MnDOT’s City Safety Pilot Project

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CH2M HILL, Inc.
MnDOT’s City Safety Pilot Project

➤ Agenda

• Background
• Crash Overview
  – State
  – St. Paul
  – Eagan
  – Metro Area
• Safety Practices
  – Curb Extensions & Medians
  – Road Diets
  – HAWK’s & RRFB’s
  – Sidewalks
  – Intersections: Red Light Enforcement
• Wrap Up
• Q & A
Background (Overview of Minnesota’s SHSP & Statewide Priorities – Fatal + Serious Injury, All Roads, Emphasis Areas & 4E’s)

SHSP Highlights

- A short-term safety goal is to have 300 or fewer fatalities and 850 or fewer serious injuries by 2020.
- It adopts a long-term goal of ZERO fatalities and identifies changing the safety culture as a fundamental safety focus area.
- The SHSP notes that traffic fatalities have decreased by 40% during the past 10 years and attributes much of that success to the formation of Minnesota’s Toward Zero Deaths program.
- The SHSP adopts severe crashes – those involving fatalities and incapacitating injuries as the safety performance measure in Minnesota.
- 4E’s – Engagement, Enforcement, Education and Engineering
## Safety Overview – Statewide Crash Numbers

<table>
<thead>
<tr>
<th></th>
<th>Total Severe Crashes</th>
<th>Unbelted</th>
<th>Impaired</th>
<th>Inattentive</th>
<th>Speeding</th>
<th>Lane Departure</th>
<th>Intersection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Statewide</strong></td>
<td>7,036</td>
<td>2,463</td>
<td>1,850</td>
<td>1,319</td>
<td>1,309</td>
<td>3,199</td>
<td>2,945</td>
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<tr>
<td><strong>Greater Minnesota Districts (2008-2012 Severe Crashes)</strong></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>State Trunk Highway</td>
<td>1,813</td>
<td>666</td>
<td>414</td>
<td>430</td>
<td>326</td>
<td>919</td>
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<td>County Roads</td>
<td>1,699</td>
<td>743</td>
<td>580</td>
<td>309</td>
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<td>435</td>
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<td>150</td>
<td>116</td>
<td>24</td>
<td>73</td>
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<tr>
<td>Other</td>
<td>17</td>
<td>3</td>
<td>9</td>
<td>1</td>
<td>4</td>
<td>9</td>
<td>2</td>
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<tr>
<td><strong>Greater Minnesota Total</strong></td>
<td>4,242</td>
<td>1,703</td>
<td>1,218</td>
<td>834</td>
<td>832</td>
<td>2,266</td>
<td>1,519</td>
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<tr>
<td><strong>Metro District (2008-2012 Severe Crashes)</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>State Trunk Highway</td>
<td>831</td>
<td>242</td>
<td>216</td>
<td>179</td>
<td>172</td>
<td>295</td>
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<td>County Roads</td>
<td>1,148</td>
<td>285</td>
<td>223</td>
<td>200</td>
<td>151</td>
<td>386</td>
<td>668</td>
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<tr>
<td>City</td>
<td>786</td>
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<td>106</td>
<td>148</td>
<td>237</td>
<td>391</td>
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<td>Township</td>
<td>22</td>
<td>11</td>
<td>10</td>
<td>0</td>
<td>5</td>
<td>11</td>
<td>6</td>
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<tr>
<td>Other</td>
<td>7</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>1</td>
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<tr>
<td><strong>Metro District Total</strong></td>
<td>2,794</td>
<td>760</td>
<td>632</td>
<td>485</td>
<td>477</td>
<td>933</td>
<td>1,426</td>
</tr>
</tbody>
</table>

*2014-2019 Minnesota Strategic Highway Safety Plan, Data 2008-2012*
Saint Paul City Crash Data Overview

Source: MnCMAT Crash Data, 2009-2013
-- Severe = Fatal + A-injury crashes.

### Ramsey County

- Total Crashes: 51,990
- Severe Crashes: 448
- Within City Limits:
  - Total: 31,357 (60%)
  - Severe: 283 (63%)

### County Roads

- Total Crashes: 8,453 (27%)
- Severe Crashes: 101 (36%)

### State Highways

- Total Crashes: 10,976 (35%)
- Severe Crashes: 70 (25%)

### Municipal Streets

- Total Crashes: 11,734 (37%)
- Severe Crashes: 109 (39%)

### Example

All – %
Severe – %

- State Highways: 10,976 – 35%
  - 70 – 25%
- County Roads: 8,453 – 27%
  - 101 – 36%
- Municipal Streets: 11,734 – 37%
  - 109 – 39%

### Example - Crashes

#### Ped/Bike

- 97 (3%), 11 (55%)
- Signalized: 471 – %
  - 2 – %
- All Stop: 286 – 9%
  - 4 – 13%
- Stop / Yield: 1,729 – 54%
  - 19 – 61%

#### Ped/Bike – 15 (3%), 5 (71%)

- Right Angle: 15 (3%)
  - 916 (53%), 10 (53%)
  - Left Turn: 70 (4%), 2 (11%)
  - Head On: 125 (7%), 1 (5%)

#### Ped/Bike – 67 (6%), 8 (73%)

- Right Angle: 15 (3%)
  - 916 (53%), 10 (53%)
  - Left Turn: 70 (4%), 2 (11%)
  - Head On: 125 (7%), 1 (5%)
Metro Counties MSP City Crash Data Overview

Source: MnCMAT Crash Data, 2009-2013
-- Severe = Fatal + A-injury crashes.

Example
All – %
Severe – %

MINNEAPOLIS & SAINT PAUL ONLY

Seven Metro Counties
214,027
2,604

Within MSP City Limits
79,261 – 37%
781 – 30%

State Highways
23,696 – 30%
166 – 21%

County Roads
21,259 – 27%
275 – 35%

Municipal Streets
33,608 – 42%
333 – 43%

Example
All – %
Severe – %

Intersection
8,026 – 48%
94 – 56%

Segment
7,658 – 46%
68 – 41%

Ped/Bike – 338 (5%), 31 (48%)
Head On – 669 (9%), 22 (34%)
Right Angle – 572 (8%), 14 (22%)
Run Off Road – 382 (5%), 9 (14%)

Intersection
4,013 – 71%
51 – 73%

Ped/Bike – 77 (6%), 10 (59%)
Rear End – 408 (31%), 5 (29%)
SS Pass – 376 (29%), 2 (12%)

Segment
1,419 – 25%
18 – 26%

Ped/Bike – 261 (10%), 17 (55%)
Right Angle – 1,013 (38%), 7 (23%)
SS Pass – 276 (7%), 6 (12%)
Left Turn – 320 (12%), 5 (16%)
Head On – 127 (5%), 3 (10%)
Head On – 127 (5%), 3 (10%)

Signalized
1,609 – 21%
17 – 18%

Stop / Yield
4,100 – 52%
49 – 53%

Ped/Bike – 303 (7%), 23 (47%)
Right Angle – 2,270 (55%), 23 (47%)
SS Pass – 276 (7%), 6 (12%)
Head On – 268 (7%), 5 (10%)

Intersection
299 – 64%
5 – 71%

Ped/Bike – 149 (8%), 11 (55%)
Right Angle – 865 (45%), 9 (45%)
SS Pass – 331 (17%), 3 (15%)
Left Turn – 320 (12%), 5 (16%)
Head On – 39 (2%), 2 (10%)

One Way Street
4,324 – 13%
47 – 14%

Signalized
2,668 – 71%
31 – 66%

Ped/Bike – 149 (8%), 11 (55%)
Right Angle – 865 (45%), 9 (45%)
SS Pass – 331 (17%), 3 (15%)
Left Turn – 320 (12%), 5 (16%)
Head On – 39 (2%), 2 (10%)

MINNEAPOLIS & SAINT PAUL ONLY

5/22/2015
Saint Paul (and MSP) Severe Crash Diagrams

**Saint Paul Severe Crashes (283)**

- **Right Angle:** 78 (28%)
- **"Other":** 48 (17%)
- **Head On:** 42 (15%)
- **Run Off Road:** 27 (10%)
- **Rear End:** 26 (9%)
- **Left Turn:** 26 (9%)
- **SS Pass:** 14 (5%)
- **N/A:** 7 (2%)
- **Right Turn:** 5 (2%)
- **Unknown:** 5 (2%)
- **SS Opp:** 3 (1%)
- **Not Coded:** 2 (1%)
- **Ped:** 84 (30%)
- **Bike:** 27 (10%)

**Minneapolis / Saint Paul Severe Crashes (781)**

- **Right Angle:** 201 (26%)
- **"Other":** 122 (16%)
- **Head On:** 125 (16%)
- **Run Off Road:** 67 (9%)
- **Rear End:** 98 (13%)
- **Left Turn:** 58 (7%)
- **SS Pass:** 54 (7%)
- **N/A:** 19 (2%)
- **Right Turn:** 14 (2%)
- **Unknown:** 9 (1%)
- **SS Opp:** 7 (1%)
- **Not Coded:** 7 (1%)
- **Ped:** 214 (27%)
- **Bike:** 91 (12%)

*Source: MnCMAT Crash Data, 2009-2013 -- Severe = Fatal + A-injury crashes.*
Saint Paul (and MSP) Severe Ped / Bike Crashes

StP Ped/Bike (111) by Relation to Int

MSP Ped/Bike (305) by Relation to Int

StP Ped / Bike (111) by Road Type

MSP Ped / Bike (305) by Road Type

StP Ped / Bike (111) by Speed Limit

MSP Ped / Bike (305) by Speed Limit

Source: MnCMAT Crash Data, 2009-2013
-- Severe = Fatal + A-injury crashes.
Saint Paul (and MSP) Severe Ped / Bike Crashes @ Ints

Saint Paul Ped Bike @ Ints (69) by Traffic Control

- Signal: 54%
- Stop / Yield: 25%
- All-Way Stop: 4%
- Not Applicable: 17%

Source: MnCMAT Crash Data, 2009-2013

Minneapolis / Saint Paul Ped Bike @ Ints (201) by Traffic Control

- Signal: 60%
- Stop / Yield: 24%
- All-Way Stop: 3%
- Not Applicable: 13%

Source: MnCMAT Crash Data, 2009-2013

-- Severe = Fatal + A-injury crashes.
Saint Paul (and MSP) Severe Right Angle Crashes

StP Right Angle (78) by Relation to Int
- Intersections: 83%
- Segment: 13%
- Alley / School / RR / Trail Xing: 4%

MSP Right Angle (201) by Relation to Int
- Intersections: 77%
- Segment: 15%
- Other / Unknown / NA: 5%
- Alley / School / RR / Trail Xing: 2%

StP Right Angle (78) by Road Type
- Freeway: 3%
- 2-lane Undivided: 29%
- 4-6-lane Undivided: 42%
- Other / Unknown / NA: 3%

MSP Right Angle (201) by Road Type
- Freeway: 1%
- One Way Street: 12%
- 2-lane Undivided: 32%
- Other / Unknown / NA: 10%

StP Right Angle (78) by Speed Limit
- <30: 1%
- 30: 87%
- 40: 1%
- 55: 45%

MSP Right Angle (201) by Speed Limit
- <30: 1%
- 30: 88%
- 40: 1%
- 55: 45%
- Other / Unknown / NA: 2%

Source: MnCMAT Crash Data, 2009-2013
-- Severe = Fatal + A-injury crashes.
Saint Paul (and MSP) Severe Right Angle Crashes @ Ints

Saint Paul Right Angle @ (65) Ints by Traffic Control
- Signal 48%
- Stop / Yield 37%
- All-Way Stop 6%
- Not Applicable 9%

Minneapolis / Saint Paul Right Angle @ Ints (154) by Traffic Control
- Signal 48%
- Stop / Yield 37%
- All-Way Stop 6%
- Not Applicable 9%

Source: MnCMAT Crash Data, 2009-2013
-- Severe = Fatal + A-injury crashes.

5/22/2015
MnCMAT Crash Data, 2009-2013
-- Severe = Fatal + A-injury crashes.

Example
All – %
Severe – %

Dakota County
23,349
374

Within City Limits
4,034 – 17%
49 – 13%

State Highways
1,434 – 36%
18 – 37%

County Roads
1,774 – 44%
25 – 51%

Municipal Streets
819 – 20%
6 – 12%

2-Lane Undivided
495 – 60%
4 – 67%

3-Lane Undivided
13 – 2%
0 – 0%

4-6 Lane Undivided
164 – 20%
1 – 17%

Segment
178 – 36%
0 – 0%

Intersection
275 – 56%
3 – 75%

Segment
27 – 16%
0 – 0%

Intersection
123 – 75%
0 – 0%

Segment
27 – 16%
0 – 0%

Intersection
59 – 88%
0 – 0%

Intersection
36 – 45%
1 – 100%

<35 mph
95 – 53%
0 – 0%

35 – 45 mph
82 – 46%
0 – 0%

<35 mph
96 – 35%
1 – 33%

35 – 45 mph
177 – 64%
2 – 67%

35 – 45 mph
94 – 76%
0 – 0%

>45 mph
9 – 7%
1 – 100%

35 – 45 mph
45 – 76%
0 – 0%

<35 mph
8 – 22%
1 – 100%

35 – 45 mph
94 – 76%
0 – 0%

35 – 45 mph
45 – 76%
0 – 0%

<35 mph
8 – 22%
1 – 100%

Ped/Bike – 1 (1%), 0 (0%)
________________________________________
Rear End – 23 (24%), 0 (0%)
Run Off Road – 13 (14%), 0 (0%)
Head On – 11 (12%), 0 (0%)

Ped/Bike – 3 (%), 0 (0%)
________________________________________
Right Angle – 31 (35%), 1 (100%)
Left Turn – 17 (19%), 0 (0%)
Rear End – 16 (18%), 0 (0%)

Ped/Bike – 1 (2%), 0 (0%)
________________________________________
Rear End – 24 (48%), 0 (0%)
Right Angle – 8 (16%), 0 (0%)
Left Turn – 4 (8%), 0 (0%)

Ped/Bike – 1 (4%), 0 (0%)
________________________________________
Rear End – 7 (27%), 0 (0%)
Left Turn – 6 (23%), 0 (0%)
Right Angle – 4 (15%), 0 (0%)

5/20/2015
**Metro Counties Suburb Crash Data Overview**

*Source: MnCMAT Crash Data, 2009-2013*  
-- Severe = Fatal + A-injury crashes.

**Example**  
All – %  
Severe – %

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**MINNEAPOLIS & SAINT PAUL REMOVED**

**Seven Metro Counties**

- **214,027**  
- **2,604**

**Within Suburb City Limits**

- **127,329** – **59%**  
- **1,616** – **62%**

**State Highways**

- 55,338 – 43%  
- 523 – 32%

**County Roads**

- 41,269 – 32%  
- 692 – 43%

**County Roads**

- 15,858 – 53%  
- 245 – 63%

**3 or 5 Lane Undivided**

- 499 – 2%  
- 8 – 2%

**4-6 Lane Undivided**

- 6,689 – 22%  
- 74 – 19%

**Other Divided Highway**

- 2,154 – 7%  
- 29 – 7%

**Alley / Driveway / Private**

- 293 – 1%  
- 4 – 1%

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**Within Suburb City Limits**

**State Highways**

- 8,068 – 51%  
- 89 – 36%

**Segment**

- 6,674 – 42%  
- 137 – 56%

**Intersection**

- 5,234 – 78%  
- 43 – 58%

**Ped/Bike – 171 (3%), 22 (22%)**

**Run Off Road – 939 (18%), 35 (35%)**

**Head On – 499 (9%), 18 (18%)**

**Rear End – 1,117 (21%), 12 (12%)**

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**Segment**

- 1,133 – 17%  
- 23 – 31%

**Intersection**

- 5,234 – 78%  
- 43 – 58%

**Ped/Bike – 12 (2%), 3 (18%)**

**Stop / Yield**

- 2,901 – 47%  
- 27 – 41%

**Ped/Bike – 54 (3%), 2 (13%)**

**Ped/Bike – 18 (3%), 2 (18%)**

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**Intersection**

- 1,734 – 81%  
- 24 – 83%

**Signalized**

- 1,685 – 54%  
- 16 – 52%

---

**<35 mph**

- 5,335 – 80%  
- 101 – 74%

**35 - 45 mph**

- 1,065 – 16%  
- 18 – 13%

---

**<35 mph**

- 6,159 – 76%  
- 66 – 74%

**<35 mph**

- 464 – 41%  
- 6 – 26%

**<35 mph**

- 1,903 – 36%  
- 9 – 21%

**<35 mph**

- 464 – 41%  
- 6 – 26%

---

**<35 mph**

- 6,30 – 24%  
- 6 – 24%

**35 - 45 mph**

- 312 – 60%  
- 31 – 72%

---

**<35 mph**

- 1,903 – 36%  
- 9 – 21%

**35 - 45 mph**

- 3,128 – 60%  
- 31 – 72%

**<35 mph**

- 1,903 – 36%  
- 9 – 21%

---

**Ped/Bike – 159 (6%), 7 (26%)**

**Right Angle – 1,453 (50%), 13 (48%)**

**Head On – 132 (5%), 2 (7%)**

**Left Turn – 279 (17%), 5 (31%)**

**Rear End – 371 (13%), 1 (4%)**

---

**Ped/Bike – 54 (3%), 2 (13%)**

**Right Angle – 445 (26%), 5 (31%)**

**Left Turn – 279 (17%), 5 (31%)**

**Head On – 84 (5%), 2 (13%)**

---

**Ped/Bike – 18 (3%), 2 (18%)**

**Right Angle – 178 (25%), 5 (45%)**

**Rear End – 276 (38%), 2 (18%)**

**Head On – 29 (4%), 2 (18%)**

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5/20/2015
Pedestrian Safety Practices
– Curb Extensions and Medians

Highlights
- Pedestrian strategies that have proven to be effective include the following:
  - Overpass (in order to be effective, crossing the roadway at-grade must be physically prevented)
  - Street Lighting
  - Refuge/Median Islands – Reduces vehicle speeds at pedestrian crossing locations or intersections.
  - Curb Extensions – Reduces potential vehicle conflicts by reducing pedestrian crossing distance and time, and improves lines of sight.
  - Sidewalks
  - Road Diets (converting four-lane undivided roads to a three-lane cross-section) – Eliminates the multi-vehicle threat that can occur on four-lane roads.
Safety Practices – Peds (Curb Extensions & Median Refuge Islands)

- One study found a 39 to 46 percent reduction in pedestrian-vehicle crashes at unsignalized crosswalks on multi-lane roads (Zegeer et al., 2002).
- They shorten the crossing distance for pedestrians, reduce the speeds of turning vehicles, and improve the sight distance between motorists and crossing pedestrians.

<table>
<thead>
<tr>
<th>Strategies</th>
<th>Pages</th>
<th>Crash Reduction/ Crash Features</th>
<th>Proven/Tried/ Experimental</th>
<th>Operational Effects (Mobility)</th>
<th>Candidate Locations</th>
<th>Design Features</th>
<th>Construction Costs</th>
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</thead>
<tbody>
<tr>
<td>Sidewalks</td>
<td>1-2</td>
<td>50 to 90% reduction in “walking in roadway” pedestrian crashes</td>
<td>Proven</td>
<td>N/A</td>
<td>Urban arterials &amp; collectors</td>
<td>Curb ramps, cross slope, buffer zones</td>
<td>$4 to $5 per square foot</td>
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<tr>
<td>Crosswalks and Crosswalk Enhancements</td>
<td>3-8</td>
<td>Varies</td>
<td>Proven/Tried</td>
<td>N/A</td>
<td>Intersections</td>
<td>Should be part of package including crosswalk enhancements</td>
<td>$200 per crosswalk</td>
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<tr>
<td>Medians and Crossing Islands</td>
<td>9-10</td>
<td>39 to 46%</td>
<td>Proven</td>
<td>May provide operational benefits</td>
<td>Wide 2-lane roads and multi-lane roadways</td>
<td>4 to 8 feet wide</td>
<td>$15,000 to $30,000 per 100 feet</td>
</tr>
<tr>
<td>Curb Extensions</td>
<td>11-12</td>
<td>39 to 46%</td>
<td>Proven</td>
<td>Potential reduction in speeds</td>
<td>Urban arterials and collectors with curb parking</td>
<td>Roadway with parking or shoulder</td>
<td>$5,000-$10,000 per extension</td>
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<tr>
<td>Pedestrian Hybrid Beacon System</td>
<td>13-15</td>
<td>60%</td>
<td>Tried</td>
<td>Additional delay for vehicles stopping for pedestrians</td>
<td>Mid-Block Crosswalk locations — Not at intersections</td>
<td>Pedestrian activated</td>
<td>$80,000</td>
</tr>
<tr>
<td>Rectangular Rapid Flashing Beacon</td>
<td>16-17</td>
<td>76 to 100% yield to pedestrian rate</td>
<td>Tried</td>
<td>Additional delay for vehicles stopping for pedestrians</td>
<td>Mid-Block Crosswalk</td>
<td>Passive or active pedestrian activation</td>
<td>$10K to $15K</td>
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<tr>
<td>Crosswalk Lighting</td>
<td>18-19</td>
<td>33 to 44%</td>
<td>Proven</td>
<td>N/A</td>
<td>Isolated crosswalks not along a continuously lit roadway</td>
<td>Require a power source</td>
<td>$10k to $25K per intersection</td>
</tr>
<tr>
<td>Traffic Signals</td>
<td>20-22</td>
<td>Leading Pedestrian Interval — 60%</td>
<td>Tried</td>
<td>Increases delay and reduces mobility of major roadway</td>
<td>Intersections that meet signal warrants</td>
<td>Short cycle lengths, countdown timers, easy accessibility</td>
<td>New Signal – $175,000 to more than $300,000 per intersection</td>
</tr>
</tbody>
</table>
Safety Practices – Peds (Road Diets)

- Road Diets have shown a 29 percent reduction in all roadway crashes.
- The addition of left turn lanes provides a place for both motorists and bicyclists to make left turns, thus reducing the incidence of left-turn, rear-end crashes.
- Improves visibility for left-turning vehicles.

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<th>Operational Effects (Mobility)</th>
<th>Candidate Locations</th>
<th>Design Features</th>
<th>Construction Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road Diet</td>
<td>29-31</td>
<td>30% all crashes (benefits to pedestrians)</td>
<td>Proven/Tried</td>
<td>Potential speed reduction</td>
<td>4-lane undivided roadways with ADT &lt;20,000</td>
<td>Variations of distribution of cross section available</td>
<td>$16,000 per mile for restriping</td>
</tr>
<tr>
<td>On-Road Bicycle Lane</td>
<td>32-34</td>
<td>-30% to +13%</td>
<td>Tried</td>
<td>NA</td>
<td>Urban and suburban</td>
<td>4 to 8 feet wide</td>
<td>$16,000 per mile for restriping</td>
</tr>
<tr>
<td>Shared (Paved) Shoulder Bicycle Lane</td>
<td>35-37</td>
<td>NA</td>
<td>Tried</td>
<td>NA</td>
<td>Rural roadways</td>
<td>4 to 10 feet wide</td>
<td>$60,000 per mile for 4-foot shoulders</td>
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<tr>
<td>Bicycle Boulevards</td>
<td>38–40</td>
<td>60%</td>
<td>Tried</td>
<td>Reduces conflict with vehicles on parallel arterial</td>
<td>Local streets</td>
<td>Traffic-calming features often used</td>
<td>Minimal — Signs and Markings</td>
</tr>
<tr>
<td>Bicycle Boxes</td>
<td>41–42</td>
<td>NA</td>
<td>Experimental</td>
<td>NA</td>
<td>Signalized intersections</td>
<td>14-foot-wide rectangle</td>
<td>$1,000 per box (see page 7 for information on pavement marking life cycles)</td>
</tr>
</tbody>
</table>
### Safety Practices – Peds (HAWK’s & RRFB’s)

- A RRFB study in Florida found that drivers were yielding or slowing down further in advance of the crosswalk with RRFB than with standard round yellow flashing beacons.
- The purpose of the RRFB is to increase driver awareness of crosswalks that are not across approaches controlled by YIELD signs, STOP signs, or traffic control signals.

#### Pedestrian Safety Strategies

<table>
<thead>
<tr>
<th>Strategies</th>
<th>Pages</th>
<th>Crash Reduction/ Crash Features</th>
<th>Proven/Tried/Experimental</th>
<th>Operational Effects (Mobility)</th>
<th>Candidate Locations</th>
<th>Design Features</th>
<th>Construction Costs</th>
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<tbody>
<tr>
<td>Sidewalks</td>
<td>1-2</td>
<td>50 to 90% reduction in “walking in roadway” pedestrian crashes</td>
<td>Proven</td>
<td>N/A</td>
<td>Urban arterials &amp; collectors</td>
<td>Curb ramps, cross slope, buffer zones</td>
<td>$4 to $5 per square foot</td>
</tr>
<tr>
<td>Crosswalks and Crosswalk Enhancements</td>
<td>3-8</td>
<td>Varies</td>
<td>Proven/Tried</td>
<td>N/A</td>
<td>Intersections</td>
<td>Should be part of package including crosswalk enhancements</td>
<td>$200 per crosswalk</td>
</tr>
<tr>
<td>Medians and Crossing Islands</td>
<td>9-10</td>
<td>39 to 46%</td>
<td>Proven</td>
<td>May provide operational benefits</td>
<td>Wide 2-lane roads and multi-lane roadways</td>
<td>4 to 8 feet wide</td>
<td>$15,000 to $30,000 per 100 feet</td>
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<tr>
<td>Curb Extensions</td>
<td>11-12</td>
<td>39 to 46%</td>
<td>Proven</td>
<td>Potential reduction in speeds</td>
<td>Urban arterials and collectors with curb parking</td>
<td>Roadway with parking or shoulder</td>
<td>$5,000-$10,000 per extension</td>
</tr>
<tr>
<td>Pedestrian Hybrid Beacon System</td>
<td>13-15</td>
<td>60%</td>
<td>Tried</td>
<td>Additional delay for vehicles stopping for pedestrians</td>
<td>Mid-Block Crosswalk locations — Not at intersections</td>
<td>Pedestrian activated</td>
<td>$80,000</td>
</tr>
<tr>
<td>Rectangular Rapid Flashing Beacon</td>
<td>16-17</td>
<td>76 to 100% yield to pedestrian rate</td>
<td>Tried</td>
<td>Additional delay for vehicles stopping for pedestrians</td>
<td>Mid-Block Crosswalk</td>
<td>Passive or active pedestrian activation</td>
<td>$10K to $15K</td>
</tr>
<tr>
<td>Crosswalk Lighting</td>
<td>18-19</td>
<td>33 to 44%</td>
<td>Proven</td>
<td>N/A</td>
<td>Isolated crosswalks not along a continuously lit roadway</td>
<td>Require a power source</td>
<td>$10K to $25K per intersection</td>
</tr>
<tr>
<td>Traffic Signals</td>
<td>20-22</td>
<td>Leading Pedestrian Interval — 60%</td>
<td>Tried</td>
<td>Increases delay and reduces mobility of major roadway</td>
<td>Intersections that meet signal warrants</td>
<td>New Signal – $175,000 to more than $300,000 per intersection</td>
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</tr>
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Sidewalks provide safety benefits due to the ability to provide pedestrians with their own travel space separated from traffic.

Sidewalks are a PROVEN safety strategy.

Sidewalks on both sides of a street have been found to significantly reduce occurrences of “walking along the roadway” compared to locations where no sidewalks or walkways exist.

Sidewalks should be implemented on all urban arterials and collectors, whenever possible.

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<td>Intersections that meet signal warrants</td>
<td>Short cycle lengths, countdown timers, easy accessibility</td>
<td>New Signal - $175,000 to more than $300,000 per intersection</td>
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Pedestrian Safety – Crash Rates vs. Crossing Features

Highlights

- Three of the more common strategies intended to address pedestrian crashes include reducing vehicle speeds, providing a marked crosswalk, and installing a traffic signal.

- The research is abundantly clear – merely changing the posted speed limit has never reduced vehicle speeds, painting crosswalks at unsignalized intersections is actually associated with higher frequencies of pedestrian crashes, and installing a traffic signal has never been proven effective at reducing pedestrian crashes.

- Reducing vehicle speeds is associated with reducing the severity of a pedestrian crash, but actually reducing speeds requires changing driver behavior, which requires changing the roadway environment. Strategies that have demonstrated an effect on driver behavior include vertical elements (speed bumps and speed tables), narrowing the roadway (converting from a rural to an urban section), and extraordinary levels of enforcement.

- A cross-sectional study of 2,000 intersections in 30 cities across the U.S. found that marked crosswalks at unsignalized intersections are NOT safety devices. The pedestrian crash rate was higher at the marked crosswalks and this effect is greatest for multilane arterials with volumes over 15,000 vehicles per day.

- A before/after study at over 500 intersections in San Diego and Los Angeles found a 70% reduction in pedestrian crashes following the removal of marked crosswalks at uncontrolled intersections.

- Traffic signals have not proven to be effective at reducing pedestrian crashes – the highest pedestrian crash frequency locations in most urban areas are signalized intersections.

- Observations of pedestrian behavior at traffic signals suggests that there is a low level of understanding of the meaning of the pedestrian indications and a high level of pedestrian violations – very few push the call button and fewer yet wait for the walk indication.
Intersections – Red Light Enforcement

Highlights

- Red Light Running (RLR) is a safety issue across the country. In 2009, RLR resulted in 676 traffic fatalities (10% of all intersection-related fatalities). In addition, the Insurance Institute for Highway Safety estimates that 130,000 people were injured in crashes in 2009 due to RLR.

- RLR has also been found to be an important safety issue in Minnesota. In the Minneapolis-St. Paul Metropolitan Area, approximately 60% of severe crashes are intersection related, approximately 50% of those occur at intersections controlled by traffic signals, and almost one-half of these involve a right angle collision.

- In the metropolitan area, the number of severe right angle crashes varies among state, county and city intersections, but one fact is consistent – along each system, right angle crashes result in more fatalities and serious injuries than rear-end, left-turn and right-turn crashes combined.

- Published research suggests that initial steps to address right angle crashes at signal-controlled intersections involve checking clearance (Yellow and All-Red) intervals and signal hardware (overhead indications, 12-inch lenses, and back plates provide better visibility for drivers).

- A review of Minnesota crash data indicates that the use of “good” clearance intervals and signal hardware is not enough to prevent right angle crashes.

- Intersections with these features have (on average) a higher density of severe crashes than intersections with only pedestal mounted signals with 8-inch lenses.

- This data suggests that additional enforcement efforts are required to address driver behavior. An American Automobile Associations survey in 2010 found that more than 30% of respondents admitted to running a red light in the previous 30 days when they could have safely stopped.
Wrap Up

- Addressing safety on **ALL** roads is a key component of Minnesota’s effort to move toward zero deaths.

- Severe crashes (involving fatalities and serious injuries) have been adopted as safety performance measures in Minnesota – approximately 20% of all severe crashes occur on city streets.

- The most common types of severe crashes on city streets are intersection-related and involve Ped/Bike and Right Angle crashes at traffic signals.

- Although Ped/Bike and Right Angle crashes are the most common types of severe crash at intersections along city streets – **no** intersection averages one of these severe crashes per year.

- This low density of severe crashes supports using a systemic (risk-based) approach to identify locations that would be priority candidates for safety investment.
Questions?