Bicycle Crash Analysis

For Tippecanoe County and the Greater Lafayette Area

A Study of Bicyclist and Motorist Crashes
2007 through 2012

Prepared by the Area Plan Commission of Tippecanoe County
April 2014

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Key Findings from this Report

The 2040 Metropolitan Transportation Plan: Completing Our Streets, calls for a 10 percent reduction in the number of bicycle and pedestrian crashes by 2020. It also calls for updating the Bicycle and Pedestrian Plan. The Area Plan Commission's analysis of 2007 through 2012 crash data is intended to provide a better understanding of factors that are involved in bicycle-motor vehicle crashes. Specific crash attributes were extracted from the ARIES crash data base, analyzed and mapped. The findings in this report should be used to inform and also influence the design and location of new bicycle facilities, the redesign of existing roadways, the development of education programs for bicyclists and motorists, and enforcement campaigns.

When Crashes Occur:

- There were 310 reported crashes that involved bicycles in Tippecanoe County from 2007 to 2012.
- An average of 52 bicyclist-vehicle crashes occurs annually in Tippecanoe County.
- Crashes are most prevalent from August-October (43.9%), on Wednesday (18.7%) and during the late afternoon from 4:00-6:00 p.m. (21.3%).
- Crashes mostly occur on clear or cloudy days (92.6%), when the road surface is dry (89.4%) and during daylight hours (79.0%).
- Less than 1 percent of all crashes in Tippecanoe County involve a bicycle.

Injuries and fatalities:

- There were no fatalities from 2007 through 2012.
- Cyclists sustained an injury in every eight out of ten crashes.

Who were Involved:

- Nearly 40% of the crashes involved cyclists between the ages of 16 and 22.
- Male cyclists were involved in over three-quarters (76.1%) of all the bicycle crashes.
- The percentage of bicycle crashes involving children 15 and younger was lower in Tippecanoe County (12.8%) when compared to all of the bicycle crashes that occurred throughout the State of Indiana (30.3%).

Who Was at Fault:

- Over the six year period, cyclists and motorists were nearly equally at fault.

Causes of Crashes:

- The most common cause of crashes when the cyclist was at fault was: failure to yield when entering the intersection and roadway (55.5%), traveling against traffic (9.0%) and rode into vehicle (7.1%).
- The most common cause of crashes when the motorist was at fault was: failure to yield when turning right, left and other (73.5%), improperly passing the cyclist (6.6%) and rear-ending the cyclist (5.3%).
- Over half of the crashes (52.3%) were at a right angle.

Location of Crashes:

- The highest concentration of bicycle-vehicle crashes was on and near the Purdue University Campus (124) and in and adjacent to downtown Lafayette (46).
- The intersections of State Street at River Road and State Street at Salisbury were the two intersections that had the highest number of crashes; seven apiece.
- The corridors that had the highest number of crashes included: State Street in West Lafayette (49), 18th Street (23), Salisbury (23), Northwestern (20), Russell (17), Grant (17), Union/Salem corridor (14), South Street in Lafayette (14), 9th Street (12), and Stadium (11).
- The highest number of crashes occurred at intersections (186).
- Nearly a third of all the crashes (29.4%) occurred when cyclists were riding on the sidewalk.
- A third of the crashes (33.9%) occurred when cyclists were riding against traffic.

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Introduction

The purpose of the this report is to provide useful information to a wide range of audiences concerning bicycle crashes that occurred within Tippecanoe County during calendar years 2007 through 2012. While this report highlights the negative aspects of cycling, it is only done to advance the safety of all road users. Research has shown that the benefits of riding a bicycle in an urban environment far outweigh the risks.[1] This report identifies safety concerns and can be used to mitigate efforts intended to reduce risks to cyclists in Tippecanoe County.

In this report, the term "fault" refers strictly to the behaviors required by statues. It should be noted that there are extenuating circumstances that affect bicyclist behavior for both children and adults.

Children, of course, depending on age, cannot always be expected to understand the rules, and have a tendency to behave impulsively: they are often determined to complete an action once they have initiated it. Children model adult behavior when cycling, and some adults model illegal or unsafe cycling behavior. Some parents direct their children to bike against the flow of traffic, "So you can see the cars coming and get out of the way." This behavior often carries through to adulthood.

Many child crashes involve behaviors that can be addressed through effective education.

Few Americans truly understand proper roadway cycling practices or the true benefits of those practices compared to commonly accepted behaviors (such as cycling on the sidewalk). Adult cyclists' behavior can be colored by a distrust of motorists. Adult cyclists who drive their vehicles properly on the roadway are sometimes threatened and harassed for doing so. Such threats come from only a very small percentage of the population, but have an intense effect on many cyclists, compelling them to utilize "coping strategies" that actually place them at greater risk. Some of these coping strategies are illegal.

Cyclists are rarely cited for basic violations such as driving against traffic, running red lights and stop signs, and traveling at night without lights.

Until effective bicycling training for children is commonplace the community understands and supports correct bicycling behavior by adults - especially motorists - attribution of "fault" will remain an incomplete portrayal of the problem.

Riding a bicycle safely with motor vehicle traffic does require certain skills, but more importantly it requires adherence to the rules of the road for vehicles and the use of key practices. Cyclists who drive properly have a much lower risk than the general population because they do not conduct high risk behaviors such as cycling at night without lights, cycling while intoxicated, or generally disobeying the rules of the road.

Cycling safely with motor vehicle traffic requires certain skills, but more importantly it requires consistent adherence to the rules of the road for vehicles and the use of key practices. The

[1] de Hartog, Jeroen Johan, et. al. "Do the Health Benefits of Cycling Outweigh the Risks?" *Environmental Health Perspectives*. 18 (2010).

Following practices are the most commonly implemented and are utilized by all vehicle drivers:

- Traveling with the flow of traffic
- Stopping for stop signs and red lights
- Yielding when entering the roadway
- Scanning ahead for threats from cross-streets, driveways and turning vehicles
- Scanning behind for and safely negotiating overtaking traffic before moving left
- Not using a right turn lane for through movements
- Yielding when changing lanes
- Turning left from the left turn lane or left-most lane
- Using reflectors, headlights and taillights at night

It should be noted that the percentages expressed in this report are based on a "snapshot" of crashes during a six-year period, and that the relative proportions of these crash types and factors will change over time. They will also differ from proportions found in other urban areas, and will certainly differ from crash characteristic of more rural areas.

About the Data

The data for this report came from the Indiana State Police (ISP) Automated Reporting Information Exchange System (ARIES) database of crash reports submitted by the police departments of Lafayette, West Lafayette, Purdue, Dayton, Battleground, the Tippecanoe County Sheriff, the Department of Natural Resources, and the ISP. The database contains a subset of the most important information that was submitted for each crash reported to the ARIES system. All crash reports that involved a bicycle were obtained through the ARIES web site.

Glossary (Terminology)

ARIES – Automated Reporting Information Exchange System developed and maintained by the Indiana State Police. ARIES provides officers an electronic means to complete the Indiana Officer's Crash Report form. The system also allows authorized individuals access to the Indiana State Police crash records database. ARIES was formerly known as the Vehicle Crash Record System (VCRS).

Alley – Indiana Code IC 9-13-2-2.5, "Alley" means a public way in an urban district that meets the following qualifications: 1) Is open to the public for vehicular traffic; 2) Is publicly maintained; 3) Is one (1) land wide; 4) Is designated as an alley by the local authorities on an official map of the urban district.

Bicycle – Indiana Code IC 9-13-2-14, "Bicycle" means any foot-propelled vehicle, irrespective of the number of wheels in contact with the ground.

Bicyclists or Cyclists - Used interchangeably; any person driving a bicycle. A person walking a bicycle (and not straddling it) is a pedestrian.

Bike or Bicycle Lane – A portion of a roadway which has been designated by pavement markings and, if used, signs, for the preferential or exclusive use of bicyclists. Bike lanes are generally five or more feet in width measured from the lane stripe to the face of the curb or edge of the roadway.

Crash – The term "accident" is not used in this report; it implies that an event could not have been avoided by one or more parties. The vast majority of collisions between road users are due to an illegal action or error on the part of one or more parties.

Crosswalk – Indiana Code IC 9-13-2-40, "Crosswalk" means any of the following" (1) That part of a roadway at an intersection included within the connections of the lateral lines of the sidewalks on opposite sides of the highway measured from the curbs, or in the absence of curbs, from the edges of the traversable roadway. (2) A part of a roadway distinctly indicated for pedestrian crossing by lines or other markings on the surface.

Driver – Any person who drives or is in actual physical control of a vehicle on a highway. Bicycles are statutorily defined as vehicles, thus cyclists are drivers.

Driveway – Indiana Code IC 9-13-2-49.1, "Driveway" means a way or place in private ownership that is used for vehicular travel by the owner and those having express or implied permission from the owner but not by other persons.

Intersection – Indiana Code IC 9-13-2-84, (a) "Intersection" means the area embraced within: (1) the prolongation or connection of the lateral curb lines, or if none, then the lateral boundary lines of the roadways of two (2) highways that join at, or approximately at, right angles; or (2) the area within which vehicles traveling upon different highways joining at any other angle may come in conflict. (b) Where a highway includes tow (2) roadways at least thirty (3) fee apart, every crossing of each roadway of the divided highway by an intersection highway is regarded as a separate intersection. If the intersecting highway also includes two (2) roadways at least thirty (3) feet apart, every crossing of two (2) roadways of the intersecting highway is regarded as a separate intersection.

Motorists – Distinct from the broader term "driver" a person in control of a motor vehicle.

Paved Shoulder – A paved portion of the roadway that is to the right of white edge line on the right side of a road. Paved shoulders are not intended for regular travel by motor vehicles, but help in recovery from run-off-the-roadway incidents and provide a space for cyclists to travel outside the regular path of motorists.

Property Damage Only Crash – A crash in which a vehicle or property is damaged and the occupant or non-motorist is not injured. A crash is required to be reported if the amount of the damage was $750 or more.

Roadway – Indiana Code IC 9-13-2-157, (a) Except as provided in subsection (b), "roadway" means that part of a highway improved, designed, or ordinarily used for vehicular travel. (b) As used in IC 9-21-12-13, "roadway" means the part of a highway that is improved, designed, or ordinarily used for vehicular travel. The term does not include the sidewalk, berm, or shoulder, even if the sidewalk, berm, or shoulder is used by persons riding bicycles or other human powered vehicles.

Sidepath – A facility adjacent to a roadway and separated from the roadway by either a curb or unpaved area. Both pedestrians and cyclists are permitted and expected to travel in either direction on such paths.

Sidewalk - Indiana Code IC 9-13-2-167, "Sidewalk" means the part of a street between the curb lines, or the lateral lines of a roadway, and the adjacent property lines intended for the use of pedestrians.

Street or Highway – Indiana Code IC 9-13-2-175, "Street" or "highway" means the entire width between the boundary lines of every way publicly maintained when any part of the way is open to the use of the public for purposes of vehicular travel. The term includes an alley in a city or town.

Shared Use Path – A paved path intended for use by both pedestrians and bicyclists. These paths may be located in entirely separated rights-of-way or may be parallel and adjacent to roadways. Such facilities are often referred to as "trails."

Sharrow – A sharrow is a pavement marking symbol that indicates an appropriate bicycle positioning in a roadway used by motor vehicles and bicycles. Sharrows may be placed at the edge of the travel lane or at the center of the travel lane, depending of factors like on-street parking, width of travel lane, or posted speed.

Vehicle – Is any vehicle whether it be an automobile or truck. It also includes motorcycles, scooters and bicycles.

When Do Crashes Occur?

By Year

Over the six years analyzed, there were 310 crashes reported that involved bicycles, **Table 1**. That is approximately 52 crashes per year. Cyclists experienced the most crashes (65) in 2007 and the fewest (43) in 2011. **Figure 1**graphically shows the number of crashes by year. From 2007 through 2011, crashes declined annually and by a total of 30 percent. Unfortunately, the number of crashes increased to 50 in 2012, constituting a 16 percent increase between the two years.

Injuries were reported in 80% of the crash events over the six-year period. Looking at the data by year, the percentage of crashes with injuries fluctuated from the mid-70s to mid-80s.

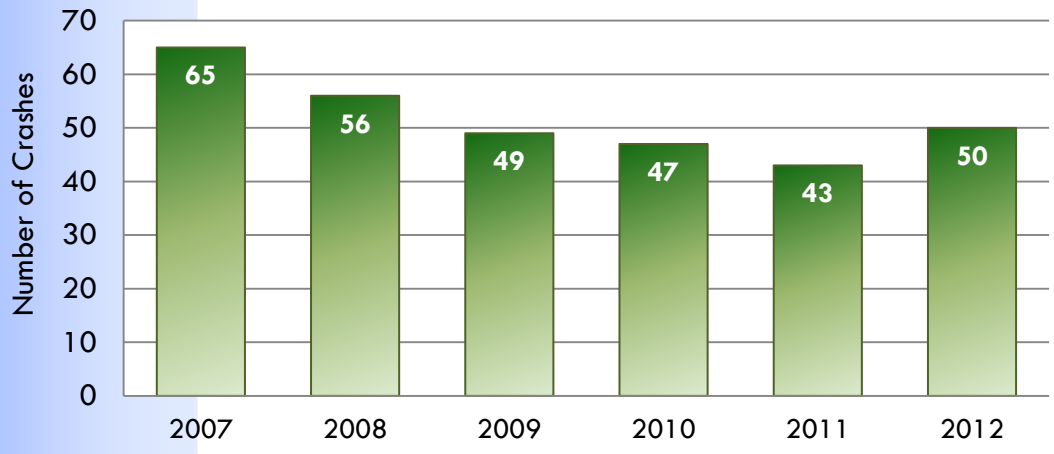
Most often, if there was an injury caused by the crash, it was the cyclist who was injured. That, however, was not necessarily the case all of the time. In 2007 and 2010, several crashes resulted in multiple injuries. Both the cyclists and motorist (one being a motorcyclist) were injured in three crashes. Multiple cyclists were injured in three crashes with one crash resulting in three injured cyclists.

There were no crashes with fatalities.

Table 1: Bicycle Crashes and Injuries in Tippecanoe County

Year	Total Number	Property Damage Only	% of Prop. Damage Crashes	Number of Injury Crashes	% of Injury Crashes	Number of Injured People	Fatalities
2007	65	15	*23.1%*	50	*78.8%*	57	0
2008	56	11	*19.6%*	45	*80.4%*	45	0
2009	49	7	*14.3%*	42	*85.7%*	42	0
2010	47	11	*23.4%*	36	*76.6%*	37	0
2011	43	10	*23.3%*	33	*76.7%*	33	0
2012	50	7	*14.0%*	43	*86.0%*	43	0
Total	*310*	*61*	*19.7%*	*249*	*80.3%*	*257*	*0*

Figure 1: Number of Bicycle Crashes by Year



Annually, less than 1 percent of all crashes in Tippecanoe County involved cyclists. **Table 2** compares the number of crashes involving bicycles to the total number of crashes reported in Tippecanoe County.

Table 2: Comparison of Bicycle and Total Crash Data

Year	Total # of Crashes in the County	Bicycle Crashes	Percentage
2007	7,474	65	0.9%
2008	7,605	56	0.7%
2009	7,010	49	0.7%
2010	7,142	47	0.7%
2011	7,113	43	0.6%
2012	6,941	50	0.7%
Total	*43,285*	*310*	*0.7%*

Table 3 shows crash data for the state of Indiana. Comparing the percentage of bicycle crashes in Tippecanoe County, **Table 2**, to state crash data, it appears there are a higher percentage of bicycle crashes occurring in the county. According to the Indiana Criminal Justice Institute's Indiana Crash Facts reports, one half of 1 percent of all the crashes statewide involves a bicycle.

Table 3: Bicycle Crash Data, State of Indiana (2007-2010)

Year	Total # of Crashes	# of Bicycle Crashes	Percentage
2007	204,999	1,170	0.6%
2008	205,452	1,100	0.5%
2009	189,661	975	0.5%
2010	192,890	1,045	0.5%
2011	188,132	857	0.5%
Total	*981,132*	*5,147*	*0.5%*

Source: Indiana Crash Facts, 2010 and 2011 developed by the Indiana Criminal Justice Institute, Center for Criminal Justice Research, the State of Indiana and the IU school of Public and Environmental affairs.

Source: Bicycle Collisions in Indiana, May 2012 Issue 12-C14. **bicycleindiana**.org/educate/**Bicycle**Collisions.pdf

By Month

One would expect intuitively that crashes by month follow the seasons, with the majority occurring during the summer months, and the fewest during the winter months. In other words, crashes would be least prevalent in the winter, increase in the spring, peak in the summer and then decrease in the autumn.

The analysis, to a degree, supports this expectation. **Figure 2** compares the number of crashes by month to the average high monthly temperature. There are significantly fewer crashes during the winter months, but the number of crashes from April through July was nearly constant. The peak period of crashes was August through October, which lags slightly after the peak in high temperatures. The three-month peak period accounts for over 40 percent of occurrences in crashes.

Figure 2: Number of Bicycle Crashes by Month Compared to Average High Temperature

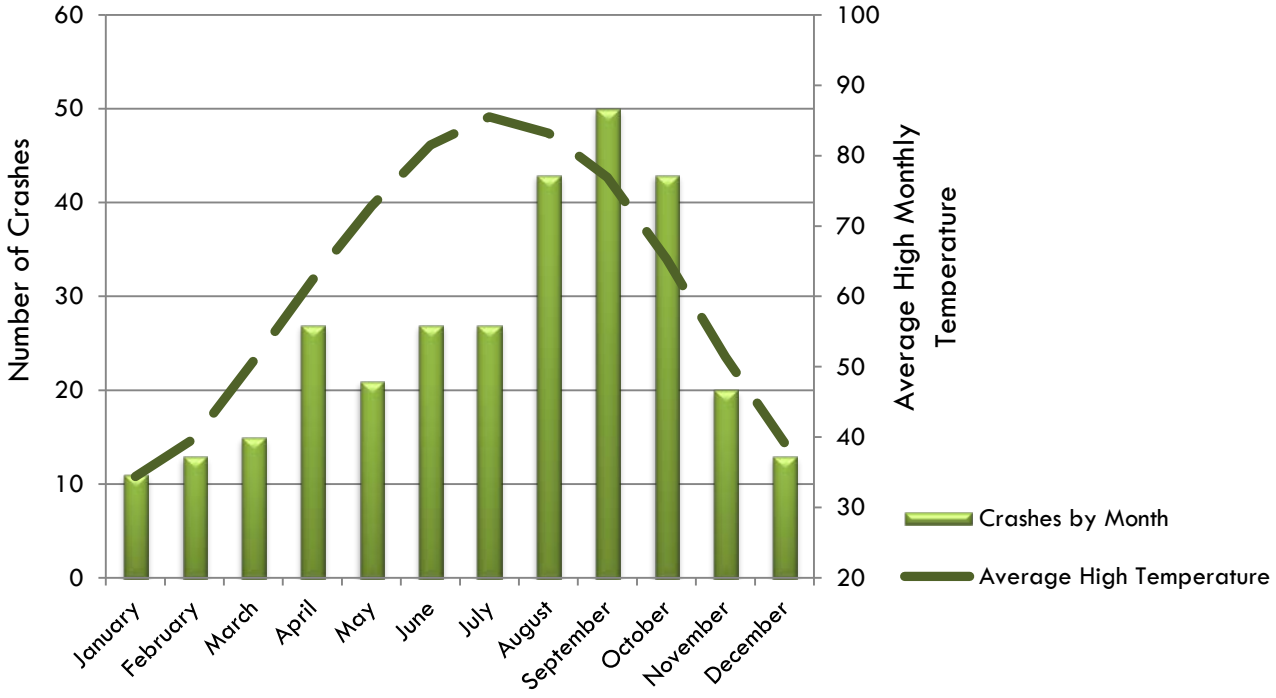


Table 4 shows the number of crashes by month and for each of the six years. The peak month fluctuated between August, September and October. No significant peak was observed in 2010.

Table 4: Bicycle Crashes by Month and Year

	2007	2008	2009	2010	2011	2012	Total	%
January	3	2	1	4	1	---	11	*3.5%*
February	---	3	3	1	2	4	13	*4.2%*
March	2	2	1	3	1	6	15	*4.8%*
April	4	6	3	5	5	4	27	*8.7%*
May	5	5	2	6	1	2	21	*6.8%*
June	9	5	4	3	4	2	27	*8.7%*
July	9	4	7	3	1	3	27	*8.7%*
August	10	10	2	5	5	11	43	*13.9%*
September	11	5	12	6	10	6	50	*16.1%*
October	5	9	9	7	8	5	43	*13.9%*
November	3	4	3	2	3	5	20	*6.5%*
December	4	1	2	2	2	2	13	*4.2%*
Total	*65*	*56*	*49*	*47*	*43*	*50*	*310*	*100%*

Table 5 compares the number of injury crashes to the total number of bicycle crashes by month. The percentage of injuries by month varies from a low of 70 percent to a high of 90 percent. The months of February and April had the lowest percentage while the months of May and November had the highest. Of more importance is the fact that a very high percentage of all bicycle crashes involved injuries.

Table 5: Comparison of the Total Number of Crashes to the Number of Injury Crashes.

Month	Total Crashes	Injuries Crashes	Percentage
January	11	9	*81.8%*
February	13	9	*69.2%*
March	15	12	*80.0%*
April	27	19	*70.4%*
May	21	19	*90.5%*
June	27	23	*85.2%*
July	27	22	*81.5%*
August	43	34	*79.1%*
September	50	38	*76.0%*
October	43	36	*83.7%*
November	20	18	*90.0%*
December	13	10	*76.9%*
Total	*310*	*249*	*80.3%*

Figure 3 graphically compares the total number and injury crashes by month. The gradual increase, peak, and decline of both series are nearly the same. Both trends peak during the months of August through October and both have the fewest during the winter months. Interestingly, the peak month for bicycle crashes has a proportionally lower number of injury crashes.

Figure 3: Number of Bicycle Crashes and Injury Crashes by Month

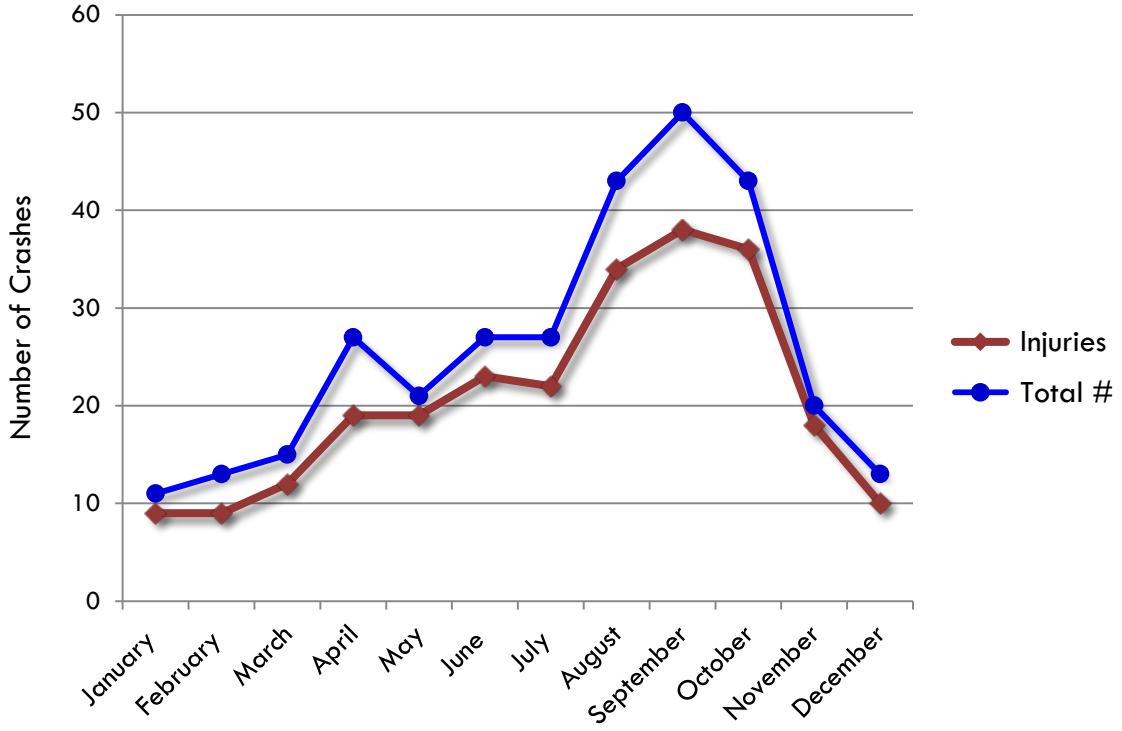


Table 6 provides a detailed look at injuries by month and by year.

Table 6: Injury Crashes by Month and by Year

	2007	2008	2009	2010	2011	2012	Total	Percent
January	2	2	1	4	0	0	9	*3.6%*
February	0	2	2	1	1	3	9	*3.6%*
March	1	1	1	3	1	5	12	*4.8%*
April	2	5	1	3	4	4	19	*7.6%*
May	5	5	1	5	1	2	19	*7.6%*
June	7	5	4	2	4	1	23	*9.2%*
July	6	4	7	2	0	3	22	*8.8%*
August	8	6	1	4	4	11	34	*20.9%*
September	10	2	11	3	6	6	38	*15.3%*
October	4	8	8	5	8	3	36	*14.5%*
November	2	4	3	2	3	4	18	*7.2%*
December	3	1	2	2	1	1	10	*4.0%*
Total	*50*	*45*	*42*	*36*	*33*	*43*	*249*	

Since the peak crash period did not occur during the summer months of June through August, another correlation must explain why it occurs from August through October. One simple explanation is the beginning of the school year. All three school corporations, as well as Purdue University, start their fall semesters in August.

Tables 7 and **8** look at the August through October data as well as the cyclists' age. The data are also geographically separated by using the Wabash River as a dividing line. In looking at the two tables, an interesting picture emerges. East of the river in Lafayette, there are far more cyclists under the age of 16 who are involved in crashes. But west of the river in West Lafayette and the Purdue campus, no one under the age of 16 was involved in a crash. Overwhelmingly, the majority of crashes west of the river involved cyclists between the ages of 16 to 24.

Table 7: Bicycle Crash by Age that Occurred East of the Wabash River, August - October

	2007	2008	2009	2010	2011	2012	Total
<16	6	4	1	2	8	1	22
16-24	3	4	2	1	1	4	15
25-34	2	3	2	1	3	3	14
35-44	1	---	---	---	1	1	3
45-54	1	---	---	3	---	1	5
55-64	---	---	---	---	---	1	1
65 >	---	---	---	---	---	---	---
Unknown	1	2	1	---	---	---	4

Table 8: Bicycle Crashes by Age that Occurred West of the Wabash River, August - October

	2007	2008	2009	2010	2011	2012	Total
<16	---	---	---	---	---	---	---
16-24	10	7	13	8	7	7	52
25-34	1	1	1	3	1	1	8
35-44	---	---	---	---	---	---	---
45-54	1	2	---	---	1	2	6
55-64	---	---	---	---	---	---	---
65 >	---	---	---	---	---	---	---
Unknown	---	---	1	---	---	---	1

By Day of Week

Crashes are more prevalent during the week than the weekend. The most common day is Wednesday with nearly 19 percent of the crashes. The fewest crashes occurred on Sunday at 7 percent. **Table 9** and **Figure 4** present this data.

Table 9: Bicycle Crashes by Day of Week and Year

Month	2007	2008	2009	2010	2011	2012	Total	Percent
Sunday	4	4	3	3	6	3	*23*	*7.4%*
Monday	8	9	*5*	*5*	*5*	*5*	*37*	*11.9%*
Tuesday	13	8	8	*7*	9	7	*52*	*16.8%*
Wednesday	*7*	*5*	13	12	12	9	*58*	*18.7%*
Thursday	10	14	7	8	2	12	*53*	*17.1%*
Friday	12	8	*7*	11	3	6	*47*	*15.2%*
Saturday	11	8	6	1	6	8	*40*	*12.9%*

Figure 4: Crashes by Day of Week

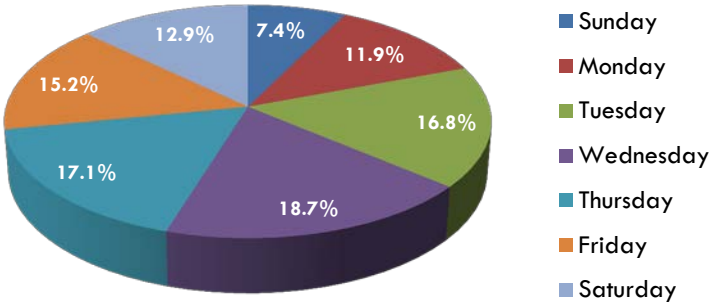


Table 10 looks at the crash data by age and by day of the week. In the youngest age group, the peak occurred on Friday. During the rest of the week, the number of crashes was consistent. For the age group with the highest number of crashes, 16-24, the peak occurred on Wednesday and then tapered off toward the weekend. For those persons who are slightly older (25-34), there is a very small peak on Thursday. Otherwise, the number of crashes was more evenly distributed for all of the other age groups.

Table 10: Crashes by Age and by Day of Week

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Total
<16	4	8	8	8	6	11	6	51
16-24	12	15	28	33	23	19	17	147
25-34	2	5	8	8	10	6	5	44
35-44	1	4	4	2	4	2	2	19
45-54	1	2	2	5	3	4	5	22
55-64	1	0	0	0	1	1	2	5
65 +	0	1	0	1	2	0	0	4
Unknown	2	2	2	1	4	4	3	18
Total	23	37	52	58	53	47	40	310

By Time of Day

Table 11 shows when the crashes occurred by time of day and year. **Figure 5** depicts the information graphically. Not surprisingly, there were very few crashes during the early morning hours. There was a small spike in the number of crashes from 7:00 to 8:00 a.m. (the morning commute.) Just before midday, the number of crashes steadily increased and then peaked between 4:00 and 6:00 p.m. (the evening commute.) The number of crashes thereafter steadily declined.

Over 20 percent of the crashes occurred during the peak late afternoon hours.

Table 11: Bicycle Crashes by Time of Day

	2007	2008	2009	2010	2011	2012	Total	
Midnight – 1am	1	1	---	2	---	---	4	*1.3%*
1:00 – 2:00	---	---	---	1	---	---	1	*0.3%*
2:00 – 3:00	---	---	---	---	---	---	---	*0.0%*
3:00 – 4:00	---	---	---	---	---	---	---	*0.0%*
4:00 – 5:00	---	1	2	---	---	---	3	*1.0%*
5:00 – 6:00	---	---	1	1	---	---	2	*0.6%*
6:00 – 7:00	1	1	---	3	---	1	6	*1.9%*
7:00 – 8:00	1	2	3	3	1	6	16	*5.2%*
8:00 – 9:00	2	5	2	3	---	1	13	*4.2%*
9:00 – 10:00	1	3	3	2	---	---	9	*2.9%*
10:00 – 11:00	1	3	---	---	4	1	9	*2.9%*
11:00 – 12:00	4	2	2	2	1	2	13	*4.2%*
Noon – 1 pm	4	4	3	---	3	2	16	*5.2%*
1:00 – 2:00	9	3	1	2	5	1	21	*6.8%*
2:00 – 3:00	3	3	4	2	5	3	20	*6.5%*
3:00 – 4:00	9	2	4	3	4	3	25	*8.1%*
4:00 – 5:00	4	5	9	5	5	6	34	*11.0%*
5:00 – 6:00	6	5	6	3	5	7	32	*10.3%*
6:00 – 7:00	6	3	6	4	4	3	26	*8.4%*
7:00 – 8:00	4	5	1	3	3	5	21	*6.8%*
8:00 – 9:00	4	4	2	3	3	2	18	*5.8%*
9:00 – 10:00	3	---	---	4	---	3	10	*3.2%*
10:00 – 11:00	2	4	---	1	---	1	8	*2.6%*
11:00 – 12:00	---	---	---	---	---	3	3	*1.0%*
Total	65	56	49	47	43	50	310	

Looking at the morning and evening peak hour crash data by cyclists' age shows some interesting information. The majority of crashes involve persons under the age of 35 for both periods. That age group accounted for over 87 percent of the crashes during the morning peak hour and 75 percent in the evening peak hours. Cyclists between the ages of 16 and 24 were involved over 40 percent of the time. **Table 12** shows the crash data by peak hour and by age group.

Figure 5: Bicycle Crashes by Time of Day

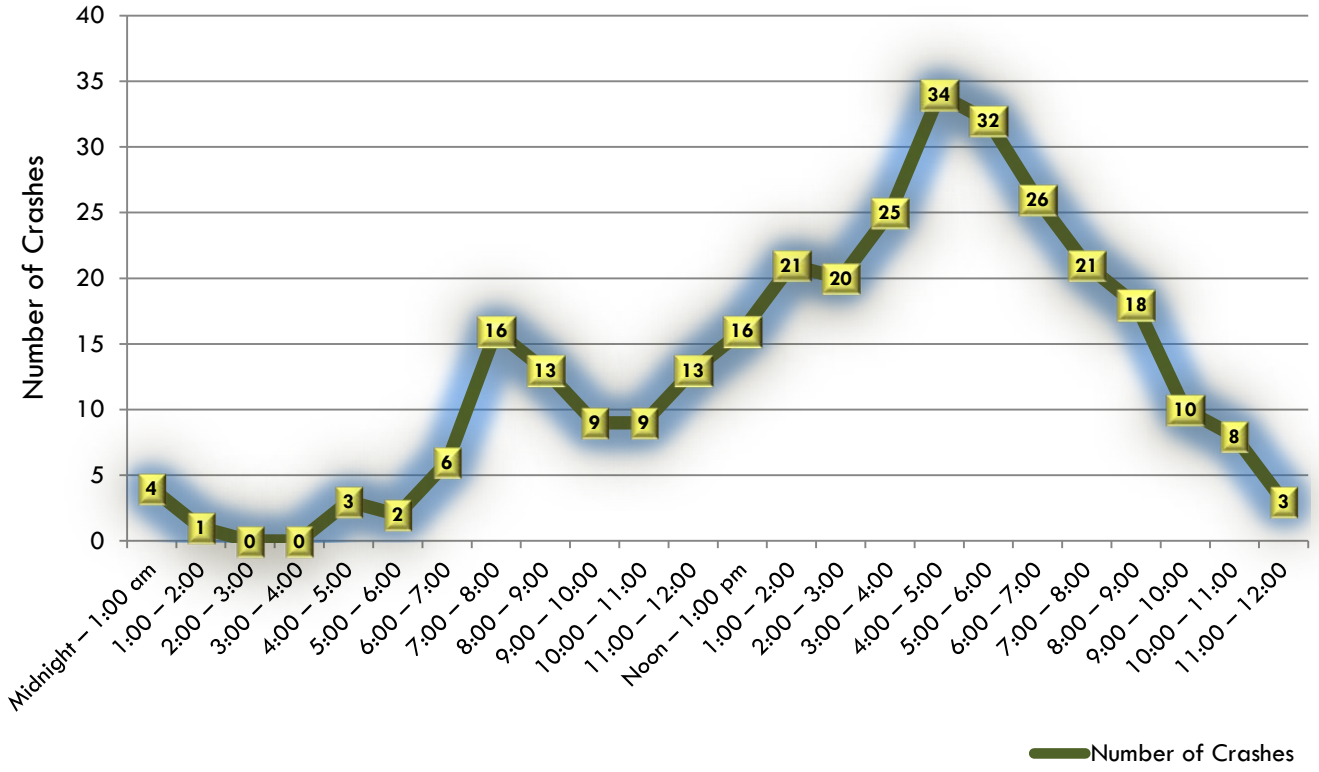


Table 12: Peak Hour Crashes by Age Group

Age	7-8 a.m.	4-6 p.m.
<16	4	12
16-24	7	27
25-34	3	11
35-44	0	5
45-54	1	4
55-64	0	1
65 +	1	2
Unknown	0	4
	16	66

By Environmental Conditions

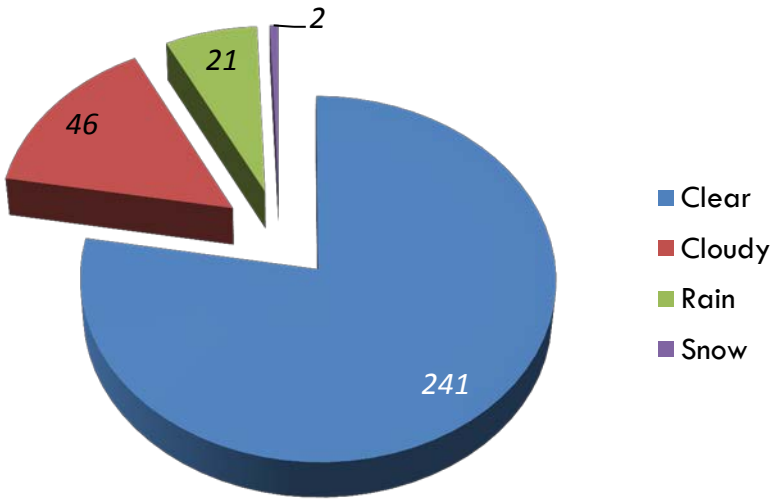
Atmospheric or Weather Conditions

Weather conditions at the time of crashes were generally favorable. Conditions were clear 77 percent of the time and cloudy nearly 15 percent of the time. It was raining when 21 of the crashes occurred, or 6.8 percent. Two crashes occurred when it was snowing. **Table 13** shows the information by condition type and year and **Figure 6** graphically shows the proportions of the four weather conditions showing that very few crashes can be attributed to bad weather conditions.

Table 13: Crashes by Atmospheric Conditions

Year	Clear	%of Crashes	Cloudy	% of Crashes	Rain	% of Crashes	Snow	% of Crashes
2007	52	80.0%	9	13.8%	4	6.2%	0	0.0%
2008	42	75.0%	10	17.9%	3	5.4%	1	1.8%
2009	34	69.4%	10	20.4%	5	10.2%	0	0.0%
2010	36	76.6%	8	17.0%	2	4.3%	1	2.1%
2011	37	86.0%	3	7.0%	3	7.0%	0	0.0%
2012	40	80.0%	6	12.0%	4	8.0%	0	0.0%
Total	*241*	*77.7%*	*46*	*14.8%*	*21*	*6.8%*	*2*	*0.6%*

Figure 6: Crashes by Atmospheric Conditions



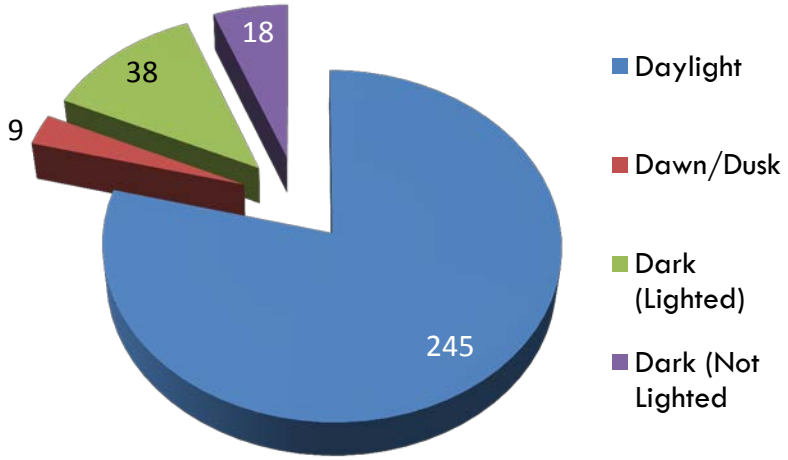
Lighting Conditions

Seventy-nine percent of crashes occurred during daylight hours, **Table 14**. Fifty-six crashes occurred when it was dark. Three quarters of those crashes occurred at locations that were lighted while the other third occurred where there was no street lighting present. Only a small fraction, less than 3 percent, occurred at dawn or dusk. **Figure 7** graphically shows the total number of crashes by lighting conditions.

Table 14: Crashes by Lighting Conditions

Year	Daylight	% of Crashes	Dawn / Dusk	%of Crashes	Dark (Lighted)	%of Crashes	Dark (Not Lighted)	%of Crashes
2007	51	78.5%	2	3.1%	9	13.8%	3	4.6%
2008	46	82.1%	2	3.6%	5	8.9%	3	5.4%
2009	44	89.8%	1	2.0%	3	6.1%	1	2.0%
2010	32	68.1%	1	2.1%	8	17.0%	6	12.8%
2011	36	83.7%	1	2.3%	4	9.3%	2	4.7%
2012	36	72.0%	2	4.0%	9	18.0%	3	6.0%
Total	*245*	*79.0%*	*9*	*2.9%*	*38*	*12.3%*	*18*	*5.8%*

Figure 7: Crashes by Lighting Conditions



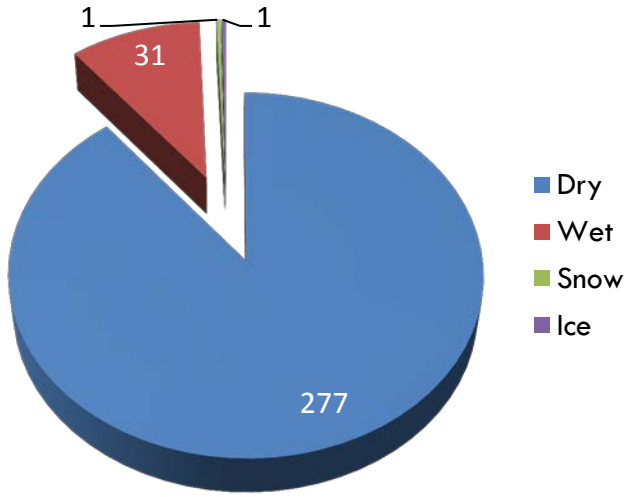
Road Surface Conditions

The road surface condition at the time of crashes was mostly favorable. Conditions were dry nearly 90 percent of the time and wet only 10 percent. Snow, slush or ice were present less than 1percent of the time.

Table 15: Crashes by Road Surface Conditions

	Dry	% of Crashes	Wet	% of Crashes	Snow	% of Crashes	Ice	% of Crashes
2007	58	*89.2%*	7	*10.8%*	0	*0.0%*	0	*0.0%*
2008	50	*89.3%*	5	*8.9%*	0	*0.0%*	1	*1.8%*
2009	43	*87.8%*	6	*12.2%*	0	*0.0%*	0	*0.0%*
2010	42	*89.4%*	4	*8.5%*	1	*2.1%*	0	*0.0%*
2011	39	*90.7%*	4	*9.3%*	0	*0.0%*	0	*0.0%*
2012	45	*90.0%*	5	*10.0%*	0	*0.0%*	0	*0.0%*
Total	277	*89.4%*	31	*10.0%*	1	*0.3%*	1	*0.3%*

Figure 8: Crashes by Road Surface Conditions



Type of Collision

The type of collision tells us what the vehicles were doing at the time of the crash. It gives us an idea not only of the position of both vehicles, but also their direction of travel. **Table 16** shows the data for each type of collision by year.

By far, the most frequent type of collision occurred when the cyclists hit or were hit at a right angle. This type of collision accounted for over half of the crashes. The second and third most common types of collisions occurred when one of the vehicles was turning right or left. Both of these types of collisions accounted for nearly 20 percent of the crashes. Head-on and same-direction sideswipe collisions accounted for 15 percent of the crashes.

Several trends become evident in looking at the data by year. The number of right angle collisions decrease from a high of 36 in 2007 to 20 in 2011. There is only a slight increase in 2012. All other types of collisions are nearly constant throughout the reporting period.

Table 16: Crashes by Type of Collision and by Year

Type of Collision	2007	2008	2009	2010	2011	2012	Total	%
Right Angle	36	33	29	22	20	22	162	*52.3%*
Right Turn	4	6	8	1	5	6	30	*9.7%*
Left Turn	3	3	3	10	4	5	28	*9.0%*
Head On	5	5	7	---	5	2	24	*7.7%*
Same Direction Sideswipe	6	3	---	4	3	7	23	*7.4%*
Rear End	1	3	1	3	5	4	17	*5.5%*
Other – Explain in Narrative	7	2	---	3	1	2	15	*4.8%*
Left/Right Turn	1	---	1	1	---	1	4	*1.3%*
Opposite Direction Sideswipe	---	---	---	2	---	1	3	*1.0%*
Ran Off Road	2	---	---	---	---	---	2	*0.6%*
Rear to Rear	---	1	---	---	---	---	1	*0.3%*
Backing Crash	---	---	---	1	---	---	1	*0.3%*
	65	56	49	47	43	50	310	

Who Was Involved in the Crashes?

By Age of Cyclists

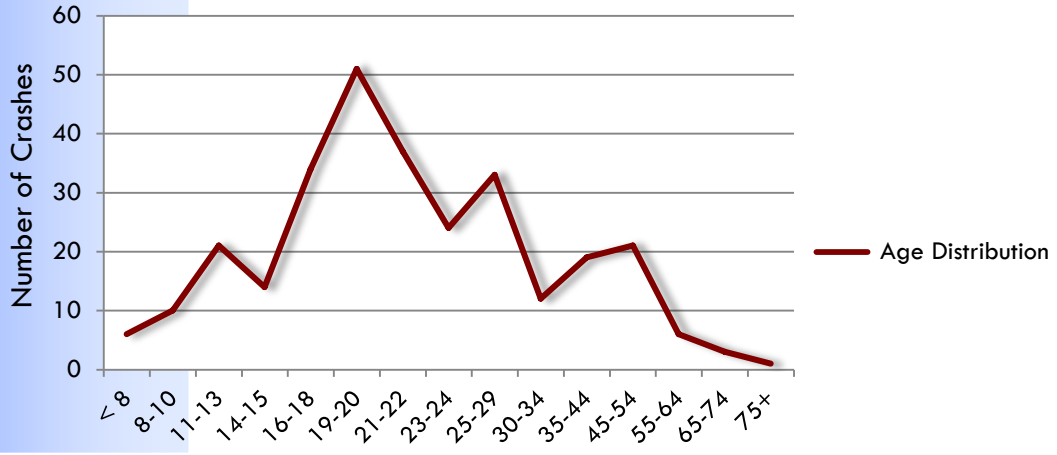
Table 17 shows that several age groups were involved in crashes more frequently than others. Fifty-one crashes involved persons who were either nineteen or twenty years old. If those persons in the two age groups, younger and older, are included, the percentage increases to nearly 40% of all crashes. The other age group that was more frequently involved in crashes are those persons from 25 to 29. Persons in that age group, account for nearly 11 percent of the crashes. **Figure 9** graphically shows the age distribution.

Only 16 crashes occurred involving children who are 10 or younger, or 5 percent of the crashes. Persons who were 55 and older were involved in only nine crashes.

Table 17: Crashes by Year and by Age Group

	2007	2008	2009	2010	2011	2012	Total	Percent
< 8	4	1	0	0	1	0	6	*1.9%*
8-10	2	2	0	2	4	0	10	*3.2%*
11-13	7	4	2	3	2	3	21	*6.8%*
14-15	4	4	0	1	3	2	14	*4.5%*
16-18	5	5	6	5	8	5	34	*11.0%*
19-20	11	12	11	7	2	8	51	*16.5%*
21-22	4	6	9	7	6	5	37	*11.9%*
23-24	4	5	4	3	2	6	24	*7.7%*
25-29	8	5	4	6	5	5	33	*10.6%*
30-34	1	2	2	1	2	4	12	*3.9%*
35-44	6	4	1	2	2	4	19	*6.1%*
45-54	2	3	3	6	2	5	22	*6.8%*
55-64	3	0	1	0	1	1	5	*1.9%*
65-74	1	0	0	0	1	1	3	*1.0%*
75+	0	0	1	0	0	0	1	*0.3%*
Unknown	3	3	5	4	2	1	18	*5.8%*
	65	56	49	47	43	50	310	

Figure 9: Crashes by Age Group



Reviewing bicycle crash data for the entire state reveals that children between the ages of 8 and 15 years old were more frequently involved in crashes. This is a much younger age group when compared to Tippecanoe County crash data. Older teenagers and young adults, 16 to 20, were more frequently involved in crashes in Tippecanoe County. **Table 18** compares the data for the State of Indiana to that of Tippecanoe County.

In 2010, the percentage of crashes involving cyclists 45 to 54 years old was nearly the same for both Tippecanoe County and for the State (13 percent).

Table 18: Comparison to the State of Indiana

	State of Indiana (2010 Crashes)		Tippecanoe County (2010 Crashes)		Tippecanoe County (Six Year Total)	
< 8	33	*3.2%*	0	*0.0%*	6	*1.9%*
8-15	284	*27.2%*	6	*12.8%*	45	*14.5%*
16-20	171	*16.4%*	12	*25.5%*	85	*27.4%*
21-24	105	*10.0%*	10	*21.3%*	61	*19.7%*
25-34	122	*11.7%*	7	*14.9%*	45	*14.5%*
35-44	94	*9.0%*	2	*4.3%*	19	*6.1%*
45-54	139	*13.3%*	6	*12.8%*	21	*6.8%*
55-64	69	*6.6%*	0	*0.0%*	6	*1.9%*
65-74	19	*1.8%*	0	*0.0%*	3	*1.0%*
75+	5	*0.5%*	0	*0.0%*	1	*0.3%*
Unknown	4	*0.4%*	4	*8.5%*	18	*5.8%*
Total	*1,045*		*47*		*310*	

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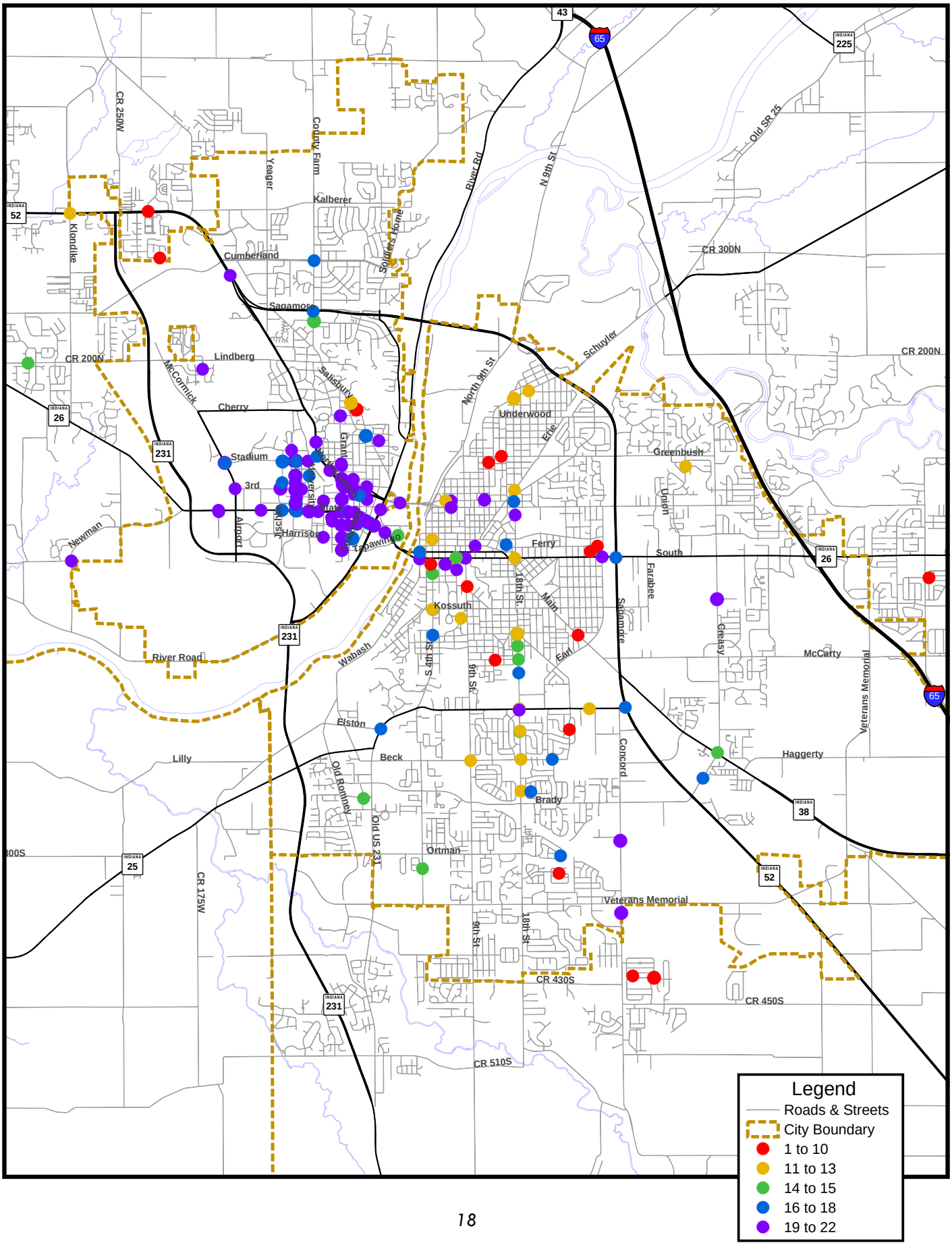
Figure 10 shows the locations of crashes that involved cyclists 22 years and younger. The information was color coded to reflect approximate grade levels: elementary and younger, middle, high school and under graduate college students. Roughly a third of the crashes involving children 10 and younger occurred in residential subdivisions. All others, with the exception of the crash at US 52W and Paramount and on Alabama Street, occurred on the more heavily traveled streets within residential areas of both cities.

Nearly all of the crashes involving children between the ages of 11 to 13 occurred within the City of Lafayette. Many of them occurred on streets designated as either primary or secondary arterials. Of the 21 crashes, nine occurred on 18th Street between Schuyler Avenue and Brady Lane, or 43% of the crashes in that age group.

In the 16 to 18 year old age group, over half (26) of the crashes involved 18 year olds. Three quarters of the crashes were located on the Purdue Campus with many of them located on or near Russell Street. In Lafayette, five occurred on 18th Street. Many of the other crashes in Lafayette occurred on primary and secondary roads.

It is no surprise that nearly all of the crashes involving 19 to 22 year olds occurred on or near the Purdue Campus. Of the remaining locations, nearly a dozen crashes occurred in and near the downtown area in Lafayette. There were three crashes located in rural Tippecanoe County. Two involved 15 year olds; the other cyclist was 20 years old. These crash locations were at CR 1150S just east of Corwin, on Division Road at CR 700W and on CR 350S just west of CR 1050E.

Figure 10: Location of Crashes by Age Group, 1 to 22 Years of Age



By Gender of Cyclists

Male cyclists accounted for the majority of bicycle crashes. Over 75 percent of crashes involved males versus 18 percent that involved females. In other words, for every one crash that involved a female, there were nearly four that involved a male. **Figure 11** portrays the crash data by gender. It should be noted that the information for age and/or gender was not recorded for 18 crashes.

Figure 11: Comparison of Crashes by Age Group and Sex, Cyclists

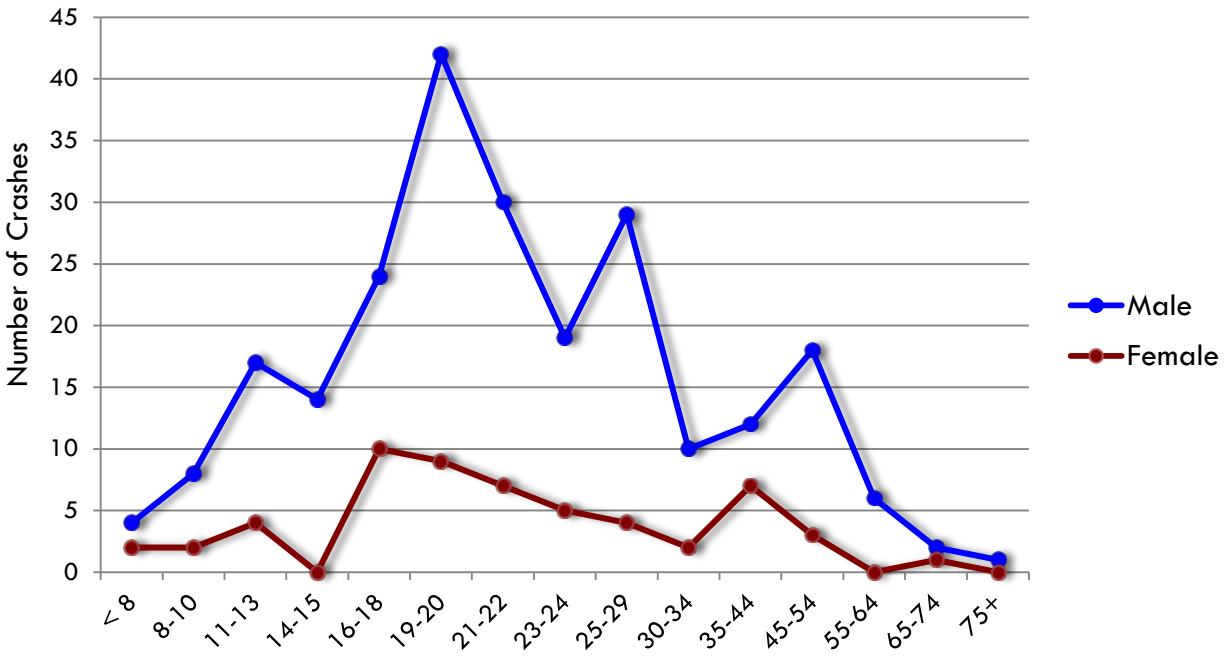


Figure 11 also shows the information by age group and **Tables 19** and **20** show the data in more detail. In looking at the crashes that involved males, there appear to be two age groups who were more frequently involved: 19 and 20 year olds and from 25 to 29. These two age groups accounted for a third of the crashes. There was a small increase in crashes for those cyclists who were from 45 to 54.

For females, there were two age groups with a higher frequency, 16 to 20 and 35 to 44, but the number of crashes was not significantly higher when compared to the other age groups. The age group with the highest number, women 16 to 18 years old, were only involved in ten crashes over the six year period. There were no crashes involving 14 and 15 year old females.

By Age and Gender of the Motor Vehicle Driver

An analysis of age and gender of motor vehicle drivers demonstrated that a greater number of males were involved in crashes. Just over half of the crashes involved male drivers. Nearly 40 percent involved female drivers. **Figure 12** shows the crash data by gender. It should be noted that the information for age and/or gender of the vehicle driver was not recorded for 32 crashes and the motor vehicle driver was at fault in 22 of those crashes.

Figure 12 also shows the information by age group and **Tables 21** and **22** show the data in more detail. In crashes that involved males, one age group was more frequently involved than the others:

21 and 22 year olds. It should be also noted that a quarter of the crashes involved male drivers who are from 45 to 64 years old.

In crashes that involved female drivers, there were several age groups that had a higher frequency of crashes when compared to male driver data. Those age groups were from 14 to 18 and from 25 to 44.

Table 19: Crashes by Age of Cyclists by Year, Male

Age	2007	2008	2009	2010	2011	2012	Total	Percent
< 8	2	1	0	0	1	0	4	1.7%
8-10	2	1	0	1	4	0	8	3.4%
11-13	6	4	2	1	2	2	17	7.2%
14-15	4	4	0	1	3	2	14	5.9%
16-18	3	4	5	3	6	3	24	10.2%
19-20	9	10	9	6	1	7	42	17.8%
21-22	3	6	8	4	6	3	30	12.7%
23-24	4	3	4	2	2	4	19	8.1%
25-29	7	4	4	5	5	4	29	12.3%
30-34	1	2	2	1	1	3	10	4.2%
35-44	5	1	1	1	2	2	12	5.1%
45-54	2	3	2	6	2	3	18	7.6%
55-64	3	0	1	0	1	1	6	2.5%
65-74	1	0	0	0	0	1	2	0.8%
75+	0	0	1	0	0	0	1	0.4%
Total	*52*	*43*	*39*	*31*	*36*	*35*	*236*	*76.1%*

Table 20: Crashes by Age of Cyclists by Year, Female

Age	2007	2008	2009	2010	2011	2012	Total	Percent
< 8	2	0	0	0	0	0	2	3.6%
8-10	0	1	0	1	0	0	2	3.6%
11-13	1	0	0	2	0	1	4	7.1%
14-15	0	0	0	0	0	0	0	0.0%
16-18	2	1	1	2	2	2	10	17.9%
19-20	2	2	2	1	1	1	9	16.1%
21-22	1	0	1	3	0	2	7	12.5%
23-24	0	2	0	1	0	2	5	8.9%
25-29	1	1	0	1	0	1	4	7.1%
30-34	0	0	0	0	1	1	2	3.6%
35-44	1	3	0	1	0	2	7	12.5%
45-54	0	0	1	0	0	2	3	5.4%
55-64	0	0	0	0	0	0	0	0.0%
65-74	0	0	0	0	1	0	1	1.8%
75+	0	0	0	0	0	0	0	0.0%
Total	10	10	5	12	5	14	56	18.1%

Figure 12: Comparison of Crashes by Age Group and Sex, Vehicle Driver

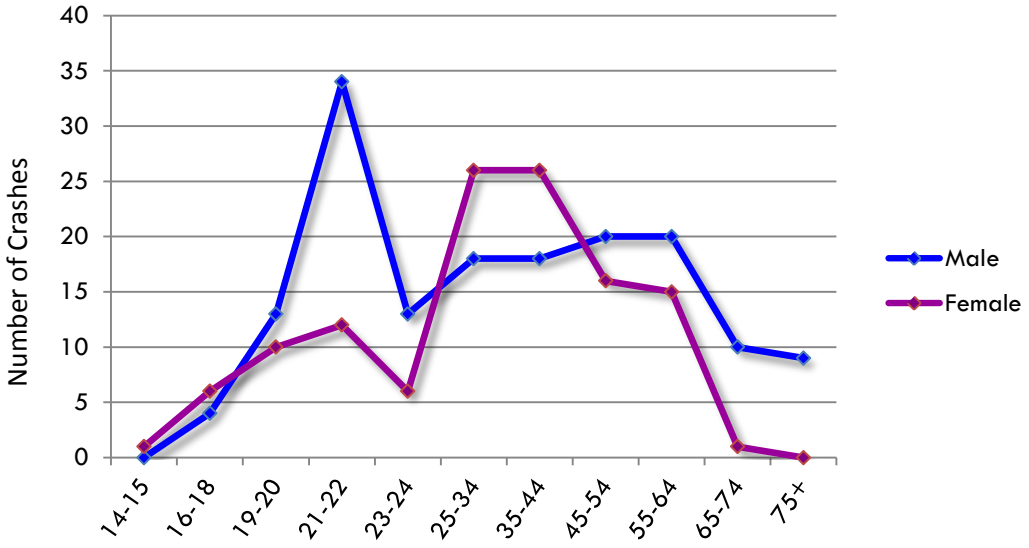


Table 21: Crash by Age of Driver by Year, Male

Age	2007	2008	2009	2010	2011	2012	Total	Percent
14-15	0	0	0	0	0	0	0	*0.0%*
16-18	0	1	2	1	0	0	4	*2.5%*
19-20	4	4	2	2	0	1	13	*8.2%*
21-22	7	7	4	6	4	6	34	*21.4%*
23-24	3	2	3	1	2	2	13	*8.2%*
25-34	4	0	1	1	7	5	18	*11.3%*
35-44	2	3	5	3	3	2	18	*11.3%*
45-54	3	3	4	4	4	2	20	*12.6%*
55-64	4	3	1	4	2	6	20	*12.6%*
65-74	1	3	2	0	2	2	10	*6.3%*
75+	2	1	2	3	1	0	9	*5.7%*
Total	30	27	26	25	25	26	159	

Table 22: Crash by Age of Driver by Year, Female

Age	2007	2008	2009	2010	2011	2012	Total	Percent
14-15	0	1	0	0	0	0	1	*0.8%*
16-18	0	1	2	0	2	1	6	*5.0%*
19-20	3	1	3	2	0	1	10	*8.4%*
21-22	3	2	3	1	1	2	12	*10.1%*
23-24	1	3	0	2	0	0	6	*5.0%*
25-34	7	5	3	2	3	6	26	*21.8%*
35-44	5	3	6	5	4	3	26	*21.8%*
45-54	7	3	0	1	2	3	16	*13.4%*
55-64	1	3	3	3	0	5	15	*12.6%*
65-74	1	0	0	0	0	0	1	*0.8%*
75+	0	0	0	0	0	0	0	0.0%
Total	28	22	20	16	12	21	119	

Where Did Crashes Occur?

By Location

Figure 13 shows the location of bicycle crashes throughout Tippecanoe County over the six year study period. While the majority of crashes appear to be clustered in the heart of both cities, crashes did occur in the suburban area and in rural Tippecanoe County.

In order to better understand and identify problematic locations such as intersections and corridors, the community was divided into four subareas. The subareas also made it easier to look at the data where there were concentrations of crashes. The subareas closely follow municipal boundaries except for the Purdue area. The Purdue area also includes Chauncey Village and the Levee.

Over the six years being studied, there were roughly the same numbers of crashes in Lafayette as there were in the Purdue area. Over 80 percent of the crashes occurred in these two areas. **Table 23** shows the breakdown of crashes by area. Just over 11 percent of the crashes occurred in the remaining portion of West Lafayette and 7 percent occurred in the rural portions of the county.

Table 23: Crashes by Sub Area

	2007	2008	2009	2010	2011	2012	Total	
PU/Levee	21	21	25	22	14	21	124	*40.0%*
West Lafayette	6	6	6	9	5	4	36	*11.6%*
Lafayette	30	28	16	13	20	22	129	*41.6%*
Rural Tipp. Co.	8	1	2	3	4	3	21	*6.8%*
	65	56	49	47	43	48	310	*100%*

Lafayette

Figure 14 shows the location of crashes within the City of Lafayette. There were 129 reported over the six year period or 41.6%. With the City encompassing just over 29 square miles that equates to 4.4 crashes per square mile for the six years.

Another area of crash concentration is in and near the downtown, roughly the area bounded by Salem Street, 18th Street, Alabama and the Wabash River. Over a third of the crashes in Lafayette, 35.7% were located in this area. **Table 24** breaks down the crashes by year for the downtown area and for the remaining part of Lafayette.

Table 24: Crashes in Lafayette

	2007	2008	2009	2010	2011	2012	Total	
Downtown Lafayette	11	12	4	3	4	12	46	35.7
Remaining Lafayette	19	16	12	10	16	10	83	64.3
	30	28	16	13	20	22	129	

Comparing the two areas, the number of crashes in the downtown area fluctuated between 3 and 12 crashes per year. The high of 12 occurred in 2008 and 2012. There was a significant decrease in the period from 2009 to 2011. The crashes in the remaining portion of Lafayette saw a decreasing trend from 2007 to 2010 until 2011 when there was a spike in crashes. There were more crashes in the downtown area in 2012 than in the remaining portion of Lafayette, the only year in which that happened.

Figure 13: Bicycle Crashes Located in Tippecanoe County, 2007-2012

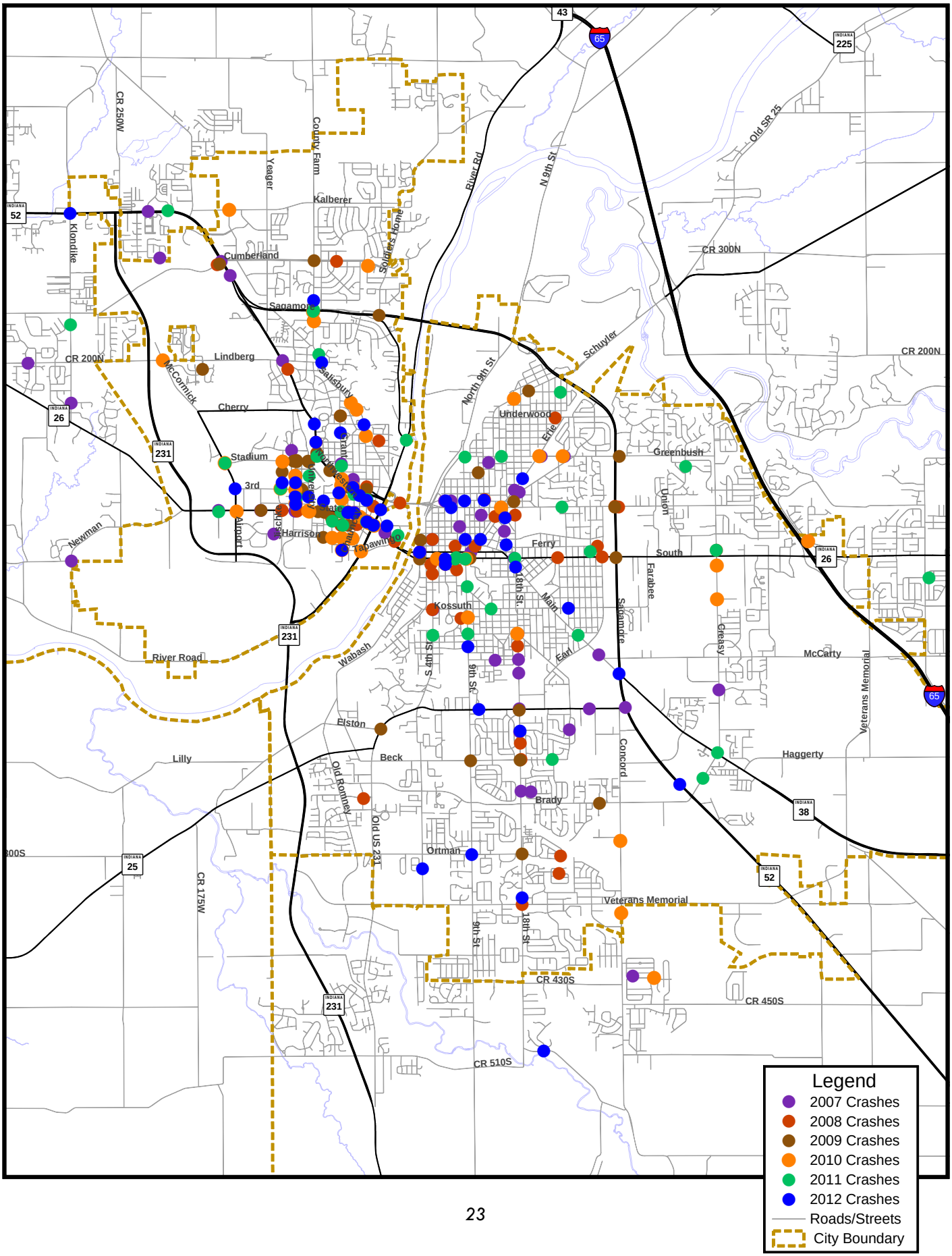
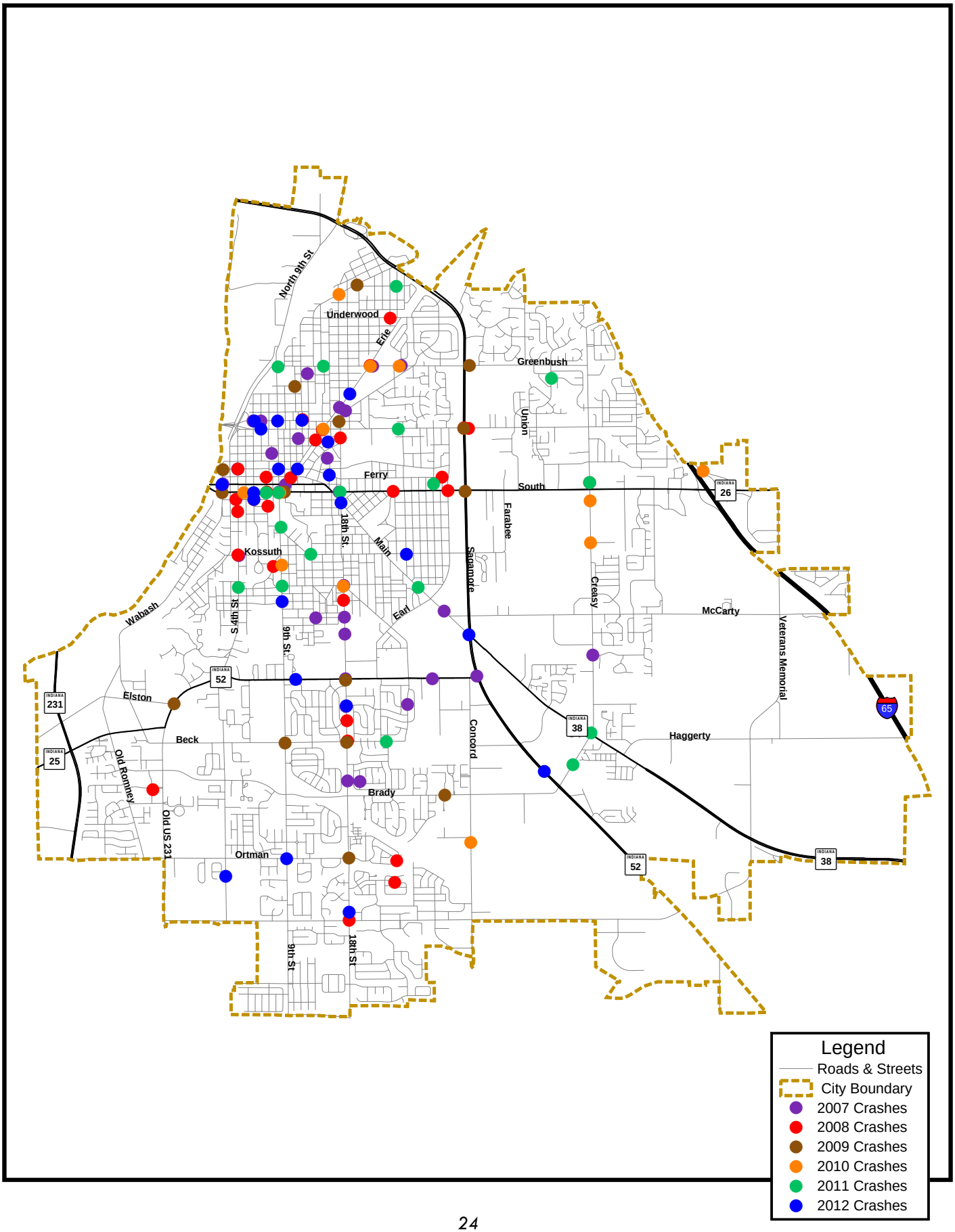


Figure 14: Bicycle Crashes Located in Lafayette



Crashes occurred on nearly all of the major roads that cross Lafayette. The following sixteen corridors experienced four or more crashes over the six year period: 18th Street (23), the Union/Salem Corridor (14), South Street (14), 9th Street (12), Erie Street (9), Greenbush (8), 4th Street (7), Creasy/Brady Lane Corridor (7), Ferry Street (7), Teal Road/SR 25 (6), Sagamore Parkway (6), Columbia (5), Main Street (6), Beck Lane and Sequoia (5), 2nd Street (5), and Kossuth Street (4).

There were four intersections within Lafayette where three crashes were report at each intersection. They were at: 9th Street and South Street, 2nd Street and Columbia, Erie and Greenbush, and Union and Sagamore Parkway.

There were thirteen intersections where two crashes occurred per intersection: 4th and Ferry, 4th and Kossuth, 6th and Salem, 6th Street and Alabama, 7th Street and South Street, 13th Street and Salem, 18th Street and South Street, 18th and Central, 18th Street and Teal, 18th and Iroquois, 18th Street and Beck Lane, Greenbush and Melbourne, and Union and Eire.

West Lafayette Area

Outside of the Purdue campus area, there were 36 crashes involving bicycles over the six year period in West Lafayette. Covering just over seven square miles, there were 5.1 crashes per square mile for the six year period. **Figure 15** shows where those crashes occurred.

There are three corridors where the crashes mainly occurred. There were 13 crashes along the Salisbury Street corridor and six along the Cumberland Avenue corridor. Half of those crashes occurred at the intersections with US 52. There were five crashes in the Grant Street corridor.

Looking at crashes by intersection, there were four within West Lafayette where two or more crashes were reported. Cumberland and Sagamore Parkway was the only intersection to experience three crashes. There were three intersections where two crashes occurred at each intersection: Sagamore Parkway and Salisbury, Salisbury and Navajo and Stadium and Grant.

Purdue Area

Even though the Purdue area, including Chauncey Village and the Levee, encompasses only 2.25 square miles, 124 crashes occurred in this area with a crash rate per square mile 55.1. That's significantly higher than Lafayette's and West Lafayette's overall rates. Over 40 percent of all the bicycle crashes during the six year period occurred in this area. **Figure 16** shows the location of the crashes.

Figure 16 also shows numerous crashes on State Street, especially between Grant Street and River Road. Along the entire corridor, there were 49 crashes with nearly two-thirds, or 31 occurring between Grant and River Road. Nearly 40 percent of the crashes in the Purdue area occurred on State Street.

Crashes occurred on nearly all of the major roads that cross the Purdue area. Excluding State Street, the following fourteen corridors saw four or more crashes over the six year period: Russell (17), Northwestern (14), Grant (12), Stadium (11), Salisbury (10), Jischke (8), Chauncey (8), University (7), 3rd Street (6), Harrison (5), McCormick (5), Fowler (4), Wood (4) and Sheetz (4).

The two intersections that had the highest number of crashes were located in the Purdue Area. They were State Street at River Road and State Street at Salisbury with seven crashes at each intersection. Adding the two crashes that occurred between the intersections, this area is the most dangerous location for cyclists within the county.

Figure 15: Bicycle Crashes Located in West Lafayette Outside the Purdue Area

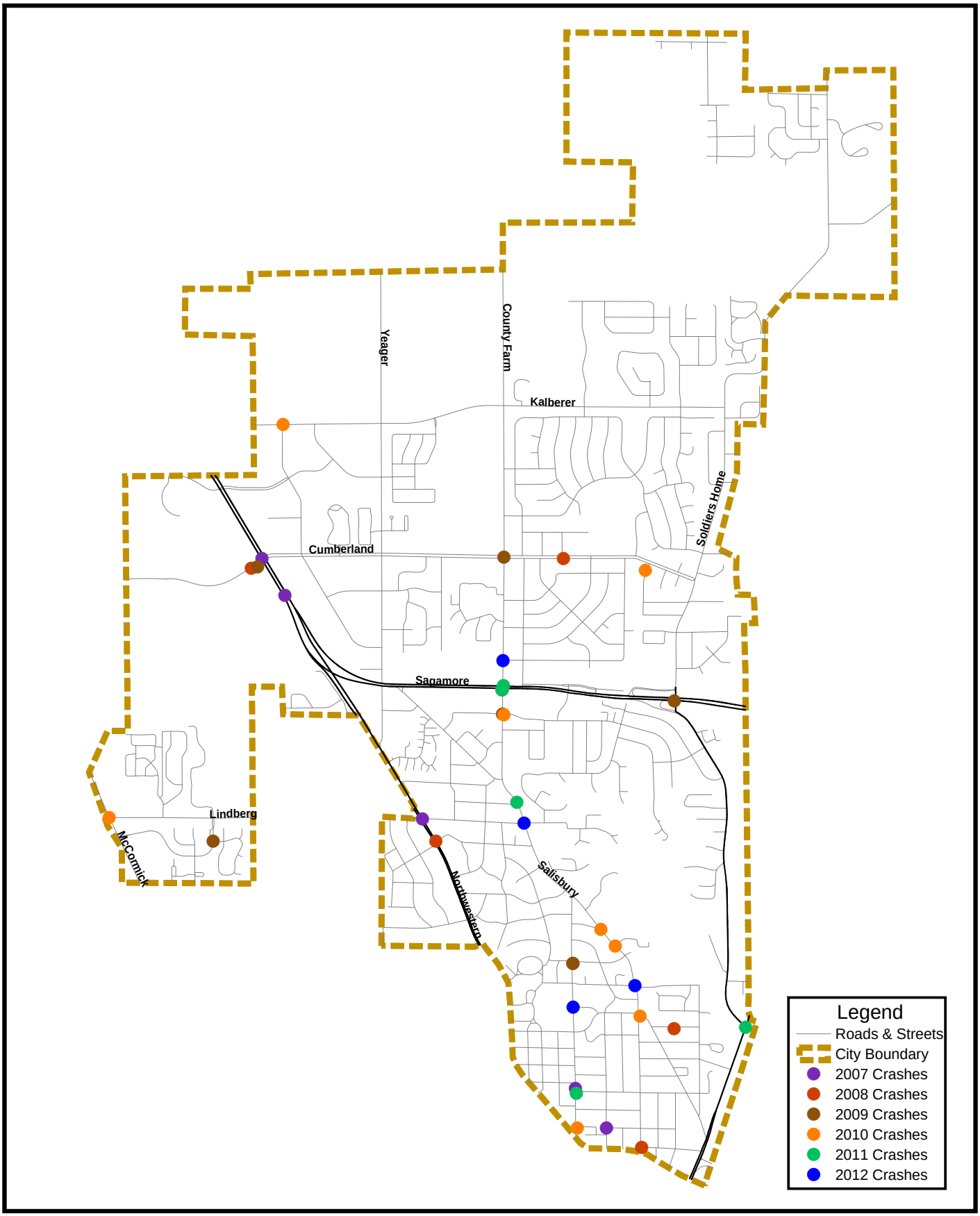
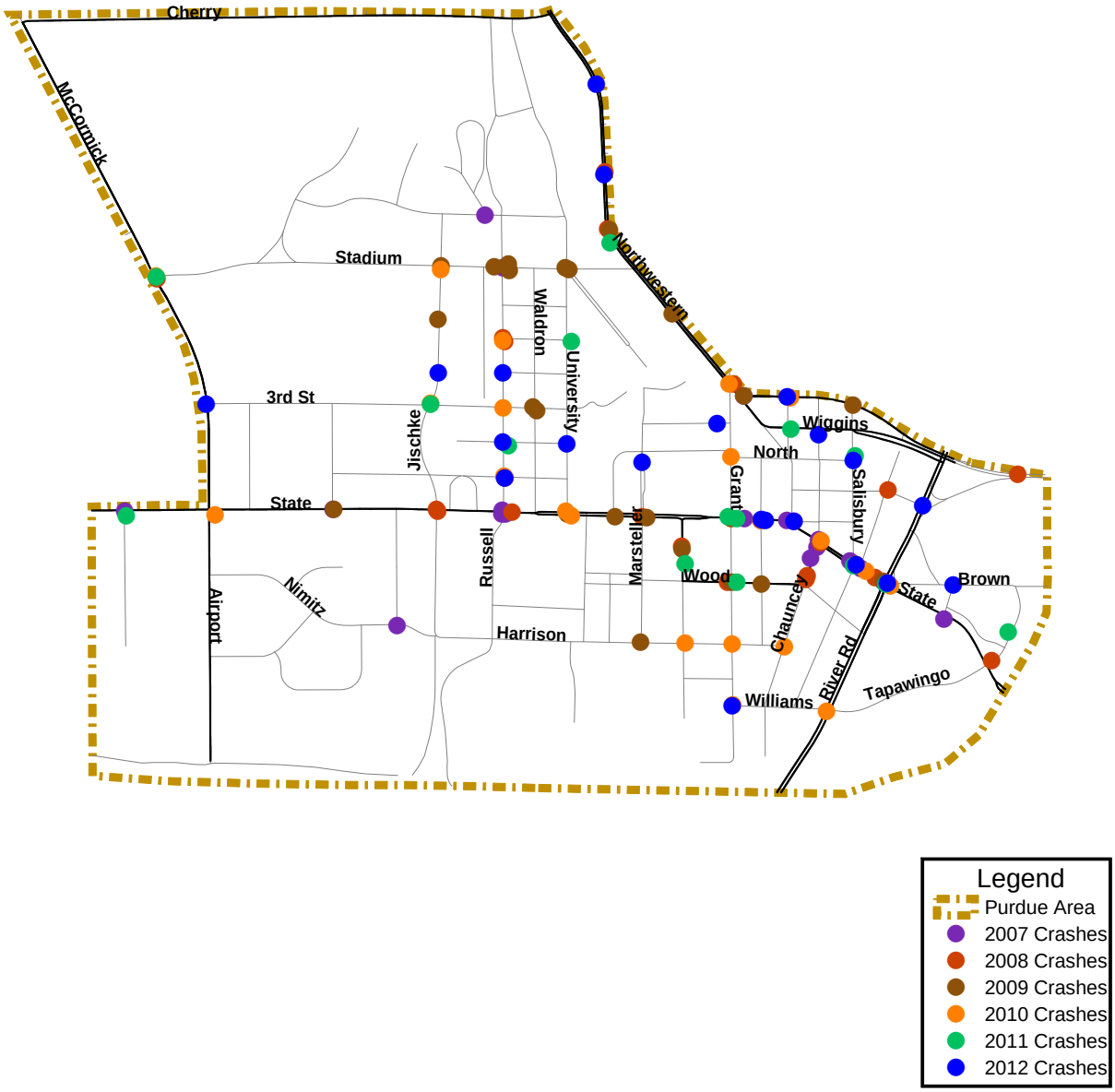


Figure 16: Bicycle Crashes Located in the Purdue Area



Excluding the two intersections mentioned above, there were an additional 29 intersections in the Purdue area that had two or more crashes per intersection. There were four intersections where four crashes were reported at each intersection. They were: State Street at Chauncey, State Street at Andrew Place, State Street at Russell, and Stadium at Russell.

There were nine intersections that had three crashes per intersection. They were: State & Northwestern, State & Grant, State & University, Stadium & McCormick, Wood & Grant, 1st & Russell, 2nd & Russell, 5th & Russell and Northwestern at Evergreen. There were 16 intersections with two crashes. They were: State & Memorial Mall, State & Martin Jischke, State & MacArthur, State & Dexter, Stadium & University, Stadium & Martin Jischke, 3rd & Jischke, 3rd & Waldron, Salisbury & North, Salisbury & North, Fowler & North, Fowler & Vine, Northwestern & Grant, Northwestern & Meridian, Northwestern & Fowler and Grant & Williams.

There were no crashes reported at Stadium and Northwestern.

Rural Tippecanoe County

The number of crashes that occurred in the suburban fringe and rural portions of Tippecanoe County was substantially fewer than in both cities and the Purdue area, accounting for 21 crashes. That translates to 6.8% of all the crashes over six years. Comparing the number of crashes by square mile, the rate is extremely small.

Figure 17 shows the location of the crashes. Nearly half of them occurred west of West Lafayette and Purdue with four in and around the US 52 West corridor and three in the Klondike and Lindberg Road area. Near Lafayette, three crashes occurred just to the south and one just to the east of the corporate limits.

Of the 21 crashes, four occurred in residential subdivisions. All of them involved children the age of ten or younger. Nearly all of the other crashes occurred on county roads with six of them occurring on state roads.

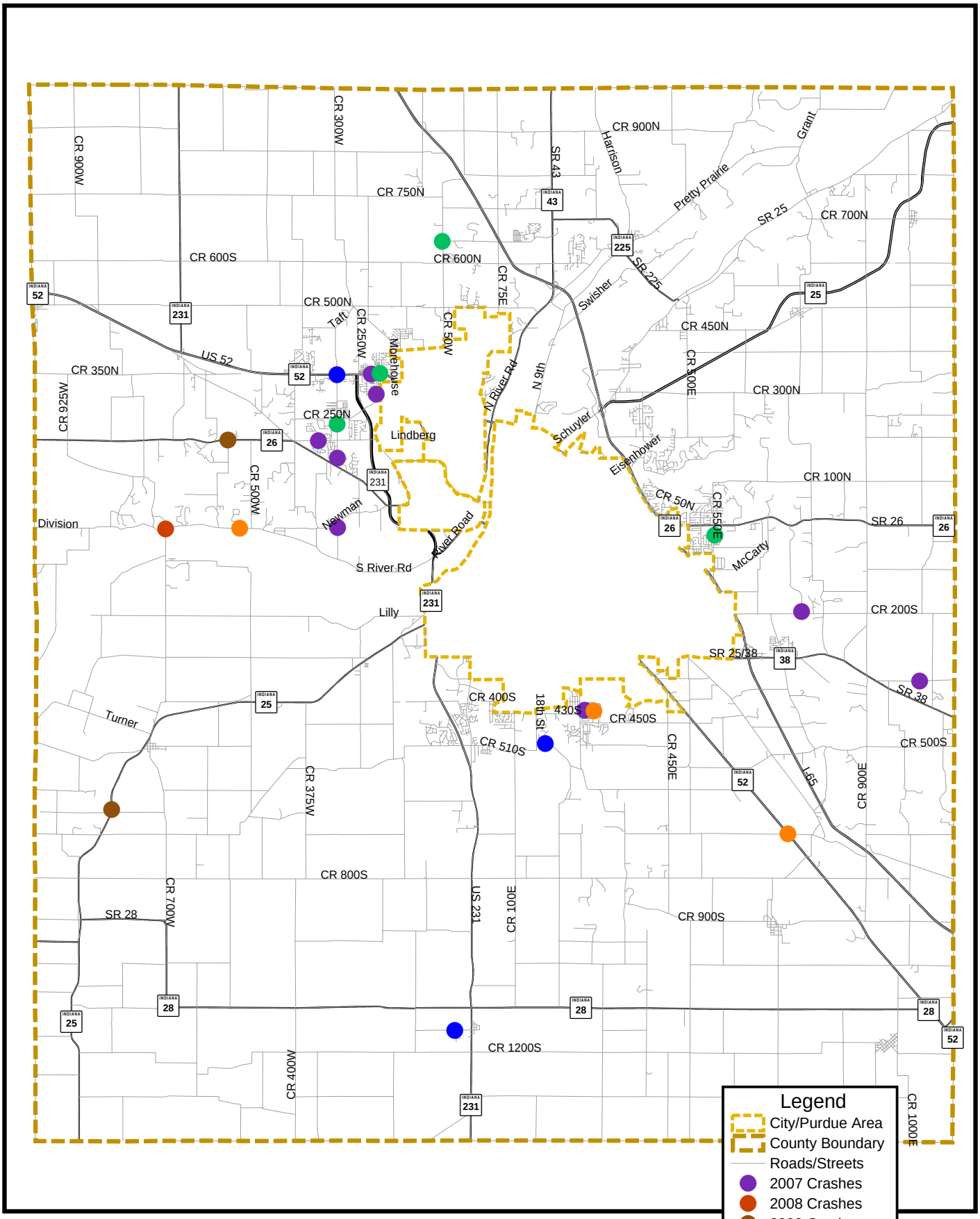
By Specific Location

Geographically we know where all of the crashes occur. Another way to analyze the crash data is to look at where they occurred on the roadway. For example, many of the crashes that occurred in Tippecanoe County took place at intersections. Those that had more than one crash reported have already been individually pointed out. This section will look at crashes that occurred on the roadway and at specific areas of the road such as in bike lanes, at driveways and alleys, on trails and sidepaths. There were no sharrows in the county during the six year period.

By far, the majority, 60%, of crashes occurred at an intersection. Looking at the data by year, the number was fairly consistent at around 30 per year. **Table 25** displays this information.

The next most frequent locations were in the roadway, at approximately 16.8 percent, and at driveways at 13.5 percent. However, the data by year shows fluctuations. The number that occurred in the roadway varied from a high of 12 (2007) to a low of 6 (2009 and 2011). The number that occurred at driveways varied from a high of 12 (2007) to a low of 4 (2011 & 2012). **Figure 18** shows where the roadway and driveway crashes occur.

Figure 17: Bicycle Crashes Located in Rural Tippecanoe County



There were 21 crashes that occurred in alleys. This includes crashes where an ally meets a road or that occurred in the alley. Nine occurred in West Lafayette with four in Chauncey Village and four in the Fowler and Wiggins corridor. The other 12 crashes occurred in Lafayette with no discernable pattern. There were some that occurred on the northern side, some in and near the downtown area. There were two locations where there were two crashes at each site. One was on Salem just east of 6th and the other was on Chauncey just north of Wood Street.

Table 25: Crashes by Specific Location

Year	Roadway	Intersection	Driveway	Alley	Trail/ Sidepath	Bike Lane	Total
2007	12	33	12	7	0	1	65
2008	10	31	8	5	1	1	56
2009	5	32	8	2	1	1	49
2010	8	28	7	3	1	0	47
2011	6	30	4	1	0	2	43
2012	10	32	4	3	0	1	50
Total	51	186	43	21	3	6	310

Both cities, as well as the county, have an established system of bike lanes, sidepaths and trails. Over the six year period, there were only three crashes reported on a trail or sidepath. There were twice as many, six, that occurred in a bike lane. But when compared to the total number of crashes, this number is very small. **Figure 19** shows where all of the bicycle crashes occurred compared to the location all of the bike lanes, sidepaths and trails in the county.

Riding on the Sidewalk and Riding Against Traffic

Riding On the Sidewalk

It is common to see cyclists who prefer to drive on the sidewalk rather than in the roadway, bike lane or sidepath. Ordnances regulating, or allowing, cyclists the use of sidewalks vary by government agency. In Lafayette, a person may drive on the sidewalk except within the Central Business District or under certain circumstances. In West Lafayette, no one is permitted to drive on the sidewalk within a business district. Outside of a business district, no one may drive on sidewalk unless they are fifteen or younger. On the Purdue Campus, a bicycle may be driven on all designated campus drives and bike paths but may not be driven on sidewalks unless otherwise posted. Tippecanoe County and the State of Indiana have no ordinances or statutes restricting driving on sidewalks.

Table 26 shows the number of crashes that occurred where cyclists were driving on the sidewalk. Nearly a third of all crashes involved a bicycle being driven on the sidewalk. **Figure 20** shows their locations. The majority of sidewalk crashes occurred in West Lafayette, 47, with nearly all of them near the Purdue Campus. Thirty-six crashes occurred in Lafayette. The remaining eight occurred on campus (6), one on the Harrison Bridge and one in a rural Tippecanoe County subdivision.

Looking at the crash location in West Lafayette, 18 crashes occurred in the State Street corridor with 10 of them between Salisbury and River Road. Ten crashes occurred in the Northwestern corridor and ten in the Salisbury corridor. There were seven crashes reported in the Russell Street corridor.

Figure 18: Bicycle Crashes that Occurred on the Roadway and at Driveways

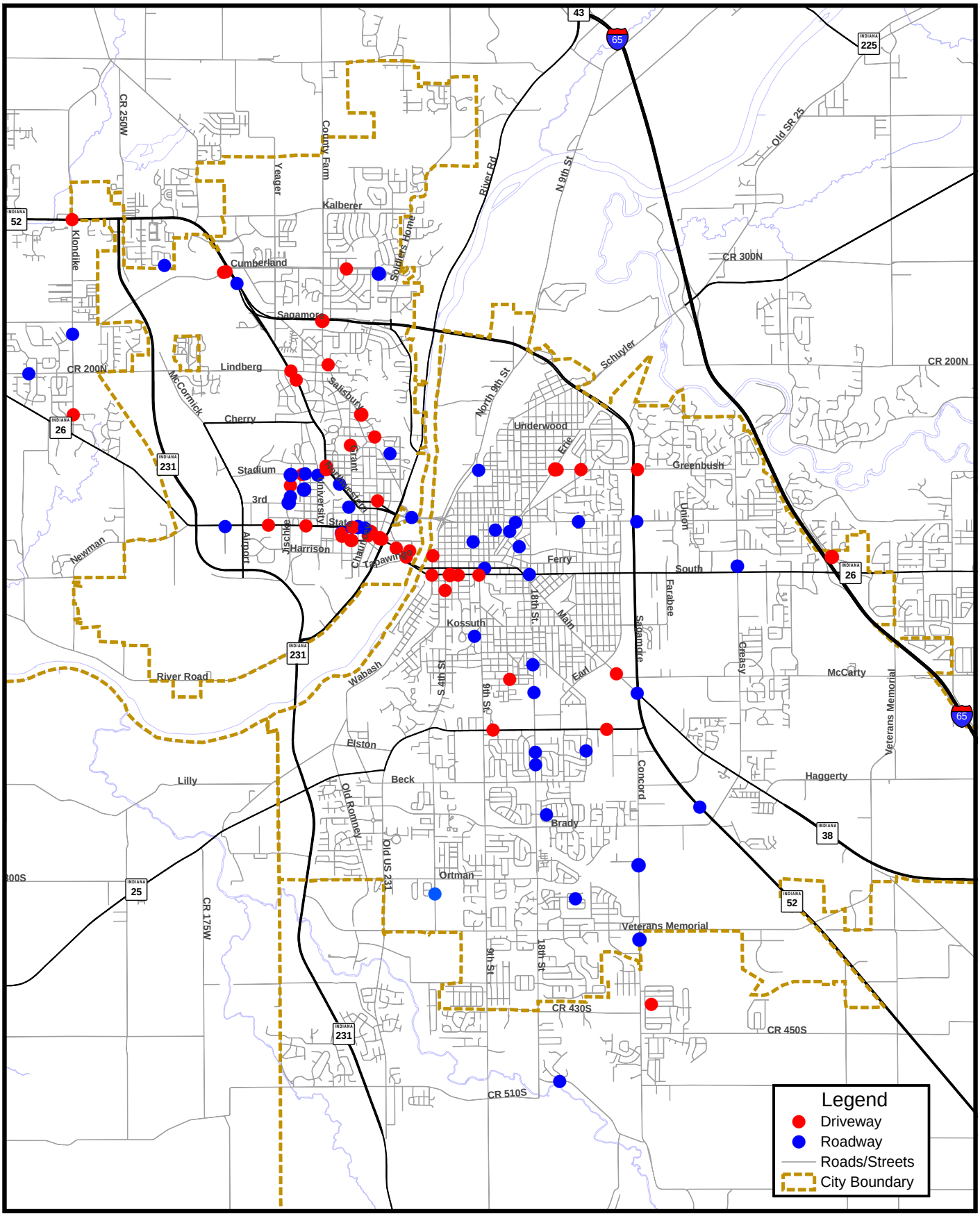


Figure 19: Bicycle Crash Locations Compared to Locations of Trails, Bike Lanes and Footpaths

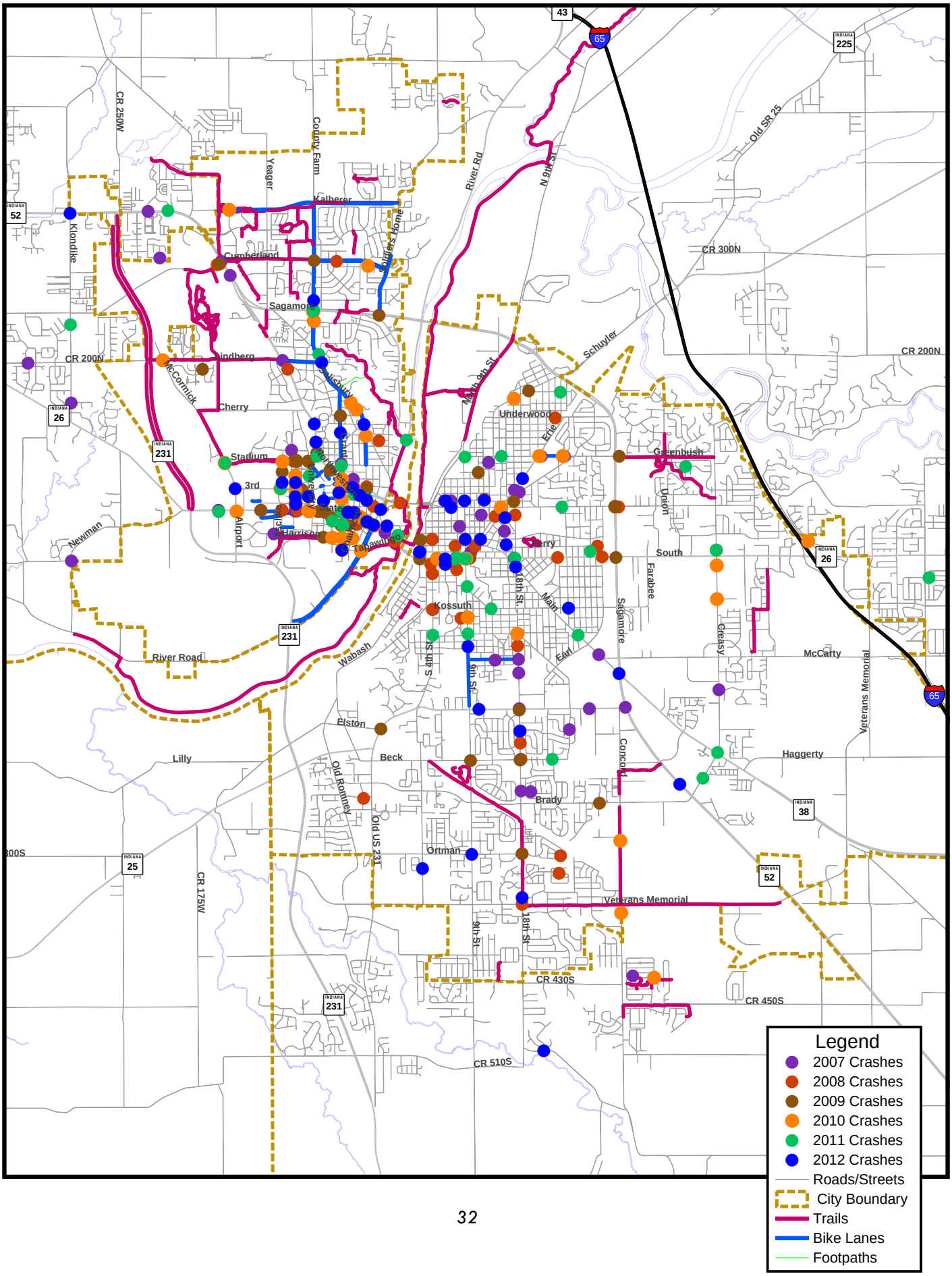


Table 26: Crashes on Sidewalks and Against Traffic

Year	Total Number	On Sidewalk	Percent	Against Traffic	Percent	Both	Percent
2007	65	22	33.8%	27	41.5%	18	27.7%
2008	56	23	41.1%	16	28.6%	14	25.0%
2009	49	16	32.7%	21	42.9%	14	28.6%
2010	47	7	14.9%	12	25.5%	5	10.6%
2011	43	11	25.6%	17	39.5%	10	23.3%
2012	50	12	24.0%	12	24.0%	7	14.0%
Total	310	91	29.4%	105	33.9%	68	21.9%

There were eight intersections where more than one crash was reported. The intersection with the highest number was at State Street and Salisbury with five. There were three intersections where three crashes occurred at each intersection: State Street and River Road, State Street and Russell, and at Wood and Grant Street. Intersections where two crashed occurred included: State Street and Northwestern, State Street and Andrew Place, Northwestern and Evergreen and Northwestern and Meridian.

In Lafayette, a third of the crashes occurred in the downtown area with five of them along South Street. The other areas where they appear to be clustered includes the 18th Street and Union and Salem area, and around the Edgelea and Tecumseh subdivisions.

Looking at the crashes by corridor, ten crashes occurred in the 18th Street corridor. Six crashes occurred in the South Street corridor from 2nd Street to 18th Street and there were five crashes in the 4th street corridor.

There were five intersections where more than one crash occurred, with two occurring at each of them. The intersections were: Salem and 14th Street, Columbia and 2nd Street, South and 7th Street, 4th Street and Kossuth and at 18th Street and Central.

Riding Against Traffic

In the roadway, a cyclist is required to ride with traffic and not against it. Unfortunately, there were 105 crashes where cyclists were riding against traffic. 16 percent, or 63, of those crashes occurred in West Lafayette with nearly 90 percent of those occurring near the Purdue Campus. There were 35 riding against traffic crashes in Lafayette with 10 of them occurring in the downtown area. **Table 26** shows the number of crashes by year and **Figure 21** shows their location.

The corridor with the highest number of these crashes was State Street in West Lafayette. There were 29 crashes between Martin Jischke Drive and Wabash Landing. The largest concentration was between Salisbury Street and River Road, 13 crashes. Other corridors where crashes were more frequent included Salisbury Street (16), Northwestern (11), Russell (7), South Street in Lafayette (7) and 18th Street (6).

Looking at crashes by intersection, the intersection with the highest number was State Street and Salisbury with seven. There were four crashes each at intersections of State Street and River Road and at State Street and Chauncey. There were three crashes each at State Street and Andrew Place, Wood and Grant, Northwestern and Evergreen and South Street and 7th Street. There were ten intersections having two crashes: State Street and Russell, State Street and Grant, State Street and Northwestern, Northwestern and Meridian, Northwestern and Fowler, Fowler and Vine, Russell at 2nd St., Salisbury at Navajo, South Street at 9th St. and Salem at 14th St.

Figure 20: Location of Crashes Where Bicycles were on the Sidewalk

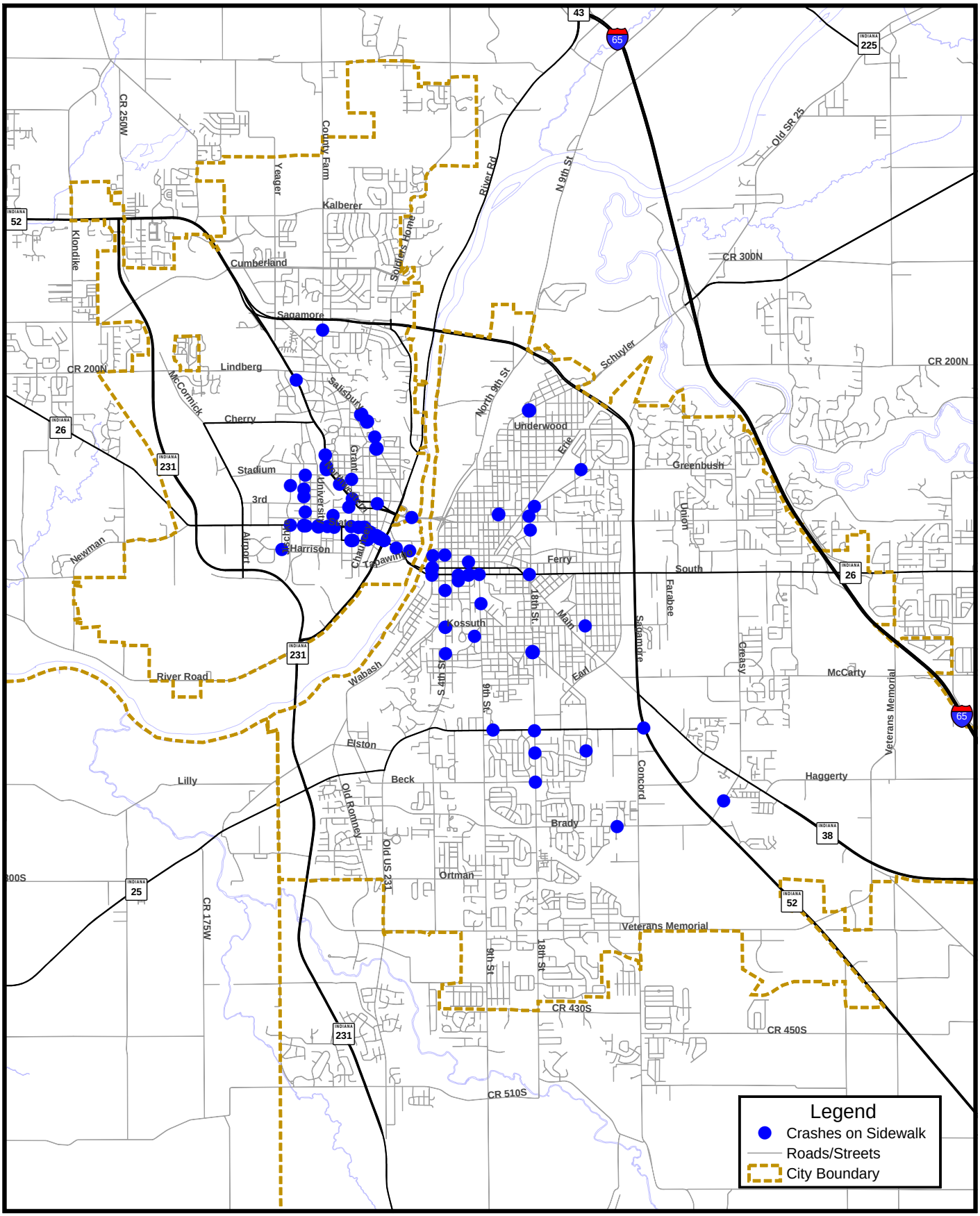
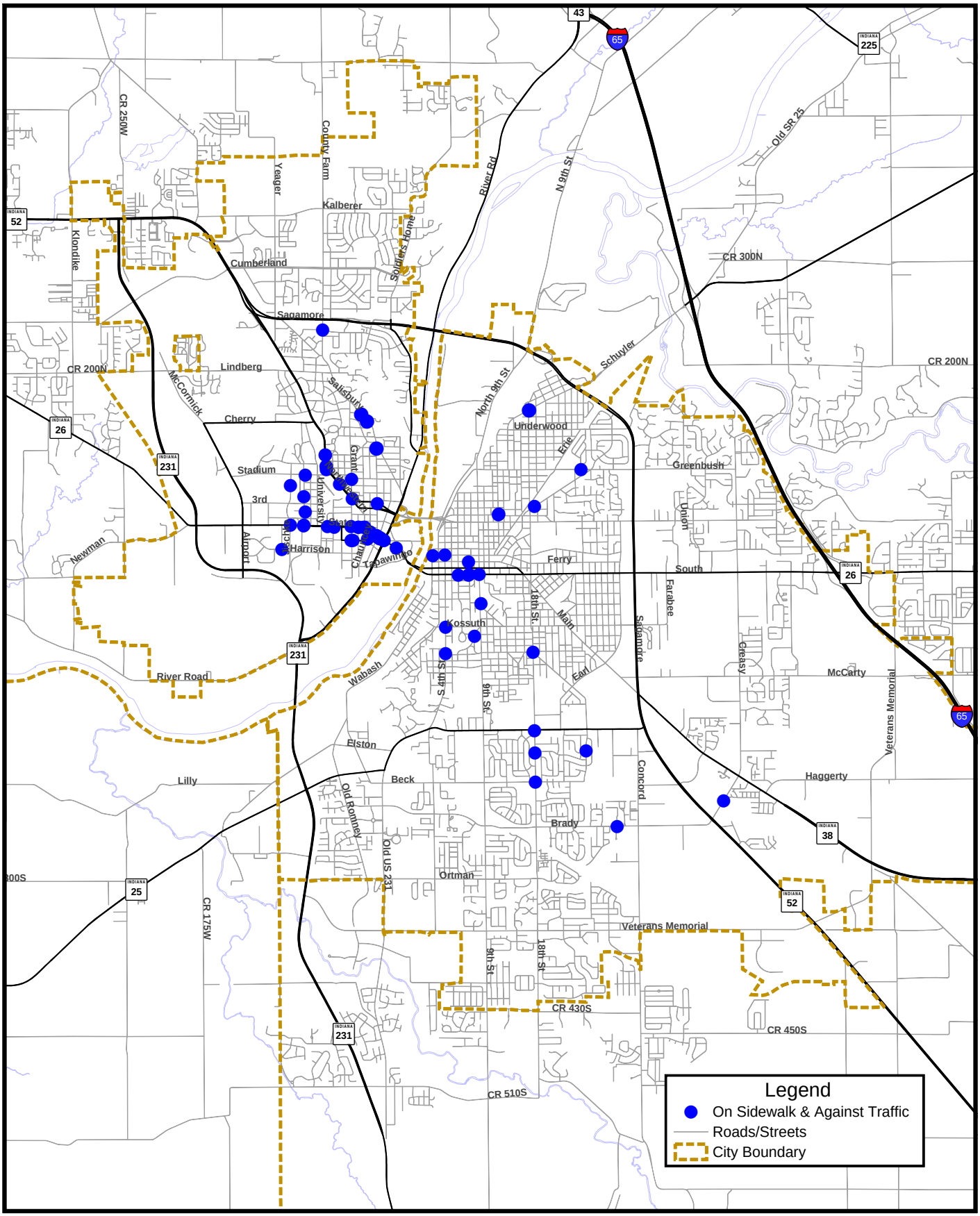


Figure 22: Locatin of Crashes Where Bicycles were Traveling on the Sidewalk and Against Traffic



Riding On the Sidewalk and Against Traffic

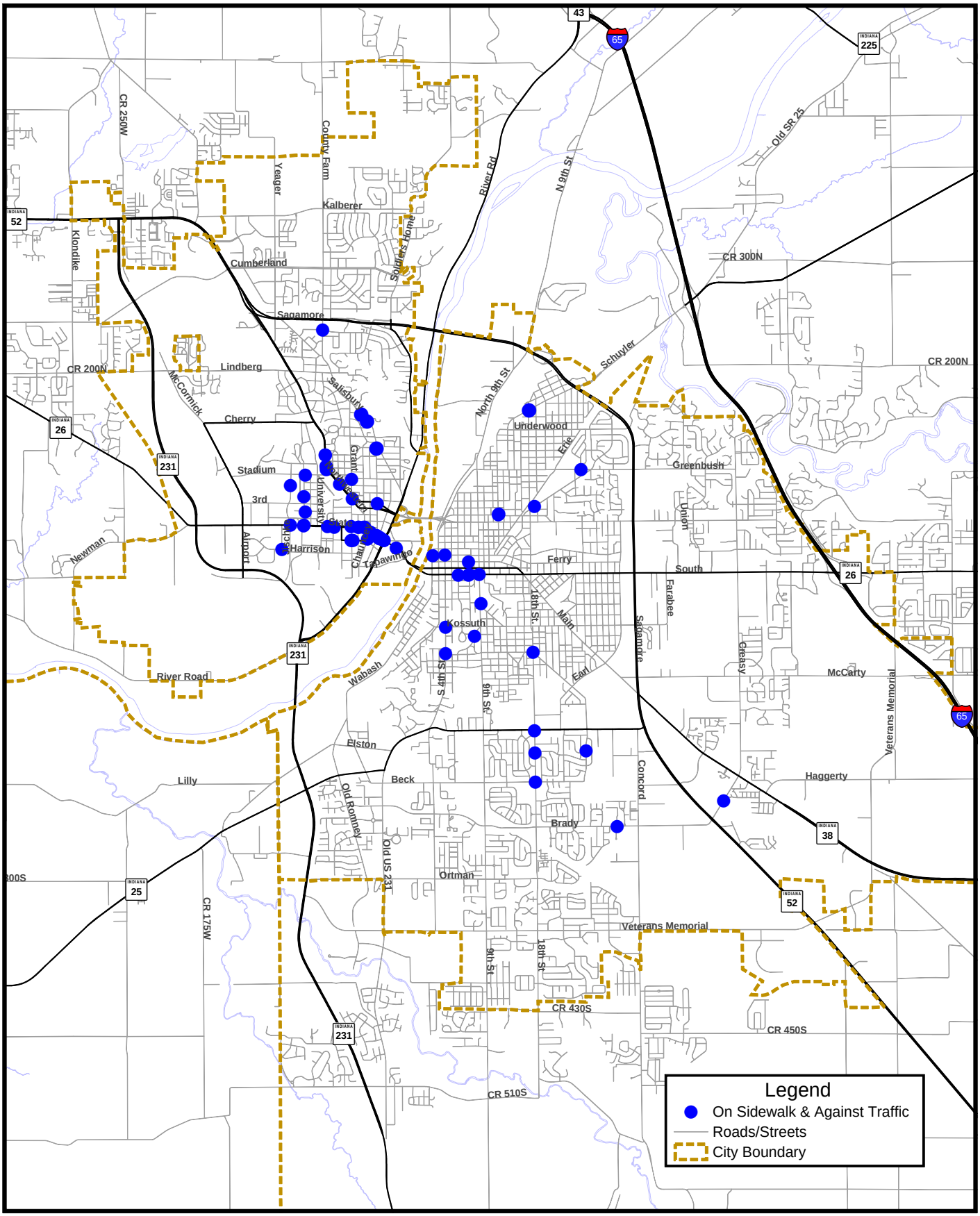
The majority, or three quarters, of cyclists who were involved in a crash while riding on the sidewalk were also traveling against traffic. Many of these crashes were located at an intersection (48) and at driveways (13.) **Figure 22** shows where those crashes occurred. When riding on a sidewalk, motorists are looking for pedestrians and not expecting bicycles.

Many of the crashes (44) were located in West Lafayette either on or near the Purdue campus. 23 of the crashes occurred in Lafayette. One crash was located in a rural subdivision.

The corridor where the majority of crashes occurred was State Street from Martin Jischke Drive to River Road with 22 crashes. Nearly half of them were located between Salisbury Street and River Road. Other notable corridors where crashes occurred, include Russell Street, Northwestern, Salisbury, South Street and 18th Street.

In Lafayette, there were several notable locations including the downtown area (7) and around the Tecumseh subdivision (4.)

Figure 22: Locatin of Crashes Where Bicycles were Traveling on the Sidewalk and Against Traffic



Who and What are Causing the Crashes?

Who Is At Fault

A crash is a complex event, and determining fault is not always clear. In order to better access who was at fault, APC staff individually reviewed each crash report. Over six years, cyclists and motorists were nearly equally at fault. **Table 27** shows the yearly variation. There were three years where one group caused more crashes - by a two to one margin. In 2008 and in 2010, motorists caused more crashes while cyclists caused more crashes in 2007.

Table 27: Crash Data by Fault and by Year

Year	Total	Cyclists Fault	Percent	Motorists Fault	Percent	Unknown	Percent
2007	65	41	*63.1%*	24	*36.9%*	---	---
2008	56	22	*39.3%*	34	*60.7%*	---	---
2009	49	26	*53.1%*	21	*42.9%*	2	*4.1%*
2010	47	17	*36.2%*	30	*63.8%*	---	---
2011	43	23	*53.5%*	19	*44.2%*	1	*2.3%*
2012	50	26	*52.0%*	23	*46.0%*	1	*2.0%*
Total	310	155	*50.0%*	151	*48.7%*	4	*1.3%*

Primary Circumstance

Many circumstances contribute to a crash. For each crash report, officers are allowed to specify two "Driver", one "Vehicle", and one "Environmental" contributing circumstances for each vehicle. For each of the vehicles in the crash, one of the four possible contributing circumstances must be listed as the primary contributing circumstance (the Primary Factor) for the crash. **Table 28** lists all of the primary contributing circumstances reported for all 310 crash reports.

The leading cause of crashes during the study period was "Failure to Yield Right-of-Way" with 113 incidents, or 36.5 percent. "Pedestrian Action" was the third leading cause. The other two leading causes were identified as "Other," assigned either to the driver or environmental. Detailed explanations of the crash were then provided in the report narrative. These four causes accounted for over 80 percent of all the crashes.

Detailed Analysis: Causes of the Crash and by Fault

While we know the primary circumstances of all the crashes, nearly a third of them were reported as "Other" with a detailed explanation following in the narrative. This makes it challenging for planners and engineers when developing safety countermeasures. To address this issue, APC staff read the narrative of each report and then specifically looked at the pre-crash conditions and movements of each vehicle involved. The crashes were then assigned to a specific crash type. The crash type list is similar to that used by the Pedestrian and Bicycle Crash Analysis Tool developed by the National Highway Traffic Safety Administration. In addition to segregating crashes by type, they were also separated by who was responsible for causing the crash and by specific location.

Table 28: Crash Data by Primary Circumstance and by Year

Primary Circumstance	2007	2008	2009	2010	2011	2012	Total	Percent
Failure to Yield Right-of-Way	19	22	20	21	17	14	113	*36.5%*
Other (driver), Explained in Narrative	24	12	10	7	4	14	71	*22.9%*
Pedestrian Action	12	10	12	3	7	7	51	*16.5%*
Other (environmental), Explained in Narrative	1	2	3	7	3	3	19	*6.1%*
Disregard Signal/ Regulator Sign	2	1	2	1	2	1	9	*2.9%*
Improper Lane Usage	1	2	---	1	2	3	9	*2.9%*
Following Too Closely	1	2	---	1	3	1	8	*2.6%*
Improper Turning	---	2	---	1	2	---	5	*1.6%*
View Obstructed	1	1	1	1	---	---	4	*1.3%*
Improper Passing	---	1	---	---	2	1	4	*1.3%*
Wrong Way on One Way	1	---	---	---	1	2	4	*1.3%*
Driver Distracted, Explain in Narrative	1	---	---	1	---	---	2	*0.6%*
Unsafe Speed	1	---	---	1	---	1	3	*1.0%*
Headlight Defector or Not On	---	---	---	1	---	---	1	*0.3%*
Unsafe Backing	---	---	---	1	---	---	1	*0.3%*
Driver Asleep or Fatigued	---	---	1	---	---	---	1	*0.3%*
Left of Center	---	1	---	---	---	---	1	*0.3%*
Ran Off Road Left	1	---	---	---	---	---	1	*0.3%*
Overcorrected/Oversteering	---	---	---	---	---	1	1	*0.3%*
Other, Lights Defective	---	---	---	---	---	1	1	*0.3%*
None Listed	---	---	---	---	---	1	1	*0.3%*
Total	65	56	49	47	43	50	310	

The Causes of Crashes Where the Cyclist Was at Fault

Looking over the crash data where the cyclists was at fault, the top two causes were failure to yield while entering the intersection, 39.4 percent, and failure to yield while entering the roadway, 16.8 percent. The third leading cause involved the cyclists traveling against traffic. 11 crashes occurred because the cyclists drove into the motor vehicle. Some of the other causes include: no reflectors or lights on the bicycle, traveling too fast, brake failure, and improperly passing. **Table 29** displays this data.

Looking at where the crashes occurred, 88 of them occurred at an intersection while 32 occurred in the roadway. These numbers appear to be close to those for all crashes in which bicycles were involved. **Figure 23** shows the locations where the cyclist was at fault.

The Causes of Crashes Where the Motorist was at Fault

The leading cause of crashes when the motorist was at fault was failure to yield, 78 crashes. 38 of those crashes occurred while the motor vehicles were making a right hand turn and 28 crashes occurred while the motor vehicles were making a left hand turn. The majority of these crashes occurred at an intersection. Some of the other leading causes include improperly passing and an obstructed view. There were eight crashes that involved the motorist rear ending the cyclist. Of those eight, only three occurred on the roadway. **Table 30** shows the detailed data.

Table 29: The Causes of Crashes Where the Cyclist Was at Fault

Cause	Number of Crashes	Percent	In Roadway	At Intersection	At Driveway	Alley	Other
Failure to Yield, Entering Intersection	60	*39.4%*	---	56	2	1	1
Failure to Yield, Entering Roadway	26	*16.8%*	16	---	5	5	---
Traveling Against Traffic	14	*9.0%*	---	10	4	---	---
Drove Into Vehicle	11	*7.1%*	2	5	4	---	---
Brakes Failed	7	*4.5%*	1	3	---	3	---
No Reflectors or Lights	5	*3.2%*	1	3	1	---	---
Traveling too Fast and Lost Control	4	*2.6%*	1	2	1	---	---
View Obscured and Travel the Against Traffic	3	*1.9%*	---	2	1	---	---
Improperly Turned in front of Vehicle	3	*1.9%*	3	---	---	---	---
Improperly Passing	3	*1.9%*	2	---	1	---	---
Changing Lanes	3	*1.9%*	2	---	1	---	---
Rear-ended Auto	3	*1.9%*	2	1	---	---	---
View Obstructed	3	*1.3%*	---	---	---	3	---
No Lights and Traveling in Wrong Direction	2	*1.3%*	---	1	1	---	---
Sideswiped Auto	2	*1.3%*	---	1	---	1	---
Wet Pavement	2	*1.3%*	---	2	---	---	---
Swerved to Miss Another Bike and Hit Car	1	*0.6%*	---	1	---	---	---
Disregarded Signal/Sign	1	*0.6%*	---	1	---	---	---
Slipped off Curb	1	*0.6%*	1	---	---	---	---
Intoxicated	1	*0.6%*	1	---	---	---	---
Total	155		32	88	21	13	1

The location where the majority of crashes occurred when the motorist was at fault was at an intersection, 93 crashes. Dropping to a distant second, the next most frequent location was at a driveway. Slightly fewer crashes occurred in the roadway. There were an equal number of crashes occurring, 8 each, at or in an alley and in a bike lane, sidepath or trail. **Figure 24** shows the location of crashes where the motorist was at fault.

Figure 23: Location of Crashes Where the Cyclist Was at Fault

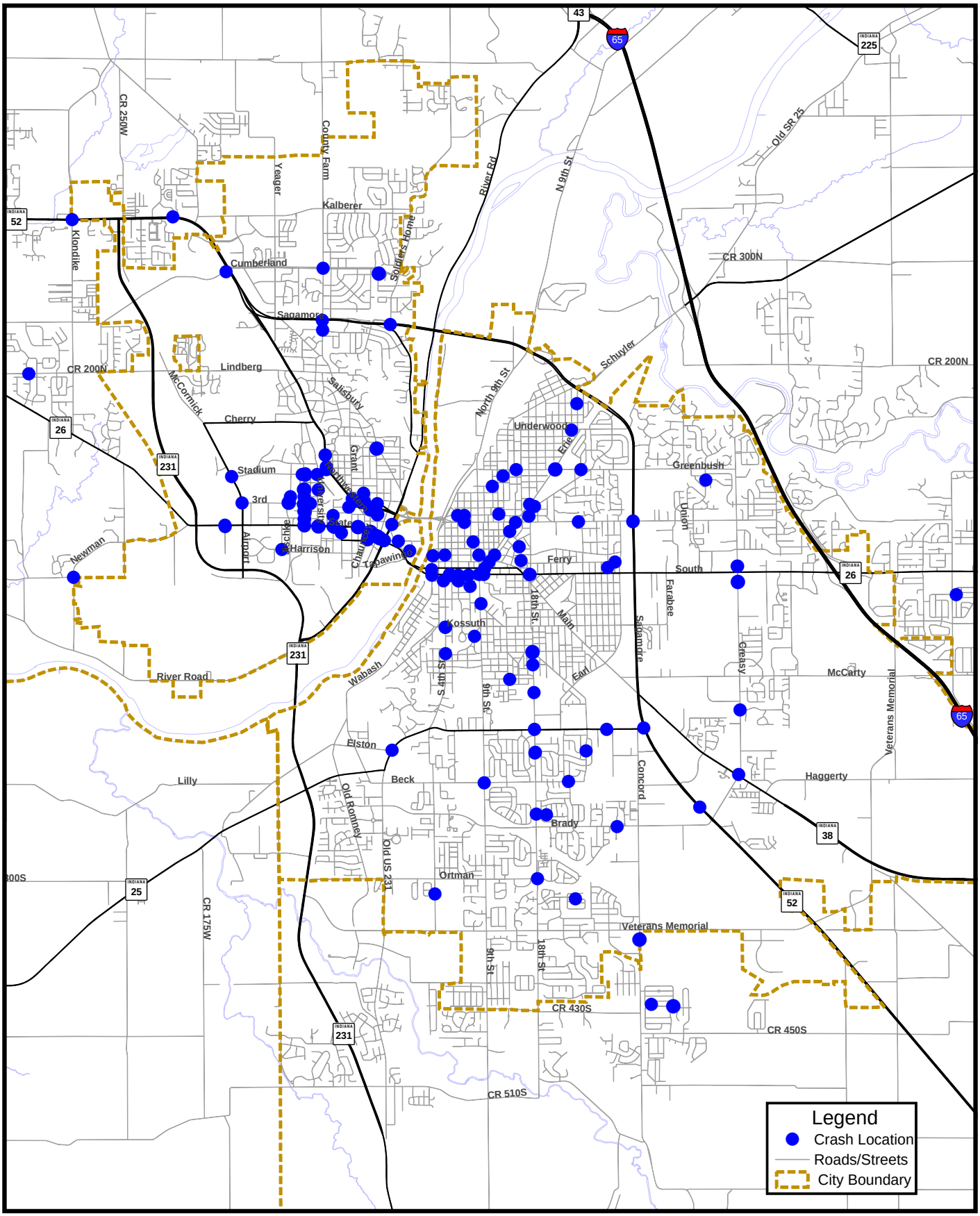
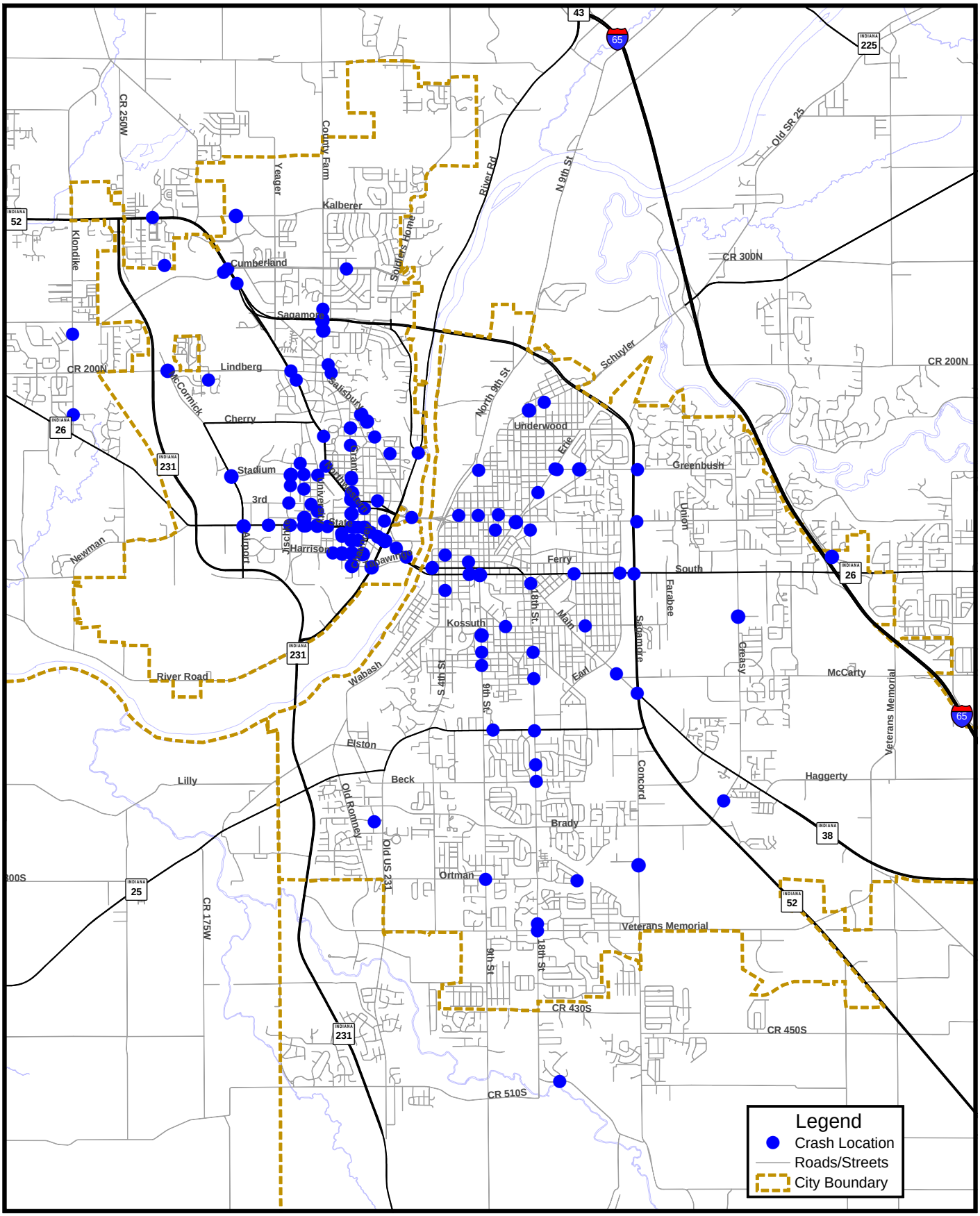


Table 30: The Causes of Crashes Where the Motorist Was a Fault

Cause	Number of Crashes	Percent	In Roadway	At Intersection	At Driveway	Alley	Other
Failure to Yield, Right Turn	54	*35.8%*	---	38	9	2	5
Failure to Yield, Left Turn	35	*23.2%*	---	28	5	2	---
Failure to Yield	22	*14.6%*	---	12	6	2	2
Improperly Passes Bicycle	10	*6.6%*	7	3	---	---	---
Rear End Cyclists	8	*5.3%*	3	5	---	---	---
View Obstructed	7	*4.6%*	---	3	2	1	1
Improperly Merges into Lane	2	*1.3%*	2	---	---	---	---
Improperly Backing	2	*1.3%*	---	---	1	1	---
Driver Distracted	2	*1.3%*	2	---	---	---	---
Failure to Yield, U-Turn	2	*1.3%*	2		---	---	---
Stopped in Crosswalk	1	*0.7%*	---	1	---	---	---
Failure to Yield, Travel Through	1	*0.7%*	---	1	---	---	---
Glare from Sun	1	*0.7%*		1	---	---	---
Auto Lost Control	1	*0.7%*	1	---	---	---	---
Swerved to Miss Car and Hit Cyclists	1	*0.7%*	1	---	---	---	---
Driver Fell Asleep	1	*0.7%*	1	---	---	---	---
Road Wet	1	*0.7%*	---	1	---	---	---
Total	151		19	93	23	8	8

Figure 24: Location of Crashes Where the Motorist Was at Fault



Initial Recommendations.

1. Discuss findings with local law enforcement and local government engineers for purposes of generating projects.

2. APC Staff will conduct detailed high crash location intersection and corridor analyses.

3. Based on information in Tables 29 and 30, the highest ranking causes of bicycle and motorist indicate that reductions may be achieved by launching a distracted driving education campaign.

4. Review city codes that allows cyclists to drive on sidewalks

5. Review the need for regulatory signage along trails and sidepaths.