

JULY 2019



**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 July 2019. 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. 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: 159420 | Passenger Vehicles: 140916 | Heavy Commercial Vehicles: 18504

Monthly Average Daily Traffic (MADT): 5102 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 597

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 Sundays, with lowest volumes reported on Thursdays. 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 01 PM and 04 PM. Similarly, WB PVs peaked in volume between 12 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 01 PM and 04 PM, while volume going WB peaked between 12 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 18504 HCVs, 1054 of them were overweight ³. These overweight HCVs contributed to 0.7% of total monthly volume, and 5.9% of total monthly

HCV volume. EB overweight vehicles typically reached highest numbers on Mondays, with lowest volumes reported on Saturdays. 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 9 and class 13 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 72.8% 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 January.

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 ,190 EB vehicles exceeded 88,000 pounds (163 vehicles were Class 13's; 16 vehicles were Class 10's). Of vehicles traveling WB,

50 EB vehicles exceeded 88,000 pounds (40 vehicles were Class 13's; 6 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from July 2019.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in July 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 empty class 10 vehicles.

Freight Totals. A total of 149641 tons of freight was recorded to have crossed the WIM. More freight was shipped EB (59.8%) than WB (40.2%). 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 159420 vehicles with a combined GVW of 1417812 kips (1 kip = 1,000 pounds = 0.5 tons) in July 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 12205 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 60.6% of all ESALs were recorded EB while 39.4% was observed WB. In particular, 76% 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:

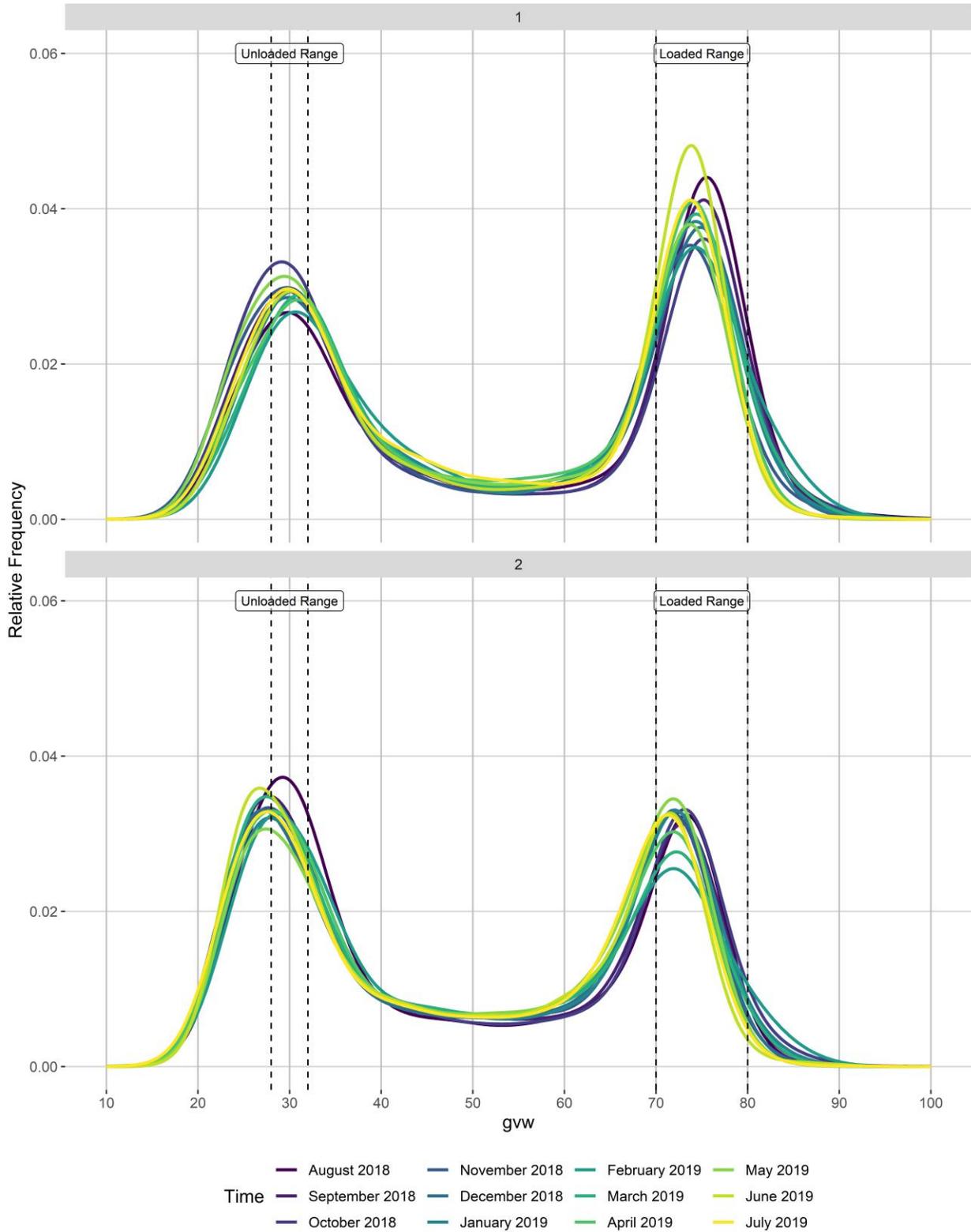
<http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html> MnDOT's vehicle

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.

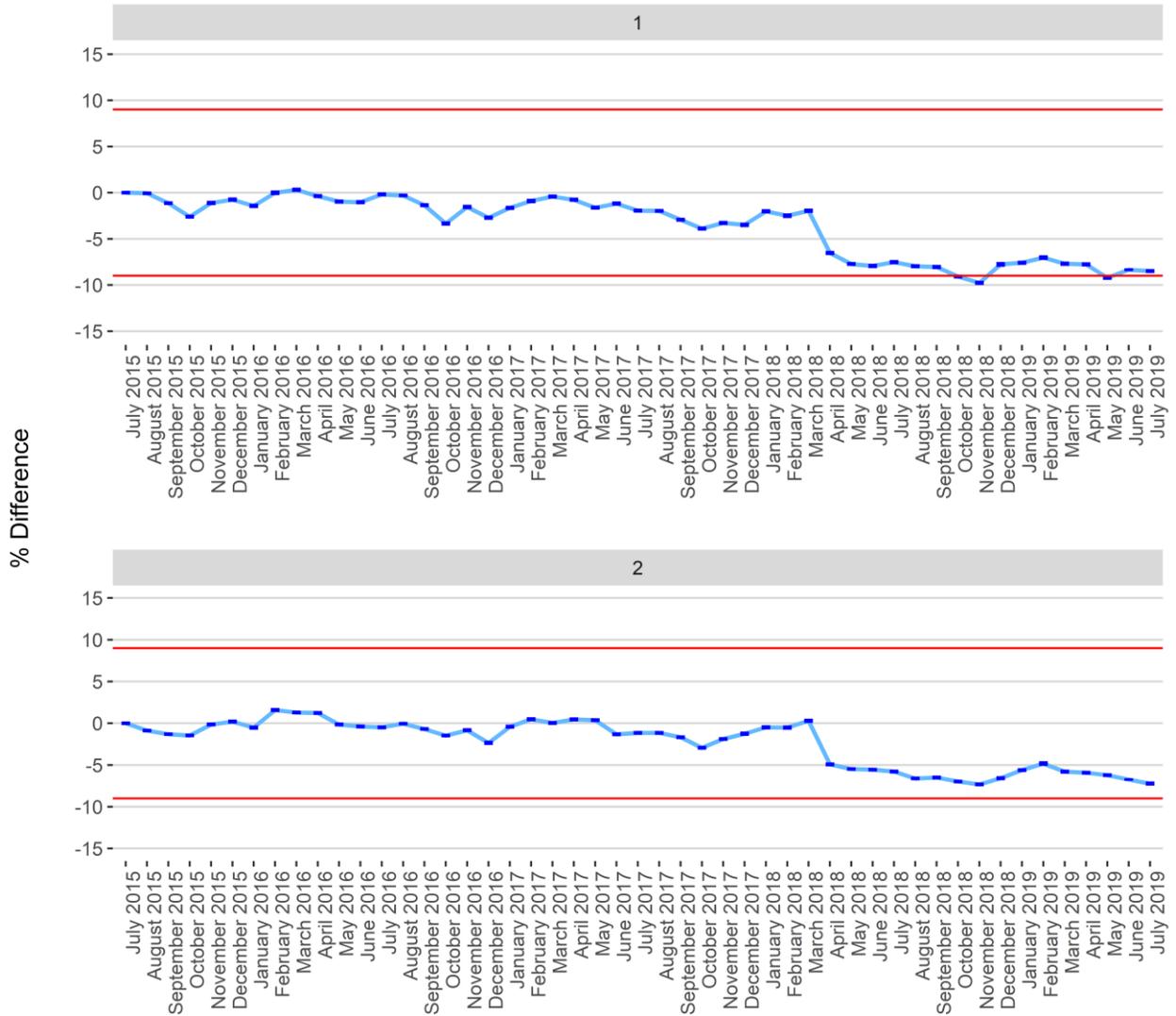
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

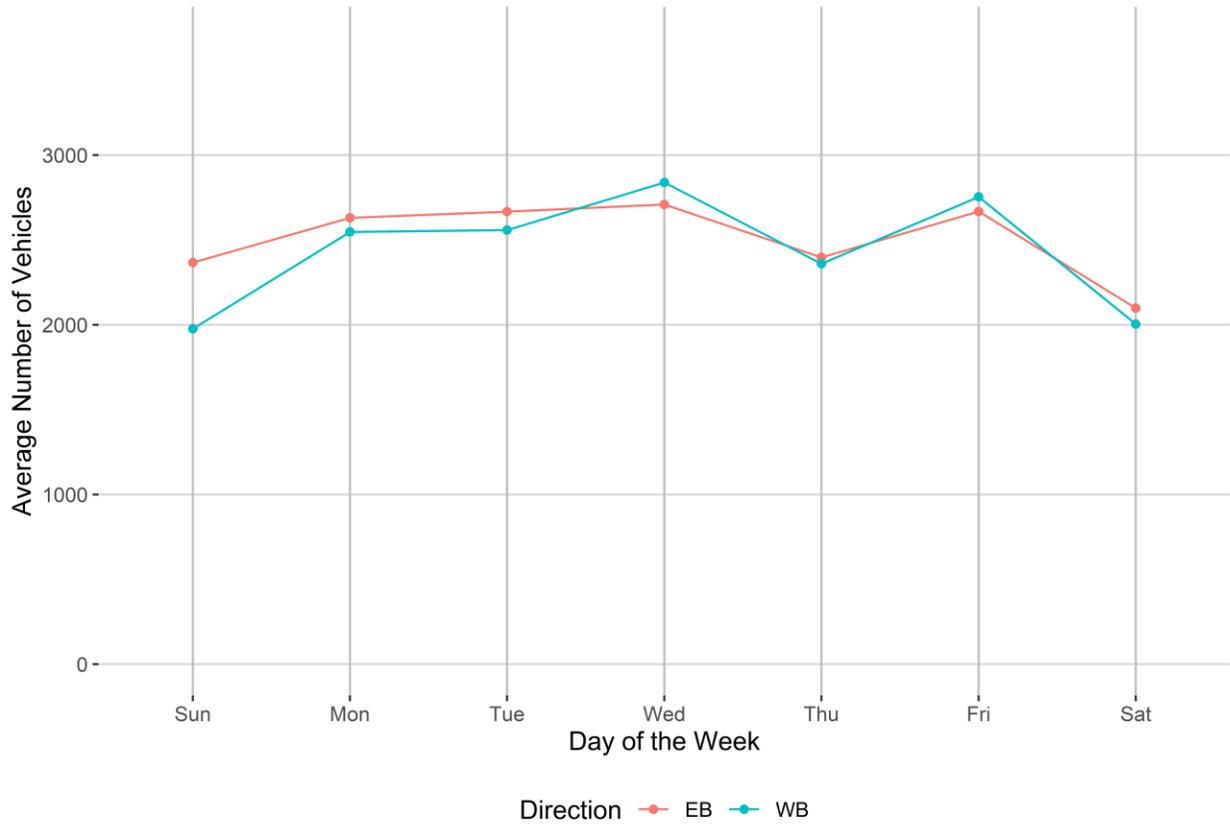


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

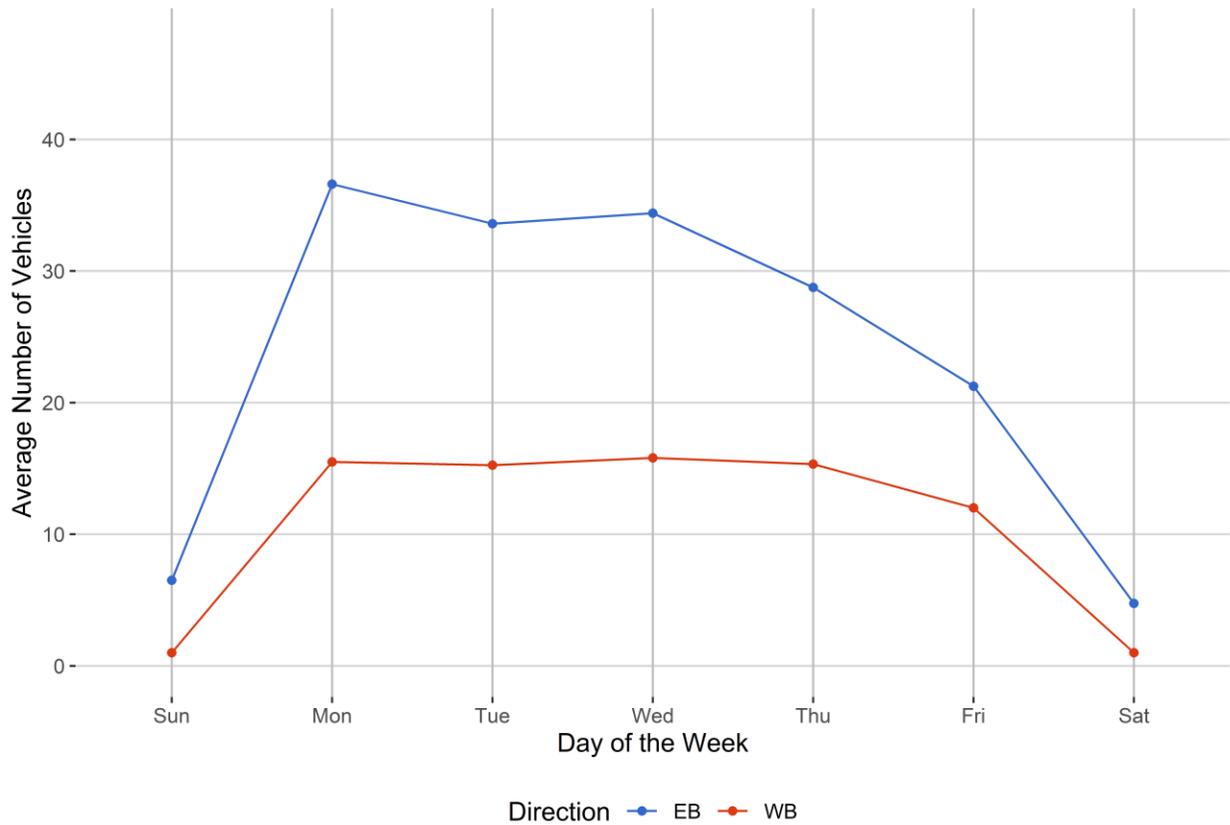


Figure 4 - Passenger Vehicles vs. Hour of the Day

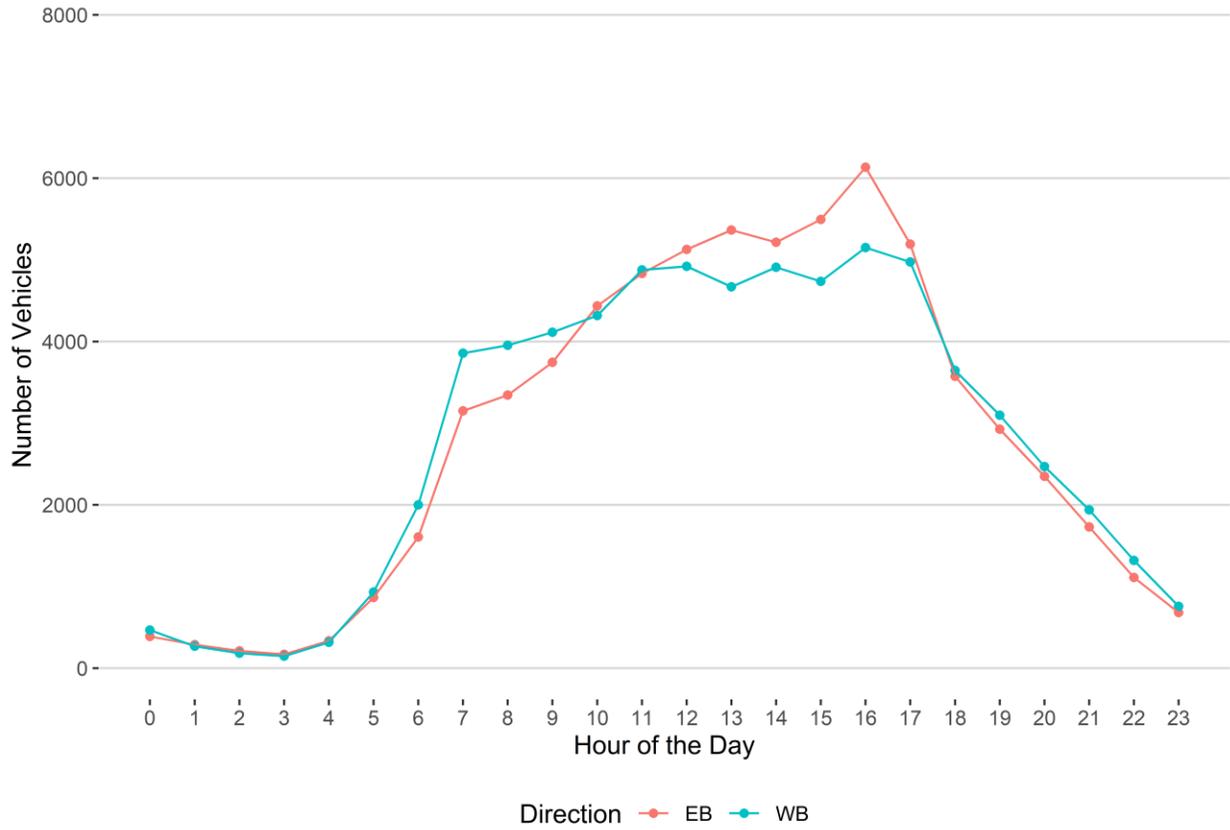


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

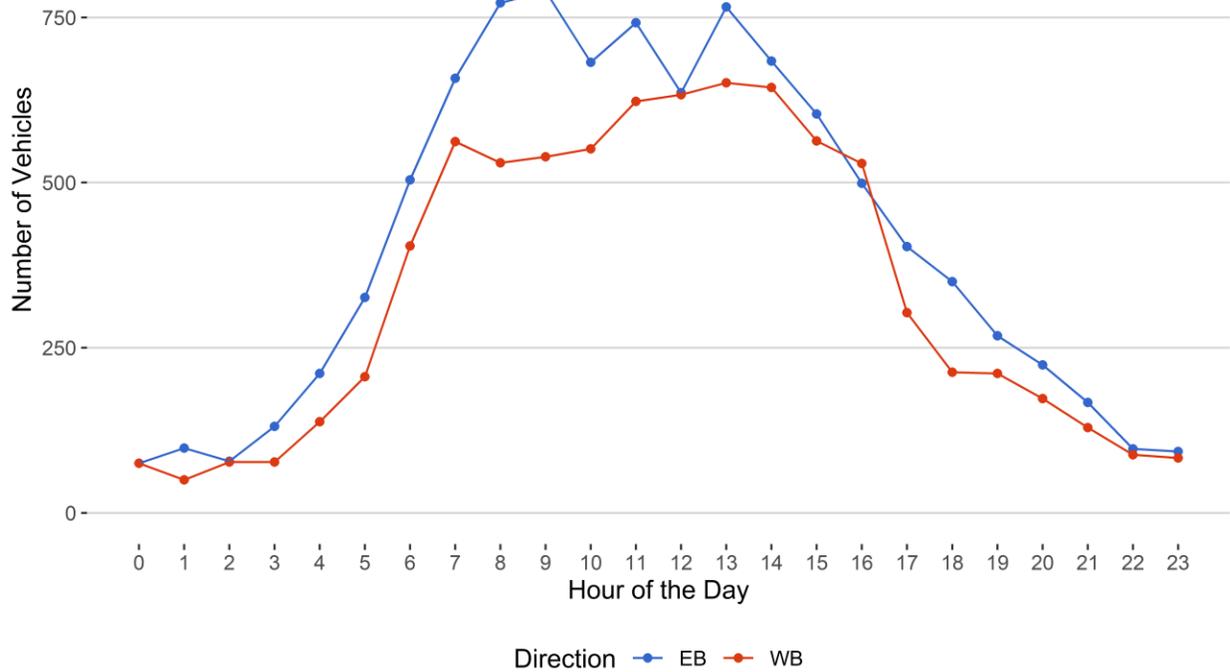


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

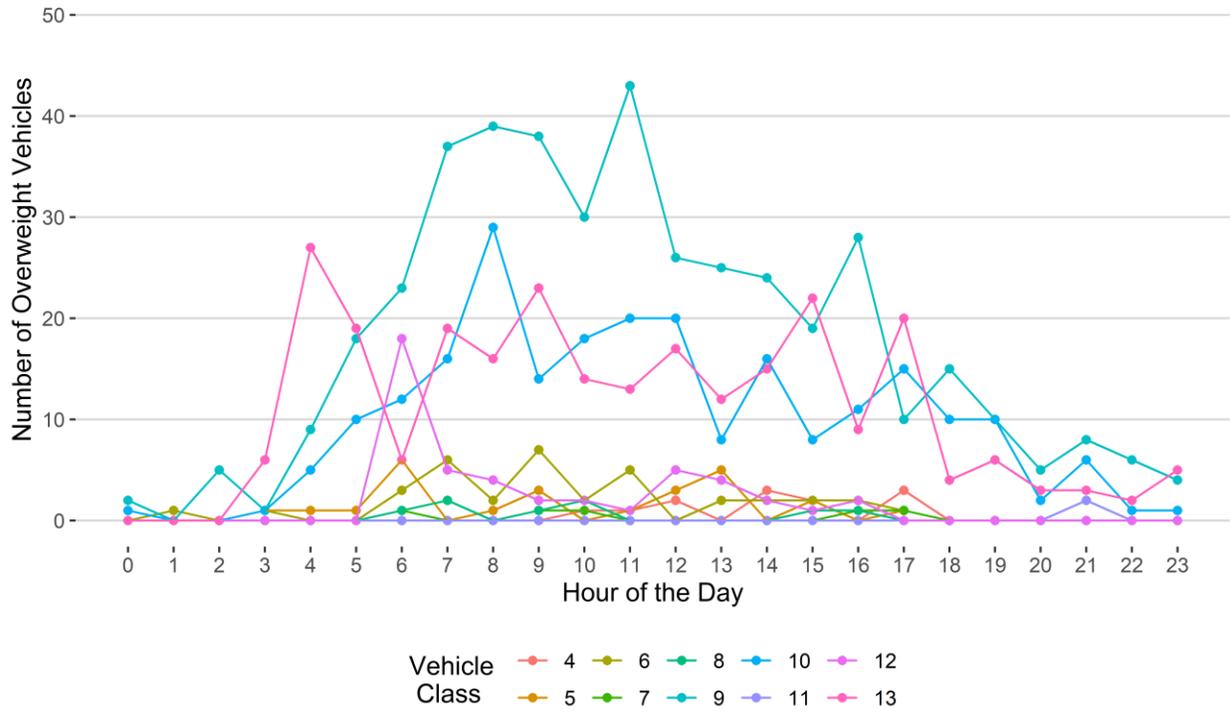


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

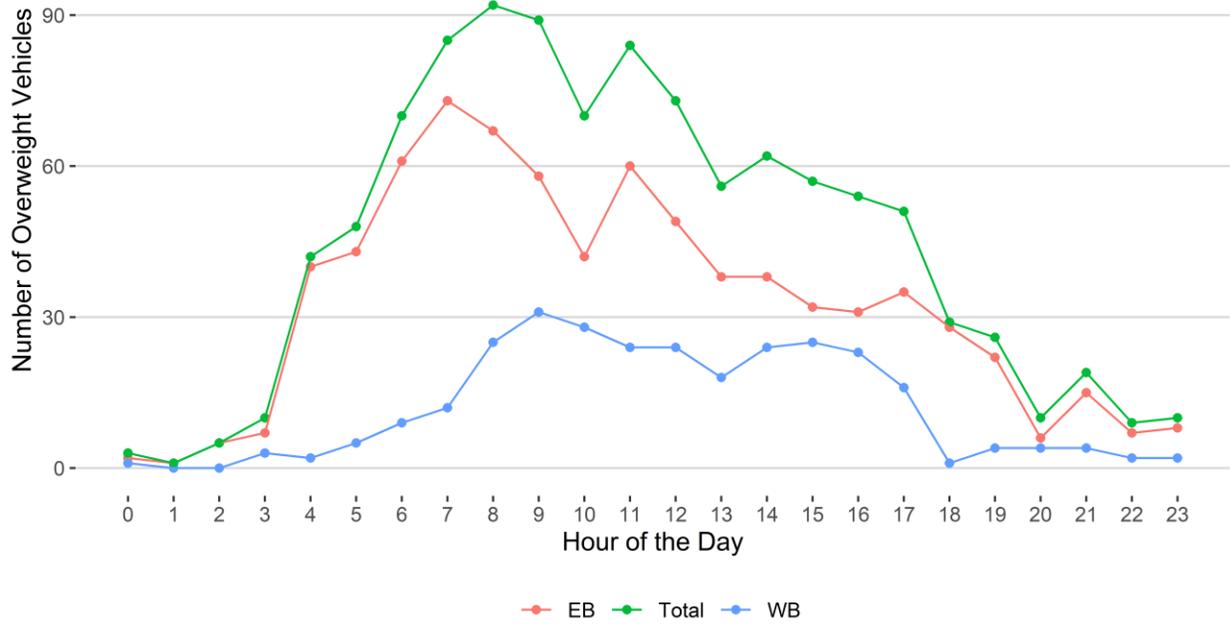
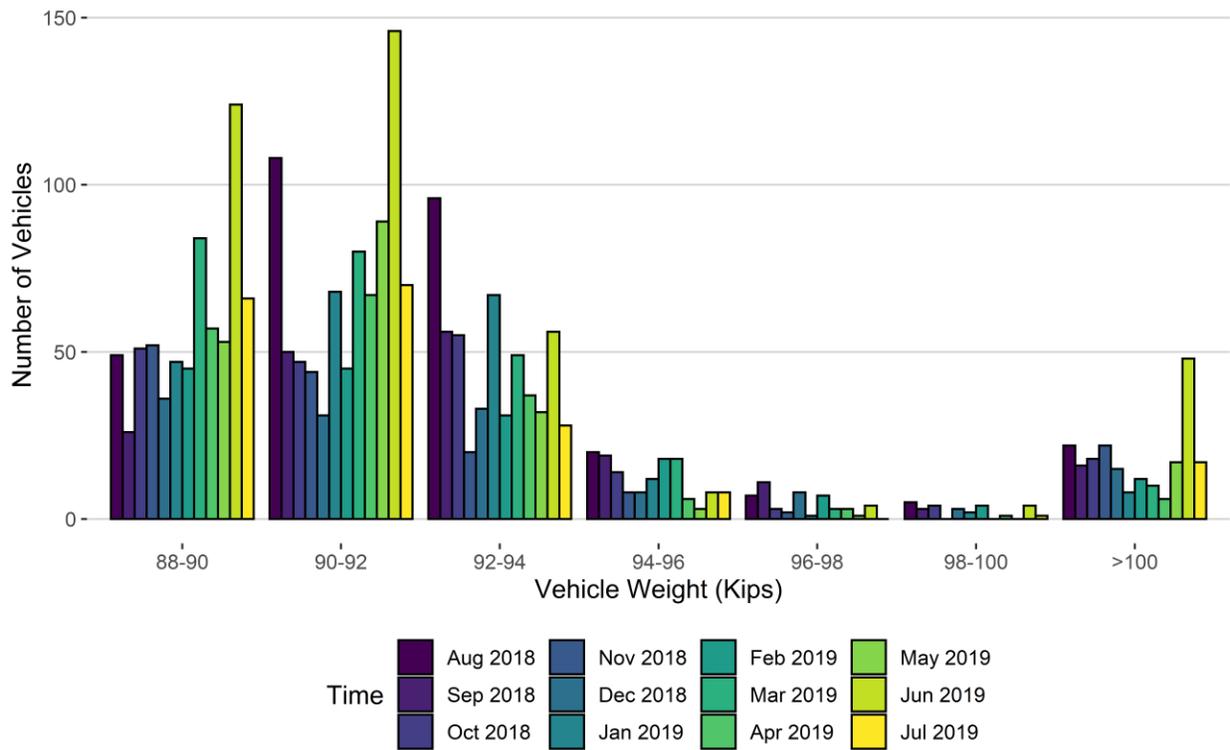
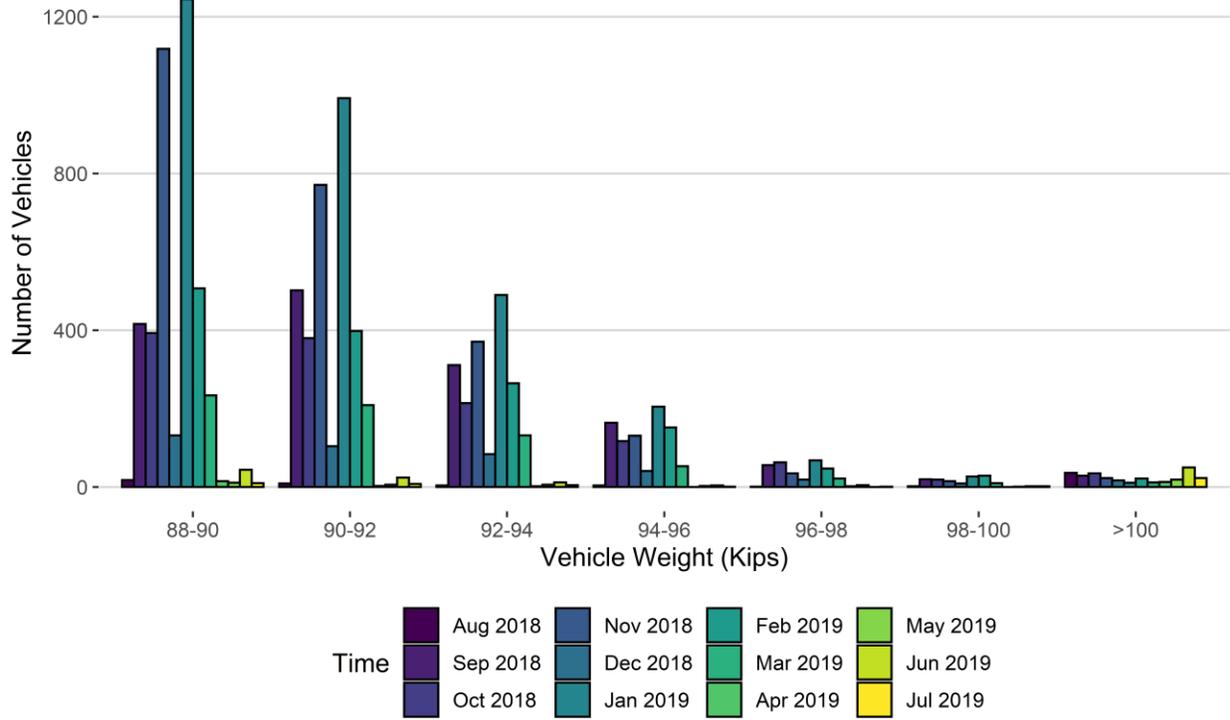


Figure 8 - Histogram of EB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019
88-90	49	26	51	52	36	47	45	84	57	53	124	66
90-92	108	50	47	44	31	68	45	80	67	89	146	70
92-94	96	56	55	20	33	67	31	49	37	32	56	28
94-96	20	19	14	8	8	12	18	18	6	3	8	8
96-98	7	11	3	2	8	1	7	3	3	1	4	0
98-100	5	3	4	0	3	2	4	0	1	0	4	1
>100	22	16	18	22	15	8	12	10	6	17	48	17
Total	307	181	192	148	134	205	162	244	177	195	390	190

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



Vehicle Weights (Kips)	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019
88-90	18	416	393	1118	132	1245	507	234	15	11	44	10
90-92	9	502	380	771	104	992	398	209	3	6	24	8
92-94	4	311	214	371	84	490	265	132	2	6	12	5
94-96	4	164	117	131	41	205	152	53	0	3	4	1
96-98	1	56	63	35	19	68	47	22	2	5	0	1
98-100	2	20	19	15	9	27	29	10	0	1	2	2
>100	36	29	35	23	17	11	22	12	13	19	50	23
Total	74	1498	1221	2464	406	3038	1420	672	35	51	136	50

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

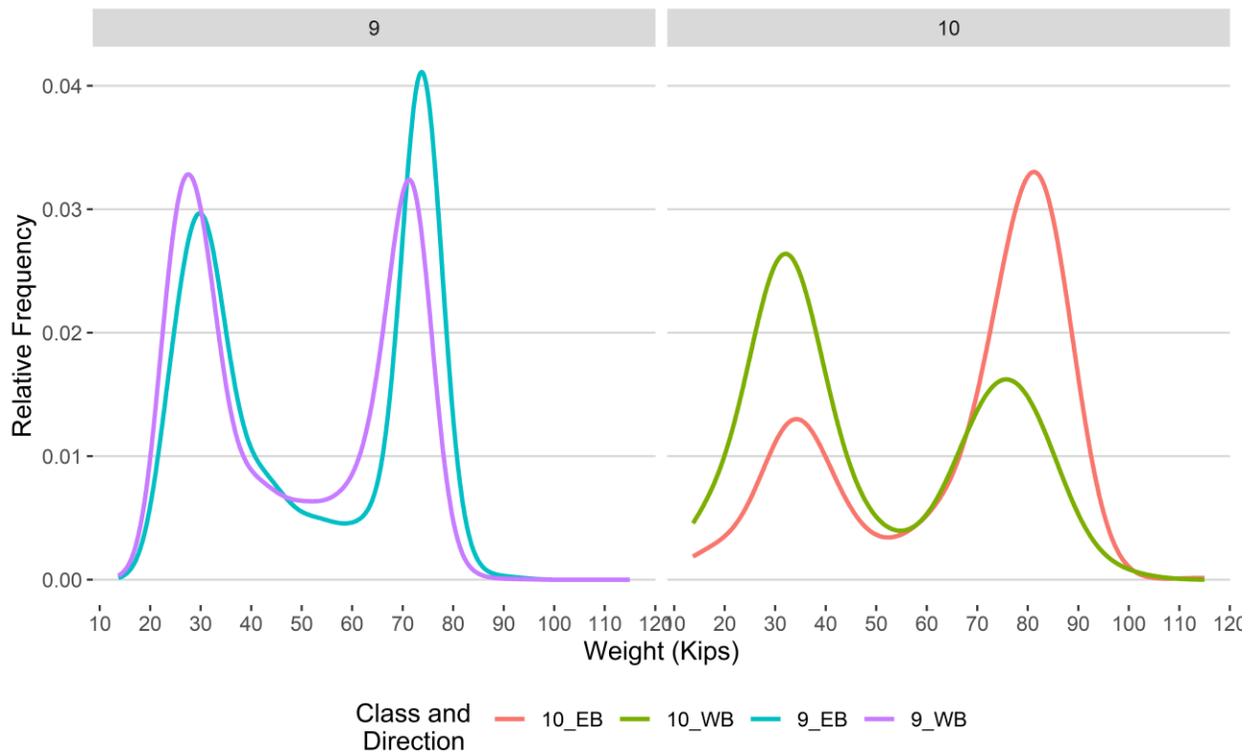


Figure 9 - Freight Percentage by Direction and Class

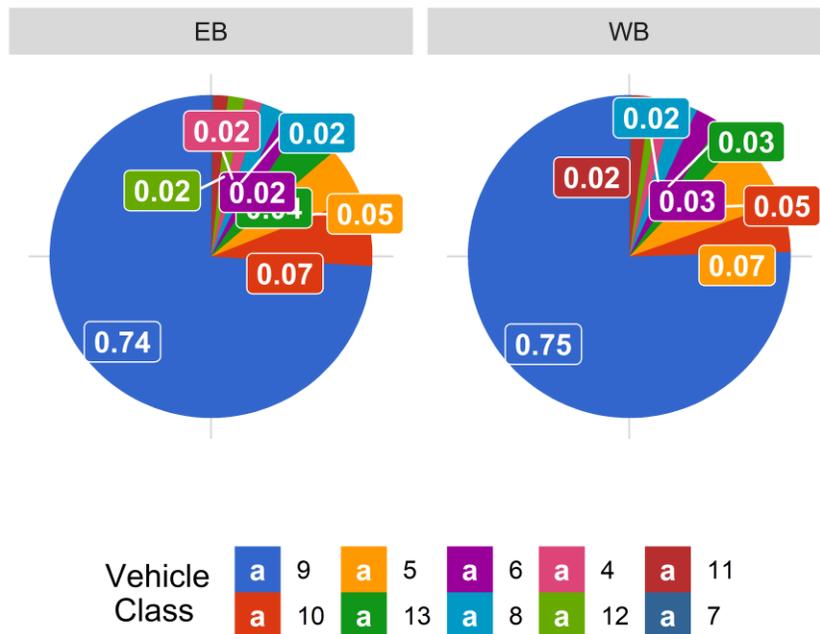


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

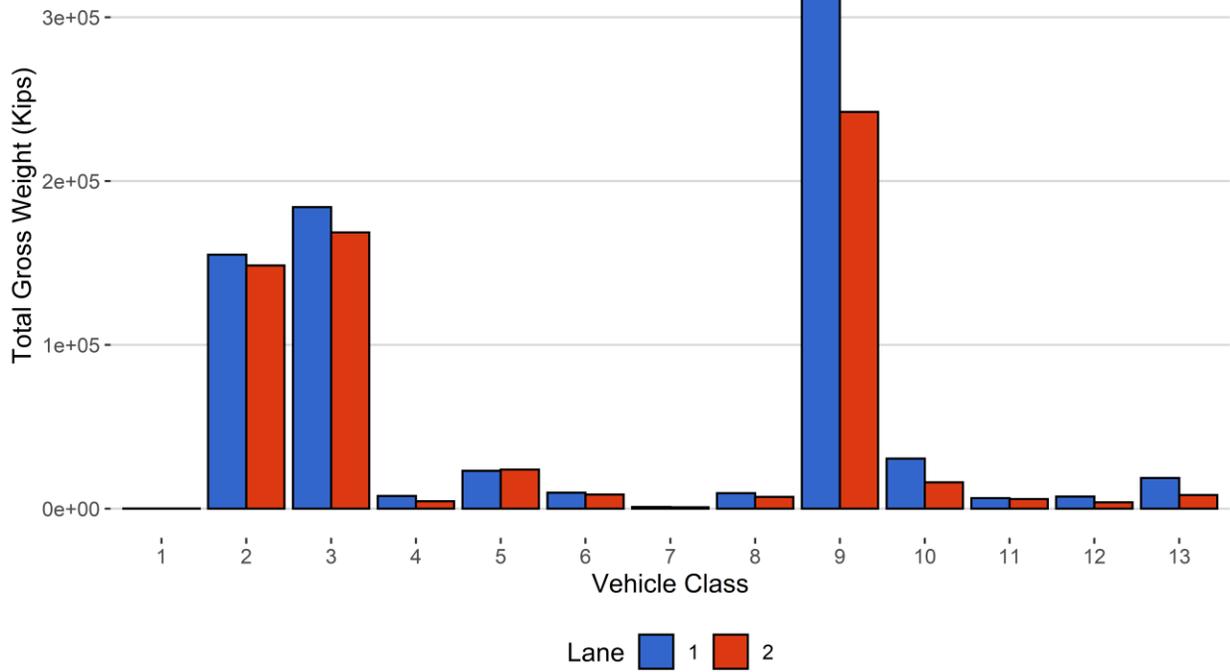


Figure 11 - Total Gross Vehicle Weight t

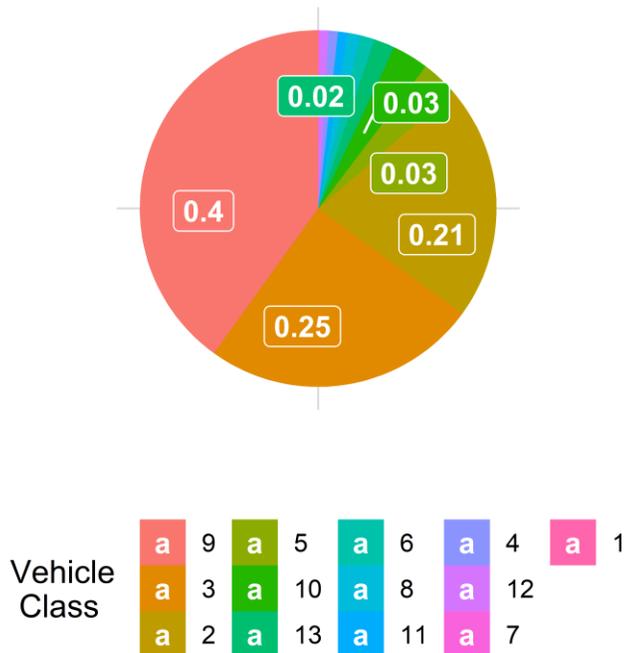


Figure 12 - Total ESALs by Class and Lane

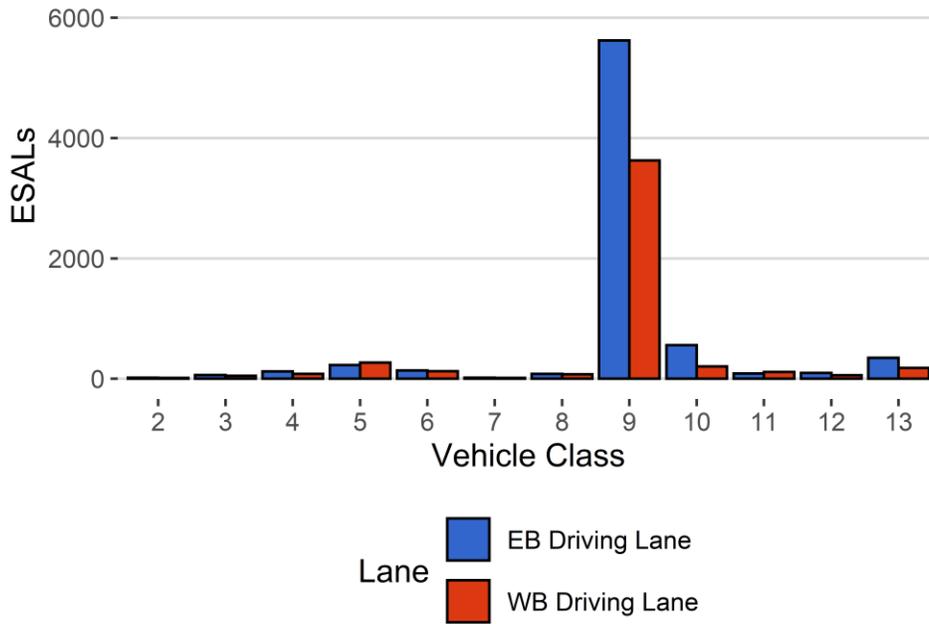


Figure 13 - ESALs by Class

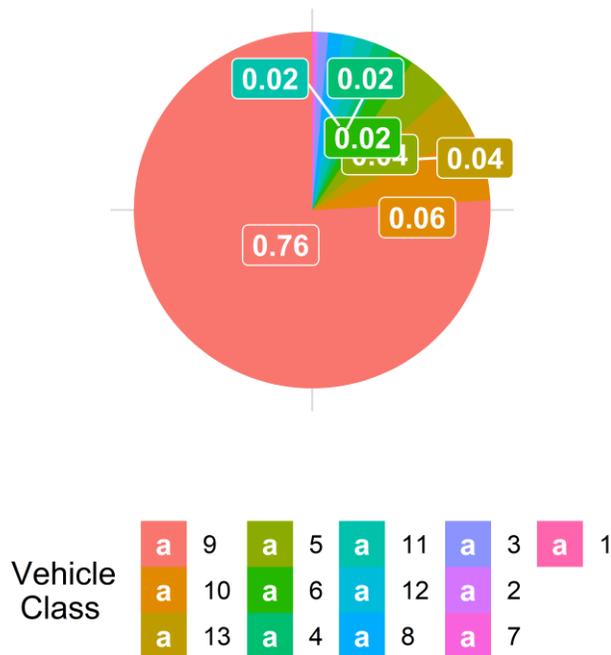


Table 1 Class 9 Front Axle Weight by Lane

<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	11.53	-1.97	11.02	0.30
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
January 2019	10.86	-7.59	10.37	-5.61
February 2019	10.93	-7.03	10.45	-4.83
March 2019	10.85	-7.70	10.35	-5.79
April 2019	10.84	-7.77	10.33	-5.92
May 2019	10.67	-9.22	10.30	-6.22
June 2019	10.78	-8.35	10.24	-6.74
July 2019	10.76	-8.49	10.19	-7.23

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	2574	79807	50.1	0	0
3	1968	61019	38.3	0	0
4	14	445	0.3	12	1.1
5	115	3568	2.2	25	2.4
6	22	677	0.4	36	3.4
7	1	40	0	5	0.5
8	20	621	0.4	8	0.8
9	374	11594	7.3	425	40.3
10	26	815	0.5	234	22.2
11	8	260	0.2	2	0.2
12	6	176	0.1	46	4.4
13	10	308	0.2	261	24.8
TOTAL	5143	159420	100	1054	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>
2019-07-27	Saturday	11:04:00	10	EB	1	114.98
2019-07-27	Saturday	08:10:23	10	WB	2	106.97
2019-07-26	Friday	20:25:34	10	WB	2	100.31
2019-07-01	Monday	18:48:40	10	WB	2	98.33
2019-07-18	Thursday	12:14:26	10	WB	2	98.15
2019-07-16	Tuesday	21:22:48	9	WB	2	94.72
2019-07-25	Thursday	15:03:04	9	EB	1	94.47
2019-07-13	Saturday	10:57:17	9	EB	1	93.5
2019-07-25	Thursday	04:34:41	10	EB	1	93.11
2019-07-03	Wednesday	08:08:14	10	WB	2	92.24

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	31	11.3	7318	397	1836
5	EB	8	1696	250	14.7	21297	1809	4865
6	EB	19	355	99	27.9	7997	1678	1567
7	EB	11.5	21	0	0	1044	0	401
8	EB	31	338	234	69.2	3962	5448	369
9	EB	33	6239	1959	31.4	270276	55021	64518
10	EB	33.5	464	65	14	28760	1806	7697
11	EB	36.5	146	46	31.5	4931	1474	640
12	EB	36.5	116	0	0	7364	0	1565
13	EB	31.5	209	0	0	18697	0	6057
TOTAL	****	****	9858	2684	****	371646	****	89515
<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	157	20	12.7	4218	259	1081
5	WB	8	1757	305	17.4	21634	2201	5009
6	WB	19	300	64	21.3	7483	1048	1499
7	WB	11.5	18	0	0	791	0	292
8	WB	31	263	179	68.1	3061	4098	228
9	WB	33	4983	1905	38.2	190340	51879	44383
10	WB	33.5	325	127	39.1	12507	3560	2937
11	WB	36.5	106	9	8.5	5600	235	1030
12	WB	36.5	54	1	1.9	3792	33	929
13	WB	31.5	89	1	1.1	8246	29	2737
TOTAL	****	****	8052	2611	****	257673	****	60126
GRAND TOTAL	****	****	17910	5295	408	629318	130976	149641

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	59	63	122	0
2	155008	148495	303502	21.4
3	184065	168685	352750	24.9
4	7715	4477	12191	0.9
5	23106	23835	46941	3.3
6	9675	8531	18206	1.3
7	1044	791	1835	0.1
8	9410	7159	16569	1.2
9	325297	242219	567516	40.1
10	30566	16067	46633	3.3
11	6405	5835	12240	0.9
12	7364	3825	11189	0.8
13	18697	8276	26973	1.9
TOTAL	778411	638257	1416668	100
GVW/LANE	54.95	45.05	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	0.0114
2	18	16	34	0.3	9e-04
3	63	49	112	0.9	0.0038
4	122	82	204	1.7	0.95
5	228	269	497	4.1	0.29
6	138	126	263	2.2	0.81
7	18	13	32	0.3	1.53
8	80	74	154	1.3	0.52
9	5621	3626	9247	75.9	1.65
10	558	205	763	6.3	1.93
11	86	114	199	1.6	1.56
12	97	58	155	1.3	1.78
13	347	178	526	4.3	3.44
TOTAL	7375	4810	12186	100	14
ESALS/LANE	60.5	39.5	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>
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
Jan 2019	136631	4407	857	110055	80.5	26575.5	19.5
Feb 2019	114260	4081	721	94070	82.3	20190.2	17.7
Mar 2019	138776	4477	648	118679	85.5	20096.7	14.5
Apr 2019	140330	4678	641	121113	86.3	19216.6	13.7
May 2019	162937	5174	679	141887	87.1	21050.5	12.9
Jun 2019	156866	5229	642	137597	87.7	19269.2	12.3
Jul 2019	159420	5102	597	140916	88.4	18504.3	11.6
TOTAL	1804276	-	-	1537484	-	266793	-
AVERAGE	150356	4940	731	128124	85	22233	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>
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
Jan 2019	7551	12934	20486	3.3
Feb 2019	7266	8726	15992	3.6
Mar 2019	7505	7468	14973	2.2
Apr 2019	7081	5767	12848	0.6
May 2019	7030	6625	13655	0.7
Jun 2019	14609	11559	26168	1
Jul 2019	7391	4814	12205	1.8
TOTAL	101315	-	-	-
AVERAGE	8443	8691	17134	2

###Gross Vehicle Weight

<i>Month</i>	<i>GVW EB Driving Lane</i>	<i>GVW WB Driving Lane</i>	<i>Total GVW Kips</i>
Aug 18	890959	859371	1750330
Sep 18	787783	920089	1707873

Oct 18	910823	1024892	1935715
Nov 18	876238	1195186	2071423
Dec 18	663511	704078	1367589
Jan 19	748717	1130601	1879318
Feb 19	624281	797364	1421645
Mar 19	705802	775079	1480881
Apr 19	705844	678545	1384390
May 19	771941	774947	1546888
Jun 19	1512692	1451859	2964551
Jul 19	779280	638532	1417812
TOTAL	9977873	10950544	20928417
AVERAGE	831489	912545	1744035

###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>
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
Jan 2019	6767	5	25.7	3243	48
Feb 2019	4196	3.8	21.2	1582	67
Mar 2019	2644	1.9	13.3	916	32
Apr 2019	1066	0.8	5.6	213	20
May 2019	1059	0.7	5.1	246	37
Jun 2019	2304	0.7	6	528	106
Jul 2019	1055	0.7	5.9	240	43
TOTAL	36550	-	-	13596	667
AVERAGE	3045.8	2	12.6	1133	55.6

###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>
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
Jan 2019	81765	228122	309886	26.4	73.6

Feb 2019	80540	135572	216113	37.3	62.7
Mar 2019	86502	104160	190662	45.4	54.6
Apr 2019	86278	71227	157505	54.8	45.2
May 2019	85927	83228	169155	50.8	49.2
Jun 2019	176389	142159	318548	55.4	44.6
Jul 2019	89515	60126	149641	59.8	40.2
TOTAL	1171596	1510704	2682299	-	-
AVERAGE	97633	125892	223525	45.3	54.7