CLRP Report No. 12-02

Cornell University Local Roads Program
February 2012
Intermunicipal Cooperation to Improve Rural Sign Safety

CLRP Report No. 12-02
February 2012

For:
Accelerating Safety Activities Program (ASAP)

Submitted to:
Federal Highway Administration

By:
Cornell University Local Roads Program
416 Riley-Robb Hall
Ithaca, NY 14853-5701
(607) 255-8033
clrp@cornell.edu
www.clrp.cornell.edu
Executive Summary

In the summer of 2011, the Cornell Local Roads Program hired a student intern to work with three County Highway Departments in western New York to determine how to best share a retroreflectometer as part of meeting the new standards on sign retroreflectivity. This sharing program needed to include all three Counties as well as local jurisdictions in the respective counties (Towns, Villages and one City).

The project examined the current status and capability of the various municipalities in inventory, inspection, and management of the signs currently along each highway and developed a simple tool to help field crews meet the new retroreflectivity standard while sharing a single retroreflectometer.

Most of these local agencies had a sign inventory, but the quality varied quite a bit. The purchase of signs and materials was mostly done in coordination with the County Highway Departments. We found that these agencies were all using sign materials that meet the new retroreflectivity and crashworthy standards. However, inspections were not consistent and most smaller agencies had no comprehensive plan for testing sign retroreflectivity. Even among the Counties, there was not a clear systematic approach in every case. Part of the issue is manpower and budget. While Counties had dedicated personnel focused on signs, the amount of work was greater than their capacity to systematically monitor installed signs. The situation for the Towns and Villages was
even worse, as signs are done by field crews as part of other duties and checking signs are sometimes given a lower priority. However, every municipality had a response time of less than 24 hours of notification of a missing or fallen sign of importance. While all agencies had some awareness of the new sign regulations, there is still a large need for training in many agencies. Some towns expressed the desire for a County takeover of sign installation and maintenance, but liability and resources are barriers to this happening.

In order to help agencies with their inspection programs, a total of 50 inexpensive sign inspection kits were prepared with a total cost of less than $50 each for the parts. Each County received ten kits, while Cornell provided most of the remaining kits to other Counties around New York State. These kits can be used to quickly confirm the level of retroreflectivity of signs in the field that have been identified as being questionable.

Sharing a retroreflectometer between agencies is very feasible, but there are certain ground rules that should be included in any sharing agreement:

- No matter how the retroreflectometer is purchased, one agency should be the official owner.
- If a sign comparison panel method is used, only the agencies with dedicated sign personnel should be using the retroreflectometer.

**Project Purpose and Description**

New standards for sign retroreflectivity are being implemented by agencies all over New York State. There is a large amount of discussion about how to best utilize a retroreflectometer in meeting this new standard. The Cornell Local Roads Program (Cornell) hired a student intern to work with three County Highway Departments in western New York to determine how to best share a retroreflectometer as part of meeting the new standards on sign retroreflectivity contained in the 2009 National Manual on Uniform Traffic Control Devices.[*FHWA, 2009*] This sharing program needed to include the three Counties as well as local jurisdictions in the respective counties (Towns, Villages and one City).

The original concept was to use the GPS capability of a retroreflectometer along with basic sign information to perform as much of the following for each jurisdiction involved in the project as is feasible in the ten weeks of the project:

- obtain a more accurate inventory of the signage currently along each highway
- determine the applicability of the signs along each highway
- develop a long range plan to meet the new retroreflectivity standard
- develop a long range plan to improve the overall safety of all signs
County Partners

The three County Highway Departments who were partners in the project are listed below.

Table 1. County Highway Department Partners

<table>
<thead>
<tr>
<th>Wyoming County</th>
<th>Todd Gadd</th>
<th>Highway Superintendent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genesee County</td>
<td>Tim Hens, P.E.</td>
<td>Highway Superintendent</td>
</tr>
<tr>
<td>Livingston County</td>
<td>Don Higgins</td>
<td>Highway Superintendent</td>
</tr>
</tbody>
</table>

After meeting with the County partners, it was agreed to refocus the project on meeting the short term needs of the various municipalities. Primary needs identified as part of an initial meeting included ways to help municipalities with inspections of existing signs and economical methods to check the retroreflectivity of these signs without having to use a retroreflectometer. It was assumed that the agencies would have a retroreflectometer available for checking any tools or to verify any decisions on the brightness of a particular sign or tool.

The final project goals therefore were:

- Determine the current status and capability of the various municipalities in inventory, inspection, and management of the signs currently along each highway
- Develop methods to help field crews determine the applicability of these signs
- Develop a simple tool to help field crews meet the new retroreflectivity standard
- Determine how multiple jurisdictions might share a retroreflectometer

Accomplishments

During the summer of 2011, a student intern, Lawrence (Larry) Lin was hired to help with the project. Larry received training relating to the MUTCD, retroreflectometer usage, and field sign investigations. A training session on the needs of the project and the requirements of the MUTCD was held in Wyoming County with representatives from each of the Counties.

Along with engineering staff from Cornell, Larry visited the Livingston County Highway Department to help him understand how local agencies manage the acquisition, maintenance, and documentation of their traffic control devices. Subsequent to this visit, Larry visited additional highway departments of various Counties, Towns, and Villages in the three Counties. All of this information was used to compile methods and the means by which Cornell could help them to meet the requirements of retroreflectivity in the MUTCD. A list of all of the Highway Departments visited is shown in Table 2. Table 3 shows the total number of each type of municipality within each County.

As shown by Table 3, it would be very expensive for every municipality to purchase a retroreflectometer at an expected price of over $10,000 per unit. In addition, the need for training to properly use the retroreflectometer would add additional time and costs.
Table 2. Municipalities Visited, Summer 2011

<table>
<thead>
<tr>
<th>Municipality</th>
<th>Visit Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Livingston County</td>
<td>June 9, June 16</td>
</tr>
<tr>
<td>Wyoming County</td>
<td>June 21</td>
</tr>
<tr>
<td>Town of Portage, Livingston County</td>
<td>June 21</td>
</tr>
<tr>
<td>Village of Mt. Morris, Livingston County</td>
<td>June 22</td>
</tr>
<tr>
<td>Town of Mt. Morris, Livingston County</td>
<td>June 22</td>
</tr>
<tr>
<td>Genesee County</td>
<td>June 29</td>
</tr>
<tr>
<td>Town of Covington, Wyoming County</td>
<td>June 30</td>
</tr>
<tr>
<td>Town of Java, Wyoming County</td>
<td>June 30</td>
</tr>
<tr>
<td>Town of Leicester, Livingston County</td>
<td>June 30</td>
</tr>
<tr>
<td>Town of Batavia, Genesee County</td>
<td>July 7</td>
</tr>
<tr>
<td>Town of Oakfield, Genesee County</td>
<td>July 13</td>
</tr>
</tbody>
</table>

Table 3. Municipalities inside Genesee, Livingston and Wyoming Counties, New York State

<table>
<thead>
<tr>
<th>County</th>
<th>Counties</th>
<th>Towns</th>
<th>Cities</th>
<th>Villages</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genesee</td>
<td>1</td>
<td>13</td>
<td>1</td>
<td>6</td>
<td>21</td>
</tr>
<tr>
<td>Livingston</td>
<td>1</td>
<td>17</td>
<td>0</td>
<td>9</td>
<td>27</td>
</tr>
<tr>
<td>Wyoming</td>
<td>1</td>
<td>16</td>
<td>0</td>
<td>9</td>
<td>26</td>
</tr>
<tr>
<td>TOTALS</td>
<td>3</td>
<td>46</td>
<td>1</td>
<td>24</td>
<td>74</td>
</tr>
</tbody>
</table>

Investigation

The interviews of the eleven municipalities found some basic information that was very useful in the determination of what the various agencies had in the way of capabilities and needs with regards to signs.

Inventories

All 3 county highway departments had detailed, completed electronic inventories. All of these inventories included sign names, face directions, and relative distances. Out of the eight other highway departments, four had completed inventories with three being electronic. None of these inventories were the same. In some cases, an Excel sheet was dedicated to every sign, and a row was dedicated to every inspection. In some cases, an Excel sheet was dedicated to every road, and a row was dedicated to every sign. In some cases, points representing signs are plotted on mapping software, and descriptions are listed in a separate Word document.

All interviewed departments expressed that they had plans to establish a full inventory within the next several years.
Sign Purchases
Livingston County and Genesee County bid blanks, sheeting, and posts from different vendors, and they assembled them all at the highway department. Wyoming County does the same for street name signs only, doing so for all County, Town, and Village roads. Wyoming County purchased all other signs completely assembled. In recent years, all of the counties have been providing most, if not all, of the signs for their respective Towns and Villages, though posts are sometimes purchased by the Towns and Villages elsewhere. Overall, collective large-scale bids and procurement through the counties have proven to be the least expensive alternative.

Sign Materials
All three counties are using high-intensity prismatic sheeting and steel posts (u-channel and square posts). Because all of the towns and villages obtain their signs from the counties, their materials are alike.

Livingston and Wyoming use crashworthy systems for all signs. The sign technician at Genesee County was new, so he was unaware of what exactly crashworthy standards entailed. Out of the Towns and Villages, all of the representatives knew that crashworthy standards were in place, but at least three of them expressed hesitancy concerning whether or not their systems were allowable. Problems noted included: use of inappropriate bolts, and longer than allowable (4 inch) stubs supporting the main sign.

Inspections
Wyoming and Genesee County perform inspections four times a year, one of which is a nighttime inspection while Livingston County performs one nighttime inspection every year. These inspections are very thorough and well-documented. In terms of retroreflectivity, however, only Livingston County had a MUTCD-approved method prior to this project. They used the Comparison Panel Procedure of the Visual Nighttime Inspection.

Although Wyoming and Genesee did nighttime inspections, they did not have a systematic way of calibrating their inspector’s vision. Both counties knew that this was an issue, and they said that they hoped to establish a better system in the near future. There was no consistent pattern among the Towns and Villages. Although most Towns and Villages had an annual nighttime inspection, some of these inspections seemed spontaneous and rough. In some cases, an inspection simply consisted of driving through all of the roads and keeping an eye out for bad signs. In these Towns, there is no documentation of the inspections.

Manpower and Budget
The three Counties had from 20 to 25 non-administrative employees each. Livingston and Wyoming Counties had two specializing in assembling and installing signs. Genesee County recently reduced the number of employees working with signs to one. The Towns and Villages varied from two to four total employees. Whereas county employees had specializations, the common trend in Towns and Villages was for all employees to be involved with all types of work in the department including placing and inspecting signage.
The County sign budgets ranged from $30,000 to $66,000. The Town sign budgets were sometimes difficult to obtain, because they were often combined with other costs, such as road striping and work zone materials. An estimated range would be $1500 to $4000 with the average annual sign budget of about $2040.

All of the Counties, and six out of the eight Towns and Villages, expressed that the lack of manpower was a major concern. Although the County highway departments had staff specifically working with signs, much of their time went into making signs for themselves and for their Towns. As a result, installations and replacements, though scheduled, are often delayed. As for the Towns and Villages, none of them employed staff that specifically worked with signs. Staff was often dedicated to summer mowing and winter plowing, with occasional traffic work zone projects.

In some cases, superintendents stated that they often did not have the proper number of workers on the field to operate legally and safely. As a result, there did not often seem to be a regular engagement with signs. In other cases, superintendents would make inspections regularly, but these were often done while working overtime because they regularly worked in the field with their employees. However, regardless of the amount of manpower, each County, Town, and Village expressed a response time of ‘less than 24 hours within the notification’ in the case of a missing or fallen sign of importance.

One of the Counties, and six out of the eight Towns and Villages, expressed that the lack of funding was a major concern. This was not a concern for the two towns interviewed in Genesee County, who reported that they obtained signs from the County highway department at no cost. While the majority of the highway departments in the Towns and Villages earnestly desired to meet standard regulations, their budgets were simply not large enough to meet every single one; this resulted in prioritization. One Town asked if there were any kinds of grants or aid from the government.

**Regulation Awareness**

Livingston County reported that although the county staff had enough regulation awareness, there was a large need for training in many of its towns. Genesee and Wyoming Counties had many questions and concerns about the regulations themselves.

Some towns expressed the desire for a County takeover of signs. In addition to County uniformity, the Towns perceived that the responsibility would be too great and the resources too minimal for them to manage the signs on their own without eventually having some lawsuits on their hands. On the other hand, Livingston County actually did an investigation of all of their Towns recently in which they concluded that replacing the outdated signs would produce too much liability for the County.

Out of the Towns and Villages, four said that regulation awareness and training were major concerns. Many requested more frequent Cornell Local Roads Program classes. While most spoke positively about the Cornell classes, a few were not even aware that they existed. One town requested that Cornell create a “cheat sheet” that could be used in the field.

Common questions regarded standard sign location, advance warning placement, curve advisory speed measurement, legal procedure and liability, and work zone signage.
**Products**

Based upon the results of the interviews and investigations, two products were highlighted as being the most beneficial to the various municipalities: a sign inspection field guide and an inexpensive sign inspection kit. Drafts of both products were developed over the summer and early fall, but based upon feedback from the municipalities and the original goals of the project, the sign retroreflectivity comparison kit was fully developed first and is the primary product of this ASAP project.

The concept of the tailored field guide was that it should be a companion document to the Traffic Sign Handbook for Local Roads - New York State Edition [Cornell Local Roads Program, 2011] that would cover some specifics of sign inspection. The written portion, along with many of the tables and figures, was completed in fall 2011 and a draft version is expected to be ready in 2012.

The concept behind the sign inspection kit was to use clear “overhead projector” sheets in layers to degrade the retroreflectivity of small comparison panels of different colors to a conservative level above the minimum retroreflective levels identified in Table 2A-3 of the MUTCD. The clear overhead sheets are the same ones used with overhead projectors and are readily available at office supply stores.

A series of kits were prepared for each County to share with the local agencies within the Counties. A total of 50 kits were prepared with parts for each kit costing less than $50. The costs for the kits Cornell made are shown in Table 4. The labor cost of making the panels is not included, but each panel took less than 30 minutes to make. Figure 1 shows the items included in the kit. A copy of the Traffic Sign Handbook for Local Roads - New York State Edition was included with each kit, but is not part of the costs listed below. While Cornell purchased new panels from a sign manufacturer, a municipality could use a sign being taken out of service which is above the minimum retroreflectivity standard to further reduce the cost of producing these kits.

A tip sheet outlining the preparation and use of the panels was prepared and posted on the Cornell Local Roads Program website. A copy of the tip sheet was also provided with each kit (and is also attached to the end of this report).

Each County received ten kits, while Cornell shared most of the remaining kits with other Counties around New York State. Cornell also provided kits to the New York State Department of Transportation, the Federal Highway Administration, and two safety circuit riders who contract with the Local Roads Program.

<table>
<thead>
<tr>
<th>Table 4. Cost of Transparency Film Comparison Panels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sign Panels</td>
</tr>
<tr>
<td>Sheeting (overhead)</td>
</tr>
<tr>
<td>Clamps</td>
</tr>
<tr>
<td>Flashlight</td>
</tr>
<tr>
<td>Storage Bags</td>
</tr>
<tr>
<td>Other parts (tape and markers)</td>
</tr>
<tr>
<td><strong>Total (50 kits)</strong></td>
</tr>
<tr>
<td>Price per kit</td>
</tr>
</tbody>
</table>
Figure 1. Retroreflectivity Testing Kit

Each sign inspection kit consist of the following items:

- 3 inch x 6 inch sign panels of appropriate colors (6 total: Yellow, Orange, Fluorescent green, Green, White, and Red)
- Clamps to hold panels to sign (2)
- Flashlight (halogen recommended)
- Small container to store and protect the panels, clamps, and flashlight
- Copy of the *NYS Edition of the Traffic Sign Handbook for Local Roads*

The sign inspection kit can be used to confirm a safe level of sign retroreflectivity in the field. These panels are intended to test signs with a questionable level of retroreflectivity that are initially identified by a visual nighttime inspection. Verification of the retroreflectivity levels of these test panels should be done once per year using a retroreflectometer to ensure that they are in compliance with the inspection requirements.

The retroreflectivity of the test panels should be conservative compared with the actual standard values in the MUTCD. Agencies using the panels as a primary tool may want to consider the purchase of more precise panels with $R_A$ values closer to the minimum allowed. These panels should only be used with post-mounted signs.

A training session was held in Wyoming County with representatives from the three Counties. The representatives were trained in how to manufacture and use the kits. Prior to this training, the sign technicians at Wyoming County were provided a prototype of the inspection kit for use during their nighttime inspection. This kit enabled the County to inspect all of its signs in only three nights.
It was agreed that to share a retroreflectometer between agencies is very feasible, but there are certain ground rules that should be included in any sharing agreement. As the Counties had not yet purchased a retroreflectometer as of the end of the project, there is not yet a formal agreement on how the device would be shared. The following items should be included in any sharing agreement:

- No matter how the retroreflectometer is purchased, one agency should be the official owner and be in charge of regularly scheduled maintenance and any upgrades or manufacturers calibrations. This agency is in charge of scheduling the loan of the retroreflectometer, but should not have priority for scheduling.
- If a sign comparison panel method is used, only the agencies with dedicated sign personnel should use the retroreflectometer. This will help ensure that the retroreflectometer is protected and reduce the chances of damage. As long as this is done, there should be no need for a special agreement to borrow the retroreflectometer between agencies. Otherwise, a loan agreement may need to be developed.

**Final Expenses**

The full $9,000 provided to the Cornell Local Roads Program was expanded to cover the cost of the student intern and the kits. Some of the costs were charged to the LTAP funds of the Cornell Local Roads Program. A breakdown of the expenses is shown in Table 5.

<table>
<thead>
<tr>
<th></th>
<th>ASAP Budget</th>
<th>Other Expenses</th>
<th>Total Expenses</th>
<th>Percentage of Project Expenses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salary</td>
<td>$3,787.50</td>
<td>$1,350.00</td>
<td>$5,137.50</td>
<td>47%</td>
</tr>
<tr>
<td>Materials &amp; Supplies</td>
<td>$1,955.97</td>
<td>$206.34</td>
<td>$2,162.31</td>
<td>20%</td>
</tr>
<tr>
<td>F&amp;A</td>
<td>$3,256.53</td>
<td>$280.14</td>
<td>$3,536.67</td>
<td>33%</td>
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<tr>
<td>TOTAL</td>
<td>$9,000.00</td>
<td>$1,836.48</td>
<td>$10,836.48</td>
<td>100%</td>
</tr>
</tbody>
</table>

**References**


Transparency Film Comparison Panels

As part of the implementation of the 2009 Manual of Uniform Traffic Control Devices (MUTCD) Section 2A.08, Maintaining Minimum Retroreflectivity, requires that “Public agencies or officials having jurisdiction shall use an assessment or management method that is designed to maintain sign retroreflectivity at or above the minimum levels in Table 2A-3.” The Cornell Local Roads has worked to develop a way to make inexpensive retroreflective comparison panels that can be used to confirm the level of retroreflectivity of signs in the field that have been identified as being questionable.

These panels are intended to supplement a visual nighttime inspection method that would be conducted to initially identify signs that would be identified as having questionable levels of retroreflectivity. Verification of the retroreflectivity levels should be done once per year to maintain that they are in compliance with the inspection requirements. This can be done by working with the county or contacting Cornell Local Roads Program. The retroreflectivity of the panels is should be conservative versus the actual standard values.

Agencies using the panels as a primary tool may want to consider the purchase of more precise panels with $R_A$ values closer to the minimum allowed value from the MUTCD. These panels should only be used with post-mounted signs.

The concept is to use clear “overhead” sheets in layers on the sign panel to degrade the retroreflectivity of small comparison panel to a conservative level above the minimum retroreflective levels identified in Table 2A-3 of the MUTCD. The clear overhead sheets are the same ones used in the old days on overhead projectors and are readily available at a local office supply store.

Different sign colors will require a different number of layers of the clear sheets to reach the level of retroreflectivity desired due to the different initial level of retroreflectivity for each color panel and the different final levels of retroreflectivity required for each color.

To simplify the need for multiple panels of the same color as per Table 2A-3, the Cornell Local Roads Program simplified the requirement for each color and utilized the most conservative retroreflectivity level. This approach minimizes the number of panels needed and provides an agency with “heads-up” on signs that are nearing the end of functionality.

For example, white is used with green on overhead and post-mounted signs, with red on stop signs and with black on regulatory signs. To avoid the need for four different white panels, we chose to use the minimum level for post-mounted green signs. This level, $R_A=120$, is greater than both the white on stop signs ($R_A=35$) and the white with black ($R_A=50$) on regulatory signs.

### Possible colors needed as per Table 2A-3

<table>
<thead>
<tr>
<th>Color</th>
<th>$R_A$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow</td>
<td>75 cd/lx/m²</td>
</tr>
<tr>
<td>Orange</td>
<td>75</td>
</tr>
<tr>
<td>Fluorescent green</td>
<td>75</td>
</tr>
<tr>
<td>Green*</td>
<td>15</td>
</tr>
<tr>
<td>White*</td>
<td>120</td>
</tr>
<tr>
<td>Red</td>
<td>7</td>
</tr>
</tbody>
</table>

* Post-mounted signs
SIGN PANEL ASSEMBLY

Parts Needed:

1. Color panels of the common sign colors
2. Clear overhead sheets
3. Ruler
4. Pencil
5. Indelible Marker
6. Scissors
7. Laboratory or painters tape (not masking)
8. Retroreflectometer

Procedure:

1. Obtain or make panels that are above the minimum level of retroreflectivity from Table 2A-3. These may be purchased from a local sign shop or cut from signs removed from service. A 3-inch by 6-inch panel is a good size for use during the nighttime inspection.

2. Measure and identify the existing level of retroreflectivity of the sign panels using a calibrated retroreflectometer.

3. Cut each of the overhead sheets into smaller sizes that match the panel sizes. The long length should be slightly shorter than the full panel length to allow a place for taping to the front of the panel. A 3 x 5 ½ inch size maximizes the number of panel sizes from a typical 8 ½ x 11 inch overhead sheet.

4. Once the clear panels sheets are cut, place them over the comparison panels one at a time, measuring the retroreflectivity level of the (panel + sheets) and comparing that value to the minimum acceptable retroreflective value for each specific color.

5. Continue adding additional clear sheets until the retroreflective level drops below the acceptable minimum level identified on Table 2A.3. At that point, remove the last clear sheet.

6. Tape the remaining clear sheets to the face of the panel. After taping, recheck the retroreflectivity of the completed panel.

7. Record this $R_A$ value along with the number of sheets, the date, and the initials of the person doing the work on the back of the panel in indelible pen. The $R_A$ value should be rechecked each year and the information on the back of the panel should be updated.
USE OF COMPARISON PANELS:

The use of Comparison Panels should be done as a supplement to a visual nighttime inspection. During the inspection, signs will be classified as **good**, **poor** or **questionable** with regards to their retroreflectivity. Those that are identified as **poor** should be taken out or service as soon as feasible. Once a sign is identified as **questionable**, the sign is inspected using the comparison panel. The description below assumes all proper work zone and other safety measures are taken as needed.

**Parts Needed:**

1. Sign panels of appropriate colors
2. Clamps to hold panels to sign (2)
3. Flashlight (halogen recommended)
4. Step ladder (if needed for taller signs)
5. Small container to store and protect the panels, clamps, and flashlight

**Procedure:**

1. Identify the **questionable** sign.
2. Attach the appropriate colored comparison panel or panels to the sign using clamps.
3. Step back from the sign face approximately 15-25 feet, place the flashlight next to your ear, and shine the light toward the sign/comparison panel combination.
   
   a. If the comparison panels are brighter than the sign, the sign should be replaced.
   
   b. If the comparison panels are nearly the same brightness, the sign is near its functional life and should be identified as one to re-inspect in the future or to be replaced.
   
   c. If the sign is brighter than the panels the sign is good until the next annual inspection.

4. Document the inspection of every sign including any conclusions found when using the comparison panels, and actions taken based on the conclusions of the inspection. Inspections are important, but are meaningless in court if they have not been documented.

5. When the inspections are complete, store the comparison panels in a safe, protected location away from the effects of UV light. This is important to extend the life of the panels and get the most use out of them.
Completed Panel - front and back

Completed Retroreflectivity Testing Kit