SMALL CITY SYNTHESIS OF TRANSPORTATION PLANNING AND ECONOMIC DEVELOPMENT: USER'S GUIDE

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IMPLEMENTATION STATEMENT

There is a need to increase cooperation and communication between small city transportation planning and economic development. This is critical at the local level, important at the regional level, and desirable at the state level. The purpose of this project is to create a traffic-modeling template to act as a guide for small cities in Texas. The pilot city for this study is the city of Alice in Jim Wells County.

Using Alice, Texas, as a model, a template has been developed to increase the cooperation and communication between transportation planning and economic development groups. The template establishes a foundation for coordinating traffic forecasts with projected urban/economic development plans. Currently, the two sets of information are rarely applied together in small Texas cities. Small cities above 10,000 and under 50,000 in population will benefit most from this research effort. Additionally, the template could be a useful planning tool at the Texas Department of Transportation (TxDOT) for corridor analyses.

DISCLAIMER

ACKNOWLEDGMENTS

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CHAPTER ONE - INTRODUCTION

The inter-relationships between transportation planning and land use patterns are well-documented (1,2,3,4). It has been shown that the history of economic and urban development is a reflection of the history of the development of transportation. Economic or employment forecasts used in conjunction with labor markets analyses can provide planners with a useful tool for estimating future land use patterns and infrastructure demands (4). Future requirements for industrial and commercial centers can also be developed using the economic and employment forecasts. Coordinating economic projections with transportation system planning is a critical element in ensuring growth and vitality within a community.

The relationship between transportation and land use underlies many of the activities that shape the form of a city. Historically, improvements to transportation networks have exerted a large influence on city development by altering accessibility and development potential. Transportation and land use have been referred to as "two sides of the same coin" since access is required for the productive use of any parcel of land (1). Ultimately, the transportation system serves many functions, but among the most important are the mobility of people and goods and the access to individual property. However, these two important functions are often in direct conflict with each other. As mobility increases, access to land decreases, and conversely, as access to land increases, mobility decreases. In other words, as the number of driveways along a corridor increases, the opportunity for congestion to occur increases and subsequently the speed along the corridor decreases. In areas where land use decisions and transportation facilities are not considered together, a range of problems occur. For example, the demand generated by a new development may exceed the available capacity of the existing system or a transportation improvement may accelerate the rate of development on the land adjacent to the facility.

The degree of technological sophistication and basic understanding of transportation and economic issues can prevent planners from coordinating transportation planning with economic projections. The problem is twofold. There is a lack of technology structured to predict the impact of transportation and economic issues, and there is a shortage of policies that advocate implementing the technology once it has been developed. Further difficulty is added since it is common among communities to have the responsibility of land use projections and transportation planning reside with different agencies. Depending upon the community, the responsibilities for developing transportation plans and land use projections can vary. For example, transportation planners can develop their own land use projections to determine future demand on the transportation system or transportation planners can obtain land use information from another agency, such as the city, to be incorporated into the long-range transportation planning process. Rarely do the two responsibilities reside under one agency (3). Smaller cities, especially rural locations, may have multiple agencies tasked with the responsibility of maintaining and updating transportation plans and land use or economic projections.

The relationship between land use decisions and transportation planning is evident in the modern transportation modeling process. The implementation of land use planning results can determine the amount and location of future population growth and economic activity (3). The transportation planning process tries to match these projections with the location of trip generators created by land use policies, the distribution of those trips between land uses, and the mode with which those trips will occur (2,3). This information can help cities identify corridors of growth, predict where travel demand created by land use decisions exceed transportation capacity, and help provide a framework for scoring projects to improve or change the system (2). Ultimately, the process should provide the planner with information that can determine the compatibility between the land use plan, as guided by economic projections and the transportation system.

It is important that cities of all sizes have a framework for coordinating transportation plans with economic projections. Urbanized areas with a population of over 50,000 people have the benefit of metropolitan planning organizations (MPO). MPOs, which were formally created as part of the Federal-Aid Highway Act of 1973, are agencies responsible for transportation planning and programming in an urbanized area. Cities with a population of less than 50,000 people, however, do not have this benefit. The modern transportation modeling process utilized by MPOs typically is not utilized in cities with a population of less than 50,000 people.

Small cities should also have a method for determining where enhancements need to be made to the transportation system in order to ensure the safe and efficient movement of people and goods through the community. This *User's Guide* presents a model for small Texas cities that will coordinate community development with future transportation plans in an effort to meet these needs. Cities with a population over 10,000 and under 50,000 people will benefit most from this methodology. This process utilizes traffic and economic data in order to project where improvements need to be made to the existing transportation system.

CHAPTER TWO - DATA ANALYSIS TEMPLATE

Template Structure

As previously mentioned, this synthesis was developed to devise a template that utilizes transportation and economic data in an effort to ascertain where transportation improvements might be necessary in small cities. The following template will allow small cities to analyze the local transportation network without significant investments of time and money. The template structure has been developed in a manner that interested individuals or agencies can readily obtain the necessary information to review both the existing transportation network for a city as well as the future traffic levels on the roadway system.

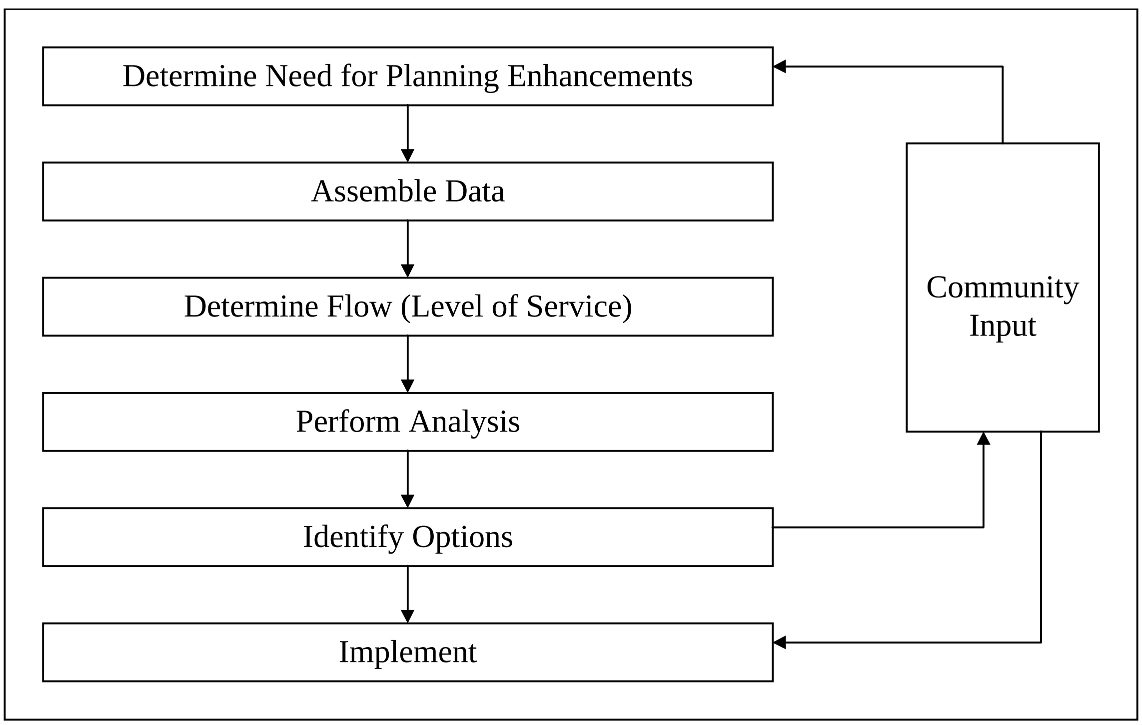


Figure 1. Template Format

Figure 1 provides a schematic representation of the format of the template. The template provides a description of the sequence of events in general terms that need to occur when planning transportation improvements. After the determination that improvements are needed, the data necessary for the analysis needs to be obtained. The primary data for the analysis will be the transportation network data provided in the TxDOT District Traffic Maps and the RI2-T Log Database. The District Traffic Maps provide the physical layout of the transportation system, and the RI2-T Log Database provides current and projected traffic volumes as well as the percent of traffic comprised of trucks. Additionally, employment indicators and demographic information will provide supplemental data that will be used to better understand some of the existing and future traffic counts on the area roadways. Any information regarding areas of the town that are expected to experience growth and development is useful. Other supplemental data includes information pertaining to the location of sites that generate higher than average traffic volumes. This could include industrial parks, hospitals, retail centers, and educational facilities, to name a few. The supplemental information is typically best obtained at the local level.

After all of the data has been assembled, the next step is determining how well the roadways are performing. This measurement is typically called the level of service (LOS). Comparing the traffic volumes on individual analysis segments to Table 3 will provide a LOS for each segment. Chapter 3 of this *User's Guide* provides more information on how to determine the LOS. After the LOS has been determined, an analysis of the system may be conducted. At this point, the supplemental data mentioned earlier needs to be considered. For example, if a particular roadway segment is projected to experience a tolerable or undesirable flow and there is expected to be growth or development adjacent to that roadway, then that roadway may be a candidate for improvement. After the analysis is complete, there may be a number of analysis segments that appear to need improvement. This leads into the next step of the template.

Since most agencies have limited financial resources, it is important to identify which options are most feasible and practical to implement. Local, regional, or state transportation or planning officials may be able to provide different options that can assist in improving the flow on local roadways. For example, if a two-lane roadway in a commercial area is experiencing a poor LOS, options could include adding a lane in each direction making it a four-lane roadway or an option could include installing a left-turn lane making it a three-lane road. Input from the community may assist in making the determination as to which improvement or which option is desired most. Community involvement is always important when performing a public improvement project. With each option, there will be different costs and benefits. Which option is most feasible might depend on financial or physical constraints. There might be only enough money for one option or there may only be enough right-of-way for another. When the number of options is narrowed down, it may be necessary to go through the process again and conduct a more detailed analysis to determine the project or projects for implementation.

Data Needs

As previously mentioned, the intent of this project is to provide a traffic modeling template for small cities in Texas. This template utilizes labor market and transportation-related data in order to produce local travel forecasts. Table 1 lists the primary data that needs to be obtained for the purpose of conducting a transportation analysis for a small city. The table includes the data category, the data type, and the potential sources of that data. As previously mentioned, the District Traffic Maps and the RI2-T Log Database are the primary data needed for the analysis. Development plans and information on the local level is needed as well. Depending on the local government structure, the planning department, economic development agency, or Chamber of Commerce should be able to provide information pertaining to projected development in the area. If a more detailed analysis is needed, it may be necessary to obtain demographic projections and occupational information. The following section provides information on how to contact these different agencies.

Table 1. Data Needs

Data Category	Data Type	Location
Transportation Network Data	R12-T Log Database	Texas Department of Transportation
	District Traffic Maps	Texas Department of Transportation
Employment Indicators	Development Plans[1]	Local Comprehensive Plan
		Local Land Use Plan
	Occupational Information	Texas State Data Center
		Texas Comptroller of Public Accounts
		Texas Department of Transportation[2]
		Texas Engineering Extension Service[2]
Demographics	Population Projections	United States Bureau of the Census
		Texas State Data Center

[1]Contact the local Planning Department, Economic Development Agency, or Chamber of Commerce.

[2]Potential source.

Data Sources

The following list contains the name, address, phone number, and Internet website address of agencies referenced in the preceding sections. These agencies can provide transportation- and economic-related information that will assist in conducting an analysis.

Texas Department of Transportation (TxDOT)
Public Information Office
125 E. 11th St.
Austin, Texas 78701-2483
512/463-8588
<http://www.dot.state.tx.us/>

Texas Department of Transportation (TxDOT)
Transportation Planning and Programming Division
(512) 486-5000

Texas Comptroller of Public Accounts
Post Office Box 13528, Capitol Station
Austin, Texas 78711-3528
1-800-252-5555
http://www.cpa.state.tx.us/

Texas State Data Center
Department of Rural Sociology
Texas A&M University
College Station, Texas 77843-2125
Voice: (409) 845-5332
Fax: (409) 845-8529
<http://www-txsdc.tamu.edu/>

Texas Engineering Extension Service
The Texas A&M University System
College Station, Texas 78843-8000
Phone: 409-845-7225
FAX: 409-845-5726
<http://teexweb.tamu.edu/index.html>

United States Bureau of the Census
Public Information Office
Washington, DC 20233
301-457-4100
http://www.census.gov/

CHAPTER THREE - ANALYSIS

Background

In order to perform an analysis of the traffic projections for a city, it is necessary to have local input on traffic, land use, and expected growth. For the city of Alice, David Cich, Executive Vice-President/CEO of the Alice Chamber of Commerce, was contacted to discuss the current and projected development in Alice as well as the existing traffic patterns (5). Some pertinent information obtained in that conversation is discussed below.

Alice has a comprehensive plan, but it was prepared in 1975 and is outdated. The city is negotiating with consultants to update the plan. This plan will address many issues concerning the city, including the historically low levels of housing in the area. The city has had, and continues to have, a shortage of housing. However, two new residential developments have occurred in the last few years. These are located in the northeast and southeast quadrants of town. As a result of this shortage, a significant number of persons commute into Alice for work.

Mr. Cich described several factors that illustrate the expected growth in Alice during the next few years, especially along the S.H. 44 corridor (see Figure 2).

- Alice Regional Hospital is being constructed near the intersection of S.H. 44 and Airport Road. The hospital is located downtown and will be relocating to this site upon construction completion. This facility will have 115 beds and employ about 500 persons.
- Another health care facility, Spohn Hospital, is planned near the same intersection and it will include 50 beds.
- There are a large number of retail establishments located along S.H. 44 between Airport Road and Texas Boulevard. This development contains high traffic-generating businesses such as fast-food restaurants, auto service businesses, and a large grocery store.

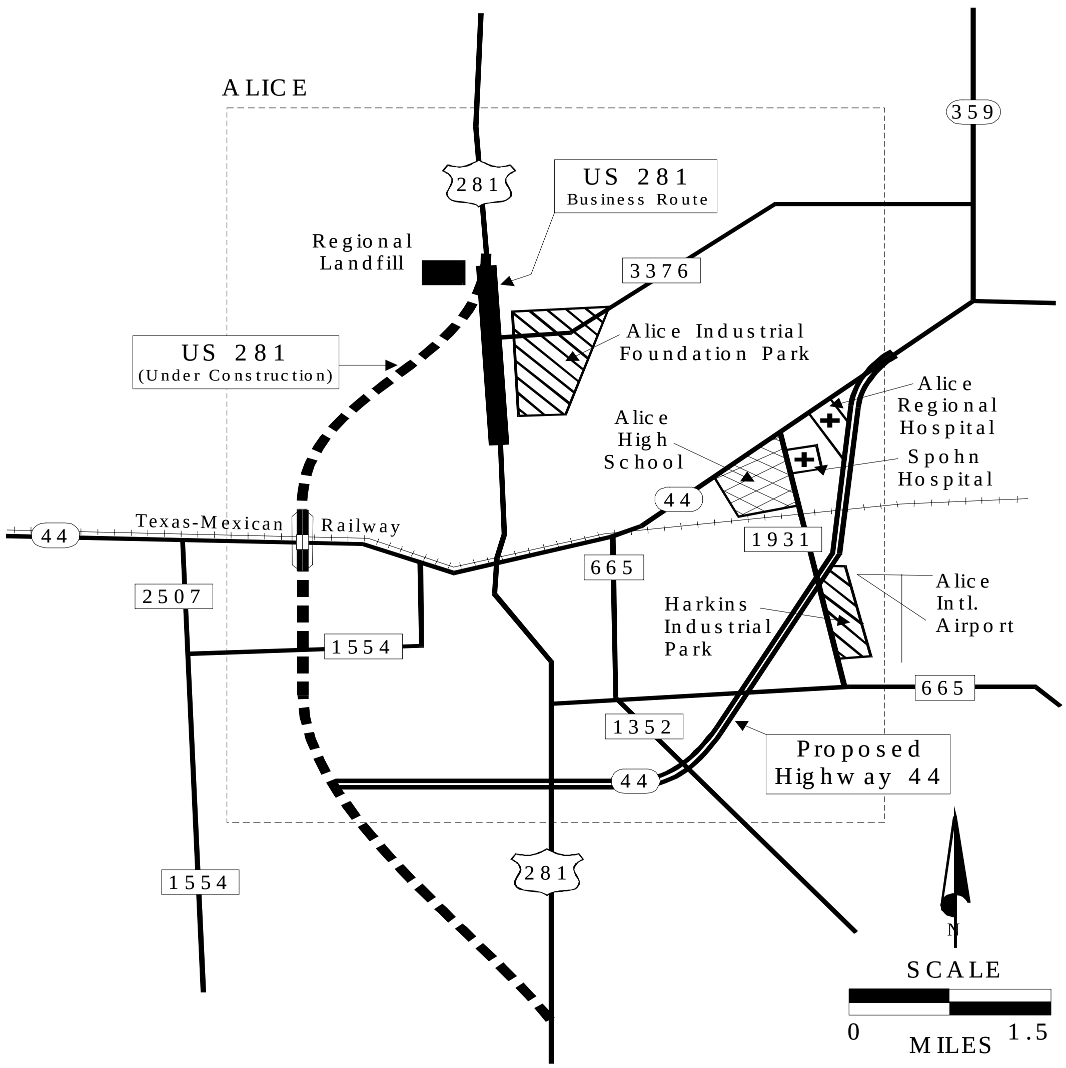


Figure 2. Transportation Network in Alice (with Current and Proposed Improvements)

- There are many schools located along the S.H. 44 corridor including a college, high school, and several other schools.

An area of concern to Mr. Cich is the increasing train traffic on the Texas-Mexican (Tex-Mex) railroad line that runs east-west through the city. Currently, there are between six and 10 trains per day moving through town. It is anticipated that this traffic will grow to between 18 and 20 trains per day by the year 2000 (5). The number of trains could be even higher than 20 since the railroad is negotiating with other lines. The city is currently addressing the at-grade rail crossings and is in the process of determining a plan to work with the increased train traffic.

There are two industrial parks located in Alice, and these parks have businesses that employ approximately 2,200 people. Harkins Industrial Park is on the east side of town by the airport on F.M. 1931 and the other, Alice Industrial Foundation Park, is north of town on F.M. 3376. Harkins Park has six acres available for purchase with no prospective purchasers, and Alice Industrial Foundation Park has four acres remaining. However, there is a firm commitment for the purchase of those four acres. Additionally, there are two privately owned industrial sites located adjacent to the Harkins Park that are approximately 200 acres apiece.

Some information about roadway improvements underway or planned was also obtained. The U.S. 281 relief route is well under way and is expected to be completed by the fall of 1999. At the time this report was prepared, the Business U.S. 281 improvements to widen the roadway from two to four lanes was under way and was anticipated to be completed by the winter of 1998. The other major improvement in the planning stage is a relief route for S.H. 44. Construction on this route has not begun. No right-of-way has been acquired. A public meeting was planned for May 1998 to discuss the project. Mr. Cich noted that there is a strong public support for these projects within the community.

Transportation Network Data

Observing current traffic patterns and operations will assist in identifying segments of the transportation system that need improvements. This information, coupled with previously obtained economic and employment data, will provide a basis upon which an analysis can be conducted. If specific segments of the network are currently operating efficiently, and there are no economic influences anticipated being made in the area, an assumption can be made that improvements to that specific segment are not warranted. Conversely, if a segment is experiencing periods of congestion, and projections indicate that economic growth is likely in that area, assumptions can be made that the segment has a potential to become further congested. At this point, a more detailed analysis can be undertaken to evaluate the situation and determine what the most appropriate solution would be.

Data pertaining to the current traffic volumes measured in annual average daily traffic (AADT), the percentage of the AADT estimated to be trucks, and a 20-year AADT projection is utilized in this analysis. This information is obtained from RI2-T Log Database and District Traffic Maps that were made available by TxDOT (6,7).

Table 2 provides a summary of the current and projected traffic volumes for the state maintained roads in Alice. The table provides the roadway and analysis segment (as identified in Figure 3); the AADT for 1986, 1991, and 1996; the percent of the 1996 AADT that is trucks; a 20-year projection of the AADT; and a percent growth in the AADT.

The state-maintained roadways shown in the District Traffic Maps and the RI2-T Logs are divided into sections. These sections, which will be referred to as 'data sections' for purposes of this discussion, contain information such as traffic counts, general facility characteristics such as number of lanes and facility type, truck percentages, and future traffic count estimates. It would be very tedious to perform an analysis on each of these small data sections, so for this analysis, many of these small sections are combined into larger segments that are easier to manipulate. In this analysis, these larger segments will be referred to as 'analysis segments', and they are shown in Figure 3. When creating an analysis segment, it is necessary to select a representative data section. The selection of a data section takes several factors into account. The data section with the highest traffic volume is typically used to represent the traffic level for the entire analysis segment of roadway. However, when the characteristics of the roadway change as shown in the data sections, it may be necessary to end the previous analysis segment and begin a new one. For example, in Figure 3 the number of lanes changed on U.S. 281 between analysis segments 2B and 2C thus creating the need for separate analysis segments. In general, it is a good idea to have no more than six or eight analysis segments for each roadway. This helps to simplify the analysis.

Traffic Data

The original template focused on data from Alice, Texas, although it could be applied to almost any small city in Texas. The template points out the high traffic volumes on the two major roadways in Alice, U.S. 281 (north-south highway) and S.H. 44 (east-west highway). It also discusses the relief routes planned for these two roadways around the city. Projected traffic volumes from other roadways are shown. Many of these projections show traffic increases of well over 2 percent per year for the next 20 years.

All of the information provided by David Cich is very helpful in analyzing the traffic projections for Alice. Without some local input, it is difficult to correctly interpret the traffic numbers provided by TxDOT. For example, Mr. Cich pointed out that most of the hotels and truck stops in Alice are along the U.S. 281 corridor and that there was a significant amount of truck traffic on this road all day long. This information corresponds with the data in Table 2 that shows over 20 percent of the daily traffic on U.S. 281 is comprised of trucks. With the additional train traffic along the east-west Tex-Mex railroad, it is increasingly important to have a grade-separated crossing for these trucks. The relief route for U.S. 281 on the western side of town will have grade-separation so that trucks can move through the city without having to sit in traffic waiting for slow moving trains.

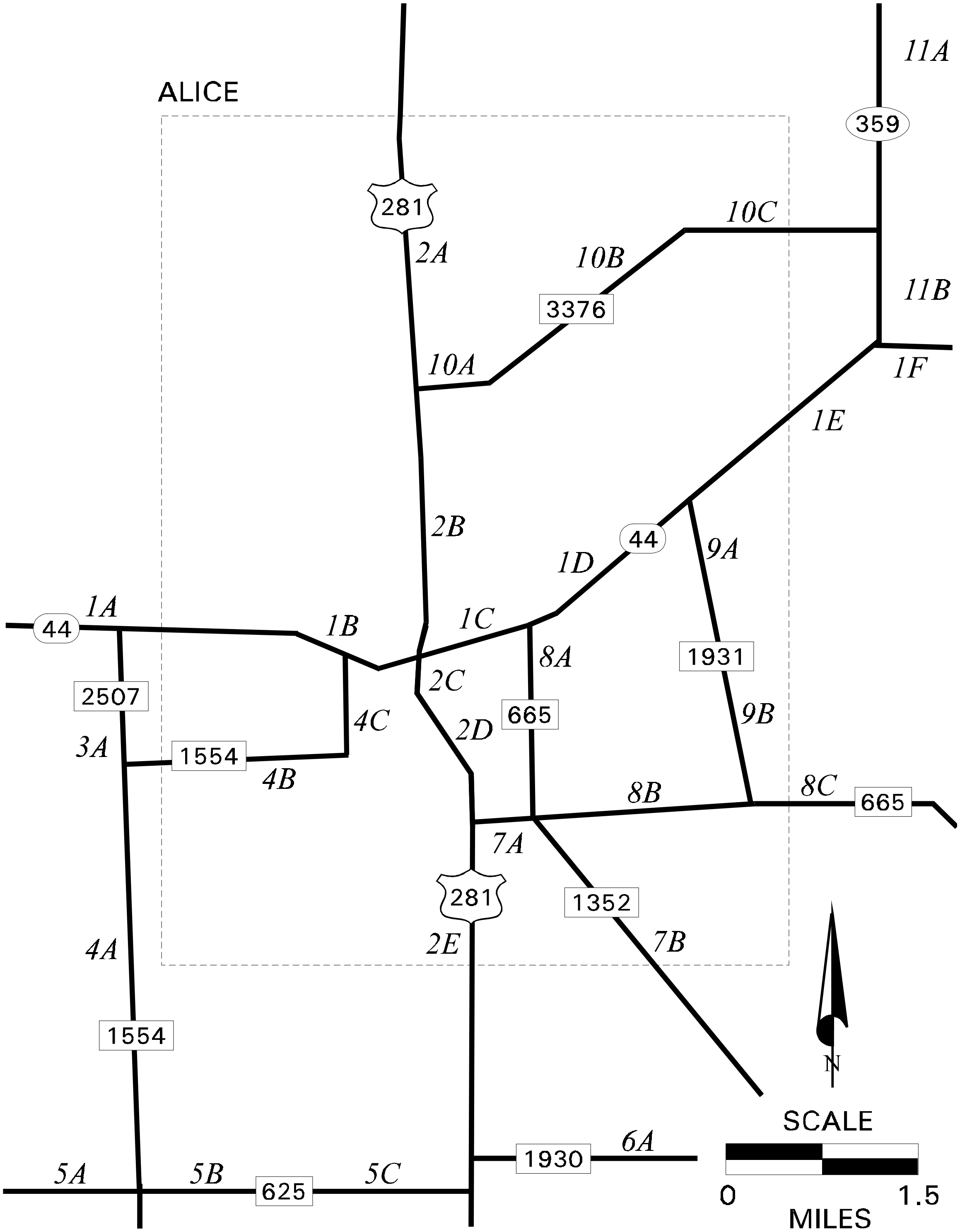


Figure 3. Alice Transportation Network

Table 2. Current and Projected Traffic Volumes

Roadway	Analysis Segment	No. of lanes	Daily Traffic			1996 % of Daily Traffic that is Trucks	Projected 2016 Daily Traffic	Percent Growth	
			1986	1991	1996			1986-1996	1996-2016
S.H. 44	1A	4	7,300	7,600	10,000	11	12,900	37	29
	1B	4	10,300	9,900	12,800	10	17,100	24	33
	1C	4	16,000	14,800	18,500	9	24,500	16	32
	1D	4	18,900	16,800	19,500	9	24,640	3	26
	1E	4	8,600	8,700	10,400	11	13,300	21	28
	1F	4	6,200	6,400	8,400	13	10,780	36	28
U.S. 281	2A	2	6,100	6,600	8,100	24	9,660	33	19
	2B	2	10,300	9,300	10,600	21	13,440	3	27
	2C	4	11,500	11,300	13,500	20	16,800	17	24
	2D	4	11,700	11,000	12,500	21	14,980	7	20
	2E	4	11,500	10,800	11,900	28	13,580	4	14
F.M. 2507	3A	2	680	750	1,050	15	1,380	54	31
F.M. 1554	4A	2	430	520	800	8	1,320	86	65
	4B	2	750	1,200	1,400	8	2,350	87	68
	4C	2	3,000	3,700	4,300	7	6,750	43	57
F.M. 625	5A	2	250	220	200	14	380	-20	90
	5B	2	430	400	550	16	730	28	33
	5C	2	1,000	860	1,000	12	1,260	0	26
F.M. 1930	6A	2	250	250	330	10	430	32	30
F.M. 1352	7A	2	3,400	6,600	7,700	5	9,100	127	18
	7B	2	400	2,200	2,800	7	5,080	600	81
F.M. 665	8A	2	7,700	6,400	7,900	5	9,940	3	26
	8B	2	7,300	6,400	7,900	5	9,660	8	22
	8C	2	3,000	2,500	2,900	7	4,340	-3	50
F.M. 1931	9A	2	3,900	3,800	5,900	7	7,840	51	33
	9B	2	3,900	3,800	4,300	7	6,160	10	43
F.M. 3376	10A	2	2,300	2,500	2,600	6	3,640	13	40
	10B	2	2,100	2,400	2,900	6	3,640	38	26
	10C	2	1,600	1,100	1,700	7	2,910	6	71
S.H. 359	11A	2	2,800	2,400	3,100	12	5,200	11	68
	11B	2	2,700	2,500	2,900	12	4,100	7	41

Source: Texas Department of Transportation- RI2-T Log Database

Mr. Cich also pointed out that trucks tend to avoid going through downtown whenever possible. They do this by using the peripheral roads around the city such as F.M. 1931 (Airport Rd), F.M. 665, F.M. 1352, F.M. 625, F.M. 1554, F.M. 2507, F.M. 1554, and F.M. 3376. Thus, these roads are carrying a large burden of the truck traffic in the area. Again, portions of these roadways show large percentages of trucks as illustr in Table 2.

Based on Table 2, it is apparent that U.S. 281 and S.H. 44 carry much of the traffic load in Alice. One item that stands out with the data from these roadways is the very large percentage of trucks that are represented by the traffic counts. Anywhere from 10 to 30 percent of the traffic volumes are generated by trucks. It is unknown exactly how many of the trucks are through-trucks, that is trucks that only pass through the city on their way to another destination. Assuming that many of these trucks are through-trucks, the relief routes on S.H. 44 and U.S. 281 may help a great deal in relieving traffic congestion along these main two thoroughfares. Traffic on much of these two roadways is projected to grow by 20 to 30 percent in the next 20 years. Again, the relief routes for both roadways may help tremendously in removing some of the through-trips from the business portion of these roadways running through town.

The two industrial parks in Alice are located on F.M. 1931 and F.M. 3376. Sections of both of these roadways have shown tremendous traffic growth in recent years and are projected to grow even larger in the next 20 years. Traffic projections show increases between 25 and 70 percent for portions of these roadways. Much of this additional traffic may be due to trucks and may create some additional transportation planning needs for these areas in the future.

Almost all of the roadways show in Table 2 have some sections of roadway that have traffic projections with at least 30 percent growth in the coming 20 years. The fluctuations in the growth projections depend on the developments and traffic generators located along each roadway. The traffic growth experienced between 1986 and 1996 on many of these roadways is due to new developments and businesses along these corridors and overall growth in the Alice area. This economic growth appears to be continuing well into the next century based on the traffic projections.

As previously mentioned, the traffic data provided by TxDOT serves as the basis for the analysis. Historical and projected traffic volumes; the number of lanes of the facility; whether the road is divided, undivided, or has a continuous left-turn lane; and whether the facility is urban or rural all factor into the analysis. Supplemental data such as growth areas and special generators of traffic assist in determining where congestion problems may occur in the future.

The following series of figures (Figures 4 through 8) illustrates current and projected traffic volumes, as well as the current percentage of traffic that is trucks, for the state-maintained roads in Alice. Figure 4 and Figure 5 illustrate the level of daily traffic for roads in Alice in 1996 and 2016, respectively.

Figure 4 and Figure 5 demonstrate the growth in travel that is predicted to occur on both U.S. 281 and S.H. 44 between 1996 and 2016. The amount of traffic on S.H. 44 is expected to increase by approximately 30 percent between 1996 and 2016, while traffic on U.S. 281 is anticipated to grow by nearly 20 percent during the same period. Increases in traffic levels can be seen on other roads as well.

Figure 6 and Figure 7 show the Average Daily Traffic per Lane (ADT/Lane) for the state-maintained roads in and around Alice. The ADT/Lane values include an observed value for 1996 and a projection for 2016.

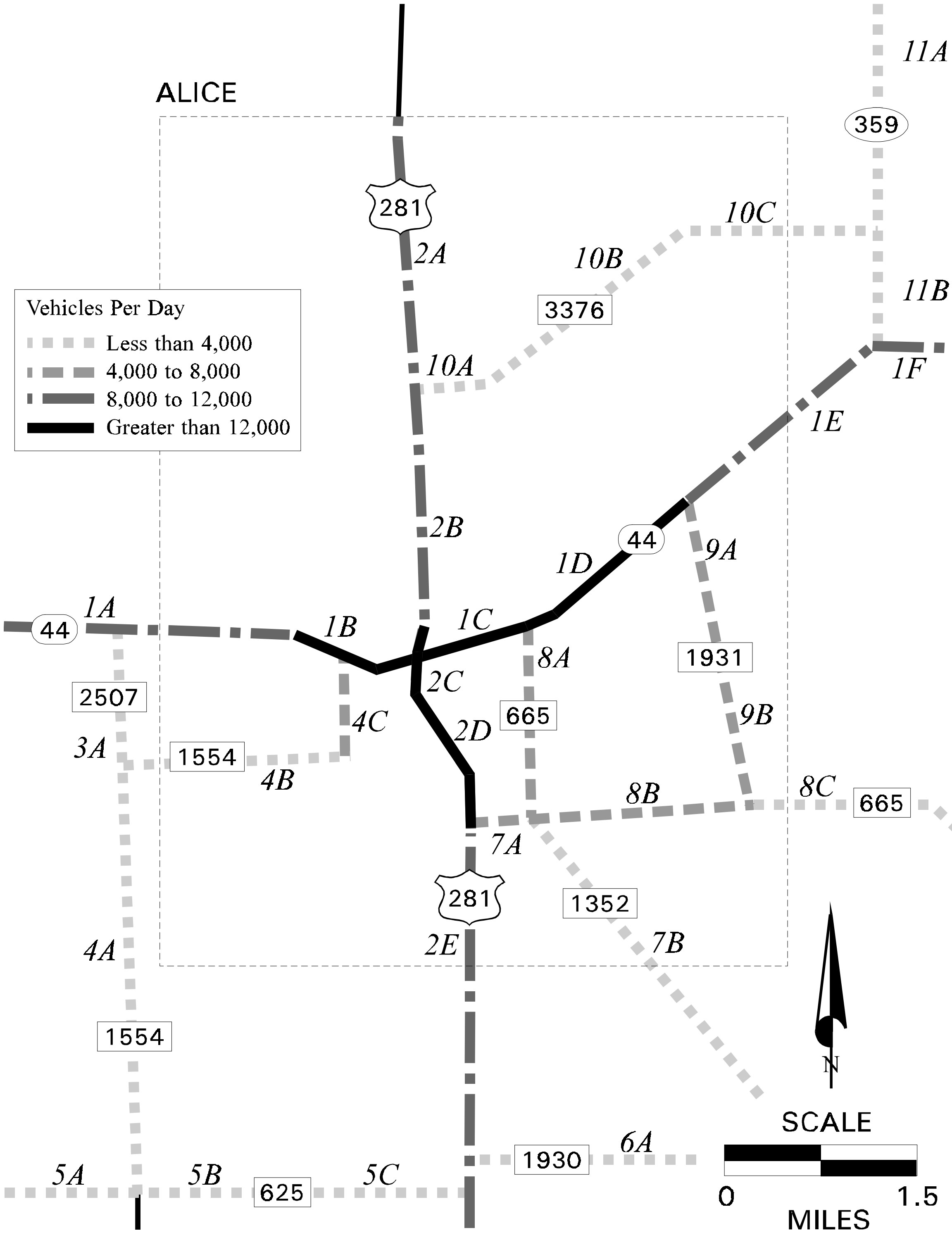


Figure 4. 1996 Daily Traffic

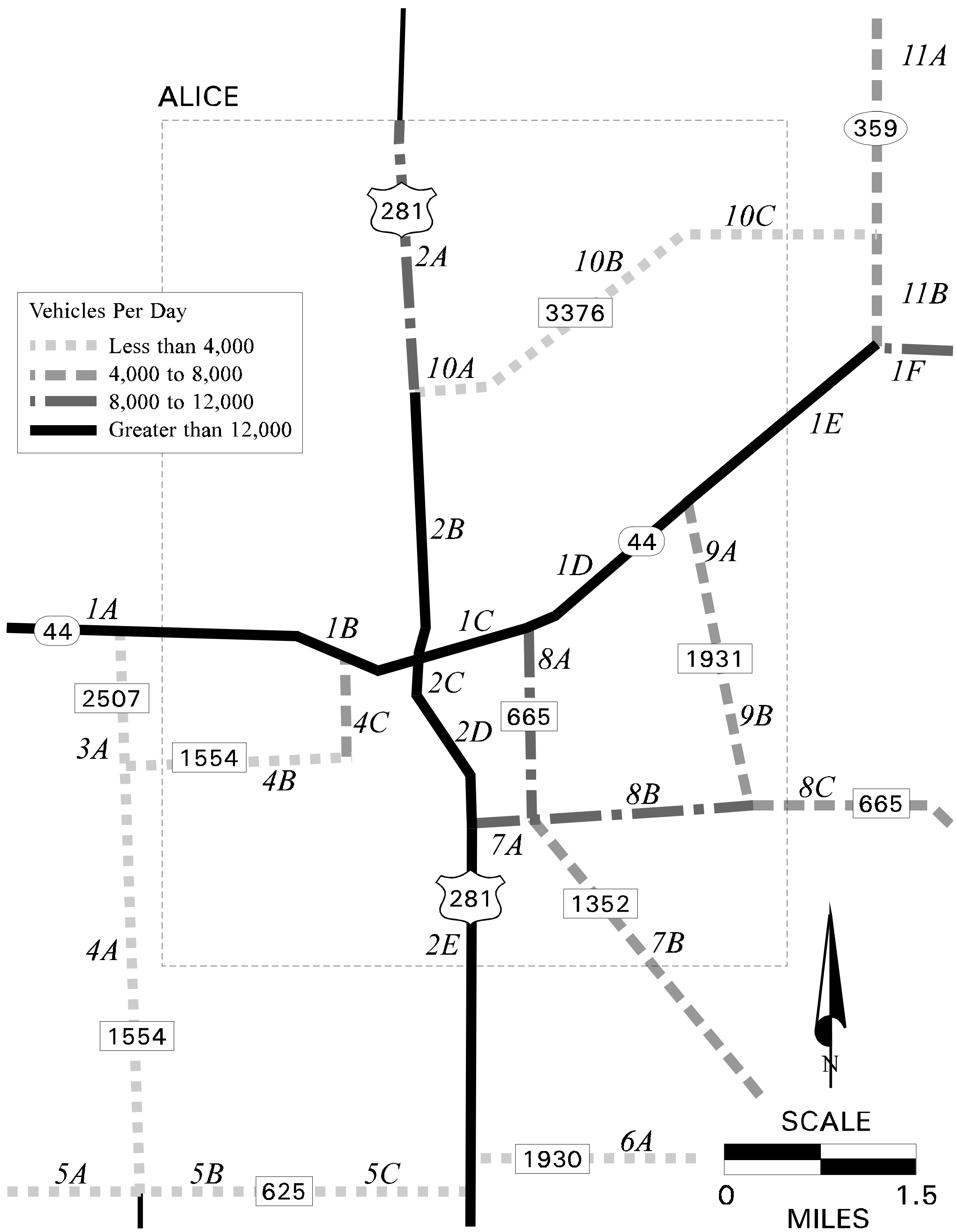


Figure 5. 2016 Daily Traffic

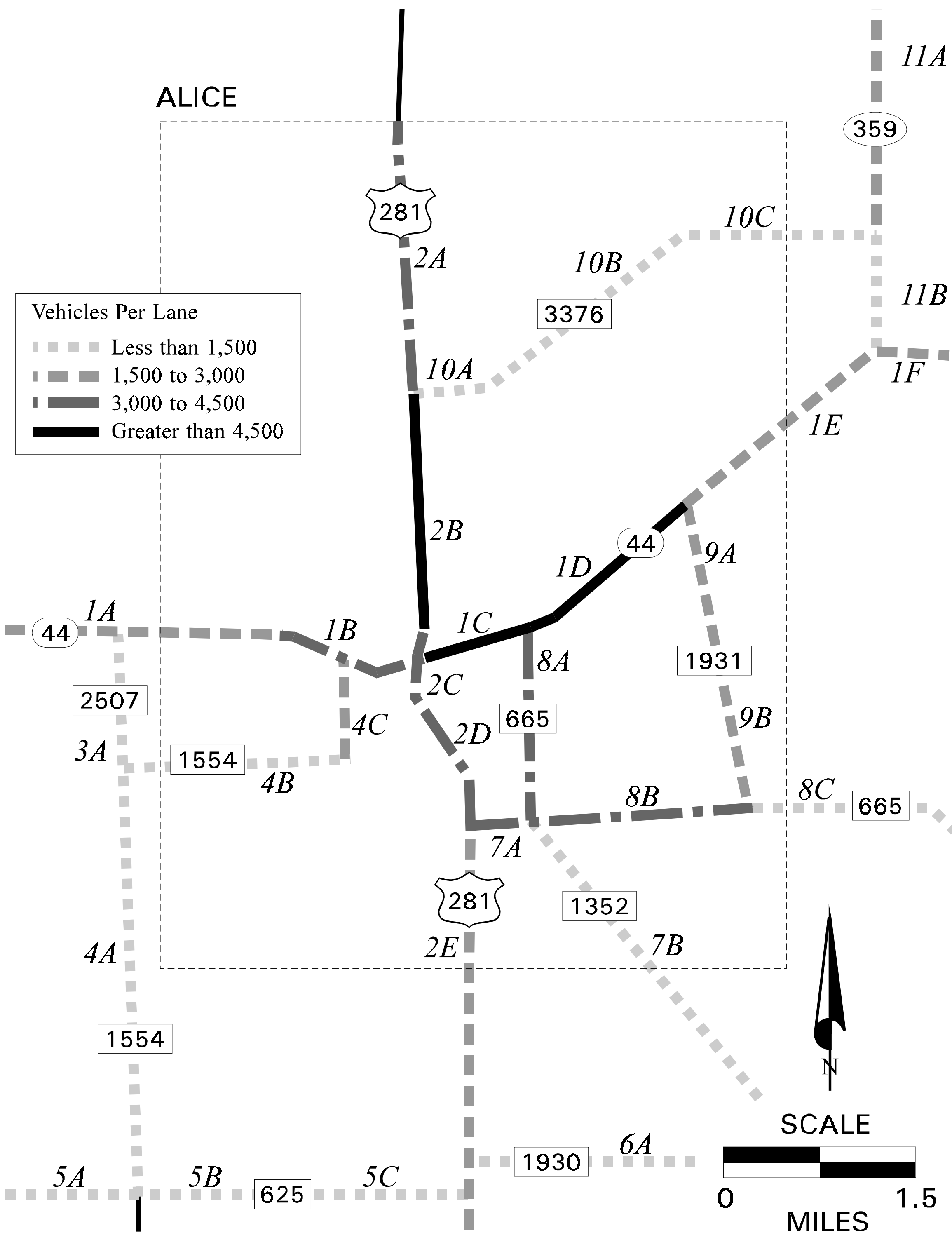


Figure 6. 1996 Daily Traffic per Lane

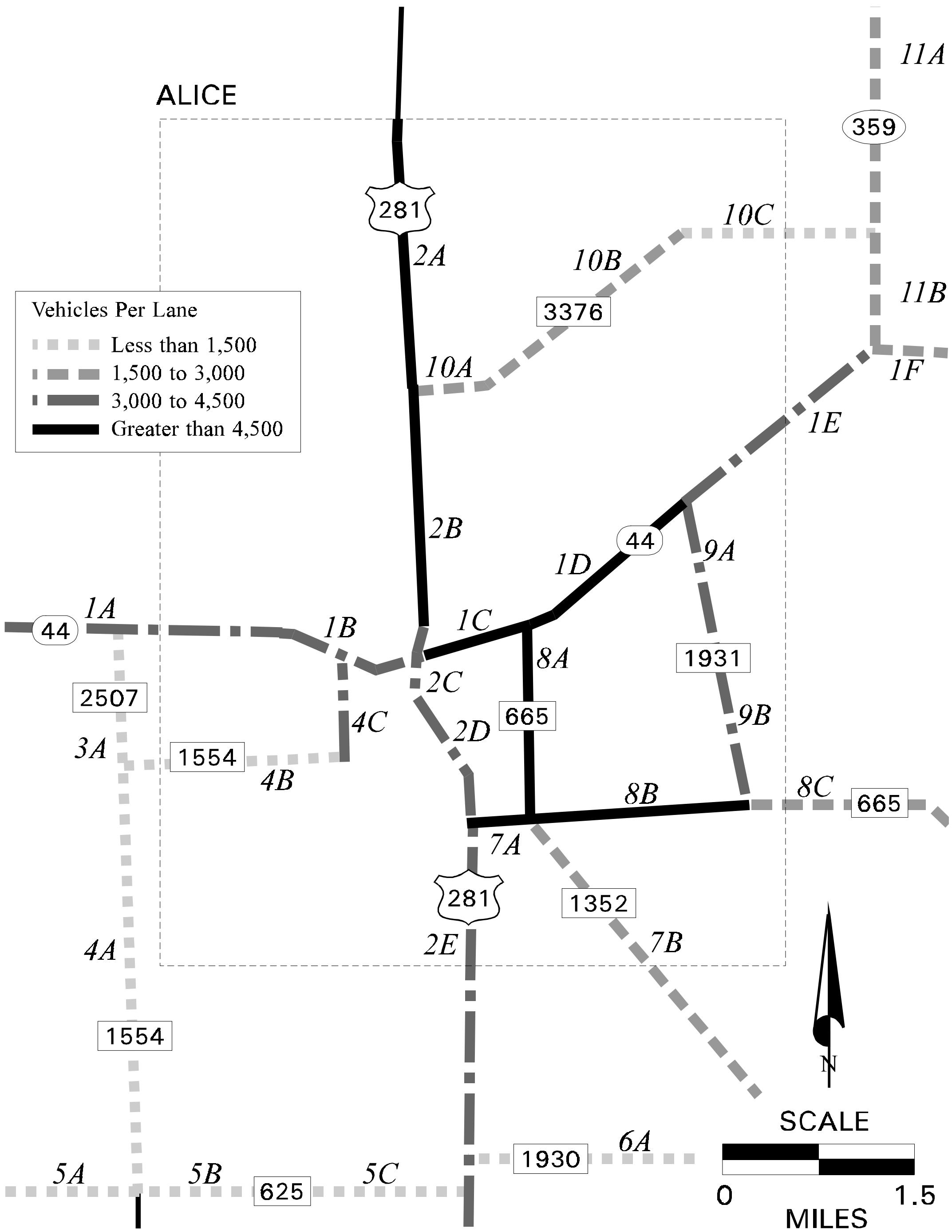


Figure 7. 2016 Daily Traffic per Lane

Many of the state-maintained roads in Alice are expected to have an increased level of traffic between 1996 and 2016. The roads in and around the central part of the city show the greatest potential for growth in ADT/Lane.

The city of Alice has a substantial volume of traffic that is composed of trucks. Figure 8 illustrates the percentage of all trips that is due to trucks. A majority of these trips are on U.S. 281 and S.H. 44 on the periphery of town.

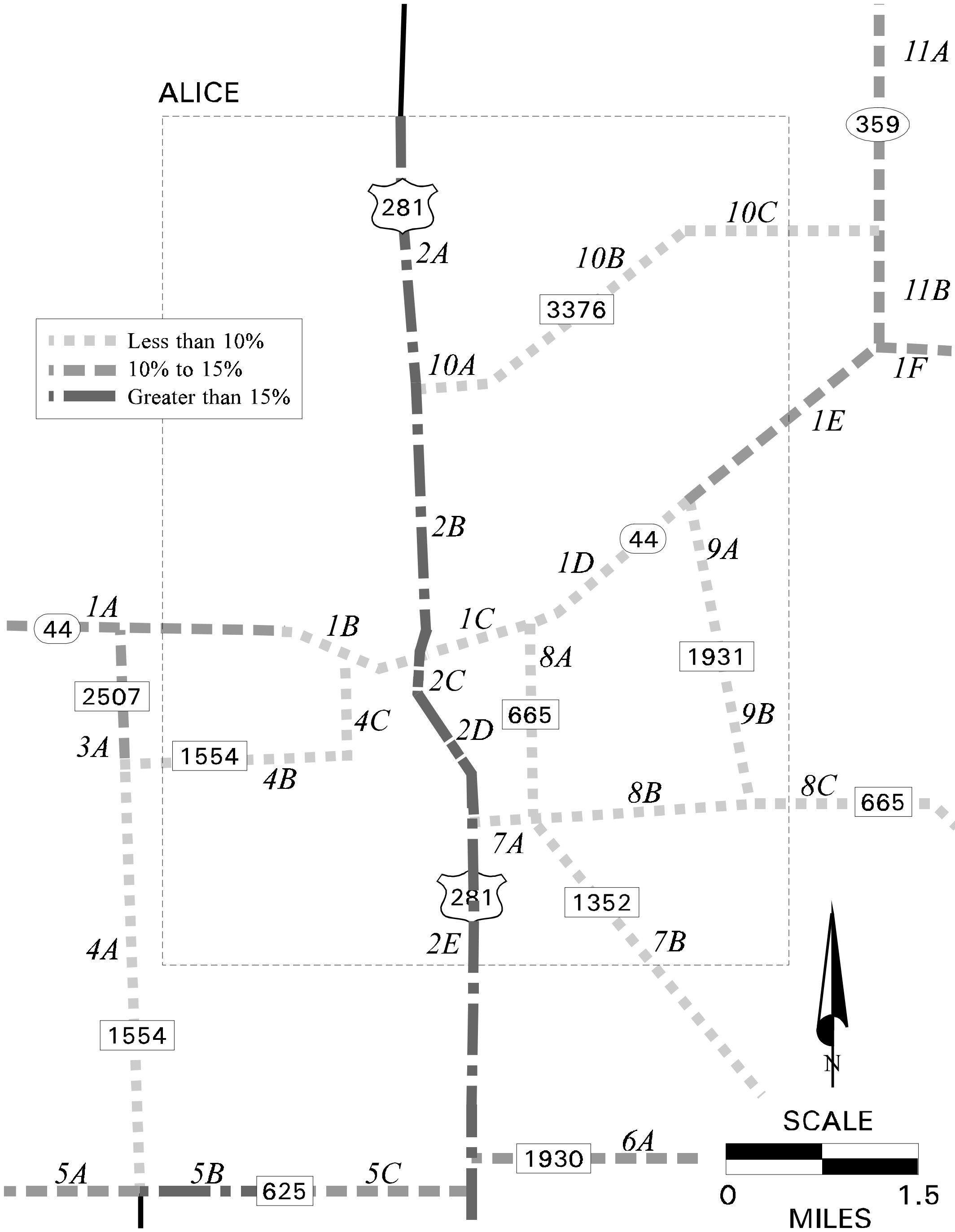


Figure 8. 1996 Percentage of Traffic Due to Trucks

Using the highway classes that have been assigned to the various roadways and the current and projected traffic volumes, it is possible to determine the quality of flow for those road segments. Table 3 delineates standard volume ranges for level of service (LOS) on different highway classes.

Table 3. Average Daily Traffic Volume Ranges

		Average Daily Traffic Volume Ranges		
Highway Class	**# of Lanes**	**Good Flow**	**Tolerable Flow**	**Undesirable Flow**
Urban Freeways				
	4	less than 44,000	44,000 to 52,800	greater than 52,800
	6	less than 66,000	66,000 to 79,200	greater than 79,200
	8	less than 88,000	88,000 to 105,600	greater than 105,600
	each additional lane	less than 11,000	11,000 to 13,200	greater than 13,200
Urban Divided Streets [1,2]				
	4	less than 16,100	16,100 to 19,100	greater than 19,100
	6	less than 23,500	23,500 to 27,900	greater than 27,900
	8	less than 29,400	29,400 to 34,900	greater than 34,900
Urban Undivided Streets [1,2]				
	2	less than 7,700	7,700 to 9,100	greater than 9,100
	4	less than 12,600	12,600 to 14,900	greater than 14,900
	6	less than 19,800	19,800 to 23,500	greater than 23,500
Rural Freeways				
	4	less than 20,800	20,800 to 31,600	greater than 31,600
	6	less than 31,200	31,200 to 47,400	greater than 47,400
Rural Divided Highways [1,2]				
	4	less than 12,000	12,000 to 17,500	greater than 17,500
	6	less than 18,000	18,000 to 26,200	greater than 26,200
Rural Undivided Highways [1,2]				
Rolling Terrain	2	less than 2,800	2,800 to 4,700	greater than 4,700
Level Terrain	2	less than 3,700	3,700 to 6,100	greater than 6,100
	4	less than 9,500	9,500 to 13,000	greater than 13,000
	6	less than 15,000	15,000 to 19,500	greater than 19,500

[1] A "divided" facility includes a flush or depressed median with sufficient width for storage of left-turning vehicles. On "undivided" facilities, left turns are made from a through lane.

[2] "Urban street," as opposed to "rural highway," conditions prevail whenever the intensity of roadside development, speed zoning, signals, stop/yield signs, etc. result in interrupted flow conditions and reduced traffic speeds.

Source: Texas Department of Transportation (TxDOT). Adapted from the Federal Highway Program Manual.

A good flow is comparable to LOS A or B, a tolerable flow is similar to LOS C or D, and an undesirable flow is equivalent to LOS E. These ranges were derived by TxDOT's Transportation Planning and Programming Division from a table in the Federal Highway Program Manual. The table is intended to provide a quick method for determining LOS based on traffic volumes on different highway classes.

The information provided in Table 2 and Table 3 serves as the basis for Figure 9 and Figure 10. The traffic data in Table 2 was compared to the volume ranges in Table 3 in order to determine which segments of roads in Alice had flows that were either good, tolerable, or undesirable. The quality of flow is given for both 1996 in Figure 9 and 2016 in Figure 10.

Based on an initial evaluation of the transportation system in Alice in 1996, relatively few analysis segments of the system have a flow that can be described as undesirable. U.S. 281 on the north side of town and S.H. 44 between F.M. 665 and F.M. 1931 are the only areas that fall into this classification. A majority of the system has a good performance level. An analysis of the 2016 system shows that substantial portions of U.S. 281, S.H. 44, and F.M. 665 may potentially have their flow levels deteriorate to an undesirable status. The U.S. 281 relief route may alleviate this problem on the current U.S. 281 route through town, but it is unknown at this point what impact it will have on traffic volumes. However, it is anticipated that it should significantly reduce the amount of through traffic as well as the number of trucks traveling through the town.

As mentioned previously, trucks and other vehicles familiar with the layout of the city tend to use peripheral roads around the city in order to avoid traffic in the center of the town. F.M. 665 and F.M. 1931 are two such routes. A proposed S.H. 44 relief route may alleviate some of the projected traffic on these routes as well. If this route is constructed, coupled with the U.S. 281 relief route and improvements to Business U.S. 281, it should provide significant relief to both F.M. 665 and F.M. 1931.

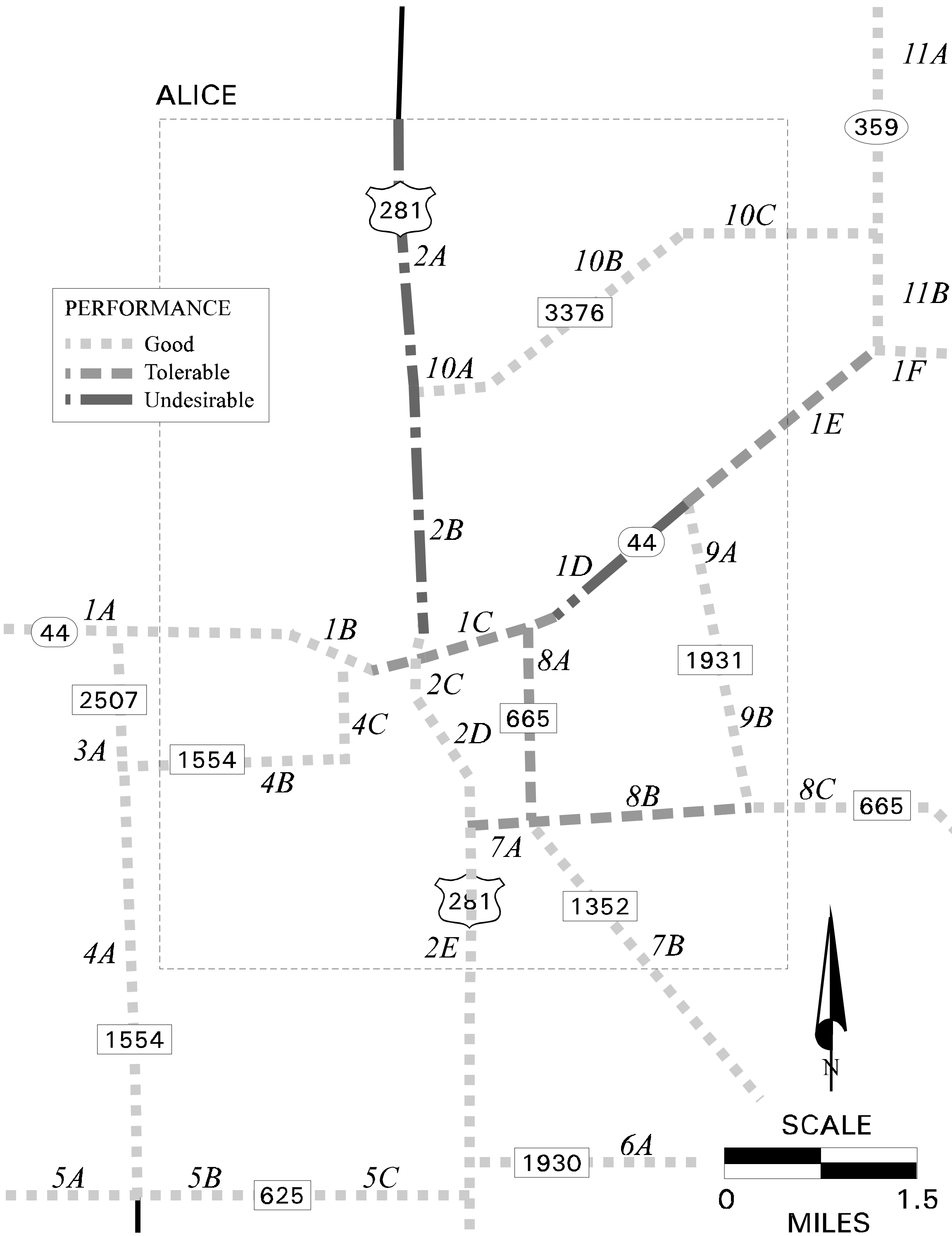


Figure 9. 1996 Performance Levels for Area Roadways

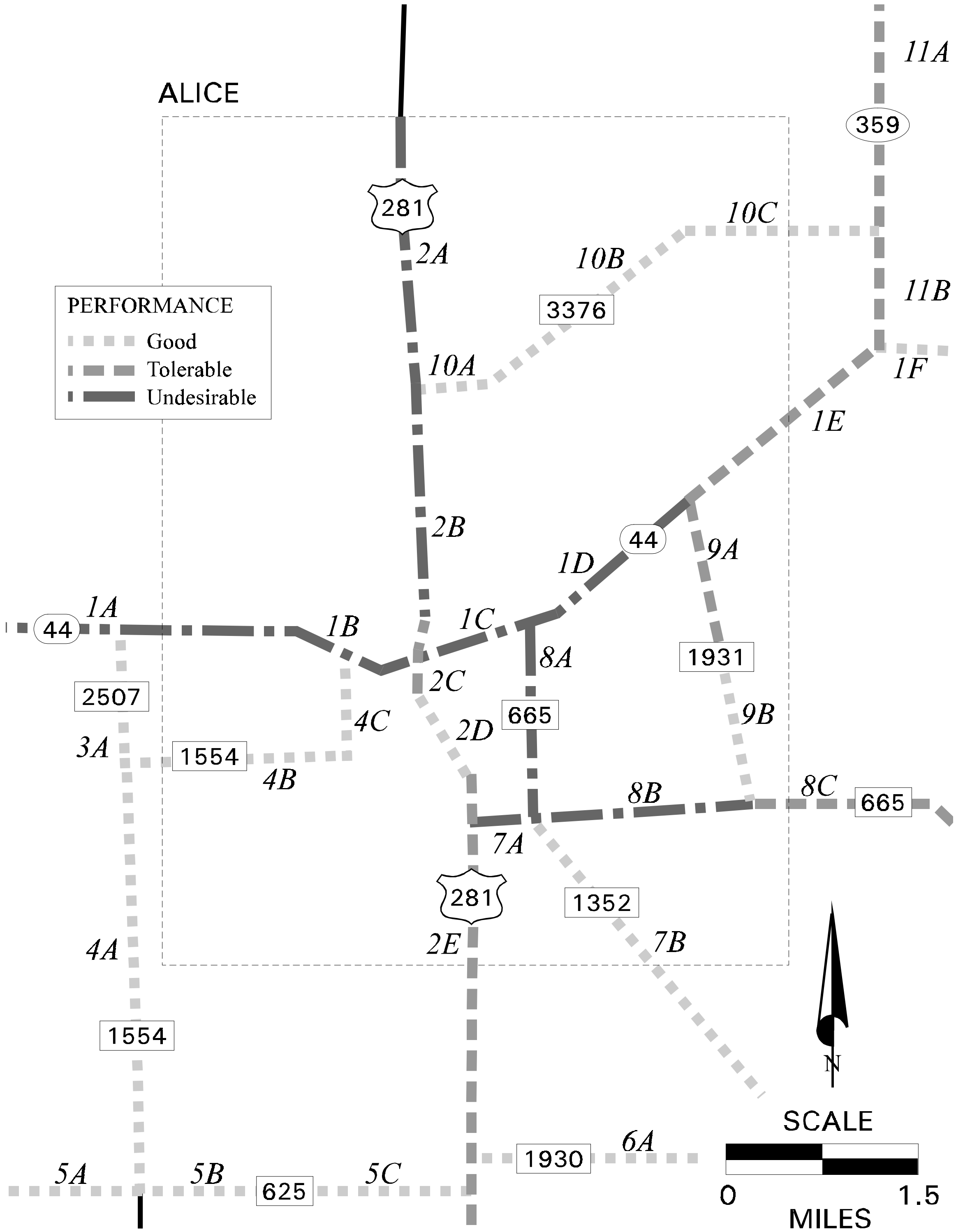
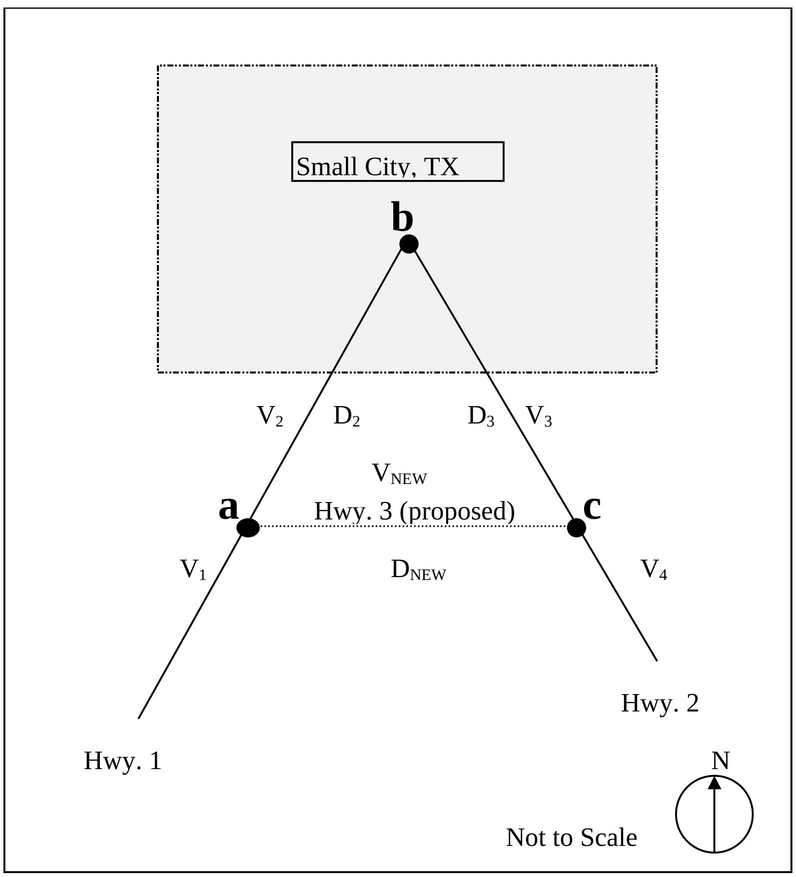


Figure 10. 2016 Performance Levels for Area Roadways

In addition to using the traffic data as in the previous analysis, the information could also be applied in order to draw some very basic generalizations pertaining to the impact that a proposed addition to the transportation network will have on the city. The impacts of some of the improvements can be measured in terms of vehicle miles saved, fuel saved, and vehicle hours saved. This information is presented in Chapter 4 of this *User's Guide*. It is important to understand, however, that the procedure presented in Chapter 4 is based on very generalized assumptions about the travel behavior of motorists. A detailed corridor analysis would need to be conducted in addition to this procedure to provide design rather than planning data to more accurately reflect the conditions that could occur as a result of an improvement to the transportation system.

CHAPTER FOUR - PLANNING ESTIMATION TOOLS

The following calculations and procedures are meant to be used by local planners to serve as a simplified approach toward determining mileage savings, fuel savings, and travel time savings. It is important to understand that there are critical assumptions to be made when performing these calculations. A more detailed corridor analysis possibly using a computerized transportation planning program is necessary to predict what changes might occur as a result of a proposed improvement to the transportation system. The formulas described here can only be applied to obtain a quick, basic understanding of how proposed changes in the transportation system can impact the roadway network.



V_1= volume south of point A
V_2= volume between point A and point B
V_3= volume between point B and point C
V_4= volume south of point C
V_{NEW}=volume on proposed highway

D_2= distance from point A to point B
D_3= distance from point B to point C
D_{NEW}= distance from point A to point C

Figure 11. Example City

The scenario that is presented in Figure 11 is a new connection between two roads on the outskirts of a community. The road would potentially reduce vehicle-miles traveled, fuel consumption, and travel times for vehicles passing through the area. The following information provides an example of how to estimate vehicle-miles saved, fuel saved, and vehicle-hours saved. For each category of savings, a formula and an example is provided. Figure 11 illustrates the network being analyzed in the calculations. The formulas are as follows:

Miles Saved- distance reduced by traveling on new roadway

Miles saved = $(D_2+D_3) - D_{NEW}$

Vehicle-Miles Saved (VMS)- reduced vehicle travel distance by traveling on new roadway

$V_{NEW} = [(V_1-V_2) + (V_4-V_3)] / 2$

$VMS = [V_{NEW} \times (D_2+D_3)] - (V_{NEW} \times D_{NEW})$

Fuel Savings- fuel saved as a result of vehicles traveling on new roadway

Vehicle-Gallons Saved = $[V_{NEW} \times (D_2+D_3)] - (V_{NEW} \times D_{NEW})$ / Average Miles per Gallon (MPG)

then:

Fuel Cost Savings per Day = Vehicle-Gallons Saved × Average Cost per Gallon of Gasoline

Time Savings for Vehicular Traffic- reduced vehicle travel time as a result of traveling on new roadway

(TS_{OLD}) Minutes used on old route = $[(D_2+D_3)$ / Assumed Average Speed on D_2 and $D_3]$ × 60 minutes per hour

and:

(TS_{NEW}) Minutes used on new route = $[D_{NEW}$ / Assumed Average Speed on $D_{NEW}]$ × 60 minutes per hour

then:

(TS_{OLD}) Vehicle-minutes on old route = Minutes used on old route × V_{NEW}

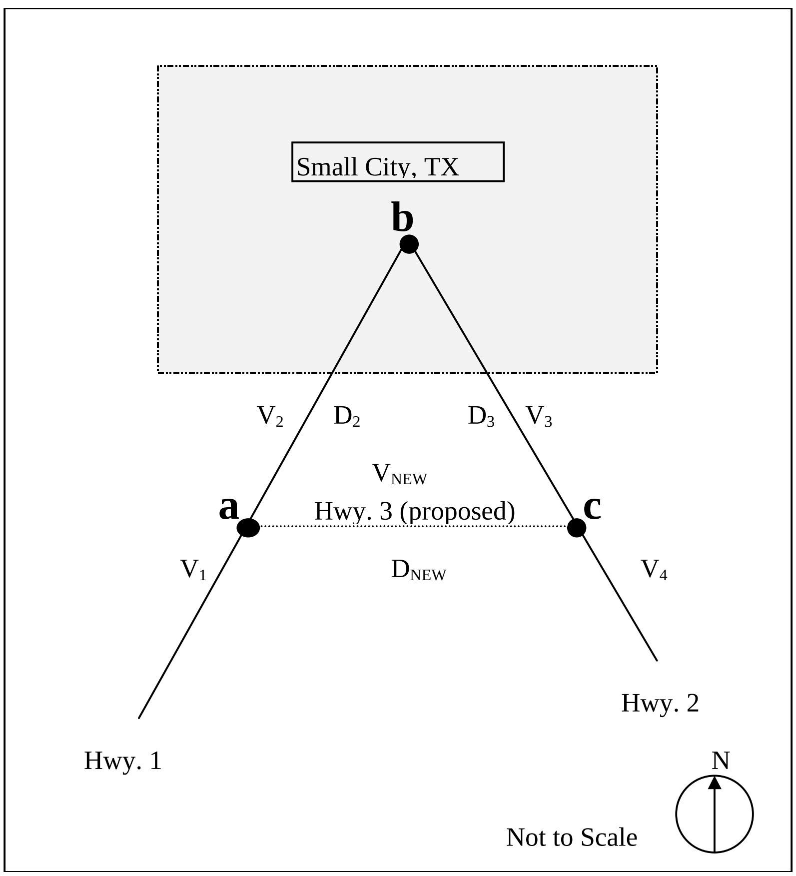
and:

(TS_{NEW}) Vehicle-minutes on new route = Minutes used on new route × V_{NEW}

The difference in vehicle-minutes for the two routes will provide the vehicle-minutes saved.

(TS_{OLD} - TS_{NEW}) / 60 minutes per hour = vehicle-hours saved per day

In order to clarify the preceding formulas, assume the terms in Figure 11 have the following values:



V_1= 6,500 vehicles per day

V_2= 5,200 vehicles per day

V_3= 24,100 vehicles per day

V_4= 24,500 vehicles per day

V_{NEW}= 850 vehicles per day

D_2= 7 miles

D_3= 4 miles

D_{NEW}= 6 miles

Assumed Average miles per gallon (MPG)= 20

Assumed Average cost per gallon of gasoline= $1.20

Assumed Average speed on D_2 and D_3= 30 miles per hour

Assumed Average speed on D_{NEW}= 50 miles per hour

V_{NEW} was calculated using the following formula:

$V_{NEW} = [(V_1-V_2) + (V_4-V_3)] / 2$

[(6,500-5,200) + (24,500-24,100)] / 2 = 850

Using the preceding values, the following savings are:

Miles Saved

(7+4) - 6 = 5 miles saved

Vehicle-Miles Saved (VMS)

[850 × (7+4)] - (850 × 6) = 4,250 vehicle-miles saved (VMS)

Fuel Savings

4,250 VMS / 20 MPG = 212.5 Vehicle-Gallons Saved (VGS)

212.5 VGS × $1.20 (Cost per Gallon of Gasoline) = $255 per day

Fuel Savings can also be expanded on in order to estimate the annual fuel savings by simply multiplying the daily fuel savings with the number of working days per year. In this example, assume that there are 250 working days per year. This would result in annual fuel savings of approximately $63,750.

Time Savings for Vehicular Traffic

TS_{OLD} [(7+4) / 30 MPH] × 60 minutes per hour = 22 minutes

TS_{NEW} (6 / 50 MPH) × 60 minutes per hour= 7.2 minutes

then:

22 minutes × 850= 18,700 vehicle-minutes used on old route

and:

7.2 minutes × 850= 6,120 vehicle-minutes used on new route

then:

(18,700 - 6,120) / 60 minutes per hour = 210 vehicle-hours saved per day

When utilizing these formulas, it is important to remember that there are significant assumptions being made with regards to certain values. It is advisable to perform these calculations using a range of values for certain terms. Some terms like D_2, D_3, D_{NEW}, V_1, and V_4 will have fairly definite values. However, other terms like V_2, V_3, V_{NEW}, Miles per Gallon, Cost per Gallon of Gasoline, and the assumed average speed on the different roadway segments will need to be applied with caution. Performing these calculations multiple times using different values will provide a range of savings that can assist in making more informed decisions about potential transportation improvements.

CHAPTER FIVE - CONCLUSIONS

Throughout history, cities have required certain services that make it possible for high concentrations of people to live together in small areas. Clean water is vital, disposal of solid and liquid waste is needed, and food and other supplies produced elsewhere is necessary to the inhabitants of a community. Transportation is a key component of the elements that make a city function. Whether the transportation system is used to import and export goods, or it is used to provide municipal services such as police and fire protection or waste disposal services. The degree to which the city functions is directly proportional to the transportation network.

The purpose of this *User's Guide* is to provide a traffic-modeling template to act as a tool for small cities in Texas to link transportation planning and economic development. The guide creates a foundation for coordinating traffic forecasts with projected economic development activities. Some of the data from these two sources included in the *User's Guide* include: traffic data counts and projections from the Texas Department of Transportation, long-term transportation improvement projects, and the location of new traffic generators such as schools, hospitals, shopping centers, and industrial parks. Also included are other important factors such as the location of rail lines in a city and what the future use of them is projected to be. The purpose of the *User's Guide* is not to make an attempt at proposing solutions based on the numbers shown in the analysis, but to put all of the information in a common location for use in performing planning for the future of a city.

Since the automobile has had and continues to have a pronounced impact on the development of a city, it is important that cities acknowledge this and plan accordingly. The automobile affects street designs, parking provisions, traffic controls, congestion, air quality, and construction costs (1). Understanding the complexity of the problems that automobiles can create within a city is the first step in developing a solution. After these issues are identified, then measures can be taken to address the problems.

Local knowledge related to which areas of the community are growing and which businesses are generating significant amounts of traffic is vital when conducting an analysis of a transportation system. Assembling information similar to that which was provided in this template will allow public officials to make an informed decision regarding the future of the transportation system within a city. Based on the importance of a transportation network to a city, an informed decision regarding where improvements need to be made will most likely result in a more efficient means for people and goods to be transported within and through the community. This is ultimately the goal of any transportation system.

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3. Rosenbloom, Sandra, "Transportation Planning." *The Practice of Local Government Planning*. 2nd Edition. International City Management Association: Washington D.C., 1988.

4. Chapin, Jr., F. Stuart, and Kaiser, Edward J., *Urban Land Use Planning*. 3rd Edition. University of Illinois Press: Urbana, Illinois, 1979.

5. David Cich; Executive Vice-President/CEO, Alice Chamber of Commerce. Telephone conversation held on April 21, 1998.

6. RI2-T Log. Jim Wells County. Texas Department of Transportation (TxDOT): Austin, Texas, 1996.

7. 1996 District Highway Traffic Map. Corpus Christi District; Jim Wells County. Texas Department of Transportation (TxDOT): Austin, Texas, 1996.

APPENDIX A

In accordance with the scope of the research effort, the template devised utilizing Alice, Texas, as a case study was tested on a second city. The city of Jacksonville, Texas, was selected as the test site. Jacksonville is located in Cherokee County in east Texas. Jacksonville had a 1990 population of 12,765 and according to the Texas Comptroller's office the city had an approximate population of 13,700 in1998.

A copy of the *User's Guide* was submitted to TxDOT officials in the Tyler District for their review. TxDOT personnel at the Tyler District then performed an analysis of the transportation system in Jacksonville in accordance with the parameters described in the *User's Guide*. The following memorandum is the response and analysis submitted by the Tyler District of TxDOT.

Texas Department of Transportation

2709 W. FRONT STREET TYLER, TEXAS 75702 (903)510-9100

October 18, 1999

Texas Transportation Institute
The Texas A&M University System
Attn: David L. Schrank
Assistant Research Scientist
College Station, TX 77843-3135

Dear Mr. Schrank:

Attached please find the data sheet that you requested that I fill out for Jacksonville, Texas. This information was based on the example that you developed for Alice, Texas and consists of information taken from TxDOT's Texas Reference Marker (TRM) database and annual traffic database. Segment breaks were determined at significant geometry or traffic volume changes. Information for 1997 and 2017 were not readily available so 1996 and 2016 were used. We can update this data at a later date.

Additional information was gathered in an interview with Wesley Burnett, Jacksonville Chamber of Commerce, and David Fain, City of Jacksonville. Several new building projects have been completed or initiated in the City since 1997. These include a Holiday Inn; 300 home subdivision; an Industrial Park with projected employment of 1,000; ETMC clinic with 50,000 square feet of space; and Allegiance Health Care plant manufacturing plastics for medical use. The housing subdivision includes an intermediate school that celebrated groundbreaking ceremonies recently. All of these facilities are located in the southern part of town along US 69 and north of Loop 456.

Additional major traffic generators in the city include Lon Morris College and Jacksonville Junior College with approximately 300 students each.

We did not experience any difficulties in preparing this map or data. We believe that this approach should be useful for other TxDOT offices and small cities that lack more formalized planning offices and tools. Results obtained from the methodology outlined in the report should be acceptable for many planning efforts and we anticipate using this for work in and around Jacksonville. Map and table preparation could have easily been completed within two working days for Jacksonville providing a benchmark for other, similar efforts.

If you have any questions or need additional information, please contact me by e-mail or at (903) 510-9224.

Sincerely,

Wesley G. McClure
Advance Project Development Engineer

Table A-1. Jacksonville Current and Projected Traffic Volumes

Roadway	Code	No. of Lanes	Daily Traffic		% Trucks in 1996 Daily Traffic	Projected 2016 Daily Traffic
			1992	1996		
US 175	1A	2	5200	6200	12.6	8680
	1B	4	N/A	N/A	N/A	8650
	1C	2	9800	12200	10.7	17080
	1D	2	4300	5300	13.3	7420
FM 747	2A	2	780	1100	5.7	1540
	2B	2	1800	2500	3.7	3500
US 79	3A	2	7500	8000	23.4	11200
	3B	4	10500	10700	20.5	14980
	3C	4	10700	11000	14.8	15400
	3D	2	7700	8900	15.6	12460
	3E	2	5800	6300	17.4	8820
SPUR 386	4A	2	2600	2600	4.5	4230
FM 2138	5A	2	1850	2400	3.8	3610
LOOP 456	6A	2	2700	2800	5.6	4540
	6B	2	2600	2800	5.6	4540
FM 768	7A	2	380	300	4.9	570
	7B	2	290	280	4.8	390
SH 204	8A	2	3600	3900	20.8	5870
	8B	2	2000	2200	17.9	3370
FM 347	9A	4	9100	10300	2.5	14730
	9B	4	7200	8300	2.6	15720
	9C	4	3900	4300	3.0	6410
	9D	2	950	1050	5.9	1470
SH 135	10A	4	4300	5200	2.9	7280
	10B	2	2200	2700	3.6	3780
US 69	11A	4	8600	9900	8.8	13860
	11B	4	7000	9200	9.1	12930
	11C	4	11800	11400	8.1	15960
	11D	4	16700	15000	11.2	21810
	11E	4	14000	14700	11.3	24400
	11F	4	9200	11300	12.8	15820

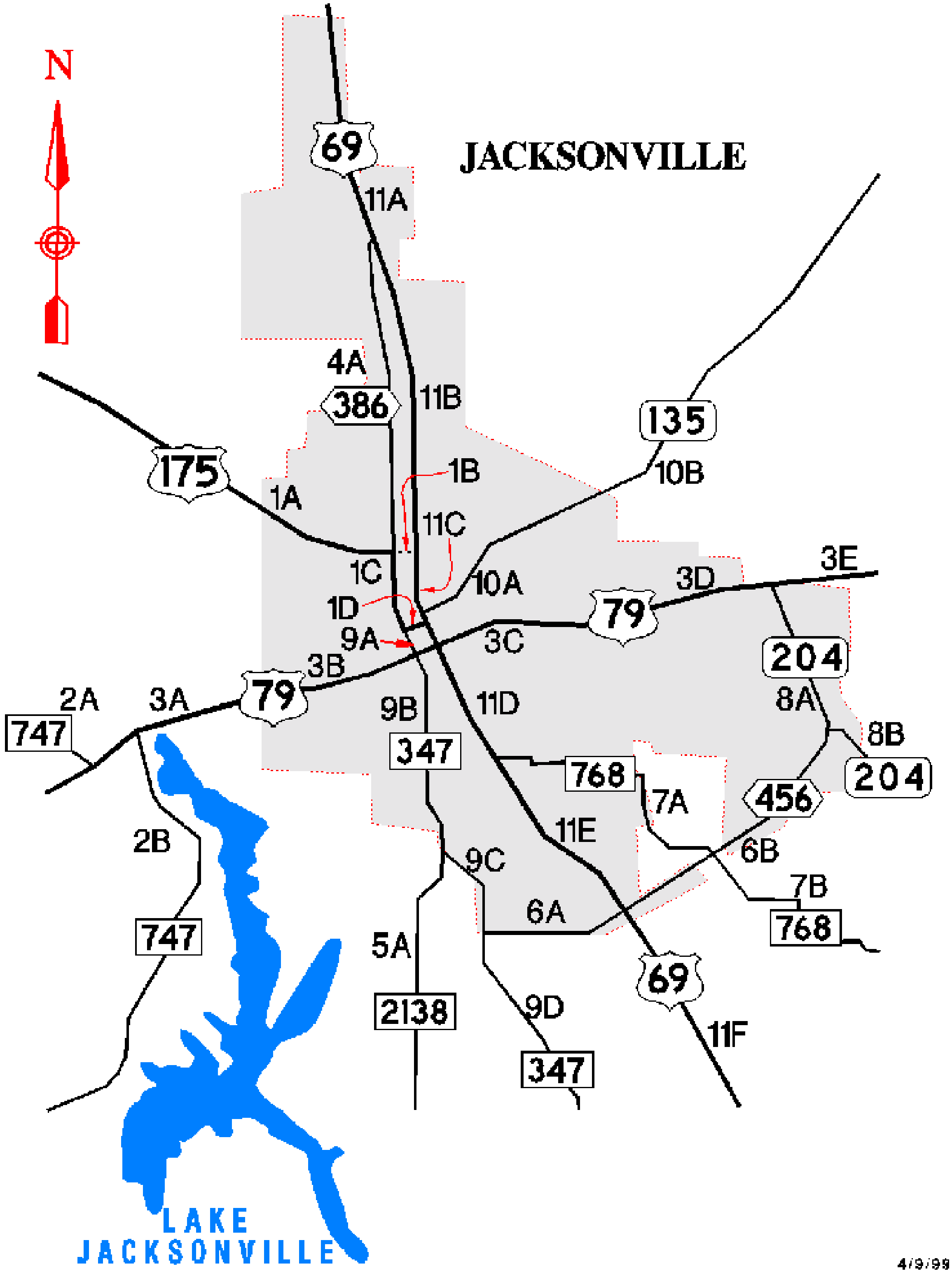

Figure A-1. Jacksonville Transportation Network