Butte Creek Ice Detection and Advanced Warning System Evaluation

August 26, 2009
National Rural ITS Conference
Seaside, Oregon

Roger Lindgren, Sean St.Clair
Department of Civil Engineering – Oregon Institute of Technology

Research Team:
Adam Bradford, Robert Bertini,
Quency Fahlgren, Roger Lindgren,
Jared Lowther, Sean St.Clair
Highway 140
(Lake of the Woods)
Highway 140
(Lake of the Woods)
Highway 140
(Lake of the Woods)

To Medford

To Klamath Falls
Roadway Prone to Icing Conditions

- Substantial change in elevation from valleys
- Particularly from the west side (Medford)
Ice Related Crashes
ODOT Ice Warning System

To West Beacon

Butte Creek RWIS

To East Beacon
Beacons/Signs

- Located at MP 21 and 41
  - Installed in late 2005
Butte Creek RWIS

- Digital radar unit (installed for this study)
- Wind direction/speed
- Moisture sensor
- Temperature
- Humidity / dew point
- Pavement condition sensor
Radar Unit

Wavetronix dual radar
Radar Speed Trap

Vehicle speed/direction determined by measuring the delay from one radar beam to the next.
System History

- Operational late 2005
- Beacons activated by certain RWIS station conditions
  - Temperature / humidity / dewpoint etc.
  - Pavement sensor (not in operation during study season)
Evaluation
Project Goals

- Evaluate crash data BEFORE and AFTER warning system deployment
- Relate road conditions to vehicle speed
- Assess motorist experience with the warning system
- Is system making roads safer??
Crash Data

Crashes MP 21.7-41.7

Without warning system

With warning system

Dry conditions
Icy conditions

Season

03_04
04_05
05_06
06_07
07_08

Crashes
Speed Analysis

The diagram shows the relationship between mean speeds and beacon status at two capture sites: ATR and RWIS. The x-axis represents the beacon status (off or on), and the y-axis represents the mean speeds (both directions). The trend lines indicate a decrease in mean speeds as the beacon status changes from off to on.
Speed Analysis

![Graph showing mean speeds (both directions) vs. packed snow at different capture sites: ATR and RWIS. The graph indicates a decrease in mean speeds as packed snow increases.](image)
Speed Analysis

- Speeds at RWIS are significantly reduced (9.5 mph overall) when the beacons are ON.
- Less decrease seen in WB traffic (8.4 mph).
- Since speed reduction is the primary goal of the system, data suggest that the beacons are fulfilling their intended purpose.
- Impossible to conclusively prove that the system caused the decrease.
Driver Surveys

PHASE ONE
- Direct survey of motorists at the five ODOT Sno-Parks on Lake of Woods Pass

PHASE TWO
- Survey of southern Oregon residents, (internet and mailout)
## Driver Surveys

### Driving Habits

2. What is your county of residence?
   - Riverview
   - Josephine
   - Klamath
   - Other (please specify)

3. What was your purpose for driving on HWY 140 today?
   - Business
   - Recreation
   - Shopping
   - Visit family/friends
   - Other (please specify)

4. On average, how often do you drive up to or over the pass on HWY 140?
   - More than once a month
   - Once a week
   - A few times each month
   - Once a year
   - Never

5. To what extent are you more or less likely to drive up to or over the pass on HWY 140 during the winter?
   - Not at all likely
   - Much less likely
   - Less likely
   - Neither more or less likely
   - More likely
   - Much more likely

6. What type of vehicle do you usually drive on HWY 140 during the winter?
   - Performance sports car
   - Passenger car
   - Pick-up truck
   - Commercial vehicle

7. What type of driveline does the vehicle that you usually drive on HWY 140 during the winter have?
   - Front-wheel drive
   - Rear-wheel drive
   - Four-wheel drive
   - Rear-wheel drive with more than four wheels

### Beacons

8. Are you aware of the signs with flashing lights, or beacons, posted on either side of the pass warning of possible icy road conditions?
   - Yes
   - No
   - Do not recall

9. Were the beacons flashing today?
   - Yes
   - No
   - Do not recall

10. Rate your level of confidence that the beacons reflect actual road conditions.
    - Extremely confident
    - Very confident
    - Somewhat confident
    - Not at all confident

11. How is your driving speed affected when you see the beacons flashing?
    - Drive much slower
    - Drive somewhat slower
    - Drive at approximately same speed

12. How is your attentiveness affected when the beacons are flashing?
    - Much more attentive
    - Somewhat more attentive
    - No change
    - Much less attentive

13. To what degree is your caution as a driver affected when you see the beacons flashing?
    - Much more cautious
    - Somewhat more cautious
    - No change
    - Much less cautious
## System Confidence

<table>
<thead>
<tr>
<th>Driver Confidence in Beacons</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely Confident</td>
<td>19</td>
<td>10.5</td>
</tr>
<tr>
<td>Very Confident</td>
<td>68</td>
<td>37.6</td>
</tr>
<tr>
<td>Somewhat Confident</td>
<td>77</td>
<td>42.5</td>
</tr>
<tr>
<td>Not at all Confident</td>
<td>17</td>
<td>9.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>False Positives</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>50</td>
<td>28.2</td>
</tr>
<tr>
<td>No</td>
<td>61</td>
<td>34.5</td>
</tr>
<tr>
<td>Do Not Recall</td>
<td>66</td>
<td>37.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>False Negatives</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>36</td>
<td>20.7</td>
</tr>
<tr>
<td>No</td>
<td>68</td>
<td>39.1</td>
</tr>
<tr>
<td>Do Not Recall</td>
<td>70</td>
<td>40.2</td>
</tr>
</tbody>
</table>

- 91.6% of drivers expressed confidence
- False +/- cannot be verified
Effect on Driver Behavior

<table>
<thead>
<tr>
<th>Effect on Speed</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Much Slower</td>
<td>56</td>
<td>31.3</td>
</tr>
<tr>
<td>Somewhat Slower</td>
<td>101</td>
<td>56.4</td>
</tr>
<tr>
<td>Same</td>
<td>20</td>
<td>11.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Effect on Attention</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Much More Attentive</td>
<td>71</td>
<td>40.3</td>
</tr>
<tr>
<td>Somewhat More Attentive</td>
<td>80</td>
<td>45.5</td>
</tr>
<tr>
<td>No Change</td>
<td>24</td>
<td>13.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Effect on Caution</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Much More Cautious</td>
<td>67</td>
<td>39.0</td>
</tr>
<tr>
<td>Somewhat More Cautious</td>
<td>85</td>
<td>49.4</td>
</tr>
<tr>
<td>No Change</td>
<td>19</td>
<td>11.0</td>
</tr>
</tbody>
</table>

Very encouraging results

Self-reporting survey bias may exaggerate the effect
## Alert Distance

<table>
<thead>
<tr>
<th>Distance from Beacons to Ice</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less Than 1 Mile</td>
<td>58</td>
<td>32.0</td>
</tr>
<tr>
<td>1 to 2 Miles</td>
<td>66</td>
<td>36.5</td>
</tr>
<tr>
<td>3 to 5 Miles</td>
<td>40</td>
<td>22.1</td>
</tr>
<tr>
<td>6 to 10 Miles</td>
<td>18</td>
<td>9.9</td>
</tr>
<tr>
<td>10 to 20 Miles</td>
<td>7</td>
<td>3.9</td>
</tr>
</tbody>
</table>

- **68.5%** expect ice within 2 miles of signs
- Actual distance is highly variable (0-10 miles)
- “reinforcement” beacons may be beneficial
Driver Comments

- ODOT does a terrific job keeping the road open.
- People are stupid; no amount of signaling is going to make them drive any better.
- The beacons to serve a good purpose as a reminder to stay alert.
- Maybe beacons that photo speeders!
- Bigger and higher.
- More beacons, each describing no more than 5 miles of the road. To say it may be icy over the next 20 miles doesn't alert you as to exactly when that icy patch is likely.
Research Team
Acknowledgements

Oregon Department of Transportation
Garry Binning, Adam Bradford, Kevin Haas, Joel McCarroll, Daniel Serpico, Michael Stinson, James Wittenberg

Advanced Traffic Products  Wavetronix
Tim Janes  Daniel Beck