

JANUARY 2019



**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 2019. 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: 367731 | Passenger Vehicles: 358419 | Heavy Commercial Vehicles: 9312

Monthly Average Daily Traffic (MADT): 11862 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 300

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 6's.

Overweight HCVs

Volume trends. Of a total of 9312 HCVs, 980 of them were overweight³. These overweight HCVs contributed to 0.1% of total monthly volume, and 5.3% of total monthly HCV volume. EB overweight vehicles typically reached highest numbers on Fridays, with lowest volumes reported on Saturdays. WB overweight vehicles tended to reach highest volumes on Fridays, 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 50.2% 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 October.

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 ,20 EB vehicles exceeded 88,000 pounds (10 vehicles were Class 10's; 8 vehicles were Class 13's). Of vehicles traveling WB,

20 EB vehicles exceeded 88,000 pounds (8 vehicles were Class 10's; 8 vehicles were Class 13's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from January 2019.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in January 2019. 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 97478 tons of freight was recorded to have crossed the WIM. More freight was shipped EB (52.5%) than WB (47.5%). 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 367731 vehicles with a combined GVW of 3617213 kips (1 kip = 1,000 pounds = 0.5 tons) in January 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 7866 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 52.3% of all ESALs were recorded EB while 47.7% was observed WB. In particular, 35% 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).

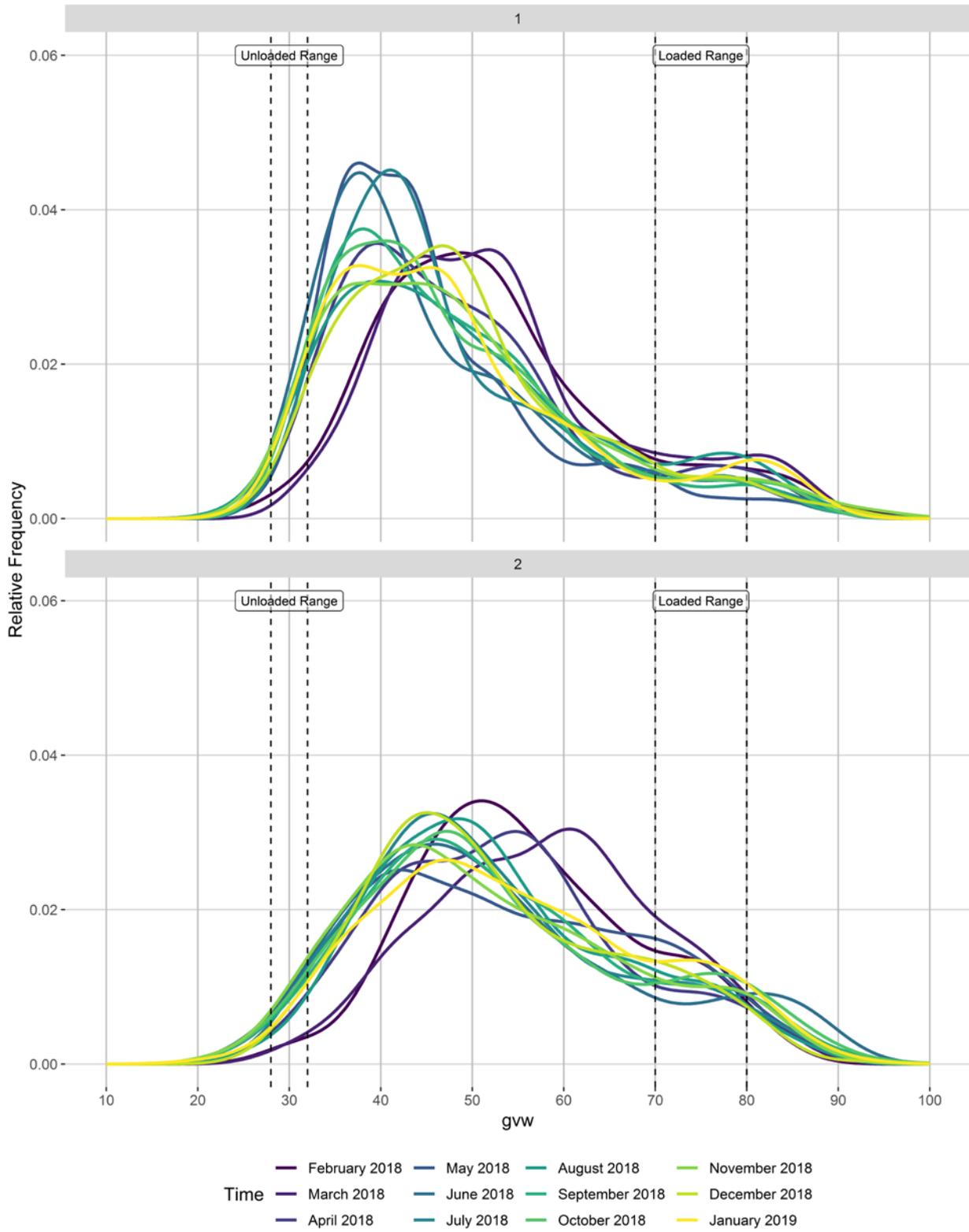
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

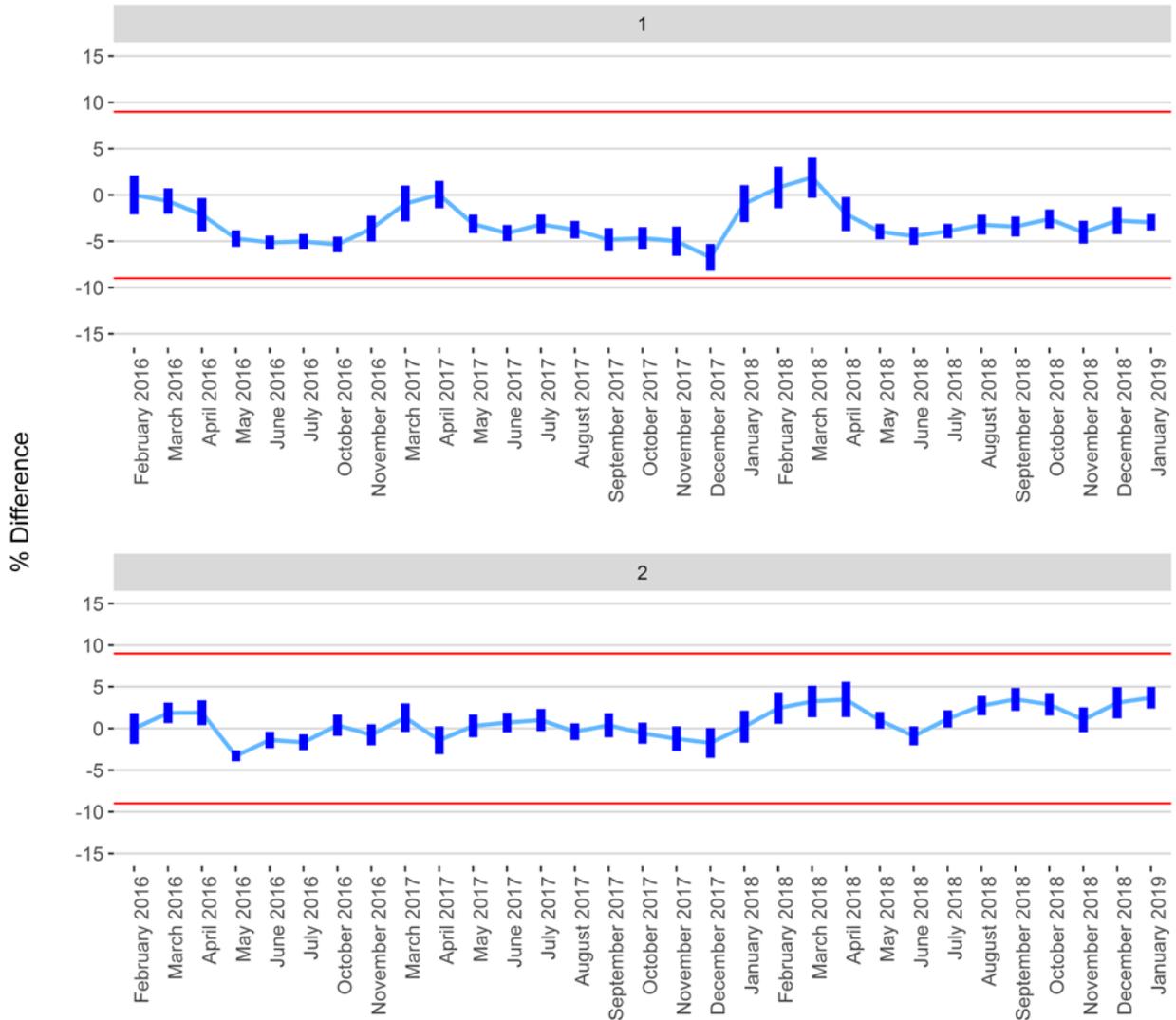
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

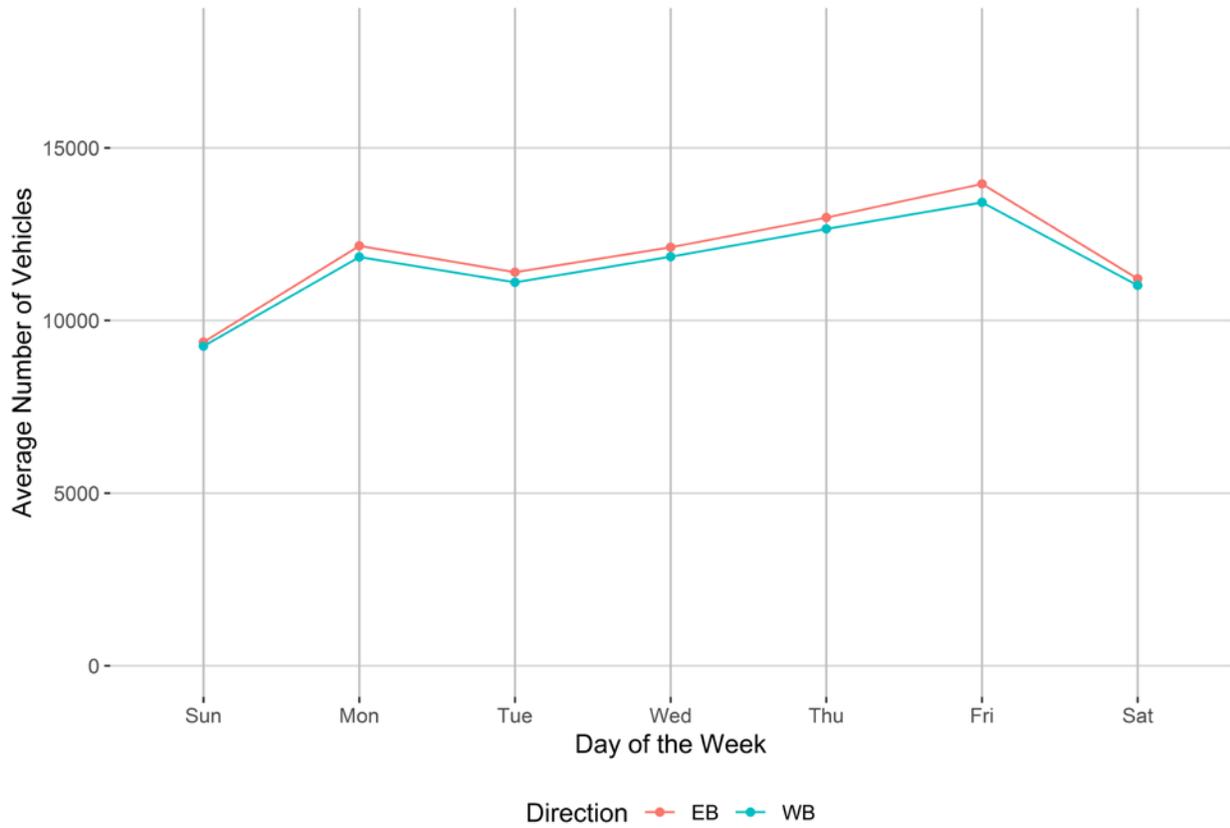


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

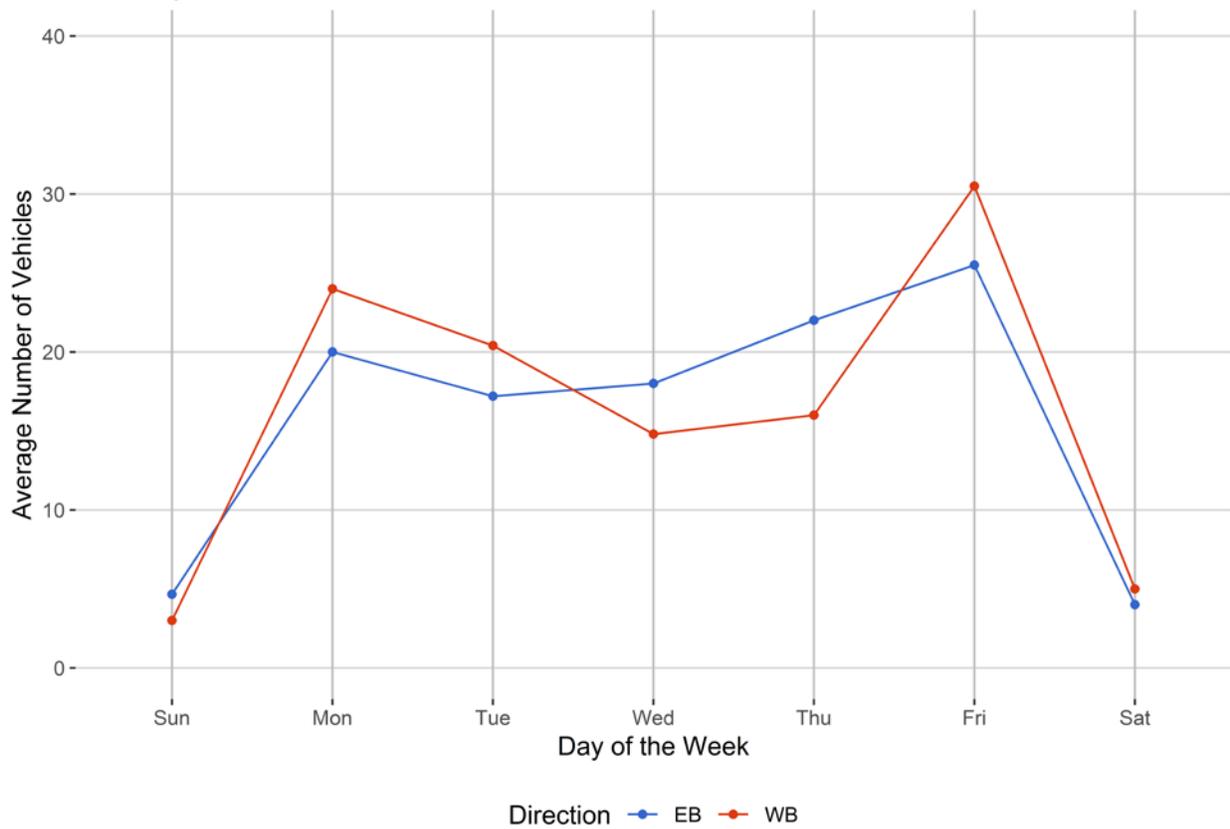


Figure 4 - Passenger Vehicles vs. Hour of the Day

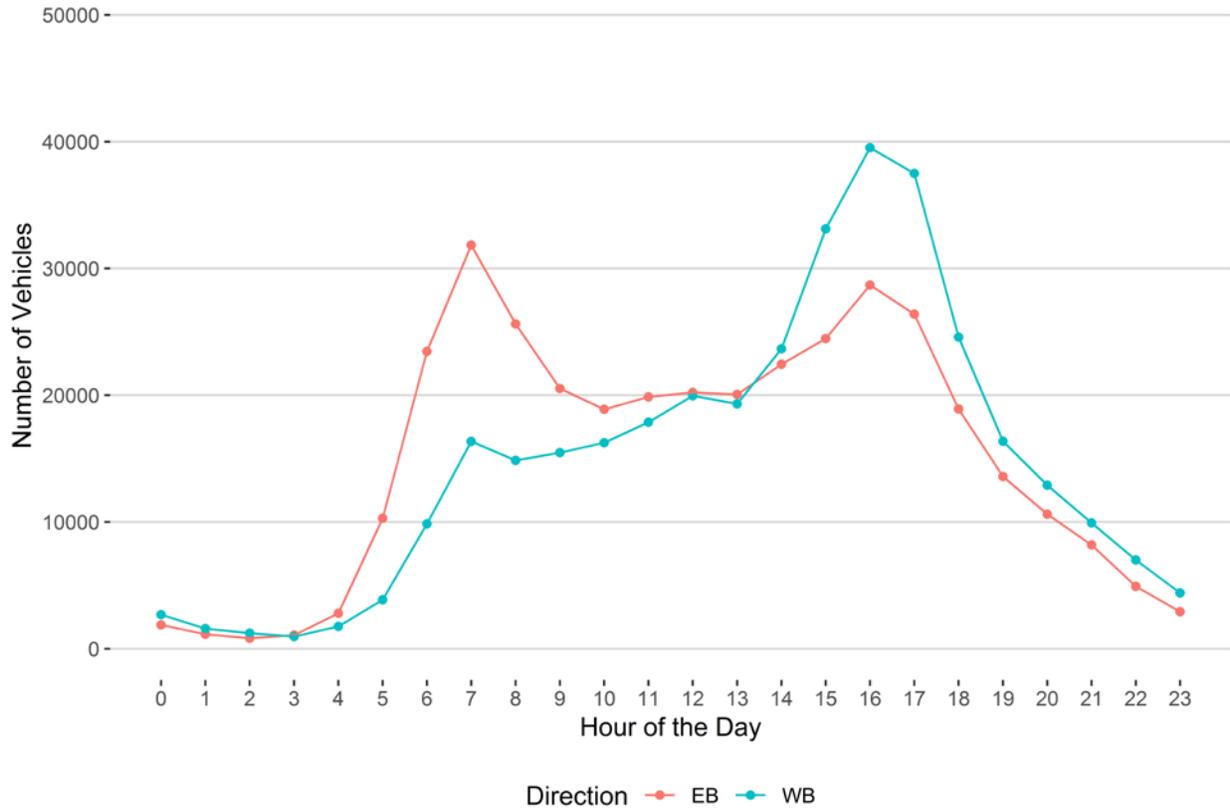


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

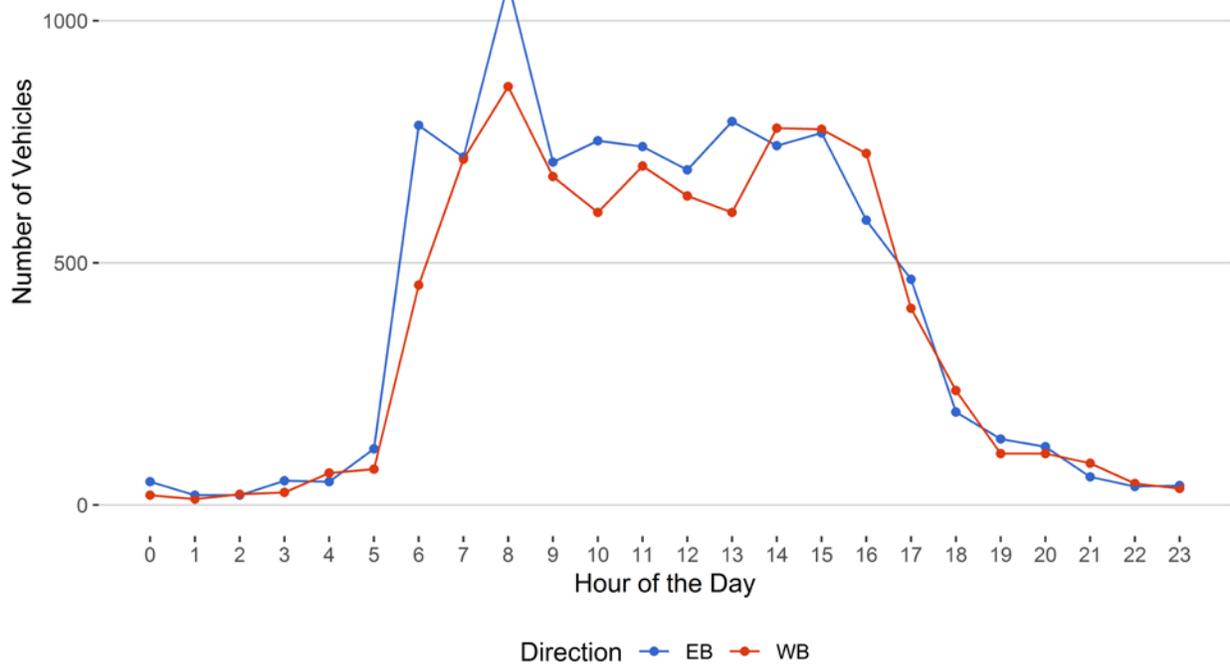


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

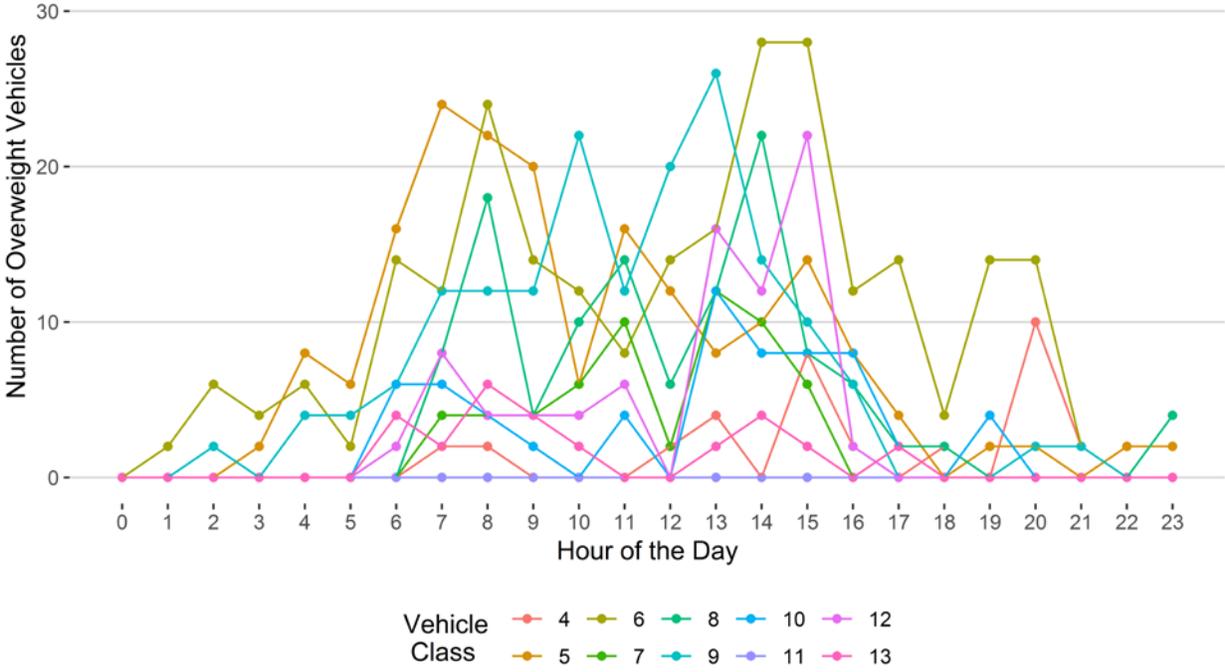


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

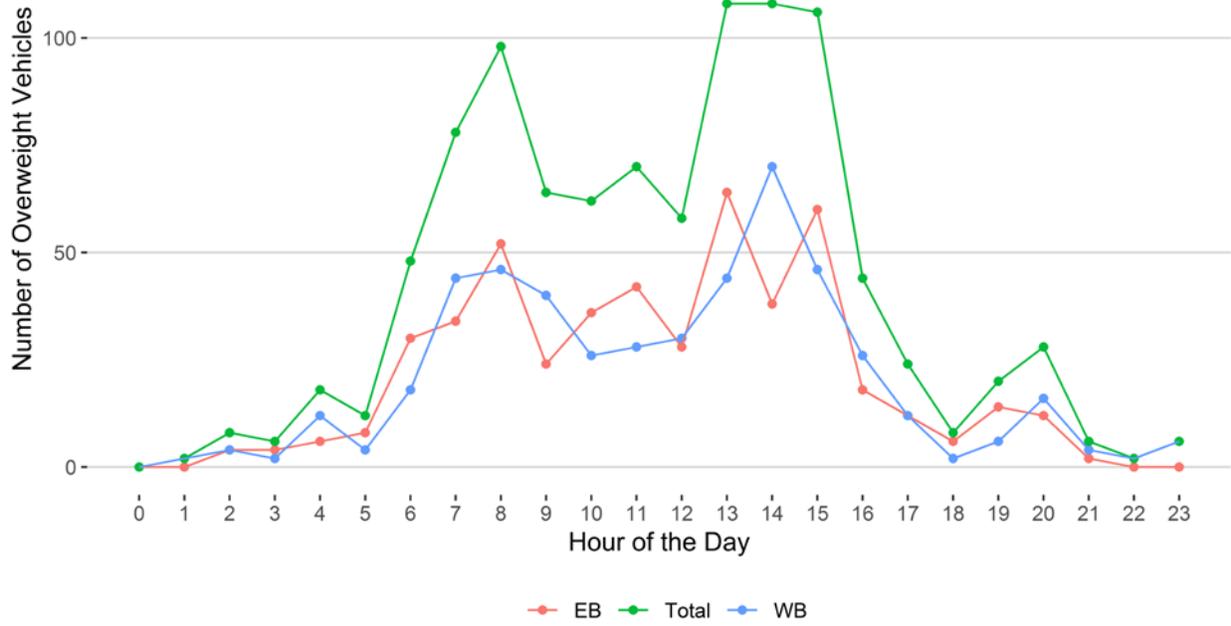
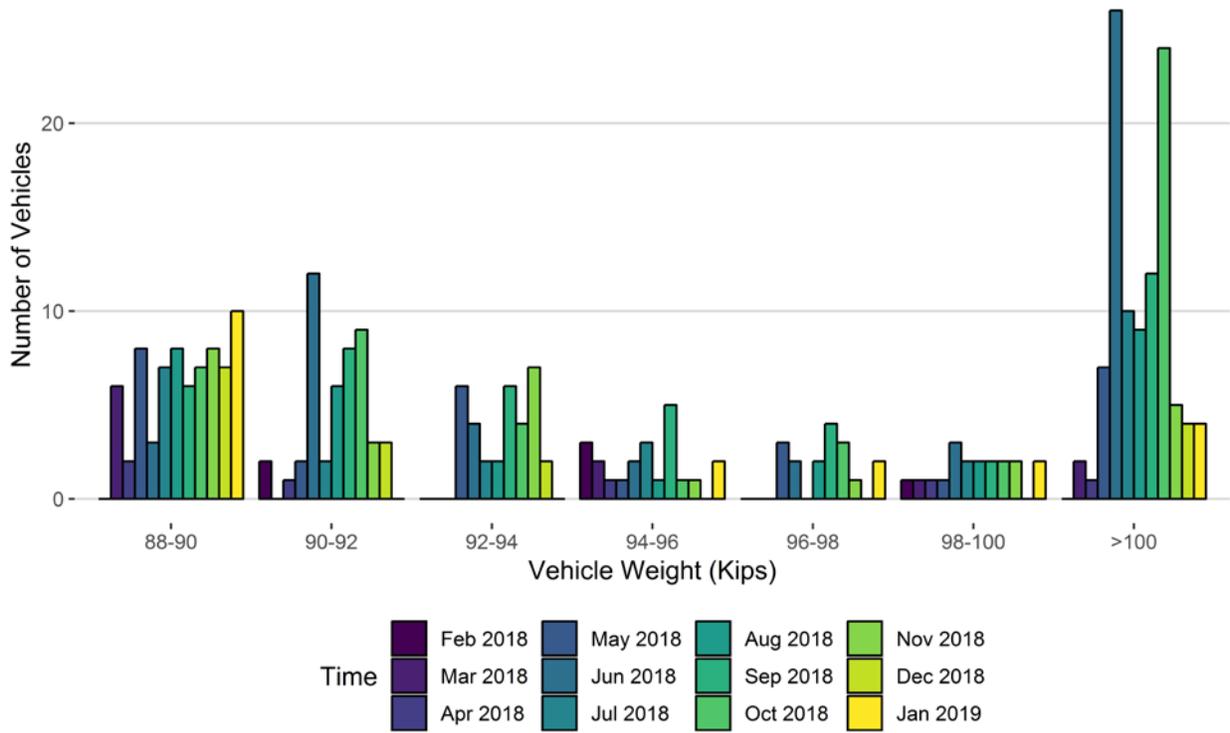
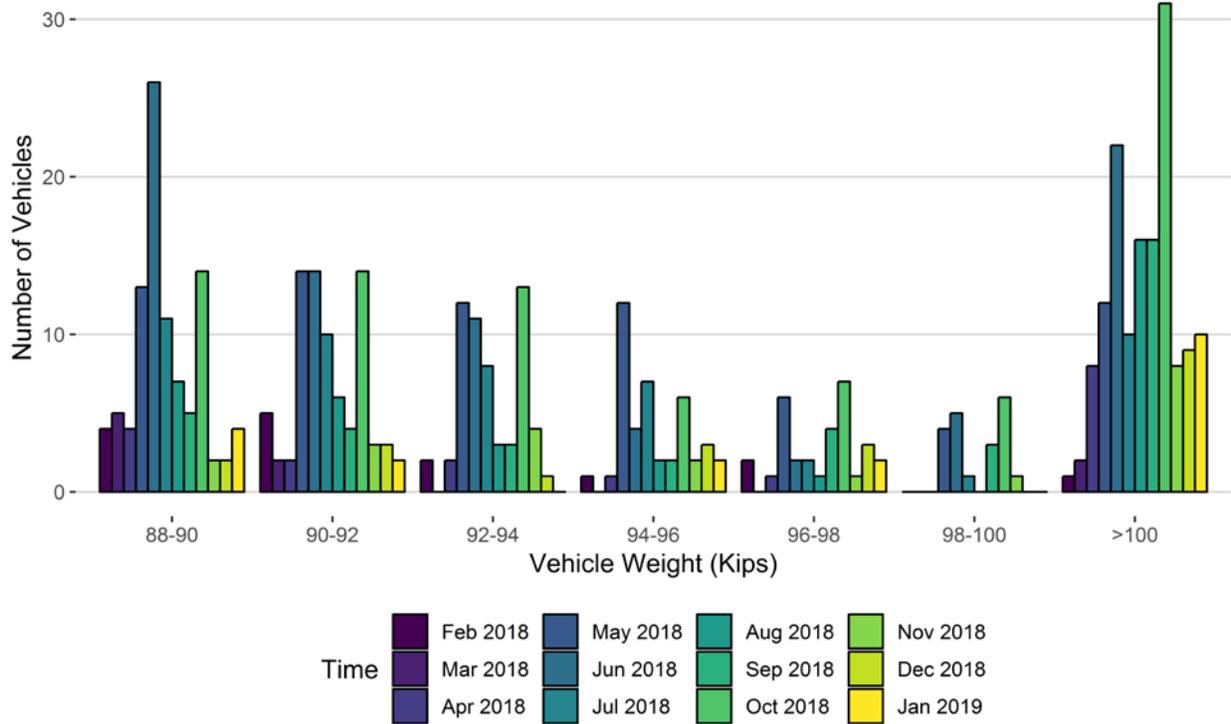


Figure 8 - Histogram of EB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019
88-90	0	6	2	8	3	7	8	6	7	8	7	10
90-92	2	0	1	2	12	2	6	8	9	3	3	0
92-94	0	0	0	6	4	2	2	6	4	7	2	0
94-96	3	2	1	1	2	3	1	5	1	1	0	2
96-98	0	0	0	3	2	0	2	4	3	1	0	2
98-100	1	1	1	1	3	2	2	2	2	2	0	2
>100	0	2	1	7	26	10	9	12	24	5	4	4
Total	6	11	6	28	52	26	30	43	50	27	16	20

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



Vehicle Weights (Kips)	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019
88-90	4	5	4	13	26	11	7	5	14	2	2	4
90-92	5	2	2	14	14	10	6	4	14	3	3	2
92-94	2	0	2	12	11	8	3	3	13	4	1	0
94-96	1	0	1	12	4	7	2	2	6	2	3	2
96-98	2	0	1	6	2	2	1	4	7	1	3	2
98-100	0	0	0	4	5	1	0	3	6	1	0	0
>100	1	2	8	12	22	10	16	16	31	8	9	10
Total	15	9	18	73	84	49	35	37	91	21	21	20

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

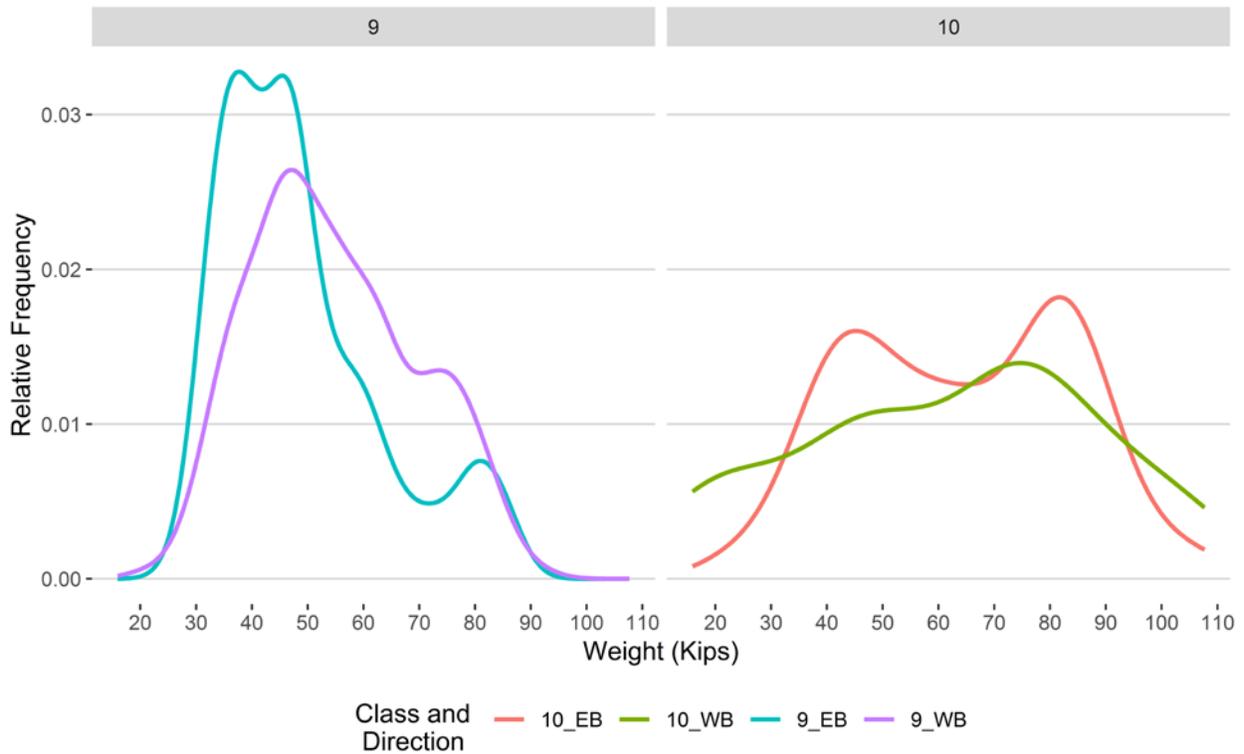


Figure 9 - Freight Percentage by Direction and Class

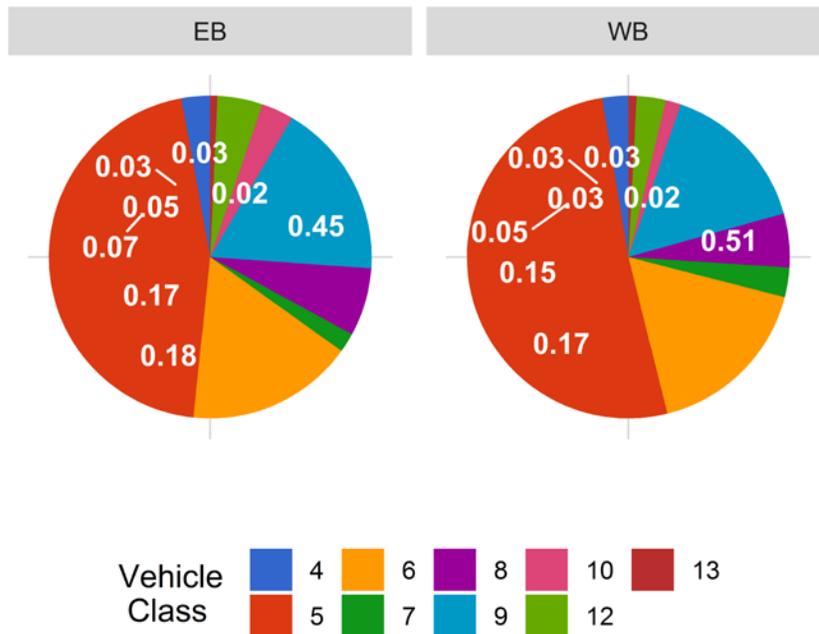


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

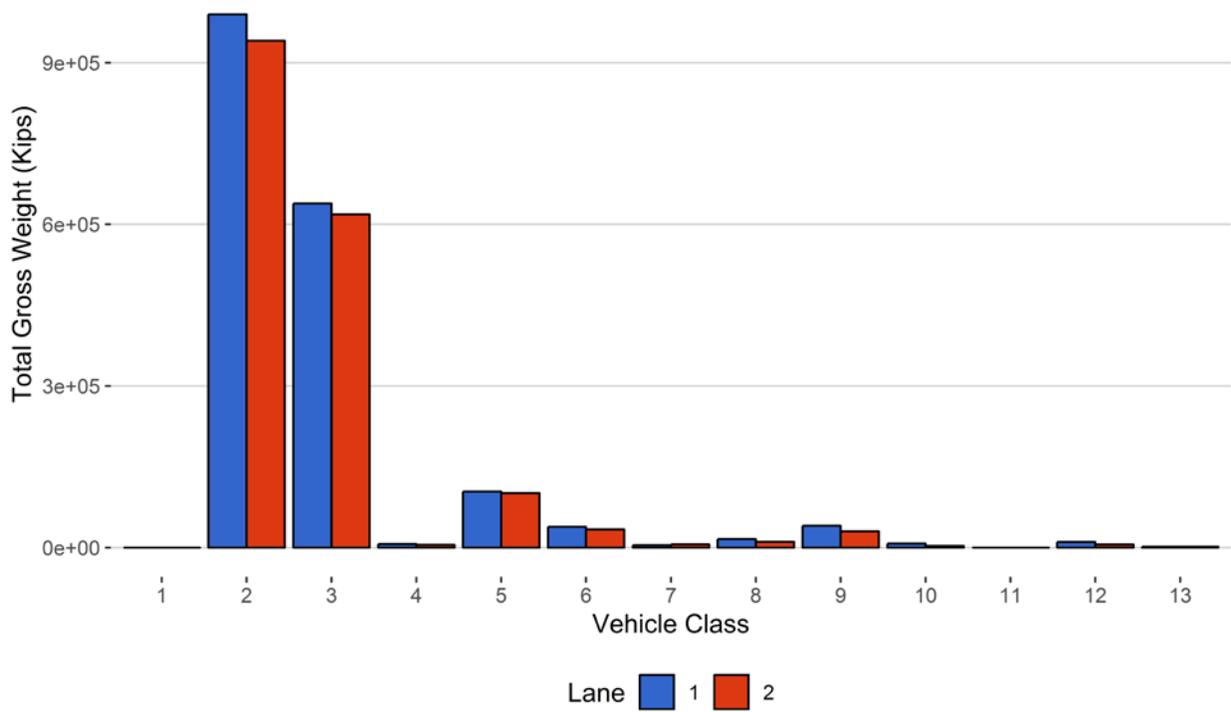


Figure 11 - Total Gross Vehicle Weight t

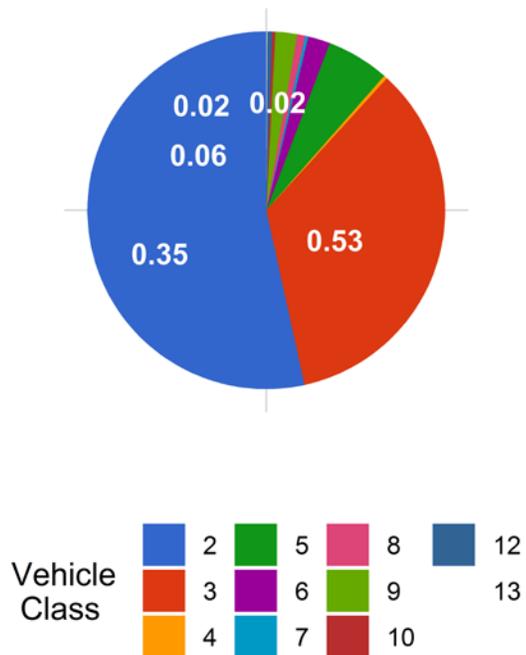


Figure 12 - Total ESALs by Class and Lane

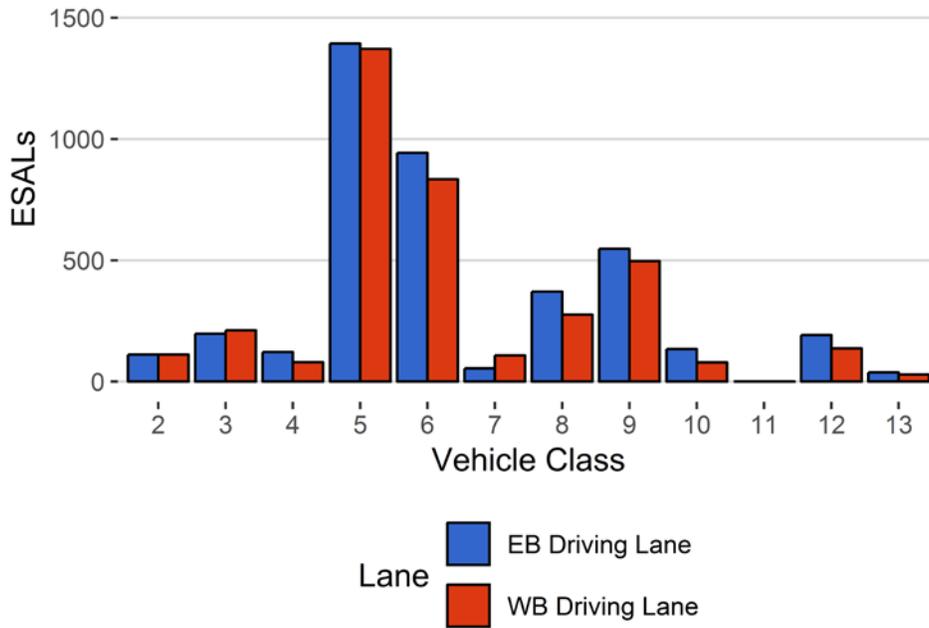


Figure 13 - ESALs by Class

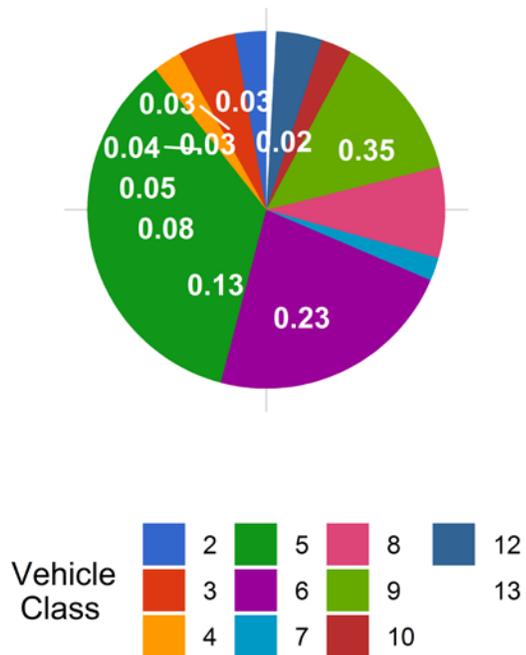


Table 1 Class 9 Front Axle Weight by Lane

<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
April 2018	11.05	-2.07	10.90	3.47
May 2018	10.84	-3.96	10.64	0.98
June 2018	10.79	-4.43	10.44	-0.89
July 2018	10.84	-3.91	10.66	1.15
August 2018	10.92	-3.21	10.83	2.74
September 2018	10.90	-3.41	10.91	3.49
October 2018	10.99	-2.60	10.84	2.89
November 2018	10.83	-4.03	10.65	1.04
December 2018	10.97	-2.76	10.86	3.08
January 2019	10.95	-2.96	10.93	3.69

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	8053	249642	67.9	0	0
3	3509	108778	29.6	0	0
4	7	211	0.1	34	3.5
5	218	6766	1.8	184	18.8
6	31	963	0.3	250	25.5
7	3	84	0	58	5.9
8	12	382	0.1	116	11.8
9	22	697	0.2	166	16.9
10	3	82	0	64	6.5
11	0	0	0	0	0
12	4	110	0	80	8.2
13	1	18	0	28	2.9
TOTAL	11862	367731	100	980	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>
2019-01-25	Friday	15:07:20	10	EB	1	107.69
2019-01-25	Friday	15:07:20	10	EB	1	107.69
2019-01-18	Friday	13:45:20	10	WB	2	107.65
2019-01-18	Friday	13:45:20	10	WB	2	107.65
2019-01-11	Friday	14:09:42	10	WB	2	101.83
2019-01-11	Friday	14:09:42	10	WB	2	101.83
2019-01-03	Thursday	16:13:42	10	EB	1	99.68
2019-01-03	Thursday	16:13:42	10	EB	1	99.68
2019-01-14	Monday	11:25:12	10	WB	2	96.85
2019-01-14	Monday	11:25:12	10	WB	2	96.85

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	224	22	9.8	6275	296	1623
5	EB	8	6850	578	8.4	99850	4154	24837
6	EB	19	1038	16	1.5	38160	281	9371
7	EB	11.5	76	0	0	4430	0	1778
8	EB	31	422	138	32.7	12862	2743	2029
9	EB	33	830	72	8.7	38212	2233	6599
10	EB	33.5	114	6	5.3	7162	174	1772
12	EB	36.5	142	0	0	10357	0	2587
13	EB	31.5	18	0	0	1640	0	536
TOTAL	****	****	9714	832	****	218947	****	51132
<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	194	26	13.4	4804	340	1142
5	WB	8	6584	472	7.2	97659	3291	24382
6	WB	19	874	14	1.6	33428	239	8544
7	WB	11.5	90	0	0	5837	0	2401
8	WB	31	336	170	50.6	7268	3343	1061
9	WB	33	554	24	4.3	29585	707	6048
10	WB	33.5	48	8	16.7	2818	167	739
12	WB	36.5	76	0	0	5760	0	1493
13	WB	31.5	18	2	11.1	1579	31	538
TOTAL	****	****	8774	716	****	188738	****	46347
GRAND TOTAL	****	****	18488	1548	171	407685	17998	97478

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	989821	940921	1930742	53.4
3	638660	618606	1257266	34.8
4	6571	5144	11715	0.3
5	104004	100950	204954	5.7
6	38441	33668	72108	2
7	4430	5837	10266	0.3
8	15605	10611	26216	0.7
9	40445	30292	70736	2
10	7336	2984	10320	0.3
12	10357	5760	16117	0.4
13	1640	1610	3250	0.1
TOTAL	1857308	1756383	3613691	100
GVW/LANE	51.4	48.6	100	0

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	111	111	223	2.8	9e-04
3	197	212	409	5.2	0.0038
4	122	80	202	2.6	0.97
5	1393	1371	2764	35.3	0.41
6	943	834	1777	22.7	1.87
7	55	108	164	2.1	1.94
8	371	276	647	8.2	1.71
9	548	496	1044	13.3	1.52
10	134	80	214	2.7	2.56
12	192	136	328	4.2	2.93
13	38	30	68	0.9	3.06
TOTAL	4105	3736	7840	100	17
ESALS/LANE	52.4	47.7	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>
Feb 2018	325130	11612	263	317772	97.7	7358.3	2.3
Mar 2018	372037	12001	262	363916	97.8	8121	2.2
Apr 2018	380697	12690	315	371242	97.5	9455.4	2.5
May 2018	474991	15322	486	459934	96.8	15057	3.2
Jun 2018	450683	15023	471	436568	96.9	14115.2	3.1
Jul 2018	438254	14137	398	425930	97.2	12323.7	2.8
Aug 2018	446876	14415	420	433854	97.1	13022.2	2.9
Sep 2018	419706	13990	419	407143	97	12563.1	3
Oct 2018	444856	14350	502	429296	96.5	15560	3.5
Nov 2018	398210	13274	359	387448	97.3	10761.7	2.7
Dec 2018	387498	12500	313	377791	97.5	9706.9	2.5
Jan 2019	367731	11862	300	358419	97.5	9311.5	2.5
TOTAL	4906669	-	-	4769313	-	137356	-
AVERAGE	408889	13431	376	397443	97	11446	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>
Feb 2018	1598	1410	3008	1.6
Mar 2018	1922	1690	3612	2.3
Apr 2018	2022	1838	3860	0.9
May 2018	3365	3799	7164	6.9
Jun 2018	3507	3885	7392	9.5
Jul 2018	2794	3073	5867	4.8
Aug 2018	3228	2941	6170	3.4
Sep 2018	2874	2745	5619	4.4
Oct 2018	3812	3986	7798	7.7
Nov 2018	2509	2284	4793	3.1
Dec 2018	2365	2179	4544	1.6
Jan 2019	4113	3753	7866	1.3
TOTAL	34109	-	-	-
AVERAGE	2842	2798	5641	4

Gross Vehicle Weight

<i>Month</i>	<i>GVW EB Driving Lane</i>	<i>GVW WB Driving Lane</i>	<i>Total GVW Kips</i>
Feb 2018	1857683	1759530	3617213
Mar 2018	794931	697417	1492348
Apr 2018	906278	785702	1691980
May 2018	951084	865467	1816551
Jun 2018	1258909	1200368	2459277
Jul 2018	1209273	1130898	2340171
Aug 2018	1148174	1088707	2236882
Sep 2018	1178091	1105327	2283419
Oct 2018	1098955	1038371	2137326
Nov 2018	1212321	1140085	2352405
Dec 2018	1022767	962848	1985615
Jan 2019	996068	942253	1938320
TOTAL	13634534	12716973	26351507
AVERAGE	1136211	1059748	2195959

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>
Feb 2018	348	0.1	3.2	21	2
Mar 2018	412	0.1	3.2	20	5
Apr 2018	427	0.1	3.6	24	10
May 2018	1095	0.2	7.1	101	24
Jun 2018	1168	0.3	8.1	138	57
Jul 2018	870	0.2	6.9	77	25
Aug 2018	902	0.2	6.8	65	27
Sep 2018	745	0.2	5.8	82	35
Oct 2018	1228	0.3	7.7	143	63
Nov 2018	615	0.2	5.6	48	16
Dec 2018	693	0.2	7	37	13
Jan 2019	984	0.1	5.2	40	16
TOTAL	9487	-	-	796	293
AVERAGE	790.6	0.2	5.8	66.3	24.4

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>
Feb 2018	19893	18452	38345	51.9	48.1
Mar 2018	23367	21391	44757	52.2	47.8
Apr 2018	25949	23798	49747	52.2	47.8
May 2018	43173	51851	95024	45.4	54.6
Jun 2018	43944	48196	92140	47.7	52.3
Jul 2018	35591	37365	72955	48.8	51.2
Aug 2018	40320	36068	76388	52.8	47.2
Sep 2018	37861	34874	72735	52.1	47.9
Oct 2018	49875	57608	107483	46.4	53.6
Nov 2018	32474	29307	61781	52.6	47.4
Dec 2018	31218	27144	58362	53.5	46.5
Jan 2019	51132	46347	97478	52.5	47.5
TOTAL	434795	432402	867197	-	-
AVERAGE	36232.9	36033.5	72266.4	50.7	49.3