

DECEMBER 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 December 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: 137277 | Passenger Vehicles: 119844 | Heavy Commercial Vehicles: 17433

Monthly Average Daily Traffic (MADT): 4576 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 562

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 Wednesdays, 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 02 PM and 04 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 02 PM and 04 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 17433 HCVs, 1708 of them were overweight³. These overweight HCVs contributed to 1.2% of total monthly volume, and 9.6% of total monthly HCV volume. EB overweight vehicles typically reached highest numbers on Wednesdays, with lowest volumes reported on Sundays. WB overweight vehicles tended to reach highest volumes on Tuesdays, with lowest volumes reported on Fridays. 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 53.7% 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 April.

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 ,134 EB vehicles exceeded 88,000 pounds (102 vehicles were Class 13's; 27 vehicles were Class 10's). Of vehicles traveling WB,

406 EB vehicles exceeded 88,000 pounds (390 vehicles were Class 13's; 15 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from December 2018.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in December 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 empty Class 10's than fully_loaded traveling in the EB direction. In the WB direction, there were more fully_loaded class 10 vehicles.

Freight Totals. A total of 155317 tons of freight was recorded to have crossed the WIM. More freight was shipped WB (53.9%) than EB (46.1%). 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 137277 vehicles with a combined GVW of 1367589 kips (1 kip = 1,000 pounds = 0.5 tons) in December 2018. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 12560 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 50.4% of all ESALs were recorded EB while 49.6% was observed WB. In particular, 73% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 40% 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).

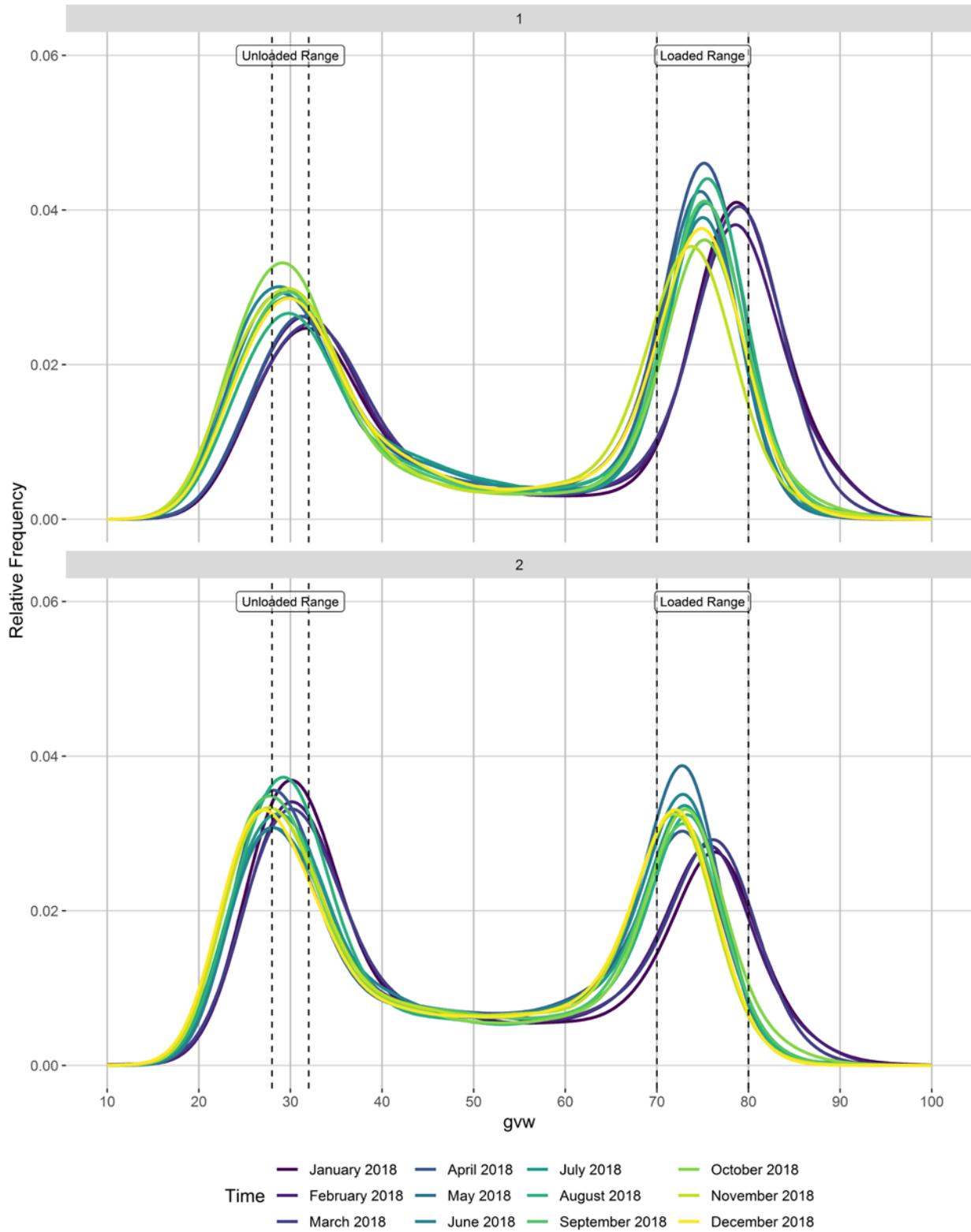
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

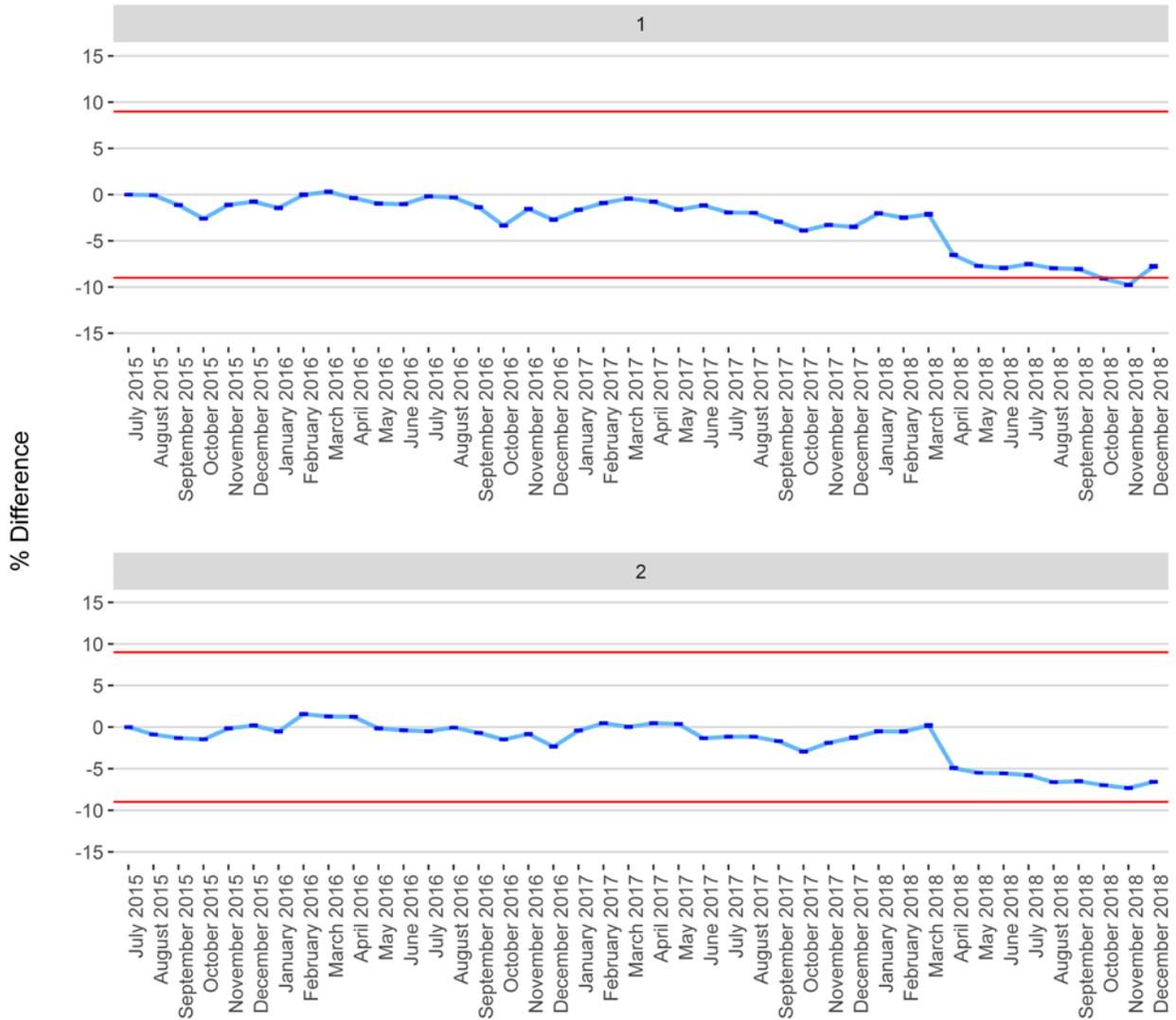
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

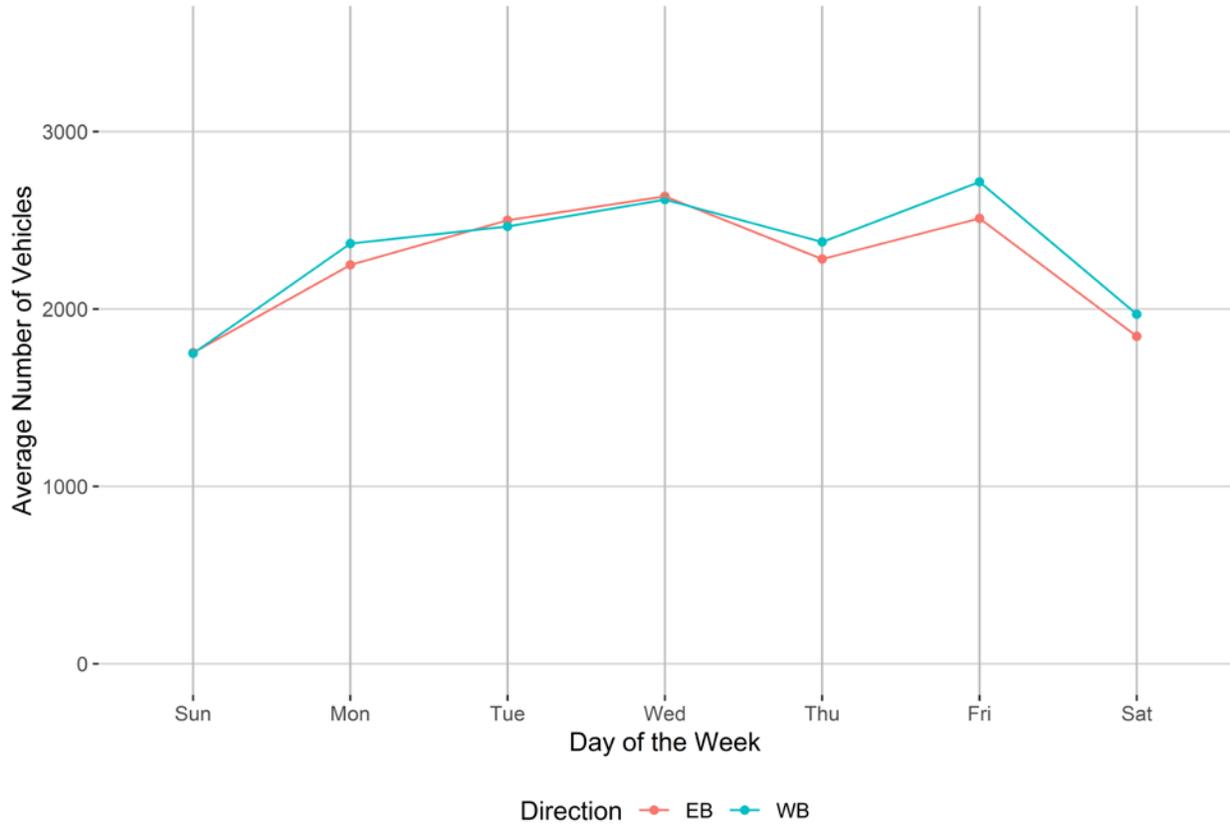


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

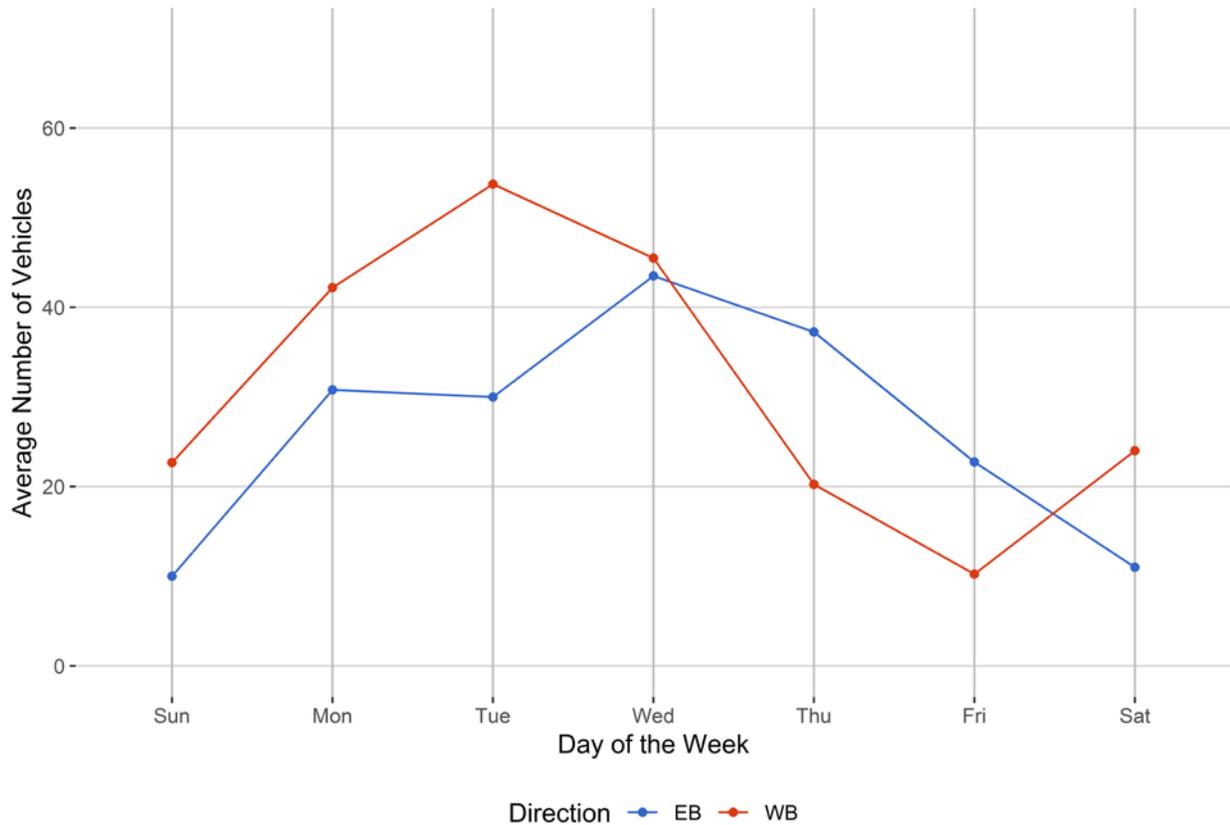


Figure 4 - Passenger Vehicles vs. Hour of the Day

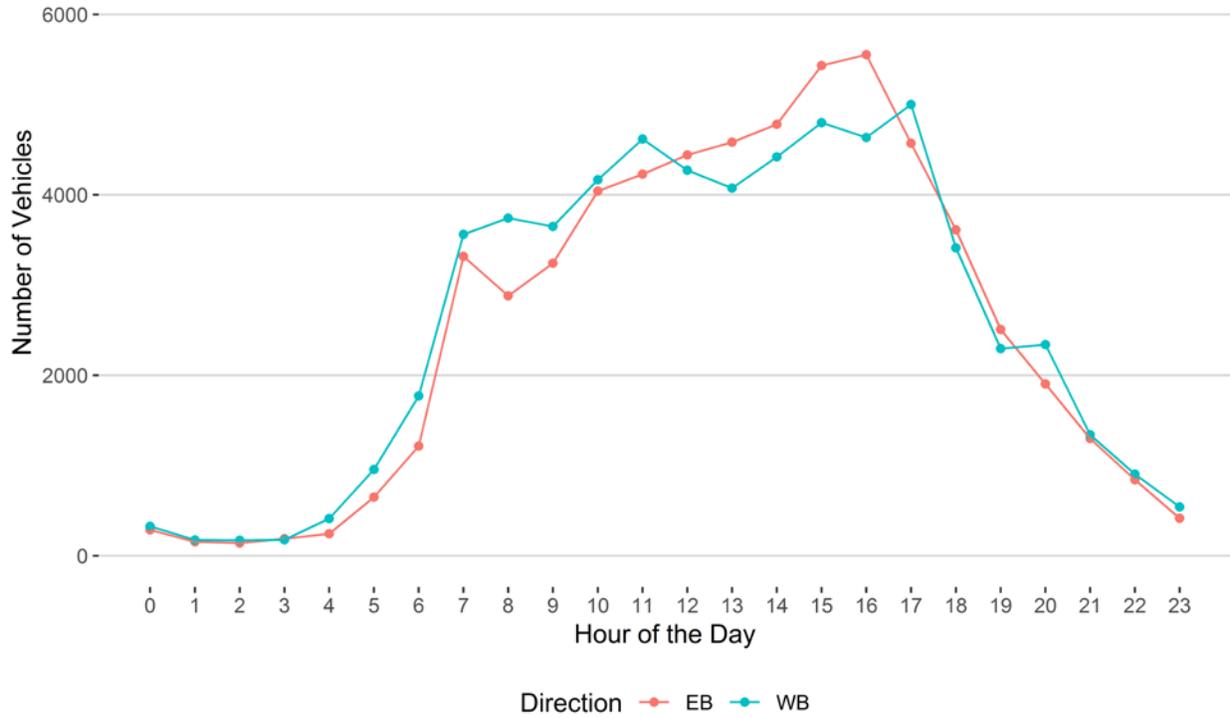


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

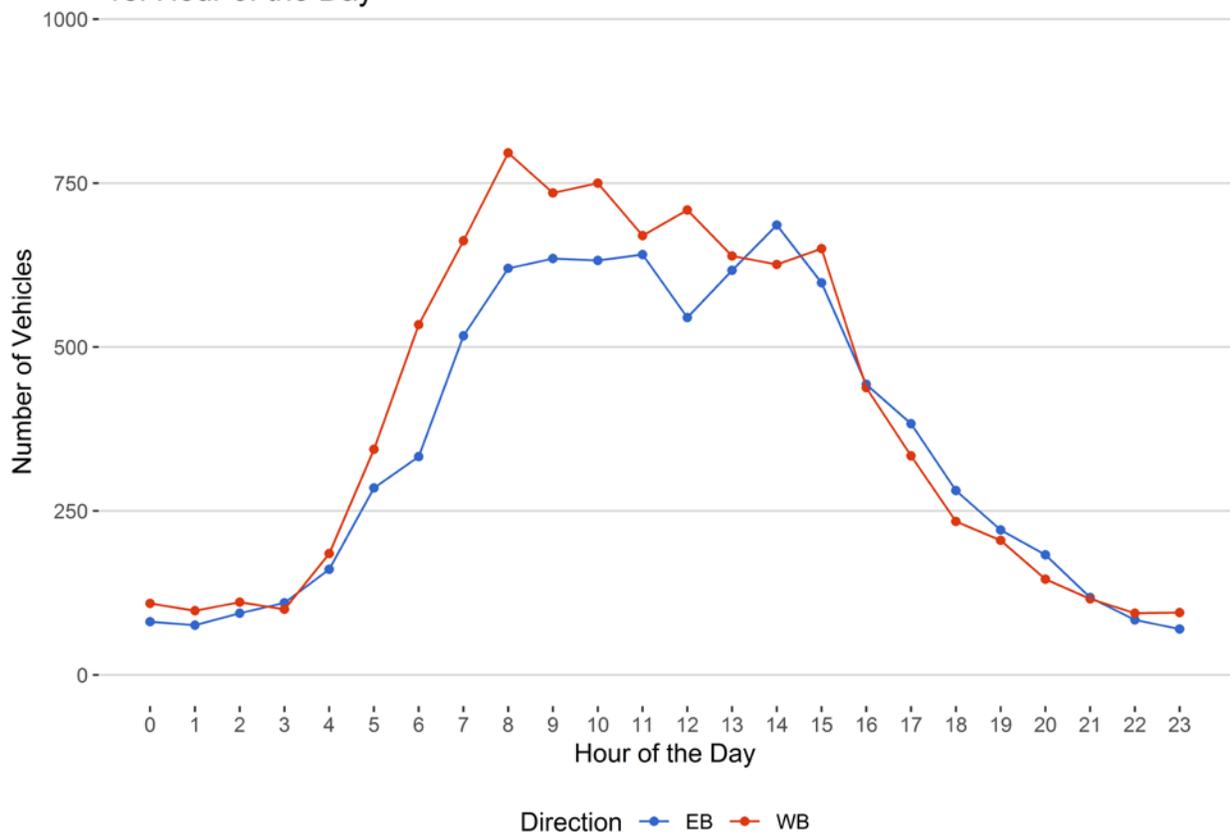


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

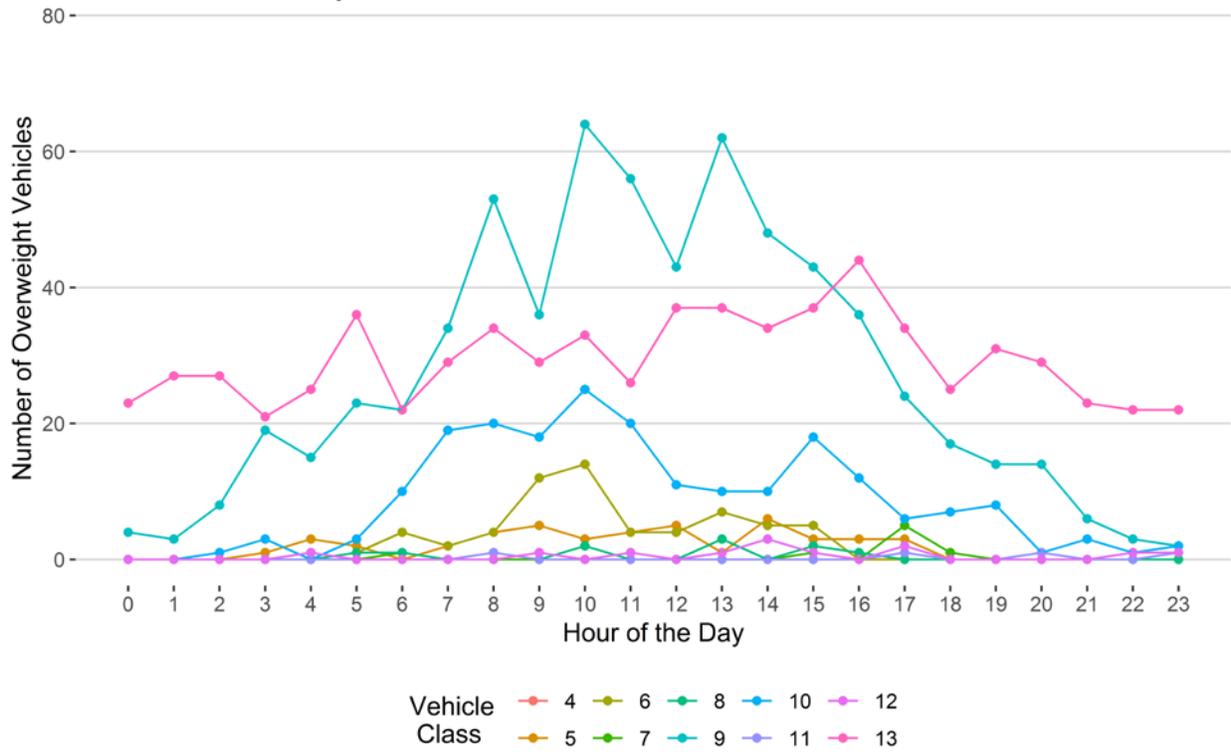


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

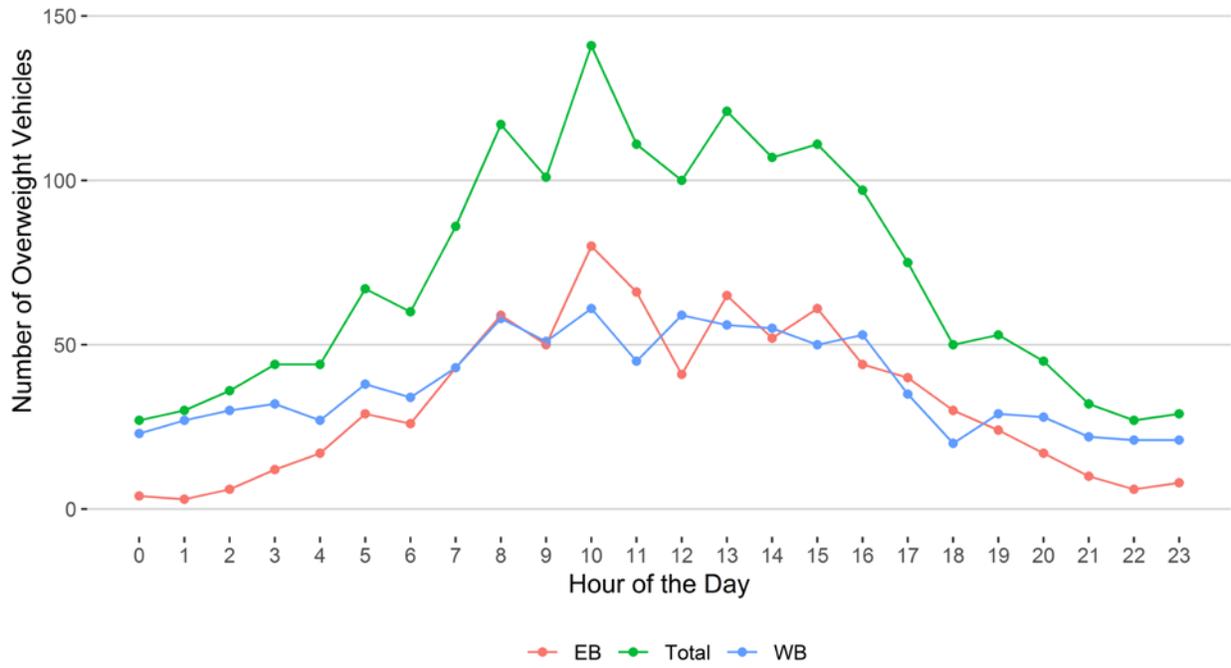
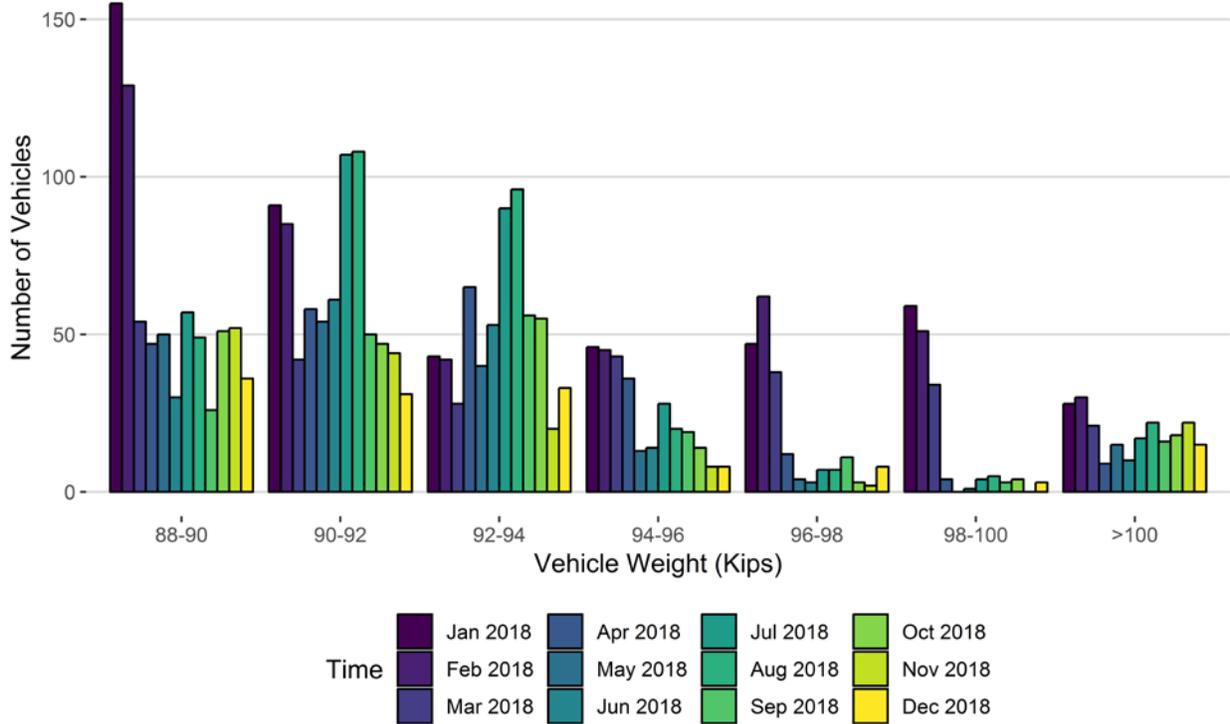
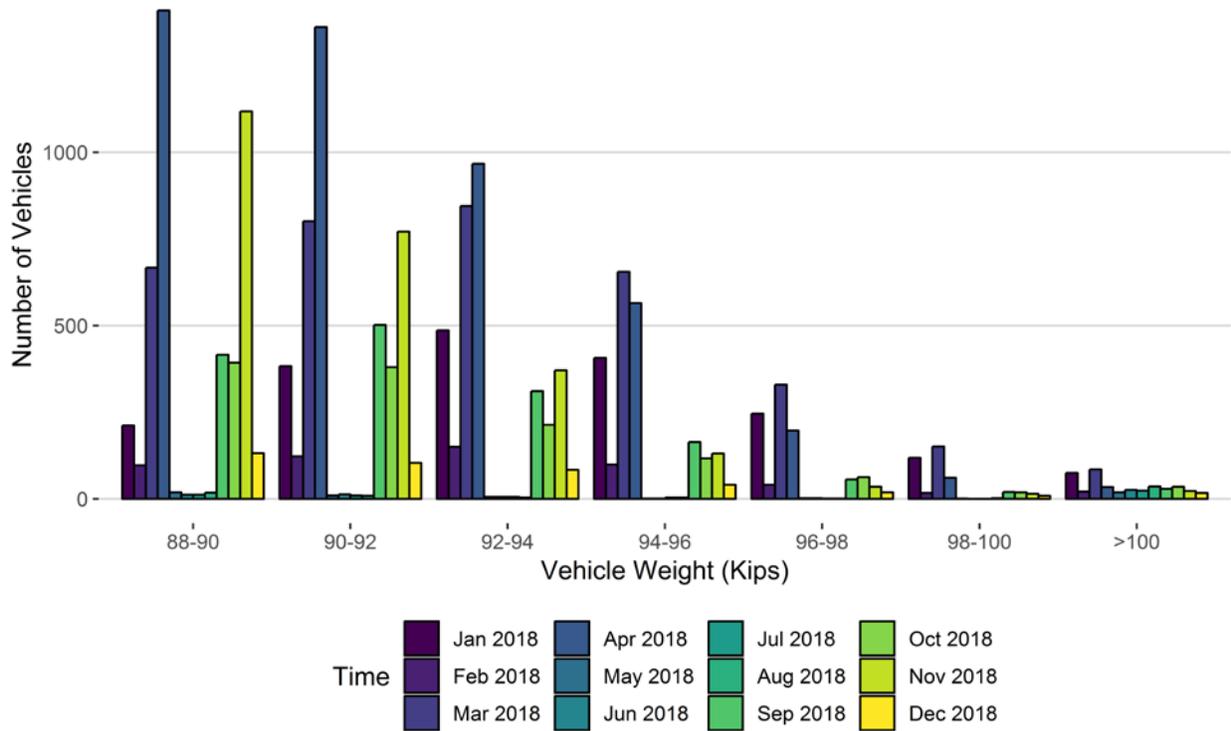


Figure 8 - Histogram of EB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018
88-90	155	129	54	47	50	30	57	49	26	51	52	36
90-92	91	85	42	58	54	61	107	108	50	47	44	31
92-94	43	42	28	65	40	53	90	96	56	55	20	33
94-96	46	45	43	36	13	14	28	20	19	14	8	8
96-98	47	62	38	12	4	3	7	7	11	3	2	8
98-100	59	51	34	4	0	1	4	5	3	4	0	3
>100	28	30	21	9	15	10	17	22	16	18	22	15
Total	469	444	260	231	176	172	310	307	181	192	148	134

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



Vehicle Weights (Kips)	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018
88-90	212	97	667	1409	19	12	12	18	416	393	1118	132
90-92	383	123	801	1361	10	13	10	9	502	380	771	104
92-94	486	150	845	967	6	6	6	4	311	214	371	84
94-96	407	99	655	565	1	1	4	4	164	117	131	41
96-98	246	41	330	197	2	2	1	1	56	63	35	19
98-100	119	17	151	61	1	0	0	2	20	19	15	9
>100	75	21	85	34	19	26	24	36	29	35	23	17
Total	1928	548	3534	4594	58	60	57	74	1498	1221	2464	406

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

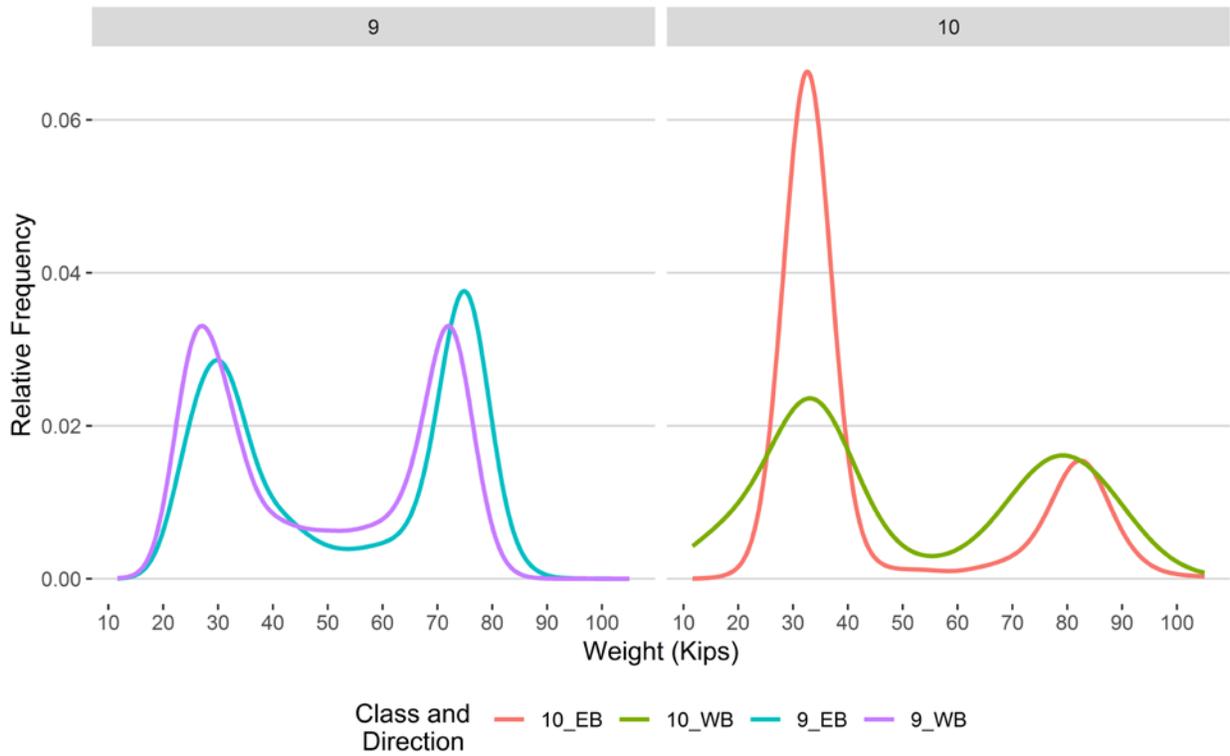


Figure 9 - Freight Percentage by Direction and Class

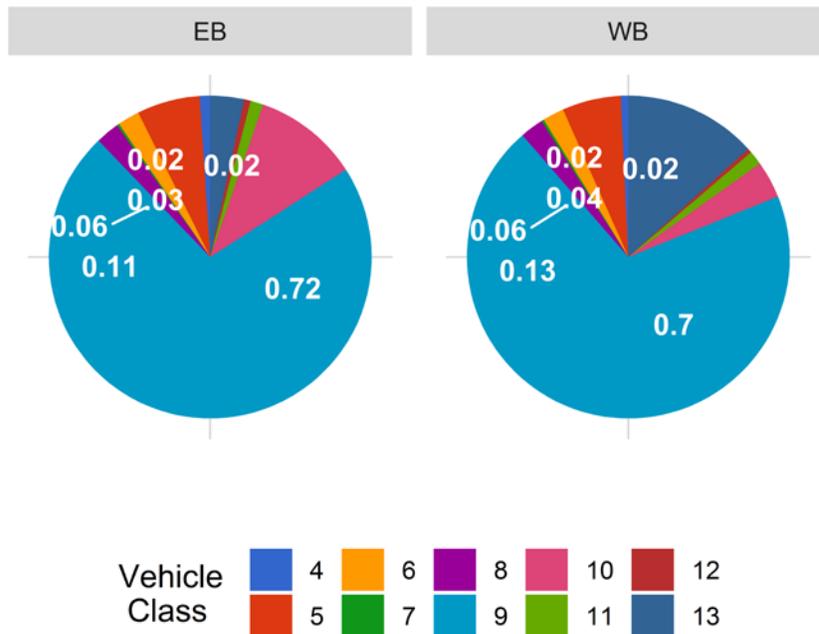


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

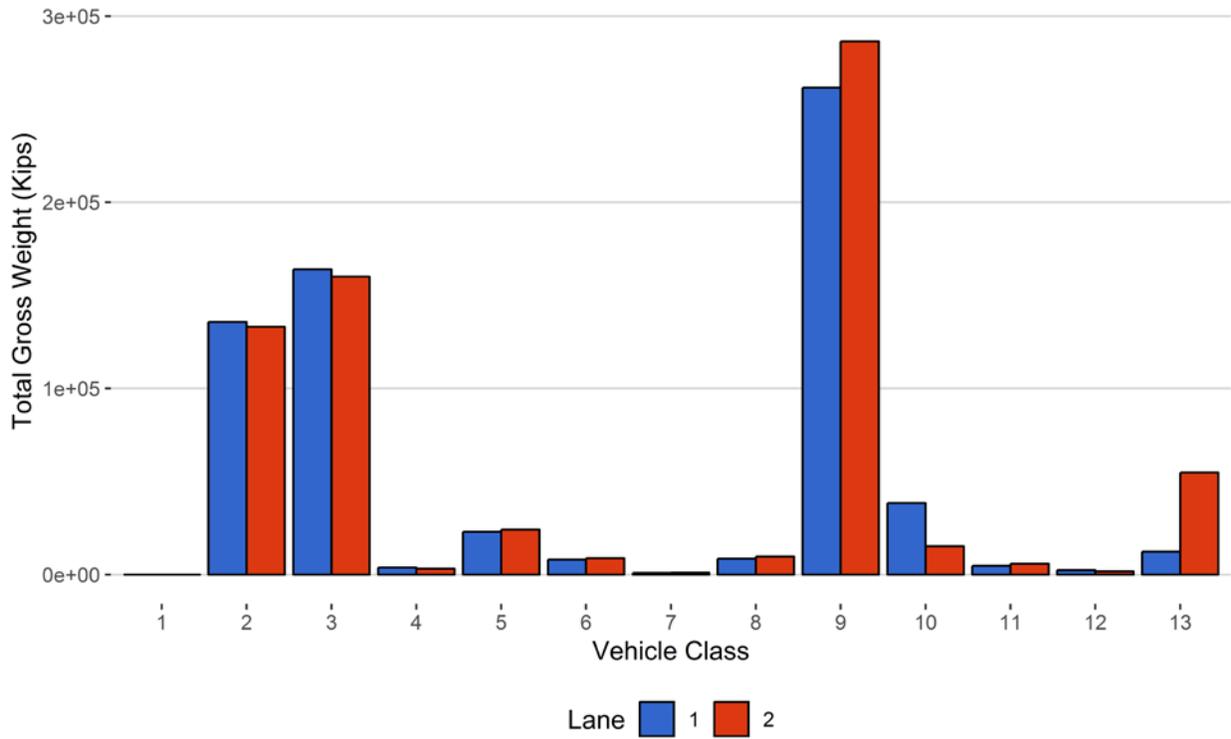


Figure 11 - Total Gross Vehicle Weight t

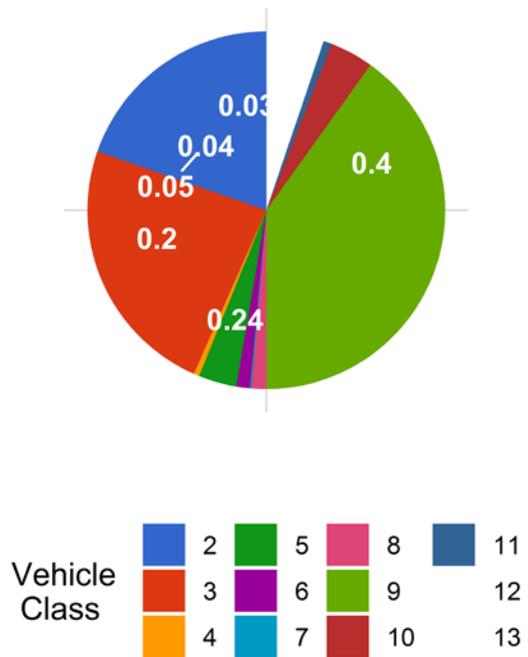


Figure 12 - Total ESALs by Class and Lane

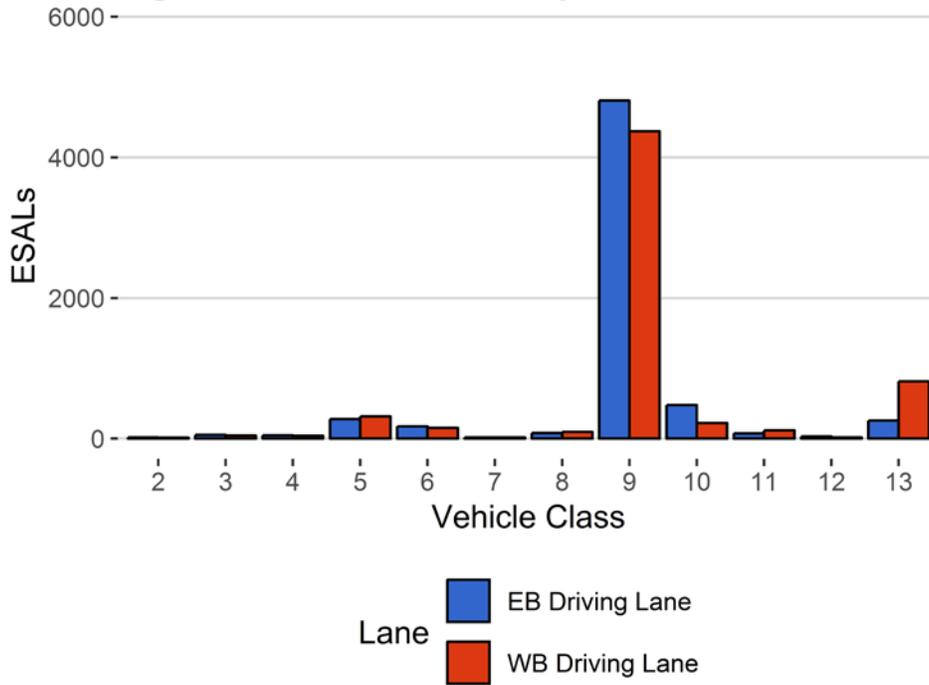


Figure 13 - ESALs by Class

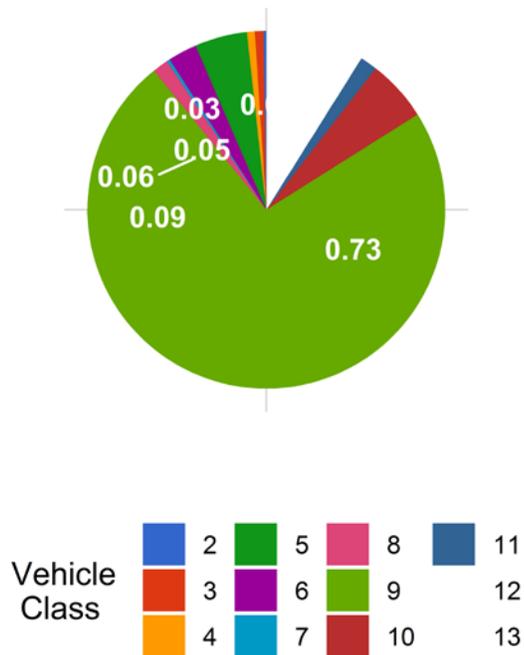


Table 1 Class 9 Front Axle Weight by Lane

<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

October 2018	10.69	-9.08	10.22	-6.98
November 2018	10.61	-9.77	10.18	-7.32
December 2018	10.84	-7.77	10.26	-6.58

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	2118	65673	47.8	0	0
3	1747	54171	39.5	0	0
4	8	248	0.2	1	0.1
5	106	3279	2.4	46	2.7
6	19	578	0.4	62	3.6
7	1	39	0	8	0.5
8	20	610	0.4	11	0.6
9	340	10551	7.7	649	38
10	36	1124	0.8	208	12.2
11	6	199	0.1	4	0.2
12	2	71	0.1	12	0.7
13	24	735	0.5	707	41.4
TOTAL	4428	137277	100	1708	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>
2018-12-01	Saturday	15:42:07	10	WB	2	105.03
2018-12-07	Friday	03:49:52	10	EB	1	104.36
2018-12-28	Friday	19:44:10	10	EB	1	103.76
2018-12-19	Wednesday	11:51:10	10	EB	1	98.08
2018-12-18	Tuesday	10:01:40	10	EB	1	97.78
2018-12-13	Thursday	19:05:47	9	EB	1	96.66
2018-12-21	Friday	06:42:17	10	EB	1	96.08
2018-12-26	Wednesday	16:01:02	10	WB	2	94.35
2018-12-30	Sunday	15:18:00	9	WB	2	94.07
2018-12-03	Monday	23:31:27	10	WB	2	93.77

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	146	23	15.8	3518	294	836
5	EB	8	1613	244	15.1	21169	1789	5109
6	EB	19	282	70	24.8	6835	1201	1403
7	EB	11.5	17	0	0	845	0	325
8	EB	31	298	196	65.8	3784	4808	311
9	EB	33	4926	1551	31.5	217933	43647	53279
10	EB	33.5	854	453	53	24093	14367	5330
11	EB	36.5	100	29	29	3701	981	555
12	EB	36.5	43	8	18.6	2094	279	408
13	EB	31.5	135	0	0	12291	0	4019
TOTAL	****	****	8414	2574	****	296263	****	71575
<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	107	13	12.1	2956	161	773
5	WB	8	1734	357	20.6	21564	2602	5274
6	WB	19	308	73	23.7	7618	1210	1577
7	WB	11.5	23	0	0	1021	0	378
8	WB	31	325	201	61.8	4589	5091	373
9	WB	33	5843	2204	37.7	226702	59763	53308
10	WB	33.5	293	101	34.5	12446	2778	3007
11	WB	36.5	103	1	1	5755	32	1016
12	WB	36.5	29	0	0	1731	0	336
13	WB	31.5	615	0	0	54773	0	17700
TOTAL	****	****	9380	2950	****	339156	****	83742
GRAND TOTAL	****	****	17794	5524	445	635419	139004	155317

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	135740	133114	268855	19.7
3	163972	160050	324022	23.7
4	3812	3118	6930	0.5
5	22958	24166	47124	3.4
6	8035	8828	16863	1.2
7	845	1021	1866	0.1
8	8592	9680	18273	1.3
9	261580	286465	548045	40.1
10	38460	15224	53684	3.9
11	4681	5787	10468	0.8
12	2373	1731	4104	0.3
13	12291	54773	67065	4.9
TOTAL	663340	703959	1367299	100
GVW/LANE	48.51	51.49	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	16	15	31	0.2	0.001
3	53	45	98	0.8	0.0036
4	47	42	90	0.7	0.72
5	279	316	594	4.7	0.36
6	174	154	328	2.6	1.12
7	18	19	37	0.3	1.72
8	81	97	179	1.4	0.58
9	4808	4371	9180	73.1	1.71
10	478	222	700	5.6	1.22
11	76	119	195	1.6	1.88
12	32	18	50	0.4	1.34
13	256	814	1071	8.5	2.83
TOTAL	6319	6233	12552	100	13
ESALS/LANE	50.3	49.7	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>
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
Oct 2018	168472	5435	901	140528	83.4	27944	16.6
Nov 2018	159326	5311	1002	129266	81.1	30060.4	18.9
Dec 2018	137277	4576	562	119844	87.3	17433.5	12.7
TOTAL	1827839	-	-	1547075	-	280765	-
AVERAGE	152320	5016	769	128923	85	23397	15

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>
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
Oct 2018	9647	10834	20480	2.5
Nov 2018	8223	12550	20773	3
Dec 2018	6326	6234	12560	2.5
TOTAL	104926	-	-	-
AVERAGE	8744	9500	18244	6

Gross Vehicle Weight

<i>Month</i>	<i>GVW EB Driving Lane</i>	<i>GVW WB Driving Lane</i>	<i>Total GVW Kips</i>
Jan 2018	793221	873170	1666391
Feb 2018	682600	690756	1373356
Mar 2018	711950	939405	1651356
Apr 2018	727732	1226632	1954364
May 2018	865371	861844	1727214
Jun 2018	780636	785631	1566267
Jul 2018	791746	765202	1556948
Aug 2018	890959	859371	1750330
Sep 2018	787783	920089	1707873
Oct 2018	910823	1024892	1935715
Nov 2018	876238	1195186	2071423
Dec 2018	663511	704078	1367589
TOTAL	9482569	10846257	20328826
AVERAGE	790214	903855	1694069

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>
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
Oct 2018	3913	2.3	14	1414	76
Nov 2018	6184	3.9	20.7	2613	60
Dec 2018	1711	1.2	9.6	540	44
TOTAL	45680	-	-	19472	1232
AVERAGE	3806.7	2.7	16.4	1622.7	102.7

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>
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
Oct 2018	107491	153333	260824	41.2	58.8
Nov 2018	93278	223361	316640	29.5	70.5
Dec 2018	71575	83742	155317	46.1	53.9
TOTAL	1162716	1637296	2800011	-	-
AVERAGE	96893	136441.3	233334.3	43.5	56.5