Minnesota Toward Zero Deaths

RAIL GRADE CROSSING SAFETY PROJECT SELECTION

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We all have a stake in A TO B

AGENDA

1. Background and Methodology
2. Crash Overview
3. Identified Risk Factors
4. Rankings and Comparisons
5. List of Potential Safety Strategies
6. Wrap-Up

BACKGROUND

- In the state of Minnesota there are approximately 4,000 at-grade public crossings
  - All roadway authorities
  - Freight Rail Lines
- Approximately 1,500 public crossings have active warning devices (Gates, Flashers), installed using FHWA Section 130 Funds ~$5M/yr.

MINNESOTA FATALITIES
FROM 2004-2013

	Passive		Active		
	Crossbucks	Stop Sign	Flashers	Gates	Total
Did not stop	14	24	2		40
Stopped on crossing	1	2	1	3	7
Stopped then proceeded	2				2
Suicide		1			1
Went around gates				9	9
Went thru gate				1	1
Unknown	1	1		7	9
Grand Total	**18**	**28**	**3**	**20**	**69**
Percent of fatalities	**26%**	**41%**	**4%**	**29%**	
Percent of AADT	**11%**	**7%**	**24%**	**58%**	
Percent of Grade Crossings	**62%**		**38%**		
Fatal + Injury Density*	**0.006**	**0.005**	**0.007**	**0.003**	

*Fatal + Injury crashes per crossing per year

BACKGROUND

- Candidate crossings have historically been selected based on federal accident prediction model that considers train and vehicle exposure, the crossing characteristics and crash history.
- The concerns are that the predictive model may place too high a priority on prior crash history, and that gates aren't preventing crashes.

BACKGROUND (continued)

- Minnesota’s 10-year crash history supports this notion
  - 91% of public grade crossings had NO crashes.
  - 96% had NO crashes resulting in injuries.
  - 99% had NO fatal crashes.
  - 1 crossing had TWO fatal crashes.
  - No crossing in Minnesota averaged a single grade crossing crash per year.
  - More than 50% of crossings with a injury crash had NO prior crashes.
  - ~ 40% of crashes occur at crossings protected with active devices
- Presence of a single crash at a crossing suggests that a second crash (in the next 10 years) is unlikely.

PAST PROJECT SELECTION CRITERIA

- Accident Prediction > 0.05 (Per FHWA guidance)
  - Highly influenced by past crashes
  - By 2014, 21 Passive that met this criteria, most were programmed or not a good candidate
- Texas Hazard Index
  - developed by Texas DOT that considers the number and speed of trains, AADT, accident history and the existing level of protection
  - Used for 2017 project selection
  - Very little differentiation on remaining passive crossings
- ***Key Question: If the presence of a crash is not a reliable indicator that additional crashes are likely to follow – can a better predictive model be developed?***

METHODOLOGY

- Inventory and analyze ALL public grade crossings and crashes.
- Identify roadway and traffic characteristics at crossings with crashes and look for overrepresented characteristics.
- Test to determine if the identified characteristics (Risk Factors) are in fact associated with the subset of crossings with a higher density of serious crashes.
- Select a group of risk factors.
- Evaluate ALL Active & Passive crossings – determine results and compare to outcomes using the current predictive models.

CRASH AND CROSSING OVERVIEW

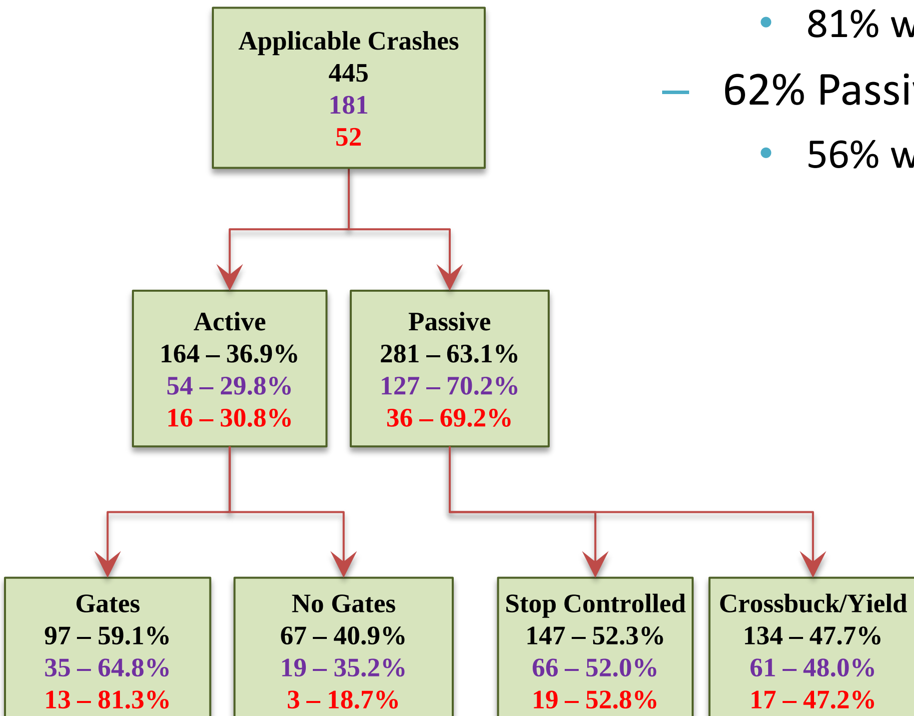
Example
All – %
Injury + Fatal – %
Fatal – %

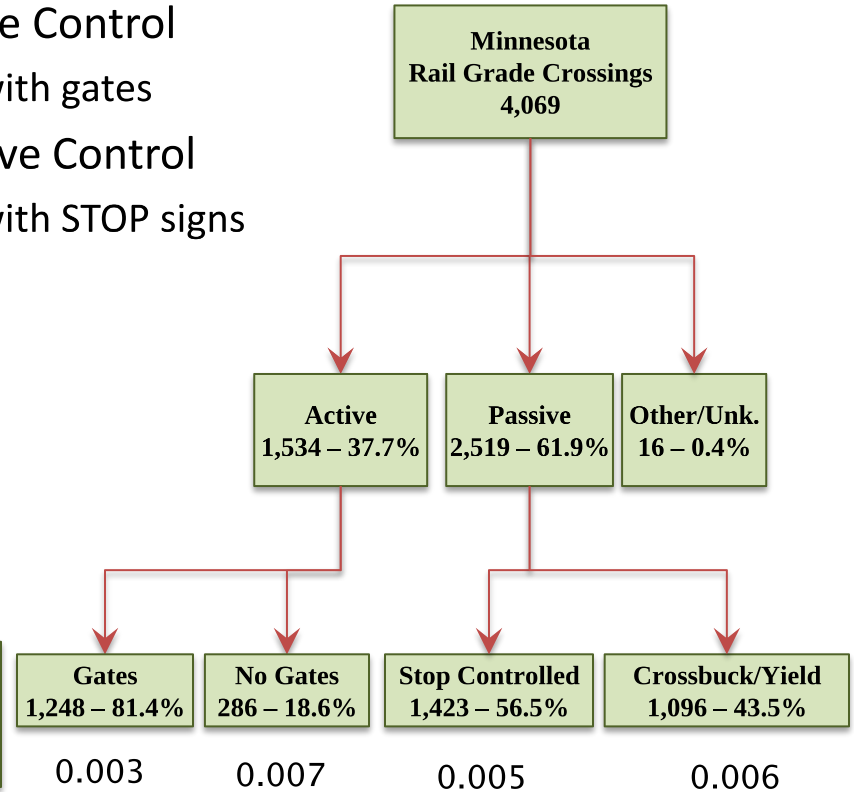
Source: Federal Railroad Administration
2004-2013 (10 Years)
Retrieved May 2015

- 4,069 public grade crossings
  - 38% Active Control
    - 81% with gates
  - 62% Passive Control
    - 56% with STOP signs

Example
Grade Crossings – %

Source: RGCIP Inventory, **2013**
Retrieved May 2015

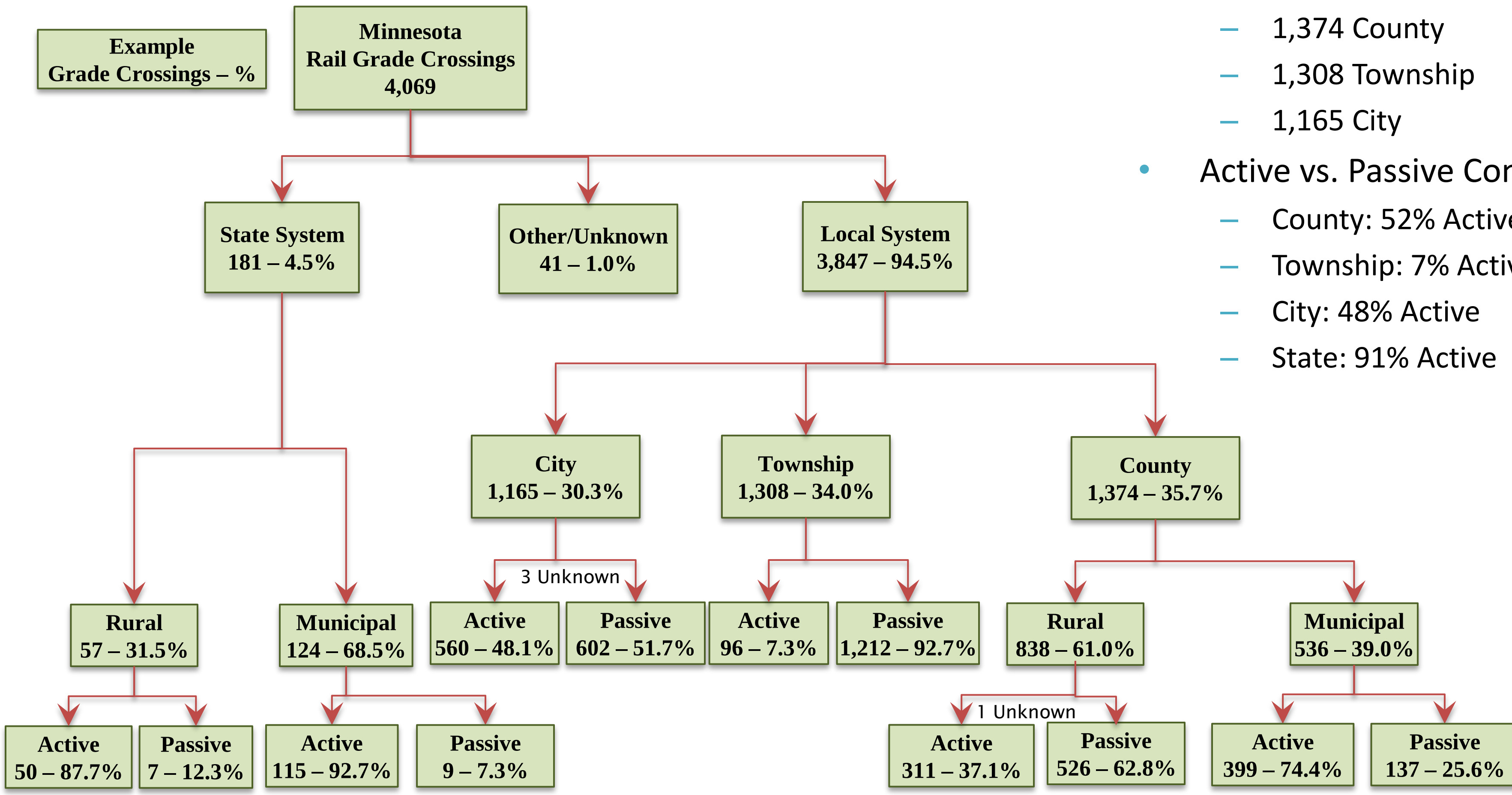




Injury + Fatal Crash Densities (crashes per crossing per year)

89 crashes (distributed across 69 crossings) occurred at passive crossings that have since been changed to active.
At these locations, 2 crashes have occurred since the control change.

CROSSING OVERVIEW



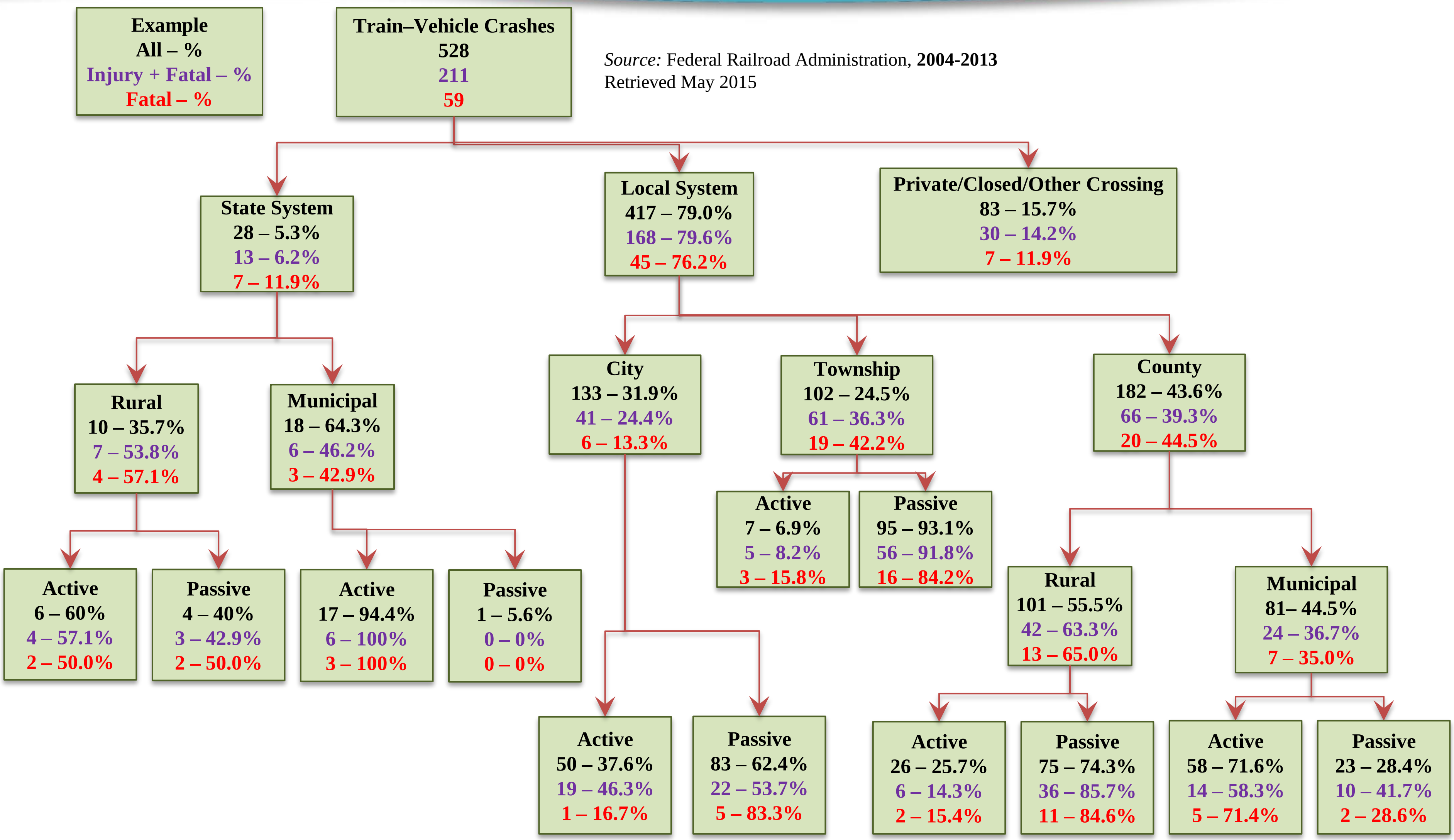
Source: RGCIP Inventory, **2013**
Retrieved May 2015

- 3,847 (95%) Local System
  - 1,374 County
  - 1,308 Township
  - 1,165 City
- Active vs. Passive Control
  - County: 52% Active
  - Township: 7% Active
  - City: 48% Active
  - State: 91% Active

Crossing Type (Active vs. Passive) is defined as that present at the time of database retrieval (May 2015).

CRASH OVERVIEW

Source: Federal Railroad Administration, **2004-2013**
Retrieved May 2015



Crossing Type (Active vs. Passive) is defined as that present at the time of the crash.

SELECTED RISK FACTORS

Highway and Grade Crossing Characteristics used in Predictive Models

Characteristics	Research Report						
	Texas (1)	Iowa	California	Texas (2)	Texas (3)	FHWA	Minnesota
Highway ADT		X	X	X	X	X	X
Heavy Vehicles	X	X	X	X			
School Busses		X	X	X			
EMS Route		X					
Nearby Intersections	X	X	X	X		X	X
Nearest At-Grade Crossing							X
Spillback	X			X			
Functional Class		X		X			
Rural versus Urban			X		X	X	
Paved Roads			X		X	X	
Number of Lanes			X		X	X	
Highway Alignment			X				
Vehicle Speeds			X	X			X
Type of Device	X		X				
Train Volume			X	X	X	X	X
Time Table Speed			X	X	X	X	X
Number of Tracks			X	X	X	X	X
Type of Train			X				
Hazmat			X	X			
Skew			X	X			X
Sight Distance			X	X	X		X
Crash History			X	X			

The selected risk factors (roadway, rail, and traffic characteristics) are used in other predictive models with one exception: proximity to nearby grade crossings.

SELECTED RISK FACTORS

Risk Factors	Active		Passive	
	Minimum	**Maximum**	**Minimum**	**Maximum**
Volumes				
Roadway AADT	2500	Unlimited	150	Unlimited
Total Trains Per Day	10	Unlimited	4	Unlimited
Volume Cross-Product	20000	Unlimited	750	Unlimited
Speeds				
Roadway Speed Limit	45	Unlimited		
Maximum Timetable Speed	31	Unlimited	36	Unlimited
Design				
Number of Mainline Tracks	2	Unlimited		
Skew	≥15°		≥15°	
Surroundings				
Distance to Nearby Intersection	1 ft	99 ft	100 ft	199 ft
Distance to Nearest Crossing	0.5 mi	1 mi	0.5 mi	1 mi
Clearing Sight Distance	Any Quadrant Fails		Any Quadrant Fails	
Approaching Sight Distance			Any Quadrant Fails	
Version 01 - 2015-10-1				

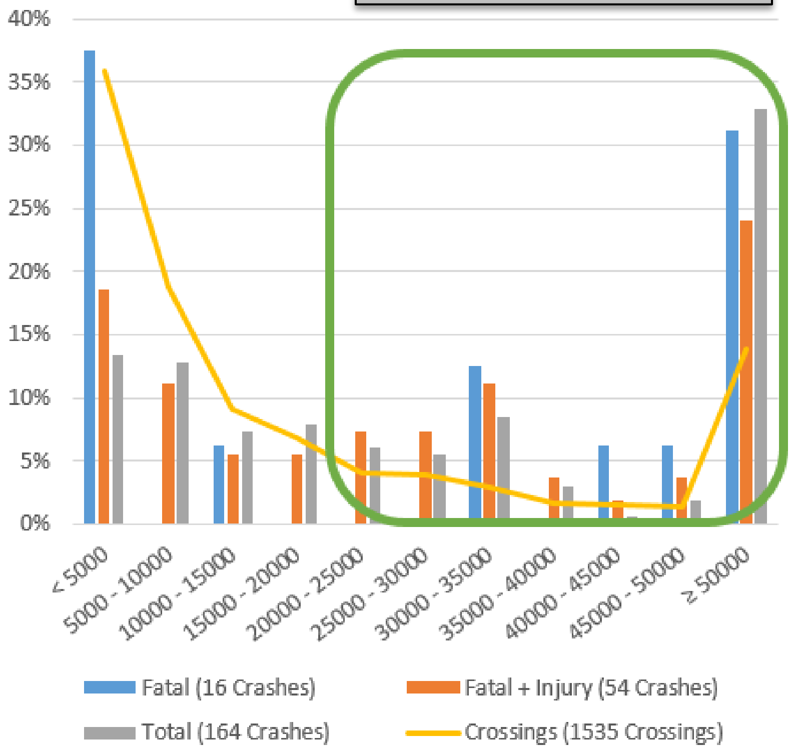
The thresholds that define risk for vehicle and train volumes, speed, skew angle, and distance to nearby intersections and crossings were derived from the crash analysis.

RISK FACTORS: PROOF OF CONCEPT

Volume Cross-Product

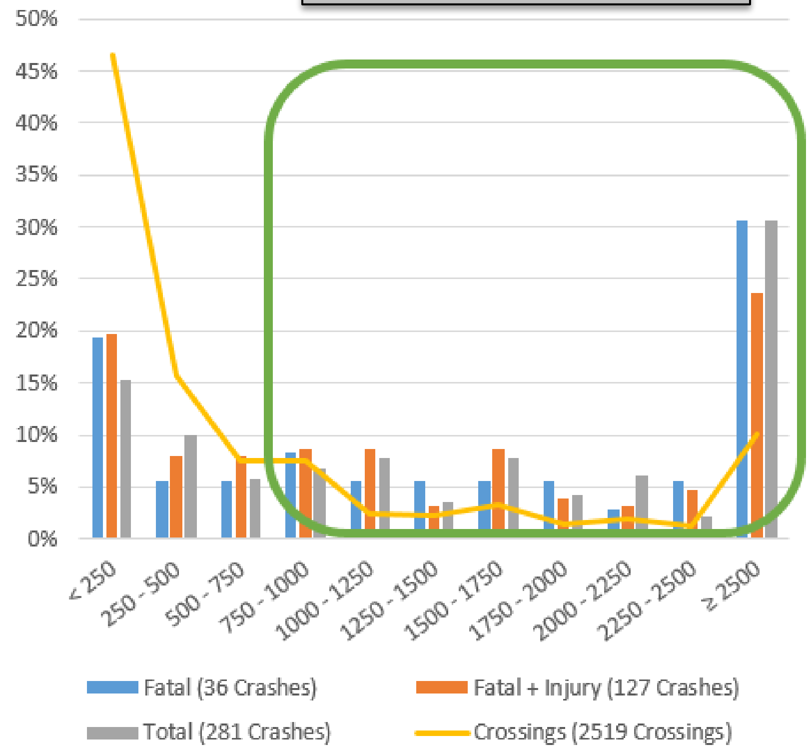
Active

74% of Fatal Crashes vs.
14% of Crossings



Passive

66% of Fatal Crashes vs.
27% of Crossings

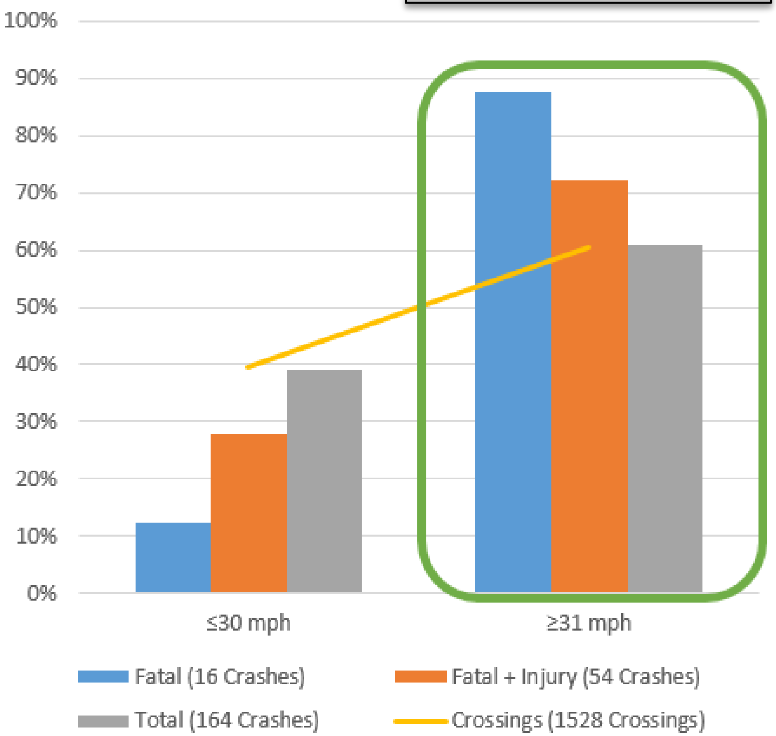


RISK FACTORS: PROOF OF CONCEPT (continued)

Maximum Timetable Speed

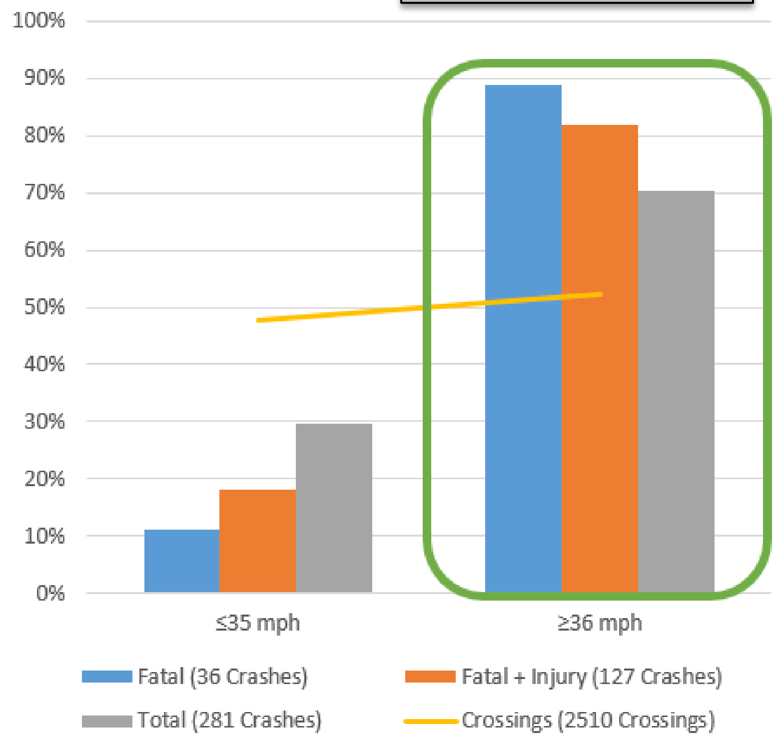
Active

90% of Fatal Crashes vs. 60% of Crossings



Passive

90% of Fatal Crashes vs. 50% of Crossings

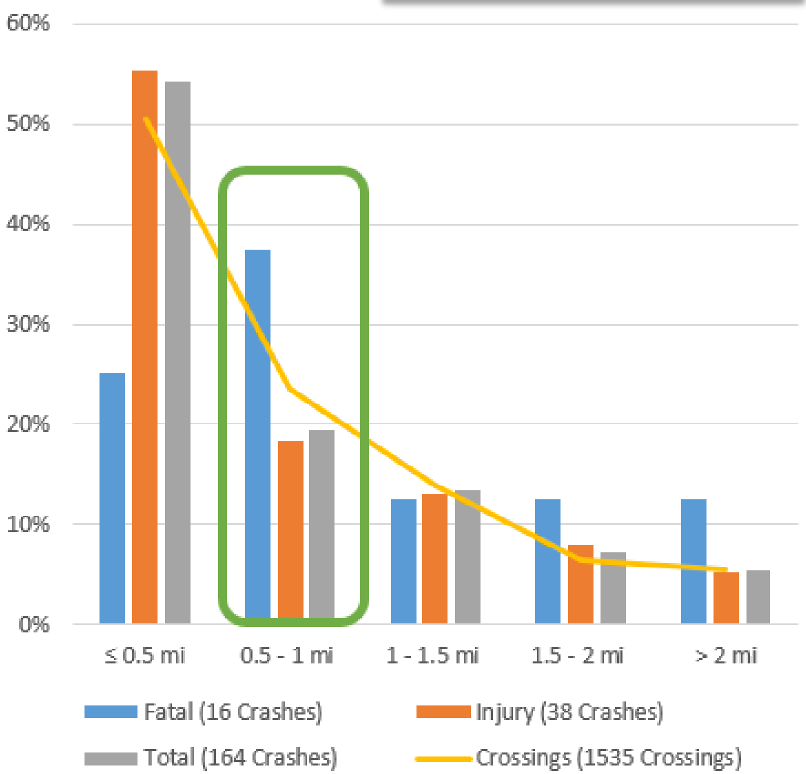


RISK FACTORS: PROOF OF CONCEPT (continued)

Nearest At-Grade Crossing

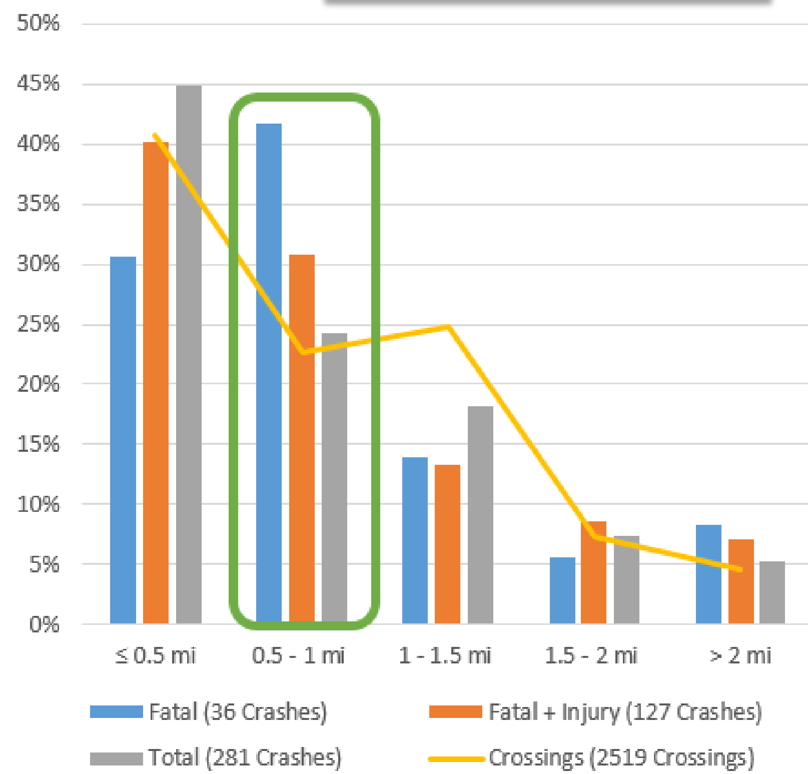
Active

38% of Fatal Crashes vs. 24% of Crossings



Passive

42% of Fatal Crashes vs. 23% of Crossings



APPLICATION OF RISK FACTORS

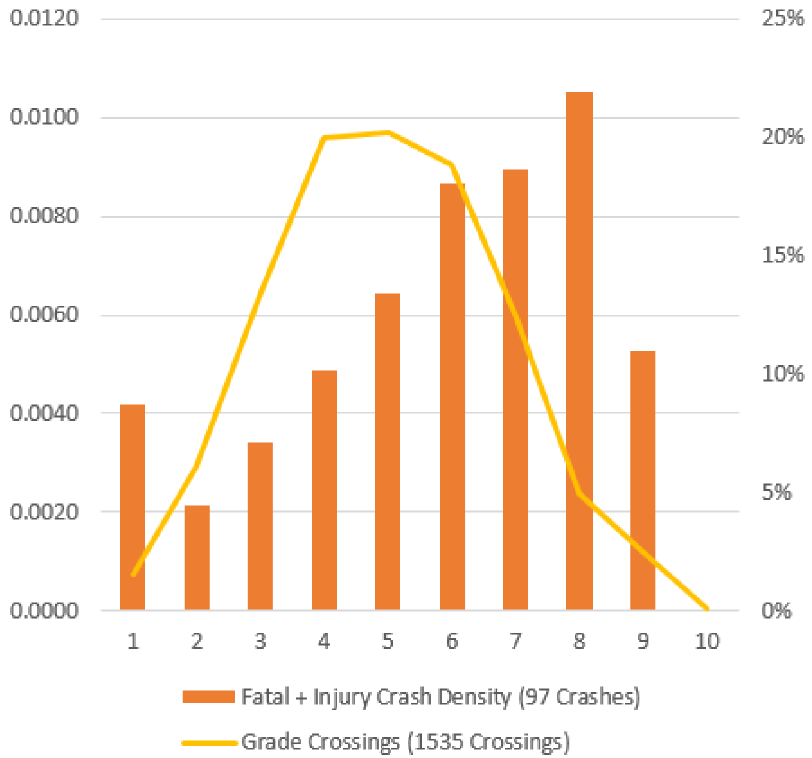
Distribution of Grade Crossings by Risk Rating

Risk Rating	Active		Passive	
0	24	2%	11	0%
1	93	6%	73	3%
2	206	13%	291	12%
3	307	20%	457	18%
4	310	20%	591	23%
5	289	19%	527	21%
6	190	12%	389	15%
7	76	5%	137	5%
8	38	2%	43	2%
9	2	0%	0	0%

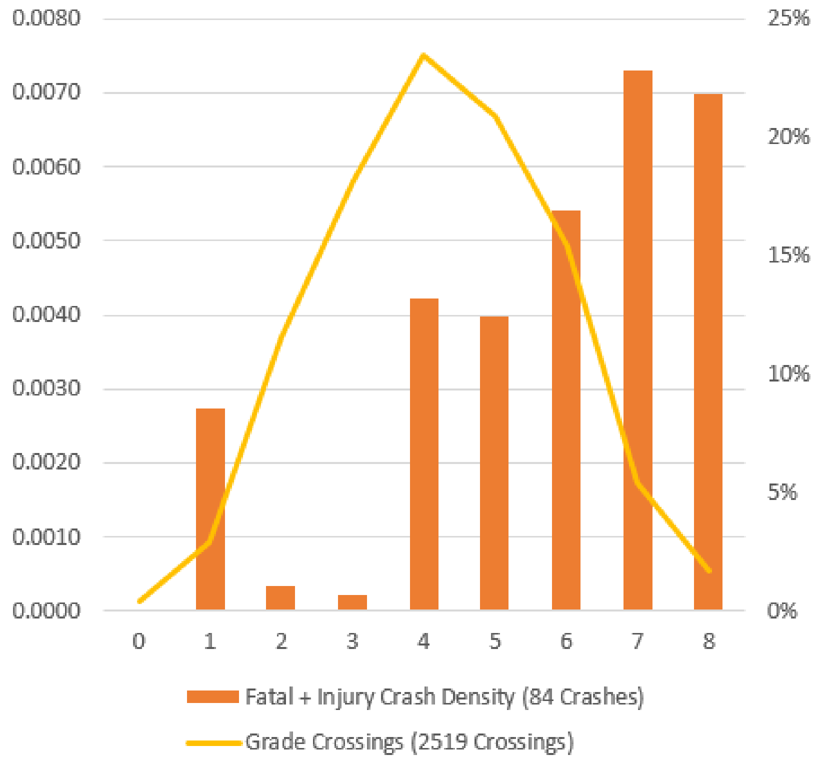
APPLICATION OF RISK FACTORS (continued)

Fatal + Injury Crash Density

Active



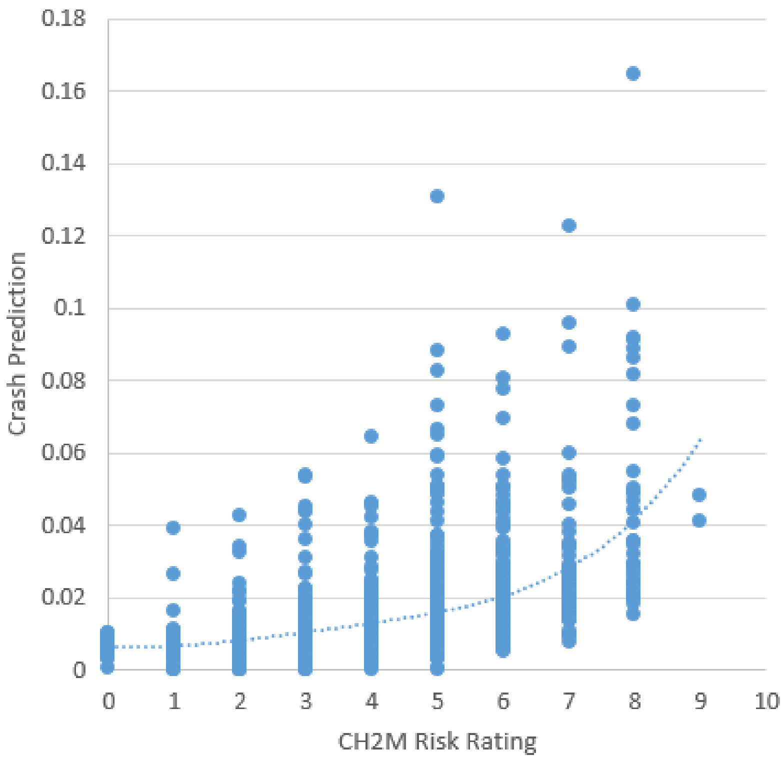
Passive



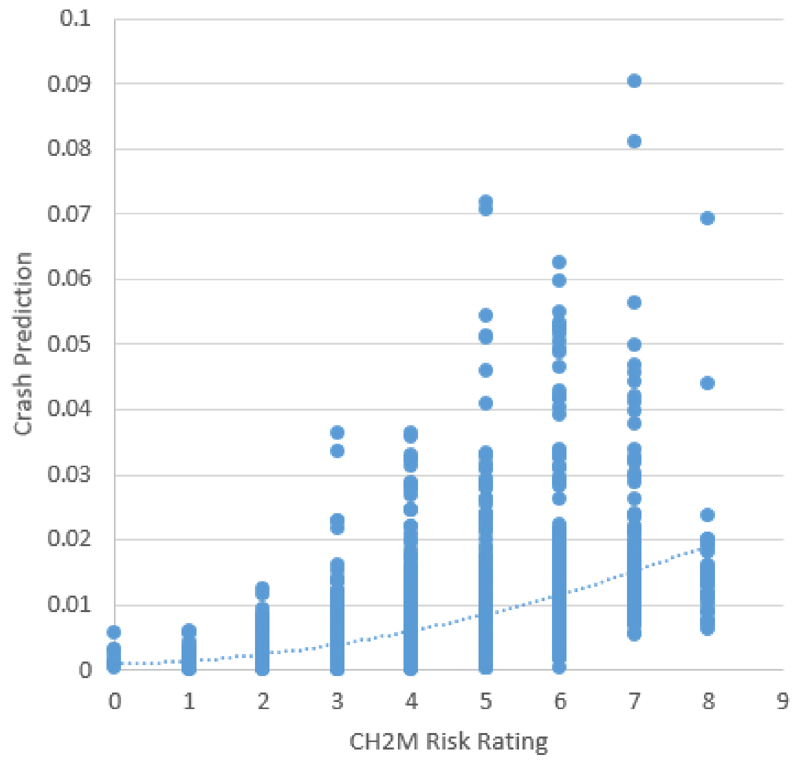
COMPARISON TO EXISTING MODELS

Crash Prediction

Active

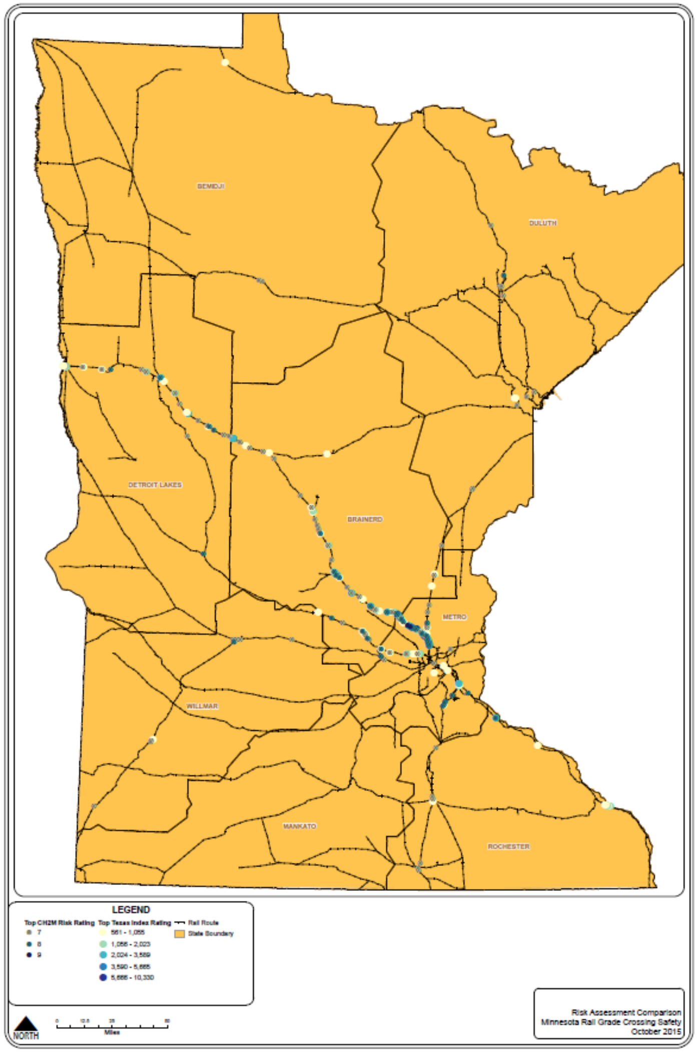


Passive

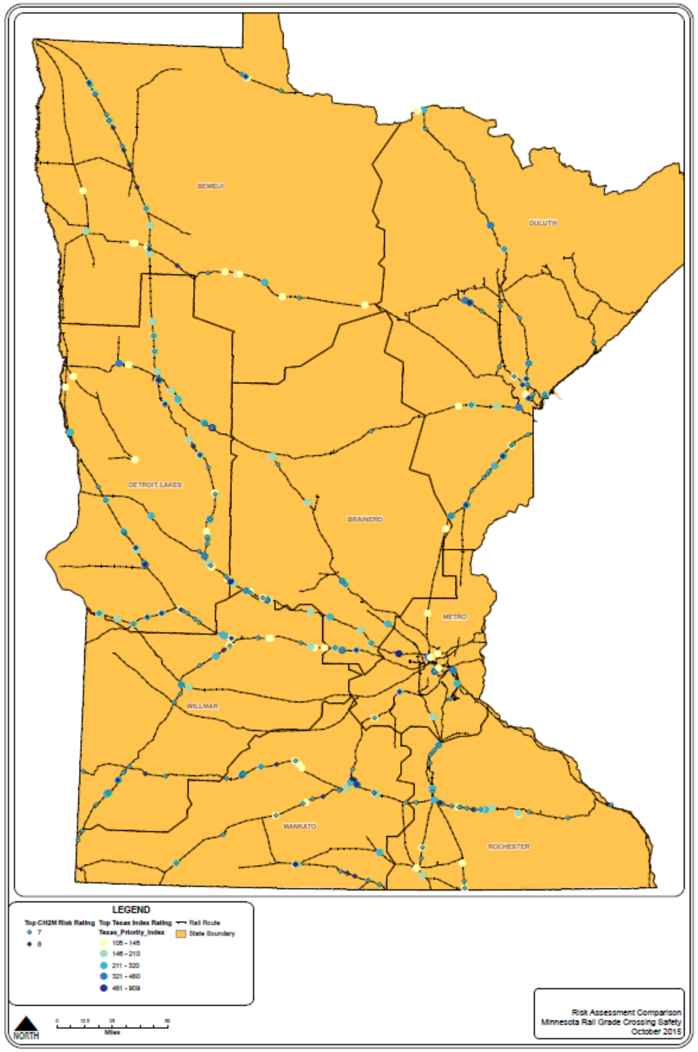


APPLICATION OF RISK FACTORS

Top Active Crossings



Top Passive Crossings



CRASHES BY COUNTY

Top Counties - Total Crashes						
County	All Severities		Injury + Fatal		Fatal	
HENNEPIN	**55**	**10%**	9	4%	0	0%
RAMSEY	**33**	**6%**	9	4%	0	0%
ST LOUIS	**29**	**5%**	14	7%	4	7%
WINONA	**18**	**3%**	4	2%	0	0%
FREEBORN	**15**	**3%**	5	2%	0	0%
OTTER TAIL	**15**	**3%**	7	3%	3	5%
BLUE EARTH	**14**	**3%**	6	3%	2	3%
STEELE	**14**	**3%**	6	3%	1	2%
SHERBURNE	**13**	**2%**	4	2%	3	5%
DAKOTA	**13**	**2%**	5	2%	1	2%

Top Counties - Injury + Fatal Crashes						
County	All Severities		Injury + Fatal		Fatal	
ST LOUIS	29	5%	**14**	**7%**	4	7%
HENNEPIN	55	10%	**9**	**4%**	0	0%
RAMSEY	33	6%	**9**	**4%**	0	0%
BROWN	12	2%	**8**	**4%**	0	0%
FARIBAULT	12	2%	**8**	**4%**	3	5%
KANDIYOHI	12	2%	**8**	**4%**	2	3%
OTTER TAIL	15	3%	**7**	**3%**	3	5%
BECKER	12	2%	**7**	**3%**	4	7%
STEVENS	8	2%	**7**	**3%**	4	7%
BLUE EARTH	14	3%	**6**	**3%**	2	3%
STEELE	14	3%	**6**	**3%**	1	2%

CONCLUSIONS

- Consistency with State and National practices and policies
  - Focus on Fatal + Injury crashes as the performance measure
  - Risk Factors are consistent with those used in other states, with the exception of distance to nearest grade crossing.
- A risk-based analysis is *more* consistent with Minnesota’s crash experience – prior crash history is an extraordinarily *bad* predictor of future crashes.
  - Only *one* crossing (out of more than 4,000) had two crashes in a 10 year period.

CONCLUSIONS (continued)

- The systemic risk-based analysis provides a complementary approach to the existing crash prediction models.
- The most successful safety strategies are not realistic for every at-risk crossing.
  - Signals + Gates + Medians has the best safety performance but the highest implementation costs ($500k-$700k). Must be replaced every 20-30 years. This results in a 300 year backlog.
  - Need lower cost (and effective) alternative strategies. It appears that *closing crossings* should be at the top of the list.
  - Corridor approach (such as the Crude by Rail Corridors) is an opportunity to partner with local agencies to accomplish closures + upgrades

Questions?