Freight Movement Inventory and Future Demand Analysis

Tennessee Rail System Plan

P R E P A R E D F O R

Tennessee Department of Transportation

Freight Movement Inventory and Future Demand Analysis

Tennessee Rail System Plan

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Tennessee Department
of Transportation

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Executive Summary

Task 5 of the Tennessee Rail Plan project provides for research and analysis of a broad range of topics including but not limited to providing forecasts through 2020 for the volume of rail traffic either transiting or with an origin/destination in Tennessee.

This report has been repeatedly delayed by the decision to utilize the national forecasting capabilities currently being developed by the U.S. Federal Highway Administration as part of its increasing focus on goods movement. This FHWA project is known as the Freight Analysis Framework (FAF) and is the most comprehensive freight forecasting approach that has been developed to date. Given the level of detail of the FAF work product, it appears that the decision to link this effort to the FAF, as a pioneering use of the FAF has been a wise decision. The FAF forecasting methodology yields several outstanding benefits. It provides a detailed forecast, it has a high probability of being updated by the FHWA in the future, and because the forecast has been done at the national level, it inherently has the lack of state-specific bias that is necessary in a study of this sort.

The forecasting methodology builds on all available trade data. It then models that data to the national transportation network by mode. This historic database is then forecast using a regional econometric model of the United States to provide forecast levels of commodity movements by mode for the years 2005, 2010, and 2020. The underlying econometric models incorporate a U.S. foreign trade component that is built in part on the extensive work that was done as a part of the Latin American Trade and Transportation Study.

The result of this extensive process is a detailed forecast of rail traffic for the State of Tennessee. This aggregate forecast shows that there will be a continuing increase in the movement of freight over the railroads in Tennessee. This forecast shows rail freight originating in and destined for Tennessee by state and international origin and destination. This data shows that by 2020, total traffic on Tennessee railroads will have increased by 69 percent over the level experienced in 1998. Looking at this growth from an interpolated 2002 base, by the year 2020, Tennessee can look forward to total rail traffic levels 51 percent greater than today's levels. Overall, this forecast shows an annual average compound growth rate of 2.4 percent over the forecast period. The foreign trade component represents 8 percent of the total cargo in 1998 but foreign trade cargoes grow at the considerably higher annual rate of 4.8 percent reflecting the impact of NAFTA on trade and considerable increases in traffic to and from the Pacific Rim. This increase in cargo volumes indicates there will be more railcars, trains, and most certainly longer trains, due to a desire on the part of the railroads to increase

productivity, moving over the network of Class I and shortline railroads located in Tennessee.

A more detailed forecast of future cargo levels for the individual Tennessee shortline railroads was developed at a company specific level of detail for each railroad. This forecast is based on detailed cargo data, on a commodity and state of origin and destination basis, provided by the Tennessee shortline railroads in the course of this study for the base year 1999. This data was also forecast using the FHWA FAF forecast as the underlying database.

The resulting forecast shows cargo traffic on the Tennessee shortline railroads will increase by 59 percent over the period 1999 to 2020. It is important to note that the preponderance of that growth, 35 percent, takes place by the year 2010, suggesting that the role of the short line railroads will escalate sharply over the remainder of the decade. This rapid increase in cargo volumes during this period will likely place considerable pressure on the Tennessee short line railroad rehabilitation programs.

To understand the potential role of an all-Tennessee east-west rail link that would be formed by restoration of rail service between Algood and Oliver Springs, an extensive analysis of the potential for the diversion of I-40 truck freight to the east-west rail link was developed. The fundamental assumption underlying this analysis was that the most likely source of new rail freight that might be diverted to an all-Tennessee east-west rail link is the cargo that is now moving by truck on I-40. The traffic potentially diverted from I-40 might be supplemented by potential industrial development in the region between Nashville and Knoxville.

This study was based on a detailed modeling of current I-40 truck traffic developed by Reebie Associates using its TRANSEARCH 2000 modeling capability. The database created in this process lists all commodities modeled to transit I-40 between Nashville and Knoxville, in both directions during the year 2000. The data created is at the four-digit STCC commodity level of detail and lists state of origin and destination. For example, the database shows the commodity detail of cargo flows from Texas to New York for those commodities modeled to transit I-40. This level of detail was required to identify those components of the freight moving on the route that could be involved in an intermodal interchange. This database was augmented, in order to provide a better understanding of the operational issues involved in routing decisions regarding freight, by extensive interviews of the Class I Railroads and a representative sample from transportation users who control the routing of this freight traffic.

The basic information on truck traffic was supplemented by an assessment of the alternative and competitive routes that now exist for the truck cargoes now transiting the I-40 corridor. It is necessary to consider the broader nature of the larger transportation system serving this region of the nation. This required identification of the alternatives that currently exist for routing this cargo, including transportation links that are not wholly within the State of Tennessee. This analysis therefore included the potential role of the existing Norfolk Southern Railway (NSR) railroad network that runs east from Memphis, through Mississippi and Alabama and through Chattanooga providing service to East Tennessee.

The transit times currently offered by the NSR between Memphis and Knoxville on its 429-mile route that goes through northern Mississippi and Alabama compares favorably to the rail transit times that have been constructed for the northern route of the all Tennessee east-west rail link which would total 414 miles between Memphis and Knoxville. Both rail routes must compete with the I-40 connection between Memphis and Knoxville that is 387 miles.

Given these facts, it is highly unlikely that any significant volume of cargo moving between points in eastern Tennessee (Knoxville and East) and Memphis, as well as cargoes now transiting Tennessee, would shift to the newly created all-Tennessee east-west rail link. The resulting forecast shows that very little cargo would be likely to use the all Tennessee east-west rail link. Approximately 23,000 truckloads of the 1.8 million truckloads transiting I-40 in 2000 would likely shift to the new rail corridor. No significant freight tonnage has been identified in the assessment of the Tennessee agricultural and silvicultural industries, which may generate traffic for the new rail corridor. However, some amount of stone has been identified as having potential to shift to the new rail corridor.

Various studies conducted in recent years have been reviewed and rail and truck companies have been interviewed to determine how the modal split on the transportation system in Tennessee would be affected given significant fuel price increases or fuel shortages. Energy costs are only one small factor in the overall comparative costs of rail and truck transportation. Only certain commodities are rail-truck competitive. Rail does best in high-density lanes moving over long distances between origin and destination. High value short and medium distance traffic is highly unlikely to divert to rail.

Although energy prices rose substantially last year, rising 100 percent from two years previous, there was not a noticeable shift of any commodities from truck to rail. If fuel

prices were to increase even more substantially, or if fuel shortages occurred, there could be disruptions or shifts throughout the economy. It is almost impossible to predict the effect of these changes on modal shifts. Given the expectations for fuel availability and pricing, and the number of other factors that must be weighed to determine the optimum freight delivery system, it is unlikely that any substantial amount of truck traffic will divert to rail in Tennessee as a consequence of foreseeable increases in fuel prices.

Based on this assessment, it does not appear necessary for the TDOT short line railroad rehabilitation program to develop a program component to ensure the sustainability of railroads during cyclical fuel price increases.

Tennessee's major railroads, as well as its short line carriers, will benefit from a variety of industry-wide technological improvements developed over the past decade. Both the short line and Class I railroads serving Tennessee have been able to capitalize on improvements such as improved metallurgy and track fastening systems, new wayside detector devices, grade crossing protective devices, and related safety advances. Increased levels of hazardous material shipments, coupled with a simultaneous demand for safe and efficient rail passenger services have established a larger market for safety and associated technological improvements. Increased car weights, faster train speeds, improved employee computer-based training programs and expanded freight carrying capacities are likely because of growing rail industry technological and informational improvements. A number of rail industry improvements have helped contribute to the overall efficiency of the Tennessee (as well as the national) rail transport system

The Association of American Railroads reports that overall average speed of trains moving through Tennessee increased by approximately 2 percent in the year 2000. That speed can be expected to increase in the future due to improved mechanical, safety and operating efficiencies. Advances in train speeds mean shorter transit times, ability to utilize just-in-time delivery systems to manufacturers, and increased overall customer service.

The growth in rail freight traffic and the overall national trend toward larger and faster trains will have a significant impact on Tennessee's many grade crossings. The increased traffic at grade crossings will lead to increased delays and safety concerns as well as increased scrutiny of railroad operations.

Because of that public scrutiny, any improvements oriented toward grade crossings, whether legal, technical or mechanical, are immediately noticed and become publicly

recognized and are important contributions to the perception of safe rail operations. Many states and most rail companies have gone to considerable expense and maximized their effort on issues related to improving crossing safety and several of those actions have been identified.

Tennessee's overall highway-grade crossing activities warrant review with respect to new technology, possible updating of laws, and new although not necessarily complex technology. One such example, the IdaShield, due to its success in reducing crashes at highway grade crossings is given special attention in this report.

An extensive survey of Tennessee government officials and industries located in Tennessee has been conducted to determine if specific rail system improvements could be targeted to benefit and increase the competitiveness of the Tennessee agricultural and silvicultural industries. It appears that these industries are primarily being served by the transportation system and various programs. Since many of these industries are located on short line railroads, the currently existing TDOT short line railroad rehabilitation program contributes to their continuing success. Specific new linkages, projects, and intermodal facilities are the subject of analysis in Task 6, *Rail Freight-Intermodal Facility Needs and System Connections.*

There are several implications for the State of Tennessee that result from this assessment of future rail traffic levels and technologies. First is the fact that traffic on the railroads in Tennessee will increase in the future. The basic forecast suggests that by 2020 rail traffic will be 50 percent higher than the levels currently being experienced in the year 2002. Much of this increase will occur by the year 2010. This may well be the minimum level of growth expected on the rail system because the underlying forecasting methodology is predicated on an unconstrained transportation infrastructure. If, as expected, it will continue to be difficult to build substantial new highway capacity, it is inevitable that truck freight will shift to the railroads due to the fact that, in most cases, there is still capacity available on the mainline tracks. Access to the railroads including inadequate intermodal facilities and congestion within existing rail yards may hamper this diversion from truck to rail.

These factors suggest a continuing need for Tennessee to take the appropriate action required to sustain the rail infrastructure. For the short line railroads, this means efficient administration of the TDOT short line railroad rehabilitation program and possibly increased funding. For the Class I railroads, the issue is not maintenance of the mainlines, but rather it is ensuring there is adequate access to the railroads, that

intermodal facilities are properly maintained and developed, and that other system improvements are provided to ensure that the railroad is more user friendly.

The increased levels of traffic leads to a public safety issue focused on the issue of grade crossings. Fifty percent more rail traffic translates into a greatly increased risk. It is clearly not possible for the railroads or the state to eliminate grade crossings or even substantially increase the rate at which at grade crossings are closed. The state must consider lower cost alternatives, such as the IdaShield program, that have been demonstrated to reduce the risk of grade crossing accidents.

Economic Forecasting

Description of Economic Forecasting Model

Data used for the forecasts in this report were developed based on the Federal Highway Administration's (FHWA) Freight Analysis Framework. FHWA has developed this system to:

1. Develop a better understanding of how freight moves,
2. Analyze freight demands and,
3. Address freight movements in a better and more comprehensive manner.

FAF is a methodology to estimate freight flows on the nation's infrastructure. FAF examines four key transportation modes; rail, highway, water and air. It includes economic forecasts for the years 2010 and 2020, which were used in this study and includes volume forecasts for the various modes of transportation.

The economic factors considered in this forecast come primarily from the DRI-WEFA data used by FHWA and others to assist in determining the economic growth in various industries. DRI-WEFA is a full-service economic and information consulting firm providing a broad range of services to more than 1,200 clients. DRI-WEFA forecasts over 90 economies in depth and maintains over 2 million time series, including data on 200 countries. These national economic forecasting models serve as the basis for forecasting trade within and among the countries forecast. For the United States, the forecasts are broken down into nine economic regions plus 20 Metropolitan Statistical Areas (MSAs) to provide inter-regional flows.

The U.S. macroeconomic model is a multiple equation economic model of the U.S. economy. It consists of over 1200 equations and is used by DRI-WEFA to generate the

results of different policy and forecast scenarios. The model is divided into the following eight major sectors:

1. Private Domestic Spending
2. Production and Income
3. Taxes
4. International Transactions
5. Financial
6. Inflation
7. Supply
8. Expectations

Private Domestic Spending components include consumption, investment and government. Consumer consumption is divided into three groups, durable goods, non-durable goods, and services. The Tennessee rail forecast concentrates on the durable and non-durable goods items. Investment is divided into two categories, fixed investment and inventories. Fixed investment is driven by relative prices, financial market conditions and other factors. Whole inventory investment is driven by past and present sales levels and utilization rates.

The government sector is divided into federal government and state and local government. Most of the federal expenditure side is exogenous. Federal receipts are endogenous and divided into personal taxes, corporate taxes, indirect business taxes, and contributions for social insurance. State and local sector receipts depend primarily on federal grants and various tax rates and bases. State and local government spending is driven by legal requirements (i.e., balanced budgets), the level of federal grants (due to the matching requirements of many programs), population growth, and trend increases in personal income.

The production sector includes 74 standard industrial classifications. Pre-tax income categories include private and government wages, corporate profits and interest rates.

The tax component of the model tracks corporate, personnel, payroll and excise taxes separately. The model adjusts the average personal tax rate for variations in inflation and income per household as well as adjusting the corporate rate for credits earned on equipment and research and development.

The international sector either adds or diverts strength from the central flow of domestic income and spending depending on various factors such as price of foreign output, U.S. exchange rate and competing domestic prices. Exports' portion of

domestic spending depends on similar variables and the level of world gross domestic product. The exchange rate itself responds to international differences in inflation, interest rates, trade deficits, and capital flows between the U.S. and its competitors. Investment income flows are also explicitly modeled.

The financial components of the model consider several short- and long-term interest rates. The short-term interest rates depend upon the balance between the demand and supply of reserves in the banking system. Longer-term interest rates are driven by shorter-term rates as well as inflation expectations, government borrowing expectations and corporate finance needs.

The inflation model is structured as a controlled interactive process involving wages, prices and market conditions. The principle domestic cost influences are labor compensation, non-farm productivity and foreign input costs.

The supply model is estimated by combining factor input growth and improvements to productivity. Many factors, such as average of labor, business fixed capital, and energy are taken into consideration.

Expectations impact several expenditure categories in the model but the most important category is the entire spectrum of interest rates. Shifts in price expectations or government capital needs influence this model.

Using these factors to predict future conditions, the FHWA, using more specific assumptions listed below, has projected future rail freight trends. The specific economic expectations considered are described below.

Economic Assumptions Used in Macroeconomic Modeling

In general, the Gross Domestic Product (GDP) is expected to grow at a rate of 2.3 percent per year over the course of the projection period (2000-2020). This growth rate is somewhat slower than the 3.0 percent growth rate seen during the 1960s. Real business growth is assumed to average 3.9 percent through 2004. Growth is then projected to slow to an average of 2.9 percent through the year 2025. Real growth is assumed to grow at an average 3.1 percent for the entire 25-year period. Inflation will average 2.5 percent per year over the same time frame.

Long-term interest rates are assumed to average 2.6 percent over the 25-year period, which is slightly lower than the 1999 long-term rate of 3.7 percent.

Industrial production is assumed to rise at 3.1 percent per year, powered mainly by the computer industry. Steel production will barely rise due to competition from other materials such as ceramics. Lumber, glass and other building products will see slower growth compared to other sectors due to the projected down turn in residential and non-residential construction.

Paper and plastics will lead other non-durable goods with an assumed growth rate 3.0 percent for the period. Plastics will benefit from technology, which is finding more uses for plastics, but may be limited by environmental concerns at some point in the future.

Chemical and paper products are assumed to grow with the rise in exports while the textile and apparel industries will lag with a growth rate of only 1 percent for the period.

Energy prices are expected to remain relatively stable over the next few years but oil prices will gradually increase over the next 25 years.

Freight Analysis Framework

The FAF work product relies on state of the art econometric forecasting and transportation modeling processes. The freight forecasts developed for the FAF are based on Regional Economic Forecasts for the United States that have been developed by DRI-WEFA.

Using the forecasting model of the U.S. economy, WEFA has developed for FHWA regional freight flow forecasts for the years 2010 and 2020 at the two-digit STCC commodity code level using historical commodity flow and transportation data developed by Reebie Associates in tons. WEFA then projected future baseline demand for freight transportation based on its econometric forecasts for the U.S. using WEFA's U.S. national, U.S. industry (covering 430 industrial sectors), U.S. regional, and world trade forecasts.

Reebie Associates has compiled a vast commodity flow database from many sources including the 1 percent waybill sample and the commodity flow surveys. Reebie further refined the inter regional cargo forecast data using its state of the art national cargo flow model that is based in part on work developed by the Oak Ridge National Laboratories Center for Transportation Analysis to develop the detailed state to state forecasts. This database represents a best estimate of the flow of commodities over the nation's transportation network.

This forecasting database includes the data developed as a part of the Latin American Trade and Transportation Study by Wilbur Smith and Associates. FHWA is currently preparing documentation detailing the procedures used to incorporate the LATTS database. There are certain key assumptions that serve as the basis for development of these forecasts:

- Transportation supply is unconstrained.
- Mode share is not constrained at the top level.
- Changes in geographic location of production and consumption affect overall mode shares.
- Shifts in commodity mix also affect overall mode shares.

The forecast commodity flows were then processed by Reebie Associates using the 1998 mode share data by commodity group to develop commodity flow forecasts by mode and were assigned to the existing transportation network. The resulting forecasts are at the two-digit STCC commodity level. This release contains an extensive package of data, including the following information:

1. Total Domestic and International State Traffic, by mode, originating in and destined for Tennessee by tonnage, value, and ton-miles.

2. Total Domestic and International State Traffic by region, by mode, originating in and destined for Tennessee by tonnage, value, and ton-miles.

3. Total International Traffic by mode for Canada, Mexico, Europe, Asia, and the rest of the world by mode originating in and destined for Tennessee by tonnage, value, and ton-miles.

4. Commodity Detail by mode used, interstate, domestic, and international, by tonnage, value, and ton-miles.

Rail Traffic Summary

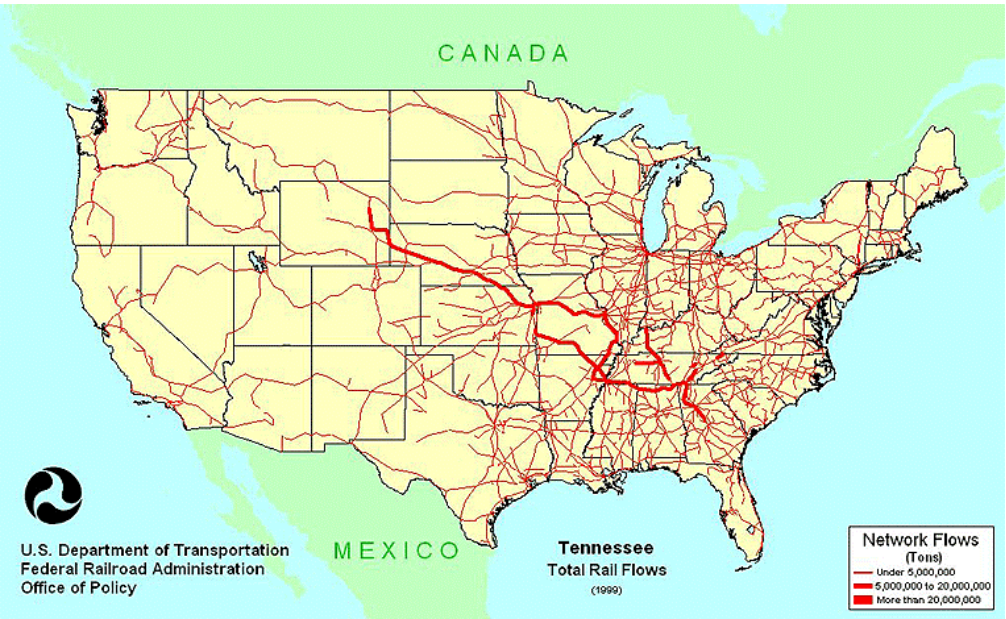
Overview of Rail Freight

The rail freight database created by the FAF has been used to create density maps detailing the flow of cargo on the nation's railroads. The maps have been developed to highlight the geographical relationships of freight transportation. Most traffic moves

within a state or to neighboring states, but traffic moves throughout the United States. Each map shows the freight traffic originating in and destined for the individual states.

The maps below show rail freight flows for Tennessee and the states bordering Tennessee for the year 1999.

Map 1
Tennessee Rail Flows



Map 2
Alabama Rail Flows

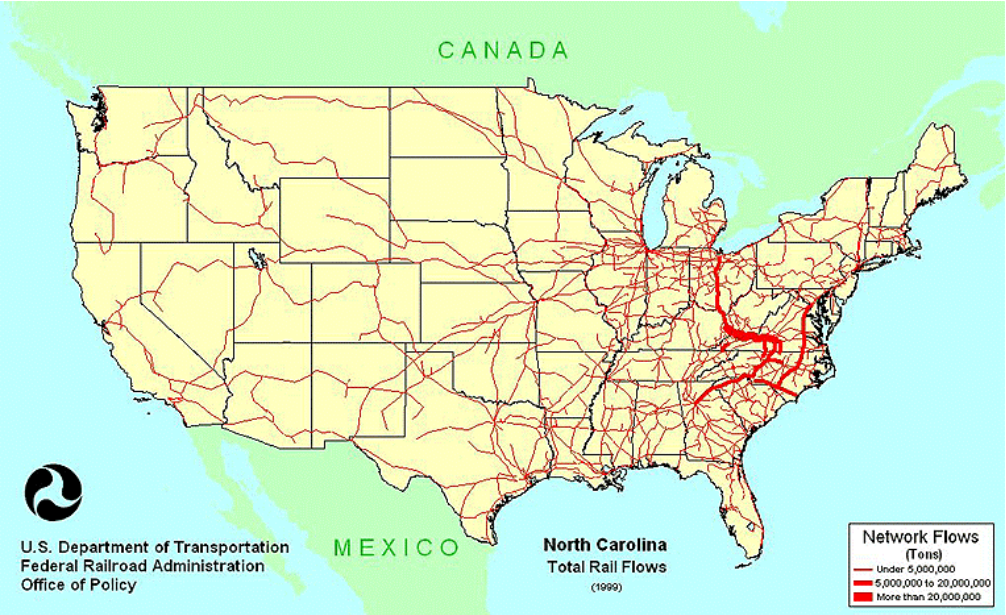
Map 3
Arkansas Rail Flows

Map 4
Georgia Rail Flows

Map 5
Kentucky Rail Flows

Map 6
Mississippi Rail Flows

Map 7
North Carolina Rail Flows



Map 8
South Carolina Rail Flows

Map 9
Virginia Rail Flows

Domestic Rail Freight Outbound From Tennessee

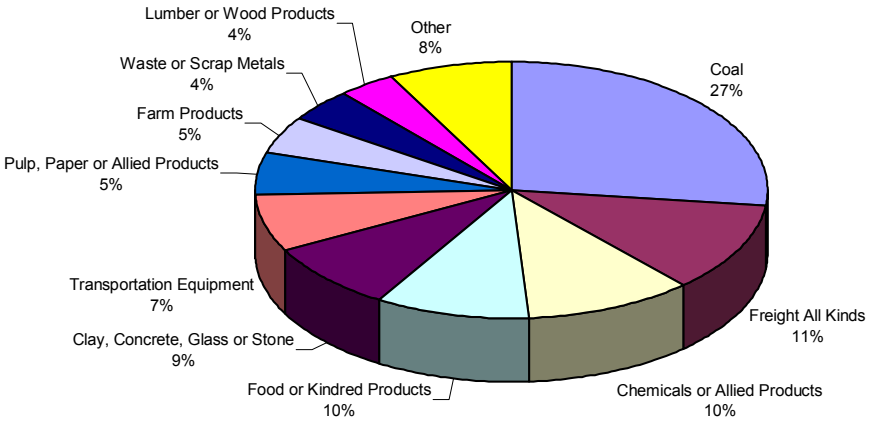
1998 to 2005

Rail freight originating in Tennessee and bound for points within the U.S. is projected to grow by 22 percent between the years 1998 and 2005. In terms of total volume of freight, coal will continue to be the major commodity exported by rail. It will grow by 13 percent to total approximately 9 million tons in 2005. Food products, chemicals and clay/glass/stone will be the next largest exports in terms of volume with approximately 3.5 million tons each in 2005.

When considering percent of growth for different commodities of significant volume (over 1 million tons in 1998), clay/glass/stone will lead the increase with an expected growth rate of 40 percent. Following clay/etc will be general freight, waste or scrap metal, lumber, transportation equipment, pulp/paper and food products, all of which will have growth rates of 20 percent or more. Other commodities will grow at relatively higher rates but also have relatively small volumes.

Figure 1

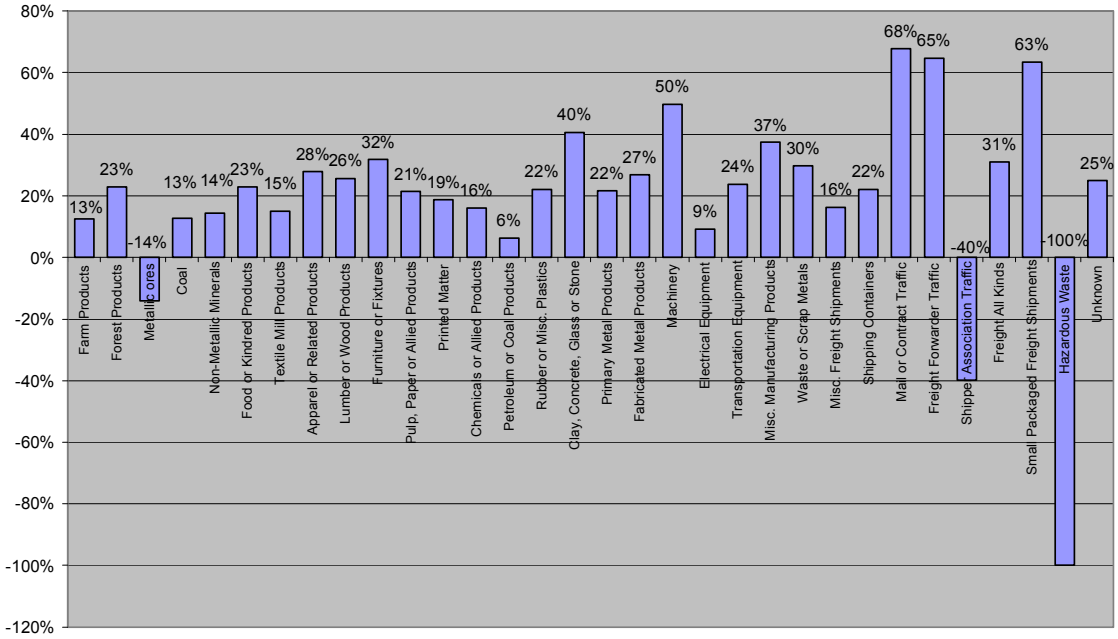
1998 Outbound Freight by Commodity (Over 1,000,000 Tons)



Certain commodities are expected to shrink over this period. Chief among them is metallic ores, which is expected to shrink by 14 percent to only 1108 tons in 2005. Shipper Association traffic will diminish by 40 percent to 26,000 tons. Other commodities will have minimal growth. Petroleum and coal products and electrical equipment will grow at less than 10 percent while other small volume commodities will grow in widely spread ranges. Primary metal products will grow into the 1 million ton per year category, growing by 22 percent. No other product will reach that export level in the 20-year time period covered by this projection.

Figure 2

Growth in Outbound Freight by Commodity
1998-2005

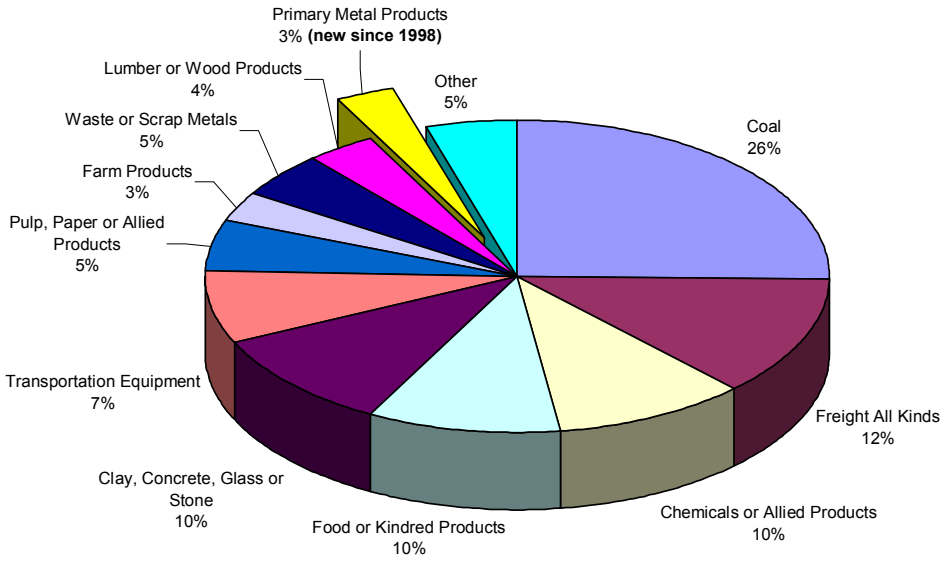


2005 to 2010

The overall growth rate for all commodities is projected to be 15 percent between the years 2005 and 2010. As in 1998, coal shipments will be the largest volume commodity exported by rail from Tennessee. No other commodity is expected to grow into the 1 million ton category. In fact, all other commodities (20 in all) will make up only 5 percent of the total volume exported by rail.

Figure 3

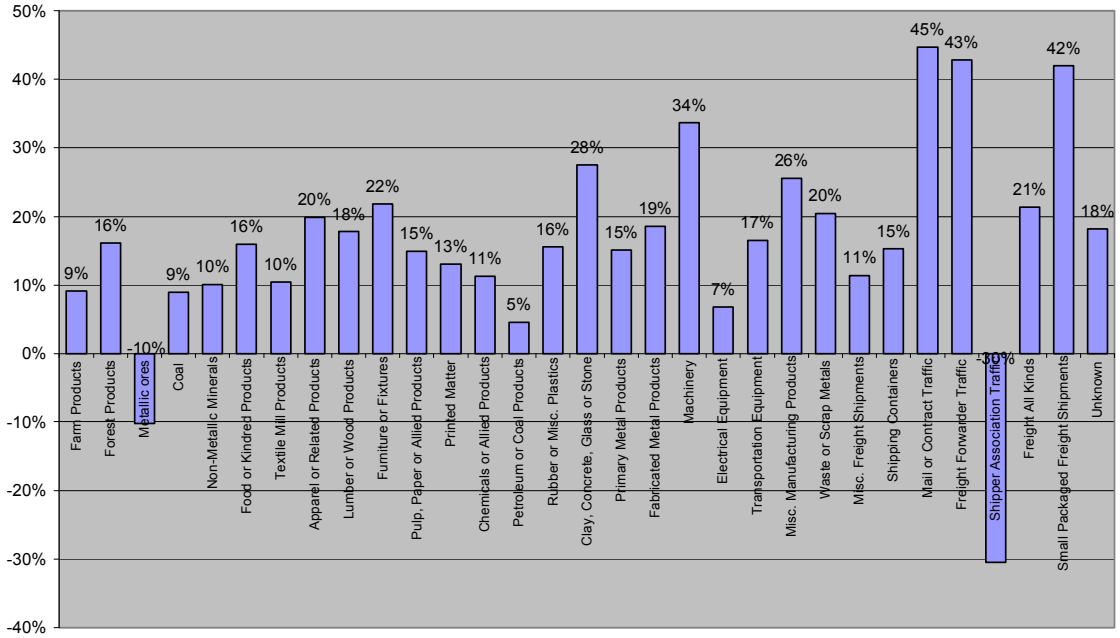
2005 Outbound Freight by Commodity (Over 1,000,000 Tons)



The trends found in the period from 1998 to 2005 will continue during 2005 to 2010. Coal will remain as the largest commodity exported by rail and will see continued growth in the 9 percent range. Metallic ores and shipper association traffic will continue their decrease with additional losses of 10 percent and 30 percent, respectively.

Figure 4

Growth in Outbound Freight by Commodity 2005-2010

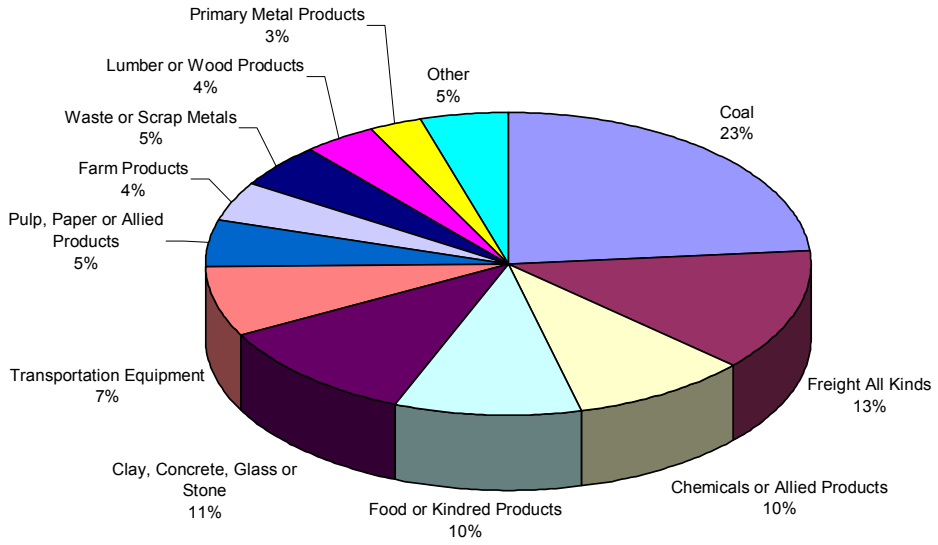


2010 to 2020

In the period from 2010 to 2020, outgoing rail freight is projected to grow at an overall rate of 22 percent when compared to 2010. Coal will stay as the dominant commodity but will fall in terms of market share from 26 percent in 2005 to 20 percent in 2020. This will result from, not decreases in coal exports, but from larger percent increases in food and clay, concrete, glass and stone exports.

Figure 5

2010 Outbound Freight by Commodity (Over 1,000,000 Tons)



Food products will continue to grow at a rapid pace (50 percent). Other high volume/high growth rate goods will be pulp/paper products, clay/glass/stone and general freight. Metallic ores shipments are predicted to continue their decrease and will reach an export level of 900 tons in 2020. Shipper Association traffic and miscellaneous freight will also decrease. Coal will still be the most common commodity with a volume of 10.5 million tons but will show a growth of only 5 percent over the 10-year period.

Figure 6

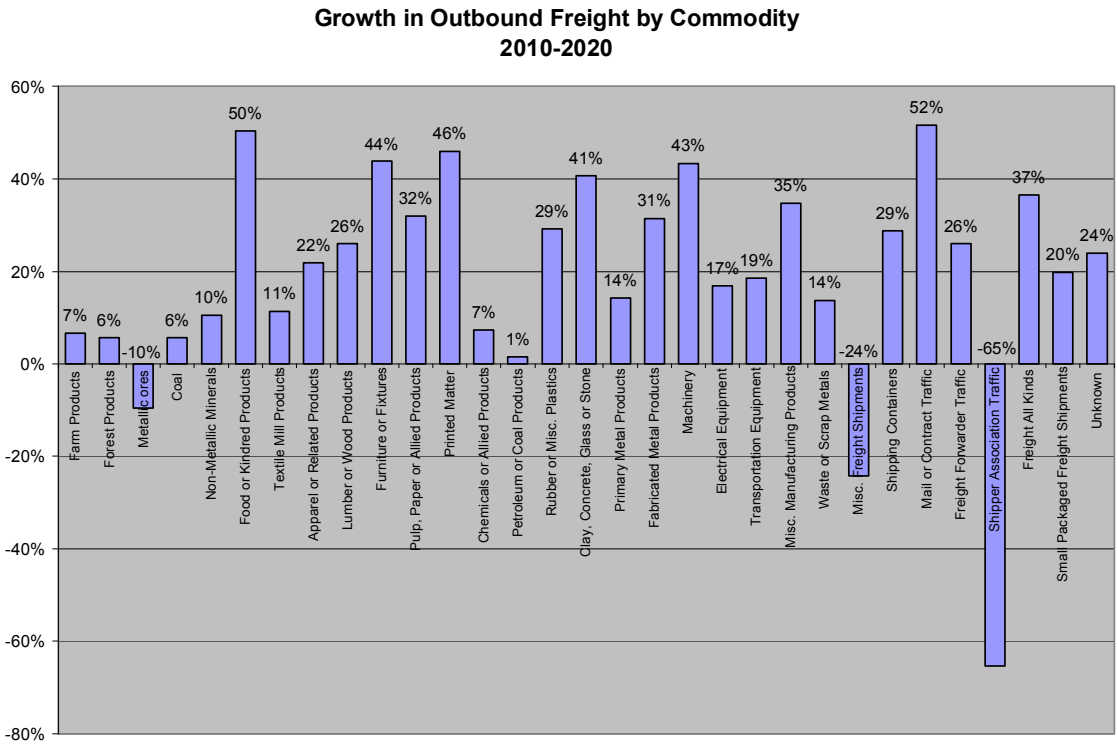
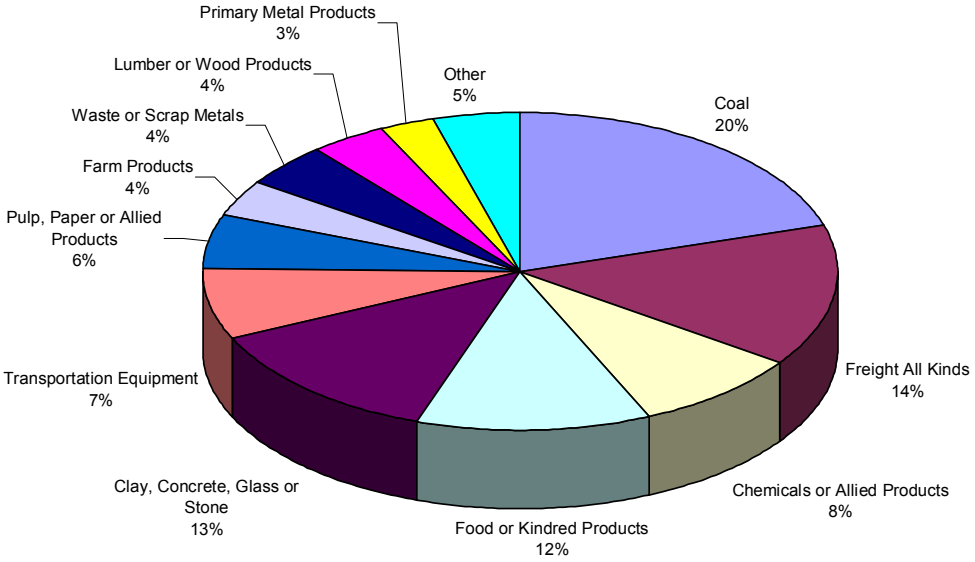

Growth in Outbound Freight by Commodity
2010-2020
60%
40%
20%
0%
-20%
-40%
-60%
-80%
7%
6%
-10%
6%
10%
50%
11%
22%
26%
44%
32%
46%
7%
1%
29%
41%
14%
31%
43%
17%
19%
35%
14%
-24%
29%
52%
26%
-65%
37%
20%
24%
Farm Products
Forest Products
Metallic ores
Coal
Non-Metallic Minerals
Food or Kindred Products
Textile Mill Products
Apparel or Related Products
Lumber or Wood Products
Furniture or Fixtures
Pulp, Paper or Allied Products
Printed Matter
Chemicals or Allied Products
Petroleum or Coal Products
Rubber or Misc. Plastics
Clay, Concrete, Glass or Stone
Primary Metal Products
Fabricated Metal Products
Machinery
Electrical Equipment
Transportation Equipment
Misc. Manufacturing Products
Waste or Scrap Metals
Misc. Freight Shipments
Shipping Containers
Mail or Contract Traffic
Freight Forwarder Traffic
Shipper Association Traffic
Freight All Kinds
Small Packaged Freight Shipments
Unknown

Figure 7

2020 Outbound Freight by Commodity (Over 1,000,000 Tons)



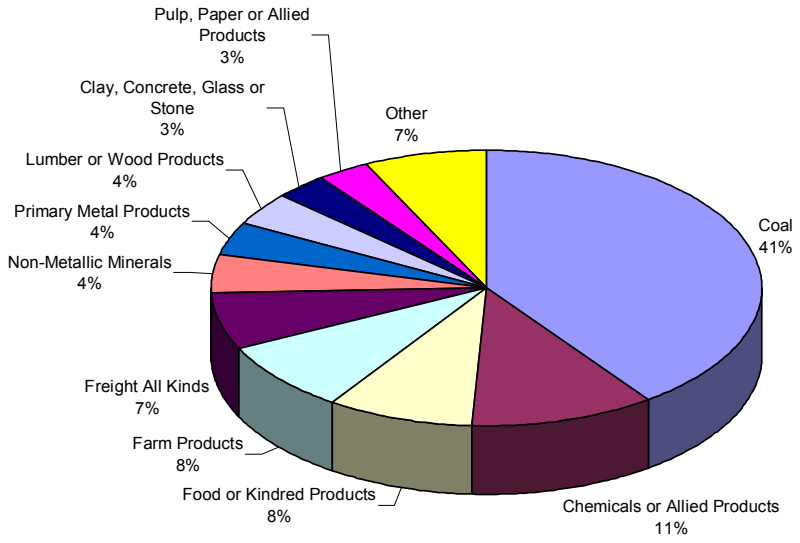
Domestic Rail Freight Destined for Tennessee

1998 to 2005

Rail freight destined for Tennessee is projected to grow 17 percent from 1998 to 2005. As with outbound traffic, coal is, by far the most common commodity. It accounts for roughly 18 million of the 45 million tons of inbound freight carried by rail in Tennessee. Chemicals, food, farm products and general freight make up the bulk of the other commonly imported commodities imported into Tennessee.

Figure 8

1998 Inbound Freight By Commodity (Over 1,000,000 Tons)

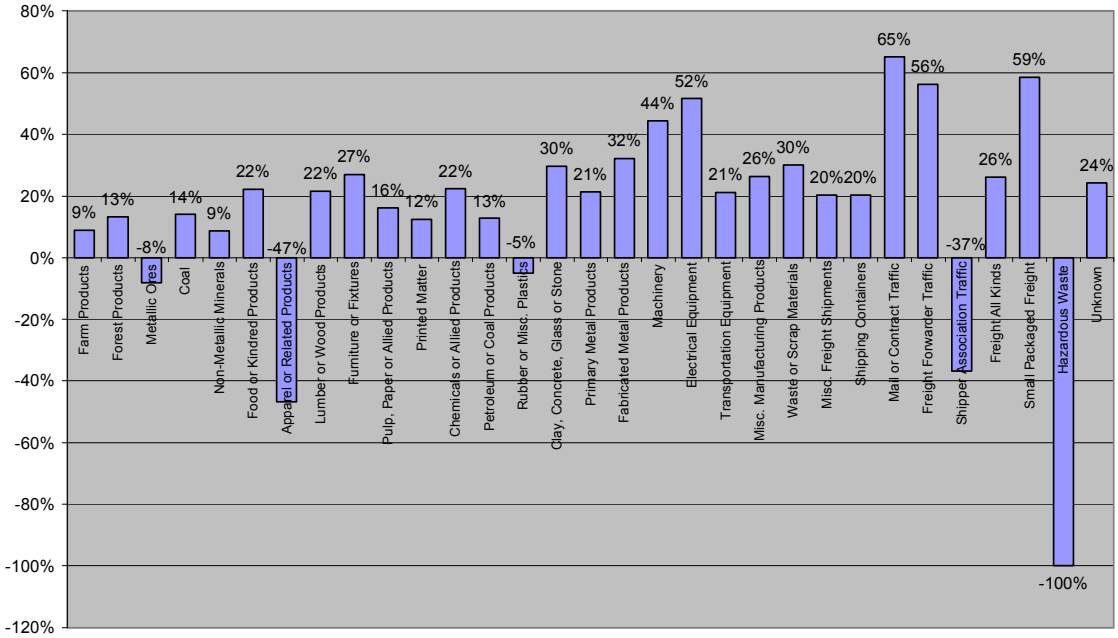


Coal imports are projected to grow by 14 percent by 2005. Clay/glass/stone will be the import that will see the largest percent increase of the commodities that have large volumes coming into the state (over 1 million tons per year in 1998). Food products, lumber, chemicals, primary metal products, and general freight will see increases in the 20 percent range. Electrical equipment will see the largest growth rate of the individual commodities (50 percent) in the 1998 to 2005 time frame.

As with exports, metallic ores and Shippers Association traffic will see real declines from 1998 levels. Apparel and related products will also decline dramatically (47 percent) to 4258 tons in 2005. Commodities with less than average growth will consist mainly of rubber, nonmetallic minerals, and farm products.

Figure 9

Growth in Inbound Freight by Commodity
1998-2005

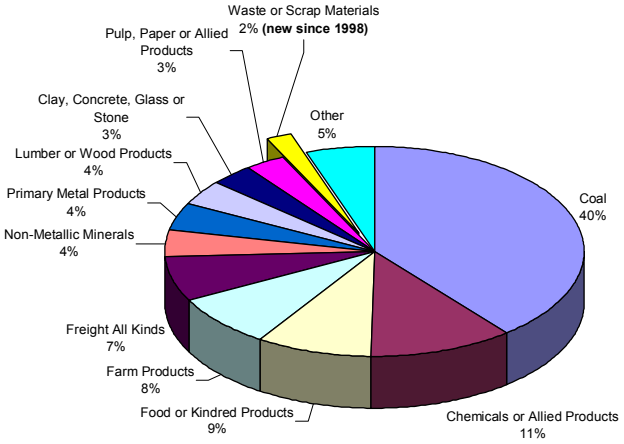


2005 to 2010

Overall imports coming into Tennessee by rail will increase by 12 percent reaching almost 60 million tons by 2010. Waste and scrap material will reach the 1 million ton mark by 2005 joining the other ten commodities at the one million ton level. These eleven commodities account for 95 percent of all rail imports in 2005.

Figure 10

2005 Inbound Freight by Commodity (Over 1,000,000 Tons)

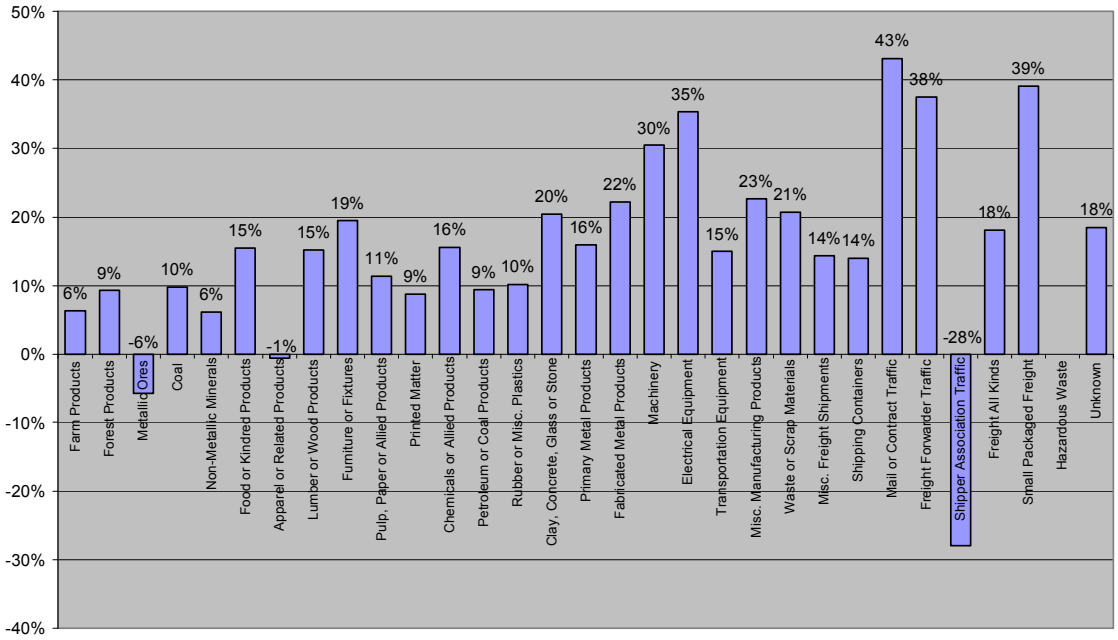


Of the large import commodities, furniture and clay/etc will lead the way with percentage increases of about 20 percent. All other large volume commodities will increase but at lower than a 20 percent rate.

Metallic ores and Shipper Association traffic will continue their downward trend but will account for less than one half of one percent of all freight.

Figure 11

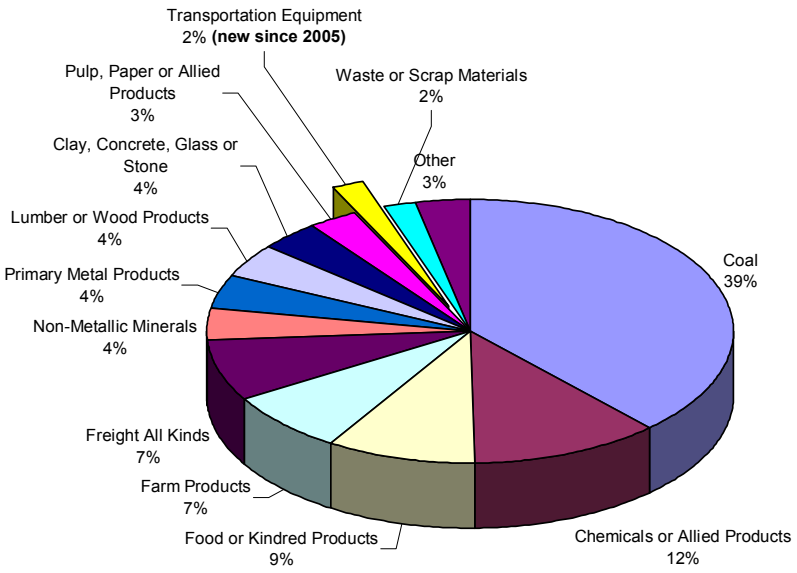
Growth in Inbound Freight by Commodity 2005-2010



Transportation equipment is projected to continue its fast growth rate and should over take waste or scrap metal in terms of volume imported. It is forecast to reach the 1 million ton level in 2010. Twelve products will now make up 97 percent of the commodities imported by rail by 2010.

Figure 12

2010 Inbound Freight by Commodity (Over 1,000,000 Tons)



2010 to 2020

The period from 2010 to 2020 will see an average growth of only 16 percent. This lack of growth is due mainly to a 10 percent growth in the coal sector which accounts for over one third of all import train traffic in 2020. Other commodities will see substantial growth rates. Food products will make large gains and will be come equal to chemicals in terms of volume of freight imported. Mail or contract freight, fabricated metal products and printer matter will see substantial growth rates. Most of the other small volume commodities will continue a steady growth pattern in the 20 to 30 percent range.

Shippers' Association traffic and metallic ores are forecasted to continue their downward trend with loss rates of 64 percent and 18 percent respectively. Miscellaneous freight shipments and forest products will also see negative growth while food products, after a substantial growth rate from 1998 to 2010 will stay flat.

Figure 13

Growth in Inbound Freight by Commodity
2010-2020

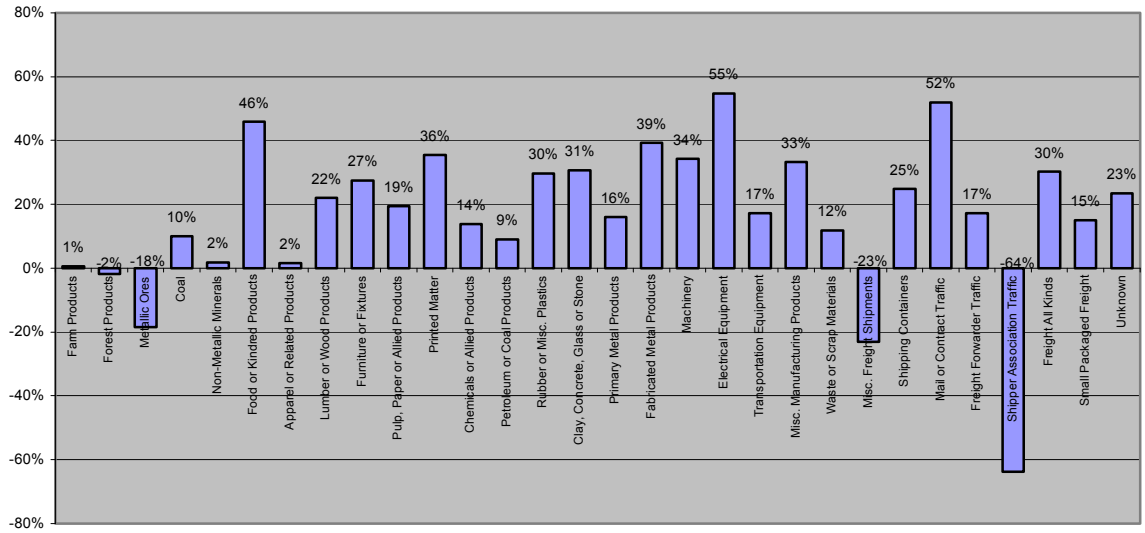
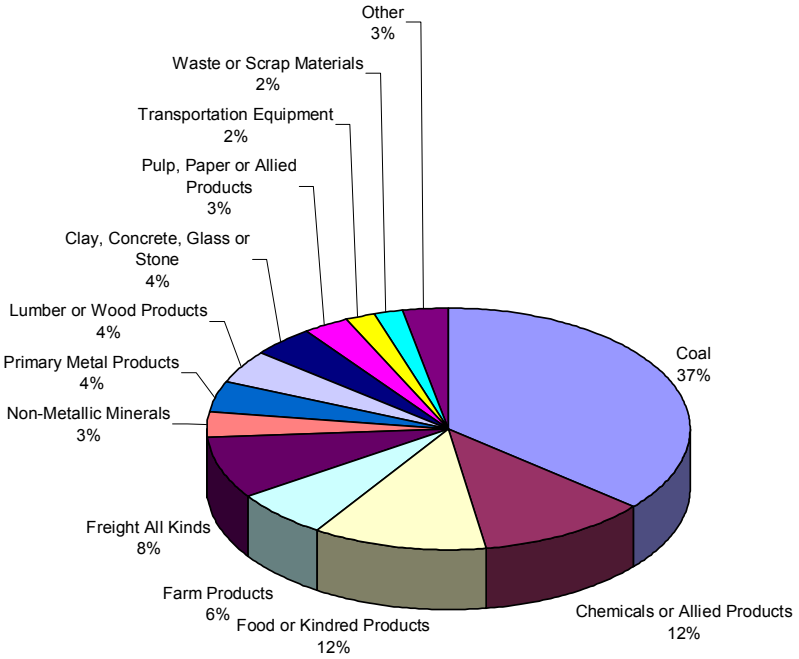


Figure 14

2020 Inbound Freight by Commodity (Over 1,000,000 Tons)



Tables 1 and 2 provide detail on both the individual commodities destined for and originating in Tennessee.

Foreign Trade Cargoes Traveling to or from Tennessee by Rail

International cargoes are those cargoes moving out of and into Tennessee from foreign (non-U.S.) destinations and origins.

International Rail Freight Exports from Tennessee

1998 to 2005

International exports using rail are projected to increase by 42 percent between 1998 (4.8 million tons) and 2005 (6.8 million tons).

Farm products are, by far, the most common commodity exported, at least partially, by rail in terms of volume. In 1998, almost 3 million tons were exported, half of which went to Asia and almost one fourth went to Latin America. Farm products are expected to grow by 44 percent between 1998 and 2005 to more than 4.3 million tons per year. Food products are the second largest exported commodity totaling just over 500,000 tons in 1998. The bulk of the food products are shipped to Latin America, Europe and Asia. This volume is expected to increase by 39 percent to just over one half million tons by 2005. Chemicals, pulp/paper, nonmetallic minerals and transportation equipment are the other commodities that are exported in significant amounts.

Figure 15

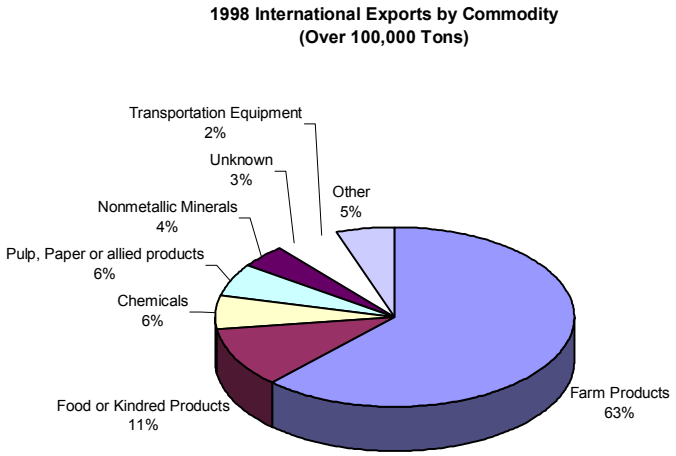
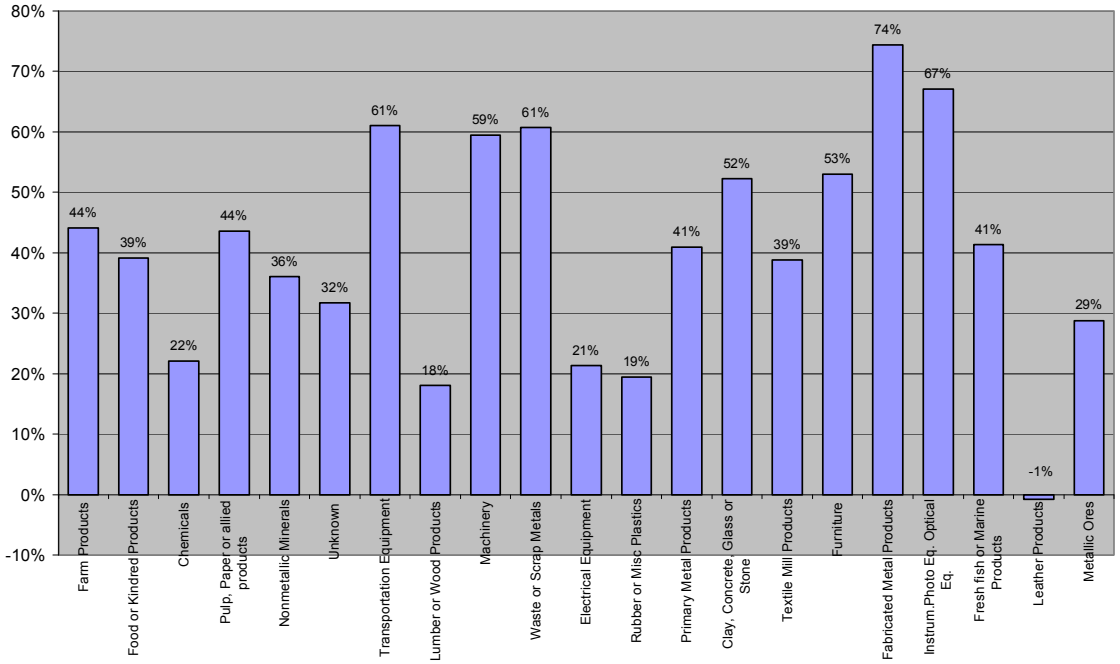


Figure 16

Growth in International Exports by Commodity 1998-2005



All of these commodities are expected to continue to grow at significant rates in the coming years. Transportation equipment will show a 61 percent increase rising to over 180,000 tons, pulp will grow by 44 percent, nonmetallic minerals will grow at a 36 percent rate while chemicals will see a 22 percent growth rate. While fabricated metal products has a relatively small volume (3,872 tons in 1998) it will see large growth rates of 74 percent in this time period while instruments/optical equipment, also a small volume commodity, will grow at a 67 percent rate.

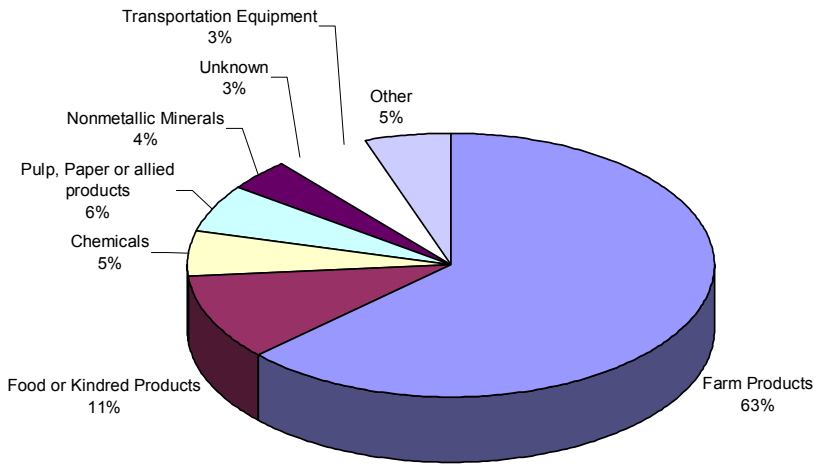
Only leather products are expected to decrease in the 1998 to 2005 timeframe.

2005 to 2010

Farm products will continue to lead the export commodities with a 63 percent share of the export volume. Exported commodities will grow by an average of 29 percent. No new commodities will break the 100,000 level in 2005.

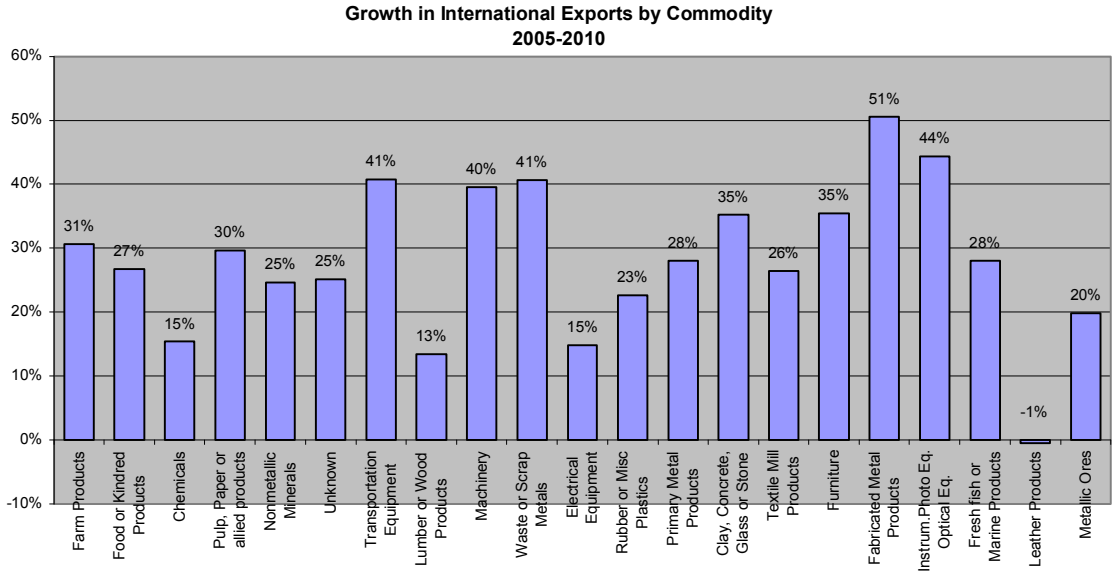
Figure 17

2005 International Exports by Commodity (Over 100,000 Tons)



Transportation equipment will lead the major exports in terms of growth with a 41 percent growth rate followed by pulp/paper and food products which will both see a 44 percent gain. Among the smaller volume commodities, fabricated metal products will se the largest percentage (51 percent) followed by instruments/ optical equipment. Only leather products will see a decrease.

Figure 18


Growth in International Exports by Commodity
2005-2010
60%
50%
40%
30%
20%
10%
0%
-10%
31%
27%
15%
30%
25%
25%
41%
13%
40%
41%
15%
23%
28%
35%
26%
35%
51%
44%
28%
-1%
20%
Farm Products
Food or Kindred Products
Chemicals
Pulp, Paper or allied products
Nonmetallic Minerals
Unknown
Transportation Equipment
Lumber or Wood Products
Machinery
Waste or Scrap Metals
Electrical Equipment
Rubber or Misc Plastics
Primary Metal Products
Clay, Concrete, Glass or Stone
Textile Mill Products
Furniture
Fabricated Metal Products
Instrum.Photo Eq. Optical Eq.
Fresh fish or Marine Products
Leather Products
Metalic Ores

2010 to 2020

Growth from 2010 to 2020 will average 47 percent with farm products remaining as the leading export and Asia remaining as the most common destination. Farm products will grow at a 53 percent rate which, besides transportation equipment, will be the highest growth rate seen among the most common exports. In general, the leading commodities from 2010 will still lead, in terms of volume exported using rail.

Several smaller exports will see a decrease in 2020, the largest decrease (6 percent) coming in the rubber and leather products area.

Figure 19

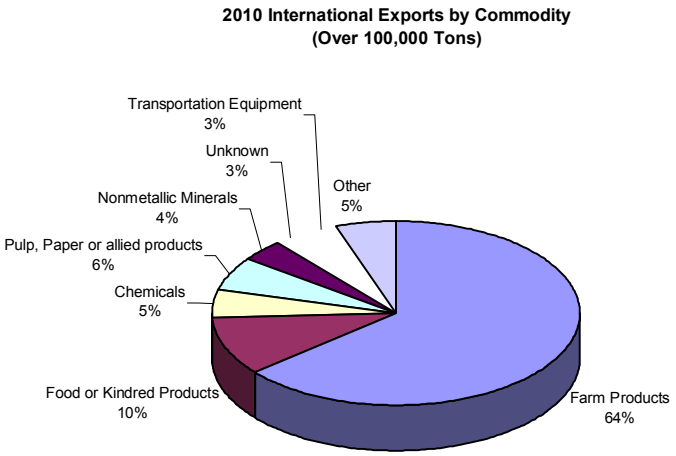


Figure 20

Growth in International Exports by Commodity 2010-2020

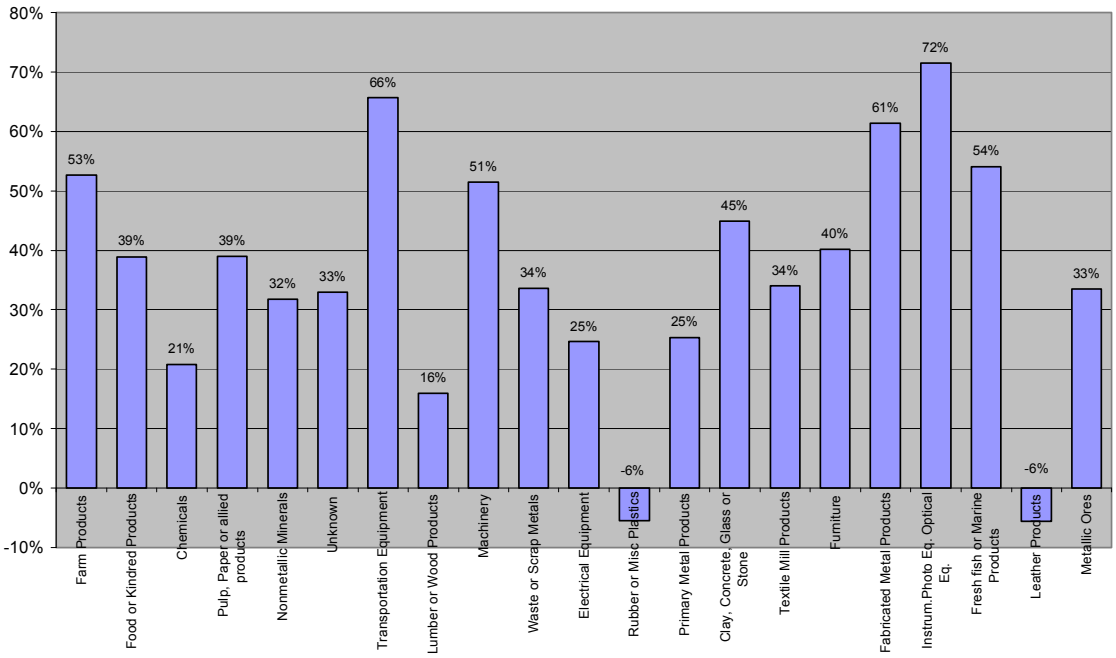
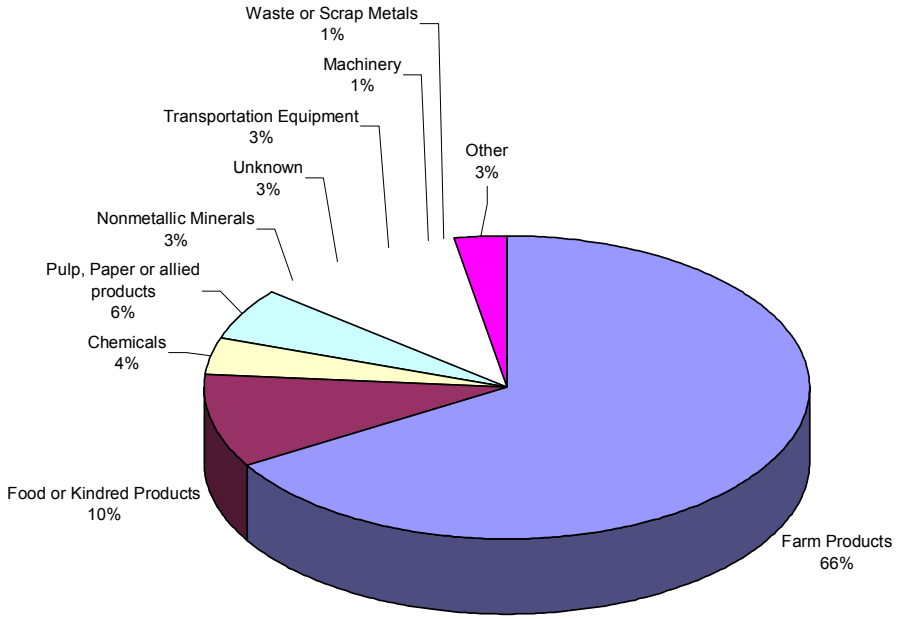


Figure 21

2020 International Exports by Commodity (Over 100,000 Tons)



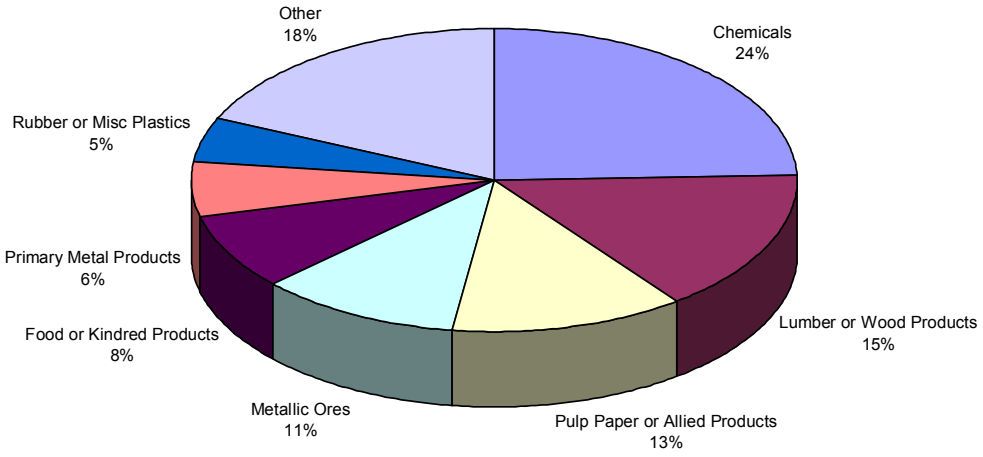
International Rail Import Freight to Tennessee

1998 to 2005

Imports are expected to rise by 38 percent between 1998 and 2005 from 2.4 million tons to 3.3 million tons. Chemicals are the most prevalent import totaling 584,000 tons in 1998 and are expected to grow by 40 percent to just over 800,000 tons in 2005. Lumber and pulp/paper products follow behind with roughly 370 million and 300 million tons each, respectively in 1998. Metallic ores, food products, rubber or plastic and primary metal products are the other most common imports using rail. All these commodities will see substantial growth in the next ten years with lumber or wood products leading the way with an anticipated growth rate of 51 percent and primary metal products at a still respectable growth rate of 31 percent. The other large volume commodities fall somewhere in between.

Figure 22

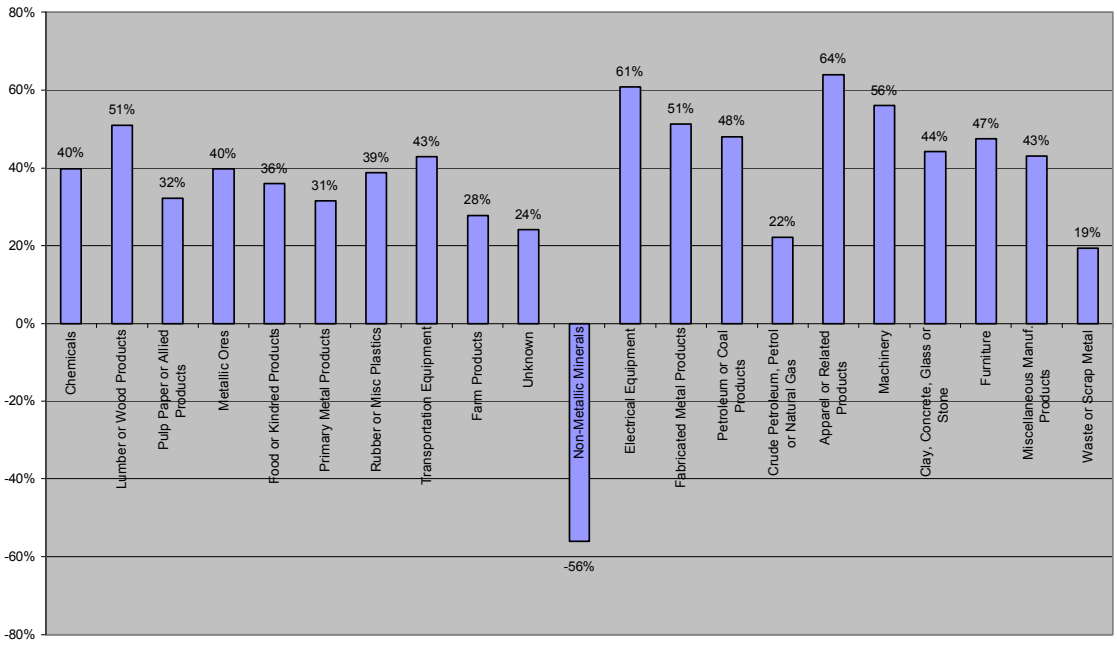
1998 International Imports by Commodity (Over 100,000 Tons)



Among the small volume imported commodities, electronic equipment and apparel will see the fastest growth with growth rates reaching above 60 percent. Nonmetallic minerals will see the only decrease, falling by 56 percent.

Figure 23

Growth in International Imports by Commodity 1998-2005

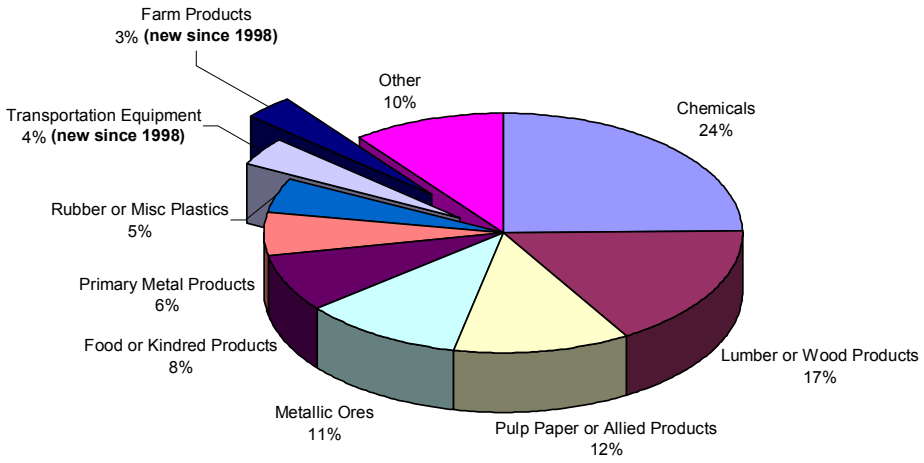


2005 to 2010

Overall imports will increase by 29 percent from 2005 to 2010. Farm products and transportation equipment will reach the 100,000-ton level by 2010. Chemicals will reach the 1 million ton level and will still be, by far the most common rail import, making up 24 percent of the total imports. Most imports are projected to maintain their relative status and will see volume increase without any major surprises.

Figure 24

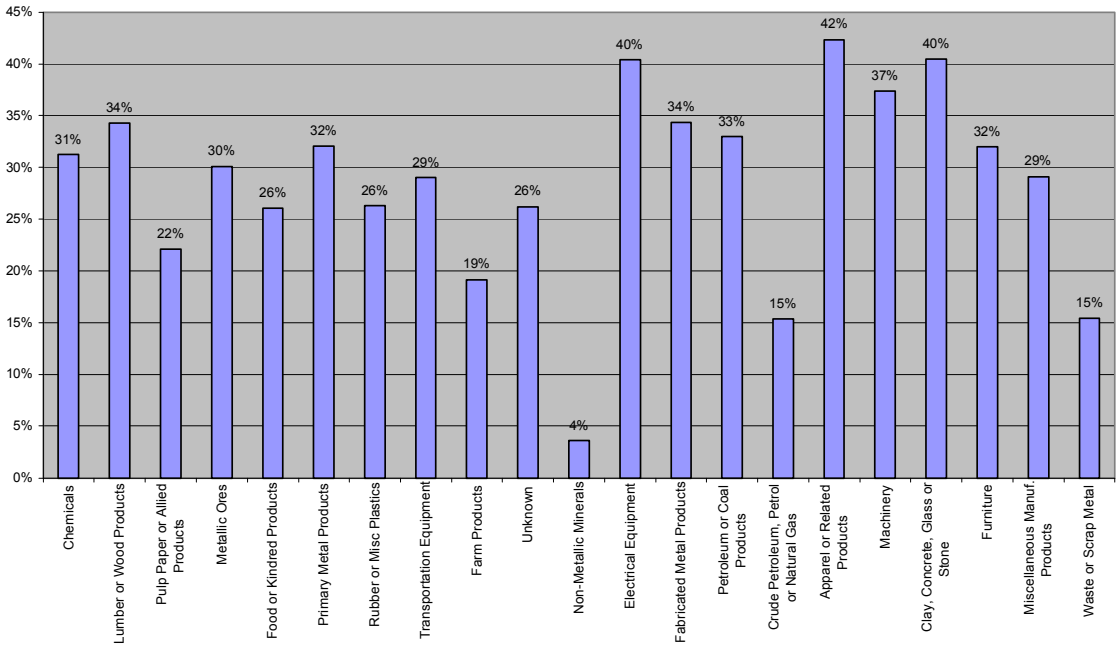
2005 International Imports by Commodity (Over 100,000 Tons)



All the major commodities will continue adequate growth in the 30 percent range with the exception of pulp/paper products, which is forecast to see a 22 percent growth rate. Electrical equipment and apparel will see growth rates in the 40 percent range as will clay/concrete/glass/stone.

Figure 25

Growth in International Imports by Commodity 2005-2010

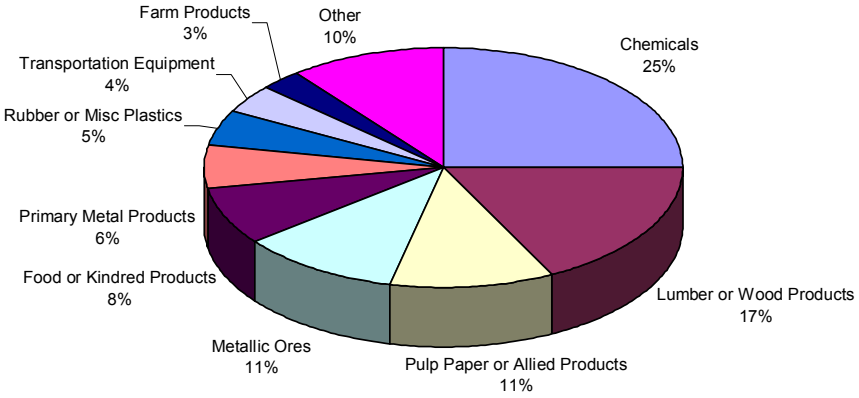


2010 to 2020

Imports will grow another 56 percent from 2010 to 2020. The same commodities will lead the import sector in 2020 as led in 2010. Chemicals will still be the leading import but will be followed closely by lumber/wood products, which will enjoy a 63 percent increase over 2010 levels. This increase will bring lumber/wood imports above the 1 million ton mark. All other commodities will remain substantially below that mark.

Figure 26

2010 International Imports by Commodity (Over 100,000 Tons)



Nonmetallic minerals, mostly from Canada will drastically decrease. Projections show overall imports of this commodity dropping by 47 percent from 2010 to 2020 (7,000 tons). Waste or scrap metal from Canada will drop by 23 percent but the overall imports of waste metal will still see an increase of 30 percent. This is due mainly to a large increase in imports from Europe.

Figure 27

Growth in International Imports by Commodity 2010-2020

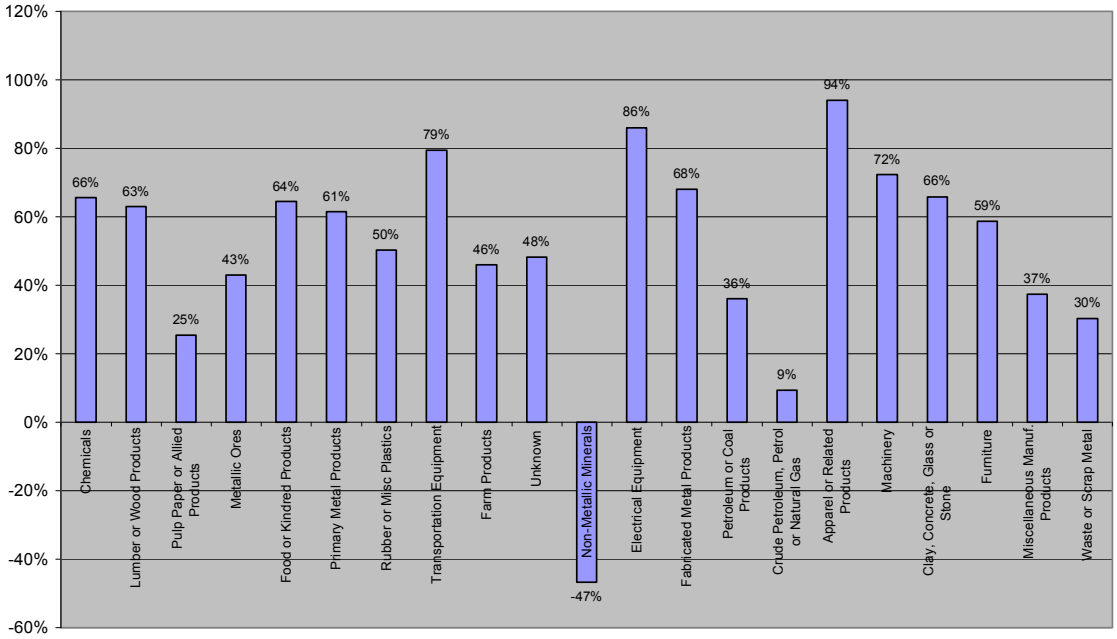
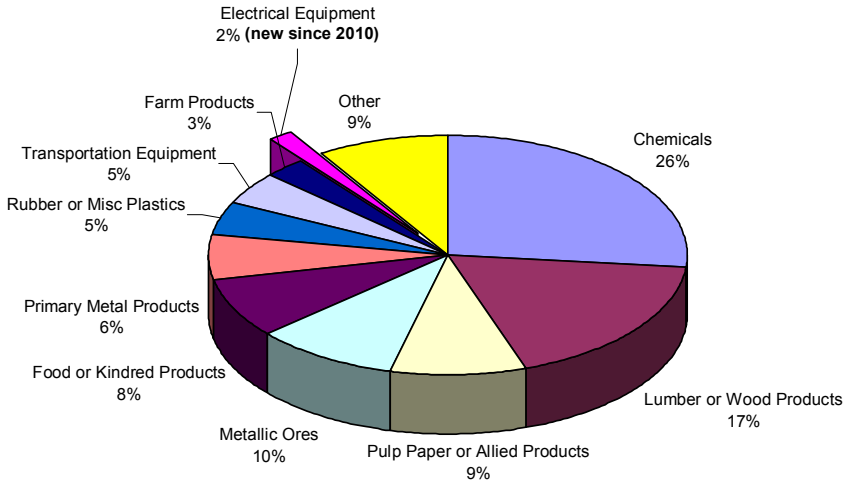


Figure 28

2020 International Imports by Commodity (Over 100,000 Tons)



Summaries showing the individual commodity, the import/export level in 1998 and the projected levels in 2010 and 2020 for U.S. export and import commodities moving by rail with origin or destination in Tennessee appear as Tables 3 and 4.

Forecasting Rail Freight Flows on the Proposed All-Tennessee East-West Rail Corridor

The objective of this section is to develop a forecast of the potential use of the all-Tennessee east-west rail link that would be created by reconstruction or restoration of an abandoned rail link between Algood and Oliver Springs, Tennessee. A fundamental assumption used in this analysis is that the primary source of the cargo that might be diverted to the east-west rail link would be the cargoes currently moved by truck on I-40 to an intermodal rail service, or an all rail service. One expected benefit of the creation of an all-Tennessee east-west rail link is that it would serve to divert cargoes now carried by truck on I-40 to rail, thereby reducing truck traffic in both directions on I-40 between Nashville and Knoxville. Another potential benefit to would provide east and west rail service to industries located on those portions of the Cumberland Plateau that do not now have such service or to provide improved service.

To develop an estimate of the potential shift of cargoes now moving by truck to a newly created rail link it is necessary to understand the types and volumes of all truck freight traffic currently moving in both directions on I-40 between Nashville and Knoxville. It is also necessary to identify the origins and destinations of these cargoes. It is well understood in goods movement industry that the distance freight moves is critical to the choice between the truck and rail modes and thus, knowledge of the distance the cargo moves permits better assessment of the likelihood that it can be shifted to rail. It is generally accepted in the freight community that, for most cargoes, a minimum shipment distance of 400 miles is necessary before most truck traffic will be considered due to economic or cost reasons for shipment by rail.

The fact that there are modal choices requires a consideration of the potentially competing roadway and intermodal rail systems not only within Tennessee but beyond the Tennessee borders in order to understand the alternatives for routing the I-40 cargo that currently exist. In this analysis, the basic information on truck traffic has been supplemented by an assessment of the alternative and competitive routes that now exist for the truck cargoes now transiting the I-40 corridor. Correspondingly, information was developed from transportation users and providers who control the routing of this freight traffic.

The development of the data, the analysis of the data, and the competitive assessment of the all-Tennessee east-west rail link are presented in the sections that follow.

Choice of Analytic Approach

Much of the data used in the forecasting developed in the Freight Movement Inventory and Future Demand Analysis is based on the highly detailed Freight Analysis Framework developed by the Federal Highway Administration. The forecast methodology used in the FAF approach, is based on an analysis of historical cargo flows. It assigns forecast cargo flows to existing modes of the national transportation system, based on the historical patterns. This information is not adaptable to an analysis of the potential freight flow over an entirely new link, such as the proposed east-west corridor. The Contractor Team has discussed this issue extensively with FHWA, Oak Ridge National Laboratory (ORNL) staff, and DRI-WEFA. There are two approaches available: extensive modeling and detailed market analysis.

The modeling approach would require use of an existing network model that would be modified by the introduction of a new corridor, in this case the east-west connection. The analytic process would include consideration of the origin and destination of currently modeled highway traffic flowing over a parallel route, in this case I-40, and using algorithms, modeling the potential share of this freight that might be carried by rail. The process would then continue by increasing, in the modeling process, the impedances of the highway freight flows, essentially forcing cargoes on to the new east-west rail route. It is our opinion, based on extensive experience in freight transportation, that however sophisticated this modeling process may be, it would not accurately reflect all of the real time market conditions that will influence actual shipper and carrier operating decisions.

FHWA and DRI-WEFA personnel also caution that forecasting potential use of this currently nonexistent segment may be more analogous to the concept of analyzing the "building of a business," which should include market surveys and discussions with individual shippers and the railroads that would be providing service over the route. In addition, the role of surveys as a data-gathering tool is noted in the *Quick Response Freight Manual* (a tool designed to assist in freight forecasting projects) prepared for the Federal Highway Administration by Cambridge Systematics in 1996. This document states in part:

> "Lengthy personal interviews are the most costly method of conducting surveys and generally involve a smaller, more select or targeted sample. This approach is particularly appropriate when assessing the feasibility of new or expanded facilities. Interviews with shippers to ascertain the demand for such facilities and interviews with carriers to determine whether they would consider providing/expanding service to/from the

> facility are critical to the freight planning and decision-making process. These types of interviews are particularly useful for analyzing special trip generators including intermodal transfer facilities and warehouses."

This is consistent with the operations of the freight transportation system. Experience indicates that most freight decisions regarding carrier, overall budget, and standards of performance are now being made at the corporate CFO/COO level. The Director of Transportation and/or Transportation Manager then implements this strategy and makes decisions regarding specifics such as mode, service requirements by location and customer/plant need. In fact, once the cargo has been consigned to a truck, the truck drivers themselves will decide to a certain extent the best and most efficient routing to their destination: this certainly applies to routings within urban areas, and within defined market areas. Frequently this routing data is simply not recorded. Models can only approximate this decision-making behavior. Only informed interviews and surveys with the Directors of Transportation and Transportation Managers can provide a sense of what the potential usage of a non-existing transportation corridor might be. To accomplish this, a survey instrument was developed to incorporate specific questions, targeted toward the industrial Transportation Manager, regarding the possible/probable diversion of freight from truck to rail in the I-40 corridor.

To determine the potential to divert highway freight traffic to an east-west rail connection the potential users of the rail connection were surveyed. The survey included the transportation providers including railroads, trucking companies and third party logistics providers (3PL). These are key decision makers in determining the future commercial feasibility and viability of the proposed rail link. Twenty-four companies, selected based on their ability to provide both a national and a regional perspective, and because they are directly involved in moving freight by truck were interviewed as part of this survey. Those companies interviewed included truckers who handle substantial volumes of "rail" shipments and who have their own 3PL components; Schneider National, J.B. Hunt, and Swift, the three largest trailerload truck companies in the U.S. The list of the transportation providers interviewed does include trucking companies who are major truckload carriers. The trucking companies and 3PLs were contacted at the decision making level at their headquarters. Many of these companies are not headquartered in Tennessee, but due to their size and national and regional impact were likely to be handling freight traffic to and from Tennessee.

I-40 Truck Data Sources

The TDOT Traffic Count Data was reviewed as potential data source. This data, while identifying truck counts, does not identify the actual carrier or operator, whether the truck is loaded or empty, and most importantly, it does not identify the type of cargo (commodity) being carried. Carrier-specific truck count data for I-40 in Tennessee does not appear to exist anywhere, including the data collected by weigh stations. Carrier-specific data will not be produced by the FHWA-FAF database.

In order to provide the best possible assessment of the potential diversion of truck traffic from I-40 to a new east-west rail corridor, Reebie & Associates was commissioned to use its TRANSEARCH 2000 database to develop specific truck traffic data for I-40 cargoes traveling between Nashville and Knoxville. This database identifies intrastate and interstate cargoes, as well as cargoes originating in and destined for Tennessee. It identifies both the state of loading and discharge as well as the regional economic areas defined by the Bureau of Economic Analysis, U.S. Department of Commerce (BEA). This data is for the year 2000 and is at the four-digit commodity level of detail. The detailed TRANSEARCH 2000 data for I-40 was included by the Consulting Team to provide even more accuracy to our database and to assist in developing conclusions and recommendations.

This level of detail is necessary to identify the cargo sufficiently to permit assessment of the susceptibility of a specific cargo to rail shipment. Reebie developed this data using its state-of-the-art truck model that is based in part on work developed by the Oak Ridge National Laboratories Center for Transportation Analysis. The analytic procedure used to sort this data is contained in Appendix A, "Analysis of I-40 Truck Data." This data is in addition to the primary source of data utilized in the Freight Movement Inventory and Future Demand Analysis: the Federal Highway Administration FAF database.

To augment the detailed statistical analysis of the potential use of the east-west connection, the Class I railroads and shippers that might potentially use the new east-west connection between Oliver Springs and Algood were surveyed. The survey attempted to (a) identify the physical infrastructure that might be required (b) the strategic and operational issues and other issues contributing to the decision making process that might affect diversion of freight traffic from roadway to rail. The survey form for the Class I railroads and the survey form used for collecting data from shippers and/or freight consolidators and trucking companies is located in Appendix B.

The process described in the following sections was used to determine the volume of freight now moving by truck on the I-40 corridor that might potentially be diverted to rail between Nashville and Knoxville.

Table 5 is a summary of the data prepared by Reebie Associates converted to truckloads. This data represents truck movements on I-40 for each commodity and origin destination pair totaling more than 1,000 tons on an annual basis during the year 2000. The data provided by Reebie in tons was converted to truckloads based on 23 tons/46,000 pounds per truckload. Not all commodities will load to the limit of 23 tons per truckload due to the volumetric nature of some commodities. However, the conversion to truckload volumes is used to provide a rough estimate of the volumes involved in a more readily understood number; truckloads are a more accessible concept than pure tonnage figures and also relate to the TDOT truck count data for I-40.

TABLE 5

Commodities transiting I-40 between Nashville and Knoxville: 2000 Truckloads

	Truckload		LTL		Private Truck		Totals
	Eastbound	Westbound	Eastbound	Westbound	Eastbound	Westbound	
Intrastate	80,859	59,430	1,962	947	99,670	155,505	398,373
Interstate Inbound	47,228	194,525	536	3,656	7,448	36,248	289,641
Interstate Outbound	215,453	19,417	8,201	1,077	28,603	2,346	275,097
Transiting	414,506	195,082	21,169	6,164	99,670	155,505	892,095
Totals	**758,046**	**468,454**	**31,868**	**11,844**	**235,391**	**349,604**	**1,855206**
Total Eastbound							**1,025,304**
Total Westbound							**829,902**
Total Truckloads							**1,855,206**

Based on Reebie and Associates Transearch 2000 Traffic Data Origin Destination commodity movements greater than 1,000 tons at 4-digit STCC code commodity detail

The basic TRANSEARCH 2000 data has been developed in three categories that reflect the business characteristics of trucking operations (a) Truckload (TL) (b) Less than Truckload (LTL) and; (c) Private Truck. Each category represents a unique

commercial market and thus each would respond differently to the creation of a rail alternative albeit one can assume that trucking companies might look less than favorably on an east-west rail connection that might divert traffic from their own operations.

The analysis of the freight traffic likely to be diverted to a new rail link parallel to I-40 requires that several steps be undertaken in order to identify the amount of truck freight that might likely be competitive on the rail route.

Potential Diversion of Truck Traffic to Rail

The most straightforward approach to estimating the potential use of the proposed east-west rail connection is to analyze the current I-40 traffic. The purpose of this effort is to remove from the I-40 cargo base the truck traffic that would not, in all probability, be diverted to the rail link, using accepted freight industry freight routing criteria. This has been done in a stepwise process. These criteria include a broad range of factors including, but not limited to, required service levels, cost, the distance the cargo is being shipped, and the requirements of the traffic/commodities being shipped.

The following general categories of truck traffic are not likely to be diverted to rail: LTL and Private Fleet (Private Truck). These types of shipments are not normally conducive to rail movement and are therefore excluded from the cargoes having potential for conversion to rail. This is because:

- Less-than-Truckload (LTL) movements are smaller shipments consolidated by the LTL carrier and are generally not suitable for conversion to rail due to schedule requirements, cost, collection, and delivery flexibility. A limited amount of LTL cargo does move by line haul rail over longer distances and primarily between Midwest and West Coast destinations.

- Private Truck/Private fleet shipments are not likely to be converted to rail. The fleet operator has chosen to use a private fleet for reasons of flexibility, the need to control delivery schedules and timing, to offer their drivers better working conditions and more down time nearer to home, and the need to serve multiple points of origin and destination to distribute freight. For example, Wal-Mart and other significant shippers have reverted to the use of their own trucks for all of the reasons indicated above. Shippers warn that unless the forward delivery system, especially from the West Coast, is substantially improved to the satisfaction of the transportation users and in particular the direct shippers (beneficial owners), more and more freight will either be

rerouted to the "line of least resistance," and more private fleets will emerge in an effort to exercise better control over scheduling, costs, and the reliability of the onward delivery system.

Applying the criteria indicated above to the overall corridor traffic effectively reduces the pool of truck traffic to 1.226 million truckloads per year along this corridor.

Factors Relating to the Relative Competitiveness of East-West Truck and Rail in Tennessee

Many factors influence the commercial competitiveness of rail service. The design characteristics for the identified east-west rail corridor define the likely service levels. The design factors include:

1. Estimated train speeds and travel time for the east-west rail corridor based on maximum allowable speeds and taking into consideration only vertical grades, horizontal curves and acceleration-deceleration going into speed zone changes.

2. The times are pure running times and do not include any delays for train meets and following another slower train.

3. Maximum proposed Super Elevation (SE) in track was 5 inches and some of the mainline operations restricted freight speeds so that only 4 inches of SE was used.

4. The track and signal systems would need to be upgraded to FRA Class 4 standards for 60-mph freight and 79-mph passenger speeds.

Additional time would need to be built into the trip schedule to accommodate the following conditions:

1. Crew change.

2. Maintenance:

   - Delays for planned and unplanned activities.

   - Planned maintenance is work by railroad crews to improve lines such as rail relays, replace ties, surface correction and other maintenance that would require a temporary restricted speed thru work zones.

- Unplanned maintenance is weather or track conditions that would require restricted speeds to be put in place until the problem is corrected.

- The FRA has a list of track quality conditions that must be met or a speed restriction will be placed. Examples are soft track, wide gauge, irregular track surface, etc., which will be a major concern operating on the vertical grades and curves on this route.

3. Train meets/passes and overtaking of another train:

   - The proposed speeds assume that all trains will have sufficient power to maintain speeds shown.

   - Many local freight trains may not have sufficient power to maintain speeds proposed on the long vertical grades.

   - Heavier freight trains with sufficient power may not be able to maintain speeds due to strength of drawbars. These conditions would require splitting the train into two trains, adding helper engines or operating at a lower speed.

   - Passenger trains have a much higher Horse Power/Trailing Ton (HPTT) ratio than freight trains and could achieve proposed speeds.

   - The differential in speeds for the various freight and passenger trains would require a passenger train to overtake and pass many freight trains.

   - The entire route is single track with limited meet/pass tracks.

   - It will be difficult to locate meet/pass tracks on much of this route since the vertical grades on a major portion of this route exceed 1 percent, which makes it difficult to stop and start trains.

   - The existing train traffic will greatly impact proposed train trip times. This can be calculated using special software similar to what railroad train dispatchers use to control train meets and passes.

4. Local switching of industries where passing tracks are not available and local freight train must use mainline to perform switching operations.

5. Yard limits must be reviewed and power switches placed on all turnouts to allow for any speed above 20 miles per hour.

6. Local speed restrictions that may be imposed by a community.

To compare times for intermodal train vs. truck highway time from Memphis to Knoxville, it is necessary to add time to the train trip time for:

1. Getting trucks from the hub centers to local businesses and return.

2. Time to inspect and load/unload trailers onto train.

3. Dwell time: time from when a trailer arrives at a hub center until the train is scheduled to depart the hub center. Train frequency and when a customer's loads are ready for shipping will determine this time. When there is an established train service, businesses will work to make departures from their businesses coordinate with the train schedule. UPS typically has its own tractors deliver trailers to a hub center 60 minutes before train departure and have tractors at the hub center when a train arrives. This requires a dedicated train schedule.

4. All outbound trains must be inspected prior to departure from the hub center. Inspections include air brake tests that are done after train has been fully loaded and approved for departure.

Table 6 details the service parameters that have been developed for the east-west rail link based on achievable train speeds defined by three scenarios identified for further analysis. Table 7 presents estimates of competing truck times on the I-40 corridor. Assuming a 50 mph average speed, truck travel on the Memphis/Knoxville route is 7 hours 45 minutes, considerably less than the optimal achievable rail transit time.

The run time projections are for unimpeded train operations throughout the corridor as stated in the report detailing the east-west connection. This is a "best-case" scenario using assumptions of optimal service and seamless operations. It is highly probable that there will be delays associated with operations but with the information presently available, the full impact of the delays can only be estimated and/or approximated and even then, this will be speculative. The information provided coupled with 15 to 30 percent added to the delay time based on operational and scheduling adjustments would result in run times of up to 21 to 24 hours in the slower model and 18 to 20 hours in the higher speed model for the Memphis – Knoxville route. The running times present a fair estimate of the best achievable operations on this route. Estimates that are more precise are not possible without the benefit of specific operational modeling which would be highly speculative at this level of the review since a portion of the

route presently does not exist. In all cases, predictability of rail service would be a key and necessary condition to attract and capture highway cargoes.

TABLE 6

Rail Transit Times for Alternate Routes
Memphis – Knoxville

	Miles	Transit Time (min)
Southern DTC Operations		
Memphis to McKenzie	110.00	195.76
McKenzie to Nashville	120.12	222.13
Nashville to Algood	94.50	207.5
Algood to Oliver Springs	84.47	196.12
Oliver Springs to Knoxville	35.55	95.13
Total	**444.64**	**15 hr., 17 min.**
Southern Improved CTC Operations		
Memphis to Huntingdon	111.03	140.08
Huntingdon to Nashville	105.38	177.22
Nashville to Algood	94.50	19913
Algood to Oliver Springs	80.23	137.15
Oliver Springs to Knoxville	35.55	85.67
Total	**426.69**	**12 hr., 19 min.**
Northern CTC Operations		
Memphis to Huntingdon	111.03	140.08
Huntingdon to Nashville	105.38	177.22
Nashville to Algood	94.50	19913
Algood to Oliver Springs	67.35	103.00
Oliver Springs to Knoxville	35.55	85.67

Total	**413.81**	**11 hr., 45 min.**

Assumptions:

The Southern Improved Alignment includes CTC operations from Memphis to Knoxville, construction of the McKenzie bypass, the proposed modfications to the alignment between algood and Rockwood and the proposed modifications to the super elevation in CSX and NSR existing rail.

The Northern Alignment included CTC operations from Memphis to Knoxville, the proposed modifications to the alignment between Algood and Monterrey, the proposed new construction between Monterrey and Oliver Springs, and the proposed modifications to the super elevation in CSX and NSR existing rail.

TABLE 7

Truck Transit Times (for comparison with rail)

	Memphis-Knoxville	Nashville-Knoxville
Distance (miles)	387	178
Average Speed	50	45
	7 hr., 45 min.	4 hr., 27 min.

Impact of Competing Rail Routes

When considering the potential diversion of I-40 truck traffic to the all-Tennessee rail link, it is necessary to consider the broader nature of the larger transportation system serving this area of the nation. This requires recognition of the alternatives that currently exist for routing this cargo, including transportation links that are not wholly within the state of Tennessee. This analysis must include the potential role of the existing Norfolk Southern Railway (NSR) railroad network that runs east from Memphis, through Mississippi and Alabama and up through Chattanooga providing service to eastern Tennessee.

The service currently offered by the NSR between Memphis and Knoxville on its 429-mile route that goes through northern Mississippi and Alabama compares favorably to the rail transit times that have been constructed for the all Tennessee east-west rail link. Although the NSR does not currently provide intermodal service in the Knoxville area due to the lack of a proper intermodal facility, NSR currently operates a pair of general

freight trains between Memphis and Knoxville, which offer a 21-hour service, not including yard time, between Knoxville and Memphis. Using the assumptions of optimal service and seamless operations that are incorporated in the analysis of rail transit times shown for the all-Tennessee east-west route that are shown in Table 6, the optimal transit times over the existing NSR route between Memphis and Knoxville would be 12 hours.

In addition, NSR advises that the Memphis-Knoxville corridor is split into three segments. Between Knoxville and Chattanooga, the NSR averages about 8 scheduled freights per day, plus locals, extras, and coal trains. One pair of the scheduled trains diverges at Cleveland, Tennessee, to go to and from Atlanta. Between Chattanooga and Sheffield, Alabama, NSR averages seven scheduled freights per day, plus locals, extras, and coal trains. Between Sheffield and Memphis, NSR averages 10 scheduled freights per day, plus locals, extras, and coal trains.

It is clear from the analyses of the two alternate routes, there is no significant time advantage represented by the all-Tennessee east-west route, when compared to the currently existing NSR transit times on the more southern route between Memphis and Knoxville. This leads to the following conclusion:

> Given the fact that a well performing rail corridor that is actually shorter in optimal transit time than the proposed all-Tennessee rail corridor now exists and is available as a competitive service for the east-west truck shipments now transiting the I-40 corridor between Memphis and Knoxville, it is highly unlikely that any significant volumes of cargo moving between points in eastern Tennessee (Knoxville and east) and Memphis would shift to the newly created all-Tennessee east-west rail link. A minor change in route mileage and travel time on what is a component of a national transportation system is not likely to affect cargo routing decisions. This is absent substantial inducements such as substantially discounted rail rates.

This has significant implications for the estimates of potential diversion of current I-40 truck traffic to the new rail link.

Cargoes Transiting Tennessee

The figures contained in Table 5 must be analyzed in light of the current availability of competing rail service. Given the fact that there currently exists an all-rail alternative available for the long distance cargoes transiting via I-40, it is highly unlikely that the cargoes now transiting Tennessee on I-40 by truck would shift to a new east-west rail

route with performance characteristics not significantly different from the currently existing, and relatively parallel, east-west NSR route. Recent service improvements by NSR, eastbound from Memphis to the northeast, should make this existing route even more attractive for the freight transiting Tennessee.

Therefore, the cargoes shown to be transiting Tennessee on I-40 are not considered available as potential traffic on the east-west all-Tennessee rail link. Removing the truckloads transiting Tennessee (609,587) from the net truckload count of 1.226 million truckloads on I-40 developed in the preceding stage of analysis, results in a figure of 616,913 annual truckloads.

Tennessee Intrastate Cargoes

The pool of truck traffic that might be available for diversion to rail must next be adjusted to reflect the likely use of the east-west rail route by Tennessee intrastate cargoes. This process must recognize the potential role of the existing NSR railroad network that runs east from Memphis, through Mississippi and Alabama and up through Chattanooga providing service to eastern Tennessee.

This analysis identifies cargoes originating and destined for Tennessee by the U.S. Department of Commerce Bureau of Economic Analysis (BEA) region. To facilitate regional economic analysis, BEA provides geographically detailed economic data by economic area, as well as by State and by 171 local areas. BEA assembles economic area data on earnings by industry, employment by industry, total personal income, population, and per capita personal income. BEA considers the area designations as useful in the analysis of local area economic activity, local inter-industry economic relationships, and inter-area population movements. BEA economic areas cross state lines and are thus likely to represent the best possible estimate of the economic areas where cargo will generate. The geographic areas identified by BEA that include Tennessee are the following:

- 043 Chattanooga, TN-GA
- 044 Knoxville, TN
- 045 Johnson City-Kingsport-Bristol, TN-VA
- 046 Hickory-Morganton, NC-TN
- 047 Lexington, KY-TN-VA-WV
- 071 Nashville, TN-KY
- 072 Paducah, KY-IL
- 073 Memphis, TN-AR-MS-KY
- 074 Huntsville, AL-TN
- 075 Tupelo, MS-AL-TN

The BEA regions used in the current study to identify cargoes originating in or destined for east Tennessee are:

- 043 Chattanooga TN-GA
- 044 Knoxville, TN
- 045 Johnson City-Kingsport-Bristol, TN-VA

Central Tennessee includes

- 071 Nashville, TN

Western Tennessee includes

- 073 Memphis, TN
- 075 Tupelo, MS

A listing of all BEA regional codes appears in Appendix C. The detailed analysis permits consideration of eastbound intrastate cargoes generated in the Memphis area (including BEA region 075, Tupelo, MS) from the cargo pool available for the east-west rail link. Again, using the logic applied to consider cargoes transiting Tennessee, any cargoes likely to move by rail would already be moving by rail from Memphis to eastern Tennessee on the NSR east-west rail link through Mississippi, Alabama, and Chattanooga. The analysis by BEA region also eliminates the possibility that national cargoes that, which due to waybill sampling procedures appear to generate in Memphis, will not be included in the potential cargo pool. This block of eastbound cargo is excluded from the pool.

Intrastate cargoes moving on I-40 from eastern Tennessee to Memphis are treated with the same logic and not included in the block of cargoes considered potentially eligible to use the new east-west all-Tennessee rail link.

The remaining subset of cargoes does include the cargo, now moving on I-40, generated west of Nashville, and destined for points in east Tennessee that could potentially move on the east-west rail link. It also includes cargoes generated in eastern Tennessee moving to the Nashville area. The pool is then reviewed by type of cargo to eliminate high value cargoes and time sensitive cargoes that are unlikely to use the rail option. This analysis is done on a commodity-by-commodity basis using the commodity classification structure developed in Appendix D.

The resulting truckload movements are shown in Table 8. As indicated, of the 81,585 truckloads moving eastbound within Tennessee, 61,975 truckloads are moving to the Memphis BEA, suggesting that these cargoes are not rail eligible because they do not now avail themselves of the currently existing east-west rail service. Similarly, for the westbound movements, the movements to Memphis constitute 41,557 of the 59,430 truckloads. This leaves only 18,883 eastbound and 17,873 westbound intrastate truck moves as being possibly eligible as rail traffic on the Knoxville-Nashville rail link. After exclusion of cargoes not likely to move by rail, the resulting figures, also in Table 7, and show that slightly more than 16,000 truckloads moved in each direction in 2000 between the Nashville BEA region and points in eastern Tennessee.

TABLE 8

Tennessee Intrastate Cargoes: All Truckload Cargoes

	Tons	Truckloads
Eastbound		
Origin BEA 73, 75 (Memphis and Tupelo. MS)	1,425,435	61,975
Origin BEA 71 (Nashville)	434,312	18,883
Total	**1,859,747**	**80,858**
Westbound		
Destination BEA 71 (Nashville)	411,081	17,873
Destination BEA 73, 75 (Memphis and Tupelo, MS)	955,816	41,557
Total	**1,366,897**	**59,430**
Rail Eligible Truckload Cargoes Moving Between Nashville and Eastern Tennessee		
Eastbound	377,217	16,401
Westbound	376,316	16,362

Tennessee Interstate Cargoes

Utilizing the same logic as was applied to transit cargoes, freight traffic between points in the eastern United States to and from Memphis is not considered likely to use the proposed all-Tennessee east-west rail link because existing rail service is currently available.

Identification of the origin and destination of the freight traffic is again important because it permits determination if the traffic moves more than 400 miles, the figure generally accepted as the minimum distance for intermodal and general cargo rail moves. Based on the origin and destination information contained in the TRANSEARCH 2000 database, there are two general categories of commodity movements that may use the all-Tennessee east-west rail link

1. Commodities originating from U.S. eastern points of origin and destined for the Nashville area and,

2. Commodities originating in Nashville and destined for points east may well use the east-west rail link.

The eastbound and westbound cargoes transiting on I-40 between the Nashville BEA and points in the following BEA regions are considered possible candidates for the east-west rail link:

- The range from 001, Bangor, ME; to 015, Richmond/Petersburg
- 020, Norfolk/Virginia Beach;
- 025, Wilmington, NC;
- 026, Charleston, SC.

The complete listing of BEA codes appears in Appendix C.

The volumes of commodities moving between Nashville and U.S. eastern points are summarized in Table 9. The pool has also been reviewed by commodity type to eliminate high value and time sensitive commodities that are unlikely to use the rail under any circumstances. This process eliminated relatively few commodities and freight traffic from the totals. Both figures are contained in Table C, which shows that freight traffic moving to Nashville from eastern points totals 39,826 annual truckloads. Freight traffic moving to Nashville from eastern points totals 18,730 annual truckloads.

TABLE 9

Nashville Area Inbound and Outbound to and from Eastern States

	Tons	Truckloads
Outbound from Nashville Area to Eastern Destinations		
To BEA Areas 001 through 015	955,330	41,536
BEA Area 020	29,654	1,289
BEA Areas 025 and 026	67,203	2,922
	1,052,187	**45,747**
Inbound to Nashville Area from Points East		
To BEA Areas 001 through 015	277,976	12,086
BEA Area 020	31,599	1,374
BEA Areas 025 and 026	122,671	5,334
	432,246	**18,793**

Rail Eligible Truckload Cargoes Moving Between Nashville and Eastern Tennessee		
Eastbound	915,995	39,826
Westbound	430,789	18,730

Table 10 provides a summary of the cargoes that, using the assumptions contained in the foregoing analysis, fall into the general range of cargoes that might be susceptible to rail transport. Of these, current market estimates are that about 25 percent of this freight traffic could be diverted to rail, assuming adequate service at a reasonable cost was available.

TABLE 10

Summary of Cargo Potential for All-Tennessee East-West Rail Link (Potential Diversion Cargoes Moving on I-40 During the Year 2000)

	Eastbound		Westbound	
	Tons	Truckloads	Tons	Truckloads
Cargo Transiting Tennessee				
Intrastate	377,217	16,401	376,316	16,362
Interstate	915,995	39,826	430,789	18,730
New Agricultural Products	None Identified		None Identified	
Total	**1,293,212**	**56,227**	**807,105**	**35,092**
25 percent of totals	323,303	**14,057**	201,776	**8,773**
Rail Carloads				
Rail Carloads at 2.5 Truckloads per Rail Car		5,629		8,773
Rail Intermodal Units at 0.67 Truckloads per Intermodal Unit		20,981		13,094

Survey Results

The results of the analysis described above are largely confirmed by survey of trucking companies, logistics providers, and the Class I Railroads.

Trucking Companies and Logistics Providers

Surveys were used to determine the potential use of an all Tennessee east-west rail connection. Questionnaires were sent to 24 major national, regional, and local trucking companies and third party transportation providers. These were then followed by telephone interviews, and selected in-person interviews, resulting in direct contact with 20 firms. The companies contacted were generally cooperative but, as can be expected in any survey effort, a few of those contacted were uncooperative.

J.B. Hunt offered work based on a model of all their existing freight in the Knoxville area (46,000 loads per year) and assuming that competitive, intermodal rail service was available into and out of Knoxville with a Class I railroad, they estimated that approximately 11,000 loads or 24 percent of this freight could be divert to rail. They emphasized that the rail service must be provided by a Class I railroad.

All of the local trucking companies, and the regional carriers interviewed, when asked if they would divert freight from truck to rail if competitive rail service at a reasonable level of cost were made available responded that they would not be likely to divert any freight to the proposed all Tennessee east-west rail route. Some of the specific comments were as follows:

- "Rail service between Memphis and Nashville is currently taking 2 to 3 days…truck is 4 hours."
- "Truck service isn't much more expensive than rail and it is much more flexible and reliable."
- "Only one rail carrier serving Memphis eastbound as opposed to three westbound."
- "Diversion of rail freight is difficult compared to truck."
- "We don't have intermodal service, we are a trucking company."
- "My customers have gotten used to truck and I doubt they will change back to rail."
- "You cannot price small truckers out of business. They will charge whatever they have to in order to keep the business"

- "The State of Tennessee has a $1 billion deficit. How can they fix the rail service in the state?"

- "Large volume of freight in/out of Memphis but no rail service eastbound."

As previously stated in this report, private fleet and LTL shipments are the most difficult to convert from truck to rail. Capital investment in the equipment makes change difficult for the fleet operators and transit time when handling LTL is an issue. The groups most willing to consider moving truckloads to the rail were the larger regional and national carriers. Some typical comments by these groups were as follows:

- Most doubted that establishing competitive intermodal rail service through the state could be accomplished.

- Cost and mountainous terrain were cited as reasons.

- Many want to increase their intermodal business due to driver shortages and raising fuel costs but service must be reliable and consistent.

Responses from Class I Railroads

Questions for Class I and Short Line Railroads Regarding Potential Freight Diversion From I-40 to East-West Rail Connector between Nashville and Knoxville

1. What operating access and infrastructure improvements would a railroad require to make freight operations on the east-west connector between Nashville and Knoxville a viable alternative for freight movement to I-40?

    - NSR would require a minimum intermodal (point-to-point) speed of 50 mph

    - Currently Burlington Northern Santa Fe (BNSF) does not have access to Nashville or Knoxville. Trackage rights over CSX between Nashville and Memphis would be required or a line would need to be built to connect with BNSF at Memphis.

2. Would a Class I railroad use the Nashville-Knoxville connector if it were built and owned by the state of Tennessee?

- Factors that would influence NSR usage include:
  - User fees.
  - Traffic origins and destinations.
  - An in-depth truck diversion study must be completed in order to determine where new rail business would originate/terminate. Would a Nashville to Knoxville route bring new business to the railroad or would traffic simply be rerouted from a currently active line (e.g., CSX's line north from Nashville or NSR's line from Memphis to Birmingham)?
  - Commercial access to Nashville customers and all customers along the route.

    This raises an issue much larger than the Nashville-Knoxville connector and leads the discussion into possibilities of open access. NSR does not believe this is the proper forum for such a debate.
  - Control of the line.
  - Whoever dispatches any new line would have to treat all railroad users equally for a given type of service.
- BNSF responds that there are too many unknowns to accurately answer this question. Operating costs, transit time parameters and many other factors need to be examined to answer this question.

3. Would your railroad use the state-owned connection if another Class 1 railroad had similar access?

   - NSR still does not have enough information at this time to say whether it would use a state-owned connection from Nashville to Knoxville. However, from a purely theoretical standpoint, another Class I railroad having similar access would not preclude NSR from operating on a state-owned connection. NSR use of the state-owned connection would depend on the user fees, ability to operate safely, and potential markets.

- BNSF responds that it would need to access Nashville to reach the connector. The amount of volume would also need to be taken into consideration; if freight density is light, BNSF would not want an operation of its own. BNSF might want to work with another railroad to consolidate volumes.

4. What levels of usage rates might the Class 1 railroad be willing to pay per rail car or container or other appropriate measure of usage?

   - NSR states the industry standard is $0.32 per car mile.

   - BNSF notes that this varies depending on the specific opportunity and economics involved.

5. Based on the highway freight transportation forecasts developed by the Federal Highway Administration in the Freight Analysis Framework, what traffic levels would you envision on an east-west rail connection in the 2010 and 2020 year periods?

   - NSR states that with no substantiated data from which to base an opinion, any projected levels would be "visionary." As it will probably take at least 20 years to acquire properties, commence necessary studies, obtain necessary permits, etc., to build the proposed connection, a conservative estimate of traffic levels in the time periods requested would be "0."

   - BNSF would need to see the forecasts in order to answer the question. Other factors such as transit times and usage fees would affect the answer to this question.

6. Would this connection require construction of additional intermodal yards, and if so where?

   - NSR states that there is not enough information at this time to answer.

   - BNSF responds Knoxville and possibly Nashville, unless BNSF gained access to CSX's facility in Nashville.

7. Is the rail infrastructure west of Nashville adequate to make the east-west connection through Tennessee a viable alternative to I-40?

- NSR does not know enough about the CSX line from Nashville to Memphis to answer this question. NSR does not have trackage rights or haulage rights on this line. NSR would have no means to connect from Nashville west to Memphis.

- The existing BNSF-NSR joint intermodal service over the Memphis gateway already offers an intermodal route parallel to I-40. Traffic comes on NSR at Memphis and travels on the NSR's line to Sheffield, Alabama, and then to Chattanooga and beyond.

- NSR states that improving the capacity and fluidity through Memphis could yield more immediate benefits to Tennessee. Grade separation and road closings along routes through Memphis would improve public safety and enable the railroads to increase speed and improve reliability, two factors required in order to attract more traffic to rail.

- BNSF responds the CSX line between Nashville and Memphis is not a high-speed route. Upgrades may need to be done on BNSF's Memphis-Avard line.

Response from the CSX Railroad

CSX declined to answer the specific questions but provided the following general response.

> "CSX does not view the so-called cross state rail corridor as an economically viable project, and we have not looked into the questions you raised concerning that proposal. The project essentially calls for recreating the old Tennessee Central route across the Cumberland Plateau between Nashville and Knoxville, and due in large part to the extreme grades on either side of the Plateau the Tennessee Central was always financially challenged and eventually filed for bankruptcy. The Tennessee Central was never a passenger carrier of any consequence due to its difficult operating challenges and the sparse population on the Plateau. With regard to freight traffic, the Plateau still has very little industry that would produce meaningful amounts of rail traffic.
>
> CSX predecessor L&N Railroad acquired the Nashville - Crossville segment of the Tennessee Central after the TC became hopelessly mired in bankruptcy. L&N found that the line was not economically viable, and it

abandoned the segment between Monterey and Crossville. The remaining segment between Nashville and Monterey ultimately was sold to the Nashville and Eastern Railroad. We would not be interested in participating in a plan to resume operations over the Plateau.

As you know, CSX owns and maintains an east-west main line between Nashville and Chattanooga. While this line has a grade requiring helper locomotives between Cowan, Tennessee, and Sherwood, Alabama, it still has far more favorable operating characteristics than the former Tennessee Central line over the Cumberland Plateau. CSX has invested a substantial amount of private capital in that line, which is paralleled by I-24, and in 2001, we finished installing concrete ties between Nashville and Tullahoma. That line links Nashville to the rest of our rail system in the East and Southeast, and it will continue to be the east-west corridor."

Response from Canadian National

Canadian National (CN) has no operations east of Memphis and does not anticipate that an improved rail corridor from Nashville to Knoxville would affect its operations or marketing at all. The only line from Memphis to Nashville is the CSX line, which presumably is adequate for existing levels of traffic. CN anticipates neither participating in nor paying for improvements and access charges east of Memphis.

However, CN encourages the Tennessee DOT to continue infrastructure improvements in the Memphis area that will improve the competitive position of that market.

Forecasting Short Line Railroad Rail Traffic

The individual forecasts of railroad traffic for the Tennessee short line railroads for the years 2005, 2010, and 2020 have been developed using the detailed capabilities of the very new and sophisticated freight forecasting tool recently created by the U.S. Federal Highway Administration: The FHWA Freight Analysis Framework. The early results of this forecasting tool have been made available by FHWA to assist in development of the rail freight forecasts required for the TDOT rail plan. This modeling base has been supplemented by the very willing cooperation of the short line railroads in providing substantial additional detail on the historical cargo flow data that serve as the basis for the forecasting effort for the individual railroads.

The FAF analysis of freight flows is the most detailed analysis and forecast of national freight flow data ever undertaken by a federal agency. It provides historical and

forecast data at the two-digit STCC level of detail for cargo moving state-to-state, intrastate, and between individual states and foreign countries. The econometric forecasts that underlie the model reflect regional U.S. growth rates and growth rates in trade between the United States regions and foreign origins/destinations. The resulting database includes substantial detail: for the rail cargoes generated in or destined for Tennessee, there are over 3,900 individual forecast points for origin-destination partner and commodity trade flows. The resulting forecast is not a single straight-line figure applied to all data in the same manner. There is great variation in the individual commodity/partner pair forecasts: the forecast rates of change vary substantially and range from a few products that are forecast to decline in volume to some commodities that are forecast to triple in volume by 2020. The data does not include a forecast for the movement of hazardous cargoes. Increases in the movements of hazardous cargoes have been forecast at average level of cargoes destined for Tennessee.

The forecasts for the individual short line railroads are based on the detailed data provided by the individual railroads in the initial survey process. In most cases, the data provided by the railroads included carload volumes, inbound and outbound, carried by the railroads during the survey base year of 1999. This data is generally for up to the top five commodities carried, inbound and outbound, by the individual railroad. This baseline data was augmented by a supplemental data call to the short line railroads to provide state of origin and state of destination detail for the individual commodity movements.

The forecast for an individual railroad is developed by taking the commodity origin and destination matrix provided by the railroad and applying to that data, the unique growth rates developed in the FAF for each state partner pair and for each commodity reported by the railroad. This produces for each short line railroad a forecast of its future traffic levels for the years 2005, 2010, and 2020. This individual railroad forecast is based on the assumption that the railroad continues to participate in trade to and from Tennessee in a manner similar to the changes in trade in a given commodity between Tennessee and other states. In those cases where detailed commodity or detailed origin and destination data were not provided by the railroad, more aggregate growth rates were applied.

It should be cautioned that these forecasts do not constitute individual business plan for each of the railroads because individual business plan forecasts would require a level of analysis beyond the scope of this project. The summary of the forecasts for the individual short line railroads is provided in Table 11.

The short line railroad forecasts for Tennessee provide a clear indication of the continuing and growing role that the currently existing short line railroads will play in the future of transportation in Tennessee. For those areas where the underlying cargo and origin destination data provided by the railroads was most detailed, short line cargo volumes are forecasted to increase by between 56 and 63 percent by the year 2020 over the 1999 base. While overall growth over the period 1999 to 2020 is expected to be 59 percent, it is important to note that the preponderance of that growth, 35 percent, takes place by the year 2010, suggesting that the role of the short line railroads will escalate sharply over the remainder of the decade. The year 2020 traffic will be about 48 percent higher than the level extrapolated for the mid point of the year 2002.

This clearly has significant implications for the TDOT short line railroad rehabilitation program, because the short line railroads will face increased traffic and heavier rail cars. It should also be noted that this forecast does not reflect the continuing addition of trackage to the short line program.

Implications of Rail Freight Forecasts for TDOT

Table 12 shows the aggregate results of the trade forecasting effort as it relates to operations of all railroads in Tennessee over the forecast period. These findings show that by 2010 overall railroad usage in Tennessee will have increased by 22 percent over the 1998 levels that serve as the basis for the forecast. By 2020, rail traffic will have increased 69.3 percent over 1998 levels. It is important to note that the highest growth rates, although not the highest absolute increases, occur in the cargoes traveling to and from foreign nations, which is consistent with expected growth in U.S. foreign trade, including the NAFTA trades.

Overall, it is important to note that while the year over year growth between 1998 and 2020 appears staggering, a nearly 70 percent increase in rail traffic over the period, it is the product of relatively modest annual compound growth rates ranging from 1.9 percent to 4.8 percent for the foreign trades.

It is important to note that this forecast is predicated on unconstrained capacity in the transportation network model. This means that the model assumes that highway and rail capacity will increase as necessary to accommodate the traffic modeled to the individual modes. However, it is obvious that highways are reaching capacity and this may cause diversion to rail because freight follows the path of least resistance. If highway constraints divert freight from highways to the railroad, and to a lesser extent the water transportation systems, the growth rates shown in Table 12 must be considered to be the minimum growth that is likely to take place over the period.

Projected inbound and outbound freight commodity increases for Tennessee railroads; particularly for Class I railroads and the short line railroads closely associated with bulk haulages, present opportunities for improved economic conditions throughout the state. Most likely to benefit from these projections are CSX Transportation Company, Norfolk Southern Railway, and to lesser extents, the Burlington Northern Santa Fe Corporation and Illinois Central Railroad Company because of their heavy coal movement characteristics.

Short line operations can also be expected to benefit over the next 5 to 8 years because of projected traffic increases primarily via bulk commodity transfers. The efforts of the Class I railroads to focus on the mainline business also provide an opportunity for the short line railroads to capture an additional segment of the market.

The increases in rail commodity flows that have been forecasted will lead to increased train lengths and an increased number of trains. This growth will require enhancement of rail capacity by adding and improving track along rights-of-way and enhanced capacity in existing and new rail terminals and facilities. The growth in rail traffic will be most apparent to the public at grade crossings where more and longer trains will increase delays. The increased traffic has the potential for increases in grade crossing incidents and public safety concerns.

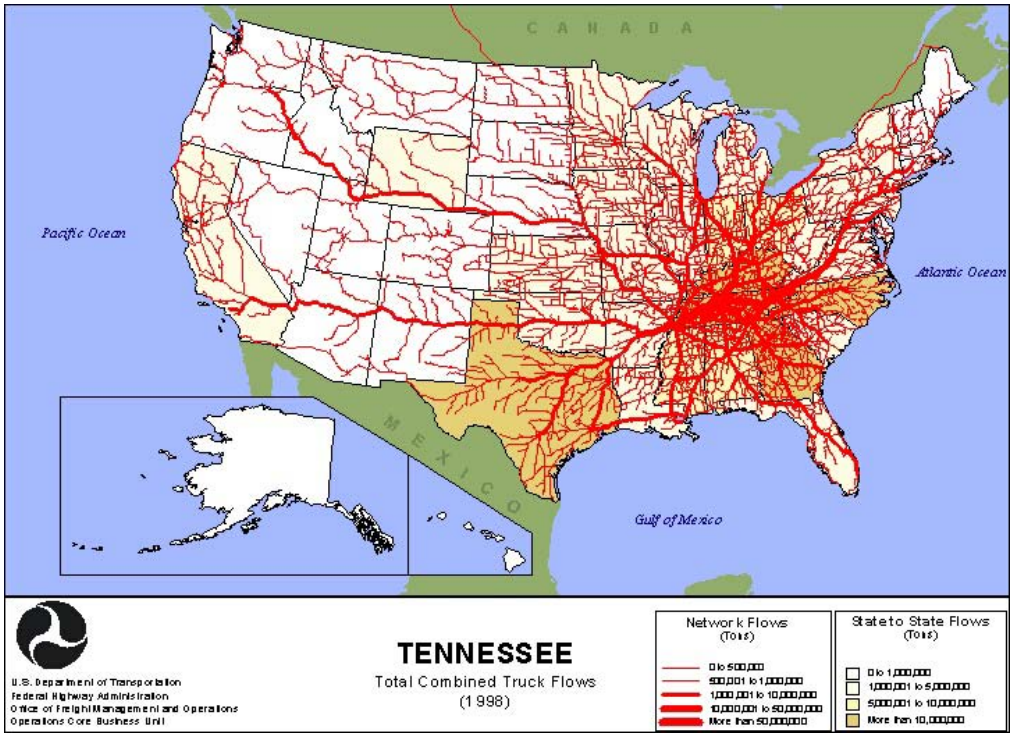
Freight Analysis Framework Forecast Results: Truck Flows

The FAF analytic approach permits identification of cargoes moving to, from, and through Tennessee from domestic and international locations. The following series of density maps represent the baseline data for combined domestic and international truck flows that relate to Tennessee. The density maps indicate the relative volumes of truck traffic serving Tennessee. Domestic truck flows, which represent the cargo moving between points in Tennessee and the other states, have been separated from international truck flows because the two types of truck movements have markedly

different distribution patterns, and thus different implications for possible transfer to rail.

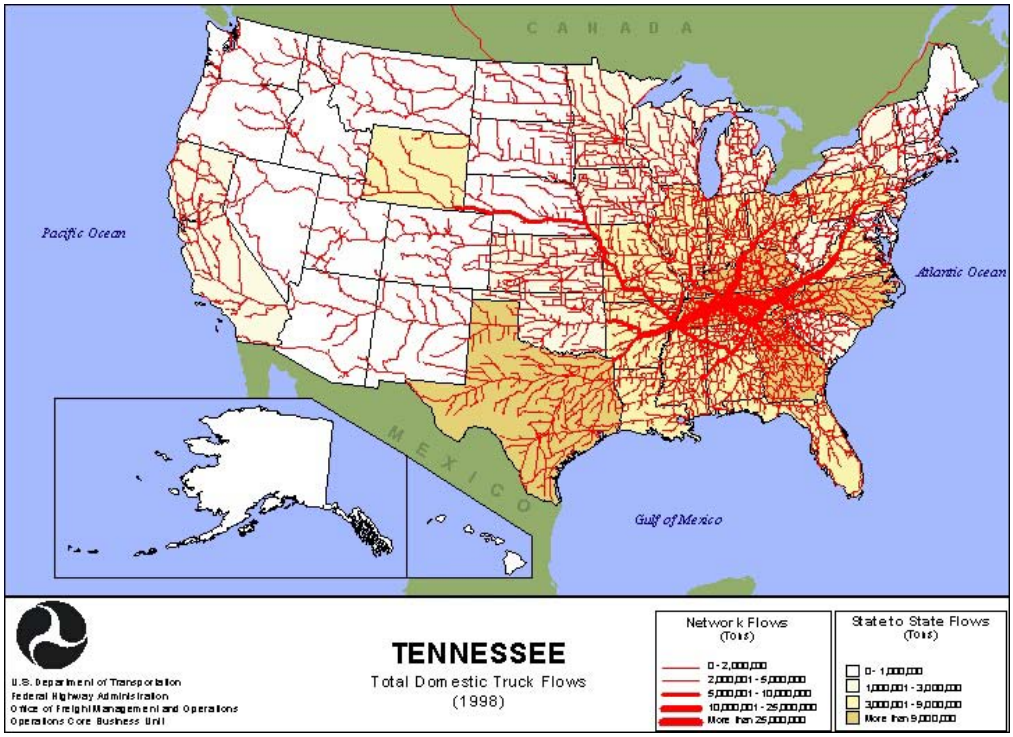
Map 10 shows Total Combined Truck Flows for Tennessee, the heaviest lines representing routes over which more than 50 million tons flow per year. Although this map is informative in that it does show that there is a great deal of trucking activity taking place, it is helpful to treat the domestic and international components separately because they have significantly different distribution patterns.

Map 10
Combined Truck Flows for Tennessee



Map 11 shows Total Domestic Truck flows, the heaviest lines representing routes over which more than 25 million tons flow per year.

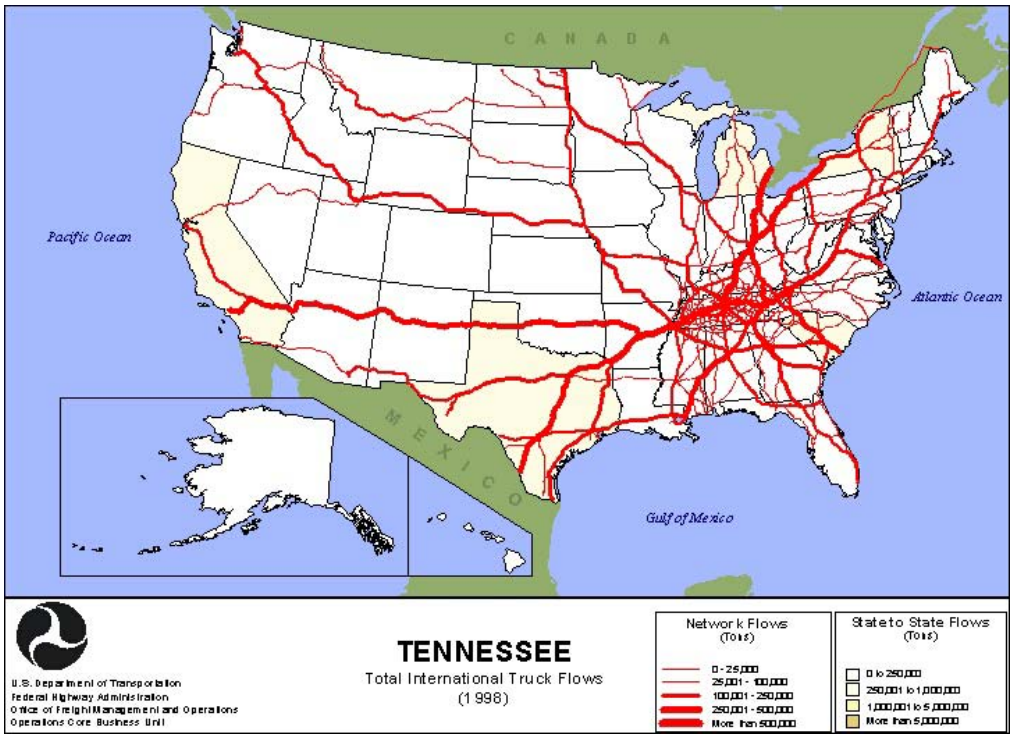
Map 11
Domestic Truck flows for Tennessee



This map shows that most domestic truck movements take place within the state or link the state to surrounding states. The longer distance truck flows serve to link major production and consumption areas together or to link regional distribution centers to local markets.

Map 12 shows Total International Truck Flows, the heaviest lines showing routes over which more than 500 thousand tons flow per year. It is important to note that this is a substantial difference in scale from the domestic movement volumes, and is consistent with the largely domestic nature of the United States economy.

Map 12
International Truck Flows for Tennessee



This map clearly indicates that truck movements supporting international trade generally move longer distances than the domestic movements and link Tennessee to ports and border gateways. For Tennessee, the most important ports include Norfolk, Virginia; Charleston, South Carolina; Savannah, Georgia; Jacksonville and Miami, Florida; New Orleans, Louisiana; Los Angeles, Long Beach, and San Francisco, California; and Seattle and Tacoma, Washington. For the international truck trade serving Tennessee, the major border crossings include Buffalo and Champlain, New York; Port Huron, Michigan; Emerson, North Dakota; Bellingham, Washington; and El Paso, Laredo, and Brownsville, Texas.

Sensitivity of Modal Shares to Fuel Prices

Fuel Cost

Fuel-related issues impact transportation costs in Tennessee. Recognition of those issues, coupled with the State's efforts to address them, can be expected to have positive results. Sensitivity must be maintained regarding the modal split analysis with regard to scenarios related to national fuel shortages or significant increases in fuel prices.

Various studies conducted in recent years have been reviewed and rail and truck companies have been interviewed to determine how the modal split on the transportation system in Tennessee would be affected given significant fuel price increases or fuel shortages.

The question of shifts in modal split arises in times of fuel shortages or significant price hikes, because rail has been shown to be more energy efficient than competing motor carriers. For example, a 1991 Federal Railroad Administration (FRA) Study, *Rail vs. Truck Fuel Efficiency*: The Relative Fuel Efficiency of Truck Competitive Rail Freight and Truck Operations Compared in a Range of Corridors, found that rail was more energy efficient than truck in all scenarios analyzed. The FRA study based its findings on simulations of rail and truck freight moves, carrying similar commodities between the same origins and destinations, using actual rail and truck operations. Only major rail-truck competitive commodities were compared. The rail scenarios included calculations of fuel used in local rail switching, terminal operations, and truck drayage, as relevant to the move. Circuity was also taken into account in calculating the amount of fuel consumed in comparable rail and truck runs. According to the analysis in the study, rail achieved from 1.41 to 9 times more ton-miles per gallon than competing truckload service. The critical factors were terrain, weight, equipment type, and average speed. The longer distance a fuel-efficient train travels, the greater the fuel savings using rail versus truck. The highest ton-mile per gallon values were obtained using trains with lower average speeds.

Rail mixed freight, which used lower average speeds than other equipment, achieved the highest level of ton-miles per gallon, followed by mixed freight with autos. Rail double-stack and trailer-on flatcar (TOFC) achieved the third and fourth highest ton-miles per gallon on Class I railroad routes. See Table 13.

TABLE 13

Fuel Efficiency by Equipment Type
For Class I/Over-The-Road Scenario (Over 100 Miles)

Train Type	Fuel Efficiency (FE) Range (tmi/g)	Truck Type	Fuel Efficiency (FE) Range (tmi/g)	Rail/Truck FE Ratio Range
Mixed Freight	471 – 843	Flatbed trailer without sides	141 – 167	2.82 – 5.51
	414 – 688	Van Trailer	131 – 163	2.96 – 5.25
Mixed Freight with Autos	279 – 499	Auto Hauler	84 – 89	3.32 – 5.61
Double-Stack	243 – 350	Container Trailer	97 – 132	2.51 – 3.43
TOFC	229	Flatbed Trailer without sides	133	1.72
	240		147	1.63
	196 – 327	with sides	134 – 153	140 – 2.14
		Van Trailer		
Unit Auto	206	Auto Hauler	86	2.40

Rail: TOFC – Trailer-on-Flat Car

The Association of American Railroads (AAR) has estimated that rail is three times more fuel-efficient than trucks. For example, in 1996, according to a recent AAR position paper on bigger trucks, the railroads generated 370 ton-miles for every gallon of fuel used, compared to approximately 123 ton-miles for trucks. The AAR *2000 Edition of Railroad Facts* (page 40) finds that, on average, rail freight overall traveled 386 ton-miles for every gallon of fuel consumed in 1999. An earlier (1994) study by the Maritime Administration (MARAD) of the U.S. Department of Transportation, *Environmental Advantages of Inland Barge Transportation*, analyzed several recent studies that compared freight energy efficiency. The MARAD study found that rail was generally three to four times more energy efficient than over-the-road truck.

Both rail and truck carriers continue to improve fuel efficiency through the use of more advanced equipment and changes in allowable capacity. Given that rail is more energy efficient than truck, other costs and factors associated with freight delivery of

competitive commodities were analyzed, including terminal and drayage costs, labor, road investment, materials, schedule reliability, line-haul speed, and in-transit time.

A summary of the commodities carried by rail and truck in 1987, as taken from AAR's March 1989, "Key Commodities in Rail/Truck Competition," is shown in Table 14. Although the paper has not been updated, market shares have remained essentially the same.

TABLE 14

Common and Competitive Commodities

		Rail			Truck		
STCC No.	Commodity	Rank*	Percent of Manufactured Commodities (ton miles)	Percent of 1987 Rail Industry (ton miles)	Rank**	Percent of Long-Haul Manufactured Commodities (ton-miles)	Percent of 1987 Total Long-Haul Trucking (ton miles)
203	Canned/Preserved Fruits, Vegetables, Seafood	12	3.64	1.22	1	20.59	8.41
204	Grain Mill Products	5	7.66	2.56	9	4.04	1.65
208	Beverages or Flavoring Extracts	10	4.23	1.41	10	3.97	1.62
209	Miscellaneous Food Preparations	9	5.40	1.80	8	6.13	2.50
242	Sawmill Products	2	11.72	3.92	2	12.12	4.93
243	Millwork or Prefabricated Wood Products	11	4.17	1.39	11	3.05	1.25
262	Paper	8	5.77	1.93	5	8.93	3.65
281	Industrial Organic or Inorganic Chemicals	3	11.15	3.73	6	6.72	2.74
282	Plastic Materials, Synthetic Fibers, Resins	7	6.76	2.26	12	2.87	1.17
289	Miscellaneous Chemical	13	1.14	0.38	13	2.29	0.93

	Products						
331	Steel Works, Rolling Mill Products	6	7.56	2.53	4	11.02	4.50
371	Motor Vehicles or Equipment	4	8.53	2.85	7	6.24	2.55
41-47	Intermodal Traffic Categories	1	22.26	7.44	3	12.03	4.91
	Totals		**99.99%**	**33.4**		**100.00%**	**40.85**

*Rank in the percent of rail ton-miles of competitive commodities
** Rank in the percent of long-haul truck ton-miles of competitive commodities

Source: Association of American Railroads, 1989

Another study that looked at rail-truck competitive freight is the U.S. Department of Transportation's *Comprehensive Truck Size and Weight (TS&W) Study*, published in August 2000. This study defines truck and rail competitive markets on the basis of distance; value of shipment, which affects logistics costs and service requirements; and product density (annual tons), which affects loading characteristics and transport costs; and lane density, which affects operating costs and service levels, especially in rail; and equipment which incorporates multiple characteristics influencing service and cost. As the TS&W study notes: "In general, shorter trip lengths with lower lane densities are dominated by trucks, while longer trip lengths with higher lane densities are dominated by rail. Lower value products that must travel longer distances are dominated by rail, whereas higher value products traveling shorter distances are dominated by truck."

Table 15 shows 1993 U.S. shipment share characteristics by transportation mode.

TABLE 15

1993 United States Shipment Characteristics by Transportation Mode

Transportation Mode	Freight Value		Tons		Ton-miles		Miles per Shipment
	Dollars (millions)	Percent	Tons (Thousands)	Percent	Ton-Miles (millions)	Percent	
Truck[1]	4,966,772	85%	6,404,807	66.11%	882,687	36.46%	362
Air	5,200	0.09%	148	0.00%	139	0.01%	1,180
Rail	247,394	4.23%	1,544,148	15.94%	942,561	38.93%	766
Water	64,077	0.09%	518,912	5.36%	271,981	11.23%	1,744
Pipeline[2]	89,849	1.54%	483,645	4.99%	--	0.00%	--
Multimodal	230,346	38.15%	190,832	1.97%	152,374	6.29%	1,049
Other	242,691	4.15%	544,885	5.62%	96,972	4.01%	229
Total[3]	5,846,334	100.00%	9,688,493	100.00%	2,420,915	100.00%	424

[1] Includes mail & parcel services
[2] Excludes most shipments of crude oil
[3] Some data may be included in the total but excluded from the modal categories, due to CFS publishing standards

Source: 1993 CFS for The United States (Bureau of Census

Data that highlights truck-dominated freight, rail- dominated freight, and modally competitive freight is summarized in Tables 16 and 17.

TABLE 16

Freight Modal Shares by Distance, Product Value, And Product Density Truck/Rail Ratio (Shaded Cells Competitive)

Highway Miles	Value per Pound					Intermodal Freight, All Kinds
	<$0.05	$0.05- 0.14	$0.15-$0.39	$0.40-$0.99	>$0.99	
Product Density: >60 pounds/cubic foot						
<100	99/1	96/4	82/18	75/25	100/0	
100-200	90/10	93/7	83/17	87/13	99/1	
201-300	90/10	87/13	66/34	84/16	99/1	

301-500	87/13	85/13	68/32	72/28	97/3	
501-700	84/16	75/25	60/40	63/37	99/1	
701-1000	66/34	72/27	56/44	50/50	96/4	
1001-1500	48/52	67/33	36/64	37/63	86/14	
>1500	55/45	66/34	58/42	39/61	85/15	
	Product Density: 36-60 pounds/cubic foot					
<100	55/45	89/11	93/7	99/1	98/2	
100-200	65/35	81/19	87/13	98/2	99/1	
201-300	43/57	74/26	73/27	98/2	99/1	
301-500	31/69	65/35	60/40	97/3	95/5	
501-700	32/68	45/55	51/49	81/11	97/3	
701-1000	11/89	45/55	42/58	86/14	94/6	
1001-1500	12/88	51/49	43/57	81/19	97/3	
>1500	74/26	27/73	47/53	46/54	83/17	
	Product Density: 1-35 pounds/cubic foot					
<100	N/A	79/21	92/8	95/5	97/3	0%
100-200	N/A	83/12	90/10	94/6	98/2	2%
201-300	N/A	83/17	82/18	91/9	87/13	2%
301-500	N/A	74/26	82/18	90/10	87/13	15%
501-700	N/A	65/35	63/37	83/17	78/22	10%
701-1000	N/A	55/45	42/58	77/23	77/23	20%
1001-1500	N/A	61/39	40/60	75/25	79/21	8%
>1500	N/A	37/63	19/81	66/34	68/32	42%

Source: Reebie Associates

TABLE 17

Modal Freight Shipments by Distance, Lane Density and Equipment Group Truck/Rail Ratio

(Shaded Cells Competitive)

Highway Miles	Lane Density (Thousands of Annual 1994 Tons) <25	25-100	101-500	501-2000	>2000
	Equipment Class: Bulks				

<100	86/14	96/4	92/8	92/8	73/27
100-200	97/3	89/11	78/22	78/22	56/44
201-300	94/6	85/15	69/31	59/41	43/57
301-500	92/8	77/23	63/37	57/43	17/83
501-700	81/19	64/36	54/46	47/53	1/99
701-1000	75/25	54/46	50/50	29/71	3/97
1001-1500	72/28	47/53	44/56	19/81	4/96
>1500	61/39	42/58	37/63	50/50	18/82
	Equipment Class: Dry Van				
<100	99/1	99/1	96/4	93/7	95/5
100-200	99/1	96/4	92/8	92/8	92/8
201-300	97/3	92/8	87/13	86/14	85/15
301-500	96/4	87/13	82/18	76/24	72/28
501-700	93/7	82/18	73/27	69/31	28/73
701-1000	90/10	74/26	67/33	52/48	32/68
1001-1500	88/12	71/29	66/34	58/42	29/71
>1500	79/21	64/36	50/50	33/67	9/91
	Equipment Class: Flatbed				
<100	100/0	100/0	85/15	84/16	89/11
100-200	97/3	97/3	87/13	84/16	90/10
201-300	97/3	92/8	85/15	81/19	79/21
301-500	96/4	86/14	80/20	83/17	71/29

Source: Reebie Associates Transearch Database

For double-stack container trains to be competitive with trucks, a 1990 FRA/MARAD study, "Double-Stack Container Systems: Implications for U.S. Railroads and Ports" found that cost-competitive double-stack hauls must be long enough for line-haul savings to outweigh terminal and drayage costs, which trucks do not incur. Also, railroads must continue to offer the lower rates that customers expect. The study found that double-stack services could compete with trucks on movements of 725 miles or more, with a drayage of up to 30 miles on each end. With higher energy costs, this distance might be reduced slightly. However, some observers have noted that, currently, containers-on-flatcar can be competitive with trucks only at about 800 miles or greater.

According to AAR estimates, fuel costs for rail represent 6.2 cents out of every revenue dollar, while fuel costs for heavy, rail-competitive trucks average over 10 cents per revenue dollar. Although energy prices rose substantially last year, rising 100 percent from two years previous, there was not a noticeable shift of any commodities from truck to rail. If fuel prices were to increase even more substantially, or if fuel shortages occurred, there could be disruptions or shifts throughout the economy. It is almost impossible to predict the effect of these changes on modal shifts.

In addition, although rail is generally more energy efficient and its energy costs are lower than competing trucks, other costs can be higher for rail. According to a June 2000 FRA study, "Railroad Cost Conditions - Implications for Policy," by John Blitzan, Ph.D., labor, road investment, and materials comprise the largest shares of total rail costs, accounting for 34.5 percent, 25.6 percent, and 18.6 percent of total costs respectively. Equipment and fuel account for approximately 14.8 percent and 6.6 percent of total costs. For motor carriers, driver wages and fuel are 43.9 percent and 20.5 percent of costs per loaded mile - higher than rail. However, other costs, such as those for tractor and trailer, at 15.8 percent and 2.9 percent, are much lower than similar costs for rail. These costs are summarized in Table 18.

TABLE 18

Total Truck Costs
Trips at Various Lengths of Haul

Loaded Miles	2500.0	2250.0	2000.0	1750.0	1500.0	1250.0
Empty Miles	125.0	112.5	100.0	87.5	75.0	62.5
Total Miles	2625.0	2362.5	2100.0	1837.5	1575.0	1312.5
Total Cost	$2657.50	$2389.50	$2144.00	$1833.00	$1638.00	$1370.00
Costs Per Loaded Mile						
Driver Wages	$0.467	$0.467	$0.467	$0.467	$0.467	$0.467
Fuel (excludes taxes)	0.218	0.218	0.218	0.218	0.218	0.218
Tractor	0.168	0.164	0.169	0.164	0.171	0.165
Trailer	0.031	0.030	0.031	0.030	0.031	0.030
Insurance	0.039	0.039	0.039	0.039	0.039	0.039
Fees and taxes	0.105	0.104	0.103	0.106	0.106	0.105
Overhead	0.036	0.041	0.046	0.052	0.061	0.073
Total Costs	**$1.063**	**$1.062**	**$1.072**	**$1.076**	**$1.092**	**$1.096**
Percent Costs per Loaded Mile						
Driver Wages	43.9	44.0	43.6	43.4	42.8	42.6
Fuel (excludes taxes)	20.5	20.5	20.3	20.3	20.0	19.9
Tractor	15.8	15.4	15.8	15.2	15.7	15.1
Trailer	2.9	2.8	2.9	2.8	2.8	2.7
Insurance	3.7	3.7	3.6	3.6	3.6	3.6
Fees and taxes	9.9	9.8	9.6	9.9	9.7	9.6
Overhead	3.4	3.9	4.3	4.8	5.6	6.7

Assumptions:

Net Weight: 50,000; single driver; dry van; 50 percent empty
Fuel Cost: $1.237 per gallon, tax 0.453 per gallon, total $1.69 per gallon
Fuel consumption: 5.90 MPG

Source: Federal Highway Administration

Railroads own the vast majority of the right-of-way over which they operate, and they spend billions of dollars each year to construct and maintain that infrastructure, as well as to upgrade costly equipment. According to AAR estimates in a paper titled, "Investment: Essential to Railroads and their Customers," railroads will have to invest an estimated $162 billion (in 1997 dollars) by the year 2020 -- the equivalent of rebuilding the entire rail system twice -- simply to maintain their current share of the freight market. In an uncertain economy, railroads are reducing their previously planned investment levels.

For rail to be competitive with trucks, overall logistic costs have to be taken into consideration. Shipper choice is also made on the basis of frequency of shipment, schedule reliability, line-haul speed, and in-transit time. Shippers are often willing to pay a higher transportation cost to achieve superior service. Both truck and rail have provided just-in-time delivery - reducing the need for warehousing by shippers. In fact, railroads, with their just-in-time delivery of autos and auto parts have 70 percent of the market of finished autos and truck and auto parts. Trucking companies have developed better tools to precisely locate the customer's shipment and accurately predict when it will arrive at its destination.

In summary, energy costs are only one small factor in the overall comparative costs of rail and truck transportation. Only certain commodities are rail-truck competitive. Rail does best in high-density lanes moving over long distances between origin and destination. High value short and medium distance traffic is highly unlikely to divert to rail. Given the expectations for fuel availability and pricing, the difference in the direction of rail/truck freight movements in Tennessee and the number of other factors that must be weighed to determine the optimum freight delivery system, it is unlikely that any substantial amount of truck traffic will divert to rail in Tennessee.

Based on this assessment, it does not appear necessary for the TDOT short line railroad rehabilitation program to develop a program component to ensure the sustainability of railroads during cyclical fuel price increases.

Locomotive Fuel Efficiency Research Partnership

A federal program to increase fuel efficiency and reduce emissions from diesel locomotives will provide public benefits to the environment similar to those of the 21st Century Truck Initiative.

Background

The 21st Century Truck Initiative is a public-private research partnership involving many of the nation's largest heavy-duty engine and truck companies; the U.S. Departments of Defense, Energy, and Transportation; and the Environmental Protection Agency.

The goals of the Truck Initiative include developing truck and bus technologies that increase fuel economy, improve safety, reduce emissions, and lower costs. The partnership is designed to lead, within 10 years, to prototypes that double existing fuel economy for long-haul trucks and significantly reduce truck emissions of nitrous oxide, particulates, and other air pollutants.

Because of the Truck Initiative, the fiscal year 2001 budget was increased by $31 million in truck research spending to a total of $137 million.

State and Federal Support for Higher Rail Freight Utilization

Since railroads are three or more times more fuel efficient than trucks, diverting traffic from trucks to railroads would increase energy efficiency. Significant increases in combination truck traffic on the nation's highway system brought about by increased truck sizes and weights would increase fuel consumption by hundreds of millions of gallons per year.

Diversion of freight to trucks would also result in increased pollution, since trucks emit substantially more pollution per ton-mile than railroads. The primary pollutants emitted in transportation are nitrogen oxides and particulates. Nitrogen oxides are a major contributor to smog. Particulates cause respiratory distress.

Diverting freight from railroads to trucks would have negative implications for highway safety. According to research by the University of Michigan Transportation Research Institute, fatal accident rates increase with heavier weight for any given truck configuration. Trucks have higher fatality, injury, and hazardous material spill rates than railroads. For example, in 1997, truck operations had more than ten times as many injuries — and three times as many fatalities — per billion ton-miles as did freight railroad operations. Trucks also typically have more than ten times as many hazardous material spills per billion ton-miles of hazardous materials traffic than railroad transportation.

Freight Technology Trends

Tennessee's major railroads, as well as its short line carriers, will benefit from a variety of industry-wide technological improvements developed over the past decade. Fuel shortages of earlier years, legislative incentives for increased truck/rail competition, and rapidly developing technological advances have contributed to an array of rail freight industry improvements. Associations such as the American Shortline Railway Association, the Association of American Railroads and similar industrial researchers continue to push for a host of mechanical and related improvements.

In July 2001, *Standard and Poors* reported that: "Our investment outlook for the railroad industry is positive. The group has performed well so far this year as increasing coal demand and international service has helped to offset the slowing economy. The long-term outlook for railroads is favorable. The industry's core traffic base of coal, grain, chemicals and intermodal traffic is expected to increase at least as fast as the economy over the next decade. In addition, there remains additional room to expand margins by elimination wasteful labor practices and applying technology in equipment and information management."

Both the short line and Class I railroads serving Tennessee have been able to capitalize on improvements such as improved metallurgy and track fastening systems, new wayside detector devices, Idaho-shield grade crossing protective devices, and related safety advances. Increased levels of hazardous material shipments, coupled with a simultaneous demand for safe and efficient rail passenger services have established a larger market for safety and associated technological improvements.

A variety of advances in the rail industry can be expected to strengthen the freight outlook for the immediate future in Tennessee. In fiscal year 2000, railroads operating in and through the state hauled over 250 million tons of freight, which contributed $375 million to the economy of the state according to the University of Tennessee. In large measure, the industry advances, which are described below, helped contribute to those financial successes and Tennessee based businesses can reasonably expect to see increased and more efficient rail services statewide.

The following organizations not only serve the railroad industry generally, but they also sponsor research and invest in a variety of activities directed at increased carrying capacity, overall track safety and more efficient use of rail services:

- Association of American Railroads

- American Shortline and Regional Railroad Association
- American Progress Institute
- Transportation Technology Institute (Pueblo, Colorado)
- Individual railroad corporations (for both short line and Class I railroads)

It can be anticipated that rail carriers in the Tennessee region will be able to increase overall business capacities. Increased car weights, faster train speeds, improved employee computer-based training programs and expanded freight carrying capacities are possible because of growing rail industry technological and informational improvements.

Increasing Train Speed

A variety of industry improvements over recent years relate to the ability of freight carriers to transport bulk commodities at an increased speed rate.

The Association of American Railroads reports that overall average speed of trains moving through Tennessee increased by approximately 2 percent in the year 2000. That speed can be expected to increase in the future due to improved mechanical, safety and operating efficiencies. Advances in train speeds mean shorter transit times, ability to utilize just-in-time delivery systems to manufacturers, and increased overall customer service.

A number of rail industry improvements have helped contribute to the overall efficiency of the Tennessee (as well as the national) rail transport system. The following advances are most notable:

Two-way end-of-train (EOT) braking devices permit the simultaneous application of air brakes from both the front and rear of a train. By July 1997, 6 months ahead of a Congressionally mandated deadline, railroads had EOT devices installed on all trains that routinely travel at speeds greater than 30 miles per hour or operate on steep grades.

Rail-funded research in the late 1980s resulted in the development of heat-treated curved plate wheels that are more durable than the straight plate wheels they replaced. Replacement of the older wheels has resulted in a substantial reduction in wheel-related derailments.

Improved Metallurgy and Premium Fastening Systems

Improved metallurgy and premium fastening systems have improved the stability of track geometry, reducing the risk of track failure leading to derailments.

Wayside Detectors

Additional wayside detectors have been installed to warn about defective equipment, permitting defective cars to be set out before wheels, axles, or other components fail.

Track Geometry Cars

Track geometry cars that combine electronic and optical instruments are used routinely to inspect track conditions, including alignment, gauge, and curvature.

Tank Car Enhancements

Enhancements to tank cars, the result of joint projects by the Association of American Railroads (AAR), the Federal Railroad Administration (FRA), and the Railway Progress Institute, including head shields, thermal protection, shelf couplers, and pressure relief devices, have helped reduce train accidents with a release of hazardous materials by approximately two-thirds since 1980.

AC Locomotives

More than 4,100 new AC traction locomotives have begun operating on the nation's railroads. Three of the new locomotives can do the work of five older DC traction locomotives. The new locomotives are also more fuel-efficient than the older ones and are less subject to mechanical breakdown, increasing both safety and efficiency.

Computer-Aided Dispatching

Computer-aided dispatching systems give dispatchers a superior overview of track segments.

Positive Train Separation

Railroads are testing or preparing to test several different positive train separation systems that could reduce further the already slim chance of mainline collisions (which account for approximately 2 percent of all train accidents) to see if the technology is feasible.

Pneumatic Braking

Electronically controlled pneumatic braking systems that cannot only reduce braking distances by as much as 40 percent and also increase track capacity are currently in limited revenue service.

Automatic Equipment Identifiers

Automatic equipment identifiers mounted on freight cars and a system of electronic readers located throughout the nation's rail network allows railroads to identify the locations of cars in transit.

Transportation Technology Center

The latest rail transportation and safety improvements are taken from the drawing board to the test track at the 52-square-mile Transportation Technology Center (TTC) in Pueblo, Colorado. A wholly owned subsidiary of the AAR operates the facility, which was established in 1971, under a long-term contract with the U.S. Department of Transportation and the FRA.

There are 48 miles of railroad track on-site devoted to testing all types of signal and safety devices and track components. The TTC has unique laboratory facilities for evaluating vehicle dynamics, structural integrity, and reliability, and is the focal point for all of North America's rail research, testing, and information exchange.

In addition to its operations at the TTC, AAR has developed an aggressive technology-scanning program involving the Massachusetts Institute of Technology, the University of Illinois, and Texas A&M University as AAR-affiliated laboratories. The industry funds programs at these universities to seek out emerging technologies — many of which are initially developed for other industries — that might have railroad application.

The TTC hazardous material responder training school enables rail personnel, truckers, firefighters, and other first responders to rehearse the management of potential hazardous materials emergencies.

Electronically Controlled Pneumatic (ECP) Braking

Electronically Controlled Pneumatic (ECP) braking was initiated by AAR-member railroads. There is both international as well as domestic interest in the system. BHP Iron Ore (Australia), Spoornet (South Africa), and Quebec Cartier Mining (Canada) have utilized ECP braking technology and have been satisfied with its many

advantages in revenue service. These railroads have experienced improved train handling, reduced trip time, decreased braking distance, reduced in-train forces, consistent, graduated brake release, reduced railcar maintenance, and reduced fuel consumption.

American Association of Railroads standards are still under development, and economics and logistics cause much trepidation. Retrofitting the 1.5 million-plus freight cars and locomotives in North American interchange service is no small feat. (Source: Railway Age 1/01)

Communication-Based Train Control

CBTC has been proven feasible by numerous successful test and demonstration projects over the past few years. Matra's METEOR system on the RATP (Paris metro), a radio-based version of which will soon be installed on NYCT's Canarsie Line. GE Harmon's ITCS (Incremental Train Control System) in Michigan, an overlay system has permitted mixed Amtrak/freight train operations with passenger train speeds up to 90 mph. That last point is true of any procurement, whether it's for a stockpile of signal lamps or a CBTC system. (Source RailwayAge 6/01 Magazine)

Trends to Heavier Rail Car Loading

Trends to Larger Cars

Increased car capacities mean greater economies of scale for both rail companies and shippers in Tennessee and throughout the country.

Freight car builders are responding to the call for equipment that offers better productivity and a higher rate of utilization. They are taking advantage of high-strength, lightweight materials to produce equipment of higher capacity. They're developing innovative designs; in some cases they're improving upon a proven product, in others they're starting with a clean sheet of paper. Advanced car designs like Johnstown America's ABC (Articulated Bulk Container), Trinity's composite-body boxcar, Gunderson's Auto-Max®, or Thrall Car's all-new Q2® are examples.

Thrall Car's Q2 is an 89-foot, tri-level, non-articulated, purpose-built motor vehicle carrier. Unlike a traditional autorack, it is not a superstructure on a flat car. Rather, it incorporates a totally new under frame, an all-steel welded car body, and a clean-bore interior. It stands 20 feet, 2 inches tall and is designed to carry all sizes of vehicles (cars, light trucks, and minivans) except large trucks and SUVs.

Increase Capacity for Cars and Locomotives

To become more competitive with other transportation systems, Tennessee railroads will need to continue to add capacity to existing networks. According to the Association of American Railroads' 1999 Railroad Equipment Report, the total number of freight cars operating on the U.S. railroad network increased for the fifth consecutive year in 1998, growing from 1,270,419 in 1997 to 1,315,667. Aggregate capacity increased for the sixth consecutive year, from 122.6 million tons to 127.6 million tons. Similarly, the number of locomotives operated by U.S. Class I Railroads grew from 19,684 units in 1997 to 20,261 in 1998. Aggregate horsepower increased by 5.2 percent to 63.3 million. Except for a few main line expansions, these increases have taken place largely without a corresponding growth in infrastructure.

One method of adding increased capacity to the Tennessee system may be in equipment designed to handle more payload. More important is efficient utilization of cars and locomotives. A key to that strategy to improve cycle time—to keep equipment rolling, reducing bottlenecks in yards and terminals, and reducing the time between delivery of a customer's load and release of the empty car.

Some railroads are increasing train lengths. Tennessee rail companies, especially those with heavy unit train utilization, may wish to explore this strategy in greater detail. Canadian Pacific Railway, for example, is increasing the maximum standard length of approximately half of its main line trains, from 7,200 feet (120 cars) to 9,000 feet (150 cars). CPR said the acquisition of 346 AC traction locomotives in the last 5 years and the development of improved information systems permit the operation of longer trains, "improving asset utilization and increasing productivity."

CSX is one Class I Railroad strongly committed to greater productivity and more efficient use of equipment. Company officials as well as government regulators need to be aware that larger freight cars are not necessarily the answer to capacity problems and thus the move to 315,000-pound cars will probably not occur at the rate at which the switch was made to 286,000-pound units. The answer is to get more capacity out of existing mechanisms. Generally, capacity problems are not on line of road but by delays and congestion in the yards and terminals and at the customers' sidings

The use of locomotives with greater horsepower is growing. Many larger companies, such as CSXT appear to be committed to the most powerful locomotives available, meaning those of the 6,000 horsepower class. That railroad now holds over 50 such power units.

Johnstown America Corporation's new two-platform, lightweight ABC car, with a total capacity of 354,000 pounds, is designed to carry special ISO 20-foot solid waste containers weighing up to 59,000 pounds each. Containers can be double-stacked at the end positions or single-stacked at the center of each unit. Additionally, the ABC can carry standard 20- and 40-foot ISO containers, and can be modified to handle structural steel, timber, and other non-hazardous container products. It's described as "an efficient, reliable way to transport a wide range of heavy non-hazardous and hazardous cargoes." They will be used by the U.S. Army Corps of Engineers, the U.S. Department of Energy, and other materials processors.

National Steel Car describes its 110-ton coil steel car as "the most compact in the industry," offering "unsurpassed flexibility in load configuration." This is a 286,000-pound GRL (gross rail load) car with a load limit of 236,500 pounds – a capacity made possible by a lightweight of 49,500 pounds. (With cover and crossbars, capacity is 226,500 pounds.) Equipped with a 42-foot single trough, it can accept coils from 40 to 84 inches in diameter. The maximum load can be distributed over 18 feet at the center of the car.

Trinity has built 50 of its 7,900-cubic-foot-capacity, temperature-controlled, insulated composite-body boxcars for Union Pacific. These are based on the Northern Star boxcar developed jointly with Hardcore-Dupont and tested by Burlington Northern. Because of its extra capacity, Trinity says revenue per car increases while shipper cost decreases, making it highly competitive with trucks, and affordable at its existing economics.

These cars, which offer reliable internal temperature control, are equipped with a GPS-based monitoring system that can alert the railroad or the user to problems.

Wheel manufacturers have been optimizing designs for 286,000 pounds GRL. The industry is now looking at GRL as high as 315,000 pounds. There are 38-inch wheels and 7X12-inch journal bearings that can handle 315, but some argue that 315 is not as cost-effective as 286 (whose standard is 36-inch wheels and smaller journals) because of a weight penalty for the larger equipment. Whether it is possible to run 315 with 286 equipment (315s effects on infrastructure notwithstanding) is the subject of ongoing industry research and development.

Six thousand horsepower locomotives have progressed beyond the experimental stage to become an accepted technology. The majority of units ordered nationally are in the

4,000-hp category, even though there are enough GE AC6000s and EMD SD90MACs in service to indicate that the industry has given its overall approval.

Onboard locomotive management systems, like EMD's FIRE (Functionally Integrated Railroad Electronics) and GE Harris's IHUB (Integration Hub), continue the evolution toward standardized, off-the-shelf control systems that will support multiple subsystems (self-diagnostics, PTC, wired or wireless ECP braking) from multiple vendors. Reliability and availability are at levels unheard of only a short time ago, and cycle time for scheduled maintenance, now at 120 days for new-builds, will likely be extended to 180 days in the foreseeable future. Because of all these positive developments, railroads and locomotive builders are in discussions with the Federal Railroad Administration to amend the current 90-day inspection requirement to an interval more in keeping with the high quality and reliability of modern units. FRA, though, has not given any strong indications that it's willing to relax the rules for newer equipment.

A challenge facing locomotive builders is compliance with EPA emissions regulations. This is a three-tier program that, began in 2001, will be phased in through 2005. As a result, technological developments are going to occur more on the emissions side, as resources are more heavily focused in this area.

The biggest advancements in locomotive technology have been in onboard control systems. Field tests of EMD’s FIRE system, which went into production recently, are underway. FIRE provides an excellent platform for the explosive growth in locomotive electronics. It is a robust but flexible system based on commercially available hardware and uses the Windows NT operating system to make it easy for third party suppliers to develop software applications. The approach is being welcomed by the railroads because it maximizes locomotive reliability by using the fewest possible hardware components. The approach also promotes competition and thereby minimizes costs in the development of third party software for such new features as PTC and ECP brakes. FIRE consists of two PC-based computer/display assemblies for the locomotive engineer, with an optional third assembly for the conductor. All are networked, thus providing an increase in processing power, and the redundancy contributes to higher locomotive reliability and availability. Source: (Railway Age June/2000)

Track Maintenance

Safety is the primary reason for well-maintained track. Operating efficiency and cuts in mechanical and fuel costs are also benefits. As a result, trains can get over the line faster, so railroads don't need as many locomotives and cars to haul the same tonnage.

Crews do not risk federal violations and fuel tanks don't run as low. Additionally, there is less wear and tear on equipment and customer service improves as shipments move faster.

Benefits from a qualitative point of view are less derailment potential and lower train resistance. In some studies in was demonstrated that the more technical obstacles there are in the track, the more fuel is necessary to negotiate them. The main challenges in this area are to understand the economics and then to reduce maintenance costs by having more productive and efficient track maintenance methods for better design of materials in the track structure itself

Maintenance-of-Way

Four factors have historically governed improvements in railroad track maintenance-of-way costs (Transportation Quarterly):

1. Economics of traffic density
2. Technological improvements
3. Network rationalization
4. Equipment productivity

Well-maintained track is track that supports on-time revenue traffic on a continuing basis. Thus, the maintenance requirements vary with the traffic demands.

Optram's ORIM system was developed for achieving well-maintained track. ORIM is a visual information system designed for railroad infrastructure maintenance.

The ORIM system integrates track layout, inventory, condition, and maintenance work at any location along a track corridor. Its ability to display a combined view of maintenance management information enables managers and engineers to correlate symptoms and view factors that cause track deterioration, thereby enabling rapid and precise corrective action. Utilization of this information system allows owners to focus on maintenance activities more precisely, resulting in improved track availability and more cost-effective use of maintenance funds. Improved maintenance results in substantial savings, especially with the heavier cars becoming increasingly popular.

Implications for Change in State Policy and Investment Programs

Transfer of New Technology Solution to State Agencies and Smaller Railroads

The technological advances described in this section, represent a number of potential improvements for both rail companies operating in Tennessee, as well as for shippers and state agencies affiliated with the rail industry. Among the larger railroads, it is understood that training is ongoing and normally represents a budgeted occurrence. For smaller operations and for state agency personnel desiring to support industrial operations on a more localized level, there are a variety of remedies. Funding and training are available for short line railroads and industrial rail company representatives, which may not retain the financial and technical capabilities of Class I organizations. In addition to technical training opportunities discussed here, the American Association of State Highway and Transportation Officials Standing Committee on Rail has among its members many experienced transportation planners who regularly offer meaningful suggestions to newer state personnel relative to rail-related issues.

Specific training in technological application of locomotive simulation, braking advances and signaling improvements are available through national organizations such as the American Shortline Railroad Association, the Association of American Railroads, and the Technical Center in Pueblo Colorado. Additionally, the University of Wisconsin regularly offers weeklong courses at reasonable cost to governmental and industrial members. The University can be contacted at www.uwis.edu.

Funding for training in software applications associated with line rehabilitation, benefit-cost ratio analysis, safety procedures and numerous related fast-changing processes can be secured by contacting the Office of Freight Programs at the Federal Railroad Administration as well as through direct inquiries at RailServe, an internet directory of training, grant availability and professional advice from long-time executive and field railroad personnel. Additionally, www.railroaddata.com serves as a clearinghouse for questions from staffs of small industrial rail firms.

Tennessee Grade Crossing Protection Programs

This section provides an assessment of freight movement trends, train speed trends, and train technology trends that will impact Tennessee's grade crossing protection programs. This assessment includes policy or program solutions for those trends that increase hazards at grade crossings.

A variety of issues impact Tennessee's rail systems, including longer, faster, and heavier trains. These issues are most readily apparent to the public at Tennessee's hundreds of highway-grade crossings. There, at those rail-highway intersections, subject to daily public scrutiny, the organizational, mechanical, and other elements of railroading are on display.

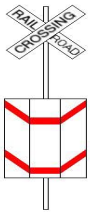
Elements include not only the positive obvious characteristics of the efficient movement of freight and passengers, but some possible negative aspects as well. These might include evidence of possible shifted freight, occasional dragging equipment, and other problems that all railroads work diligently to minimize.

Because of that public scrutiny, any improvements oriented toward grade crossings, whether legal, technical or mechanical, are immediately noticed and become publicly recognized and are important contributions to the perception of safe rail operations. Many states and most rail companies have spent considerable expense and effort on issues related to improved crossing safety and several of those actions are discussed here.

Tennessee's overall highway-grade crossing activities warrant review with respect to new technology, possible updating of laws, and new although not necessarily complex technology.

Due to the its success in reducing crashes at highway grade crossings the IdaShield has been given special attention in this report.

Figure 29
The IDASHIELD



Directed at improved grade crossing safety, first in Ohio and then in Idaho, the "IdaShield" is primarily a highway/rail warning signage system, consisting of reflectorized panels, angled to reflect both approaching car and locomotive lights across high-rail crossings to alert motorists of approaching trains. Reflected light is

seen as train cars pass over a crossing and cause a "strobe-effect" as passing rail cars alternately create a flashing effect for motorists awaiting the train to pass.

Initially borrowed from the state of Ohio, the IdaShield program has a growing number of supporting states. The Ohio "Buckeye Shield" was red and white with "YIELD" printed vertically in the middle of the sign. Idaho Code states that stop signs shall be installed at all passive highway-rail crossings unless an engineering study has been conducted and the results showed that the existence of stop signs are more hazardous than their absence. In order for the sign to be used in Idaho, the word "YIELD" had to be removed. The modified Ohio Buckeye shield was subsequently renamed the IdaShield.

Idaho Operation Lifesaver requested of Union Pacific Railroad sufficient funding to produce 25 sets of the modified Ohio Buckeye. Union Pacific Railroad provided the funding and made the initial 25 sets of IdaShield signs. These signs were installed at 25 locations throughout the State of Idaho. A study of driver reaction to the signs was made over a 2-year period. The study showed that 74 percent of the drivers stopped at crossings with the IdaShield and stop signs compared to 52 percent stopping at crossings with stop signs only. *It was also noted that 89 percent of the drivers looked for trains with the IdaShield compared to 65 percent at crossings with only stop signs.* These results encouraged Idaho Operation Lifesaver and the Idaho Transportation Department to continue its IdaShield activities.

At the May 1996 meeting of Idaho Operation Lifesaver, Governor Phil Batt announced that funding was available for the IdaShield installation project that was being proposed. Funding was available from "Stripper Well Funds" secured due to a class action lawsuit against oil companies. The Idaho Department of Water Resources was charged with the distribution of these funds and a grant was approved by the U.S. Department of Energy for $1.1 million in early August 1996.

A request for Federal Highway Administration (FHWA) approval to install the IdaShield sign was submitted in early August 1996 and approval was received for an experimental project in early October 1996. FHWA approval was needed since the IdaShield is not recognized in the *Manual on Uniform Traffic Control Devices* (MUTCD). Subsequently, all railroad companies agreed to install and maintain the sign installations as part of their participation in the project and agreements were finalized with each railroad company to install and maintain the signs.

Installation efforts started in May 1997 and as of August 15, 1998, all IdaShield installations were completed. The following railroad companies support the IdaShield project:

- Burlington Northern Santa Fe Railway
- Camas Prairie Railnet
- Eastern Idaho Railroad
- Idaho Northern and Pacific Railroad
- Montana Rail Link
- Palouse River and Coulee City Railroad
- Saint Maries River Railroad
- Union Pacific Railroad

The installations by railroad companies are indicated in Table 19.

TABLE 19

IdaShield Installations

Railroad Company	Passive Crossings	Active Crossings	Total Crossings
Burlington Northern and Santa Fe Railway	63	19	82
Camas Prairie Railnet	100	9	109
Eastern Idaho Railroad	263	80	343
Idaho Northern and Pacific Railroad	57	4	61
Montana Rail Link	5	4	9
Palouse River and Coulee City Railroad	26	12	38
Saint Maries River Railroad	24	3	27
Union Pacific Railroad	493	179	672
Total	**1,031**	**310**	**1,341**

The costs related to this project as of August 15, 1998, are shown in Table 20.

TABLE 20

Costs of IdaShield Installations

Materials Costs	$1,071,703.37
Labor Paid	$109,300.00
Subtotal	$1,181,003.37
Labor Donated*	$603,450.00

Grand Total	**$1,784,543.37**

*Estimated labor donated by railroad companies

This represents a cost of $1,330 per installation, a very modest investment when compared to the very high cost of a grade separation.

Each railroad company received a minimum of 10 percent excess material to be used as replacement for signs damaged or vandalized. The cost of excess material came to $127,474. The material is stored by Union Pacific Railroad and distribution will be made by Idaho Operation Lifesaver upon request from rail companies in Idaho.

Total projected cost of the IdaShield project after inspections is $1,181,003.37, a 9.8 percent overrun of the initial $1.1 million funded for the project. The overrun was made up out of the Railroad Grade Crossing Protection Account, set up by the Idaho Legislature to match federal aid or fund (in whole) railroad crossing safety projects.

Study Findings

Studies were conducted at crossings to determine the effectiveness of the IdaShield signs. The study examined the percent of drivers that stopped at crossings with stop signs, and the percent of drivers that actually looked for trains (head motion) while approaching the crossing or stopping at the crossing. This study was agreed upon with FHWA in the initial request to install the signs.

Results of the study of head motion of drivers indicated that there was an 18 percent increase (64 percent before to 82 percent after) in drivers looking for trains upon approaching the crossing. There was only a 12 percent increase (52 percent before to 64 percent after) in drivers stopping at the stop sign.

A related study that was agreed upon with FHWA was a public opinion poll of the value of six different signs. The public was asked to evaluate six signs and rank them from one to five. The people completing the questionnaire were interviewed afterward to determine their reasoning in ranking the signs.

A public opinion poll was conducted in two areas of the State of Idaho, the Western Idaho State Fair and the Eastern Idaho State Fair. The results of the public opinion poll that ranked the signs above average (4 or 5) are as follows:

1.	Stop Sign	78.9 percent
2.	Advanced Warning (W10-1)	77.6 percent

3.	Crossbuck Sign	64.9 percent
4.	Advanced Warning (W10-2)	63.1 percent
5.	Stop Ahead	62.5 percent
6.	IdaShield Sign	42.9 percent

Interviews of the public at the two state fairs indicated that most of the public did not recognize the IdaShield sign. Of those that did recognize the sign, most of them were professional drivers (truck and school bus) or did a lot of driving at night. It was their opinion that the sign was very good at night but was of less use during daylight hours. The graph below indicates that the nighttime collisions between trains and highway vehicles are still decreasing even though there was some increase in overall collisions for the year 2000.

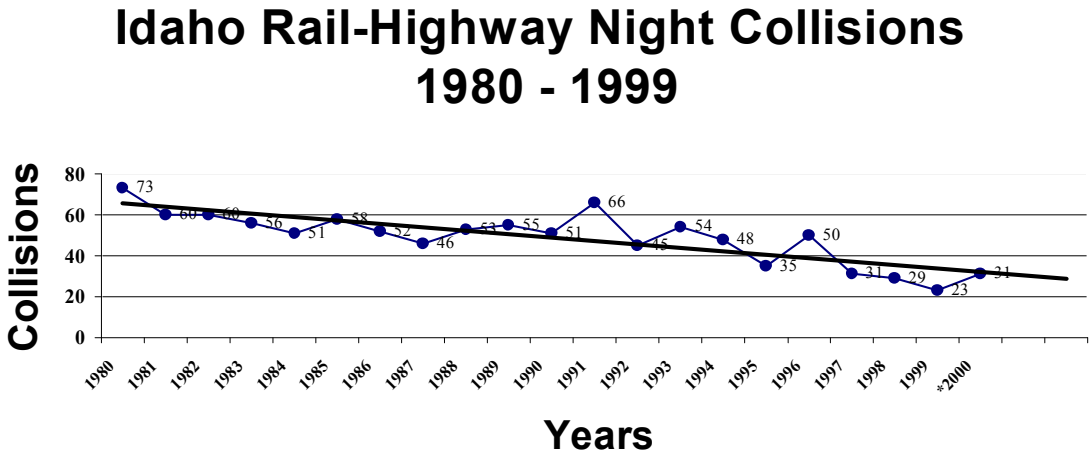
With an increase of 18 percent of the drivers looking for trains, it appears that the signing has improved the safety at the passive crossings. During this study period, collisions between automobiles and trains also decreased.

The study of head motion indicated that the IdaShield did little good without the stop sign. This study showed only 17 percent of the drivers looking for trains at locations with IdaShield signs only.

With the personal interviews of the people completing the opinion poll, it is felt that the

Figure 30
Source: Idaho DOT

IdaShield sign is of good value for people driving at night. (See trend line on chart in Figure 30 – Idaho Rail Highway Night Collisions.)



The Idaho Transportation Department recommends that the IdaShield be adopted by the MUTCD as an optional sign for railroad grade crossings that have passive warning only (no flashing lights or gates).

Comparison of Tennessee Grade Crossing Laws with Those of Other States

The matter of safety at grade crossings throughout the country will continue to be a high-profile safety issue. As the numbers and lengths of trains increase, as more freight moves from highway to rail and as hazardous materials increasingly move by rail, grade crossing safety awareness will demand increasing public and legislative attention.

Because of that, the consultant team reviewed both Tennessee statutes as they relate to crossing issues and those of other states, in order to make informative as well as instructively useful comparisons.

There are approximately 280,000 highway-rail crossings in the United States. Among those, about 50,000 are private crossings. Jurisdiction over public crossings normally resides with state agencies and among the states; responsibility is divided among highway departments, transportation departments, and public regulatory agencies.

Crossing Consolidations and Closures

In Tennessee, the Department of Transportation, through the discretion of the Commissioner or the Commissioner's designee, has the authority to eliminate grade crossings whenever the crossing elimination is necessary for the protection of persons traveling on the highway or railroad.

The affected railroad company has the right to appeal to the Public Service Commission but only with regard to the period of time required to comply. The Public Service Commission has the authority to stay the order of the Commissioner for the actual construction for any length of time not exceeding two years. Tennessee Code Ann. §§ 65-11-107-108-109 (1999).

This system compares favorably with the crossing closure systems of other states in the region.

Crossing Treatment Procedures

This section presents a description of the processes and procedures required, along with the roles to be played by the respective parties (units of government and the railroads),

when undertaking elimination, relocation, construction, repair and/or improvement of grade crossings.

In Tennessee, when any grade crossing is ordered to be eliminated by the Commissioner of Transportation, it is the duty of the affected railroad company to comply with the order within the specified time by first submitting to the Commissioner or the Commissioner's designee detailed plans and specifications along with estimates of cost for the construction of a grade separation, including its approaches.

The affected railroad company has the right to appeal the order of the Commissioner to the Public Service Commission for an extension of time given to begin and complete the actual construction of the grade separation. If it finds that the financial condition of the affected railroad would be adversely affected, the Public Service Commission is empowered to stay the order for any length of time, not to exceed two years.

If the affected railroad fails to comply with the Commissioner's order for grade separation or fails to avail itself of the opportunity to appeal the order within 60 days from the date of the service of the order, the Commissioner is empowered to proceed immediately with the construction of the separation and, upon completion, to assess one half of the cost of preparation of plans and estimates and one half of the cost of the work of construction against the affected railroad company.

All costs as are assessed in this manner will constitute a lien upon the physical properties of the railroad recoverable by suit. Tennessee Code Ann. § 65-11109 (1999).

The Commissioner of Transportation may, by agreement or contract with a railroad company, apportion the work to be done in constructing a grade separation between the railroad company and contractors acting under the control and supervision of the Commissioner, provided that, when any of the Commissioner's contractors or employees are on the railroad's right-of-way, they are subject to railroad company rules and regulations for safety purposes. Tennessee Code Ann. § 65-11-110 (1999).

When an overpass or underpass is constructed on any state highway, the railroad company will maintain it, the approaches on its right-of-way and any part of a structure not supported by fill, but not the surface of the highway. The flooring of the overpass supporting the surface of the highway or constituting the surface of the highway will be considered as a part of the structure to be maintained by and at the expense of the railroad company. The Commissioner of Transportation will maintain, out of public

funds, any fill, approach to any crossing not on the railroad company's right-of-way and the entire surface of the highway at all points. Tennessee Code Ann. § 65-11-112 (1999).

Blocked Crossings

This section examines the subject of the blocking of crossings by railroads, the exceptions to the law and the penalties imposed. The majority of states place restrictions on the amount of time a highway-rail crossing can be blocked. The laws and regulations vary, but never do they exceed more than ten minutes. A number of states list an exception for emergencies or circumstances beyond the control of the railroad company. That is not to say that the individual cities and towns within those states with no relevant statute do not have an ordinance restricting the blocking of highway-rail crossings within their jurisdictions. A number of them do, but to list them all would extend beyond the scope of this report.

In comparison, South Carolina permits standing trains to block crossing for a maximum of 5 minutes. The person in charge of the train must be notified before the 5 minutes commence. South Carolina Code Ann. § 57-7-240 (Law. Co-op. 1998).

For every such offense, a person shall pay not less than $5 or more than $20. It is considered a new offense for every 24-hour period the blockage continues. South Carolina Code Ann. § 58-17-4080 (Law. Co-op. 1998).

Alternatively, South Dakota prohibits trains from blocking any street, road, or highway-rail crossing for more than 20 consecutive minutes if it is blocking the path of an emergency vehicle. The state makes exceptions if the train is disabled by accident or otherwise, or if it cannot be moved without striking an object or a person on the track. South Dakota Codified Laws Ann. § 49-16A-119 (1999).

South Dakota law considers a violation of this section a Class 2 misdemeanor. South Dakota Codified Laws Ann. § 49-16A-119 (1999).

The state exempts railroad employees from liability if the blockage was necessary under state and federal rules. South Dakota Codified Laws Ann. § 49-16A-94 (1999).

Texas law prohibits a blocked crossing for more than 5 minutes. This law applies only to a stopped train and is addressed to any officer, agent, servant or receiver of a railroad corporation. Local ordinances may allow passenger trains to stand for the purpose of

receiving or discharging passengers, mail, express, or freight for a period longer than 5 minutes. Texas [Transp] Code Ann. § 471.008-471.007 (West 1999).

Violators are guilty of a misdemeanor punishable by a fine of not less than $5 or more than $100. Texas [Transp] Code Ann.§ 471.007(West 1999).

Tennessee has no applicable statute associated with blocked crossings, although numerous municipalities have related local ordnances.

Warning Devices – Passive

This section looks at laws and regulations concerning the use of passive warning devices at highway-rail crossings. Approximately 78 percent of the reported 280,503 highway-rail crossings in the United States have passive warning devices or traffic control devices as opposed to automatic gates, flashing lights or other train-activated devices.

These passive devices are designed to direct the attention of the driver to the location of highway-rail crossings so they may exercise caution when traversing the crossing. The messages conveyed by these devices provide warning and guidance, but they also may direct some mandatory action by the driver. These devices consist of regulatory, warning and guide signs and supplemental pavement markings. All states require that these devices conform with the Manual on Uniform Traffic Control Devices.

In Oklahoma Corporation Commission has authority, after proper investigation, to identify grade crossings that are extra hazardous. Once a designation is made, the Commission has the authority to order the installation of appropriate warning devices. The type, location and number of devices is to be determined by the Commission, as is the division of costs. The devices are to conform as near as possible to national standards. Oklahoma Stat tit. 17, § 86 (1999).

Every railroad corporation in the state has a duty to erect suitable warning signs at each crossing of its tracks by a public highway. Oklahoma Stat. tit. 66, § 124 (1999).

The Commission is also vested with the authority to promulgate rules and regulations concerning the design, installation, construction, maintenance, inspection and testing of warning signal devices at highway-rail crossings. Oklahoma Stat. tit. 66, § 130 (1999).

In contract, with other states, all railroads in Oregon must install and maintain STOP signs at every farm or private grade crossing. The Oregon Department of

Transportation has the authority to prescribe the number, type and location of the STOP signs and may exempt a farm or private grade crossing if the Department determines that an even more dangerous condition would be created by the installation of the sign. Oregon Rev. Stat. § 824.224 (1999).

The Department may prescribe the number, kind and location of advance warning signs to be installed on the highway before each highway-rail crossing. The Department shall adopt rules prescribing specifications for the design and location of protective devices. Oregon Rev. Stat. § 824.220 (1999).

Rhode Island statutes provide that every railroad corporation must install and maintain at every highway-rail crossing a suitable signboard for the purpose of warning traffic of approaching trains. Rhode Island Gen. Laws § 39-8-13 (1999).

Railroad corporations neglecting or refusing to comply with the provisions of § 39-8-13 may be fined an amount not to exceed one thousand dollars and may be liable for all damages due to neglect or refusal to comply. Rhode Island Gen. Laws § 39-8-15 (1999).

South Dakota law requires that except within the limits of a municipality, the Department of Transportation and county commissioners have the authority to designate any hazardous highway-rail crossing as a "stop" crossing by placing a STOP sign preceded by a warning sign at the crossing. South Dakota Codified Laws Ann. § 31-28-17 (1999).

At all points where the railroad tracks cross a public road, the railroad owning the tracks is responsible for the erection of a sign with large and distinct letters warning drivers to use caution when crossing the upcoming track. South Dakota Codified Laws Ann. § 49-16A-87 (1999).

The public board or officer who is responsible for the repair and maintenance of a public highway shall erect and maintain a standard railroad advance warning sign at a distance from the crossings as specified by the Department of Transportation or other controlling body. South Dakota Codified Laws Ann. § 31-28- 7 (1999).

In Tennessee the Public Service Commission of the state and the Commissioner of Transportation or his designee have the power and authority to determine the type of railroad crossing sign which shall be uniform throughout the state. Tennessee Code Ann. § 65-11-105 (1999).

"Boards, well supported by posts or otherwise, shall be placed and constantly kept, across each public road, when the same is crossed on the same level by the track of the railway, the boards are to be elevated so as not to obstruct travel and, on each side of such board, there shall be printed in large letters, easily to be seen by the traveler, the words 'Railroad Crossing -- Look Out for the Cars'." Tennessee Code Ann. § 65-18-104 (1999).

Warning Devices – Train Borne

This safety element addresses the legal and regulatory requirements for trains operating within states to provide some type of auditory alarm as they approach grade crossings. A state may require that a train carry a bell, whistle or a horn and require the repeated use of that bell, whistle or horn at a specified distance before reaching crossings. Some state laws may also require that trains be equipped with headlights of a certain candlepower while operating at night. As with any law, failure to comply brings penalties. In recent years, a couple of states have passed legislation to allow individual municipalities to regulate through their local ordinances, the blowing of the train horn at crossings. If a state has such a law, it is listed here under the subtitle "local option". If a state has a penalty codified, it is presented here.

Under Arizona law, each railroad must equip its locomotives with a bell weighing not less than 20 pounds. Any railroad that fails to comply with this section is liable for a penalty of $100 recoverable in an action filed by the attorney general in the name of the state. A separate action may be filed for each violation. In addition to the $100 penalty, the railroad may be liable for all damages sustained by any person for failure of the corporation to comply with this section. Arizona Rev. Stat Ann. § 40-847 (1999).

It is unlawful for any locomotive not equipped with an automatically operated bell ringer, which will cause the bell on the engine to continue to ring after being set in motion by the engineer or fireman to operate in the state. The starting and stopping device for the bell ringer must be placed in a position where it can be operated by the engineer or fireman. A violation of this section makes the railroad guilty of a petty offense for each day the locomotive is used in violation of this section. If the ringer should become inoperable while the engine is in use, the engine may complete its trip. Arizona Rev. Stat. Ann. § 40-858 (1999).

Any person in charge of a railroad locomotive who, before crossing any traveled way, does not cause the bell to ring or a whistle, siren, or other sounding device to sound at a distance of at least 80 rods (1,320 feet or 440 yards) from a crossing until it is reached

is guilty of a Class 2 misdemeanor. Arizona Rev. Stat. Ann. § 40-854 (1999). Arizona requires a headlight brilliancy of not less than 1,500 candlepower measured without the aid of a reflector. Failure to comply with this section makes the railroad liable to the state for not less than $100 or more than $1,000 for each offense. Arizona Rev. Stat. Ann. § 40-846 (1999).

Arkansas requires locomotives or engines to have a bell of at least thirty pounds weight or a steam whistle. The bell or whistle must be sounded at a distance of at least 80 rods (1,320 feet or 440 yards) from the place where the track crosses any road or street and shall sound continuously until through the crossing. A violation of this section will result in a penalty of $200 for each incident of neglect plus possible liability for all damages sustained by any person as a result of such neglect. Arkansas Code Ann. § 23-12-410 (Michie 1998).

Arkansas law requires any company owning or operating a locomotive on a rail line over 50 miles in length to equip all their locomotives being operated at night with a headlight of power and brilliancy equal to 1,500 candlepower. A violation of this section will subject the offending railroad to a penalty of not less than $300 or more than $500 for each separate offense. Arkansas Code Ann. § 23-12-402 (Michie 1998).

Tennessee law requires repeated use of a bell or whistle for a distance of one quarter of a mile from the crossing and at short intervals until the train has passed the crossing. Tennessee Code Ann. § 65-12-108 (1999).

Warning Devices – Active

State laws and regulations concerning active warning devices have received much recent attention. Active warning devices as used here is intended to mean those devices that are activated automatically at the approach of a train. If a state does not have a pertinent law or regulation, it is listed as such.

Tennessee law requires that, within six months after the occurrence of a fatality resulting from a collision between a train and a vehicle or pedestrian at an unmarked highway-rail crossing where there are regularly scheduled trains, 100 or more vehicles cross daily and a regular school bus crossing, and/or upon the order of the Commissioner of Transportation, the affected railroad company install a marker with automatic flashing signal lights and a bell on either side of the tracks along the street, road or highway crossing the tracks. Installation costs are to be apportioned equally to the railroad company, the state of Tennessee and the county, municipality or the

metropolitan government in accordance with the fiscal procedures of each unit. Tennessee Code Ann. § 65-11-113 (1999).

Slow, Low, and Special Vehicles

This examination of regulations concerning slow, low and special vehicles at highway-rail grade crossings is especially important for a state such as Tennessee, with numerous tunnels, close clearances and related "high and wide" load restrictions.

"Slow and low vehicles" are variously referred to in the statutes as types of heavy equipment, e.g. any crawler-type tractor, steam shovel, derrick, roller or any other equipment or structure having a normal operating speed of 10 miles per hour or less. Some statutes specifically mention 6 miles per hour or less and one as low as 4 miles per hour in this category of vehicles.

"Special vehicles" as they are referred to in the statutes are vehicles carrying usually passengers for hire and school buses carrying children. Also included under this category are vehicles carrying explosive substances, flammable materials, or other types of hazardous material.

With the exception of Alaska, all of the states require one or more of the vehicles in these two categories to come to a full stop before traversing a highway-rail crossing. Federal regulations require every bus transporting passengers and vehicles carrying hazardous materials to stop and to listen and look in both directions along the tracks for an approaching train. When it is safe to do so, drivers may cross, however, federal regulations prohibit the drivers from manually shifting gears while moving across the tracks. For a complete listing of vehicles required to stop under federal regulations, see 49 CFR 392.10 (1997).

Tennessee law requires persons operating slow and low vehicles to stop before crossing a highway-rail crossing. The stop must be made within 15 to 50 feet of the nearest rail. After stopping, the operator must listen and look in both directions for an approaching train and for signals indicating the approach of a train. The driver may not proceed until it is safe to do so.

Tennessee law prohibits crossing when an automatic signal, crossing gates, a flagman or other device gives warning of an approaching train. If a flagman is used by the railroad, any movement over the crossing must be done under the flagman's direction. Tennessee Code Ann. § 55-8-148 (1999).

Tennessee law requires drivers of school buses carrying any children, vehicles carrying passengers for hire and vehicles transporting explosive substances or flammable liquids as cargo or part of a cargo to stop at crossings. The stops must be made within 15 to 50 feet of the nearest rail of the tracks. The driver is required to listen and look in both directions for an approaching train and for signals indicating the approach of a train, and may then proceed only when it is safe to do so. While proceeding over the highway-rail crossing, the driver is prohibited from shifting gears. Tennessee Code Ann. § 55-8-147(a)(1999).

A violation of the "stop" requirement by drivers of special vehicles is a Class B misdemeanor. Tennessee Code Ann. § 55-8-147(c) (1999)

Driver Action

This section presents an overview and survey of the various laws and regulations concerning the responsibility of the motorist with respect to highway-rail crossings.

The laws and regulations cover such things as reduced speed when approaching and crossing a highway-rail crossing, standing, stopping or parking in close proximity to tracks at highway-rail crossings, limitation of driving to the left side of the roadway to pass or overtake another vehicle and regulations covering full stops at highway-rail crossings.

Penalties are included where they are mentioned. Consistent with all other chapters, the relevant citations are included in the text for ease of reference.

In Alabama, except where a lower speed is specified, it is lawful for a motorist to drive at a speed not exceeding 15 miles per hour when approaching within 50 feet of a highway-rail crossing when the view of the motorist is obstructed. A motorist's view is considered to be obstructed when, at any time during the last 200 feet of the approach to the crossing, there is not a clear and uninterrupted view of the approach to the crossing or of any traffic on the railroad track for a sight distance of 400 feet in each direction from the crossing. Alabama Code § 32-5-91 (1999).

It is unlawful for any motorist in Alabama to proceed onto a railroad grade crossing unless there is adequate space on the other side of the crossing to accommodate his vehicle without obstructing the passage of other vehicles, notwithstanding any traffic control signal indication to proceed. Alabama Code § 32-5A-61 (1999).

Unless the right side of the highway is obstructed or impassable, all motorists are required to keep to the right side of the highway when traversing a highway-rail crossing. Alabama Code § 32-5-54 (1999).

Under certain conditions, drivers of all vehicles in Alabama are required to bring their vehicles to a complete stop within 15 to 50 feet of the nearest rail of a highway-rail crossing. The driver may not proceed until it is safe to do so. These requirements are applicable at all highway-rail crossings where the following conditions exist:

1. When a clearly visible electrical or mechanical device is giving warning of an approaching train.

2. When a crossing gate is down or flagman is indicating the approach of a train.

3. When a railroad train is within 1,500 feet of the crossing and is emitting an audible signal.

4. When an approaching train is clearly visible.

When approaching a highway-rail crossing in Texas, all motorists are required to come to a full stop within 15 to 50 feet of the nearest rail of the tracks and may not proceed over the crossing until it may be done safely. These requirements apply at highway-rail crossings under the following circumstances:

1. Where warning of an approaching train is being given by a clearly visible electrical or mechanical device.

2. Where a crossing gate is lowered or a flagman is giving a signal indicating that a train is approaching or passing.

3. Where a train approaching within approximately 1,500 feet of a highway-rail crossing is emitting a signal audible at that distance and, because of its speed or close proximity to the crossing, constitutes an immediate hazard.

4. Where a train is in hazardous proximity to the crossing and is plainly visible.

5. The operator is required to stop by:

    a. other law;

    b. a rule adopted under a statute;

c. an official traffic-control device; or

d. a traffic-control signal.

An operator of a vehicle who approaches a railroad grade crossing equipped with railroad crossbuck signs without automatic, electric, or mechanical signal devices, crossing gates, or a flagger warning of the approach or passage of a train is required to yield the right-of-way to a train in hazardous proximity to the crossing, and proceed at a speed that is reasonable for the existing conditions. If required for safety, the operator shall stop at a clearly marked stop line before the crossing or, if no stop line exists, not closer than 15 feet or farther than 50 feet from the nearest rail.

A driver commits an offense if the operator drives around, under, or through a crossing gate or a barrier at a railroad crossing while the gates or barrier is closed, being closed, or being opened.

All drivers in Tennessee are required to stop within 15 to 50 feet of the nearest rail of the tracks at any highway-rail crossing and may not proceed over the crossing until it can be done safely. These requirements apply under any of the following circumstances:

1. Where warning of an approaching train is being given by a clearly visible electrical or mechanical device.

2. When a crossing gate is lowered or a flagman is giving a signal indicating the approach or passage of a train.

3. Where a train approaching within approximately 1,500 feet of the crossing is emitting a signal audible at that distance and, because of its speed or close proximity to the crossing, constitutes an immediate hazard.

4. When a train is in hazardous proximity to a crossing and is clearly visible.

It is unlawful in Tennessee for any person to drive any vehicle through, around or under any crossing gate or barrier that is closed or is in the process of being opened or closed. Tennessee Code Ann. § 55-8-145(a)(b) (1999).

A violation of Section 55-8-145 is a Class C misdemeanor. Tennessee Code Ann. § 55-8-145(c) (1999).

The Tennessee Department of Transportation and local authorities with the approval of the Department have statutory authority to designate a highway-rail crossing as particularly dangerous one and may require a stop sign be erected at the crossing. At any such crossing, motorists are required to bring their vehicles to a complete stop within 15 to 50 feet of the nearest rail of the tracks and may proceed only while exercising due care. Tennessee Code. Ann. § 55-8-146(a) (1999).

Failing to comply with any of the provisions of Section 55-8-146 is a Class 2 misdemeanor in Tennessee. Tennessee Code Ann. § 55-8-146(c) (1999).

It is unlawful in Tennessee for anyone to stop, stand or park a vehicle within 50 feet of the nearest rail of the tracks at a highway-rail crossing, except where stopping, standing or parking is necessary to avoid conflict with other traffic or under the direction of a police officer or traffic control device. These requirements are only applicable outside the limits of an incorporated municipality in Tennessee. Tennessee Code Ann. § 55-8-160(a) (1999).

Failure to comply with any provision of Section 55-8-160 is a Class C misdemeanor. Tennessee Code Ann. 55-8-160(d) (1999).

Private Crossings

Private highway-rail grade crossings are those that are on roadways not open to use by the public nor are they maintained by public authority.

Typical types of private crossings are as follows:

- Farm crossings that provide access between tracts of land lying on both sides of the railroad.
- Industrial plant crossings that provide access between plant facilities on both sides of the railroad.
- Residential access crossings over which the occupants and their invitees reach private residences from another road, frequently a public road paralleling and adjacent to the railroad right-of-way.
- Temporary crossings established for the duration of a private construction project or other seasonal activity.

In some instances, changes in land use have resulted in expanded use of such private crossings to the extent that they have become public crossings as evidenced by frequent use of the general public. This occurs whether or not any public agency accepted responsibility for maintenance or control of the use of the traveled way over the crossing.

There are an estimated 100,671 private highway-rail crossings on the U.S. rail system (Source: *Railroad Safety Statistics, Annual Report 1998, Table 9-10)*. U.S. Department of Transportation, Federal Railroad Administration). Casualties and property losses resulting from accidents at these crossings are a continual concern. At present, authority for closure or treatment of private crossings does not exist in all states. Those that do are listed in this chapter. Typically, there is an agreement between the landowner and the railroad that governs the use of the private crossing.

Every railroad company operating in Utah is required to erect and maintain a fence of each side of its rights-of-way where the same passes through lands owned and improved by private owners. The fence shall not be less than 4½ feet in height and may be constructed of barbed or other fencing wire with not less than five wires, and good, substantial posts not more than one rod apart with a stay midway between the posts attached to the wires to keep the wires in place. Whenever any railroad company shall provide gates for private crossings for the convenience of the owners of the land through which the railroad passes, such gates are to be constructed so that they may be easily operated; and every railroad company shall be liable for all damages sustained by the owner of any domestic animal killed or injured by such railroad as a consequence of the failure to build or maintain such fence. The owner of the land is required to keep the gate closed at all times when not in actual use, and if he fails to do so, and in consequence thereof, any animal strays upon the railroad and is killed or injured, the owner is not entitled to recover damages from the railroad. Utah Code Ann. § 56-1-13 (1999).

Photographic Monitoring and Enforcement

Automated enforcement of traffic laws using photographs and videotapes has assumed a new presence in the effort to enforce speed limits, and ticketing red light violators. In the last year of so it has entered the discussion as a possible tool for monitoring highway-railroad grade crossings. The success of several research projects that used photographic monitoring of driver behavior at highway-railroad grade crossings has prompted a new round of discussion concerning the use of such technology as a means of enforcement against violators at highway-railroad crossings.

This discussion presents an overview of state laws concerning photographic enforcement of traffic laws. Several states now have such laws, but only a couple allow for specific application to railroad crossings.

The California Vehicle Code authorizes governments and law enforcement agencies to operate "automated enforcement systems" at both traffic light intersections (Section 21455.5) and at railroad grade crossings (Section 21362.5). California [Veh.] Code §§ 22451.5 - 21362.5 (West 1999) Section 210 of California's Vehicle Code defines an "automated enforcement system" as "...any system...that photographically records a driver's response to a rail or rail transit signal or crossing gate, or both, or to an official traffic control signal...and is designed to obtain a clear photograph of a vehicles license plate and the driver of the vehicle." Automated enforcement systems are authorized for permanent use at railroad crossings. However, under Section 21455.5, the devices could only be used at traffic light intersections until January 1, 1999.

Both sections 21362.5 and 21455.5 require that signs be posted giving notice to drivers of the presence of automated enforcement systems. Both statutes also provide that photographic records made by automated enforcement systems are confidential. These records may only be accessed by relevant governmental and law enforcement agencies, the registered owner of the violating vehicle, and any individual identified by the violating vehicle's owner as the driver at the time of the alleged violation, if signs are posted to notify drivers of the systems' presence.

Section 22451 states that violations detected by an automated enforcement system are subject to the procedures established by Section 40518. Under Section 40518, a written notice to appear, issued by peace officer or a qualified employee of a law enforcement agency and mailed with 15 days of the alleged violation to the current address of the registered owner of the violating vehicle, constitutes a complaint against the vehicle owner.

The general assembly of Colorado declared that the enforcement of traffic laws through the use of automated vehicle identification systems is a matter of statewide concern and an area in which uniform state standards are necessary, passed a law allowing municipalities to adopt an ordinance authorizing the use of an automated vehicle identifications system to detect violations of traffic regulations adopted by the municipality, or the state, a county, or a municipality may utilize an automated vehicle identification system to detect traffic violations under state law, subject to the following conditions and limitations:

(a)(I) In order for a municipal court to establish personal jurisdiction over a defendant in any case involving an automated vehicle identification system, a penalty assessment notice or summons and complaint shall be served upon the defendant in accordance with the Colorado municipal court rules of procedure. In order for the state or county to establish personal jurisdiction over a defendant in any case involving an automated vehicle identification system, a penalty assessment notice or summons and complaint shall be personally served upon the defendant. Nothing in this section may be deemed to prevent the state, a county, or a municipality from mailing a written notice to the defendant advising the defendant of the alleged violation and permitting the defendant to waive such process of service. (II) If the state, a county, or a municipality detects any alleged violation of a municipal traffic regulation or a traffic violation under state law through the use of automated vehicle identification systems, then the state, county or municipality shall serve the penalty assessment notice or summons and complaint for the alleged violation no later than ninety days after the violation occurred.

(b) Notwithstanding any other provision of the statutes to the contrary, the state, county, or a municipality may not report to the Department of Transportation any conviction or entry of judgment against a defendant for violation of a municipal traffic regulation or a traffic violation under state law if the violation was detected through the use of an automated vehicle identification system.

(c) The state, a county, or a municipality may not report to the Department of Transportation any outstanding judgment or warrant for purposes of section 42-2-107(5) or 42-2-118(3) based upon any violation or alleged violation of a municipal traffic regulation or traffic violation under state law detected through the use of an automated vehicle identification system.

Recent Recommendations from the National Transportation Safety Board Regarding Grade Crossings

As recently as February 2002, the National Transportation Safety Board issued new recommendations specific to highway/grade crossings. The following elements have been recommended to the Federal Railroad Administration for possible adoption and will be exposed to both public input and opinion from groups such as the American Short Line and Regional Railroad Association, the Association of American Railroads, and AASHTO's Standing Committee on Rail.

- For all railroads that install new or upgraded grade crossing warning systems that include crossing gates and that are equipped with event recorders, require

that the information captured by those event recorders include the position of the deployed gates.

- In fulfilling the federal mandate to help prepare emergency responders to respond to an accident involving Amtrak and freight-based equipment, emphasize to those responders the possibility that such an accident could result in large quantities of burning diesel fuel and urge them to be prepared to respond to this specific hazard. (R-02-3)

TABLE 1

Inbound Domestic Rail Freight by Commodity
Rail Cargoes with Origin in United States and Destination in Tennessee

STCC2	Commodity	1998 (tons)	2005 (tons)	2010 (tons)	2020 (tons)	Growth 1998-2005	Growth 2005-2010	Growth 2010-2020
1	Farm Products	3,831,873	4,174,452	4,438,638	4,469,442	9%	6%	1%
8	Forest Products	3,334	3,773	4,122	4,046	13%	9%	-2%
10	Metallic Ores	425,510	390,633	368,262	300,576	-8%	-6%	-18%
11	Coal	18,288,110	20,832,855	22,864,656	25,164,367	14%	10%	10%
14	Non-Metallic Minerals	1,989,630	2,161,911	2,294,969	2,336,922	9%	6%	2%
20	Food or Kindred Products	3,873,583	4,732,979	5,463,662	7,963,017	22%	15%	46%
23	Apparel or Related Products	8,010	4,258	4,230	4,297	-47%	-1%	2%
24	Lumber or Wood Products	1,744,932	2,120,993	2,443,443	2,983,780	22%	15%	22%
25	Furniture or Fixtures	26,508	33,643	40,178	51,210	27%	19%	27%
26	Pulp, Paper or Allied Products	1,397,364	1,623,039	1,807,610	2,159,014	16%	11%	19%
27	Printed Matter	1,600	1,800	1,957	2,653	12%	9%	36%
28	Chemicals or Allied Products	4,960,004	6,062,781	7,009,616	7,975,429	22%	16%	14%
29	Petroleum or Coal Products	504,053	568,488	622,013	677,829	13%	9%	9%
30	Rubber or Misc. Plastics	51,070	48,497	53,426	69,198	-5%	10%	30%
32	Clay, Concrete, Glass or Stone	1,438,575	1,864,395	2,245,212	2,934,784	30%	20%	31%
33	Primary Metal Products	1,811,178	2,199,422	2,549,653	2,959,741	21%	16%	16%
34	Fabricated Metal Products	21,346	28,230	34,493	48,031	32%	22%	39%
35	Machinery	15,088	21,793	28,432	38,141	44%	30%	34%
36	Electrical Equipment	20,220	30,657	41,491	64,184	52%	35%	55%
37	Transportation Equipment	814,596	986,884	1,134,685	1,329,318	21%	15%	17%
39	Misc. Manufacturing Products	24,474	30,917	37,913	50,479	26%	23%	33%
40	Waste or Scrap Materials	787,534	1,023,780	1,235,815	1,381,005	30%	21%	12%

TABLE 1

Inbound Domestic Rail Freight by Commodity
Rail Cargoes with Origin in United States and Destination in Tennessee

STCC2	Commodity	1998 (tons)	2005 (tons)	2010 (tons)	2020 (tons)	Growth 1998-2005	Growth 2005-2010	Growth 2010-2020
41	Misc. Freight Shipments	114,925	138,224	158,075	121,848	20%	14%	-23%
42	Shipping Containers	249,704	300,391	342,344	427,589	20%	14%	25%
43	Mail or Contract Traffic	30,278	50,011	71,571	108,722	65%	43%	52%
44	Freight Forwarder Traffic	15,078	23,557	32,400	38,000	56%	38%	17%
45	Shipper Association Traffic	88,444	55,800	40,168	14,544	-37%	-28%	-64%
46	Freight All Kinds	3,003,100	3,787,426	4,473,444	5,821,767	26%	18%	30%
47	Small Packaged Freight	8,858	14,041	19,532	22,459	59%	39%	15%
48	Hazardous Waste	36,440	0			-100%		
99	Unknown	36,520	45,340	53,700	66,266	24%	18%	23%
	Grand Total	**45,621,939**	**53,360,969**	**59,915,711**	**69,588,658**	**17%**	**12%**	**16%**

TABLE 2

Outbound Domestic Rail Freight by Commodity
Rail Cargoes with Origin in Tennessee and Destination in United States

STCC2	Commodity	1998 (tons)	2005 (tons)	2010 (tons)	2020 (tons)	Growth 1998-2005	Growth 2005-2010	Growth 2010-2020
1	Farm Products	1,428,093	1,606,675	1,752,721	1,868,798	13%	9%	7%
8	Forest Products	25,348	31,121	36,131	38,148	23%	16%	6%
10	Metallic ores	1,288	1,108	995	899	-14%	-10%	-10%
11	Coal	8,175,927	9,212,836	10,033,186	10,596,838	13%	9%	6%
14	Non-Metallic Minerals	476,779	545,150	599,980	662,855	14%	10%	10%
20	Food or Kindred Products	2,926,100	3,597,847	4,171,285	6,272,007	23%	16%	50%
22	Textile Mill Products	3,308	3,802	4,200	4,675	15%	10%	11%
23	Apparel or Related Products	12,624	16,145	19,354	23,576	28%	20%	22%
24	Lumber or Wood Products	1,067,194	1,340,687	1,578,666	1,988,482	26%	18%	26%
25	Furniture or Fixtures	24,444	32,202	39,245	56,451	32%	22%	44%
26	Pulp, Paper or Allied Products	1,580,810	1,919,703	2,205,979	2,911,896	21%	15%	32%
27	Printed Matter	30,376	36,072	40,786	59,524	19%	13%	46%
28	Chemicals or Allied Products	3,146,318	3,652,370	4,063,973	4,360,305	16%	11%	7%
29	Petroleum or Coal Products	262,346	278,759	291,340	295,692	6%	5%	1%
30	Rubber or Misc. Plastics	61,958	75,649	87,404	112,928	22%	16%	29%
32	Clay, Concrete, Glass or Stone	2,653,722	3,728,137	4,754,995	6,687,181	40%	28%	41%
33	Primary Metal Products	895,409	1,089,023	1,253,561	1,431,491	22%	15%	14%
34	Fabricated Metal Products	39,512	50,078	59,374	78,009	27%	19%	31%
35	Machinery	24,992	37,408	50,006	71,642	50%	34%	43%
36	Electrical Equipment	11,030	12,054	12,875	15,040	9%	7%	17%
37	Transportation Equipment	2,186,387	2,706,500	3,153,913	3,740,330	24%	17%	19%

TABLE 2

Outbound Domestic Rail Freight by Commodity
Rail Cargoes with Origin in Tennessee and Destination in United States

STCC2	Commodity	1998 (tons)	2005 (tons)	2010 (tons)	2020 (tons)	Growth 1998-2005	Growth 2005-2010	Growth 2010-2020
39	Misc. Manufacturing Products	7,082	9,727	12,214	16,453	37%	26%	35%
40	Waste or Scrap Metals	1,275,945	1,654,906	1,993,114	2,265,649	30%	20%	14%
41	Misc. Freight Shipments	31,867	37,034	41,240	31,244	16%	11%	-24%
42	Shipping Containers	235,894	287,804	331,853	427,385	22%	15%	29%
43	Mail or Contract Traffic	50,580	84,851	122,822	186,227	68%	45%	52%
44	Freight Forwarder Traffic	43,620	71,842	102,632	129,233	65%	43%	26%
45	Shipper Association Traffic	44,094	26,509	18,438	6,388	-40%	-30%	-65%
46	Freight All Kinds	3,454,226	4,523,858	5,489,853	7,496,428	31%	21%	37%
47	Small Packaged Freight Shipments	23,604	38,569	54,781	65,639	63%	42%	20%
48	Hazardous Waste	7,328	0			-100%		
99	Unknown	41,718	52,107	61,609	76,378	25%	18%	24%
	Grand Total	**30,249,923**	**36,760,534**	**42,438,526**	**51,977,793**	**22%**	**15%**	**22%**

TABLE 3

International Commodity Exports

Commodities with Origin in Tennessee Destined for Locations Outside the United States

		Data				Growth		
Commodity	**Destination**	**1998**	**2005**	**2010**	**2020**	**1998-2005**	**2005-2010**	**2010-2020**
Farm Products	Asia	1,414,003	2,055,466	2,685,460	4,075,738	45%	31%	52%
	Canada	25,951	35,541	44,644	68,069	37%	26%	52%
	Europe	64,996	94,860	124,336	187,709	46%	31%	51%
	Lat in America	696,347	1,019,527	1,338,949	2,041,922	46%	31%	53%
	Mexico	5,917	8,511	11,035	14,650	44%	30%	33%
	Rest of World	762,202	1,103,033	1,436,333	2,222,306	45%	30%	55%
	Unknown	25,895	0	0	0			
Farm Products Total		2,995,312	4,316,940	5,640,757	8,610,393	44%	31%	53%
Fresh fish or Marine Products	Asia	3,384	4,782	6,122	9,437	41%	28%	54%
Fresh fish or Marine Products Total		3,384	4,782	6,122	9,437	41%	28%	54%
Metallic Ores	Asia	2,175	2,802	3,356	4,479	29%	20%	33%
Metallic Ores Total		2,175	2,802	3,356	4,479	29%	20%	33%
Nonmetallic Minerals	Asia	4,900	6,123	7,179	9,969	25%	17%	39%
	Lat in America	1,415	1,733	2,003	2,725	22%	16%	36%
	Mexico	193,643	264,177	329,798	433,999	36%	25%	32%
Nonmetallic Minerals Total		199,958	272,033	338,980	446,693	36%	25%	32%
Food or Kindred Products	Asia	118,550	164,993	209,146	294,941	39%	27%	41%
	Canada	9,338	11,337	13,030	15,717	21%	15%	21%
	Europe	158,259	210,203	257,470	330,327	33%	22%	28%
	Lat in America	179,224	258,516	335,890	487,273	44%	30%	45%
	Mexico	4,600	6,276	7,836	8,969	36%	25%	14%
	Rest of World	48,200	69,688	90,709	132,560	45%	30%	46%
Food or Kindred Products Total		518,171	721,013	914,080	1,269,786	39%	27%	39%
Textile Mill Products	Asia	5,302	7,268	9,104	12,514	37%	25%	37%
	Mexico	5,491	7,716	9,838	12,880	41%	28%	31%
Textile Mill Products Total		10,793	14,984	18,942	25,394	39%	26%	34%

TABLE 3

International Commodity Exports

Commodities with Origin in Tennessee Destined for Locations Outside the United States

		Data				Growth		
Commodity	**Destination**	**1998**	**2005**	**2010**	**2020**	**1998-2005**	**2005-2010**	**2010-2020**
Lumber or Wood Products	Asia	21,097	28,607	35,558	44,161	36%	24%	24%
	Canada	1,747	1,931	2,073	2,147	10%	7%	4%
	Europe	37,047	40,143	42,511	46,606	8%	6%	10%
Lumber or Wood Products Total		59,892	70,680	80,142	92,913	18%	13%	16%
Furniture	Latin America	6,384	9,765	13,228	18,547	53%	35%	40%
Furniture Total		6,384	9,765	13,228	18,547	53%	35%	40%
Pulp, Paper or allied products	Asia	83,441	122,829	161,930	230,254	47%	32%	42%
	Canada	47,956	61,973	74,431	95,213	29%	20%	28%
	Europe	113,470	165,326	216,325	302,231	46%	31%	40%
	Latin America	20,232	29,554	38,741	54,433	46%	31%	41%
	Mexico	3,957	5,808	7,640	9,969	47%	32%	30%
	Rest of World	10,158	15,279	20,452	30,252	50%	34%	48%
Pulp, Paper or allied products Total		279,214	400,769	519,519	722,351	44%	30%	39%
Chemicals	Asia	118,284	147,851	173,565	214,427	25%	17%	24%
	Canada	59,745	71,187	80,684	96,705	19%	13%	20%
	Europe	66,531	80,523	92,316	109,447	21%	15%	19%
	Latin America	50,555	60,917	69,645	82,518	20%	14%	18%
	Rest of World	3,494	4,127	4,648	5,357	18%	13%	15%
Chemicals Total		298,608	364,605	420,859	508,454	22%	15%	21%
Rubber or Misc Plastics	Asia	12,006	15,964	19,567	18,968	33%	23%	-3%
	Canada	2,849	3,338	3,739	3,550	17%	12%	-5%
	Latin America	7,980	7,980	10,149	9,089	0%	27%	-10%
Rubber or Misc Plastics Total		22,835	27,282	33,455	31,607	19%	23%	-6%
Leather Products	Latin America	2,297	2,279	2,267	2,140	-1%	-1%	-6%
Leather Products Total		2,297	2,279	2,267	2,140	-1%	-1%	-6%
Clay, Concrete, Glass or Stone	Canada	1,201	1,492	1,742	2,099	24%	17%	20%
	Mexico	14,592	22,545	30,761	44,982	55%	36%	46%

TABLE 3

International Commodity Exports

Commodities with Origin in Tennessee Destined for Locations Outside the United States

		Data				Growth		
Commodity	**Destination**	**1998**	**2005**	**2010**	**2020**	**1998-2005**	**2005-2010**	**2010-2020**
Clay, Concrete, Glass or Stone Total		15,793	24,037	32,504	47,081	52%	35%	45%
Primary Metal Products	Asia	3,048	4,698	6,401	9,395	54%	36%	47%
	Canada	1,446	1,844	2,193	2,739	28%	19%	25%
	Lat in America	1,693	2,180	2,612	3,008	29%	20%	15%
	Mexico	12,255	17,269	22,063	26,559	41%	28%	20%
Primary Metal Products Total		18,441	25,991	33,269	41,702	41%	28%	25%
Fabricated Metal Products	Asia	3,872	6,750	10,161	16,403	74%	51%	61%
Fabricated Metal Products Total		3,872	6,750	10,161	16,403	74%	51%	61%
Machinery	Asia	6,753	10,991	15,569	24,540	63%	42%	58%
	Europe	21,203	33,659	46,821	71,326	59%	39%	52%
	Lat in America	11,189	17,809	24,821	36,338	59%	39%	46%
	Rest of World	5,094	8,067	11,201	16,885	58%	39%	51%
Machinery Total		44,240	70,525	98,411	149,090	59%	40%	51%
Electrical Equipment	Asia	9,532	11,480	13,112	16,580	20%	14%	26%
	Europe	2,764	3,543	4,230	5,689	28%	19%	34%
	Lat in America	16,230	19,385	22,019	26,633	19%	14%	21%
	Mexico	1,614	2,110	2,555	3,201	31%	21%	25%
	Rest of World	1,216	1,519	1,781	2,371	25%	17%	33%
Electrical Equipment Total		31,356	38,038	43,697	54,473	21%	15%	25%
Transportation Equipment	Asia	36,286	60,803	88,098	160,276	68%	45%	82%
	Canada	40,958	64,512	89,270	145,150	58%	38%	63%
	Lat in America	28,941	44,863	61,377	91,162	55%	37%	49%
	Mexico	3,393	6,145	9,393	15,629	81%	53%	66%
	Rest of World	3,843	6,258	8,866	13,680	63%	42%	54%
Transportation Equipment Total		113,421	182,582	257,005	425,898	61%	41%	66%
Instrum.Photo Eq. Optical Eq.	Asia	1,386	2,408	3,574	6,502	74%	48%	82%
	Lat in America	2,069	3,363	4,758	7,792	63%	41%	64%

TABLE 3

International Commodity Exports

Commodities with Origin in Tennessee Destined for Locations Outside the United States

		Data				Growth		
Commodity	Destination	1998	2005	2010	2020	1998-2005	2005-2010	2010-2020
Instrum.Photo Eq. Optical Eq. Total		3,455	5,771	8,332	14,294	67%	44%	72%
Waste or Scrap Metals	Asia	6,096	9,211	12,439	16,910	51%	35%	36%
	Canada	10,382	16,071	21,959	29,301	55%	37%	33%
	Lat in America	2,355	3,668	5,033	6,618	56%	37%	32%
	Mexico	15,983	27,015	39,303	52,349	69%	45%	33%
Waste or Scrap Metals Total		34,817	55,965	78,734	105,179	61%	41%	34%
Unknown	Asia	22,835	31,492	39,689	54,177	38%	26%	37%
	Canada	10,642	13,539	16,112	19,899	27%	19%	24%
	Europe	11,729	16,619	21,335	29,072	42%	28%	36%
	Lat in America	100,134	136,607	170,579	225,904	36%	25%	32%
	Mexico	4,571	6,465	8,314	10,445	41%	29%	26%
	Rest of World	9,007	12,379	15,635	21,767	37%	26%	39%
	Unknown	5,914	0	0	0			
Unknown Total		164,833	217,100	271,663	361,264	32%	25%	33%
Grand Total		**4,829,251**	**6,834,694**	**8,825,485**	**12,957,579**	**42%**	**29%**	**47%**

TABLE 4

International Commodity Imports

Commodities with Origin Outside the United States Destined for Tennessee

		Data				Growth		
Commodity	Origin	1998	2005	2010	2020	1998-2005	2005-2010	2010-2020
Farm Products	Canada	82,109	104,913	124,984	182,314	28%	19%	46%
Farm Products Total		82,109	104,913	124,984	182,314	28%	19%	46%

TABLE 4

International Commodity Imports

Commodities with Origin Outside the United States Destined for Tennessee

		Data				Growth		
Commodity	**Origin**	**1998**	**2005**	**2010**	**2020**	**1998-2005**	**2005-2010**	**2010-2020**
Metallic Ores	Asia	1,435	2,011	2,560	3,590	40%	27%	40%
	in America	150,022	219,172	287,328	424,223	46%	31%	48%
	Rest of World	96,274	136,814	175,853	238,349	42%	29%	36%
	Unknown	8,451	0	0	0	-100%		
Metallic Ores Total		256,181	357,997	465,741	666,162	40%	30%	43%
Crude Petro or Nat. Gas	Canada	20,862	25,471	29,374	32,112	22%	15%	9%
Crude Petro or Nat. Gas Total		20,862	25,471	29,374	32,112	22%	15%	9%
Nonmetallic Minerals	Asia	2,104	2,451	2,734	2,556	17%	12%	-6%
	Canada	9,944	10,183	10,358	4,417	2%	2%	-57%
	Unknown	16,720	0	0	0	-100%		
Lat Nonmetallic Minerals Total		28,768	12,635	13,092	6,973	-56%	4%	-47%
Food or Kindred Products	Asia	2,437	3,470	4,466	7,609	42%	29%	70%
	Canada	152,548	209,587	262,970	428,659	37%	25%	63%
	Europe	1,192	1,698	2,185	3,722	42%	29%	70%
	in America	30,456	43,359	55,803	95,072	42%	29%	70%
	Rest of World	1,383	1,970	2,535	4,319	42%	29%	70%
	Unknown	3,354	0	0	0	-100%		
Food or Kindred Products Total		191,372	260,084	327,959	539,381	36%	26%	64%
Apparel or Related Products	Asia	13,603	22,376	31,929	62,377	64%	43%	95%
	in America	5,545	9,014	12,753	24,358	63%	41%	91%

Lat

TABLE 4

International Commodity Imports

Commodities with Origin Outside the United States Destined for Tennessee

		Data				Growth		
Commodity	**Origin**	**1998**	**2005**	**2010**	**2020**	**1998-2005**	**2005-2010**	**2010-2020**
Apparel or Related Products Total		19,148	31,390	44,682	86,735	64%	42%	94%
Lumber or Wood Products	Asia	1,409	2,204	3,034	5,165	56%	38%	70%
	Canada	366,416	553,293	742,673	1,209,596	51%	34%	63%
Lumber or Wood Products Total		367,825	555,496	745,707	1,214,761	51%	34%	63%
Furniture	Asia	8,910	13,138	17,339	27,511	47%	32%	59%
Furniture Total		8,910	13,138	17,339	27,511	47%	32%	59%
Pulp, Paper or Allied Products	Canada	285,351	376,556	459,055	574,187	32%	22%	25%
	Europe	8,868	12,132	15,176	19,841	37%	25%	31%
	in America	5,280	7,224	9,036	11,813	37%	25%	31%
Pulp, Paper or Allied Products Total		299,499	395,911	483,267	605,840	32%	22%	25%
Chemicals	Asia	32,497	47,832	63,042	105,140	47%	32%	67%
	Canada	98,458	139,642	179,234	285,998	42%	28%	60%
	Europe	39,507	58,150	76,642	127,821	47%	32%	67%
	in America	151,959	223,669	294,794	491,650	47%	32%	67%
	Rest of World	236,318	347,838	458,448	764,588	47%	32%	67%
	Unknown	25,849	0	0	0	-100%		
Chemicals Total		584,588	817,131	1,072,161	1,775,197	40%	31%	66%
Lat								
Petroleum or Coal Products	Canada	21,411	31,002	40,385	55,002	45%	30%	36%
	Mexico	1,321	2,657	4,378	5,879	101%	65%	34%
Petroleum or Coal Products Total		22,732	33,660	44,763	60,880	48%	33%	36%
Rubber or Misc. Plastics	Asia	114,211	158,615	200,553	301,650	39%	26%	50%

Lat

TABLE 4

International Commodity Imports

Commodities with Origin Outside the United States Destined for Tennessee

		Data				Growth		
Commodity	**Origin**	**1998**	**2005**	**2010**	**2020**	**1998-2005**	**2005-2010**	**2010-2020**
	Canada	1,912	2,421	2,866	4,127	27%	18%	44%
Rubber or Misc. Plastics Total		116,123	161,036	203,418	305,778	39%	26%	50%
Clay, Concrete, Glass or Stone	Canada	5,320	8,420	11,688	19,017	58%	39%	63%
	in America	3,871	6,361	9,070	15,424	64%	43%	70%
	Unknown	1,061	0	0	0	-100%		
Clay, Concrete, Glass or Stone Total		10,252	14,781	20,758	34,441	44%	40%	66%
Primary Metal Products	Asia	6,995	10,408	13,824	22,687	49%	33%	64%
	Canada	45,886	65,804	85,131	133,673	43%	29%	57%
	Europe	32,134	47,814	63,509	104,228	49%	33%	64%
	in America	23,908	35,574	47,251	77,547	49%	33%	64%
	Mexico	1,369	2,729	4,466	6,914	99%	64%	55%
	Rest of World	15,952	23,736	31,528	51,742	49%	33%	64%
Lat	Unknown	15,310	0	0	0	-100%		
Primary Metal Products Total		141,552	186,064	245,710	396,792	31%	32%	61%
Fabricated Metal Products	Asia	24,576	37,163	49,933	83,978	51%	34%	68%
Fabricated Metal Products Total		24,576	37,163	49,933	83,978	51%	34%	68%
Machinery	Asia	17,377	27,103	37,230	64,172	56%	37%	72%
Machinery Total		17,377	27,103	37,230	64,172	56%	37%	72%
Lat								
Electrical Equipment	Asia	24,406	39,304	55,241	102,956	61%	41%	86%
	Canada	1,163	1,802	2,464	4,393	55%	37%	78%

TABLE 4

International Commodity Imports

Commodities with Origin Outside the United States Destined for Tennessee

		Data				Growth		
Commodity	**Origin**	**1998**	**2005**	**2010**	**2020**	**1998-2005**	**2005-2010**	**2010-2020**
Electrical Equipment Total		25,569	41,107	57,705	107,349	61%	40%	86%
Transportation Equipment	Asia	76,934	110,419	142,932	257,892	44%	29%	80%
	Canada	4,498	6,217	7,834	13,523	38%	26%	73%
	Europe	2,578	3,699	4,789	8,640	44%	29%	80%
	Mexico	7,239	9,994	12,583	21,722	38%	26%	73%
Transportation Equipment Total		91,249	130,329	168,137	301,778	43%	29%	79%
Misc. Manufacturing Products	Asia	7,001	10,013	12,928	17,757	43%	29%	37%
Misc. Manufacturing Products Total		7,001	10,013	12,928	17,757	43%	29%	37%
Waste or Scrap Metal	Canada	1,522	1,252	1,088	836	-18%	-13%	-23%
	Europe	3,367	4,381	5,287	7,250	30%	21%	37%
	Rest of World	1,915	2,487	2,998	4,129	30%	21%	38%
Waste or Scrap Metal Total		6,804	8,119	9,372	12,216	19%	15%	30%
Unknown	Asia	32,512	45,296	57,422	84,641	39%	27%	47%
	Canada	8,038	10,243	12,192	17,042	27%	19%	40%
	Europe	9,862	13,737	17,418	25,888	39%	27%	49%
	in America	10,413	14,672	18,759	28,728	41%	28%	53%
	Mexico	942	1,390	1,845	2,885	48%	33%	56%
	Rest of World	2,750	3,866	4,939	7,562	41%	28%	53%
	Unknown	7,385	0	0	0	-100%		
Unknown Total		71,902	89,203	112,575	166,747	24%	26%	48%

Lat

TABLE 4

International Commodity Imports

Commodities with Origin Outside the United States Destined for Tennessee

		Data				Growth		
Commodity	Origin	1998	2005	2010	2020	1998-2005	2005-2010	2010-2020
Grand Total		2,394,399	3,312,743	4,286,835	6,688,874	38%	29%	56%

TABLE 11

Summary of Short Line Railroad Forecasts

					Percentage Growth					Compound Annual Growth
	1999	**2005**	**2010**	**2020**	**1999-2005**	**2005-2010**	**2010-2020**	**1999-2020**	**1999-2010**	**1999-2020**
Inbound	24,527	28,698	32,904	38,164	17.00	14.66	15.99	55.60	2.7	2.1
Transiting	1,677	1,949	2,219	2,648	16.22	13.85	19.33	57.90	2.6	2.2
Outbound	18,711	22,157	25,603	30,542	18.42	15.56	19.28	63.22	2.9	2.4
Hazardous	4,007	4,568	5,116	5,935	14.00	12.00	16.00	48.11	2.2	1.9
Not Specified	3,106	3,641	4,175	4,935	17.21	14.69	18.20	58.89	2.7	2.2
Total	**52,028**	**61,012**	**70,019**	**82,223**	**17.27**	**14.76**	**17.43**	**58.04**	**2.7**	**2.2**

(Inbound, Outbound and Transiting data reflect cargo detail by commodity provided by railroads)
(Hazardous and Not Specified forecast at average growth rates for cargoes inbound to Tennessee)

TABLE 12

Total Tennessee Rail Flows (tons)

					Percent Growth				Annual Compound Growth
	1998	2005	2010	2020	1998-2005	2005-2010	2010-2020	1998-2020	1998-2020
US Interstate Inbound to TN	42,908,491	50,120,634	56,223,189	65,219,741	16.8	12.2	16.0	52.0	1.9
US Interstate Outbound from TN	27,536,475	33,519,988	38,746,004	47,608,876	21.7	15.6	22.9	72.9	2.5
Tennessee Intrastate	2,713,448	3,240,051	3,692,522	4,368,917	19.4	14.0	18.3	61.0	2.2
Foreign Imports into TN	2,394,399	3,312,743	4,286,835	6,688,874	38.4	29.4	56.0	179.4	4.8
Foreign Exports from TN	3,668,076	6,835,896	6,808,765	10,202,740	86.4	-0.4	49.8	178.1	4.8
Total	**79,220,889**	**97,029,311**	**109,757,315**	**134,089,148**	**22.5**	**13.1**	**22.2**	**69.3**	**2.4**

Source: FHWA Freight Analysis Framework

Appendix A

Analysis of I-40 Truck Data

The TRANSEARCH 2000 database represents all truck shipments modeled to move over I-40 between Nashville and Knoxville, both east and west, for the year 2000. The following stepwise process was used to sort the data into blocks representative of different shipment distances. The database includes both the BEA area of origin or destination and within the BEA area, the state of origin and destination.

1. Isolate shipments 1000 tons or greater for Truckload, LTL, Private Truck

2. Sort to provide movement detail

   a. **Commodities originating or destined for Tennessee**:

      Intrastate commodities with both origin and destination in Tennessee (exclude non-Tennessee destinations from BEA region sorts):

      - Eastbound: TN to TN
      - Westbound: TN to TN

   b. **Inbound Interstate**

      i. Eastbound over I-40: Commodities with origin West of Tennessee destined for points in Tennessee, Knoxville, and East of Knoxville:

         - Western origin: >BEA areas greater 75
         - Tennessee destination: TN

      ii. Westbound over I-40: Commodities with origin East of Tennessee destined for points in Tennessee, Nashville and West of Nashville:

         - Eastern origin: BEA areas <43, 48 through 67
         - Tennessee destination: TN

   c. **Outbound Interstate**

      i. Eastbound over I-40:

         - Tennessee origin: TN
         - Eastern destination: BEA areas <43, 48 through 67

      ii. Westbound over I-40:

         - Tennessee origin: TN
         - Western destination: BEA areas >75

d. Commodities transiting Tennessee, over the Nashville-Knoxville I-40 corridor, with both origin and destination out of the state.

   i. Westbound

      - Origin: BEA areas <43, 48 – 67
      - Destination: BEA areas {71, 73, 74, 75 (excluding TN)}, >75

   ii. Eastbound

      - Origin: BEA areas {71, 73, 74, 75 (excluding TN)}, >75
      - Destination: BEA areas <43, 48 - 67

Appendix B

Survey Forms

Questions For Class 1 and Shortline Railroads Regarding Potential Freight Diversion From I-40 To East-West Rail Connector Between Nashville And Knoxville

1. What operating access and infrastructure improvements would a railroad require to make freight operations on the east-west connector between Nashville and Knoxville a viable alternative for freight movement to I-40?

2. Would a Class 1 railroad use the Nashville-Knoxville connector if it were built and owned by the State of Tennessee?

3. Would your railroad use the state owned connection if another Class 1 railroad had similar access?

4. What levels of usage rates might the Class 1 railroad be willing to pay per rail car or container or other appropriate measure of usage?

5. Based on the highway freight transportation forecasts developed by the Federal Highway Administration in the Freight Analysis Framework, what traffic levels would you envision on an east-west rail connection in the 2010 and 2020 year periods?

6. Would this connection require construction of additional intermodal yards, and if so where?

7. Is the rail infrastructure west of Nashville adequate to make the east-west connection through Tennessee a viable alternative to I-40?

Trucking and 3PL's Questionnaire Potential Diversion of Freight: Truck/Rail

I-40 to the East-West Connector between Nashville and Knoxville

All data and information collected in this study are kept confidential and no company names are used in any report to TDOT or any other agency.

1. Please identify in detail the origin/destination and volume of the truck traffic/cargos currently being shipped over I-40 through Eastern Tennessee?

2. Is the traffic directional (please provide details)?

3. What rail service characteristics are required to make the rail route commercially competitive (please provide details if available)?

    a. Transit time?

    b. Day of the week/month pickup/delivery?

c. Frequency and consistency of service?

d. Type of equipment required?

e. Multiple drop points?

f. Other?

4. What portion of this traffic would be/could be diverted to throughput rail if available (please provide details if available)? Would this be a decision based on cost or service standards or both (please provide details if available)?

5. Based on the highway freight transportation forecasts developed by the Federal Highway Administration in the Freight Analysis Framework and your own direct experience, what traffic levels would you envision on an East-West rail connection in 2010 and 2020 based on current traffic in the corridor and based on a new connection being constructed (please provide details if available)?

6. Based on your experience and the facts at hand do you believe that the rail infrastructure west of Nashville is adequate to make the east-west connection through Tennessee a viable alternative to I-40 (please provide details)?

7. At 400, 500, 600, and 700 miles, what is your company's current volume by rail and truck for I-40 and other key corridors? We realize this will, in most cases, be an estimate but please be as specific as you can.

Appendix C

Codes For BEA Areas

Codes and Names for BEA Economic Areas

Code Name

001 Bangor, ME
002 Portland, ME
003 Boston-Worcester-Lawrence-Lowell-Brockton, MA-NH-RI-VT
004 Burlington, VT-NY
005 Albany-Schenectady-Troy, NY
006 Syracuse, NY-PA
007 Rochester, NY-PA
008 Buffalo-Niagara Falls, NY-PA
009 State College, PA
010 New York-No. New Jersey-Long Island, NY-NJ-CT-PA-MA-VT
011 Harrisburg-Lebanon-Carlisle, PA
012 Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD
013 Washington-Baltimore, DC-MD-VA-WV-PA
014 Salisbury, MD-DE-VA
015 Richmond-Petersburg, VA
016 Staunton, VA-WV
017 Roanoke, VA-NC-WV
018 Greensboro-Winston-Salem-High Point, NC-VA
019 Raleigh-Durham-Chapel Hill, NC
020 Norfolk-Virginia Beach-Newport News, VA-NC
021 Greenville, NC
022 Fayetteville, NC
023 Charlotte-Gastonia-Rock Hill, NC-SC
024 Columbia, SC
025 Wilmington, NC-SC
026 Charleston-North Charleston, SC
027 Augusta-Aiken, GA-SC
028 Savannah, GA-SC
029 Jacksonville, FL-GA
030 Orlando, FL
031 Miami-Fort Lauderdale, FL
032 Fort Myers-Cape Coral, FL
033 Sarasota-Bradenton, FL
034 Tampa-St. Petersburg-Clearwater, FL
035 Tallahassee, FL-GA
036 Dothan, AL-FL-GA
037 Albany, GA
038 Macon, GA
039 Columbus, GA-AL
040 Atlanta, GA-AL-NC
041 Greenville-Spartanburg-Anderson, SC-NC
042 Asheville, NC
043 Chattanooga, TN-GA
044 Knoxville, TN
045 Johnson City-Kingsport-Bristol, TN-VA
046 Hickory-Morganton, NC-TN
047 Lexington, KY-TN-VA-WV
048 Charleston, WV-KY-OH
049 Cincinnati-Hamilton, OH-KY-IN
050 Dayton-Springfield, OH
051 Columbus, OH
052 Wheeling, WV-OH
053 Pittsburgh, PA-WV
054 Erie, PA
055 Cleveland-Akron, OH-PA
056 Toledo, OH
057 Detroit-Ann Arbor-Flint, MI
058 Northern Michigan, MI
059 Green Bay, WI-MI
060 Appleton-Oshkosh-Neenah, WI
061 Traverse City, MI
062 Grand Rapids-Muskegon-Holland, MI
063 Milwaukee-Racine, WI
064 Chicago-Gary-Kenosha, IL-IN-WI
065 Elkhart-Goshen, IN-MI
066 Fort Wayne, IN
067 Indianapolis, IN-IL
068 Champaign-Urbana, IL
069 Evansville-Henderson, IN-KY-IL
070 Louisville, KY-IN
071 Nashville, TN-KY
072 Paducah, KY-IL
073 Memphis, TN-AR-MS-KY
074 Huntsville, AL-TN
075 Tupelo, MS-AL-TN
076 Greenville, MS
077 Jackson, MS-AL-LA
078 Birmingham, AL
079 Montgomery, AL
080 Mobile, AL
081 Pensacola, FL
082 Biloxi-Gulfport-Pascagoula, MS
083 New Orleans, LA-MS
084 Baton Rouge, LA-MS
085 Lafayette, LA
086 Lake Charles, LA
087 Beaumont-Port Arthur, TX
088 Shreveport-Bossier City, LA-AR
089 Monroe, LA
090 Little Rock-North Little Rock, AR
091 Fort Smith, AR-OK
092 Fayetteville-Springdale-Rogers, AR-MO-OK
093 Joplin, MO-KS-OK
094 Springfield, MO
095 Jonesboro, AR-MO
096 St. Louis, MO-IL
097 Springfield, IL-MO

098 Columbia, MO
099 Kansas City, MO-KS
100 Des Moines, IA-IL-MO
101 Peoria-Pekin, IL
102 Davenport-Moline-Rock Island, IA-IL
103 Cedar Rapids, IA
104 Madison, WI-IL-IA
105 La Crosse, WI-MN
106 Rochester, MN-IA-WI
107 Minneapolis-St. Paul, MN-WI-IA
108 Wausau, WI
109 Duluth-Superior, MN-WI
110 Grand Forks, ND-MN
111 Minot, ND
112 Bismarck, ND-MT-SD
113 Fargo-Moorhead, ND-MN
114 Aberdeen, SD
115 Rapid City, SD-MT-NE-ND
116 Sioux Falls, SD-IA-MN-NE
117 Sioux City, IA-NE-SD
118 Omaha, NE-IA-MO
119 Lincoln, NE
120 Grand Island, NE
121 North Platte, NE-CO
122 Wichita, KS-OK
123 Topeka, KS
124 Tulsa, OK-KS
125 Oklahoma City, OK
126 Western Oklahoma, OK
127 Dallas-Fort Worth, TX-AR-OK
128 Abilene, TX
129 San Angelo, TX
130 Austin-San Marcos, TX
131 Houston-Galveston-Brazoria, TX
132 Corpus Christi, TX
133 McAllen-Edinburg-Mission, TX
134 San Antonio, TX
135 Odessa-Midland, TX
136 Hobbs, NM-TX
137 Lubbock, TX
138 Amarillo, TX-NM
139 Santa Fe, NM
140 Pueblo, CO-NM
141 Denver-Boulder-Greeley, CO-KS-NE
142 Scottsbluff, NE-WY
143 Casper, WY-ID-UT
144 Billings, MT-WY
145 Great Falls, MT
146 Missoula, MT
147 Spokane, WA-ID
148 Idaho Falls, ID-WY
149 Twin Falls, ID
150 Boise City, ID-OR
151 Reno, NV-CA
152 Salt Lake City-Ogden, UT-ID
153 Las Vegas, NV-AZ-UT
154 Flagstaff, AZ-UT
155 Farmington, NM-CO
156 Albuquerque, NM-AZ
157 El Paso, TX-NM
158 Phoenix-Mesa, AZ-NM
159 Tucson, AZ
160 Los Angeles-Riverside-Orange County, CA-AZ
161 San Diego, CA
162 Fresno, CA
163 San Francisco-Oakland-San Jose, CA
164 Sacramento-Yolo, CA
165 Redding, CA-OR
166 Eugene-Springfield, OR-CA
167 Portland-Salem, OR-WA
168 Pendleton, OR-WA
169 Richland-Kennewick-Pasco, WA
170 Seattle-Tacoma-Bremerton, WA
171 Anchorage, AK
172 Honolulu, HI

NOTE—Codes are assigned, beginning with 001 in northern Maine, continuing south to Florida, then north to the Great Lakes, and continuing in a serpentine pattern to the West Coast. Except for the Western Oklahoma economic area (126), the Northern Michigan economic area (058), and the 17 economic areas mainly corresponding to CMSA's, each economic area is named for the metropolitan area or city that is the node of its largest CEA and that is usually the largest metropolitan area or city in the economic area. The name of each economic area includes each State that contains counties in that economic area.

Appendix D

Annotated Four-Digit STCC

STCC4	NAME
01 00	FARM PRODUCTS
01 10	FIELD CROPS
01 12	COTTON,RAW
01 13	GRAIN
01 14	OIL KERNELS, NUTS OR SEEDS
01 15	FIELD SEEDS
01 19	MISC. FIELD CROPS
01 20	FRESH FRUITS OR TREE NUTS
01 21	CITRUS FRUITS
01 22	DECIDUOUS FRUITS
01 23	TROPICAL FRUITS
01 29	MISC FRESH FRUITS OR TREE NUTS
01 30	FRESH VEGETABLES
01 31	BULBS,ROOTS OR TUBERS
01 33	LEAFY FRESH VEGETABLES
01 34	DRY RIPE VEGETABLE SEEDS
01 39	MISC FRESH VEGETABLES
01 40	LIVESTOCK OR LIVESTOCK PROD
01 41	LIVESTOCK
01 42	DAIRY FARM PRODUCTS
01 43	ANIMAL FIBERS
01 50	POULTRY OR POULTRY PRODUCTS
01 51	LIVE POULTRY
01 52	POULTRY EGGS
01 90	MISC FARM PRODUCTS
01 91	HORTICULTURAL SPECIALTIES
01 92	ANIMAL SPECIALTIES
01 99	FARM PROD, NEC
08 00	FOREST PRODUCTS
08 40	BARKS OR GUMS,CRUDE
08 42	BARKS OR GUMS,CRUDE
08 60	MISC FOREST PRODUCTS
08 61	MISC FOREST PRODUCTS
09 00	FRESH FISH OR MARINE PRODUCTS
09 10	FRESH FISH OR MARINE PRODUCTS
09 12	FRESH FISH OR WHALE PRODUCTS
09 13	MARINE PRODUCTS
09 80	FISH HATCHERIES
09 89	FISH HATCHERIES

Notes:

Yellow indicates items that are either too valuable, time-sensitive or damage prone to permit rail transport.

Blue indicates the need for temperature control which by its very nature is time sensitive and rail can only handle well over very long distances, i.e., the West Coast to the Northeast, etc.

STCC4	NAME
10 00	METALLIC ORES
10 10	IRON ORES
10 11	IRON ORES
10 20	COPPER ORES
10 21	COPPER ORES
10 30	LEAD OR ZINC ORES
10 31	LEAD ORES
10 32	ZINC ORES
10 33	LEAD AND ZINC ORES COMBINED
10 40	GOLD OR SILVER ORES
10 41	GOLD ORE
10 42	SILVER ORE
10 50	BAUXITE OR OTHER ALUM ORES
10 51	BAUXITE OR OTHER ALUM ORES
10 60	MANGANESE ORES
10 61	MANGANESE ORES
10 70	TUNGSTEN ORES
10 71	TUNGSTEN ORES
10 80	CHROMIUM ORES
10 81	CHROMIUM ORES
10 90	MISC METAL ORES
10 92	MISC METAL ORES
11 00	COAL
11 10	ANTHRACITE
11 11	ANTHRACITE
11 20	BITUMINOUS COAL OR LIGNITE
11 21	BITUMINOUS COAL
11 22	LIGNITE
13 00	CRUDE PETROL. OR NATURAL GAS
13 10	CRUDE PETROL. OR NATURAL GAS
13 11	CRUDE PETROLEUM
13 12	NATURAL GAS
13 20	NATURAL GASOLINE
13 21	NATURAL GASOLINE
14 00	NONMETALLIC MINERALS
14 10	DIMENSION STONE, QUARRY
14 11	DIMENSION STONE,QUARRY
14 20	BROKEN STONE OR RIPRAP
14 21	BROKEN STONE OR RIPRAP
14 40	GRAVEL OR SAND

STCC4	NAME
14 41	GRAVEL OR SAND
14 50	CLAY CERAMIC OR REFRAC MINERALS
14 51	CLAY CERAMIC OR REFRAC MINERALS
14 70	CHEM OR FERTILIZER MINERALS
14 71	CHEM OR FERTILIZER MINERI CRUDE
14 90	MISC NONMETALLIC MINERALS
14 91	MISC NONMETALLIC MINERALS, NEC
14 92	WATER
19 00	ORDNANCE OR ACCESSORIES
19 10	GUNS,HOWITZERS,MORTARS, ETC.
19 11	GUNS,HOWITZERS,MORTARS, ETC.
19 20	AMMO, OVER 30MM
19 25	GUIDED MISSILES OR SPACE VEHICLE
19 29	AMMO OR RELATED PARTS, NEC
19 30	TRACKED COMBAT VEHIC OR PARTS
19 31	TRACKED COMBAT VEHIC OR PARTS
19 40	MILITARY FIRE CONTROL EQUIPT
19 41	MILITARY FIRE CONTROL EQUIPT
19 50	SMALL ARMS,30MM OR LESS
19 51	SMALL ARMS,30MM OR LESS
19 60	SMALL ARMS AMMO,30MM OR LESS
19 61	SMALL ARMS AMMO,30MM OR LESS
19 90	MISC ORDNANCE OR ACCESSORIES
19 91	MISC ORDNANCE OR ACCESSORIES
20 00	FOOD OR KINDRED PRODUCTS
20 10	MEAT OR POULTRY, FRESH OR CHILLED
20 11	MEAT, FRESH OR CHILLED
20 12	MEAT, FRESH FROZEN
20 13	MEAT PRODUCTS
20 14	ANIMAL BY-PROD,INEDIBLE
20 15	DRESSED POULTRY, FRESH
20 16	DRESSED POULTRY, FROZEN
20 17	PROCESSED POULTRY OR EGGS
20 20	DAIRY PRODUCTS
20 21	CREAMERY BUTTER
20 23	CONDENSED, EVAP OR DRY MILK
20 24	ICE CREAM OR REL FROZ DESSERTS
20 25	CHEESE OR SPECIAL DAIRY PRODUCTS
20 26	PROCESSED MILK
20 30	CANNED OR PRESERVED FOOD

STCC4	NAME
20 31	CANNED OR CURED SEA FOODS
20 32	CANNED SPECIALTIES
20 33	CANNED FRUITS,VEGETABLES, ETC.
20 34	DEHYDR OR DRIED FRUIT OR VEG
20 35	PICKLED FRUITS OR VEGETABLES
20 36	PROCESSED FISH PRODUCTS
20 37	FROZEN FRUIT, VEG OR JUICE
20 38	FROZEN SPECIALTIES
20 39	CANNED OR PRES FOOD, MIXED
20 40	GRAIN MILL PRODUCTS
20 41	FLOUR OR OTHER GRAIN MILL PRODUCTS
20 42	PREPARED OR CANNED FEED
20 43	CEREAL PREPARATIONS
20 44	MILLED RICE, FLOUR OR MEAL
20 45	BLENDED OR PREPARED FLOUR
20 46	WET CORN MILLING OR MILO
20 47	DOG,CAT OR OTHER PET FOOD,NEC
20 50	BAKERY PRODUCTS
20 51	BREAD OR OTHER BAKERY PROD
20 52	BISCUITS, CRACKERS OR PRETZLES
20 60	SUGAR, BEET OR CANE
20 61	SUGAR MILL PROD OR BY-PROD
20 62	SUGAR, REFINED, CANE OR BEET
20 70	CONFECTIONERY OR REL PROD
20 71	CANDY OR OTHER CONFECTIONERY
20 80	BEVERAGES OR FLAVOR EXTRACTS
20 82	MALT LIQUORS
20 83	MALT
20 84	WINE,BRANDY OR BRANDY SPIRIT
20 85	DISTILLED OR BLENDED LIQUORS
20 86	SOFT DRINKS OR MINERAL WATER
20 87	MISC FLAVORING EXTRACTS
20 90	MISC FOOD PREPARATIONS
20 91	COTTONSEED OIL OR BY-PROD
20 92	SOYBEAN OIL OR BY-PRODUCTS
20 93	NUT OR VEG OILS OR BY-PRODUCTS
20 94	MARINE FATS OR OILS
20 95	ROASTED OR INSTANT COFFEE
20 96	MARGARINE,SHORTENING, ETC.
20 97	ICE, NATURAL OR MANUFACTURED

STCC4	NAME
20 98	MACARONI,SPAGHETTI, ETC.
20 99	MISC FOOD PREPARATIONS, NEC
21 00	TOBACCO PRODUCTS
21 10	CIGARETTES
21 11	CIGARETTES
21 20	CIGARS
21 21	CIGARS
21 30	CHEWING OR SMOKING TOBACCO
21 31	CHEWING OR SMOKING TOBACCO
21 40	STEMMED OR REDRIED TOBACCO
21 41	STEMMED OR REDRIED TOBACCO
22 00	TEXTILE MILL PRODUCTS
22 10	COTTON BROAD-WOVEN FABRICS
22 11	COTTON BROAD-WOVEN FABRICS
22 17	COTTON BROAD-WOVEN FABRICS
22 20	MAN-MADE OR SILK WOVEN FIBRE
22 21	MAN-MADE OR GLASS WOVEN FIBRE
22 22	SILK-WOVEN FABRICS
22 30	WOOL BROAD-WOVEN FABRICS
22 31	WOOL BROAD-WOVEN FABRICS
22 40	NARROW FABRICS
22 41	NARROW FABRICS
22 50	KNIT FABRICS
22 51	KNIT FABRICS
22 70	FLOOR COVERINGS
22 71	WOVEN CARPETS,MATS OR RUGS
22 72	TUFTED CARPETS,RUGS OR MATS
22 79	CARPETS,MATS OR RUGS, NEC
22 80	THREAD OR YARN
22 81	YARN
22 84	THREAD
22 90	MISC TEXTILE GOODS
22 91	FELT GOODS
22 92	LACE GOODS
22 93	PADDINGS,UPHOLSTERY FILL,ETC
22 94	TEXTILE WASTE, PROCESSED
22 95	COATED OR IMPRINTED FABRIC
22 96	CORD OR FABRICS,INDUSTRIAL
22 97	WOOL OR MOHAIR
22 98	CORDAGE OR TWINE

STCC4	NAME
22 99	TEXTILE GOODS, NEC
23 00	APPAREL OR RELATED PRODUCTS
23 10	MENS OR BOYS CLOTHING
23 11	MENS OR BOYS CLOTHING
23 30	WOMENS OR CHILDRENS CLOTHING
23 31	WOMENS OR CHILDRENS CLOTHING
23 50	CAPS,HATS OR MILLINERY
23 51	MILLINERY
23 52	CAPS OR HATS OR HAT BODIES
23 70	FUR GOODS
23 71	FUR GOODS
23 80	MISC APPAREL OR ACCESSORIES
23 81	GLOVES,MITTENS OR LININGS
23 84	ROBES OR DRESSING GOWNS
23 85	RAINCOATS OR OTHER RAIN WEAR
23 86	LEATHER CLOTHING
23 87	APPAREL BELTS
23 89	APPAREL, NEC
23 90	MISC FINISHED TEXTILE GOODS
23 91	CURTAINS OR DRAPERIES
23 92	TEXTILE HOUSEFURNISHINGS
23 93	TEXTILE BAGS
23 94	CANVAS PRODUCTS
23 95	TEXTILE PROD,PLEATED, ETC.
23 96	APPAREL FINDINGS
23 99	MISC FABRICATED TEXTILE PRODUCTS
24 00	LUMBER OR WOOD PRODUCTS
24 10	PRIMARY FOREST MATERIALS
24 11	PRIMARY FOREST MATERIALS
24 20	SAWMILL OR PLANING MILL PRODUCTS
24 21	LUMBER OR DIMENSION STOCK
24 29	MISC SAWMILL OR PLANING MILL
24 30	MILLWORK OR PREFAB WOOD PRODUCTS
24 31	MILLWORK OR CABINETWORK
24 32	PLYWOOD OR VENEER
24 33	PREFAB WOOD BUILDINGS
24 34	KITCHEN CABINETS,WOOD
24 39	STRUCTURAL WOOD PROD, NEC
24 40	WOODEN CONTAINERS
24 41	WOOD CONT. OR BOX SHOOKS

STCC4	NAME
24 90	MISCELLANEOUS WOOD PRODUCTS
24 91	TREATED WOOD PRODUCTS
24 92	RATTAN OR BAMBOO WARE
24 93	LASTS OR RELATED PRODUCTS
24 94	CORK PRODUCTS
24 95	HAND TOOL HANDLES
24 96	SCAFFOLDING EQUIP OR LADDERS
24 97	WOODEN WARE OR FLATWARE
24 98	WOOD PROD, NEC
24 99	MISC WOOD PRODUCTS
25 00	FURNITURE OR FIXTURES
25 10	HOUSEHOLD OR OFFICE FURNITURE
25 11	BENCHES,CHAIRS, STOOLS
25 12	TABLES OR DESKS
25 13	SOFAS, COUCHES, ETC.
25 14	BUFFETS, CHINA CLOSETS, ETC.
25 15	BEDSPRINGS OR MATTRESSES
25 16	BEDS,DRESSERS,CHESTS, ETC.
25 17	CABINETS OR CASES
25 18	CHILDRENS FURNITURE
25 19	HOUSEHOLD OR OFFICE FURN, NEC
25 30	PUBLIC BUILDING OR RELATED FURNITURE
25 31	PUBLIC BUILDING OR RELATED FURNITURE
25 40	LOCKERS,PARTITIONS OR SHELV
25 41	WOOD LOCKERS,PARTITIONS, ETC.
25 42	METAL LOCKERS,PARTITIONS, ETC.
25 90	MISC FURNITURE OR FIXTURES
25 91	VENETIAN BLINDS,SHADES, ETC.
25 99	FURNITURE OR FIXTURES, NEC
26 00	PULP,PAPER OR ALLIED PRODUCTS
26 10	PULP OR PULP MILL PRODUCTS
26 11	PULP OR PULP MILL PRODUCTS
26 20	PAPER
26 21	PAPER
26 30	FIBER, PAPER OR PULPBOARD
26 31	FIBER, PAPER OR PULPBOARD
26 40	CONVERTED PAPER OR PPBD PRODUCTS
26 42	ENVELOPES
26 43	PAPER BAGS
26 44	WALLPAPER

STCC4	NAME
26 45	DIE-CUT PAPER OR PPBD PRODUCTS
26 46	PRESSED OR MOLDED PULP GOODS
26 47	SANITARY PAPER PRODUCTS
26 49	MISC CONVERTED PAPER PRODUCTS
26 50	CONTAINERS OR BOXES,PAPER
26 51	CONTAINERS OR BOXES,PAPER
26 54	SANITARY FOOD CONTAINERS
26 55	FIBRE CANS, DRUMS OR TUBES
26 60	PAPER OR BUILDING BOARD
26 61	PAPER OR BUILDING BOARD
27 00	PRINTED MATTER
27 10	NEWSPAPERS
27 11	NEWSPAPERS
27 20	PERIODICALS
27 21	PERIODICALS
27 30	BOOKS
27 31	BOOKS
27 40	MISC PRINTED MATTER
27 41	MISC PRINTED MATTER
27 60	MANIFOLD BUSINESS FORMS
27 61	MANIFOLD BUSINESS FORMS
27 70	GREETING CARDS, SEALS, ETC.
27 71	GREETING CARDS, SEALS, ETC.
27 80	BLANKBOOK, LOOSE LEAF BINDER
27 81	BLANKBOOK, LOOSE LEAF BINDER
27 90	SVC INDUS FOR PRINT TRADES
27 91	SVC INDUS FOR PRINT TRADES
28 00	CHEMICALS OR ALLIED PRODUCTS
28 10	INDUSTRIAL CHEMICALS
28 11	IND, INORG, OR ORG CHEMICALS
28 12	POTASSIUM OR SODIUM COMPOUND
28 13	INDUSTRIAL GASES
28 14	CRUDE PROD OF COAL,GAS,PETROLEUM
28 15	CYCLIC INTERMEDIATES OR DYES
28 16	INORGANIC PIGMENTS
28 18	MISC INDUSTRIAL ORGANIC CHEMICALS
28 19	MISC INDUS INORGANIC CHEMICALS
28 20	PLASTIC MATER OR SYNTH FIBRES
28 21	PLASTIC MATER OR SYNTH FIBRES
28 30	DRUGS

STCC4	NAME
28 31	DRUGS
28 40	SOAP OR OTHER DETERGENTS
28 41	SOAP OR OTHER DETERGENTS
28 42	SPECIALTY CLEANING PREPARATIONS
28 43	SURFACE ACTIVE AGENTS
28 44	COSMETICS,PERFUMES, ETC.
28 50	PAINTS, LACQUERS, ETC.
28 51	PAINTS, LACQUERS, ETC.
28 60	GUM OR WOOD CHEMICALS
28 61	GUM OR WOOD CHEMICALS
28 70	AGRICULTURAL CHEMICALS
28 71	FERTILIZERS
28 79	MISC AGRICULTURAL CHEMICALS
28 90	MISC CHEMICAL PRODUCTS
28 91	ADHESIVES
28 92	EXPLOSIVES
28 93	PRINTING INK
28 99	CHEMICAL PREPARATIONS, NEC
29 00	PETROLEUM OR COAL PRODUCTS
29 10	PROD OF PETROLEUM REFINING
29 11	PETROLEUM REFINING PRODUCTS
29 12	LIQUEFIED GASES,COAL OR PETROLEUM
29 50	PAVING OR ROOFING MATERIALS
29 51	ASPHALT PAVING BLOCKS OR MIX
29 52	ASPHALT COATINGS OR FELT
29 90	MISC COAL OR PETROLEUM PRODUCTS
29 91	MISC COAL OR PETROLEUM PRODUCTS
30 00	RUBBER OR MISC PLASTICS
30 10	TIRES OR INNER TUBES
30 11	TIRES OR INNER TUBES
30 20	RUBBER OR PLASTIC FOOTWEAR
30 21	RUBBER OR PLASTIC FOOTWEAR
30 30	RECLAIMED RUBBER
30 31	RECLAIMED RUBBER
30 40	RUB OR PLAS HOSE OR BELTING
30 41	RUB OR PLAS HOSE OR BELTING
30 60	MISC FABRICATED PRODUCTS
30 61	MISC FABRICATED PRODUCTS
30 70	MISC PLASTIC PRODUCTS
30 71	MISC PLASTIC PRODUCTS

STCC4	NAME
30 72	MISC PLASTIC PRODUCTS
31 00	LEATHER OR LEATHER PRODUCTS
31 10	LEATHER
31 11	LEATHER,FINISHED OR TANNED
31 20	INDUSTRIAL LEATHER BELTING
31 21	INDUSTRIAL LEATHER BELTING
31 30	BOOT OR SHOE CUT STOCK
31 31	BOOT OR SHOE CUT STOCK
31 40	LEATHER FOOTWEAR
31 41	LEATHER FOOTWEAR
31 42	LEATHER HOUSE SLIPPERS
31 50	LEATHER GLOVES OR MITTENS
31 51	LEATHER GLOVES OR MITTENS
31 60	LEATHER LUGGAGE OR HANDBAGS
31 61	LEATHER LUGGAGE OR HANDBAGS
31 90	LEATHER GOODS, NEC
31 99	LEATHER GOODS, NEC
32 00	CLAY,CONCRETE,GLASS OR STONE
32 10	FLAT GLASS
32 11	FLAT GLASS
32 13	LAMINATED SAFETY GLASS
32 20	GLASSWARE, PRESSED OR BLOWN
32 21	GLASS CONTAINERS
32 29	MISC GLASSWARE,BLOWN OR PRESSED
32 40	PORTLAND CEMENT
32 41	PORTLAND CEMENT
32 50	STRUCTURAL CLAY PRODUCTS
32 51	CLAY BRICK OR TILE
32 53	CERAMIC FLOOR OR WALL TILE
32 55	REFRACTORIES
32 59	MISC STRUCTURAL CLAY PRODUCTS
32 60	POTTERY OR RELATED PRODUCTS
32 61	VITREOUS CHINA PLUMBING FIXTURES
32 62	VITREOUS CHINA KITCHEN ARTICLES
32 64	PORCELAIN ELECTRIC SUPPLIES
32 69	MISC POTTERY PRODUCTS
32 70	CONCRETE, GYPSUM, OR PLASTER
32 71	CONCRETE PRODUCTS
32 73	READY-MIX CONCRETE, WET
32 74	LIME OR LIME PLASTER

STCC4	NAME
32 75	GYPSUM PRODUCTS
32 80	CUT STONE OR STONE PRODUCTS
32 81	CUT STONE OR STONE PRODUCTS
32 90	ABRASIVES,ASBESTOS PRODUCTS, ETC.
32 91	ABRASIVE PRODUCTS
32 92	ASBESTOS PRODUCTS
32 93	GASKETS OR PACKING
32 95	NONMETAL MINERALS, PROCESSED
32 96	MINERAL WOOL
32 99	MISC NONMETALLIC MINERALS
33 00	PRIMARY METAL PRODUCTS
33 10	STEEL MILL PRODUCTS
33 11	BLAST FURNACE OR COKE
33 12	PRIMARY IRON OR STEEL PRODUCTS
33 13	ELECTROMETALLURGICAL PRODUCTS
33 15	STEEL WIRE, NAILS OR SPIKES
33 16	COLD FINISHING OF STEEL SHAPES
33 20	IRON OR STEEL FORGINGS
33 21	IRON OR STEEL CASTINGS
33 30	NONFERR PRIMARY SMELTER PRODUCTS
33 31	PRIMARY COPPER SMELTER PRODUCTS
33 32	PRIMARY LEAD SMELTER PRODUCTS
33 33	PRIMARY ZINC SMELTER PRODUCTS
33 34	PRIMARY ALUMINUM SMELTER PRODUCTS
33 39	MISC PRIM NONFERR SMELTER PRODUCTS
33 50	NONFERROUS METAL BASIC SHAPES
33 51	COPPER OR ALLOY BASIC SHAPES
33 52	ALUMINUM OR ALLOY BASIC SHAPES
33 56	MISC NONFERROUS BASIC SHAPES
33 57	NONFERROUS WIRE
33 60	NONFERROUS METAL CASTINGS
33 61	ALUMINUM OR ALLOY CASTINGS
33 62	COPPER OR ALLOY CASTINGS
33 69	MISC NONFERROUS CASTINGS
33 90	MISC PRIMARY METAL PRODUCTS
33 91	IRON OR STEEL FORGINGS
33 92	NONFERROUS METAL FORGINGS
33 99	PRIMARY METAL PRODUCTS, NEC
34 00	FABRICATED METAL PRODUCTS
34 10	METAL CANS

STCC4	NAME
34 11	METAL CANS
34 20	CUTLERY, HAND TOOLS OR HARDWARE
34 21	CUTLERY,NOT ELECTRICAL
34 23	EDGE OR HAND TOOLS
34 25	HAND SAWS OR SAW BLADES
34 28	BUILDERS OR CABINET HARDWARE
34 29	MISC HARDWARE
34 30	PLUMBING OR HEATING FIXTURES
34 31	METAL SANITARY WARE
34 32	PLUMBING FIXTURES
34 33	HEATING EQUIP,NOT ELECTRICAL
34 40	FABRICATED STRUCTURAL METAL PRODUCTS
34 41	FABRICATED STRUCTURAL METAL PRODUCTS
34 42	METAL DOORS, SASH, ETC.
34 43	FABRICATED PLATE PRODUCTS
34 44	SHEET METAL PRODUCTS
34 46	ARCHITECTURAL METAL WORK
34 49	MISC METAL WORK
34 50	BOLTS, NUTS, SCREWS, ETC.
34 52	BOLTS, NUTS, SCREWS, ETC.
34 60	METAL STAMPINGS
34 61	METAL STAMPINGS
34 80	MISC FABRICATED WIRE PROD
34 81	MISC FABRICATED WIRE PRODUCTS
34 90	MISC FABRICATED METAL PRODUCTS
34 91	METAL SHIPPING CONTAINERS
34 92	METAL SAFES OR VAULTS
34 93	STEEL SPRINGS
34 94	VALVES OR PIPE FITTINGS
34 99	FABRICATED METAL PRODUCTS, NEC
35 00	MACHINERY
35 10	ENGINES OR TURBINES
35 11	STEAM ENGINES, TURBINES, ETC.
35 19	MISC INTERNAL COMBUSTION ENGINES
35 20	FARM MACHINERY OR EQUIPMENT
35 22	FARM MACHINERY OR EQUIPMENT
35 23	FARM MACHINERY OR EQUIPMENT
35 24	LAWN OR GARDEN EQUIPMENT
35 30	CONSTR MACHINERY OR EQUIPMENT
35 31	CONSTR MACHINERY OR EQUIPMENT

STCC4	NAME
35 32	MINING MACHINERY OR PARTS
35 33	OIL FIELD MACHINERY OR EQUIPMENT
35 34	ELEVATORS OR ESCALATORS
35 35	CONVEYORS OR PARTS
35 36	HOISTS, INDUSTR CRANES, ETC.
35 37	INDUSTRIAL TRUCKS, ETC.
35 40	METALWORKING MACHINERY
35 41	MACHINE TOOLS, METAL CUTTING
35 42	MACHINE TOOLS, METAL FORMING
35 44	SPECIAL DIES,TOOLS,JIGS,ETC.
35 45	MACHINE TOOL ACCESSORIES
35 48	METALWORKING MACHINERY
35 50	SPECIAL INDUSTRY MACHINERY
35 51	FOOD PROD MACHINERY
35 52	TEXTILE MACHINERY OR PARTS
35 53	WOODWORKING MACHINERY
35 54	PAPER INDUSTRIES MACHINERY
35 55	PRINTING TRADES MACHINERY
35 59	MISC SPECIAL INDUSTRY MACH
35 60	GENERAL INDUSTRIAL MACHINERY
35 61	INDUSTRIAL PUMPS
35 62	BALL OR ROLLER BEARINGS
35 64	VENTILATING EQUIPMENT
35 66	MECH POWER TRANSMISSION EQUIPMENT
35 67	INDUSTRIAL PROCESS FURNACES
35 69	MISC GENERAL INDUSTRIAL
35 70	OFFICE OR COMPUTING MACHINERY
35 72	TYPEWRITERS OR PARTS
35 73	ELECTRONIC DATA PROC EQUIPMENT
35 74	ACCOUNTING OR CALCULATING EQUIPMENT
35 76	SCALES OR BALANCES
35 79	MISC OFFICE MACHINES
35 80	SERVICE INDUSTRY MACHINES
35 81	AUTOMATIC MERCHANDISING MACHINES
35 82	COMMERCIAL LAUNDRY EQUIPMENT
35 85	REFRIGERATION MACHINERY
35 89	MISC SERVICE INDUSTRY MACHINERY
35 90	MISC MACHINERY OR PARTS
35 92	CARBURETORS, PISTONS, ETC.
35 99	MISC MACHINERY OR PARTS

STCC4	NAME
36 00	ELECTRICAL EQUIPMENT
36 10	ELECTRIC TRANS OR DISTRIBUTORS
36 11	ELECTRIC MEASURING INSTRMTS
36 12	ELECTRICAL TRANSFORMERS
36 13	SWITCHGEAR OR SWITCHBOARDS
36 20	INDUSTRIAL ELECTRICAL EQUIPMENT
36 21	MOTORS OR GENERATORS
36 22	INDUSTRIAL CONTROLS OR PARTS
36 23	WELDING APPARATUS
36 24	CARBON PROD FOR ELECTRIC USES
36 29	MISC ELECTRICAL INDUSTRIAL EQUIPMENT
36 30	HOUSEHOLD APPLIANCES
36 31	HOUSEHOLD COOKING EQUIPMENT
36 32	HOUSEHOLD REFRIGERATORS
36 33	HOUSEHOLD LAUNDRY EQUIPMENT
36 34	ELECTRIC HOUSEWARES OR FANS
36 35	HOUSEHOLD VACUUM CLEANERS
36 36	SEWING MACHINES OR PARTS
36 39	MISC HOUSEHOLD APPLIANCES
36 40	ELECTRIC LIGHTING OR WIRE EQUIPMENT
36 41	ELECTRIC LAMPS
36 42	LIGHTING FIXTURES
36 43	CURRENT CARRYING WIRING EQUIPMENT
36 44	NONCURRENT WIRING DEVICES
36 50	RADIO OR TV RECEIVING SETS
36 51	RADIO OR TV RECEIVING SETS
36 52	PHONOGRAPH RECORDS
36 60	COMMUNICATION EQUIPMENT
36 61	TELEPHONE OR TELEGRAPH EQUIPMENT
36 62	RADIO OR TV TRANSMITTING EQUIPMENT
36 70	ELECTRONIC COMPONENTS
36 71	ELECTRONIC TUBES
36 74	SOLID STATE SEMICONDUCTS
36 79	MISC ELECTRONIC COMPONENTS
36 90	MISC ELECTRICAL MACHINERY
36 91	STORAGE BATTERIES OR PLATES
36 92	PRIMARY BATTERIES
36 93	X-RAY EQUIPMENT
36 94	ELEC EQ FOR INTERN COMB ENGINE
36 99	ELECTRICAL EQUIPMENT, NEC

STCC4	NAME
37 00	TRANSPORTATION EQUIPMENT
37 10	MOTOR VEHIC OR EQUIPMENT
37 11	MOTOR VEHICLES
37 12	PASSENGER MOTOR CAR BODIES
37 13	MOTOR BUS OR TRUCK BODIES
37 14	MOTOR VEHICLE PARTS OR ACCESSORIES
37 15	TRUCK TRAILERS
37 20	AIRCRAFT OR PARTS
37 21	AIRCRAFT
37 22	AIRCRAFT OR MISSILE ENGINES
37 23	AIRCRAFT PROPELLERS OR PARTS
37 29	MISC AIRCRAFT PARTS
37 30	SHIPS OR BOATS
37 32	SHIPS OR BOATS
37 40	RAILROAD EQUIPMENT
37 41	LOCOMOTIVES OR PARTS
37 42	RAILROAD CARS
37 50	MOTORCYCLES, BICYCLES OR PARTS
37 51	MOTORCYCLES, BICYCLES OR PARTS
37 60	MISSILE OR SPACE VEH PARTS
37 69	MISSILE OR SPACE VEH PARTS
37 90	MISC TRANSPORTATION EQUIPMENT
37 91	TRAILER COACHES
37 99	TRANSPORTATION EQUIPMENT, NEC
38 00	INSTRUM, PHOTO EQUIPMENT, OPTICAL EQ
38 10	ENGRG, LAB OR SCIENTIFIC EQUIPMENT
38 11	ENGRG, LAB OR SCIENTIFIC EQUIPMENT
38 20	MEASURING OR CONTROLLING EQUIPMENT
38 21	MECH MEASURING OR CONTROL EQUIPMENT
38 22	AUTOMATIC TEMPERATURE CONTROLS
38 30	OPTICAL INSTRUMENTS OR LENSES
38 31	OPTICAL INSTRUMENTS OR LENSES
38 40	MEDICAL OR DENTAL INSTRUMENTS
38 41	SURGICAL OR MEDICAL INSTRUMENTS
38 42	ORTHOPEDIC OR PROSTHETIC SUPPLIES
38 43	DENTAL EQUIPMENT OR SUPPLIES
38 50	OPHTHALMIC OR OPTICIANS GOODS
38 51	OPHTHALMIC OR OPTICIANS GOODS
38 60	PHOTOGRAPHIC EQUIP OR SUPPLIES
38 61	PHOTOGRAPHIC EQUIP OR SUPPLIES

STCC4	NAME
38 70	WATCHES, CLOCKS, ETC.
38 71	WATCHES, CLOCKS, ETC.
39 00	MISC MANUFACTURING PRODUCTS
39 10	JEWELRY, SILVERWARE, ETC.
39 11	JEWELRY, PRECIOUS METAL, ETC.
39 14	SILVERWARE OR PLATED WARE
39 30	MUSICAL INSTRUMENTS OR PARTS
39 31	MUSICAL INSTRUMENTS OR PARTS
39 40	TOYS, AMUSEMENT, ATHLETIC EQUIPMENT
39 41	GAMES OR TOYS
39 42	DOLLS OR STUFFED TOYS
39 43	CHILDRENS VEHIC OR PARTS, NEC
39 49	SPORTING OR ATHLETIC GOODS
39 50	OFFICE OR ART MATERIALS
39 51	PENS OR PARTS
39 52	PENCILS,CRAYONS,OR ARTISTS MATERIALS
39 53	MARKING DEVICES
39 55	CARBON PAPER OR INKED RIBBONS
39 60	COSTUME JEWELRY OR NOVELTIES
39 61	COSTUME JEWELRY OR NOVELTIES
39 62	FEATHERS, PLUMES, ETC.
39 63	BUTTONS
39 64	APPAREL FASTENERS
39 90	MISC MANUFACTURED PRODUCTS
39 91	BROOMS, BRUSHES, ETC.
39 92	LINOLEUM OR OTHER COVERINGS
39 93	SIGNS OR ADVERTISING DISPLAYS
39 94	MORTICIANS GOODS
39 96	MATCHES
39 97	FURS,DRESSED OR DYED
39 99	MANUFACTURED PROD, NEC
40 00	WASTE OR SCRAP MATERIALS
40 10	ASHES
40 11	ASHES
40 20	WASTE OR SCRAP
40 21	METAL SCRAP OR TAILINGS
40 22	TEXTILE SCRAP OR SWEEPINGS
40 23	WOOD SCRAP OR WASTE
40 24	PAPER WASTE OR SCRAP
40 25	CHEMICAL OR PETROLEUM WASTE

STCC4	NAME
40 26	RUBBER OR PLASTIC SCRAP
40 27	STONE, CLAY OR GLASS SCRAP
40 28	LEATHER WASTE OR SCRAP
40 29	MISC WASTE OR SCRAP
41 00	MISC FREIGHT SHIPMENTS
41 10	MISC FREIGHT SHIPMENTS
41 11	MISC FREIGHT SHIPMENTS
41 20	SPECIAL COMMODITIES
41 21	SPECIAL COMMODITIES
41 92	SPECIAL COMMODITIES
42 00	SHIPPING CONTAINERS
42 10	SHIPPING CONTAINERS
42 11	SHIPPING CONTAINERS
42 20	SEMI-TRAILERS RETURNED EMPTY
42 21	SEMI-TRAILERS RETURNED EMPTY
42 30	EMPTY EQUIPMENT, REVERSE ROUTE
42 31	EMPTY EQUIPMENT, REVERSE ROUTE
43 00	MAIL OR CONTRACT TRAFFIC
43 10	MAIL AND EXPRESS TRAFFIC
43 11	MAIL AND EXPRESS TRAFFIC
43 20	OTHER CONTRACT TRAFFIC
43 21	OTHER CONTRACT TRAFFIC
44 00	FREIGHT FORWARDER TRAFFIC
44 10	FREIGHT FORWARDER TRAFFIC
44 11	FREIGHT FORWARDER TRAFFIC
45 00	SHIPPER ASSOCIATION TRAFFIC
45 10	SHIPPER ASSOCIATION TRAFFIC
45 11	SHIPPER ASSOCIATION TRAFFIC
46 00	MISC MIXED SHIPMENTS
46 10	FAK SHIPMENTS
46 11	FAK SHIPMENTS
46 20	MIXED SHIPMENTS, MULTI-STCC
46 21	MIXED SHIPMENTS, MULTI-STCC
47 00	SMALL PACKAGED FREIGHT SHIPMENTS
47 10	SMALL PACKAGED FREIGHT SHIPMENTS
47 11	SMALL PACKAGED FREIGHT SHIPMENTS
48 07	WASTE FLAMMABLE LIQUIDS
48 09	WASTE FLAMMABLE LIQUIDS
48 10	WASTE FLAMMABLE LIQUIDS, MISC
48 12	FLAMMABLE LIQUIDS

STCC4	NAME
48 13	WASTE COMBUSTIBLE LIQUIDS
48 14	COMBUSTIBLE LIQUIDS
48 15	WASTE COMBUSTIBLE LIQUIDS
48 16	WASTE FLAMMABLE SOLIDS
48 17	WASTE FLAMMABLE SOLIDS
48 18	WASTE OXIDIZING MATERIALS
48 20	WASTE POISONOUS LIQUIDS
48 21	WASTE POISON B, ORGANIC
48 23	WASTE POISONOUS MATERIALS
48 25	WASTE ETIOLOGIC AGENTS
48 32	WASTE CORROSIVE MATERIALS
48 35	WASTE CORROSIVE MATERIALS
48 36	WASTE CORROSIVE MATERIALS
48 45	WASTE OTHER REGULATED MATERIALS, GROUP C
48 50	FREIGHT ALL KINDS, HAZARDOUS WASTES
48 60	WASTE OTHER REGULATED MATERIALS GROUP E
48 61	WASTE MISCELLANEOUS HAZARDOUS MATERIALS
48 63	WASTE MISCELLANEOUS HAZARDOUS MATERIALS
48 75	WASTE STREAM OTHER REGULATED
49 00	HAZARDOUS MATERIALS
49 03	EXPLOSIVES
49 04	NON FLAMMABLE COMPRESSED GASES
49 05	FLAMMABLE COMPRESSED GASES
49 06	FLAMMABLE LIQUIDS
49 07	FLAMMABLE LIQUIDS
49 08	FLAMMABLE LIQUIDS
49 09	FLAMMABLE LIQUIDS
49 10	FLAMMABLE LIQUIDS
49 12	COMBUSTABLE LIQUIDS
49 13	COMBUSTBALE LIQUIDS
49 15	COMBUSTBALE LIQUIDS
49 16	COMBUSTABLE SOLIDS
49 17	FLAMMABLE SOLIDS
49 18	OXIDIZING MATERIALS
49 19	ORGANIC PEROXIDES
49 20	POISONS A
49 21	POISONS B,ORGANIC
49 23	POISONS B,INORGANIC
49 25	IRRITATING MATERIALS - ETIOLOGIC AGTS
49 26	RADIOACTIVE MATERIALS

STCC4	NAME
49 27	RADIOACTIVE MATERIALS, FISSILE CL III
49 28	RADIOACTIVE MATERIALS, FISSILE CL II
49 29	RADIOACTIVE MATERIALS, FISSILE CL I
49 30	CORROSIVE MATERIALS
49 31	CORROSIVE MATERIALS
49 32	CORROSIVE MATERIALS
49 33	CORROSIVE MATERIALS
49 34	CORROSIVE MATERIALS
49 35	CORROSIVE MATERIALS
49 36	CORROSIVE MATERIALS
49 40	OTHER REGULATED MATERIALS GROUP A
49 41	OTHER REGULATED MATERIALS GROUP A
49 44	OTHER REGULATED MATERIALS GROUP B
49 50	MIXED LOADS
49 61	OTHER REGULATED MATERIALS GROUP E
49 62	OTHER REGULATED MATERIALS GROUP E
49 63	OTHER REGULATED MATERIALS GROUP E
49 66	OTHER REGULATED MATERIALS GROUP E
50 00	SECONDARY TRAFFIC
50 10	WAREHOUSE & DISTRIBUTION CENTER
50 20	RAIL INTERMODAL DRAYAGE
50 30	AIR FREIGHT DRAYAGE
60 00	UNCLASSIFIED

Tennessee Rail System Plan

Identification of Tennessee Agricultural and Silvicultural Products Possibly Benefiting from Rail System and Rail Related Improvements

PREPARED FOR

Tennessee Department
of Transportation

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Identification of Agricultural and Silvicultural Products Possibly Benefiting from Rail System and Rail Related Improvements

Study Approach

To determine the potential agricultural use of the east-west rail corridor, and the need for rail system and rail related improvements that might benefit the Tennessee agricultural and silvicultural industries, direct interviews with the largest producers and transportation decision-makers were conducted. The Tennessee Farm Bureau and the Tennessee Department of Agriculture assisted in identifying the organizations that were interviewed. Appendix A-1 lists the contacts for the interview process.

This analysis presents the current production of agricultural and silvicultural products on a county-by-county basis. It also relates this production to the existing and abandoned rail system. The actual analysis of the specific rail system improvements that may increase the competitiveness of these industries is contained in Task 6, "Rail Freight Intermodal Facility Needs and Rail System Connections."

A study of potential agribusiness opportunities had been previously commissioned by the Tennessee Department of Agriculture in conjunction with the Tennessee Department of Economic and Community Development. This study was reviewed to determine the importance of rail service to the development of, or recruitment of, new agribusiness enterprises.

While stone, zinc and other mining outputs are not strictly considered agricultural products, the interview process pointed to mining-related operations as the most likely users of the Tennessee rail system and the east-west rail corridor. The Tennessee Department of Agriculture specifically identified mining operations in the Cumberland Plateau as potential users of the corridor. Those specific companies were interviewed, along with other companies having similar operations in that region and across the state.

It is our general finding that with the exception of the Cumberland Plateau, most industries contacted had adequate rail service. This is also apparent from maps included in this study showing agricultural and silvicultural activity by county and the rail lines that serve those counties. Specific improvements that may be of value to agriculture related enterprise; these will be identified in Task 6 – Rail Freight Intermodal Facility Needs and Rail System Improvements.

AGRICULTURAL CROPS

Tennessee produces a variety of crops including hay, alfalfa, sorghum, tobacco and vegetables. These crops are produced in relatively small volumes and are ultimately consumed within close proximity to the producer; consequently rail transport is not cost effective.

There is a small but increasing amount of floriculture production in Tennessee. However, the time-sensitivity of these products prohibits the use of rail.

The top agricultural products in Tennessee are corn, wheat, soybeans and cotton. The production level for each of these crops is shown in the table below.

Crop	**1999 Production**
Corn	67.3 million bushels
Wheat	18.4 million bushels
Soybeans	28.8 million bushels
Cotton	595,000 bales lint 223,000 tons seed

The majority of these crops are grown in northwest Tennessee.
The top producing Tennessee counties for these crops are:

Crop	**Top 5 Producing Counties**
Corn	Obion, Weakley, Gibson, Henry, Carroll
Wheat	Gibson, Obion, Weakley, Dyer, Robertson
Soybeans	Obion, Dyer, Gibson, Weakley, Lake
Cotton	Haywood, Crockett, Tipton, Lauderdale, Fayette

Maps A1 – A4 illustrate the levels of crop production and the proximity to rail. All of the top-producing counties are served by rail. As can be seen in these maps, top producing counties are served by rail.

Archer Daniels Midland and Cargill are the two largest buyers of agricultural commodities from these counties. These buyers determine where and how the producers will ship the commodities. A combination of rail, barge and truck is currently used. No additional use of rail was projected by either of these buyers if the east-west rail corridor is developed.

These commodities are generally shipped to sites along the Mississippi river for processing or loading onto barges.

FORESTRY PRODUCTS

Tennessee produces the second highest volume of hardwood in the United States. As a result, furniture manufacturers and other hardwood products manufacturers have located in the state and in adjacent states.

Tennessee ranks: 4th in the US in Household Furniture Manufacturing
7th in the US in Office Furniture Manufacturing
1st in the US in Hardwood Flooring Production
2nd in the US in Hardwood Lumber Production

A large percentage of the wood harvested in Tennessee is utilized within the state by the industries listed above and by pulp and paper mills within the state. A significant economic cluster of furniture manufacturers already exists in East Tennessee. Map A5 illustrates the levels of hardwood production by county and the proximity to rail.

The largest customers of forestry products outside the state are the furniture manufacturing industry clusters centered in Tupelo, MS and High Point, NC. Both of these manufacturing centers are within two hundred miles, or less, of the top-producing hardwood counties in Tennessee, therefore transporting by truck is less expensive than rail. The current allow to control costs and delivery times. Rail service is already available to both the harvesting counties and the product producing counties.

AGRIBUSINESS

In 1999 the following agriculture-related industry targets were identified through a study conducted by the Sparks Companies, Inc. in conjunction with the agricultural research division of the University of Tennessee:

- Furniture Manufacturing
- Soybean/Cottonseed Crush Mill
- Pork Packing
- Hog Production
- Broiler Plant

The Tennessee Department of Agriculture and the Tennessee Department of Economic and Community Development commissioned this study and have been working to recruit these target industries to Tennessee. There is sufficient rail infrastructure and ample trucking services currently in place to support these industries. In general, transportation services beyond the railroads themselves providing rail sidings as is traditionally done would not provide a major incentive to these industries locating to Tennessee.

Soybean/Cottonseed Crush Mill

Only one soybean/cottonseed crush mill, located in Memphis, is currently in operation in Tennessee. The preferred location of a new mill, if recruited to Tennessee is in Lake County at the site of the future Cates Landing Port/Intermodal Terminal. This site is preferred by state economic developers due to the proximity to the top five soybean and cotton producing counties. The Cates Landing site which is above the flood plain and accessible without a levy.

Input to a soybean and/or cottonseed mill is projected to be transported via truck or barge. Output is expected to be transported by rail, truck or barge. Since the Cates Landing site is not currently served by rail, an extension of rail to the site would be required.

The Northwest Tennessee Port Authority has initiated a study to determine the feasibility of developing the port and intermodal site and that could play a key role in the development of a crush mill and generate other freight in the region. The feasibility study has been delivered to he Army Corp of Engineers and additional studies are underway.

Pork Packing

Currently two pork packing plants are operating in Tennessee: Fineberg in Memphis and Sara Lee in Newbern (Dyer County). Both of these West Tennessee locations are served by rail.

The preferred/projected site recruitment of an additional plant is Cocke County in East Tennessee. Cocke County is served by shortline rail. The Sparks study indicates that rail to the specific site would be a key factor in the location decision if the recruitment of this target industry is achieved.

Hog Production

Tennessee is a feed grain deficit area. If hog production is to be increased, feed grain will have to be shipped into the state by rail. Therefore any area within the state that seeks to develop hog production will need rail service for delivery of feed grain from the high volume producing states from the Midwest.

Eight west Tennessee counties are proposed by the Tennessee Department of Economic and Community Development as potential sites for increased hog production: Obion, Weakley, Henry, Carroll, Benton, Henderson, Decatur, and Perry. Of these counties, Decatur and Perry are not served by rail.

Broiler Production

Tennessee was the 15th largest broiler producer in 1998 with production projected to grow due to expansions underway at five slaughter plants already located in Tennessee:

- Tyson, Union City
- Tyson, Shelbyville
- Koch Foods, Chattanooga
- Koch Foods, Morristown
- Seaboard, Chattanooga

Henning (Lauderdale County) and Humboldt (Gibson County) are noted as potential sites for broiler production. Both cities have the necessary infrastructure and have expressed willingness to locate a broiler production plant. Both are served by rail.

Since Tennessee is a feed grain deficit area, rail transportation is necessary for receiving corn and soybean meal from the US Midwest for broiler production.

MINING

Tennessee is a top producer of clay, zinc and stone. Annual output is shown in the table below:

Mining	US Production Rank	Production
Clay	1	7 million short tons (1997)
Zinc	2	1 million metric tons (1985)
Stone	11	67.5 million short tons (2001)

Much of the mining activity in Tennessee takes place in the Cumberland Plateau. Top producers and processors of clay, zinc, and stone were contacted directly to determine potential utilization of rail if the abandoned link between Allgood and Oliver Springs were reconstructed to form an east-west rail corridor.

The following table summarizes the findings from those contacts made with the top mining related operations in Tennnessee.

Name: Franklin Industrial Minerals
TN Locations: Crab Orchard, Anderson
Products: Limestone, chemical grade fillers, crushed stone
Current Transportation:
Crab Orchard: 70 percent shipped by truck because the product is used locally
30 percent shipped by rail (NS) to the Carolinas, Kentucky, Georgia and Mississippi

Anderson: 70 percent shipped by rail (CSX) to Nashville and into Kentucky through the Carolinas, Georgia, Alabama and Mississippi
Other information: Shipment by rail totals 4,300 cars per year, per location. The company purchased a shortline railroad from Rockwood to Crab Orchard.
Use of East-West Corridor: Some use probable but not a large volume. The company currently has flexibility due to access to Norfolk-Southern and CSX.

Name: Crossville Porcelain Stone
TN Locations: Crossville
Products: Porcelain stone tiles for residential and commercial construction
Current Transportation: Truck, 150 million pounds outbound
160 million pounds inbound
Use of East-West Corridor: Would consider if cost effective.

Name: Pasminco Zinc Inc.
TN Locations: Gordonsville mine, Knoxville area mine, Clarksville-Refinery
Products: zinc, industrial lime
Current Transportation: Trucked from mine to refinery due to short distance. Finished product shipped by truck because next day delivery is required by customers.
Other information: Refinery output is 300,000 tons per year.
Use of East-West Corridor: None projected.

Name: Vulcan Materials Company
TN Locations: 50 locations
Products: limestone, asphalt mix, sand, gravel, ready-mix concrete
Current Transportation: Truck- products are utilized within a short distance of production sites
Use of East-West Corridor: None projected.

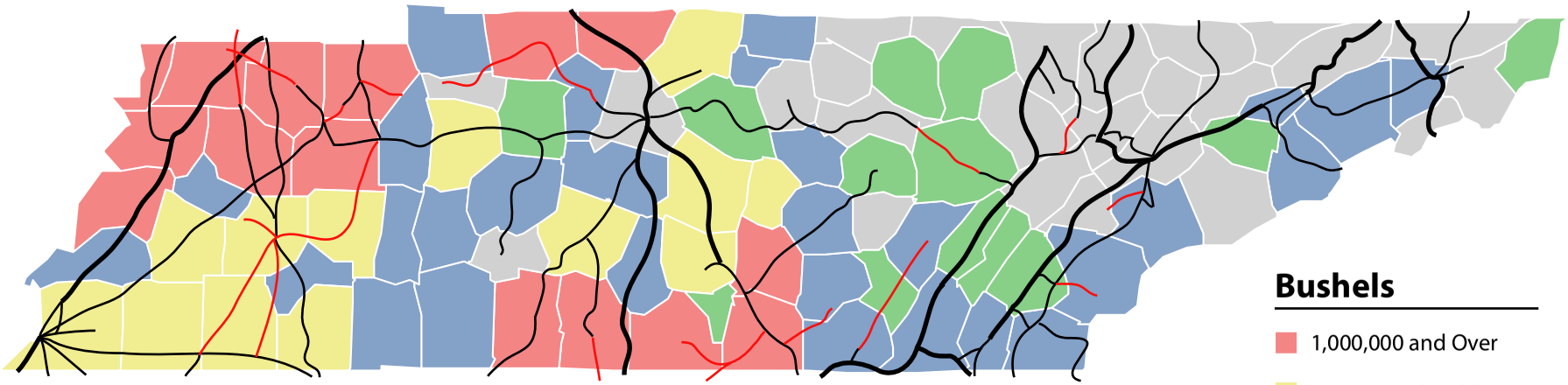
Name: Tennessee Asphalt Company
TN Locations: 10
Products: crushed stone, asphalt, sand, gravel
Current Transportation: Truck – Received 30,000 to 40,000 tons of raw materials (D-mix aggregate) from North Carolina to various facilities. Finished product is moved by truck because it is utilized within a short distance of sites.
Other Information: In 1997/98 the company looked into moving their sand and gravel across the state by utilizing empty hopper cars during the off-season of Midwest grain transportation. They found the railroad companies unresponsive. In 1999/2000, the company looked into moving granite from North Carolina to East Tennessee by rail at $12 per ton. Trucks were more cost effective at $8-9 per ton. In 2002, the company could have sold pea gravel out-of-state but was unable to find an affordable transportation method. Additional rail-use problems remain. Some Tennessee Asphalt Co. facilities have adjacent tracks but no access, and limited or no space for spurs.
Projected Tonnage: 100,000 tons sand; 125,000-150,000 gravel
Use of East-West Corridor: Some use probable, if cost effective, to move sand and gravel from West Tennessee locations to Tennessee Asphalt facilities across the state.

Name: Rogers Group Inc.
TN Locations: 38
Products: crushed stone, agricultural limestone
Current Transportation: Truck – products are utilized within a short distance of production sites.
Use of East-West Corridor: None projected.

Name: ASARCO/American Limestone, Inc.
TN Locations: 17 (Tennessee & Virginia)
Products: agricultural limestone
Current Transportation: Truck – products are utilized within a short distance of quarries.
Use of East-West Corridor: None projected.

Corn Production

Tennessee 2000



Bushels

- 1,000,000 and Over
- 500,000 - 999,999
- 100,000 - 499,999
- 45,000 - 99,999
- Under 45,000

- Class I
- Shortline
- Abandoned

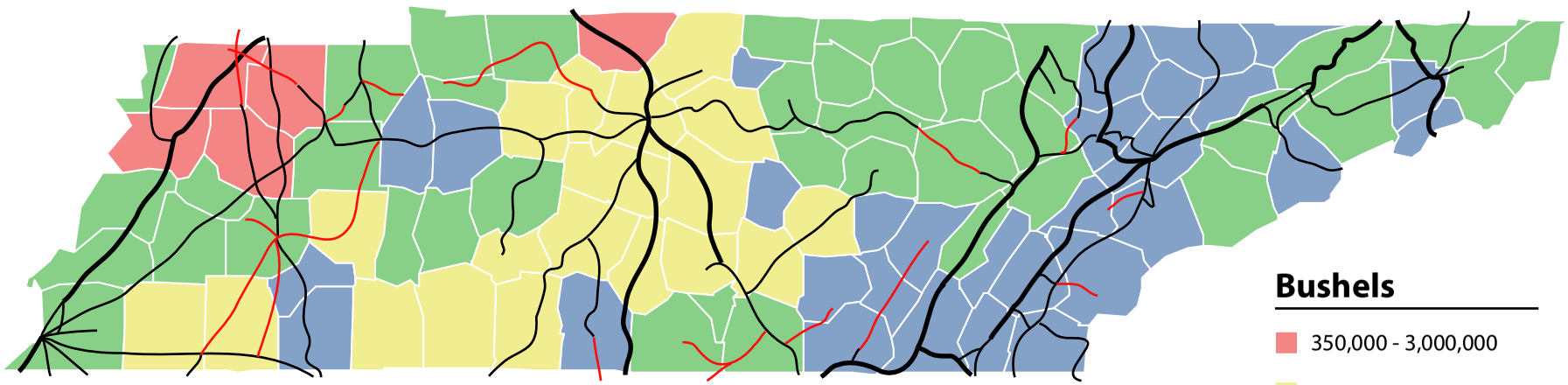
Top Five Counties

1. Obion	8,500,000
2. Weakley	6,440,000
3. Gibson	6,400,000
4. Henry	3,450,000
5. Carroll	3,130,000

Map A1

Wheat Production

Tennessee 2000



Bushels

- 350,000 - 3,000,000
- 100,000 - 349,999
- 40,000 - 99,999
- 20,000 - 39,999
- 0 - 19,999

- Class I
- Shortline
- Abandoned

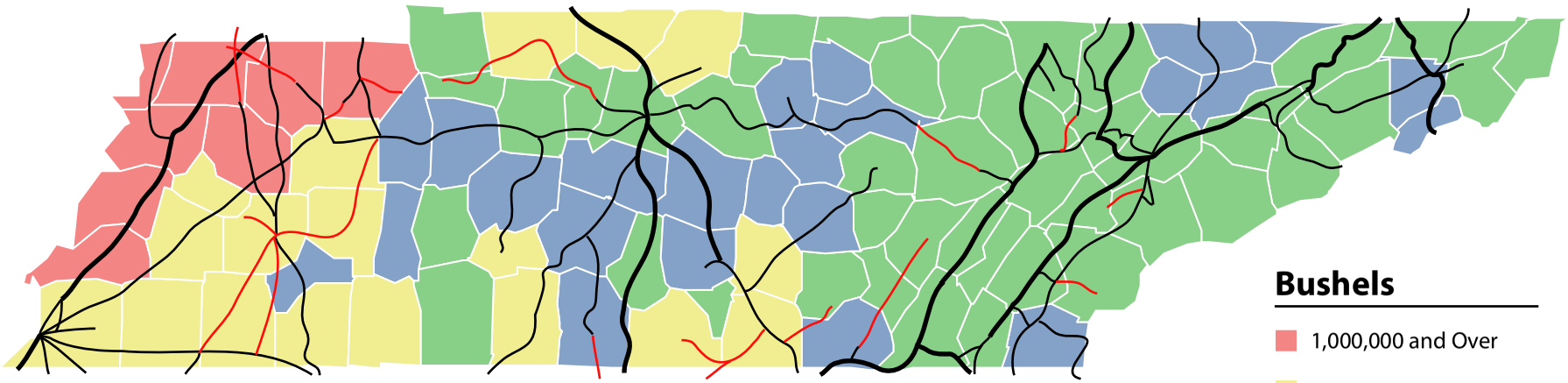
Top Five Counties

1. Gibson	2,985,000
2. Obion	2,190,000
3. Weakley	1,870,000
4. Dyer	1,760,000
5. Robertson	1,750,000

Map A2

Soybean Production

Tennessee 2000



Bushels

- 1,000,000 and Over
- 250,000 - 999,999
- 75,000 - 249,999
- 10,000 - 74,999
- Under 10,000

- Class I
- Shortline
- Abandoned

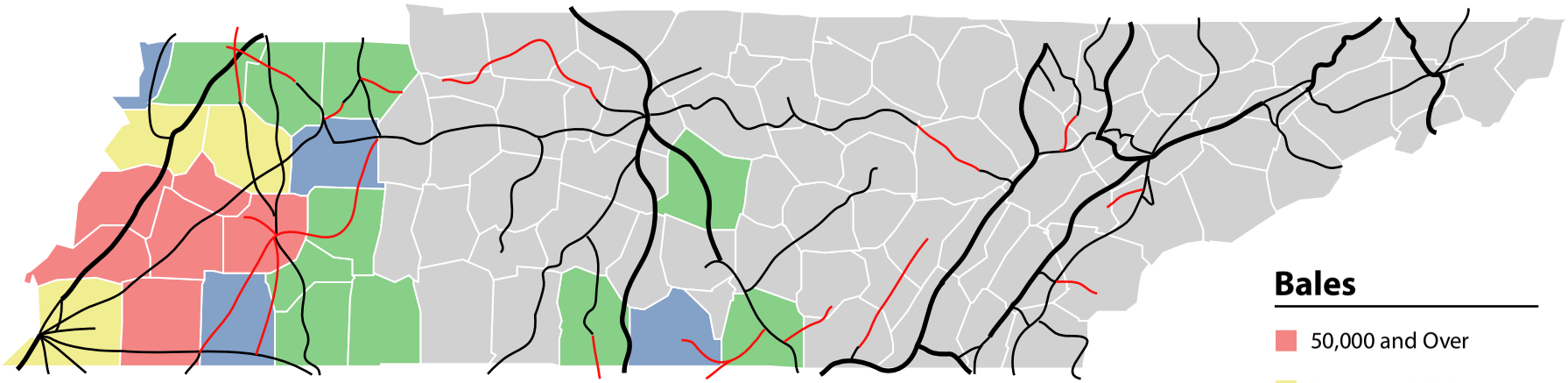
Top Five Counties

1. Obion	3,410,000
2. Dyer	2,930,000
3. Gibson	2,660,000
4. Weakley	2,135,000
5. Lake	1,550,000

Map A3

Cotton Production

Tennessee 2000



Bales

- 50,000 and Over
- 25,000 - 49,999
- 10,000 - 24,999
- Under 10,000
- No Production

- Class I
- Shortline
- Abandoned

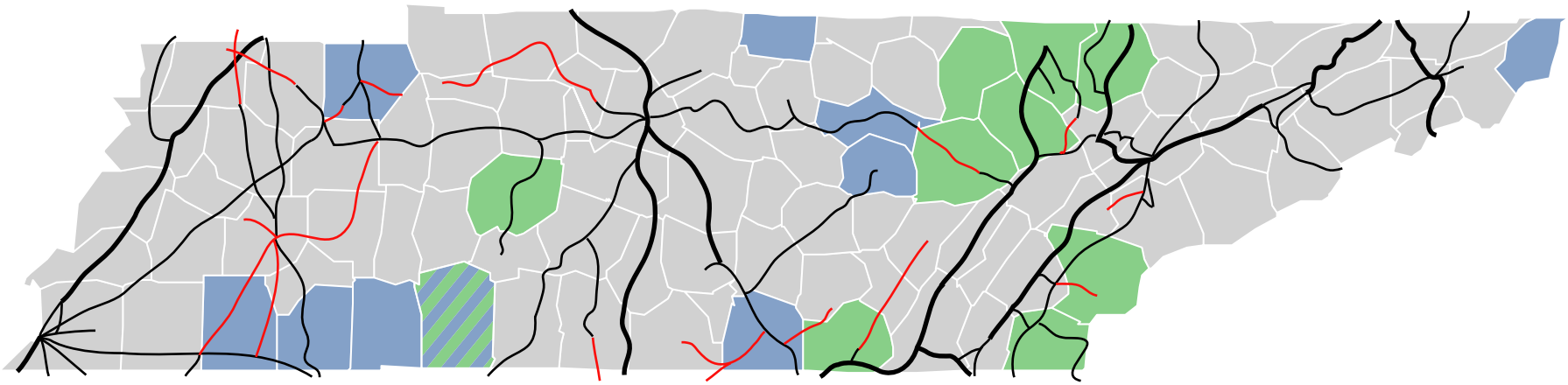
Top Five Counties

1. Haywood	138,000
2. Crockett	98,000
3. Tipton	83,000
4. Lauderdale	66,000
5. Fayette	60,000

Map A4

Forestry Products

Tennessee 2000



Class I

Shortline

Abandoned

TOP TEN COUNTIES

Growing Stock
Million Cu. Feet

1.	Cumberland	587.8
2.	Wayne	573.9
3.	Morgan	544.5
4.	Monroe	528.3
5.	Hickman	527.1
6.	Scott	506.9
7.	Campbell	480.2
8.	Polk	426.4
9.	Marion	409.4
10.	Fentress	393.7

Lumber Production
Million Bd. Ft.

1.	Hardeman	86.1
2.	Macon	46.0
3.	McNairy	40.8
4.	Johnson	38.3
5.	Henry	37.6
6.	White	36.8
7.	Wayne	33.6
8.	Franklin	32.4
9.	Hardin	31.6
10.	Putnam	30.5

Map A5

Contacts:

The following individuals and organizations were contacted to obtain data for this study.

Dan Wheeler, Commissioner
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Tennessee Rail System Advisory Committee

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Tennessee Agricultural Statistics Service

Lacy Upchurch
Tennessee Farm Bureau
Tennessee Rail System Advisory Committee

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Crossville Porcelain Stone USA

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