HSIS

HIGHWAY SAFETY INFORMATION SYSTEM

SUMMARY REPORT

Investigation of National Highway System Roadways in the HSIS States

IN THE 1991 INTERMODAL SURFACE TRANSPORTATION EFFICIENCY ACT (ISTEA), Congress requested that the U.S. Department of Transportation (DOT) submit a proposal of routes to be included in a National Highway System (NHS). The NHS-designated system now includes approximately 262,005 km (162,807 mi) of the most important U.S. roads (about 4 percent of the 6.3 million km (3.9 million mi) of public roads). This system carries more than 40 percent of the Nation's traffic. The NHS consists of the Interstate system, high-priority corridors identified in ISTEA, and the Strategic Highway Network and connectors, as well as selected principal arterials.[1]

Since ISTEA was enacted, the States have been able to use NHS project funding on any road classified as a principal arterial. However, after congressional approval, Federal funding will be limited to use on NHS roadways. This new system will encourage State DOTs to improve a limited number of higher priority projects with Federal-aid funds. Such improvements will address traffic safety and efficiency, and will also strengthen links with Canada and Mexico.[1]

With the advent of the National Highway System, questions may be raised about the safety of this system. For example, since NHS routes carry the highest traffic volumes, it is important for engineers and planners to know how safe they are. Are NHS roads safer than non-NHS roads and, if so, how much safer? Also, if the safety of the NHS were to be upgraded in a systematic manner, what level of effort would be required?

The purpose of this study was to examine these and other NHS safety issues of interest using the Federal Highway Administration's Highway Safety Information System (HSIS). The HSIS database contains information on accident, traffic, and roadway characteristics in California, Illinois, Maine, Michigan, Minnesota, North Carolina, Utah, and Washington State. This analysis used data from each HSIS State except Utah. It should be noted that this analysis only includes routes on State roadway systems.

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.

RESULTS

The first question examined was the relative safety of NHS and non-NHS highways—how their crash rates compare within each of the major functional classes:

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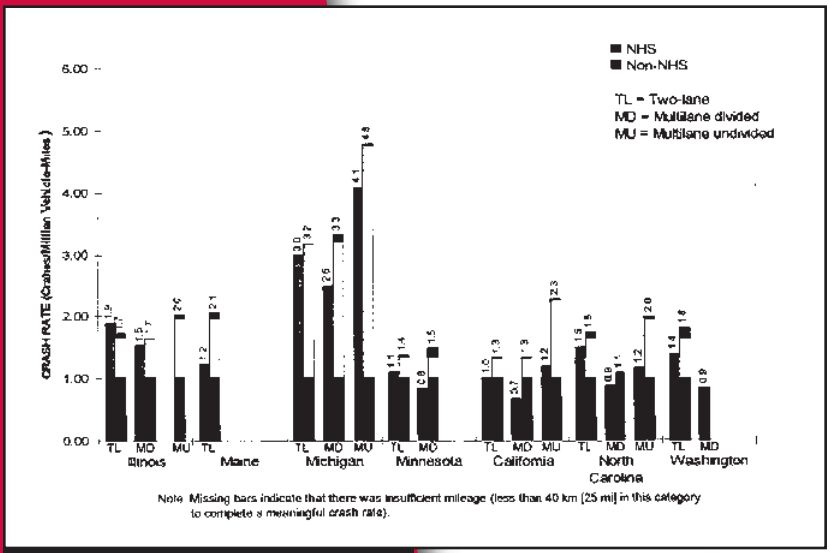

Figure 1. Crash Rates on Rural Roads.

two-lane, multilane undivided, and multilane divided. For example, two-lane rural roads on the NHS are compared with two-lane rural roads that are not on the NHS.

Crash rates were compared for NHS vs. non-NHS routes for three functional classes of rural highways, as shown in **figure 1**. *(Note: missing bars indicate that there was insufficient mileage (less than 40 km [25 mi]) in this category to compute a meaningful crash rate.)* Some of the State-by-State variation in crash rates may be the result of differences in reporting practices, the different nature of the highway systems, geographic conditions, driving populations, or other factors. For rural two-lane roads, non-NHS roads had higher crash rates than NHS routes, except for Illinois. For rural multilane undivided roads, only California and Michigan had adequate samples for comparison purposes. Again, the crash rates were higher for non-NHS routes than for NHS roads. Rural multilane divided roadways also showed somewhat higher rates for non-NHS routes as compared to NHS routes.

HSIS Mileage	IL	ME	MI	MN	CA	NC	WA	Total
NHS Interstate	1679.7	361.9	1215.1	912.9	2182.1	560.5	763.0	7675.2
NHS Non-Interstate	3168.9	752.1	3116.0	3029.3	4588.9	2240.2	2635.1	19,530.5
Total NHS	4848.6	1114.0	4331.1	3942.1	6771.0	2800.8	3398.1	27,205.7
Non-NHS	10,873.0	20,725.7	5259.8	44,963.0	8182.1	10,975.1	3772.8	104,751.5
Total Miles (NHS+Non-NHS)	15,721.6	21,839.7	9590.9	48,905.1	14,953.1	13,775.9	7170.9	131,957.2

Table 1. Summary of NHS and non-NHS mileage analyzed from seven HSIS States.

Urban crash rate comparisons were also made in each State for three functional classes of NHS and non-NHS roadways. For urban two-lane roads, crash rates were higher for non-NHS roads than for NHS roads in each State except Washington. For urban multilane divided roads and urban multilane undivided roads, crash rates were generally higher for non-NHS roads than for NHS roads, with the exception of Illinois multilane undivided roads.

These crash comparisons show that NHS highways are generally experiencing lower crash rates than non-NHS highways, perhaps due to the better design standards and geometrics that exist on the NHS system as compared to the non-NHS system. Statistical modeling procedures were used to determine whether these differences were statistically significant. The overall NHS effect shows crash rates to be about 10 percent lower on NHS routes for all States except California and Illinois. For Illinois, the overall NHS effect and the interaction term essentially cancel so that there is no significant difference between crash rates for NHS and non-NHS roads ($p = 0.2914$). On the other hand, the net effect in California is more than doubled (i.e., crash rates are 23 percent lower on NHS roads). In general, then, these data show crash rates to be somewhat lower (approximately 10 percent) on the NHS roads, though there is some State-to-State variation.

The sample sizes of NHS and non-NHS roadways in each State are given in **table 1**. The NHS mileage is further broken down into Interstate and non-Interstate. For example, a total of approximately

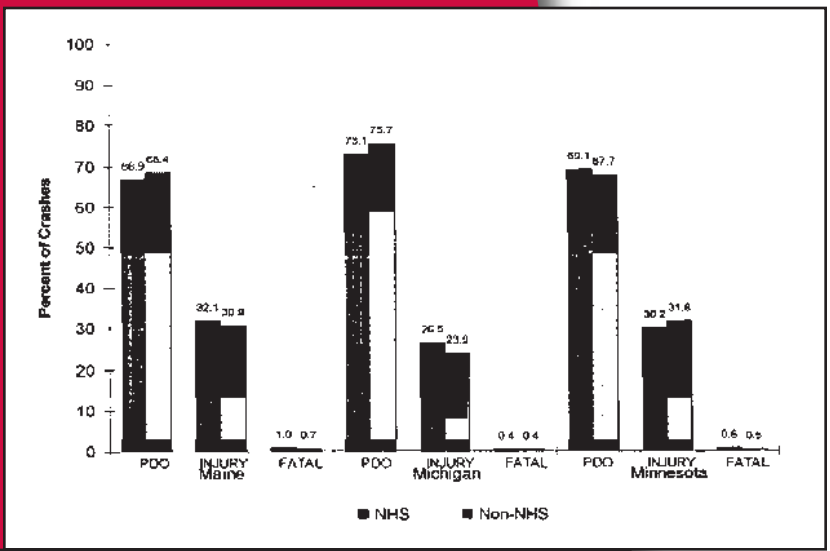

Figure 2. Crash Severity on NHS vs. Non-NHS Roads.

12,392 km (7700 mi) of NHS Interstate and 31,381 km (19,500 mi) of NHS non-Interstate roads are available from the seven States. This compares with more than 168,493 km (104,700 mi) of non-NHS routes (mostly from Minnesota) on the HSIS data system.

The HSIS allows investigators to examine a variety of crash attributes for various roadway types. One key crash attribute of research and policy interest is crash severity. Crash severity data on NHS and non-NHS roads were readily available in Maine, Michigan, and Minnesota. A comparison of crash severity reveals fairly consistent patterns, with some slight differences among States for reasons that are not readily apparent (**figure 2**). For example, in both Maine and Michigan, the percentage of injury crashes was slightly higher on NHS roads than on non-NHS roads. The situation was reversed in Minnesota. Whereas NHS roads may be expected to be safer in general than non-NHS roads because of their higher design standards, their design may also encourage higher speeds. Thus, the effects of design and speed on crash severity may tend to counteract each other.

Many types of crashes on NHS and non-NHS roadways may be analyzed using HSIS data. **Figure 3** illustrates the rate of fixed-object crashes on rural roads in Maine, Michigan, and Minnesota. This type of crash is fairly common in rural areas, where the likelihood of motorists running off the road and striking fixed objects is related to design features such as lane and shoulder widths, shoulder type, roadway alignment, and roadside conditions. Thus, a comparison of the fixed-object crash rates may be indicative of the safety of design features of NHS vs. non-NHS roads. In these three States, fixed-object crash rates were lower on NHS roads than on non-NHS roads for all roadway classes. In fact, on two-lane roads in Maine and on multilane divided roads in Michigan, the crash rates on NHS roads were less than one-half those on non-NHS roads. Because of small sample sizes, crash rates for multilane divided and multilane undivided roads in Maine are not shown.

In addition to comparing crash experiences on NHS and non-NHS roads, the HSIS data were analyzed to determine the percentage of NHS roads that would have to be upgraded if a systematic improvement program were put in place. Assume, for example, that it was desirable to have lane widths of 3.4 m (11 ft) or greater and shoulder widths of 1.2 m (4 ft) or greater on all NHS roads. What percentage of current NHS roads would have to be improved to meet such criteria? Using the

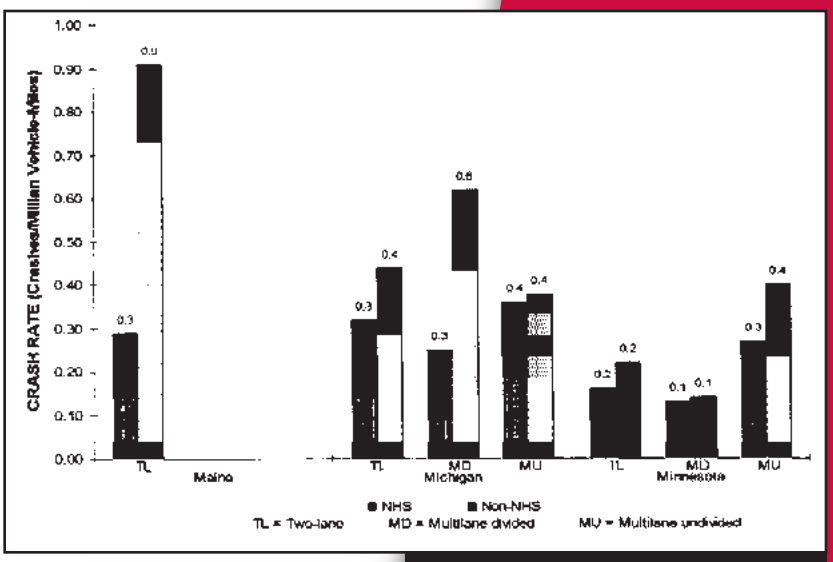

Figure 3. Fixed Object Crash Rates on Rural Roads.

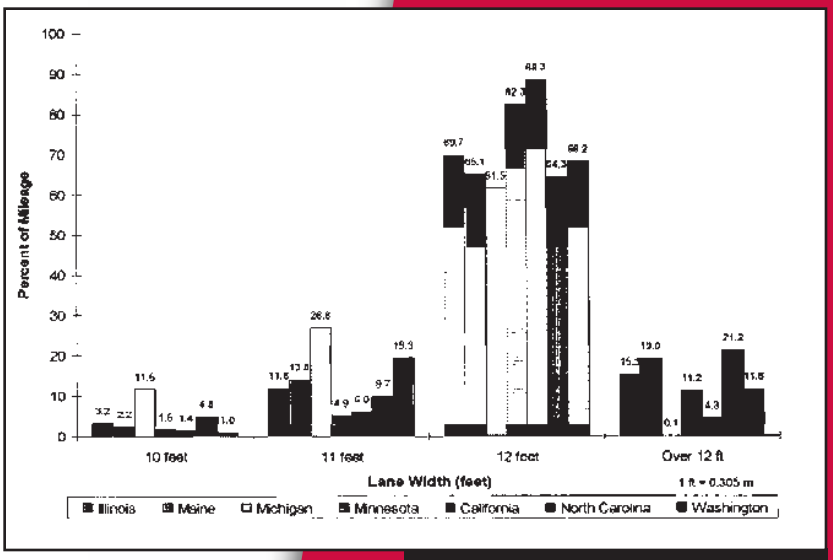

Figure 4. Lane Widths on NHS Roads.

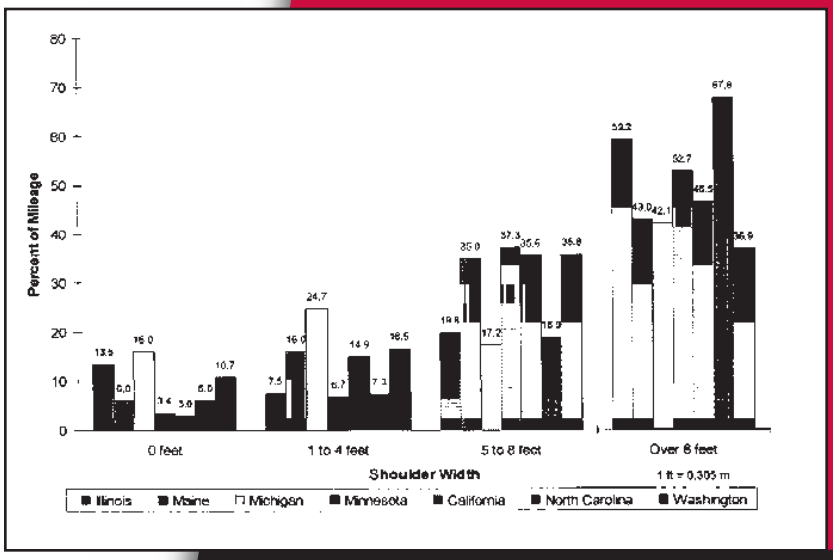

Figure 5. Shoulder Widths on NHS Roads.

results from this effort, one could estimate the number of miles that would need to be upgraded to meet those standards/guidelines. Consider the roadway features below:

LANE WIDTH: **Figure 4** shows the percentage of NHS mileage for four lane-width categories. The vast majority of each State's NHS mileage would meet a 3.4-m (11-ft) lane-width guideline. The percentage of NHS routes with lane widths less than 3.4 m (11 ft) range from 1.0 percent in Washington State to 11.6 percent in Michigan.

SHOULDER WIDTH: The distribution of shoulder widths on NHS roads is given in **figure 5** for the seven States. To meet shoulder-width guidelines greater than 1.2 m (4 ft), between 10.1 percent (Minnesota) and 40.7 percent (Michigan) of NHS roads would need wider shoulders. In fact, 16.0 percent of Michigan's NHS roads have no shoulder at all (i.e., width = 0). By comparison, 67.8 percent of North Carolina's NHS roads have shoulders greater than 2.4 m (8 ft) wide.

IMPLICATIONS

While the HSIS database contains only eight of the total States in the Nation, the data are of high quality, accident and roadway inventory files can be linked, and detailed NHS segment specifications are either already available or will be available soon. The comparison of NHS and non-NHS crash rates indicates that the generally improved geometrics on NHS roads, such as wider lanes and shoulders as compared to non-NHS roads, may be responsible for the lower crash rates on NHS roads.

This summary explored the types of analysis that can be conducted with the HSIS regarding the impact of systematic improvements on NHS roadways. The results demonstrate that crash rates are consistently lower on NHS than on non-NHS roads for various roadway classes for all but one of the seven States that were examined. The data also revealed that NHS roads had a lower rate of fixed-object crashes, although the crash severity distribution was relatively constant for NHS and non-NHS roads. Furthermore, roadway geometrics such as lane and shoulder widths are better on NHS roads than on non-NHS roads, which could help to explain the lower crash rates on NHS roads. It is also possible that roadway alignment, roadside conditions, intersection design, and/or other roadway features are somewhat better on the NHS road system than on other roads.

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3. Zegeer, C.; Huang, H.; Stewart, R.; and Williams, C. "Investigation of National Highway System Roadways in the HSIS States," paper presented at the Transportation Research Board Annual Meeting, Washington, DC, January 1998.

FOR MORE INFORMATION

This research was conducted by Charlie V. Zeeger, Herman F. Huang, J. Richard Stewart, and Carolyn Williams of the University of North Carolina Highway Safety Research Center. The final report, *Investigation of Natonal Highway System Roadways in the HSIS States* will be published in a 1998 *Transportation Research Record*. For further information about HSIS, contact Michael S. Griffith, HSIS Program Manager, HSR-20, at (703) 285-2382, *mike.griffith@fhwa.dot.gov*.

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