

APRIL 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 April 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. 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: 420217 | Passenger Vehicles: 409564 | Heavy Commercial Vehicles: 10653

Monthly Average Daily Traffic (MADT): 14007 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 355

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 10653 HCVs, 634 of them were overweight ³. These overweight HCVs contributed to 0.2% of total monthly volume, and 6% of total monthly

HCV volume. EB overweight vehicles typically reached highest numbers on Fridays, with lowest volumes reported on Sundays. WB overweight vehicles tended to reach highest volumes on Thursdays, with lowest volumes reported on Sundays. See Figure 3 . The top two overweight violators by class were the class 9 and class 6 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 60.5% 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 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 report ⁴.

Using normal load limits ,16 EB vehicles exceeded 88,000 pounds (10 vehicles were Class 10's; 6 vehicles were Class 13's). Of vehicles traveling WB,

79 EB vehicles exceeded 88,000 pounds (54 vehicles were Class 10's; 21 vehicles were Class 9's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from April 2019.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in April 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 60251 tons of freight was recorded to have crossed the WIM. More freight was shipped EB (50.6%) than WB (49.4%). 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 420217 vehicles with a combined GVW of 2083955 kips (1 kip = 1,000 pounds = 0.5 tons) in April 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 4888 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 51.4% of all ESALs were recorded WB while 48.6% was observed EB. In particular, 31% 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).

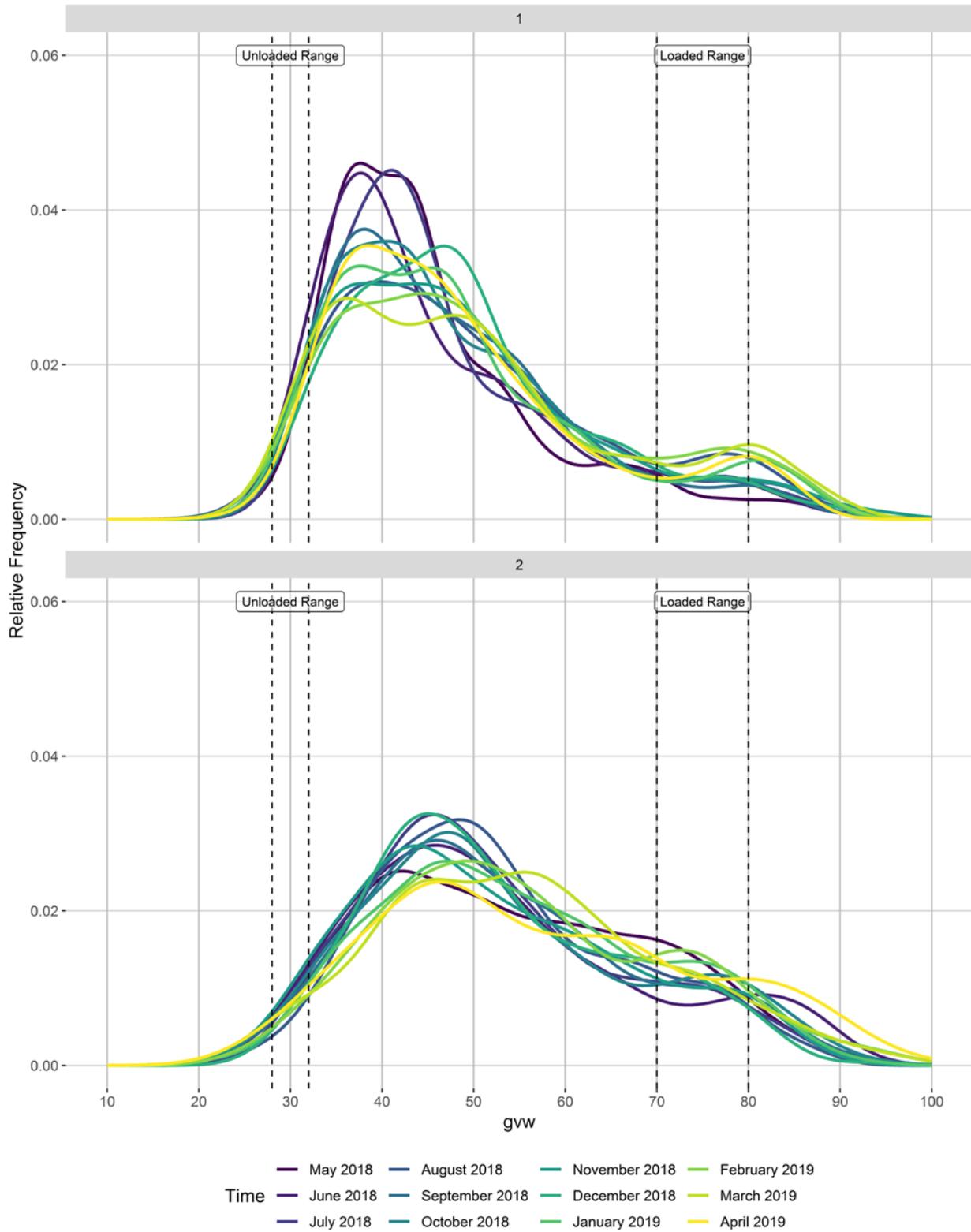
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

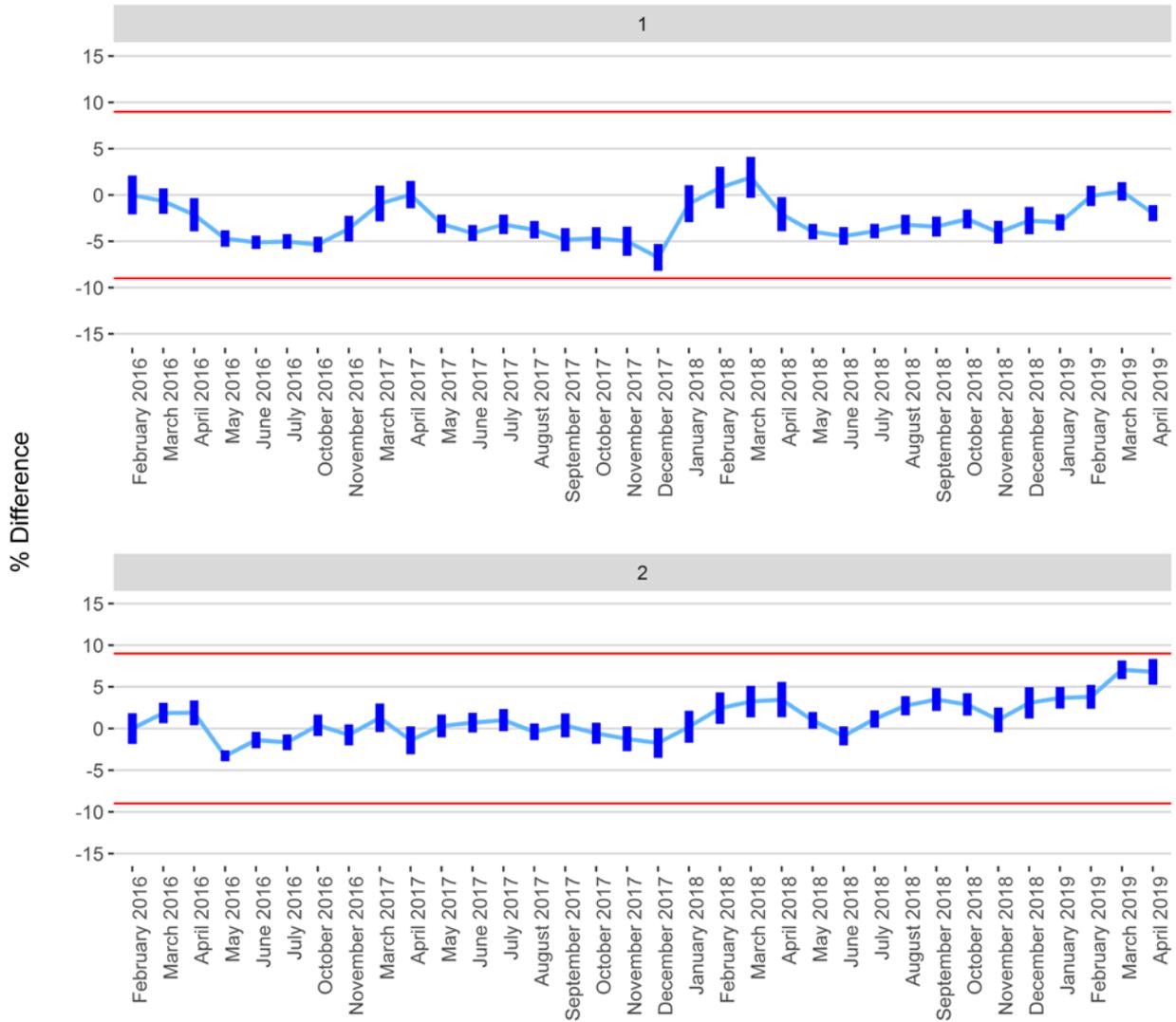
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

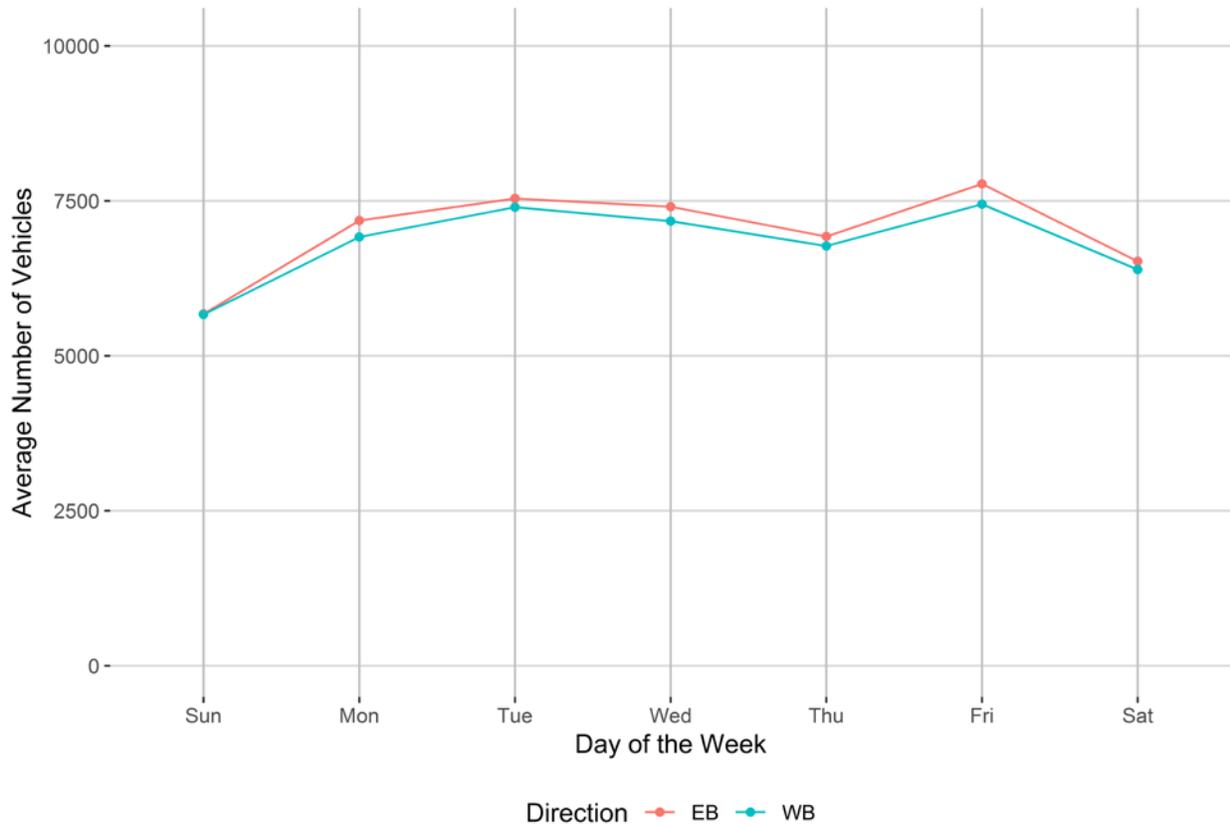


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

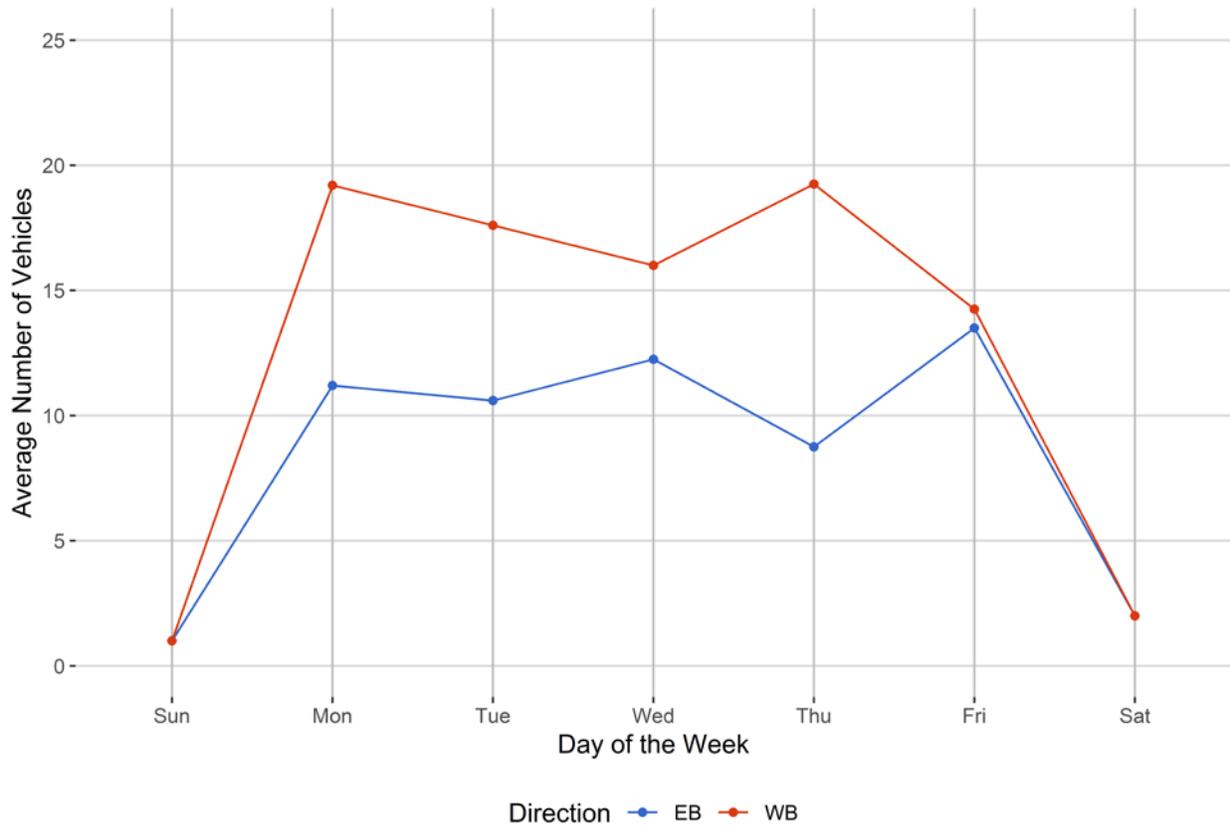


Figure 4 - Passenger Vehicles vs. Hour of the Day

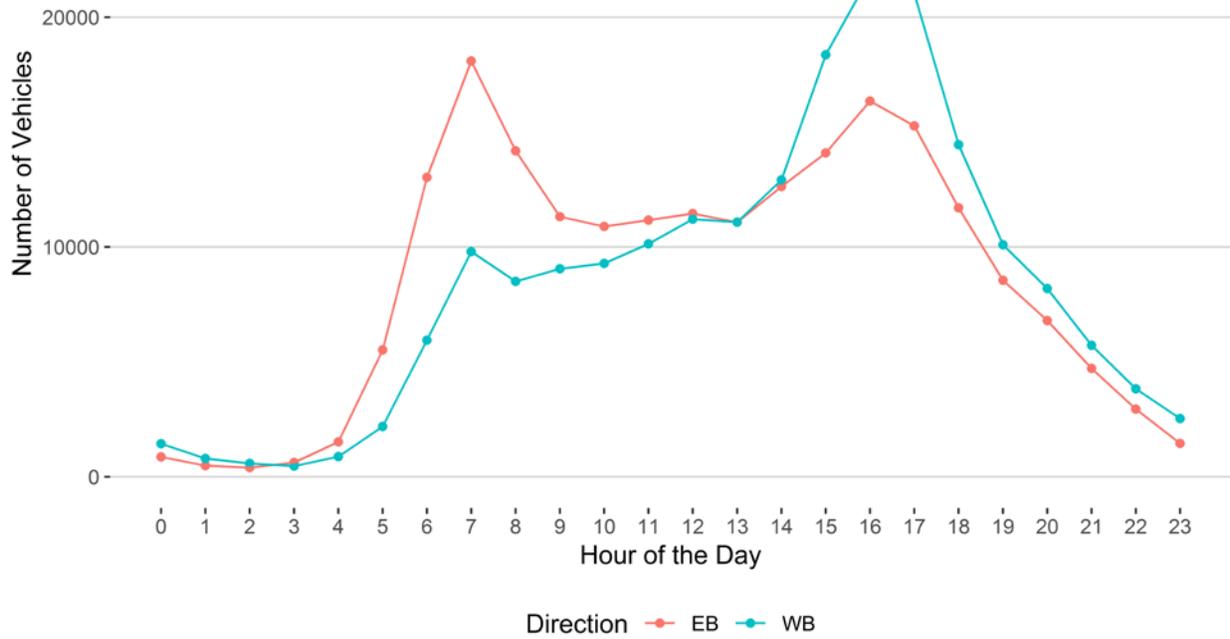


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

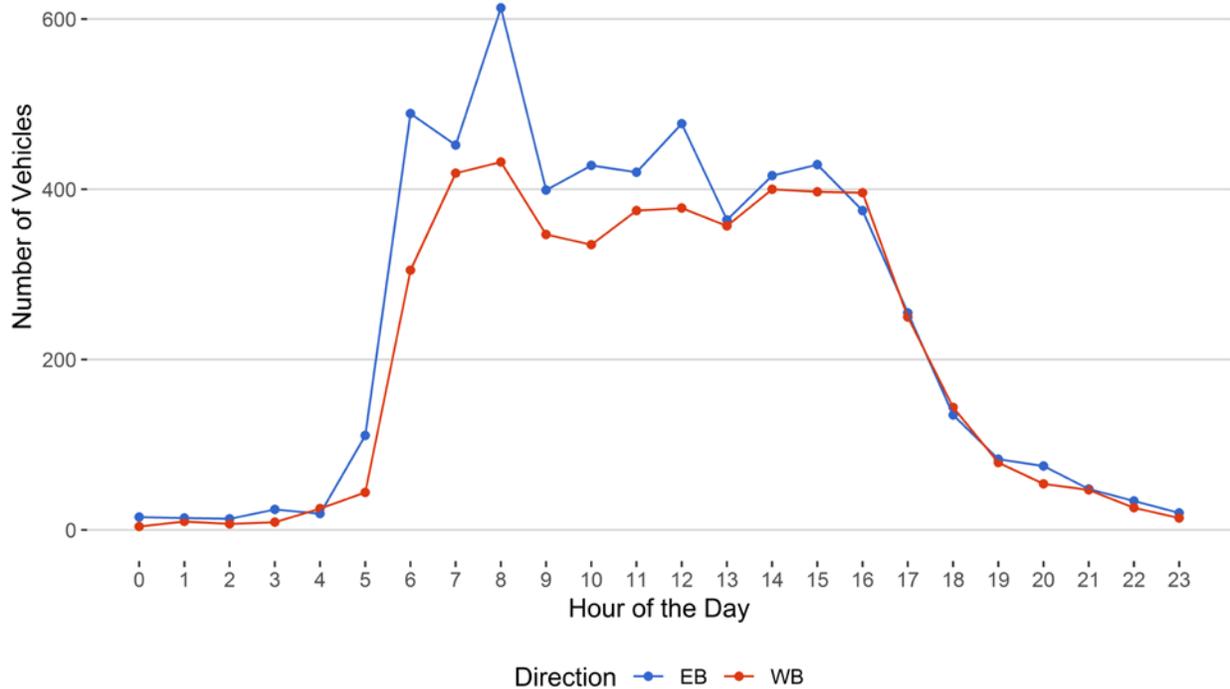


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

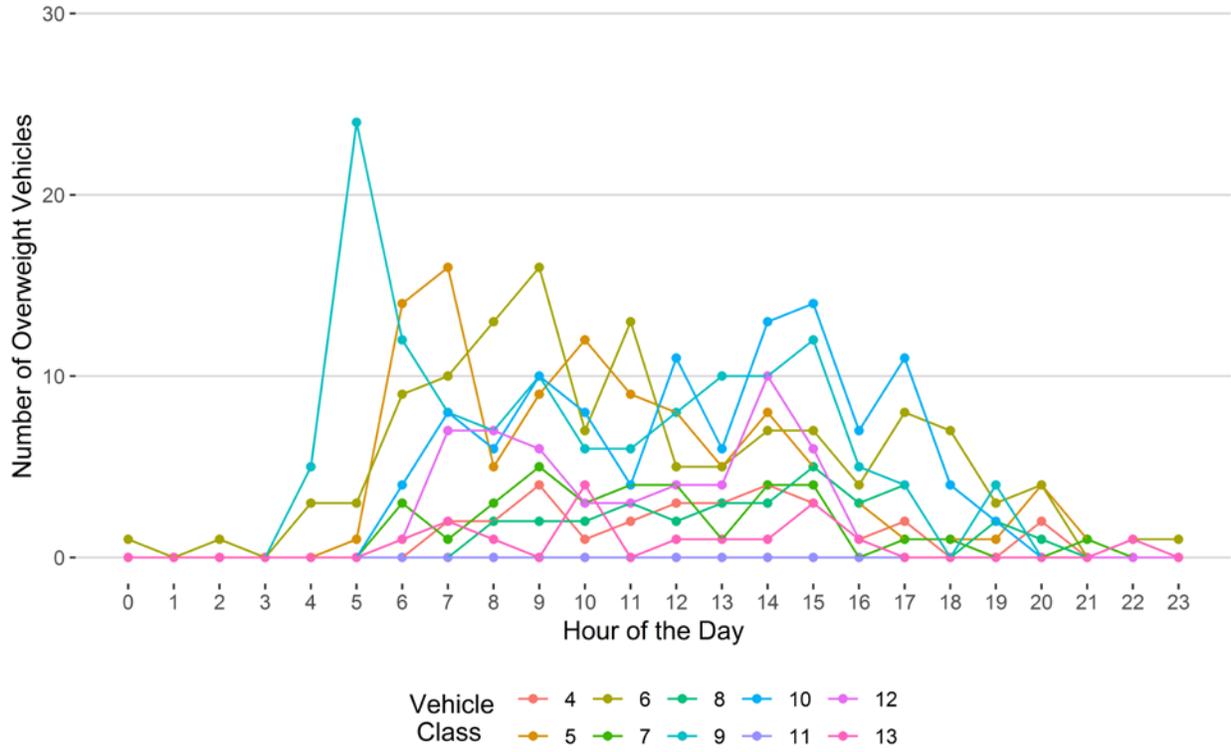


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

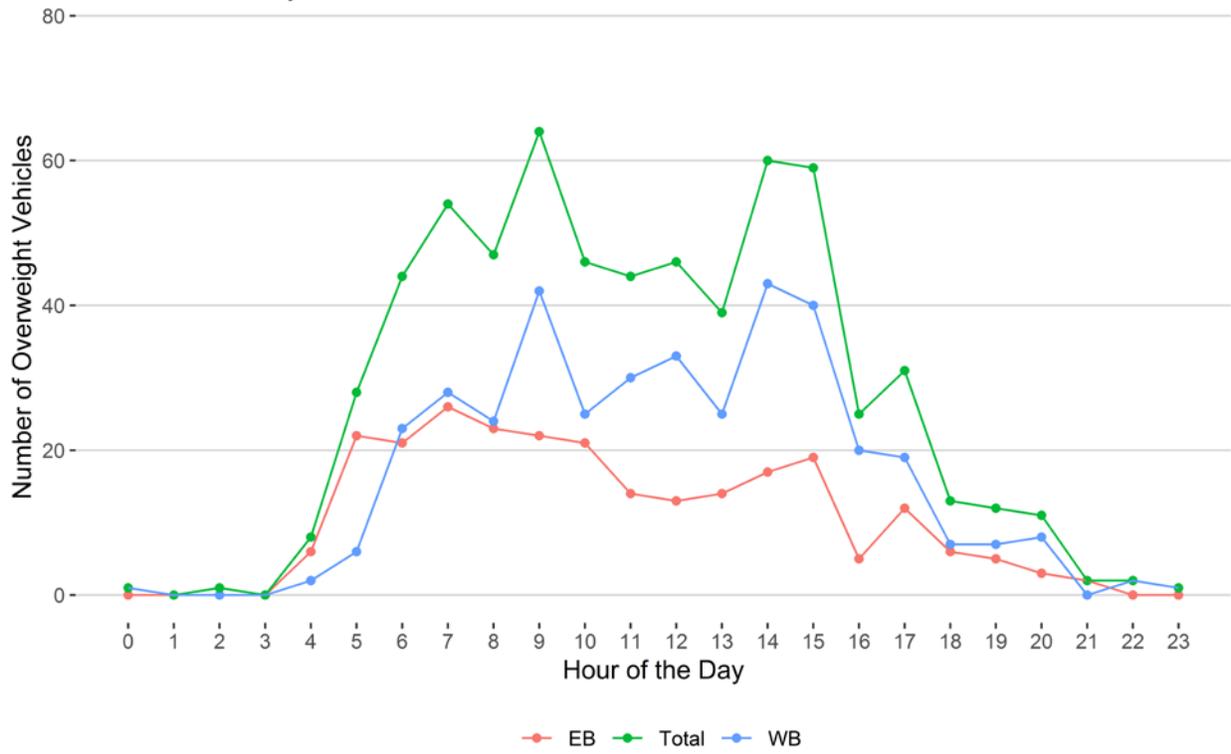
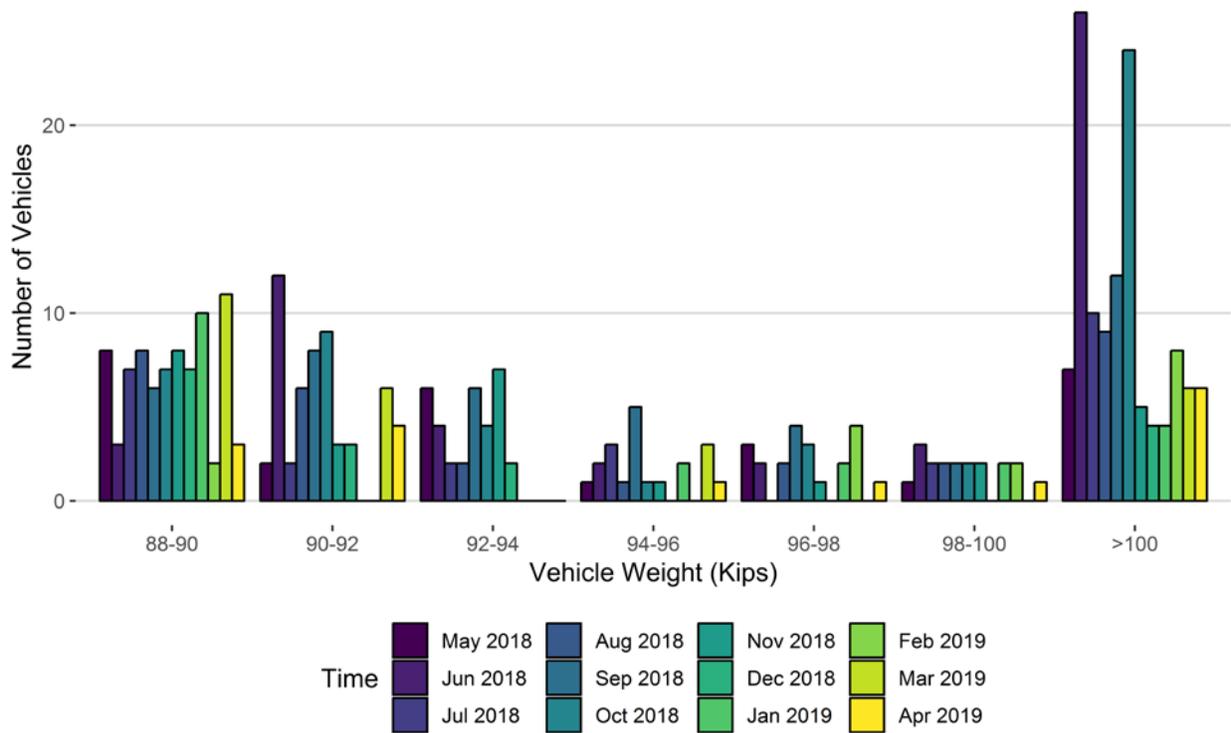
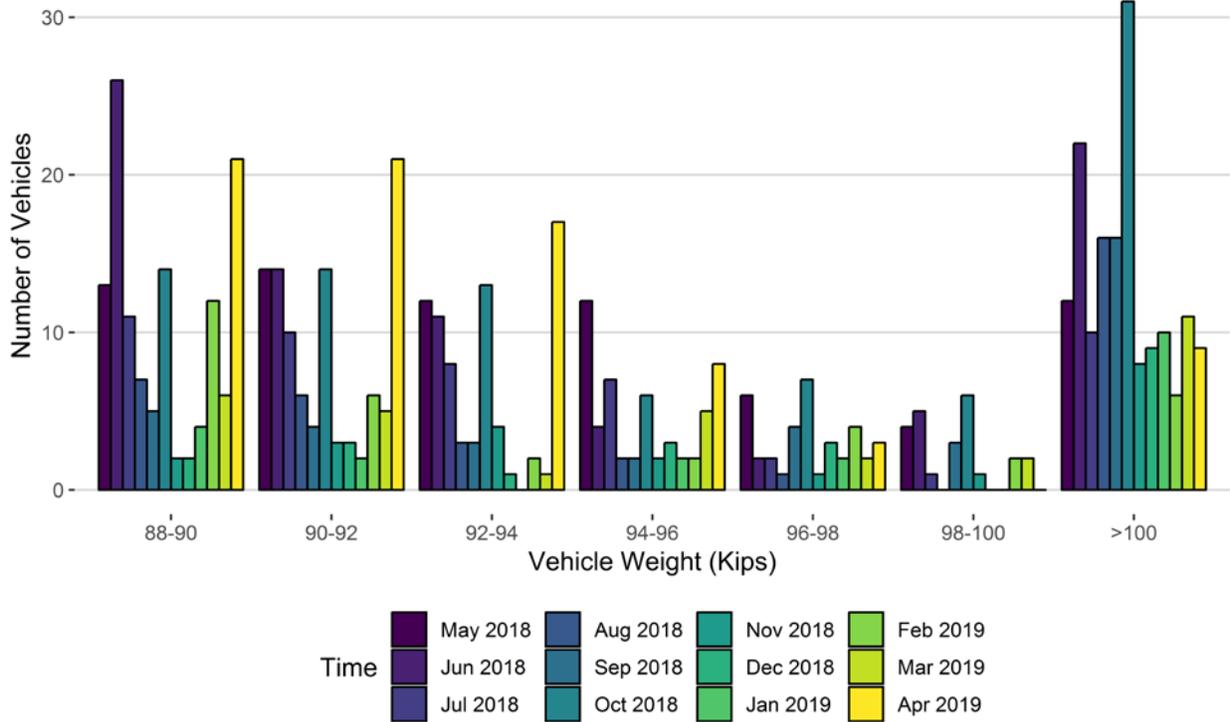


Figure 8 - Histogram of EB Vehicles Over 88,000 Pounds for Current Month



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

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



Vehicle Weights (Kips)	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019
88-90	13	26	11	7	5	14	2	2	4	12	6	21
90-92	14	14	10	6	4	14	3	3	2	6	5	21
92-94	12	11	8	3	3	13	4	1	0	2	1	17
94-96	12	4	7	2	2	6	2	3	2	2	5	8
96-98	6	2	2	1	4	7	1	3	2	4	2	3
98-100	4	5	1	0	3	6	1	0	0	2	2	0
>100	12	22	10	16	16	31	8	9	10	6	11	9
Total	73	84	49	35	37	91	21	21	20	34	32	79

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

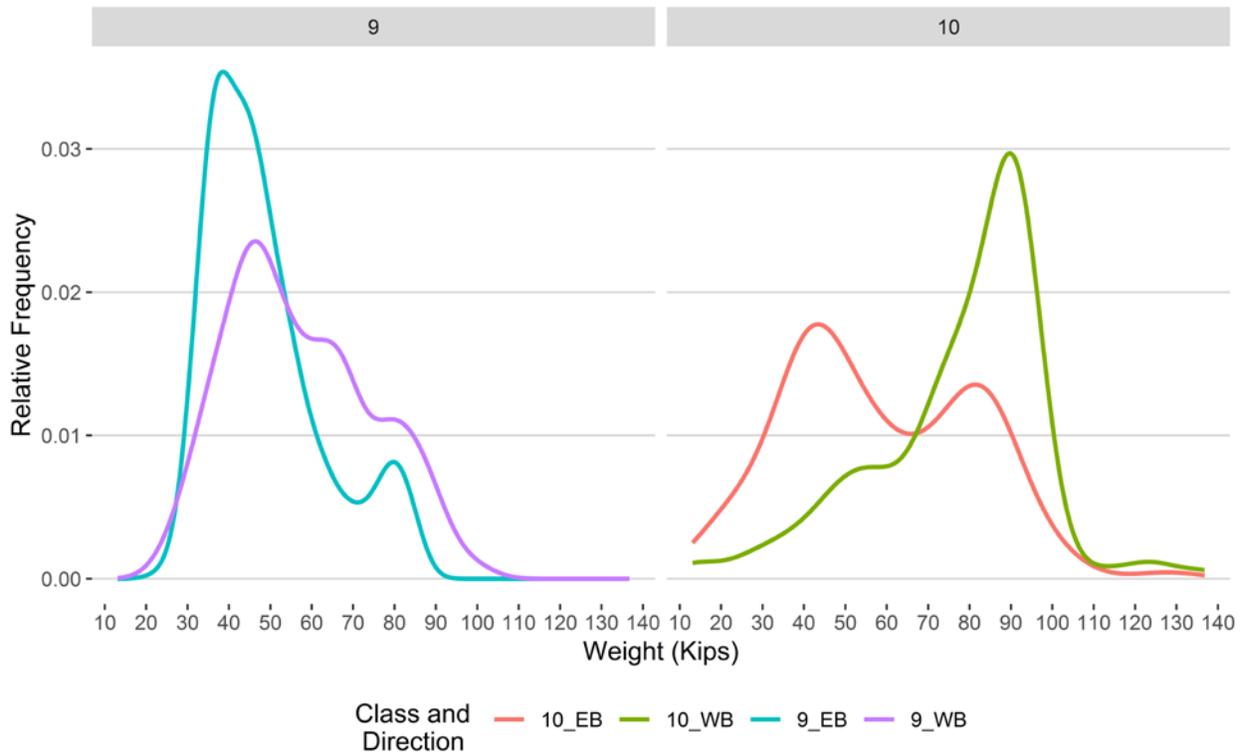


Figure 9 - Freight Percentage by Direction and Class

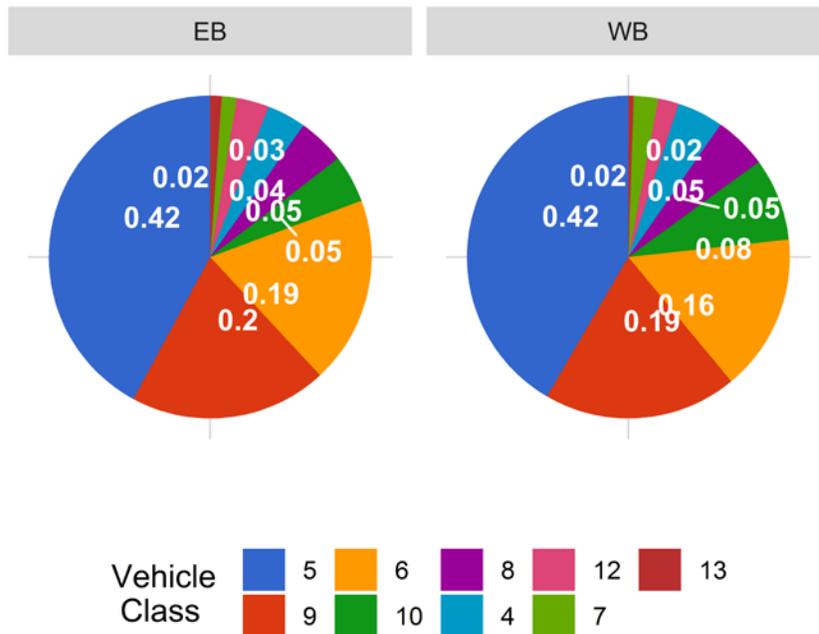


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

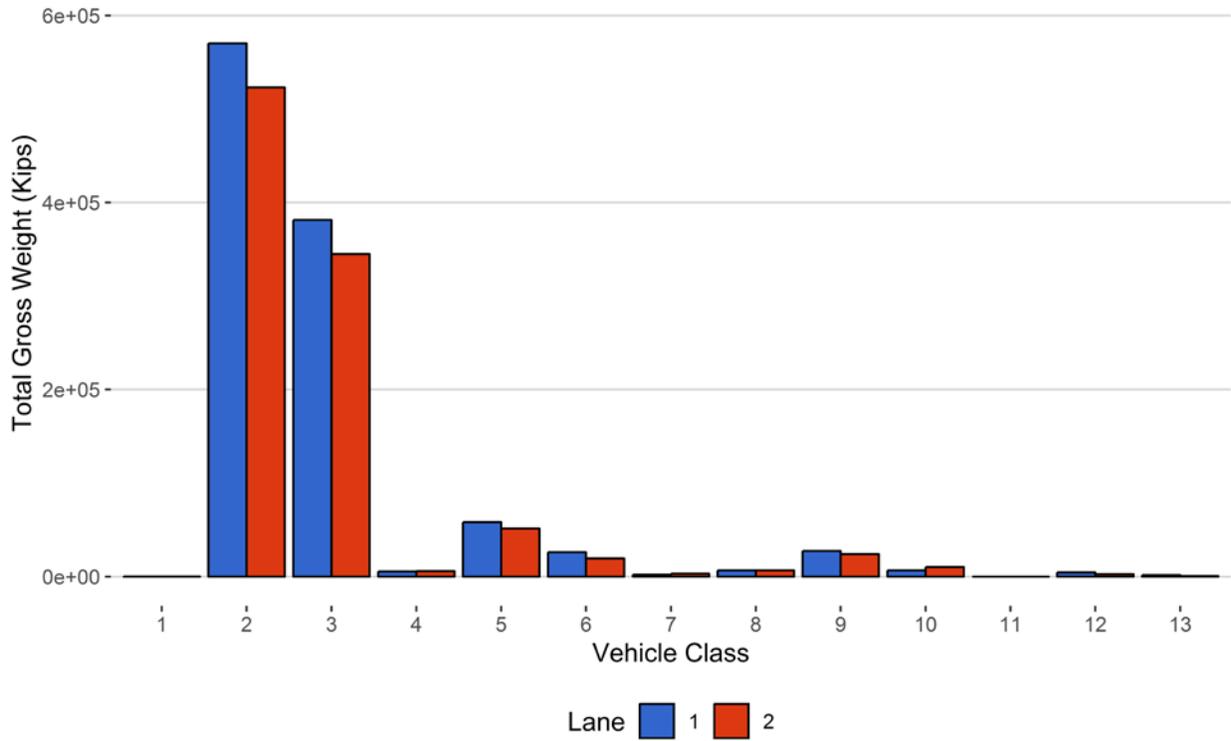


Figure 11 - Total Gross Vehicle Weight t

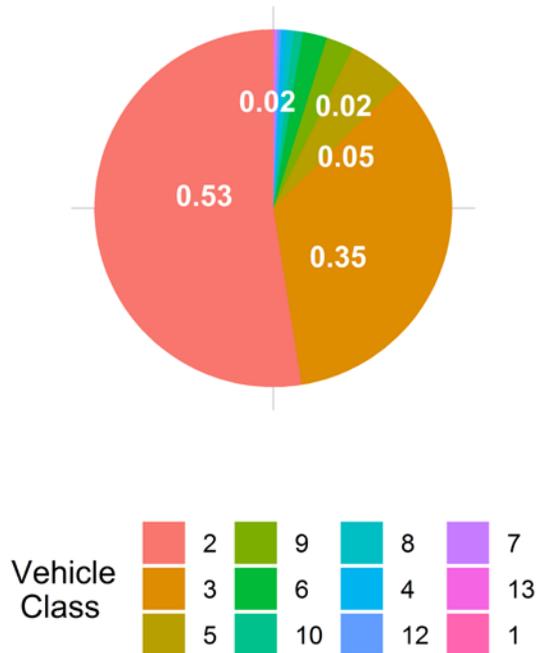


Figure 12 - Total ESALs by Class and Lane

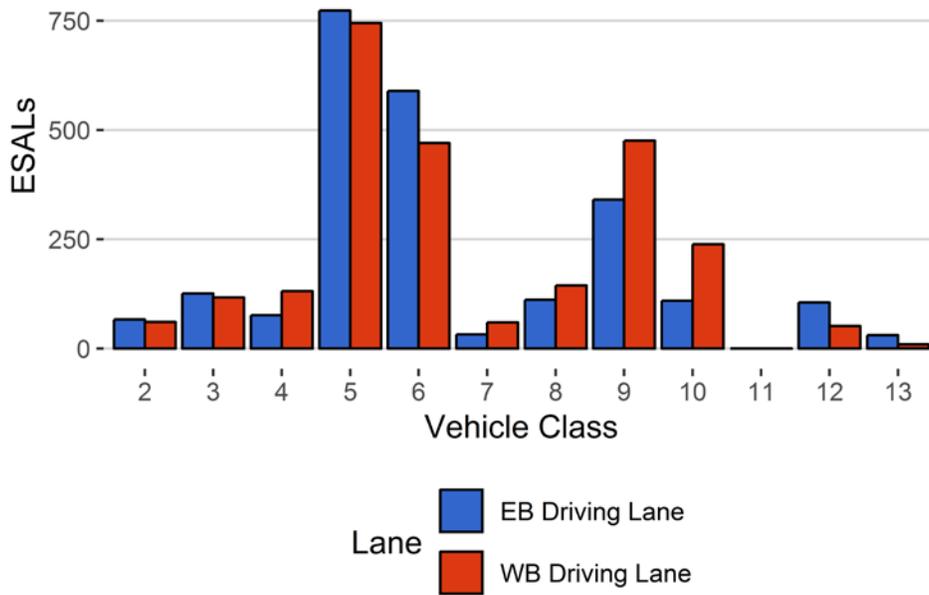


Figure 13 - ESALs by Class

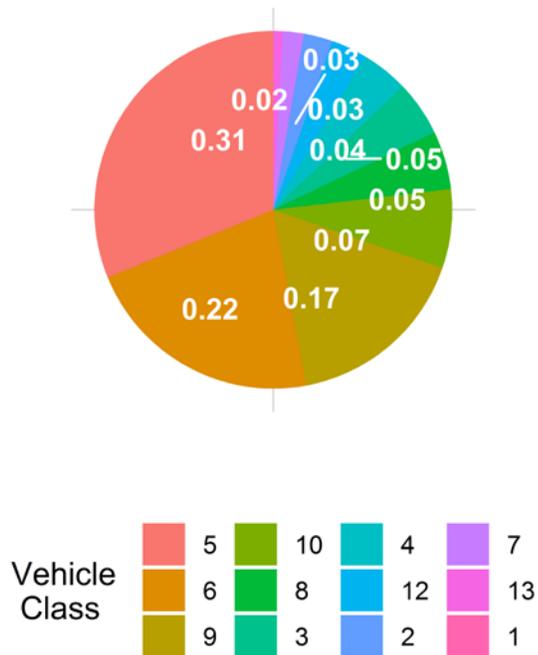


Table 1 Class 9 Front Axle Weight by Lane

<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
February 2019	11.27	-0.11	10.94	3.80
March 2019	11.33	0.38	11.28	7.05
April 2019	11.06	-1.97	11.26	6.80

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	6	184	0	0	0
2	9453	283590	67.5	0	0
3	4193	125790	29.9	0	0
4	12	374	0.1	29	4.6
5	240	7187	1.7	103	16.2
6	41	1226	0.3	128	20.2
7	3	84	0	35	5.5
8	14	424	0.1	32	5
9	33	990	0.2	131	20.7
10	8	247	0.1	108	17
11	0	0	0	0	0
12	3	96	0	52	8.2
13	1	26	0	16	2.5
TOTAL	14007	420217	100	634	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>
2019-04-19	Friday	12:11:04	10	WB	2	136.77
2019-04-10	Wednesday	08:21:40	10	EB	1	127.96
2019-04-15	Monday	12:20:23	10	WB	2	124.37
2019-04-15	Monday	09:35:42	10	WB	2	123.64
2019-04-16	Tuesday	14:51:51	10	WB	2	113.42
2019-04-20	Saturday	08:41:02	10	EB	1	103.01
2019-04-17	Wednesday	10:51:40	10	WB	2	102.68
2019-04-05	Friday	15:46:51	9	WB	2	101.25
2019-04-30	Tuesday	15:39:46	9	WB	2	101.01
2019-04-17	Wednesday	16:57:46	10	EB	1	100.09

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	199	23	11.6	5107	304	1234
5	EB	8	3798	307	8.1	56053	2170	14063
6	EB	19	710	10	1.4	25772	171	6236
7	EB	11.5	34	0	0	2093	0	851
8	EB	31	212	101	47.6	4602	1931	581
9	EB	33	563	35	6.2	26305	1072	4440
10	EB	33.5	113	11	9.7	6371	249	1477
12	EB	36.5	61	0	0	4483	0	1128
13	EB	31.5	18	0	0	1574	0	503
TOTAL	****	****	5708	487	****	132360	****	30513
<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	172	17	9.9	5479	230	1577
5	WB	8	3327	242	7.3	49678	1678	12499
6	WB	19	505	8	1.6	19289	143	4923
7	WB	11.5	49	0	0	3038	0	1237
8	WB	31	208	101	48.6	4535	2011	609
9	WB	33	419	24	5.7	23254	707	5110
10	WB	33.5	132	5	3.8	10106	111	2926
12	WB	36.5	34	0	0	2561	0	660
13	WB	31.5	8	0	0	647	0	197
TOTAL	****	****	4854	397	****	118588	****	29739
GRAND TOTAL	****	****	10562	884	162	250948	10776	60251

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>
1	114	79	193	0
2	570316	523129	1093444	52.5
3	381395	344858	726253	34.9
4	5411	5709	11120	0.5
5	58223	51356	109579	5.3
6	25943	19432	45375	2.2
7	2093	3038	5131	0.2
8	6533	6545	13078	0.6
9	27377	23961	51338	2.5
10	6619	10217	16837	0.8
12	4483	2561	7044	0.3
13	1574	647	2220	0.1
TOTAL	1090081	991533	2081614	100
GVW/LANE	52.37	47.63	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>
1	0	0	0	0	0.0055
2	67	61	128	2.6	9e-04
3	126	117	243	5	0.004
4	76	131	208	4.3	1.13
5	773	745	1518	31.2	0.43
6	589	470	1060	21.8	1.76
7	32	60	93	1.9	2.16
8	112	144	256	5.3	1.23
9	341	475	816	16.8	1.67
10	109	239	348	7.2	2.8
12	106	52	157	3.2	3.08
13	31	10	41	0.8	2.44
TOTAL	2363	2505	4868	100	17
ESALS/LANE	48.5	51.5	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>
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
Feb 2019	343809	12279	328	334638	97.3	9170.8	2.7
Mar 2019	385777	12444	295	376642	97.6	9135	2.4
Apr 2019	420217	14007	355	409564	97.5	10653.3	2.5
TOTAL	4978608	-	-	4837227	-	141380	-
AVERAGE	414884	13634	387	403102	97	11782	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>
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
Feb 2019	4402	4199	8602	1.1
Mar 2019	3766	2953	6720	2.1
Apr 2019	2374	2514	4888	15.4
TOTAL	39109	-	-	-
AVERAGE	3259	3193	6452	5

Gross Vehicle Weight

<i>Month</i>	<i>GVW EB Driving Lane</i>	<i>GVW WB Driving Lane</i>	<i>Total GVW Kips</i>
May 18	1258909	1200368	2459277
Jun 18	1209273	1130898	2340171
Jul 18	1148174	1088707	2236882
Aug 18	1178091	1105327	2283419
Sep 18	1098955	1038371	2137326
Oct 18	1212321	1140085	2352405
Nov 18	1022767	962848	1985615
Dec 18	996068	942253	1938320
Jan 19	1857683	1759530	3617213
Feb 19	1787044	1662299	3449343
Mar 19	1664007	1419392	3083399
Apr 19	1090589	993366	2083955
TOTAL	15523881	14443445	29967326
AVERAGE	1293657	1203620	2497277

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>
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
Feb 2019	1106	0.2	5.9	54	22
Mar 2019	832	0.1	5.3	58	19
Apr 2019	638	0.2	5.8	95	16
TOTAL	10876	-	-	938	333
AVERAGE	906.3	0.2	6.4	78.2	27.8

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>
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
Feb 2019	51615	45267	96882	53.3	46.7
Mar 2019	44907	35204	80111	56.1	43.9
Apr 2019	30513	29739	60251	50.6	49.4
TOTAL	492620	478971	971591	-	-
AVERAGE	41051.7	39914.2	80965.9	51	49