

# **Road Safety Audit for US 6 from the ECL of Iowa City to the WCL of West Liberty in Johnson and Muscatine Counties, Iowa**

**Final Report  
November 2008**

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<b>16. Abstract</b>  <p>Approximately 13.2 miles of US 6 in eastern Iowa extends from the east corporate limits of Iowa City, Iowa, to the west corporate limits of West Liberty, Iowa. This segment of US 6 is a service level B primary highway, with an annual daily traffic volume varying from 3,480 vehicles per day (vpd) to 5,700 vpd. According to 2001–2007 crash density data from the Iowa Department of Transportation (Iowa DOT), the corridor is currently listed among the top 5% of non-freeway Iowa DOT roads in several crash categories, including crashes involving excessive speed, impaired drivers, single-vehicle run-off-road, and multiple-vehicle crossed centerline.</p> <p>A road safety audit of this corridor was deemed appropriate by the Iowa Department of Transportation's Office of Traffic and Safety. Staff and officials from the Iowa DOT, Iowa State Patrol, Governor's Traffic Safety Bureau, Federal Highway Administration, Center for Transportation Research and Education, and several local law enforcement and transportation agencies met to review crash data and discuss potential safety improvements to this segment of US 6.</p> <p>This report outlines the findings and recommendations of the road safety audit team to address the safety concerns on this US 6 corridor and explains several selected mitigation strategies.</p>			
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## **INTRODUCTION**

On October 14 and 15, 2008, a road safety audit was conducted for a segment of US 6 in eastern Iowa extending from the east corporate limits of Iowa City, Iowa, to the west corporate limits of West Liberty, Iowa. US 6 between Iowa City and West Liberty is a 13.2 mile length of primary highway with an annual daily traffic volume varying from 3,480 vehicles per day (vpd) to 5,700 vpd, including 290 commercial vehicles, according to 2006 data from the Iowa Department of Transportation (Iowa DOT). According to 2001–2007 crash density data, the corridor is currently listed among the top 5% of non-freeway Iowa DOT roads in several crash categories, including crashes involving excessive speed, impaired drivers, single-vehicle run-off-road, and multiple-vehicle crossed centerline. Maps showing this information are included in Appendix B of this report.

For approximately 5.5 miles from Iowa City to just past American Legion Road in Johnson County, US 6 is a 24 ft wide pavement with approximate 10 ft wide granular shoulders. This section was constructed in 1958 using portland cement concrete (PCC), and no major work has been completed since then. The remaining section of US 6 in Johnson County has approximately 2 to 3 ft wide granular shoulders and a narrow right-of-way. This section was originally constructed in 1928 and then overlaid with 1.5 in. of asphalt in 1956 and 3 in. of asphalt in 1987.

The segment of US 6 in Muscatine County is 5.5 miles in length and was originally constructed in 1930. A 1.5 in. asphalt overlay was added in 1956, and an additional 3 in. of asphalt was added in 1987. In addition, an approximately 1.5 mile section just west of West Liberty was reconstructed in 1989 with a 24 ft wide PCC pavement and 10 ft wide granular shoulders as part of a railroad overpass removal.

## INITIAL MEETING

An introductory meeting was conducted in the Iowa DOT's Coralville maintenance garage to initiate the safety audit. The following individuals participated in the meeting:

- Jerry Roche, Federal Highway Administration
- Adam Larsen, Federal Highway Administration
- Tom Welch, Iowa DOT Safety Engineer
- Greg Parker, Johnson County Engineer
- Jack Latterell, Safety Consultant
- Sgt. Sharon Kurt, Iowa State Patrol
- Gary Kramer, Johnson County Sheriff
- Capt. Jeff Mullen, Muscatine County Sheriff
- Major Dave White, Muscatine County Sheriff's Office
- Randy Hunefeld, Governor's Traffic Safety Bureau
- Newman Abuissa, Iowa DOT Area Engineer
- Steve Wilson, Iowa DOT Traffic Technician
- Bryan Bradley, Iowa DOT, Office of Traffic and Safety
- Travis Nitcher, Iowa DOT Maintenance Supervisor
- Bob Sperry, Center for Transportation Research and Education, Iowa State University
- Tom McDonald, Center for Transportation Research and Education, Iowa State University

Following introductory comments by Jack Latterell, Jerry Roche, and Tom McDonald describing the scope, purpose, and reason for this road safety audit, copies of crash data for the most recent seven years, 2001–2007, were distributed and summarized. A total of 187 crashes were recorded during the analysis period, including 4 fatal, 10 major injury, 27 minor injury, 36 possible injury or unknown, and 110 property damage only crashes. Among the two counties, 123 crashes (66%) occurred in Johnson County and 64 (34%) occurred in Muscatine County. These percentages are approximately equal to the length of roadway in each county, 7.7 miles (58%) in Johnson County and 5.5 miles (42%) in Muscatine County. Crash types noted included 41 rear-end collisions, a high number for a rural roadway, 24 sideswipe crashes, also a high number, and approximately 24 crashes associated with intersections. Run-off-road crashes totaled 20, and approximately 18 crashes were noted as directly related to excessive speed. The most prevalent driver ages for these crashes were the twenties and thirties. Most crashes, 63%, occurred on dry pavement, and 51% occurred in daylight conditions, but 36% occurred at night. Although crash locations were scattered throughout the entire section, many crashes occurred in horizontal and/or vertical curve areas. A total of 24 animal-related crashes were noted, many in an approximate 4 mile section around Baker Avenue (County Road X-30). Most severe crashes, including fatalities, were related to speed, crossing the centerline, and impairment. Some of the law enforcement officers believed that more fatal crashes than shown in the data occurred, and this issue was reviewed before this final report was issued. The crash data will be examined in more detail later in this report in the descriptions of the daytime and nighttime reviews.

After the overview of the crash data, the value of a multidisciplinary approach to crash problem identification and mitigation was discussed, including low-cost engineering, enhanced enforcement, and public information/education efforts. It was noted that a major employer in West Liberty, a turkey processing plant, has a safety program, and crash concerns on US 6 might be a good topic for presentation to commuting workers.

The law enforcement officers and Iowa DOT field staff with experience with this road section offered comments and opinions about road conditions that may contribute to these crashes. Much of the roadway, especially in Muscatine County, has narrow 2–3 ft wide shoulders and a right-of-way with small ditches and little storage area for snow in the winter. As a consequence, the super-elevated curves in particular can exhibit icing due to the thawing and refreezing of the built-up snow, which can be a friction concern for drivers. This road is listed as Service Level B section by Iowa DOT maintenance, with a lower priority for snow and ice removal than roads such as Interstate 80 and US 218. Edge rutting has also been noted along this route. Excessive speeding (80–90 mph or more) and passing by some drivers in restricted areas has prompted more focused law enforcement efforts, especially by Major Dave White, with good results. Driver performance is a real concern on this road, but very few Iowa State Patrol officers in the area are available for assistance on US 6.

The Muscatine County Sheriff's Department plans to experiment with an infrared detection system for nighttime seat belt surveillance in the near future, and Randy Hunefeld of the Governor's Traffic Safety Bureau indicated an interest in the results of this trial.



## **FIELD REVIEWS**

Images from the daytime and nighttime field reviews are included in Appendix D. A description of the field reviews is presented below.

### **Daytime Field Review**

After lunch, the group traveled to the roadway section for a daylight review of road conditions and possible high-crash locations. Trooper Jose Valera of the Iowa State Patrol also participated in this review.

The daylight review began at Scott Boulevard on the east corporate limits of Iowa City, which had been the location of numerous crashes over the analysis period. Twenty-three total crashes occurred here, many of which were rear-end collisions. However, major improvements were made to US 6 at this intersection in 2006, particularly the addition of protected left-turn lanes. No crashes were recorded at this intersection in 2007, and only one was recorded in 2006. Large cedar trees were noted within the clear zone easterly from the 420th Street intersection, and these may be obstructing passing sight distance. The current no-passing zone should be studied for adequacy.

The 10–12 ft granular shoulders in this area have been recently maintained and were in good condition. However, the granular material layer was very thin. The painted edge lines were good through a curve area, but were very poor easterly from the 420th Street intersection. Centerline paint markings were satisfactory. The PCC pavement in this area has been patched in a few locations and exhibits some cracking, but it is in fairly good condition considering its age.

A pothole was noted in the shoulder near the Taft Avenue intersection. Street name signs at this intersection were not clearly legible. The northbound Stop sign is twisted and not clearly visible for approaching traffic until just south of the intersection due to tall grass in the ditch and the horizontal alignment of Taft Avenue. The Stop Ahead sign location should be reviewed to assure compliance with the *Manual on Uniform Traffic Control Devices* guidelines. Consideration should be given to adding a Stop sign on the left side of Taft Avenue and shifting the double arrow sign opposite the intersection to the left (westerly) to improve visibility for northbound traffic on Taft Avenue. A supplemental arrow sign may also be added. Some sign posts in this area exhibited evidence of use for unofficial signs. This area should be monitored to prohibit such practices.

Advance curve warning signs for two curves east of Taft Avenue appear to be 30 in. in size with a standard yellow background color and no advisory speed plaques. Some cedar trees may be within the clear zone in this area.

The Utah Avenue (County Road X-14) intersection features a large raised island that extends into the eastbound US 6 shoulder. Consideration should be given to removing the area of island in the shoulder. The Lone Tree destination sign should be relocated from Utah Avenue to US 6

in advance of the intersection. The existing Stop sign for northbound Utah Avenue is not clearly visible for approaching traffic and should be supplemented with another Stop sign, possibly located on the left side in the raised island. A Do Not Enter sign is in poor condition and should be replaced.

Granular material on the shoulders is minimal in this area. Some wheel track ruts were noted in the shoulders due to the thin layer of crushed stone. The painted edge line was observed to be in better condition for a distance easterly from Utah Avenue.

The American Legion Road intersection features two raised islands, again extending into the shoulder. Modification should be considered to clear the shoulder width. A Do Not Enter sign is mounted on the backside of a Stop sign and should be relocated to avoid conflict with the octagonal shape of the Stop sign. Installation of a larger Stop sign would also eliminate this concern.

Easterly from American Legion Road, the granular shoulders narrow to a 3–4 ft maximum width, and the right-of-way narrows significantly. Ditches are narrow, and snow storage in winter is minimal. The composite pavement is 24 ft wide, and moderate edge rutting was noticeable east of this intersection. Due to the narrow right-of-way, utility poles are located much closer to the roadway than in the previous roadway section.

At the Oasis Road intersection, large fluorescent advance warning curve signs with a 40 mph advisory speed have been installed, along with large fluorescent yellow chevrons. These had been installed in November 2000. Afterwards, there was a 40% raw reduction in all crashes, a 57% reduction in night/dark crashes, and a significant reduction in crash severity. Approximately 4 ft wide paved shoulders and ditch grading was accomplished throughout the curve area in 2007.

No passing zones in this area should be checked for adequacy.

The Johnson/Muscatine Road (Atwood Avenue) intersection consists of offset T intersections. Both approach roads are granular surfaced. Street name signs should be reset. Several large trees were noted in the northerly right-of-way, well within the clear zone, and should be considered for removal. Larger lettering and high-visibility sheeting for all street name signs throughout would be beneficial.

A curve near mile post (MP) 263 is marked with conventional yellow and black advance curve warning signs, approximately 30 in. in size, with no advisory speed plaques. A wood pile was observed in the right-of-way, and a utility pole downguy is located within the clear zone east of this location. Vegetation (tall grass) observed along the north side of the curve may hamper visibility.

At the Bancroft Avenue (County Road X-30) intersection, larger street name signs have been installed. The intersection Stop sign is offset from the approach roadway, and a private footbridge is located in the right-of-way easterly from this intersection.

A curve near MP 264 has conventional yellow and black advance warning signs, approximately 30 in. in size, with no advisory speed plaques. Older yellow chevrons are in place throughout the curve, although two have been replaced with newer signs. Edge rutting was noted along the low side of the super-elevated curve.

A curve at Burkitt Avenue has conventional yellow and black advance warning signs, approximately 30 in. in size, and no advisory speed plaques. The street name sign post is tipped. Sight distance to the east from this intersection appears hampered. Easterly from this intersection, trees were observed in the right-of-way. Enforcement officers observed that near MP 265 three vertical curves are located within a no-passing zone. The existing no-passing zones should be reviewed for adequacy.

At the Davis Street (County Road X-34) intersection, sight distance to the east is obstructed by a vertical curve in US 6. Seven crashes have occurred at this intersection during the analysis period. A short culvert is located in the southeast quadrant, marked with a vertical panel object marker.

Near MP 266, an approximately 30 ft wide bridge is shielded with w-beam guardrails on all corners, but the terminal sections are not up to date. Vertical panel object markers are installed at all corners of the bridge.

From the bridge through an at-grade railroad crossing, the roadway section has been reconstructed with approximately 10 ft granular shoulders and a wide right-of-way. The rail crossing has flashing lights to warn roadway traffic of approaching trains.

At the Dean Avenue intersection, the Stop sign is not aligned well on the side road approach.

Almost all intersections on this roadway section are T configurations.

The entire US 6 corridor that was examined includes several horizontal curve areas with varying degrees of curvature. Three curves are located in areas with narrow shoulders and limited right-of-way and with aging asphalt pavement. One curve in this area, at Oasis Road, has been recently overlaid. Two curves are located in areas with wider shoulders and right-of-way and with newer PCC pavement. One curve in this area has been partially overlaid with asphalt.

### **Nighttime Field Review**

Following dinner, members of the review team performed a nighttime review of the US 6 roadway section. Most of the painted edge lines throughout the corridor did not appear satisfactory. Dotted edge lines should be considered through intersections that are located at curves. Many signs did not exhibit good visibility. Law enforcement officers reported that a fatal crash had occurred in the first curve westerly from the Bancroft Avenue (County Road X-30) intersection in 2008 and was not listed in the review crash data. Another fatal crash resulting in two fatalities occurred in December 2008 in a curve area just west of County Road X-30.

A review of selected county road approaches indicated excellent pavement markings in Johnson County, with advance Stop Ahead signs on both sides of the roadway. However, the Stop signs were not easily visible for approaching traffic until immediately at the intersection due to the offset installation locations.

## **WRAP-UP MEETING AND RECOMMENDATIONS**

On the morning of October 15, 2008, a wrap-up meeting for the safety audit was conducted at the Coralville maintenance garage. Participating in this meeting were Sgt. Doug Ockenfels from the Johnson County Sheriff's Office, Steve Wilson, Travis Nitcher, Greg Parker, Dave White, Jeff Mullen, Randy Hunefeld, Tom Welch, Newman Abuissa, Jerry Roche, Jack Latterell, Bob Sperry, Adam Larsen, Brian Bradley, and Tom McDonald.

Tom McDonald began the meeting by reporting a morning conversation with two local citizens who were familiar with this roadway section. The citizens had observed that it was not uncommon to observe some drivers drifting across centerline in the curves.

The causes of and possible mitigation for the many reported sideswipe crashes remain a concern. Some thoughts on the contributing factors to these crashes included excessive speed and cross-lane steering following an edge drop-off experience.

A speed study was undertaken, the results of which are presented in Appendix C. Friction test results obtained for this section of US 6 are included in Appendix A.

Greg Parker advised that stop sign rumble strips would be installed only as a last resort due to complaints by local residents. Many other mitigation options for Stop sign violations are available for consideration.

A note will be sent on behalf of the review team to the Iowa DOT District 6 Office requesting consideration of edge line pavement marking application before the end of the season.

Iowa DOT district staff advised that some signing will be relocated and replaced in the near future, especially at the Utah Avenue intersection.

This final report recommends that focused enforcement be undertaken for such violations as speeding, seat belt usage (especially at night), and impaired driving. Though the Iowa State Patrol may not be available to assist to a great extent in these efforts, the use of an air patrol will be suggested to assist officers on the ground.

The law enforcement officers indicated that widened areas for stationary enforcement are probably not needed, as existing driveways can also be used for that purpose. The major concern is finding a safe location for pulling offenders over. Extension of mailbox turnouts should be beneficial for mail carriers, and this could be accomplished using backfill from ditch cleaning.

Media releases and educational efforts are also recommended, especially those emphasizing increased enforcement and low-cost engineering improvements. Media in both counties should be included. Discussion with the turkey processing plant safety program may help raise awareness among commuting employees about the safety concerns on this segment of US 6.

Long-range improvements should include lowering the crest vertical curve just easterly from the Davis Street (County Road X-34) intersection.

New or updated chevrons should be considered for all curves as needed. Working with utility companies may be beneficial in relocating poles and downguys in the clear zone. If removal is not possible, poles and downguys in vulnerable locations should be marked. Fluorescent yellow advance curve warning signs should be installed at all curves, and larger size signs should be considered for problem curves. All signing throughout the section should be reviewed for needed upgrading.

Newman Abuissa suggested that some existing entrances could be removed and side slopes flattened at other entrances, especially on curves.

This report recommends partial paving of shoulders, especially those with narrow widths, and the adjustment of Stop signs at intersections where visibility for approaching drivers is hampered. Rumble stripes along with the shoulder paving would provide excellent additional guidance through curves.

Centerline rumble stripes would be recommended in several areas, including on each side of the railroad crossing and in curve areas. Prior to milling, a thin overlay may need to be applied in the older asphalt sections due to the deteriorated condition of the existing centerline joint.

Some relief from drifting snow might be found by negotiating with farmers about leaving several rows of corn in place along the northerly side of US 6 to act as a snow fence throughout the winter. Ditch cleaning to provide snow storage may also be effective, especially on the high side of super-elevated curves, if the right-of-way width is adequate.

Some funding may be made available to Iowa DOT maintenance staff for acquiring granular material to add on the shoulders.

If this section of US 6 is designated a “Safety Corridor” by the Iowa DOT, a suggestion was made to include a stamp with the statement “US 6 Safety Corridor” on citations to alert judges and prosecutors of the safety concern in this area and possibly reduce the number of dismissals.

## **DATA COLLECTED**

### **Pavement Friction Data**

The Iowa DOT undertook pavement surface friction testing on selected sections of this route in 2004 and again in 2008. Results of this testing indicated friction numbers varying from the low 30s to the middle 50s, with a general decreasing trend over that four-year period. The PCC surface testing indicated somewhat higher friction than most asphalt concrete sections. The district should continue to monitor the lower friction numbers and address this matter as needed in the future. Complete results of the friction testing are included in Appendix A.

### **Traffic Speed Data**

On October 29 and 30, 2008, Iowa DOT district traffic technicians Frank Redeker and Steve Wilson obtained traffic speed samples from three locations along US 6:

- Eastbound lane at MP 258.7
- Westbound lane at MP 258.7
- Westbound lane at MP 262

Equipment used for this study included Nu-Metrics Traffic Analyzers, which were deployed for a period of 24 hours in each location. One additional unit in the eastbound lane at MP 262 failed to collect data.

Traffic volumes over this period ranged from 1,792 to 2,003 total vehicles per lane. Approximately 6% were trucks and busses.

The average recorded speed for all vehicles ranged from 57 to 61 mph, with 25% to 53 % of the vehicles exceeding the posted speed of 55 mph. The calculated 85th percentile speed varied from 63.8 to 69.4 mph.

The complete summary of these data can be found in Appendix C.

### **Crash Data**

For reference during this road safety audit, the Iowa DOT crash database was reviewed for the crash history of this section of US 6 for the period from 2001 through 2007. Copies of pertinent data were provided to all audit team members.

The data summary listed a total of 187 crashes during the study period, with 4 fatal crashes resulting in 6 fatalities, 10 major injury crashes resulting in 19 major injuries, 27 minor injury crashes with 36 minor injuries, 36 possible injury crashes with 61 possible injuries, and 110 crashes that resulted in property damage only.

The major crash collision type was rear-end collisions, followed by sideswipe and broadside collisions. There were 9 left-turn crashes. Non-collision crashes totaled 86, indicating a high number of run-off-road and animal-related crashes. Intersection-related crashes totaled 24 during the review period, with 18 speed-related incidents.

For run-off-road crashes, the most frequent object struck was a ditch or embankment, although utility poles were impacted by five errant vehicles. The majority of run-off-road vehicles (78%) were noted as not striking any obstacle.

Younger drivers, especially those in their twenties, were the group most frequently involved in the recorded crashes. Of the 187 drivers involved in the recorded crashes, 142 were judged to be apparently normal, and 10 were impaired in some manner.

Light conditions were found to be daylight for 51% of the crashes, but 36% occurred at night and 6% occurred during dusk or dawn. Pavement surface conditions were recorded as dry for 63% of all crashes, wet for 16%, and snowy or icy for 10%.

Time of day analysis indicated that many crashes occurred during commuting times: 15% of all crashes occurred between 6:00 a.m. and 8:00 a.m., and 14% occurred between 6:00 p.m. and 8:00 p.m. Day of the week analysis showed that crashes were quite consistent throughout the week, although the highest number of crashes (19%) occurred on Saturday.

These data, along with visual observations during the field reviews, were used to develop mitigation suggestions for this roadway section. Complete copies of the crash data are included in Appendix B.

Subsequent to the road safety audit, Iowa DOT District 6 staff applied new pavement markings along the route and proceeded to upgrade signing as needed.



## **FOLLOW UP MEETING**

As a follow up to the road safety audit that had been conducted on October 14 and 15, 2008, Randy Hunefeld and Tom McDonald met with city officials on November 18, 2008, at City Hall in West Liberty. Participating in that meeting were Mayor Cliff McFerren, City Manager Chris Ward, Police Chief P.J. Brewer, and Sgt. Bill Miller of the West Liberty Police Department.

Tom McDonald explained the purpose of the road safety audit and the reasons why US 6 between Iowa City and West Liberty was selected for this detailed safety examination. Copies of pertinent crash data were furnished to the officials, and their input was invited.

Mayor McFerren stated that the following issues are of concern to him and others in West Liberty:

- The pavement surface condition is rough and uneven to drive. Asphalt resurfacing would be recommended.
- Shoulder drop-off and narrow shoulders in Muscatine County are also a concern. These should be addressed by widening the shoulders and acquiring additional right of way.
- The numerous tight curves can pose a problem for drivers. Overhead lighting could be installed to better illuminate the curves at night.
- Intersection safety is a concern for the mayor and the city manager.
- Warning signs for the Davis Street intersection are especially recommended.
- The high number of deer-related crashes is certainly a concern, but few methods of reducing these seemed feasible.

The police chief noted that city officers do patrol outside of city limits routinely, as far as the railroad crossing west of town. Randy Hunefeld suggested additional assistance if possible.

The mayor advised that ambulances from West Liberty commonly use this section of US 6 to transport patients to the Iowa City hospitals, so safety on this road is very important. In addition, US 6 in this area is also a designated emergency detour route for Interstate 80 when closures are necessary, so additional priority should be given to needed improvements.

In addition, the use of the road by bicyclists may increase, and shoulders should be widened sufficiently for the bikers' safety when riding on this section.

Major employers in the area that contribute to the high commuter travel are Proctor and Gamble in Iowa City and a nursing home, schools, and a turkey processing plant in West Liberty. All employ daily commuters who drive on US 6. The mayor indicated that some consideration had been given to approaching the City of Iowa City about providing one or more commuter buses for daily transport of some of these commuters. This effort would reduce passenger car travel and improve safety.

Tom McDonald promised to provide copies of the final the road safety audit report to the City of West Liberty for reference.

MATERIALS DEPARTMENT PAVEMENT FRICTION TESTS Program S4164115										12:59 Wednesday, October 22, 2008 1	
County: Johnson(52)		Highway: US 6		Begin Milepost: 254.64		End Milepost: 255.58		Direction: E			
Lane: 1		Pavement Type: AC		Date Tested: 08-06-07		Friction Trailer:		Lab. No.: FR8-0008			
Year Built: 2006		Est. Mileage: 0.94		Project No.: STPN-6-7(66)--2J-52		Pavement Friction Engineering Bureau District 6					
MPH: 40		Wheel Track: I		Special Test Indicator:							

MILE-POST	R E	M Fr	Fr	MILE-POST	R E	M Fr	Fr	MILE-POST	R E	M Fr	Fr	MILE-POST	R E	M Fr	Fr	MILE-POST	R E	M Fr	Fr
254.900			32																
255.000			32																
255.100			34																
255.300			30																
255.400			44																

A = Asphaltic Cement Concrete Pavement Section  
P = Portland Cement Concrete Pavement Section  
Q = Tested at Quarter Point  
O = Oily Spot on Pavement

* * * SUMMARY STATISTICS * * *						***** HISTORY *****									
MEAN	S.E.	STD.DEV.	MAX.	MIN.											
31 +/- 1		1	32	30											
37 +/- 4		6	44	32											
COMBINED	34 +/- 2	6	44	30											

NOTE: A, P, Q, and O tests are not included in summary statistics.

REMARKS:

ACTION REQUIRED:

To Friction Review Committee



MATERIALS DEPARTMENT  
PAVEMENT FRICTION TESTS  
Program S4164115

12:59 Wednesday, October 22, 2008 2

County: Johnson(52) Highway: US 6 Begin Milepost: 260.08 End Milepost: 262.30 Direction: B  
Lane: 1 Pavement Type: AC Date Tested: 08-07-07 Friction Trailer: Lab. No.: FR8-0007  
Year Built: 1987 Est. Mileage: 2.22 Project No.: FN-6-7(31)--21-52 Pavement Friction  
MPH: 40 Wheel Track: I Special Test Indicator: Engineering Bureau  
District 6

MILE- POST	R E	M Fr Fr	MILE- POST	R E	M Fr Fr	MILE- POST	R E	M Fr Fr	MILE- POST	R E	M Fr Fr	MILE- POST	R E	M Fr Fr	MILE- POST	R E	M Fr Fr
260.300		40	262.100		40												
260.500		42															
260.700		41															
260.900		47															
261.100		48															
261.200		40															
261.300		40															
261.500		44															
261.700		43															
261.900		44															

A = Asphaltic Cement Concrete Pavement Section Q = Tested at Quarter Point  
P = Portland Cement Concrete Pavement Section O = Oily Spot on Pavement

\* \* \* SUMMARY STATISTICS \* \* \*

	MEAN	S.E.	STD.DEV.	MAX.	MIN.
	43 +/- 1		3	48	40
COMBINED	43 +/- .9		3	48	40

NOTE: A, P, Q, and O tests are not included  
in summary statistics.

REMARKS:

ACTION REQUIRED:

No action required

HISTORY									
MILEPOST	TEST	FRICTION	TEST	FRICTION					
BEGIN	END	DATE	AVG	MAX	MIN	DATE	AVG	MAX	MIN
260.08	262.30	07-2001	45	50	40	07-2001	46	52	43
260.08	262.30	06-1999	39	43	37	06-1999	38	40	37
260.08	262.30	08-1997	36	40	34	08-1997	35	36	34
260.08	262.30	08-1995	41	43	37	08-1995	41	42	40
260.08	262.26	10-1993	40	42	37	10-1993	39	41	36
260.08	262.16	09-1991	42	42	41	09-1991	40	42	38
260.08	262.26	09-1991	42	42	41	09-1991	40	42	38
260.08	262.16	08-1988	43	44	42	08-1988	42	45	40

MATERIALS DEPARTMENT  
PAVEMENT FRICTION TESTS  
Program S4164115

08:26 Monday, July 26, 2010

County: Muscatine(76) Highway: US 6 Begin Milepost: 262.30 End Milepost: 267.85 Direction: B

Lane: 1 Pavement Type: AC Date Tested: 07-19-04 Friction Trailer: E Lab. No.: FR4-0593

Year Built: 1987 Est. Mileage: 5.55 Project No.: FN-6-7(31)--21-52

Pavement Friction  
Engineering Bureau  
District 5

MPH: 40

Wheel Track: I

Special Test Indicator:

MILE- POST	R E EB WB M Fr Fr	MILE- POST	R E EB WB M Fr Fr	MILE- POST	R E EB WB M Fr Fr	MILE- POST	R E EB WB M Fr Fr	MILE- POST	R E EB WB M Fr Fr	MILE- POST	R E EB WB M Fr Fr
262.49	40	264.99	40	267.49	40						
262.52	43	265.02	43	267.52	53						
262.99	34	265.49	37								
263.02	37	265.52	44								
263.49	40	265.99	35								
263.52	37	266.02	41								
263.99	39	266.49	42								
264.02	45	266.52	50								
264.49	41	266.99	33								
264.52	42	267.02	40								

A = Asphaltic Cement Concrete Pavement Section  
P = Portland Cement Concrete Pavement Section

Q = Tested at Quarter Point  
O = Oily Spot on Pavement

\* \* \* SUMMARY STATISTICS \* \* \*

	MEAN	S.E.	STD.DEV.	MAX.	MIN.
EASTBOUND	43 +/- 1		5	53	37
WESTBOUND	38 +/- .9		3	42	33
COMBINED	41 +/- 1		5	53	33

NOTE: A, P, Q, and O tests are not included  
in summary statistics.

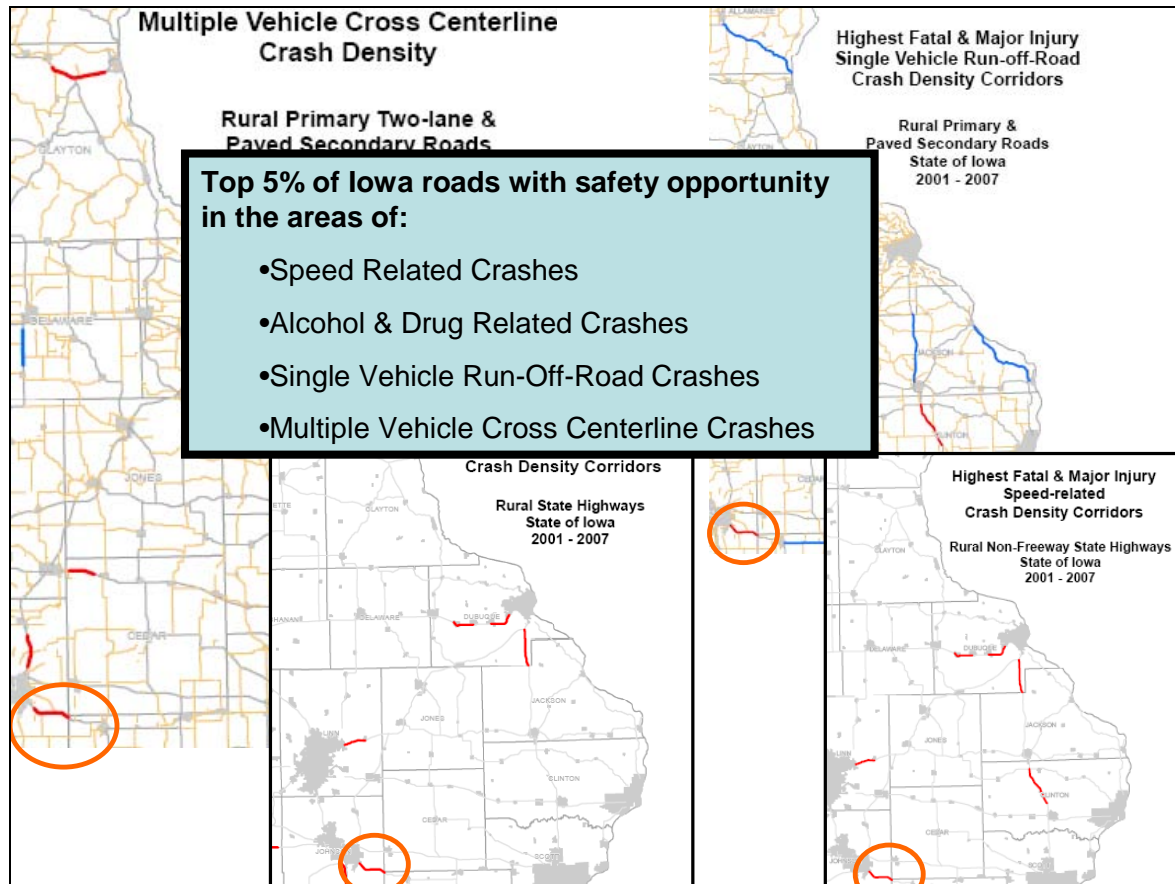
REMARKS:

ACTION REQUIRED:

No action required

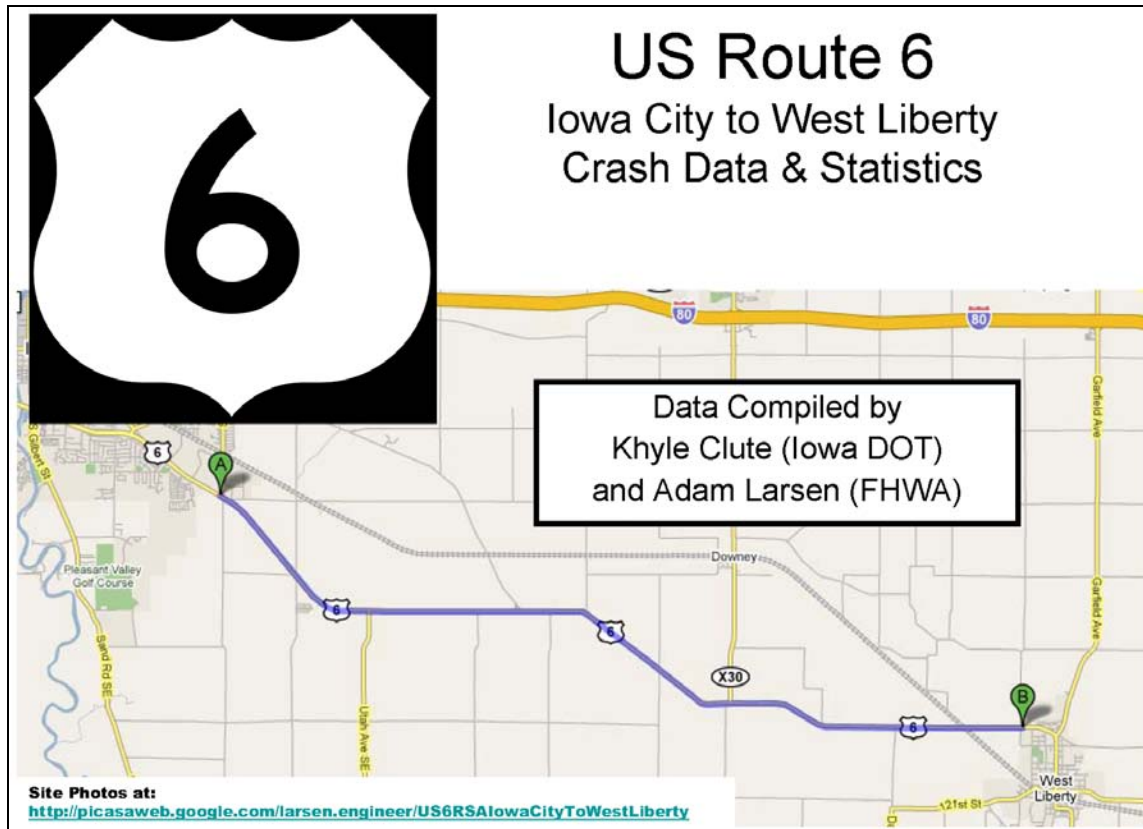
		HISTORY										
MILEPOST		TEST	EASTBOUND FRICTION			TEST	WESTBOUND FRICTION					
BEGIN	END	DATE	AVG	MAX	MIN	DATE	AVG	MAX	MIN			
262.30	267.85	07-2000	39	47	33	07-2000	34	38	26			
262.30	267.85	06-1998	40	44	34	06-1998	36	41	27			
262.30	267.85	08-1997	36	41	31	08-1997	33	38	26			
262.30	267.85	08-1996	35	41	30	08-1996	34	39	24			
262.26	267.85	06-1994	39	50	29	06-1994	37	40	26			
262.16	267.85	09-1990	36	47	29	09-1990	35	41	27			
262.16	267.85	08-1988	38	44	30	08-1988	37	41	27			

## APPENDIX B. CRASH DATA



**Figure B.1. US 6 from Iowa City to West Liberty**





**Figure B.2. Overview of US 6**



**Table B.1. Crash history for the corridor, 2001–2007**

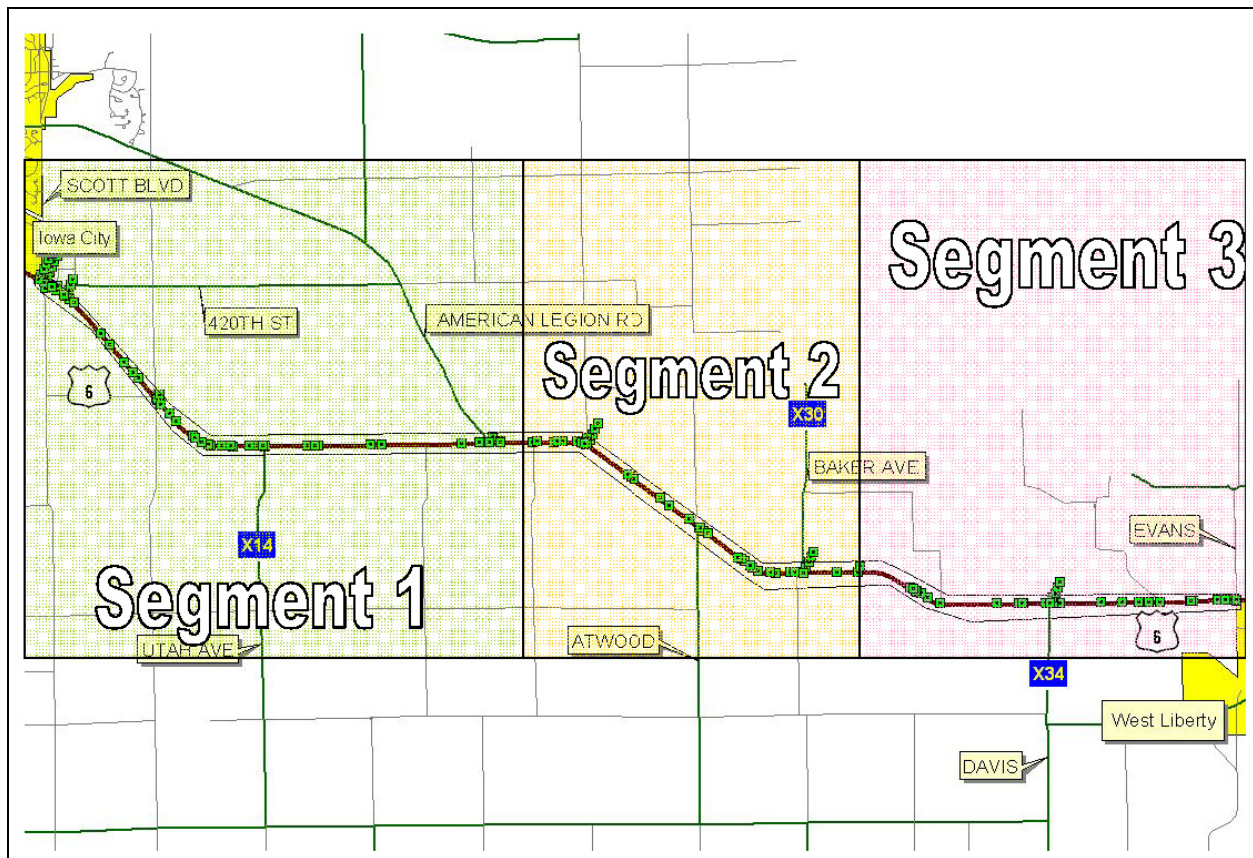
			Fatal	Major injury	Minor injury	Possible/ unknown	PDO	Total
2001	Crashes	Muscatine	0	0	1	2	8	11
		Johnson	0	2	1	2	8	13
	Injuries	Muscatine	0	0	2	2/0		4
		Johnson	0	2	1	2/0		5
2002	Crashes	Muscatine	0	0	2	1	3	6
		Johnson	1	0	0	3	12	16
	Injuries	Muscatine	0	0	3	1/0		4
		Johnson	1	0	0	3/2		4
2003	Crashes	Muscatine	0	2	1	0	7	10
		Johnson	0	3	4	6	14	27
	Injuries	Muscatine	0	5	2	2/0		9
		Johnson	0	6	7	6/0		19
2004	Crashes	Muscatine	0	0	2	2	5	9
		Johnson	0	1	2	2	11	16
	Injuries	Muscatine	0	0	3	2/0		5
		Johnson	0	1	2	2/0		5
2005	Crashes	Muscatine	2	1	1	1	9	14
		Johnson	1	0	3	5	12	21
	Injuries	Muscatine	3	3	2	5/0		13
		Johnson	2	0	4	9/2		17
2006	Crashes	Muscatine	0	0	1	1	3	5
		Johnson	0	0	3	3	10	16
	Injuries	Muscatine	0	0	1	3/0		4
		Johnson	0	0	3	4/0		7
2007	Crashes	Muscatine	0	0	3	3	3	9
		Johnson	0	1	3	5	5	14
	Injuries	Muscatine	0	0	3	4/0		7
		Johnson	0	2	3	10/2		17
7-yr sum	Crashes		4	10	27	36	110	187
	Injuries		6	19	36	61		122

**Table B.2 Crashes by day of week**

<b>Day</b>	<b>Crash Severity</b>	<b>Total</b>
Sunday	Possible/Unknown	2
	Property Damage Only	16
	Sunday Total	18
Monday	Major Injury	3
	Minor Injury	2
	Possible/Unknown	5
	Property Damage Only	14
	Monday Total	24
Tuesday	Fatal	1
	Major Injury	2
	Minor Injury	8
	Possible/Unknown	5
	Property Damage Only	14
Wednesday	Tuesday Total	30
	Minor Injury	4
	Possible/Unknown	4
	Property Damage Only	17
Thursday	Wednesday Total	25
	Major Injury	1
	Minor Injury	7
	Possible/Unknown	3
	Property Damage Only	14
Friday	Thursday Total	25
	Fatal	1
	Major Injury	1
	Minor Injury	3
	Possible/Unknown	8
Saturday	Property Damage Only	17
	Friday Total	30
	Fatal	2
	Major Injury	3
	Minor Injury	3
Saturday	Possible/Unknown	9
	Property Damage Only	19
	Saturday Total	35
<b>Grand Total</b>		<b>187</b>

**Table B.3. Crashes by time of day**

<b>Time of Day</b>	<b>Minor Injury</b>	<b>Major Injury</b>	<b>Fatal</b>	<b>PDO</b>	<b>Possible/Unknown</b>	<b>Total</b>
0:00-0:59		1		2		3
1:00-1:59				4		4
2:00-2:59		1				1
3:00-3:59	1	1		4		6
4:00-4:59				2	1	3
5:00-5:59	1	2		6	1	10
6:00-6:59	2			8	2	12
7:00-7:59	3	1		8		12
8:00-8:59	1		1	5	2	9
9:00-9:59	1	1		4	3	9
10:00-10:59	3			2	1	6
11:00-11:59	1			2	3	6
12:00-12:59				3	2	5
13:00-13:59	1			4	3	8
14:00-14:59				3	4	7
15:00-15:59	2		1	8		11
16:00-16:59	2	1		5	1	9
17:00-17:59	3			9	1	13
18:00-18:59	2	1		11	4	18
19:00-19:59	2			4	2	8
20:00-20:59			1	3		4
21:00-21:59	1			5	2	8
22:00-22:59	1	1		2	2	6
23:00-23:59			1	4	2	7
Unknown				2		2
<b>Grand Total</b>						<b>187</b>



**Figure B.3. All crashes, 2001–2007**

**Table B.4. Crash type by severity**

<b>Severity</b>	<b>Manner of Crash</b>	<b>Total</b>
Fatal	Head-on	2
	Rear-end	1
	Sideswipe - opposite direction	1
Fatal Total		4
Major Injury	Broadside	1
	Head-on	2
	Non-collision	4
	Rear-end	1
	Sideswipe - opposite direction	2
Major Injury Total		10
Minor Injury	Broadside	4
	Head-on	3
	Non-collision	12
	Rear-end	6
	Sideswipe - opposite direction	2
Minor Injury Total		27
Possible/Unknown	Angle - oncoming left turn	5
	Broadside	1
	Head-on	3
	Non-collision	12
	Not Reported	1
	Rear-end	12
	Sideswipe - opposite direction	2
Possible/Unknown Total		36

**Table B.4. Crash type by severity (continued)**

Severity	Manner of Crash	Total
Property Damage Only	Angle - oncoming left turn	4
	Broadside	4
	Non-collision	58
	Not Reported	4
	Rear-end	21
	Sideswipe - opposite direction	5
	Sideswipe - same direction	12
	Unknown	2

**Table B.5. Crash severity by county**

CSEVERITY	Johnson	Muscatine	Total
Fatal	2	2	4
Major Injury	7	3	10
Minor Injury	16	11	27
Possible/Unknown	26	10	36
Property Damage Only	72	38	110
All	123	64	187

**Table B.6. Crash severity by major cause**

<b>Severity</b>	<b>MAJOR CAUSE</b>	<b>Total</b>
Fatal	Crossed centerline	3
	Other improper action	1
<b>Fatal Total</b>		<b>4</b>
Major Injury	Ran off road - right	2
	Exceeded authorized speed	2
	Ran off road - left	2
	Traveling wrong way or on wrong side of road	1
	FTYROW: Other (explain in narrative)	1
	FTYROW: From stop sign	1
	Swerving/Evasive Action	1
<b>Major Inj Total</b>		<b>10</b>
Minor Injury	Swerving/Evasive Action	8
	Crossed centerline	3
	Followed too close	3
	Driving too fast for conditions	2
	FTYROW: From stop sign	2
	Traveling wrong way or on wrong side of road	1
	FTYROW: Making left turn	1
	FTYROW: Other (explain in narrative)	1
	Operating vehicle in a reckless manner	1
	Other Vision obstructed	1
	Over correcting/over steering	1
	Ran off road - left	1
	Ran Stop Sign	1
	Exceeded authorized speed	1
<b>Minor Inj Total</b>		<b>27</b>

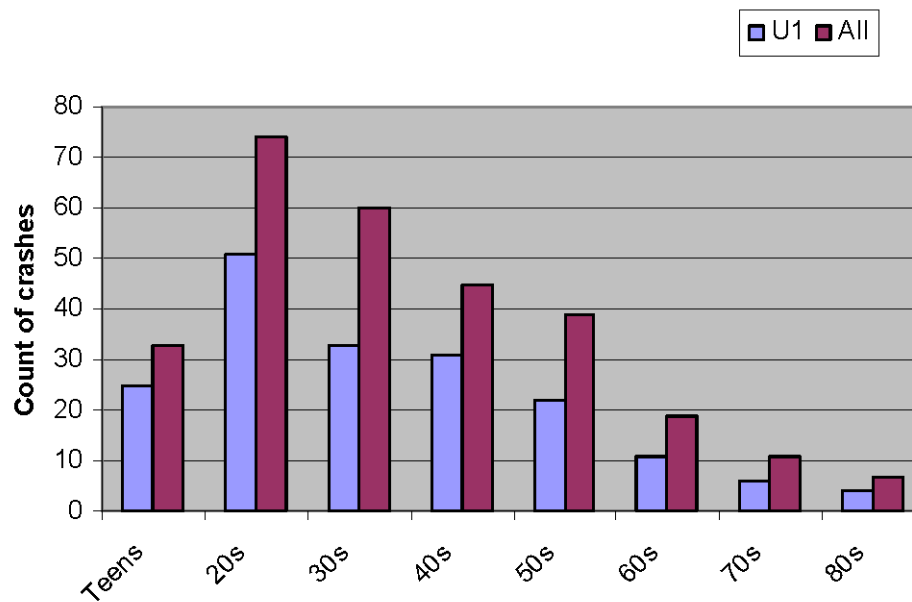
**Table B.6. Crash severity by major cause (continued)**

Possible Unknown	Followed too close	8
	FTYROW: Other (explain in narrative)	4
	Driving too fast for conditions	4
	Swerving/Evasive Action	3
	Ran off road - right	3
	Ran off road - left	2
	Made improper turn	2
	Crossed centerline	2
	Traveling wrong way or on wrong side of road	1
	Lost Control	1
	FTYROW: Making left turn	1
	Operating vehicle in a reckless manner	1
	Other: No improper action	1
	FTYROW: From stop sign	1
	Animal	1
	Exceeded authorized speed	1
Poss/Unk Total		36
PDO	Animal	24
	Swerving/Evasive Action	11
	Followed too close	11
	Unknown	9
	Driving too fast for conditions	7
	Ran off road - right	7
	Lost Control	7
	Ran off road - left	5
	FTYROW: From stop sign	4
	FTYROW: Making left turn	4

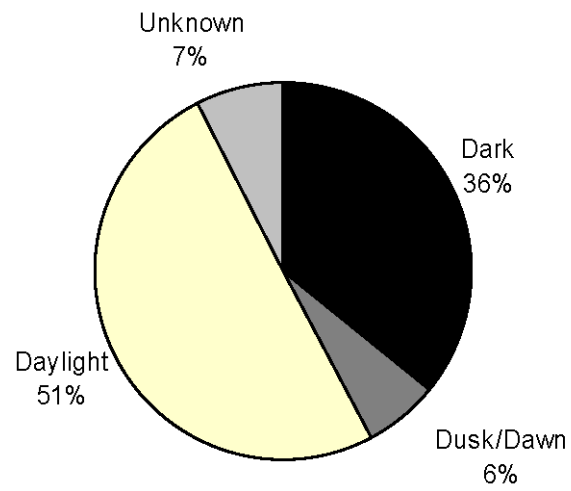


**Table B.7. Driver condition for all crashes**

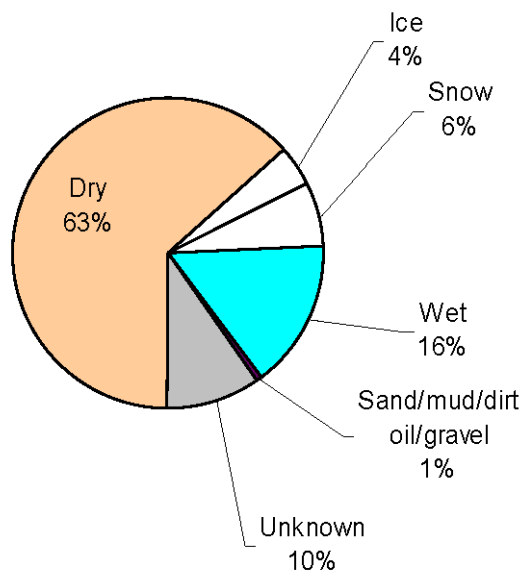
Condition of Driver of Unit #1	Total
Apparently normal	142
Under the influence of alcohol/drugs/medications	10
Asleep/fainted/fatigued/etc.	3
Emotional (e.g. depressed/angry/disturbed)	1
Physical impairment	2
Other or Unknown	29
Total	187



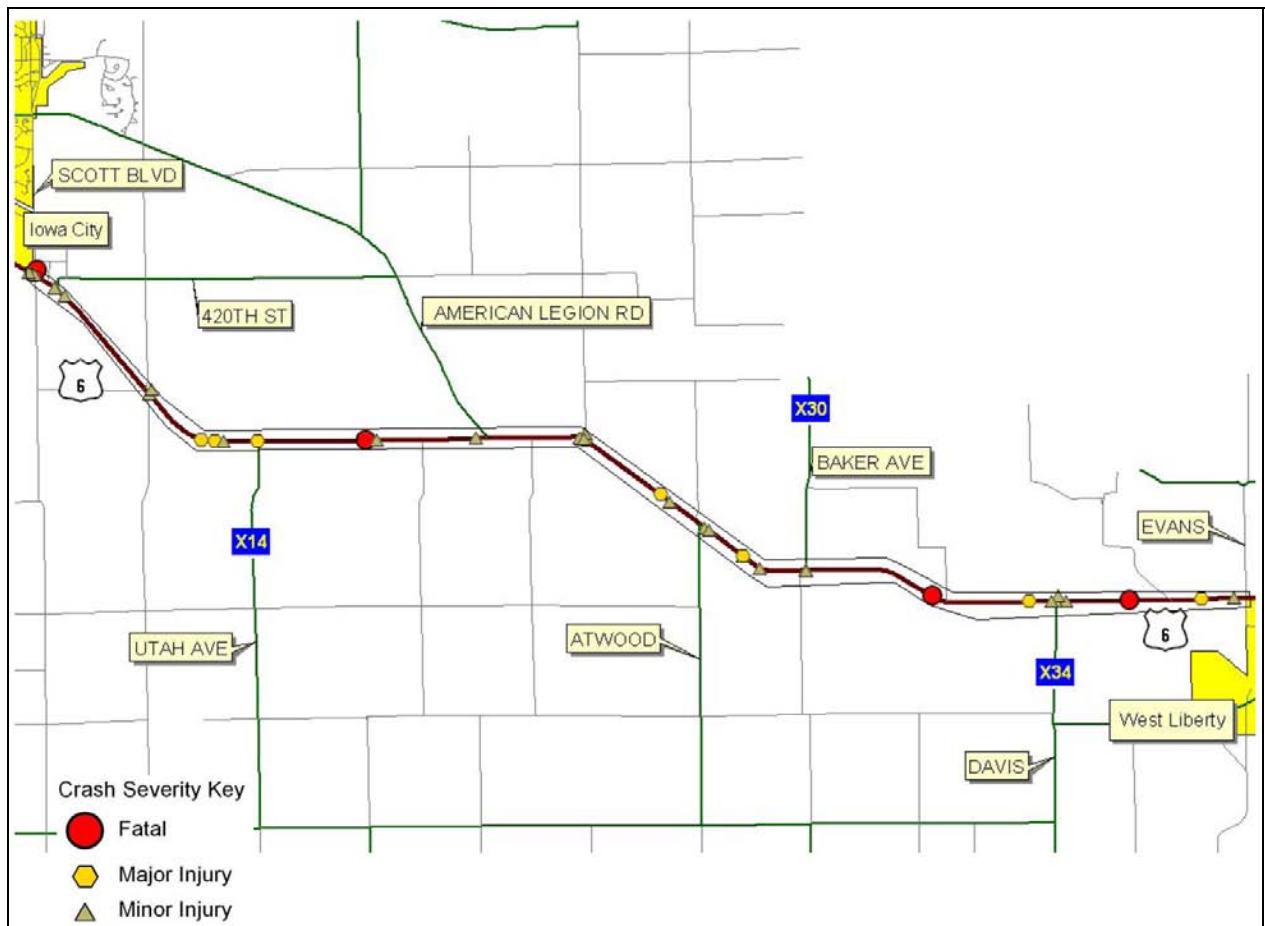
**Figure B.4. Crashes by driver age**



**Figure B.5. Light conditions for all crashes**



**Figure B.6. Surface conditions for all crashes**



**Figure B.7. All fatal and injury crashes, 2001–2007**

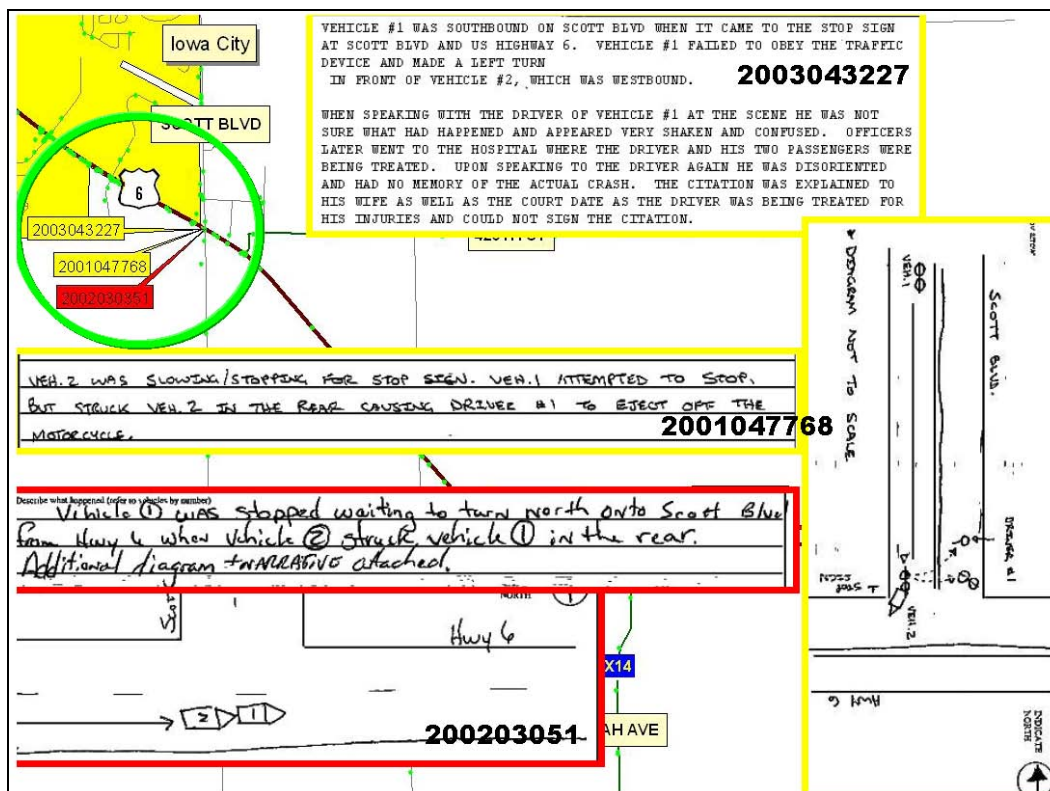
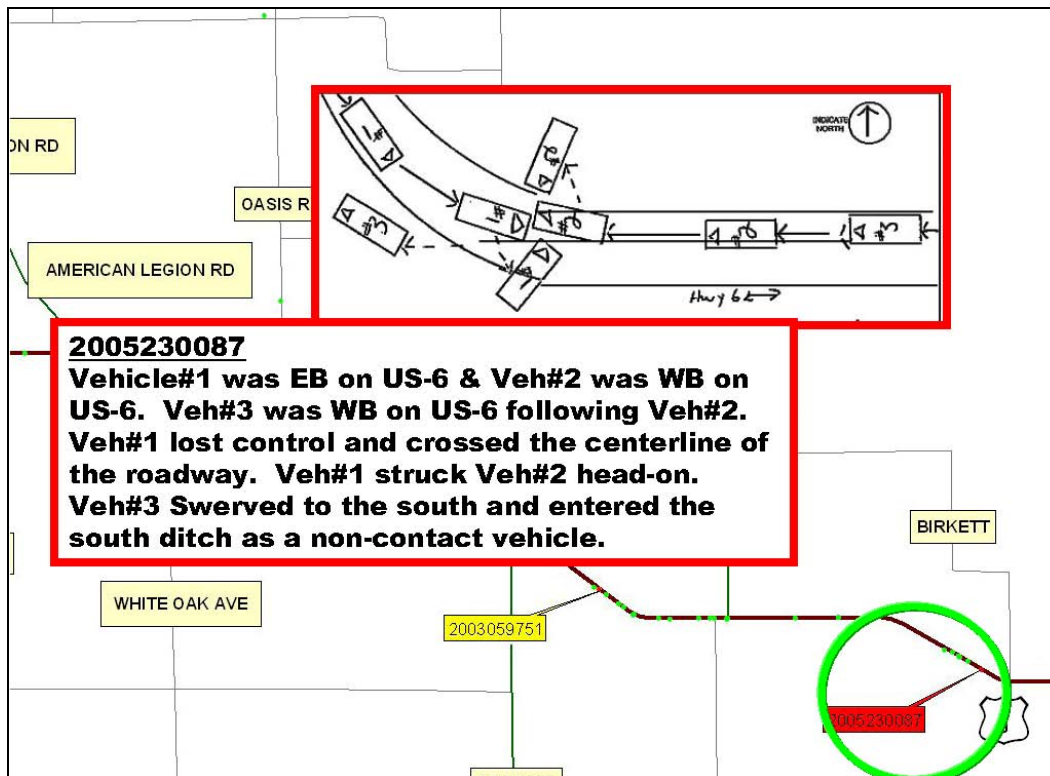


Figure B.8. Crash diagrams for serious crashes



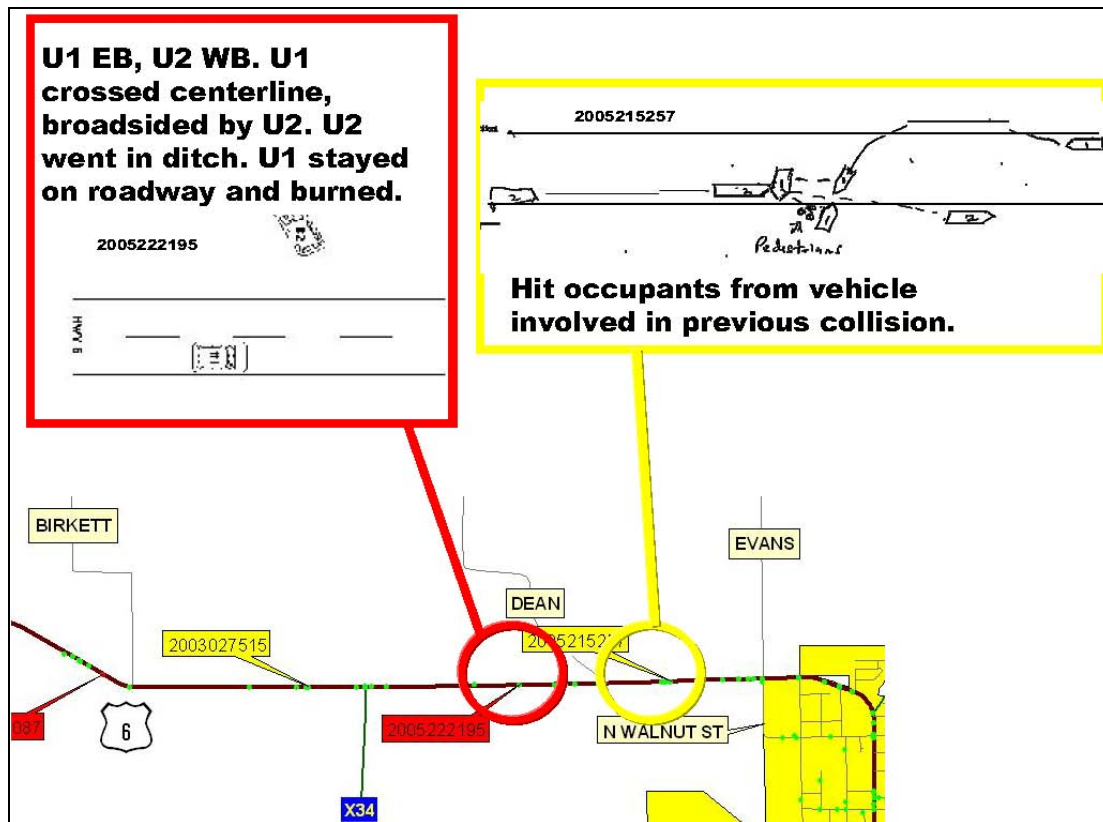
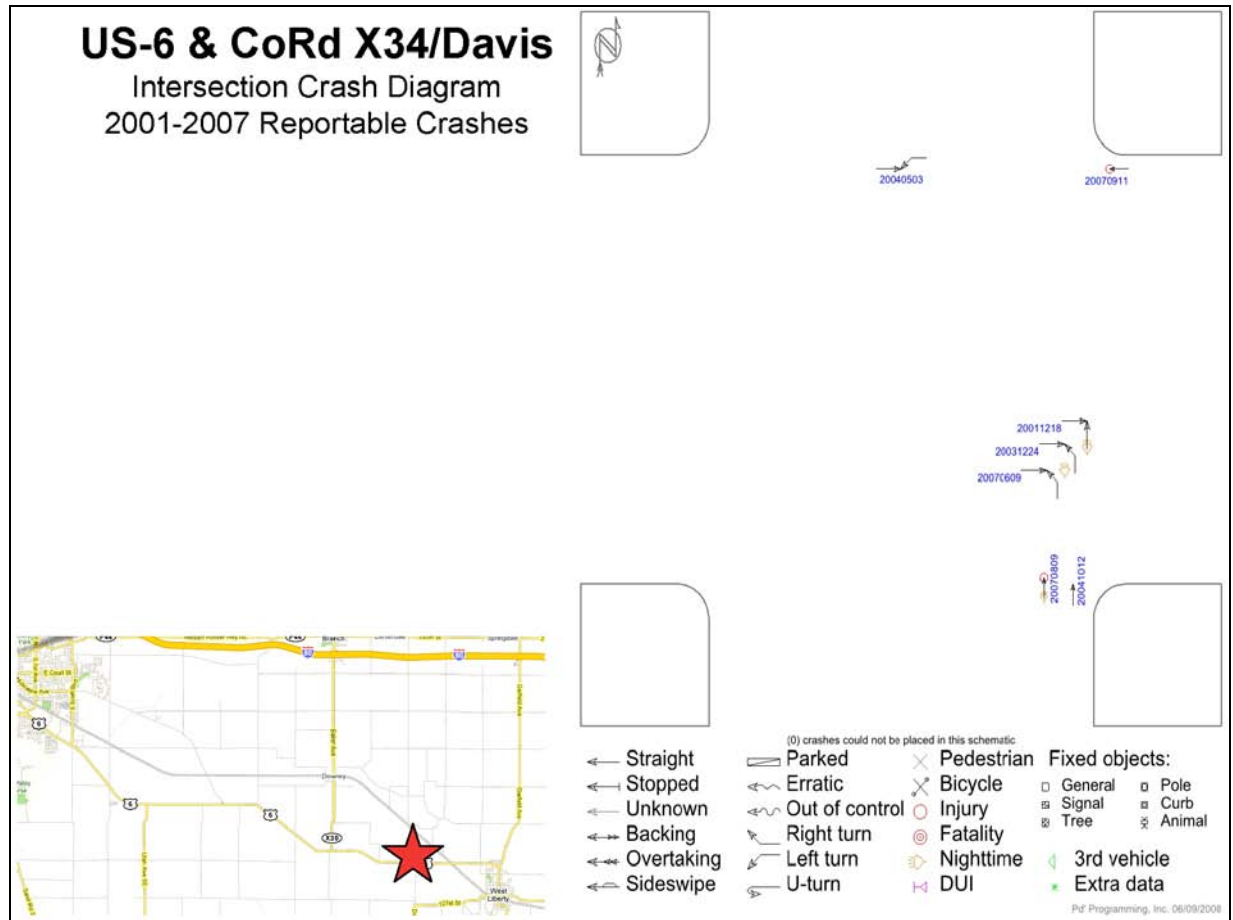
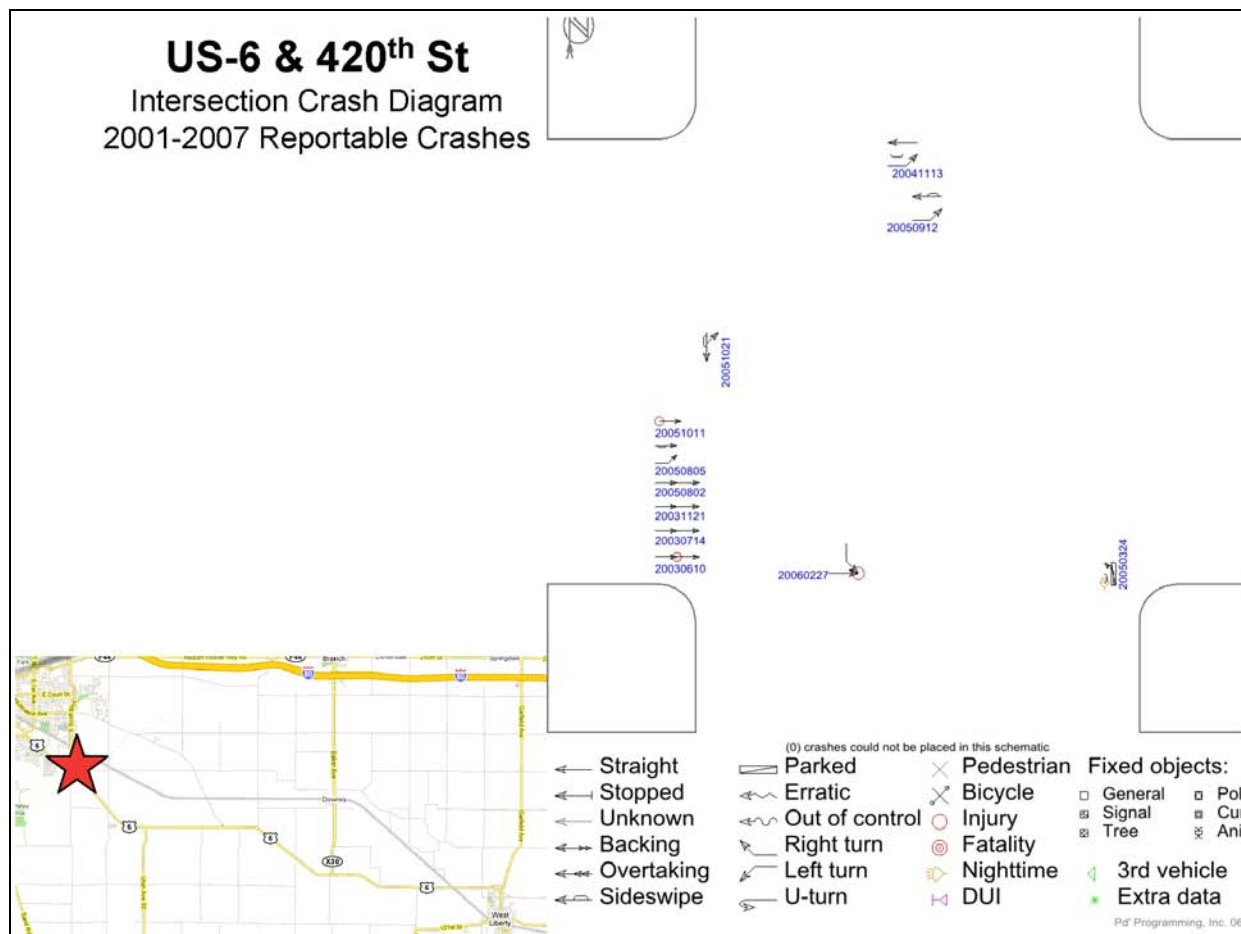


Figure B.8. Crash diagrams for serious crashes (continued)

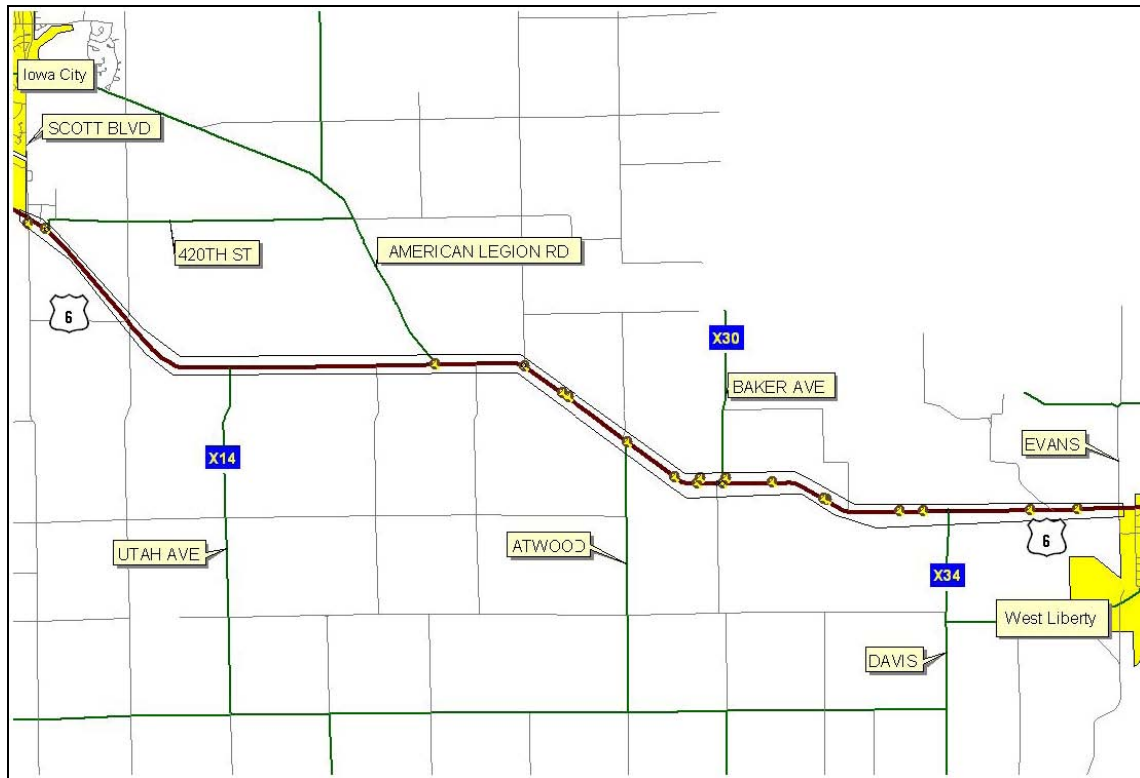


**Figure B.9. Intersection crash diagram for US 6 and Davis Street (X-34)**

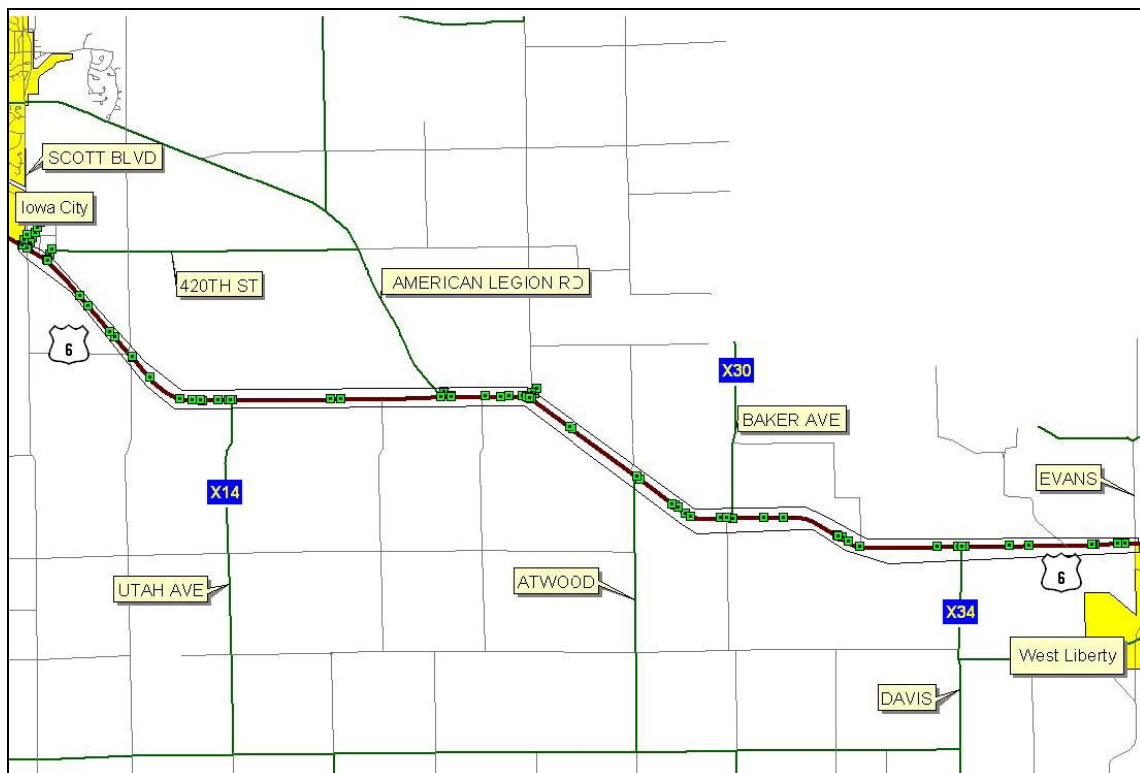


**Figure B.10. Intersection crash diagram for US 6 and 420th Street**

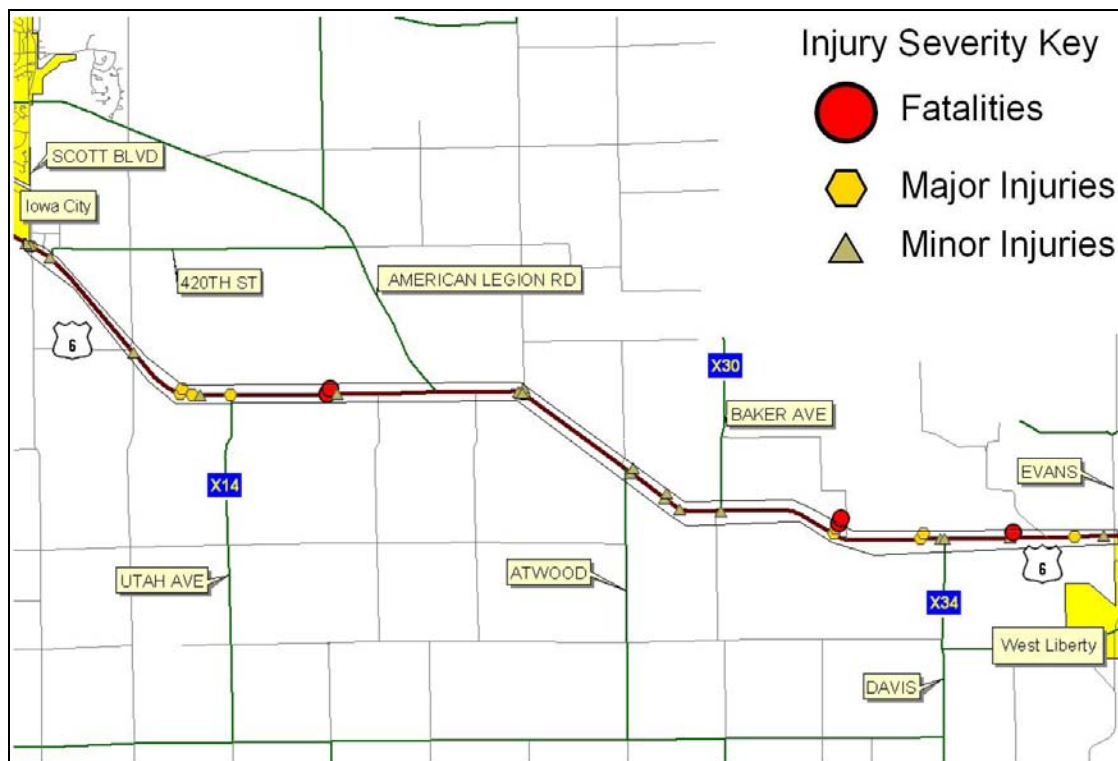




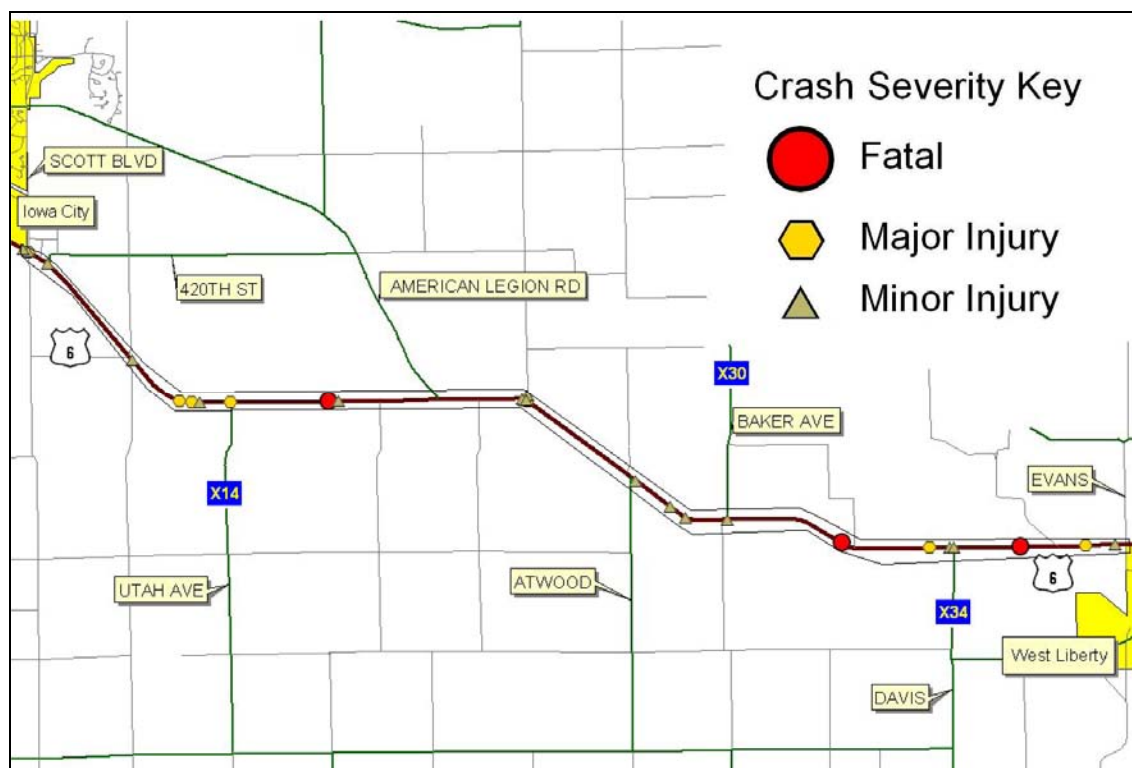
**Figure B.11. All animal-related crashes**



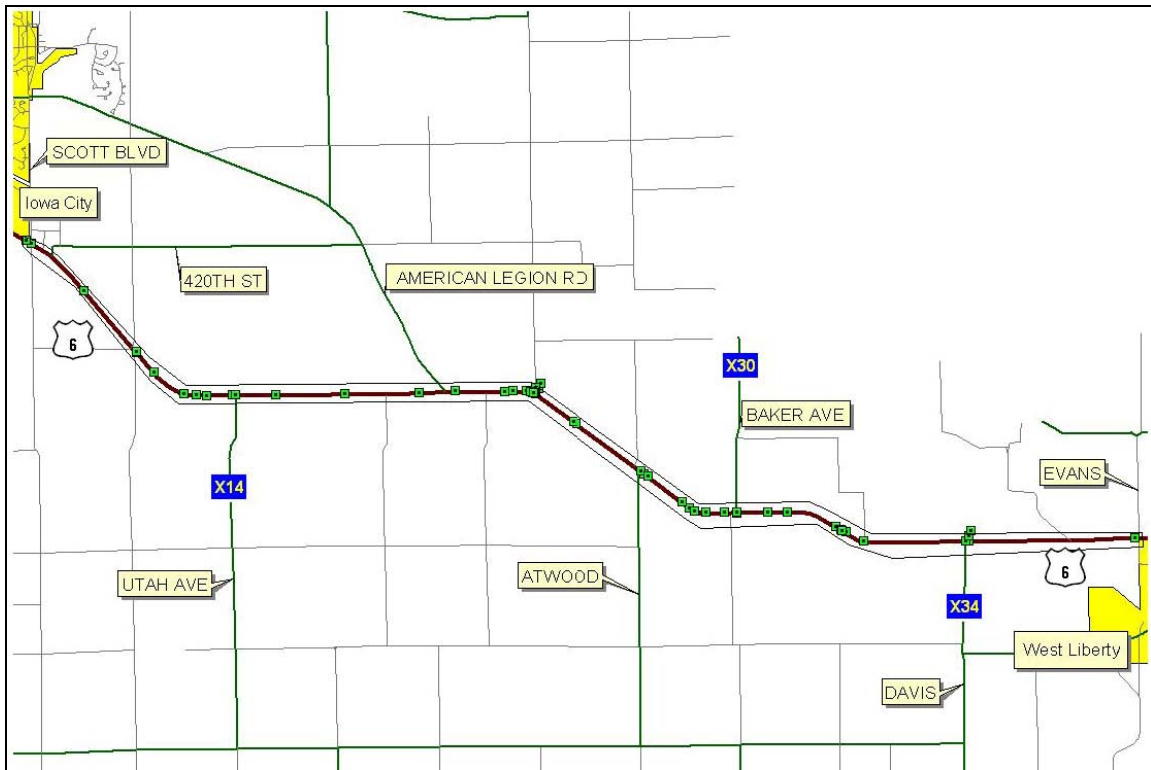
**Figure B.12. All speed-related crashes**



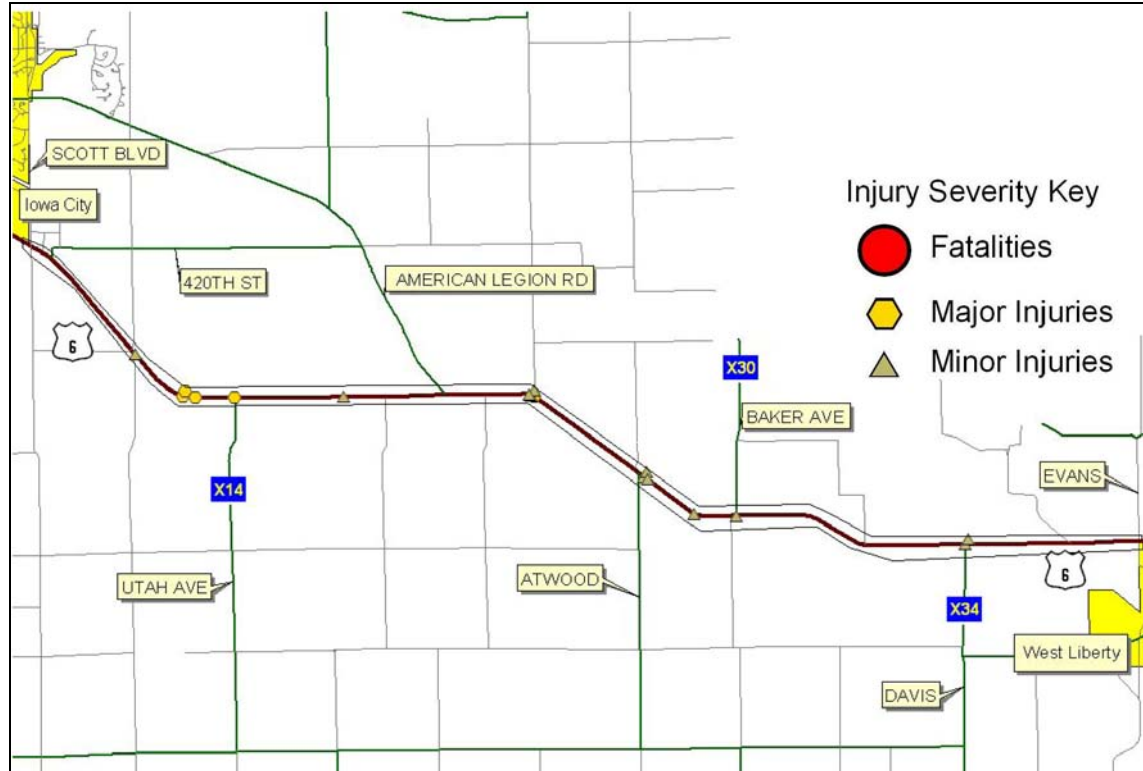
**Figure B.13. Speed-related crashes by injury severity**



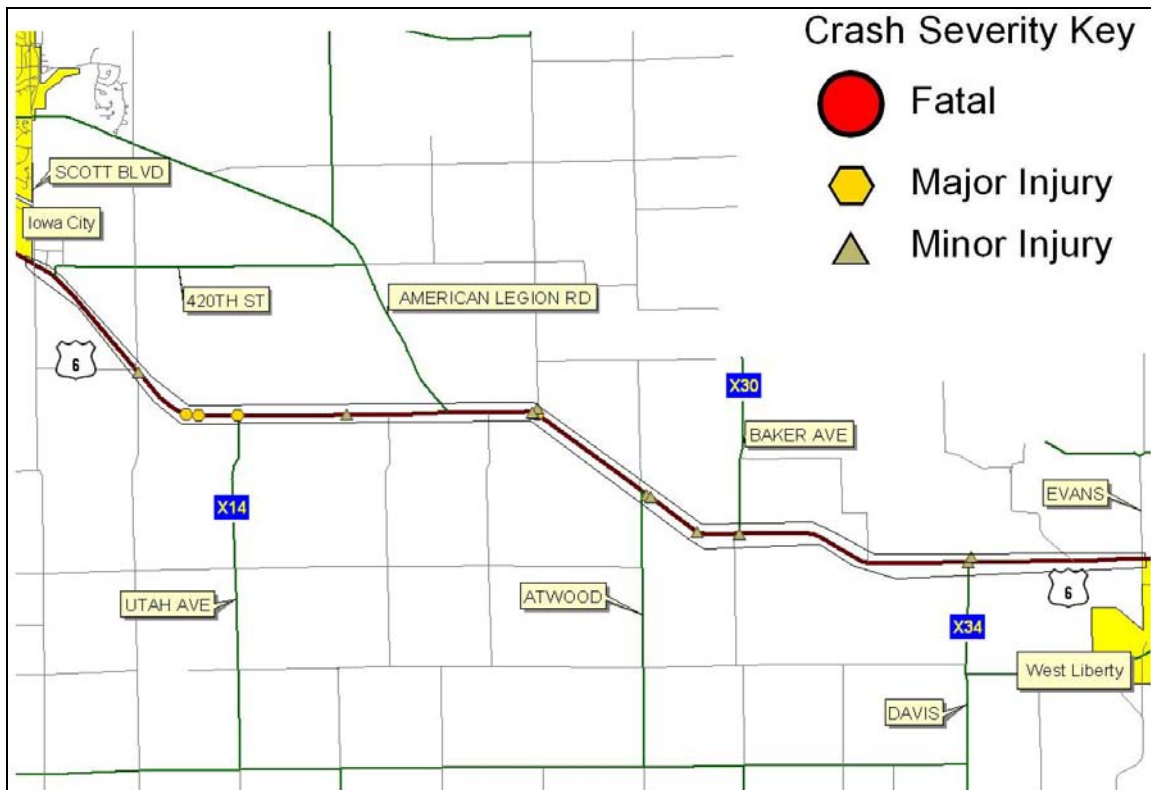
**Figure B.14. Speed-related crashes by crash severity**



**Figure B.15. All single-vehicle run-off-road crashes**



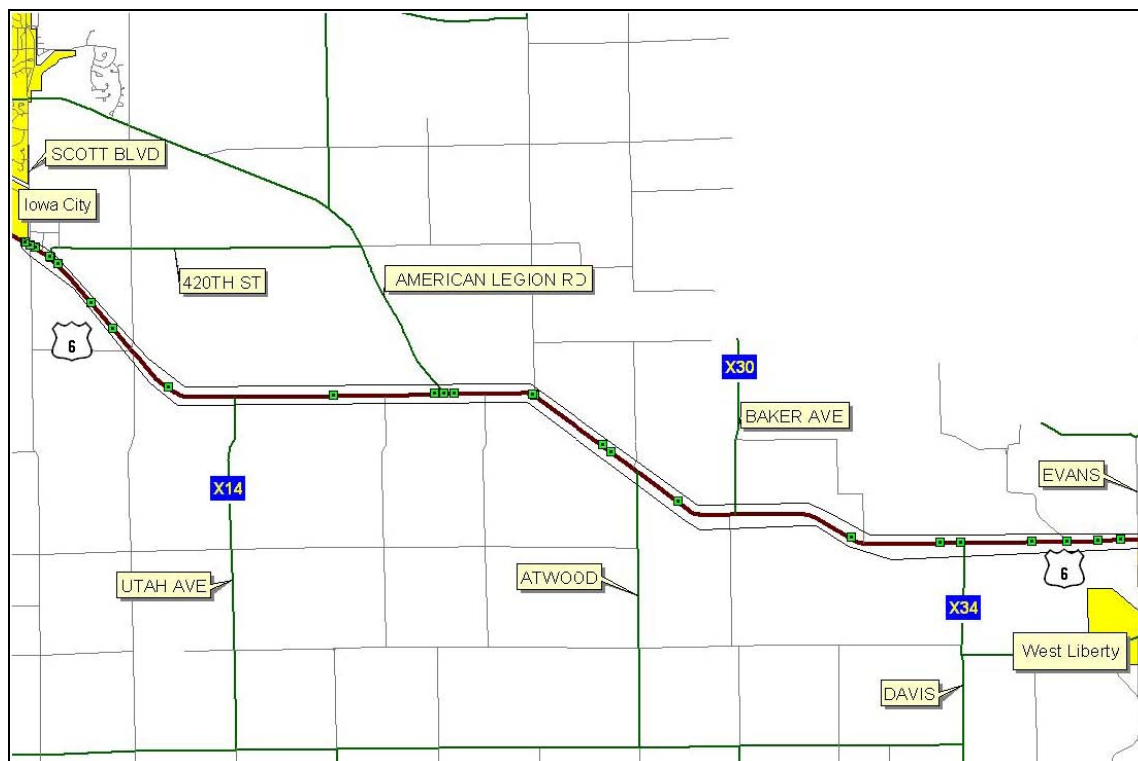
**Figure B.16. Single-vehicle run-off-road crashes by injury severity**



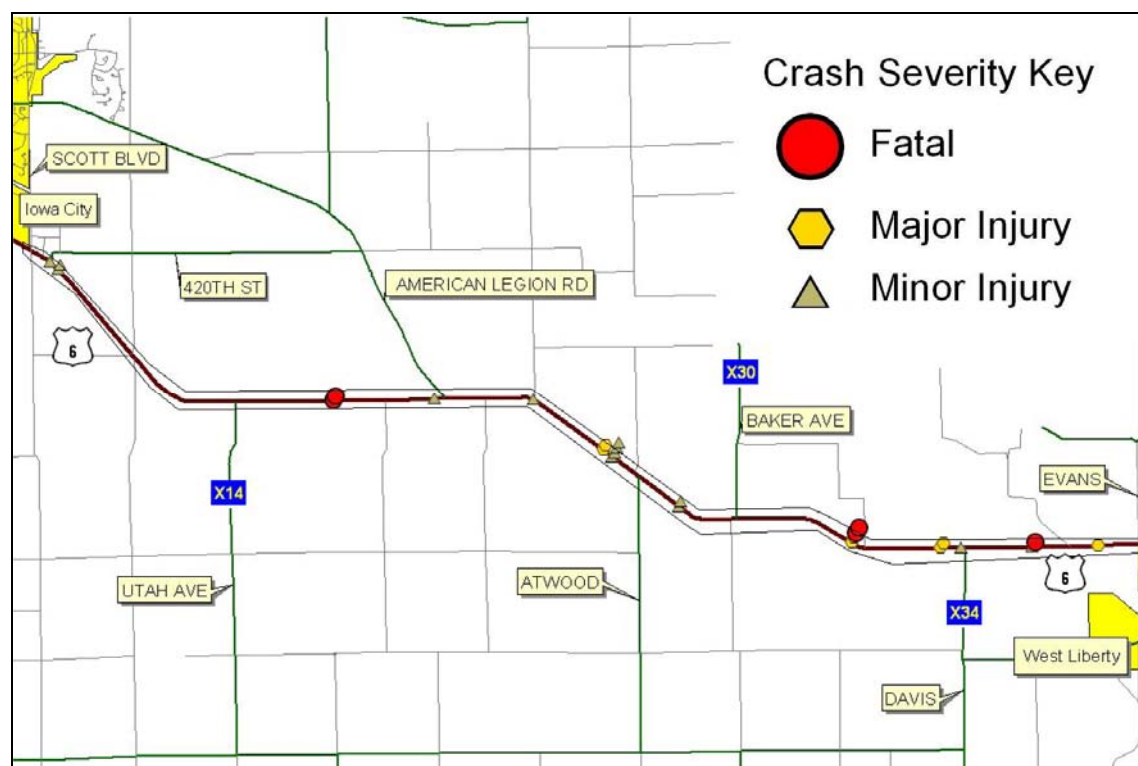
**Figure B.17. Single-vehicle run-off-road crashes by crash severity**

**Table B.8. Objects struck by run-off-road vehicles**

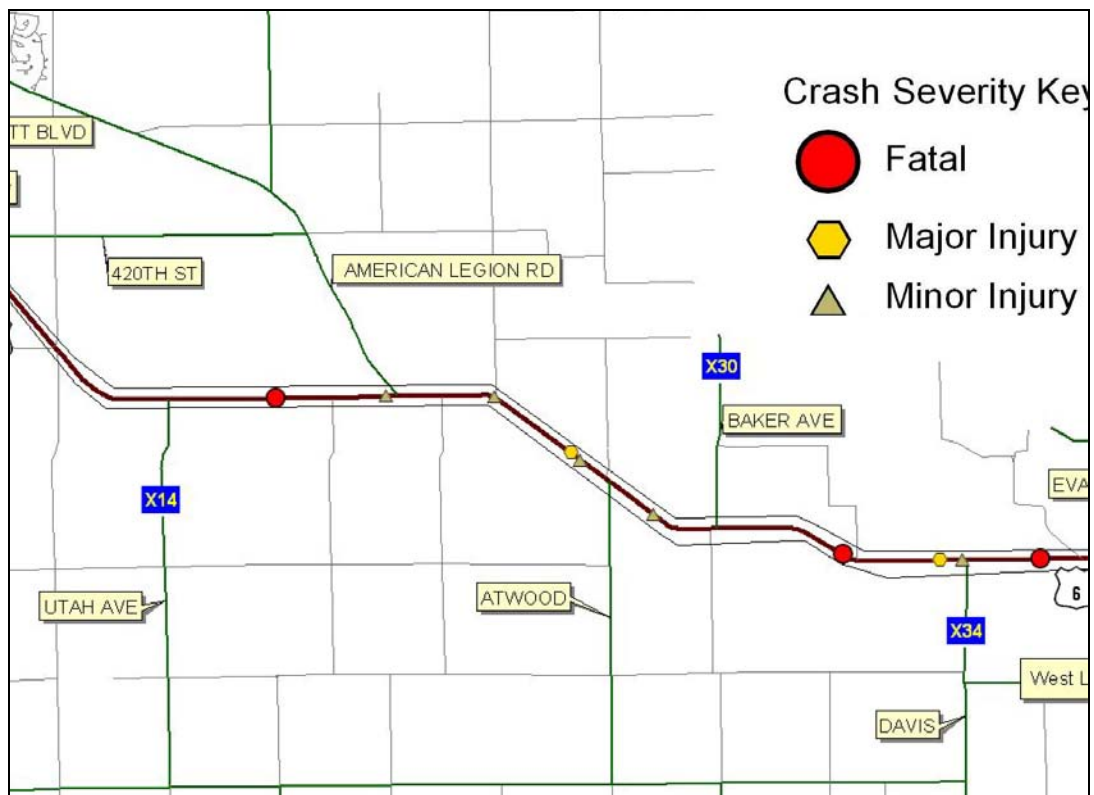
First Object Struck	Number of Crashes
Ditch/embankment	14
Mailbox	2
Poles	3
Sign Post	1
Tree	1
Other/Unknown/	
Not Reported Elsewhere	5



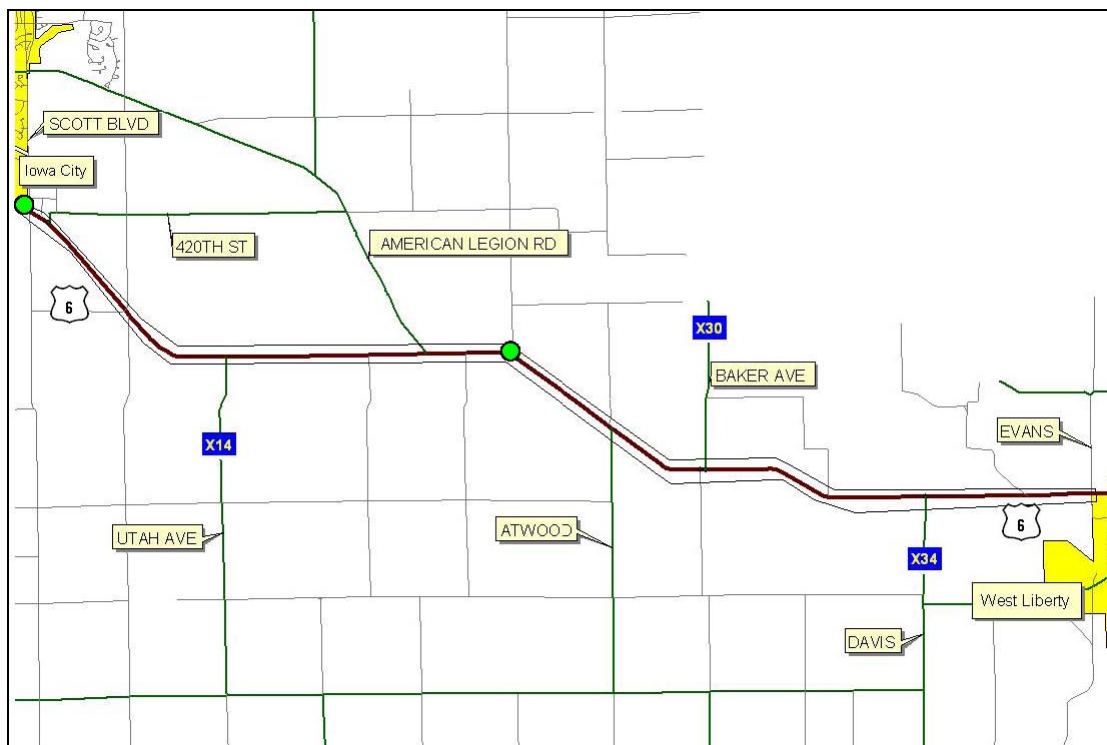
**Figure B.18. All multi-vehicle crossed-centerline crashes**



**Figure B.19. Multi-vehicle crossed-centerline crashes by injury severity**

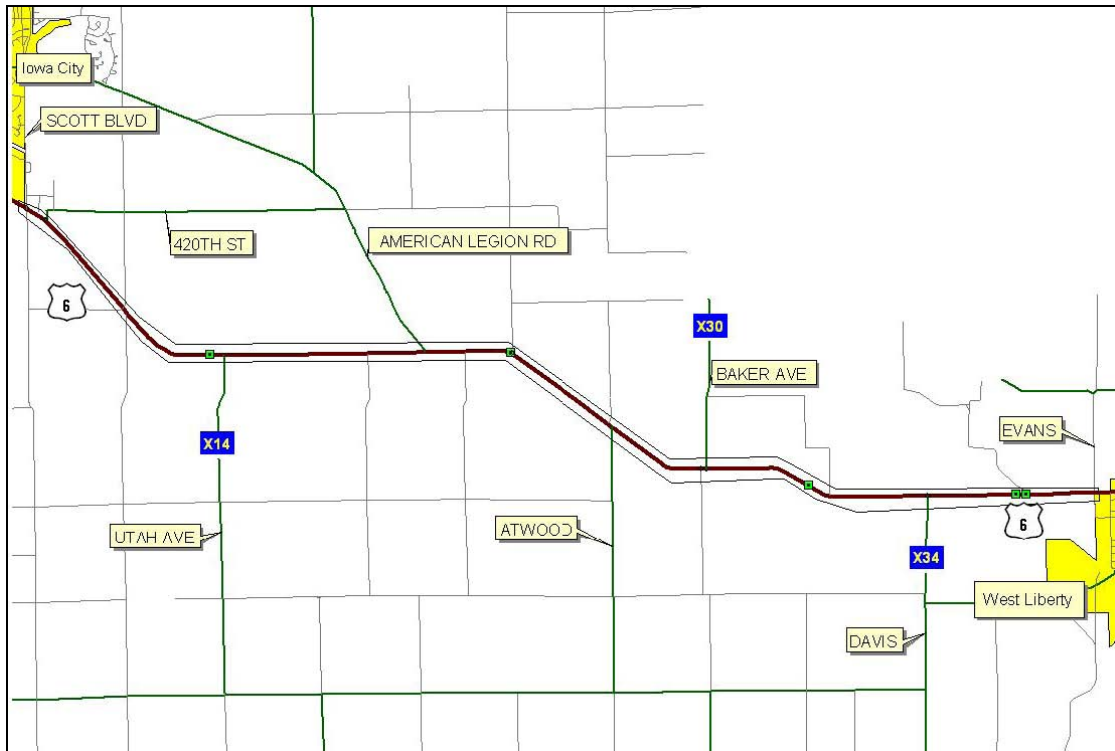


**Figure B.20. Multi-vehicle crossed-centerline crashes by crash severity**

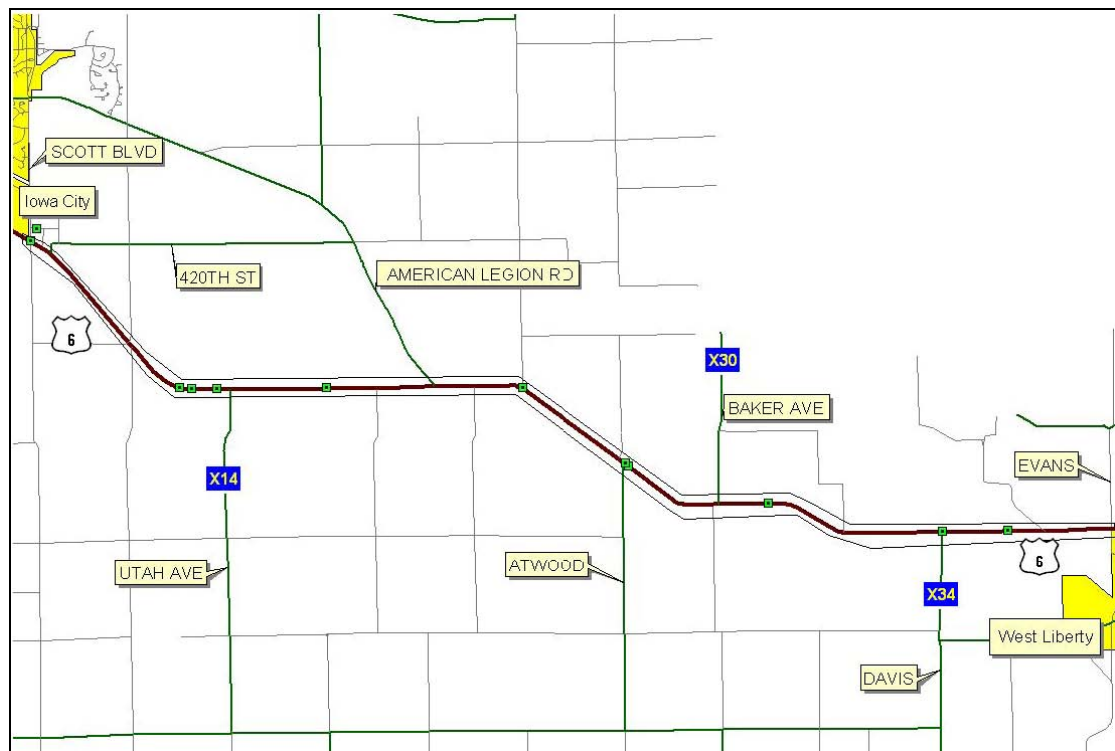


**Figure B.21. All motorcycle-related crashes**

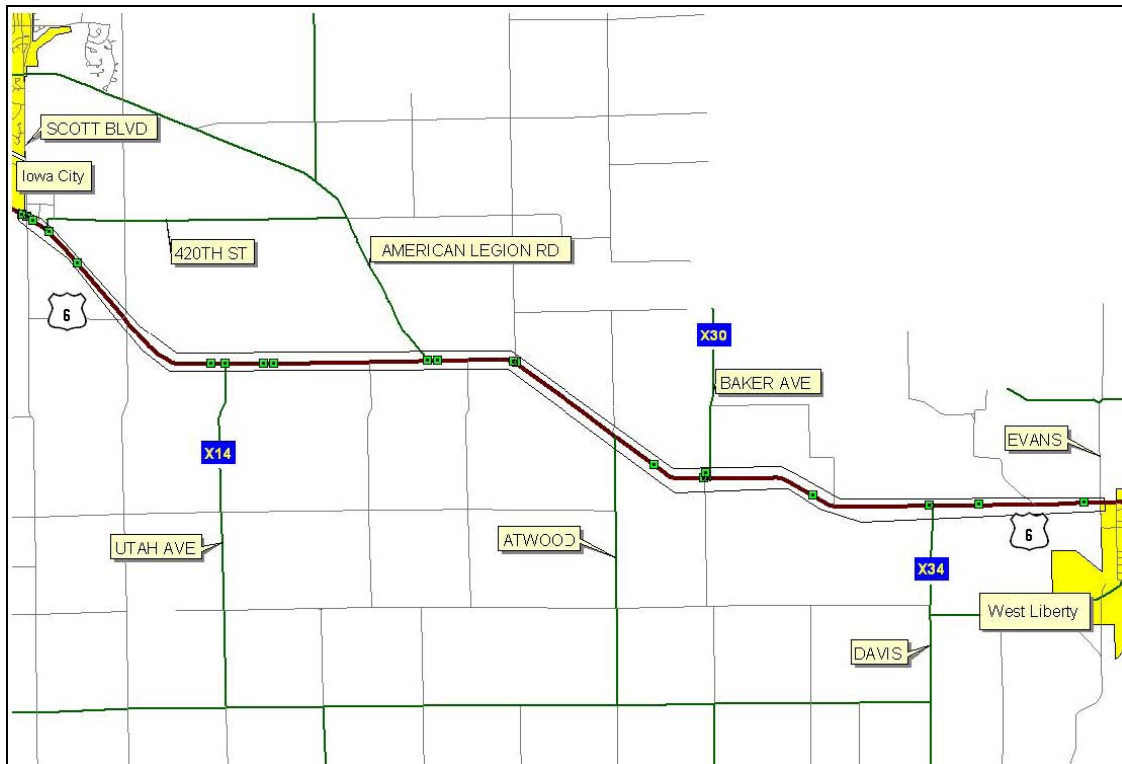




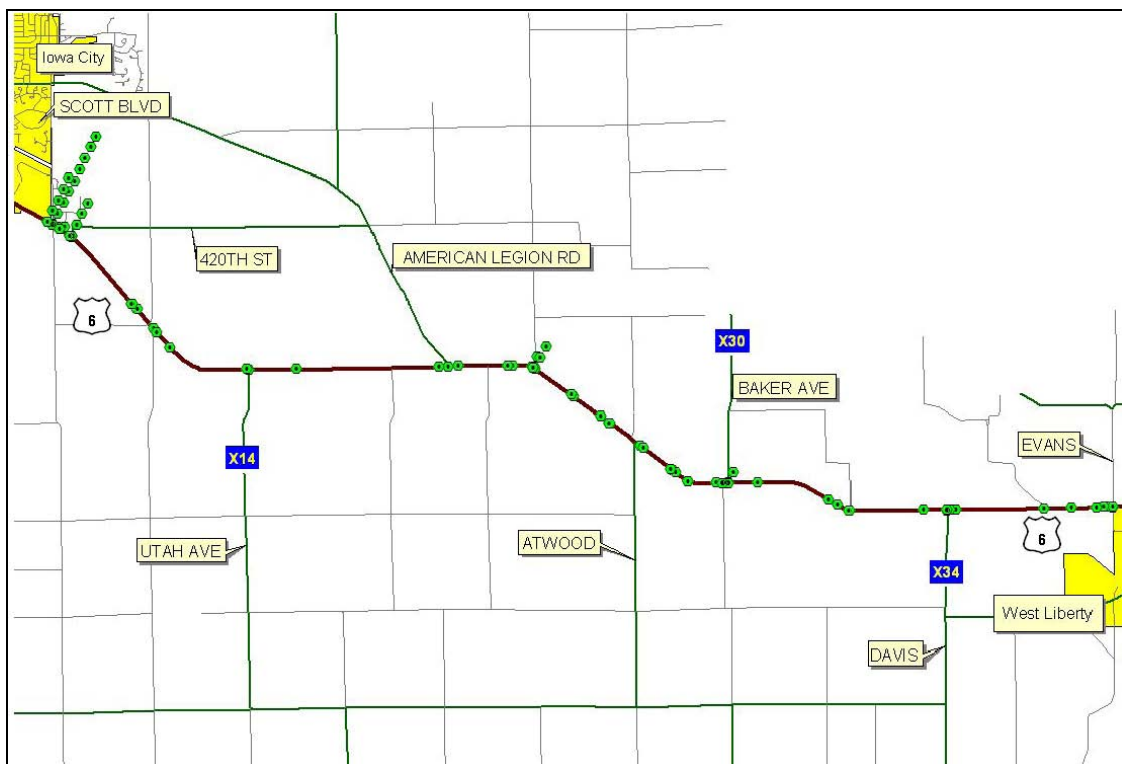
**Figure B.22. All heavy truck-related crashes**



**Figure B.23. All impairment crashes**



**Figure B.24. All crashes in ice, snow, and slush conditions**



**Figure B.25. All daytime crashes**



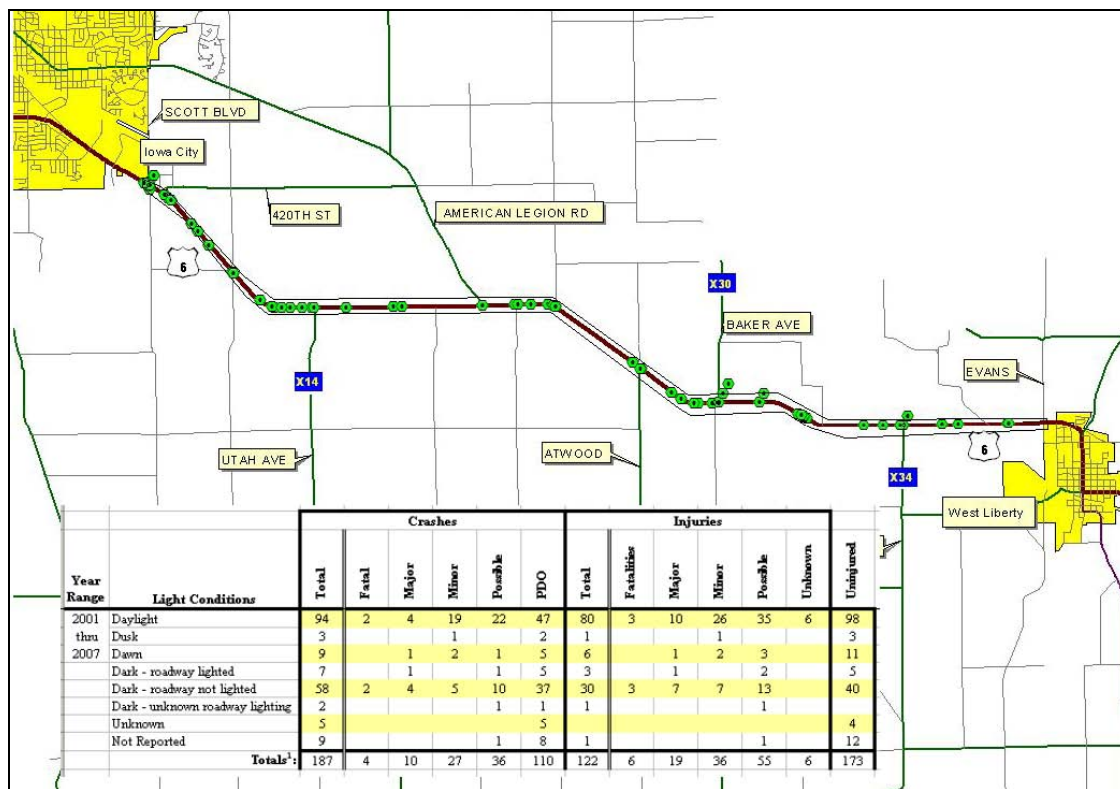


Figure B.26. All nighttime crashes

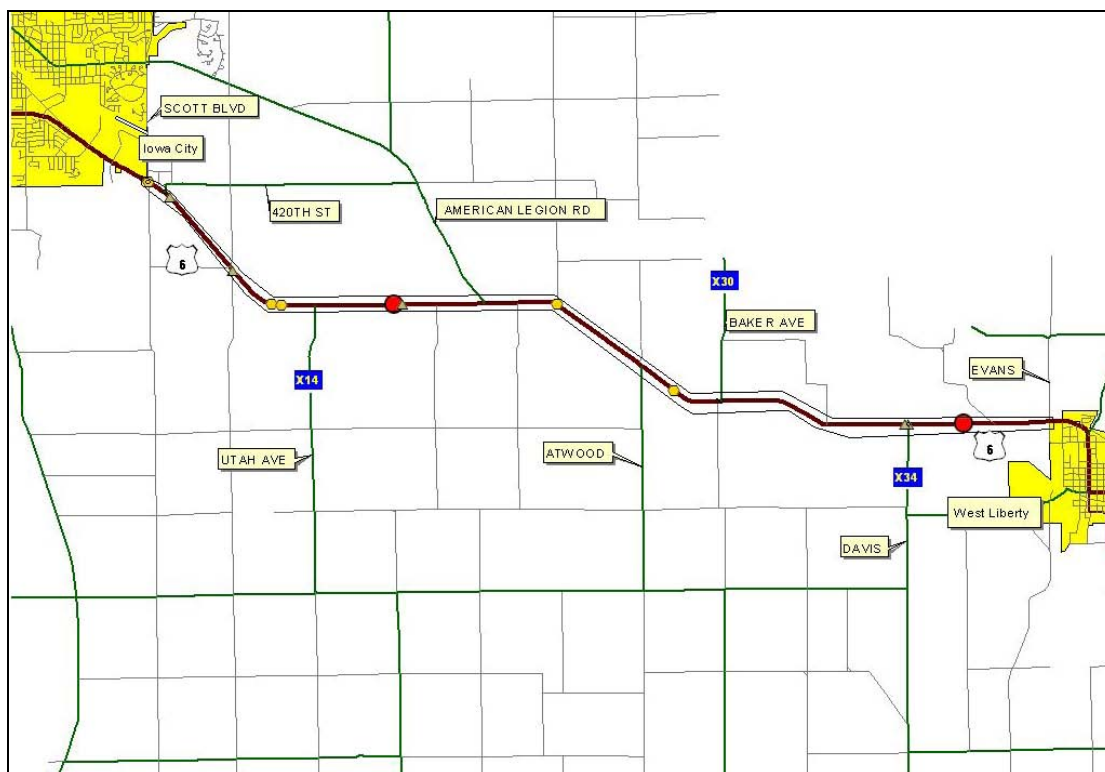
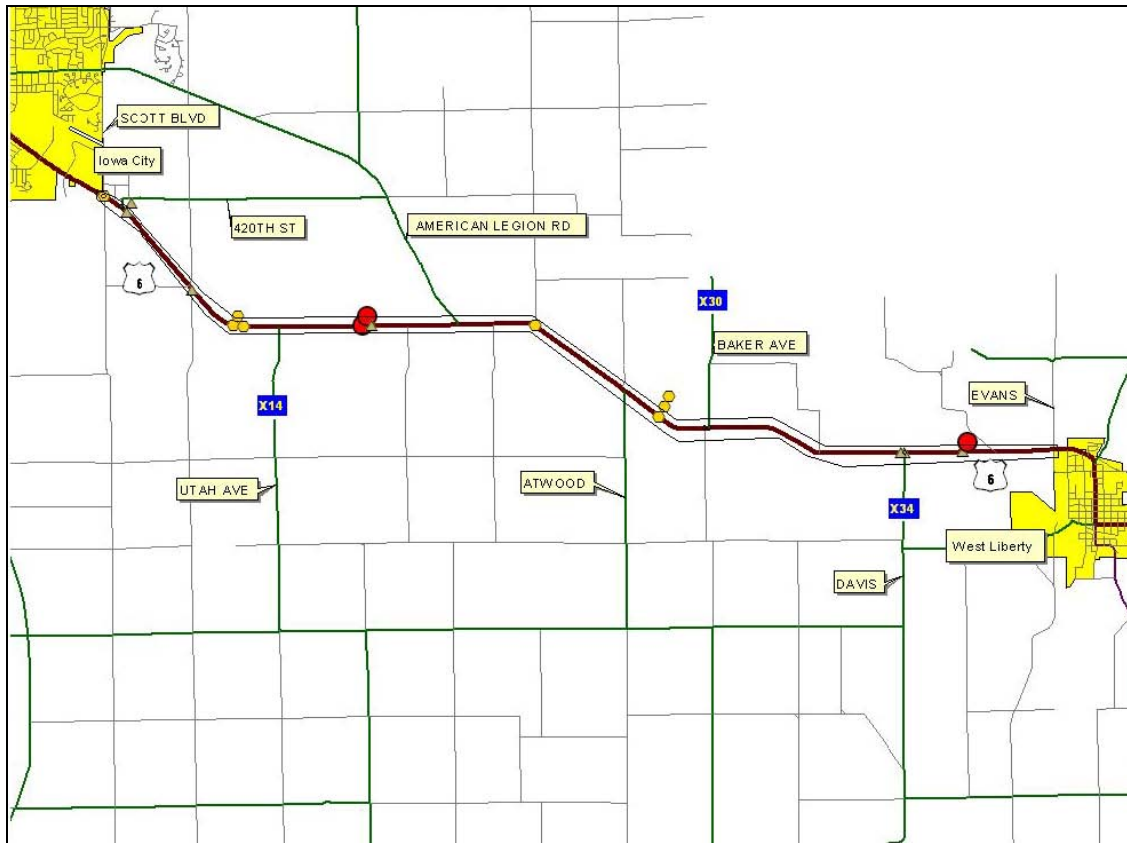


Figure B.27. Nighttime crashes by crash severity



**Figure B.28. Nighttime crashes by injury severity**

## APPENDIX C. SPEED DATA

**Nu-Metrics Traffic Analyzer Study**  
**Computer Generated Summary Report**  
**City:**  
**Street: Hwy 6**

A study of vehicle traffic was conducted with HI-STAR unit number 7576. The study was done in the EB @ MP 258.7 lane at Hwy 6 in , Ia in Johnson county. The study began on Oct/29/2008 at 10:30:00 AM and concluded on Oct/30/2008 at 10:30:00 AM, lasting a total of 24.00 hours. Traffic statistics were recorded in 60 minute time periods. The total recorded volume showed 1858 vehicles passed through the location with a peak volume of 222 on Oct/29/2008 at [16:30-17:30] and a minimum volume of 10 on Oct/30/2008 at [02:30-03:30]. The AADT count for this study was 1,858.

### SPEED

Chart 1 lists the values of the speed bins and the total traffic volume for each bin. At least half the vehicles were traveling in the 56 - 61 MPH range or lower. The average speed for all classified vehicles was 57 MPH with 25.20% vehicles exceeding the posted speed of 55 MPH. The HI-STAR found 25.20 percent of the total vehicles were traveling in excess of 55 MPH. The mode speed for this traffic study was 56MPH and the 85th percentile was 63.77 MPH.

< to 10	11 to 15	16 to 20	21 to 25	26 to 30	31 to 35	36 to 40	41 to 45	46 to 50	51 to 55	56 to 60	61 to 65	66 to 70	71 to 75	76 to >					
0	8	6	4	2	8	21	34	105	447	701	329	96	21	4					

CHART 1

### CLASSIFICATION

Chart 2 lists the values of the classification bins and the total traffic volume accumulated for each bin. Most of the vehicles classified during the study were Passenger Vehicles. The number of Passenger Vehicles in the study was 1697 which represents 95 percent of the total classified vehicles. The number of Vans & Pickups in the study was 18 which represents 1 percent of the total classified vehicles. The number of Busses & Trucks in the study was 10 which represents 1 percent of the total classified vehicles. The number of Tractor Trailers in the study was 61 which represents 3 percent of the total classified vehicles.

< to 16	17 to 23	24 to 29	30 to 39	40 to 49	50 to 59	60 to 69	70 to >												
1527	170	18	10	9	28	20	4												

CHART 2

### HEADWAY

During the peak traffic period, on Oct/29/2008 at [16:30-17:30] the average headway between vehicles was 16.143 seconds. During the slowest traffic period, on Oct/30/2008 at [02:30-03:30] the average headway between vehicles was 327.273 seconds.

### WEATHER

The roadway surface temperature over the period of the study varied between 37.00 and 76.00 degrees F. The HI-STAR determined that the roadway surface was Dry 100.00% of the time.

**Nu-Metrics Traffic Analyzer Study**  
**Computer Generated Summary Report**  
City:  
Street: Hwy 6

A study of vehicle traffic was conducted with HI-STAR unit number 2245. The study was done in the WB @ MP 258.7 lane at Hwy 6 in , Ia in Johnson county. The study began on Oct/29/2008 at 10:30:00 AM and concluded on Oct/30/2008 at 10:30:00 AM, lasting a total of 24.00 hours. Traffic statistics were recorded in 60 minute time periods. The total recorded volume showed 1792 vehicles passed through the location with a peak volume of 183 on Oct/30/2008 at [06:30-07:30] and a minimum volume of 8 on Oct/30/2008 at [01:30-02:30]. The AADT count for this study was 1,792.

**SPEED**

Chart 1 lists the values of the speed bins and the total traffic volume for each bin. At least half the vehicles were traveling in the 61 - 66 MPH range or lower. The average speed for all classified vehicles was 61 MPH with 52.97% vehicles exceeding the posted speed of 55 MPH. The HI-STAR found 52.97 percent of the total vehicles were traveling in excess of 55 MPH. The mode speed for this traffic study was 61MPH and the 85th percentile was 69.39 MPH.

< to 10	11 to 15	16 to 20	21 to 25	26 to 30	31 to 35	36 to 40	41 to 45	46 to 50	51 to 55	56 to 60	61 to 65	66 to 70	71 to 75	76 to >					
0	13	0	7	8	4	10	30	63	179	415	421	246	118	36					

CHART 1

**CLASSIFICATION**

Chart 2 lists the values of the classification bins and the total traffic volume accumulated for each bin. Most of the vehicles classified during the study were Passenger Vehicles. The number of Passenger Vehicles in the study was 1417 which represents 91 percent of the total classified vehicles. The number of Vans & Pickups in the study was 48 which represents 3 percent of the total classified vehicles. The number of Busses & Trucks in the study was 15 which represents 1 percent of the total classified vehicles. The number of Tractor Trailers in the study was 70 which represents 5 percent of the total classified vehicles.

< to 16	17 to 23	24 to 29	30 to 39	40 to 49	50 to 59	60 to 69	70 to >												
1150	267	48	15	7	22	32	9												

CHART 2

**HEADWAY**

During the peak traffic period, on Oct/30/2008 at [06:30-07:30] the average headway between vehicles was 19.565 seconds. During the slowest traffic period, on Oct/30/2008 at [01:30-02:30] the average headway between vehicles was 400 seconds.

**WEATHER**

The roadway surface temperature over the period of the study varied between 37.00 and 76.00 degrees F. The HI-STAR determined that the roadway surface was Dry 100.00% of the time.

**Nu-Metrics Traffic Analyzer Study  
Computer Generated Summary Report  
City:  
Street: Hwy 6**

A study of vehicle traffic was conducted with HI-STAR unit number 2251. The study was done in the WB @ MP 262 lane at Hwy 6 in , Ia in Johnson county. The study began on Oct/29/2008 at 10:30:00 AM and concluded on Oct/30/2008 at 10:30:00 AM, lasting a total of 24.00 hours. Traffic statistics were recorded in 60 minute time periods. The total recorded volume showed 2003 vehicles passed through the location with a peak volume of 205 on Oct/30/2008 at [06:30-07:30] and a minimum volume of 7 on Oct/30/2008 at [00:30-01:30]. The AADT count for this study was 2,003.

**SPEED**

Chart 1 lists the values of the speed bins and the total traffic volume for each bin. At least half the vehicles were traveling in the 56 - 61 MPH range or lower. The average speed for all classified vehicles was 58 MPH with 40.63% vehicles exceeding the posted speed of 55 MPH. The HI-STAR found 40.63 percent of the total vehicles were traveling in excess of 55 MPH. The mode speed for this traffic study was 56MPH and the 85th percentile was 65.40 MPH.

< to 10	11 to 15	16 to 20	21 to 25	26 to 30	31 to 35	36 to 40	41 to 45	46 to 50	51 to 55	56 to 60	61 to 65	66 to 70	71 to 75	76 to >					
0	5	4	2	3	7	2	1	16	40	107	91	32	3	2					

CHART 1

**CLASSIFICATION**

Chart 2 lists the values of the classification bins and the total traffic volume accumulated for each bin. Most of the vehicles classified during the study were Passenger Vehicles. The number of Passenger Vehicles in the study was 285 which represents 90 percent of the total classified vehicles. The number of Vans & Pickups in the study was 10 which represents 3 percent of the total classified vehicles. The number of Busses & Trucks in the study was 0 which represents 0 percent of the total classified vehicles. The number of Tractor Trailers in the study was 20 which represents 6 percent of the total classified vehicles.

< to 16	17 to 23	24 to 29	30 to 39	40 to 49	50 to 59	60 to 69	70 to >												
242	43	10	0	2	8	10	0												

CHART 2

**HEADWAY**

During the peak traffic period, on Oct/30/2008 at [06:30-07:30] the average headway between vehicles was 17.476 seconds. During the slowest traffic period, on Oct/30/2008 at [00:30-01:30] the average headway between vehicles was 450 seconds.

**WEATHER**

The roadway surface temperature over the period of the study varied between 39.00 and 76.00 degrees F. The HI-STAR determined that the roadway surface was Dry 100.00% of the time.



## APPENDIX D. IMAGES OF SITE



**Figure D.1. Road safety audit team**



**Figure D.2. Partially paved shoulder**





**Figure D.3. Wide granular shoulder with worn edge line**



**Figure D.4. Shoulder conditions with worn edge line**





**Figure D.5. Narrow granular shoulders and right of way with worn edge line**



**Figure D.6. Narrow right of way approaching a curve**



**Figure D.7. Short culvert end**



**Figure D.8. Large trees in right of way**





**Figure D.9. Utility pole with downguy in clear zone**



**Figure D.10. Street name signs**



**Figure D.11. Pavement edge conditions**

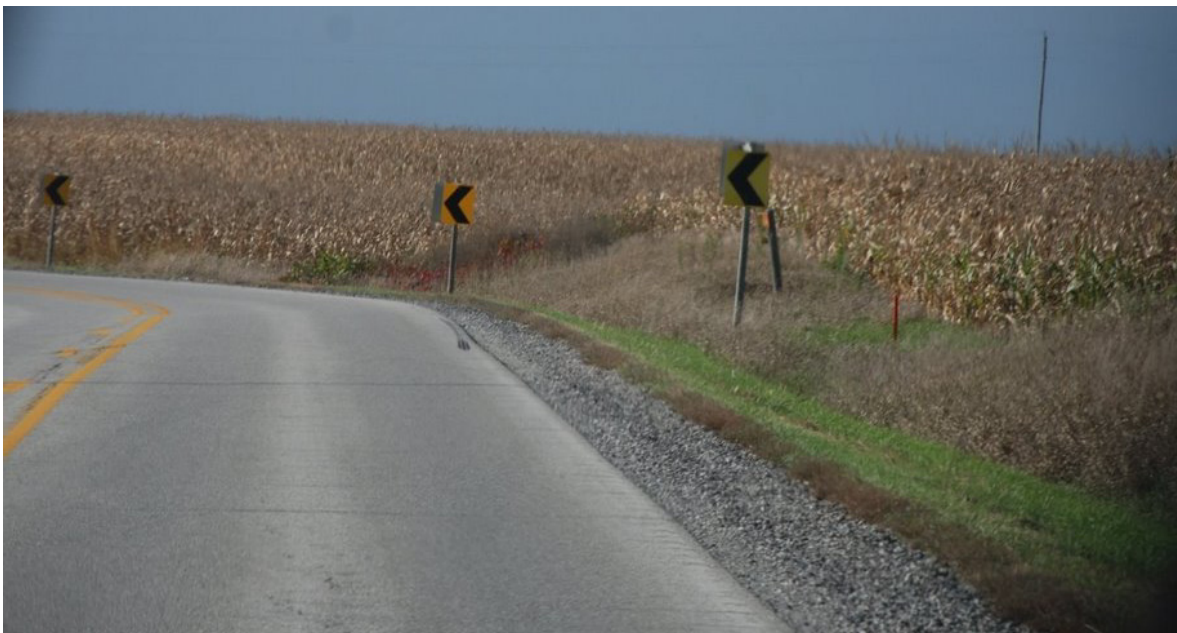


**Figure D.12. Fatal crash site**





**Figure D.13. Bridge west of West Liberty looking westerly**



**Figure D.14. Older and newer chevrons on curve**



**Figure D.15. Night view of chevrons**



**Figure D.16. Night view of horizontal curve sign and chevrons**





**Figure D.17. Railroad crossing**



**Figure D.18. Scott Boulevard intersection with US 6, looking southerly**



**Figure D.19. Taft Avenue intersection looking northerly**



**Figure D.20. Taft Avenue intersection, approaching US 6 from south**





**Figure D.21. Utah Avenue intersection with raised island**



**Figure D.22. Utah Avenue (X-14) looking easterly**



**Figure D.23. Utah Avenue (X-14) Intersection with Stop sign and shoulder conditions**



**Figure D.24. Approaching US 6 Intersection on Utah Avenue (X-14) from the south**





**Figure D.25. American Legion Road intersection with raised islands, looking southerly**



**Figure D.26. American Legion Road intersection looking easterly**



**Figure D.27. Oasis Road intersection with newer chevron signs**



**Figure D.28. New horizontal curve warning signs at Oasis Road**





**Figure D.29. Curve east of Atwood Avenue (Johnson/Muscatine Road) with worn edge lines**



**Figure D.30. Bancroft Avenue (X-30) looking southerly**



**Figure D.31. Curve west of Burkitt Avenue**



**Figure D.32. Burkitt Avenue intersection with US 6, utility pole with downguy in clear zone**





**Figure D.33. Davis Street (X-34) intersection, looking westerly**