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16. Abstract

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The growing volume of trade between the United States and Mexico has, predictably, increased border traffic at U.S.-Mexico ports of entry. And passage of the proposed North American Free Trade Agreement—a trade pact that will eliminate tariffs and other trade barriers between the U.S., Canada, and Mexico—is expected to increase this traffic even more dramatically, generating in the process problems of congestion and infrastructure maintenance. Because such traffic is channeled through key gateway cities along the Texas-Mexico border, transportation planners in both the U.S. and Mexico have grown increasingly concerned about the impact this is having on border street and highway infrastructure.

This study examines the effects of the recent and projected growth of transborder truck traffic on the city of Laredo, a key gateway for U.S.-Mexico trade. It concludes that additional investments in city infrastructure are needed to manage truck and auto traffic, and that dedicated truck routes could be financed by raising bridge tolls to incorporate a user fee for their provision and maintenance. Additionally, traffic forecast models (which include rail) capable of encompassing the whole U.S.-Mexico border area must be developed to validate specific infrastructure investment decisions, from both a highway and multimodal planning perspective.

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TRANSBORDER TRAFFIC AND INFRASTRUCTURE IMPACTS ON THE CITY OF LAREDO, TEXAS

by

Claudia Said
Rob Harrison
W. R. Hudson

Research Report 1312-1

Truck Traffic in Laredo, Texas: A Case Study of Issues and Remedies
Research Project 7-1312

conducted for the

Texas Department of Transportation

by the

Center for Transportation Research
Bureau of Engineering Research
The University of Texas at Austin

November 1993

IMPLEMENTATION STATEMENT

By focusing on a key Texas border city, this study hopes to provide insight into the possible consequences of the North American Free Trade Agreement. Because this report represents an assessment of possible transportation implications for the city of Laredo, Texas, implementation of the findings is limited to whatever policy changes might derive from its recommendations.

Prepared in cooperation with the Texas Department of Transportation.

DISCLAIMERS

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SUMMARY

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CHAPTER 1. BACKGROUND AND SCOPE OF STUDY

The growing volume of U.S.-Mexico trade has generated, predictably, a significant rise in border traffic congestion. It is a problem certain to be compounded by the ratification of the proposed North American Free Trade Agreement, a trade pact currently being negotiated by the U.S., Canada, and Mexico. What transportation planners—particularly those in Texas—fear most about the trade agreement is that it will lead to unrestrained and damaging heavy-truck traffic. At risk, planners say, is, first, the border area's existing street and highway infrastructure, and, second, the state highway corridors that channel this traffic across Texas.

This study analyzes the impact of both recent and projected transborder truck traffic on the city of Laredo, a key site along the Texas-Mexico border and the main U.S. port of entry for U.S.-Mexico trade. In recent years, this city has experienced significant increases in both transborder traffic (particularly truck traffic) and trade-related services. Yet along with the economic benefits of high-volume truck traffic, the city has seen an increase in road wear, congestion, unsafe facilities, and pollution. Laredo has now to balance the immediate economic benefits of increased traffic with the longer-term environmental, social, and infrastructure costs.

Bridges I and II, located in downtown Laredo, and the recently completed Colombia Bridge, located approximately 20 miles (32.2 km) outside the city, are all poised to play key roles in the routing of transborder truck traffic. But while Colombia Bridge is expected to absorb an increasing share of overall border traffic, it will, as this report will suggest, continue to be under-utilized because of its remote location and inadequate connecting infrastructure. Therefore, the more heavily used downtown bridges, Bridges I and II, are expected to continue handling significant traffic volumes over the short term.

Transborder freight operations are also examined in this report. What we have found is that the efficient management of rising trade volumes depends on such factors as the adequacy of inspection facilities and the expediency of their operations. Whereas current regulations on transborder motor-carrier accessibility hinder efficient transborder crossing operations, the free trade agreement, proponents say, will ease transborder operations, though border inspections will still be required. (Crucial to this would be a reduction in the number of restrictive and expensive border transfer processes, particularly those related to brokers.) NAFTA provisions (including the opening of border states to foreign trucking 3 years after the execution of the agreement) might also reduce demand for traditional border port services (e.g., warehousing). However, these ports will still play a central role in crossings and in trade-related services.

In terms of narrative structure, this report is presented in eight chapters. In Chapter 2, we discuss Mexico's economic policies, U.S.-Mexico trade, and general provisions of the free trade agreement. We then describe, in Chapter 3, present Texas-Mexico border conditions, highlighting in particular the economic activity of the region, trade flows, environmental concerns, and the current state of the region's transportation infrastructure. Various elements that affect transborder traffic are described in Chapter 4, while Chapter 5 focuses on the city of Laredo and its transportation infrastructure. One element of Laredo's infrastructure that is particularly affected by rising truck traffic volumes is the city's network of truck routes. A more detailed analysis of the likely effects of rising truck traffic volumes on these routes—namely, maintenance and rehabilitation life-cycle costs—is presented in Chapter 6, along with specific cost-allocation mechanisms. Chapter 7 describes present efforts to improve the city's transportation infrastructure, while Chapter 8 presents the conclusions and recommendations of the study.

CHAPTER 2. U.S.-MEXICO TRADE AND THE NORTH AMERICAN FREE TRADE AGREEMENT

In recent years, Mexico's economic reforms, including the liberalization of its international trade policies, have resulted in more trade between the U.S. and Mexico. In many respects, the proposed North American Free Trade Agreement represents the culmination of this trend. This chapter briefly describes Mexico's economic policies, U.S.-Mexico trade, and the free trade agreement.

2.1 MEXICAN ECONOMY AND TRADE POLICIES

Mexico is presently the third largest U.S. trading partner, behind Canada and Japan. In 1991, bilateral trade between the U.S. and Mexico amounted to almost $65 billion, with Mexico accounting for about 7 percent of all U.S. exports and 6 percent of all U.S. imports. By contrast, almost 66 percent of all Mexican imports derive from the United States, with a comparable percentage of Mexican exports destined for U.S. markets.

While the economic relationship between the U.S. and Mexico has been developing over many decades, only recently has Mexico been able to boost dramatically its foreign trade and investment — a direct result of its economic restructuring and the liberalization of its trade policies. For example, from 1987 to 1991, total U.S.-Mexico trade increased by more than 87 percent, from $34 billion to $65 billion. This trend is expected to continue as the Mexican economy continues to prosper. Exports from the U.S. are now approximately $330 for each Mexican and $3,200 for each Canadian, an almost 10-to-1 ratio that is nearly equal to the ratio of yearly per capita gross domestic product in the two countries: $21,000 in Canada and $2,500 in Mexico (Ref 1).

Economic integration is expected to increase even more dramatically with the passage of the North American Free Trade Agreement (NAFTA), a trade pact that would gradually eliminate all tariffs on trade between the U.S., Canada, and Mexico. This agreement, which has been under negotiation since mid-1991, will purportedly enhance the flow of goods, services, and investment capital among the three countries, creating a free-trade zone of 360 million consumers and a combined annual economic output of more than $6 trillion.

2.1.1 Mexican Economy

In recent years Mexico has undertaken efforts to liberalize its economy by overturning decades of government intervention in the country's economic system. Post-war Mexican industry has, by and large, favored protectionism, demonstrating an unrestrained prejudice against imports and exercising discretionary control over direct foreign investment. These measures were intended to stimulate domestic production, using the Import Substituting Industrialization (ISI) program to increase the industrial independence of the country. Initially, this policy did in fact contribute to the growth of the manufacturing sector; but, as many Mexican economists concede, it also led to a decline in international competitiveness.

Between 1955 and 1970, Mexico's economy, bolstered by public infrastructure investment and low inflation worldwide, grew at a rate of 6.7 percent annually. The red ink created by Mexico's public finances, however, led to a loss of economic stability. While the model fell apart in 1976, the discovery of oil, along with an influx of foreign credit, enabled the country to recover (briefly) and to achieve sustained growth from 1978 to 1981. In 1981, when oil prices fell and international credit ran out, the economy collapsed again. By 1982, Mexico's foreign debt had reached almost $90 billion (Ref 3).

In 1983, the Mexican government, anxious to forge a more effective development strategy (and overcoming its apprehension regarding international trade), launched a series of radical economic reforms. Thus, a wide-ranging policy of import liberalization was announced in 1985, and in 1986, Mexico joined the GATT (General Agreement on Tariffs and Trade), the 109-member world trade body. As a result, Mexico reduced its import tariffs and eliminated most nontariff barriers. By the end of 1990, the average tariff on imports was reduced from almost 80 percent to 6 percent, with a trade-weighted average of 10.4 percent and a maximum of 20 percent. The number of items on the tariff list requiring import licenses was also reduced from almost 100 percent to less than 2 percent (bringing the number of items down to about 230). In other moves, official reference prices, which served as a barrier on imports by artificially inflating the prices of certain items for duty purposes, were eliminated in 1987. And restrictions to foreign investment, though still remaining, were also relaxed: Today, foreign companies can now, under certain conditions, wholly own manufacturing firms valued at $100 million or less; larger firms can also be owned by foreigners, but at the discretion of the Mexican government (Refs 4, 5, 6, 7).

Open trade policies have been consolidated and enhanced by the administration of Mexican President Carlos Salinas de Gortari, who began his 6-year term in 1988. In 1989, the government issued its "Plan Nacional de Desarrollo" (National Development Plan) for 1989-94. The main economic goals of the plan include attaining a GDP annual growth rate of 6 percent by 1994, and reducing inflation to levels similar to those of Mexico's main trading partners. To meet these goals, the Mexican government emphasized public and private investment — a position compatible with the government's actions regarding the privatization of state companies, the deregulation of industry in general (and of banking and transportation in particular), and the opening of the economy to foreign capital (Ref 6).

To date, Mexico's economic reforms have had exceptionally positive results. Inflation decreased from nearly 160 percent in 1988 to about 19 percent in 1991 and, finally, to last year's 1992 rate of 12 percent, the lowest rate in 20 years. During this same period, total foreign investment arriving in the country increased to $16.2 billion, 49 percent of which came from the U.S. The Gross National Product (GNP) increased by 4.4 percent in 1990 and by 3.6 percent in 1991 (Table 2.1), compared with 1.0 and -0.7, respectively, in the U.S. (Refs 7 and 8).

2.1.2 U.S.-Mexico Trade

Economic integration and trade between the U.S. and Mexico are greatly influenced by the economic conditions and regulatory frameworks of the two countries. During Mexico's economic crises in the early 1980s, trade volumes dropped substantially (U.S. exports especially). But with the recovery of the Mexican economy and the liberalization of its trade policies, bilateral trade has increased steadily.

Table 2.1 Mexico's GNP and consumer price index: 1977-1991 (Ref 9)

	YEAR														
	'77	**'78**	**'79**	**'80**	**'81**	**'82**	**'83**	**'84**	**'85**	**'86**	**'87**	**'88**	**'89**	**'90**	**'91**
GNP Growth (%)	3.4	8.2	9.2	8.3	8.8	-0.6	-4.2	3.6	2.6	-3.8	1.7	1.2	3.3	4.4	3.6
Consumer Price Index (%)	20.7	16.2	20.0	29.8	28.7	98.8	80.8	59.2	63.7	105.7	159.2	51.7	19.7	29.9	18.8

Trade between the U.S. and Mexico has not only increased in volume; it has also changed in its composition. For Mexican exports, the highest real growth before 1983 was in raw materials, whereas after 1983 it was in machinery and miscellaneous manufacturing. For U.S. exports to Mexico, machinery has always been the most important category. The center of Mexico-U.S. trade today lies in manufactured goods and machinery, with intermediate products becoming increasingly important (Tables 2.2 and 2.3).

Table 2.2 Percent of total U.S.-Mexico trade by commodity group (Ref 2)

	YEAR				
COMMODITY GROUP	**1986**	**1987**	**1988**	**1989**	**1990**
Food and Beverages	10.7%	9.2%	9.0%	9.3%	8.6%
Fuel and Raw Material	19.2%	17.2%	13.2%	13.9%	14.4%
Manufactured Goods	66.7%	69.5%	73.5%	71.5%	72.1%
Other	3.4%	4.1%	4.3%	5.3%	4.9%

Table 2.3 U.S.-Mexico leading trade commodities: 1989 (Ref 4)

U.S. EXPORTS	Total Trade ($ Billions)	MEXICAN EXPORTS	Total Trade ($ Billions)
Motor vehicle parts	2.0	Crude petroleum	4.0
Telecommunications equipment/parts	1.0	Electrical distribution equipment	1.5
Automobiles	1.2	Motor vehicle parts	1.1
Electrical switchgear apparatus	0.9	Telecommunications equipment/parts	1.0
Electrical distribution equipment	0.9	Electrical switch gear apparatus	0.9
Cathode tubes and valves	0.6	Internal combustion engines	0.8
Measurement and checking instruments	0.5	Radio receivers	0.7
Television receivers	0.9	Fresh and frozen vegetables	0.7
Internal combustion engines	0.5		
Automated data processing parts	0.5		
Base metal manufactures	0.5		
Corn	0.5		

According to some estimates, more than 50 percent of non-oil trade between the two countries involves U.S. corporations that have established production relationships with subsidiary firms in Mexico (Ref 3). Multinational corporations, including U.S. automakers, are attracted to Mexico for several reasons: Mexico has low tariffs for cross-border trade, low transportation costs, low labor costs, and a national market demanding products. The maquiladora industry, for instance, epitomizes U.S.-Mexico industrial integration.

Of the total 1989 U.S. exports to Mexico, about 40 percent originated from Texas, followed by California with almost 15 percent, and Michigan with about 5 percent (Ref 10). Texas exports include electronic equipment, industrial machinery, transportation equipment, and chemicals. The businesses that are in or connected to these commercial areas are well-positioned to substantially profit from the increased Mexican trade that will result from the passage of the North American Free Trade Agreement (Ref 4).

2.1.3 North American Free Trade Agreement and Trade Growth

In 1990, the governments of Mexico and the U.S. proposed that both countries participate in a formal free trade agreement. In 1991, Canada joined in the negotiations, expanding the trade pact into what would become known as the North American Free Trade Agreement (NAFTA). Official talks started in June of that same year, and in August of 1992 the agreement was announced by the three countries. The main points of the preliminary trade pact included the elimination of tariffs on all trade between the three countries within a 15-year period; the opening of Mexico's banking, insurance, and securities industries (as well as parts of its petroleum industry) to American and Canadian investment; the gradual removal of barriers to the provision of land transportation services between the NAFTA countries over a 10-year period; and the creation of trilateral panels to resolve commercial disputes regarding environmental standards, among other issues (Ref 11). To go into effect, the agreement must be approved by the legislatures of the three countries. Although the legislatures are controlled by the parties of the respective presidents in all three countries, only in Mexico is there expected to be little opposition. In Canada, the resignation of Prime Minister Mulroney has raised new concerns that the ratification of the agreement by Canada may be in jeopardy. And in the U.S., the Clinton Administration first adopted a tough negotiating stance to protect the environment and the rights of workers. Such a position had the effect, some analysts say, of weakening the prospects of the trade pact, permitting it, for example, to be entirely overshadowed by the Administration's health care proposals. Many now concede that the pact has been made vulnerable to Democrats from industrial districts, who fear further job losses to Mexican workers. In any event, the pact, if ratified in 1993 as planned, will not be fully implemented until 2009.

The potential effects of the North American Free Trade Agreement on the economies of the countries involved — and in particular on trade volumes between the U.S. and Mexico — have been hotly debated. According to a report by the U.S. International Trade Commission, a free trade agreement with Mexico will benefit the U.S. economy by expanding trade opportunities, lowering prices, increasing competition, and improving the ability of U.S. firms to exploit economies of scale. In the short term, however, the benefits may be few, since Mexico's economy pales in comparison with the U.S. economy, and because tariff and nontariff barriers between the two countries are already low (Ref 12).

Some analysts predict that U.S.-Mexico trade could reach over $200 billion by the year 2000, and $430 billion by the year 2010 (Ref 14). A recent University of Texas study concluded that — given different scenarios of GDP growth and price elasticities — a free trade agreement between the two countries could result, over a 5-year period, in an increase in U.S. exports of between 9 and 14 percent, and in Mexican exports of between 3 and 4 percent. Texas, which among U.S. states has the largest volume of trade with Mexico, is likely to benefit most from any form of free trade agreement. The University of Texas study further predicted that over the next 5 years Texas exports to Mexico could increase anywhere from 4 to 29 percent (Ref 4). According to a study by the Office of the Texas Comptroller, the 1990 level of total exports to Mexico could increase by more than 41 percent by 1995 and by nearly 74 percent by 2000. Exports of electronic equipment, industrial machinery, and motor vehicle parts, among other commodities, are expected to grow, while exports in industries such as agriculture, apparel, and primary metals are expected to decline (Ref 13). Mexican imports from Canada amounted to $2.6 billion in 1991, which represents about 1.5 percent of U.S.-Canada trade for that same year. However, under a free trade agreement, Canada-Mexico bilateral trade is expected to increase significantly from the current low base.

2.2 MAQUILADORA IMPACT

One of the more visible examples of U.S.-Mexico industrial integration is the maquiladora program. It has been estimated that in 1989, almost one-fourth, or $12 billion, of U.S.-Mexico trade occurred under the special tariff provisions applicable to this industry.

Maquiladoras, also known as “twin plants” or “in-bond companies,” are Mexican assembly or manufacturing plants that produce products mainly for export and which operate under special provisions of both Mexican and American law (Ref 15). Mexico allows duty-free imports of equipment for manufacturing and components for assembly in-bond, so long as at least 80 percent (or, under certain conditions, 50 percent) of the plant’s output is exported. Products assembled in Mexico are imported into the United States, with duties levied only on the value added in Mexico or, under other import incentive programs, with no duties. Maquiladoras may be 100-percent foreign owned and managed, and they can be located anywhere in Mexico (except Mexico City). However, most choose to locate along the U.S.-Mexico border in proximity to their major markets. The term “maquiladora” is usually applied in general to industrial operations in Mexico that import intermediate products and re-export the finished product with duty paid only on the Mexican value added element of the total product value. It is not always clear when an industrial plant is a maquiladora, since there are a wide variety of Mexican permits that apply to temporary importation.

Besides tariff provisions, Mexican maquiladoras offer the advantages of low Mexican wages (about a seventh to a tenth of U.S. wages), and lower transportation costs (as compared with Asian operations). Presently, 95 percent of maquiladoras are American owned (Ref 14).

2.2.1 Development of the Program

The maquiladora program was established in Mexico in 1965 as part of an effort to attract more U.S. companies to the border region (tariff provisions for foreign assembly plants had already been established in the U.S. in 1962). Initially, the growth of the maquiladora program was slow, mainly because Mexican wages were not competitive with such Pacific rim countries as Taiwan, South Korea, and Singapore. Following the devaluation of the peso in 1976, however, large automotive assembly plants began to move into Mexico, though extensive industrial expansion was checked by Mexican inflation and wage increases. When the peso was again devalued in 1982, the maquiladora industry received a much-needed boost. Starting with only a few assembly plants, the program grew to include more than 120 plants and 20,000 workers in

1970; in 1992 there were approximately 2,070 plants employing over 510,000 workers, with total plant value estimated at more than $4 billion (Figures 2.1 through 2.3).

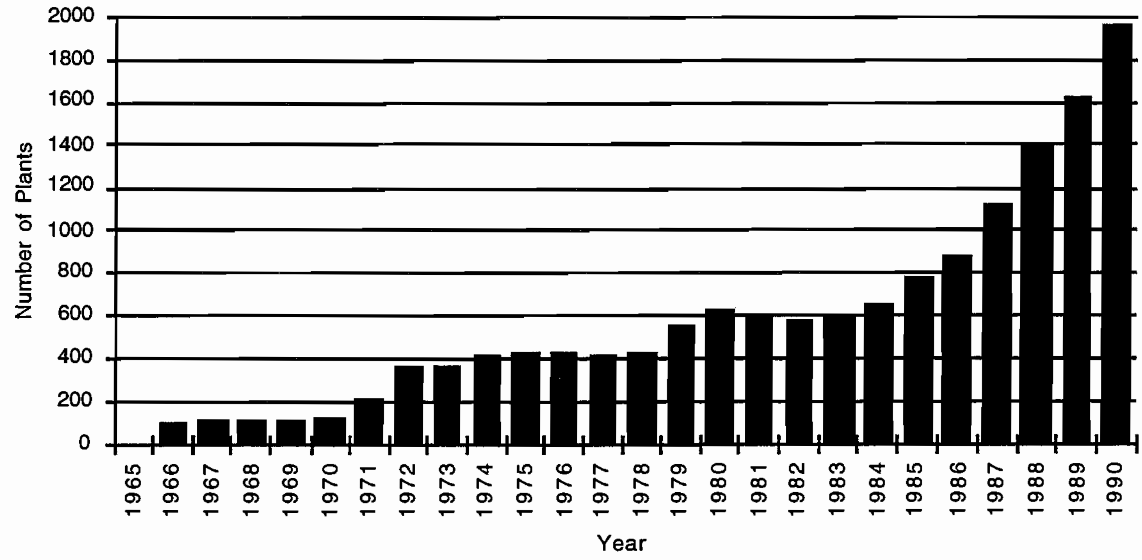


Figure 2.1 Total maquiladora plants in Mexico (Refs 9 and 14)

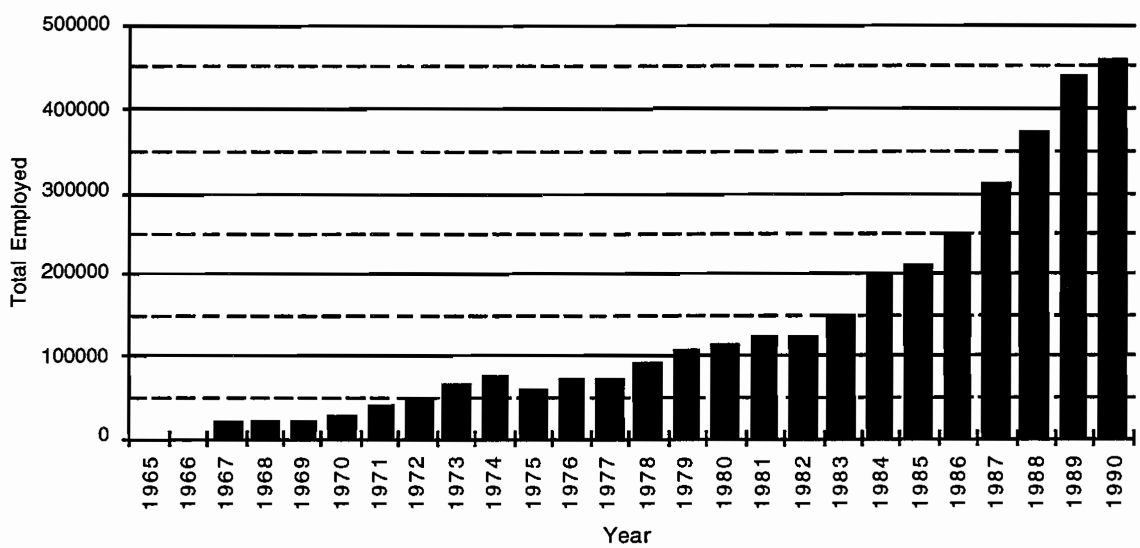


Figure 2.2 Maquiladora annual average employment (Refs 9 and 14)

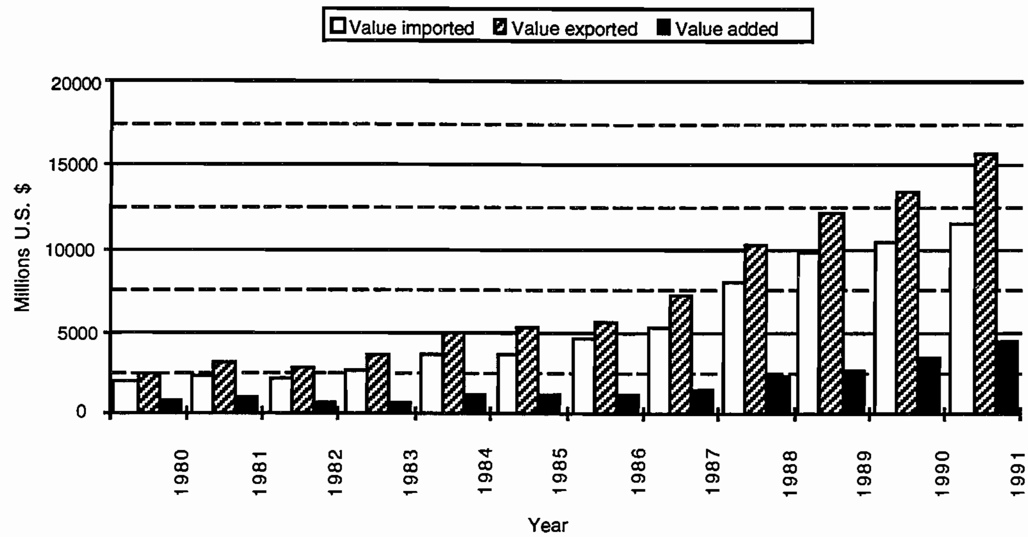


Figure 2.3 Values imported, exported, and added by the maquiladora industry (Refs 9 and 14)

The sectors with the largest participation in maquiladora operations are the automotive and electronic industries. Automobile-related maquiladoras are the most dynamic in terms of added value and employment generation. Transportation equipment in-bond plants grew from 7,500 workers and $62 million in value added in 1980, to nearly 88,000 workers and $725 million in value added by 1989 (Fig. 2.4).

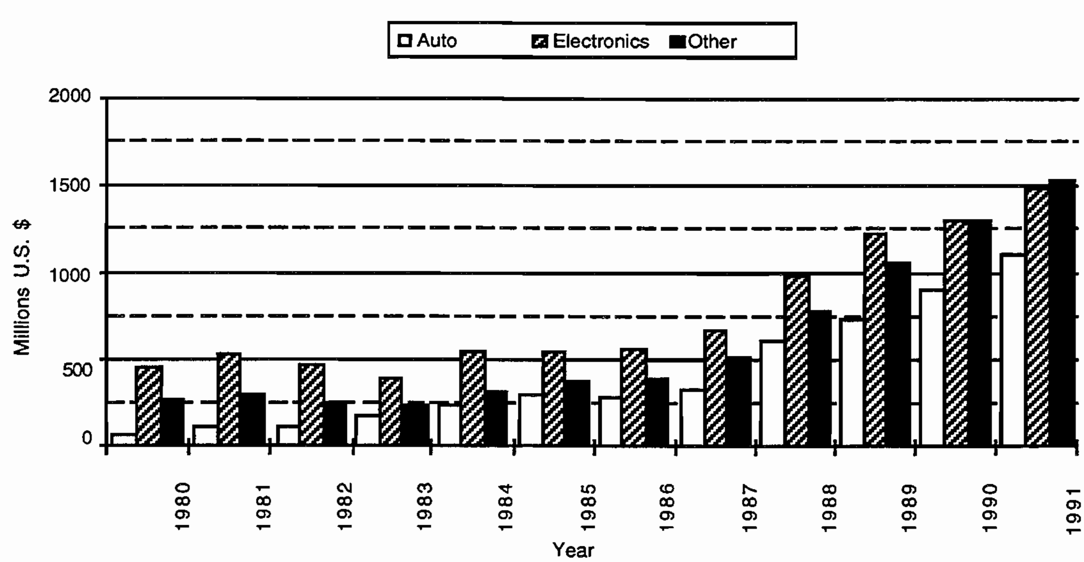


Figure 2.4 Value added by maquiladora industry group (Refs 9 and 14)

From the Mexican perspective, maquiladoras stimulate the economy by creating jobs. Their growth has been such that, today, maquiladora plants have replaced tourism as the second largest source of foreign currency (after oil exports) in Mexico. For the U.S., Mexican maquiladoras stimulate the border economy by creating jobs there as well (Ref 16). As the U.S. Department of Labor reported in 1988, if the U.S. eliminated the special tariff provisions of the maquiladora industry, the U.S. would lose about 76,000 jobs and $2.6 billion of its GNP (Ref 17).

Most maquiladoras in Mexico currently acquire the majority of their supplies from U.S. sources, with less than 2 percent purchased locally. The value of U.S. components used by maquiladoras increased from $1.1 billion in 1979 to $10 billion in 1990. More than 90 percent of maquiladora imports are raw materials. A survey regarding the purchasing patterns of 128 maquiladora factories adjacent to Laredo, Eagle Pass, and Del Rio, Texas, indicated that these plants purchase (a) raw materials primarily from non-border suppliers, (b) industrial supplies from border cities, and (c) services from the closest city. Large maquiladoras tend to buy the bulk of their raw material product inputs from parent firms, such as those located in the upper midwest in the case of the automotive industry (Ref 18). Texas provides about 15 percent of maquiladora supplies: In 1990, maquiladora supplies represented $1.5 billion, or about 12 percent of all Texas exports to Mexico (Ref 16).

2.2.2 Location of Maquiladora Plants—Possible Impacts of a Free Trade Agreement

Over 80 percent of Mexico's maquiladora plants are located in that country's northern border region, a strategy aimed at reducing transportation costs and avoiding distribution inconveniences. In the beginning of the program, maquiladoras tended to locate in Tijuana, near San Diego, California; however, land costs and a shortage of labor prompted a relocation to the Texas border area.

Maquiladoras have also been moving their operations to the interior of Mexico, particularly after the Mexican government began allowing them to sell a higher percentage of their production in the local market. The Mexican interior offers the advantage of a more stable and better educated labor force, superior infrastructure, and a stronger local supplier base. For example, the components of maquiladoras located in the Monterrey area are about 20 percent locally made, compared with the almost 5 percent locally made components of maquiladoras in other parts of the country (Ref 19).

Under a free trade agreement, the maquiladoras would become indistinguishable from other Mexican production facilities. To maquiladora operations, a free trade agreement would provide little additional duty reductions (Ref 20). Some speculate that border maquiladoras would move to the interior of Mexico, while others suggest that the costs associated with moving to the interior of Mexico would make this alternative unattractive. A University of Texas study involving 39 border maquiladora plant managers in Texas and their plans under a free trade agreement found that none of the respondents considered relocating their plants, and that a slight majority would continue to purchase most of their raw materials from U.S. firms. Among their reasons for not relocating were the proximity to U.S. materials and market, low transportation cost, U.S. infrastructure, and the opportunity to live in the U.S. (Ref 4). It has also been projected that under a free trade environment, U.S.-owned maquiladoras will convert into regular foreign investment manufacturing firms, will probably consume more supplies, and will sell more products in Mexico—a move that would allow them to become better integrated with the Mexican economy (Ref 16).

The increase in U.S.-Mexico trade is expected to continue, given Mexico's economic environment, the prospects of a North American Free Trade Agreement, and the continued growth of maquiladoras and other industrial linkages. Thus, the adequacy of the Texas-Mexico border region's infrastructure, which is examined in the next chapter, is a critical factor certain to either impede or support further growth in trade.

CHAPTER 3. THE TEXAS-MEXICO BORDER

The border between the United States and Mexico extends over 2,000 miles (3,220 km), from the Pacific Ocean in the west, to the Gulf of Mexico in the east. The Texas-Mexico border, defined precisely by the Rio Grande, accounts for slightly over half this distance, stretching for more than 1,250 miles (2,012 km) from Brownsville to El Paso (Fig. 3.1). Concerned that recent increases in U.S.-Mexico trade and transborder traffic will tax the existing border resources (particularly in Texas), policymakers from both the United States and Mexico have begun evaluating projected traffic flows and the requirements of the industrial and social communities certain to develop in the area. In examining these issues, this chapter describes the Texas-Mexico border region's economy, environment, and transportation infrastructure.

3.1 TEXAS-MEXICO BORDER ECONOMY

The Texas-Mexico border trading region comprises areas well beyond either side of the border. Accordingly, the area whose "economic and social life is directly and significantly affected by proximity to the international boundary" (Ref 21) may extend from south of Monterrey, one of Mexico's main industrial centers, to north of San Antonio. In the last decade, the maquiladora-driven economy of northern Mexico has generated a demand for retailing and service industries on the U.S. side of the border, the result of which has been more opportunity for workers in both countries.

About 85 percent of the border population and most of the border's economic activity are concentrated in metropolitan areas serving also as international ports of entry. From 1980 to 1990, the population of the major border metropolitan areas grew from about 2.4 million to 3.1 million (Table 3.1).

Yet despite the increase in employment opportunities, border wages have not achieved parity. Thus, average wages for Texas border counties, for 1988, were about $7.00 an hour for a 40 hour week, well below the state average of $10.00 an hour. The average wage of maquiladora operators was, in 1988, $1.12 and $1.81, with and without fringe benefits, respectively (Ref 22). (More current investigations, however, suggest that the competition for labor has driven the maquiladora labor costs up substantially since then.

In 1992, we were informed that rates were now in the $2.50 to $3.00 per hour range, but that this was undocumented and, consequently, not available for reference. We will have to wait until current wage studies — now underway as part of the U.S.-Mexico trade debate — report their findings.)

The economy of the border region is based primarily on trade, manufacturing, and agriculture, with the manufacturing sector driven mainly by the maquiladora industry. Texas-Mexico border maquiladoras exported in 1990 almost $8 billion, or about 65 percent of the total exports of the maquiladora industry (Table 3.2).

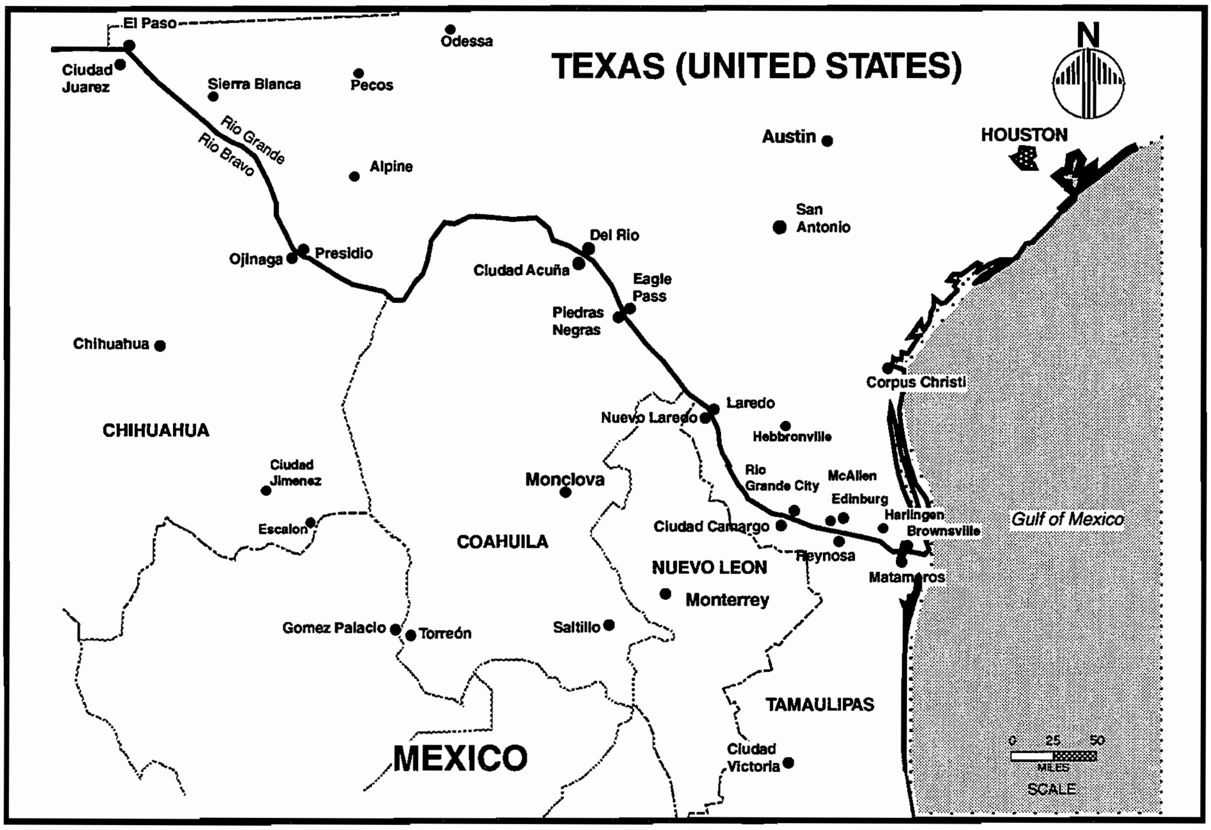


Figure 3.1 Texas-Mexico border (Note: 1 mile=1.61 km)

Table 3.1 Population of selected metropolitan areas in the U.S. and in Mexico, 1980 and 1990, and percent change (Ref 23)

US METROPOLITAN AREA / MEXICAN MUNICIPIO	1980	1990	% INCREASE
Las Cruces, NM / El Paso, TX	580,590	737,830	27.1 %
Juarez	591,000	727,679	23.1 %
Laredo, TX	100,290	132,190	31.8 %
Nuevo Laredo	203,286	217,912	7.2 %
Mc Allen-Edinburg-Mission, TX	286,460	416,660	45.5 %
Reynosa	220,000	281,618	28.0 %
Brownsville-Harlingen, TX	211,780	281,210	32.8 %
Matamoros	249,000	303,392	21.8 %
Total	2,442,406	3,098,491	27.0 %

Table 3.2 Texas border maquiladoras in Mexico (Ref 24)

	NUMBER OF MAQUILADORA PLANTS		TOTAL PERSONS EMPLOYED		TOTAL EXPORT VALUE (Mill. U.S. $)	
	1989	**1990**	**1989**	**1990**	**1989**	**1990**
TEXAS-MEXICO BORDER TOTAL	687	830	278,666	298,684	5,964.3	7,915.0
MEXICO TOTAL	1,642	1,939	429,058	461,569	9,390.3	12,262.7
PERCENT SHARE	41.8 %	42.8 %	64.9 %	64.7 %	63.5 %	64.6 %

Maquiladoras also generate employment and income on the U.S. side of the border. In the 1970s, it was estimated that as much as 60 to 75 percent of the income earned by maquiladora workers was spent in the U.S. (Ref 15). In the city of Laredo, while the median household purchasing power in 1989 was $13,900, per-house retail spending was about $34,000, one of the highest in Texas (Ref 23). The retail sector, very important in terms of tax revenues for U.S. border cities, also benefits from Mexican tourism. Sales by industry are shown in Table 3.3.

Table 3.3 1990 sales by industry in Texas border cities (Ref 24)

Industry Class	**BROWNS-VILLE**	**DEL RIO**	**EAGLE PASS**	**EL PASO**	**LAREDO**	**Mc ALLEN**
Agriculture/ Forestry	3,073,819	88,525	n.a.	11,645,736	804,199	4,197,995
Mining	n.a.	n.a.	n.a.	n.a.	1,416,450	0
Construction	10,781,549	4,804,818	929,082	283,785,112	29,931,284	40,869,974
Manufacturing	1,087,164,047	11,794,803	4,496,087	1,161,696,044	78,564,124	271,940,912
Transportation/ Utilities	67,358,527	12,809,307	n.a.	404,062,218	23,865,415	13,286,766
Total Wholesale	286,036,671	24,793,545	32,961,946	2,203,659,855	484,529,525	664,865,288
Total Retail	805,658,216	197,212,997	209,641,048	3,578,028,058	1,488,154,685	1,321,699,701
Financial Services	4,498,600	123,488	n.a.	11,068,074	1,460,498	4,695,081
Services	57,389,508	13,528,897	9,243,453	633,443,107	114,397,271	90,592,364
Nonclassifiable	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
TOTALS	**2,321,960,937**	**264,281,607**	**254,715,619**	**8,287,631,300**	**2,223,123,451**	**2,412,148,081**

In addition, agriculture continues to be an important part of the U.S. border economy (though overall to a lesser degree than manufacturing and trade). As a principal source of income in the lower Rio Grande Valley, agriculture accounts for a significant share of employment in those counties having no major ports of entry (Ref 22).

3.2 TRADE FLOWS

The most significant component of Texas-Mexico border activity is international trade. Over 60 percent of all U.S. exports to Mexico and about 50 percent of all Mexican imports are moved through Texas ports. Within Texas, south Texas gateways, led by the port of Laredo-Nuevo Laredo, eclipse all other Texas ports in value of products imported and exported (Table 3.4). The customs district of Laredo accounted for about 54 percent of the bilateral trade moved across the U.S.-Mexico border in 1990. Approximately 50 percent of the bilateral trade of the Laredo customs district originated from the port of Laredo. West Texas ports account for the largest volume of maquiladora imports and exports, though South Texas ports also have a significant share, especially in automotive-related maquiladora trade. The main commodities of imports and exports are shown in Tables 3.5 and 3.6. Those items that appear as both import and export commodities are related mainly to maquiladora products.

Table 3.4 U.S.-Mexico border customs districts bilateral trade: 1990 (Ref 25)

U.S. Customs District	1990 Total Bilateral Trade (Bill. $US)	Largest Port of Entry
Laredo	25.5	Laredo / Nuevo Laredo
El Paso	9.1	El Paso / Ciudad Juárez
San Diego	7.1	Otay Mesa / Mesa de Otay
Nogales	5.2	Nogales / Nogales

3.3 ENVIRONMENTAL AND INFRASTRUCTURE CONCERNS IN THE U.S.-MEXICO BORDER REGION

Population and industrial growth in the U.S.-Mexico border region have placed greater demands on its land, air, and water resources. Local communities on both sides of the border have long suffered shortages and deficiencies in housing, drinking water, waste-water treatment facilities, road paving, hazardous waste disposal, pollution control, and public services in general. It is generally agreed that failure to address these problems could jeopardize the region's ability to take full advantage of increased trade, and that the potential growth resulting from such trade may strain an already inadequate infrastructure (a situation that would, in turn, contribute to environmental deterioration).

Table 3.5 Imports from Mexico through Texas-Mexico border ports: 1990 (Ref 24)

LAREDO CUSTOMS DISTRICT	
COMMODITY	**Millions US $**
Motor cars & vehicles for transporting persons	1,070
Parts and accessories for motor vehicles	877
Insulated wire, cable, etc.; opt. sheath fib. cables	466
Coffee; coffee husks, etc.; substitutes with coffee	290
Spark-ignition recip or rotary int. comb. piston eng.	266
Motor vehicles for transport. of goods	230
Exports of repaired imports, Impts. of retd. expts.	221
Automatic data process. machines and magn. readers	203
Electr. apparatus for switching or protecting circ.	203
Television receivers (incl. monitors & proj.)	200
Bovine animals, live	193
Other	5,762
Total	**9,981**
EL PASO CUSTOMS DISTRICT	
COMMODITY	**Millions US $**
Insulated wire, cable, etc.; opt. sheath fib. cables	779
Parts for television, radio and radar apparatus	357
Expts. of repaired impts.; impts of returned expts.	350
Seats (mainly car seats) and parts	254
Electrical apparatus for switching or protecting circ.	249
Electric transformers, static converters and induct. pts.	178
Television receivers (incl. monitors and proj.)	178
Bovine animals, live	151
Electric motors and generators	119
Garments of felt and other impregnated fabric	110
Automatic data process. machines, magn. radar, etc.	97
Other	2,236
Total	**5,058**

NOTE: The customs district of El Paso includes El Paso, Ysleta, Presidio, Fabens, Columbus (NM), Albuquerque (NM), and Santa Teresa Airport (NM). The customs district of Laredo includes Del Rio, Eagle Pass, Laredo, Hidalgo, Rio Grande City, Progresso, Roma, and Brownsville.

Table 3.6 Exports to Mexico through Texas-Mexico border ports: 1990 (Ref 24)

COMMODITY	**Millions US $**
Parts and accessories for tractors, motor vehicles, special purpose, n.e.s.	2,288
Parts and accessories for telecommunications, etc.	665
Insulated wire, cable; optical fiber cables	631
Parts for internal combustion piston engines, n.e.s.	290
Parts of electrical apparatus for switch, protect., control electr.	243
Automatic regulating controlling instruments and apparatuses	165
Parts & accessories for office machines, n.e.s. and data proc. machines	144
Seats and parts	125
Motor vehicles for the transportation of persons, n.e.s.	120
Polymers of propylene or other olefins, primary forms	104
Other	11,481
Total	**16,256**

Of special concern to border communities are toxic spills, the possibility of which is heightened by the large volumes of chemicals transported across the border to be used by local industries, particularly the maquiladoras. There are few shipping routes for hazardous materials, and some of the older international bridges cannot safely handle the weight of large chemical tank trucks (Ref 26). Another concern is hazardous waste, both that generated by maquiladoras, which the law requires be exported, as well as the hazardous waste illegally shipped to Mexico from the U.S. In a survey of maquiladoras, a quarter of the respondents cited lax Mexican enforcement of environmental regulations as a factor in their decision to relocate to the border (Ref 3).

Air pollution generated by industries, vehicles, and over-population is also a growing problem in the borderlands. Major problem areas include El Paso (whose pollution problem ranks second in Texas, after Houston) and, to a lesser extent, Brownsville and Eagle Pass, where suspended particulates are the primary problem. In El Paso, industrial pollution is exacerbated by adverse topography and climatic conditions. One problem unique to border cities is that of emissions from vehicles as they wait to be cleared by Customs at international crossings. Another air pollution problem just beginning to be recognized is that of abandoned waste disposal sites and industrial facilities. Finally, international border areas often have masses of contaminated air moving between the two countries, making enforcement of air pollution regulations extremely difficult (Ref 27).

U.S.-Mexico border environmental policies are determined by U.S., Mexican, and international regulations. Mexico promulgated its General Law for Ecological Equilibrium and Environmental Protection in 1988, which revised previous laws and which was intended to enforce standards as strict as those of the United States or European countries. However, shortages of funds and lack of environmental support services hinder effective enforcement. In addition, Mexico is attempting to accomplish in a very short time what has evolved in other countries over many years (Ref 27).

Transboundary pollution was first formally addressed by the 1983 Comprehensive Border Pollution Accord, and later by the 1991 Binational Border Management Plan. Criticisms by border communities to this last plan resulted in a vastly changed version: the February 1992 Integrated Environmental Plan for the Mexican-U.S. Border Area, prepared by the U.S. Environmental Protection Agency and the Mexican Secretaría de Desarrollo Urbano y Ecología (SEDUE), now known as Secretaría de Desarrollo Social (SEDESOL). This plan is not intended to supersede regulations in either country, but is designed to coordinate the activities of the governments and private sector companies on both sides of the border in order to solve mutual problems (Ref 28). The development of this plan coincided with NAFTA negotiations and is part of the U.S. "parallel track" approach in addressing environmental concerns that arise from increasing commercial activity between the two countries. The free trade agreement affirms the right of each country to choose the level of environmental protection that it considers necessary. The February 1992 plan focused particularly on the need for waste-water treatment systems, with air pollution and municipal solid waste problems also given priority. Multi-media industrial source controls are to be initiated through a collection of data concerning toxins released from industrial facilities. The plan also briefly addresses infrastructure needs in a section on bridges and border crossings (Ref 26).

3.4 GENERAL DESCRIPTION OF TEXAS-MEXICO BORDER CROSSINGS AND TRANSPORTATION INFRASTRUCTURE

The increase in transborder traffic resulting from the U.S.-Mexico trade boom has prompted several U.S. agencies to question the adequacy of the existing border transportation infrastructure, in particular highways and bridges (Refs 25, 29, 30). In Texas, where the majority of U.S. border crossings into Mexico are located, it has been estimated that meeting current capacity needs alone will require at least a $2-billion investment in highways and border crossings (Ref 25).

3.4.1 Texas-Mexico Border Crossings

In Texas, there are currently 23 motor vehicle crossings into Mexico, most of which are bridges spanning the Rio Grande. Table 3.7 gives a list and brief description of these crossings, together with 24-hour traffic counts (Ref 31).

There are also a number of proposed projects for new bridge crossings in different stages of development. For border communities, and especially for those with high volumes of vehicle crossings, new bridge and the connecting highway infrastructure not only help alleviate traffic congestion; they also attract tourism and trade, which boosts the local economy through retail sales and through bridge toll revenues. The potential for additional bridge sites is currently being examined by a group at the Center for Transportation Research at The University of Texas (Ref 32), with findings expected to be published by the end of 1993.

Although any border community can put in a request for construction of a new bridge, the process of having a project approved and funded by the federal governments of both countries is not simple. In the U.S., the State Department issues bridge permits and acts as a liaison between both federal governments. It also coordinates the Interagency Committee on Bridges and Border Crossings that meets with its Mexican counterpart on a regular basis to discuss issues related to border crossings (Ref 25).

Funding on the U.S. side is usually provided by the local community itself. State and local governments generally provide the connecting highway infrastructure, while federal agencies provide the necessary inspecting facilities. In recent years, Mexican states have been given more autonomy regarding bridge projects, and sources of private investment have been allowed to participate in the funding and operation of these projects — both of which will likely expedite the completion of new border crossing projects.

Table 3.7 Texas-Mexico border crossings (Refs 31, 33, 34)

NAME	LOCATION U.S.-Mexico	DESCRIPTION	24-HOUR TRAFFIC COUNTS[1]			
			Pedestr.	Total Vehicles	Total Trucks	% Trucks
Gateway Bridge	Brownsville-Matamoros	There are two bridges at this crossing: one with two lanes for inbound traffic, and one with two lanes for outbound traffic. Bridge owner: Cameron County. Toll facility.	30,166	15,228	208	1.4
B&M Bridge	Brownsville-Matamoros	This bridge is actually a railroad bridge that allows only one lane of traffic in each direction. Privately owned (B&M Bridge Co. and GOM). Toll facility.	1,452	8,281	46	0.6
Free Trade Bridge	Los Indios-Lucio Blanco	Four-lane bridge opened in Nov. 1992; Owner: Harlingen, San Benito, and Cameron County (U.S.). GOM toll facility.	NA	NA	NA	NA
B&P Bridge	Progreso-Nuevo Progreso	Two-lane bridge. Privately owned (B&P Bridge Co. and GOM). Toll facility.	8,632	4,352	254	5.8
Hidalgo-Reynosa	Hidalgo-Reynosa	Two four-lane bridges with one-way traffic on each. They connect the McAllen-Edinburgh urbanized area with Reynosa. Owner: City of McAllen and GOM. Toll facility.	8,778	23,545	864	3.7
Los Ebanos Ferry	Los Ebanos-S.M.Camargo	This is a hand-pulled ferry. Privately owned toll ferry.	507	216	•	•

[1] Traffic counts correspond to a 24-hour weekday period, inbound and outbound trips, 1991 data. Not adjusted for seasonal or weekend variation.

GOM: Government of Mexico. IBWC: International Boundary and Water Commission.

Table 3.7 Continued

NAME	LOCATION U.S.-Mexico	DESCRIPTION		24-HOUR TRAFFIC COUNTS		
			Pedestr.	**Total Vehicles**	**Total Trucks**	**% Trucks**
Lake Falcon Dam	Lake Falcon-Nuevo Guerrero	This is a road built on top of Falcon Dam, which is owned by the two countries. Not a toll facility.	0	616	16	2.6
Lincoln-Juarez	Laredo-Nuevo Laredo	Also referred to as Bridge II. Seven-lane bridge. Owner: City of Laredo and GOM. Toll facility.	•	24,150	2,262	9.4
Convent Street Br.	Laredo-Nuevo Laredo	Also referred to as Bridge I. Four-lane bridge. Owner: City of Laredo and GOM. Toll facility.	27,355	14,645	1,864	12.7
Solidarity Bridge	Laredo-Colombia	Also known as Colombia Bridge. Eight-lane bridge. Owner: Laredo and GOM. Toll facility.	NA	NA	NA	NA
Eagle Pass-Piedras Negras	Eagle Pass-Piedras Negras	Two-lane bridge. Owner: City of Eagle Pass and GOM. Toll facility.	4,557	13,957	398	2.9
Del Rio Bridge	Del Rio-Ciudad Acuña	Four-lane bridge. Owner: City of Del Rio and GOM. Toll facility.	557	6,615	305	4.6
Lake Amistad Dam	Lake Amistad-Ciudad Acuña	Two-lane road built on top of Lake Amistad Dam. This is not a toll facility. Owner: U.S. and GOM.	0	164	3	1.8
La Linda (Big Bend) Br.	Brewster County	This is a small facility with little traffic. Privately owned. This is not a toll facility.	12	49	na	na
Presidio Br.	Presidio-Ojinaga	Two-lane bridge. Owner: State of Texas and GOM. Toll facility.	125	2,350	42	1.8
Fort Hancock- El Porvenir Br.	Fort Hancock-El Porvenir	Two-lane, light-duty bridge with very little traffic. This is not a toll facility. Owner: IBWC.	15	511	3	0.6
Fabens-Caseta Br.	Fabens-Caseta	Two-lane bridge. This is not a toll facility. Owner: IBWC.	131	1,924	13	0.7
Ysleta-Zaragosa Bridge	Ysleta-Zaragosa	Two four-lane bridges, one for commercial traffic and one for non-commercial traffic. Owner: City of El Paso and GOM. Toll facility.	1,282	9,036	190	2.1
Bridge of the Americas	El Paso-Ciudad Juarez	Eight-lane bridge, also known as the Cordova Bridge. Owner: IBWC. Free facility.	3,629	41,983	2,559	6.1
Good Neighbor Br.	El Paso-Ciudad Juarez	Three-lane bridge for southbound traffic into Mexico only. Also known as the "Friendship Bridge." Owner: El Paso and GOM. Toll facility.	4,451	5,527	105	1.9
Paso del Norte Bridge	El Paso-Ciudad Juarez	Four-lane bridge for non-commercial traffic traveling north into the U.S. Owner: El Paso and GOM. Toll facility.	20,543	11,625	50	0.4

Table 3.8 lists approximate preliminary costs of some of the bridge crossing projects under development, ranging from the preliminary to the construction phase.

Table 3.8 Proposed Texas-Mexico bridge crossings (Ref 25)

Proposed Bridge	**Estimated cost for bridge**	**Additional estimated cost for roadways**
Port of Brownsville-Matamoros (vehicular/railroad) Bridge	$9,000,000	$3,000,000
Brownsville-Matamoros III (Los Tomates) Bridge	8,000,000	0
Pharr-Reynosa Bridge	10,000,000	21,000,000
Los Ebanos-Diaz Ordaz Bridge	760,000	0
Laredo-Nuevo Laredo III Bridge	4,100,000	2,000,000
Eagle Pass-Piedras Negras II Bridge	3,560,000	0
Bridge of the Americas (rehabilitation)	4,000,000	0
Total	**$39,420,000**	**$26,000,000**

Note: Other proposed bridges include Donna-Rio Bravo, Hidalgo-Reynosa, Mission-Reynosa, and Socorro-Zaragosa. Costs for bridge construction are for the U.S. side of the border only.

3.4.2 Texas Border Highway Infrastructure

Of the approximately $48 billion in U.S.-Mexico trade for 1990, over 70 percent moved through Texas ports of entry (Ref 30). Most of this trade was conveyed by ground transportation, which includes truck and rail. Highway infrastructure therefore plays an important role in ground transportation efficiency. Figure 3.2 shows the main U.S. and Interstate highways on the Texas-Mexico border. A major north-south corridor into Mexico is provided by IH-35, which reaches the northeast and central regions of the U.S. (e.g., New York and Chicago) as well as Canada, areas which are major providers of the maquiladoras' raw materials. IH-10 is an important route for trucks from the northwest and west regions, and for cargo coming from ports in the Pacific (Los Angeles, Long Beach) and also from the southeast. This is also the most convenient corridor for cargo moving from the Pacific to eastern Mexico, a route made difficult by the lack of infrastructure and by the mountain topography on the Mexican side. The three main north-south corridors that connect the Mexican border and Monterrey, and, further south, Saltillo and Mexico City, are also shown in Figure 3.2.

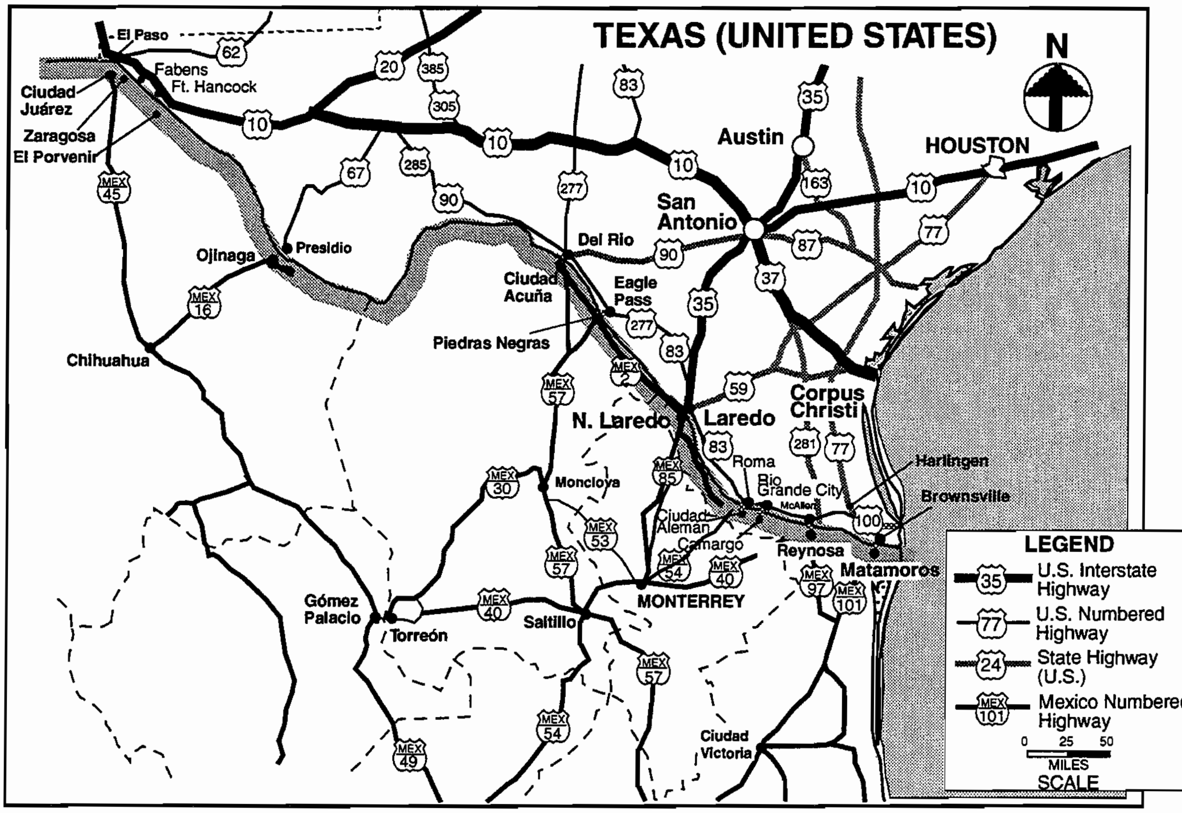


Figure 3.2 Texas-Mexico border highway infrastructure (Note: 1 mile=1.61 km)

According to a 1991 study conducted by the Texas Department of Transportation (TxDOT) for the U.S. General Accounting Office, the highways on the Texas border with Mexico cannot accommodate current traffic levels (Ref 29). The cost of upgrading these highways to meet present-day traffic levels has been estimated at almost $850 million, while the costs associated with the Texas Highway Trunk System were estimated at about $1.2 billion. The Texas Highway Trunk System is a 30-year planned four-lane divided highway network that will provide direct access to every Texas city with a population over 20,000, and which will also connect with major ports of entry in Texas and ports in adjacent U.S. states and Mexico. This same TxDOT study estimated additional highway needs for meeting the traffic increases that will result from a free trade agreement with Mexico (Table 3.9). These estimates, derived from different scenarios of trade growth resulting from NAFTA, include only upgrades of the previously mentioned projects. With the exception of a few cases in which added capacity is considered, the increase in project cost is linked to the need for more pavement structures to support the expected increase in truck traffic. The study assumes that overloads from Mexico are not allowed in the system, which is a central concern given the flagrant abuse of load limits by many Mexican truckers. According to these estimates, a 100-percent increase in trade, within a

10-year timeframe, results in about a 6 percent rise in the cost of highway projects if compared with the costs necessary to meet current needs. A comparison of the estimates from Tables 3.8 and 3.9 shows that bridge construction costs represent less than 8 percent of additional pavement structure needs under these assumptions.

Table 3.9 Estimated border highway infrastructure needs (Ref 25)

Area	**Number of Projects**	**Current Costs**	**Costs at four levels of trade increase (percent) within a 10-year frame (millions U.S. $)**			
			10	**25**	**50**	**100**
El Paso	12	$513	$517	$522	$527	$538
Del Rio	1	9	9	9	9	9
Laredo	6	127	127	129	133	135
Rio Grande Valley	25	94	95	96	97	101
U.S. 281	9	106	107	108	110	113
Subtotal	53	848	855	864	876	897
Trunk System	26	1,180	1,192	1,207	1,224	1,256
Total	**79**	**$ 2,028**	**$ 2,047**	**$ 2,071**	**$ 2,100**	**$ 2,153**

Note: Current costs are based on 1990 traffic levels. Estimated cost increases were projected to the year 2000 for each of the four scenarios. These numbers are non-additive.

3.4.3 Texas Border Railway Infrastructure

Of the six Class 1 railroad companies operating in Texas, three provide international rail crossings into Mexico: Southern Pacific (SP), Union Pacific (UP), and Atchinson Topeka & Santa Fe (ATSF). There are five crossing points into Mexico, which are shown in Figure 3.3. In Mexico, railway services are provided by Ferrocarriles Nacionales de México. The main port for rail crossings on the U.S.-Mexico border is Laredo/Nuevo Laredo, with a 53 percent share, approximately, of total car crossings in 1989 (Ref 34).

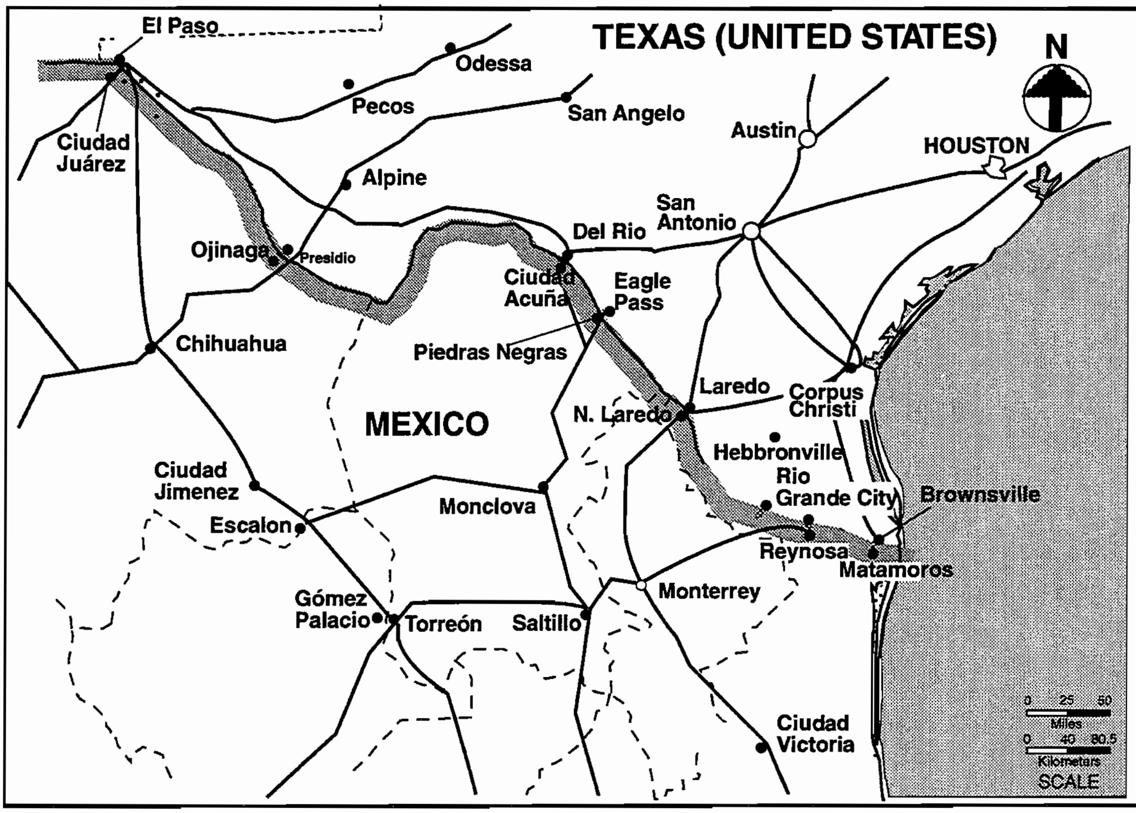


Figure 3.3 Texas-Mexico border railway infrastructure

As part of the trend toward an increased use of intermodal operations in overland transportation, two intermodal ramps have recently begun operating on the Texas-Mexico border. Southern Pacific operates an intermodal facility in El Paso, and Union Pacific operates another in Laredo. Southern Pacific offers double-stack container service from Los Angeles to Mexico City, while Union Pacific provides the same service between Chicago and Mexico City.

In general, transportation analysts concede that investment in infrastructure along the U.S. side of the Texas-Mexico border has not kept pace with that region's growth in population, industry, and trade. Although the subject will be more completely addressed in the second report from this study, the same can be said of the Mexican side of the border. Transportation infrastructure requirements with respect to projected traffic growth rates should be investigated further (using more accurate traffic forecasts). Other elements affecting the efficiency of transborder movements under present and projected conditions, such as border inspection operations and the transportation regulations of each country, are described in the next chapter.

CHAPTER 4. BORDER TRANSPORTATION ISSUES

The transborder traffic of the United States and Mexico is heavily influenced by the regulatory environment of both countries. As indicated in this chapter, international border inspection procedures, particularly as they relate to motor carrier and rail operations, determine the efficiency of crossborder transports.

4.1 CUSTOMS PROCEDURES

Border inspection operations have a direct bearing on the flow of traffic across the U.S.-Mexico border. The efficiency of these operations, in turn, depends not only on the adequacy of inspection facilities, but also on the staffing of these facilities, on the degree of simplicity and automation of the processing and clearing procedures, and on U.S. interagency and U.S.-Mexico coordination. The three main U.S. federal agencies in charge of the inspection and clearance of traffic crossing the border are the U.S. Customs Service, the Immigration and Naturalization Service (INS), and the U.S. Department of Agriculture, which is represented by the Animal and Plant Health Inspection Service (APHIS). While APHIS inspects for agricultural trade diseases, the INS is mainly responsible for inspecting passenger vehicles and pedestrian traffic for proper documentation.

The Customs Service's principal responsibilities include processing entry documents, collecting duties, inspecting for illegal substances and contraband, and enforcing laws of other federal agencies (for example, verifying that all vehicles comply with U.S. DOT and ICC regulations regarding, among other things, proof of liability insurance) (Ref 30).

A 1991 U.S. General Accounting Office (GAO) study, undertaken to assess the ability of the U.S.-Mexico border infrastructure to meet present and future needs under a free trade agreement, concluded that the existing border inspection facilities could not accommodate the current flow of commercial traffic (Refs 25, 30). According to the GAO study, even such programs as the Southern Border Capital Improvement Program, a 1988 U.S. program set up to renovate, replace, and construct the border stations used by customs officers, do not take into account the increased traffic that is expected from the free trade agreement. (The Laredo district received from this program $122 million for several projects, including the renovation and expansion of the Juarez-Lincoln Bridge border station and the construction of the Laredo-Colombia Bridge border station.) According to the GAO, the shortage of customs and immigration inspectors hampers U.S.-Mexico border-crossing inspection operations.

Both U.S. and Mexican customs departments have adopted in recent years a number of new procedures to ease and to expedite the processing of commercial traffic. U.S. customs adopted in 1984 the Automated Commercial System (ACS), a central data bank that can be accessed by customs officials and that reduces paperwork and identifies high-risk imports. Customs brokers can also access the ACS data bank (using the Automated Broker Interface) to obtain useful trade data and to submit in advance the information required in the release documents.

Another automated system introduced in 1987 is the "line release." This system uses bar-code technology to identify problem-free import cargo that can be allowed to pass the inspections of customs and other agencies quickly. Commodities qualify for line release on the basis of high volume and low risk, among other things. Line release can be performed at primary lanes and in less than two minutes, thus reducing congestion at customs import lots. However, this system is not yet widely used, partly because of the qualification restrictions and partly because of the inability of small customs brokers to acquire the necessary equipment (Ref 30).

Mexican customs services have also improved in recent years. Once known for their inefficiency and corruption, these services have undergone major restructuring (in tandem with Mexico's adoption of open trade policies). The customs office in the city of Nuevo Laredo, responding to directives from the Mexican Secretaría de Hacienda y Crédito Público, adopted a series of changes to streamline operations. These changes have so far been effective in reducing inspection time and, equally important, in eliminating an underlying source of corruption. An important part of the streamlining process was the adoption of an automated processing system, referred to as the Integral Customs Automation System (Sistema Aduanero de Automatización Integral). The system randomly selects the shipments that are to be inspected according to a percentage that depends on the type of cargo. Because it can handle up to 1,450 trucks daily, this system speeds up considerably the processing of cargo (Ref 31). Another effort contributing to the expediting of transborder crossings is the processing and sealing of trucks by customs officials in the interior of the country (e.g., in Monterrey) or at the maquiladora plants (especially those having large and repetitive types of cargo), so that the shipment passes the border "in bond" for inspection at other sites.

While the North American Free Trade Agreement will simplify customs procedures with regard to trade flows throughout the U.S., Mexico, and Canada, rules of origin, which refer to the percentage of North American content that a product must contain in order to qualify for preferential tariff treatment, as well as other enforcement concerns, will still require a continuous customs presence, much like that currently in effect between the U.S. and Canada. (We were informed by GSA staff in Fort Worth that this had increased inspections — and the numbers of customs staff required — along the U.S.-Canada border. Thus, cuts in U.S. Customs operators will be unlikely along the U.S.-Mexico border.) Under NAFTA, country-of-origin markings must be verified; quotas and other restrictions enforced; trademarks, copyrights, and patents protected; unsafe products prohibited; and all other federal border-inspection requirements observed (Ref 35).

4.2 MOTOR CARRIER TRANSPORTATION AND REGULATIONS

Motor-carrier operations play a major role in U.S.-Mexico transborder traffic. At present, however, the efficiency of these operations is compromised by discrepancies among each country's carrier-weight and size-limit regulations. The proposed North American Free Trade Agreement includes provisions that would eliminate the restrictions on land transportation services among the three participating countries. It also includes recommendations regarding the compatibility of standards for vehicle weights, dimensions, equipment, emission levels, and driver licensing and medical testing (Ref 36).

4.2.1 Cross Border Accessibility

U.S. commercial motor carriers are generally denied access to Mexico, in accordance with the Mexican law of General Means of Communication (which limits commercial use of federal highways to Mexican nationals only). Likewise, Section 226 of the U.S. Motor Carrier Safety Act (1984) imposes restrictions on Mexican commercial motor carriers' access to the U.S. Specifically, Section 226 limits the operation of foreign commercial motor carriers to the Interstate Commerce Commission (ICC) border commercial zones, which encompass the municipality of the border port of entry and the adjacent areas within a specific mileage that depends on the population size of the base municipality, which ranges from 3 to 20 miles (4.8 to 32 km). Foreign motor carriers must obtain a certificate of registration from the ICC in order to operate in these border zones. This certificate of registration is issued only to carriers that comply with U.S. equipment safety standards, that are current in their U.S. highway tax obligations, and that have insurance to operate in the U.S. Mexican trucks are permitted to haul only from one point in Mexico to another point in the commercial zone (nor can they engage in local cartage within the border zone; see Refs 22 and 30).

With regard to access for U.S. trucks to the Mexican frontier zone, which extends approximately 17 miles (27.37 km) from the border into the interior, the 1955 "Ruiz Cortinez Decree" provides a legal precedent for U.S. motor carrier access to Mexico. However, because it has not been uniformly applied along the border, U.S. commercial motor carriers are, in practice, denied access to most areas of Mexico.

In recent years, after the deregulation of Mexico's trucking industry in 1989, U.S. maquiladora plants in Mexico were allowed to use their own motor carriers to move parts and final products across the border. The most relevant features of this deregulation included the elimination of exclusive concessions for route corridors, the elimination of price restrictions, and the opening of the trucking industry to competition by the easing of for-hire carrier requirements (Ref 22).

Compliance with U.S. safety standards, defined by the U.S. Code of Federal Regulations, is compulsory for both U.S. and Mexican carriers operating in the U.S. In Texas, funding for the enforcement of these regulations has been provided, since 1989, by the Motor Carrier Safety Assistance Program. Through its participation in this program, Texas ensures that state and federal regulations are compatible. Enforcement is carried out by the Texas Department of Public Safety (Ref 22).

The FHWA ruled in July 1992 that Mexican federal commercial and operator driving licenses meet U.S. commercial and operator testing standards, and that, consequently, Mexican drivers no longer have to obtain commercial licenses issued in the U.S. Failure by states to comply with this regulation could result in the loss of federal highway funds (Ref 37).

4.2.2 Truck Weight Regulations

U.S. and Mexican truck-weight-limit regulations are, at present, incompatible. This incompatibility — which has a direct impact on the highway infrastructure of Texas in particular — is a critical factor that highway officials must consider as they plan strategies for dealing with transborder traffic. A major concern is the effect of overweight Mexican trucks on the U.S. infrastructure. According to U.S. federal regulations, truck weights should not exceed any of the following (Ref 38):

- a total, or gross, vehicle weight limit of 80,000 lb (36,320 kg)
- a maximum axle load of 20,000 lb (9,080 kg) for single axles and 34,000 lb (15,436 kg) for tandem axles
- a maximum weight for any group of consecutive axles given by the following "bridge formula"

$$W = 500\left(\frac{L\,N}{N-1} + 12N + 36\right) \tag{4.1}$$

where:

W = overall gross weight on any group of two or more consecutive axles to the nearest 500 lb (227 kg),

L = distance in feet between the extreme of the group of axles, and

N = number of axles in the group under consideration.

Mexican weight regulations are defined by the Mexican federal government through the Secretariat of Communications and Transportation (SCT) (Ref 39). According to current regulations, which were last modified in 1980, the maximum allowable gross vehicle weight is 77.5 tons (171,000 lb or 77,634 kg). Axle weight limits depend on the road type and are listed in Table 4.1. Given these axle weight limits, the maximum allowable gross weight for the following vehicles, and for type A roads, are those indicated in Table 4.2.

Three observations can be made regarding current Mexican truck weight limits and how these compare with their U.S. counterparts. First, the Mexican limits are significantly higher than those permitted for equivalent U.S. truck types. Second, the need for Mexican trucks to operate over poor road surfaces has led to strong chassis and suspension designs (some done by operators themselves), which drives up the unloaded vehicle weight when compared with equivalent U.S. truck types. Finally, the lack of vehicle size and weight enforcement in Mexico has permitted operators to run at whatever weight they considered profitable. Understandably, the substantial degree of overloading within the Mexican trucking sector, openly admitted by the truckers and confirmed by authorities on both sides of the border, is now a great cause for concern. Not only do such trucks severely damage the pavements for all highway users (and increase the likelihood of accidents through poorer braking performance), they also unfairly compete with other modes (e.g., rail). Accordingly, SCT in 1991 sponsored a massive study into the problem by first attempting to define its severity (Ref 78). It is expected that the study will report its results by the end of 1993 in order to contribute to the debate into the harmonization of truck size and weight limits among the three countries.

Table 4.1 Mexican truck axle weight limits (Ref 37)

AXLE	Tires/Axle	Road Type		
		A	B	C
Single	2	5.5 tons (5,504 kg)	5 tons (5,004 kg)	4 tons (4,003 kg)
Single	4	10 tons (10,009 kg)	9 tons (9,008 kg)	8 tons (8,007 kg)
Dual	2	9 tons (9,008 kg)	7.5 tons (7,507 kg)	7 tons (7,006 kg)
Dual	4	18 tons (18,016 kg)	15 tons (15,013 kg)	14 tons (14,012 kg)
		22.5 tons (22,520 kg)	NA	NA

Road Type A allows all truck traffic specified in the regulations
Road Type B allows only truck types C2, C3, T2-S1, T2-S2, and T3-S2
Road Type C allows only truck types C2 and C3
NA: Not allowed

Table 4.2 Examples of Mexican maximum truck weight limits (Ref 40)

Vehicle Type	Gross Weight Limit
C2	15.5 tons (15,513 kg)
C3	23.5 tons (23,521 kg)
T3-S2	41.5 tons (41,537 kg)
T3-S3	46 tons (46,041 kg)
T3-S2-R4	77.5 tons (77,569 kg)

4.2.3 Motor Carrier Transportation Under NAFTA

The proposed North American Free Trade Agreement includes provisions that would reduce barriers to foreign investment and to cross-border access of land transportation services among the three countries. The intent of the provisions is to create equal opportunities and to enhance the competitiveness of the land transportation service industries of the NAFTA countries. Current restrictions are to be liberalized gradually: Three years after the execution of the agreement, U.S. and Canadian truck operators will be able to make cross-border deliveries and cargo pickups in Mexican border states, with Mexican truckers granted similar privileges in U.S. border states. Three years after the agreement takes effect, Mexico will allow U.S. and Canadian investment of up to 49 percent in Mexican trucking companies providing international cargo services, including point-to-point distribution within Mexico; also, Mexican truck companies will be allowed to distribute international cargo in the U.S. and in Canada. Six years after the agreement goes into effect, the U.S. will provide Mexican trucking firms with access to the entire U.S.; and Mexico, similarly, will provide U.S. and Canadian firms with unrestricted access to Mexican markets. Seven years after the agreement is executed, Mexico will allow U.S. and Canadian investment of up to 51 percent in Mexican trucking companies, and total ownership three years after that. However, no NAFTA country will be required to remove restrictions on truck carriage of domestic cargo (Ref 36).

Despite current restrictions for cross-border operations, some U.S. trucking companies have found ways to improve freight services to and from Mexico. Some of these companies, having subsidiaries headquartered in Mexico, use Mexican trucking companies as subcontractors (Ref 41). Others have a partnership agreement with one or more Mexican trucking firms, so that they can provide direct, door-to-door transportation in both countries, including customs clearance (Refs 42 and 43). These types of arrangements give foreigners the opportunity to learn from Mexican companies the best ways of conducting business in Mexico. Some predict that under a free trade agreement these partnership operations will continue.

At the same time, however, there are obstacles that discourage U.S. truckers from operating in Mexico. According to a study of U.S.-Mexico trucking issues related to the North American Free Trade Agreement (Ref 44), major areas inhibiting U.S. trucking operations in Mexico (besides trucking regulations) include the Mexican legal environment, the danger of theft and vandalism, the lack of rest areas, inadequate communications, and Mexico's competition and labor unions, among other things. An important concern, also, is Mexican highway infrastructure: Only 8 percent of Mexican primary roads have four lanes or more, and highway curves have half the minimum radius of those in the U.S. In the near term, Mexico will invest heavily in its highway infrastructure. Part of Mexico's strategy is that private capital will build highways in exchange for credit from the federal government. For example, the government had planned for the private sector to build over 3,000 miles (4,830 km) of new toll highways by 1994. In any case, it will take at least 20 years (according to most estimates) before the Mexican highway system reaches adequate levels (Ref 45). Concerning the unrestricted access of Mexican trucking services into the U.S. market (made attractive by low Mexican wages), the projection is that the overall effect on U.S. imports of Mexican transportation services should be moderate (Ref 20). However, unless specific actions to prevent overloaded Mexican trucks from entering the U.S. are undertaken, U.S. corridors (like IH 35) will be subject to accelerated deterioration.

With regard to the trucking industry in Texas, the free trade agreement is also expected to have positive impacts. Officials in the city of Dallas see their community becoming a major distributor and trans-shipment center for Mexican goods. In one scenario, large convoys of trucks could bring goods from Mexico to Dallas, where they would be stored for later shipment by truck or air. However, the regulatory system that controls the Texas trucking industry—a regulatory system that produces higher shipping rates when compared with deregulated states—would be detrimental to the competitiveness of Texas-based trucking companies. Companies may eventually prefer to locate their warehouses in adjoining states (Ref 46). This is examined in detail in a forthcoming University of Texas publication on bridge capacity across the Rio Grande.

4.3 TRANSBORDER EFFICIENCY

According to current regulations, U.S. carriers cannot operate in the interior of Mexico and Mexican carriers cannot operate in the interior of the U.S. There are also a series of obstacles that discourage both country's carriers from operating in the border zones of the neighboring country. These obstacles, when combined with the convenience of having import and export customs procedures handled by customs brokers at the border, have resulted in recognizable transborder commercial traffic patterns.

A shipment arrives at the U.S. border city via a U.S. carrier and is typically unloaded and routed into Mexico by a local drayage company (also known as "transfers" or "shuttle carriers"). From there it is delivered by a Mexican carrier to its final destination. A similar operation takes place for northbound traffic. In most border communities, Mexican shuttle carriers dominate the transport of shipments through the ports of entry. Some of the reasons for this are that they hold Mexican concessions to service border communities, and that they are a powerful political force which has so far prevented the Mexican government from liberalizing laws of commercial access to Mexico. They also have long-established relationships with Mexican brokers. This has resulted in a quasi-monopolistic process for border transfers, predominantly controlled by Mexican brokers. This costly and inefficient system is currently the focus of much U.S. broker lobbying to liberalize (through legal and federal powers) the process.

The case of the city of Laredo, which will be described in this section, is unique in that U.S. carriers receive reciprocal treatment in the city of Nuevo Laredo. An informal agreement between local U.S. and Mexican drayage companies allows each side's tractors to deliver trailers across the border, though they must return without a load or with an empty trailer. Older tractors are usually used (because of the short distances they travel) and are generally operated by Mexican drivers.

Many of the drayage companies are small and owner-operated, and tractors do not always comply with liability insurance and safety requirements. Lack of enforcement is due mainly to the fact that, according to regulations of the Texas Department of Public Safety, only cities with a population of over 350,000 can be assigned DPS troopers. Currently, there is only one DPS officer examining trucks in the whole of Webb County (Laredo area), a number obviously inadequate for the city's volume of truck traffic (Ref 47). On the Mexican side, similarly, most transfers do not have the authorization to circulate in Mexican territory. However, Mexican officials recognize that enforcing their regulations and stopping these vehicles would create chaos in the international shipping business, since there are no alternatives for transborder traffic (Ref 34).

Most southbound transborder cargo movement is provided by freight forwarding companies that either own tractors or hire the services of a drayage company. They usually have an in-house customs broker to handle customs processing, and they may also consolidate freight and arrange the pickup of merchandise by Mexican truck lines in Mexico on behalf of U.S. exporters. Brokers can arrange for transportation of freight by motor carriers, in this case acting as independent contractors (Ref 48). Most freight forwarding companies are either Mexican owned or they have a direct relationship with a Mexican customs broker. This is a central issue in the current debate over monopolistic practices within the transfer process and the higher costs that (it is argued) these practices foster. The following describes typical crossing operation patterns for southbound and northbound traffic (Refs 49 and 50).

(A) Southbound Truck Traffic (Figure 4.1)

A U.S. carrier brings a loaded trailer from the trailer's point of origin to the carrier's yard in Laredo. A freight forwarding company, or, less frequently, a U.S. customs broker agency will handle the border crossing. Usually, they will receive pre-notification of the shipment, allowing them to prepare the documents needed to clear U.S. and Mexican customs. Having the documentation in a timely manner is critical in order to expedite the crossing. In the case of LTL (less-than-truckload) shipments, the loads are broken down into different routes or consolidated in the carrier's yard. The trailer is then delivered to the freight forwarder's yard, where the load may be consolidated or deconsolidated, checked, or downloaded in order to be inspected or classified. Trailers from larger U.S. carriers will usually be truckload shipments and will cross the border and reach their destination with their original load. The freight forwarders may use their own tractors, or they may subcontract the services of a drayage company.

The import documents or "pedimentos" are prepared and duties are paid prior to the crossing of the merchandise into Mexico. Once the pedimento has been submitted to Mexican customs, the documents are taken to the Mexican broker, who works with the U.S. freight forwarder. On the U.S. side, the freight forwarder is notified that the load has been cleared, and the truck then proceeds southbound. To get merchandise out of the U.S., a Shipper's Export Declaration has to be presented at U.S. customs, either manually or electronically. Documents for licensed material or in-bond documents to be canceled are also presented when necessary. Once on the Mexican side, the dispatcher from the Mexican customs brokerage meets the trucks, matches the manifest (or "relacion de entrada") brought by the trucker with the pedimento, and presents them to the Mexican customs officer. The Mexican customs' computer then determines whether the truck should be inspected. The percentage of shipments inspected depends on the regulation that is applicable to different categories of merchandise. If the shipment gets a green light, it proceeds, with the entire process normally taking about 15 minutes. If it gets a red light, the truck goes to the inspection yard. Once released from customs, the truck proceeds to the Mexican carrier's yard. The trailer is then hooked up to the Mexican carrier's tractor and taken to its final destination.

In the case of intermodal movements, the trailer arrives at Laredo by rail on a flatcar; the railway company then notifies the freight forwarder (or the broker), who arranges for the trailer to be picked up from the intermodal yard and crossed into Nuevo Laredo. The U.S. carrier may (like J. B. Hunt) also pick up its own trailers and take them to its own warehouse in Laredo before arranging their passage into Mexico.

A large number of trailers that go into Mexico belong to U.S. carriers (an advantage to Mexican carriers who are spared this investment). In addition to reducing time and cost, not having to transboard from the trailer avoids the risk of damaging the load. Large U.S. carriers keep track of their trailers, so they know where they are at any given time. They usually impose a time limit on the freight forwarder for crossing the trailer, as well as on the Mexican carriers for bringing it back. There is usually an agreement between the U.S. carrier and the Mexican carriers it has contracted with. The Mexican carriers are responsible for each trailer, and they are encouraged to bring them back with a load, if only to the border. Since Mexican law states that bonds on trailers cannot be transferred from one Mexican truck line to another, the same company has to bring the load north (Ref 43). Some U.S. carriers have vendors in Mexico to avoid the imbalance of empty trailers coming north (Ref 41).

(B) Northbound Truck Traffic (Figure 4.2)

A load to be imported into the U.S. is brought from its point of origin to Nuevo Laredo by a Mexican carrier. From there, a Mexican transfer or "alijador" crosses the trailer into the U.S. Prior to crossing, the Mexican export documents (pedimentos), which are similar to the import documents, are presented in order to clear Mexican customs. Imports to the U.S. are usually handled by a U.S. customs broker, who will work in coordination with a Mexican customs broker to handle the export documentation in Mexico. In an automated process, the Mexican broker will send the documents electronically or by fax to the U.S. broker, who then inputs the information into the U.S. customs centralized database. When the truck arrives at U.S. customs, there are different ways of dispatching. The truck goes into the import lot with the driver's and truck documentation, and with the Inward Cargo Manifest. The broker's dispatcher meets the truck, matches the documents prepared at the broker's office with those brought by the truck, and gives them to the import inspector, who scans the bar code of the documents. The computer, which has a history of the client, indicates whether to inspect or not. However, the inspector can always override the computer's decision. If it is going to be inspected, the truck goes into the customs import lot. Once the truck is cleared, the documents are handed over to the dispatcher, and the broker has 10 days to pay customs' duties. A similar procedure takes place for "line release" clearance. Trailers can also be dispatched by Mexican customs to the interior of Mexico, particularly in the case of large production plants. In the case of large production plants, the trailer is sealed and picked up by the Mexican carrier that takes it north.

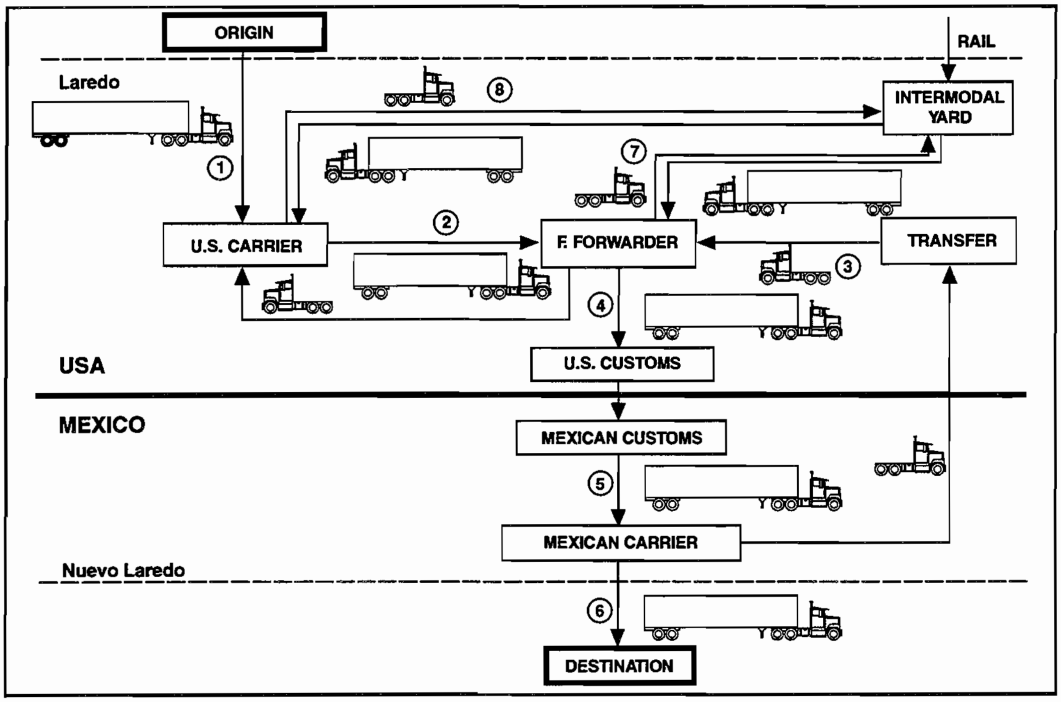


Figure 4.1 Crossing pattern for southbound truck traffic

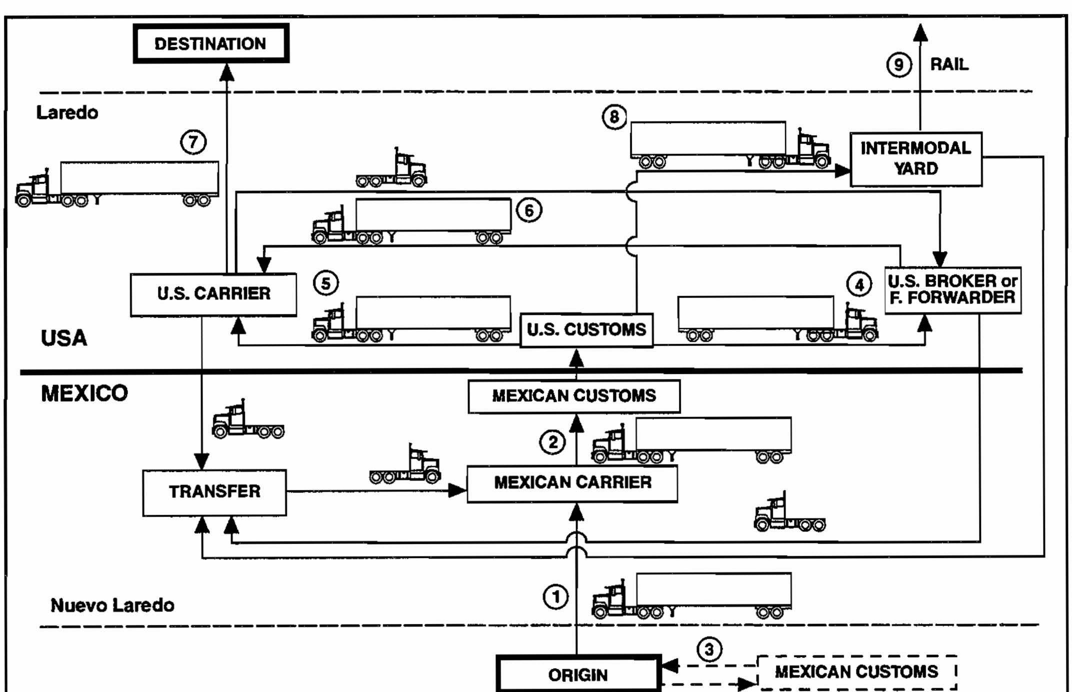


Figure 4.2 Crossing pattern for northbound truck traffic

From the import lot, the Mexican transfer delivers the trailer to the broker's yard, in case the load needs to be verified, consolidated, kept in the warehouse until it is sold, or turned over to another U.S. carrier. From there it is picked up by the U.S. carrier. Otherwise, the transfer can take the trailer directly from the import lot to the U.S. carrier's yard, where it is then delivered to its final destination. Trailers can also be delivered to the intermodal yard, where they then proceed north by rail.

Overloaded trailers coming from Mexico can be downsized to U.S. regulations at the freight forwarder's yard. The Union Pacific intermodal yard has cranes equipped with electronic scales, and all lifted trailers and containers are automatically weighed to ensure compliance with U.S. limits. Truck trailers are less regionally controlled (and only where scales are installed at yards or warehouses). There are no weighing systems in operation for northbound trucks entering the U.S., and "leakage" of overloaded trucks or trailers onto the U.S. highway system is suspected by TxDOT officials (Byron Blaschke, former Deputy Executive Director of the Texas Department of Transportation stated in his April 1993 testimony before the House Public Works Committee's Subcommittee on Investigations and Oversight that "According to the Texas Department of Public Safety, Mexican vehicles are consistently weighed with gross weights ranging from 100,000 to 140,000 pounds."). Trailers found to be overloaded are not carried north and have to be picked up by the freight forwarder or the customer.

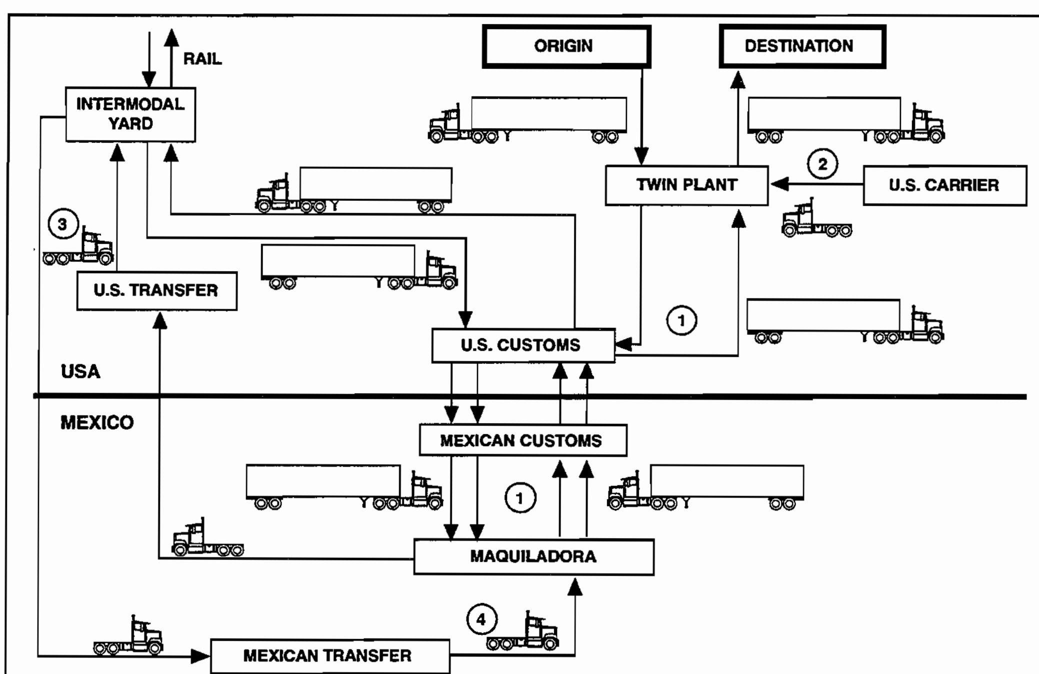


Figure 4.3 Crossing pattern for maquiladora traffic

(C) Maquiladoras Transborder Traffic (Figure 4.3)

In the case of maquiladora plants, particularly those located within the 17-mile (27-km) Mexican border zone, there is no need to switch the trailers to a Mexican carrier, since U.S. trucks have access to this area. The maquiladora may have its own trucks for shipping across the border, and then have a U.S. carrier deliver it to some location within the U.S. (Ref 51). It may also use the services of local transfers for transborder movements, an example being intermodal shipments.

(D) Rail Traffic

In the case of rail shipments, their crossing has been greatly streamlined with the introduction of pre-clearing operations, called "Despacho Previo." Union Pacific, for example, holds its Mexico-destined traffic on the U.S. side of the border until its cars have been cleared by Mexican customs. Once cleared, the broker's agent sends notification, and the cars proceed through Nuevo Laredo to their final destination. About 60 percent of all rail shipments are pre-cleared using this system.

Northbound traffic can also be pre-cleared. When the trailer leaves its point of departure in Mexico, an invoice is faxed to the U.S. customs broker who pre-files the documents with U.S. customs. When the cars cross the rail bridge, U.S. customs is notified so that they can check, using their system, whether the car can proceed or has to be verified (Ref 51). Rail cars that are not pre-cleared are sealed by customs with a holding seal at the bridge and are then held at the railway yard until the broker presents the corresponding documentation (Ref 22).

The transborder crossing of commercial traffic through Laredo/Nuevo Laredo (or through other U.S.-Mexico border stations) is not as efficient as it should be. Many in the border community, perhaps not surprisingly, consider the present system to be beneficial to the local economy, since the system is a source of jobs and revenue for the city. In any event, trade operations may change with the ratification of the North American Free Trade Agreement. (NOTE: Since this report was first drafted, complaints about the broking system at the border have intensified. It is alleged, often with powerful logic, that the current system underutilizes the infrastructure [particularly the bridges]; opponents of the present system argue that trips could be reduced, waiting curtailed, and costs lowered by making structural changes to the transfer process. These developments will have to be noted and evaluated by future researchers in this area.)

The previous description provides a background for the analysis of traffic in border cities, particularly the city of Laredo, which is the subject of the next chapter.

CHAPTER 5. LAREDO CASE STUDY

The city of Laredo (Webb County, Texas) is the second largest U.S. inland port of entry (behind Detroit). It is located on the Texas-Mexico border, 150 miles (241 km) south of San Antonio, 125 miles (201 km) west of the deep-water port of Corpus Christi, and 150 miles (241 km) north of Monterrey, Mexico. It lies on a natural mountain corridor that runs from the interior of Mexico through Monterrey and straight into Nuevo Laredo, Laredo's sister city across the Rio Grande. With major highways in both the U.S. and Mexico, including IH-35 and MEX85, Laredo is located on a direct route that connects key industrial zones in the U.S. to the principal industrial areas of Mexico. This strategic location has made Laredo a major international gateway to Mexico and a central focus of impact studies of the North American Free Trade Agreement.

5.1 DESCRIPTION OF THE CITY

Founded in 1755, the city of Laredo is the oldest continuously settled site in Texas. Its population of 122,899 includes the largest percentage of Hispanics of any U.S. city (93 percent of its population). Forecasts indicate that Laredo's population should reach almost 250,000 by the year 2010 (Refs 21, 52, 53).

Laredo's economic growth is driven mainly by U.S.-Mexico trade. Revenues collected by the U.S. Customs District of Laredo are on the order of $30 million per month, half of which is collected by the port of Laredo. As with other border cities, the principal industries are retail and services, including those which are trade-related (e.g., transportation, warehousing, distribution centers, freight forwarding, and customs brokerage). Maquiladoras (or "twin plants") in Laredo also account for an increasing share of the services industry. Laredo currently serves approximately 80 maquiladoras in Nuevo Laredo, and another 90 located in adjacent Mexican States. These plants generate, directly and indirectly, approximately 12,000 jobs in Laredo, and they contribute almost $230 million a year to the local economy through wages, taxes, services, and sales. Job creation in Laredo averaged 6 percent annually from 1989 to 1991, triple the state's average (Refs 54, 55). However, the unemployment rate is still about 3 percent above both the national and state average. Indicators of Laredo's economic activity are shown in Figure 5.1.

Laredo has an area of 37.8 square miles (98 km^2), with its 5-mile (8-km) extraterritorial jurisdiction (ETJ) extending to 320 square miles (829 km^2). The city limits and ETJ boundaries have expanded through annexations over the years, the latest one being the area adjacent to FM 1472 (Mines Road) to the west up to the Colombia Bridge. Almost 50 percent of the developed land in Laredo is zoned residential, while industrial and commercial areas together account for about 25 percent of the city's development (Refs 52 and 57).

Streets in Laredo originally followed a grid-pattern design typical of Spanish colonial cities, and narrow streets following a rectangular north-south/east-west grid are still found in the central business district.

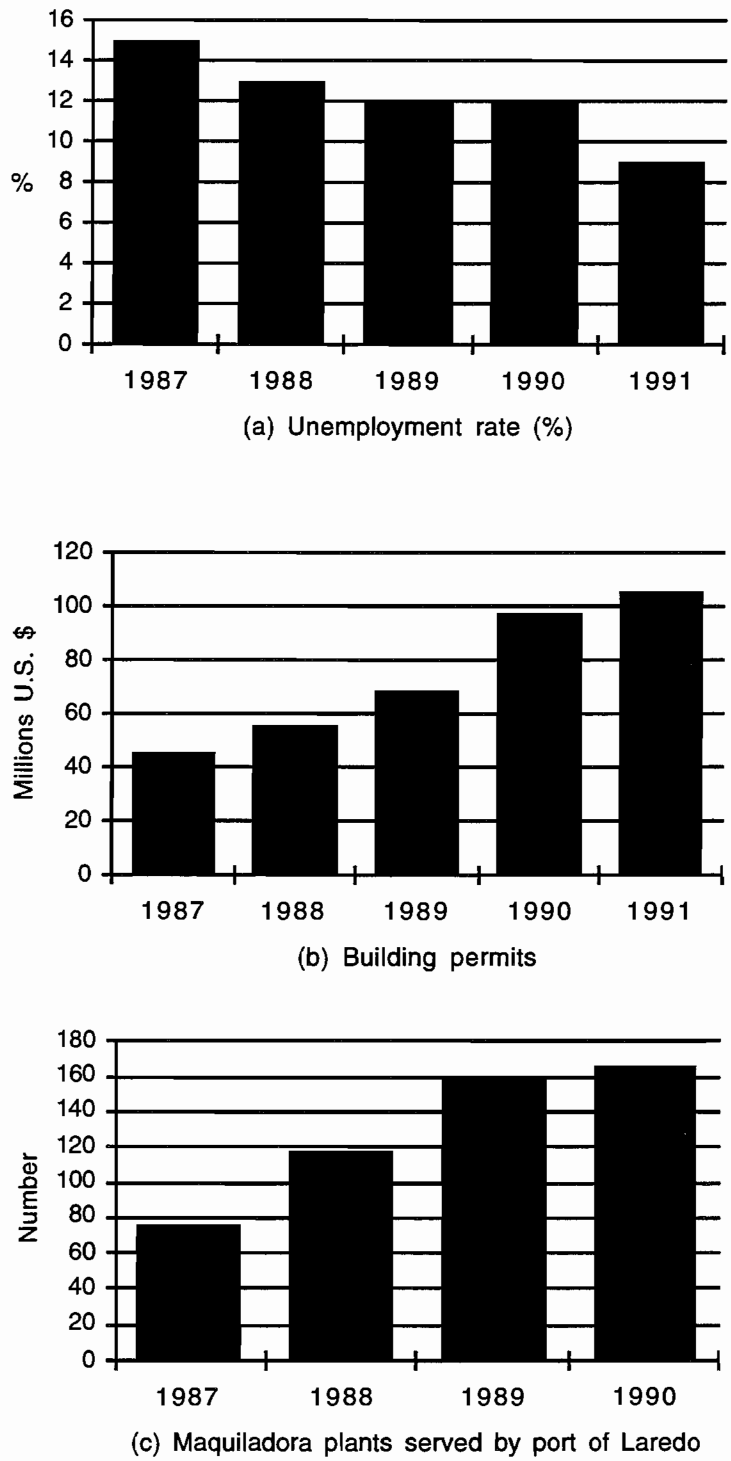
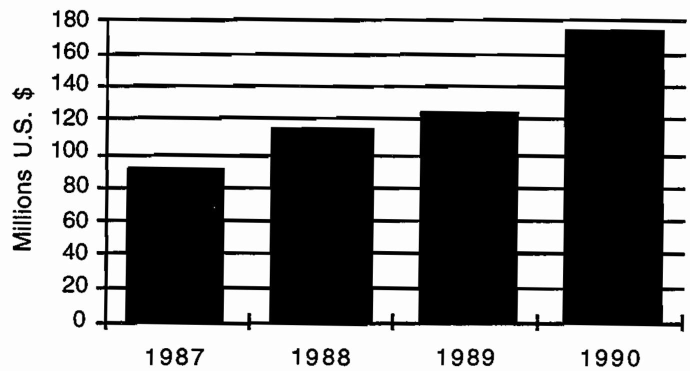


Figure 5.1 Indicators of Laredo's economic activity (Ref 56)



(d) U.S. duties collected at Laredo

Figure 5.1 (continued)

With the growth of the city, this pattern overlapped with a more dispersed, freeway-oriented urban shape. Commercial and industrial development (e.g., warehousing serving transborder truck traffic) has been established by traffic corridors, such as IH-35, Santa Maria Street, or Santa Isabel Avenue, in the west-central part of the city. In recent years, the greatest increase in land use has occurred to the north of the city, along Mines Road; there is also a strong trend toward decentralized clustering in industrial parks (Fig. 5.2). In the old sections of the city, which include most of the central business district adjacent to the international bridge crossings, streets have relatively narrow rights-of-way, while the more recently developed streets have wider right-of-way sections. Many local streets serving residential areas remain unpaved.

5.2 HIGHWAY INFRASTRUCTURE

The major highways serving the port of Laredo are IH-35, U.S. 59, and U.S. 83. Laredo is connected to the city of San Antonio via IH-35 and from there to the central, west, and northeast regions of the U.S. U.S. 59 leads to the deep-water port of Corpus Christi, to the port of Houston, and to the Southeast. The U.S. 83 highway connects Laredo to McAllen, Brownsville, and to other border cities. The U.S. 83, IH-35, and U.S. 59 highway system is linked in Laredo to Nuevo Laredo and from there — through MEX85 and MEX40 — to Monterrey, Saltillo, and Mexico City, along the main north-south highway transportation corridor in Mexico.

Interstate Highway 35 has the largest share of traffic in and out of Laredo. Figure 5.3 shows the 1992 ADT and percentage of trucks for the Laredo highway system. Interestingly, unlike other cities of its size in non-border areas, the central business district of Laredo has not been by-passed. Nor does the city yet have an inner or outer loop. Consequently, all truck traffic is funneled through the city's center to Bridges I or II—a problem situation that could be avoided with a good loop system. Realizing this, city planners have announced that an inner loop is to be constructed over the next 5 years to improve connectivity with new bridge sites and with the Colombia structure.

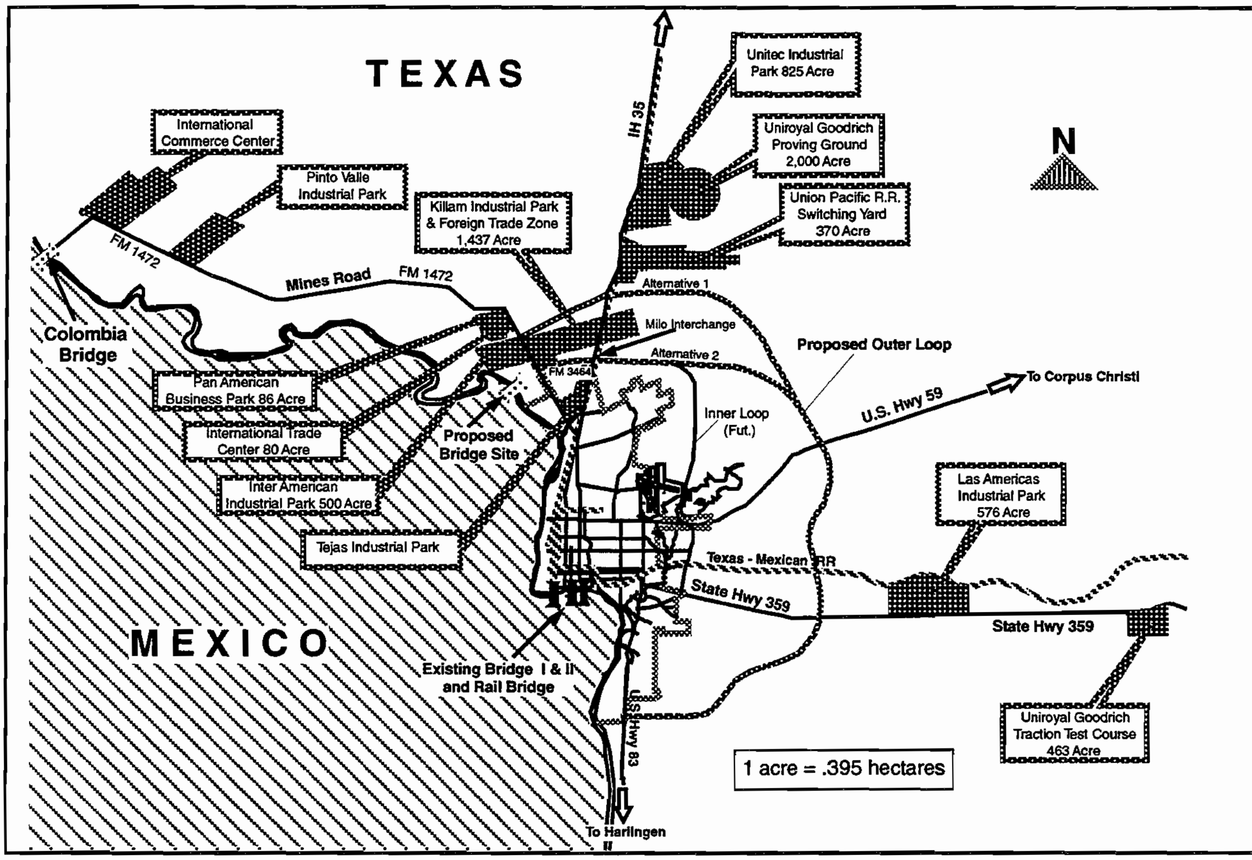


Figure 5.2 Laredo highway infrastructure and industrial developments

5.3 INTERNATIONAL BRIDGE CROSSINGS

Laredo has three international highway bridges: Convent Street Bridge, Juarez-Lincoln Bridge, and the Solidarity Bridge (located in the city's most recently annexed western limits, 25 miles or 40 km from the downtown area). The three bridges are toll facilities owned and operated by the city of Laredo on the U.S. side and by the Government of Mexico on the Mexican side.

Convent Street Bridge, also known as Bridge I or the "Old Bridge," has four lanes for vehicles and two 8-foot (2.4-m) lanes for pedestrians. The original bridge was destroyed in a flood in 1954; a new bridge was built in 1956. Its inspection facilities are probably the oldest in use on the Texas-Mexico border and were completely renovated in 1991 (Ref 34). The Convent Street Bridge currently provides the only pedestrian crossing between Laredo and Nuevo Laredo (pedestrian traffic is not allowed on Juarez-Lincoln Bridge) and, among the three, is located closest to downtown shopping areas.

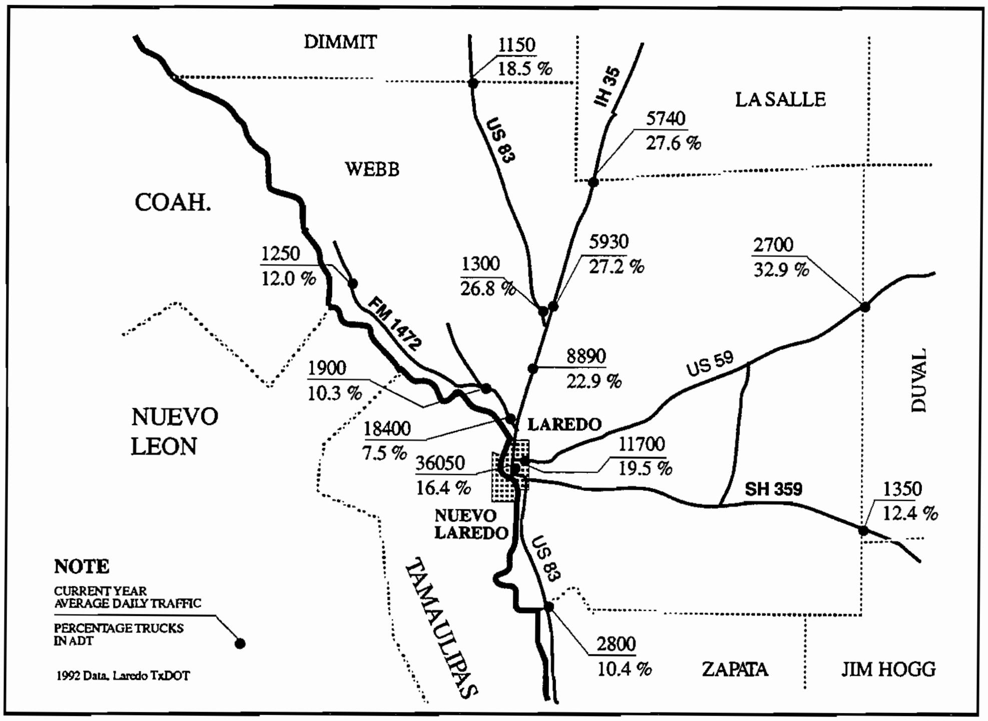


Figure 5.3 Average daily traffic on Laredo highways

The Juarez-Lincoln Bridge, also known as Bridge II, has seven lanes (2, 2, and 3 reversible) and two 10-ft-wide (3-m) pedestrian lanes (presently not in use). This bridge was opened to traffic in 1976 and is accessed directly from IH-35.

Laredo's third international bridge, known as Solidarity Bridge (but also known as the Colombia Bridge), is located in Laredo's western extraterritorial limits and is accessed from FM 1472 (Mines Road). Unlike Bridges I and II, which cross into the state of Tamaulipas, Solidarity is an 8-lane bridge that links Dolores, Texas, with the town of Colombia, located on that part of the border (12 miles or 19 km) that separates the states of Nuevo Leon and Texas. A joint venture proposal for construction of the bridge was made to the U.S. by Nuevo Leon — representing the first time that Mexico has initiated plans and sought U.S. participation in constructing a new bridge at a specific location (Ref 58). Both Bridges I and II and the Colombia Bridge lead to the MEX85 highway and, from there, to Monterrey, Nuevo Leon's capital city and one of Mexico's major industrial centers. However, the state of Nuevo Leon was interested in having an international crossing within its own state limits. The city of Laredo initially opposed this project, fearing that the remote bridge would divert economic activity away from the city. But faced with the possibility of a state-built, toll-free facility, Laredo decided to take part in the project. Laredo then annexed a strip of land following Mines Road up to Dolores and met the $12 million cost of the U.S. bridge portion with a bond issued in 1990; the U.S. government was to cover the $35 million dollar cost for customs, INS, and other inspection facilities (Ref 59). Presently, TxDOT is improving the road system leading to the Solidarity Bridge from Laredo: The section on FM 255 was completed in 1991 prior to bridge completion, the remainder on FM 1472 is currently underway.

At the time the project for Colombia Bridge was started in 1990, the amount of traffic at Bridges I and II had been increasing substantially as a result of the trade expansion. In addition, the Mexican customs import lot in Nuevo Laredo had not yet been constructed. These two factors combined to produce some degree of congestion in Laredo, which made a new bridge seem more necessary. Completed in less than one year, the bridge was in operation by August 1991. Still, at present, Colombia Bridge is far from operating at full capacity. From October 1991 to October 1992, it accounted for 2.7 percent of southbound freight crossings and 0.6 percent of total southbound vehicle crossings at Laredo. One reason for this small share in transborder traffic is the additional travel distance: nearly 19.5 miles (31 km) from the intersection of FM 1472 and IH-35 to the bridge, and similarly from the bridge to MEX85. The added distance of approximately 45 miles (72 km) is a particular disadvantage for trucks and shuttle carriers crossing to and from warehouses that are located in proximity to Bridges I and II: The older vehicle fleet used for drayage cannot handle the longer trip distances, owing to the frequent breakdowns. Another disadvantage of the Colombia Bridge is inadequate connecting highway infrastructure on both sides of the border. At the time the bridge started operating, FM 1472 was deteriorated and too narrow (only 20 ft or 8 m wide) to appropriately handle truck traffic. However, there have been improvements in this area (and more improvements are currently in development), such as the upgrading of FM 1472 and the implementation of new highway facilities on the Mexican side, which will be described in a subsequent chapter. Another problem of particular importance that has deterred freight crossings at Colombia is the scarcity of customs brokers at that bridge. In Mexico, few brokers currently have licenses to operate in both Tamaulipas and Nuevo Leon.

5.3.1 Congestion at Laredo Bridges

Routing heavy traffic through the center of Laredo over Bridges I and II leads to sporadic and severe congestion. Although projections show that the underutilized Colombia Bridge would be able to accommodate all future medium-term traffic growth, its remoteness from the traditional truck routes discourages shippers from diverting traffic to this site. A study conducted by TxDOT in 1987 regarding international bridge traffic congestion in the Laredo/Nuevo Laredo area identified four elements that can affect the capacity of vehicular flow at these two bridges: the total number of lanes, toll collection, customs inspection, and the adjacent street system both in the U.S. and in Mexico (Ref 60). The eleven lanes between the two bridges appear to handle current traffic volumes adequately. Toll collection does not seem to present capacity problems, whereas customs inspectors have cited a lack of staff support as a serious problem when they (the inspectors) must handle peak traffic.

According to a study conducted by the General Services Administration, inspection facilities in the Laredo area are projected to reach their maximum capacity in 24 years, assuming a 100 percent growth in traffic over the next 10 years, or in 10 years, assuming the same annual growth rates of recent years — approximately 18 percent (Ref 25). For local trucking companies, customs operations—most notably inspection delays — apparently do not represent a problem, because their operating hours can be cut or extended to fit the job at hand, both in the U.S. and in Mexico. Some minor disturbances occur during periods of the year when there is a 1-hour time zone difference between Laredo and Nuevo Laredo.

Inspection facilities for Mexican and U.S. customs authorities have recently been and are currently being expanded, which greatly expedites transborder movements. The one element that appears to have a limited additional capacity for future traffic growth is the street system adjacent to the bridges. Except for IH-35, which feeds directly into Bridge II, the streets in the downtown area are curved and narrow. At the entrance of Bridge I, at the end of Convent Street, there are no distinct corridors for pedestrian and vehicle traffic, and this area becomes congested frequently. In Nuevo Laredo, the street system feeding into the bridges presents problems similar to those found in the older downtown area of Laredo.

One of the infrastructure improvement projects in Nuevo Laredo—the construction of a new road to access the bridge areas, bordering the river from the east—is expected to reduce motor vehicle congestion in that city (and will also benefit the city of Laredo).

The effect of the adjacent street system on transborder traffic flows is to some extent determined by the crossing patterns of passenger and freight vehicles. Passenger vehicles can use both Bridge I and II, whereas the use of each bridge for truck crossings is determined by current customs and by city policies both in the U.S. and Mexico. Northbound and southbound loaded and empty truck flows are shown in Figures 5.4 through 5.7.

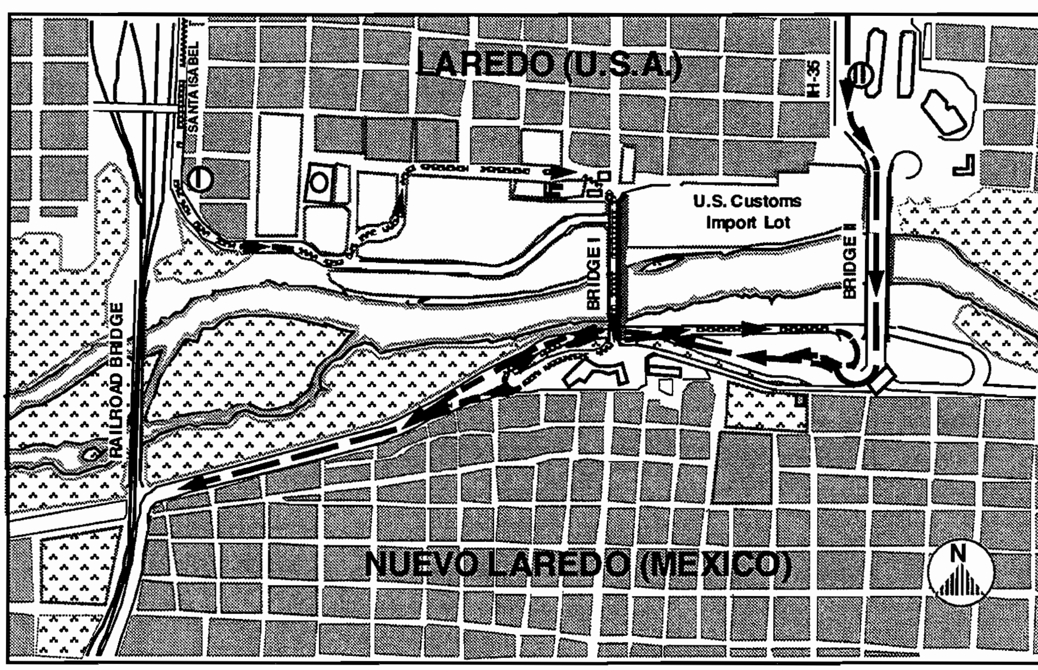


Figure 5.4 Cross-border route for southbound loaded trucks

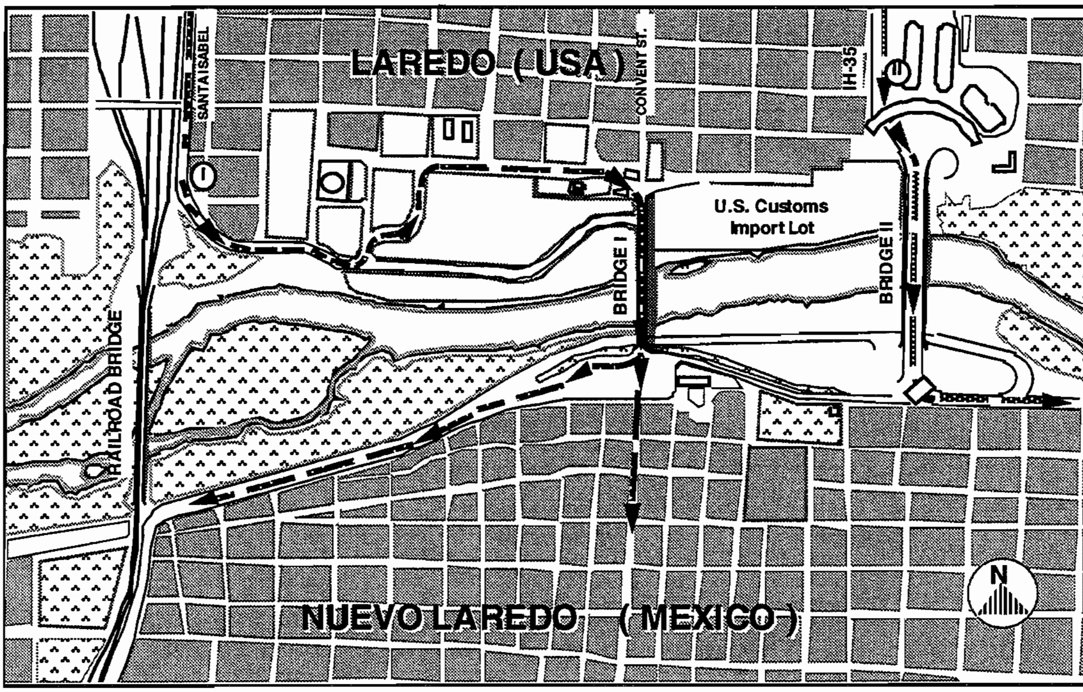


Figure 5.5 Cross-border route for southbound tractors of empty trailers

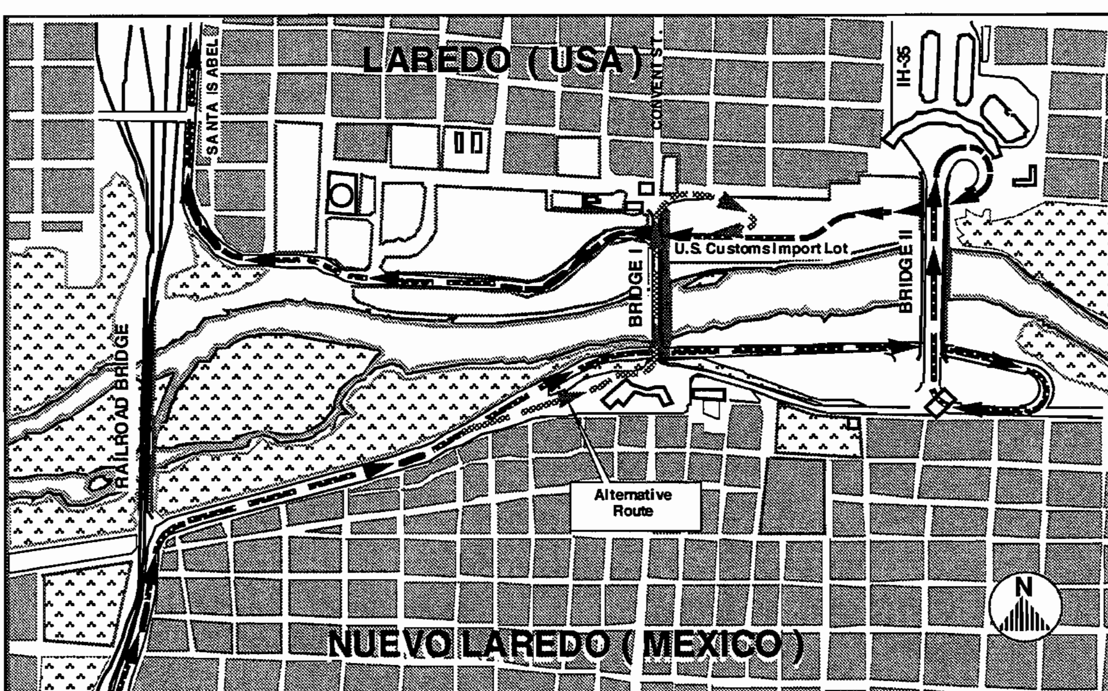


Figure 5.6 Cross-border route for northbound loaded trucks

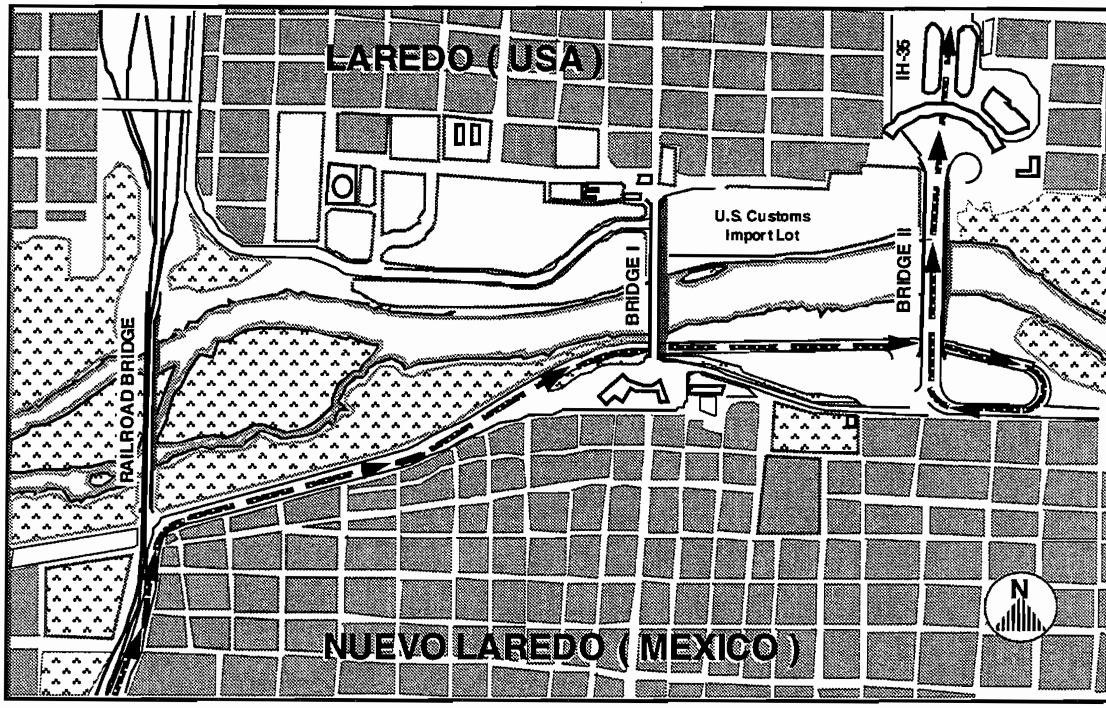


Figure 5.7 Cross-border route for northbound tractors of empty trailers

Northbound loaded trucks use Bridge II almost without exception. Once in the U.S. customs import lot, these trucks either wait for inspection or exit directly (in the case of shipments under line release). All trucks exiting the import lot proceed up River Road and then turn onto Santa Isabel Avenue, which runs parallel to the Union Pacific's railroad track. Southbound loaded trucks can use both Bridge I and II, with some cargoes directed to use one or the other. For example, southbound in-bond shipments (i.e., shipments with final destination in a third country) must use Bridge I. Convent Avenue, which directly feeds Bridge I, cannot be accessed by freight vehicles.

5.3.2 City Truck Weight Regulations

Trucks crossing into Mexico have limitations on their GVW imposed by Laredo authorities and enforced at the entrance to the international bridges; northbound traffic has no such limitations currently. Laredo city officials, concerned about the structural integrity of their bridges, set a load limit of 130,000 lb (59,020 kg) for Bridge I and a load limit of 230,000 lb (104,420 kg) for both Bridge II and the Colombia Bridge. According to city ordinances (which correspond with state highway regulations), vehicles over 84,000 lb (38,136 kg) GVW are not allowed to operate on any street or roadway within the city. Vehicles with loads heavier than 84,000 lb (38,136 kg) can operate within city limits, provided they obtain a permit from the City Engineering Department, show proof of the total vehicle weight, and show proof that the load is indivisible. This permit may also define specific routes and movement times. The permit requires the payment of a fixed fee and, since December 1992, an additional street maintenance fee, which is indicated in Table 5.1.

Table 5.1 Additional fees for overweight trucks

WEIGHT GROUP (in pounds/kg)	STREET MAINTENANCE FEE	PERMIT FEE	TOTAL
84,001-120,000 (38,136-54,480 kg)	$50.00	$30.00	$80.00
120,001-160,000 (54,480-72,640 kg)	$75.00	$30.00	$105.00
160,001-200,000 (72,640-90,800 kg)	$100.00	$30.00	$130.00
200,001 and above	$125.00	$30.00	$155.00

Source: City of Laredo Engineering Dept.

The maintenance fee, according to the corresponding ordinance, is intended to "defray the cost of operations in order to contribute to the abnormal street maintenance costs derived from the transportation of overweight cargo vehicles over the city streets." Although load limits are applicable throughout the city, in practice enforcement mostly takes place at the entrance of the international bridges. Currently, Bridge I and Colombia Bridge have scales at their entrance, and the city is in the process of installing a scale also at Bridge II. Last year (1992), the city issued on average 60 overload permits per month.

Load controls for southbound trucks have been criticized by the local trucking industry, since there are no such controls for northbound truck traffic. Although there is, as yet, no monitoring of loads for northbound vehicles, it is very probable that northbound trucks exceed U.S. legal load limits, owing to the differences between Mexican truck weight limitations and level of enforcement, and U.S. truck weight limitations and enforcement. However, there is currently no accurate data on the level of compliance of load limits for the overall truck population in the Laredo area, including both Mexican and U.S. shipments.

The Center for Transportation Research at The University of Texas at Austin is conducting a study (Research Project 1319) that includes the installation of a Weigh-in-Motion device at the exit of the U.S. customs import lot. The city of Laredo is also studying the feasibility of installing portable scales at the exit of the import lot, in order to check northbound loads. One concern is the Mexican reaction to these kinds of controls; that is, any decision made without consultation with the other side might affect the reciprocity of U.S.-Mexican transborder motor carrier transportation in the area (Ref 61).

5.4 TRUCK ROUTES

To control the movement of trucks along its city streets (and to reduce the disruptions that trucks bring to non-truck traffic and city residents), Laredo city officials have established a dedicated truck route — a network of city streets that trucks and trailers are permitted to use when moving throughout the city (Fig. 5.8).

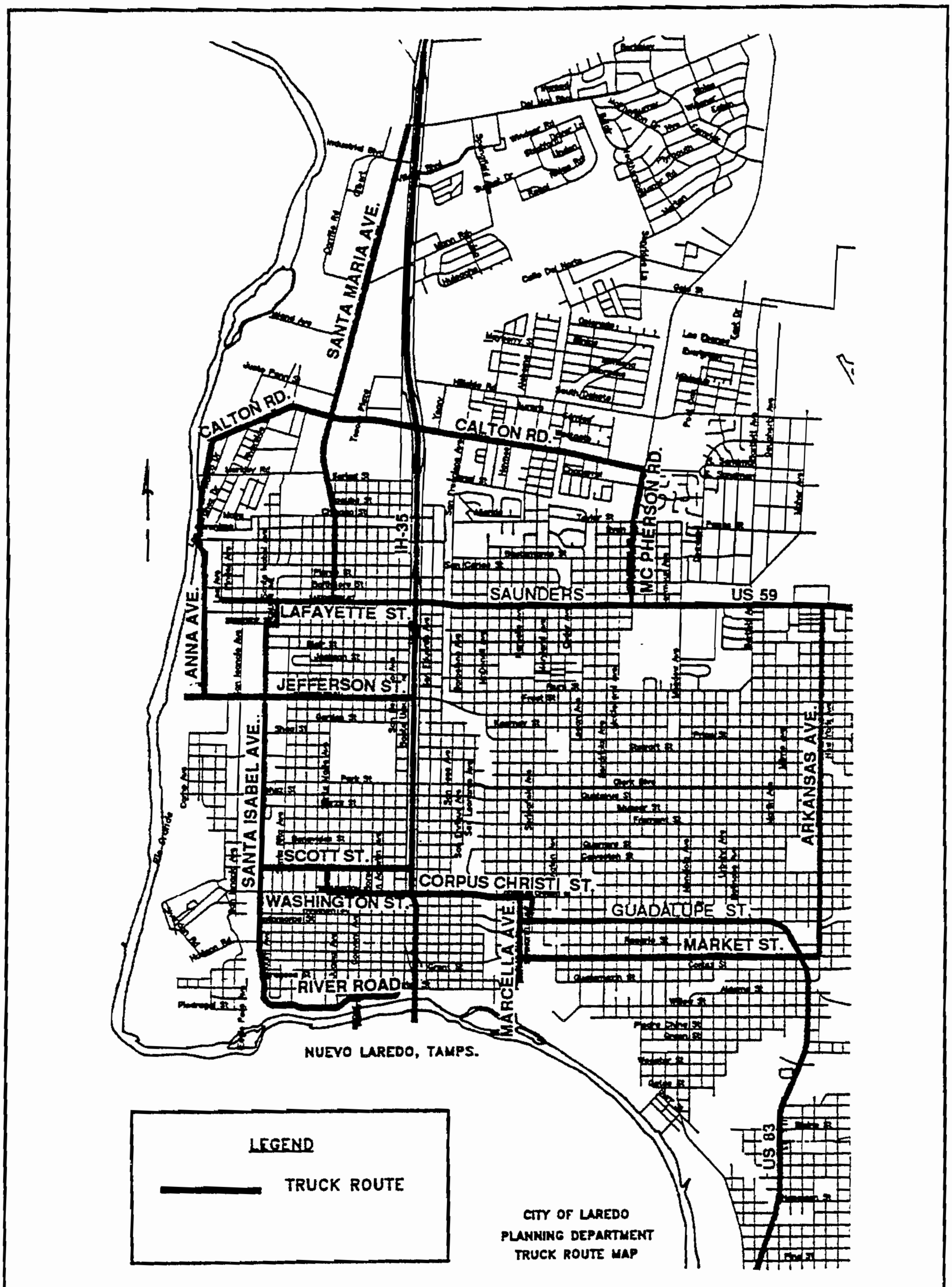


Figure 5.8 Laredo truck routes

The route was selected for its accessibility to and from bridge crossings and warehouses, and for its ability to limit disruptions in residential areas. All interstate and U.S. highways within the city are also included as truck routes. According to city regulations, trucks originating outside the city and with a destination inside the city must proceed over streets designated for truck traffic, with minor deviations allowed on streets where such traffic is permitted. Upon leaving the destination point, they must return to the truck route by the shortest permissible route. Similar instructions apply to trucks originating inside the city with a destination point outside the city. Trucks do not strictly comply with these regulations (since they may use shortcuts through less congested areas) and enforcement is difficult because of the large number of trucks.

Because of the downtown location of the international crossings, the location of warehouses, and the pattern of transborder crossings, the truck route includes streets that were built with neither the design nor the structural capacity to support increasing volumes of truck traffic. Limited rights-of-way in the older sections of the city preclude geometric improvements on some of these routes. Table 5.2 includes a list of some of the truck routes and their section width, and the width that would be required according to their functional classification, which is determined by the city's planning policies. Lack of maintenance and rehabilitation in some of the truck routes is due partly to lack of funding and partly to the problems that are created when the two-lane truck routes have to be closed for maintenance or rehabilitation. One such case is that of Santa Isabel Avenue at River Road, which is the only route for trucks exiting the U.S. customs import lot.

Table 5.2 Truck routes sections

TRUCK ROUTE (From/To)	**Functional Classification**	**Actual Width (ft and m)**	**Policy Width (ft and m)**
SANTA ISABEL (River Rd./Burnside)	Major Collector	36 (11 m)	48 (14.6 m)
LAFAYETTE (Vidaurri/Santa Maria)	Major Collector	36 (11 m)	48 (14.6 m)
SANTA MARIA (Lafayette/DelMar)	Minor Arterial	36 (11 m)	48 (14.6 m)
SCOTT (Sta. Isabel/IH-35)	Major Collector	40 (12 m)	48 (14.6 m)

Laredo's transportation and future land use policies include within their objectives a program to identify appropriate truck routes, including existing and future roadways; it also seeks to establish a "logical future street system to emphasize truck traffic access and mobility" (Ref 52). New truck routes, or those in the more recently developed areas of the city, can be designed to accommodate adequately truck traffic. In the older areas of the city, major improvements would only be possible by diverting additional truck traffic. In any case, the mix of passenger vehicles and truck traffic, a mix similar to that found in any city that has a patchwork of industrial and residential areas, is far from ideal.

5.5 TRANSBORDER TRAFFIC AND TRAFFIC GROWTH

As previously mentioned, the major corridors for traffic in Laredo are IH-35, U.S. 83, and U.S. 59. Table 5.3 shows the results of a 1986 to 1988 survey regarding truck traffic through the port of Laredo. This survey shows the predominance of the U.S. northeast and central regions with regard to origin and destination points of transborder traffic; similarly, Monterrey and Mexico City are the predominate regions for origin and destination points in Mexico.

Table 5.3 Origin and destination of truck shipments through Laredo

UNITED STATES REGIONS				**MEXICAN CITIES**			
Into Laredo		Out of Laredo		Into the U.S.		Into Mexico	
Southeast	19.0%	Southeast	22.9%	Monterrey	40.3%	Monterrey	49.6%
Northeast	38.3%	Northeast	27.2%	Mexico City	36.0%	Mexico City	33.3%
Central	30.2%	Central	29.2%	Nuevo Laredo	17.7%	Nuevo Laredo	14.1%
Southwest	7.1%	Southwest	7.1%	Guadalajara	6.0%	Guadalajara	3.0%
West	5.4%	West	4.7%				

Note: This survey does not include 1993 information.
Source: Laredo Development Foundation

The growth in recent years of U.S.-Mexican trade, including that generated by the maquiladora industry, has resulted in increasing volumes of transborder traffic. Figure 5.9 shows the volumes of northbound, southbound, and total number of freight crossings through Laredo from 1986 to 1991. During this period, the number of total freight crossings increased by approximately 150 percent (30 percent simple annual growth). In 1991, an average of 1,450 truck shipments were moved daily between Laredo/Nuevo Laredo. Figure 5.9 also shows the imbalance between southbound and northbound shipments.

While autos and other non-freight vehicles' southbound crossings increased by about 48 percent from 1977 to 1991, freight vehicles' southbound crossings increased by almost 600 percent over the same period (Fig. 5.10). The percentage of trucks in total southbound crossings increased from 1.3 percent in 1977 to 5.2 percent in 1991.

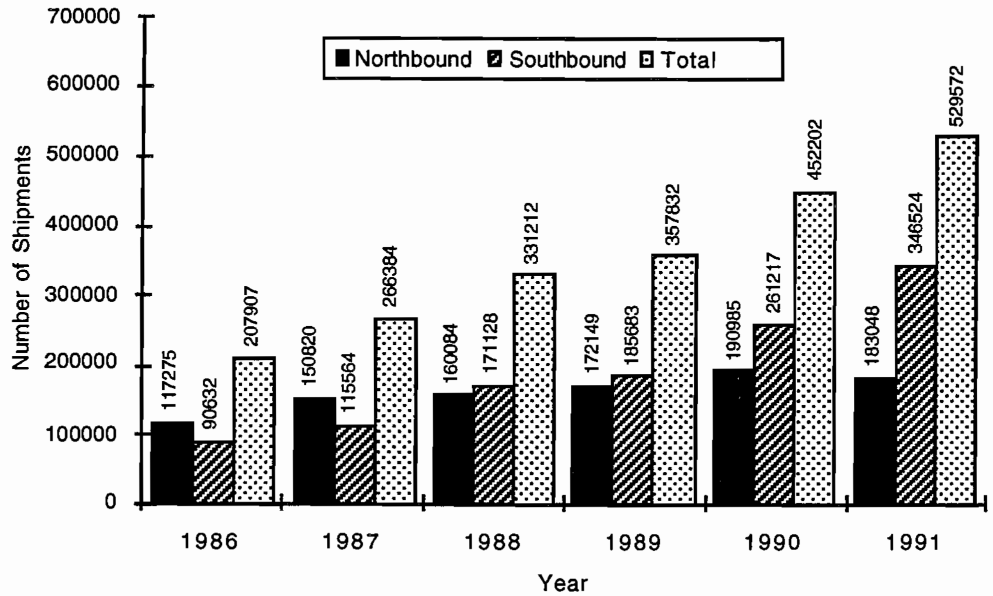


Figure 5.9 Truck shipments at Laredo bridges 1986-1991 (Source: Laredo Bridge System and U.S. Customs)

The distribution of traffic between the three Laredo bridges indicates that Bridges I and II combined account for 97.3 percent of freight vehicles, and 99.5 percent of other vehicles that make up southbound traffic, with an approximately 50-percent share of truck crossings for each (Fig. 5.11). While crossings at Colombia Bridge have been increasing (Fig. 5.12), it still has a minimum share of total traffic.

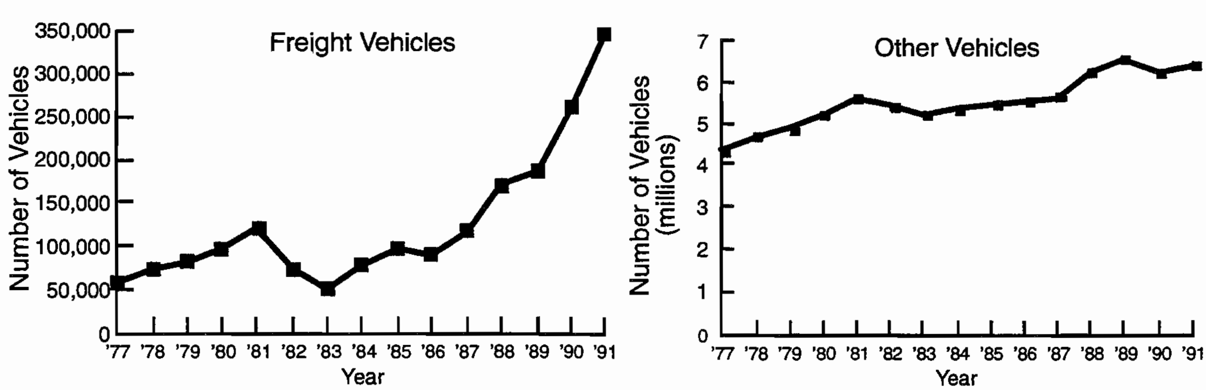


Figure 5.10 Southbound vehicles crossings through Laredo 1977-1991

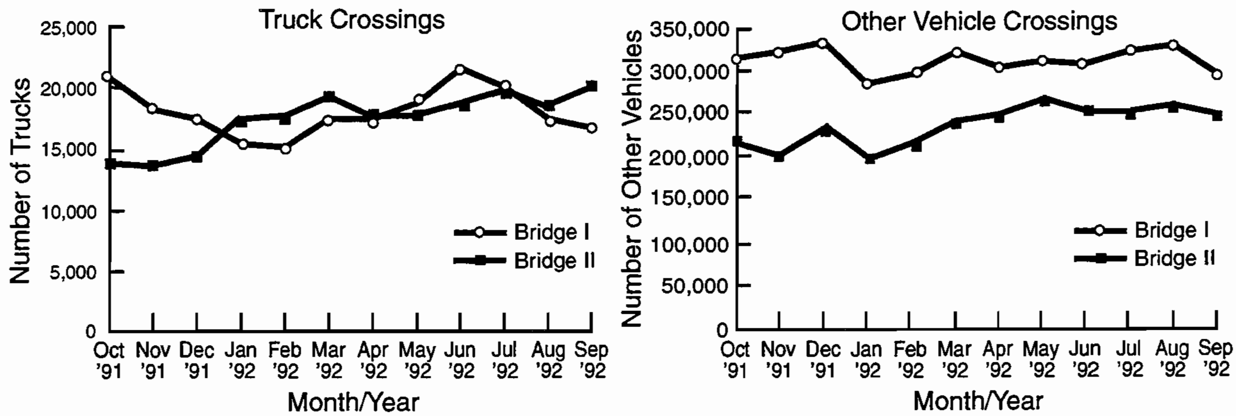


Figure 5.11 Southbound crossings at Bridges I & II, Oct. 1991-Oct. 1992

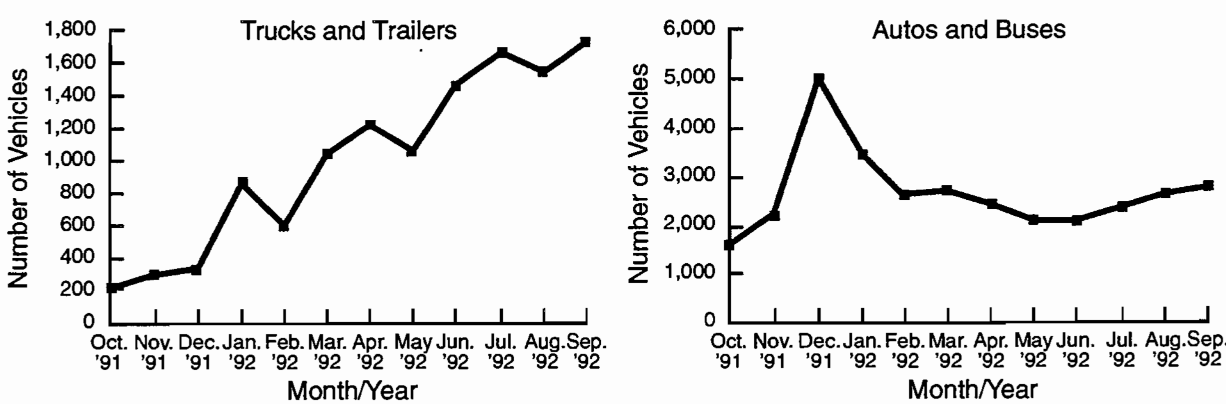


Figure 5.12 Southbound crossings at Colombia Bridge, Oct. 1991-Oct. 1992

Projections of future transborder traffic through Laredo/Nuevo Laredo—based on simplified assumptions that trade growth translates directly and equally to traffic growth of all types—indicate that transborder truck shipments through Laredo could reach 1.6 million by the year 2000 (Fig. 5.13) (Ref 57). Prediction models have not yet been developed that take into account the various factors affecting truck traffic increases by transport mode in all border crossings in general, and in Laredo in particular.

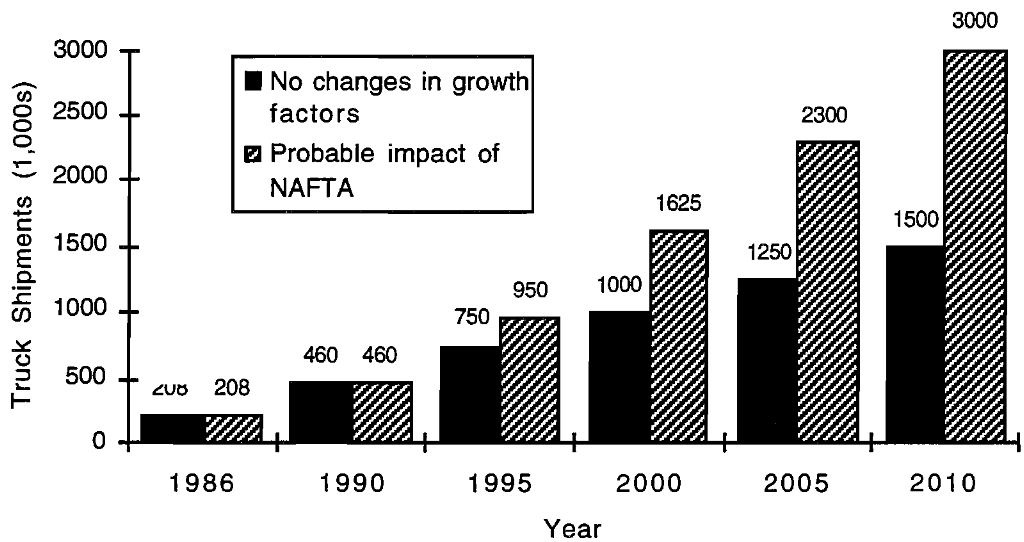


Figure 5.13 Projected truck shipments through Port of Laredo (Ref 57)

5.6 INTERMODALISM

The two rail companies that operate in Laredo are Union Pacific, which handles most of this traffic, and Texas-Mexican Railroad (Tex-Mex), a Class 2 railroad. Both lines use the same railroad bridge, located next to Bridge I to the west, which is owned jointly by Tex-Mex and Ferrocarriles Nacionales de Mexico (FNM). Cars going into Mexico are pushed halfway onto the bridge; from there they are pulled by FNM. The same operation takes place for northbound cars. Table 5.4 gives recent values of monthly loaded car crossings at Laredo. Like the imbalance between southbound and northbound truck traffic, there is an imbalance between southbound and northbound rail car shipments.

Table 5.4 Rail car shipments through Laredo/Nuevo Laredo

	NO. OF LOADED CARS	
	EXPORTS INTO MEXICO	IMPORTS INTO TEXAS
October 1991	7,307	1,942
November 1991	6,548	1,608
December 1991	8,150	1,074
January 1992	8,768	1,479
February 1992	9,044	1,804
March 1992	10,962	1,585
April 1992	10,983	1,853

Source: Border Business Indicators

Intermodal operations have played a major role in transborder transportation in Laredo since 1991, when Union Pacific started operating its intermodal yard, located on 350 acres (138 hectares) 14 miles (22.5 km) north of Laredo, adjacent to IH-35. This facility, which was constructed at an initial cost of $12 million, has a capacity of over 900 trailer/container units and two tracks which can handle 50 regular cars. It is also equipped with two 100,000-lb (45,400-kg) straddle cranes, which can complete a loading operation in 90 seconds. These cranes have built-in scales that detect overloaded trailers (which are then rejected). This intermodal yard handles both trailers on flat cars (TOFCs or piggybacks) and container double-stacks. It is estimated that approximately 10 percent of intermodal traffic into Laredo crosses into Mexico by rail, the rest being downloaded at the intermodal yard and transferred to tractors (Ref 63).

The development of intermodal (truck and rail) freight systems is a significant component of Laredo's transportation and economic planning policies (Ref 62). The Intermodal Surface Transportation Efficiency Act of 1991 also requires that a Metropolitan Planning Organization's plans provide for all modes of transportation, such as intermodal operations (Ref 64). There is not yet much evidence that Laredo has responded by developing any multimodal planning, but may very well in the immediate future.

5.7 CONGESTION, POLLUTION, AND SAFETY

Even when the truck route system mitigates some of the worse adverse effects of truck traffic in the central city, the mix of high volumes of truck traffic and passenger vehicles, combined with the inadequate geometric route conditions, creates congestion problems over the network. Additional congestion problems are created by railroad operations, such as the movement of Texas-Mexico trains through the city, and the insufficient number of overpasses above the railroad tracks.

With the rise in truck traffic, the number of tractor-trailer accidents in Laredo has increased during recent years (see Table 5.5). Shuttle carriers, which are paid by the trip, have a tendency to speed on IH-35 after each delivery in order to make as many crossings per day as possible. This is another potential source of accidents. Moreover, safety regulations on trucks are difficult to enforce because of the shortage of Department of Public Safety troopers (described in a previous chapter).

Table 5.5 Tractor-trailer accidents in Laredo (Ref 56)

Year	Number of Tractor / Trailer Accidents
1986	103
1987	137
1988	193
1989	462
1990	380

Large volumes of truck traffic are also likely to have an effect on the air quality of the city. Border crossings are characterized by long lines of cars and trucks whose running engines pollute the air. Unlike the city of El Paso, which has adverse topographic conditions that aggravate its air quality, Laredo, along with all of Webb County, is classified as an attainment area for carbon monoxide and nitrogen dioxide. The only air pollutant currently being monitored is particulate matter, which is assessed in terms of its concentration of PM10 (micrograms of particles smaller than 10 microns per cubic meter). PM10 is not specifically associated with vehicle emissions, and its levels for Laredo fall within established air quality standards (Ref 65). But in any case, it is expected that should the new controls on vehicle emissions mandated by the EPA be enforced in Laredo, there will be trouble with Mexican truckers, especially in light of the number of older tractors operated by the shuttle carriers, the expected increase in truck traffic, and the problems caused by simply trying to impose the new truck insurance and safety rules in Laredo during 1992 and 1993.

The city of Laredo has experienced, in recent years, substantial growth in transborder traffic. Major concerns regarding the adequacy of the city's infrastructure in handling more truck traffic include the capacity of border inspection facilities and of city roadways. Current truck volumes have already led to street damage and to congestion problems in some areas of the city. Thus, adequate maintenance and rehabilitation programs for this truck route system represent one of the city's important infrastructure needs. The next chapter will focus on the costs of these required maintenance and rehabilitation programs.

CHAPTER 6. LAREDO ROADWAY INFRASTRUCTURE

Transborder traffic has had a beneficial effect on the economy of Laredo and other border ports of entry. However, this traffic also generates additional costs, including costs related to the repair of streets damaged by excessive truck-axle loads. As described in a previous chapter, Laredo can adopt one of several strategies to offset infrastructure problems generated by high volumes of truck traffic: It can strengthen and maintain the truck route network, so that the network will be able to carry additional truck volumes and loads at desired service levels. Or, it can also divert part of or most of the transborder truck traffic from the downtown area, using orbital truck routes. In any case, present truck routes accommodating current levels of traffic will continue; in the future, however, traffic volumes will inevitably have to be diverted to alternative roadways. Given present truck-route and truck-volume conditions, policymakers should now assess and then allocate the funding required for truck route maintenance and reconstruction.

6.1 TRUCK ROUTES MODELING

One of the main transportation infrastructure concerns in Laredo is how to handle the increase in transborder traffic volumes. This concern is compounded by truck overloads (mainly from Mexican shipments) and the damage to city streets caused by such overloads. Truck volumes and truck-axle overloads, as they continue to grow, will drive up the overall life-cycle cost of maintaining and rehabilitating the Laredo streets that have been designated as truck routes. These life-cycle costs for Laredo truck routes (excluding state highways) are estimated under different conditions of truck traffic growth and truck loads in the following section.

The life-cycle cost of a facility represents the total cost of ownership over the facility's life span. Such cost includes initial costs and all subsequent costs of significance, as well as disposal value and any quantifiable benefits, all expressed in constant dollars. For pavements, different design, maintenance, and rehabilitation strategies will yield different life-cycle costs during the life of the project. In general, the economic evaluation of pavements should include both agency costs (e.g., initial construction costs, maintenance and rehabilitation costs, and salvage value) and users' costs (e.g., travel time, vehicle operation, accident, discomfort, and traffic delay costs created by construction operations) (Ref 66). For this study, only agency costs will be considered, which makes it very conservative and likely to significantly undervalue the true benefits of the investments).

Various computer models can be used to determine pavement maintenance and rehabilitation costs over a given analysis period and for given traffic conditions. Additionally, Laredo's truck routes can be analyzed as a network, or as the sum of individual projects or component sections—that is, at either the network or project level. At the network level, the objective is, in general, to determine project feasibility or the priority of projects within a given budget. A project-by-project analysis, on the other hand, determines the cost of each project, or the most economical alternative for each project case. While a network-level analysis would perhaps be more appropriate for the level of detail of the required analysis and of the available data in this case, we selected a project-level analysis, since it provided an estimation of near optimal costs for each project. A preliminary selection of models took into account the required output, the availability of input data, the required level of detail of the analysis, the consideration of Texas conditions, and the ease of operation. The following section lists the computer programs that researchers considered with regard to modeling typical sections of the Laredo truck route system.

(1) RENU: This program was developed by the Center for Transportation Research (CTR) and the Texas Transportation Institute in 1981 (Ref 67). Combining the previously developed REHAB and NULOAD into a new program that forecasts pavement rehabilitation costs, this computer model basically compares the effects of growing levels of truck size, weight, and configuration on pavement performance and maintenance/rehabilitation costs. The programs require detailed traffic input data, including truck types and axle load distribution by weight intervals (its pavement performance functions are based on Texas conditions). Such detailed information was not available for Laredo truck routes, and the conditions in Laredo cannot be considered typical of other sites in Texas. Therefore, the results obtained with the program would not be backed up by the appropriate level of detail in the input data. Moreover, the available version of RENU has a non-interactive type of input, which made its operation time-consuming and prone to error (each typical section requires a different run).

(2) *PRDS* (Pavement Rehabilitation Design System): This program was originally developed by CTR in 1982, with its latest version released by ARE, Inc., in 1988 (Ref 68). This program gives optimum rehabilitation strategies for given project conditions, based on minimizing net present value. It uses a combination of layer theory and finite element theory to predict pavement response under load, and fatigue models to estimate the life of overlay strategies. There are two disadvantages to using this program: (1) it requires a large number of input variables, and (2) most of these input variables would have to be estimated for Laredo at this time.

(3) *MPRDS-1* (Municipal Pavement Rehabilitation Design System, Version 1, ARE, Inc., 1990) (Ref 69): This program, adapted from PRDS, MFPS-1, and MRPS-1, was developed by personnel with the city of Austin, Texas. A number of input data are set as default values in the program. It is simpler and more user-friendly than PRDS. Some of its default values are based on conditions in Houston, which may not match conditions in Laredo. The program option that uses the default data for the calculation of traffic delay costs was not used in this analysis.

(4) DNPS86 (ARE, Inc., 1986) (Ref 70): This computer model for new pavement design was used to analyze a hypothetical scenario of new pavement structures for the truck routes. The program is based on the contents of the AASHTO Guide for Design of Pavement Structures

(1986), and it provides the life-cycle costs of the new pavement, of maintenance, and of proposed overlays over a given analysis period.

6.1.1 Selection of the Model

MPRDS-1 was selected to calculate the life-cycle costs of maintaining and rehabilitating Laredo's truck routes. This project-level pavement and rehabilitation design program determines the most cost-effective maintenance and rehabilitation design strategies for each pavement section, including each section's life-cycle costs. Total network cost is obtained by adding the cost of each component section.

The life-cycle cost obtained with MPRDS-1 for each project consists of the net present value of overlay construction and maintenance costs; MPRDS-1 also estimates the salvage value of the existing pavement at the time of overlay and the value of its extended life, which gives researchers the opportunity to compare the costs of strategies with different performance periods, in order to obtain the optimum. In the case of this analysis, the expression for the life-cycle cost would be the following:

$$\text{TOTCOST} = \text{EPMNTC} + \text{CC1} + \text{OVMNTC1} + \text{CC2} + \text{OVMNTC2} - \text{TVEXL} - \text{SALV} \quad (6.1)$$

where:

TOTCOST	=	net present value of strategy,
EPMNTC	=	present value of existing pavement maintenance cost,
CC1	=	present value of 1st overlay construction cost,
OVMNTC1	=	present value of 1st overlay maintenance cost,
CC2	=	present value of 2nd overlay construction cost,
OVMNTC2	=	present value of 2nd overlay maintenance cost,
TVEXL	=	present value of extended life, and
SALV	=	present value of salvage value.

The net present value of each of the above terms is calculated by multiplying the costs by a present worth factor. For example:

$$\text{OVMNTC1} = \text{OVMNTC1}_t \sum_{t=n1}^{t=n} \frac{1}{(1+i)^t} \quad (6.2)$$

where:

OVMNTC1	=	maintenance costs of overlay 1 in year t,
n1....n	=	years from year 0 when the sum will be expended, and
i	=	discount rate.

This model does not consider the impact of user costs or benefits, which represent in this analysis case reduction in costs owing to the varied scheduling of maintenance and rehabilitation strategies. The varied scheduling of the strategies is directly related to the different operating costs, time costs, and discomfort costs associated with pavement serviceability (Ref 71). Normally, a network-level analysis would have preceded the project-level analysis. However, the costs obtained here are adequate for estimation purposes.

While MPRDS-1 includes a program option that can estimate traffic delay costs during overlay operations, these traffic delay costs were not included in this analysis for two reasons: (1) they were calculated using default data that did not match local conditions, and (2) their impact on the total cost, as calculated, was not relevant.

6.1.2 Input Data

The input data for both MPRDS-1 and DNPS86 can be broadly grouped into (1) pavement layers/overlay characteristics and costs; (2) traffic factors; and (3) other life-cycle cost data. The following is a summary of the most relevant input data for both analyses.

(1) Pavement Layer Characteristics

In order to model the truck route system, the route was subdivided into different sections of constant total width within each street. A list of these sections and general characteristics is provided in Table 6.1.

According to data obtained from the City of Laredo Engineering Department, for most of the truck routes, the thicknesses of the existing pavement layers were similar, with the exception of a few sections. The same pavement structure was assumed for all the sections (in order to simplify the analysis), and the material characteristics and properties of each layer had to be estimated according to the thickness of each layer.

The remaining life of the existing pavement—which is one of the variables that most affects the resulting overlay design strategy—was approximately estimated by correlating a visual inspection rating (from poor to excellent, and averaged for the overall section length) for each of the truck routes, with a 0-to-100 scale of remaining life. The resulting values can be considered conservative. For the new pavement case, the same component materials were assumed.

Table 6.1 Models input data

Truck Route	**From - To**	**Section Length (ft / m)**	**No. of Lanes**	**Lane Width (ft / m)**	**Sect. Type**	**AREA (SY / m^2)**	**ADT (1991)**	**% Trucks**
Calton Road	Anna Ave. - San Bernardo Ave.	5,500 / 1,676	2	18.5 / 5.6	D3	22611/ 18,903	3,300	15
Calton Road	San Bernardo Ave.- McPherson Rd.	7,800 / 2,377	4	12 / 3.6	B2	41600 / 34,777	12,100	7
McPherson Rd.	Saunders St.-Calton Rd.	5,200 / 1,585	3	14 / 4.2	C2	24266.67/ 20,287	7,550	8
Sta. Isabel Ave.	River Rd.-Gonzalez St.	7,110 / 2,167	2	16 / 4.8	B3	25280.00/ 21,134	3,000	30
Sta. Isabel Ave.	Gonzalez St. - Burnside St.	3,050 / 929	2	16 / 4.8	D2	10844.44/ 9,066	2,950	22
Burnside St.	Sta. Isabel Ave.- Vidaurri Ave.	300 / 91	2	16 / 4.8	D2	1066.67/ 891	2,900	20
Vidaurri Ave.	Burnside St.-Lafayette St.	600 / 183	2	16 / 4.8	D2	2133.33/ 1,783	2,900	20
Sta. Maria Ave.	Lafayette St.-Del Mar Blvd.	13,500 / 4,115	2	16 / 4.8	B2	48000/ 40,128	5,100	17
Lafayette St.	Vidaurri Ave.- Sta. Maria Ave.	1,600 / 487	2	16 / 4.8	C3	5688.89/ 4,756	4,150	15
Lafayette St.	Sta. Maria-San Bernardo	1,850 / 564	2	20.5 / 6.2	C3	8427.78/ 7,045	3,500	15
Jefferson St.	Anna Ave.- IH-35	6,300 / 1,920	2	19.5 / 5.9	D3	27300/ 22,823	2,750	20
Scott St.	Sta. Isabel Ave.- IH-35	4,300 / 1,310	2	18 / 5.5	B3	17200/ 14,379	3,150	25
Washington St.	Sta. Maria Ave.-Zacate Creek	4,500 / 1,371	2	18.5 / 5.6	D2	18500/ 15,466	3,100	12
Sta. Maria Ave.	Washington St.- Scott St.	660 / 201	2	18.5 / 5.6	D3	2713.33/ 2,268	3,050	12
Corpus Christi	Zacate Creek-Springfield	1,200 / 365	2	19 / 5.8	D2	5066.67/ 4,235	3,950	12
Marcella Ave.	Guatemozin-Corpus Christi	2,300 / 701	2	18.5 / 5.6	D2	9455.56/ 7,905	3,500	12
Market St.	Marcella Ave.-US-83	7,700 / 2,347	2	19 / 5.8	D2	32511.11/ 27,179	8,100	7
Arkansas Ave.	Market St.-Saunders St.	9,700 / 2,956	2	18.5 / 5.6	C2	39877.78/ 33,338	9,500	7
River Road	Water St.-Export Lot	4,400 / 1,341	2	12.5 / 3.8	B2	12222.22/ 10,218	2,560	35
Anna Ave.	Jefferson St.-Markley Ln.	6,200 / 1,889	4	12 / 3.6	D1	33066.67/ 27,644	1,300	40
		93,770 / 28,581				**387832.22/ 324,228**		

Other input data

Pavement Layer	Thickness (in./cm)	Elastic Mod. (psi)	Poiss. Rat / Lay. CF.	Unit Cost	Discount Rate: 5%
Asphalt Concrete	3 / 7.62	450,000	0.30 / 0.44	80 $/CY	Overlay Unit Cost (MPRDS): $88/CY
Flexible Base	12 / 30.48	100,000	0.35 / 0.20	25 $/CY	Fixed Construction Cost (MPRDS) $5/SY
Flexible Subbase	6 / 15.24	15,000	0.40 / 0.15	15 $ CY	Overlay Construction Cist (DNPS): $80/CY
Roadbed Soil		6,000			Fixed Costs (DNPS): $10/lf

(2) Traffic Factors

The other input variables that are critical in determining the overlay and maintenance program for pavements include the initial year accumulated 18-kip equivalent single-axle loads (ESAL) and their growth factor. No reliable data of ADT or percentage trucks on the truck routes were currently available, and there were no data available on axle loads by weight intervals. The city has not yet performed traffic counts (such as percentage of trucks), although city officials plan to do so in the near future. Some data were available from traffic counts on the interstate and U.S. highways that have been designated as truck routes, but the particular characteristics of traffic flow determined by the bridge crossings and by the channelization of trucks into the truck routes made any extrapolation of percentage of trucks, in this analysis case, inadvisable. The same can be said of using traffic data from similar sites in Texas. Therefore, traffic and truck percentage values were estimated from the following sources: (a) 24-hour, 1991 traffic count data derived from a few sections of some of the truck routes; (b) 2-hour traffic counts performed by the study group in July 1992 on four truck route intersections (these counts included number of trucks by number of axles, and a 1-hour count of percentage of trucks); (c) volumes of southbound loaded and empty truck crossings and northbound loaded truck crossings at Bridges I and II for 1991 and previous years. The patterns of transborder truck crossings were also used to estimate the yearly number of trucks for some of the truck routes.

Truck loads were estimated by assuming the same proportion of loaded trucks in total truck traffic as in the bridge crossings (i.e., a conservative value of 70 percent). Trucks were distributed by truck types in a proportion estimated from (a) the study group's traffic counts, and (b) Mexican bridge truck crossing counts (1987-1989), which include the number of northbound trucks and number of axles. It was assumed that loaded trucks were carrying U.S. legal loads. The input value corresponding to truck loads can be expressed in terms of an average truck load equivalence factor (ATLEF), which is the average number of 18-kip ESALs of the existing truck traffic mix. The adopted ATLEFs fall within the range of values suggested by the Asphalt Institute (Ref 72). Different scenarios based on a truck percentage of 35 (i.e., half the loaded trucks) with a 10 to 50 percent overload (i.e., 1.1 to 1.5 of the base GVW) were also analyzed. These overloads result in higher ATLEFs, which is indicated in Table 6.2. Higher GVWs (i.e., higher payloads) in general would produce a lower number of trips, but this effect was not taken into consideration in this preliminary analysis.

Table 6.2 Average truck load equivalency factors

	Base Case	1.1 GVW	1.2 GVW	1.3 GVW	1.4 GVW	1.5 GVW
ATLEF	0.82	1.08	1.40	1.87	2.39	3.05

In this analysis, truck traffic growth is a value of particular relevance, but, as described in a previous chapter, it is not easy to determine. Assuming that the truck crossings' growth rates of recent years will continue, the projections derived from this assumption would far exceed the capacity of the existing truck routes in less than 20 years, which was also the adopted analysis period. Future truck traffic growth will depend on local factors, such as more crossings at Colombia Bridge or at future bridge crossings in the area (Ref 73). Assuming a range of possible traffic growth rates from the projections cited in Chapter 5, values from 10 percent of simple annual growth under present conditions, to 30 percent under a free trade agreement could be expected. Scenarios ranging from 5 percent to 30 percent were analyzed. The adopted growth factors were based on projected volumes for the end of the analysis period. Linear growth rates give a greater number of accumulated ESALs than compound growth rates, given the same final volume of trucks.

In order to simplify the analysis, and given that the truck traffic and pavement remaining life are the two dominate variables with regard to the resulting life-cycle cost of maintaining and rehabilitating existing pavement, the different truck routes were classified into categories according to these two variables, and the analysis was performed for each of these groups (see Table 6.3).

Table 6.3 Truck routes categories

Number of Daily Trucks	**Remaining Life (%)**				
	100-90	90-70	70-50	50-30	≤30
900-1,000	A1	A2	A3	A4	A5
700-900	B1	B2	B3	B4	B5
500-700	C1	C2	C3	C4	C5
300-500	D1	D2	D3	D4	D5
100-300	E1	E2	E3	E4	E5

(3) Other Life-cycle Cost Data

The analysis period adopted for both existing and new pavement was 20 years, which falls within the values recommended by AASHTO (Ref 66). Although the uncertainty of future traffic conditions may suggest a shorter analysis period, for many of the truck routes, any time period shorter than 20 years would be insufficient for the inclusion of overlay costs.

6.2 LIFE-CYCLE COSTS

The life-cycle costs for existing pavement on the truck routes under analysis are shown in Figure 6.1, which illustrates the increase in net present value of overlay and maintenance costs under different traffic growth scenarios. If the initial truck volumes on the truck routes are associated with a certain initial number of trucks using the truck route system, and if this initial number is accumulated with the growth rates assumed for the truck routes, then an estimated cost per truck can be obtained. This method would result in a better comparison between different growth rate scenarios—in other words, a different number of trucks accumulated over the analysis period—and was formulated only for that purpose. Assuming, for example, an initial volume of 1,400 trucks, the costs estimated per truck range from $0.23 for a 5-percent growth rate to $0.18 for a 30-percent growth rate. Within the range of assumed traffic growth values, and given the other traffic and existing pavement characteristics, decreasing unit costs per truck can be obtained. It should be noted, however, that the accumulated number of trucks does not take into account the number of trucks in each year of the analysis period; number of trucks in each year of the analysis period would have to be taken into account for payment per truck purposes. Similar results are obtained with the new pavement alternative (Figure 6.2).

Researchers used another set of scenarios for both existing and new pavement to consider the costs associated with different levels of overweight trucks. Figure 6.3 shows the expected additional costs versus average truck load equivalency factors. These overweight truck costs were calculated assuming a 10-percent truck traffic growth. The unit costs per truck, for the existing pavement analysis, varied from $0.22, with no overloads, to $0.46, with a 50-percent overload for half of the loaded trucks. For the new pavement case, and under the same conditions, it ranges from $0.72 to $0.80. Existing pavement maintenance and rehabilitation costs double with the 50-percent overload case.

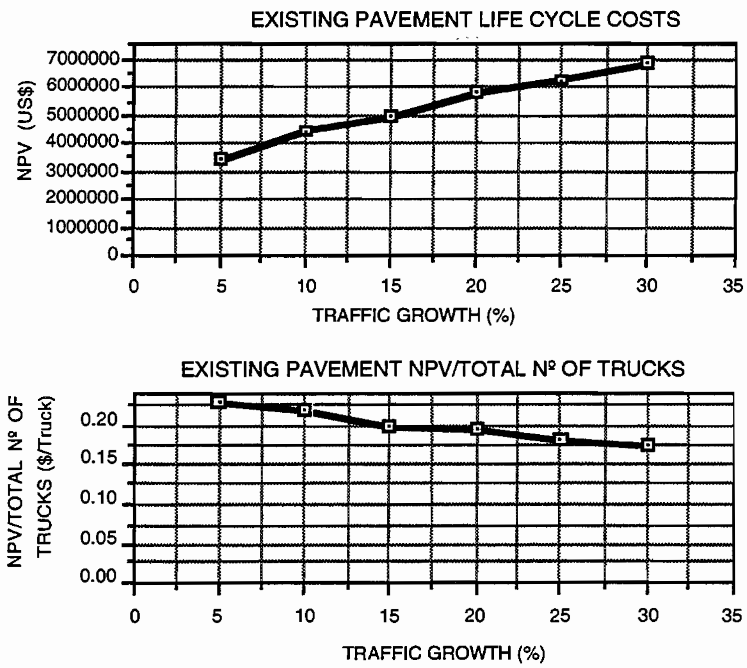


Figure 6.1 Life-cycle costs for existing pavement

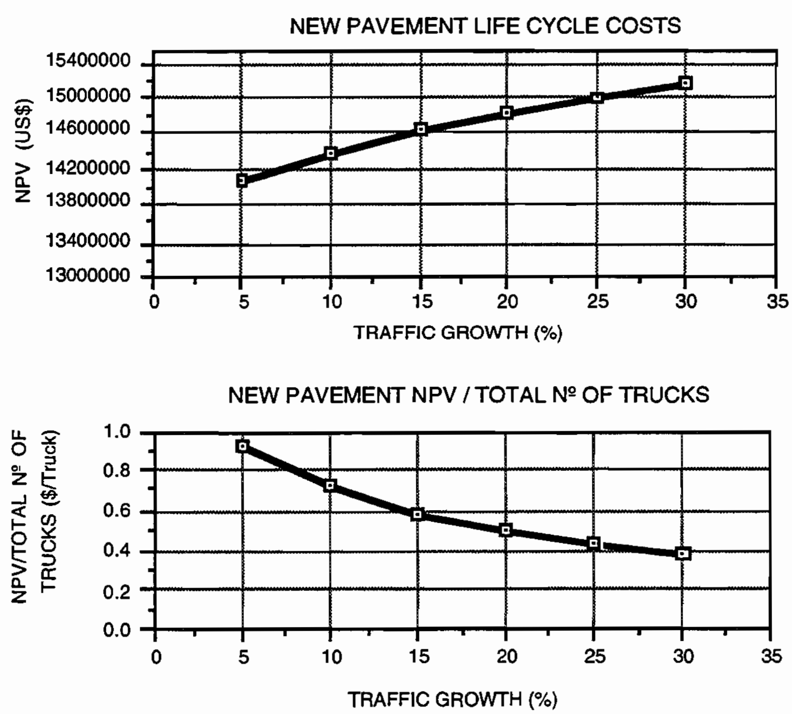


Figure 6.2 Life-cycle costs for new pavement

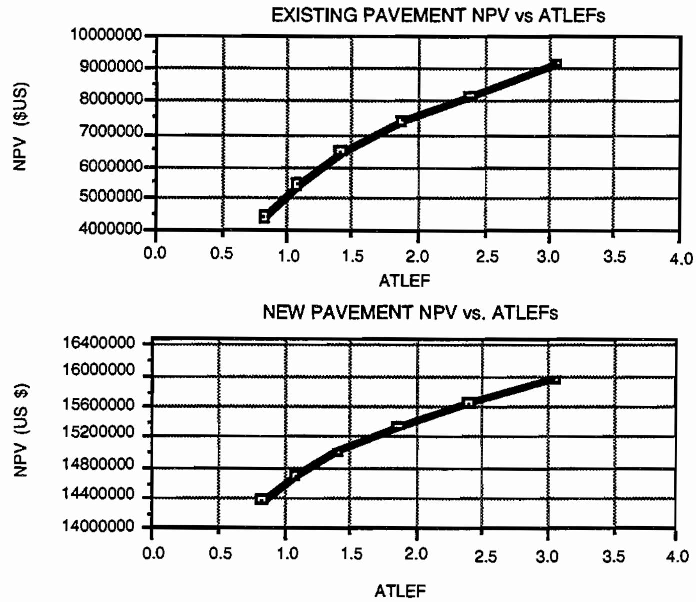


Figure 6.3 Net present value for increasing ATLEFs

Since the truck volumes for the routes used in this analysis were estimated from available data, previous results were obtained for different percentage of trucks in order to determine the sensitivity of the results to this data input. A sensitivity analysis evaluates values 20 and 40 percent above and below the averages originally assumed for each of the truck routes. For example, for a route with 10 percent trucks, the analysis was repeated for 6, 8, 12, and 14 percent trucks. This range is about the same as the likely errors in the assumed values. The results are shown in Figure 6.4. The net present values of optimum overlay and maintenance strategies appear to be very sensitive to the number of trucks—that is, to the initial number of ESALs. Lower percentages of variation result for the existing pavement case. Therefore, it is of vital importance to have reliable traffic information in order to obtain reliable cost predictions for both existing and new pavement cases.

A similar sensitivity measure (regarding truck loads) can be assimilated to the results obtained for different ATLEFs.

The above results relied on a number of simplifications with regard to costs, traffic, and existing pavement characteristics. For overlay strategies, the values of overlay thicknesses calculated in some cases reached 7 inches (17.78 cm), which for city streets could mean removing the existing surface layer and improving the subbase (which is the rehabilitation strategy needed for those truck routes not designed for high truck volumes; costs might fall between the existing pavement and the new pavement scenarios). Maintenance costs were probably underestimated in overlay strategies, since truck traffic loads are more than likely above legal limits, and a more costly maintenance program might be required.

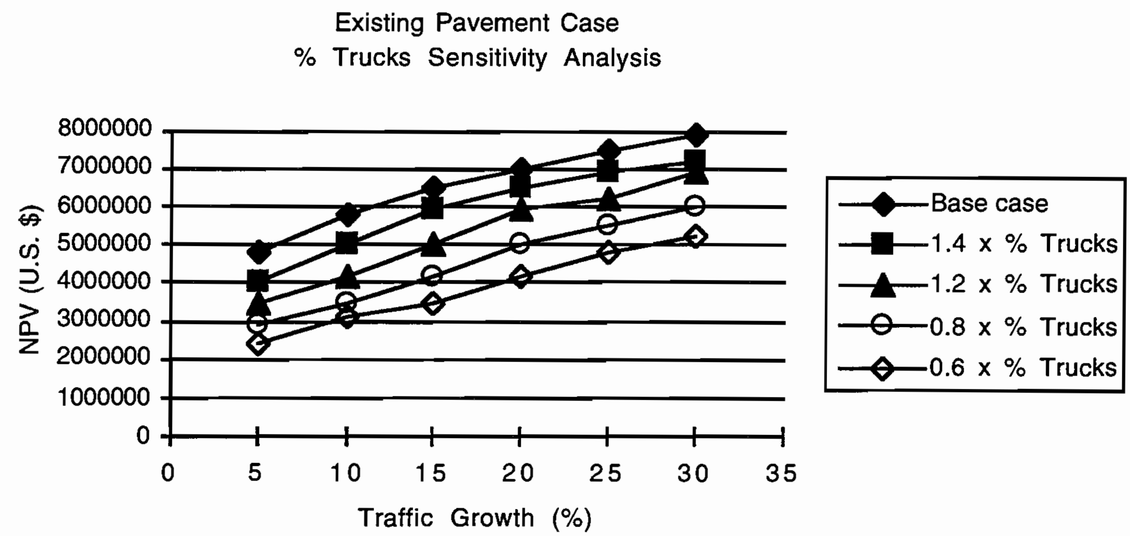


Figure 6. 4 Percentage trucks sensitivity analysis

6.3 COST RECOVERY MECHANISMS

Once the life-cycle costs for the truck routes are obtained (including maintenance and rehabilitation), the next step in the analysis is to determine possible sources of funding for the additional costs resulting from transborder truck traffic. One possible source would be a surcharge levied on trucks licensed to operate in the city. Other approaches would be to add an additional fee to the bridge tolls, or to allocate a higher percentage of bridge revenues to street reconstruction. The following section will describe the current bridge fee revenues and budget.

6.3.1 Bridge Tolls

In Mexico, international bridges have a unified toll structure for northbound traffic into Texas, which is administered by a federal agency (Caminos y Puentes Federales y Servicios Conexos) belonging to the Secretariat of Communications and Transportation. In the U.S., conversely, tolls vary from city to city, and sometimes even from bridge to bridge within the same city (e.g., in Brownsville). While Laredo tolls are fixed for different types of loaded trucks, tolls in Del Rio, Eagle Pass, and McAllen have a component that depends on the truck load (Ref 24). For Mexican bridge tolls for truck traffic, these bridge tolls depend on the number of axles, and it is the same for loaded or empty trucks. For southbound traffic, tolls are determined by the City of Laredo, which administers the bridges through the Laredo Bridge System. Tolls are based on truck type and vary for loaded and empty trucks. In most cases, loaded trucks pay their tolls with freight coupons purchased in advance.

Table 6.4 shows the northbound and southbound tolls for Laredo Bridges (Ref 74). Although vehicle grouping for toll purposes are not identical in Mexico and the U.S., it follows from this table that Mexican tolls are higher than U.S. tolls for similar vehicles. In the case of a loaded 5-axle semi-trailer combination or 3-S2 type truck, the driver would have to pay $12 on the U.S. side and the U.S. equivalent of $17 on the Mexican side.

Table 6.4 Laredo bridge tolls

SOUTHBOUND BRIDGE TOLLS

December 1992

VEHICLE	EMPTY (U.S. $)	LOADED
Autos	1.00	
1/2 Ton (907 Mg) Pickups	1.00	2.00
Autos and 1/2 Ton (907 Mg) Pickups pulling small Trailers	2.00	3.00
Pickups with rear Twin Wheels	1.00	4.00
Two-Axle Bob-Tail Truck	1.00	4.00
Three-Axle Bob-Tail (Torton)	1.50	6.00
Tractor Trailer under 84,000 lb (38,136 kg)	5.00	12.00
Tractor Trailer with 84,000–100,000 lb (38,136–45,400 kg)	5.00	24.00
Tractor Trailer with over 100,000 lb (45,400 kg)	5.00	30.00

Source: Laredo Bridge System

NORTHBOUND BRIDGE TOLLS

December 1992

VEHICLE	TOLL (Mexican Pesos)	TOLL (U.S. $)
Autos and Pickups	6,000	1.90
Buses and Two-Axle Trucks	18,000	5.70
Three-Axle Trucks	30,000	9.50
Four-Axle Trucks	42,000	13.30
Five-Axle Trucks	54,000	17.10
Six-Axle Trucks	66,000	20.90
Additional Axles	12,000	3.80

Source: Caminos y Puentes Federales de Ingresos y Servicios Conexos

Laredo's bridge toll revenues from 1991 to 1992 amounted to approximately $12 million, about 12 percent of the city's total operating funds. From these revenues, approximately $2 million, or 16 percent, was allocated to a street reconstruction fund (Table 6.5). The largest proportion of the bridge revenues went to the city's general funds, while another $2 million was used to service the bridge debt (an obligation resulting from a $12 million bond that was issued in 1990 for the construction of the Colombia Bridge, and from two other bond issues dating from 1976 and 1986).

The street reconstruction fund derived from the Bridge System accounts for almost 75 percent of all available funds for street reconstruction (Table 6.6). Street reconstruction funds apply to all the city street network, of which the truck routes constitute a minor portion, and these funds apply, in part, to new paving as well.

6.3.2 Cost Allocation

Given the existing structure of bridge toll collection, the cost of maintaining and rehabilitating the existing truck routes could be included as part of the existing truck fees. For this purpose, the net present values obtained for each of the traffic growth scenarios considered can be expressed as an equivalent annual cost or as an equal series of payments for each year of the analysis period. These annual payments can be calculated as follows:

$$\text{Equivalent Annual Payment} = \text{NPV}\,\frac{i\,(1+i)^{n}}{(1+i)^{n}-1} \qquad (6.3)$$

where:

NPV = net present value of the maintenance and rehabilitation strategy,

n = discount rate, and

n = number of years of the analysis period.

In this case, a conservative 5-percent discount rate was assumed for the 20-year analysis period.

The annual payments can then be divided into annual costs per truck. For the initial year of the analysis period (1991), and for cost allocation purposes, the assumed total number of trucks will be the total number of southbound loaded truck crossings, that is, approximately 350,000. Annual payments and costs are summarized in Table 6.7.

An increasing number of trucks, given the traffic growth rates assumed for running the models, would yield lower values of cost per truck. For design purposes, it is necessary to consider traffic growth factors, since the adopted design will remain beyond the entire analysis period. However, for the purposes of truck payments, and because of the uncertainty of traffic predictions under the changing bilateral trade environment, these traffic growth factors will be revised on a regular basis. In subsequent years, traffic growth factors will be adapted to the prevailing traffic situation.

The values obtained for existing pavement, and for a tractor-trailer under 84,000 lb (38,136 kg), represent 7 to 13 percent of present tolls. Assuming that the total cost of new pavement would be added to the toll fees, these charges would represent a more substantial 30 percent for the same type of vehicle. The order of magnitude of the maintenance and rehabilitation costs per truck do not represent major increases in the tolls, and this system would allow repayment of the loans for the required program. The increased fees for trucks would still be lower on the U.S. side of the border than on the Mexican side. It should be noted, however, that the costs that were calculated in this analysis did not reflect the damage imposed by trucks on non-truck route streets. (Truck routes represent only a minor portion of the city street network.) Nor were bridge maintenance and bridge funding for future truck routes considered.

The feasibility of assigning a percentage of the bridge revenues for a specific purpose, such as the maintenance and rehabilitation of truck routes, deserves further analysis, since these revenues are today largely incorporated into the general funds, and since the city has extensive infrastructure needs.

Bridges can provide needed revenues (through tolls) and can be used to divert traffic according to the city's infrastructure planning policies (e.g., to relieve congestion at certain points). Current traffic conditions may also be substantially altered by future infrastructure developments in the area. Some of these future projects will be described in the next chapter.

Table 6.5 Bridge system operating budget

City of Laredo, Texas, Bridge System Operating Budget (Summary) 1992-1993 (from City of Laredo data)

DESCRIPTION	**ESTIMATED 1991-1992**	**PROPOSED 1992-1993**
OPENING BALANCE	400,000	128,895
REVENUES		
Total Receipts	12,282,663	12,877,034
Rental of Facilities	31,886	32,631
Miscellaneous	2,903	2,100
TOTAL REVENUES	12,317,452	12,911,765
TOTAL AVAILABLE	12,717,452	13,040,660
EXPENSES		
Bridge I & II Operations		
Personal Services	1,082,940	1,199,087
Materials & Supplies	25,695	28,970
Contractual Services	537,873	551,490
Other Charges	71	204,171
Capital Outlay	13,208	45,410
Debt Service	600	
Total Bridge I & II	1,660,478	2,029,108
Colombia Bridge		
Personal Services	133,123	167,268
Materials and Supplies	5,887	8,300
Contractual Services	129,065	220,788
Capital Outlay	18,353	-
Total Colombia Bridge	286,428	396,356
Transfers Out		
General Fund	5,252,374	5,800,000
Street Reconstruction	1,980,655	1,926,875
Bridge-Debt Service	2,708,622	1,952,321
Street Paving	700,000	700,000
Construction		200,000
Total Transfers Out	10,641,651	10,615,196
TOTAL EXPENSES	12,588,557	13,040,660

Table 6.6 Street reconstruction operating budget

City of Laredo, Texas, Street Reconstruction Operating Budget (Summary) 1992-1993

DESCRIPTION	**ESTIMATED 1991-1992**	**PROPOSED 1992-1993**
OPENING BALANCE	588,741	-
REVENUES		
Interest Earnings	22,372	20,000
State Grant- Traffic Light	100,079	
Operating Transfers In:		
General Fund	131,362	-
Bridge System	1,980,655	1,962,875
Transit Sakes Tax	500,000	550,000
Risk Management		335,531
TOTAL REVENUES	2,734,468	2,568,406
TOTAL AVAILABLE	3,323,209	2,568,406
EXPENDITURES		
Personnel Services	427,523	507,053
Materials and Supplies	918,456	708,506
Contractual Services	45,118	50,003
Other		70,508
Debt Service	79,429	-
Operating Transfers Out:		
General Fund	650,000	623,536
EDA-Anna Truck Route	521,636	-
EDA-McPherson Extension	-	350,000
Street Improvements	76,000	-
Total Operating Expenditures	2,718,162	2,309,606
Capital Outlay	605,047	258,800
TOTAL EXPENDITURES	3,323,209	2,568,406
CLOSING BALANCE	-	-

Table 6.7 Annual payments and costs per truck

IMPROVING EXISTING PAVEMENT

TRAFFIC GROWTH (%)	NET PRESENT VALUE (U.S. $)	EQUIVALENT ANNUAL COST (US $)	COST PER TRUCK ($ / unit)
5	3,471,000	278,500	0.80
10	4,389,000	352,200	1.00
15	4,990,000	400,400	1.15
20	5,813,000	466,500	1.35
25	6,292,000	504,900	1.45
30	6,895,000	553,300	1.60

NEW PAVEMENT EXAMPLE

TRAFFIC GROWTH (%)	NET PRESENT VALUE (U.S. $)	EQUIVALENT ANNUAL COST (U.S. $)	COST PER TRUCK ($ / unit)
5	14,092,000	1,130,800	3.20
10	14,392,000	1,154,900	3.30
15	14,634,000	1,174,300	3.35
20	14,836,000	1,190,500	3.40
25	15,008,000	1,204,300	3.45
30	15,161,000	1,216,600	3.50

CHAPTER 7. MEDIUM- AND LONG-TERM STRATEGIES FOR LAREDO'S INFRASTRUCTURE PLANNING

As stated previously, the city of Laredo, representing one of the major ports of entry into the U.S. and Mexico, is expected to face significant increases in traffic in all modes as a result of a free trade agreement. Indeed, city officials have estimated that $300 million in infrastructure improvements would be needed for the Laredo area, given the anticipated impacts of a free trade agreement (Ref 30). Central to the planning process have been three key entities — the Metropolitan Planning Organization, the Texas Department of Transportation (TxDOT), and the City of Laredo.

7.1 METROPOLITAN PLANNING ORGANIZATION (MPO)

The Metropolitan Planning Organization (MPO), a state organization formed by city, county, and state representatives, prepares and updates periodically a long-range (20-year) plan (LRP) specific to a state metropolitan area. Its goal is to provide, as far as possible, transportation facilities that function as an integrated metropolitan transportation system, with emphasis placed on those facilities serving important national and regional transportation functions. For the city of Laredo, the metropolitan planning area covers approximately the city limits.

A vital function of the MPO is its preparation of a Transportation Improvement Program (TIP). This program — a requirement of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 — includes (a) a priority list of projects to be carried out over a 3-year period; (b) all projects within the metropolitan planning area requesting federal highway or transit funding; and (c) a financial plan that demonstrates how the TIP can be implemented. The TIP is updated at least once every 2 years.

7.2 TEXAS DEPARTMENT OF TRANSPORTATION (TXDOT)

In coordination with the MPO (and in accordance with ISTEA mandates), TxDOT maintains a 10-year development plan. A series of projects in various stages of development are presently underway on both the national highway system and on some city roadways receiving TxDOT assistance (Fig. 7.1). In the Laredo area, projects under construction in 1992 included a 2.5-mile (4-km) section of McPherson Road, and a stretch of U.S. 83 from Guadalupe to Matamoros, with a new bridge structure over Zacate Creek (these projects are intended to improve east-west vehicular movements). And almost complete is the widening and reconstruction of FM 1472 (Mines Road) from IH-35 to Colombia Bridge. A second stage in this project includes the construction of a four-lane divided highway. TxDOT has already acquired more than 80 percent of the right-of-way and has contracted for the first 4 miles (6.4 km) from Colombia Bridge. The urban section of this highway will have two lanes in each direction, with allowances for left turns and parking helping to ease access to the adjacent industrial developments.

Looking toward the near future, TxDOT plans to expand IH-35 from four to six lanes in its urban section. Another project in the Laredo area is the Inner Loop. This project is scheduled for expedited construction in three phases. The first phase, a section running from IH-35 to the airport, will be let in November 1993 for completion in August 1994. The second phase, a section running from the airport to Spur 400, will be let in June of 1994, and the third and final phase, a section running from Spur 400 to SH 359, will be let one month later. Phases two and three will be completed in about 12 months (i.e., August 1995).

Because plans for the Outer Loop are still in a preliminary phase, the loop's exact location has not yet been determined. Both the Inner and the Outer Loops are intended to divert truck traffic from the downtown area (Ref 74). The Inner Loop connects with Milo Interchange and FM 3464 at the extension of the proposed Laredo III Bridge. Laredo's plans for a fourth bridge site use the Milo Interchange as the entry point into the loop system. It is recognized that any link from the Rio Grande to the Milo Interchange would need to be a controlled access route, in order to limit congestion from businesses that may relocate to take advantage of the new truck routes. The Outer Loop may also connect with this bridge and with Union Pacific's Intermodal Yard. It could also be tied, to the south, with a future fifth international bridge (Ref 75).

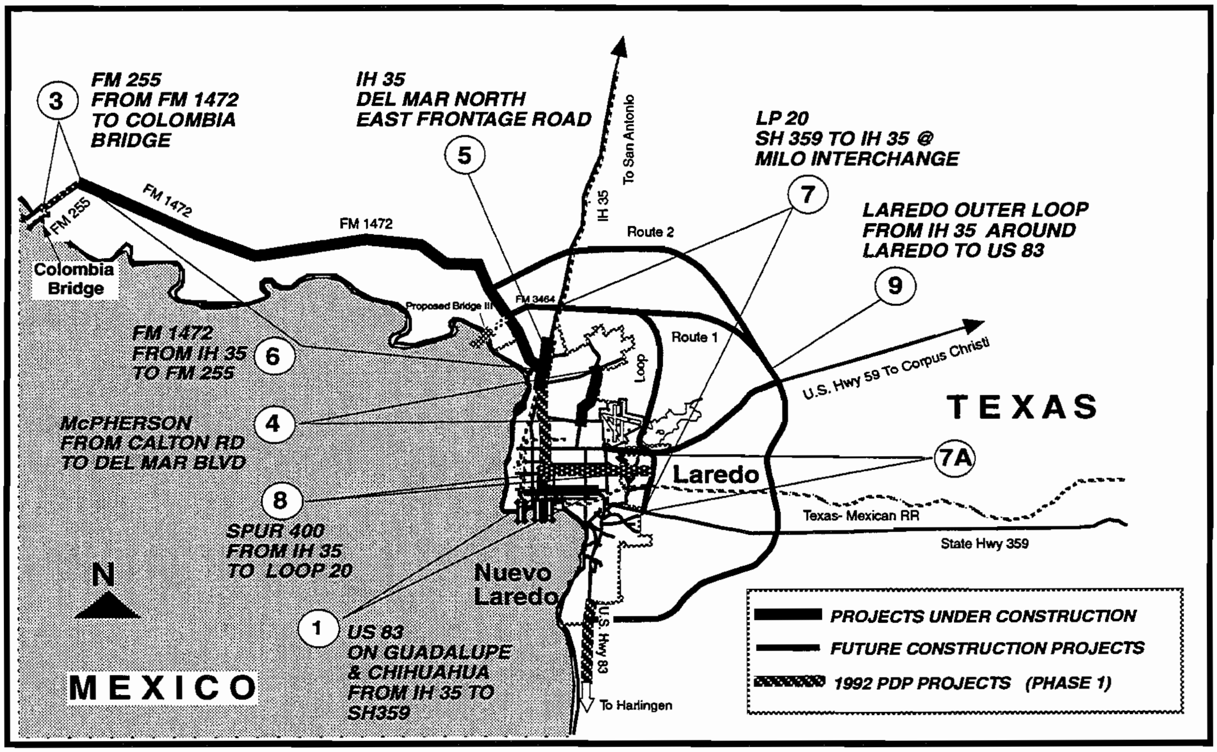


Figure 7.1 Major Laredo projects (June 1992)

7.3 CITY OF LAREDO

At the city level, the main policies, goals, and objectives for infrastructure planning are summarized in the City of Laredo Comprehensive Plan. This plan, covering both land use and transportation requirements, guides public and private decisions regarding new developments. The tools for implementing this plan are the city zoning and subdivision ordinances and the Capital Improvements Program (CIP). The CIP guides public investment in roadways and in drainage, water, and wastewater public facilities, coordinating all projects from different departments into one multi-year program. Most CIPs are planned over 5 years, with the first year covered as part of the annual budget. City street reconstruction projects are included within the CIP (although those receiving TxDOT assistance are excluded). Given the Comprehensive Plan, it is expected that the northern and northwestern portions of Laredo from Mines Road, including Colombia Bridge, will become Laredo's dominant industrial and warehousing sector (developments in this area can be better planned than developments in areas closer to the city). The comprehensive plan also includes a Thoroughfare Plan based on existing and estimated demand for transportation facilities. Basically, a Thoroughfare Plan reserves rights-of-way for future thoroughfares. According to the Comprehensive Plan, a Thoroughfare Plan should be considered in regional travel demand modeling by TxDOT. The plan should also be reviewed regularly as transportation networks are refined (Ref 52). The strategies and entities involved in Laredo's transportation infrastructure planning are summarized in Figure 7.2.

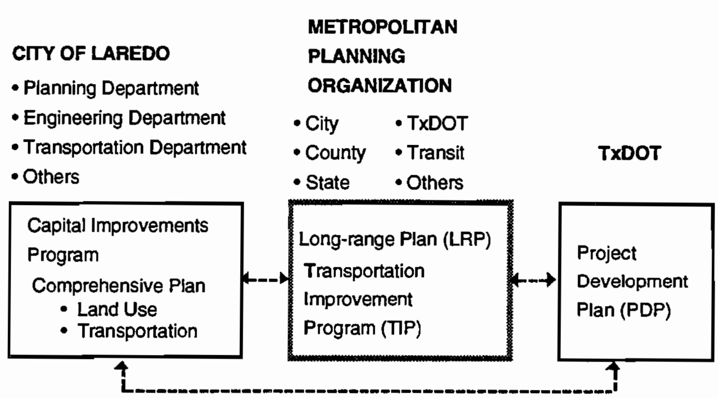


Figure 7.2 City of Laredo transportation infrastructure planning

While the city had proposed the construction of a fourth international bridge, Bridge III, to be located to the north of Bridges I and II on the extension of FM 3464, the application was denied by federal authorities, who indicated that there was no need to build another bridge as long as Colombia Bridge continued to operate below its capacity. Moreover, another crossing would, say federal authorities, increase expenditures relating to Customs, Immigration, and Animal and Plant

Health inspection facilities and personnel. However, the bridge would be particularly convenient for the industrial and warehousing developments in the industrial parks adjacent to the area. Local drayage companies, interested in maximizing the number of crossings per day, also regard this project as having the potential to be more efficient than Colombia Bridge for their operations. The project is also promoted by the City of Nuevo Laredo, since it would divert traffic from Colombia Bridge in Nuevo León. Nuevo Laredo's future plans also include the construction of a loop connecting MEX85 with the proposed Bridge III (Ref 34) . The possibility of building another railroad bridge parallel to Bridge III, which would alleviate rail interferences in the city, was also being considered.

On a regional scale, one of TxDOT's projects is to upgrade U.S. 59 to a four-lane highway (U.S. 59 being part of the Texas Highway Trunk System leading to Corpus Christi). Another project under development for the medium term is Camino Colombia, a 22-mile (35.4-km) private toll highway facility that would connect Colombia Bridge via FM 1472 with IH-35 at a point 26 miles (41.8 km) north of Laredo (Figure 7.3). Anticipating the likely prospect of rising trade between the U.S. and Mexico, a group of area landowners initiated a private toll corporation which will fund and operate this facility; the facility would be built on right-of-way dedicated by the same corporation shareholders. Once completed, this facility would provide direct access from Colombia Bridge to IH-35 and from there to U.S. 83, U.S. 59, and SH-44 (Ref 76). On the Mexican side, a toll road connecting Monterrey with Colombia Bridge will also be constructed. Although Camino Colombia promises to generate economic growth for the Laredo area, the city of Laredo is skeptical, since this road could divert significant volumes of traffic, thus reducing the city's benefits related to border-traffic services. The lower taxes of the area adjacent to Camino Colombia could attract industrial development.

In addition, a public-private investor group has proposed a longer-term project to connect Colombia Bridge with the existing highway infrastructure. In this case, the project consists of a beltway that will circle the area, from Colombia Bridge in the north to U.S. 83 in the south, and will possibly connect with a potential international bridge (Figure 7.4). The project also includes a link to U.S. 59 leading to Corpus Christi. The completion of the beltway on the Mexican side of the border will also be proposed (Ref 77).

Finally, current and future projects indicate that Laredo is undergoing great changes in its street system (which is expected to handle both present and future traffic volumes). The Metropolitan Planning Organization plays a key role in the financing and planning of these projects and interacts with the other entities involved in the city's infrastructure planning. The transborder nature of Laredo's traffic calls for coordination with Nuevo Laredo's highway infrastructure projects, and also with infrastructure planning along the Texas-Mexico border (Figure 7.5). Long-term projects in Laredo, which are also related to projects on the Mexican side of the border, include toll road links with interstate and U.S. highways. Over the short term, however, current truck traffic must have an improved roadway system, and the trucking industry (directly) and consumers (indirectly) should be prepared to pay for it.

The preliminary findings of these costs and cost recovery mechanisms, together with the general conclusions of this study, are summarized in the next chapter.

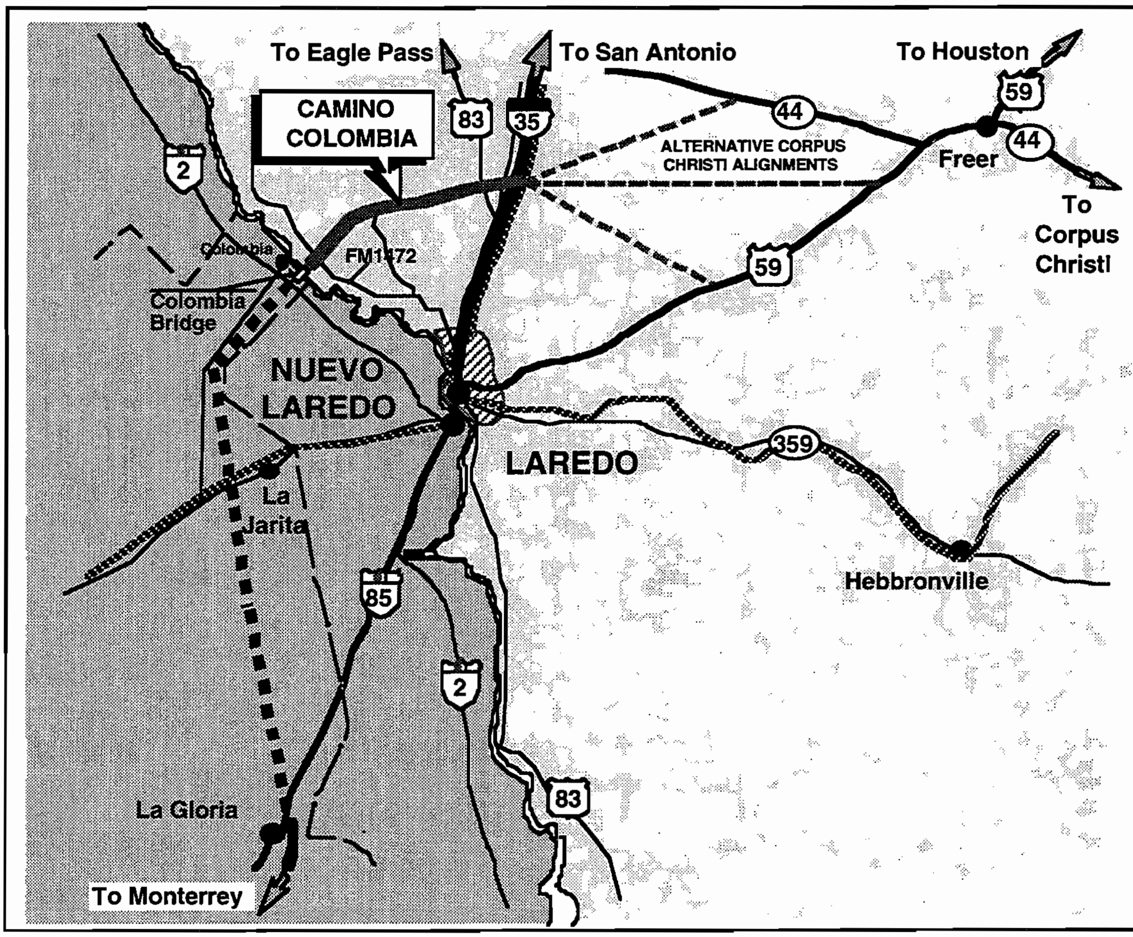


Figure 7.3 Camino Colombia

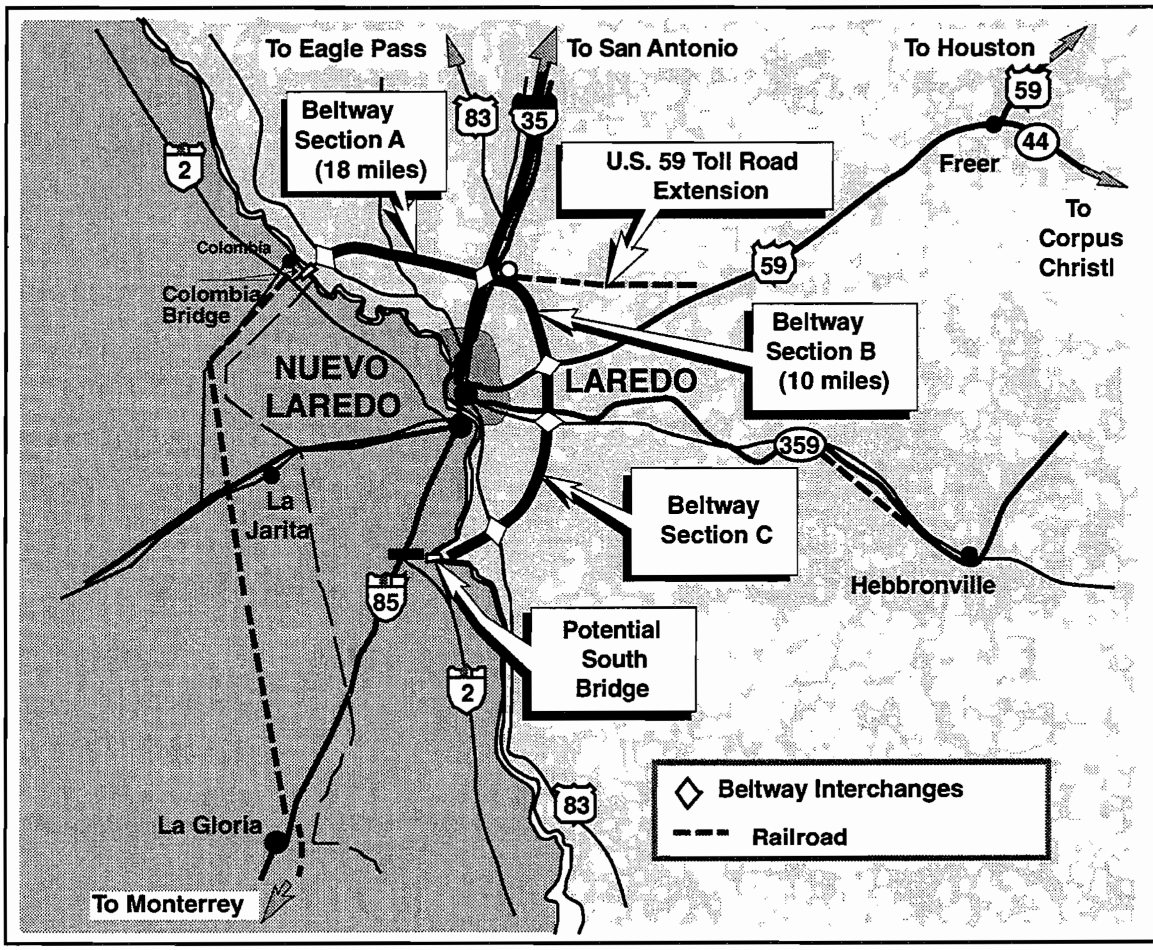


Figure 7.4 Laredo Beltway (Note: 1 mile=1.61 km)

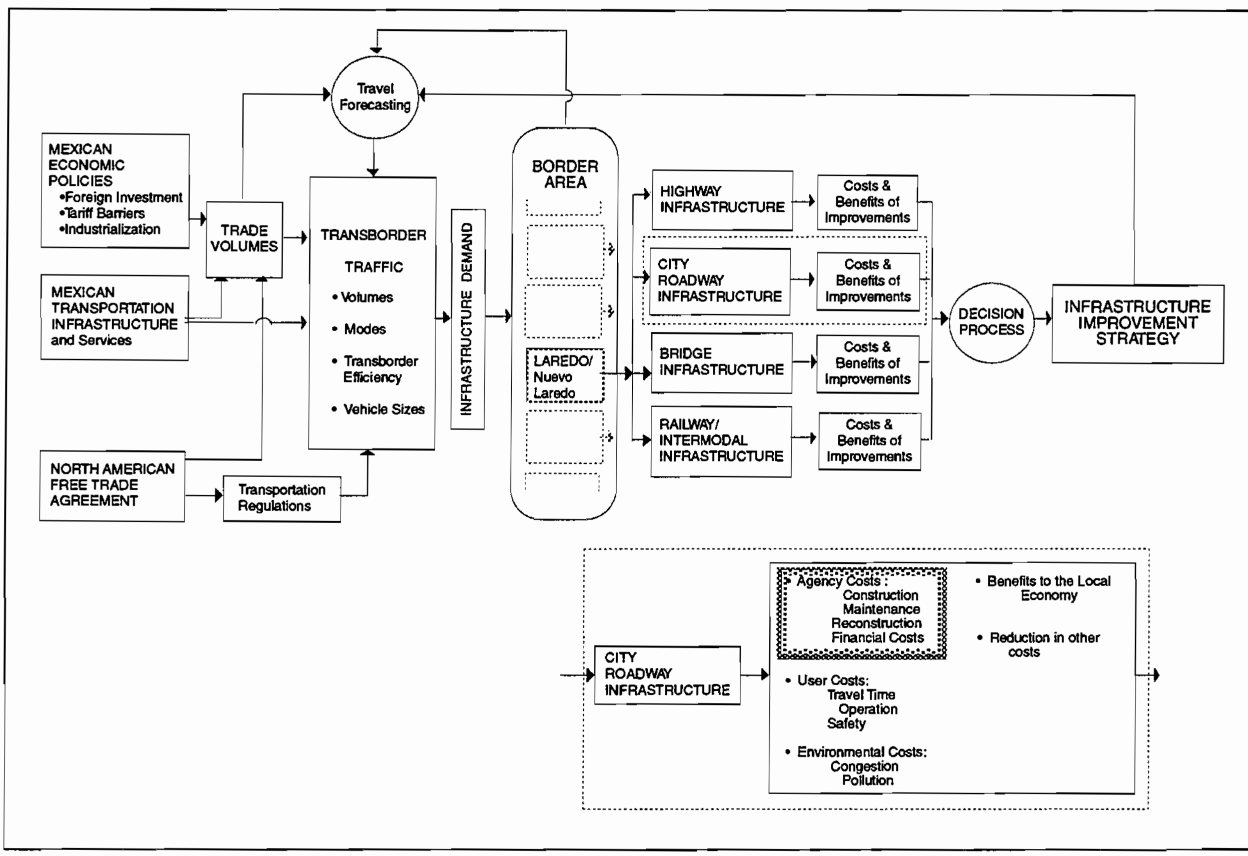


Figure 7.5 Border infrastructure planning

CHAPTER 8. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Most analysts agree that a free trade agreement linking the U.S., Mexico, and Canada will substantially increase trade volumes among the three countries. A boost in trade will also be brought about by Mexico's growing economy and its greater openness to foreign investment. The maquiladora industry, a key factor in stimulating trade, has contributed significantly to the ongoing industrial integration of the two countries. The growth of the maquiladoras is an example of U.S. investment in Mexico and of the growing commercial interdependence between the two countries.

As trade volumes increase, the need for a sound transportation infrastructure becomes imperative—particularly along the Texas-Mexico border, where over 60 percent of present bilateral trade takes place. With ground transportation being the major component of transborder traffic, additional investment along the border will be required to handle current and projected traffic volumes. To adequately plan these projects, engineers must develop traffic forecasting models that take into account trade predictions, modal choice, and the conditions of both the U.S. and Mexican infrastructure. Comprehensive planning should include consideration of both border ports and Mexican ports. Economic growth in the border area also requires bilateral planning and investment in environmental protection projects.

The capacity of border crossings in efficiently managing rising trade volumes depends on factors such as the adequacy of inspection facilities and the expediency of their operations. The introduction of pre-clearance operations in U.S. and Mexican customs operations for both motor carrier and railway crossings has reduced border congestion at ports of entry. Current regulations on transborder motor-carrier accessibility produce complex transborder crossing operations. The free trade agreement is intended to ease transborder operations, though border inspections will still be required. NAFTA provisions (including the opening of border states to foreign trucking 3 years after the execution of the agreement) might reduce demand for such border port services as warehousing. However, these ports will still play a central role in crossings and trade-related services.

This study focused on the city of Laredo as a key U.S. port of entry. In recent years, this city has experienced significant increases in transborder traffic (particularly truck traffic) and trade-related services. But along with the economic benefits of high-volume truck traffic, there are drawbacks, including accelerated road wear, congestion, unsafe facilities, and pollution. Laredo is now in the position of having to balance the economic benefits of increased trade with the direct and indirect costs of rising truck traffic volumes. While Colombia Bridge, located outside the downtown area, is expected to absorb an increasing share of overall border traffic, it will continue to be underutilized (compared with the downtown bridges) as long as it has inadequate connecting infrastructure. New industrial developments in the area adjacent to FM 1472 and infrastructure improvements on both the U.S. and Mexican sides of the border are expected to increase the number of crossings at Colombia. The two bridges in the downtown area, Bridges I and II, however, are expected to continue handling significant traffic volumes in the short term, especially that traffic destined for maquiladoras in Tamaulipas.

The roadway system feeding into Bridges I and II, which includes the city's truck route system, requires an appropriately funded maintenance and rehabilitation program in order to provide adequate serviceability levels. This study obtained estimates of the life-cycle costs of maintenance and rehabilitation programs for the city of Laredo truck route under different scenarios of traffic growth and in cases of existing pavement and new pavement (including construction costs). Because reliable data regarding truck traffic volumes, vehicle classification, and axle loads were not available at the time of the study, their values were estimated after conferring with city staff. Cost predictions derived from the adopted models proved to be sensitive to traffic volumes, to load data, and to pavement condition data. The estimated life-cycle costs, when annualized to an equal series of payments during the analysis period, were on the order of 15 to 30 percent of the current bridge tolls for southbound trucks. Even with this surcharge, total southbound tolls would be less than current northbound tolls for the same vehicle. A cost recovery mechanism can therefore be implemented through an increase of these bridge tolls.

Some of the existing truck routes adjacent to Bridges I and II, because of their downtown location and limited right of way, are not expected to handle the projected increases in transborder truck traffic under a free trade agreement. Projects such as the Inner Loop and Outer Loop are expected to provide alternative routes for trucks (and so reduce truck interference with the rest of the city's traffic). In addition to Colombia Bridge, projects such as the proposed Bridge III are intended to absorb increasing transborder traffic (i.e., with the appropriate connecting infrastructure and supporting services). Longer-term plans, including toll road links with U.S. and interstate highways, will divert traffic from the city, which could have an adverse effect on the city's economy. It is, therefore, important for Laredo to develop and to improve its transportation infrastructure so as to maintain its position as a leading port of entry.

8.1 CONCLUSIONS AND RECOMMENDATIONS

The following are the conclusions and recommendations of this study:

1. With the expected increase in trade between the U.S. and Mexico, additional investments in transportation infrastructure will be needed to manage truck, rail, and auto traffic. Traffic forecast models that encompass the whole border area between Texas and Mexico must be developed to validate infrastructure investment decisions.
2. NAFTA provisions on cross-border motor carrier accessibility and foreign investment in transportation services will increase the efficiency of transborder operations. The opening of border states to foreign trucking competition may divert trade-related services to various locations in the interior. However, until the trucking industry adapts to new regulatory conditions, border ports of entry will continue to play vital roles in transborder crossings and in border-traffic-related services.
3. Laredo can be viewed as a case study of the effects of transborder traffic on roadway infrastructure. Laredo's current traffic conditions and the crossing volumes at its three bridges can also be taken as representative of the factors—other than bridge capacity—

that should be considered in the planning of new crossings. These other factors include (a) the capacity of the adjacent street system on both sides of the border, (b) the expediency of and potential improvements in customs operations in the U.S. and Mexico, (c) the adequacy of the connecting highway infrastructure on both sides of the border, and (d) the location of trade related services.

4. Laredo's current truck route system plays a vital role in channeling transborder traffic through Bridges I and II. This truck route system should be strengthened and maintained at adequate serviceability levels through a maintenance and rehabilitation program. The estimated life-cycle costs derived from this study for a maintenance and rehabilitation program, under the assumed conditions, indicate that the program's cost can be recovered by an increase in bridge tolls of about 15 percent. Given the costs of construction, maintenance, and rehabilitation, funding the program would require a toll increase of no more than 30 percent, under the same assumed conditions. Bridge tolls are the most direct means for recovering these costs, since funds are collected by the city by means of an already existing toll structure.

5. For the city to obtain better cost projections of pavement maintenance and rehabilitation (projections which can be regularly updated), data need to be gathered regarding traffic volumes, percentage of trucks, truck traffic classification, axle loads, pavement condition, and maintenance costs. Axle load data are of particular importance, given the differences that exist between U.S. and Mexican truck weight limits. All incoming trucks should be monitored to ensure compliance with U.S. trucking regulations. Gross and axle loads could be checked efficiently using a weigh-in-motion (WIM) system to protect both the city and state highway pavements from accelerated wear.

6. To better assess the effects of transborder truck traffic on roadway infrastructure, Laredo should implement a pavement management system (PMS) tailored to its needs. Such a PMS could determine pavement life-cycle costs and, thus, facilitate decisions regarding the allocation of funds. This PMS would comprise the entire network of city streets, of which the truck route is an important subsystem. Further studies should be conducted to include users' costs as well as agency costs in a PMS model.

7. An increase in city truck traffic translates into additional costs associated with congestion, air pollution, safety, and discomfort to residents. These factors should be quantified and included in the city's transportation infrastructure decision process.

8. The Metropolitan Planning Organization not only plays an important role in the financing and planning of new projects; it also serves to coordinate planned projects with city and TxDOT projects. An example of one of these projects is the Inner Loop, which is intended to complement existing truck routes. U.S. and Mexican authorities should work to coordinate U.S. projects with those planned across the border in Mexico, so that resources are used efficiently to provide a well-planned transborder transportation system for the area.

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