

MARCH 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 March 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: 372037 | Passenger Vehicles: 363916 | Heavy Commercial Vehicles: 8121

Monthly Average Daily Traffic (MADT): 12001 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 262

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 14's.

Overweight HCVs

Volume trends. Of a total of 8121 HCVs, 407 of them were overweight³. These overweight HCVs contributed to 0.1% of total monthly volume, and 5% of total monthly HCV volume. EB overweight vehicles typically reached highest numbers on Tuesdays, with lowest volumes reported on Saturdays. 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 51.2% of all overweight vehicles traveling WB 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 June.

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, 11 EB vehicles exceeded 88,000 pounds (7 vehicles were Class 10's; 2 vehicles were Class 13's). Of vehicles traveling WB,

9 EB vehicles exceeded 88,000 pounds (5 vehicles were Class 12's; 3 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from March 2018.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in March 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 44757 tons of freight was recorded to have crossed the WIM. More freight was shipped EB (52.2%) than WB (47.8%). 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 372037 vehicles with a combined GVW of 1691980 kips (1 kip = 1,000 pounds = 0.5 tons) in March 2018. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 3612 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, 35% of all ESALs were generated by the Class 5's (Class 5's were also responsible for generating 5% 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).

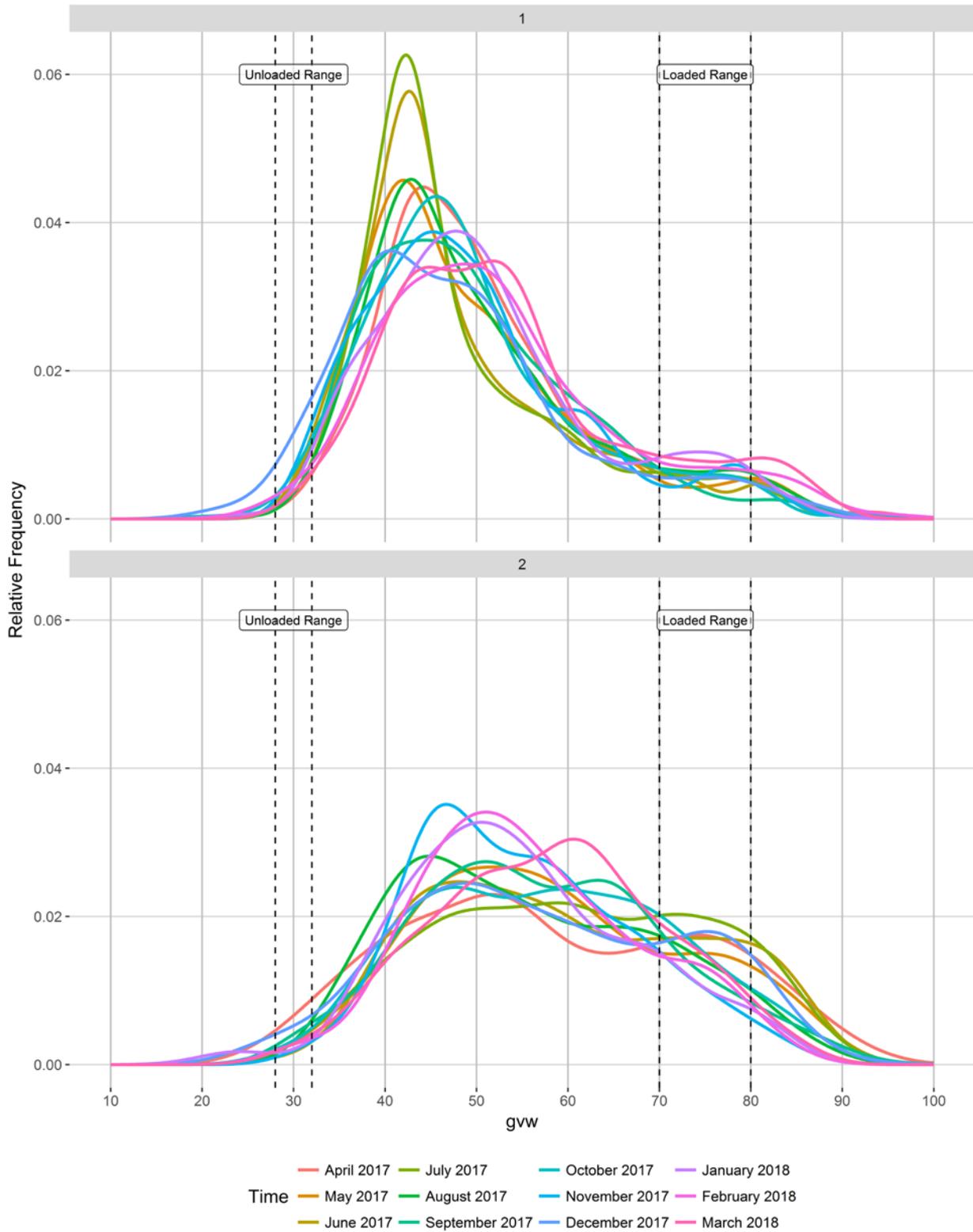
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

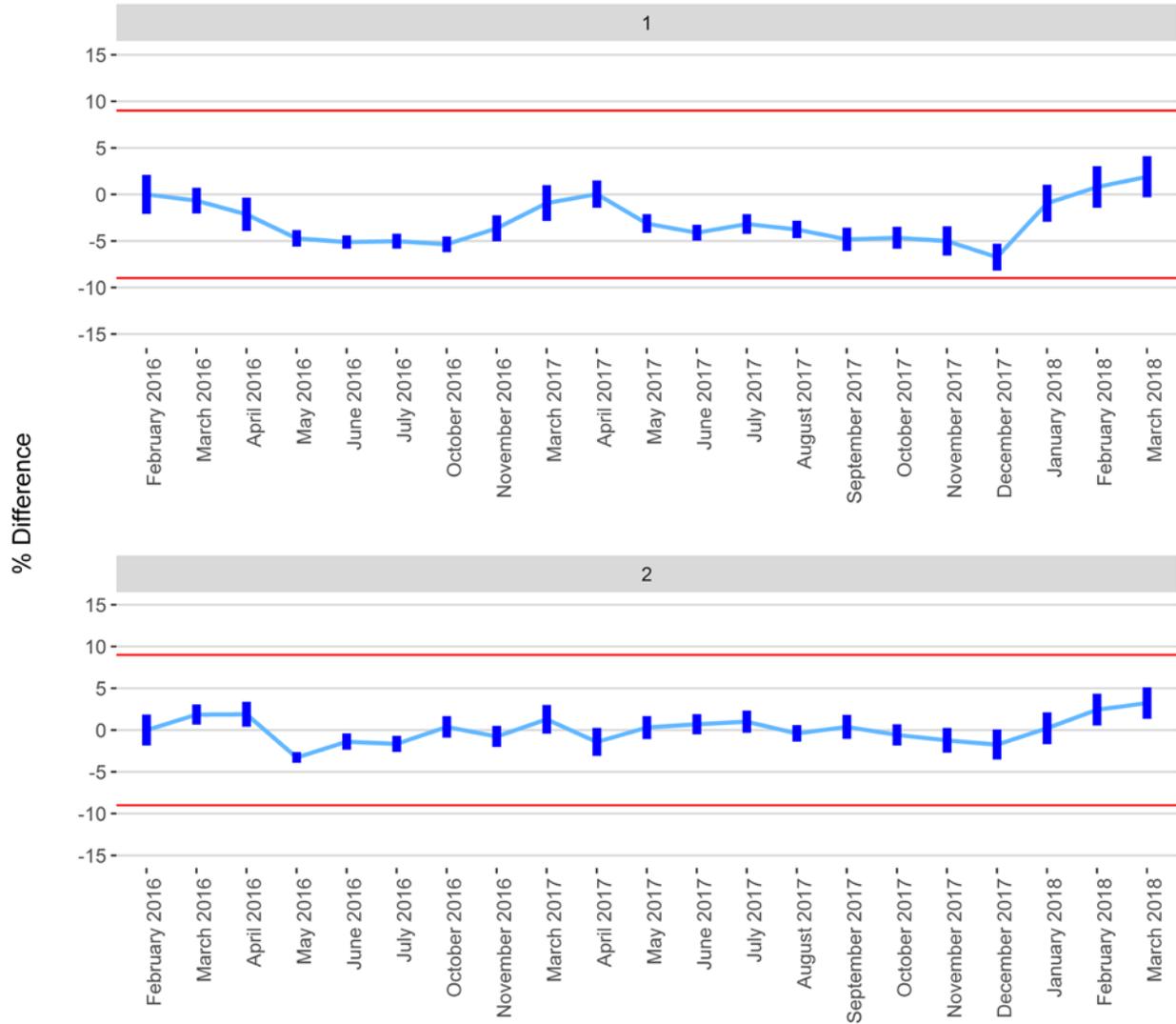
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Figure 1 - Monthly Class 9 GVW Histogram



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

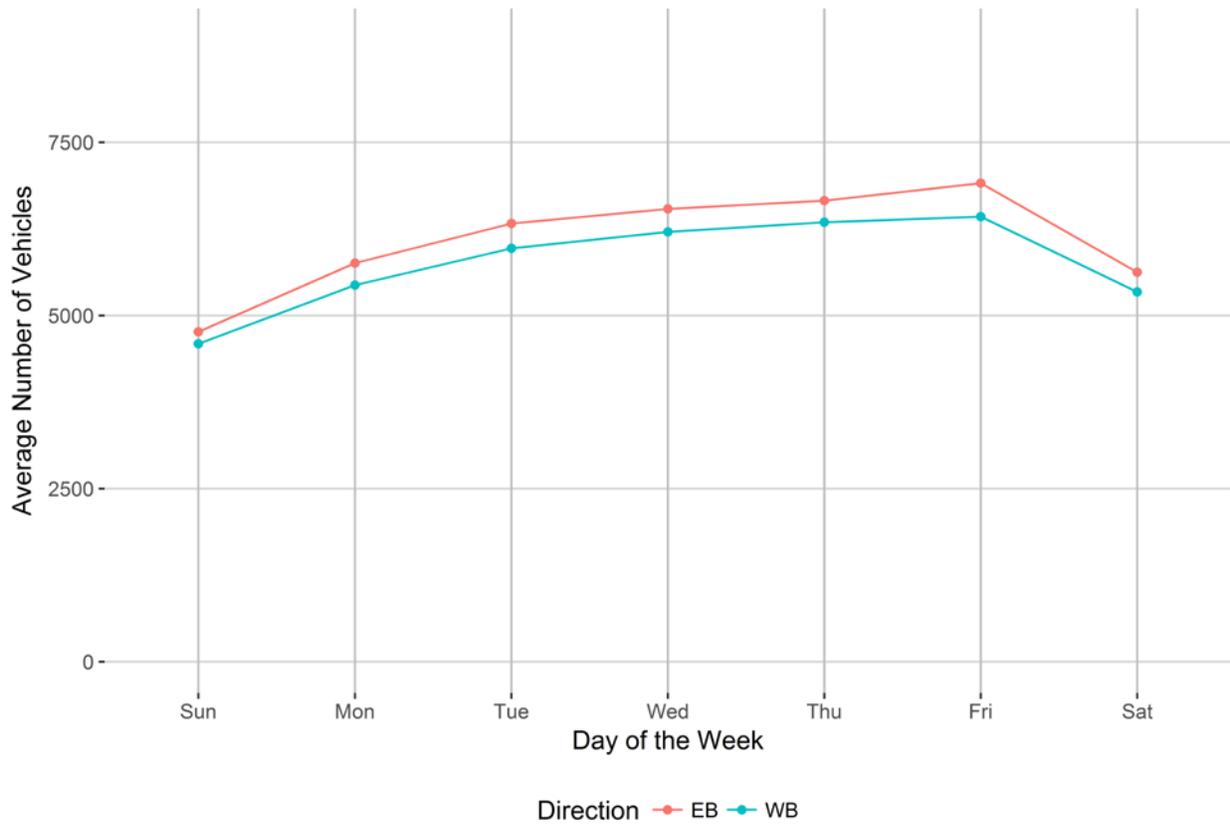


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

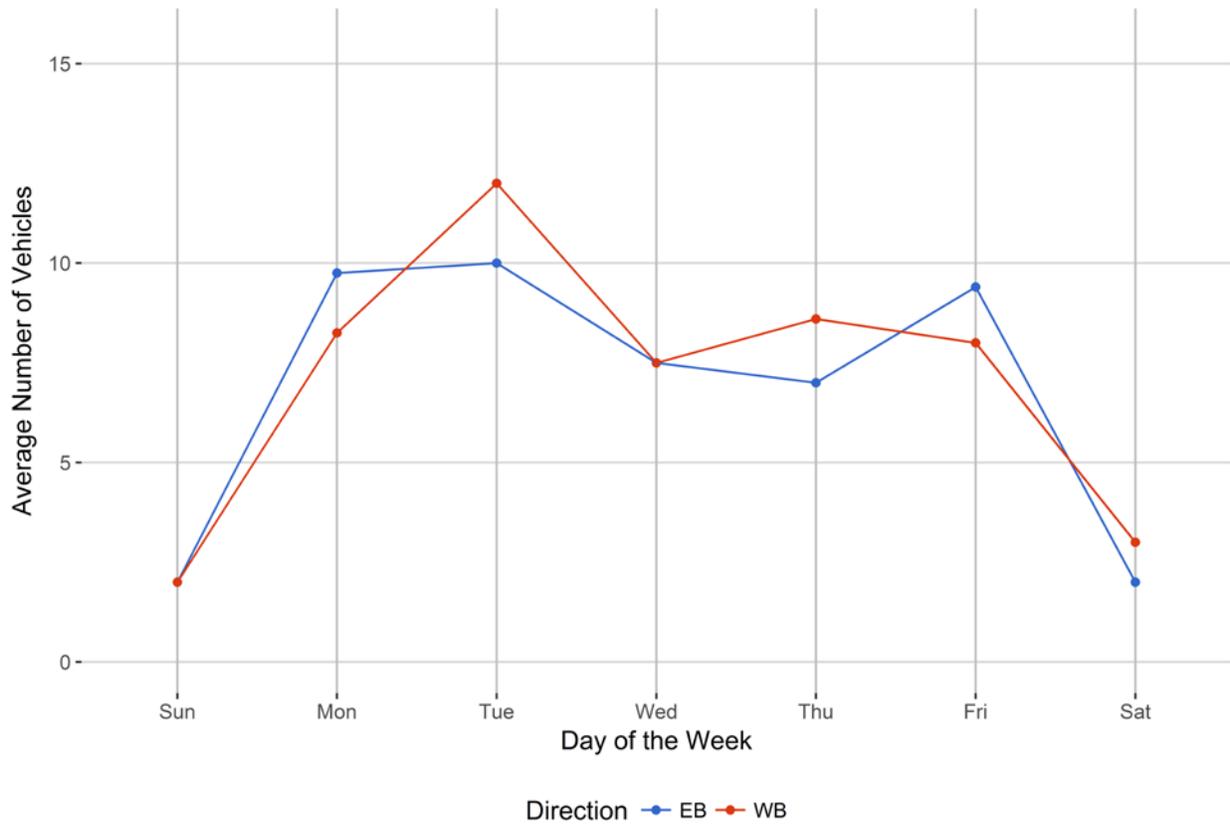


Figure 4 - Passenger Vehicles vs. Hour of the Day

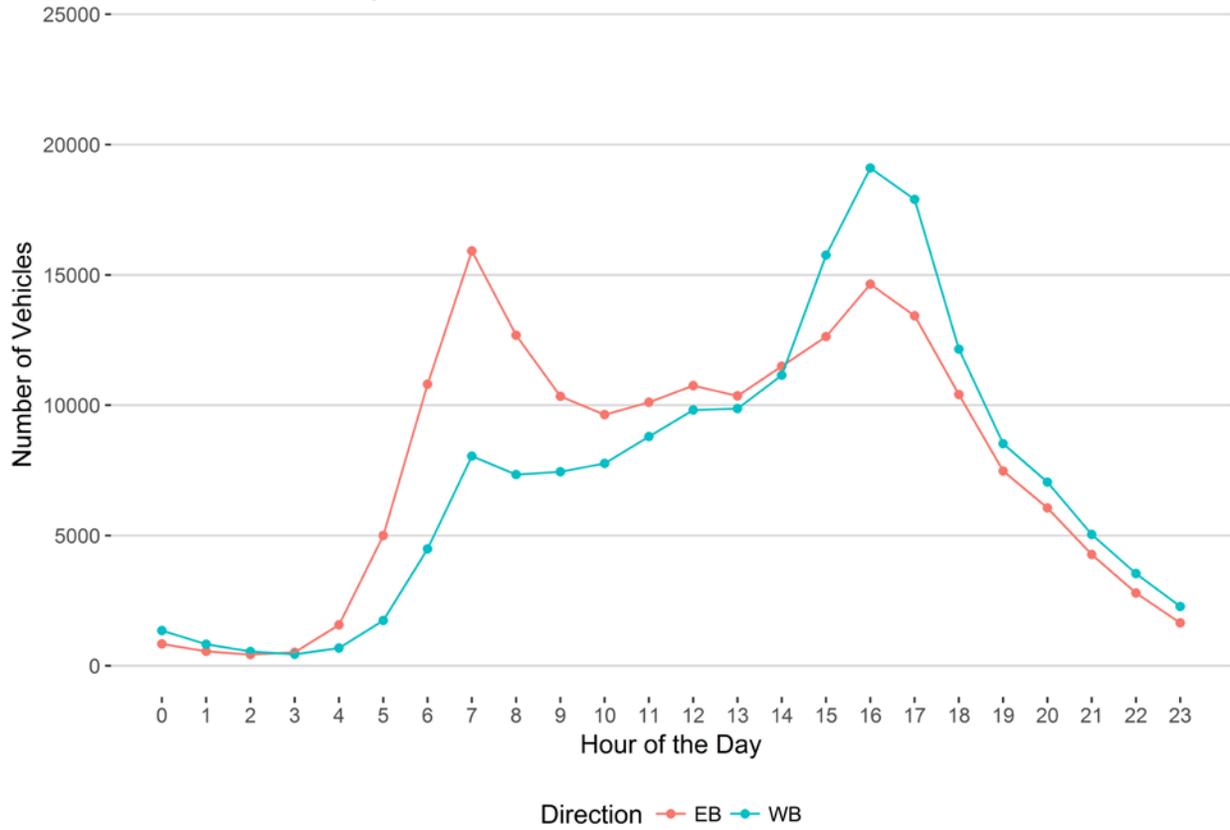


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

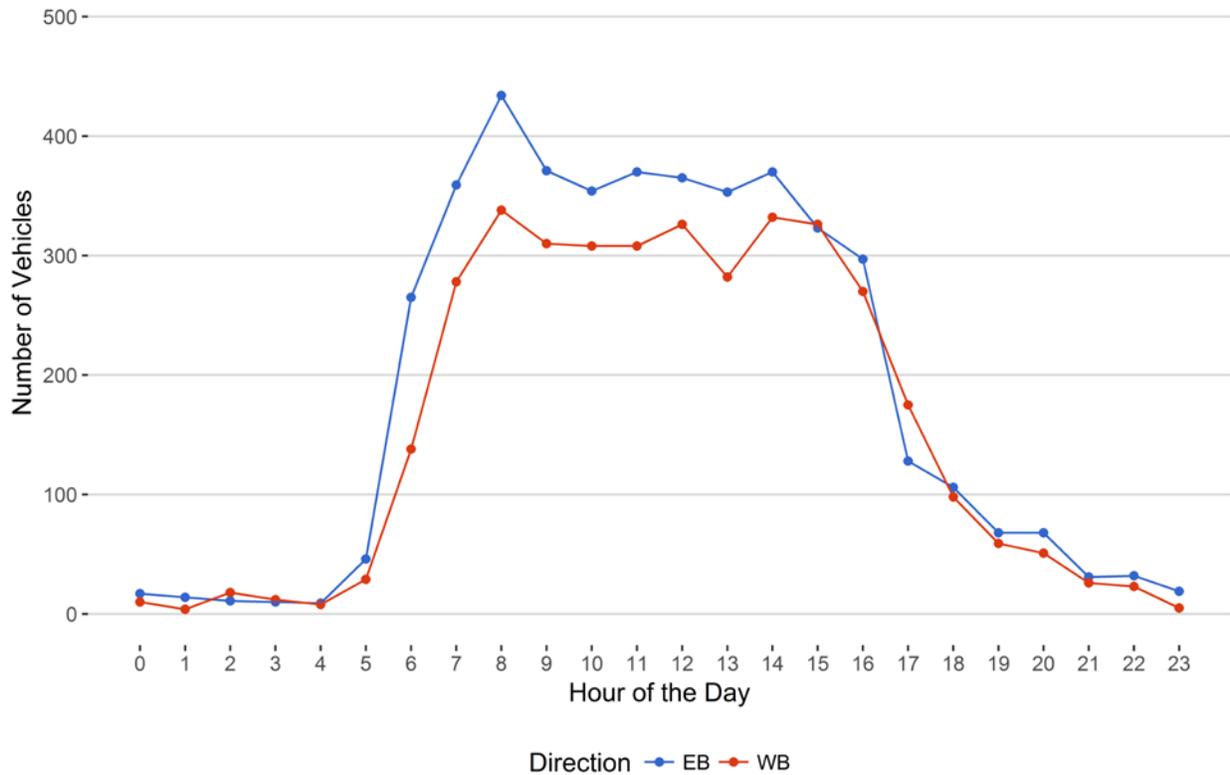


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

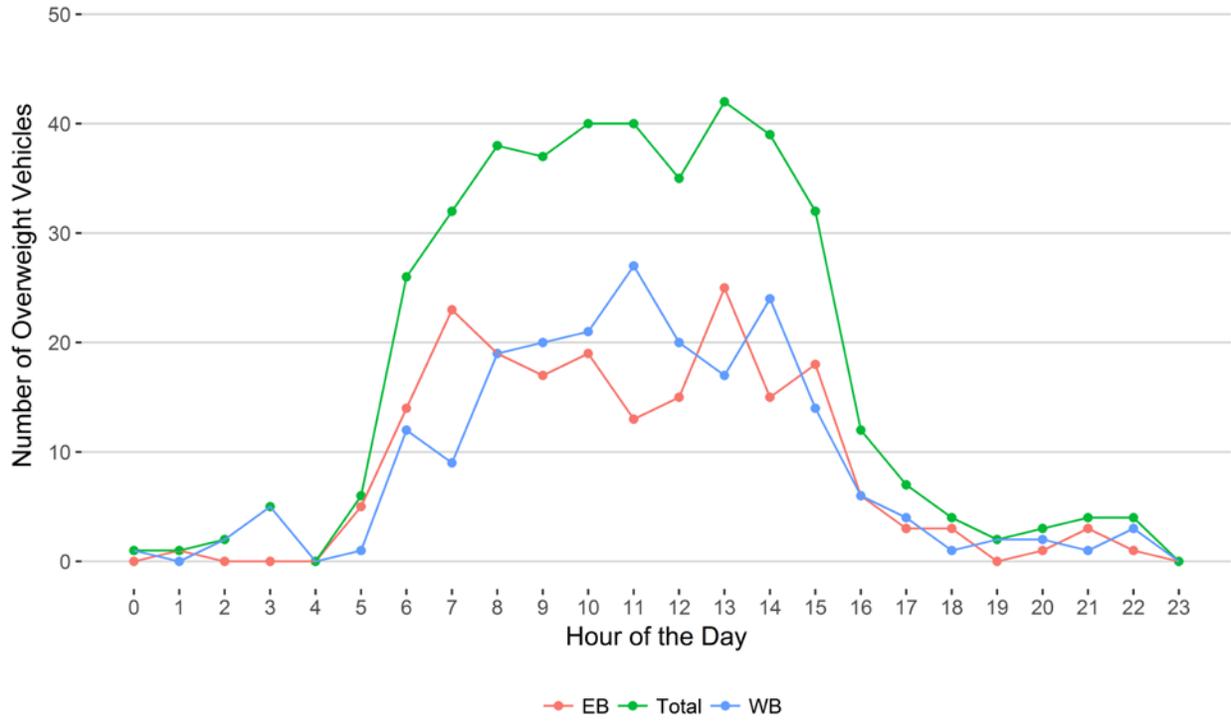
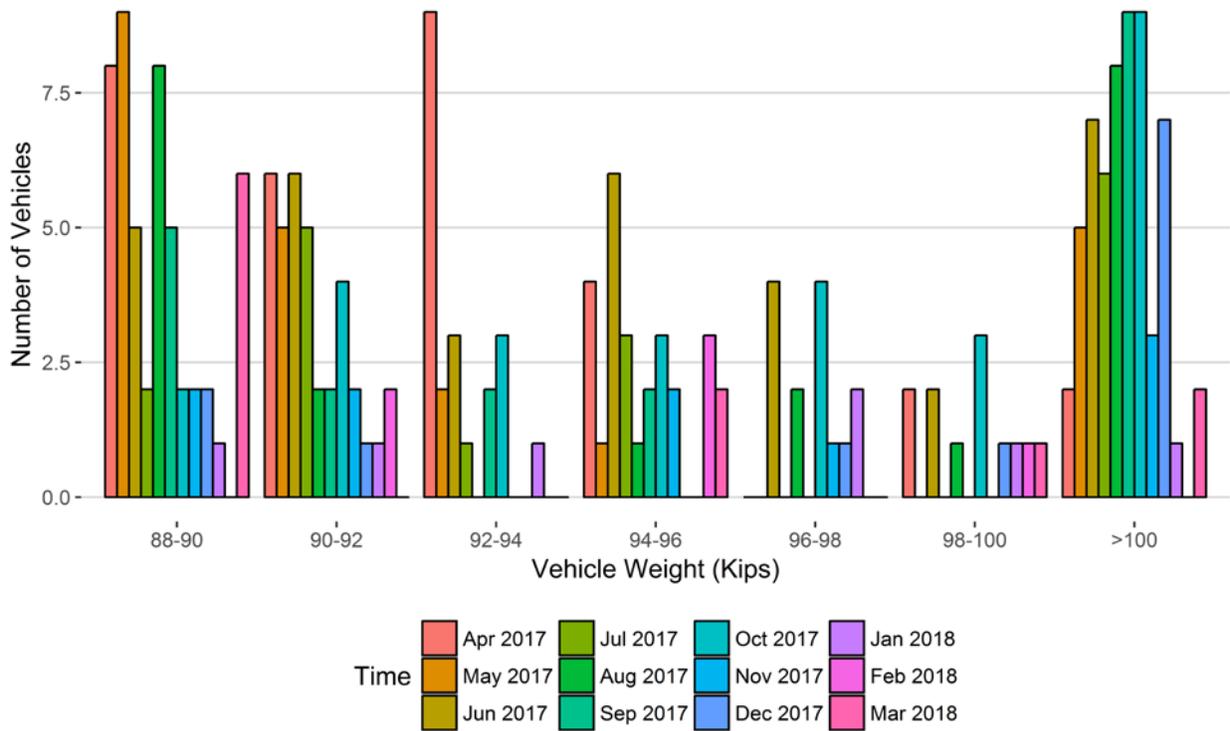
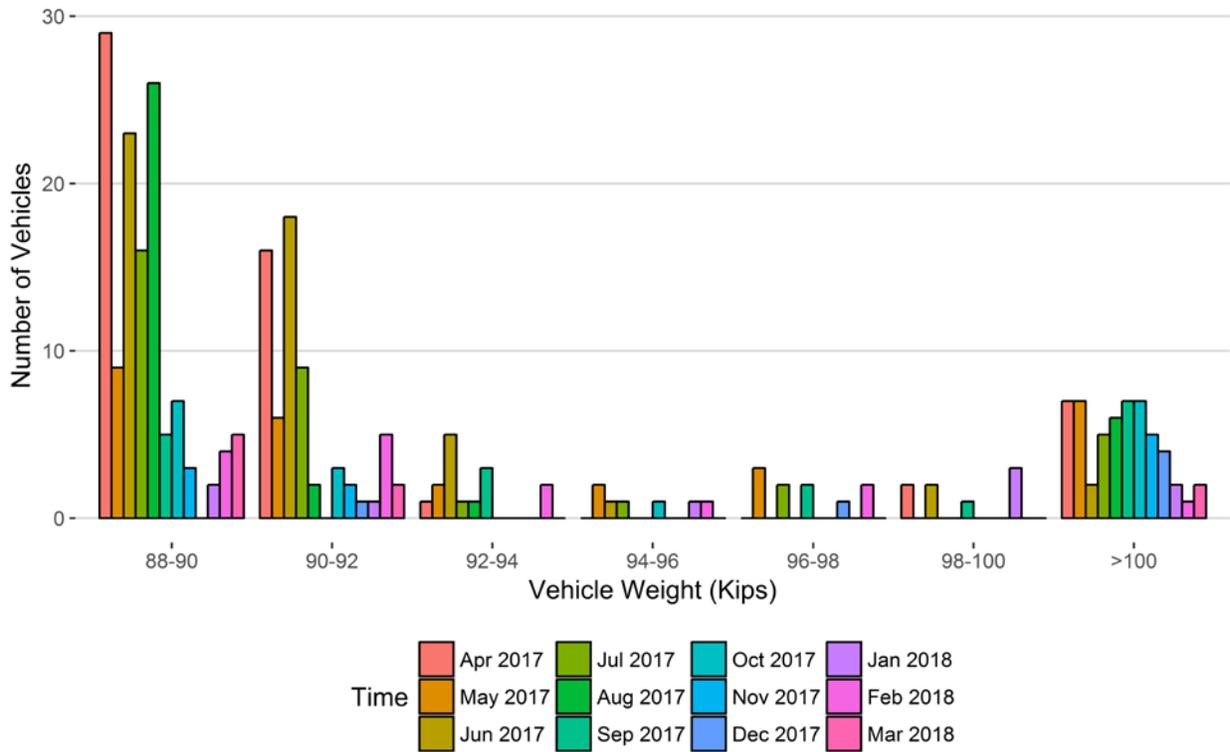


Figure 8 - Histogram of EB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018
88-90	8	9	5	2	8	5	2	2	2	1	0	6
90-92	6	5	6	5	2	2	4	2	1	1	2	0
92-94	9	2	3	1	0	2	3	0	0	1	0	0
94-96	4	1	6	3	1	2	3	2	0	0	3	2
96-98	0	0	4	0	2	0	4	1	1	2	0	0
98-100	2	0	2	0	1	0	3	0	1	1	1	1
>100	2	5	7	6	8	9	9	3	7	1	0	2
Total	31	22	33	17	22	20	28	10	12	7	6	11

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



Vehicle Weights (Kips)	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018
88-90	29	9	23	16	26	5	7	3	0	2	4	5
90-92	16	6	18	9	2	0	3	2	1	1	5	2
92-94	1	2	5	1	1	3	0	0	0	0	2	0
94-96	0	2	1	1	0	0	1	0	0	1	1	0
96-98	0	3	0	2	0	2	0	0	1	0	2	0
98-100	2	0	2	0	0	1	0	0	0	3	0	0
>100	7	7	2	5	6	7	7	5	4	2	1	2
Total	55	29	51	34	35	18	18	10	6	9	15	9

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

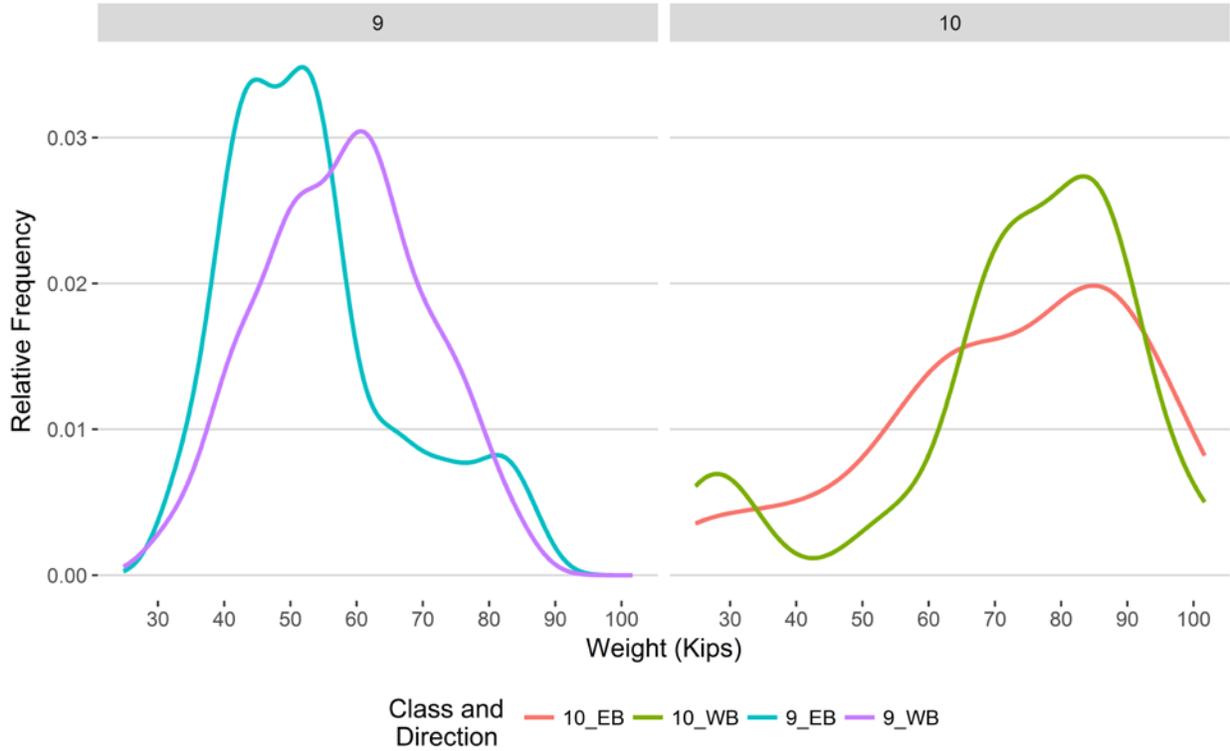


Figure 9 - Freight Percentage by Direction and Class

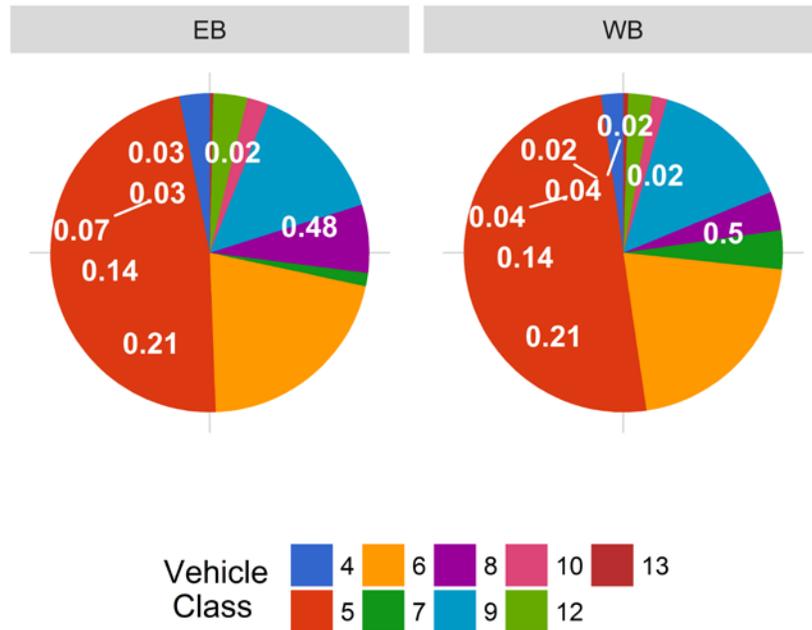


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

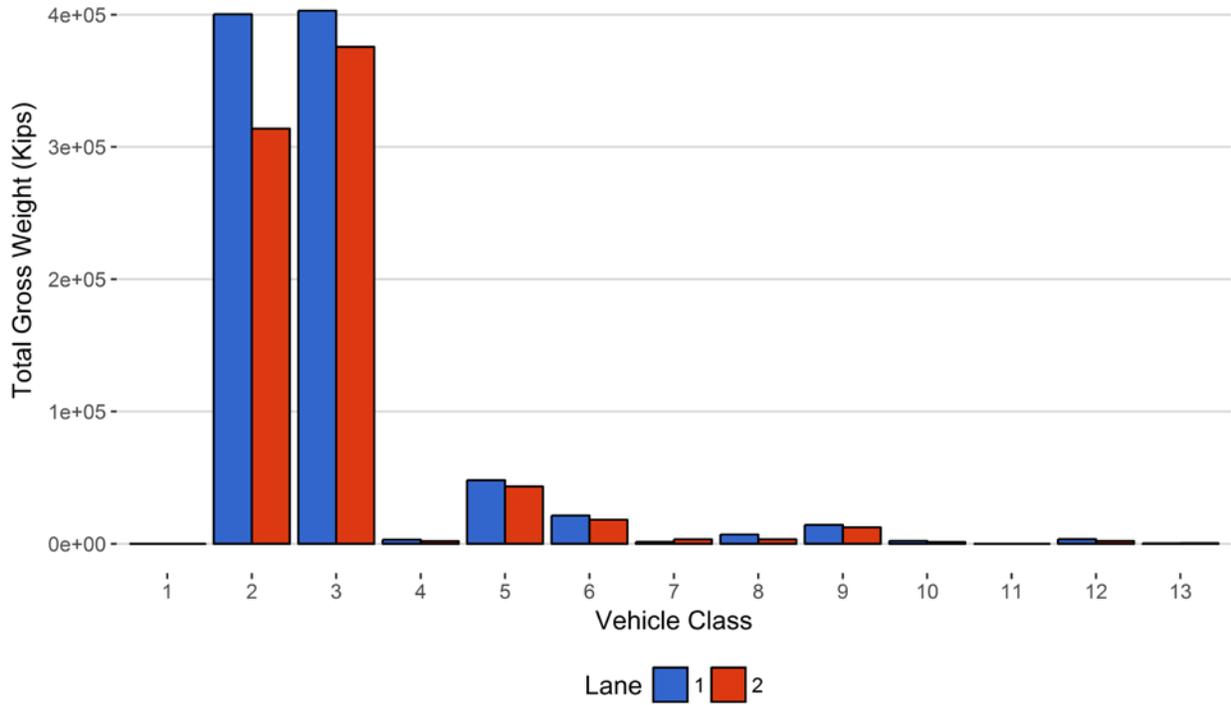


Figure 11 - Total Gross Vehicle Weight I

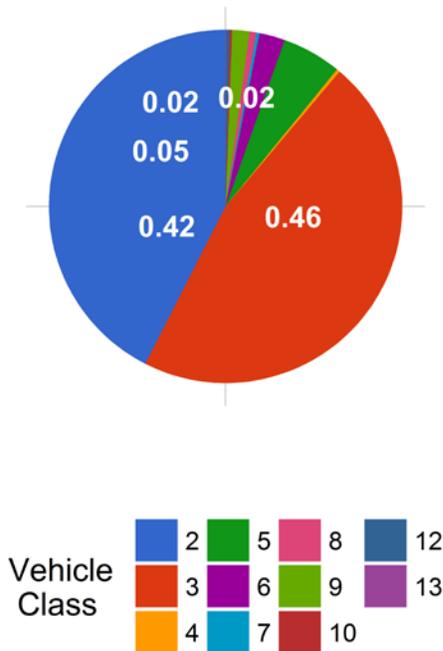


Figure 12 - Total ESALs by Class and Lane

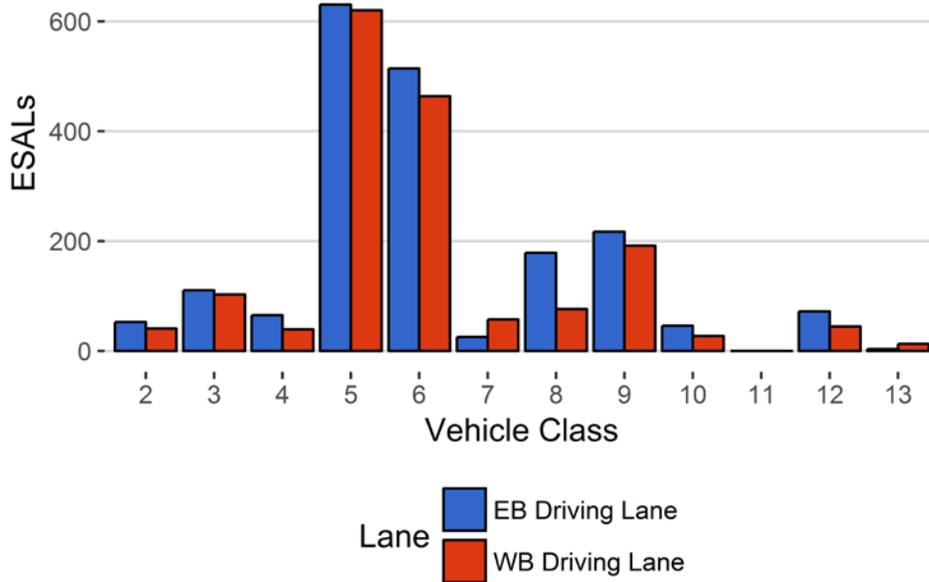


Figure 13 - ESALs by Class

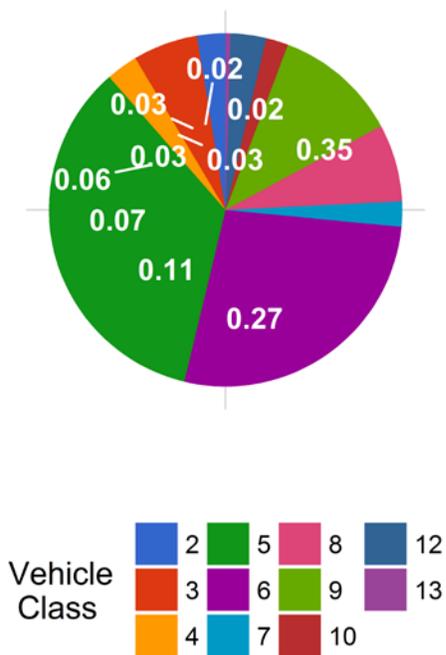


Table 1 Class 9 Front Axle Weight by Lane

<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
February 2018	11.38	0.81	10.80	2.44
March 2018	11.50	1.90	10.88	3.23

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	5984	185501	49.9	0	0
3	5755	178415	48	0	0
4	5	153	0	11	2.7
5	194	6016	1.6	72	17.7
6	32	998	0.3	148	36.4
7	3	80	0	23	5.7
8	8	263	0.1	25	6.1
9	15	479	0.1	54	13.3
10	2	49	0	24	5.9
11	0	0	0	0	0
12	2	75	0	44	10.8
13	0	9	0	6	1.5
TOTAL	12001	372037	100	407	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>
2018-03-26	Monday	09:00:37	10	EB	1	101.67
2018-03-27	Tuesday	12:37:33	10	WB	2	100.08
2018-03-06	Tuesday	18:26:40	10	EB	1	98.18
2018-03-23	Friday	09:09:16	10	EB	1	95.92
2018-03-28	Wednesday	06:56:32	10	EB	1	95.48
2018-03-16	Friday	11:53:54	10	WB	2	89.84
2018-03-02	Friday	07:07:33	10	EB	1	89.27
2018-03-09	Friday	15:04:16	10	EB	1	89.02
2018-03-22	Thursday	07:55:41	10	EB	1	89.01
2018-03-09	Friday	12:21:31	10	WB	2	88.55

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	97	7	7.2	3046	75	848
5	EB	8	3225	265	8.2	46123	1910	11221
6	EB	19	555	0	0	21266	0	5360
7	EB	11.5	24	0	0	1360	0	542
8	EB	31	168	38	22.6	6215	775	1093
9	EB	33	267	6	2.2	14079	192	2733
10	EB	33.5	31	2	6.5	2173	53	601
12	EB	36.5	49	0	0	3493	0	852
13	EB	31.5	4	0	0	358	0	116
TOTAL	****	****	4420	318	****	98113	****	23367
<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	57	3	5.3	1905	42	547
5	WB	8	2815	126	4.5	42465	911	10477
6	WB	19	447	0	0	18186	0	4846
7	WB	11.5	56	0	0	3420	0	1388
8	WB	31	96	33	34.4	2691	710	369
9	WB	33	214	3	1.4	12326	91	2681
10	WB	33.5	18	2	11.1	1258	56	361
12	WB	36.5	26	0	0	2122	0	586
13	WB	31.5	5	0	0	426	0	134
TOTAL	****	****	3734	167	****	84799	****	21391
GRAND TOTAL	****	****	8154	485	103	182912	4816	44757

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	400320	313744	714064	42.5
3	403053	375661	778714	46.3
4	3121	1946	5067	0.3
5	48032	43377	91409	5.4
6	21266	18186	39452	2.3
7	1360	3420	4780	0.3
8	6990	3401	10392	0.6
9	14271	12417	26688	1.6
10	2226	1314	3541	0.2
12	3493	2122	5615	0.3
13	358	426	784	0
TOTAL	904491	776015	1680506	100
GVW/LANE	53.82	46.18	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	53	41	94	2.6	0.0011
3	110	103	213	5.9	0.0024
4	65	40	105	2.9	1.37
5	630	620	1251	34.8	0.42
6	514	464	978	27.2	1.97
7	26	58	83	2.3	2.02
8	179	76	255	7.1	1.93
9	217	192	409	11.4	1.71
10	46	27	73	2	2.69
12	72	45	117	3.2	2.86
13	4	13	16	0.5	2.1
TOTAL	1917	1677	3594	100	17
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>
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
Feb 2018	325130	11612	263	317772	97.7	7358.3	2.3
Mar 2018	372037	12001	262	363916	97.8	8121	2.2
TOTAL	4844790	--	--	4720457	--	124335	--
AVERAGE	403732	13266	340	393371	97	10361	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>
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
Feb 2018	1598	1410	3008	1.6
Mar 2018	1922	1690	3612	2.3
TOTAL	30570	--	--	--
AVERAGE	2548	2222	4769	2

Gross Vehicle Weight

<i>Month</i>	<i>GVW EB Driving Lane</i>	<i>GVW WB Driving Lane</i>	<i>Total GVW Kips</i>
Apr 2017	863971	774480	1638451
May 2017	794931	697417	1492348
Jun 2017	906278	785702	1691980
Jul 2017	945902	804981	1750883
Aug 2017	1058817	930014	1988831
Sep 2017	1127354	1007720	2135074
Oct 2017	1100039	981541	2081580
Nov 2017	1144199	1024598	2168797
Dec 2017	956898	854725	1811623
Jan 2018	1075078	966463	2041541
Feb 2018	936552	846652	1783204
Mar 2018	888219	819015	1707234
TOTAL	11798239	10493308	22291547
AVERAGE	983187	874442	1857629

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>
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
Feb 2018	348	0.1	3.2	21	2
Mar 2018	412	0.1	3.2	20	5
TOTAL	7896	--	--	521	146
AVERAGE	658	0.2	4.4	43.4	12.2

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>
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
Feb 2018	19893	18452	38345	51.9	48.1
Mar 2018	23367	21391	44757	52.2	47.8
TOTAL	381182	358008	739189	--	--
AVERAGE	31765.1	29834	61599.1	51.6	48.4