

Deer-Vehicle Crash Patterns and Proposed Warning Sign Installation Guidelines

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ABSTRACT

Deer crossing signs are the most widely used potential countermeasure to deer-vehicle crashes (DVCs). The Manual on Uniform Traffic Control Devices provides qualitative guidance and indicates the installation of these signs where animal crossings are unexpected. Most drivers assume these signs designate roadway segments with larger than typical numbers of DVCs and/or deer crossings. Studies of deer crossing signs have generally focused on their enhancement and assumed that they are correctly located and ineffective at DVC reduction. No generally available, documented, and defensible DVC-related guidance criteria for the installation of deer crossing signs were found during this project. These signs, however, are numerous and their proper installation at locations with a DVC problem would be more consistent, use limited resources more efficiently, and maximize whatever potential impact these signs might have on drivers. The research summarized in this paper investigated DVC patterns near 38 pairs of deer crossing sign pairs in five Wisconsin counties. Three years of reported DVCs were collected and summarized for the roadway segments between and within two miles of these pairs. Overall, 1/4-mile and average segment DVC frequencies and rates were calculated between and outside each sign pair, and compared with each other and the county and state averages. Fourteen of the 38 sign pairs were further evaluated because their average and peak DVC measures were all located between the signs. The findings of this research were used to develop some general installation guidelines for deer crossing signs. The limitations of the guidelines are noted.

KEYWORDS: Deer-vehicle crash, safety, deer crossing warning signs, Manual on Uniform Traffic Control Devices

INTRODUCTION

A number of methods have been used to reduce deer-vehicle crashes (DVCs) (1, 2). Some of these countermeasures included deer fencing, wildlife crossing structures, roadside reflectors, vehicle whistles, highway lighting, and speed limit reductions (2). The installation of a deer crossing sign (W11-3) to warn drivers of a roadway segment with a potential problem, however, is the most widely used and familiar attempt at DVC mitigation (See Figure 1). The primary objective of these signs is to warn the driver of that they are driving along a roadway segment that may experience unexpected animal crossings (3). If anything, however, a typical driver assumes that these signs are installed in locations with a higher than normal number of DVCs and/or deer crossings. The installation of these signs along segments that do not have a DVC-related problem is not only a waste of resources (e.g., funding, manpower, and time), but also reduces whatever impact these signs might have on the driver.

RESEARCH SCOPE AND OBJECTIVE

Deer crossing signs (See Figure 1) are used throughout the United States, but the proper placement of these signs has not been studied. Very few published documents were found that focused on the methods or criteria to properly locate these signs, and quantitative guidance on their installation is almost non-existent. In addition, those jurisdictions that do use some type of quantitative DVC-related installation criteria appear to rarely document the methodology and often do not know the basis of the criteria used. The Manual of Uniform Traffic Control Devices (MUTCD) provides some qualitative installation guidance, but is purposely broad in its language and allows the installation criteria used (if any) for the animal crossing warning sign to be decided locally (3).

This research does not attempt to measure the vehicle-speed or DVC reduction capabilities of deer crossing signs. Its scope is limited to the investigation of DVC patterns near a sample of sign pair sites in Wisconsin, and the development of suggested sign installation guidelines. These signs are extensively used, however, and must be properly located to maximize the impact they might have on driver choice, and for researchers to measure that “true” impact. In addition, it was hypothesized that the current overuse and misuse of deer crossing signs is not only costly, but may also reduce whatever potential impact these signs may have on a driver.

The research described in this paper investigated the DVC patterns near 38 deer crossing sign pairs in five Wisconsin counties. Three years of reported DVCs were summarized between and within two miles of each of these sign pairs, and then compared with each other, and county and statewide measures. The peaking patterns of the DVC data along each segment were also investigated and the sign pairs that were most likely to be in the proper location identified. Based on the activities in this research, some deer crossing sign installation guidelines are suggested, and future research projects to improve the methodology recommended. The authors believe that the application of the proposed guidelines could result in the more effective and efficient installation of deer crossing signs.

PAST RESEARCH

Factors Impacting DVCs

Relationships between the magnitude and/or the location of DVCs and a number of roadway, land use, and ecological factors have been shown to exist (4, 5, 6, 7, 8, 9, 10, 11, 12). Some researchers believe these factors have a direct influence on the probability of a DVC occurring at a particular location. Some of the factors identified included, but are not limited to, the following:

- Traffic volume;
- Vehicle speeds;
- Roadway mileage;
- Roadway features (e.g., number of lanes and bridges);
- Roadside features (e.g., gullies and rivers);
- Roadside and roadway visibility;
- Adjacent land type (e.g., forestland, rural area);
- Adjacent land use or activity (e.g., urban, rural, residence, buildings, and parks);
- Deer population;
- Human population; and
- Vegetation cover.

The individual influence of each factor on the magnitude and location of a DVC is difficult to quantify. The inter-correlation between the factors is significant. Researchers in Ohio found correlations between the number of DVCs in a county and its area, amount of forestland/rural land/cropland, human population, and length of major roadway mileage (9). In addition, an Illinois study found correlations between the number of DVCs in a county, and the deer density and average daily vehicle-miles-of-travel (VMT) in that county (11). Not surprisingly, the factors that apparently have the strongest linear relationship with the magnitude of DVCs in a county appear to be related to the DVC exposure measures of deer population and the amount of vehicle travel.

Hubbard, et al. have also investigated the relationships between several factors and the probability that a particular segment along a roadway might be a “high” DVC location (5). The data considered for a series of roadway segments included nearby deer harvest numbers, traffic volume estimates, grass and woody patches, the distance from the segment to the nearest town or city, and the distance to the nearest city with a population greater than 2,000 (5). The number of bridges nearby and the number of roadway lanes were also included. The final model indicated that the number of nearby bridges, lanes of traffic, and the average size and number of nearby grass and woody patches were positively related to the probability that the segment would be a “high” DVC location (5). The number of bridges was the strongest predictor (5).

DVC Sign Installation Guidance

Section 2C.27 of the Manual on Uniform Traffic Control Devices (MUTCD) specifically addresses the installation of animal crossing signs (See Figure 2). The portion of this section that specifically applies to undomesticated animal crossing signs is primarily limited to three options and a support statement. The remainder of the section (although not stated directly) appears to

be focused on signing locations where the crossing location would be known (3). In general, for deer crossing signs, the MUTCD indicates that the signs may be placed where "...unexpected entries in the roadway...might occur" (3). Unfortunately, most wild deer crossings are unexpected, and in many states these crossings and DVCs occur along entire roadway alignments. In fact, during the last several years, approximately 15 percent of all reported crashes in Wisconsin have been DVCs. A support statement in the MUTCD recognizes this potential pattern of animal-vehicle conflicts by stating that they can be "...relatively confined, or might occur randomly over a segment of roadway" (3). Overall, the MUTCD allows each jurisdiction the ability to determine if it will install deer crossing signs and how the location of these installations will be chosen.

A search of the web and published documents revealed that only a few jurisdictions have attempted to create or publicly document their deer crossing sign installation guidelines (13, 14, 15). Several agencies were also contacted directly and many appear to follow an undocumented rule-of-thumb or guideline and some even have a specific number of segment DVCs they consider unusual during a certain time period. These criteria, guidelines, or procedures are rarely documented (outside internal reports), and the basis of any quantitative DVC criteria is often unknown.

As indicated, some samples of documented criteria were found (13, 14, 15). The Washtenaw County Michigan Road Commission has suggested a warning sign installation procedure that considers the DVC history along a road segment of interest and one mile in each direction (13). Its suggested procedure indicates that a deer crossing sign should be warranted if five DVCs have occurred along the segment within a twelve-month period (13). The procedure also recommends that DVC levels near existing signs be reviewed every third year and adjustments made if appropriate (13). Other criteria are less specific, but offer more guidance than the MUTCD. A traffic control document from Iowa recommends that deer crossing signs be installed where the posted speed is in greater than 45 miles per hour or an obstruction and topography occasionally limit sight distance (14). It is also recommended that historical DVC data be reviewed to determine appropriate installation locations (14, 15).

Deer Crossing Warning Sign Effectiveness and Enhancements

No documented research was found that specifically examined the vehicle speed- and/or DVC-reduction effectiveness of *typical* deer crossing signs (See Figure 1). However, two studies have been documented that focused on the *enhancement* of deer crossing signs (16, 17, 18). These enhancements included different sign designs, the addition of lights, and the combination of roadside animal detection systems and active signing/lighting. The general conclusions of these two studies was that the design improvements and more responsive signing systems do reduce vehicle speeds (in the case of these two studies it was often less than an average of three miles per hour), but that the impact of this reduction on the occurrence of DVCs (especially in the long-term) was unknown or questionable (16, 17, 18). Not surprisingly, the largest reductions in vehicle speed during the studies were observed when the sign enhancements were active and there was a deer, deer decoy, or deer carcass on the roadside. Several new sign and sensor technologies (combining roadside animal detection and some type of sign warning system such as flashing lights) have been implemented in North America, and most are being closely evaluated. None of the documented sign enhancement studies, however, address whether the

existing or new signs are properly located (16, 17, 18). All of the studies are based on the initial assumption that the typical deer crossing signs are ineffective.

SIGN PAIR LOCATION SELECTION

One of the primary objectives of this research project was the investigation of DVC patterns near a sample of deer crossing sign locations. The first step in the process to identify the sample sign locations was the analysis of the reported DVC and deer carcasses removed (DCR) data available for each Wisconsin county. Overall, the number of DCRs in Wisconsin is more than twice the reported number of DVCs. A ranked plot of the county DCR to DVC ratios is shown in Figure 3. Visually identified breakpoints in this plot appear at about 4.9 and 14.9, and with a state average ratio of 2.2 it was decided that those counties with ratios less than 4.9 were more representative of the data in the state. Wisconsin has 72 counties, and this decision removed 14 of these counties from further consideration in this research. The annual DVC and DCR data from the remaining 58 counties were then ranked by

- Total Magnitude,
- Per Hundred-Million-Vehicle-Miles-Traveled (HMVMT),
- Per Mile of Roadway,
- Per Land Area,
- Per Human Population, and
- Per Deer Population.

The top ten Wisconsin counties in these 12 rankings are shown in Table 1. Thirty counties appear in Table 1, and 16 counties are in three or more of the lists. In fact, two counties are in 10 and 11 lists. A sample of sign locations in five counties was selected for DVC pattern analysis. These counties included Adams, Dane, Sauk, Shawano, and Waupaca. These counties are in close proximity to the University of Wisconsin-Madison and appear in 2 to 10 of the rankings shown in Table 1. Their DCR to DVC ratios range from 0.98 to 2.72 with an average of about 1.97. This average is slightly smaller and somewhat better than the state average (i.e., the reported DVCs and DCRs are closer to being equal). All five of these counties have above average DVCs.

The deer crossing sign pairs evaluated in this research are along the state highway system in the five counties selected. First, the deer crossing signs in each county that were in the Wisconsin Department of Transportation sign management system were identified, and then their location determined and existence confirmed with the state photolog. A total of 68 signs were identified for further analysis. Using the photolog, it was confirmed that all of these signs existed between 1996 and 1998 (the years of analysis). Eight additional deer crossing signs were also assumed to exist, but removed or stolen. These eight signs represent the other half of a sign pair of which only one sign along with a distance plaque (e.g., "NEXT 7 MILES) were confirmed in the photolog. The location of the removed or stolen signs was determined by the length indicated on the distance plaque. The DVC pattern analyses described in the following paragraphs, therefore, are based on 76 individual deer crossing sign locations or a total of 38 deer crossing sign pairs.

DVC PATTERN ANALYSIS

The DVC patterns near 38 deer crossing sign pairs were examined as part of this research. The number of sign pairs per county, and the average and range of roadway segment length designated by these sign pairs are shown in Table 2. Overall, the average length between the signs was about 2.8 miles, but ranged from 0.7 to 11.0 miles.

Reported DVCs from 1996 to 1998 that occurred between and within two miles of the 38 sign pairs were counted, summarized, and evaluated. More specifically, the total number and rate of DVCs along each sign pair site was calculated and plotted at 1/4-mile increments. An example is shown in Figure 4. The average DVC frequency (i.e., DVCs per year per mile) and rate (i.e., DVCs per HMVMT) for each section of the segment (i.e., the roadway segment *between* the signs, and the two-mile segments on each end or *outside* the signs) were also calculated (See Figure 5). In addition, the 1996 to 1998 average DVC frequency and rate for all the roadways in each county and the state were determined for comparison purposes.

The average 1996 to 1998 DVC frequency and rate for all the roadways in Wisconsin and each of the five counties, along with these measures between the deer crossing sign pair locations considered, are shown in Table 3. Not surprisingly, given the methodology used to select the sign pair locations, the average county frequencies and rates are generally greater than the state average. Only the Dane County rate was lower, and that is most likely due to the fact that it is one of the more populated counties in the state. The average state DVC frequency from 1996 to 1998 was 0.17 DVCs per roadway mile per year, and the average frequencies in the counties selected ranged from 0.25 to 0.41 (47 to 141 percent greater than the state average). The county average DVCs per HMVMT ranged from 30.6 to 186.6, and the state average DVCs per HMVMT was only 36.2. Four of the five counties considered had average DVC rates approximately 98 to 515 percent greater than the state average.

The average DVC rate between the sample deer crossing sign pairs was more than five times (or 500 percent) greater than the state average. The average DVC rates between the sample sign pairs in each county also ranged from 4.0 to 7.2 times the state average. The DVC rate outside the sample sign pairs (but within two miles of each sign) was generally somewhat lower than between the signs, and ranged from 3.1 to 4.9 times the state average. Similar results were found when the DVC frequency per mile per year analysis was completed. The average DVC rate between the sign pairs in four of the five counties also ranged from about 1.4 to 6.4 times the average DVC rate in each particular county. The average DVC rate between the sample sign pairs in Adam County was only about 97 percent of the average rate in the entire county (See Table 3). The average rates outside the sign pairs in each county were also only about 50 to 93 percent of the average rates between the signs. Clearly, the locations being considered, on average, were in counties that had a higher than typical DVC problem, and the signs designated problem locations within the county in which they were installed. The signs also designated roadway sections with DVC rates and frequencies that experienced higher DVC problems than on nearby (i.e., *outside* or within 2 miles of the sign pair) roadway segments (See Figure 5). A paired t-test showed that the DVC frequency and rate between the signs were significantly greater (at a 95 percentile level of confidence) than these measures, outside, but within two miles, of the sign pair.

Additional analyses were completed by plotting the 1996 to 1998 1/4-mile total DVCs and DVC rates near each sign pair (See Figure 4). These plots were evaluated to determine if they might contain additional information for a suggested guidance procedure. The initial investigation indicated that 11 of the 38 sign pair sites had their peak 1/4-mile and peak segment average DVC frequencies and rates occur outside the sign pairs. As previously indicated, each sign pair site has three segments, one between the signs and the two-mile segments *outside* the signs at each end of the site (See Figure 5). Another 13 of the 38 sites had two or more of these four measures occur both between and outside the sign pairs. The remaining sites had all four measures occur between the deer crossing signs. The DVC characteristics of these 14 positive sign locations (PSLs) were further evaluated because the authors had more confidence that these signs were properly located.

Overall, the average DVC frequency (i.e., crashes per mile per year) between the 14 PSL sign pairs was about 50 percent higher than the average between sign pair frequency for all 38 sites. Similarly, the average between sign DVC rate for the PSLs was approximately 27 percent higher than the between sign rate for all 38 sites. The average between to outside (See Figure 5) ratios of DVC frequency and rate were also about 76 and 84 percent, respectively, higher than that of the 38 sites. On average, almost twice as many crashes occurred between the PSL signs during the three years considered than occurred outside the signs. The difference in DVC frequencies and rates between and outside the signs ranged from about 29 to 85 percent.

PROPOSED WARNING SIGN INSTALLATION GUIDANCE

The previously described evaluation activities and DVC pattern results of this research were used to create a suggested set of guidelines for deer crossing sign installation. All or part of these guidelines could be applied in any jurisdiction if the necessary data and resources were available. Limitations to the proposed guidelines are also discussed. The following steps are suggested, and the procedure is summarized in Figure 6.

Step 1: Site Visit and Segment Limit Definition

Visit the site to determine the physical outer limits of the proposed sign pair. Factors to consider when identifying the segment limits include, but should not be limited to, changes in land use cover and topography, suggestions by local residents, fencing locations or woodland/crop edges, and water source locations. Refer to the literature review portion of this paper for a more detailed list of factors. Assistance from the local or state natural resources staff and enforcement personnel is strongly suggested. If the defined segment length is less than one mile the need for the sign pair should be questioned. If the segment length defined is greater than five miles the use of multiple sign pairs may be appropriate.

Step 2: DVC Data Collection

Collect DVC data by location for the site defined in Step 1 (i.e., the potential outer limit locations of the sign pair) plus two miles in each direction. This will define the three segments within your study site (See Figure 5). A minimum of three years of the most recent DVC data should be collected from state and/or local enforcement agencies. More DVC data should be collected if at all possible. The location of each crash should be identified. County and state DVC frequency and rate averages should be calculated.

Step 3: DVC Measure Calculations

Calculate the measures of safety considered in this research (i.e., DVCs per mile per year and DVCs per HMVMT) to describe the DVC problem along the defined segment. These calculations should be for 1/4-mile sections of the entire roadway length of interest (i.e., between the proposed sign pair and the two miles on each end). Average segment DVC measures should also be calculated between and outside the proposed sign locations, and for the overall roadway length. Individual between to outside DVC frequency and rate ratios (for the two “outside” two-mile ends at each study site) should be calculated and the 1/4-mile patterns of the DVC measures plotted.

Step 4: State and County Average Comparison

Compare the site DVC measures to the DVC averages for the entire state and county. If either the average frequency or rate between the proposed sign pair is less than the state average, the installation of the signing should be reconsidered. If both measures are greater than the state average they should then be compared to the county DVC averages. If either the average DVC frequency or rate between the proposed signs is less than the county average the installation of the signs should be reconsidered.

Step 5: Between to Outside Comparison

Compare the between to outside sign pair DVC measure ratios calculated for the site to the average ratio from the county (if available). The ratios should be greater than one. Proceed to Step 6 if both ratios are greater than the average calculated for that county. If either ratio is less than one or the calculated county average the installation of the sign pair should be reconsidered. The average county DVC ratios used in this step could be based on a sample of existing sign sites in the county.

Step 6: Positive Sign Location (PSL) Determination

Use the 1/4-mile plots of the DVC measures to determine whether the proposed location is a PSL. A PSL has its peak total 1/4-mile frequency and rate, and peak average segment frequency and rate all occurring between the signs of the proposed installation site. If the PSL requirements are met the proposed sign installation should be considered feasible. If these PSL requirements are not met, a redefinition of the proposed site may be appropriate, and Step 7 should be applied.

Step 7: Redefine DC Sign Locations

If necessary, the results of Step 6 can also be used to redefine the initially proposed deer crossing sign locations. If all four DVC measures used to define a PSL occur within one of the segments outside the signs, it is recommended that the initially proposed location of both signs be shifted until the peak 1/4-mile frequency and rate are included between the signs. The procedure suggested here should then be reapplied from Step 2 for the newly defined sign locations. If the four DVC measures occur outside both ends of the signed segment (but within the study site) it is recommended that the initial length proposed between the sign pair be extended in both directions until the peak 1/4-mile frequency and rate are included between the signs. The procedure suggested here should then be reapplied from Step 2 for the newly defined sign pair locations. Single sign pair installations should continue to be considered until a suggested

maximum length (e.g., five miles) is met, or this step is being considered for the third time. At that point the value of installing signs at this location should be evaluated.

LIMITATIONS TO THE SUGGESTED GUIDANCE

There are several limitations to the suggested installation guidance. First, the procedure, if followed directly, does not allow the installation of deer crossing signs at locations that currently have DVC measures that are less than the average of the sign pairs that already exist. The effectiveness, therefore, of this procedure depends on past (good or poor) decisions used to locate existing deer crossing signs. Fortunately, the critical DVC values or measures (e.g., the existing averages) in the procedure, depending on the capabilities of jurisdiction, can also be increased, reduced, or eliminated as appropriate. To minimize the overuse and misuse of deer crossing signs the level of DVC criteria or rules in the suggested guidance, however, were purposely made rather difficult to meet. Second, the crash and locational data required for this procedure can be difficult to collect and calculate, and the comparison measures used should be updated every year for the most recent three-year average. However, the procedure can also be partially applied. Third, it should be recognized that the “blind” application of these guidelines is not appropriate. Judgment will always be necessary at those locations that do not meet any or all of the criteria suggested, but are still believed to have a DVC problem. Finally, the guidelines could also be applied to existing sign pairs, but the DVC data from that site should be excluded from any of the average DVC criteria used for comparison purposes.

CONCLUSIONS AND RECOMMENDATIONS

- There are a large number of physical factors that appear to be related to the number and location of DVCs and/or the probability of a location being a “high” DVC location. These factors include, but are not limited to, adjacent traffic volume, vehicle speeds, land type, adjacent land use, human population, deer population, roadway mileage, roadway features, roadside features, roadside visibility, and vegetation cover. It is recommended that these factors, along with DVC measures, be considered when identifying the roadway segment designated by deer crossing signs.
- No research was found that evaluated the potential vehicle-speed and/or DVC-reduction effectiveness of *typical* deer crossing signs. At least two studies have evaluated the improved effectiveness of *enhanced* signs and sign-sensor systems (16, 17, 18). The vehicle speed reductions found in these studies were typically no more than 3.0 mph unless a deer, deer decoy, or deer carcass was present on the roadside. A number of deer crossing warning sign and sensor system installations have been installed and are being tested throughout North America. It is recommended that the actual effectiveness and attention value (if any) of typical deer crossing signs be studied, and that the evaluation of new sign systems continue.
- The five counties considered in this research were partially selected by their position in rankings for total DVCs, DCRs, and DCR and DVC rate by HMVMT, roadway length, county land area, human population and deer population. These data and rankings were useful in the determination of which counties might have DVC concerns. They also allowed the comparison of DCR and DVC data that could result in the identification of concerns

related to the collection of crash and carcass data. It is recommended that the data for the rankings used in this research be collected and these types of measures calculated. It is also recommended that a county estimate of deer population be completed for a better understanding of this DVC exposure measure. Many states estimate deer population by ecological management unit rather than governmental jurisdiction.

- The location of DVCs and DCRs is a key evaluation input. It is recommended that the number and location of both DVCs and DCRs be recorded as accurately as possible. DVCs, like other property-damage only crashes, tend to be highly underreported, and most jurisdictions do not record their DCRs. Both types of data can be used to better understand the actual status of a DVC problem.
- The average DVC rate between the 38 pairs of deer crossing signs was more than five times the state average. Average DVC frequencies between the signs were also much higher than the state and appropriate county averages. It was concluded that most of the sign pair locations chosen for this research were placed along segments with higher than average DVC problems. A paired t-test also showed that the DVC frequencies and rates between the signs were significantly larger than these measures outside the signs (at a 95 percent level of confidence). This test result supported the conclusion that the sign pairs evaluated appear to designate roadway segments with DVC problems greater than their adjacent roadway segments. It is recommended that these characteristics be present at existing and future deer crossing sign locations, and they are included in the proposed guidance.
- Further analysis of DVC patterns revealed that only 14 of the 38 sign pairs were at a positive sign location (PSL). A PSL is defined as a sign pair study site where all the peak 1/4-mile DVC total frequency and rate, and the highest segment DVC frequency (DVCs per mile per year) and rate (DVCs per HMVMT) average occurs between the signs. It was concluded that the PSL sign pairs were more likely to be in the correct location (i.e., designate a segment with a DVC problem). The average PSL frequency and rate between the signs were 49 and 27 percent higher than the same measure for all 38 sign pairs. This site characteristic is also recommended for use in the proposed installation guidelines.
- It is recommended that all or part of the suggested deer crossing sign installation guidelines be implemented. Each jurisdiction should evaluate what portions of the guidelines seem appropriate, and whether the DVC criteria suggested should remain as proposed, relaxed, or increased. It is strongly suggested that personnel from departments of enforcement, natural resources, and transportation coordinate in the proper installation of deer crossing signs.

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List of Figures and Tables

FIGURE 1 Deer crossing sign (3).

FIGURE 2 Section 2C.37 of Manual on Uniform Traffic Control Devices (3).

FIGURE 3 Ranked county deer carcass removal (DCR) to deer-vehicle crash (DVC) ratios.

FIGURE 4 Example 1/4-mile deer-vehicle crash (DVC) patterns near deer crossing signs (1996 to 1998).

FIGURE 5 Example of deer crossing sign study site.

FIGURE 6 Deer crossing sign installation procedure guidance.

TABLE 1 Wisconsin Counties with Highest Deer Carcass Removal (DCR) and Deer-Vehicle Crash (DVC) Characteristics¹

TABLE 2 Deer Crossing Sign Pair Sample Characteristics

TABLE 3 State, County, and Sample Sign Pair Deer-Vehicle Crash Measures (1996 to 1998)¹



FIGURE 1 Deer crossing sign (3).

Section 2C.37 Crossing Signs (W11-1, W11-2, W11-3, W11-4, W16-7P)**Option:**

Crossing (W11-1 through W11-4) signs may be used to alert road users to locations where unexpected entries into the roadway by pedestrians, bicyclists, animals, and other crossing activities might occur.

Support:

These conflicts might be relatively confined, or might occur randomly over a segment of roadway.

Option:

Crossing signs may be supplemented with supplemental plaques (see Section 2C.39) with the legend AHEAD, XX METERS (XX FEET), or NEXT XX KILOMETERS (NEXT XX MILES) to provide advance notice to road users of crossing activity.

Standard:

Crossing signs shall be used adjacent to the crossing location. If the crossing location is not delineated by crosswalk pavement markings, the Crossing sign shall be supplemented with a diagonal downward pointing arrow plaque (W16-7P) showing the location of the crossing. If the crossing location is delineated by crosswalk pavement markings, the diagonal downward pointing arrow plaque shall not be required.

Option:

The crossing location may be defined with pavement markings (see Section 3B.17). Pedestrian, Bicycle, School Advance Crossing, and School Crossing signs may have a fluorescent yellow-green background with a black legend and border.

Guidance:

When a fluorescent yellow-green background is used, a systematic approach featuring one background color within a zone or area should be used. The mixing of standard yellow and fluorescent yellow-green backgrounds within a selected site area should be avoided.

Crossing signs should be used only at locations where the crossing activity is unexpected or at locations not readily apparent.

FIGURE 2 Section 2C.37 of Manual on Uniform Traffic Control Devices (3).

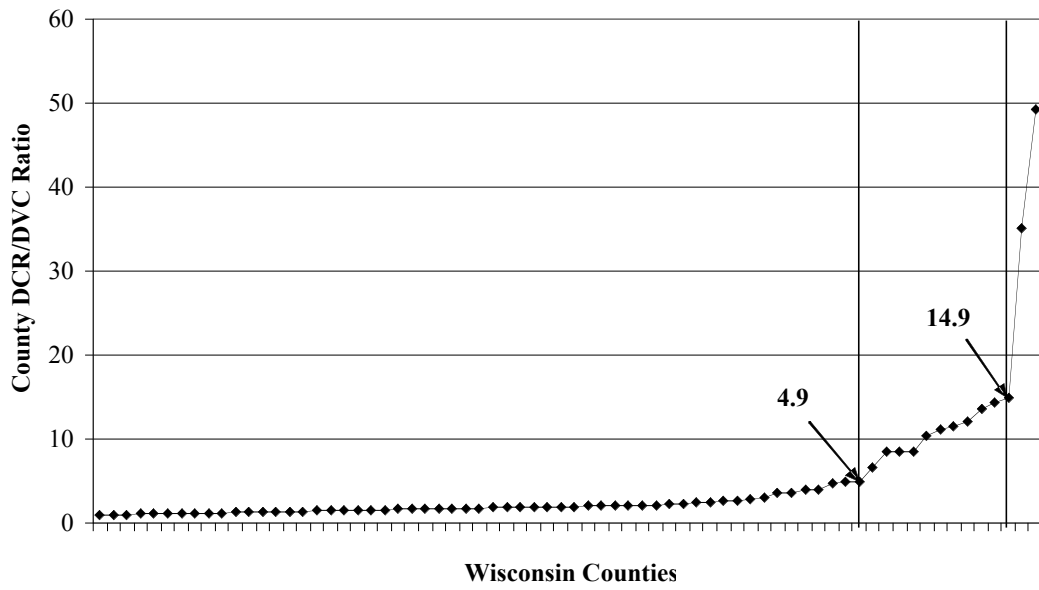


FIGURE 3 Ranked county deer carcass removal (DCR) to deer-vehicle crash (DVC) ratios.

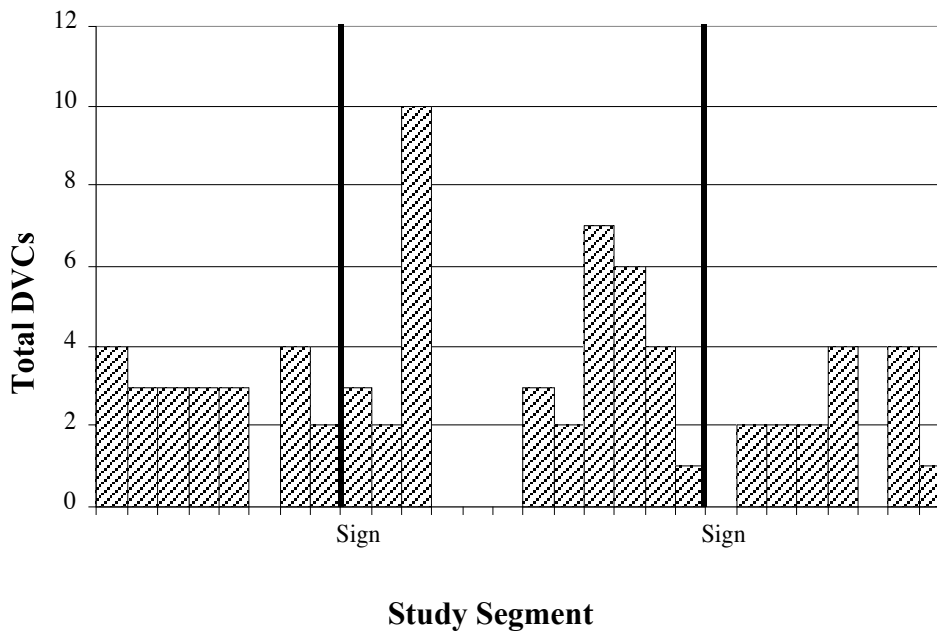
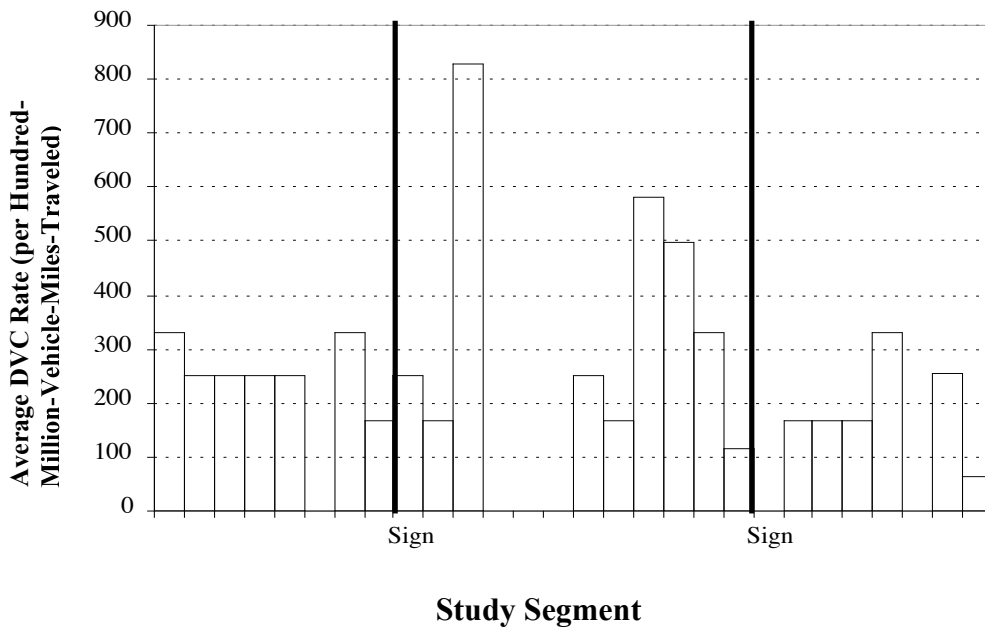


FIGURE 4 Example 1/4-mile deer-vehicle crash (DVC) patterns near deer crossing signs (1996 to 1998).

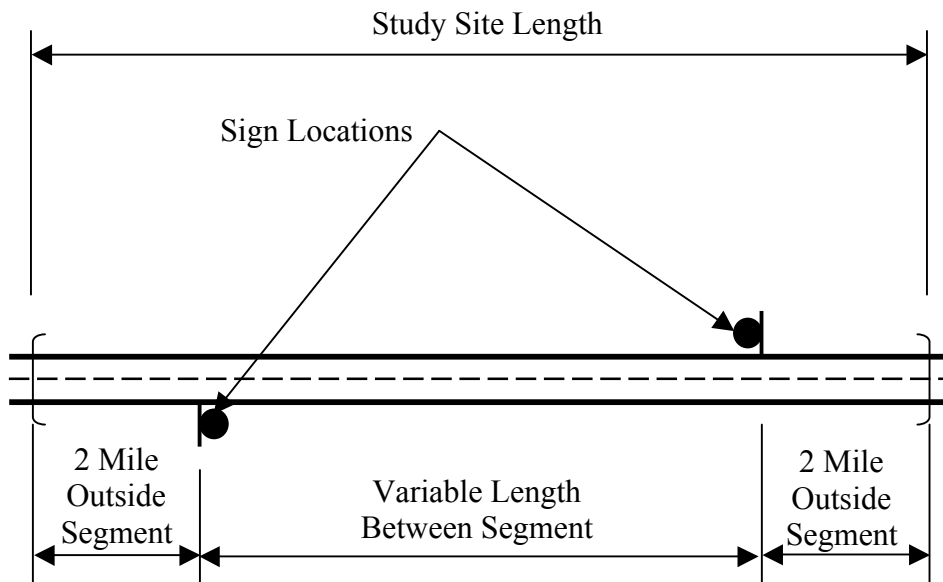


FIGURE 5 Example of deer crossing sign study site.

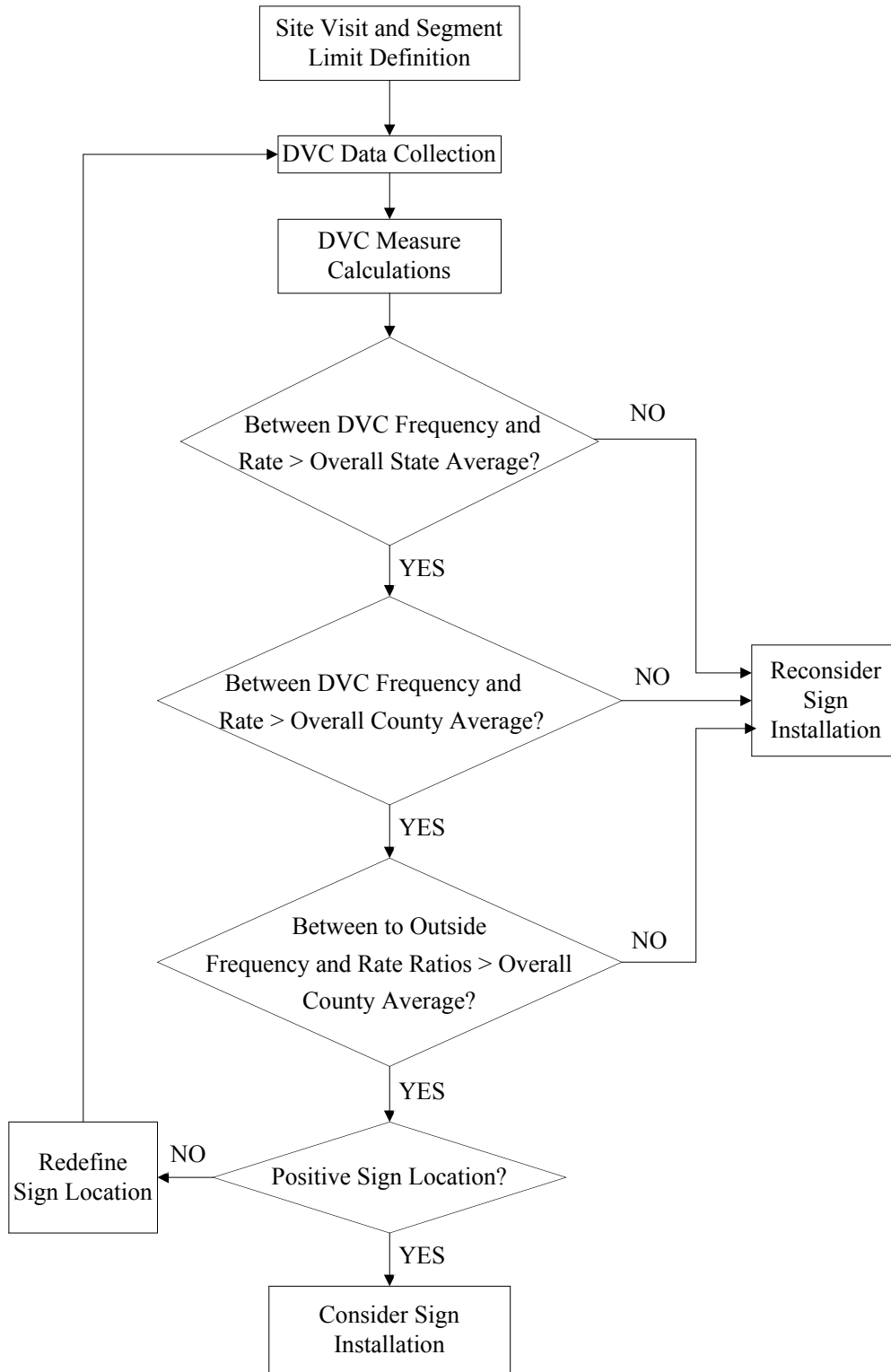


FIGURE 6 Deer crossing sign installation guidance.

TABLE 1 Wisconsin Counties with Highest Deer Carcass Removal (DCR) and Deer-Vehicle Crash (DVC) Characteristics¹

	Total DCRs	DCRs per HMVMT	DCRs per Mile of Roadways	DCRs per County Land Area	DCRs per Thousand Human Population	DCRs per Thousand Deer Population
1	Waupaca	Adams	Waupaca	Waukesha	Florence	Ozaukee
2	Shawano	Shawano	Shawano	Waupaca	Adams	Waukesha
3	Dane	Florence	Green Lake	Winnebago	Waushara	Milwaukee
4	Waukesha	Waupaca	Waushara	Shawano	Shawano	Washington
5	Columbia	Green Lake	Columbia	Ozaukee	Marquette	Brown
6	Marathon	Waushara	Oneida	Green Lake	Waupaca	Walworth
7	Oneida	Oneida	Marquette	Waushara	Oneida	Winnebago
8	Waushara	Marquette	Adams	Columbia	Jackson	Sheboygan
9	Dodge	Taylor	Florence	Brown	Green Lake	Fond du Lac
10	Adams	Clark	Winnebago	Washington	Columbia	Dane

¹DCR = Deer carcass removals and HMVMT = Hundred million vehicle miles traveled.

	Total DVCs	DVCs per HMVMT	DVCs per Mile of Roadways	DCRs per County Land Area	DVCs per Thousand Human Population	DVCs per Thousand Deer Population
1	Dane	Adams	Waupaca	Sheboygan	Florence	Waukesha
2	Marathon	Shawano	Shawano	Winnebago	Adams	Milwaukee
3	Shawano	Taylor	Green Lake	Waukesha	Shawano	Ozaukee
4	Waupaca	Green Lake	Columbia	Ozaukee	Marquette	Brown
5	Columbia	Waupaca	Sheboygan	Dane	Jackson	Sheboygan
6	Portage	Forest	Portage	Waupaca	Green Lake	Kenosha
7	Waukesha	Florence	Winnebago	Columbia	Taylor	Washington
8	Sheboygan	Marquette	Sauk	Washington	Forest	Dane
9	Sauk	Richland	Dane	Shawano	Waupaca	Rock
10	Winnebago	Portage	Marquette	Green Lake	Columbia	Racine

¹DVC = Deer-vehicle crash and HMVMT = Hundred million vehicle miles traveled.

TABLE 2 Deer Crossing Sign Pair Sample Characteristics

Wisconsin County	Number of Pairs	Average Distance between Signs (Miles)	Range of the Distance between Signs (Miles)
Adams	5	2.8	2.0 to 4.0
Dane	11	2.5	0.7 to 5.5
Sauk	8	3.0	1.0 to 10.0
Shawano	6	2.2	1.0 to 3.6
Waupaca	8	3.4	0.9 to 11.0
Overall	38	2.8	0.7 to 11.0

TABLE 3 State, County, and Sample Sign Pair Deer-Vehicle Crash Measures (1996 to 1998)¹

County and State	Overall Frequency (DVCs per Mile per Year)²	Average Between Sign Sample Frequency (DVCs per Mile per Year)	Overall Rate (DVCs per HMVMT)²	Average Between Sign Sample Rate (DVCs per HMVMT)
Adams	0.29	2.92 (n = 5)	186.6	181.8 (n = 5)
Dane	0.32	3.28 (n = 11)	30.6	196.2 (n = 11)
Sauk	0.29	1.91 (n = 8)	71.8	154.2 (n = 8)
Shawano	0.25	1.80 (n = 6)	97.1	254.9 (n = 6)
Waupaca	0.41	2.04 (n = 8)	130.3	187.5 (n = 8)
Total County Sample	NA	2.45 (n = 38)	NA	192.9 (n = 38)
Wisconsin	0.17	NA	36.2	NA

¹DVC = Deer-vehicle crash, HMVMT = Hundred million vehicle miles traveled, and NA = Data not available.

²Overall frequencies and rates are for the roadway segments in the entire county and state.