Appendix C

Technical Report on Pedestrian and Bicycle Crash Analyses

CORE COASTAL REGION MPO

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Technical Report on Pedestrian and Bicycle Crash Analysis

Introduction

Pedestrian and bicycle safety is a critical issue in the effort to promote walking and bicycling. The surveys conducted in the initial participation process for this Plan revealed that a perceived lack of safety with regard to traffic is the biggest barrier to increasing walk trips and bicycle trips both. An understanding of the crash data is important for assessing the accuracy of such perception and for prioritizing all efforts to increase safety, whether through engineering, education, enforcement, encouragement, or evaluation.

To learn more about non-motorized crashes within all of Chatham County, staff analyzed data from hundreds of crashes from the years 2006-2008, obtained from the Georgia Department of Transportation. These data include information such as location, severity of injury, time of day, type of maneuver, road condition, and many other attributes.

A major limitation for comparing differences in the number of crashes over time, or in different locations, is that very little is known about exposure levels, because data about the amount or distance of pedestrian and bicycle trips are lacking. While automobile crashes are typically normalized against 100 million miles of (motor) vehicle miles traveled (VMT), lack of robust count data, facility data, and adjustment factors for pedestrians and bicyclists means pedestrian and bicycle crashes cannot be normalized in that manner. (Difficulty with exposure levels is one of the problems that the National Bicycle and Pedestrian Documentation Project is trying to address in its promotion of a consistent count method. Information available at: http://bikepeddocumentation.org/.) Normalizing pedestrian and bicycle crashes against (motor) vehicle miles traveled is a less than ideal; the missing bicycle and pedestrian miles of travel do not necessarily correlate with VMT (e.g. actual bicycle or pedestrian exposure could have decreased or remained the same even when VMT increased, if bicycle or pedestrian travel decreased at the same time). Normalizing pedestrian and bicycle crashes against area populations does not account for the presence of tourists, of which Chatham County has many.

Raw numbers of pedestrian or bicycle crashes, with no reference to exposure, often will indicate that crashes are clustered on local streets in denser, urban areas. This cannot be interpreted necessarily to mean that such roads or such areas are the most dangerous to these modes; these are exactly the types of areas that usually experience more pedestrian and bicycle trips, thus making it more likely for crashes to occur there. Pedestrian and bicycle crashes cannot take place if there are no pedestrians or bicyclists (but discouraging these modes is not an appropriate strategy for crash reduction). The fact may be that a busy, suburban arterial, while showing few crashes overall, actually has a higher number of crashes *per pedestrian or bicycle trip at that location*, which would constitute a higher risk.

Regarding the local availability of exposure levels, MPO staff and the City of Savannah have separately organized a number of pedestrian and bicycle counts since 2009, but limited resources mean that the data are collected for a few hours during the year and at only few locations. National research has provided adjustment factors, to estimate an annual figure from the sample count, for only two types of locations:

high-activity retail areas and multi-use paths[1]. Only three of the MPO's regular pedestrian and bicycle count locations match either of those area types, severely limiting the amount of comparisons that can incorporate some type of exposure level. Until pedestrian and bicycle data collection is given more attention nationally and locally, drawing conclusions about the relative safety in different locations will be difficult. However, the investigation of crash data is only one part of determining the needs of pedestrians and bicyclists.

In spite of the lack of exposure levels, some insight may be gained from looking at the crash data for pedestrians and bicyclists.

Pedestrian Crashes

Between January 1, 2006 and December 31, 2008, there were 421 reported pedestrian crashes within Chatham County, involving 435 pedestrians, for an average of about 140 crashes and 145 pedestrians per year. Actual occurrences could be higher if some minor crashes were not reported to police.

Pedestrian Crashes by Location

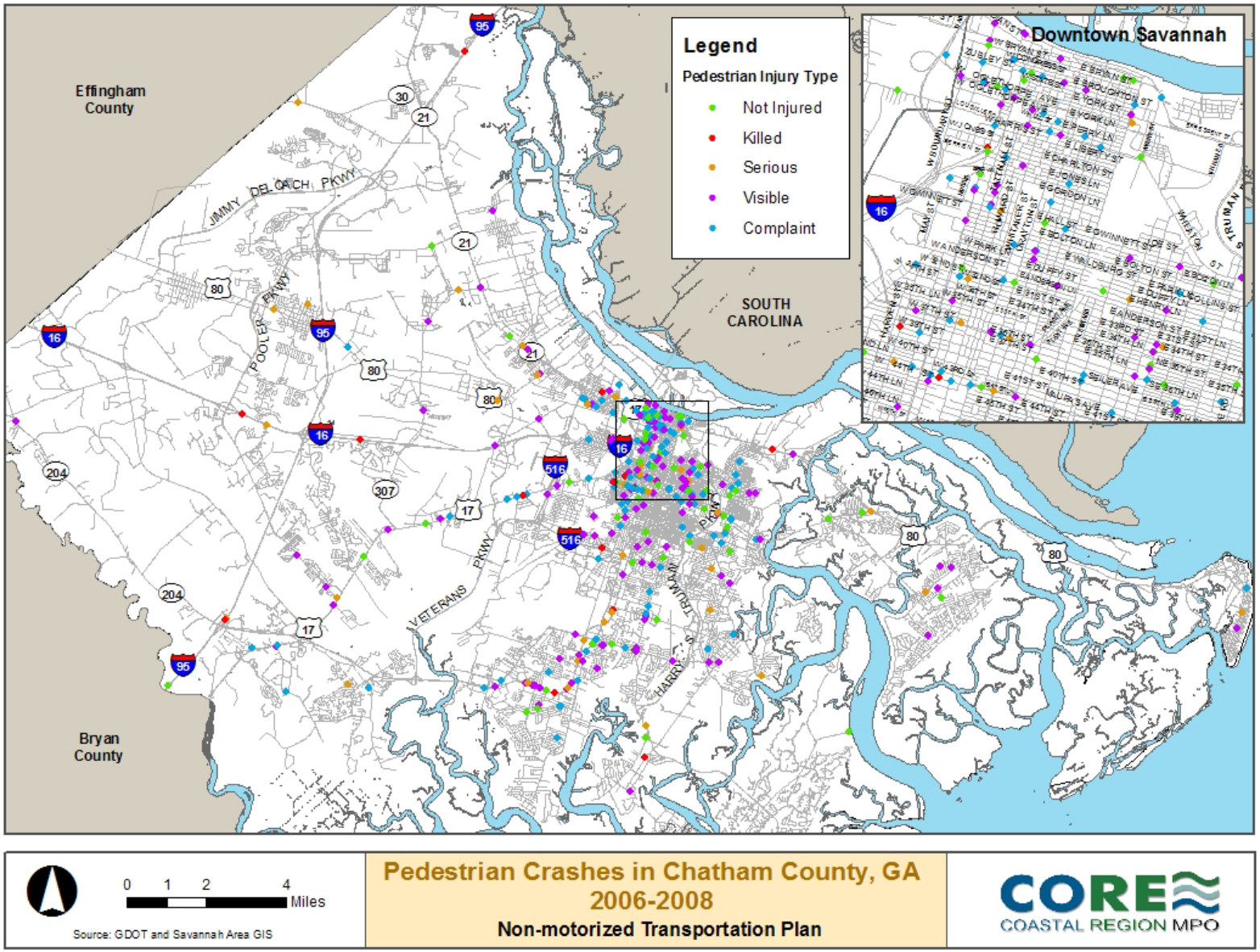
Using a Geographic Information System to plot the crashes assists in looking at the spatial distribution of the crashes (Figure 1). Fifty-nine crashes did not have sufficient records for geocoding.

In an effort to acknowledge the effects of the unknown exposure levels, MPO staff looked at a broad downtown area (within the rectangle bounded by River St., Victory Dr., MLK Jr. Blvd., and East Broad St.) separately from all other areas of the county because of the awareness that the density, mixed land uses, mixed incomes, smaller blocks, tourist attractions, commercial attractions, and Savannah College of Art and Design buildings within this area generate more pedestrian traffic than in other areas of the county. Crashes appear clustered within this area, when looking at the whole county, but exposure is assumed to be highest downtown. It is not necessarily the worst part of the county for pedestrians and bicyclists. The purpose of the separation of data into the two groups is to use different definitions of "normal" distribution for these areas assumed to have different exposure levels.

Any high-crash locations found in the analysis will be inspected in the field, to determine if design rather than exposure or other factors may be contributing to the crashes.

[1] National Bicycle and Pedestrian Documentation Project website, bikepeddocumentation.org

Figure 1: Pedestrian Crash Locations and Severity, 2006-2008



Within Broader Downtown Savannah (i.e. inside or on edge of the rectangle formed by River St., Victory Dr., MLK Jr. Blvd., and East Broad St.)

Looking closer at this "north of Victory" area (Figure 2), one sees many single-crash locations distributed across the area, with a few points having multiple crashes in the three-year period. The map displays downtown crash locations with dark brown points, in a range of sizes to indicate number of crashes. The intersection of Barnard St. and Victory Drive was the only location to experience as many as four crashes. Intersections at MLK Jr. Blvd. and Oglethorpe Ave., Montgomery St. and Victory Dr., and Abercorn St. and Victory Drive each experienced three crashes. However, in order to know whether these numbers differ from random occurrence, the GIS was used to conduct hot spot analysis.

In preparation for the hot spot analysis, broader clusters within downtown were identified. The data was integrated to bring together data points within a short distance of each other (200 feet, to have a greater range of incident counts among records, while not reducing the total number of records in this sub-area to less than 30). The lighter brown bull's eye symbols on the map represent the center of integrated cluster areas, and the size of the symbol indicates how may crashes were integrated into the cluster. These centers may or may not overlap an actual location of a crash. Geographically isolated points have a "cluster of one" in the same location as the crash point.

The hot spot analysis investigated whether any clusters have a significantly high number of crashes. "Inverse distance" was chosen as the method of conceptualizing the data, using a distance band (4,005 feet, for this downtown group) that allows each cluster to have at least eight neighbors included in the analysis; closer neighbors contribute more weight to each point than do the farther neighbors in the analysis. Manhattan distance, rather than Euclidean distance, was used in both the calculation of distance band and in the hot spot analysis, because crashes tend to be constrained to the roadway network rather than occurring anywhere on the surface of the earth.

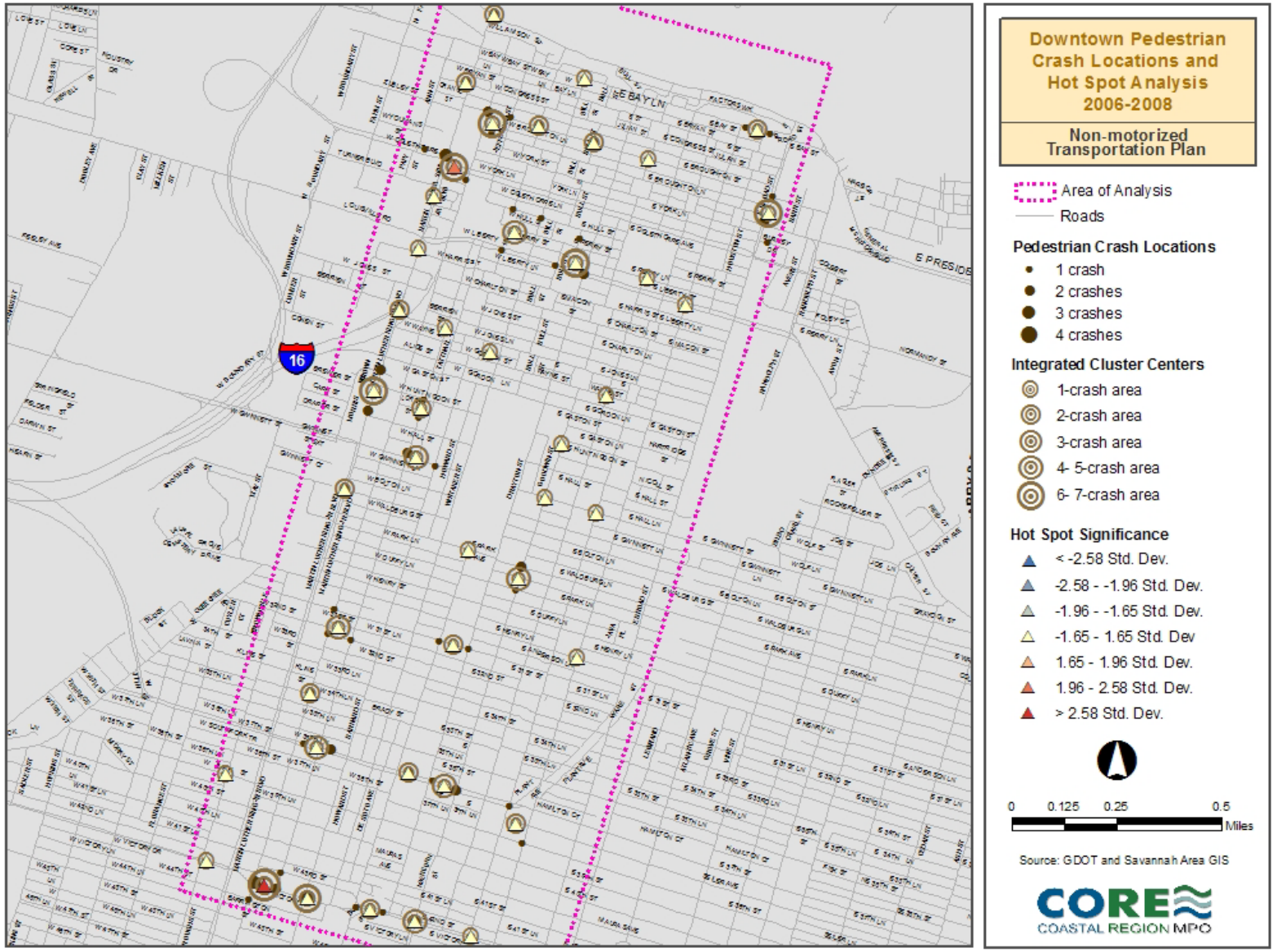
The result shows that two clusters are significant at a 95% confidence level. Most clusters have no more crashes than randomly expected (yellow triangles are neither hot spots nor cold spots), suggesting that specific characteristics of the location were not factors for those crash(es). The two areas within downtown that experienced a high number of crashes, relative to the random expectation, are listed in Table 1:

Table 1: High Pedestrian Crash Clusters Within Broader Downtown Savannah

	Number of Crashes	Standard Deviations
The area centered on Victory Dr. between Montgomery St. and Jefferson St., extending approximately one block in each direction	7	3.65
The area around Oglethorpe Ave. and MLK, Jr. Blvd., extending approximately one block in each direction	5	2.14

Three (or 3%) of the total 96 pedestrian crashes known to occur within the broad, downtown area were fatal for the pedestrian(s) involved. Eleven (or 11%) of the crashes resulted in serious injury for the pedestrian(s). One of the fatalities and one of the serious injuries occurred in the high-crash area on Victory Dr., listed above.

Figure 2: Downtown Pedestrian Crash Locations and Hot Spot Analysis



Outside Broader Downtown Savannah (i.e. outside of the rectangle formed by River St., Victory Dr., MLK Jr. Blvd., and East Broad St.)

A few areas and intersections in this more suburban and rural, countywide zone (outside downtown) appear to have more crashes than other areas in this zone (see Figure 3). A location on Montgomery Cross Rd. just west of Waters Ave. had four crashes within the three-year period. Locations with three crashes were: Oglethorpe Ave., just east of Fahm St.; the intersection of DeRenne Ave. and White Bluff Rd.; the intersection of Montgomery Cross Rd. and Hodgson Memorial Dr.

As with the crashes within downtown, a hot spot analysis was conducted on the suburban and rural crashes to determine whether these apparent high-crash locations were significantly different from random geographic distribution. Again the data was integrated to form cluster areas consisting of points within 200 feet of each other, since an excessively fine-grained scale of analysis would not have shown any clustering. The lighter brown bull's eye symbols on the map in Figure 3 represent the center of integrated cluster areas, and the size of the symbol indicates how may crashes were integrated into the cluster. These centers may or may not overlap an actual location of a crash. Geographically isolated points have a "cluster of one" in the same location as the crash point.

The hot spot analysis for this area outside of the broadly defined downtown was conducted with the same parameters as the downtown analysis, except that a larger distance band was used in this suburban and rural zone (55,039 feet). The larger band was required to ensure that each point in the analysis had at least eight neighbors. It is appropriate that the analyses for these separate areas have different distance bands, used in the assessment of normal distribution, because the purpose of performing separate analyses was to use different definitions of normal for the two areas assumed to have different exposure levels.

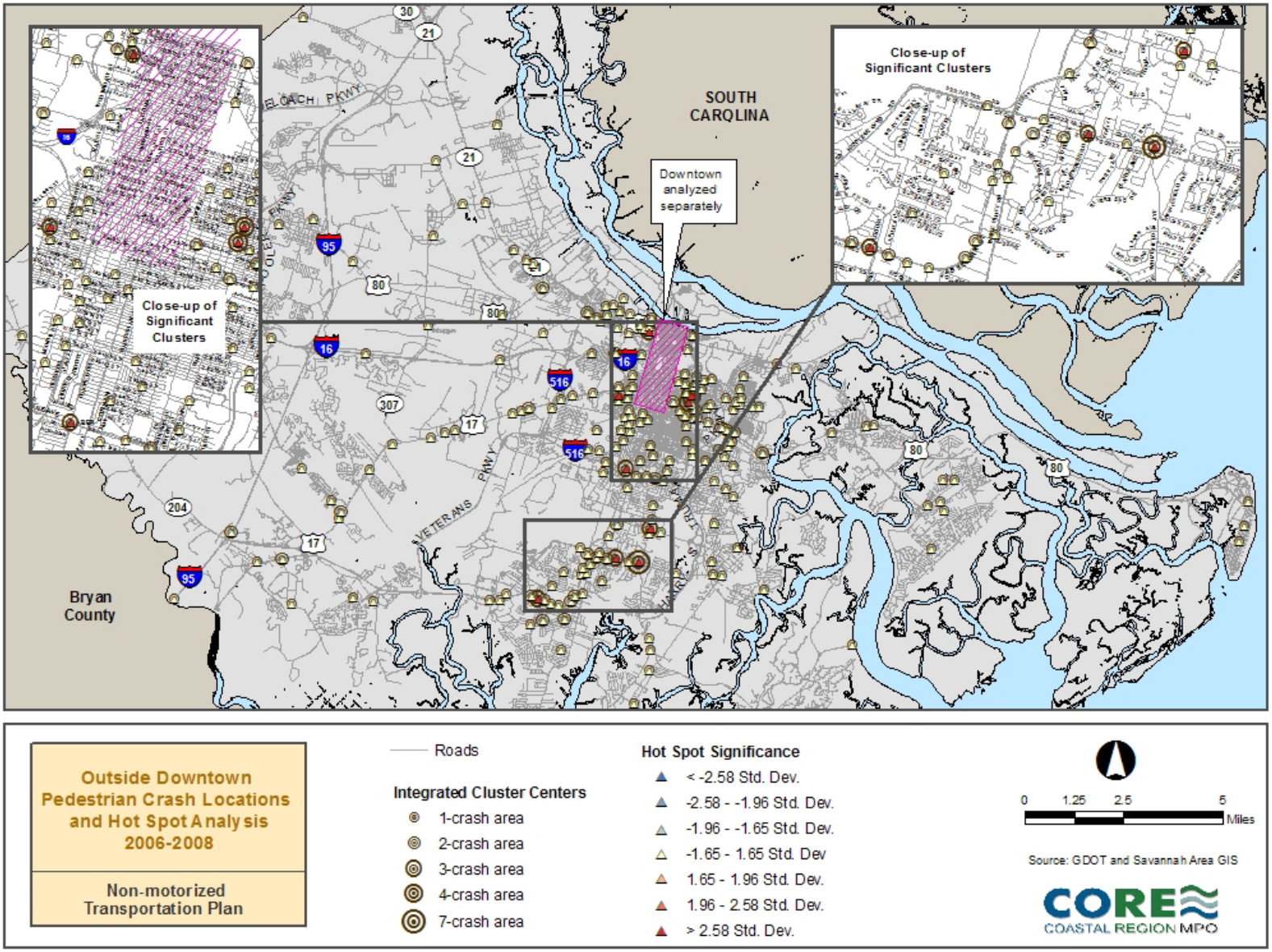
Nine integrated cluster areas outside of downtown are significant high-crash locations at the 99% confidence level. These are areas where at least three crashes occurred within 200 feet of each other within the three years. Some of these clusters incorporate the four locations mentioned above, but another five clusters are also significant.

Table 2: High Pedestrian Crash Clusters Outside Broader Downtown Savannah

	Number of Crashes	Standard Deviations
The area around on Montgomery Cross Rd. and Waters Ave.	7	8.67
The area centering on Waters Ave. between 33rd St. and 34th St.	4	4.15
The area bounded by 36th St., Waters Ave., 37th St. and Ott St.	4	4.15
The location approximately at Montgomery Cross Rd. and Hodgson Memorial Blvd.	3	2.64
The area around Abercorn St. and Largo Dr.	3	2.64
The location near Oglethorpe Ave. and Fahm St.	3	2.64
The area around Eisenhower Dr. and Waters Ave.	3	2.64
The location at DeRenne Ave. and White Bluff Rd.	3	2.64
The area around Victory Dr. and Stevens St.	3	2.64

Fourteen (or 5%) of the 266 crashes known to occur in the more suburban and rural area of the county were fatal for the pedestrian(s) involved. Thirty-seven (or 14%) resulted in serious injury for the pedestrian(s). Two of the fatalities outside of downtown were in high-crash locations identified in the table above: Victory Dr./Stevens St. area; and Abercorn St./Largo Dr. area. Three of the serious injuries outside of downtown occurred in high-crash locations: Waters Ave./34th St. area; DeRenne Ave./White Bluff Rd. area; and Montgomery Cross Rd./Hodgson Memorial Dr. area.

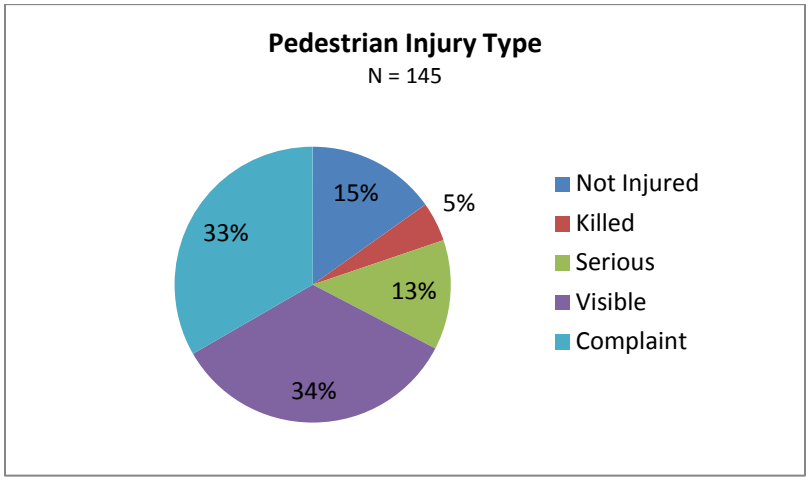
Figure 3: Outside Downtown Pedestrian Crash Locations and Hot Spot Analysis



Pedestrian Crashes by Injury Type

Countywide, a large majority (82%) of pedestrian crashes did not cause serious injury to the pedestrian (see Figure 4). Eighteen percent of crashes resulted in either a serious injury or a fatality.

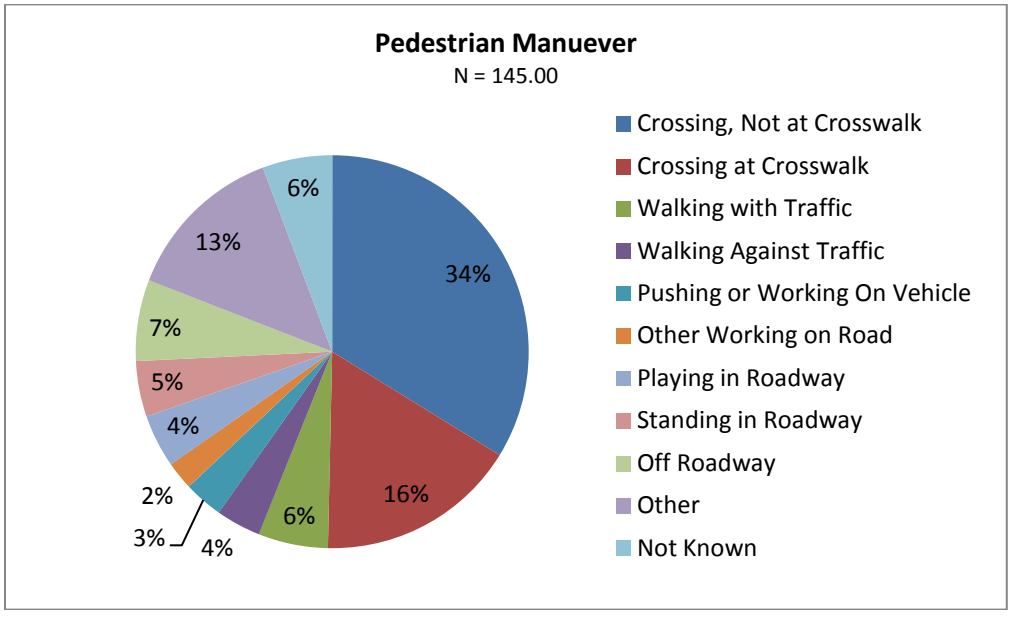
Figure 4: Average Annual Pedestrians in Crashes, by Injury Type



Pedestrian Crashes by Pedestrian Maneuver

More than twice as many pedestrians were hit crossing outside of a crosswalk than within one (see Figure 5). It is not surprising that the crossing maneuver in general, whether in a crosswalk or outside of crosswalk, captures 50% of the crashes, as this is maneuver naturally introduces conflicts with vehicular traffic.

Figure 5: Average Annual Pedestrians in Crashes, by Pedestrian Maneuver

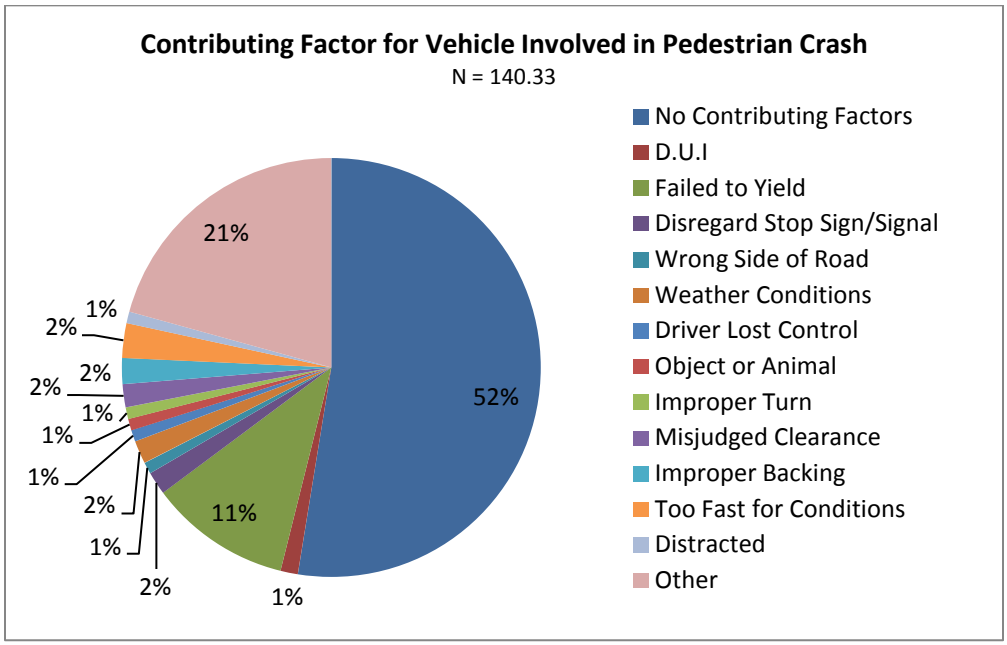


Pedestrian Crashes by Primary Contributing Factor

Contributing factors are reported for the vehicle(s) involved. Pedestrians, though, may contribute to cause of the crash in some cases, based on certain maneuvers, covered above.

This analysis depends upon the police officers' categorization of crash causes, as MPO staff did not review written descriptions of the crashes. In a majority of cases, the officers' coding of crash factors indicated that the vehicle driver was not considered to have contributed, in primary way, to the cause of the crash (see Figure 6). The second most frequently cited category was "Other" at 21%. Among the remainder, "Failing to Yield," was the most common factor (11%).

Figure 6: Average Annual Pedestrian Crashes, by Contributing Factor



Pedestrian Crashes by Functional Classification

When looking at the pedestrian crashes on different types of roadway, it is important to remember that the hierarchical nature of the roadway classification system essentially guarantees different exposure levels.

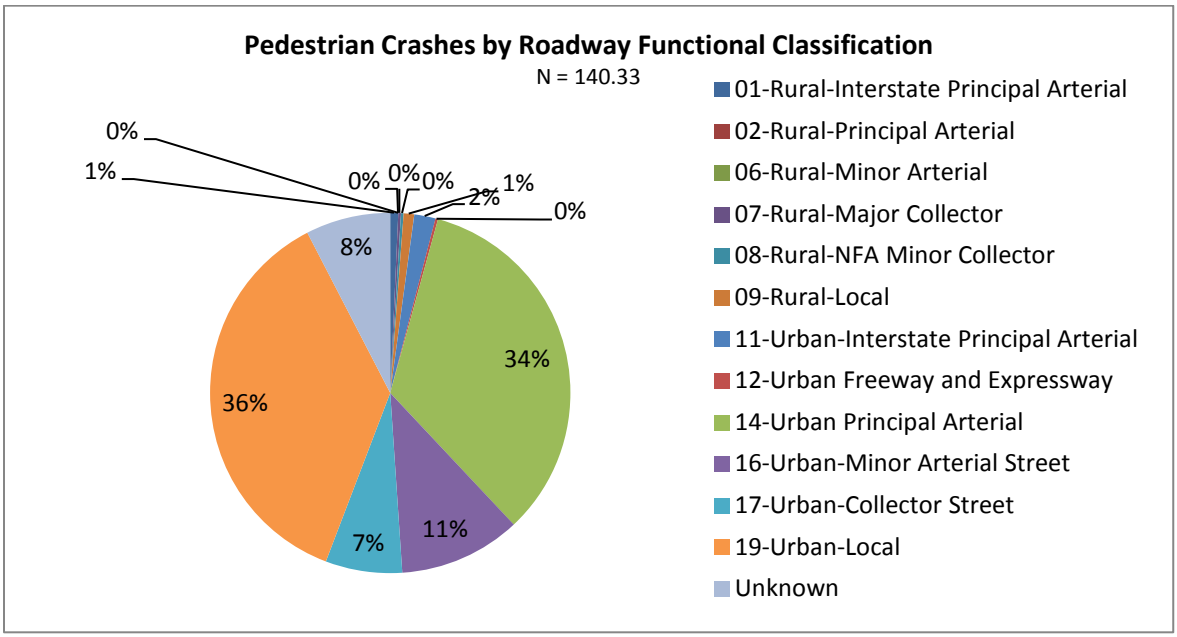
By far, the most pedestrian crashes (90%) occur within the urban roadway classifications (see Figure 7). This is not surprising because urban areas bring origins and destinations closer together and thus see more pedestrian trips – which are not to be discouraged.

In particular, Urban Local roads and Urban Principal Arterial roads stand out for percentage of pedestrian crashes (36% and 34% respectively). This is probably not an unusual pattern, due both to the exposure levels and to the roadway characteristics that correlate with the roadways' roles within the classification system. In this pattern, the Urban Principal Arterials are more likely needing physical improvements for pedestrians, although some local roads will have deficiencies also. The rationale for this theory is explained below.

Exposure levels are likely high for the Urban Local roads, because the role of these roads (providing access to land uses) makes them most numerous type of road in the classification system and the most likely to see high numbers of pedestrians. Exposure is high in two ways, but at the same time, the role of these roads results in characteristics that are more pedestrian-friendly, such as fine-grained networks, fewer lanes, slower motorized traffic. The higher number of crashes of crashes on local roads should not be interpreted to mean those roads present the most danger to pedestrians.

On the other hand, principal arterials' role in the hierarchy makes them naturally unpleasant for pedestrians, as these roads are fewer but larger and tend have posted speeds of 35 to 45 miles per hour. These roads naturally have the higher motorized volumes and, for that reason, tend to attract commercial uses, if zoning does not prohibit them. Some pedestrians are attracted to these land uses too, in spite of the more auto-oriented nature of the principal arterials. Thus, the Urban Principal Arterials in Chatham County most likely do need special attention for pedestrian safety, but not to the exclusion of all other road types.

Figure 7: Average Annual Pedestrian Crashes, by Roadway Functional Classification

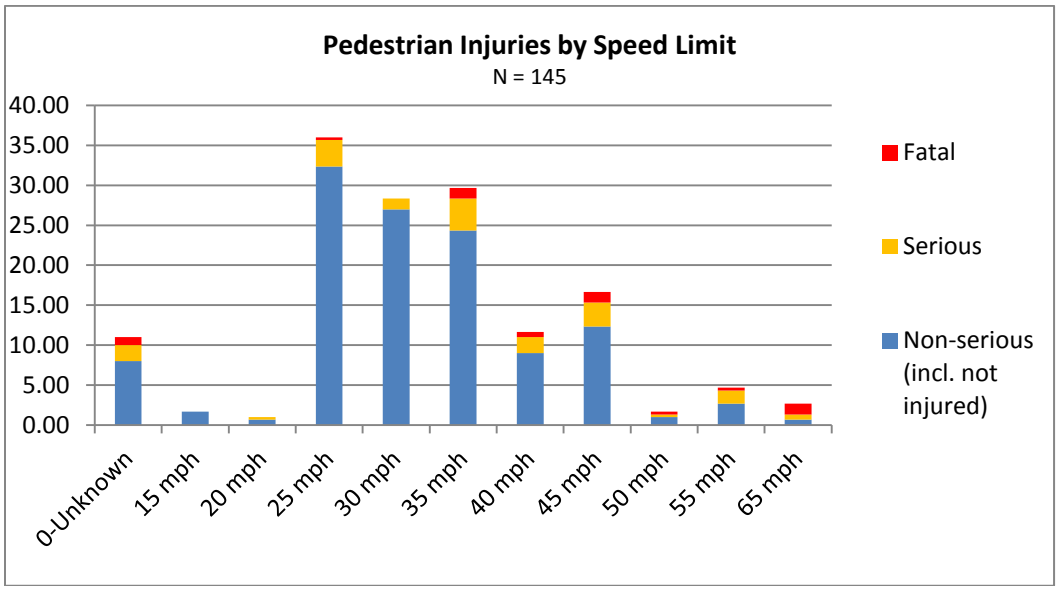


Pedestrian Crashes by Speed Limit

The pattern of total crashes demonstrated in the chart below (Figure 8) is related to the pattern for the functional classification discussed above, in that speed limits correlate with functional classifications. Thus the high bars for the low and moderate speed limits are in part related to the higher numbers of pedestrians expected on local roads which tend to be in pedestrian-friendly areas.

However, the proportion of fatalities and serious injury within the different speed limit categories is additional information of interest here. Not surprisingly, higher speed zones tend to see higher proportions of fatalities than do the lower speed zones. Speed limits at the crash locations do not necessary indicate the actual speed of the vehicle(s) involved, but are the only way of approximating vehicle speed, after the fact, in a large set of data.

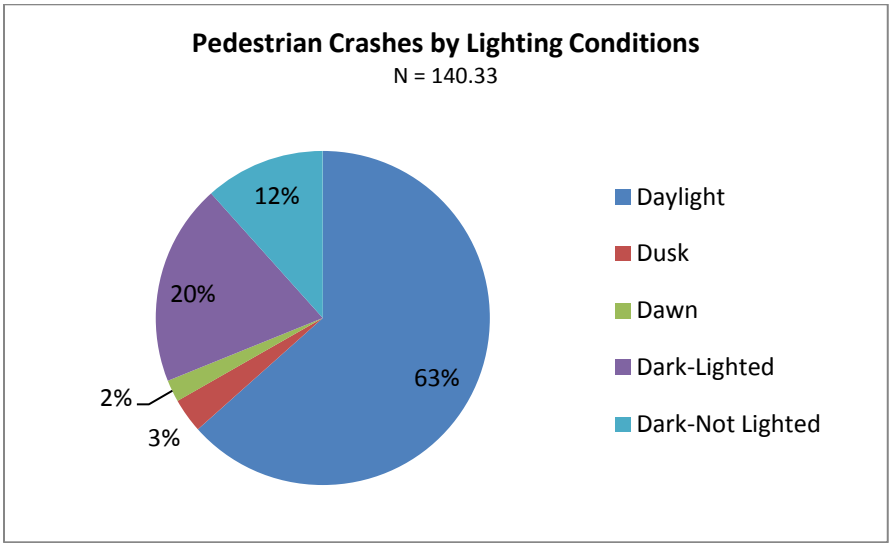
Figure 8: Average Annual Pedestrian Injuries, by Posted Speed Limit



Pedestrian Crashes by Lighting Condition

Most crashes occurred during daylight hours, a more active time of day for travel in general (see Figure 9). For those crashes that occurred in dark conditions, more were in lighted areas, but this is likely related to the fact that urban areas, which tend to be lighted, attract more pedestrian trips.

Figure 9: Average Annual Pedestrian Crashes, by Lighting Conditions

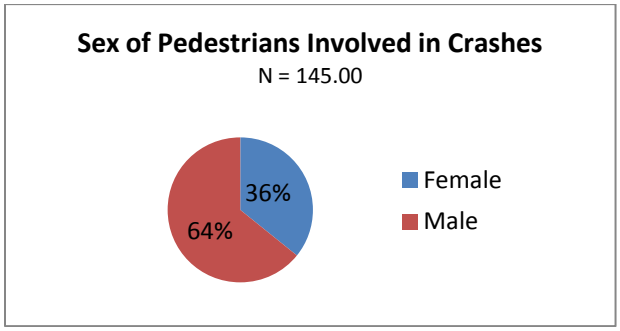


Pedestrian Crashes by Sex

More male pedestrians than female pedestrians are involved in the crashes (see Figure 10). Again exposure levels for the sexes are not truly known. The MPO's pedestrian count samples indicate that the low-income count locations have a high proportion of male pedestrians versus female (for instance, 75% male on average at the screenline on W. Victory Dr.), while the gender split was nearly even when including all nine of the count locations. Several of the pedestrian crash hot spots are indeed within low income areas (including W. Victory Dr.); however less than half of the total number of pedestrian crashes are in strictly low-income areas.

It also is possible that male pedestrians are inherently more likely to be involved in crashes. Chatham County's distribution of pedestrian crashes between the sexes is consistent with national data showing that in general the majority of pedestrians involved in crashes are male.[2]

Figure 10: Average Annual Pedestrians in Crashes, by Sex



Bicycle Crashes

Between January 1, 2006, and December 31, 2008, there were 291 reported bicycle crashes, for an average of 97 per year. Additional crashes likely occurred and were not reported because there was little or no injury or property damage.

Bicycle Crashes by Location

Figure 11 shows location and severity of the geocoded, reported crashes throughout Chatham County in the three-year period. (Twenty-five crash records did not have the data needed for geocoding.) There were three fatalities during this period, and these occurred at:

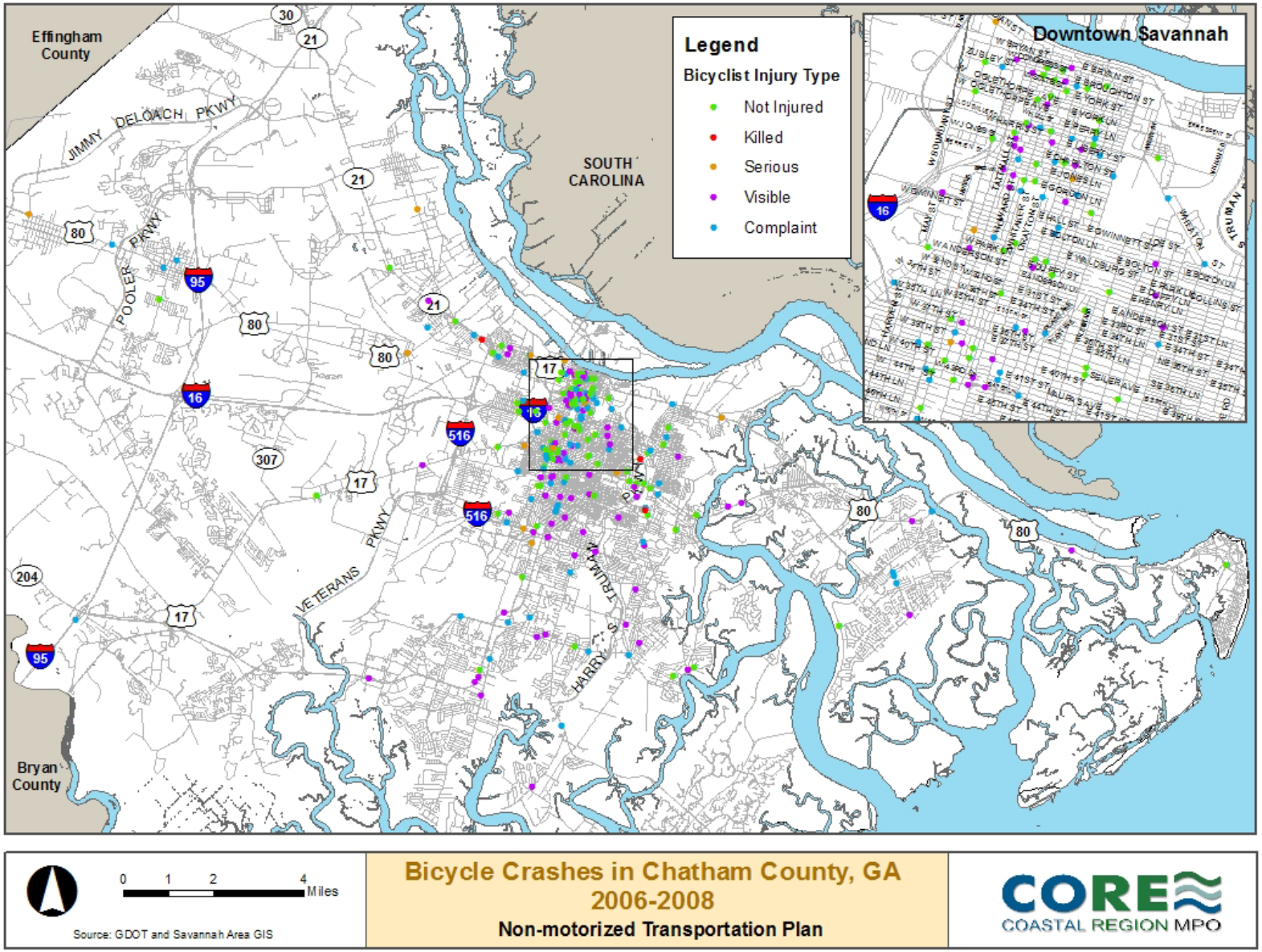
- The intersection of E. 51st St. and Linnhurst Ln.;
- The intersection of W. Bay St. between Lissner Ave. and Collins St.; and
- On the Truman Pkwy. at the northbound exit to Anderson St.

As with the pedestrian crashes, staff separated the location analysis into two different areas, on the assumption that exposure is higher in a broadly defined, downtown area, than in the rest of the county. The assumption is based on the higher density and higher number of attractions within the downtown area. The purpose of the separation of data into the two groups is to use different definitions of "normal" distribution for these areas assumed to have different exposure levels.

Any high-crash locations found in the analysis will be inspected in the field, to determine if design rather than exposure or other factors may be contributing to the crashes.

[2] PEDSAFE, Crash Statistics, http://www.walkinginfo.org/pedsafe/crashstats.cfm

Figure 11: Bicycle Crash Locations and Severity, 2006-2008



Within Broader Downtown Savannah (i.e. inside of the rectangle formed just beyond River St., Victory Dr., MLK Jr. Blvd., and East Broad St.)

In this "north of Victory" area, the crashes are distributed among a large number of blocks and intersections. The map in Figure 12 displays downtown crash locations with dark green points. A few locations experienced two or three crashes within the 2006-2008 period, as indicated by larger points. The intersection of Lincoln St. with Bolton St. is the only single point with three crashes in the downtown area. However, in order to know whether these numbers differ from random occurrence, the GIS was used to conduct hot spot analysis.

In preparation for the hot spot analysis, broader clusters within downtown were identified. The data was integrated to bring together data points within a short distance of each other (260 feet, to have a greater range of incident counts among records, while not reducing the total number of records to less than 30). The light green bull's eye symbols on the map represent the center of cluster areas, and the size of the symbol indicates how may crashes were integrated into the cluster. These centers may or may not overlap an actual location of a crash. Geographically isolated points have a "cluster of one" in the same location as the crash point.

A hot spot analysis was conducted in the GIS to investigate whether any clusters have a significantly high number of crashes. "Inverse distance" was chosen as the method of conceptualizing the data, using a distance band (4,071 feet, for this downtown group) that allows each cluster to have at least eight neighbors included in the analysis; closer neighbors contribute more weight to each point than do the farther neighbors in the analysis. Manhattan distance, rather than Euclidean distance, was used in both the calculation of distance band and in the hot spot analysis, because crashes tend to be constrained to the roadway network rather than occurring anywhere on the surface of the earth.

The result shows that only those clusters incorporating six or seven crashes were significant at the 90% confidence level. Most clusters have no more crashes than randomly expected (yellow triangles are neither hot spots nor cold spots), suggesting that characteristics of the location were not factors for those crash(es). The three areas within downtown that experienced a high number of crashes, relative to the random expectation, are listed in Table 3:

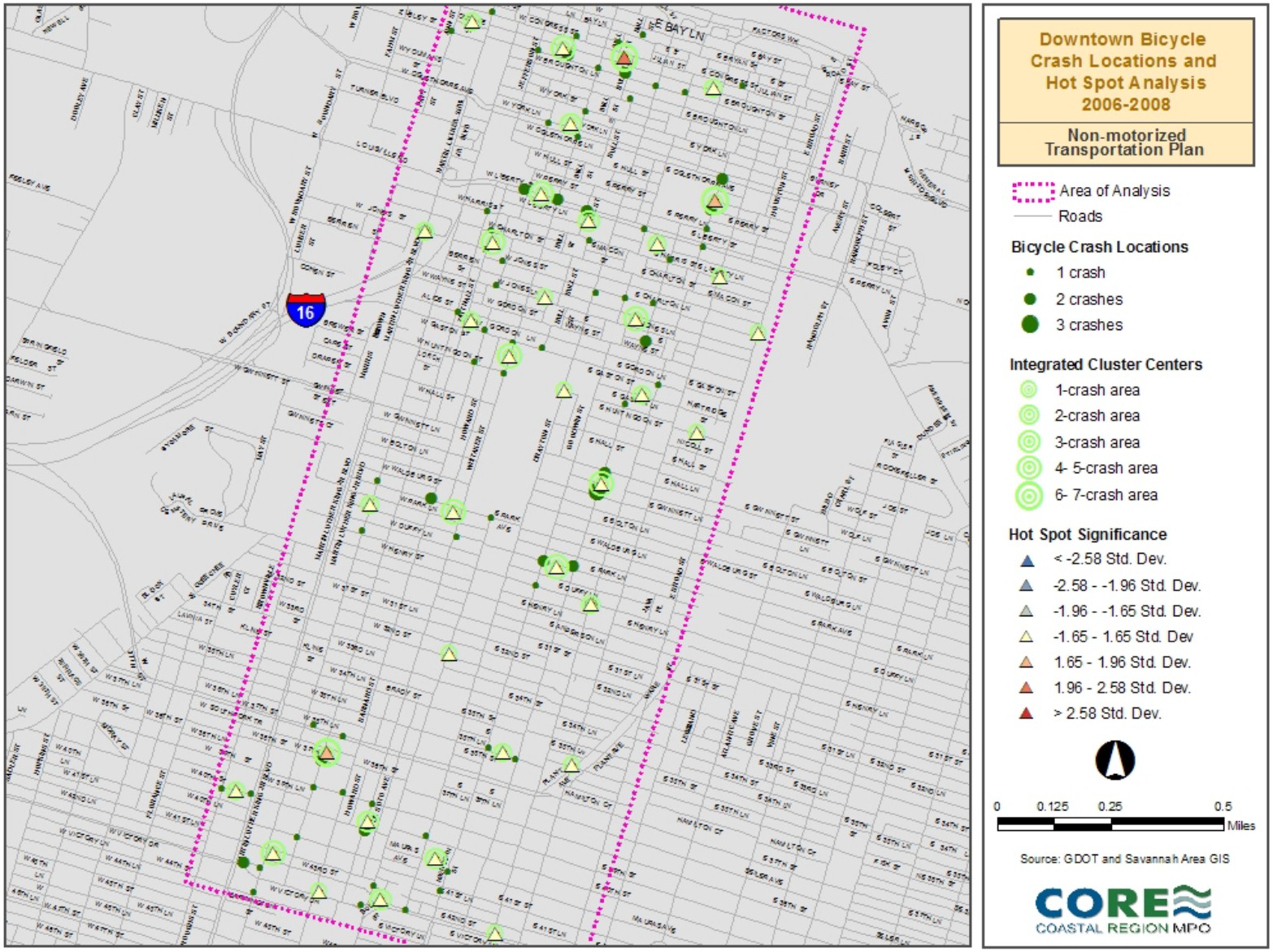
Table 3: High Bicycle Crash Clusters within Broader Downtown Savannah

	Number of Crashes	Standard Deviations
The area around the intersection of Broughton St. and Bull St., extending approximately one block in each direction	7	2.43
The area on Habersham St., between Oglethorpe St. and Liberty St.	6	1.83
The area around the intersection of W. 38th St. and Jefferson St., extending approximately one block in each direction	6	1.83

Exposure levels could vary substantially even within the downtown analysis area, and that could be one of the possible non-random processes influencing the crash distribution; the area around Broughton St. and Bull St. is in the middle of Savannah's central business district, and thus has an especially high number of attractions. Street design could be another factor in some of these hot spots; the block of Habersham St. listed above includes a segment at the police station with back-out, diagonal, on-street parking, which introduces visibility problems.

None of the crashes within the broad, downtown area resulted in a fatality. Three (or 3%) of the total 104 geocoded crashes within downtown resulted in serious injury for the bicyclists. One of those was within a high-crash area listed above: the area around W. 38th St. and Jefferson St. (The serious crash specifically was at W. 39th St. and Jefferson St.).

Figure 12: Downtown Bicycle Crash Locations and Hot Spot Analysis



Outside Broader Downtown Savannah (i.e. outside of the rectangle formed by River St., Victory Dr., MLK Jr. Blvd., and East Broad St.)

Outside of the broadly defined downtown area, crash clustering is mainly associated with high-crash intersections (see Figure 13). As with the analysis of downtown crashes, points within 260 feet of each other were integrated for the hot spot analysis. Green bull's eye symbols on the map in Figure 13 represent the centers of these cluster areas. The centers of the clusters may or may not coincide with an actual crash point. Many clusters are "clusters of one," where a given point had no neighbors within 260 feet.

The hot spot analysis was conducted on the cluster centers, again using "inverse distance" as the conceptualization method, and using a distance band that allowed each cluster to have at least eight neighbors (64,500 feet, for this more suburban group). Again the calculations and analysis used Manhattan distance rather than Euclidean distance, because crashes tend to be constrained to the street network. The distance band in this suburban analysis naturally was larger than the distance band used in the downtown analysis, as some crash clusters in the suburban area are very isolated. Different distance bands are appropriate because the purpose of separating the analysis into "downtown" and "outside downtown" was to use different descriptions of "normal" distribution, to acknowledge likely differences in exposure levels.

The results show that clusters incorporating three or more crashes are significant at the 99% confidence level. Most clusters have no more crashes than randomly expected (yellow triangles are neither hot spots nor cold spots), suggesting that characteristics of the location were not factors for those crash(es). The six areas outside of downtown that experienced a high number of crashes, relative to the random expectation, are listed in Table 4:

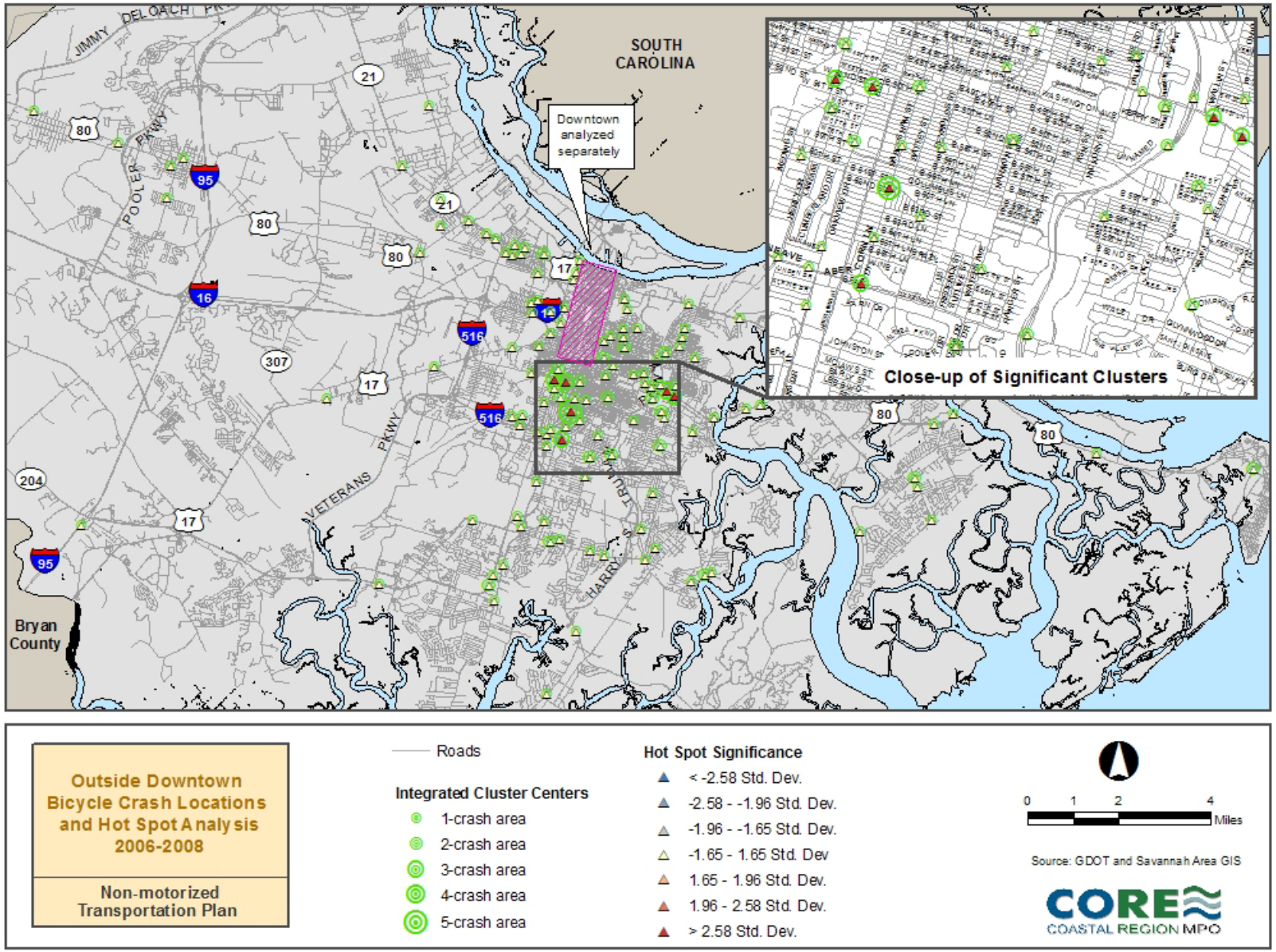
Table 4: High Bicycle Crash Clusters Outside Broader Downtown Savannah

	Number of Crashes	Standard Deviations
Habersham Village area on Habersham St.	5	6.17
The area on Bull St., between 50th St. and 53rd St.	3	2.87
The intersection of 52nd St. and Montgomery St.	3	2.87
The intersection of Victory Dr. and Wallin St.	3	2.87
The intersection of Victory Dr. and Skidaway Rd.	3	2.87
The intersection of Habersham St. and DeRenne Ave.	3	2.86

Half of these locations are on historical bicycle routes (Habersham St. and 52nd St.), and so the clustering in those locations could be due to higher exposure there, compared to other locations in the suburban analysis. However, the Habersham Village area, in addition to being on a popular bicycle route, also has back-out, diagonal, on-street parking, similar to one of the high crash locations discussed in the downtown analysis. The Victory Dr. crash sites listed above are in an area with retail attractions (Target, Home Depot, Piggly Wiggly) which at the same time has no bicycle infrastructure other than shared lanes. This area is one of those that are the subjects of special area planning in the Total Mobility Plan.

Three (or 2%) of the total 162 geocoded crashes in the outside-of-downtown area resulted in death for the bicyclist(s). Eleven (or 7%) resulted in serious injury for the bicyclist(s). One of the latter was at a high crash locations listed in the table above: Victory Dr. and Skidaway Rd.

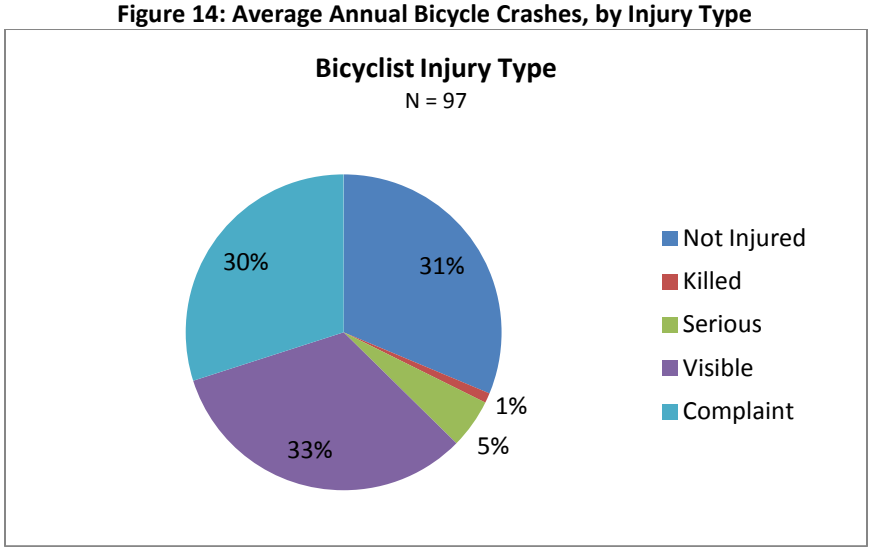
Figure 13: Outside Downtown Bicycle Crash Locations and Hot Spot Analysis



Bicycle Crashes by Injury Type

As with the pedestrian injury types, bicyclists' injuries typically were not serious (see Figure 14). Ninety-four percent were either not injured or sustained minor injuries. Six percent of crashes resulted in serious injury or death for the bicyclists.

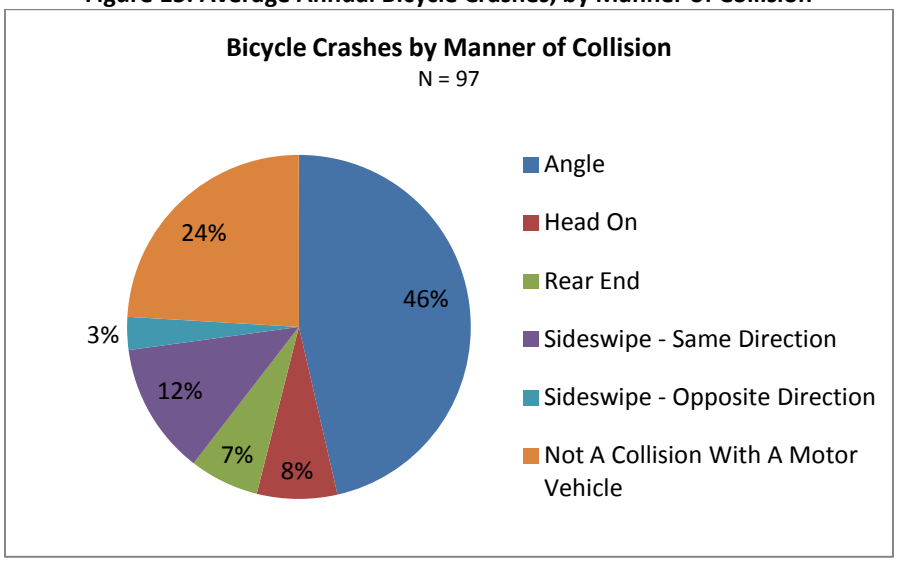
Figure 14: Average Annual Bicycle Crashes, by Injury Type



Bicycle Crashes by Manner of Collision

Angled crashes were the most frequent manner of collision, at 46% of all crashes (see Figure 15). Although many people fear being sideswiped or hit from behind when on a bicycle, these types of collisions are less frequent, at 12% and 7% respectively. Crashes not involving a motor vehicle constitute a bigger share of the crashes (24%) than either of those types, but not as much as the angled crashes do.

Figure 15: Average Annual Bicycle Crashes, by Manner of Collision



Bicycle Crashes by Primary Contributing Factor

Officers categorize the causes of the crashes on the report forms, according to established categories. Generally forms also include written descriptions of the event, based on interviews with the parties involved, if they are able to speak. MPO staff obtained only the coded data for the crashes, which includes the categories of crash causes, but not the descriptions of the events. If staff had been able to review the descriptions for all 271 crashes, it is possible that staff would disagree, in some cases, with police officers' assignment of cause and responsibility. This possibility is mentioned due to awareness that, when local League Cycling Instructors with the Savannah Bicycle Campaign reviewed individual forms of one year's worth of bicycle crashes, obtained from the Savannah Chatham Metropolitan Police Department, their assignment of cause and fault frequently differed from the officers' (and not necessarily in defense of the bicyclist each time).

Because staff did not obtain detailed, event descriptions, the following analysis is based on the officers' interpretations of cause.

Figures 16 and 17 show the primary contributing factors for bicyclists and for motorists respectively. It is possible for both the bicyclist and the motorist to contribute to a given crash.

Although "No Contributing Factor" is the single most common assignment for the bicyclists' role (32%), this category is assigned to the bicyclist in less than half of the cases, while motorists are considered to have no contributing factor in more than half of the cases (59%).

When bicyclists do contribute to the cause of the crash, they often are cited for failing to yield (18%). When motorists contribute, the cause is most often something other than the pre-defined categories. After that, it is failure to yield (12%).

Interestingly, driving under the influence (D.U.I.) was a factor contributed by bicyclists in a small number of cases, but was never a primary contributing factor from motorists in the bicycle crashes.

Figure 16: Average Annual Bicycle Crashes, by Bicyclists' Contributing Factors

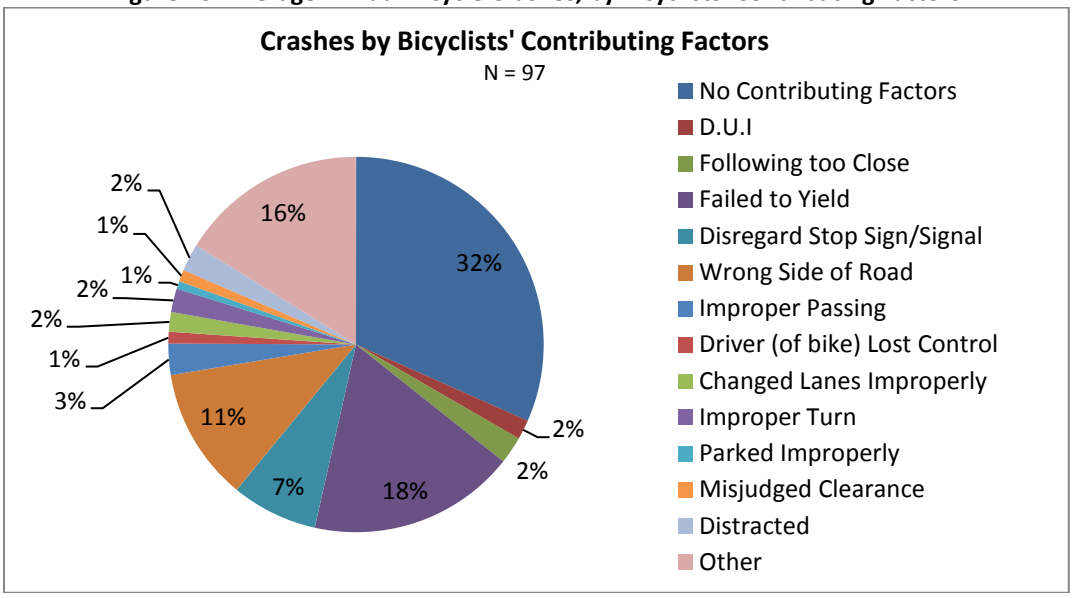
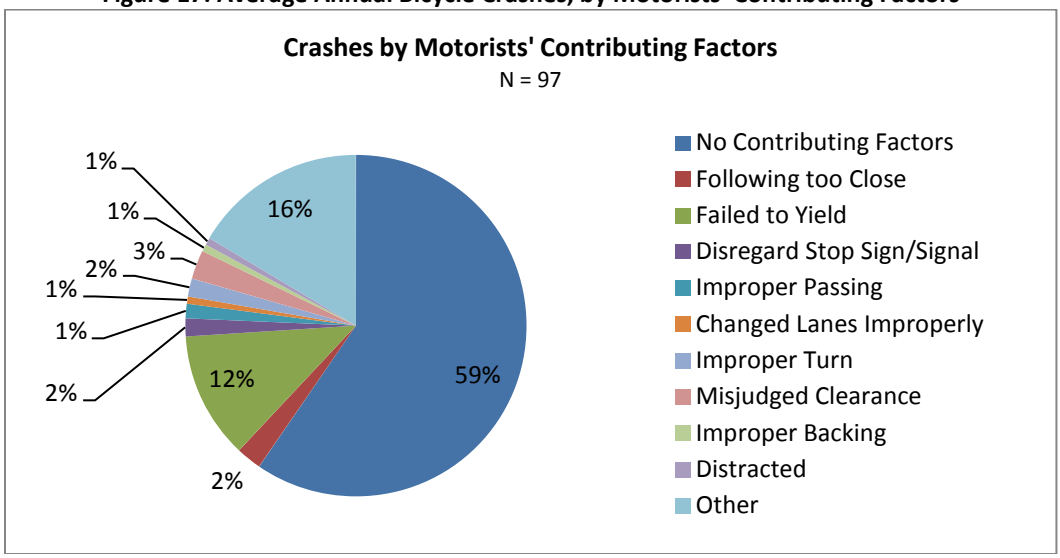


Figure 17: Average Annual Bicycle Crashes, by Motorists' Contributing Factors

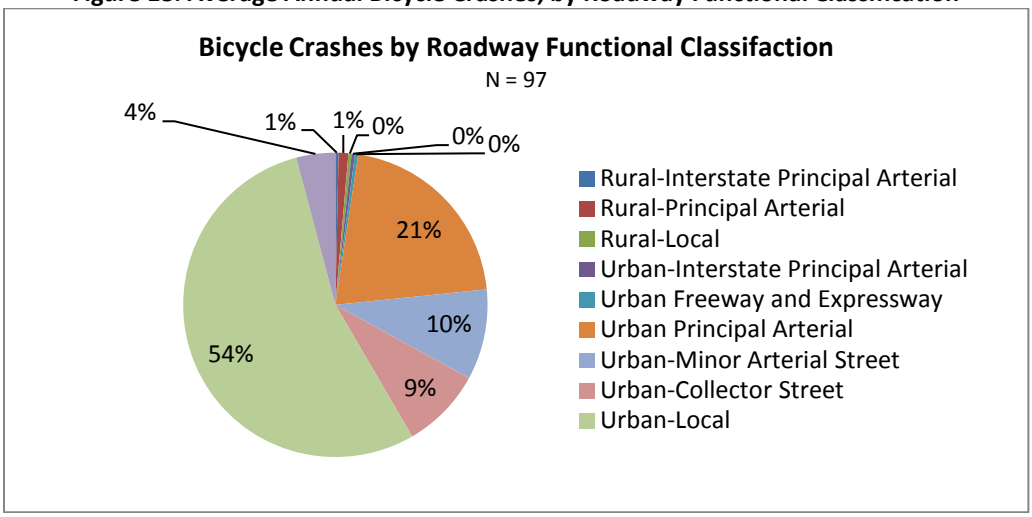


Bicycle Crashes by Functional Classification

Most crashes occurred on urban local roads (see Figure 18). However, as mentioned in the analysis of pedestrian crashes, the hierarchical nature of the roadway classification system essentially guarantees different exposure levels among the roadway types. There are more local roads in the classification, and bicycle use is expected to be higher on local roads, compared to the arterials and collectors, due to the typical preference for avoiding higher auto volumes inherent with arterials and collectors. Both of those factors increase the likelihood that crashes will occur on local roads, regardless of the design of the local road.

Also similar to the pedestrian crashes is the fact that Urban Principal Arterials are the second most frequent type of roadway for bicycle crashes. Given that principal arterials have higher auto volumes while often simultaneously providing access to important destinations, these types of roadways likely need special attention for bicycle accommodation, especially since the geography of Chatham County (e.g. wetlands) often precludes the existence of an alternative route to those destinations.

Figure 18: Average Annual Bicycle Crashes, by Roadway Functional Classification

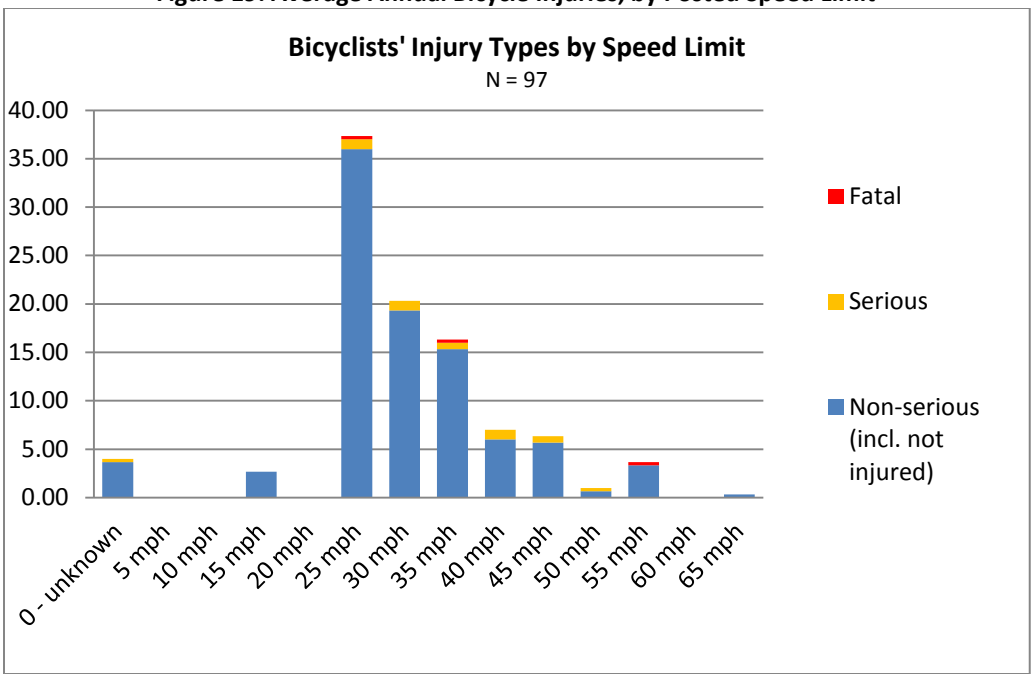


Bicycle Crashes by Speed Limit

The pattern of total crashes demonstrated in the chart below (Figure 19) is related to the pattern for the functional classification discussed above, in that speed limits correlate with functional classifications. Thus the high bars for the low and moderate speed limits are in part related to the higher numbers of bicyclists expected on local roads which tend to be in bicycle-friendlier areas. Speed limits at the crash locations do not necessary indicate the actual speed of the motor vehicle(s) involved, but are the only way of approximating motor vehicle speed for a large set of data.

Looking at the severity of injury (for the bicyclist) by speed limit, one sees that serious injuries are evenly spread among speed zones from 25 mph up to 45 mph. There were only three fatalities and these were in a 25 mph zone, a 35 mph zone, and a 55 mph zone.

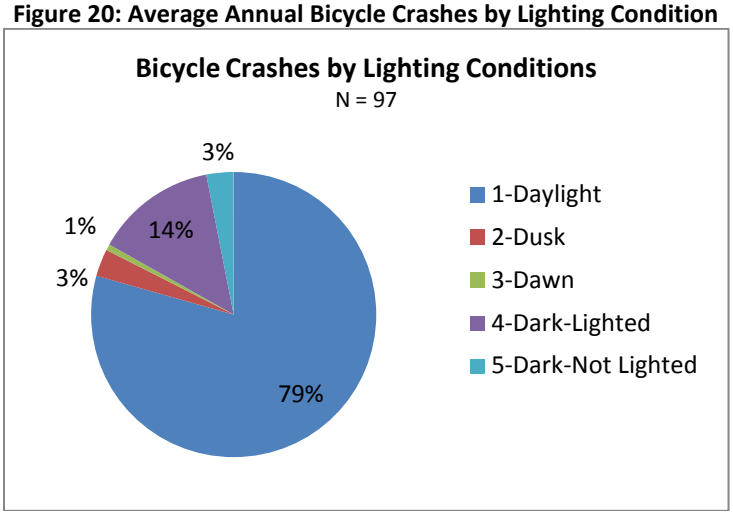
Figure 19: Average Annual Bicycle Injuries, by Posted Speed Limit



Bicycle Crashes by Lighting Condition

Most crashes happen during daylight hours, which is generally when more travel occurs by any mode (see Figure 20). The fact that "Dark – Lighted" category sees more crashes than the "Dark – Unlighted" category is likely related to the tendency for urban areas, which tend to be lighted, to have more bicycle trips.

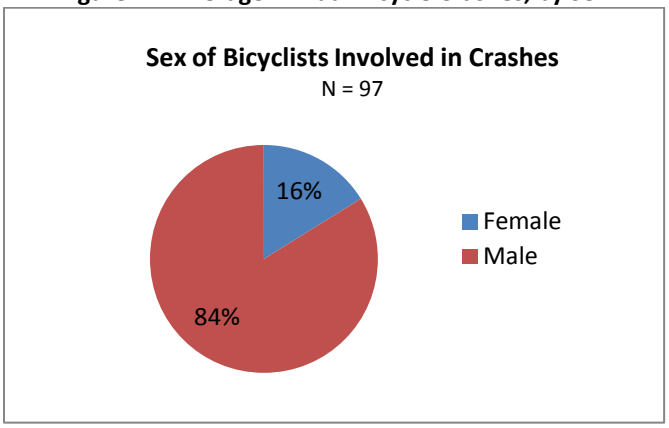
Figure 20: Average Annual Bicycle Crashes by Lighting Condition



Bicycle Crashes by Sex

At 84%, the large majority of bicyclists involved in crashes in Chatham County are male (see Figure 21). However, it is well known that, in the U.S., bicycle trips are more likely to be made by males than females, thus making it more likely that bicycle crashes involve males. Within Chatham County, the MPO's annual samples of bicycle trip counts consistently have shown the female/male split to be about 31%/69% respectively. Crashes appear to have a higher proportion of males than expected, based on the estimate of the male share of bicycle trips in Chatham County overall.

Figure 21: Average Annual Bicycle Crashes, by Sex



Conclusions on Pedestrian and Bicycle Safety

Safety is very important to making walking and bicycling viable options for transportation. Analysis of multiple years' worth of pedestrian and bicycle crashes can help indicate what changes are necessary for improved safety in traffic.

The interpretation of pedestrian and bicycle crash data is greatly limited by lack of information about exposure to crashes (average amounts of pedestrian and bicycle trips in various locations). In the absence of average annual daily traffic numbers for pedestrians and bicyclists, MPO staff assumed a higher exposure for both pedestrians and bicyclists within a broadly defined downtown area and therefore used different thresholds, for downtown compared to the rest of the county, to define "high" numbers of crashes in the analysis within a GIS.

Important observations from the analysis of numerous attributes of the pedestrian and bicycle crashes throughout Chatham County, from January 1, 2006 through December 31, 2008, can be summarized as follows:

- High-crash locations for **pedestrians**, as shown in Figures 2 and 3 above, are:
  - The area centered on Victory Dr. between Montgomery St. and Jefferson St., extending approximately one block in each direction;
  - The area around Oglethorpe Ave. and MLK, Jr. Blvd., extending approximately one block in each direction;
  - The area around on Montgomery Cross Rd. and Waters Ave.;
  - The area centering on Waters Ave. between 33rd St. and 34th St.;
  - The area bounded by 36th St., Waters Ave., 37th St. and Ott St.;
  - The location approximately at Montgomery Cross Rd. and Hodgson Memorial Blvd.;
  - The area around Abercorn St. and Largo Dr.;
  - The location near Oglethorpe Ave. and Fahm St.;
  - The area around Eisenhower Dr. and Waters Ave.;
  - The location at DeRenne Ave. and White Bluff Rd.;
  - The area around Victory Dr. and Stevens St.

- High-crash locations for **bicyclists**, as shown in Figures 12 and 13 above, are:
  - The area around the intersection of Broughton St. and Bull St., extending approximately one block in each direction;
  - The area on Habersham St., between Oglethorpe St. and Liberty St.;
  - The area around the intersection of W. 38th St. and Jefferson St., extending approximately one block in each direction;
  - Habersham Village area on Habersham St.;
  - The area on Bull St., between 50th St. and 53rd St.;
  - The intersection of 52nd St. and Montgomery St.;
  - The intersection of Victory Dr. and Wallin St.;
  - The intersection of Victory Dr. and Skidaway Rd.;
  - The intersection of Habersham St. and DeRenne Ave.;

- Not all of the locations listed above should be assumed to be dangerous by design; exposure levels could still vary substantially within the "downtown" and "non-downtown" areas of analysis, causing some locations in each area to appear high-risk when actually the number of crashes *per trip* could be low. However, the design of facilities at the above locations will be investigated in the field.

- A minority of pedestrian and bicycle crashes result in injury or death for those mode users (18% for pedestrians; 6% for bicyclists).

- In most of the incidents (52% of pedestrian crashes and 59 % of bicycle crashes), the responding officer(s) judged from interviews that the motorist(s) did not contribute in a primary way to the cause of the crash.

- Urban Local Roads and Urban Principal Arterials (within the state's functional classification system) are the two most frequent types of streets for pedestrian and bicycle crashes. Exposure levels are very likely to be a factor in the high number of crashes on the Urban Local Roads, as these are more attractive for pedestrian and bicycle trips. Design, rather than exposure levels, is likely more of a factor on Urban Principal Arterials.

- Male pedestrians and male bicyclists are more prevalent in the crashes. In the case of bicycle crashes, different exposure levels for the two sexes are very likely to explain part of the observation, as local and national data show most bicycle trips are made by males.

Analysis of crashes is only part of the process of determining what is needed for more and better walking and bicycling. This crash analysis, along with other elements such as public participation, the investigation of existing physical conditions, and the review of policies, enhances an overall understanding that informs the recommendations of the Non-motorized Transportation Plan.