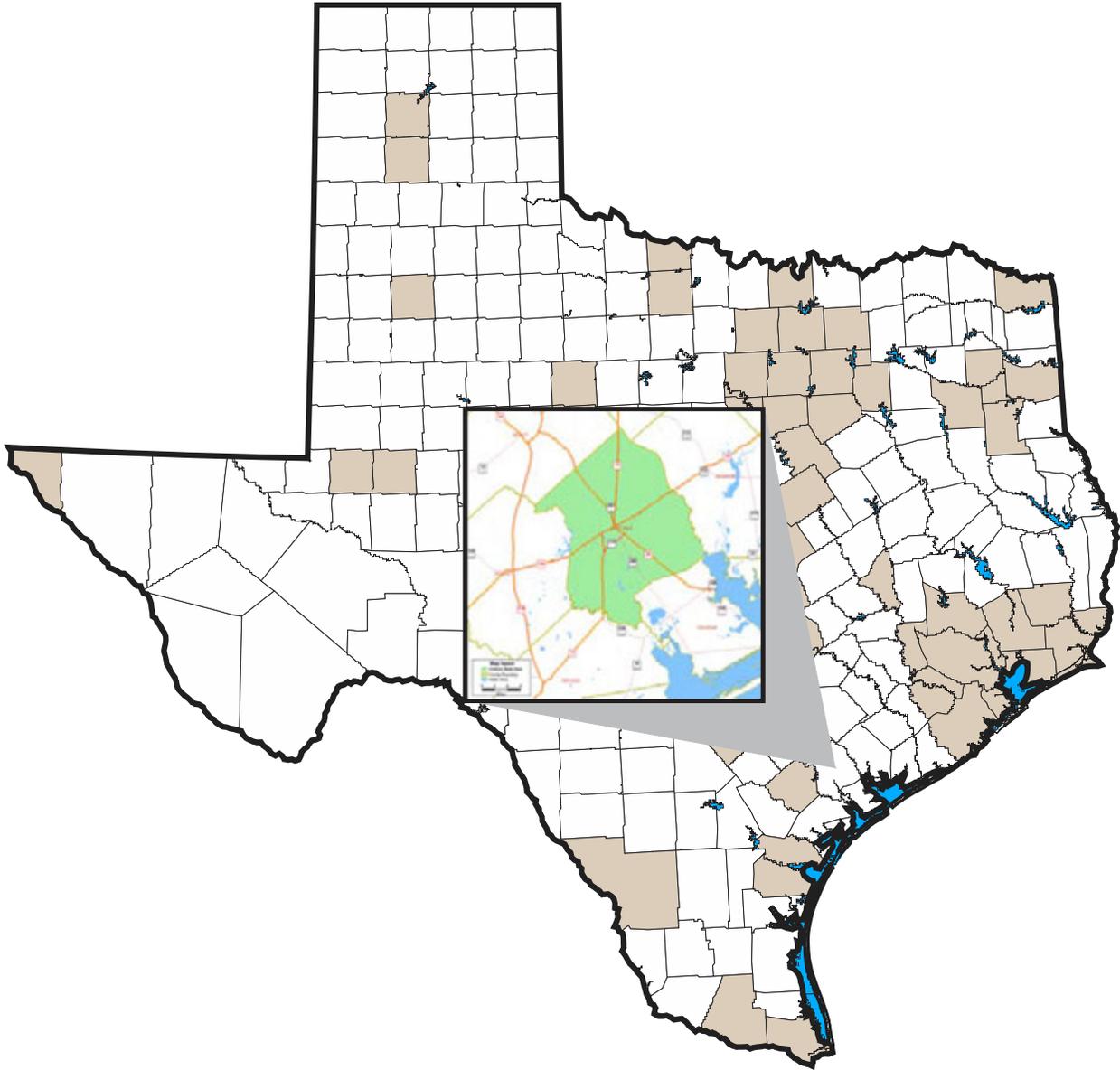


2010-2011 Victoria Commercial Vehicle Survey Technical Summary



Prepared by the
Texas A&M Transportation Institute
September 2014

**2010-2011 Victoria
Commercial Vehicle Survey
TECHNICAL SUMMARY**

Texas Department of Transportation Travel Survey Program

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INTRODUCTION

In 2010 and 2011, the Texas Department of Transportation (TxDOT) funded a commercial vehicle survey in the Victoria area. The purpose of this survey was to provide data that would enable TxDOT to forecast total commercial vehicle travel demand within the Victoria urban area. The study area is located in west south Texas, as shown in Figure 1, and includes the entirety of Victoria County. The study area had a total population of approximately 151,700 people in 2010 (American Fact Finder).

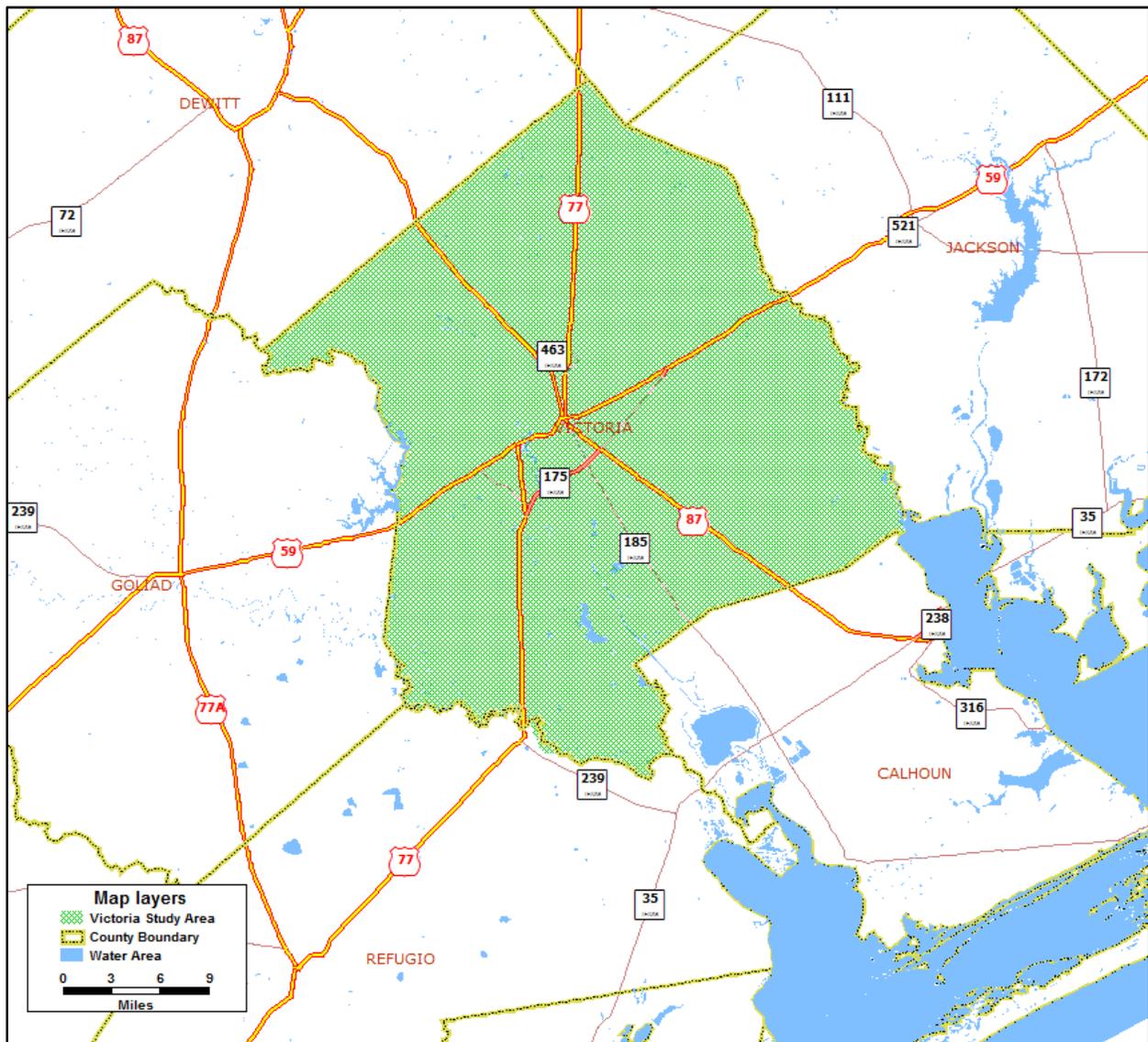


Figure 1. Victoria Study Area.

This report presents a technical summary of the commercial vehicle travel survey conducted from 2010 to 2011 in the Victoria 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 Victoria study area were conducted during the period between September 2010 and December 2010. 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 conducted, which consisted of 25 commercial vehicles. A target number of 300 commercial vehicles (150 cargo vehicles and 150 service vehicles) was established for the Victoria study area (ETC Institute and TxDOT, 2011).

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 filled out. 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, 421 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	170	40.4
Refused to Participate	169	40.1
Not participating	82	19.5
Total	421	100.0

Source: 2010-2011 Commercial Vehicle Survey – Final Summary Report, ETC Institute.

Approximately 120 companies participated in the Victoria commercial vehicle survey, from which a total of 332 commercial vehicle surveys were obtained (ETC Institute, 2011). 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 used 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 292 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 Victoria 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 3,400 trucks registered in the Victoria study area in 2012. Table 2 shows the distribution of registered diesel trucks and gasoline trucks by gross vehicle weight. Over 74 percent of all trucks registered in the Victoria study area are diesel-fueled vehicles. Sixty-one 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 Victoria 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	1,544	61.7	508	58.9	2,052	60.9
> 10000	340	13.6	218	25.3	558	16.6
> 14000	91	3.6	27	3.1	118	3.5
> 16000	112	4.5	43	5.0	155	4.6
> 19500	174	6.9	49	5.7	223	6.6
> 26000	78	3.1	9	1.0	87	2.6
> 33000	144	5.8	8	0.9	152	4.5
> 60000	21	0.8	1	0.1	22	0.7
Total	2,504	100.0	863	100.0	3,367	100.0

Source: TxDOT 2012.

Figure 2 shows the distribution of registered diesel trucks and gasoline trucks by model year. The one hybrid vehicle present in the raw data was not included in summary tables involving fuel type. Registered gasoline trucks were older relative to the diesel trucks. Approximately 81 percent of the diesel trucks were less than 10 years old, compared to 76 percent of gasoline trucks within that age range. Less than three percent of the over 2,500 registered diesel trucks were 20 years or older, while less than five percent of registered gasoline trucks were 20 years or older.

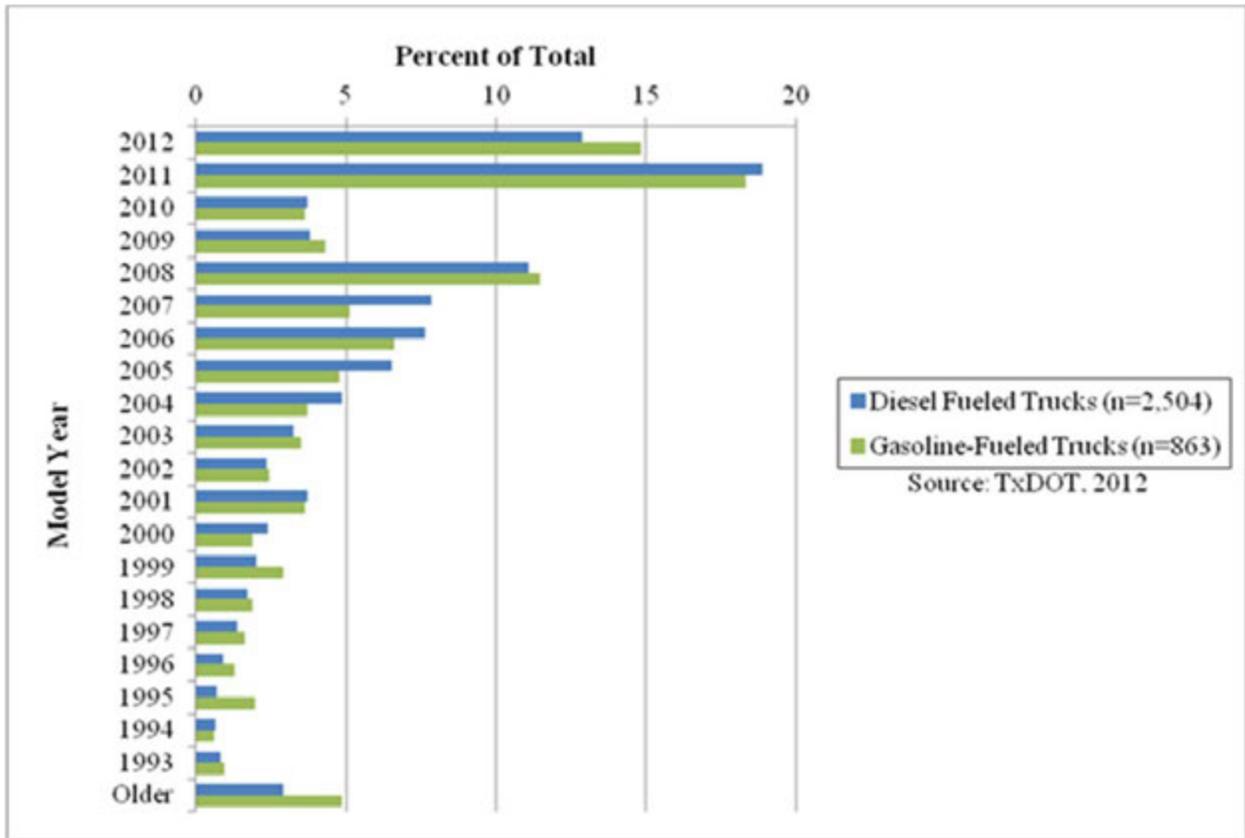


Figure 2. Model Year of Registered Trucks in the Victoria Study Area.

Surveyed Commercial Vehicles

Commercial vehicles that participated in the Victoria commercial vehicle survey were distinguished based on the nine 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 district.

Table 3 shows the distribution of surveyed vehicles by vehicle classification type and commercial type. Out of the total 292 vehicles surveyed, 144 were cargo vehicles and 148 were service vehicles. Among cargo vehicles, approximately 31 percent were pick-up trucks, 29 percent were semi (tractor-trailers), 20 percent were vans, and nine percent were single unit 2-axle (6 wheels). Among service vehicles, approximately 51 percent were pick-up trucks, 17 percent were vans, and 15 percent were passenger cars.

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	0	0.0	22	14.9	22	7.5
Pickup Truck	45	31.3	75	50.7	120	41.1
Van (passenger or mini)	29	20.1	25	16.8	54	18.5
Sport Utility Vehicle	2	1.4	10	6.7	12	4.1
Single Unit 2-axle (6 wheels)	13	9.0	8	5.4	21	7.2
Single Unit 3-axle (10 wheels)	7	4.8	6	4.1	13	4.5
Single Unit 4-axle (14 wheels)	3	2.1	0	0.0	3	1.0
Semi (tractor-trailer)	42	29.2	0	0.0	42	14.4
Other	3	2.1	2	1.4	5	1.7
Total	144	100.0	148	100.0	292	100.0

Figure 3 shows the distribution of surveyed vehicles by fuel type. Approximately 49 percent of the surveyed vehicles used unleaded gasoline and 51 percent used diesel. Among cargo vehicles, 49 percent used gasoline and 51 percent used diesel. Among service vehicles, 85 percent used gasoline and 15 percent used diesel.

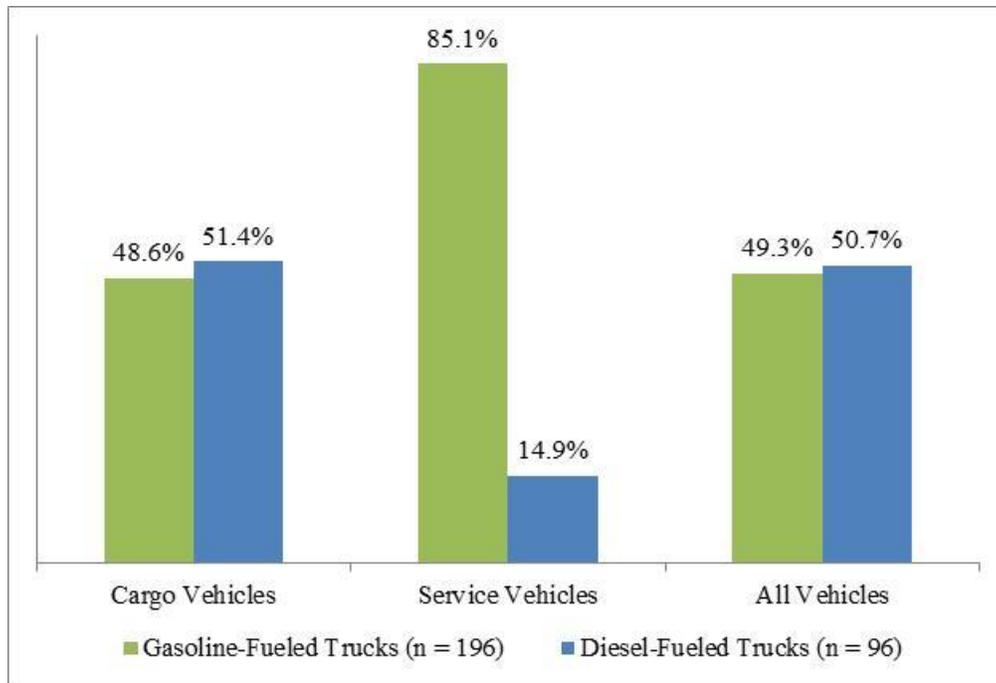


Figure 3. Type of Fuel Used by Surveyed Commercial Vehicles.

Table 4 shows the distribution of surveyed vehicles by gross vehicle weight. The survey included commercial vehicles with gross vehicle weight of less than 10,000 pounds. Approximately 92 percent of the service vehicles belonged to this category, while approximately 36 percent of the cargo vehicles weighed more than 19,500 pounds.

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	81	56.3	136	91.8	217	74.3
> 10,000	2	1.4	2	1.4	4	1.4
> 14,000	2	1.4	2	1.3	4	1.4
> 16,000	7	4.8	0	0.0	7	2.4
> 19,500	9	6.3	0	0.0	9	3.1
> 26,000	8	5.6	2	1.4	10	3.4
> 33,000	17	11.7	6	4.1	23	7.8
> 60,000	18	12.5	0	0.0	18	6.2
Total	144	100.0	148	100.0	292	100.0

Figure 4 shows the distribution of surveyed vehicles by model year. Note that although some of the commercial vehicles registered in the Victoria study area had a model year of 2012, none of the surveyed vehicles fell into this category. Approximately 57 percent of cargo vehicles and 74 percent of service vehicles were less than 10 years old. The average age for cargo vehicles was 9.3 years, while the average age for service vehicles was 7.4 years (assuming 2012 as the base year).

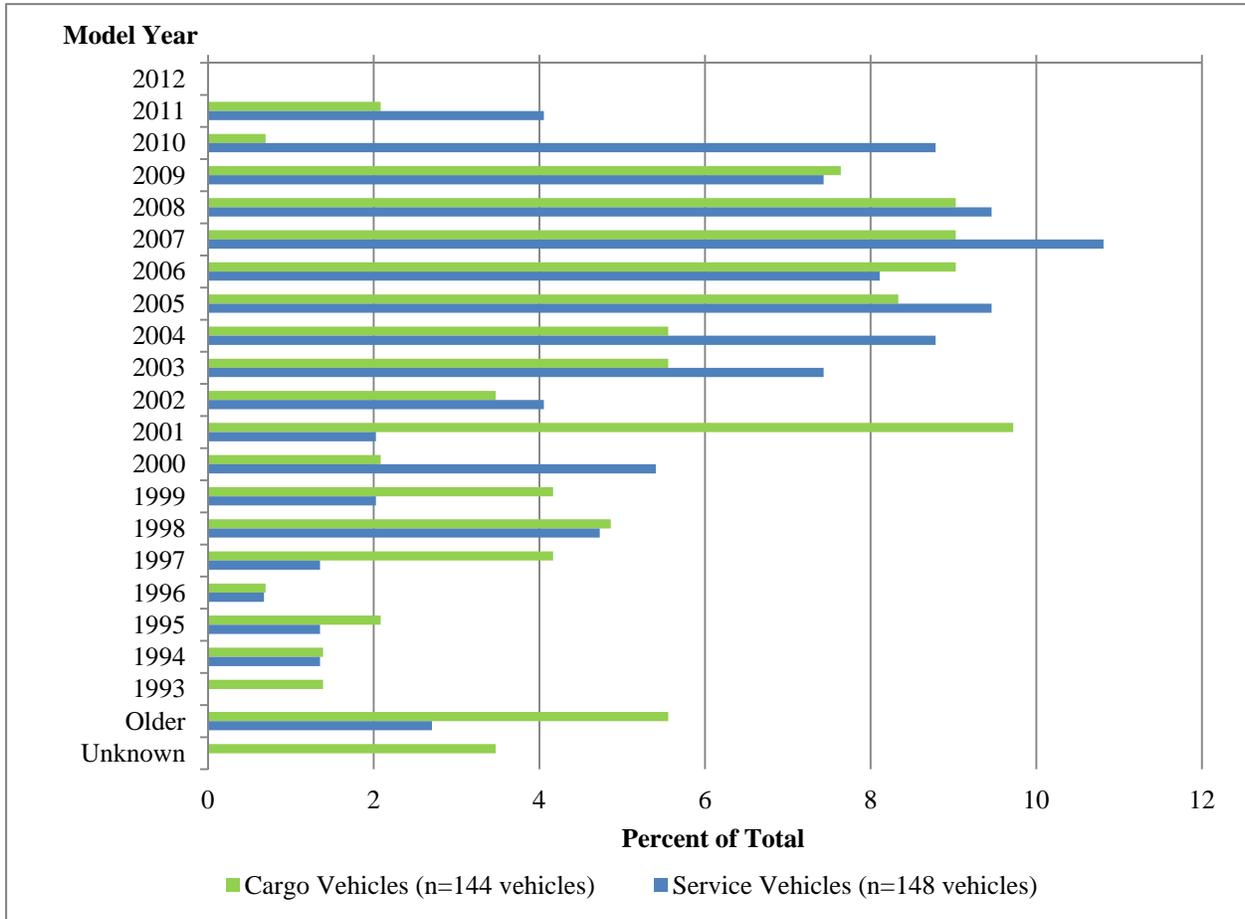


Figure 4. Vehicle Model Year.

Table 5 shows the average vehicle mileage by model year based on reported odometer readings from 280 surveyed vehicles at the beginning of their survey travel day. Cargo vehicles reported higher average odometer readings of over 200,000 miles compared to over 137,000 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	0	0	0	0	0	0
2011	3	10,883	6	3,239	9	5,787
2010	1	21,000	13	20,172	14	20,231
2009	11	49,697	11	28,394	22	39,046
2008	13	95,451	13	78,166	26	86,808
2007	12	156,291	15	71,589	27	109,234
2006	13	124,846	12	102,500	25	114,120
2005	11	188,981	14	155,038	25	169,973
2004	8	154,739	13	186,663	21	174,501
2003	8	186,632	11	126,807	19	151,996
2002	4	470,775	5	155,721	9	295,745
2001	14	290,379	3	221,606	17	278,242
2000	3	254,929	8	722,734	11	595,151
1999	5	238,287	3	131,610	8	198,283
1998	6	371,131	7	202,429	13	280,291
1997	6	393,695	1	205,991	7	366,880
1996	1	300,000	1	171,043	2	235,522
1995	3	195,490	2	15,585	5	123,528
1994	2	286,630	2	37,038	4	161,834
1993	2	529,203	0	0	2	529,203
Older	8	239,693	4	92,547	12	190,644
Unknown	2	73,500	0	0	2	73,500
Total	136	200,189	144	137,469	280	167,933

Trip Frequency

The surveyed vehicles generated a total of 1,818 trips, of which 1,145 were internal trips and 673 were external trips. Internal trips were defined as those trips made within the Victoria 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 881 trips, of which approximately 49 percent were inter-zonal trips, two percent were intra-zonal trips, and 49 percent were external trips. Service vehicles generated 937 trips, of which 68 percent were inter-zonal trips, six percent were intra-zonal trips, and 26 percent were external trips.

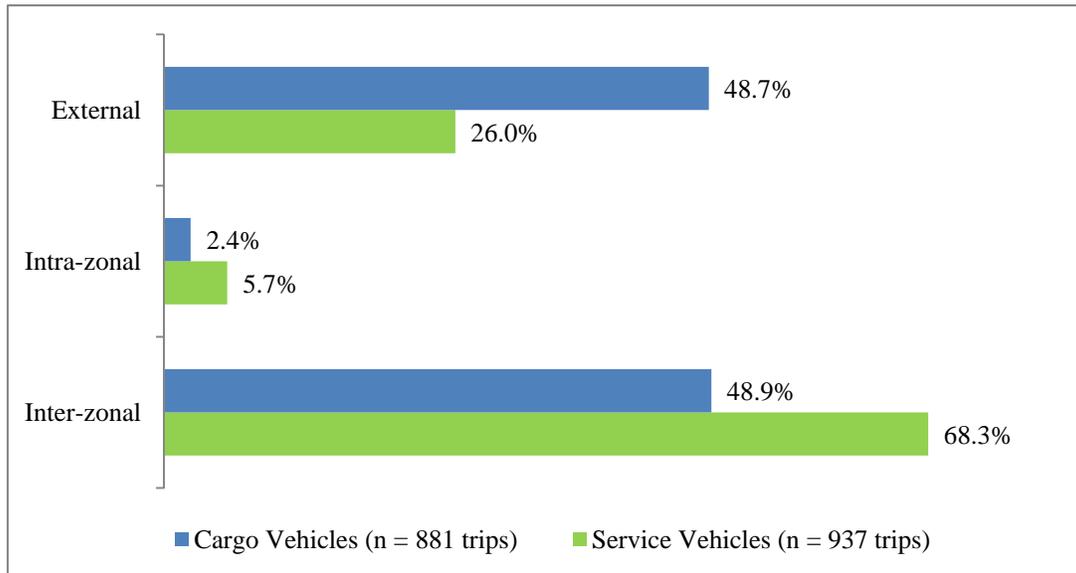


Figure 5. Inter-Zonal, Intra-Zonal, and External Trips.

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	431	48.9	640	68.3	1,071	58.9
Intra-zonal	21	2.4	53	5.7	74	4.1
Total Internal	452	51.3	693	74.0	1,145	63.0
External	429	48.7	244	26.0	673	37.0
Total	881	100.0	937	100.0	1,818	100.0

Figure 6 shows the distribution of total trips (internal and external trips), which varied from one trip to 44 trips per cargo vehicle and from one trip to 17 trips per service vehicle on their survey day. The average number of total trips per day was 6.1 trips for cargo vehicles and 6.3 trips for service vehicles.

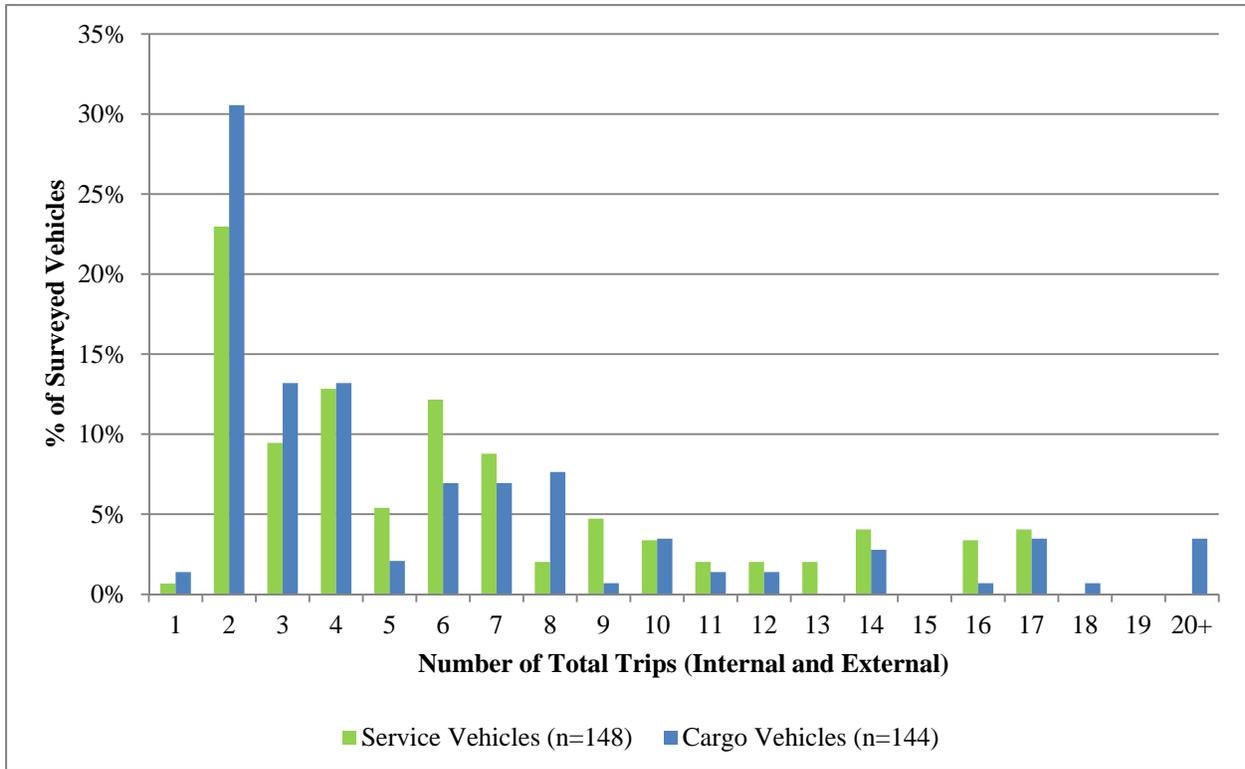


Figure 6. Total Trips per Vehicle.

Figure 7 shows the distribution of internal trips only. Approximately seven percent of cargo vehicles, as well as seven percent of service vehicles, made one internal trip per day. Approximately 44 percent of cargo vehicles did not make any internal trips; while only 17 percent of service vehicles did not make any internal trips. The average number of internal trips per day was 3.1 trips for cargo vehicles and 4.7 trips for service vehicles.

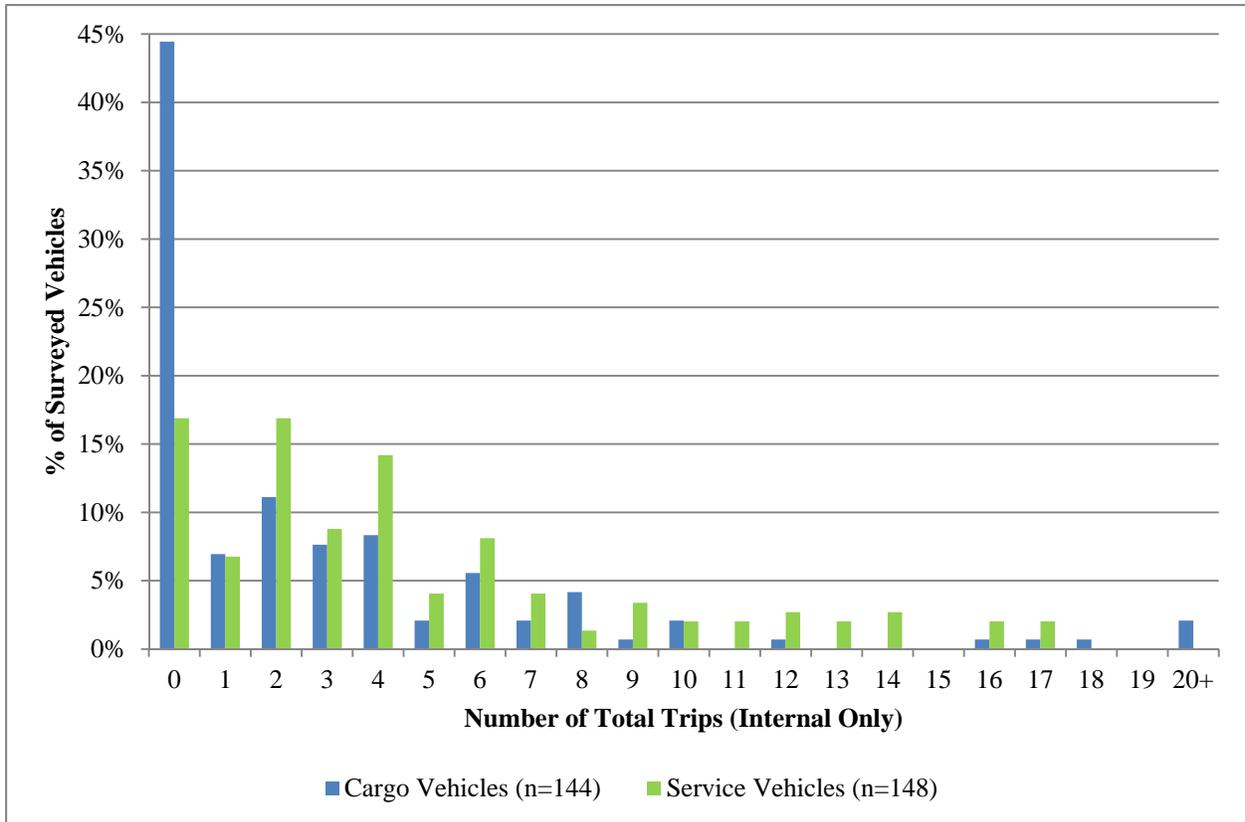


Figure 7. Total Internal Trips per Vehicle.

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 31 percent of the trips made by cargo vehicles traveled to retail locations, followed by 12 percent to “other” locations, and 10 percent to industrial/manufacturing locations. For service vehicles, nearly 23 percent of the trips traveled to retail/shopping sites, followed by nearly 18 percent to residential locations, and 13 percent to office 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)	62	7.0	125	13.3
Retail/Shopping	271	30.8	213	22.7
Industrial/Manufacturing	90	10.2	33	3.6
Medical/Hospital	35	4.0	109	11.6
Education (< 12th grade)	51	5.8	66	7.0
Education (College, Trade)	1	0.1	1	0.1
Government Office/Building	16	1.8	42	4.5
Residential	53	6.0	164	17.5
Airport	0	0.0	1	0.1
Intermodal Facility	0	0.0	0	0.0
Warehouse	74	8.5	50	5.4
Distribution Center	39	4.4	20	2.1
Construction Site	84	9.5	36	3.8
Other	105	11.9	77	8.3
Refused/Unknown	0	0.0	0	0.0
Total Trips	881	100.0	937	100.0

Table 8 shows the distribution of internal trips by trip purposes at trip destinations. Approximately 58 percent of the cargo vehicle internal trips were for maintenance, 24 percent were base, and nine percent were classified as driver needs. For trips made by service vehicles, approximately 56 percent were classified as government, 33 percent were classified as base, and six percent were pick-up and delivery.

Table 8. Trip Purposes at Destination Locations.

Trip Purpose	Cargo		Service	
	Number	Percent of Cargo	Number	Percent of Service
Base	108	23.9	225	32.5
Maintenance	262	58.0	0	0.0
Driver Needs	39	8.6	0	0.0
Delivery	22	4.8	0	0.0
Pick-up	4	0.9	18	2.6
Pick-up & Delivery	14	3.1	41	5.9
Gov't	3	0.7	386	55.7
Service	0	0.0	23	3.3
Sales	0	0.0	0	0.0
Other	0	0.0	0	0.0
Total Trips	452	100.0	693	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 Victoria 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 a delivery trip purpose but did not report any cargo weights at drop-off.

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/Equip.	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 27 percent of the total cargo vehicle trips were transporting manufactured goods/equipment, followed by 23 percent transporting food, health, and beauty products, about 12 percent transporting unclassified/other cargo, and about 10 percent transporting wood products. Approximately seven percent of the cargo trips were empty shipping containers.

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

Cargo Type	Number of Trips	% of Total
Farm Products	53	6.0
Forest Products	0	0.0
Marine Products	0	0.0
Metals and Minerals	19	2.2
Food, Health, and Beauty Products	200	22.6
Tobacco Products	0	0.0
Textiles	0	0.0
Wood Products	86	9.8
Printed Matter	20	2.3
Chemical Products	13	1.5
Refined Petroleum or Coal Products	20	2.3
Rubber, Plastic, and Styrofoam Products	15	1.7
Clay, Concrete, Glass, or Stone	38	4.3
Manufactured Goods/Equipment.	238	27.0
Wastes	3	0.3
Miscellaneous Shipments	0	0.0
Hazardous Materials	5	0.6
Transportation	0	0.0
Unclassified/Other Cargo	106	12.0
Driver Refused to Answer	0	0.0
Unknown to Driver	0	0.0
Total Trips with Cargo	816	92.6
Empty	65	7.4
Total Cargo Vehicle Trips	881	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. Over 34 percent of the trips traveled to “other” land use types, which were mainly warehouses, distribution centers, and construction sites. By commodity group, approximately 27

percent of the trips were transporting machinery, and about 23 percent were transporting food. Around 7 percent were not transporting cargo.

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	4	3	0	1	0	0	2	43	53	6.0
Raw Materials	2	8	17	0	0	0	2	23	52	5.9
Food	1	132	6	3	45	3	0	10	200	22.7
Textiles	3	3	3	0	0	0	0	6	15	1.7
Wood	20	18	5	7	4	6	1	45	106	12.0
Building Materials	0	1	15	0	0	0	8	14	38	4.4
Machinery	13	75	23	2	1	4	27	93	238	27.0
Miscellaneous	0	0	0	2	0	0	0	1	3	0.3
Hazardous	0	0	2	0	0	0	0	3	5	0.6
Transportation	0	0	0	0	0	0	0	0	0	0.0
Secondary	9	11	13	20	2	2	10	39	106	12.0
Unknown	0	0	0	0	0	0	0	0	0	0.0
Empty	10	20	6	0	0	1	3	25	65	7.4
Total	62	271	90	35	52	16	53	302	881	100.0
Percent of Total	7.0	30.8	10.2	4.0	5.9	1.8	6.0	34.3	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. Roughly 60 percent of the total cargo vehicle trips were maintenance. Approximately 5 percent of the total cargo vehicle trips were delivery, with machinery as the most common commodity group cited for surveyed trips. The trip purpose “pick-up” made up just over 1 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.

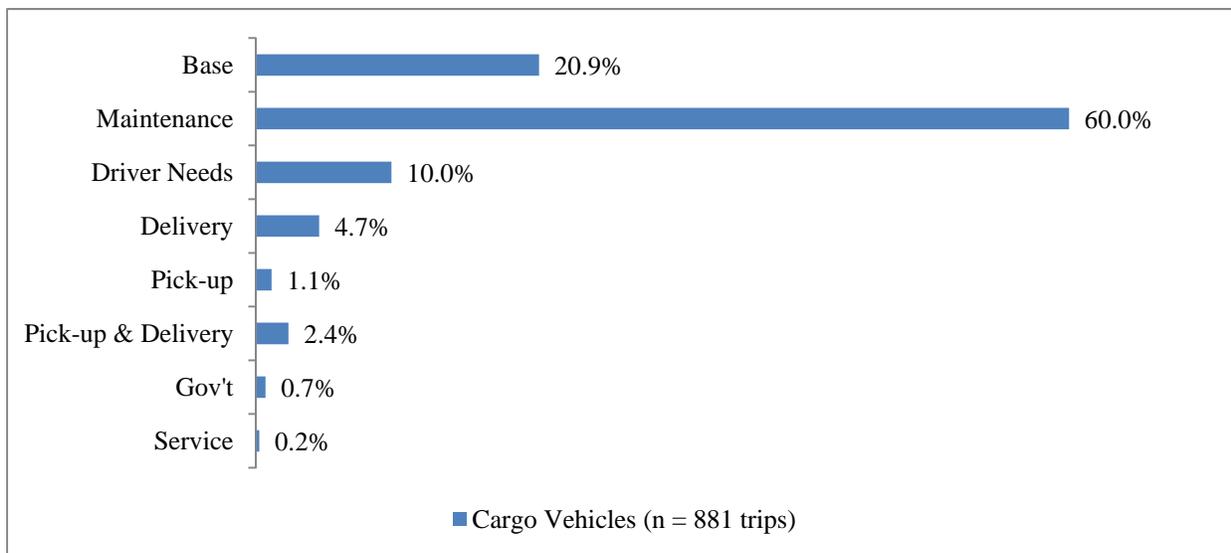


Figure 8. Cargo Trip Purposes at the Trip Destinations.

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

Commodity Group	Trip Purpose									Total Trips	% of Total
	Base	Mainten ance	Driver Need	Deliv	Pick- up	Pick-up & Deliv	Govt	Srvc	Oth		
Agriculture	8	23	19	0	0	3	0	0	0	53	6.0
Raw Materials	14	25	13	0	0	0	0	0	0	52	5.9
Food	13	182	3	0	1	1	0	0	0	200	22.7
Textiles	2	11	2	0	0	0	0	0	0	15	1.7
Wood	15	73	5	11	0	1	1	0	0	106	12.0
Building Materials	11	19	6	0	0	0	0	2	0	38	4.4
Machinery	49	125	34	19	3	6	2	0	0	238	27.0
Miscellaneous	0	0	3	0	0	0	0	0	0	3	0.3
Hazardous	2	3	0	0	0	0	0	0	0	5	0.6
Transportation	0	0	0	0	0	0	0	0	0	0	0.0
Secondary	21	68	3	11	0	3	0	0	0	106	12.0
Unknown	0	0	0	0	0	0	0	0	0	0	0.0
Empty	49	0	0	0	6	7	3	0	0	65	7.4
Total	184	529	88	41	10	21	6	2	0	881	100.0
Percent of Total	20.9	60.0	10.0	4.7	1.1	2.4	0.7	0.2	0.0	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. Building materials being transported to residential sites has the highest average net cargo weight by commodity group and land use at the trip destination. Agriculture products being transported to maintenance trip purposes had the highest average net cargo weight by commodity group and trip purpose at the trip destination.

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	16,773	0	50	0	0	25	27,150
Raw Materials	89	25,434	4,057	0	0	0	1,642	5,051
Food	0	979	9,493	169	595	630	0	4,271
Textiles	38	1	68	0	0	0	0	52
Wood	586	43	402	19	86	64	900	1,431
Building Materials	0	1,000	0	0	0	0	28,750	18,117
Machinery	21	94	114	18	20	88	232	6,565
Miscellaneous	0	0	0	0	0	0	0	0
Hazardous	0	0	8,224	0	0	0	0	836
Transportation	0	0	0	0	0	0	0	0
Secondary	6	71	15,538	10	10	3	1,057	5,656

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

Commodity Group	Trip Purpose						
	Base Location	Maintenance	Driver Needs	Delivery	Pick-up	Pick-up & Delivery	Sales
Agriculture	0	52,951	0	0	0	0	0
Raw Materials	0	15,683	0	0	0	0	0
Food	0	1,418	0	0	0	0	0
Textiles	0	58	0	0	0	0	0
Wood	0	1,095	0	64	0	0	0
Building Materials	0	25,507	0	0	0	0	0
Machinery	0	4,927	0	597	0	0	0
Miscellaneous	0	0	0	0	0	0	0
Hazardous	0	6,319	0	0	0	0	0
Transportation	0	0	0	0	0	0	0
Secondary	1,905	5,797	0	1	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 (excluding trips with empty cargo) per trip was just over 4,300 lbs. Of the classified commodity groups, agriculture showed the highest average net cargo weight of nearly 23,000 lbs. per trip. Machinery was the most frequently transported of the commodity groups, with average net cargo weights of over 2,600 lbs. 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	53	1,217,884	53	22,979
Raw Materials	52	392,077	52	7,540
Food	200	258,133	200	1,291
Textiles	15	633	15	42
Wood	106	80,664	106	761
Building Materials	38	484,640	38	12,754
Machinery	238	627,189	238	2,635
Miscellaneous	3	0	3	0
Hazardous	5	18,956	5	3,791
Transportation	0	0	0	0
Secondary	106	434,205	106	4,096
Unknown	0	0	0	0
Empty	65	0	0	0
Total	881	3,514,381	816	4,307

* 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 over 8,200 lbs. per trip, followed by residential 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	62	12,348	52	199
Retail	271	392,692	251	1,449
Industrial	90	349,221	84	3,880
Medical	35	923	35	26
Education	52	27,163	52	522
Government	16	2,628	15	164
Residential	53	251,078	50	4,737
Other	302	2,478,328	277	8,206
Total	881	3,514,381	816	4,307

* Excluding trips with empty cargo.

Table 19 shows the distribution of cargo trips and net cargo weights by trip purpose. Maintenance trip purposes had the highest average net weight of over 6,500 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	184	40,000	135	296
Maintenance	529	3,462,324	529	6,545
Driver Needs	88	0	88	0
Delivery	41	12,057	41	294
Pick-up	10	0	4	0
Pick-up & Delivery	21	0	14	0
Government	6	0	3	0
Service	2	0	2	0
Sales	0	0	0	0
Other	0	0	0	0
Total	881	3,514,381	816	4,307

* 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 Victoria 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 Victoria 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 Victoria 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 Victoria study area was considered an external trip.

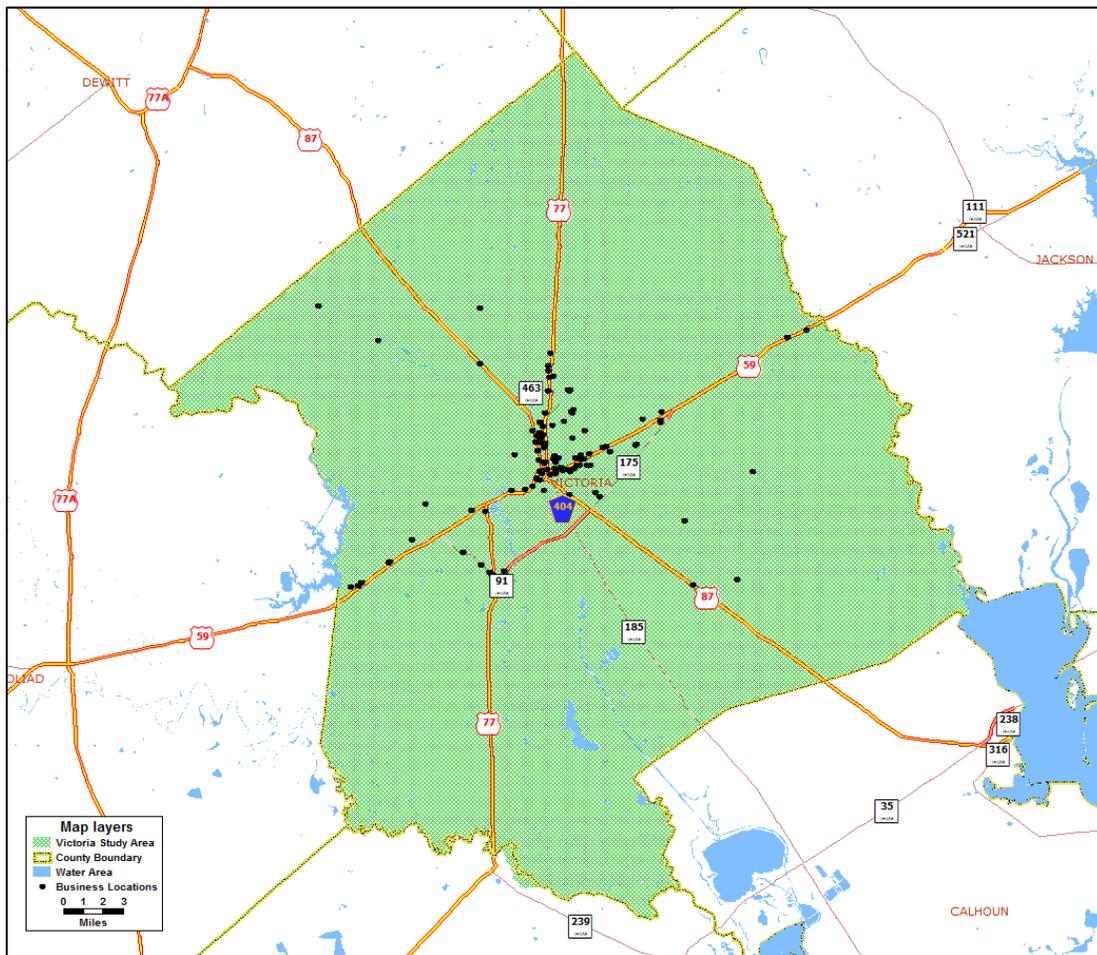


Figure 9. TAZ Boundary and Base Locations of Surveyed Commercial Vehicles.

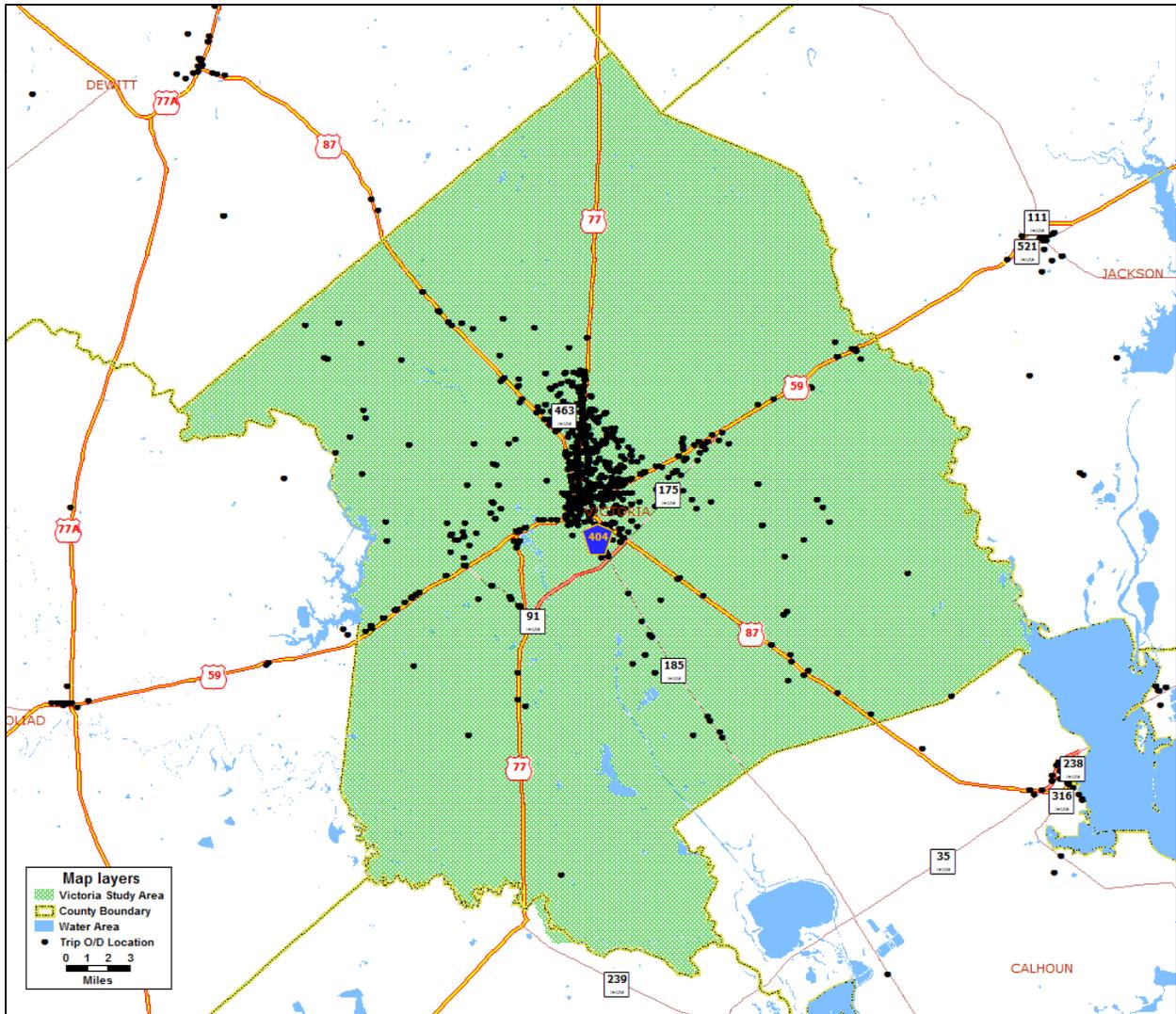


Figure 10. Trip Origins and Destinations of Surveyed Commercial Vehicles.

The results presented in this section pertain to trip length characteristics for 1,071 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 60 percent of the cargo vehicles and 73 percent of the service vehicle trips had trip lengths less than five miles. Additionally, 24 percent of the cargo vehicle trips and 15 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 both 27 miles.

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	260	59.8	470	73.1	730	67.8
6 to 10	104	24.0	97	15.1	201	18.6
11 to 15	45	10.4	42	6.5	87	8.1
16 to 20	19	4.4	24	3.7	43	4.0
21 to 25	4	0.9	9	1.4	13	1.2
26 to 30	2	0.5	1	0.2	3	0.3
Total	434	100.0	643	100.0	1,077	100.0

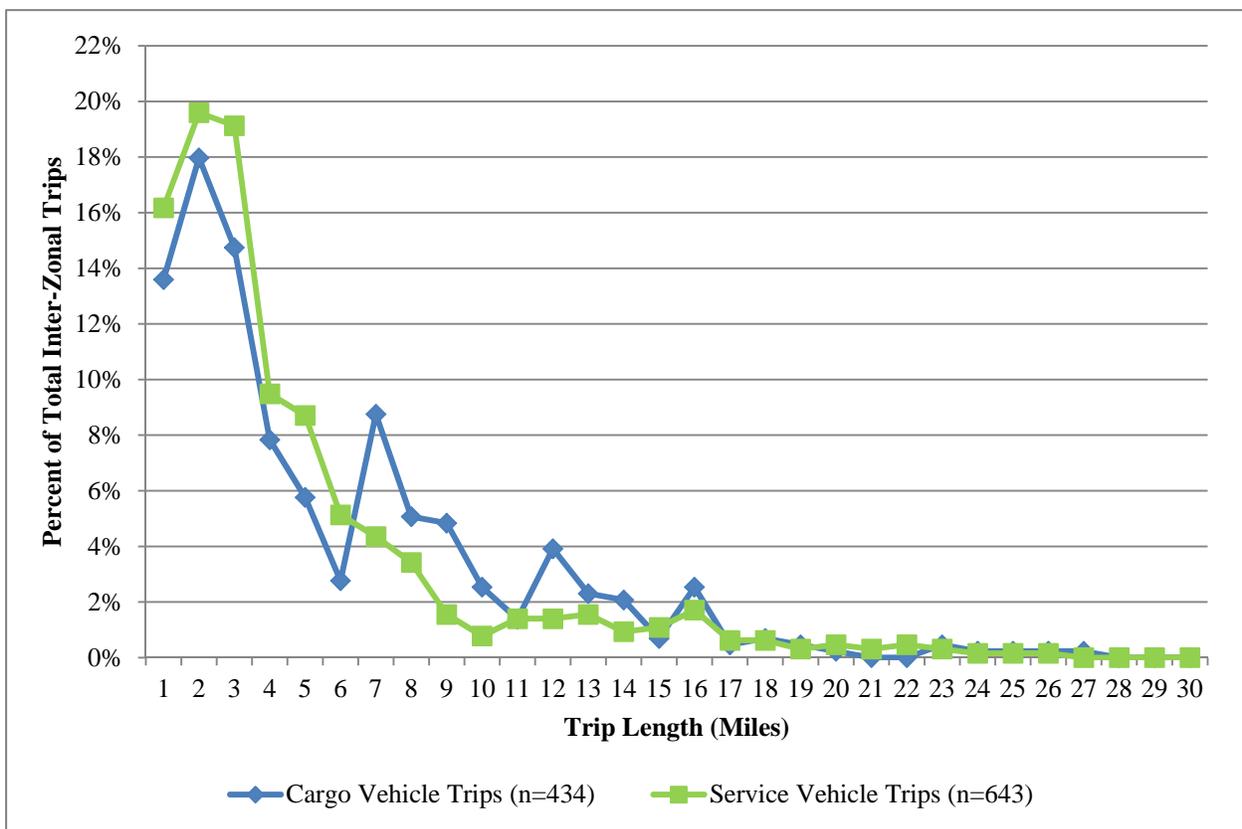


Figure 11. Surveyed Commercial Vehicle Trips TLFD.

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	59	13.6	104	16.2	163	15.1
2	78	18.0	126	19.6	204	18.8
3	64	14.7	123	19.1	187	17.4
4	34	7.8	61	9.5	95	8.8
5	25	5.8	56	8.6	81	7.5
6	12	2.8	33	5.1	45	4.2
7	38	8.8	28	4.4	66	6.1
8	22	5.1	22	3.4	44	4.1
9	21	4.8	10	1.5	31	2.9
10	11	2.5	5	0.8	16	1.5
11	6	1.4	9	1.4	15	1.4
12	17	3.9	9	1.4	26	2.4
13	10	2.3	10	1.6	20	1.9
14	9	2.1	6	0.9	15	1.4
15	3	0.7	7	1.1	10	0.9
16	11	2.5	11	1.7	22	2.0
17	2	0.5	4	0.6	6	0.6
18	3	0.7	4	0.6	7	0.6
19	2	0.5	2	0.3	4	0.4
20	1	0.2	3	0.5	4	0.4
21	0	0.0	2	0.3	2	0.2
22	0	0.0	3	0.5	3	0.3
23	2	0.5	2	0.3	4	0.4
24	1	0.2	1	0.2	2	0.2
25	1	0.2	1	0.2	2	0.2
26	1	0.2	1	0.2	2	0.2
27	1	0.2	0	0.0	1	0.1
Total	434	100.0	643	100.0	1,077	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 4.7 miles, with cargo vehicles and service vehicles averaging 5.3 miles and 4.4 miles, respectively. The most number of trips by cargo vehicles occurred at “other” land use types, with an average trip length of 5.7 miles, followed by retail and industrial sites with average trip lengths of 4.6 miles and 9.2 miles, respectively. For service vehicles, the highest frequency of trips occurred at retail land use types, with an average trip length of 3.6 miles. Almost two-thirds (62 percent) of the trips made by service vehicles occurred at either retail, 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	26	84	3.2	91	374	4.1	117	458	3.9
Retail	109	498	4.6	136	494	3.6	245	992	4.1
Industrial	49	451	9.2	14	157	11.2	63	608	9.6
Medical	25	51	2.0	52	107	2.1	77	158	2.0
Education	28	78	2.8	54	157	2.9	82	235	2.9
Government	8	42	5.3	31	144	4.6	39	186	4.8
Residential	44	258	5.9	133	612	4.6	177	870	4.9
Other	145	832	5.7	132	768	5.8	277	1,600	5.8
Total	434	2,294	5.3	643	2,813	4.4	1,077	5,107	4.7

Table 23 shows the average trip length to destinations by commodity group for trips made by cargo vehicles only. Approximately 24 percent of the trips cited the commodity group machinery, with an average trip length of 5.2 miles per trip. The commodity group secondary was the next most frequently transported commodity group, with an average trip length of 3.7 miles per trip. The average trip length for vehicles with no cargo (empty) was 5.3 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	12	73	6.1
Raw Materials	25	149	6.0
Food	70	329	4.7
Textiles	15	69	4.6
Wood	57	285	5.0
Building Materials	30	312	10.4
Machinery	103	540	5.2
Miscellaneous	0	0	0.0
Hazardous	0	0	0.0
Transportation	0	0	0.0
Secondary	84	308	3.7
Unknown	0	0	0.0
Empty	38	230	6.1
Total	434	2,295	5.3

Travel Time and Speed

The Victoria 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 Victoria 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 TLFD. Approximately 43 percent of the trips made by cargo vehicles were less than five minutes, 23 percent were between 6-and-10 minutes, and 17 percent were between 11-and-15 minutes. For service vehicles, approximately 52 percent of the trips were less than five minutes, 27 percent were between 6-and-10 minutes, and eight percent were between 11-and-15 minutes. The longest duration of travel time for cargo vehicles was 39 minutes, while the longest travel duration for service vehicles was 36 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	188	43.3	333	51.8	521	48.4
6 to 10	100	23.0	177	27.5	277	25.7
11 to 15	75	17.3	54	8.4	129	12.0
16 to 20	28	6.5	33	5.2	61	5.6
21 to 25	31	7.1	31	4.8	62	5.8
26 to 30	6	1.4	9	1.4	15	1.4
31 to 35	3	0.7	4	0.6	7	0.6
36 to 40	3	0.7	2	0.3	5	0.5
Total	434	100.0	643	100.0	1,077	100.0

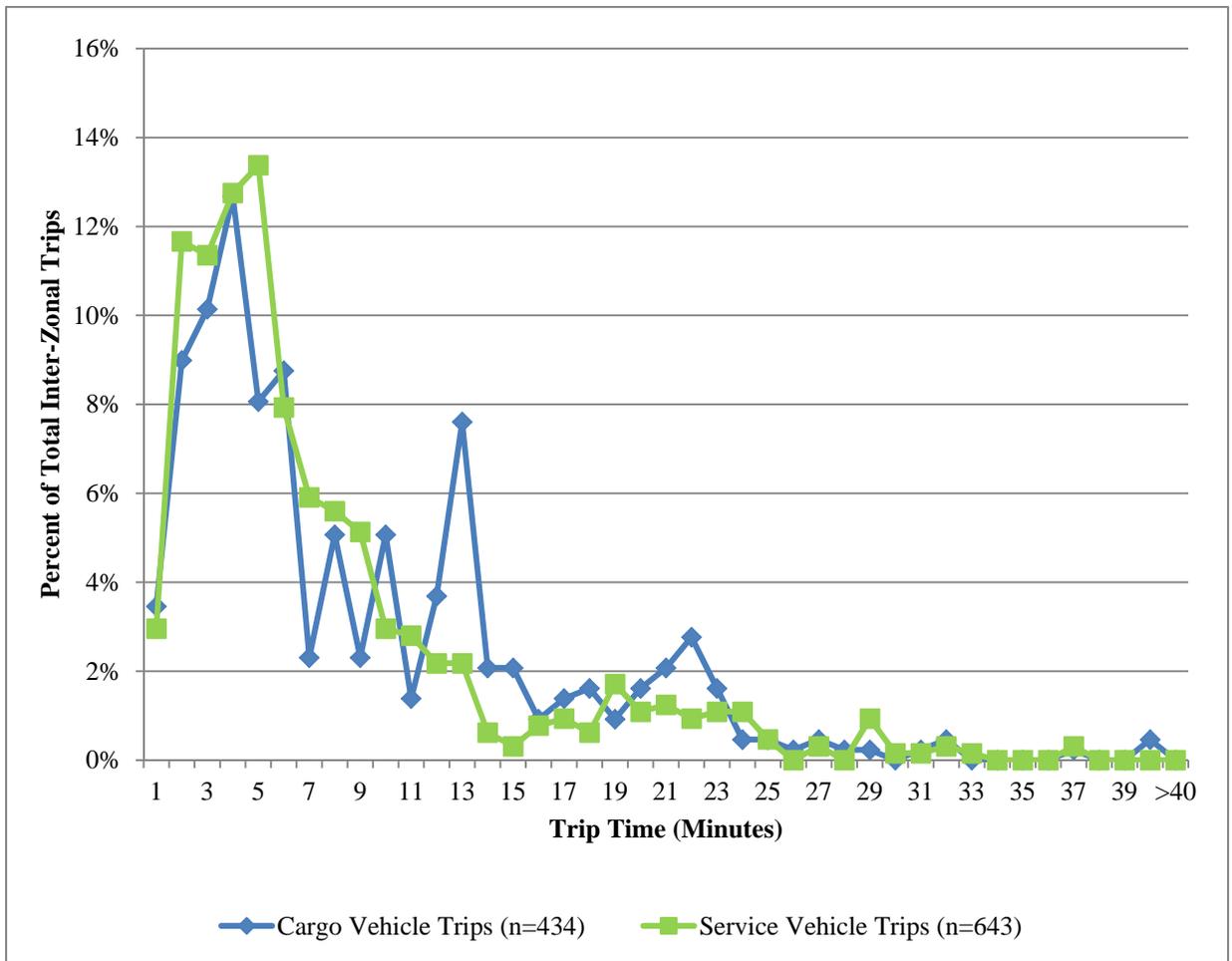


Figure 12. Surveyed Commercial Vehicle Trips Travel Time.

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	15	3.5	19	3.0	34	3.2
2	39	9.0	75	11.7	114	10.6
3	44	10.1	73	11.4	117	10.8
4	55	12.6	82	12.7	137	12.7
5	35	8.1	86	13.4	121	11.2
6	38	8.8	51	7.9	89	8.3
7	10	2.3	38	5.9	48	4.5
8	22	5.1	36	5.6	58	5.4
9	10	2.3	33	5.1	43	4.0
10	22	5.1	19	3.0	41	3.8
11	6	1.4	18	2.8	24	2.2
12	16	3.7	14	2.2	30	2.8
13	33	7.5	14	2.2	47	4.4
14	9	2.1	4	0.6	13	1.2
15	9	2.1	2	0.3	11	1.0
16	4	0.9	5	0.8	9	0.8
17	6	1.4	6	0.9	12	1.1
18	7	1.6	4	0.6	11	1.0
19	4	0.9	11	1.6	15	1.4
20	7	1.6	7	1.1	14	1.3
21	9	2.1	8	1.2	17	1.5
22	12	2.7	6	0.9	18	1.7
23	7	1.6	7	1.1	14	1.3
24	2	0.5	7	1.1	9	0.8
25	2	0.5	3	0.5	5	0.5
26	1	0.2	0	0.0	1	0.1
27	2	0.5	2	0.3	4	0.4
28	1	0.2	0	0.0	1	0.1
29	1	0.2	6	0.9	7	0.6
30	0	0.0	1	0.2	1	0.1
31	1	0.2	1	0.2	2	0.2
32	2	0.5	2	0.3	4	0.4
33	0	0.0	1	0.2	1	0.1
34	0	0.0	0	0.0	0	0.0
35	0	0.0	0	0.0	0	0.0
36	0	0.0	0	0.0	0	0.0
37	1	0.2	2	0.3	3	0.3
38	0	0.0	0	0.0	0	0.0
39	0	0.0	0	0.0	0	0.0
40	2	0.5	0	0.0	2	0.2
Total	434	100.0	643	100.0	1,077	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 7.7 minutes, with cargo vehicles averaging 8.5 minutes and service vehicles averaging 7.1 minutes. By land use types, trips made by cargo vehicles to industrial sites have the longest average travel duration of 14.2 minutes, with an average travel speed of 38.9 mph. For service vehicles, trips to industrial sites also had the highest average travel time of 17.0 minutes and an average travel speed of 39.6 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	26	5.6	34.3	91	6.7	36.8	117	6.5	36.3
Retail	109	7.3	37.4	136	5.9	36.6	245	6.6	37.0
Industrial	49	14.2	38.9	14	17.0	39.6	63	14.8	39.1
Medical	25	3.7	33.0	52	3.7	33.3	77	3.7	33.2
Education	28	4.9	34.2	54	5.0	34.6	82	5.0	34.5
Government	8	8.1	39.3	31	7.0	39.5	39	7.3	39.4
Residential	44	9.5	37.1	133	7.7	36.0	177	8.1	36.3
Other	145	9.2	37.4	132	9.2	37.9	277	9.2	37.6
Unknown	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Total	434	8.5	37.3	643	7.1	36.9	1,077	7.7	37.1

Table 27 shows the average travel time and speed to destinations by commodity group for trips made by cargo vehicles only. Trips transporting building materials had the longest average trip duration of 16.0 minutes, with an average travel speed of 39.0 mph. Of the known commodity groups, machinery had the highest number of trips, with an average travel time of 8.3 minutes and 37.7 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	12	10.4	35.2
Raw Materials	25	9.6	37.5
Food	70	7.5	37.6
Textiles	15	7.3	37.5
Wood	57	8.3	36.2
Building Materials	30	16.0	39.0
Machinery	103	8.3	37.7
Miscellaneous	0	0.0	0.0
Hazardous	0	0.0	0.0
Transportation	0	0.0	0.0
Secondary	84	6.2	35.5
Unknown	0	0.0	0.0
Empty	38	9.4	38.5
Total	434	8.5	37.3

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 start 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 1,818 trips observed in the Victoria commercial vehicle survey area. 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 in 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 two-thirds (67 percent) of the total trips generated by cargo vehicles were non-base trips and 33 percent were base trips. For trips made by service vehicles, 56 percent were non-base trips and 44 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	290	32.9	416	44.4	706	38.8
Non-Base	591	67.1	521	55.6	1,112	61.2
Total	881	100.0	937	100.0	1,818	100.0

Table 29 shows the distribution of trip tours for cargo and service vehicles. There were 391 trip tours generated by 261 vehicles making at least one trip tour. Cargo vehicles made 178 tours and service vehicles produced 213 tours. The number of tours varied from 1-to-5 tours for cargo vehicles, and 1-to-14 tours for service vehicles. Roughly 75 percent of the cargo and service vehicles (that made trip tours) made only one trip tour (82 percent and 69 percent, respectively). For those cargo and service vehicles making only one trip tour, they averaged 5.4 trips and 4.5 trips within the tour, respectively. For all vehicles combined, the average number of tours per vehicle was 1.5 and the average number of trips per tour was 3.9.

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	112	112	605	5.4
2	15	30	91	3.0
3	5	15	33	2.2
4	4	16	40	2.5
5	1	5	11	2.2
Cargo Total	137	178	780	4.4
Service Vehicles				
Total Number of Trip Tours	Number of Vehicles	Number of Tours	Number of Trips	Average Trips per Tour
1	85	85	385	4.5
2	19	38	134	3.5
3	12	36	107	3.0
4	3	12	39	3.3
5	0	0	0	0.0
6	3	18	34	1.9
7	0	0	0	0.0
8	0	0	0	0.0
9	0	0	0	0.0
10	1	10	16	1.6
11	0	0	0	0.0
12	0	0	0	0.0
13	0	0	0	0.0
14	1	14	16	1.1
Service Total	124	213	731	3.4
Grand Total	261	391	1,511	3.9

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 1,511 trips observed within the total 391 trip tours. For all vehicles, 577 were external trips (38 percent), 864 were inter-zonal trips

(57 percent), and 70 were intra-zonal trips (5 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	334	161	258	207	13	17	605	385
2	18	37	70	95	3	2	91	134
3	6	6	27	98	0	3	33	107
4	2	0	35	34	3	5	40	39
5	9	0	2	0	0	0	11	0
6	0	0	0	30	0	4	0	34
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	4	0	4	0	8	0	16
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	4	0	12	0	16
Total	369	208	392	472	19	51	780	731

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	431	247	678	605	77.6	385	52.7	990	65.5
2	49	76	125	91	11.7	134	18.3	225	14.9
3	9	35	44	33	4.2	107	14.6	140	9.3
4	10	16	26	40	5.1	39	5.3	79	5.2
5	1	0	1	11	1.4	0	0.0	11	0.7
6	0	2	2	0	0.0	34	4.7	34	2.2
7	0	0	0	0	0.0	0	0.0	0	0.0
8	0	0	0	0	0.0	0	0.0	0	0.0
9	0	0	0	0	0.0	0	0.0	0	0.0
10	0	4	4	0	0.0	16	2.2	16	1.1
11	0	0	0	0	0.0	0	0.0	0	0.0
12	0	0	0	0	0.0	0	0.0	0	0.0
13	0	0	0	0	0.0	0	0.0	0	0.0
14	0	0	0	0	0.0	16	2.2	16	1.1
Total	500	380	880	780	100.0	731	100.0	1,511	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.

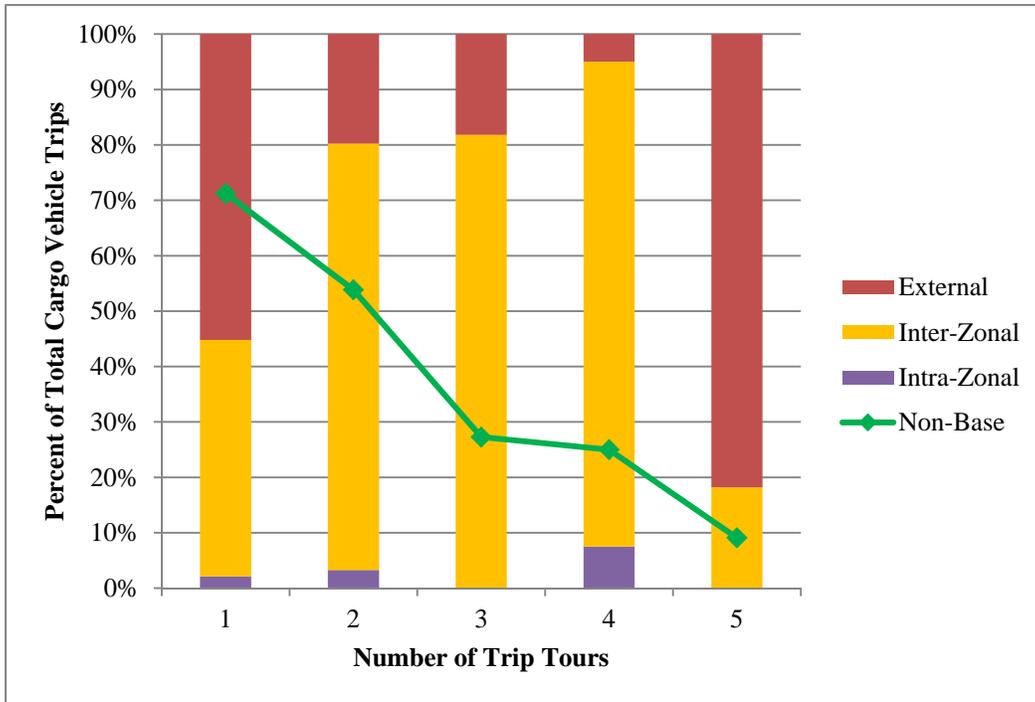


Figure 13. Cargo Vehicle Trips within Trip Tours by Trip Type.

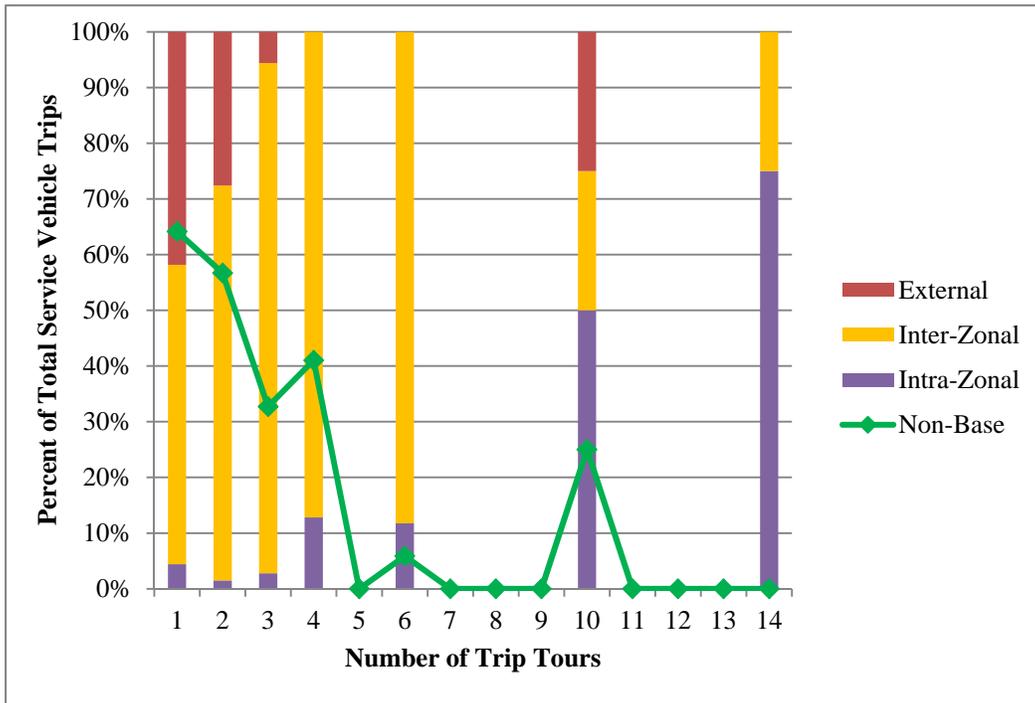


Figure 14. Service Vehicle Trips within Trip Tours by Trip Type.

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. Slightly less than 4 percent of the trips made in an open tour (that contained a tour) by cargo and service vehicles combined were before the first trip tour or after the last completed trip tour. A total of 28 trips (seven cargo trips and 21 service trips) 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 start of first tour	1	0.1	24	2.6	25	1.4
After end of last tour	6	0.7	37	4.0	43	2.4
Only Open	94	10.7	140	14.8	234	12.8
Within Closed	780	88.5	736	78.6	1,516	83.4
Total	881	100.0	937	100.0	1,818	100.0
No Tours	7	NA	21	NA	28	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 Victoria 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 Victoria study area.

Table 33. 2011 HPMS Estimates of Weekday VMT in the Victoria Study Area.

Functional Classification	Total Weekday VMT
Freeway	252,948
Arterial	1,819,259
Collector	265,158
Local	275,025
Total	2,612,390

The percentages of commercial and non-commercial vehicles by functional classification were determined by using vehicle classification counts for the Victoria 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.

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 (82%)	External Sites (18%)	Weighted Average	Internal Sites (82%)	External Sites (18%)	Weighted Average
Freeway	11	11	11	89	89	89
Arterial	9	16	10	91	84	90
Collector	7	11	8	93	89	92
Local	4	13	8	96	87	92

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

Functional Classification	Commercial VMT	Non-Commercial VMT	Total VMT
Freeway	28,047	224,901	252,948
Arterial	179,254	1,640,004	1,819,258
Collector	20,026	245,133	265,159
Local	22,002	253,023	275,025
Total	249,329	2,363,061	2,612,390

The total commercial VMT of 249,329 miles represents all commercial vehicles that traveled within the Victoria 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 36,712 miles. Therefore, the internal commercial VMT estimate was 212,616 miles.

The total internal VMT observed from the commercial vehicle survey was 5,100 miles, of which 2,284 miles were cargo VMT and 2,816 miles were service VMT. This estimate was based on 1,071 inter-zonal trips (431 cargo vehicle trips and 640 service vehicle trips), multiplied by the average trip length (5.3 miles for cargo and 4.4 miles for service vehicles). The total internal commercial VMT (212,616 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 34 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 66 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 72,289 miles for cargo vehicles and 140,327 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 (31.65 for cargo vehicles and 49.83 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 13,640 cargo vehicle trips and 31,892 service vehicle trips. Additionally, 3,306 intra-zonal trips were made, bringing the total number of internal commercial vehicle trips to 48,838. Based on the average number of inter-zonal trips per day of 2.99 trips for cargo vehicles and 4.32 trips for service vehicles, 12,765 commercial vehicles (4,779 cargo vehicles and 7,986 service vehicles) were estimated to be operating within the Victoria study area on a daily basis. This estimate is 3.8 times more than the approximate 3,370 trucks registered in the study area in 2011. Table 36 provides a summary of key results from the Victoria 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	144	148	292
Total Inter-zonal Trips	431	640	1,071
Total Intra-zonal Trips	21	53	74
Total Internal Trips	452	693	1,145
Total External Trips	429	244	673
Total Internal and External Trips	881	937	1,818
Average Total Trips per Vehicle	6.1	6.3	6.2
Average Total Internal Trips per Vehicle*	3.1	4.7	3.9
Average Trip Length	5.3	4.4	4.7
Observed Internal VMT	2,284	2,816	5,100
Total Internal Commercial VMT	72,289	140,327	212,616
Survey Expansion Factor	31.65	49.83	41.69
Total Expanded Inter-Zonal Commercial Vehicle Trips	13,640	31,892	45,532
Total Expanded Intra-Zonal Commercial Vehicle Trips	665	2,641	3,306
Total Expanded Commercial Vehicle Trips	14,304	34,534	48,838
Number of Commercial Vehicles Operating on a Daily Basis	4,779	7,986	12,765
Attraction Rate to Households	--	--	0.246

*Based on internal trips of 292 surveyed commercial vehicles (144 cargo vehicles and 148 service vehicles).

One final calculation was the determination of the commercial vehicle attraction rate to households. In the survey, approximately 16 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 7,912 trips to residential locations. The residential trip estimate was divided by the estimated number of households in the Victoria area (32,187) to obtain an attraction rate of 0.246.

SURVEY SUMMARY

This section provides a summary of vehicle and trip characteristics of 292 commercial vehicles that participated in the 2010-2011 Victoria 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 9.3 years compared to 7.4 years for service vehicles. The odometer readings reported by cargo vehicles indicated an average mileage of 200,000 miles, which was approximately 50 percent more than the reported average mileage of 137,000 miles by service vehicles. In terms of fuel use, around 51 percent of cargo vehicles used diesel and 49 percent used unleaded gasoline, while 85 percent of service vehicles used unleaded gasoline and 15 percent used diesel.

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. Surveyed cargo vehicles made an average of 6.1 total trips per day, compared to 6.3 trips per day for service vehicles. Excluding the trips made outside of the study area (external trips), cargo vehicles produced 3.1 internal trips per day, with average travel distance of 5.3 miles, compared to service vehicles which made 4.7 internal trips per day, with average trip length of 4.4 miles. The average travel time per trip for cargo vehicles was 8.5 minutes and for service vehicles the average travel time per trip was 7.1 minutes.

In terms of trip purpose at trip destinations, approximately 58 percent of the cargo vehicle trips were for maintenance, 24 percent were base related, and 9 percent were classified as driver needs. For trips made by service vehicles, approximately 56 percent were government related, 33 percent were base related, and 6 percent were for pickup and delivery.

In terms of land use activity, approximately 31 percent of the trips made by cargo vehicles traveled to retail locations, followed by 12 percent to “other,” and 10 percent to industrial/manufacturing locations. For service vehicles, nearly 23 percent of the trips traveled to retail/shopping sites, followed by 18 percent to residential locations, and 13 percent to office 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 approximately 4,300 lbs. Agriculture products showed the highest average net cargo weight of approximately 23,000 lbs. per trip, but the most frequently transported commodity was

machinery products with an average net cargo weight of over 2,600 lbs. per trip. The land use “other” showed the highest average net cargo weight of approximately 8,200 lbs. per trip. Maintenance trip purpose had the highest average net cargo weight of approximately 6,500 lbs. per trip.

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 391 trip tours were generated by the surveyed vehicles, with cargo vehicles making 178 tours and service vehicles producing 213 tours. The number of trip tours per vehicle varied from one-to-five tours for cargo vehicles and 1-to-14 for service vehicles. The average number of trips tours for all vehicles was 1.5 and the average number of trips per tour was 3.9. Trips made as part of trip tours accounted for 1,511 trips (780 trips by cargo vehicles and 731 trips by service vehicles). Within the trip tours, approximately 57 percent were inter-zonal trips, 5 percent were intra-zonal trips and the remaining 38 percent were external trips. Non-base trips (which were not mutually-exclusive of the other trip types) comprised approximately 61 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 Victoria 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 12,800 commercial vehicles (4,800 cargo vehicles and 8,000 service vehicles) were estimated to be operating within the Victoria study area on a daily basis, approximately 3.8 times the volume of trucks registered in the study area in 2012.

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

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 4 PLACE 5 PLACE 6 PLACE 7 PLACE 8 PLACE 9		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
		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
<p>(1) Base Location / Return to Base Location (5) Maintenance (fuel, oil, etc.)</p> <p>(2) Delivery (6) Driver Needs (lunch, etc.)</p> <p>(3) Pick-up (7) Service related business</p> <p>(4) Pick-up and Delivery (8) Other (Please specify)</p>	<p>(1) Office Building (Non-Government) (6) Education (college, trade) (11) Warehouse</p> <p>(2) Retail / Shopping (7) Government Office / Building (12) Distribution Center</p> <p>(3) Industrial/Manufacturing (8) Residential (13) Construction Site</p> <p>(4) Medical / Hospital (9) Airport (14) Other (specify)</p> <p>(5) Education (12th grade or less) (10) Intermodal Facility (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 PLACE 11 PLACE 12 PLACE 13 PLACE 14		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery <hr/> Picked Up
		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery <hr/> Picked Up
		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery <hr/> Picked Up
		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery <hr/> Picked Up
		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

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 PLACE 16 PLACE 17 PLACE 18 PLACE 19		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery <hr/> Picked Up
		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery <hr/> Picked Up
		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery <hr/> Picked Up
		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery <hr/> Picked Up
		Arrive: _____ am/pm Depart: _____ am/pm			<input type="checkbox"/> - Yes <input type="checkbox"/> - No		Delivery <hr/> Picked Up

ACTIVITY OPTIONS	TYPE OF PLACE OPTIONS
<ul style="list-style-type: none"> (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) 	<ul style="list-style-type: none"> (1) Office Building (Non-Government) (2) Retail / Shopping (3) Industrial/Manufacturing (4) Medical / Hospital (5) Education (12th 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