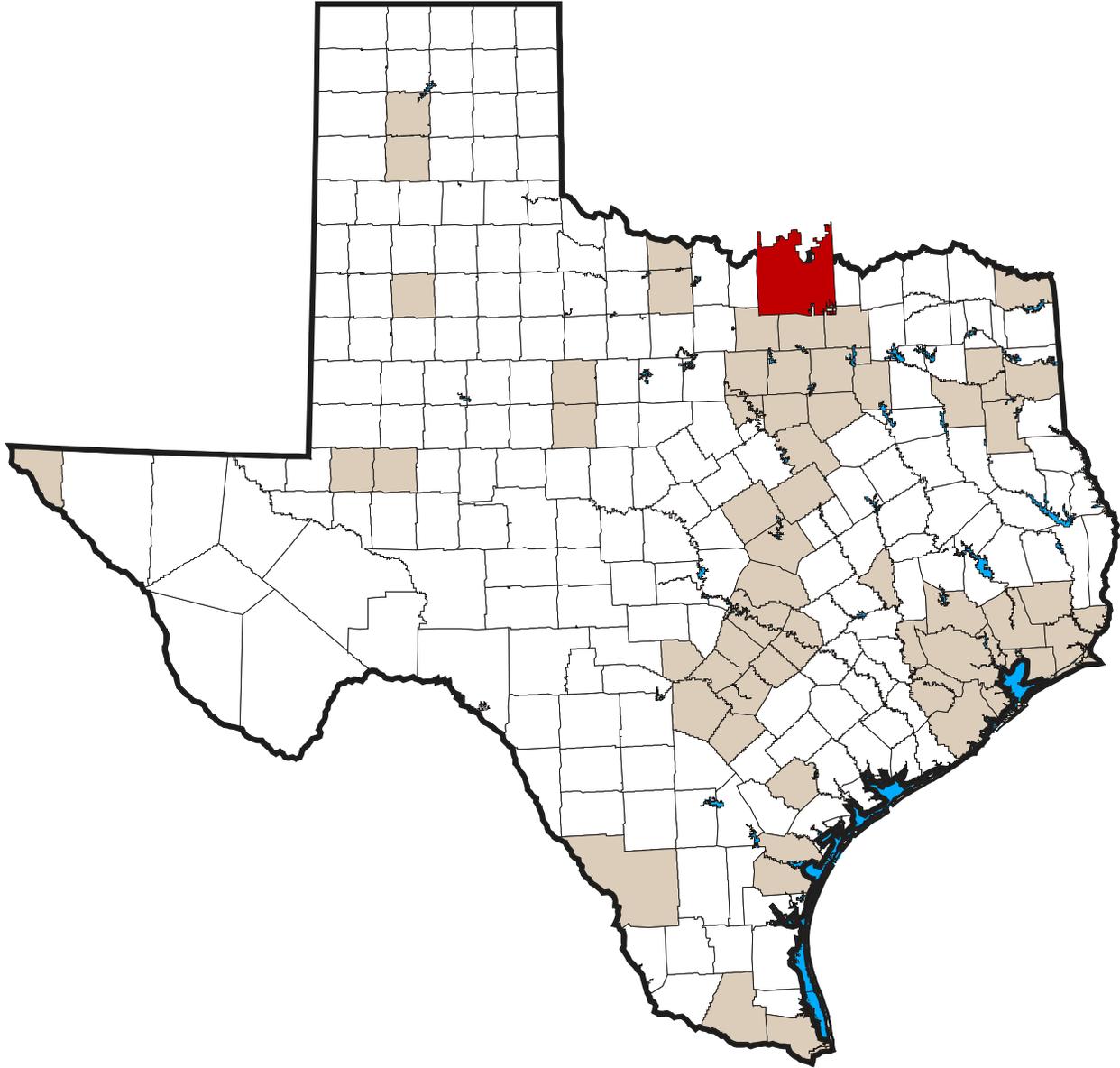


2010 Sherman-Denison Commercial Vehicle Survey Technical Summary



Prepared by the
Texas A&M Transportation Institute
September 2013

2012 Sherman-Denison Commercial Vehicle Survey

TECHNICAL SUMMARY

Texas Department of Transportation Travel Survey Program

Prepared by

Stephen Farnsworth
Associate Research Scientist

and

Lisa Larsen
Graduate Assistant Researcher

of the
Texas A&M Transportation Institute

September 2013

TEXAS A&M TRANSPORTATION INSTITUTE
The Texas A&M University System
College Station, Texas 77843-3135

DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the data, findings, and conclusions presented herein. The content does not necessarily reflect the official views or policies of the Federal Highway Administration or the Texas Department of Transportation (TxDOT). This report does not constitute a standard, specification, or regulation.

ACKNOWLEDGEMENTS

There were a number of individuals who extended technical support and assistance during the preparation of this report. Special thanks are due to Mark Ojah, Jack Bauer, Dr. Dennis Perkinson, and Gary Lobaugh of the Texas A&M Transportation Institute.

The authors would like to 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.

TABLE OF CONTENTS

List of Figures	vii
List of Tables	viii
Introduction.....	1
Survey Methodology.....	2
Survey Results	4
Vehicle Characteristics	4
Registered Commercial Vehicles.....	4
Surveyed Commercial Vehicles.....	5
Trip Frequency.....	9
Trip Characteristics.....	12
Cargo Characteristics	14
Trip Length	23
Travel Time and Speed	29
Trip Tours	33
Survey Expansion	38
Survey Summary.....	42
Appendix.....	45

LIST OF FIGURES

Figure 1. Sherman-Denison Study Area.	1
Figure 2. Model Year of Registered Trucks in the Sherman-Denison Study Area.	5
Figure 3. Type of Fuel Used by Surveyed Commercial Vehicles.	7
Figure 4. Vehicle Model Year.	8
Figure 5. Inter-Zonal, Intra-Zonal, and External Trips.	10
Figure 6. Total Trips per Vehicle.	11
Figure 7. Total Internal Trips per Vehicle.	12
Figure 8. Cargo Trip Purposes at the Trip Destinations.	19
Figure 9. TAZ Boundary and Base Locations of Surveyed Commercial Vehicles.	24
Figure 10. Trip Origins and Destinations of Surveyed Commercial Vehicles.	25
Figure 11. Surveyed Commercial Vehicle Trips TLFD.	26
Figure 12. Surveyed Commercial Vehicle Trips Travel Time.	30
Figure 13. Cargo Vehicle Trips within Trip Tours by Trip Type.	37
Figure 14. Service Vehicle Trips within Trip Tours by Trip Type.	37

LIST OF TABLES

Table 1. Survey Participation Rates.....	3
Table 2. Gross Vehicle Weight of Registered Trucks in the Sherman-Denison Study Area.	4
Table 3. Vehicle Classification Type of Surveyed Commercial Vehicles.....	6
Table 4. Gross Vehicle Weight.....	7
Table 5. Average of Reported Odometer Readings by Model Year.....	9
Table 6. Total Internal and External Trips.....	10
Table 7. Distribution of Internal Trips by Land Use Type at Trip Destinations.	13
Table 8. Trip Purposes at Destination Locations.	14
Table 9. Cargo Classification Types.....	15
Table 10. Distribution of Trips by Cargo Type at Destinations.	16
Table 11. Equivalency between SAM Commodity Groups and Survey Classifications.	17
Table 12. Equivalency between Land Use Category and Survey Type of Place.....	17
Table 13. Cargo Trips by Commodity Group and Land Use Destinations.....	18
Table 14. Cargo Trips by Commodity Group and Trip Purpose at the Trip Destinations.....	19
Table 15. Average Net Cargo Weight by Commodity Group and Land Use at Trip Destinations.....	21
Table 16. Average Net Cargo Weight by Commodity Group and Trip Purpose at Trip Destinations.....	21
Table 17. Cargo Trips and Net Cargo Weight by Commodity Group at Trip Destinations.	22
Table 18. Cargo Trips and Net Cargo Weights by Land Use at Trip Destinations.	22
Table 19. Cargo Trips and Net Cargo Weights by Trip Purpose at Trip Destinations.	23
Table 20. Trip Length Frequency Distribution (Grouped Interval).	26
Table 21. Trip Length Frequency Distribution (Ungrouped).	27
Table 22. Average Trip Length to Destinations by Land Use Type.....	28
Table 23. Average Trip Length to Destinations by Commodity Group.	29
Table 24. Travel Time Frequency Distribution (Grouped Interval).	30
Table 25. Travel Time Frequency Distribution (Ungrouped).....	31
Table 26. Average Travel Time and Speed to Destinations by Land Use Type.....	32
Table 27. Average Travel Time and Speed to Destinations by Commodity Group.....	33
Table 28. Base and Non-Base Trips.	34
Table 29. Trip Tours per Vehicle.....	35
Table 30. External, Inter-Zonal and Intra-Zonal Trips within Trip Tours.....	36
Table 31. Non-Base Trips within Trip Tours.....	36
Table 32. Summary of Open Tour Trips.....	38
Table 33. 2011 HPMS Estimates of Weekday VMT in the Sherman-Denison Study Area.....	39
Table 34. Percentage of Commercial and Non-Commercial Vehicles by Functional Classification.....	40
Table 35. Estimated VMT for Commercial and Non-Commercial Vehicles.	40
Table 36. Key Survey Results and Expanded Trip and VMT Data.....	42

INTRODUCTION

In 2012, the Texas Department of Transportation (TxDOT) funded a commercial vehicle survey in the Sherman-Denison area. The purpose of this survey was to provide data that would enable TxDOT to forecast total commercial vehicle travel demand within the Sherman-Denison urban area. The study area is located north of Dallas along the Texas/Oklahoma border, and as shown in Figure 1. The study area covers the entirety of Grayson County, and it had a total population of approximately 120,900 people in 2010 (U.S. Census Bureau 2013).

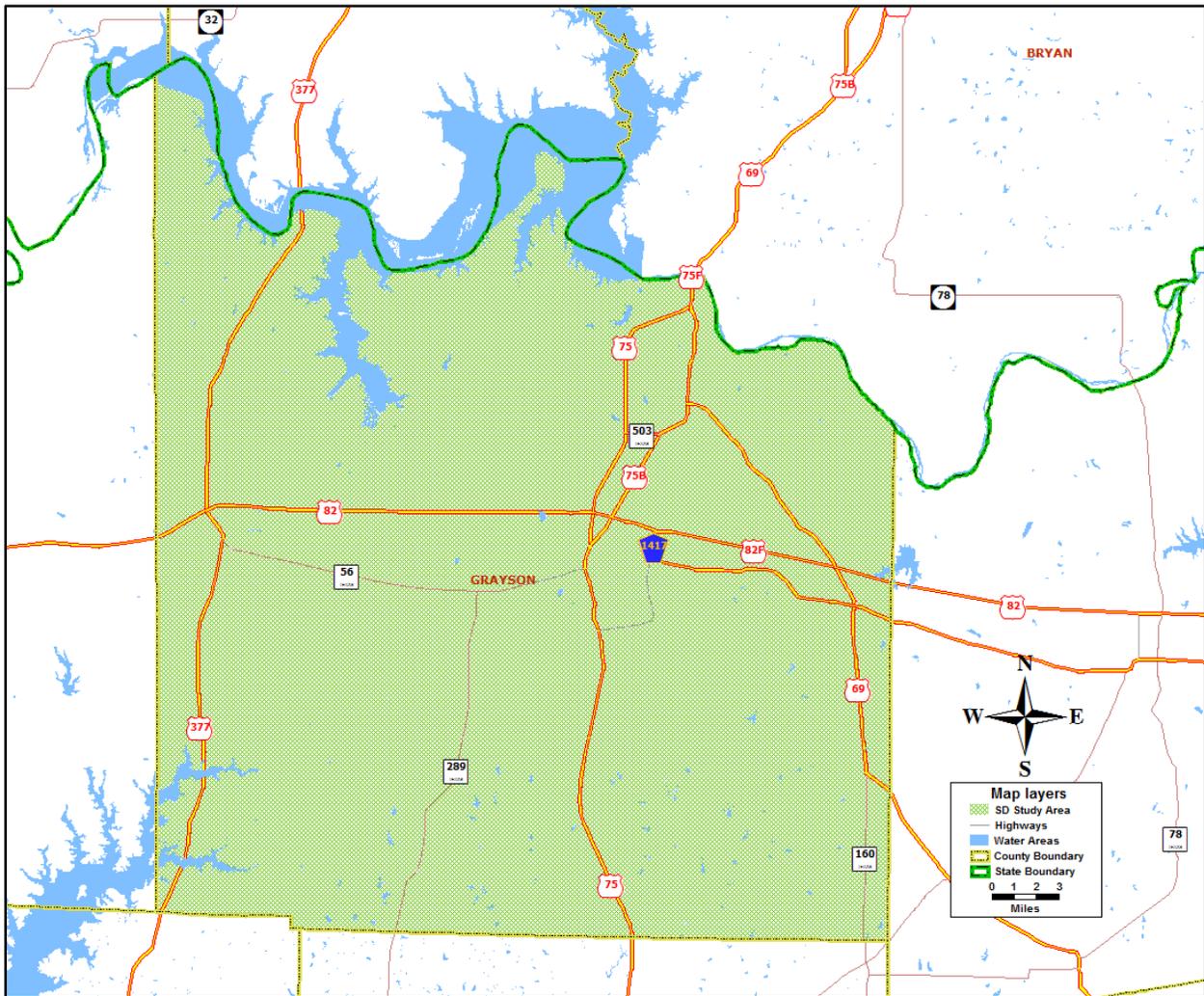


Figure 1. Sherman-Denison Study Area.

This report presents a technical summary of the commercial vehicle travel survey conducted in 2012 in the Sherman-Denison region 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 surveys for the Sherman-Denison study area were conducted during the period between May 2012 and July 2012. ETC Institute was contracted by TxDOT to conduct the commercial vehicle surveys for the study area, with technical assistance from the Texas A&M Transportation Institute (TTI). Prior to these surveys, a pilot study was carried out which consisted of 25 commercial vehicles. A target number of 300 commercial vehicles (150 cargo vehicles and 150 service vehicles), was established for the Sherman-Denison survey area (ETC Institute 2012).

The survey sample was randomly selected from a listing of all business individuals, companies, and public agencies that own, operate, or lease commercial vehicles within the study area. This list was generated from the Texas Workforce Commission (TWC) employer database that was provided by TxDOT in random order. 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.

As Table 1 shows, 463 businesses were contacted during the recruitment process. Contacts were tracked based on the following three categories:

- Agreed to Participate - The company or individual operated qualifying vehicles making trips within the study area, agreed to participate, and complete and return the survey materials.
- Refused to Participate - The company or individual operated qualifying vehicles making trips within the study area but refused to participate in the survey.
- Not Participating - The company or individual did not operate a qualifying vehicle making trips within the study area; or the company or individual did operate a qualifying vehicle that did not make trips within the study area.

Table 1. Survey Participation Rates.

Category	Contact Calls	
	Number	Percent of Total
Agreed to Participate	180	38.8
Refused to Participate	161	34.8
Not participating	122	26.4
Total	463	100.0

Source: 2011-2012 Commercial Vehicle Survey – Final Summary Report. ETC Institute.

Approximately 134 companies participated in the Sherman-Denison commercial vehicle survey, from which a total of 306 commercial vehicle surveys were obtained (ETC Institute 2012). 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. The majority of data errors were expected to be corrected prior to final data submittals by the contractor (ETC Institute). However, it was not unusual to find errors during actual data processing and analysis. In this study, survey responses with irreconcilable data were not included in the survey analysis. Additionally, inconsistent trip records were dropped from the survey analysis.

The results presented in this technical summary are therefore based on data from 299 surveyed commercial vehicles.

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 Sherman-Denison study area. Information on registered trucks includes the number of diesel-fueled, gasoline-fueled, and propane-fueled trucks by gross vehicle weight and by model year. Information on surveyed commercial vehicles includes 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 nearly 2,550 trucks registered in the Sherman-Denison study area in 2012. Table 2 shows the distribution of registered diesel trucks and gasoline trucks by gross vehicle weight. Nearly 79 percent of all trucks registered in the Sherman-Denison study area are diesel-fueled vehicles. Over 70 percent of all registered trucks had a gross vehicle weight of less than 10,000 pounds.

Table 2. Gross Vehicle Weight of Registered Trucks in the Sherman-Denison Study Area.

Gross Vehicle Weight	Diesel Trucks		Gasoline Trucks		Total	
	Number of Vehicles	% of Diesel Trucks	Number of Vehicles	% of Gasoline Trucks	Number of Vehicles	% of Total Trucks
< 10000	1,457	72.5	331	61.8	1,788	70.2
> 10000	196	9.7	109	20.3	305	12.0
> 14000	44	2.2	21	3.9	65	2.6
> 16000	52	2.6	12	2.2	64	2.5
> 19500	114	5.7	34	6.3	148	5.8
> 26000	60	3.0	10	1.9	70	2.7
> 33000	85	4.2	17	3.2	102	4.0
> 60000	3	0.1	2	0.4	5	0.2
Total	2,011	100.0	536	100.0	2,547	100.0

Source: TxDOT 2012.

Figure 2 shows the distribution of registered diesel trucks and gasoline trucks by model year. The five propane vehicles present in the raw data were not included in summary tables involving fuel type. Registered gasoline trucks were older relative to the diesel trucks. The majority of the

diesel trucks (77 percent) were less than 10 years old, which was notably more than the 52 percent of gasoline trucks within that age range. Less than 4 percent of the over 2,000 registered diesel trucks were 20 years or older, while 13 percent of registered gasoline trucks were 20 years or older.

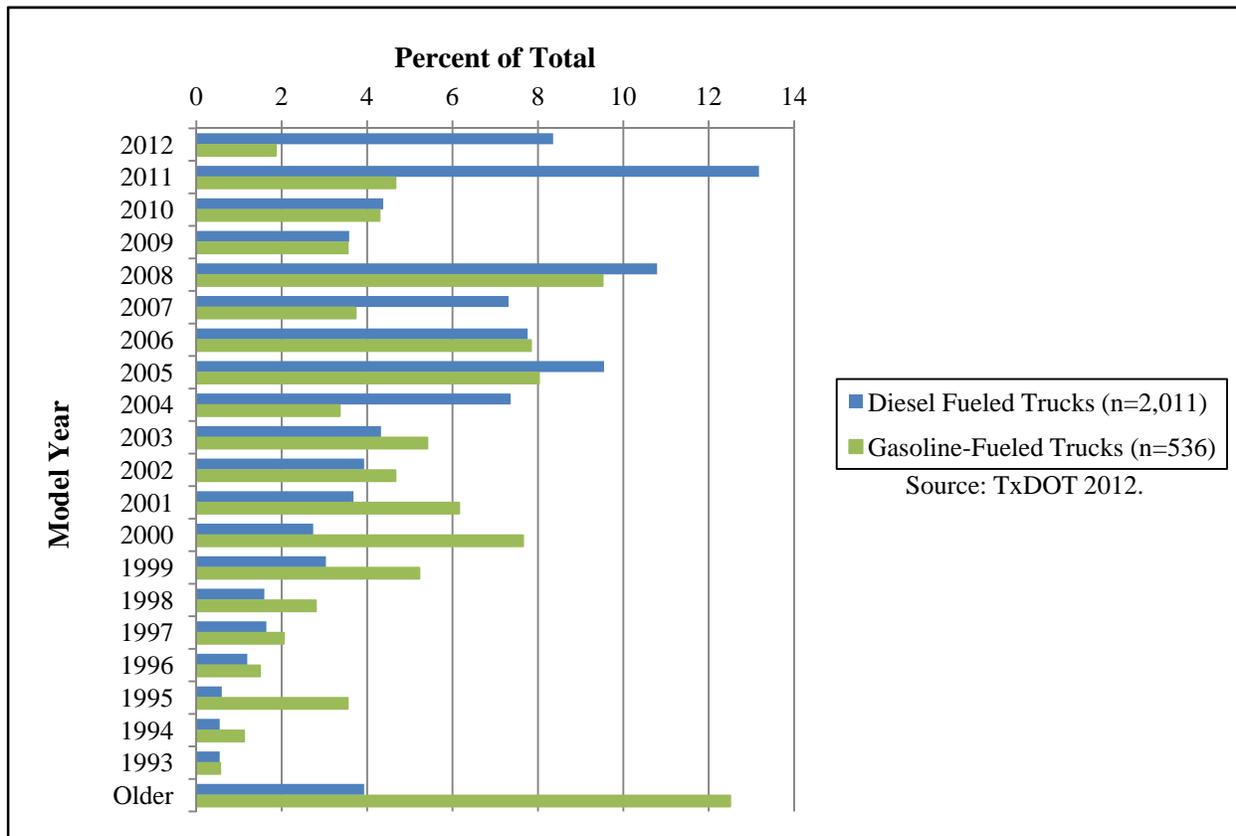


Figure 2. Model Year of Registered Trucks in the Sherman-Denison Study Area.

Surveyed Commercial Vehicles

Commercial vehicles that participated in the Sherman-Denison commercial vehicle survey were distinguished based on the 10 classification types listed in Table 3. These 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, respectively.

Cargo vehicles were defined as vehicles mainly used to transport cargo or freight, which were 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 of public agencies such as TxDOT, city, county, or school districts.

Table 3 shows the distribution of surveyed vehicles by vehicle classification type and commercial type. Out of the total 299 vehicles surveyed, 171 were cargo vehicles and 128 were service vehicles. Among cargo vehicles, approximately 29 percent were semi-tractor/trailer combinations, 25 percent were pick-up trucks, 23 percent were single unit 2-axle trucks (6-wheelers), and 12 percent were vans. Among service vehicles, approximately 63 percent were pick-up trucks, 11 percent were passenger cars, 9 percent were sport utility vehicles, and 8 percent were vans.

Table 3. Vehicle Classification Type of Surveyed Commercial Vehicles.

Vehicle Classification	Cargo Vehicles		Service Vehicles		Total Vehicles	
	Number of Vehicles	Percent of Cargo	Number of Vehicles	Percent of Service	Number of Vehicles	Percent of Total
Passenger Car	6	3.5	14	10.9	20	6.7
Pick-Up Truck	43	25.1	80	62.5	123	41.1
Van (passenger or mini)	21	12.3	10	7.8	31	10.4
Sport Utility Vehicle	1	0.6	11	8.6	12	4.0
Single Unit 2-axle (6 wheels)	39	22.8	7	5.5	46	15.4
Single Unit 3-axle (10 wheels)	9	5.3	0	0.0	9	3.0
Single Unit 4-axle (14 wheels)	2	1.2	0	0.0	2	0.7
Semi (tractor-trailer)	50	29.2	1	0.8	51	17.1
Other	0	0.0	5	3.9	5	1.7
Total	171	100.0	128	100.0	299	100.0

Figure 3 shows the distribution of surveyed vehicles by fuel type. Approximately 56 percent of the surveyed vehicles used unleaded gasoline and 44 percent used diesel. Among cargo vehicles, 66 percent used diesel and 34 percent used gasoline. Among service vehicles, 80 percent used gasoline and 20 percent used diesel.

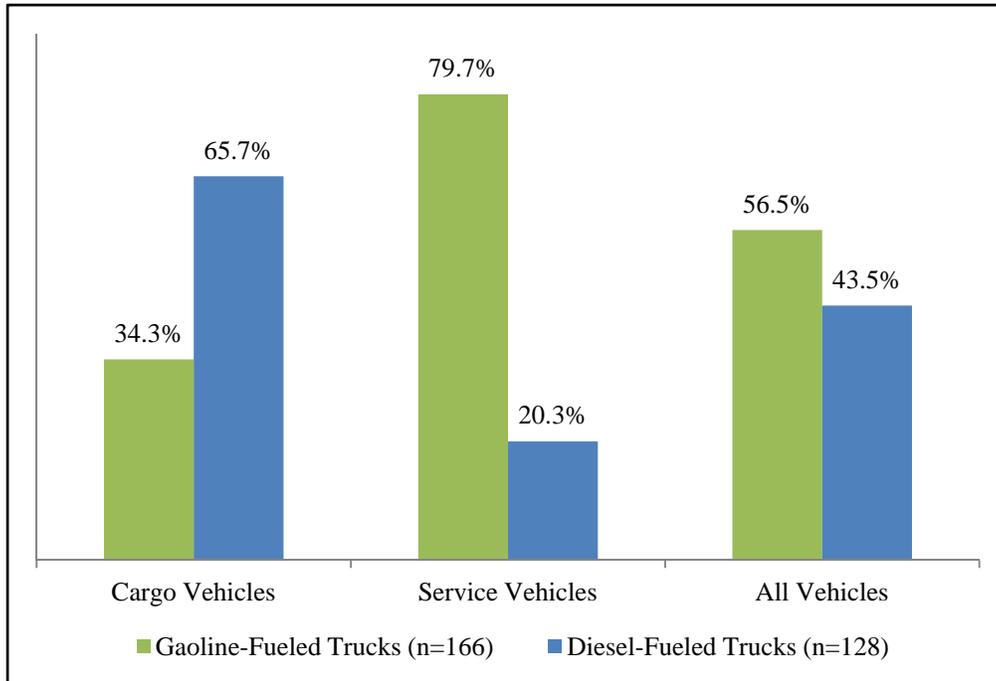


Figure 3. Type of Fuel Used by Surveyed Commercial Vehicles.

Table 4 shows the distribution of surveyed vehicles by gross vehicle weight. The survey included commercial vehicles with a gross vehicle weight of less than 10,000 pounds. Approximately 95 percent of the service vehicles belonged to this category, while approximately 51 percent of the cargo vehicles weighed more than 19,500 pounds. One of the vehicles included in Table 3 did not provide a vehicle weight and therefore was not included in Table 4.

Table 4. Gross Vehicle Weight.

Gross Vehicle Weight (lbs.)	Cargo		Service		Total	
	Number of Vehicles	% of Cargo Vehicles	Number of Vehicles	% of Service Vehicles	Number of Vehicles	% of Total Vehicles
< 10,000	72	42.1	121	95.3	193	64.8
> 10,000	5	2.9	0	0.0	5	1.7
> 14,000	6	3.5	3	2.4	9	3.0
> 16,000	1	0.6	1	0.8	2	0.7
> 19,500	21	12.3	1	0.8	22	7.4
> 26,000	17	9.9	1	0.8	18	6.0
> 33,000	33	19.3	0	0.0	33	11.1
> 60,000	16	9.4	0	0.0	16	5.4
Total	171	100.0	127	100.0	298	100.0

Figure 4 shows the distribution of surveyed vehicles by model year. Approximately 63 percent of cargo vehicles and 61 percent of service vehicles were less than 10 years old. The average age for cargo vehicles where the model year is provided was 7.7 years, while the average age for service vehicles was 7.6 years (assuming 2012 as the base year).

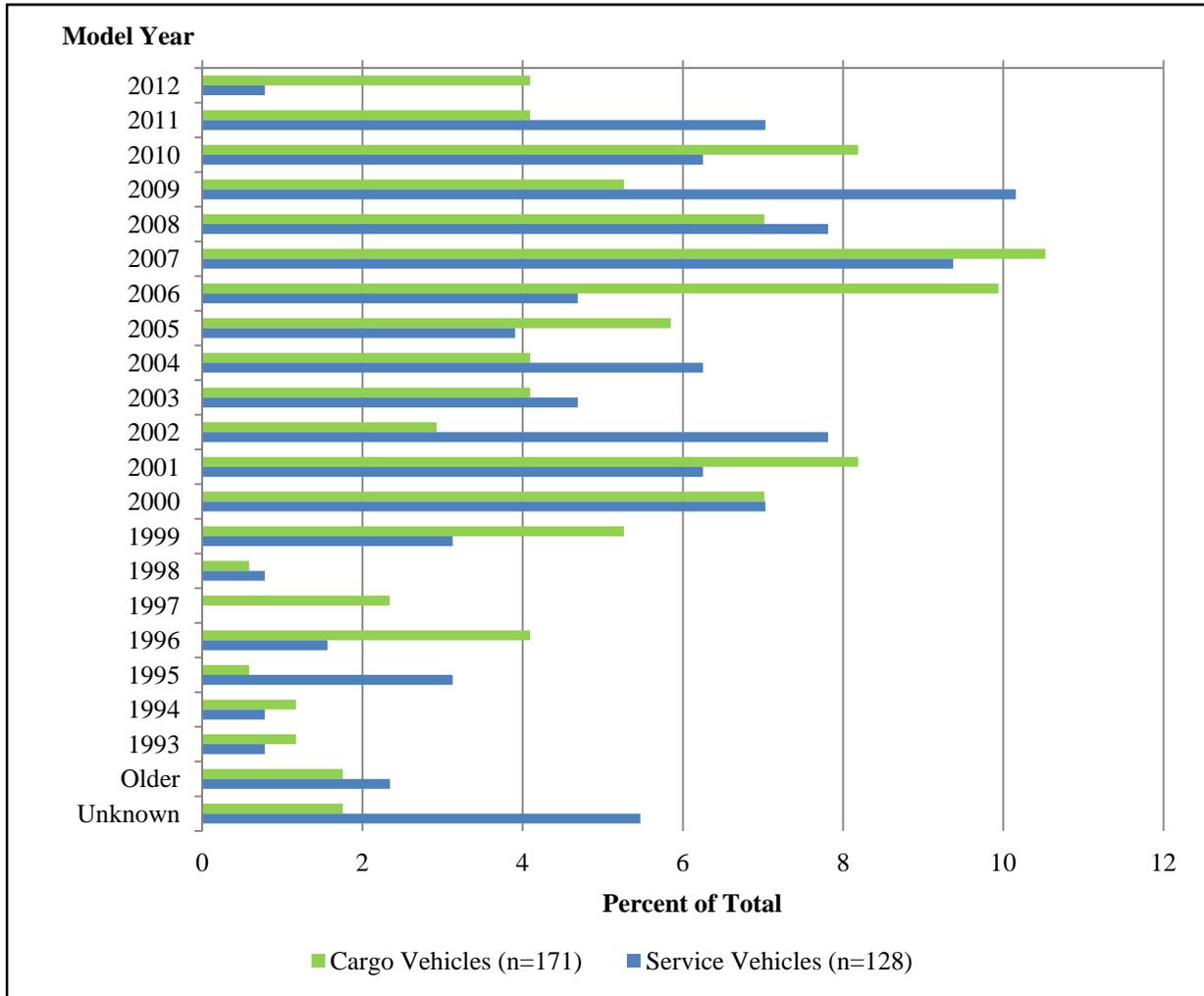


Figure 4. Vehicle Model Year.

Table 5 shows the average vehicle mileage by model year based on reported odometer readings from 259 surveyed vehicles at the beginning of their survey travel day. Cargo vehicles reported higher average odometer readings of nearly 225,000 miles compared to just under 108,500 miles for service vehicles.

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

Model Year	Cargo Vehicles		Service Vehicles		Total Vehicles	
	Number of Vehicles	Avg. Odometer Reading	Number of Vehicles	Avg. Odometer Reading	Number of Vehicles	Avg. Odometer Reading
2012	7	16,183	1	3,259	8	14,567
2011	5	29,452	8	13,408	13	19,579
2010	14	74,195	8	30,448	22	58,287
2009	9	112,175	12	55,508	21	79,794
2008	10	123,541	9	60,555	19	93,705
2007	17	313,024	10	88,087	27	229,714
2006	17	193,726	5	89,779	22	170,101
2005	8	272,494	5	238,860	13	259,558
2004	4	197,709	8	134,503	12	155,571
2003	6	297,443	5	142,083	11	226,825
2002	4	446,264	10	206,104	14	274,721
2001	13	340,501	6	151,553	19	280,833
2000	10	252,912	5	112,604	15	206,143
1999	9	275,476	3	141,441	12	241,967
1998	1	166,313	1	221,518	2	166,313
1997	4	295,265	0	0	4	295,265
1996	4	407,894	2	168,965	6	328,251
1995	1	132,087	3	179,165	4	167,396
1994	2	271,103	1	152,178	3	231,461
1993	2	471,127	0	0	2	471,127
Older	5	347,352	3	74,898	8	211,125
Unknown	1	179,717	3	134,704	4	145,957
Total	151	224,846	108	108,438	259	176,092

Trip Frequency

The surveyed vehicles generated a total of 2,037 trips, of which 1,345 were internal trips and 692 were external trips. Internal trips were defined as those trips made within the Sherman-Denison area. These trips 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 made within the same zone. External trips were those trips made outside of the study area.

Figure 5 shows the distribution of inter-zonal, intra-zonal, and external trips, while the breakdown of these trips is provided in Table 6. Cargo vehicles generated 1,332 trips, of which approximately 46 percent were inter-zonal trips, 8 percent were intra-zonal trips, and 46 percent were external trips. Service vehicles generated 705 trips, of which 81 percent were inter-zonal trips, 8 percent were intra-zonal trips, and 11 percent were external trips.

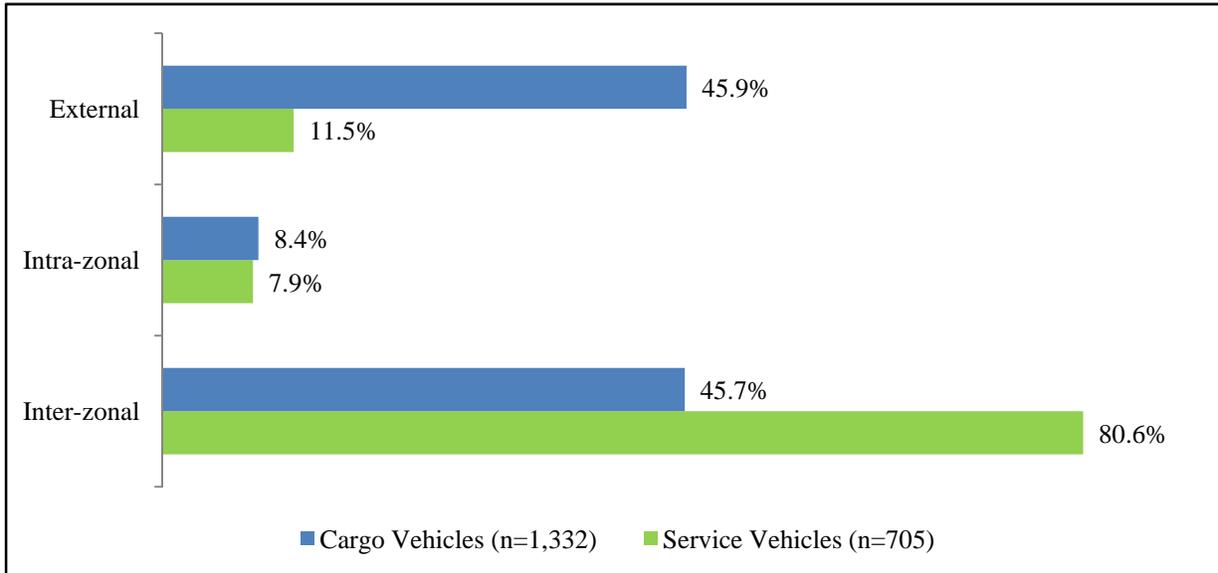


Figure 5. Inter-Zonal, Intra-Zonal, and External Trips.

Table 6. Total Internal and External Trips.

Vehicle Type Trip Type	Cargo Vehicles		Service Vehicles		Total Vehicles	
	Number	% of Total	Number	% of Total	Number	% of Total
Inter-Zonal	609	45.7	568	80.6	1,177	57.8
Intra-Zonal	112	8.4	56	7.9	168	8.2
Total Internal	721	54.1	624	88.5	1,345	66.0
External	611	45.9	81	11.5	692	34.0
Total	1,332	100.0	705	100.0	2,037	100.0

Figure 6 shows the distribution of total trips (internal and external trips), which varied from one trip to 64 trips per cargo vehicle and from one trip to 30 trips per service vehicle on their survey day. The average number of total trips per day was 7.9 trips for cargo vehicles and 5.8 trips for service vehicles.

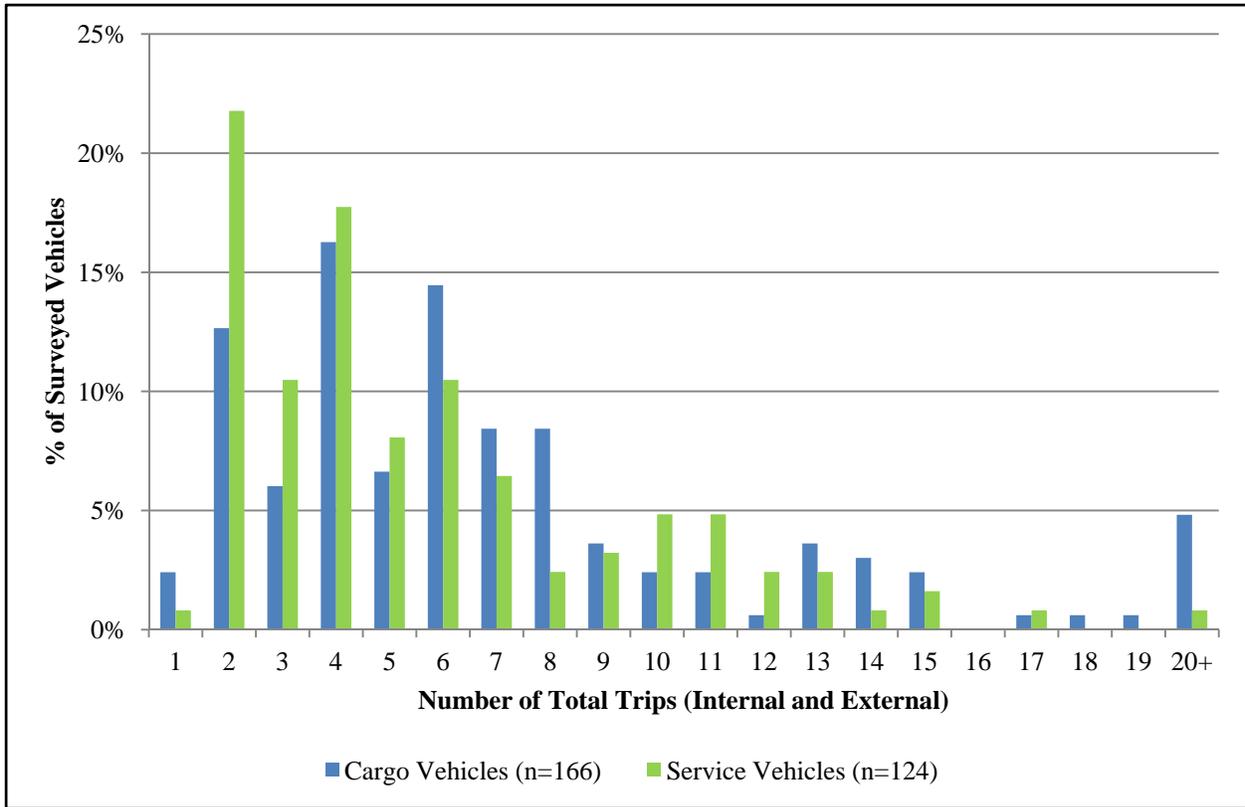


Figure 6. Total Trips per Vehicle.

Figure 7 shows the distribution of internal trips only. Approximately 10 percent of cargo vehicles made one internal trip per day, while only 6 percent of service vehicles reported making one internal trip per day. Additionally, 27 percent of cargo vehicles did not make an internal trip, while 12 percent of service vehicles fell into this category. The average number of internal trips per day was 4.3 trips for cargo vehicles and 5.0 trips for service vehicles.

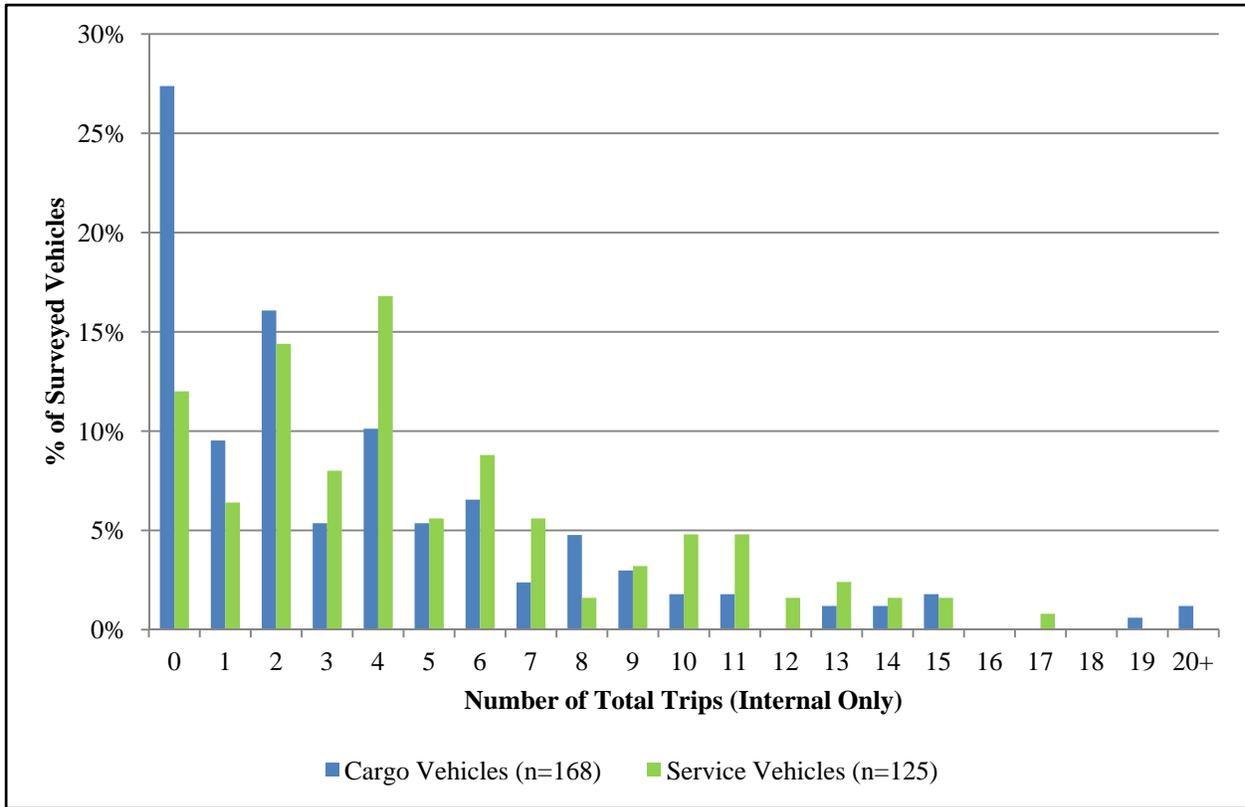


Figure 7. Total Internal Trips per Vehicle.

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 analysis of trips presented in this section is based solely on internal trips and does not include external trips.

Table 7 shows the distribution of internal trips by land use type at trip destinations. Approximately 34 percent of the trips made by cargo vehicles occurred at residential locations, followed by 25 percent at retail locations, and nine percent at industrial locations. For service vehicles, over 20 percent of the trips occurred at residential sites, followed by nearly 20 percent at locations classified as “other,” and 17 percent at retail locations.

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

Land Use	Cargo		Service	
	Number	Percent of Cargo	Number	Percent of Service
Office Building (Non-government)	14	1.9	44	7.1
Retail/Shopping	183	25.4	103	16.5
Industrial/Manufacturing	67	9.3	7	1.1
Medical/Hospital	50	6.9	49	7.9
Education (< 12th grade)	31	4.3	80	12.8
Education (College, Trade)	4	0.6	0	0.0
Government Office/Building	14	1.9	63	10.1
Residential	244	33.8	126	20.2
Airport	0	0.0	6	1.0
Intermodal Facility	0	0.0	0	0.0
Warehouse	13	1.8	2	0.3
Distribution Center	25	3.5	11	1.8
Construction Site	26	3.6	10	1.6
Other	50	6.9	123	19.7
Refused/Unknown	0	0.0	0	0.0
Total Trips	721	100.0	624	100.0

Table 8 shows the distribution of internal trips by trip purposes at trip destinations. Approximately 46 percent of the cargo vehicle internal trips were delivery, 25 percent were base, and 11 percent were classified as pick-up and delivery. For trips made by service vehicles, approximately 40 percent were classified as service, 37 percent were classified as base, and 11 percent were driver needs.

Table 8. Trip Purposes at Destination Locations.

Trip Purpose	Cargo		Service	
	Number	Percent of Cargo	Number	Percent of Service
Base	158	24.9	169	37.1
Delivery	292	46.1	0	0.0
Pick-up	65	10.3	0	0.0
Pick-up & Delivery	70	11.0	0	0.0
Driver needs	17	2.7	49	10.8
Maintenance	8	1.3	19	4.2
Service-Related	14	2.2	183	40.2
Other	10	1.6	35	7.7
Total Trips	634	100.0	455	100.0

Cargo Characteristics

Information on the type of cargo being delivered or picked up at each stop, the weight of cargo, and the type of land use where the cargo trip occurred was collected in the Sherman-Denison commercial vehicle survey to examine the movement of commodities within and outside of the study area. The analyses presented in this section are for both internal and external trips made by surveyed cargo vehicles only, and do not include the trips made by service vehicles. The types of cargo in the survey were based on 22 classification types listed in Table 9.

The analysis of cargo trip data examined the types of cargo being transported at trip destinations, the trip purpose and land use activity at each stop, and the estimated net weight of the cargo being picked up and/or delivered for each trip. Several inconsistencies were observed during the processing and analysis of cargo trip data. There were some trips with full or partial cargo loads that did not report cargo weights but actually reported the type of cargo being transported. There were some trips that indicated delivery trip purpose but did not report any cargo weights at the drop-off location. There were some trips that reported cargo weights at pick-up but the weights that were reported were not consistent at drop-off. Such inconsistencies generated errors in the estimation of net weight of cargo for that particular trip. Hence, it was necessary to manually process the cargo trip data, and use the researchers' judgment when making changes as deemed fit.

Table 9. Cargo Classification Types.

Cargo Type	Cargo Descriptions
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, metals, gypsum, ores, 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	Soaps, paints, household or industrial chemicals, etc.
11. Refined Petroleum or Coal Products	Gasoline, etc.
12. Rubber, Plastic, and Styrofoam Products	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 24 percent of the total cargo vehicle trips were transporting food, health, and beauty products, followed by 23 percent transporting manufactured goods, and approximately 11 percent transporting unclassified cargo. Approximately 9 percent were empty shipping containers.

Table 10. Distribution of Trips by Cargo Type at Destinations.

Cargo Type	Number of Trips	% of Total
Farm Products	19	1.4
Forest Products	27	2.1
Marine Products	0	0.0
Metals and Minerals	55	4.2
Food, Health, and Beauty Products	315	23.9
Tobacco Products	0	0.0
Textiles	14	1.1
Wood Products	66	5.0
Printed Matter	0	0.0
Chemical Products	2	0.2
Refined Petroleum or Coal Products	32	2.4
Rubber, Plastic, and Styrofoam Products	29	2.2
Clay, Concrete, Glass, or Stone	34	2.6
Manufactured Goods/Equipment	298	22.6
Wastes	23	1.7
Miscellaneous Shipments	70	5.3
Hazardous Materials	25	1.9
Transportation	28	2.1
Unclassified/Other Cargo	139	10.6
Driver Refused to Answer	18	1.4
Unknown to Driver	0	0.0
Total Trips with Cargo	1,194	90.7
Empty	123	9.3
Total Cargo Vehicle Trips	1,317	100.0

The commodity grouping scheme used by TxDOT in its Texas Statewide Analysis Model (SAM) was used to simplify the cargo types into 10 commodity groups. The type of place option in the survey was 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 or Coal Products
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	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
-- Other	Airport, Inter-Modal Facility, Warehouse, Distribution Center, Construction Site, Other
-- Unknown	Land use category not provided, Omitted, Driver refused to answer

Table 13 shows the distribution of cargo trips by commodity group and land use type at trip destinations. Approximately 31 percent occurred at residential sites, and 25 percent of the trips occurred at retail sites. Nearly 19 percent of the trips occurred at “Other” land use types, which

were mainly warehouses, distribution centers, and construction sites. By commodity group, approximately 24 percent of the trips were transporting food, and about 23 percent were transporting machinery.

Table 13. Cargo Trips by Commodity Group and Land Use Destinations.

Commodity Group	Land Use								Total Trips	% of Total
	Office	Retail	Ind'l	Med	Edu	Gov't	Res	Othr		
Agriculture	0	3	18	0	0	0	3	22	46	3.5
Raw Materials	0	20	13	0	1	5	23	27	89	6.8
Food	7	64	0	5	4	0	218	17	315	23.9
Textiles	3	12	5	1	0	0	12	10	43	3.3
Wood	1	6	11	2	0	0	12	34	66	5.0
Building Materials	0	6	8	0	0	1	9	10	34	2.6
Machinery	2	135	60	3	4	2	43	49	298	22.6
Miscellaneous	2	1	2	2	26	40	12	8	93	7.1
Hazardous	0	2	3	0	0	0	12	8	25	1.9
Transportation	1	17	3	0	0	0	5	2	28	2.1
Secondary	6	9	3	46	5	2	47	21	139	10.6
Unknown	0	5	6	0	0	0	0	7	18	1.4
Empty	3	48	8	11	3	2	16	32	123	9.3
Total	25	328	140	70	43	52	412	247	1,317	100.0
Percent of Total	1.9	24.9	10.6	5.3	3.3	3.9	31.3	18.8	100.0	---

Figure 8 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 41 percent of the total cargo vehicle trips were delivery, with food as the most frequent commodity group cited for surveyed trips. The trip purpose “pick-up” comprised over 10 percent of the total cargo trips. However, these do not represent the actual portion of trips that picked up cargo because some of the trips coded as “base location” trip purpose were also the pick-up location for cargo.

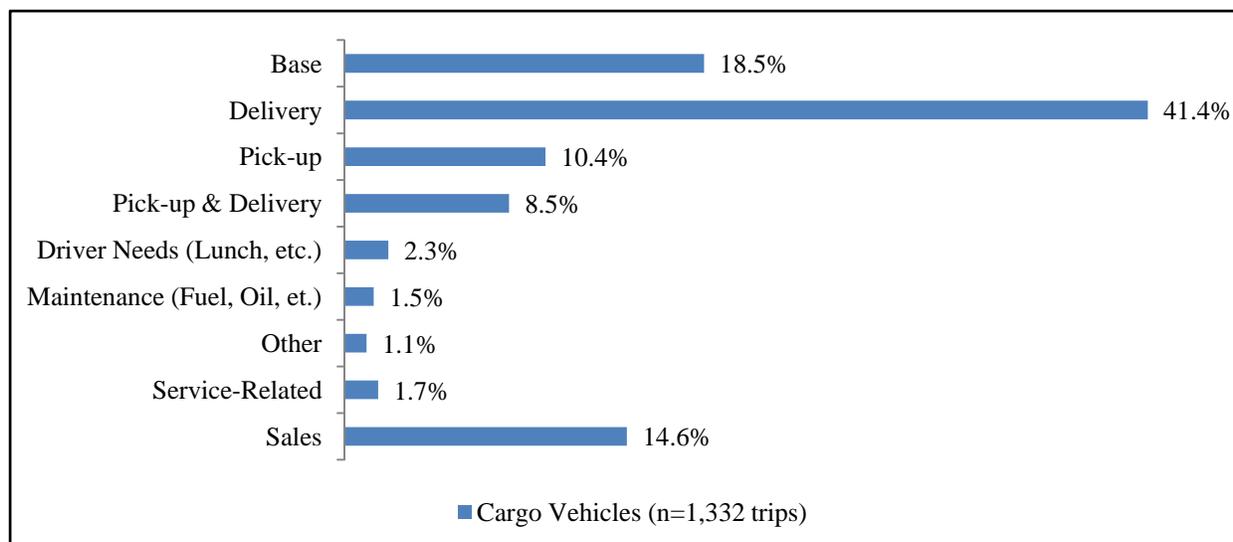


Figure 8. Cargo Trip Purposes at the Trip Destinations.

Table 14. Cargo Trips by Commodity Group and Trip Purpose at the Trip Destinations.

Commodity Group	Trip Purpose									Total Trips	% of Total
	Base	Delivery	Pick-Up	Pick-Up & Deliv	Driv Need	Maint	Other	Sales	Serv		
Agriculture	6	21	18	0	1	0	0	0	0	46	3.5
Raw Materials	9	45	19	1	4	2	3	0	6	89	6.8
Food	10	119	2	0	1	0	0	183	0	315	23.9
Textiles	11	22	5	3	1	0	1	0	0	43	3.3
Wood	16	40	3	4	2	1	0	0	0	66	5
Building Materials	7	18	7	1	0	1	0	0	0	34	2.6
Machinery	57	141	46	32	3	6	0	10	3	298	22.6
Misc.	5	43	18	24	1	0	2	0	0	93	7.1
Hazardous	4	21	0	0	0	0	0	0	0	25	1.9
Transportation	12	2	0	14	0	0	0	0	0	28	2.1
Secondary	20	70	9	34	3	0	0	0	3	139	10.6
Unknown	2	9	7	0	0	0	0	0	0	18	1.4
Empty	80	1	4	0	13	10	8	1	6	123	9.3
Total	239	552	138	113	29	20	14	194	18	1,317	100.0
Percent of Total	18.1	41.9	10.5	8.6	2.2	1.5	1.1	14.7	1.4	100.0	---

The analysis of cargo weights 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, continued making trips until it reached its destination(s), 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 or food type), even if the same cargo was being transported either for delivery or pick-up. The driver of the surveyed cargo vehicle reported a different trip purpose during a particular stop (i.e., driver needs - lunch, etc.), which indicated that no cargo was delivered and/or picked-up but the cargo remained in transit. In such cases, the cargo weight from the trip origin should be 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 should be deducted from the current weight load, and if cargo was picked-up, the cargo weight should be added to the current weight load, thus resulting in an estimated net cargo weight for that particular trip.

Table 15 shows the distribution of average net cargo weight per trip by commodity group and land use type at destination locations and Table 16 shows the distribution by commodity group and trip purpose. Agriculture products being transported to residential sites have the highest average net cargo weight. The trip purpose of delivery had a listed average net cargo weight for all listed commodity groups. Intuitively it would be expected that the average net cargo weight for the empty commodity group to be zero. However, there was one empty trip for which a non-zero weight was provided for the trip destination—leading to the non-zero value for empty trips going to “other” lane use in Table 15. For similar reasons, the average net cargo weight is not zero for empty vehicles with the trip purpose of delivery at their trip destination, as seen in Table 16.

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

Commodity Group	Land Use							
	Office	Retail	Ind'l	Med	Edu	Gov't	Res	Other
Agriculture	0	0	21,379	0	0	0	13,400	22,096
Raw Materials	0	22,005	3,360	0	2,626	44,040	486	9,426
Food	4	322	0	1	3	0	1	44
Textiles	0	447	1,360	8	0	0	16	2,620
Wood	0	0	1,357	45	0	0	10,518	6,615
Building Materials	0	42	20,750	0	0	0	7,251	10,114
Machinery	0	1,030	463	233	44	153	1,253	1,133
Miscellaneous	0	0	0	0	13	650	0	4,911
Hazardous	0	2,180	2,824	0	0	0	371	404
Transportation	2,800	1,506	9,467	0	0	0	2,585	0
Secondary	333	139	933	29	9	10	50	2,799
Unknown	0	270	0	0	0	0	0	19,843
Empty	0	0	0	0	0	0	0	266

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

Commodity Group	Trip Purpose								
	Base	Delivery	Pick-Up	Pick-Up & Delivery	Driver Needs	Maint	Other	Sales	Serv
Agriculture	0	43,387	0	0	0	0	0	0	0
Raw Materials	0	21,578	0	1,275	0	0	0	0	0
Food	0	182	0	0	0	0	0	0	0
Textiles	0	1,298	0	3,333	0	0	0	0	0
Wood	0	9,147	0	63	0	0	0	0	0
Building Material	0	18,467	0	250	0	0	0	0	0
Machinery	0	1,852	0	509	0	8	0	0	0
Miscellaneous	0	1,519	0	15	0	0	0	0	0
Hazardous	0	977	0	0	0	0	0	0	0
Transportation	0	513	0	4,907	0	0	0	0	0
Secondary	0	972	0	15	0	0	0	0	0
Unknown	0	15,583	0	0	0	0	0	0	0
Empty	0	8,500	0	0	0	0	0	0	0

Table 17 shows the distribution of cargo trips and net cargo weights at trip destinations by commodity group. Overall, the average net cargo weight per trip (excluding empty trips) was just over 2,750 lbs. Of the classified commodity groups, agriculture showed the highest average net

cargo weight of over 19,800 lbs. per trip. Food was the most frequently transported of the commodity groups, with an average net cargo weight of just 69 pounds per trip.

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

Commodity Group	Total Cargo Trips	Total Net Cargo Weight (lbs.)	Number of Trips*	Average Net Cargo Weight (lbs.)*
Agriculture	46	911,130	46	19,807
Raw Materials	89	972,277	89	10,924
Food	315	21,682	315	69
Textiles	43	38,562	43	897
Wood	66	366,148	66	5,548
Building Materials	34	332,650	34	9,784
Machinery	298	277,427	298	931
Miscellaneous	93	65,651	93	706
Hazardous	25	20,518	25	821
Transportation	28	69,725	28	2,490
Secondary	139	68,552	139	493
Unknown	18	140,250	18	7,792
Empty	123	8,500	0	0
Total	1,317	3,284,572	1,194	2,751

* Excluding trips with empty cargo.

Table 18 shows the number of trips and net cargo weights at trip destinations by land use type. “Other” land use sites showed the highest average net cargo weight of nearly 5,700 lbs. per trip—followed by industrial sites, with an average net cargo weight of nearly 4,900 lbs. per trip and government sites, with an average net cargo weight of over 4,700 lbs. per trip.

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

Land Use	Total Cargo Trips	Total Net Cargo Weight (lbs.)	Number of Trips*	Average Net Cargo Weight (lbs.)*
Office	25	4,825	25	193
Retail	328	637,973	328	1,945
Industrial	140	683,663	140	4,883
Medical	70	2,120	70	30
Education	43	3,206	43	75
Government	52	246,540	52	4,741
Residential	412	316,940	412	769
Other	247	1,397,805	247	5,659
Total	1,317	3,293,072	1,317	2,500

* Excluding trips with empty cargo.

Table 19 shows the distribution of cargo trips and net cargo weights by trip purpose. Delivery trip purposes had the highest average net weight at over 5,800 lbs. per trip.

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

Trip Purpose	Total Cargo Trips	Total Net Cargo Weight (lbs.)	Number of Trips*	Average Net Cargo Weight (lbs.)*
Base	239	0	239	0
Delivery	552	3,195,379	552	5,789
Pick-up	138	0	138	0
Pick-up & Delivery	113	97,643	113	864
Driver Needs	29	0	29	0
Maintenance	20	50	20	3
Other	14	0	14	0
Service	18	0	18	0
Sales	194	0	194	0
Total	1,317	3,293,072	1,317	2,500

* Excluding trips with empty cargo.

Trip Length

Odometer readings at the beginning and end of the trip are useful in estimating travel distances for external and intra-zonal trips. The Sherman-Denison commercial vehicle survey, however, only provided odometer mileage on each vehicle for the beginning of the trip and not for the end of the trip. Because this incomplete information makes odometer readings not particularly useful for trip length measurement in the analysis, network matrices available for the study area were used to estimate trip lengths. The network matrices provide travel distance and time estimates from one zone to all other zones in the Sherman-Denison study area. Since each reported trip in the survey was coded with a traffic analysis zone (TAZ) number assigned to the study area, it was then possible to estimate the trip length based on the distance provided in the network matrix.

Figure 9 shows the TAZ boundary and base locations of surveyed vehicles within the Sherman-Denison study area, while Figure 10 shows the origin and destination locations of trips made by the surveyed vehicles. Any trip that had at least one trip outside of the Sherman-Denison study area was considered an external trip.

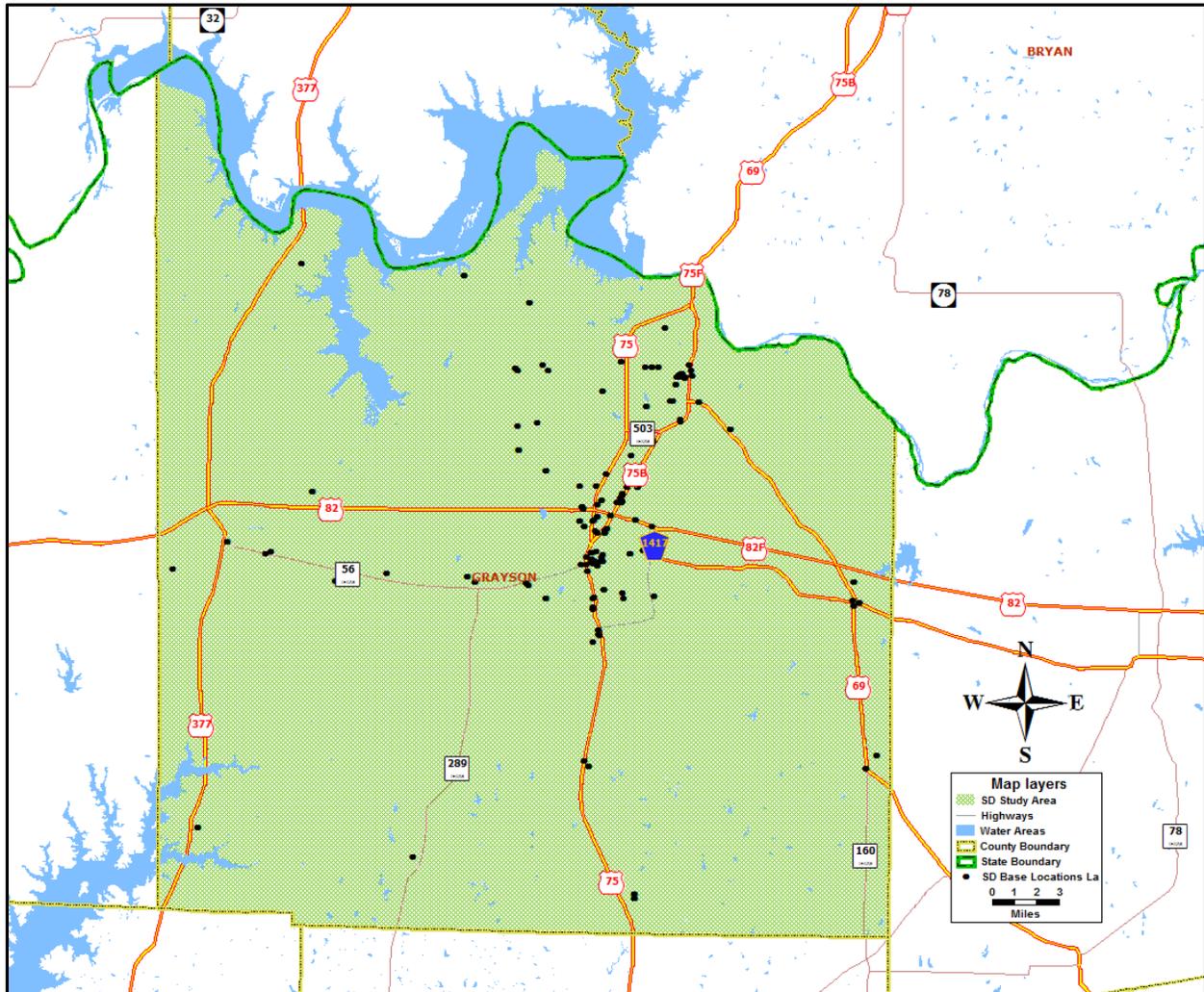


Figure 9. TAZ Boundary and Base Locations of Surveyed Commercial Vehicles.

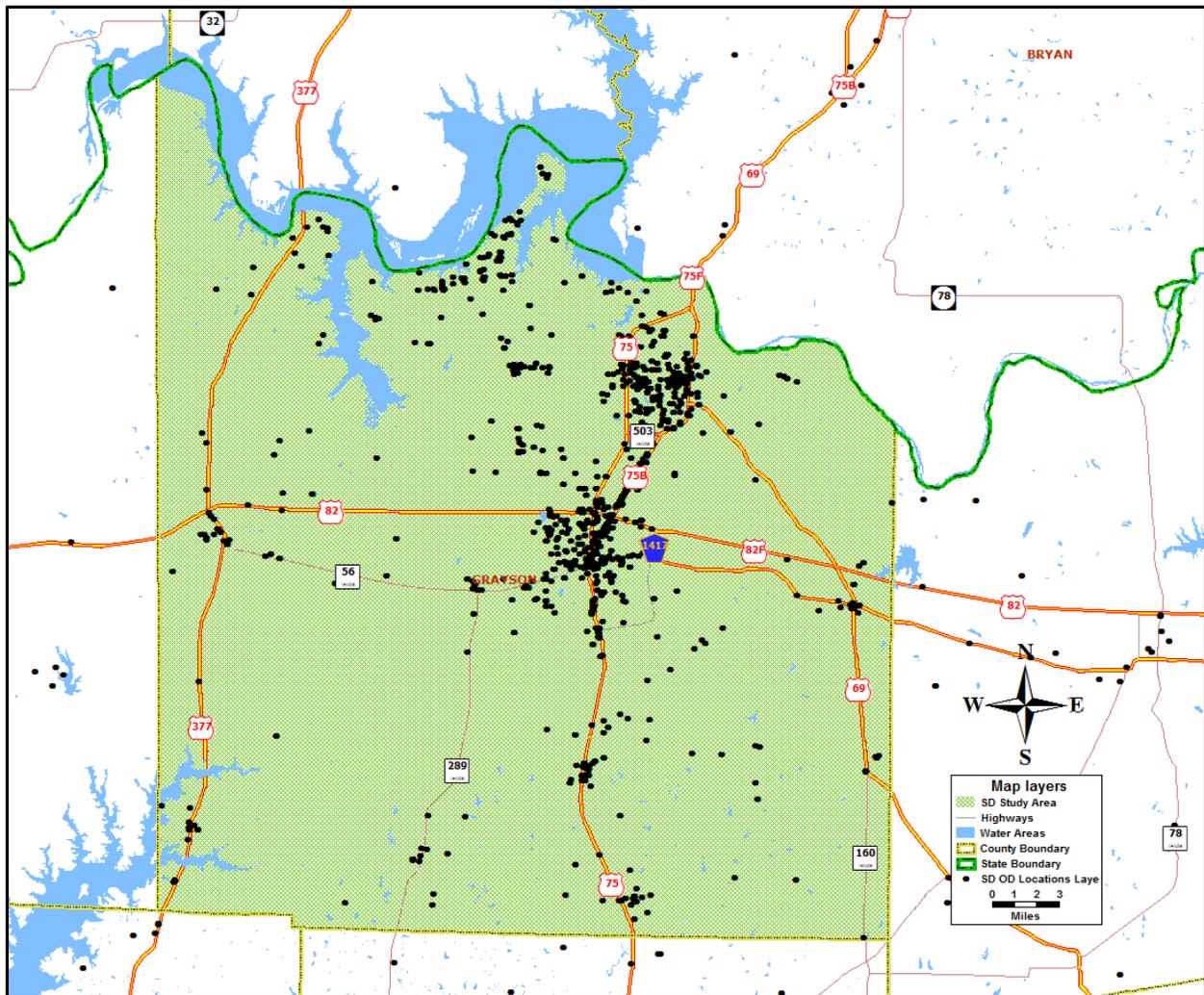


Figure 10. Trip Origins and Destinations of Surveyed Commercial Vehicles.

The results presented in this section pertain to trip length characteristics for 1,177 inter-zonal trips only. Table 20 shows the trip length frequency distribution (TLFD), grouped at five-mile intervals, while Table 21 show the ungrouped TLFD. Approximately 48 percent of the cargo vehicles and 71 percent of the service vehicle trips had trip lengths less than five miles. Additionally, 25 percent of the cargo vehicle trips and 17 percent of the service vehicles had trip lengths between six miles and 10 miles. The longest trip lengths reported by cargo and service vehicles were 39 miles and 33 miles, respectively.

Table 20. Trip Length Frequency Distribution (Grouped Interval).

Trip Length (miles)	Cargo		Service		All Vehicles	
	# of Trips	% of Total	# of Trips	% of Total	# of Trips	% of Total
Less than 5	290	47.6	402	70.8	692	58.8
6 to 10	154	25.3	96	16.9	250	21.2
11 to 15	83	13.6	25	4.4	108	9.2
16 to 20	39	6.4	35	6.2	74	6.3
21 to 25	25	4.1	4	0.7	29	2.5
26 to 30	14	2.3	3	0.5	17	1.4
31 to 35	3	0.5	3	0.5	6	0.5
36 to 40	1	0.2	0	0.0	1	0.1
Total	609	100.0	568	100.0	1,177	100.0

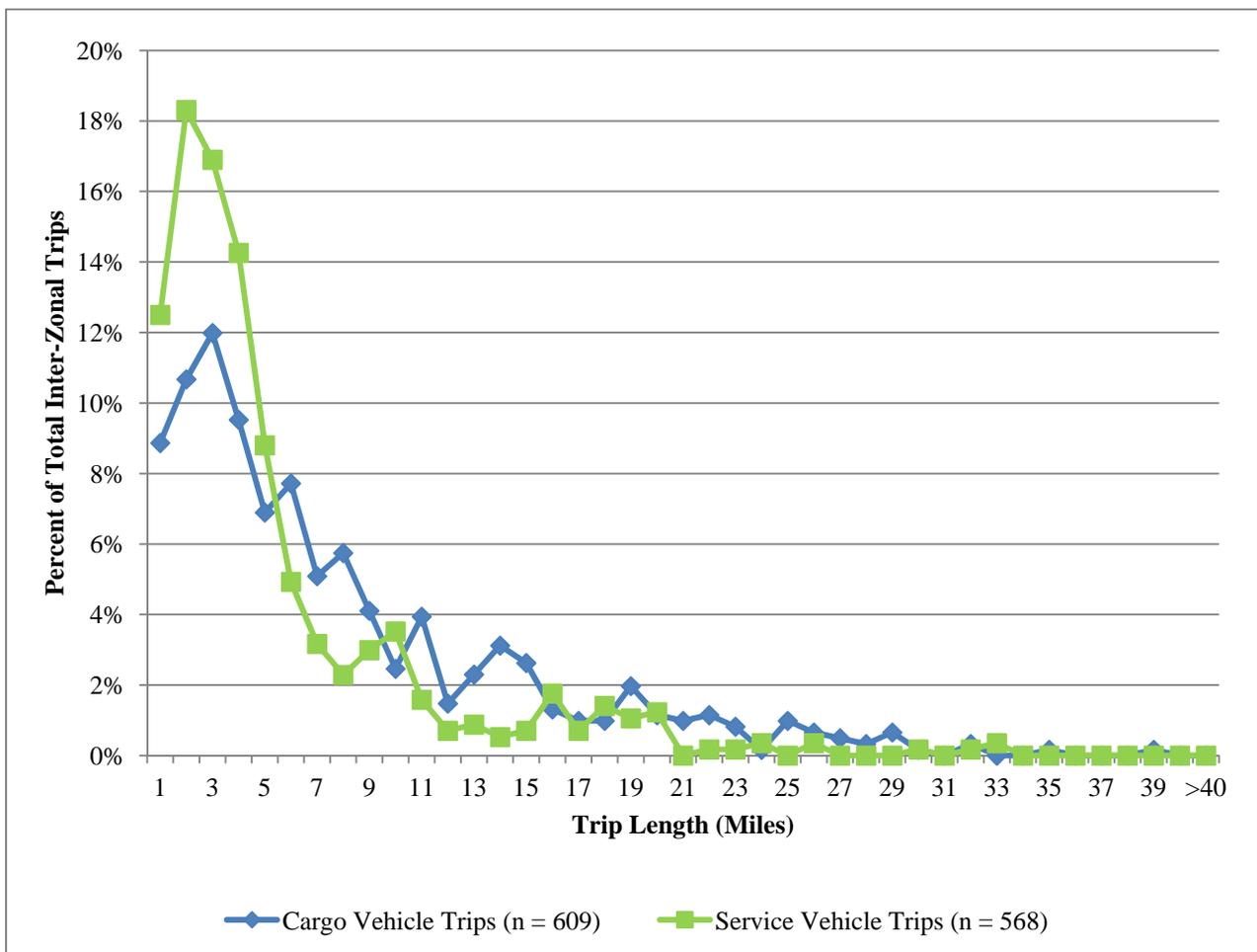


Figure 11. Surveyed Commercial Vehicle Trips TLFD.

Table 21. Trip Length Frequency Distribution (Ungrouped).

Trip Length (miles)	Cargo Vehicles		Service Vehicles		All Vehicles	
	# of Trips	% of Total	# of Trips	% of Total	# of Trips	% of Total
1	54	8.9	71	12.5	125	10.6
2	65	10.7	104	18.3	169	14.4
3	73	12.0	96	16.9	169	14.4
4	58	9.5	81	14.3	139	11.8
5	42	6.9	50	8.8	92	7.8
6	47	7.7	28	4.9	75	6.4
7	31	5.1	18	3.2	49	4.2
8	35	5.7	13	2.3	48	4.1
9	25	4.1	17	3.0	42	3.6
10	15	2.5	20	3.5	35	3.0
11	24	3.9	9	1.6	33	2.8
12	9	1.5	4	0.7	13	1.1
13	14	2.3	5	0.9	19	1.6
14	19	3.1	3	0.5	22	1.9
15	16	2.6	4	0.7	20	1.7
16	8	1.3	10	1.8	18	1.5
17	6	1.0	4	0.7	10	0.8
18	6	1.0	8	1.4	14	1.2
19	12	2.0	6	1.1	18	1.5
20	7	1.1	7	1.2	14	1.2
21	6	1.0	0	0.0	6	0.5
22	7	1.1	1	0.2	8	0.7
23	5	0.8	1	0.2	6	0.5
24	1	0.2	2	0.4	3	0.3
25	6	1.0	0	0.0	6	0.5
26	4	0.7	2	0.4	6	0.5
27	3	0.5	0	0.0	3	0.3
28	2	0.3	0	0.0	2	0.2
29	4	0.7	0	0.0	4	0.3
30	1	0.2	1	0.2	2	0.2
31	0	0.0	0	0.0	0	0.0
32	2	0.3	1	0.2	3	0.3
33	0	0.0	2	0.4	2	0.2
34	0	0.0	0	0.0	0	0.0
35	1	0.2	0	0.0	1	0.1
36	0	0.0	0	0.0	0	0.0
37	0	0.0	0	0.0	0	0.0
38	0	0.0	0	0.0	0	0.0
39	1	0.2	0	0.0	1	0.1
Total	609	100.0	568	100.0	1,177	100.0

Table 22 shows the average trip length to destinations by land use type for cargo and service vehicle trips. Overall, the average distance per trip traveled by the surveyed vehicles was 6.3 miles, with cargo vehicles trips averaging 7.5 miles and service vehicles trips averaging 5.0 miles. The most number of trips by cargo vehicles occurred at retail land use types, with an average trip length of 6.6 miles, followed by residential and “other” sites with average trip lengths of 7.0 miles and 11.5 miles, respectively. For service vehicles, the highest frequency of trips occurred at “other” land use types, with an average trip length of 4.0 miles. Approximately 45 percent of the trips made by service vehicles occurred at either residential or “other” land use sites.

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

Land Use	Cargo			Service			All Vehicles		
	Number of Trips	Total Trip Length (miles)	Avg. Trip Length (miles)	Number of Trips	Total Trip Length (miles)	Avg. Trip Length (miles)	Number of Trips	Total Trip Length (miles)	Avg. Trip Length (miles)
Office	12	77	6.4	44	289	6.6	56	366	6.5
Retail	171	1,135	6.6	97	419	4.3	268	1,554	5.8
Industrial	57	433	7.6	6	22	3.7	63	455	7.2
Medical	45	237	5.3	49	407	8.3	94	644	6.8
Education	32	91	2.8	69	284	4.1	101	375	3.7
Government	14	151	10.8	48	223	4.6	62	373	6.0
Residential	166	1,160	7.0	118	625	5.3	284	1,784	6.3
Other	112	1,289	11.5	137	554	4.0	249	1,843	7.4
Total	609	4,572	7.5	568	2,822	5.0	1,177	7,395	6.3

Table 23 shows the average trip length to destinations by commodity group for trips made by cargo vehicles only. Approximately 22 percent of the trips cited the commodity group machinery. The commodity group secondary was the next most frequently transported commodity group, with an average trip length of 7.4 miles per trip. The average trip length for vehicles with no cargo (empty) was 6.8 miles.

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

Commodity Group	Cargo		
	Number of Trips	Total Trip Length (miles)	Average Trip Length (miles)
Agriculture	11	157	14.3
Raw Materials	40	354	8.9
Food	78	327	4.2
Textiles	27	290	10.7
Wood	30	314	10.5
Building Materials	13	161	12.4
Machinery	131	945	7.2
Miscellaneous	53	400	7.5
Hazardous	14	167	11.9
Transportation	18	121	6.7
Secondary	100	738	7.4
Unknown	9	57	6.3
Empty	75	510	6.8
None	10	32	3.2
Total	609	4,572	7.5

Travel Time and Speed

The Sherman-Denison commercial vehicle survey provided travel logs on the arrival and departure times for each trip made by the surveyed commercial vehicles. The travel logs can be compared with the network travel time matrix table available for the study area. However, some of the reported travel logs had missing departure or arrival times, which rendered them unreliable in generating accurate estimates. Hence, as has been done in the estimation of trip lengths, travel time estimates were generated from the network travel time matrix table available for the Sherman-Denison study area, and travel speed estimates were derived from the estimated trip lengths.

Table 24 shows the travel time frequency distribution of inter-zonal trips, grouped at five-mile intervals, while Figure 12 and Table 25 show the ungrouped TLF. Approximately 24 percent of the trips made by cargo vehicles were less than five minutes, 29 percent were between 6-and-10 minutes, and 17 percent were between 11-and-15 minutes. For service vehicles, approximately 38 percent of the trips were less than five minutes, 36 percent were between 6-and-10 minutes, and 11 percent were between 11-and-15 minutes. The longest duration of travel time for cargo vehicles was 54 minutes, while the longest travel duration for service vehicles was 48 minutes.

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

Travel Time (minutes)	Cargo		Service		All Vehicles	
	# of Trips	% of Total	# of Trips	% of Total	# of Trips	% of Total
Less than 5	144	23.6	216	38.0	360	30.6
6 to 10	177	29.1	205	36.1	382	32.5
11 to 15	106	17.4	64	11.3	170	14.4
16 to 20	66	10.8	26	4.6	92	7.8
21 to 25	45	7.4	22	3.9	67	5.7
26 to 30	26	4.3	20	3.5	46	3.9
31 to 35	20	3.3	8	1.4	28	2.4
36 to 40	12	2.0	3	0.5	15	1.3
41 to 45	9	1.5	1	0.2	10	0.8
46 to 50	2	0.3	3	0.5	5	0.4
> 50	2	0.3	0.0	0	2	0.2
Total	609	100.0	568	100.0	1,177	100.0

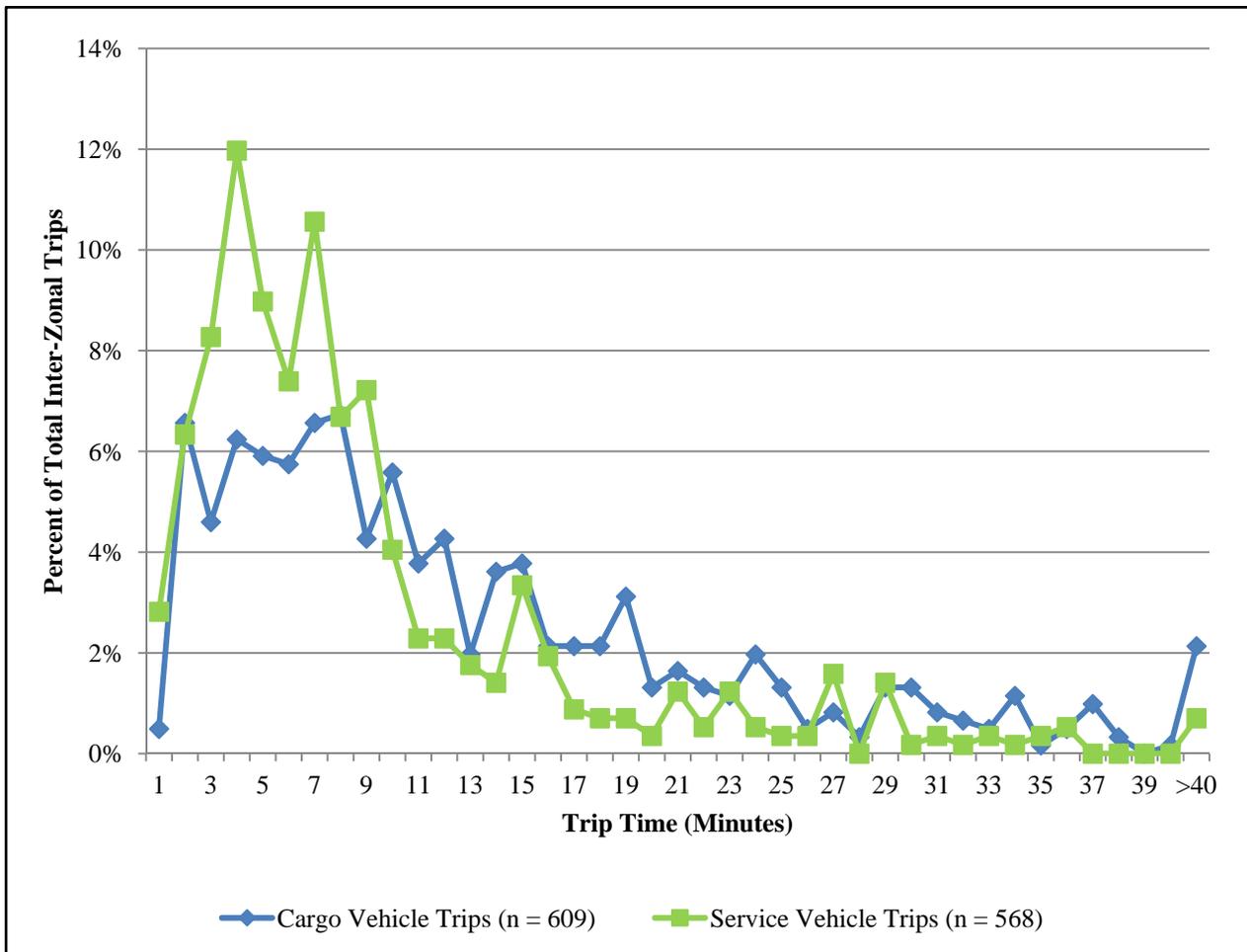


Figure 12. Surveyed Commercial Vehicle Trips Travel Time.

Table 25. Travel Time Frequency Distribution (Ungrouped).

Travel Time (minutes)	Cargo Vehicles		Service Vehicles		All Vehicles	
	# of Trips	% of Total	# of Trips	% of Total	# of Trips	% of Total
1	3	0.5	16	2.8	19	1.6
2	40	6.6	36	6.3	76	6.5
3	28	4.6	47	8.3	75	6.4
4	38	6.2	68	12.0	106	9.0
5	36	5.9	51	9.0	87	7.4
6	35	5.7	42	7.4	77	6.5
7	40	6.6	60	10.6	100	8.5
8	41	6.7	38	6.7	79	6.7
9	26	4.3	41	7.2	67	5.7
10	34	5.6	23	4.0	57	4.8
11	23	3.8	13	2.3	36	3.1
12	26	4.3	13	2.3	39	3.3
13	12	2.0	10	1.8	22	1.9
14	22	3.6	8	1.4	30	2.5
15	23	3.8	19	3.3	42	3.6
16	13	2.1	11	1.9	24	2.0
17	13	2.1	5	0.9	18	1.5
18	13	2.1	4	0.7	17	1.4
19	19	3.1	4	0.7	23	2.0
20	8	1.3	2	0.4	10	0.8
21	10	1.6	7	1.2	17	1.4
22	8	1.3	3	0.5	11	0.9
23	7	1.1	7	1.2	14	1.2
24	12	2.0	3	0.5	15	1.3
25	8	1.3	2	0.4	10	0.8
26	3	0.5	2	0.4	5	0.4
27	5	0.8	9	1.6	14	1.2
28	2	0.3	0	0.0	2	0.2
29	8	1.3	8	1.4	16	1.4
30	8	1.3	1	0.2	9	0.8
31	5	0.8	2	0.4	7	0.6
32	4	0.7	1	0.2	5	0.4
33	3	0.5	2	0.4	5	0.4
34	7	1.1	1	0.2	8	0.7
35	1	0.2	2	0.4	3	0.3
36	3	0.5	3	0.5	6	0.5
37	6	1.0	0	0.0	6	0.5
38	2	0.3	0	0.0	2	0.2
39	0	0.0	0	0.0	0	0.0
40	1	0.2	0	0.0	1	0.1
> 40	13	2.1	4	0.7	17	1.4
Total	609	100.0	568	100.0	1,177	100.0

Table 26 shows the average travel time and speed to destinations by land use for cargo and service vehicles. Overall, the average travel time for all surveyed vehicles was 10.6 minutes, with cargo vehicles averaging 12.5 minutes and service vehicles averaging 8.7 minutes. By land use types, trips made by cargo vehicles to “other” sites had the longest average travel duration of 18.3 minutes, with an average travel speed of 37.7 mph. For service vehicles, trips to medical sites had the highest average travel time of 13.2 minutes and an average travel speed of 37.9 mph.

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

Land Use	Cargo			Service			All Vehicles		
	Number of Trips	Avg. Travel Time (min)	Avg. Travel Speed (mph)	Number of Trips	Avg. Travel Time (min)	Avg. Travel Speed (mph)	Number of Trips	Avg. Travel Time (min)	Avg. Travel Speed (mph)
Office	12	10.9	35.5	44	11.2	35.3	56	11.1	35.3
Retail	171	11.3	35.1	97	7.9	32.8	268	10.1	34.5
Industrial	57	12.2	37.4	6	6.6	33.1	63	11.7	37.2
Medical	45	9.4	33.6	49	13.2	37.9	94	11.4	36.2
Education	32	5.7	30.1	69	7.8	31.6	101	7.1	31.2
Government	14	16.7	38.6	48	7.7	36.3	62	9.7	37.2
Residential	166	11.7	35.9	118	9.3	34.2	284	10.7	35.3
Other	112	18.3	37.7	137	7.2	33.6	249	12.2	36.4
Unknown	0	NA	NA	0	NA	NA	0	NA	NA
Total	609	12.5	36.1	568	8.7	34.3	1,177	10.6	35.4

Table 27 shows the average travel time and speed to destinations by commodity group for trips made by cargo vehicles only. Trips transporting agriculture products had the longest average trip duration of 23.0 minutes, with an average travel speed of 37.3 mph. The machinery commodity group had the highest number of trips, with an average travel time of 12.0 minutes and an average travel speed of 35.9 mph.

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

Commodity Group	Cargo		
	Number of Trips	Average Travel Time (minutes)	Average Travel Speed (mph)
Agriculture	11	23.0	37.3
Raw Materials	40	14.1	37.5
Food	78	7.2	34.7
Textiles	27	17.7	36.4
Wood	30	16.7	37.6
Building Materials	13	20.4	36.4
Machinery	131	12.0	35.9
Miscellaneous	53	12.2	37.2
Hazardous	14	19.4	36.9
Transportation	18	11.4	35.5
Secondary	100	12.5	35.5
Unknown	9	10.7	35.3
Empty	75	11.5	35.6
None	10	6.3	30.6
Total	609	12.5	36.1

Trip Tours

The analyses of trip tours show the amount of circuitous travel undertaken 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. However, those cases where a vehicle did not report a base location (i.e., all of the reported trips were non-base) were considered on a case-by-case basis. In cases where the beginning and ending non-base zone were the same, a tour was considered to be made. In a handful of cases where only non-base trips were reported, the trip tour was determined to have an open beginning or end, with a trip tour happening as well.

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 end or return to the study area. Therefore, to exclude external trips in the analysis could result in not capturing those trips that occur outside the study area that occur within the trip tour.

There were 2,037 trips observed in the Sherman-Denison 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 ends (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. Such instances were treated separately from those vehicles with at least one trip involving a base in determining whether the trip tour could be considered “all open,” “completely closed,” “before a closed tour,” or “after a closed tour.” Rather than simply labeling such trips as “all open,” each case was considered individually. If the trips began or ended at the same zone number, the trips for this vehicle were classified as “completely closed.” Similar logic was used in determining if a “trip before the tour” or a “trip after the tour” had occurred.

As Table 28 shows, approximately 62 percent of the total trips generated by cargo vehicles were non-base trips and 38 percent were base trips. For trips made by service vehicles, 41 percent were non-base trips and 59 percent were base trips.

Table 28. Base and Non-Base 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
Base	501	37.6	416	59.0	917	45.0
Non-Base	831	62.4	289	41.0	1,120	55.0
Total	1,332	100.0	705	100.0	2,037	100.0

Table 29 shows the distribution of trip tours for cargo and service vehicles. There were 450 trip tours generated by 276 vehicles making at least one trip tour. Cargo vehicles made 251 tours and service vehicles produced 199 tours. The number of tours varied from 1-to-6 tours for cargo vehicles, and 1-to-5 tours for service vehicles. Nearly 63 percent of the cargo and service vehicles made only one trip tour (67 percent and 53 percent, respectively). For those cargo and service vehicles making only one trip tour, they averaged 8.2 trips and 3.8 trips within the tour, respectively. For all vehicles combined, the average number of tours per vehicle was 1.6 and the average number of trips per tour was 4.2.

Table 29. Trip Tours per Vehicle.

Cargo Vehicles				
Total Number of Trip Tours	Number of Vehicles	Number of Tours	Number of Trips	Average Trips per Tour
1	108	108	884	8.2
2	34	68	205	3.0
3	10	30	83	2.8
4	6	24	59	2.5
5	3	15	37	2.5
6	1	6	6	1.0
Cargo Total	162	251	1,274	5.1
Service Vehicles				
Total Number of Trip Tours	Number of Vehicles	Number of Tours	Number of Trips	Average Trips per Tour
1	60	60	230	3.8
2	32	64	189	3.0
3	15	45	127	2.8
4	5	20	52	2.6
5	2	10	18	1.8
Service Total	114	199	616	3.1
Grand Total	276	450	1,890	4.2

The analyses 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. There were 1,890 trips observed within the total 450 trip tours. For all vehicles, 653 were external trips (35 percent), 1,078 were inter-zonal trips (57 percent), and 159 were intra-zonal trips (8 percent). 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	468	56	326	165	90	9	884	230
2	77	2	120	165	8	22	205	189
3	27	6	52	108	4	13	83	127
4	6	4	51	44	2	4	59	52
5	2	5	34	13	1	0	37	18
6	0	0	0	0	6	0	6	0
Total	580	73	583	495	111	48	1,274	616

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).

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	666	107	773	884	69.4	230	37.3	1,114	58.9
2	92	69	161	205	16.1	189	30.7	394	20.8
3	25	32	57	83	6.5	127	20.6	210	11.1
4	12	19	31	59	4.6	52	8.4	111	5.9
5	6	8	14	37	2.9	18	2.9	55	2.9
6	0	0	0	6	0.5	0	0.0	6	0.3
Total	801	235	1,036	1,274	100.0	616	100.0	1,890	100.0

Figure 13 and Figure 14 show the percentage distribution of non-base trips, external trips, inter-zonal trips, and intra-zonal trips within trip tours for cargo vehicles and service vehicles, respectively.

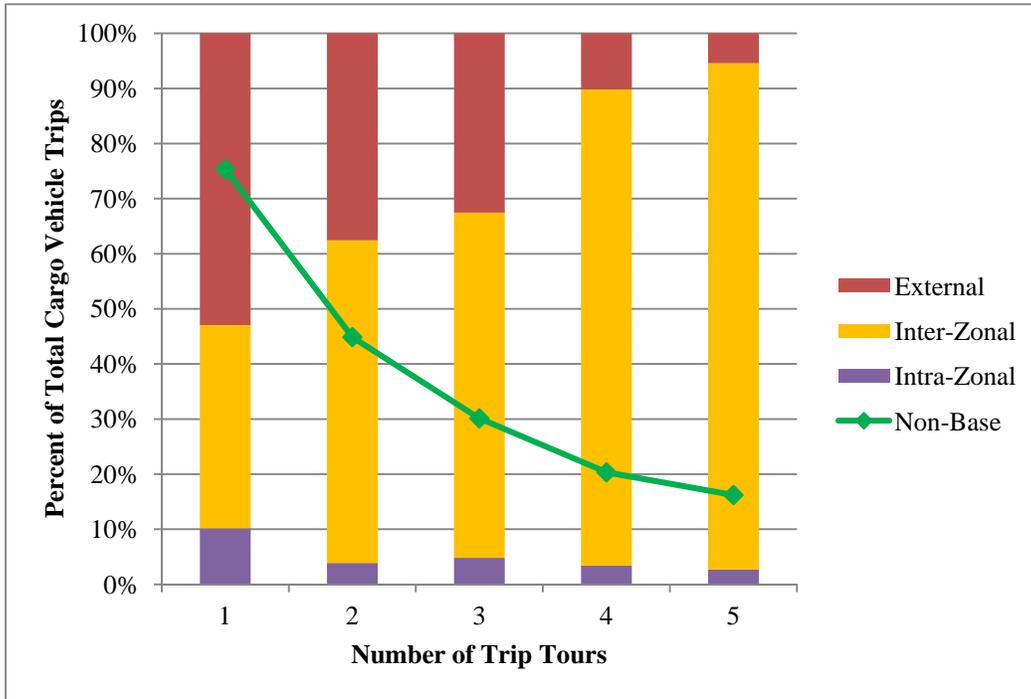


Figure 13. Cargo Vehicle Trips within Trip Tours by Trip Type.

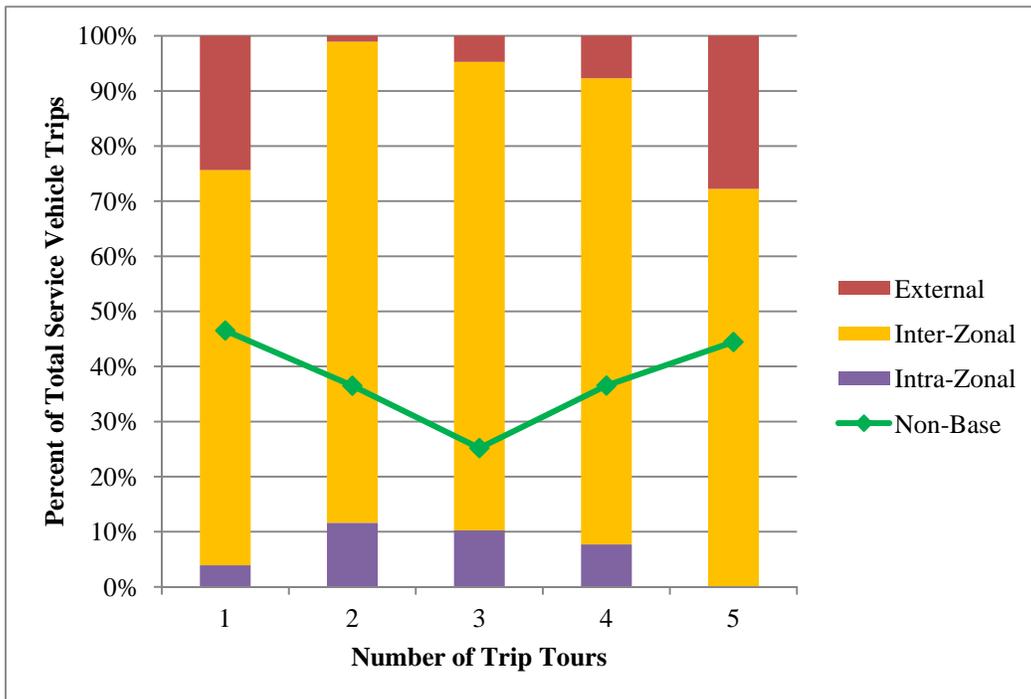


Figure 14. Service Vehicle Trips within Trip Tours by Trip Type.

The analyses of trip tours involved counting all the trips that began at the base location until the vehicle returned to its base location. Those trip chains that did not begin and/or end at their base location, as well as those that only went to the base one time on the survey day, were considered open tours (except in the case of all non-base trips). In the case of non-base trips, if the trips were determined to contain completely closed tours under the criteria described earlier. They were labeled as completely closed tours. Due to the number of trips that were made in open tours, a review of when these trips occurred was performed. Table 32 provides an overview of when trips that are not part of tours were made relative to trip tours. Over 3 percent of the trips made by cargo and service vehicles combined were before the first trip tour or after the last completed trip tour. Nearly 4 percent of trips were made by surveyed vehicles that did not complete any trip tours (i.e., were considered “All Open”). A total of 17 vehicles (6 cargo and 11 service) defined to be within an open tour were not associated with any tours.

Table 32. Summary of Open Tour Trips.

Trip Type	Cargo		Service		All Vehicles	
	# of Trips	% of Total	# of Trips	% of Total	# of Trips	% of Total
Before Closed	18	1.4	10	1.4	28	1.4
After Closed	16	1.2	25	3.5	41	2.0
All Open	24	1.8	54	7.7	78	3.8
Within Closed	1,274	95.6	616	87.4	1,890	92.8
Total	1,332	100.0	705	100.0	2,037	100.0
No Tours	6	NA	11	NA	17	NA

*Total does not include the “No Tours” category; NA: Not Applicable.

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

Sherman-Denison 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 contain 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 33 provides the adjusted 2011 HPMS VMT estimates for the Sherman-Denison study area.

Table 33. 2011 HPMS Estimates of Weekday VMT in the Sherman-Denison Study Area.

Functional Classification	Total Weekday VMT
Freeway	857,374
Arterial	1,978,229
Collector	425,591
Local	226,189
Total	3,487,383

The percentages of commercial and non-commercial vehicles by functional classification were determined by utilizing vehicle classification counts for the Sherman-Denison area that were obtained from TxDOT. The percentage of commercial vehicles for internal sites for each functional classification were combined with the corresponding percentage for external sites based on the percentage of regional VMT estimated as external travel.

Table 34 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 shown in Table 33 to estimate the total commercial and non-commercial VMT. Table 35 shows the estimated VMT for commercial and non-commercial vehicles. There were no count data for local roadways at external sites, and as a result, the percentages obtained at internal locations were utilized for that road classification.

Table 34. Percentage of Commercial and Non-Commercial Vehicles by Functional Classification.

Functional Classification	Percent of Commercial Vehicles			Percent of Non-Commercial Vehicles		
	Internal Sites (50%)	External Sites (50%)	Weighted Average	Internal Sites (50%)	External Sites (50%)	Weighted Average
Freeway	16	26	21	84	74	79
Arterial	8	11	9	92	89	91
Collector	4	10	7	96	90	93
Local	3	N/A	3	97	N/A	97

Table 35. Estimated VMT for Commercial and Non-Commercial Vehicles.

Functional Classification	Commercial VMT	Non-Commercial VMT	Total VMT
Freeway	179,100	678,274	857,374
Arterial	187,711	1,790,518	1,978,229
Collector	29,023	396,568	425,591
Local	6,786	219,403	226,189
Total	402,620	3,084,763	3,487,383

The total commercial VMT of 402,620 miles represents all commercial vehicles that traveled within the Sherman-Denison study area. To properly expand the survey data and determine the total internal commercial vehicle trips generated in the study area, external VMT estimates had to be subtracted from the total commercial VMT. The external commercial VMT was estimated to be 84,598 miles. Therefore, the internal commercial VMT estimate was 318,022 miles.

The total internal VMT observed from the commercial vehicle survey was 7,408 miles, of which 4,568 miles were cargo VMT and 2,840 miles were service VMT. This estimate was based on 1,177 inter-zonal trips (609 cargo vehicle trips and 568 service vehicle trips), multiplied by the average trip length (7.5 miles for cargo and 5.0 miles for service vehicles). The total internal commercial VMT (318,022 miles) represented all commercial vehicles and is not distinguished by cargo or service vehicles. Based on the vehicle classification counts conducted in the study area, approximately 33 percent of the commercial vehicles belonged to Class 5 (two-axle six-tire single unit trailers) through Class 13 (seven or more axle multi-trailers) and were assumed as cargo transport vehicles. Approximately 67 percent of the commercial vehicles belonged to Class 3 (pick-up, van, or two-axle four-tire single unit trailers) and Class 4 (buses) and were assumed

as service vehicles. Therefore, to establish the VMT estimates by commercial cargo and service types, it was deemed reasonable to apply these percentages to the total internal commercial VMT. The resulting VMT estimates were 104,947 miles for cargo vehicles and 213,075 miles for service vehicles.

An expansion factor was derived based on the quotient between total internal VMT and observed internal VMT (from the survey) for each commercial vehicle type. The expansion factors (22.98 for cargo vehicles and 75.03 for service vehicles) were then multiplied by the observed number of inter-zonal trips to estimate the total vehicle trips. The resulting inter-zonal trip estimates were approximately 13,993 cargo vehicle trips and 42,615 service vehicle trips. Additionally, 6,775 intra-zonal trips were made, bringing the total number of internal commercial vehicle trips to 63,383. Based on the average number of inter-zonal trips per day of 3.6 trips for cargo vehicles and 4.4 trips for service vehicles, 15,202 commercial vehicles (4,652 cargo vehicles and 10,550 service vehicles) were estimated to be operating within the Sherman-Denison study area on a daily basis. This estimate is six times more than the approximate 2,550 trucks registered in the study area in 2011. Table 36 provides a summary of key results from the Sherman-Denison commercial vehicle survey and data expansion.

Table 36. Key Survey Results and Expanded Trip and VMT Data.

Indicator	Cargo Vehicles	Service Vehicles	All Vehicles
Sample Size	171	128	299
Total Inter-zonal Trips	609	568	1,177
Total Intra-zonal Trips	112	56	168
Total Internal Trips	721	624	1,345
Total External Trips	611	81	692
Total Internal and External Trips	1,332	705	2,037
Average Total Trips per Vehicle	7.8	5.5	6.8
Average Total Internal Trips per Vehicle*	3.6	4.4	3.9
Average Trip Length	7.5	5.0	6.3
Observed Internal VMT	4,568	2,840	7,408
Total Internal Commercial VMT	104,947	213,075	318,022
Survey Expansion Factor	22.98	75.03	42.93
Total Expanded Inter-Zonal Commercial Vehicle Trips	13,993	42,615	56,608
Total Expanded Intra-Zonal Commercial Vehicle Trips	2,573	4,201	6,775
Total Expanded Commercial Vehicle Trips	16,566	46,816	63,383
Number of Commercial Vehicles Operating on a Daily Basis	4,652	10,550	15,202
Attraction Rate to Households	--	--	0.380

*Based on internal trips of 299 surveyed commercial vehicles (171 cargo vehicles and 128 service vehicles).

One final calculation was the determination of the commercial vehicle attraction rate to households. In the survey, approximately 27 percent of the trips went to residential land use types. This percentage was applied to the total, expanded commercial vehicle trips within the study area to obtain an estimated 17,436 trips to residential locations. The residential trip estimate was divided by the estimated number of households in the Sherman-Denison area (45,878) to obtain an attraction rate of 0.380.

SURVEY SUMMARY

This section provides a summary of vehicle and trip characteristics of 299 commercial vehicles that participated in the 2011-2012 Sherman-Denison commercial vehicle survey. Based on the results from the survey, significant differences as well as similarities on travel characteristics were observed between cargo vehicles and service vehicles.

The average vehicle age for cargo vehicles was 7.7 years compared to 7.6 years for service vehicles. The odometer readings reported by cargo vehicles indicated an average mileage of 225,000 miles, which was nearly double the reported average mileage of 108,500 miles by service vehicles. In terms of fuel use, around 66 percent of cargo vehicles used diesel and 34 percent used unleaded gasoline, while 80 percent of service vehicles used unleaded gasoline and 20 percent used diesel.

The analyses of trip characteristics included in-depth examination of trip frequency, trip type, average trip length, trip purpose, and land use activity at trip destinations by commercial vehicle type. Surveyed cargo vehicles made an average of 7.8 total trips per day, compared to 5.5 trips per day for service vehicles. Excluding the trips made outside of the study area (external trips), cargo vehicles produced 4.2 internal trips per day, with average travel distance of 7.5 miles, compared to service vehicles which made 4.9 internal trips per day, with average trip length of 5.0 miles. The average travel time per trip for cargo vehicles was 12.5 minutes and for service vehicles the average travel time per trip was 8.7 minutes.

In terms of trip purpose at trip destinations, approximately 46 percent of the cargo vehicle trips were delivery, 25 percent were base related, and 11 percent were pick-up and delivery. For trips made by service vehicles, approximately 40 percent were service related, 37 percent were base related, and 11 percent were driver needs.

In terms of land use activity, approximately 34 percent of the trips made by cargo vehicles occurred at residential locations, 25 percent occurred at retail locations, and nine percent occurred at industrial sites. For service vehicles, nearly 20 percent of the trips occurred at residential sites, 20 percent occurred at “other” sites, and 17 percent occurred at retail locations.

The analyses of cargo characteristics were exclusive to trips made by cargo vehicles only and 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. Overall, the average net cargo weight per trip was around 2,750 lbs. Agriculture showed the highest average net cargo weight of around 19,800 lbs. per trip, but the most frequently transported commodity was machinery with a net cargo weight of 930 lbs. per trip. The land use “other” showed the highest average net cargo weight of around 5,600 lbs.

per trip, but the residential land use had the most number of trips and an average cargo weight of approximately 770 lbs. per trip. Delivery trip purpose had the highest average net cargo weight of around 5,800 lbs. per trip and it had the highest number of trip occurrences.

The analyses 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 450 trip tours were generated by the surveyed vehicles, with cargo vehicles making 251 tours and service vehicles producing 199 tours. The number of trip tours per vehicle varied from 1-to-6 tours for cargo vehicles and 1-to-5 tours for service vehicles. The average number of trips tours for all vehicles was 1.6 and the average number of trips per tour was 4.2. Trips made as part of trip tours accounted for 2,037 trips (1,332 trips by cargo vehicles and 705 trips by service vehicles). Within the trip tours, approximately 57 percent were inter-zonal trips, 8 percent were intra-zonal trips and the remaining 35 percent were external trips. Non-base trips (which were not mutually-exclusive of the other trip types) comprised approximately 55 percent of the trips within the tours.

Lastly, the expansion of commercial vehicle survey data were based on VMT estimates and vehicle classification counts for the Sherman-Denison study area. The commercial VMT estimates represented all commercial vehicles and do not distinguish by cargo and service vehicle types. Therefore, the estimation of VMT and volume of cargo and service vehicles operating within the study area were mainly based on key findings from the survey, such as the total number of internal cargo and service vehicle trips, the average number of trips per cargo and service vehicle, and the average trip lengths per cargo and service vehicle. Based on these findings, approximately 15,200 commercial vehicles (4,650 cargo vehicles and 10,550 service vehicles) were estimated to be operating within the Sherman-Denison study area on a daily basis, approximately six times the volume of trucks registered in the study area in 2011.

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) Passenger Car
- 2) Pick-up
- 3) Van (Cargo or Mini)
- 4) Sport Utility Vehicle (SUV)
- 9) Other _____
- 5) Single Unit 2-axle (6 wheels)
- 6) Single Unit 3-axle (10 wheels)
- 7) Single Unit 4-axle (14 wheels)
- 8) Semi (all Tractor-Trailer combinations)

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 th grade or less)	(10) Intermodal Facility	(99) Refused/Unknown

**Commercial Vehicle Survey
PART 2: Travel Log**

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: _____ a.m./p.m.

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		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)
<i>NAME of Place:</i>	<i>Address including city, state, and zip OR Nearest street intersection or Landmark</i>						
PLACE 1		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery Picked Up
		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery Picked Up
		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	(5) Maintenance (fuel, oil, etc.)	(1) Office Building (Non-Government)	(6) Education (college, trade)	(11) Warehouse
(2) Delivery	(6) Driver Needs (lunch, etc.)	(2) Retail / Shopping	(7) Government Office / Building	(12) Distribution Center
(3) Pick-up	(7) Service related business	(3) Industrial/Manufacturing	(8) Residential	(13) Construction Site
(4) Pick-up and Delivery	(8) Other (Please specify)	(4) Medical / Hospital	(9) Airport	(14) Other (specify)
		(5) Education (12 th grade or less)	(10) Intermodal Facility	(99) Refused / Unknown

Record Type 21

Commercial Vehicle Survey Travel (continued)

VEHICLE LICENSE #: _____

RECORD the following information about each place		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?	Type of Cargo What is it?	Cargo Weight (in Pounds)
NAME of Place:	Address including city, state, and zip OR nearest street intersection or Landmark						
PLACE 4		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery Picked Up
PLACE 5		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery Picked Up
PLACE 6		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery Picked Up
PLACE 7		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery Picked Up
PLACE 8		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery Picked Up
PLACE 9		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery Picked Up

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

Commercial Vehicle Survey Travel (continued)

RECORD the following information about each place		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?	Type of Cargo What is it?	Cargo Weight (in Pounds)
NAME of Place:	Address including city, state, and zip OR Nearest street intersection or Landmark						
PLACE 10		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery Picked Up
PLACE 11		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery Picked Up
PLACE 12		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery Picked Up
PLACE 13		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery Picked Up
PLACE 14		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	(5) Maintenance (fuel, oil, etc.)	(1) Office Building (Non-Government)	(6) Education (college, trade)	(11) Warehouse
(2) Delivery	(6) Driver Needs (lunch, etc.)	(2) Retail / Shopping	(7) Government Office / Building	(12) Distribution Center
(3) Pick-up	(7) Service related business	(3) Industrial/Manufacturing	(8) Residential	(13) Construction Site
(4) Pick-up and Delivery	(8) Other (Please specify)	(4) Medical / Hospital	(9) Airport	(14) Other (specify)
		(5) Education (12 th grade or less)	(10) Intermodal Facility	(99) Refused / Unknown

Record Type 21

Commercial Vehicle Survey (continued)

VEHICLE LICENSE #: _____

RECORD the following information about each place		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?	Type of Cargo What is it?	Cargo Weight (in Pounds)
NAME of Place:	Address including city, state, and zip OR Nearest street intersection or Landmark						
PLACE 15		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery <hr/> Picked Up
PLACE 16		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery <hr/> Picked Up
PLACE 17		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery <hr/> Picked Up
PLACE 18		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery <hr/> Picked Up
PLACE 19		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		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 th 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