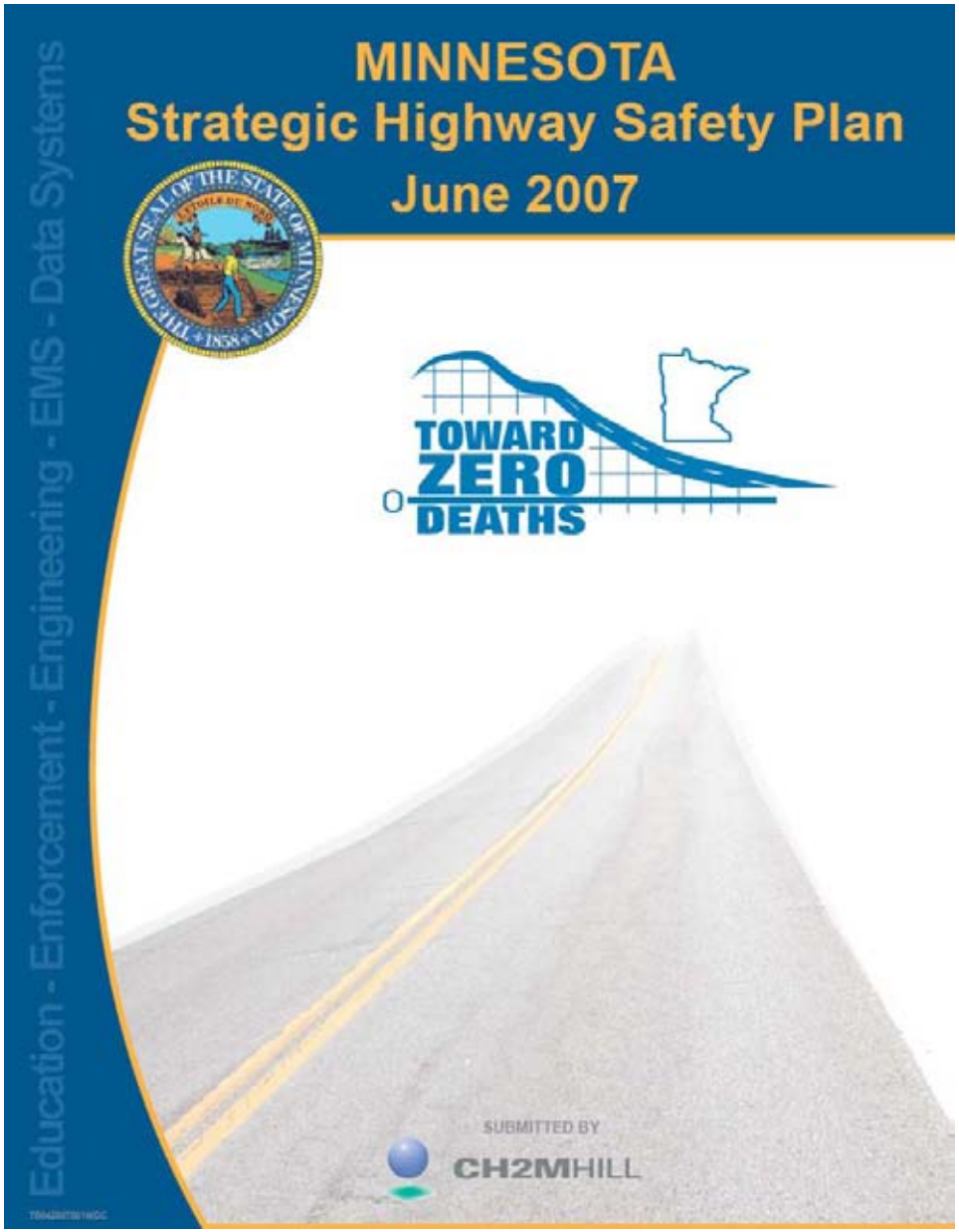
Southwest Minnesota Toward Zero Deaths Workshop

April 30, 2009

Redwood Falls Community Center

Redwood Falls, MN



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Statewide Fatalities (2001-2005)

Total Fatalities	3,008		
Total Vehicle Occupant Fatalities	2,429		
Driver Behavior Based Emphasis Areas			
Unbelted (Based on Veh. Occ. Fatalities)	1,271	(52%)	1
Alcohol-Related	1,068	(36%)	2
Speeding-Related	850	(28%)	5
Involved Drivers Under 21	718	(24%)	6
Infrastructure Based Emphasis Areas			
Single Vehicle ROR	965	(32%)	4
Intersection	1,004	(33%)	3
Head-On and Sideswipe	611	(20%)	7

Emphasis Area Fatality Rank

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ATP 8 Fatalities (2001-2005)

		Driver Behavior Based Emphasis Areas				Infrastructure Based Emphasis Areas		
	Total Fatalities	Unbelted	Alcohol-Related	Speeding-Related	Young Driver Involved	Single Vehicle ROR	Inter-section	Head-on & Sideswipe
Statewide	3,008	1,271 (52%)	1,068 (36%)	850 (28%)	718 (24%)	965 (32%)	1,004 (33%)	611 (20%)
ATP 8 Total	207	104 (55%)	60 (29%)	51 (25%)	55 (27%)	67 (32%)	86 (42%)	51 (25%)
State Trunk Highway	108 (52%)	43 (42%)	14 (13%)	21 (19%)	27 (25%)	17 (16%)	44 (41%)	45 (42%)
Local Roads	99 (48%)	61 (71%)	46 (46%)	30 (30%)	28 (28%)	50 (51%)	42 (42%)	6 (6%)

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Priority Facility Types for the State System - ATP 8

	Facility Type		Miles	Crashes		Crash Rate	Severity Rate	Fatal Rate	Crash Density	Priority
				Fatal	Serious Injury					
Rural	Freeway		0	0	0	0.0	0.0	0.0	0.0	
	4-lane Expressway		9	1	2	1.0	1.8	2.4	2.4	
	4-Lane Undivided		1	0	0	0.0	0.0	0.0	0.0	
	4-Lane Divided Conventional (Non expressway)		35	4	7	1.0	1.6	2.1	2.7	♂
	2-Lane	ADT < 1,500	521	6	9	0.8	1.3	1.6	0.3	♂
		1,500 ≤ ADT < 5,000	665	19	25	0.6	1.0	1.4	0.6	♂
		5,000 ≤ ADT < 8,000	109	4	5	0.7	1.1	0.8	1.5	♂
		ADT > 8,000	3	0	0	1.5	2.1	0.0	5.2	
	Sub Total		1,342	34	48					
Urban	Freeway		0	0	0	0.0	0.0	0.0	0.0	
	4-lane Expressway		0	0	0	0.0	0.0	0.0	0.0	
	4-Lane Undivided		1	0	0	5.6	8.2	0.0	19.1	
	4-Lane Divided Conventional (Non expressway)		2	0	1	5.1	7.4	0.0	19.9	
	Three-Lane		7	0	4	3.3	4.7	0.0	10.7	
	Five-Lane		2	0	1	3.2	4.1	0.0	10.7	
	2-Lane	ADT < 1,500	7	0	0	2.9	4.2	0.0	1.1	
		1,500 ≤ ADT < 5,000	37	0	2	2.0	2.9	0.0	2.2	
		5,000 ≤ ADT < 8,000	16	1	2	2.6	3.9	1.4	5.9	
		ADT > 8,000	10	2	1	4.0	5.8	2.5	15.5	
	Sub Total		82	3	11					

Source: Minnesota crash records, 2004-2005

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Fatal and Serious Injury Crash Summary for Priority Facility Types – ATP 8

Priority Facility Type	Fatal Crashes						
	Alcohol-Related	Unbelted Veh. Occupant	Under the Age of 21	Speeding-Related	Intersection	Head-on and Sideswipe	Single Vehicle ROR
Rural							
4-Lane Divided Conventional (Non expressway)	0	3 (1st)	3 (1st)	1 (1st)	3	3 (1st)	0
Multi-Lane Subtotal	**0**	**3**	**3**	**1**	**3**	**3**	**0**
2-Lane Conventional: ADT < 1,500	4	7	4	4	6	3 (1st)	4
2-Lane Conventional: 1,500 ≤ ADT < 5,000	2	17	13 (1st)	11 (1st)	20 (1st)	24 (1st)	6
2-Lane Conventional: 5,000 ≤ ADT < 8,000	1	2	2	3	5	6	0
2-Lane Conventional Subtotal	**7**	**26**	**19**	**18**	**31**	**33**	**10**
Rural Subtotal	**7**	**29**	**22**	**19**	**34**	**36**	**10**
TOTAL	**7**	**29**	**22**	**19**	**34**	**36**	**10**

Priority Facility Type	Fatal + Serious Injury Crashes						
	Alcohol-Related	Unbelted Veh. Occupant	Under the Age of 21	Speeding-Related	Intersection	Head-on and Sideswipe	Single Vehicle ROR
Rural							
4-Lane Divided Conventional (Non expressway)	2	5 ♂	9 ♂	6 ♂	15 ♂	4 ♂	6 ♂
Multi-Lane Subtotal	**2**	**5**	**9**	**6**	**15**	**4**	**6**
2-Lane Conventional: ADT < 1,500	16 ♂♂♂	19 ♂♂	12 ♂♂	9 ♂	15 ♂	10 ♂♂	17 ♂♂
2-Lane Conventional: 1,500 ≤ ADT < 5,000	12 ♂♂	38 ♂♂♂	41 ♂♂♂	30 ♂♂♂	61 ♂♂♂	46 ♂♂♂	24 ♂♂♂
2-Lane Conventional: 5,000 ≤ ADT < 8,000	8 ♂	12 ♂	11 ♂	13 ♂♂	15 ♂♂	20 ♂♂	5
2-Lane Conventional Subtotal	**36**	**69**	**64**	**52**	**91**	**76**	**46**
Rural Subtotal	**38**	**74**	**73**	**58**	**106**	**80**	**52**
Urban							
Urban Subtotal	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL	**38**	**74**	**73**	**58**	**106**	**80**	**52**

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STEP 1: Summarize Data & Rank Counties

	TOTALS			FATALITIES																						
	Total Fatalities #	Vehicle Occupant Fatalities #	Vehicle Miles Traveled	Under the Age of 21 #	Under the Age of 21 %	Under the Age of 21 Rate	Speeding-Related #	Speeding-Related %	Speeding-Related Rate	Alcohol-Related #	Alcohol-Related %	Alcohol-Related Rate	Unbelted Vehicle Occupant #	Unbelted Vehicle Occupant %	Unbelted Vehicle Occupant Rate	Single Vehicle ROR #	Single Vehicle ROR %	Single Vehicle ROR Rate	Intersection #	Intersection %	Intersection Rate	Head-on and Sideswipe #	Head-on and Sideswipe %	Head-on and Sideswipe Rate	
Statewide	**3,008**	**2,429**	**276,072,182,210**	**718**	**24%**	**0.3**	**850**	**28%**	**0.3**	**1,068**	**36%**	**0.4**	**1,271**	**52%**	**0.5**	**965**	**32%**	**0.3**	**1,004**	**33%**	**0.4**	**611**	**20%**	**0.2**	**Statewide**
ATP 8 Total	**207**	**188**	**12,489,973,298**	**55**	**27%**	**0.4**	**51**	**25%**	**0.4**	**60**	**29%**	**0.5**	**104**	**55%**	**0.8**	**67**	**32%**	**0.5**	**86**	**42%**	**0.7**	**51**	**25%**	**0.4**	**ATP 8 Total**
Local Road System	**99**	**86**	**5,648,880,732**	**28**	**28%**	**0.5**	**30**	**30%**	**0.5**	**46**	**46%**	**0.8**	**61**	**71%**	**1.1**	**50**	**51%**	**0.9**	**42**	**42%**	**0.7**	**6**	**6%**	**0.1**	**Local Road System**
Chippewa	8	8	310,931,280	4	50%		2	25%		5	63%		6	75%		1	13%		5	63%		0	0%		Chippewa
Kandiyohi	20	18	1,168,963,202	3	15%		3	15%		4	20%		11	61%		12	60%		8	40%		1	5%		Kandiyohi
Lac Qui Parle	5	4	256,686,298	2	40%		3	60%		3	60%		4	100%		5	100%		1	20%		0	0%		Lac Qui Parle
Lincoln	7	6	202,408,448	4	57%		6	86%		6	86%		5	83%		4	57%		4	57%		0	0%		Lincoln
Lyon	5	5	518,246,190	1	20%		2	40%		3	60%		3	60%		4	80%		0	0%		0	0%		Lyon
McCleod	8	8	785,970,658	1	13%		3	38%		2	25%		5	63%		4	50%		5	63%		0	0%		McCleod
Meeker	12	6	457,703,334	4	33%		2	17%		7	58%		6	100%		6	50%		4	33%		3	25%		Meeker
Murray	6	5	269,227,266	0	0%		1	17%		2	33%		4	80%		2	33%		3	50%		1	17%		Murray
Pipestone	2	1	232,964,732	1	50%		0	0%		1	50%		1	100%		1	50%		1	50%		0	0%		Pipestone
Redwood	3	3	561,012,936	0	0%		2	67%		3	100%		2	67%		0	0%		0	0%		1	33%		Redwood
Renville	16	15	568,203,724	7	44%		5	31%		8	50%		11	73%		7	44%		8	50%		0	0%		Renville
Yellow Medicine	7	7	316,562,664	1	14%		1	14%		2	29%		3	43%		4	57%		3	43%		0	0%		Yellow Medicine

	TOTALS			FATALITIES + SERIOUS INJURIES ("A" Crashes Only)																						
	Total Fatalities + Serious Injuries #	Vehicle Occupant Fatalities + Serious Injuries #	Vehicle Miles Traveled	Under the Age of 21 #	Under the Age of 21 %	Under the Age of 21 Rate	Speeding-Related #	Speeding-Related %	Speeding-Related Rate	Alcohol-Related #	Alcohol-Related %	Alcohol-Related Rate	Unbelted Vehicle Occupant #	Unbelted Vehicle Occupant %	Unbelted Vehicle Occupant Rate	Single Vehicle ROR #	Single Vehicle ROR %	Single Vehicle ROR Rate	Intersection #	Intersection %	Intersection Rate	Head-on and Sideswipe #	Head-on and Sideswipe %	Head-on and Sideswipe Rate	
Statewide	**15,174**	**9456**	**276,072,182,210**	**4343**	**29%**	**1.6**	**3511**	**23%**	**1.3**	**3573**	**24%**	**1.3**	**4,351**	**46%**	**1.6**	**3845**	**25%**	**1.4**	**6896**	**45%**	**2.5**	**2216**	**15%**	**0.8**	**Statewide**
ATP 8 Total	**919**	**796**	**12,489,973,298**	**309**	**34%**	**2.5**	**209**	**23%**	**1.7**	**215**	**23%**	**1.7**	**338**	**42%**	**2.7**	**278**	**30%**	**2.2**	**412**	**45%**	**3.3**	**164**	**18%**	**1.3**	**ATP 8 Total**
Local Road System	**544**	**455**	**5,648,880,732**	**188**	**35%**	**3.3**	**133**	**24%**	**2.4**	**153**	**28%**	**2.7**	**212**	**47%**	**3.8**	**202**	**37%**	**3.6**	**242**	**44%**	**4.3**	**54**	**10%**	**1.0**	**Local Road System**
Chippewa	36	32	310,931,280	17	47%	☿☿	8	22%		15	42%	☿☿☿	24	75%	☿☿	14	39%		16	44%	☿	1	3%		Chippewa
Kandiyohi	176	148	1,168,963,202	67	38%	☿☿☿	33	19%	☿☿☿	37	21%	☿☿☿	53	36%	☿☿☿	49	28%	☿☿☿	95	54%	☿☿☿	20	11%	☿☿☿	Kandiyohi
Lac Qui Parle	22	21	256,686,298	8	36%		9	41%	☿	8	36%	☿	10	48%	☿	19	86%	☿☿☿	5	23%		0	0%		Lac Qui Parle
Lincoln	20	18	202,408,448	7	35%	☿	13	65%	☿☿☿	11	55%	☿	11	61%	☿	15	75%	☿	5	25%		0	0%		Lincoln
Lyon	25	22	518,246,190	8	32%	X	6	24%		8	32%	X	7	32%		14	56%	☿	6	24%		1	4%		Lyon
McCleod	65	50	785,970,658	17	26%	☿	13	20%	☿	13	20%		25	50%	☿☿	19	29%	☿☿	32	49%	☿☿	3	5%		McCleod
Meeker	44	31	457,703,334	15	34%		11	25%		15	34%	☿☿☿	12	39%		19	43%	☿☿☿	16	36%		9	20%	☿☿☿	Meeker
Murray	22	17	269,227,266	2	9%		4	18%		8	36%	☿	11	65%	☿	10	45%	☿	12	55%		2	9%		Murray
Pipestone	19	17	232,964,732	4	21%		1	5%		2	11%		10	59%	☿☿	5	26%		10	53%	X	3	16%		Pipestone
Redwood	38	31	561,012,936	13	34%		9	24%		15	39%	☿☿	16	52%		13	34%		8	21%		8	21%	☿☿	Redwood
Renville	55	50	568,203,724	24	44%	☿☿☿	19	35%	☿☿☿	14	25%	☿☿	24	48%	☿☿	17	31%	☿	28	51%	☿☿	1	2%		Renville
Yellow Medicine	22	18	316,562,664	6	27%		7	32%		7	32%		9	50%	X	8	36%		9	41%	X	6	27%		Yellow Medicine

= Between 5 and 10 percentage points above ATP average

= More than 10 percentage points above ATP average

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Local System Priorities by County – ATP 8

County	Crash Data Filter	Emphasis Area						
		Under 21	Speed	Alcohol	Unbelted	ROR	Intersection	Head-On
Chippewa	Number and Rate of Severe Crashes	✓✓		✓✓✓	✓✓		✓	
Kandiyohi		✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Lac Que Parle			✓	✓	✓	✓✓✓		
Lincoln		✓	✓✓✓	✓	✓	✓		
Lyon		X		X		✓		
McCleod		✓	✓		✓✓	✓✓	✓✓	
Meeker				✓✓✓		✓✓✓		✓✓✓
Murray				✓	✓	✓		
Pipestone					✓✓		X	
Redwood				✓✓✓				✓✓
Renville		✓✓✓	✓✓✓	✓✓	✓✓	✓	✓✓	
Yellow Medicine					X		X	

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Priority Strategies by Facility Type for the State System – ATP 8

Minnesota CHSP: Critical Emphasis Area	Countermeasure	State Trunk Highway			
		Rural 4-Lane Divided Conv.	Rural 2-Lane		
			ADT < 1,500	1,500 ≤ ADT < 5,000	5,000 ≤ ADT < 8,000
Reducing Impaired Driving	Conduct highly publicized sobriety saturation to deter impaired drivers.		☆☆☆	☆☆	☆
Increasing Seat Belt Use	Conduct highly publicized targeted enforcement to increase seat belt use.	☆	☆☆	☆☆☆	☆
Addressing Young Drivers Over Involvement	Create a communications/marketing task force to raise awareness or establish a traffic safety panel to coordinate agencies.	☆	☆☆	☆☆☆	☆
Curbing Aggressive Driving	Conduct highly publicized targeted enforcement to deter aggressive driving.	☆	☆☆	☆☆☆	☆
Improving the Design and Operation of Highway Intersections	Utilize indirect left-turn treatments.	☆			
	Provide lighting to increase intersection visibility.	☆	☆	☆☆☆	☆☆
Reducing Head-On and Across-median Crashes	Construct median barriers for narrow-width medians on multilane roads.	☆			
	Utilize centerline rumble strips on undivided, two-way roads.		☆☆	☆☆☆	☆☆
Keeping Vehicles on the Roadway and Minimizing the Consequences of Leaving the Road	Utilize shoulder or mid-lane rumble strips (or edgeline rumble stripes).	☆	☆☆	☆☆☆	
	Enhance warning of sharp curves. Utilize brighter or wider lane markings (see Enhance Pavement Markings).	☆	☆☆	☆☆☆	
	Eliminate shoulder drop-offs. Pave shoulders. Add safety wedge (45 degree beveled to edge of pavement).	☆	☆☆	☆☆☆	

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HIGH PRIORITY **LANE DEPARTURE** STRATEGIES

Objectives	Strategies	Relative Cost to Implement and Operate	Effectiveness	Typical Timeframe for Implementation
A—Assist drivers in maintaining their lane	A1—Use longitudinal rumble strips to warn drivers when leaving their lane. This includes centerline rumble strips for two-lane roads, shoulder rumble strips, and shoulder rumble stripes.	Low	Tried	Short (< 1 yr.)
	A2—Provide enhanced centerline and edgeline pavement markings for improved day/night/wet visibility. Treatments may include 6" or 8" wide markings instead of 4", durable pavement markings, and raised pavement markers.	Low	Tried	Short (< 1 yr.)
	A3—Provide advance warning of unexpected horizontal curves along with enhanced curve delineation (i.e., edgeline enhancements, chevrons, delineators).	Low	Proven/Tried/ Experimental	Short (< 1 yr.)
B—Minimize the likelihood of crashing into an oncoming vehicle	B1—Use alternating passing lanes or four-lane sections at key locations.	Moderate to High	Tried	Medium (1-2 yrs.)
C—Keep vehicles from encroaching on the roadside	C1—Eliminate shoulder drop-offs by paving or widening shoulders.	Moderate to High	Proven/Tried	Medium (1-2 yrs.)
	C2—Construct a beveled edge (a.k.a. safety edge) to assist drivers getting back onto the travel lane if on the shoulder.	Low	Tried	Short (< 1 yr.)
D—Reduce the severity of run-off the road crashes	D1—Remove/relocate objects (such as trees, utility poles, light poles, extend culverts to move outside of clearzone, etc.) to provide adequate clear zones.	Low to Moderate	Proven	Short (< 1 yr.)
	D2—Design safer slopes and ditches to prevent rollovers, including transverse slope (i.e., flatten or use culvert safety grates).	Moderate to High	Proven	Medium (1-2 yrs.)
	D3—Shield motorists from steep slopes and roadside objects. Including updating of barriers and crash cushions that do not meet current standards.	Moderate to High	Proven/Tried	Medium (1-2 yrs.)

HIGH PRIORITY **INTERSECTION** STRATEGIES

Objectives	Strategies	Relative Cost to Implement and Operate	Effectiveness	Typical Timeframe for Implementation
A—Improve access management	A1—Implement intersection or driveway closures, relocations, and turning restrictions using signing or by providing channelization.	Low to Moderate	Tried	Medium (1-2 yrs.)
B—Reduce the frequency and severity of intersection conflicts through geometric design improvements	B1—Provide left-turn lanes at intersections; provide sufficient length to accommodate deceleration and queuing; and use offset turn lanes to provide better visibility if needed.	Moderate to High	Proven	Medium (1-2 yrs.)
	B2—Provide bypass lanes on shoulders at T-intersections.	Low	Tried	Short (<1 yr.)
	B3—Provide right-turn lanes at intersections; provide sufficient length to accommodate deceleration and queuing; use offset turn lanes to provide better visibility if needed; and provide right-turn acceleration lanes.	Moderate to High	Proven	Medium (1-2 yrs.)
	B4—Realign intersection approaches to reduce or eliminate intersection skew.	High	Proven	Medium (1-2 yrs.)
C—Improve driver awareness of intersections as viewed from the intersection approach	C1—Improve visibility of intersections by providing enhanced signing. This may include installing larger regulatory, warning, and guide signing and supplementary stop signs.	Low	Tried	Short (<1 yr.)
	C2—Improve visibility of the intersection by providing lighting (install or enhance) or red flashing beacons mounted on stop signs.	Low to Moderate	Proven	Medium (1-2 yrs.)
	C3—Improve visibility of intersections by providing enhanced pavement markings, such as adding or widening stop bar on minor-road approaches, supplementary messages (i.e., STOP AHEAD).	Low	Tried	Short (<1 yr.)
	C4—Improve visibility of traffic signals using overhead mast arms and larger lenses.	Moderate	Tried	Short (<1 yr.)
	C5—Deploy mainline dynamic flashing beacons to warn drivers of entering traffic.	Low	Experimental	Short (<1 yr.)

HIGH PRIORITY **INTERSECTION** STRATEGIES

Objectives	Strategies	Relative Cost to Implement and Operate	Effectiveness	Typical Timeframe for Implementation
D—Improve sight distance at intersections	D1—Clear sight triangles approaches to intersections; in addition to eliminating objects in the roadside, this may also include eliminating parking that restricts sight distance.	Low to Moderate	Tried	Short (<1 yr.)
E—Choose appropriate intersection traffic control to minimize crash frequency and severity	E1—Provide all-way stop control at appropriate intersections.	Low	Proven	Short (<1 yr.)
	E2—Provide roundabouts at appropriate locations.	High	Proven	Long (>2 yrs.)
F—Improve driver compliance with traffic control devices and traffic laws at intersections	F1—Enhance enforcement of red-light running violations using automated enforcement (cameras) or adding confirmation lights on the back of signals to assist traditional enforcement methods.	Moderate	Proven/Tried	Medium (1-2 yrs.)
G—Reduce frequency and severity of intersection conflicts through traffic signal control and operational improvements	G1—Employ multiphase signal operation, signal coordination, emergency vehicle preemption optimize clearance intervals; implement dilemma zone protection; on high speed roadways, install advance warning flashers to inform driver of need to stop; and retime adjacent signals to create gaps at stop-controlled intersections	Low to Moderate	Proven/Tried	Medium (1-2 yrs.)

Systematic Analysis—State Highways

Crash Summary by Facility Types – Greater Minnesota Districts

	Facility Type		Miles	Crashes: Fatal	Crashes: Serious Injury	Crash Rate	Severity Rate	Fatal Rate	Crash Density	Priority
Rural	Freeway		702	54	77	0.6	0.8	0.6	3.7	✓
	4-Lane Expressway		712	80	94	0.8	1.2	0.8	3.5	✓
	4-Lane Undivided		27	0	4	0.9	1.4	0	2.5	
	4-Lane Divided Conventional (Non expressway)		123	11	24	1.2	1.9	1.2	4.4	
	2-Lane	ADT < 1,500	3,774	48	74	0.8	1.4	1.9	0.3	✓
		1,500 ≤ ADT < 5,000	3,916	119	185	0.7	1.2	1.4	0.7	✓
		5,000 ≤ ADT < 8,000	563	45	52	0.9	1.4	1.7	2.0	✓
		ADT ≥ 8,000	198	24	26	0.9	1.4	1.6	3.6	✓
	Sub Total		**10,034**	**341**	**545**					
Urban	Freeway		21	2	7	1.4	1.9	0.3	21.3	
	4-Lane Expressway		41	4	19	2.4	3.5	0.9	12.6	
	4-Lane Undivided		43	1	20	3.9	5.6	0.3	16.9	
	4-Lane Divided Conventional (Non expressway)		66	8	45	3.3	5.1	1.2	17.6	
	Three-Lane		30	0	10	2.8	3.8	0.0	10.1	
	Five-Lane		12	2	4	2.8	3.9	1.6	13.7	
	2-Lane	ADT < 1,500	81	1	4	1.9	3.0	1.8	0.7	
		1,500 ≤ ADT < 5,000	238	0	22	2.1	3.0	0.0	2.4	
		5,000 ≤ ADT < 8,000	111	10	19	2.0	2.8	1.9	4.6	
		ADT ≥ 8,000	75	5	19	2.6	3.7	0.8	10.5	
	Sub Total		**718**	**33**	**169**					

Crash Summary by Facility Types – Metro District

	Facility Type		Miles	Crashes: Fatal	Crashes: Serious Injury	Crash Rate	Severity Rate	Fatal Rate	Crash Density	Priority
Rural	Freeway		122	22	34	0.6	0.9	0.5	11.1	✓
	4-Lane Expressway		111	17	65	1.0	1.5	0.7	10.3	✓
	4-Lane Undivided		0	0	0	2.5	3.1	0.0	14.8	
	4-Lane Divided Conventional (Non expressway)		1	0	0	1.3	2.0	0.0	9.2	
	2-Lane	ADT < 1,500	13	0	2	0.0	0.0	0.0	0.5	
		1,500 ≤ ADT < 5,000	89	5	8	1.0	1.5	2.0	1.3	
		5,000 ≤ ADT < 8,000	98	8	18	1.2	2.0	1.8	2.7	✓
		ADT ≥ 8,000	137	17	33	1.3	2.0	1.2	6.9	✓
	Sub Total		**571**	**69**	**150**					
Urban	Freeway		267	43	139	1.2	1.6	0.2	41.7	✓
	4-Lane Expressway		124	17	81	1.9	2.7	0.5	23.9	✓
	4-Lane Undivided		20	2	25	5.0	7.8	0.7	41.3	✓
	4-Lane Divided Conventional (Non expressway)		21	3	19	5.0	6.8	0.9	38.6	✓
	Three-Lane		9	0	2	3.1	4.3	0.0	16.8	
	Five-Lane		2	0	3	5.6	8.8	0.0	52.4	
	2-Lane	ADT < 1,500	1	0	0	4.0	6.3	0.0	2.1	
		1,500 ≤ ADT < 5,000	9	0	0	2.8	3.9	0.0	3.7	
		5,000 ≤ ADT < 8,000	26	2	2	2.3	3.3	1.6	5.5	
		ADT ≥ 8,000	54	6	20	3.0	4.2	1.1	15.6	✓
	Sub Total		**523**	**73**	**280**					

Source: MnDOT SHSP Crash Records, 2004–2005

Highlights

- Historically, the absence of Black Spots in a system of roads was interpreted to mean that there were no safety deficiencies and that there were no opportunities to effectively make investments to reduce crashes.
- However, a new interpretation of the crash data by the Federal Highway Administration (FHWA) and an increasing number of state departments of transportation suggests that neither of these assumptions is correct.
- A review of Minnesota's crash data, conducted as part of the Strategic Highway Safety Plan, provides several insights in support of a systematic approach for addressing safety deficiencies.
- On the state's highway system, the facility types that present the greatest opportunity to reduce fatal crashes (based on the total number of fatal crashes) are rural two-lane roads (50%) and freeways (22%). However, until recently there have been few projects on these facilities because the process of filtering the data failed to identify any Black Spots.
- Further analysis of these priority facilities shows that neither the overall crash rate nor the fatality rate are at all unusual, but the pool of fatal crashes susceptible to correction is still large and represents the greatest opportunity for reduction: addressing road departure crashes on rural two-lane roads and cross-median crashes on freeways.
- The final point in support of a systematic approach to address safety in rural areas is the very low density of crashes along rural two-lane highways – 61% of fatal crashes occur on the 87% of the system that averages less than one crash per mile per year.

Note: Crash rate is crashes per million vehicle miles; fatality rate is fatal crashes per 100 million vehicle miles

Example Safety Improvements

Reactive → Proactive

Goal For Metro District

High Cost Improvements

* Interchanges

* Roundabouts

* Road Re-Construction

Moderate Cost Intersection Improvements

* Improve Traffic Signal Operations
* Accel / Decel Lanes
* Indirect Turns

* Improve Sight Distance

50 / 50

Corridor Management and Technology Improvements

* Employ ITS Technologies
* Elec. Speed Enforcement in School Zones
* Access Mgmt.

* Road Safety Audit

Goal For Out State Districts

Low - Cost Intersection Improvements

* Red Light Enforcement
* Turn Lane Modifications

* Channelization

* Street Lights

* Enhance Traffic Signs & Markings

* Curb Extensions

Road Departure Improvements

* Edge Treatments
* Enhanced Del. of curves

* Safety Wedge

* Paved Sholders Rumble Strips / Stripes

* Cable Median Barrier

* Upgrade Roadside Hardware

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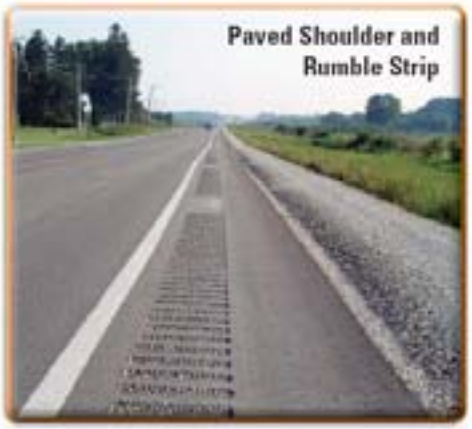
Edge Treatments

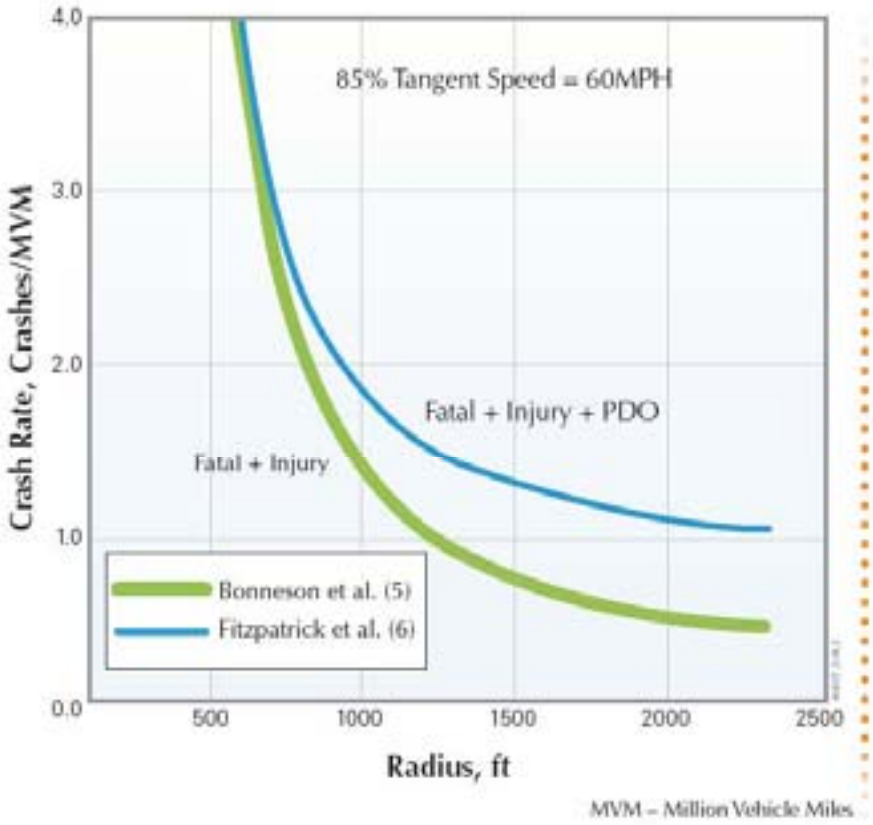


Highlights

- Typical edge treatments include shoulder/edgeline rumble strips, enhanced pavement markings, and eliminating shoulder drop offs.
- Implementation costs vary from no cost (safety edge) to several thousand dollars per mile for rumble strips/stripEs.
- National safety studies have documented crash reductions in the range of 20 to 50% for road departure crashes.
- An unexpected benefit has been observed on projects where edgelines have been painted over the edgeline rumble strips – night time visibility in wet pavement conditions was improved (the reflective beads applied to the nearly vertical face of the rumble strip remain above the film of water on the pavement surface) and the life of the pavement marking was extended (snow plows cannot scrap away the beads on the vertical faces).

Roadside Safety Strategies (2 of 6)

Horizontal Curves



MVM – Million Vehicle Miles

Source: Texas Transportation Institute (FHWA/TX-07/0-5439-1)
Roadside Safety Strategies (3 of 6)

Highlights

- A number of previously published research reports have identified horizontal curves as at-risk elements of rural road systems, however, the degree of risk was not quantified.
- A recent report prepared by the Texas Transportation Institute (FHWA/TX-07/0-5439-1) related actual crash rates on rural roads to the radius of curvature. The results of this research indicates that the crash rate on curves with radii greater then 2,500 feet is approximately equal to the crash rate on tangent sections.
- On curves with radii of 1,000 feet, the crash rate is twice the rate on tangents and curves; curves with radii of 500 feet have crash rates eight times higher than on tangents.
- A number of safety studies that were focused on local, rural systems in Minnesota have found road departure crashes are overrepresented on horizontal curves – 40 to 50% of the road departure crashes in the selected counties occurred on curves, and curves made up less than 10% of the county's system.
- The same studies also documented that over 60% of the horizontal curves on the county system have radii less than 1,000 feet – from a system perspective, these curves are more at risk.

Traffic Safety Fundamentals Handbook—2008

C-6

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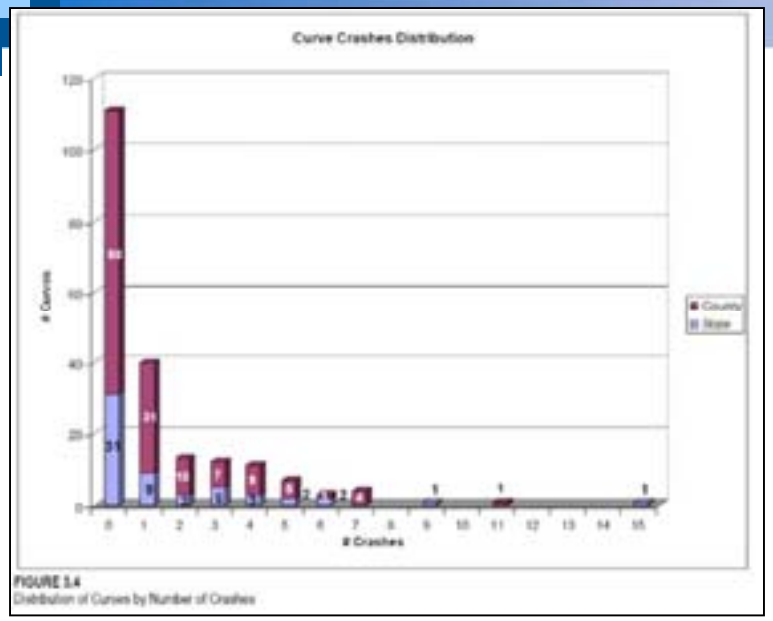

FIGURE 3.4
Distribution of Curves by Number of Crashes

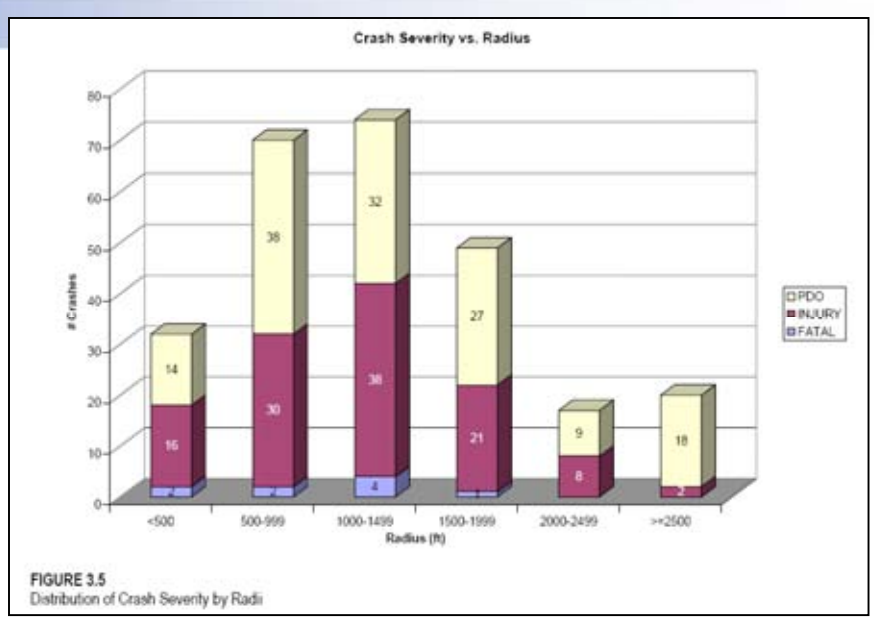

FIGURE 3.5
Distribution of Crash Severity by Radii

A follow up study of over 200 curves on both the State and County highway system in Minnesota found:

- More than 50% of the curves had NO crashes during the Study period.
- The curves averaged between 0.1 and 0.2 crashes per year and the “worst” curve averaged 1.5 crashes per year.
- 90% of fatal crashes and 75% of injury crashes occurred on curves with radii less than 1,500 feet.
- Crash rates on curves with radii greater than 2,000 feet approximate the overall rate on 2-lane rural roads.
- As curve radii decrease, crash rates increase – the crash rate at 1,500 feet = 2x, at 1,000 feet = 5X and at 500 feet = 11X.

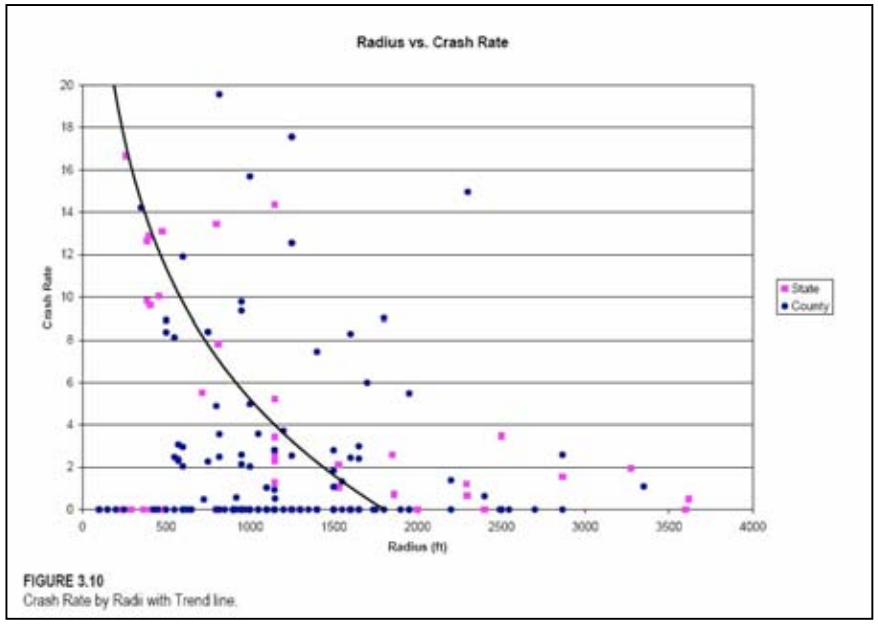

FIGURE 3.10
Crash Rate by Radii with Trend line

Source: Preston, H, Shankerwitz, C, Barry, M; Analysis of Highway Design and Geometric Effects on Crashes, Draft Report; Minnesota Department of Transportation, July, 2009.

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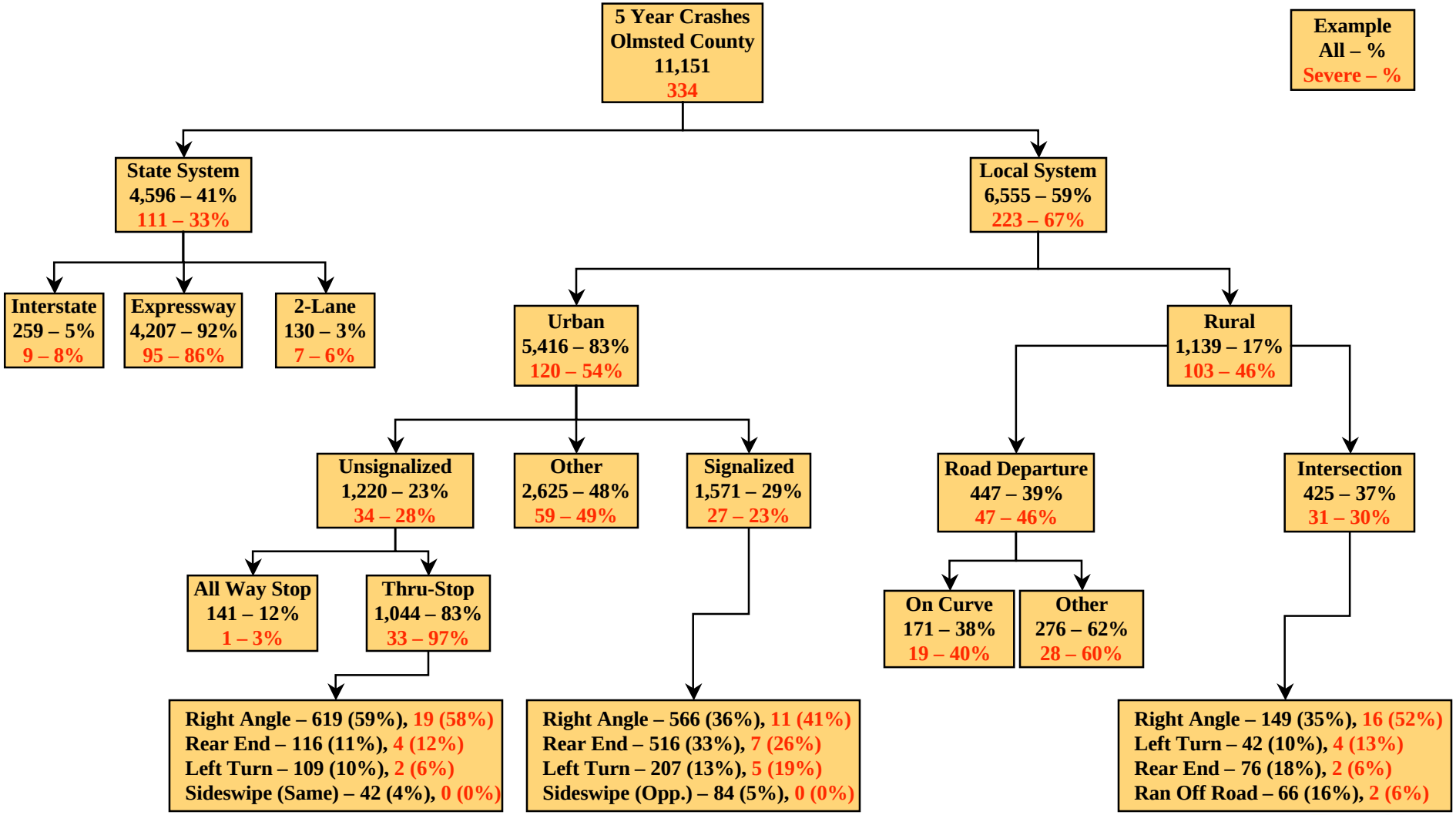
Crash Data Overview



Source: MnCMAT Crash Data, 2002-2006
Severe is fatal plus serious injury crashes.

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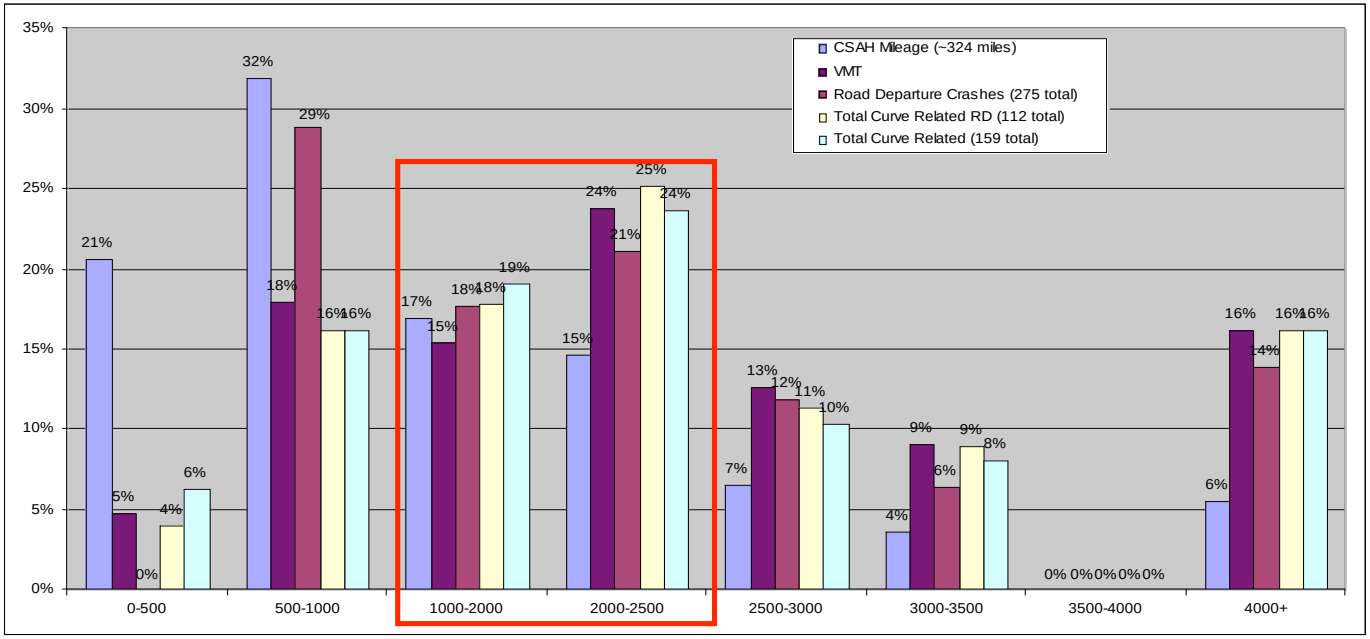
Enhanced Curve Delineation



- 57 curves
- $1,000/curve
- $57,000

- Criteria
  - ADT range between 1,000 and 2,500
  - Severe Crash (K or A)
  - Curve radius between 750 and 1,250
  - Intersection in curve
  - Visual trap
  - Proximity to other priority curves

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Example of a Visual Trap at a Horizontal Curve in Freeborn County

Enhanced Curve Delineation

Corridor	Segment	Description	Curve	Corridor Weighted ADT	Crashes K	A	B	C	PDO	Radius	Intersection on Curve	Chevrons	Visual Trap	Rank
1	CSAH 3	CSAH 4 - CSAH 14								No Curves				
2	CSAH 14	US 52 - US 63	1	5800			None			1,700				
			2	5800	0	0	0	0	1	1,150				x
			3	5800	0	0	1	0	1	1,750				
3	CSAH 36	US 52 - CR 143	1	4775	0	0	0	0	1	1,850				
			2	4450	0	0	0	2	0	1,700	Yes			x
4	CSAH 13	Dodge Co - Goodhue Co	1	760			None			1,200				x
			2	760			None			1,500				
			3	760	0	0	1	0	0	850				x
			4	760			None			1,500				
			5	760			None			900				x
5	CR 147	48th St SW - CR 125								No Curves				
6	CR 112	55th St NW - CSAH 14	1	5,100			None			2,500				
			2	5,100	0	0	1	0	0	1,200				x
			3	5,100			None			2,200				
7	CSAH 3	Mower Co - CSAH 6	1	295	1	0	0	0	0	800			Yes	xxx
8	CSAH 8	Mower Co - CSAH 6	1	1,500	0	0	0	0	1	1,300				x
			2	1,500			None			150				x
9	CSAH 4	CSAH 5 - CSAH 22	1	1,950			None			1,250				xx
			2	1,950	0	0	1	0	0	1,150				xx
			3	2,650			None			3,000				
			4	2,650	0	0	0	0	1	3,000	Yes			x
			5	2,650	0	0	0	0	3	1,150	Yes			xx
			6	3,075	1	0	1	1	1	1,150	Yes			xxx
10	CR 154	US 52 - CR 112								No Curves				
11	CSAH 8	CSAH 6 - CSAH 35	1	1,150			None			2,500	Yes			xx
			2	1,150			None			2,200				x
			3	1,150			None			1,150	Yes		Yes	xxxx
			4	1,150			None			1,600	Yes			xx
12	CSAH 9	CSAH 35 - Meadow Crossing Rd	1	2,100	0	0	0	0	1	600	Yes	Yes	Yes	xxx
			2	2,100	0	1	0	0	2	600	Yes	Yes		xxx
			3	3,500	0	0	0	1	0	1,100				x
			4	3,500	0	0	1	0	0	1,150				x
			5	3,500	0	0	0	0	1	850				x
			6	3,500	0	0	1	1	2	1,450				
13	CSAH 21	US 63 - Wabasah Co								No Curves				
14	CSAH 1	Fillmore Co - US 52	1	1,400			None			850				xx
			2	1,400			None			850				xx
			3	1,400	0	0	0	1	0	500	Yes	Yes		xx
			4	1,400			None			1,150				xx
			5	1,400	0	0	0	0	1	2,200				x
			6	1,400	0	0	0	0	1	2,300				x
			7	1,400	0	0	1	0	2	450	Yes			xx
			8	1,400			None			1,050				xx
			9	1,400			None			1,050				xx
			10	2,300			None			550		Yes		x
			11	2,300	0	0	1	0	1	600		Yes		x
			12	2,150	0	0	1	0	0	600	Yes	Yes	Yes	xxx
			13	2,000	0	0	1	0	1	850	Yes	Yes	Yes	xxxx

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Effectiveness of Roadside Safety Initiatives

TH 6		TH 38
11.2	Length (Miles)	11.2
23	Total Crashes (5 Years) +122%	51
11	PDO Crashes	25
12	Injury Crashes +117%	26
0	Fatal Crashes	0
1,100	Volume (VPD)	1,100
22.48	MVM	22.48
1.0	Crash Rates (Crashes/MVM) +130%	2.3
1.5	Severity Rate +173%	4.1
1.3	Critical Crash Rates	1.3
10 (43%)	SVRD Crashes	37 (73%)
3	Hit Trees +1000%	30
8 (35%)	Passing Crashes	3 (6%)
2	Angle Crashes	4
6	Deer Hits	1
10 (43%)	Night	21 (41%)

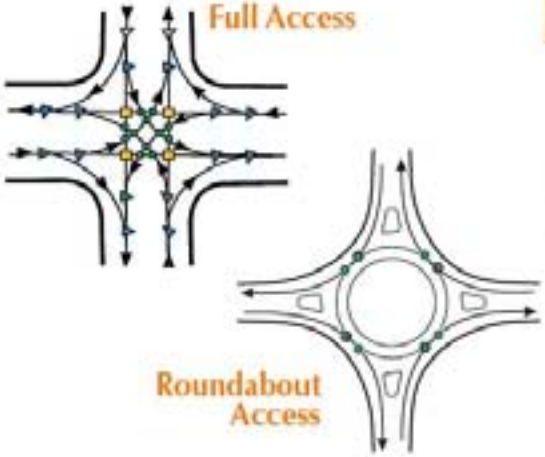
Source: MnDOT District 1, Traffic Engineering *Roadside Safety Strategies (6 of 6)*

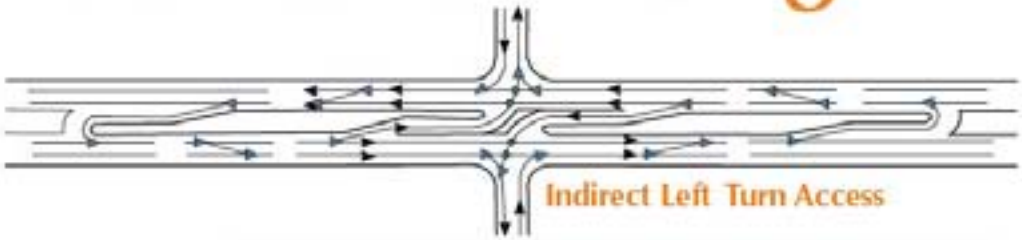
Highlights

- An estimate of the safety implications by evaluating two very similar segments of two-lane rural trunk highways in northern Minnesota: TH 6 and TH 38.
- Both roads have the following similar characteristics:
  - Have virtually identical volumes
  - Serve similar functions (recreational and logging).
  - Traverse the Chippewa National Forest.
  - Have scenic qualities.
- TH 6 has been reconstructed and TH 38 has not. (Note: This segment of TH38 has recently been reconstructed but a Before vs. After Study has not been completed)
- The results are obvious. TH 38 has the following characteristics:
  - More than twice as many crashes.
  - More than twice as many injuries.
  - A crash rate more than twice the average for two-lane rural roads (and 30% greater than the critical rate).
  - Almost four times as many SVRD crashes (and more than three the average for similar roads).
  - Ten times as many tree hits.
  - More than twice as many night time crashes.

PDO – Property Damage Only
VPD – Vehicles Per Day
MVM – Million Vehicle Miles
SVRD – Single Vehicle Road Departure

Conflict Points—New Intersection Design





	Crossing	Turning	Merge/Diverge	Total	Typical Crash Rate (crashes per mil. entering vehicles)
Full Access	4	12	16	32	0.3 [1]
Roundabout	0	0	8	8	0.2 [2]
Indirect Left Turn	0	4	20	24	0.1 [3]

[1] 2004-2006 Minnesota TB crash data [2] Estimated based on a limited sample of Mn/DOT data [3] NCHRP 15-30 Preliminary Draft

Highlights

- Analysis of crash data proves that the most frequent type of severe intersection crash is a right angle – vehicle maneuvers that involve crossing conflicts.
- In response to this data, highway agencies are beginning to implement intersection designs that reduce or eliminate the at-risk crossing maneuvers by substituting lower-risk turning, merging and diverging maneuvers. Two examples of these new designs include Roundabouts and Indirect Turn Treatments.
- Roundabouts have been implemented at a sufficient number of intersections in Minnesota and around the County, such that follow-up studies have documented a Proven effectiveness of reducing both the frequency and severity of crashes. More information regarding Roundabouts can be found at – Roundabouts: An Informational Guide (Report No. FHWA-RD-00-067 www.tfhrc.gov/safety/00-0675.pdf)
- The concept of Indirect Turns has primarily been applied to divided roadways where there is sufficient room in the median to construct the channelization necessary to restrict crossing maneuvers and to accommodate U-turns. This design technique has been implemented at approximately a dozen intersections in Maryland and North Carolina and as a result is considered Tried. Before/After studies at these locations have documented close to a 90% reduction in total crashes and a 100% reduction in angle crashes. More information about Indirect Turns can be found in NCHRP 15-30: Median Intersection Design for Rural High Speed Divided Highways (currently in draft form at http://www.ctre.iastate.edu/educweb/nchrp%20final%20report/)

Intersections (2 of 8)

Roundabout

- Cost
  - $800,000 to $1,000,000
- Safety Benefit
  - Reduce all crashes by 38%
  - Reduce injury crashes by 76%
  - Reduce fatal and serious injury crashes by 90%

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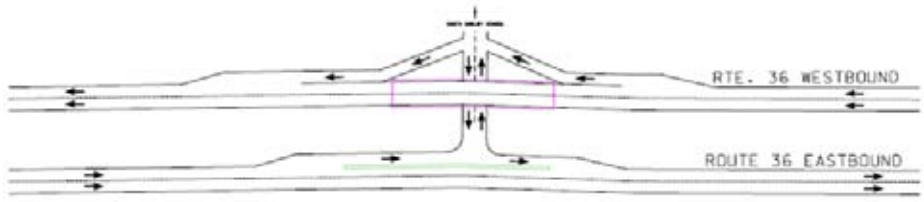
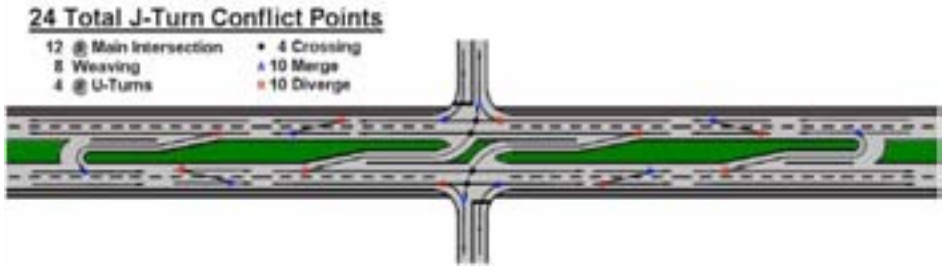
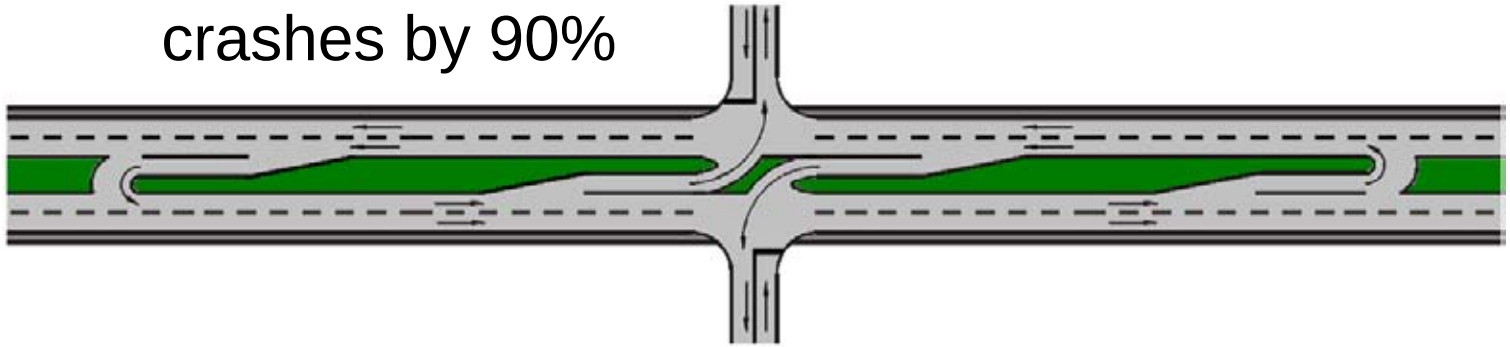
Indirect Turns & Partial T-Interchange

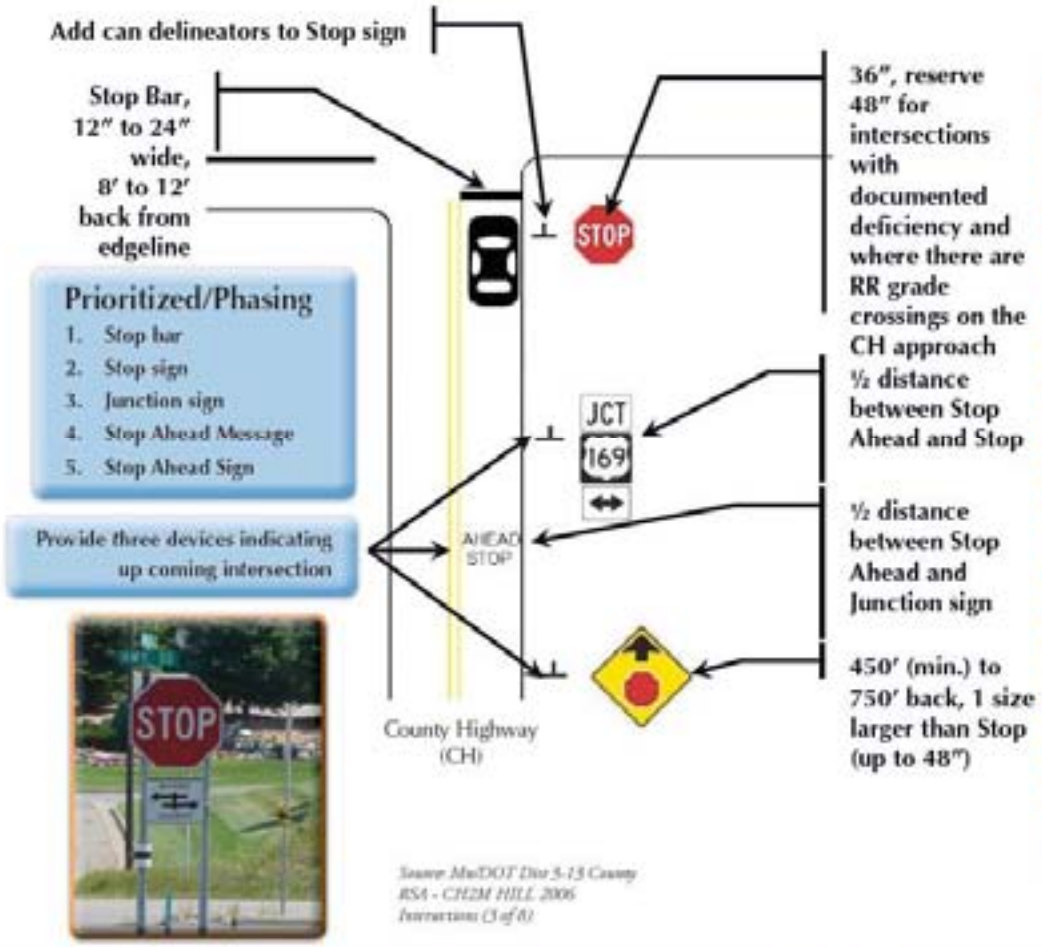
- J-Turn or Superstreet
  - Cost ≈ $500,000
  - Safety Benefit: At a Maryland location, the J-Turn eliminated all crossing path crashes and reduced total crashes by 90%







Enhanced Signs and Markings



Source MnDOT Dist 5-15 County RSA - CH2M HILL 2006 Intersection (3 of 8)

Highlights

- The most common type of crash at STOP controlled intersections is a right angle crash.
- Research performed in Minnesota (Reducing Crashes at Controlled Rural Intersections – Mn/DOT No. 2003-15) found that approximately 60% of these angle crashes involved vehicles on the minor road stopping and then pulling out and 26% involved vehicles running through the STOP sign.
- This same study also found that increasing the conspicuity of traffic control devices by using bigger, brighter or additional signs and markings (such as the STOP AHEAD message and a STOP bar) are associated with decreasing Run the STOP crashes.
- A more recent – Safety Evaluation of STOP AHEAD Pavement Markings (FHWA-HRT-08-043) – documents the effects of adding STOP AHEAD pavement markings. The study looked at 175 sites in Arkansas, Maryland and Minnesota. The study found crash reductions in the range of 20 to 40%, benefit/cost ratios greater than 2 to 1 and concluded that this strategy has the potential to reduce crashes at signalized intersections.

Red Light Enforcement

- Red-Light Running Cameras
  - Cost ≈ $50,000 per intersection
  - Safety Benefit: Observed 40% reduction in violations; FHWA estimates a 15% reduction in crashes
- Confirmation Light
  - Need acceptance from the local traffic court to assure that the citations will be accepted
  - Safety Benefit: At a Florida intersection, three month evaluation found a 50% decrease in RLR violations and 11% crash decrease with 519 citations issued.

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Street Lights

- Cost
  - Typically $5,000 to $30,000 per location
- Safety Benefit
  - Recent Minnesota Study of Rural Intersections
  - 27% reduction in nighttime collisions
  - 35% reduction in nighttime crash rates
  - 20% reduction in crash severity

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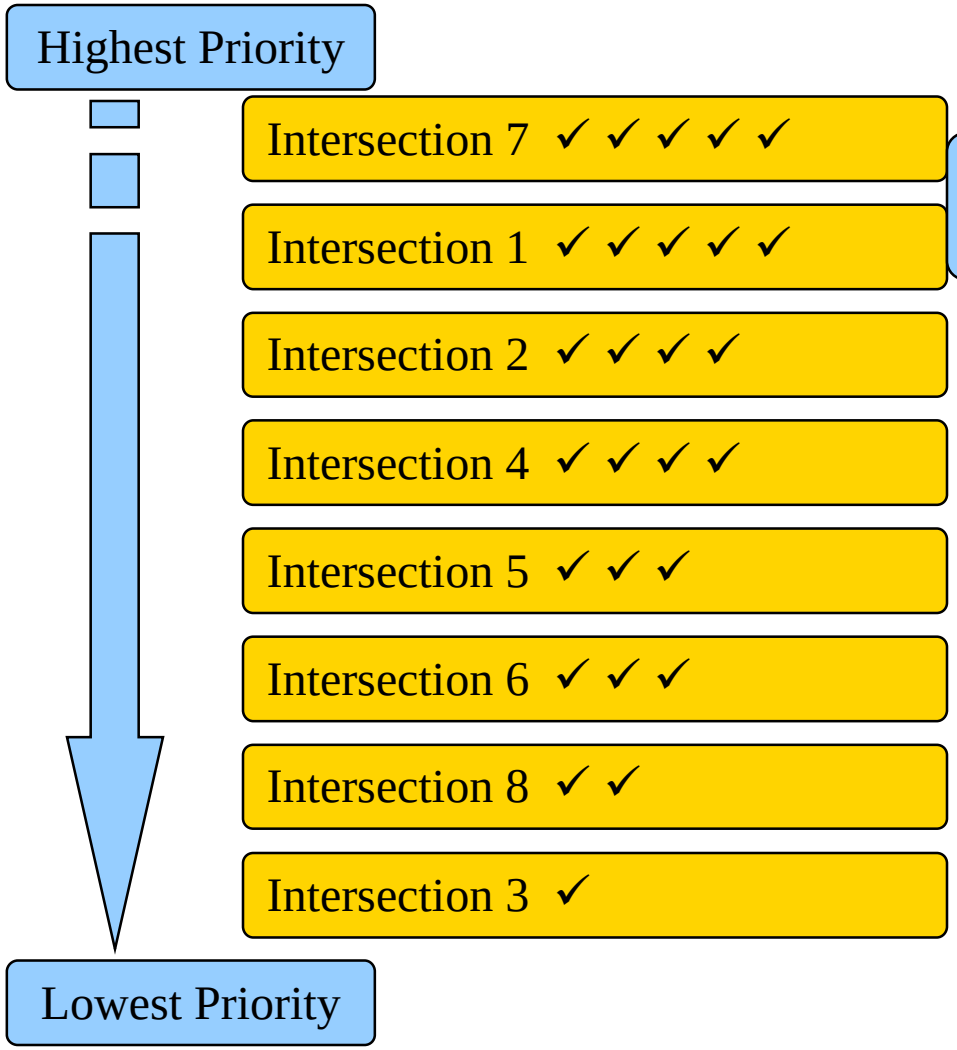
Proactive Methodology

Expressway Intersections	Geometry		Volume	Proximity			
	Skew	On/Near Curve	ADT Ratio	previous STOP sign	RR Xing	Crashes	**Others?**
Intersection 1	✓	✓	✓	✓	✓		
Intersection 2	✓		✓	✓		✓	
Intersection 3						✓	
Intersection 4			✓	✓	✓	✓	
Intersection 5		✓		✓	✓		
Intersection 6		✓	✓			✓	
Intersection 7	✓	✓	✓	✓		✓	
Intersection 8	✓		✓				

Proactive Methodology



Engineering judgment required for additional interclass ranking

- Rank according to number of checkmarks
- Intersection 3 only received a checkmark for crashes, but received a low ranking, while Intersection 7 had no crashes but matched other criteria.

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Olmsted County
Intersection - Rural - Priority Ranking

Rank	Intersection	Min 0.3 ADT Ratio Skew 41%	Max 0.8 ADT Ratio Curve 42%	STOP Sign ADT Ratio 32%	5.0 miles STOP Sign 39%	RR Crossing 6%	Crash 63%	Development 4%	Totals	Overall Rank	Crash Rate	Right Angle Crashes	Severe Crashes	Crash Cost	Cumulative Cost
1	CSAH 3 & CSAH 26	✓	✓		✓		✓	✓	✓✓✓✓✓	27	0.7	1	-	75,000	0.6%
2	CSAH 5 & CSAH 4	✓	✓	✓	✓		✓		✓✓✓✓✓	43	0.2	-	-	12,000	0.7%
3	CSAH 3 & CSAH 12	✓	✓	✓			✓		✓✓✓✓	10	1.2	1	1	523,000	4.9%
4	CSAH 11 & CSAH 9	✓	✓	✓			✓		✓✓✓✓	8	0.5	3	1	644,000	10.0%
5	CSAH 23 & CSAH 19 (east)	✓	✓	✓			✓		✓✓✓✓	18	2.5	-	-	133,000	11.0%
6	US 63 & CSAH 14	✓		✓	✓		✓		✓✓✓✓	2	1.1	13	1	1,214,000	20.7%
7	CSAH 3 & CSAH 5		✓	✓	✓		✓		✓✓✓✓	14	0.7	-	-	225,000	22.5%
8	TH 30 & CSAH 1		✓	✓	✓		✓		✓✓✓✓	34	0.6	1	-	36,000	22.8%
9	CSAH 16 (West) & CSAH 20	✓	✓	✓			✓		✓✓✓✓	39	0.4	-	-	12,000	22.9%
10	US 52 & CSAH 19 (west)	✓	✓		✓		✓		✓✓✓✓	32	0.1	1	-	75,000	23.4%
11	TH 42 & CSAH 9			✓	✓		✓		✓✓✓	4	0.9	3	1	915,000	30.7%
12	US 63 & CSAH 21	✓			✓		✓		✓✓✓	3	0.5	3	1	1,133,000	39.7%
13	US 63 & CSAH 12/TH 247			✓	✓		✓		✓✓✓	9	1.0	9	-	609,000	44.6%
14	CSAH 10 & CSAH 32	✓	✓				✓		✓✓✓	37	0.9	-	-	12,000	44.7%
15	TH 30 & CSAH 8			✓	✓		✓		✓✓✓	13	0.5	4	-	237,000	46.6%
16	TH 14 & CR 104	✓				✓	✓		✓✓✓	7	0.4	8	-	679,000	52.0%
17	CSAH 14 & CSAH 3 (west)			✓	✓		✓		✓✓✓	40	0.4	1	-	12,000	52.1%
18	CSAH 6 & CSAH 8 (west)			✓	✓		✓		✓✓✓	41	0.4	-	-	12,000	52.1%
19	CSAH 4 & CSAH 3 (east)	✓	✓				✓		✓✓✓	26	0.4	-	-	87,000	52.8%
20	TH 42 & CSAH 2 (north)	✓	✓				✓		✓✓✓	35	0.3	-	-	24,000	53.0%
21	CSAH 2 & CSAH 11 (south)	✓	✓				✓		✓✓✓	21	0.3	-	-	133,000	54.1%
22	CSAH 1 & CSAH 16 (south)	✓	✓				✓		✓✓✓	42	0.3	-	-	12,000	54.2%
23	US 52 & CSAH 7 (west)	✓	✓				✓		✓✓✓	16	0.3	-	-	145,000	55.3%
24	US 52 & CSAH 16	✓	✓				✓		✓✓✓	17	0.2	2	-	145,000	56.5%
25	CSAH 34 & CR 104		✓	✓			✓		✓✓✓	29	0.2	1	-	75,000	57.1%
26	CSAH 4 & CR 104	✓	✓				✓		✓✓✓	24	0.1	-	-	121,000	58.0%
27	CSAH 36 & CSAH 11	✓	✓				✓		✓✓✓	45	0.1	-	-	12,000	58.1%
28	US 52 & CSAH 7 (east)	✓	✓				✓		✓✓✓	31	0.1	1	-	75,000	58.7%
29	CSAH 10 & CSAH 30	✓	✓		✓				✓✓✓	47	-	-	-	-	58.7%
30	CSAH 2 & CSAH 10 (east)	✓	✓		✓				✓✓✓	51	-	-	-	-	58.7%
31	CSAH 6 & CSAH 8 (east)	✓		✓	✓				✓✓✓	61	-	-	-	-	58.7%
32	US 14 & CSAH 10	✓	✓		✓				✓✓✓	69	-	-	-	-	58.7%
33	US 14 & CSAH 19	✓				✓		✓	✓✓✓	70	-	-	-	-	58.7%
34	US 14 & CSAH 32	✓	✓			✓			✓✓✓	71	-	-	-	-	58.7%
35	CSAH 11 & CSAH 21				✓		✓		✓✓	1	1.2	5	3	2,170,000	76.0%
36	CSAH 3 & CSAH 34			✓			✓		✓✓	6	1.6	8	-	716,000	81.7%
37	CSAH 10 & CSAH 9				✓		✓		✓✓	15	0.9	2	-	145,000	82.8%
38	CSAH 11 & CSAH 14			✓			✓		✓✓	22	0.5	-	-	121,000	83.8%
39	CSAH 20 & CSAH 16 (East)			✓			✓		✓✓	38	0.5	-	-	12,000	83.9%
40	TH 42 & CSAH 23				✓		✓		✓✓	25	0.4	2	-	99,000	84.7%
41	TH 30 & CSAH 15				✓		✓		✓✓	20	0.4	-	-	133,000	85.7%
42	US 52 & CSAH 19 (east)		✓				✓		✓✓	12	0.3	-	-	254,000	87.8%
43	CSAH 14 & CR 112			✓			✓		✓✓	11	0.2	1	-	271,000	89.9%
44	CSAH 4 & CSAH 3 (west)			✓			✓		✓✓	44	0.2	-	-	12,000	90.0%
45	TH 42 & CSAH 2 (south)				✓		✓		✓✓	30	0.2	1	-	75,000	90.6%

	#	%	% Cumulative
✓✓✓✓✓	2	3%	3%
✓✓✓✓	8	11%	14%
✓✓✓	24	34%	48%
✓✓	16	23%	70%
✓	16	23%	93%
-	5	7%	100%
	71	100%	

Southwest Minnesota Workshop
TOWARD ZERO DEATHS

Conclusions

- Southwest Minnesota's Infrastructure-Based Safety Emphasis Areas include: Road Departure and Intersection Crashes.
- These types of crashes tend to be distributed across the system – rural roads average less than 1 crash/mile/year and rural intersections average less than 1 crash/year.
- Mn/DOT's Highway Safety Improvement Program used to be focused on finding and fixing Black Spots which tend to be located in urban areas. The Program for Greater Minnesota is now focused on systematically addressing design and land use characteristics that are associated with locations that are at-risk.
- This new focus on rural safety requires identifying a new set of low-cost strategies that can be widely deployed across rural systems.

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