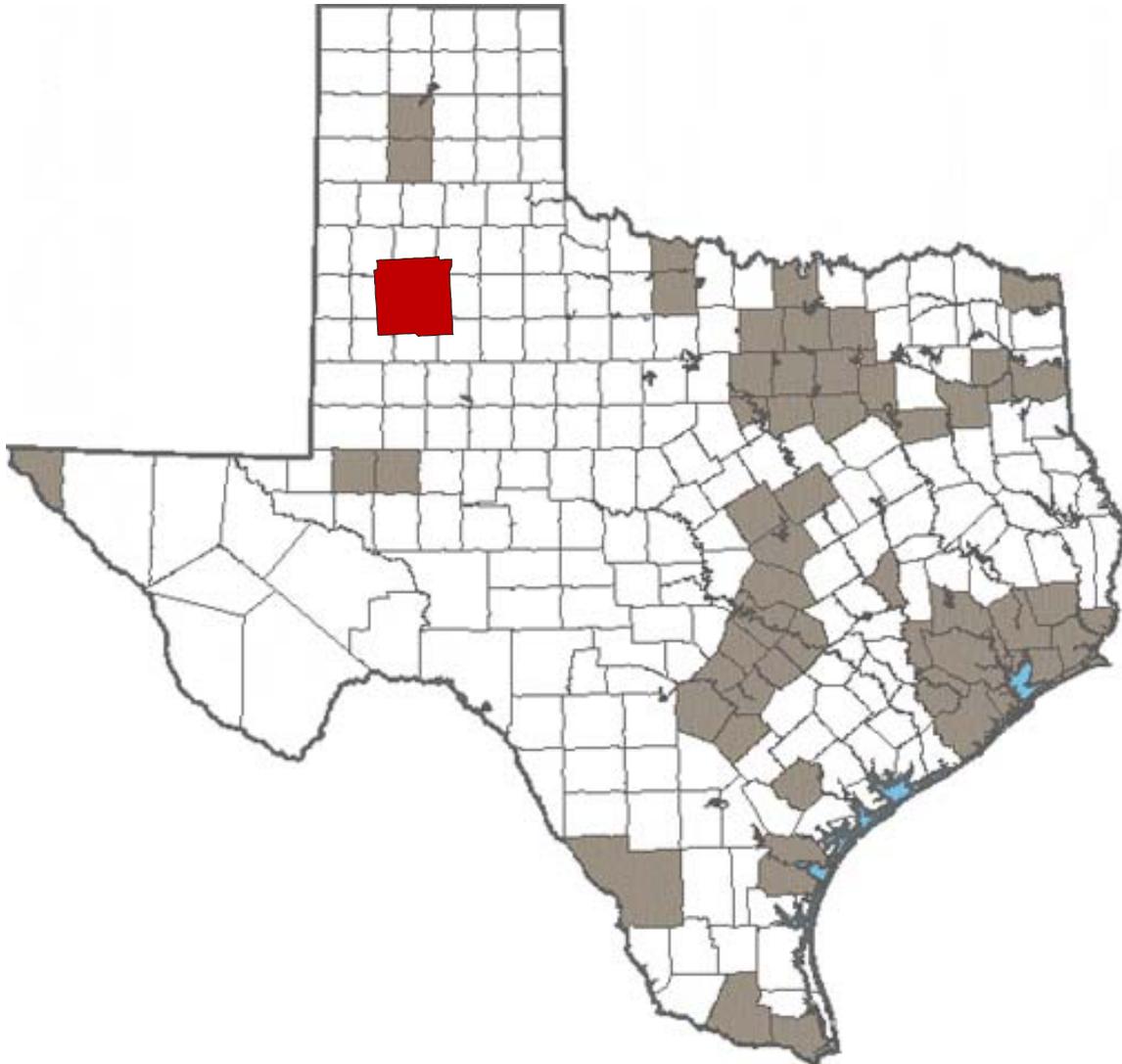


# 2005 Lubbock Commercial Vehicle Survey Technical Summary



Prepared by the  
Texas Transportation Institute  
May 2012



**2005 Lubbock  
Commercial Vehicle Survey**

**TECHNICAL SUMMARY**

**Texas Department of Transportation Travel Survey Program**

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## **DISCLAIMER**

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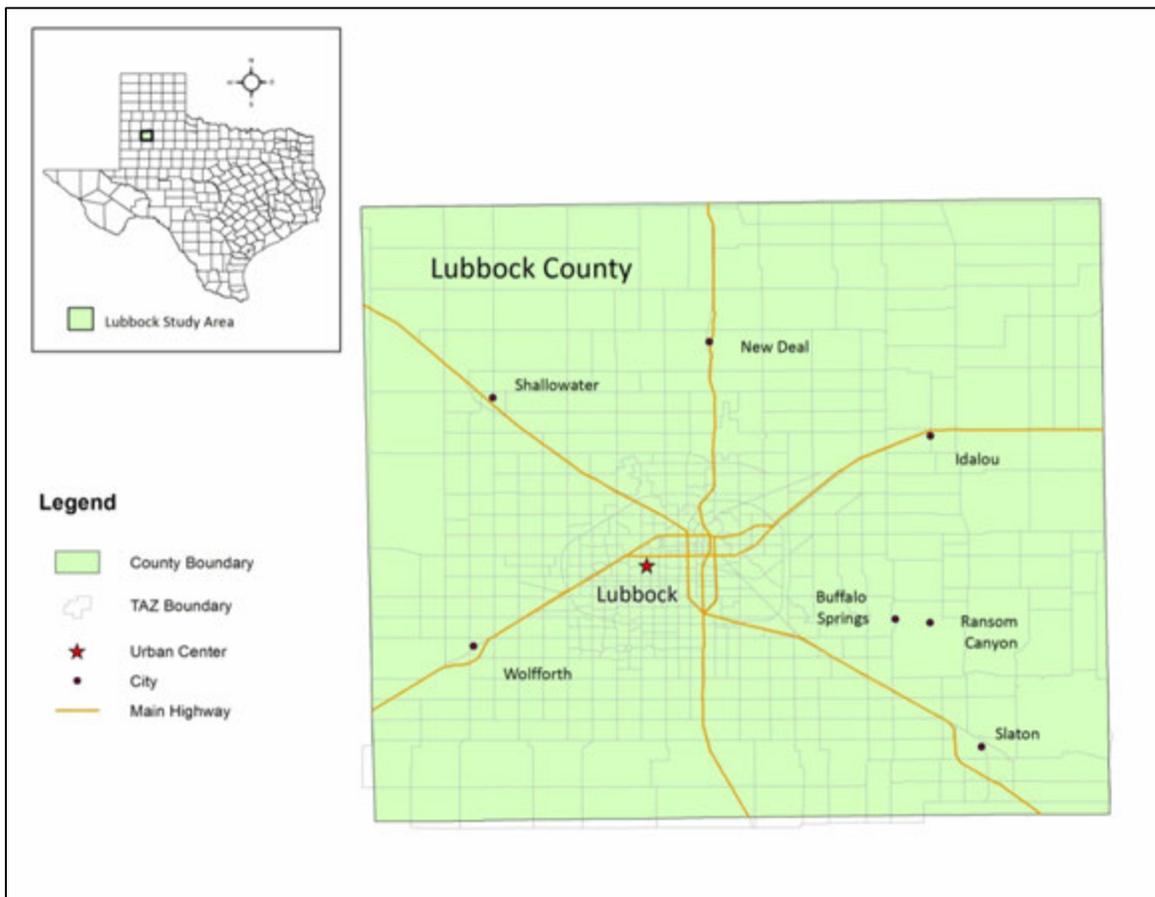
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## INTRODUCTION

In 2005, the Transportation Planning and Programming (TPP) Division of the Texas Department of Transportation (TxDOT) funded a Commercial Vehicle Survey in the Lubbock Metropolitan Planning Organization (MPO) study area. The purpose of this survey was to collect data on travel and trip-making characteristics of commercial vehicles that will enable TxDOT to plan for and forecast total commercial vehicle travel demand within the Lubbock study area.

The study area, shown in Figure 1, is located in northwest Texas, which covers all of Lubbock County, and includes the city of Lubbock as its urban center. The study area had a total population of 278,831, a total land area of 896 square miles and a population density of 311 persons per square mile based on the 2010 Census. The city of Lubbock had a total population of 229,573, a total land area of 122 square miles, and a population density of 1,875 persons per square mile.



**Figure 1. Lubbock MPO Study Area.**

This report presents a technical summary of the commercial vehicle travel survey conducted in 2005 in the Lubbock urban area and documents the data collected and the analysis of results for the study area. The forms used in the survey are included in the Appendix of this report.

## **SURVEY METHODOLOGY**

The commercial vehicle survey for the Lubbock study area was conducted during the spring of 2005 (January to March). Alliance Transportation Group (ATG) was contracted by TxDOT to conduct the commercial vehicle survey for the study area, with technical assistance from the Texas Transportation Institute (TTI). Field observations were conducted to identify companies operating qualifying commercial vehicles in the study area. The information was then used to supplement the Vehicle Registration, Motor Carrier, and Employer databases provided by TxDOT to the contractor. The combined database was sorted according to a list of random numbers assigned to each record to ensure a random sample. Selected businesses were contacted and requested to participate in the survey. Those who agreed to participate were provided survey packets and instructions on how the survey forms should be completed. The drivers of the commercial vehicles were asked to keep a 24-hour diary of the locations of all trips made by each vehicle.

A total of 86 companies participated in the Lubbock commercial vehicle survey, from which a total of 273 commercial vehicle surveys were obtained. Data editing and review processes were performed by TTI to ensure that the survey data collected were complete and followed the guidelines set forth in TxDOT's bid specification for the project. A data check program was also utilized to examine the accuracy of geocoding of locations and logic of survey responses.

## SURVEY RESULTS

### Vehicle Characteristics

This section presents the characteristics of registered trucks and surveyed commercial vehicles to provide an overview of the type and condition of commercial vehicles operating within the Lubbock study area.

Information on registered trucks include the number of diesel-fueled and gasoline-fueled trucks by gross vehicle weight and by model year. Information on surveyed commercial vehicles include the vehicle's make, model and year, odometer reading, gross vehicle weight, vehicle classification, and fuel use.

#### *Registered Commercial Vehicles*

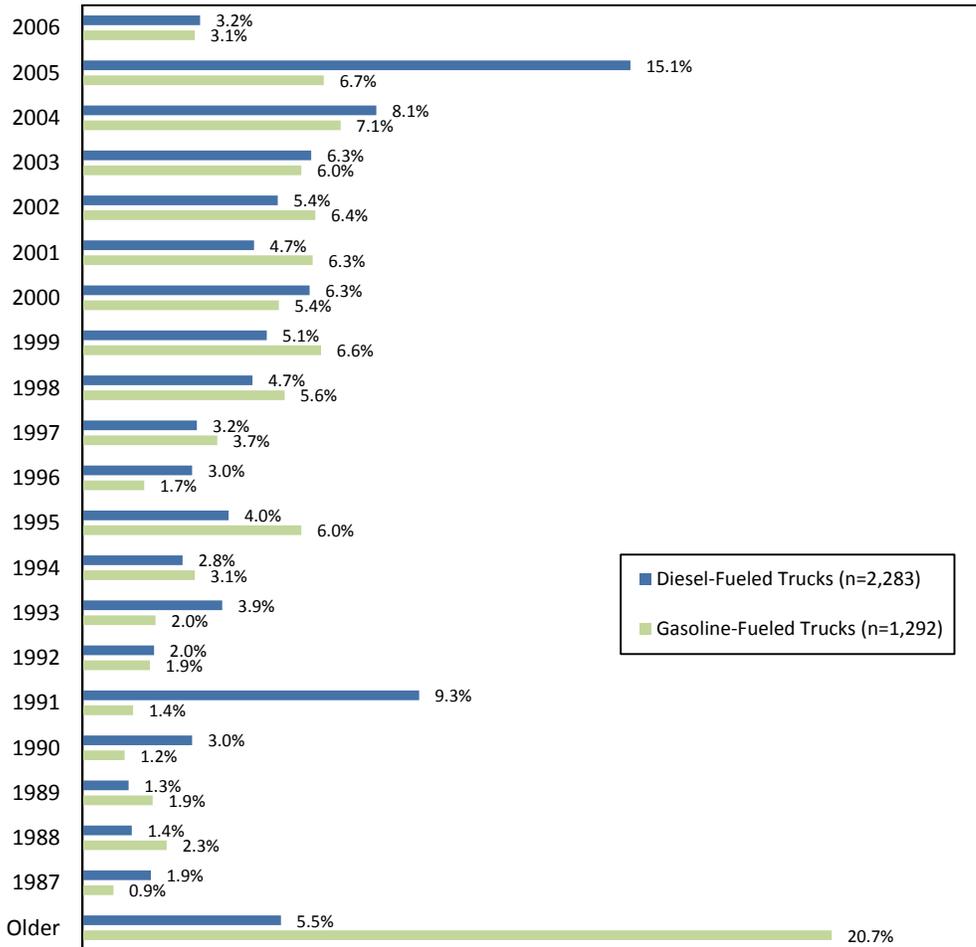
Based on TxDOT's vehicle registration data, there were 3,575 trucks registered in the Lubbock study area in 2005. There were 2,283 diesel-fueled trucks and 1,292 gasoline-fueled trucks, with gross vehicle weights of not less than 8,500 lbs. Approximately 35 percent of the diesel trucks and 41 percent of the gasoline trucks had gross vehicle weights between 8,500 and 10,000 lbs. Table 1 shows the distribution of registered diesel trucks and gasoline trucks by gross vehicle weight. Figure 2 shows the distribution of the trucks by model year, with nearly 50 percent of the diesel trucks and 41 percent of the gasoline trucks being model years 2000 to 2006. Approximately 21 percent of the gasoline trucks were model years prior to 1987, compared to less than 6 percent of the diesel trucks.

**Table 1. Gross Vehicle Weight of Registered Trucks in the Lubbock Study Area.**

Gross Vehicle Weight (1000 lbs.)	Diesel Trucks	Percent of Total	Gasoline Trucks	Percent of Total	All Trucks	Percent of Total
8.5 - 10	799	35.0	526	40.7	1,325	37.1
10 - 14	189	8.3	254	19.7	443	12.4
14 - 16	63	2.8	66	5.1	129	3.6
16 - 19.5	90	3.9	113	8.8	203	5.7
19.5 - 26	292	12.8	216	16.7	508	14.2
26 - 33	420	18.4	83	6.4	503	14.1
33 - 60	372	16.3	30	2.3	402	11.2
> 60	58	2.5	4	0.3	62	1.7
<b>Total Vehicles</b>	<b>2,283</b>	<b>100.0</b>	<b>1,292</b>	<b>100.0</b>	<b>3,575</b>	<b>100.0</b>

Source: TxDOT, 2006.

**Model Year**



**Figure 2. Model Year of Registered Trucks in the Lubbock Study Area.**

*Surveyed Commercial Vehicles*

Commercial vehicles that participated in the Lubbock commercial vehicle survey were distinguished based on the classification types listed in Table 2. The surveyed commercial vehicles were further categorized by commercial type as either major cargo/freight transport or local service vehicles, simply referred to in this report as cargo vehicles and service vehicles.

Cargo vehicles were defined as vehicles mainly used to transport cargo or freight, typically bulk goods, materials, and cargo in large quantities for wholesale distribution. Service vehicles were defined as vehicles mainly used to perform services such as those used by building contractors, plumbers, electricians, cable and telephone services/repairs, and delivery vans/vehicles used by

local retailers. These also included company fleet vehicles or fleets and maintenance vehicles belonging to public agencies such as TxDOT, city, county, or school districts.

Table 2 shows the vehicle classification of the surveyed commercial cargo and service vehicles. Of the total 273 vehicles surveyed, 37 were classified as cargo vehicles and 236 as service vehicles. Among the cargo vehicles, approximately 27 percent were single unit two-axle trucks (six-wheelers), 16 percent were single unit three-axle (10-wheelers), and 57 percent were semi tractor/trailer combinations. Among the service vehicles, approximately 67 percent were single unit two-axle trucks, 16 percent were single unit three-axle trucks, 2 percent were single unit four-axle (14 wheelers), and 14 percent were semi tractor/trailer combinations. There was one vehicle classified as “other,” but this vehicle was re-classified as a semi tractor to properly represent its characteristics.

**Table 2. Vehicle Classification Types of Surveyed Commercial Vehicles.**

Vehicle Classification	Cargo Vehicles		Service Vehicles		All Vehicles	
	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
Single Unit two-axle (six wheels)	10	27.0	158	67.0	168	61.6
Single Unit three-axle (10 wheels)	6	16.2	38	16.1	44	16.1
Single Unit four-axle (14 wheels)	-	-	5	2.1	5	1.8
Semi (all tractor-trailer combinations)	21	56.8	35	14.8	56	20.5
<b>Total Vehicles</b>	<b>37</b>	<b>100.0</b>	<b>236</b>	<b>100.0</b>	<b>273</b>	<b>100.0</b>

Table 3 shows the distribution of surveyed vehicles by fuel type. Approximately 91 percent of the surveyed vehicles used diesel fuel. The remaining 9 percent used gasoline.

**Table 3. Types of Fuel Used by Surveyed Commercial Vehicles.**

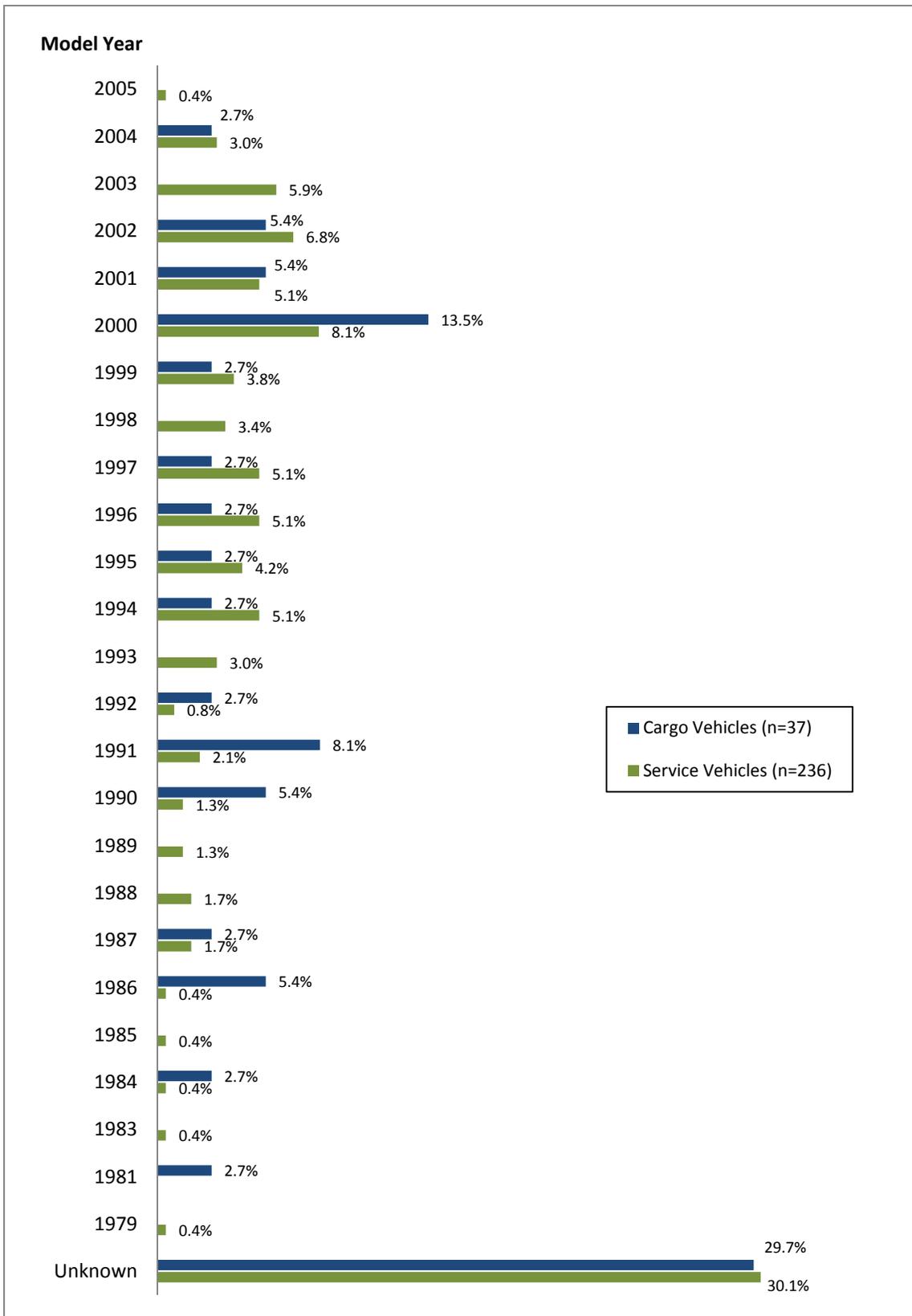
Fuel Type	Cargo Vehicles		Service Vehicles		All Vehicles	
	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
Leaded Gasoline	0	0.0	4	1.7	4	1.5
Unleaded Gasoline	1	2.7	20	8.5	21	7.7
Diesel	36	97.3	212	89.8	248	90.8
<b>Total Vehicles</b>	<b>37</b>	<b>100.0</b>	<b>236</b>	<b>100.0</b>	<b>273</b>	<b>100.0</b>

Table 4 shows the distribution of surveyed vehicles by gross vehicle weight. Approximately 65 percent of the cargo vehicles and 50 percent of the service vehicles weighed more than 19,500 lbs., but not exceeding 80,000 lbs. The gross vehicle weight for approximately 30 percent of the cargo vehicles and 38 percent of the service vehicles were not reported.

**Table 4. Gross Vehicle Weight of Surveyed Commercial Vehicles.**

<b>Gross Vehicle Weight (1000 lbs.)</b>	<b>Cargo Vehicles</b>	<b>Percent of Total</b>	<b>Service Vehicles</b>	<b>Percent of Total</b>	<b>Total Surveyed Vehicles</b>	<b>Percent of Total</b>
< 8.5	-	-	4	1.7	4	1.5
8.5 - 10	-	-	5	2.1	5	1.8
10 - 14	-	-	11	4.7	11	4.0
14 - 16	-	-	6	2.5	6	2.2
16 - 19.5	2	5.4	4	1.7	6	2.2
19.5 - 26	2	5.4	12	5.1	14	5.1
26 - 33	1	2.7	24	10.2	25	9.2
33 - 60	8	21.6	48	20.3	56	20.5
> 60	13	35.2	33	14.0	46	16.9
Unknown	11	29.7	89	37.7	100	36.6
<b>Total Vehicles</b>	<b>37</b>	<b>100.0</b>	<b>236</b>	<b>100.0</b>	<b>273</b>	<b>100.0</b>

Figure 3 shows the distribution of surveyed commercial vehicles by model year. Approximately 47 percent of service vehicles and 35 percent of cargo vehicles were less than 10 years old. The average age for cargo vehicles was 11.4 years, while the average age for service vehicles was 8.8 years.



**Figure 3. Model Year of Surveyed Commercial Vehicles.**

Table 5 shows the average vehicle mileage by model year based on reported odometer readings. Only 95 of the 273 surveyed commercial vehicles reported odometer readings at the beginning of their survey travel day. The average vehicle mileage was 180,792 miles. The majority of these surveyed vehicles were service vehicles.

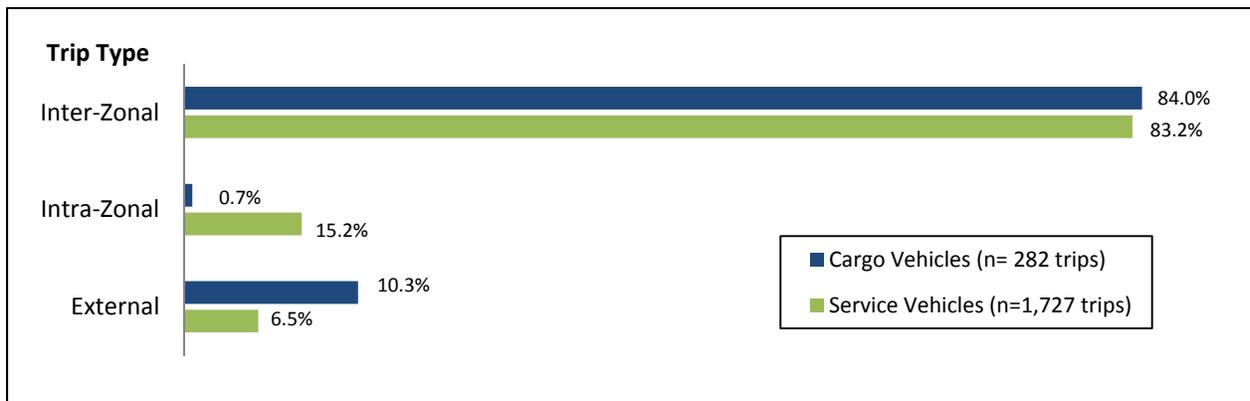
**Table 5. Average of Reported Odometer Readings by Model Year.**

<b>Model Year</b>	<b>Number of Vehicles</b>	<b>Average of Reported Odometer Readings</b>
2004	5	15,508
2003	9	88,504
2002	10	45,379
2001	5	63,182
2000	10	123,002
1999	6	143,117
1998	2	409,135
1997	8	193,212
1996	6	310,198
1995	9	159,468
1994	6	385,792
1993	5	90,211
1992	2	182,537
1991	1	455,620
1990	2	452,332
1989	2	86,855
1988	1	164,055
1987	2	448,463
1985	1	85,868
Unknown	3	656,892
<b>Total</b>	<b>95</b>	<b>180,792</b>

## Trip Frequency

The surveyed commercial vehicles generated a total of 2,009 trips, of which 1,854 were internal trips and 155 were external trips. Internal trips were defined as those trips made within the Lubbock study area, and they were further distinguished by travel within or between zones. Inter-zonal trips were those trips made from one zone to another, while intra-zonal trips were those made within the same zone. External trips were defined as trips made outside of the study area, i.e., that had one or both trip ends outside the study area.

Figure 4 shows the distribution of inter-zonal, intra-zonal and external trips, while Table 6 provides a breakdown of these trips. Approximately 92 percent of the total trips were internal, of which 83 percent were inter-zonal and 9 percent were intra-zonal. The remaining 8 percent were external trips. Cargo vehicles generated 282 trips, of which approximately 84 percent were inter-zonal trips, less than one percent were intra-zonal trips, and 15 percent were external trips. Service vehicles generated 1,727 trips, of which 83 percent were inter-zonal trips, 10 percent were intra-zonal trips, and approximately 7 percent were external trips.

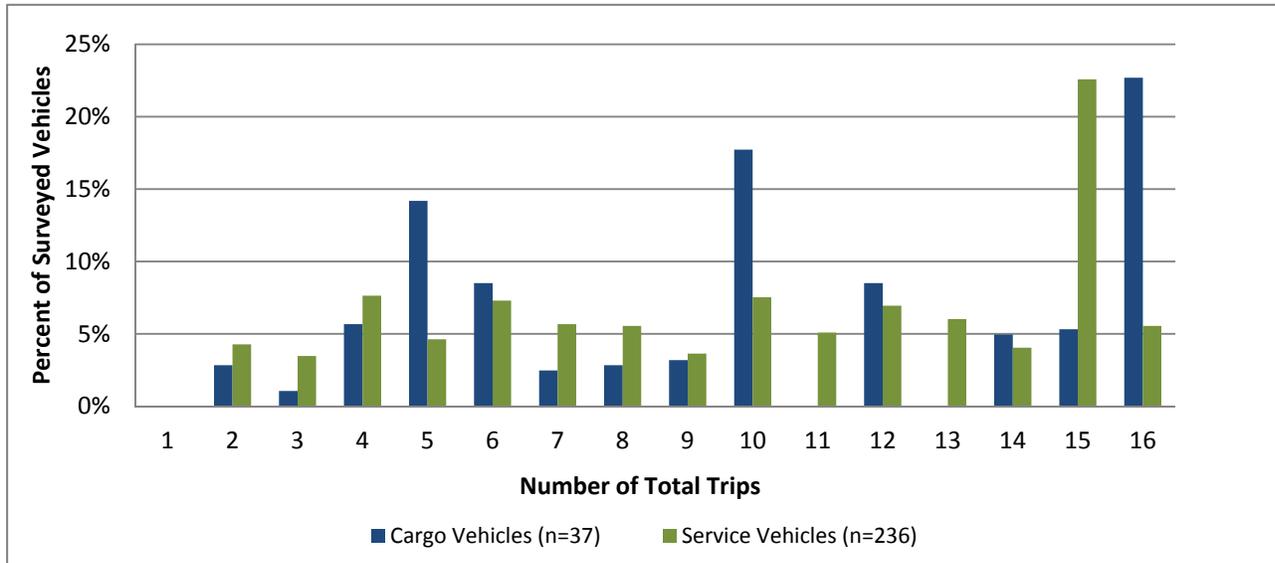


**Figure 4. Inter-Zonal, Intra-Zonal, and External Trips.**

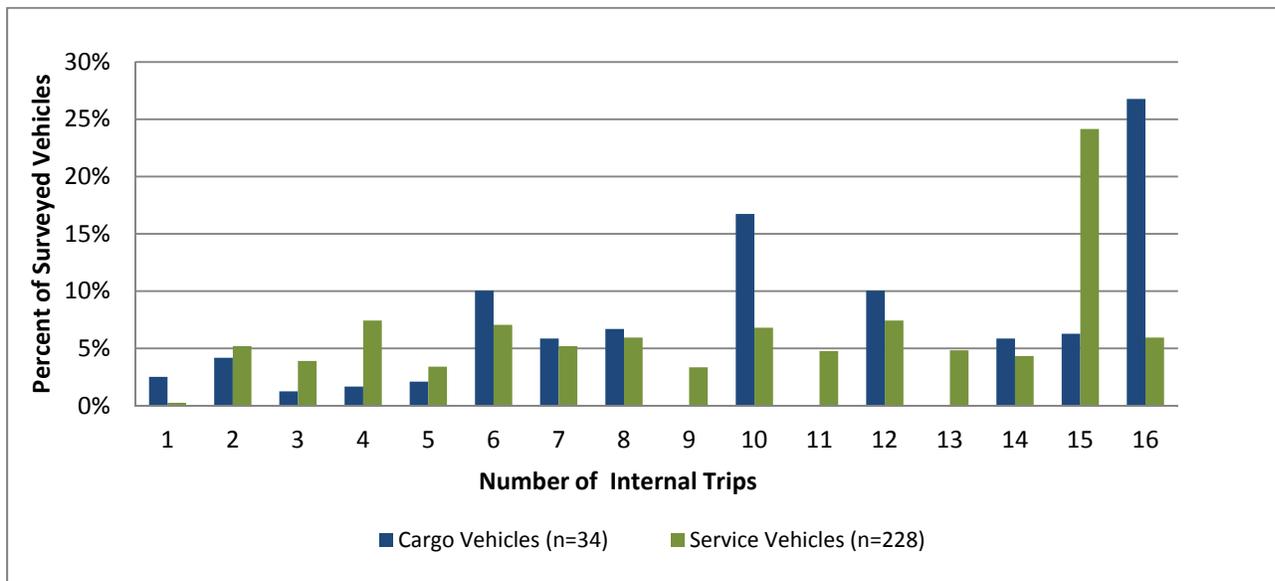
**Table 6. Total Internal and External Trips.**

Trip Type	Cargo Vehicles		Service Vehicles		All Vehicles	
	Number of Trips	Percent of Total	Number of Trips	Percent of Total	Number of Trips	Percent of Total
Inter-Zonal	237	84.0	1,437	83.2	1,674	83.3
Intra-Zonal	2	0.7	178	10.3	180	9.0
<b>Total Internal</b>	<b>239</b>	<b>84.8</b>	<b>1,615</b>	<b>93.5</b>	<b>1,854</b>	<b>92.3</b>
External	43	15.2	112	6.5	155	7.7
<b>Total Trips</b>	<b>282</b>	<b>100.0</b>	<b>1,727</b>	<b>100.0</b>	<b>2,009</b>	<b>100.0</b>

Figure 5 shows the distribution of total commercial vehicle trips (internal and external trips), which varied from two to 16 trips per cargo and service vehicle. Figure 6 shows the distribution of total internal trips only, which varied from one to 16 trips per vehicle. The average number of total trips per day was 7.6 trips for cargo vehicles and 7.3 trips for service vehicles. The average number of internal trips per day was 7.0 trips per cargo vehicle and 7.1 trips per service vehicle.



**Figure 5. Total Trips per Vehicle.**



**Figure 6. Total Internal Trips per Vehicle.**

## Trip Characteristics

Information on travel purpose and the type of land use activity where these trips occurred are important in estimating commercial vehicle trip patterns. The analyses presented in this section pertain only to internal trips made by surveyed cargo and service vehicles and does not include external trips.

Table 7 shows the distribution of internal trips by land use type at trip destinations. Approximately 29 percent of the trips made by cargo vehicles occurred at construction sites, followed by 26 percent at industrial sites. For service vehicles, approximately 31 percent of the trips occurred at other sites, followed by 18 percent at retail/shopping sites, and 12 percent at construction sites.

**Table 7. Distribution of Internal Trips by Land Use Type at Trip Destinations.**

Land Use Type	Cargo Vehicles	Percent of Total	Service Vehicles	Percent of Total	All Vehicles	Percent of Total
Office Building (non-government)	2	0.8	47	2.9	49	2.6
Retail/Shopping	26	10.9	292	18.1	318	17.2
Industrial/Manufacturing	61	25.5	140	8.6	201	10.8
Medical/Hospital	1	0.4	18	1.1	19	1.0
Education	0	0.0	35	2.2	35	1.8
Government Office/Building	20	8.4	8	0.5	28	1.5
Residential	13	5.4	124	7.7	137	7.4
Airport	0	0.0	5	0.3	5	0.2
Intermodal Facility	0	0.0	1	0.1	1	0.1
Warehouse	0	0.0	33	2.0	33	1.8
Distribution Center	20	8.4	61	3.8	81	4.4
Construction Site	69	28.9	199	12.3	268	14.5
Other	27	11.3	499	30.9	526	28.4
Refused/Unknown	0	0.0	153	9.5	153	8.3
<b>Total Trips</b>	<b>239</b>	<b>100.0</b>	<b>1,615</b>	<b>100.0</b>	<b>1,854</b>	<b>100.0</b>

Table 8 shows the distribution of internal trips by trip purposes at trip destinations. Approximately 55 percent of the trips made by cargo vehicles were delivery, 23 percent were return-to-base location, and 16 percent were pick-up. Some cargo vehicles also reported service-related trip purposes. For trips made by service vehicles, approximately 55 percent were delivery, 19 percent were return-to-base location, 11 percent were service-related trip purpose, and 9 percent were pick-up.

**Table 8. Trip Purposes at Destination Locations.**

<b>Trip Purpose</b>	<b>Cargo Vehicles</b>	<b>Percent of Total</b>	<b>Service Vehicles</b>	<b>Percent of Total</b>	<b>All Vehicles</b>	<b>Percent of Total</b>
Return to Base Location	56	23.4	308	19.1	364	19.6
Delivery	132	55.2	880	54.5	1,012	54.6
Pick-Up	38	15.9	147	9.1	185	10.0
Pick-Up and Delivery	0	0.0	57	3.5	57	3.1
Maintenance (fuel, oil, etc.)	0	0.0	9	0.6	9	0.5
Driver Needs (lunch, etc.)	5	2.1	27	1.7	32	1.7
To Home	0	0.0	4	0.2	4	0.2
Service-Related	8	3.4	183	11.3	191	10.3
<b>Total Trips</b>	<b>239</b>	<b>100.0</b>	<b>1,615</b>	<b>100.0</b>	<b>1,854</b>	<b>100.0</b>

### **Cargo Characteristics**

Information on the type of cargo or goods being delivered or picked up at each stop, the weight of cargo, and the type of land use where the trip occurred were collected in the Lubbock commercial vehicle survey to examine the movement of commodities within and outside of the study area.

The analyses presented in this section pertain to internal as well as external trips made by all surveyed vehicles. It was deemed reasonable not to limit the analyses to cargo vehicle trips but to also include the trips made by the surveyed service vehicles since these vehicles also reported transporting goods at trip origin and destination locations.

The analysis of cargo trip data examined the types of cargo being reported at trip destinations, the trip purpose, land use activity, and estimated net weight of cargo being picked up and/or delivered for each trip. There were several inconsistencies observed in the cargo trip data. Some trips reported cargo being transported but did not provide the cargo weight. Some trips reported empty cargo, but the cargo being transported during the trip remained in transit. There were some trips that reported the cargo weight at pick-up but the weight was not consistent at drop-off. Such inconsistencies generated errors in the estimation of the cargo net weight for that particular trip. Hence, it was necessary to manually process the cargo trip data, and use the researchers' judgment when making changes.

Table 9 lists the types of cargo in the survey based on 22 classification types.

**Table 9. Cargo Classification Types.**

Survey Cargo Classification	Cargo Description
1. Farm Products	Livestock, fertilizer, dirt, landscaping, etc.
2. Forest Products	Trees, sod, etc.
3. Marine Products	Fresh fish, seafood, etc.
4. Metals and Minerals	Crude petroleum, natural gas, propane, metal, gypsum, etc.
5. Food, Health, and Beauty Products	Assorted food products, cosmetics, etc.
6. Tobacco Products	Cigarettes, cigars, and chewing tobacco
7. Textiles	Clothing, linens, etc.
8. Wood Products	Lumber, paper, cardboard, wood pulp, etc.
9. Printed Matter	Newspapers, magazines, books, etc.
10. Chemical Products	Soap, paint, household or industrial chemicals, etc.
11. Refined Petroleum or Coal	Gasoline, etc.
12. Rubber, Plastic, and Styrofoam	Finished products of rubber, plastic, or Styrofoam
13. Clay, Concrete, Glass, or Stone	Finished products of clay, concrete, glass, or stone
14. Manufactured Goods/Equipment	Miscellaneous products - machinery, appliances, furniture, etc.
15. Wastes	Waste products including scrap and recyclable materials
16. Miscellaneous Shipments	U.S. mail, U.P.S., Federal Express, and other mixed cargo
17. Hazardous Materials	Hazardous chemicals and substances
18. Transportation	Automobiles and other transport vehicles
19. Unclassified Cargo	Cargo not falling within one of the above categories
20. Driver Refused to Answer	Driver refused to answer
21. Unknown to Driver	Unknown to driver
22. Empty	Empty (including empty shipping containers)

Table 10 shows the distribution of trips by cargo type. Approximately 22 percent of the total trips that reported cargo were transporting food, health, and beauty products or manufactured goods and equipment. More than 15 percent were miscellaneous shipments, and 14 percent were clay, concrete, glass or stone products. Approximately 21 percent of the total surveyed reported empty cargo, including empty shipping containers.

**Table 10. Type of Cargo being Transported at Tip Destinations.**

<b>Cargo Type</b>	<b>Number of Trips</b>	<b>Percent of Total</b>
Farm Products	146	9.2
Forest Products	14	0.9
Metals and Minerals	19	1.2
Food, Health, and Beauty Products	351	22.0
Textiles	47	3.0
Wood Products	79	5.0
Chemical Products	2	0.1
Refined Petroleum or Coal Products	2	0.1
Rubber, Plastic, and Styrofoam Products	1	0.1
Clay, Concrete, Glass, or Stone	223	14.0
Manufactured Goods/Equipment	359	22.5
Wastes	31	1.9
Miscellaneous Shipments	243	15.3
Hazardous Materials	3	0.2
Transportation	39	2.4
Unclassified/Other Cargo	22	1.4
Unknown to Driver	12	0.8
<b>Total Trips with Cargo</b>	<b>1,593</b>	<b>79.3<sup>1</sup></b>
<b>Empty</b>	<b>416</b>	<b>20.7<sup>1</sup></b>
<b>Total Surveyed Trips</b>	<b>2,009</b>	<b>100.0</b>

<sup>1</sup> Value was calculated from total surveyed trips.

The commodity grouping scheme used by TxDOT in the Texas Statewide Analysis Model (SAM) was used to simplify the cargo types into 10 commodity groups. The type of place options in the survey were categorized into seven land use categories. Table 11 shows the equivalency between SAM commodity groups and cargo classifications from the survey, while Table 12 shows the land use categories and their corresponding equivalents in the type of place options from the survey. Those items in *italics* did not have equivalents but were added or grouped together so as not to exclude any trips in the analysis.

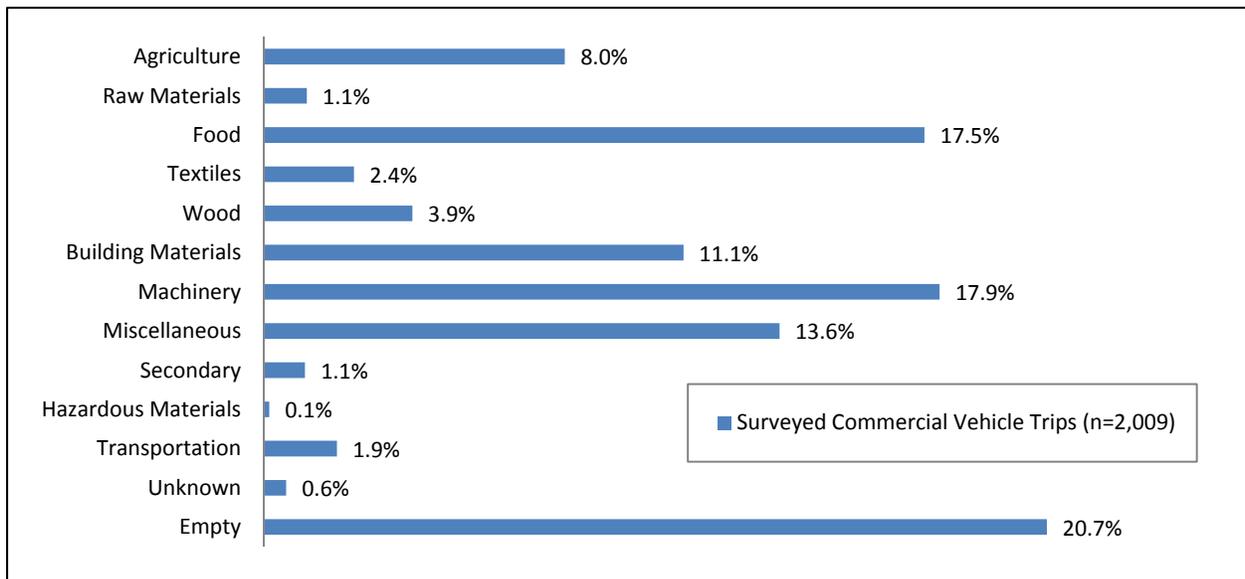
**Table 11. Equivalency between SAM Commodity Groups and Survey Classifications.**

Commodity Group	Survey Cargo Classification
1 Agriculture	Farm Products, Forest Products, Marine Products
2 Raw Materials	Metals and Minerals, Chemical Products, Refined Petroleum, Coal
3 Food	Food, Health and Beauty Products, Tobacco Products
4 Textiles	Textiles, Rubber, Plastic, and Styrofoam Products
5 Wood	Wood Products, Printed Matter
6 Building Materials	Clay, Concrete, Glass or Stone Products
7 Machinery	Manufactured Goods/Equipment
8 Miscellaneous	Wastes, Miscellaneous Shipments
9 Secondary	Unclassified Cargo
10 Hazardous Materials	Hazardous Materials
<i>Transportation</i>	<i>Transportation</i>
<i>Empty</i>	<i>Empty</i>
<i>Unknown</i>	<i>Unknown to Driver/ Driver Refused to Answer</i>

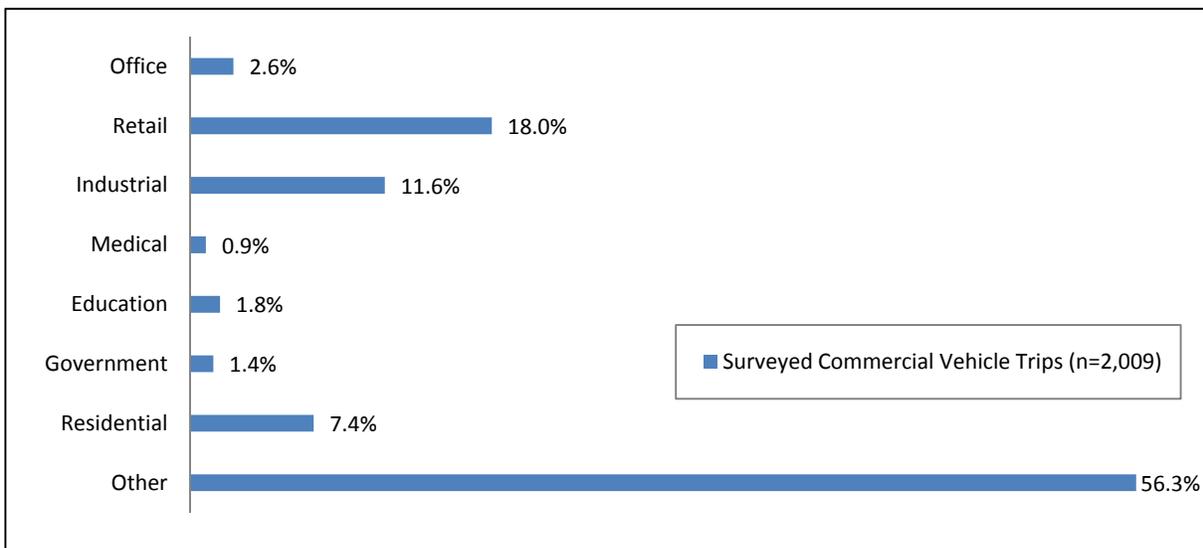
**Table 12. Equivalency between Land Use Category and Survey Type of Place.**

Land Use Category	Survey Type of Place
1 Office	Office Building
2 Retail	Retail/Shopping
3 Industrial	Industrial/Manufacturing
4 Medical	Medical/Hospital
5 Education	Educational (12th grade or less and college, trade, etc.)
6 Government	Government Office/Building
7 Residential	Residential
<i>Other</i>	<i>Airport, Inter-Modal Facility, Warehouse, Distribution Center, Construction Site, Other</i>

Figures 7 and 8 show the percentage distribution of commercial vehicle trips by commodity group and land use type at the destinations, respectively. Approximately 56 percent of the trips occurred at “other” land use types, which were reported to be construction sites, maintenance facilities, and restaurants. Approximately 18 percent of the trips occurred at retail sites, 12 percent occurred at industrial sites, and 7 percent occurred at residential sites. Table 13 provides a breakdown of total trips by commodity group and land use type at the destinations.



**Figure 7. Commodity Groups at Trip Destinations.**



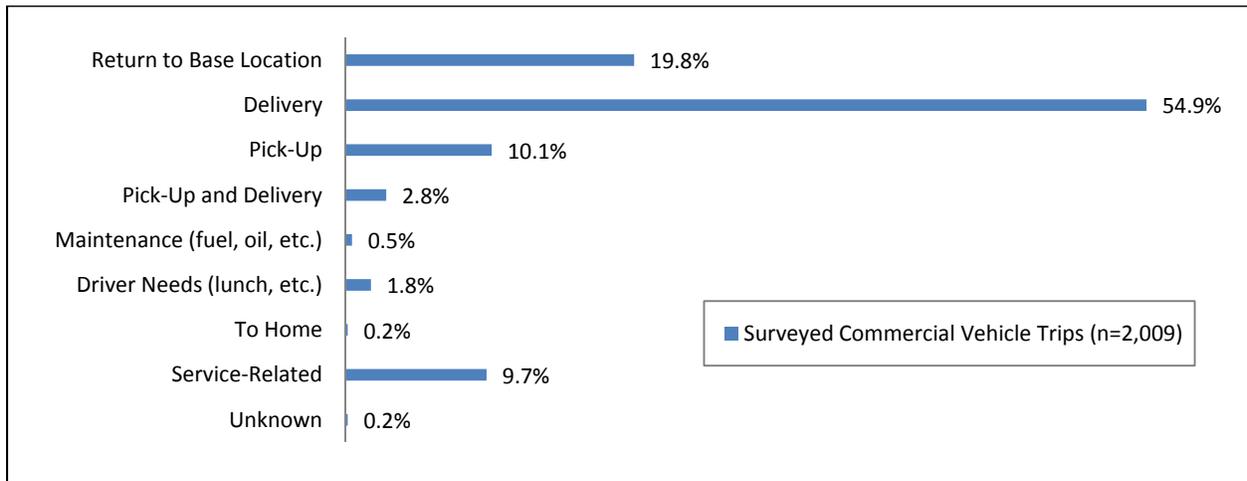
**Figure 8. Land Use Types at Trip Destinations.**

**Table 13. Number of Trips by Commodity Group and Land Use at Destinations.**

Commodity Group	Land Use								Total Trips	Percent of Total
	Office	Retail	Industrial	Medical	Education	Government	Residential	Other		
Agriculture	-	10	26	-	-	1	3	120	<b>160</b>	<b>8.0</b>
Raw Materials	-	-	6	-	-	1	8	8	<b>23</b>	<b>1.2</b>
Food	-	152	1	3	19	-	16	160	<b>351</b>	<b>17.5</b>
Textiles	6	15	6	3	2	3	1	12	<b>48</b>	<b>2.4</b>
Wood	3	22	7	1	6	-	-	40	<b>79</b>	<b>3.9</b>
Building Materials	1	6	4	-	1	-	6	205	<b>223</b>	<b>11.1</b>
Machinery	16	70	39	9	7	1	63	154	<b>359</b>	<b>17.9</b>
Miscellaneous	7	34	41	1	-	1	1	189	<b>274</b>	<b>13.6</b>
Secondary	9	-	-	-	-	-	-	13	<b>22</b>	<b>1.1</b>
Hazardous Materials	1	-	-	2	-	-	-	-	<b>3</b>	<b>0.1</b>
Transportation	1	5	4	-	1	-	3	25	<b>39</b>	<b>1.9</b>
Empty	8	47	99	-	-	20	47	195	<b>416</b>	<b>20.7</b>
Unknown	-	-	-	-	-	1	-	11	<b>12</b>	<b>0.6</b>
<b>Total</b>	<b>52</b>	<b>361</b>	<b>233</b>	<b>19</b>	<b>36</b>	<b>28</b>	<b>148</b>	<b>1,132</b>	<b>2,009</b>	<b>100.0</b>
<b>Percent of Total</b>	<b>2.6</b>	<b>18.0</b>	<b>11.6</b>	<b>0.9</b>	<b>1.8</b>	<b>1.4</b>	<b>7.4</b>	<b>56.3</b>	<b>100.0</b>	

The analysis of cargo weight by cargo type provides information on the volume and type of commodities being moved from the time the surveyed cargo vehicle left its base location, began its trip, and continued making trips until it reached its destination and returned to its base location. The net cargo weight for each trip was estimated based on the cargo weight being picked-up and/or being dropped-off, consistent with the reported trip purpose for each stop. There were several cases when cargo types were changed between trips (i.e., reported as empty cargo), when the cargo still remained in transit. In such cases, the cargo weight from the trip origin was used as the net cargo weight at that particular stop or trip destination with its corresponding cargo type. If a delivery occurred during that particular stop, the cargo weight for that particular drop-off was deducted from the current weight load, and if cargo was picked-up, the cargo weight was added to the current weight load, thus resulting in an estimated net cargo weight for that particular trip.

Figure 9 shows the distribution of trips at destination locations by trip purpose, while Table 14 shows a detailed summary of trips by commodity group and trip purpose. Approximately 55 percent of the trips were delivery, with food, miscellaneous shipments, machinery, and building materials being the most frequently delivered commodities. The trip purpose “pick-up” comprised 10 percent of the total trips. The “return-to-base location” trip purpose represented nearly 20 percent of the total trips. It was apparent, however, that some of these base location trips were also the pick-up locations for cargo. Approximately 10 percent of the total trips were service-related.



**Figure 9. Trip Purposes at Trip Destinations.**

**Table 14. Number of Trips by Commodity Group and Trip Purpose at Destinations.**

Commodity Group	Trip Purpose									Total Trips
	Return to Base Location	Delivery	Pick-Up	Pick-Up and Delivery	Maintenance	Driver Needs	To Home	Service-Related	Unknown	
Agriculture	25	97	22	1	-	3	-	12	-	<b>160</b>
Raw Materials	2	11	-	7	1	1	-	1	-	<b>23</b>
Food	6	320	14	-	-	-	-	11	-	<b>351</b>
Textile	1	1	-	44	-	1	-	1	-	<b>48</b>
Wood	4	71	2	-	2	-	-	-	-	<b>79</b>
Building Materials	23	137	50	-	-	1	-	12	-	<b>223</b>
Machinery	43	188	41	-	3	10	1	73	-	<b>359</b>
Miscellaneous	9	251	10	1	-	-	-	3	-	<b>274</b>
Secondary	5	4	1	4	-	-	-	8	-	<b>22</b>
Hazardous Materials	-	-	3	-	-	-	-	-	-	<b>3</b>
Transportation	14	12	13	-	-	-	-	-	-	<b>39</b>
Empty	263	11	46	-	4	20	1	71	-	<b>416</b>
Unknown	3	-	-	-	-	-	2	3	4	<b>12</b>
<b>Total Trips</b>	<b>398</b>	<b>1,103</b>	<b>202</b>	<b>57</b>	<b>10</b>	<b>36</b>	<b>4</b>	<b>195</b>	<b>4</b>	<b>2,009</b>
<b>Percent of Total</b>	<b>19.8</b>	<b>54.9</b>	<b>10.1</b>	<b>2.8</b>	<b>0.5</b>	<b>1.8</b>	<b>0.2</b>	<b>9.7</b>	<b>0.2</b>	<b>100.0</b>

Table 15 shows the distribution of average net cargo weight per trip by commodity group and land use at destination locations, and Table 16 shows the distribution by commodity group and trip purpose. Agricultural products being transported to industrial sites showed the highest average net cargo weight, followed by building materials being transported to residential, industrial, and other sites.

**Table 15. Average Net Cargo Weight by Commodity Group and Land Use at Destinations.**

Commodity Group	Land Use (Average Net Cargo Weight in lbs. per Trip) <sup>1</sup>							
	Office	Retail	Industrial	Medical	Education	Government	Residential	Other
Agriculture	-	9,500	78,000	-	-	2,000	3,333	27,939
Raw Materials	-	-	10,678	-	-	1,860	2,418	8,929
Food	-	1,861	-	2,886	6	-	6,438	1,106
Textiles	200	200	200	200	200	200	200	200
Wood	1,305	9,108	7,538	1,400	830	-	-	3,965
Building Materials	-	1,000	39,200	-	-	-	40,000	44,967
Machinery	1,537	1,718	5,293	549	375	-	444	12,280
Miscellaneous	550	1,211	2,753	-	-	-	550	19,515
Secondary	400	-	-	-	-	-	-	513
Hazardous Materials	500	-	-	500	-	-	-	-
Transportation	3,000	3,000	5,035	-	3,000	-	3,167	3,391

<sup>1</sup> Excluding empty vehicles.

**Table 16. Average Net Cargo Weight by Commodity Group and Trip Purpose at Trip Destinations.**

Commodity Group	Trip Purpose (Average Net Cargo Weight in lbs. per Trip) <sup>1</sup>							
	Base Location	Delivery	Pick-Up	Pick-Up and Delivery	Maintenance	Driver Needs	Service-Related	Other
Agriculture	41,206	34,932	38,727	12,000	-	2,000	-	11,091
Raw Materials	-	2,487	-	10,429	12,000	6,000	-	-
Food	1,003	1,321	-	-	-	-	-	8,052
Textiles	-	-	-	200	-	200	-	-
Wood	19,967	3,412	21,550	-	30,250	-	-	-
Building Materials	40,517	44,777	55,699	-	-	-	-	4,384
Machinery	6,360	3,418	13,159	-	1,000	16,400	450	5,485
Miscellaneous	7,854	5,602	28,776	30,000	-	-	-	8,667
Secondary	513	380	300	446	-	-	-	-
Hazardous Materials	-	-	500	-	-	-	-	-
Transportation	3,117	4,357	3,038	-	-	-	-	-

<sup>1</sup> Excluding empty vehicles.

Table 17 shows distribution of trips and net cargo weights at the trip destinations by commodity group. Overall, the average net cargo weight was approximately 14,378 lbs. per trip. Building materials showed the highest average net cargo weight of 44,630 lbs. per trip. However, machinery and food were the most frequently transported commodity groups with average net cargo weight per trip of approximately 5,155 lbs. and 1,633 lbs., respectively.

**Table 17. Total Trips and Net Cargo Weight by Commodity Group at Trip Destinations.**

Commodity Group	Total Trips	Total Net Cargo Weight (lbs.)	Number of Trips <sup>1</sup>	Average Net Cargo Weight (lbs.) <sup>1</sup>
Agriculture	160	4,311,110	126	34,215
Raw Materials	23	110,899	17	6,523
Food	351	382,132	234	1,633
Textiles	48	9,000	45	200
Wood	79	361,396	65	5,560
Building Materials	223	7,230,010	162	44,630
Machinery	359	1,185,590	230	5,155
Miscellaneous	274	645,219	65	9,926
Secondary	22	6,168	14	441
Hazardous Materials	3	1,500	3	500
Transportation	39	135,420	39	3,472
Empty	416	-	-	-
Unknown	12	-	-	-
<b>Total</b>	<b>2,009</b>	<b>14,378,444</b>	<b>1,000</b>	<b>14,378</b>

<sup>1</sup> Excluding trips with empty cargo and unknown cargo weights.

Table 18 shows the distribution of trips and net cargo weights at the trip destinations by land use type. Industrial sites showed the highest average net cargo weight of 20,641 lbs. per trip, followed by “other” land use category with an average net cargo weight of 20,584 lbs. per trip. However, the highest frequency of trips occurred at retail sites, with an average net cargo weight of 2,754 lbs. per trip.

Table 19 shows the distribution of trips and net cargo weights at the trip destinations by trip purpose. The pick-up trip purpose had the highest average net weight of 33,462 lbs. per trip. However, there were more delivery trips, with an average net cargo weight of 11,170 lbs. per trip. The return-to-base location trip purpose showed an average net cargo weight of 21,572 lbs. per trip. These were believed to be trips intended to re-load or pick-up cargo from the base location.

**Table 18. Total Trips and Net Cargo Weights by Land Use at Trip Destinations.**

Land Use	Total Trips	Total Net Cargo Weight (lbs.)	Number of Trips <sup>1</sup>	Average Net Cargo Weight (lbs.) <sup>1</sup>
Office	52	28,134	31	908
Retail	361	514,977	187	2,754
Industrial	233	1,919,615	93	20,641
Medical	19	13,715	17	807
Education	36	10,717	29	370
Government	28	4,460	5	892
Residential	148	195,072	70	2,787
Other	1,132	11,691,754	568	20,584
<b>Total</b>	<b>2,009</b>	<b>14,378,444</b>	<b>1,000</b>	<b>14,378</b>

<sup>1</sup> Excluding trips with empty cargo and unknown cargo weights.

**Table 19. Total Trips and Net Cargo Weights by Trip Purpose at Trip Destinations.**

Trip Purpose	Total Trips	Total Net Cargo Weight (lbs.)	Number of Trips <sup>1</sup>	Average Net Cargo Weight (lbs.) <sup>1</sup>
Return to Base Location	398	2,049,381	95	21,572
Delivery	1,103	7,316,435	655	11,170
Pick-Up	202	4,417,035	132	33,462
Pick-Up and Delivery	57	125,585	57	2,203
Maintenance (fuel, oil, etc.)	10	73,500	4	18,375
Driver Needs (lunch, etc.)	36	24,600	4	6,150
To Home	4	450	1	450
Service-Related	195	371,458	52	7,143
Unknown	4	-	-	-
<b>Total</b>	<b>2,009</b>	<b>14,378,444</b>	<b>1,000</b>	<b>14,378</b>

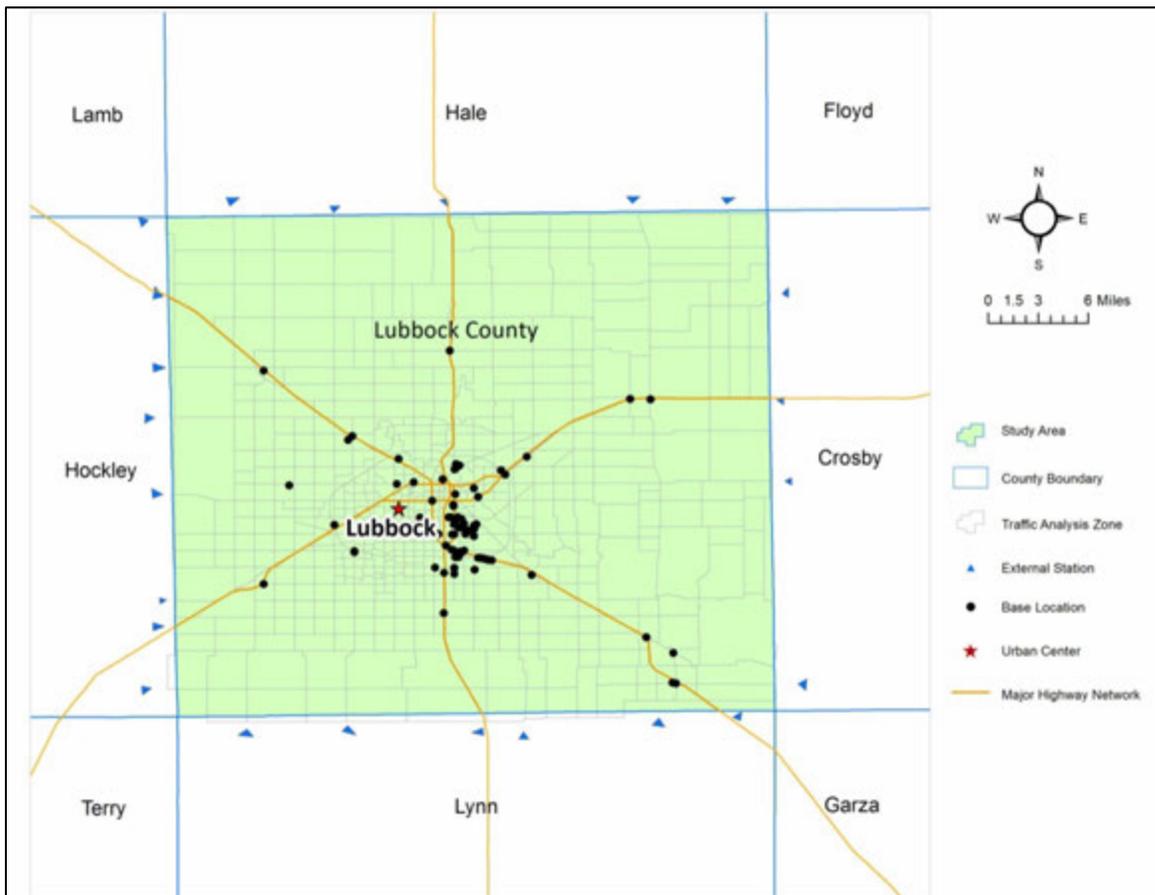
<sup>1</sup> Excluding trips with empty cargo and unknown cargo weights.

## Trip Length

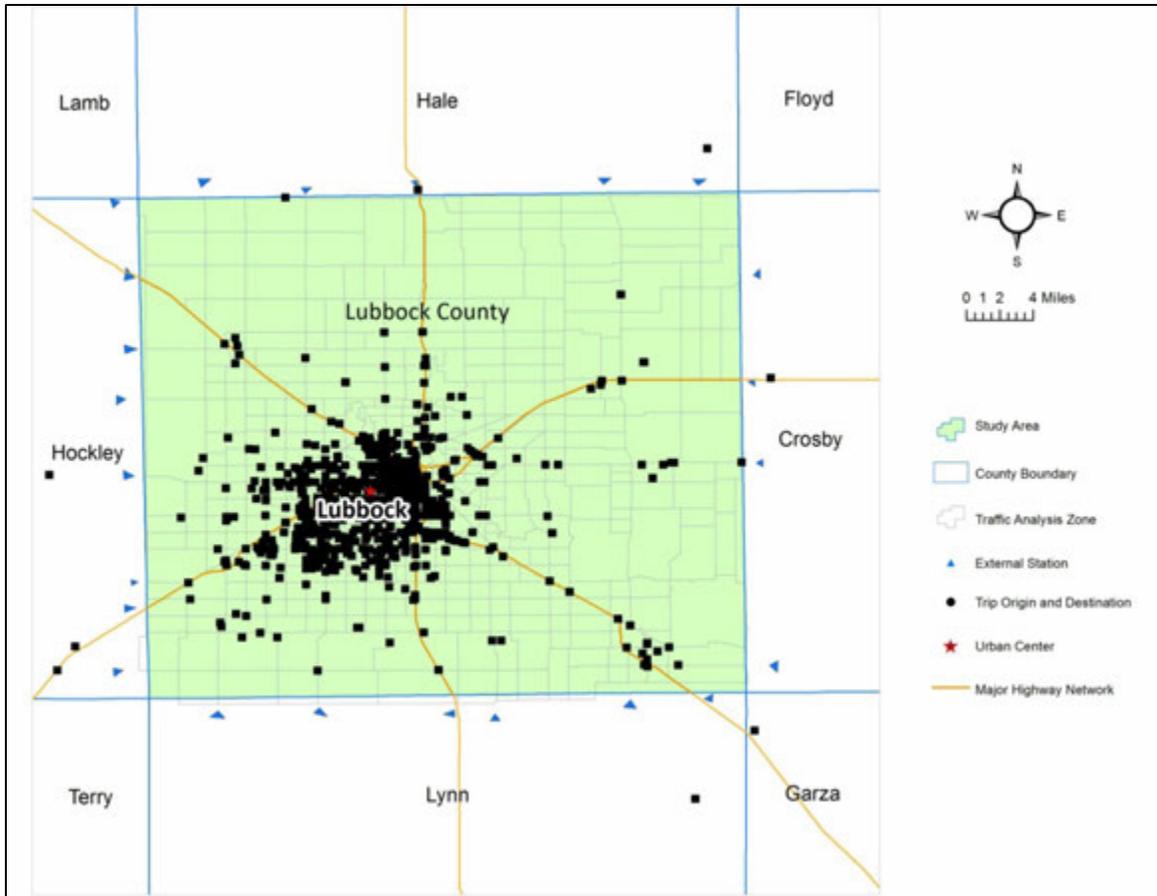
The network matrices available for the Lubbock study area provide travel distance and time estimates from one zone to another zone. Since each reported trip in the survey was coded with a traffic analysis zone (TAZ) number assigned in the study area, it was then possible to estimate the trip length based on the distance provided in the network matrix.

The results presented here pertain to 1,622 inter-zonal trips only, where trip lengths for origin and destination zones were available. There were 52 reported trips within the Lubbock study area that were not included in the analysis and estimation of average trip lengths because the origin and/or destination zones could not be determined based on unknown locations.

Figure 10 shows the TAZ boundary and base locations of surveyed vehicles within the Lubbock study area, while Figure 11 shows the origin and destination locations of trips made by the surveyed vehicles. Any trip that occurred outside of the study area was considered an external trip.



**Figure 10. TAZ Boundary and Base Locations of Surveyed Commercial Vehicles.**



**Figure 11. Trip Origin and Destination Locations of Surveyed Commercial Vehicles.**

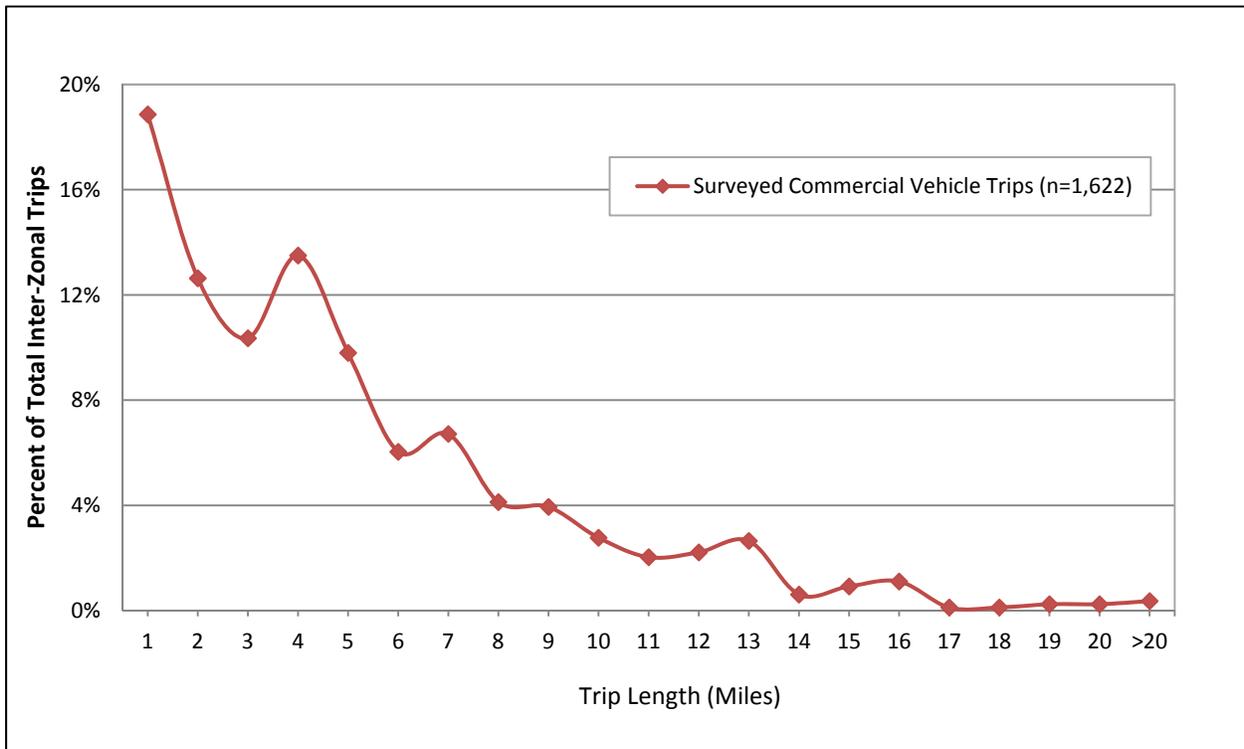
Table 20 shows the trip length frequency distributions (TLFDs), grouped at five-mile intervals, while Table 21 and Figure 12 show the ungrouped TLFDs. Approximately 55 percent of the trips had trip lengths less than 5 miles, and 30 percent had trip lengths between 5 miles and 10 miles. The longest distance travelled by the surveyed vehicles was 30 miles.

**Table 20. Trip Length Frequency Distributions (Grouped Interval).**

Trip Length (miles)	All Vehicles	Percent of Total
Less than 5	898	55.4
5 to 9	497	30.6
10 to 14	167	10.3
15 to 19	41	2.5
20 to 24	15	1.0
25 to 30	4	0.2
<b>Total</b>	<b>1,622</b>	<b>100.0</b>

**Table 21. Trip Length Frequency Distributions (Ungrouped).**

Trip Length (miles)	Number of Trips	Percent of Total	Trip Length (miles)	Number of Trips	Percent of Total
<b>1</b>	306	18.9	<b>14</b>	10	0.6
<b>2</b>	205	12.6	<b>15</b>	15	0.9
<b>3</b>	168	10.4	<b>16</b>	18	1.1
<b>4</b>	219	13.5	<b>17</b>	2	0.1
<b>5</b>	159	9.8	<b>18</b>	2	0.1
<b>6</b>	98	6.1	<b>19</b>	4	0.2
<b>7</b>	109	6.7	<b>20</b>	4	0.2
<b>8</b>	67	4.1	<b>21</b>	6	0.4
<b>9</b>	64	4.0	<b>23</b>	4	0.3
<b>10</b>	45	2.8	<b>24</b>	1	0.1
<b>11</b>	33	2.0	<b>26</b>	2	0.1
<b>12</b>	36	2.2	<b>30</b>	2	0.1
<b>13</b>	43	2.7	<b>Total</b>	<b>1,622</b>	<b>100.0</b>



**Figure 12. Surveyed Commercial Vehicle Trips TLFDs.**

Tables 22 and 23 show the average trip lengths to destinations by land use type and commodity group for all surveyed vehicle trips. The average trip length was 5.58 miles. The most number of trips occurred at other land use types, with an average trip length of 5.80 miles. Trips to industrial sites had the longest average travel distance of 7.33 miles. A significant number of trips occurred at retail sites, with an average trip length of 4.41 miles. The average travel distance to residential sites was 5.32 miles. Machinery was the most frequently transported cargo, with an average trip length of 4.89 miles. Trips that transported raw materials had the longest average travel distance of 8.25 miles, followed by agriculture with 7.46 miles. The average trip length for trips with no cargo was 6.59 miles.

**Table 22. Average Trip Length to Destinations by Land Use Type.**

Land Use	Number of Trips	Total Trip Length (miles)	Average Trip Length (miles)
Office	47	214.94	4.57
Retail	285	1,257.71	4.41
Industrial	192	1,408.10	7.33
Medical	17	59.05	3.47
Education	21	69.90	3.33
Government	27	110.95	4.11
Residential	121	643.94	5.32
Other	912	5,286.67	5.80
<b>Total</b>	<b>1,622</b>	<b>9,051.26</b>	<b>5.58</b>

**Table 23. Average Trip Length to Destinations by Commodity Group.**

Commodity Group	Number of Trips	Total Trip Length (miles)	Average Trip Length (miles)
Agriculture	115	858.33	7.46
Raw Materials	20	164.93	8.25
Food	260	980.86	3.77
Textiles	38	93.29	2.46
Wood	70	418.51	5.98
Building Materials	201	1,416.86	7.05
Machinery	287	1,404.42	4.89
Miscellaneous	208	913.17	4.39
Secondary	17	118.90	6.99
Hazardous Materials	3	14.29	4.76
Transportation	36	221.47	6.15
Empty	359	2,366.41	6.59
Unknown	8	79.82	9.98
<b>Total</b>	<b>1,622</b>	<b>9,051.26</b>	<b>5.58</b>

## Travel Time and Speed Characteristics

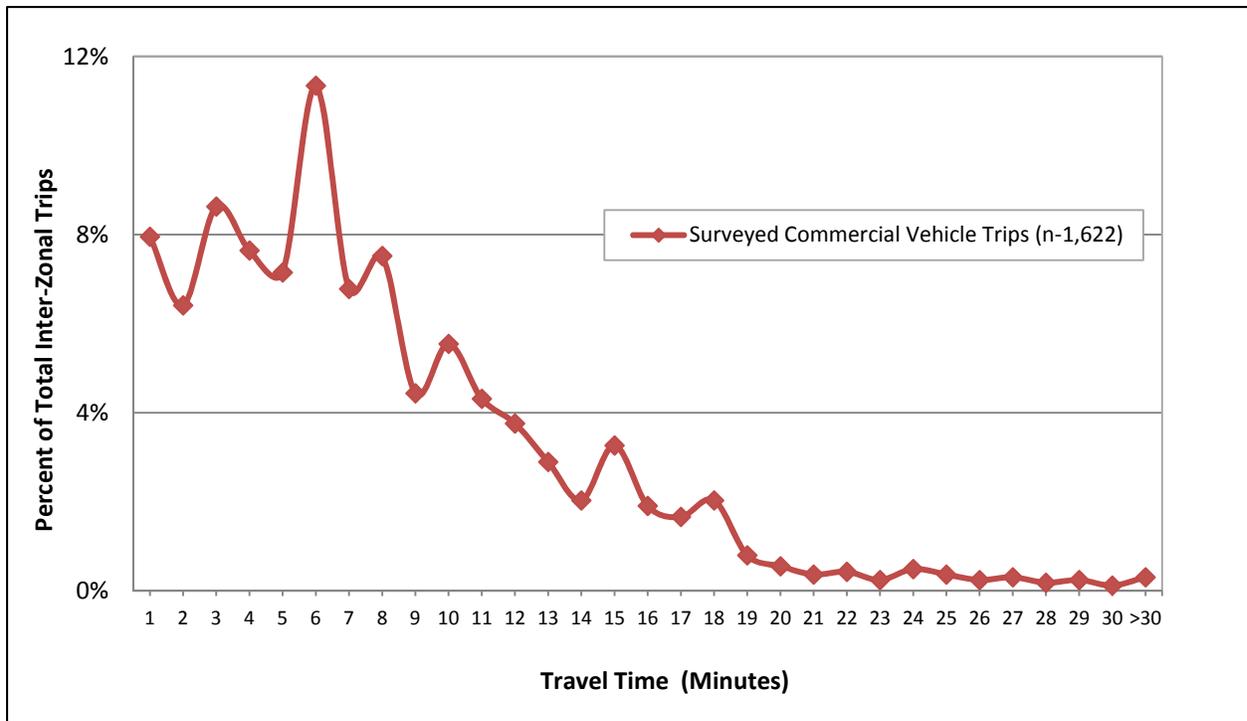
The estimation of travel time and speed was generated from the network travel time matrix table that was available for the study area. Table 24 shows the travel time frequency distribution of inter-zonal trips, grouped at five-minute intervals, while Table 25 and Figure 13 show the ungrouped distribution. Approximately 68 percent of the trips made by the surveyed commercial vehicles were less than 10 minutes in length.

**Table 24. Travel Time Frequency Distribution (Grouped Interval).**

Travel Time (minutes)	All Vehicles	Percent of Total
Less than 5	497	30.6
5 to 9	604	37.2
10 to 14	301	18.6
15 to 19	157	9.7
20 to 24	34	2.1
25 to 29	22	1.4
30 to 34	5	0.3
35 to 40	2	0.1
<b>Total</b>	<b>1,622</b>	<b>100.0</b>

**Table 25. Travel Time Frequency Distribution (Ungrouped).**

Trip Length (minutes)	Number of Trips	Percent of Total	Trip Length (minutes)	Number of Trips	Percent of Total
<b>1</b>	129	8.0	<b>19</b>	13	0.8
<b>2</b>	104	6.4	<b>20</b>	9	0.6
<b>3</b>	140	8.6	<b>21</b>	6	0.4
<b>4</b>	124	7.6	<b>22</b>	7	0.4
<b>5</b>	116	7.2	<b>23</b>	4	0.2
<b>6</b>	184	11.3	<b>24</b>	8	0.5
<b>7</b>	110	6.8	<b>25</b>	6	0.4
<b>8</b>	122	7.5	<b>26</b>	4	0.2
<b>9</b>	72	4.4	<b>27</b>	5	0.3
<b>10</b>	90	5.6	<b>28</b>	3	0.2
<b>11</b>	70	4.3	<b>29</b>	4	0.2
<b>12</b>	61	3.8	<b>30</b>	2	0.1
<b>13</b>	47	2.9	<b>32</b>	2	0.1
<b>14</b>	33	2.0	<b>33</b>	1	0.1
<b>15</b>	53	3.3	<b>39</b>	1	0.1
<b>16</b>	31	1.9	<b>40</b>	1	0.1
<b>17</b>	27	1.7	<b>Total</b>	<b>1,622</b>	<b>100.0</b>
<b>18</b>	33	2.0			



**Figure 13. Surveyed Commercial Vehicle Trips Travel Time.**

Table 26 shows the average travel time and speed to destinations by land use type, while Table 27 shows the distribution by commodity group. Overall, the average travel time for all surveyed vehicles was 8.47 minutes and the average travel speed was 39.52 miles per hour (mph).

**Table 26. Average Travel Time and Speed to Destinations by Land Use Type.**

Land Use	Number of Trips	Average Travel Time (minutes)	Average Travel Speed (mph)
Office	47	7.47	36.75
Retail	285	7.08	37.40
Industrial	192	10.48	41.97
Medical	17	6.20	33.62
Education	21	5.49	36.40
Government	27	6.22	39.62
Residential	121	8.52	37.50
Other	912	8.71	39.95
<b>Total</b>	<b>1,622</b>	<b>8.47</b>	<b>39.52</b>

**Table 27. Average Travel Time and Speed to Destinations by Commodity Group.**

<b>Commodity Group</b>	<b>Number of Trips</b>	<b>Average Travel Time (minutes)</b>	<b>Average Travel Speed (mph)</b>
Agriculture	115	10.45	42.84
Raw Materials	20	11.50	43.02
Food	260	6.26	36.15
Textiles	38	4.12	35.75
Wood	70	9.50	37.75
Building Materials	201	10.39	40.61
Machinery	287	7.63	38.37
Miscellaneous	208	6.63	39.71
Secondary	17	10.67	39.33
Hazardous Materials	3	8.60	33.25
Transportation	36	9.62	38.37
Empty	359	9.85	40.30
Unknown	8	14.10	42.45
<b>Total</b>	<b>1,622</b>	<b>8.47</b>	<b>39.52</b>

### **Trip Tour Characteristics**

The analysis of trip tours shows the amount of circuitous travel performed by commercial vehicles in the study area. Trip tours are defined as a combination (or chaining) of trips in which a vehicle leaves and returns to a common point, typically its base location.

To accurately analyze trip tours, external trips had to be included in the analysis. This is done because it is possible for trip tours to begin within the study area, then travel outside the study area, and then travel ends or returns to the study area. Therefore, to exclude external trips in the analysis would result in not capturing those trips that occur outside the study area that are part of the trip tour.

There were 2,009 trips observed from the Lubbock commercial vehicle survey. Each trip in the survey provided information on whether or not the origin of the trip was the vehicle's base location. This served as the basis for determining if the trip was a base trip or a non-base trip. A base trip was defined as when either trip end (origin or destination) began or ended at the base location. If neither trip end was at the base location, then the trip was considered as a non-base trip.

As Table 28 shows, base trips made up 52 percent of the total trips generated by cargo vehicles and 40 percent of the trips by service vehicles. Overall, base trips accounted for 42 percent of total trips by all surveyed vehicles, and non-base trips accounted for 58 percent.

**Table 28. Number of Base and Non-Base Trips by Cargo and Service Vehicles.**

Trip Type	Cargo Vehicles		Service Vehicles		All Vehicles	
	Number of Trips	Percent of Total	Number of Trips	Percent of Total	Number of Trips	Percent of Total
Base	147	52.1	693	40.1	840	41.8
Non-Base	135	47.9	1,034	59.9	1,169	58.2
<b>Total</b>	<b>282</b>	<b>100.0</b>	<b>1,727</b>	<b>100.0</b>	<b>2,009</b>	<b>100.0</b>

The analysis of trip tours involved counting all the trips that began at the base location until the vehicle returned to its base location. Those trips that did not start and end at the base location were considered open tours. There were 26 vehicles that made open tours in the Lubbock commercial vehicle survey. The number of open tours consisted of 365 trips. The analysis presented here pertains only to the 1,644 trips that occurred within the trip tours and exclude the 365 trips that occurred in the open tours.

Table 29 shows the distribution of trip tours, the number of trips within trip tours, and the average number of trips per tour for cargo and service vehicles. There were 407 trip tours generated by the surveyed vehicles. The number of tours varied from one to eight tours, with the number of trips averaging four trips within each tour.

**Table 29. Trip Tours per Vehicle.**

Number of Trip Tours	Total Tours			Total Trips within Tour			Average Trips within Tour		
	Cargo Vehicles	Service Vehicles	All Vehicles	Cargo Vehicles	Service Vehicles	All Vehicles	Cargo Vehicles	Service Vehicles	All Vehicles
1	14	144	158	69	879	948	4.9	6.1	6.0
2	24	84	108	111	238	349	4.6	2.8	3.2
3	21	42	63	57	113	170	2.7	2.7	2.7
4	8	24	32	18	58	76	2.3	2.4	2.4
5	0	10	10	0	29	29	0	2.9	2.9
6	6	6	12	12	12	24	2.0	2.0	2.0
7	0	0	0	0	0	0	0	0.0	0.0
8	0	24	24	0	48	48	0	2.0	2.0
<b>Total</b>	<b>73</b>	<b>334</b>	<b>407</b>	<b>267</b>	<b>1,377</b>	<b>1,644</b>	<b>3.7</b>	<b>4.1</b>	<b>4.0</b>

The analysis of trip tours also involved counting the number of non-base trips, external trips, inter-zonal trips, and intra-zonal trips within trip tours to determine the total amount and types of travel that occur during the course of the tour. Of the total 1,644 trips within the trip tours, 153 were external trips, 1,394 were inter-zonal trips, and 97 were intra-zonal trips. Table 30 shows the distribution of these trips for cargo and service vehicles.

**Table 30. External, Inter-Zonal and Intra-Zonal Trips within Trip Tours.**

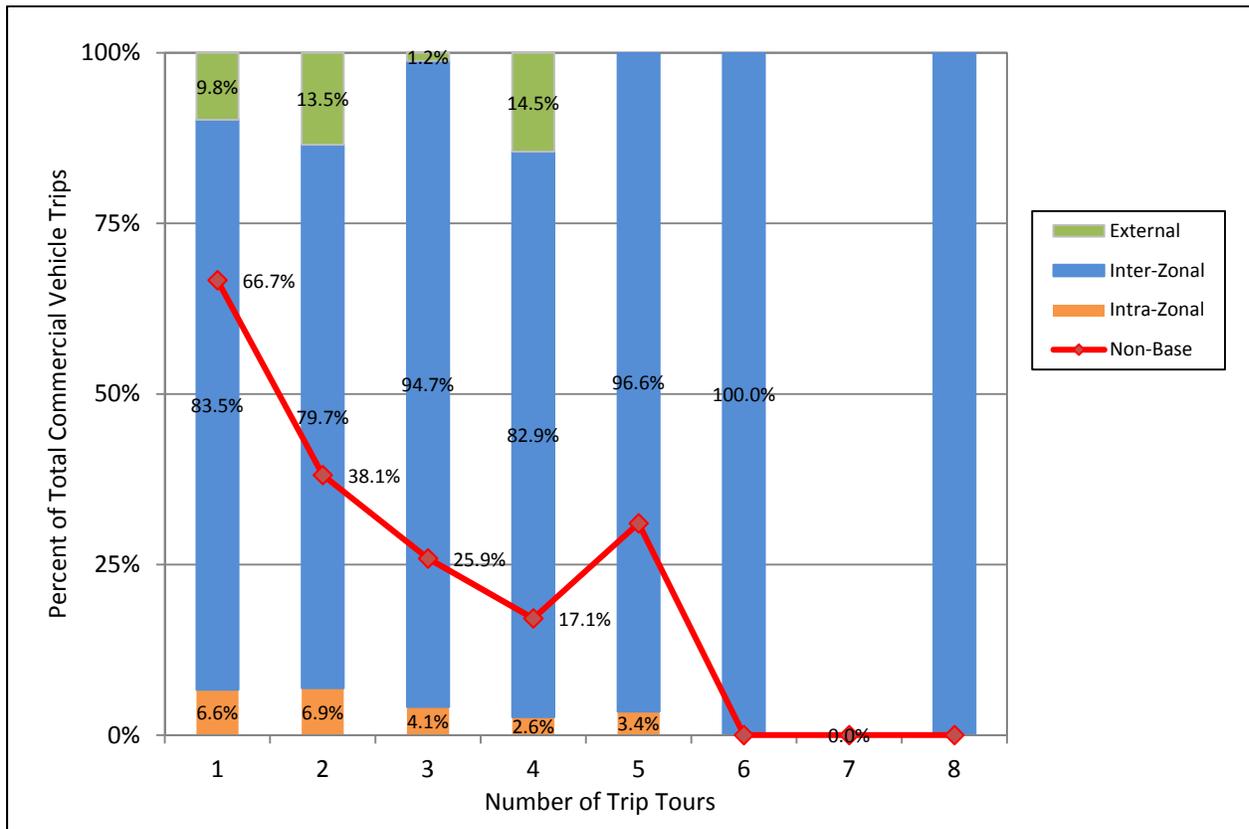
No. of Trip Tours	External		Inter-Zonal		Intra-Zonal		Total Trips	
	Cargo Vehicles	Service Vehicles						
1	20	73	48	744	1	62	69	879
2	21	26	90	188	0	24	111	238
3	0	2	56	105	1	6	57	113
4	2	9	16	47	0	2	18	58
5	0	0	0	28	0	1	0	29
6	0	0	12	12	0	0	12	12
7	0	0	0	0	0	0	0	0
8	0	0	0	48	0	0	0	48
<b>Total</b>	<b>43</b>	<b>110</b>	<b>222</b>	<b>1,172</b>	<b>2</b>	<b>95</b>	<b>267</b>	<b>1,377</b>

Table 31 shows the number of non-base trips within trip tours separately since non-base trips are not mutually exclusive of the other trip types (i.e., a non-base trip may also be an inter-zonal or external trip).

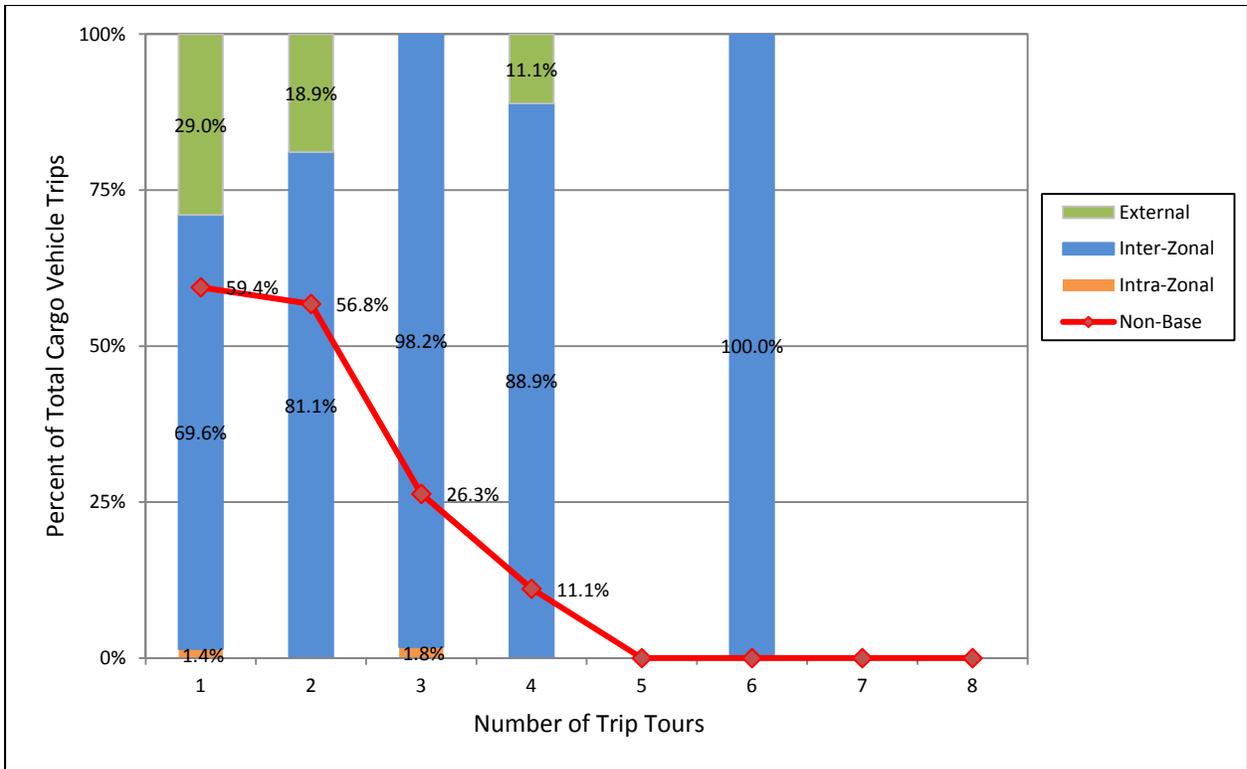
Within the trip tours made by the surveyed commercial vehicles, approximately 85 percent were inter-zonal trips, 9 percent were external trips, and the remaining 6 percent were intra-zonal trips. Non-base trips comprised 51 percent of the trips within the tours. Figure 14 shows the percentage distribution of non-base trips, external trips, inter-zonal trips, and intra-zonal trips within trip tours for all surveyed commercial vehicles. Figures 15 and 16 show the percentage distribution of trips within trip tours by commercial cargo and service types, respectively.

**Table 31. Non-Base Trips within Trip Tours.**

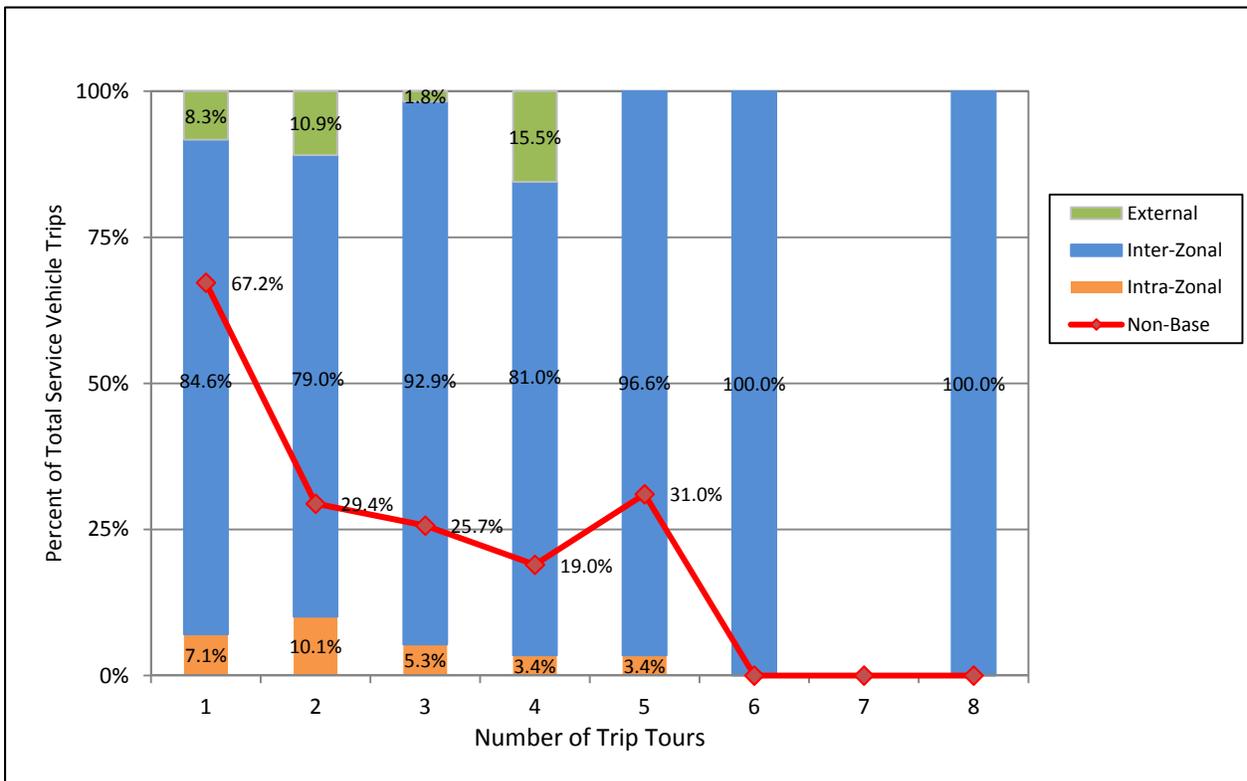
No. of Trip Tours	Non-Base Trips within Trip Tours			Total Trips within Trip Tours					
	Cargo Vehicles	Service Vehicles	All Vehicles	Cargo Vehicles	Percent of Total	Service Vehicles	Percent of Total	All Vehicles	Percent of Total
1	41	591	632	69	25.8	879	63.8	948	57.7
2	63	70	133	111	41.6	238	17.3	349	21.2
3	15	29	44	57	21.4	113	8.2	170	10.3
4	2	11	13	18	6.7	58	4.2	76	4.6
5	0	9	9	0	0.0	29	2.1	29	1.8
6	0	0	0	12	4.5	12	0.9	24	1.5
7	0	0	0	0	0.0	0	0.0	0	0.0
8	0	0	0	0	0.0	48	3.5	48	2.9
<b>Total</b>	<b>121</b>	<b>710</b>	<b>831</b>	<b>267</b>	<b>100.0</b>	<b>1,377</b>	<b>100.0</b>	<b>1,644</b>	<b>100.0</b>



**Figure 14. All Surveyed Commercial Vehicle Trips within Trip Tours by Trip Type.**



**Figure 15. Cargo Vehicle Trips within Trip Tours by Trip Type.**



**Figure 16. Service Vehicle Trips within Trip Tours by Trip Type.**

## SURVEY EXPANSION

The expansion of commercial vehicle survey data is conducted in an indirect manner. In typical travel surveys, an estimate of the population being sampled is known and data are then expanded to represent that population. In the case of commercial vehicle surveys, the population of vehicles operating in the study area is unknown. Vehicle registration data are not considered a viable basis to estimate the number of commercial vehicles in the study area because other vehicles operating in the area may be registered in neighboring counties. However, in the Lubbock commercial vehicle survey analysis, information on registered trucks has been included to show how the survey data compare with existing vehicle registration data.

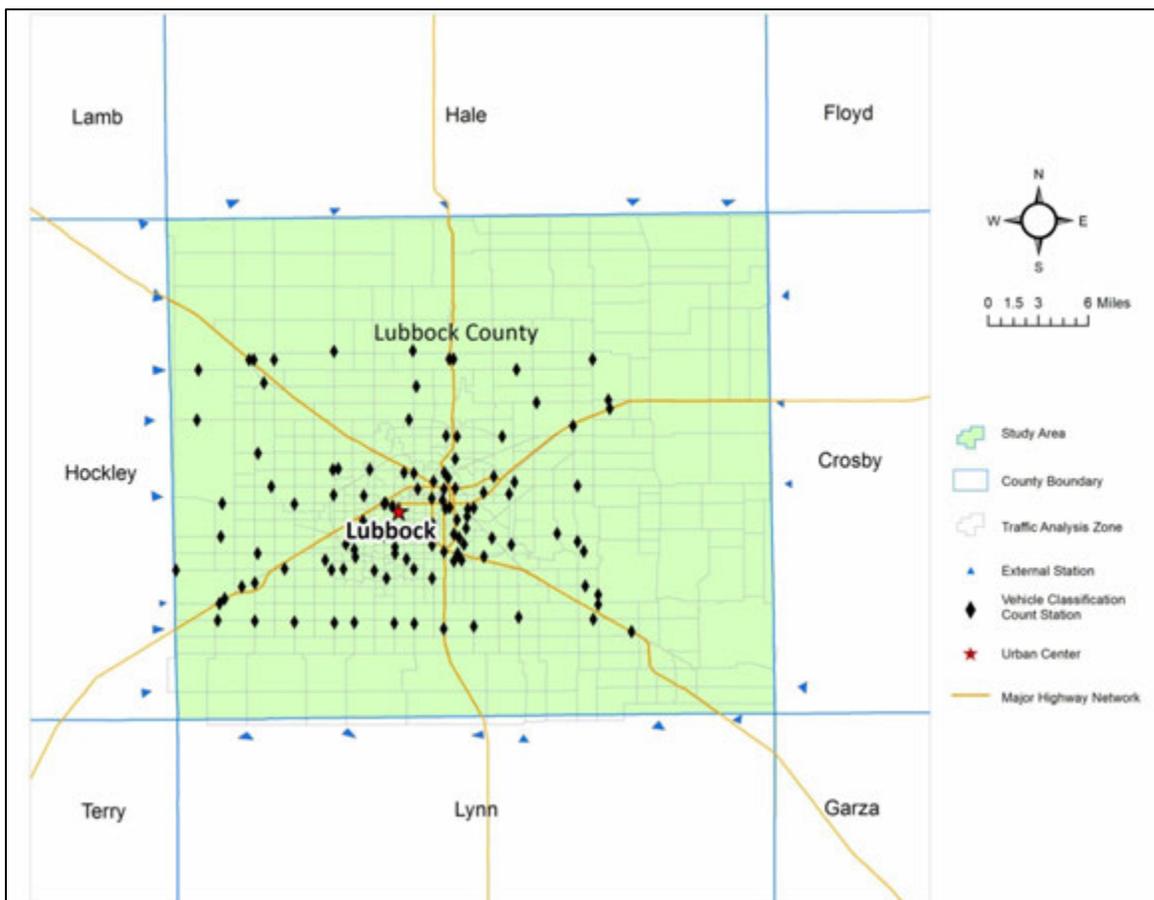
The methodology currently used to expand commercial vehicle survey data is based on vehicle miles of travel (VMT) estimates from the Highway Performance Monitoring System (HPMS), and vehicle classification counts by functional classification for the study area. In essence, an estimate of the commercial VMT is developed from the HPMS data and is then used to expand the VMT observed from sampled commercial vehicles. HPMS data contains annual average daily traffic (AADT) estimates of the total VMT by functionally classified facilities such as freeways, arterials, collectors, and local roadways. Since AADT includes weekend traffic, a correction factor is applied to the data to obtain average weekday VMT by functional classification. Table 32 provides the adjusted 2005 HPMS VMT estimates for the Lubbock study area.

**Table 32. 2005 HPMS Estimates of Weekday VMT in the Lubbock Study Area.**

<b>Functional Classification</b>	<b>Total Weekday VMT</b>
Freeway	1,181,089
Arterial	3,231,733
Collector	919,482
Local	376,430
<b>Total</b>	<b>5,708,734</b>

The percentages of commercial and non-commercial vehicle counts by functional classification were determined by using the commercial vehicle counts from the 2005 Lubbock External

Survey and vehicle classification counts conducted at 103 randomly selected locations in the Lubbock study area (Figure 17) averaged with vehicle classification counts from the Waco and Killeen/Temple study areas. The decision to combine data from the Lubbock, Waco, and Killeen/Temple areas was based on a comparison of these data that indicated the vehicle classification counts in the Lubbock County area were inconsistent with commercial vehicle counts in other studies and would result in significantly lower estimates of commercial vehicle trips.



**Figure 17. Vehicle Classification Count Stations in the Lubbock Study Area.**

The percentage of commercial vehicles for internal count sites for each functional classification were combined with the corresponding percentage for external count sites based on the percentage of regional VMT estimated as external travel. Based on the 2005 external survey, external VMT for the study area was 1,238,204 miles. This is approximately 22 percent of the total HPMS VMT of 5,708,734 miles. Therefore, it was estimated that 78 percent of the total

VMT was internal travel. These percentages were applied to obtain the weighted average for each functional classification.

Table 33 provides the internal, external, and weighted percentages of commercial and non-commercial vehicles by functional classification. The weighted percentages were applied to the HPMS estimated weekday VMT in Table 32 to estimate the total commercial and non-commercial VMT. Table 34 shows the estimated VMT for commercial and non-commercial vehicles.

**Table 33. Percentage of Commercial and Non-Commercial Vehicles by Functional Classification.**

Functional Classification	Percent of Commercial Vehicles			Percent of Non-Commercial Vehicles		
	Internal Sites (78%)	External Sites (22%)	Weighted Average	Internal Sites (78%)	External Sites (22%)	Weighted Average
Freeway	18.5	15.2	17.8	81.5	84.8	82.2
Arterial	11.4	15.7	12.3	88.6	84.3	87.7
Collector	12.2	20.5	14.0	87.8	79.5	86.0
Local	9.0	N/A	9.0	91.0	N/A	91.0

**Table 34. Estimated VMT for Commercial and Non-Commercial Vehicles.**

Functional Classification	Commercial VMT	Non-Commercial VMT	Total VMT
Freeway	209,764	971,325	1,181,089
Arterial	398,440	2,833,293	3,231,733
Collector	129,152	790,330	919,482
Local	33,904	342,526	376,430
<b>Total</b>	<b>771,260</b>	<b>4,937,474</b>	<b>5,708,734</b>

The total commercial VMT of 771,260 miles represented all commercial vehicles that travelled within and outside the Lubbock study area for a typical non-holiday weekday. VMT estimates from the external survey had to be subtracted from the total commercial VMT to properly expand the data and determine the total internal commercial vehicle trips generated in the study area. Based on the 2005 external survey, the external commercial VMT was 204,119 miles. Therefore, internal commercial VMT was 567,141 miles.

The total internal VMT observed from the commercial vehicle survey was 9,341 miles. The expansion factor was calculated by dividing the total internal commercial VMT by the observed internal VMT (from the survey). The resulting expansion factor of 60.71 was then multiplied by

the observed number of internal trips to estimate the total commercial vehicle trips. The resulting trip estimate was 111,129.

Based on the average number of 7.07 internal trips per day per commercial vehicle, 15,715 commercial vehicles were estimated to be operating within the Lubbock study area on a daily basis. This estimate is more than four times the 3,575 trucks registered in the study area in 2005.

Table 35 provides a summary of key results from the Lubbock commercial vehicle survey and data expansion.

**Table 35. Key Survey Results and Expanded Trip and VMT Data.**

<b>Indicator</b>	<b>Cargo Vehicles</b>	<b>Service Vehicles</b>	<b>All Vehicles</b>
Sample Size	37	236	273
Total Inter-zonal Trips <sup>1</sup>	237	1,437	1,674
Total Intra-zonal Trips	2	178	180
Total Internal Trips	239	1,615	1,854
Total External Trips	43	112	155
Total Internal and External Trips	282	1,727	2,009
Average Total Trips per Vehicle	7.62	7.32	7.36
Average Total Internal Trips per Vehicle <sup>2</sup>	7.03	7.08	7.07
Average Trip Length	5.70	5.56	5.58
Observed Internal VMT	1,352 miles	7,989 miles	9,341 miles
Total Internal Commercial VMT	138,814 miles	428,327 miles	567,141 miles
Survey Expansion Factor	102.689	53.614	60.712
Total Expanded Inter-zonal Commercial Vehicle Trips	24,337	77,043	101,380
Total Expanded Intra-zonal Commercial Vehicle Trips	206	9,543	9,749
Total Expanded Internal Commercial Vehicle Trips	24,543	86,586	111,129
Number of Commercial Vehicles Operating on a Daily Basis	3,491	12,224	15,715

<sup>1</sup> Includes 52 trips with unknown origin or destination zones.

<sup>2</sup> Based on internal trips of 262 surveyed commercial vehicles (34 cargo vehicles and 228 service vehicles).

## **SURVEY SUMMARY**

This section provides a summary of vehicle and trip characteristics of 273 commercial vehicles that participated in the 2005 Lubbock commercial vehicle survey.

The average vehicle age of surveyed commercial vehicles based on their model year at the time of survey was 11.4 years for cargo vehicles and 8.8 years for service vehicles. The average mileage, based on the odometer readings that were reported by the surveyed vehicles, was 180,792 miles. Approximately 91 percent of the surveyed vehicles used diesel fuel, and the remaining 9 percent used gasoline.

The analyses of trip characteristics included an in-depth examination of trip frequency, trip type, average trip length, trip purpose, and land use activity at trip destinations by commercial vehicle type. The surveyed vehicles made an average of 7.4 total trips per day. Excluding the trips made outside of the study area (external trips), the surveyed vehicles produced 7.1 internal trips per day, with an average trip length of 5.6 miles. The average travel time was estimated at 8.5 minutes per trip. The average travel speed was estimated at 39.5 mph.

In terms of trip purpose at trip destinations, approximately 55 percent of the total internal trips were delivery, 20 percent were return-to-base location, 10 percent were pick-up, and another 10 percent were service-related trips.

Regarding land use activity, approximately 17 percent of the total internal trips occurred at retail/shopping places, 15 percent at construction sites, 11 percent at industrial sites, and 7 percent at residential sites.

The analyses of cargo characteristics were not exclusive to trips made by the surveyed cargo vehicles since the service vehicles that were surveyed also reported cargo being transported at origin and destination locations. The analysis involved examining the types of cargo/commodities being transported at trip destinations, the trip purposes and land use activity at each stop, and the net weight of cargo being picked-up and/or dropped-off for each trip. Building materials had the highest average net cargo weight of 44,630 lbs. per trip, followed by agriculture with an average net cargo weight of 34,215 lbs. per trip. However, the highest frequency of trips were transporting food and machinery, with an average net weight per trip of

1,633 lbs. and 5,155 lbs., respectively. Overall, the estimated average net cargo weight per trip was 14,378 lbs.

The analysis of trip tours involved examining the amount of circuitous travel performed by the commercial vehicles in the study area. It also involved counting the number of non-base trips, external trips, inter-zonal trips, and intra-zonal trips within trip tours to determine the total amount and types of travel that occur during the course of the tour. A total of 407 trip tours were generated by the surveyed commercial vehicles. The number of trip tours per vehicle ranged from one tour to eight tours, with an average of four trips within each tour. Within the trip tours, approximately 85 percent were inter-zonal trips, 9 percent were external trips and the remaining 6 percent were intra-zonal trips. Non-base trips (which were not mutually-exclusive of the other trip types) comprised 51 percent of the trips within the tours.

The expansion of commercial vehicle survey data were based on VMT estimates and vehicle classification counts for the Lubbock study area. The estimation of VMT and volume of commercial vehicles operating within the study area were based on key findings from the survey, such as the total number of internal vehicle trips, the average number of trips per vehicle, and average trip lengths per vehicle. Based on these findings, approximately 15,715 commercial vehicles were estimated to be operating within the Lubbock study area on a daily basis, which is approximately more than four times the number of trucks registered in the study area in 2005.

## REFERENCES

Alliance Transportation Group (ATG), Inc. *Amarillo-Lubbock Commercial Vehicle Survey Final Report*. March 2006.

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Texas Department of Transportation (TxDOT). *Rural, Small Urban, and Urbanized Mileage by County and Functional System*. Austin, TX. December 2005.

Alliance-Texas Engineering Company and Wilbur Smith and Associates. *Texas Statewide Analysis Model (SAM) Theory Report*. Texas Department of Transportation. March 2004.

Farnsworth, Stephen F. *2005 Lubbock External Survey Technical Summary*. Texas Transportation Institute. The Texas A&M University System, College Station, TX. April 2006.



## **APPENDIX**



**COMMERCIAL VEHICLE SURVEY  
PART 1: VEHICLE INFORMATION**

(If you have participated in prior surveys, please fill out this form anyway.)

Vehicle ID#: \_\_\_\_\_

Vehicle License # : \_\_\_\_\_

Survey Location (zone): \_\_\_\_\_

SIC Code: \_\_\_\_\_

Travel Day: \_\_\_\_\_  
Month / Day

Company or Name of Owner (name on registration):

\_\_\_\_\_

Address of location where vehicle was based at beginning of travel day:

\_\_\_\_\_ (Street Address or Nearest Intersection)

City State ZIP

Type of Place vehicle was based at on beginning of travel day. (SEE BELOW) \_\_\_\_\_

Vehicle Info: Make \_\_\_\_\_; Model: \_\_\_\_\_; Year: \_\_\_\_\_

Vehicle Type  
1)  Cargo / Freight Transport Vehicle  
2)  Service Vehicle (vehicle is not used to transport cargo or freight)

Vehicle Fuel: 1)  Unleaded Gas 2)  Diesel 3)  Propane 4)  Hybrid  
5)  Other \_\_\_\_\_ (Specify)

Vehicle Classification:

- |   |   |
|---|---|
| 1) <input type="checkbox"/> Passenger Car               | 5) <input type="checkbox"/> Single Unit 2-axle (6 wheels)           |
| 2) <input type="checkbox"/> Pick-up                     | 6) <input type="checkbox"/> Single Unit 3-axle (10 wheels)          |
| 3) <input type="checkbox"/> Van (Cargo or Mini)         | 7) <input type="checkbox"/> Single Unit 4-axle (14 wheels)          |
| 4) <input type="checkbox"/> Sport Utility Vehicle (SUV) | 8) <input type="checkbox"/> Semi (all Tractor-Trailer combinations) |
|   | 9) <input type="checkbox"/> Other _____                             |

Gross Vehicle Weight: \_\_\_\_\_ pounds

**Beginning Odometer Reading:** \_\_\_\_\_ **Number of Trips Total:** \_\_\_\_\_

Type of Place Codes		
(1) Office Building	(6) Educational (college, trade, etc.)	(11) Warehouse
(2) Retail / Shopping	(7) Government Office / Building	(12) Distribution Center
(3) Industrial / Manufacturing	(8) Residential	(13) Construction Site
(4) Medical / Hospital	(9) Airport	(14) Other (specify)
(5) Educational (12 <sup>th</sup> grade or less)	(10) Intermodal Facility	(99) Refused / Unknown

## Commercial Vehicle Survey PART 2: Travel Log

VEHICLE LICENSE #: \_\_\_\_\_

**THE PLACE MY TRAVEL BEGAN TODAY WAS:**

Work / Base Location     Other Location (Please describe) \_\_\_\_\_

Type of Place (Specify Type of Place 1-14 or 99, see codes below) \_\_\_\_\_

\_\_\_\_\_  
(Street address or nearest intersection for place travel began)

TRAVEL DATE \_\_\_\_\_  
Month / Day

\_\_\_\_\_  
(City, state, zip code)

DEPARTURE TIME: \_\_\_\_\_ am/pm

**When you left the above location was your vehicle:**  Fully Loaded     Partially Loaded     Empty     Not Applicable (Service Vehicle)

**If loaded, what is the total weight in pounds of the cargo being transported? (Please provide an estimate if unsure of exact weight)** \_\_\_\_\_

**RECORD EVERY PLACE YOU GO, INCLUDING QUICK STOPS**

	RECORD the following information about each place <i>NAME of Place:</i> _____ <i>Address including city, state, and zip OR Nearest street intersection or Landmark</i> _____	What time did you arrive and depart this location? (record exact times)	Activity What are you doing at this Location (See options below)	What type of place is this? (see options below)	Is this the work / base location for this vehicle?  <input type="checkbox"/> - Yes <input type="checkbox"/> - No	Type of Cargo What is it?	Cargo Weight ( in Pounds)
<b>PLACE 1</b>		Arrive: _____ am/pm Depart: _____ am/pm					Delivery Picked Up
<b>PLACE 2</b>		Arrive: _____ am/pm Depart: _____ am/pm					Delivery Picked Up
<b>PLACE 3</b>		Arrive: _____ am/pm Depart: _____ am/pm					Delivery Picked Up

ACTIVITY OPTIONS	TYPE OF PLACE OPTIONS
<ul style="list-style-type: none"> <li>(1) Base Location / Return to Base Location</li> <li>(2) Delivery</li> <li>(3) Pick-Up</li> <li>(4) Pick-Up and Delivery</li> <li>(5) Maintenance (fuel, oil, etc.)</li> <li>(6) Driver Needs (lunch, etc.)</li> <li>(7) Service-Related Business</li> <li>(8) Other (please specify)</li> </ul>	<ul style="list-style-type: none"> <li>(1) Office Building (non-government)</li> <li>(2) Retail / Shopping</li> <li>(3) Industrial / Manufacturing</li> <li>(4) Medical / Hospital</li> <li>(5) Education (12<sup>th</sup> grade or less)</li> <li>(6) Education (college, trade)</li> <li>(7) Government Office / Building</li> <li>(8) Residential</li> <li>(9) Airport</li> <li>(10) Intermodal Facility</li> <li>(11) Warehouse</li> <li>(12) Distribution Center</li> <li>(13) Construction Site</li> <li>(14) Other (specify)</li> <li>(99) Refused / Unknown</li> </ul>

### Commercial Vehicle Survey Travel (continued)

	<b>RECORD the following information about each place</b>  <i>NAME of Place:</i> _____ <i>Address including city, state, and zip</i> <b>OR</b> <i>Nearest street intersection or Landmark</i> _____	What time did you arrive and depart this location?  (record exact times)	Activity What are you doing at this location? (see options below)	What type of place is this? (see options below)	Is this the work / base location for this vehicle?  <input type="checkbox"/> - Yes <input type="checkbox"/> - No	Type of Cargo What is it?	Cargo Weight ( in Pounds)
<b>PLACE 4</b>		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		_____ Delivery _____ Picked Up
<b>PLACE 5</b>		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		_____ Delivery _____ Picked Up
<b>PLACE 6</b>		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		_____ Delivery _____ Picked Up
<b>PLACE 7</b>		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		_____ Delivery _____ Picked Up
<b>PLACE 8</b>		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		_____ Delivery _____ Picked Up
<b>PLACE 9</b>		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		_____ Delivery _____ Picked Up

ACTIVITY OPTIONS	TYPE OF PLACE OPTIONS				
(1) Base Location / Return to Base Location (2) Delivery (3) Pick-Up (4) Pick-Up and Delivery (5) Maintenance (fuel, oil, etc.) (6) Driver Needs (lunch, etc.) (7) Service-Related Business (8) Other (please specify)	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;">                             (1) Office Building (non-government)                              (2) Retail / Shopping                              (3) Industrial / Manufacturing                              (4) Medical / Hospital                              (5) Education (12<sup>th</sup> grade or less)                         </td> <td style="width: 50%; border: none;">                             (6) Education (college, trade)                              (7) Government Office / Building                              (8) Residential                              (9) Airport                              (10) Intermodal Facility                         </td> </tr> </table> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;">                             (11) Warehouse                              (12) Distribution Center                              (13) Construction Site                              (14) Other (specify)                         </td> <td style="width: 50%; border: none;">                             (99) Refused / Unknown                         </td> </tr> </table>	(1) Office Building (non-government) (2) Retail / Shopping (3) Industrial / Manufacturing (4) Medical / Hospital (5) Education (12 <sup>th</sup> grade or less)	(6) Education (college, trade) (7) Government Office / Building (8) Residential (9) Airport (10) Intermodal Facility	(11) Warehouse (12) Distribution Center (13) Construction Site (14) Other (specify)	(99) Refused / Unknown
(1) Office Building (non-government) (2) Retail / Shopping (3) Industrial / Manufacturing (4) Medical / Hospital (5) Education (12 <sup>th</sup> grade or less)	(6) Education (college, trade) (7) Government Office / Building (8) Residential (9) Airport (10) Intermodal Facility				
(11) Warehouse (12) Distribution Center (13) Construction Site (14) Other (specify)	(99) Refused / Unknown				

### Commercial Vehicle Survey Travel (continued)

	<b>RECORD the following information about each place</b>  <i>NAME of Place:</i> _____ <i>Address including city, state, and zip</i> <b>OR</b> <i>Nearest street intersection or Landmark</i> _____	What time did you arrive and depart this location?  (record exact times)	Activity What are you doing at this location? (see options below)	What type of place is this? (see options below)	Is this the work / base location for this vehicle?  <input type="checkbox"/> - Yes <input type="checkbox"/> - No	Type of Cargo What is it?	Cargo Weight ( in Pounds)
PLACE 10		Arrive: _____ am/pm Depart: _____ am/pm					Delivery <hr/> Picked Up
PLACE 11		Arrive: _____ am/pm Depart: _____ am/pm					Delivery <hr/> Picked Up
PLACE 12		Arrive: _____ am/pm Depart: _____ am/pm					Delivery <hr/> Picked Up
PLACE 13		Arrive: _____ am/pm Depart: _____ am/pm					Delivery <hr/> Picked Up
PLACE 14		Arrive: _____ am/pm Depart: _____ am/pm					Delivery <hr/> Picked Up

ACTIVITY OPTIONS	TYPE OF PLACE OPTIONS
(1) Base Location / Return to Base Location (2) Delivery (3) Pick-Up (4) Pick-Up and Delivery (5) Maintenance (fuel, oil, etc.) (6) Driver Needs (lunch, etc.) (7) Service-Related Business (8) Other (please specify)	(1) Office Building (non-government) (2) Retail / Shopping (3) Industrial / Manufacturing (4) Medical / Hospital (5) Education (12 <sup>th</sup> grade or less) (6) Education (college, trade) (7) Government Office / Building (8) Residential (9) Airport (10) Intermodal Facility (11) Warehouse (12) Distribution Center (13) Construction Site (14) Other (specify) (99) Refused / Unknown

### Commercial Vehicle Survey (continued)

	<b>RECORD the following information about each place</b>  <i>NAME of Place:</i> _____ <i>Address including city, state, and zip</i> <b>OR</b> <i>Nearest street intersection or Landmark</i> _____	What time did you arrive and depart this location?  (record exact times)	Activity What are you doing at this location? (see options below)	What type of place is this? (see options below)	Is this the work / base location for this vehicle?  <input type="checkbox"/> - Yes <input type="checkbox"/> - No	Type of Cargo What is it?	Cargo Weight ( in Pounds)
PLACE 15		Arrive: _____ am/pm Depart: _____ am/pm					_____ Delivery _____ Picked Up
PLACE 16		Arrive: _____ am/pm Depart: _____ am/pm					_____ Delivery _____ Picked Up
PLACE 17		Arrive: _____ am/pm Depart: _____ am/pm					_____ Delivery _____ Picked Up
PLACE 18		Arrive: _____ am/pm Depart: _____ am/pm					_____ Delivery _____ Picked Up
PLACE 19		Arrive: _____ am/pm Depart: _____ am/pm					_____ Delivery _____ Picked Up

ACTIVITY OPTIONS	TYPE OF PLACE OPTIONS
(1) Base Location / Return to Base Location (2) Delivery (3) Pick-Up (4) Pick-Up and Delivery (5) Maintenance (fuel, oil, etc.) (6) Driver Needs (lunch, etc.) (7) Service-Related Business (8) Other (please specify)	(1) Office Building (non-government) (2) Retail / Shopping (3) Industrial / Manufacturing (4) Medical / Hospital (5) Education (12 <sup>th</sup> grade or less) (6) Education (college, trade) (7) Government Office / Building (8) Residential (9) Airport (10) Intermodal Facility (11) Warehouse (12) Distribution Center (13) Construction Site (14) Other (specify) (99) Refused / Unknown

