Minnesota’s County Roadway Safety Plans in Minnesota

Center for Transportation Studies Research Conference
St. Paul, Minnesota
May 22, 2013

Howard Preston, PE, CH2M HILL
Agenda

- Why? Why are Safety Plans for local systems a priority?
- Challenges
- What is Needed to Get Started?
- Safety Plan Development Process
- Analytical Techniques
- What Did We Find?
- What Did We Learn?
- Questions?
Why Prepare Safety Plans for Local Systems?

- **MAP-21**: Requires states to address ALL roads as part of their statewide safety planning effort.

- **Minnesota’s Strategic Highway Safety Plans**: 
  - Identified short and long term crash reduction goals. Are these stretch goals achievable if all safety investments are directed to the state system?
  - Committed to increasing the level of participation by local agencies in Statewide Safety Planning.

- **In Minnesota**: 
  - Toward Zero Deaths was adopted as a long term vision in 2003.
  - In 2009, MnDOT changed the distribution of Highway Safety Improvement Program funds – from virtually all on State highways to a distribution proportional to the number of severe crashes – basically 50% state and 50% local systems.
What are the Key Challenges?

Institutional Inertia

“Our HSIP has ALWAYS been directed to our State system of roads.”

“Our HSIP has bee focused on correcting “Black Spots”, we are unaware of any on the local system.”

“The density of severe crashes on our State System is 2 TIMES higher than on the local system – investments on State System offers a better pay back.”

<table>
<thead>
<tr>
<th></th>
<th>Minnesota</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>State (2-lane)</td>
</tr>
<tr>
<td>Miles</td>
<td>8,760</td>
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<tr>
<td>No. of Severe Injuries</td>
<td>1320</td>
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<tr>
<td>Severe Injury Density</td>
<td>0.15</td>
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Project Champions?

- State Safety Engineer – Sue Groth, Brad Estochen and Derek Leuer
- Local Systems Safety Engineer – Mark Vizecky
- County Engineer’s Safety Committee – Mike Sheehan, Sue Miller, Wayne Sandberg, Kristi Sebastian, Rick West, ....
- FHWA Division Safety Engineer – Dave Kopacz and Will Stein
What is Needed to Start?

1. Understand the concept of PERSPECTIVE – the view from the top looking down (at the entire system) is much different than from the bottom up.

Greater Minnesota Crash Data Overview

Source: MnDOT Crash Data, 2006-2010
Severe is fatal or serious injury crashes (K-A)

Example
- All - %
  - Severe - %

State System
70,889 - 65%
2,080 - 21%

Urban
14,050 - 33%
5,677 - 13%

Net Inters-Related
5,177 - 37%
177 - 5%

Run Off Road - 1,202 (13%)
  - Head On - 306 (7%)
  - Left Turn - 375 (9%)
  - Head On - 333 (13%)

Right Angle - 653 (17%)
  - 157 (23%)

5 Year Crashes
154,132

5/yr (13)
2/yr (12)
1/yr (9)

City, Township, Other
41,658 - 21%
332 - 19%

Rural
22,659 - 52%
1,265 - 55%

Net Inters-Related
5,177 - 37%
145 - 10%

Run Off Road - 1,202 (13%)
  - Head On - 306 (7%)
  - Left Turn - 375 (9%)
  - Head On - 333 (13%)

Right Angle - 653 (17%)
  - 157 (23%)

Cooperative
367,715 - 24%
1,265 - 49%

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5,177 - 37%
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  - 157 (23%)

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Safety Plan Development Process

Key elements of the approach:

- We are the technical analysts:
  - All work is done in the office – no field work.
  - The identified safety projects are suggestions, project development is the responsibility of the counties.
  - MnDOT retains the authority to decide which projects receive the HSIP funds based on consistency with statewide priorities.

Diagram:

1. Crash Analysis
2. Select Safety Emphasis Areas
   - What types of crashes offer the greatest opportunity for reduction?
3. Develop Comprehensive List of Safety Strategies
4. Safety Workshop
5. Identify Safety Projects
   - What parts of your system are the highest priority candidates for safety investment?
6. Identify Short List of Critical Strategies
   - What strategies have been demonstrated to effectively reduce your priority crash types?
7. Safety Plan
### What Crash Types Represent the Greatest Opportunity?

<table>
<thead>
<tr>
<th>Emphasis Area</th>
<th>Statewide Percentage</th>
<th>Greater Minnesota</th>
<th>Metro</th>
<th>City, Twonshp &amp; Other</th>
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<td>Total Fatal and Serious Injury Crashes</td>
<td>19,648</td>
<td>5121</td>
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<td>Young drivers (under 21)</td>
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<td>7% (555)</td>
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<td>7% (157)</td>
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<td>4% (80)</td>
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<td>4% (82)</td>
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<td>Older drivers (over 64)</td>
<td>5%</td>
<td>7% (363)</td>
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<td>4% (95)</td>
<td>5% (145)</td>
<td>4% (89)</td>
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<td>Aggressive driving and speeding-related</td>
<td>7%</td>
<td>7% (365)</td>
<td>8% (390)</td>
<td>9% (192)</td>
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<td>8% (187)</td>
<td>5% (161)</td>
<td>8% (89)</td>
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<td>Drug and alcohol-related</td>
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<td>13% (634)</td>
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<td>10% (230)</td>
<td>8% (221)</td>
<td>9% (182)</td>
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<td>Inattentive, distracted, asleep drivers</td>
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<td>9% (445)</td>
<td>6% (308)</td>
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<td>8% (175)</td>
<td>8% (226)</td>
<td>5% (110)</td>
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<td>Safety awareness</td>
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<tr>
<td>Unbelted vehicle occupants</td>
<td>9%</td>
<td>11% (539)</td>
<td>12% (591)</td>
<td>10% (232)</td>
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<td>8% (188)</td>
<td>6% (163)</td>
<td>5% (107)</td>
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<td>Special Users</td>
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<tr>
<td>Pedestrians crashes</td>
<td>3%</td>
<td>2% (85)</td>
<td>1% (68)</td>
<td>4% (96)</td>
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<tr>
<td></td>
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<td>4% (85)</td>
<td>5% (149)</td>
<td>8% (189)</td>
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<tr>
<td>Bicycle crashes</td>
<td>2%</td>
<td>1% (32)</td>
<td>1% (40)</td>
<td>3% (70)</td>
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<td></td>
<td></td>
<td>1% (18)</td>
<td>3% (85)</td>
<td>4% (92)</td>
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<td>Vehicles</td>
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<tr>
<td>Motorcycles crashes</td>
<td>6%</td>
<td>5% (269)</td>
<td>7% (359)</td>
<td>5% (112)</td>
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<td></td>
<td></td>
<td>6% (132)</td>
<td>7% (195)</td>
<td>7% (140)</td>
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<tr>
<td>Heavy vehicle crashes</td>
<td>4%</td>
<td>7% (333)</td>
<td>3% (138)</td>
<td>2% (46)</td>
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<td></td>
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<td>6% (105)</td>
<td>3% (88)</td>
<td>3% (54)</td>
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<td>Train-vehicle collisions</td>
<td>1%</td>
<td>1% (36)</td>
<td>2% (92)</td>
<td>1% (25)</td>
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<td></td>
<td></td>
<td>1% (32)</td>
<td>1% (29)</td>
<td>1% (22)</td>
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<td>Road departure crashes</td>
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<td>11% (579)</td>
<td>16% (825)</td>
<td>11% (247)</td>
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<td></td>
<td></td>
<td>9% (101)</td>
<td>6% (172)</td>
<td>8% (122)</td>
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<td>Highways</td>
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<td>Consequences of leaving road</td>
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<td>Intersection crashes</td>
<td>16%</td>
<td>15% (745)</td>
<td>12% (552)</td>
<td>15% (343)</td>
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<td></td>
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<td>17% (379)</td>
<td>24% (707)</td>
<td>21% (445)</td>
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<tr>
<td>Head-On and Side-Imp (opposite) crashes</td>
<td>6%</td>
<td>7% (373)</td>
<td>5% (249)</td>
<td>5% (110)</td>
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<tr>
<td></td>
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<td>6% (127)</td>
<td>7% (209)</td>
<td>6% (134)</td>
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<tr>
<td>Work zone crashes</td>
<td>1%</td>
<td>1% (33)</td>
<td>0% (14)</td>
<td>0% (5)</td>
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<tr>
<td></td>
<td></td>
<td>2% (36)</td>
<td>1% (17)</td>
<td>1% (12)</td>
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<td>EMS</td>
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<tr>
<td>Enhancing Emergency Capabilities</td>
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<td>Management</td>
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<tr>
<td>More effective processes</td>
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DPS Crash Data Records, 2006 to 2010
Top 5 Emphasis Areas by Jurisdiction.
Note: Numbers are not additive, as one crash may involve a young driver at an intersection.
The numbers represent severe crashes (Fatal and A-type Injury crashes)
Greater Minnesota Crash Data Overview

Source: MnCMAAT Crash Data, 2006-2010
Severe is fatal and serious injury crashes (K+A).

5 Year Crashes
156,182
4,902

- ATP’s 1, 2, 3, 4, 6, 7, and 8 – ND Metro

State System
70,808 – 45%
2,000 – 41%

CSAH/CR
36,716 – 24%
1,963 – 40%

City, Township, Other
48,658 – 31%
939 – 19%

Urban
14,086 – 38%
337 – 17%

Rural
22,630 – 62%
1,626 – 83%

Not Inter-related
5,177 – 37%
175 – 52%

Inters-related
7,332 – 52%
145 – 43%

Animal
4,009 – 18%
60 – 4%

Unknown/Other
1,276 – 7%
61 – 4%

Not Animal
18,616 – 82%
1,866 – 96%

Run off Road – 1,202 (23%), 69 (39%)
Head On – 366 (7%), 27 (15%)
“Other” – 540 (10%), 25 (14%)
Rear End – 1,336 (26%), 17 (10%)

Other/Unknown
2,600 – 47%
228 – 49%

Signalized
209 – 4%
4 – 1%

All Way Stop
164 – 3%
15 – 3%

2,511 – 46%
216 – 47%

Thru-Stop
751 – 6%
132 – 13%

Run off Road – 7,891 (67%)
675 – 65%

On Curve
3,222 – 40%
339 – 50%

Right Angle – 849 (34%), 127 (56%)
“Other” – 464 (18%), 33 (15%)
Run off Road – 342 (14%), 21 (10%)
Left Turn – 184 (7%), 10 (5%)
Metro County Crash Data Overview

Source: MnCMAT Crash Data, 2006-2010
Severe is fatal and serious injury crashes (K+A).

5 Year Crashes Metro
214,139
3,157

State System
83,784 – 39%
924 – 29%

CSAH/CR
68,322 – 32%
1,339 – 42%

City, Twrshp, Other
62,033 – 29%
894 – 28%

Urban
65,433 – 96%
1,171 – 17%

Ped/Bike
2,486 – 4%
225 – 19%

Ped
1,076 – 43%
145 – 64%

Int
767 – 71%
93 – 64%

Signal
536 – 70%
51 – 55%

Rural
2,848 – 4%
164 – 12%

Animal
483 – 17%
6 – 4%

Not Animal
2,364 – 83%
158 – 96%

Inters-Related
924 – 39%
61 – 39%

Unknown/Other
264 – 11%
5 – 3%

Not Inters-Related
1,176 – 50%
92 – 58%

Run Off Road – 2,264 (15%), 77 (27%)
Rear End – 5,575 (36%), 62 (21%)
Head On – 1,097 (7%), 61 (21%)
“Other” – 1,262 (8%), 29 (10%)
Right Angle – 1,619 (10%), 24 (8%)

Signalized
23,077 – 61%
277 – 49%

All Way Stop
1,376 – 4%
23 – 4%

Thru-Stop
7,344 – 19%
156 – 27%

Other/Unknown
6,241 – 16%
113 – 20%

Run Off Road – 81 (32%), 6 (25%)
Head On/SS Opp – 19 (7%), 4 (17%)
Right Angle – 20 (8%), 3 (13%)

On Curve
34 – 37%
4 – 25%

Run off Road
719 – 61%
56 – 61%

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What Strategies have been PROVEN Effective?

- **NCHRP Report 500**
  - A series of guides to assist state and local agencies in reducing injuries and fatalities in targeted emphasis areas
  - The guides correspond to the emphasis areas outlined in the AASHTO Strategic Highway Safety Plan.
  - Each guide includes a brief introduction, a general description of the problem, the strategies/countermeasures to address the problem, and a model implementation process.
Example – Typical Run-Off Road Strategies

Lane Departure Crashes

Key Objectives: Keep Vehicles in Their Lane

Key Strategies:
- Improved curve delineation
- Improved lane markings

Key Objectives: Improve Shoulders

Key Strategies:
- Safety edge
- Paved shoulders
- Shoulder rumble strips

Rumble Strip
Without Safety Edge
With Safety Edge
Example – Typical Intersection Strategies

Included Strategies:

- Change Intersection Type
- Street Lighting
- Dynamic Warning Signs
- Indirect Turns
- Enhanced Signing and Delineation
- Adequate Sight Distance
- Inadequate Sight Distance

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Example – Signalized Intersection Strategies

Countdown Timers and Advanced Pedestrian Intervals

Confirmation Red-Light Running Lights
What parts of the System are high priority candidates for safety investment?

- **Reactive Approach** — Identifying Black Spot locations with multiple severe crashes in the 5-year study period. We found 18 of these for rural thru-stop intersections in the 80 rural counties – supports the need for a new method of identifying candidates for safety investment.

- **The Systemic Approach** — Developed a new approach using crash surrogates to identify the at-risk locations across each county’s system of highways that are the priority candidates for safety investment.

The key questions:

- Is every element (mile of rural road, curve or intersection) of the county system equally at risk?
- Where to Start?

**Old Approach**
Crashes = Risk & No Crashes = No Risk

**New Approach**
No Crashes ≠ No Risk

Use surrogates of crashes (roadway and traffic characteristics) to identify risk and prioritize – the 5 🗼 (or 6) Ranking System
Roadway Characteristics Associated with Severe Crashes – Paved vs. Gravel

- Gravel roads make up approximately 44% of Minnesota’s 45,000 mile County Highway system.
- Almost one-half of Minnesota’s counties have NO fatal crashes on their gravel roads and only ONE county averages one fatal crash per year.
- Severe RD Crash Density
  - Gravel Roads: 0.001 crashes/mi/year
  - Paved Roads: 0.006 crashes/mi/year

- Statewide, 94% of crashes and 88% of severe crashes occur on the 56% of the county system that is paved.

- Gravel roads were removed from further detailed analysis.
The Systemic Approach: Risk Rating Criteria for Rural Paved Roads

Rural Segments:
- Density of Road Departure
- Traffic Volume
- Critical Curve Radius Density
- Access Density
- Edge Risk Assessment

Curves:
- ADT Range
- Radius Range
- Severe Crash on curve
- Intersection on curve
- Visual Trap on curve

Urban Signalized Intersections – Pedestrian Analysis:
- Major Approach Speed
- Traffic Volume
- Number of Approach Lanes
- Bus Stop Presence
- Pedestrian Generator
- On-Street Parking
- Crash History

Intersections:
- Skewed approaches
- On/near curve Volume
- Proximity to railroad crossing
- Proximity to last STOP sign
- Intersection related crashes
- Commercial Development in quadrant

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Risk Assessment Findings – Rural Road Segments

- 21,700 miles of paved roads evaluated
- 1,056 severe road departure crashes
- 0.009 crashes/mile/year

High Priority Segments have HIGHER crash density.

Higher levels of access density are associated with MORE and MORE SEVERE crashes.
Risk Assessment Findings – Rural Curves

- 19,730 curves evaluated
- 482 severe curve crashes
  - 95% of curves had NO severe crashes
  - 2% of curves had ONE severe crash
  - No Dead Man’s Curve – no curve averaged one severe crash per year
  - 0.005 severe crashes/curve/year

High Priority Curves have HIGHER crash density.
Severe Road Departure Crashes are overrepresented in curves with radii between 500 and 1,200 feet.
Risk Assessment Findings – Rural Intersections

- 12,690 intersections evaluated
- 470 severe crashes, 317 severe right angle crashes
  - 95% of intersections had NO severe crashes
  - 4% of intersections had ONE severe crash
  - No intersection averaged ONE severe crash/year
  - 0.005 severe crashes/intersection/year

<table>
<thead>
<tr>
<th>Rank</th>
<th>Int #</th>
<th>Sys</th>
<th>Sys #</th>
<th>Intersection Description</th>
<th>Skew</th>
<th>On/Near Curve</th>
<th>Development</th>
<th>RR Xing</th>
<th>Previous STOP (&gt;5mi)</th>
<th>RA Crashes</th>
<th>Ratio (Min/Maj)</th>
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<td>1</td>
<td>12.06</td>
<td>CSAH</td>
<td>12</td>
<td>CSAH 12 AND BOUTWELL RD N MSAS-122</td>
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</tbody>
</table>

Risk factor was present

Crashes per Intersection

<table>
<thead>
<tr>
<th>RR Crossing</th>
<th>Development</th>
<th>Skew</th>
<th>On/Near Curve</th>
<th>Greater than 5 mi. to Previous Stop</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.07</td>
<td>0.06</td>
<td>0.07</td>
<td>0.06</td>
<td>0.09</td>
</tr>
</tbody>
</table>

Intersection Risk Factors

05/22/13
Suggested Projects –
HSIP Application Sheets

Intersections

Segments

Urban Corridors
# Suggested Projects

## Rural Segment Project Summary (measured in miles)

<table>
<thead>
<tr>
<th>2' Shoulder Pave+RS +Safety Wedge</th>
<th>2' Shoulder Pave+RS Rumble Strip</th>
<th>Rumble StripE</th>
<th>6-inch Edge Lines</th>
<th>Ground In Wet-Reflective Markings</th>
<th>4' Buffer</th>
<th>12' Painted Median</th>
<th>Total Project Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(miles)</td>
<td>(miles)</td>
<td>(miles)</td>
<td>(miles)</td>
<td>(miles)</td>
<td>(miles)</td>
<td>(miles)</td>
<td>$101,553,800</td>
</tr>
<tr>
<td>1,135</td>
<td>1,514</td>
<td>3,816</td>
<td>1,645</td>
<td>2,163</td>
<td>39</td>
<td>23</td>
<td></td>
</tr>
</tbody>
</table>

## Rural Curve Project Summary (number of curves)

<table>
<thead>
<tr>
<th>Total</th>
<th>Currently Installed Chevrons</th>
<th>«Ranking»</th>
<th>Proximity</th>
<th>HP Seg + Crit Rad</th>
<th>Total Project Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>19,829</td>
<td>3,238</td>
<td>2,836</td>
<td>3,505</td>
<td>4,068</td>
<td>$78,174,000</td>
</tr>
</tbody>
</table>

## Rural Intersection Project Summary (number of intersections)

<table>
<thead>
<tr>
<th>Roundabout</th>
<th>All-Way STOP</th>
<th>Directional Median</th>
<th>Dynamic Warning Sign</th>
<th>Street Lights</th>
<th>Upgraded Signs &amp;/or Markings</th>
<th>Review Signs &amp; CST</th>
<th>Total Project Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>55</td>
<td>189</td>
<td>1,692</td>
<td>3,287</td>
<td>258</td>
<td>$38,108,000</td>
</tr>
</tbody>
</table>

## Urban Project Summary

<table>
<thead>
<tr>
<th>Confirmation Lights</th>
<th>Access Management (miles)</th>
<th>Countdown Timers/Advanced Walk</th>
<th>Curb Extensions</th>
<th>Medians</th>
<th>Sidewalks</th>
<th>3-Lane Conversion (miles)</th>
<th>5-Lane Conversion (miles)</th>
<th>Total Project Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>435</td>
<td>35.3</td>
<td>321</td>
<td>50</td>
<td>15</td>
<td>3</td>
<td>53.3</td>
<td>8.4</td>
<td>$18,403,709</td>
</tr>
</tbody>
</table>
# Proactive Project Summary

<table>
<thead>
<tr>
<th></th>
<th>Segments</th>
<th>Curves</th>
<th>Intersections</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RURAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATP 1 Total</td>
<td>$9,834,459</td>
<td>$11,060,829</td>
<td>$5,029,100</td>
<td>$25,924,338</td>
</tr>
<tr>
<td>ATP 2 Total</td>
<td>$9,007,632</td>
<td>$5,197,441</td>
<td>$4,828,100</td>
<td>$19,033,173</td>
</tr>
<tr>
<td>ATP 3 Total</td>
<td>$16,106,107</td>
<td>$19,794,813</td>
<td>$7,972,400</td>
<td>$43,873,320</td>
</tr>
<tr>
<td>ATP 4 Total</td>
<td>$10,008,015</td>
<td>$9,749,702</td>
<td>$4,553,100</td>
<td>$24,310,817</td>
</tr>
<tr>
<td>ATP 6 Total</td>
<td>$10,889,554</td>
<td>$16,897,132</td>
<td>$3,013,650</td>
<td>$30,800,336</td>
</tr>
<tr>
<td>ATP 7 Total</td>
<td>$14,875,107</td>
<td>$7,085,797</td>
<td>$5,108,450</td>
<td>$27,069,354</td>
</tr>
<tr>
<td>ATP 8 Total</td>
<td>$8,014,553</td>
<td>$4,838,190</td>
<td>$4,764,050</td>
<td>$17,616,793</td>
</tr>
<tr>
<td>ATP Metro</td>
<td>$22,818,381</td>
<td>$3550,087</td>
<td>$2,839,150</td>
<td>$29,207,618</td>
</tr>
<tr>
<td>Statewide Rural County Roads Total</td>
<td>$101,553,808</td>
<td>$78,173,991</td>
<td>$38,108,000</td>
<td>$217,835,799</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Right Angle Corridors</th>
<th>Pedestrian Corridors</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>URBAN</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATP Metro</td>
<td>$3,444,709</td>
<td>$11,036,000</td>
<td>$3,923,000</td>
<td>$18,403,709</td>
</tr>
</tbody>
</table>

**TOTAL = $236M**
What Did We Learn?

- Conducting a system-wide risk assessment using surrogates for crashes DOES work.
- The high priority segments, curves and intersections had higher crash densities.
- Benefits of Proactive Approach – don’t have to wait for the “phone call”
- Having a Safety Plan with identified project does NOT save lives or reduce crashes - IMPLEMENTATION is required.
- To date MnDOT has programmed over $33 million of HSIP funds to support implementation on Minnesota County Roadways.
  - Edge Enhancements - $19.5M
  - Curve Enhancements - $8M
  - Intersection Improvements - $5.6M

THANK YOU – MnDOT, Project Team, County Engineers
Questions?