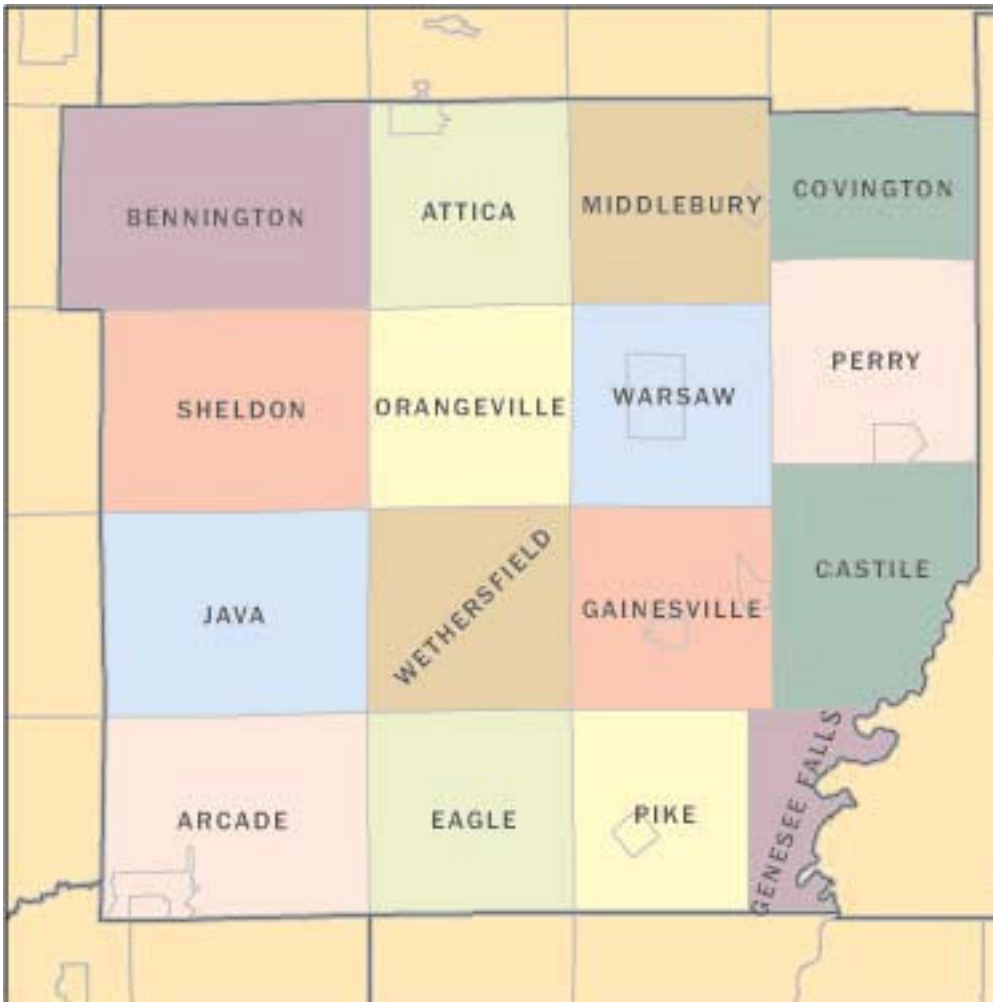
Wyoming County Highway Department
Horizontal Curve Study

UPWP #6228

Wyoming County, New York



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EXECUTIVE SUMMARY

Background

The Wyoming County Horizontal Curve Study was initiated by the Wyoming County Highway Department to perform ball bank studies on all of the horizontal curves on County roads with or without existing curve warning signs. The consultant was required to drive every county road in search of curves. The curves currently have warning signs in place which included horizontal curve warning and/or advisory speed plaque signs. The consultant evaluated the existing traffic control devices in place and made recommendations to the existing signage or for any additional traffic control devices that may be required. These recommendations were made in accordance with the 2009 National Manual of Uniform Traffic Control Devices (NMUTCD) and the current New York State Supplement to the MUTCD.

Recent updates to the NMUTCD made revisions to key sections that directly affect the existing warning signage on the roadways today. These revisions have superseded prior ball banking standards that were developed based on research from the 1930's. In specific, Section 2C.05 Placement of Warning Signs; Section 2C.06 Horizontal Alignment Warning Signs; Section 2C.07 Horizontal Alignment Signs; Section 2C.08 Advisory Speed Plaque and Section 2C.09 Chevron Alignment Signs of the 2009 NMUTCD were revised. The New York State supplement to the NMUTCD replaces Section 2C.07 in its entirety since it changed the majority of that section.

Previously, New York State accepted the standards set forth in the American Association of State Highway and Transportation Officials (AASHTO) green manual entitled "A Policy on Geometric Design of Highways and Streets" for determining safe speeds on horizontal curves. These speeds were established in Section 2C.08 Advisory Speed Plaque of the 2009 NMUTCD. With the acceptance of these new standards, Wyoming County retained Hunt Engineers, Architects and Land Surveyors, PC (HUNT) to perform the Horizontal Curve Study via UPWP Project #6228.

Horizontal Curve Analysis

Wyoming County provided HUNT a partial list of curves for each county road. Incorporated in this list was a Distance Measuring Instrument (DMI) reading that was used as a guide to assist in verifying the curves on each road. Since there was no formal inventory in the county HUNT had to drive each road and document each curve that was found. The DMI is a lineal footage reading from the southerly to northerly or westerly to easterly end of the roadway to the curves located on each county road. The DMI readings provided were inconsistent and overall difficult to utilize. This map was used in the field to locate each curve and a number was given to the curve to correlate between the field sheets and the individual county road maps. The county supplied list contained 125 curves. HUNT discovered an additional 102 curves through the study. Refer to county wide map, Figure 1 A for an overview of Wyoming County owned and maintained roads.

A family type sedan vehicle with an automatic transmission was used to complete the ball banking procedure for each curve. The vehicle type used represents the average vehicle driven on the roadways today. SUV's, trucks and sports cars were not permitted to complete the analysis as these vehicle suspensions were too stiff to accurately collect the ball bank readings. HUNT used a *Reiker RDS-BB-09* electronic Ball Bank Indicator (BBI), connected to a laptop computer to collect the ball bank degree readings as set forth in the 2009 NMUTCD. The BBI takes a reading every 250 milliseconds providing extremely accurate degree readings for the study. The readings were recorded to the nearest hundredth of a degree. The field data was collected during favorable weather conditions and off peak travel times to limit any possible deficiencies in the data collection process.

Once the field technician arrived at a curve location, the data collection process began by taking an inventory of the existing horizontal alignment warning sign, existing advisory speed from the advisory plaque (if there is a plaque) and any chevrons or arrows located within the curve. The technician would then start the actual electronic ball bank collection process by driving the curve at the existing advisory speed (if one exists) to determine what the existing degree of ball banking was in relation to the existing advisory speed. At this point the technician determined if the next speed trial would be an increase in speed, decrease in speed or if the speed would remain the same. If the advisory speed was to increase the technician would increase the vehicle speed by 5 mph to the next advisory speed. (Example, if the existing advisory speed was 35mph the next speed trial would be completed at 40mph.) This increase continued until the degree of ball banking matched with the correct advisory speed as shown below in Table 1. The table shows the degree of ball bank to advisory speed relationship. This same process applied if there was a decrease in speed. Once the advisory speed and the degree of ball bank matched, the technician would complete the analysis two more times at the corrected advisory speed (three total times) to eliminate any possible irregularities in speed trials.

Table 1

Ball Bank Indicator Criteria Per NMUTCD Sec. 2C.08.07
16 Degrees of ball bank for speeds of 20 mph or less
14 Degrees of ball bank for speeds of 25 to 30 mph
12 Degrees of ball bank for speeds of 35 mph or higher

If no advisory speed plaque existed the technician would begin the analysis at the existing posted speed limit. If no advisory speed was necessary, three trials were still completed to insure accuracy. If an advisory speed was required where one did not exist, the technician began at the speed limit, or at the highest possible safe traveling speed. Where it was determined due to safety issues the speed limit was too fast to complete the analysis, the technician would begin the speed trial at a safer speed. For example, if 55 mph was the posted speed limit and the analysis had to be aborted due to safety concerns, the technician began the analysis at 45mph. The vehicle speed was then decreased by 5 mph to establish a new advisory speed. Once again three trials were completed at the new advisory speed to ensure accuracy. All of the data was recorded on a field sheet developed by HUNT specifically for the Horizontal Curve Study. Refer to figure 2 for the field data collection sheet used.

Office Analysis

Once all of the field data collection was completed, the data from the field sheets was entered into a detailed spreadsheet developed by HUNT and Wyoming County to analyze the curves. Spreadsheets were created for each county road containing information for all curves in that town. HUNT created a numbering system that coincides with the county road map to show a direct link between the county road map and the curve numbering system.

Each county road's spreadsheet shows existing warning signage; existing posted speed limit; advisory speed; curve direction; existing chevrons or arrows and BBI reading. It also includes required warning signage and advisory speed per BBI reading. If chevrons or arrows were required as part of the analysis it was conveyed in a column entitled "Chevrons or Arrows required". In section 2C.06.03 of the Horizontal Alignment Warning Signs section the following is an option "Horizontal Alignment Warning signs may also be used on other roadways or on arterial and collector roadways with less than 1,000 AADT based on engineering judgment". Wyoming County has chosen to follow this option. Although if there is a higher accident rate on one of these curve locations the county must place chevrons at these locations. According the NMUTCD, chevrons or arrows are required (indicated in the manual as "shall") if the difference between the posted speed limit and advisory speed is 15 mph or more, and recommended (indicated in the manual and "should") if the difference is 10 mph or more. However, per NYSDOT interpretation of the NMUTCD a "should" will be a "shall" unless there is a sound engineering reason. Thus, Hunt indicated in the spreadsheet that chevrons or arrows are required for both of these conditions. The spreadsheet also included the date and weather conditions at the time of data collection. A sample of one county road (County Road 9) spreadsheet with recommendations is attached to this summary.

Conclusion

Many of the current warning signs (especially the advisory speed plaques) are out of date with regard to current standards when the horizontal curves are driven due to indicated speeds that are slower than the vehicles of today can safely negotiate. It is very important to note that this study and its recommendations do not change the actual speed limit, but just the advisory speed for a particular curve. The new advisory speeds will coincide with advances in automobile and tire technology as well as highway design. Having the correct warning signs and advisory speed plaques will assist the motorist in safely navigating county roads.

There were 227 curves that were analyzed as part of this study, 185 of them require a change per the new regulations. The remaining 42 locations require no signage revisions however; the county will need to evaluate each location to determine if the current sign locations meet the revised standards. There are a variety of changes that will be required, ranging from removing the advisory speed plaque and relocating the sign, to requiring a full sign replacement, including chevron installation. Regardless of the required changes, the outcome will be a much safer roadway network designed for today's vehicles.