The Impact of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) On Rural Areas:

Changes in Road and Bridge Conditions

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Abstract

The Intermodal Surface Transportation Efficiency Act of 1991, better known as ISTEA, changed the Federal transportation relationship with the States. The Act devolved substantial planning and financial decision- making responsibilities to the States. States in turn were required to work closely with Metropolitan Planning Organizations and local officials to plan, implement and fund transportation improvements. Rural officials had the opportunity to influence long-range transportation plans and improvement projects in their local communities. ISTEA was authorized for a 6-year period, beginning in fiscal 1992 and continuing through fiscal 1997.

This study asks how rural areas fared under the new, devolved ISTEA provisions. Information is used on physical condition of roads and bridges in rural areas to ascertain how the condition of rural roads and bridges changed during the ISTEA era. To do so, it uses two databases maintained by the U.S. Department of Transportation. The Highway Performance Monitoring System (HPMS) is a database of the U.S. public road system. States and localities annually collect highway data specified by the Federal Highway Administration; the data are then used to allocate Federal funding for eligible roads. The National Bridge Inventory (NBI) is a database of bridges on all public roads in the U.S. States collect bridge information according to specified criteria; the data are used to allocate Federal funding for bridge maintenance and replacement. Because HPMS collects detailed information on roads eligible for Federal funding only, this analysis pertains to federally-funded rural roads, not the local road system.

The study uses HPMS data on road surface type, lane width, condition and average daily traffic to evaluate rural road condition changes during the ISTEA years. NBI data are utilized to examine the number of deficient bridges on public roads. Financing data are reviewed to examine level of funding for rural roads and bridges. HPMS data indicate that road surface types improved since the passage of ISTEA, with more rural roads having better paved road surfaces in 1997, the last year of ISTEA. Lane width, a measure of road safety, increased for federally funded roads. Condition, a measure of road roughness, improved during the ISTEA years. Bridges in rural areas demonstrated a dramatic improvement, especially on Interstates and other national roadways. These improvements took place during a period of steadily increasing daily traffic: all categories of rural roads demonstrated an increase in daily traffic. Funding data indicate that funding across all rural road categories increased during the ISTEA years, and that the majority of these funds were dedicated to road improvements, not new construction.

While study findings indicate overall improvement in rural road and bridge condition during the ISTEA years, several trends emerged. First, a growing condition divergence appeared between rural roads serving local traffic and those serving national travel. Road and bridge conditions improved more for roads serving national travel than for local roads. Since these improvements took place during a period of increased Federal funding, a second question arises with respect to future funding and its impact on roads serving local traffic—might reductions in funding result in greater condition differences between local roads and those serving national travel?

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Eileen S. Stommes

Introduction

On December 18, 1991, the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) was signed into law, inaugurating a major shift in policies and programs that had guided the U.S. surface transportation system since the 1956 Interstate Highway Act. Because rural America relies on transportation to access goods and services in the larger economy, changes in transportation policy affect the ability of rural areas to link with opportunities available outside the local community. This report examines the impact of ISTEA on the physical conditions of rural roads and bridges. It begins with background information on ISTEA as it affected rural areas. It then describes the data used to analyze the impact of ISTEA.

Highlights of ISTEA for Rural Areas

The purpose of ISTEA was clearly articulated in its statement of policy: "to develop a National Intermodal Transportation System that is economically efficient, environmentally sound, provides the foundation for the Nation to compete in the global economy and will move people and goods in an energy efficient manner" (A Summary, 1992). ISTEA was comprehensive in scope, laying out a broad range of new economic, environmental and intermodal objectives. The legislation was in fact more than a collection of funding programs to build highways. Rather, it represented an integrated, systemic approach to transportation that considered its role and function within the larger society, including its impact on the environment, the local economy, and passenger and freight mobility. The eight titles of the legislation covered surface transportation, highway safety, transit, motor carrier issues, intermodal objectives, research agenda, air transportation and extension of the Highway Trust Fund to ensure adequate funding. ISTEA authorized funding for a 6-year period, from fiscal 1992 through fiscal 1997.

Three provisions in particular affected road and bridge conditions in rural areas: the Surface Transportation Program, the Bridge Replacement and Rehabilitation Program, and the management systems and Statewide planning requirements.

The Surface Transportation Program (STP) was a new block grant program that could be used by the States and localities for any roads not classified as local or rural minor collectors (See The Federal-Aid Rural Road and Bridge System for definitions and terms). States were required to set aside 10 percent for safety construction activities, and 10 percent for transportation enhancements, which included a range of environmentally related activities. States were further required to divide 50 percent of the funding by population between each of its areas over 200,000 and the remainder of the state. The remaining 30 percent could be used in any area of the State. Areas of 5,000 or less were guaranteed an amount not less than previous funding for Secondary roads, with up to 15 percent allowed for spending on rural minor collectors.

The Bridge Replacement and Rehabilitation Program (BRRP) continued largely unchanged, but ISTEA expanded eligible activities and allowed a State to transfer up to 40 percent of the funds to the National Highway System, which included the Interstate System and specified Principal Arterial roads or to the STP.

In addition to granting States greater flexibility in the use of transportation funds, ISTEA increased the overall level of funding for transportation. Before passage of ISTEA, the Federal share of funding for highways had declined relative to State and local expenditures. ISTEA reversed that trend, infusing additional money into road and bridge repair. Title I, the section of the Act that provided funds for rural roads and bridges, was authorized at $18.7 billion in 1992, rising to $20.4 billion in 1994 and 1997. During the ISTEA years, the Federal level of funding for highways increased relative to State and local funding, beginning with 20.1 percent of total funding in 1992, rising to 22 percent in 1994 and dropping back down to 20.8 percent in 1997. The State share of highway funding for those years moved from 52.5 percent in 1992 to 50 percent in 1994 and rising to 52.1 percent in 1997. Local government provided the remainder of highway funding (1999 Status of the Nation's Highways, Bridges and Transit (www.fhwa.dot.gov/policy/1999cpr).

States were required to establish six management systems: highway pavement, bridge, highway safety, traffic congestion, public transportation, and intermodal facilities/systems that combined two or more transportation systems such as rail and highway or waterways and rail. While many States already had highway pavement and bridge management systems in place, the other four systems were new. Because the plans generated concern among the States, the mandate to establish these plans was dropped in 1995, with States given the option to use them as needed (Transportation Infrastructure, 1997).

The ISTEA Statewide planning requirement specified that States set up a statewide planning process, a statewide transportation plan and a statewide transportation program. Two new requirements changed the customary transportation planning process: first, the planning process was broadened to include additional factors such as land use, intermodal connectivity and other identified needs. Second, Metropolitan Planning Organizations (MPOs) and local governments obtained an enhanced role in transportation planning: MPOs were to work with States to develop a long-range transportation plan and a transportation improvement program. States were required to work with local governments in developing transportation plans outside designated MPO areas, namely rural areas.

ISTEA in Rural America—Key Program Issues

Several key rural issues flowed from the ISTEA legislation. ISTEA differed from earlier transportation legislation on several critical fronts, both in its policy approach and in its program delivery mechanisms. These differences permeated delivery of ISTEA programs to the States and their respective rural areas. New organizational relationships were mandated, new planning requirements were instituted and new funding patterns were created, all affecting delivery of Federal transportation resources to rural areas.

First, ISTEA devolved substantial responsibility to the States for all federally funded transportation programs. In lieu of Federally controlled programs, the U.S. Department of Transportation (DOT) set general program parameters and required States to report program progress using specific indicators. States had considerable discretion to tailor program delivery and funding to State needs within broad program parameters. This program environment gave rural areas the potential opportunity to affect both the level of funding and the type of transportation project delivered to their community. Rural areas would now work directly with State transportation officials on transportation matters affecting their communities, rather than receiving information about transportation improvements once plans had been finalized.

Second, ISTEA planning requirements specified that local officials were to be involved in the planning process. They were to be consulted in developing the statewide transportation improvement plan and in selecting projects for funding within their region. Local involvement in transportation planning was a radically different approach to the traditional planning paradigm that involved planners and engineers presenting a final plan to local officials for their approval. Further, the planning activity was no longer strictly confined to transportation alone. It now encompassed environmental concerns, enhancement of community transportation infrastructure, transit, economic impact on the community and broad consideration of the role of transportation in improving community livability. Communities and their officials now had input into decisions allocating transportation resources for their community.

Third, the management plans set in motion a long-range planning and implementation process. While transportation planning had previously sequenced priority projects across the State, it had been largely limited to surface transportation improvements. The six management systems now set the stage for long-range planning and management for a range of transportation, transit and related environmental actions. Information provided by the management systems was to provide state and local officials data for planning and evaluation of existing transportation systems. While these six systems became optional in 1995, about half the States were implementing the plans. Again, the transportation planning process was opened up to involve rural areas in a broader decision making role while simultaneously providing a defined set of procedures and measures as a common language for engagement.

Fourth, funding priorities were broadened to allow greater flexibility to states in selecting appropriate transportation options. ISTEA specified levels of funding for enhancements, safety, environmental objectives, and transit but allowed States discretion to shift specified levels of funding from one program to another based on State-defined needs. Again, ISTEA gave rural areas a voice about funding priorities for their region.

Fifth, ISTEA increased overall Federal funding for transportation nationwide. As a result, both rural and urban areas received higher levels of Federal road and bridge funding than under previous surface transportation legislation.

In summary, ISTEA initiated a major policy shift by devolving transportation program delivery to the States. In exchange for devolving decision making to the States, ISTEA required the States to consult with local officials in establishing transportation priorities and to report to USDOT on its transportation activities. Given the higher level of funding and larger role of rural officials in the transportation planning process, this report asks whether ISTEA made a difference in rural highway and bridge infrastructure. While little systematic information is available to measure the level of involvement and the effectiveness of local official participation in the statewide transportation planning process during ISTEA implementation, data are available that measure the physical condition of roads and bridges in rural areas. Accordingly, this paper uses these data to determine whether rural road and bridge conditions declined, remained static or improved during ISTEA's implementation.

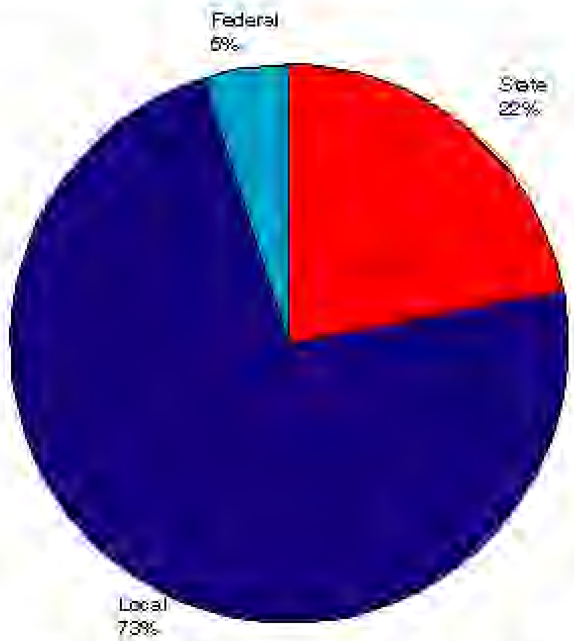
The Federal-Aid Rural Road and Bridge System

This section describes the Federal-Aid portion of the rural road and bridge system. The road system is described in terms of its ownership, functional classification, and surface type. The bridge system includes a description of bridge ownership and a brief discussion of the bridge inventory system.

Rural Public Road Mileage

In 1997, the United States had approximately 3.9 million miles of public roads. (Our Nation's Highways, 1998, www.fhwa.dot.gov/ohim/onh.htm) Almost 80 percent of this road mileage is in rural areas. U.S. DOT/FHWA defines rural as places with population of less than 5,000. Local governments, including county, town, and municipal governments, are responsible for 73 percent of rural road mileage. States are responsible for 22 percent of rural road mileage, which includes Interstate, NHS and State roads. The Federal government is responsible for the remaining 5 percent, which includes National Park, National Forest and other roads located on Federally owned land (Figure 1).

Figure 1
Rural road mileage by ownership, 1997
County, town, and municipal governments are responsible for 73 percent of rural roads



Source: Table HM-10, 1997 Highway Statistics, U.S. Department of Transportation, Federal Highway Administration, Washington, D.C.

Slightly over 700,000 miles, or 22 percent, of the 3.1 million miles of rural roads are part of the Federal Aid system, best described as the portion of public roads eligible for Federal funding. Data on these roads are collected to allocate Federal funding. The remaining 78 percent of rural road mileage does not receive Federal funding so that only limited data on mileage and condition are available in national transportation databases (Linking America, 1989; 1999 Status of the Nation's Highways, Bridges and Transit, www.fhwa.dot.gov/policy/1999cpr). This report focuses on the 22 percent of rural road mileage eligible for Federal funding under the ISTEA legislation. The following section describes in more detail how rural roads are classified according to their function, and which categories of rural roads receive Federal funding.

Functional Road Classification

Roads are further classified by function, creating a hierarchy of roads from the Interstate Highway System, a national transportation network, to roads serving local areas. Functional road classification categories define the type and level of service provided by a given road within the transportation network. Within the functional classification system, roads provide two basic functions: access and mobility. Access to local land is a key function of local roads, while mobility, defined as moving traffic on longer trips, is a key function of national roadways such as Interstate Highways. Road design criteria flow from functional classification, with overall highway design based on traffic. Traffic indicates the level of service for which road construction or improvements are being made, and directly affects geometric features of design such as width, alignment and grades. Design criteria are based on average daily traffic, the composition of that traffic, speed based on trip length, and level of service as local, regional or national (A Policy on Geometric Design of Highways and Streets,1990). Construction design standards are then set according to functional class for, among other features, lane width, type of surface, runoff criteria, access control and sight distance.

Functional road classifications used by the U.S. Department of Transportation include Interstate, Other Principal Arterial roads, Minor Arterial roads, Major Collector roads, Minor Collector roads and local roads (Highway Functional Classification, 1989; 1999 Status of the Nations' Highways, Bridges and Transit, www.fhwa.dot.gov/policy/1999cpr). In rural areas, Federal funds are allocated to Interstates, Other Principal Arterial roads, Minor Arterial roads and Major Collector roads. Since Federal funding is allocated according to road miles and condition, the HPMS collects data on roads eligible for Federal funds. As indicated above, roads eligible for Federal funding comprise 22 percent of rural road mileage in the U.S. Minor Collector roads and local roads do not receive Federal funding, and rely on State and local funding. Limited data, including mileage and paved vs. unpaved, are gathered for Minor Collector roads and local roads.

The Interstate System is an arterial network serving long-distance, national trips. This System accounts for 1.2 percent of the total mileage of the Nation's roadways, but 23.6 percent of total travel occurs on the Interstate.

The Principal Arterial system, divided into major and minor arterial roads, is a network of continuous routes serving statewide or interstate travel. Rural Principal Arterial roads link urban areas of 50,000 or more, and serve most urban areas larger than 25,000 people. In 1997, the rural Principal Arterial system made up 3.3 percent of total miles, and carried 46.8 percent of rural traffic and l8.3 percent of total U.S. travel. Rural Minor Arterial roads represented 3.5 percent of total U.S. miles, and carried 16.5 percent of rural traffic and 6.4 percent of total U.S. travel.

Rural collectors are designed for lower-speed travel, and support local, intracounty trips. Rural Major Collectors link county seats and larger towns not on arterial routes. Major Collectors include 10.9 percent of total U.S. miles, carrying 20.2 percent of rural traffic, and 7.9 percent of total travel in the U.S. Rural Minor Collectors collect traffic from local roads, making up 6.9 percent of total U.S. mileage.

Rural local roads provide access to individual homes, farms and businesses in the open country and accommodate local trips. Local roads are the largest component of the U.S. public road system, with rural local roads representing 54 percent of total U.S. mileage and 68 percent of public road mileage in rural areas. Total local rural roads included 2,141,111 miles in 1997.

ISTEA used the functional classification system to create new Federal-aid categories to establish funding priorities. To focus on roads of national significance, it established the National Highway System (NHS), a national road network that includes the Interstate System and key arterial routes. The NHS was designated by the President in 1995 to serve as the Nation's priority road system. Approximately 74 percent of NHS mileage is rural, but 60 percent of NHS travel occurs in urban locations. While the NHS includes about 4 percent of total

U.S. highway mileage, it carries over 43 percent of total travel. As a national system, the NHS receives priority funding.

Road Surface Types

Rural roads are further defined by surface type. The Highway Performance Monitoring System (HPMS), used by the U.S. Department of Transportation to classify surface types, includes the following pavement types (Highway Performance Monitoring System Field Manual, 1999, www.fhwa.dot.gov/ohim), listed in order of quality.

High type pavements provide a road surface that is suitable for high speed traffic. They range from concrete surface to high type flexible, with a bituminous surface and base thickness of 7 inches or more. Intermediate surfaces include bituminous surfaces of less than 7 inches. Low type roads are dirt roads with a bituminous surface of less than 1 inch. Unpaved mileage is best described as a gravel road that is graded and drained, a road surface more commonly found in local roads characterized by low speeds and light traffic.

Types of Highway Pavement

High type rigid includes Portland cement concrete pavement with or without joints and with or without mesh or similar reinforcement.

High type composite consists of a mixed bituminous or bituminous penetration road on a rigid pavement with a combined surface and base thickness of 7 inches or more, and includes any bituminous concrete, sheet asphalt or rock asphalt overlay of rigid pavement greater than 1 inch of compacted bituminous material.

High type flexible involves a mixed bituminous or bituminous penetration road on a flexible base with a combined surface and base thickness of 7 inches or more. It includes brick, block or combination roads.

Intermediate type includes mixed bituminous or bituminous penetration road of less than 7 inches, composed of gravel, stone, sand or similar material mixed with bituminous material.

Low type bituminous surface-treated roads are earth, gravel or stone roads with a bituminous surface less than 1 inch thick, and may or may not have a seal coat.

Unpaved mileage includes unimproved roadways using natural surfaces and maintained to permit use as well as graded and drained roadways of natural earth aligned and graded to permit use by motor vehicles.

Generally, roads with a heavier volume of traffic, including Interstates, Other Principal Arterial roads and Minor Arterial roads, have a higher percent of their road surface in high type pavements. Roads with lower traffic volume have a higher percentage of their road surface in the Intermediate or Low type category.

Rural Bridges

Bridges are the second component of the rural road system. The U.S. Department of Transportation annually compiles information on bridges and maintains the National Bridge Inventory (NBI), a national database of all bridges on public roads in the Nation. (The Status of the Nation's Highway Bridges, 1997). NBI data thus provide a current, comprehensive inventory of all bridges on public roads throughout the country.

In examining bridge data, it is important to understand the bridge definition used in the NBI, as not all structures commonly understood to be bridges are included. The NBI defines bridges to include structures of 20 feet or more, a definition published in 23 CFR 650.3:

"A structure including supports erected over a depression or an obstruction, such as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than 20 feet between undercopings of abutments or spring lines of arches, or extreme ends of openings for multiple boxes; it may also include multiple pipes, where the clear distance between openings is less than half of the smaller contiguous opening." Culverts are included as bridges, provided they are more than 20 feet in length and include a driveable surface for vehicle use.

The NBI inventories bridges according to highway functional classification. Bridges are thus reported according to their location on different road classes. Since ISTEA made changes in the Federal-aid system with the creation of the National Highway System, the NBI reflected those changes as follows. Before ISTEA, bridges were classified as on-system, or on the Federal-Aid system, or off-system, not on the Federal-Aid system. ISTEA changed the definition of off-system bridges so that a higher number of bridges were included as NHS or other Federal-aid bridges. Generally, rural bridges on the Interstate, Other Principal Arterial, Minor Arterial and Major Collector road systems are included in the Federal-Aid, on-system bridge count. Bridges on the Minor Collector and Local road systems are considered off-system bridges.

In 1997, there were 582,734 bridges in the United States. Of these bridges, 455,106 or 78 percent, were in rural areas. Bridges on local rural roads accounted for 46 percent of total rural bridges, or 210,678 bridges. It is worth noting the preponderance of local rural bridges, since the majority of these bridges are off-system, located on Minor Collector or Local road systems and the responsibility of State or local governments. (Transportation Statistics Annual Report, 1999, http://www.bts.gov/publications/tsar/1999/index.html).

Measuring ISTEA Impact: The Data

The impact of ISTEA on rural roads and bridges will be measured using condition information provided by two databases maintained by the U.S. Department of Transportation. They are the Highway Performance Monitoring System (HPMS) and the National Bridge Inventory (NBI). Each database is described below.

Highway Performance Monitoring System (HPMS)

The HPMS was developed in 1978 as an integrated database for the national highway transportation system (http://www.fhwa.dot.gov/policy/ohpi/hpms/index.htm). It is a national inventory that includes data for all of the Nation's public road mileage as certified annually by each State governor. It includes limited data on local roads, summary information for urbanized, small urban and rural areas, and more detailed information on a sample of the arterial and collector functional systems. It provides overall data that reflect the "extent, condition, performance, use, and operating characteristics of the Nation's highways."

The Federal Highway Administration (FHWA) works in cooperation with State highway agencies, local governments and metropolitan planning organizations to collect, compile and report HPMS data. FHWA has defined the data to be reported and provided data standards. The data are now collected in a PC-based system, with more recent data summaries available in the annual Highway Statistics report on DOT's web site (http://www.fhwa.dot.gov/policy/ohpi/hss/index.htm).

HPMS data are widely used throughout the transportation community. A key use of the data is the apportionment of Federal-aid highway funds pursuant to ISTEA. They are also used to assess and report highway system performance under FHWA's strategic planning process and form the basis of the analysis that supports DOT's Condition and Performance Reports to Congress. State transportation departments use the data for surface transportation planning and transportation improvements. Other governmental interests, business and industry, academic institutions, the media and the general public use HPMS data for analysis, planning and evaluation of the transportation system.

Considerations in Using HPMS Data

In analyzing the impact of ISTEA on rural areas, it is useful to know the HPMS definitions of rural, small urban and urbanized areas. Urbanized areas are those areas with a population of 50,000 or more, as designated by the Census. Small urban areas are places of 5,000 to 49,999 population outside urbanized areas. Rural areas are then defined as "all areas of a State outside of the FHWA-approved adjusted Census boundaries of small urban and urbanized areas." Rural areas are those places with a population under 5,000.

This analysis uses HPMS data from 1994 and 1997, the last year of ISTEA, to measure the impact of the Act on rural roads and bridges. Several factors were considered in selecting 1994 and 1997 data for comparison. Initial analysis focused on comparing 1990 pre-ISTEA condition data with 1997. However, several changes made a direct comparison of 1990 and 1997 road and bridge conditions problematic.

- The 1990 Census led to changes in rural and urban boundaries. The 1990 HPMS data utilized the 1980 Census, while the 1997 report uses 1990 Census information. Population changes, particularly urban/suburban expansion, influence roadway mileage by functional classification, by rural, small urban or urbanized areas. Specifically, rural road mileage would be reduced in those areas with expanding urban populations.
- ISTEA replaced the four Federal-aid systems (Interstate, Primary, Secondary, and Urban) with two systems, namely the NHS and the Interstate System. Surface Transportation Program funding would be available for all roads not functionally classified as local or rural minor collector. The NHS was adopted in 1995, so that the 1997 HPMS data include the NHS as a separable system. As a result, the 1997 Federal-aid highway mileage data are not directly comparable with the 1990 data.

- ISTEA directed USDOT to cooperate with state highway/transportation departments, Metropolitan Planning Organizations and other local officials to carry out a functional reclassification to update highways eligible for Federal aid and begin development of the National Highway System (A Report to Congress on the Results of the Highway Functional Reclassification,1993). The last previous realignment of the Federal-aid system had taken place in 1976, and highway usage and population changes required a re-examination of road classes to synchronize highway use with Federal funding. As a result, the 1990 mileage within each functional road class was not directly comparable to the realigned 1997 mileage. By 1994, the majority of state transportation departments had incorporated the functional reclassification and the 1990 Census changes into the HPMS data reported to USDOT (1994 Highway Statistics, http://www.fhwa.dot.gov/ohim/1994/index.html).
- To ascertain stability of the mileage within each functional class, 1990 functional classification mileage was compared to 1997 mileage (Table 1). The comparison shows that the mileage by functional class varied up to a 17 percent increase in Other Principal Arterial mileage by 1997. The same mileage comparison using 1994 data indicates that 1997 mileage in each functional class varied no more than 1 percent from the 1994 mileage, demonstrating relative stability in the mileage for each functional class from 1994 to 1997. Overall 1997 Federal-aid mileage increased less than 1 percent from the 1994 total. Table HM-20 in the 1994 Highway Statistics report (http://www.fhwa.dot.gov/ohim/1994/index.html) displays functional class mileage by state for 1994, and Table HM-20 of the 1997 Highway Statistics report (http://www.fhwa.dot.gov/ohim/hs97/hs97page.htm) provides the 1997 mileage.
- The HPMS itself was reassessed during December 1996 to December 1998. Changes to the system were subsequently implemented, including the elimination of 14 data items and 90 reported detail lines, and the addition of one new item. Sample sizes were reduced, and FHWA reduced the number of records by grouping. The data used in this analysis were not affected by the HPMS revision, but it is useful to keep in mind that the inventory system itself was undergoing change during the period of analysis.

National Bridge Inventory (NBI)

The NBI was established by the 1968 Federal-Aid Highway Act, which required DOT, in cooperation with the States, to inspect and maintain a current inventory of all bridges on the Federal-Aid system. The 1970 Federal-Aid Highway Act required that all Federal-Aid highway bridges be rated. In 1978, Congress extended the inventory and inspection requirement to all bridges on public roads. In 1987, the Surface Transportation and Uniform Relocation Assistance Act created a separate section of Title 23 to establish a National Bridge Inspection Program. In addition to inspection and inventory, the Secretary of DOT was required to establish: national bridge inspection standards, the methods of inspection, the qualifications of those who would carry out the inspections, including training and national certification of bridge inspectors, and written inspection report requirements for State inventories (The Status of the Nation's Highway Bridges, 1997). Considerable attention was given to the rating system, since the data are used to establish funding eligibility under the Highway Bridge Replacement and Rehabilitation Program (HBRRP). The program functions as follows.

Table 1. Comparison of Rural Mileage by Functional Classification, 1990, 1994, 1997

Functional Classification	1990	% of Total	1994	% of Total	1997	% of Total	90/97 Change	94/97 Change
Interstate	33547	5%	32457	5%	32809	5%	-2%	1%
Other Principal Arterial	83802	12%	96995	14%	98261	14%	17%	1%
Minor Arterial	144735	21%	138171	20%	137497	20%	-5%	0%
Major Collector	436365	62%	431111	62%	432726	62%	-1%	0%
Total Miles	698449		698734		701293		0%	0%

Data compiled from Table HM-20, 1990, 1994, and 1997 *Highway Statistics*, U.S. Dept. of Transportation, Federal Highway Administration, Washington, D.C.

FHWA, in consultation with the States, establishes general bridge funding priorities by assigning a sufficiency rating (SR) from 0 to 100 for each bridge. The SR is calculated as follows:

- 55 percent — structural adequacy and safety
- 30 percent — serviceability and functional obsolescence
- 15 percent — essentiality for public use

100 percent

Under the NBI, there are two types of deficient bridges: structurally deficient and functionally obsolescent. A structurally deficient (SD) bridge (1) is restricted to light vehicles only, (2) is closed, or (3) requires immediate rehabilitation to remain open. A functionally obsolescent (FO) bridge is one whose design capacity no longer meets the design criteria of the system of which it is a part. A bridge built in the 1920's to accommodate narrower, lighter-weight vehicles being used for longer-combination vehicles is an example of a functionally obsolescent bridge.

An SD or FO rating does not necessarily imply the bridge is unsafe for vehicle use. With proper load posting and enforcement, most SD bridges can be used. While FO bridges may have design deficiencies, using roadway striping, signals and other traffic control devices can mitigate those deficiencies.

An SR is the basis for establishing eligibility and priority for replacement and rehabilitation of bridges within each State. The lower the SR, the higher the funding priority. All deficient bridges with an SR of 80 or less are included on an HBRRP "selection list" for each State. These bridges are eligible for rehabilitation, while bridges with an SR of less than 50 are also eligible for replacement. Bridges are placed into one of four priority categories: (1) Federal-aid system bridges eligible for replacement; (2) Federal-aid system bridges eligible for rehabilitation; (3) off-system bridges eligible for replacement; and (4) off-system bridges eligible for rehabilitation.

Considerations in Using NBI Data

First, while ISTEA did not change the HBRRP, changes in highway functional classifications have an impact on whether a bridge is considered a Federal-aid bridge (on-system) or a non-Federal-aid bridge (off-system). According to the 1997 FHWA Bridge Report, the old classification resulted in the following count on June 30, 1992:

Federal-aid	276,510
Off-system	298,903
TOTAL	575,413

The new ISTEA definition resulted in the following NBI bridge count on June 30, 1994:

NHS	126,911
Other Federal-aid	170,178
Off-system	279,371
TOTAL	576,460

More bridges are now included in the Federal-aid category, so that they receive a higher rating for funding under the HBRRP. Off-system bridges are functionally classified as located on rural Minor Collector roads and Local roads.

Data used in this analysis were obtained by request from FHWA, with U.S. Dept. of Agriculture's Economic Research Service (ERS) compiling the 1994 and 1997 State-level information from the NBI database. Bridge data are available on the DOT web site at http://www.fhwa.dot.gov/bridge/nbi.htm.

ISTEA Impact on Rural Roads: 1994 and 1997

Changes in Surface Type by Rural Road Functional Classification

Table 2 presents summary statistics on rural road mileage by functional classification and surface type for 1994 and 1997. Tables HM-51 and HM-67 from the 1994 Highway Statistics report (http://www.fhwa.dot.gov/ohim/1994/index.html) contain 1994 state-level data for Federal-aid functional road classes and Minor Collector and local mileage, while Table HM-51 from the 1997 Highway Statistics report (http://www.fhwa.dot.gov/ohim/hs97/hs97page.htm) includes 1997 data.

Generally, surface type improvements were noted across all categories of rural roads from 1994 to 1997. There were differences, however, by functional classification, with the higher functional roads demonstrating a greater level of improvement. Rural Interstate mileage shows a 12 percent increase in high type-composite surface. Other Principal Arterial roads, 14 percent of rural Federal-aid mileage, demonstrate an overall surface type improvement, with a decline in Intermediate type and increases in high type flexible and composite surfaces.

Overall, road condition improved for rural Minor Arterial roads. Both Low Type and Intermediate mileage dropped by 22 percent. Major Collector mileage, 62 percent of rural Federal-aid mileage, showed an 11 percent decrease in Low Type road surface, as well as a 4 percent decline in unpaved mileage.

Detailed data are not collected on Minor Collector and Local roads, as these roads are not eligible for Federal funding. Instead, these roads are described by Paved vs. Unpaved only. Minor Collector road mileage decreased by 3 percent with unpaved mileage dropping by 14 percent. Rural Local road mileage in 1994 totaled 2,112,194, with 65 percent of that mileage unpaved. In 1997, local mileage increased by 1 percent, with 64 percent of that mileage unpaved.

Table 2. Rural Mileage by Type of Surface and Functional Classification, 1994 and 1997

Functional Classification (FC)	1994	% FC	% Fed Aid	1997	% FC	% Fed Aid	94-97 Change
Interstate							
High Type-Flexible	15,922	49%	2%	16,010	49%	2%	1%
High Type-Composite	6,088	19%	1%	6,791	21%	1%	12%
High Type-Rigid	10,447	32%	1%	10,008	31%	1%	-4%
Total FC Miles	32,457		5%	32,809		5%	1%
Other Principal Arterial							
Low Type	287	0%	1%	468	0%	0%	63%
Intermediate	5,276	5%	0%	4,321	4%	1%	-18%
High Type-Flexible	61,281	63%	9%	63,767	65%	9%	4%
High Type-Composite	19,661	20%	3%	20,122	20%	3%	2%
High Type-Rigid	10,490	11%	2%	9,853	10%	1%	-6%
Total FC Miles	96,995		14%	98,261		14%	1%
Minor Arterial							
Low Type	2,264	2%	0%	1,746	1%	0%	-23%
Intermediate	14,771	11%	2%	11,488	8%	2%	-22%
High Type-Flexible	98,547	71%	14%	101,530	74%	14%	3%
High Type-Composite	18,378	13%	3%	18,747	14%	3%	2%
High Type-Rigid	4,211	3%	1%	3,986	3%	1%	-5%
Total FC Miles	138,171		20%	137,497		20%	0%
Major Collector							
Unpaved	46,040	11%	7%	44,196	10%	6%	-4%
Low Type	50,614	12%	7%	44,826	10%	6%	-11%
Intermediate	97,685	23%	14%	101,939	24%	15%	4%
High Type-Flexible	208,321	48%	30%	211,991	49%	30%	2%
High Type-Composite	19,080	4%	3%	20,261	5%	3%	6%
High Type-Rigid	9,371	2%	1%	9,513	2%	1%	2%
Total FC Miles	431,111		62%	432,726		62%	0%
Total Federal Aid Mileage	698734			701293			

Table 2. Rural Mileage by Type of Surface and Functional Classification, 1994 and 1997 (Cont.)

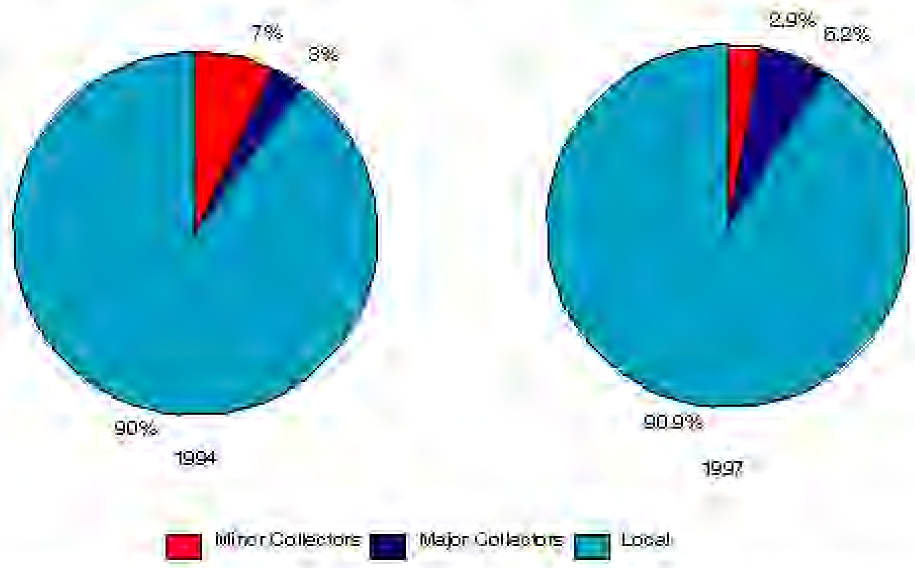
Minor Collector						
Unpaved		107,758	38%	92,829	34%	-14%
Paved		174,267	62%	179,584	66%	3%
	Total FC Miles	282,025		272,413		-3%
Local						
Unpaved		1,377,714	65%	1,371,946	64%	0%
Paved		734,480	35%	762,893	36%	4%
	Total FC Miles	2,112,194		2,134,839		1%

Data compiled from Tables HM-51 and HM-67, 1994 *Highway Statistics*, and Table HM-51, 1997 *Highway Statistics*, U.S. Dept. of Transportation, Federal Highway Administration, Washington, D.C.

In general, rural Federal-aid mileage trended towards a higher proportion of higher-level or better surface types from 1994 to 1997. However, it is worth noting that while Federal-aid mileage improved, Minor Collector and Local mileage did not appear to improve at the same pace. As indicated, the only data reported for these roads is whether they are paved or unpaved.

The percentage of Minor Collector paved mileage increased by 3 percent from 1994 to 1997, while paved mileage for Local roads stayed constant at 65 percent. In 1994, 90 percent of rural unpaved mileage was local, with 90.9 percent unpaved in 1997 (Figure 2). However, without additional data on traffic, unpaved mileage may simply reflect the lower traffic demands placed on these local roads. These numbers do indicate little road surface improvement on roads not included in the Federal aid system, roads that serve primarily local traffic.

Figure 2
Rural unpaved mileage by functional road categories,* 1994 and 1997
Most rural unpaved mileage is found on local roads



*One-hundred percent of Interstates, Other Principal Arterials, and Minor Arterials were paved in 1994 and 1997.
Source: Tables HM-51 and HM-67, 1994 Highway Statistics, and Table HM-51, 1997 Highway Statistics, U.S. Department of Transportation, Federal Highway Administration, Washington, D.C.

Changes by Lane Width

Lane width affects highway safety and capacity. Narrow lanes prevent roadways from operating at capacity. High-type road facilities such as Interstates are expected to have 12-foot lanes, with both the American Association of State Highway and Transportation Officials (A Policy on Geometric Design of Highways and Streets, 1990) and FHWA recommending12-foot lanes for most types of roads (1999 Status of the Nation's Highways, Bridges and Transit, www.fhwa.dot.gov/policy/1999cpr). The AASHTO Guide states that "Ten-to 13-ft lane widths are generally used, with a 12-ft lane predominant on most high-type highways." Highways with less than 11-foot lanes demonstrate inadequate vehicle clearance, while 10-foot lanes are considered adequate only for low volume roads with limited truck traffic.

Because lane width is a measure of both safety and highway capacity, HPMS collects lane-width data on Federal-Aid highways. Interstate mileage includes information on lane widths of less than 12 feet, 12 feet and more than 12 feet. Other Principal Arterial, Minor Arterial and Major Collector roads include lane width data on lanes less than 9 feet, 9 feet, 10 feet, 11 feet, 12 feet and more than 12 feet. Lane widths are not reported for Minor Collector or Local mileage.

Summary Table 3 compares lane widths by functional classification for 1994 and 1997. Table HM-53 from the 1994 Highway Statistics report (http://www.fhwa.dot.gov/ohim/1994/index.html) presents 1994 state-level data and Table HM-53 of the 1997 Highway Statistics report (http://www.fhwa.dot.gov/ohim/hs97/hs97page.htm) presents 1997 state-level data. Overall, lane widths improved for most categories of rural Federal-Aid highways. Interstates in 1997 have virtually no mileage with lane width less than 12 feet: less than 1 percent of Interstate mileage lane width is less than 12 feet. Other Principal Arterial mileage is primarily characterized by 12-foot lanes: overall mileage with 12 foot or above (12+) lane width increased by 17 percent from 1994 to 1997. By 1997, 88 percent of Other Principal Arterial roads had lane widths of 12 + feet.

It is worth noting that the National Highway System, formalized in 1995, is primarily composed of Interstate and Other Principal Arterial mileage. The rural Principal Arterial system accounts for 3.3 percent of total miles, but carried 46.8 percent of rural travel and 18.3 percent of total U.S. travel in 1997 (1999 Status of the Nation's Highways, Bridges and Transit, www.fhwa.dot.gov//policy/1999cpr).

Minor Arterial roads demonstrated improvements in lane widths, with less than 1 percent having lane widths fewer than 9 feet in 1997. By 1997, 68 percent of Minor Arterial mileage had lane widths of 12 feet and over. Major Collector highways also showed improvements in lane widths, with a 5 percent reduction in roadways with lane widths of 10 feet and under. Roads with lane widths of 12 feet and over comprised 37 percent of Major Collector roads.

Table 3 illustrates an overall improvement in mileage with lane widths of 12 feet or over on Federal-Aid highways, or those highways eligible to receive Federal funding. In general, the percent of 12+ foot lanes increases as the highway functional classification serves an increasing volume of travel. By 1997, the data indicate that Interstates have 12+ foot lanes on more than 99 percent of their mileage. Other Principal Arterial roads have 12+ foot lanes on 89 percent of their mileage while 68 percent of Minor Arterial and 37 percent of Major Collector roads have 12+ foot lanes. By 1997, 6.5 percent of all Federal-Aid highways had lane-widths of 9 feet or less, a slight reduction from the 1994 mileage of 7 percent, which includes 49,227 miles.

Table 3. Rural Mileage by Lane Width and Functional Classification, 1994 and 1997

Functional Classification (FC)/ Lane Width in Feet	1994	% FC	% of Total	1997	% FC	% of Total	94-97 Change
Interstate							
<12	102	0%	0%	58	0%	0%	-43%
12	31,516	97%	5%	32,243	98%	5%	2%
>12	839	3%	0%	511	2%	0%	-39%
Total FC Miles	32,457		5%	32,812		5%	1%
Other Principal Arterial							
<9	103	0%	0%	154	0%	0%	50%
9	442	0%	0%	455	0%	0%	3%
10	2,139	2%	0%	1,877	2%	0%	-12%
11	9,600	10%	1%	8,874	9%	1%	-8%
12	80,794	83%	12%	82,392	84%	12%	2%
>12	3,917	4%	1%	4,509	5%	1%	15%
Total FC Miles	96,995		14%	98,261		14%	1%
Minor Arterial							
<9	172	0%	0%	222	0%	0%	29%
9	2,202	2%	0%	1,704	1%	0%	-23%
10	16,278	12%	2%	16,457	12%	2%	1%
11	26,068	19%	4%	26,029	19%	4%	0%
12	87,121	63%	12%	87,548	64%	12%	0%
>12	6,330	5%	1%	5,536	4%	1%	-13%
Total FC Miles	138,171		20%	137,496		20%	0%

Table 3. Rural Mileage by Lane Width and Functional Classification, 1994 and 1997 (Cont.)

Functional Classification (FC)/ Lane Width in Feet	1994	% FC	% of Total	1997	% FC	% of Total	94-97 Change
Major Collector							
<9	11,054	3%	2%	10,766	2%	2%	-3%
9	39,107	9%	6%	35,926	8%	5%	-8%
10	125,524	29%	18%	121,214	28%	17%	-3%
11	103,295	24%	15%	105,530	24%	15%	2%
12	140,839	33%	20%	147,068	34%	21%	4%
>12	11,292	3%	2%	12,226	3%	2%	8%
Total FC Miles	431,111		62%	432,730		62%	0%
Total Federal Aid Mileage	698,734			701,299			

Data compiled from Table HM-53, 1994 and 1997 *Highway Statistics,*
U.S. Dept. of Transportation, Federal Highway Administration, Washington, D.C.

Changes in Road Surface Condition Rating

Pavement condition affects travel cost, particularly the cost of vehicle operation, causes delays and increases the risk of accidents. Pavement condition is also visible to the motorist, since potholes and pavement roughness affect the quality of the ride. FHWA currently uses two pavement rating systems. One system is based on the Pavement Serviceability Rating (PSR) that uses sufficiency ratings from a pavement rating table in the HPMS. The second system is an objective measure, the International Roughness Index (IRI), developed by the World Bank for international equivalency in assessing roadway conditions. A brief description of each system helps understand Table 4, surface condition data from 1994 and 1997.

Present Serviceability Rating (PSR)

PSR uses a numerical value ranging from zero to five, with zero reflecting poor pavement condition and 5 indicating very good pavement. This rating provides a subjective judgement of pavement condition based on an assessment of ride and pavement condition by a panel of road users. A brief description of the ratings is found in 1999 Status of the Nation's Highways, Bridges and Transit, www.fhwa.dot.gov/policy/1999cpr)

PSR Rating Scale

4.0-5.0—Only new or nearly new superior pavements are likely to be included in this category as they would be smooth and free of cracks and patches. Newly constructed or resurfaced roads would fall into this rating.

3.0-4.0—This pavement exhibits few, if any, visible signs of surface deterioration. Flexible pavements may show slight rutting and fine random cracks.

2.0-3.0—Riding qualities at this level are noticeably inferior to new pavements and may be barely tolerable for high-speed traffic. Surface defects may include "rutting, map cracking and extensive cracking." (IBID, p. 3-4)

1.0-2.0—Pavement at this category has deteriorated sufficiently to affect free flow of traffic. Flexible pavement may have large potholes and deep cracks, with cracking and rutting occurring in over 50 percent of the surface.

0.0-1.0—Pavement is extremely deteriorated and passable only at reduced speed and considerable ride discomfort. Large potholes and deep cracks cover more than 75 percent of the surface.

The PSR was adapted from the AASHTO Road Tests conducted in the late 1950's and early 1960's. Because they are subjective, ride-based ratings and because the States use various methodologies to collect the data, the ratings may not be consistent or comparable among States.

International Roughness Index (IRI)

The International Roughness Index (IRI), or measured pavement roughness, is an objective equipment-based rating reported in the HPMS as IRI in inches per mile. These ratings are based on information collected by mechanical devices, some of which require calibration to known profiles. The World Bank established the rating in the early 1980's as part of an effort to establish a pavement roughness indicator that could be used throughout the world to produce comparable measurements of pavement roughness for lending purposes. The IRI is a numerical value that is an accumulation of inches of vertical movement of a vehicle over a road surface, adjusted to reflect a rate per mile. Lower values indicate a smooth riding quality, while higher values indicate a rougher road. FHWA indicates that an acceptable rating requires an IRI value of less than or equal to 170 inches per mile. Because IRI is an objective, mechanically measured index, it is considered to be a more consistent and comparable measure among States (www.umtri.umich.edu/erd/roughness/iri.html).

Prior to 1993, all road condition data were reported using the PSR. Beginning in 1993, States began reporting IRI ratings for the higher functional systems, with the PSR used for the lower functional systems. For rural roadways, IRI ratings are given for Interstates, Other Principal Arterial roads, and Minor Arterial mileage by 1997. PSR ratings are given for Major Collector mileage. Pavement condition ratings are not reported for Minor Collector or Local roads.

Table 4 summarizes data from 1994 and 1997 to indicate condition of U.S. roads by functional classification, compiling data provided by Table 1-23 of the National Transportation Statistics 2000 report and Table H-63 of the 1994 Highway Statistics report (http://www.fhwa.dot.gov/ohim/1994/index.html) provides 1994 state-level data that combines the PSR and IRI measures, while Table HM-64 provides the IRI for rural roads except for the Major Collector system. Tables HM-63 and HM-64 of the 1997 Highway Statistics report, Tables HM-63 (http://www.fhwa.dot.gov/ohim/hs97/hs97page.htm) provide state-level data for 1997. Table HM-63 provides the PSR ratings for Major Collector mileage, while Table HM-64 provides the IRI for Interstates, Other Principal Arterial and Minor Arterial roads.

One caveat is in order when reviewing Table 4. The summary ratings combine the PSR and IRI ratings to provide overall ratings of Poor, Mediocre, Fair, Good and Very Good. The PSR and IRI ratings can be cross-walked, and DOT has done so in Exhibit 3-7 of its 1999 Status of the Nation's Highways, Bridges and Transit (www.fhwa.dot.gov/policy/1999cpr) . However, DOT warns that translation between PSR and IRI is not exact, since the two ratings are separately calculated using different evaluation systems.

Overall, the condition of roads within each functional classification improved between 1994 and 1997. The improvement was most pronounced for Interstate and Other Principal Arterial mileage: 56.7 percent of Interstates were rated Good or Very Good, while 45.8 percent of Other Principal Arterial roads were so rated. Generally, the overall percentage of mileage rated Poor declined across all functional classifications, while the percentage of roads rated Good and Very Good increased. One exception is Major Collector mileage, which showed a slight decline in the Very Good category, from 21.9 percent to 19.3 percent.

Table 4. Condition of Rural U.S. Roads by Functional Classification, 1994 and 1997

Functional Classification (FC)	1994	1997
Interstate		
Poor (%)	6.5	3.6
Mediocre (%)	26.5	19.1
Fair (%)	23.9	20.7
Good (%)	33.2	41
Very Good (%)	9.9	15.7
Unpaved (%)	N	N
Miles not Reported	955	1,382
Total FC Miles Reported	31,502	31,431
Other Principal Arterials		
Poor (%)	2.4	1.6
Mediocre (%)	8.2	4.9
Fair (%)	57.4	47.7
Good (%)	26.6	37.2
Very good (%)	5.4	8.6
Unpaved	N	N
Miles not Reported	7,489	6,083
Total FC Miles Reported	89,506	92,170
Minor Arterials		
Poor (%)	3.5	2.3
Mediocre (%)	10.5	6.7
Fair (%)	57.9	50.4
Good (%)	23.6	33.6
Very good (%) `	4.5	7
Unpaved	N	N
Miles not Reported	13,294	10,978
Total FC Miles Reported	124,877	126,525
Major Collectors		
Poor (%)	6.5	7.8
Mediocre (%)	11.3	12.3
Fair (%)	33.5	37.6
Good (%)	16.1	23
Very Good (%)	21.9	19.3
Unpaved	10.7	N
Miles not Reported	N	2,402
Total FC Miles Reported	431,111	386,122

Note: N--data do not exist

Data compiled from Table 1-23, Condition of U.S. Roadways by Functional System, *National Transportation Statistics*, 2000, U.S. Dept. of Transportation, Bureau of Transportation Statistics, Washington, D.C.

While the percentage of roads in poor condition decreased for each functional classification, the decrease was greatest for Interstates. In 1994, 6.5 percent of Interstate mileage rated poor, with 3.6 percent of mileage considered poor in 1997. By 1997, 40.6 percent of Minor Arterial mileage was rated Good or Very Good, compared to 28.1 percent in 1994. Major Collector mileage showed an increase in mileage rated Fair and Good, plus small percentage increases in mileage rated Poor and Mediocre.

Changes in Rural Bridge Condition, Average Daily Traffic, and ISTEA Financing

Changes in Rural Bridge Condition

National Bridge Inventory (NBI) data indicate that the condition of rural bridges improved across all functional road classifications from 1994 to 1997, from Interstates to local bridges. Table 5 compares condition of rural bridges in 1994 with 1997 by functional classification. Minor Collector and Local bridges are included in this table because all bridges on public roadways are eligible for Federal funding according to a priority based on condition and functional classification.

In 1994, 32 percent of all rural bridges were deficient. The majority of deficient bridges were structurally deficient, with 20 percent exhibiting structural defects. The remaining 12 percent were functionally obsolete. Deficiencies varied according to functional classification, with the higher order roads having fewer deficient bridges.

Nineteen percent of the bridges on Interstate highways were rated deficient in 1994. Of the deficient Interstate bridges, 4 percent were structurally deficient and 15 percent were functionally obsolete. Other Principal Arterial roads had 19 percent of their bridges rated deficient. Minor Arterial roads had 24 percent of bridges rated deficient, with Major Collector roads also having 24 percent rated deficient. Local roads fared the worst, with 41 percent of their bridges rated deficient.

By 1997, overall bridge condition had improved across all functional road classifications: 29 percent of all rural bridges were rated deficient for a reduction of 3 percent. The greatest reduction was in number of structurally deficient bridges: 18 percent were rated deficient. Functionally obsolete bridges made up 11 percent of total bridges. Again, the higher functional road systems had fewer deficient bridges.

Table 5. Rural Bridge Conditions by Functional Classification, 1994 and 1997

Functional Classification	1994	% FC	% of Total	1997	% FC	% of Total	94-97 Change
Interstate							
SD*	1,149	4%	0%	1,239	4%	0%	8%
FO*	4,165	15%	1%	3,417	12%	1%	-18%
Total	28,718		6%	27,899		6%	
Other Principal Arterial							
SD	2,546	7%	1%	2,423	7%	1%	-5%
FO	4,267	12%	1%	3,727	11%	1%	-13%
Total	35,044		8%	34,787		8%	
Minor Arterial							
SD	4,355	12%	1%	3,968	10%	1%	-9%
FO	4,520	12%	1%	4,462	12%	1%	-1%
Total	37,361		8%	38,297		8%	
Major Collector							
SD	14,154	14%	3%	12,793	13%	3%	-10%
FO	10,097	10%	2%	9,853	10%	2%	-2%
Total	97,902		22%	95,512		21%	

Table 5. Rural Bridge Conditions by Functional Classification, 1994 and 1997 (Cont.)

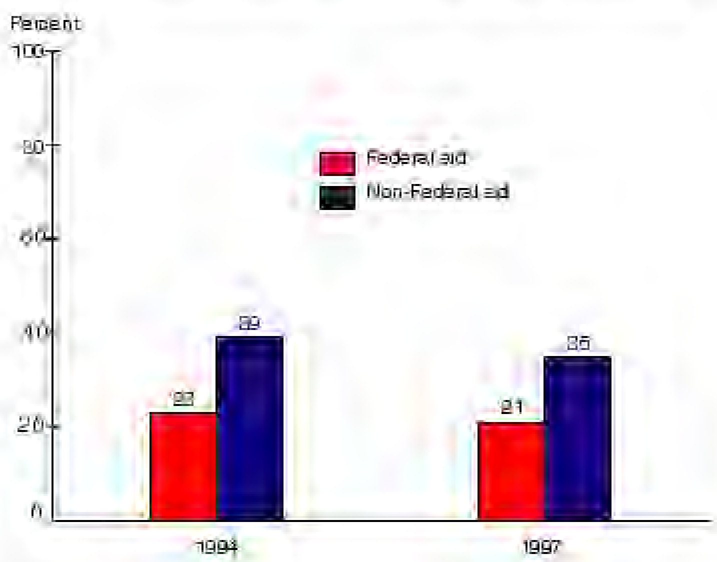
	1994	% FC	% of Total	1997	% FC	% of Total	94-97 Change
Minor Collector							
SD	9,358	19%	2%	8,033	17%	2%	-14%
FO	5,440	11%	1%	5,078	11%	1%	-7%
Total	49,100		11%	47,233		10%	
Local							
SD	60,148	29%	13%	55,028	26%	12%	-9%
FO	24,001	12%	5%	23,607	11%	5%	-2%
Total	206,260		45%	210,399		46%	
Total Rural Bridges	454,385			454,127			0%
% SD		20%			18%		
% FO		12%			11%		
% Deficient		32%			29%		

*SD-Structurally Deficient
*FO-Functionally Obsolete

Data compiled from National Bridge Inventory databases, U.S. Dept. of Transportation, Federal Highway Administration, Washington, D.C.

Interstate bridge conditions had improved, with only 16 percent rated deficient. The principal change was in a reduction of functionally obsolete bridges from 15 percent to 12 percent of Interstate bridges, meaning these bridges had been reconstructed to current design requirements. Other Principal Arterial bridges now included 18 percent deficient. Minor Arterial bridges totaled 22 percent deficient, with 23 percent of Major Collector bridges rated deficient. Twenty-seven percent of Minor Collector bridges were rated deficient. Local roads, which include the highest number of bridges, now included a total of 37 percent deficient. These data again point out the differences in overall bridge condition between Federal-aid roads and those not receiving Federal funding. Both Minor Collector and Local roads continued to have a higher percentage of deficient bridges in 1997, due mainly to structural deficiencies, indicating that while bridge conditions on these roads improved during the 3-year period, bridge improvements lagged behind the higher functional road classes. However, Figure 3 illustrates the overall decline in deficient bridges across all categories of rural roads.

Figure 2
Percent of deficient rural bridges by Federal aid category, 1994 and 1997
The percent of deficient bridges dropped from 1994 to 1997 for all rural roads



Source: National Bridge Inventory databases, U.S. Department of Transportation, Federal Highway Administration, Washington, D.C.

NBI data indicate that rural bridge conditions improved over the 3-year period. While 32 percent of all bridges were deficient in 1994, 29 percent were rated deficient in 1997. Or, alternatively, 68 percent of bridges were rated in good condition in 1994, with 71 percent rated in good condition in 1997.

And, with few exceptions, bridge ratings improved in all States. Some States with over 15,000 bridges demonstrated significant improvement. In 1994, 41 percent of the 15,592 bridges in Mississippi were deficient, by 1997 36 percent were deficient. Illinois, with over 20,000 bridges, reduced deficient bridges by 4 percent. Missouri, with over 19,000 bridges, reduced deficient bridges by 4 percent during this 3-year period. Tennessee, with more than 15,000 bridges, reduced deficient bridges by 4 percent. Ohio reduced deficient bridges by 3 percent on its 21,000+ bridges.

Changes in Average Daily Traffic

Condition data describe the physical status of roadways and bridges, but do not reveal usage or traffic patterns. Increasing traffic can damage the physical condition of roads and bridges, while declining or static traffic can reduce maintenance requirements. Average daily traffic data help set priorities for maintenance and determine where major investments are required to meet increasing traffic/travel demands. Comparative data from 1994 to 1997 indicate that improvements were made on rural roadways and rural bridges, but do not indicate whether those improvements took place in a static traffic environment or in a period of increased traffic. This section looks at an objective measure of traffic to examine rural road and bridge usage during the 1994-1997 period. Average daily traffic data are not collected for Minor Collector and Local mileage.

FHWA uses daily vehicle-miles of travel as the primary measure of travel activity on the Nation's road system. Daily travel multiplied by 365 days (366 days for leap years) equals annual travel. States report average daily traffic for each section of Interstate, National Highway System and other Principal Arterial mileage. Travel is calculated for these higher level functional systems on a 100 percent basis, so that these traffic data are considered to be of reasonable quality. For Minor Arterial roads and Major Collector roads, travel is calculated from sample road segments using FHWA procedures, so that some variability may be found in data for the lower functional systems.

Table 6 demonstrates that traffic increased on all Federal-aid rural highways from 1994 to 1997. Table HM-57 from the 1994 Highway Statistics report (http://www.fhwa.dot.gov/ohim/1994/index.html) presents state level data for 1994, while Table HM-57 of the 1997 Highway Statistics report (http://www.fhwa.dot.gov/ohim/hs97/hs97page.htm) presents the 1997 data.

Table 6. Rural Mileage by Average Daily Traffic and Functional Classification, 1994 and 1997

Functional Classification (FC)	1994 Mileage			1997 Mileage			
		% FC	% Total		% FC	% Total	94-97 Change
Interstate							
< 6,000	4,642	14%	1%	4,128	13%	1%	-11%
6,000-9,999	4,900	15%	1%	4,416	13%	1%	-10%
10,000-19,999	11,212	35%	2%	10,873	33%	2%	-3%
20,000 +	11,703	36%	2%	13,399	41%	2%	14%
Total FC Miles	32,457		5%	32,816		5%	
Other Principal Arterial							
<1,000	7,205	7%	1%	6,900	7%	1%	-4%
1,000-1,999	14,086	15%	2%	13,089	13%	2%	-7%
2,000-2,999	13,628	14%	2%	12,923	13%	2%	-5%
3,000-9,999	47,291	49%	7%	47,906	49%	7%	1%
10,000-14,999	8,219	8%	1%	9,372	10%	1%	14%
15,000+	6,566	7%	1%	8,068	8%	1%	23%
Total FC Miles	96,995		14%	98,258		14%	
Minor Arterial							
< 1,000	31,358	23%	4%	28,090	20%	4%	-10%
1,000-1,999	35,232	25%	5%	33,491	24%	5%	-5%
2,000-2,999	25,647	19%	4%	24,574	18%	4%	-4%
3,000-9,999	41,275	30%	6%	45,653	33%	7%	11%
10,000-14,999	3,036	2%	0%	3,977	3%	1%	31%
15,000+	1,623	1%	0%	1,715	1%	0%	6%
Total FC Miles	138,171		20%	137,500		20%	

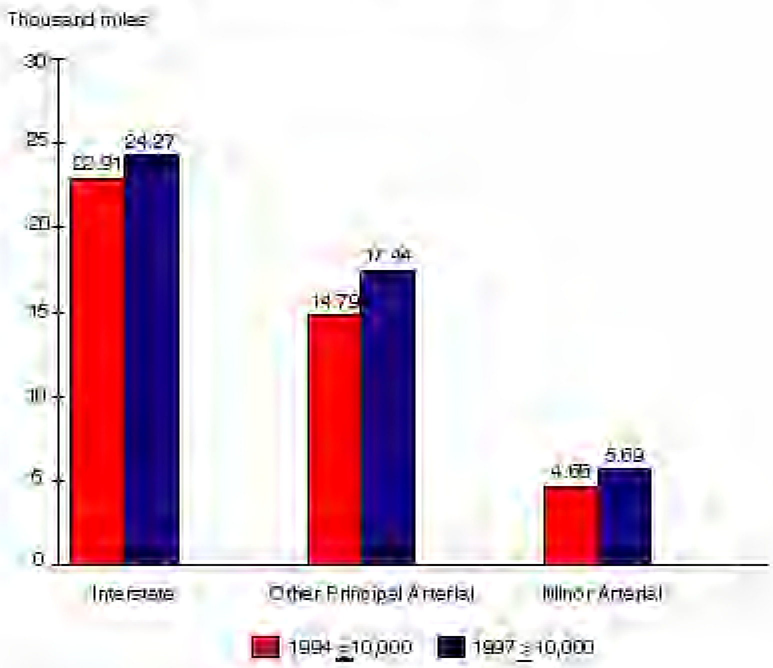
Table 6. Rural Mileage by Average Daily Traffic and Functional Classification, 1994 and 1997 (Cont.)

	1994 Mileage	% FC	% Total	1997 Mileage	% FC	% Total	94-97 Change
Major Collector							
<100	39,347	9%	6%	38,644	9%	6%	-2%
100-499	141,453	33%	20%	133,778	31%	19%	-5%
500-999	90,091	21%	13%	90,144	21%	13%	0%
1,000-4,999	146,341	34%	21%	154,128	36%	22%	5%
5,000-9,999	11,891	3%	2%	13,630	3%	2%	15%
10,000+	1,988	0%	0%	2,411	1%	0%	21%
Total FC Miles	431,111		62%	432,735		62%	
Total Federal Aid Mileage	698,734			701,309			

Data compiled from Table HM-57, 1994 and 1997 *Highway Statistics,*
U.S. Dept. of Transportation, Federal Highway Administration, Washington, D.C.

Figure 4 illustrates a clear pattern of increased traffic (>10,000 daily) on all Federal Aid roads from 1994 to 1997.

Figure 4
Rural road mileage experiencing heavy traffic,[1] 1994 and 1997
Heavily traveled rural roads accounted for more miles in 1997



[1] Most Major Collector mileage had < 10,000 average daily traffic for both 1994 and 1997.
Source: Developed by ERS from Table HM-67, 1994 and 1997 Highway Statistics, U.S. Department of Transportation, Federal Highway Administration, Washington, D.C.

The data indicate that traffic increased substantially on rural roads between 1994 and 1997. Interstate travel increased substantially, with mileage including 20,000+ vehicles per day increasing 14.5 percent. Or, stated alternatively, by 1997, 40.8 percent of rural Interstate mileage had daily traffic counts of 20,000+ vehicles, compared to 36 percent of the 1994 mileage. Traffic on Other Principal Arterial roads showed the greatest increases in the 10,000+ vehicles per day category, with traffic on most of these road segments clustered around 3,000-9,999 vehicles per day. Minor Arterial roads also showed traffic gains, with segments showing the greatest gains in the 10,000+ traffic categories. Major Collector mileage also showed the greatest gains in the 5,000+ categories, with 35 percent of this mileage showing traffic at 1,000-4,999 vehicles per day. Across all functional classes, mileage with the lowest average daily traffic declined, while mileage with the higher average daily traffic increased.

ISTEA Changes in Financing of Rural Roads and Bridges

Before drawing general conclusions from these condition and use data, a note on ISTEA funding provides useful background information. As described in the Introduction, ISTEA increased the overall level of funding for transportation. Another way to examine funding patterns is by functional classification. Table 7 provides information on the obligation of Federal funds by functional class for 1994 and 1997, indicating that Federal funds for all functional classes rose during this period, with the Interstate system the one exception. The Interstate system was largely complete by 1997, and no longer required the same funding levels required during the construction phase. State-level data for 1994 can be found in Table FA-4C of the 1994 Highway Statistics report (http://www.fhwa.dot.gov/ohim/1994/index.html), while 1997 state-level data is found in Table FA-4C of the 1997 Highway Statistics report (http://www.fhwa.dot.gov/ohim/hs97/hs97page.htm). These tables include Minor Collector and Local roads as ISTEA provided funding for all functional classes for bridges, enhancements, safety and other improvement activities.

Table 7. Obligation of Federal Funds by Rural Functional Classification, 1994 and 1997

(Thousands of Dollars)

	1994	1997	94-97 Change
Interstate	1,857,216	1,396,972	-33%
Other Principal Arterials	2,467,362	2,919,944	15%
Minor Arterial	803,869	1,213,534	34%
Major Collector	723,814	950,494	24%
Minor Collector	382,545	652,193	41%
Local	442,818	479,826	8%
Total Rural Mileage With Federal Funds Obligation	6,677,624	7,612,963	12%

Compiled from Table FA-4C, 1994 and 1997 *Highway Statistics*,
U.S. Dept. of Transportation, Federal Highway Administration, Washington, D.C.

Allocation of Federal funds also changed from pre-ISTEA years. Before ISTEA, most Federal highway funding could be used only for new construction. ISTEA allowed states to fund a wide range of transportation projects, including repair and maintenance. The Surface Transportation Policy Project (STPP) study examined FHWA's Fiscal Management Information System records, which included approximately 360,000 federally funded transportation projects across the country, and Federal Transit Administration reports, to ascertain how Federal transportation funds were spent during the 1990's. Figure 7 indicates that during the ISTEA years, an increasing proportion of funding was allocated to highway and bridge repair, while new construction and widening projects utilized a smaller share of Federal funds (Changing Direction, http://www.transact.org/report.asp?id=163). Several observations follow from these funding data. First, Federal highway expenditures rose for each functional class during the ISTEA years. Second, rural roads received increased funding over the ISTEA time span. Third, an increasing proportion of that funding was used for maintenance and repair of the rural road system.

Summary and Conclusions

This report has looked at the impact of ISTEA on rural road and bridge condition. ISTEA was landmark legislation, changing the Federal transportation role from one involving close management of transportation planning, implementation and funding, to one that provides States a general program framework that leaves program management and funding to the discretion of the States. In return, ISTEA required States to involve local officials in the planning and implementation process. While little information is available on the extent of and the impact of local official involvement during the ISTEA years, data are available on rural road and bridge condition—a measure that indicates how well rural areas fared under ISTEA.

To evaluate how ISTEA affected rural areas, this report compares 1994 condition data with 1997 condition data, with 1997 the last year of ISTEA. Preliminary analysis indicated that comparison of pre-ISTEA 1990 condition data with 1997 ISTEA data did not provide an accurate description of rural road and bridge condition, as the 1990 data were compiled using the 1980 Census and a different functional classification system than the 1997 data. Since the 1994 data incorporated the 1990 Census and a revised functional classification system, the 1994 data were used to examine changes during the ISTEA period.

The report uses bridge condition data as reported by USDOT/FHWA National Bridge Inventory, and highway condition data as reported by the USDOT/FHWA Highway Performance Monitoring System. Several characteristics about the data provide the context for a review of the condition data and this summary of the impact of ISTEA on rural roads and bridges.

First, the FHWA definition of rural includes areas of 5,000 or less. Since other Federal programs use different definitions of rural, it is well to keep in mind that rural in this report refers only to those areas of 5,000 or less. Second, these data describe only the portion of rural roadways eligible for Federal funding. Total rural public road mileage is 3.1 million miles, with 22 percent of that mileage eligible for Federal funding. The remaining 78 percent is local road mileage that does not receive Federal funding. Other than mileage data and information on bridge counts, very little national-level information is available on the local road system.

Given these caveats, the following conclusions about the impact of ISTEA on rural road and bridge condition can be drawn from comparing the 1994 and 1997 data:

- Overall, rural road and bridge condition improved from 1994 to 1997.
- Road surface type improvements were noted across all rural road categories from 1994 to 1997. Higher functional road classes, including Interstates and Other Principal Arterial roads, demonstrated a greater level of improvement than did the lower functional road classes.
- Lane width, a measure of highway safety and capacity, improved across most categories of rural Federal-Aid highways. With a 12-foot lane considered standard for higher functional classifications, the data indicate that Interstates and Other Principal Arterial roadways demonstrate the highest mileage with 12-foot lanes. Minor Arterial roads and Major Collector roads, roads with lower speed travel and less overall traffic, showed a decline in 9 foot lanes, with increases in 11+ lane mileage.
- Road surface condition ratings improved between 1994 and 1997 across all categories of highways receiving Federal funding. Again, higher functional classification roadways, including Interstates and Other Principal Arterial roads, showed the greatest improvement in surface condition. Minor Arterial and Major Collector roads demonstrated increases in roads rated Fair.
- Bridges demonstrated the greatest improvement overall. In 1994, 32 percent of all rural bridges were rated deficient: by 1997, only 29 percent of all rural bridges were deficient.
- Condition improvements took place in a dynamic traffic environment in which average daily traffic increased for all categories of roadways. Interstate travel increased substantially, with mileage including 20,000+ vehicles per day increasing by 14 percent. Travel increased most on the higher-level roads serving national, regional and state travel, with lower increases tallied for roads serving local travel.
- Federal funding during ISTEA increased for all functional highway classes.
- Overall, rural road and bridge conditions improved most for higher level functional classification, i.e., Interstates, Other Principal Arterial roads, Minor Arterial roads and Major Collector roads. Limited data on Minor Collector and Local roads indicate a lower level of improvements on this portion of the public road system. A higher proportion of these roads remained unpaved than any other class of road, and these roads included a higher percentage of deficient bridges than any other road.

In summary, the impact of ISTEA on rural road and bridge condition has been positive. National-level data compiled to gauge road conditions demonstrate that improvements can be noted in rural road surface types, lane width, and road condition ratings. A national bridge data inventory demonstrates that the condition of rural bridges has improved significantly from 1994 to 1997. Lastly, these improvements took place over a period of time when average daily traffic, or highway use, expanded across all roadways in the United States.

Several issues emerge from the ISTEA data.

- First, while rural road and bridge condition improved overall during ISTEA, conditions improved most for higher-level functional classes, leading to a widening divergence between roads serving national travel and those serving local traffic.
- Second, these improvements took place under the increased funding that characterized the ISTEA years. Should funding in the future decline, questions could arise about the impact of declining funds on the condition divergence between higher-level roads serving national travel and those serving local traffic.
- Third, while much of the ISTEA funding focused on improvements to the existing road network, this report demonstrates that traffic increased on all portions of that network. Increased traffic levels create a dual funding dilemma for rural roadways. Continued traffic increases will strain network capacity, leading to pressure for expanded roads to accommodate higher traffic loads. And, continued traffic increases will accelerate deterioration of existing roadways, leading to higher maintenance costs.

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