# Appendix D

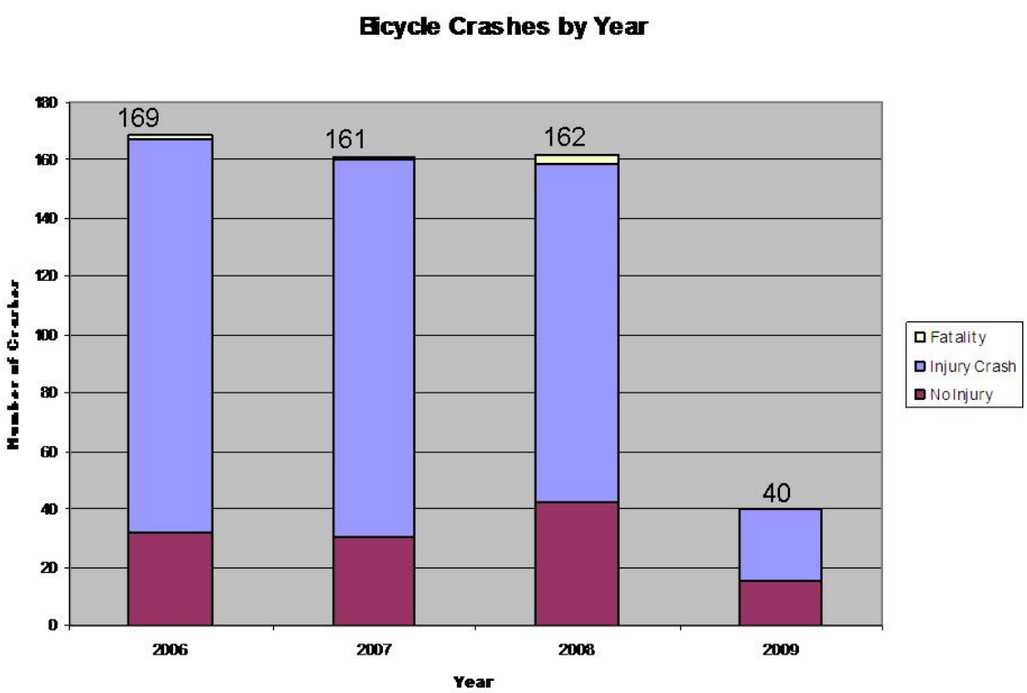
## Data Analysis

As part of this project, bicycle and pedestrians crash trends for Jefferson County were analyzed. The following sections discuss the findings and recommendations associated with these analyses.

Data for the crash analyses were obtained from the Kentucky State Police (KSP) Collision Analysis for the Public website.[1] Crash data from January 1, 2006 to May 31, 2009 was used for these analyses.

### Bicycle Crashes

Between January 1, 2006 and May 31, 2009, the KSP database reports 532 bicycle crashes. As shown below, the trend across the years is fairly consistent – with an average of approximately 165 crashes per year. Of the years for which there is complete data, a high of three fatalities occurred in 2008. The frequency and severity of crashes is shown in Figure 1.




[1] http://crashinformationky.org/KCAP/Public/Home.aspx

## Bicycle Crashes by Lighting Condition

One of the data fields in the crash reports indicates the lighting conditions at the time of the crash. If we look at the total number of crashes across the period reviewed, we can see that of the 532 crashes reported in that time, 72% occurred in "Daylight," leaving 28% in categories which might be considered suboptimal lighting conditions: dawn, dusk, dark (without streetlights), dark (street lights on) dark (streetlights present, but off).[2] While still a minority of crashes, these non-daylight crashes seem disproportionately high for the share of total bicycle trips that would be made in these conditions; it is unlikely that close to 30% of Louisville's bicycling activity occurs outside of daylight hours. There may be several factors which may account for the increases crash risk at these times:

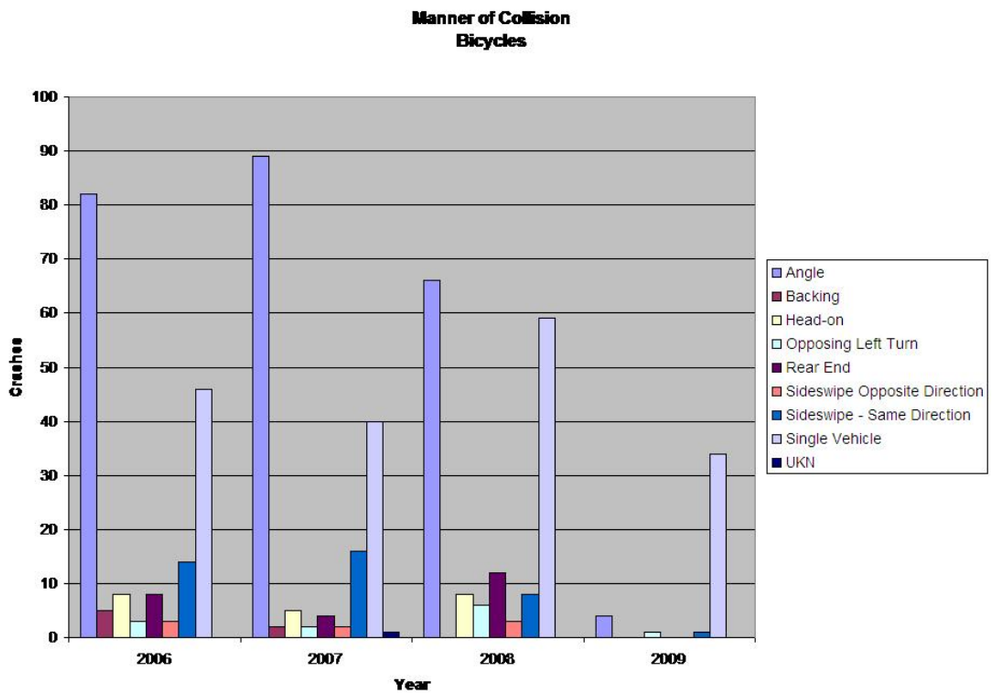
- Night time crashes are often the result of at least one crash participant being under the influence of alcohol,
- Bicycles are often unlit and may have poorly aligned reflectors,
- Bicyclists riding at night (and motorists driving at night) may be fatigued or sleepy, and
- Glare on windshields can reduce motorists' visibility of the roadway environment.

## Manner of Collision

Another type of information that can be deduced from the crash reports relates to the manner of collision. The Kentucky crash reporting system is unusual in that in addition to merely reporting that a crash involved a bicycle, the report goes onto provide basic "manner of the collision" information. While not providing enough information to make conclusive observations on what occurred during a crash event, this field does allow us to draw some insights. The collision types listed include: angle, backing, head on, opposing left turn, rear end, and single vehicle crashes. The distribution of crashes types is shown in Figure 2. The "single vehicle" crash type is the second most common type of crash involving bicycles, with 179 instances in the time period reviewed. Unfortunately, though, we lose information about the actual manner of crash for those coded this way. Also,

[2] It is important to note that the degree of streetlighting is not quantified for crash reports. Therefore, "Dark, with streetlights, on" can represent lighting conditions ranging from well lit downtown urban arterial roadways to sporadically lit rural collectors.

closer review of these crash reports reveals that they all at involved at least two units—the bicyclist and one motor vehicle. Because they are placed in this category, though, we cannot infer anything about the manner of the collision between the units.




The most common crash manner, however, appears to be the “angle” crash, recorded as occurring 241 times. An angle crash seems to describe a crash involving one party moving across the path of the other party. Given that there is a separate code for “opposing left turn crashes” it is likely, then, that angle crashes largely represent either right or left turns from side streets. Unfortunately, another field, “pre-collision vehicle action,” is primarily coded for motorists but not for bicyclists. Consequently, no conclusive crash causes can be inferred from this data.

However, given what we know about bicycle crash patterns across the country, it is likely that many of these angle crashes involve bicyclists riding against traffic, either on or off the sidewalk, but in either case coming from the right on the near side of the road. This places them outside of the usual areas scanned by

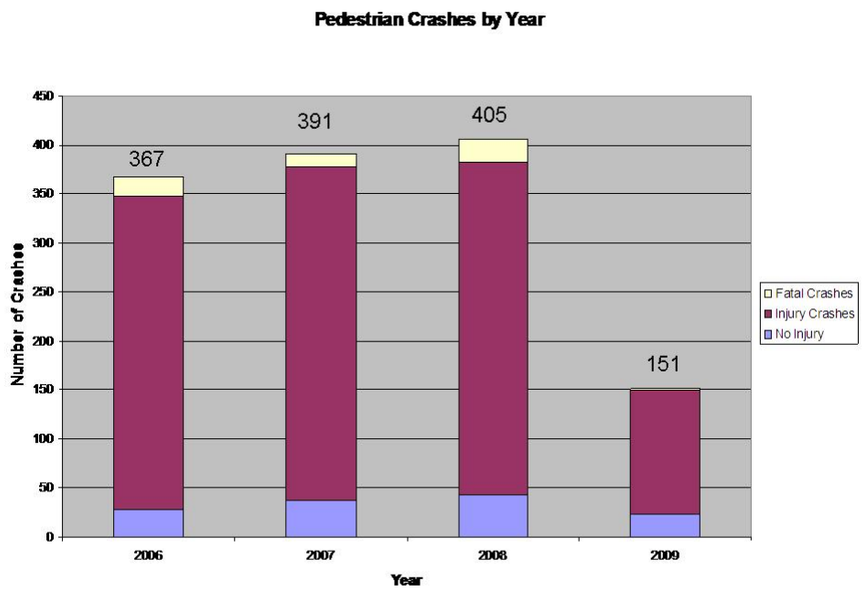
motorists entering from cross streets: looking into left into the near lane and looking right into the far lane.

The crash type classified as “sideswipe same direction” is the next most frequently occurring type, with 39 occurrences in the study period. Again, the data does not specify much more about the individual crashes. But, given what is known about common bicycle crashes across the country, sideswipe crashes could be the result of motorists or bicyclists swerving during a passing event, collisions of bicyclist with open doors of parked cars, or right-turning motorists cutting off bicyclists. Several of the Jefferson County crashes appeared to involve parked cars, supporting the inclusion of “dooring” crashes in this crash type.

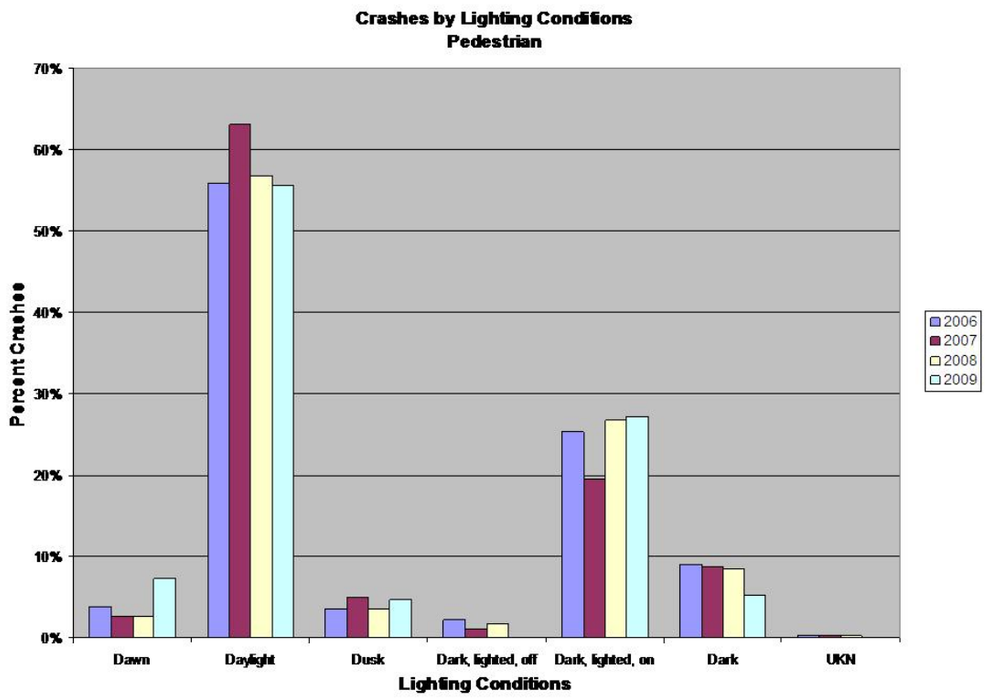
Of particular interest are the numbers of “rear end” and “head-on” collisions. It is unclear what type of bicycle crashes are classified as “head on”: they could either be similar to the “opposing left turn” type, or could be the result of a bicyclist (or motorist) riding against traffic in the roadway. “Rear-end” collisions involving bicycles are not common nationally, and may be a classification chosen for  a crash during a passing event, which may just as easily been classified as a “sideswipe same direction.”

## Pedestrian Crash Data

Pedestrian crashes were also reviewed. Between January 1, 2006 and May 31, 2009, the KSA database reports 1314 pedestrian crashes.  These were also fairly consistent, but rising, across the full years reviewed, ranging from 367 in 2006 to 405 in 2008. The highest fatality figure was 24 in 2008.




As was the case with bike crashes, pedestrian crashes in conditions other than daylight account for a disproportionate share than might be expected relative to the number of trips made at those times. In the case of pedestrians, 41% of reported crashes took place outside of daylight conditions. This disproportionate distribution again suggests that there is a higher risk associated with walking in suboptimal lighting condition. The factors that contribute to this increase are similar to those described in the section about bicycle crashes above: fatigue on the part of either party, a more likely influence of alcohol, and reduced visibility.




## Countywide Countermeasures

There are specific countermeasures that can be developed to address the factors believed to contribute to crashes involving bicycles and pedestrians in Jefferson County; these include engineering, educational, and enforcement countermeasures. Each of these types is discussed in detail below.

*Engineering Countermeasures*

**Intersection signage:** Intersection signage can remind motorists of their obligation to yield to pedestrians (or bicycles riding on the sidewalk). Among the crash types identified in the Jefferson County data are collisions with vehicles making and opposing left turn and angle turns, some of which could involve bicycles on sidewalks colliding with motor vehicles emerging from side streets. Signs such as the *NO RIGHT ON RED when Pedestrians Present* or the *Left Turning Vehicles Yield to Peds* signs are currently being evaluated for their effectiveness in reducing pedestrian conflicts and crashes. If these signs are found to be effective for reducing crashes between pedestrians and motor vehicles, it is reasonable to expect that these signs could also reduce the

conflicts between motorists and bicyclists riding on the sidewalk (or on a sidepath). However, even if these signs are found to be effective tools in reducing crashes, they should be used sparingly and only where there is a documented problem and relatively constant pedestrian / bicycle use of the intersection. The overuse of signs, or the use of the signs where pedestrians and / or cyclists are not using the crosswalks, dilutes the signs' ability to command the attention of motorists and eventually result in the signs being just background visual clutter.

"Blank out" signs are connected to some sort of detection mechanism or call button; they are dark until actuated and only then display their message. Because they are "real time" traffic control devices, they maintain effectiveness by only alerting motorists when a conflict is actually present. If motorists see a YIELD TO PEDS sign hung next to a permissive left turn signal, they will also see a pedestrian crossing the conflicting crosswalk at the same time. This "real-time" aspect of blank out signs allows for them to be placed at locations where conflicts are not frequent or constant enough to make a static sign appropriate.

**Shared Lane Symbol:** The Shared Lane Symbol (sometimes referred to as a "sharrow") has the potential to reduce several different types of crashes and is being used in several jurisdictions across the country. Research has shown that bicyclists tend position themselves over the center of the symbol, which, if properly placed, puts them out of the conflict zone with the open doors of parked cars. This may make this marking useful in reducing "dooring" crashes, which are perhaps among the "sideswipe same direction" or "rear end" crashes reported in the Jefferson County data. Research on a shared lane symbol of a slightly different design found the treatment helped reduce wrong way riding and riding on the sidewalk, and helped bicyclists claim a position a bit farther from the curb in the travel lanes. Reducing wrong way riding and sidewalk riding could reduce the occurrence of motorists failing to yield to bicyclists on sidewalks, which are possible circumstances of "angle crashes" and "opposing left turn crashes" in Jefferson County. Positioning

Photo Credit: Aaron Naparstek

riders away from the curb could cause motorists to give a wider berth to bicyclists they pass: if the bicyclist is “hugging” the curb, the motorist may try to pass while remaining in the same lane. This, in turn could reduce the occurrence of “same direction sideswipe” and “rear end” type crashes, as identified in the Jefferson County Crash reports.

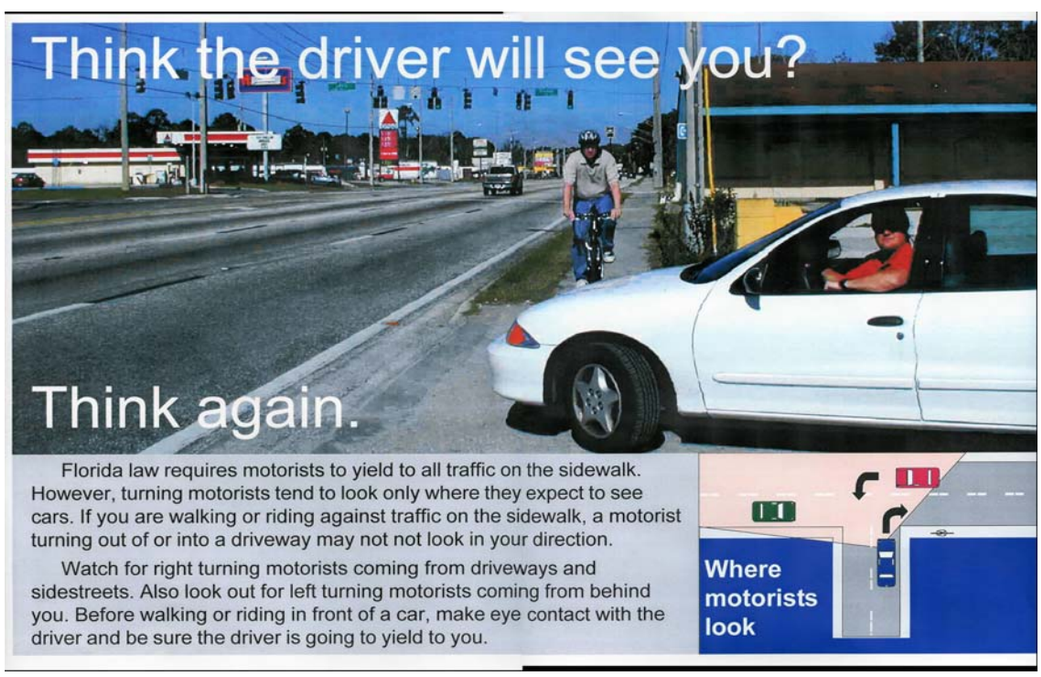
- Note: The shared lane symbol is still technically experimental but has been included in the *Notice of Proposed Amendment* for the *MUTCD*.

*Educational Countermeasures*

Educational countermeasures will have a greater effect if they are implemented across the urbanized area of the county. Consequently, we recommend a broad application of these campaigns, but with greater saturation within the high crash areas.

**The Dangers of Riding Against Traffic, Yield to Sidewalk Traffic:** Riding against traffic, either on the sidewalk or on the roadway, is a common practice across the country, and has been found to contribute to nearly 1/3 of all crashes between bicycles and motor vehicles. We realize, however, that sidewalk riding will continue because many people simply are not comfortable riding bikes on the roadway with motor vehicles. Additionally, we cannot expect cyclists to cross a multi-lane roadway to get to a sidewalk so they can ride in the same direction as

cars in the adjacent travel lane. Thus, it is imperative that cyclists who choose to ride on the sidewalk be aware of the hazards associated with this practice. It is also important to make the drivers aware that of the need to scan for traffic on the sidewalk. We recommend driver- and cyclist-targeted campaigns with graphics depicting recognizable local sites and tailored to local demographics, including translation into Spanish where appropriate. To maximize the potential for reducing crashes, these campaigns for bicyclists and motorists must be run


Think the driver will see you?
Think again.
Florida law requires motorists to yield to all traffic on the sidewalk. However, turning motorists tend to look only where they expect to see cars. If you are walking or riding against traffic on the sidewalk, a motorist turning out of or into a driveway may not not look in your direction.
Watch for right turning motorists coming from driveways and sidestreets. Also look out for left turning motorists coming from behind you. Before walking or riding in front of a car, make eye contact with the driver and be sure the driver is going to yield to you.
Where motorists look

**The Danger of Riding at Night without Lights and Walking at Night:**
Bicyclists operating at night without lights are nearly invisible to motorists – until it is too late. Even if a bicycle is properly fitted with reflectors, motorists coming from a side street will not see the cyclists until it is too late for the driver to react. If bicyclists choose ride at night without lights, they must be made aware of the dangers they face in the dark. We have had the opportunity to review as yet unpublished research papers which show that an pedestrians' awareness of how well they can be seen by motorists at night can be increased by a relatively brief exposure to information illustrating their conspicuity along a nighttime roadway.

We recommend the development of informational posters showing sight distances for various colors of clothing, and illustrating the limitations of reflectors. Such materials may provide cyclists (and pedestrians) the information they need to make better choices when choosing gaps to cross the road or when anticipating driver behaviors at driveways and intersections.

*Enforcement Countermeasures*

The effort to enforce the traffic laws as they relate to bicycle safety should be addressed in an overall, countywide, coordinated, bicycle enforcement campaign. Sporadic enforcement will not result in significant improvements to cyclist behavior and will likely result in resentment of law enforcement personnel. Those behaviors to be targeted should be determined at the outset of the law enforcement campaign. We recommend the following behaviors be targeted:

- riding at night without lights,
- violating traffic signals, and
- riding against traffic on the roadway.

These three behaviors were chosen for two reasons. First, they represent particularly hazardous behaviors which result in many crashes. Secondly, and very importantly, the enforcement of these behaviors is easy to justify to the public. When enforcement measures are coupled with (and, in fact, preceded by) large scale education campaigns, the public comes to understand the importance of the campaign and is more accepting the enforcement activity.

For benefit of pedestrians measures could include enforcement of yielding to pedestrians at crosswalks. Additionally, blatant violation of pedestrian traffic signals and failure to yield when crossing midblock should be the subjects of addition enforcement.

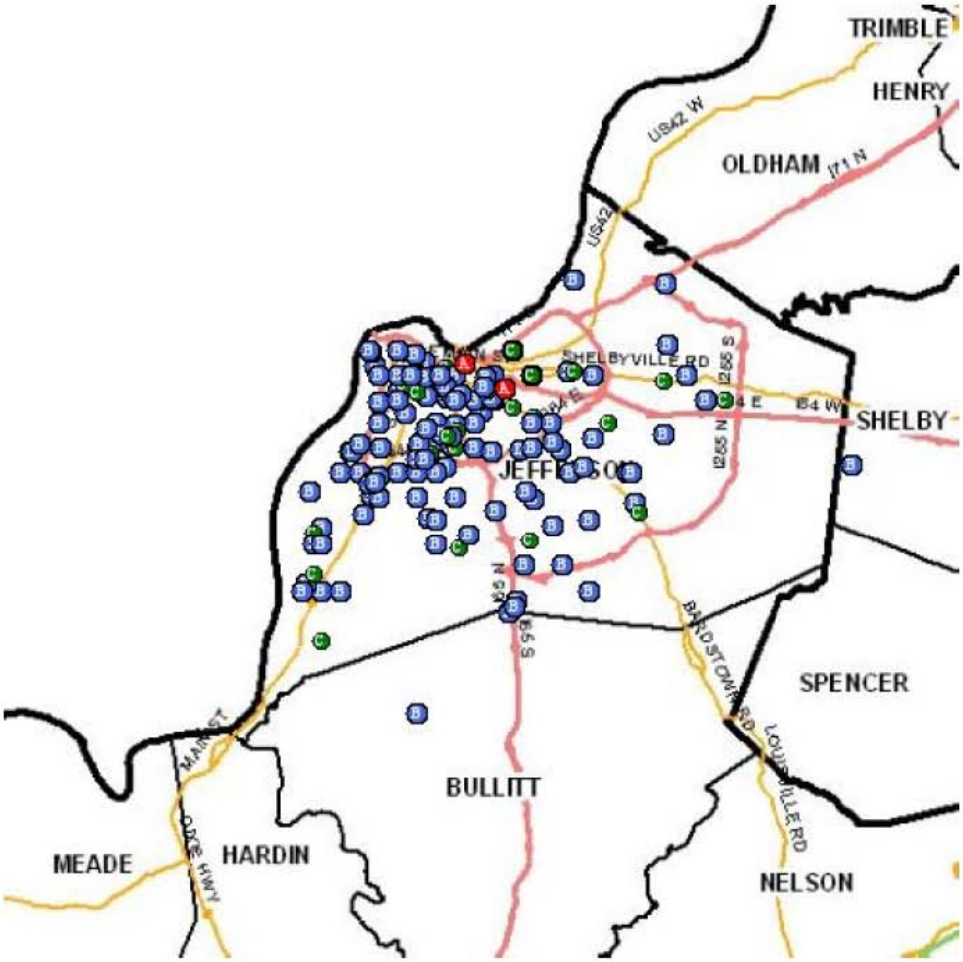
*Crash Locations*

The locations of the bicycle and pedestrian crashes were also reviewed for consistency with expected high demand, and commensurate use, biking and walking area. The KSP website was once again used as a data source.

While the exact locations of the crashes as located in the KSP database are suspect – the latitude and longitude fields locate the crashes outside of Jefferson County, the overall trends of the crash locations are as expected: largely clustered along major arterials and becoming more densely distributed as one nears central Louisville.

The maps provided below were prepared from the KSA website at a resolution to show all bicycle or pedestrian crashes occurring in any one year a single page.

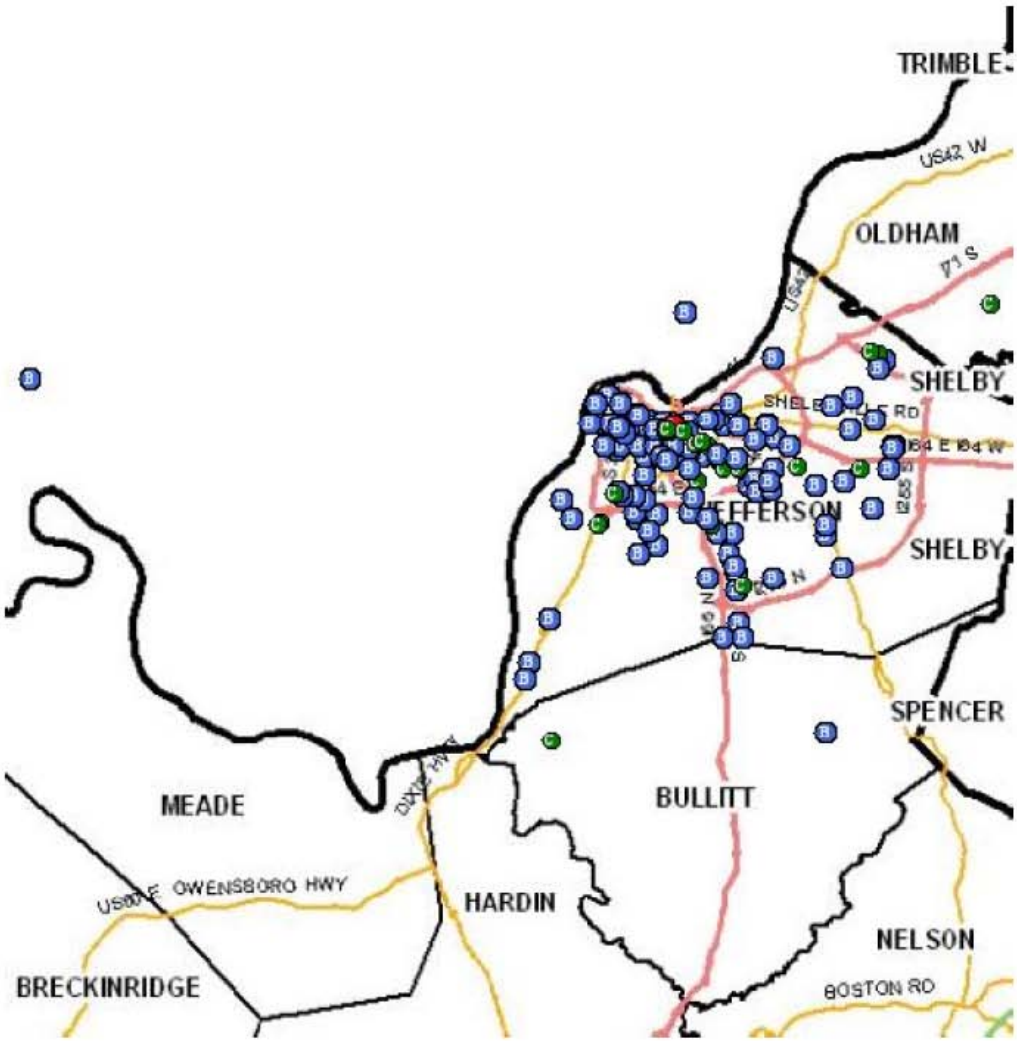
**Criteria:** Collision Date is between 1/1/2006 and 12/31/2006 ***And*** County Name is one of: JEFFERSON ***And*** First Event Collis With Code is one of: BICYCLE




| | | |
|---|---|---|
| Collision w/Injury | B | 135 |
| Collision w/Fatality | A | 2 |
| Collision w/Prop Damage | C | 32 |
| Total Mapped | | 169 |
| Total NOT Mapped | | 0 |

Scale: 1 inch = 47694.8 Feet, 9.03 Miles

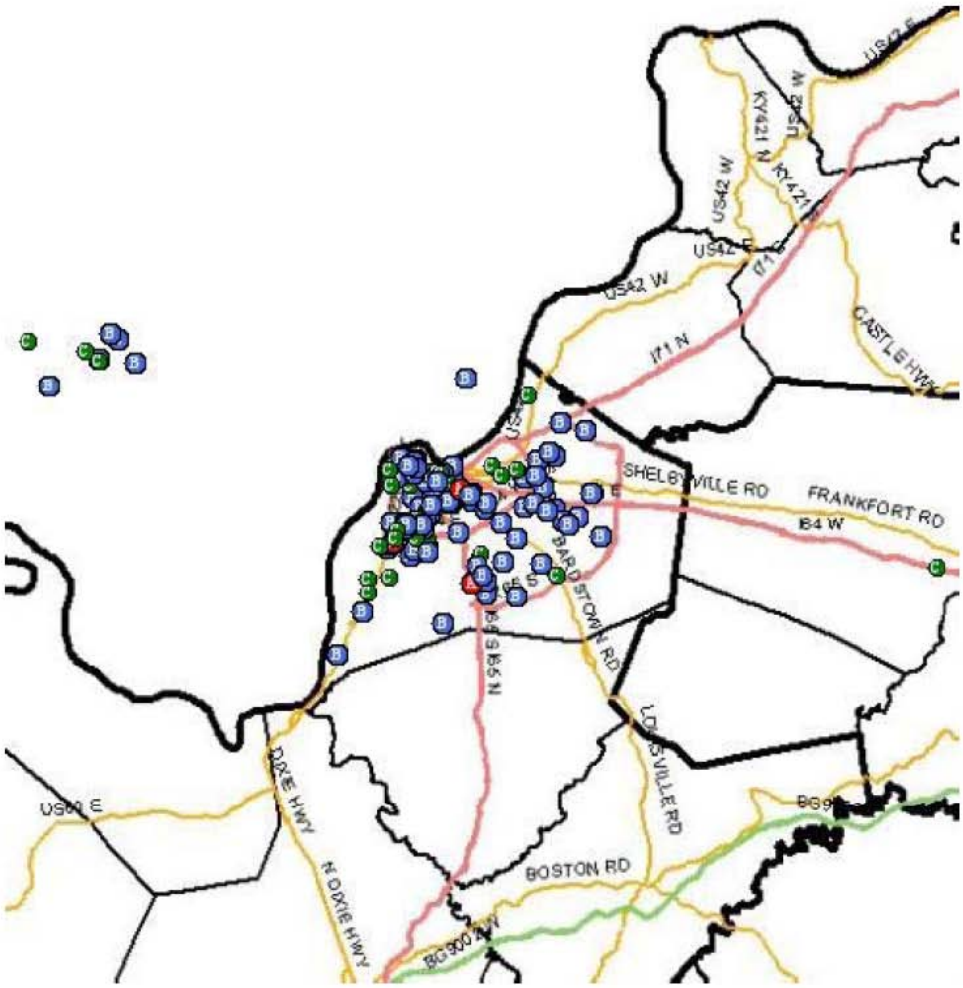
**Criteria**: Collision Date is between 1/1/2007 and 12/31/2007 ***And*** County Name is one of: JEFFERSON ***And*** First Event Collis With Code is one of: BICYCLE




| | | |
|---|---|---|
| Collision w/Injury | B | 130 |
| Collision w/Fatality | A | 1 |
| Collision w/Prop Damage | C | 30 |
| Total Mapped | | 161 |
| Total NOT Mapped | | 0 |

Scale: 1 inch = 56708.6 Feet, 10.74 Miles

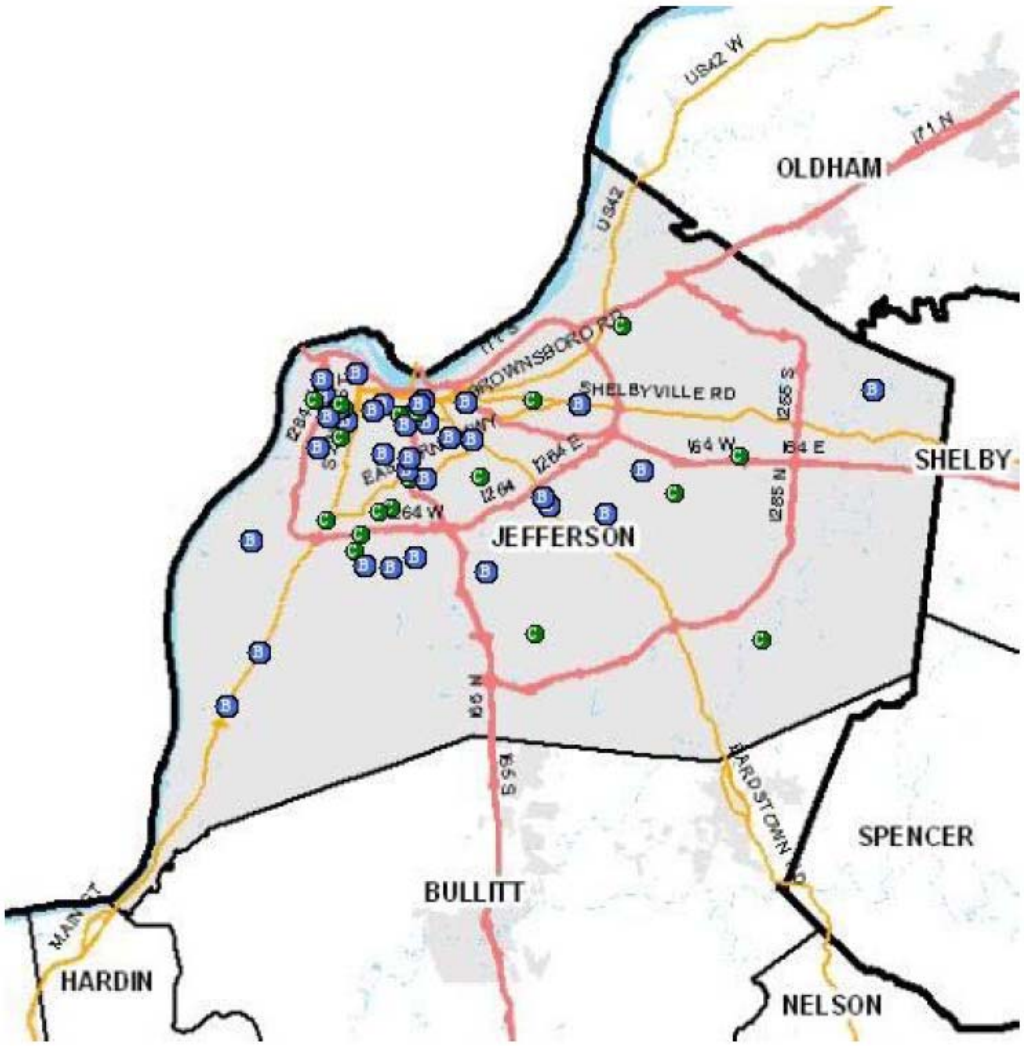
**Criteria:** Collision Date is between 1/1/2008 and 12/31/2008 ***And*** County Name is one of: JEFFERSON ***And*** First Event Collis With Code is one of: BICYCLE




| | | |
|---|---|---|
| Collision w/Injury | B | 117 |
| Collision w/Fatality | A | 3 |
| Collision w/Prop Damage | C | 42 |
| Total Mapped | | 162 |
| Total NOT Mapped | | 0 |

Scale: 1 inch = 76843 Feet, 14.55 Miles

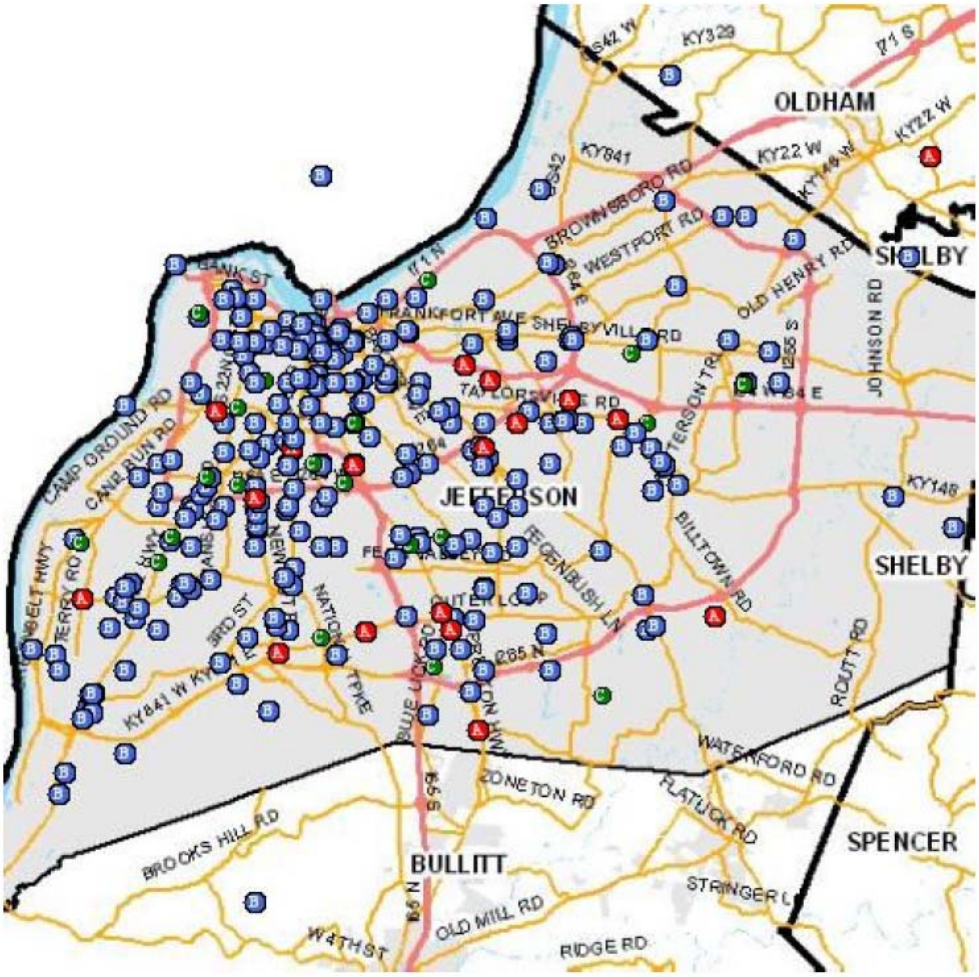
**Criteria:** Collision Date is greater than 1/1/2009 ***And*** County Name is one of: JEFFERSON ***And*** First Event Collis With Code is one of: BICYCLE




| | | |
|---|---|---|
| Collision w/Injury | B | 35 |
| Collision w/Fatality | A | 0 |
| Collision w/Prop Damage | C | 20 |
| Total Mapped | | 55 |
| Total NOT Mapped | | 0 |

Scale: 1 inch = 37411.4 Feet, 7.09 Miles

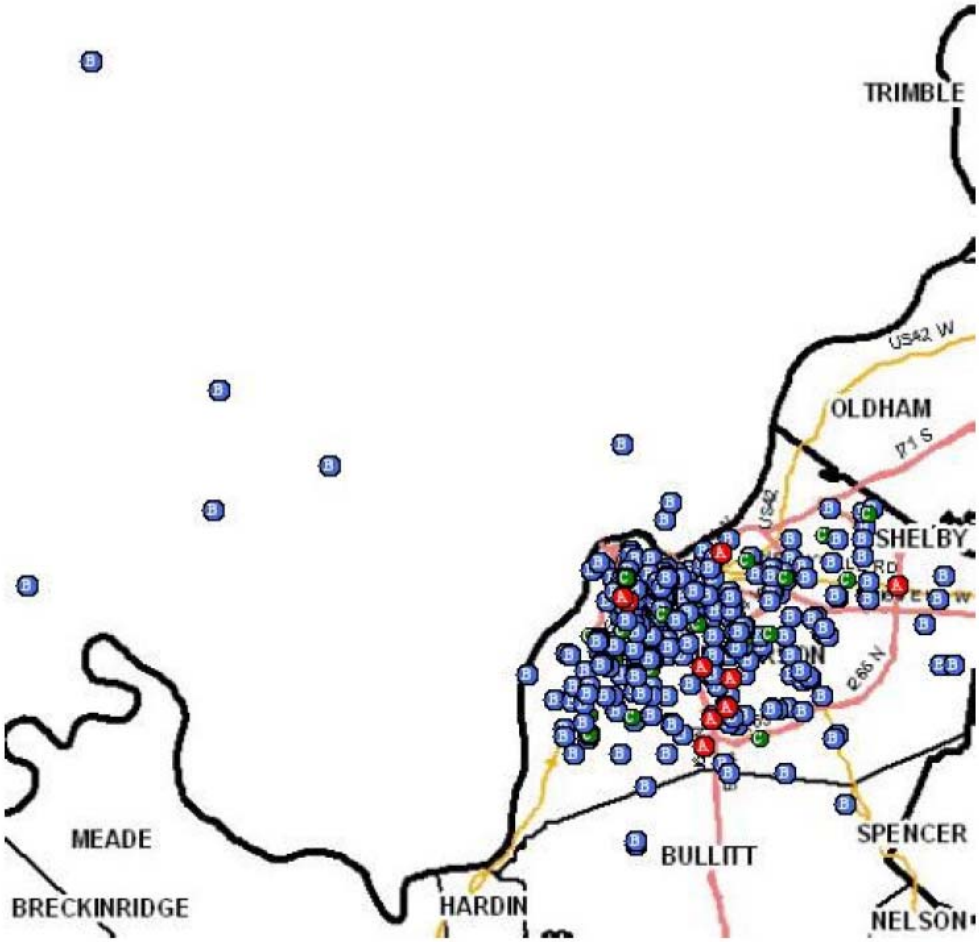
**Criteria:** Collision Date is between 1/1/2006 and 12/31/2006 ***And*** County Code is one of: 056-JEFFERSON ***And*** First Event Collis With Code is one of: PEDESTRIAN




| | | |
|---|---|---|
| Collision w/Injury | B | 319 |
| Collision w/Fatality | A | 20 |
| Collision w/Prop Damage | C | 28 |
| Total Mapped | | 367 |
| Total NOT Mapped | | 0 |

Scale: 1 inch = 28420.8 Feet, 5.38 Miles

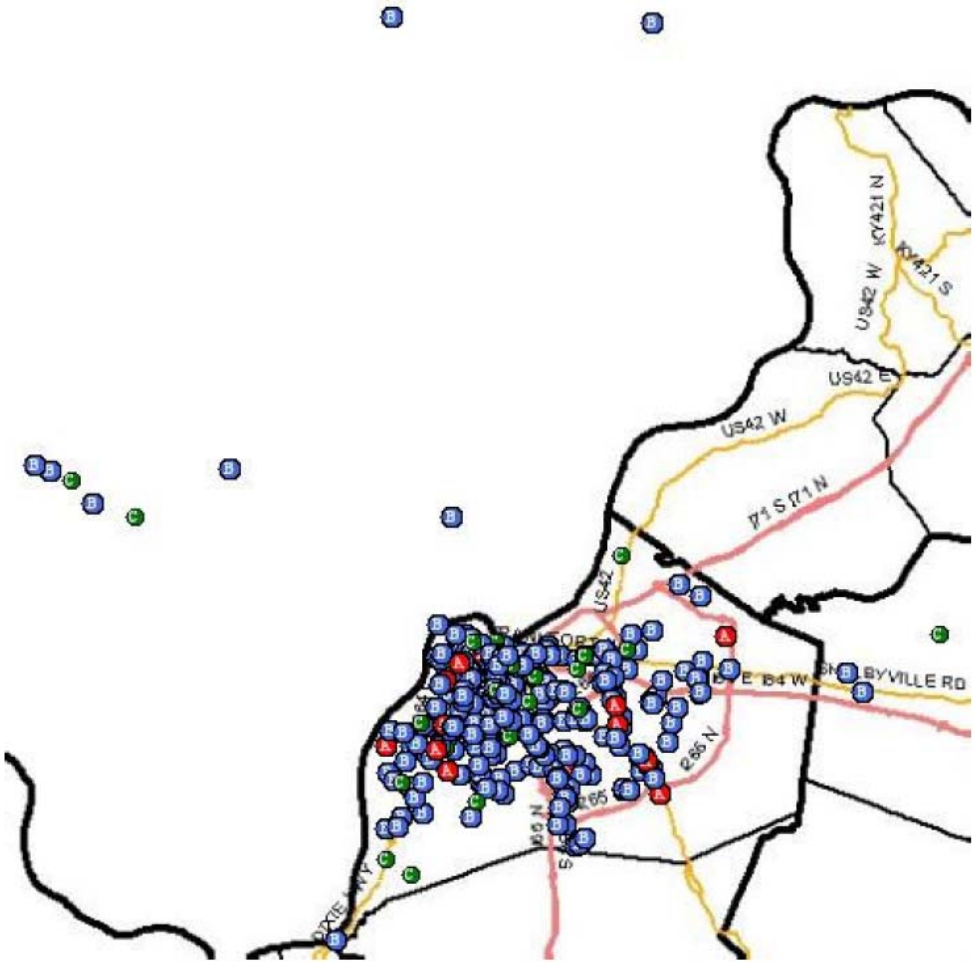
**Criteria:** County Code is one of: 056-JEFFERSON ***And*** First Event Collis With Code is one of: PEDESTRIAN ***And*** Collision Date is between 1/1/2007 and 12/31/2007




| | | |
|---|---|---|
| Collision w/Injury | B | 341 |
| Collision w/Fatality | A | 13 |
| Collision w/Prop Damage | C | 37 |
| Total Mapped | | 391 |
| Total NOT Mapped | | 0 |

Scale: 1 inch = 59905 Feet, 11.35 Miles

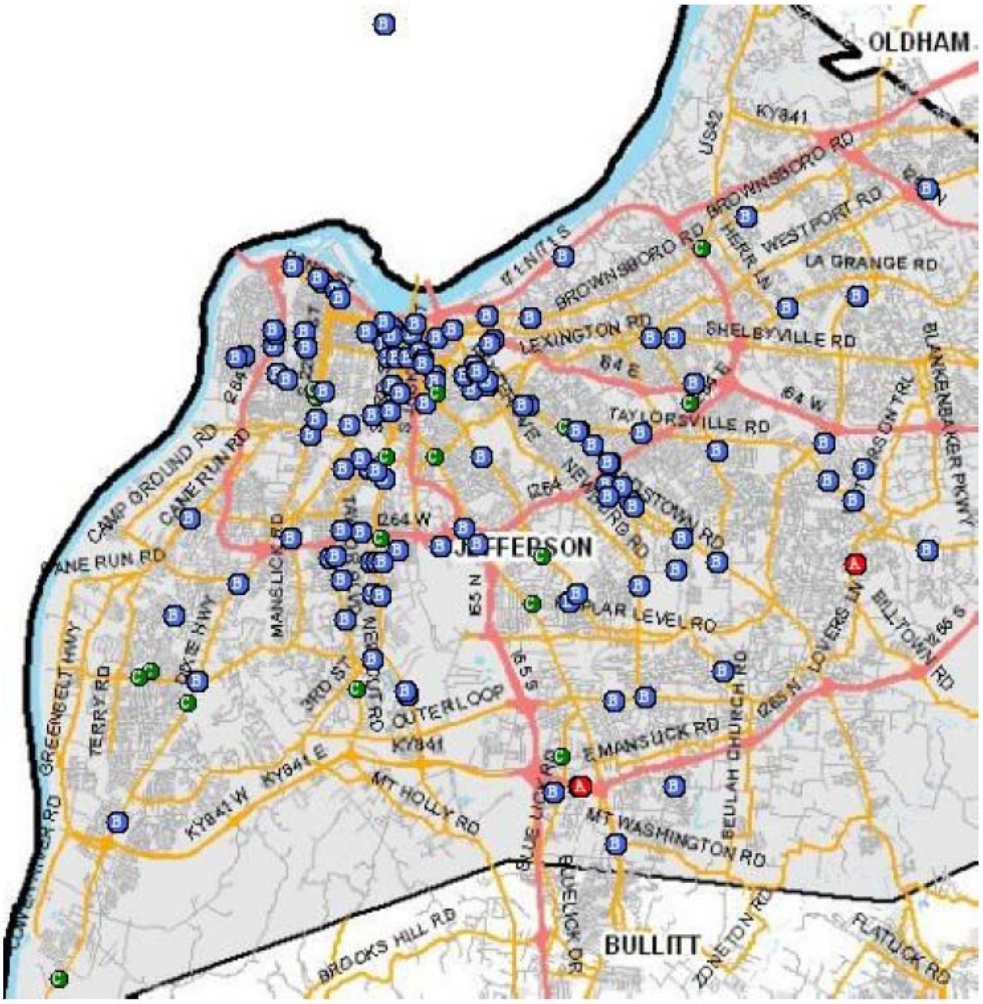
**Criteria:** County Code is one of: 056-JEFFERSON ***And*** First Event Collis With Code is one of: PEDESTRIAN ***And*** Collision Date is between 1/1/2008 and 12/31/2008




| | | |
|---|---|---|
| Collision w/Injury | B | 335 |
| Collision w/Fatality | A | 22 |
| Collision w/Prop Damage | C | 43 |
| Total Mapped | | 400 |
| Total NOT Mapped | | 0 |

Scale: 1 inch = 60819 Feet, 11.52 Miles

**Criteria:** County Code is one of: 056-JEFFERSON ***And*** First Event Collis With Code is one of: PEDESTRIAN ***And*** Collision Date is between 1/1/2009 and 5/31/2009




| | | |
|---|---|---|
| Collision w/Injury | B | 125 |
| Collision w/Fatality | A | 2 |
| Collision w/Prop Damage | C | 23 |
| Total Mapped | | 150 |
| Total NOT Mapped | | 0 |

Scale: 1 inch = 22786.6 Feet, 4.32 Miles