074	19.042	5	3	2	7.231405	2
75060000	SR 50	7.473	8.004	3	2	1	7.532957	2
75060000	SR 50	13.021	13.254	2	2	0	8.583691	2
75060000	SR 50	8.08	8.915	7	5	2	10.77844	2
75060000	SR 50	5.24	5.822	6	5	1	12.02749	2
75060000	SR 50	6.972	7.417	4	2	2	13.48315	2
75060000	SR 50	10.251	10.712	6	5	1	15.18438	2
75060000	SR 50	2.173	2.37	3	3	0	15.22843	2
75060000	SR 50	0.167	0.361	2	1	1	15.46392	2
75060000	SR 50	2.952	3.07	2	2	0	16.94915	2
75060000	SR 50	5.822	6.403	7	4	3	17.2117	1
75060000	SR 50	0.028	0.111	3	3	0	36.14458	1
75060000	SR 50	1.047	1.102	2	2	0	36.36364	1
75080000	SR 15	15.124	15.757	4	4	0	6.319115	2
75090000	SR 426	3.485	4.097	4	3	1	8.169935	2
75190000	SR 423	8.136	8.37	2	2	0	8.547009	2
75190001	SR 423	39.542	39.668	1	1	0	7.936508	2
75190001	SR 423	39.724	39.972	3	3	0	12.09677	2
75200000	SR 551	4.434	4.499	1	1	0	15.38462	2
75200000	SR 551	4.527	4.546	1	1	0	52.63158	1
75220000	SR 530	1.487	1.726	2	2	0	8.368201	2
75250000	SR 438	6.145	6.276	2	1	1	22.90076	1
75260000	SR 434	6.448	6.737	1	0	1	6.920415	2
75260000	SR 424	4.253	4.826	4	3	1	8.726003	2
75260000	SR 424	2.311	2.439	2	2	0	15.625	2
75270000	SR 435	1.983	2.258	5	4	1	21.81818	1

Table 5-10: Orange County Worst Signalized Intersections

Roadway ID	State Road	Signal Mp	Total Severe Crashes	IC	FC	Score	Rank
75003000	SR 436	1.245	4	4	0	4	2
75003000	SR 436	3.308	3	1	2	5	2
75003000	SR 436	4.995	5	4	1	6	1
75003000	SR 436	7.324	6	6	0	6	1
75010000	SR 600	8.638	3	2	1	4	2
75010000	SR 600	10.145	6	6	0	6	1
75020000	SR 500	4.835	3	2	1	4	2
75020000	SR 500	10.312	3	2	1	4	2
75050000	SR 50	11.606	4	4	0	4	2
75050000	SR 50	13.739	4	4	0	4	2
75050000	SR 50	14.869	3	2	1	4	2
75050000	SR 50	7.079	5	5	0	5	2
75050000	SR 50	13.872	4	3	1	5	2
75050000	SR 50	12.825	7	7	0	7	1
75060000	SR 50	2.653	3	2	1	4	2
75060000	SR 50	8.943	2	0	2	4	2
75190000	SR 423	4.428	4	4	0	4	2
75270000	SR 435	0.543	5	5	0	5	2

Orange County

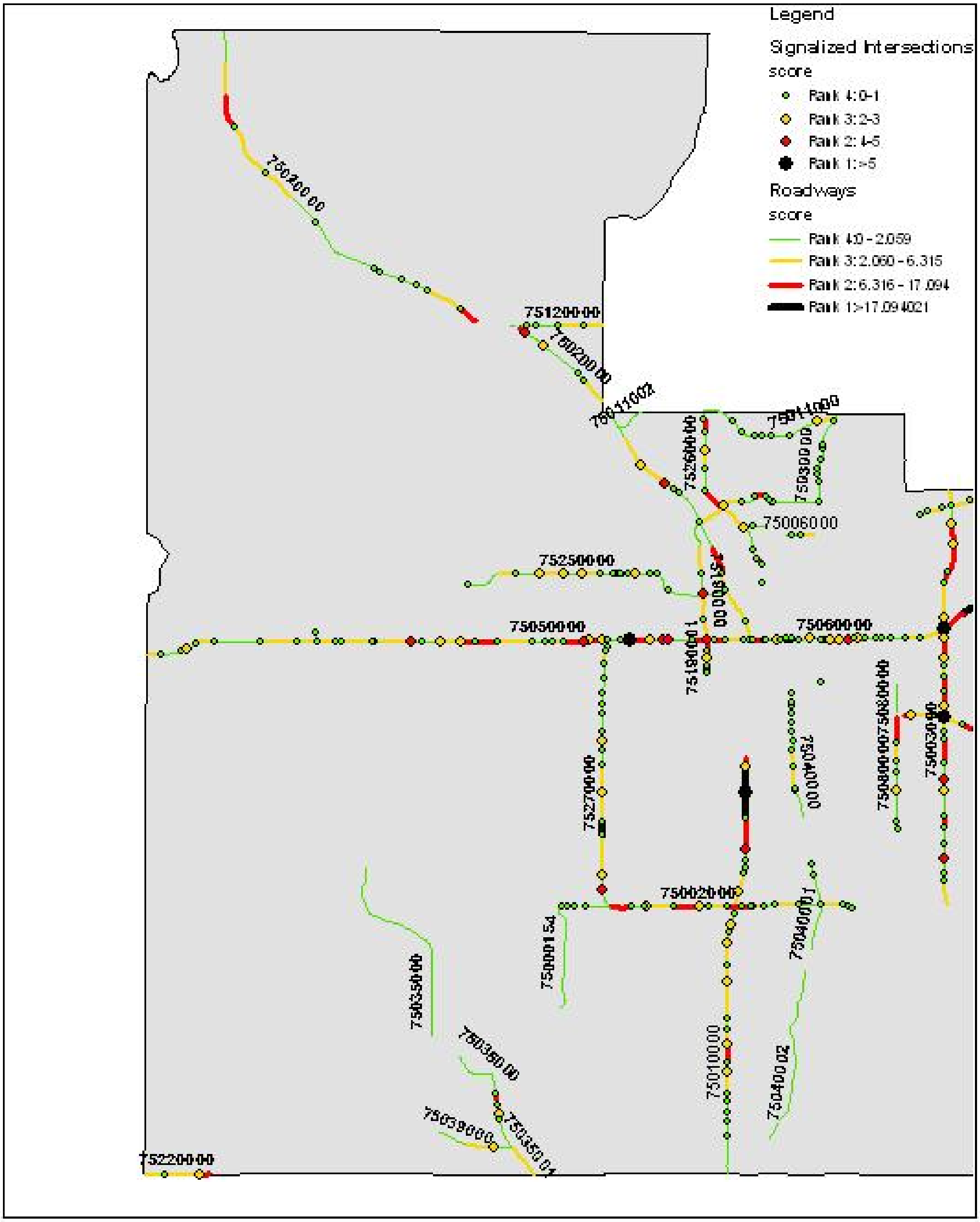

Figure 5-6: Orange County (West)

Orange County Cntd.

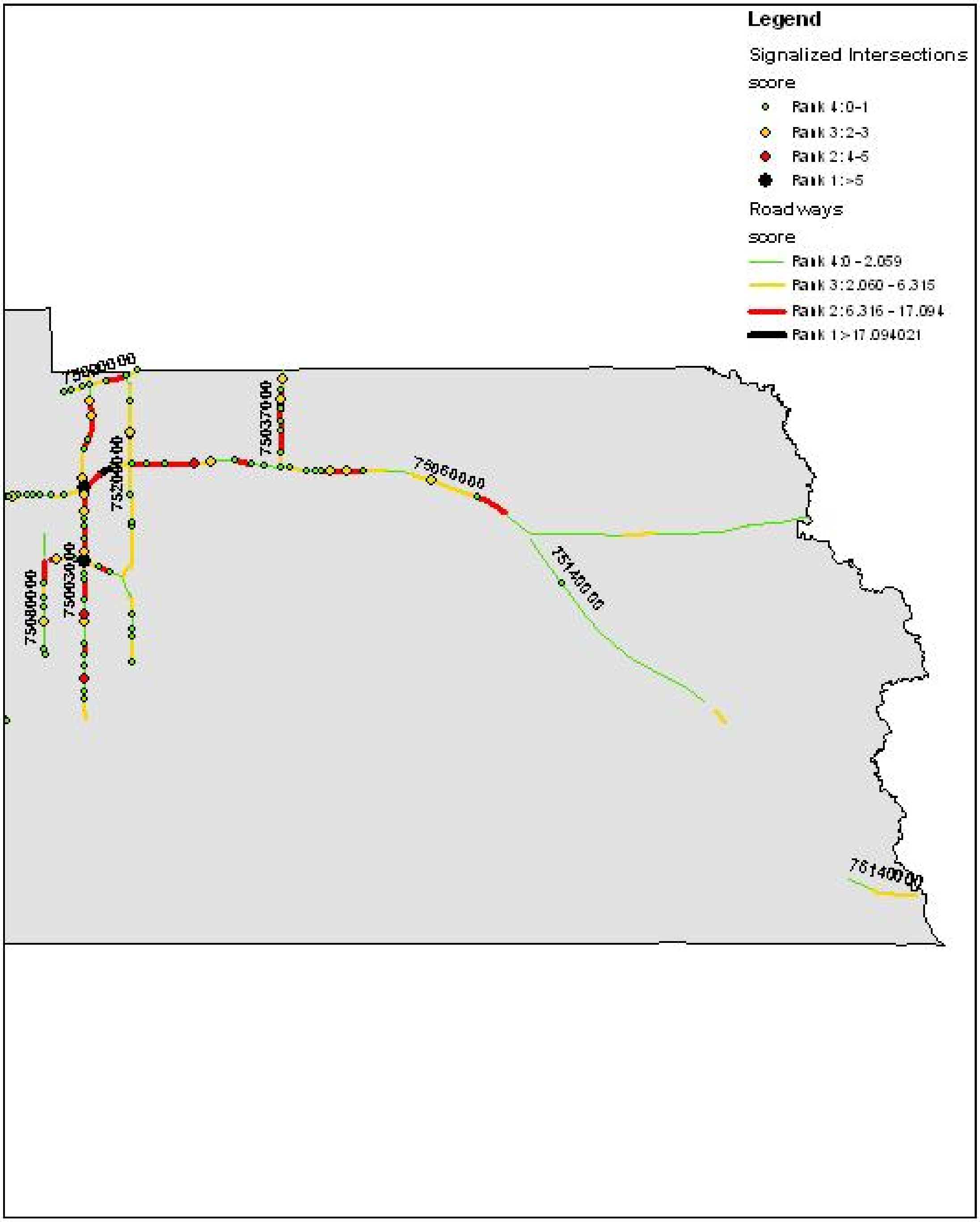

Figure 5-7: Orange County (East)

5.2.4 Miami-Dade County

Roadways 87020000 and 87030000 have the most dangerous roadway segments (see Table 5-11 Figure 5-8 and Figure 5-9). In fact both roadways are part of the same corridor near the eastern portion of the county. The most hazardous signalized intersections are spread around the county. There does not seem to be any clusters of bad intersections, with the exception of those on Roadway 87020000.

Table 5-11: Miami-Dade Worst Road Segments

Roadway ID	State Road	Beg Mp	End Mp	Total Severe Crashes	IC	FC	Score	Rank
87001000	SR 94	3.782	3.924	1	1	0	7.042254	2
87001000	SR 94	4.791	4.926	1	1	0	7.407407	2
87001000	SR 94	3.474	3.726	2	2	0	7.936508	2
87001000	SR 94	5.402	5.505	1	1	0	9.708738	2
87001000	SR 94	2.157	2.408	3	3	0	11.95219	2
87001000	SR 94	6.489	7.094	7	6	1	13.22314	2
87001000	SR 94	6.153	6.433	3	2	1	14.28571	2
87002000	SR 823	3.598	3.747	1	1	0	6.711409	2
87002000	SR 823	1.31	1.434	1	1	0	8.064516	2
87002000	SR 823	7.918	8.478	5	5	0	8.928571	2
87002000	SR 823	2.017	2.254	3	3	0	12.65823	2
87002000	SR 823	0.796	0.861	1	1	0	15.38462	2
87002000	SR 823	4.648	4.71	1	1	0	16.12903	2
87002000	SR 823	3.803	3.912	1	0	1	18.34862	1
87008000	SR 916	9.415	9.612	1	0	1	10.15228	2
87008000	SR 916	8.916	8.986	1	1	0	14.28571	2
87015000	SR 989	0.409	1.129	7	5	2	12.5	2
87019000	SR 817	0.87	1.285	4	4	0	9.638554	2
87019000	SR 817	2.267	2.702	4	3	1	11.49425	2
87019000	SR 817	1.788	2.211	5	5	0	11.82033	2
87019000	SR 817	2.778	2.963	3	3	0	16.21622	2
87019000	SR 817	0.586	0.707	2	1	1	24.79339	1
87020000	SR 5	12.203	12.355	1	1	0	6.578947	2
87020000	SR 5	11.685	11.986	1	0	1	6.644518	2
87020000	SR 5	2.453	3.046	4	4	0	6.745363	2
87020000	SR 5	5.724	6.277	3	2	1	7.233273	2
87020000	SR 5	8.243	8.372	1	1	0	7.751938	2
87020000	SR 5	16.848	17.358	3	2	1	7.843137	2
87020000	SR 5	15.265	15.504	1	0	1	8.368201	2
87020000	SR 5	7.64	8.187	3	1	2	9.140768	2
87020000	SR 5	3.102	3.319	2	2	0	9.21659	2

Roadway ID	State Road	Beg Mp	End Mp	Total Severe Crashes	IC	FC	Score	Rank
87020000	SR 5	12.411	13.046	4	2	2	9.448819	2
87020000	SR 5	12.042	12.147	1	1	0	9.52381	2
87020000	SR 5	3.671	4.295	6	6	0	9.615385	2
87020000	SR 5	18.256	19.042	8	8	0	10.17812	2
87020000	SR 5	10.837	11.122	3	3	0	10.52632	2
87020000	SR 5	7.093	7.64	5	4	1	10.96892	2
87020000	SR 5	19.656	20.014	4	4	0	11.17318	2
87020000	SR 5	6.779	7.037	2	1	1	11.62791	2
87020000	SR 5	8.428	8.637	2	1	1	14.35407	2
87020000	SR 5	13.824	13.934	1	0	1	18.18182	1
87020000	SR 5	6.333	6.685	4	1	3	19.88636	1
87020000	SR 5	13.99	14.139	3	3	0	20.13423	1
87020000	SR 5	5.045	5.098	3	2	1	75.4717	1
87026000	SR 860	6.136	6.537	2	1	1	7.481297	2
87026000	SR 860	8.744	9.186	3	2	1	9.049774	2
87026000	SR 860	6.631	6.735	1	1	0	9.615385	2
87026000	SR 860	5.606	5.752	3	3	0	20.54795	1
87026000	SR 860	6.791	6.806	1	1	0	66.66667	1
87026005	SR 860	1.764	2.362	5	5	0	8.361204	2
87030000	SR 5	4.892	5.026	1	1	0	7.462687	2
87030000	SR 5	22.072	22.602	3	2	1	7.54717	2
87030000	SR 5	1.469	1.6	1	1	0	7.633588	2
87030000	SR 5	8.825	8.942	1	1	0	8.547009	2
87030000	SR 5	2.466	2.568	1	1	0	9.803922	2
87030000	SR 5	6.014	6.506	5	5	0	10.1626	2
87030000	SR 5	7.648	7.745	1	1	0	10.30928	2
87030000	SR 5	3.251	3.504	3	3	0	11.85771	2
87030000	SR 5	2.13	2.293	1	0	1	12.26994	2
87030000	SR 5	3.56	3.721	2	2	0	12.42236	2
87030000	SR 5	23.414	23.567	2	2	0	13.0719	2
87030000	SR 5	23.89	24.039	2	2	0	13.42282	2
87030000	SR 5	20.437	20.502	1	1	0	15.38462	2
87030000	SR 5	21.253	21.488	3	2	1	17.02128	2
87030000	SR 5	24.677	24.777	1	0	1	20	1
87030000	SR 5	0.989	1.037	1	1	0	20.83333	1
87030000	SR 5	23.02	23.145	3	3	0	24	1
87030000	SR 5	2.349	2.39	1	1	0	24.39024	1
87030000	SR 5	0.901	0.933	1	1	0	31.25	1
87030000	SR 5	24.23	24.25	1	1	0	50	1
87034000	SR 915	3.192	3.572	3	3	0	7.894737	2
87038000	SR 932	1.678	1.786	1	1	0	9.259259	2
87038000	SR 932	1.211	1.286	1	1	0	13.33333	2
87038000	SR 932	1.342	1.446	2	2	0	19.23077	1
87038000	SR 932	3.037	3.122	2	2	0	23.52941	1
87039000	SR 992	1.637	2.387	5	4	1	8	2

Roadway ID	State Road	Beg Mp	End Mp	Total Severe Crashes	IC	FC	Score	Rank
87039000	SR 992	0.121	0.339	1	0	1	9.174312	2
87044000	SR 976	5.228	5.683	2	1	1	6.593407	2
87044000	SR 976	2.179	2.624	3	3	0	6.741573	2
87044000	SR 976	4.4	4.668	2	2	0	7.462687	2
87044000	SR 976	0.328	0.632	2	1	1	9.868421	2
87044000	SR 976	4.724	5.172	4	3	1	11.16071	2
87044000	SR 976	0.213	0.272	1	1	0	16.94915	2
87047000	SR 973	3.949	4.567	3	2	1	6.472492	2
87047000	SR 973	9.15	9.285	1	1	0	7.407407	2
87047000	SR 973	7.805	7.958	1	0	1	13.0719	2
87052000	SR 924	0.553	0.987	2	1	1	6.912442	2
87052000	SR 924	1.043	1.49	4	2	2	13.42282	2
87052000	SR 924	1.546	1.742	3	2	1	20.40816	1
87053000	SR 968	3.596	3.748	1	1	0	6.578947	2
87053000	SR 968	2.032	2.48	3	2	1	8.928571	2
87053000	SR 968	0.28	0.479	2	2	0	10.05025	2
87053000	SR 968	4.446	4.637	2	2	0	10.4712	2
87053000	SR 968	2.536	2.614	1	1	0	12.82051	2
87053000	SR 968	0	0.224	3	3	0	13.39286	2
87053000	SR 968	5.558	5.845	2	0	2	13.93728	2
87053000	SR 968	5.071	5.502	6	5	1	16.2413	2
87053000	SR 968	1.536	1.772	3	2	1	16.94915	2
87053000	SR 968	3.458	3.54	1	0	1	24.39024	1
87053000	SR 968	5.901	6.054	3	2	1	26.14379	1
87054000	SR 972	2.577	2.852	2	1	1	10.90909	2
87055000	SR 986	1.384	1.99	2	0	2	6.60066	2
87060000	SR A1A	0.817	1.606	5	5	0	6.337136	2
87060000	SR A1A	2.482	2.583	1	0	1	19.80198	1
87062000	SR 959	5.37	5.448	1	1	0	12.82051	2
87072000	SR 985	3.535	4.132	4	4	0	6.700168	2
87072000	SR 985	2.542	2.976	2	1	1	6.912442	2
87072000	SR 985	4.208	4.642	3	3	0	6.912442	2
87072000	SR 985	5.985	6.123	1	1	0	7.246377	2
87072000	SR 985	7.354	7.604	1	0	1	8	2
87072000	SR 985	6.217	6.384	1	0	1	11.97605	2
87080900	SR 934	37.807	37.94	1	1	0	7.518797	2
87080900	SR 934	37.996	38.16	2	2	0	12.19512	2
87090000	SR 934	9.618	10.058	3	3	0	6.818182	2
87090000	SR 934	5.014	5.201	2	2	0	10.69519	2
87090000	SR 934	0	0.997	7	3	4	11.0331	2
87090000	SR 934	5.277	6.162	8	6	2	11.29944	2
87090000	SR 934	10.152	10.256	3	3	0	28.84615	1
87090000	SR 934	13.583	13.609	1	1	0	38.46154	1
87091000	SR 994	6.386	6.53	1	1	0	6.944444	2
87091000	SR 994	5.698	5.813	1	1	0	8.695652	2

Roadway ID	State Road	Beg Mp	End Mp	Total Severe Crashes	IC	FC	Score	Rank
87091000	SR 994	6.586	6.801	2	2	0	9.302326	2
87120000	SR 90	4.497	5	4	4	0	7.952286	2
87120000	SR 90	5.921	6.17	1	0	1	8.032129	2
87120000	SR 90	5.056	5.491	3	2	1	9.195402	2
87120000	SR 90	7.097	7.53	2	0	2	9.237875	2
87120000	SR 90	6.596	6.779	1	0	1	10.92896	2
87120000	SR 90	6.455	6.54	1	1	0	11.76471	2
87120000	SR 90	9.09	9.557	6	5	1	14.98929	2
87120000	SR 90	6.835	7.021	3	3	0	16.12903	2
87140000	SR 7	7.701	8.133	3	3	0	6.944444	2
87140000	SR 7	5.801	6.176	2	1	1	8	2
87140000	SR 7	12.642	12.866	2	2	0	8.928571	2
87140000	SR 7	13.124	13.56	3	2	1	9.174312	2
87140000	SR 7	13.636	13.854	2	2	0	9.174312	2
87140000	SR 7	14.215	14.652	5	5	0	11.44165	2
87140000	SR 7	10.216	10.7	6	6	0	12.39669	2
87140000	SR 7	5.477	5.621	1	0	1	13.88889	2
87190000	SR 909	2.134	2.43	3	3	0	10.13514	2
87190000	SR 909	2.486	2.782	3	3	0	10.13514	2
87220000	SR 948	2.193	2.47	3	3	0	10.83032	2
87220000	SR 948	3.535	3.675	3	3	0	21.42857	1
87240000	SR 9	9.506	9.576	1	1	0	14.28571	2
87240000	SR 9	8.323	8.81	6	5	1	14.37372	2
87240000	SR 9	2.259	2.326	1	1	0	14.92537	2
87240000	SR 9	9.301	9.45	2	1	1	20.13423	1
87250000	SR 944	4.275	4.469	2	2	0	10.30928	2
87250000	SR 944	0.483	0.663	2	1	1	16.66667	2
87281000	SR 953	2.123	2.588	3	1	2	10.75269	2
87281000	SR 953	7.989	8.168	1	0	1	11.17318	2

Table 5-12: Miami Dade-Worst Signalized Intersections

Roadway ID	State Road	Signal Mp	Total Severe Crashes	IC	FC	Score	Rank
87001000	SR 94	3.129	4	4	0	4	2
87002000	SR 823	0.566	3	2	1	4	2
87002000	SR 823	6.058	4	4	0	4	2
87002000	SR 823	8.746	4	4	0	4	2
87002000	SR 823	4.738	6	6	0	6	1
87008000	SR 916	8.637	4	3	1	5	2
87015000	SR 989	2.417	4	4	0	4	2
87019000	SR 817	4.351	4	3	1	5	2
87020000	SR 5	6.305	3	2	1	4	2
87020000	SR 5	7.065	3	2	1	4	2
87020000	SR 5	10.47	4	4	0	4	2
87020000	SR 5	11.647	4	4	0	4	2
87020000	SR 5	13.234	4	4	0	4	2
87020000	SR 5	2.425	3	1	2	5	2
87020000	SR 5	4.323	5	3	2	7	1
87026000	SR 860	8.185	3	2	1	4	2
87026000	SR 860	2.021	6	6	0	6	1
87026000	SR 860	2.519	6	5	1	7	1
87030000	SR 5	7.62	3	2	1	4	2
87030000	SR 5	23.605	4	4	0	4	2
87030000	SR 5	24.649	4	4	0	4	2
87030000	SR 5	3.749	5	5	0	5	2
87030000	SR 5	6.534	5	3	2	7	1
87037000	SR 907	1.54	4	4	0	4	2
87044000	SR 976	4.696	2	0	2	4	2
87044000	SR 976	2.652	3	2	1	4	2
87044000	SR 976	4.175	3	1	2	5	2
87044000	SR 976	0.66	5	5	0	5	2
87053000	SR 968	2.004	3	2	1	4	2
87053000	SR 968	4.031	3	2	1	4	2
87060000	SR A1A	12.733	3	2	1	4	2
87060000	SR A1A	1.634	4	3	1	5	2
87072000	SR 985	5.161	3	1	2	5	2
87090000	SR 25	4.986	3	1	2	5	2
87090000	SR 25	5.239	3	1	2	5	2
87090000	SR 25	8.804	6	5	1	7	1
87091000	SR 994	7.466	4	4	0	4	2
87120000	SR 90	5.874	4	3	1	5	2
87140000	SR 7	12.604	4	4	0	4	2
87240000	SR 9	8.848	2	0	2	4	2
87240000	SR 9	11.809	2	0	2	4	2
87240000	SR 9	9.864	3	2	1	4	2
87240000	SR 9	9.478	4	2	2	6	1
87250000	SR 944	2.967	4	3	1	5	2
87281000	SR 953	8.647	4	4	0	4	2

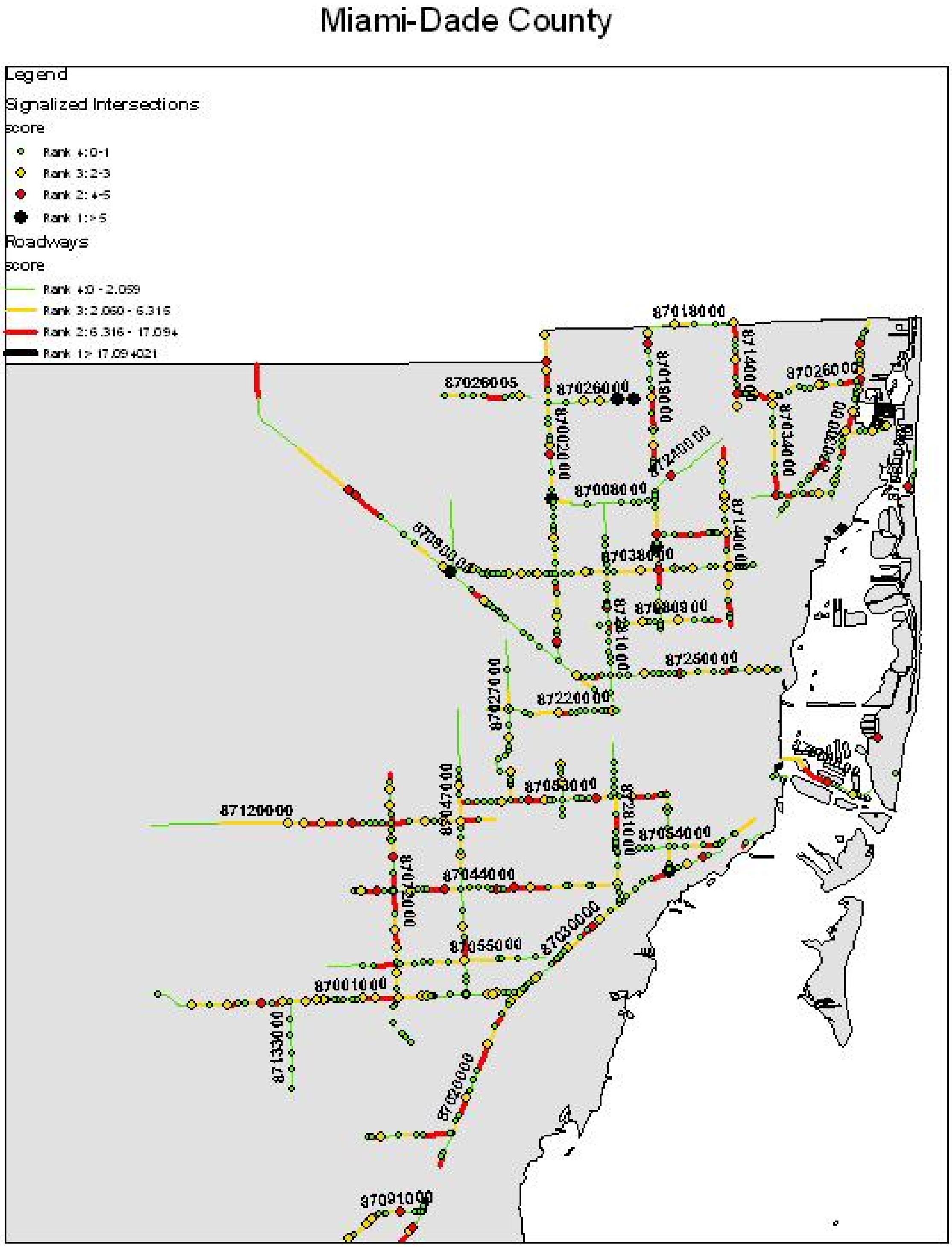

Figure 5-8: Miami-Dade County (North)

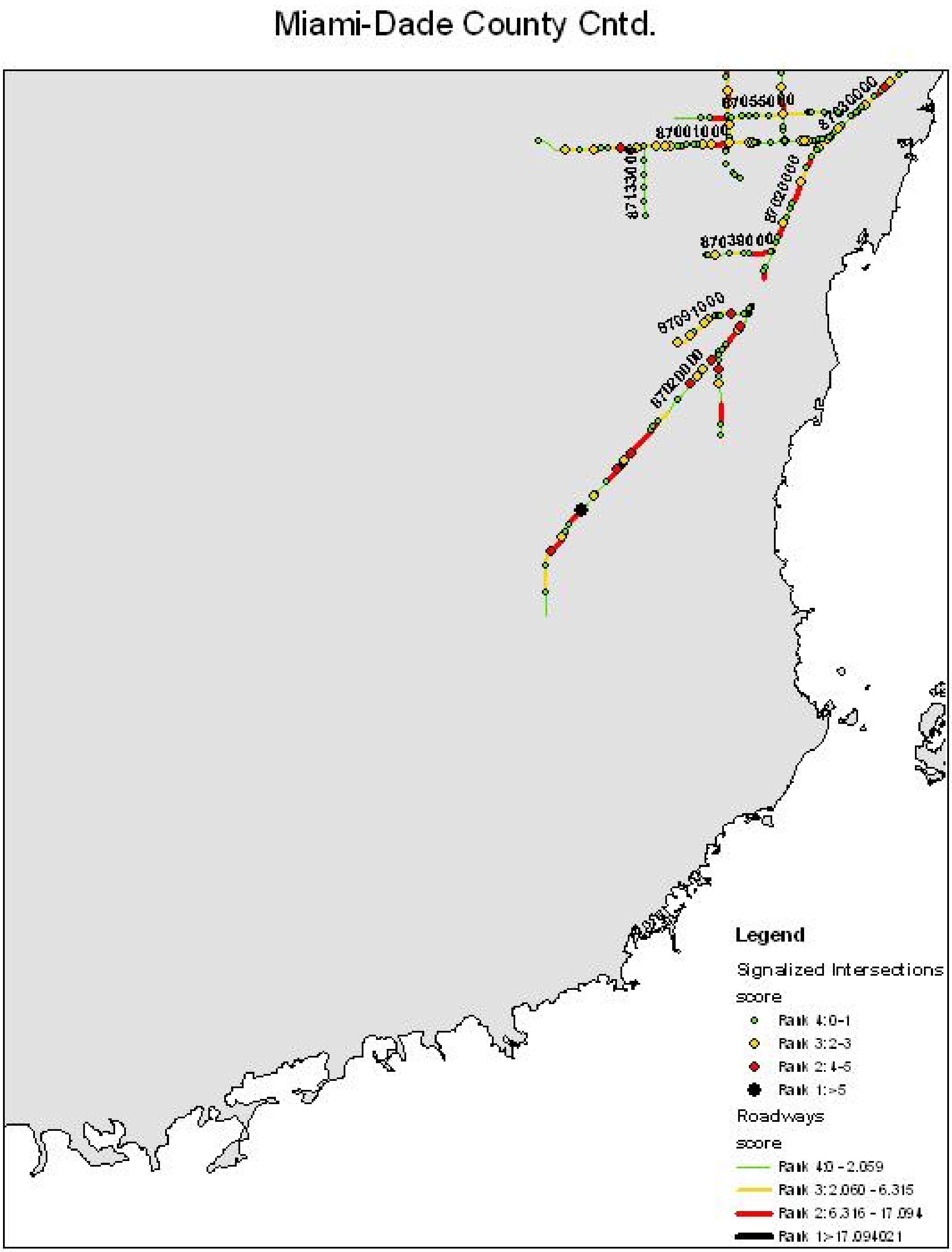

Figure 5-9: Miami-Dade County (South)

5.2.5 Pasco County

It is very clear from Table 5-13 Table 5-14 and Figure 5-10, that the western corridor (Roadway 14030000) that runs from the north to the south of Pasco County has many dangerous roadway segments and intersections. This corridor was found to be the most dangerous among all seven counties.

Table 5-13: Pasco County Worst Road Segments

Roadway ID	State Road	Beg Mp	End Mp	Total Severe Crashes	IC	FC	Score	Rank
14030000	SR 55	2.545	3.005	3	3	0	6.521739	2
14030000	SR 55	4.21	4.635	3	3	0	7.058824	2
14030000	SR 55	1.547	1.683	1	1	0	7.352941	2
14030000	SR 55	9.755	9.964	1	0	1	9.569378	2
14030000	SR 55	12.902	13.81	9	9	0	9.911894	2
14030000	SR 55	10.02	10.455	5	5	0	11.49425	2
14030000	SR 55	0.298	0.627	4	4	0	12.15805	2
14030000	SR 55	8.784	9.023	3	3	0	12.5523	2
14030000	SR 55	7.745	8.454	8	7	1	12.69394	2
14030000	SR 55	13.866	14.469	7	6	1	13.267	2
14030000	SR 55	4.691	4.832	2	2	0	14.1844	2
14030000	SR 55	11.517	11.938	6	6	0	14.25178	2
14030000	SR 55	4.888	5.415	8	7	1	17.0778	2
14030000	SR 55	7.186	7.689	8	7	1	17.89264	1
14030000	SR 55	5.471	6.3	11	7	4	18.09409	1
14030000	SR 55	3.081	3.565	10	9	1	22.72727	1
14030000	SR 55	0.683	0.99	6	5	1	22.8013	1
14030000	SR 55	11.994	12.902	17	13	4	23.12775	1
14030000	SR 55	1.739	2.489	17	16	1	24	1
14030000	SR 55	0	0.242	6	6	0	24.79339	1
14030000	SR 55	6.3	7.13	16	11	5	25.3012	1
14030000	SR 55	10.511	11.441	22	20	2	25.80645	1
14030000	SR 55	1.046	1.491	13	12	1	31.46067	1
14030000	SR 55	9.079	9.528	16	14	2	40.08909	1
14050000	SR 35	15.958	16.886	4	2	2	6.465517	2
14050000	SR 39	7.248	8.016	5	5	0	6.510417	2
14050000	SR 35	16.886	17.814	5	3	2	7.543103	2
14050000	SR 39	8.868	9.692	7	7	0	8.495146	2
14050000	SR 35	15.03	15.958	8	8	0	8.62069	2
14090000	SR 54	0.038	0.889	5	4	1	7.050529	2
14090000	SR 54	9.34	9.554	2	2	0	9.345794	2
14120000	SR 52	2.05	2.49	3	3	0	6.818182	2
14120000	SR 53	3.056	3.465	2	1	1	7.334963	2

Roadway ID	State Road	Beg Mp	End Mp	Total Severe Crashes	IC	FC	Score	Rank
14120000	SR 54	0.796	1.289	5	5	0	10.14199	2
14120000	SR 55	0.039	0.473	5	4	1	13.82488	2

Table 5-14: Pasco County Worst Signalized Intersections

Roadway ID	State Road	Signal Mp	Total Severe Crashes	IC	FC	Score	Rank
14030000	SR 55	0.655	3	2	1	4	2
14030000	SR 55	8.756	4	4	0	4	2
14030000	SR 55	11.479	4	4	0	4	2
14030000	SR 55	16.126	4	4	0	4	2
14030000	SR 55	10.483	5	5	0	5	2
14030000	SR 55	1.018	6	6	0	6	1
14030000	SR 55	14.818	7	7	0	7	1
14030000	SR 55	9.727	7	6	1	8	1
14030000	SR 55	13.838	6	4	2	8	1
14030000	SR 55	3.043	7	5	2	9	1
14030000	SR 55	1.711	9	8	1	10	1
14030000	SR 55	1.519	10	9	1	11	1
14090000	SR 54	1.778	3	2	1	4	2
14120000	SR 52	0.501	4	4	0	4	2
14120000	SR 52	0.768	5	5	0	5	2
14120000	SR 52	3.028	5	5	0	5	2
14120000	SR 52	2.012	6	6	0	6	1
14570101	SR 54	0.201	5	5	0	5	2

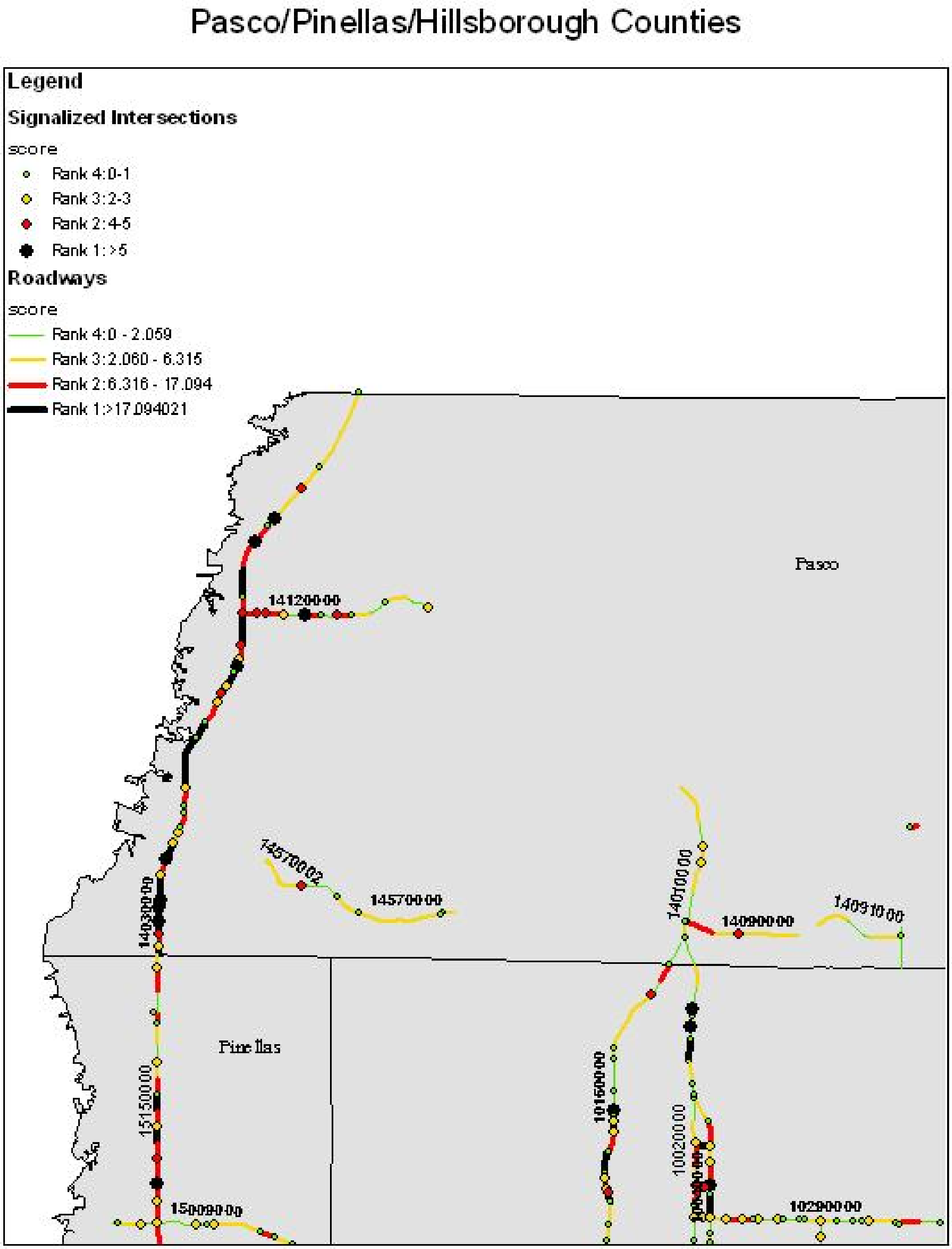

Figure 5-10: Pasco County

5.2.6 Pinellas County

As observed in Table 5-15, Table 5-16 and Figure 5-11 that Roadway 15150000 has the most hazardous road segments and intersections. It has to be noted that this roadway is not continuous since several sections in it do not classify as a multilane corridor. It is also interesting to note that Roadway 15150000 is a continuation of Roadway 14030000, from Pasco County (Figure 5-10). Thus both roadways are part of the same corridor system.

Table 5-15: Pinellas County Worst Road Segments

Roadway ID	State Road	Begpt	Endpt	Total Severe Crashes	IC	FC	Score	Rank
15007000	SR 595	0.788	1.091	1	0	1	6.60066	2
15007000	SR 595	0.278	0.732	3	2	1	8.810573	2
15007000	SR 595	1.305	1.507	2	2	0	9.90099	2
15007000	SR 651	3.572	3.77	2	2	0	10.10101	2
15010000	SR 595	5.432	5.921	4	4	0	8.179959	2
15010000	SR 595	13.568	14.014	4	4	0	8.96861	2
15010000	SR 595	11.294	11.493	1	0	1	10.05025	2
15010000	SR 595	15.087	15.286	1	0	1	10.05025	2
15010000	SR 595	10.191	10.484	4	4	0	13.65188	2
15010000	SR 595	6.11	6.617	6	5	1	13.80671	2
15010000	SR 595	14.582	15.031	6	5	1	15.5902	2
15010000	SR 595	18.147	18.366	4	4	0	18.26484	1
15030000	SR 686	1.057	1.52	2	1	1	6.479482	2
15030000	SR 686	2.081	2.529	3	3	0	6.696429	2
15030000	SR 686	9.107	9.683	4	4	0	6.944444	2
15030000	SR 686	3.609	3.74	1	1	0	7.633588	2
15030000	SR 686	2.605	2.86	2	2	0	7.843137	2
15030000	SR 686	3.796	4.033	2	2	0	8.438819	2
15030000	SR 686	2.916	3.239	2	1	1	9.287926	2
15030000	SR 686	4.571	5.112	4	2	2	11.09057	2
15030000	SR 686	5.168	5.401	3	3	0	12.87554	2
15030000	SR 686	4.089	4.515	6	5	1	16.43192	2
15030000	SR 686	5.457	5.501	1	1	0	22.72727	1
15040000	SR 60	5.765	5.916	1	1	0	6.622517	2
15040000	SR 60	4.974	5.675	4	3	1	7.132668	2
15040000	SR 60	3.469	4.134	6	6	0	9.022556	2
15040000	SR 60	2.708	2.903	2	2	0	10.25641	2
15040000	SR 60	2.463	2.652	2	2	0	10.58201	2
15040000	SR 60	4.285	4.379	1	1	0	10.6383	2

Roadway ID	State Road	Begpt	Endpt	Total Severe Crashes	IC	FC	Score	Rank
15040000	SR 60	4.708	4.806	2	2	0	20.40816	1
15040000	SR 60	4.862	4.918	2	1	1	53.57143	1
15050000	SR 590	2.461	2.748	2	2	0	6.968641	2
15050000	SR 590	1.507	2.115	5	5	0	8.223684	2
15050000	SR 580	13.068	13.172	1	1	0	9.615385	2
15050000	SR 590	2.804	2.88	1	1	0	13.15789	2
15050000	SR 590	2.171	2.405	3	2	1	17.09402	1
15050000	SR 580	11.438	11.48	1	1	0	23.80952	1
15070000	SR 580	5.008	5.161	1	1	0	6.535948	2
15070000	SR 580	0.602	1.004	3	3	0	7.462687	2
15070000	SR 580	2.235	2.489	2	2	0	7.874016	2
15070000	SR 580	1.781	1.993	2	2	0	9.433962	2
15070000	SR 580	2.545	2.744	2	2	0	10.05025	2
15070000	SR 580	1.272	1.361	1	1	0	11.23596	2
15080000	SR 584	0.637	1.04	3	3	0	7.444169	2
15090000	SR 687	3.938	4.375	3	3	0	6.864989	2
15090000	SR 687	4.431	5	4	4	0	7.029877	2
15090000	SR 600	6.625	7.103	5	5	0	10.46025	2
15090000	SR 687	2.931	3.882	9	8	1	10.51525	2
15090000	SR 687	5.404	5.688	3	3	0	10.56338	2
15090000	SR 687	2.227	2.373	2	2	0	13.69863	2
15090000	SR 687	5.056	5.348	3	1	2	17.12329	1
15120000	SR 688	2.278	2.891	4	4	0	6.525285	2
15120000	SR 688	7.227	8.071	5	4	1	7.109005	2
15120000	SR 688	0.27	0.677	3	3	0	7.371007	2
15120000	SR 688	8.558	9.083	4	4	0	7.619048	2
15120000	SR 686	10.641	10.762	1	1	0	8.264463	2
15120000	SR 688	6.348	7.028	10	10	0	14.70588	2
15120000	SR 688	7.104	7.171	1	1	0	14.92537	2
15120000	SR 688	4.814	5.013	2	1	1	15.07538	2
15120000	SR 686	10.818	11.113	6	6	0	20.33898	1
15150000	SR 55	30.972	31.262	2	2	0	6.896552	2
15150000	SR 55	23.141	23.851	4	3	1	7.042254	2
15150000	SR 55	23.851	24.55	5	5	0	7.153076	2
15150000	SR 55	31.995	32.672	4	3	1	7.385524	2
15150000	SR 55	24.626	25.267	4	3	1	7.800312	2
15150000	SR 55	26.678	27.155	4	4	0	8.385744	2
15150000	SR 55	1.401	1.846	2	0	2	8.988764	2
15150000	SR 55	25.87	26.622	7	7	0	9.308511	2
15150000	SR 55	15.968	16.274	3	3	0	9.803922	2
15150000	SR 55	5.548	5.85	3	3	0	9.933775	2
15150000	SR 55	25.323	25.814	5	5	0	10.1833	2

Roadway ID	State Road	Begpt	Endpt	Total Severe Crashes	IC	FC	Score	Rank
15150000	SR 55	7.928	8.119	2	2	0	10.4712	2
15150000	SR 55	12.482	12.766	3	3	0	10.56338	2
15150000	SR 55	8.175	8.351	2	2	0	11.36364	2
15150000	SR 55	18.886	19.317	3	1	2	11.60093	2
15150000	SR 55	9.862	10.445	6	5	1	12.00686	2
15150000	SR 55	10.501	11.164	7	6	1	12.06637	2
15150000	SR 55	27.688	28.164	6	6	0	12.60504	2
15150000	SR 55	28.696	29.177	5	3	2	14.55301	2
15150000	SR 55	11.164	11.827	10	10	0	15.08296	2
15150000	SR 55	11.883	12.406	7	6	1	15.29637	2
15150000	SR 55	3.152	3.342	2	1	1	15.78947	2
15150000	SR 55	8.677	8.867	3	3	0	15.78947	2
15150000	SR 55	7.398	7.872	7	6	1	16.87764	2
15150000	SR 55	6.409	6.849	8	7	1	20.45455	1
15150000	SR 55	27.155	27.632	9	8	1	20.96436	1
15150000	SR 55	28.164	28.64	9	8	1	21.0084	1
15150000	SR 55	8.961	9.171	6	6	0	28.57143	1
15150000	SR 55	9.278	9.862	19	18	1	34.24658	1
15150000	SR 55	8.445	8.621	7	7	0	39.77273	1
15230000	SR 693	3.662	4.092	3	3	0	6.976744	2
15230000	SR 693	1.653	1.793	1	1	0	7.142857	2
15230000	SR 693	3.161	3.606	3	2	1	8.988764	2
15230000	SR 693	5.169	5.354	2	2	0	10.81081	2
15230000	SR 693	4.669	5.113	5	5	0	11.26126	2
15230000	SR 693	0.647	0.845	2	1	1	15.15152	2
15240000	SR 687	3.31	4.108	7	7	0	8.77193	2
15240000	SR 693	0.038	0.633	9	9	0	15.12605	2

Table 5-16: Pinellas County Worst Signalized Intersections

Roadway ID	State Road	Signal Mp	Total Severe Crashes	IC	FC	Score	Rank
15010000	SR 595	6.072	4	4	0	4	2
15010000	SR 595	8.033	4	4	0	4	2
15010000	SR 595	14.042	4	4	0	4	2
15030000	SR 686	1.029	3	2	1	4	2
15040000	SR 60	3.441	3	2	1	4	2
15040000	SR 60	2.435	6	6	0	6	1
15070000	SR 580	5.199	6	4	2	8	1
15120000	SR 688	2.25	2	0	2	4	2
15120000	SR 688	10.613	3	2	1	4	2
15120000	SR 688	10.79	6	5	1	7	1
15120000	SR 688	11.141	8	8	0	8	1
15150000	SR 55	2.628	4	4	0	4	2
15150000	SR 55	2.879	4	4	0	4	2
15150000	SR 55	8.649	4	4	0	4	2
15150000	SR 55	8.914	4	4	0	4	2
15150000	SR 55	9.199	4	4	0	4	2
15150000	SR 55	11.855	4	4	0	4	2
15150000	SR 55	8.398	5	5	0	5	2
15150000	SR 55	9.25	5	5	0	5	2
15150000	SR 55	20.418	5	5	0	5	2
15150000	SR 55	26.65	4	3	1	5	2
15150000	SR 55	25.842	6	5	1	7	1
15150000	SR 55	12.444	11	11	0	11	1
15230000	SR 693	4.139	4	4	0	4	2
15230000	SR 693	3.133	5	5	0	5	2

Pasco/Pinellas/Hillsborough Counties Cntd.

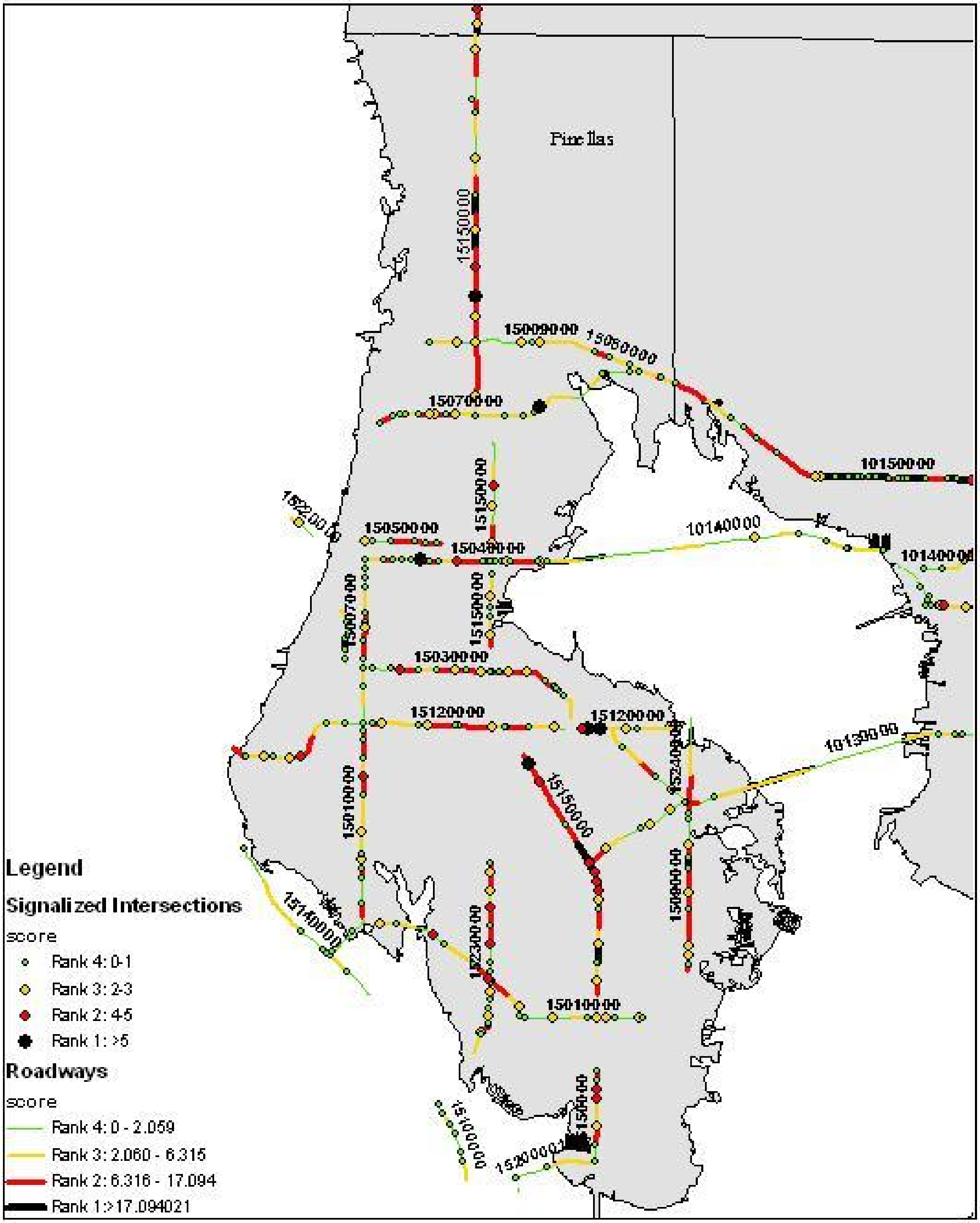

Figure 5-11: Pinellas County

5.2.7 Hillsborough County

Hillsborough County has many dangerous roadway segments and intersections. The most notable roadways are: Roadway 10110000 and Roadway 10150000.

Table 5-17: Hillsborough County Worst Road Segments

Roadway	State Road	Beg Mp	End Mp	Total Severe Crashes	IC	FC	Score	Rank
10005000	SR 569	1.184	1.385	2	2	0	9.950249	2
10005000	SR 599	2.2	2.397	1	0	1	10.15228	2
10005000	SR 599	1.948	2.144	3	3	0	15.30612	2
10005000	SR 599	2.453	2.521	2	1	1	44.11765	1
10005000	SR 569	0.778	0.819	1	0	1	48.78049	1
10010000	SR 43	17.287	17.866	4	4	0	6.908463	2
10010000	SR 43	19.185	19.897	4	3	1	7.022472	2
10010000	SR 43	16.716	17.231	4	4	0	7.76699	2
10010000	SR 43	16.294	16.66	3	3	0	8.196721	2
10010000	SR 43	21.221	21.848	5	4	1	9.569378	2
10010000	SR 43	19.897	20.573	6	5	1	10.35503	2
10010000	SR 41	25.36	26.225	9	9	0	10.40462	2
10010000	SR 43	22.503	23.28	9	9	0	11.58301	2
10010000	SR 43	20.649	21.089	6	5	1	15.90909	2
10010000	SR 43	21.904	22.447	9	9	0	16.57459	2
10010000	SR 43	15.598	15.642	1	1	0	22.72727	1
10020000	SR 685	3.868	4.303	3	3	0	6.896552	2
10020000	SR 685	2.967	3.307	3	3	0	8.823529	2
10020000	SR 685	3.363	3.812	3	2	1	8.908686	2
10020000	SR 685	4.397	4.704	3	3	0	9.771987	2
10020000	SR 685	7.773	8.36	6	5	1	11.92504	2
10020000	SR 685	9.049	9.672	8	7	1	14.44623	2
10020000	SR 685	5.197	5.334	2	2	0	14.59854	2
10020000	SR 685	5.39	5.592	3	3	0	14.85149	2
10030000	SR 600	0.522	0.971	3	3	0	6.681514	2
10030000	SR 600	0.028	0.466	2	1	1	6.849315	2
10030000	SR 600	2.9	3.494	4	3	1	8.417508	2
10030000	SR 600	2.316	2.9	5	5	0	8.561644	2
10030000	SR 600	4.08	4.494	3	2	1	9.661836	2
10030000	SR 600	3.938	4.024	1	1	0	11.62791	2
10030000	SR 600	4.55	4.744	2	1	1	15.46392	2
10030000	SR 600	21.143	21.249	1	0	1	18.86792	1

Roadway	State Road	Beg Mp	End Mp	Total Severe Crashes	IC	FC	Score	Rank
10030000	SR 600	1.779	2.24	9	9	0	19.52278	1
10040000	SR 45	5.198	5.424	2	2	0	8.849558	2
10040000	SR 45	5.745	6.167	4	4	0	9.478673	2
10040000	SR 45	8.242	8.957	7	7	0	9.79021	2
10040000	SR 45	9.531	10.237	8	7	1	12.74788	2
10040000	SR 45	5.48	5.669	3	3	0	15.87302	2
10040000	SR 45	4.418	4.521	1	0	1	19.41748	1
10040000	SR 45	12.312	12.975	13	13	0	19.60784	1
10040000	SR 45	7.256	7.933	13	12	1	20.67947	1
10060000	SR 45	6.34	7.077	5	5	0	6.784261	2
10060000	SR 45	17.257	18.212	6	5	1	7.329843	2
10060000	SR 45	11.688	12.494	5	4	1	7.444169	2
10060000	SR 45	3.717	4.646	6	4	2	8.61141	2
10060000	SR 45	15.061	15.852	6	5	1	8.849558	2
10060000	SR 45	8.161	8.661	5	5	0	10	2
10060000	SR 45	23.575	24.235	6	4	2	12.12121	2
10070000	SR 39	3.328	3.51	2	2	0	10.98901	2
10080000	SR 685	1.64	1.707	1	1	0	14.92537	2
10090000	SR 574	4.154	4.306	2	2	0	13.15789	2
10110000	SR 60	11.475	11.927	3	3	0	6.637168	2
10110000	SR 60	21.53	22.248	5	5	0	6.963788	2
10110000	SR 60	7.118	7.396	2	2	0	7.194245	2
10110000	SR 60	5.584	6.098	4	4	0	7.782101	2
10110000	SR 60	4.121	5.014	7	7	0	7.838746	2
10110000	SR 60	6.154	6.275	1	1	0	8.264463	2
10110000	SR 60	17.479	18.479	7	4	3	10	2
10110000	SR 60	7.957	8.152	2	2	0	10.25641	2
10110000	SR 60	9.71	9.903	2	2	0	10.36269	2
10110000	SR 60	12.474	13.449	12	12	0	12.30769	2
10110000	SR 60	5.07	5.584	7	6	1	15.5642	2
10110000	SR 60	10.083	10.912	13	12	1	16.88782	2
10110000	SR 60	9.453	9.654	4	4	0	19.9005	1
10110000	SR 60	8.63	8.904	7	7	0	25.54745	1
10110000	SR 60	6.331	6.496	6	6	0	36.36364	1
10110000	SR 60	6.895	7.062	9	8	1	59.88024	1
10120000	SR 674	5.068	5.219	1	1	0	6.622517	2
10120000	SR 674	0.907	1.662	5	4	1	7.94702	2
10120000	SR 674	1.718	2.424	7	6	1	11.33144	2
10130000	SR 600	4.287	4.411	1	1	0	8.064516	2
10130000	SR 600	9.866	9.989	1	1	0	8.130081	2
10130000	SR 600	8.542	8.745	2	2	0	9.852217	2
10130000	SR 600	5.903	5.998	1	1	0	10.52632	2
10130000	SR 600	11.084	11.84	8	7	1	11.90476	2
10130000	SR 600	9.192	9.271	1	1	0	12.65823	2

Roadway	State Road	Beg Mp	End Mp	Total Severe Crashes	IC	FC	Score	Rank
10130000	SR 600	9.327	9.495	3	3	0	17.85714	1
10130000	SR 600	11.896	11.986	2	2	0	22.22222	1
10130000	SR 600	9.551	9.81	6	6	0	23.16602	1
10140000	SR 616	8.678	9.015	3	3	0	8.902077	2
10150000	SR 600	11.394	11.701	2	2	0	6.514658	2
10150000	SR 600	0.069	0.958	6	6	0	6.749156	2
10150000	SR 580	12.703	12.85	1	1	0	6.802721	2
10150000	SR 600	2.358	2.748	3	3	0	7.692308	2
10150000	SR 600	2.804	3.437	5	4	1	9.478673	2
10150000	SR 600	4.109	4.724	6	6	0	9.756098	2
10150000	SR 600	6.847	7.029	2	2	0	10.98901	2
10150000	SR 600	9.098	9.42	3	2	1	12.42236	2
10150000	SR 600	7.851	8.412	7	7	0	12.47772	2
10150000	SR 600	3.493	4.109	8	8	0	12.98701	2
10150000	SR 600	4.78	4.848	1	1	0	14.70588	2
10150000	SR 600	6.077	6.211	2	2	0	14.92537	2
10150000	SR 580	10.618	10.751	1	0	1	15.03759	2
10150000	SR 600	4.924	5.271	6	6	0	17.29107	1
10150000	SR 600	7.348	7.795	8	8	0	17.89709	1
10150000	SR 600	5.327	5.652	6	6	0	18.46154	1
10150000	SR 600	5.708	5.901	4	4	0	20.72539	1
10150000	SR 600	8.723	9.042	7	7	0	21.94357	1
10150000	SR 580	11.147	11.319	4	4	0	23.25581	1
10150000	SR 580	9.861	10.562	17	16	1	25.6776	1
10150000	SR 600	6.457	6.791	10	10	0	29.94012	1
10150000	SR 600	8.468	8.667	5	4	1	30.15075	1
10150000	SR 580	10.845	11.072	5	3	2	30.837	1
10150000	SR 580	9.626	9.805	7	7	0	39.10615	1
10150000	SR 600	5.957	6.021	3	3	0	46.875	1
10150000	SR 600	7.169	7.292	5	4	1	48.78049	1
10150000	SR 600	6.267	6.401	7	5	2	67.16418	1
10150000	SR 580	12.613	12.627	1	1	0	71.42857	1
10150000	SR 600	7.085	7.113	5	5	0	178.5714	1
10150000	SR 600	0	0.013	3	3	0	230.7692	1
10160000	SR 597	7.184	7.335	1	1	0	6.622517	2
10160000	SR 597	12.197	12.767	4	4	0	7.017544	2
10160000	SR 597	6.207	6.801	5	5	0	8.417508	2
10160000	SR 597	4.968	5.287	4	4	0	12.53918	2
10160000	SR 580	2.328	2.822	7	7	0	14.17004	2
10160000	SR 580	1.318	2.007	9	8	1	14.51379	2
10160000	SR 597	5.516	6.151	12	11	1	20.47244	1
10160000	SR 597	5.343	5.46	3	3	0	25.64103	1
10160000	SR 597	6.857	7.128	7	7	0	25.83026	1
10160000	SR 580	2.953	3.098	4	4	0	27.58621	1

Roadway	State Road	Beg Mp	End Mp	Total Severe Crashes	IC	FC	Score	Rank
10160000	SR 597	7.391	7.482	3	3	0	32.96703	1
10160000	SR 597	4.603	4.79	7	7	0	37.43316	1
10160000	SR 597	4.846	4.912	4	4	0	60.60606	1
10180000	SR 573	1.162	1.776	4	4	0	6.514658	2
10250000	SR 676	3.081	3.145	1	1	0	15.625	2
10270000	SR 60	2.483	2.702	2	2	0	9.13242	2
10270000	SR 60	3.027	3.334	3	3	0	9.771987	2
10290000	SR 582	1.041	1.49	3	3	0	6.681514	2
10290000	SR 582	6.54	7.142	5	5	0	8.305648	2
10290000	SR 582	1.546	1.842	3	3	0	10.13514	2
10310000	SR 580	3.348	4.328	7	6	1	8.163265	2
10310000	SR 580	6.398	6.835	2	0	2	9.153318	2
10310000	SR 580	4.384	4.591	3	3	0	14.49275	2
10330000	SR 583	2.148	2.62	3	3	0	6.355932	2
10330000	SR 583	4.977	5.127	1	1	0	6.666667	2
10340000	SR 574	9.65	10.382	3	1	2	6.830601	2
10340000	SR 574	8.123	8.852	5	5	0	6.858711	2
10340000	SR 574	11.947	12.139	2	2	0	10.41667	2
10340000	SR 574	4.348	4.702	3	2	1	11.29944	2
10340000	SR 574	7.555	7.688	2	2	0	15.03759	2
10340000	SR 574	10.438	10.771	6	6	0	18.01802	1
10350000	SR 579	0.352	0.471	1	1	0	8.403361	2
10350000	SR 579	0.028	0.212	3	3	0	16.30435	2
10360000	SR 678	0	0.501	9	8	1	19.96008	1

Table 5-18: Hillsborough County Worst Signalized Intersections

Roadway ID	State Road	Signal Mp	Total Severe Crashes	IC	FC	Score	Rank
10010000	SR 43	18.473	5	5	0	5	2
10010000	SR 43	15.67	6	6	0	6	1
10010000	SR 43	5.685	5	2	3	8	1
10020000	SR 685	4.35	3	2	1	4	2
10020000	SR 685	8.388	4	4	0	4	2
10020000	SR 685	5.362	6	6	0	6	1
10020000	SR 685	5.887	6	6	0	6	1
10030000	SR 600	0.999	4	4	0	4	2
10030000	SR 600	4.052	4	4	0	4	2
10030000	SR 600	3.522	5	5	0	5	2
10030000	SR 600	1.751	5	4	1	6	1
10040000	SR 45	3.668	3	2	1	4	2
10040000	SR 45	13.993	6	6	0	6	1
10040000	SR 45	8.214	7	7	0	7	1
10040000	SR 45	13.401	6	5	1	7	1
10060000	SR 45	7.6	4	4	0	4	2
10060000	SR 599	24.924	3	2	1	4	2
10060000	SR 45	17.229	5	4	1	6	1
10070000	SR 39	0	5	5	0	5	2
10110000	SR 60	7.09	4	4	0	4	2
10110000	SR 60	10.94	5	5	0	5	2
10110000	SR 60	11.447	6	6	0	6	1
10110000	SR 60	11.955	6	5	1	7	1
10120000	SR 674	3.497	4	4	0	4	2
10150000	SR 580	9.07	4	4	0	4	2
10160000	SR 580	2.3	4	4	0	4	2
10160000	SR 597	4.818	4	4	0	4	2
10160000	SR 597	11.628	3	2	1	4	2
10160000	SR 580	0.785	5	5	0	5	2
10160000	SR 597	7.51	6	6	0	6	1
10270000	SR 60	1.608	3	2	1	4	2
10330000	SR 583	3.15	4	4	0	4	2
10330000	SR 583	2.648	5	5	0	5	2
10340000	SR 574	11.418	3	2	1	4	2
10340000	SR 574	12.167	4	4	0	4	2
10340000	SR 574	10.41	5	5	0	5	2
10340000	SR 574	11.919	7	7	0	7	1
10350000	SR 579	0.314	5	5	0	5	2

Pasco/Pinellas/Hillsborough Counties Cntd.

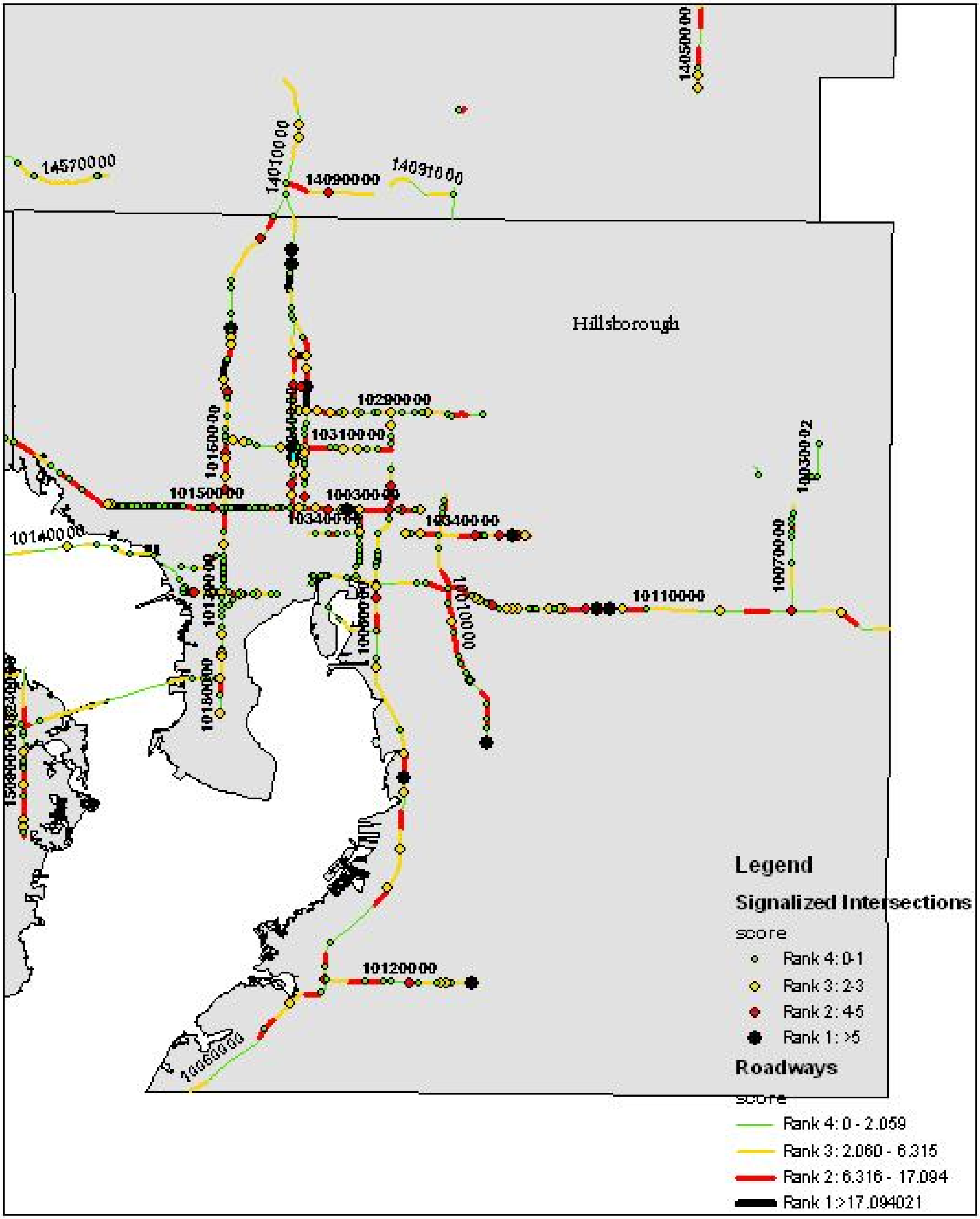

Figure 5-12: Hillsborough County

It is interesting to note that the three neighboring counties, Pinellas, Pasco and Hillsborough have more dangerous road elements than the other four counties and this is evident from the crash frequency and score values of road segments and intersections in several locations of those three counties. These findings also conform to Table 5-1 which ranked those three neighboring counties in the top three from the rate of crashes per mile perspective.

CHAPTER 6. SLIDING WINDOW ANALYSIS

The sliding window analysis is a method used to identify roadway segments with a high crash occurrence. The analysis segment is not fixed but rather slides along the route in an incremental fashion. The user defines the segment length (the window size) and the increment length for analysis. The frequency of crashes is counted within the window. The end result of the analysis includes a plot showing high crash locations. The window size used in this analysis was a 0.5 mile window with an increment of 0.1 miles. The aim of the sliding window analysis is to locate the most hazardous 0.5 mile range on a roadway that has already been established to be of high risk in the micro-GIS analysis. We tried to use the FHWA sliding window add-on package to ArcMap 9.2, however the program did not run properly, so a different non-GIS approach was used to conduct the analysis.

6.1 Methodology

Ten corridors (roadway IDs) were chosen for the sliding window analysis. These corridors were chosen using the results of the micro-GIS analysis. Only corridors longer than three miles were selected for the analysis. A corridor sum of ranks procedure was developed for this part. A corridor's sum of rank is determined by a combination of a weighted score for the segments and intersections within that corridor (see Chapter 5, section 5-1 on score calculation). A high corridor road segment or intersection rank (rank 1, 2) reflects a high score (bad safety rating). The corridors with the highest sum of ranks (lowest combined value) were chosen for the sliding window analysis as they represented the corridors with the worst safety rating.

Table 6-1 and Table 6-2 present an example for the calculation of the worst corridor in Pasco County (Roadway ID: 14030000).

Table 6-1: Sample Calculation of Rank for Roadway ID: 14030000, Road Segments

Roadway	Beg Mp	End Mp	Crashes	Severe	Fatal	Sectlength	Score	Product:Score *sectlength
14030000	0	0.242	6	6	0	0.242	24.79339	6
14030000	0.298	0.627	4	4	0	0.329	12.15805	4
14030000	0.683	0.99	6	5	1	0.307	22.8013	7
14030000	1.046	1.491	13	12	1	0.445	31.46067	14
14030000	1.547	1.683	1	1	0	0.136	7.352941	1
14030000	1.739	2.489	17	16	1	0.75	24	18
14030000	2.545	3.005	3	3	0	0.46	6.521739	3
14030000	3.081	3.565	10	9	1	0.484	22.72727	11
14030000	3.621	3.945	2	2	0	0.324	6.17284	2
14030000	4.001	4.154	0	0	0	0.153	0	0
14030000	4.21	4.635	3	3	0	0.425	7.058824	3
14030000	4.691	4.832	2	2	0	0.141	14.1844	2
14030000	4.888	5.415	8	7	1	0.527	17.0778	9
14030000	5.471	6.3	11	7	4	0.829	18.09409	15
14030000	6.3	7.13	16	11	5	0.83	25.3012	21
14030000	7.186	7.689	8	7	1	0.503	17.89264	9
14030000	7.745	8.454	8	7	1	0.709	12.69394	9
14030000	8.51	8.728	1	1	0	0.218	4.587156	1
14030000	8.784	9.023	3	3	0	0.239	12.5523	3
14030000	9.079	9.528	16	14	2	0.449	40.08909	18
14030000	9.584	9.699	0	0	0	0.115	0	0
14030000	9.755	9.964	1	0	1	0.209	9.569378	2
14030000	10.02	10.455	5	5	0	0.435	11.49425	5
14030000	10.511	11.441	22	20	2	0.93	25.80645	24
14030000	11.517	11.938	6	6	0	0.421	14.25178	6
14030000	11.994	12.902	17	13	4	0.908	23.12775	21
14030000	12.902	13.81	9	9	0	0.908	9.911894	9
14030000	13.866	14.469	7	6	1	0.603	13.267	8
14030000	14.525	14.79	1	1	0	0.265	3.773585	1
14030000	14.846	15.472	2	1	1	0.626	4.792332	3
14030000	15.472	16.098	3	3	0	0.626	4.792332	3
14030000	16.154	16.968	3	3	0	0.814	3.685504	3
14030000	17.024	17.888	4	3	1	0.864	5.787037	5
14030000	17.888	18.78	4	3	1	0.892	5.605381	5
14030000	18.78	19.645	2	0	2	0.865	4.624277	4
					Sum:	17.981	Sum:	255

The sum of the products is 255 whereas the sum of the section lengths of the roadway is 17.981. The weighted score value for the corridor is 255/17.981=14.181 which ranks as the fourth worst corridor from a road segment perspective among all corridors in the seven chosen counties.

Table 6-2: Sample Calculation of Rank for Roadway ID: 14030000, Signalized Intersections

Roadway ID	Signal Mp	Crashes	Severe	Fatal	Score
14030000	0.27	2	2	0	2
14030000	0.655	3	2	1	4
14030000	1.018	6	6	0	6
14030000	1.519	10	9	1	11
14030000	1.711	9	8	1	10
14030000	2.517	2	2	0	2
14030000	3.043	7	5	2	9
14030000	3.593	2	1	1	3
14030000	3.973	2	2	0	2
14030000	4.182	1	1	0	1
14030000	4.663	1	1	0	1
14030000	4.86	0	0	0	0
14030000	5.443	3	3	0	3
14030000	7.158	1	1	0	1
14030000	7.717	1	1	0	1
14030000	8.482	3	3	0	3
14030000	8.756	4	4	0	4
14030000	9.051	2	2	0	2
14030000	9.556	1	1	0	1
14030000	9.727	7	6	1	8
14030000	9.992	2	2	0	2
14030000	10.483	5	5	0	5
14030000	11.479	4	4	0	4
14030000	11.966	1	1	0	1
14030000	13.838	6	4	2	8
14030000	14.497	0	0	0	0
14030000	14.818	7	7	0	7
14030000	16.126	4	4	0	4
14030000	16.996	1	1	0	1
14030000	19.673	1	1	0	1
				Sum:	107

The sum of the scores is 107 and the number of the signalized intersections on the roadway is 30 signals. The weighted intersection score value is 107/30=3.57 which ranks as the 6^{th} worst intersection score among the corridors of the seven counties.

The sum of ranks for Roadway 14030000 in Pasco County is, 4+6=10, which is the highest sum of ranks (lowest combined value) and translates to the worst corridor among all the corridors in the seven chosen counties.

Following the process described above, the 10 worst corridors were:

Table 6-3: The Ten Worst Corridors

Roadway	Corridor length	#of intersections in corridor
14030000	17.981	30
15150000	23.175	36
48020000	3.086	8
10030000	4.477	13
48004000	3.179	10
10160000	11.403	21
10020000	7.318	16
10010000	9.903	14
10110000	22.096	25
10040000	10.406	24

It is interesting to note that 6 out of the 10 corridors were located in Hillsborough County.

A 2:1 ratio of fatal to incapacitating crashes was used again in calculation of crash frequency within the sliding window. The weighted frequency total was named *score* in the analysis. The crash score values within every 0.5 mile analysis window were then plotted against the midpoints of each 0.5 mile window. Ten plots were generated corresponding to the ten selected corridors.

6.2 The Use of the Kernel Regression Smoothing Technique for the Plots

The ten plots that were generated came out to be somehow visually unfriendly and noisy.

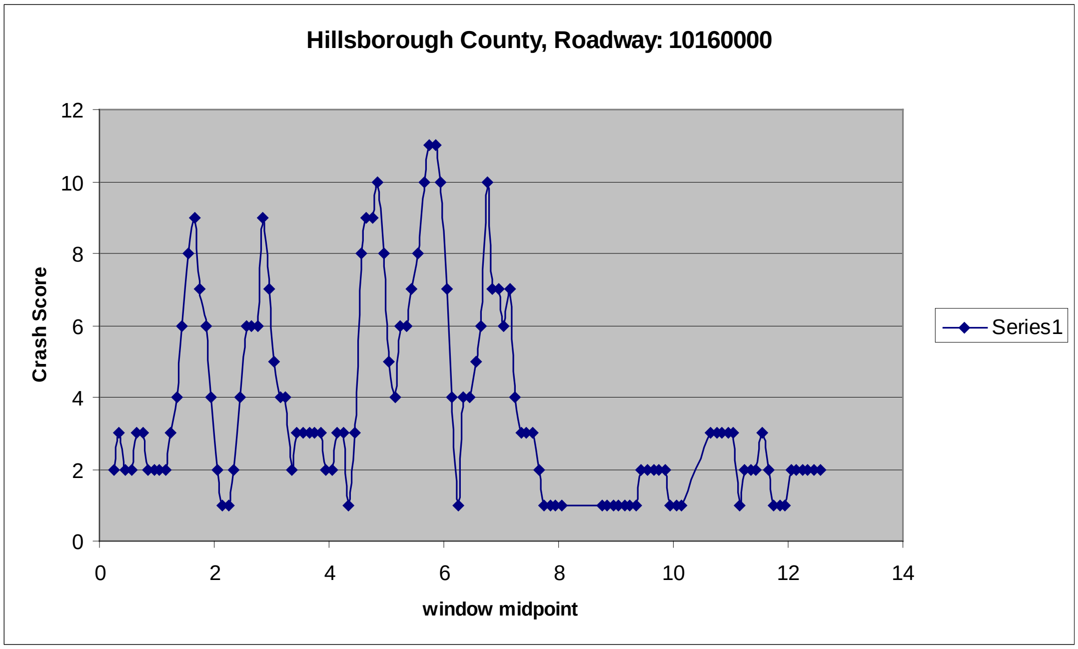

Figure 6-1: Roadway 10160000

As observed in Figure 6-1, there are several repeated peaks on adjacent midpoints. Kernel Regression is a smoothing technique that fits a curve to a given set of data (x_i,y_i). In this case the y_is are the crash score whereas the x_is are the midpoints of the 0.5 mile window range. The aim of Kernel smoothing is to find a regression function, f, that best fits the given data set.

Kernel smoothing is classified as a non-parametric regression technique because it does not assume any underlying distribution to estimate the function, as in linear or polynomial regression (Teknomo, 2006).

Kernel regression places identical weighted function called *kernel* local to each observational data point. The kernel assigns weight to each location based on distance from the data point. The kernel basis function depends only on the radius or width (or variance) from the 'local' data point X to a set of neighboring locations x (Teknomo, 2006).

The most common type of kernel basis function is the Gaussian Kernel function given by the equation:

Equation 6-1: Gaussian Kernel

$$K(x, X) = \exp\left(-\frac{(x-X)^2}{2\alpha^2}\right)$$

where x is a value starting from 0 and whose incremental value, dx, is defined by the use; the smaller the value of dx, the smoother the curve. X are the observations (window midpoint values), and α is the kernel width.

The kernel regression formula used in this analysis is called the Nadaraya-Watson regression formula:

Equation 6-2: Nadaraya-Watson Regression Formula

$$\hat{y}_j = f_j(x, w) = \frac{\sum_{i=1}^{n} w_i K(x_j, X_i)}{\sum_{i=1}^{n} K(x_j, X_i)}$$

where w_i is the weight assigned for the kernel function and ŷ is the estimated value at x. Using the R 2.7.2 statistical software, the optimal combination of dx, α, and w_i are computed in a manner that minimizes the Sum of Square Errors (SSE) between the estimated observation $\hat{y}$, when $x_j=X_i$ and the actual observed value y_i.

6.3 Results

Only road segment crashes were included in the sliding window analysis. Signalized intersection crashes were excluded. The intersection influence areas which were used to calculate the number of intersection related crashes act as a window of analysis except that they have a smaller range. Thus the results presented in Chapter 5 of this report for signalized intersections were considered sufficient since they display the exact mile points of intersections with high crash frequency scores.

6.3.1 Roadway 10160000

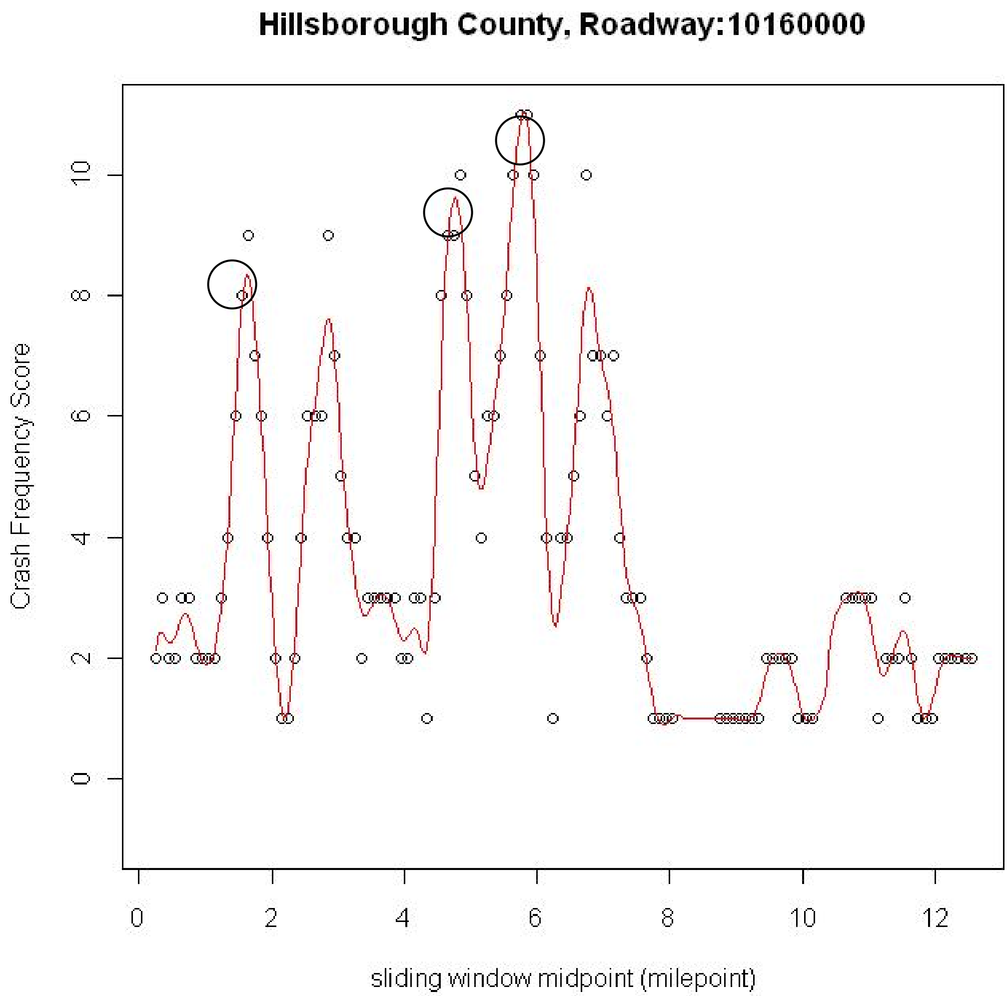

Figure 6-2: Hillsborough County, Roadway 10160000

The locations with the highest 0.5 mile frequency crash scores are:

- Midpoint milepoint: 1.63, corresponding to milepoints' range (1.38-1.88)
- Midpoint milepoint: 4.77, corresponding to milepoints' range (4.52-5.02)
- Midpoint milepoint: 5.82, corresponding to milepoints' range (5.57-6.07)

6.3.2 Roadway 10010000

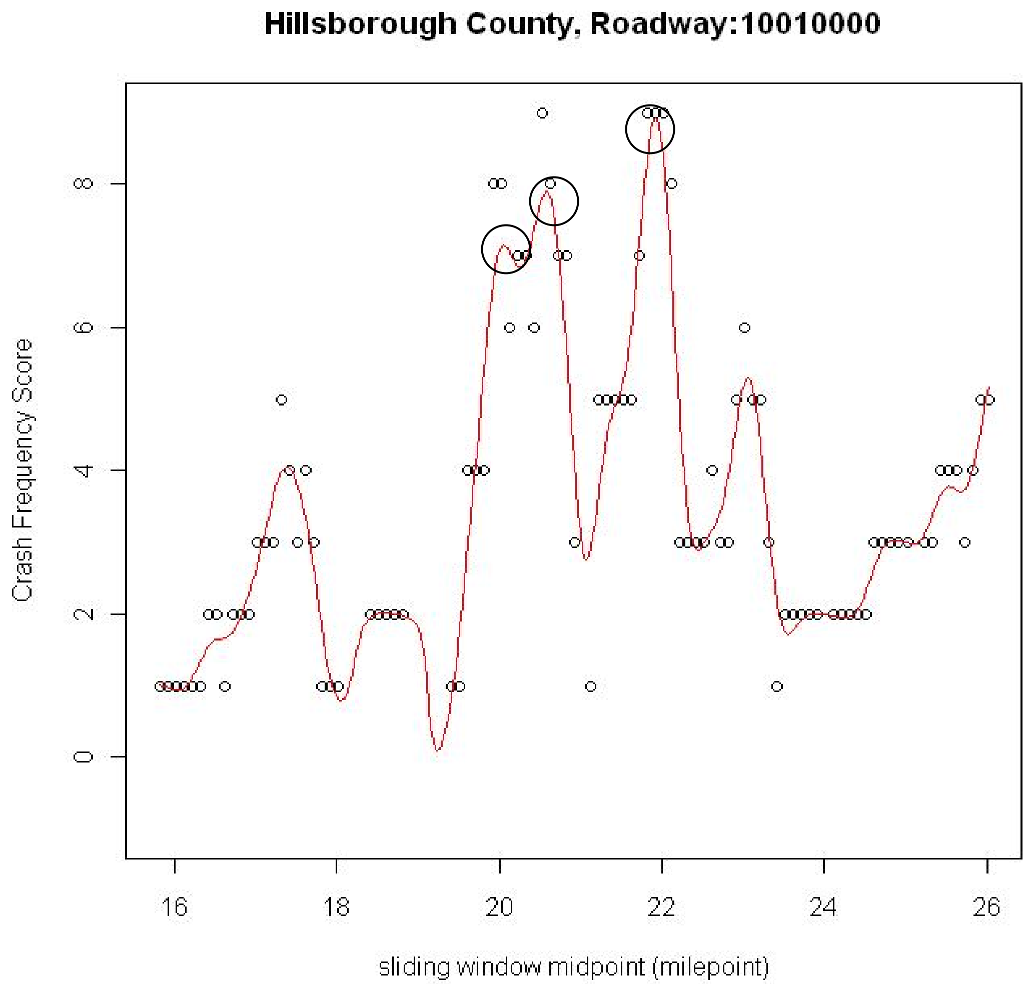

Figure 6-3: Hillsborough County, Roadway 10010000

The locations with the highest 0.5 mile frequency crash scores are:

- Midpoint milepoint: 20.05, corresponding to milepoints' range (19.8-20.3)
- Midpoint milepoint: 20.59, corresponding to milepoints' range (20.34-20.84)
- Midpoint milepoint: 21.91, corresponding to milepoints' range (21.66-22.16)

6.3.3 Roadway 10020000

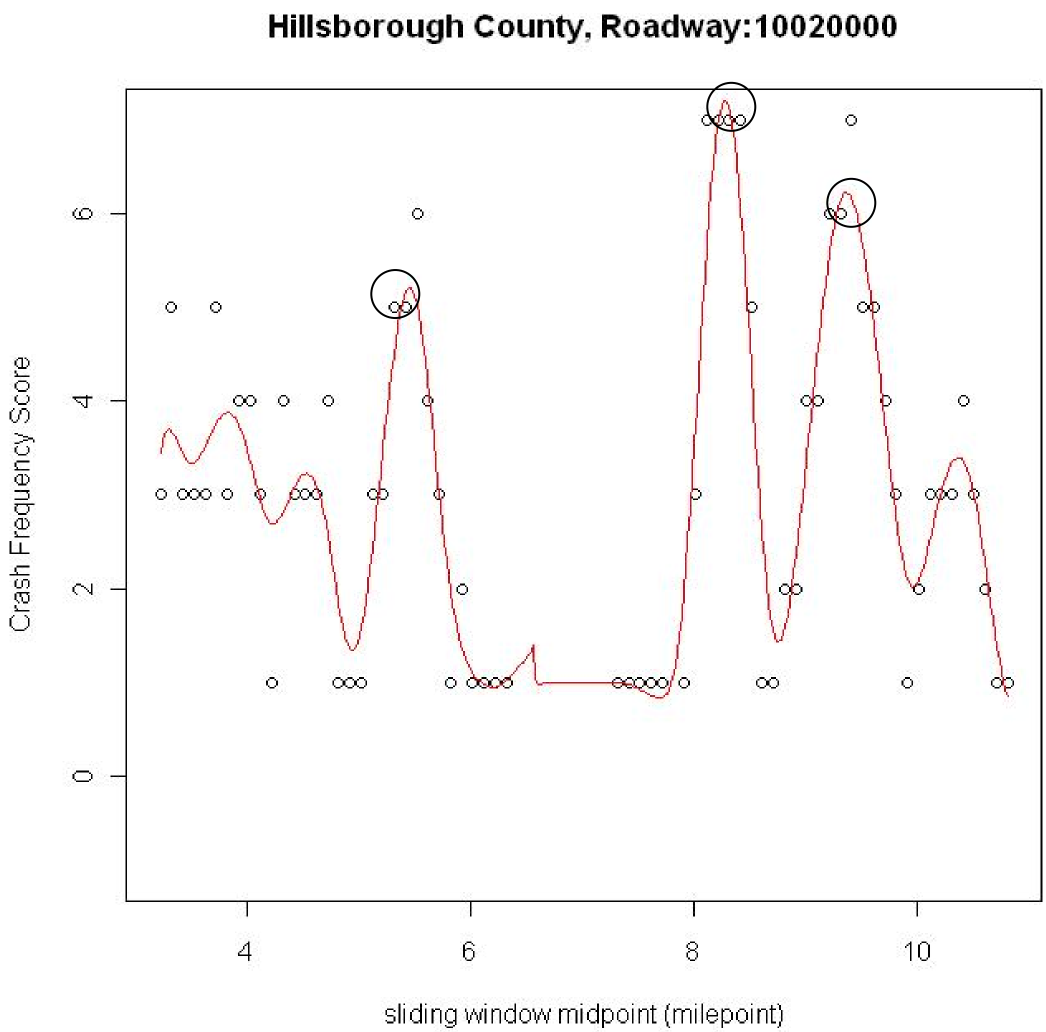

Figure 6-4: Hillsborough County, Roadway 10020000

The locations with the highest 0.5 mile frequency crash scores are:

- Midpoint milepoint: 5.46, corresponding to milepoints’ range (5.21-5.71)
- Midpoint milepoint: 8.27, corresponding to milepoints’ range (8.02-8.52)
- Midpoint milepoint: 9.37, corresponding to milepoints’ range (9.12-9.62)

6.3.4 Roadway 10030000

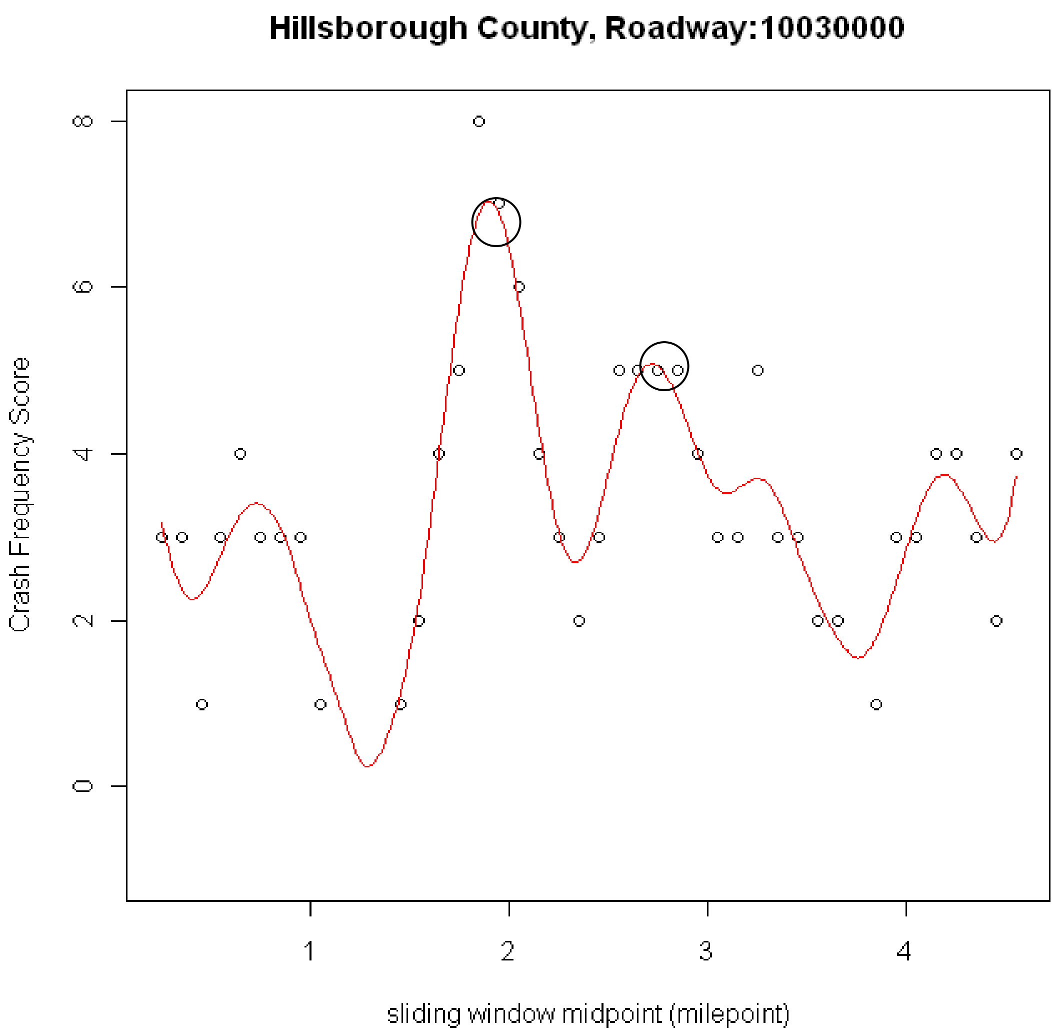

Figure 6-5: Hillsborough County, Roadway 10030000

The locations with the highest 0.5 mile frequency crash scores are:

- Midpoint milepoint: 1.89, corresponding to milepoints' range (1.64-2.14)
- Midpoint milepoint: 2.72, corresponding to milepoints' range (2.47-2.97)

6.3.5 Roadway 10040000

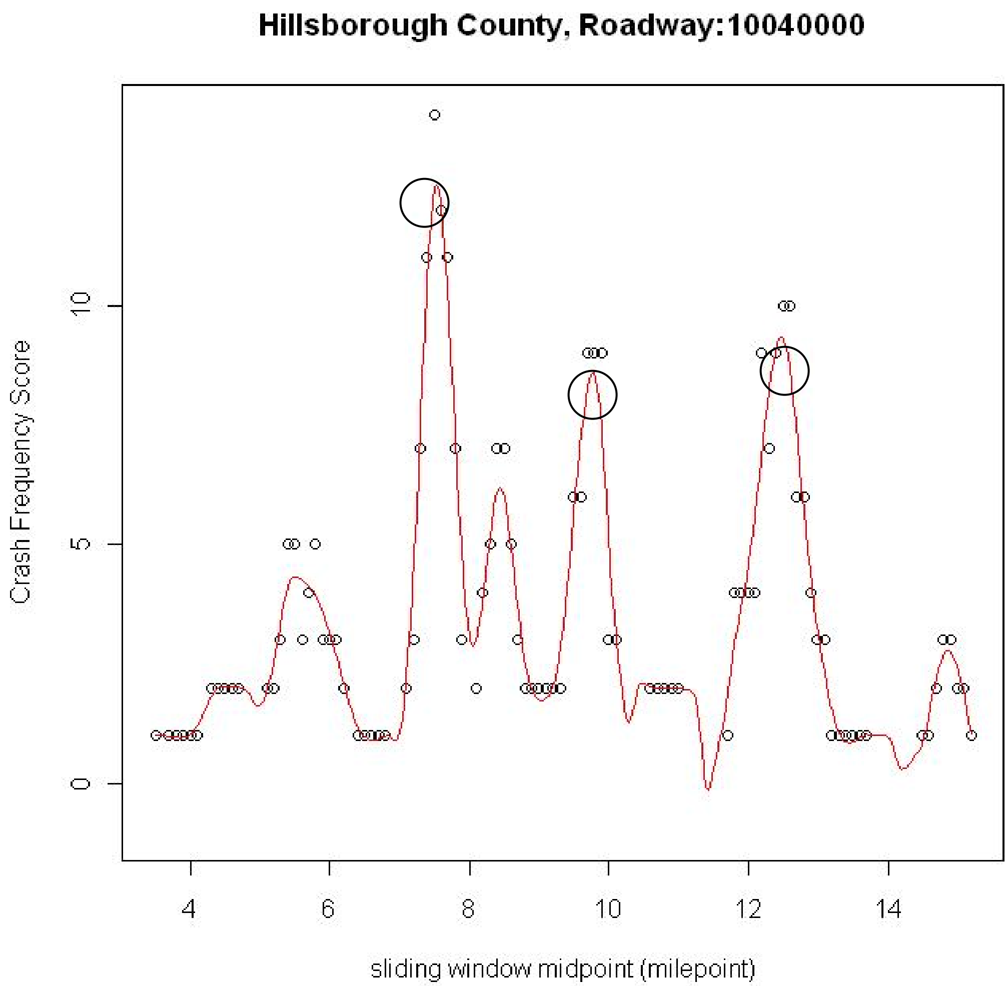

Figure 6-6: Hillsborough County, Roadway 10040000

The locations with the highest 0.5 mile frequency crash scores are:

- Midpoint milepoint: 7.53, corresponding to milepoints' range (7.28-7.78)
- Midpoint milepoint: 9.78, corresponding to milepoints' range (9.53-10.03)
- Midpoint milepoint: 12.47, corresponding to milepoints' range (12.22-12.72)

6.3.6 Roadway 10110000

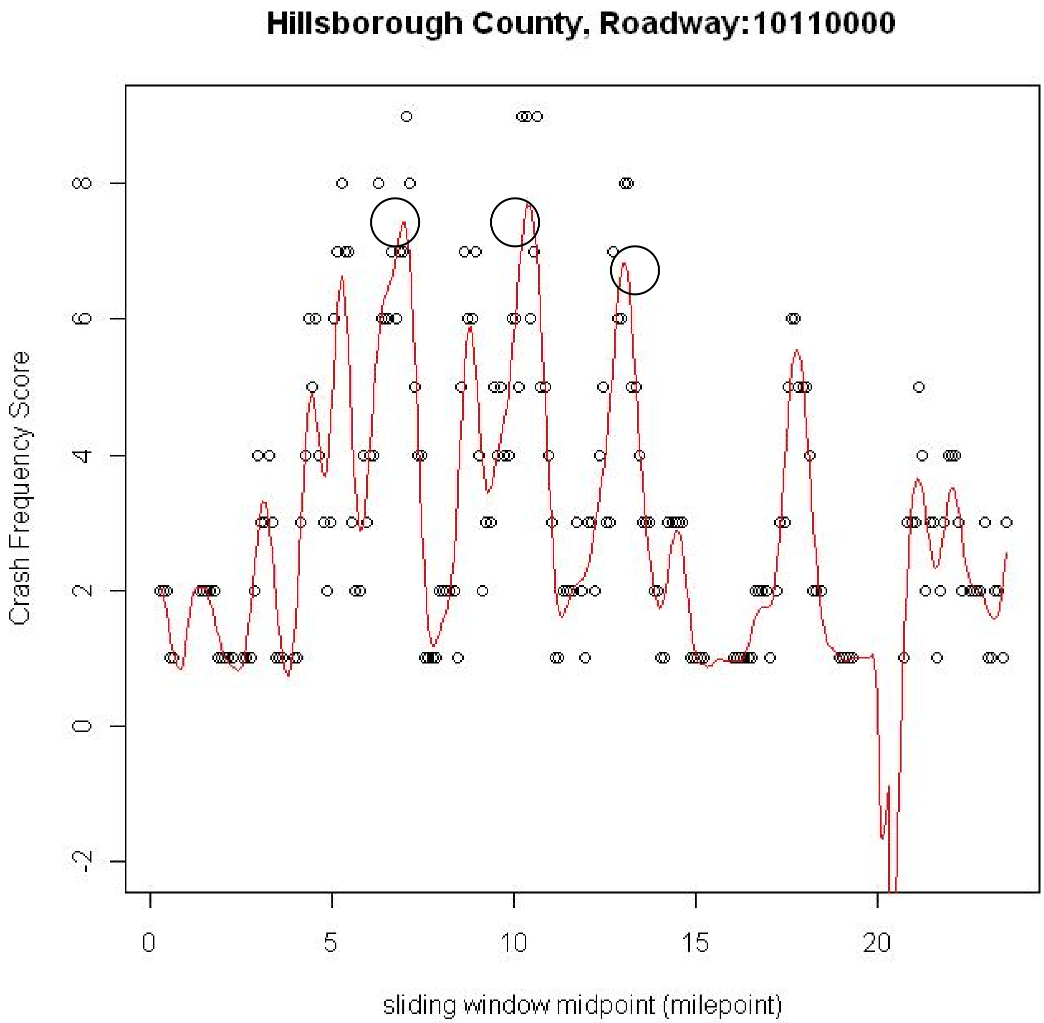

Figure 6-7: Hillsborough County, Roadway 10110000

The locations with the highest 0.5 mile frequency crash scores are:

- Midpoint milepoint: 6.95, corresponding to milepoints' range (6.70-7.20)
- Midpoint milepoint: 10.39, corresponding to milepoints' range (10.14-10.64)
- Midpoint milepoint: 13.07, corresponding to milepoints' range (12.82-13.32)

6.3.7 Roadway 14030000

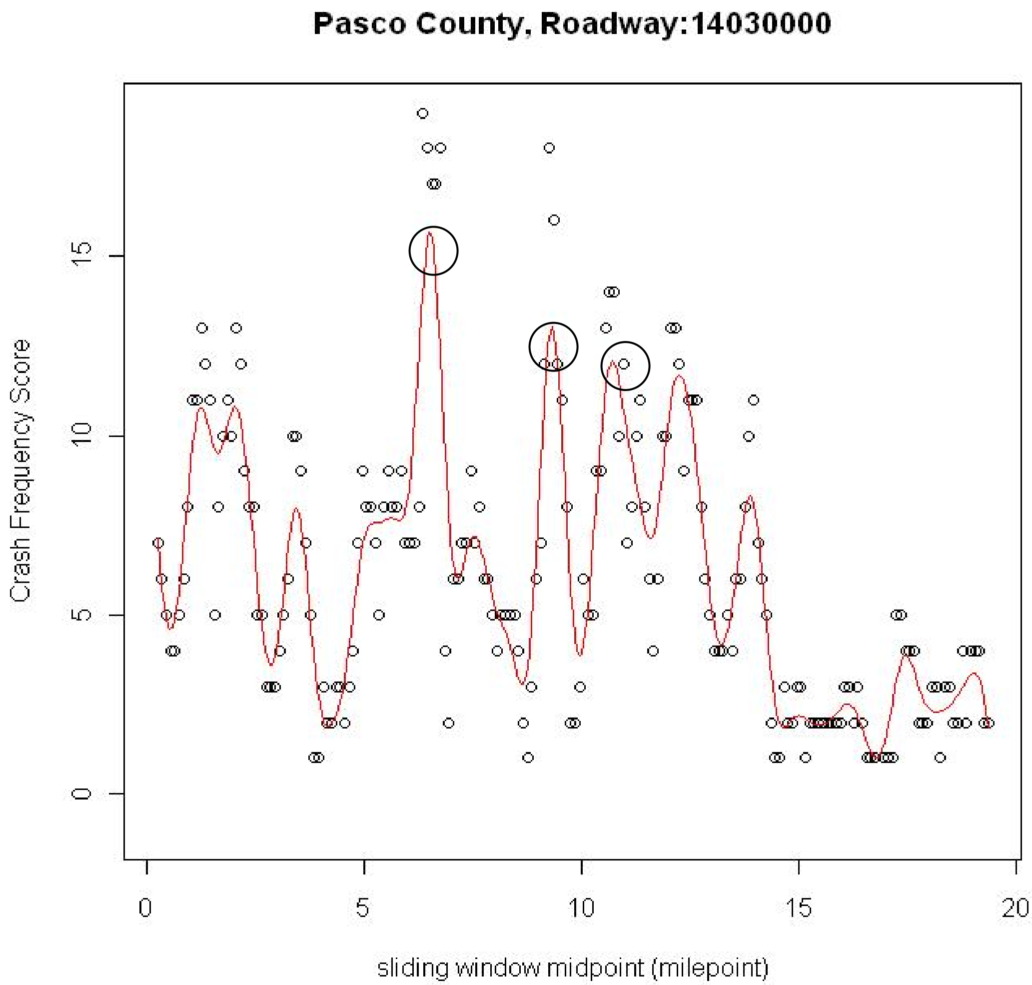

Figure 6-8: Pasco County, Roadway 14030000

The locations with the highest 0.5 mile frequency crash scores are:

- Midpoint milepoint: 6.51, corresponding to milepoints' range (6.26-6.76)
- Midpoint milepoint: 9.32, corresponding to milepoints' range (9.07-9.57)
- Midpoint milepoint: 10.71, corresponding to milepoints' range (10.46-10.96)

6.3.8 Roadway 15150000

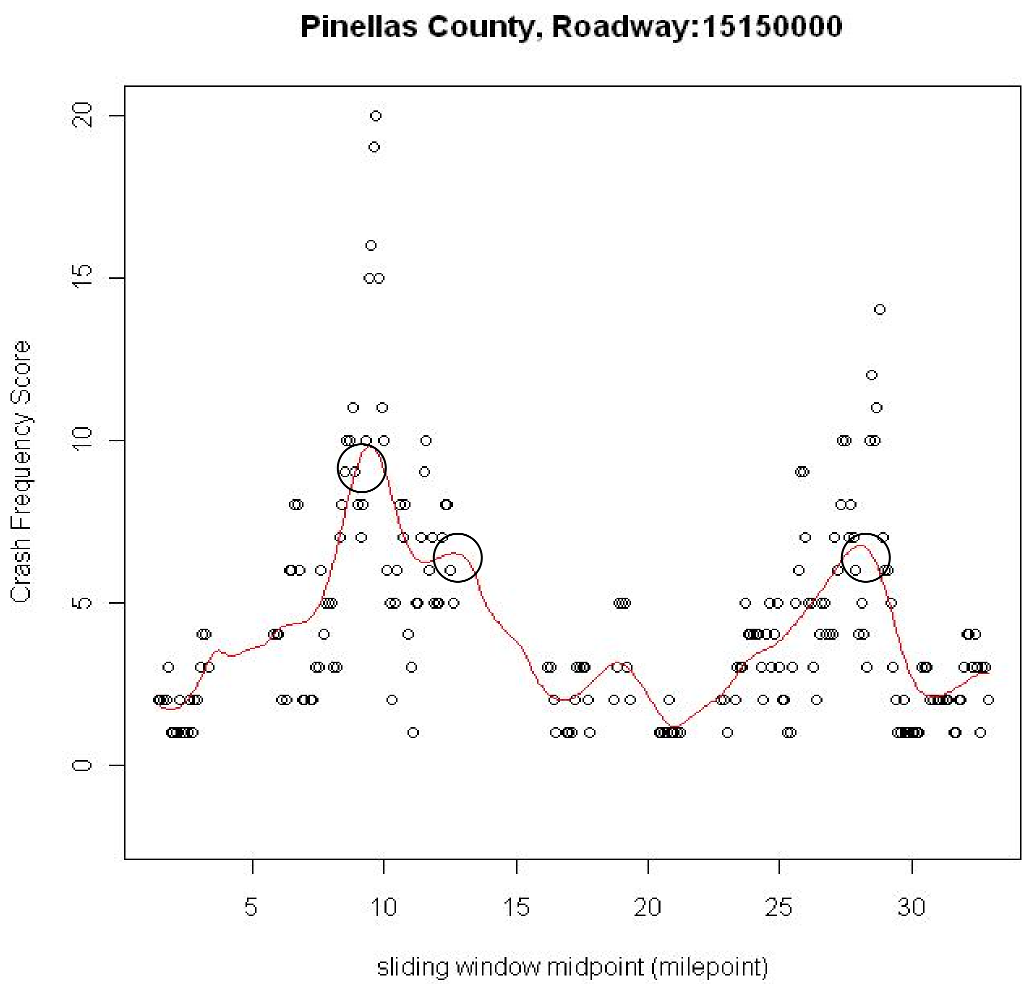

Figure 6-9: Pinellas County, Roadway 15150000

The locations with the highest 0.5 mile frequency crash scores are:

- Midpoint milepoint: 9.44, corresponding to milepoints' range (9.19-9.69)
- Midpoint milepoint: 12.59, corresponding to milepoints' range (12.34-12.84)
- Midpoint milepoint: 28.02, corresponding to milepoints' range (27.77-28.27)

6.3.9 Roadway 48004000

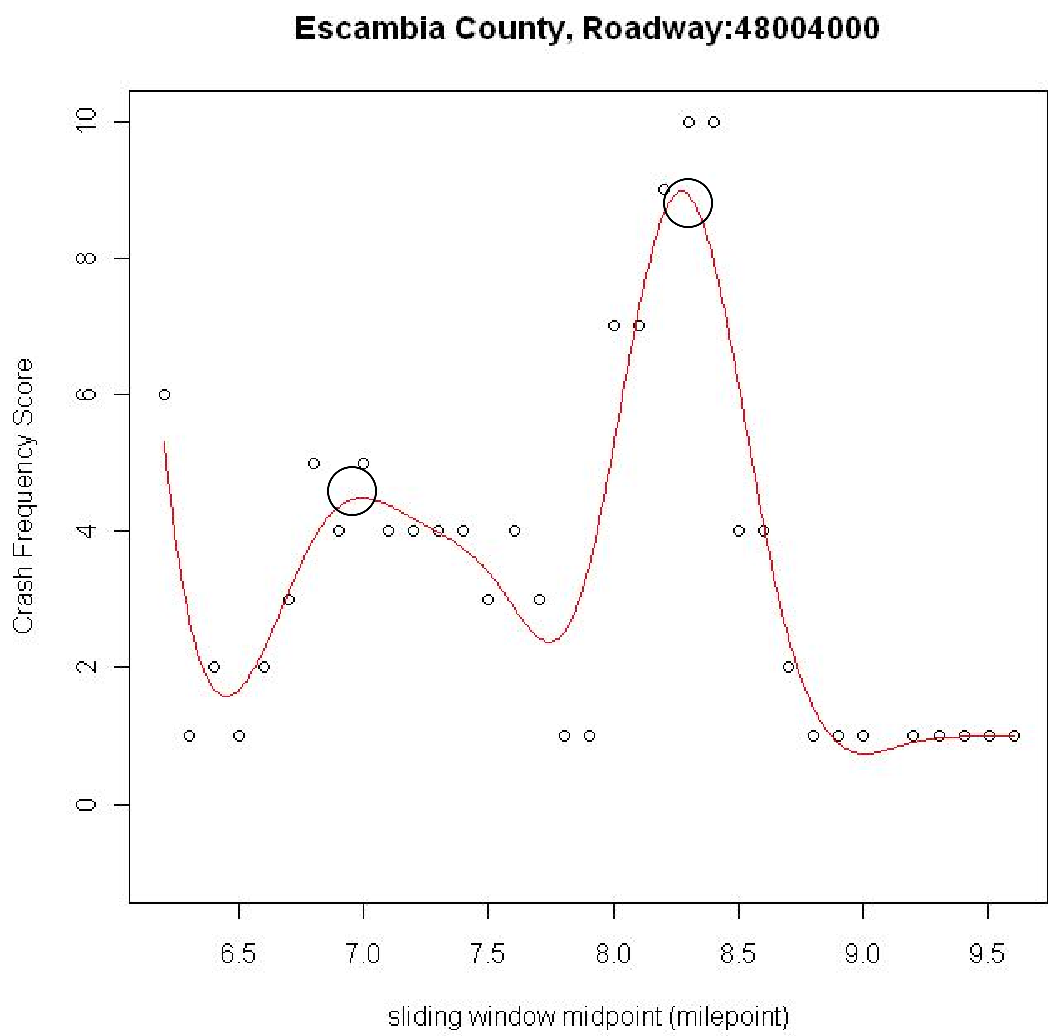

Figure 6-10: Escambia County, Roadway 48004000

The locations with the highest 0.5 mile frequency crash scores are:

- Midpoint milepoint: 6.99, corresponding to milepoints' range (6.74-7.24)
- Midpoint milepoint: 8.27, corresponding to milepoints' range (8.02-8.52)

6.3.10 Roadway 48020000

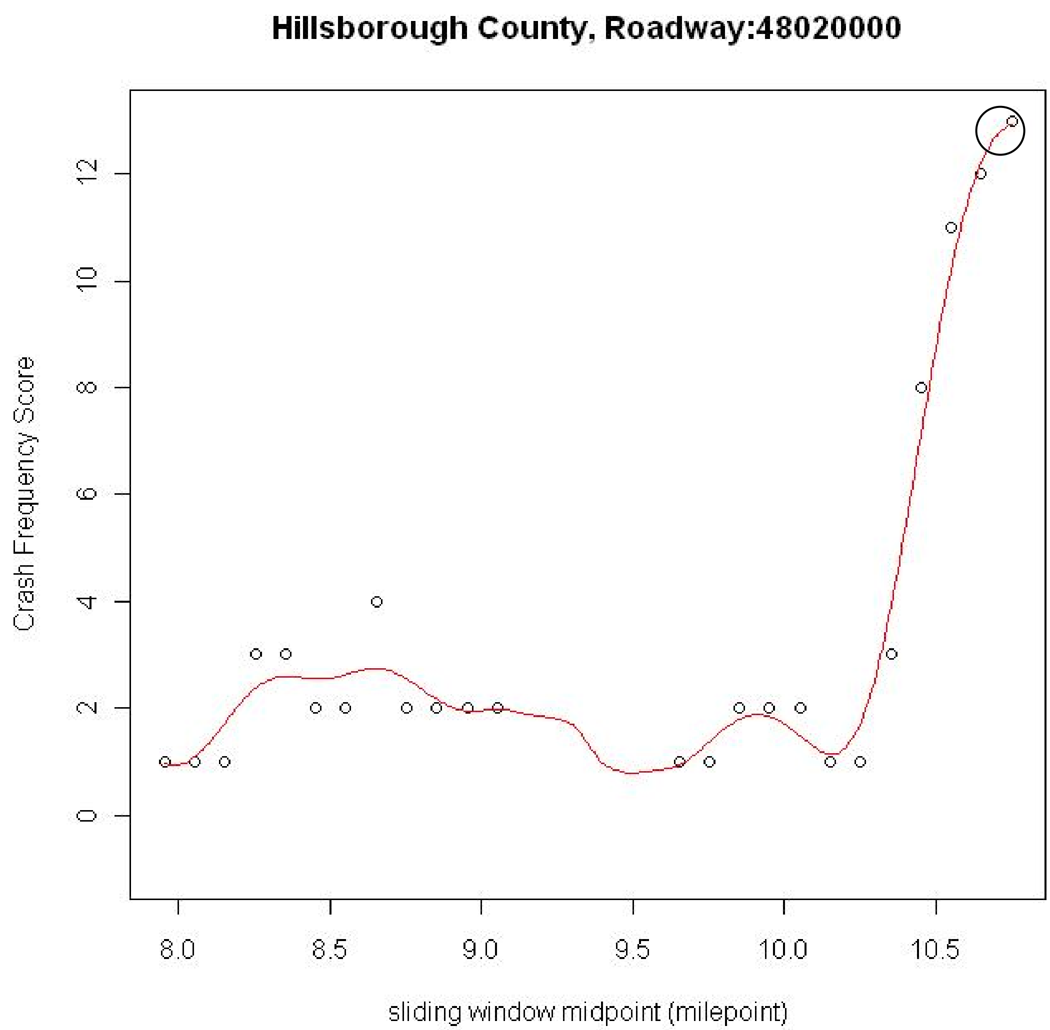

Figure 6-11: Escambia County, Roadway 48020000

The locations with the highest 0.5 mile frequency crash scores are:

- Midpoint milepoint: 10.75, corresponding to milepoints' range (10.5-11.00)

CHAPTER 7. CONCLUSION

The aim of this report was to identify the hazardous locations on multilane corridors in Florida and to visually display them in GIS. The report focused on identifying counties and roadway sections where high trends of severe crashes were observed. This was done in order for FDOT to target roadway sections where improvements are required in order to enhance the safety performance and reduce road fatalities.

1. **District and County Level GIS Analysis**: At the macro level of the analysis, it was found that the counties with the highest severe crash trends were mostly urban. It was also found that the counties with the highest trends of such type of crashes were neighbors (Pasco County, Pinellas County and Hillsborough County).

2. **Roadway Level GIS Analysis**: There were seven counties chosen for this type of analysis; all exhibited high trends of severe crashes. It was found that the worst road safety conditions were in the neighboring counties of Pasco, Pinellas and Hillsborough. The locations of dangerous road segments and signalized intersections were also found for all seven counties. Roadway 14030000, SR 55, in Pasco County was found to be the most problematic corridor.

3. **Sliding Window Analysis**: This type of analysis identified the ten worst corridors in the seven selected counties. It was found that 6 out of the 10 worst corridors were in Hillsborough County. The sliding window analysis provided the locations of the worst 0.5 mile ranges on those 10 corridors.

The main objective of the report was accomplished by providing the roadway locations were high trends of severe crashes occurred and displaying them using the Geographic Information System (GIS) tool. The analysis methodology explained in this report could be expanded to include all 67 counties in Florida as long as crash and roadway characteristics databases are available.

APPENDIX A

A.1 Macro-GIS Analysis: County Level GIS Maps

A. 1.1 Ratio of Rear-end Crashes to Total Crashes vs. Landuse

Ratio of Read-end Crashes to Total Crashes vs. Landuse

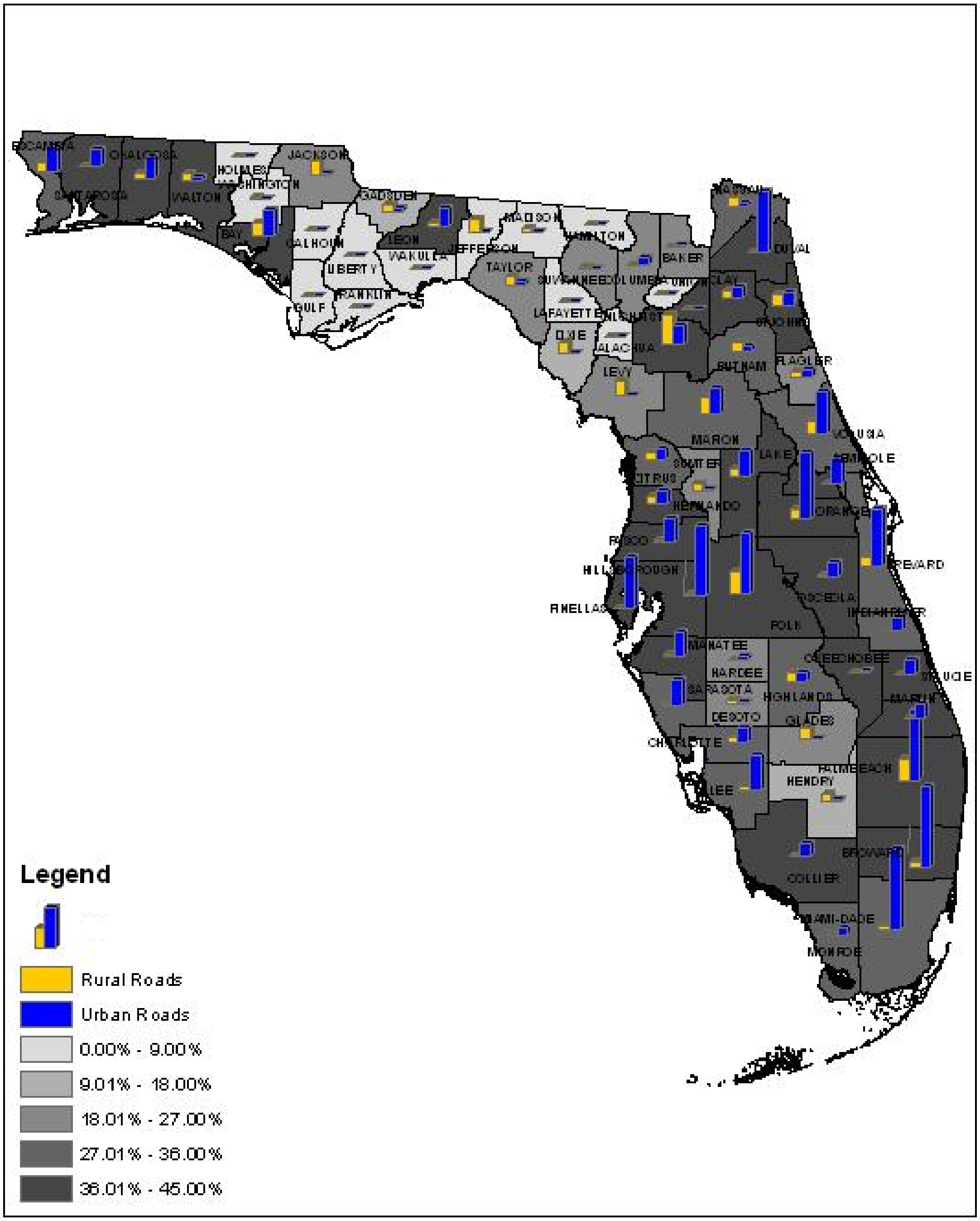

Figure A 1: Ratio of rear-end Crashes to Total Crashes vs. Landuse

A. 1.2 Ratio of Angle Crashes to Total Crashes vs. Landuse

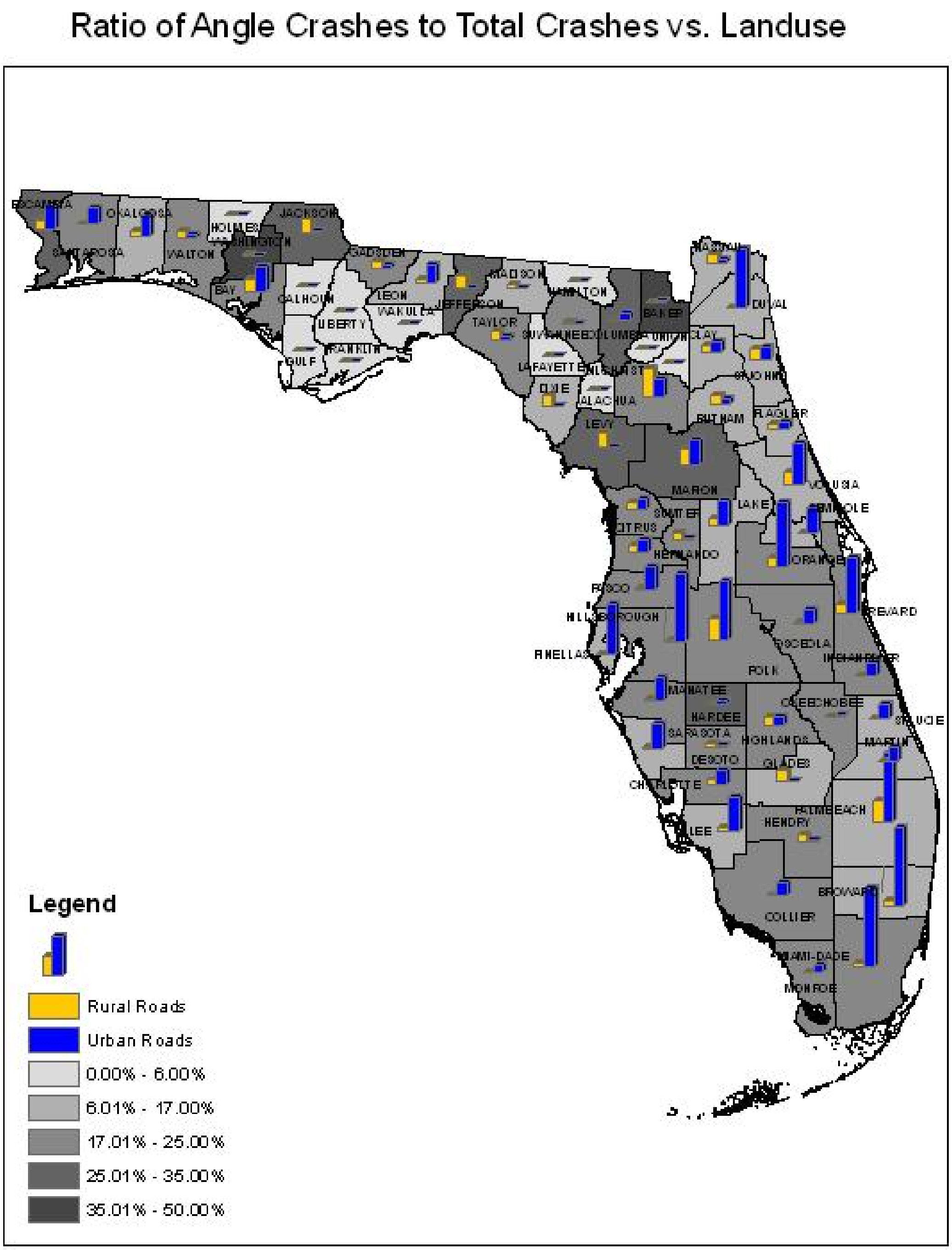

Figure A 2:Ratio of Angle Crashes to Total Crashes vs. Landuse

A. 1.3 Ratio of Sideswipe Crashes to Total Crashes vs. Landuse

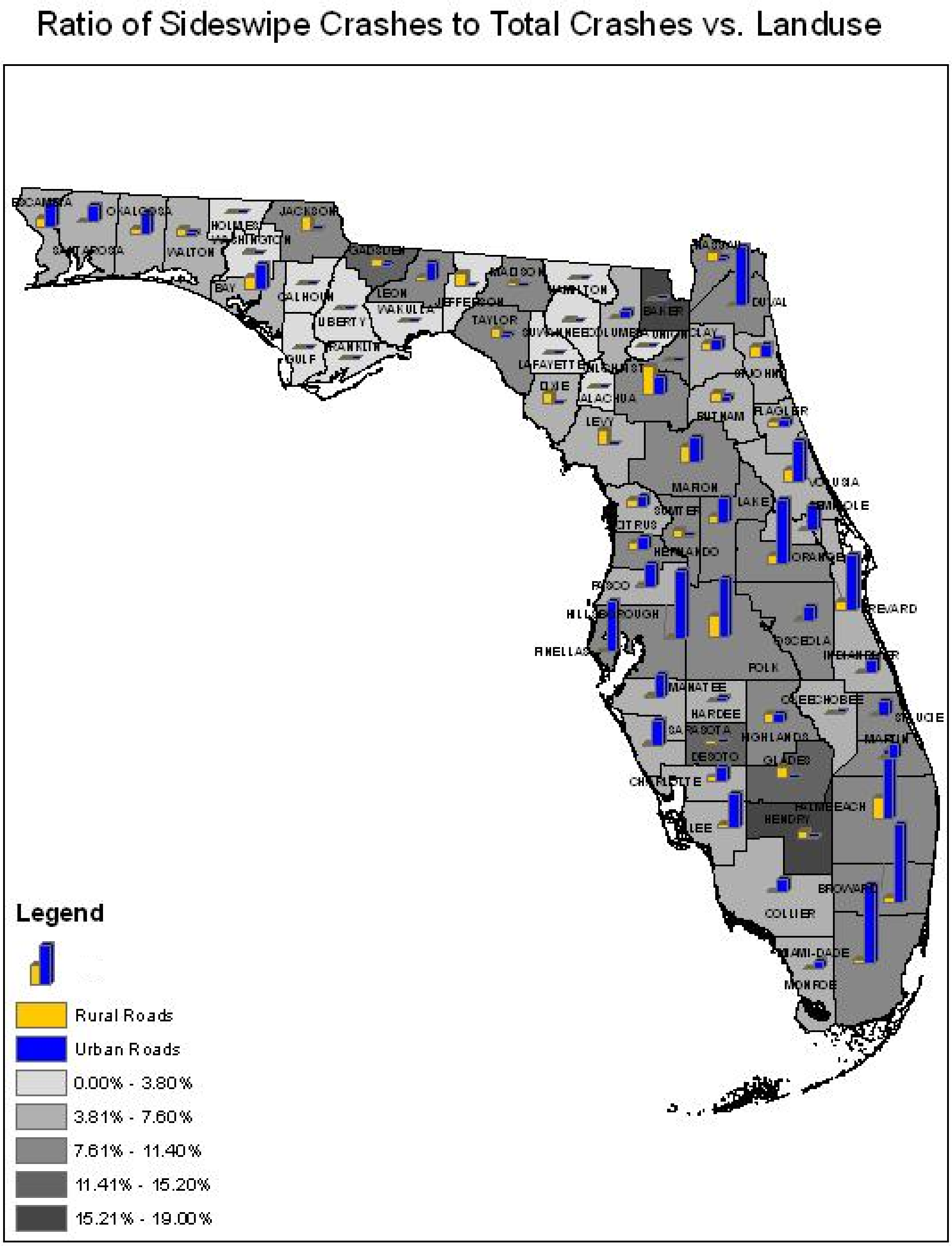

Figure A 3: Ratio of Sideswipe Crashes to Total Crashes vs. Landuse

A. 1.4 Ratio of Severe Rear-end Crashes to Total Severe Crashes vs. Landuse

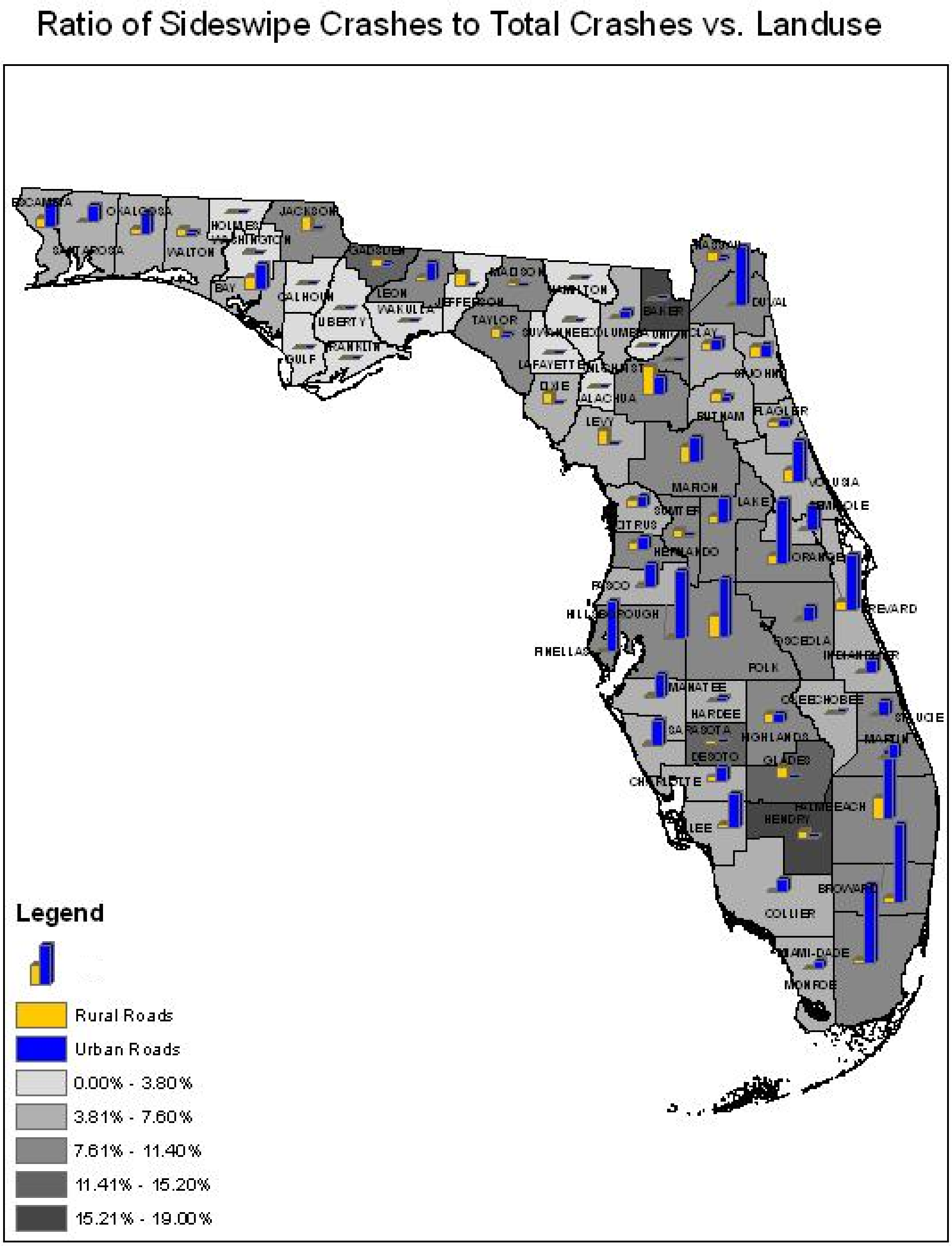

Figure A 4: Ratio of Severe & Fatal Rear-end Crashes to Total Severe Crashes vs. Landuse

A. 1.5 Ratio of Severe Angle Crashes to Total Severe Crashes vs. Landuse

Ratio of Severe Angle Crashes to Total Severe Crashes vs. Landuse

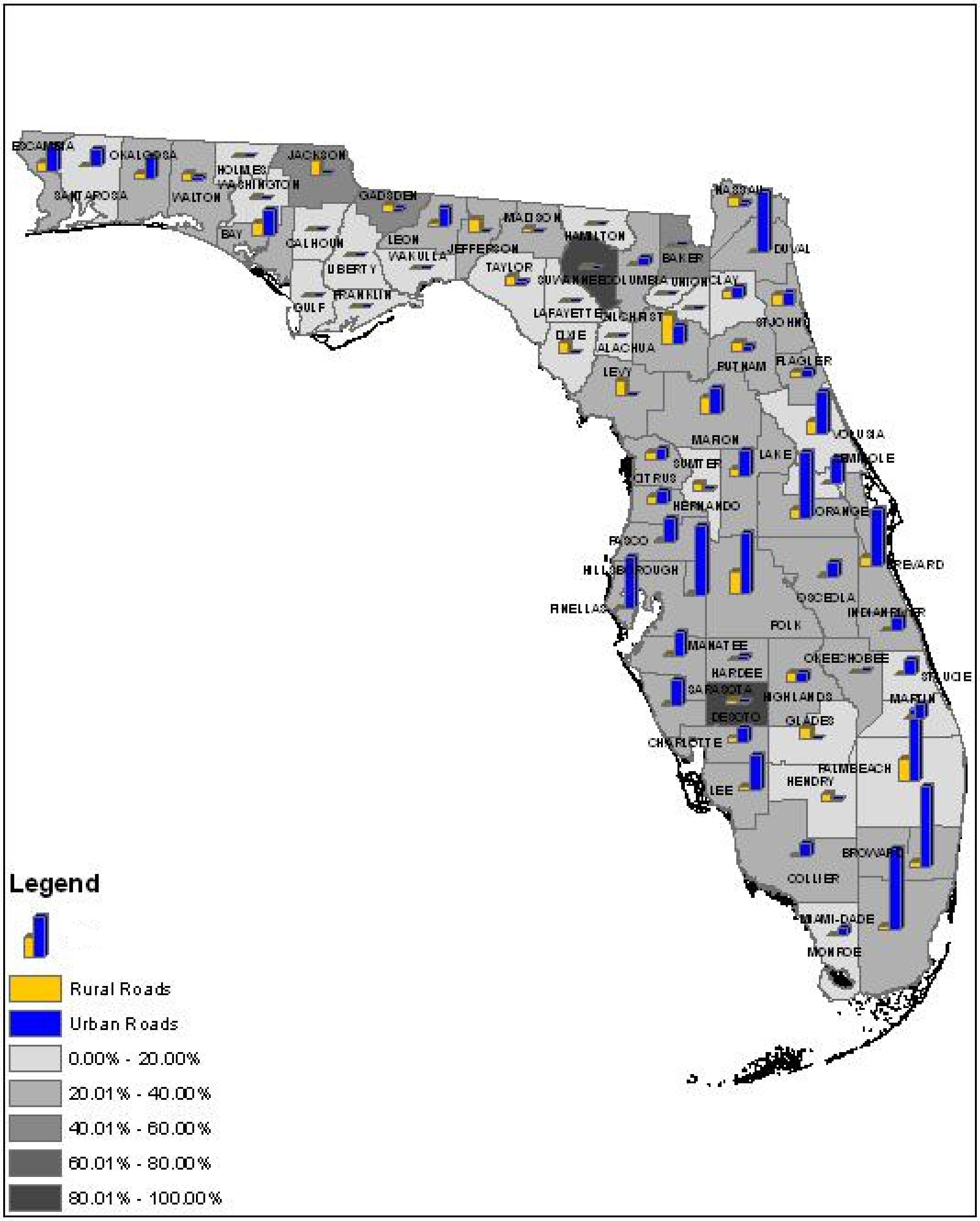

Figure A 5: Ratio of Severe Angle Crashes to Total Severe Crashes vs. Landuse

A. 1.6 Ratio of Severe Sideswipe Crashes to Total Severe Crashes vs. Landuse

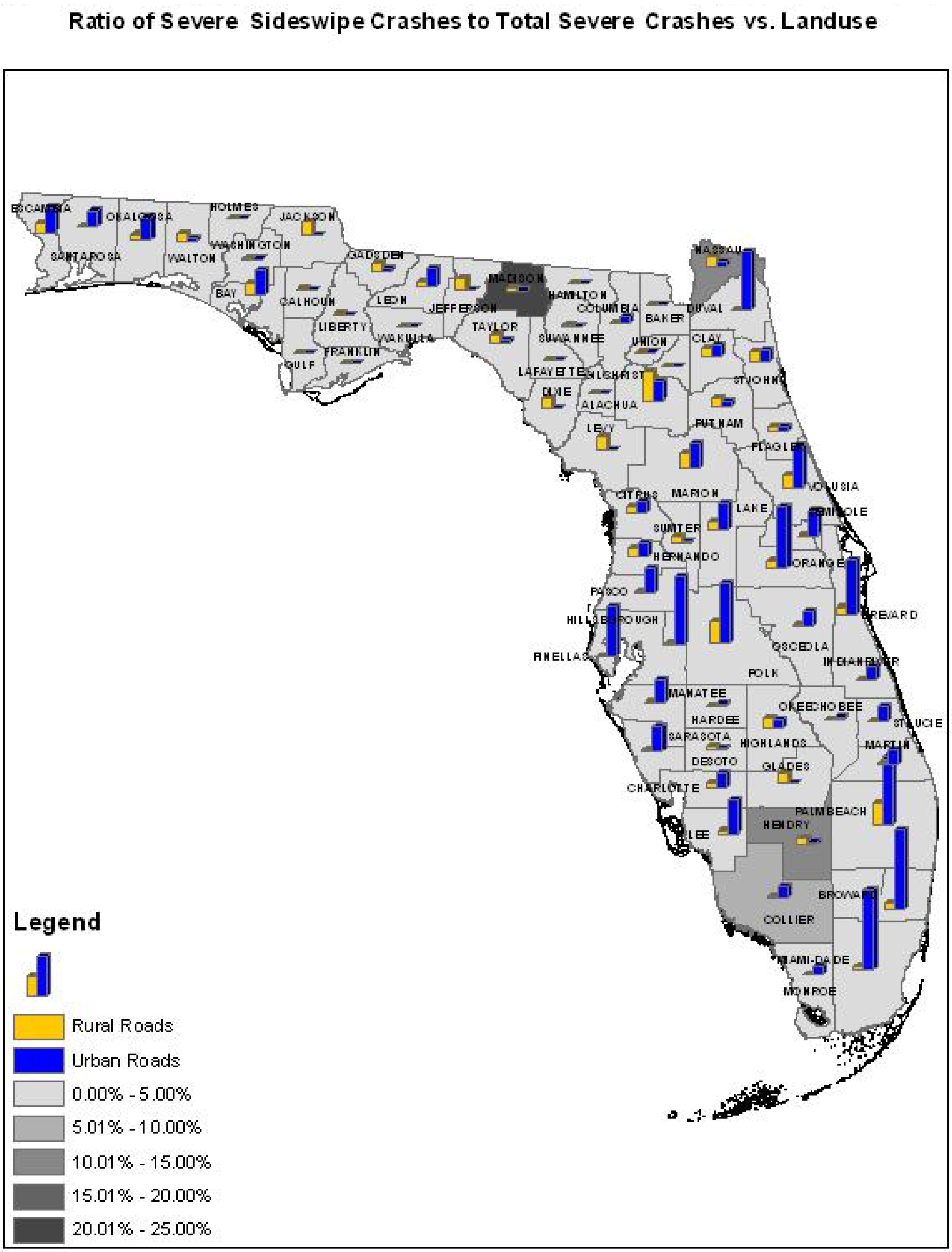

Figure A 6: Ratio of Severe Sideswipe Crashes to Total Severe Crashes vs. Landuse

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