CAIT-UTC-018

Warehouse Location and Freight Attraction in the Greater El Paso Region

FINAL REPORT
December 2013

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Rutgers, The State University of New Jersey
And
El Paso Metropolitan Planning Organization
And
U.S. Department of Transportation
Federal Highway Administration

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TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
CAIT-UTC-018		

4. Title and Subtitle	5. Report Date
Warehouse Location and Freight Attraction in the Greater El Paso Region	December 2013
	6. Performing Organization Code CAIT/CTIS
7. Author(s) Ruey Long Cheu, Salvador Hernandez, Jessica Miramontes, Yvonne Colmenero, Esmaeil Balal	8. Performing Organization Report No. CAIT-UTC-018
9. Performing Organization Name and Address Center for Transportation Infrastructure Systems The University of Texas at El Paso 500 W University Ave, El Paso, TX 79968-0516	10. Work Unit No. 11. Contract or Grant No. DTRT12-G-UTC16
12. Sponsoring Agency Name and Address Center for Advanced Infrastructure and Transportation Rutgers, The State University of New Jersey 100 Brett Road Piscataway, NJ 08854	13. Type of Report and Period Covered Final Report 1/1/2013-12/31/2013 14. Sponsoring Agency Code

15. Supplementary Notes
U.S. Department of Transportation/Research and Innovative Technology Administration
1200 New Jersey Avenue, SE
Washington, DC 20590-0001

16. Abstract
This project analyzes the current and future warehouse and distribution center locations along the El Paso-Juarez regions in the U.S.-Mexico border. This research seeks has developed a comprehensive database to aid in decision support process for identifying potential warehouse and distribution center locations. This database will provide information regarding accessibility, mobility, safety, and economic feasibility of the sites. In addition, truck volumes at four selected sites in El Paso have been collected and analyzed to provide planners information on the expected truck trips that would be generated and attracted in the warehouse and distribution center locations. The observed trip generation and attraction rates are compared with the Institute of Transportation Engineers' trip generation models.

17. Key Words	18. Distribution Statement
Warehouse, freight, trip generation, GIS, land use, border	

19. Security Classification (of this report)	20. Security Classification (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	99	

Form DOT F 1700.7 (8-69)

Acknowledgments

The authors would like to acknowledge the invaluable insights and guidance of public and private entities that collaborated in this project. Thanks to Dr. Salvador Gonzalez and Efren Meza from El Paso Metropolitan Planning Organization for their assistance in developing this project idea. Special thanks for the meaningful information that Denisse Rodarte, CNU-A, Program Administrator at the City of El Paso provided. The authors are grateful for the data and help provided by the UTEP Geospatial Information Service Center. The participations from Alma DeAnda from the Land Administration Department at El Paso Water Utilities, Manual Ochoa, Carey Westin and Bob Cook from Borderplex Alliance are greatly appreciated. The authors sincerely appreciate the collaboration of Mr. David Reyes-Arteaga, Operations Manager at Kuehne and Nagel El Paso Office. Finally, the authors would like to recognize the significant inputs that Miguel A. Miramontes in representation of TCC Soft Inteligente.

Abstract

This report describes the recent information regarding freight activities and centers of freight distribution in the El Paso-Juarez border region. Data collection was obtained from public and private entities. Using Geographic Information System (GIS), maps were created to illustrate current status of land use, facility location, traffic data and crash occurrence. Economic market for industrial activity and processes involving freight logistics in this border region are also described in this report. Through interviewing stakeholders, it was possible to describe the current and project the future development of industrial activities, which are closely related to freight generation and attraction. Truck volume surveys have been performed for four sites in El Paso that have predominantly freight activities. The freight generation and attraction rates were compiled, analyzed and compared with the models provided in the Institute of Transportation Engineers' Trip Generation Handbook. This research has compiled a comprehensive pool of information that can help a decision support process that seeks to account for accessibility, mobility and safety of freight transportation in the El Paso-Juarez border region.

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1 Introduction

1.1 Motivation

As the national economy continues to recover, the volume of freight shipments present on the nation's highway system will also experience slow but consistent growth. This is also true for bi-national freight flows. Thus, from a planning perspective, identifying the points of origin and points of destination of current and future freight flows can provide planners with valuable data to update current demand forecasting models along the border regions. Of special interest are the warehouse and distribution centers that attract these freight flows—this is because the location of these facilities can greatly influence the surrounding traffic behavior and truck routes. Currently, warehouses and distribution centers that surround border towns (such as the Greater El Paso region) tend to be located close to airports and/or off transportation facilities (interstates, state highways) that are in the general proximity of the international ports of entry. However, these locations may not always be optimal, for example, in terms of capacity utilization, operational efficiency (for both the facilities and the transportation companies), competition, and safety. Hence, this study seeks to collect information on current and future warehouse and distribution center locations along border regions, understand the factors that influence the choice of their locations, and also analyze truck trip generation and attraction rates.

1.2 Objectives

The objectives of this project are to analyze current and future warehouse and distribution center locations along the El Paso-Juarez border region that can provide greater accessibility and mobility for increasing bi-national freight flows and that are economically feasible. To accomplish these objectives we propose the following set of work aims:

- Identify current and planned locations of warehouse and distribution centers.
- Identify potential locations that meet the criteria of warehouse and distribution center and that promote increased accessibility, mobility and safety.
- Assess the monetary feasibility (costs) of the potential location.

This research seeks to develop a comprehensive database to aid in decision support process for identifying potential warehouse and distribution center locations. This database will provide information regarding accessibility, mobility, safety, and economic feasibility of the sites. To accomplish this, data will first be gathered from various sources—for example, through interviewing stakeholders via a stated preference survey, ArcGIS Business Analyst, Texas Crash Information System (CRIS), land use code data, and traffic data.

In addition, truck volume at four selected sites in El Paso will be collected and analyzed to provide planners information on the expected truck trips that would be generated and attracted in potential warehouse and distribution center locations. The observed trip generation and attraction rates will be compared with the Institute of Transportation Engineers' trip generation models.

1.3 Relevance to USDOT Strategic Goals

This work is directly aligned with the stated goals and research priorities of "Safety" and "Economic Competitiveness." In addition, this proposal supports the Center for Advanced Infrastructure for Transportation (CAIT)'s theme of "State of Good Repair." For example, by identifying current (e.g., to update or improve service quality) and potential warehouse and distribution center locations that promote increased accessibility, mobility and safety, the stakeholders will be able to assess the economic feasibility of the sites.

2 Literature Review

This chapter reviews the issues related to freight-land use planning. It also reviews data sources of freight activities as indicated in the published reports. Towards the end of this chapter, past studies of freight transportation in the El Paso-Juarez region are also reviewed.

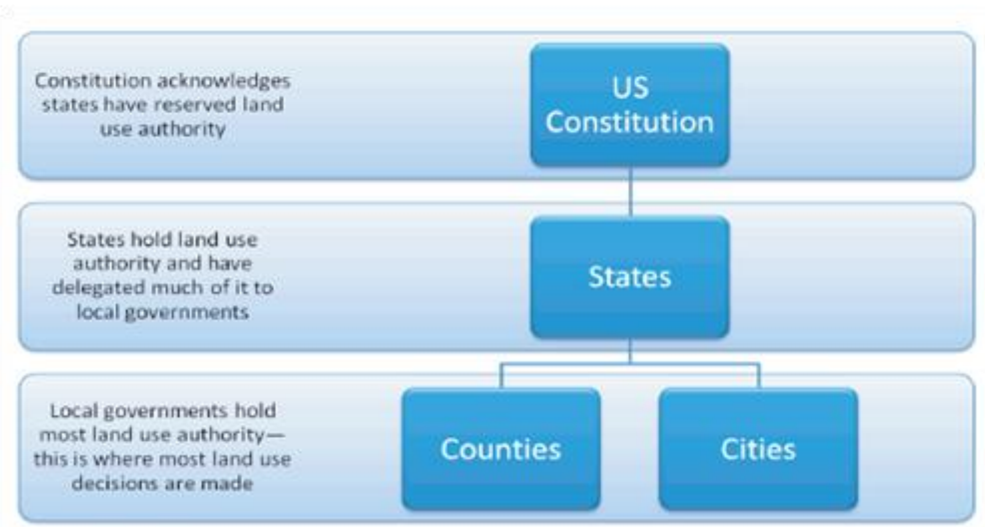
2.1 Freight Activity Planning

2.1.1 Land Use

Land use is one of the most important topics in freight as the latter can cause conflicts among stakeholders, especially residents, private vehicle and transit users. Land use planning is the first and most important step in creating effective processes and opportunities to achieve freight-compatible development, reduce community-freight conflicts, and preserve critical freight corridors and facilities (Rhodes et al. 2012). The report by Rhodes et al. (2012) gives advice to stakeholders on how to successfully achieve advanced planning by providing specific tools such as:

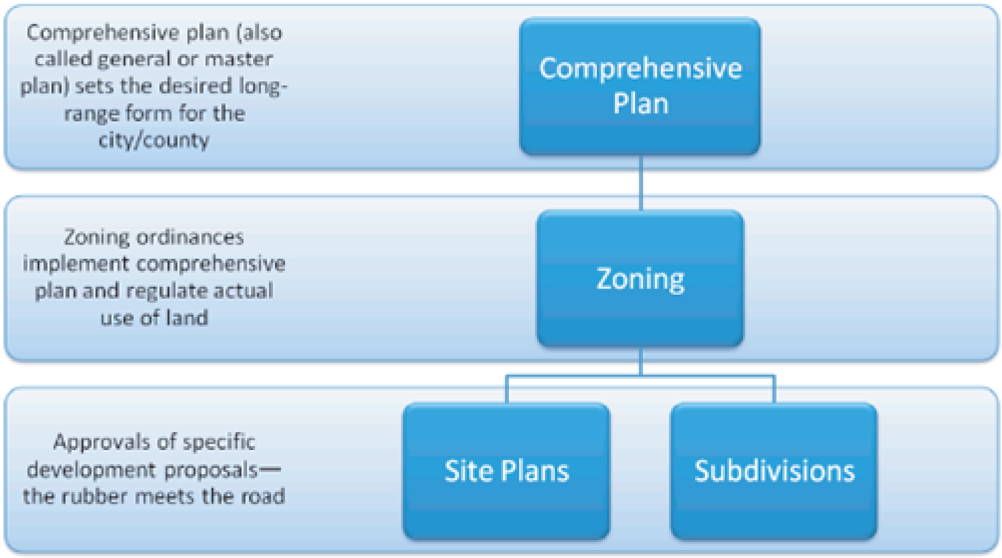
• State enabling acts;
• Local comprehensive plans;
• State and regional plans;
• Regional collaboration; and
• Mapping.

The state does not play a big role in deciding land use. The state is divided into cities and counties and these local municipals are the ones that make the decisions on land use. Figure 2.1 shows a schematic of how land use authorities are divided. Figures 2.1 and 2.2 show land use decisions within local counties and cities. It can be observed from these figures that cities and counties are in charge of decisions on the land use and zoning.



Source: Rhodes et al. (2012**)**

Figure 2.1 Land use authority in the United States



Source: Rhodes et al. (2012**)**

Figure 2.2 Typical local government land use system

Figures 2.1 and 2.2 describe how state government is divided regarding land use decision making. However, the state does not take into account freight within their comprehensive plans and this is what creates the main problem for freight land owners. As mention in Rhodes et al. (2012) "If the state enabling laws required or suggested that plans to protect all modes of freight should be included in a general plan, significant new protections would likely evolve naturally in the land use system nationwide in the next decade or so." Figure 2.3 shows how state enabling acts do not take into account freight systems.

Source: Rhodes et al. (2012)

Figure 2.3 State enabling acts often do not account for freight

2.1.2 Conflicts Related to Freight Activity

The National Cooperative Freight Research Program (NCFRP) has developed a report (Rhodes et al. 2012) regarding freight and land use conflict. Residential, medical, and educational areas are the three land uses that are least compatible with freight due to pollutions created by freight movements. Air pollution, noise pollution, light pollution and vibration pollution are among the main conflicts related to these areas. Figure 2.4 displays the main conflicts that arise with respect to freight activity.

Noise Sensitive Uses	Dwelling units (residential, motels, etc.); educational uses (childcare, schools, colleges, etc.); libraries; hospitals and other residential health care providers; playgrounds.
Light Sensitive Uses	Dwelling units (residential, motels, etc.); and hospitals and other residential health care providers.
Vibration Sensitive Uses	Dwelling units; educational uses; vibration sensitive industries (such as precision high-tech industry); all buildings not constructed to withstand the fatigue caused by rail vibrations.
Pollution/Air Quality Sensitive Uses	Dwelling units (residential, motels, etc.); medical (hospitals and other residential health care providers); educational(childcare, schools, colleges, etc.); park and recreational facilities.
Uses Requiring Potentially Incompatible At-grade Crossings	Dwelling units; educational uses; libraries; hospitals and other residential health care providers; commercial uses; emergency services; park and recreational facilities.
Uses Associated with the Potential for Dangerous Trespass	Dwelling units; education uses (especially childcare facilities and schools); libraries; playgrounds; commercial uses.
Time Sensitive Uses	Night-time sensitive uses*; dwelling units, hospitals and residential care facilities.
Traffic and Congestion Sensitive Uses	Dwelling units; emergency service provider uses; residential health care facilities.
Height Sensitive Uses	Residential and commercial uses that may impact approach and landing flight paths.

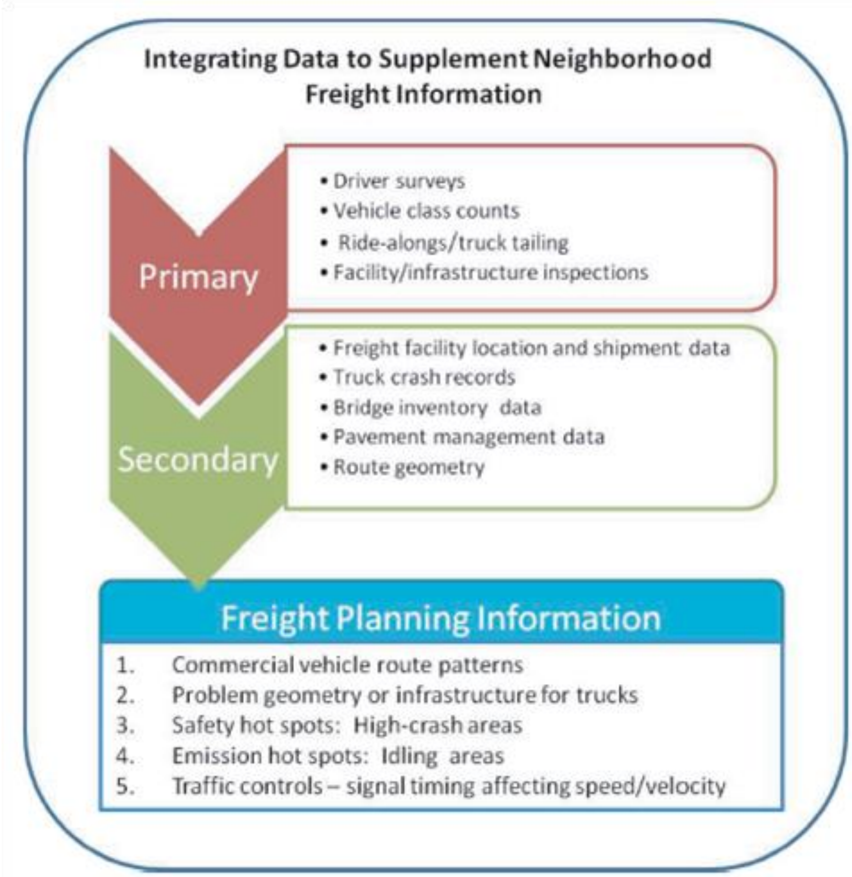
* Nighttime sensitive uses are those types of uses that may cause disruption in the sleep pattern of an individual. The Day night average noise level that was developed by the Department of Housing and Urban Development recognizes the heightened community annoyance caused by late-night or early-morning operations of certain industries and transportation uses. Where nighttime sensitive uses is utilized, it specifically refers to freight activities that may create noise that impacts residential land uses.

Source: Rhodes et al. (2012)

Figure 2.4 Land uses and conflicts adjacent to freight activity

2.2 Data Source for Freight Activity

According to Christensen Associates et al. (2012), freight data should always be considered in the planning process for the equilibrium between (freight and personal) transportation demands and community objectives, for examples, sustainable land use, economic development, environmental protection and livable neighborhoods. To provide better freight planning, the report uses primary and secondary data sources (see Figure 2.5). Primary sources are truck counts or surveys that can provide details needed for urban planning but they can also require huge effort in data collection. Secondary freight data collected from public and private sources do not capture detail information that can directly be used for urban freight planning. In this report, freight activity data are collected from both primary and secondary sources.



Source: Christensen Associates et al. (2012)

Figure 2.5 How to address freight data to neighborhood issues

2.2.1 Neighborhood Freight Data

As mentioned in Christensen Associates et al. (2012), freight issues affecting neighborhoods are: safety, traffic congestion, land use, emissions, and environmental justice (see Figure 2.6). Freight should consider in the neighborhood planning process for better safety of residents and truck divers because of blind spots, larger loads, hazardous materials loads and slower vehicle reaction times. Likewise, truck drivers complain about landscaping and tree trimming blocks the sight and when they are using local streets they face with inadequate infrastructure such as narrow or low bridges. Big volume of truck traffic, air quality and emissions are important issues that are increasing due to freight operations. Communities and states are working for regulations on residential areas (for example, the Port of Los Angeles has installed monitoring stations that measure air quality). The Environmental Protection Agency (EPA) has industrialized the Smartway Program that inspires implementation of activities and new technologies to decrease diesel emissions. Environmental justice states that areas with low income get more impact of negative environmental effects due to transportation development but now federal agencies have been required to identify and address those problems. For better management of some problems on neighborhood related to freight, it is necessary to collect traffic data, land use compliance information, travel demand modeling data, freight facility location and shipment data and truck crash records (Christensen Associates et al. 2012).

Source: Christensen Associates et al. (2012)

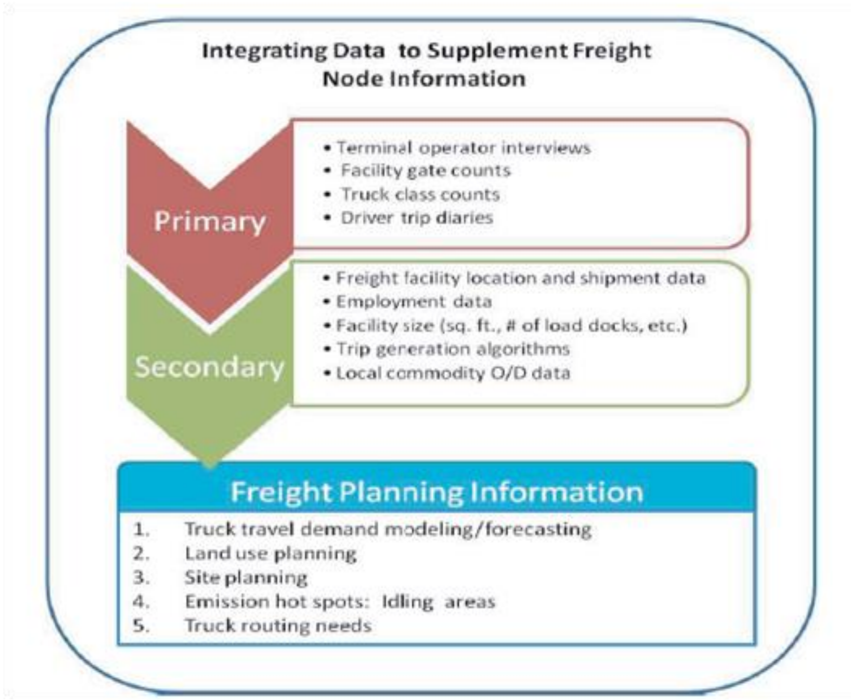
Figure 2.6 Freight data issues affecting neighborhoods

Freight nodes are terminals, rail yards, ports, distribution centers, manufacturing plants, and etc. Freight nodes characterize the end points that generate or attract freight flows. They are also the main points of production, consumption or handling of goods. For better understanding of trip generation, it is necessary to conduct surveys of vehicles generated by freight and also apply generation rates based on industry employment nodes in a given Traffic Analysis Zone (TAZ).

Source: Christensen Associates et al. (2012)

Figure 2.7 Freight node data-tonnage production by facility

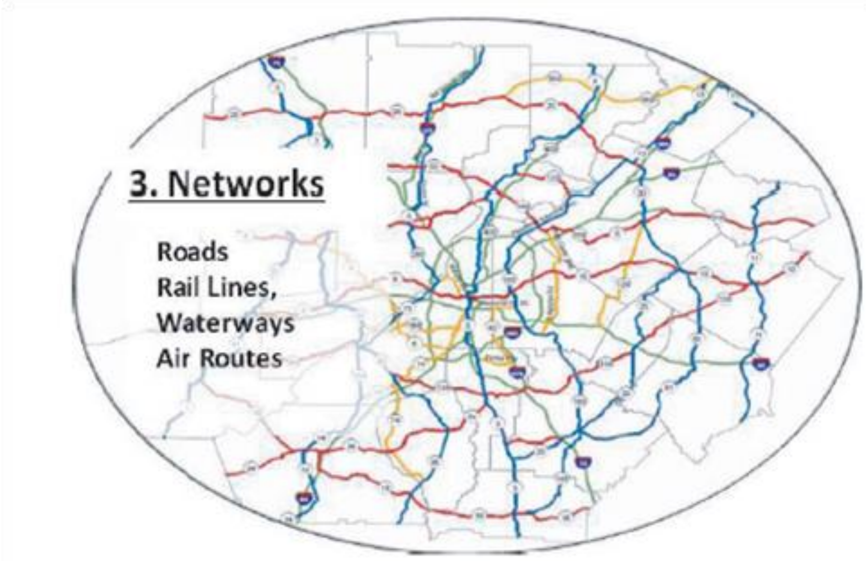
Freight node data can be used in travel demand modeling, environmental analysis and land use planning. It can be useful in designating truck routes (Christensen Associates et al. 2012).



Source: Christensen Associates et al. (2012)

Figure 2.8 Integrating node data for travel demand modeling and other planning issues

As described by Christensen Associates et al. (2012), freight network data helps analysts to know the routes and critical infrastructure being used by freight. Network data include roads, rail lines, waterways capacity, port; posted speeds on roads, weight and height limitations on bridges and pavements (see Figure 2.9). Freight networks (capacities) should be capable of sustaining truck traffic volumes efficiently. Therefore they should be protected by building permits, proper zoning and law enforcement. Likewise, freight should be considered when planning road geometry, pavement structures and bridge design with adequate turning radii, passing points and height clearance. Global Positioning Systems (GPS) is used by many trucking companies and private carriers to keep track of driver and equipment movements. Merchants that use GPS-based fleet management software are collecting the data for examining the network choices that truck drivers are making. Network data is useful in identifying route usage, current and future level of service, and potential alternatives that facilitate a faster trip.



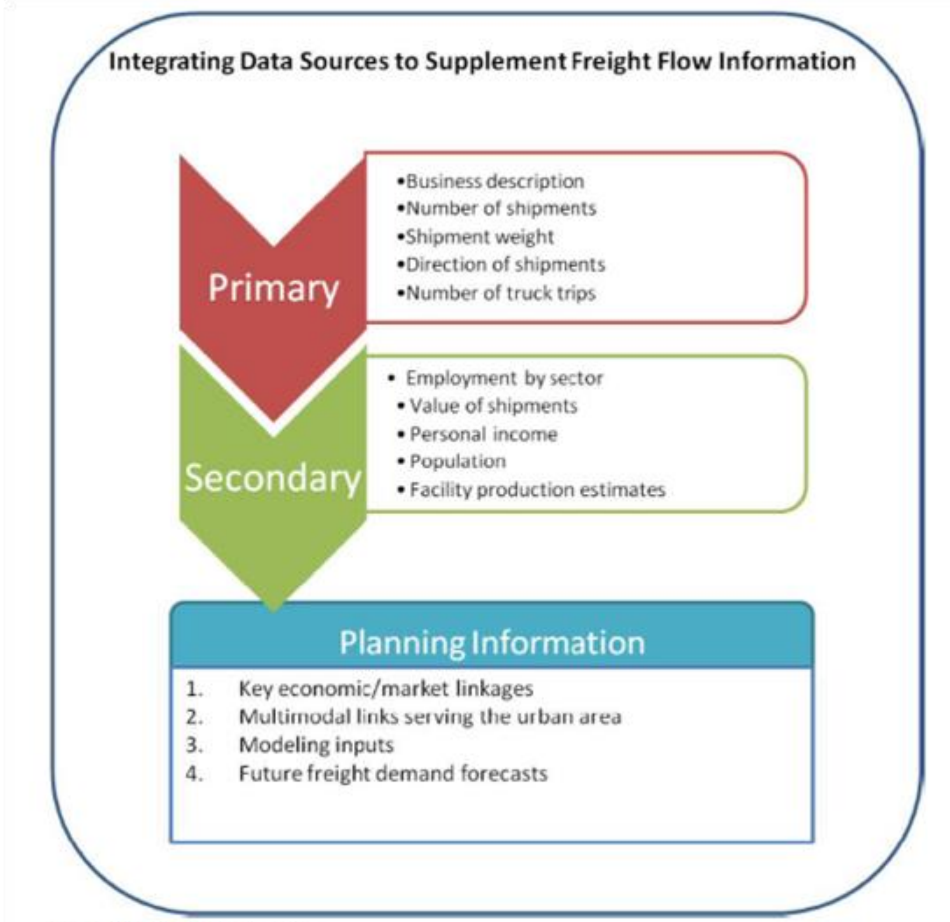
Source: Christensen Associates et al. (2012)

Figure 2.9 Freight network data

Commodity flow information is used to calculate trip estimates and helps to understand the economic and trade environment of a region. Commodity flow data also helps to tie goods movement to economic development, providing information such as imports and exports. Similarly, it can help to recognize industries that are greatly dependent on transportation, for example, those that produce high volume of products. According to Christensen Associates et al. (2012), there are different sources that this data can be obtained. The most often cited sources are the Commodity Flow Survey conducted by Bureau of Transportation Statistics, Freight Analysis Framework Version 3 by Federal Highway Administration, and Railroad Waybill by Surface Transportation Board and TRANSEARCH by HIS Global Insight.

2.3 Freight Data Protocols

Due to the complexity of freight data, some protocols for freight data in planning process are: identify the data needs and define the issues to be addressed (Christensen Associates et al. 2012). Business groups, trade associations or economic development agencies may provide freight data, information/freight volume on nodes (port of entry, terminals, distribution centers, and manufacturing plants).



Source: Christensen Associates et al. (2012)

Figure 2.10 Integrating data sources for customizing freight flow data

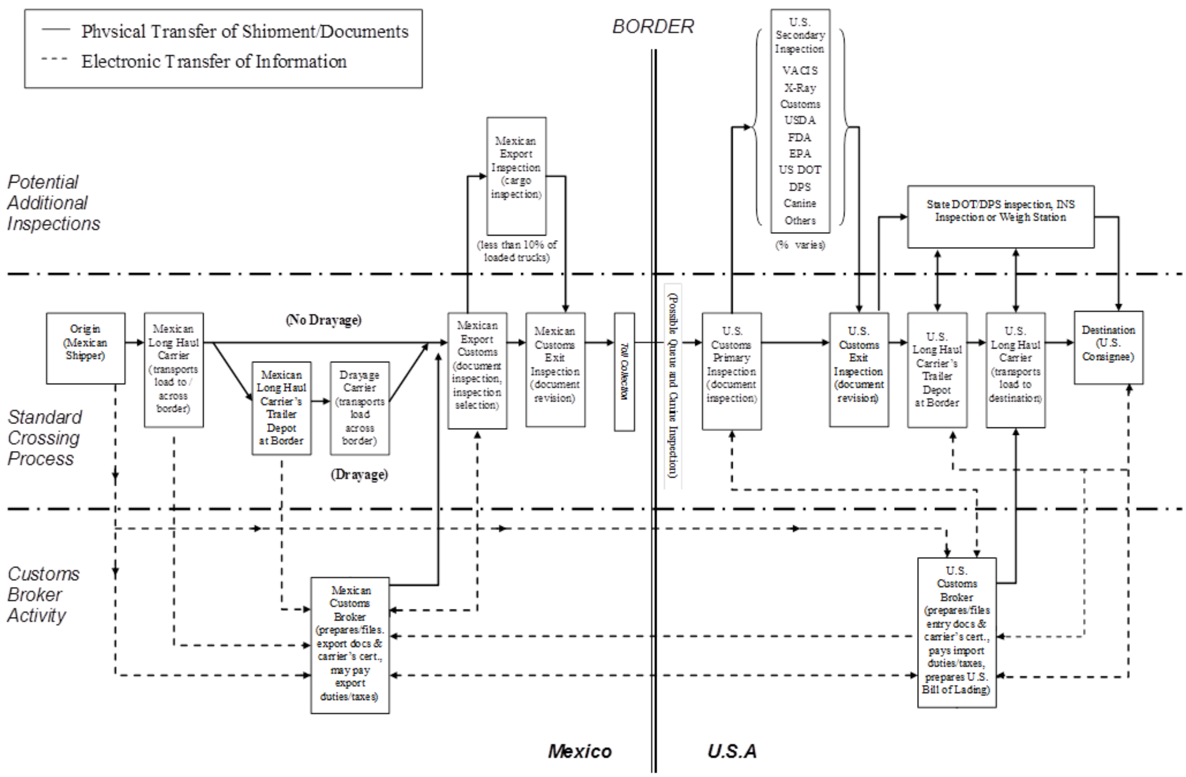
2.4 Freight Activity in US-Mexico Border

The study performed by Ojah et al. (2002) addresses the issues regarding the efficiency of the U.S. and Mexico border crossing process for trucks. According to Ojah et al. (2002), the lack of contribution on operational decisions from local stakeholders has created conflict for the planning and development of initiatives to build a structured truck-crossing system. The study analyzed stakeholders' coordination system at U.S.-Mexico border Ports of Entry (POEs) and recommended alternatives to help improve the operations and reduce congestion and delay. The report described specific alternatives to address the problems and create solutions from the provided alternatives. The investigation identified the lack of opportunity for a coordinated planning and operations as the main problem. The study identified the following issues:

- **Physical layout and truck movement** - Infrastructure issues regarding the movement of trucks across the border and traffic flow problems regarding the efficiency and organization of inspections at POEs.

- **Demand management** – Conflict with traffic congestion at the border area and the lack of effective methods to manage it.
- **Standards** – Lack of regulations to improve security and reduce delay for trucks.
- **Information management**: Weaknesses in information collection impairs efficient border coordination.
- **Stakeholder coordination**: Stakeholder schedules and coordination structures.

The process of the northbound border crossing is described in Figure 2.11. Table 2.1 discusses the stakeholder activities. Figure 2.11 and Table 2.1 explain the complexity of the border truck crossing process.



Source: Ojah et al. (2002)

Figure 2.11 Northbound border crossing process for trucks

Table 2.1 Principal Stakeholders in the Mexico-U.S. Border Crossing Process

Stakeholder	Function
	U.S. Public Agencies
U.S. Customs Service(USCS)	Ensures goods and services entering / exiting the U.S. abide by laws and pay applicable duties and taxes
Immigration and Naturalization Service (INS)	Regulates entry of visitors and immigrants into the U.S. and prevents unlawful employment

U.S. Department of Agriculture (USDA)	Inspects animals, plants, related products entering the U.S.
Food and Drug Administration (FDA)	Regulates entry of food, drugs, bio products into the U.S.
Environmental Protection Agency (EPA)	Regulates transportation of hazardous materials in the U.S.
General Services Administration(GSA)	Designs, owns, and operates U.S. ports of entry
Department of Transportation (DOT), Department of Public Safety (DPS)	Enforce U.S. motor carrier, driver, and vehicle safety regulations
Mexican Public Agencies	
Secretaría de Hacienda y Crédito Público (SHCP)	Ensures goods and services entering / exiting Mexico abide by laws and pay taxes - Mexican counterpart of U.S. Customs
Secretaría de Agricultura, Ganadería, Desarrollo Rural (SAGAR)	Conducts phyto sanitary inspections of plant and meat products – Mexican counterpart of USDA
Caminos y Puentes Federales de Ingresos y Servicios Conexos (CAPUFE)	Administration, operation, and maintenance of roads and international bridges
Secretaría del Medio Ambiente y Recursos Naturales (SEMARNAT)	Regulation of hazardous materials and fumigation of forest products – Mexican counterpart of EPA
Comisión Nacional de Avalúos de Bienes Nacionales (CABIN)	Manages and operates Mexican port of entry facilities – Mexican counterpart of GSA
Instituto Nacional de Migración (INM)	Mexican immigration authority inspects documentation 20 miles south from the border – Mexican counterpart of INS
Secretaría de Comunicaciones y Transportes (SCT)	SCT enforces motor carrier, driver, and safety regulations – Mexican counterpart of DOT
Private Firms	
Mexican Shipper	Loads trailer at origin and provides sales documentation
Mexican Long-Haul Carrier	Transports trailer from origin to the border
Mexican or U.S. Drayage Carrier	Shuttles trailer across border
Mexican Customs Broker	Prepares, files export documentation with Mexican Customs
U.S. Customs Broker	Prepares and files import documentation with U.S. Customs
U.S. Importer (final consignee)	May provide shipment information to customs brokers

Source: Ojah et al. (2002)

As mentioned in Ojah et al. (2002), majority of the coordination issues are related to inadequate interaction among the stakeholders in either the planning or operations phases. For this reason, Ojah et al. (2002) recommended to focus on the broad range of stakeholders instead of trying to improve specific coordination issues, since these issues will vary between each POE. Once the involvement among local stakeholders is improved and the issues can be addressed, the coordination effectiveness can be increased.

The El Paso-Juarez region can be a potential example to implement such alternatives. According to Ojah et al. (2002), this gateway could be chosen for the following attributes:

- Address coordination in a high-volume border system in which a variety of factors contribute to congestion and delay.
- Three commercial POEs within the system (Santa Teresa-San Jerónimo, Bridge of the Americas, and Ysleta-Zaragoza).
- Local maquiladora and trade associations that facilitate the organization of stakeholder meetings.
- The interest from the port authorities, and trade communities in exploring new alternatives to improve border operations.
- Diverse size and the imbalance of truck volumes among crossings.

Some examples of alternatives that could be combined for implementation in the El Paso-Juarez region as shown in Tables 2.2 and 2.3 include:

- Data collection and benchmarking (C-2).
- Retrofitting and traffic circulation (R-4).
- Stakeholder schedules (C-13).
- Opportunities to improve inspection sequencing (C-8).
- Trailer seal notation protocol (C-16).
- Commercial traffic segregation and pricing instruments (C-4).

Table 2.2 Coordination and Related Issues

Coordination Issues	Coordination-Related Issues
Planning	
C-1. Inadequate Long-Term Planning Strategy for Border Crossings C-2. Lack of Data Collection and Benchmarks C-3. Inconsistent Planning for Truck Safety Inspection Facilities	R-1. Inadequate Incentives for Participation in Pre-Clearance Programs
Demand Management	
C-4. Lack of Fee-Based Priority Shipment Lane C-5. Commingling of Commercial Traffic Types	R-2. Lack of Congestion Pricing
Physical Layout and Truck Movement	
C-6. POE Configuration – New inspection technologies cannot be accommodated C-7. POE Configuration - Poor Internal POE Circulation C-8. Capacity - Inspection Sequencing C-9. Capacity - Uncoordinated access road design and a limited number of lanes C-10. Lack of ITS Solutions to Streamline Truck Movements	R-3. POE Configuration –Outdated facility layouts R-4. Capacity –Some POEs lack a sufficient number of primary inspection booths
Staff Management	
C-11. Personnel Turnover - USCS inspector attrition rates are high C-12. No Mechanism to Predict and Prevent Queue Development	R-5. Insufficient Customs Personnel R-6. Personnel Turnover - Mexican Customs' rotation of port directors
Stakeholder Coordination	
C-13. Poorly Coordinated Stakeholder Schedules C-14. Inadequate Informal Stakeholder Coordination C-15. Untapped Opportunities to Enhance Broker Process	No Identified Stakeholder Issues
Standards	
C-16. Absence of Standardized Seal Notation Protocol C-17. Lack of Harmonized Truck Safety Standards	No Identified Standards Issues
Information Management	
C-18. Information Systems –Excessive Paperwork Preparation and Handling C-19. Information Systems –Antiquated Technology C-20. No Advanced Threat Detection	No Identified Information Management Issues

Source: Ojah et al. (2002)

Table 2.3 Port of Entry Coordination Problems

Most Prominent Pilot Project Issues at POES	El Paso Ysleta	El Paso BOTA	Santa Teresa
C-2. Lack of Data Collection and Benchmarks	*	*	*
R-2. Lack of Congestion Pricing	*	*	
C-4. Lack of Fee-Based Priority Shipment Lane	*	*	
C-5. Commingling of Commercial Traffic Types	*	*	
R-3. POE Configuration & Outdated facility layouts	*	*	
C-6. POE Configuration & New inspection technologies cannot be accommodated			
R-4. Capacity & lack a sufficient number of primary inspection booths	*	*	
C-9. Capacity & Uncoordinated access road planning	*	*	*
C-10. Lack of ITS Solutions to Streamline Truck Movements			
C-7. POE Configuration & Poor Internal POE Circulation	*	*	
C-8. Capacity & Inspection Sequencing			
C-12. No Mechanism to Predict and Prevent Queue Development	*	*	
C-13. Poorly Coordinated Stakeholder Schedules	*	*	
C-14. Inadequate Informal Stakeholder Coordination	*	*	*
C-16. Absence of Standardized Seal Notation Protocol			

Source: Ojah et al. (2002)

3 Stakeholder Interviews

This chapter reports the outcomes of interviews conducted with stakeholders involved in freight transportation business in El Paso-Juarez region. The interviews were conducted with representatives of Kuehne and Nagel (an international transportation firm), Borderplex Alliance (an El Paso-Juarez bi-national economic interest group with memberships from local businesses) and TCC Soft Inteligente (a business consultant in Ciudad Juarez). The interviews focused on the transportation/import/export processes, current and future development of industrial parks and warehouses.

3.1 El Paso

3.1.1 Kuehne and Nagel

Kuehne and Nagel, a global transportation and logistics company, has offices in El Paso and provide services for the importation, exportation and warehousing of raw materials and produced goods between the maquiladoras in Mexico, the distribution centers and consumers markets in the U.S. As a company with U.S. and Mexico custom brokerage capabilities, the study team interviewed Mr. David Reyes-Arteaga, a trans-border manager for Kuehne and Nagel (El Paso branch) for a better understanding of the system, and the process for the importation and exportation of goods between the two countries in the El Paso-Juarez region.

The process for the importation of goods into the U.S. coming from Mexico is explained in the next few steps (Kuehne and Nagel 2013):

1. Document is received by the Kuehne and Nagel Mexican broker team.
2. Verification/receipt is approved and cleared from the client's Harmonized Tariff Schedule of the United States (HTSUS) assigned to Customs and Border Protection (CBP) for the filing and export process. The goods are transported in a U.S. trailer with a Mexican tractor.
3. The Kuehne and Nagel Mexican broker revisers are dispatched to the carrier's site for previous process (make of truck, model of the truck, serial number, photos, etc.).
4. Kuehne and Nagel Mexican brokers create a Pedimento (order). Then, they pay the Derecho de Trámite Aduanero (DTA) and/or pre-validation when a U.S. entry or a Standard Carrier Alpha Code (SCAC) is transmitted. A sample Pedimento is shown in Figure 3.1.

IMPRESION SIMPLIFICADA DEL PEDIMENTO			
NUM. PEDIMENTO:	T. OPER	CVE. PEDIMENTO:	CERTIFICACIONES
DESTINO:	PESO BRUTO:	ADUANA E/S:	
NUM. E-DOCUMENT:			
DATOS DEL IMPORTADOR /EXPORTADOR			
RFC:	CURP:		
ACUSE ELECTRONICO DE VALIDACION:		CLAVE DE LA SECCION ADUANERA DE DESPACHO:	
MARCAS, NUMEROS Y TOTAL DE BULTOS:			
FECHAS			
OBSERVACIONES			

CUADRO DE LIQUIDACION								
CONCEPTO	F.P.	IMPORTE	CONCEPTO	F.P.	IMPORTE	TOTALES		
						EFECTIVO		
						OTROS		
						TOTAL		

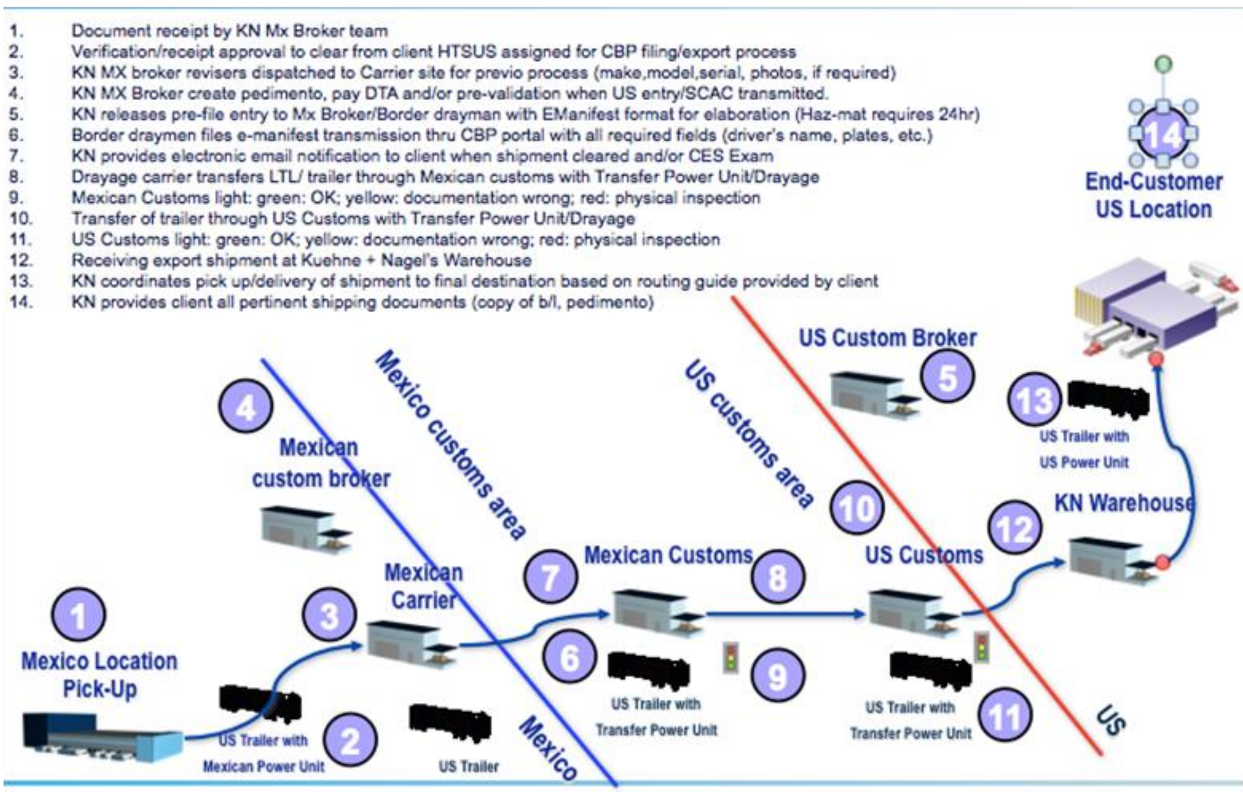
Source: Kuehne and Nagel (2013)

Figure 3.1 Order sample (Pedimento)

5. Kuehne and Nagel releases pre-filed entry to Mexican brokers and the border drayman with EManifest format for elaboration (HAZMAT requires 24 hours).
6. The border draymen file an EManifest transmission through CBP portal with all the required information, such as the driver's name, plates, and etc.
7. Kuehne and Nagel provide an electronic email notification to the client when shipment cleared, or is assigned to a Centralized Examination Station (CES) exam.
8. The drayage carrier transfers the Less than Truck Load (LTL)/trailer through Mexican customs with transfer power unit/drayage.
9. When the trailer reaches the Mexican custom, it will receive a signal:
   - Green: OK;
   - Yellow: documentation is wrong;
   - Red: physical inspection must be performed to the truck.
10. The trailer is transferred through U.S. Customs with a Transfer Power Unit /drayage.
11. At U.S. CBP, the trailer receives another signal:
    - Green: OK;
    - Yellow: documentation is wrong;
    - Red: physical inspection must be performed to the truck.
12. The shipment is received at Kuehne and Nagel warehouse in El Paso.

13. Kuehne and Nagel coordinate the pick-up and delivery of the shipment to the final destination, based on routing guide provided by the client.
14. Kuehne and Nagel provide the client with all pertinent shipping documents like the Bill of Landing (B/L) and the Pedimento.

The abovementioned process is graphically illustrated in Figure 3.2.



Source: Kuehne and Nagel (2013)

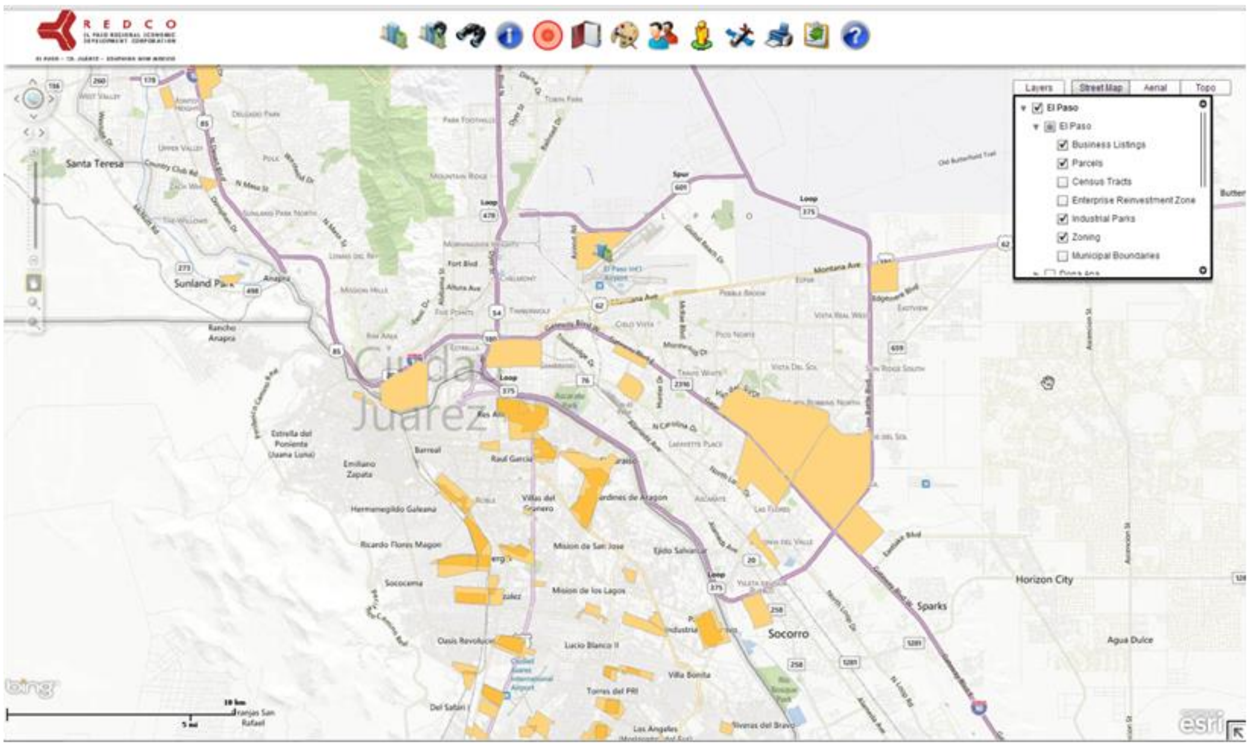
Figure 3.2 Process for imports at Kuehne and Nagel

3.1.2 Borderplex Alliance

A visit to Borderplex Alliance (formerly Regional Economic Development Corporation, REDCo) took place in order to gain an insight of industrial development in the border region. The topics discussed during this meeting were: past and current status of maquiladora industry in Ciudad Juarez and future development for industrial zones in El Paso.

Borderplex Alliance provides services and resources to entrepreneurs looking for a business investment opportunity in El Paso-Juarez region. Current data archived by Borderplex Alliance serves as a tool to analyze viability and risks involved in business decisions.

One of the tools that Borderplex Alliance provides to the public is the interactive map called FastGIS (REDCo 2013). This map allows the user to see business listing, parcels, industrial parks and zoning for El Paso. Also, information can be displayed to illustrate industrial parks, census tracts, and other information for Ciudad Juarez. The following Figure shows the industrial parks for El Paso and Ciudad Juarez.



Source: REDCo (2013)

Figure 3.3 FastGIS interactive map

3.1.3 Future Growth for Warehouse and Distribution Center

Additional information was provided by Mr. Cary Westin of Borderplex Alliance about future trends for warehousing development in El Paso. Mr. Westin described that Global Reach Drive near Spur 601 can be considered as a potential industrial park and/or warehousing facility in the near future. He explained that land located near the border does not have the potential to grow further due to space constraint. Mr. Westin also mentioned that city land available for development is currently under the jurisdiction of the El Paso Water Utilities (EPWU). Therefore, for future growth in the industrial sector, the City of El Paso or El Paso County should consider the purchase or annexing parcels of land from EPWU.

With this meeting, it was possible to conclude that in order to achieve a successful industrial expansion in the region, it is necessary for all parties involved having as a common goal to be part of a strong and competitive industrial market. For this it would be necessary to consider both cities as one and design a connected transportation and land use networks. EPWU should be included as a stake holder in the future freight planning initiatives. It also appears that future land for warehouse and distribution centers should be located at the fringe of the City of El Paso, along major corridors such as I-10 Freeway and Loop 375 Freeway.

3.2 Ciudad Juarez

3.2.1 Borderplex Alliance

Future Growth for Industrial Parks

During the meeting at Borderplex Alliance, Mr. Manuel Ochoa provided insights on how industrial parks were developed in Ciudad Juarez. Mr. Ochoa described that the distribution of the various maquiladoras does not follow a strategic plan but rather has been accommodated based on the growth of the city. This means that newest industrial parks have been located on the south part of the city where economic expansion has taken place due to geographical constraints at other areas.

An unintended consequence of locating industrial parks far from the POEs is the congestion generated when having commercial vehicles passing the principal arterials. Maquiladoras are attracted to use the Bridge of the Americas (BOTA) POE to cross the border since it is the only POE in the region that is free of charge. However, this results in a long trip for trucks from one end of the city to the other. The other option is to use The Ysleta-Zaragoza POE which is closer to industrial parks in the east side of the city. The Ysleta-Zaragoza POE offers longer hours of operation. However, the heavy traffic demand and the crossing fee involved have discouraged some trucking companies to use this POE.

According to Mr. Ochoa, the transportation of goods from Mexico to the U.S. has been a challenge to the shippers and transportation companies. This is because there has not been a successful combined effort between the U.S. CBP and manufacturing industries to optimize truck crossings at the POEs. Securing the border has been the priority for CBP regardless of the long waiting time for its clients (passenger cars and commercial vehicles). In addition, CBP offers limited hours of operation for commercial vehicles, thus constraining the production schedule of maquiladoras and trucking companies to deliver products. At the same time, within the above operating constrain, the maquiladoras and/or trucking companies have not implemented a logistic strategy that includes freight carrier collaboration to minimize expenses for freight transportation. As a result, maquiladoras have included the cost of 2 to 3 hours of waiting time at the POEs as part of the supply chain solution.

3.2.2 TCC Soft Inteligente

In order to gain an insight of maquiladora industry in Ciudad Juarez, the research team contacted TCC Soft Inteligente. Mr. Miguel A. Miramontes who works as a commercial representative shared with us his knowledge on manufacturing companies in Ciudad Juarez. According to Mr. Miramontes, the industrial parks located in Ciudad Juarez that have a potential to expand are:

- Santa Teresa Industrial Park
- Intermex Sur Industrial Park

(Location: Blvd independencia /Paseos del Sur/ Prol. Miguel de la Madrid)

- Tierra Nueva Industrial Park
  (Location: Blvd Independencia and Puerto de Palos)
- Salvacar Industrial Park : Location
  (Location: Blvd Independencia y Santiago Troncoso)

Their locations are shown in Figure 3.4.

Mr. Miramontes explained that these industrial parks have an opportunity to grow as the safety in the city gets better. Growth is expected for corporative engineering design centers with diverse expertise. In addition, Mr. Miramontes expects that industries that require complex manufacturing process will be potential candidates in the future.

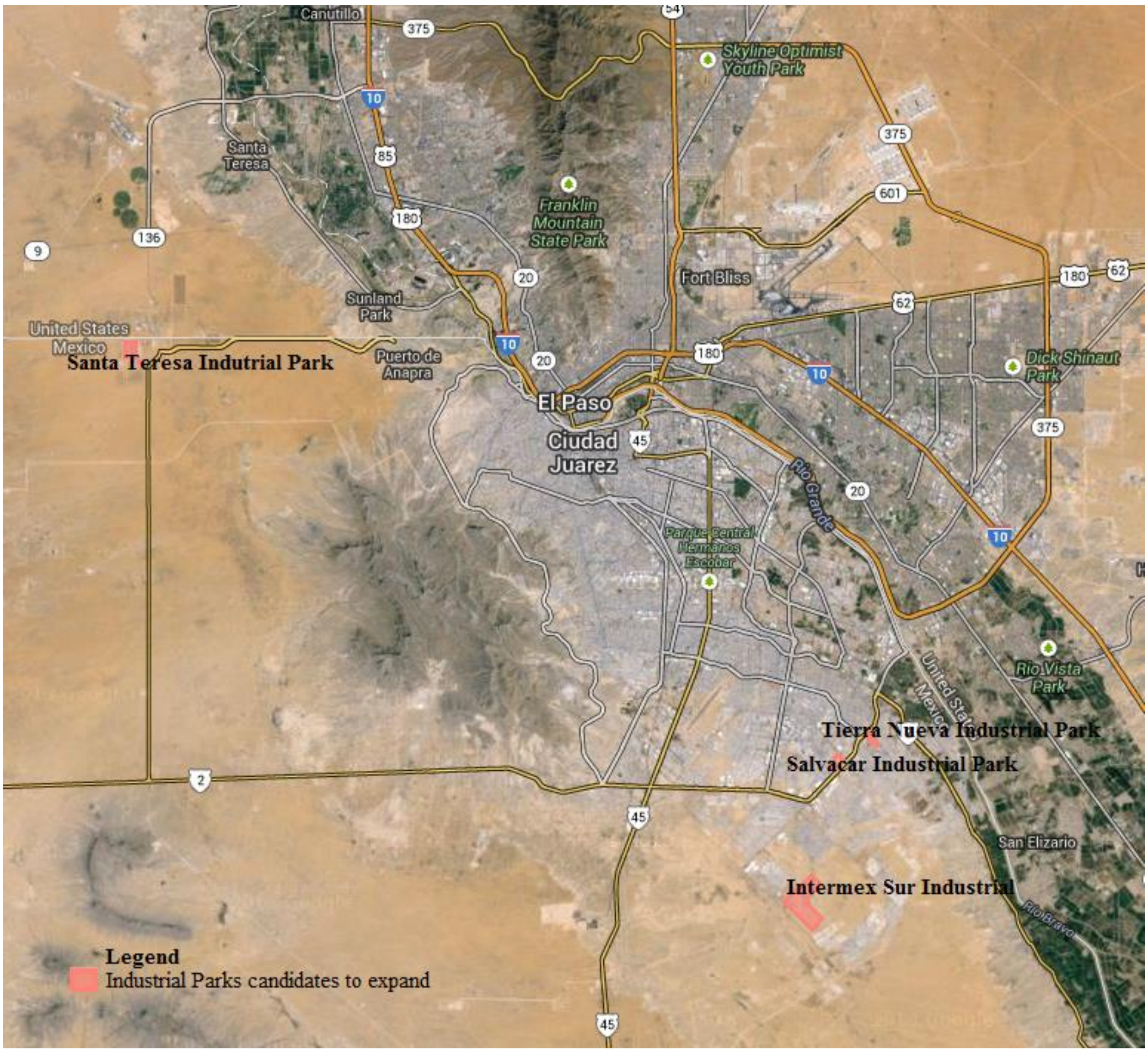


Figure 3.4 Potential expansions of industrial parks in Ciudad Juarez

4 Freight Industry Outlook and Survey

This chapter reports the outlook of freight-related industries in the El Paso region. It first begins by reporting the key economic indicators in this region. This is followed by an analysis of truck volumes at border crossings, and the challenges. To understand the freight transportation demand, this chapter also includes a survey conducted earlier on brokers and maquiladora who are the main driving forces of shipping goods across the border in the El Paso-Juarez region.

4.1 El Paso

4.1.1 Regional Border Complex

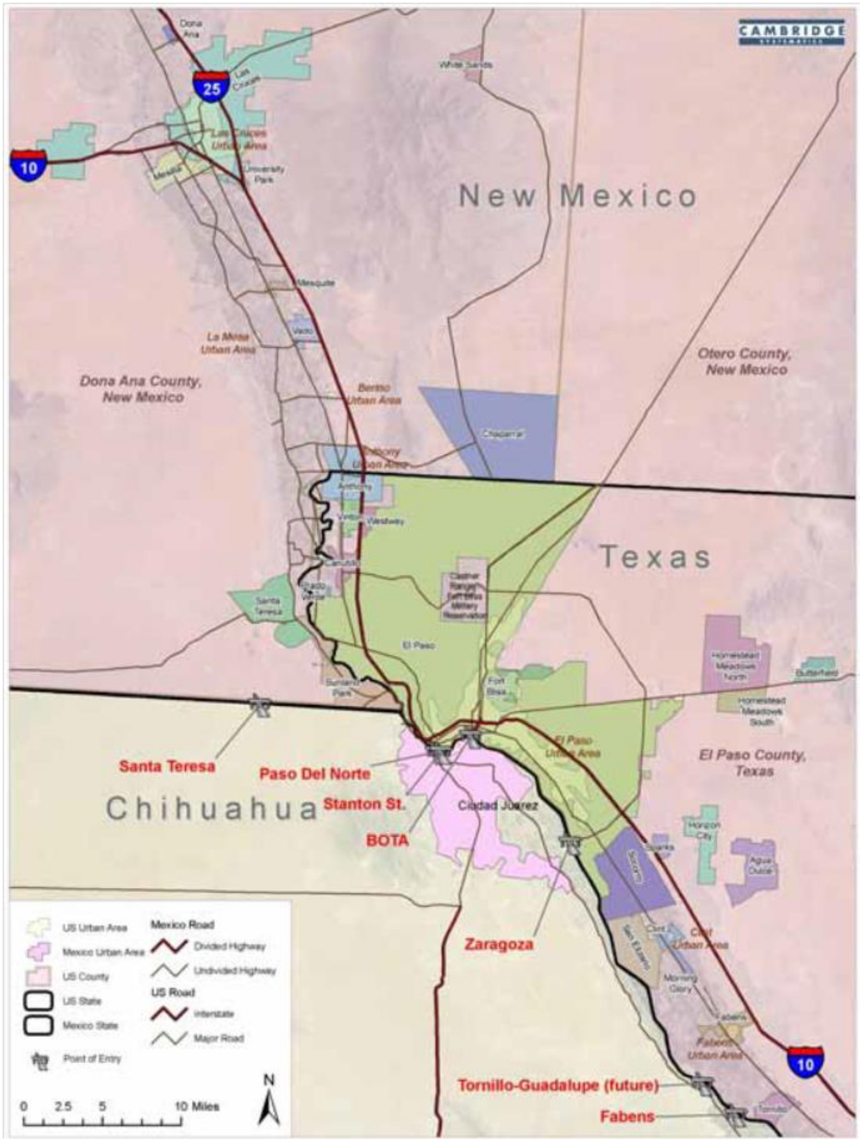
The El Paso-Juarez POEs provide critical links of regional, statewide and national significance. Maquiladora factories, mainly located in Ciudad Juarez, are linked to consumer markets and distribution centers located in metropolitan El Paso, and states like Texas, New Mexico, and beyond. The region's POEs handled nearly 18% of total trade (in dollars) between U.S. and Mexico in 2010, making El Paso-Juarez region the second busiest U.S. land POEs by total trade value. Overall, the region's manufacturing, services, educational, and retail sectors are strongly linked and are of crucial importance for the regional, statewide, national and international economic strength.

Located in a 45-mile stretch of the U.S.-Mexico border, comprising two U.S. states (Texas and New Mexico) and one Mexican state (Chihuahua), the six POEs in the region, as shown in Figure 4.1, include:

- **Santa Teresa**, located in Dona Ana County, New Mexico. Non-tolled facility.
- **Paso del Norte Bridge (PDN)**, handles northbound automobile traffic and northbound and southbound pedestrian traffic. Tolled facility.
- **Stanton St. Bridge**, handles mostly southbound vehicular traffic. Tolled facility.
- **Bridge of the Americas (BOTA)**, handles more than half of all international passenger and commercial crossings in the region. Non-tolled facility.
- **Ysleta-Zaragoza Bridge**, located in Eastern El Paso. Tolled facility.
- **Fabens-Caseta Bridge**, is a small, light-duty bridge.

Together, these POEs handle the second largest volumes of trucks, passenger vehicles and pedestrians.

The movement of goods and passengers across the border contributes greatly to the regional economy, providing jobs and increasing the Gross Regional Product (GRP). Industries dependent on border crossing such as the manufacturing and good-producing industries (natural resources, and construction) account for a great share of the El Paso and Juárez economies. El Paso supply and distribution facilities, administrative offices, and legal, accounting and financial services and manufacturing industries (maquiladoras) located in Ciudad Juarez require each other, and create a link between both economies.



Source: Cambridge Systematics (2011)

Figure 4.1 El Paso regional border crossings

4.1.2 El Paso Industrial Market

Since 2010, maquiladora production has started to recover (CBRE Global Research and Consulting 2013a). Due to some concerns including the violence in Juarez and slowdown in the global economy, firms started looking for better and more flexible real estate options in El Paso rather than investing in Juarez. In the past two years, El Paso started to experience a shift in the industry going from old multi-facility operations to a consolidated class A set-up. This shift has created an impact in the overall market. Most of the class A warehouse space has been leased. Rental rates are climbing and several submarkets are very tight for core space. Overall, an improvement for El Paso's industrial real estate market is expected in 2013. Growing demand related to the maquiladora industry, infrastructure improvements and increasing interest from regional investors will have a positive impact in the local market demand. The current breakdown in industrial space in El Paso is presented in Table 4.1.

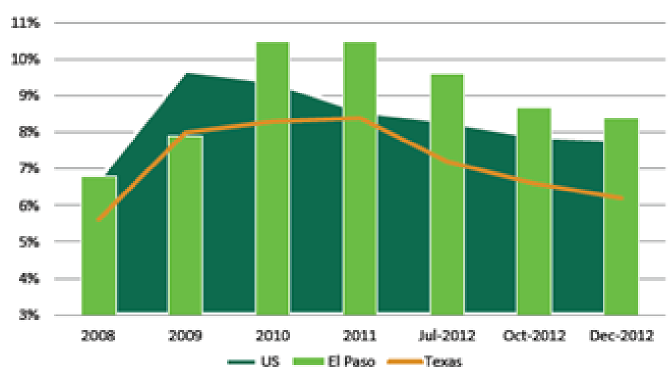
Table 4.1 Market statistics for El Paso in 2013

Market Statistics

Market	Rentable Area	Vacant SF	Vacancy Rate	Net Absorption SF	Delivered Construction SF	Under Construction SF	Net Avg. Asking Lease Rates ($/SF/YR)
West	7,214,653	162,241	2.2%	16,000	0	0	$3.77
Northeast	9,002,447	1,871,957	20.8%	(112,911)	0	0	$3.20
Central	13,768,564	935,124	6.8%	0	0	0	$3.13
East	18,146,860	2,991,787	16.5%	74,543	0	0	$3.76
Lower Valley	6,252,169	1,721,492	27.5%	(100,000)	0	0	$3.83
Totals	**54,384,693**	**7,682,601**	**14.1%**	**(122,368)**	**0**	**0**	**$3.59**

Source: CBRE Global Research and Consulting (2013a)

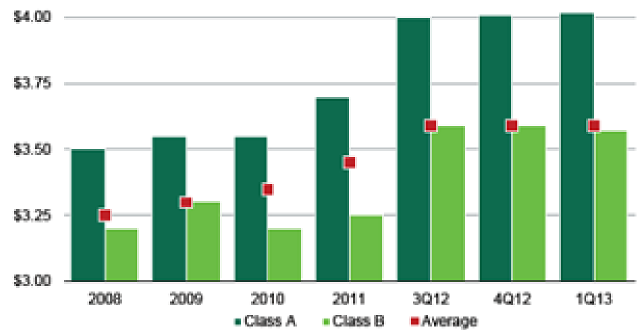
Although El Paso added close to 3,600 new jobs in December 2012, the overall employment decreased at a 0.4% annualized rate (see Figure 4.2). Job losses were widespread among the service-providing sectors (including the transportation, warehousing and distribution industries), while the goods-producing sectors registered gains. El Paso's unemployment rate now stands at 8.9% (CBRE Global Research and Consulting 2013a).



Source: CBRE Global Research and Consulting (2013a)

Figure 4.2 Unemployment rates for El Paso

CBRE Global Research and Consulting expects the rising trend of pricing dynamics to continue as shown in Figure 4.3.



Source: CBRE Global Research and Consulting (2013a)

Figure 4.3 Annual average asking rates for El Paso

There are many potential users looking for space in El Paso. These companies will consider a build-to-suit even though buildings in El Paso have remained unchanged and land developers do not plan any construction in the near future (see Figure 4.4).

Source: CBRE Global Research and Consulting (2013a)

Figure 4.4 Construction in square feet in El Paso

According to CBRE, One factor that may impact new construction is the Union Pacific Rail Yard in Santa Teresa, New Mexico. Once this facility becomes operational in 2015 the attractiveness of the intermodal capabilities along with the Overweight Cargo Zone in New Mexico could attract new users to this area. The logistical cost benefits could outweigh the real estate considerations and make new construction more viable.

4.2 Ciudad Juarez

4.2.1 Ciudad Juarez Industrial Market

Mexico has big trade agreements all over the world, especially with U.S. Ciudad Juarez is one of the largest industrialized cities in Mexico due to its low land and labor costs. U.S. companies send raw materials to the maquiladora in Ciudad Juarez. The maquiladoras are responsible for manufacturing and/or assembling products to ship back to U.S. Maquiladoras are arranged in different categories such as automotive, electrical, electronics, plastics/metals, medical devices, services, office products and packing material. Some maquiladoras are located in industrial parks.

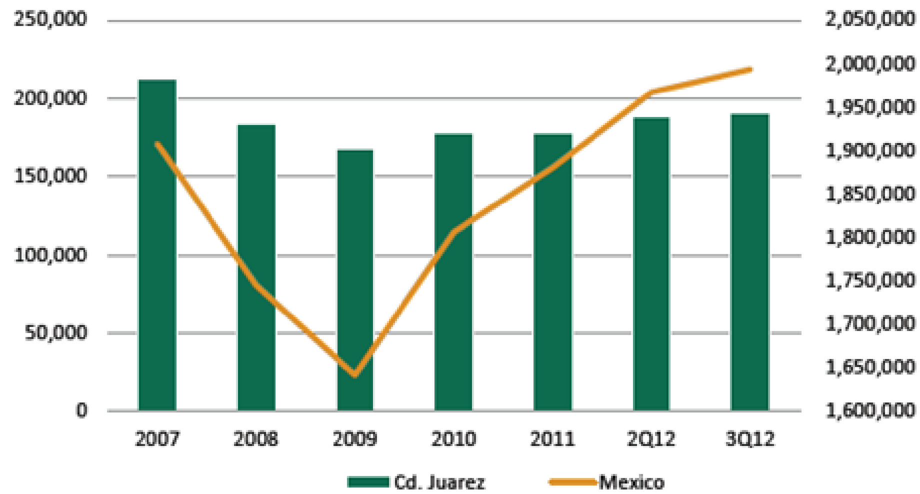
Since 1969, Ciudad Juarez plays a significant role in the industrial real estate market along the U.S and Mexico border. For the past years, a recession struck the city because of the violence. This year (2013) the demand of industrial space in Ciudad Juarez has increased slightly as the violence diminishes and economic recovery of Juarez increases. The current market statistics of industrial land in Ciudad Juarez is listed in Table 4.2.

Table 4.2 Market Statistics for Ciudad Juarez

Market	Rentable Area	Vacant SF	Vacancy Rate	Net Absorption SF	Net Avg. Asking Lease Rates ($/SF/YR)
North	13,689,900	1,187,765	8.5%	74,150	$3.85
West	9,992,131	2,723,711	27.3%	72,948	$3.65
Central	4,455,978	1,219,886	24.4%	0	$3.85
Southwest	7,705,462	1,348,739	13.7%	0	$4.25
Southeast	19,316,417	2,855,939	14.6%	228,305	$4.31
South / Electrolux	3,481,486	112,146	3.2%	0	$4.25
San Jeronimo	1,642,000	0	0.0%	0	N/A
Totals	60,283,374	9,448,186	14.9%	375,403	$4.02

Source: CBRE Global Research and Consulting (2013a)

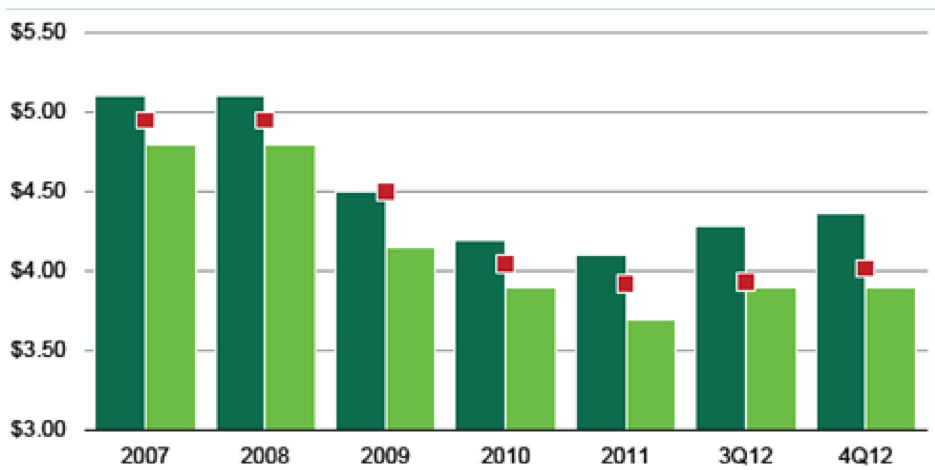
Ciudad Juarez has some of the largest manufacturing companies in the world including automotive, medical, appliance and electronics industries. As the industry gets stronger, employment opportunities increase as well. The employment trend in the past several years is shown in Figure 4.5.



Source: CBRE Global Research and Consulting (2013a)

Figure 4.5 Maquiladora employment in Ciudad Juarez

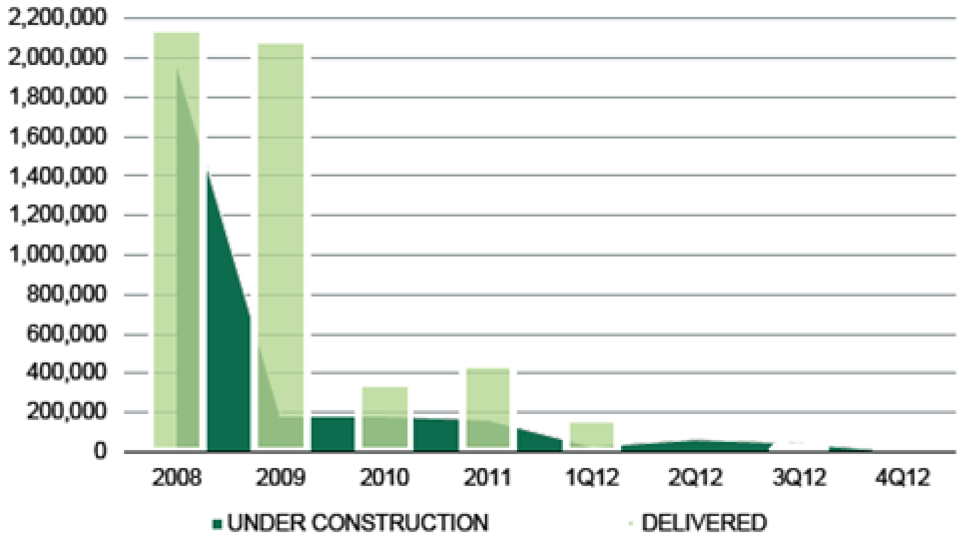
For the past years as the recession intensified, rental rates decreased. There were over 100 buildings available but since 2011 the rental rate has been increasing (as can be seen in Figure 4.6). It is likely to continue to increase for the next years. Since there were too many empty buildings several years ago, the construction of new buildings stopped (see Figure 4.7) and it appears that it will remain like this in the near future.



Source: CBRE Global Research and Consulting (2013a)

Figure 4.6 Annual average asking rates per square foot in Ciudad Juarez

Manufacturing industry is growing in Ciudad Juarez and there are many existing empty factory spaces in the city that can attract more businesses. This means that north bound and southbound traffic demands in the border region will continue to increase.



Source: CBRE Global Research and Consulting (2013a)

Figure 4.7 Construction per square feet in Ciudad Juarez

4.2.2 Northbound Truck Crossings

Table 4.3 and Figure 4.8 show the northbound crossings (from Ciudad Juarez to El Paso) for commercial vehicles in the three POEs that served commercial traffic in 2012. It can be observed that Ysleta-Zaragoza POE was preferred among trucking companies during that year. The highest number of crossings occurred in the month of October. BOTA was the second busiest POE. This POE has no toll but the limited operational hours and farther location from the industrial parks and distribution centers may influence the demand at BOTA. Santa Teresa POE has relatively lesser northbound traffic, almost five times less than the Ysleta-Zaragoza POE. The remote location from industrial parks may discourage local users to take advantage of this POE.

Table 4.3 Northbound Truck Crossings in 2012

trucks/month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
BOTA	27,349	25,562	28,090	25,701	27,745	26,280	26,024	27,602	24,199	28,392	26,332	21,454
Ysleta-Zaragoza	31,554	32,044	36,094	31,814	36,744	35,780	33,459	37,131	33,527	38,741	34,655	28,387
Santa Teresa	6,628	6,436	6,832	6,693	7,818	6,949	7,046	7,048	5,969	7,550	6,728	5,642

Source: City of El Paso (2013)

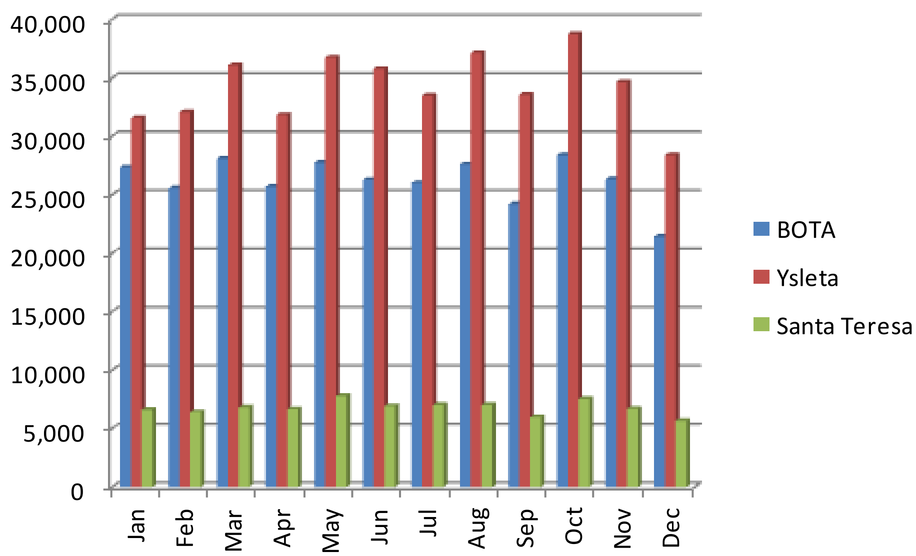


Figure 4.8 Monthly northbound truck crossings

4.2.3 Freight Transportation Challenges

Based on the above information collected, the following challenges and constraints for freight transportation in the El Paso-Juarez region have been identified.

<u>Delivery Constraints</u>

The actual border crossing inspection infrastructure in the El Paso-Juarez region is not serving the commercial demand and this results in long waiting times. Time spent in border crossings (northbound and southbound) directly affect the cost of production of sub-assembled and final products manufactured in Ciudad Juarez. The delays increase the operating costs of the maquiladoras and this translates into the cost of final products. Ultimately, this becomes a challenge for the region's economy.

<u>Congestion</u>

The lack of planned road network infrastructure for freight causes a lengthy movement of goods in Ciudad Juarez. The congestion generated in principal arterials delays freight movement. Trucks in return cause more congestion in the arterials. Industrial parks require better access to deliver raw material and assembled products.

Pollution

In order to overcome delivery constraints, trucking industry must rely on newer vehicle models with higher load carrying capacities, better fuel efficiency and mechanical performance. Getting newer tractors and cargo units not only allows a more efficient movement of goods, but also, reduces pollution generated by old cargo trucks. At the same time, long vehicle queues accelerate the emission of greenhouses gases to the atmosphere. Shortening inspection times is a challenge that can benefit the environment. However, emission is always considered as an external cost to private companies, although air quality is always of concern by government agencies such as the El Paso Metropolitan Planning Organization and Texas Commission of Environmental Quality.

Safety

Due to the violence in the region many manufacturing companies were closed. The lack of employees is a limitation when maquiladoras try to open more shifts to satisfy their production demands.

4.2.4 Broker and Maquiladora Survey

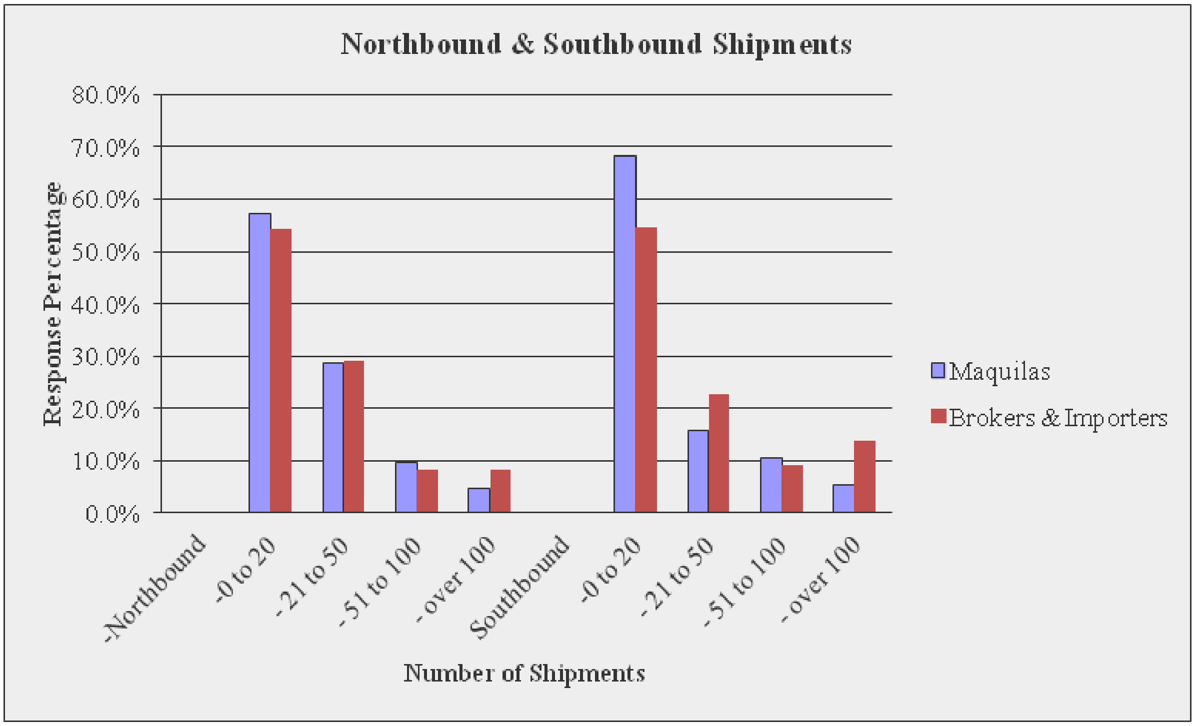
This section reports a survey that was conducted over a period of four weeks, from September 12th to October 12th of 2012, under the direction of El Paso Ports of Entry Task Force and Mayor John Cook (Caviness-Tantimonaco and Hernandez 2013). The purpose of the survey was to gather information from maquiladoras located in Ciudad Juarez, and brokers and importers serving the El Paso and Ciudad Juarez region regarding the impact of proposed alternatives that may help improve the border wait times at the POEs. The questions were posed to the top operational executive in charge of the day-to-day operations for the maquiladoras, and to brokers and importers who service manufacturing cross-border operations in El Paso and Ciudad Juarez region. The survey was conducted through an online survey with an average completion time of about 15 minutes. A total of 107 emails were sent of which 48 were to maquiladoras and 59 were to brokers and importers. A total of 40 completed responses were collected. Of the 40 responses collected, 19 were from the maquiladoras and 21 from the brokers and importers.

The survey was comprised of two sections:

- The first section dealt with questions regarding the operational characteristics of the respondents.
- The second section dealt with questions regarding scenarios under consideration for the Bridge of the Americas (BOTA).

The survey results provide insights into two surveyed groups: (1) the maquiladoras, and (2) brokers and importers. Important findings about the current operations are presented in the remaining parts of this section.

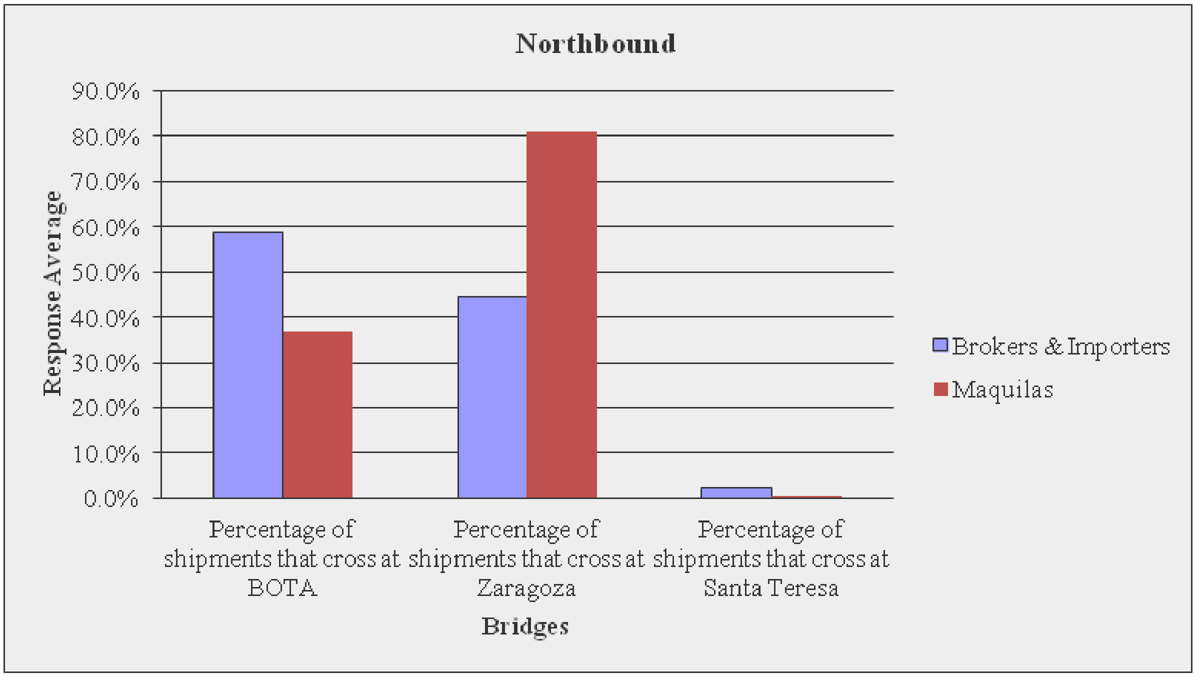
Figure 4.9 shows the distribution of companies that have different number of shipments, in the northbound and southbound directions, respectively. Each shipment may be approximated as one one-way trip. Although majority of the companies surveyed have less than 20 shipments/day, there are a few companies with over 100 shipments/day.



Source: Caviness-Tantimonaco and Hernandez (2013)

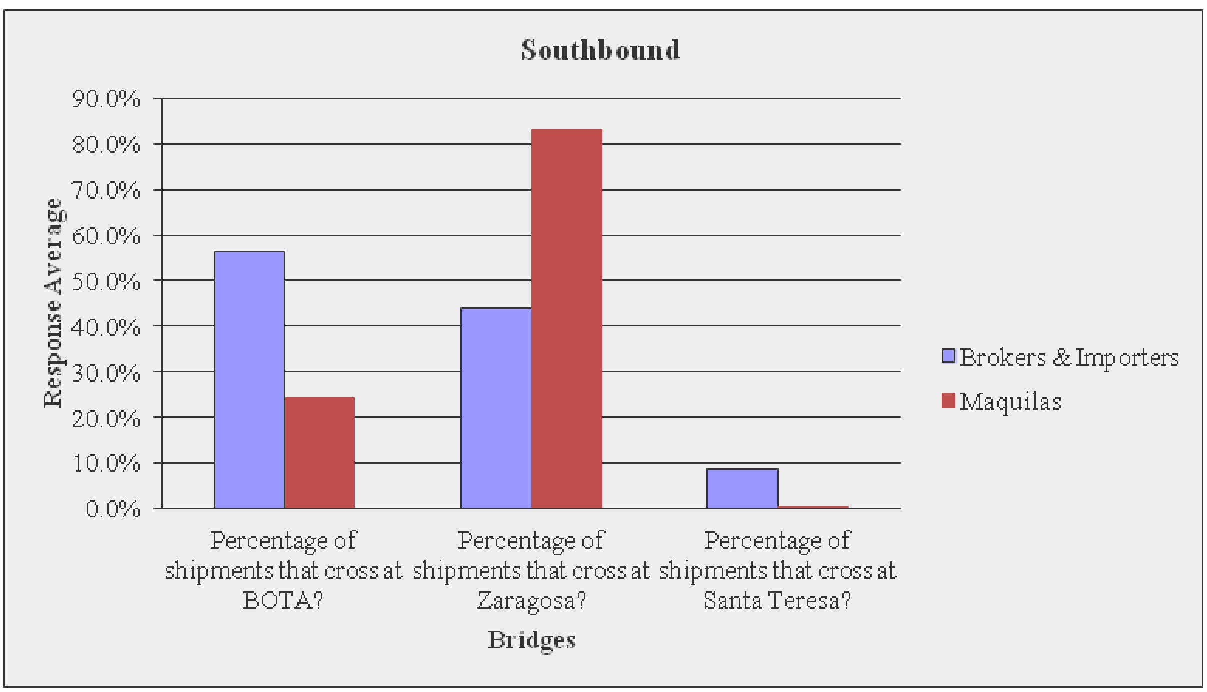
Figure 4.9 Northbound and southbound shipments crossing on a daily basis

Figures 4.10 and 4.11 show the distributions of trips among the three POEs that serve commercial traffic. One noticeable trend is that majority of the brokers and importers prefer to use BOTA POE while majority of the maquiladoras prefer to use Ysleta-Zaragoza POE.



Source: Caviness-Tantimonaco and Hernandez (2013)

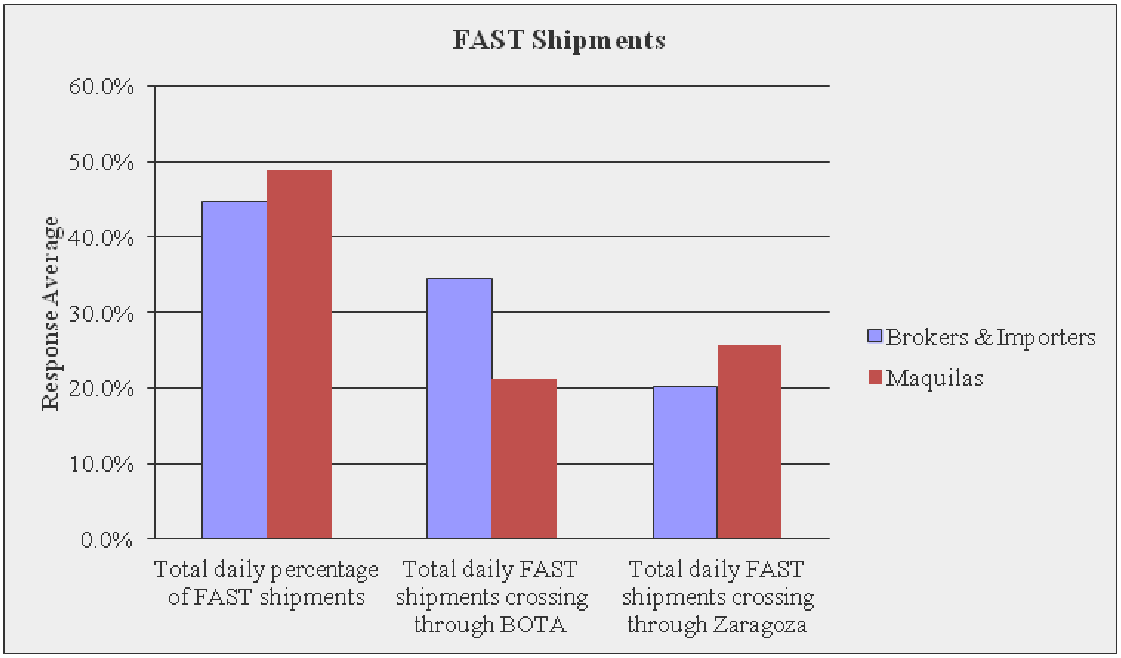
Figure 4.10 Daily northbound shipments distributed per bridge



Source: Caviness-Tantimonaco and Hernandez (2013)

Figure 4.11 Daily southbound shipments distributed per bridge

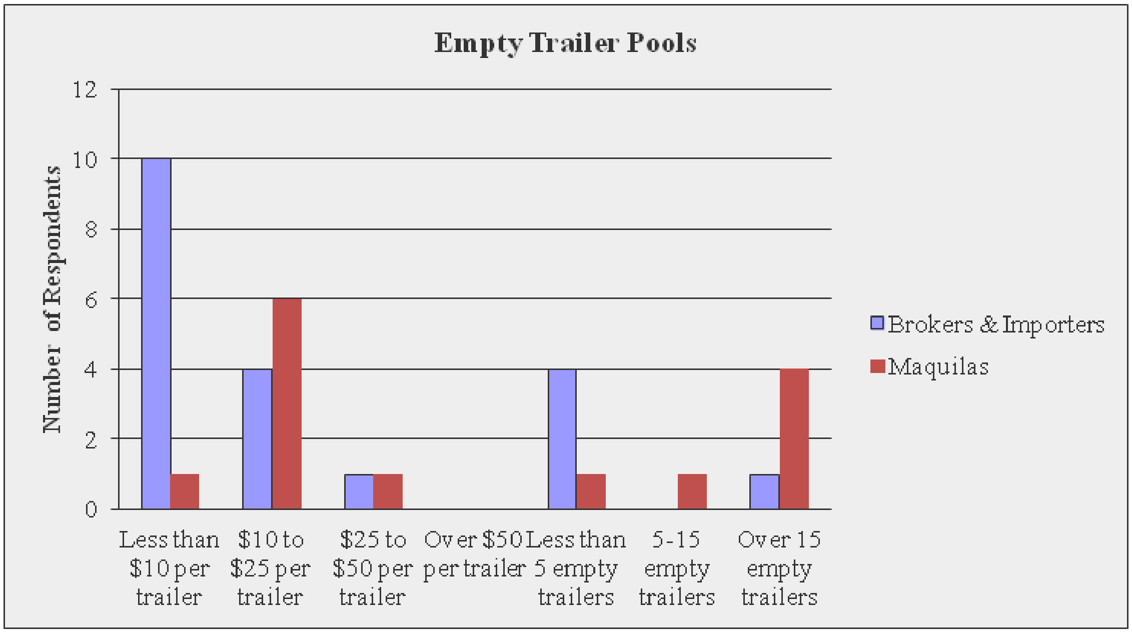
Fast and Secured Trade (FAST) is a U.S. Customs and Border Protection (CBP) program that allowed expedited processing of import documents. Figure 4.12 shows the percentages of shipments among all northbound shipments made by the companies. It further breaks the FAST shipments down to the two POEs which handle this type of shipment. Overall, the responded companies have at least 42% of the shipment that are classified as FAST. However, the breakdowns into the BOTA and Ysleta-Zaragoza POEs do not match with the total percentages.



Source: Caviness-Tantimonaco and Hernandez (2013)

Figure 4.12 Total daily percentage of shipments that are FAST and bridge used

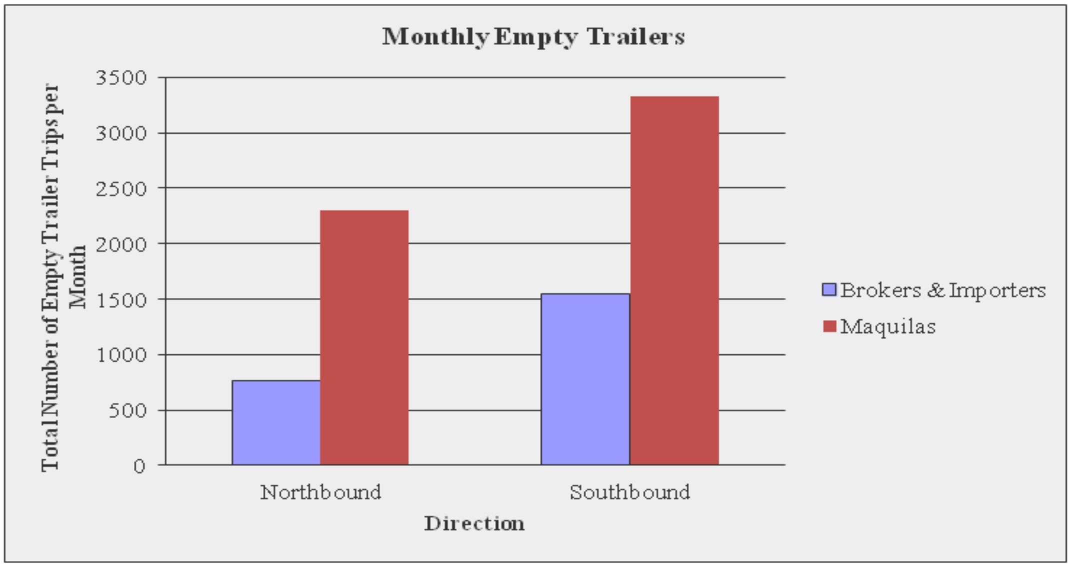
About half of the trailers crossing northbound at the BOTA POE are empty. One suggestion to reduce the number of empty trailer is to set up "empty trailer pools" at strategic locations in Juarez. Shippers could request trailers from the pools as needed. A question in the survey asked the respondents if they were willing to participate in a trailer pool program to help to reduce cost or improve efficiency. As seen from Figure 4.13, roughly half of the brokers and importers would consider an empty trailer program if it cost less than $10 per trailer. In contrast, some of the maquiladoras were in favor for a cost between $10 and $25.



Source: Caviness-Tantimonaco and Hernandez (2013)

Figure 4.13 Empty trailer pools

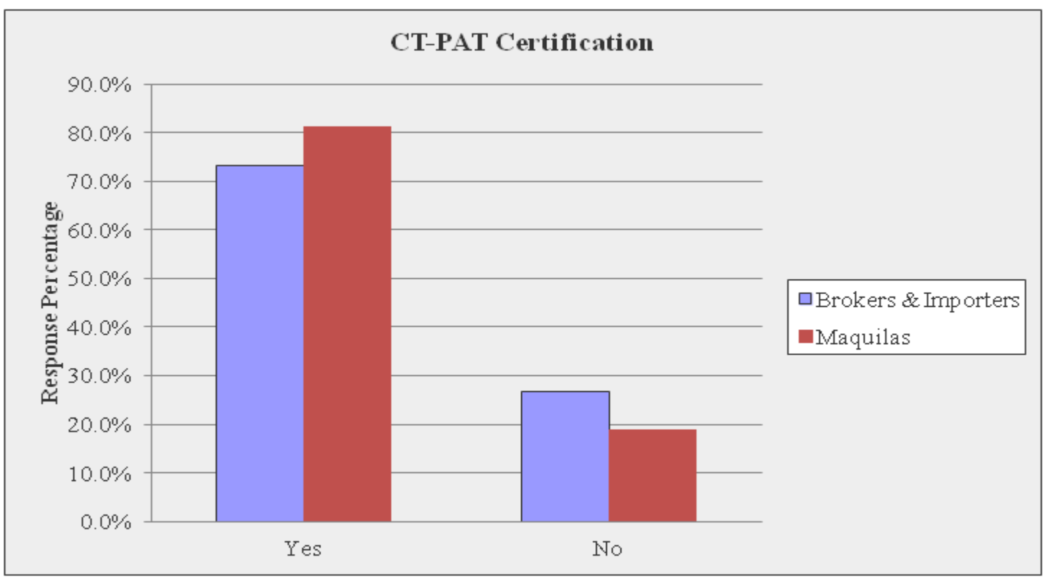
Figure 4.14 displays, according to the survey results, the total number of empty trainers that are moved across the three POEs by all the respondents. The movements of such empty trailers add to the queue and waiting time of real shipments at POEs.



Source: Caviness-Tantimonaco and Hernandez (2013)

Figure 4.14 Empty trailers shipped monthly

Customs-Trade Partnership against Terrorism (C-TPAT) is a CBP program that involves all stakeholders in a supply chain to improve the security of shipments. Majority (approximately 75%) of the companies which participated in this survey are C-TPAT certified.



Source: Caviness-Tantimonaco and Hernandez (2013)

Figure 4.15 C-TPAT certification

5 Data Collection and Analysis

This chapter reports the regional freight activity data gathered by the research team from various sources. The freight related data included, in El Paso the locations of industrial zones, statistics of parcels, list of trucking companies and manufacturing facilities, truck volumes on major highways, accident locations; and in Juarez the locations of industrial parks, statistics of maquiladoras and future sites.

5.1 El Paso

5.1.1 Land Development

The land development data was found in the website Paso del Norte Mapa (UTEP Regional Geospatial Service Center 2013). Paso del The Paso del Norte Mapa steering committee consists of: Paso del Norte Health Foundation, Center for Border Health Research, EPWU, City of El Paso, El Paso County Central Appraisal District, El Paso County Roads and Bridges, El Paso County 911, The University of Texas at El Paso, The Institute for Municipal Planning and Development of Ciudad Juárez (Instituto Municipal de Investigacion y Planeacion, or IMIP). The coalition has the support of representatives of the City of Las Cruces, Doña Ana County Planning Department, and New Mexico State University.

Norte Mapa is in charge of providing the County of El Paso with parcel information. Paso del Norte Mapa provides an ArcGIS database with a parcel layer that gives a specific record on each parcel. The website also includes an interactive map where any person can search and find information within a parcel. Paso del Norte Mapa works in hand with EPWU, the latter provides aerial photographs to make the coding of the parcel layer possible. This dataset contains the following useful layers, each with specific attributes: Parcels, Traffic Count, Schools, Head Start Locations, Clinics, EP Centerline, Historic Districts, Foreign Trade Zones, and Rep. Districts. The most important layer for this research is the parcel layer. A parcel is a plot of land that comes from a division of larger areas that can be owned by different people. In this layer the research team was able to find zoning area according to their districts. Some districts found were residential, commercial, special purpose and, industrial and manufacturing. Figure 5.1 is a map of the parcel layer.

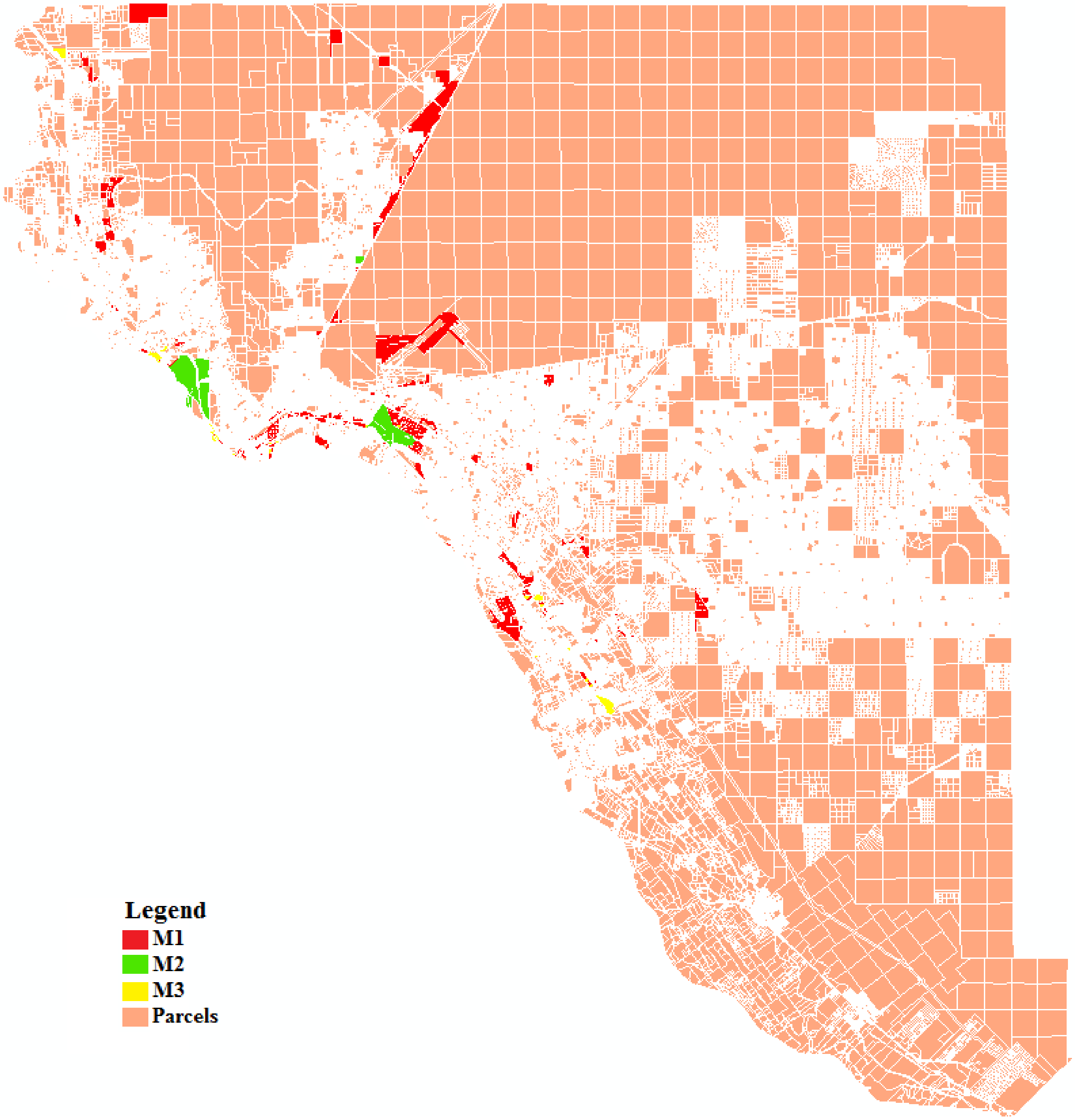


Figure 5.1 Parcels and industrial zones

5.1.2 Industrial Zoning

Zoning data was collected from Municode (Municipal Code Corporation 2013) which is a data source that codify municipal laws and ordinances. According to the Municipal Code of the City of El Paso, the code of ordinances used in the project was processed on October 9, 2012. The data implemented on the ArcMap is located in Chapter 20.06 called *Zoning Districts and Map* under a file named *Zoning*.

In order to identify the industrial and manufacturing districts located in El Paso, three different zone classifications were selected as shown in Table 5.1.

Table 5.1 Industrial Zoning Districts

Zoning Code	Description
M1	Light Manufacturing
M2	Heavy Manufacturing
M3	Unrestricted Manufacturing

Source: Municipal Code Corporation (2013)

The first zone, called Light Manufacturing District, is for light industries related to manufacturing facilities, distribution, and warehousing. This type of district, denominated as M1, is intended to preserve a light industry nature regarding conditions such as noise, smoke, or vibrations. The second zone is named Heavy Manufacturing District is denoted as M2. This zone describes the industrial regions where more conflict regarding hazardous conditions is found. The third zone called Unrestricted Manufacturing District, denominated as M3, has the same characteristics as the Heavy Manufacturing District.

Among the data provided by Municode, there were different types of M1, M2, and M3 codes, in some cases there were subscripts (or extensions) such as SP, SC, or H. These subscripts stand for Secondary Pedestrian Precinct, Shopping Center, and Historic Landmark District. It was decided to combine all the subscripts in a single category.

In order to visualize the gathered data, three ArcGIS map layers were created. The first layer was to identify the Light Manufacturing Districts (M1), which is denoted in red color. The second layer, in yellow color, classifies the Heavy Manufacturing Districts (M2). The third layer, in green, identifies the Unrestricted Manufacturing Districts (M3).

As show in Figure 5.2, most of the districts located in El Paso region are classify as Light Manufacturing Districts, or M1. The map also shows how M1 districts are concentrated mainly around the El Paso International Airport, Railroad Drive located on the city's northeast region, and on Desert Boulevard/Artcraft Road located on the far west side of the city. Two additional clusters are located at south of I-10 Freeway at Hawkins Boulevard, and Loop 375 north of Yslete-Zaragoza POE. As it can be seen in the map, M2, or Heavy Manufacturing District, is not very popular in the El Paso region. The Unrestricted Manufacturing District, M3, is show to be concentrated closed to the POEs, mainly near Paso del Norte Bridge and BOTA. It was noticed that M3 is concentrated along railroads, which suggest that the main transportation mode for freight coming out of this district is train.

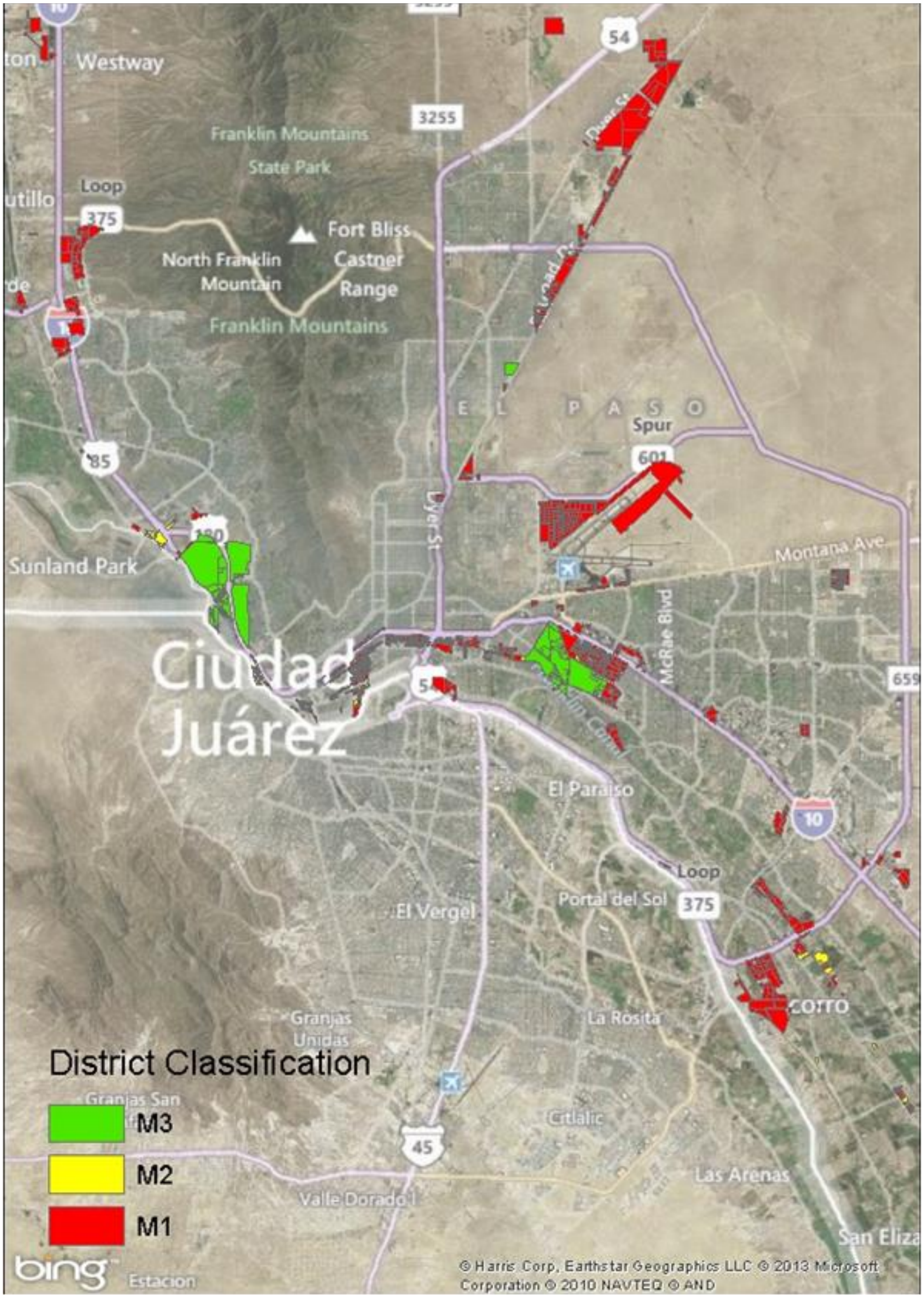


Figure 5.2 Industrial and manufacturing districts

Lot Size

Figure 5.3 shows the industrial and manufacturing area of each district in square foot. Almost three quarters of the total area belongs to the Light Manufacturing District (M1, red color), with an area of 288,346,549 ft^2. Unrestricted Manufacturing District (M3, green color) has an area of 80,923,958 ft^2. Heavy Manufacturing District only has an area of 17,189,107 ft^2. Taking in consideration the three different districts, there is a total area of 386,459,614 ft^2.

The average size for a M1 facility is 148,479 ft^2/parcel whereas the average area for a M2 and M3 industries are 245,559 ft^2/parcel and 749,296 ft^2/parcel, respectively. This indicates that the few facilities used for Unrestricted Manufacturing (M3) uses a greater space per parcel than heavy industries (M2) or light manufacturing (M1).

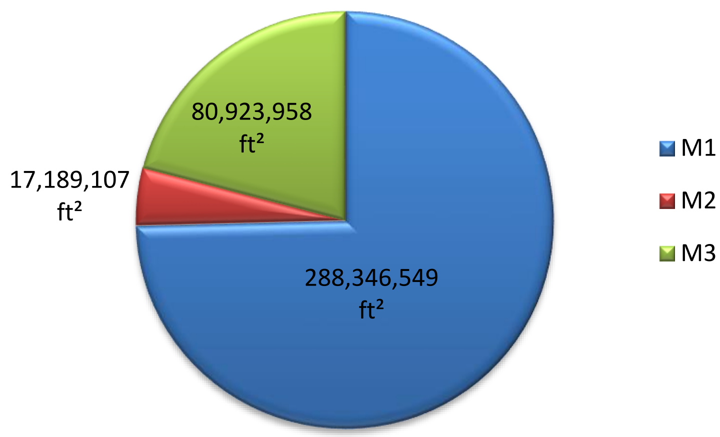


Figure 5.3 Area for industrial and manufacturing zones

<u>Facilities</u>

Figure 5.4 shows the number of facilities (parcels) per industrial manufacturing district. There are a total of 2120 facilities concentrated in El Paso Region. M1 has the largest number of facilities compare to M2 and M3 in the region. As show in Figure 4.4, M1 has 1942 facilities, while M3 has 108 facilities, whereas M2 shows a small amount of 70 units in the El Paso region. Once Figures 5.3 and 5.4 are observed, it can be concluded that the M1 - Light Manufacturing District predominated over the others districts.

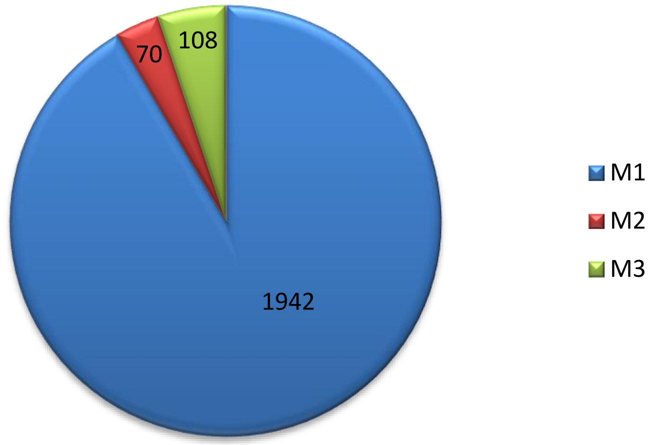


Figure 5.4 Number of facilities per manufacturing zone

5.1.3 Trucking and Warehousing Facilities

Trucking and warehousing data was collected from Miss Denisse Rodarte, Program Administrator in the City of El Paso. Miss Rodarte used a software program called Hoovers (Hoover's Inc. 2013) which provides information about companies, decision makers, and industries. Hoovers also helps to identify and evaluate potential sales leads, markets, and business partners; build presentations, reports and customized lists of companies, industries for decision makers. Hoovers' information was updated in 2013. The list of warehouses and trucking companies included company's name, address, longitude, latitude, and other information as seen in Tables 5.2 and 5.3. Companies not listed but still in the scope of work of this project, such as Mesilla Valley Transportation and Kuehne & Nagel, were manually added.

Table 5.2 Trucking Companies in El Paso

Company Name	Primary Industry	Line Of Business	Address	Latitude	Longitude	Facility Size (sq.Ft)	Employees
Desert Mountain Transportation, LLC	Trucking	Local trucking, without storage, nsk	1301 Quail Spring Dr	31.636622	-106.17775	1000	18
Dykes & Dykes Trailers Inc	Truck Rental & Leasing	Truck rental and leasing, no drivers, nsk	1150 Joe Battle Blvd	31.705956	-106.279723	1000	8
GLS Carrier, Inc.	Trucking	Local trucking, without storage, nsk	100 Desert Skies Pl	31.833698	-106.556112	1000	3
Motor Carrier Service	Truckload Carriers	Trucking, except local	3013 Killarney St	31.78641	-106.35188	1000	8
P & H Trailer Enterprises, Inc	Truck Rental & Leasing	Utility trailer rental	9742 N Loop Dr	31.684935	-106.296632	10000	6
West Texas Express	Trucking	Local trucking, without storage, nsk	1155 Valley Crest Dr	31.719288	-106.311299	10000	198
ARMSTRONG UNITED VAN LINES	Truckload Carriers	Trucking, except local	8201 Lockheed Dr Ste 130	31.792375	-106.378613	10206	30
Premium Carriers, LLC	Truckload Carriers	Trucking, except local	3700 Durazno Ave	31.776341	-106.449502	10528	30
Stagecoach Cartage	Trucking	Local trucking, without storage, nsk	7167 Chino Dr	31.759389	-106.378098	110250	4
SILVA TRUCKING CO	Truckload Carriers	Trucking, except local	512 Nw 5th St	31.509154	-106.159458	11034	35
T B S Transportation Inc	Truckload Carriers	Trucking, except local	13632 Nayarit Dr	31.725963	-106.213565	11313	30
Hobo Enterprises Inc	Trucking	Local trucking with storage, nsk	7916 Quejette Rd	31.955859	-106.590568	11500	3
Snl Trucking	Trucking	Local trucking, without storage, nsk	301 Dallas St	31.766497	-106.470245	11536	11
Pack-N-Ship	Truckload Carriers	Trucking, except local	6112 N Mesa St	31.831282	-106.531059	1200	2
Vicky Trucking Inc	Trucking	Local trucking, without storage, nsk	7612 Clio St	31.849323	-106.436303	1216	2
Riveros Trucking	Trucking	Local trucking, without storage, nsk	3904 Tierra Marfil Rd	31.802992	-106.260188	1230	2
Calfrnia Gas Trnsprt	Truckload Carriers	Trucking, except local	3638 Hondo Pass Dr	31.869351	-106.450338	12787	50

Source: Hoover's Inc. (2013)

Table 5.3 Warehousing Facilities in El Paso

Company Name	Line of Business	Address	Latitude	Longitude	Facility Size (sq.Ft)	Revenue (US Dollars, million)	Employees At This Location	Year of Founding
A. O. Smith Corporation	Warehousing & Storage	401 Frederick Rd	31.772237	-106.41825	27349		56	
Aber Gateway Storage, LLC	Warehousing & Storage	2244 Trawood Dr Ste 206	31.764898	-106.322936	3757	0.11	2	2010
AEES INC.	Warehousing & Storage	12135 Esther Lama Dr	31.722457	-106.298814				
APL Logistics Warehouse Management Services, Inc.	Warehousing & Storage	11970 Pellicano Dr	31.735049	-106.28753	24354		45	
Apollo Self Storage	Warehousing & Storage	8533 Dyer St	31.858529	-106.43593	544	0.12	3	1987
ARMOUR DRIVE SELF STORAGE INC	Warehousing & Storage	11211 Armour Dr	31.751236	-106.31912	51431	0.16	3	1981
ASW	Warehousing & Storage	1530 Goodyear Dr	31.747592	-106.309946	3220	0.092	2	2010
AUTO VIDRIO/GLASS DIV	Warehousing & Storage	1301 Joe Battle Blvd	31.719512	-106.269096	5791		3	
AUTOMOTIVE LIGHTING LLC	Warehousing & Storage	12112 Rojas Dr Ste B	31.72252	-106.296013	13599		15	
Brokers Logistics Genpar LLC	Warehousing & Storage	1000 Hawkins Blvd	31.767074	-106.379845	28769	19.1	175	1962
Brokers Logistics Genpar LLC	Warehousing & Storage	6830 Industrial Ave	31.773172	-106.389535	10968		10	
Budget Self Storage	Warehousing & Storage	11655 Pellicano Dr	31.743328	-106.298217	3757	0.097	2	
Cadillac Rubber & Plastics, Inc.	Warehousing & Storage	12425 Rojas Dr Bldg 1	31.700271	-106.270584				
Carnegie U Self Storage	Warehousing & Storage	9720 Carnegie Ave	31.796316	-106.354777	3813	0.12	2	1995
Casa De Musica Deluxe	Warehousing & Storage	3815 Buckner St Ste E	31.796987	-106.365803	3220	0.12	2	2008
CDM of Mexico	Warehousing & Storage	2120 E Paisano Dr	31.766174	-106.461603	3206	0.16	4	2002
Charlotte's, Inc.	Warehousing & Storage	5411 N Mesa St Ste 12	31.818346	-106.516406	4671		2	

Source: Hoover's Inc. (2013)

With the longitude and latitude, it was possible to label the spatial locations of companies in a GIS map. Two different symbols were used, one for warehouses and another for the trucking companies. For Warehouses a blue box with a "w" was used and for the trucking companies a truck icon. The locations of warehouses and trucking companies can be seen in the following figures. The map includes registered office addresses, not necessary the operation facilities.

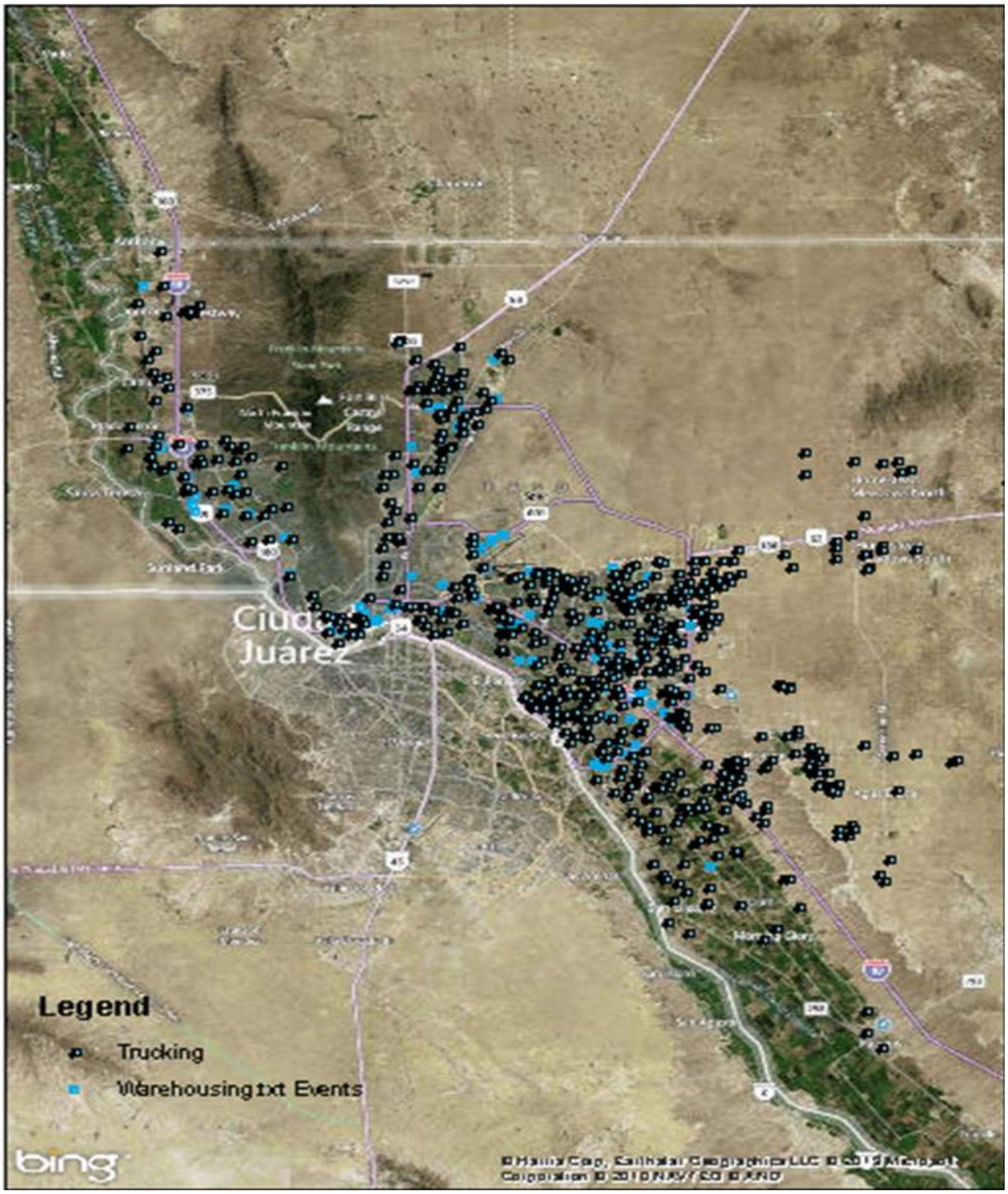


Figure 5.5 Warehousing and trucking GIS map

<u>Warehousing Lot Size</u>

Additional analysis was performed on number of employees and the size of the facility. This information was of interest because they are related to truck trip generation. It is expected that bigger facilities will generate more truck traffic. It is possible to see from Figure 5.6 that the number of warehouses based on square footage. It can be observed from Figure 5.6 that most warehouses range from 2,000 to 4,000 ft^2. Also, it is common for the size of warehousing facilities to be greater than 10,000 ft^2 (shown in orange color in Figure 5.6).

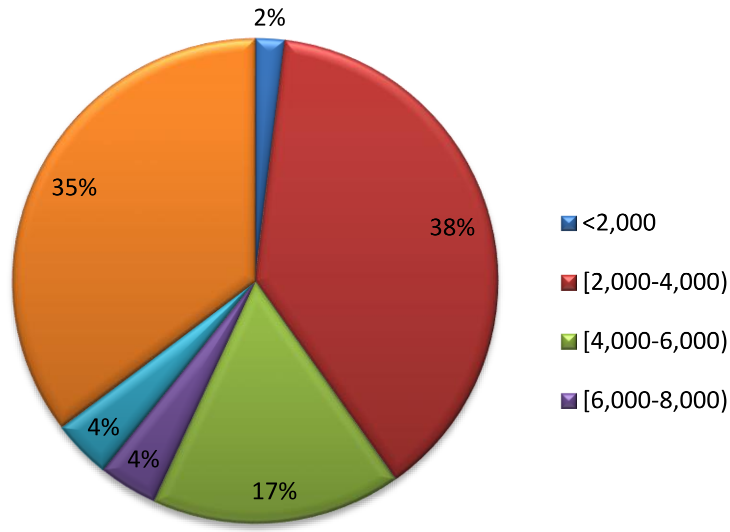


Figure 5.6 Warehousing facilities size (square feet)

<u>Trucking Companies Lot Size</u>

Almost 71% of trucking companies' facility size has a similar range from 2,000 to 4,000 ft^2. Comparing Figures 5.6 with 5.7, it appears that trucking companies occupy smaller square footage.

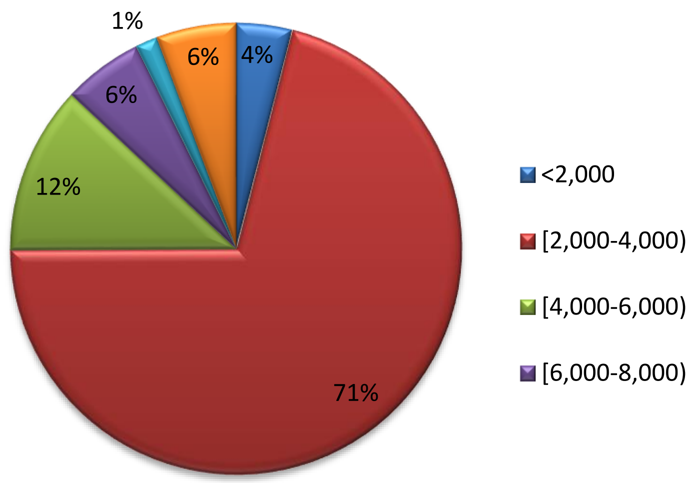


Figure 5.7 Trucking facilities size (square feet)

5.1.4 Vehicle Classification Count

In 2011, Texas Department of Transportation (TxDOT) collected traffic data in major highways in the El Paso District (Texas Department of Transportation 2011). Figure 5.8 shows the vehicle counting stations. The traffic volume reported contains disaggregated data that accounts for the 13 different vehicle classes. The 13 vehicle classes were aggregated into passenger-pickups, single unit trucks, combination semi-trailer trucks, and combination semi-trailer trailer trucks. Figure 5.9 shows a sample of data provided from a counting station. TxDOT provided volume count data from 59 stations on interstate, U.S. and state highways. Only 13 counting stations are within the El Paso MPO's planning area. The data from these 13 stations is summarized in Table 5.4.

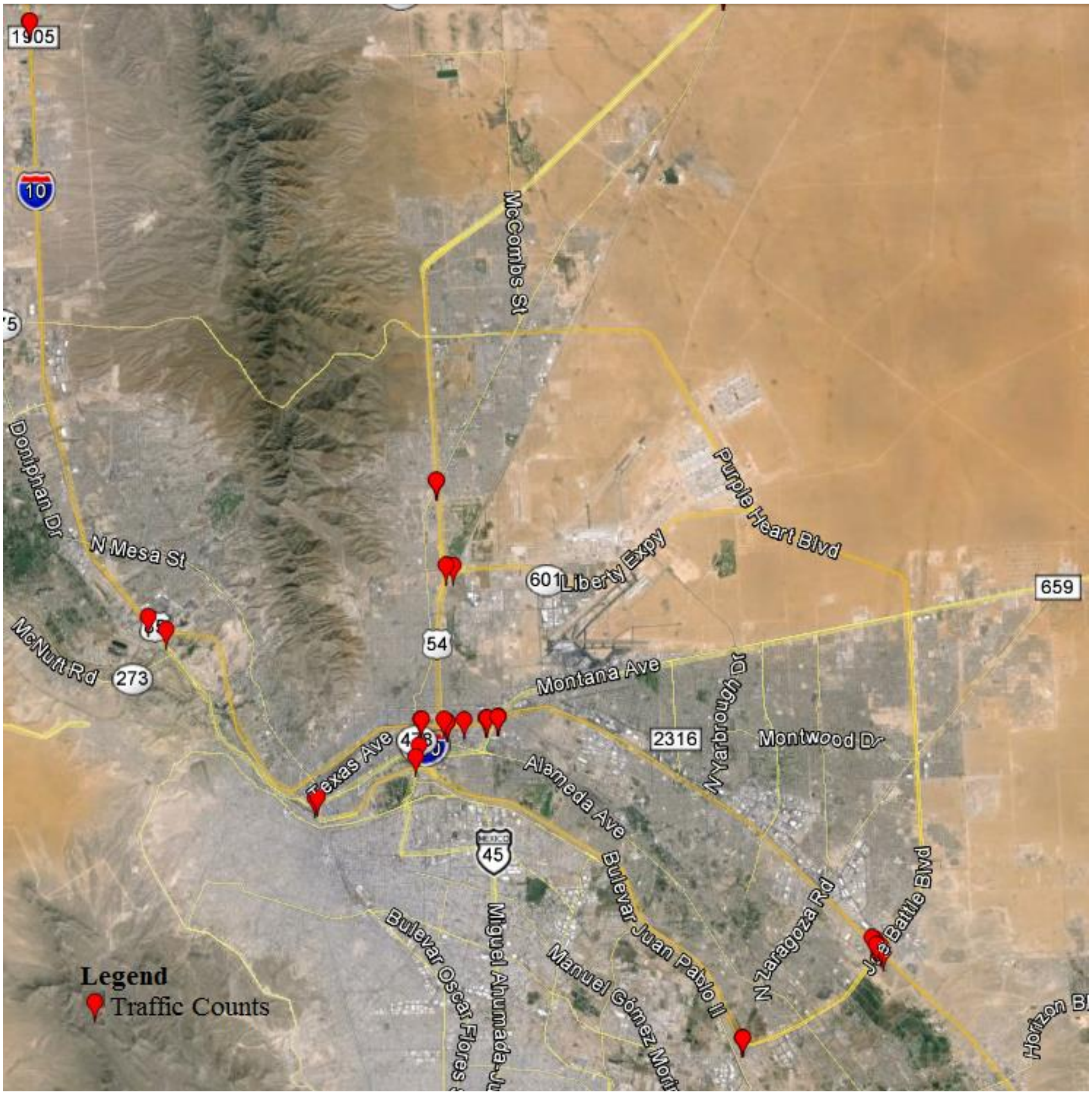


Figure 5.8 TxDOT's vehicle counting stations in El Paso

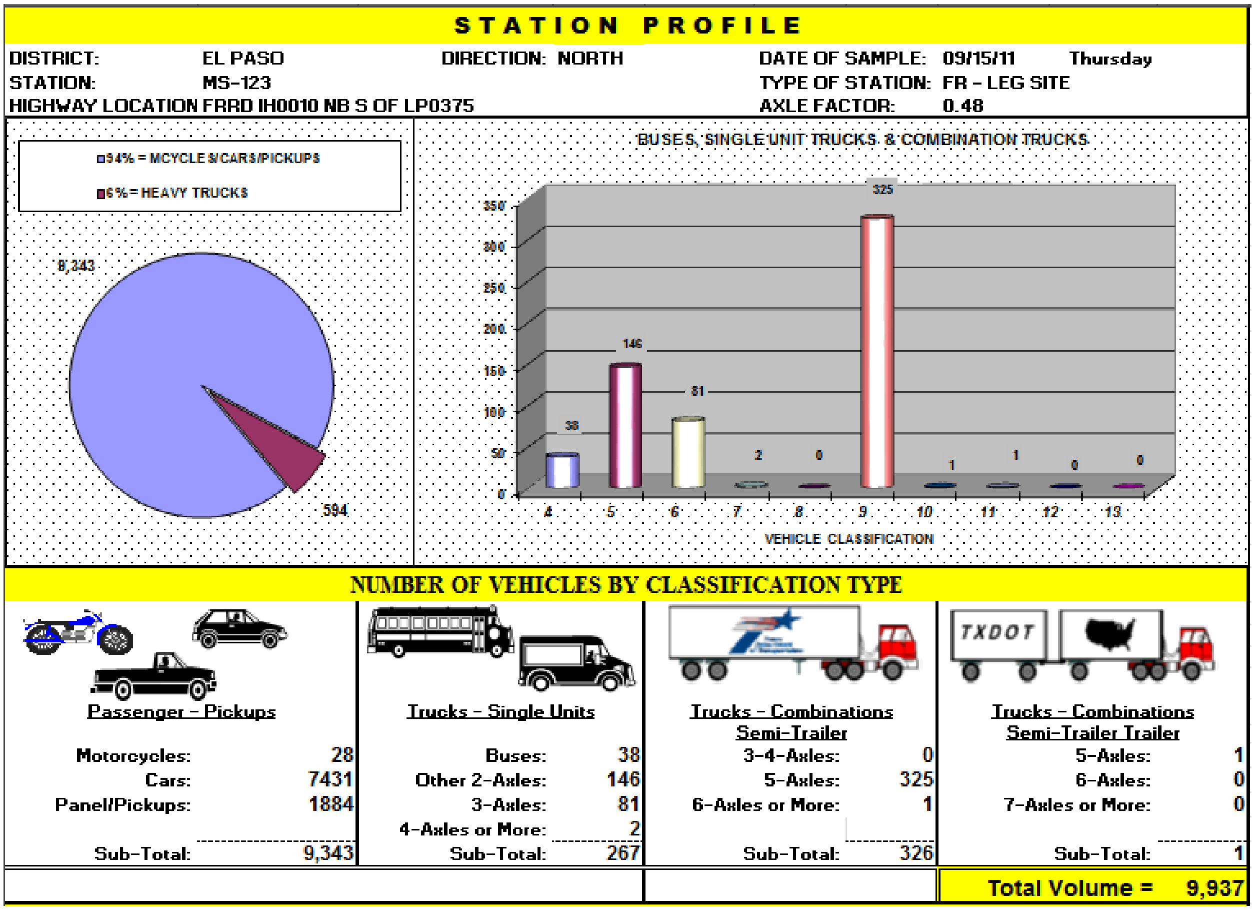


Figure 5.9 Format of vehicle volume count data provided by TxDOT

Table 5.4 Summary of Traffic Count Provided by TxDOT

Station	Location	Direction	Date	Traffic composition (%)		Daily volime (veh/day)					
				% Mcycle, cars, pickups	% heavy trucks	Pax, pickups	Single unit trucks	Combi semi-trailer	Combi, semi-trailer trailer	Total trucks	Total
HP-972	DYER ST. W OF US0054	North	9/12/11	98	2	8520	204	11	0	215	8735
HP-972	DYER ST. W OF US0054	South	9/12/11	98	2	7134	162	5	0	167	7301
HP-973	IH0010 W OF US0054	West	9/15/11	92	8	70218	2299	3520	221	6040	76258
HP-973	IH0010 W OF US0054	East	9/15/11	93	7	72170	1930	3669	222	5821	77991
HP-974	IH0010 W OF US0085	East	9/15/11	91	9	61345	2203	3646	292	6141	67486
HP-974	IH0010 W OF US0085	West	9/15/11	91	9	60780	1997	3458	229	5684	66464
HP-975	IH0010 W OF US0062	West	9/12/11	92	8	73700	1966	3973	143	6082	79782
HP-975	IH0010 W OF US0062	East	9/12/11	93	7	63831	1849	2881	127	4857	68688
HP-975	FRRD IH0010 EB E OF US0062	West	9/12/11	93	7	13554	581	508	1	1090	14644
HP-975	FRRD IH0010 EB E OF US0062	East	9/12/11	94	6	15540	488	516	3	1007	16547
HP-976	FRED WILSON RD E OF US0054	East	9/14/11	96	4	28379	698	431	14	1143	29522
HP-976	FRED WILSON RD E OF US0054	West	9/14/11	97	3	13486	295	123	1	419	13905
LW-510	IH0010 N OF EL PASO	North	9/15/11	81	19	19443	1238	2968	212	4418	23861
LW-510	IH0010 N OF EL PASO	South	9/15/11	82	18	19831	1125	3122	222	4469	24300
M-1168	US0054 S OF NEW MEXICO ST L	SW	11/15/11	85	15	2963	227	307	3	537	3500
M-1168	US0054 S OF NEW MEXICO ST L	Northeast	11/15/11	85	15	2342	194	213	3	410	2752
M-1680	IH0010 SE OF LP0375 EL PASO	EAST	9/12/11	87	13	27277	1111	2826	171	4108	31385
M-1680	IH0010 SE OF LP0375 EL PASO	WEST	9/12/11	88	12	28283	1240	2519	114	3873	32156
M-1680	FRRD IH0010 WB SE OF LP0375	WEST	9/12/11	88	12	4144	389	184	15	588	4732
M-1680	FRRD IH0010 EB SE OF LP0375	EAST	9/12/11	94	6	4681	155	143	3	301	4982
MS-123	IH0010 S OF LP0375	SOUTH	9/15/11	86	14	26013	820	3483	0	4303	30316
MS-123	IH0010 S OF LP0375	NORTH	9/15/11	86	14	23123	723	2903	172	3798	26921
MS-152	IH0010 W OF SH0054	EAST	9/8/11	34	66	1816	265	2996	257	3518	5334
MS-152	IH0010 W OF SH0054	WEST	9/8/11	37	63	1813	194	2576	260	3030	4843
MS-162	IH0010 W OF US0054	WEST	9/15/11	94	6	94324	2245	3575	173	5993	100317
MS-162	IH0010 W OF US0054	EAST	9/15/11	94	6	92585	2019	3694	239	5952	98537
MT-660	ZARAGOSA ROAD BRG	SOUTH	11/17/11	82	18	6094	241	1072	1	1314	7408
MT-660	ZARAGOSA ROAD BRG	NORTH	11/17/11	87	13	8539	288	1036	0	1324	9863
MT-680	IH0110 BRG OF THE AMERICAS	SOUTH	9/13/11	85	15	17011	1251	1811	28	3090	20101
MT-680	IH0110 BRG OF THE AMERICAS	NORTH	9/13/11	99	1	9217	54	1	0	55	9272
MT-700S	US0062 SB STANTON STR BRG	SOUTH	9/13/11	97	3	2831	83	0	0	83	2914
MT-700S	US0062 NB STANTON STR BRG	NORTH	9/13/11	100	0	3871	1	0	0	1	3872
MT-704N	US0062 NB ONLY EL PASO ST BRG	NORTH	9/13/11	100	0	4089	6	0	0	6	4095

The data in Table 5.4 may be analyzed by (i) percentage of trucks; and (ii) by total number of trucks. Station MS-152 has the highest truck percentages in traffic (63% and 66% respectively). This station has two counting locations at the connectors from BOTA to I-10 Freeway toward the westbound and eastbound directions, respectively. Several other locations (such as Stations LW-510, M-1168, MT-660, M-1680 and M680) also have high percentages of trucks. These locations are near Texas-New Mexico state lines in the west and north of El Paso, Zaragosa POE, I-10 and Loop 375 interchange (Americas Interchange), and BOTA POE. The percentage of trucks at these stations ranges from 15% to 19%. In terms of total truck volume, Stations HP-973, HP974, HP-975 and MS-162 have the highest truck volumes (more than 5000 trucks/day). In general, the I-10 and U.S. 54 interchange (also known as Spaghetti Bowl), and the I-10 and Loop 375 (Americas Interchange) have high truck volumes.

5.1.5 Crashes Involving Commercial Vehicles

A request for the Crash Records Information System (CRIS) was ordered through the TxDOT website (Texas Department of Transportation 2013). The data was given in an Excel file. The data provided all the automotive crashes in the State of Texas from years 2008 through 2012. It was necessary to filter all the crashes of Texas to only the ones that occurred in El Paso (city identification 136). After identifying the crashes in El Paso, the CRIS information was filtered again, but this time, to account crashes that involved a Commercial Motor Vehicle (CMV). The final Excel spreadsheet contained only crashes in El Paso in which a CMV was involved. In the data there were two important columns for the study: latitude and longitude of the crash. With the latitude and longitude it was possible to plot the crashes into the GIS map as shown in Figure 5.9. From here, it can be observed that most crashes involving CMV were located in I-10 or in main streets of the city. The concentration of crash spots does not appear to correlate with locations of industrial districts in Figure 5.2.

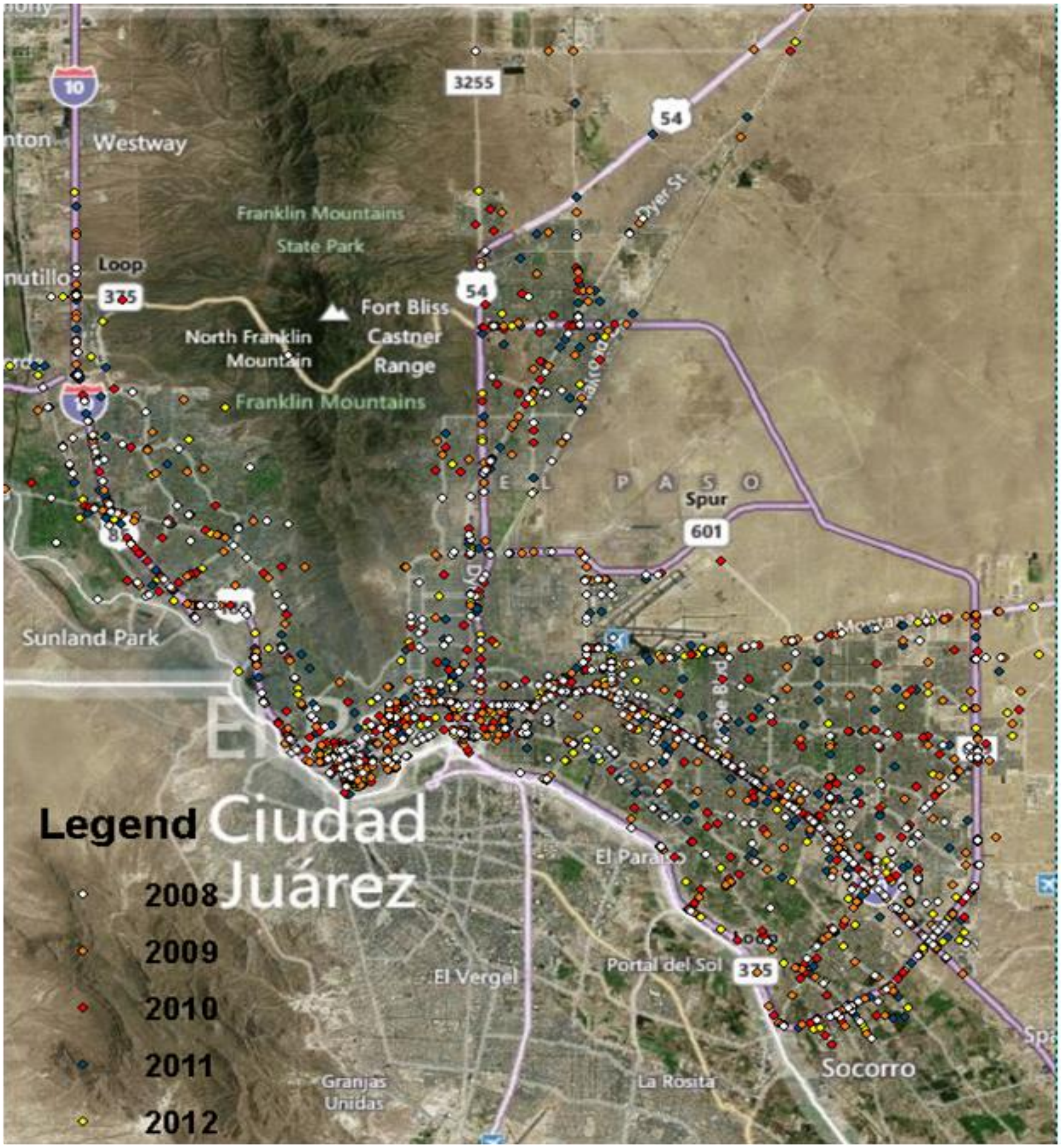


Figure 5.10 Commercial motor vehicle crashes in El Paso

Figure 5.10 compares the number of crashes that involved a CMV in the last five years. It is possible to observe that crashes have decreased since 2008, possibly because of the decline in the economy during the same years. Nevertheless, there was an increase from 2011 to 2012.

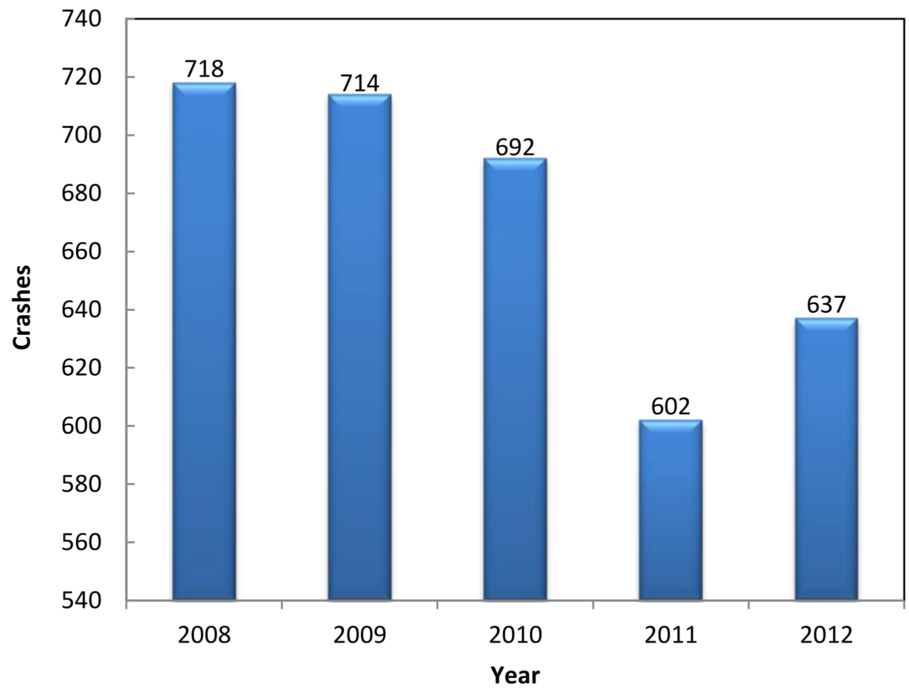


Figure 5.11 Commercial motor vehicle crashes per year

5.1.6 Available Land

Based on the available properties listed in CBRE Global Research and Consulting (2013b), it is possible to identify the commercial real estate in the border region. Information available in El Paso market is summarized in the following Tables 5.5, 5.6 and Figure 5.12. Most of the available industrial parcels are in the northeast of El Paso, around El Paso International Airport, and along I-10 and Loop 375 Freeways in the east El Paso.

Table 5.5 Available Properties for Sale in El Paso

NAME	BLDG/LOT SIZE	CATEGORY
10.41 ACRES	10.41 acre	Commercial/Other (land)
1400 HENRY BRENNAN	127,730 ft^2	Manufacturing
7825 HELEN OF TROY	18,395 ft^2	Warehouse
9300 BILLY THE KID	108,125 ft^2	Warehouse
9500 PLAZA CIRCLE	101983 ft^2	Warehouse
9601 RAILROAD	52,000 ft^2	Distribution Warehouse
NWC OF ZARAGOZA & PELICANO	1.35 acre	Commercial/Other (land)
WASHINGTON FEDERAL LAND	0.77 acre	Retail (land)

Table 5.6 Available Properties for Lease in El Paso

NAME	BLDG/LOT SIZE (ft^2)	CATEGORY
11500 ROJAS	12,600-41,000	Warehouse
11800 ROJAS	2,600-16,250	Warehouse
12 LEIGH FISHER	64,800	Warehouse
12120 ESTHER LAMA	39,500	Warehouse
12134 ESTHER LAMA	48,000	Warehouse
12430 MERCANTILE	22,320	Warehouse
12435 ROJAS	48,000	Distribution Warehouse
1435 HENRY BRENNAN	13,720-19,200	Warehouse
19 LEIGH FISHER	30,000-120,000	Manufacturing
32 CELERITY WAGON	144,000	Manufacturing
9 BUTTERFIELD TRAIL	18,000-43,000	Warehouse
9500 PLAZA CIRCLE	56,700-101,983	Distribution Warehouse
9601 PAN AMERICAN	45,000-89,460	Warehouse
9601 RAILROAD	52,000	Warehouse
9615 PLAZA CIRCLE	25,311	Warehouse

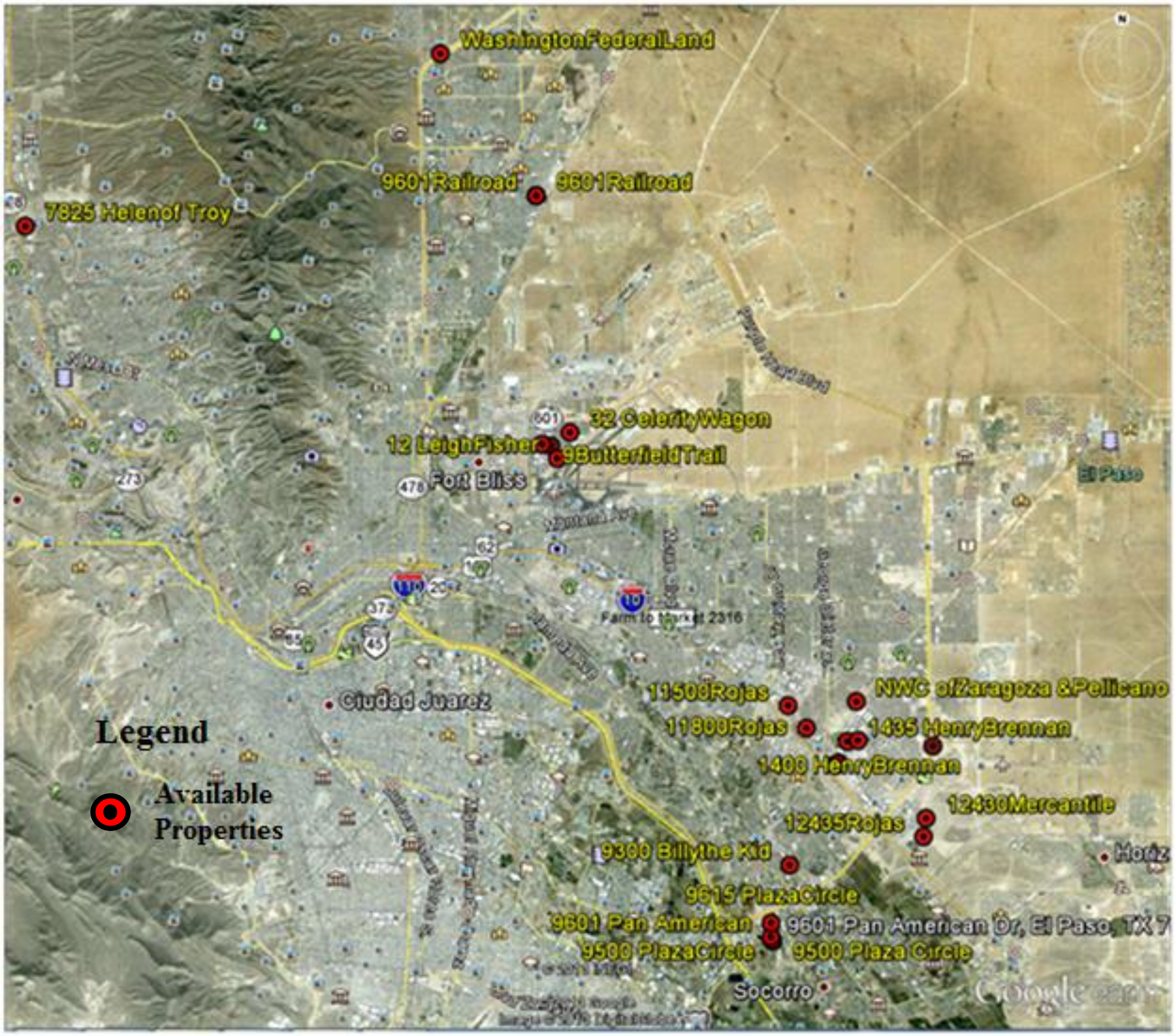


Figure 5.12 Available properties in El Paso

5.2 Ciudad Juarez

5.2.1 Industrial Parks

Information regarding Ciudad Juarez was gathered from different sources: Desarrollo Economico de Ciudad Juarez (2011), Al Dia editors (2011), Instituto Nacional de Estadistica y Geografia (2011). These references provided economic and business information for the study.

Juarez Invest is an organization responsible for economic development and international trade (Desarrollo Economico de Ciudad Juarez 2011). The website has an interactive map that has the most updated information about industrial parks and maquiladoras.

“Al Dia” is a magazine that contains a directory of manufacturing industries in Ciudad Juarez that has their address , zip code , telephone ,category , and industrial park (Al Dia 2011).

The Instituto Nacional de Estadistica y Geografia (INEGI, or National institute of Statistic and Geography) is an agency of the Mexican government dedicated to coordinate the national system of statistical and geographical information of the country. The web has the number of employees of each maquiladora on Ciudad Juarez.

Some information was missing from the ArcGIS file used as base map which was provided by Borderplex Alliance (Figure 3.3). Some industrial parks and maquiladoras were not found on the based map. Another attribute omitted in the original file was the number of employees. The ArcGIS map was updated using the sources previously described. Juarez Invest, a primary resource of information, was compared with the base map to find current industrial parks and maquiladoras that were not located in the map. In order to find the exact location of each industrial park and maquiladora “Al Dia” magazine was essential.

Google Earth (Google 2013) is a virtual map that has geographical information all over the world. With the help of Google Earth, missing locations for industrial parks with polygon shapes were identified and created.

ArcGIS was used to measure distance, area, perimeter in a map. With this tool, the area and perimeter of the industrial parks that need to be updated were calculated. The use of INEGI website was necessary because the number of employees of some maquiladoras was not present.

The following figure (Figure 5.13) is an updated map of Ciudad Juarez’s maquiladoras and industrial parks. It includes green polygons that represent Industrial parks and orange points that represent maquiladoras. Table 5.7 shows the area and perimeter for the different industrial parks.

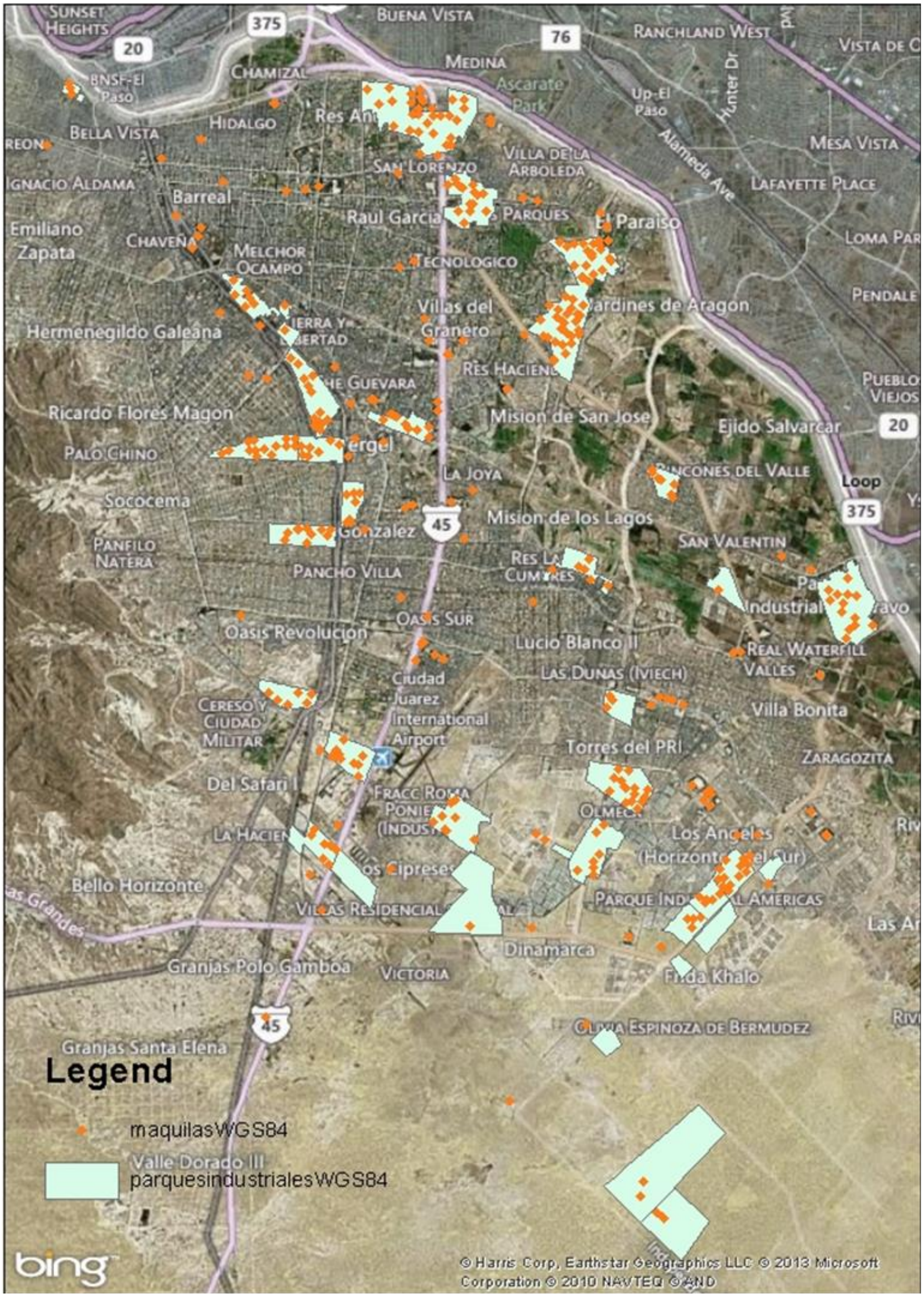


Figure 5.9 Ciudad Juarez maquiladora industry locations

Table 5.7 Industrial Park Size

FID	NAME OF INDUSTRIAL PARK	AREA (ft^2)	PERIMETER (ft)
0	PARQUE IND. ALTAVISTA	83,429.60	1,624.43
1	PARQUE INDUSTRIAL OMEGA	1,757,461.96	8,690.64
2	PARQUE INDUSTRIAL LOS FUENTES	771,259.50	5,293.56
3	PARQUE IND. ANTONIO J. BERMUDEZ	1,874,142.34	9,167.03
4	PARQUE INDUSTRIAL EJE J. GABRIEL	534,777.33	6,926.64
5	PARQUE INDUSTRIAL JUAREZ	724,726.40	4,213.34
6	PARQUE INDUSTRIAL RAMON RIVERA LARA	370,638.87	3,387.23
7	PARQUE INDUSTRIAL FERNANDEZ	606,327.77	4,106.32
8	PARQUE INDUSTRIAL GEMA	430,953.95	2,892.92
9	PARQUE INDUSTRIAL ZARAGOZA	266,373.75	2,175.78
10	PARQUE INDUSTRIAL GEMA II	312,133.93	2,427.87
11	PARQUE INDUSTRIAL AZTECAS	518,869.70	3,375.77
12	PARQUE INDUSTRIAL LAS LOMAS	393,958.40	4,950.96
13	PARQUE INDUSTRIAL RIO BRAVO	1,200,509.36	5,071.63
14	PARQUE INDUSTRIAL ABH	290,023.41	2,736.13
15	PARQUE INDUSTRIAL NORTH GATE	399,990.95	2,910.43
16	PARQUE INDUSTRIAL HENEQUEN	307,301.32	2,254.61
17	PARQUE IND. AEROPUERTO	522,714.65	3,039.01
18	PARQUE INDUSTRIAL PIMSA INTERMEX	792,013.61	3,674.79
19	PARQUE IND. AEROJUAREZ	737,498.25	4,075.29
20	PARQUE INDUSTRIAL PANAMERICANO	416,598.16	3,606.06
21	INTERMEX INDUSTRIAL LAS TORRES	778,178.35	4,076.33
22	LAS TORRES INDUSTRAIL ZONE	10,550,240.70	14,585.78
23	PARQUE INDUSTRIAL AXIAL	428,962.91	3,018.05
24	PARQUE INDUSTRIAL SALVARCAR	414,168.49	2,569.45
25	CENTRO INDUSTRIAL JUAREZ	1,263,040.61	5,460.64
26	PARQUE INDUSTRIAL AMERICAS	320,498.06	2,305.95
27	PARQUE INDUSTRIAL INTERMEX SUR	929,523.99	3,869.42
28	PARQUE INDUSTRIAL ELECTROLUX	2,100,794.47	6,537.12
29	ZONA INDUSTRIAL THOMSON	330,919.89	2,436.43
30	VERDE INDEPENDENCIA INDUSTRIAL PARK	5,205,151.69	10,605.80
31	PUNTAL DEL ESTE INDUSTRIAL ZONE	2,865,397.95	15,248.87
32	IGS-PASO DEL NORTE INDUSTRIAL PARK	1,526,994.15	8,958.97
33	PROLOGIS INDEPENDENCIA INDUSTRIAL PARK	1,990,356.87	5995.02
	Average	**1,357,429.52**	**5,066.71**
	Minimum	**83,429.60**	**1624.43**
	Maximum	**10,550,240.70**	**15,248.87**

The following figure shows different ranges of number of employees in the maquiladoras taken from Instituto Nacional de Estadistica y Geografia (2011). The highest range indicates that maquiladora employees have up to 5000 workers. The lowest range, on the contrary represents maquiladoras with up to 100 employees. The numbers in the pie chart indicate the number of maquiladoras that have the range of employees.

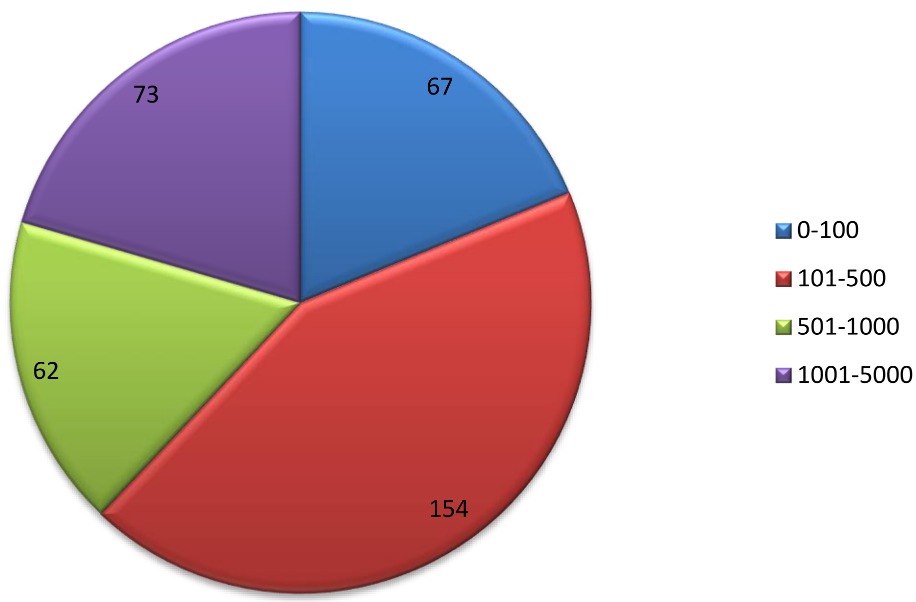


Figure 5.10 Number of employees in maquiladoras

5.2.2 Available Land

Real estate information for sale and lease of industrial property in Ciudad Juarez can be found in the following tables and figure. The market information was provided by CBRE Global Research and Consulting (2013b).

Table 5.8 Available Properties for Sale in Ciudad Juarez

NAME	BLDG/LOT SIZE	CATEGORY
KIT	43,900 ft^2	Manufacturing
VERDE LAND AIRPORT	29.2 acre	Industrial (Land)
VERDE LAND-AIRPORT WEST	21 acre	Industrial (Land)

Table 5.9 Available Properties for Lease in Ciudad Juarez

NAME	BLDG/LOT SIZE (ft^2)	CATEGORY
COCLISA CHAMIZAL	309,135	Warehouse
FORMER GREENBAY BUILDING	83,278	Warehouse
O'DONNEL CALLE HORNOS	174,802	Manufacturing
O'DONNEL HENEQUEN V	79,700	Manufacturing
PANAMERICANO 3	103,644	Manufacturing
NORTHGATE I	59,901	Manufacturing

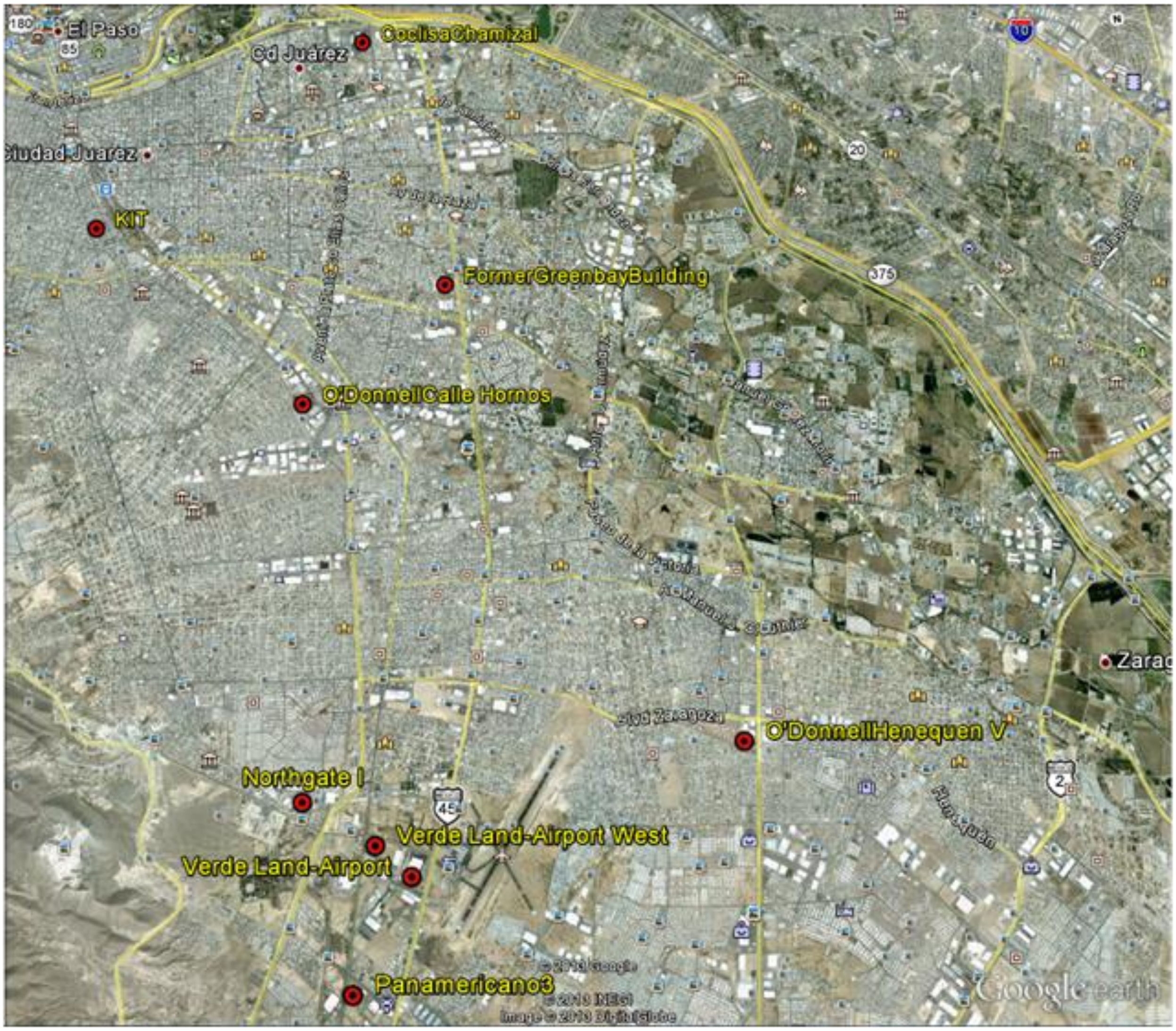


Figure 5.15 Available properties in Ciudad Juarez

5.3 Truck Origin-Destination in the El Paso-Juarez Region

Having obtained the locations of industrial lands/parcels in El Paso and Ciudad Juarez, the following map is created to visualize the origins and destinations of truck trips in the region, without the use of trip volume data. The origins and destinations include the industrial park near the Santa Teresa POE at the western end of the region.

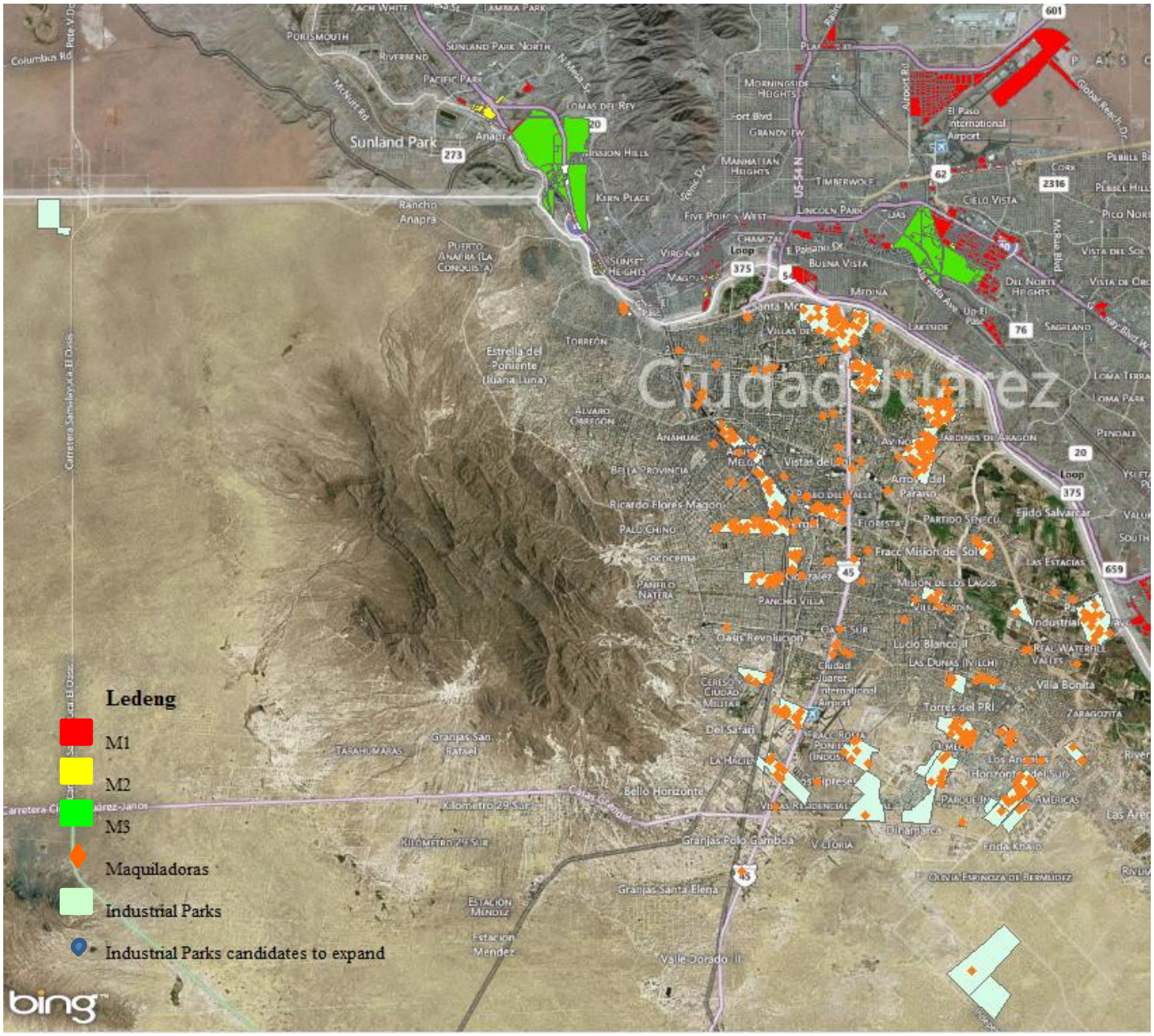


Figure 5.16 Origins and destinations of truck trips in the El Paso-Juarez region

6 Trip Generation Analysis

This chapter analyzes truck trip generation and attraction rates for warehouses and distribution centers in El Paso. Truck volumes at four selected sites in El Paso were collected and then correlated with land use attributes. The observed trip generation and attraction rates were compared with the values calculated by the models recommended by the Trip Generation Manual (ITE 2003). The purpose of this chapter is to gather information on truck trip generation rate in El Paso, and to determine if the Trip Generation Manual can be used to predict the truck trip generation rates in El Paso with reasonable accuracy.

6.1 Data Collection Sites

Four sites were selected in the City of El Paso. The criteria of site selection were:

1. Each site has a catchment consisted of predominantly warehouses and distribution centers of M1 land use classification (as described in Figure 5.2); and
2. The site was the major entrance and exit for trucks to from the catchment.

The four sites and not more were selected for this project because of budget and time limitations. In addition, there are also limited sites in the El Paso region that meet the selection criteria.

Site 1 is located at the intersection of Founders Blvd and Airport Dr. This is the main entrance and exit for warehouses that are located near the airport. The catchment is bounded by Airport Dr., Founders Blvd and El Paso International Airport. Figure 6.1 shows the aerial view of the site and its catchment. Two other intersections (Butterfield Blvd and Airport Dr., Leigh Fisher Blvd and Airport Dr.) are possible access points but they are seldom used by trucks because of construction activities (lane closure).

Figure 6.1 Aerial view of site 1

Site 2 is located in the east side of El Paso near the intersection of Rojas Dr. and Joe Battle Blvd. This location has a catchment bounded by Rojas Dr. and Mercantile Ave. Figure 6.2 shows the location and catchment of this site. The warehouse area is on the right hand side of the figure.

Figure 6.2 Aerial view of site 2

The third site (site 3) is also located in the east side of El Paso, near the intersection of Don Haskins Dr. and Rojas Dr. This location was chosen because of the high volume of trucks traveling in the out of the north approach of the intersection. Figure 6.3 shows the location of the site and part of the catchment. The warehouse area is in the north of the intersection along Don Haskins Dr. From a preliminary site reconnaissance rucks in this catchment area use Don Haskins Dr. to access the I-10 Freeway.

Figure 6.3 Aerial view of site 3

Site 4 is located near the intersection of Pan American Dr. and Plaza Circle. The site is near the interchange of Loop 375 Freeway (also known as the Cesar Chavez Border Highway) and Pan American Dr. It is also near the Isleta-Zaragoza POE. Figure 6.4 shows the location of the site and its catchment. This site was chosen because it is the only access point for trucks to enter and exit the warehouses in the catchment area from the Loop 275 Freeway.

Figure 6.4 Aerial view of site 4

6.2 Data Collection Process

At each site, videos of traffic movements along the main road (in both directions) were recorded from a parked vehicle. Videos of traffic movements were record for one week, on Monday, Wednesday and Friday from 6:00 a.m. to 10:00 a.m. and from 12:00 p.m. to 3:00 p.m. (with the exception of site 4 which lasted until 4:00 p.m.). The durations of video recordings were limited by one camera and its battery life. These days and hours were recommended by staff in Kuehne and Nagel, and the hours coincided with the opening hours of commercial lanes of the POEs. Table 6.1 lists the dates and time for data collection.

The video was later replayed in the laboratory (in a desktop or laptop computer) so that trucks were counted manually. Trucks have been divided into medium and large trucks depending on the number of axles. Two axle trucks (including tandem rear axle trucks) were counted as medium trucks while triple axle trucks (including trailer with or without a container) were counted as heavy trucks. The only exception was truck tractors or caps (without towing a trailer) were considered as heaving trucks, because their presence is related to heavy truck generations. That is, they were going to warehouses to tow trailers, or coming from warehouses after dropping off trailers. Each video file was replayed twice and counted by the same person, or once but counted by two persons, so that medium and heavy trucks could be counted separately. Medium and heavy trucks volumes were counted at every 15-minute intervals and then summarized into hourly volume. They were further divided into outbound (trip generated) and outbound (trip attracted).

The hourly trends of medium and heavy trucks in the inbound and outbound directions were analyzed. No distinct difference in the trends has been found. Therefore, in the subsequent analysis the volumes of medium and heavy trucks were combined.

The counted hourly volumes of trucks were further processed as follows:

- For each morning or afternoon observation period, the peak hour was identified, and labeled as "maximum" volume.
- For each morning or afternoon observation period, the average hourly volume was identified, and labeled as "average" volume.

The processed volumes are summarized in Tables 6.2 and 6.3.

Table 6.1 Data Collection Dates and Times

Site	Date	Day	Time
Site 1	05/31/13	Friday	6:00 a.m.-10:00 a.m.
	06/03/13	Monday	12:00 p.m.-3:00 p.m.
	06/05/13	Wednesday	12:00 p.m.-3:00 p.m.
	06/07/13	Friday	12:00 p.m.-3:00 p.m.
	06/10/13	Monday	6:00 a.m.-10:00 a.m.
	06/19/13	Wednesday	8:00 a.m-10:00 a.m.
	06/19/13	Wednesday	12:00 p.m.-3:00 p.m.

Site 2	06/21/13	Friday	12:00 p.m.-3:00 p.m.
	06/24/13	Monday	6:00 a.m.-10:00 a.m.
	06/24/13	Monday	12:00 p.m.-3:00 p.m.
	06/26/13	Wednesday	6:00 a.m.-10:00 a.m.
	06/28/13	Friday	6:00 a.m.-10:00 a.m.
Site 3	07/10/13	Wednesday	6:00 a.m.-10:00 a.m.
	07/12/13	Friday	6:00 a.m.-10:00 a.m.
	07/15/13	Monday	6:00 a.m.-10:00 a.m.
	07/29/13	Friday	12:00 p.m.-3:00 p.m.
	07/22/13	Monday	12:00 p.m.-3:00 p.m.
	07/24/13	Wednesday	12:00 p.m.-3:00 p.m.
Site 4	08/07/13	Wednesday	6:00 a.m.-10:00 a.m.
	08/09/13	Friday	6:00 a.m.-10:00 a.m.
	08/12/13	Monday	6:00 a.m.-10:00 a.m.
	08/14/13	Wednesday	12:00 p.m.-4:00 p.m.
	08/16/13	Friday	12:00 p.m.-4:00 p.m.
	08/19/13	Monday	12:00 p.m.-4:00 p.m.

Table 6.2 Summary of Truck Volume in the Morning Period

Site	Day of week	AM average inbound volume (veh/hr)	AM maximum inbound volume (veh/hr)	AM average outbound volume (veh/hr)	AM maximum outbound volume (veh/hr)	AM average inbound & outbound volume (veh/hr)	AM maximum inbound & outbound volume (veh/hr)
Site 1	Monday	46	60	60	108	105	168
	Wednesday	28	34	43	93	71	125
	Friday	38	47	60	110	98	157
Site 2	Monday	65	83	48	64	113	141
	Wednesday	33	43	33	44	66	82
	Friday	49	67	34	50	82	116
Site 3	Monday	35	55	26	44	61	99
	Wednesday	28	51	24	44	52	95
	Friday	30	45	25	50	55	95
Site 4	Monday	39	60	27	53	66	113
	Wednesday	26	41	20	40	46	76
	Friday	33	50	26	42	58	91

Table 6.3 Summary of Truck Volume in the Afternoon Period

Site	Day of week	PM average inbound volume (veh/hr)	PM maximum inbound volume (veh/hr)	PM average outbound volume (veh/hr)	PM maximum outbound volume (veh/hr)	PM average inbound & outbound volume (veh/hr)	PM maximum inbound & outbound volume (veh/hr)
Site 1	Monday	53	59	76	82	128	141
	Wednesday	51	53	63	74	114	125
	Friday	42	49	67	71	117	119
Site 2	Monday	56	62	38	43	94	105
	Wednesday	72	85	44	51	116	121
	Friday	62	66	49	51	110	117
Site 3	Monday	53	57	62	71	115	128
	Wednesday	57	68	65	68	122	133
	Friday	69	75	69	79	138	154
Site 4	Monday	38	43	38	42	74	85
	Wednesday	50	58	49	60	99	117
	Friday	50	52	49	54	99	105

6.3 Trip Generation Modeling

6.3.1 Land Use Attributes

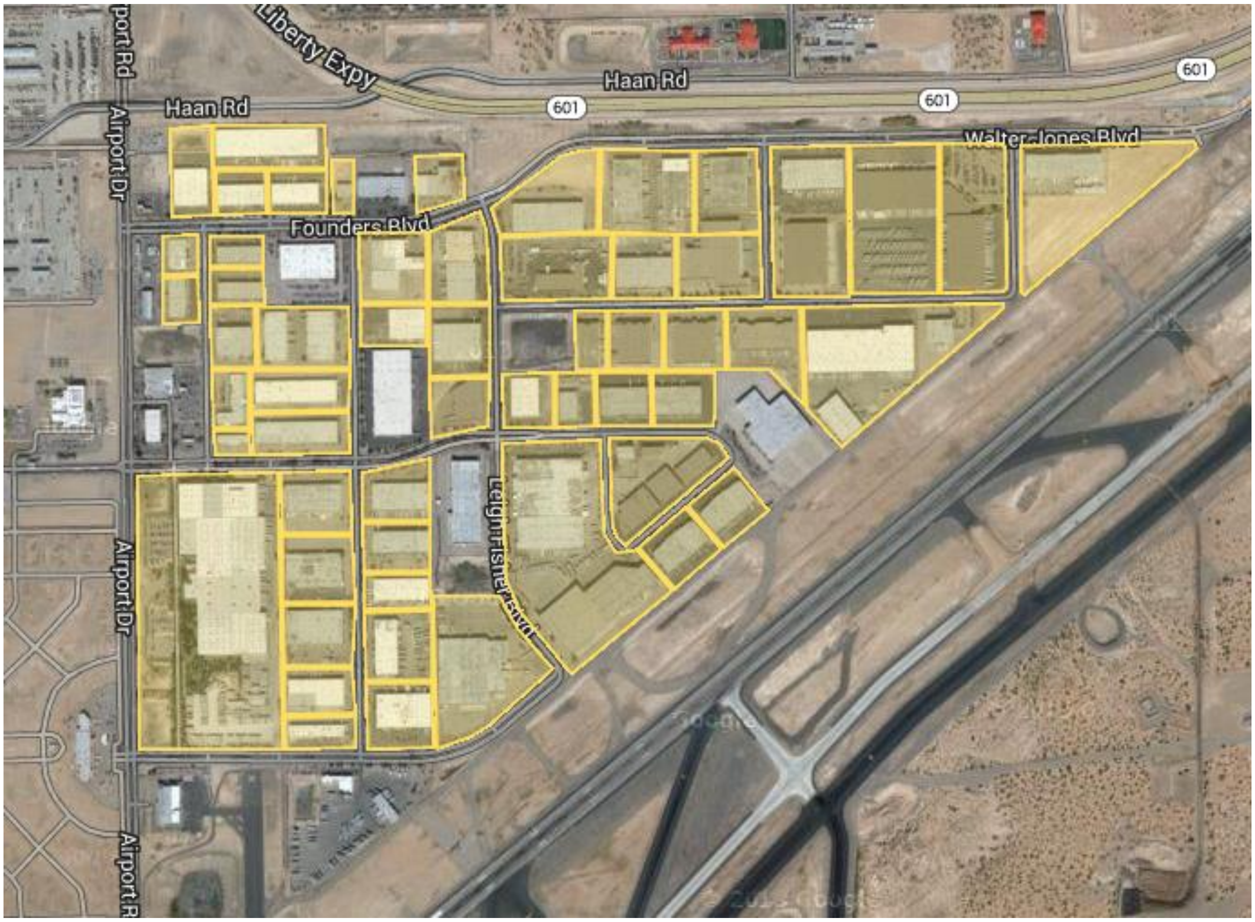
Trips generation (and attraction) models predict vehicle volume using land use attributes such as land area, floor area and number of employees. The model is usually a simple linear equation with volume in vehicles per hour as the dependent variable and only one land use attribute as the independent variable.

From the National Cooperative Highway Research Report (NCHRP) 739 and National Cooperative Freight Research Report (NCFRP) 19 (Holguin-Veras et al., 2012), the number of employees appears to be the best predictor of truck trip generation rate. However, the data on the number of employee of trucking companies and warehouse facilities in El Paso is incomplete (see Tables 5.2 and 5.3, for examples). The data provided by Hoover's Inc. (2013) does not list all the facilities that are within the catchment areas of the four sites. Of the data provided, the numbers of employee of some companies are missing. Therefore, the number of employees cannot be used as an independent variable in trip generation. The alternatives are total parcel area (in acre) and total building area (in acre) which can be measured from GIS maps.

The catchment land area of each of the four sites were measured from a polygon drawn to cover the parcels from which trucks were generated (or attracted) and passed through the counting location. The sum of areas from all the parcels was taken as the total parcel area. Figures 6.5 to 6.8 show the polygons of the sites. The building area within each catchment was measured from the footprint of the aerial photograph, assuming all the facilities are single story. Table 6.4 summarizes the land areas and the building areas of the four sites.

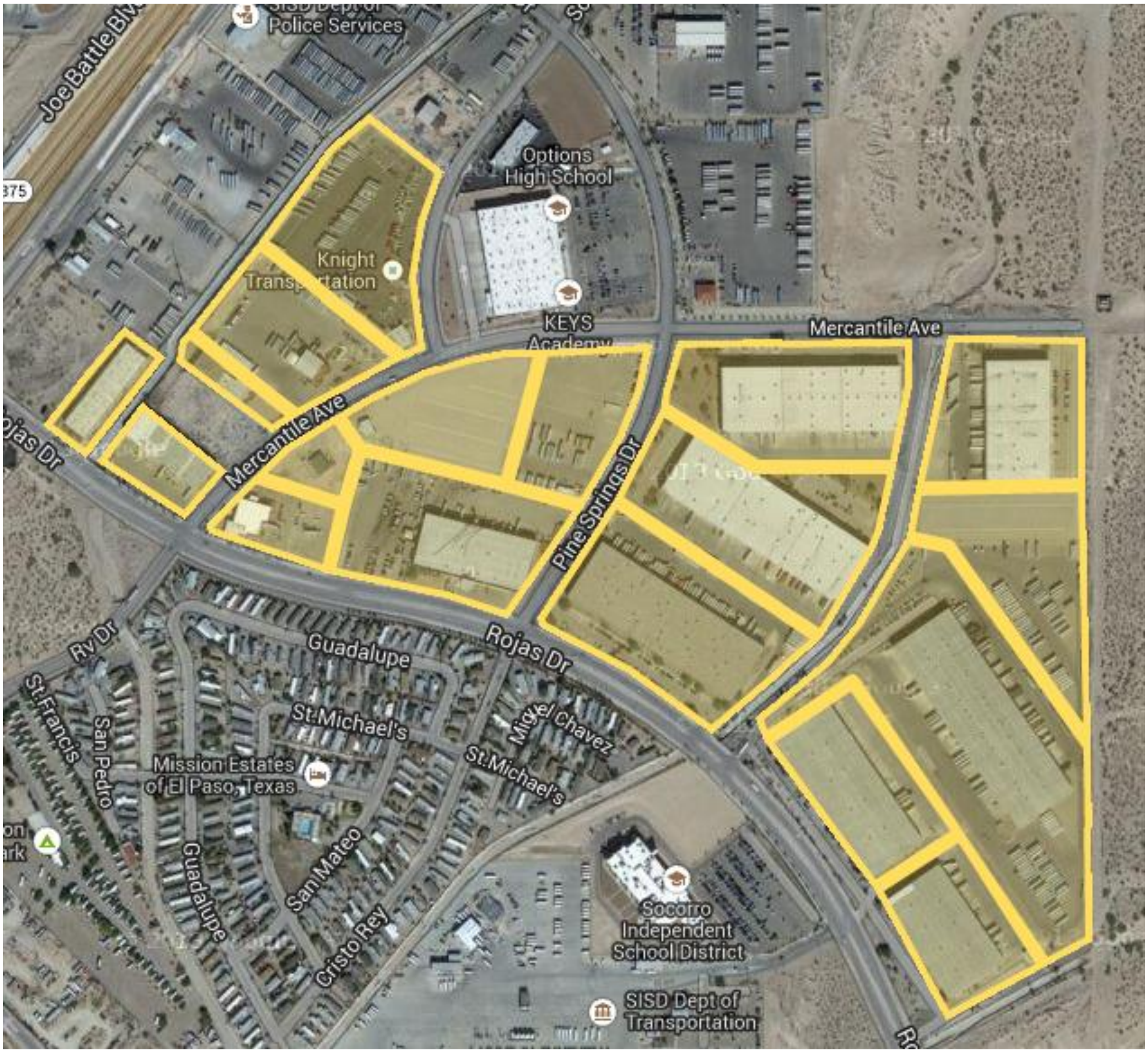
Table 6.4 Land Area and Building Area

Site	Total parcel area (acre)	Total building area (acre)
1	492	209
2	81	28
3	118	48
4	121	53



The parcels that are not included are call centers or empty plots.

Figure 6.5 Parcels that generate truck trips at site 1

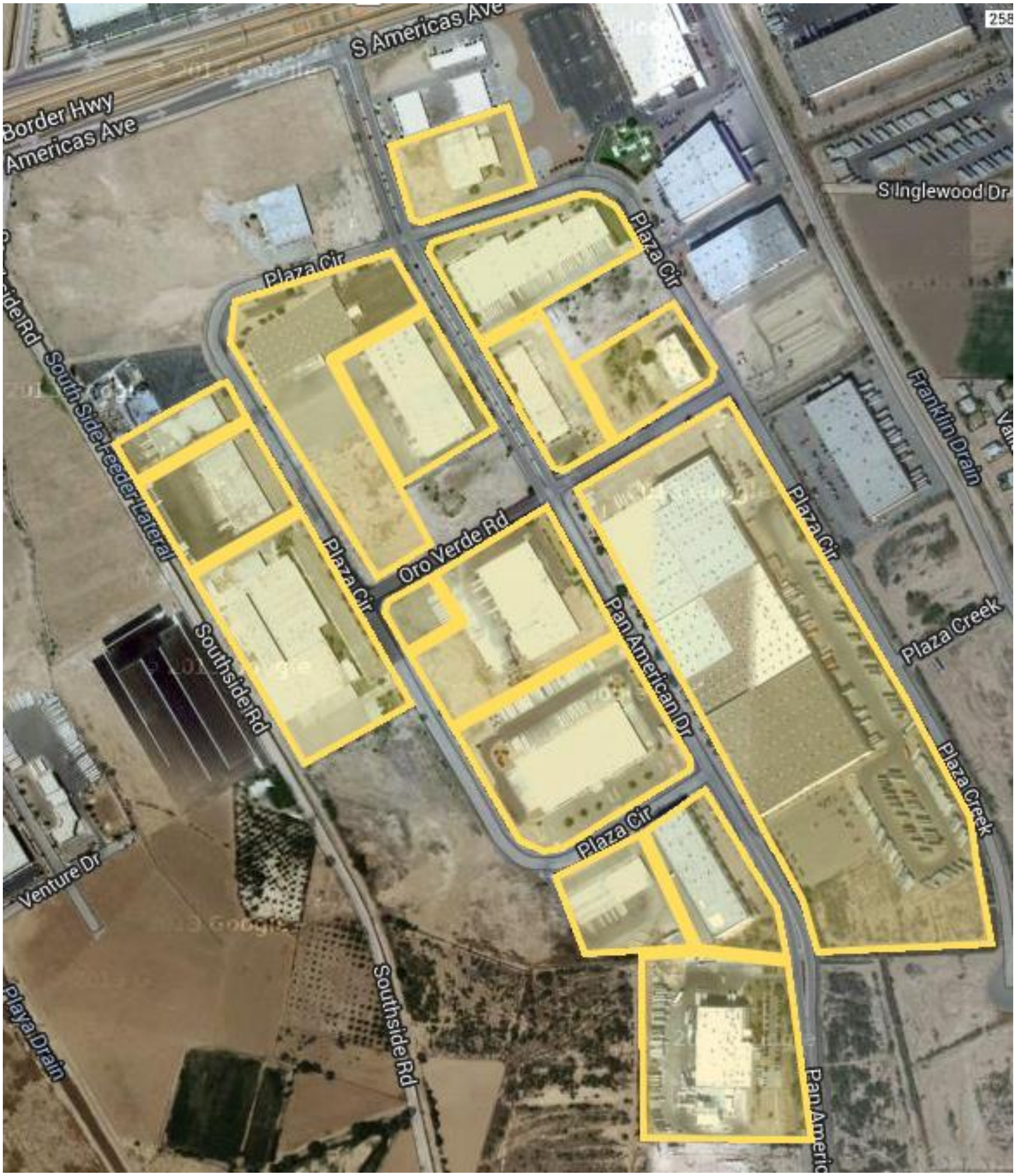


The parcels that are not included are schools.

Figure 6.6 Parcels that generate truck trips at site 2

The parcel in the middle that is not included is a call center.

Figure 6.7 Parcels that generate truck trips at site 3



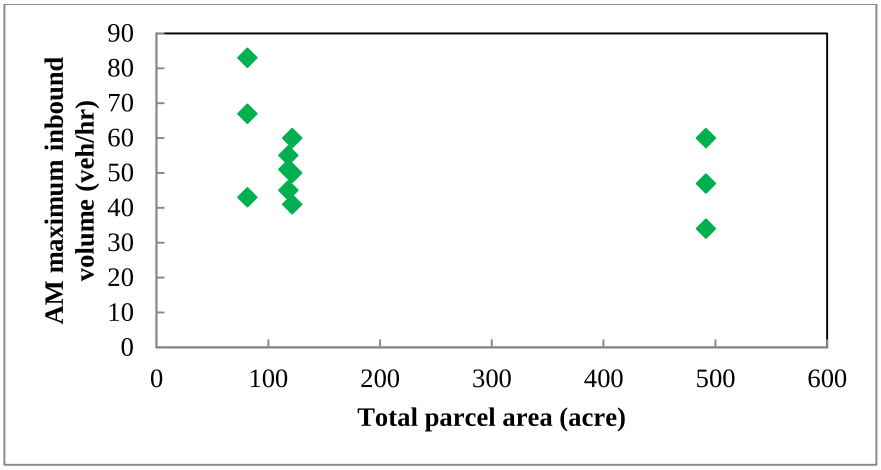
The parcel in the middle that is not included is a fitness center.

Figure 6.8 Parcels that generate truck trips at site 4

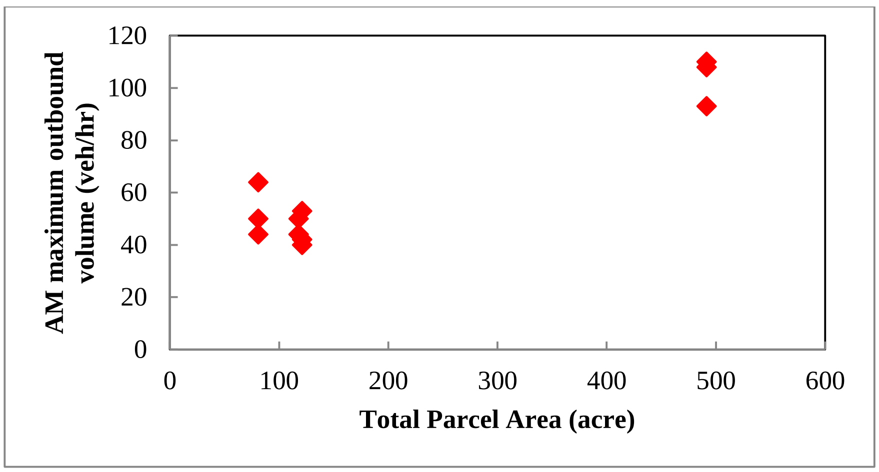
6.3.2 Trip Generation Rates

Figures 6.9 to 6.12 plot the observed maximum hourly volume against the total parcel area or total building area. Since there are four sites, and each site was observed on a Monday, a Wednesday and a Friday, there are 12 data points in each plot. Data for the morning and afternoon periods are presented in separate figures. Each figure is further divided into three plots for inbound volume, outbound volume and inbound and outbound volume, respectively.

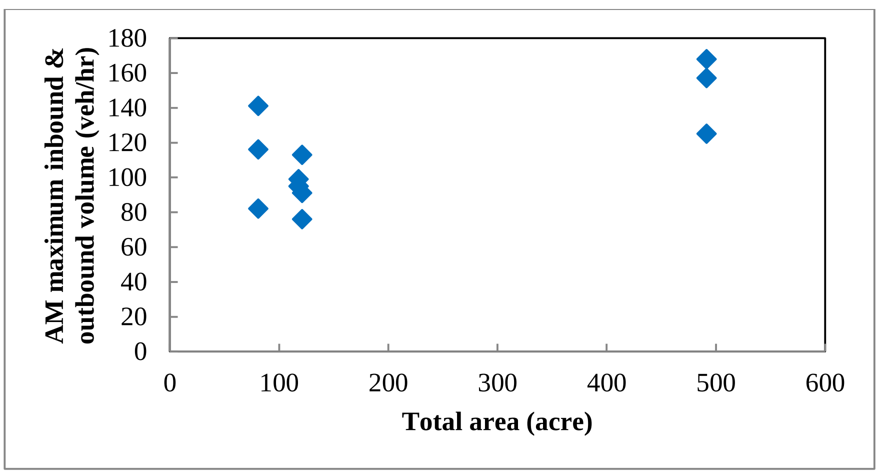
From these figures it can be concluded that only the outbound volume is correlated with the total parcel area and total building area. The inbound volume appears relatively independent from the catchment's the total parcel area and total building area. Because of this the total inbound and outbound volume is also relatively uncorrelated with the total parcel area and total building area.



(a) Inbound volume

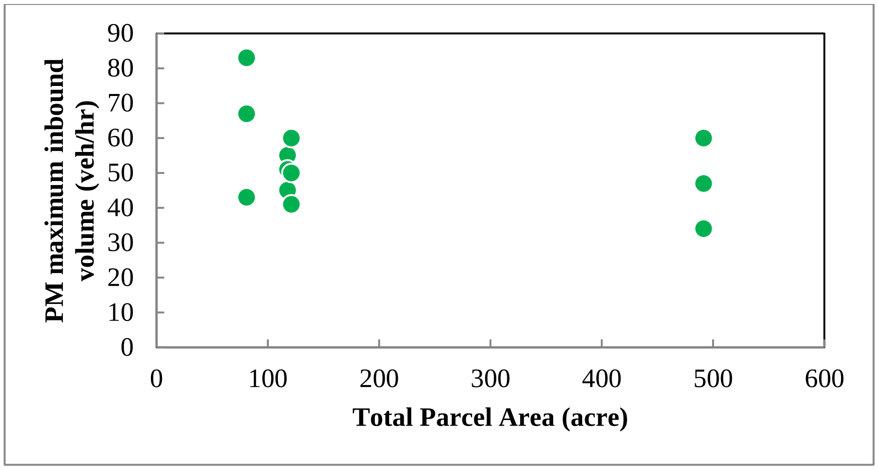


(b) Outbound volume

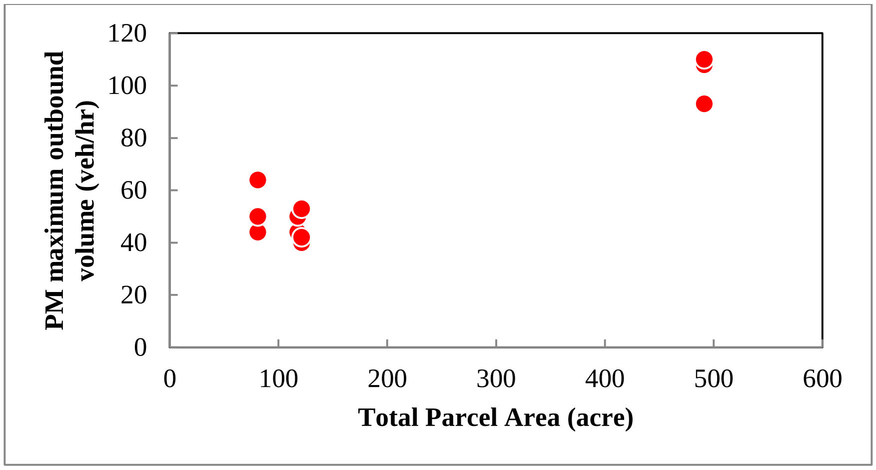


(c) Inbound and outbound volume

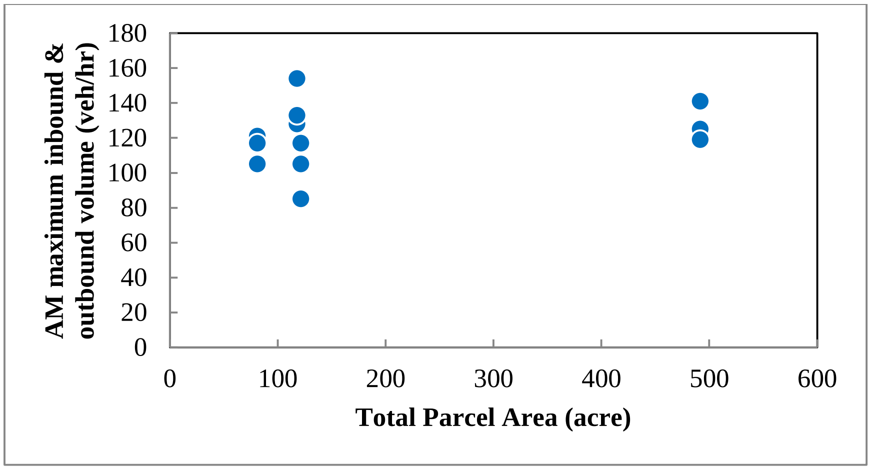
Figure 6.9 Observed A.M. maximum truck volume against total parcel area



(a) Inbound volume

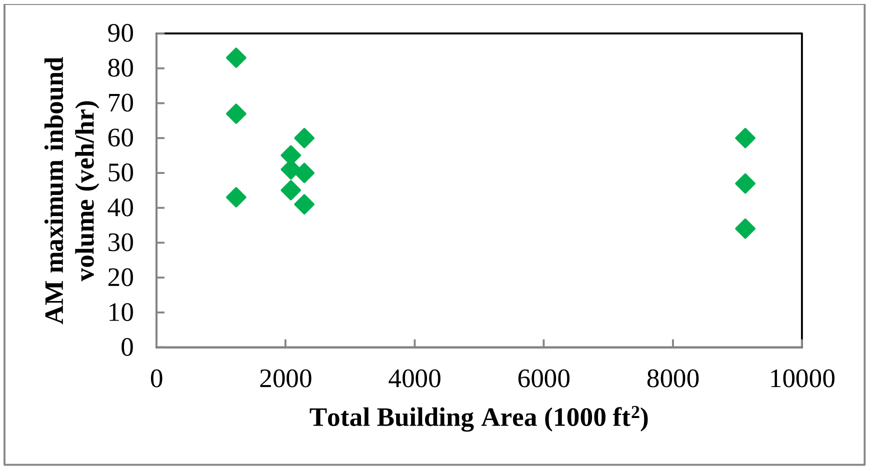


(b) Outbound volume

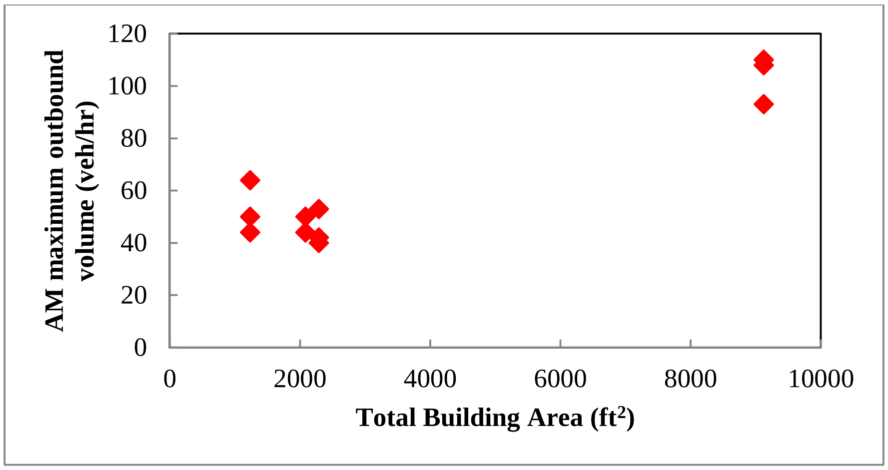


(c) Inbound and outbound volume

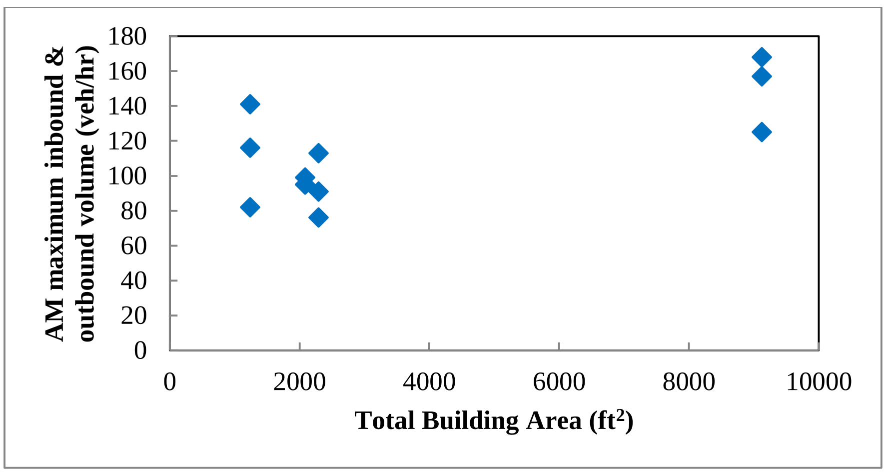
Figure 6.10 Observed P.M. maximum truck volume against total parcel area



(a) Inbound volume

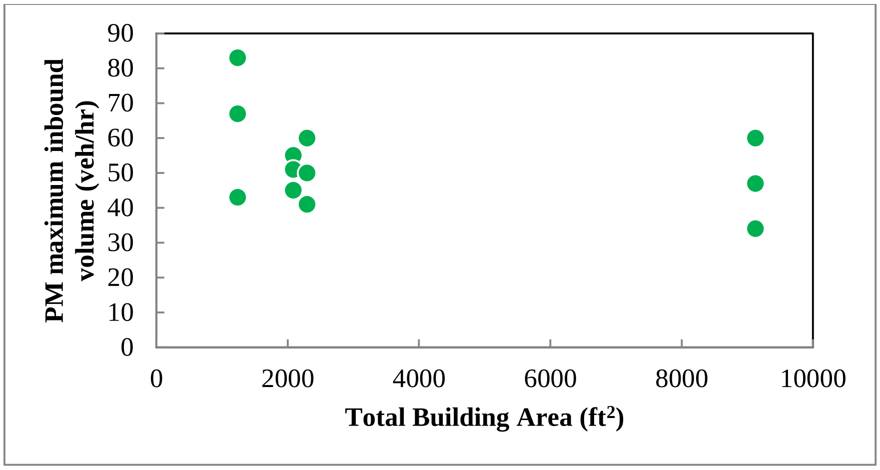


(b) Outbound volume

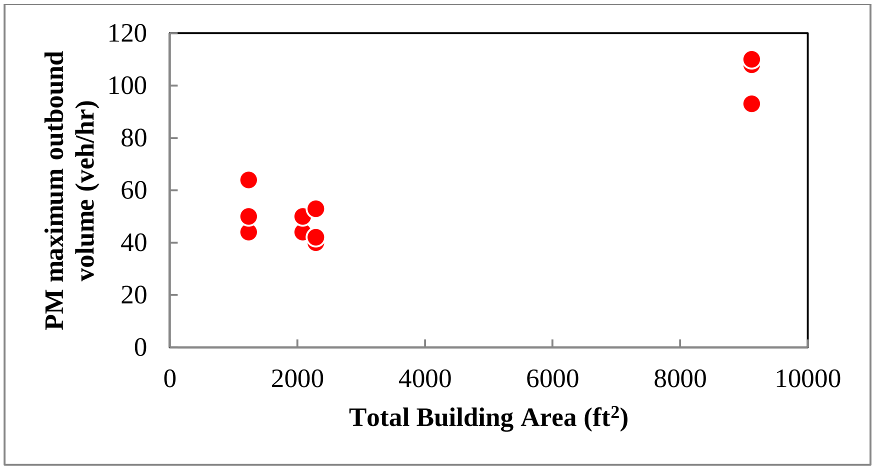


(c) Inbound and outbound volume

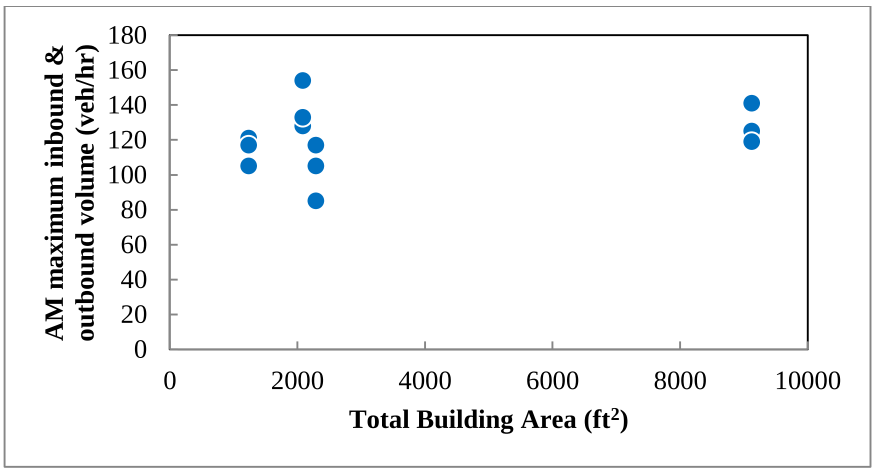
Figure 6.11 Observed A.M. maximum truck volume against total building area



(a) Inbound volume



(b) Outbound volume



(c) Inbound and outbound volume

Figure 6.12 Observed P.M. maximum truck volume against total building

6.3.3 Comparison with ITE Trip Generation Models

This sub-section compares the selected trip generation rates with the corresponding models found in ITE Trip Generation Manual (ITE 2003). Among the many land use classifications presented in the ITE Trip Generation Manual, the followings were found to be closest to the M1 classification in El Paso and at the four data collection sites:

- General light industrial (code 110)
- Industrial park (130)
- Warehousing (150)

The following models were extracted from the ITE Trip Generation Manual and used in this comparison. The equations apply to average A.M. or average P.M. peak hours on weekday.

Table 6.5 ITE Trip Generation Models Used

Page	Land use code	A.M. or P.M.	Dependent variable T	Independent variable X	Equation	Splits
111	110	A.M.	Ave. veh. trip ends (veh/hr)	Total land area (acre)	T=3.76X+117.68	85% entering 15% exiting
112	110	P.M.	Ave. veh. trip ends (veh/hr)	Total land area (acre)	T=4.94X+105.18	30% entering 70% exiting
154	130	A.M.	Ave. veh. trip ends (veh/hr)	Total land area (acre)	Ln(T)=0.68Ln(X)+3.26	87% entering 13% exiting
155	130	P.M.	Ave. veh. trip ends (veh/hr)	Total land area (acre)	Ln(T)=0.62Ln(X)+3.52	21% entering 79% exiting
211	150	A.M.	Ave. veh. trip ends (veh/hr)	Total land area (acre)	T=5.68X+53.61	50% entering 50% exiting
212	150	P.M.	Ave. veh. trip ends (veh/hr)	Total land area (acre)	Ln(T)=0.76Ln(X)+3.04	22% entering 78% exiting
102	110	A.M.	Ave. veh. trip ends (veh/hr)	Gross floor area (1000 ft^2)	T=1.18X-60.80	90% entering 10% exiting
103	110	P.M.	Ave. veh. trip ends (veh/hr)	Gross floor area (1000 ft^2)	T=1.42X-125.20	14% entering 86% exiting
145	130	A.M.	Ave. veh. trip ends (veh/hr)	Gross floor area (1000 ft^2)	T=0.66X+76.27	86% entering 14% exiting
146	130	P.M.	Ave. veh. trip ends (veh/hr)	Gross floor area (1000 ft^2)	T=0.73X+59.62	21% entering 79% exiting
202	150	A.M.	Ave. veh. trip ends (veh/hr)	Gross floor area (1000 ft^2)	T=0.39X+63.12	59% entering 41% exiting
203	150	P.M.	Ave. veh. trip ends (veh/hr)	Gross floor area (1000 ft^2)	T=0.46X+53.12	8% entering 92% exiting

The average vehicle trip ends (T) presented in the ITE Trip Generation Manual includes all vehicles in both directions of travel. It must be multiplied by the average percentage of trucks in the traffic stream and if necessary, the splits, for inbound and outbound truck volumes. The ITE Trip Generation Manual provides the following average percentages of trucks: 8% for industrial park and 20% for warehousing. The percentage for general light industrial is not given, but was assumed to be 8% (same as industrial park).

ITE Trip Generation Manual uses average vehicle trip ends (T) on weekday, for A.M. or P.M. peak hour of generator, for the models selected in Table 6.5. The manual defines *average trip rate for the peak hour of the generator* as "the average vehicle trip generation rate during the hour of highest volume of traffic entering and exiting the site during the a.m. or p.m. hours." According to this definition, the trip rate is interpreted as corresponding to the maximum hourly volume in the data in Table 6.3, and Figures 6.9 to 6.12. In addition, for this comparison, the *total land area* in the ITE Trip Generation Manual is assumed to be equivalent to the *total parcel area* measured at the catchments, and the *gross floor area* in the ITE Trip Generation Manual is assumed to be equivalent to the *total building area* measured at the catchments.

Table 6.6 summarizes the results of the model evaluation. Each of the 12 trip generation models described in Table 6.5 was further broken down into three sub-models: inbound, outbound, and combined inbound and outbound volumes. For each sub-model, the Root-Mean-Square Error (RMSE) between the observed truck volumes and model predictions was calculated. The RMSE approximates the standard deviation between the observed volume and the model's prediction. The rows in Table 6.6 are grouped by the independent variable X, followed by A.M./P.M.

From Table 6.6, it can be observed that, in general, using X=gloss floor area=total building area leads to relatively higher RMSE, compare to using X=total land area=total parcel area. Even at the minimum RMSE=30 veh/hr for A.M. volume using general light industrial classification, the model consistently underestimates the truck volume. Therefore, it is concluded that, trip general models using X=total land area=total parcel area can better predict inbound, outbound and total truck trips. The analysis thus continued with only the models that use X=total land area=total parcel area.

The next step in the analysis focused on the data plotted in Figures 6.9 and 6.10. Only Figures 6.9(b) and 6.10(b) exhibits a linear relationship between the maximum hourly truck volume (outbound, in A.M. and P.M. respectively) with total parcel area.

Table 6.6 Root-Mean-Square Errors in Model Evaluation

Page	Land use code	A.M. or P.M.	Independent variable X	Root-mean-square error Inbound (veh/hr)	Outbound (veh/hr)	Inbound & outbound (veh/hr)
111	110 Gen. light industrial	A.M.	Total land area (acre)	49	**54**	56
154	130 Industrial park	A.M.	Total land area (acre)	**42**	56	**49**
211	150 Warehousing	A.M.	Total land area (acre)	125	97	223
112	110 Gen. light industrial	P.M.	Total land area (acre)	38	24	72
155	130 Industrial park	P.M.	Total land area (acre)	42	**12**	**63**
212	150 Warehousing	P.M.	Total land area (acre)	**37**	142	171
102	110 Gen. light industrial	A.M.	Gross floor area (1000 ft^2)	374	30	362
145	130 Industrial park	A.M.	Gross floor area (1000 ft^2)	191	35	172
202	150 Warehousing	A.M.	Gross floor area (1000 ft^2)	195	99	294
103	110 Gen. light industrial	P.M.	Gross floor area (1000 ft^2)	56	407	457
146	130 Industrial park	P.M.	Gross floor area (1000 ft^2)	45	166	207
203	150 Warehousing	P.M.	Gross floor area (1000 ft^2)	39	357	367

The next step in the analysis focused on the data plotted in Figures 6.9 and 6.10. Only Figures 6.9(b) and 6.10(b) exhibits a linear relationship between the maximum hourly truck volume (outbound, in A,M. and P.M. respectively) with total parcel area.

Figure 6.13 superimposes the observed data for A.M. outbound truck volume with the best trip generation equations for general light industrial (code 112). This equation produces a RMSE of 54 veh/hr which is lower than the RMSEs given by the other two land use classifications (see Table 6.6). In Figure 6.13, the observed data is represented by red diamonds while the ITE trip generation model is plotted in a straight line. It is clear that the ITE trip generation model predicts lower volumes for the A.M. outbound truck traffic in El Paso.

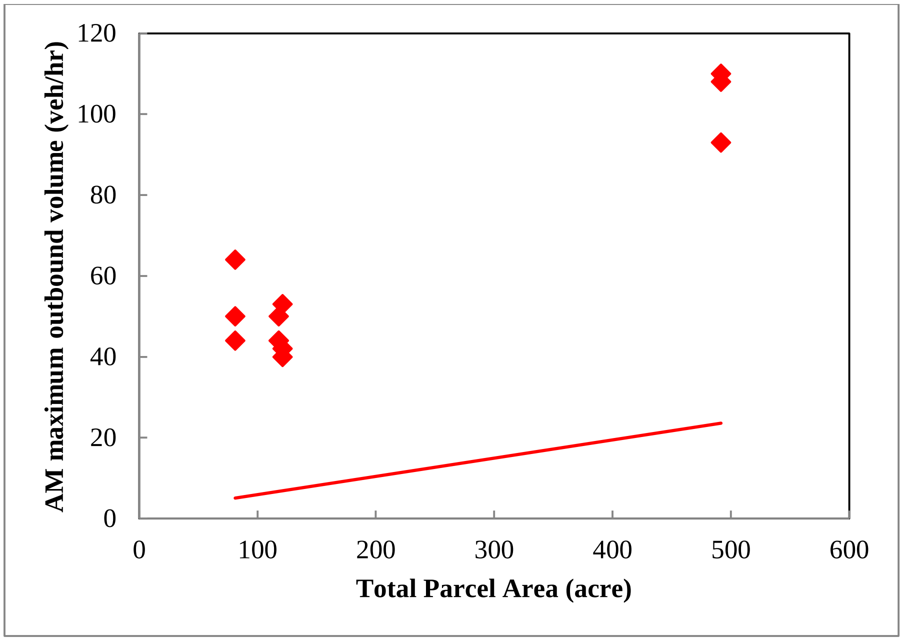


Figure 6.13 A.M. maximum truck volume against total parcel area: observed data versus ITE trip generation model

Figure 6.14 superimposes the observed data for P.M. outbound truck volume with the best trip generation equations for industrial park (code 155). This equation produces a RMSE of 12 veh/hr which is lower than the RMSEs given by the other two land use classifications (see Table 6.6). In Figure 6.14, the observed data is represented by red circles while the ITE trip generation model is plotted in a line. The plotted line is not linear because the trip generation equation is in the log-log format (see Table 6.5). The ITE trip generation model appears to provide a good fit to the P.M. outbound truck traffic in El Paso.

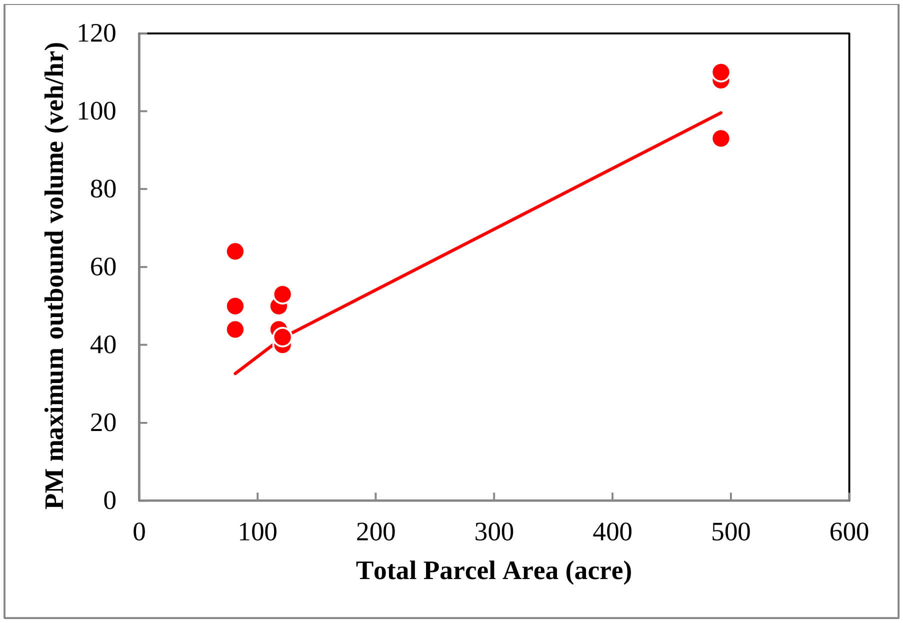


Figure 6.14 P.M. maximum truck volume against total parcel area: observed data versus ITE trip generation model

6.4 Summary

In this chapter, truck volumes at four selected industrial sites in El Paso have been collected in the morning and afternoon peak periods on three weekdays. The peak hour inbound, outbound and total truck volumes have been plotted against the total parcel area and total building area, in an attempt to correlate truck trip generation or attraction with land use attribute (that can easily be measured from GIS maps or aerial photograph, without obtaining commercially sensitive information). The collected truck volume data is also compared with the selected ITE trip generation models. It is found that:

- Among the two land use attributes tested, total parcel area gives better estimates than total building area.
- Only the A.M. and P.M. outbound truck volume is positively correlated with the total parcel area of the sites.
- The ITE trip generation model for industrial park (land use code 155) provides good prediction of P.M. outbound truck volume.

As the total parcel area and total building area do not in general serve as independent variable for truck trip generation modeling, this research has suggested that more data that relate to the type of business, number of employees, floor area, and etc be collected in the facilities within a catchment area so that a more detail analysis can be performed.

7 Conclusions

In this research, a literature review on freight activity planning and freight data sources has been conducted. For the El Paso-Juarez region, interviews and questionnaire survey with local industry stakeholders to understand the process of transporting goods across the U.S.-Mexico border, their choices of warehouse and transportation facilities. The research has collected information concerning trucking and warehouse activities in the El Paso-Juarez region, and whenever possible organized into GIS maps. Economic market in El Paso and Ciudad Juarez for industrial activity is also described in this report. This report represents the most comprehensive compilation of freight, warehousing and trucking activities in the region.

To supplement the data collected from existing sources, truck volume counts were performed at four selected industrial sites in El Paso. The counted traffic volumes in the morning and evening peaks were correlated with the land use attributes, using site's total building area as well as total parcel area as the independent variable. The observed truck volumes were also compared with the ITE trip generation models. It was found that (i) only the total parcel area provides good predictions of the afternoon peak outbound truck volumes leaving the sites; (ii) the ITE trip generation model for industrial park (land use code 155) provides good predictions of the afternoon peak outbound truck volumes. Because of these findings, it is recommended that more detailed data concerning industry type and number of employees be collected to develop truck trip generation and attraction models with better accuracy. However, this will involve massive data collection effort.

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