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# Rural Roads and Bridges, 1994–2000: How Did the South Fare?

Eileen S. Stommes

In 1991, the Intermodal Surface Transportation Efficiency Act (ISTEA) changed the federal–state transportation relationship by devolving decision making to the states. In turn, states were required to work with local officials on transportation improvements. ISTEA was authorized for 1992–1997, and the Transportation Equity Act for the 21st Century continued ISTEA policies through 2003. Changes in road and bridge conditions in the rural south are examined under these new transportation policies. Federal funding trends are detailed with state funding. Overall condition of roads and bridges eligible for federal funding improved, traffic increased on all roads, but condition disparities between local roads and federally funded roads grew.

*Key Words:* southern road and bridge condition, southern road and bridge financing, southern rural bridges, southern rural roads

**JEL Classifications:** H54, R40, R41, R49

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. In 1998, the Transportation Efficiency Act for the 21st Century (TEA-21) was signed, continuing the policies of ISTEA and the shift in emphasis toward an intermodal, seamless transportation system. 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.

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This paper examines the effect of ISTEA and TEA-21 on the physical condition of rural roads and bridges in the southern states. It begins with a brief background on ISTEA and TEA-21, particularly as they affected rural areas. It then describes the effect of the legislation on southern road and bridge conditions from 1994 to 2000. It concludes with an overview of the effect of the program and discusses rural infrastructure research issues.<sup>1</sup>

## Highlights of ISTEA and TEA-21 for Rural Areas

ISTEA clearly articulated 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

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<sup>1</sup> In this paper, southern states include Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia.



global economy and will move people and goods in an energy efficient manner" (U.S. Department of Transportation [USDOT] 1992). ISTEA was designed to be comprehensive, laying out a broad range of new economic, environmental, and intermodal objectives. The objective was the development of an integrated, systemic approach to transportation that considered its role and function within the larger society, including its effect on the environment, the local economy, and passenger and freight mobility. ISTEA authorized funding for the 6-year period from fiscal years 1992 through 1997. TEA-21, which maintained many of the policies and programs of ISTEA, authorized funding for fiscal years 1998 through 2003.

### **ISTEA and TEA-21 in Rural America**

Several key rural issues flowed from ISTEA and TEA-21. Both legislative initiatives differed from earlier transportation legislation in several critical ways: in their approaches to policy as well as their program delivery mechanisms. These differences characterized delivery of transportation programs to the states and their respective rural areas. New organizational relationships were mandated, new planning requirements were instituted, and new funding formulas were created, all affecting delivery of federal transportation resources to rural areas.

First, the legislation devolved substantial responsibility to the states for all federally funded transportation programs. In lieu of federally controlled programs, USDOT set general parameters and required States to report program progress using specific indicators. States had considerable discretion to tailor program delivery and funding according to state needs. 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 communities. The intent was that rural areas would work directly with state transportation officials on transportation matters affecting their communities.

Second, the legislation 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 (USDOT 1997a). Furthermore, the planning activity was no longer strictly confined to transportation alone. It now encompassed environmental concerns, enhancement of community transportation infrastructure, transit, economic effects on the community, and the role of transportation in improving community livability.

Third, a long-range planning and implementation process was set in motion. Although transportation planning had previously identified priority projects across individual states, it had been largely limited to surface transportation improvements. Now, transportation planning was to encompass not only surface transportation, but also transit and related environmental actions, with information from the planning process, in turn, providing state and local officials with data to evaluate existing systems and their performance. The new process involved rural areas in a broader decision making role, while developing a set of procedures and measures as a common language for engagement.

Fourth, funding priorities were broadened to allow states greater flexibility to select appropriate transportation options. The legislation specified levels of funding for enhancements (e.g., environmental, recreational, and other project activities to enhance development, safety, environmental objectives, and transit) and allowed states discretion to shift specified levels of funding from one program to another based on state-defined needs. Again, rural areas were to have a voice in setting funding priorities for their regions.

Fifth, the legislation 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 addition to granting states greater flexibility in the use of transportation funds, both ISTEA and TEA-21 authorized higher overall funding levels for transportation (USDOT 1992, 38–41; 1998a, 44–49). Of particular note for the south was the TEA-21 guarantee that each state would receive at least 90.5% return on their share of money contributed in federal gas tax revenue. Under previous funding formulas, many of the southern states were considered “donor” states; that is, they received less money from the Trust Fund than they had contributed.<sup>2</sup> TEA-21 guaranteed a minimum amount to each state, thereby decreasing the variation in funding provided to the states (Brown).

ISTEA and TEA-21 initiated a major policy shift by devolving transportation program delivery to the states. In exchange, the legislation required the states to consult with local officials in establishing transportation priorities and to report to USDOT on their transportation activities. Given the higher level of funding and larger role of rural officials in the transportation planning process, this paper focuses on the specific question of whether the legislation made a difference in the condition of rural highway and bridge infrastructure in the southern states.

### **The Federal-Aid Rural Road and Bridge System**

Before discussing road and bridge conditions in the southern states, this paper describes the Federal-Aid portion of the rural road and bridge system (i.e., the extent of the system eligible for federal funding). 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.

### *Federal-Aid Rural Road Mileage*

In 2000, the United States had approximately 3.9 million miles of public roads, with the South accounting for 1.1 million miles of these roads (USDOT 2000b, Table HM10). Almost 80% of total road mileage is in rural areas.<sup>3</sup> Slightly over 700,000 miles, or 22%, of the 3.1 million miles of rural roads in the United States 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% of rural road mileage—primarily local roads—does not receive federal funding, so only limited data on mileage and condition are available in national transportation databases (Walzer and McFadden). This paper focuses on only the rural portion of the Federal-Aid system. 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 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, whereas 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. Design criteria are based on average daily traffic volume, the composition of that traffic, speed based on trip length, and level of service considered as local, regional, or na-

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<sup>2</sup> These states included Alabama, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia.

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<sup>3</sup> The Federal Highway Administration defines rural as places with populations of less than 5,000.



tional (American Association of State Highway and Transportation Officials, 53–92).

Functional road classifications used by USDOT include Interstate, Other Principal Arterial roads, Minor Arterial roads, Major Collector roads, Minor Collector roads, and Local roads (USDOT 1989). In rural areas, federal funds are allocated to Interstates, Other Principal Arterial roads, Minor Arterial roads, and Major Collector roads. Because federal funding is allocated according to road miles and condition, USDOT's Highway Performance Monitoring System (HPMS) collects data on roads eligible for federal funds. As indicated above, roads eligible for federal funding comprise 22% of rural road mileage in the United States. Minor Collector roads, a distinction made only for rural areas, and Local roads do not receive federal funding and rely on state and local funding. Limited data, including information on mileage and paved versus unpaved status, 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% of the total mileage on the Nation's roadways, but 23.6% of total national travel. 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. Nationwide, in 1997, the rural Principal Arterial system made up 3.3% of total miles and carried 46.8% of rural traffic and 18.3% of total U.S. travel. Rural Minor Arterial roads represented 3.5% of total U.S. miles and carried 16.5% of rural traffic and 6.4% of total U.S. travel (USDOT 2000d).

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 account for 10.9% of total U.S. miles, carrying 20.2% of rural traffic and 7.9% of total travel in the Nation. Rural Minor Collectors collect traffic from Local roads, making up 6.9% of total U.S. mileage. Rural Local roads provide access to individual homes,

farms, and businesses in the countryside and accommodate local trips. In 2000, Local roads were the largest component of the U.S. public road system, with rural Local roads representing 58% of total U.S. mileage and 75% of public road mileage in rural areas. In the southern states, Local rural roads totaled 729,232 miles, or 69% of rural public mileage.

### *Road Surface Types*

Rural roads are further defined by surface type. HPMS, used by USDOT to classify surface types, includes a number of pavement types, listed in order of quality (USDOT 1999b). 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 (i.e., asphalt mixture) 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 on Local roads characterized by low speeds and light traffic. Generally, roads with a heavier volume of traffic, including Interstates, Other Principal Arterial roads, and Minor Arterial roads, have a higher proportion of their road surface classified as high-type pavements. Roads with lower traffic volumes have a higher percentage of their road surfaces classified as intermediate or low type.

### *Rural Bridges*

Bridges are the second component of the rural road system. USDOT annually compiles information on bridges and maintains the National Bridge Inventory (NBI), a national database of all bridges on public roads in the Nation (USDOT 1997b, 2000c). In examining bridge data, it is important to keep in mind that NBI defines bridges to include structures only 20 ft. and more in length. Culverts are included as bridges, provided they are more than 20 ft. in length and include a drivable surface for vehicle use.



The NBI lists bridges according to highway functional classification. Bridges are thus reported according to their location on different road classes. Because ISTEA made changes in the Federal-Aid system, the NBI also reflected those changes. 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 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 1999, there were over 585,500 bridges in the Nation. Of these, 455,200, or 78%, were in rural areas. Bridges on Local rural roads accounted for 46% of all rural bridges, or about 210,280 in total. It is worth noting the large number of Local rural bridges, since the majority of these are off-system and are therefore the responsibility of state or local governments (USDOT 1999a, 20; 2000a, 35).

### **Measuring the Effect of ISTEA and TEA-21 on Rural Roads and Bridges**

This paper measures the effect of ISTEA on rural roads and bridges using condition information provided by two databases maintained by the USDOT: HPMS and NBI. Each database is described below.

#### *HPMS*

The HPMS was developed in 1978 as an integrated database for the national highway transportation system (USDOT 1999b). 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 areas, small urban areas, and rural areas; and more detailed information on a sample of the arterial and collector functional systems. It provides overall data that re-

flect the "extent, condition, performance, use, and operating characteristics of the Nation's highways" (USDOT 1999b, I-1).

In analyzing the effect of ISTEA and TEA-21 on rural areas, it is useful to keep in mind HPMS definitions of urbanized, small urban, and rural areas. Urbanized areas are those having a population of 50,000 or more, as designated by the Census Bureau. Small urban areas are places with a population of 5,000 to 49,999 outside urbanized areas. Rural areas are "all areas of a state outside of the Federal Highway Administration (FHWA)-approved adjusted Census boundaries of small urban and urbanized areas," and have populations under 5,000 (USDOT 1999b, II-4).

This paper uses HPMS data from 1994, 1997, and 2000 to measure the effect of ISTEA and TEA-21 on rural roads and bridges. Several factors were considered in selecting these years for comparison. Initial analysis focused on comparing 1990 pre-ISTEA condition data (USDOT 1991) with post-ISTEA and TEA-21 data. However, a direct comparison of 1990 and 2000 road and bridge conditions proved problematic.

- The 1990 Census of Population led to changes in rural and urban boundaries. The 1990 HPMS data used the 1980 Census, whereas the 1994 and 2000 HPMS reports used 1990 Census information. Population changes, particularly urban/suburban expansion, influence roadway mileage by functional classification. Hence, rural road mileage would be reduced in those areas with expanding urban populations.
- 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 (USDOT 1993; Bennett). The last previous realignment of the Federal-Aid system had taken place in 1976, and highway usage and population changes required a reexamination of road classes to synchronize highway use with federal funding. As a result, the 1990 mileage



within each functional road class could not be compared to ISTEA or TEA-21 mileage. By 1994, the majority of state transportation departments had incorporated the new functional reclassification and the 1990 Census changes into the HPMS data reported to USDOT. The effect of TEA-21 is described by the 2000 HPMS data, which uses the 1990 Census and the accompanying functional classification.

### NBI

The Federal-Aid Highway Acts of 1968 and 1970 required the USDOT, in cooperation with the states, to establish national bridge inspection standards (NBIS) for the proper safety inspection of Federal-Aid highway bridges. The law also required that each state maintain a current inventory of all Federal-Aid highway bridges and that each bridge be rated to establish general funding priorities. The NBIS were issued in 1971 and were described in Title 23, Section 116 (Maintenance). In 1987, the Surface Transportation and Uniform Relocation Assistance Act created a separate section of Title 23 identified as the National Bridge Inspection Program. This new section broadened the NBIS provisions to include training and national certification requirements for bridge inspectors. 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 (USDOT 1995b).

The FHWA, in consultation with the states, establishes general bridge funding priorities by assigning a sufficiency rating (SR) from 0 to 100 for each bridge. Under the NBI, there are two types of deficient bridges: structurally deficient (SD) and functionally obsolescent (FO). An SD bridge (1) is restricted to light vehicles only, (2) is closed, or (3) requires immediate rehabilitation to remain open. An 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 1920s to accommodate narrower, lighter-weight vehicles being used for longer-combination ve-

hicles is an example of a functionally obsolescent bridge.<sup>4</sup>

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. Although FO bridges might have design deficiencies, using roadway striping (painting), signals, and other traffic control devices can mitigate those deficiencies.

The SR is the basis for establishing eligibility and priority for replacement and rehabilitation of bridges within each state. As a bridge's SR decreases, its funding priority increases. 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, whereas 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.

Although ISTEA did not change the HBRRP, changes in highway functional classifications required by the Act have an effect on whether a bridge is considered on-system or off-system. More bridges are now included in the Federal-Aid category (on-system) category, so that they receive a higher rating for funding under the HBRRP. Off-system bridges in rural areas are located on rural Minor Collector roads and Local roads.

### Effect of ISTEA and TEA-21 on Southern Rural Road and Bridge Conditions

#### *Road Condition Changes by Surface Type and Functional Classification*

Before describing changes in southern road surface type, it is helpful to describe Nationwide changes briefly. Generally, surface type

<sup>4</sup> Additional information about classification of deficient bridges is listed in the Federal-Aid Policy Guide, NS 23 CFR 650D, paragraph 9.



improvements were noted nationwide across all categories of rural roads from 1994 to 2000. There were differences, however, by functional classification, with the higher functional roads demonstrating more improvement. Rural Interstate mileage showed an increase in high-type composite surface. Other Principal Arterial roads demonstrated an overall surface type improvement, with a decline in intermediate and increases in high-type flexible and composite surfaces. Overall, road surface type improved for rural Minor Arterial roads, with both low-type and intermediate mileage declining. Major Collector mileage, 62% of rural Federal-Aid mileage, showed a decrease in low-type road surface, and unpaved mileage declined. Detailed data are not collected on Minor Collector and Local roads because these roads are not eligible for federal funding and are described by paved versus unpaved status only. Unpaved Minor Collector road mileage dropped, while unpaved rural Local road mileage remained stable.

In general, rural Federal-Aid mileage trended toward a higher proportion of higher quality surface types. However, it is worth noting that although the quality of Federal-Aid surface mileage improved, the surface quality of 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. However, without additional data on traffic, unpaved mileage could simply reflect the lower traffic demands placed on these Local roads.

Table 1 presents summary statistics on southern rural road mileage by functional classification and surface type for 1994, 1997, and 2000. This table presents all 3 years, since it demonstrates fluctuations in road surface types by functional class during the period. Southern surface type generally reflected national trends during this period but demonstrated considerable variability within functional classes. Interstate surface type changed, with an 11% increase in composite and a 5% decline in rigid (concrete) pavement. Other Principal Arterial roads demonstrate variable change across functional classes, indicating shifting mileage within the road class. Roads with low-type

surfaces declined by 19% from 1994 to 1997, but the percent change from 1994 to 2000 indicates low-type mileage increased from 102,000 miles to 914,000 miles. However, mileage on intermediate surfaces increased by 22% from 1994 to 2000. Minor arterial roads also displayed a similar pattern, with low-type declining from 1994 to 1997, but more than doubling from 1994 to 2000. Major Collector mileage demonstrated variability across functional classes, with declines in mileage for unpaved, intermediate, and high-type flexible roads, but mileage increases for low-type and high-type rigid roads. Low-type surfaces for Arterial and Major Collector roads demonstrated increased mileage, a change that can be largely attributed to the state of Texas bringing its inventory into a statewide system.<sup>5</sup> Minor Collector roads remained relatively stable during the period, but Local roads improved—whereas 44% of the roads were paved in 1994, by 2000, 50% of Local roads were paved.

Whereas surface type data indicate variability within road classes, the data by state also demonstrate mileage changes within each road class. Because total mileage in each class remained stable, the variability might derive from changes in road classification brought about by usage patterns. It should be noted that the largest percent changes, for the most part, took place in the road categories with the lowest mileage. From 1994 to 2000, the southern states were in a period of economic growth, with large cities such as Atlanta spreading into rural areas. Such growth can have an effect on roads in rural areas because increased traffic affects functional classification. However, more detailed data would be needed to ascertain the cause of these changes and whether southern urbanization patterns af-

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<sup>5</sup> Texas accounts for much of the variability noted in Table 1. Between 1997 and 2000, Texas changed the reporting of surface type, greatly increasing mileage of low-type surface category for Minor Arterial and Major Collector roads. In 1997, Texas totaled 783 low-type road miles for these roads but listed 23,754 miles for 2000. In 1997, Texas had 42,545 miles of high-type flexible surface for these roads but only listed 19,508 such miles in 2000.



**Table 1.** Southern Federally Funded Road Mileage by Type of Surface and Functional Classification (FC), 1994–2000

Functional Classification	Road Statistics										
	1994			1997				2000			
	Mileage	% FC	% Federal Aid	Mileage	% FC	% Federal Aid	% Change 1994–1997	Mileage	% FC	% Federal Aid	% Change 1994–2000
Interstate											
High-Type Flexible	5,697	56	2	5,660	56	2	–1	5,779	57	2	1
High-Type Composite	1,107	11	0	1,324	13	1	20	1,230	12	0	11
High-Type Rigid	3,326	33	1	3,168	31	1	–5	3,172	31	1	–5
Total Miles	10,130		4	10,152		4	0	10,181		4	1
Other Principal Arterial											
Low-Type	102	0	0	83	0	0	–19	914	3	0	796
Intermediate	493	2	0	459	1	0	–7	600	2	0	22
High-Type Flexible	23,831	77	10	25,136	78	10	5	24,688	76	10	4
High-Type Composite	4,708	15	2	4,674	15	2	–1	4,307	13	2	–9
High-Type Rigid	1,731	6	1	1,730	5	1	0	1,789	6	1	3
Total Miles	30,865		13	32,082		13	4	32,298		13	5
Minor Arterial											
Low-Type	816	2	0	655	1	0	–20	2,776	6	1	240
Intermediate	3,184	7	1	2,895	6	1	–9	2,991	6	1	–6
High-Type Flexible	40,819	85	17	40,668	85	16	0	38,697	81	16	–5
High-Type Composite	2,910	6	1	3,015	6	1	4	3,183	7	1	9
High-Type Rigid	269	1	0	440	1	0	64	287	1	0	7
Total Miles	47,998		19	47,673		19	–1	47,934		19	0
Major Collector											
Unpaved	7,274	5	3	6,359	4	3	–13	6,270	4	3	–14
Low-Type	23,651	15	10	20,223	13	8	–14	42,920	27	17	81
Intermediate	25,857	16	10	27,449	17	11	6	23,498	15	9	–9
High-Type Flexible	95,072	60	39	98,152	62	40	3	79,208	50	32	–17
High-Type Composite	4,820	3	2	4,336	3	2	–10	5,304	3	2	10
High-Type Rigid	709	0	0	1,024	1	0	44	680	0	0	–4
Total Miles	157,383		64	157,543		64	0	157,880		64	

**Table 1.** Continued

Functional Classification	Road Statistics										
	1994			1997				2000			
	Mileage	% FC	% Federal Aid	Mileage	% FC	% Federal Aid	% Change 1994–1997	Mileage	% FC	% Federal Aid	% Change 1994–2000
Total Federal Aid Mileage	246,376			247,450				248,293			
Minor Collector											
Unpaved	12,166	14		11,903	14		–2	10,658	12		–12
Paved	75,826	86		75,296	86		–1	76,159	88		0
Total Miles	87,992			87,199			–1	86,817			
Local											
Unpaved	389,212	56		393,189	55		1	362,621	50	–7	
Paved	303,623	44		318,199	45		5	366,611	50	21	
Total Miles	692,835			711,388			3	729,232			
Total	1,027,203			1,046,037				1,064,342			

Note: % Fed Aid is percentage of road category receiving federal funding.

Source: Data compiled from tables HM-51 and HM-67, *1994 Highway Statistics*, and table HM-51, *1997 and 2000 Highway Statistics* (USDOT 1995a, 1998b, 2000b).



**Table 2.** Southern Rural Bridge Conditions by Functional Classification (FC), 1994–2000

Functional Classification	Bridge Statistics								
	1994			1997			2000		
	No.	% FC	% of Total	No.	% FC	% of Total	No.	% FC	% of Total
<b>Interstate</b>									
SD	208	2	0	261	3	0	257	3	0
FO	1,397	13	1	1,300	13	1	1,046	10	1
Total	10,613		6	10,109		6	10,185		6
<b>Other Principal Arterial</b>									
SD	802	5	0	715	5	0	650	4	0
FO	2,372	15	1	2,096	13	1	1,921	12	1
Total	16,196		9	15,638		9	15,652		9
<b>Minor Arterial</b>									
SD	1,271	9	1	1,266	8	1	1,217	7	1
FO	2,144	15	1	2,330	15	1	2,450	14	1
Total	14,460		8	15,909		9	17,303		10
<b>Major Collector</b>									
SD	6,282	14	3	5,666	13	3	5,277	12	3
FO	4,888	11	3	4,974	12	3	5,260	12	3
Total	44,721		25	43,192		24	43,070		24
<b>Minor Collector</b>									
SD	3,577	18	2	2,584	14	1	2,367	13	1
FO	2,267	11	1	2,185	12	1	2,288	12	1
Total	20,126		11	18,149		10	18,465		10
<b>Local</b>									
SD	23,486	32	13	21,725	29	12	18,229	25	10
FO	8,520	12	5	8,498	11	5	8,894	12	5
Total	73,741		41	74,440		42	72,575		41
Total Bridges	179,857			177,437			177,250		
% SD	20			18			16		
% FO	12			12			12		
% Deficient	32			30			28		

Note: SD is structurally deficient; FO is functionally obsolete.

Source: 1994 and 1997 statistics compiled from NBI data (USDOT 1995b, 1997b); 2000 data compiled from USDOT (2000c) Internet site.

affected the changes in road categories noted in Table 1.

#### *Status and Condition of Rural Bridges*

NBI data indicate that the condition of rural bridges improved across all functional road classifications from 1994 to 2000, from Interstates to Local bridges. Table 2 compares the condition of rural bridges in 1994, 1997, and 2000 by functional classification. Minor Col-

lector and Local bridges are included in this table because all bridges 20 ft. and longer on public roadways are eligible for federal funding. National trends are compared with those taking place in southern states during this period.

In 1994, 32% of all rural bridges were deficient nationwide. The majority of deficient bridges—20%—were structurally deficient. The remaining 12% were functionally obsolete. Higher order roads (i.e., Interstates) had

fewer deficient bridges. The southern states exhibited a similar pattern, with 32% of all bridges deficient, 20% structurally deficient, and 12% functionally obsolete. Sixty-eight percent of all rural bridges were not deficient.

The 1994 pattern of bridge deficiencies in the southern states generally tracked national trends, with slightly fewer Interstate bridges rated deficient. Whereas 19% of all bridges on Interstate highways were rated deficient in 1994, 15% of Interstate bridges were deficient in southern states. Nationally, Other Principal Arterial roads had 19% of their bridges rated deficient, whereas 20% of southern bridges on these roads were deficient. Twenty-four percent of bridges on Minor Arterial roads were rated deficient both nationwide and in the southern states. Nationwide, Major Collector roads had 24% of their bridges rated deficient, with southern states having 25% rated deficient. Local roads fared the worst both nationally and in the southern states, with 44% of southern Local bridges rated deficient.

By 1997, overall bridge condition had improved across all functional road classifications: 29% of all rural bridges were rated deficient. The southern states had 30% of their bridges rated deficient. Both nationwide and in the southern states, most of the reduction was in percentage of structurally deficient bridges: 18% in 1997. Functionally obsolete bridges made up 11% of total bridges, with 12% of southern bridges rated functionally obsolete.

In 1997, Interstate bridge conditions improved, with only 16% rated deficient, compared to 19% in 1994. Other Principal Arterial bridges included 18% deficient in 1997, compared to 19% in 1994. Minor Arterial bridges totaled 22% deficient, with 23% of Major Collector bridges rated deficient. Twenty-eight percent of Minor Collector bridges were rated deficient. Local roads, which include the highest number of bridges, included a total of 37% deficient in 1997. The southern states exhibited overall improvements in bridge conditions as well, with 16% of Interstate bridges rated deficient, 18% of Other Principal Arterial bridges rated deficient, and 23% of Minor Arterial bridges listed as deficient. Twenty-five

percent of Major Collector bridges and 26% of Minor Collector bridges were deficient. Compared to the Nation as a whole, slightly more Local southern bridges were rated deficient at 40%.

A 2000 USDOT compilation of rural and urban bridge conditions indicates that deficient rural Interstate bridges remained roughly constant at 16%, while Other Principal Arterial bridges also remained at 18%. Minor Arterial bridges listed as deficient declined to 21%, with deficient bridges on Major Collectors and Minor Collectors dropping slightly. Local deficient bridges dropped by 2% to 35% (USDOT 2000a).

In 2000, southern states did not vary widely from national trends, but demonstrated fewer deficient bridges on Interstates, Other Principal Arterials, and Minor Collectors, with slightly higher numbers of deficient bridges in all other categories. Thirteen percent of Interstate bridges were deficient, slightly lower than the national 16%. Deficient bridges on Other Principal Arterials were slightly lower at 16%, with deficient bridges on Minor Arterials accounting for 23%, and 25% of Major Collector bridges rated as deficient. Minor Collector bridges rated deficient totaled 25%, with Local bridges rated deficient declining to 37%.

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 continue to have a higher percentage of deficient bridges, mainly because of structural deficiencies, indicating that although bridge conditions on these roads improved, bridge improvements lagged behind the higher functional road classes.

NBI data indicate that rural bridge conditions improved during ISTEA and TEA-21 overall, with southern bridges generally following the national trend. Whereas 32% of southern bridges were deficient in 1994, 30% were deficient in 1997, and 28% in 2000, demonstrating a steady decline in deficient bridges during this period. Alternatively, 68% of bridges were rated in good condition in 1994, 70% in 1997, and 72% in 2000.



**Table 3.** Southern States Annual Vehicle-Miles of Travel, 1994–2000

Functional Class	1994		1997		2000		% Change
	Miles ( $\times 10^6$ )	% of Total	Miles ( $\times 10^6$ )	% of Total	Miles ( $\times 10^6$ )	% of Total	1994– 2000
Interstate	82,134	24	94,682	24	106,488	24	30
Other Principal Arterial	75,434	22	88,723	22	97,887	22	30
Minor Arterial	59,640	17	66,096	17	71,688	16	20
Major Collector	71,036	20	83,457	21	87,438	20	23
Minor Collector	18,725	5	20,806	5	22,355	5	19
Local	40,221	12	44,088	11	52,306	12	30
Total	347,190		397,852		438,162		26

Source: Data compiled from table VM-2, 1994, 1997, and 2000 *Highway Statistics* (USDOT 1995a, 1998b, 2000b).

With few exceptions, bridge ratings improved in all southern states. Some states with more than 15,000 bridges demonstrated significant improvement. In 1994, 41% of the nearly 16,000 bridges in Mississippi were deficient; by 1997, 36% were deficient. Tennessee, with more than 15,000 bridges, reduced deficient bridges by 4%. Louisiana reduced its deficient bridges from 38% to 34%.

#### *Changes in Annual Vehicle-Miles of Travel*

Condition data describe the physical status of roadways and bridges but do not reveal usage or travel patterns. Increasing traffic can damage the physical condition of roads and bridges, and declining or static traffic can reduce maintenance requirements. Annual vehicle-miles of travel data, collected by HPMS, help set priorities for maintenance and determine where major investments are required to meet increasing traffic/travel demands. Comparative data from 1994, 1997, and 2000 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 annual vehicle-miles of travel, an objective measure of traffic, to examine rural road and bridge usage during 1994–2000. This measure is based on data collected by HPMS for all Federal-Aid rural roads.

The FHWA uses annual vehicle-miles of travel as the primary measure of travel activity

on the Nation's road system. Annual vehicle-miles of travel data are estimated highway travel based on traffic counts by functional system. States report average daily traffic for each section of Interstate, the National Highway System (NHS), and other Principal Arterial mileage. Travel is calculated for these higher level functional systems on a 100% basis, so these data are considered to be of reasonable quality. For Minor Arterial roads and Major Collector roads, travel is calculated from sample road segments, so some variability might be found in the data. States provide the values for Minor Collector and Local roads on a system aggregate basis, using their own estimating procedures.

Travel increased on all southern Federal-Aid rural highways from 1994 to 2000. Table 3 lists annual vehicle miles of travel for southern states for 1994, 1997, and 2000. Overall, from 1994 to 2000, travel increased in each road category. Interstates, Other Principle Arterials, and Local roads all demonstrated a 30% increase in vehicle-miles of travel, while Minor Arterials and Major Collectors experienced growth of 20% or more. Compared to the national travel trend, the southern states' travel growth was slightly less for Interstates and Other Principle Arterials, but greater for Minor Arterials and Major Collectors. Traffic on Minor Collectors and Local roads virtually mirrored the national pattern (USDOT 1998c, 2000d). Although the number of annual vehicle-miles was greater for the higher level

**Table 4.** Federal Transportation Funding for Southern States, 1994–2000

Functional Class	1994		1997		2000	
	U.S.\$ ( $\times 10^3$ )	% of Total	U.S.\$ ( $\times 10^3$ )	% of Total	U.S.\$ ( $\times 10^3$ )	% of Total
Interstate	502,383	22	507,997	17	470,174	12
Other Principal Arterial	1,037,177	45	1,240,574	41	1,740,752	43
Minor Arterial	250,171	11	507,719	17	754,692	19
Major Collector	258,996	11	370,371	12	629,853	15
Minor Collector	137,044	6	241,600	8	330,736	8
Local	139,224	6	172,539	6	150,504	4
Total	2,324,995		3,040,800		4,076,711	

Source: Compiled from table FA-4C, 1994, 1997, and 2000 *Highway Statistics* (USDOT 1995a, 1998b, 2000b).

roads, the southern states' percentage growth in vehicle miles was greater than the national growth for the "secondary" level roads (i.e., Minor Arterial and Major Collector roads). This would seem to indicate a clustering of greater traffic growth around urbanized areas along those secondary level roads feeding into the Interstate System and Other Principle Arterials. However, because these are sample data, the precise geographic location of clusters can only be speculative at this point.

#### *Financing of Rural Roads and Bridges*

Both ISTEA and TEA-21 increased the overall level of funding for transportation. Because this paper examines federally funded roads by functional classification, the following section examines funding patterns by functional classification, by federal funding, and by state funding. With the exception of Interstates, the obligation of federal funds by functional class rose between 1994 and 2000 for all functional classes. The Interstate system was largely complete by 1997 and no longer required the same funding levels needed during the construction phase. Although federal transportation monies are generally not provided for Minor Collector and Local roads, these two road categories are included in the financing tables because ISTEA and TEA-21 provided funding for all functional classes for bridges, enhancements, safety, and other improvement activities.

Table 4 indicates that the southern states

follow the same pattern of increasing federal funding, since surface transportation funding is provided on a formula allocation basis. From 1994 to 2000, federal funds to southern states increased 75%. As noted earlier, TEA-21 changed the funding formula to guarantee at least a 90.5% return on the share of money a state contributes to the Trust Fund, a change that affected most southern states by guaranteeing them a greater share of transportation funding. In comparison, nationwide funding for Federal-Aid rural roads from 1994 to 2000 increased by 55%. The formula change affecting southern states would be reflected in 2000, a year funded under TEA-21. However, funding allocations varied considerably by functional class. The pattern of increase tracks the travel increases noted above for Minor Arterials and Major Collectors, with funding more than doubling for Minor Arterials and increasing by 143% for Major Collectors. These increases demonstrate the greater flexibility provided to states by ISTEA and TEA-21 to allocate funding in response to state road conditions and travel patterns, rather than according to preset federal requirements.

From 1994 to 2000, states also increased their rural highway funding in tandem with federal funds. Table 5 indicates that the southern states increased their funding by 50%. The largest state funding increase was for Minor Collectors, which increased by 78%. Local roads are not included in this table, since local governments provide funds to maintain local roads.



**Table 5.** State Highway Department Capital Outlay and Maintenance, Rural Areas of Southern States, 1994 and 2000

Functional Class	State Funding U.S.\$ ( $\times 10^3$ )		
	1994	2000	% Change
Interstate	1,186,490	1,574,901	33
Other Principal Arterial	2,259,126	3,730,946	65
Minor Arterial	1,262,018	1,935,487	53
Major Collector	1,403,703	1,835,962	31
Minor Collector	286,067	508,996	78
Total	6,397,404	9,586,292	50

Source: Data compiled from table SF-12, 1994 and 2000 *Highway Statistics* (1995a, 2000b).

The USDOT provides a perspective on federal, state, and local funding for 1990, immediately preceding ISTEA, and for 1997, the last year of ISTEA. In 1990, federal funds provided 20.6% of total Government funding for highways; state funds provided 52.3% and local governments 28.1%. By 1997, the federal share was 20.8%, the state share 52.1%, and the local share 27.1%, indicating a slightly larger federal share and a slight decrease in local funding (USDOT 2000a, 6-6).

Allocation of federal funds also changed from pre-ISTEA years. Before ISTEA, most federal highway funding could be used only for new construction. ISTEA and TEA-21 allowed states to fund a wide range of transportation projects, including repair and maintenance. One exception is the HBRRP, which exclusively funds bridge replacement and rehabilitation, not new bridge construction. A Surface Transportation Policy Project study (McCann, Klenitz, and DeLille) 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 1990s. The results indicate that during the ISTEA years, an increasing proportion of funding was allocated to highway and bridge repair, while new construction and widening projects used a smaller share of federal funds. Hartgen and Lindeman found a widening condition gap between federally funded roads and locally funded roads, raising the issue of sys-

tem efficiency when the local feeder system is not effectively channeling traffic onto the higher level road system.

### Summary and Conclusions

This report has looked at the effect of ISTEA and TEA-21 on rural road and bridge conditions. 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 and its successor legislation, TEA-21, required states to involve local officials in the planning and implementation process. This paper uses data on rural road and bridge conditions to measure how well rural areas fared under ISTEA and TEA-21.

To evaluate how both Acts affected rural areas, this paper analyzes data on the condition and financing of roads and bridges in 1994, 1997, and 2000. The analysis uses bridge condition data as reported by the NBI and highway condition data as reported by the HPMS. Several considerations must be kept in mind when using these data. First, it should be stressed that rural in this paper refers only to those places of population 5,000 or less. Second, these data describe only the portion of rural roadways eligible for federal funding. Southern rural public road mileage totals 1.1 million miles, with 23% of that mileage eligible for federal funding. The remaining 77%

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 effect of ISTEA and TEA-21 on rural road and bridge conditions in the southern states from 1994 to 2000 can be drawn.

- Overall, rural road and bridge conditions improved from 1994 to 2000. Higher functional road classes demonstrated more improvement than did the lower functional road classes.
- Bridges demonstrated the greatest improvement overall. In 1994, 32% of all rural bridges were rated deficient; by 2000, only 28% of all rural bridges were deficient.
- Road surface type improvements took place in a dynamic traffic environment in which annual vehicle-miles of travel increased for all categories of roadways. In the southern states, travel increased not only on the higher level roads serving national, regional, and state travel, but also increased by 30% on Local roads.
- Both federal and state funding during the ISTEA and TEA-21 years studied increased for all functional highway classes.
- Overall, rural road and bridge conditions improved most for higher level functional classifications. 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.

Several research issues emerge from these conclusions.

First, although rural road and bridge conditions improved overall, conditions improved most for higher level functional classification roads, leading to a widening divergence between roads designed to serve national travel and those serving local traffic.

Second, these improvements took place under the increased funding that characterized the ISTEA and TEA-21 years. Should funding in the future decline, questions could arise about the effect of declining funds on the condition divergence between higher level roads serving national travel and those serving local traffic and the ability of local communities to access goods and services in the larger region.

Third, although much of ISTEA and TEA-21 funding focused on improvements to the existing road network, this paper 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.

Fourth, current budget deficits at both the federal and state levels raise concern about their ability to fund maintenance of existing rural road and bridge infrastructure to ensure access and mobility. ISTEA and TEA-21 provided higher levels of funding from 1991 to 2003, leading to improved road and bridge conditions while traffic increased on all road segments. If traffic continues to increase while maintenance funding declines, rural infrastructure condition could decline.

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