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16. Abstract

Public investment in transportation infrastructure has traditionally been along modal lines with little effort to develop a multimodal approach. Consequently, it is difficult to determine if public transportation dollars have been invested in the most cost-effective manner. This study examines alternate strategies to transport raw timber from the stump to mills. At present, all raw timber is delivered to the mills within the Lufkin District utilizing the existing roadway system. The existing transportation system is examined using a "system costs" approach that includes public facility (infrastructure) costs, vehicle operating costs, and externalities like accident and environmental costs. Some of these costs are paid for by vehicle operators through user fees and taxes and represent the "supported" cost component of total system costs. However, unaccounted costs remain and consist of some proportion of the facility costs not paid by vehicle operators through user taxes and fees and system externalities.

It is recommended that alternate configurations for the transportation of raw timber in the Lufkin District involve an intermodal approach. The alternate solution to the timber transportation problem is viable if it exploits each mode (rail or truck) for the portion of the timber haul for which it is best suited and builds on modal complementarities that best serve the needs of the industry. The encouragement of an alternate method for the delivery of raw timber to the mills could be a more economical use of public funds.

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ECONOMICS OF RAW TIMBER TRANSPORTATION: A FEASIBILITY STUDY

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Sponsored by the
Texas Department of Transportation

October 1997

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IMPLEMENTATION RECOMMENDATIONS

This feasibility study evaluated alternate methods to deliver raw timber from the stump to mills in TxDOT's Lufkin District. The economic evaluation takes into consideration costs to the industry and to the state. The results of this project will provide useful information to TxDOT for setting priorities for strategic planning as it applies to timber transportation. The results will provide direction in developing alternate transportation configurations, with the existing system as a baseline. The results of the project may also provide a background in fostering of public-private partnerships for providing efficient transportation services and may be used to argue for multimodal methods to deliver timber to mills other than over-the road hauling. Implementation recommendations made as a result of this study are found in chapter 6.

DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the Texas Department of Transportation. This report does not constitute a standard, specification, or regulation.

ACKNOWLEDGMENT

The authors wish to thank several timber industry participants in the Lufkin District who were willing to offer their time and experience to the research team. These industry sources provided valuable information related to the different facets of timber transportation and industry activities. We would also like to recognize the support and guidance of the Lufkin District TxDOT Project Director, Mr. Michael Offield.

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SUMMARY

Efficient transportation networks are critical elements in maintaining and promoting an industry's or community's productivity. The movement of goods on road infrastructure is an important factor in the economic health of the state, and truck shipping productivity is a key element in this movement. The public sector plays a critical role in the development of transportation infrastructure. However, there is a tradeoff between vehicle weight management policies and pavement management policies in the maximization of this productivity. The goal of planners, engineers, and administrators in the highway transportation sector of government is to manage available public funds in the most efficient and equitable manner possible.

There is little argument as to the negative impact truck traffic has on roadways and highways. Trucks cause accelerated pavement deterioration resulting in constant repair of highways, closed lanes, and the presence of maintenance and repair crews on already congested highways. Although it is unrealistic to assume that all freight currently transported by truck could be shifted to trains, even a relatively small modal shift could be consequential in terms of cost savings associated with reduced infrastructure maintenance. Heavy truck loads directly affect federal and state highway budgets and therefore taxpayers in general.

At present, all raw timber is delivered to the mills within the Lufkin District utilizing the existing roadway system. This method of delivery is causing damage and deterioration to the roadway system, particularly the state and U.S. highways. The cost to rehabilitate these roadways is impacted by the large number of repetitive loads. TxDOT could more economically use its funds to encourage an alternate method for the delivery of raw timber to the mills. Other benefits could include improvements in highway safety and in the air quality of the region.

Comparisons between truck and rail transportation in the non-roadway impact areas of energy consumption, pollution, and accidents involving fatalities all demonstrate rail's superiority over trucks. Additionally, rail's potential for reducing congestion on our roadways further highlights the beneficial returns that could be expected if rail's share of transportation were to increase. It should be a matter of public policy to encourage intermodal freight transportation because this would exploit complementarities among modes.

The purpose of this study is to identify and evaluate alternate methods for delivery of raw timber to mills in the Lufkin District. Texas Department of Transportation's (TxDOT) Lufkin

District is located in East Texas along the Texas-Louisiana border and consists of nine counties. The results from the study will assist in the selection of a feasible and preferred alternative method for transportation of raw timber to mills in the Lufkin District. The assessment must include the interests of all public and private participants in timber transportation.

The research approach involves, as a first step, documentation of the existing road and rail network that supports timber industry activities. This documentation is organized timber industry related information in a form that allows an economic evaluation of alternate methods to deliver timber from the stump to mills.

The existing transportation system is examined using a "system costs" approach that includes public facility (infrastructure) costs, vehicle operating costs, and externalities including accident and environmental costs. These system costs are costs that are actually incurred in the operation of vehicles or use of the road facility and represent the true system costs. Some of these costs are paid for by vehicle operators through user fees and taxes and represent the "supported" cost component of total system costs. However, part of the system costs are not covered by user fees and taxes. These unaccounted costs typically consist of some proportion of the facility costs not paid by vehicle operators through user taxes and fees and system externalities like pollution and public safety impacts.

Industry sources indicate that "optimal" truck hauling distances range between 56-80 km (30-50 miles). Conversations with local industry sources suggest that while mills typically attempt to meet their daily timber requirements from sources within 160 km (100 miles) of their operations, some large mills, especially pulp and paper mills, receive shipments from distances over 160 km (100 miles). While recognizing that truck transportation affords flexibility and spontaneity in obtaining raw materials from diverse harvesting sites, rail is potentially a more appropriate carrier for long distance freight movement. This study examines an intermodal configuration for transporting raw timber with concentration yards (timber collection yards) serving as truck to rail transfer yards.

Based on the findings of this study, it is recommended that alternate configurations for the transportation of raw timber in the Lufkin District involve a multimodal approach and not a mutually exclusive modal solution (just trucking or railroading). The alternate solution to the timber transportation problem is viable if it exploits each mode for the portion of the timber haul to which it is best suited and builds on modal complementarities that best serve the needs of the industry. Also, the alternate timber transportation strategy must build on existing transportation infrastructure (rail or road), thus avoiding significant new construction or rehabilitation expenditures. By identifying paralleling highway and rail infrastructure that geographically overlay timber industry activity nodes, the timber transportation network can be disaggregated into several seamless intermodal transportation system units.

1.0 INTRODUCTION

Timber is Texas' third most valuable agricultural commodity, exceeding $1 billion, and represents 35 percent of East Texas' agricultural income (1). The annual economic impact of the Texas forest industry is estimated to be $21.8 billion and over $3 billion has been invested in new manufacturing since 1986. Wood-based manufacturing provides over 80,000 jobs, spreads over all regions of the state, and pays $2.0 billion in wages and salaries each year. This wood-based industry is a vital part of Texas' diverse economy.

At present, all raw timber is delivered to the mills within the Lufkin District by the existing roadway system. There is little argument that this method of delivery will cause damage and deterioration to the roadway system, particularly to state and U.S. highways. The cost to rehabilitate these roadways is affected by the large number of repetitive loads. TxDOT could more economically use its funds to encourage an alternate method for the delivery of raw timber to the mills. Other benefits could include improvements in highway safety and in the air quality of the region.

Transportation investment decisions involve multiple, often conflicting objectives. Conflicts arise as costs and benefits accrue to various individuals and organizations. The solution to such multicriteria economic problems requires the valuation of such benefits and costs and the consideration of tradeoffs among them. The scientific approach to public policy decision making must link preferences, institutions, feasible outcomes, and actual outcomes.

1.1 STUDY AREA

The purpose of this study is to identify and evaluate alternate methods for delivery of raw timber to mills in the Lufkin District. Texas Department of Transportation's (TxDOT) Lufkin District is located in East Texas along the Texas-Louisiana border, and consists of nine counties: Angelina, Houston, Nacogdoches, Polk, Sabine, San Augustine, San Jacinto, Shelby, and Trinity. The district covers 18,423 square kilometers (7,113 square miles) and in 1996 had an estimated population of 266,010 (TxDOT Homepage). Figure 1-1 shows the nine counties along with relevant cities with a timber industry base.

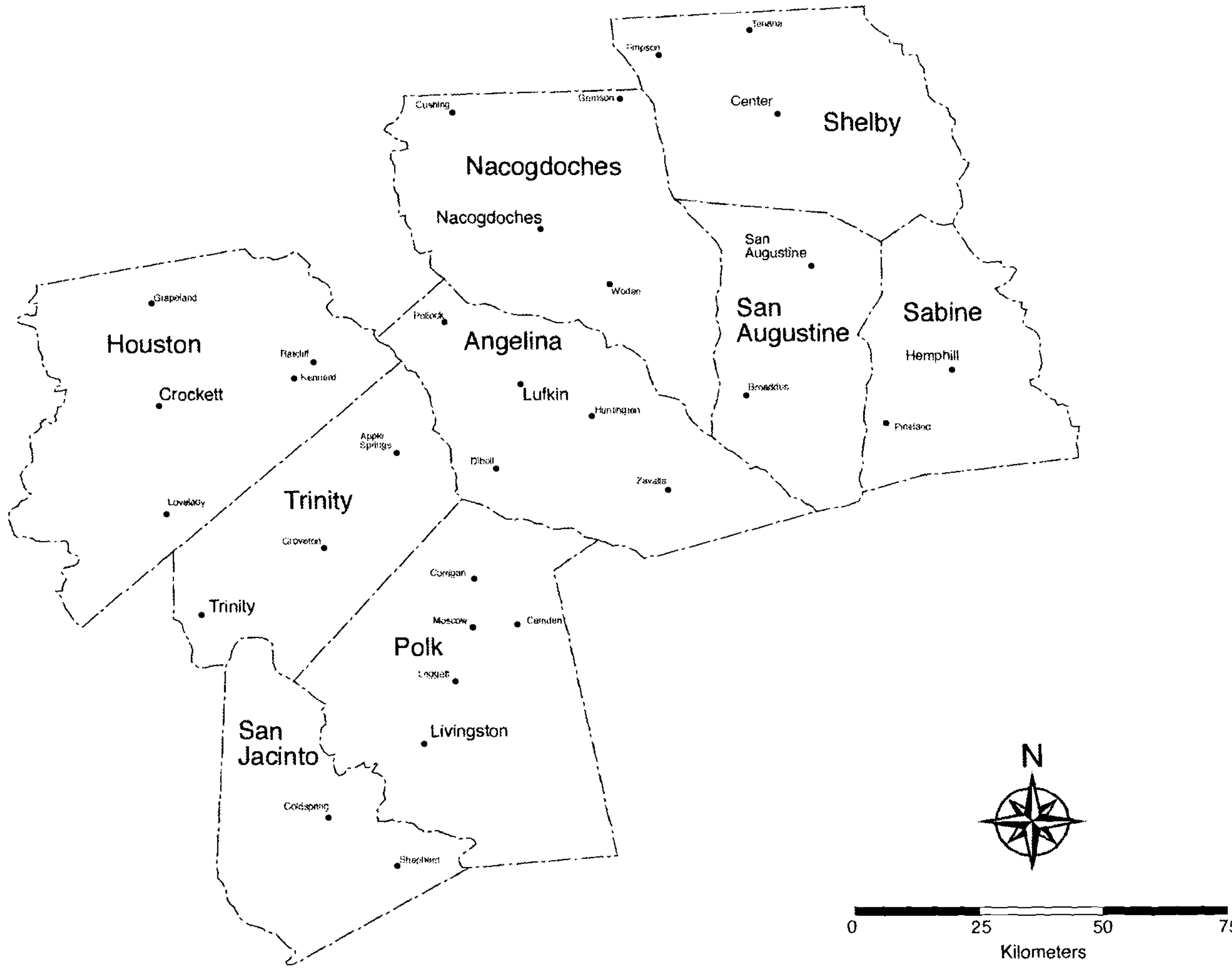

Figure 1-1. Lufkin District

1.2 FEASIBILITY STUDY

To evaluate the timber transportation problem, researchers conducted an economic feasibility study that takes into account timber industry costs and costs to the state to assess potential tradeoffs for investment of public funds in addressing highway and other alternatives. The results from the study will assist in the selection of a feasible and preferred alternative method for transportation of raw timber to mills in the Lufkin District.

The research documented in this project summary report includes the following items:

- Description of timber industry participants in the Lufkin District.
- Documentation of the existing road network that supports timber transportation in the Lufkin District.
- Documentation of the rail network that supports timber transportation in the Lufkin District.
- Review of organizational, institutional, and public policy elements relevant to transportation of raw timber to mills in the Lufkin District.
- Identification and definition of an alternate method for transportation of raw timber to mills.
- Identification of factors for inclusion in the economic valuation.
- Application of alternative strategy for transporting raw timber to mills in the Lufkin District.

In line with the objectives of the study, the first step towards identifying an alternate method of transporting raw timber to mills is to document the existing transportation system that supports timber industry activities in the Lufkin District of East Texas. It is important to organize related information in a form that can be readily utilized in a comprehensive examination of timber transportation methods. Chapter 2.0 provides a geographical background of the timber industry in the Lufkin District by identifying the locations of timberlands, harvest trends, mill locations, and related characteristics of timber transportation. This documents the existing transportation network (road and rail) as it supports timber industry components (e.g., timberlands and timber mills). Based on discussions with select timber industry participants, chapter 3.0 reviews organizational, institutional, and public policy elements in the Lufkin District to articulate the timber transportation problem. Economic aspects of the various public and private interests are summarized to allow a meaningful evaluation of the existing timber transportation configuration. Chapter 4.0 develops an alternate method for transportation of raw timber as a combination of different modes into a seamless transportation system with efficient transload terminals or timber concentration yards. Chapter 5.0 identifies a feasible transfer yard location in the Lufkin District and highlights the various timber industry nodes that could potentially be served in a multimodal configuration. Chapter 6.0 provides implementation recommendations and identifies additional research needed to implement results of this feasibility study.

2.0 TIMBER INDUSTRY IN THE LUFKIN DISTRICT

One of the major tasks in this study is to document the existing transportation system as it supports timber industry activities in the study area. An important first step is to organize timber industry related information in a form that will allow an examination of the timber transportation system in the Lufkin District.

2.1 LOCATION OF TIMBER INDUSTRY COMPONENTS

2.1.1 Land Ownership in the Lufkin District

The United States Department of Agriculture classifies *forest lands* as lands with at least 16.7 percent stocked by forest trees of any size, or formerly having such tree cover, and not currently developed for nonforest uses. Minimum area considered for classification is 0.41 hectares (1.0 acre). Forest lands fall under several broad ownership classes (2, 3):

- Farmer-owned lands - lands operated as a unit of 4.1 hectares (10 acres) or more and from which the sale of agricultural products totals $1,000 or more annually.

- Forest industry lands - lands owned by companies or individuals operating wood-using plants (either primary or secondary).

- National forest lands - federal lands that have been legally designated as national forests or purchase units and other lands under the administration of the Forest Service, including experimental lands.

- Nonindustrial private lands (corporate) - lands privately owned by private corporations other than forest industries and incorporated farms.

- Nonindustrial private lands (individual) - lands privately owned by individuals other than forest industries or farmers.

- Other federal lands - federal lands other than National Forests.

- State, county, and municipal lands - lands owned by states, counties, and local agencies or municipalities or lands leased to governmental units for 50 years or more.

Total land ownership in the Lufkin District exceeds 1.3 million hectares (3.2 million acres) and consists of public and private lands (subdivided into industrial and individual ownership). Public lands include four national forests: Sam Houston, Davy Crockett, Angelina, and Sabine National Forests. Table 2-1 shows timberland ownership patterns for the nine Lufkin District counties (3, 4).

Table 2-1. Timberland Ownership in the Lufkin District in Thousands of Hectares (Thousands of Acres)

County	Private			Public	Other	Total Ownership
	Industrial	Individual	Sub-Total			
Angelina	74.1 (183.1)	55.6 (137.3)	129.7 (320.4)	17.4 (43.2)	2.6 (6.5)	149.7 (370.1)
Houston	21.9 (54.0)	74.3 (183.6)	96.2 (237.6)	36.2 (89.5)	21.9 (54.0)	154.3 (381.2)
Nacogdoches	47.6 (117.6)	95.2 (235.2)	142.8 (352.8)	6.1 (15.1)	4.8 (11.8)	153.7 (379.7)
Polk	159.0 (392.9)	51.4 (127.1)	210.4 (520.0)	0.0 (0.0)	7.0 (17.3)	217.4 (537.4)
Sabine	52.4 (129.5)	19.4 (48.0)	71.8 (177.5)	33.6 (82.9)	1.9 (4.8)	107.3 (265.2)
San Augustine	57.2 (141.3)	29.8 (73.7)	87.0 (215.0)	23.1 (57.2)	2.5 (6.1)	112.6 (278.4)
San Jacinto	37.8 (93.4)	35.3 (87.2)	73.1 (180.6)	26.2 (64.8)	15.1 (37.4)	114.4 (282.9)
Shelby	24.8 (61.3)	85.4 (211.0)	110.2 (272.3)	23.6 (58.2)	11.0 (27.2)	144.8 (357.7)
Trinity	86.0 (212.5)	21.5 (53.1)	107.5 (265.6)	27.0 (66.7)	8.1 (19.9)	142.6 (352.2)

2.1.2 Harvest Trends in the Lufkin District

According to harvest trends published by the Texas Forest Service (5), total timber removals increased 4 percent to a record 22.1 million cubic meters (778.8 million cubic feet) in 1993. The harvest of timber for industrial use in the production of wood products was 17.9 million cubic meters (633.8 million cubic feet). The value of timber harvested increased significantly due to higher prices and volumes. Texas was a net exporter of timber to surrounding states. Table 2-2 presents harvest trends in the Lufkin District nine-county area for select types of wood.

Table 2-2. Lufkin District Nine County Harvest Trends in Thousands of Cubic Meters

County	Sawlogs (Thousand Brd Ft)	Roundwood and Pulpwood (Thousand Cords)	Veneer and Panel Roundwood (Million Cubic Ft)	Total Timber Harvested (Million Cubic Ft)
Angelina	317.4 (70,041)	261.2 (108.5)	396.4 (14.0)	976.5 (34.5)
Houston	171.5 (37,840)	148.8 (61.8)	338.5 (12.0)	653.5 (23.1)
Nacogdoches	288.2 (63,598)	117.9 (49.0)	336.3 (11.9)	743.2 (26.2)
Polk	221.9 (48,972)	308.6 (128.2)	187.0 (6.6)	709.3 (25.0)
Sabine	153.3 (33,838)	84.8 (35.2)	224.8 (7.9)	460.8 (16.3)
San Augustine	158.9 (35,061)	135.6 (56.3)	245.6 (8.7)	536.3 (18.9)
San Jacinto	154.9 (34,176)	148.2 (61.6)	103.7 (3.7)	401.4 (14.2)
Shelby	217.0 (47,891)	312.5 (129.9)	268.0 (9.5)	785.2 (27.7)
Trinity	195.8 (43,212)	146.3 (60.8)	132.2 (4.7)	473.1 (16.7)

2.1.3 Mills Moving Forest Products in the Region

The forest products industry is significant in the region in terms of bulk freight. Figure 2-1 illustrates select locations of timber mills in various cities in the nine-county area of the Lufkin District (6). In Figure 2-1, "timber mills" broadly include sawmills and pallet mills, paper mills, wood chip and wood shaving mills, plywood and composite board mills located across the district. This documentation of timberlands and timber mills illustrates the road and rail infrastructure that supports the various industry activities.

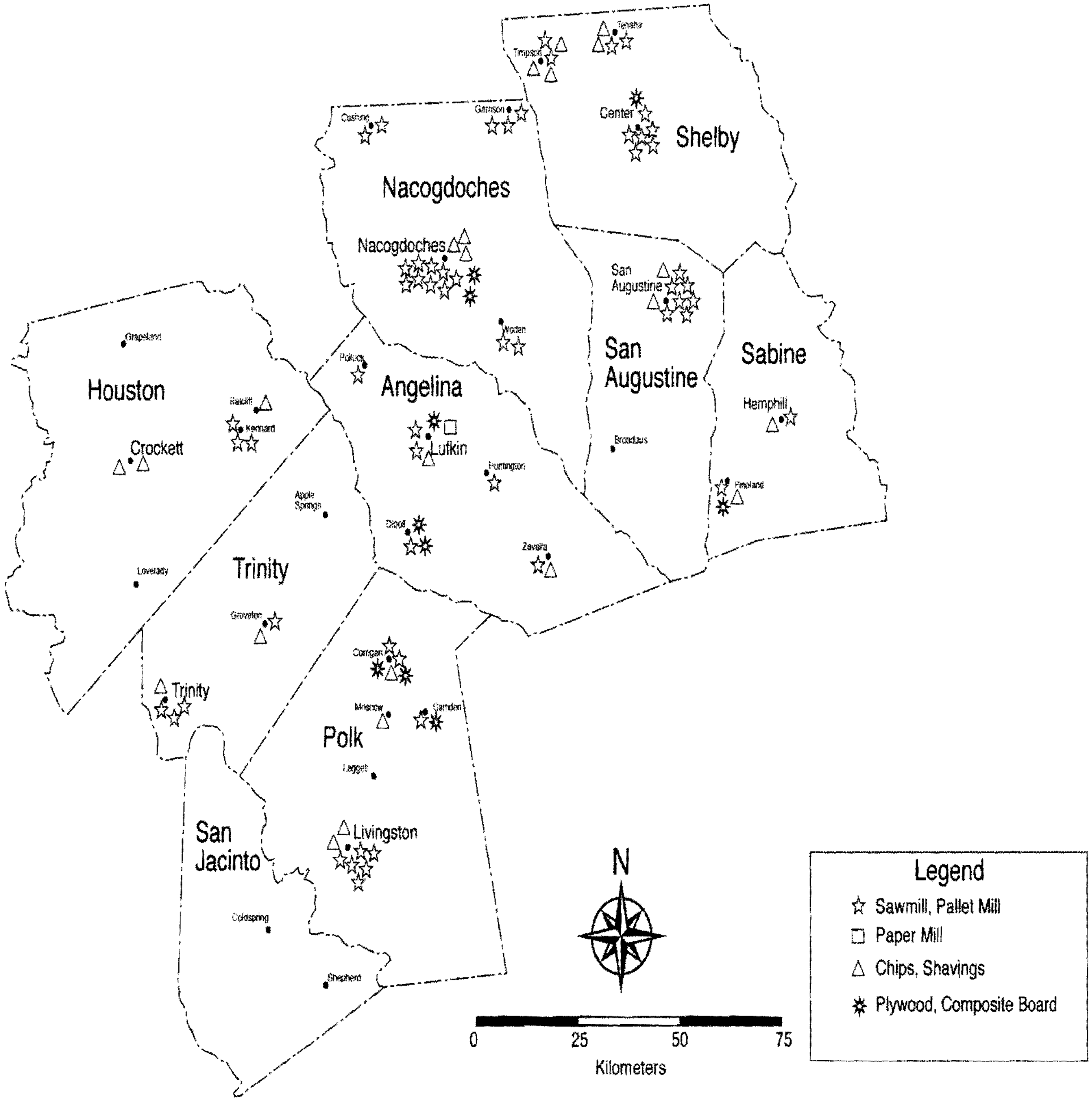

Figure 2-1. Lufkin District Timber Mills

2.2 LUFKIN DISTRICT TIMBER TRANSPORTATION NETWORK

This section describes the major U.S., state, and farm-to-market (FM) highways serving the timber industry in the nine county area of the Lufkin District. This review includes the existing rail infrastructure that may be relevant to providing transportation services to the timber industry. The Appendix provides in detail the relevant road and rail infrastructure that serves the timber industry nodes (cities) in each county of the Lufkin District.

2.2.1 Road Transportation

The Lufkin District highway network consists of 4,545 centerline km (2,823 miles), 10,093 lane km (6,269 miles), and accommodates 11,466,707 daily vehicle km (7,122,178 daily vehicle miles) (7). The District highway system is comprised of a variety of federal, state, and farm-to-market (FM) roadways. Figure 2-2 illustrates the Lufkin District highway network.

Federal highways US 59, US 69, and US 96 are the major north/south highways, and US 190 and US 287 are the major east/west highways. US 59 supports the most vehicles by averaging over 10,000 vehicles per day in most locations and as many as 20,000 vehicles per day around Lufkin and Nacogdoches. US 59 is a major corridor for trade between Mexico, the United States, and Canada. It originates on the Texas-Mexico border in Laredo, travels north through Houston, transverses the Lufkin District, and continues north through Minnesota into Canada. The other federal highways in the Lufkin District average approximately 5,000 vehicles per day or less. The state highway system consists of state and farm-to-market highways. Tables 2-3 and 2-4 provide traffic and truck volumes from the 1990 Texas Traffic Map and 1990 Texas Truck Traffic Flow Map published by TxDOT (8, 9), for both the federal and state highways as they relate to the Lufkin District. Table 2-3 shows that the federal highways in the district average 20 percent trucks while Table 2-4 shows that the state highways average 16 percent trucks.

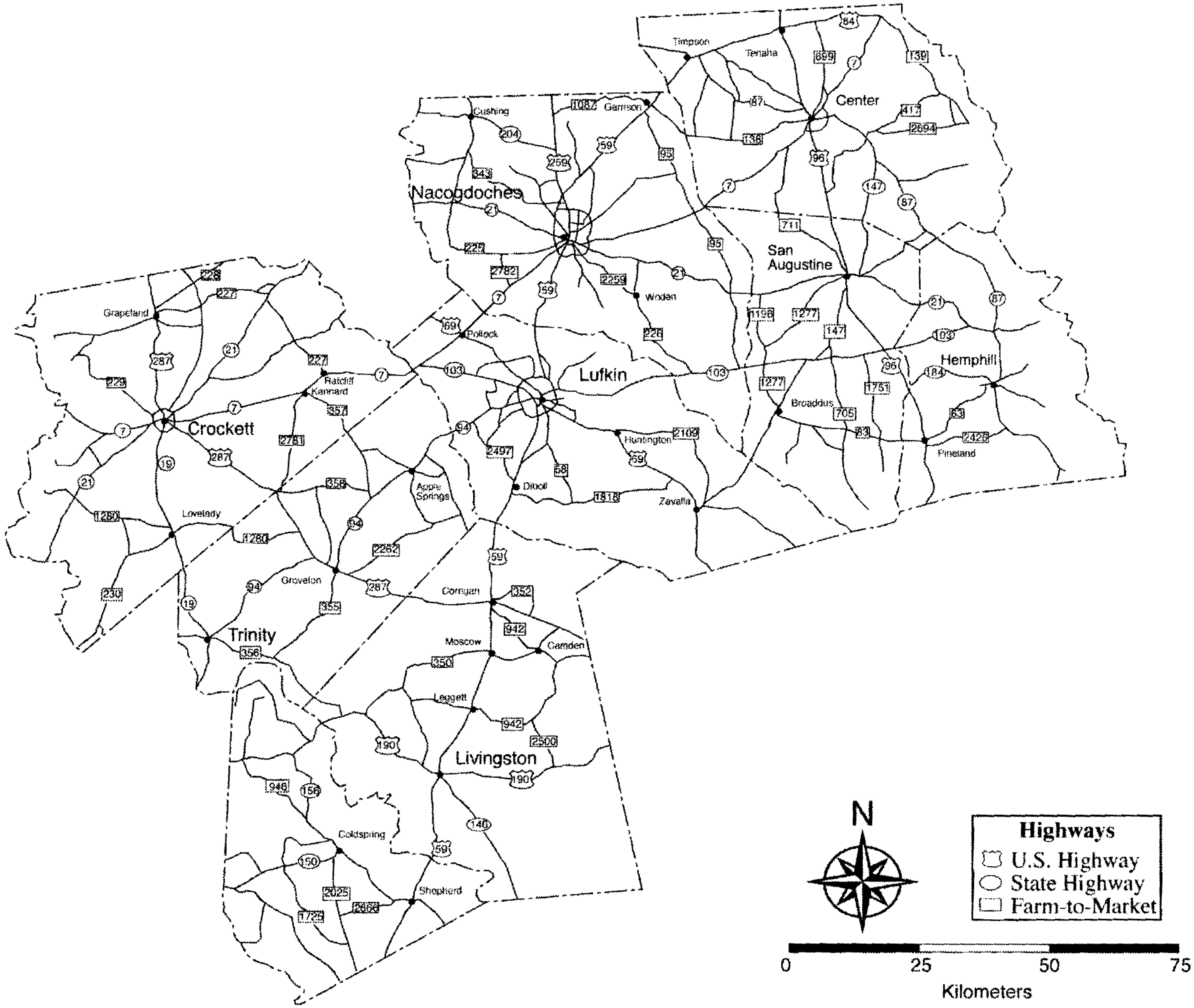

Figure 2-2. Lufkin District Highway Network

Table 2-3. Federal Highway Traffic and Truck Volumes for the Lufkin District (1990)

Highway	Nodes	Traffic Volumes	Truck Volumes	Percent Trucks
US 59	Cleveland - Shepherd	19,200	4,500	23
	Shepherd - Livingston	17,500	4,200	24
	Livingston - Corrigan	15,200	3,900	26
	Corrigan - Lufkin	13,900	3,600	26
	Lufkin - Nacogdoches	18,000	3,900	22
	Nacogdoches -US 259	12,000	3,200	27
	US 259 - Tenaha	6,100	2,000	33
	Tenaha - Carthage	7,000	2,000	29
US 69	Woodville - Zavalla	3,800	800	21
	Zavalla - Lufkin	6,000	1,000	17
	Lufkin - Pollock	9,200	1,300	14
	Pollock - Rusk	5,300	1,000	19
US 287	Woodville - Corrigan	2,200	500	23
	Corrigan - Groveton	1,950	500	26
	Groveton - TX 94	3,400	400	12
	TX 94 - Crockett	1,200	300	25
	Crockett - Palestine	3,900	400	10
US 190	Huntsville - Point Blank	3,800	400	11
	Point Blank - Livingston	5,800	400	7
	Livingston - Woodville	2,900	300	10
US 259	US 59 - Henderson	7,400	1,900	26
US 96	Jasper - TX 103	5,900	1,000	17
	TX 103 - San Augustine	2,700	500	19
	San Augustine - Center	3,100	500	16
	Center - Tenaha	4,200	600	14
US 84	Tenaha - Louisiana	2,100	400	19
		Average Percent Trucks		20

Table 2-4. State Highway Traffic and Truck Volumes for the Lufkin District (1990)

Highway	Nodes	Traffic Volumes	Truck Volumes	Percent Trucks
TX 19	Huntsville - Trinity	7,000	700	10
	Trinity - Crockett	2,800	400	14
	Crockett - Palestine	3,900	400	10
TX 21	Madisonville - Crockett	1,850	300	16
	Nacogdoches - San Augustine	2,600	200	8
	San Augustine - Milam	600	50	8
	Milam - Louisiana	1,800	300	17
TX 94	Trinity - US 287	1,600	300	19
	US 287 - Groveton	3,400	400	12
	Groveton - Lufkin	1,800	300	17
TX 156	Coldspring - Point Blank	1,250	200	16
TX 150	New Waverly - Cold Springs	1,500	100	7
	Cold Springs - Shepherd	1,500	100	7
TX 146	Liberty - Livingston	2,200	300	14
TX 7	Centerville - Crockett	1,450	400	28
	Crockett - TX 103	2,800	500	18
	TX 103 - Pollock	1,300	300	23
	Pollock - Nacogdoches	1,950	500	26
TX 103	TX 7 - Lufkin	2,400	500	21
	Lufkin - US 96	1,850	400	22
	US 96 - TX 21	1,300	400	31
TX 63	Zavalla - US 190	2,800	500	18
TX 87	Burkeville - Hemphill	870	100	11
	Hemphill - Milam	2,100	200	10
	Milam - Center	1,550	200	13
		Average Percent Trucks		16

2.2.2 Logging Trucks

An important problem in forest operations is the daily transport of timber from different stands being harvested, with known supplies, to destinations, such as pulp mills, sawmills, sorting yards, and ports, with their daily demands. The basic objective is to satisfy the demand for different products at each destination, while minimizing transportation costs within technical, policy, and labor constraints.

Currently almost all raw timber from the stump to the mills is transported by truck. Interviews with knowledgeable timber industry sources in the Lufkin District indicate that there are over 200 mills in the 42 counties of East Texas. Conversations with local industry participants indicated that wood is delivered by trucks chartered by "logging contractors" or "gate-wooders," who show up at various raw timber processing mills. The number of trucks at a mill site ranges from 45 trucks per day to 150 trucks per day. Table 2-5 indicates the average number of incoming timber trucks at the various mill locations.

Table 2-5. Average Daily Truck Counts at Mill Sites

Average Mill Type	Number of Trucks
Sawmill	50
Paper Mill	125
Chip Mill	50
Plywood, Composite Board	75

A recently concluded Technical Traffic Report (10) for TxDOT, looked at existing and projected future traffic operations along US 59 through Corrigan, Texas. The technical report's study area included the city of Corrigan and its surrounding community.

According to the technical traffic report, US 59 varies from a four-lane divided rural highway north and south of Corrigan to a four-lane undivided facility through Corrigan. Federal highway US 287 is the principal east/west highway providing access from Corrigan to Crockett to the west and then northwest to Fort Worth. FM 942 intersects US 59 just south of US 287 and extends southeast. FM 352 intersects US 59 north of US 287 and extends east. FM 352 also intersects US 287 approximately 4.3 km (2.7 miles) east of US 59. FM 1987 intersects US 59 at the northern limits of Corrigan and extends north where it intersects US 59 again approximately 8.0 km (5.0 miles) north of Corrigan.

According to the report, fluctuations of daily traffic on US 59 south of Corrigan occurring on one-day count by TxDOT in May 1995 suggest that the peak occurs between 2:00 p.m. and 3:00 p.m. when 6.63 percent of the daily traffic is present. Approximately 75 percent of the daily traffic using US 59 corridor is accommodated between the hours of 7:00 a.m. and 8:00 p.m. In addition, approximately 70 percent of all vehicles on US 59 are passenger vehicles consisting of either autos or pick-up trucks. Single unit trucks accounted for approximately 5 percent, with the remaining 25 percent of the vehicles considered as multi-axle heavy vehicles.

The study also reports results from a sample survey of logging truck activities. The survey was conducted during December 1996, for two 30-minute intervals at seven locations around Corrigan. Logging vehicles were counted as loaded or unloaded when observed. Table 2-6 presents the expanded estimate of logging trucks at five of the seven locations for the 12-hour period between 7:00 a.m. and 8:00 p.m. No logging trucks were counted on FM 352 (East) or FM 1987 (East) during the survey. The two 30-minute counts were expanded to represent a 12-hour count period based upon the percentage of total traffic within the 12-hour period at US 59 south of Corrigan. An average of the two 12-hour counts was used as the average number of daily logging trucks, as indicated in Table 2-6.

Based on this survey researchers estimated that approximately 730 trips were made by logging trucks in the Corrigan area. A survey of local mills conducted in October 1996 confirmed a total of 370 log loads per day at the three sites. This represents 740 one-way trips, a figure similar to the expanded survey data. Corrigan logging truck estimates are shown in Table 2-6. The study reports that logging trucks on US 59 account for approximately 12 percent of the heavy vehicles.

Table 2-6. Corrigan Logging Truck Estimates, Polk County, Lufkin District

12-Hour Traffic on U.S. 59, South of Corrigan		Expanded Number of Logging Trucks					TOTAL ESTIMATED NUMBER OF LOGGING TRUCKS
Hour Beginning	Percent of Traffic	U.S. 59 - South	U.S. 59 - North	U.S. 287 - West	U.S. 287 - East	F.M. 942 - East	
7:00 A.M.	6.1%	7	16	15	3	4	45
8:00	7.3%	8	19	18	4	4	53
9:00	8.2%	**9**	**22**	**23**	**4**	**5**	63
10:00	8.7%	9	23	22	4	5	63
11:00	9.1%	10	24	22	5	5	66
12:00 P.M.	8.8%	10	23	22	5	5	65
1:00	8.7%	9	23	22	4	5	63
2:00	9.3%	10	24	**23**	5	**6**	68
3:00	9.1%	**10**	**24**	22	**5**	5	66
4:00	9.0%	10	24	22	5	5	66
5:00	8.5%	9	22	21	4	5	61
6:00	7.2%	8	19	18	4	4	53
	100.0%						
Average Number of Daily Logging Trucks		109	263	250	52	58	732
Percent of Logging Trucks		14.9%	35.9%	34.2%	7.1%	7.9%	100.0%

(X) = 30-minute field count x 2, Sample survey taken between December 6 and 11, 1996 (Includes finished product trucks)

2.2.3 Railroad Network

The Lufkin District railroad network consists of two Class I railroad lines: the Union Pacific Railroad (UP) and the Burlington Northern & Santa Fe Railroad (BNSF). In addition there are three shortlines operating in the District: the Texas South-Eastern Railroad (TSE), the Moscow, Camden & San Augustine Railroad (MCSA), and the Angelina & Neches River Railroad Company (ANR). Figure 2-3 shows the rail lines and select timber industry nodes on their route in the nine-county Lufkin District.

The Burlington Northern & Sante Fe Railroad line runs north/south through eastern sections of the Lufkin District. It begins its north/south direction in Silsbee and terminates north of the district in Longview. The Union Pacific Railroad Company (UP) owns two of the major rail lines in the district. Both UP lines run north/south and originate in Houston. One line terminates in Palestine while the other continues through the Lufkin District into Louisiana. The UP line to Louisiana traverses several of the major cities in the Lufkin District, which include Livingston, Corrigan, Diboll, Lufkin, and Nacogdoches. According to Union Pacific, there are 23-25 trains traveling through Corrigan, crossing US 287 each day. Table 2-7 details Class I railroad routes as they relate to timber industry hubs in the Lufkin District nine-county area.

Table 2-7. Class I Railroads in the Lufkin District

Railroad Company	Route
Union Pacific (Houston to Palestine) • Runs North-South along TX 19	Connects Houston to Palestine through Trinity in Trinity County; and Crockett and Grapeland in Houston County
Union Pacific (Houston to Shreveport, La) • Runs North-South along US 59 • Connects to ANR, TSE, and MCSA railroads • Intersects BNSF railroad line in Tenaha	Connects Houston to Shreveport through Shepherd in San Jacinto County; Livingston, Leggett, Moscow, and Corrigan in Polk County; Diboll and Lufkin in Angelina County; Nacogdoches and Garrison in Nacogdoches County; and Timpson and Tenaha in Shelby County
Burlington Northern & Sante Fe Railroad • Runs North-South along US 96 • Intersects UP line in Tenaha	Connects Silsbee to Longview through Pineland in Sabine County; San Augustine in San Augustine County; and Center and Tenaha in Shelby County

All three of the shortlines have connections to the Union Pacific line that runs from Houston to Shreveport, Louisiana. In addition, the three shortlines in the Lufkin District serve major timber companies. The Texas South-Eastern (TSE) Railroad serves Temple-Inland Forest Products Corporation, located in Diboll. Champion International has 50 percent ownership of the Angelina & Neches River Railroad, which serves the Lufkin city area. The Moscow, Camden & San Augustine Railroad Company, owned by Champion International, operates approximately 12.2 km (7.6 miles) between Moscow and Camden. Table 2-8 details shortline rail routes as they relate to timber industry hubs in the Lufkin District nine-county area.

Table 2-8. Shortlines in the Lufkin District

Railroad	Route
Texas South-Eastern Railroad (TSE) • Operates 19.3 km (12.0 miles)	Loop from Diboll to Lufkin in Angelina County
Moscow, Camden & San Augustine Railroad (MCSA) • Operates 12.2 km (7.6 miles)	Runs between Moscow and Camden in Polk County
Angelina & Neches River Railroad Company (ANR) • Operates 18.4 km (11.4 miles)	Lufkin to Keltys to Prosser to Herty to Dunagan in Angelina County

2.2.4 Abandoned Rail Lines

Several known abandonments in the Lufkin District could be potentially rehabilitated if sufficient freight demand could be demonstrated. Among these is a Southern Pacific (SP) line which connected ANR at Dunagan east of Lufkin and went south towards Beaumont along US 69. In addition, an SP line northwest out of Nacogdoches connected to then SP line, now UP, through Nacogdoches. Other abandoned lines of interest were a Texas South-Eastern line from Blix to Fastrill and a St. Louis-Southwestern Railway Company line connected to the then SP line northwest out of the city of Lufkin along US 69. Figure 2-3 shows the rail lines and select timber industry nodes on their route in the nine-county Lufkin District.

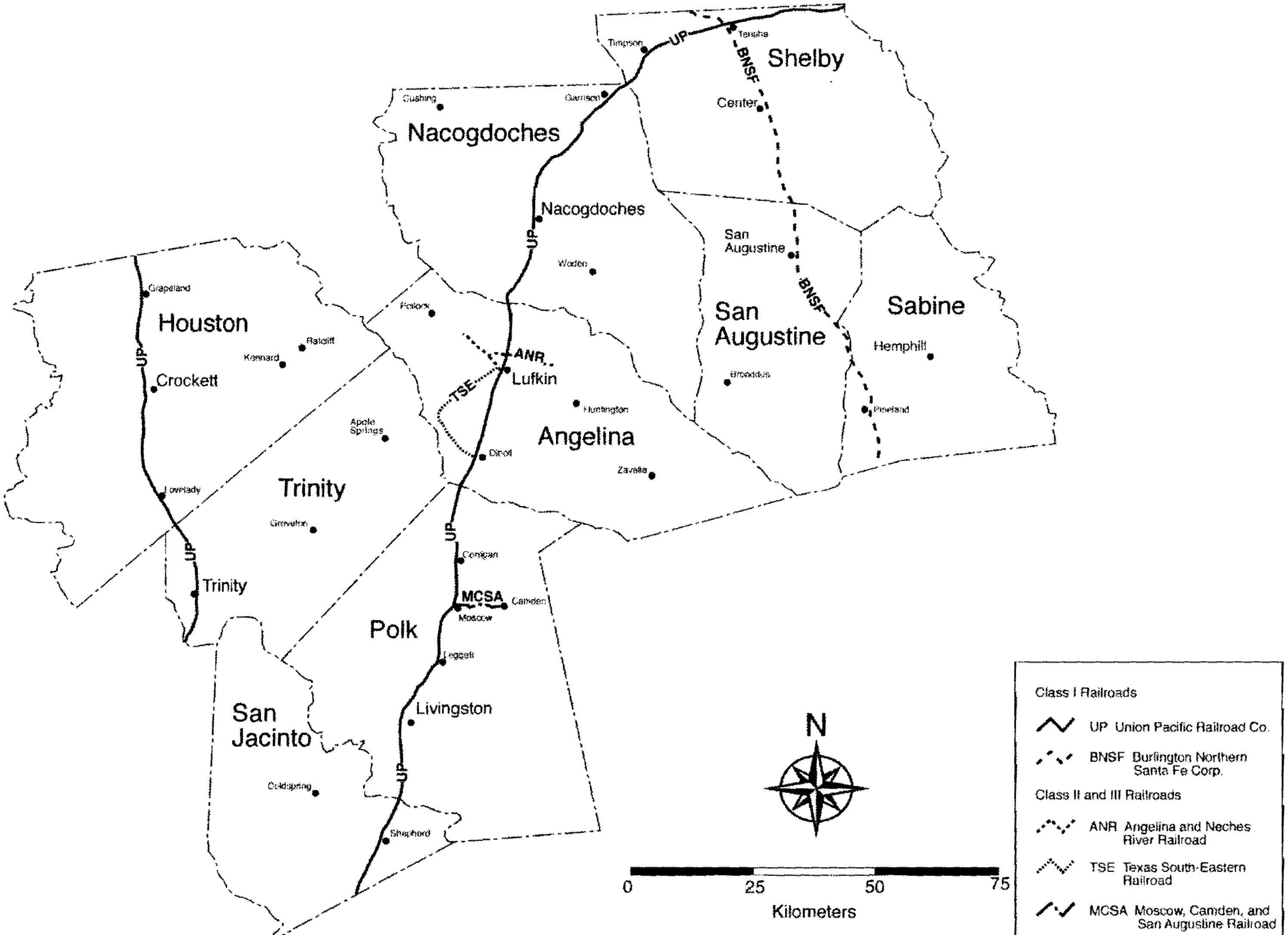

Figure 2-3. Lufkin District Railroad Network

2.2.5 Conclusion

Figure 2-4 combines the timber industry nodes, major highways, and the railroad infrastructure to show linkage between the road and rail network with timber industry hubs. Based on Figure 2-4, Table 2-9 presents estimates of average logging truck volumes at different forestry industry mills in select cities in the Lufkin District. These estimates are based on benchmark truck counts from Table 2-5.

Table 2-9 indicates that over 4,000 trucks carry raw timber to mills in these cities. These cities are selected on the basis of their proximity to a rail line. Potentially, some proportion of this timber truck traffic could be moved by rail if it were to become logistically and economically feasible.

Table 2-9. Timber Industry Nodes Along Rail Lines in the Lufkin District

County	Nodes	Mill Type (Benchmark Average Number of Trucks Per Day)				
		Saw Mill, Pallet Mill (50)	Paper Mill (125)	Chips, Shavings (50)	Plywood, Composite (75)	Total Trucks
Angelina	Lufkin	2	1	1	1	350
	Diboll	1	0	0	2	200
Houston	Crockett	0	0	2	0	100
Nacogdoches	Nacogdoches	9	0	3	2	750
	Garrison	3	0	0	0	150
Polk	Livingston	6	0	2	0	400
	Corrigan	2	0	1	2	300
	Camden	1	0	0	1	125
	Moscow	0	0	1	0	50
Sabine	Pineland	1	0	1	1	175
San Augustine	San Augustine	7	0	2	0	450
Shelby	Center	6	0	0	1	375
	Tenaha	2	0	2	0	200
	Timpson	2	0	3	0	250
Trinity	Trinity	3	0	1	0	200
Total Number of Trucks Per Day to Nodes Located Along a Railroad						4,075

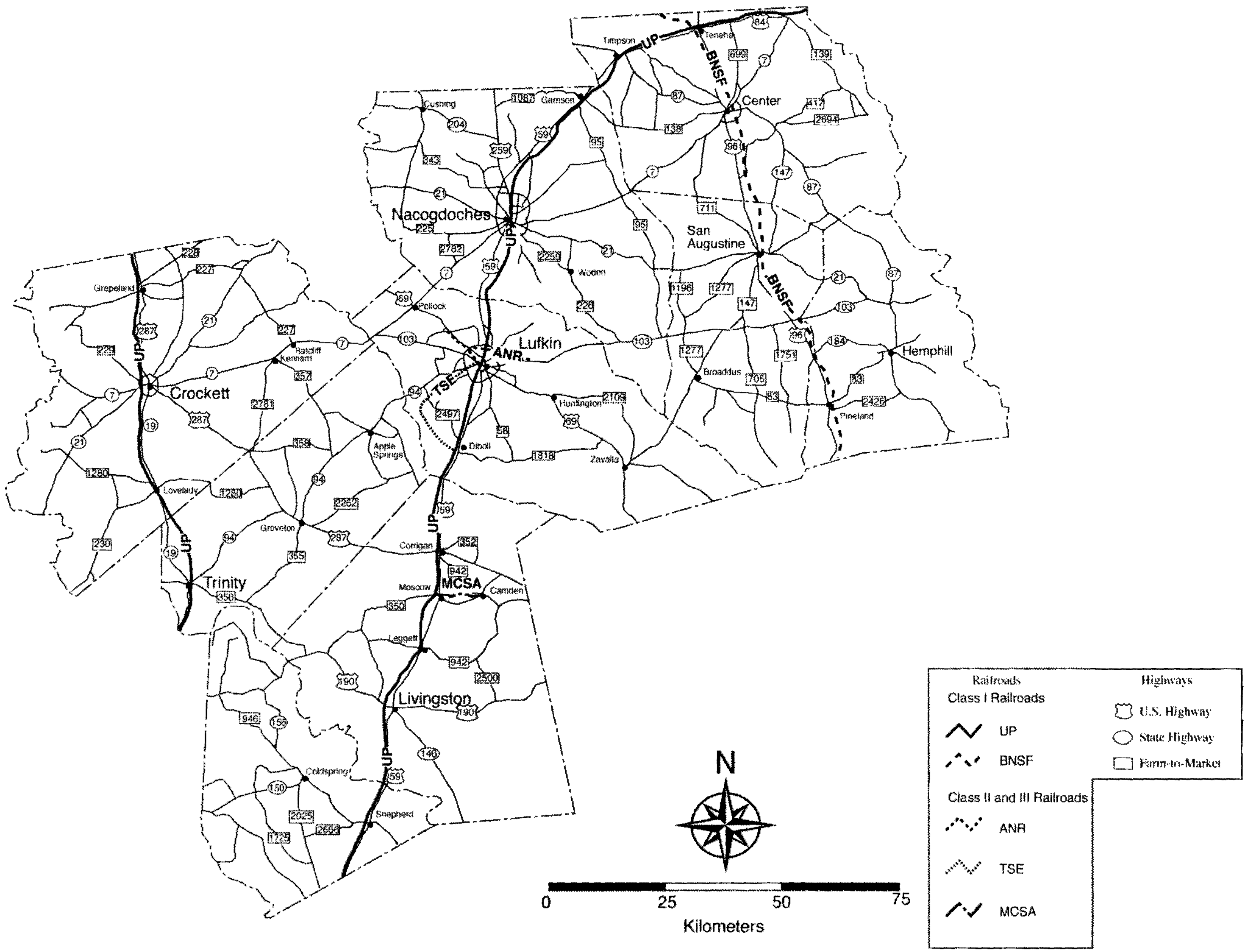

Figure 2-4. Lufkin District Timber Industry & Transportation Network

3.0 RAW TIMBER MOVEMENT USING TRUCKS

3.1 LOGISTICS OF DELIVERING TIMBER

3.1.1 Timber Harvesting

Harvesting or "logging" defines the transition from forestry to forest products. Typically, procurement foresters, or timber buyers, employed in large numbers by the forest industry, purchase standing timber, or stumpage, from many small private forest landowners. These foresters then negotiate timber harvesting or "cut and haul" contracts with independent logging contractors who provide timber harvesting services for the forest industry firms. A few large forest products firms employ company-owned logging operations to supplement their force of independent contractors. The actual cutting, processing, and removing of trees from the forest, along with their transport to a delivery point, are usually performed by these independent logging contractors, and play a vital role in the overall wood supply system throughout this region.

The different timber products harvested and transported daily are characterized by the length and diameter of the logs. To pull the logs out of the stands, forest crews use skidders upon which they carry the logs to landings where they load them on trucks. Each day's supply comes from logs left over the previous day plus the present day's production. The firms pay logging contractors according to agreed-upon formulas based on number of ton and miles handled by each truck (empty trips do not receive pay). Drivers and their trucks stay overnight at the drivers' homes in towns near the forests. Each morning they start by loading at an origin. After delivering their last load at the end of their work day, they drive back home. Proximity of the first origin and last destination to the drivers' home is relevant to enhancing driver convenience.

3.1.2 Supply and Demand of Timber

Demand for each product can be satisfied from any origin that supplies it. Timber harvesting activities tend to be vertically integrated, with logging contractors attempting to coordinate timber deliveries with origins and potential destinations. It is important to achieve consistency between delivery of raw materials with down stream mill operations which generally involve conveyor belts with a given capacity. If truck arrivals are regular, the trucks can unload directly onto the conveyor belt at the wood processing plants. If they are uneven, the mill must hold safety stocks to avoid the risk of stopping down stream operations, and then trucks arrive and typically unload in the mill yard. Later the plant will move the logs to the conveyor belt, which increases operational costs.

Mills maintain raw timber inventories based on the "value" of wood in-stock at the mill yard, buying more wood to maintain the buffer necessary to meet their daily requirements. The following impact inventory management and related processing operations at mills locations:

- organized truck delivery schedules
- waiting times
  - at cut site
  - at mill yard
  - at intermediate collection (concentration) yard (if applicable)
- length of working day
  - number of truck deliveries
  - mill operations/processing
- utilization of equipment
  - conveyer belt at the mill
  - mill yard stocking

3.2 PRIVATE SECTOR COSTS

3.2.1 Harvesting Costs

The first destination for harvested timber is a stocking point located at the cut site, from which it is loaded onto trucks for hauling to sell to mills. Conventionally, timber is presorted at harvest sites and loaded onto trucks for delivery to the mills. According to industry sources in the Lufkin District, it costs the logging "contractor" approximately $11.60 per Mg ($10.50/ton) to cut, separate (sorting at cut site), skid, and load trucks.

Interviews with regional shippers revealed that almost all incoming raw timber to mills arrives by truck (the exception is chemical shipments to paper producers and the occasional shipment of logs or chips by rail). Logging contractors (or truckers) charge a flat rate of $3.90 per Mg ($3.50/ton) to haul timber for the first 56 km (35 miles). Final destination of the raw timber haul notwithstanding, and with the recognition that truck transportation is the mode of choice for the initial movement of raw timber from harvesting sites, truck haul rates of $3.90 per Mg ($3.50/ton) could be included with the harvesting costs presented in Table 3-1. This implies that the initial movement of raw timber (within 56 km), harvesting and trucking from the stump to mill would cost $15.40 per Mg ($14.00/ton).

Table 3-1. Harvesting Costs

Activity	$/Mg	$/Ton
Cutting and Skidding	6.10	5.50
Sorting	2.20	2.00
Loading	3.30	3.00
Total	11.60	10.50

3.2.2 Price of Wood

Mills seek to minimize transportation costs by moving the greatest volume over the shortest distance. To meet their daily production needs, timber mills attempt to acquire maximum raw materials from the shortest distance and progressively receive additional shipments from longer distances. The current estimate of the average price that mills pay for wood delivered at its gate is about $30.90 per Mg ($28.00/ton) when procured within a 56 km (35 mile) radius. Table 3-2 presents additional correspondences between hauling distances and the "gatewood" prices at mill sites. This price includes the price of wood, harvesting costs, and truck hauling rates.

Table 3-2 also illustrates that as raw timber hauling distances increase, hauling costs as a proportion of total raw timber price rise progressively. This supports the popular contention that in order for mills to keep transportation costs down, they choose to "cut and haul" timber within a radius of 160 km (100 miles) for their daily requirements.

Table 3-2. Price of Wood at Mill Site

Hauling Distance		Price of Wood		Truck Hauling Cost Component of Price (%)
(km)	(miles)	($/Mg)	($/ton)	
56	35	30.90	28.00	13
80	50	32.50	29.50	17
160	100	35.80	32.50	25
242	150	40.20	36.50	33

3.2.3 Private Truck Operating Costs and Truck Hauling Rates

Depending on the distance involved, while coordinating timber origins with destinations, a typical forest logging contractor will use trucks where each truck may make between five or six trips per day from the stump to mills. The cost of operating the vehicles falls upon the users. Fuel and oil consumption, tire wear, maintenance, repair, insurance, and depreciation are the types of costs incurred and are reflected in the price charged to specific users. Table 3-3 describes the schedule of hauling rate that timber trucks charge per Mg (ton).

Table 3-3. Timber Truck Hauling Distances and Freight Rates

Hauling Distance		Truck Haul Rate	
(km)	(miles)	($/Mg)	($/ton)
56	35	3.90	3.50
80	50	5.50	5.00
160	100	8.80	8.00
242	150	13.20	12.00

3.3 PUBLIC SECTOR TIMBER TRANSPORTATION COSTS

The movement of goods on road infrastructure is an important factor in the economic health of the state, and truck shipping productivity is a key element in this movement. The public sector plays a critical role in the development of the transportation infrastructure. However, there is a tradeoff between vehicle weight management policies and pavement management policies in the maximization of this productivity. The goal of planners, engineers, and administrators in the highway transportation sector of government is to manage available public funds in the most efficient and equitable manner possible.

3.3.1 Incurred Costs and Supported System Costs

The enormous financial and social consequences of highway investments dictate that the economic analysis of existing and proposed policies take a full system cost approach (11). System costs include infrastructure or facility costs, vehicle operating costs, and externalities (e.g., accident and environmental costs). These system costs are costs that are actually incurred in the operation of vehicles or the use of the facility and represent the true system costs. Some of these costs are paid for by vehicle operators through user fees and taxes and represent the "supported" cost component of total system costs. However, part of the system costs are not covered by user fees and taxes. These unaccounted costs are typically externalities (pollution, safety, etc.) and some proportion of the facility or infrastructure costs not paid by vehicle operators through user taxes and fees. Examination of system costs is necessary for evaluating modal options and strategies. It is important to determine truck system costs on a per-km (per-mile) or Mg-km (ton-mile) basis to obtain a truer picture of freight transportation costs.

The following inputs combine to identify the total system costs of truck operations (12):

- incurred facility costs comprised of initial construction, rehabilitation, and maintenance,
- user taxes and fees paid by truck operators,
- relationship between incurred facility costs and supported facility costs,
- range of operating costs paid by truck operators, and
- externalities not currently met from freight revenue.

3.3.2 Public Costs of Providing Road Infrastructure or Facility

The cost of providing the highway facility, which includes construction, rehabilitating, maintaining, and administering highways, requires significant financial investments. These investments are the responsibility of the Texas Department of Transportation (TxDOT). Table 3-4 presents select Lufkin District statistics (7).

Table 3-4. Lufkin District Statistics

Square Kilometers (Miles)	18,423 (7,113)
Centerline Kilometers (Miles) (as of 12/31/1995)	4,545 (2,823)
Lane Kilometers (Miles) (as of 12/31/1995)	11,466,707 (7,122,178)
Daily Vehicle Kilometers (Miles) (as of 12/31/1995)	10,093 (6,269)
Vehicles Registered (09/1995-08/1996)	237,745
Population 1996 (est)	266,010
Construction Expenditures (09/1995-08/1996)	$45,633,755
Contracted Preventive Maintenance (09/1995-08/1996)	$15,258,856
Maintenance Expenditures (09/1995-08/1996)	$17,973,712

The equitable distribution of these costs and subsequent pricing strategies that generate revenues are achieved by applying the process of user cost responsibility and road cost recovery (12).

Loading (weight of vehicles and cargo) plays a primary role in roadway degradation. The weight of the vehicle and its cargo relative to the number of axles and the specific physical configuration of the vehicle determine the amount of loading. To systematically and uniformly evaluate loads, a convention of measurement has been established. This widely used standard is referred to as the 80 kN (18 Kip) Equivalent Single Axle Loading (ESAL). The unit of measure relates to the effects of an 80 kN (18kip) load on one axle. Two other factors relate to roadway performance and the speed to which they degrade under conditions of accelerated load. These are the supporting foundation upon which the roadway is built and the general climate within which the structure exists (13).

A study on pavement life and safety conducted by TxDOT (12), calculates the cost per ESAL-1.61 km (ESAL-mile) to be $0.0836 by taking into consideration the following:

- Texas rehabilitation and maintenance costs,
- Weigh-In-Motion (WIM) data,
- TxDOT revenues and expenses,
- Computer spreadsheets that calculate the AASHTO damage factors, and
- Computer spreadsheets that calculate ADT by vehicle class and road type.

3.3.3 Calculation of Infrastructure Costs per Timber Truck

According to vehicle classifications defined by TxDOT, the typical truck used is a 3-axle tractor with 2 axle semi-trailer. Therefore, assuming that an average timber truck can be classified as a 5-axle combination vehicle, the following estimates, based on a study done for TxDOT (12), may be applied to estimate facility costs that can be applied to timber truck operation on a per-km (per-mile) basis. Table 3-5 illustrates the calculations for estimating per-1.61 km (per-mile) facility costs for a timber truck.

Table 3-5. Estimation of Per 1.61 Kilometer (Per Mile) Facility Costs for a Timber Truck

Input	Estimate
5-axle combination truck	0.84346 ESAL per vehicle-1.61 km (vehicle-mile)
Rehabilitation and maintenance costs	$0.0836 per ESAL-1.61 km (ESAL-mile)
Facility cost per truck per 1.61 km (mile)	$0.0705 per truck/1.61 km (truck/mile)

According to a highway cost allocation study conducted for TxDOT (14), analysis of costs and revenues suggests that combination trucks and buses operating on Texas highways are not paying, through user fees and taxes, their fair share of highway costs. The researchers argue that these vehicles are being subsidized by lighter vehicles, principally pickup trucks and automobiles. The report indicates a revenue-cost ratio of approximately 0.5, or in other words, trucks pay only 50 percent of their true facility costs, which implies that trucks receive a $0.035 per truck-1.61 km (truck-mile) subsidy from other vehicle users. This taxpayer subsidy of per truck per 1.61 km (mile) operation must be included for estimating timber truck haul costs. Table 3-6 presents the calculations for estimating facility costs incurred but not paid for by vehicle operators (taxpayer subsidy).

Table 3-6. Estimation of Facility Costs Incurred but Not Paid for by Vehicle Operators

Input	Estimate
Facility cost per truck per 1.61 km (mile)	$0.07/ truck/1.61 km ($0.07/truck/mile)
Revenue-cost ratio	0.5
Incurred cost unpaid (subsidy)	$0.035/truck/1.61 km ($0.035/truck/mile)

Based on the results from Tables 3-5 and 3-6 and depending on timber hauling distances, Table 3-7 summarizes estimates of public facility cost incurred per truck operation. Also presented are estimates of the portion of these facility costs that are potentially not covered through truck user fees and taxes. These unpaid amounts range from $1.26 to $7.05 per truck, and constitute a taxpayer "subsidy" of sorts to private trucking.

Table 3-7. Timber Truck Hauling Subsidy Per Truck

Hauling Distance		Public Facility Costs Incurred ($/truck)	Unpaid Public Costs ($/truck subsidy)
(km)	(miles)		
56	35	2.47	1.26
80	50	3.50	1.80
160	100	7.00	3.50
242	150	10.50	5.25
322	200	14.10	7.05

With the contention that almost all raw timber from the stump to timber mills is currently being hauled using trucks, these per unit estimates can be projected to estimate highway infrastructure costs for the Lufkin District as a whole. As indicated in Table 3-4 earlier, over $33 million is expended by TxDOT for the Lufkin District on highway maintenance and preventive maintenance. Based on the calculations presented in Table 3-8, it can be inferred that about 2.5 percent, that is, over $0.8 million could potentially be attributed to the operation of timber trucks in the district and a potential taxpayer subsidy to timber trucking of over $0.4 million. These estimates assume that the average truck hauling distance is 80 km (50 miles) (timber hauling distances range anywhere between 56 to 322 km (35 to 200 miles)).

Table 3-8. Public Highway Costs and Subsidy for Timber Trucking in the Lufkin District

Item	Estimate
Public facility costs incurred by truck	$3.50 per truck per 80 km (50 miles)
Unpaid public infrastructure cost	$1.80 per truck per 80 km (50 miles)
Total district timber harvest	6,016,780 Mg (6,632,365 tons)
Average truck freight	26 Mg per truck (29 tons/truck)
Approx. annual number of trucks	228,702
Potential annual highway facility costs	$800,457
Annual unpaid infrastructure costs	$411,664

3.4 CONCLUSION

There is little argument about the negative impact truck traffic has on roadways and highways. Trucks cause accelerated pavement deterioration resulting in constant repair of highways, closed lanes, and the presence of maintenance and repair crews on already congested highways. Although it is unrealistic to assume that all freight currently transported by truck could be shifted to trains, even a relatively small modal shift could be consequential in terms of cost savings associated with reduced infrastructure maintenance. Heavy truck loads directly affect federal and state highway budgets and therefore taxpayers in general. Given this fact, it should be a matter of public policy to encourage intermodal freight transportation. Such action will allow rail transportation to more effectively complement truck transportation.

Conversations with local industry sources suggest that while mills typically attempt to meet their daily timber requirements from sources within 160 km (100 miles) of their operations, some mills, especially pulp and paper mills, receive shipments from trucking distances over 160 km (100 miles). At the same time, industry sources indicate that "optimal" hauling distances would range between 48-80 km (30-50 miles). While recognizing that truck transportation affords the flexibility and spontaneity in obtaining raw materials from diverse harvesting sites, concentration yards (timber collection yards) could be setup as truck-rail transfer yards. These transfer yards could offer an alternate intermodal configuration for transporting raw timber with potential savings to both industry participants and society. A multimodal approach would exploit potential complementarities not taken advantage of in the existing unimodal configuration to transport raw timber. Moreover, a more holistic approach to the distribution of forest products should take into account not just the Lufkin District, but also the East Texas, national, and international flow of shipments. Operational rail infrastructure could play a productive role in supporting timber transportation flows.

4.0 ALTERNATE METHOD FOR TRANSPORTING RAW TIMBER

Public investment in transportation infrastructure has traditionally been along modal lines with little effort to develop a multimodal approach. Consequently, it is difficult to determine if public transportation dollars have been invested in the most cost-effective manner. Previous research has indicated that modally oriented planning and investment is economically inefficient and generates fewer social benefits than a multimodal investment analysis (15). Chapter 3 discussed the relationship between incurred infrastructure costs and truck user costs and fees. In addition, full system costs must include not only truck operating but public impacts like safety and environmental costs.

4.1 DEVELOPING AN ALTERNATE TRANSPORTATION STRATEGY

An alternate method for transporting raw timber in the Lufkin district can be conceptualized within the following environment for policy planning and investment decision making:

- a shift towards intermodal/multimodal planning,
- supply of infrastructure with a focus on meeting the needs of the users of the transportation system, and
- flexible use of funds that can be transferred between modes in the interest of improving overall system efficiency.

4.1.1 Rationale for Modal Choice

Alternate configurations for transporting raw timber from stump to mills would involve planning, building, and operating a transportation system that emphasizes the optimal utilization of transportation resources and connections between modes. This would involve combining different modes into a seamless transportation system with efficient intermodal transfer terminals. Although rail used to be the dominant mode for hauling timber from the forests to processing plants, currently almost all raw timber movement from the stumps to mills is done by trucks.

Interviews with local timber industry participants indicated the following aspects impacting modal choice for timber hauls:

- Factors for trucking
  - greater flexibility and spontaneity in moving raw timber from diverse sources to meet daily timber requirements;
  - initial movement of timber from the forests is infeasible using rail as it is logistically and economically impractical to lay and move rail tracks as harvesting sites move around;
  - lack of widespread rail infrastructure that will restrict receipt of shipments via rail compared to being able to drive up to the mill gate by truck;
  - modal transfer from truck to rail would add an additional layer of "handling costs" that would potentially erode viability of rail transportation over shorter distances;
  - shipper perception of service dependability and reliability is relatively weaker for rail;
  - maintenance of raw material "freshness" may be better preserved if travel time from stump mills is kept at a minimum; and
  - security issues become relevant at the timber concentration (transfer) yards.
- Factors for railroading
  - larger timber mill cannot meet requirements from proximate sources and require shipments from longer distances;
  - rail freight rates become competitive over long distance hauls;
  - rail can potentially play a more important role in outbound shipments from mills;
  - rail transportation reduces the insurance liability responsibilities of shippers;
  - provides a 24-hour window for timber processing activities at the mill site as rail shipments can be unloaded during night or day from arriving rail cars (timber truck drivers participate in hauling and loading and unloading activities during normal business hours only);
  - freight can be tracked better and will constitute inventory in-transit for mills; and
  - timber concentration yard (transfer yard) will serve as a predictable fixed point for short timber hauls from neighboring timberlands allowing the state agency responsible for maintaining highway facilities to better predict road infrastructure that will potentially be impacted by repetitive timber loads.

The interviews with regional timber industry participants reveal that almost all incoming raw materials arrive by truck from a radius of 160 km (100 miles), with the exception of some large mills (especially pulp and paper mills) who complete their requirements by obtaining raw materials by rail or truck from longer distances. As indicated, trucks afford the industry the necessary flexibility and spontaneity to transport raw timber from the harvest points to proximate locations. It is perceived that it is not feasible, logistically or economically to use rail infrastructure to transport timber from the stump to mills or an intermediate. However, it has been suggested that the optimal trucking distance is around 56-80 km (35 to 50 miles).

In summary, the most important factors governing the use of one freight transportation mode over another include the proximity between origin and distribution locations, the transportation infrastructure available for shipping commodities to and from markets, customer's specified requirements, freight type and dimensions, travel time and schedule reliability, and transportation costs.

4.1.2 Evaluating Rail Transportation

Recognizing that the initial timber movement from harvesting sites will be undertaken using trucks, rail service can be brought into the transportation scheme through a truck-rail transfer yard (concentration yard). The evaluation of such a transportation arrangement must assess its performance on the following aspects:

- lowering of transportation costs by allowing each mode to be used for the portion of the trip for which it is best suited,
- reducing the burden on over-stressed road infrastructure, and
- reducing energy consumption and contributing to improved air quality and environmental conditions.

Superior performance on the above aspects would indicate that the proposed alternate transportation method would generate higher returns from public and private infrastructure investments.

4.2. RAIL TRANSPORTATION COSTS

To remain in business, land owners, logging contractors, truckers, and mills must be profit-oriented. Profitability can be improved if forest firms handle the transportation aspect efficiently. An important problem in forest operations is the daily transport of timber from different timber stands being harvested, with known supplies, to destinations, such as pulp mills, sawmills, sorting yards, and ports, with their daily demands.

Lowest transportation costs are achieved by moving the greatest volume over the shortest distance (16). In an ideal situation, if all logs are consumed at a common point, external costs will be optimized by placing the handling system at that location. In reality, however, raw materials originate from and are consumed at different locations. Optimizing transport costs would justify setting up a satellite log handling system, which in this report is referred to as a collection, concentration, or transfer yard.

4.2.1 Wood Separation/Sorting

Currently, timber is being sorted at cutting sites and loaded onto trucks for movement to mills. This does not have to change in any potential intermodal configuration for transporting raw timber using rail. At timber concentration yards, truck's loads would arrive presorted from the cut sites, as presently done, and unload into appropriate "piles" or rail cars for final movement to respective destinations. According to timber industry sources, this will eliminate a cost of about $2.20 per Mg ($2.00/ton) for wood separation at a collection yard.

This structuring of the concentration yard as a modal transfer yard qualitatively differs from a "sort" yard problem. The difference between these problems is that a transfer yard involves a single commodity that changes transportation mode at an intermediate point, whereas the sort yard problem involves the routing of several commodities to the sort yard location and involves a physical transformation (i.e., wood separation) of the commodity (17, 18). By maintaining the current convention in the Lufkin District where wood separation is done at the cut-site before delivery, the collection yard problem is reduced to just a modal transfer yard problem, avoiding complexities of a sort yard which requires not only intermediate wood separation, but identification of the ultimate destination, and implementation of a modal change.

4.2.2 Handling and Railroading Costs

Again, with the recognition that the initial move of timber from the forests would be implemented using trucks, initial trucking and transfer yard handling costs (unload, store, and reload) need to be added to rail freight rates. Local industry sources indicate that handling costs are about $3.90 per Mg ($3.50/ton) and that the trucking rate is $3.90 per Mg ($3.50/ton) for distances within 56 km (35 miles). Therefore, one must tack about $7.70 per Mg ($7.00/ton) onto rail freight rates.

For "proprietary reasons," it was not possible to obtain accurate rail freight rates. However, according to local timber industry sources, rail freight rates, compared to trucking rates, are about 10 percent higher for hauling distances less than 160 km (100 miles), and become competitive for timber hauls over 160 km (100 miles). Based on this rationale, it has been suggested that "truck's competitive edge" will be eroded and raw timber railroading will become feasible if a transfer yard is located at least 160 km (100 miles) from potential destinations.

4.3 TRANSFER YARD AND HANDLING SYSTEM CAPITAL COSTS

This section identifies some initial capital costs that would be incurred to setup a timber transfer yard. Broadly, costs will fall in the following categories:

- Land acquisition,
- Handling system (load/reload) equipment costs, and
- Rail infrastructure.

Estimates for the land acquisition and timber handling equipment costs were obtained through interviews with local timber industry sources. Conrail facility costs reviewed in a study conducted for TxDOT provide rail equipment costs relevant to setting up a spur line located at the timber collection yard (19). Table 4-1 summarizes the different capital cost components.

Table 4-1. Collection Yard Facility Costs

Item	Unit Costs ($)	Quantity	Total Costs ($)
Collection Yard Facility Costs			
Land per 0.41 hectare (per acre)	1,000	20	20,000
Log Loader	285,000	2	570,000
Yard Truck	100,000	1	100,000
Weighing Scale	50,000	1	50,000
Sub Total			740,000
Rail/Spur Line Costs			
Track per km (per mile)	92,510 (148,849)	0.6096 (0.38)	56,500
Switches per km (per mile)	2,446 (3,936)	0.609 (0.38)	3,000
Sub-Total			58,500
Total			798,500

Besides initial set-up costs, local timber sources anticipate a handling system crew of three persons at an annual salary of $35,000 per person amounting to a total annual cost of $105,000.

4.4 SOME OTHER PUBLIC BENEFITS AND COSTS

A long-term modal shift of at least a proportion of freight movement in the Lufkin District from truck to rail would impact more than roadway degradation. An intermodal configuration of timber transportation would result in decreased fuel usage and emissions, decreased accident rates, and reduced traffic congestion.

4.4.1 Fuel Consumption and Costs

In the calculation of fuel consumption, a high-end and a low-end measurement may be used rather than an average or best estimate (20). Table 4-2 shows the high- and low-end efficiencies for large diesel trucks and rail cars. The unit of measure, Mg-km/L (ton-mile/gallon), specifies the number of km (miles) that one Mg (ton) can be moved by one liter (gallon) of fuel. On average, railroads can carry over five times more cargo per liter (gallon) of fuel than diesel trucks.

Table 4-2. Modal Fuel Efficiency Ranges

	Diesel Trucks	Railroads
High End	23.2 Mg Km/L (60 ton mi/gal)	123.5 Mg Km/L (320 ton mi/gal)
Low End	15.4 Mg Km/L (40 ton mi/gal)	96.5 Mg Km/L (250 ton mi/gal)

Roop et al. 1995 (20) indicate that railroads spend $0.172 per liter ($0.65/gallon) for diesel fuel, while trucks spend about $0.264 per liter ($1.00/gallon). This effectively breaks down into a dollars per Mg km (dollars/ton mile) comparative analysis which is summarized in Table 4-3.

Table 4-3. Modal Fuel Cost Ranges

	Diesel Trucks	Railroads
High End	$0.0114/Mg Km ($0.0167/ ton mi)	$0.00139/Mg Km ($0.00203/ ton mi)
Low End	$0.017/Mg Km ($0.025/ ton mi)	$0.0018/Mg Km ($0.0026/ ton mi)

Shipping cost based upon capacities and fuel cost would decrease in the event of a modal shift from truck to rail in timber transportation. The extent of this decrease depends upon the modal shift and production levels. This can be determined through a detailed origin-destination examination of timber shipments at target locations in the region.

4.4.2 Emissions

Both the truck and rail modes emit harmful gases. The primary constituents of exhaust contaminants are carbon monoxide, oxides of nitrogen, and particulate matter. A modal shift would also have an immediate impact on the environment due to decreased engine emissions. Diesel trucks emit 0.037 Kg per liter (0.31 lbs/gal) and rail locomotives emit 0.083 Kg per liter (0.69 lbs/gal) (21). Although trucks emit less pollution per unit liter (gallon) of fuel burned, the greater carrying capacity of rail easily compensates for its deficiency with a lower overall emissions level. For extremely low density products, such as chemicals, rail transport emissions are only 26 percent that of truck transport.

4.4.3 Safety

Rail and truck safety statistics indicate that rail can transport 7.7 times more Mg-km (ton-miles) than trucks before an accident occurs, and 13.4 times more Mg-km (ton-miles) before a fatality occurs (21). Table 4-4 illustrates some rail and truck safety rate comparisons.

Table 4-4. Rail and Truck Safety Rate Comparison

	Rail	**Truck**	**Rail/Truck Ratio**
Mg-Km/accident (Ton-miles/accident)	2.62×10^9 (1.80×10^9)	3.42×10^8 (2.35×10^8)	7.7
Mg-Km/accident (Ton-miles/fatality)	4.55×10^8 (3.12×10^8)	3.38×10^7 (2.32×10^7)	13.4

Roop et al. 1995 (20) suggest that the rate at which accidents occur on the highways is based on the number of vehicle miles traveled. The standard trucking accident rate is approximately 76.6 accidents per 160 million km (100 million miles) traveled. This rate, when applied to each truck shipment shift to rail, will readily project the decrease in accidents from such a shift. The calculations follows:

Accident Decrease = (76.6 accidents/160,000,000 truck km)
*(Number of km) *(Number of shifted trucks)

The nature of this accident analysis precludes the accidents which may be caused by passenger vehicles, and is justified by the number of vehicles and miles traveled by passenger cars unaffected by a shift from truck to rail. New accident rates can be determined through simple subtraction of present accident rates and number of accidents prevented by shifting to rail shipments.

4.5 CONCLUSION

The discussion in chapters 3 and 4 quantified interests and roles of the various participants in the choice of a transportation system. The examination of alternate methods for transporting raw timber from the stump to mills included potential benefits and costs accruing to the public agency responsible for providing highway resources. Aspects examined were highway safety, highway maintenance, fuel efficiency, and environmental concerns. Private industry concerns included those of the timber and logging companies. In addition, railroad interests may be better served from potential incremental use of their capital facility and enhanced revenues from track-use fees.

Comparisons between truck and rail transportation in the non-roadway impact areas of energy consumption, pollution, and accidents involving fatalities all demonstrate rail's superiority over trucks. Additionally, rail's potential for reducing congestion on our roadways further highlights the many beneficial returns that could be expected if rail's modal share of transportation were to increase.

Depending on the density of the cargo being transported (i.e., whether the cargo is low or high density), rail can be four to eight times more energy efficient than trucks. This observation is directly related to the fact that rail transportation is inherently less polluting than truck transportation. Although locomotives emit over twice the air pollution of trucks for every liter (gallon) of fuel burned in transport, the greater carrying capacity of rail easily compensates for this with a lower overall emissions level that is 26 percent that of trucks.

Railroads are over 13 times safer than trucks in regard to accidents resulting in a fatality. Were it not for the fatalities associated with grade crossing encroachment and trespassing, rail and truck safety comparisons would demonstrate an even greater disproportion in favor of the railroads. In 1993, the average train consisted of 67 cars averaging 59 Mg (65 tons) per car (22). Assuming the cargo of each rail car could be carried by two to three trucks, the average train would represent between 130 to 180 trucks not impacting the roadways.

Many experts have stated that North American Free Trade Agreement (NAFTA) portends increases in the number of trucks on U.S. highways. This increase in truck traffic will necessarily result in a concomitant expansion of energy consumption, pollutant emissions, the number of accidents, and congestion. The previous discussion clearly demonstrates rail's potential for mitigating the detrimental impacts truck transportation has on non-roadway factors associated with freight transport.

5.0 POTENTIAL COLLECTION YARD SITE IN THE LUFKIN DISTRICT

As described in the previous chapter, in the proposed intermodal approach, a collection yard would serve as a temporary destination along the road network where logs or trees are apportioned into such intermediate forest-product categories as saw timber and pulpwood and then shipped to specialized manufacturing facilities.

Site location has an overriding effect on transportation costs. The transfer yard location strategy exploits two related shortest path subproblems:

- Path from the point of harvest to the potential transfer yard location, and
- Path from transfer yard to mills.

The shortest path subproblem is resolved by letting trucks provide the initial movement of raw timber from points of harvest (within a radius of 56 km (35 miles)) to the transfer yard. Next, rail infrastructure will move the raw materials from the transfer yard to mill locations. This strategy accommodates the necessary flexibility and spontaneity afforded by trucks in timber movement from diverse harvest sites, while capturing the gains in moving freight over long hauls by rail. Therefore, an ideal location for a collection yard would be amidst harvesting sites (i.e., timberlands) but about 160 km (100 miles) or more from timber mills.

5.1 BASIS FOR SITE SELECTION

A potential transfer yard location in the Lufkin District can be identified in the following manner:

- Examine the existing raw timber transportation network
    - identify timber industry nodes (paper mills, loggers, etc.)
    - identify supporting road transportation network (existing)
- Disaggregate Lufkin District timber transportation network into several seamless intermodal transportation system units
    - identify paralleling rail infrastructure
    - cartographically overlay timber industry and transportation system elements

5.1.1 Feasible Transfer Yard Location in Shelby County in the Lufkin District

Chapter 2.0 identified various timber industry nodes in the Lufkin District and documented relevant road and rail infrastructure that support industry activities. This background will be useful in identifying a potential location for a timber transfer yard. Recall (from Figure 2-3), that BNSF, which runs north-south along US 96, intersects the UP line in Tenaha in Shelby County. This meeting point of the railroads in Tenaha is potentially a viable timber transfer yard location as it strategically links significant timberlands (harvest sites) to major timber industry nodes along the railroad network through the Lufkin District and East Texas region.

The strategic location of the yard will potentially take timber truck traffic off paralleling highway infrastructure and restrict truck movement from harvest sites to the vicinity of the collection yard. The timber concentration yard (transfer yard) will serve as a predictable fixed point (attractor) for short timber hauls from neighboring timberlands allowing the state agency responsible for maintaining highway facilities to better predict road infrastructure that will potentially be impacted by repetitive timber truck loads.

5.1.2 Tenaha Transfer Yard Linkage with Transportation System Components

Industry sources indicate that "optimal" trucking distances would range between 56-80 km (30-50 miles). Therefore, timberlands located within this range from the Tenaha collection yard are identified in Table 5-1.

Table 5-1. Tenaha Transfer Yard and Timberland Links

County	Harvest Volumes in Thousands of Cubic Meters (Million Cubic Feet)
Shelby	785.2 (27.7)
Nacogdoches	743.2 (26.2)
San Augustine	536.3 (18.9)
Sabine	460.8 (16.3)
Panola	621.6 (22.0)
Rusk	682.9 (24.1)

In addition, the following relationships between highway and rail supports a transfer yard location in Tenaha:

- US 96 parallels BNSF line from Beaumont to Tenaha;
- US 59 parallels UP line from Houston to Tenaha; and
- US 59 parallels BNSF line from Tenaha to Carthage.

Industry sources also indicated that large paper mills routinely receive 30-40 percent of their shipments from distances farther than the "optimal" trucking distance. The following paper mills located in the East Texas region will be linked to the transfer yard through the existing highway-rail infrastructure:

1. Champion International in Lufkin,
2. Champion International in Sheldon,
3. Temple-Inland in Evadale,
4. Inland Container in Orange,
5. International Paper in Texarkana,
6. Simpson Pasadena Paper Company in Pasadena, and
7. Southland Newsprint (proposed) in Longview.

Table 5-2 identifies the approximate distances from the proposed transfer yard to the paper mills along with the supporting rail infrastructure that could potentially relieve the burden on paralleling highways.

Table 5-2. Tenaha, Shelby County Transfer Yard Linkages

Paper Mills	Yard to Mill Distances (km)	Yard to Mill Distances (miles)	Railroads	Highways
Champion (Lufkin)	80	50	UP	US 59
Champion (Sheldon)	282	175	UP	US 59, US 90
Simpson (Pasadena)	282	175	UP	US 59, I 45
Temple-Inland (Evadale)	160	100	BNSF	US 96
Inland Container (Orange)	201	125	BNSF, UP or Sabine River & Northern RR	US 96, TX 62/I 10
International Paper (Texarkana)	160	100	BNSF, UP	US 59
Southland Newsprint (Longview)	80	50	BNSF	US 59, TX 149

5.2 CONCLUSION

This chapter described a potential intermodal timber transportation strategy that is feasible in the Lufkin District. In this approach, planning, building, and operating the transportation system emphasizes optimal utilization of transportation resources and connections between modes. From the perspective of the user — the shipper of timber — the particular mode itself is irrelevant; what matters is the quality, cost, timeliness, and safety of the trip.

Oregon, Washington, and Florida offer specific examples of state efforts to rise to the challenge of intermodal transportation planning (23). Through unique but similar approaches to information gathering, economic analysis, coordination, and financing, these states have succeeded in moving transportation planning efforts toward a more integrated approach. In all three states, the broad based involvement of interest and community groups with the state department of transportation fostered many synergistic relationships. These agencies worked closely with regional and local agencies, as well as with private-sector interests to identify the issues affecting a sound and desirable transportation network. These partnerships highlight the relationship between the movement of goods and a community's economy. It is only with this understanding that sound analysis and decision making can occur.

6.0 RECOMMENDATIONS AND IMPLEMENTATION

This report summarizes the results of an economic feasibility study that evaluates alternate methods of delivering raw timber from the stump to mills in TxDOT's Lufkin District of East Texas. Based on the findings of this feasibility study, the research team makes the following implementation recommendations.

1. Transportation productivity and rate structures are critical elements in maintaining and promoting timber industry competitiveness. As part of this need to maintain competitiveness, economic data on timber industry activities are held as 'proprietary' information by the various industry participants. A full-fledged implementation should attempt to involve key industry participants as part of a 'project advisory committee' to enhance the robustness of the evaluation of the transportation system that supports industry activities. This will potentially enhance the 'openness' needed to obtain a clearer picture of the costs and benefits relevant to private timber mill, truck, and railroad companies. Also, this will lay the groundwork for fostering public-private partnerships to implement the most efficient transportation system.

2. The alternate solution to the timber transportation problem is viable if it exploits each mode for the portion of the timber haul for which it is best suited and builds on multimodalism, which best serve the needs of the industry. Chapters 3 and 4 discuss factors that favor delivery of raw timber from the stump to mills by road and/or rail. For various reasons trucking is more suitable for initial moves from timber cutting-sites and short hauls. Industry sources indicate that 'optimal' trucking distances would range between 56-80 km (30-50 miles). Rail becomes relevant over the longer haul and to destinations which cannot satisfy their raw material needs from proximate sources. For 'proprietary reasons,' it was not possible to obtain precise rail freight rates. However, according to local timber industry sources, rail freight rates, compared to trucking rates, are about 10 percent higher for hauling distances less than 160 km (100 miles), and become superior for timber hauls over 160 km (100 miles). Therefore, it is suggested that the 'truck's competitive edge' will be eroded and raw timber railroading becomes feasible if a transfer yard is located about 160 km (100 miles) from potential destinations.

3. Chapter 5 presents an example alternate configuration for delivery of raw timber to mills. In this alternate configuration, a timber collection yard (transload facility) could be located

in Tenaha (Shelby County) at the intersection of the BNSF and UP lines. This location strategically links the region using existing rail infrastructure. Timber harvesting lands and mills that could be served by the Tenaha timber collection yard are identified. Mill distances from the Tenaha transfer yard location will potentially support movement of raw timber by rail, with initial timber movement from harvesting sites to the transload facility done by trucks.

4. The strategic location of the yard will potentially take timber truck traffic off paralleling highway infrastructure and restrict truck movement from harvest sites to the vicinity of the collection yard. The timber concentration yard (transfer yard) will serve as a predictable fixed point (attractor) for short timber hauls from neighboring timberlands thereby allowing the state agency responsible for maintaining highway facilities to better predict road infrastructure that will potentially be impacted by repetitive timber truck loads.

5. With the transportation aspect integral to the timber industry, implementation of any alternate configuration must be a 'win-win' situation for the various public and private entities. A private-public partnership will be needed to encourage a multimodal method of raw timber delivery. More private industry participation would be needed to obtain precise information on timber volumes, supply and demand (origin-destination) linkages to allow better prediction of the impacts of implementing a timber transfer yard as part of the intermodal approach. Chapter 3 presents estimates of highway infrastructure costs that accrue to the state agency responsible for the maintaining road network that supports timber trucking. A modal shift would result in public facility costs savings that could be used to sponsor initial capital expenses needed for setting up a rail-truck transload facility (discussed in chapter 4). In the long run, this would potentially be a more economical use of TxDOT's limited funds.

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APPENDIX

LUFKIN DISTRICT TRANSPORTATION NETWORK

Table A-1. Angelina County

Nodes	Forest Products Industries	Highways	Railroads
Lufkin	Sawmill, Pallet Mill: 2 Paper Mill: 1 Chips, Shavings: 1 Plywood, Composite Board: 1	US US 59, US 69 State TX 103, TX 94 Farm-to-Market FM 58, FM 2251, FM 2021, FM 841, FM 324, FM 1271, FM 3150, FM 325	Union Pacific Railroad (UP) Angelina & Neches River Railroad (ANR) Texas South-Eastern Railroad (TSE)
Huntington	Sawmill, Pallet Mill: 1	US US 69 Farm-to-Market FM 1669, FM 2109, FM 328	No Rail Access
Diboll	Sawmill, Pallet Mill: 1 Plywood, Composite Board: 2	US US 59 Farm-to-Market FM 1818	UP TSE
Zavalla	Sawmill, Pallet Mill: 1 Chips, Shavings: 1	US US 69 State TX 147, TX 63 Farm-to-Market FM 2109	No Rail Access
Pollock	Sawmill, Pallet Mill: 1	State TX 7	No Rail Access

Table A-2. Houston County

Nodes	Forest Products Industries	Highways	Railroads
Kennard	Sawmill, Pallet Mill: 3	State TX 7 Farm-to-Market FM 2781, FM 357	No Rail Access
Crockett	Chips, Shavings: 2	US US 287 State TX 7, TX 19, TX 21 Farm-to-Market FM 229, FM 2022, FM 2076, FM 2110, FM 2712	UP
Ratcliff	Chips, Shavings: 1	State TX 7 Farm-to-Market FM 227	No Rail Access

Table A-3. Nacogdoches County

Nodes	Forest Products Industries	Highways	Railroads
Nacogdoches	Sawmill, Pallet Mill: 9 Chips, Shavings: 3 Plywood, Composite Board: 2	US US 59, US 259 State TX 21, TX 7 Farm-to-Market FM 2259, FM 225, FM 343, FM 1878, FM 2609, FM 1638, FM 1275, FM 2863	UP
Garrison	Sawmill, Pallet Mill: 3	US US 59 Farm-to-Market FM 1087, FM 95, FM 138	UP
Woden	Sawmill, Pallet Mill: 2	Farm-to-Market FM 2259, FM 226	No Rail Access
Cushing	Sawmill, Pallet Mill: 2	State TX 204 Farm-to-Market FM 225	No Rail Access

Table A-4. Polk County

Nodes	Forest Products Industries	Highways	Railroads
Livingston	Sawmill, Pallet Mill: 6 Chips, Shavings: 2	US US 59, US 190 State TX 146 Farm-to-Market FM 350, FM 1316	UP
Corrigan	Sawmill, Pallet Mill: 2 Chips, Shavings: 1 Plywood, Composite Board: 2	US US 59, US 287 Farm-to-Market FM 352, FM 942	UP
Camden	Sawmill, Pallet Mill: 1 Plywood, Composite Board: 1	Farm-to-Market FM 942, FM 62	Moscow, Camden & San Augustine Railroad (MCSA)
Moscow	Chips, Shavings: 1	US US 59 Farm-to-Market FM 350, FM 62	UP MCSA

Table A-5. Sabine County

Nodes	Forest Products Industries	Highways	Railroads
Hemphill	Sawmill, Pallet Mill: 1 Chips, Shavings: 1:	State TX 87, TX 184 Farm-to-Market FM 83, FM 944, FM 2971, FM 1175	No Rail Access
Pineland	Sawmill, Pallet Mill: 1 Chips, Shavings: 1 Plywood, Composite Board: 1	Farm-to-Market FM 83, FM 2426, FM 1	Burlington Northern & Sante Fe Railroad (BNSF)

Table A-6. San Augustine County

Nodes	Forest Products Industries	Highways	Railroads
San Augustine	Sawmill, Pallet Mill: 7 Chips, Shavings: 2	<u>US</u> US 96 <u>State</u> TX 147, TX 21 <u>Farm-to-Market</u> FM 711, FM 353, FM 1277, FM 2213, FM 3230, FM 3483	BNSF

San Jacinto County

No forest products industries identified

Table A-7. Shelby County

Nodes	Forest Products Industries	Highways	Railroads
Center	Sawmill, Pallet Mill: 6 Plywood, Composite Board: 1	<u>US</u> US 96 <u>State</u> TX 87, TX 7 <u>Farm-to-Market</u> FM 699, FM 138, FM 2974, FM 2788, FM 2468	BNSF
Tenaha	Sawmill, Pallet Mill: 2 Chips, Shavings: 2	<u>US</u> US 84, US 59, US 96, US 84/59 <u>Farm-to-Market</u> FM 947, FM 2141	UP BNSF
Timpson	Sawmill, Pallet Mill: 2 Chips, Shavings: 3	<u>US</u> US 84, US 59, US 84/59 <u>State</u> TX 87 <u>Farm-to-Market</u> FM 947	UP

Table A-8. Trinity County

Nodes	Forest Products Industries	Highways	Railroads
Groveton	Sawmill, Pallet Mill: 1 Chips, Shavings: 1	<u>US</u> US 287 <u>State</u> TX 94 <u>Farm-to-Market</u> FM 355, FM 2912	No Rail Access
Trinity	Sawmill, Pallet Mill: 3 Chips, Shavings: 1	<u>State</u> TX 94, TX 19 <u>Farm-to-Market</u> FM 356, FM 230	UP