Chicago Metropolitan Agency for Planning

233 South Wacker Drive
Suite 800
Chicago, Illinois 60606

312 454 0400
www.cmap.illinois.gov

MEMORANDUM

To: **File**
From: Claire Bozic
Date: August 24, 2015
Re: Day of Week Distribution MOVES Input File Development (DRAFT)

Background

The MOVES Air Quality model requires a number of inputs that are not calculated using the results of the regional travel demand model. One of these inputs is an Excel workbook containing the distribution of vehicle miles traveled by source type (vehicle class), by month, facility type, and by day of week. There isn't a source of information which presents regional observed vehicle miles traveled by month. As a proxy for vehicle miles traveled, we used the Illinois Department of Transportation continuous count station data. Only the continuous count stations which provide vehicle class data were used.

MOVES Input File Excerpt

The resulting file resembles the excerpt below. The day VMT fraction should add to 1 for each month and road type within the vehicle class.

sourceTypeID	monthID	roadTypeID	dayID	dayVMTFraction
21	1	1	2	0.22809
21	1	1	5	0.77191
21	1	2	2	0.279201
21	1	2	5	0.720799
21	1	3	2	0.233973
21	1	3	5	0.766027
21	1	4	2	0.230606
21	1	4	5	0.769394
21	1	5	2	0.213409
21	1	5	5	0.786591

sourceTypeID = each of the 13 MOVES vehicle classes (discussed later)
monthID = 1-12, representing January – December
roadTypeID = 1: off network, 2: rural Restricted, 3: rural unrestricted 4: urban restricted 5: urban unrestricted
dayID = 2 : weekends, 5 : weekdays

Continuous Count Stations

The following table presents the locations of stations which were included in the data received from IDOT. Stations with Y in the drop category were dropped from the analysis because they either had questionable data quality or were missing too much data.

Nearest City	County	Location	Illinois Functional Class Description	Rural/ Urban	Restricted Access	Drop
Fox Lake	Lake	US 12 1.0 mile south of IL 134	Other Principal Arterial	Urban	no	
	Cook	IL 59 0.4 mile south of US 20	Other Principal Arterial	Urban	no	Y
Addison	DuPage	I 290	Interstate	Urban	yes	
Palos Park	Cook	IL 7 NE of West 131st St.	Minor Arterial	Urban	no	Y
Elk Grove Village	Cook	Devon Ave. west of Ridge Ave. and Mittel Blvd	Minor Arterial	Urban	no	
Rosemont	Cook	IL 72 (Higgins Rd.) West of I-294 overpass	Major Collector	Urban	no	
Northbrook	Cook	IL 43 (Waukegan Rd.) NW of Techny Dr.	Other Principal Arterial	Urban	no	
Wheeling	Cook	IL 68 (Dundee Rd.) East of Portwine Rd.	Other Principal Arterial	Urban	no	
Woodridge	DuPage	IL 53 0.02 mi south of 75th St.	Other Principal Arterial	Urban	no	Y
West Chicago	DuPage	IL 64 0.9 mile west of IL 59	Other Principal Arterial	Urban	no	
Hinsdale	DuPage	IL 83 (Kingery Hwy) North of 55th Street overpass	Other Principal Arterial	Urban	yes	Y
Lake Zurich	Lake	IL 22 .14 mile W. of Quentin	Other Principal Arterial	Urban	no	
North Barrington	Lake	IL 59 (Hough Rd.) South of Cresthill Rd.	Other Principal Arterial	Urban	no	
Woodstock	McHenry	US 14 SE of Deep Cut Road	Other Principal Arterial	Rural	no	
Romeoville	Will	IL 53 (Independence Blvd.) North of Taylor Rd.	Other Principal Arterial	Urban	no	Y
Plainfield	Will	IL 126 ne of 143rd St.	Minor Arterial	Urban	no	
Elwood	Will	Arsenal / Manhattan Rd. West of S. Brandon Rd.	Other Principal Arterial	Urban	no	
Peotone	Will	I-57 North of MM 326 at Kennedy Rd. Stub -- South	Interstate	Rural	yes	
Beecher	Will	Peotone/Beecher Road west of Kedzie Ave.	Other Principal Arterial	Urban	no	Y
Joliet	Will	I 80 east of Cherry Hill Road	Interstate	Urban	yes	
Minooka	Will	I-80 NE of Shepley Rd Overpass	Interstate	Urban	yes	

Braidwood	Will	I-55 North of Reed Rd. Exit 233 -- North of MM 234	Interstate	Rural	yes	

Here are the numbers and types of station used in the analysis. There were originally 22 stations in the dataset. Six were dropped, which left sixteen in the dataset.

	Retained		
	Unrestricted	Restricted	Total
Rural	1	2	3
Urban	10	3	13
Total	11	5	16

	Dropped		
	Unrestricted	Restricted	Total
Rural	0	0	0
Urban	5	1	6
Total	5	1	6

Dataset Description

Datasets were obtained at two different times. The first dataset included only data from 2011. The data was presented by station, direction, and lane of travel. It included records representing hours 1 – 24. The second dataset covered the years 2012 – 2014. This dataset was aggregated by station without lane and direction of travel information and also included hourly records for each date. To make the two datasets compatible, the 2011 data was aggregated to the station level, eliminating the lane and direction information. The two datasets were combined and used together.

Each record in the dataset represents one hour of one calendar day. Theoretically, for each station there are 24 records for each day of the year. Each record presents a vehicle count by 13 FHWA vehicle category classifications. IDOT's datasets also include class 14 "unknown" and class 15 "unclassified."

Assignment of FHWA Classes to MOVES Classes

The following table shows which continuous count station vehicle classes were assigned to each MOVES source type (vehicle) category.

MOVES Vehicle Class	FHWA Vehicle Category
11 Motorcycle	Class 1 Motorcycles
21 Passenger car	Class 2 Passenger cars
31 Passenger trucks	Class 3 Four tire single unit
32 Light commercial truck	Class 5 Two Axle, six tire single unit
41 Intercity bus 42 Transit bus 43 School bus	Class 4 Buses
51 Refuse truck 52 Single unit short haul truck 53 Single unit long haul truck	Class 6 Three axle, single unit Class 7 Four or more axle, single unit
54 Motor home	Included in Class 5 and can't be pulled out – used equal daily distribution
61 Combination short-haul truck	Class 8 Four or less axle, single trailer

62 Combination long-haul truck	Class 9 Five axle tractor semi-trailer Class10 Six or more axle, single trailer Class 11 Five or less axle, multi trailer Class 12 Six axle, multi trailer Class 13 Seven or more axle, multi trailer

Method

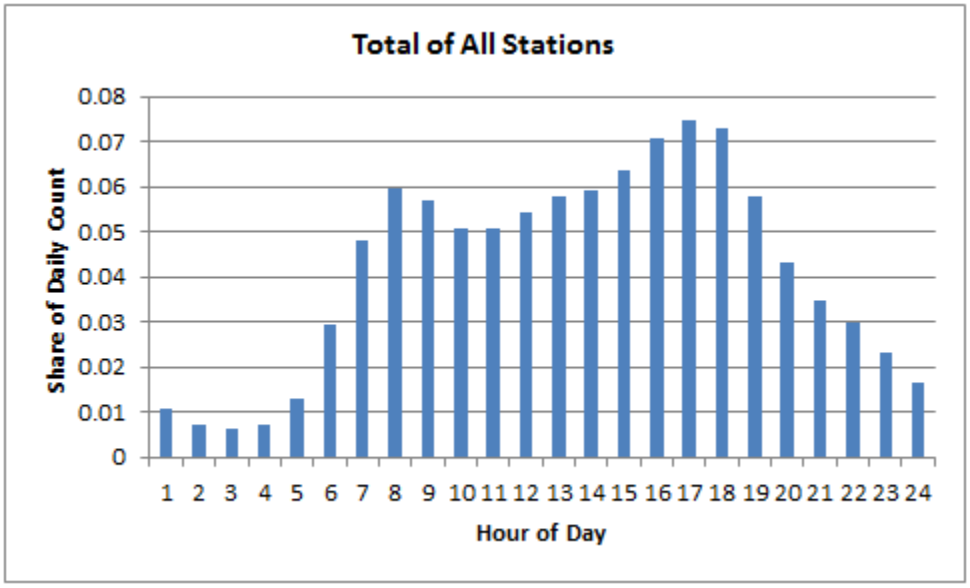
1. Hourly data by station, month, and day of week were averaged to develop an average count by station, month, day of week (Sunday – Saturday), and hour of day.
2. The average hour was aggregated to a number representing an average count for each station by month and day of week for each of the vehicle classes. For example, Mondays in January, Tuesdays in January, etc.
3. The average weekdays counts for each station, by month, were then multiplied by the average number of those days for each month, over the 2011 – 2014 period (shown below), resulting in an the total expected volume for each month, day of week, by station and by vehicle class.
4. One expressway station which had not included any observations for the month of February was retained, and an estimate for February counts was calculated from the average of January and March counts.

Average Number of Days by Type per Month 2011 – 2014

Average Number of Days per Month 2011-2014								
Month	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Total
January	4.5	4.5	4.5	4.5	4.5	4.25	4.25	31
February	4	4	4	4.25	4	4	4	28.25
March	4.5	4.25	4.25	4.25	4.5	4.5	4.75	31
April	4.25	4.5	4.5	4.25	4	4.25	4.25	30
May	4.25	4.25	4.5	4.5	4.75	4.5	4.25	31
June	4.5	4.25	4	4.25	4.25	4.25	4.5	30
July	4.5	4.5	4.75	4.5	4.25	4.25	4.25	31
August	4.25	4.25	4.25	4.5	4.5	4.75	4.5	31
September	4.5	4.5	4.25	4	4.25	4.25	4.25	30
October	4.25	4.5	4.5	4.75	4.5	4.25	4.25	31
November	4.25	4	4.25	4.25	4.25	4.5	4.5	30
December	4.5	4.75	4.5	4.25	4.25	4.25	4.5	31
Grand Total	52.25	52.25	52.25	52.25	52	52	52.25	365.25

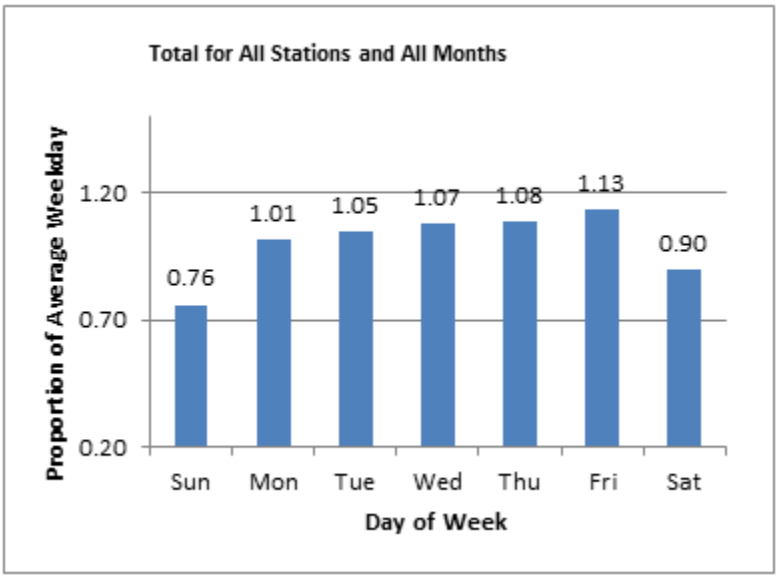
Average Hour by Station

A plot of each station's average hourly volume, summed for all the months and days, was produced to ensure that the distribution of hourly volumes looked reasonable. All of the station average hourly volumes were summed and presented in the following chart. The shape of the distribution for each station resembled the total for all stations, with some variation.



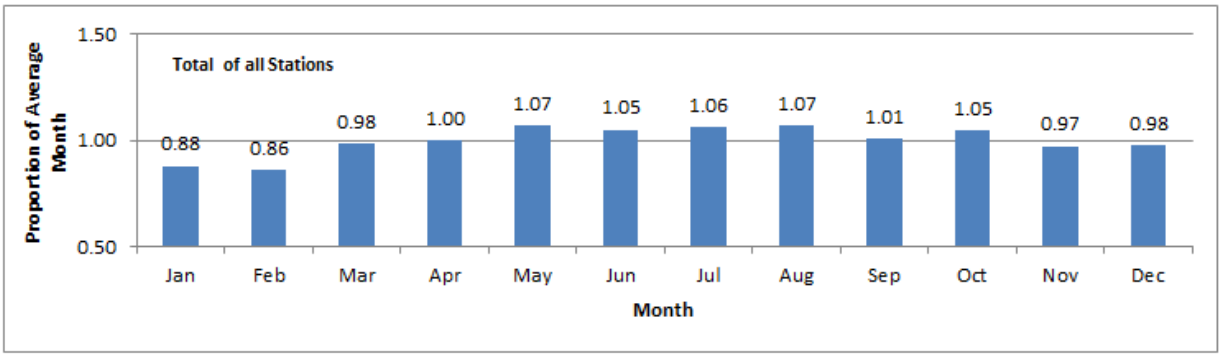
Average Day of Week

The average days of week, generated by aggregating the average hour of each weekday per month, was then calculated. Charts for each station were produced and reviewed. They resembled the following chart, which is a summary of all the total average day of week volumes for all stations.



Average Month

Charts of the distribution of monthly total volume were produced for each station and reviewed. The charts showed generally higher volumes in the warmer months and lower volumes in the winter months. All the stations were combined into the following chart, showing the relationship of the monthly volumes to an average month, for all stations.

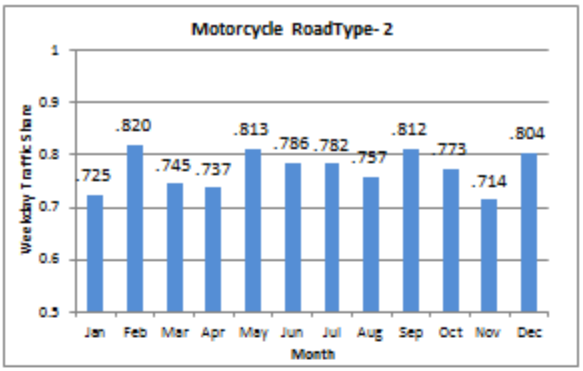


MOVES Inputs

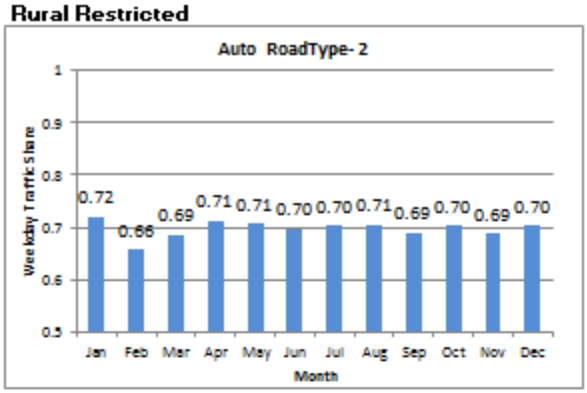
Once we were satisfied that the distribution of total volume by hour of day, day of week, the final file of volumes by station, vehicle, month, and day of week (monthly expected sum for each day) was imported to a spreadsheet where MOVES input data could be developed. The volume data by station, month, day of week was summarized into facility type (urban/rural, restricted access/unrestricted access) and MOVES days (weekdays/weekends) for each class of vehicle. The following charts show the proportion of weekday traffic to weekend traffic for each month.

Motorcycle and Auto Distributions

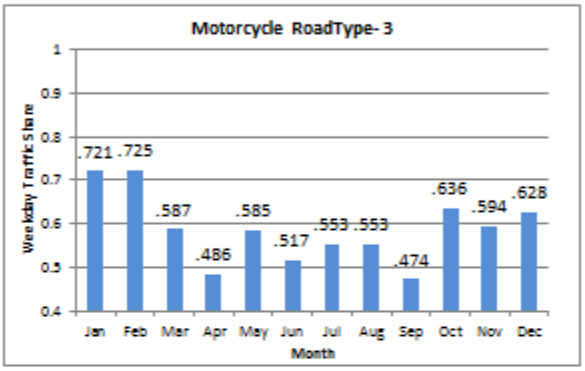
Rural Restricted



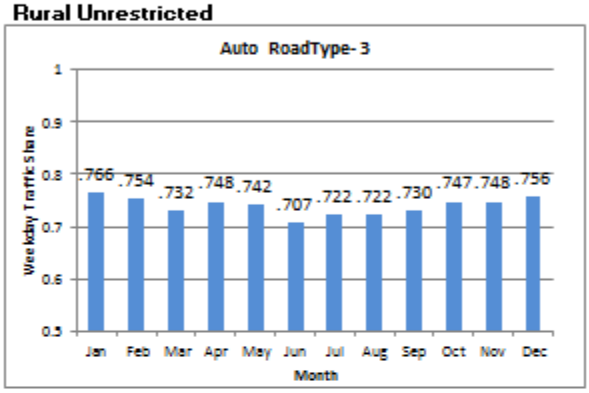
Rural Restricted



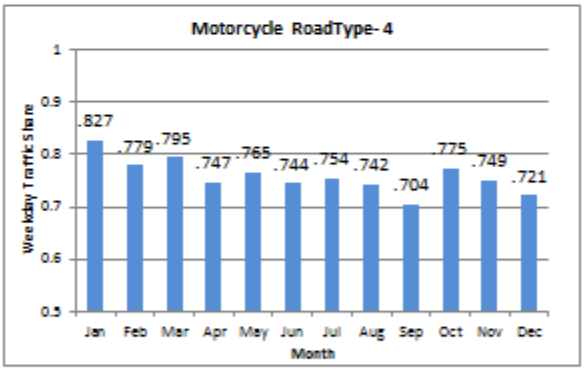
Rural Unrestricted



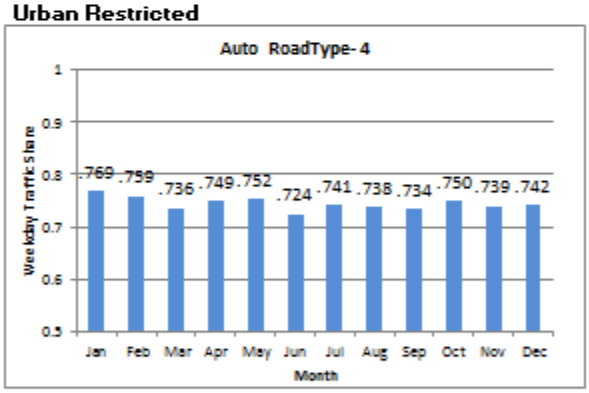
Rural Unrestricted



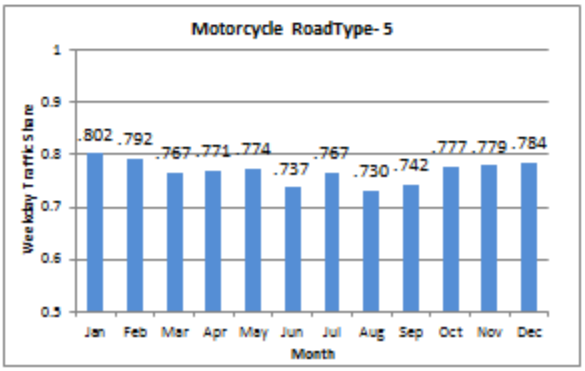
Urban Restricted



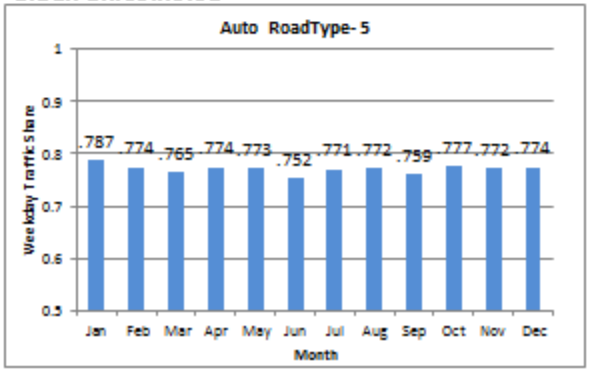
Urban Restricted



Urban Unrestricted

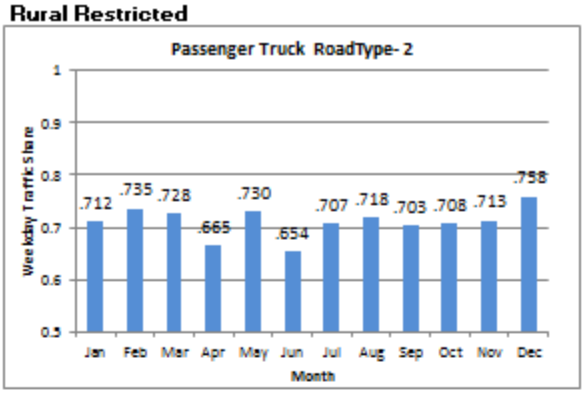


Urban Unrestricted

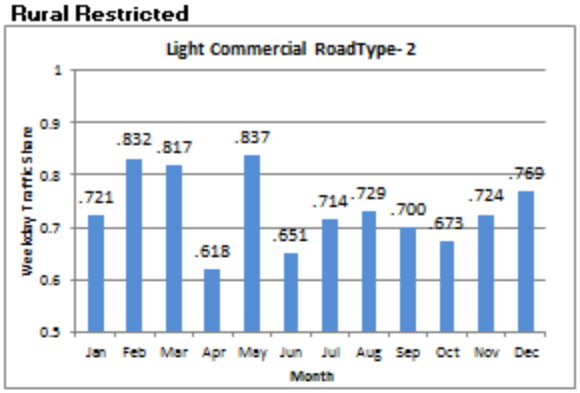


Passenger Truck and Light Commercial Truck Distributions

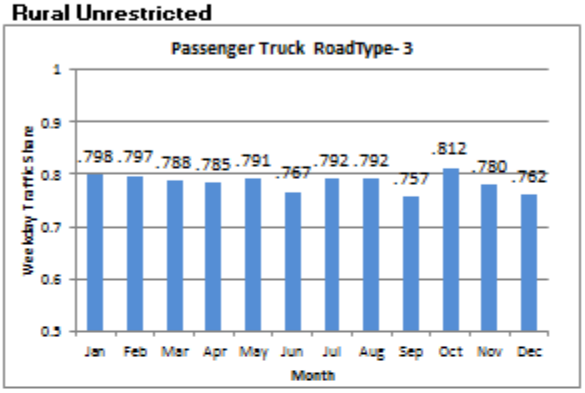
Rural Restricted



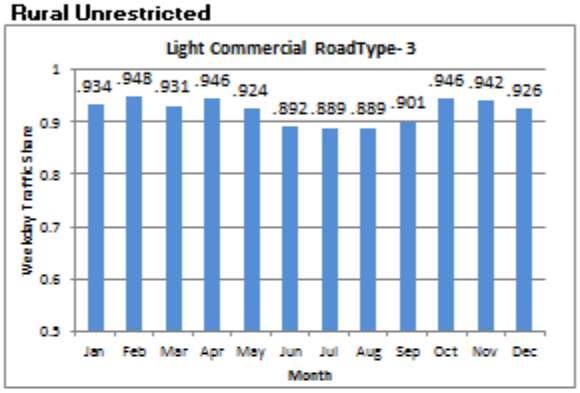
Rural Restricted



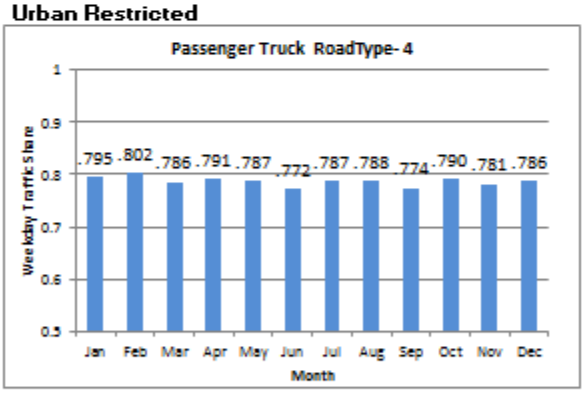
Rural Unrestricted



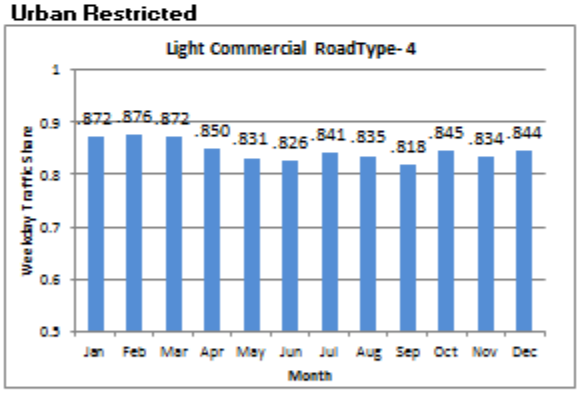
Rural Unrestricted



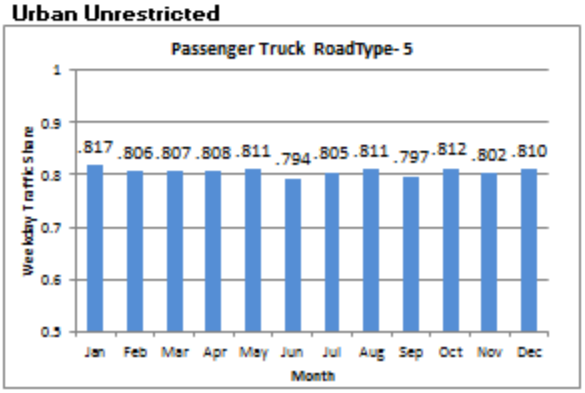
Urban Restricted



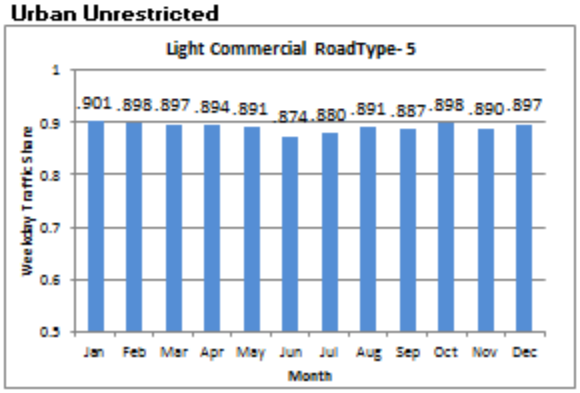
Urban Restricted



Urban Unrestricted

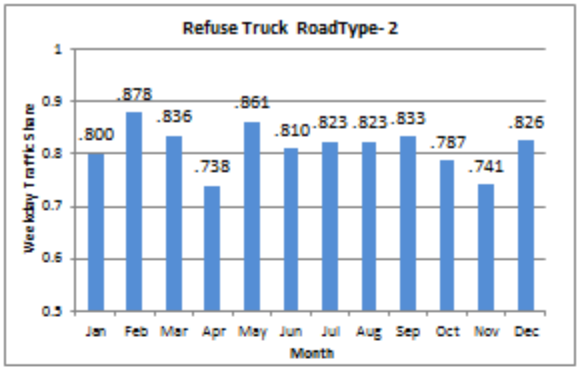


Urban Unrestricted

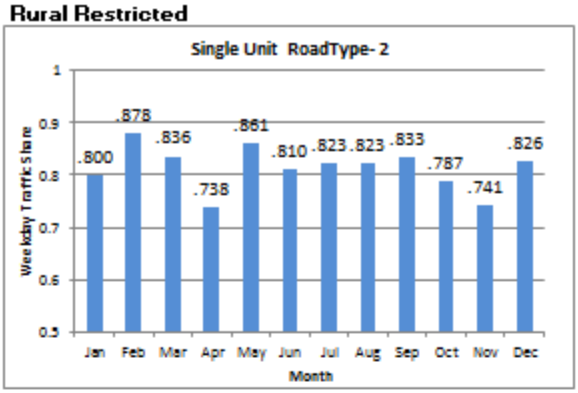


Refuse Truck and Single Unit Truck

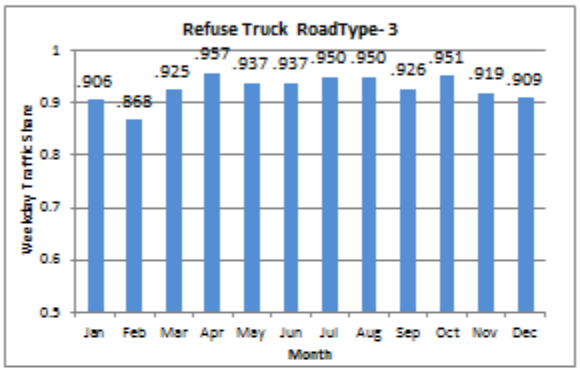
Rural Restricted



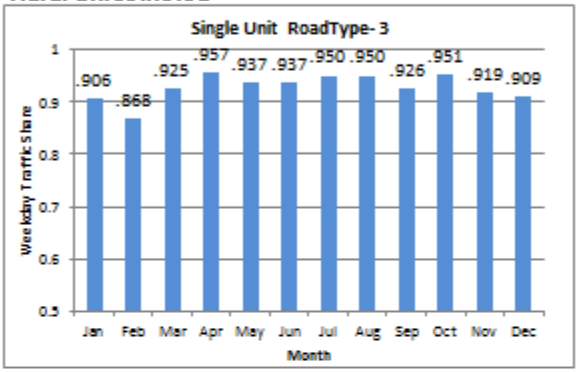
Rural Restricted



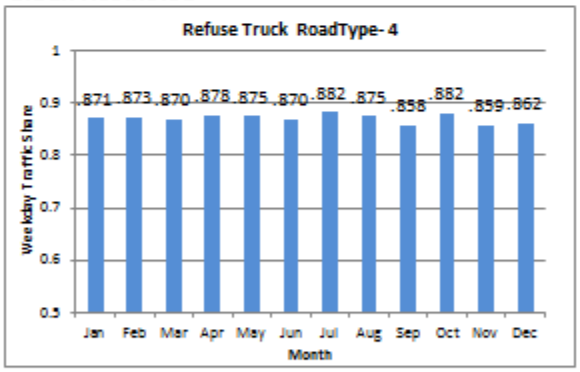
Rural Unrestricted



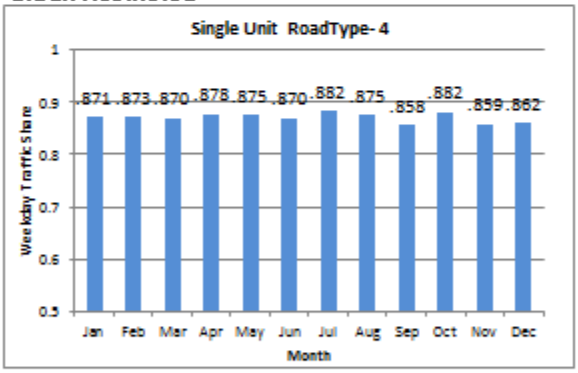
Rural Unrestricted



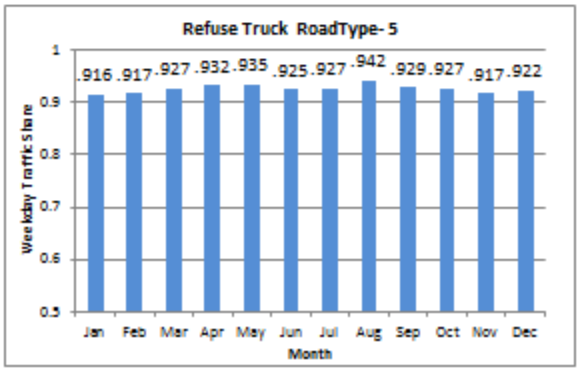
Urban Restricted



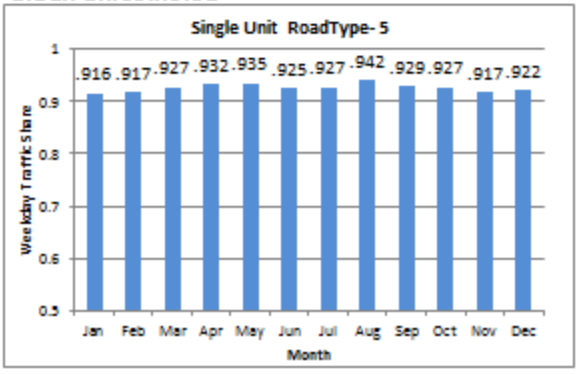
Urban Restricted



Urban Unrestricted

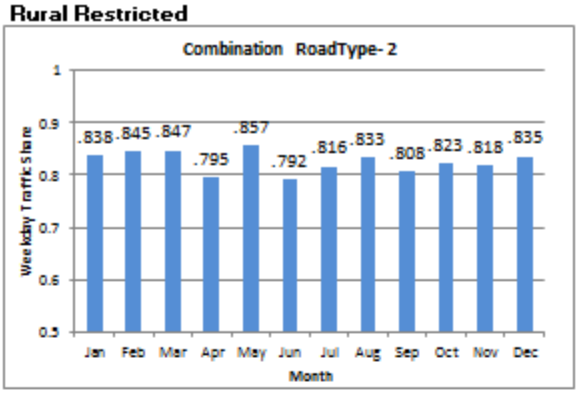


Urban Unrestricted

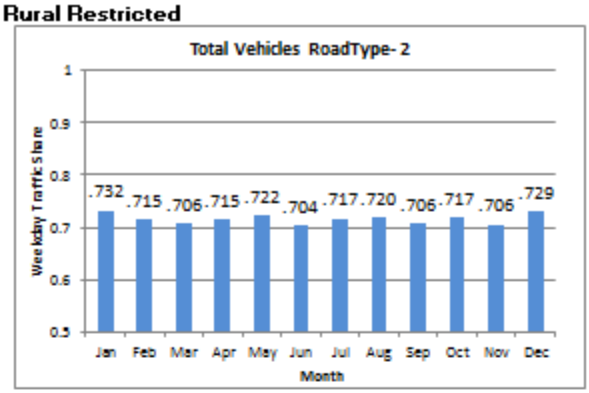


Combination Truck and Total Vehicle Summary

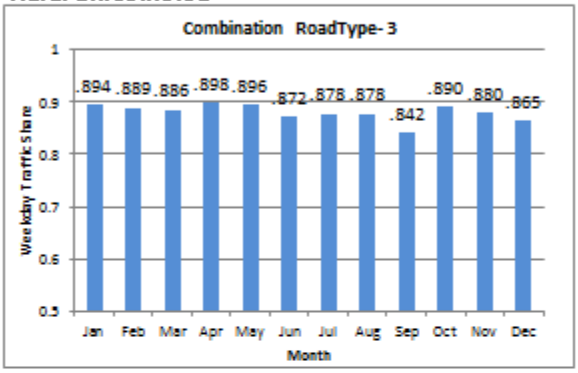
Rural Restricted



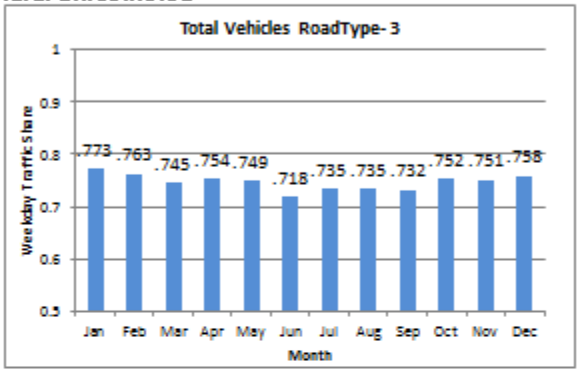
Rural Restricted



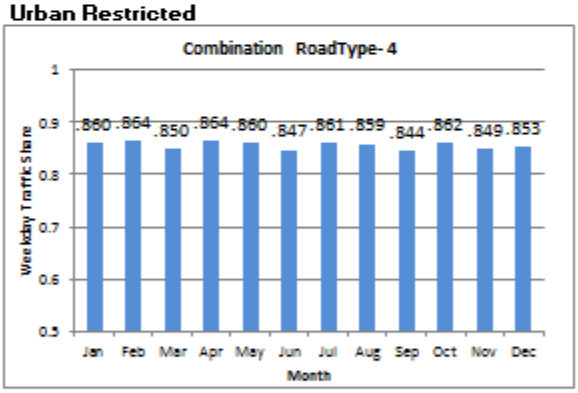
Rural Unrestricted



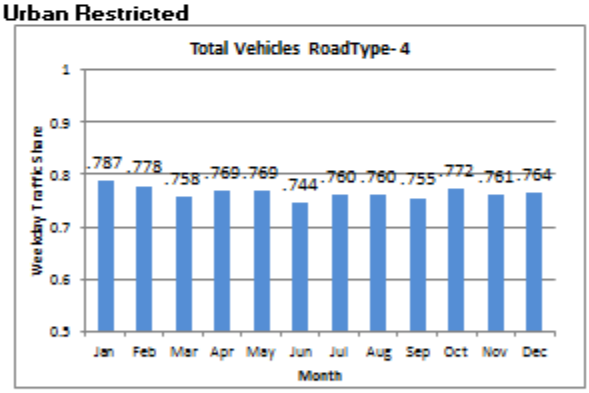
Rural Unrestricted



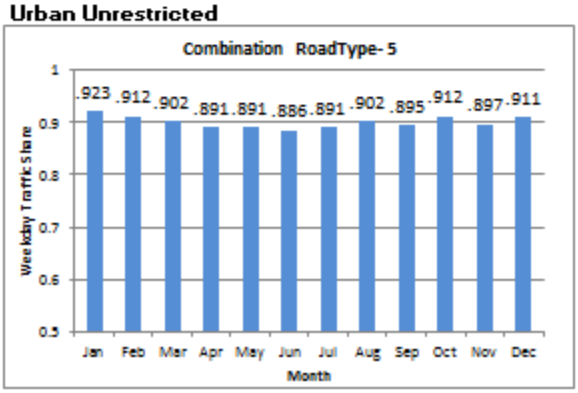
Urban Restricted



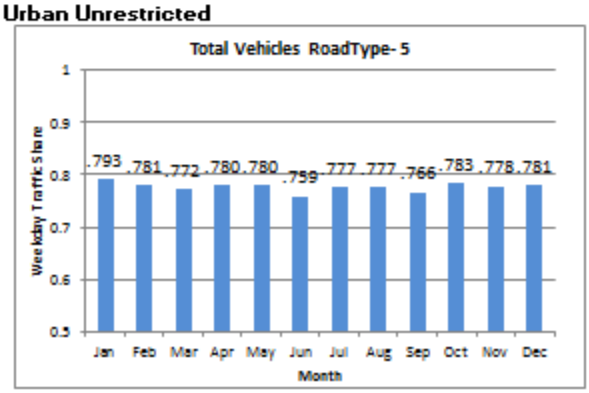
Urban Restricted



Urban Unrestricted



Urban Unrestricted



Intercity Bus, Transit Bus, School Bus, Motor Homes, and Motorcycles

Based on findings from previous work, alternative sources of information were used to generate the fractions needed for all bus types, for motor homes and for motorcycles.

Transit bus

We assumed that the amount of service provided was related the amount of ridership on the service. A 2013 CTA report provided the average weekday boardings, and average Saturday, Sunday and Holiday boardings. A similar statistic was calculated for Pace buses, for April 2015. The average weekday was multiplied by 5, and the average Saturday + Sunday was used as-is. The regional figures of (0.8284 weekday, 0.1716 weekend) for every month and facility type. This shows more service on the weekdays than weekends. An even distribution would result in the proportions 0.2857 weekend and 0.7143 weekday.

		Total Weekdays	Total Weekend
Average Week	Pace	511,361	67,471
	CTA	4,785,165	1,029,309
	Total	5,296,526	1,096,780
Shares	Pace	0.8834	0.1166
	CTA	0.8230	0.1770
	Total	0.8284	0.1716

Intercity bus

Lacking a better source of data, we assumed a distribution of weekday and weekend vehicle miles traveled proportional to the days of the week (0.2857 weekend, 0.7143 weekday), for all months and facility types.

School bus

We assumed that school bus travel was 100% weekday, 0% weekend.

Motor home

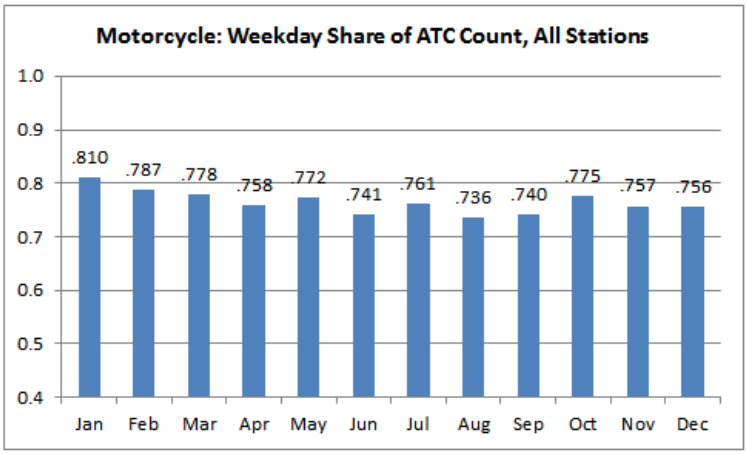
Lacking a better source of data, we assumed a distribution of weekday and weekend vehicle miles traveled proportional to the days of the week (0.2857 weekend, 0.7143 weekday), for all months and facility types.

Road Type 1

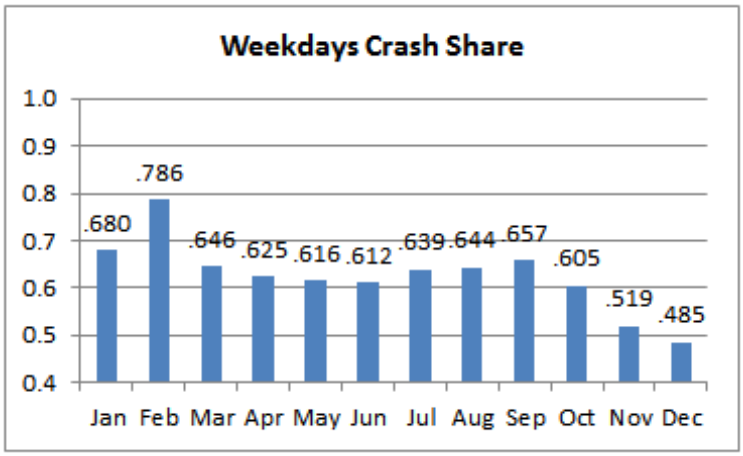
Road type 1 represents off-network travel. Since this information would be related to counts on the network, these figures were estimated based on a summary of the other four road types (urban/rural, restricted/unrestricted) combined.

Motorcycles

As discussed in another memo, we believe that the ATC system may not accurately count motorcycle vehicles. We used the motorcycle crash data for the seven counties of northeastern Illinois, all severities, as a proxy to infer the motorcycle VMT.



Motorcycle percent weekday count is fairly consistent throughout the year. We do not observe the variation of weekday traffic implied by the crash data.



The weekday crash share is much lower than the weekday ATC system count. We are postulating that the crash data more accurately represents motorcycle VMT than the ATC vehicle count. These shares were included in the MOVES input files.