SUMMARY REPORT

A Review of the Impacts of the Towaway Reporting Threshold on a Highway Safety Program

HSIS

Highway Safety Information System

The Highway Safety Information Systems (HSIS) is a multi-State safety data base that contains accident, roadway inventory, and traffic volume data for a select group of States. The participating States, California, Illinois, Maine, Michigan, Minnesota, North Carolina, Utah, and Washington, were selected based on the quality of their data, the range of data available, and their ability to merge data from the various files. The HSIS is used by FHWA staff, contractors, university researchers, and others to study current highway safety issues, direct research efforts, and evaluate the effectiveness of accident countermeasures.

U.S. Department of Transportation
Federal Highway Administration

Research, Development, and Technology
Turner-Fairbank Highway Research Center
6300 Georgetown Pike • McLean, Virginia 22101-2296

State, county, and municipal governments are all seeking ways to meet increasing demands on their limited resources. In many cases, the available resources are either shrinking or growing at a slower rate than demand. For this reason, a number of States are in the process of studying, or have studied, the possibility of changing the non-injury threshold to a higher level where at least one vehicle is disabled to the extent it must be towed from the scene—the "towaway" threshold. This threshold has already become the default standard in some major metropolitan areas, in spite of what the law may require. Some States are even considering an injury threshold for reporting collisions.

A 1998 study by Zegeer et al. found that if there were a towaway threshold, only 51.7 percent of crashes would be included and if there were an injury threshold, only 33.7 percent of crashes would be included. They also found that a towaway threshold would: (1) exclude more crashes on urban streets than on rural roads (2) underestimate rear-end, sideswipe, parking, and animal crashes and (3) seriously affect the reporting of run-off-road, angle, and turning crashes. Zegeer et al. concluded that a towaway threshold would seriously affect the ability to meaningfully evaluate roadside safety treatments.[1] (Also see HSIS Summary: *Effects of Towaway Reporting Threshold on Crash Analysis,* August 1998—FHWA-RD-98-114.) Miller et al. (1987) showed that underreporting of crashes to include only towaway, injury, and fatal crashes would result in lost benefits because of the non-optimal selection of safety projects as safety funding increased.[2]

Although these studies have investigated the effects of a towaway reporting threshold on fundamental issues related to resulting changes in reported crash types, more information is clearly needed on the effects of a towaway threshold on the State or local safety engineer's use of crash data. These effects include the development of a high-crash priority location listing, the identification of crash patterns for these locations, and the related selection of appropriate crash countermeasures. The purpose of this study was to review the potential impacts of a towaway reporting threshold on the North Carolina Highway Safety Improvement Program (HSIP) listings and on the locations and types of crash patterns identified on collision diagrams by field engineers.

Methodology

Highway Safety Improvement Program Listings

To review the impacts of the towaway reporting threshold on the HSIP listings, the computer programs used to identify potentially hazardous intersections and sections in North Carolina were run twice and then compared—once with all reported crashes and then with only crashes that met the towaway threshold. The methodology was consistent during both series of queries and was based on the *North Carolina Highway Safety Improvement Program 1998 Fall Update.*[3] This report and documents from the preceding year outline the methods employed by the North Carolina Department of Transportation to identify potentially hazardous locations.

Collision Pattern Identification Exercise

To test how a towaway reporting threshold would affect safety analysis of crash patterns and resulting countermeasures, 12 practicing engineers representing all regions of North Carolina were selected to participate in a crash pattern identification exercise. Their individual experience with high-crash site analysis ranged from 0.5 to 15 years.

Each engineer was given seven pairs of collision diagrams that showed the type and severity of each crash reported at a selected intersection and roadway segments over a given time period (11 months to 3 years). Diagram pairs were identical except that one displayed all reported crashes at the site while the other showed only towaway and injury crashes. Three of the pairs displayed crashes at intersections, and four pairs showed crashes on longer segments of roadway.

The engineers were instructed to review the 14 collision diagrams, circle any definable crash patterns, and place a star next to any pattern they believed would be a serious problem and have a high potential for correction. The engineers were asked to be consistent with their normal manner of analysis and, once they had analyzed a diagram, to proceed with the next diagram without turning back. To minimize bias in the selection of patterns, diagrams were presented in random order, and the engineers were not initially told the purpose of the exercise. Consequently, it was possible to evaluate the differences between crash patterns that would be evaluated in practice under current reporting versus under a towaway threshold.

Results

HSIP Listings

The following observations and comments are based only on the differences between the listings and do not attempt to indicate which threshold generates a better listing.

Intersections

The most apparent change between the traditional and towaway reporting thresholds is the shuffling of the locations in the rankings (Table 1). In all, 1,902 locations meet the intersection warrants with the traditional reporting threshold. In contrast 1,694 intersections meet the same warrants with the towaway reporting threshold. Using the towaway criteria, 101 dropped out of the top 200 listing and 25 dropped off the list completely. The 11th-ranked location was the highest location dropped. Almost 38.5 percent of the intersections (732 locations) dropped from the program completely when using the towaway threshold. Of the 101 new locations in top 200, 27 were completely new to the listing. The highest "new" location ranked number 4. About 26.7 percent of the towaway listing locations (452 locations) were added using the towaway threshold.

Sections

The shuffling is even more prolific with sections than with intersections (Table 1). A total of 299 locations were flagged by the section warrants with the traditional threshold, 213 by the towaway threshold, and 128 locations were on both lists. The traditional listing

Table 1. Top 20 Priority Intersection and Non-Intersection Locations Listed by Traditional and Towaway Threshold (taken from Top 200 Lists, data collected between 9/1/96 and 8/31/99).

INTERSECTIONS

Traditional Threshold Total Crashes	Towaway Threshold Total Crashes	Traditional Threshold Severity Index	Towaway Threshold Severity Index	Traditional Threshold Total Weight	Towaway Threshold Total Weight	Traditional Threshold Ranking	Towaway Threshold Ranking	Change in Ranking
25	25	17.27	17.86	665.08	355.04	1	1	0
28	22	14.21	21.59	240.23	234.34	2	2	0
16	15	19.38	25.65	178.22	164.35	3	3	0
21	19	16.76	18.42	147.30	76.49	4	9	-5
16	15	18.91	20.11	131.37	65.99	5	13	-8
47	41	16.70	19.36	99.08	85.71	6	8	-2
35	30	19.97	23.13	84.74	63.12	7	14	-7
24	15	9.78	15.05	75.89	29.09	8	32	-24
34	32	20.74	24.34	67.49	62.80	9	15	-6
18	17	20.72	22.32	63.59	35.02	10	25	-15
19	12.09	53.73	11	DROP				
21	16	11.74	15.10	39.24	19.39	12	83	-71
25	24	16.98	17.64	38.64	27.81	13	37	-24
45	32	11.52	16.03	37.08	28.13	14	35	-21
16	13.25	34.16	15	DROP				
47	34	10.44	14.05	32.70	26.34	16	44	-28
63	49	8.60	11.23	31.61	24.61	17	53	-36
22	20	21.25	23.28	31.40	23.69	18	59	-41
31	20	12.93	19.49	31.30	18.47	19	94	-75
26	21	14.02	17.11	31.14	20.09	20	77	-57

ROADWAY SECTIONS

Traditional Threshold Total Crashes	Towaway Threshold Total Crashes	Traditional Threshold Severity Index	Towaway Threshold Severity Index	Traditional Threshold Total Weight	Towaway Threshold Total Weight	Traditional Threshold Ranking	Towaway Threshold Ranking	Change in Ranking
117	79	3.38	5.12	379.36	205.05	1	2	-1
170	141	5.76	8.09	211.01	1689.02	2	1	1
55	45	14.68	17.95	86.82	160.22	3	3	0
46	39	6.81	8.25	86.59	59.58	4	5	-1
16	16	12.75	12.75	81.55	48.21	5	6	-1
18	14.67	58.57	6	DROP				
39	28	9.14	12.73	50.23	19.67	7	17	-10
60	50	7.20	9.14	37.04	28.32	8	11	-3
17	17	8.47	8.96	34.50	22.64	9	16	-7
28	21	13.67	18.23	31.66	16.10	10	22	-12
61	41	7.24	10.98	29.27	18.45	11	18	-7
16	15	17.55	19.28	27.36	15.50	12	23	-11
17	16	9.95	10.58	26.42	8.59	13	29	-16
16	16.50	25.06	14	DROP				
21	19	7.26	8.02	21.01	7.60	15	33	-18
30	23	8.20	14.03	20.11	22.97	16	15	1
92	65	4.87	7.27	18.39	17.24	17	19	-2
25	19	14.98	19.71	18.30	4.05	18	59	-41
15	8.48	17.43	19	DROP				
15	15.84	16.19	20	DROP				

had 171 locations (57.2 percent) dropped from the towaway threshold listing, and the towaway threshold contained 84 new locations (39.4 percent). Three locations kept the same position on both lists. The highest location that dropped from the section listing was the sixth-ranked location, and the highest new location ranked 12th.

Crash Pattern Identification Exercise

The engineers participating in the exercise identified fewer crash patterns and serious problems needing safety improvements when using the collision diagrams of only towaway and injury crashes compared with using diagrams of all crashes. Table 2 shows the differences between the crashes shown on each pair of two corresponding collision diagrams. In all, the 12 engineers identified 247 crash patterns on diagrams with all available crashes. (Note: Several engineers may have identified the same pattern, but it was counted each time it was identified.) Only 160 patterns (35.2 percent fewer) were identified on the corresponding towaway threshold diagrams. When the engineers analyzed all crashes, they noted 126 crash patterns as serious with a high potential for correction; when the engineers analyzed the towaway threshold, they identified only 75 (40.5 percent fewer) as serious. If the towaway reporting threshold were used in practice, engineers would focus their attention on fewer crash patterns, resulting in "missed opportunities" to improve safety.

For example, when examining Diagram B (all crashes), Engineer 10 noted six separate serious problems, including patterns with turning, rear-end, angle, head-on, run-off-road, and sideswipe crash types. Yet, on Diagram M (corresponding towaway diagram), the same engineer identified only one serious problem—a turning crash pattern. Figure 1 shows a different example of the differences in pattern recognition when reviewing all reported crashes versus only crashes meeting the towaway threshold.

In total, patterns containing nearly all crash types were identified less often under the towaway threshold. Table 3 summarizes the crash type groups noted by the safety engineers and shows that several crash types are affected more than others. In particular, the reduced amount of crash data resulted in the identification of far fewer turning and rear-end/sideswipe crash problems. Indeed, if one sums all the rear-end crash types, the towaway threshold total is 72.3 percent less than the property damage only (PDO)-threshold total.

Conclusions and Recommendations

This review of the impacts of a towaway reporting threshold on the identification (listing) of sites for treatment shows that there would be significant shuffling of HSIP listings that North Carolina uses to identify, investigate, and treat potentially hazardous locations on the highway system. Yet, it is not clear if one threshold listing is necessarily better at identifying hazardous locations with the greatest need and at the same time reducing the number of false positives that misdirect valuable resources. It appears to us that the best listing would be one that ultimately produces the most safety effects for the dollars spent. Such an examination can only be conducted years after the listing is produced and the treatments implemented, which was not possible in this analysis. In addition, such a decision of best would change over time as we develop new or better treatments for certain crashes.

Table 2. Number of Crashes and Serious Problems Identified on Collision Diagrams with All Crashes and with Towaway Crashes Only

Collision Diagram Pair	Number of Crashes on Diagram with:[@]		Percentage of Total Crashes on Towaway Diagram	Number of Serious-Problem Groups Identified from Diagrams with:		Percentage Difference: All Crashes to Towaway Only[+]
	All Crashes	Towaway Crashes		All Crashes	Towaway Threshold	
Pair 1 (Diagrams A/J)*	30	20	66.7%	17	3	-82.4%
Pair 2 (Diagrams B/M)	95	43	45.2%	21	10	-52.4%
Pair 3 (Diagrams I/C)	95	55	57.9%	10	7	-30.0%
Pair 4 (Diagrams D/F)	231	156	67.5%	36	13	-63.9%
Pair 5 (Diagrams E/L)*	102	44	43.1%	7	5	
Pair 6 (Diagrams N/G)*	29	24	82.8%	16	20	+25.0%
Pair 7 (Diagrams H/O)	39	25	64.1%	19	17	-10.5%
TOTAL	621	367	59.1%	126	75	-40.5%

Notes: * Indicates intersections. [@] Data collection periods range from 11 months to 3 years. [+] Minimum of 10 crash groups identified from diagrams with all crashes to compute percent difference.

Figure 1. Crash Patterns Identified on Diagram Including All Crashes (top) and Diagram Including Only Crashes Reported under Towaway Threshold (bottom)

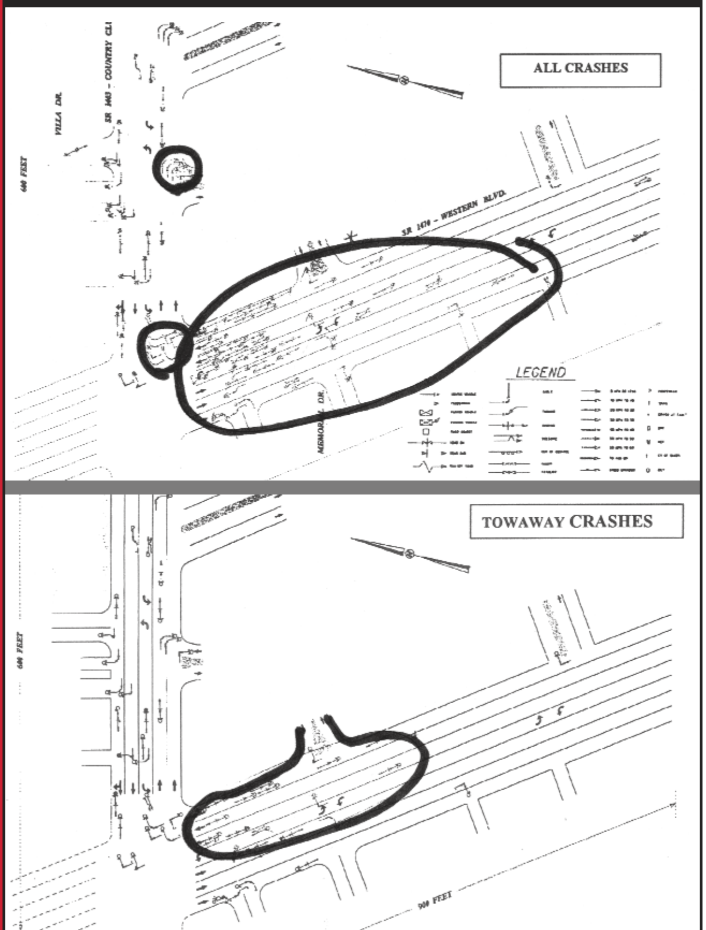

Table 3. Crash Types Identified from Diagrams with All Crashes and Towaway Crashes Only

Type of Crashes in Crash Pattern Group	Number of Groups Identified From Diagrams With: All Crashes	Towaway Threshold	Percent Difference All Crashes to Towaway Only*
Angle	52	46	-11.5%
Rear-End	31	28	-9.7%
Turning	97	55	-43.3%
Angle/Turn	20	18	-10.0%
Head-On/Rear-End	2	0	
Rear-End/Ran-Off-Road	0	1	
Rear-End/Sideswipe	30	10	-66.7%
Rear-End/Turn	7	1	
Angle/Sideswipe/Turn	1	0	
Rear-End/Sideswipe/Turn	6	0	
Rear-End/Ran-Off-Road/Sideswipe	1	0	
Angle/Rear-End/Sideswipe/Turn	0	1	
TOTAL	247	160	-35.2%

*Minimum of 10 crash groups identified from diagrams with all crashes to compute percent difference.

The results of our crash-pattern analysis, however, do indicate that a towaway crash reporting threshold would make it more difficult for a group of engineers to identify crash patterns and therefore less likely to recommend improvements to certain sites with serious problems. Under a towaway threshold, safety engineers identified fewer total and serious patterns, especially for turning, rear-end, and sideswipe crashes. It appears that this would result in missed opportunities for treatment and benefit. More specifically, rear-end patterns, which might be corrected by the elimination of unnecessary traffic signals or better signal timing or progression, would be less likely to be identified. In addition to safety benefits, such treatments could affect traffic operations (reducing delays). It is noted that the exercise used only a small sample of diagrams and a small group of engineers from North Carolina. It would be useful if similar tests were made with larger groups of engineers and using crash data from different States.

While this work and the studies preceding it have shown that movement away from reporting PDO crashes will have a significant impact on the resulting list of crash problem sites for safety analyses, there remains the simple question: "So what?" That is, is the loss of information about PDO's really that serious? In fact, it might be asked if the resultant picture just brings into better focus what must be done to rid our highways of the more serious crashes by eliminating the "noise" of the many minor crashes that we will always have with us. On the other hand, given that almost all of these data are used by State and local agencies to identify and correct specific locations, will the loss of sample size at specific locations that are truly hazardous and correctable mean that they are not identified? Or, that when identified, correctable problems will be overlooked? Or could the loss of PDO-related sample size mean that we are eliminating sites that now have a significant number of less severe crashes that could become severe in the future—our "predictor sites"?

These questions are difficult to answer. At the root of these questions and of the view that non-towaway crashes are not important is the assumption that PDO crashes are of limited concern. The assumption implies that it is not a wise use of resources to collect data on PDO crashes because the economic loss associated with a PDO crash is relatively small compared with those involving injury and death. In addition, research has suggested that almost half of PDO crashes are not reported. Furthermore, in some States, PDO crashes are often reported by drivers at locations away from the scene of the crash, and the investigating officer never sees the scene or the involved vehicles. The result is poor quality information regarding PDO crashes. In North Carolina, however, law enforcement officers complete all crash reports.

Given these and other issues, it seems there are two basic approaches to consider:

1) Eliminate the reporting of most or all PDO crashes.
2) Improve the reporting of PDO crashes.

As noted above, the first of these options is receiving much attention, given the limited and declining resources with which law enforcement agencies have to work. This study, however, has shown that there are reasons to seriously consider the second option.
1) This work has demonstrated that without information on PDO crashes, highway engineers and safety analysts will see an entirely different picture of crash patterns at a site.
2) The limited number of crashes that result with a towaway or a more restrictive threshold will mean that different locations move to the top of the safety program listing.
3) As safety funding increases, agencies will potentially lose safety benefits from non-optimal selection of safety projects.

The relative importance of PDO crashes must be put into proper perspective. Because of their relatively large frequency, PDO crashes represent, in aggregate, a very significant amount of the economic loss resulting from crashes on the highway. In 1998, the National Highway Traffic Safety Administration (NHTSA) estimated that PDO crashes accounted for about two-thirds of all crashes in the United States. It seems inappropriate for the safety community to ignore more than 4 million crashes annually when planning and implementing improvement programs. The increased frequency of PDO crashes allows potential problems to be identified at an earlier stage than would otherwise be possible. This study made it clear that analysts desire this detail because they explicitly or implicitly believe that a PDO non-towaway crash could have just as easily been a more serious towaway, injury, or fatality crash (e.g., if occupant restraints were not used). If one accepts this belief, all crashes become equal in their importance as information on which to base future action.

This analysis provides further evidence of the effects of adopting a towaway threshold. Certain crash patterns will not be identified or corrected, and major changes will occur in high-crash priority listings. Both effects will result in considerable negative impacts on State and local safety programs in terms of missed opportunities to identify and correct safety problems.

These and other considerations regarding the value and importance of PDO crashes suggest that it is more appropriate to pursue the second of the two options cited above. Rather than abandoning the collection and use of non-towaway PDO data, efforts should be made to acquire the data in more cost-effective ways and with improved quality. Any State that is considering going to a towaway threshold should consider more than just the potential for saving costs on crash reporting and data handling and processing. Such States must also consider carefully the resulting loss in valuable information for safety analysis and decision making. Instead of eliminating PDO crashes, States should look toward technological solutions to reduce the time and cost for managing crash data. Further, States should collaborate with other agencies such as municipalities to reduce redundancies and costs.

In summary, while these analyses do not allow us to say that the changes in high-crash listings as a result of a towaway threshold will be a detriment to safety engineering, it does appear that such a threshold will significantly affect the identification of key crash patterns at high-crash locations and, thus, the choice of treatments. Although further research is needed, we argue that the retention (and improvement) of non-towaway PDO data is critical to safety engineering.

REFERENCES

1. Zegeer, C. V., Huang, H. F., Stewart, J. R., Pfefer, R. and Wang, J. *Effects of a Towaway Reporting Threshold on Crash Analysis Results,* Record No. 1635, Transportation Research Board, 1998.

2. Miller, T., Whiting, B., Kragh, B., and Zegeer, C. *Sensitivity of a Highway Safety Resource Allocation Model to Variations in Benefit Computation Parameters*, Record No. 1124, Transportation Research Board, 1987.

3. North Carolina Department of Transportation Traffic Safety Systems Management Unit. *North Carolina Highway Safety Improvement Program 1998 Fall Update.*

FOR MORE INFORMATION

This research was conducted by Kevin Lacy and Charles Zeeger of the University of North Carolina Highway Safety Research Center and Robert Schneider of the University of North Carolina. For more information regarding the research, contact Kevin Lacy at (919) 962-7418. For further information about HSIS, contact Michael S. Griffith, HSIS Program Manager, HRDS-06, at (202) 493-3316, *mike.griffith@fhwa.dot.gov.*

Visit us on the web at www.tfhrc.gov

FHWA-RD-01-114
July 2001