MnDOT
District Safety Plan Updates

Minnesota's Transportation Conference

November 16, 2016

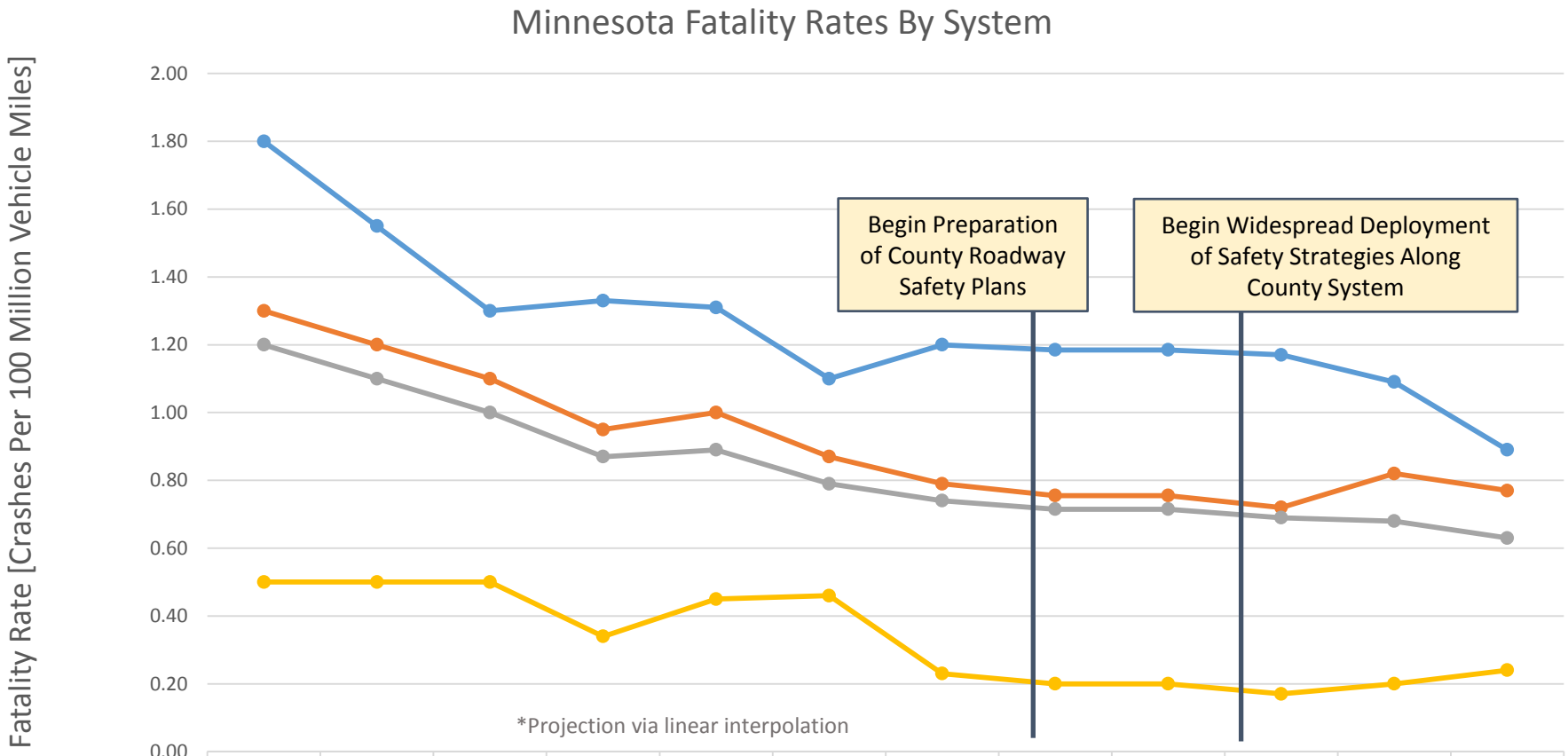
Agenda

- Background
- Methodology
- Overview
  - Network
  - Crashes
  - Strategies
- Analytical Approach
  - High Crash Locations
  - Systemic At-Risk Locations
- Statewide Results
- Contribution to HSIP Development

Background

- Commitment to:
  - Short term crash reduction goal – <300 Traffic Deaths by 2020
  - Long term crash reduction goal – Zero Traffic Deaths
- Adoption of severe crashes (fatal + severe) as Minnesota's safety performance measure
- Acknowledges:
  - Severe crashes are over represented in Greater MN
  - Severe crashes are wildly but NOT randomly scattered
    - Sets of roadway and traffic characteristics (risk factors) common to the sites with severe crashes
- Update the District Plans originally prepared between 2009 – 2012 using enhanced analytical methods that were refined during preparation of safety plans for each of Minnesota's 87 counties

Background



	2003	2004*	2005	2006	2007	2008	2009	2010*	2011*	2012	2013	2014
County	1.80	1.55	1.30	1.33	1.31	1.10	1.20	1.19	1.19	1.17	1.09	0.89
Trunk Highway	1.30	1.20	1.10	0.95	1.00	0.87	0.79	0.76	0.76	0.72	0.82	0.77
State Total	1.20	1.10	1.00	0.87	0.89	0.79	0.74	0.72	0.72	0.69	0.68	0.63
Interstate	0.50	0.50	0.50	0.34	0.45	0.46	0.23	0.20	0.20	0.17	0.20	0.24

Methodology

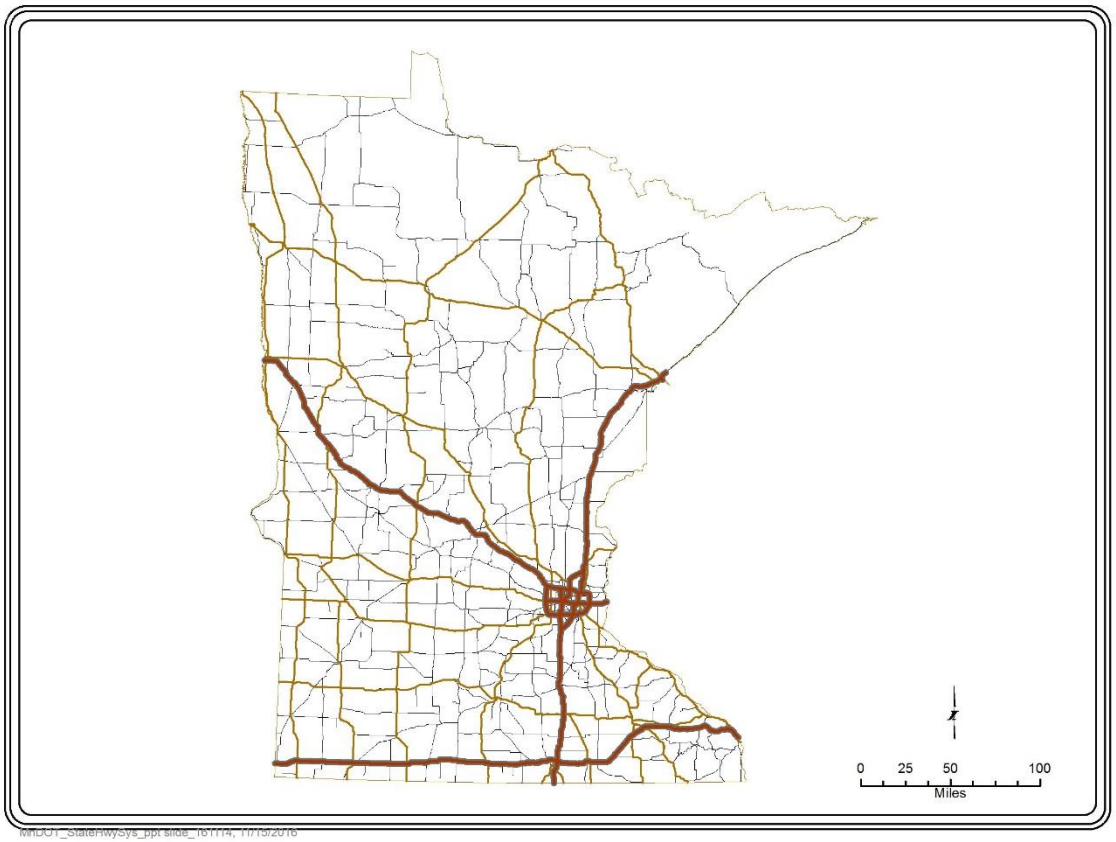
- Identify focus crash types & risk factors
- Identify & prioritize safety strategies
- Conduct systemic analysis
  - Site analysis of high crash locations
  - Systemic risk assessment for segments, intersections and curves
- Prioritize candidate locations
- Develop safety projects

Outreach & Engagement

- Two workshops with District staff
  - Workshop No. 1 – Individual Districts
    - April & May, 2015
    - Participation: District Management, Local Agencies & Law Enforcement
    - Facilitated discussions of selected locations, safety challenges and solutions.
    - Common themes: Expressway Intersections, High Volume Rural 2-lane Corridors and Urban Signalized Intersections
  - Workshop No. 2 – All Districts
    - September, 2015
    - Participation: District Management
    - Overview of results of systemic risk assessment and approach to project development

State Network Overview – Greater MN

- 10,700 miles
- 6,260 intersections
- 5,500 curves



Trunk Highway Severe Crashes by Emphasis Areas

Emphasis Area	Statewide	Metro Severe Crashes	Metro Percent	Greater Minnesota Severe Crashes	Greater Minnesota Percent
Total Severe Crashes	**7,071**	**780**	**100%**	**1,702**	**100%**
Nonmotorists	-	109	14%	98	6%
Pedestrian	*9%*	*91*	*12%*	*75*	*4%*
Bicyclist	*4%*	*18*	*2%*	*23*	*1%*
Vehicle/Train	<1%	0	0%	3	<1%
Heavy Vehicle	10%	90	12%	311	18%
Motorcycle	18%	133	17%	232	14%
Intersection	42%	339	43%	622	37%
Lane Departure	46%	307	39%	902	53%
Run-Off-Road	-	*219*	*28%*	*561*	*33%*
Head-On	-	*88*	*11%*	*341*	*20%*
Work Zone	1%	33	4%	32	2%
Deer/Animal	-	7	1%	41	2%
Winter Weather	-	62	8%	294	17%

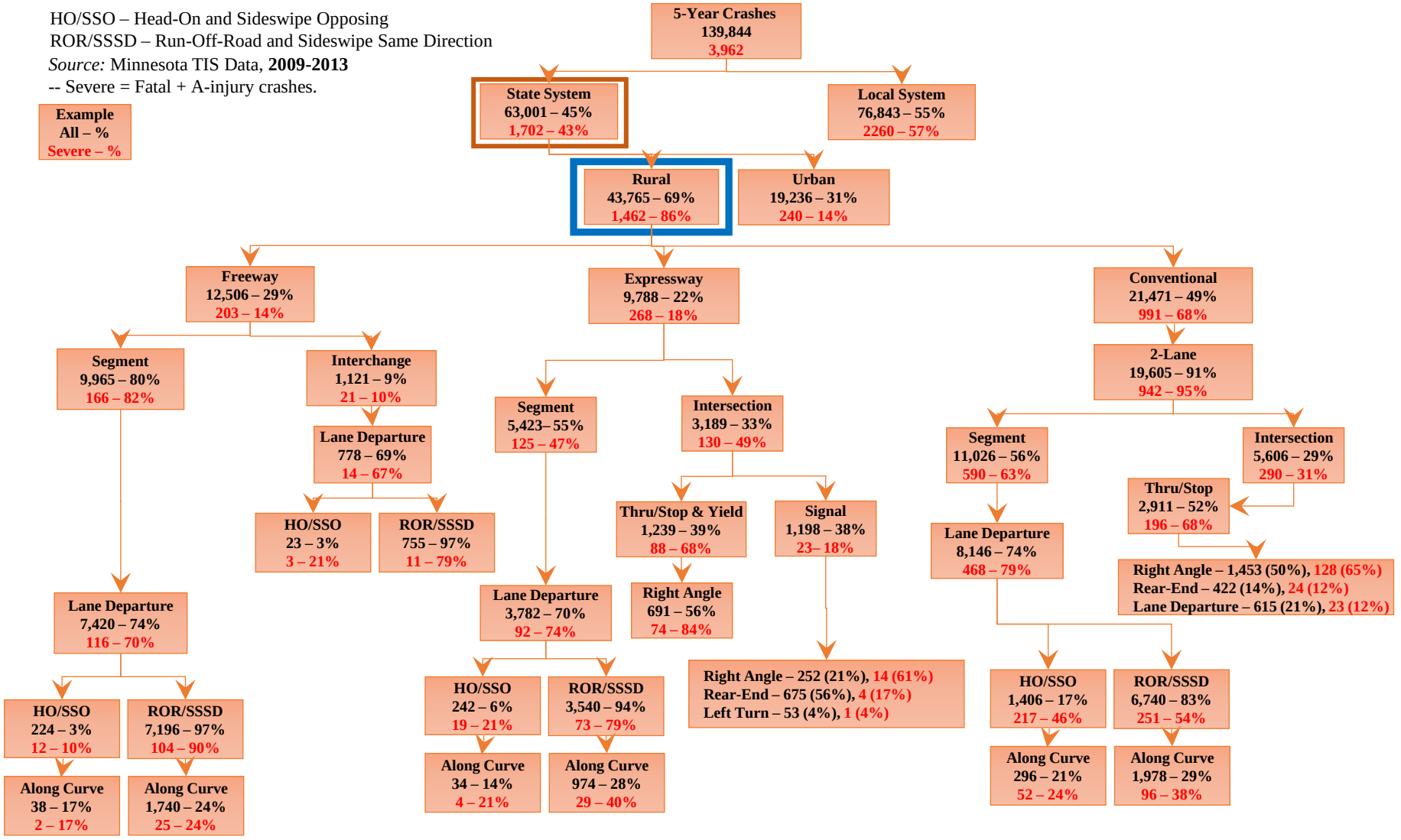
Used to identify *urban* safety projects.

Used to identify *urban & rural* safety projects.

Used to identify *rural* safety projects.

Greater Minnesota Crash Overview
Rural

HO/SSO – Head-On and Sideswipe Opposing
ROR/SSSD – Run-Off-Road and Sideswipe Same Direction
Source: Minnesota TIS Data, **2009-2013**
-- Severe = Fatal + A-injury crashes.



Sustained High Crash Location - Identification

District	SHCL Intersections	Severe Intersection Crashes	Severe Crashes at SHCL	% Severe SHCL Crashes	ALL Severe Crashes	% of All Severe Crashes
1 – Duluth	27	65	36	55%	368	10%
2 – Bemidji	38	63	47	75%	243	19%
3 – Brainerd	41	116	51	44%	602	8%
4 – Detroit Lakes	13	66	15	23%	296	5%
6 – Rochester	37	88	46	52%	454	10%
7 – Mankato	9	57	9	16%	300	3%
8 – Willmar	47	75	55	73%	302	18%
Total	212	530	259	49%	2,565	10%

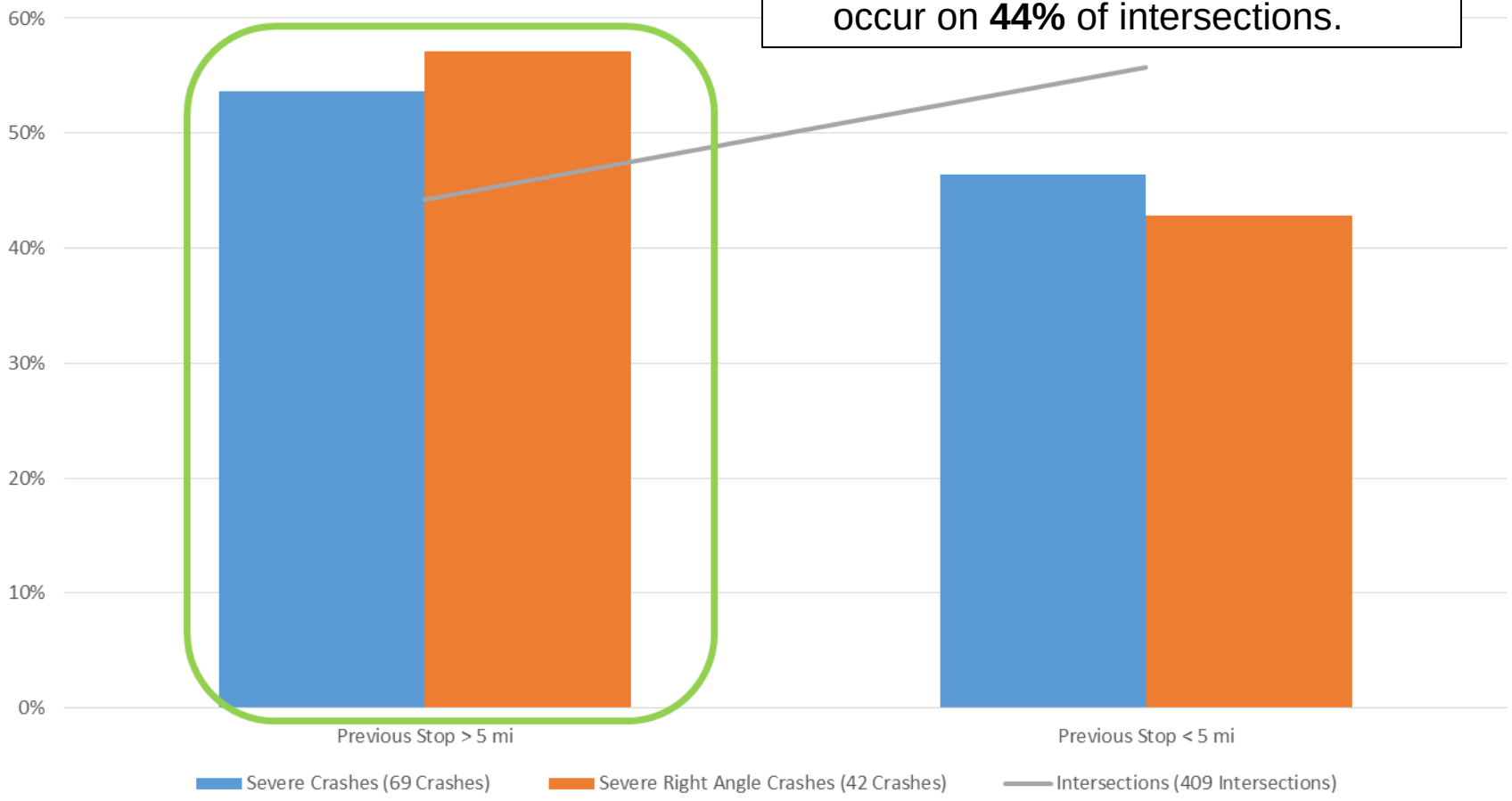
Rural Systemic Risk Factors

- Risk Factors – Roadway & traffic characteristics that are overrepresented at locations with severe crashes

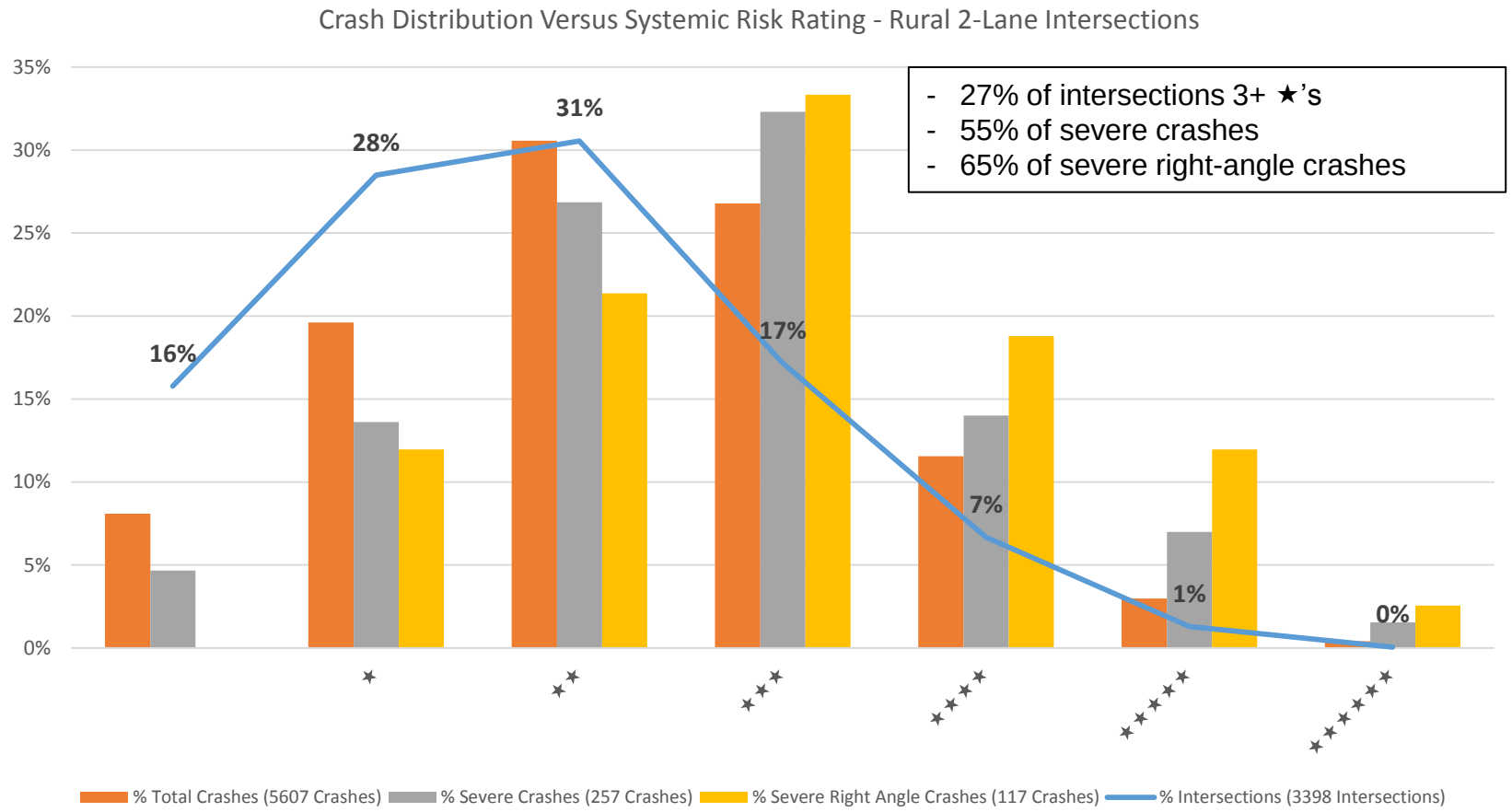
	2-Lane Undivided		4-Lane Expressway		4-Lane Freeway	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Rural Segments						
Shoulder Width	-	2 ft				
Critical Radius Curve Density	0.1	Unlimited	0.25	Unlimited	0.125	Unlimited
Median Width			-	65 ft		
Edge Risk Assessment	2	3				
Access Density	8	Unlimited	5	Unlimited		
ADT Range	3500	Unlimited	16,000	Unlimited	20,000	Unlimited
Severe Lane Departure Density	0.014	Unlimited	0.037	Unlimited	0.028	Unlimited
Interchange Density					0.4	Unlimited
Rural Curves						
Radius	500	1800	500	3750		
ADT Range	2000	Unlimited	16,000	Unlimited		
Severe Lane Departure Density	0.007	Unlimited	0.019	Unlimited		
Visual Trap	Present		Present			
Intersection on Curve	Present		Present			
Shoulder Width	-	4 ft				
Rural Intersections						
Skew	10˚	Unlimited	10˚	Unlimited		
On/Near Curve	Present		Present			
Adjacent Development	Present		Present			
Previous Stop >5 Miles	Present		Present			
Volume Cross Product	400,000	Unlimited	6,000,000	Unlimited		
Severe Right Angle Density	0.007	Unlimited	0.022	Unlimited		

Systemic Risk Factors – Proof of Concept Examples

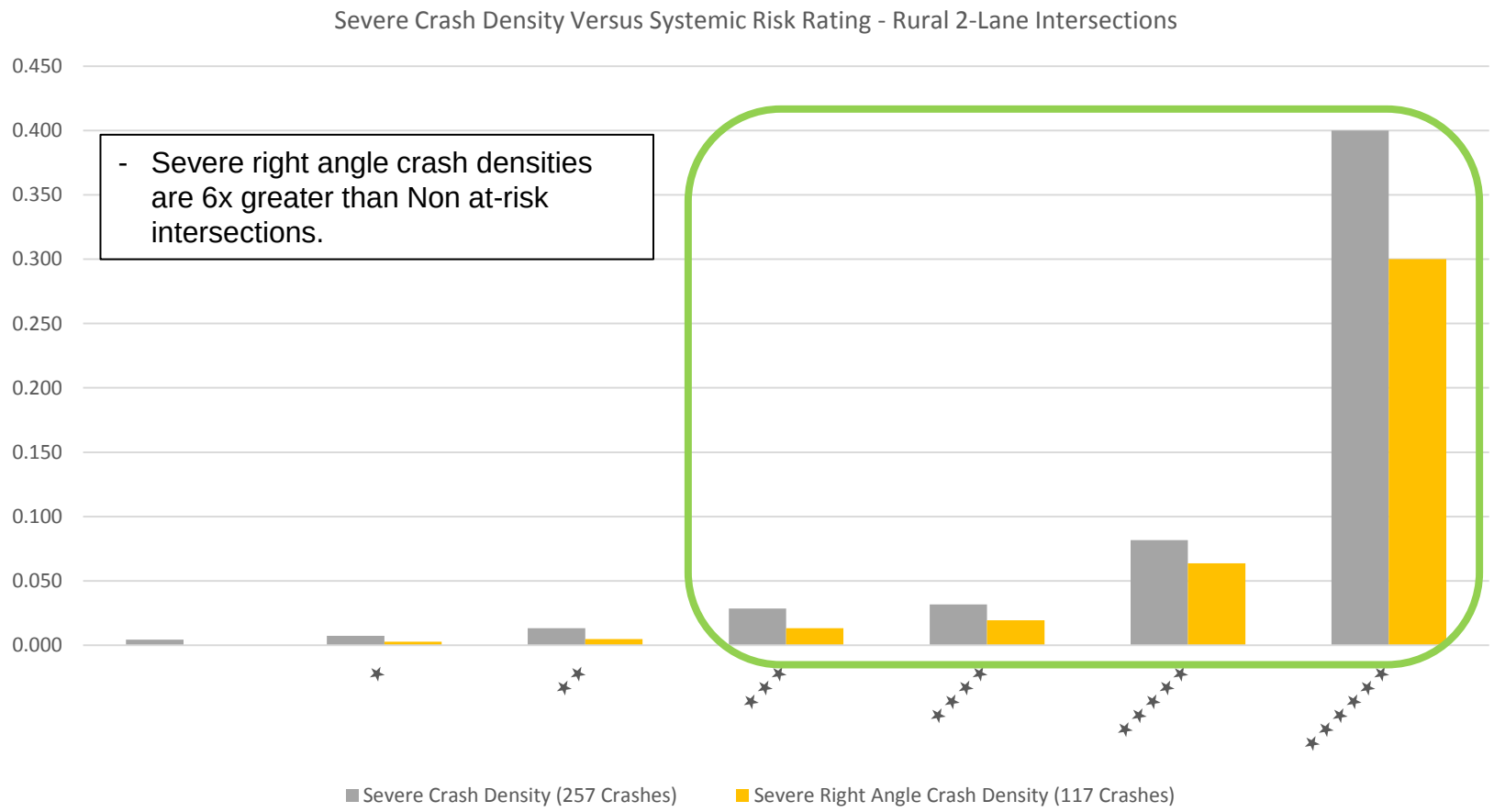
- **57%** of severe Right Angle crashes occur on **44%** of intersections.



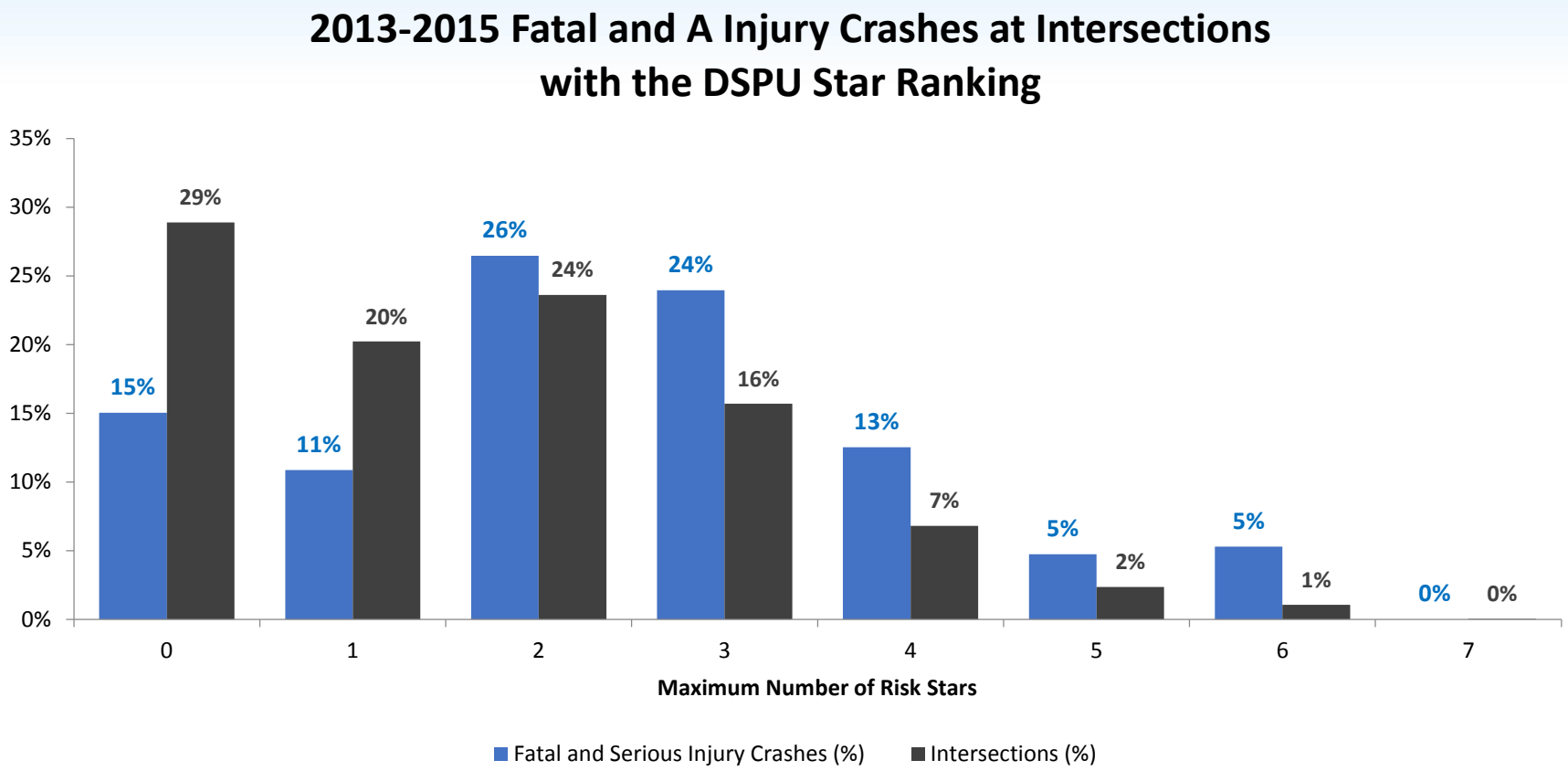
Systemic Risk Factors – Proof of Concept Examples



Systemic Risk Factors – Proof of Concept Examples



Systemic Risk Rating – Recent Crashes



- The DSPU predicted where 47% of the fatal and serious injury crashes from 2013 to 2015 occurred, at the 26% of high risk intersections. DSPU crash data was from 2009-2013!

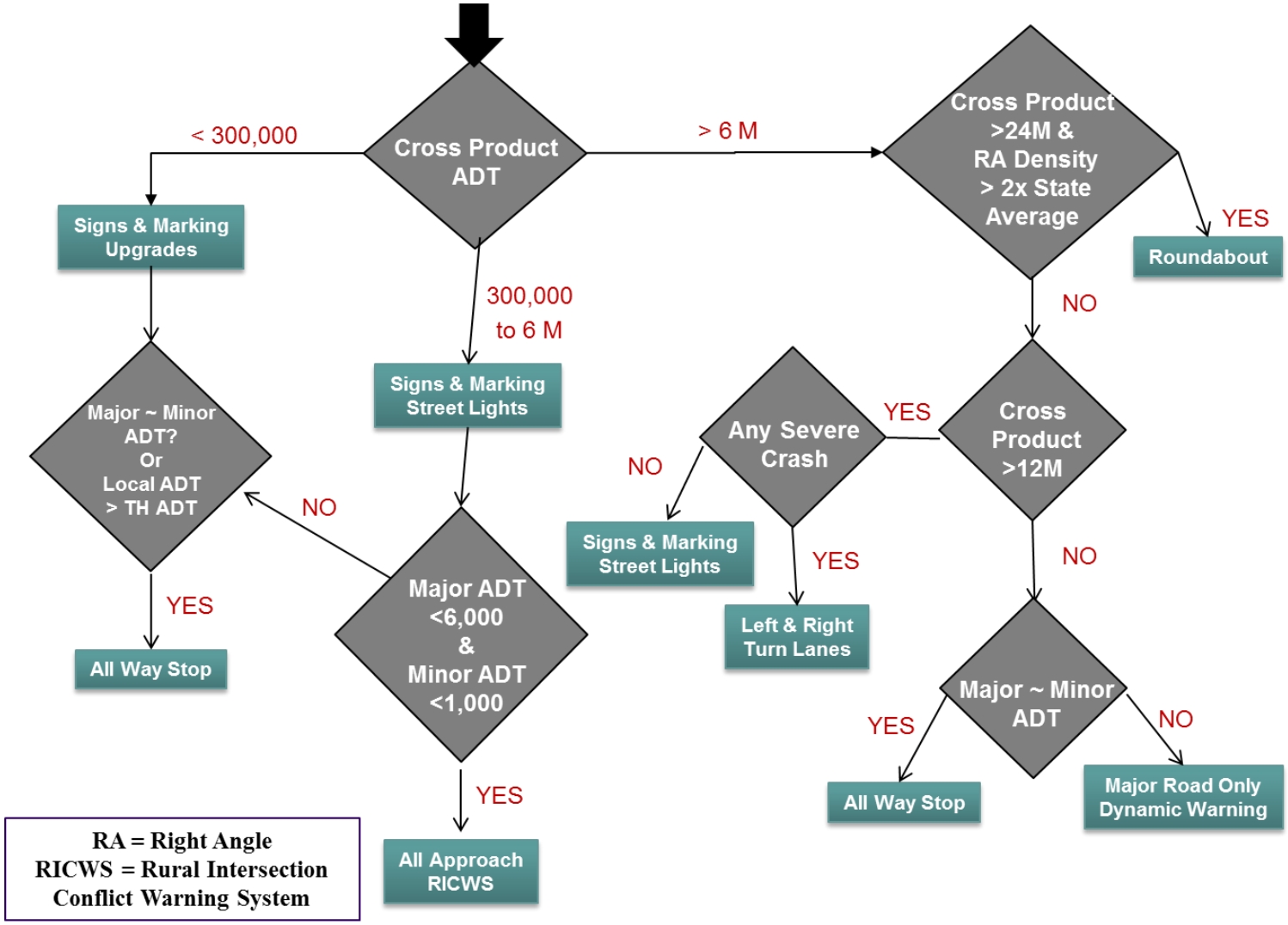
Strategies:
Rural Conventional Segments

Strategy	Crash Reduction Factor	Typical Installation Costs
Centerline Rumble Strip	40% head-on/sideswipe crashes 14% all crashes 15% all injury crashes 21% all head-on and opposite direction sideswipe crashes 25% head-on and opposite direction sideswipe injury crashes	$3,600 per mile
Buffers Between Opposing Lanes	50% for all crashes & 100% for head-on crashes [based on TH 5 in Lake Elmo, MN]	$150,000 to $500,000 per mile
Shoulder / Edge Line Rumble Strip	20% run off road crashes 16% all crashes 17% all injury crashes 10% all single-vehicle run-off-the –road crashes 22% single-vehicle run-off-the-road injury crashes	$5,850 per mile
Safety Edge	5% to 10% 5.7% all crashes	
Enhanced Edge Line (Embedded wet-reflective, 6” or 8” edge lines)	10% to 45% all rural serious crashes (6”)	$1,980 per mile

Strategies:
Rural Conventional Segments

Strategy	Crash Reduction Factor	Typical Installation Costs
Shoulder Paving (2', 4', 6 ')	20% to 30% run-off-the-road crashes (with shoulder rumble) (2' only) Up to 8% reduction on single-vehicle run-off-the-road crashes and multiple-vehicle head-on, opposite-direction sideswipe and same-direction sideswipe crashes	$54,000 per mile +$5,850 per mile (for Edge Rumble)
Clear Zone Maintenance / Enhancements	24% total crashes	
Ditch / Embankment Improvements	6% – 27% run-off-the-road crashes	$500,000 to $1M per mile
2+1 Design	55% all crashes- NCHRP RRD 275	$750,000 per mile

Project Decision Tree: Rural 2-lane Intersections



Systemic Risk Assessment – Output

Project Sheet – HSIP Submittal Form

Intersection on MN 27 at CSAH 8

Roadway Data

Description:	CSAH 8
Route System:	MN
Route No:	27
District:	3
Environment:	Rural
Design Type:	Conventional
Configuration:	X
Intersection Geometry:	Traditional
Traffic Control Device:	Thru-Stop
Street Lights:	Present
Flashers:	Sign Mounted
Major ADT:	1,150
Minor ADT:	810
Total Entering ADT:	1,960

Crash Data

2009-2013 Crash History 5 Years

	Total	Total Right Angle	Severe Right Angle
Crash Frequency	7	3	1
Density (per int per yr)	1.400	0.600	0.200
Rate (per MEV)	1.957	0.839	0.280

Systemic Safety Risk Factors

	Value	Threshold Value	Star Assignment
Skew	10	≥ 10°	★
On/Near Curve	Yes	Present	★
Adjacent Development	Yes	Present	★
Previous Stop >5 Miles	Yes	Present	★
Volume Cross Product	931,500	≥ 400000	★
Severe RA Density	0.200	≥ 0.007	★
		Total Stars	★★★★★★

Short List of Strategies Considered

	Type	Unit Cost	Unit	Cost
Upgrade Signs & Markings	Proactive	$ 3,000	2	$6,000
All-Way STOP Conversion	Proactive	$ 1,000	0	$0
Street Lights	Proactive	$ 6,000	0	$0
Left & Right Turn Lanes	Proactive	$ 150,000	0	$0
Mainline Dynamic Warning Sign	Proactive	$ 75,000	0	$0
All Approach RICWS	Proactive	$ 150,000	1	$150,000
Roundabout	Proactive	$ 2,000,000	0	$0
		Total Estimated Project Cost		**$156,000**

Notes - Could add Stopbar

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Segment ID: 3.027.030
Date: 1/22/2016

Systemic Risk Locations – Projects

At-risk Location	Approved
Rural	
2-Lane Segments	$71,543,504
Expressway Segments	$22,495,788
Freeway Segments	$13,167,194
Curves	$11,852,490
2-Lane Intersections	$50,838,000
Expressway Intersections	$52,963,000
Urban	
Urban Segments	$37,031,624
Urban Intersections (Right Angle)	$79,167,400
Urban Intersections (Ped/Bike)	$11,457,800
Total	**$350,516,799**

Contribution to the Highway Safety Improvement Program

- Completed safety plan updates for all districts (excluding Metro)
- Provided Districts with prioritized lists of their facilities based on severe crashes and the presence of adopted risk factors
- Provided Districts with lists of suggested safety projects – specific safety strategies at specific high priority locations
- First comprehensive assessment and qualification of safety needs across MnDOT's system
  - ~$400M
- 2017 HSIP - $12M/$15M attributed to safety projects identified though this update process

Questions?