

# **BEST PRACTICES FOR ACCOMMODATING PEDESTRIANS AT INTERNATIONAL BRIDGE CROSSINGS**

*by*

Steven P. Venglar and Karen P. Fierro

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*Report prepared by*

Center for International Intelligent Transportation Research

Texas Transportation Institute

4050 Rio Bravo, Suite 151

El Paso, TX 79902

TEXAS TRANSPORTATION INSTITUTE

The Texas A&M University System

College Station, Texas 77843-3135

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## EXECUTIVE SUMMARY

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There are currently 24 international bridge crossings of the Rio Grande River between Texas and Mexico, as well as two dam crossings and one ferry crossing. In total, these crossings carry between 45 and 55 million vehicles on an annual basis and transport over 100 million people between Texas and Mexico each year. This level of international crossing activity has beneficial economic, community, and social impacts on border communities in both Texas and Mexico. Unfortunately, increasing violence and security concerns in Mexico have had a recent negative impact on border-crossing activity. However, the everyday needs of shopping, local employment, and social interaction continue to be met even though elective recreation and vacation trips are declining.

Pedestrian crossings of international bridges along the Texas-Mexico border account for roughly 20 million annual crossings, or 20 percent of cross-border travel. Unlike private automobile trips, most pedestrian trips are essential rather than discretionary. As a result, pedestrian border-crossing activity has not been negatively impacted in recent years, at least not anywhere near the extent private-vehicle crossing activity has declined. The current research was framed recognizing the needs represented by international bridge users in the pedestrian mode and reveals best practices for accommodating pedestrian demand in the proximity of international bridge crossings.

While literature on the topic of pedestrian international bridge users is limited due to the narrow focus of the topic, supporting literature is available from such sources as traffic engineering and general public-facilities design. Engineering design guidelines and standards reveal conditions where pedestrian-related signs, signals, and markings are needed, and indicate requirements for their appearance and placement. Supplemental guidance, some of which is the result of recent research on pedestrian crossing treatments, provides the design engineer with methods for determining which type of pedestrian crossing treatment and advance motorist warning or control device is appropriate for a given set of roadway volume, pedestrian volume, and roadway speed conditions.

A component of this research investigation was four site visits conducted at high-volume international pedestrian bridge crossings in the Brownsville, McAllen/Hidalgo, Laredo, and El Paso, Texas, metropolitan areas. The site visits served a two-fold purpose:

- they revealed needs around which future best practices could be developed, and
- they provided in-situ examples of successful methods for addressing several important pedestrian-related mobility and safety concerns.

As an example of needs, the literature review identified a travel survey for the El Paso region that documented a higher-than-expected percentage of pedestrian bridge users being dropped off and picked up at the bridge crossing by private automobile. This activity was then observed and verified in the field at each of the four bridge crossings where site visits were conducted, resulting in recommendations and suggested best practices for addressing this issue.

In terms of site visits directly revealing best practices, several examples exist from each bridge crossing and the roadway network in the vicinity of each bridge:

- In Brownsville, the needs assessment for a new primary multimodal transit center accounted for the proximity of the Gateway International Bridge and its international pedestrian users in site selection; the new multimodal facility is currently being constructed only three blocks from the bridge.
- In Hidalgo, the McAllen-Hidalgo-Reynosa International Bridge has a transit station located on the grounds of the bridge-crossing land port of entry, precluding the need for most transit users to cross roadways in order to access transit service from/to the bridge. Where roadway crossings are necessary away from a signalized intersection near the bridge, advance warning signs of the downstream crosswalk are provided to alert motorists.
- In Laredo, a new bridge management complex was recently constructed, and refinements were made for the roadway approaches to the Gateway to the Americas International Bridge. Improvements include a grade-separated pedestrian walkway to remove auto/pedestrian conflicts, a pedestrian plaza near the bridge passageway to Mexico, low walls and landscaping to direct at-grade pedestrian activity to marked crosswalks that feature a pedestrian table treatment (i.e., raised crosswalk), and a drop-off turnout designed into the new bridge complex to expedite safe pedestrian access to the Mexico-bound walkway component of the bridge facility.
- In El Paso, a shopping area and pedestrian destination known as Lion's Plaza has been recently reconstructed and enhanced close to the point where pedestrians access the bridge into Mexico. A new Sun Metro transit transfer center has recently been constructed within four blocks of the Paso Del Norte International Bridge, and a pedestrian pick-up/drop-off facility is being constructed between the Paso Del Norte and Good Neighbor Bridges, both of which serve high volumes of international pedestrian bridge traffic.

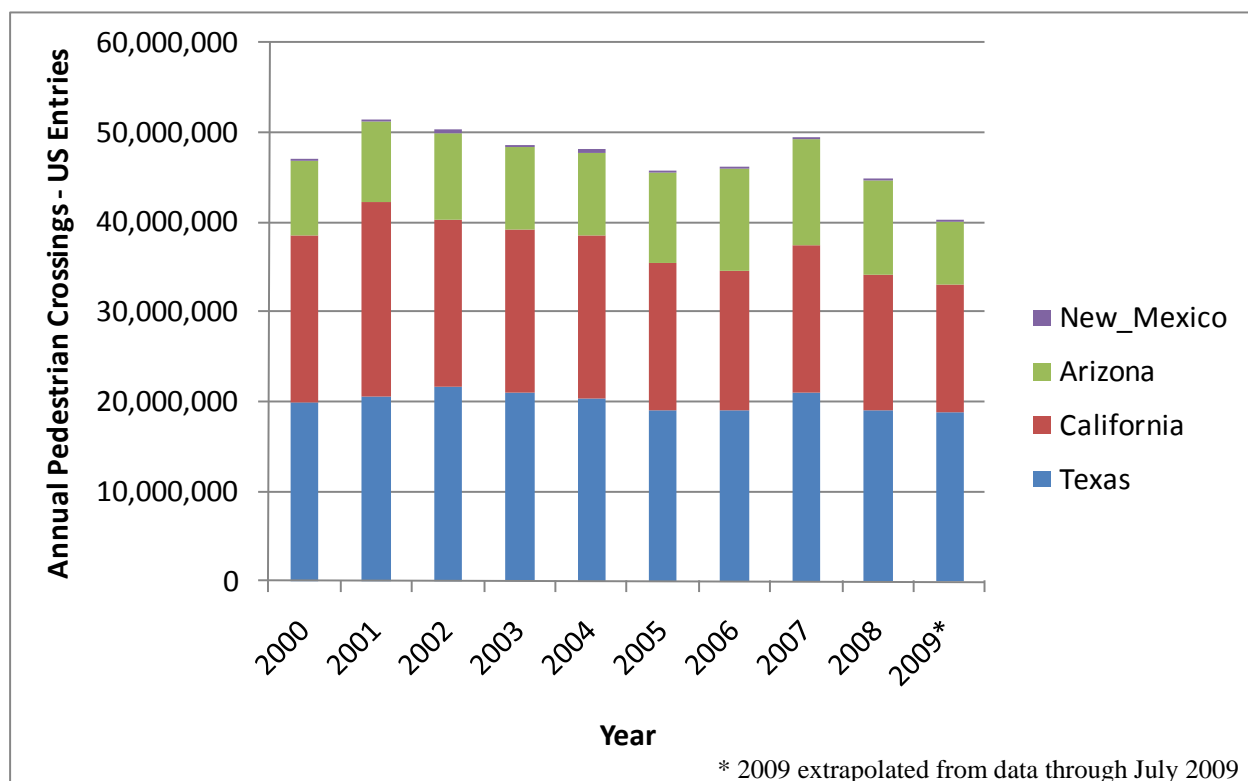
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## CHAPTER 1: INTRODUCTION

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The Texas-Mexico border has 27 crossings; 24 are bridges, two are dam crossings, and one is a hand-drawn ferry (*1*). While the Rio Grande River creates a physical barrier along the length of the Texas-Mexico border, these crossings create modal, community, and cultural links between over a dozen Texas cities and towns and their sister communities in Mexico. To provide a frame of reference for a discussion of pedestrian utilization of international bridges in Texas, a variety of relative usage statistics are provided in the following figures.

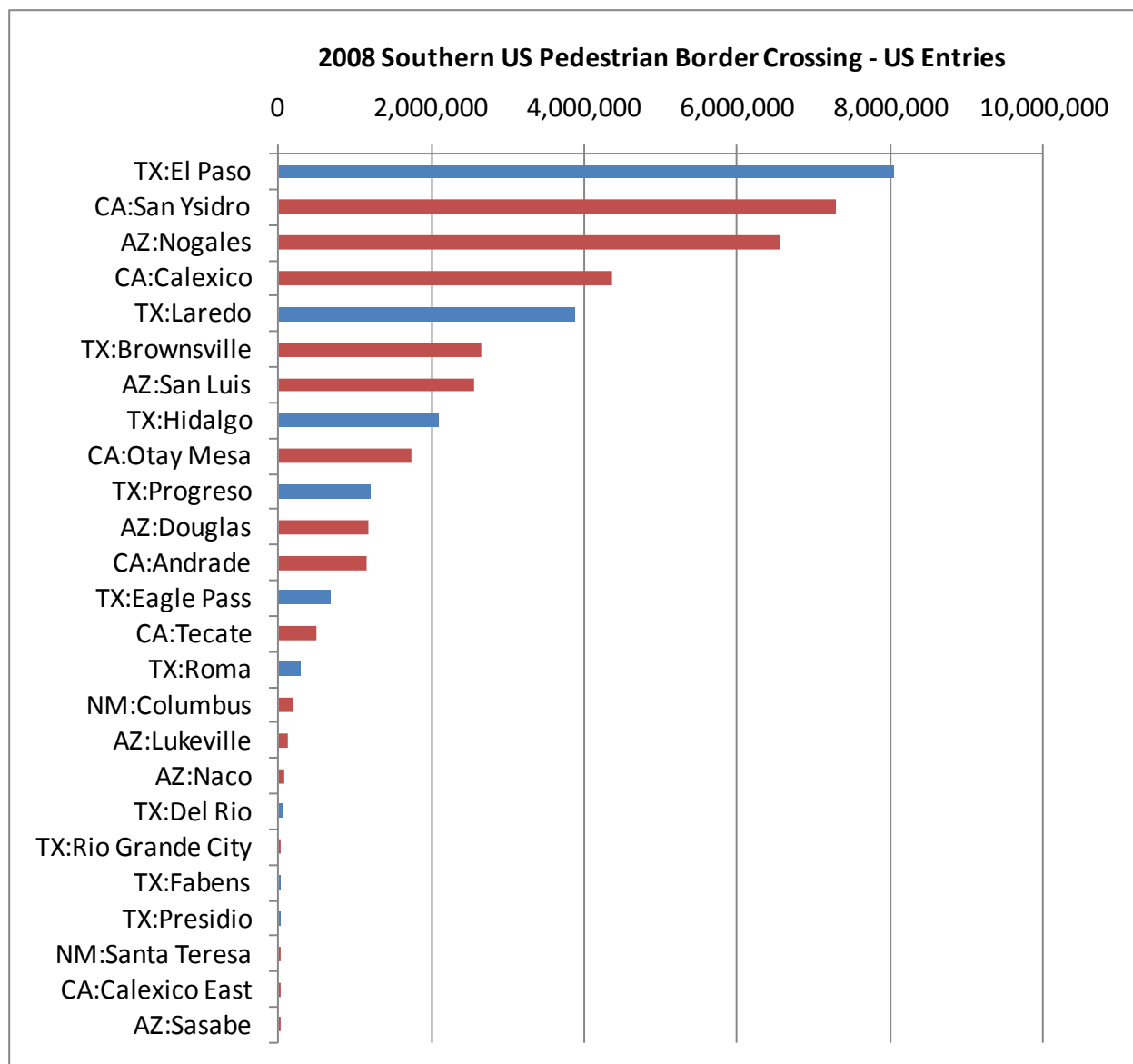
Figure 1 highlights the relative pedestrian crossing volumes for the four southern U.S. states bordering Mexico. Data for the figure are supplied by the U.S. Bureau of Transportation Statistics' online border-crossing database (*2*). While pedestrian crossings in southern California have historically been consistently high due to the high-volume San Ysidro crossing between San Diego, California, and Tijuana, Mexico, for almost all of the last 10 years the pedestrian volumes using Texas border crossings—all of which require crossing the Rio Grande River—have exceeded those of California. For the past several years, pedestrian volumes in all southern states have decreased in response to several trends including increased border security and scrutiny since 2001, an economic recession that began in both the United States and Mexico in 2007, and increased violence in Mexico in the past several years.



**Figure 1. Southern U.S. Border Crossing Pedestrian Entries—2000–2009.**

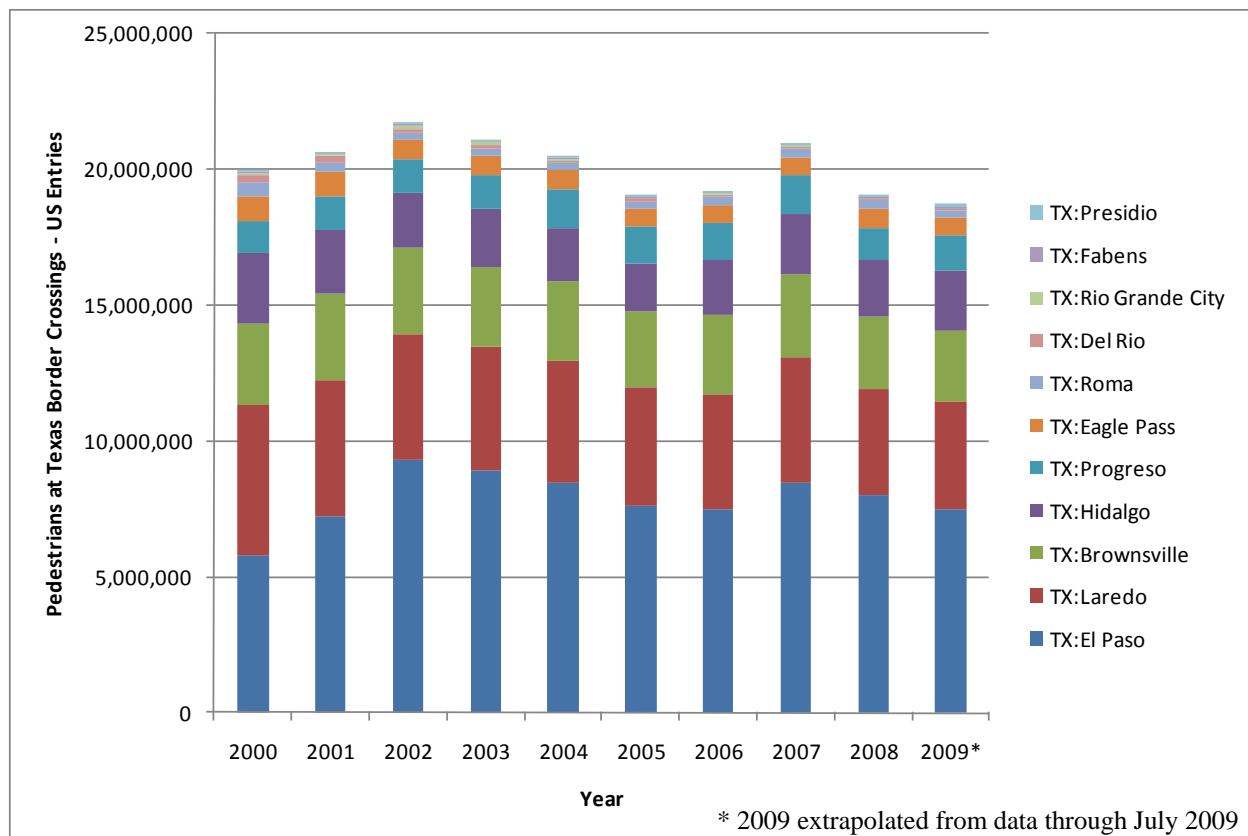


When pedestrian border crossings for developed areas are considered (2), pedestrian crossings in the El Paso, Texas, region are the highest in the country (see Figure 2). With over eight million annual pedestrian border-crossing entries into the United States, there is an average of 22,000 daily walking trips into the El Paso region across the Texas-Mexico border. In spite of depressed economies in both the United States and Mexico and despite violence in Mexico and U.S. border towns that is usually attributed to the negative economy of drug activity, the necessities of everyday work, school, shopping, and social activity result in a large number of pedestrian cross-border trips that, by their nature, contribute to the transborder community and economy.



**Figure 2. U.S. Southern Pedestrian Border Entries by Urbanized Region—2008.**

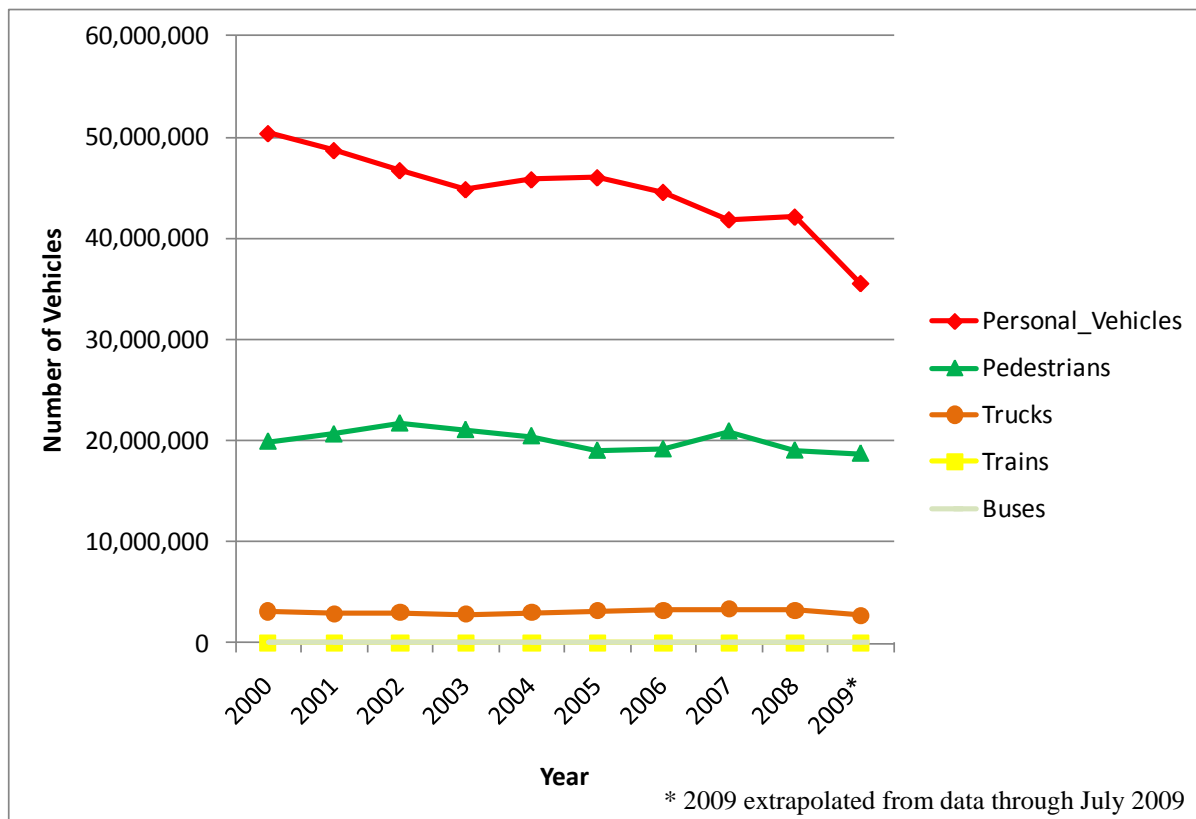
Comparing pedestrian border-crossing activity in El Paso with the rest of Texas (Figure 3, data from the Bureau of Transportation Statistics [2]), it is clear that while the El Paso region may have the highest-volume crossing of pedestrian users, it by no means is the only international crossing where pedestrian border-crossing activity plays a vital role in the transborder community's economic, cultural, and social well-being. It is also significant to note that high-volume pedestrian border crossings are found across the entirety of the Texas-Mexico border, from El Paso to Brownsville, Texas.



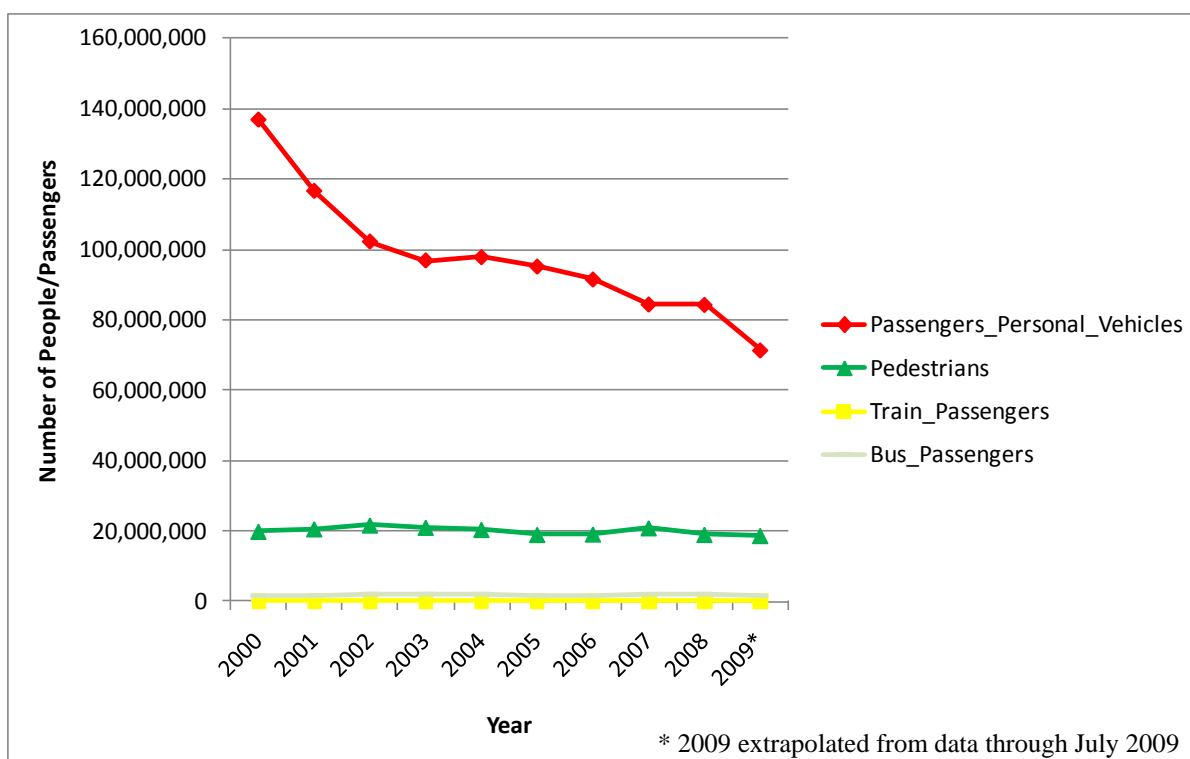
**Figure 3. Texas Pedestrian Border Crossing Entries—2000–2009.**

Texas-Mexico border crossings by mode are portrayed in Figure 4 (data from the Bureau of Transportation Statistics [2]). Personal vehicles greatly outnumber the other transportation modes used to enter the United States, not only by the number of entering vehicles (or individuals, in the case of pedestrians), but also in terms of the number of people ultimately crossing the border to enter the United States (Figure 5). However, Texas border entry trips by personal vehicle have borne virtually the entire decline in overall border-crossing travel in recent years, as shown in both figures. It can be argued that while the recent reduction in economic activity and increase in border violence have affected leisure/vacation trips largely taken by automobile, there has been considerably less impact on trips by other modes. Reasons for the relative stability of pedestrian, train, and bus modes are likely linked to trip purpose; border

crossings are local daily trips of necessity between home and work or school, or local social and shopping trips that are intrinsic to everyday life.



**Figure 4. Texas-Mexico Border Entries by Mode—2000–2009.**



**Figure 5. Texas-Mexico Border Entries—Passengers by Mode—2000–2009.**

## EXISTING INTERNATIONAL BRIDGE INFRASTRUCTURE IN TEXAS

Texas' 24 international bridge crossings of the Rio Grande River carry nearly all of the border-crossing travel described in the previous section. Of these 24 bridges, many have been expanded and/or have undergone modifications in vehicle utilization in their history. Not only are these bridges the physical infrastructure by which each border crossing is made, they are also the link in the transportation network that conveys individuals from their trip origin on either side of the border to their destination on the other side of the border.

Table 1 provides details about the location and types of traffic (automobile, commercial truck, and pedestrian) served at each crossing. In communities with multiple bridges (i.e., El Paso, Laredo, McAllen/Pharr/Mission/Hidalgo, and Brownsville, Texas), a historical and generic overview of bridge infrastructure progression would include construction of additional bridges as capacity of an existing bridge is reached, conversion to one-way bridge operations as multiple adjacent structures are built, and the eventual specialization of bridge functions to remove commercial vehicles/trucks from congested urban centers.

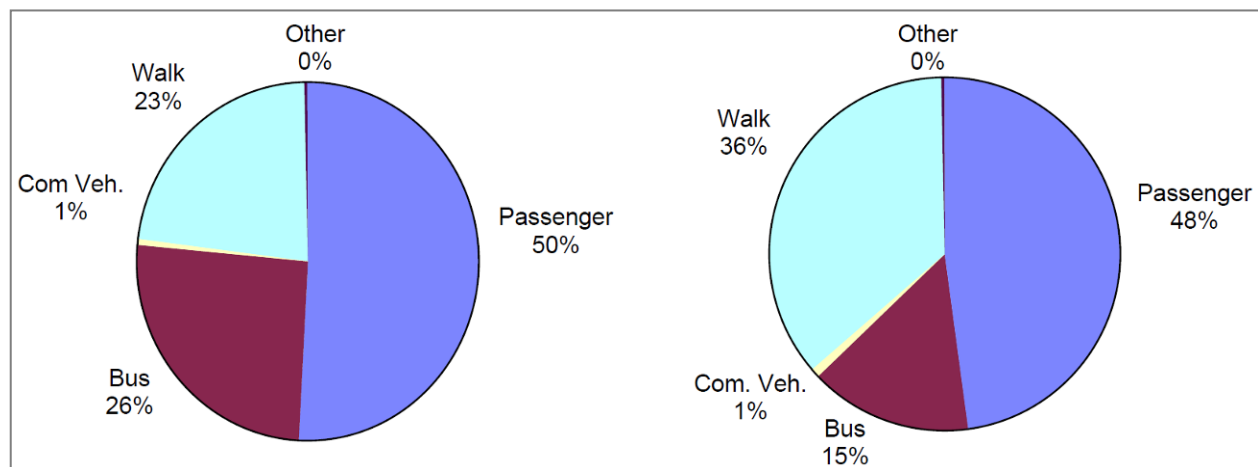
**Table 1. Texas International Bridges and Summary Details (Adapted from the Texas Department of Transportation [1]).**

<b>Bridge</b>	<b>Location</b>	<b>Autos</b>	<b>Trucks</b>	<b>Pedestrians</b>	<b>Expanded</b>	<b>Truck Details</b>	<b>Pedestrian Details</b>
<b>Brownsville and Matamoros (B&amp;M)</b>	Brownsville	✓		✓	✓	Discontinued in 1999	SB on old bridge, NB on new bridge
<b>Gateway</b>	Brownsville	✓		✓		Discontinued northbound (NB) in 1999, southbound (SB) in 2001	High pedestrian volume (many students)
<b>Veterans (Los Tomates)</b>	Brownsville	✓	✓	✓	Opened April 1999	Serves all commercial traffic in Brownsville	
<b>Del Río-Ciudad Acuña</b>	Del Rio	✓	✓	✓	Rebuilt 1987		
<b>Camino Real</b>	Eagle Pass	✓	✓	✓	Opened September 1999		
<b>Eagle Pass Bridge I</b>	Eagle Pass	✓	✓	✓	Reinforced 1985		
<b>Bridge of the Americas</b>	El Paso	✓	✓	✓	Rebuilt 1998	Two bridges for trucks, two for autos	
<b>Good Neighbor (Stanton Street)</b>	El Paso	✓		✓	Rebuilt 1967		SB pedestrian only; high pedestrian volume
<b>Paso Del Norte</b>	El Paso	✓		✓	Rebuilt 1967		High pedestrian volume
<b>Ysleta-Zaragoza</b>	El Paso	✓	✓	✓	Rebuilt 1990	One bridge for trucks, one for autos and pedestrians	Elevated pedestrian bridge to immigration building
<b>Fabens-Caseta</b>	Fabens	✓	✓	✓	Built 1938	New cargo facility to be built	
<b>Fort Hancock-El Porvenir</b>	Fort Hancock	✓			Built 1936		
<b>McAllen-Hidalgo-Reynosa</b>	Hidalgo	✓	✓	✓	✓	Discontinued NB in 1996	SB on old bridge, NB on new bridge
<b>Gateway to the Americas (Bridge I)</b>	Laredo	✓		✓	Rebuilt 1956	Discontinued in 2000	High pedestrian volume; covered walkways
<b>Juarez-Lincoln (Bridge II)</b>	Laredo	✓		✓	Opened 1976	Discontinued in 2000	
<b>Laredo-Colombia Solidarity</b>	Laredo	✓	✓	✓	Opened 1991	High volume of trucks	

Bridge	Location	Autos	Trucks	Pedestrians	Expanded	Truck Details	Pedestrian Details
<b>World Trade</b>	Laredo		✓		Opened 2000	Serves only trucks	
<b>Free Trade (Los Indios)</b>	Los Indios	✓	✓	✓	Opened 1992		
<b>Anzalduas</b>	Mission	✓	✓		Opened 2009		Location is remote from current development
<b>Pharr-Reynosa (Bridge on the Rise)</b>	Pharr	✓	✓	✓	✓		
<b>Presidio</b>	Presidio	✓	✓		Rebuilt 1985		
<b>Progreso</b>	Progreso	✓	✓	✓	Rebuilt 2003	One bridge for trucks, one for autos	Covered walkways SB and NB
<b>Rio Grande City-Camargo</b>	Rio Grande City	✓	✓	✓	Opened 1966		
<b>Roma-Ciudad Miguel Alemán</b>	Roma	✓	✓	✓	✓		

## MODAL CONNECTIVITY NEEDS AT INTERNATIONAL BRIDGES

In the case of trips by vehicle—automobile, truck, train, or bus—the border crossing by bridge in itself usually presents no change in mode or travel connectivity. However, for the pedestrian, the border-crossing trip into the United States is very often one link in a multimodal trip to their destination. Pedestrian travel details from an external survey of the El Paso region (3) provide some insight into the nature of transborder travel that involves a pedestrian crossing of an international bridge. As pedestrians were queried for their travel modes, as well as more traditional travel survey questions regarding trip purpose, it was possible to quantify travel-mode allocation for pedestrian bridge users for both their arrival and departure from the international bridge. However, since the survey was only for travelers entering the El Paso region, the survey only represents the experience of travelers entering the United States. Figure 6 details the travel mode of international bridge users both approaching and departing the crossing.



**Figure 6. Pedestrian Travel Mode to International Bridges (Left Chart) and from (Right Chart) International Bridges (3).**

According to Figure 6, the preferred travel mode both to and from the international bridge is the passenger vehicle. The implications on the roadway network are clear—traffic is significantly increased in the vicinity of international bridge crossings in Texas as a result of passenger drop-off and pick-up, and this travel-mode interface approach likely occurs on both sides of the Texas-Mexico border. The summary report indicates:

Given that more than 50,000 pedestrians cross into and out of the study area by the bridges, this means that there are about 25,000 vehicle trips to and from the bridges for the purposes of transporting people from and to the bridges in the El Paso Transportation Study (3).

An additional insight found in the summary of El Paso international-bridge pedestrian external surveys was that, on average, a pedestrian made a crossing 2.2 times per week.

## LITERATURE REVIEW

Aside from several port-of-entry site studies and general border-crossing-area traffic studies, the issue of pedestrian accommodation at international bridges is not directly addressed in the literature. Even within port-of-entry or crossing-area studies, the issue of pedestrian mobility and safety is often tangentially referred to in the context of improving safety and operations for all modes by removing conflicts between pedestrians and all vehicular modes—automobile, truck, and bus. However, given the context of international border crossings as areas that can have high traffic volumes and adjacent commercial land development, a clear need exists for safety and mobility plans and measures that incorporate pedestrians:

...research based on land use as a proxy for transportation demand has shown that higher densities of development along road facilities, attractor land uses, traffic volumes and transit are associated with increases in pedestrian volumes.

Among the three strong correlates of collision occurrence, the presence of crosswalks with or without signals pointed to the limited effectiveness of engineering solutions and to the need to change pedestrians' and drivers' behaviors through education and enforcement of traffic laws; wider roads and locations with concentrations of retail uses also seemed to be promising targets for future [pedestrian] safety programs (4).

### Pedestrian Safety Measures

Improvements in pedestrian safety have long been the subject of research studies and the object of improved planning, design, and engineering of facilities that accommodate vehicles and pedestrians. However, it was with the enactment of the Intermodal Surface Transportation Efficiency Act (ISTEA) in 1991, the Transportation Equity Act of the 21<sup>st</sup> Century (TEA-21) in 1998, and the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFTEA-LU) in 2005 that federal-aid funds could be used not only for vehicle-oriented roadway projects, but also for bicycle and pedestrian projects.

For the past two decades, the requirement that pedestrian facilities be considered in the design of public rights-of-way has been outlined in transportation enabling and funding legislation, including ISTEA, TEA-21, and SAFTEA-LU. The types of facilities compliant with this legislation are primarily defined by the Americans with Disabilities Act of 1990 (ADA) as interpreted through the U.S. Access Board's *Accessible Rights-of-Way: A Design Guide* (5) and *Revised Draft Guidelines for Accessible Public Rights-of-Way* (6). The actual design features and signing and marking of pedestrian facilities are dictated by the *Manual on Uniform Traffic Control Devices* (MUTCD) (7).

Research has reinforced the requirements and standards for pedestrian facilities by attempting to identify the context and type of additional safety measures. Table 2 contains a summary of strategies whose purpose is to improve pedestrian safety.



**Table 2. Strategies for Increasing Pedestrian Safety (Adapted from Zegeer et al. [8]).**

<b>Objectives</b>	<b>Strategies</b>
<b>Reduce Pedestrian Exposure to Vehicular Traffic</b>	<ul style="list-style-type: none"> <li>• Provide sidewalks/walkways and curb ramps (P)</li> <li>• Install or upgrade traffic and pedestrian signals (P, T, E)</li> <li>• Construct pedestrian refuge islands and raised medians (P)</li> <li>• Provide vehicle restriction/diversion measures (P, T)</li> <li>• Install overpasses/underpasses (P)</li> </ul>
<b>Improve Sight Distance and/or Visibility between Motor Vehicles and Pedestrians</b>	<ul style="list-style-type: none"> <li>• Provide crosswalk enhancements (P, T)</li> <li>• Implement lighting/crosswalk illumination measures (P)</li> <li>• Eliminate screening by physical objects (T)</li> <li>• Install signals to alert motorists that pedestrians are crossing (T, E)</li> <li>• Improve reflectorization/conspicuity of pedestrians (T)</li> </ul>
<b>Reduce Vehicle Speed</b>	<ul style="list-style-type: none"> <li>• Implement road-narrowing measures (T)</li> <li>• Install traffic calming—road sections (P, T)</li> <li>• Install traffic calming—intersections (P, T)</li> <li>• Provide school-route improvements (T)</li> </ul>
<b>Improve Pedestrian and Motorist Safety Awareness and Behavior</b>	<ul style="list-style-type: none"> <li>• Provide education, outreach, and training (P)</li> <li>• Implement enforcement campaigns (T)</li> </ul>

P = proven; T = tried; E = experimental.

With increased support and motivation for pedestrian- and bicycle-oriented planning, facilities design, and safety, bicycle and pedestrian elements are now commonplace in metropolitan transportation plans. An increase in the amount of research devoted to non-vehicular travel and modal connectivity has also occurred in recent years. Research on pedestrian and bicycle facilities in Texas included a survey of practitioners with pedestrian-facility expertise. Table 3 contains a summary of responses as these practitioners ranked the importance of planning factors for pedestrian facilities. Recent research on crosswalks, signing, and signal applications for pedestrians is also summarized to frame later discussions of best practices.

**Table 3. Practitioners' Rating of Pedestrian-Facility Planning Factors (Adapted from Hauser et al. [9]).**

<b>Importance</b>	<b>Factor</b>
<b>Very important</b>	<ul style="list-style-type: none"> <li>• Roadway traffic volume</li> <li>• Motor-vehicle operating speed</li> <li>• Roadway classification</li> <li>• Removal of physical barriers</li> <li>• Funding</li> <li>• ADA requirements</li> </ul>
<b>Important</b>	<ul style="list-style-type: none"> <li>• Type of pedestrian</li> <li>• Volume of pedestrians</li> <li>• Posted roadway speed</li> <li>• Percentage truck volume</li> <li>• Roadway width</li> <li>• Geometrics</li> <li>• Roadway access</li> <li>• Adjacent land use</li> </ul>
<b>Suggested by respondents</b>	<ul style="list-style-type: none"> <li>• Requests from the public</li> <li>• Availability of right-of-way</li> </ul>

### **Crosswalks**

Despite the many guidelines, requirements, and standards guaranteeing “proper” design, signing, and marking of crosswalks, transportation professionals continue to face a paradox that marked crosswalks have a higher pedestrian-vehicle crash rate than unmarked pedestrian crossings. While varying theories exist regarding the underlying causes of this phenomenon and whether or not using marked crosswalks provides a benefit to the public, there is general understanding that pedestrian crash rates increase with roadway width and the possibility of “multiple-threat” crashes. Recent research has shed some light on contributing issues (10) that designers and engineers should consider for future crosswalks:

- Pedestrians exhibit a greater level of caution when crossing in unmarked versus marked crosswalks.
- Drivers yield more frequently to pedestrians in marked crosswalks compared to unmarked crosswalks.
- Differences in marked and unmarked crosswalks are more pronounced for multilane roads.
- Multiple-threat scenarios arise more frequently at marked versus unmarked crosswalks.

In summary of the findings and recommendations from this recent research, the safety disadvantages of marked crosswalks can be alleviated by multiple means, including efforts to increase pedestrian and bicyclist caution at marked crosswalks and to increase advance vehicle warning of a downstream crosswalk, especially along multilane roadways. Researchers emphasized (10) that adopting practices to minimize marked crosswalks does not meet the needs of the nonvehicle population. The findings of this recent research are particularly relevant

around border crossings due to the multiple lanes of traffic—and the increased risk for multiple-threat crashes—both approaching and departing the international border.

### ***Signing and Signals***

The MUTCD (7) serves as the standards definition document for traffic engineering signs, markings, and signals. As effective a guide as this manual has proven to be, it is ultimately limited in the fact that while it provides clarity on device design and deployment, it cannot supplant engineering judgment as to which type of device is best suited for any given driver or non-vehicular user information or control need. Further, engineering details can only be provided for known devices and customary applications of those devices; innovation in the use of new traffic control devices or revised methods for deploying existing devices to increase effectiveness are deferred to the “next edition,” following the standards development and application process of the National Committee on Uniform Traffic Control Devices.

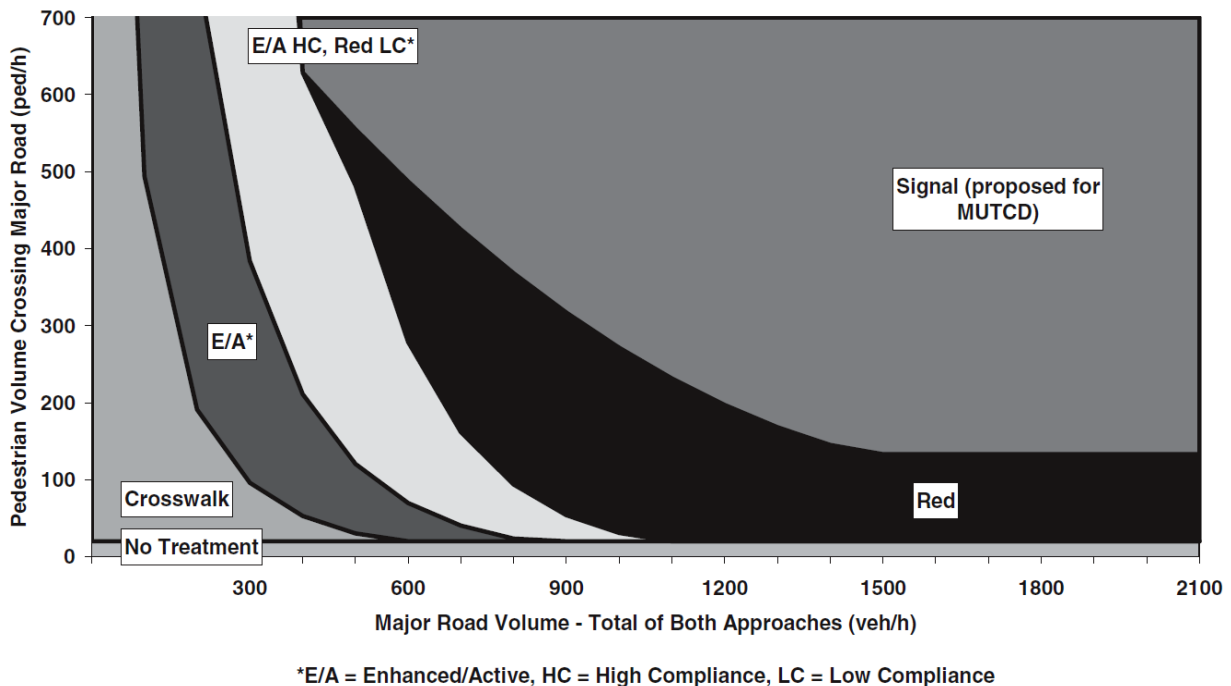
An example of an effective timeline of the standards improvement process is Transit Cooperative Research Program (TCRP)/National Cooperative Highway Research Program (NCHRP) Project D-08/3-71 entitled “Innovative Pedestrian Treatments at Unsignalized Crossings” (NCHRP component) and “Safe Roadway Crossings for Bus Passengers” (TCRP component). Research conducted between November 2002 and March 2006 resulted in a final report (11), which laid the foundation for a new MUTCD signal warrant for intersections with pedestrians and provided engineering practitioners with refinements and guidance on the type of traffic control to provide under varying pedestrian and vehicular volume conditions. The signal-warrant factors identified in the research were incorporated into the eventual pedestrian signal-warrant revision found in the current (2009) edition of the MUTCD (7), which was refined by the national committee and under professional review between January and July 2008.

A range of findings from the TCRP/NCHRP research are utilitarian when examining the accommodation of pedestrians near international bridge crossings. The research included a pedestrian survey that, in part, identified pedestrians’ primary safety concerns. Pedestrian safety concerns included traffic volume (particularly turning traffic), vehicle speeds, and—most importantly to pedestrians—the unpredictability of drivers (i.e., whether they will stop at marked crosswalks) (11). Pedestrians were also asked to rank their perceived safety at intersections, which was noted to increase as the level of traffic control increased. Ironically, it is this increased perception of safety that may cause pedestrians to be less vigilant at pedestrian crossings where an increased level of control is provided, as indicated in previous research on pedestrian behavior (10).

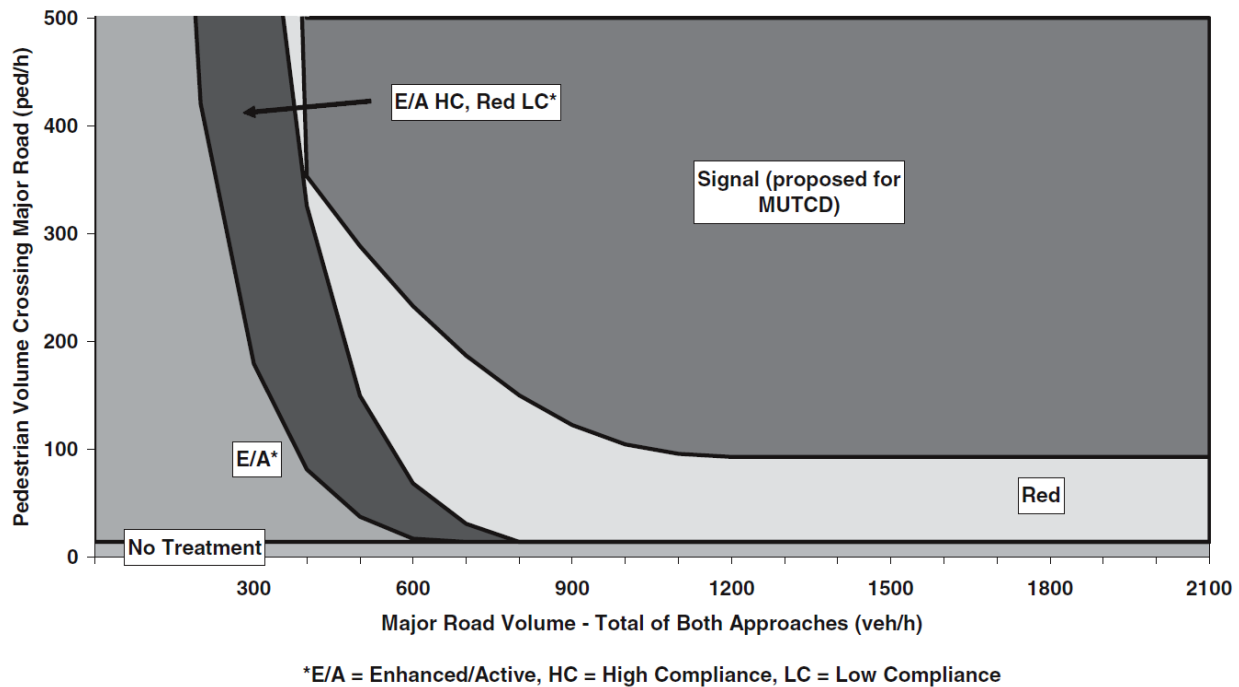
Pedestrian behavior examined by the TCRP/NCHRP research revealed an additional concern for pedestrians at international border crossings in that “...a small but notably larger percentage of transit pedestrians ran or walk/ran as compared with the general population” (11). This finding is particularly relevant to the current investigation given that the percentage of pedestrian users of international bridge crossings by bus is high (see Figure 6) compared to the percentage of everyday commuting trips made by transit, which tend to be between two and five percent.

Examples of the application of the TCRP/NCHRP guidance for practitioners include Figure 7 and Figure 8, which indicate the type of crossing protection for given levels of pedestrian and

vehicle volume. Levels of protection include no treatment (at low pedestrian volumes); marked crosswalk; enhanced/active devices (such as advance signing and/or pedestrian flashers); high-compliance enhanced devices, such as active pedestrian flashers; control devices displaying a red indication to motorists, such as a high-intensity activated crosswalk beacon (HAWK) pedestrian treatment; and a pedestrian signal. As evidenced by the differences between the figures, increased speed is a significant decision-making factor for the design engineer—marked crosswalks alone are not included in the guidance for speeds above 35 mph.



**Figure 7. Guidelines Plot for 72-ft (22 m) Pavement,  $\leq 35$  mph (55 km/h), and 3.5-ft/s (1.1 m/s) Walking Speed (II).**



**Figure 8. Guidelines Plot for 72-ft (22 m) Pavement, > 35 mph (55 km/h), and 3.5-ft/s (1.1 m/s) Walking Speed (11).**

The following are additional findings from the TCRP/NCHRP pedestrian crossing research (11) that are relevant to international bridges and the transportation facilities in their vicinity:

- Those treatments that show a red indication to the motorist have a statistically significant different compliance rate from devices that do not show a red indication.
- Red signals or beacon devices had compliance rates greater than 95 percent and included midblock signals, half signals, and HAWK signal beacons. Nearly all the red signal or beacon treatments evaluated were used on busy, high-speed arterial streets.
- Pedestrian crossing flags and in-street crossing signs also were effective in prompting motorist yielding, achieving 65 and 87 percent compliance, respectively. However, most of these crossing treatments were installed on lower-volume, two-lane roadways.
- The number of lanes being crossed influences the effectiveness of the crossing treatment. All but one of the treatments on the two-lane roadways performed at a better than 75 percent compliance rate. On four-lane roadways, compliance ranged from below 30 percent to 100 percent.

## Bridge and Supporting Facility Design

While we often conceive of bridges as static infrastructure fixtures with a very long-term design life, the various details of Texas' international bridges with Mexico shown in Table 1 indicate that in the border environment these facilities are adapted with some regularity to the changing needs of the communities in which they are located and to changing traffic volumes that show steady increases over long periods of time. The relatively recent redesign and reconstruction of the Progreso International Bridge in 2003 included covered walkways for both north- and southbound pedestrians (Figure 9), an often-cited feature when this international crossing and bridge is described as “pedestrian friendly.”



Source: Google™ Earth, accessed March 30, 2010.

**Figure 9. Progreso International Bridge Crossing in Progreso, Texas.**

While the bridge structure itself is a primary component of any Texas land port of entry (LPE), the additional components of each border station have their role in the border entry process and are considered here as they serve or affect pedestrian border crossers. The U.S. General Services Administration (GSA) or one of the federal inspection agencies usually owns and operates LPEs, but they can also be leased from local agencies or even private entities (i.e., toll bridges). The Customs and Border Protection (CBP) arm of the U.S. Department of Homeland Security performs the main inspection functions for vehicles and pedestrians entering the United States, but additional agencies are also present at the LPEs, including Veterinary



Services, the Food and Drug Administration, and Fish and Wildlife Services. The Public Buildings Service, a component of GSA, is responsible for facilities management at the LPEs (12).

While each LPE has a unique site layout to accommodate a range of areas/facility types, the only areas that typically concern border-crossing pedestrians are the pedestrian/bus-passenger queuing, processing, and inspection areas. General design guidelines for these areas of the LPEs (and the overall LPE) indicate that the aesthetics should be “welcoming but formal” and provide clear circulation patterns, offering simple, direct movement of traffic and staff (12). Further design standards for LPE (and all public) buildings have been established by the GSA, including:

**Pedestrian Circulation.** The project team should consider neighboring uses, existing pedestrian patterns, local transit, and the building’s orientation to anticipate pedestrian ‘desire lines’ to and from the building from off site. Designers should avoid dead ends, inconvenient routes, and the like and consider how people moving across the site might help to activate sitting areas, outdoor art, programmed events, etc.

**Drop-Off.** If the security analysis determines it is feasible, a vehicular drop-off area should be located on the street nearest the main entrance...

**Walkways.** Pedestrian walkways shall link the parking area with the building entrance. Provide curbs, bollards, other barriers or low walls to prevent vehicles from encroaching upon pedestrian walkways. Identify pedestrian crossings of vehicular traffic lanes by painted crosswalks and signage (13).

With the above guidelines in place, the portion of a pedestrian’s trip across the international bridge and through the LPE’s CBP facility is often safe and efficient. Where facilities predate these standards and practices, the resultant traffic situation is often one justification for facility redesign and reconstruction. In the environmental assessment for the Nogales Mariposa U.S. LPE, the project needs included “frequent conflicts between pedestrians and vehicular traffic within and adjacent to the LPE...” and the fact that pedestrian processing was not planned for in the original design (14).

Once pedestrian users of the international bridge crossing are beyond the federally controlled LPE, they become users of the local roadway network, transit network, and/or land development. Since this transition is a major focus of the current research, an extreme example of a border crossing is used to frame an issues discussion: the San Ysidro (California) LPE. Border-crossing statistics in Figure 2 cite that the El Paso, Texas, pedestrian border-crossing volume is higher than that of San Ysidro; however, in El Paso the pedestrian volume is spread across four LPEs. In San Ysidro, a single LPE accommodates the demand. Pedestrian demand service needs are such that the San Ysidro International Gateway is the (southern) terminus of the south line of the San Diego Trolley. The *San Ysidro Community Plan* states that:

The International Gateway at the Border Trolley Station is congested with many different types of vehicular traffic, including the trolley, jitneys, buses, taxis, passenger cars and service vehicles. These vehicles conflict with one another and

threaten the safety of the many pedestrians that use this area. In addition, the large volume of pedestrians crossing at the border gate makes it difficult to move across the border (15).

One of the stated objectives of the International Gateway component of the San Ysidro plan is to improve the transportation system at the border to smooth traffic and minimize conflicts between vehicles and pedestrians. One of the recommendations to achieve this objective is to develop a multimodal transit terminal to incorporate transit modes, taxis, bicycles, and passenger drop-offs to safely separate these modes from pedestrians (15). The following are additional pedestrian issues being considered within and around the San Ysidro border crossing, the International Gateway, and their immediate vicinity:

- San Ysidro Boulevard is a barrier to pedestrians due to fast-moving vehicular traffic and the absence of crossings and traffic signals.
- New development is required to address pedestrian activity in site-design proposals.
- Pedestrian access across the trolley corridor needs to be improved.
- Pedestrian pathways need to be developed throughout San Ysidro.

## **Multimodal Service Integration**

Though issues exist with respect to safety and efficiency, the San Ysidro International Gateway is an excellent example of the type of service integration that would be expected at a high-demand multimodal generator like the San Ysidro border crossing. While border crossings in Texas do not currently have sufficient volume to consider such a high-volume transit mode as a trolley, crossings in metropolitan areas are served by transit routes, jitneys, and taxis.

Fruin succinctly summarizes transit-service basic requirements:

It is critical that the designs for all types of transit facilities provide a positive image for the system, communicate basic information about how to use the service, and provide a convenient, comfortable, and safe environment for passengers (16).

While system image and basic usage information play a part in the desirability and ease of use of the service, the convenience, comfort, and safety of the service and its connections are of interest in the current research. As stated in the *San Ysidro Community Plan*, multifaceted safety concerns have arisen as practitioners identify the conflicts between pedestrian border-crossing traffic and the transit services within the International Gateway. Similar conflicts arise between pedestrians departing the crossing vicinity on foot and automobile traffic on the San Ysidro roadways approaching and departing the international crossing. A general lack of sidewalks and crossings within the community of San Ysidro further extends these issues (15).



Conditions at the Paso Del Norte International Bridge crossing in El Paso, Texas, mimic to some degree the congestion situation in San Ysidro, though on a different scale. A border improvement plan for the region indicates that:

Congestion is caused by taxi and bus concentration past the entry point into the U.S. There is a taxi stand as well as a Sun Metro bus stop at 6<sup>th</sup> Street and El Paso Street where pedestrians crossing the bridge can obtain transportation to different parts of El Paso. This causes congestion of pedestrian as well as vehicular traffic. The City of El Paso has plans to construct an International Transit Terminal close to the bridge, which will help in alleviating this congestion (17).

The El Paso transportation plan further suggests the need for transit service to meet the needs of pedestrians crossing at the Paso Del Norte bridge; it points out that this bridge has very high pedestrian volumes and that this is one fact supporting the potential for "...a bus alternative to attract a high number of bus passengers..." (18). The plan goes further in providing a pedestrian plan that emphasizes pedestrian and bicycle pathway needs and support by local agencies throughout the community, but does not specifically mention pedestrian connections at El Paso's international bridge crossings. A section of the plan is devoted to specific issues associated with international bridge crossings and includes a study that was performed to determine the impact on pedestrian and auto activity at the bridges should improved transit service be provided between the cities of El Paso, Texas, and Ciudad Juárez, Mexico. Significant changes were observed in that transit trips connecting with auto trips decreased and transit trips coupled with walking trips increased (18).

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## **CHAPTER 2:**

### **TEXAS-MEXICO BORDER-CROSSING SITE INVESTIGATIONS**

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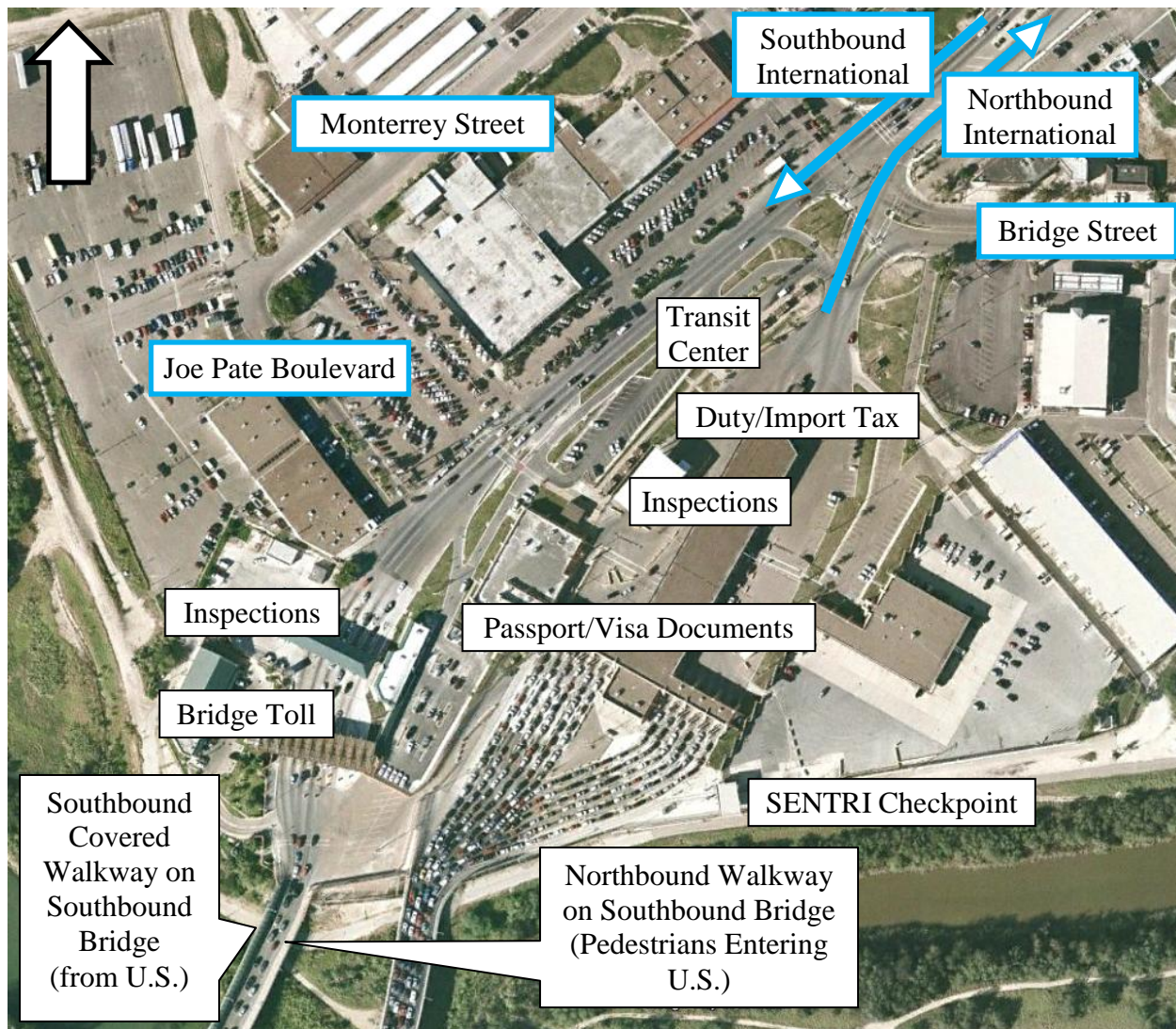
Four international bridges in Texas with high pedestrian volumes were selected for site investigations. Site visits occurred along the entire Texas border with Mexico, including the metropolitan areas of McAllen/Hidalgo, Brownsville, El Paso, and Laredo, Texas. The intent of each site study was to explore how the responsible local agencies addressed the pedestrian-accommodation and safety issues revealed through the literature review. For project purposes, exploration of these issues led to the derivation of a list of best practices and procedures for ensuring safe and efficient pedestrian utilization of international bridge crossings.

#### **MCALLEN-HIDALGO-REYNOSA INTERNATIONAL BRIDGE (HIDALGO, TEXAS)**

Since the early 1850s a means has existed to cross the Rio Grande River between Reynosa, Mexico, and the community now known as Hidalgo, Texas. The first bridge structure was built in 1926 and was rebuilt in various forms several times before the construction of a four-lane prestressed concrete structure in 1967 (19). A second four-lane bridge structure opened in 1988. Northbound truck traffic was discontinued at this crossing in 1996, concomitant with the opening of the Pharr-Reynosa Bridge/Bridge on the Rise. Southbound traffic currently uses the older, westernmost structure, while the newer bridge carries northbound traffic into the United States. The addition of a Secure Electronic Network for Travelers Rapid Inspection (SENTRI) lane to the northbound bridge resulted in the removal of the pedestrian walkway from this structure; pedestrians entering the United States currently use a walkway on the east side of the southbound structure to cross over the Rio Grande River. Mexico-bound (southbound) pedestrians use a walkway on the west side of the southbound bridge.

#### **Infrastructure**

An annotated aerial photograph is provided in Figure 10 to present the site layout for the McAllen-Hidalgo-Reynosa International Bridge LPE. Approach and departure from the international bridge occurs by way of International Boulevard, also designated as Spur 115 and US 281. A signalized intersection with Bridge Street is located just outside the physical boundary of the LPE, and all vehicles entering and exiting the LPE pass through this intersection. South of Bridge Street, southbound transit vehicles and taxis are able to access the transit center for passenger pick-up/drop-off. An additional taxi drop-off station is located to the right of the southbound lanes just north of Joe Pate Boulevard. Privately owned passenger vehicles dropping off pedestrian bridge users often do so very close to the intersection along Joe Pate Boulevard just west of International Boulevard and then depart the bridge area using Monterrey Street. Vehicles and pedestrians bound for Mexico pass first through an inspection station, where random vehicle inspections and passport/visa checks occur, and then negotiate a bridge toll-payment station before passing into Mexico across the southbound bridge.



Source: Adapted from Google™ Earth, accessed June 22, 2010.

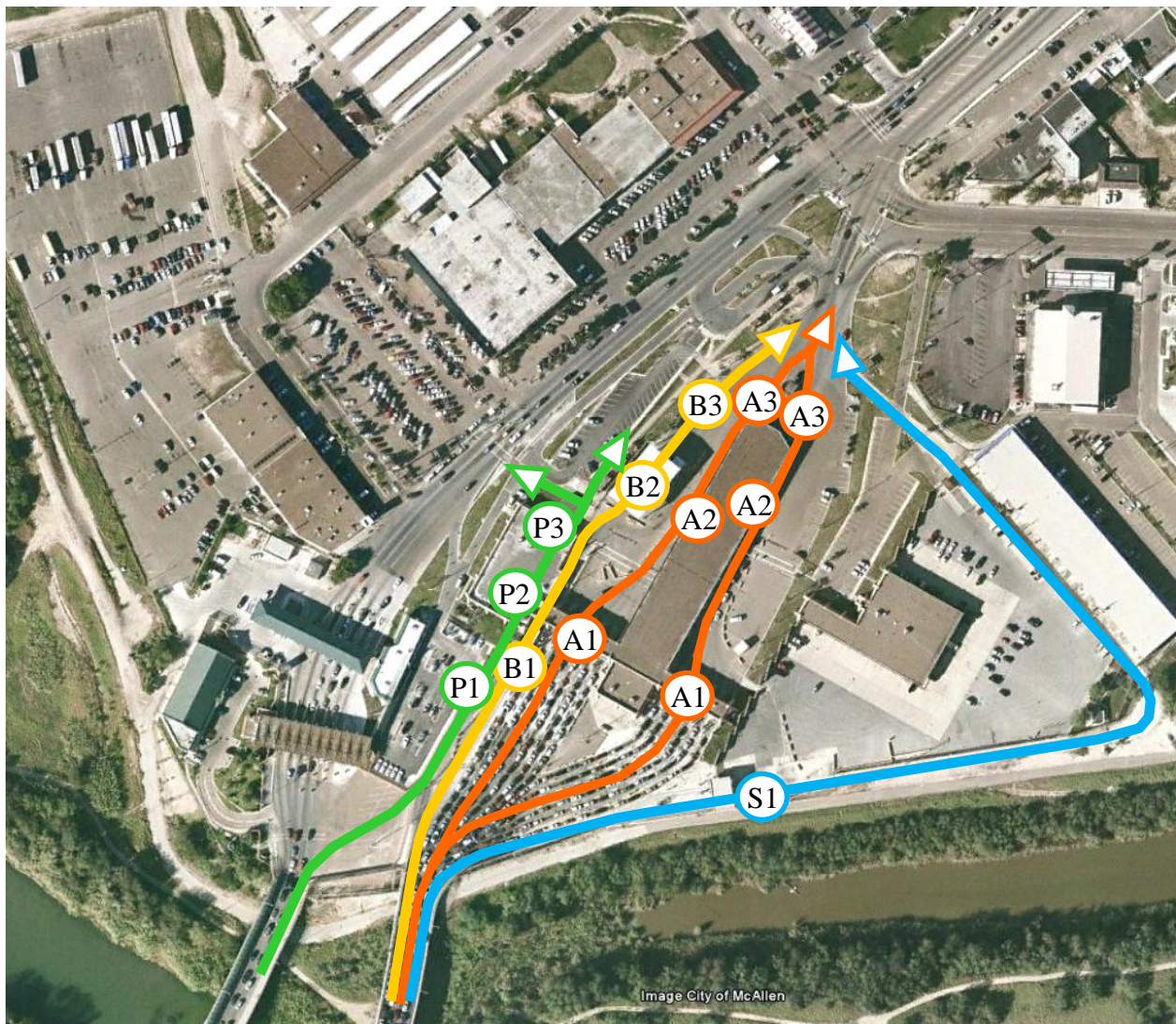
**Figure 10. McAllen-Hidalgo-Reynosa International Bridge Land Port of Entry.**

Northbound passenger automobiles, buses, and pedestrians pass through different processing procedures within the LPE, but the overall process involves—in order—passport/visa document verification, inspection, and payment of duties and import taxes. When this process is complete, vehicles and buses depart the LPE northbound on International Boulevard, while pedestrians use the transit facility, meet personal vehicles for passenger pick-up, or travel on foot to reach local restaurants or shopping venues.

Figure 11 depicts the travel paths through the LPE for various modes of travel. For passenger-automobile traffic (orange path), the three-stage entry process includes passport/visa document validation by CBP officers at station A1, vehicle inspection by CBP at station A2, and duty payment on alcohol and other import fees at station A3. If all occupants of a passenger vehicle have SENTRI passes/cards, the vehicle uses the SENTRI lane (blue path) through the SENTRI checkpoint (S1) to bypass routine passport/visa validation and inspection. Buses



(yellow path) entering the United States are first required to disembark their passengers at station B1 before passing through x-ray and inspection at station B2. After inspection, buses pick up their passengers at station B3 and then exit the LPE. Pedestrians walking across the international bridge (green path) join bus passengers (who are required to disembark their vehicle) in queue at station P1 before entering the building for passport/visa document validation at station P2. Random pedestrian/bus-passenger inspections occur within the building, and then both pedestrians and bus passengers exit the building and pay any alcohol duties or other import taxes at station P3. Pedestrians who hold SENTRI passes/cards are able to use a pedestrian station within the building that expedites the process. Bus passengers reboard their vehicle at station B3, while pedestrians either cross International Boulevard to the west to shop or eat, or walk northeastward to the transit center to shop or eat north or east of the LPE, or meet a passenger vehicle for pick-up.



Source: Adapted from Google™ Earth, accessed June 22, 2010.

**Figure 11. McAllen-Hidalgo-Reynosa International Bridge Land Port of Entry.**

## Pedestrian Circulation

Approximately 145,000 pedestrians per month use the McAllen-Hidalgo-Reynosa International Bridge to cross into Mexico; similar pedestrian volume is assumed into the United States. As with overall trends for southern border crossings (see Figure 4 and Figure 5), the pedestrian utilization of this international crossing remains relatively stable despite reductions in vehicular travel that are increasing over time. Overall trends indicate a midweek increase in northbound morning trips for shopping that occurs throughout the year, and a slight decrease in summer pedestrian bridge-crossing traffic that is associated with reductions in school trips.

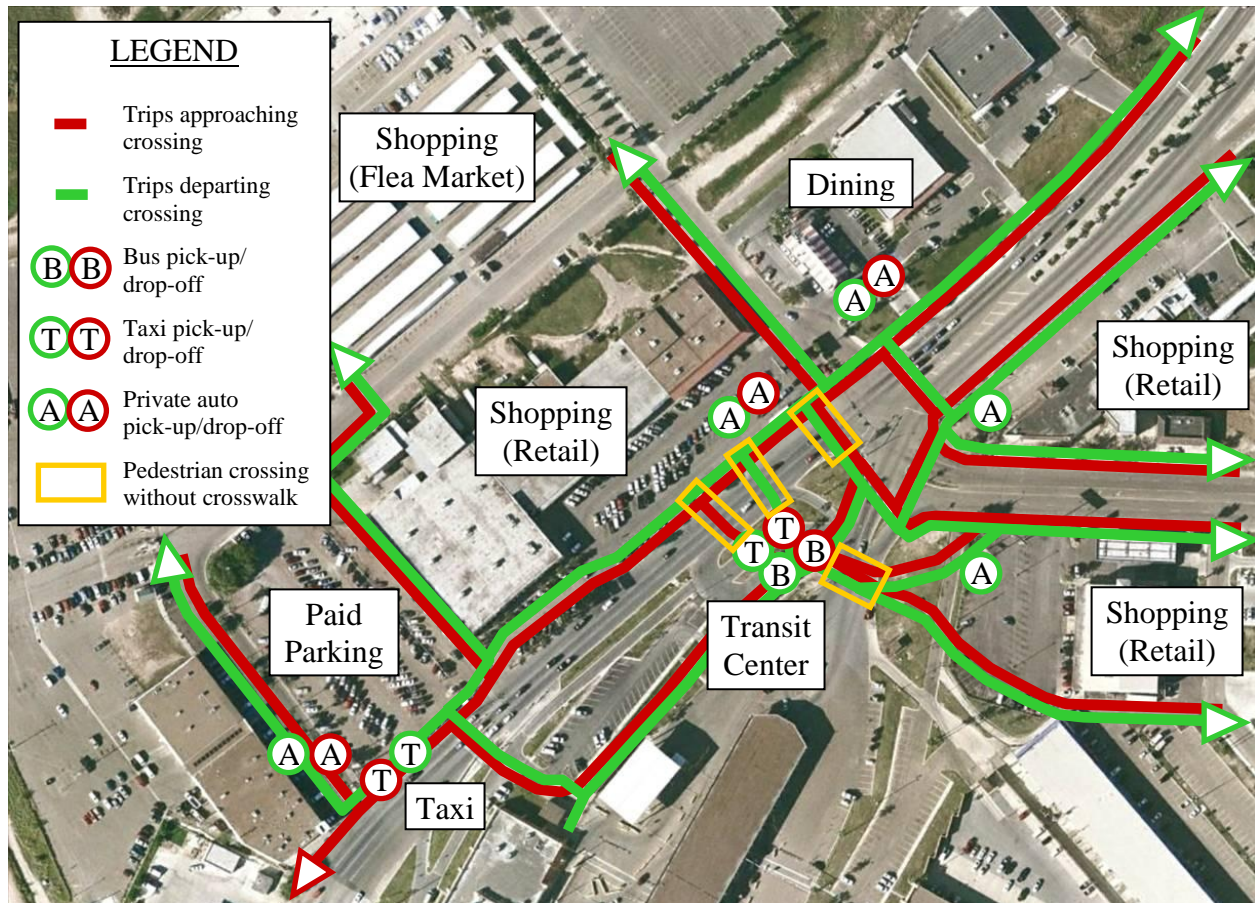
Because bus riders disembark their vehicle before entering the CBP processing facility at each international crossing, it is not possible to quantify the number of pedestrians who cross into the United States separately from those who arrive and depart the crossing by bus. However, assuming that the entry volume of pedestrians into the United States is similar to the 145,000 departing the United States each month, the annual pedestrian volume entering the U.S. is approximately 1,740,000. The difference between this volume and the total pedestrian volume entering the United States at the McAllen-Hidalgo-Reynosa International Bridge (i.e., 2,100,000 from Figure 2) is approximately 360,000, and the assumption is made that this volume represents bus riders entering the United States each year at this crossing. Of the 145,000 assumed to enter the United States as pedestrians each month, a rough estimate (Figure 6, with 10 percent taxi assumed) of 25 percent local bus/taxi riders, 50 percent private vehicle pick-up, and 35 percent pedestrian-only trips would indicate that roughly 3,550 daily pedestrians pass through the CBP checkpoint and either shop/eat in the vicinity of the border crossing or are picked up by a privately owned automobile. The remaining 1,200 pedestrians are believed to take a local bus or taxi into Hidalgo, Pharr, or McAllen or make a regional bus trip elsewhere in the Rio Grande Valley via the transit center located adjacent to the LPE grounds.

The mode of pedestrian bridge user arrival at the crossing can also be calculated using a rough distribution of 40 percent arriving by private automobile, 35 percent arriving by local bus or taxi, and 25 percent arriving on foot from local land use in the vicinity of the international bridge (Figure 6, with 10 percent taxi assumed). Respective daily volumes by mode from these estimates would indicate that 1,900 pedestrian users of the bridge into Mexico arrive by private automobile, an additional 1,650 arrive by local bus or taxi, and the remaining 1,200 arrive at the bridge after walking from adjacent shops, restaurants, or places of employment.

The research team developed Figure 12 to document pathway “desire lines” for the estimated 4,750 pedestrian trips destined for the McAllen-Hidalgo-Reynosa International Bridge and the additional 4,750 pedestrian trips departing from the bridge each day. Trips departing the United States are drawn in red, while trips entering the United States are drawn in green. The transit center located to the south of the International Boulevard/Bridge Street intersection is the logical hub of pedestrian activity, not only because it is the source and destination of all bus transit and most taxi trips, but also because it is the logical point of departure for all pedestrian trips leaving the bridge crossing that are not headed immediately to the shopping, parking lots, or taxi stand on the west side of International Boulevard (see Figure 13 for signing supporting this crosswalk and Figure 14 for a user view facing west). Parking lots for all businesses around the International Boulevard/Bridge Street intersection are frequently used as pedestrian bridge user drop-off/pick-up locations. As pedestrians seek out their least-resistance (though not necessarily



safest) travel path to and from both the transit center and bridge crossing, they occasionally cross roadways at locations without crosswalks or any form of advance pedestrian warning; these locations are highlighted in yellow in the figure.



Source: Adapted from Google™ Earth, accessed June 22, 2010.

**Figure 12. Pedestrian Pathway Desire Lines to/from International Crossing.**



**Figure 13. Southbound US 281 Approaching the International Bridge.**



**Figure 14. Crosswalk near LPE Pedestrian Processing Building (Viewing West).**

## Transit Service

Many elements of local transit service and its users have previously been described in discussions of pedestrian activity proximate to the McAllen-Hidalgo-Reynosa International Bridge. However, it is important to note that all service providers making use of the transit center (Figure 15) are private companies. Small buses from a local provider take riders between the bridge crossing and several stops in the Hidalgo and McAllen areas, including a grocery store and the central transit station in McAllen. Larger buses from a regional transit provider (which is a subsidiary of a national transit company) also connect with McAllen's primary transit center but have stops in more distant locations within the Rio Grande Valley, south Texas, and Reynosa, Mexico. Taxis and privately owned autos also make use of the transit center, but private autos are prohibited from anything but immediate drop-off/pick-up activities for security reasons and to avoid congesting the center for taxis and buses.

The transit center is serviced 26 times per day by the regional transit service. Service is between the hours of 5:30 AM and 8 PM, and the route includes taking passengers across the border both into and out of Mexico. Approximately 800 riders per day use the international bridge's stop along the route. Boarding and alighting are roughly equal. The local transit provider serves approximately 700 riders per day between the hours of 6 AM and 8 PM. Nine buses running the fixed local route each stop at the international bridge an average of 10 times each day.



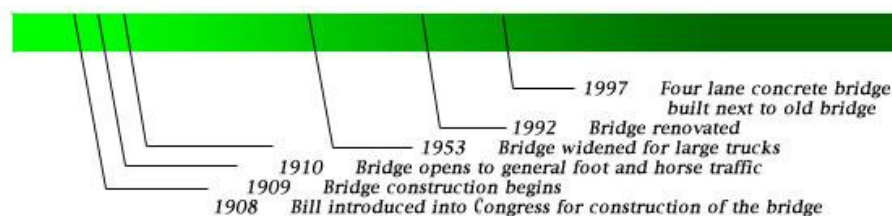
**Figure 15. Transit Center Adjacent to McAllen-Hidalgo-Reynosa International Bridge Land Port of Entry.**



## GATEWAY INTERNATIONAL BRIDGE (BROWNSVILLE, TEXAS)

The first bridge structure connecting the communities of Brownsville, Texas, and Matamoros, Tamaulipas, Mexico, was the Brownsville and Matamoros Bridge, which began serving traffic in 1910. This bridge originally served rail, pedestrian, and carriage traffic and was expanded several times to serve increasing sizes and weights of automobile and truck traffic, including the eventual construction of an adjacent concrete bridge for automobile traffic and pedestrians. While the historic B&M Bridge provided person and goods mobility across the border, it does not represent a direct connection with downtown Brownsville. In 1926, the Gateway International Bridge was built; it is this structure that provides daily commuter and community connectivity between Brownsville and Matamoros.

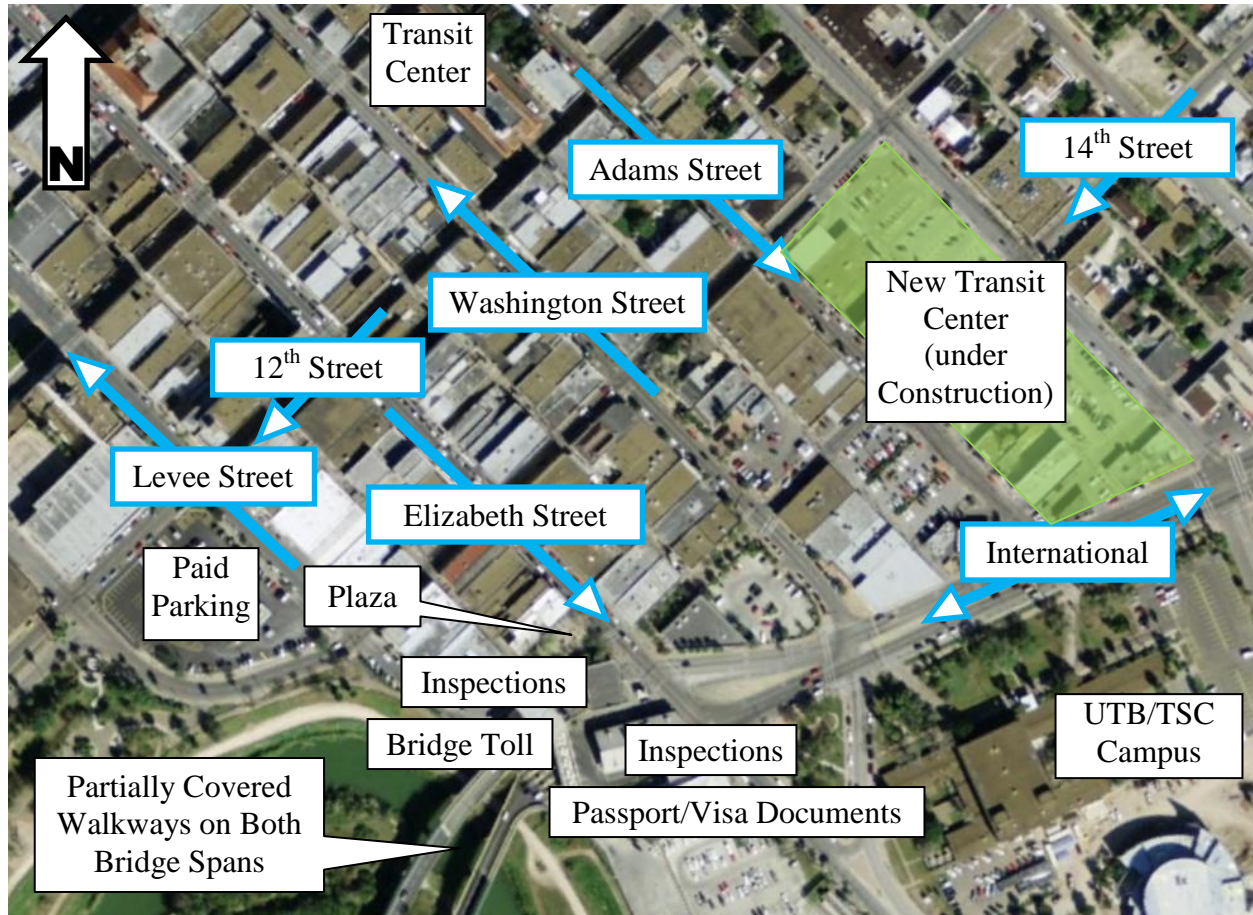
The development of international bridges serving Brownsville is an excellent example of infrastructure adapting and expanding to meet demand. As the original B&M Bridge became overcongested, the “new bridge” at Gateway was constructed. Then, the original B&M Bridge was eventually expanded in 1997 to include an adjacent structure serving automobile traffic and pedestrians (trains and trucks continued to use the historic bridge). The complete history of the B&M Bridge is presented in Figure 16 as a timeline of significant events. After completion of the Gateway International Bridge in 1926, a substantial shift of automobile and pedestrian traffic occurred, given the better proximity of the Gateway International Bridge to downtown Brownsville. Eventual overcongestion of the original B&M, Gateway, and B&M expansion bridges led to the construction of the Veterans International Bridge at Los Tomates. The latter structure was completed in 1999 and now accommodates all truck and bus traffic between Brownsville and Matamoros.



**Figure 16. Brownsville and Matamoros Bridge Timeline (20).**

### Infrastructure

Figure 17 contains an annotated map of the Gateway International Bridge LPE and the surrounding area of south downtown Brownsville. To the east of the bridge is the campus of the University of Texas at Brownsville (UTB)/Texas Southmost College (TSC), and to the north of the bridge is the street grid and shopping district found in south downtown Brownsville. The east bridge span accommodates northbound pedestrians and vehicles; the west span is for Mexico-bound autos and pedestrians. Cameron County operates the U.S. side of the bridge and tolls southbound traffic.



Source: Adapted from Google™ Earth, accessed August 6, 2010.

**Figure 17. Gateway International Bridge and Vicinity (Brownsville, Texas).**

While the majority of automobile traffic using the Gateway Bridge uses International Boulevard, the majority of pedestrian traffic arrives and departs the bridge vicinity along Elizabeth Street. Intermittent pick-up and drop-off occurs along Elizabeth Street throughout the day just to the north of the bridge complex. An open-air plaza exists immediately to the north of the bridge and serves to create a sense of place for Mexico-bound pedestrians before they enter the bridge complex (see Figure 18). Additional pedestrian pick-up/drop-off occurs in a business parking lot just west of the bridge and along Levee Street, also just west of the bridge facilities.

The short-block downtown grid of one-way streets immediately north of the bridge is a low-speed automobile environment amenable to heavy pedestrian use, and virtually every intersection is signalized for both automobiles and pedestrians and contains marked crosswalks. A common destination for bridge-using pedestrians is the Brownsville Urban System (BUS) transit center located in Market Square, north of the intersection of Washington Street and 12<sup>th</sup> Street.



**Figure 18. Open-Air Plaza near Gateway International Bridge Southbound Pedestrian Entrance.**

Pedestrians arriving in the United States and departing the Gateway International Bridge LPE exit from a building in the southeast corner of the intersection of Elizabeth Street and northbound International Boulevard. Most pedestrians exiting the LPE walk westbound on the south side of Elizabeth Street (see Figure 19) until they reach the downtown shopping district or turn northward on 13<sup>th</sup> or 12<sup>th</sup> Streets to reach the BUS transit center. Pedestrian signals are found at the intersection of southbound International Boulevard and Elizabeth Street, and pedestrian warning signs and marked crosswalks are found along Elizabeth Street and for vehicles exiting the Gateway International Bridge LPE along northbound International Boulevard. Traffic exiting the LPE must stop before proceeding northward across Elizabeth Street. Some pedestrian bridge users from Mexico use taxis queued along Elizabeth Street east of International Boulevard, while others walk northwest along International Boulevard.





**Figure 19. Elizabeth Street in Front of Gateway International Bridge (Facing Southeast).**

## **Pedestrian Circulation**

Each month, approximately 155,000 pedestrians and 1,450 bicyclists are accommodated at Gateway International Bridge in each direction (i.e., both departing and leaving the United States). Daily trend data show stability for weekday trips, with increasing southbound traffic observed approaching weekends. Pedestrian pick-up and drop-off activity in the vicinity of the international crossing is linked, in part, to everyday work schedules; pick-up activity is more prevalent in the mornings, while drop-offs are observed to increase in the late afternoon.

Seasonal trends are revealed through increases in pedestrian trips around the Christmas holiday and during the summertime vacation months of May through August. Spring Break has historically been a time of very high pedestrian demand, but student-related violence in the late 1980s and early 1990s caused huge reductions in such trips. In more recent years, drug-related violence and security concerns have kept seasonal discretionary trips to a minimum. Other holiday traffic trends are known and relate to whether the holiday is observed in the United States or Mexico. For the Fourth of July, for instance, increased traffic is observed entering the United States before the holiday and leaving following the occasion; trends are reversed for Mexican holidays.

Though specific survey data are unavailable, historic observations suggest that the highest-frequency trip purpose—potentially as high as 60 to 70 percent of trips—for pedestrians utilizing the Gateway International Bridge LPE is shopping. Many of the businesses located within the urban street grid in south downtown proximate to the Gateway International Bridge cater to this demand. The second most prevalent trip purpose is work, followed by social visits with family and friends.

Though the traffic and pedestrian environment in the vicinity of the Gateway International Bridge is generally uncongested, the situation was notably different before the opening of the Veterans Bridge. Traffic volume overall was nearly twice levels seen today, and a significant truck percentage (primarily tractor-trailer combinations) was also present. Few if any pedestrian/automobile conflicts are observed in today's operating environment, but bridge staff indicate that minor incidents for both automobiles (rear-end crashes) and pedestrians (minor pedestrian/automobile crashes) were much more frequent before traffic diversion to Veterans Bridge.

## Transit Service

Access to transit service for pedestrian users of the Gateway International Bridge is excellent. The existing downtown Market Square transit center is three blocks from Gateway International Bridge and is the hub for almost all transit routes provided by BUS. Hourly service to all parts of Brownsville is provided into and out of the transit center, and one route even extends to smaller communities to the west. The center itself is a linear, covered open-air station served by bus-only one-way streets (Figure 20).



**Figure 20. Market Square BUS Transit Center (Facing West on East Side).**

Not only is there easy pedestrian access to local transit, there are also regional and national transit carriers represented in close proximity to the Gateway International Bridge. Greyhound and its regional carrier, Valley Transit Company, have a station four blocks to the west of the bridge. Also, Tornado Bus Company and Americanos USA serve customers from stations within five blocks of the bridge (Americanos is co-located with Greyhound).

Undoubtedly, the most interesting recent development for bridge users who also make use of the local transit network is the construction of a new transit terminal underway at Adams Street and International Boulevard (see shaded area of Figure 17). A feasibility study completed in 2003 not only presented a needs assessment for a new multimodal terminal facility in Brownsville, but also assessed local sites for the facility and contained details regarding the proposed facility's design (21).

The relationship between transit access and utilization and the Gateway International Bridge is well represented in the feasibility study of the multimodal terminal. In fact, among the top several stated goals and objectives in the needs assessment for the multimodal terminal was "Provide convenient and safe access to local and regional transportation for pedestrians, especially visitors crossing into the United States from international bridges" (21).

Additional facts and figures from the feasibility study that pertain to pedestrian transit utilization and the international bridge crossing, either directly or indirectly, include the following:

- Local transit service provided by BUS is a popular way for shoppers and visitors to get from the border to shopping destinations throughout Brownsville.
- An estimated 40 percent of BUS riders are Mexican nationals.
- In a survey of riders at intercity and international transit providers in Brownsville, 55 percent of passengers who begin their trip in Brownsville are dropped off by others at the terminal, 14 percent walk to the terminal, 11 percent are dropped off by taxi, and about 9 percent arrive using their own vehicle.
- In the same survey, 31 percent of passengers departing Brownsville come across the border.
- Pick-up/drop-off locations are directly incorporated into conceptual designs of the future BUS multimodal terminal; these locations are found along Jefferson Street for private autos and along Adams Street for taxis.
- The Downtown Development Corporation estimates that between 85 and 90 percent of downtown retail customers come across the border.
- Proximity to international bridges was among the transportation criteria used in the assessment of sites for multimodal terminal location, including a review of walking distance for higher-priority sites.

Collectively, these facts and issues depict a set of considerations that either apply to, or can be extended to apply to—at least in principle—the Gateway International Bridge:

- Pedestrian users of the Gateway International Bridge conduct a range of shopping activities in the southern downtown Brownsville area immediately adjacent to the bridge.

- When shopping, business, or social activities result in trips beyond the southern downtown Brownsville area, local transit service provided by BUS is a popular way for pedestrian bridge users to reach destinations throughout Brownsville.
- Local pick-up/drop-off activity is a popular method—perhaps accounting for as many as half of users, depending on the service—for customers of public facilities (such as BUS transit or the Gateway International Bridge) to arrive at and depart from the point of service.
- Future consolidation of transit services (BUS as well as private intercity and international carriers) at the future BUS multimodal terminal facility will both consolidate and increase the number of pedestrians (and other modal users) making trips between the Gateway International Bridge and the downtown BUS facility.

## **PASO DEL NORTE INTERNATIONAL BRIDGE (EL PASO, TEXAS)**

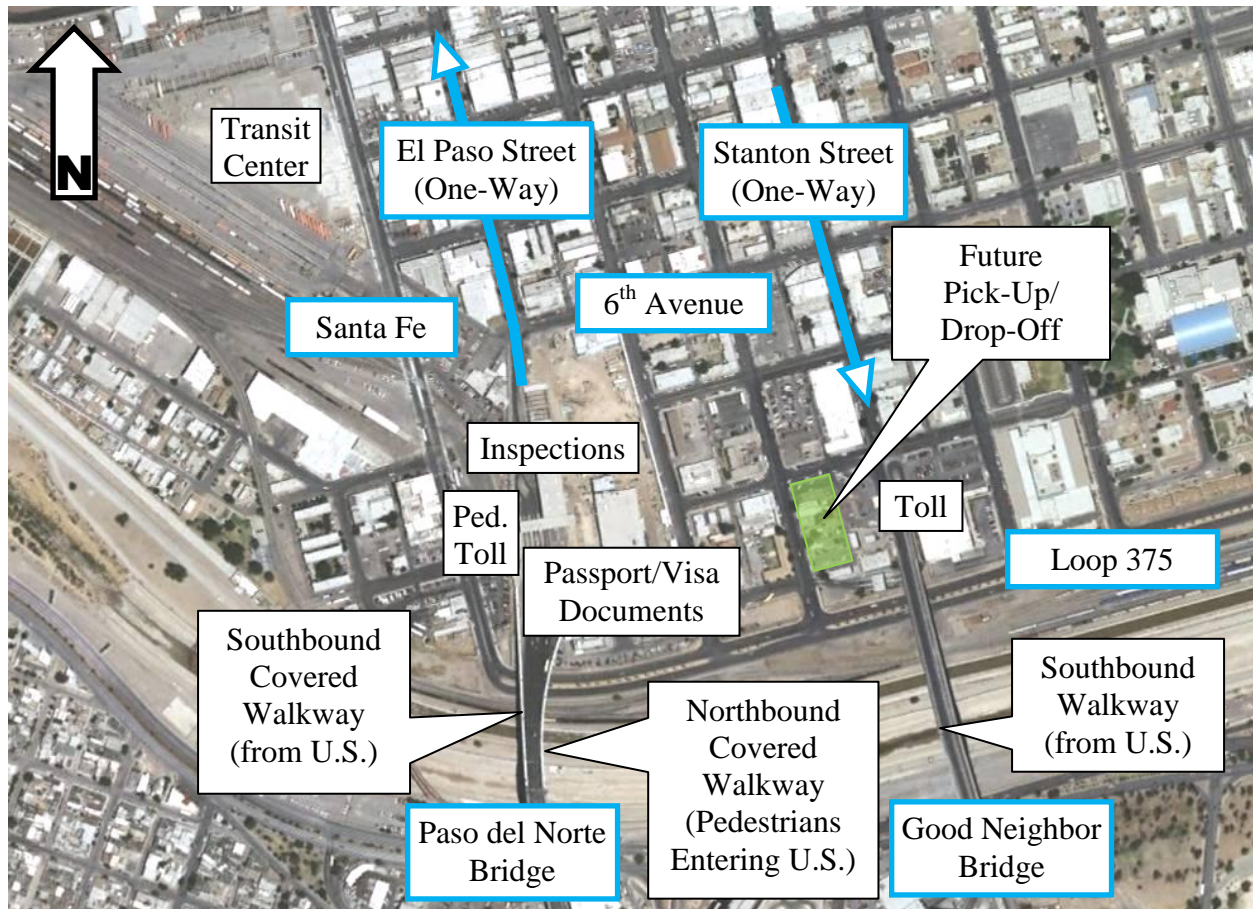
The Paso del Norte International Bridge and Good Neighbor (Stanton Street) Bridge were constructed on the U.S.-Mexico border following the border alignment terms contained within the Chamizal Treaty, an agreement between the United States and Mexico to resolve a nearly century-long dispute over the U.S.-Mexico border brought about by natural changes in the alignment of the Rio Grande River. Both bridges carry one-way, noncommercial vehicular traffic.

The Paso del Norte International Bridge carries southbound pedestrian traffic into Mexico on a covered walkway on the west side of the bridge. Northbound pedestrians entering the United States use a similar walkway on the east side of the bridge. The Good Neighbor Bridge carries only southbound pedestrian traffic, and the sidewalk is located on the west side of the bridge. The U.S. side of both bridges is owned and operated by the City of El Paso, and the pedestrian toll is \$0.50.

### **Infrastructure**

Figure 21 presents an annotated view of the roadway network and bridge system south of downtown El Paso. Vehicles and pedestrians entering the United States pass through the LPE in three typical stages: passport/documents validation, toll payment, and inspection. After departing the LPE, vehicles and pedestrians travel northward along El Paso Street until they reach 6<sup>th</sup> Avenue, where they can turn east. If pedestrians are bound for locations to the north or west, they continue north on El Paso Street for one or two blocks to Father Rahm Avenue or 4<sup>th</sup> Avenue where they can turn west to reach the new Sun Metro Transit Center. Shopping and restaurants are found in the area surrounding the Paso del Norte International Bridge and Good Neighbor Bridge, and personal vehicles also use these blocks for pick-up/drop-off. The most common pick-up/drop-off point is near the intersection of 6<sup>th</sup> Street and El Paso, where a taxi waiting area is found along westbound 6<sup>th</sup> Street.





Source: Adapted from Google™ Earth, accessed July 28, 2010.

**Figure 21. Paso del Norte International Land Port of Entry and Good Neighbor Bridge.**

Several recent improvements have been made to the pedestrian connection between Paso del Norte and the new transit terminal. The intersection of 4<sup>th</sup> Avenue with both El Paso and Santa Fe Streets is now signalized, and the signal installation includes pedestrian signals and crosswalks on all four approaches of each intersection (see 4<sup>th</sup> Avenue at Santa Fe Street in Figure 22). And, while there are no clear locations for a marked crosswalk on Santa Fe Street to accommodate pedestrians passing through Lion's Plaza on their way to the transit center, pedestrian warning signs are located in both directions along Santa Fe (Figure 23).





**Figure 22. Signalized Intersection of 4<sup>th</sup> Avenue and Santa Fe Street.**



**Figure 23. Pedestrian Warning Signing on Santa Fe Street West of Lion's Plaza.**

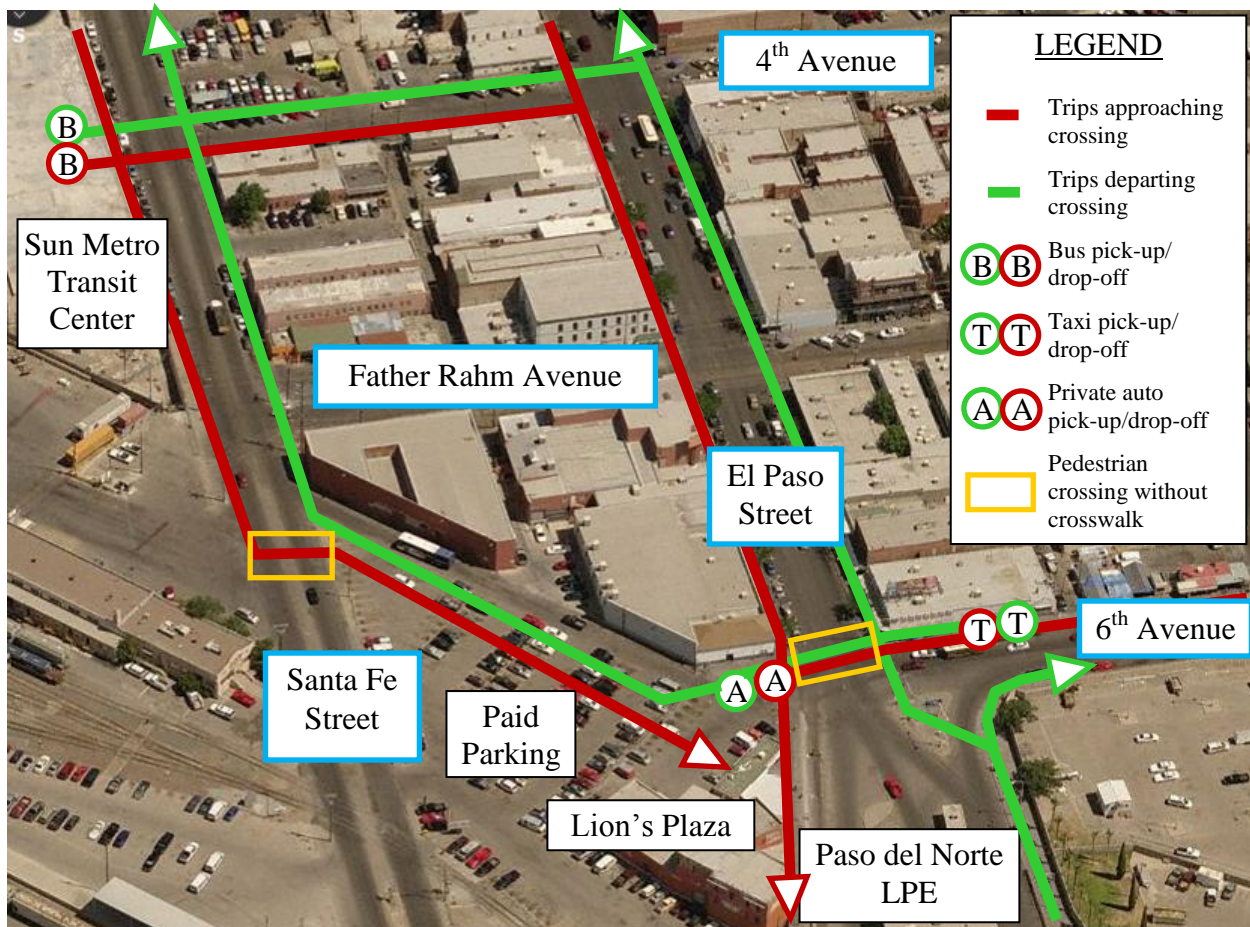
## Pedestrian Circulation

A daily average of approximately 16,000 pedestrians enters the United States using the northbound pedestrian portion of the Paso del Norte International Bridge. Similar volumes occur in total for southbound pedestrian activity, though the volume is split between the Paso del Norte International Bridge and Good Neighbor Bridge; the Paso Del Norte International Bridge carries about 12,000 daily pedestrians. Pedestrian volume is relatively stable throughout the year, though a light decrease is observed during summer months. Decreases are also noticeable on days with inclement weather. High volumes of pedestrians result in heavy utilization of the sidewalks on both the east and west sides of El Paso Street for four blocks from 6<sup>th</sup> Avenue north to Paisano Drive/US 85/US 62.

Most minor intersections between 6<sup>th</sup> Avenue and Paisano Drive are all-way stop controlled, resulting in a low-speed environment that, while very active in terms of pedestrian and vehicular traffic, remains relatively safe. Parallel parking exists on higher-volume road sections, while angle parking occurs on lower-volume roadways. Figure 24 illustrates higher-volume pedestrian routes to and from the bridge, the new Sun Metro transit center, auto and taxi pickup/drop-off locations, and local land use. While crosswalks exist for crossing 6<sup>th</sup> Avenue at El Paso Street, no marked crosswalk exists across El Paso Street at 6<sup>th</sup> Avenue (Figure 25).

Figure 26 provides some insight into the nature of the pedestrian and modal environment at the departure from the Paso del Norte International Bridge LPE. Pedestrian activity is present throughout the day, along with use of the 6<sup>th</sup> Street taxi stand (right center of Figure 26a) and impromptu bicycle security provided in the right-turn island along El Paso Street.

Several improvement projects have been proposed to increase pedestrian safety and comfort within the roadway network surrounding the Paso del Norte International Bridge and Good Neighbor Bridge. The first such improvement is a pick-up/drop-off area in the southwest corner of the intersection of 8<sup>th</sup> Avenue and Mesa Streets (see Figure 21 for the location east of the Paso del Norte International Bridge LPE). This facility is currently under construction and will remove some of the informal on-street and parking-lot pick-up and drop-off activity currently found surrounding the LPE and provide such service for both bridges because of its central location. Lion's Plaza may also be expanded to include canopies and vending machines, which would mainly serve southbound pedestrians on their way to the Paso del Norte International Bridge. Another potential improvement is the construction of a pedestrian canopy and additional lighting at the exit of the Paso del Norte International Bridge LPE and extending up to the intersection of El Paso Street and 6<sup>th</sup> Avenue.



Source: Adapted from Bing™ Maps, accessed July 28, 2010.

**Figure 24. Major Pedestrian Routes to/from International Crossing.**



**Figure 25. Westbound Pedestrian Crossing El Paso Street at 6<sup>th</sup> Avenue.**





a. Facing North on El Paso Street



b. Facing West on 6<sup>th</sup> Avenue

**Figure 26. Northbound Departure from Paso del Norte International Bridge Land Port of Entry.**

## Transit Service

A number of different transit options exist for the pedestrian user of the Paso del Norte International Bridge and Good Neighbor Bridge. Sun Metro routes provide local service along Santa Fe, El Paso, and Stanton Streets, and a brand-new Sun Metro Transit Center serving over 25 local and area routes is located three blocks from the Paso del Norte International Bridge west of the intersection of 4<sup>th</sup> Avenue and Santa Fe Street. Complementing public services (restrooms and water fountains) found within the LPE, the new transit center provides full public amenities (Figure 27). Not only are local transit services found within the vicinity of the crossing, but regional carriers are also present. A Greyhound terminal is located approximately eight blocks

north of the Paso del Norte International Bridge LPE along Santa Fe Street, and other regional transit providers (Americanos USA, Autobuses Los Paisanos, Tornado Bus, etc.) also have terminals along Santa Fe Street.



**Figure 27. Bert Williams Downtown Santa Fe Transfer Center (El Paso, Texas).**

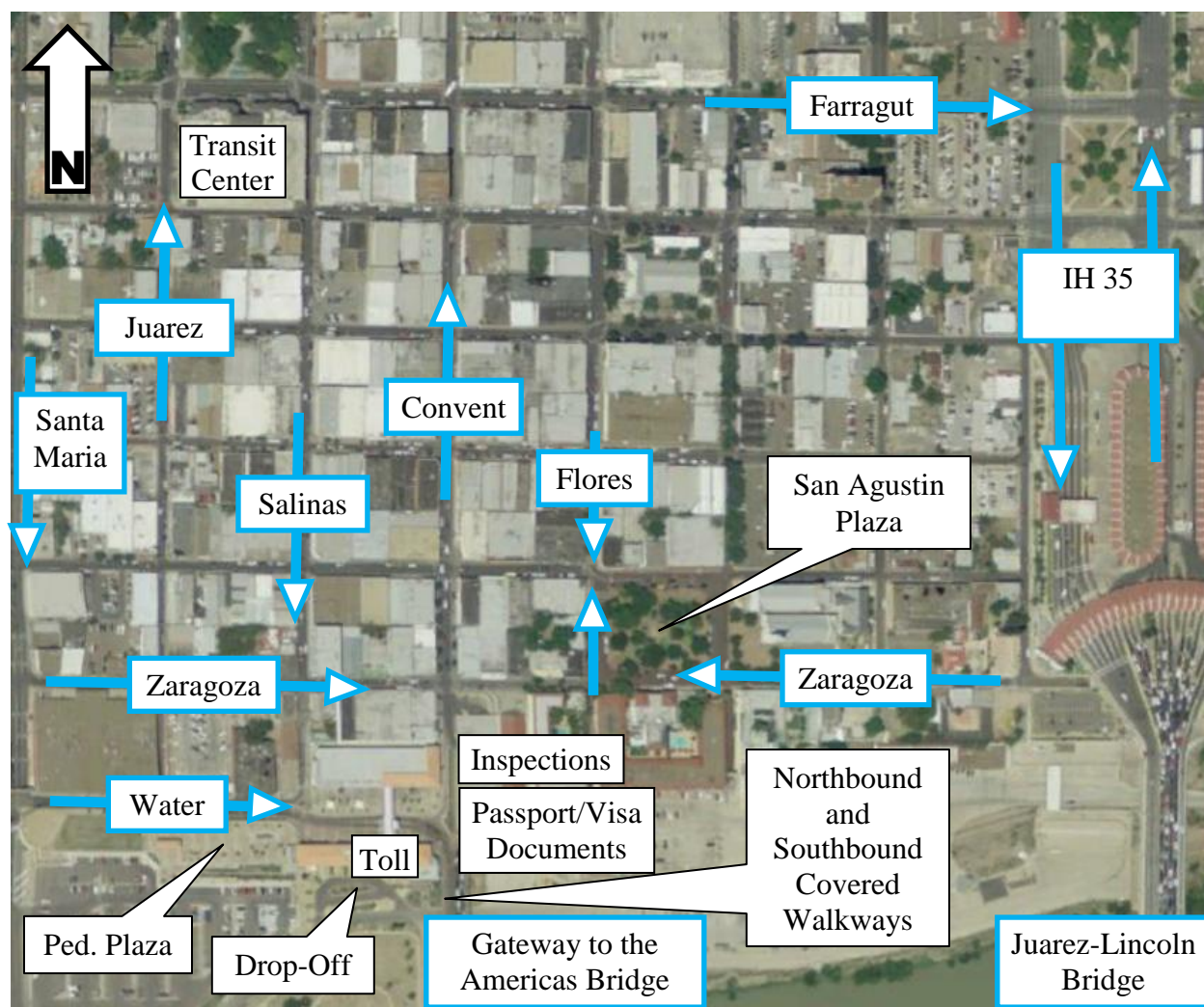
## **GATEWAY TO THE AMERICAS INTERNATIONAL BRIDGE (LAREDO, TEXAS)**

The histories of the international bridges serving Texas border cities and their sister Mexican cities across the Rio Grande are as complex as the communities they serve. The Gateway to the Americas International Bridge in Laredo, Texas, is certainly no exception. The first bridge constructed at this site was built in the 1880s. However, that bridge was destroyed by a flood, the same fate that befell the next two bridges built at the site in 1932 and 1954. The current bridge structure was completed in 1956 and has been in continuous service since that time.

Since other bridges in the Laredo urban area have taken various traffic types away from the Gateway to the Americas International Bridge over time, this facility currently serves pedestrian and private automobile traffic between Laredo and Nuevo Laredo, Mexico; it is the only urban Laredo international bridge where pedestrians are allowed to cross the U.S.-Mexico border. Several blocks to the east of the Gateway to the Americas International Bridge is the Juarez-Lincoln Bridge. This bridge, which is located at the terminus of IH 35 at the U.S.-Mexico border, was the primary automobile and truck/commercial traffic bridge in Laredo between the mid-1970s and the opening of the World Trade Bridge in 2000. Juarez-Lincoln currently serves automobile (noncommercial) traffic and buses, while World Trade Bridge serves truck/commercial traffic only. Located just to the west of urban Laredo is Columbia-Solidarity Bridge, which serves border traffic between Texas and the Mexican State of Nuevo Leon; the other three Laredo bridges across the U.S.-Mexico border enter the State of Tamaulipas.

## Infrastructure

Figure 28 presents both an aerial view of the southern downtown Laredo area and details regarding major transportation-facility components. Note that the transit center in the upper left corner is the primary terminal for El Metro transit as well as the station for intercity bus providers Greyhound and Americanos USA. Convent Avenue is the primary pedestrian route between the Gateway to the Americas International Bridge and local destinations, including downtown Laredo (shopping/restaurants) and the transit center. Vehicular traffic approaching the bridge is typically southbound on Santa Maria Avenue before turning east on Water Street to pay their toll and cross the bridge. Northbound traffic out of Mexico typically remains northbound on Convent Avenue after passing through Customs and Border Protection for document validation and inspection. Traffic takes one-way cross streets off of Convent Avenue to reach IH 35 to the east or to reach surface arterial roadways to desired parts of Laredo.



Source: Adapted from Google™ Earth, accessed August 11, 2010.

**Figure 28. Gateway to the Americas International Bridge and Vicinity.**



The City of Laredo facilities serving Mexico-bound automobile and pedestrian traffic were recently redeveloped and reconstructed, with construction being completed in 2006. Prior to the redesign, all pedestrian and automobile traffic interacted at grade within the surface street network. The situation was especially complex for southbound pedestrian traffic since it had to cross all Water Street automobile traffic heading eastbound toward the Laredo bridge toll facility. The new bridge management offices and tolling facility are shown in Figure 29, including the overhead pedestrian bridge (left center) that removes day-to-day automobile-pedestrian exposure for the 12,000 southbound pedestrians each day at Water Street. As part of the redesign, land to the west of the bridge facility that was previously parking lot was converted into a west-side pedestrian plaza for pedestrians approaching the bridge facility (Figure 30).



**Figure 29. Gateway to the Americas International Bridge Management Complex.**





**Figure 30. Gateway to the American International Bridge West-Side Pedestrian Plaza, South Side of Water Street (Viewing West).**

### **Pedestrian Circulation**

The Gateway to the Americas International Bridge accommodates a southbound pedestrian volume of over 325,000 on an average monthly basis. Volumes are relatively stable throughout the workweek, with a reduction only typical for Sundays. Pedestrian volume is very directional; traffic is northbound (into the United States) in the mornings and southbound (into Mexico) in the evenings. Figure 31 illustrates the directionality of AM pedestrian and automobile traffic into the United States (northbound traffic is approaching in the picture). Seasonal variations are observed as increases in pedestrian activity during Christmas and Holy Week (the week before Easter) and as school releases for summer holidays at the beginning of June.



**Figure 31. Gateway to the Americas International Bridge—AM Peak-Hour Operation (Facing South).**

Pick-up and drop-off activity is divided into two locations, only one of which has so far been accommodated in the design. Close to the Juarez-Lincoln International Bridge, a ramp exists that carries southbound traffic down to Santa Isabel Avenue (labeled on some maps as Pedregal Street) and under the Gateway to the Americas International Bridge. A drop-off loop was constructed off of this roadway on the river side of the bridge management facility, just west of Gateway to the Americas International Bridge, to provide a simple connection to the pedestrian facilities of the bridge. This location is not used as a pick-up location since it is almost two blocks and several changes in grade level removed from the pedestrian exit from the bridge LPE, which is located at the intersection of Zaragoza Street and Convent Avenue (Figure 32, pedestrians walking from right to left in front of the white wall on the right side of the picture).

The block of Zaragoza Street east of Convent Avenue has actually been closed to vehicular traffic for several years, a change that may become permanent. This street has now become a pedestrian passageway to Flores Avenue and San Agustin Plaza, where pedestrian pick-up activity occurs along the one-way roadway loop around the plaza. Unfortunately, these activities impede traffic flow around the plaza and are not directly regulated. A current effort is underway to develop a new master plan for downtown Laredo; the one-way street circulation system south of downtown is being examined as part of this effort, as is the need for pedestrian circulation, pick-up/drop-off activity, and automobile and pedestrian safety and security in the vicinity of the international bridge crossing. It has been locally estimated that half of downtown retail business activity occurs as the result of Mexican residents visiting and shopping in south Laredo, where Gateway to the Americas International Bridge is the only international bridge serving pedestrian traffic. These statistics reinforce the economic and safety needs of the pedestrian population in this area.



**Figure 32. Pedestrian Exit from Gateway to the Americas International Bridge Land Port of Entry (Middle Right of Image).**

Several modern and innovative pedestrian safety treatments have been incorporated into the Gateway to the Americas International Bridge facility redesign and redevelopment. Figure 33 shows pedestrian/crosswalk warning signs and a pedestrian table, a raised roadway section allowing pedestrians to cross the roadway at sidewalk level. This treatment is found along Water Street just south of Juarez Avenue.

Figure 34 shows a pedestrian gate found along the east side of Salinas Avenue at Water Street. The gate is normally closed to prevent pedestrian traffic from crossing Water Street at grade; such traffic is encouraged to use the overhead walkway for safety reasons. During holidays, however, the volume of pedestrian traffic is such that the overhead walkway and its stairs, elevator, and escalator become overcrowded. When this occurs, an enforcement officer opens the pedestrian gate to alleviate pedestrian congestion. The officer remains at the pedestrian crossing to manage traffic along Water Street and ensure that pedestrians cross only when appropriate. In-roadway lighting provides nighttime illumination of the crosswalk. Another, and more subtle, pedestrian feature found in Figure 34 is the pedestrian fence and landscaping wall found along Water Street. This visually unobtrusive barrier blends into the landscaping design and effectively limits pedestrian at-grade activity to the sidewalks and plaza north and south of Water Street; pedestrian crossing activity is focused at the overhead walkway or at the pedestrian table at the west end of the small plaza on the west side of the bridge management building (Figure 33).





**Figure 33. Pedestrian Warning Signs and Pedestrian Table along Water Street.**



**Figure 34. “Event Gate” Treatment for Holiday Pedestrian Traffic.**

## **Transit Service**

In the southwest corner of the intersection of Farragut Street and Salinas Avenue is the downtown Laredo transit center facility. This facility is the main transit terminal for El Metro (Figure 35) and includes surface-level shopping and bus loading (Figure 36), along with three

levels of elevated garage parking. Buses also pick up passengers along Farragut Street on the north side of the terminal.



**Figure 35. El Metro Downtown Transit Center (North Façade).**



**Figure 36. Transit Terminal Loading/Unloading (Facing East on Juarez Avenue).**

A pick-up/drop-off zone is located on the west side of Salinas Avenue (east side of the transit center), and a taxi wait line is located along Salinas Avenue just north of Farragut Street. With its location seven blocks from the Gateway to the Americas International Bridge, the transit center is in an ideal location to allow for pedestrian bridge users to reach and return from nearly any location in Laredo. Pedestrian activity between the bridge and the transit center is most often along Convent Avenue, but most south downtown roadways have a common one-way cross section amenable to pedestrian use that features sidewalks, intersections controlled by signals (with pedestrian signals) or stop signs, side-of-street parking, and lower automobile speeds.

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## **CHAPTER 3: BEST PRACTICES**

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The best practices described below represent findings from the literature review on pedestrian issues and other issues related to international bridge crossings, as well as the outcomes from four site visits conducted at international bridges with high pedestrian volume along the Texas-Mexico border. While the results are expected to be useful to operating agencies in Texas due to similar system issues associated with relatively short bridges crossing the Rio Grande River, many of the findings would apply for designers of any border crossing with significant pedestrian volume. Best practices are presented in a “top-down” manner, beginning with planning considerations and then progressing through design and operations.

### **PLANNING—FACILITY NEEDS ASSESSMENT AND LOCATION**

The planning and construction of a new multimodal terminal in Brownsville afforded the opportunity to better integrate transit services with the municipal roadway network and the Texas-Mexico border. The site-evaluation component of the feasibility study (21) for the new center emphasized proximity to the Gateway to the Americas International Bridge, recognizing the needs of international bridge users relating to transit proximity and usage as well as the need to have the transit center directly link the arterial roadway network in Brownsville for effective and efficient service. The location of the new Sun Metro transit center within several blocks of the Paso Del Norte International Bridge in El Paso is a second example of a desirable outcome in transit facility planning and provision for the international (and pedestrian bridge-using) community.

Another example of effective facilities design is the incorporation of a local transit station directly into the international LPE exit, as is the case in Hidalgo, Texas, at the McAllen-Hidalgo-Reynosa International Bridge. This facility is situated such that many transit users never need to cross a roadway when connecting between the transit station and the bridge facilities, and those who must cross the roadway have to do so only once, with exposure to only one direction of traffic. While it is recognized that transit stations and centers for larger communities would not fit in direct proximity to the exit point from an international bridge crossing, the Hidalgo example is one that provides many-faceted solutions for smaller communities.

### **DESIGN—MODAL TRANSFER ELEMENTS**

One of the prevailing safety and operations concerns evident at the entrance to/exit from the international bridge crossing review in this investigation was pedestrian bridge user pick-up/drop-off activity by private automobiles. The research team observed the extent of this activity by reviewing the pedestrian mode data from an El Paso travel survey (3) and the four site studies conducted as part of this investigation. An excellent example of providing a pedestrian bridge user drop-off point is the turn-out provided in the recent redesign of the City of Laredo’s bridge management facility at the Gateway to the Americas International Bridge (see the bottom left of Figure 28). While it is certainly desirable to be able to fully accommodate both drop-off and pick-up for pedestrian bridge users, the design of the overall roadway and bridge facility



layout often precludes being able to do so at one location since the roadway serving the bridge itself physically divides southbound lanes and pedestrian walkways bound for Mexico from northbound lanes and Customs and Border Protection facilities within the LPE serving northbound traffic and pedestrians entering the United States.

The needs for pedestrian pick-up and drop-off zones are known in the context of transit facility design; pick-up and drop-off zones are being built into the new Brownsville multimodal facility, along one street for private autos and another street for taxis. A pick-up/drop-off facility is also being construction to meet international bridge user needs in El Paso between the Paso del Norte International Bridge and Good Neighbor Bridge (the shaded region in Figure 21). Facility design guidelines for international bridge facilities (13) cite the need to provide for drop-off/pick-up where security concerns do not prevent this activity, but no distances are provided for the desired proximity of the drop-off/pick-up location with respect to border pedestrian-processing facilities. Researcher observation at international bridges in Texas suggests that the pick-up/drop-off location should be as close to the entry or exit point for pedestrians into/out of bridge facilities as physically possible.

## **DESIGN—PEDESTRIAN SEPARATION ELEMENTS**

Design guidelines for public facilities (13) also suggest that pedestrian walkways should be designed such that provisions are made—curbs, bollards, low walls, etc.—to prevent vehicle encroachment. Effective use of low walls to limit pedestrian encroachment into roadway lanes entering the Gateway to the Americas International Bridge facility into Mexico are found in the new bridge management complex in Laredo (Figure 29 and Figure 34); such low walls simultaneously prevent vehicle intrusion into the pedestrian plaza and walkways. As this example illustrates, these elements can be thoughtfully designed into the outdoor landscaping and can be sufficiently open so as not to present a security concern. Low walls of open fencing (again, to reduce security concerns with a solid fence) have potential to be used along roadways entering and exiting international bridge facilities to reduce pedestrian/vehicle conflicts or to focus pedestrian crossing activity at signalized intersections or marked crosswalks; examples are again found in the new Laredo complex (Figure 33).

Another desirable and noteworthy feature of pedestrian design for international bridge crossings is a plaza or shopping complex adjacent to the bridge entrance for Mexico-bound pedestrians. Such elements contribute to the creation of a “sense of place” within the urban context, and provide a logical meeting location and destination for Mexico-bound travelers. Since the international bridges in El Paso, Brownsville, and Laredo are all contextually within or proximate to the downtowns of those communities, it is not happenstance that pedestrian bridge destinations exist within these communities (Figure 24 from El Paso [Lion’s Plaza], Figure 18 from Brownsville, and Figure 30 from Laredo).

## **DESIGN—PEDESTRIAN CANOPIES**

Texas heat is legendary, as is the unpredictability of thunderstorms in border areas, especially close to the Texas coast. Most of the high-volume pedestrian walkways along international bridges between Texas and Mexico are at least partially covered, and plans exist in most



locations without full coverage to provide full canopy coverage of the bridge walkways and the sidewalks/walkways that connect to Customs and Border Protection facilities as funding becomes available. Other public comfort amenities, including restrooms, benches, and/or water fountains/vending, are being designed into new bridge crossing and management complexes as those facilities are being redesigned and reconstructed.

## **DESIGN—APPROPRIATE PEDESTRIAN SIGNING**

Recent TCRP/NCHRP study recommendations and procedures for matching pedestrian crossing accommodations and warning to volume conditions and roadway speed are a practical asset to the transportation engineering community (11). While many pedestrian-related roadway design elements are featured in the guidelines and standards of the transportation engineering profession, the TCRP/NCHRP study succinctly presents examples of each pedestrian crossing and advance warning device treatment and provides practical guidance on which devices are most applicable for given roadway and pedestrian crossing conditions. Recommendations from the study separate recommendations for roadways with speeds above 35 mph and those with speeds below 35 mph; the roadway environment typically found proximate to international bridges in Texas, at least directly proximate to the LPE, is below 35 mph. Examples of pedestrian crossing and advance pedestrian warning signing are found at each high-volume pedestrian international bridge crossing studied during this investigation (Figure 13, Figure 19, Figure 23, and Figure 33).

## **OPERATIONS—FLEXIBILITY FOR HIGH-VOLUME EVENTS**

Certainly one criteria for evaluating the success of any deployment is its ability to accommodate levels of use beyond its everyday design. Such flexibility was built into the design and operation of the new Gateway to the Americas International Bridge facility in Laredo. While Mexico-bound pedestrians use an overhead walkway to eliminate daily conflicts with automobile traffic approaching the bridge along Water Street (Figure 29), a redundant, at-grade crossing was maintained to accommodate overflow volumes during holiday and other high-volume pedestrian events/occasions (Figure 34).

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