Raising Speed Limits on Rural Highways: A Process for Identification of Candidate Segments

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Speed limits on much of Interstate as several rural Oregon highways Tuesday as a law passed last year.

Oregon speed limit signs changed
Oregon Department of Transportation crew: Idaho border around 5:30 a.m. March 1, the freeway.

Speed limit increase to 75 squeezes through House, heads to governor
Some highway speeds could increase to 75 miles-per-hour.


The bills also allow for speed limit changes in other areas, including:
- Speed limits on gravel roads in counties with populations over 1 million would decrease to 45 miles per hour.
- Up to 900 miles of rural state trunk line highways would see hikes to 65 miles per hour.

Note: This story has been edited to reflect the speed limit of state trunk line highways.
Maximum Limits - Undivided Highways

Undivided - 2012

Undivided - 2017

Legend:
- Black: 75 mph
- Gray: 70 mph
- Light Gray: 65 mph
- Medium Gray: 60 mph
- White: 55 mph
- Very Light Gray: 50 mph
Impacts of Policy on Safety

- Safety impacts of important Federal actions
  - 1974 – 1987
    - 55 mph maximum speed limit on all U.S. roadways
    - Traffic fatalities decreased by ~7,500 annually
  - 1987 – 1995
    - 65 mph allowed on rural interstates
    - Traffic fatalities increased by 29 percent
  - 1995 – present
    - Maximum speed limits controlled by states
    - More than 12,500 total additional fatalities (through 2005)
US Interstate Fatality Trends 1999 - 2011

SL = 75-80
SL = 70
SL = 60-65
Speed and Crash Risk

Solomon (1964)

Cirillo (1968)

West and Dunn (1971)

[Graph showing the relationship between change in average speed (in mph) and crash involvement rate per million vehicle miles. The graph includes data points for Denmark, Finland, Switzerland, and the USA, with linear and asymptotic trend lines.]
Recent Speed Limit Policy Changes: Summary of Findings

- Increases have generally occurred on select segments (rather than system-wide)
- Feasibility determined based on engineering studies, evidence, and data
- Too soon for formal before/after safety analyses
- Unknown economic impacts
- Literature -> interstates/freeways and/or outdated
Study Purpose and Objectives

- In response to proposed speed limit legislation introduced in Michigan, MDOT sought to:
  1. Develop data driven process to identify candidate highway segments for speed limit increases, based on
     - Crash data
     - Additional risk criteria (geometry, driveways, schools, etc.)
     - Operating speeds
     - Infrastructure cost estimates
  2. Use the strategy to determine candidates on MDOT’s rural highway network
Candidate Selection Process

Part A - Safety/Risk Assessment:
- Step 1: Compare segment crash rates to statewide rates
- Step 2: Assess additional risk criteria

Part B - Infrastructure Cost Assessment:
- Step 3: Review geometric features for Part A candidates
- Step 4: Estimate costs (initial vs. 3R/4R)

Part C - Field Study for Initial Candidates:
- Step 5: Analyze travel speeds, review crashes, and assess factors not available in statewide datasets
Data Collection

Michigan Crash Databases (2004-2013)
- Total
- Injury
- K&A

MDOT Roadway Inventory Files (2004-2013)
- AADT
- Laneage
- Shoulders
- Speed Limit
- Area Type
- Medians
- NPZs
- Passing Lanes

Independently Collected Data:
- Driveways
- Horizontal Curves
- K-8 Schools
## Safety/Risk Assessment

<table>
<thead>
<tr>
<th>Factor</th>
<th>Criteria</th>
</tr>
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</table>
| **Segment Length**                  | **UNDIVIDED:** Minimum 8.0 mi. posted at 55 mph  
                                      **DIVIDED:** Minimum 4.0 mi. posted at 55 mph |
| **Total Crash Rate, 2004-2013**     | **UNDIVIDED:** Fewer than 252.58 crashes per 100M VMT  
                                      **DIVIDED:** Fewer than 219.73 crashes per 100M VMT |
| **Injury Crash Rate, 2004-2013**    | **UNDIVIDED:** Fewer than 35.80 crashes per 100M VMT  
                                      **DIVIDED:** Fewer than 44.74 crashes per 100M VMT |
| **Severe (K+A) Crash Rate, 2004-2013** | **UNDIVIDED:** Fewer than 7.12 crashes per 100M VMT  
                                      **DIVIDED:** Fewer than 4.80 crashes per 100M VMT |

**Step 1: Assess Crash Rates**

**Step 2: Assess Additional Risk Criteria**

- **Horizontal Curvature**: No curves with radii below 3R minimum design speed
- **Speed Reduction Zones**: Less than 25% of the total segment length below 55 mph
- **Proximity to K-8 Schools**: Fewer than 1 per 10 miles
- **Signalized Intersections**: **UNDIVIDED:** Fewer than 1 per 10 miles  
  **DIVIDED:** Fewer than 1 per 2 miles
- **Access Point Density**: Fewer than 20 driveways per mile
- **No-Passing Zones**: Less than 40% of the segment in NPZ (undivided only)
- **Lane Width**: Greater than 10 ft
- **Paved Shoulder Width**: Greater than or equal to 3 ft

*Developed based on MDOT crash data analysis and literature*
1540.8 miles met crash criteria (25.3% of statewide mileage)

772.8 miles met all criteria (12.7% of statewide mileage)
Cost Assessment

- Benefit/cost analysis performed for several 65 mph implementation scenarios
  1. Minimum cost candidates from Part A
  2. Candidates from Part A with no major geometric upgrades
  3. All candidates from Part A
  4. All routes systemwide

- Considered costs and benefits related to
  - Infrastructure upgrades
  - Travel time and fuel consumption
  - Traffic crashes
Infrastructure Upgrade Costs

- Costs estimated from recent MDOT 3R projects
  - **Initial** upgrades:
    - Speed limit signage, no-passing zone extensions, restripe merging tapers, curve warning signs
    - $10,000 /mi
  - **3R/4R** upgrades:
    - Minimal Upgrades (Guardrail extension, Tapers): $8,000 /mi
    - Moderate Upgrades with No Realignment: $70,000 /mi
    - Major Upgrades (Horizontal or Vertical Realignment): $195,000 /mi
Deficient Curves
I-94 in Southwest Michigan

Expected Future Project Geometric Upgrades with 80 mph Posted Speed on I-94 Berrien & Van Buren County

- Red: Vertical Curve, Alignment
- Blue: Horizontal Curve, Alignment
- Green: Horizontal Curve, Vertical Clearance at Bridge

MILES

Map showing locations of deficient curves along I-94 in Southwest Michigan.
User Benefits and Costs

- Mean speeds estimated to increase by 3.4 mph per 10 mph speed limit increase
  - Travel times decrease by 5.5 - 5.7 %
  - Fuel consumption increases by 4.6 - 5.0 %
    - -0.1 mpg/mph (trucks)
    - -0.4 mpg/mph (cars)

- Time savings outweigh fuel consumption costs by
  - 1.06 for heavy trucks ($0.0019/mile)
  - 2.98 for passenger vehicles ($0.0113/mile)
Safety Impacts and Costs

- Increasing the speed limit to 65 mph is expected to
  - Increase crash occurrence by 3.3%
  - Increase crash severity

<table>
<thead>
<tr>
<th>Crash Severity</th>
<th>Estimated Increase in Crash Occurrence (Kockelman, 2006)</th>
<th>Cost Per Additional Crash (National Safety Council, 2014)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatality (K)</td>
<td>28.1%</td>
<td>$1,693,476</td>
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<tr>
<td>Incapacitating Injury (A)</td>
<td>12.1%</td>
<td>$120,526</td>
</tr>
<tr>
<td>Non-Incapacitating Injury (B, C)</td>
<td>5.0%</td>
<td>$38,455</td>
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<tr>
<td>Property Damage (O)</td>
<td>2.7%</td>
<td>$9,194</td>
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</table>
### Benefit/Cost Analysis by Implementation Scenario

<table>
<thead>
<tr>
<th>Scenario</th>
<th>MDOT Affected Mileage</th>
<th>B/C</th>
</tr>
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<tbody>
<tr>
<td><strong>65 mph Highway Speed Limit</strong></td>
<td></td>
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<tr>
<td>Implementation Scenario</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scenario 1: Lower Risk, Lower Cost Candidates</td>
<td>235.1</td>
<td>1.23</td>
</tr>
<tr>
<td>(M-28 and US-2)</td>
<td></td>
<td></td>
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<tr>
<td>Scenario 2: Lower Risk, Moderate Cost Candidates</td>
<td>512.6</td>
<td>1.12</td>
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<td>Scenario 3: All Lower Risk Candidates</td>
<td>772.8</td>
<td>0.94</td>
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<tr>
<td>Scenario 4: All MDOT 55 mph Trunklines</td>
<td>6,092.2</td>
<td>0.77</td>
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</table>
Implementation Recommendations

- Systemwide application of increased maximum speed limits is **not desirable**
- Identify “Lower Risk/Lower Cost” candidate segments for further consideration
  - Low crash, injury, and K&A rates
  - Favorable roadway geometry
  - High operating speeds
  - Few access points
  - Low truck volumes
- Perform project-level engineering, speeds/operations, safety, and infrastructure cost assessment prior to final segment selection (Part C)
  - Can’t ignore federal design standards
Recommended vs. Implemented: Non-Freeways

Based on:
- HSM LOSS Cat.1,2;
- Geometry;
- AADT;
- Speeds

**Legend**
- Lower Risk Segments (All Criteria Satisfied)
- Crash Criteria Satisfied
- All Other MDOT Roadways
Recommended vs. Implemented: Freeways

Recommended

Implemented

Lower Risk MDOT Freeway Segments
(Criteria for Total and Injury Crash Rates and CMV % are Satisfied)

All Other MDOT Freeways

75 mph May 2017
75 mph June 2017
70 mph

Curve Design Speed < 80 mph
Ongoing Research

- Horizontal Curves
  - Determine how speeds and safety are affected by speed limit increases on these curves
  - Determine how various curve warning devices (traditional and innovative) may mitigate any driver speed control concerns at such locations

- Policy Impacts
  - Statewide speed and safety evaluation
  - MDOT implementations vs. Research recommendations
  - Life cycle costs
Questions?

- Research Report Links

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