SECTION D3
INVESTMENT NEEDS FOR THE LATTS STRATEGIC HIGHWAY SYSTEM

OVERVIEW

This report section has two parts (a) the LATTS Strategic (Mainline) Highway System, and (b) the LATTS Highway Connectors (i.e., facilities which link a LATTS Strategic Highway with a LATTS airport or waterport). Beyond the anticipated overall growth in traffic, the analysis addressed the additional impact of projected LATTS traffic. A statistical analysis model was utilized to perform these assessments. The Mainline and Connectors were analyzed for performance and deficiencies (for example, truck operating speed was identified as a major performance measure). The analysis yielded several conclusions which are presented at the end of this report section in more detail. The conclusions identify:

- Type of traffic with the highest growth;
- Investments needed by type of traffic;
- Investments needed by highway type;
- Investments needed by corridor; and
- Investments needed by state.

Some highlights of the significant findings include:

- Truck traffic is projected to grow at a greater rate than all other traffic types;
- Truck traffic will require significant highway investments in capacity and pavement rehabilitation;
- Interstate highways were identified as the type of highway having the greatest projected need for capacity improvements;
- Corridor 14 (I-10 from West Texas to Jacksonville, FL) was identified as the LATTS corridor with the greatest projected needs for highway investment; and
- Texas is projected to be the Alliance member with the highest investment need.

LATTS STRATEGIC HIGHWAY NETWORK

Section C of this report describes the criteria and process that was used to identify mainline highways which are of the greatest significance to Latin American trade flows. Section C also identifies the Strategic Highway System that emerged from those analyses.

In this report section, the process and results of the analyses conducted to determine investment needs of these mainline facilities are presented. The presentation is organized as follows:

- Network Database
- Truck Traffic
- Needs Categories
- Capacity Analysis
- Pavement Analysis
- Operating Speeds

Network Database

For purposes of these analyses it was necessary to compile a database which described the main features of the Strategic Highway Network. A principal consideration was to develop a database that was consistent for all of the more than 22,000 miles of highways comprising the LATTS Strategic Highway System. It was also recognized that gathering new data on a timely basis from 13 different States and Puerto Rico would be difficult. Accordingly, it was determined that the source of data for the strategic network would come from an existing database--the Highway Performance Monitoring System (HPMS) database.

The HPMS is the nation’s highway database, maintained by the FHWA, using data supplied by the states, and updated on a regular basis. The HPMS was developed to replace a series of random-needs studies conducted by the FHWA for the U.S. Congress. Among other things, the HPMS data can be used to:

- Calculate performance characteristics
- Model traffic growth and pavement deterioration
- Calculate capacity and congestion
- Estimate capital needs by functional classification and category over time

In fact, HPMS is used by the federal government to compute the apportionment of some federal highway funding authorized by TEA-21. Because of the familiarity of Alliance members with HPMS and the consistency in format and information it provides, the LATTS investment needs evaluation was based upon data and processes from the HPMS, modified for use in the LATTS analyses.

As part of the HPMS database, the states report certain information to FHWA for every segment of highway and roadway open to the public. For example, the states report mileage, average annual daily traffic (AADT), route number, jurisdiction, functional classification, number of lanes and pavement condition. In addition, the states report additional information for a statistically valid sample of roadway sections by functional classification and volume group. The highway sections with additional information are called *sample segments* as opposed to the former segments called *universe segments.* The additional data required for the *sample segments* include detailed pavement information, geometric data, traffic/capacity data, and environmental data. The FHWA asks the states to update the HPMS data every year. Not every item is updated every year but items which can change quickly, like traffic volume and pavement condition, are updated more frequently than other data items.

Higher-order routes, such as interstates, typically have 40 to 60 percent of their mileage sampled by the HPMS. The sample rate decreases as the functional classification drops in importance. Not every route in a state is necessarily sampled for the HPMS. The random nature of selecting sample sections ensures representation of like routes with like traffic volumes, but there is no requirement that every route be sampled. Many states prefer to sample their routes at rates higher than the FHWA minimum, especially on interstates and on the NHS. The number of states with 100 percent representation on higher-order functional classes in the HPMS is growing. This is because more states have come to appreciate and use some of the supporting HPMS analytical software provided by the FHWA to help quantify investment needs over time.

The 1997 HPMS database was obtained from the FHWA and used in this study because it was the latest HPMS database available at the time it was needed. First, the records for the 13 LATTS states and Puerto Rico were extracted. The database was reduced further by identifying and keeping only those highway records that represented a segment of highway belonging to the LATTS strategic network. During this process, the corridor number to which each highway was assigned was affixed to each record. In all, 19,423 HPMS records were identified and selected for further analysis.

The LATTS HPMS database consists of 6,540 sample records (34 percent) and 12,883 universe records (66 percent). Most needs studies ignore universe records and only use sample records by appending an expansion factor to each sample record to estimate total needs. This method ignores all of the specific segment information contained on the universe records. Also, with such an approach, one database record can correspond to a portion of many highway segments scattered all over the state, rather than to one cohesive segment of highway. For this study, which analyzed needs in limited categories, all records for both the universe and samples were used.

Data items needed for the analyses but not available on the universe records were defaulted, based on the sample records for the same route and the same functional classification within each state. For example, highway capacity was required for some of the analyses but is not available on universe records. For example, capacity for a universe record representing a rural segment of I-95 in Florida was estimated. The estimate was based on the number of lanes on that segment and an average capacity per lane, calculated from all sample segments in Florida representing the rural portion of I-95.

Where insufficient sample segments were available for a specific route and functional classification, a statewide average default value by functional class was used. With this approach, critical data such as AADT and number of lanes available on all records were used. In addition, with this approach, an equivalency between physical highway segments and database records was maintained. This last feature was important to match LATTS' River Of Trade truck volumes and highway segments.

The LATTS HPMS database only includes information for existing (1997) highways. A number of existing highways in the Alliance Region are planned to be upgraded to higher standard roadways as part of the ISTEA/TEA-21 High Priority Corridors (from major arterial to interstate standards, for example). New highways, such as I-69, are also planned but not built yet. These highways, and their potential impact on existing facilities, were not included in the estimation of investment needs (diverted traffic).

The information in the HPMS database may differ from information in other databases. For purposes of consistency, the LATTS analyses used only the information in the HPMS database and did not attempt reconciliation with other databases.

Truck Traffic

Analyses were undertaken to estimate the volume of truck flows associated with Latin American trade that would use the LATTS Strategic Highway System. Additional analyses were performed to quantify LATTS truck traffic in terms of annual vehicle miles of travel and to relate LATTS truck traffic to total trade truck traffic on the Strategic Highway System.

Latin America Trade Flows

As explained in a previous section of this report, 1996 and expected 2020 trade volumes with Latin America were estimated. The portion of this trade that would be transported using highway facilities was translated into truck flows. These truck flows were then assigned to specific highway facilities using GIS generated shortest time paths. The resulting truck traffic from both cross-border and intermodal traffic is shown in **Exhibit D3-1** for 1996 and **Exhibit D3-2** for 2020. **Exhibit D3-3** shows the change in Latin American truck traffic between 1996 and 2020.

As illustrated in these two maps, LATTS truck traffic is much higher in some corridors than in others. Some of the corridors with the heaviest truck traffic include:

- I-10 corridor through Texas, Louisiana, Florida, Alabama and Mississippi;
- I-35/I-37 corridor in Texas; and,
- I-95 from Florida to Washington, D.C.

Other corridors which also have significant truck traffic include:

- I-59/I-81 from Mississippi to the northeast;
- I-20/I-30/I-40 through Texas and Arkansas; and,
- I-65/I-85 from Mobile, AL, to Atlanta, GA.

Exhibit D3-1
LATIN AMERICAN TRUCK FLOWS – 1996
Annual Truck Flows

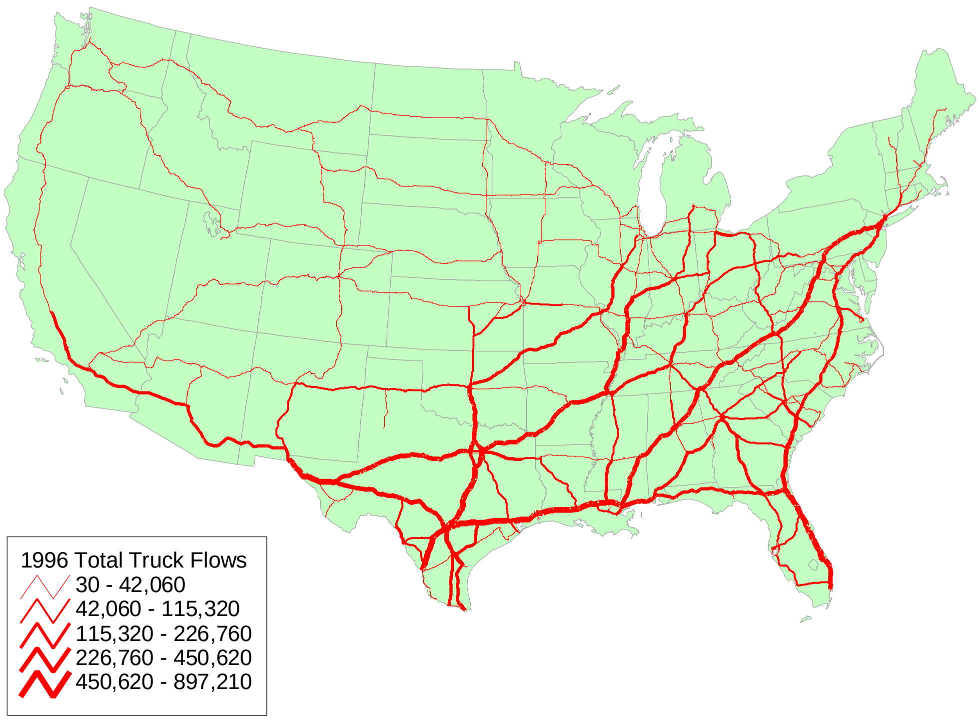


Exhibit D3-2
LATIN AMERICAN TRUCK FLOWS – 2020
Annual Truck Flows

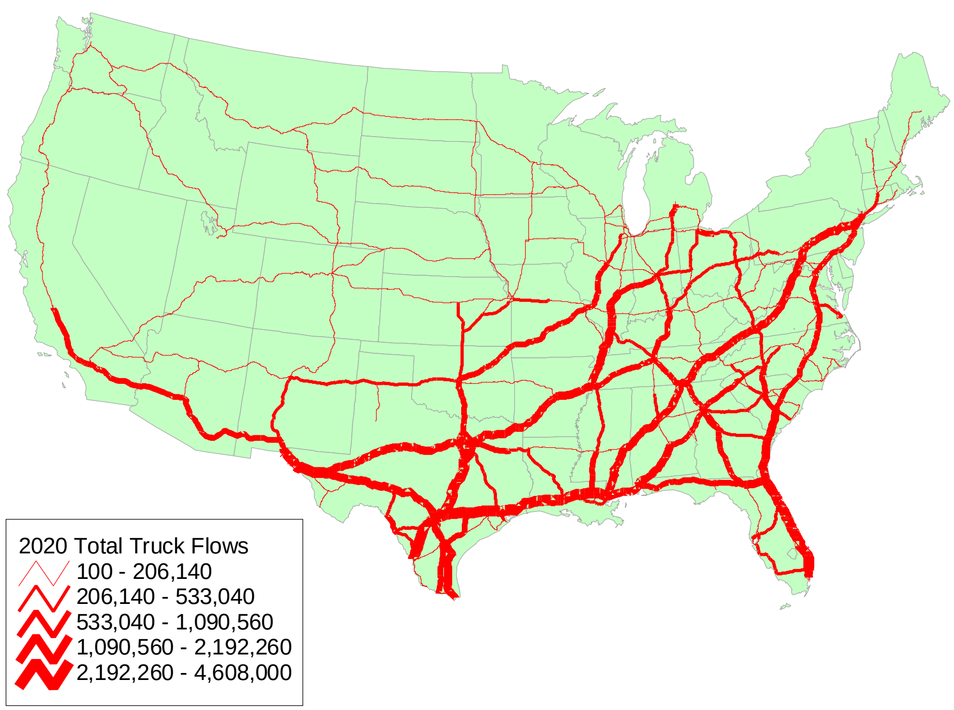
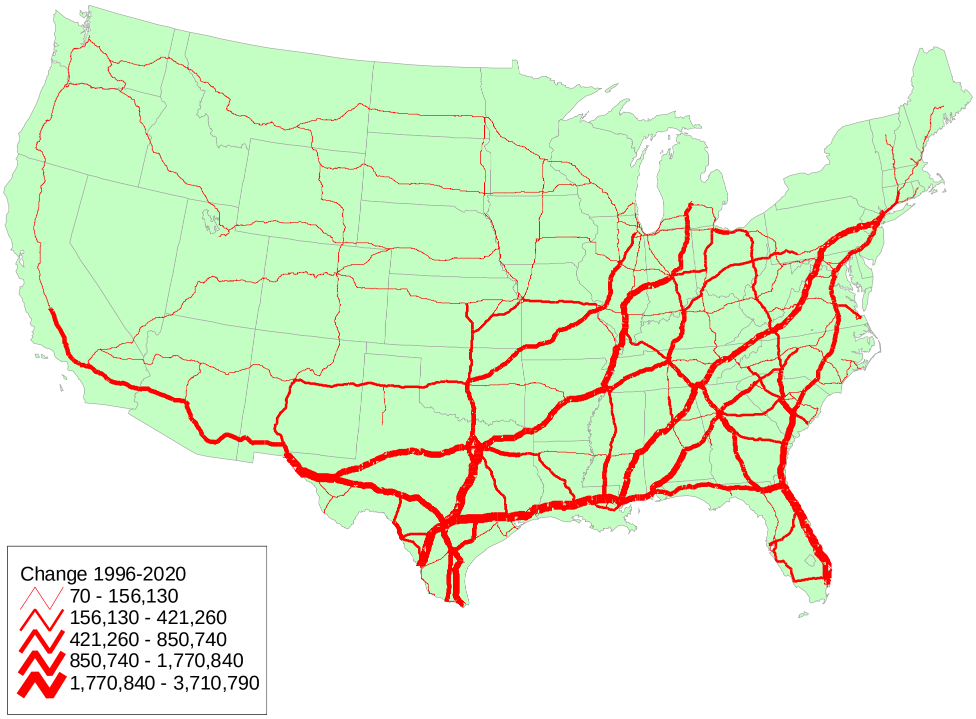


Exhibit D3-3
CHANGE IN LATIN AMERICAN TRUCK FLOWS – BETWEEN 1996 & 2020
Annual Truck Flows



It should be noted that the process sometimes assigns no LATTS traffic to certain portions of the LATTS strategic network. This is because the assignment procedure, which is based on the shortest time path, favors interstates. Further, the selected strategic network includes more routes than are needed to distribute LATTS traffic throughout the Region. Some highway segments in the network, especially among those corresponding to a lower functional classification, have no LATTS traffic assigned, as follows:

- 34 percent (7,729 miles) of the 21,956 miles of highways;
- 7 percent (1,047 miles) of the 14,525 miles of interstate; and
- 90 percent (6,683 miles) of the 7,430 miles of other non-interstate routes.

The network database and results of the LATTS truck flow assignments were combined by appending the LATTS truck traffic by route segment to the corresponding HPMS highway segments. First, 1996 LATTS truck flows were replaced by 1997 flow-through interpolations to make traffic volumes from HPMS and LATTS compatible. The combined two sets of data yielded total traffic on given highway segments (cars and trucks) and that portion of the truck traffic that was Latin American trade specifically.

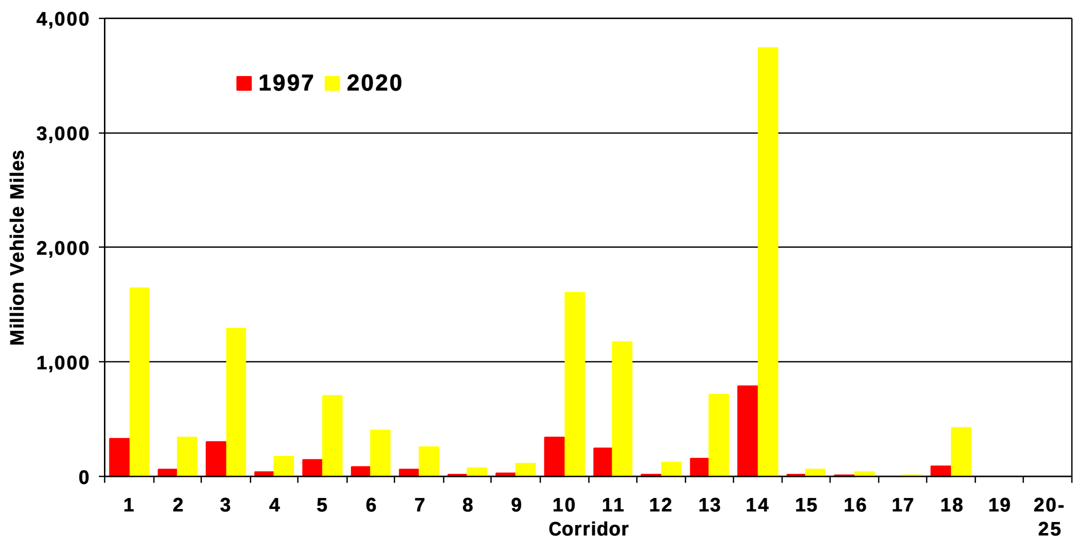
LATTS Trucks Vehicle Miles of Travel (VMT)

Exhibit D3-4 presents the LATTS truck traffic in VMT by corridor for both 1997 and 2020. Some corridors are shown to carry much more LATTS trucks than other corridors:

Corridor 14 (I-10 from West Texas to Jacksonville, FL) will carry more than twice the VMT of any other corridor --3.7 billion LATTS truck miles in 2020;

Corridor 1 (I-95 from South Florida to Washington D.C.) and Corridor 10 (I-3/I-37 from South Texas to the Plains) – 1.6 billion LATTS truck miles in 2020;

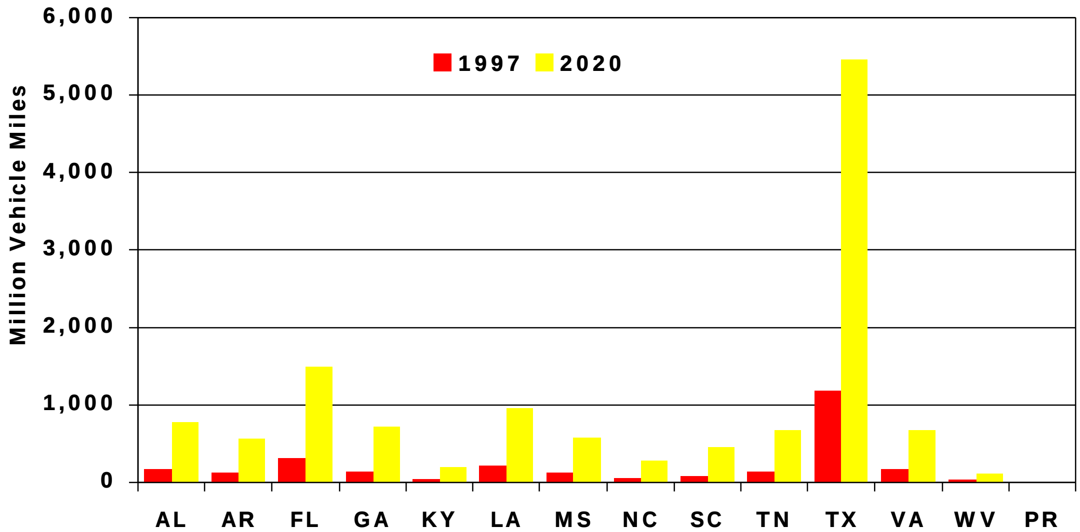
Exhibit D3-4
LATTS ANNUAL TRUCK TRAFFIC
By Corridor



- Corridor 3 (I-59/I-81/I-66 from New Orleans, LA to Washington, D.C.) and Corridor 11 (I-40 from North Texas to Wilmington, NC) -- 1 billion LATTS truck miles expected in 2020;
- Corridor 5 (I-75/I-74 from South Florida to Illinois) and Corridor 13 (I-20/U.S. 76 from El Paso, TX to Wilmington NC) both will carry more than 0.7 billion truck miles of LATTS traffic in 2020; and
- Other corridors have less LATTS traffic and Corridors 20 through 25 were assigned no LATTS truck traffic.

Exhibit D3-5 presents LATTS truck traffic by state. Considering that the most heavily LATTS traveled corridor (I-10 from West Texas to Jacksonville, FL) and several other heavily used LATTS corridors pass through Texas, it is not surprising that Texas is expected to carry a large portion of the total LATTS truck traffic.

Exhibit D3-5
LATTS ANNUAL TRUCK TRAFFIC
By State



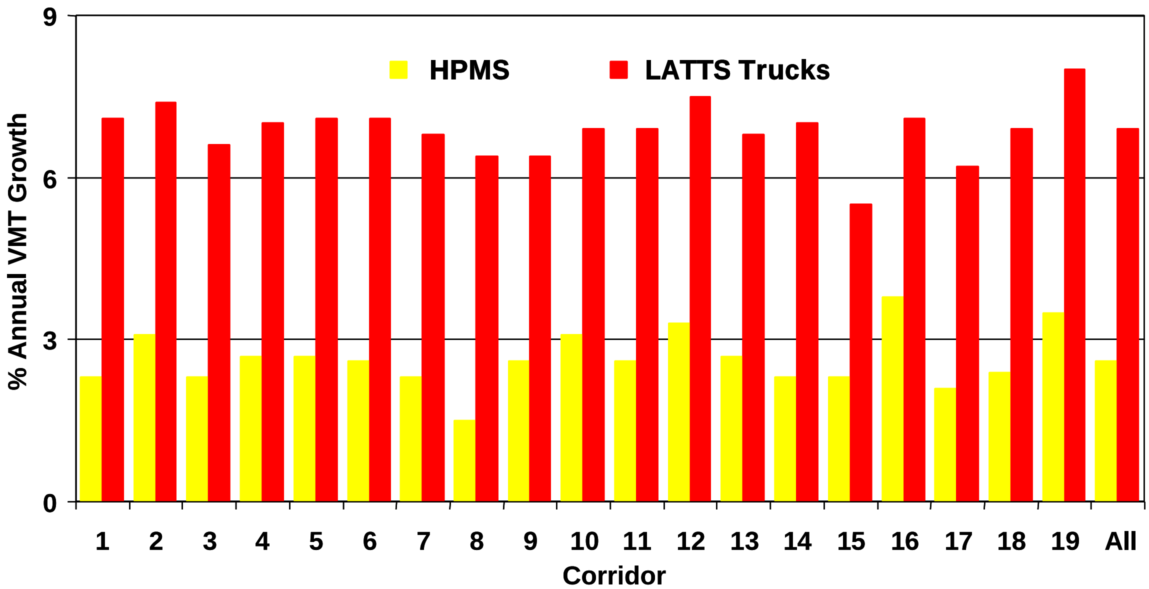
Findings by state for most LATTS annual truck miles include:

- Texas will carry 42 percent or 5.5 billion LATTS truck miles in 2020 out of 12.9 billion LATTS truck miles for all the states within the Alliance; and,
- Florida (1.5 billion) and Louisiana (nearly 1 billion) are a distant second and third.

Exhibits D3-4 and D3-5 also indicate the tremendous growth in traffic expected from the increased trade with Latin America between 1997 and 2020. Overall, VMT from LATTS will increase nearly five times, from 2.8 billion truck miles in 1997 to 12.9 billion truck miles in 2020. This represents an average annual growth rate of 6.9 percent.

An analyses was performed to compare this expected LATTS traffic growth with the overall growth expected on the strategic network from all sources of traffic. To accomplish this, overall traffic growth on all segments was estimated, based on the 1997 AADT and projected 2020 AADT included in the HPMS database. **Exhibit D3-6** shows, by corridor, expected overall traffic growth compared to LATTS truck traffic growth.

Exhibit D3-6
LATTS TRUCKS versus OTHER TRAFFIC
Average Annual VMT Growth



As shown, truck traffic from LATTS is expected to grow at a much higher annual rate than overall traffic, 6.9 percent versus 2.6 percent. Over the 23-year span, such annual growth will translate into a 365 percent increase for LATTS trucks versus an 80 percent increase for all traffic, according to the information in the HPMS database.

LATTS "Additional" Truck Traffic

The overall "base" growth projected from the HPMS database does not include the expected additional growth in traffic from Latin American trade flows. Whereas the 1997 "base" HPMS traffic included the full LATTS traffic, the 2020 "base" traffic (2020 HPMS traffic) would have only included that portion of LATTS traffic corresponding to the "base" traffic growth. The projection would have only shown LATTS traffic growing at the HPMS 2.6 percent annual rate instead of 6.9 percent annual rate. To fully account for LATTS traffic, the truck traffic and the total traffic on each HPMS highway record was adjusted to reflect this "additional" LATTS truck traffic. The difference in 2020 LATTS truck growing at the "base" rate (overall 2.6 percent annual rate) versus the LATTS growth rate (overall 6.9 percent annual rate) produced the calculated 2020 "additional" LATTS truck traffic. This "additional" truck traffic was added to both the 2020 overall truck traffic and the 2020 total traffic (AADT) for each segment.

Since a main purpose of the LATTS highway investment study was to measure the additional impact of LATTS traffic which is not already anticipated, this "additional" LATTS truck traffic is specifically addressed in the analysis of needs, capacity and pavement which follow. Needs caused by that portion of LATTS traffic already included in the existing traffic forecast were treated as part of overall needs and were not the focus of this analysis.

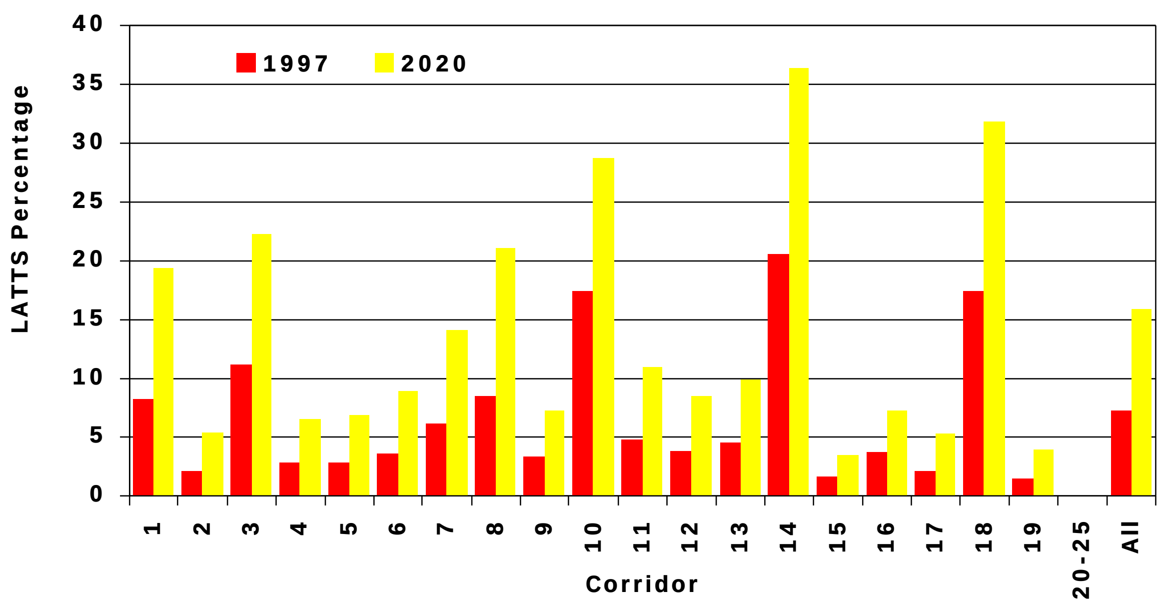
LATTS Share of Total Truck Traffic

Exhibit D3-7 shows, by corridor, the dramatic increase in the LATTS total share of truck traffic. From 1997 to 2020, LATTS overall share of total truck VMT will more than double from 7.3 percent to 15.9 percent. These percentages were calculated using only those highway segments that carry some LATTS traffic.

Comparisons of the expected growth rate of LATTS share of the total truck traffic (Exhibit D3-7) to the projected growth rate only for LATTS traffic (Exhibit D3-4) produced the following observations:

- Corridor 14 (I-10 from West Texas to Jacksonville, FL) will serve a higher share of LATTS traffic than any other corridor;
- The difference with other corridors is not as significant as for total traffic, i.e., the Corridor 14 "spike" is not as pronounced; and
- Corridor 18 (from Laredo, TX to Indianapolis, IN) has the second largest share of LATTS traffic to total truck traffic but only the eighth highest LATTS annual truck traffic.

Exhibit D3-7
LATTS SHARE OF TOTAL TRUCK TRAFFIC
by Corridor



Note: Highway segments not used by LATTS not included.

This indicates that some corridors will be proportionally more affected than others by LATTS traffic regardless of the actual volume. For example, Corridor 14 carries so much traffic from various sources that LATTS traffic will not affect it proportionately as much as might otherwise be expected, considering it will carry 29 percent of all LATTS traffic. Inversely, LATTS traffic on Corridor 18 is much lower by volume but represents a large portion of total traffic on that corridor.

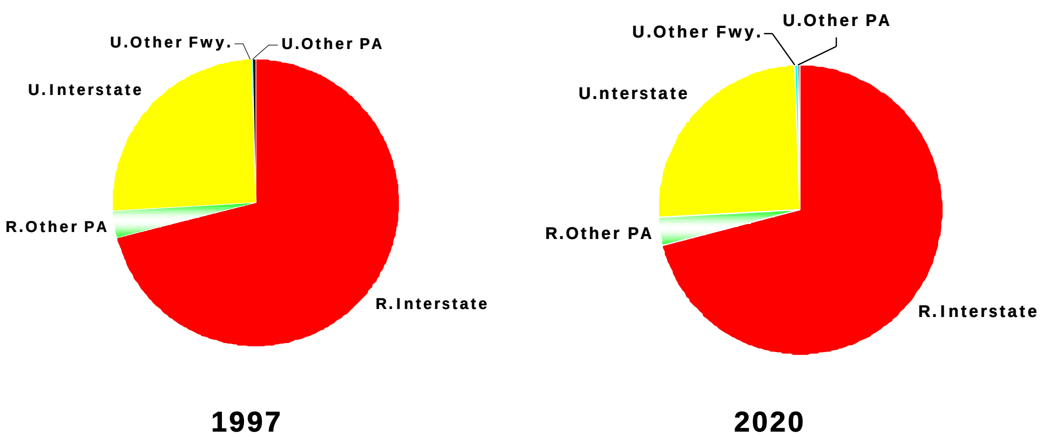
LATTS Traffic by Functional Classification

Exhibit D3-8 shows the distribution of LATTS expected truck traffic by the functional classification of the highway:

- 71 percent of the LATTS traffic will be on Rural Interstate;
- 3 percent will use Rural Other Principal Arterials;
- 25 percent will travel on Urban Interstate; and
- Less than 1 percent will use other urban facilities.

Considering the long distance nature of the LATTS truck traffic once the freight has arrived in the U.S., such a distribution pattern is to be expected.

Exhibit D3-8
LATTS TRUCK TRAFFIC
by Functional Class



NEEDS CATEGORIES

The highway analysis quantified the LATTS strategic network total investment needs as well as the incremental investment needs attributed specifically to LATTS truck traffic. Most highway needs can be organized into four general categories i.e., level of service, geometric, pavement, and maintenance and administration. Because of the unique nature of LATTS and its focus, only two of the four possible needs categories (or impact measures) were used for this study.

- Level of Service Needs – For this study, capacity needs due to LATTS truck traffic were quantified and priced in terms of additional lanes of traffic. As overall traffic from both cars and trucks grows, the amount of congestion on a given highway increases, thereby resulting in lower operating speeds. To maintain an acceptable level of service, additional capacity must be provided. The most direct way to add highway capacity is to add travel lanes. While less expensive measures are available to increase capacity (ITS, Travel Demand Management, etc.) they are less applicable to truck traffic.

- Geometric Needs – Highway geometric deficiencies (lane width, shoulder width, grades and curves) were not considered in this study. While geometrics affect vehicle performance, the geometric deficiencies are not a result of LATTS truck traffic. In addition, because the LATTS strategic highway network consists mostly of interstates and other higher level roadways, geometric needs on these types of highway would be minimal.

- Pavement Needs – Increased resurfacing needs due to LATTS traffic were estimated and priced as part of this study. Pavement condition deteriorates over time and highway must be resurfaced periodically. Since heavy truck traffic greatly affects pavement deterioration rates, LATTS truck traffic will increase the frequency of resurfacing needs.

- Maintenance and Administration Needs – The additional maintenance needs (snow removal, traffic signals, mowing, litter cleanup) due to LATTS truck traffic were considered marginal compared to overall maintenance needs. Consequently, incremental maintenance needs due to LATTS traffic were not estimated.

In summary, capacity needs and pavement resurfacing needs were the two needs categories used in this study.

Methodology

A special methodology was developed to distinguish the needs specifically attributable to LATTS traffic from the needs for traffic other than LATTS (i.e., cars and other trucks). This was done for year 2020 by calculating needs twice:

(1) With the “normal” traffic as defined by HPMS coded AADT, truck percentages, and growth rate; and

(2) With the same HPMS traffic plus the “additional” LATTS truck traffic defined and described earlier.

The differences in values thus derived represented the incremental needs due to LATTS.

Minimum Tolerable Conditions

In order to estimate needs, minimum tolerable conditions (MTCs) were defined. Minimum tolerable conditions represent the lowest acceptable threshold for highway facilities. MTCs are different from design standards, which are the features associated with a new, reconstructed, or rehabilitated roadway. MTCs are used to signal the need for an improvement once an impact measure falls below the minimum. The states represented in the Alliance typically establish unique MTCs to quantify highway needs and set capital improvement priorities in their respective states. For this study, however, it was desirable to establish a set of minimum tolerable conditions that were consistent for all of the Alliance Members. Consequently, the LATTS minimum tolerable conditions are in no way intended to replicate or replace individual state criteria. The LATTS minimum tolerable conditions are presented in the following paragraphs.

Capacity Analysis

Roadway operational deficiencies are manifested as congestion (i.e. too many vehicles trying to travel on a roadway with inadequate capacity). The LATTS deficiency analysis for capacity examines the volume-to-capacity ratio and level of service (LOS) on each highway segment. The LOS is a qualitative expression of operating conditions (congestion) using an alphabetic rating scheme (A to F) as defined below:

- A – free flow (low volumes and high speeds)
- B – stable flow (speed restricted somewhat by volume)
- C – restricted stable flow (lower speed, less maneuverability)
- D – approaching unstable flow (speed considerably affected by changes in operating conditions)
- E – unstable flow (at or near capacity, some stoppages)
- F – forced flow (volumes exceed capacity, slow speeds, frequent stoppages)

For LATTS highway analysis the following minimum tolerable conditions for capacity were used:

- Rural highways: Level of Service C
- Urban highways: Level of Service D

Pavement Analysis

The measure of pavement condition used for this study was the Pavement Serviceability Rating (PSR). PSR is a 0 to 5 value which is reported to the nearest tenth. It is derived from the Pavement Serviceability Index and other condition ratings, and is designed to assess pavement condition as well as roughness. The following exhibit (**Exhibit D3-9**) taken from the HPMS Field Manual depicts PSR ratings.

Exhibit D3-9
PAVEMENT CONDITION RATING

PSR	*Description*
4.0 – 5.0	Only new (or nearly new) superior pavements are likely to be smooth enough and distress free (sufficiently free of cracks and patches) to qualify for this category. Most pavements constructed or resurfaced during the data year would normally be rated in this category.
3.0 – 4.0	Pavements in this category, although not quite as smooth as those described above, give a first class ride and exhibit few, if any, visible signs of surface deterioration. Flexible pavements may be beginning to show evidence of rutting and fine random cracks. Rigid pavements may be beginning to show evidence of slight surface deterioration, such as minor cracks and spalling.
2.0 – 3.0	The riding qualities of pavements in this category are noticeably inferior to those of new pavements, and may be barely tolerable for high-speed traffic. Surface defects of flexible pavements may include rutting, map cracking, and extensive patching. Rigid pavements in this group may have a few joint failures, faulting and/or cracking, and some pumping.
1.0 – 2.0	Pavements in this category have deteriorated to such an extent that they affect the speed of free-flow traffic. Flexible pavement may have large potholes and deep cracks. Distress includes raveling, cracking, rutting and occurs over 50 percent of the surface. Rigid pavement distress includes joint spalling, patching, cracking, scaling and may include pumping and faulting.
0.0 – 1.0	Pavements in this category are in an extremely deteriorated condition. The facility is passable only at reduced speeds, and with considerable ride discomfort. Large potholes and deep cracks exist. Distress occurs over 75 percent or more of the surface.

Source: HPMS Field Manual, 1998.

For the LATTS highway analysis, the following MTCs for pavement condition were used:

- Interstate type facilities: PSR 3.0
- Other facilities: PSR 2.5

Capacity Analysis

A needs analysis model was developed to analyze capacity needs for 1997 and 2020. This model applied the same methodology as found in the HPMS Analytical Package to calculate capacity needs. For the year 2020, capacity needs, with and without the “additional” LATTS traffic, were estimated. The model was applied to each of the 19,423 HPMS records forming the LATTS highway database and the results were summarized. Some important features of the methodology include:

- The existing capacity used in this analyses was the 1997 capacity coded in the HPMS database, based on the 1994 Highway Capacity Manual. The same existing capacity was used for 1997 as for 2020.

- A capacity deficiency was identified when the volume/capacity ratio of a section during peak hour exceeded a threshold value. The threshold value corresponds to the selected minimum LOS criteria for that type of facility.

- Needed additional lanes were calculated to meet the minimum LOS criteria in 2020.

- In pricing the identified capacity needs, the same major widening unit costs were used consistently throughout the Alliance Region. These unit costs were provided by the FHWA and correspond to 1997 national averages. They are presented in **Exhibit D3-10**. To maintain consistency throughout the Region, no attempt was made to tailor these unit costs to each Alliance member beyond the stratification provided by the FHWA.

- Results reflect the information contained in the HPMS database and do not consider any improvements that may have occurred subsequently or any planned improvements.

Exhibit D3-10
MAJOR WIDENING UNIT COSTS

	Rural Interstate			Rural Other Princ. Arterial		
	Flat	Rolling	Mountain	Flat	Rolling	Mountain
Construction	309	329	418	315	350	670
Right of Way	41	45	73	44	52	78
Total	**350**	**374**	**491**	**359**	**402**	**748**

Costs are in $ 1,000 per finished lane mile.

	Urban Fwy. & Exp.	Urban Other Divided	Urban Undivided
Construction	2,322	1,398	1,117
Right of Way	1,149	776	506
Total	**3,471**	**2,174**	**1,623**

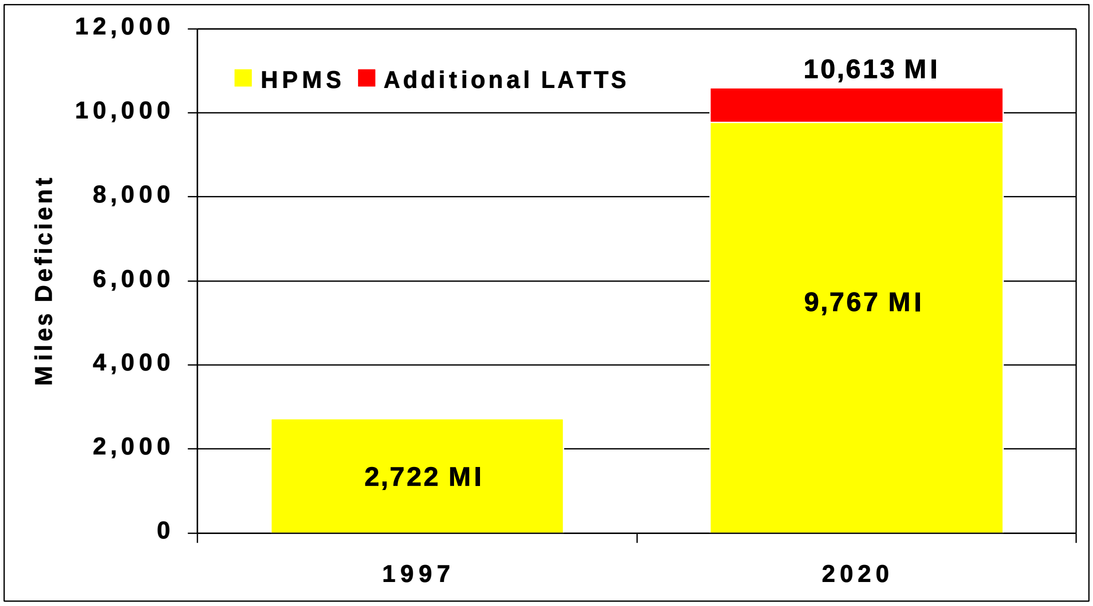
Costs are in $ 1,000 per added lane mile.

Source: FHWA 1997 Unit Cost

Capacity Needs

Exhibit D3-11 portrays projected 1997 and 2020 capacity deficiencies, by miles, for the LATTS strategic highway network. For 2020, the capacity deficiencies, with and without the “additional” LATTS traffic, are shown. Some significant findings include:

Exhibit D3-11
LATTS STRATEGIC HIGHWAY NETWORK
Capacity Deficiencies – Mileage

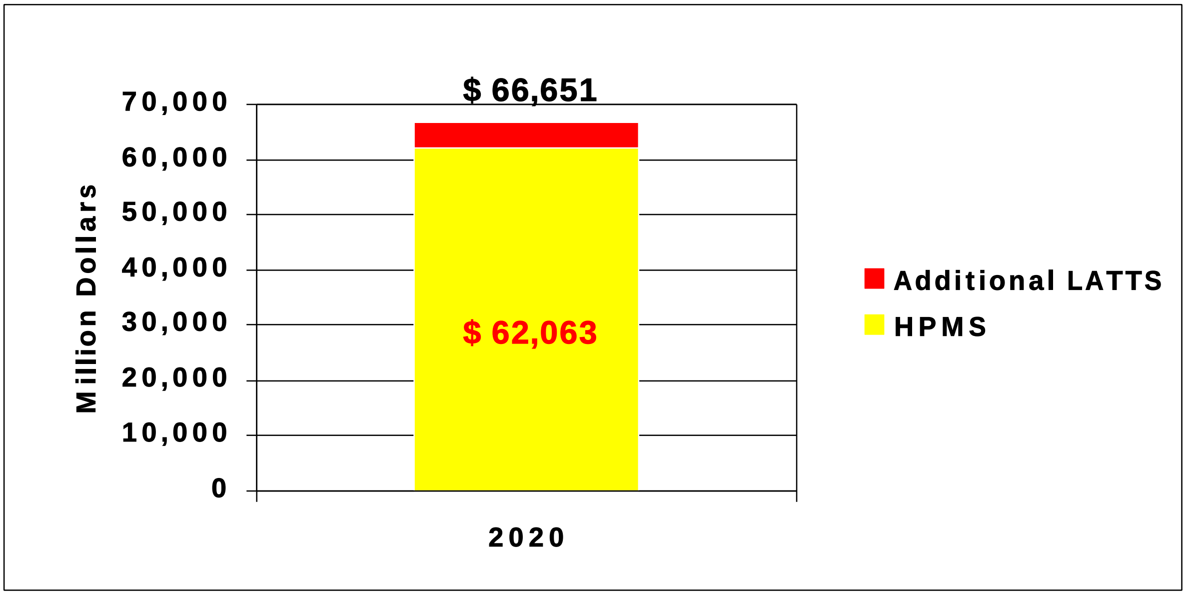


- While 12.4 percent (2,722 miles) of the network has existing capacity problems, the majority of the capacity deficiencies will occur in the next 20 years, unless capacity is added.
- With the expected "normal" growth (as defined by the HPMS database), 44.5 percent (9,767 miles) will have congestion problems by 2020.
- The "additional" LATTS trucks are expected to increase the total to 48.3 percent (10,613 miles) of total mileage.
- LATTS trucks will increase congested miles of roadway by about 8.7 percent.
- The majority of the projected congestion problems in the Region are due to expected overall growth, not LATTS traffic.
- Unless these capacity needs are met, LATTS truck traffic will be affected by all the capacity deficiencies regardless of their source.

As congestion increases, LATTS truck traffic (like other traffic) can be expected to experience lower operating speeds, more frequent speed changes, lower travel time reliability, and increased operating costs.

Exhibit D3-12 shows the projected, cumulative cost of capacity improvements until the Year 2020. Some key points:

Exhibit D3-12
LATTS HIGHWAY NETWORK
2020 Capacity Analysis - Costs



- Based on the HPMS expected growth in traffic, more than $ 62 billion will be required in the next 20 years to address congestion problems on the LATTS Strategic Highway Network.

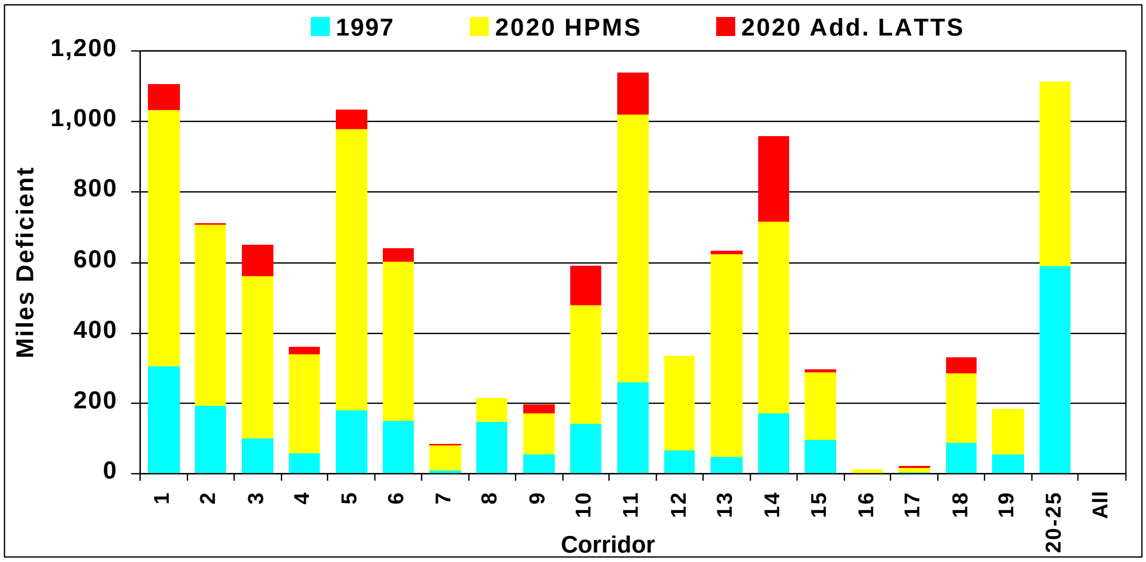
- The "additional" LATTS traffic will bring that total to nearly $ 67 billion, a 7.4 percent increase.

- The majority of LATTS truck traffic occurs on rural highways, which are less expensive to improve than urban highways. Therefore, the increase in costs to improve capacity deficiencies (as shown in Exhibit D3-11) is lower than the increase in capacity deficiencies per mile (as shown in Exhibit D3-10) for the LATTS Strategic Highway Network.

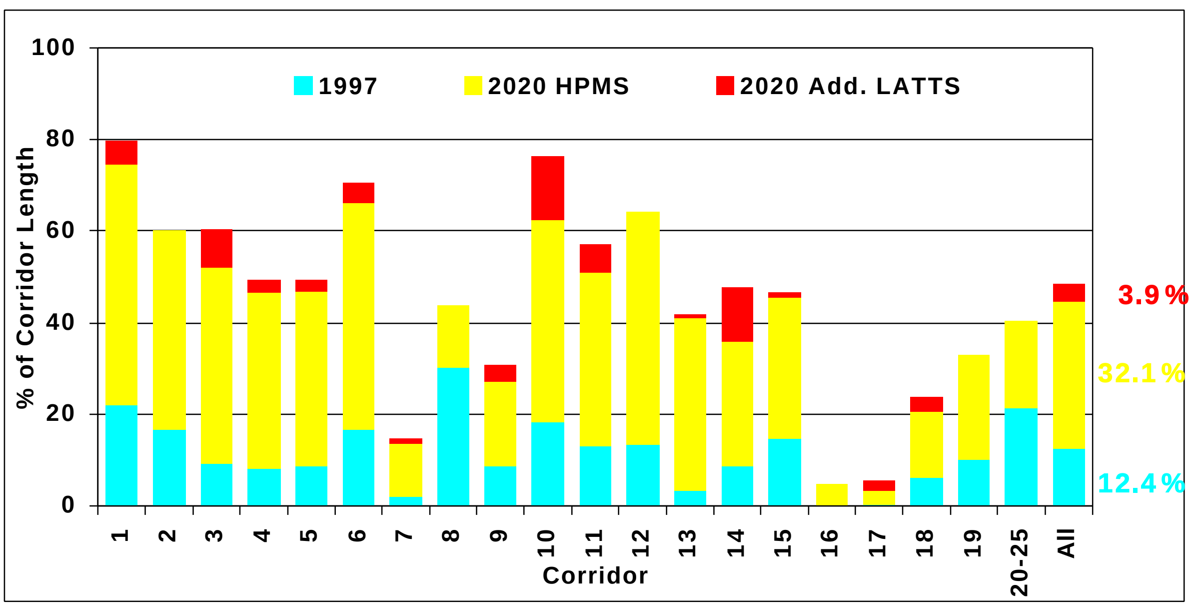
The top of **Exhibit D3-13** presents the roadway miles with capacity deficiencies, by corridor. The deficient mileages for 1997 and 2020, with and without LATTS additional traffic, are shown cumulatively. The bottom part of the exhibit shows the percentage of each corridor length with deficient capacity. The 25 LATTS corridors have different capacity deficiencies whether measured in terms of miles or percentages of corridor with deficient capacities.

- Corridor 1 (I-95 from South Florida to Washington, D.C.) and Corridor 11 (I-40 from North Texas to Wilmington, NC) both will have more than 1,100 miles with capacity deficiencies by 2020 including those due to LATTS "additional" traffic. Nearly 80 percent of Corridor 1 will have capacity deficiencies while 57 percent of Corridor 11 will suffer the same problem.

Exhibit D3-13
CAPACITY DEFICIENCIES
by Corridor



Percent of Corridors with Deficient Capacity



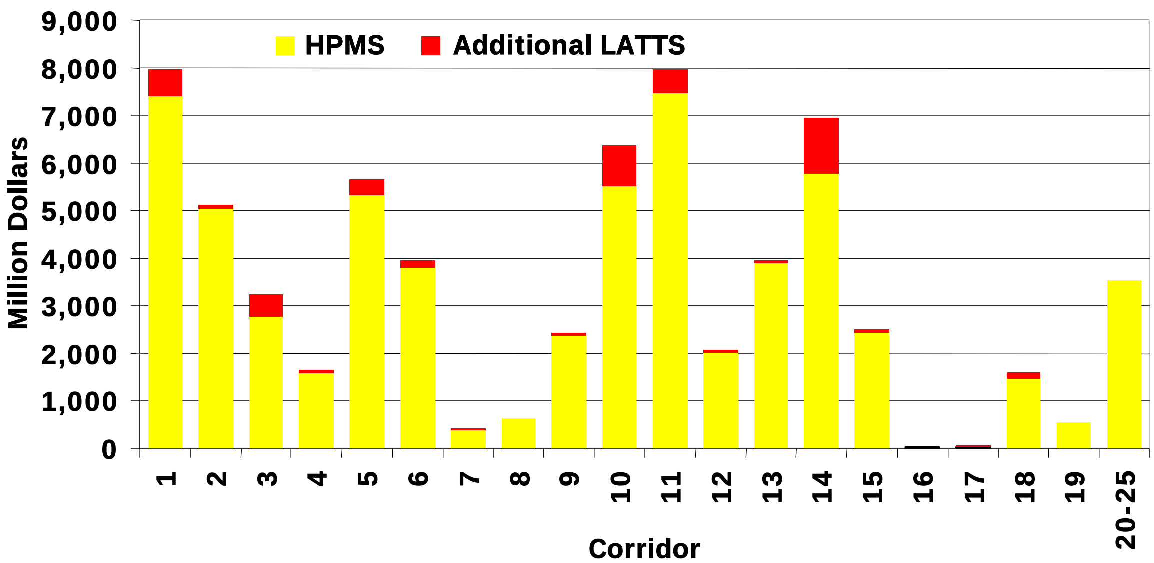
- Corridor 5 (I-75/I-24 from South Florida to Illinois) and Corridor 14 (I-10 from West Texas to Jacksonville, FL) will have the next highest capacity-deficient mileage with about 1,000 miles deficient each. This represents about 49 percent and 48 percent of the respective corridor length.

- Corridor 2 (I-85 from West Alabama to Norfolk, VA), Corridor 3 (I-59/I-81/I-66 from New Orleans, LA to Washington, D.C. and Pennsylvania), Corridor 6 (I-65 from Mobile, AL to Cincinnati, OH) and Corridor 13 (I-20/U.S. 76 from El Paso, TX to Wilmington, NC), will have approximately 600 capacity-deficient miles respectively. This represents about 60 percent of the length of Corridors 2 and 3, 70 percent of Corridor 6 and 40 percent of Corridor 13.

- The portion of these capacity deficient miles due to the "additional" LATTS traffic corresponds with the LATTS traffic usage of the corridors. Corridors 14, 1, 10, 3, and 11 will have the highest LATTS truck traffic and the highest capacity deficient miles due to LATTS traffic. As a group, they also will have the highest proportion of their length with capacity deficiencies due to LATTS traffic but with some variations. For example, Corridor 14 will have by far the highest volumes of LATTS truck traffic, but the percentage of this corridor length with capacity deficiencies due to "additional" LATTS traffic will be lower than for Corridor 10.

Exhibit D3-14 presents, by corridor, the estimated costs of providing the 2020 needed capacity. These costs conform to the miles of capacity-deficient highway as presented in Exhibit D3-13. The added costs to provide capacity for the "additional" LATTS traffic is roughly proportional to the corresponding deficient miles, except for Corridor 14 (the cost of providing the additional capacity is relatively lower than the corresponding additional deficient mileage). The cost to

Exhibit D3-14
CAPACITY IMPROVEMENT COSTS
by Corridor



address all capacity needs on Corridor 5 (I-75/I-24 from South Florida to Illinois) is proportionally lower than the number of miles with capacity deficiencies. The reverse is true for Corridor 10 (I-35/I-37 South Texas to Plains). These variations between the miles deficient and the associated costs are related to the proportion of rural versus urban mileage with capacity deficiencies and the fact that adding capacity is more expensive in urban areas than in rural ones. For example, Corridor 5 has a higher proportion of rural highway with capacity deficiencies and so, relatively lower costs to address these deficiencies. Corridor 10 has a higher proportion of urban capacity deficiencies and severe congestion in the Dallas-Fort Worth and Houston areas, which increases the costs.

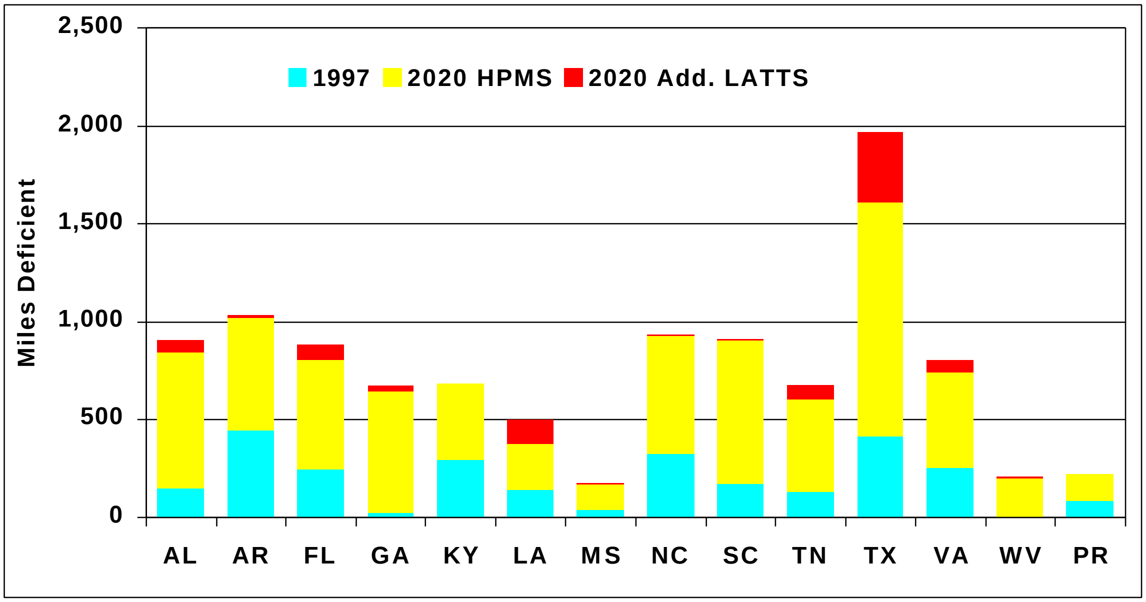
The top of **Exhibit D3-15** shows the roadway miles with capacity deficiencies, by state. The deficient miles for 1997 and 2020, with and without LATTS additional traffic, are shown cumulatively. The bottom part of the exhibit shows the miles of interstate highways within each state. These two graphs are presented together to show the strong relationship between the total miles with capacity deficiencies, and the total miles of interstate highways, which are the most traveled type of highway. Texas is shown to have about twice the number of miles with capacity deficiencies as does the next closest state (Arkansas). It also has more than twice the number of interstate highways.

The portion of the capacity-deficient miles due to the “additional” LATTS traffic for each state is related somewhat to the volume of LATTS traffic within that state, although the correspondence is not exact. For example, the large volume of LATTS truck traffic within Texas (see Exhibits D3-2 and D3-5) results in the largest incremental capacity deficiencies. Florida and Louisiana, however, which are second and third in terms of LATTS truck traffic, are third and second respectively in terms of incremental miles with capacity problems.

The top of Exhibit D3-16 presents the estimated total costs of providing the 2020 needed capacity by state. These costs are in line with the miles of capacity-deficient highway as presented in Exhibit D3-15. The added costs to provide capacity for the “additional” LATTS traffic are approximately proportional to the corresponding deficient miles.

The bottom part of **Exhibit D3-16** presents the same incremental costs due to LATTS expressed in terms of percentage of total capacity improvement costs. While the capacity improvements costs due to LATTS for Louisiana and Mississippi are much smaller than in Texas, they represent a larger share of total capacity needs than in Texas, 22 and 15 percent respectively versus 12 percent. The overall average for the Alliance States is a 7.4 percent increase in costs to address additional capacity requirements due to LATTS traffic.

Exhibit D3-15
CAPACITY DEFICIENCIES BY STATE
Miles with Deficient Capacity



Miles of Interstate by State

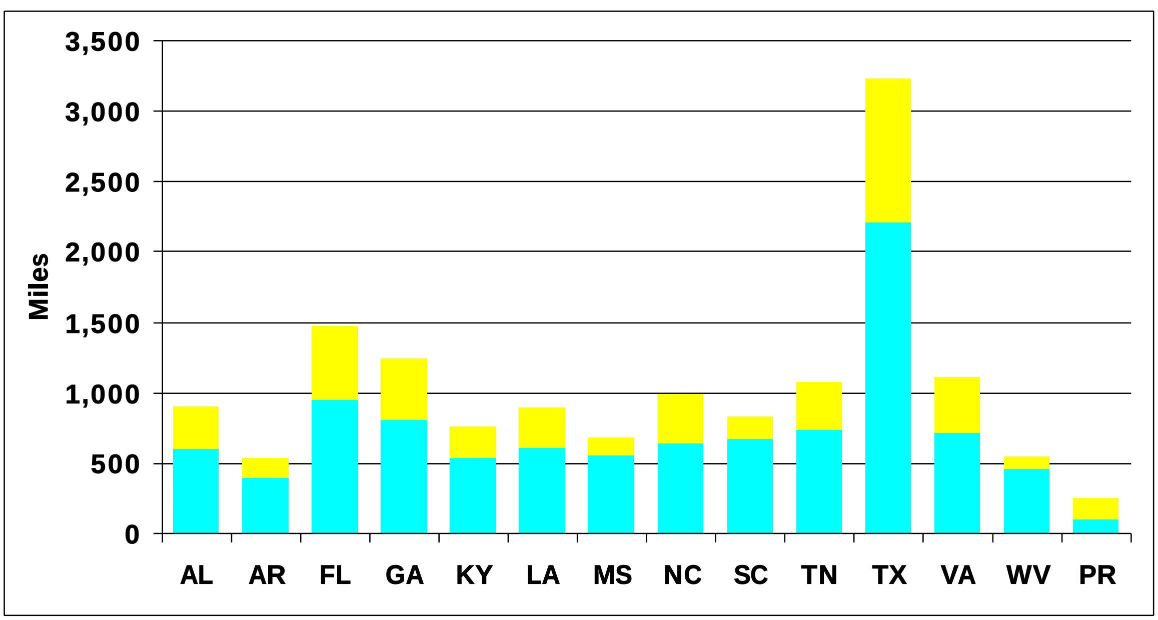
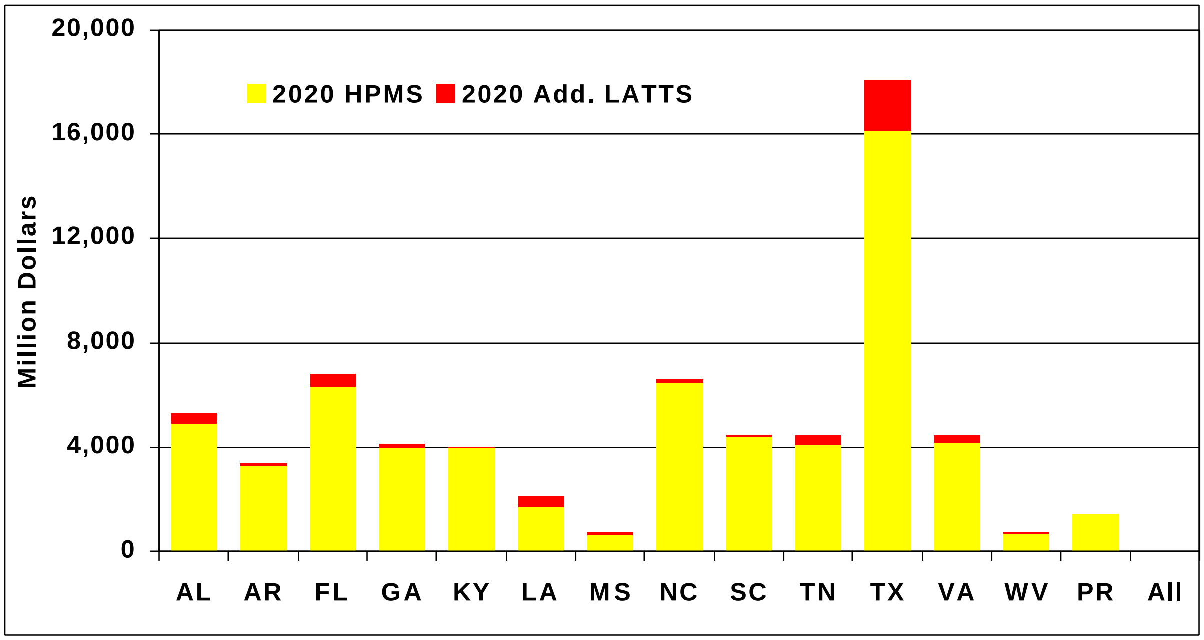


Exhibit D3-16
TOTAL CAPACITY IMPROVEMENT COSTS BY STATE



% Costs Increase Due to LATTS

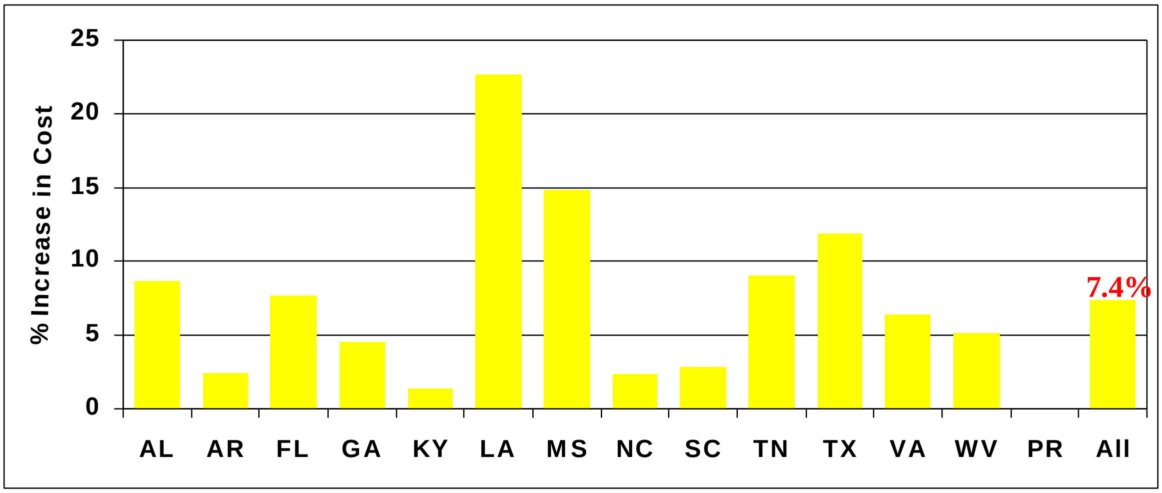


Exhibit D3-17 shows the LATTS network capacity needs in terms of miles to be improved and costs of the improvements by functional classification. The left portion of the exhibit corresponds to the “base” needs while the right portion corresponds to the "additional" needs due to LATTS “additional” traffic. The two key points from this exhibit are:

1) The "additional capacity-deficient miles due to LATTS" are more concentrated into the rural interstate category than the "base" case (LATTS traffic's long distance nature favors a heavier usage of the rural interstate). This represents more than 80 percent of total LATTS related deficiencies.

2) Because the costs of providing additional capacity are much higher in urban areas than in rural areas, most of the costs to provide the needed capacity are for the urban interstate system. This is true for both the "base" case and the “additional LATTS” case.

Pavement Analysis

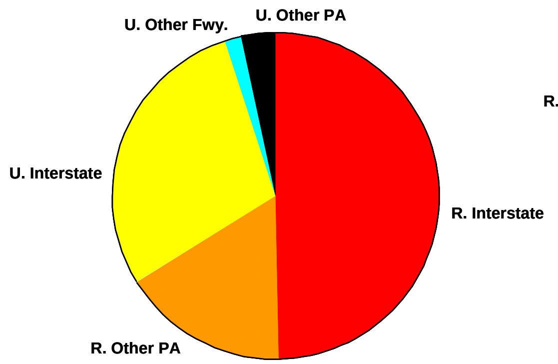
Unlike capacity needs, pavement needs are not cumulative. If a highway section needs four additional lanes by 2020 to handle the predicted traffic, two lanes can be added in 2010 and another two in 2020. On the other hand, if pavement is left to deteriorate past a certain level, a more expensive improvement such as reconstruction will be needed. The frequency of the need to resurface depends on both the volume of traffic (truck traffic mostly) using the highway and on the pavement maintenance program applicable to the specific highway.

Methodology

The methodology used to evaluate pavement needs of the LATTS highway network estimated the average annual pavement needs in 2020 instead of the total, cumulative needs through 2020 (measured in the earlier model). The number of years it would take for the pavement to deteriorate from new in 2020 to a deficient PSR rating (as defined by the minimum tolerable conditions presented earlier) was calculated for each highway segment with and without LATTS additional traffic. As an indicator of the existing condition of the network, pavement deficiencies were also identified for 1997. The difference in average pavement life is an indicator of the impact of LATTS additional traffic on the Region’s pavements. It can also be translated into incremental pavement costs.

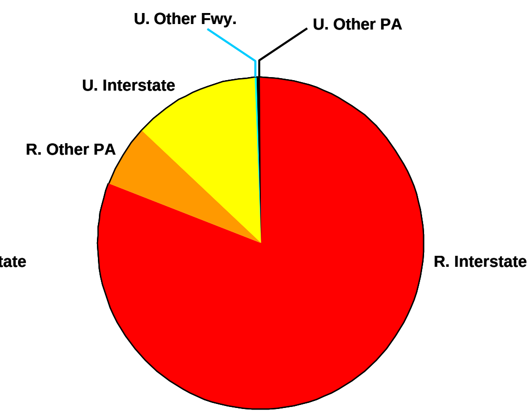
Pavements typically are designed to last for a fairly long time. However, as they age and are subjected to traffic loads, they deteriorate. The pavement life measure used in these analyses is dependent on the amount of traffic using the highway and, more specifically, truck traffic (car traffic is a factor in the pavement deterioration rate but it has much less impact). The type of pavement (for example, high flexible versus high rigid) is also an important factor affecting pavement deterioration rates. The pavement type on each highway segment, as indicated by the 1997 HPMS database, was used in the estimation of the deterioration rates. Finally, the HPMS-AP methodology for deteriorating

Exhibit D3-17
CAPACITY IMPROVEMENTS
by Functional Classification



2020 Base (HPMS)

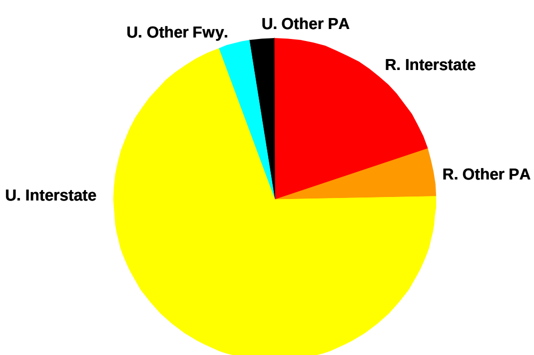
Total Miles: 9,767 Miles



Additional LATTS

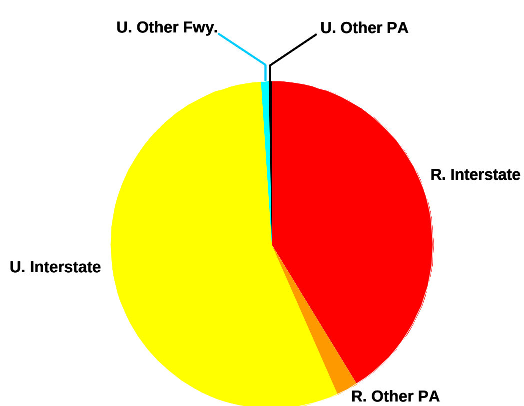
Additional Miles: 847 Miles

2020 CAPACITY IMPROVEMENT COSTS
by Functional Class



2020 Base (HPMS)

Total Costs: $62,063 Million



Additional LATTS

Additional Costs: $ 4,588 Million

pavement was applied in this study. It is based on the concept of 18 Kip Equivalent Single Axle Loads (ESALs). Weather condition or type of subsoil can also influence pavement deterioration rates. For this study, only traffic and pavement type were used to differentiate pavement deterioration rates between states.

Each highway segment pavement's remaining life was calculated twice-- first using the “base” car and truck traffic from the HPMS database, then adding the “additional” LATTS traffic to the base. The difference in the two pavement lives is a measure of the impact of LATTS traffic on the Region's pavements.

Similar to the capacity analysis, the same resurfacing unit costs were used consistently throughout the Region. The 1997 FHWA unit costs were used. They are presented in **Exhibit D3-18**. To maintain consistency throughout the Region, no attempt was made to tailor these unit costs to each state beyond the stratification provided.

Exhibit D3-18
RESURFACING UNIT COSTS

	Rural Interstate			Rural Other Princ. Arterial		
	Flat	Rolling	Mountain	Flat	Rolling	Mountain
Resurfacing	109	106	136	70	70	101

Note: Costs are in $1,000 per finished lane mile.

	Urban Fwy. & Exp.	Uuban Other Divided	Urban Undivided
Resurfacing	202	135	154

Note: Costs are in $1,000 per finished lane mile.

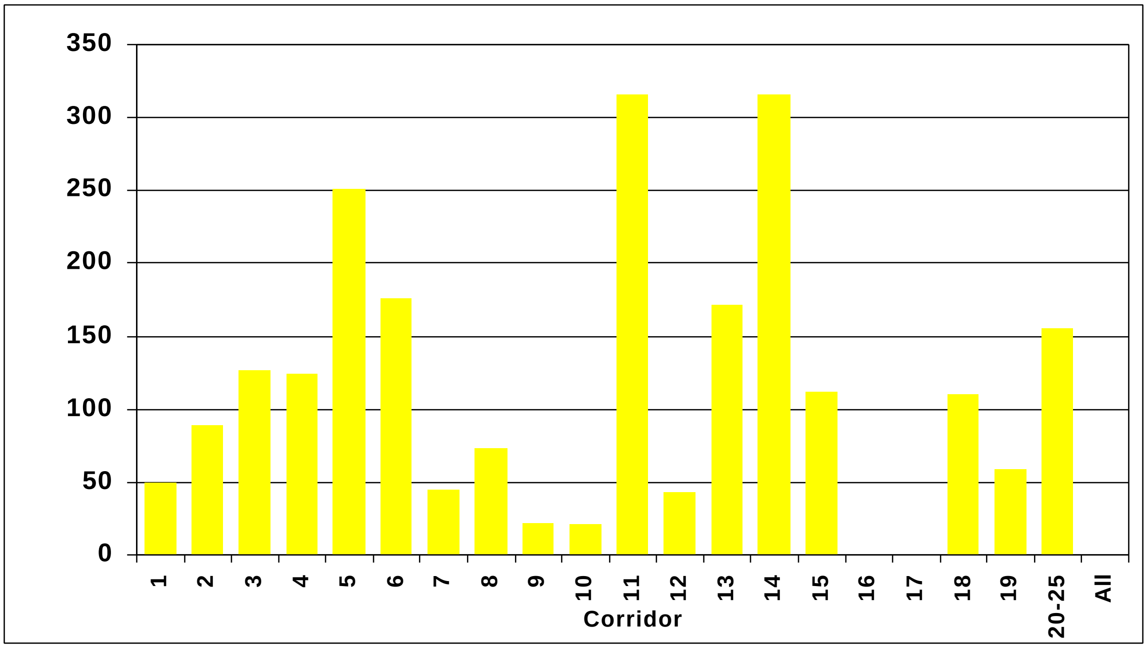
Source: FHWA 1997 Unit Costs

Pavement Needs

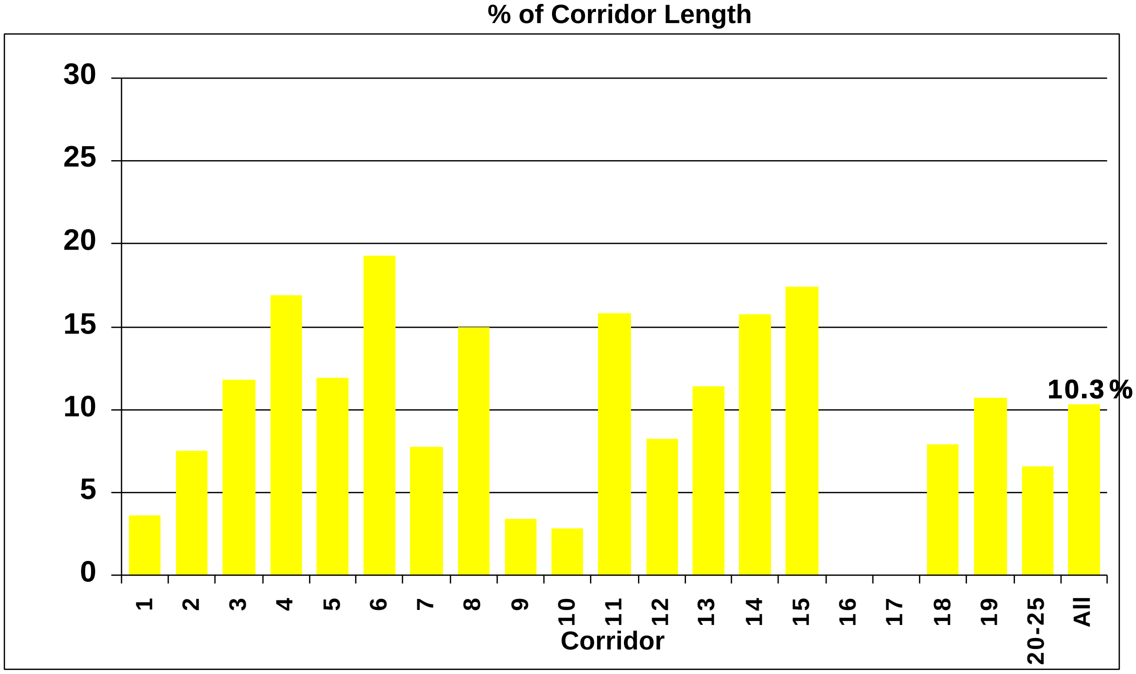
Exhibit D3-19 illustrates the extent of existing (1997) pavement deficiencies by corridor. The top of the exhibit shows the number of highway miles with deficient pavement condition. The corridor miles with deficient pavement are related to the total corridor length. For example, Corridors 5 (I-75/I-24 from South Florida to Illinois), Corridor 11 (I-40 from North Texas to Wilmington, NC) and Corridor 14 (I-10 from West Texas to Jacksonville, FL) are the longest corridors and have the most pavement deficiencies. The lower part of the exhibit demonstrates that the percentage of each corridor with pavement deficiencies does vary. Overall, about 10 percent of the LATTS strategic network has existing pavement

Exhibit D3-19
1997 PAVEMENT CONDITION DEFICIENCIES BY CORRIDOR

Miles Deficient



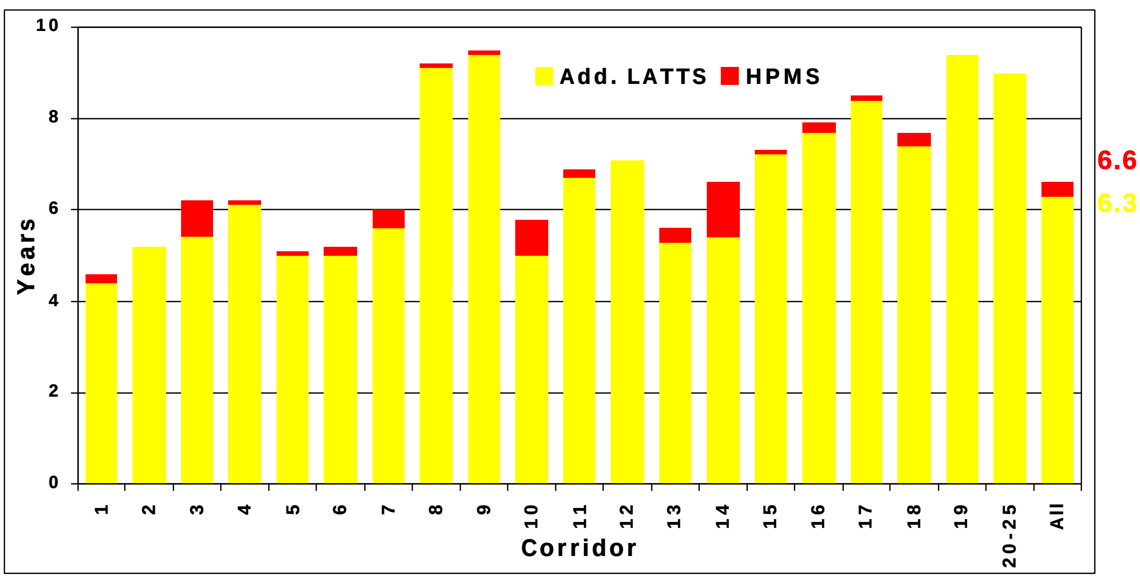
% of Corridor Length



deficiencies. This percentage varies by corridor from zero for Corridor 16 (I-16/U.S. 80 in Georgia) and Corridor 17 (I-27/U.S. 87/U.S. 277 from Texas to Denver, CO), to close to 20 percent deficient for Corridor 6 (I-65 from Mobile, AL to Cincinnati, OH).

The LATTS Strategic Highway Network's expected average pavement life in 2020, with and without the LATTS "additional" traffic, is summarized in **Exhibit D3-20**. There are significant differences between corridors. The first differences are in overall pavement life. While the pavement life of Corridor 1 (I-95/I-4 from South Florida to Washington, D.C) averages 4.6 years, Corridor 9 (I-45/U.S. 287 from Amarillo, TX to Galveston, TX) has a pavement life expectancy of 9.5 years, more than twice as much. Such disparity is due to a combination of factors including the existing pavement type/strength (high rigid pavement lasts longer than flexible pavement for example) and the amount of truck traffic (LATTS and others) using these highways.

Exhibit D3-20
2020 AVERAGE PAVEMENT LIFE
by Corridor

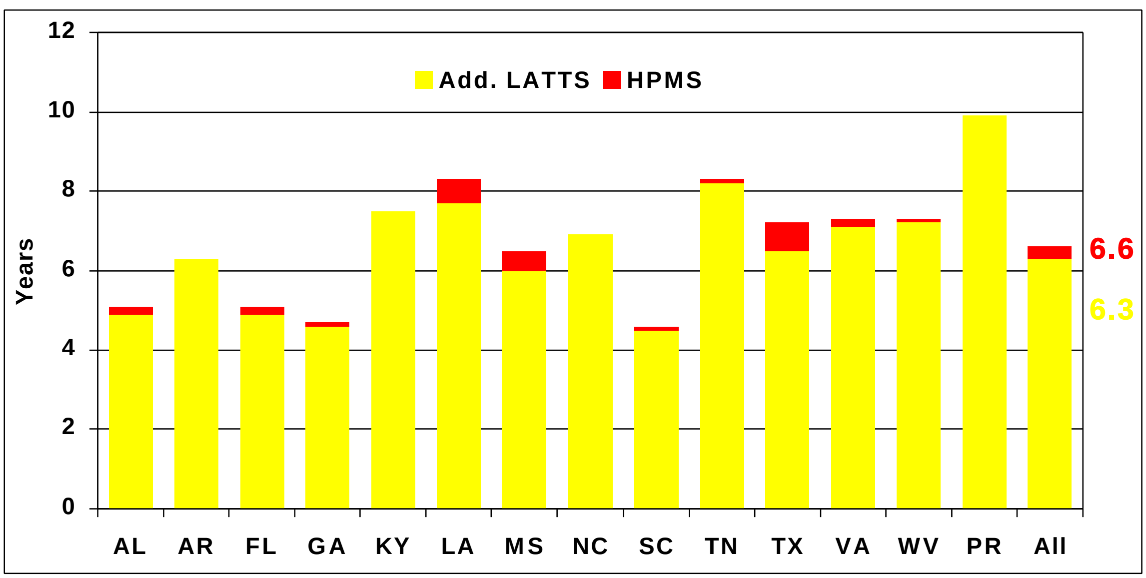


The second difference is in the LATTS "additional" traffic impact. One would expect that the most heavily traveled corridor would show the largest impact. Exhibit D3-20 confirms this expectation only partially. Corridor 14 (I-10 from West Texas to Jacksonville, FL), by far the most heavily traveled corridor, shows the highest reduction in pavement life due to LATTS traffic, from 6.6 years to 5.4 years on average. Other heavily traveled corridors such as Corridor 3 (I-59/I-81/I-66 from New Orleans, LA to Washington, D.C. and Pennsylvania) and Corridor 10 (I-35/I-37 from South Texas to the Plains) also indicate significant reduction in average pavement life due to LATTS traffic. However, Corridor 1 (I-95/I-4 from South Florida to Washington D.C) and Corridor 11 (I-40 from North

Texas to Wilmington, NC) were determined to experience smaller reductions in pavement life despite the heavy traffic from LATTS.

Average pavement life, with and without LATTS "additional" traffic, is displayed, by state, in **Exhibit D3-21**. Pavement life varies from 4.6 years in South Carolina to 8.3 years in Louisiana and 9.9 years in Puerto Rico. The pavement life for the entire LATTS Strategic Network averages 6.6 years. The differences between states are due to a variety of reasons including pavement design standards and truck traffic (LATTS and others). The estimated impact of LATTS traffic in terms of decreased pavement life is related to the proportion of LATTS truck traffic. Texas, Louisiana and Mississippi will experience the highest share of LATTS truck traffic relative to total truck traffic and also will experience the most reduction in pavement life. However, Florida will experience less impact than would be expected considering the amount of LATTS truck traffic in this state. It may be due to the fact that the LATTS truck traffic in Florida represents only 2.9 percent of total traffic traveling on the LATTS Strategic Network in 2020 versus 5.4 percent in Texas and Louisiana, and 4.6 percent in Mississippi.

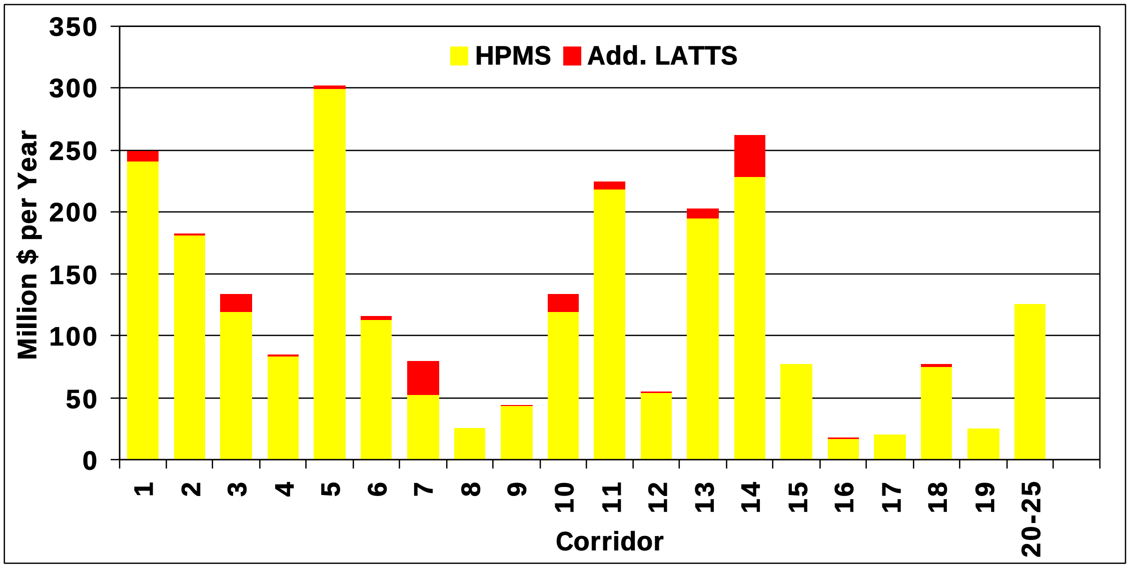
Exhibit D3-21
2020 AVERAGE PAVEMENT LIFE
by State



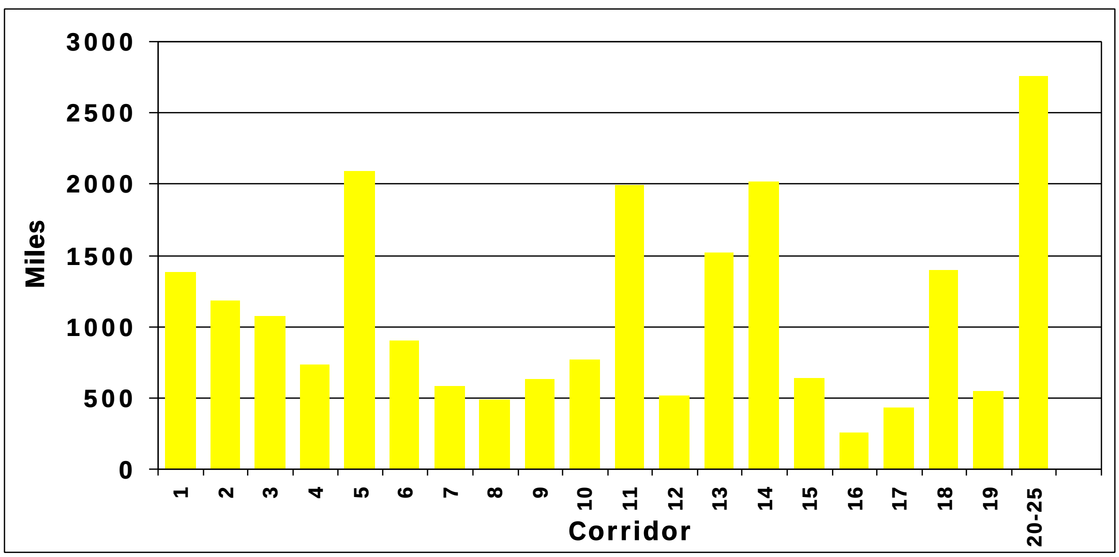
Total resurfacing costs are a function of the average pavement life and the length of the corridors. Average annual resurfacing costs were calculated as the total pavement resurfacing cost amortized over the life of the pavement i.e., resurfacing cost divided by the expected life of the pavement. **Exhibit D3-22** summarizes the average annual resurfacing costs by corridor. The top part shows the total costs with and without LATTS "additional" traffic, and the bottom part presents the total length of each corridor. Total corridor pavement costs are

Exhibit D3-22
2020 AVERAGE ANNUAL RESURFACING COSTS
by Corridor

Total Annual Resurfacing Costs



Total Length of Corridors



highly correlated to corridor length yet there is a less than perfect correspondence between costs and length. The shorter pavement life on Corridor 1 (I-95/I-4 from South Florida to Washington D.C) and the longer pavement life on Corridor 18 (from Laredo, TX to Indianapolis, IN) demonstrate this point. The incremental costs due to LATTS traffic are closely related to the reduction in pavement life due to LATTS traffic (shown previously in Exhibit D3-20).

Exhibit D3-23 summarizes the average annual resurfacing costs by state. Total resurfacing costs are a function of the average pavement life and the length of the LATTS network within each state. Texas, with the longest LATTS network, has the highest annual resurfacing costs followed by Florida, which has the next longest LATTS network. While the top part of Exhibit D3-23 shows the total costs with and without LATTS "additional" traffic, the bottom part presents the percentage increase in annual resurfacing costs due to LATTS traffic. On average, LATTS "additional" traffic will result in a 4.3 percent increase in resurfacing costs for the Region. However, this increase is not uniform among the Alliance states. The incremental costs due to LATTS traffic are closely related to the reduction in pavement life due to LATTS truck traffic. Texas and Louisiana will experience about a 10 percent increase in resurfacing costs while Arkansas, Georgia, Kentucky and Puerto Rico will experience less than 1 percent increase in costs.

Exhibit D3-24 presents, by functional classification, the LATTS highway network resurfacing needs in terms of pavement life and incremental resurfacing costs due to LATTS traffic. Increases in pavement needs due to LATTS traffic will occur mostly on the rural interstate system since, as mentioned earlier, the heaviest LATTS traffic will occur on that part of the system. While about one-fourth of the LATTS traffic will occur on the urban interstate system, the impact is lower because it represents a smaller portion of total traffic on these facilities. As a result, the increase in resurfacing costs will vary from 8.3 percent for the rural interstate system to 2.5 percent for urban interstates and lower for other functional classifications.

Operating Speeds

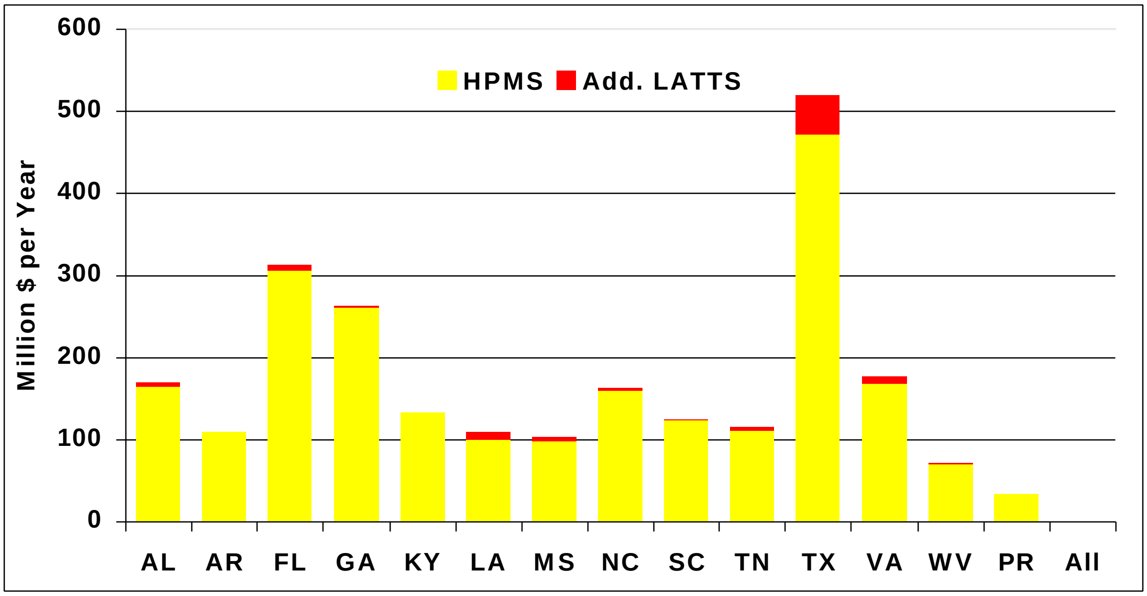
Truck operating speed was chosen as the key study performance measure for the LATTS Strategic Highway Network. Truck operating speeds were estimated for each LATTS roadway segment based on the conditions of the roadway, including roadway geometry and alignment, pavement condition, speed limit and traffic volumes.

Two types of truck operating speeds were calculated:

- The average daily truck operating speed; and
- The peak hour truck operating speed (as defined by the peak hour factor or "K" factor for each road segment).

Exhibit D3-23
AVERAGE ANNUAL RESURFACING COSTS
by State

Total Costs



Percentage Increase Due to LATTS

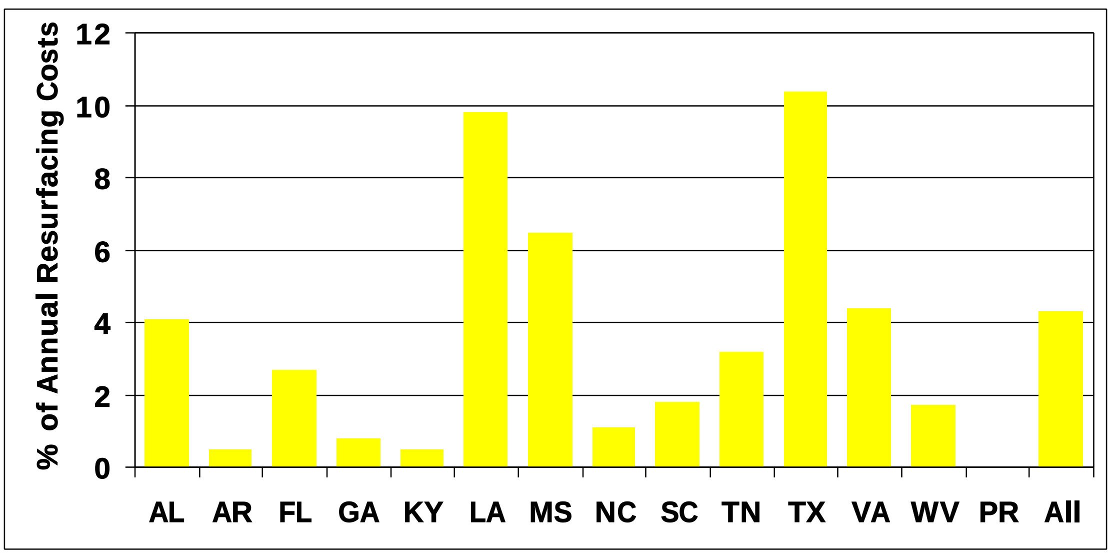
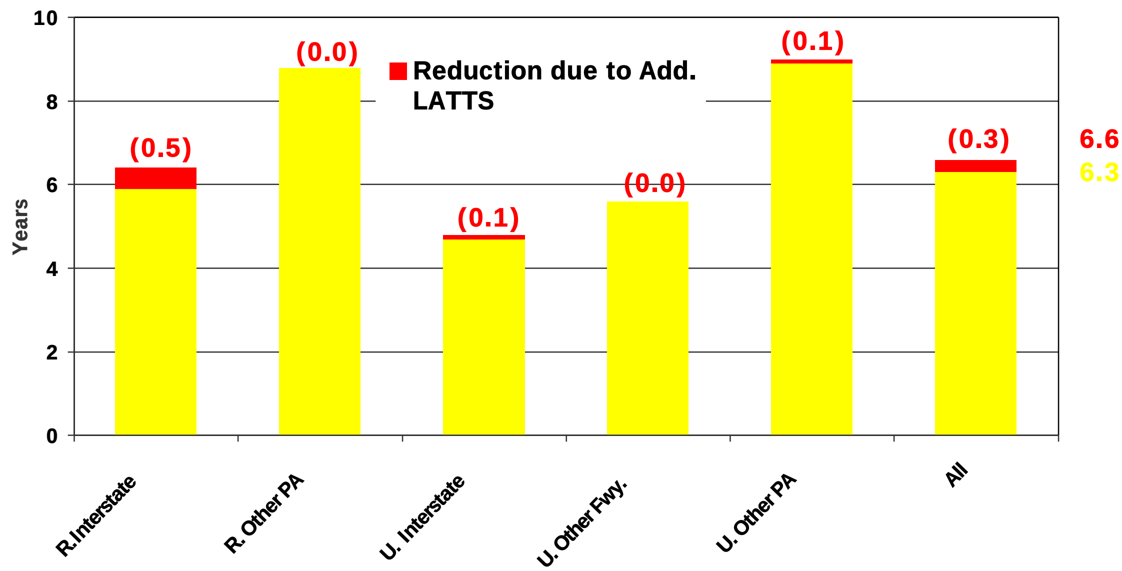
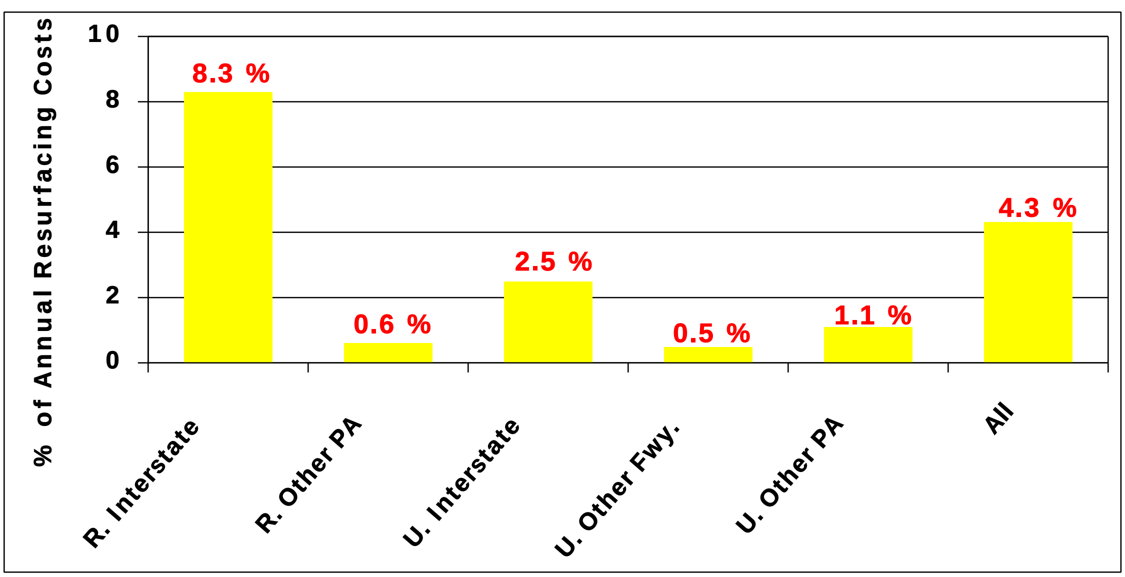


Exhibit D3-24
2020 AVERAGE PAVEMENT LIFE
by Functional Classification



Additional Resurfacing Costs per Year
by Functional Class



Because available information does not denote when a truck would travel over a specific highway section during the peak hour, the peak hour operating speed assumes that the forecast trucks would travel over every section during peak hour. As a result the calculated peak hour speed and travel time for an entire corridor is overstated, as it is unlikely that a truck would travel every section during peak hour conditions. However, the difference in peak hour operating speeds with and without additional LATTS traffic is a good indicator of how much worse existing congestion problems are going to become with the additional LATTS traffic.

Truck Operating Speed Methodology

Truck operating speeds were calculated for each LATTS roadway section. Operating speeds over a combination of segments were then calculated by adding travel time and distance for each segment and calculating the new speed.

The operating speed calculation for each sample segment or link was based on the methodology of the HPMS Analytical Package used by FHWA to estimate highway needs. The process is summarized in **Exhibit D3-25** and is as follows:

1. Based on the type of facility (urban interstate versus two-lane rural arterial, for example) and the ratio of Average Annual Daily Traffic (AADT) to hourly capacity, the AADT was distributed into as many as 12 time periods, each with a specific hourly Volume to Capacity ratio (V/C ratio). Obviously, the higher the AADT compared to capacity, the more traffic occurs during congested (high V/C ratio) periods.

2. For a given time period, initial speed per vehicle type was then estimated based on the time period V/C ratio, type of facility, weighted design speed and the speed limit. This initial speed was adjusted to take into account pavement condition and the section's alignment characteristics (steep grades and/or sharp curves reduce speed). The "initial" speed represents operating speed assuming neither speed change nor stop or idling time.

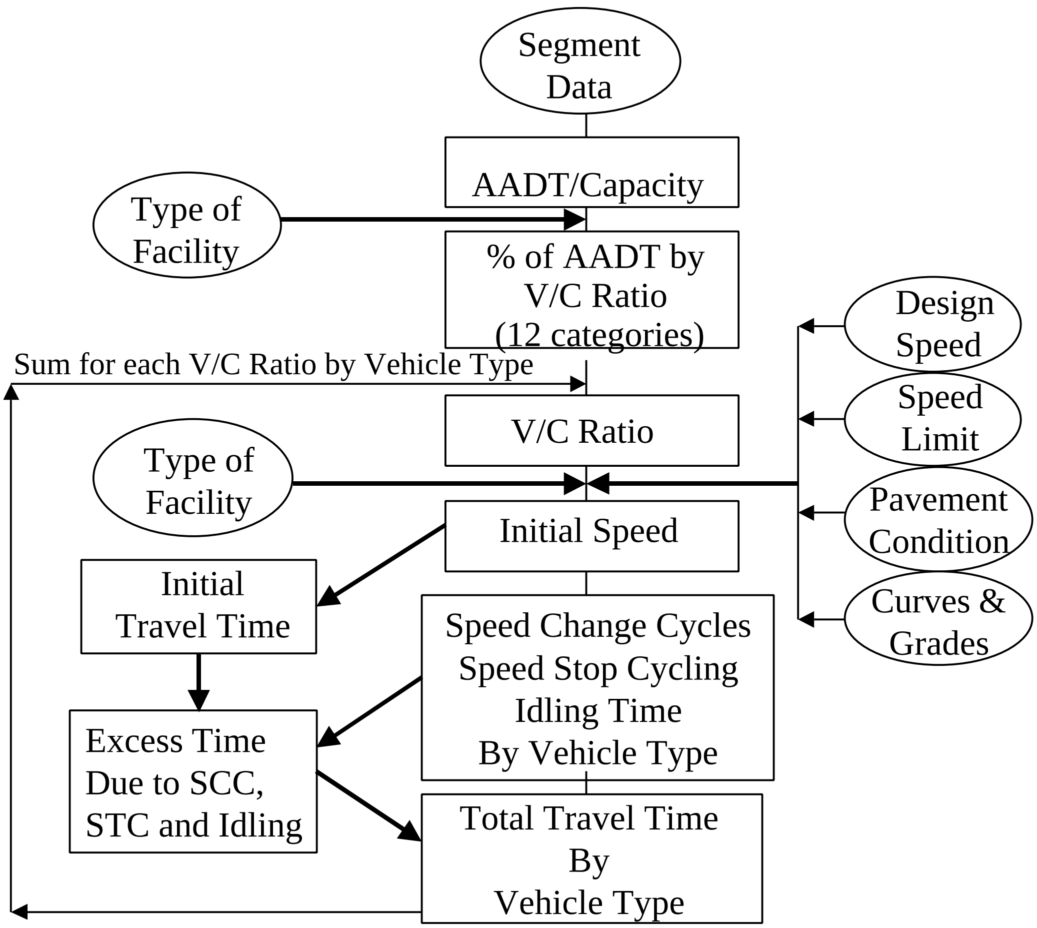
3. The initial speed was translated into initial time to travel the length of the highway segment.

4. Next, the average number of speed change cycles and stop cycles per vehicle mile of travel per vehicle type was calculated, based again of the facility type and the V/C ratio. Those cycles were then translated into excess travel time and average idling time was added.

5. The initial travel time and excess travel time by vehicle type was added for each time period, to estimate total travel time for that period.

6. The average daily operating speed was calculated by weighting travel time, by time period, by the proportion of traffic during that period, and translating into speed. This calculation assumes that the proportion of trucks in the traffic stream remains constant during the day.

Exhibit D3-25
OPERATING SPEED CALCULATION



Source: HPMS Analytical Package

Peak hour operating speed was estimated in a similar fashion, but assumes a single time period whose V/C ratio is the peak hour V/C ratio as defined by the peak hour or "K" factor.

Truck Operating Speeds Results

Truck operating speeds were calculated and summarized using the process explained above. An example of results is shown in **Exhibit D3-26**.

For each corridor, results are presented by functional class. The total lengths of all the segments used in the analysis of the corridor are listed first. This is followed by items which describe the principal characteristics of the segments, including average number of lanes, speed limit, and AADT. The purpose of

Exhibit D3-26
LATTS TRUCKS OPERATING SPEEDS

Corridor/ Functional Class	Length (Miles)	Average No. Lane	Speed Limit (MPH)	Average 1997 AADT	1997 Truck Speed (MPH)		2020 Truck Speed (MPH) W/O Added LATTS Traffic		2020 Truck Speed (MPH) With Added LATTS Traffic	
					Daily Average	Peak Hour	Daily Average	Peak Hour	Daily Average	Peak Hour
1	**I-95, I-4**		**South Florida to Washington, DC**							
R.Interstate	796.5	4.2	66.2	39,935	62.3	56.4	58.1	30.0	57.1	29.2
R.Other PA	48.8	4.0	55.0	11,592	53.8	53.8	53.8	53.2	53.8	53.2
U.Interstate	523.8	5.8	61.9	95,183	53.8	25.0	38.0	18.8	37.5	18.7
U.Other Fwy.	12.1	4.5	55.0	26,513	57.4	56.9	57.2	31.4	57.2	31.4
U.Other PA	4.7	4.0	48.8	19,529	33.7	33.7	33.7	33.7	33.7	33.7
TOTAL	**1,385.8**	**4.8**	**63.9**	**59,632**	**58.3**	**38.2**	**48.2**	**24.8**	**47.5**	**24.4**
Time					**23.8**	**36.3**	**28.7**	**55.9**	**29.2**	**56.7**
10	**I-35, I-37**		**South Texas to Plains**							
R.Interstate	428.4	4.1	69.3	23,068	60.8	58.3	56.6	43.1	55.5	40.1
U.Interstate	340.8	5.6	63.0	84,745	53.4	25.5	33.9	17.5	32.8	17.1
TOTAL	**769.2**	**4.8**	**66.4**	**50,393**	**57.3**	**37.1**	**43.6**	**26.1**	**42.5**	**25.2**
Time					**13.4**	**20.7**	**17.6**	**29.4**	**18.1**	**30.6**
11	**I-40**		**North Texas to Wilmington, NC**							
R.Interstate	1,223.8	4.0	67.2	24,902	61.8	59.5	60.1	40.1	59.9	38.2
R.Other PA	182.0	3.3	54.9	11,506	50.9	47.5	49.7	40.0	49.7	39.9
U.Interstate	559.7	5.1	60.9	62,123	54.4	30.5	39.8	19.3	39.4	18.7
U.Other Fwy.	15.8	4.5	49.3	21,786	39.2	29.9	35.8	26.2	35.8	26.2
U.Other PA	17.2	4.0	52.5	31,606	31.9	18.6	23.1	15.2	23.1	15.2
TOTAL	**1,998.6**	**4.3**	**63.7**	**34,139**	**57.8**	**45.2**	**50.9**	**30.4**	**50.6**	**29.3**
Time					**34.6**	**44.2**	**39.3**	**65.8**	**39.5**	**68.3**
14	**I-10**		**West Texas to Jacksonville, FL**							
R.Interstate	1,377.3	4.0	67.0	19,532	61.0	59.9	60.3	47.8	60.1	44.5
R.Other PA	86.7	4.0	55.0	16,913	54.6	54.5	54.6	53.6	54.6	53.6
U.Interstate	505.7	5.3	59.1	71,879	54.8	30.4	40.8	21.1	40.0	19.7
U.Other Fwy.	8.1	4.0	55.0	12,242	51.0	51.0	51.0	51.0	51.0	51.0
U.Other PA	37.7	4.6	45.8	33,892	30.9	16.7	27.6	13.8	27.3	13.8
TOTAL	**2,015.5**	**4.4**	**63.7**	**32,794**	**57.9**	**46.2**	**52.6**	**35.2**	**52.1**	**32.9**
Time					**34.8**	**43.7**	**38.3**	**57.3**	**38.7**	**61.2**

listing these items is to facilitate a better understanding of the calculated operating speeds. For example, two/three-lane highways have lower operating speeds than equivalent four-lane highways because of passing difficulties. Similarly, low speed limits will result in low operating speeds on facilities no matter what the road conditions are. The average daily and peak period speeds/travel times for trucks are then presented for the base year (1997). Finally, truck operating speeds are listed twice for year 2020. For the first entry, truck operating speeds were calculated assuming the base growth rate, i.e. the growth rate indicated by the HPMS database. For the second entry, truck operating speeds were calculated with the LATTS “additional” traffic. Overall results for the entire corridor are then listed, as well as the overall time required to travel the entire corridor. By comparing these speed and travel time values (based on present conditions), it is possible to determine:

- Which facilities are most efficient today;

- Which facilities are going to experience deteriorating conditions due to traffic growth regardless of LATTS impact; and,

- Which facilities are going to be most affected by LATTS traffic.

Exhibit D3-27 summarizes the calculated truck operating speeds, daily average and peak hour, by corridor. With the exception of Corridor 4 (I-77/I-79 from Columbia, SC to Ohio and Pennsylvania) most corridors with a majority of interstate facilities (Corridors 1 through 16) had average daily operating speeds above 50 MPH in 1997. Corridors 17 through 25 had lower average daily speeds in the 40 to 50 MPH range because they are composed of lower type facilities. The projected growth in traffic between 1997 and 2020 will affect this measure of performance significantly:

- Unless additional capacity is provided, the average daily speed in many of the LATTS corridors will be reduced by more than five MPH.

- Corridor 10 (I-35/I-37 from South Texas to the Plains) will experience the most deterioration in average daily travel speeds, close to a 14 MPH reduction, unless new measures are taken.

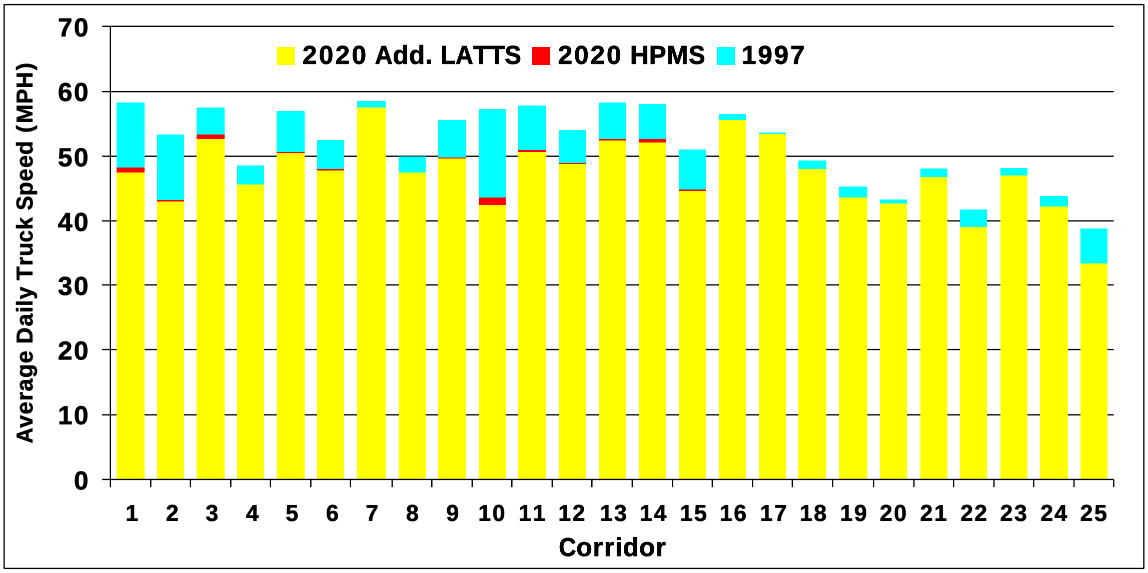
- Corridor 1 (I-95/I-4 from South Florida to Washington, D.C.) and Corridor 2 (I-85 from West Alabama to Norfolk, VA) could experience a reduction in average travel speed of more than 10 MPH.

The impact of the “additional” LATTS traffic, on average daily truck travel speed, appears minor compared to the impact of the expected traffic growth between 1997 and 2020. Even the worse case, Corridor 10 will only experience an additional reduction in average daily speed of 1.1 MPH. The reason there is such an apparently minor impact on average speeds, when the impact of LATTS traffic on capacity appeared much more significant, is due to the selected minimum tolerable standards used to identify capacity needs. The capacity needs are based on not exceeding LOS C on rural highways and LOS D on urban highways. However, travel speeds are most affected (change rapidly) when the LOS reaches E and F. In other words, capacity needs are based on explicit standards that are higher than those used implicitly in the operating speed calculation.

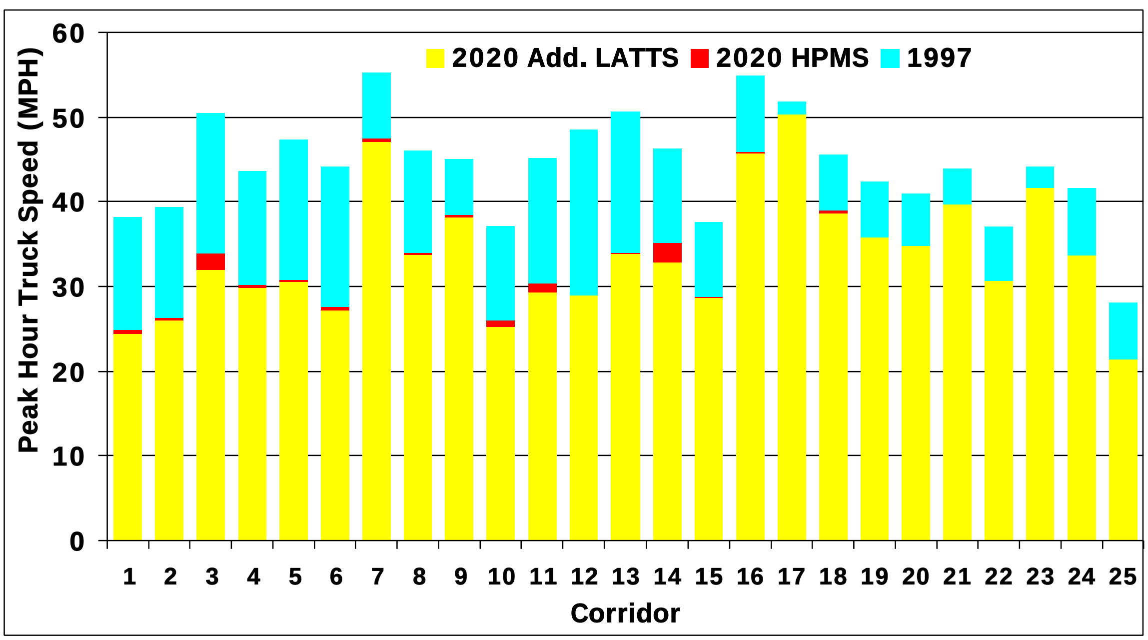
There is significantly more variation in truck “peak hour” speeds such as from 37.1 MPH on Corridor 10 (I-35/I-37 from South Texas to the Plains) to about 55 MPH on Corridor 7 (I55 from New Orleans, LA to St. Louis, MO) and Corridor 16 (I-16 from Columbus, GA to Savannah, GA). In addition, the impact of additional traffic is more pronounced on “peak hour” speeds than on average daily speeds. Five corridors could experience reductions in truck “peak hour” speeds of more than 15 MPH and another 7 corridors could be reduced between 10 and 15 MPH.

Exhibit D3-27
TRUCK OPERATING SPEEDS

Truck Traffic Impact – Daily Average Speed



Truck Traffic Impact – "Peak Hour" Speed



As mentioned earlier, these travel speeds were estimated assuming no change in capacity on any section of the LATTS highway network and future traffic peaking patterns which are the same as they are today.

The potential impact of the LATTS "additional" traffic is also more pronounced on truck "peak hour" speeds than on average daily speeds. Corridor 14 (I-10 from West Texas to Jacksonville, FL), the most traveled LATTS corridor, and Corridor 3 (I-59/ I-81/I-66 from New Orleans, LA to Washington, D.C. and Pennsylvania), the fourth most traveled LATTS corridor, were estimated to have their truck "peak hour" speeds further reduced by 2.3 and 2.0 MPH respectively due to LATTS "additional" truck traffic.

Conclusions

Major observations derived from the above analyses for the mainline Strategic Highway System can be summarized as follows:

- LATTS truck traffic is expected to grow at a much higher rate than the rest of the traffic in the region. From 1997 to 2020, LATTS truck traffic will increase by 364 percent while all other traffic is expected to increase by 80 percent.

- As a result, LATTS truck traffic will have an increasing impact on the Region's highway investment needs. By 2020, LATTS "additional" truck traffic will result in:
  - 8.7% more highway miles needing capacity improvements.
  - 7.4% additional costs to provide these capacity improvements.
  - 4.3% increase in pavement resurfacing costs.

- The additional highway investment needs are not uniformly distributed among the various types of highways comprising the LATTS Strategic Highway Network.
  - 93 % of the additional miles with capacity deficiencies are interstate highways (81% rural interstate and 12% urban interstate).
  - 97% of the additional capacity costs are for interstate highways (41% rural interstate and 56% urban interstate).
  - 98% of the additional pavement needs are for interstate highways (69% rural interstate and 29% urban interstate).

- The additional highway investment needs are not uniformly distributed among the various corridors of the LATTS Strategic Highway Network.
  - Corridor 14 (I-10 from West Texas to Jacksonville, FL), which will carry 29% of all LATTS truck traffic by 2020, will have 25% of all LATTS additional capacity needs and 34% of its additional pavement needs.
  - Corridor 10 (I-35/I-37 from South Texas to Plains), which will carry 12% of all LATTS truck traffic by 2020, will have 18% of all LATTS additional capacity needs and 14% of its additional pavement needs.
  - Corridor 3 (I-59/I-81/I-66 from New Orleans, LA to D.C. and Pennsylvania), which will carry 10% of all LATTS truck traffic by 2020, will have 11% of all LATTS additional capacity needs and 14% of its additional pavement needs.

- Corridor 1 (I-95/I-4 from South Florida to Washington D.C.), which will carry 13% of all LATTS truck traffic by 2020, will have 12% of all LATTS additional capacity needs and 8% of its additional pavement needs.
- Corridor 11 (I-40 from North Texas to Wilmington NC), which will carry 12% of all LATTS truck traffic by 2020, will have 18% of all LATTS additional capacity needs and 14% of its additional pavement needs.
- Corridors 2, 4, 5, 6, 7, 8, 9, 12, 13, 15, 16, 17, 18 and 19 carry the rest of the LATTS traffic in the Region (27% of all LATTS truck traffic). Together, they will have 23% of all LATTS additional needs and 15.5% of its additional pavement needs.
- Corridors 20 through 25 do not carry any significant portion of the LATTS truck traffic and as a result have no additional needs due to LATTS traffic.

▶ The additional highway investment needs are not uniformly distributed among the various states comprising the LATTS Strategic Highway Network.

- Texas alone will carry 42% of all LATTS truck traffic in 2020. It will have 42% of all LATTS additional capacity needs and 49% of its additional pavement needs.
- Florida, which will carry 12% of all LATTS truck traffic in the Region by 2020, will have 11% of all LATTS additional capacity needs and 8% of its pavement needs.
- Louisiana, which will carry 7% of all LATTS truck traffic in the Region by 2020, will have 8.5% of all LATTS additional capacity needs and 10% of its pavement needs.
- Alabama, which will carry 6% of all LATTS truck traffic in the Region by 2020, will have 9% of all LATTS additional capacity needs and 7% of its pavement needs.
- All other states in the Region will collectively carry 33% of all LATTS truck traffic and will have 29.5% of the additional capacity needs and 26% of its additional pavement needs.

LATTS HIGHWAY CONNECTORS

While the HPMS database was available for purposes of the LATTS analyses of mainline facilities, detailed information of this type has not been compiled for LATTS connectors. Instead, a more limited inventory of those facilities has been compiled by FHWA, using data supplied by the states. While the database did not include all of the LATTS connectors, it was possible to conduct an analysis for those connectors for which inventory data were available. The analysis utilized the NHS Connector data for 168 miles of NHS connectors (i.e., 88 highway connectors linking LATTS intermodal facilities with the mainline LATTS Strategic Highway System) for which inventory data were available. Although the 168 miles are not a 100% inventory of all LATTS Highway connectors, the sample was deemed to be reasonably representative of the LATTS Connector "universe" because it includes nearly all important freight-related intermodal facilities.

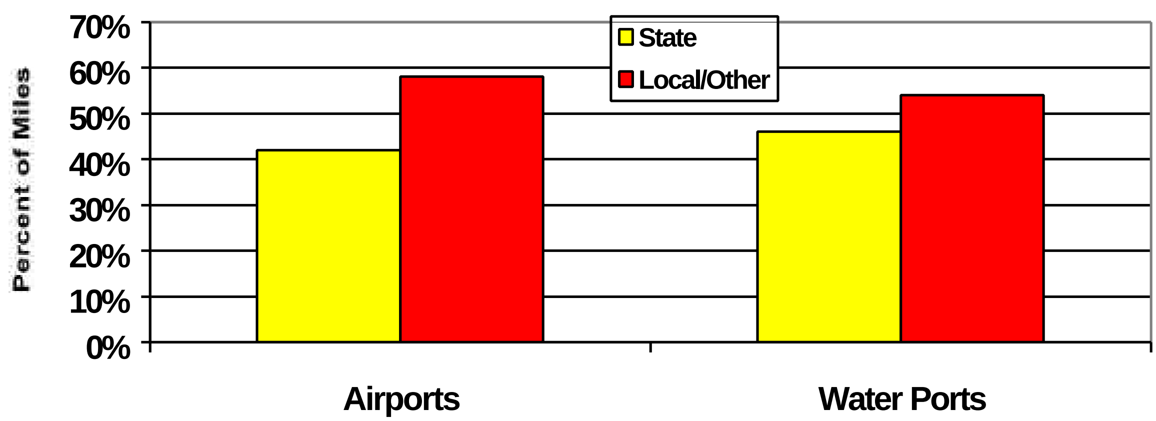
The information from the inventory database was segregated into the following categories:

- **Jurisdictional breakdown of LATTS connectors**
- **Connectors with pavement problems**
- **Connectors with geometric/physical problems**
- **Connectors with at-grade railroad crossing problems**
- **Connectors with traffic operations and safety problems**

JURISDICTIONAL RESPONSIBILITY FOR LATTS CONNECTORS

State governments have jurisdiction over 46% of the LATTS waterport connectors and 42% of the airport connectors in the sample (45% total). Jurisdiction for the remaining connectors varies between different levels of local (municipal, county, township) government and private authorities (see **Exhibit D3-28**). This information is important to the overall picture, as responsibility for maintenance and improvement of all the mainline LATTS Strategic System rests 100% with state government. Since this is not the case with the intermodal connectors, it complicates the capital improvement process. Although NHS connectors are eligible for NHS funds, on an overall basis local governments and private authorities tend to have fewer financial resources upon which to draw to address highway deficiencies. In addition, the priority-determination process at the local level often gives greater weight to high volume roadways, as opposed to lower-volume intermodal connectors.

Exhibit D3-28
JURISDICTION OF LATTS CONNECTOR MILES



State vs. Local/Other

The following physical and operational information shows that the connectors under the state jurisdiction are generally in better condition than those that are not state responsibility (referred to as “local” through the remainder of this discussion).

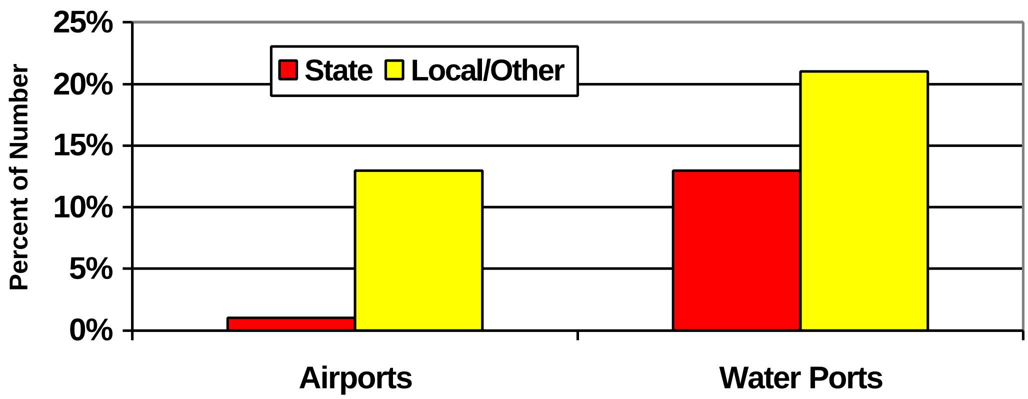
CONNECTORS WITH PAVEMENT PROBLEMS

Roadway pavements on connectors serving LATTS cargo facilities were generally not built to withstand the heavy truck weights they currently serve. Pavement materials and foundation thickness are, in many cases, not able to stand up to the volume and weight demands placed on them. This is compounded by exploding auto traffic on many connector highways and increased size and weight of container trailers.

Pavement conditions directly impact the quality and efficiency of truck access to intermodal facilities. Poor pavement quality caused by any number of pavement distresses (cracking, joint deterioration, potholes, shoving, spalling, etc.) results in lower truck operating speeds to minimize vehicle damage, reduce freight breakage, and enhance vehicle control. The “spin-off” effects of lower operating speeds due to poor pavement quality are congestion and accidents. Thus, pavement issues can affect the landside access to airports and waterports and be a factor in shipper/manufacturer decisions to use a particular facility.

Pavement problems are more common on waterport connectors than on airport connectors. The NHS Connector sample of all LATTS Connectors shows 17% of LATTS waterport connector miles and 8% of LATTS airport connector miles have poor or very poor pavement conditions, compared with the U.S. average of 8% (see **Exhibit D3-29**). Pavement conditions on local jurisdiction connectors are somewhat worse than on state jurisdiction connectors: 21% of local waterport connector miles and 13% of local airport connector miles have pavement problems, compared with 13% of state jurisdiction waterport connector and 1% of state jurisdiction airport connector mileage.

Exhibit D3-29
LATTS CONNECTORS WITH PAVEMENT PROBLEMS



State vs. Local/Other

These numbers are not unexpected. The high percentage of pavement problems associated with waterport connectors can be attributed to the high volume of heavy truck traffic in and around Alliance waterports. Trucks and trailers exact a much greater toll on roads than do passenger automobiles, and waterports tend to handle heavier cargoes than airports.

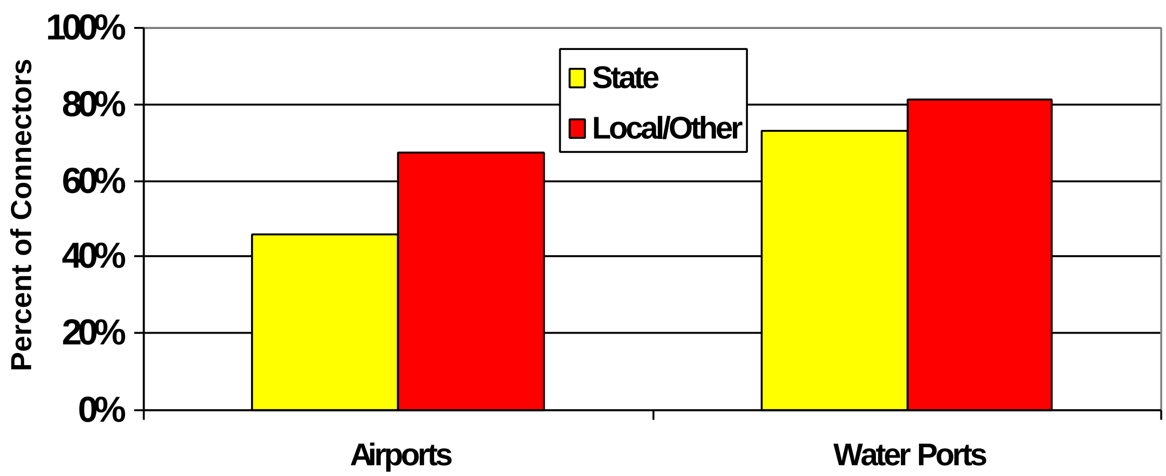
Somewhat unexpected is the geographic distribution of connectors with pavement problems. Just two states (Louisiana and Mississippi) have a higher than average rate of pavement deficiencies.

CONNECTORS WITH GEOMETRIC/PHYSICAL PROBLEMS

The connector inventory data revealed high percentages of certain geometric and physical deficiencies on LATTS Connectors. Included in the "Geometric/Physical Problem" definition are drainage problems, rough rail/highway crossings, horizontal/vertical bridge clearance restrictions, bridge weight limits, tight turning radii at intersections, narrow/unstabilized shoulders, and narrow travel way width (which restricts widening opportunities).

The data shows that both waterport and airport connectors have significant geometric/physical problems (77% and 58% of the connectors respectively have at least one). However, in both instances there are more problems on local jurisdiction connectors (see **Exhibit D3-30**) than on connectors under the jurisdiction of the state. Alliance members with a high percentage of connectors with geometric/physical problems are Florida, Louisiana, and Texas.

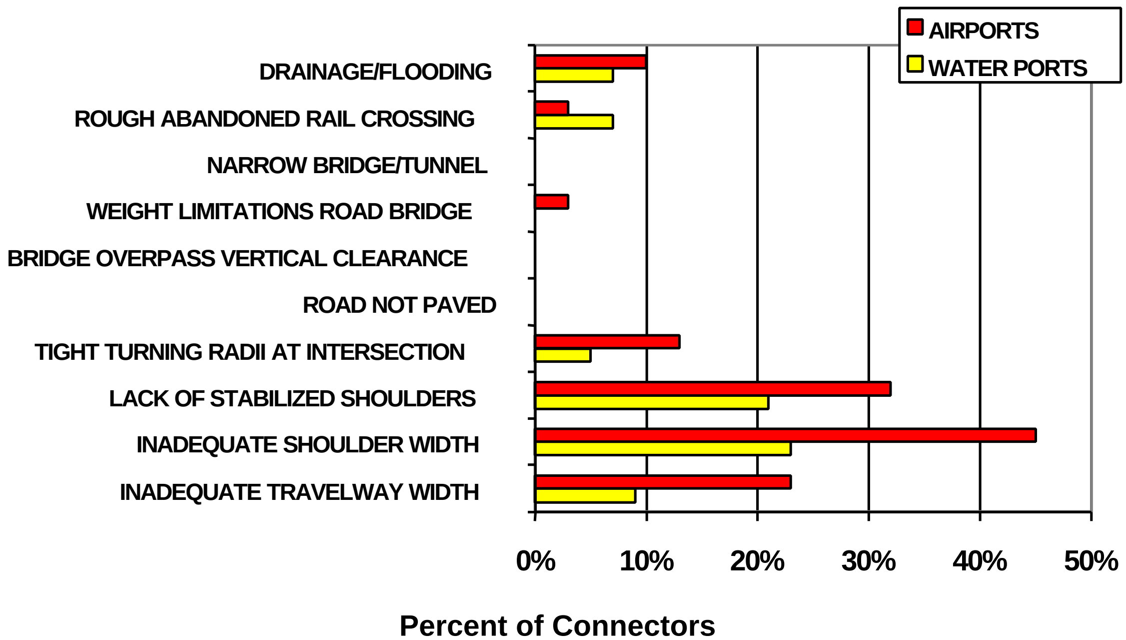
Exhibit D3-30
LATTS CONNECTORS WITH GEOMETRIC/PHYSICAL PROBLEMS
State vs. Local/Other



Geometric and physical deficiencies, like pavement problems, slow vehicle operating speeds. Trucks facing bridge clearance restrictions, inadequate shoulders, tight turning radii, and rough rail crossings must reduce speed in order to operate safely. This, of course, affects delivery reliability and efficiency.

Exhibit D3-31 indicates that inadequate shoulder width and the lack of stabilized shoulders is the most common geometric/physical deficiency, followed by inadequate travel way width.

Exhibit D3-31
GEOMETRIC/PHYSICAL PROBLEMS
LATTS Connectors

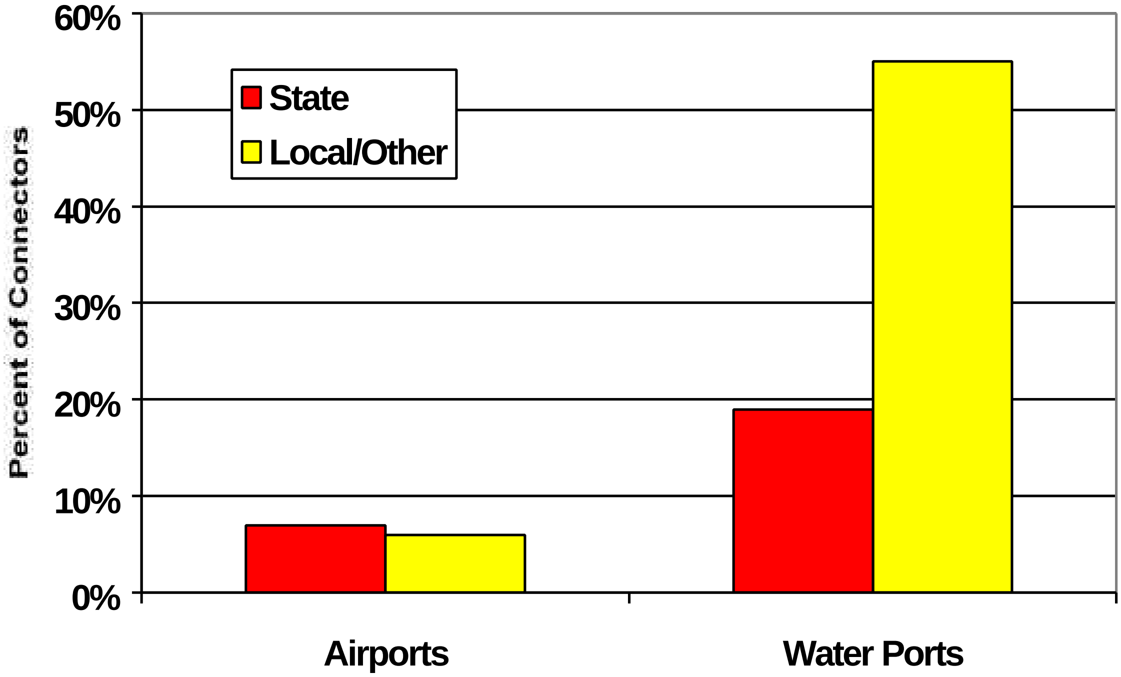


Connectors with At-Grade Railroad Crossing Problems

At-grade railroad crossing problems can severely impact the quality of access to intermodal facilities. Railroad crossing problems such as rough crossings, delays, extended switching operations, lack of an alternate route, inadequate sight distance, and warning device problems (missing, broken, inadequate) are fairly common on LATTS waterport connectors, with 39% having at least one deficiency. Waterport at-grade crossings under local jurisdiction have a much larger share of problems (55%) than their state counterparts (19%). Airport connectors, predictably, have fewer at-grade rail crossing problems (see **Exhibit D3-32**).

States with the greatest share of rail crossing problems on LATTS connectors include Mississippi, Texas and Louisiana.

Exhibit D3-32
CONNECTORS WITH AT-GRADE RR XING PROBLEMS
State vs. Local/Other



Rough at-grade crossings are the most common problem in this category. It was also discovered that the lack of an alternate route, warning device deficiencies, and delays were common problems. **Exhibit D3-33** illustrates the different deficiencies inventoried in this area of the survey.

Connectors with Traffic Operations and Safety Problems

Traffic operations and safety problems include on-street parking conflicts, frequent accidents, intersection problems (lack of signals or turning lanes, difficult right turns, signal timing), and congestion. Nearly 75% of LATTS waterport connectors have at least one traffic/safety problem. Contrary to patterns regarding other deficiency types, 81% of state jurisdiction connectors have at least one deficiency, compared with 58% of local jurisdiction waterport connectors. Fewer airport connectors (58%) have at least one traffic/safety problem, with more state than local deficiencies (92% vs. 33%) (see **Exhibit D3-34**).

Exhibit D3-33
RAILROAD CROSSING PROBLEMS
LATTS Connectors

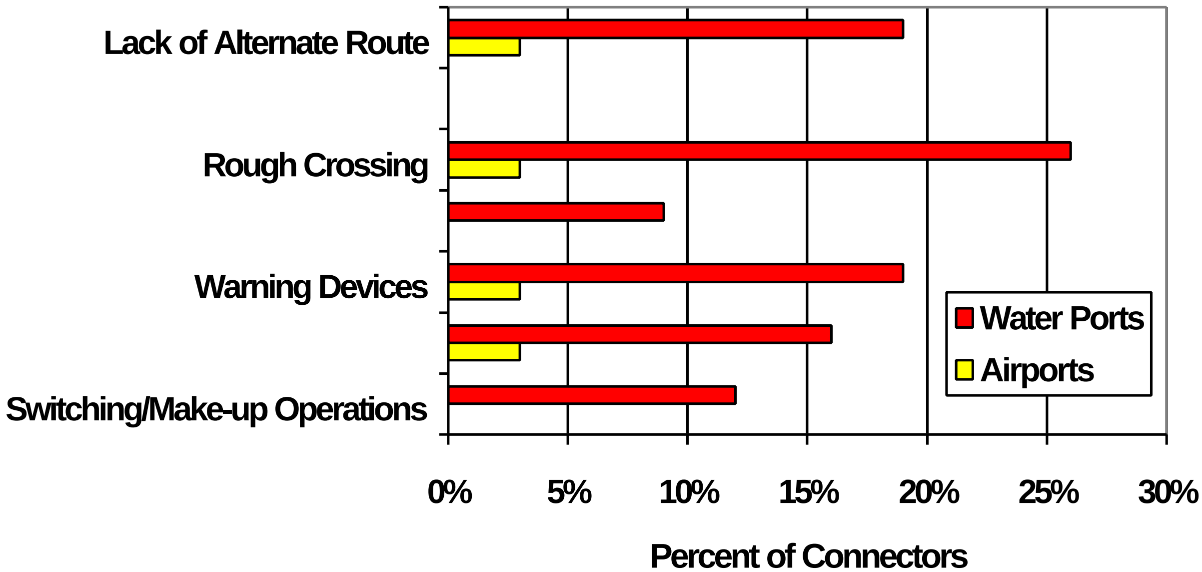
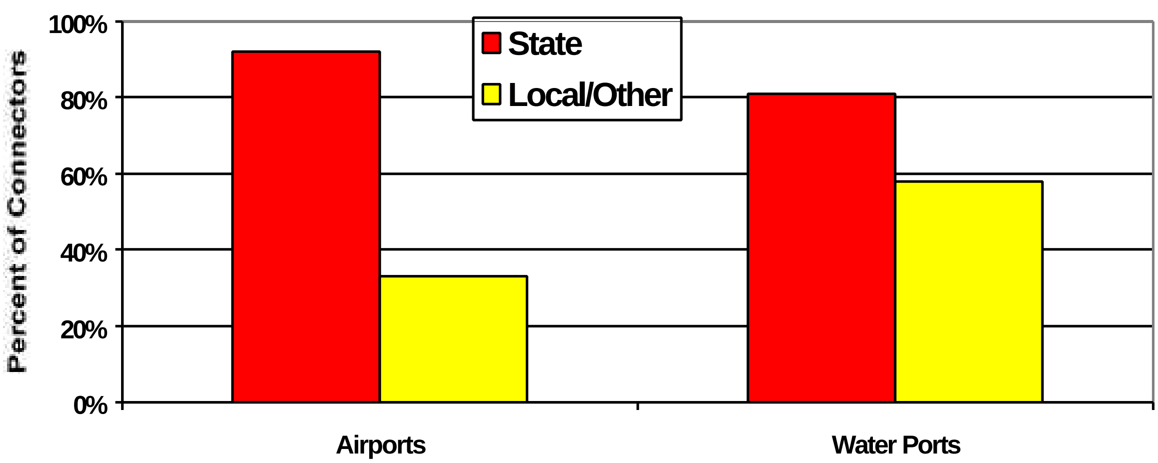


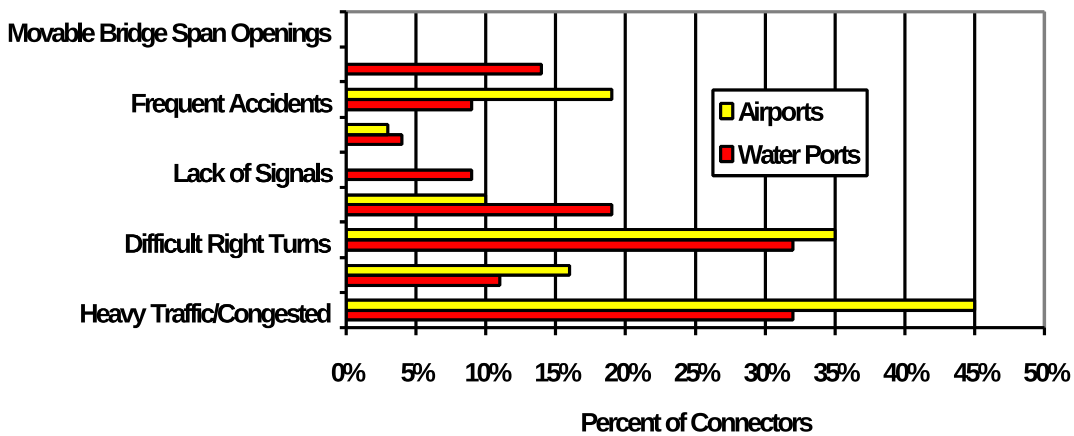
Exhibit D3-34
LATTS CONNECTORS WITH TRAFFIC OPERATIONS & SAFETY PROBLEMS
State vs. Local/Other



Heavy traffic (congestion) and intersection turning problems are the most frequent traffic/safety deficiencies mentioned for both waterport and airport connectors. **Exhibit D3-35** shows the distribution of different deficiency types.

Alliance members with higher than average operations/safety deficiencies on intermodal connectors include South Carolina, Florida, North Carolina, and Puerto Rico.

Exhibit D3-35
TRAFFIC OPERATIONS & SAFETY PROBLEMS
LATTS Connectors



SUMMARY

Many deficiencies on LATTS connectors were revealed by this analysis. It should be emphasized that, with the exception of pavement condition analysis, none of this information is quantitative in nature. Also, the data does not indicate the degree to which the different deficiencies affect the accessibility to any LATTS facility. The data does however provide insight into a growing concern in the national arena, the reduced efficiency of and congestion around landside cargo facilities.

The primary findings from the LATTS Connector analysis are summarized below.

Waterport Connector Issues

- 54% of waterport connector miles are local jurisdiction
- More than 80% of waterport connectors have at least one deficiency, and 45% have two or more
- Pavement condition problems are more prevalent on local jurisdiction connector roadways – more than twice the U.S. average

- More than 75% of the connectors have geometric/physical problems, including shoulder type/width, turning movement restrictions, and narrow travel way

- Nearly 40% of the connectors have rail crossing deficiencies, notably rough crossings, delays, lack of alternate routings, and devices; more than half of the local jurisdiction roadways have rail crossing deficiencies

- Congestion and difficult right turns are common problems, especially on local roadways

Airport Connector Issues

- Nearly 60% of LATTS airport connector miles are local jurisdiction

- Shoulder type/width deficiencies and safety problems are prevalent

- Congestion, delays, turning restrictions are high, especially on state jurisdiction roadways

Jurisdiction Issues

Lack of adequate financial resources makes it difficult to address all connector issues or deficiencies. Another factor that complicates the connector issue is the mix of jurisdiction and responsibility – more than half the LATTS Connectors are the responsibility of local agencies. This pattern of jurisdictional responsibility presents a significantly different set of problems for the Alliance members as they try to address connector problems. It contrasts with the mainline LATTS Strategic Highway System for which the state governments have jurisdiction over all the mileage. Coordination between more than one level of government is not an issue for the mainline portion of the System.

On the other hand multiple agency ownership of LATTS connectors complicates planning for these facilities. Local agencies typically have fewer financial resources upon which to draw, and their transportation priorities may be concentrated on high volume arterials and congestion hotspots instead of lower volume connectors to intermodal facilities. In order to successfully address connector issues, more coordinated, comprehensive planning is needed to cut across jurisdictions.