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FINAL REPORT: Horizontal Alignment Safety Study

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LIVINGSTON COUNTY HORIZONTAL ALIGNMENT SAFETY STUDY

Our Thanks to the Following:

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Donald Higgins, Superintendent - Livingston County Highway Department
David Woods, Director - Livingston County Planning Department
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Appendix C:	FINAL Shape files, Photos, ArcView extension & documentation
Appendix D:	Town map breakdown by priority level

I. Purpose

In an effort to make the County road system safer for the traveling public, Livingston County has conducted a Horizontal Alignment Safety Study for the County road system. The study is administered by Livingston County. The Genesee Transportation Council is the contracting agency through the Unified Planning Work Program (UPWP)

II. Project Limits

The study area includes all County Roads within Livingston County (See Figure II-1). This encompasses approximately 250 miles of road network and includes 274 curves.

Prior to the study, the following changes were noted by Livingston County in regard to the County's road network mapping used to identify all County Roads:

- County Route 14 in North Dansville should read County Route 9
- County Route 59 between Byersville and Route 436 should read County Route 57
- Maxwell Station Road in the Town of Caledonia is no longer County Route 53
- Cameron Road in the Town of Caledonia is no longer County Route 73
- River Road in the Town of Caledonia is now County Route 84
- Short Tract Road in the Town of Portage is now County Route 20
- A new roadway installed in Mount Morris located between New Campus Road and Murry Hill Road is now County Route 85
- A new roadway installed in Livonia that goes up to a tower located on Stone Hill Road between County Route 47 and County Route 39 is now County Route 83

III. Project Scope

The scope of the project includes the following:

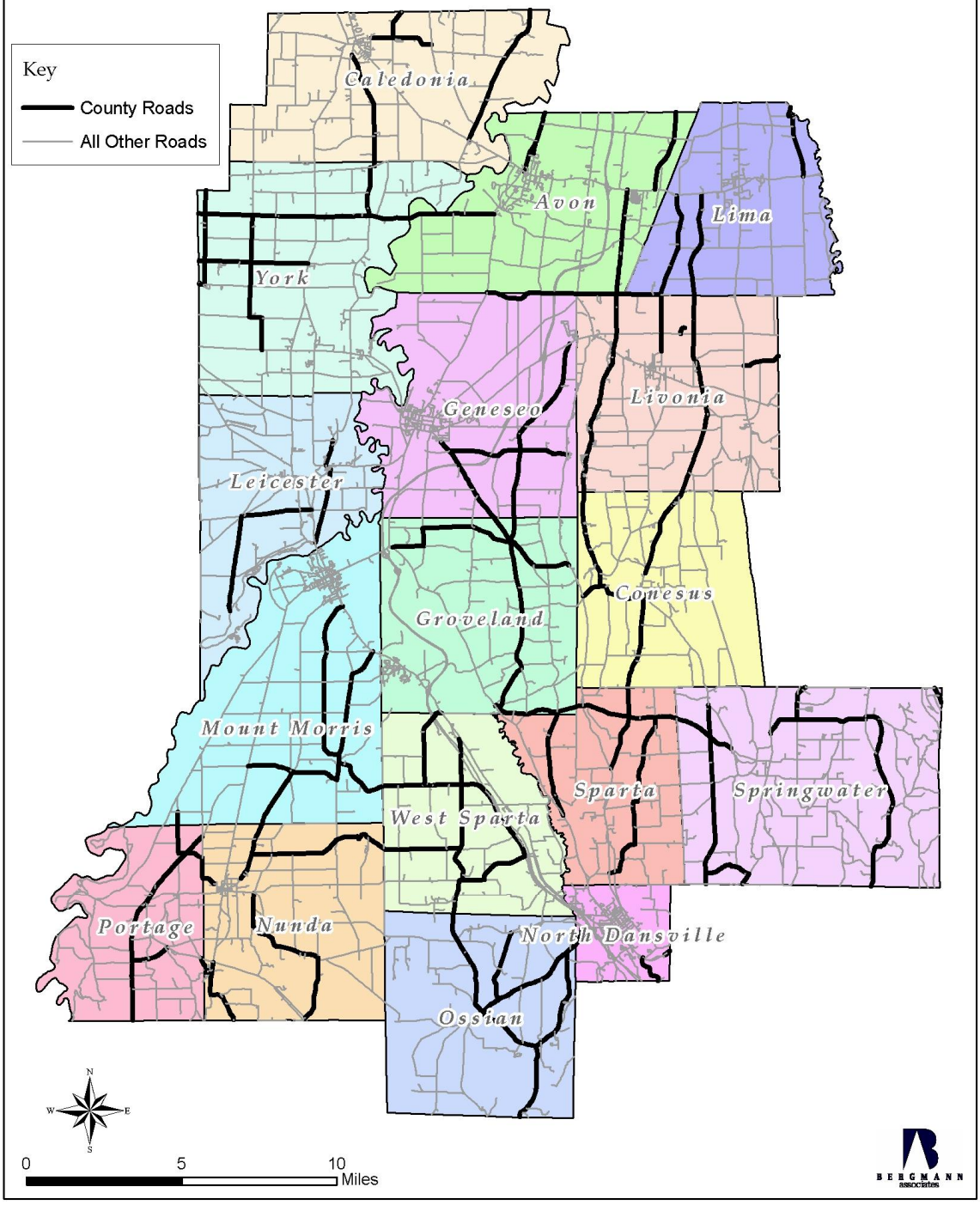
- Coordinating all project activities and progress with Livingston County and GTC.
- Locating and verifying horizontal curves and the corresponding placement of existing advisory signs.
- Evaluating the adequacy of existing signs and the need for new signs per New York State Manual of Uniform Traffic Control Devices (MUTCD) guidelines.
- Developing a prioritized set of improvement recommendations.

IV. Project Summary

A Global Positioning System (GPS) unit running a custom ArcPad application was used to locate curve signs and record curve data for all signed curves on Livingston County roads. Each sign was digitally photographed and essential data such as height, offset, condition, type of sign, type of sign sheeting material and condition were recorded. The data were then categorized into an excel spreadsheet and evaluated. The project database is located in Appendix A. A further explanation of the data can be found in the Project Results section of this report.

Livingston County Study Area

Figure II-1



Each point collected by the GPS unit was given a Distance Measuring Instrument (DMI) station distance. The instrument, measuring a distance in feet, was set to zero at the beginning (westernmost or southernmost point) of each route number. A distance was traveled to each sign, Point of Curvature (PC) and Point of Tangency (PT) and given the appropriate DMI stationing distance. This distance was then recorded for each particular point into the GPS unit. This measurement allows any user of the spreadsheet to easily locate the point again. Occasionally, a curve located on or just inside the border of Livingston County had an associated warning sign outside of Livingston County. In this case, a GPS point was taken outside of Livingston County prior to setting the zero station. In this instance, a distance was taken from the "zero" station, which would be the County line. This distance is registered as a negative number in the spreadsheet.

The test vehicle was a 2001 Ford Taurus. An electronic ball bank indicator was used to verify if the posted speed of the curve was appropriate. A ball bank indicator is an instrument that measures the amount of centrifugal force acting on a vehicle as it travels through a curve. A force of 10 degrees or greater is considered to be unacceptable. Each curve was driven at the highest posted speed to verify if that posted speed was correct. If the ball bank indicator indicated a banking of greater than 10%, the curve was driven again 5 miles per hour lower than the posted speed. This process continued until the ball bank indicator showed a satisfactory level. Once an appropriate speed was established, the curve was driven 3 times in each direction to verify that reading. Results for each trial run are saved in an excel spreadsheet and contained in Appendix B.

Curves not posted with a curve sign were traveled 5 m.p.h. higher than the posted speed limit. If the ball bank indicator did not show unsatisfactory results, the curve was considered acceptable for not being posted. If the ball bank indicator showed unsatisfactory results, the curve was driven in decreasing 5 m.p.h. increments, establishing the correct posted advisory speed.

V. Project Results

Once all data was collected using the GPS unit, it was differentially corrected to give sub-meter location accuracy. Projection to NY State Plane West, NAD83, feet was confirmed. Then it was post-processed to assign the correct DMI distance and digital photograph. Metadata was written according to Livingston County policies and procedures, and the Federal Geographic Data Committee approved Content Standard for Digital Geospatial Metadata (FGDC-STD-001-1998). This data was then downloaded into an Excel spreadsheet and evaluated. This data table can be found in Appendix A.

Sign height, offsets and advance posting distances were compared to NYS MUTCD standards and evaluated. If a height adjustment, offset change, or modification in advance posting distance is recommended, it is stated in the table.

Per NYS MUTCD guidelines, there are 192 signs that require an increased advance posting distance. Posting distance is the distance between the sign warning of a curve

ahead and the beginning of the curve itself. There is limited guidance in the NYSMUTCD with regards to a maximum advance posting distance. Therefore, engineering judgment was used to evaluate if any signs were posted too far in advance. A "rule of thumb "for increasing advance posting distances applies to downhill grades. A posting distance of an additional 150% of the standard distance is considered acceptable on steep grades. Therefore, a value slightly higher than that was used to determine a maximum advance posting distance (1.75 times the required distance). Based on this criterion, 87 signs require a decreased posting distance.

There are 16 signs that require increased height and 540 signs that require an increased offset. Height of the signs is measured from the edge of the traveled roadway to the bottom of the sign. Sign offset was measured from the edge of the traveled roadway to the edge of the sign closest to the road. Section 201.5 of the NYS MUTCD states that physical limitations or visibility considerations allow for exceptions to lateral placement and height requirements. For example, if there is excessive growth from trees and brush or if there is a large embankment or cliff adjacent to the road, it may not be possible to achieve the desired offset requirements. It should be noted that actual field conditions vary and as such, each location must be evaluated on a case by case basis.

An explanation of the data table located in Appendix A is as follows:

Point Type

For each posted curve on the project, all associated signs (including delineators) and curve data (PC and PT) were located and categorized using a GPS unit. Under this column, PC=Point of curvature, PT= Point of tangency and Sign=Delineator and curvature signs.

Curve ID Number

The County maintains a spreadsheet of data, called a Project List Report that breaks each route into a smaller series of section numbers. For example, County Route 1 is labeled as Route 01-1 for the area between State Route 63 and County Route 51, and Route 01-2 for the area between County Route 51 and State Route 256.

Changes to the Project List Report as determined in the field are as follows:

- County Route 85 in Mount Morris between New Campus Road and Murry Hill Road is actually between Parker Road and Murry Hill Road.
- County Route 5, Section 05-2 is located between County Route 67 and the Genesee River, not River Road (County Route 22, adjacent to Route 05-2 is appropriately labeled with the limit being the York Town Line).

Per County request, field inventories of signs performed on each route were broken down according to the sections described in the project list report. Then, an associated curve number was added to the route section number for each curve. Using the same example, the third curve on Route 01, section 2 is labeled as Rte01-2.3.

Post Condition

Sign posts were rated based on the following categories:

- Excellent: A brand new galvanized sign post.
- Good: A galvanized sign post that is in good condition, but not new.
- Fair: A sign post that is painted with some signs of rust.
- Poor: A sign post that is covered with rust.

In total, there are 51 posts that are in poor condition and in need of replacement.

Sign Condition

Signs were rated based on the following categories:

- Excellent: A brand new sign
- Good: A sign with no bends or surface damage, but not a new sign.
- Fair: A sign with minor surface damage.
- Poor: A sign that is damaged, or has any holes or bends in it. Signs with Engineering Grade Sheeting are also considered to be 'Poor.'

Correct/Adjusted DMI Distances

In an effort to make data collection productive, some roadways were traveled southbound or westbound, which is opposite to the way the County performs their stationing. In these cases, a final DMI distance was recorded at the westernmost or southernmost point of that particular route. Each DMI distance for each point along this route was then subtracted from the final end distance in order to give a 'proper' DMI distance from the beginning of each Route.

Fabrication Number/Installation Number

Fabrication numbers for signs varied in the field. If the fabrication number was a series of 4 numbers, it represented a date (month/year).

For newer signs, a date preceded the fabrication number and was a series of 8 numbers (03040978, representing March, 2004, #978).

Installation numbers also varied. Some of the numbers were shown as 8 digits, representing a date and installation number (05015216, representing May, 2001, #5216). Other numbers had 4 digits, representing only the installation number (4926). Some of the installation numbers had the letters 'lchd' preceding the 4 digit installation number (lchd4573).

Federal MUTCD

This column references the Federal MUTCD number for each sign as they differ from the NYSMUTCD numbers. If New York State adopts the Federal Manual in lieu of their own in the future, the signs can be properly referenced to the Federal Manual.

Comment

The comment column provides guidance as to the conditions encountered in the field for each particular curve. It is a summary of the results of the ball bank indicator as compared to the posted advisory speed of the curve.

Action Item

This column identifies work that needs to be performed at the curve to make it meet NYSMUTCD guidelines. This column was also the basis for a prioritization schedule.

Prioritization

Summarizing the type of work to be performed under the Action Item 'column, this column establishes the level of priority in which the curves should be corrected. These priority levels apply to each curve as a whole. Prioritization of curves was established strictly on highest point of need. For example, if a curve was missing a speed sign (Priority 1), and the existing signs were in poor condition (Priority 3), the overall level of the curve would be Priority 1.

- Priority 1 locations are those that are missing signs (for example a posted curve with no associated advisory speed sign that should be posted for a speed of 45 m.p.h.). In total, there are 42 priority 1 locations, accounting for 15.3% of the data.
- Priority 2 locations are those that are posted incorrectly, such as a posted speed of 45 m.p.h. that should be posted as 40 m.p.h. In total, there are 57 Priority 2 locations, accounting for 20.8% of the data.
- Priority 3 locations are those that are posted correctly, but in poor condition. In total, there are 56 Priority 3 locations, accounting for 20.4% of the data.
- Priority 4 locations are those that require an increased height, offset, or increased (or decreased) advance posting distance. In total, there are 118 Priority 4 locations, accounting for 43.1% of the data.
- Priority 5 locations are those requiring minor work, such as trimming a bush or tree blocking the sign or straightening a sign so it is more visible. In total, there is 1 Priority 5 location, accounting for 0.4% of the data.

Consideration Action Item

This column suggests optional efforts that the County can take in order to meet NYSMUTCD recommendations. For example, if there are 2 curves posted separately that are close enough to each other to be posted as a single reverse curve, it is so noted in this column.

An explanation of the data table located in Appendix C is as follows:

VI. GIS

An ESRI ArcMap extension was developed to evaluate adequacy of sign data and to provide a reporting function. Three tools were developed: a street zoom tool, a sign tool, and a reporting tool.

The street zoom tool allows custom zoom by street, street intersection, and street between two cross streets. See Figure VI-1.

The sign tool displays all attributes for signs (and PC or PT) for any location chosen by the user, including all history data associated with that location. History can be edited, deleted, updated, and added using this tool. Signs (or PC/PT) can be edited, deleted, updated, and added using this tool. See Figure VI-2.

The reporting tool sets up four ways in which the signs/locations can be queried, the resulting features can be viewed on the screen and a comma-separated-value file (.csv) is created containing a summary of the attributes for these features. This file can be easily read by Microsoft Excel and then sorted and displayed as desired. The queries are: (1) by school district and/or municipality, (2) by sign type and/or road name, (3) by sign type and/or condition, (4) by post condition. See Figure VI-3 which also shows a report as displayed in Microsoft Excel.

Existing school district, town boundary, ALIS (Accident Location Information System) road data as shapefiles, and orthophotography as Mr. SID files were collected for inclusion as base map information. The GIS based query and reporting tool was reviewed with County Highway Department staff to ensure the needs of the County were addressed.

On Oct. 19, Bergmann Associates installed the sign/PC/PT shapefile data, the metadata and the ArcView extension described above at the Livingston County Highway Department. A training session was held for County staff in use of the GIS data developed and the customized query tool.

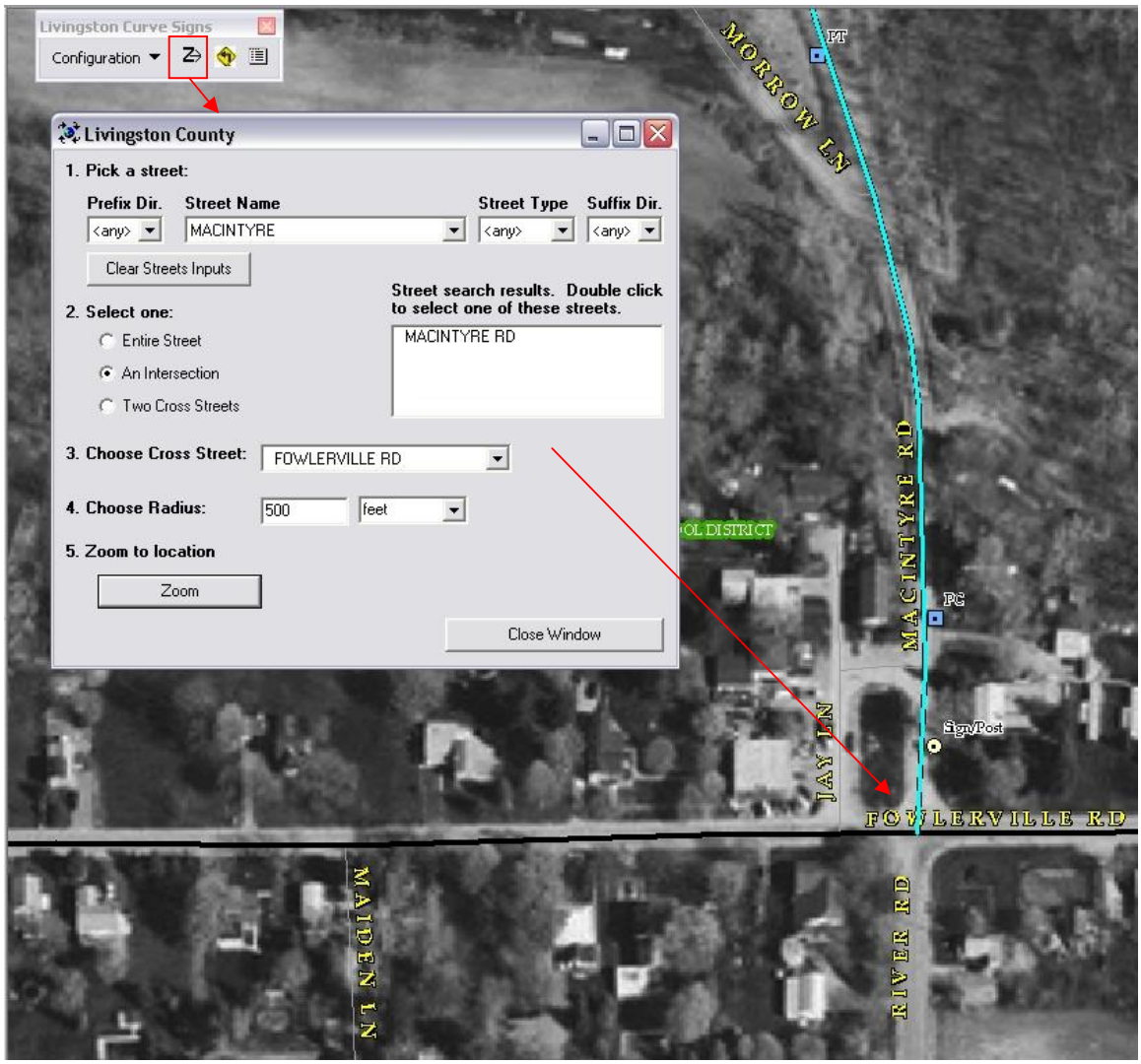


Figure VI-1: Street Zoom Tool

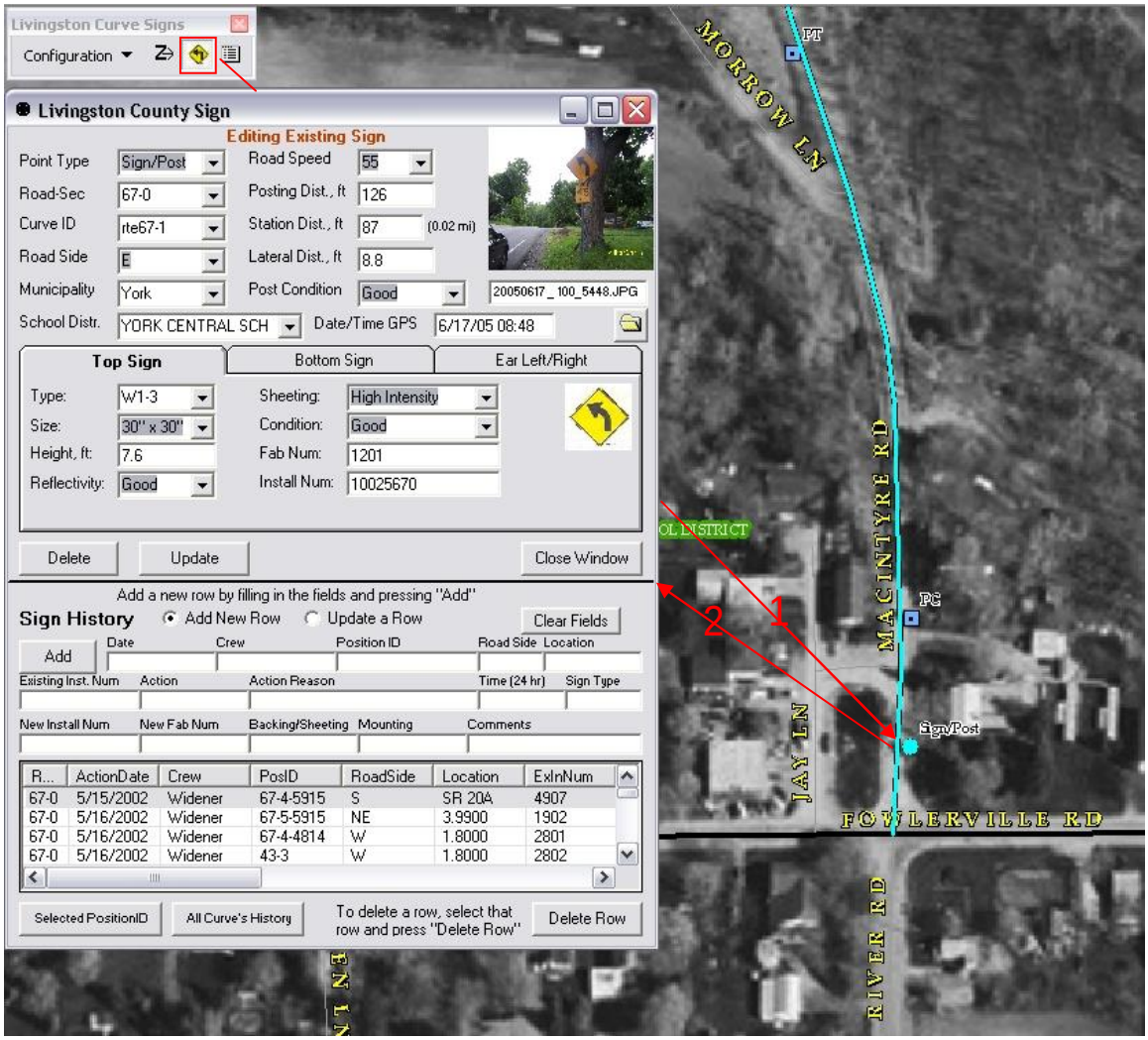
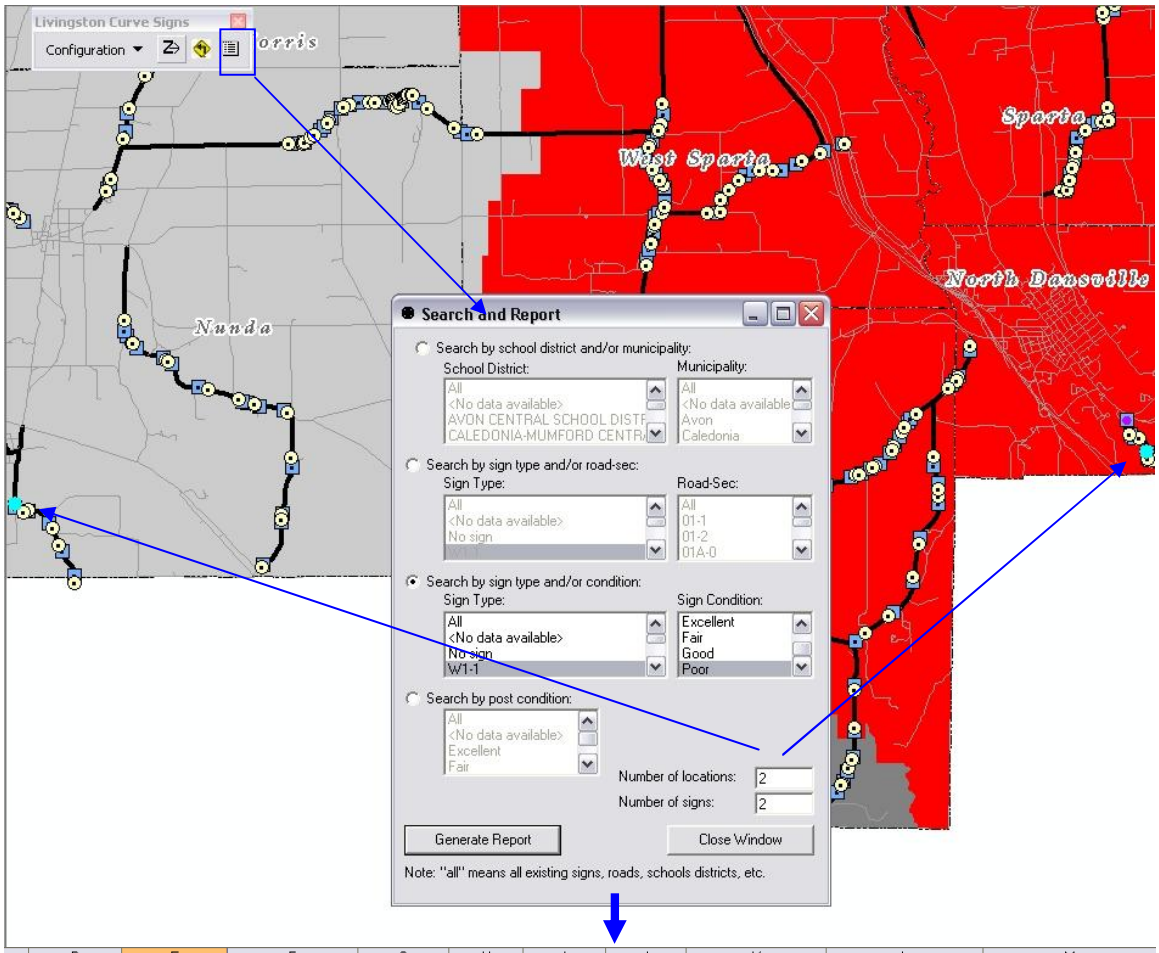


Figure VI-2: Sign Tool



	D	E	F	G	H	I	J	K	L	M
1	DMI Distance (feet)	Distance Between Sign and PC or PT and Sign (feet)	Lateral Distance Edge of Sign to Edge of Pavement (feet)	Sign Height Above Edge of Pavement (feet)	Sign Type	Fabrication Number	Installation Number	Post Condition Including Hardware (E G F P)	Sign Condition Including Reflectivity and Hardware (E G F P)	Digital Picture ID
2	2506	398	5.9	6	Sign/Post		Ichd3144	Good	Poor	20050603 _ 100_5089.JPG
3	6925	243	11.5	6.9	Sign/Post		Ichd2913	Good	Poor	20050527 _ 100_4906.JPG

Figure VI-3: Report Tool –shows report as displayed in Microsoft Excel.

VII. Conclusions

In total, there are 274 curve locations in Livingston County. A curve location can represent a series of curves, a reverse curve, or a single curve, provided they are, or should be, posted as such. These curves are located on approximately 250 miles of County roads. There are 684 curve and delineator signs with an additional 394 associated advisory speed signs, making the total County curve sign inventory 1,078 signs in total.

Based on the field survey, 76 new signs are required. This includes curves that are posted in one direction, but not in the other. The addition of these signs would make the curves properly posted in both travel directions. Of the missing 76 signs, 42 (55%) of them are associated advisory speed signs. The remaining 34 (45%) are curve signs.

The field survey also identified curve signs requiring replacement. For example, replacements should be made on a curve that should be posted as a reverse curve or where associated advisory speed signs are incorrect. Replacement locations include those where signs are in poor condition. In total, there are 242 signs that require replacement. Of these 242 signs, 143 (59.1%) of them are in poor condition.

For comparison purposes, current NYSMUTCD guidelines were compared against the Federal MUTCD. It should be noted that the Federal MUTCD requirements are less stringent at this time. As of this time, New York State will be maintaining their document and issuing amendments to it. An Engineering Bulletin has been distributed to announce future changes. This amendment will not affect advance posting distances, offset, or height recommendations.

In conclusion, the Livingston County Highway Department should be recognized for having the foresight regarding the importance of this study. The incorporation of the recommended changes will provide an increased safety benefit for the traveling public on all County Roads.

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Appendix B:	CD containing ball bank Indicator results
Appendix C:	FINAL Shape File, Photos, ArcView extension and documentation
Appendix D:	Town map breakdown by priority level