

AUGUST 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 August 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: 170178 | Passenger Vehicles: 146561 | Heavy Commercial Vehicles: 23617

Monthly Average Daily Traffic (MADT): 5490 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 762

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 Tuesdays. WB vehicles typically reached highest volume levels on Fridays, with lowest volumes reported on Tuesdays (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 11 AM 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 11 AM 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 23617 HCVs, 2160 of them were overweight³. These overweight HCVs contributed to 1.3% of total monthly volume, and 9.2% of total monthly HCV volume. EB overweight vehicles typically reached highest numbers on Thursdays, with lowest volumes reported on Saturdays. 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 10 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 74.2% 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 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 ,307 EB vehicles exceeded 88,000 pounds (222 vehicles were Class 13's; 47 vehicles were Class 9's). Of vehicles traveling WB,

74 EB vehicles exceeded 88,000 pounds (52 vehicles were Class 13's; 13 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from August 2018.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in August 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 209654 tons of freight was recorded to have crossed the WIM. More freight was shipped EB (55.7%) than WB (44.3%). 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 170178 vehicles with a combined GVW of 1750330 kips (1 kip = 1,000 pounds = 0.5 tons) in August 2018. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 18098 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 57% of all ESALs were recorded EB while 43% was observed WB. In particular, 77% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 45% 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).

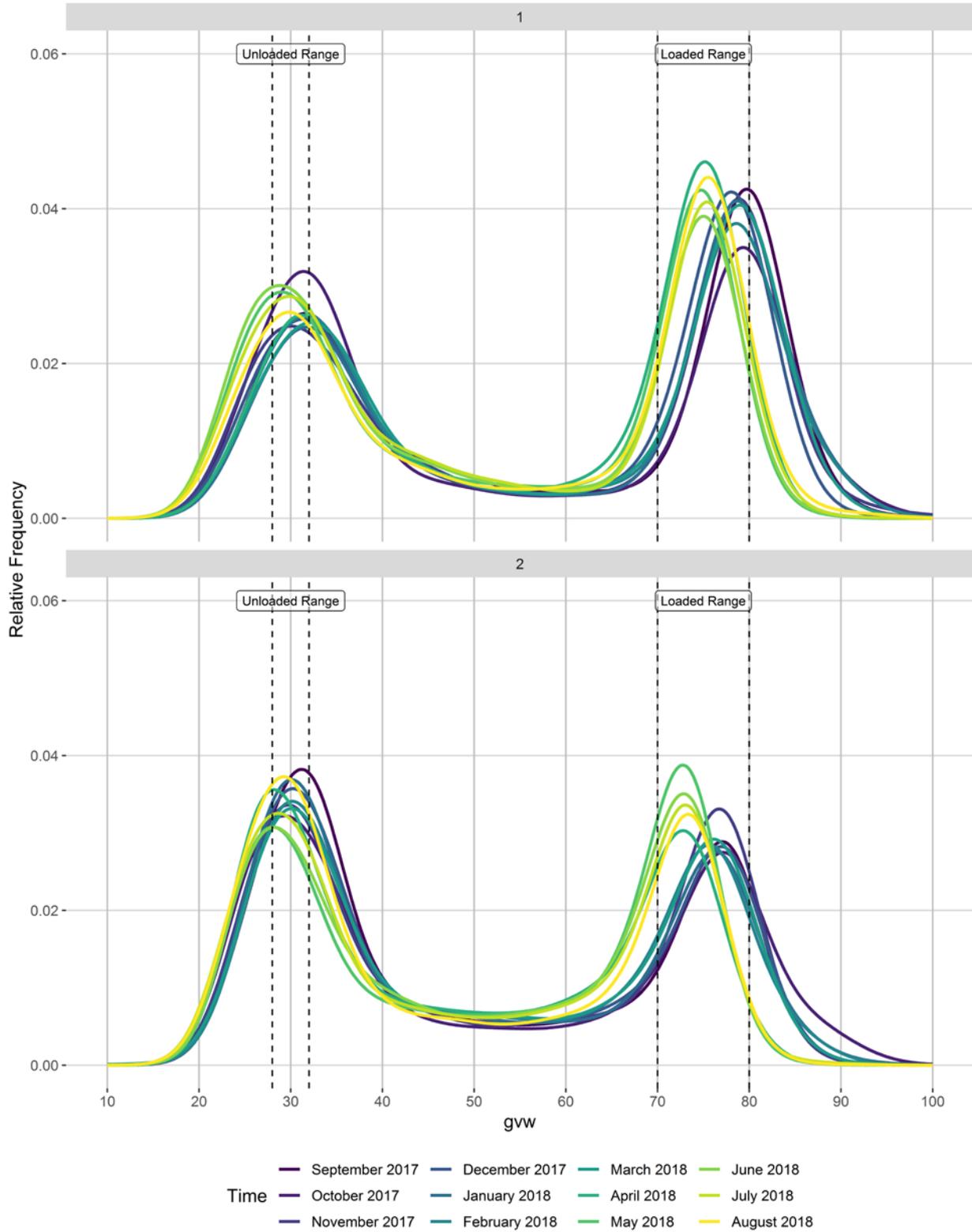
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

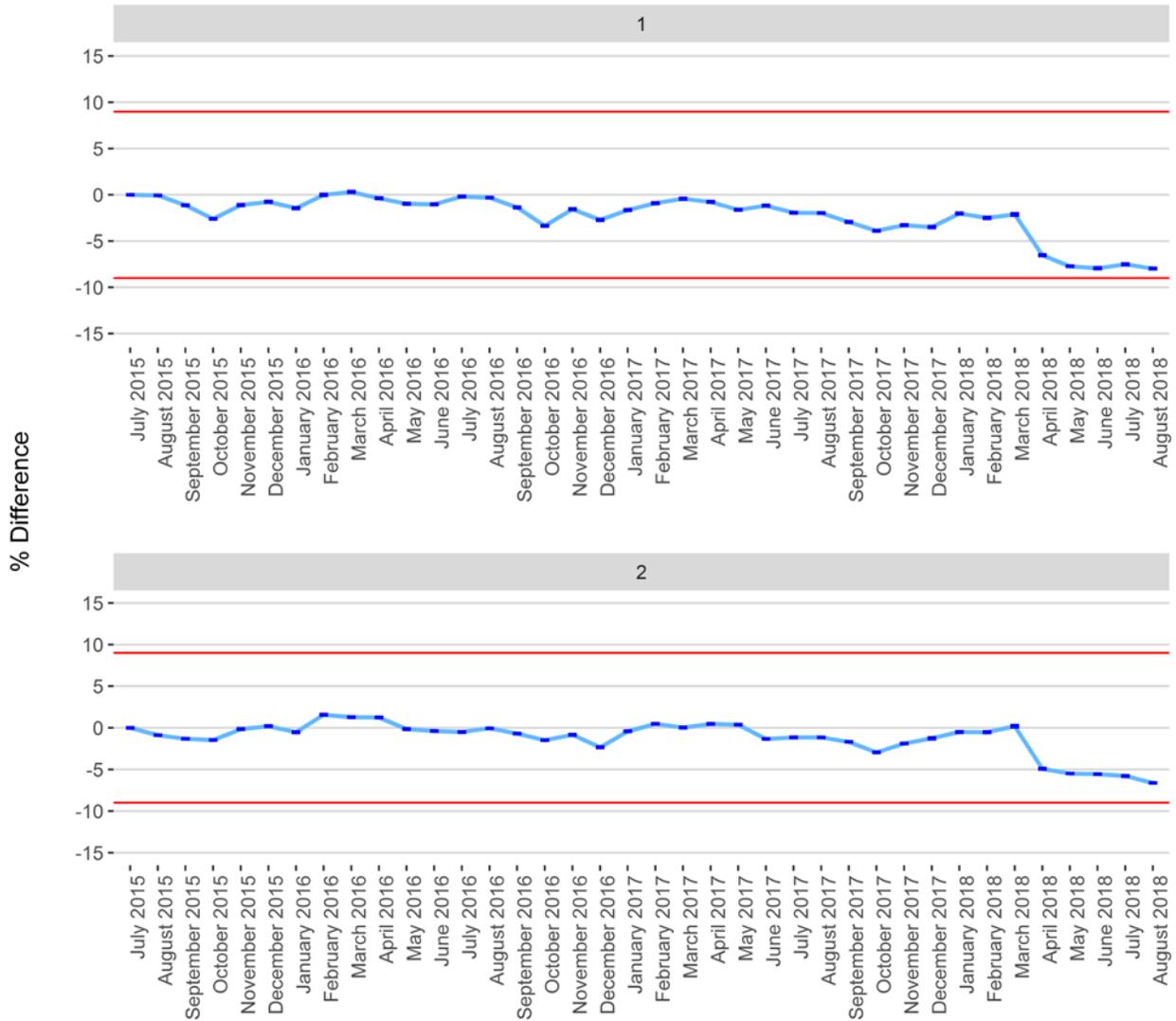
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

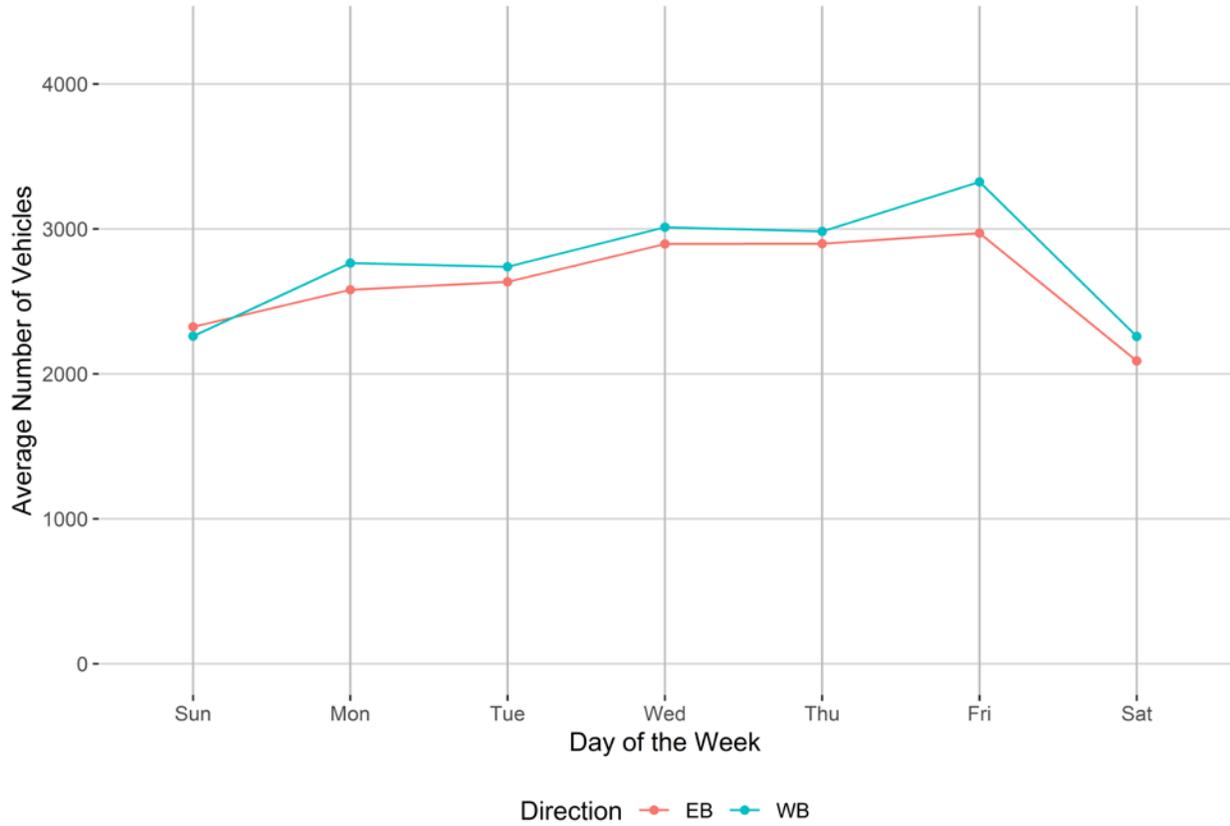


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

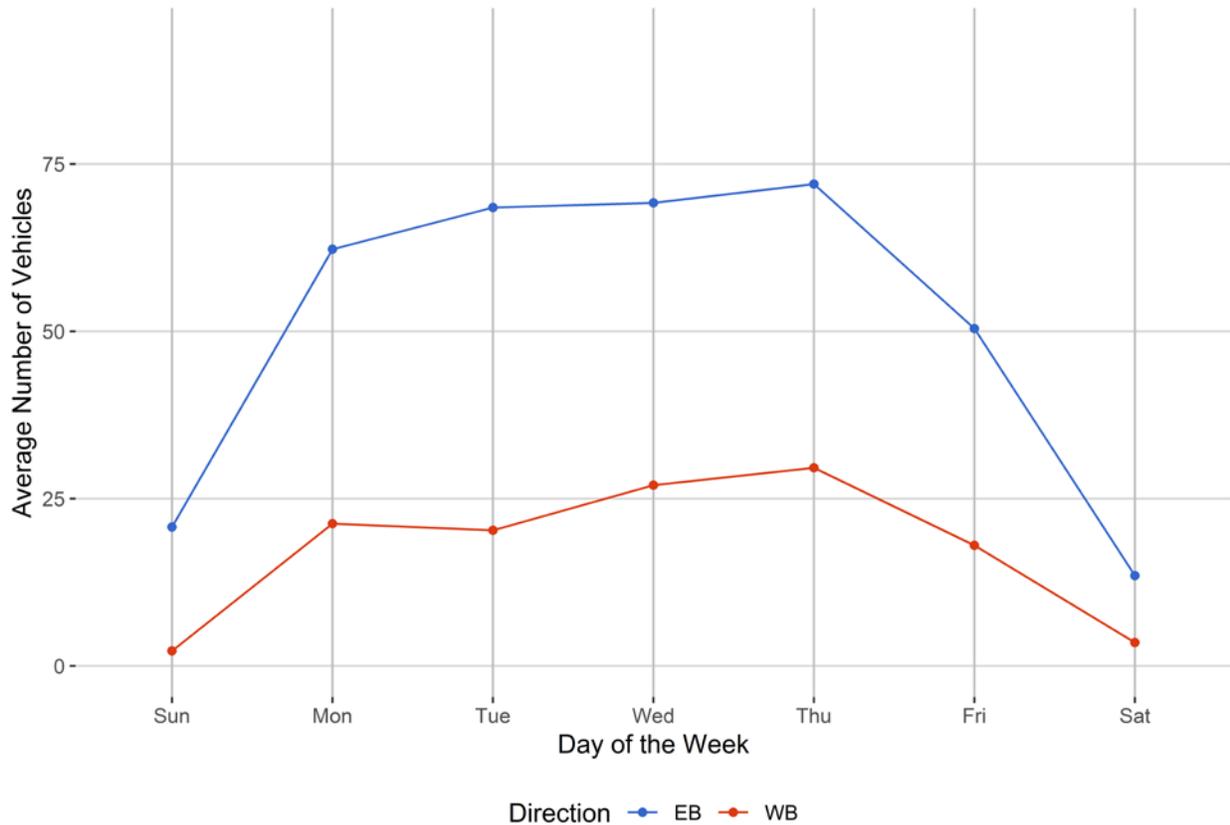


Figure 4 - Passenger Vehicles vs. Hour of the Day

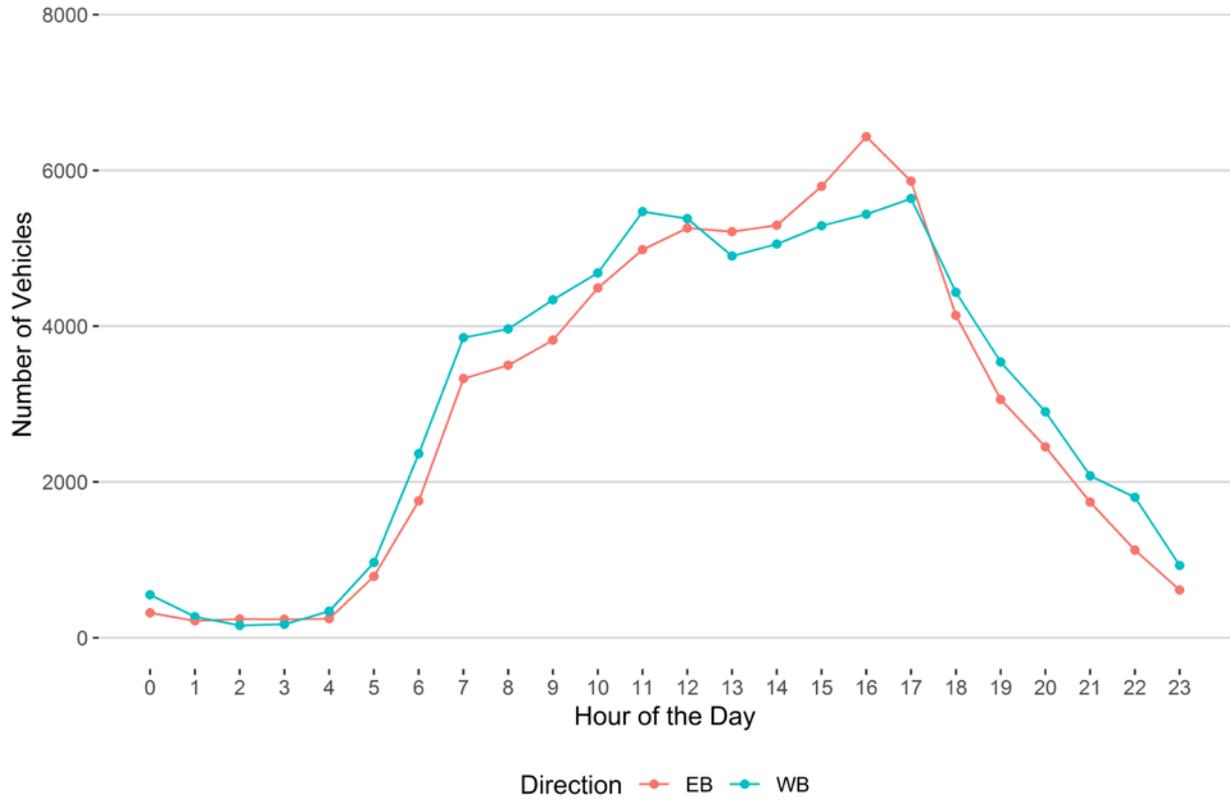


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

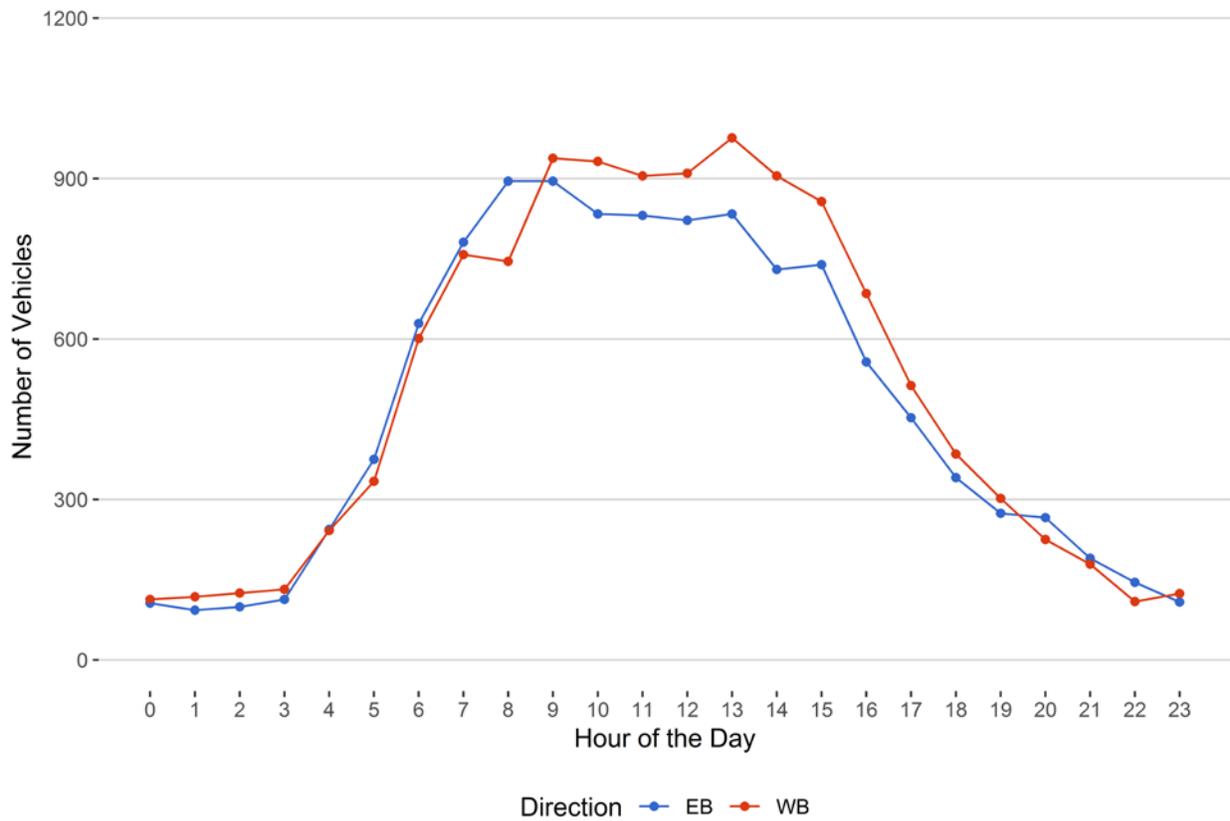


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

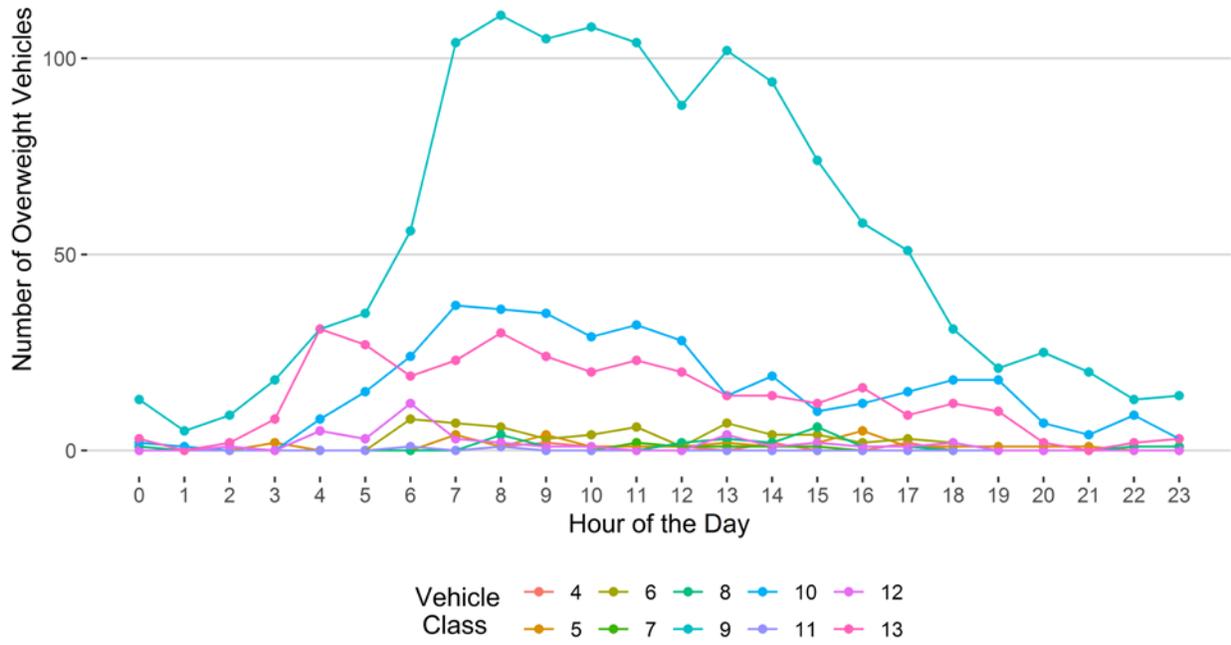


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

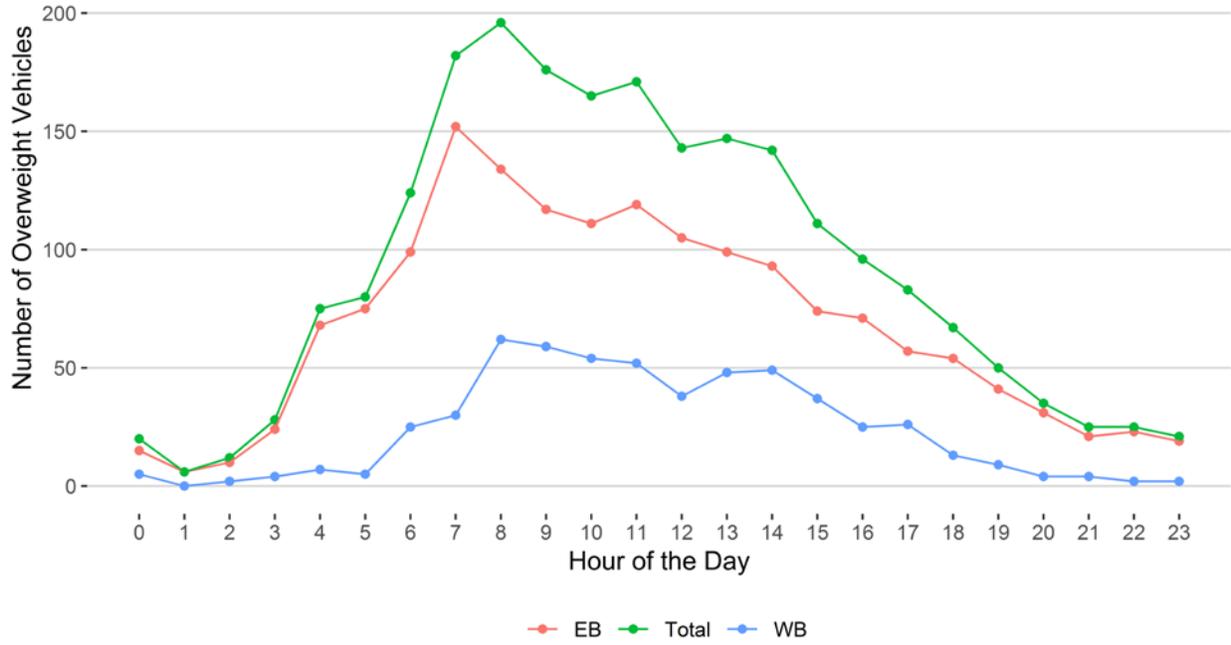
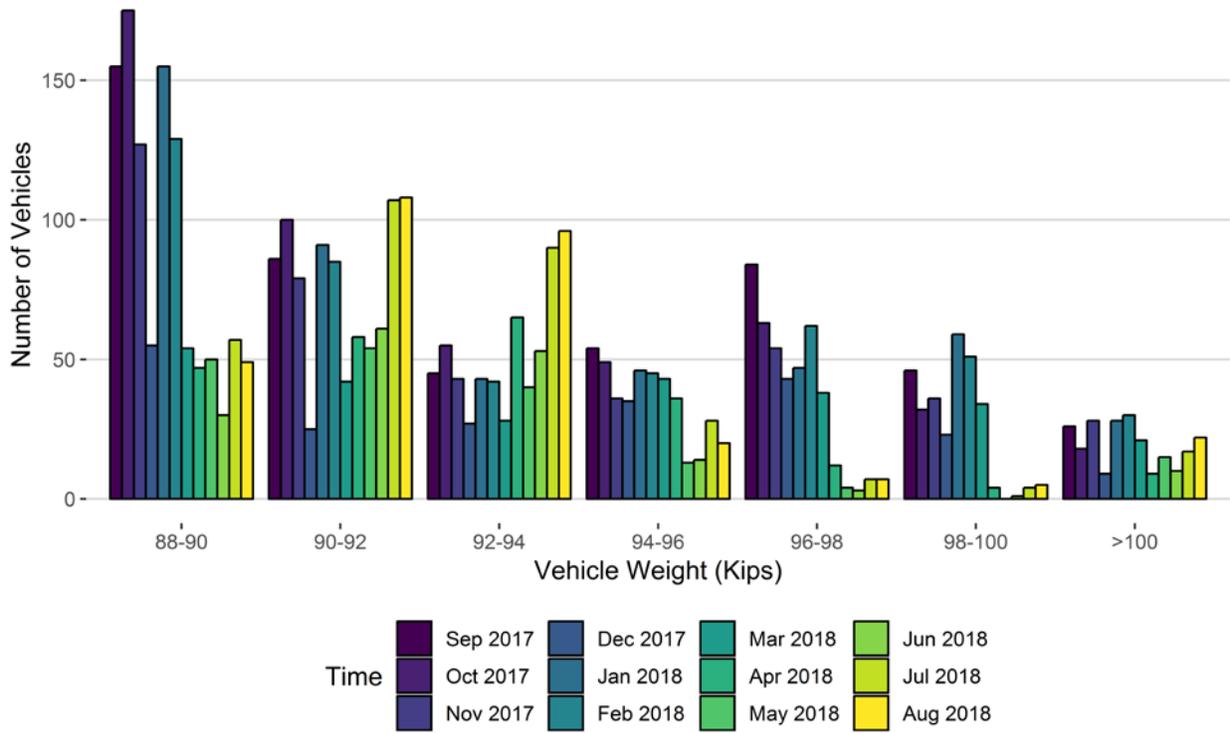
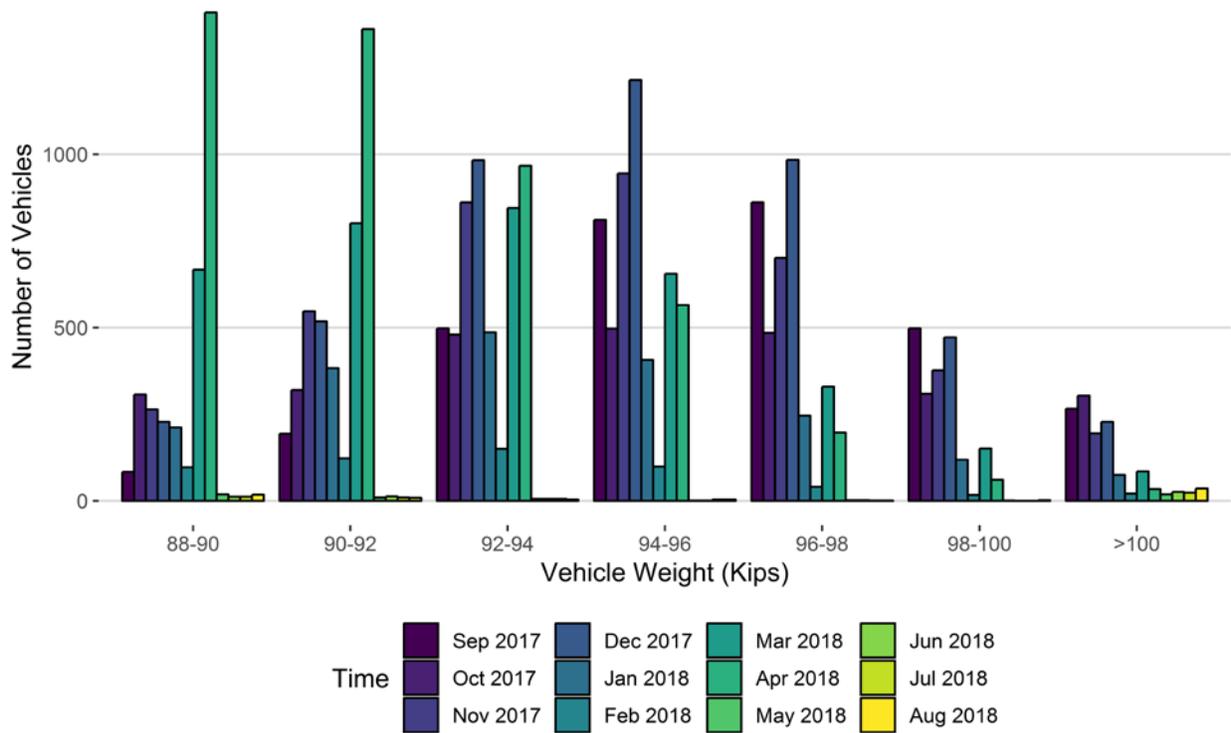


Figure 8 - Histogram of EB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018
88-90	155	175	127	55	155	129	54	47	50	30	57	49
90-92	86	100	79	25	91	85	42	58	54	61	107	108
92-94	45	55	43	27	43	42	28	65	40	53	90	96
94-96	54	49	36	35	46	45	43	36	13	14	28	20
96-98	84	63	54	43	47	62	38	12	4	3	7	7
98-100	46	32	36	23	59	51	34	4	0	1	4	5
>100	26	18	28	9	28	30	21	9	15	10	17	22
Total	496	492	403	217	469	444	260	231	176	172	310	307

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



Vehicle Weights (Kips)	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018
88-90	84	307	264	228	212	97	667	1409	19	12	12	18
90-92	194	320	547	518	383	123	801	1361	10	13	10	9
92-94	498	480	861	983	486	150	845	967	6	6	6	4
94-96	811	497	945	1214	407	99	655	565	1	1	4	4
96-98	861	485	701	984	246	41	330	197	2	2	1	1
98-100	498	309	377	472	119	17	151	61	1	0	0	2
>100	266	304	195	228	75	21	85	34	19	26	24	36
Total	3212	2702	3890	4627	1928	548	3534	4594	58	60	57	74

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

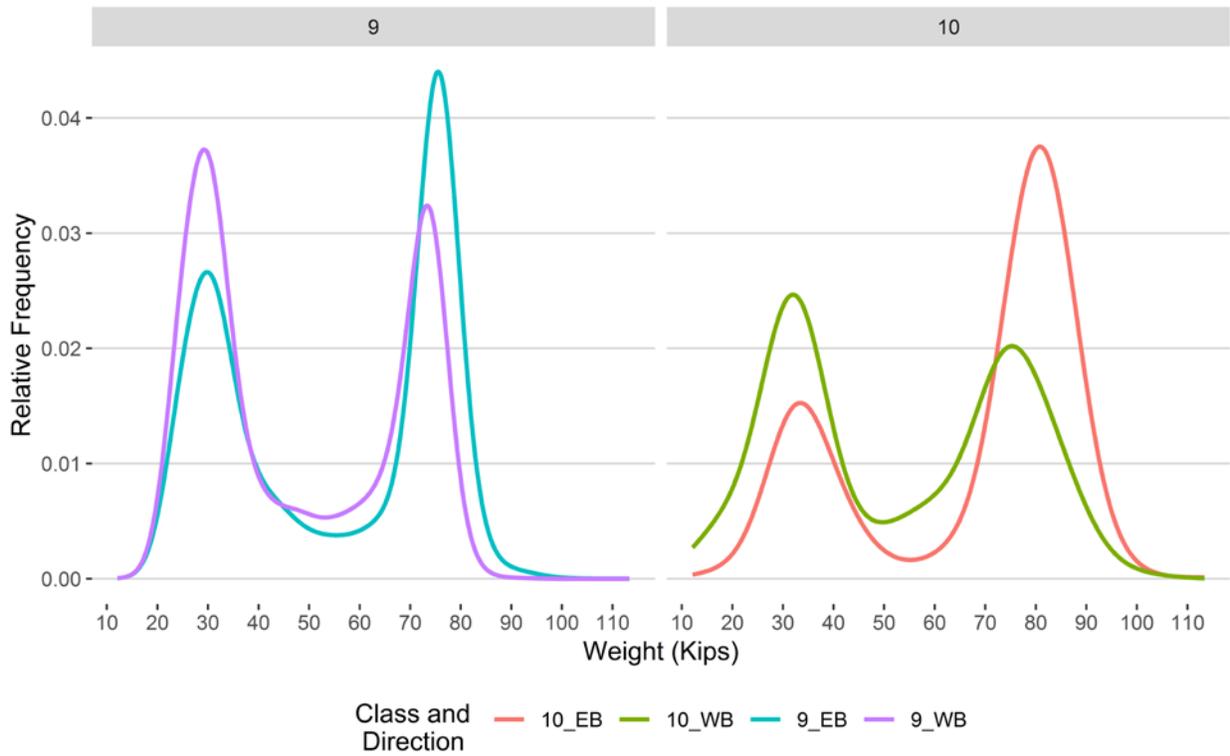


Figure 9 - Freight Percentage by Direction and Class

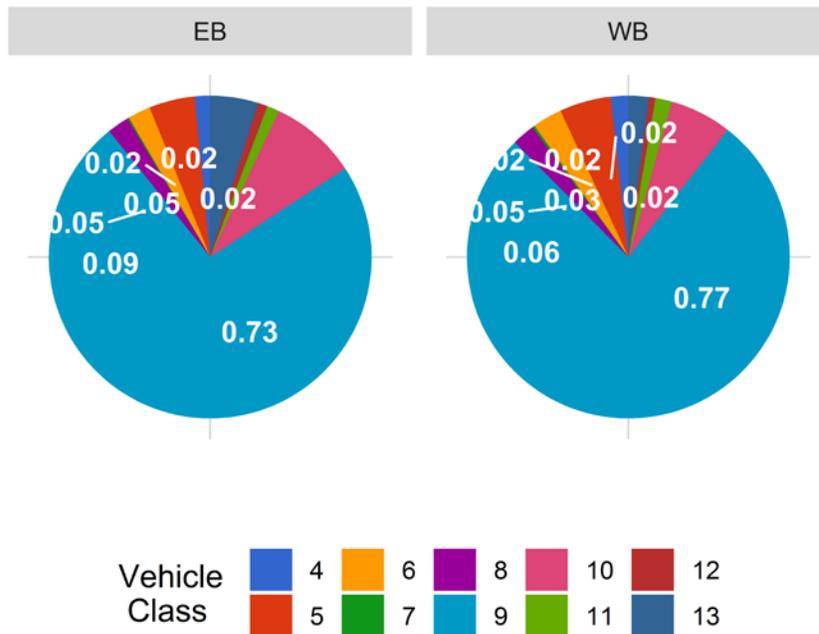


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

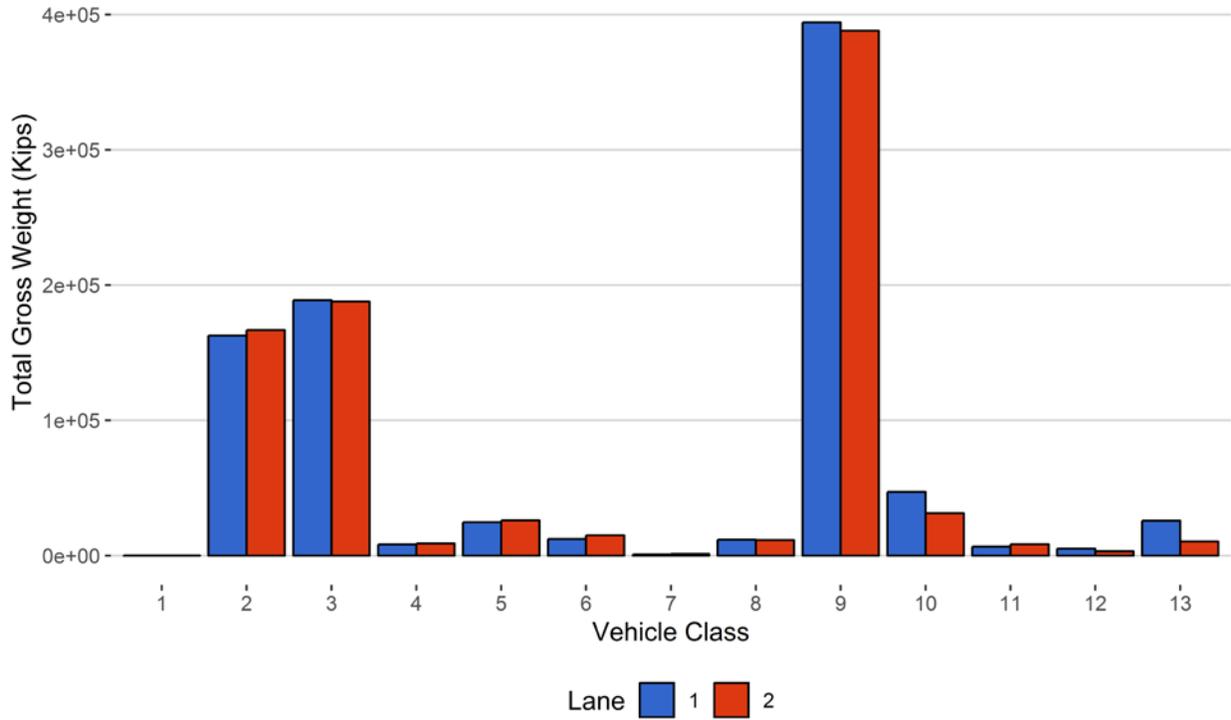


Figure 11 - Total Gross Vehicle Weight t

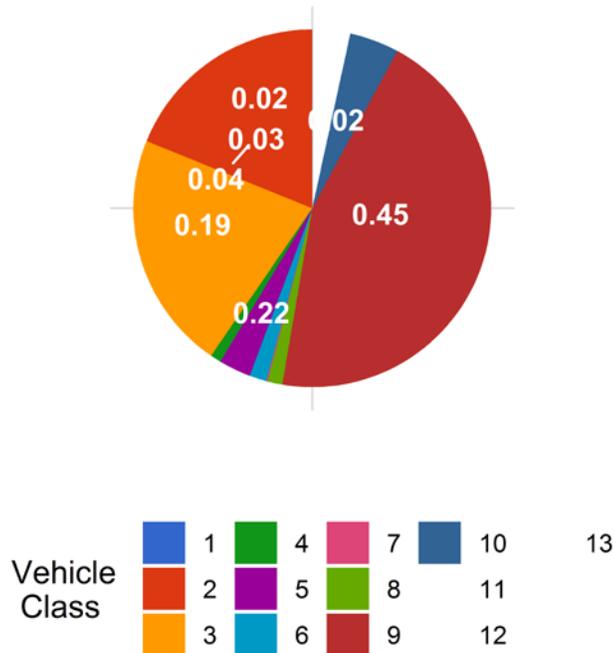


Figure 12 - Total ESALs by Class and Lane

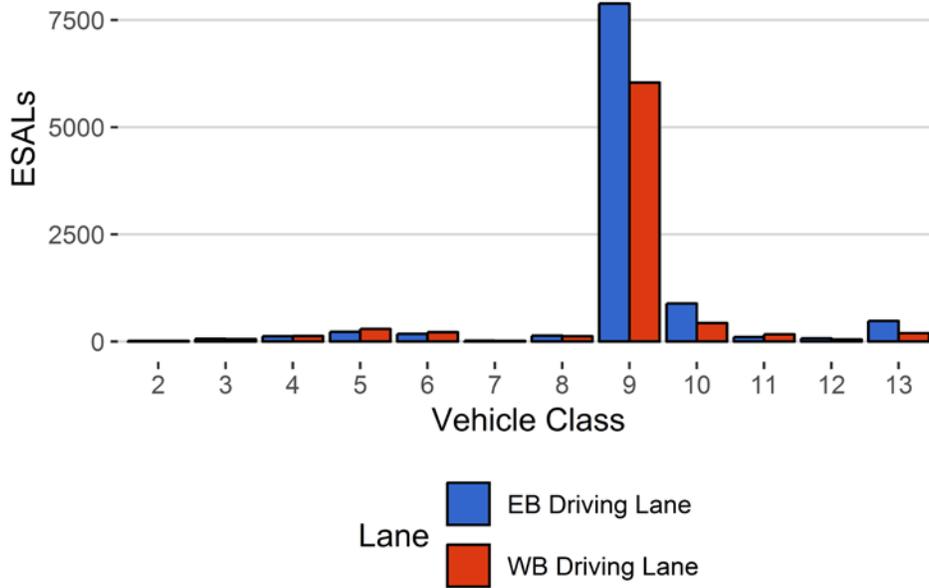


Figure 13 - ESALs by Class

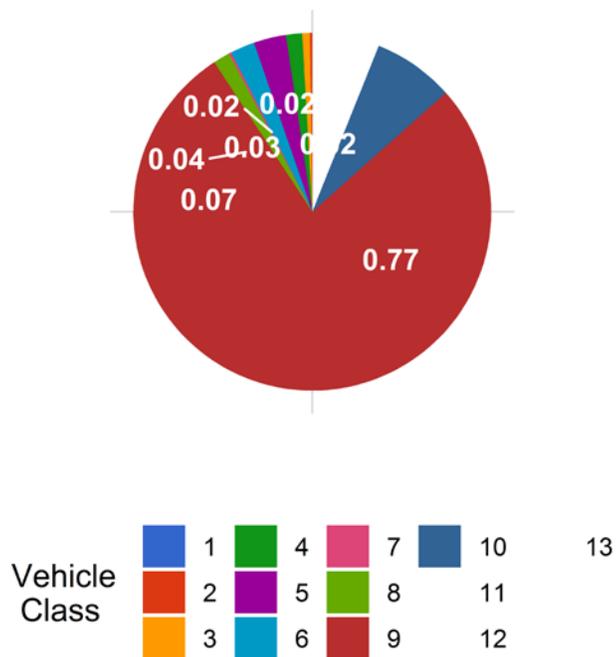


Table 1 Class 9 Front Axle Weight by Lane

<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

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	90	0.1	0	0
2	2707	83908	49.3	0	0
3	2018	62564	36.8	0	0
4	20	613	0.4	11	0.5
5	124	3835	2.3	29	1.3
6	32	978	0.6	58	2.7
7	1	45	0	7	0.3
8	26	804	0.5	24	1.1
9	491	15229	8.9	1290	59.7
10	42	1294	0.8	376	17.4
11	9	287	0.2	2	0.1
12	4	131	0.1	39	1.8
13	13	401	0.2	324	15
TOTAL	5490	170178	100	2160	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>
2018-08-01	Wednesday	08:36:00	9	EB	1	125.54
2018-08-06	Monday	19:46:08	9	WB	2	125.16
2018-08-28	Tuesday	10:49:53	10	EB	1	113.37
2018-08-08	Wednesday	14:30:11	9	WB	2	113.02
2018-08-08	Wednesday	08:50:38	9	EB	1	109.85
2018-08-01	Wednesday	11:36:37	10	WB	2	103.95
2018-08-24	Friday	00:28:08	10	EB	1	101.38
2018-08-17	Friday	11:44:07	9	EB	1	101.11
2018-08-03	Friday	10:45:22	10	WB	2	100.35
2018-08-21	Tuesday	13:14:25	9	EB	1	99.21

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	302	46	15.2	7661	606	1911
5	EB	8	1859	273	14.7	22631	1999	4972
6	EB	19	449	114	25.4	10296	1913	1966
7	EB	11.5	17	0	0	849	0	327
8	EB	31	400	238	59.5	6416	5386	697
9	EB	33	7124	2057	28.9	336349	57875	84569
10	EB	33.5	698	102	14.6	43903	3076	11969
11	EB	36.5	140	32	22.9	5584	1062	821
12	EB	36.5	83	4	4.8	5047	123	1082
13	EB	31.5	282	0	0	25747	0	8432
TOTAL	****	****	11354	2866	****	464485	****	116744
<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	307	51	16.6	8222	657	2191
5	WB	8	1952	353	18.1	23435	2542	5322
6	WB	19	523	104	19.9	13246	1712	2642
7	WB	11.5	28	0	0	1266	0	472
8	WB	31	399	240	60.2	5945	5533	508
9	WB	33	8008	3180	39.7	298983	89051	69829
10	WB	33.5	588	196	33.3	25735	5551	6302
11	WB	36.5	145	0	0	8384	0	1546
12	WB	36.5	47	1	2.1	3162	29	741
13	WB	31.5	116	1	0.9	10335	31	3356
TOTAL	****	****	12113	4126	****	398713	****	92910
GRAND TOTAL	****	****	23467	6992	377	863198	177146	209654

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	54	71	125	0
2	162661	166667	329328	18.9
3	188785	187774	376558	21.6
4	8267	8879	17146	1
5	24630	25977	50608	2.9
6	12209	14958	27167	1.6
7	849	1266	2115	0.1
8	11802	11477	23279	1.3
9	394224	388034	782258	44.8
10	46979	31286	78266	4.5
11	6647	8384	15031	0.9
12	5170	3191	8360	0.5
13	25747	10366	36113	2.1
TOTAL	888025	858331	1746356	100
GVW/LANE	50.85	49.15	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	0.0111
2	19	18	37	0.2	9e-04
3	67	59	126	0.7	0.0041
4	129	133	262	1.5	0.86
5	229	297	526	2.9	0.28
6	180	219	399	2.2	0.82
7	22	18	41	0.2	1.7
8	141	129	270	1.5	0.68
9	7882	6041	13923	77.3	1.84
10	888	436	1324	7.4	2.06
11	110	171	281	1.6	1.94
12	76	51	127	0.7	1.88
13	482	200	682	3.8	3.36
TOTAL	10226	7773	17999	100	15
ESALS/LANE	56.8	43.2	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>
Sep 2017	174582	5819	1022	143917	82.4	30665.3	17.6
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
TOTAL	1855392	-	-	1556378	-	299014	-
AVERAGE	154616	5079	818	129698	84	24918	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>
Sep 2017	14359	14776	29134	4.4
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
TOTAL	121960	-	-	-
AVERAGE	10163	11352	21515	8

Gross Vehicle Weight

<i>Month</i>	<i>GVW EB Driving Lane</i>	<i>GVW WB Driving Lane</i>	<i>Total GVW Kips</i>
Sep 2017	793221	873170	1666391
Oct 2017	682600	690756	1373356
Nov 2017	711950	939405	1651356
Dec 2017	727732	1226632	1954364
Jan 2018	865371	861844	1727214
Feb 2018	780636	785631	1566267
Mar 2018	791746	765202	1556948
Apr 2018	890959	859371	1750330
May 2018	1071249	1199149	2270398
Jun 2018	1012456	1200320	2212776
Jul 2018	927055	1192270	2119325
Aug 2018	890224	1132994	2023218
TOTAL	10145198	11726745	21871944
AVERAGE	845433	977229	1822662

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>
Sep 2017	8234	4.7	26.9	3710	837
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
TOTAL	62274	-	-	29267	3852
AVERAGE	5189.5	3.5	20.6	2438.9	321

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>
Sep 2017	147260	204769	352029	41.8	58.2
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
TOTAL	1293183	1908749	3201931	-	-
AVERAGE	107765.2	159062.4	266827.6	42.5	57.5