TRB Webinar: Maintenance Practices for Traffic Sign Retroreflectivity
Today’s Presenters and Moderator

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Dave Kniffin, 3M Company, DRKniffin@mmm.com
Introductory Remarks

Paul Carlson
Texas Transportation Institute at Texas A&M University
Chair of TRB’s Signing and Marking Materials committee

Paul-Carlson@tamu.edu
Tapping into the Power of a Traffic Sign Inventory to Meet the New Retroreflectivity Requirements

James W. Ellison, P.E.
County Traffic Engineer
Pierce County, WA
Sign Retroreflectivity
MUTCD Requirements

• Establish/implement assessment management method by Jan, 2012

• Replace ground-mount signs identified in first assessment by Jan, 2015

• Replace overhead signs identified in first assessment by Jan, 2018
Assessment/Management Methods

A. Visual Nighttime Inspection
B. Measured Retroreflectivity
C. Expected Life
D. Blanket Replacement
E. Control Signs
F. Other Supported Methods
Sign Retroreflectivity

• Which assessment or management method is best??
• What is the best way to optimize use of our labor, equipment, and materials??

• Our Sign Inventory became a powerful tool that helped guide us to the best answer…. for us.
Pierce County Sign Inventory
(~1,500 centerline miles of roads)

• 24,530 traffic signs
• 2,967 STOP & YIELD signs
• 6,761 warning (W-series) signs
• 3,117 Speed Limit signs
• 8,345 street name signs (34%)
### Sign Inspection Route

Listed by Route and Position Number

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Method A: Visual Nighttime Inspection

Trained sign inspector, Moving vehicle

PROCEDURE OPTIONS:
1. Calibration Signs
2. Consistent Parameters
3. Comparison Panels
Retroreflectivity measurements
Method B: Measured Retroreflectivity

- Measure signs with retroreflectometer
- Compare measured values with minimum values
- Replace signs when measured values approach minimums
Serial number tagging

Pierce County
24 Hour On Call
(253)531-6990
20024559
Signs left by vandals... where do they belong?
Date stamping within serial number

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Pierce County Signs by Age

SIGNS - AGE GRAPH

Year

Number of Signs

Method C: Expected Life

- Determine expected life of sheeting types used in geographical area
- End of life based on retro values in Table 2A-3
- Set up replacement program that ensures signs are replaced prior to the end of service life expectancy
- Periodic inspections or measurements to verify
# Route for Control Signs in Field

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- **Red Average**
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<td></td>
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<td></td>
<td></td>
<td>Red Average 38</td>
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<td></td>
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<tr>
<td>BR001</td>
<td>1200</td>
<td>008 AVE</td>
<td>20</td>
<td>S</td>
<td>121 ST E</td>
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<td>R</td>
<td>30x30</td>
<td>R1-1</td>
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<tr>
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<td>1250</td>
<td>008 AVE</td>
<td>17</td>
<td>N</td>
<td>121 ST E</td>
<td>S</td>
<td>R</td>
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<td>95010125</td>
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<td>W</td>
<td>GOLDEN GIVEN RD E E</td>
<td>E</td>
<td>R</td>
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<td>126 ST CT E</td>
<td>15</td>
<td>W</td>
<td>GOLDEN GIVEN RD E E</td>
<td>E</td>
<td>R</td>
<td>30x30</td>
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<td>95012231</td>
<td>95012231</td>
<td>15</td>
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<td>Red Average 39</td>
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<td>16</td>
<td>E</td>
<td>008 AVE</td>
<td>W</td>
<td>R</td>
<td>30x30</td>
<td>R1-1</td>
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<td>95012134</td>
<td>16</td>
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<td>White Average 317</td>
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<tr>
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<td>1525</td>
<td>126 ST CT E</td>
<td>16</td>
<td>E</td>
<td>008 AVE</td>
<td>W</td>
<td>R</td>
<td>30x30</td>
<td>R1-1</td>
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<td>95012134</td>
<td>16</td>
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<td>Red Average 41</td>
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## Retroreflectivity Data and Calculations

<table>
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<th>Serial #</th>
<th>Sequence</th>
<th>Result / Date</th>
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</thead>
<tbody>
<tr>
<td>95020557</td>
<td>1</td>
<td>March 6, 2007</td>
</tr>
</tbody>
</table>

**White Average**

- W 000001/1: 316
- W 000001/2: 300
- W 000001/3: 313

**Red Average**

- R 000001/4: 41
- R 000001/5: 41
- R 000001/6: 40

**Ratio**: 7.6

<table>
<thead>
<tr>
<th>Serial #</th>
<th>Sequence</th>
<th>Result / Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>95020557</td>
<td>1</td>
<td>March 6, 2007</td>
</tr>
</tbody>
</table>

**White Average**: 310

**Red Average**: 41
Method E: Control Signs

- Replacement of signs based on performance of control signs
- Control signs monitored to determine end of service life for associated signs
- Field signs represented by control samples are replaced prior to reaching minimum levels
Control Sign Measurements

Range of Values (cd/lux/m2)

Red Series (R1-1, R1-2, R5-1)

• Red
  Minimum 20 → Maximum 59
• White
  Minimum 258 → Maximum 325
• Contrast Ratio
  Minimum 5:1 → Maximum 9:1

• Proposed MUTCD Minimums
  Red 7  White 35  Contrast Ratio > 3:1
Method D: Blanket Replacement

• All signs in area/corridor, or signs of a specific type, are replaced at specific intervals
• No need to track individual signs
• Intervals based on the expected life of material
Pilot Study Findings

• 12-year old Type III STOP signs okay

• 10 to 12-year old Type III Warning signs well above minimums

• 10 to 12-year old Type I Speed Limit signs still above minimums
Pilot Study Findings

- Engineer grade Street Name signs need to be replaced
- High intensity Type III or IV logical selection for ground-mounted Street Name signs
Pilot Study Findings

• Control Signs (in-field) Method was not too labor-intensive

• Oldest Signs easily identified & monitored via serial numbers

• Inspection Route → Measuring Efficiencies

• First Priorities Set → Street Name signs
Lessons Learned

• Standardize procedures & training for using retroreflectometer

• Increased sample sizes to 150 signs for each category

• Began adding serial numbers to street name signs
Serial number on street name sign

20079266
Lessons Learned

• Continue to use Type I sheeting for regulatory (e.g., Speed Limit) signs?

• Retroreflectivity – the final piece to our asset management system for signs
Degradation of Sign Retroreflectivity

- New R
- Sign Installed
- Minimum retro needs of drivers
- Sign Replacement Scheduled
Paper Reference

“Tapping into the Power of a Traffic Sign Inventory to Meet the New Retroreflectivity Requirements”

Published in the ITE 2008 Annual Meeting (Anaheim) Compendium of Technical Papers

jelliso@co.pierce.wa.us  253-798-2267
Developing Sign Retroreflectivity Geographic Information System Databases for Selected Municipalities in PA

November 17, 2009
Transportation Research Board Sign Retroreflectivity Webinar
GIS - Data Integration and Asset Management

- GPS
- PAPER MAPS
- DATABASES
- ORTHOPHOTOGRAPHY
- DIGITAL PRODUCTS
- PAPER PRODUCTS
What is Asset Management?

- What do we own?
  Manholes, Roads, Hydrants, Signs, Poles, etc.

- What are its unique characteristics?
  Material, Mounting Height, Orientation, Retroreflectivity, Photo, Video, etc.

- Where is it?
  GIS / GPS

- How long has it been there?

- When was it last inspected?

- What is its history?
What is Asset Management?

Implementation Steps

1. Plan First!!
2. Establish Goals and Priorities
3. Determine Budget
4. Select Software and Hardware
5. Perform Data Collection / Inventory
6. Training / Implementation
7. Maintain the Database
8. Continued Funding
What is Asset Management?

Three Main Pieces to Asset Management

1. Data Collection
   - Collecting / Mapping Assets (GPS)
   - Collecting / Inputting Data for Assets (Paper Maps, Employees, Field Inspections, etc.)

2. Maintaining Information
   - Updating the collected assets information
   - If the information is not current accurate analysis can not be performed

3. Analyzing Data
   - Effective Decision Making using the inputted information (Maintenance, Replacement, Budgeting, etc.)
GIS / GPS in Asset Management

GIS

GPS (RTK vs Code)
## Code vs RTK

<table>
<thead>
<tr>
<th>Accuracy</th>
<th>Occupation Time</th>
<th>GPS Signal</th>
<th>Post Processing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Horizontal</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+/- 1 m to</td>
<td>1-2 Minutes</td>
<td>CODE portion or GPS Signal</td>
<td>• <strong>Requires</strong> Post Possessing for most accurate results</td>
</tr>
<tr>
<td>+/- 1 foot (ProXH)</td>
<td></td>
<td></td>
<td>• Real-time Corrections are available. (ex.WAAS)</td>
</tr>
<tr>
<td><strong>Vertical</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>~3x's Horizontal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Horizontal</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+/- 1 cm + 1 ppm</td>
<td>~5 Seconds</td>
<td>• <strong>CARRIER PHASE</strong> of GPS Signal</td>
<td>• <strong>No</strong> Post Possessing Required</td>
</tr>
<tr>
<td><strong>Vertical</strong></td>
<td></td>
<td>• RTK requires a minimum of two GPS receivers (base station and rover).</td>
<td>• Real-time results</td>
</tr>
<tr>
<td>+/- 2 cm + 1 ppm</td>
<td></td>
<td>• Base broadcasts data to the rover via radio or cellular modem</td>
<td></td>
</tr>
</tbody>
</table>
Some Questions to Consider:
(Define proper GPS data collection techniques according to specific projects.)

Budget / Schedule?
(RTK Technology – Better Accuracy, Further Distance, Quicker / Cheaper)

Is Elevation Important? How accurate must the data be?
What will be the future use / analysis of the data?
Who will conduct field data collection / process the data?

➢ RTK GPS
  ▪ Utility Systems (Networks)
    » Potable Water
    » Sanitary Sewer
    » Storm Water

➢ Code GPS
  ▪ Reference locations
    » Signs
    » Water samples
    » Wetland Delineation
Data Collected - Now What?

• How do we use the data?
  – Stand alone GIS (ArcView, ArcEditor, ArcInfo)
  – WebGIS
  – Mobile Computing
    (Laptops, Tablet PC, Smart Phones)

• Asset Management Database
  – Data Input
  – Data Analysis
  – Data Storage

• Integration / Joining of GIS and Asset Management Databases
Web-Based GIS - Expanding Current GIS Capabilities

- Access your infrastructure data **anywhere**, even in the field
- Available day or night
- Any member of your staff can access it, use it, and understand it
- Multiple Applications
- Security
- Cost Effective
Web-Based GIS Example
Asset Management
Software Examples

- CarteGraph – www.CarteGraph.com
- GBA Master Series – www.gbams.com
- Azteca – www.azteca.com
Questions and Answers

Thank you for your time.

For additional questions please contact:

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www.hrg-inc.com
Compliance with the MUTCD Minimum Sign Retroreflectivity Standards

TRB Webinar
November 17, 2009

Matthew R. Rauch, P.E.
State Signing Engineer
Bureau of Highway Operations
matt.rauch@dot.wi.gov
(608) 266-0150
Compliance with MUTCD Minimum Sign Retroreflectivity Standards

- A BIG Challenge for a State Agency with a lot of traffic signs to maintain and limited dollars and manpower.

- Approximately 300,000 signs to maintain on the state highway system.

- WisDOT has been proactive and had started to tackle this challenge several years ago.

- Launched Statewide Sign Inventory Management System in February 1999.

- Began Phaseout of Engineer Grade Sheeting in March 2002.
First Step of the Process: Field Inventory of Signs

- Sign Inventory Standards Committee started 1996
- Utilize Cartegraph SignView System
- WisDOT Sign Shop Staff upload data from laptops into Central ORACLE Database
- Approx. 300,000 Signs in Database
Implementation of the MUTCD Standard to Maintain Minimum Sign Reflectivity

- **Sign Assessment Methods** require evaluation of individual signs within an agency's jurisdiction.
- **Sign Management Methods** provide an agency the ability to maintain sign retroreflectivity without having to assess individual signs.

After much discussion, it was determined that the **Sign Assessment Methods** were not feasible for WisDOT. Expense and lack of manpower prohibited utilization of this method.

As a result, a **combination of Sign Management Methods** are being used by WisDOT to maintain minimum sign retroreflectivity.
Sign Management Methods Used by WisDOT

**BLANKET REPLACEMENT** - Utilized in roadway improvement projects where all of the signs are replaced. Lots of benefits to this method:

- Utilize Sign Inventory Management System to help prepare sign replacement plans.

- All Signs are the same age. Do not have to send sign crews back in for routine replacements. Thus manpower savings.

- Good opportunity to “clean-up” the signing on the roadway by re-positioning signs, adjust spacing and ensure mounting heights and offsets are correct.

- Helps save dollars on the maintenance budget.
Sign Management Methods Used by WisDOT

**EXPECTED SIGN LIFE** - Annual program to replace signs at a 12-year interval (current WisDOT policy).

- Signs are date tagged.

- Date information is included in the Sign Inventory Management System.

- Utilize Sign Inventory Management System to prepare budgets for annual sign replacements and work orders for field crews.
Sign Management Methods Used by WisDOT

CONTROL SIGNS- Provide Support to our sign replacement policy.

- All Colors of ASTM D4956 Type III, IV, IX and XI are on the test deck.

- Some Engineer grade (black on white and white on red) included on test deck.

- Different sheeting manufacturers.

- Signs face south (worst case UV exposure) are of different ages ranging from 1998 to 2009.

- Readings taken every 6 months.

- Data available to Local units of government.
How do we accomplish this huge task and pay for it!?!?!

LIMITED MAINTENANCE DOLLARS

- 4 yrs (January, 2012)
  Establish and implement method to track condition of signs
- 7 yrs (January, 2015)
  Replace identified regulatory, warning, ground-mounted guide signs (except street-name)
- 10 yrs (January, 2018)
  Replace identified street name & overhead guide signs
How do we accomplish this huge task and pay for it!?!?!

- Approx. 300,000 signs to maintain!
- Over 102,000 signs still Engineer Grade!!
- 1308 Overhead Guide signs (green background) still have Type I or Type III Sheeting!!!
Establish Replacement Priorities

- Start with Critical signs – these are safety related signs that may expose us to potential liability.
- Regulatory, Warning and School Signs – Started with these signs first.
- Higher Priority Guide signs versus lower priority guide signs
Aggressively Replace Signs within Highway Improvement Projects

- All signs replaced at once.
- Project funding will pay for the sign replacements.
- Signs are a relatively low cost in comparison to rest of project costs.
- Doesn’t hit the maintenance budget.
- Update the section of roadway to current MUTCD Standards.
Utilize Longer Life Sign Sheeting

- Eliminating Remaining Engineer Grade signs.
- Utilizing Type IV Sheeting (Prismatic High Intensity) for signs.
- Utilizing higher end prismatics (Type IX or better) for interchange guide signs.
Continue to monitor and refine Sign Replacement Policy

- Based on data from Control Signs on Test Deck.
Sign Inventory Systems

- Reliable
- Easy to use
- Cost effective
- Adaptive to agency needs
Assessment/Management Methods

Assessment Methods: Determine what you have
• Visual Nighttime Inspections
• Measured retroreflectivity

Management Methods: Manage what you have
• Expected Life
• Blanket Replacement
• Control Signs
Sign Inventory System

Importance of a Sign Inventory

– Asset capture
– Asset analysis
– Efficient asset management
– Budgeting
Sign Life Cycle Management

- Capture Base Inventory
- Assess Condition
- Update Inventory
- Workplan
- Maintain and Install
- Fabricate
“MultiCapture” Mobile Asset Logging System

A Portable Mobile Logging Platform uses:

- Multiple high-resolution cameras and sub-meter GPS
- Software records a Mobile Asset Log of GPS-synchronized digital images.
“MultiCapture” Mobile Asset Logging System

A Portable Mobile Logging Platform uses:
- Multiple high-resolution cameras and sub-meter GPS
- Software records a Mobile Asset Log of GPS-synchronized digital images.

“VideoFramer” Post Processing

Processing Software:
- Plays Mobile Asset Log “video” with GPS tracklog within GIS software.
- GIS technicians build a detailed Post and Sign Inventory
- Inventory is stored in a Sign Inventory Database
Post Processing
Building the Initial Sign Inventory

➢ The sign inventory database has a record for each sign
➢ Each record stores sign attributes and location
➢ An inventory can contain 10,000s or 100,000s of signs
Fieldwork tool

Field Tracking and Assessment Software

- Similar look and feel to the inventory database:
  - Shorter learning curve
- Easy for field crews to use:
  - “10 minutes to learn, 30 minutes to master”
- Portability is important:
  - Durable & reliable mini size computer
  - GPS receiver & wireless capabilities
- Built for fast and efficient field data entry:
  - Touch screen interface
  - Single keystroke inputs
Sign Management System Work Flow

BUILD INITIAL INVENTORY

"MultiCapture" Mobile Asset Logging

Inventory Database

ASSESSMENT & INVENTORY MANAGEMENT

"FAST" Field Tool

VISUALIZATION, MANAGEMENT, REPORTING

Web-Based Database Management

Queries and Reports

“VideoFramer” Post Processing
The Zoom In tool gives a closer look at the map

- Select the Tool, then drag a box to define a zoom area
Sign Management Website

Scroll the data table to review records for all selected signs.
Sign Management Website

Click link to view photos
Sign Management System

BUILD INITIAL INVENTORY

“MultiCapture” Mobile Asset Logging

Inventory Database

“VideoFramer” Post Processing

“FAST” Field Tool

ASSESSMENT & INVENTORY MANAGEMENT

VISUALIZATION, MANAGEMENT, REPORTING

Web-Based Database Management

Queries and Reports

“MultiCapture” Mobile Asset Logging

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“VideoFramer” Post Processing

“FAST” Field Tool

ASSESSMENT & INVENTORY MANAGEMENT

VISUALIZATION, MANAGEMENT, REPORTING

Web-Based Database Management

Queries and Reports
Summary

• Many options for sign management methods
• Sign inventory is key
• Cost effective short and long term
• A total solution including simple maintenance tools is important to long term success