

EXECUTIVE SUMMARY



2005 – 2010

# Amarillo Travel Surveys

Randall and Potter Counties

## **DISCLAIMER**

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## **ACKNOWLEDGEMENTS**

This report provides a summary of the travel surveys conducted during the period between 2005 and 2010 in the Amarillo MPO study area. Details of these surveys are provided in the following separate technical reports, which are available for viewing through the Amarillo MPO and TxDOT Transportation Planning and Programming Division.

- 2005 Amarillo External Survey Technical Summary, authored by Stephen P. Farnsworth, Texas Transportation Institute, March 2006.
- 2005 Amarillo Commercial Vehicle Survey Technical Summary, authored by Stella Amor Nepal, Stephen P. Farnsworth, and David F. Pearson, Texas Transportation Institute, November 2007.
- 2006–2007 Amarillo Metropolitan Planning Organization Household Travel Survey Technical Summary, authored by Debbie Spillane and David Pearson, Texas Transportation Institute, August 2008.
- 2006 Amarillo GPS-Enhanced Household Travel Survey Technical Summary, authored by Mark Ojah and David F. Pearson, Texas Transportation Institute, October 2008.
- 2006–07 Regional Household Activity/Travel Survey Summary Report, prepared by ETC Institute, December 2007.
- 2009/2010 Amarillo Work Place Travel Survey Technical Summary, authored by Stella Amor F. Nepal, David F. Pearson, and Edwin Hard, Texas A&M Transportation Institute, September 2012.
- Amarillo Lubbock Workplace Survey Final Report, Alliance Transportation Group, Inc., January 2011.

The factual contents of this report were taken from the above summary reports and the contributions of the authors of these reports are acknowledged. Other factual sources are referenced in the report. The authors are responsible for the opinions, findings, and conclusions. There were a number of individuals who provided technical support and assistance during the preparation of this report. Special thanks are due to Gary Lobaugh of the Texas A&M Transportation Institute for his help in formatting this report. The authors also thank Charlie Hall, TxDOT Travel Survey Program Manager, and the Department for its continuing program to collect and analyze urban travel data to support travel demand modeling.



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# Amarillo Travel Surveys

## EXECUTIVE SUMMARY

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East 8th Avenue looking east toward South Fillmore Street, Amarillo, Texas

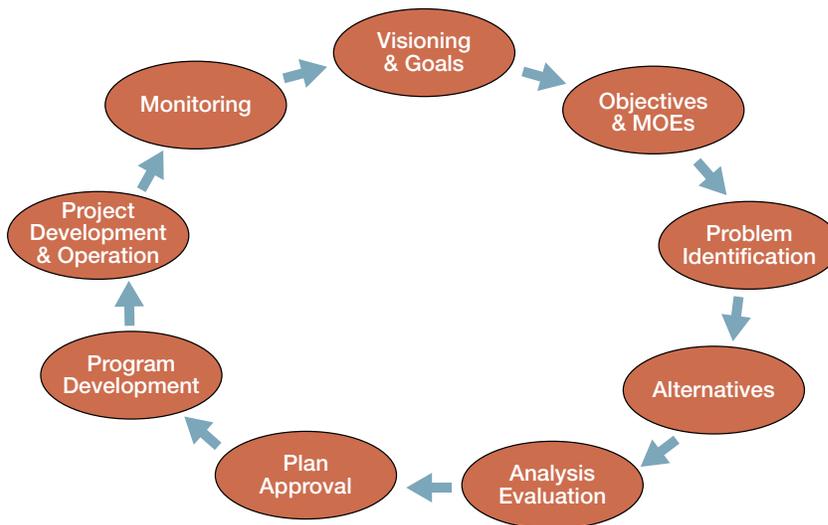
## INTRODUCTION

The metropolitan transportation planning process is based on the Federal-Aid Highway Acts of 1962 and 1973. These acts established the cooperative, continuing, and comprehensive (3C) transportation planning process and created metropolitan planning organizations (MPOs) to assist in conducting the process. Subsequent federal acts strengthened the transportation planning process and the role of MPOs. Figure 1 shows the key elements of the metropolitan transportation planning process.

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The metropolitan transportation planning process is based on the Federal-Aid Highway Acts of 1962 and 1973.

Figure 1. Key Elements of the Planning Process.



Source: National Highway Institute Course No. 152069, Metropolitan Transportation Planning.

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Where do travel surveys fit into this process? Data collected from travel surveys serve as vital input to travel demand models. Most MPOs use a travel demand model to forecast the demand for transportation and capacity needs and to evaluate how proposed alternative transportation systems will perform. MPOs use this analysis to support the development of a long-range transportation plan and short-range transportation improvement program that are adopted by an MPO's policy board. These plans are approved at a minimum of once every five years for metropolitan areas that are in attainment of the National Ambient Air Quality Standards (NAAQS) and once every four years for metropolitan areas that are not in attainment of the NAAQS.

Modelers require travel surveys to support travel demand model estimation, calibration, and validation for the model's base year. After the travel demand model is validated, it is used as an evaluation tool to determine how well or how poorly the proposed urban transportation system will perform in the future given the land use forecast of where people will live and work. Travel surveys are the essential first step for travel model estimation, calibration, and validation. The Texas Department of Transportation (TxDOT) has supported, and continues to support, the timely conduct of urban travel surveys that are essential for the development of travel demand models to support the metropolitan transportation planning process.

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**Travel surveys are required to support travel demand model estimation, calibration, and validation for the model's base year.**

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During the period between 2005 and 2010, the Transportation Planning and Programming Division (TPP) of TxDOT funded a comprehensive set of travel surveys in the Amarillo MPO study area. Four types of travel surveys were conducted to collect information on different aspects of travel and trip making in the Amarillo MPO study area. These four types included the following:

- A *household travel survey* to collect information on amounts, origins, and destinations of resident travel within the area. Note that a subsample of the household sample recorded their travel information via both computer-assisted telephone interviewing (CATI) and via the use of a Global Positioning System (GPS). Use of these tools allowed for interesting comparisons of these two survey methods; however, the household values included within this report do not distinguish or highlight the comparison of the results obtained via the two technologies.
- A *work place survey* (including special generators) to collect information on the number and types of trips attracted to basic, retail, service, and education establishments.
- An *external survey* to collect information on travel coming into, going out of, or passing through the study area.
- A *commercial vehicle survey* to collect information on travel made by commercial vehicles operating within the study area.

The Amarillo MPO is the organization responsible for transportation planning for the Amarillo metropolitan area. This report presents a summary of the travel surveys conducted in Randall County and Potter County. Figure 2 shows the location map of the Amarillo MPO study area.

**Figure 2. Amarillo Study Area.**



This section presents selected demographic and transportation statistics to provide a frame of reference for the Amarillo MPO study area compared to the state of Texas. Improved transportation planning and analysis tools are needed to plan for the future needs of Randall County and Potter County. The travel surveys, summarized in the remainder of this report, provide the travel-related data needed to continue to improve these analysis tools.

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**Improved transportation  
planning and analysis tools  
are needed to plan for the  
future needs of Randall and  
Potter Counties.**

**Population Growth**

The Amarillo area’s population is forecasted to increase by about 79,169 people or 33.9 percent between 2007 and 2035 (Texas State Data Center, Texas Population Projections Program). The population of the state of Texas as a whole is projected to increase from 23,837,701 in 2007 to 34,962,746 in 2035. Thus, in 2035, the combined population of Randall and Potter Counties is projected to make up only 0.89 percent of the Texas population, compared to the 0.98 percent it contained in 2007 (Table 1).

**Table 1. Population Estimates.**

Geography	Year	
	2007	2035
Randall County	112,775	158,321
Potter County	120,758	154,381
Randal and Potter Counties	233,533	312,702
Texas	23,837,701	34,962,746



Persons commuting to work in the Amarillo MPO study area primarily drive alone or use carpools.

### Transportation Statistics

Persons commuting to work in the Amarillo MPO study area primarily drive alone or use carpools (Table 2). In Randall County and Potter County, there is limited use of public transportation. Part of the reason for this modest use of public transportation is that the percentage of households with a vehicle available in the Amarillo MPO study area is over 97 percent.

**Table 2. Mode of Commuting to Work, 2007.**

Mode of Commuting to Work	Randall County	Potter County	Randall County and Potter County	Texas
Drive Alone	86.22	77.40	82.08	78.88
Carpool	9.68	14.90	12.13	12.19
Public Transportation	0.00	0.24	0.11	1.69
Other	4.10	7.46	5.68	7.24
<b>Total</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>

Source: U.S. Census Bureau, 2007 American Community Survey (ACS).

Table 3 shows the population and daily vehicle miles of travel (VMT) estimates and projections for the Amarillo MPO study area. The daily VMT is projected to increase by around 22.3 percent between 2007 and 2035, and the daily VMT per person is estimated to be 4.81 miles by 2035.

**Table 3. Population and Vehicle Miles Traveled Data.**

Year	Population of Randall County and Potter County	Daily Vehicle Miles of Travel (1,000)	Daily Vehicle Miles of Travel per Person
2007	233,533	1,229.7	5.27
2030	297,612	1,442.6	4.85
2035	312,702	1,504.2	4.81

To estimate future travel, the studies divide the travel between trips made within the study area (internal trips), trips made into or out of the study area (external-local trips), and trips made through the study area (external-through trips). The household survey collected information and data on internal trips.

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## HOUSEHOLD SURVEY

The primary purpose of the household survey is to understand the travel patterns of households as a function of their characteristics, such as household size, number of persons employed, income, vehicles available, and trip purpose. The data obtained from the survey are used in the trip generation step of the travel demand model to estimate trip production rates by trip purpose. The average travel distances and trip length frequency distributions for each trip purpose are then estimated, and, along with the number of productions and attractions, are used in the trip distribution step of the travel demand model to estimate the attraction end for each trip produced (see the Glossary and Terminology section of this report for an explanation of terms).

### Household Characteristics

Households that participated in the survey were randomly selected and were asked to record in a diary the trips made by each person in the household during a 24-hour period. For each trip, participants were asked to record the time and place the trip began and ended, mode of travel, number of passengers, purpose of the trip, and other descriptive information. In addition to the trip diary, households were asked to provide information on household characteristics that are closely correlated with household travel, such as the number and age of persons in the household, number of members employed, income, and the number of vehicles available to the household.

The Amarillo MPO study area household survey included 1,521 randomly selected households from within the study area. The joint distribution of household size and income characteristics from the 2000 U.S. and the Texas State Data Center (TSDC) population projections for the study area were used to expand the household survey data. The results presented in this section are based on expanded survey data.

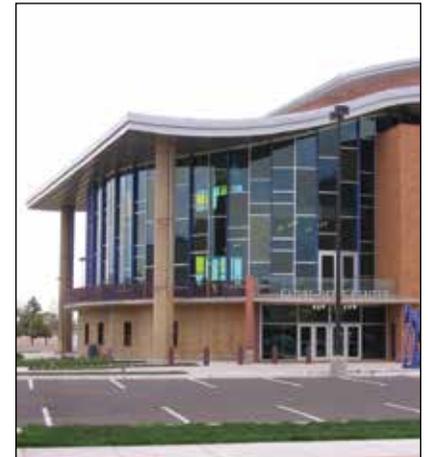
### Household Size and Income

Household size and income are used in the travel demand model for estimating and forecasting travel. In general, as household size increases, daily household travel increases. Similarly, when household income increases, daily household travel increases. By controlling for these two household characteristics, future travel demand can be estimated with greater accuracy. The average household size in the Amarillo MPO study area in 2006–2007 was 2.6 persons per household, equal to the 2.6 persons per household average calculated for the area in 1990. Figures 3 and 4 show the distribution of households by household size and household income in the study area from 2006–2007, respectively. Over one quarter of the households (26.9 percent) have a household size of one, and nearly one-third (32.9 percent) have a household size of two. Over 40 percent (41.1 percent) of households have an annual household income greater than \$50,000.



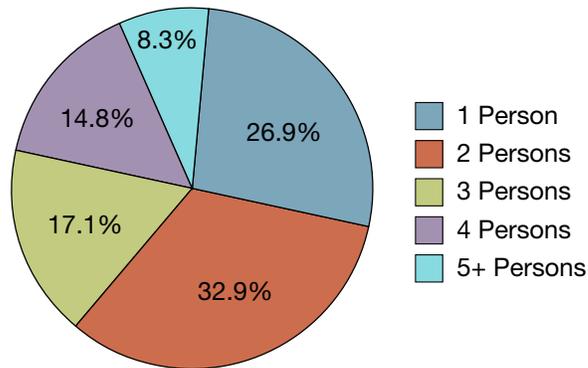
Households that participated in the survey were randomly selected and were asked to record in a diary the travel made by each person in the household during a 24-hour period.

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The Globe-News Center in Amarillo, Texas

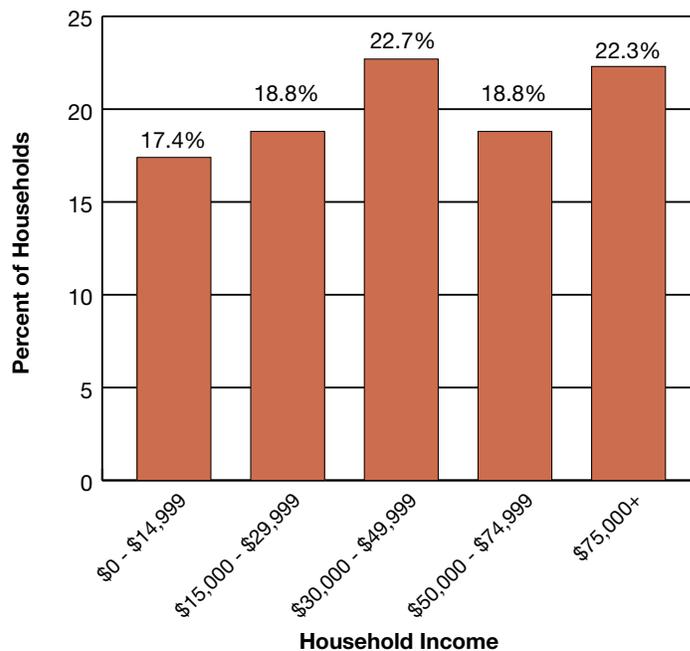
**Figure 3. Distribution of Households by Household Size.**



Generally, household travel increases as the number of vehicles available to the household increases.



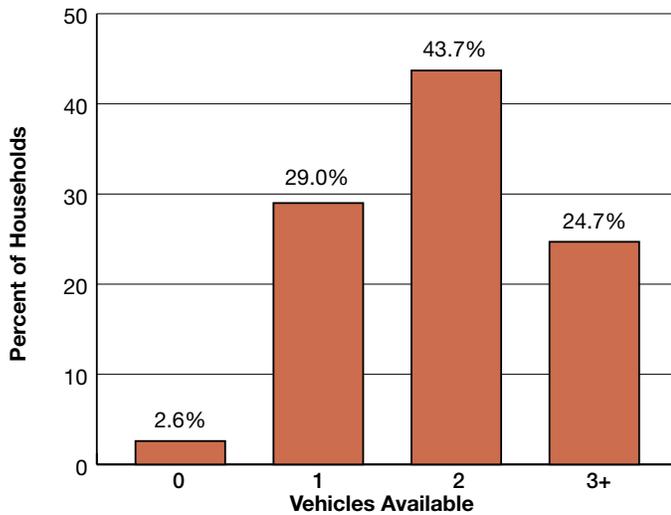
**Figure 4. Distribution of Households by Household Income.**



**Vehicles Available**

Generally, daily household travel also increases as the number of vehicles available to the household increases. Household demand for public transportation tends to decrease as vehicle availability to the household increases. Figure 5 shows the distribution of households by number of vehicles available. Less than 3 percent (2.6 percent) of households in the study area do not have a vehicle available, 29.0 percent of the households have only one vehicle available. Nearly a quarter of households (24.7 percent) have three or more vehicles available.

**Figure 5. Distribution of Households by Vehicles Available.**



**Age Cohort**

The impact of age on daily travel of household members is more complex than the other household characteristics shown and is not being used directly in the travel demand model. However, age cohort can be used to characterize household life cycle. Figure 6 shows the distribution of persons by age cohort and the percentage of persons not making any internal trips on their survey day. As expected, older persons are less likely to travel than younger persons, but the older population is mobile and contributes significantly to the amount of household travel. The percentage of 65+ age cohorts not making internal trips ranged from 15.1 percent for 65–69 year-olds to 33.2 percent for 80+ year-olds.

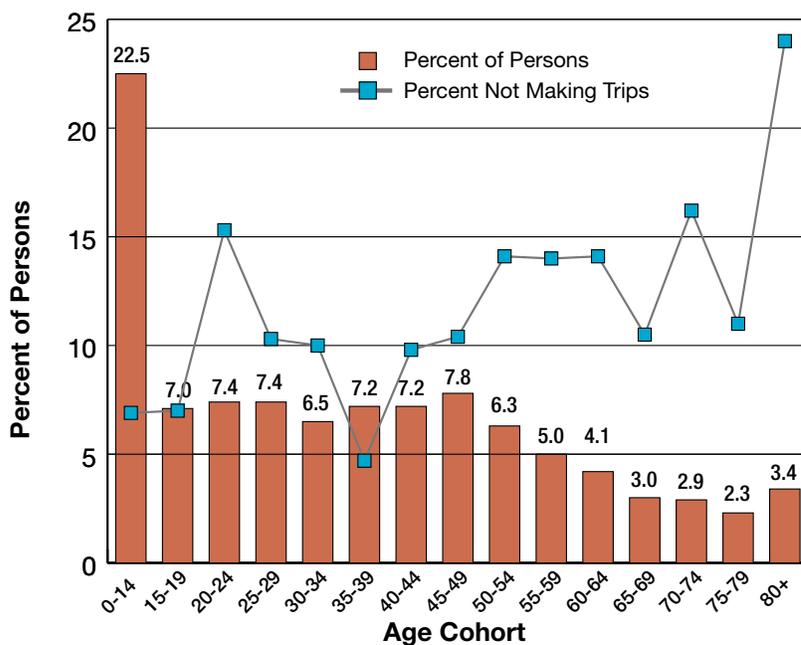
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Older persons are less likely to travel than younger persons, but the older population is mobile and contributes significantly to the amount of household travel.

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**Figure 6. Distribution of Persons by Age Cohort.**



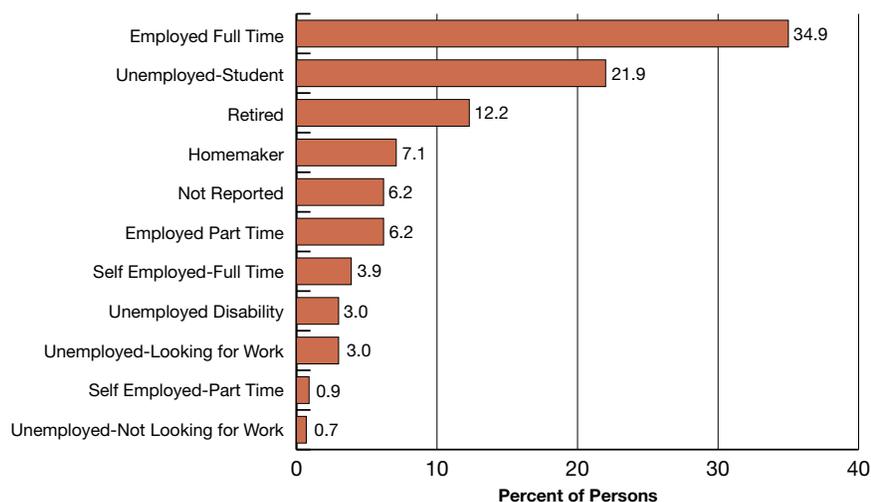
### Employment Status

Employment status is used to characterize household life cycle. Life cycle can be an excellent household characteristic to help forecast future travel demand. It can be defined by a combination of the ages of the head of household and the ages of the children in the household, if any. A young couple of working age with no children will have different daily trip-making characteristics than will a retired couple with no children at home.

Figure 7 provides the distribution of all persons by employment status in the study area. Over one-third of the population (34.9 percent) is employed full time and over one-fifth of the population (21.9 percent) is students.

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Employment status is used to characterize household life cycle.

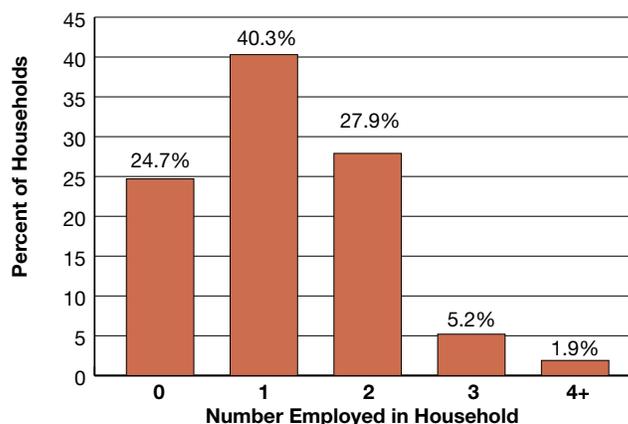
Figure 7. Distribution of Persons by Employment Status.



Source: 2007–2008 Waco MPO Household Travel Survey and TTI Analysis.

Daily household travel also increases as the number of persons employed in the household increases. Figure 8 presents the distribution of households by number of persons employed in the study area. Interestingly, nearly a quarter of households (24.7 percent) do not have an employed household member. This may stem partially from unemployment and partially from households with retired household members.

Figure 8. Distribution of Employed Household Members.

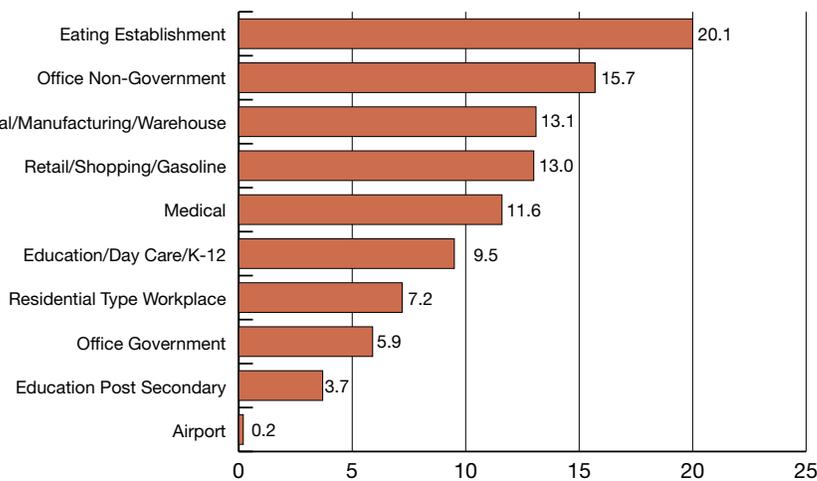


## Employment Type

The household characteristics described previously are used to help estimate the demand (trip productions) for travel. Work place characteristics are used to help estimate where people are attracted (trip attractions). In the travel demand model, the type of employment is summarized into four employment types—basic, retail, service, and education. While the latter three employment types are fairly self-explanatory, the “basic” category includes a variety of the industries such as agriculture; forestry; fishing; hunting; mining; utilities; construction; manufacturing; wholesale trade; transportation and warehousing. Each of these employment types has a different attracting power or attraction rate.

Figure 9 shows the data on the type of work place for employed persons from the household survey. The most prevalent employment type in the Amarillo study area is eating establishments (20.1 percent). Over 15 percent of employees work in a non-government office; 13.1 percent work in an industrial, manufacturing, or warehouse setting; and 13.0 percent work in retail, shopping, or gasoline industries. Figure 10 shows the distribution of basic, retail, service, and education by employment.

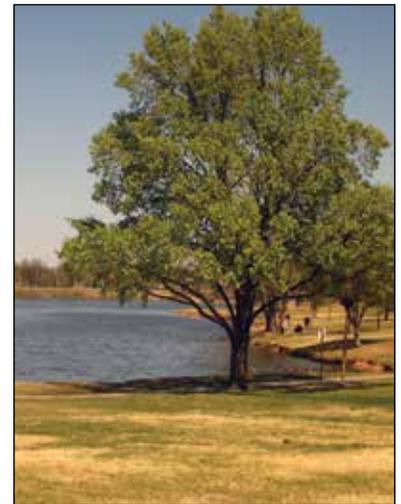
**Figure 9. Type of Work Place.**



Source: 2007–2008 Waco MPO Household Travel Survey and TTI Analysis.

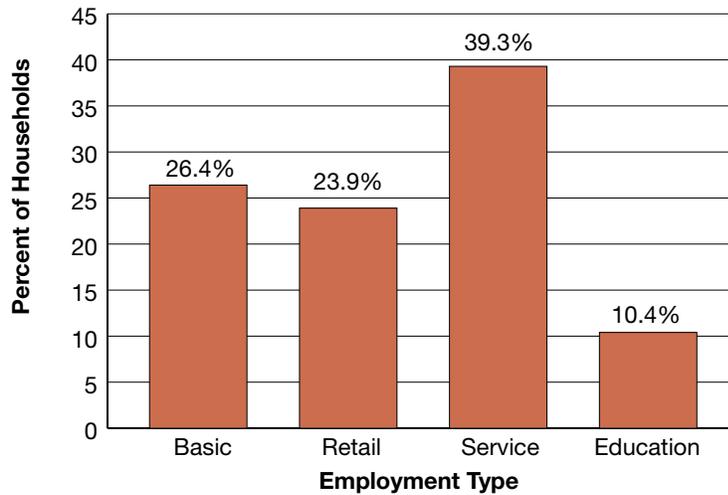


In the travel demand model, the type of employment is summarized into four employment types—basic, retail, service, and education.



Pond and park adjacent to Amarillo Botanical Gardens

**Figure 10. Distribution of Employed Persons by Basic, Retail, Service, and Education Employment.**



Source: Texas Workforce Commission, 2004.

### HOUSEHOLD TRAVEL CHARACTERISTICS

The travel characteristics of a household are determined by the purpose for each trip being made at certain locations. In travel demand modeling, trip purposes are defined as home-based work trips (HBW), home-based non-work trips (HBNW), and non-home-based trips (NHB). HBW trips are those trips with one end at home and the other at work. HBNW trips are those trips with one end at home and the other not at work. NHB trips are those trips with neither end at home. Trips are divided into these purposes to account for the different trip length characteristics for each purpose. HBW trips generally have the longest average trip length, while HBNW trips and NHB trips tend to have shorter average trip lengths.

For travel demand model application, the HBNW trip purpose may be further divided among trips to school, trips to shopping centers, and trips to other locations. The trip purposes are also classified in terms of person trips or vehicle driver trips, depending on the mode of travel used. Person trips include walk, bicycle, and vehicle trips, while vehicle driver trips are those trips made by an individual driving a vehicle.

#### **Trip Productions**

Trip ends are divided between trip productions, the home end of the trip, and trip attractions, the non-home end of the trip. If neither end of the trip is at home (NHB), the production end of the trip is defined as the origin end of the trip. These distinctions are important because the number of trip productions is a function of the number of households and the household characteristics, and the number of trip attractions is a function of the number of work places, the number of employees, and the types of employment.

Figure 11 shows the distribution of trip productions by trip purpose for the Amarillo study area. HBNW trips account for about 55.8 percent of all household person trips and 48.3 percent of all household vehicle trips.

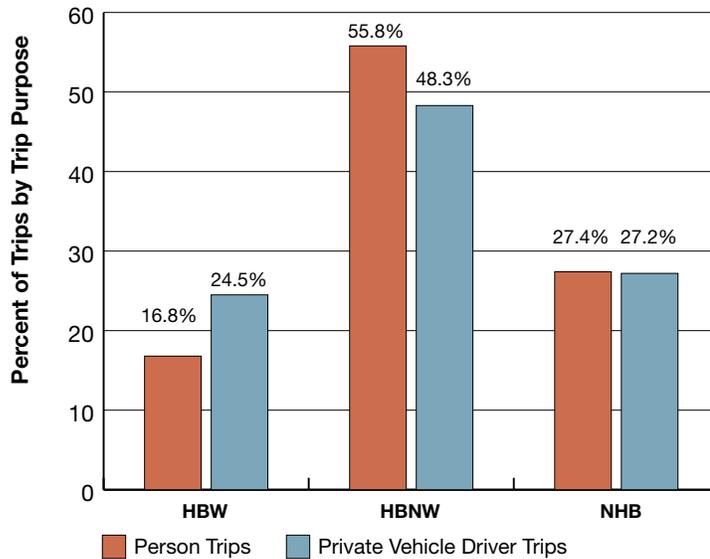


Person trips include walk, bicycle, and vehicle trips, while vehicle driver trips are those trips made by an individual driving a vehicle.



The Amarillo Museum of Art

**Figure 11. Distribution of Trip Productions by Trip Purpose.**



### **Trip Production Rates**

Among the important products of the household survey are the trip production rates for use in the trip generation step of the travel demand model. Table 4 shows the person trip rates (trips per household) cross-classified by household size and household income for all internal trip purposes combined, that is, trips that begin and end inside the Amarillo MPO study area. These trip rates are for all trips by all modes including transit, bicycle, and walk trips. For travel forecasting applications, the cross-classified trip rates are disaggregated by trip purpose into HBW trips, HBNW trips, and NHB trips. As part of the travel forecasting process, the person trips are divided among the modes during the mode split step. The average daily person trip rate for all households, internal to the study area, is around 9.4 trips per household.

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Travel distances vary by trip purpose with the HBW trip purpose having the longest average trip length.

**Table 4. Person Trip Rates by Household Size and Household Income**

Household Income Range	Household Size				
	1	2	3	4	5+
\$0-\$14,999	3.0	5.6	8.7	10.5	27.3
\$15,000-\$29,999	4.1	5.4	9.0	12.7	32.5
\$30,000-\$49,999	4.4	6.9	10.5	12.3	22.5
\$50,000-\$74,999	5.1	6.2	10.6	15.0	26.2
\$75,000+	4.3	7.5	10.0	17.7	39.6

### **Trip Length**

Travel distances vary by trip purpose with HBW trips having the longest average trip length. The average travel distance and trip length frequency distribution by trip purpose are estimated from the household survey. These measures are used to calibrate the trip distribution step of the travel demand model. The trip distribution model is calibrated so that the modeled average travel distance and trip length frequency distribution by trip purpose agree with the values estimated from the travel surveys.

Over time, the average trip length for HBW trip purposes tends to increase along with urban growth, and the average trip length for HBNW trip purposes tends to remain stable. For HBNW trip purposes, which are largely shopping and school trips, the marketplace provides attraction opportunities, such as new retail stores and new schools, as the urban area grows.

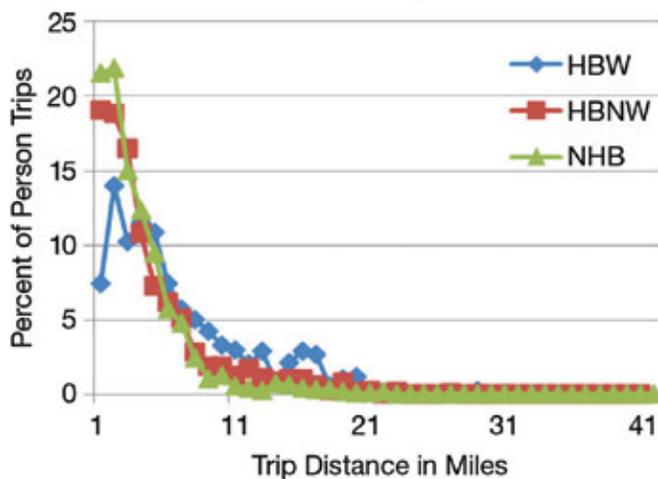
Figure 12 shows the distribution of person trips by the length of the trip in miles by trip purpose, while Figure 13 presents the distribution of person trips by trip duration in minutes by trip purpose. The distribution is for internal person trips, which are those trips beginning and ending within the Amarillo MPO study area. The average person trip length is 6.7 miles for HBW trips, 4.6 miles for HBNW trips, and 3.8 miles for NHB trips. The average person trip duration is 7.8 minutes for HBW trips, 5.7 minutes for HBNW trips, and 5.0 minutes for NHB trips.

Overall, the average person trip length is 4.7 miles and the average person trip duration is 5.9 minutes.

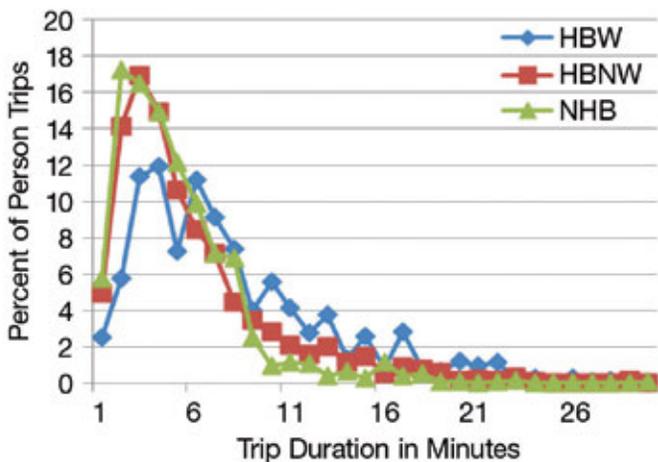
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**The time-of-day that people travel is generally dictated by the scheduled start times of their activities.**

**Figure 12. Distribution of Person Trips by Trip Length in Miles by Trip Purpose.**



**Figure 13. Distribution of Person Trips by Trip Duration in Minutes by Trip Purpose.**



### Time-of-Day Travel

The time of day that people travel is generally dictated by the scheduled start times of their activities (i.e., home to work/home to school). For other trips, the start times are flexible and the decision as to when to make these trips may partially depend on the amount of traffic congestion that the trip maker expects to experience. As the amount of peak period traffic increases, the trip maker may choose to make discretionary trips during a less congested time of day.

Figure 14 shows the distribution of daily person trips by time of day. The highest percentage of daily person trips occur during the morning peak, as both home-to-work and home-to-school trips are occurring during this time period. The modest noon peak, the school-to-home peak and the work-to-home peak are all evident. As the amount of travel in an urban area increases, the duration of the morning and afternoon peak periods increases in time as people choose to travel just prior to or just after the morning and afternoon peaks. This phenomenon is referred to as peak spreading. Time-of-day travel information may also be used to estimate air quality emissions inventories that are used for air quality photochemical analysis models.

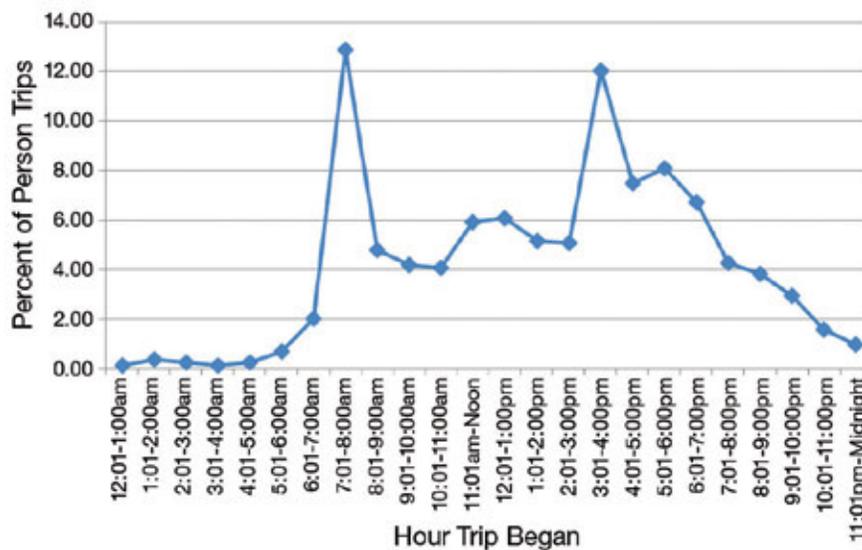
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**The modest noon peak, the school-to-home peak, and the work-to-home peak are all evident.**

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**Figure 14. Distribution of Person Trip Start Times by Hour of the Day.**



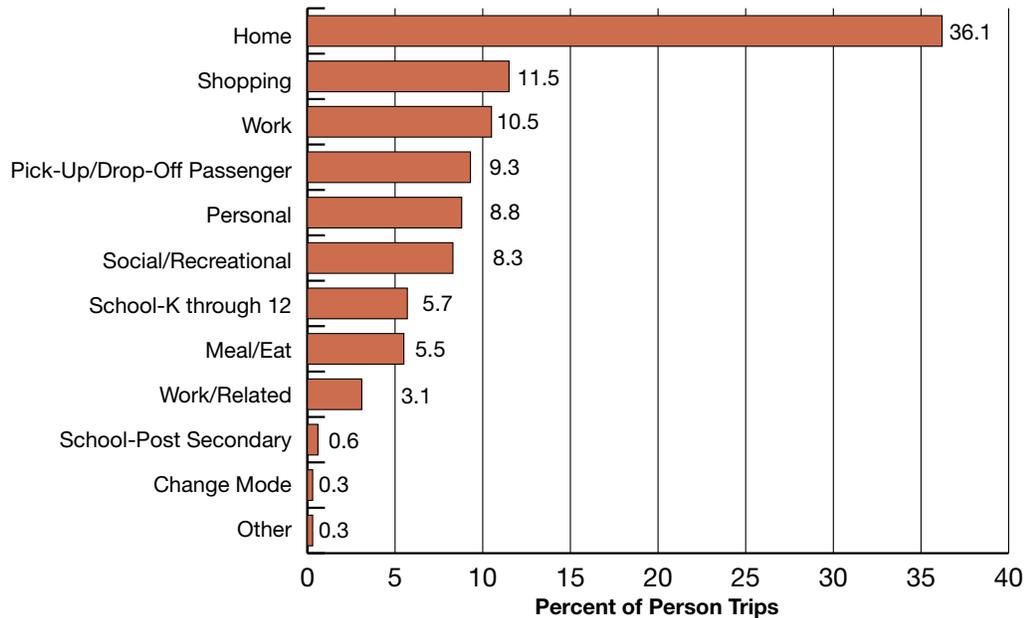
Texas Tech University Health Sciences Center

### Trip Purpose

As a part of their travel diary, each household member in the Amarillo household survey was asked to identify from a list of choices what he or she did at each trip destination. The information about the trip destination was used to categorize the trip according to trip purpose. In travel demand modeling, typically there are three internal trip purposes—HBW, HBNW, and NHB trips—that are used for forecasting future travel. For each of these trip purposes, trip rates and trip length frequency distributions are estimated from the household survey.

Figure 15 shows the distribution of person trips by the trip destination purposes used in the survey. As would be expected, the most frequent trip destination is the return-to-home trip, which accounts for 36.1 percent of the person trips on the destination side.

**Figure 15. Distribution of Person Trips by Destination Purpose.**



The household survey provides a representative sampling of trip origins and destinations within the study area. This information is then used in a gravity model formula to estimate trip volumes between distinct geographical areas used in modeling, termed traffic analysis zones (TAZs). Using the results from the household survey, the relative amounts of travel between subregions in the Amarillo area are shown in the *2006 – 2007 Amarillo Metropolitan Planning Organization Household Travel Survey Technical Summary*.

### WORK PLACE SURVEY

The primary purpose of a work place survey is to understand the trip attraction characteristics of basic, retail, service, and education establishments. While the household survey collects information on the travel characteristics of persons living in the study area at the household level, the work place survey collects similar information at the destination end of the travel. The 2009/2010 Amarillo Work Place Travel Survey, like other work place surveys across the U.S., consisted of a combination of survey instruments and data collection efforts, which included:

- A *general survey* of the work place.
- A *travel survey* of employees and visitors at the work place.
- *Counts* of either persons or vehicles traveling to and from the work place.

Data collected from these efforts were used to develop trip attraction rates by purpose, stratified by area type and employment type.

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The primary purpose of a work place survey is to understand the trip attraction characteristics of basic, retail, service, and education establishments.

For analysis purposes, TAZs in the work place survey are grouped according to the level of activity within the zone as measured by the density of population and employment within the zone. There were four area types identified in the Amarillo MPO study area—central business district (CBD), urban, suburban, and rural.

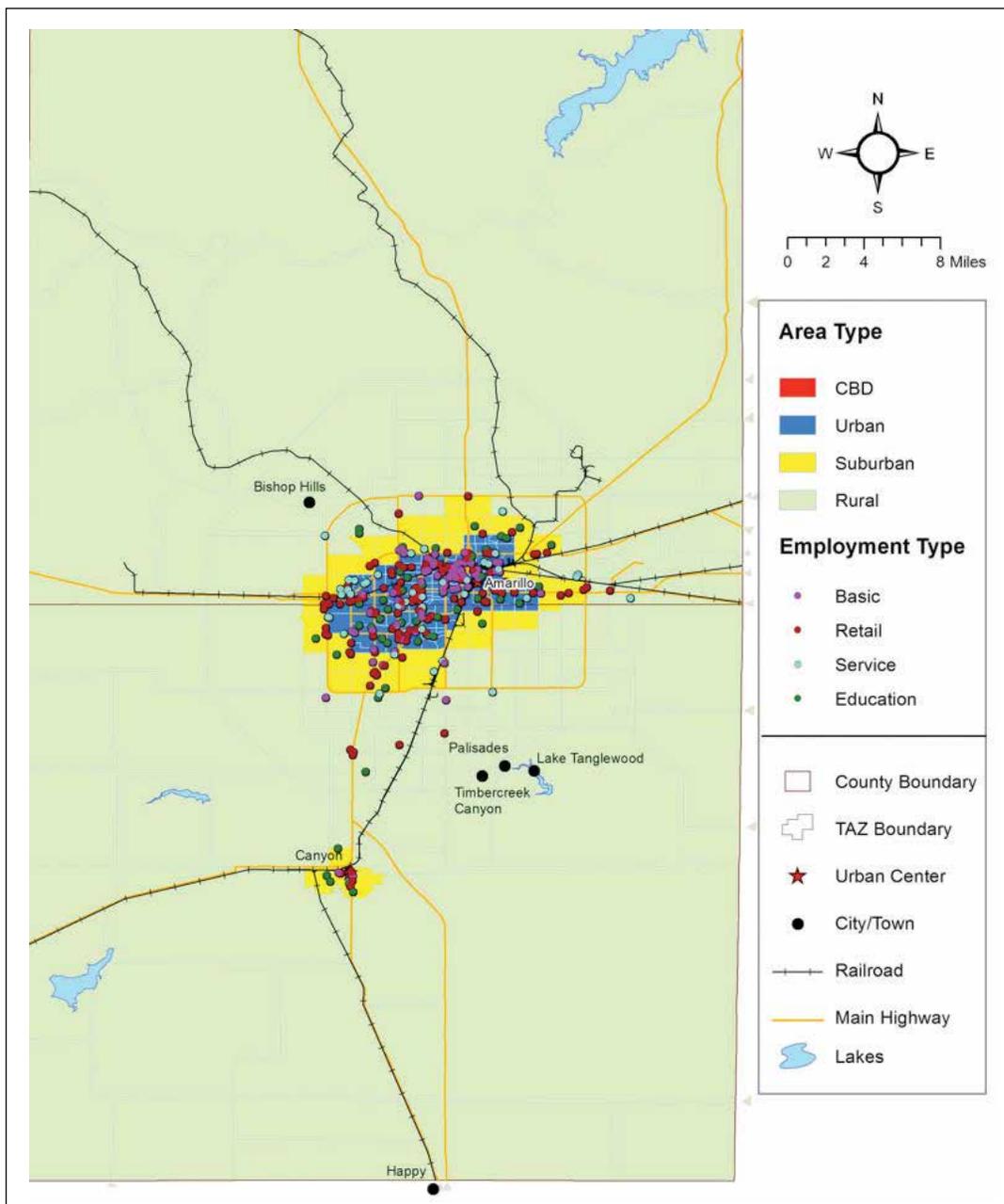
Figure 16 shows the locations of the establishments that participated in the work place survey. The data presented in this section are based on survey data and are not expanded.

The 2009/2010 Amarillo Work Place Travel Survey included 304 randomly selected business establishments (not including one special generator), of which 118 had full surveys and 186 had partial surveys. The full surveys

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**There were four area types identified in the Amarillo MPO study area—Central Business District (CBD), Urban, Suburban, and Rural.**

**Figure 16. Amarillo Study Area Surveyed Work Place Locations.**



consisted of surveys of 1,221 employees and 1,883 visitors or non-employees. The full surveys also included surveys of vehicles owned and leased by the establishments and used for business purposes, and counts of persons or vehicles arriving and departing the establishments. The partial survey mainly included a general survey of the establishment, such as the type, location, total employment, and number of employees at work on the day of the survey.

**Work Place Travel Characteristics**

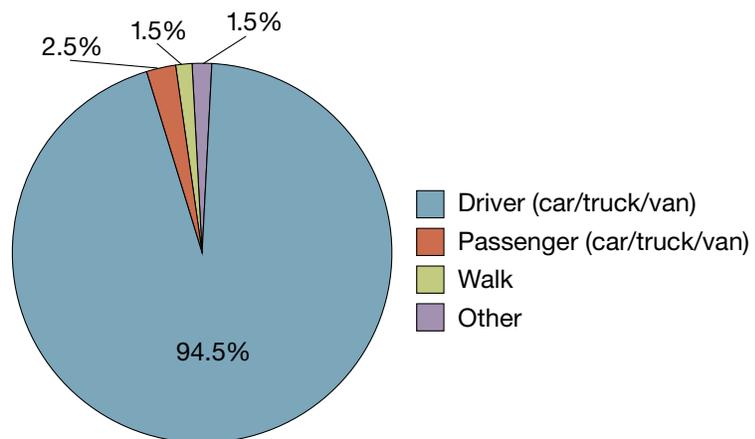
Trip purposes to the work place are categorized to include not only internal home-based (HBW and HBNW) trips and non-home-based (NHB-O and NHB-D) trips at origin and destination locations, but also external trips from and to the study area. The external trips include external-origin trips (EXT-O), which are trips whose destinations are outside the study area when leaving the establishment, and non-resident trips (NON-RES), which are those internal trips to the establishment made by persons who live outside the study area. Attraction rates are then developed for each trip purpose, area type, and employment type for use in travel demand models.

Figure 17 presents the distribution of reported trips to the work place by mode of travel. The majority of trips are by drivers. A total of 94.5 percent of the work place trips were made by drivers of a vehicle, with less than 3 percent (2.5 percent) of the trips made as a passenger of a vehicle. Less than 2 percent (1.5 percent) of the trips were made by walking, with relatively few trips made by other modes.



Amarillo City Transit

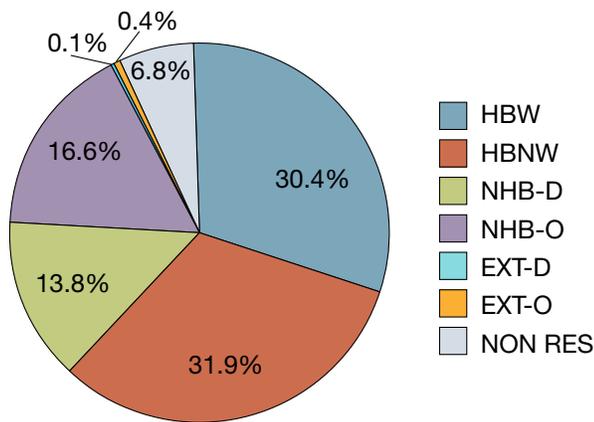
**Figure 17. Distribution of Reported Trips by Modes of Travel.**



Source: 2010 Waco Work Place Travel Survey and TTI Analysis.

Figure 18 shows the distribution of reported trips by trip purpose. Approximately 92.7 percent of the trips are internal trips, with 31.9 percent being HBNW trips, 30.4 percent being HBW trips, and 30.4 percent being NHB trips. The remaining 7.3 percent are external trips, with 0.4 percent being EXT-O trips, another 0.1 percent being EXT-D trips, and 6.8 percent being NON-RES trips.

**Figure 18. Distribution of Reported Trips by Trip Purpose.**



The reported trips for both employees and visitors were geocoded to the study area's TAZs to compute the travel distance by trip purpose. Table 5 shows the average trip lengths by trip purpose for person trips and vehicle trips, while Figure 19 shows the trip length frequency distributions for person trips by travel distance. The average trip lengths and trip length frequency distributions are only for HBW, HBNW, NHB and NON-RES travel.

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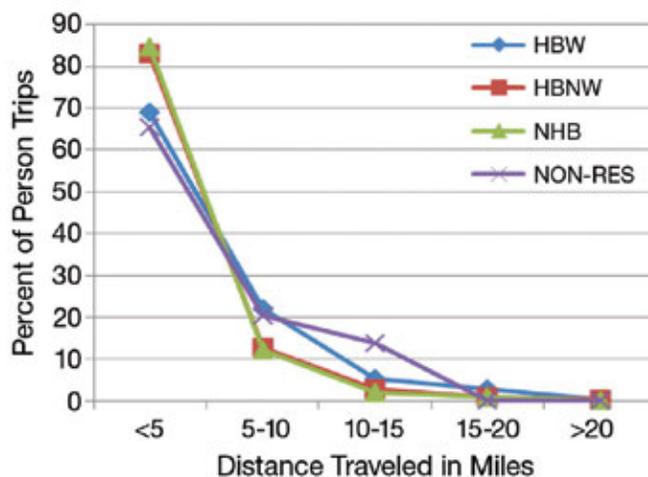
**Trips with a distance between 1 and 5 miles are the most common trip length.**

**Table 5. Average Trip Lengths by Trip Purpose for Person Trips and Vehicle Trips to the Work Place (does not reflect intra-zonal trips).**

Trip Purpose	Average Person Miles	Average Vehicle Miles
HBW	5.45	5.48
HBNW	3.81	3.78
NHB	3.61	3.68
NON-RES	5.51	5.58

Source: 2010 Waco Work Place Travel Survey and TTI Analysis.

**Figure 19. Distribution of Person Trips by Travel Distance at Surveyed Work Place Establishments.**



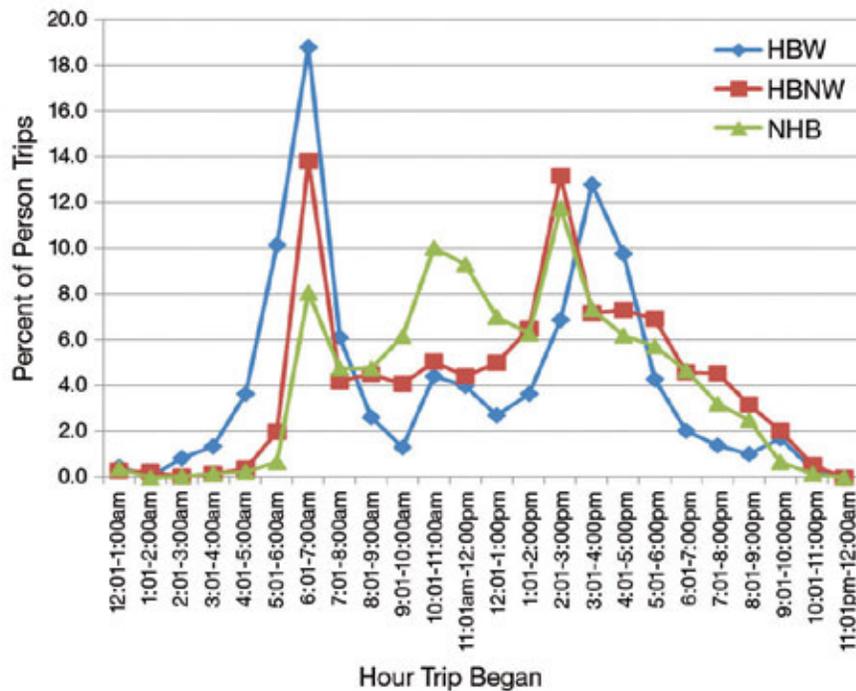
The surveyed NON-RES person trips have the highest average trip length when compared against the average person trip length of HBW, HBNW, and NHB person trips as Table 5 shows—though the HBW average person trip length is comparable to the average for NON-RES trips. This result is not surprising, as non-residents, by definition, do not live within the study area. This fact opens up the possibility for longer trips by non-residents because there is no limit on the distance from the origin of their trip to the Amarillo MPO study area border. Additionally, it is not surprising that average HBW trip length is longer than HBNW and NHB trip length averages, since options for services accessed for everyday activities (i.e., grocery store, gas station, etc.) are often available in closer proximity to homes than work. The surveyed average trip lengths and the trip length frequency distribution model is calibrated so that the modeled average trip length and trip length frequency distributions closely match the average trip length and trip length frequency distributions estimated from the travel surveys.



**Trips by purpose typically have distinct characteristics by time of day that are consistent for nearly all urban areas.**

Trips by purpose typically have distinct characteristics by time of day that are consistent for nearly all urban areas. Figure 20 shows the distribution of trips by purpose by their time of arrival at the establishments surveyed. The results indicate that the characteristics for travel in the Amarillo MPO study area are similar to those for other urban areas. HBW trips exhibit two time periods when those types of trips are most likely to occur, in the morning and afternoon. The morning peak is between 6:01 a.m. and 7:00 a.m., and the afternoon peak is between 3:01 p.m. and 4:00 p.m. Typically, HBNW and NHB trips are more evenly spread throughout the day—though peaks in NHB trips can be seen in the morning during lunch, and in the early afternoon. The HBNW lunch peak is not nearly as pronounced as the peaks experienced in HBW and NHB trips around lunch.

**Figure 20. Distribution of Person Trips by Time of Day.**





Rick Husband Amarillo International Airport

## SPECIAL GENERATORS

One important work place surveyed, the Amarillo Airport, was treated as a special generator. Special generators are those types of employment locations that are considered unique and subject to modeling outside the typical modeling framework. The methodology used to survey special generators is the same as that used for a full work place survey, except to a much larger scale.

### ***Amarillo Airport***

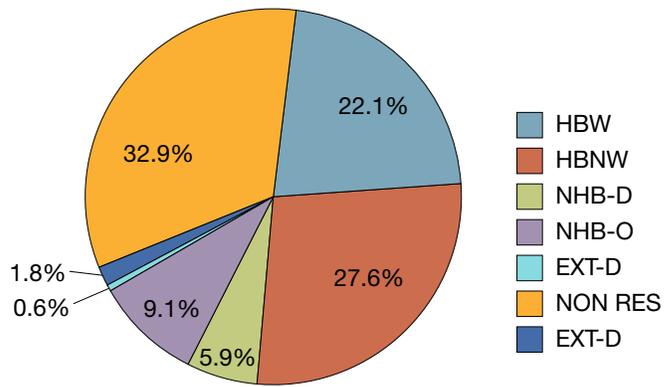
Vehicle counts for the Amarillo Airport, performed for a 24-hour period from 6 a.m. to 6 a.m., totaled 3,430 non-commercial vehicles and 168 commercial vehicles. A total of 31 employees and 139 visitors participated in the survey. It was estimated that 200 of the 630 employees were at work on the travel survey day.

Figure 21 shows the surveyed trips by trip purpose at the Amarillo Airport. Nearly one-third (32.9 percent) of the trips were NON-RES, slightly more than a quarter (27.6 percent) of the trips were HBNW, and not quite a quarter (22.1 percent) of the trips were HBW.



Special generators are those types of development that are considered unique and subject to modeling outside the typical modeling framework.

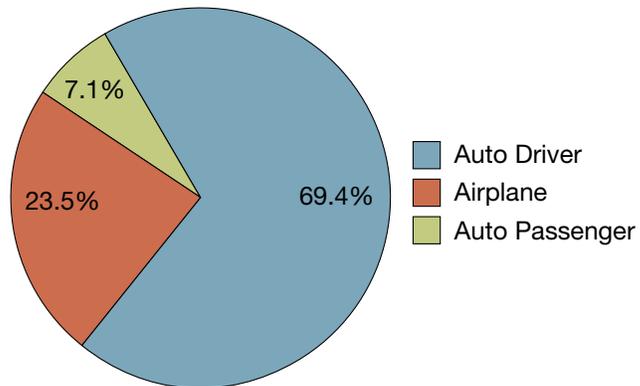
**Figure 21. Surveyed Trips by Trip Purpose at Amarillo Airport.**



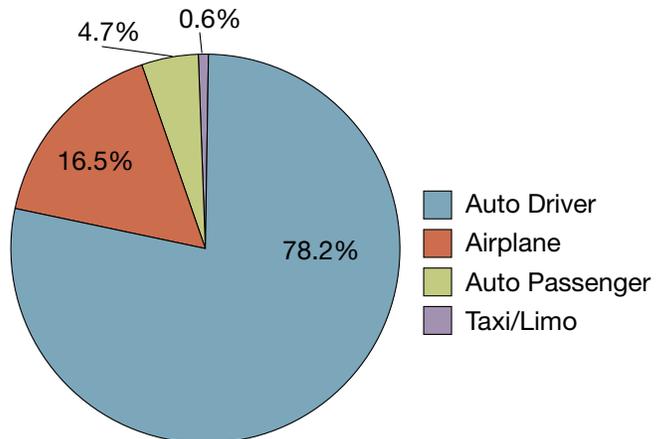
Data for the Amarillo Airport were processed and average trip length was calculated for travel distance by trip purpose.

Figure 22 shows the distribution of mode of travel entering the Amarillo Airport. Similarly, Figure 23 provides the distribution of mode of travel leaving the Amarillo Airport.

**Figure 22. Mode of Travel to the Amarillo Airport.**



**Figure 23. Mode of Travel from the Amarillo Airport.**



The data were processed and average trip length was calculated for travel distance by trip purpose. It is recognized that these data are based on a small number of observations, but they do provide a reference of comparison with the average trip lengths found for the full work place survey. Table 6 shows the average trip lengths to the Amarillo Airport by trip purpose.

**Table 6. Average Surveyed Inter-Zonal Trip Lengths to the Amarillo Airport by Trip Purpose.**

Trip Purpose	Average Person Miles	Average Vehicle Miles
HBW	12.47	12.67
HBNW	13.97	14.22
NHB-D	10.81	10.60
NON-RES	9.25	8.62
ALL	12.74	12.76



Table 7 shows the expanded survey results for the Amarillo Airport. Like those from the airport, the total trips and trip rates were estimated by multiplying the non-commercial vehicle counts with the average employee and visitor auto-driver vehicle occupancy. Trip rates were estimated by dividing the total trips by the total employment of the site.

**Table 7. Amarillo Airport Person and Auto-Driver Trips and Attraction Rates.**

Trip Purpose	Person Trips	Person Trip Rates	Auto-Driver Trips	Auto-Driver Trip Rates
HBW	810	1.29	595	0.95
HBNW	1,920	3.05	1,025	1.63
NHB	441	0.70	256	0.41
Non-Resident Trips	1,080	1.71	606	0.96
Commercial Vehicle Trips	84	0.13	84	0.13
<b>Total</b>	<b>4,335</b>	<b>6.88</b>	<b>2,566</b>	<b>4.08</b>



The primary purpose of the external station survey is to understand the travel patterns of people and vehicles entering and exiting the study area.

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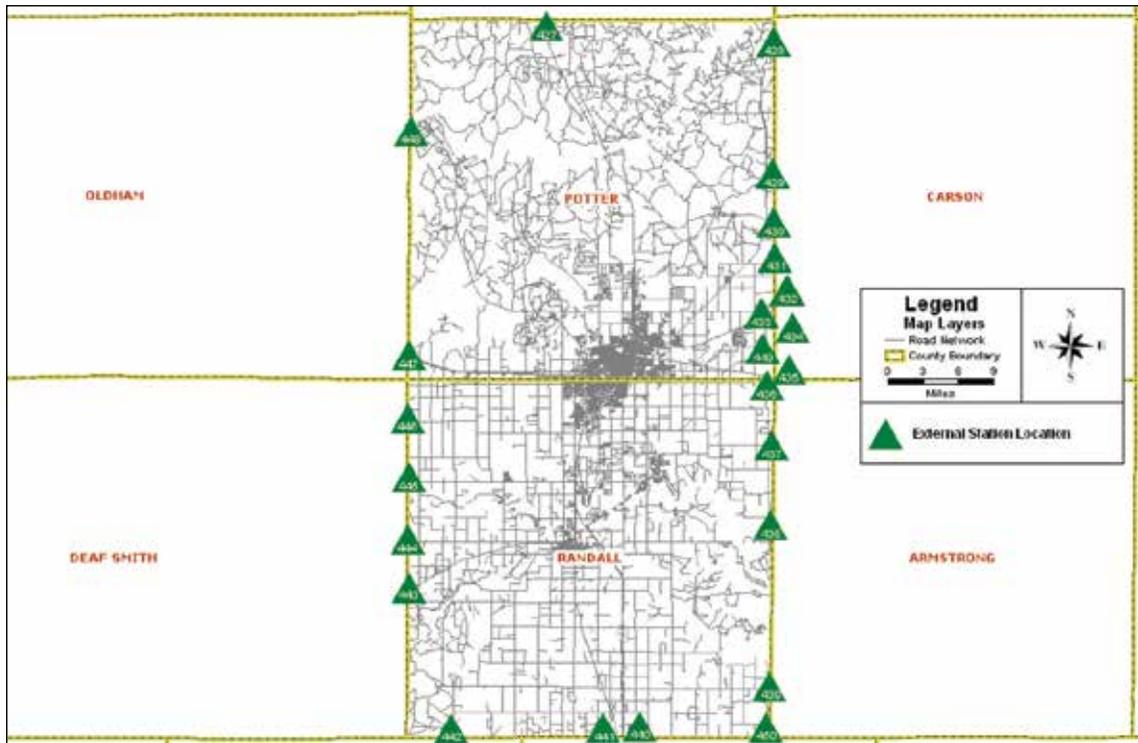


### EXTERNAL SURVEY

The primary purpose of the external station survey is to understand the travel patterns of people and vehicles entering and exiting the study area. These trips are subsequently divided between trips passing through the study area (external-through trips) and trips by persons coming into the study area to conduct activities within the study area (external-local trips). Surveys are conducted during the daylight hours for one day at each designated location. Additionally, 24-hour vehicle classification counts are performed on the same day as the survey at each survey location. These counts provide a basis for expanding the survey data to represent the average weekday movements into and out of the study area. Data are also collected on trips made during the survey day prior to the point at which the vehicle is surveyed. These data provide a basis for estimating the amount of travel occurring within the study area prior to the time of the survey.

The locations where transportation facilities cross the study area boundary are identified as external stations and represent where travelers may enter and exit the study area. There were 24 external stations that crossed the border of the Amarillo MPO study area, and 12 of these locations were selected as sites to conduct external travel surveys. Figure 24 shows the locations of the external station sites.

**Figure 24. Amarillo External Station Locations.**



The number of surveys collected varied by survey site. The sites were operated during daylight hours. Data were collected for vehicles leaving the study area (outbound) by performing a survey in areas set up with trained survey personnel. Approximately 20 percent of non-commercial vehicles and 8 percent of commercial vehicles that traveled through the external stations during survey hours were interviewed. The Amarillo external station survey included 4,234 surveyed vehicles. Approximately 85.7 percent of the surveyed vehicles were non-commercial vehicles and 14.3 percent were commercial vehicles.

The estimates presented in this section are based on expanded survey data. Based on 24-hour vehicle counts, there were 38,941 inbound vehicles and 39,093 outbound vehicles entering and exiting the Amarillo MPO study area on a daily basis. Figure 25 and Figure 26 show the estimates of external-local and external-through trip movements of non-commercial and commercial vehicles by direction and location group, respectively.

The external stations were grouped by location and included North, East, South, and West groups. The East group had the largest estimated number of external-local trip movements, with over 34,000 total daily trips. The West group had the second largest estimated number of external-local trips with nearly 18,000 total daily trips. The most common external-through movements were between the East and West groups, largely due to Interstate Highway (IH) 40 running East-West through the study area. The most heavily traveled external-through route is between the East and West groups, with over 5,000 trips.



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**Based on 24-hour vehicle counts, there were 38,941 inbound vehicles and 39,093 outbound vehicles entering and exiting the Amarillo MPO study area on a daily basis.**

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Figure 25. Estimates of External-Local Trip Movements by Location Group.

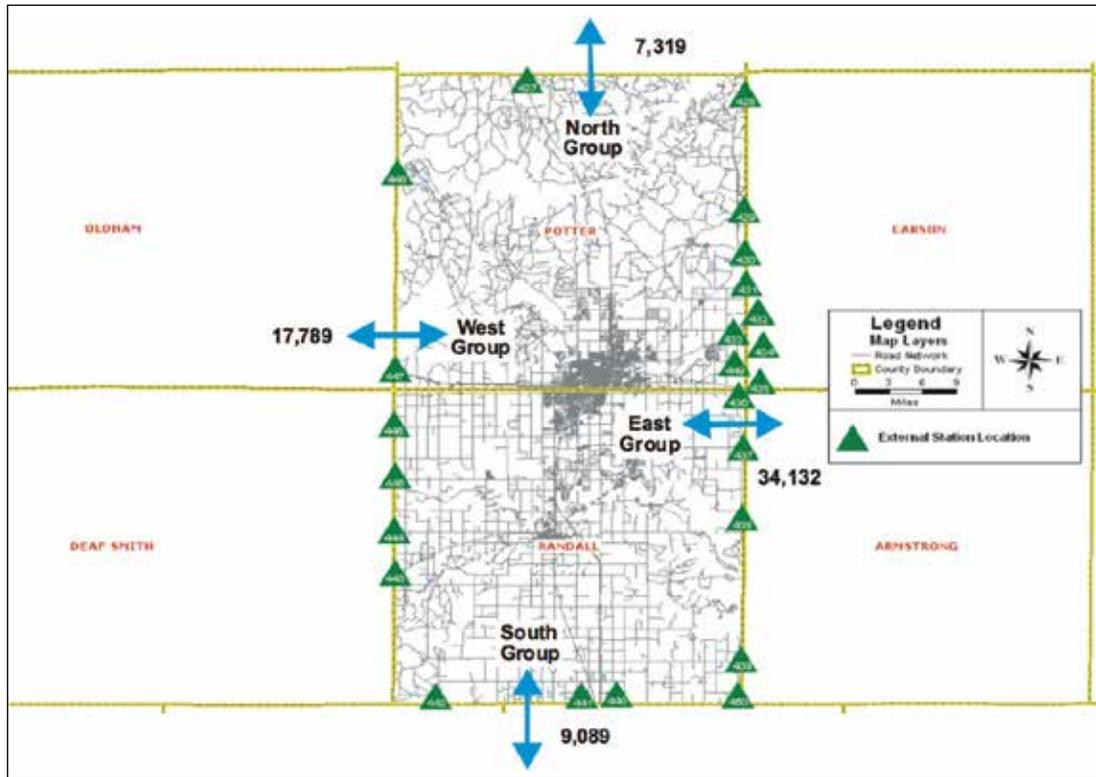
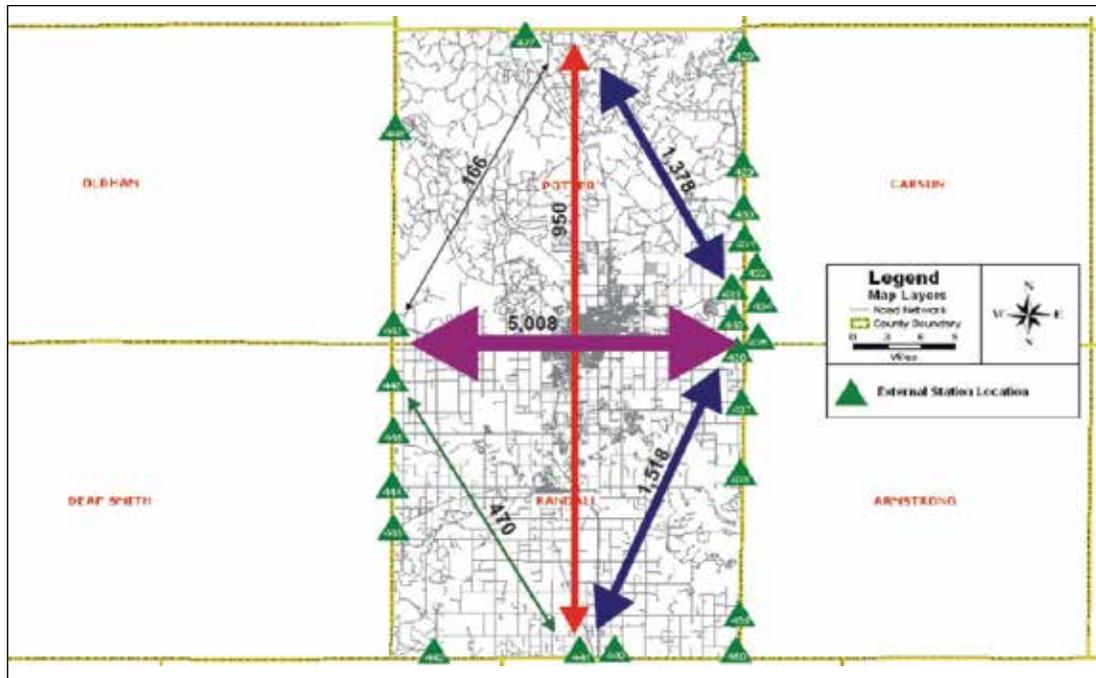


Figure 26. Estimates of External-Through Trip Movements by Location Group.





## COMMERCIAL VEHICLE SURVEY

The primary purpose of the commercial vehicle survey is to collect data on commercial vehicle trip making that is needed to estimate total commercial vehicle travel in the Amarillo MPO study area. In the travel demand model, trips made by commercial vehicles are modeled separately from trips made by non-commercial or private passenger vehicles. The commercial vehicle survey is concerned with internal commercial vehicle trips, which are trips made within the study area. Commercial vehicle trips that are coming into or departing the study area boundary are surveyed as a part of the external station survey. The surveys collect data on commercial cargo/freight vehicles, as well as vehicles used for commercial service, such as plumbers, electricians, deliveries, and governmental fleet vehicles. The data are used in the trip generation step of the travel demand model to estimate total trips and travel patterns for commercial vehicle trips.

In the 2005 Amarillo Commercial Vehicle Survey, a sample of vehicles was randomly selected from motor carrier and vehicle registration databases. The establishments or agencies operating the selected vehicles were contacted and asked to participate in the survey. A total of 258 commercial vehicles participated in the survey. The drivers of the vehicles were asked to keep a 24-hour diary of the locations of all trips made by the vehicle. A variety of questions were asked about the vehicle, such as the type of cargo being transported (if any) and the purpose of the trip. The questions of primary concern for estimating commercial vehicle trip patterns were the location and time of each trip from when the driver of the vehicle started his or her daily activities until the driver of the vehicle completed his or her daily activities.



The commercial vehicle survey is concerned with internal commercial vehicle trips, which are trips made within the study area.

The number of commercial vehicles in a designated study area cannot be determined reliably from vehicle registration data due to the presence of commercial vehicles registered in other counties, and in other states. The commercial VMT observed from sampled commercial vehicles in the Amarillo area was expanded using VMT estimates from the Highway Performance Monitoring System (HMPS) data, combined with vehicle classification counts for roadway functional classification (freeway, arterial, collector, and local). Table 8 shows the estimated VMT for commercial vehicles operating in the Amarillo MPO study area by roadway functional classification. The total commercial VMT was 1,031,230 miles, with external commercial VMT estimated at 436,989 miles and internal commercial VMT estimated at 594,241 miles.

**Table 8. Estimated VMT for Commercial Vehicles Operating in the Amarillo MPO Study Area by Roadway Functional Classification.**

Functional Classification	Weekday VMT	Percent Commercial Vehicles	Commercial Vehicles Weekday VMT
Freeway	2,122,505	25.1	532,726
Arterial	2,395,024	14.2	340,067
Collector	1,263,146	10.0	126,301
Local	396,790	8.1	32,136
<b>All Classifications</b>	<b>6,177,465</b>	<b>16.7</b>	<b>1,031,230</b>

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On a daily basis, approximately 11,746 commercial vehicles (nearly four times the 3,018 registered trucks in the study area in 2005) were estimated to be operating in the Amarillo study area.



On a daily basis, approximately 11,746 commercial vehicles (nearly four times the 3,018 registered trucks in the study area in 2005) were estimated to be operating in the Amarillo study area, with each vehicle averaging 6.9 internal trips per day. The average distance traveled by all surveyed vehicles was estimated at 7.3 miles. Approximately 8.9 percent of the surveyed commercial vehicles in the study area in 2005 were cargo or freight transport, with 91.1 percent being local service transport. Among the surveyed commercial vehicles, the most frequently reported types of cargo included manufactured goods and equipment (20.2 percent of trips); food, health, and beauty products (13.6 percent of trips); and clay/concrete/glass or stone (7.1 percent of trips). Over 30 percent of the surveyed commercial cargo vehicle trips were not carrying any cargo and nearly 16 percent of the surveyed commercial cargo vehicle trips contained unclassified or “other” cargo.



The clock tower at the Amarillo College's Washington Street Campus.

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**The travel demand model is the preferred tool for supporting analysis and evaluation of proposed transportation alternatives within the transportation planning process.**

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## **SUMMARY OF FINDINGS**

The travel surveys conducted in the Amarillo MPO study area during the period between 2005 and 2010 provide the household, work place, external station, and commercial vehicle travel behavior information needed to estimate, calibrate, and validate a travel demand model. This model can be used as a transportation analysis tool for planning improvements to the region's transportation system for the next 20 years. The travel demand model is the preferred tool for supporting analysis and evaluation of proposed transportation alternatives within the transportation planning process. The population of Randall and Potter Counties is forecasted to increase from 233,533 in 2007 to 312,702 by 2035, an increase of about 33.9 percent. The daily VMT is expected to increase by 22.0 percent during this 28-year period, from 448,832,329 miles in 2007 to 549,039,772 miles by 2035. With this growth, TxDOT and the Amarillo MPO will need to plan new and/or improved facilities to provide added transportation capacity during the next 20 years. Such facilities will be needed to maintain the relatively high level of mobility currently enjoyed by travelers in the Amarillo MPO study area.

### ***Household Travel***

Persons commuting to work in the Amarillo MPO study area display limited use of public transportation. This largely stems from the fact that over 97 percent of the households have at least one vehicle available. The average household size in the study area in 2006–2007 was 2.6 persons, equal to the 2.6 persons per household average calculated for the area in 1990. The average number of person trips per household was around 9.4 trips per day, with each person in the household making between three and four trips per day. The average person trip length was 4.7 miles, and the average duration on the trips was 5.9 minutes.



The Potter Courthouse building in downtown Amarillo, Texas

Trip purposes in the household survey were categorized as internal (HBW, HBNW and NHB) trips. The HBW trips in the Amarillo MPO study area in 2006–2007 had the longest average travel distance of 6.7 miles, and accounted for 16.8 percent of the total household person trips. In terms of trip purpose by destination, the return-to-home trip was the most frequent trip destination, which accounted for 36.2 percent of the total household person trips. HBNW trips accounted for 55.8 percent of the total household person trips, with an average travel distance of 4.6 miles. NHB trips accounted for around 27.4 percent of the total household person trips, with an average travel distance of 3.8 miles. Shopping, trips to work, pick-up/drop-off, and personal business comprised approximately 40.1 percent of the total person trips by destination purpose.

#### ***Work Place Travel***

Trip purposes in the work place survey were categorized to include not only internal trips but also external trips (EXT-O, EXT-D, and NON-RES) to and from the study area. In terms of trip purposes to and from the work place based on survey trips, external trips (EXT-D, EXT-O, and NON-RES) accounted for 7.3 percent of the total person trips in the Amarillo MPO study area. The majority of trips (92.7 percent) were internal trips, of which more than two-thirds were home-based trips (31.9 percent HBNW and 30.4 percent HBW), and 30.4 percent were NHB trips. The average inter-zonal person trip lengths to and from the work place for HBW trips was 5.5 miles, compared to 3.8 miles for HBNW trips, and 3.6 miles for NHB trips. The average inter-zonal person trip length for NON-RES trips to and from the work place was 5.5 miles.



#### ***External-Local and External-Through Travel***

Over 78,000 vehicles entered or exited the Amarillo MPO study area on an average weekday basis. Approximately 91.1 percent of the total daily external trip movements were external-local trips, while the remaining 8.9 percent were external-through trips. Of the total external-local trips, 76.8 percent were made by non-commercial vehicles and 23.2 percent were made by commercial vehicles. Approximately 46.1 percent of the total external-through trips were made by non-commercial vehicles and the remaining 53.9 percent were made by commercial vehicles.

#### ***Commercial Vehicle Travel***

The total commercial VMT for the Amarillo MPO study area in 2005 was estimated at 1,031,230 miles, of which 436,989 miles were external commercial VMT and 594,241 miles were internal commercial VMT. Approximately 81,403 total internal commercial trips were made in the study area on a daily basis in 2005. The travel demand model is the preferred tool for supporting analysis and evaluation of proposed transportation alternatives within the transportation planning process with each surveyed vehicle averaging 6.9 internal trips per day. The average travel time was estimated to be 8.5 minutes per trip, with the average travel speed estimated at 46.5 miles per hour.

Approximately 8.9 percent of the surveyed commercial vehicles were cargo or freight transport, while the remaining 91.1 percent were local service transport. Among the surveyed commercial vehicles, the most frequently reported types of cargo included manufactured goods and equipment (20.2 percent of trips); food, health, and beauty products (13.6 percent of trips); and clay/concrete/glass or stone (7.1 percent of trips). Over 30 percent of the surveyed commercial cargo vehicle trips were not carrying any cargo and nearly 16 percent (15.7 percent) of the surveyed commercial cargo vehicle trips contained unclassified or “other” cargo.



Over 78,000 vehicles entered or exited the Amarillo MPO study area on an average weekday basis.

## COMPARISON TO OTHER AREAS

Table 9 provides a comparison of the household survey summary data for the Potter and Randall Counties, to Lubbock County, McLennan County, and Cameron and Hidalgo Counties.

**Table 9. Comparative Household Survey Data for Lubbock County, McLennan County, Potter and Randall Counties, and Cameron and Hidalgo Counties.**

Urban Area	Lubbock County	McLennan County	Potter and Randall Counties	Cameron and Hidalgo Counties
<b>Demographics</b>				
Household Population	261,608	228,241	233,533	1,030,139
Licensed Drivers	185,436	151,191	164,001	585,035
Number of Households	97,598	83,995	88,507	294,825
Average Household Size	2.76	2.72	2.64	3.49
Number of Motor Vehicles	186,412	158,805	178,784	555,443
Motor Vehicles per Household	1.91	1.89	2.02	1.88
<b>Number of Daily Trips by Mode</b>				
Total Person Trips	950,628	712,766	830,583	3,583,480
Automobile-Driver Trips	628,352	450,637	523,635	2,023,295
Motor Vehicle Passenger Trips	268,711	223,990	265,544	1,243,681
School Bus Trips	4,957	3,201	7,872	188,781
Walk Trips	14,964	16,627	11,563	93,337
Public Transit Trips	4,957	3,201	7,872	9,889
Bicycle Trips	1,829	4,781	2,002	6,571
Commercial Vehicle Trips*	111,129	111,659	81,403	83,600
Other Modes/Taxi	2,907	NA	1,873	3,709
<b>Number of Daily Trips by Destination/Purpose</b>				
Trips to Home	328,343	254,084	300,993	1,322,199
Trips to Work	111,325	80,919	86,938	353,105
Trips Work Related	43,807	21,604	25,302	109,126
Trips to Shop	94,199	74,105	95,421	333,674
Trips to Pick-Up/Drop Off Passenger	82,822	65,744	77,014	410,936
Trips for Personal Business	73,200	59,229	73,011	228,654
Trips for Social/Recreation	82,872	69,543	68,556	276,680
Trips for School K-12	45,823	35,467	46,973	292,203
Trips for School Post Secondary	17,321	5,739	4,897	46,762
Trips for Meal/Eat	57,574	40,757	46,049	171,603
Trips to Change Mode	6,083	4,038	2,836	24,622
Other Trips	7,261	1,537	2,590	3,596
<b>Daily Trip Rates</b>				
Person Trips per Person	3.8	3.16	3.62	3.48
Person Trips per Household	9.7	8.48	9.38	12.15
<b>Trip Lengths and Durations</b>				
Average Person Trip Length in Miles	5.9	5.8	4.7	6.5
Average Vehicle Trip Length in Miles	6.1	6.3	5.0	7.0
Average Person Trip Duration in Minutes	4.7	8.8	5.9	9.2
Average Vehicle Trip Duration in Minutes	5.0	9.4	6.1	9.8
<b>Vehicle Miles of Travel (VMT)</b>				
VMT per Capita	NA	31.6	11.4	13.8

\*Value taken from commercial vehicle reports.

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## GLOSSARY AND TERMINOLOGY

Within the context of travel surveys there are a number of terms used that may cause confusion. These terms are defined as follows.

*Attractions:* The number of trips that are attracted to a location. Attractions are computed by purpose and mode of travel for different land use categories.

*External Destination (EXT-D) Trip:* A trip whose destination is outside the study area when leaving the establishment.

*External Origin (EXT-O):* A trip that originated outside the study area.

*Home Based Non Work (HBNW) Trip:* A trip which that has one end at home and the other at a location other than the work location. It is non-directional in terms of the activity/purpose.

*Home-Based Work (HBW) Trip:* A trip which that has one end at home and the other at work. It is non-directional in terms of the activity/purpose, i.e., a trip from home to work or from work to home is still defined as a HBW trip.

*Linked Trips:* Trips are linked (i.e., combined) into a single trip that reflects what is perceived to be the true purpose of the trip. Only trips that involve a serve passenger or change mode of travel between home and work (or vice versa) are considered for linking. For example, a person driving a child to a day care center (or school) and then proceeding on to work would have made two unlinked trips, an HBNW trip and an NHB trip. These two trips would be “linked” to create one trip, a HBW trip.

*Mode of Travel:* The physical means used to make a trip. The modes recorded in the survey included walk, vehicle driver, vehicle passenger, carpool driver, carpool passenger, vanpool driver, vanpool passenger, commercial vehicle driver, commercial vehicle passenger, public transportation, school bus, taxi/paid limo, bicycle, motorcycle/moped, and other.

*Non Home Based (NHB) Trip:* A trip which that has neither end at home.

*Non-Resident (NON-RES) Trip:* An internal trip to the establishment made by a person who lives outside the study area.

*Person Trip:* The movement of an individual from one location to another location. In the 2006–2007 Amarillo MPO Household Travel Survey, these trips were recorded for all members of a household regardless of age.

*Trip Activity:* The activity the individual did at the location the trip began and/or the location the trip ended. These activities were recorded in the survey and post processed to identify the purpose associated with the activity.

*Trip Attractions:* The number of trips that are attracted to a location. These are computed by purpose and mode of travel for different land use categories.

*Trip Productions:* The number of trips that are produced by members of a household. These are computed by purpose and mode of travel. Production rates refer to the number of trip productions divided by the number of households.

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*Trip Purpose:* The purpose of the trip being made by an individual. It is stated in terms of the purpose at the location the trip began and the purpose at the location the trip ended. For example, a trip that began at home and ended at work would be referred to as a home-based work (HBW) trip.

*Vehicle Availability:* The vehicles available to members of a household for travel.

*Vehicle Miles of Travel:* A measurement of the total miles traveled by all vehicles in the area for a specified time period.

*Vehicle Trip:* The movement of a vehicle from one location to another location. These trips are recorded for the person driving the vehicle.

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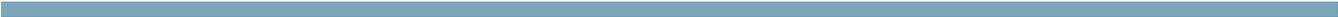
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