

JUNE 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 June 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: 156866 | Passenger Vehicles: 137597 | Heavy Commercial Vehicles: 19269

Monthly Average Daily Traffic (MADT): 5229 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 642

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 Saturdays. 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 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 19269 HCVs, 1149 of them were overweight ³. These overweight HCVs contributed to 0.7% of total monthly volume, and 6% of total monthly

HCV volume. EB overweight vehicles typically reached highest numbers on Wednesdays, with lowest volumes reported on Saturdays. WB overweight vehicles tended to reach highest volumes on Wednesdays, with lowest volumes reported on Sundays. 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 65.8% 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, 195 EB vehicles exceeded 88,000 pounds (178 vehicles were Class 13's; 13 vehicles were Class 10's). Of vehicles traveling WB,

69 EB vehicles exceeded 88,000 pounds (51 vehicles were Class 13's; 10 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from June 2019.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in June 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 159274 tons of freight was recorded to have crossed the WIM. More freight was shipped EB (55.4%) than WB (44.6%). 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 156866 vehicles with a combined GVW of 1482276 kips (1 kip = 1,000 pounds = 0.5 tons) in June 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 13084 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 55.8% of all ESALs were recorded EB while 44.2% was observed WB. In particular, 76% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 41% 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).

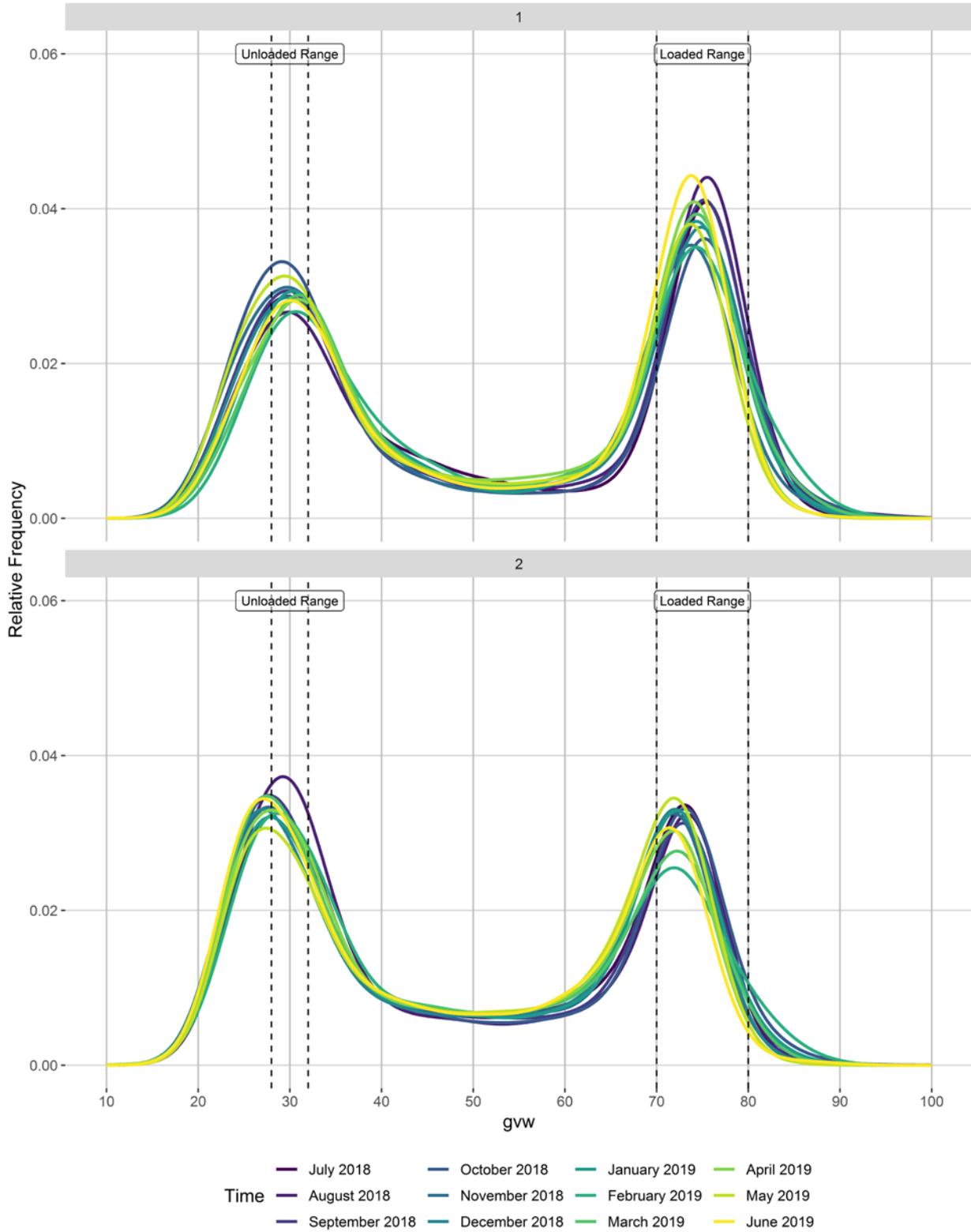
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

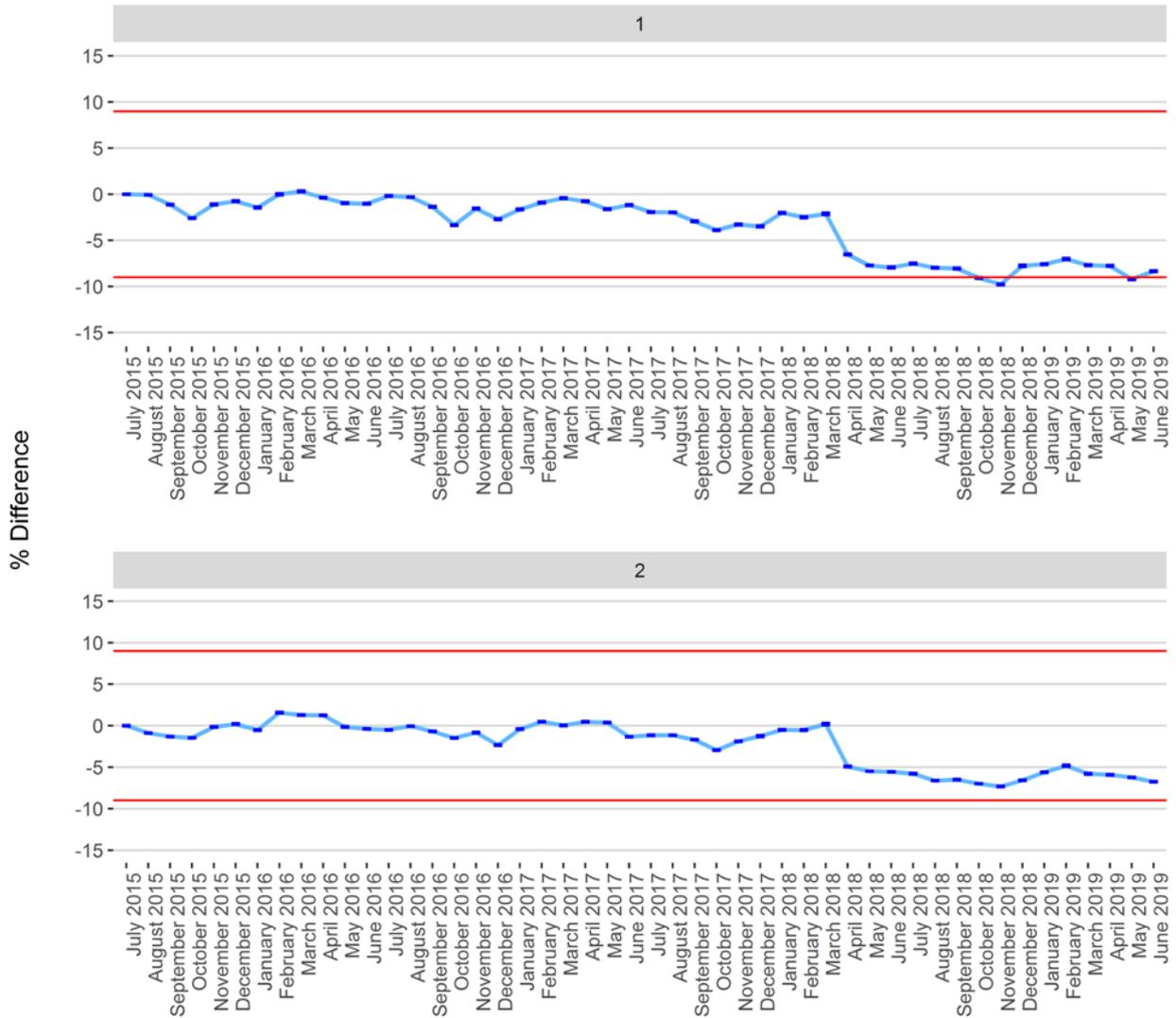
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

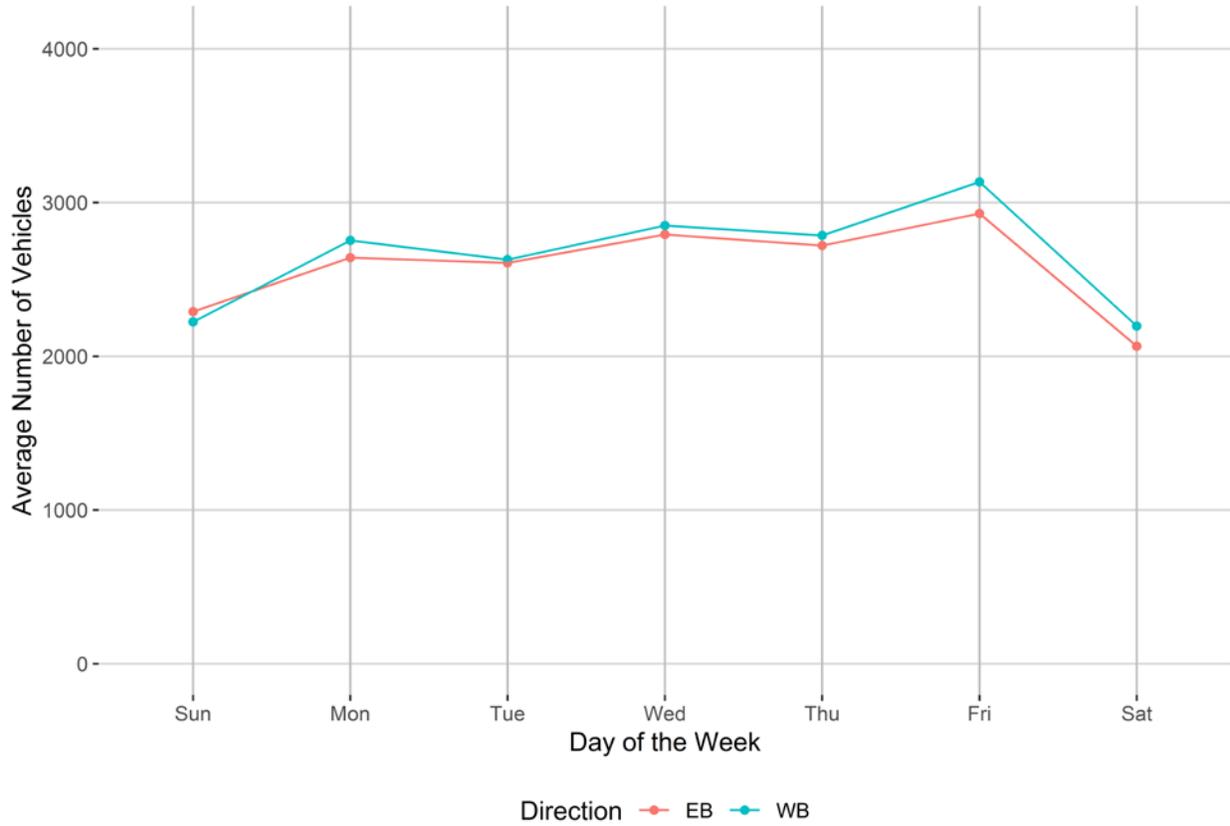


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

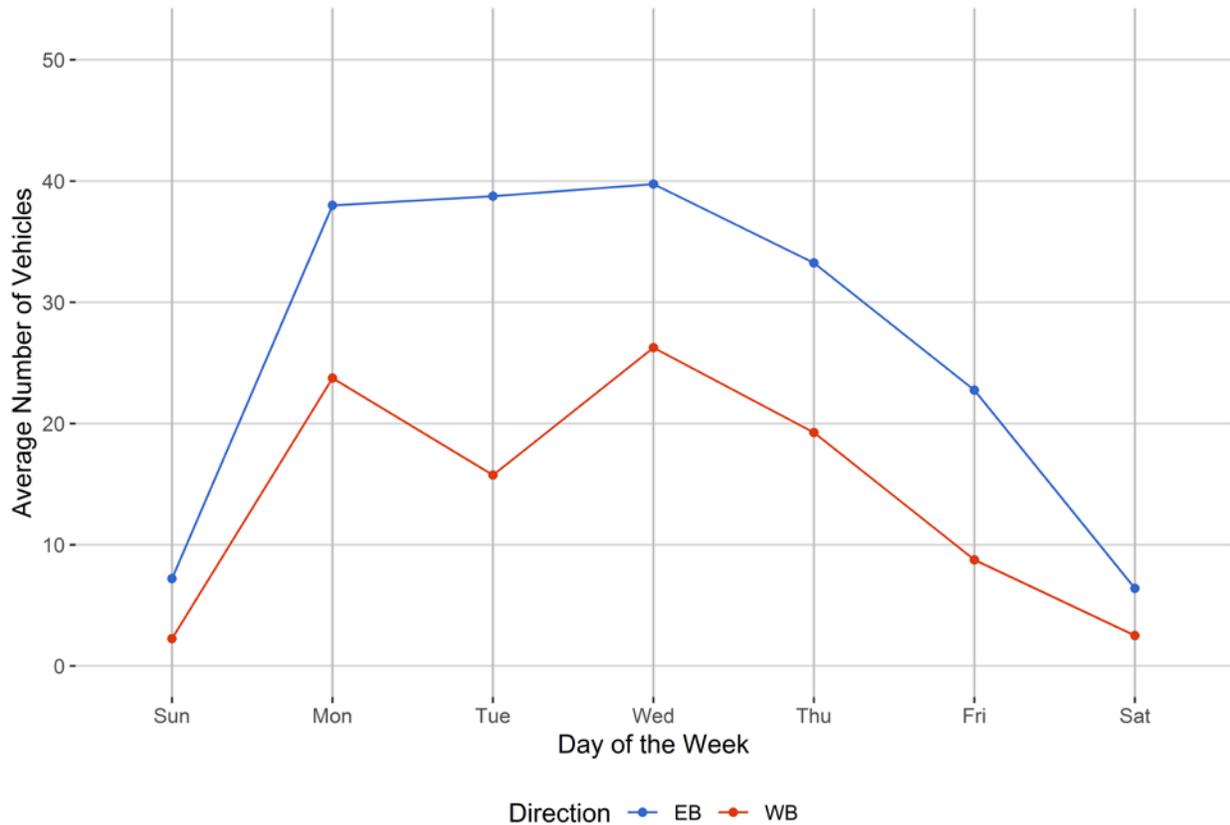


Figure 4 - Passenger Vehicles vs. Hour of the Day

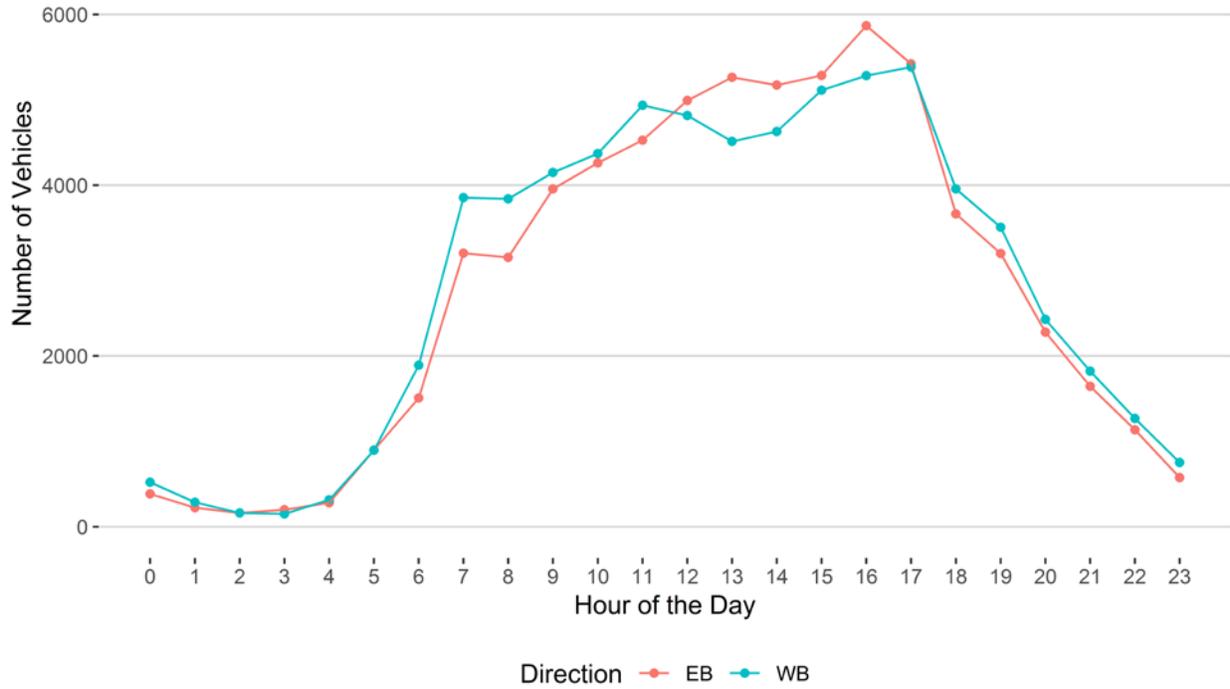


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

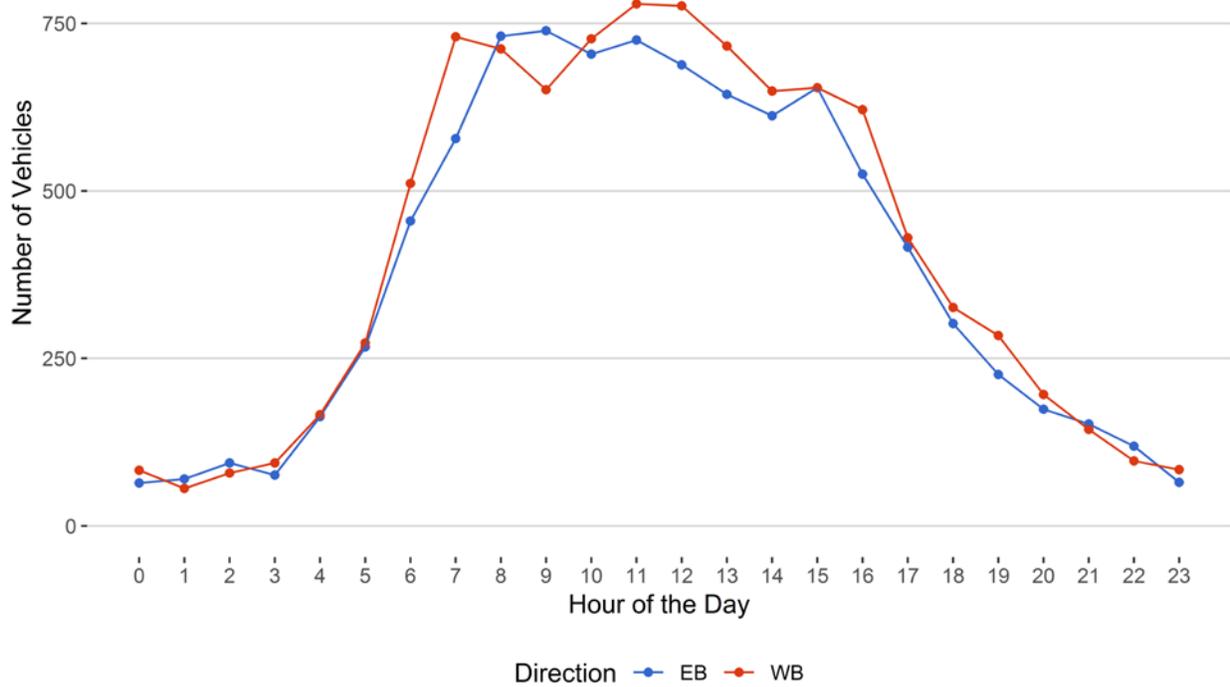


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

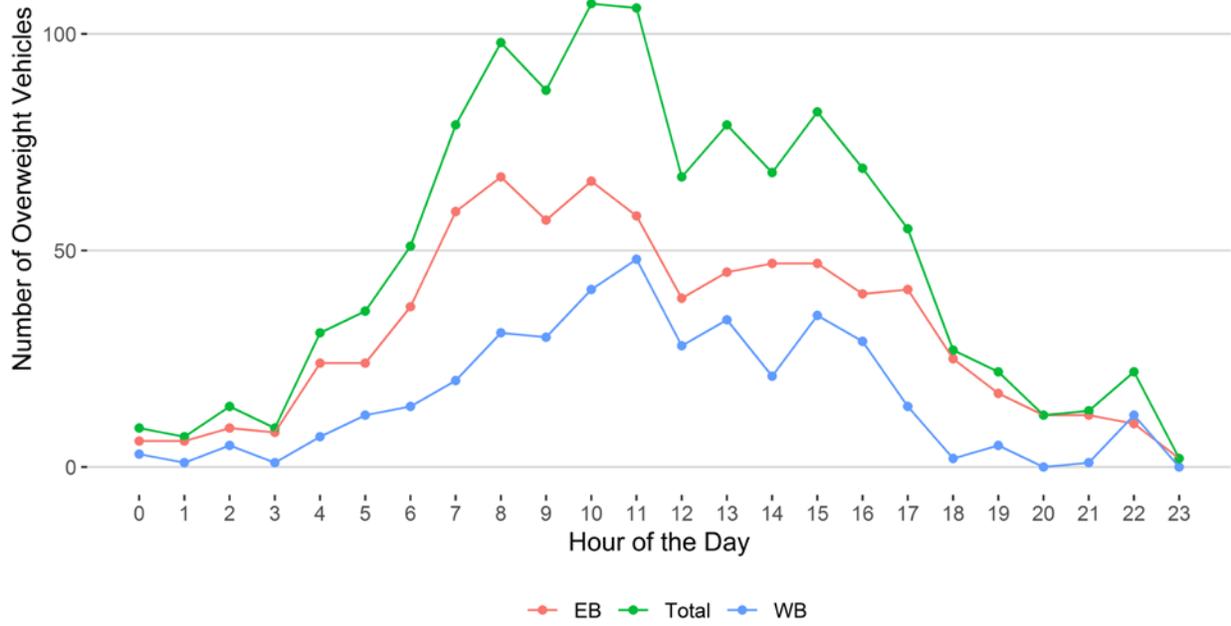
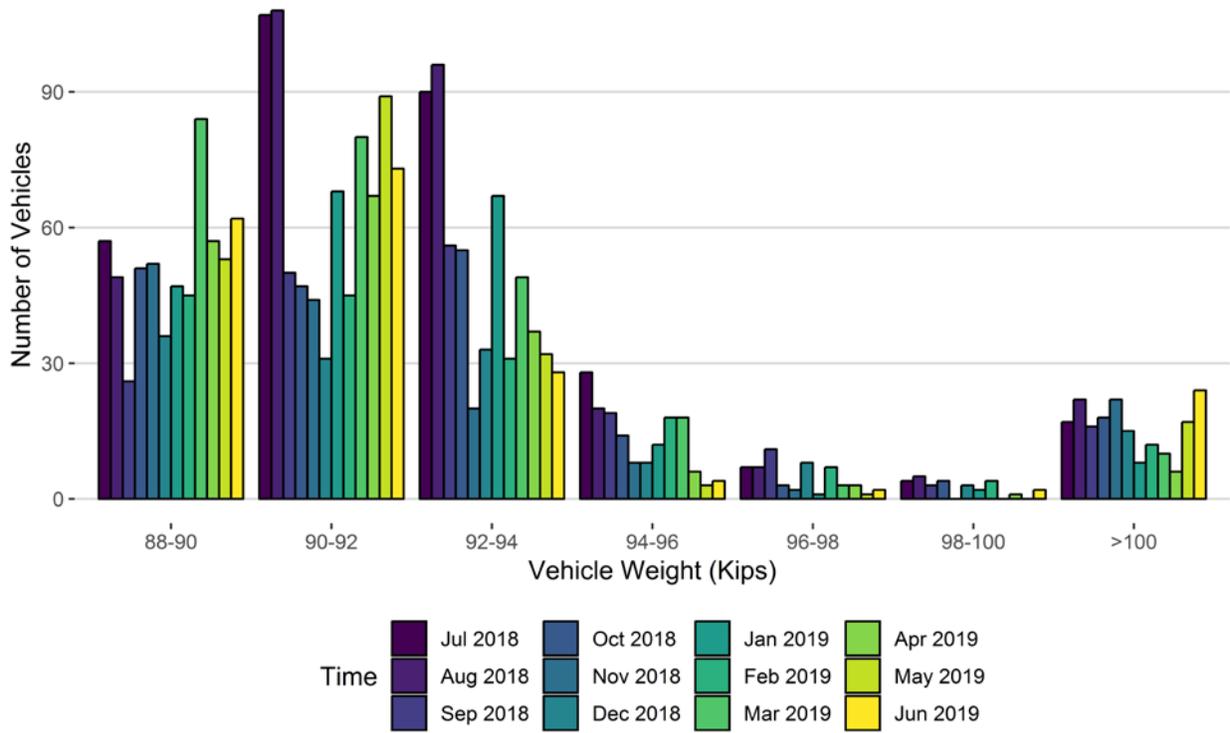
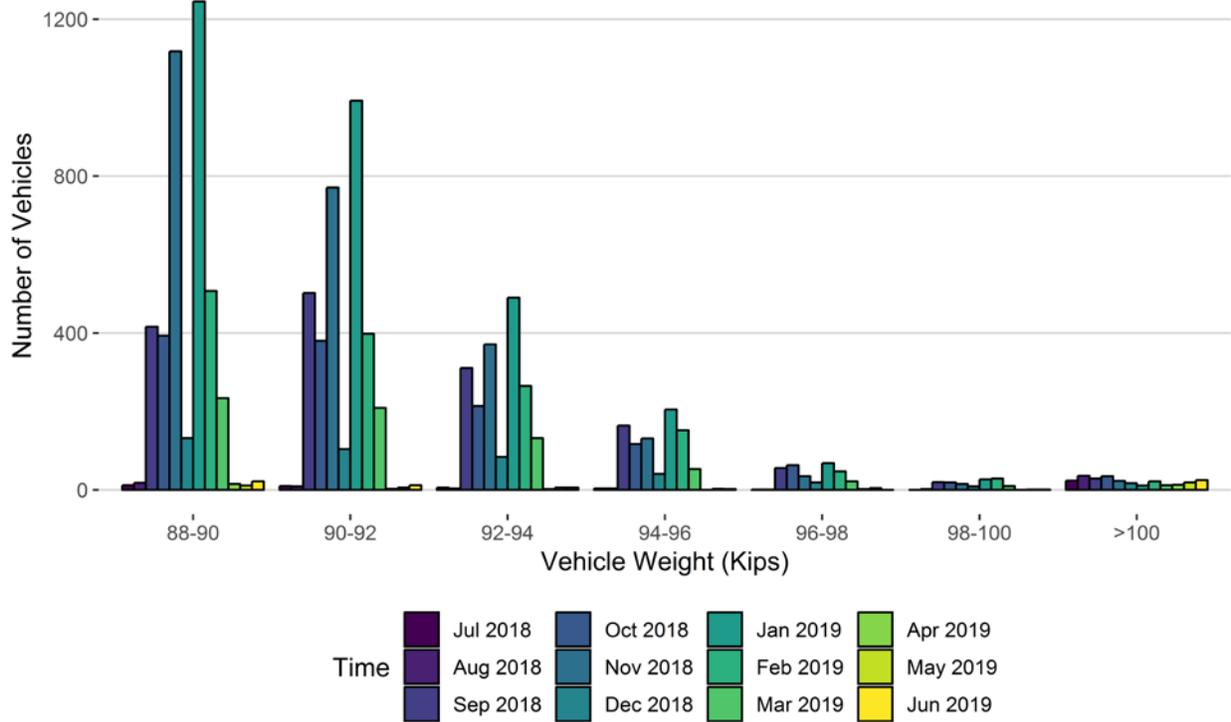


Figure 8 - Histogram of EB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019
88-90	57	49	26	51	52	36	47	45	84	57	53	62
90-92	107	108	50	47	44	31	68	45	80	67	89	73
92-94	90	96	56	55	20	33	67	31	49	37	32	28
94-96	28	20	19	14	8	8	12	18	18	6	3	4
96-98	7	7	11	3	2	8	1	7	3	3	1	2
98-100	4	5	3	4	0	3	2	4	0	1	0	2
>100	17	22	16	18	22	15	8	12	10	6	17	24
Total	310	307	181	192	148	134	205	162	244	177	195	195

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



Vehicle Weights (Kips)	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019
88-90	12	18	416	393	1118	132	1245	507	234	15	11	22
90-92	10	9	502	380	771	104	992	398	209	3	6	12
92-94	6	4	311	214	371	84	490	265	132	2	6	6
94-96	4	4	164	117	131	41	205	152	53	0	3	2
96-98	1	1	56	63	35	19	68	47	22	2	5	0
98-100	0	2	20	19	15	9	27	29	10	0	1	1
>100	24	36	29	35	23	17	11	22	12	13	19	25
Total	57	74	1498	1221	2464	406	3038	1420	672	35	51	68

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

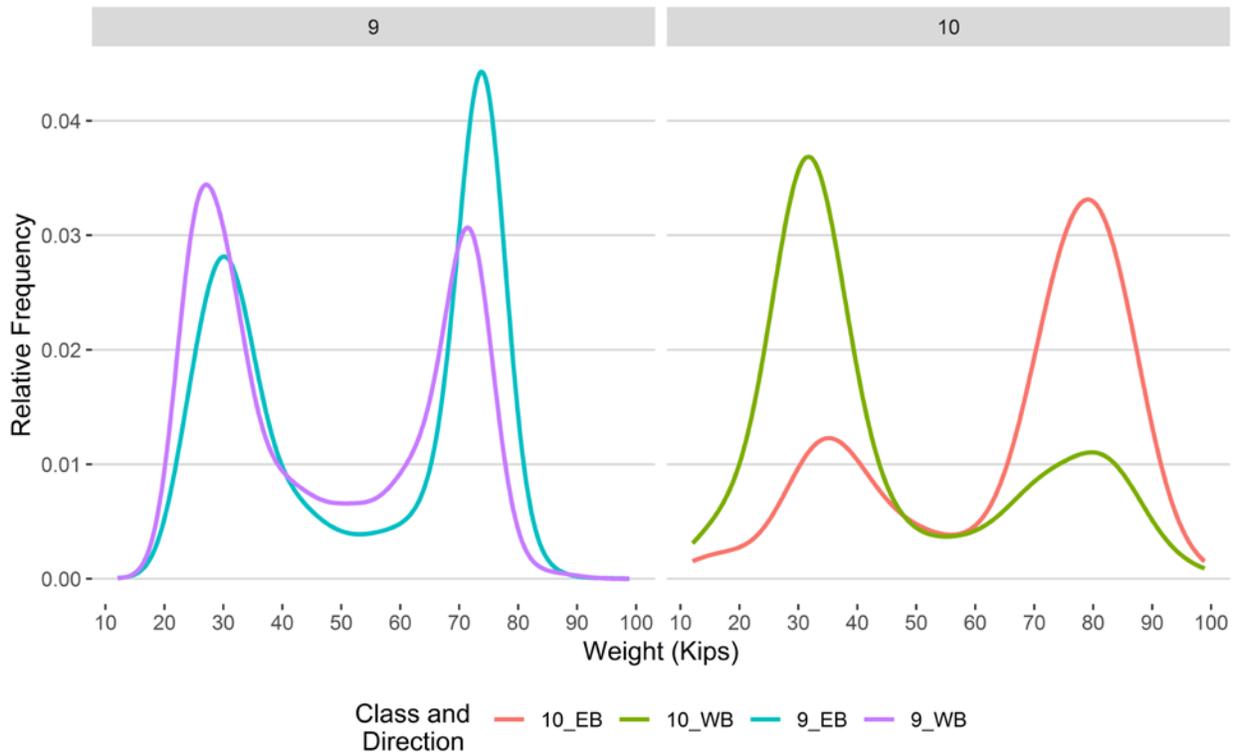


Figure 9 - Freight Percentage by Direction and Class

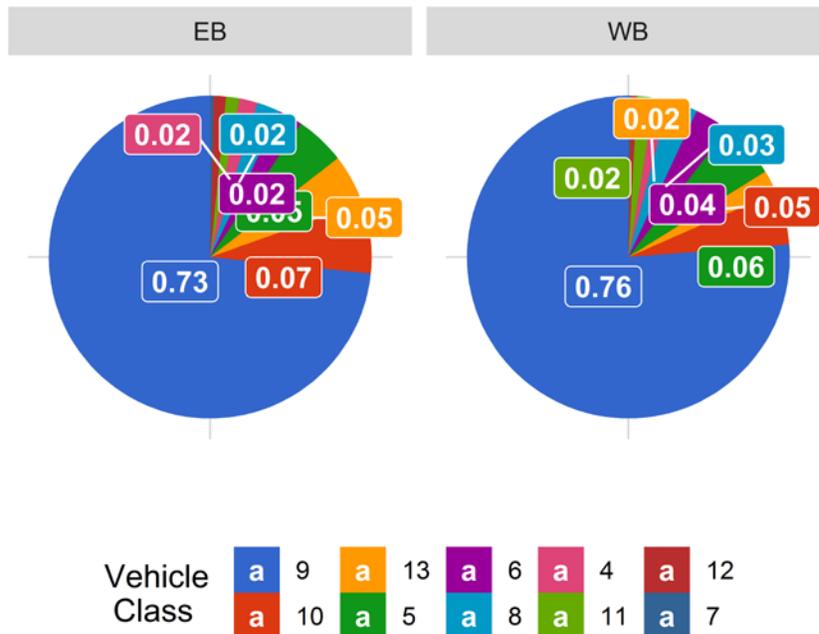


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

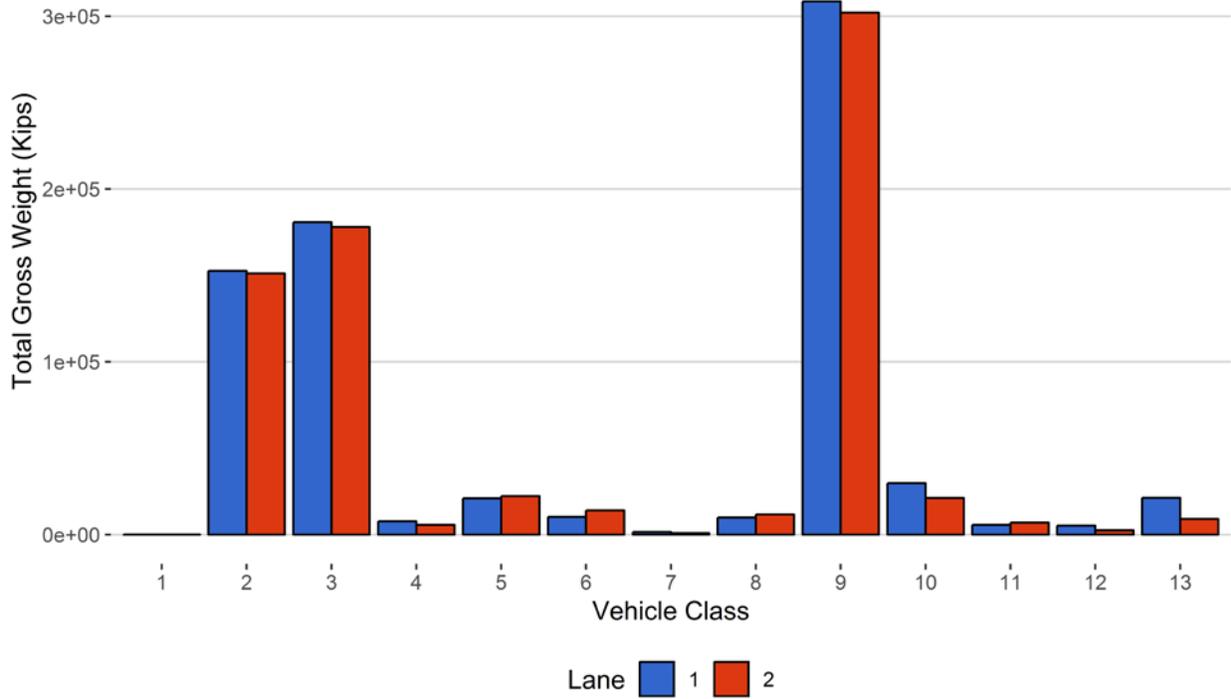


Figure 11 - Total Gross Vehicle Weight t

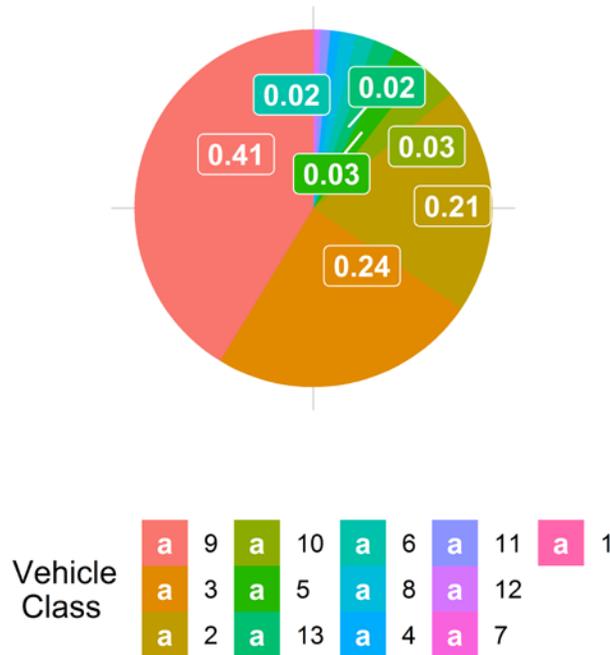


Figure 12 - Total ESALs by Class and Lane

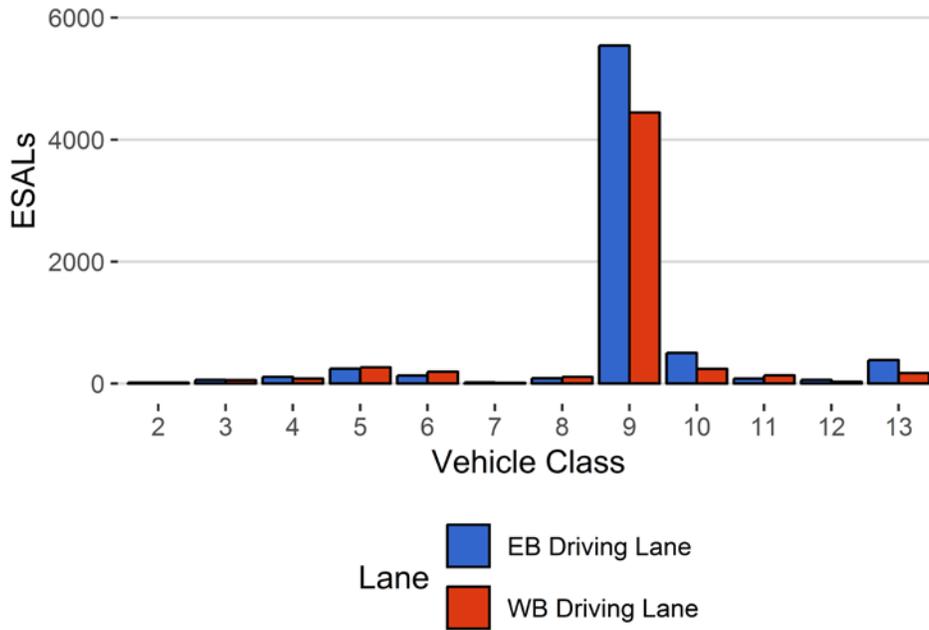


Figure 13 - ESALs by Class

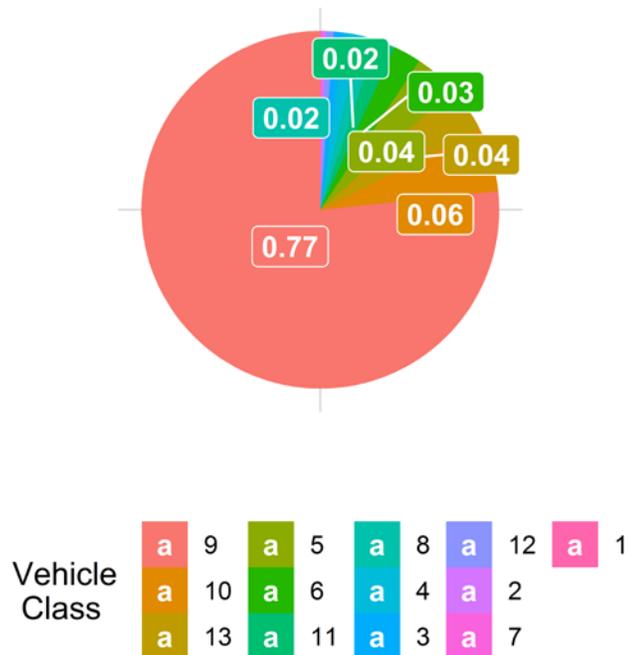


Table 1 Class 9 Front Axle Weight by Lane

<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
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

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	4	113	0.1	0	0
2	2591	77718	49.5	0	0
3	1992	59766	38.1	0	0
4	17	496	0.3	16	1.4
5	106	3191	2	46	4
6	30	890	0.6	43	3.7
7	2	46	0	1	0.1
8	27	812	0.5	9	0.8
9	406	12181	7.8	500	43.5
10	31	931	0.6	228	19.8
11	8	252	0.2	3	0.3
12	4	129	0.1	17	1.5
13	11	340	0.2	286	24.9
TOTAL	5229	156866	100	1149	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>
2019-06-14	Friday	10:23:22	10	WB	2	98.88
2019-06-14	Friday	15:30:44	10	EB	1	97.09
2019-06-04	Tuesday	09:25:36	10	WB	2	95.89
2019-06-10	Monday	12:38:11	10	EB	1	95.67
2019-06-19	Wednesday	05:24:29	9	EB	1	95.47
2019-06-14	Friday	06:05:58	10	WB	2	95
2019-06-24	Monday	07:27:03	10	EB	1	94.37
2019-06-24	Monday	04:48:50	10	EB	1	93.09
2019-06-25	Tuesday	04:51:35	10	EB	1	92.38
2019-06-10	Monday	09:51:42	9	EB	1	92.08

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	283	54	19.1	7026	707	1796
5	EB	8	1527	214	14	19454	1565	4475
6	EB	19	387	112	28.9	8367	1842	1571
7	EB	11.5	25	0	0	1448	0	580
8	EB	31	370	252	68.1	4480	5394	411
9	EB	33	5749	1658	28.8	261906	46689	63451
10	EB	33.5	451	52	11.5	28271	1419	7452
11	EB	36.5	126	43	34.1	4233	1363	602
12	EB	36.5	88	3	3.4	5035	108	966
13	EB	31.5	237	0	0	21245	0	6890
TOTAL	****	****	9243	2388	****	361466	****	88195
<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	208	38	18.3	5160	496	1305
5	WB	8	1633	265	16.2	20334	1922	4695
6	WB	19	494	86	17.4	12509	1470	2378
7	WB	11.5	21	0	0	872	0	315
8	WB	31	434	289	66.6	5378	6306	441
9	WB	33	6313	2469	39.1	234804	67243	53976
10	WB	33.5	471	233	49.5	14482	6734	3255
11	WB	36.5	124	7	5.6	6742	166	1236
12	WB	36.5	40	1	2.5	2471	36	524
13	WB	31.5	100	0	0	9059	0	2955
TOTAL	****	****	9838	3388	****	311810	****	71079
GRAND TOTAL	****	****	19081	5776	423	673276	143459	159274

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	66	85	150	0
2	152580	151119	303699	20.5
3	180758	177959	358717	24.2
4	7733	5656	13389	0.9
5	21019	22256	43275	2.9
6	10210	13978	24188	1.6
7	1448	872	2320	0.2
8	9874	11684	21558	1.5
9	308595	302047	610642	41.3
10	29690	21216	50906	3.4
11	5597	6908	12505	0.8
12	5143	2506	7649	0.5
13	21245	9059	30304	2
TOTAL	753957	725345	1479302	100
GVW/LANE	50.97	49.03	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	0.0089
2	18	16	34	0.3	9e-04
3	62	58	120	0.9	0.0041
4	110	82	192	1.5	0.79
5	247	267	514	4	0.33
6	133	196	329	2.5	0.75
7	20	13	33	0.2	1.37
8	88	112	200	1.5	0.5
9	5542	4444	9986	76.7	1.66
10	503	244	748	5.7	1.62
11	83	136	219	1.7	1.73
12	61	29	90	0.7	1.37
13	387	172	559	4.3	3.24
TOTAL	7254	5770	13024	100	13
ESALS/LANE	55.7	44.3	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>
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
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
TOTAL	1803766	-	-	1535283	-	268483	-
AVERAGE	150314	4942	736	127940	85	22374	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>
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
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	7305	5779	13084	1
TOTAL	94834	-	-	-
AVERAGE	7903	8378	16281	2

Gross Vehicle Weight

<i>Month</i>	<i>GVW EB Driving Lane</i>	<i>GVW WB Driving Lane</i>	<i>Total GVW Kips</i>
Jul 18	791746	765202	1556948
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	756346	725929	1482276
TOTAL	9233992	10351285	19585277
AVERAGE	769499	862607	1632106

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>
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
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	1152	0.7	6	264	53
TOTAL	36032	-	-	13459	616
AVERAGE	3002.7	2.1	12.8	1121.6	51.3

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>
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
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	88195	71079	159274	55.4	44.6
TOTAL	1089666	1461091	2550756	-	-
AVERAGE	90805.5	121757.6	212563	44.9	55.1