

Road Safety Audit For County Road W-55 in Washington County, Iowa

**Final Report
June 2009**

IOWA STATE UNIVERSITY
Institute for Transportation

Sponsored by
the Iowa Department of Transportation

About the Institute for Transportation

The mission of the Institute for Transportation (InTrans) at Iowa State University is to develop and implement innovative methods, materials, and technologies for improving transportation efficiency, safety, reliability, and sustainability while improving the learning environment of students, faculty, and staff in transportation-related fields.

Iowa State University Disclaimer Notice

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the information presented herein. The opinions, findings and conclusions expressed in this publication are those of the authors and not necessarily those of the sponsors.

The sponsors assume no liability for the contents or use of the information contained in this document. This report does not constitute a standard, specification, or regulation.

The sponsors do not endorse products or manufacturers. Trademarks or manufacturers' names appear in this report only because they are considered essential to the objective of the document.

Iowa State University Non-discrimination Statement

Iowa State University does not discriminate on the basis of race, color, age, religion, national origin, sexual orientation, gender identity, sex, marital status, disability, or status as a U.S. veteran. Inquiries can be directed to the Director of Equal Opportunity and Diversity, (515) 294-7612.

Iowa Department of Transportation Statements

Federal and state laws prohibit employment and/or public accommodation discrimination on the basis of age, color, creed, disability, gender identity, national origin, pregnancy, race, religion, sex, sexual orientation or veteran's status. If you believe you have been discriminated against, please contact the Iowa Civil Rights Commission at 800-457-4416 or Iowa Department of Transportation's affirmative action officer. If you need accommodations because of a disability to access the Iowa Department of Transportation's services, contact the agency's affirmative action officer at 800-262-0003.

The preparation of this (report, document, etc.) was financed in part through funds provided by the Iowa Department of Transportation through its "Agreement for the Management of Research Conducted by Iowa State University for the Iowa Department of Transportation," and its amendments.

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

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Road Safety Audit for County Road W-55 in Washington County, Iowa		5. Report Date June 2009	
		6. Performing Organization Code	
7. Author(s) Thomas J. McDonald		8. Performing Organization Report No.	
9. Performing Organization Name and Address Institute for Transportation Iowa State University 2711 South Loop Drive, Suite 4700 Ames, IA 50010-8664		10. Work Unit No. (TRAIS)	
		11. Contract or Grant No.	
12. Sponsoring Organization Name and Address Iowa Department of Transportation 800 Lincoln Way Ames, IA 50010		13. Type of Report and Period Covered Final Report	
		14. Sponsoring Agency Code	
15. Supplementary Notes Visit www.intrans.iastate.edu for color PDF files of this and other research reports.			
16. Abstract A road safety audit was conducted for a seven-mile section of County Road W-55 in Washington County, Iowa. In 2006, the average annual daily traffic on this roadway was found to be 1,290 vehicles per day. Using crash data from 2001 to 2007, the Iowa Department of Transportation (Iowa DOT) has identified this roadway as being in the top 5% of Iowa secondary rural roads with the highest density of serious (fatal and major injury) crashes for single-vehicle run-off-road incidents. Considering these safety data, the Washington County Engineer requested that a road safety audit be conducted to identify areas with safety concerns and to recommend low-cost mitigation to address those concerns. Staff and officials from the Iowa DOT, Iowa State Patrol, Governor's Traffic Safety Bureau, Federal Highway Administration, Institute for Transportation, and local law enforcement and transportation agencies met to review crash data and discuss potential safety improvements to this segment of W-55. This report outlines the findings and recommendations of the road safety audit team to address the safety concerns on this W-55 corridor and explain several selected mitigation strategies.			
17. Key Words accidents—County Road W-55—Iowa DOT—road safety audit		18. Distribution Statement No restrictions.	
19. Security Classification (of this report) Unclassified.	20. Security Classification (of this page) Unclassified.	21. No. of Pages 31	22. Price NA

ROAD SAFETY AUDIT FOR COUNTY ROAD W-55 IN WASHINGTON COUNTY, IOWA

**Final Report
June 2009**

Principal Investigator

Thomas H. Maze
Professor, Department of Civil, Construction, and Environmental Engineering
Institute for Transportation, Iowa State University

Co-Principal Investigator

Thomas J. McDonald
Safety Circuit Rider
Institute for Transportation, Iowa State University

Author

Thomas J. McDonald

Preparation of this report was financed in part through funds provided by the Iowa Department of Transportation through its research management agreement with the Institute for Transportation.

A report from
Institute for Transportation
Iowa State University
2711 South Loop Drive, Suite 4700
Ames, IA 50010-8664
Phone: 515-294-8103
Fax: 515-294-0467
www.intrans.iastate.edu

TABLE OF CONTENTS

ACKNOWLEDGMENTS	IX
INTRODUCTION	1
Audit Team	1
INITIAL MEETING.....	2
FIELD REVIEWS	2
Daylight Review	2
Nighttime Review	3
WRAP-UP MEETING.....	3
CRASH DATA	4
SPEED DATA	5
SUGGESTIONS AND RECOMMENDATIONS	5
APPENDIX A. CRASH DATA, 2002–2008.....	A-1
APPENDIX B. SPEED STUDY RESULTS	B-1
APPENDIX C. IMAGES FROM FIELD REVIEWS	C-1

LIST OF FIGURES

Figure A.1. All crashes from 2002 to 2008	A-1
Figure B.1. Placement of NuMetrics Traffic Analyzer plates	B-1
Figure C.1. Intersection with Washington County Road W-47 (Coppock Road)	C-1
Figure C.2. Bridge with current design beam guardrail	C-2
Figure C.3. Horizontal curve with entrance to rural cemetery	C-3
Figure C.4. Existing signing and pavement markings	C-4
Figure C.5. Nighttime view of signing and pavement markings	C-5

LIST OF TABLES

Table A.1. Crashes by major cause.....	A-2
Table A.2. Crashes by manner of collision.....	A-2
Table A.3. Total crashes by hour of day	A-3
Table A.4. Total crashes by day of week.....	A-3
Table A.5. Total crashes by month	A-3
Table A.6. Crashes by hour of day and crash severity	A-4
Table A.7. Crashes by day of week and crash severity	A-4
Table A.8. Crashes by light conditions.....	A-4
Table A.9. Crashes by weather conditions	A-5
Table A.10. Crashes by driver condition	A-5
Table A.11. Crashes by road surface conditions	A-5
Table A.12. Crashes by driver contributing circumstances	A-6
Table A.13. Crashes by driver age.....	A-6

ACKNOWLEDGMENTS

The author would like to thank the Washington County Engineer and staff for requesting and participating in this road safety audit and the Iowa Department of Transportation for sponsorship of the effort. Input from the Washington County Sheriff's Office, Iowa State Patrol, and emergency services was also valuable.

Participation and contribution by the members of the road safety audit team were invaluable in the successful completion of this activity. The audit team included

- David Patterson Washington County Engineer
- Jake Hotchkiss Assistant to Washington County Engineer
- Richard Young Washington County Ambulance Director
- Sgt. Jared Schneider Washington County Deputy
- Sgt. Troy Bailey Iowa State Patrol
- Larry Roehl Louisa County Engineer
- Jerry Roche Federal Highway Administration, Iowa Division
- Kevin Korth Federal Highway Administration, Iowa Division
- Randy Hunefeld Governor's Traffic Safety Bureau
- LeRoy Bergmann Secondary Roads Engineer, Iowa Department of Transportation
- Bryan Bradley Iowa Department of Transportation, Office of Traffic and Safety
- Bob Sperry Safety Liaison, Institute for Transportation
- Tom McDonald Safety Circuit Rider, Institute for Transportation

INTRODUCTION

Beginning on May 12, 2009, a road safety audit was initiated for a seven-mile section of County Road W-55 in Washington County, Iowa. Using crash data from 2001 to 2007, the Iowa Department of Transportation (Iowa DOT) has identified this roadway as being in the top 5% of Iowa secondary rural roads with the highest density of serious (fatal and major injury) crashes for single-vehicle run-off-road incidents. Considering this, the Washington County engineer requested that a road safety audit be conducted to identify areas with safety concerns and to recommend low-cost mitigation to address those concerns. This report includes a compilation of crash data on this roadway section.

The Iowa DOT reported the average annual daily traffic on this roadway section to be 1,290 vehicles per day (VPD) in 2006. The number of truck and trailer combinations counted on this section in 2006 varied from 14 near the southerly terminus to 53 toward the northerly end per day, Washington County Engineer David Patterson advised that bicycle riders also use W-55 often. The most recent major improvement on this section of W-55 was a 22 foot wide by 6 inch thick portland cement concrete (PCC) pavement overlay constructed in 1977 over an existing asphaltic concrete and rolled stone base roadway. Shoulders vary from 6 to 8 feet in width and are granular surfaced.

Audit Team

Audits were conducted concurrently for Washington County Road W-55 and Louisa County Road X-37, and some staff from each county participated in both audits. The following professionals comprised the audit team for W-55 in Washington County:

- David Patterson Washington County Engineer
- Jake Hotchkiss Assistant to Washington County Engineer
- Richard Young Washington County Ambulance Director
- Sgt. Jared Schneider Washington County Deputy
- Sgt. Troy Bailey Iowa State Patrol
- Larry Roehl Louisa County Engineer
- Jerry Roche Federal Highway Administration, Iowa Division
- Kevin Korth Federal Highway Administration, Iowa Division
- Randy Hunefeld Governor's Traffic Safety Bureau
- LeRoy Bergmann Secondary Roads Engineer, Iowa DOT
- Bryan Bradley Iowa DOT, Office of Traffic and Safety
- Bob Sperry Safety Liaison, Institute for Transportation (InTrans)
- Tom McDonald Safety Circuit Rider, Institute for Transportation (InTrans)

INITIAL MEETING

The initial meeting for the Washington County audit was conducted on the morning of May 12, 2009, in the Washington County Sheriff's Office.

Following introductions, Tom McDonald explained the scope, purpose, and goals of road safety audits briefly and why this road section was selected for this review. Copies of the most recent crash data from the years 2004 to 2008, including a crash map for the subject road segment and summaries of important crash features, were distributed to each participant. This final report includes seven years of data from the years 2002 to 2008.

For the most recent five years of data, a total of four serious crashes were recorded on W-55: two fatal and two with major injuries. According to Deputy Schneider, drivers in all these serious crashes were local residents, and both fatal crashes occurred at night in the southbound direction and were alcohol related. A total of 48 crashes were included in the summaries, most of which were single-vehicle incidents. Many crashes occurred during morning and evening commuting times. Adverse weather and road conditions apparently contributed to crash numbers on this section, although W-55 is a high priority in the county for winter maintenance. In addition, many crashes occurred during nighttime hours. Driver control issues were listed as contributing factors for many crashes, although almost all drivers were judged to be apparently normal at the time of the incidents. Driver ages were well distributed, with no age group indicating a high involvement in crashes. It appeared that the percentage of animal crashes was somewhat lower than what might be expected for a rural road in Iowa. A complete discussion of crash history is included later in the report.

FIELD REVIEWS

Daylight Review

A daylight review of Washington County W-55 was completed in the early afternoon of May 12. The route was driven from north to south, beginning at the southerly corporate limits of the city of Washington.

The PCC pavement overlay is in excellent condition with no evidence of patching or needed repairs. The granular surfaced shoulders are in good condition with some pavement edge drop-off observed, particularly along the low side of horizontal curves but also in some tangent alignment areas. Routine maintenance of the shoulders is difficult in many areas due to the curvilinear alignment of the roadway. The painted pavement markings appeared in good to adequate condition during daylight hours. The centerline markings were re-painted about two years ago and the edge lines one year ago. There are many no-passing areas along the section. Some foreslope flattening has been accomplished by Washington County from 320th Street northerly in the past four to five years.

About 80 larger-sized (24 inch by 30 inch) chevrons have been installed along all horizontal curves on the route. These devices appear in excellent condition, both in visibility and spacing. According to County Engineer Patterson, these devices have been in place for many years, although some have been replaced due to damages. Double-arrow warning signs are in place at T intersections, but no Deer Crossing signs were observed. All signing along this route appears in good to excellent condition.

Two bridges approximately 300 feet long exist on the route. One structure appears relatively new and has current design approach guardrail in place. The other structure is somewhat older with older design guardrail terminals, one of which was damaged.

Images taken during the daylight review are included in Appendix C.

Nighttime Review

A nighttime review of Washington County W-55 was conducted during the evening of May 12. Pavement conditions were wet from recent rain during the review.

Pavement markings did not exhibit good visibility in some areas, possibly due to snow plow damage during winter maintenance activities.

Chevrons in horizontal curves were highly visible. Signs and other traffic control devices also exhibited excellent conspicuity at night.

Images taken during the nighttime reviews are included in Appendix C.

WRAP-UP MEETING

A wrap-up meeting for both Washington and Louisa Counties was conducted on the morning of May 13 in the Washington County Sheriff's Office. Participating in this meeting were David Patterson, Larry Roehl, Jared Schneider, Troy Bailey, Jerry Roche, Kevin Korth, Randy Hunefeld, LeRoy Bergmann, Bryan Bradley, Bob Sperry, and Tom McDonald.

Tom McDonald and other team members briefly reviewed notes and observations from the daylight and nighttime reviews of these routes. Some possible mitigation steps were discussed and these will be included below in this final report.

Sgt. Bailey and Sgt. Schneider indicated that increased law enforcement presence could be established to improve driver performance. Use of LIDAR detection equipment can make these efforts more efficient and effective.

It was suggested that Washington County consider additional foreslope flattening, especially in areas where run-off-road incidents are frequent and right-of-way width is sufficient. In addition, flattening of side slopes at entrances and intersections can be very effective in these areas.

More advisory speed signs with existing warning signs at curves should be considered, as should milled-in, all-weather pavement markings.

Iowa Traffic Safety Data Service (ITSDS) staff at InTrans provided crash data from 2002 through 2003 to supplement the data distributed during the audits, and this added data will be discussed later in this report.

Iowa DOT District 5 Office staff later conducted and provided traffic speed and volume studies for the reviewed section.

CRASH DATA

Seven years of crash data, for the years 2002–2008, were reviewed for the audited section of W-55. Copies of a crash location map that indicates severity and crash summary tables are included in Appendix A.

A total of 64 crashes were recorded during the review period; 26 (41%) were listed as animal collisions. Other major causes of these crashes were ran-off-road (11) and swerving/evasive action (9). Very few intersection-related crashes were noted. The number of crashes per year was quite consistent over the seven-year period. Non-collision crashes were recorded for 54 of the 64 total crashes (84%), which indicates a high percentage of single-vehicle occurrences.

Hour of day for crashes displayed some consistency, but early morning and late afternoon crash numbers were higher, indicating occurrence during possible commuting times. However, day of week crash distribution did indicate significant numbers on the weekends.

Both fatal crashes and one of three major injury crashes occurred during nighttime hours, all during the work week. Month of crash occurrence showed that many crashes occurred during the months of November through March, 39 of 64 (61%), indicating possible adverse weather and/or road condition contribution.

Although 27 of 64 crashes were recorded during daylight conditions, 25 (39%) occurred during nighttime hours. Weather conditions were reported as clear, partly cloudy, or cloudy for 47 of 64 crashes (73%), but 9 of 64 occurred during snow or sleet/freezing rain. Road surface conditions were reported as dry for 41 crashes (64%) and as icy, snowy, or slushy for 15 crashes (23%).

Driver condition was assessed to be apparently normal for 61 of 72 drivers involved in these crashes (85%); “under the influence” was recorded for only 3 drivers. Improper action on the part of drivers, such as too fast for conditions, lost control, or swerved to avoid, was listed for a

high number of crashes. No improper action was recorded for only 22 of 72 involved drivers (31%).

Driver age indicated a somewhat uniform distribution, although the data shows that the 16–18 age group made up 14 of 72 drivers (19%). The two age groups displaying the highest involvement in crashes were 40–44 and 45–49, totaling 24%. Over-65 age groups were only involved as 11% of the drivers in these crashes.

SPEED DATA

Traffic data were sampled on June 2–3, 2009, by Iowa DOT District 5 Traffic Technician Frank Redeker on County Road W-55 at locations on either side of the W-47 (Coppock Road) intersection. The data were collected between 10:00 a.m. on June 2 and concluded on June 3 at 10:00 a.m. using three NuMetrics Traffic Analyzer plates.

For westbound traffic east of the W-47 intersection, average speed was measured at 55 mph, with approximately 24% exceeding the posted speed limit of 55 mph. The 85th percentile speed was calculated at about 64 mph. Traffic volume over this 24 hour period was 898, with 94% classified as passenger cars. The remaining 6% were pickups, vans, buses, and trucks. The peak-hour volume was 78 vehicles from 7:00 a.m. to 8:00 a.m., and the low-hour volume was 1 vehicle from midnight to 1:00 a.m.

For westbound traffic west of the W-47 intersection, average speed was measured at 54 mph, with about 18% exceeding the posted speed limit of 55 mph. The 85th percentile speed was calculated at almost 62 mph. Traffic volume over this 24 hour period was 1,197 total vehicles, of which 95% were passenger cars. The remaining 5% were pickups, vans, buses, and trucks. Peak-hour volume was 104 vehicles at 7:00 a.m. to 8:00 a.m., and the low-hour volume was 3 vehicles from midnight to 1:00 a.m.

For eastbound traffic west of the W-47 intersection, average speed was measured at 54 mph, with about 9% exceeding the posted speed limit. The 85th percentile speed was calculated at 59.83 mph. Traffic volume over the 24 hour period was 1,190, of which 97% were passenger cars; the remaining 3% were pickups, vans, busses, and trucks. Peak hourly volume was 133 vehicles from 5:00 p.m. to 6:00 p.m., and the low-hour volume was 2 vehicles between 3:00 a.m. and 4:00 a.m.

Weather conditions during this sampling exhibited temperatures varying from 54°F to 82°F with a dry pavement surface.

SUGGESTIONS AND RECOMMENDATIONS

Considering the observations made during field reviews, examination of available data, and comments from audit team members, the following suggestions are offered for consideration as

mitigation strategies for improving traffic safety on the reviewed section of county road W-55. The options are not listed in a priority order.

1. To improve nighttime visibility along this route, consider use of milled-in, all-weather pavement markings. Another possible enhancement option would be to revise the current replacement schedule for pavement markings to one or two years. A cost comparison between these options might be worthwhile.
2. Install 2–3 foot wide paved shoulders with narrow rumble strips along the frequent run-off-road locations and in areas where pavement edge drop-off occurs frequently. Placement of edge line paint over the rumble strips would provide even more effective results (rumble strips). Three relatively short sections would address approximately half of the non-animal crash locations.
3. Consider additional foreslope and side slope flattening in frequent run-off-road locations to reduce the severity of possible future crashes.
4. Study additional mowing and vegetation removal in the right-of-way to improve visibility of deer.
5. In consultation with the Department of Natural Resources, study installation of Deer Crossing signs at frequent animal crash locations. If a concentration of animal-related crashes has occurred near a bridge, installation of high fencing to direct deer to an under-road crossing might be an effective mitigation.
6. Advance warning for higher degree horizontal curves and combination horizontal-vertical curves might be improved with double signing, larger sizes, advisory speed plates, and fluorescent micro-prismatic sheeting.
7. Ascertain that street name signs are visible and compliant with 2009 *Manual on Uniform Traffic Control Devices* recommendations for letter size, color, and placement.
8. Considering the traffic speed measured during the data sampling, discuss increased surveillance and patrol activities with the Iowa State Patrol and Washington County Sheriff's Office. Aerial enforcement and/or LIDAR equipment could both be used effectively on this route, as the existing shoulders are of a sufficient width to permit stopping vehicles along the roadway.

APPENDIX A. CRASH DATA, 2002–2008

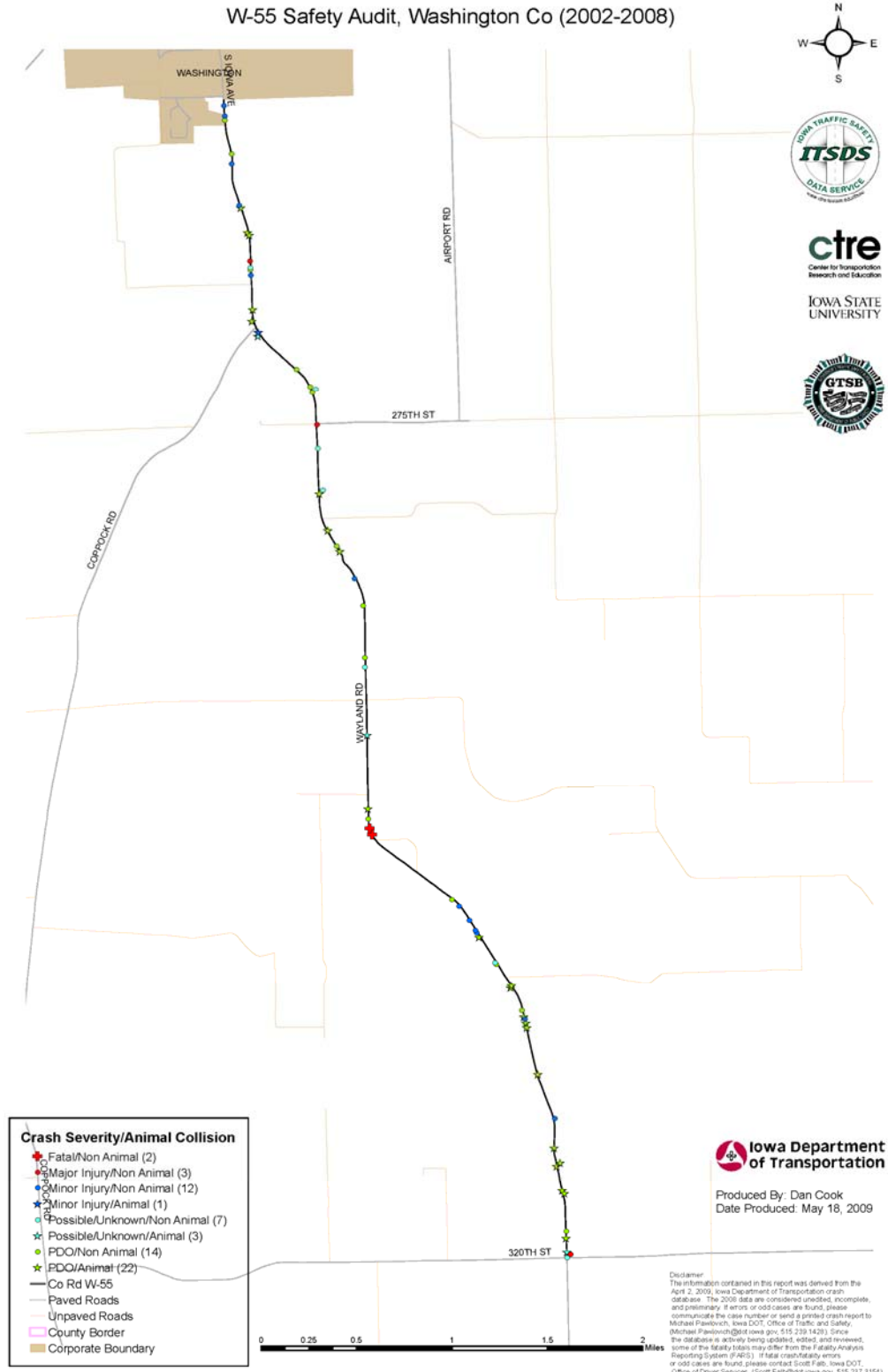


Figure A.1. All crashes from 2002 to 2008

The following disclaimer applies to Tables A.1. through A.13: The information contained in this report was derived from the April 2, 2009, Iowa Department of Transportation crash database. The 2008 data are considered unedited, incomplete, and preliminary. If errors or odd cases are found, please communicate the case number or send a printed crash report to Michael Pawlovich, Office of Traffic and Safety, (Michael.Pawlovich@dot.iowa.gov, 515.239.1428). Since the database is actively being reviewed and updated, some of the fatality totals may differ from the Fatality Analysis Reporting System (FARS). If fatal crash/fatality errors or odd cases are found, please contact Scott Falb, Office of Driver Services, (Scott.Falb@dot.iowa.gov, 515.237.3154).

Table A.1. Crashes by major cause

Year	Major Cause															Total	
	Animal	Ran Stop Sign	Crossed Centerline	FTYROW: From Stop Sign	FTYROW: Other	Driving too Fast for Conditions	Exceeded Authorized Speed	Followed too Close	Swerving/Evasive Action	Over Correcting/Over Steering	Ran off Road/Right	Ran off Road/Left	Lost Control	Other Improper Action	Unknown		Other/No Improper Action
2002	5						1		1			1					8
2003	5										1	2					8
2004	3	1	1			1		1	1								8
2005	3					1			2		2	1				1	10
2006	3								3	1	1					1	9
2007	4			1		1			1		1	1		1	1	1	12
2008	3				1	1			1		1		1			1	9
Total	26	1	1	1	1	4	1	1	9	1	6	5	1	1	1	4	64

Table A.2. Crashes by manner of collision

Year	Manner of Collision						Total
	Non-collision	Head-on	Rear-end	Broadside	Sideswipe, Same Direction	Sideswipe, Opposite Direction	
2002	8						8
2003	8						8
2004	4		2	1		1	8
2005	10						10
2006	9						9
2007	9		1	2			12
2008	6	1	1		1		9
Total	54	1	4	3	1	1	64

Table A.3. Total crashes by hour of day

Year	Hour of Day																									Total
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Unkn	
2002					1	1		1										3		1				1		8
2003							2						1					1	1	2			1			8
2004	1						1		2			1			1	2										8
2005	1						1	1	2								2			1	1				1	10
2006				1				1			1		1		1	1		1				1	1			9
2007					1	1	2		1			1		1	1		1	1	2							12
2008				1			1	1		1	1		1								1	1	1			9
Total	2	0	0	2	2	2	7	4	5	1	2	2	2	2	3	3	3	6	4	5	1	2	2	1	1	64

Table A.4. Total crashes by day of week

Year	Day of Week							Total
	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	
2002		1	1	2	3		1	8
2003	1	2	1		1	1	2	8
2004	2	3			1		2	8
2005	2	2	2		3	1		10
2006		1	2	1	2	2	1	9
2007	2		2	1	3	3	1	12
2008	2	1	1	1	2		2	9
Total	9	10	9	5	15	7	9	64

Table A.5. Total crashes by month

Year	Month												Total
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	
2002		1			1	1				3	2		8
2003	2	1	1		1		1			1		1	8
2004	1		3		1	1				1	1		8
2005	4	1			2	1				1		1	10
2006	2	1				1				2	1	2	9
2007		2		2				1	1	1	1	4	12
2008			2	1	1							3	9
Total	9	6	6	3	6	4	1	1	1	9	8	10	64

Table A.6. Crashes by hour of day and crash severity

Crash Severity	Hour of Day																							Total
	0	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Unkn	
Fatal	1																				1			2
Major Inj			1												1			1						3
Minor Inj	1	1			1		1		1	1		1	1	2		1		1				1		13
Poss/Unk			1		1		2		1		1		1			1	2							10
PDO		1		2	5	4	2	1		1	1	1	1	1	2	4	2	3	1	2	1		1	36
Total	2	2	2	2	7	4	5	1	2	2	2	2	3	3	3	6	4	5	1	2	2	1	1	64

Table A.7. Crashes by day of week and crash severity

Crash Severity	Day of Week							Total
	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	
Fatal		1			1			2
Major Inj				1	1	1		3
Minor Inj	2	2	2	2	1		4	13
Poss/Unk	1	2			4	2	1	10
PDO	6	5	7	2	8	4	4	36
Total	9	10	9	5	15	7	9	64

Table A.8. Crashes by light conditions

Year	Light Conditions					Total
	Daylight	Dusk	Dawn	Dark - Roadway not Lighted	Unknown/Not Reported	
2002		1	1	6		8
2003	1		1	4	2	8
2004	7			1		12
2005	5	1	1	2	1	10
2006	4		1	4		9
2007	5	2		5		14
2008	5		1	3		11
Total	27	4	5	25	3	72

Table A.9. Crashes by weather conditions

Year	Weather Conditions									Total
	Clear	Partly Cloudy	Cloudy	Fog/ smoke	Mist	Rain	Sleet/ hail/ freezing rain	Snow	Other/Not Reported	
2002	6		1			1				8
2003	3		2		1				2	8
2004	2	5						1		8
2005	6		3						1	10
2006	5		2					1	1	9
2007	6	1		1		1	2	1		12
2008	4	1					3	1		9
Total	32	7	8	1	1	2	5	4	4	64

Table A.10. Crashes by driver condition

Year	Driver Condition					Total
	Apparently Normal	Asleep/ fainted/ fatigued/ etc.	Under the Influence	Unknown	Not Reported	
2002	6	1	1			8
2003	4			1	3	8
2004	11		1			12
2005	8			1	1	10
2006	7	1	1			9
2007	14					14
2008	11					11
Total	61	2	3	2	4	72

Table A.11. Crashes by road surface conditions

Year	Road Surface Conditions						Total
	Dry	Wet	Ice	Snow	Slush	Unknown/Not Reported	
2002	7	1					8
2003	4		1	1		2	8
2004	6	1	1				8
2005	6		3			1	10
2006	8			1			9
2007	6	2	2	2			12
2008	4	1	2	1	1		9
Total	41	5	9	5	1	3	64

Table A.12. Crashes by driver contributing circumstances

Year	Driver Contributing Circumstances														Total	
	Ran Stop Sign	Exceeded Authorized Speed	Driving too fast for conditions	Made improper turn	Crossed Centerline	Lost Control	Followed too close	Swerved to avoid	Over correcting/ over steering	FTYROW: From stop sign	Inattentive or distracted by fatigue/ asleep	Other: Vision obstructed	Other improper action	No improper action		Not reported/ Unknown
2002		1				1					1			2	3	8
2003						2								2	4	8
2004	1		2		1		1	1					1	4	1	12
2005			1			5								2	2	10
2006						1		1	2					3	2	9
2007			1			3				1		1	1	5	2	14
2008			1	1		2		2						4	1	11
Total	1	1	5	1	1	14	1	4	2	1	1	1	2	22	15	72

Table A.13. Crashes by driver age

Year	Driver Age																	Total
	16	17	18	20	21-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	80-84	85-89	
2002	1	1	1				1	1	2					1				8
2003		1			1	1			1	2		1			1			8
2004		2	1	1	2		1		2	1		1					1	12
2005	2	1			1				2		2	1	1					10
2006	2					1	1		2			2	1					9
2007			1			1	1	1	1	3			2	1	1	1	1	14
2008	1			1	2	1	2	1		1		1		1				11
Total	6	5	3	2	6	4	6	3	10	7	2	6	4	3	2	1	2	72

APPENDIX B. SPEED STUDY RESULTS

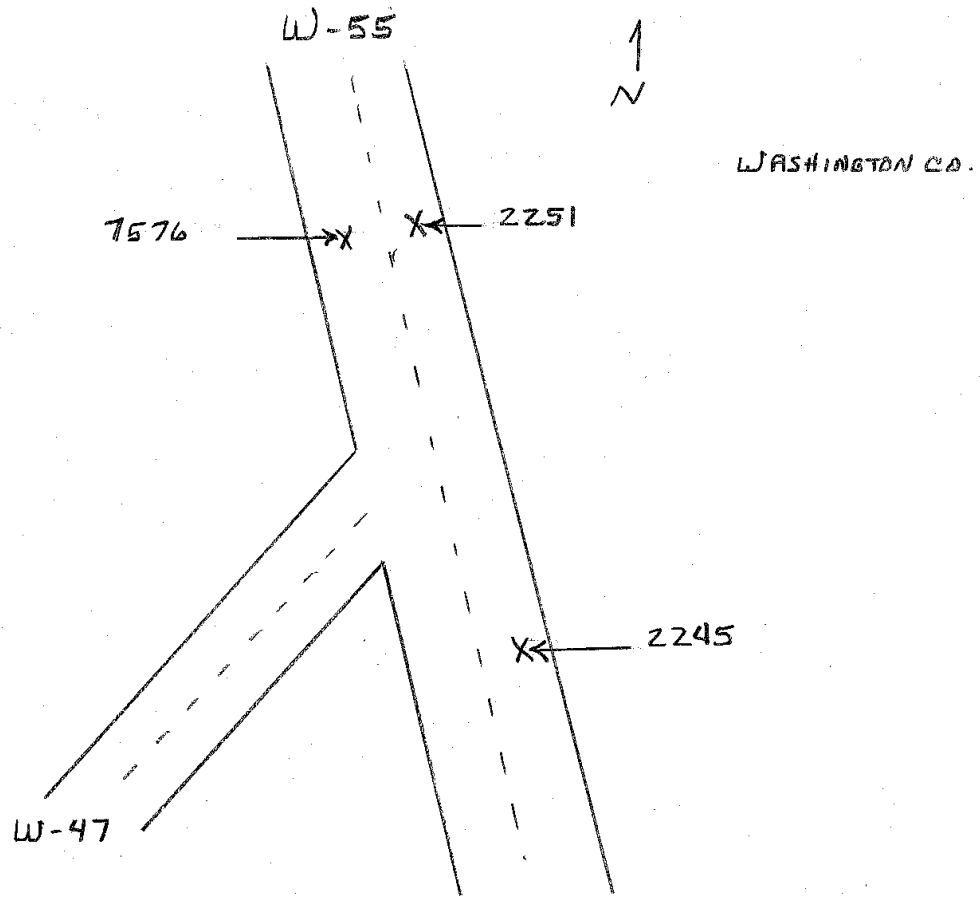


Figure B.1. Placement of NuMetrics Traffic Analyzer plates

**Nu-Metrics Traffic Analyzer Study
Computer Generated Summary Report
City: Washington
Street: W-55**

A study of vehicle traffic was conducted with HI-STAR unit number 7576. The study was done in the SB-N of W45 lane at W-55 in Washington, Ia in Washington county. The study began on Jun/02/2009 at 10:00:00 AM and concluded on Jun/03/2009 at 10:00:00 AM, lasting a total of 24.00 hours. Traffic statistics were recorded in 60 minute time periods. The total recorded volume showed 1190 vehicles passed through the location with a peak volume of 133 on Jun/02/2009 at [17:00-18:00] and a minimum volume of 2 on Jun/03/2009 at [03:00-04:00]. The AADT count for this study was 1,190.

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 51 - 56 MPH range or lower. The average speed for all classified vehicles was 54 MPH with 8.56% vehicles exceeding the posted speed of 55 MPH. The HI-STAR found 8.56 percent of the total vehicles were traveling in excess of 55 MPH. The mode speed for this traffic study was 51MPH and the 85th percentile was 59.83 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	1	4	3	4	8	17	68	205	428	320	82	14	3	0						

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 1118 which represents 97 percent of the total classified vehicles. The number of Vans & Pickups in the study was 10 which represents 1 percent of the total classified vehicles. The number of Busses & Trucks in the study was 13 which represents 1 percent of the total classified vehicles. The number of Tractor Trailers in the study was 16 which represents 1 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 >													
936	182	10	13	8	8	0	0													

CHART 2

HEADWAY

During the peak traffic period, on Jun/02/2009 at [17:00-18:00] the average headway between vehicles was 26.866 seconds. During the slowest traffic period, on Jun/03/2009 at [03:00-04:00] the average headway between vehicles was 1200 seconds.

WEATHER

The roadway surface temperature over the period of the study varied between 56.00 and 82.00 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: Washington
Street: W-55**

A study of vehicle traffic was conducted with HI-STAR unit number 2251. The study was done in the NB-N of W45 lane at W-55 in Washington, Ia in Washington county. The study began on Jun/02/2009 at 10:00:00 AM and concluded on Jun/03/2009 at 10:00:00 AM, lasting a total of 24.00 hours. Traffic statistics were recorded in 60 minute time periods. The total recorded volume showed 1197 vehicles passed through the location with a peak volume of 104 on Jun/03/2009 at [07:00-08:00] and a minimum volume of 3 on Jun/03/2009 at [00:00-01:00]. The AADT count for this study was 1,197.

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 51 - 56 MPH range or lower. The average speed for all classified vehicles was 54 MPH with 17.55% vehicles exceeding the posted speed of 55 MPH. The HI-STAR found 17.55 percent of the total vehicles were traveling in excess of 55 MPH. The mode speed for this traffic study was 51MPH and the 85th percentile was 61.89 MPH.

<	11	16	21	26	31	36	41	46	51	56	61	66	71	76						
to	to	to	to	to	to	to	to	to	to	to	to	to	to	to						
10	15	20	25	30	35	40	45	50	55	60	65	70	75	>						
0	4	2	3	2	11	23	67	154	274	254	135	28	4	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 919 which represents 95 percent of the total classified vehicles. The number of Vans & Pickups in the study was 9 which represents 1 percent of the total classified vehicles. The number of Busses & Trucks in the study was 12 which represents 1 percent of the total classified vehicles. The number of Tractor Trailers in the study was 23 which represents 2 percent of the total classified vehicles.

<	17	24	30	40	50	60	70													
to	to	to	to	to	to	to	to													
16	23	29	39	49	59	69	>													
799	120	9	12	4	14	4	1													

CHART 2

HEADWAY

During the peak traffic period, on Jun/03/2009 at [07:00-08:00] the average headway between vehicles was 34.286 seconds. During the slowest traffic period, on Jun/03/2009 at [00:00-01:00] the average headway between vehicles was 900 seconds.

WEATHER

The roadway surface temperature over the period of the study varied between 56.00 and 80.00 degrees F. The HI-STAR determined that the roadway surface was Dry 45.83% of the time.

**Nu-Metrics Traffic Analyzer Study
Computer Generated Summary Report
City: Washington
Street: W-55**

A study of vehicle traffic was conducted with HI-STAR unit number 2245. The study was done in the NB-S of W45 lane at W-55 in Washington, Ia in Washington county. The study began on Jun/02/2009 at 10:00:00 AM and concluded on Jun/03/2009 at 10:00:00 AM, lasting a total of 24.00 hours. Traffic statistics were recorded in 60 minute time periods. The total recorded volume showed 898 vehicles passed through the location with a peak volume of 78 on Jun/03/2009 at [07:00-08:00] and a minimum volume of 1 on Jun/03/2009 at [00:00-01:00]. The AADT count for this study was 898.

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 55 MPH with 23.50% vehicles exceeding the posted speed of 55 MPH. The HI-STAR found 23.50 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 64.02 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	1	3	6	6	7	21	49	112	209	224	116	57	18	5						

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 785 which represents 94 percent of the total classified vehicles. The number of Vans & Pickups in the study was 18 which represents 2 percent of the total classified vehicles. The number of Busses & Trucks in the study was 11 which represents 1 percent of the total classified vehicles. The number of Tractor Trailers in the study was 20 which represents 2 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 >													
667	118	18	11	6	9	4	1													

CHART 2

HEADWAY

During the peak traffic period, on Jun/03/2009 at [07:00-08:00] the average headway between vehicles was 45.57 seconds. During the slowest traffic period, on Jun/03/2009 at [00:00-01:00] the average headway between vehicles was 1800 seconds.

WEATHER

The roadway surface temperature over the period of the study varied between 56.00 and 85.00 degrees F. The HI-STAR determined that the roadway surface was Dry 100.00% of the time.

APPENDIX C. IMAGES FROM FIELD REVIEWS



Figure C.1. Intersection with Washington County Road W-47 (Coppock Road)



Figure C.2. Bridge with current design beam guardrail



Figure C.3. Horizontal curve with entrance to rural cemetery



Figure C.4. Existing signing and pavement markings

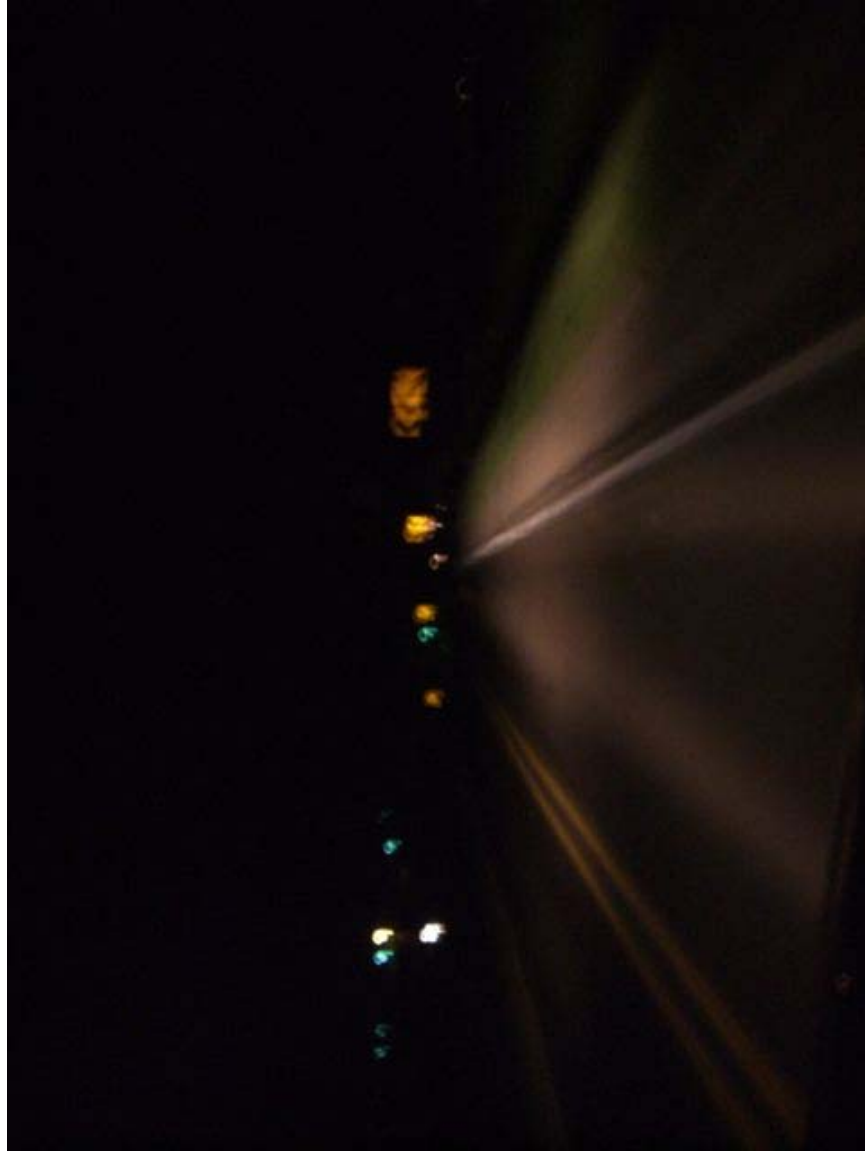


Figure C.5. Nighttime view of signing and pavement markings