

# CMF for ICWS



## ELCSI-PFS

E N T E R  P R I S E

AASHTO SCOTE Annual Meeting  
June 14-17, 2015

# Outline

- ICWS Background
- Crash Modification Factor Results



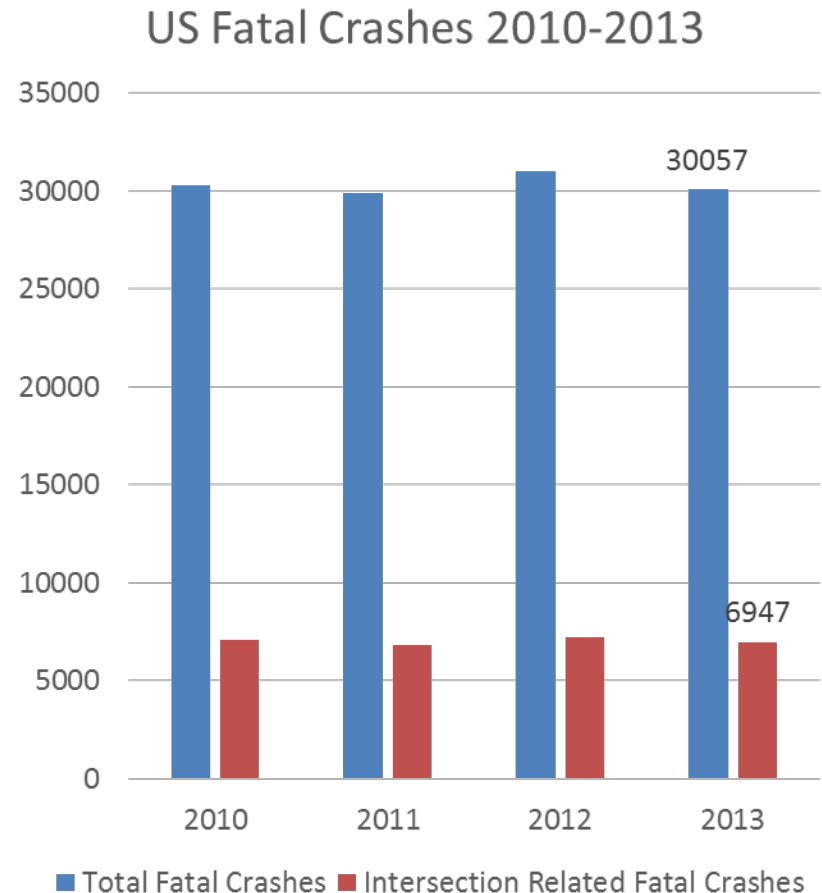
# ICWS Background

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# ICWS Background

- Intersection crashes continue to be safety challenge in US
- 6,947 fatal crashes associated with intersections in 2013 (FARS Data, US)
  - 23% of the 30,057 fatal crashes in 2013



# ICWS Background

- Many intersection safety strategies
  - Overhead lighting
  - Conspicuous signing/markings
  - Traffic signals
  - Roundabouts
  - J-turns
- ICWS have evolved as another safety strategy to address the often severe crashes at stop-controlled intersections



# ICWS Background

## Many different approaches to ICWS!



# ICWS Background

- ENTERPRISE and ELCSI both worked on ICWS to...
  - Engage stakeholders
  - Develop design and evaluation guidance
  - Develop model systems engineering
  - Develop ICWS planning guidance (warrant)
  - *Evaluate ICWS to develop a crash modification factor*
    - *This is what we're here to discuss today!*



# CMF Results

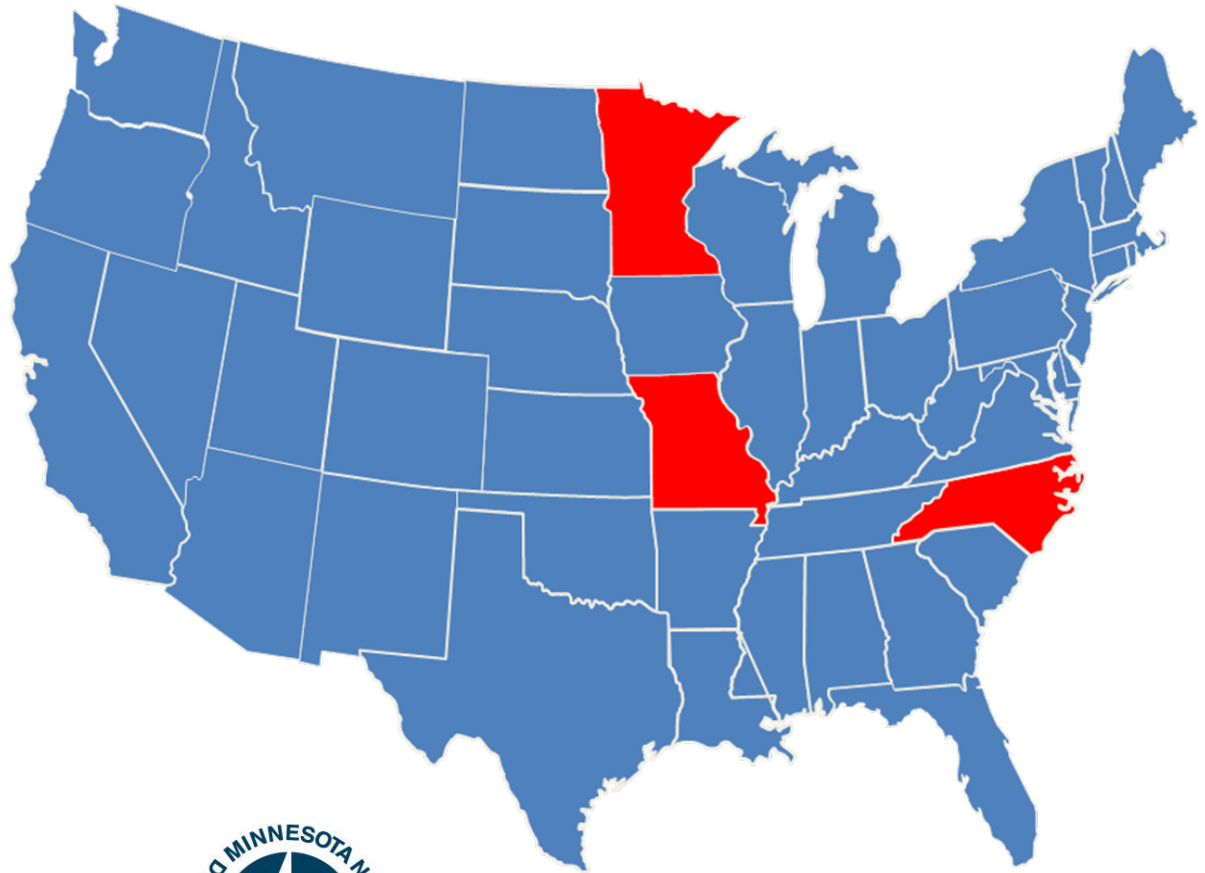
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# ICWS Evaluation Volunteer States

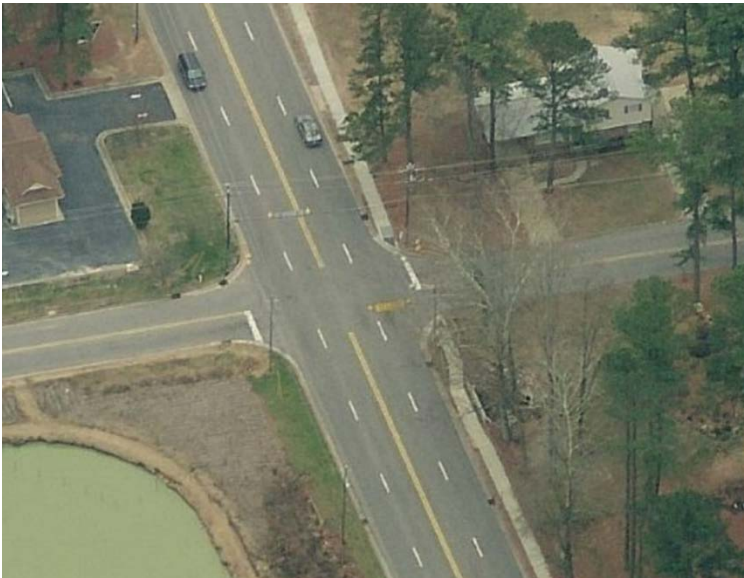
Sites contributed for empirical Bayes before-after analysis

- MN – 13 Sites
- MO – 14 Sites
- NC – 66 Sites



# ICWS Evaluation Applicability

- Four-leg intersections with stop control on minor road approaches
- Two-lane at two-lane intersections
- Four-lane at two-lane intersections



# NCDOT Treatment Categories

- Category 1 – Overhead signs and flashers on major; loop on minor
- Category 2 – Overhead signs and flashers on minor; loop on major
- Category 3a – Post-mounted signs and flashers on major; loop on minor
- **Category 3b – Post-mounted signs and flashers on minor; loop on major**
- Category 4 - Other



# Combined Results: Two-Lane at Two-Lane

Crash Type	Total	Fatal and Injury	Right Angle	Rear-end	Night time
EB estimate without strategy	912.8	515.6	522.2	100.5	128.8
Observed crashes with strategy	670	362	420	43	116
CMF	<b>0.73</b>	<b>0.70</b>	<b>0.80</b>	<b>0.43</b>	0.90
Standard error	0.04	0.05	0.05	0.07	0.10



# Combined Results: Four-Lane at Two-Lane

Crash Type	Total	Fatal and Injury	Right Angle	Rear-end	Night time
EB estimate without strategy	464.5	263.6	295.5	33.1	85.5
Observed crashes with strategy	385	212	252	33	53
CMF	<b>0.83</b>	<b>0.80</b>	<b>0.85</b>	0.97	<b>0.61</b>
Standard error	0.06	0.07	0.08	0.22	0.11



# Results by Category: Two-Lane at Two-Lane

Category		1 OH-Maj	2 OH-Min	3a PM-Maj	3b PM-Min	4 Combo
Sites		16	15	14	8	16
Total	CMF (SE)	<b>0.74 (0.07)</b>	0.89 (0.08)	<b>0.52 (0.06)</b>	0.89 (0.16)	<b>0.70 (0.09)</b>
	N	173	241	120	42	94



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Total	CMF (SE)	<b>0.74 (0.07)</b>	0.89 (0.08)	<b>0.52 (0.06)</b>	0.89 (0.16)	<b>0.70 (0.09)</b>
	N	173	241	120	42	94
Fatal and Injury	CMF (SE)	<b>0.60 (0.08)</b>	0.94 (0.10)	<b>0.45 (0.07)</b>	1.06 (0.29)	<b>0.74 (0.12)</b>
	N	91	144	58	18	51
Right Angle	CMF (SE)	<b>0.81 (0.10)</b>	1.08 (0.11)	<b>0.45 (0.07)</b>	1.25 (0.30)	<b>0.70 (0.11)</b>
	N	111	169	61	25	54



# Results by Category: Four-Lane at Two-Lane

Category		1	2	3a PM-Maj	3b PM-Min	4
Sites				12	7	
Total	CMF (SE)			<b>0.75 (0.07)</b>	<b>0.69 (0.13)</b>	
	N			243	35	
Fatal and Injury	CMF (SE)			<b>0.73 (0.08)</b>	0.90 (0.21)	
	N			138	22	
Right Angle	CMF (SE)			<b>0.77 (0.08)</b>	0.76 (0.17)	
	N			174	23	



# Results by Before Period Crash Frequency: Four-Lane at Two-Lane

Crash Type	Crashes/ Year	EB estimate without strategy	Observed crashes with strategy	CMF	SE
Total Crashes	$\leq 3$	114.2	121	1.05	0.15
	$> 3$	350.3	264	<b>0.75</b>	0.06
Fatal & Injury Crashes	$\leq 2$	66.3	74	1.10	0.18
	$> 2$	197.3	138	<b>0.70</b>	0.08
Right-Angle Crashes	$\leq 2.5$	93.3	116	1.23	0.18
	$> 2.5$	202.2	136	<b>0.67</b>	0.08



# Economic Analysis

- Approximated costs for installation, annual maintenance, and annual operations
- Benefits included savings in prevented crashes
- Assumed 10-year lifespan with 7 percent discount rate
- Two-lane at two-lane B/C ratio: 27:1
- Four-lane at two-lane B/C ratio: 10:1



# Summary

- Aggregate CMFs estimated as shown below
- The results suggest ICWS can be highly cost-effective as a safety treatment

Crash Type	Total	Fatal and Injury	Right Angle	Rear-end	Night time
Two-Lane at Two-Lane					
CMF	<b>0.73</b>	<b>0.70</b>	<b>0.80</b>	<b>0.43</b>	0.90
Standard error	0.04	0.05	0.05	0.07	0.10
Four-Lane at Two-Lane					
CMF	<b>0.83</b>	<b>0.80</b>	<b>0.85</b>	0.97	<b>0.61</b>
Standard error	0.06	0.07	0.08	0.22	0.11



# More Information

***[www.enterprise.prog.org](http://www.enterprise.prog.org)***

## **Next ENTERPRISE Webinar: Liability, Reliability and Credibility – Challenges for ICWS**



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**June 25, 2015**

**2:00 – 3:30PM (Central)**



# More Information

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**Comments?**

# ENTERPRISE ICWS Highlights

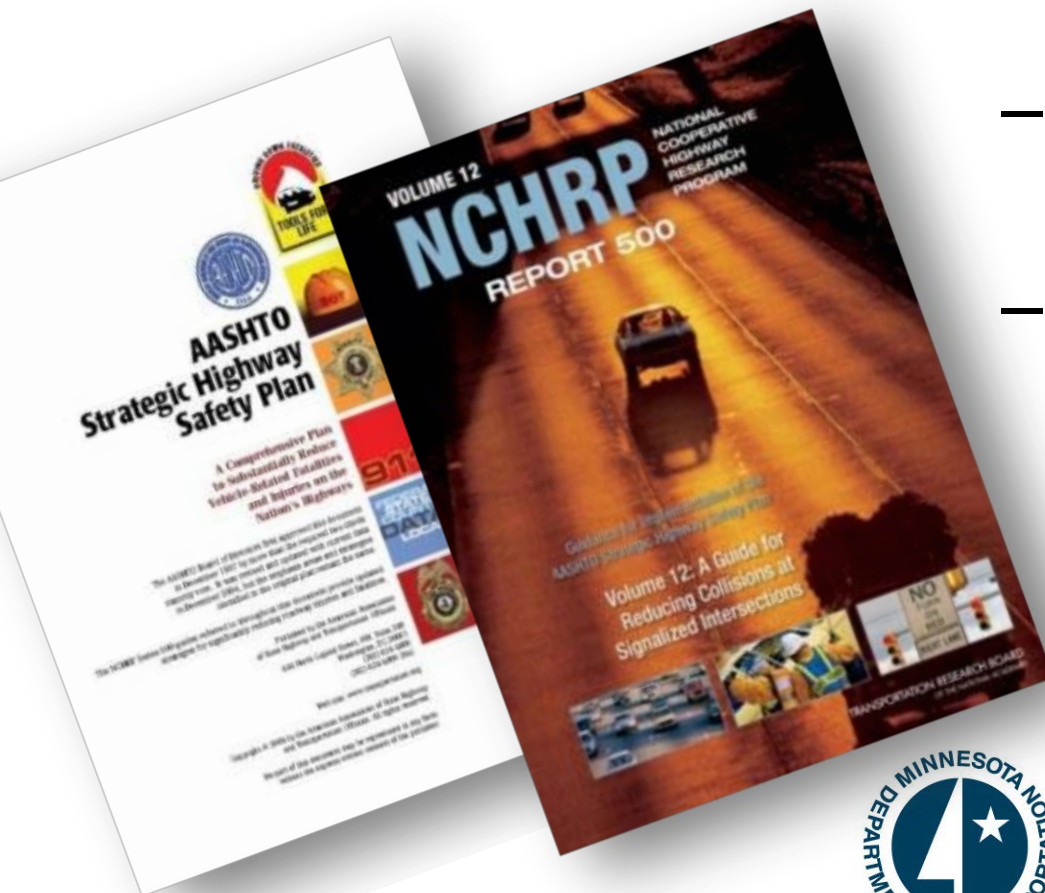
- Established in 1991, ENTERPRISE is one of longest-running pooled fund programs
- Use combined resources of members to develop, evaluate and deploy ITS
- Members include
  - AZ, GA, ID, IL, IA, KS, MI, MN, OK, PA, TX, WA, Ministry of Transport Ontario, Transport Canada, Dutch Ministry of Transport, FHWA



# Overview of ELCSI-PFS

- FHWA Evaluation of Low-Cost Safety Improvements Pooled Fund Study

- Est. in 2005; continued in 2012 under DCMF Project
- Study goal:
  - Develop scientific measures of crash-effectiveness of safety strategies to support investing decisions



# Overview of ELCSI-PFS (cont.)

- 38 member States
- Technical Advisory Committee (TAC):
  - Composed of one rep from each State
  - Meets annually to **review** study results, **share** information, **discuss** safety issues, and **set direction** of future evaluations

