

JANUARY 2018



**WIM #45
CSAH 14, MP
10.1
BLAINE, MN**

**MONTHLY
REPORT**



Your Destination... Our Priority



WIM Site Location

WIM #45 is located on CSAH 14 near Blaine in Anoka county.

System Operation

WIM #45 was operational for the entire month of January 2018. Volume was computed using all monthly data.

System Calibration

WIM #45 was most recently calibrated on 2016-01-19. Table 1 summarizes the front axle weights of class 9s by lane ¹. Table 1 indicates that the class 9 front axle weights were all within +/- 9% of baseline calibration values for all lanes. Figure 1 shows the distribution of gross vehicle weights (GVW) in Class 9 vehicles at this site for the last 12 months of operation ². Figure 2 depicts the average front axle weight as a percent difference from the first full month following calibration.

Summary of Volume Statistics

Total Monthly Volume: 355465 | Passenger Vehicles: 347380 | Heavy Commercial Vehicles: 8085

Monthly Average Daily Traffic (MADT): 11467 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 261

See Table 2 for vehicle class breakdown

Passenger Vehicles (PVs) and Heavy Commercial Vehicles (HCVs)

Volume trends. EB vehicles typically reached highest volume levels on Fridays, with lowest volumes reported on Sundays. WB vehicles typically reached highest volume levels on Fridays, with lowest volumes reported on Sundays (see Figure 3 and 4).

Passenger Vehicles (PVs)

Volume trends. On an average 24-hour day (see Figure 5), EB PVs generally reached peak volume levels between 07 AM and 05 PM. Similarly, WB PVs peaked in volume between 03 PM and 05 PM

Heavy Commercial Vehicles (HCVs)

Volume trends. On an average 24-hour day, HCVs traveling EB typically reached peak volume levels between 07 AM and 05 PM, while volume going WB peaked between 03 PM and 05 PM. See Figure 6. Out of all HCVs, the two highest traffic volumes were generated by Class 5's and Class 15's.

Overweight HCVs

Volume trends. Of a total of 8085 HCVs, 358 of them were overweight³. These overweight HCVs contributed to 0.1% of total monthly volume, and 4.4% of total monthly HCV volume. EB overweight vehicles typically reached highest numbers on Tuesdays, with lowest volumes reported on Sundays. WB overweight vehicles tended to reach highest volumes on Tuesdays, with lowest volumes reported on Sundays. See Figure 3 .

The top two overweight violators by class were the class 6 and class 5 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 51.8% of all overweight vehicles traveling EB this month (see Figure 7 & 8). Figure 9 shows the number of vehicles exceeding 88,000 pounds that crossed the WIM over the last 12 months. The highest number of 88,000+ vehicles within the last 12 months occurred in March.

WIMs are currently used as a screening tool for weight enforcement, and it is estimated that the WIM scales can measure gross vehicle weights (GVW) within 90-95% of static weight scale measurements. Due to the possibility of measurement error, vehicles exceeding 10% of their legal weight limits (or 1.1 times their legal weight limits) are considered overweight in this report⁴.

Using normal load limits ,7 EB vehicles exceeded 88,000 pounds (4 vehicles were Class 10's; 3 vehicles were Class 13's). Of vehicles traveling WB,

9 EB vehicles exceeded 88,000 pounds (7 vehicles were Class 10's; 2 vehicles were Class 13's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from January 2018.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in January 2018. Data suggests that there were greater numbers of fully_loaded Class 9's than empty Class 9's traveling EB, while there were more fully_loaded Class 9's than empty traveling WB. Data also suggests that there were more fully_loaded Class 10's than empty traveling in the EB direction. In the WB direction, there were more fully_loaded class 10 vehicles.

Freight Totals. A total of 41507 tons of freight was recorded to have crossed the WIM. More freight was shipped EB (52.1%) than WB (47.9%). See Table 4 and Figure 11 for more freight information.

Infrastructure Considerations

Bridge. Bridge No. 02051 (a prestressed concrete beam span) is approximately 2.8 miles west of WIM #45 on CSAH 14, and Bridge No. 02006 (a prestressed concrete beam span) is approximately 5.2 miles east of WIM #45 on CSAH 14. WIM #45 recorded a total of 355465 vehicles with a combined GVW of 1638451 kips (1 kip = 1,000 pounds = 0.5 tons) in January 2018. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 3305 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 53.2% of all ESALs were recorded EB while 46.8% was observed WB. In particular, 41% of all ESALs were generated by the Class 5's (Class 5's

were also responsible for generating 6% of total GVW observed this month). See Table 6 and Figures 14-15 for more information on ESALs (Table 6 also provides flexible ESAL factors for each vehicle class using a terminal serviceability of 2.5 and a structural number of 5).

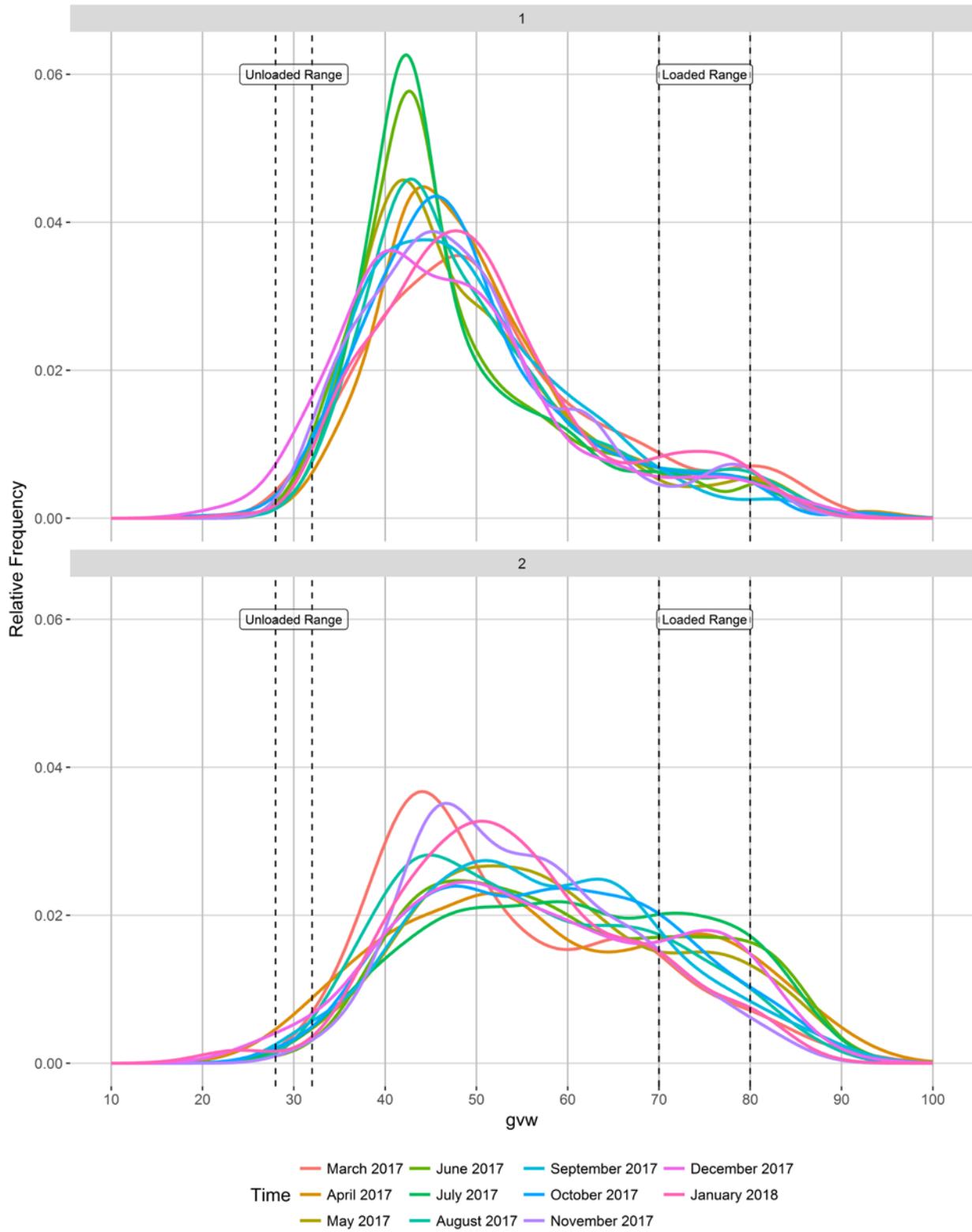
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

MnDOT's vehicle classification scheme and vehicle class groupings for traffic forecasting can be found at: <http://www.dot.state.mn.us/traffic/data/data-products.html#weight>

- ¹ Front axle weights of Class 9s are monitored on a monthly basis to assure performance between calibrations. The current goal of the WIM scale calibration is to have each individual axle weight stay within a range of ±9% of baseline calibration values
- ² Previous WIM research indicates that unloaded Class 9s typically weigh 28-32 kips, while loaded Class 9s generally fall in the 70-80 kip range. More recent data from several WIM sites suggests that the unloaded Class 9 range may have moved a little higher over time (due to increased presence of sleeper cabs, etc.), although these ranges are also thought to be site-specific.
- ³ An HCV is considered overweight during normal load limits in this report if they satisfy any of the following 1) exceed a gross vehicle weight (GVW) of 80,000 pounds, 2) exceed any of the legal weight maximums on any axle configurations (legal maximums are: single axle = 20,000 pounds; tandem axles spaced 8' or less = 34,000 pounds; tridem axles spaced 9' or less = 43,000 pounds; quad axles spaced 13' or less = 51,000 pounds). Monthly reports use this standard regardless of the time of year however, the Winter Load Increase (WLI) allows a 10% across the board increase in axle and gross vehicle weights without a permit on US, state routes, and county roads. An HCV is considered overweight during Winter Load Increase(WLI) if they satisfy any of the following 1) exceed a gross vehicle weight (GVW) of 88,000 pounds, 2) exceed any of the legal weight maximums on any axle configurations (legal maximums are: single axle = 22,000 pounds; tandem axles spaced 8' or less = 37,400 pounds; tridem axles spaced 9' or less = 47,300 pounds; quad axles spaced 13' or less = 56,100 pounds). An overweight HCV is only included once in the overweight volume calculations regardless of how many of the aforementioned conditions are violated. For information on MN weight limit dates and statutes: http://www.mrr.dot.state.mn.us/research/seasonal_load_limits/sllindex.asp
- ⁴ For example, Class 9s and 10s can legally have gross vehicle weights up to 80,000 lbs (with the exception of permitted loads) during normal load limits. To account for measurement error on the WIM scales, those exceeding 10% of the legal GVW maximum (or 1.1 times the legal GVW) should be screened (e.g., 80,000 lbs + 8,000 lbs = 88,000 lbs). Similarly during WLI vehicles weighing 96,800 lbs should be screened.

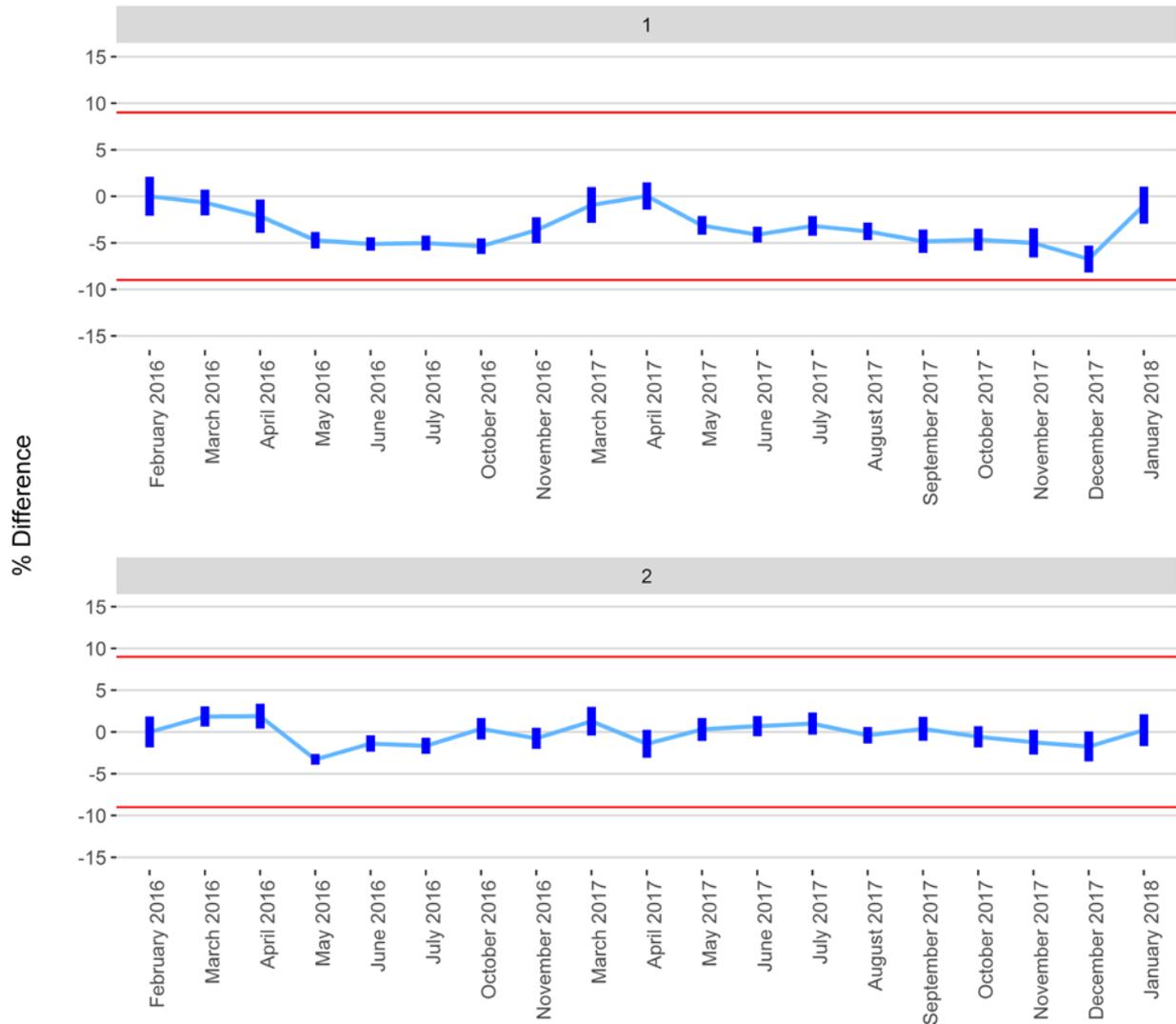
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

Figure 1 - Monthly Class 9 GVW Histogram



Months that have not passed QC parameters are not displayed

Figure 2 - Percent Difference of Front Axle Weight from Last Calibration (+/- 95% CI)



Months that have not passed QC parameters are not displayed

Figure 2 - Average Vehicle Volume vs. Day of the Week

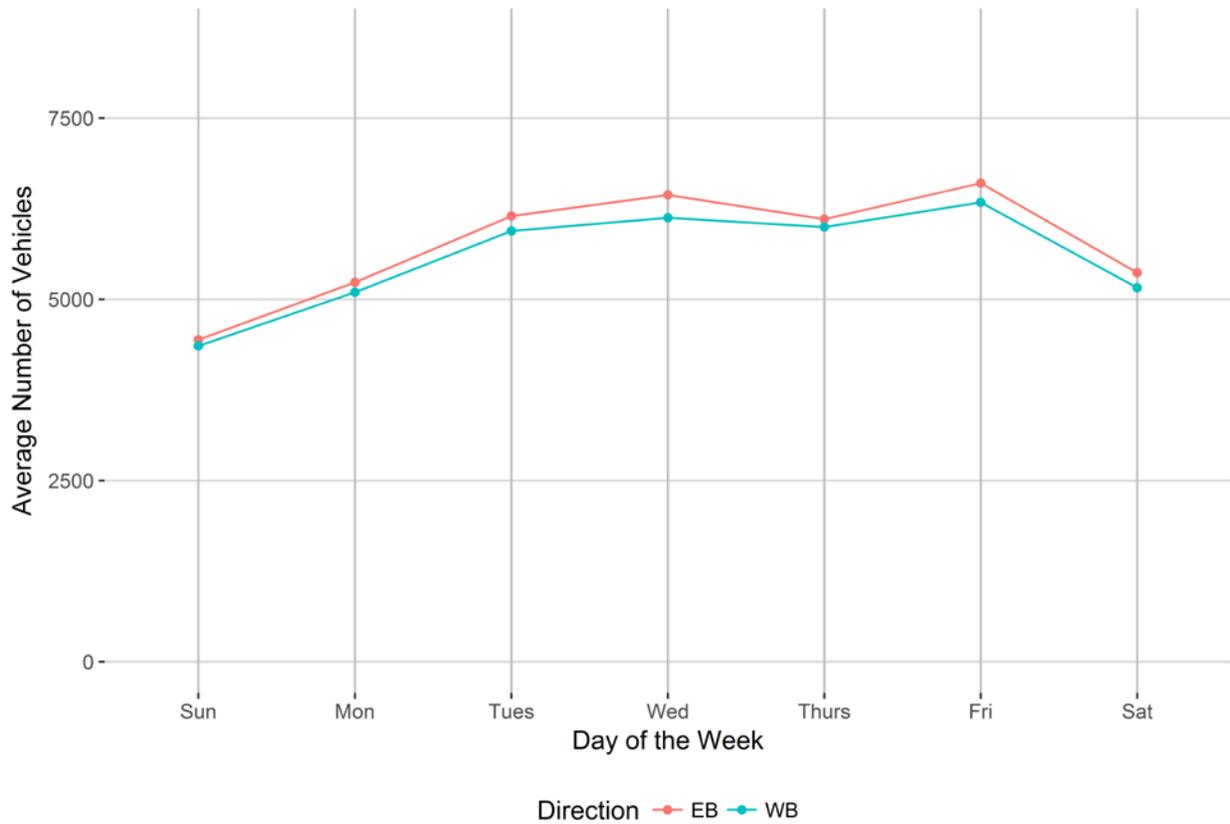


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

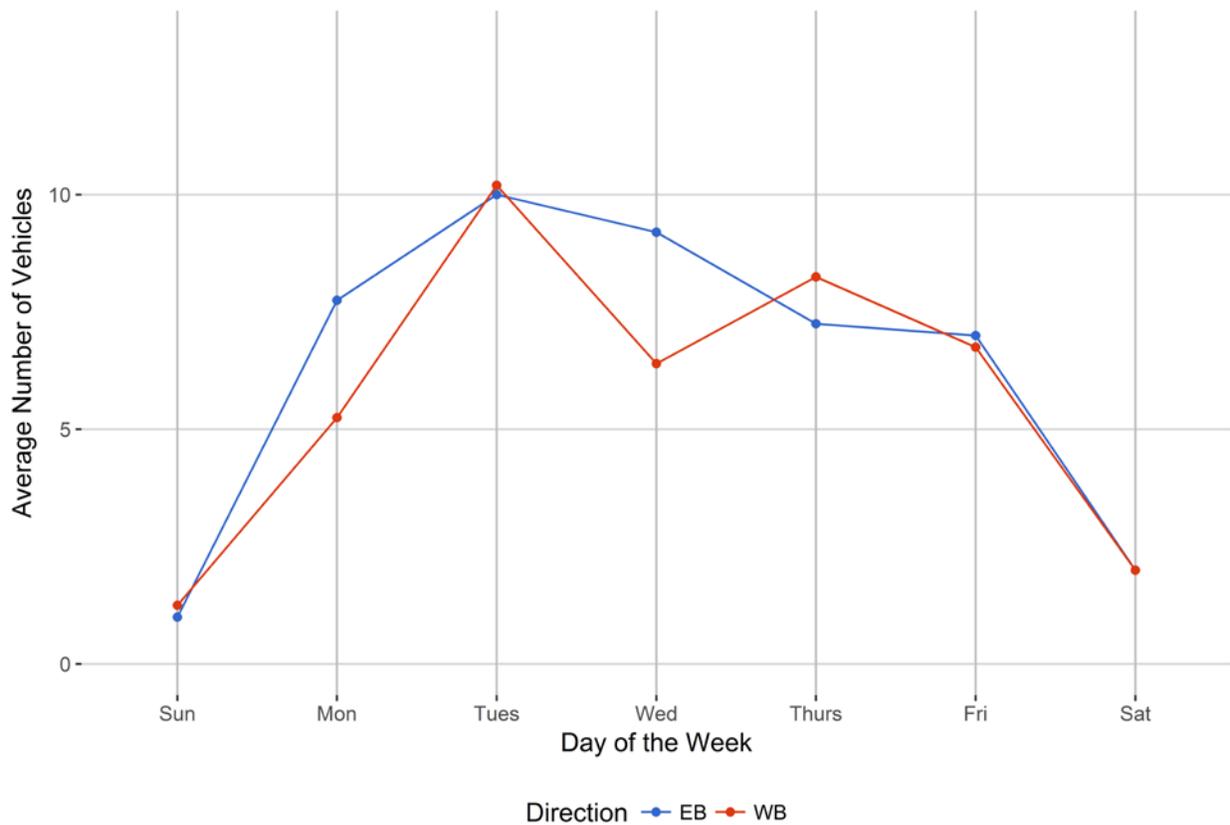


Figure 4 - Passenger Vehicles vs. Hour of the Day

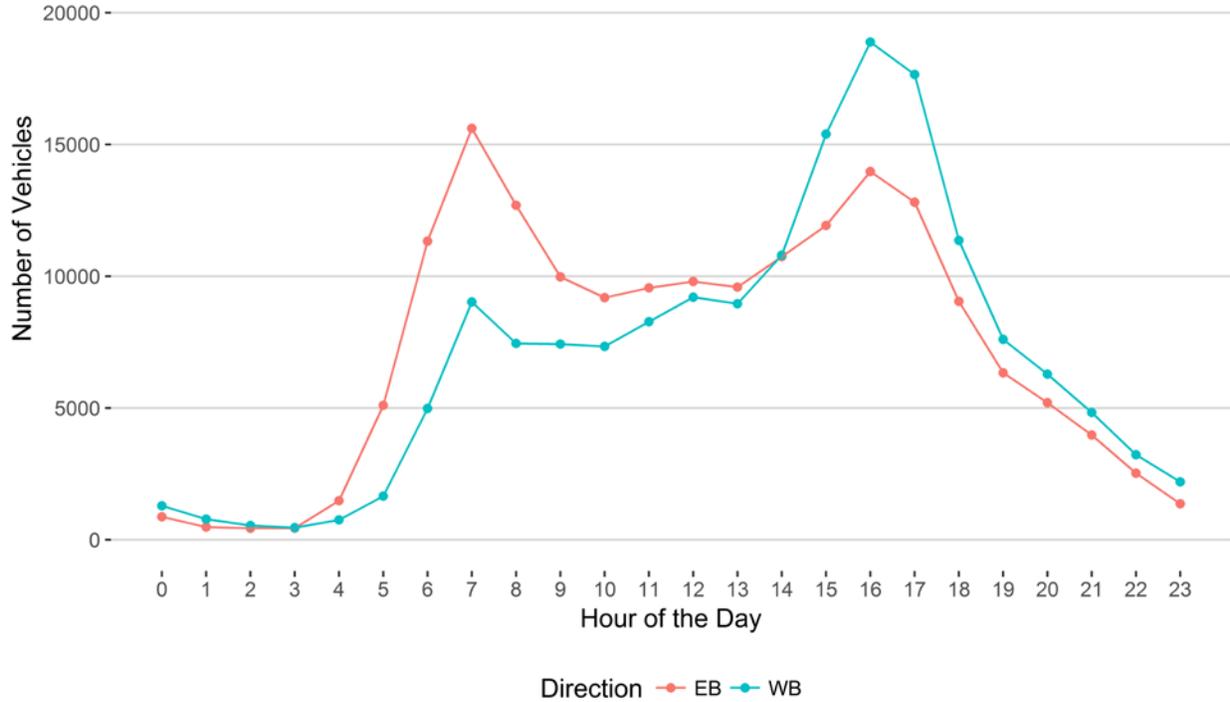


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

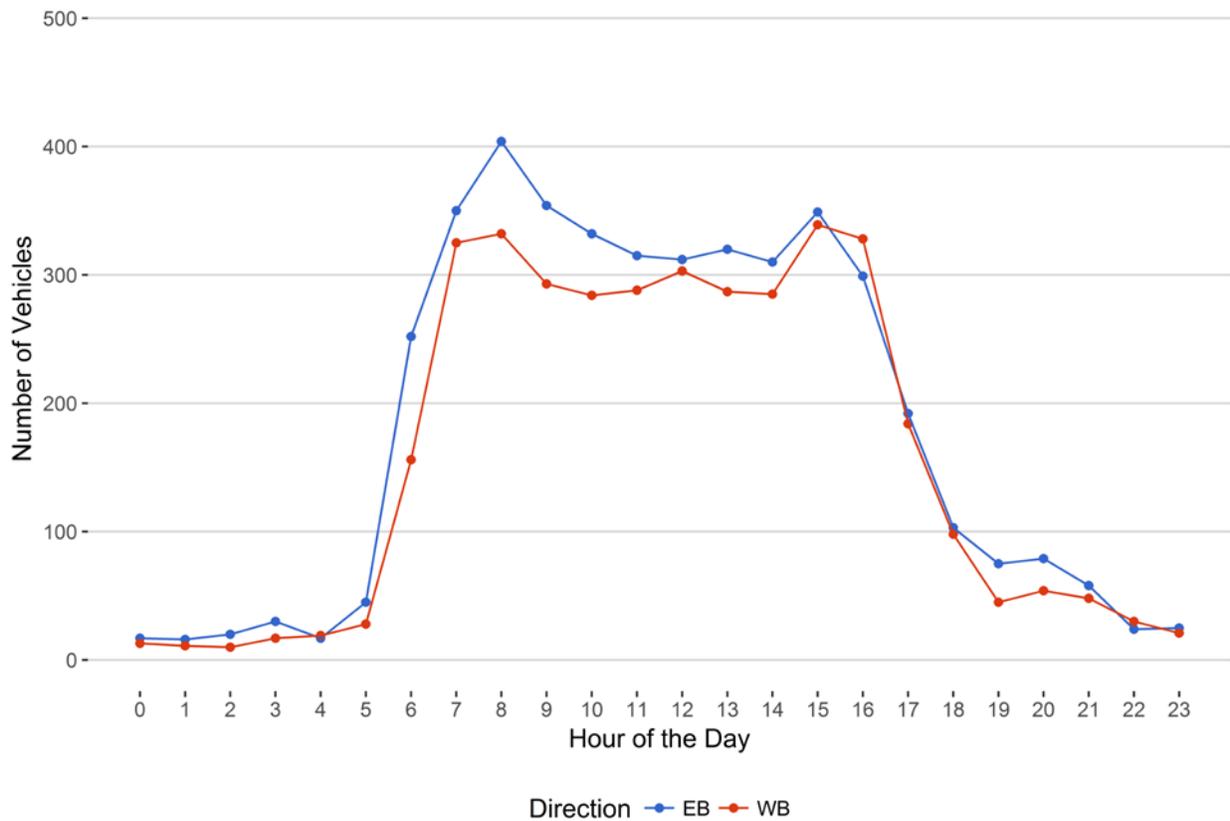


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

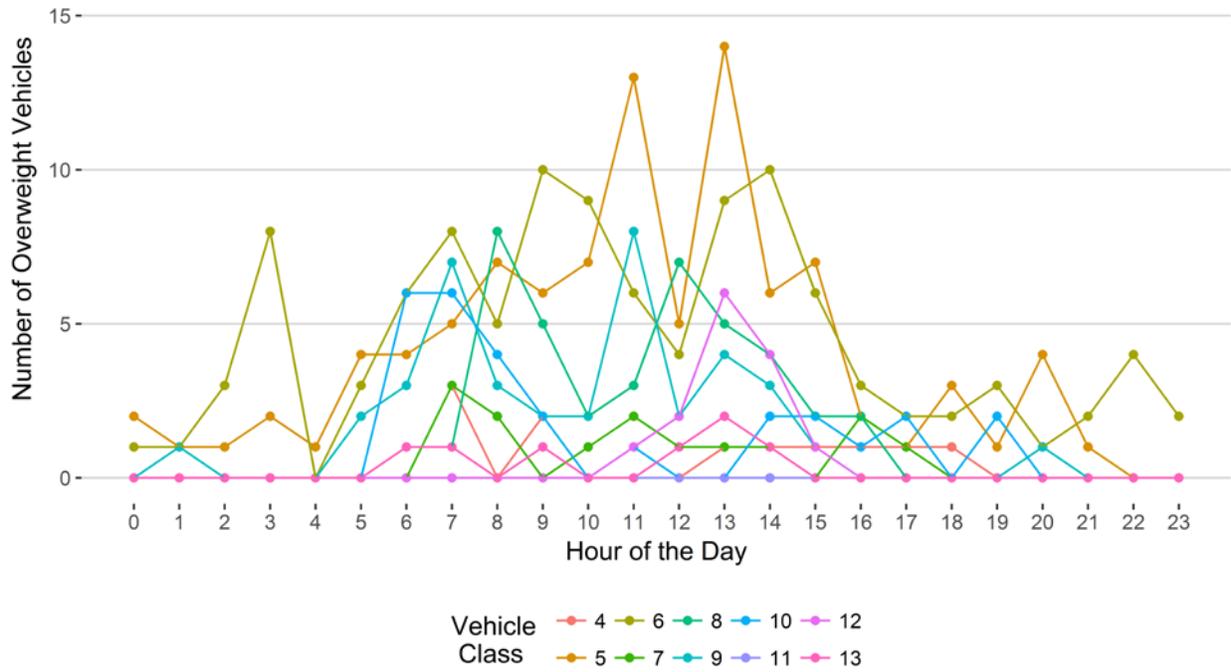


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

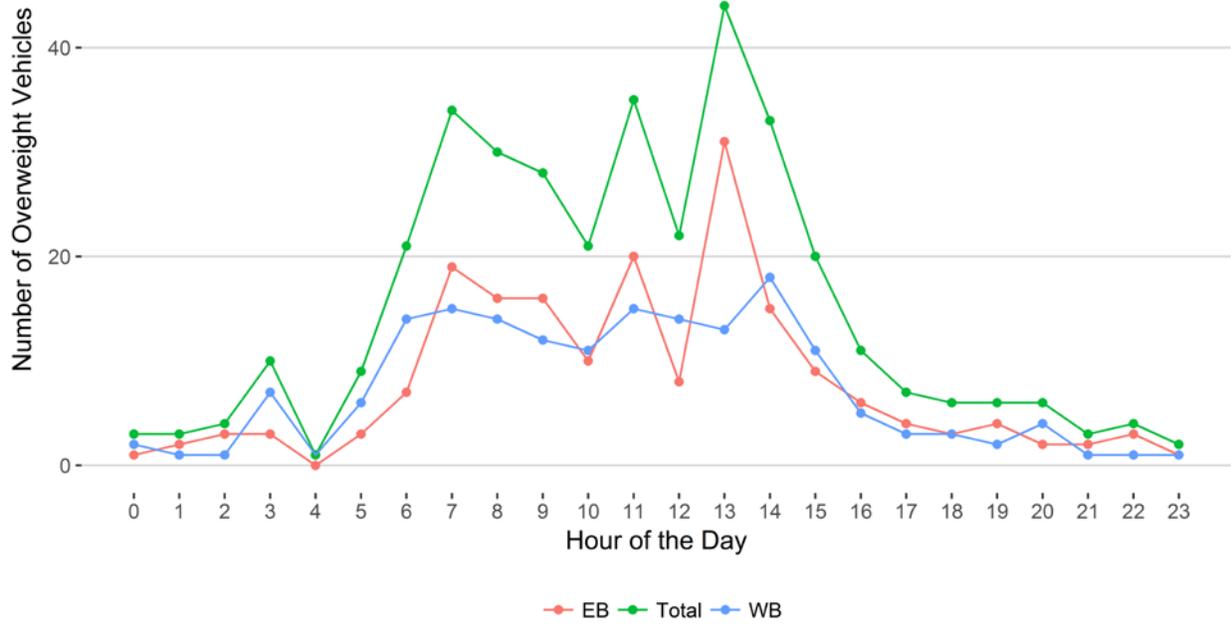
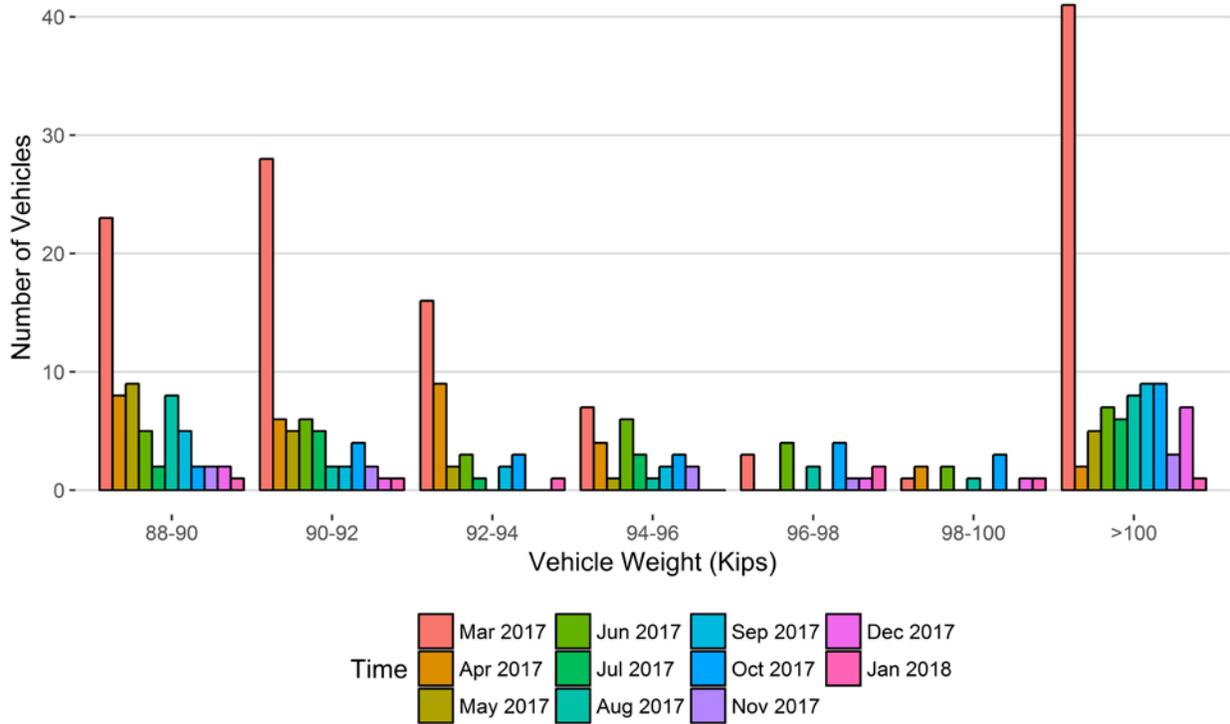
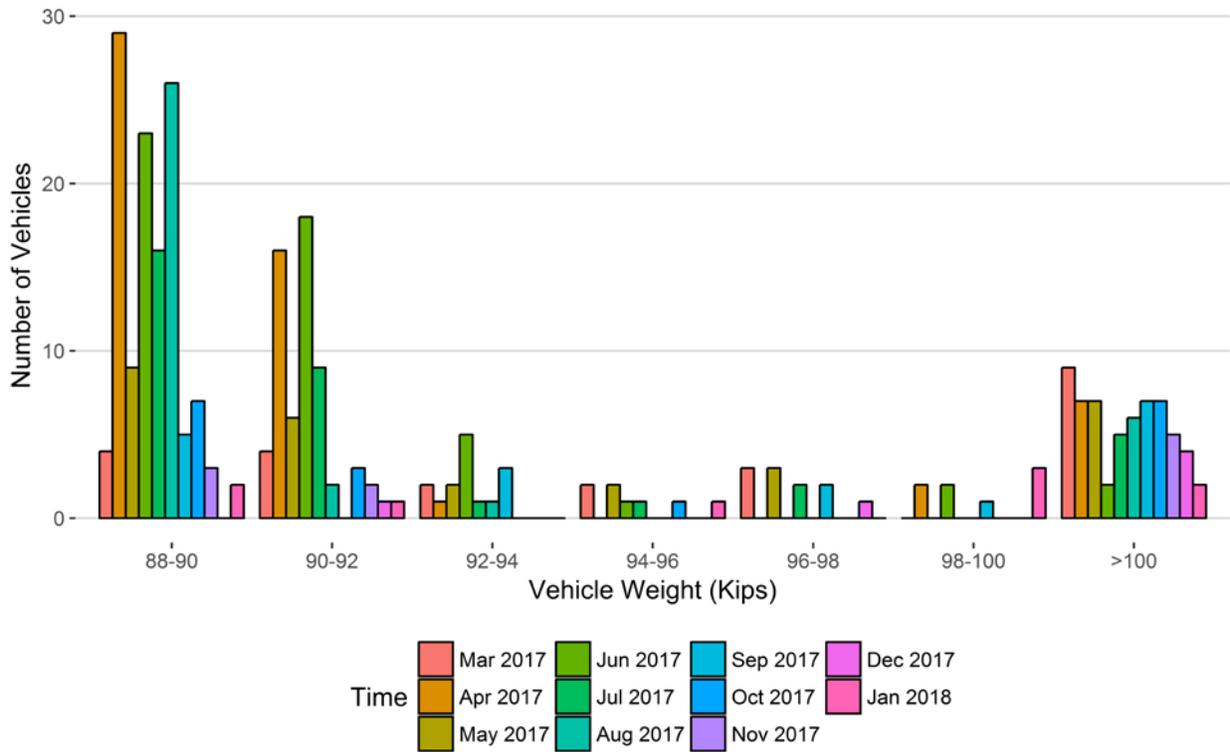


Figure 8 - Histogram of EB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018
88-90	23	8	9	5	2	8	5	2	2	2	1
90-92	28	6	5	6	5	2	2	4	2	1	1
92-94	16	9	2	3	1	0	2	3	0	0	1
94-96	7	4	1	6	3	1	2	3	2	0	0
96-98	3	0	0	4	0	2	0	4	1	1	2
98-100	1	2	0	2	0	1	0	3	0	1	1
>100	41	2	5	7	6	8	9	9	3	7	1
Total	119	31	22	33	17	22	20	28	10	12	7

Figure 8 - Histogram of WB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018
88-90	4	29	9	23	16	26	5	7	3	0	2
90-92	4	16	6	18	9	2	0	3	2	1	1
92-94	2	1	2	5	1	1	3	0	0	0	0
94-96	2	0	2	1	1	0	0	1	0	0	1
96-98	3	0	3	0	2	0	2	0	0	1	0
98-100	0	2	0	2	0	0	1	0	0	0	3
>100	9	7	7	2	5	6	7	7	5	4	2
Total	24	55	29	51	34	35	18	18	10	6	9

Figure 8 - Class 9's and 10's by Direction vs Gross Vehicle Weight

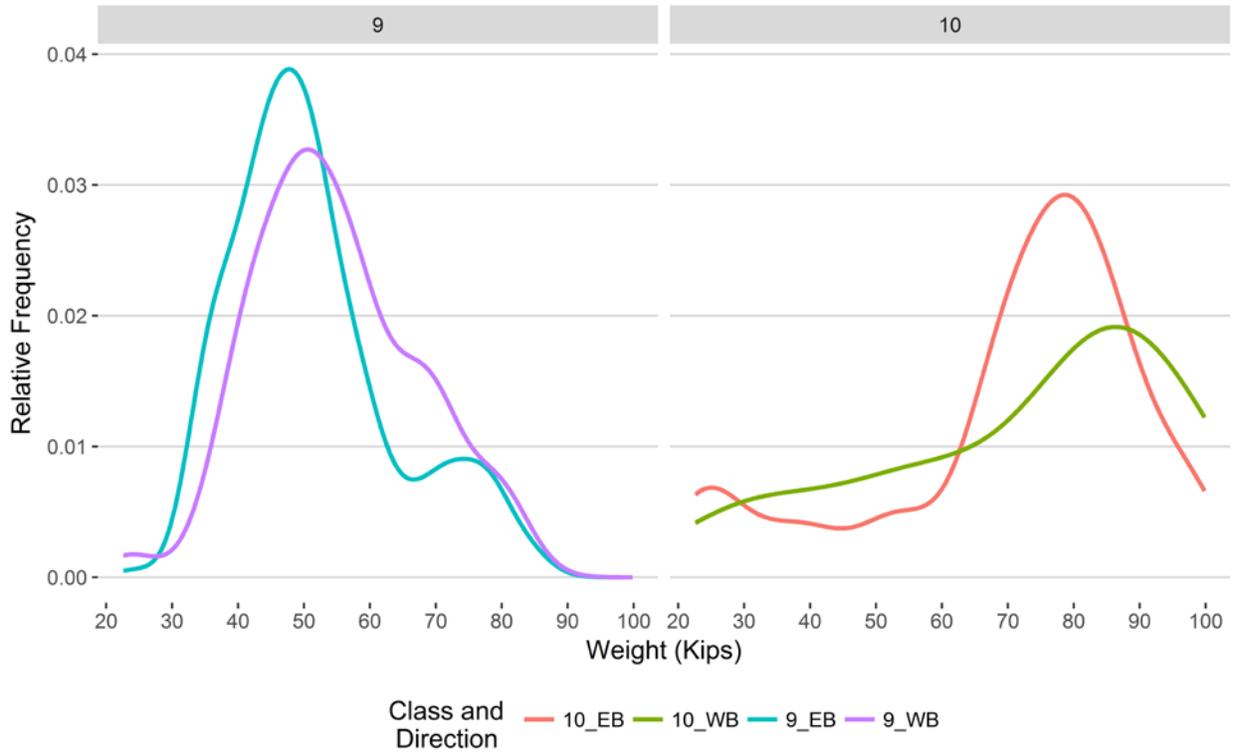


Figure 9 - Freight Percentage by Direction and Class

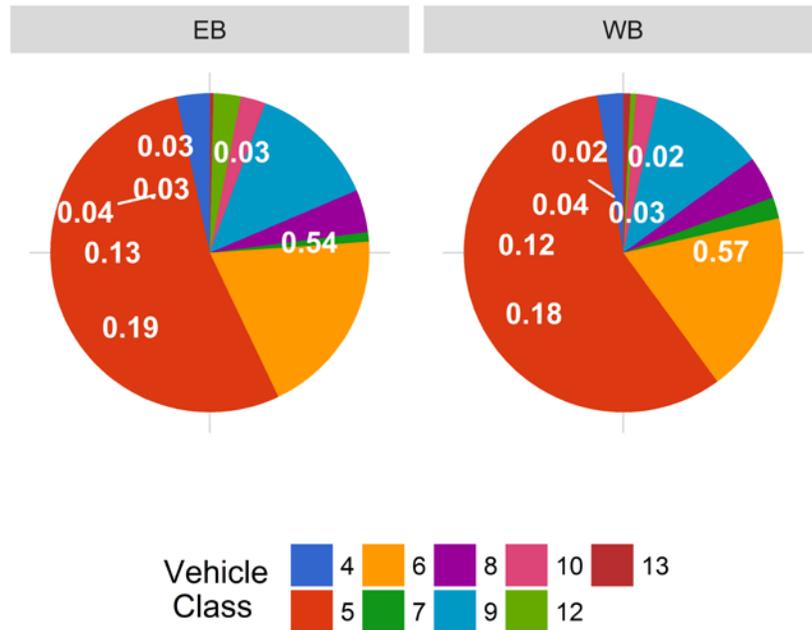


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

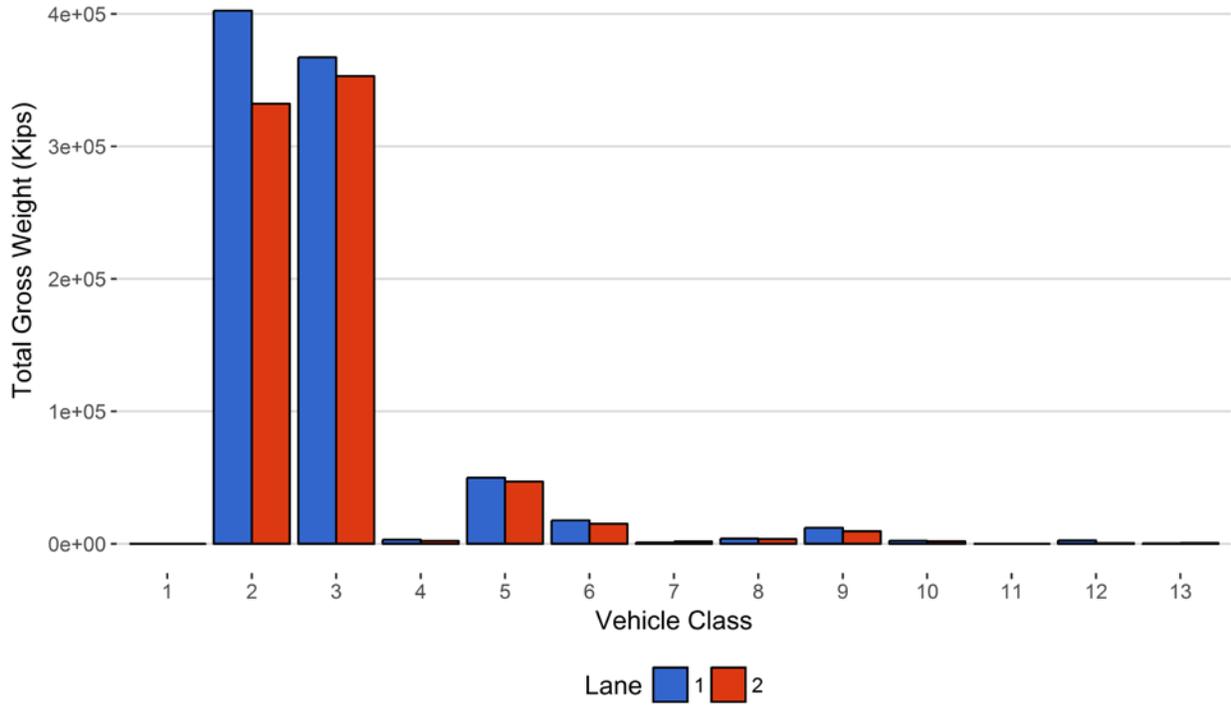


Figure 11 - Total Gross Vehicle Weight I

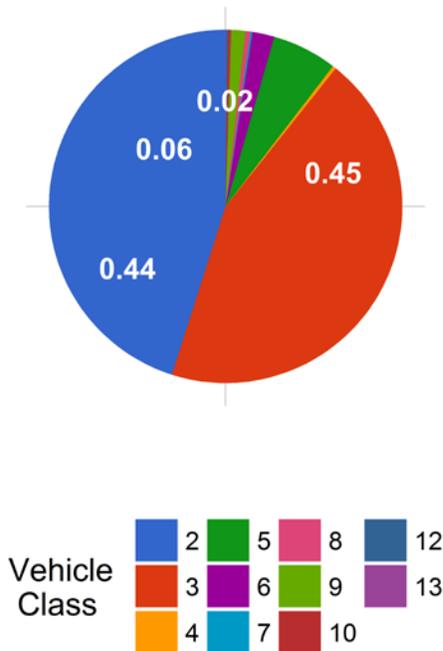


Figure 12 - Total ESALs by Class and Lane

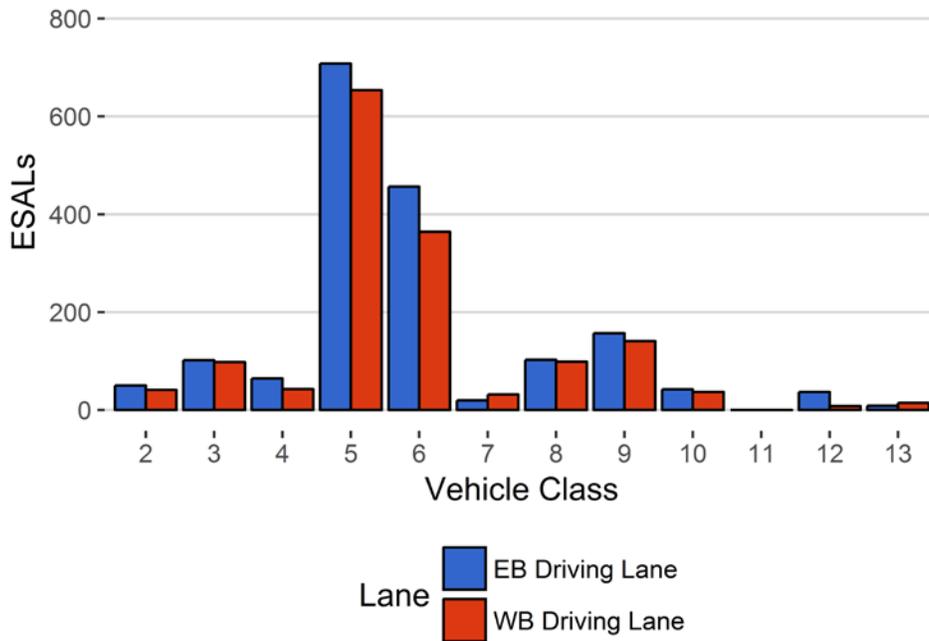


Figure 13 - ESALs by Class

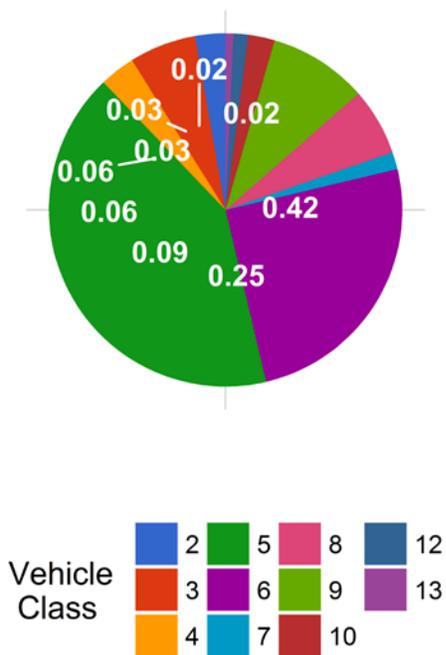


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
February 2016	11.29	0.00	10.54	0.00
March 2016	11.21	-0.66	10.73	1.86
April 2016	11.05	-2.13	10.74	1.89
May 2016	10.75	-4.71	10.19	-3.28
June 2016	10.71	-5.12	10.39	-1.38
July 2016	10.72	-5.02	10.36	-1.66
October 2016	10.68	-5.35	10.58	0.39
November 2016	10.87	-3.64	10.46	-0.76
March 2017	11.18	-0.93	10.67	1.29
April 2017	11.29	0.03	10.39	-1.41
May 2017	10.93	-3.13	10.57	0.31
June 2017	10.82	-4.11	10.61	0.71
July 2017	10.93	-3.18	10.65	1.01
August 2017	10.86	-3.76	10.50	-0.39
September 2017	10.74	-4.83	10.58	0.39
October 2017	10.76	-4.66	10.48	-0.58
November 2017	10.72	-5.00	10.41	-1.23
December 2017	10.53	-6.74	10.36	-1.74
January 2018	11.18	-0.95	10.56	0.22

Table 2 Vehicle Classification Data

<i>Vehicle Class</i>	<i>Monthly Average Daily Volume</i>	<i>Monthly Total Volume</i>	<i>Monthly Total Volume Percentage</i>	<i>Monthly Total Overweight Vehicles</i>	<i>Monthly Total Overweight Percentage</i>
1	0	0	0	0	0
2	6159	190915	53.7	0	0
3	5047	156465	44	0	0
4	5	165	0	11	3.1
5	204	6313	1.8	97	27.1
6	27	849	0.2	108	30.2
7	1	46	0	14	3.9
8	6	198	0.1	40	11.2
9	13	406	0.1	39	10.9
10	2	58	0	28	7.8
11	0	0	0	0	0
12	1	41	0	14	3.9
13	0	9	0	7	2
TOTAL	11467	355465	100	358	100

Table 3 Top 10 Gross Vehicle Weight, Class 9 and 10

<i>Date</i>	<i>Day of Week</i>	<i>Time</i>	<i>Vehicle Class</i>	<i>Direction</i>	<i>Lane</i>	<i>GVW (lbs)</i>
2018-01-09	Tuesday	07:45:49	10	WB	2	99.85
2018-01-30	Tuesday	09:25:14	10	WB	2	99.57
2018-01-31	Wednesday	06:24:28	10	EB	1	98.83
2018-01-16	Tuesday	06:35:44	10	WB	2	98.62
2018-01-09	Tuesday	08:41:19	10	EB	1	96.28
2018-01-10	Wednesday	07:08:07	10	EB	1	96.04
2018-01-22	Monday	08:58:54	10	WB	2	94.13
2018-01-15	Monday	14:55:34	10	WB	2	90.69
2018-01-30	Tuesday	19:15:38	10	EB	1	89.83
2018-01-15	Monday	08:25:15	10	WB	2	89.73

Table 4 Freight Summary

<i>Vehicle Class</i>	<i>Direction</i>	<i>Weight of Empty Vehicle (Kips)</i>	<i>Total Number of Vehicles</i>	<i>Number of Empty Vehicles</i>	<i>Percentage of Empty Vehicles</i>	<i>Total Weight of Vehicles with Freight (Kips)</i>	<i>Total Weight of Empty Vehicles (Kips)</i>	<i>Total Weight of Freight (Tons)</i>
4	EB	15	100	10	10	3024	96	837
5	EB	8	3307	258	7.8	48090	1826	11849
6	EB	19	462	0	0	17692	0	4457
7	EB	11.5	16	0	0	906	0	361
8	EB	31	107	38	35.5	3277	729	569
9	EB	33	235	3	1.3	11948	89	2146
10	EB	33.5	33	3	9.1	2261	73	628
12	EB	36.5	35	0	0	2584	0	653
13	EB	31.5	3	0	0	334	0	120
TOTAL	****	****	4298	312	****	90115	****	21619
<i>Vehicle Class</i>	<i>Direction</i>	<i>Weight of Empty Vehicle (Kips)</i>	<i>Total Number of Vehicles</i>	<i>Number of Empty Vehicles</i>	<i>Percentage of Empty Vehicles</i>	<i>Total Weight of Vehicles with Freight (Kips)</i>	<i>Total Weight of Empty Vehicles (Kips)</i>	<i>Total Weight of Freight (Tons)</i>
4	WB	15	65	7	10.8	2094	68	612
5	WB	8	3015	131	4.3	46022	939	11475
6	WB	19	388	4	1	15008	70	3856
7	WB	11.5	30	0	0	1772	0	713
8	WB	31	91	29	31.9	2983	565	531
9	WB	33	172	3	1.7	9365	71	1894
10	WB	33.5	25	2	8	1750	54	490
12	WB	36.5	6	0	0	456	0	119
13	WB	31.5	6	0	0	586	0	199
TOTAL	****	****	3798	176	****	80037	****	19888
GRAND TOTAL	****	****	8096	488	121	170151	4580	41507

Table 5 Gross Vehicle Weight by Class and Lane

<i>Vehicle Class</i>	<i>EB</i>	<i>WB</i>	<i>Total</i>	<i>Percentage</i>
2	402507	332190	734696	45.1
3	367232	353009	720240	44.2
4	3121	2162	5283	0.3
5	49916	46961	96877	5.9
6	17692	15078	32769	2
7	906	1772	2678	0.2
8	4006	3548	7554	0.5
9	12037	9436	21472	1.3
10	2334	1804	4138	0.3
12	2584	456	3040	0.2
13	334	586	920	0.1
TOTAL	862667	767001	1629668	100
GVW/LANE	52.94	47.06	100	0.01

Table 6 ESALs by Class and Lane and Flexible ESAL Factors

<i>Vehicle Class</i>	<i>EB</i>	<i>WB</i>	<i>Total</i>	<i>Percentage</i>	<i>Flexible ESAL Factor</i>
2	50	41	91	2.8	0.001
3	102	98	200	6.1	0.0026
4	65	43	108	3.3	1.31
5	708	654	1361	41.5	0.44
6	457	364	821	25	1.95
7	20	32	52	1.6	2.11
8	103	99	201	6.1	2.02
9	157	141	298	9.1	1.48
10	42	37	79	2.4	2.51
12	37	8	45	1.4	1.94
13	9	14	23	0.7	2.73
TOTAL	1748	1530	3278	100	16
ESALS/LANE	53.3	46.7	100	--	--

Table 7 Site Summary: Volume and Vehicle Class

<i>Month</i>	<i>Total Volume</i>	<i>Monthly ADT</i>	<i>Monthly HCADT</i>	<i>Passenger Vehicles</i>	<i>Passenger Vehicles %</i>	<i>Heavy Commercial Vehicles</i>	<i>Heavy Commercial Vehicles %</i>
Mar 2017	364371	11754	259	356348	97.8	8022.8	2.2
Apr 2017	389177	12973	310	379867	97.6	9309.6	2.4
May 2017	432003	13936	370	420530	97.3	11473.3	2.7
Jun 2017	453923	15131	415	441488	97.3	12435.4	2.7
Jul 2017	443990	14322	382	432147	97.3	11843.4	2.7
Aug 2017	449958	14515	431	436604	97	13354	3
Sep 2017	428575	14286	412	416216	97.1	12359.3	2.9
Oct 2017	431651	13924	387	419648	97.2	12002.7	2.8
Nov 2017	386452	12882	329	376587	97.4	9865.3	2.6
Dec 2017	376429	12143	262	368302	97.8	8127.3	2.2
Jan 2018	355465	11467	261	347380	97.7	8085	2.3
TOTAL	4511994	--	--	4395117	--	116878	--
AVERAGE	410181	13394	347	399556	97	10625	3

ESALS

<i>Month</i>	<i>ESALS EB Driving Lane</i>	<i>ESALS WB Driving Lane</i>	<i>Total ESALS</i>	<i>Pavement Life Decrease Months</i>
Mar 2017	2621	1337	3958	21.3
Apr 2017	2497	2000	4497	3.8
May 2017	2886	2560	5447	1.7
Jun 2017	3121	3091	6212	3.7
Jul 2017	2944	2874	5818	2.5
Aug 2017	3339	3144	6484	1.5
Sep 2017	2556	2289	4845	1.6
Oct 2017	2635	2471	5106	5
Nov 2017	2032	1968	4000	1.9
Dec 2017	3283	1617	4900	0.8
Jan 2018	1757	1548	3305	1
TOTAL	29671	--	--	--
AVERAGE	2697	2264	4961	4

Gross Vehicle Weight

<i>Month</i>	<i>GVW EB Driving Lane</i>	<i>GVW WB Driving Lane</i>	<i>Total GVW Kips</i>
Mar 2017	863971	774480	1638451
Apr 2017	894072	715280	1609352
May 2017	945902	804981	1750883
Jun 2017	1058817	930014	1988831
Jul 2017	1127354	1007720	2135074
Aug 2017	1100039	981541	2081580
Sep 2017	1144199	1024598	2168797
Oct 2017	956898	854725	1811623
Nov 2017	1075078	966463	2041541
Dec 2017	936552	846652	1783204
Jan 2018	888219	819015	1707234
TOTAL	10991102	9725469	20716571
AVERAGE	999191	884134	1883325

Overweight Vehicles

<i>Month</i>	<i>Total Number of Overweight Vehicles</i>	<i>Overweight / Total Volume</i>	<i>Overweight / Heavy Commercial Volume</i>	<i>Number Over 88,000 lbs</i>	<i>Number Over 98,000 lbs</i>
Mar 2017	722	0.2	5.5	143	51
Apr 2017	693	0.2	4.9	86	13
May 2017	771	0.2	4.7	53	14
Jun 2017	1043	0.2	5.9	89	18
Jul 2017	928	0.2	5.5	51	11
Aug 2017	986	0.2	5.6	57	15
Sep 2017	712	0.2	4.8	38	17
Oct 2017	701	0.2	4.4	46	19
Nov 2017	526	0.1	3.8	21	8
Dec 2017	413	0.1	3.6	23	17
Jan 2018	363	0.1	3.1	16	7
TOTAL	7858	--	--	623	190
AVERAGE	714.4	0.2	4.7	56.6	17.3

Freight

<i>Month</i>	<i>EB Freight Tons</i>	<i>WB Freight Tons</i>	<i>Total Freight</i>	<i>EB Freight %</i>	<i>WB Freight %</i>
Mar 2017	36827	18167	54994	67	33
Apr 2017	34063	29521	63584	53.6	46.4
May 2017	39681	35904	75585	52.5	47.5
Jun 2017	42002	41361	83363	50.4	49.6
Jul 2017	37976	36984	74960	50.7	49.3
Aug 2017	43397	41766	85163	51	49
Sep 2017	34598	30379	64977	53.2	46.8
Oct 2017	35932	34011	69943	51.4	48.6
Nov 2017	27530	27260	54790	50.2	49.8
Dec 2017	21124	21090	42214	50	50
Jan 2018	21619	19888	41507	52.1	47.9
TOTAL	374749	336332	711081	--	--
AVERAGE	34068.1	30575.7	64643.8	52.9	47.1