Innovative Approaches to Assessing Risk Exposure on Rural Road Networks: Clarington Ontario’s Experience

Brian Malone, P. Eng.
Vice President, Transportation, CIMA+
Burlington, Ontario

Dan Campbell
Project Manager & GIS Specialist, CIMA+
Bowmanville, Ontario

June 2016
Clarington, Ontario

- Population 90,000
  - Growing rapidly ‘905’ community
- 612 Sq. Km.
  - Primarily rural
  - 4 Major Urban Centres
  - 13 Hamlets

Features
- Lake Ontario
- Ontario “Greenbelt”
- Oak Ridges Moraine
Study Outline

**The Challenge**
- Diverse, rural road network
- Traffic installations ‘evolved’ over time
- Missing standards-driven design processes

**The Goal**
- Reduce risk exposure, achieve liability reduction
- Complete comprehensive review
- Document issues identified
- Develop remedial action plan
- Use innovative approaches
The Real Challenge

- Long distances
  - 448km of Rural Road
  - 442km of Urban Road

- Information challenges
  - Uncertain sign inventory
  - Limited roadside safety details
  - No curve ball-bank records

- No system plan

- Cost and time constraints
Project Approach Overview

Phase 1: Project Initiation
- Client Kick-off Meeting
- Priorities and Issues Review

Phase 2: Field Data Collection
- LIDAR & Imagery Data Collection
- Safety Field Screening
- Ball Bank Curve Data Collection
- Feature Data Extraction

Phase 3: Network Analysis (In-Office)
- Identify & Assess Deficiencies
  - Signage
  - Guiderails
  - Vegetation
  - Pavement Marking

Phase 4: Recommendations
- Countermeasure Identification
- Countermeasure Evaluation
- Improvement Program

Phase 5: Reporting
- Draft Report
- Review Meeting
- Final Report
- Data Delivery

QA/QC Review
Innovative Approaches

LiDAR
- Light Detection And Ranging
- Surveying technology, measure distance by illuminating a target with a laser light

Automated Curve Ball Bank Measurements
- CARS™ Curve Advisory Reporting Service
- Capture road curve “ball-bank” data in one pass

Quantitative Prioritization
- Treatment plan
LiDAR Survey
- Used on all roads
- Both directions
- 3-D point cloud
  - 25mm accuracy

Video Data
- AVI HD Video
  - 3 m interval

Observer notes
- Geo-reference
- Audio log
LiDAR Technology

+ LiDAR Survey
Video Geo-reference Survey
Sign Inventory

- LiDAR GIS / Mapping
  - 6598 Signs
- Correlation to existing inventory
  - Geo-location verification
  - Correction & adjustment
- Video check
- Retro-reflectivity analysis
  - Multi-point measurement
  - Aged / Damage / Alignment / Obstruction
+ **Sign Inventory**
+ **System consideration**
  - Comprehensive route treatment

[Diagram showing road signs and route treatment]
Sign Inventory

Non-standard applications

WA-7T Augmenting Regulatory Speed Sign on William Allin Court
WA-7T Augmenting Narrow Structure Sign on Conc. Road 1 at CPR
WA-7T Augmenting Intersection Warning Sign and Regulatory Speed Sign Conc. Road 10 east of RR57
WA-7T Augmenting Non-standard Hidden Int. Sign Conc. Road 6 West of Jewell Road
Non-standard review process

Figure 2-4: Non-standard Warning Sign Review Process

- Are the Conditions that Motivated the Installation Still Applicable?
- Does a Policy Framework Exist to Justify Existing Non-standard Signage?
- Is the Installation Consistent with Policy Framework?
- Maintain Existing Signage
- Can a Logical Policy Framework be Developed?
- Develop Documented Policy Framework
- Are There Potentially other Similar Locations?
- Ensure that the Policy Addresses How the Need for Signage at Similar Locations will be Established
- Remove Existing Signage
CIMA+ Advantage: Recognized Safety Expertise

+ Road Safety Evaluation
+ In-Service Road Safety Review Process
  – Application of Standards
  – Ontario Traffic Manual
    – OTM Books 6, 7, 11…
  – Liability risk consideration
Roadside Safety Evaluation

- Embankments
- Bridge Structure
- Headwalls
- Guiderail
- Trees
- Utility poles

<table>
<thead>
<tr>
<th>Location ID</th>
<th>Road Name</th>
<th>Structure No.</th>
<th>Hazard Type</th>
<th>Ex. Sys. Type</th>
<th>Type</th>
<th>Counternmeasure Description</th>
<th>Cost (2015 $)</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>RH120</td>
<td>Best Rd</td>
<td></td>
<td>Slope, Trees</td>
<td>Linear Delineation</td>
<td></td>
<td>Provide linear delineation (pavement markings and FMDs)</td>
<td>24,200.00</td>
<td>M</td>
</tr>
<tr>
<td>RH123</td>
<td>Bragg Rd</td>
<td>98217</td>
<td>Fixed Object, Structure</td>
<td>Linear Delineation</td>
<td></td>
<td>Install WB Narrow Structure Sign with One-way tab. Improve delineation for narrowing on approaches (edge markings/FMDs)</td>
<td>550.00</td>
<td>H</td>
</tr>
<tr>
<td>RH130</td>
<td>Lockhart Rd</td>
<td>98365</td>
<td>Slope, Creek Crossing</td>
<td>Point Hazard Marker</td>
<td></td>
<td>Adjust existing hazard markers to lower sign position and correct rotation</td>
<td>1,100.00</td>
<td>L</td>
</tr>
<tr>
<td>RH131</td>
<td>Squair Rd</td>
<td></td>
<td>Slope, Trees</td>
<td>Linear Delineation</td>
<td></td>
<td>Consider providing edge line pavement markings</td>
<td>13,200.00</td>
<td>M</td>
</tr>
<tr>
<td>RH132</td>
<td>Cohonski Rd</td>
<td></td>
<td>Fixed Object, Sign, Pole, etc.</td>
<td>Point Hazard Marker</td>
<td></td>
<td>Install hazard markers at 1 driveway culvert on east side</td>
<td>550.00</td>
<td>L</td>
</tr>
<tr>
<td>RH133</td>
<td>Cohonski Rd</td>
<td></td>
<td>Slope, Trees</td>
<td>Linear Delineation</td>
<td></td>
<td>Consider providing edge line pavement markings at southern end</td>
<td>3,060.00</td>
<td>L</td>
</tr>
<tr>
<td>RH135</td>
<td>Jewel Rd</td>
<td></td>
<td>Slope, Trees</td>
<td>Point Hazard Marker</td>
<td></td>
<td>Install hazard markers at slope location</td>
<td>550.00</td>
<td>M</td>
</tr>
<tr>
<td>RH138</td>
<td>Conco Rd 5</td>
<td></td>
<td>Slope, Trees</td>
<td>Linear Delineation</td>
<td></td>
<td>Provide linear delineation (pavement markings and FMDs)</td>
<td>8,280.00</td>
<td>L</td>
</tr>
<tr>
<td>RH139</td>
<td>Conco Rd 5</td>
<td></td>
<td>Slope, Trees</td>
<td>Linear Delineation</td>
<td></td>
<td>None: Slope is bordeirine, guiderail not warranted. Linear delineation included in horz. curve recommendations.</td>
<td>-</td>
<td>L</td>
</tr>
<tr>
<td>RH140</td>
<td>Conco Rd 5</td>
<td></td>
<td>Slope, Trees</td>
<td>P</td>
<td>Remove</td>
<td>Guiderail not required remove posts.</td>
<td>3,820.00</td>
<td>L</td>
</tr>
<tr>
<td>RH142</td>
<td>Conco Rd 5</td>
<td>98385</td>
<td>Drop, Culvert</td>
<td>Point Hazard Marker</td>
<td></td>
<td>Adjust hazard markers heights ASAP</td>
<td>1,102.00</td>
<td>L</td>
</tr>
<tr>
<td>RH143</td>
<td>Conco Rd 4</td>
<td>98387</td>
<td>Drop, Culvert</td>
<td>Point Hazard Marker</td>
<td></td>
<td>Install hazard markers at all quadrants ASAP</td>
<td>1,100.00</td>
<td>H</td>
</tr>
<tr>
<td>RH144</td>
<td>Conco Rd 4</td>
<td>98309</td>
<td>Drop, Culvert</td>
<td>Point Hazard Marker</td>
<td></td>
<td>Install hazard markers at all quadrants ASAP</td>
<td>1,100.00</td>
<td>H</td>
</tr>
</tbody>
</table>
Curve Speed Evaluation

**Curve Advisory Speed – Ball-Bank**

- Manual – Slope Meter
- Electronic Ball Bank
Automated Curve Speed Evaluation

- **Automatic Ball-Banking**
  - Reiker Inc.
    - Proprietary System
    - Sold as a service
  - Rapid data collection
  - Large area review
  - Single Pass
  - One Operator
    - GPS - Curve geometry
    - Acceleration measure
+ Curve analysis
+ Complex system integration
+ Quick data collection

Note: This diagram intended to represent supplementary measures recommended for Curves C-23 & C-24. Detailed curve data sheets should be consulted for complete recommendations for all curves.
Recommendations Development Process

1. Deficiencies & Non-conformities
2. Possible Countermeasures
3. Recommended Countermeasures
4. Prioritized Improvement Program

- Standards-based
- Cost-benefit analysis driven
- Integrated with capital programs
Optimization

+ **Prioritized Improvement program**
  + Maximize safety improvement
  + Optimize budget

+ **Challenges**
  + Budget constraints
  + Risk determination

+ **Risk**
  + Expert priority index
  + AADT
  + Speed
  + Improvement Potential

+ **Cost / Budget**
  + Treatment cost
  + Life cycle cost
  + Budget scenarios
Lessons Learned

Conclusions

+ LiDAR
  – Rapid data collection
  – Massive data quantity / management key
  – Some automation, not all

+ Curve Analysis
  – Accurate, rapid
  – Proprietary system
  – Not cost effective in this instance
Lessons Learned

+ **Conclusions**
  + Innovative approach
    – Quick data collection
    – Network wide information gathering
    – Comprehensive records
    – Potential future data analysis
  + System rationalization
    – Full compliance check
    – Development of complete plan for needed system improvements