

SEPTEMBER 2018



**WIM #33
US 212, MP 78.5
OLIVIA, MN**

**MONTHLY
REPORT**



Your Destination...Our Priority



WIM Site Location

WIM #33 is located on US 212 near Olivia in Renville county.

System Operation

WIM #33 was operational for the entire month of September 2018. Volume was computed using all monthly data.

System Calibration

WIM #33 was most recently calibrated on 2015-06-17. 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: 159803 | Passenger Vehicles: 136968 | Heavy Commercial Vehicles: 22835

Monthly Average Daily Traffic (MADT): 5327 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 761

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 Mondays. 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 03 PM 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 03 PM 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 9's and Class 5's.

Overweight HCVs

Volume trends. Of a total of 22835 HCVs, 3443 of them were overweight³. These overweight HCVs contributed to 2.2% of total monthly volume, and 15.1% 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 Wednesdays, with lowest volumes reported on Saturdays. See Figure 3 . The top two overweight violators by class were the class 13 and class 9 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 66.1% 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 December.

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 ,182 EB vehicles exceeded 88,000 pounds (140 vehicles were Class 13's; 24 vehicles were Class 10's). Of vehicles traveling WB,

1498 EB vehicles exceeded 88,000 pounds (1459 vehicles were Class 13's; 34 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from September 2018.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in September 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 228355 tons of freight was recorded to have crossed the WIM. More freight was shipped WB (58.1%) than EB (41.9%). See Table 4 and Figure 11 for more freight information.

Infrastructure Considerations

Bridge. Bridge No. 6299 (a box culvert) is approximately 13.4 miles east of WIM #33, and Bridge No. 96640 (a box culvert) is 2.5 miles west of WIM #33. WIM #33 recorded a total of 159803 vehicles with a combined GVW of 1707873 kips (1 kip = 1,000 pounds = 0.5 tons) in September 2018. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 17371 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 51.8% of all ESALs were recorded WB while 48.2% was observed EB. In particular, 66% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 38% 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).

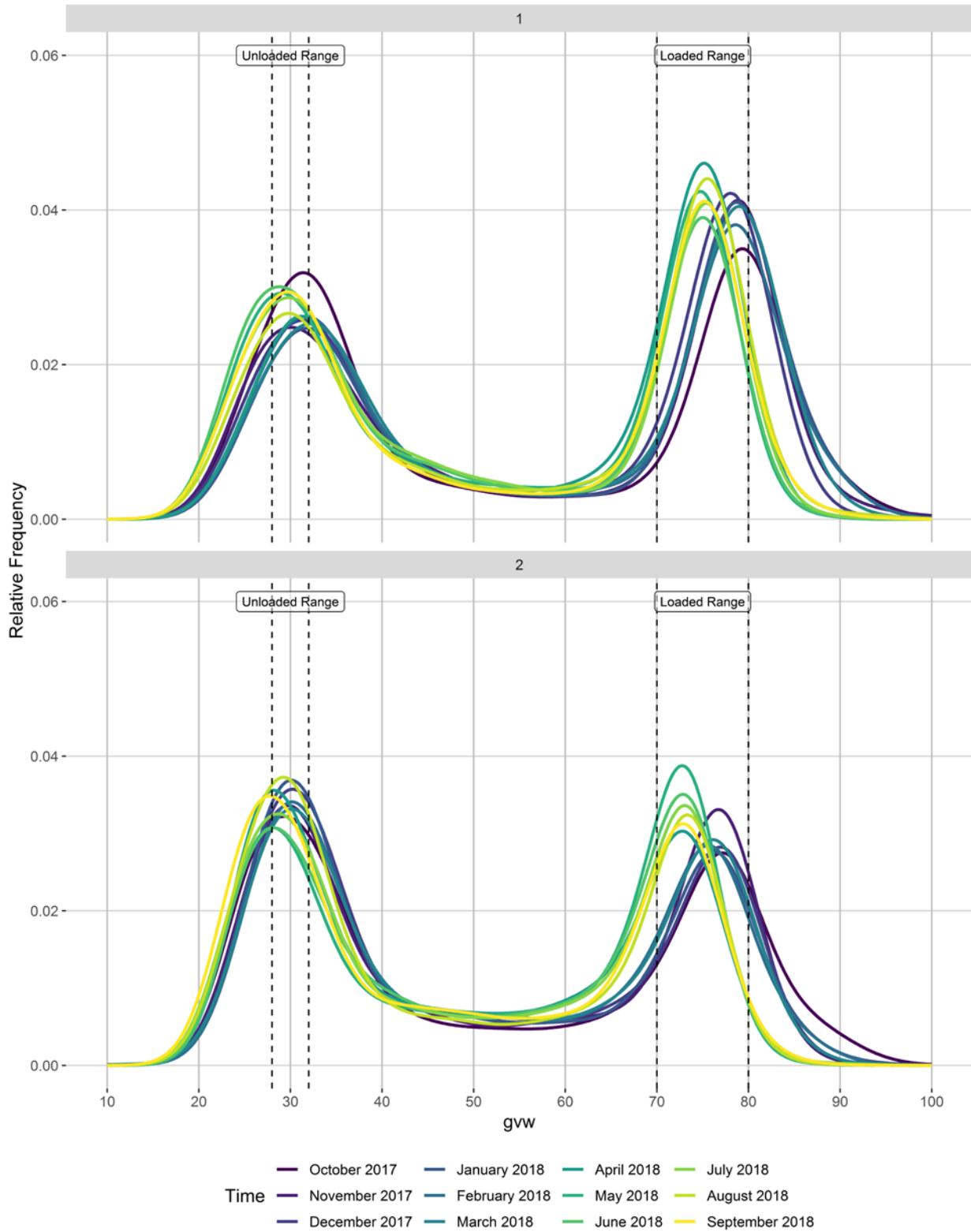
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

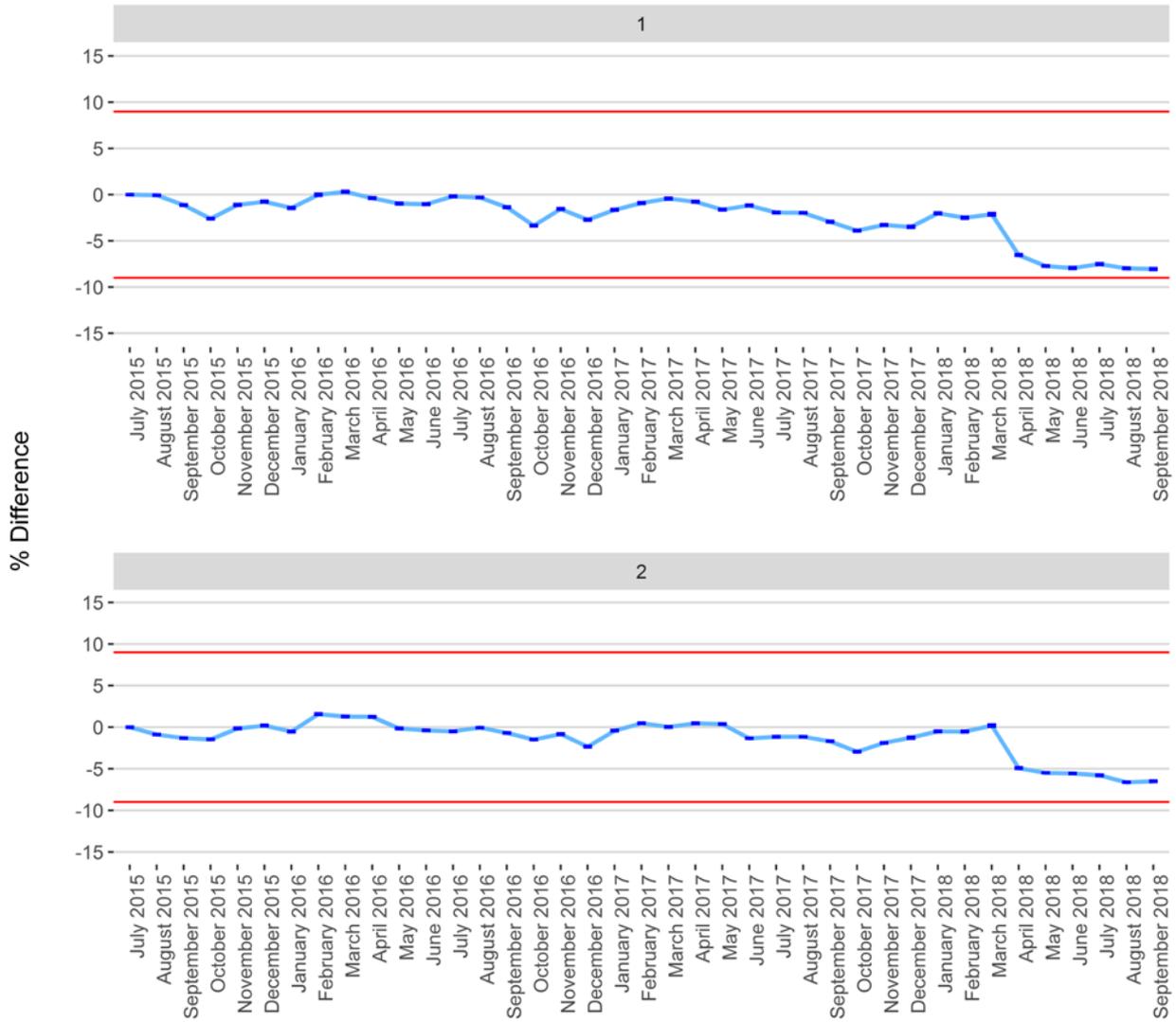
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

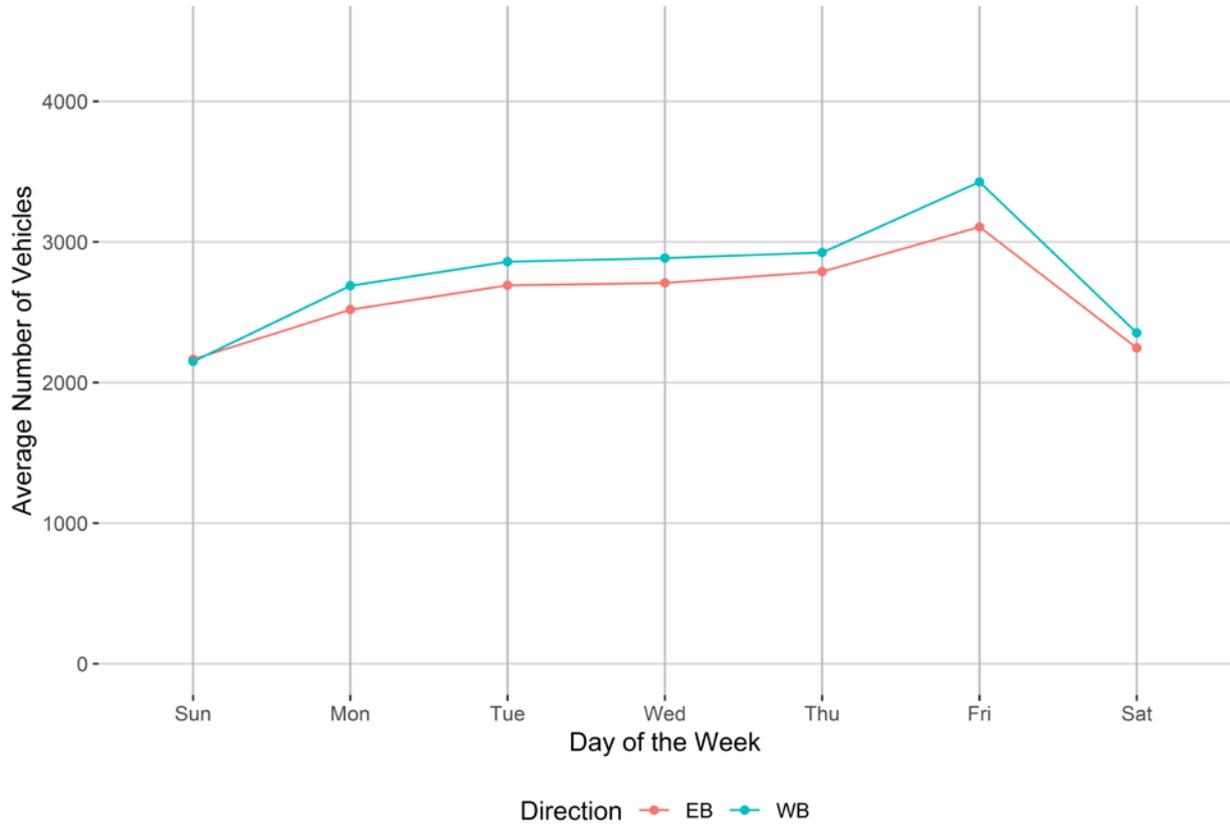


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

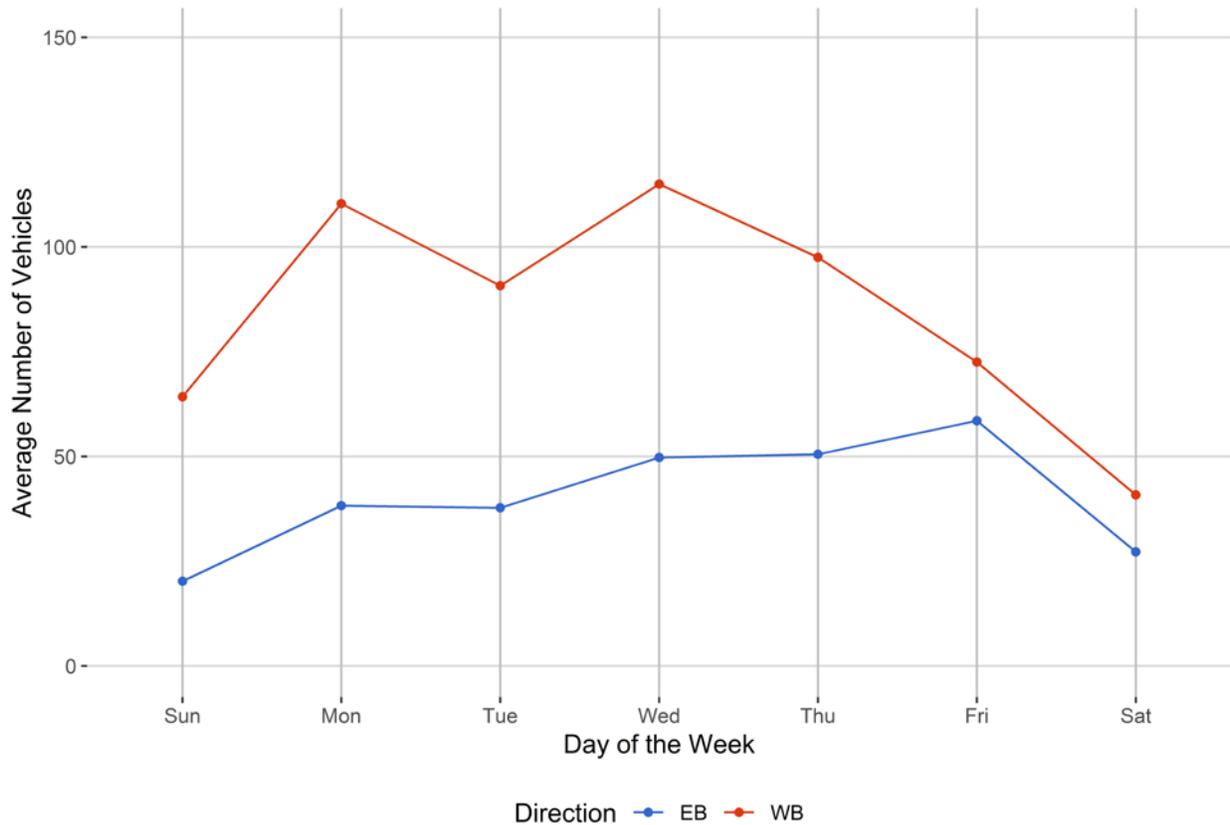


Figure 4 - Passenger Vehicles vs. Hour of the Day

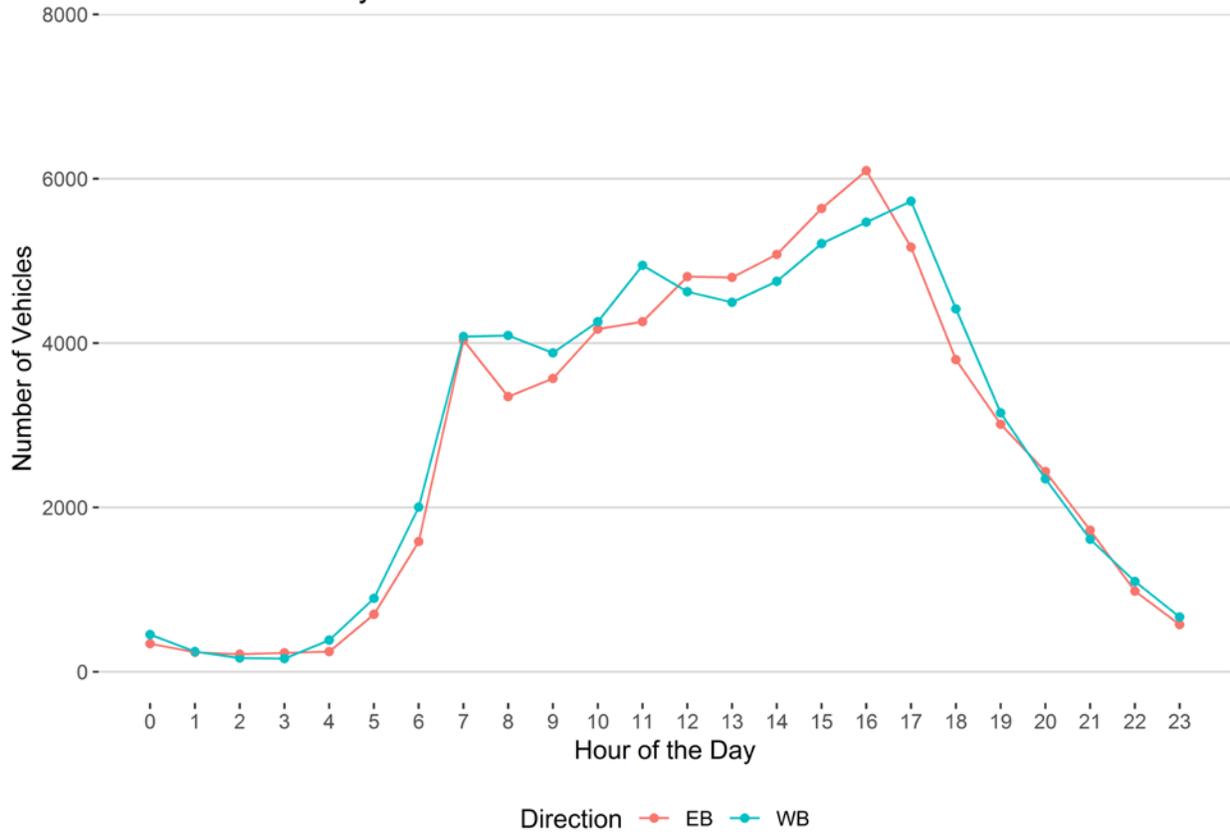


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

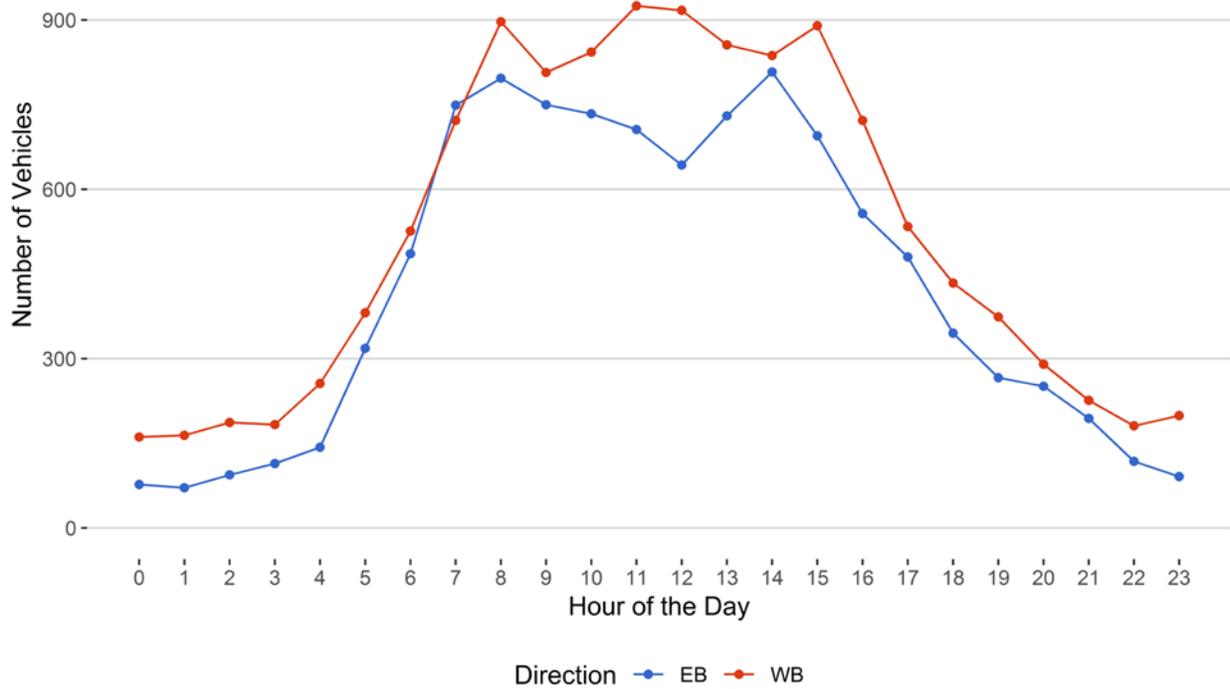


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

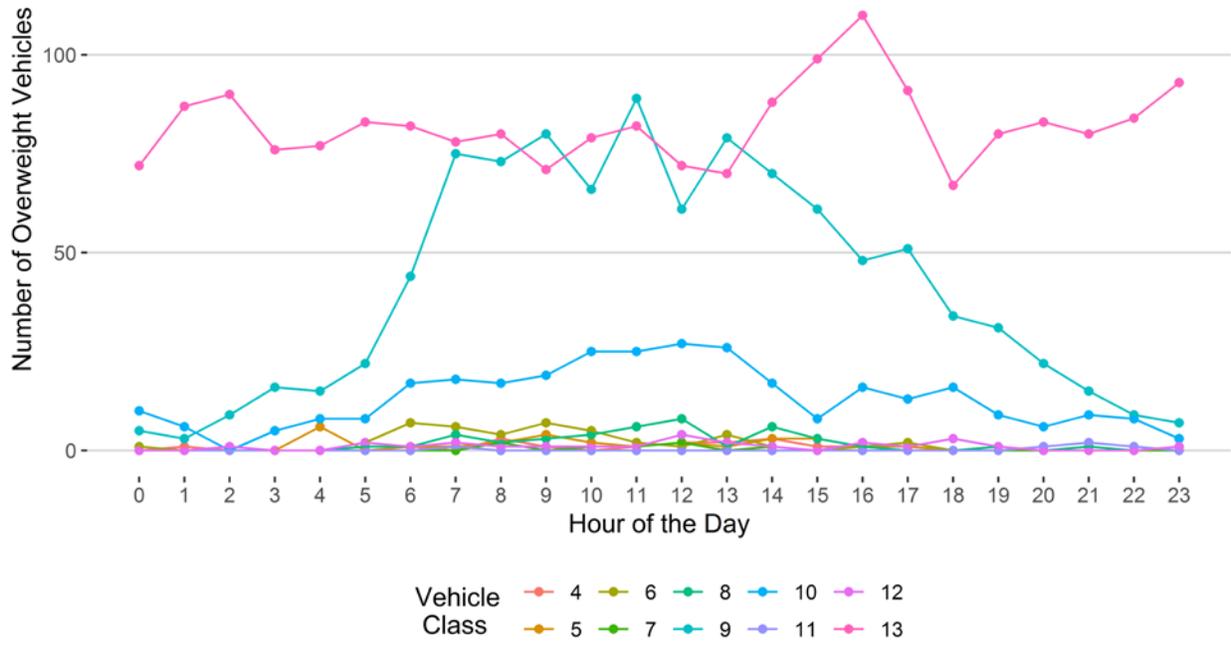


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

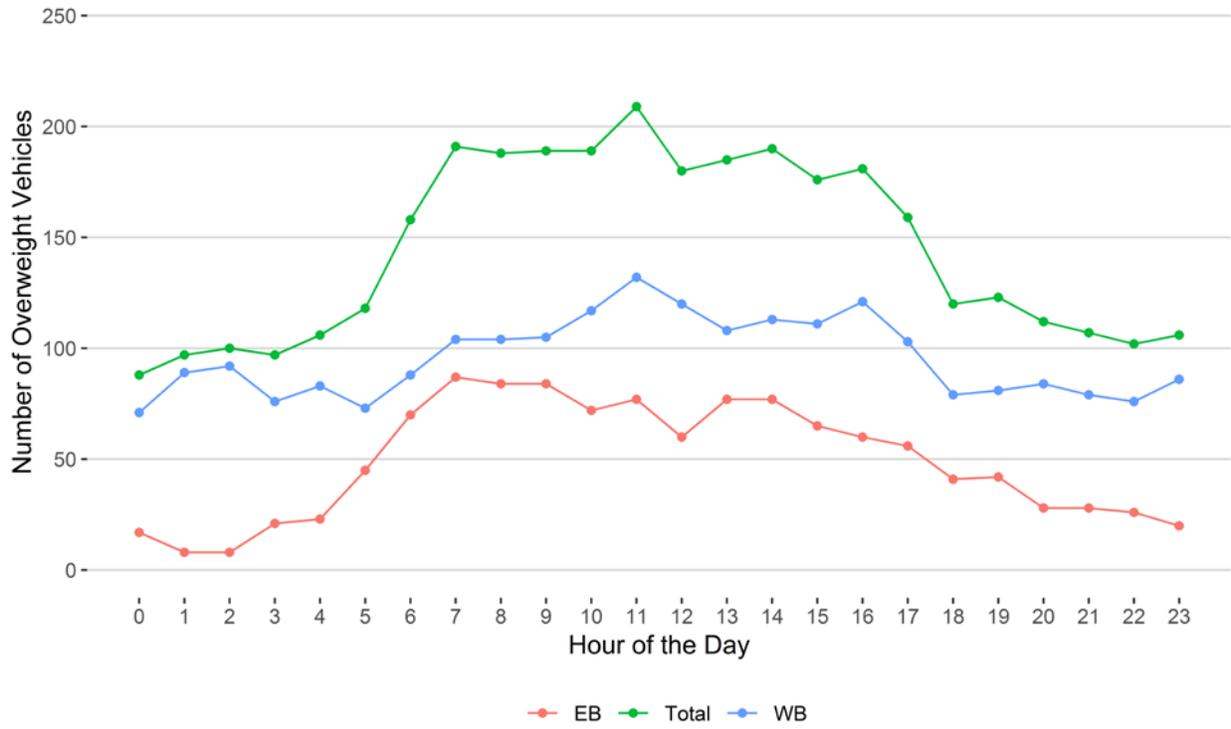
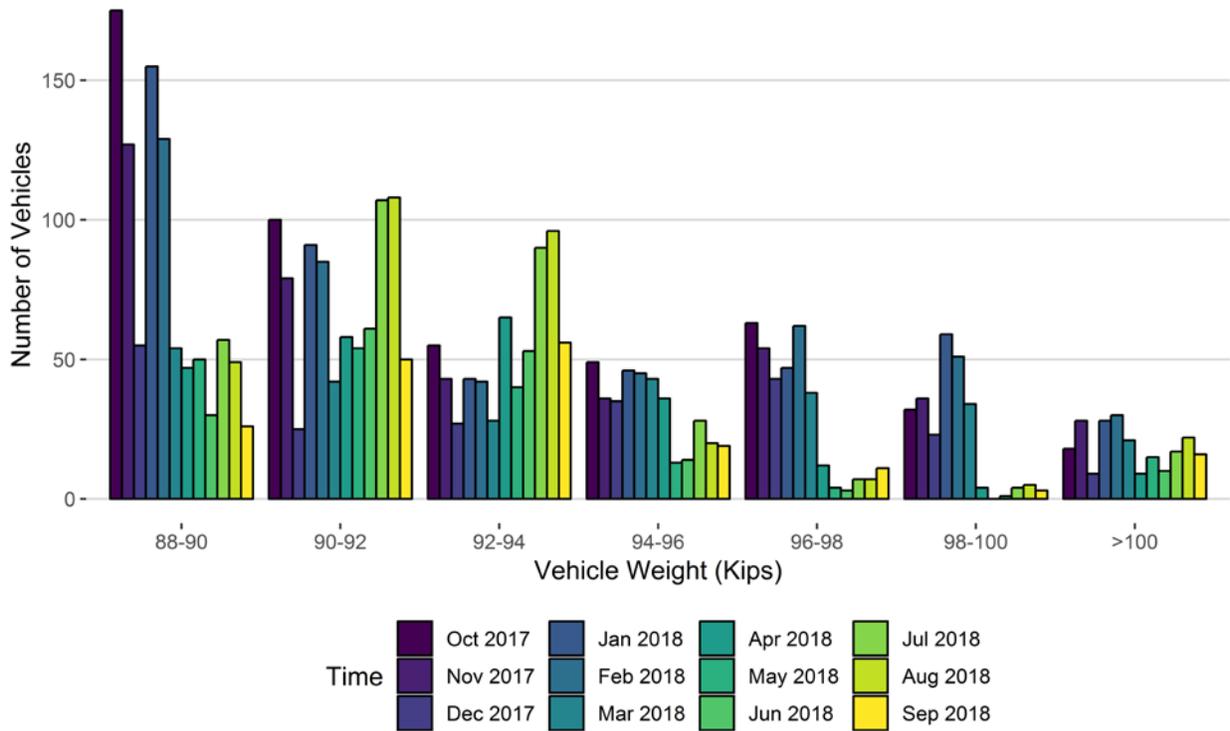
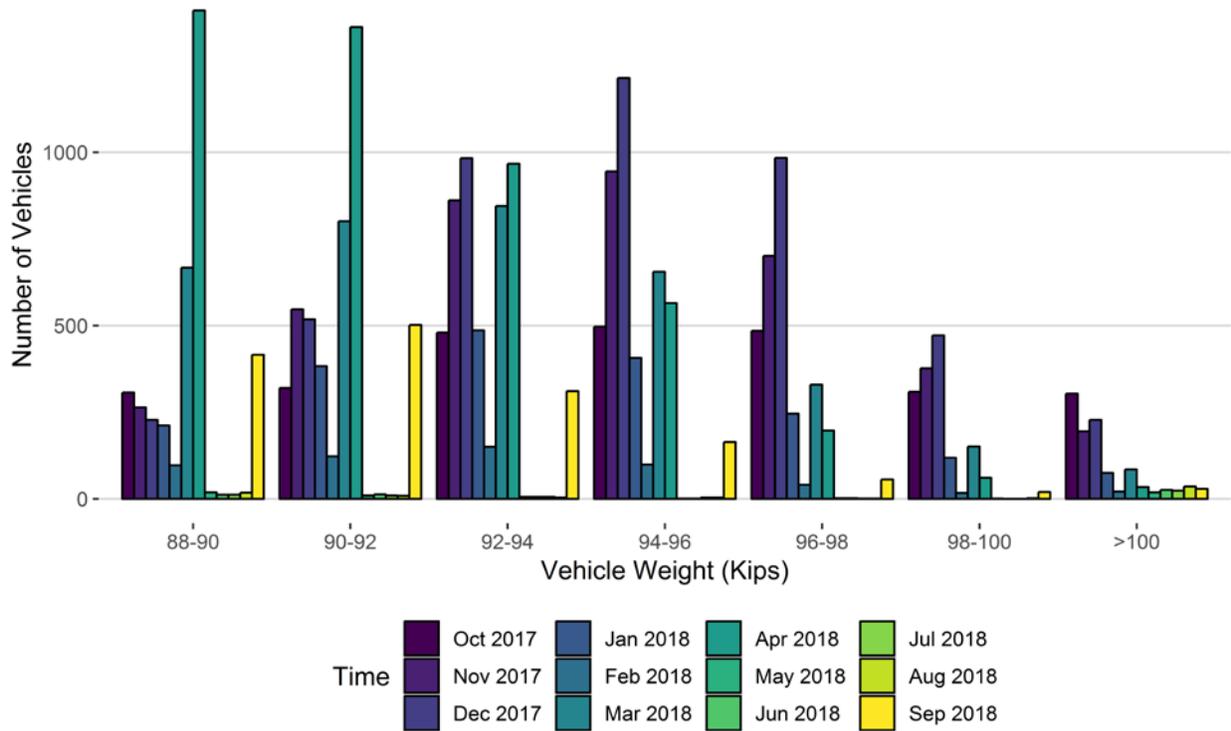


Figure 8 - Histogram of EB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018
88-90	175	127	55	155	129	54	47	50	30	57	49	26
90-92	100	79	25	91	85	42	58	54	61	107	108	50
92-94	55	43	27	43	42	28	65	40	53	90	96	56
94-96	49	36	35	46	45	43	36	13	14	28	20	19
96-98	63	54	43	47	62	38	12	4	3	7	7	11
98-100	32	36	23	59	51	34	4	0	1	4	5	3
>100	18	28	9	28	30	21	9	15	10	17	22	16
Total	492	403	217	469	444	260	231	176	172	310	307	181

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



Vehicle Weights (Kips)	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018
88-90	307	264	228	212	97	667	1409	19	12	12	18	416
90-92	320	547	518	383	123	801	1361	10	13	10	9	502
92-94	480	861	983	486	150	845	967	6	6	6	4	311
94-96	497	945	1214	407	99	655	565	1	1	4	4	164
96-98	485	701	984	246	41	330	197	2	2	1	1	56
98-100	309	377	472	119	17	151	61	1	0	0	2	20
>100	304	195	228	75	21	85	34	19	26	24	36	29
Total	2702	3890	4627	1928	548	3534	4594	58	60	57	74	1498

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

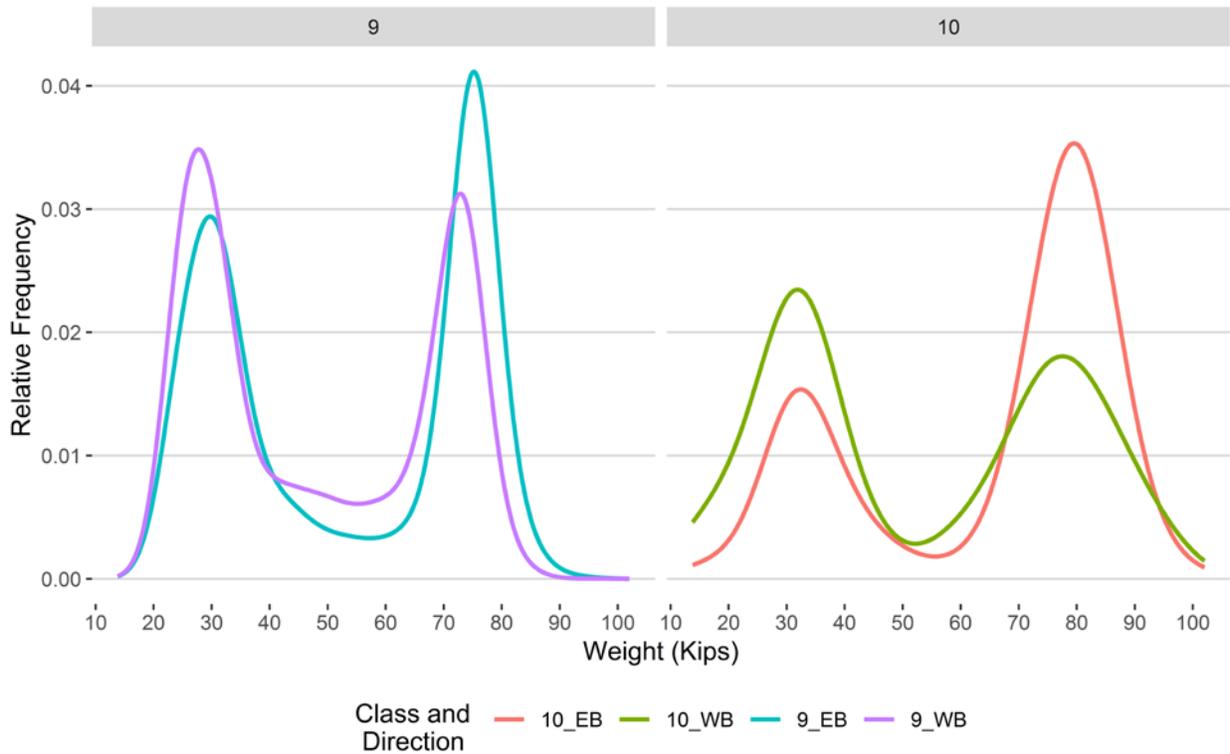


Figure 9 - Freight Percentage by Direction and Class

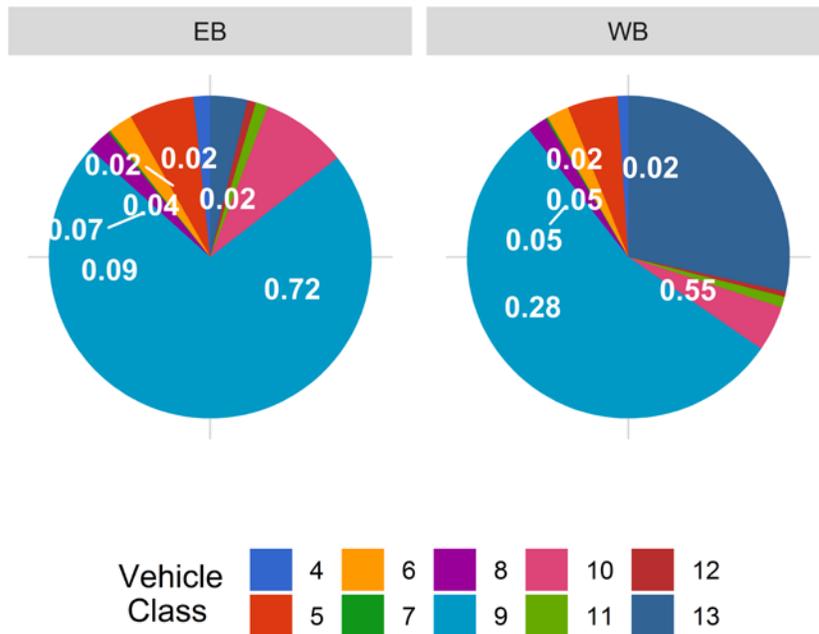


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

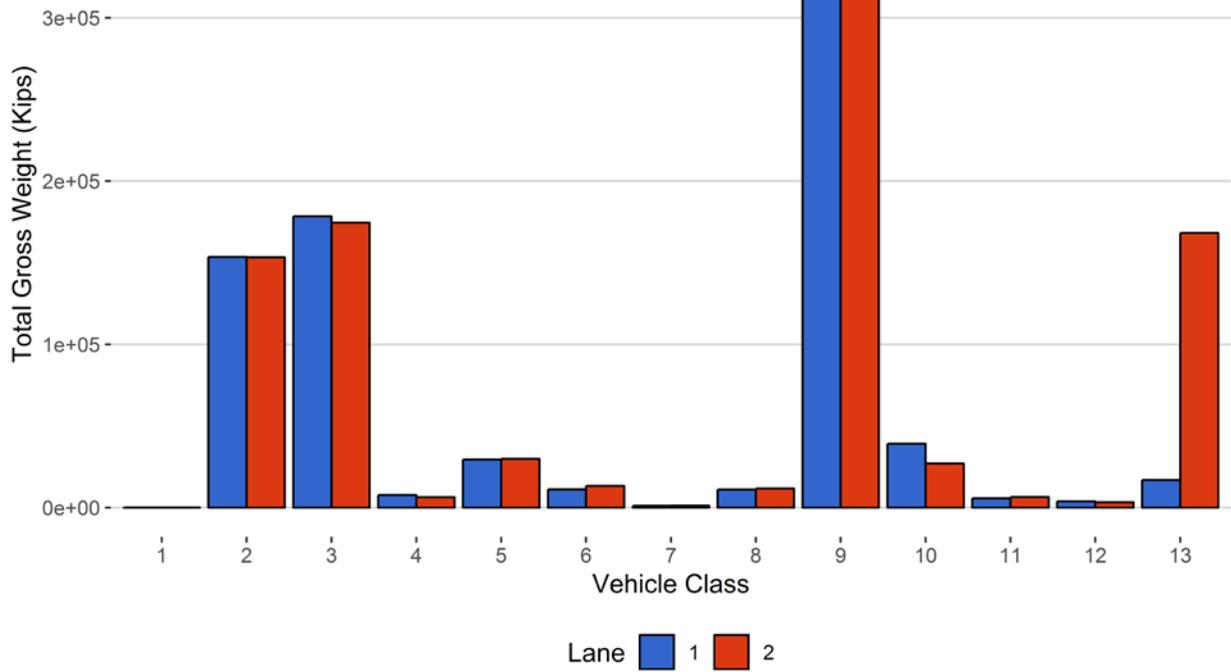


Figure 11 - Total Gross Vehicle Weight t

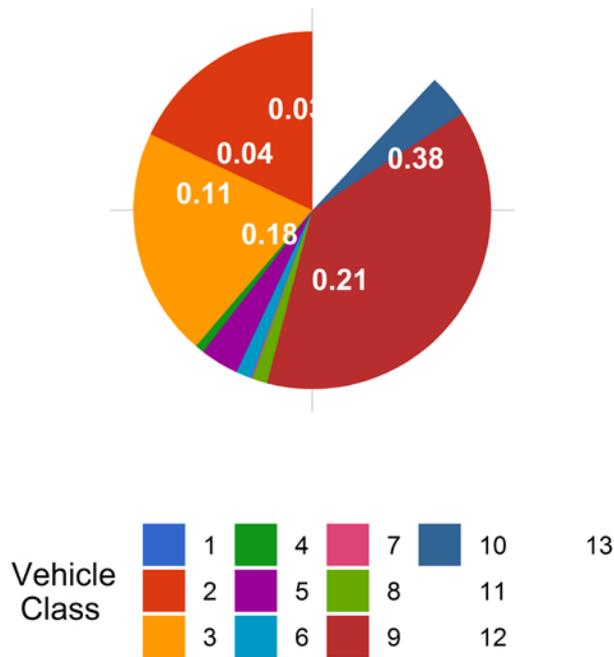


Figure 12 - Total ESALs by Class and Lane

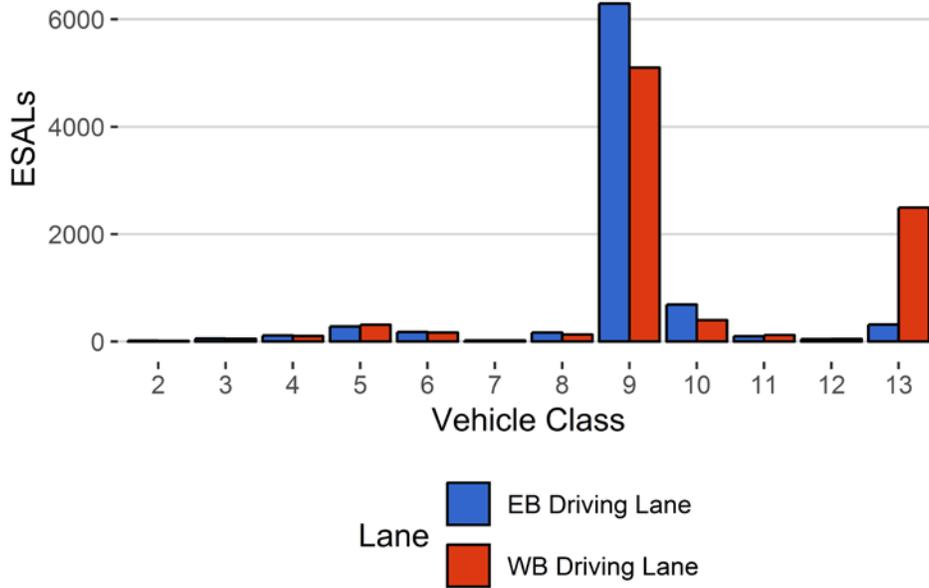


Figure 13 - ESALs by Class

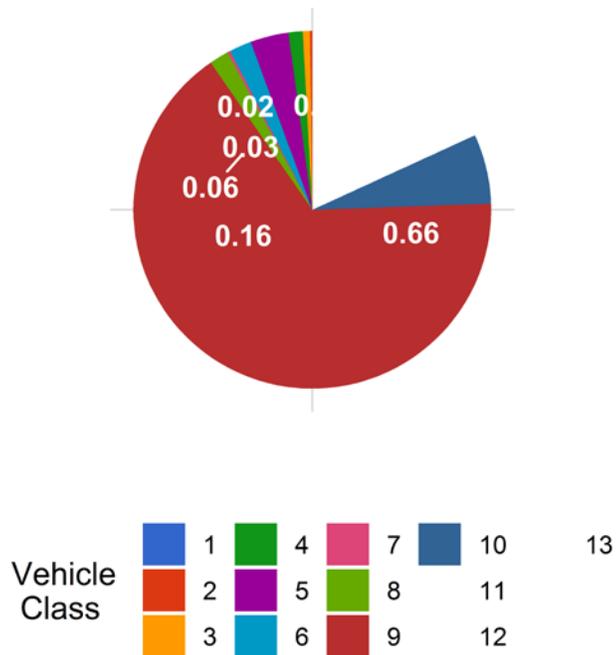


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
July 2015	11.76	0.00	10.98	0.00
August 2015	11.75	-0.07	10.89	-0.88
September 2015	11.62	-1.13	10.84	-1.31
October 2015	11.45	-2.60	10.82	-1.46
November 2015	11.63	-1.12	10.97	-0.15
December 2015	11.67	-0.76	11.00	0.20
January 2016	11.59	-1.44	10.92	-0.53
February 2016	11.76	-0.01	11.16	1.58
March 2016	11.79	0.31	11.12	1.28
April 2016	11.71	-0.37	11.12	1.23
May 2016	11.64	-0.97	10.97	-0.15
June 2016	11.64	-1.04	10.94	-0.39
July 2016	11.74	-0.19	10.93	-0.49
August 2016	11.72	-0.31	10.98	-0.05
September 2016	11.60	-1.36	10.91	-0.69
October 2016	11.36	-3.35	10.82	-1.48
November 2016	11.58	-1.55	10.89	-0.83
December 2016	11.44	-2.72	10.72	-2.35
January 2017	11.56	-1.65	10.94	-0.41
February 2017	11.65	-0.91	11.03	0.47
March 2017	11.71	-0.43	10.99	0.03
April 2017	11.67	-0.77	11.03	0.46
May 2017	11.57	-1.63	11.02	0.37
June 2017	11.62	-1.18	10.84	-1.33
July 2017	11.53	-1.94	10.86	-1.15
August 2017	11.53	-1.98	10.86	-1.15
September 2017	11.41	-2.94	10.80	-1.68
October 2017	11.30	-3.90	10.66	-2.94
November 2017	11.37	-3.28	10.77	-1.89
December 2017	11.35	-3.49	10.84	-1.26
January 2018	11.52	-2.02	10.93	-0.49
February 2018	11.46	-2.50	10.93	-0.52
March 2018	11.51	-2.12	11.00	0.19
April 2018	10.99	-6.53	10.44	-4.92
May 2018	10.85	-7.73	10.38	-5.48
June 2018	10.82	-7.93	10.37	-5.55
July 2018	10.87	-7.53	10.35	-5.78
August 2018	10.82	-7.97	10.26	-6.62
September 2018	10.81	-8.05	10.27	-6.50

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	3	79	0	0	0
2	2597	77907	48.8	0	0
3	1966	58982	36.9	0	0
4	17	509	0.3	16	0.5
5	142	4271	2.7	28	0.8
6	31	918	0.6	44	1.3
7	2	51	0	7	0.2
8	25	747	0.5	43	1.2
9	428	12830	8	985	28.6
10	37	1102	0.7	316	9.2
11	8	235	0.1	5	0.1
12	4	110	0.1	25	0.7
13	69	2062	1.3	1974	57.3
TOTAL	5327	159803	100	3443	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>
2018-09-11	Tuesday	20:36:15	9	WB	2	113.39
2018-09-12	Wednesday	19:09:22	10	EB	1	102.02
2018-09-18	Tuesday	23:42:23	10	EB	1	101.87
2018-09-26	Wednesday	15:37:13	10	EB	1	99.59
2018-09-26	Wednesday	10:01:54	9	WB	2	98.56
2018-09-04	Tuesday	08:53:17	10	WB	2	96.63
2018-09-16	Sunday	17:29:26	9	EB	1	96.36
2018-09-10	Monday	13:00:45	10	WB	2	96.28
2018-09-18	Tuesday	04:51:55	10	WB	2	95.82
2018-09-16	Sunday	16:49:33	9	WB	2	95.01

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	274	34	12.4	7180	446	1790
5	EB	8	2089	253	12.1	27617	1875	6464
6	EB	19	418	124	29.7	9063	2074	1738
7	EB	11.5	22	0	0	1094	0	420
8	EB	31	355	216	60.8	5874	5080	783
9	EB	33	6091	1995	32.8	270596	56090	67714
10	EB	33.5	595	112	18.8	35702	3316	9761
11	EB	36.5	119	33	27.7	4628	1073	744
12	EB	36.5	65	1	1.5	3757	35	710
13	EB	31.5	189	0	0	16886	0	5466
TOTAL	****	****	10217	2768	****	382395	****	95591
<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	233	41	17.6	5778	539	1449
5	WB	8	2162	340	15.7	27410	2465	6417
6	WB	19	496	144	29	10848	2394	2080
7	WB	11.5	29	0	0	1234	0	450
8	WB	31	389	249	64	5597	6023	629
9	WB	33	6679	2625	39.3	252682	71946	59450
10	WB	33.5	502	185	36.9	21806	5190	5593
11	WB	36.5	115	2	1.7	6386	34	1131
12	WB	36.5	44	0	0	3158	0	776
13	WB	31.5	1863	1	0.1	168231	29	54789
TOTAL	****	****	12512	3587	****	503131	****	132764
GRAND TOTAL	****	****	22729	6355	400	885526	158609	228355

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	47	64	110	0
2	153473	153294	306766	18
3	178461	174583	353044	20.7
4	7626	6317	13944	0.8
5	29492	29875	59367	3.5
6	11136	13242	24379	1.4
7	1094	1234	2328	0.1
8	10954	11620	22574	1.3
9	326685	324628	651314	38.2
10	39018	26997	66015	3.9
11	5701	6420	12120	0.7
12	3792	3158	6950	0.4
13	16886	168260	185145	10.9
TOTAL	784365	919691	1704056	100
GVW/LANE	46.03	53.97	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>
1	0	0	0	0	0.0125
2	18	16	35	0.2	9e-04
3	60	54	114	0.7	0.0039
4	116	106	221	1.3	0.88
5	284	314	598	3.5	0.28
6	178	170	348	2	0.77
7	22	22	44	0.3	1.66
8	168	135	302	1.8	0.82
9	6294	5101	11395	65.9	1.79
10	688	399	1087	6.3	1.98
11	101	123	224	1.3	1.87
12	49	52	101	0.6	1.78
13	320	2494	2814	16.3	2.74
TOTAL	8299	8984	17283	100	15
ESALS/LANE	48	52	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>
Oct 2017	168933	5450	991	138200	81.8	30732.8	18.2
Nov 2017	157271	5242	946	128891	82	28380.1	18
Dec 2017	151645	4892	863	124901	82.4	26744.2	17.6
Jan 2018	134369	4334	714	112230	83.5	22139.3	16.5
Feb 2018	121042	4323	646	102947	85.1	18095.1	14.9
Mar 2018	148999	4806	935	120016	80.5	28983	19.5
Apr 2018	142113	4737	837	117010	82.3	25103.3	17.7
May 2018	166568	5373	771	142675	85.7	23892.8	14.3
Jun 2018	160782	5359	682	140315	87.3	20466.9	12.7
Jul 2018	158910	5126	651	138715	87.3	20194.6	12.7
Aug 2018	170178	5490	762	146561	86.1	23616.9	13.9
Sep 2018	159803	5327	761	136968	85.7	22835.3	14.3
TOTAL	1840613	-	-	1549429	-	291184	-
AVERAGE	153384	5038	797	129119	84	24265	16

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>
Oct 2017	13340	16038	29378	10.4
Nov 2017	11998	15611	27609	7.5
Dec 2017	9912	14401	24312	6.4
Jan 2018	11044	10493	21537	13.7
Feb 2018	9442	7840	17282	15.9
Mar 2018	8342	12669	21011	17.3
Apr 2018	8199	14246	22446	3.3
May 2018	9112	8387	17499	1.6
Jun 2018	7690	7131	14821	1.5
Jul 2018	8215	6839	15054	3.2
Aug 2018	10307	7791	18098	5
Sep 2018	8379	8992	17371	2
TOTAL	115980	-	-	-
AVERAGE	9665	10870	20535	7

Gross Vehicle Weight

<i>Month</i>	<i>GVW EB Driving Lane</i>	<i>GVW WB Driving Lane</i>	<i>Total GVW Kips</i>
Oct 2017	793221	873170	1666391
Nov 2017	682600	690756	1373356
Dec 2017	711950	939405	1651356
Jan 2018	727732	1226632	1954364
Feb 2018	865371	861844	1727214
Mar 2018	780636	785631	1566267
Apr 2018	791746	765202	1556948
May 2018	890959	859371	1750330
Jun 2018	787783	920089	1707873
Jul 2018	1012456	1200320	2212776
Aug 2018	927055	1192270	2119325
Sep 2018	890224	1132994	2023218
TOTAL	9861732	11447686	21309418
AVERAGE	821811	953974	1775785

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>
Oct 2017	7755	4.6	25.3	3194	663
Nov 2017	8139	5.2	28.8	4294	637
Dec 2017	7745	5.2	29.1	4844	732
Jan 2018	5586	4.2	25.4	2397	281
Feb 2018	3644	3	20.2	992	119
Mar 2018	6820	6	30.5	3794	291
Apr 2018	7653	5.5	30.7	4826	109
May 2018	1525	0.9	6.4	235	36
Jun 2018	1304	0.8	6.4	233	37
Jul 2018	1689	1.1	8.4	367	45
Aug 2018	2180	1.3	9.3	381	65
Sep 2018	3471	2.2	15.2	1680	69
TOTAL	57511	-	-	27237	3084
AVERAGE	4792.6	3.3	19.6	2269.8	257

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>
Oct 2017	130713	210740	341452	38.3	61.7
Nov 2017	120349	225464	345812	34.8	65.2
Dec 2017	100081	223681	323763	30.9	69.1
Jan 2018	111522	140745	252267	44.2	55.8
Feb 2018	94761	92652	187413	50.6	49.4
Mar 2018	82554	190642	273196	30.2	69.8
Apr 2018	96393	254998	351391	27.4	72.6
May 2018	107468	104264	211732	50.8	49.2
Jun 2018	89560	86293	175852	50.9	49.1
Jul 2018	95779	81593	177372	54	46
Aug 2018	116744	92910	209654	55.7	44.3
Sep 2018	95591	132764	228355	41.9	58.1
TOTAL	1241514	1836744	3078258	-	-
AVERAGE	103459.5	153062	256521.5	42.5	57.5