

AUGUST 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 August 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: 169242 | Passenger Vehicles: 147124 | Heavy Commercial Vehicles: 22118

Monthly Average Daily Traffic (MADT): 5447 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 713

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 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 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 03 PM and 05 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 22118 HCVs, 1341 of them were overweight ³. These overweight HCVs contributed to 0.8% of total monthly volume, and 6.1% 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 Saturdays. 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 77.5% 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 (152 vehicles were Class 13's; 19 vehicles were Class 10's). Of vehicles traveling WB,

39 EB vehicles exceeded 88,000 pounds (33 vehicles were Class 13's; 4 vehicles were Class 9's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from August 2019.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in August 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 empty Class 9's than fully_loaded 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 184900 tons of freight was recorded to have crossed the WIM. More freight was shipped EB (54.3%) than WB (45.7%). 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 169242 vehicles with a combined GVW of 1646034 kips (1 kip = 1,000 pounds = 0.5 tons) in August 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 14889 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 57.1% of all ESALs were recorded EB while 42.9% was observed WB. In particular, 75% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 43% 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

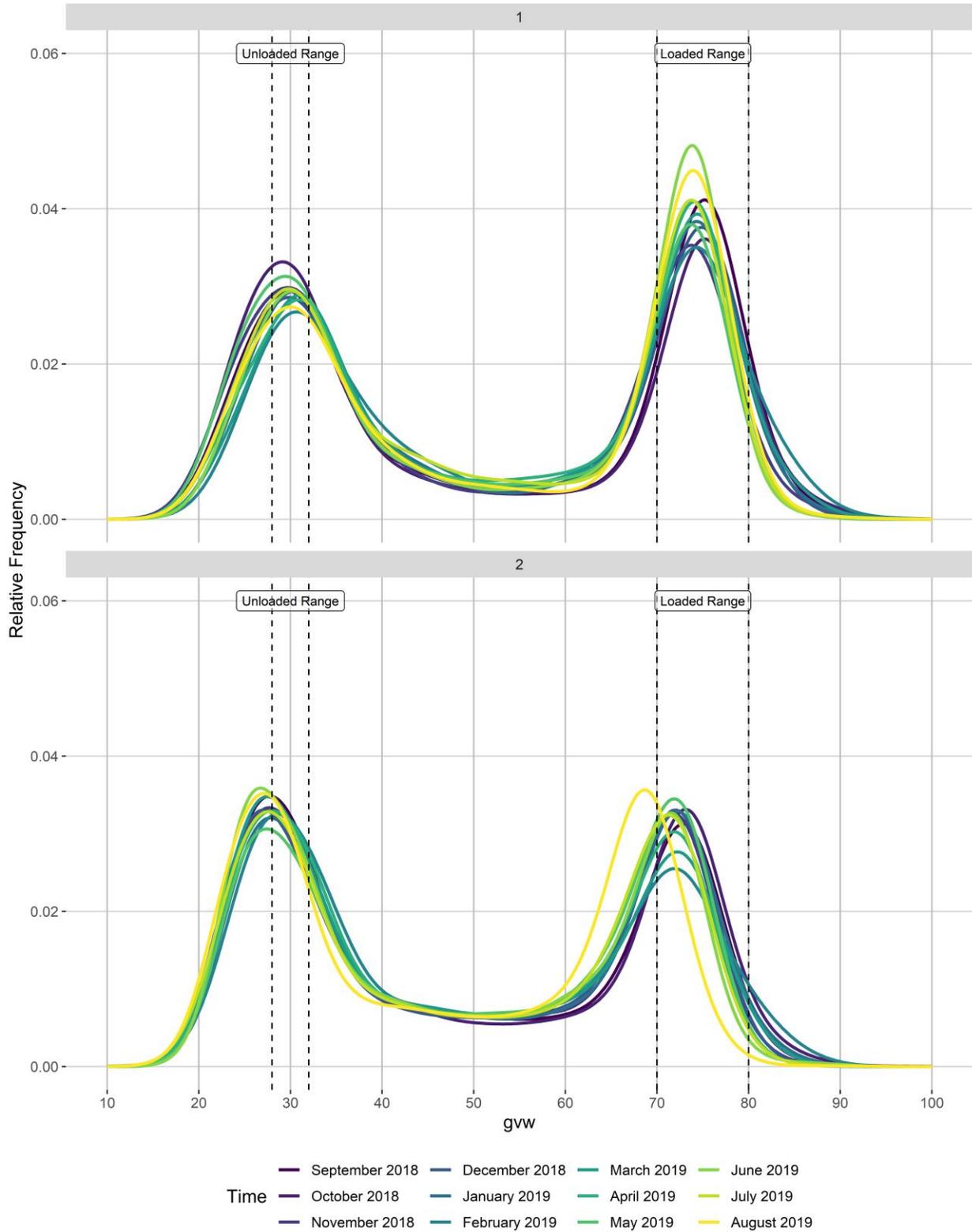
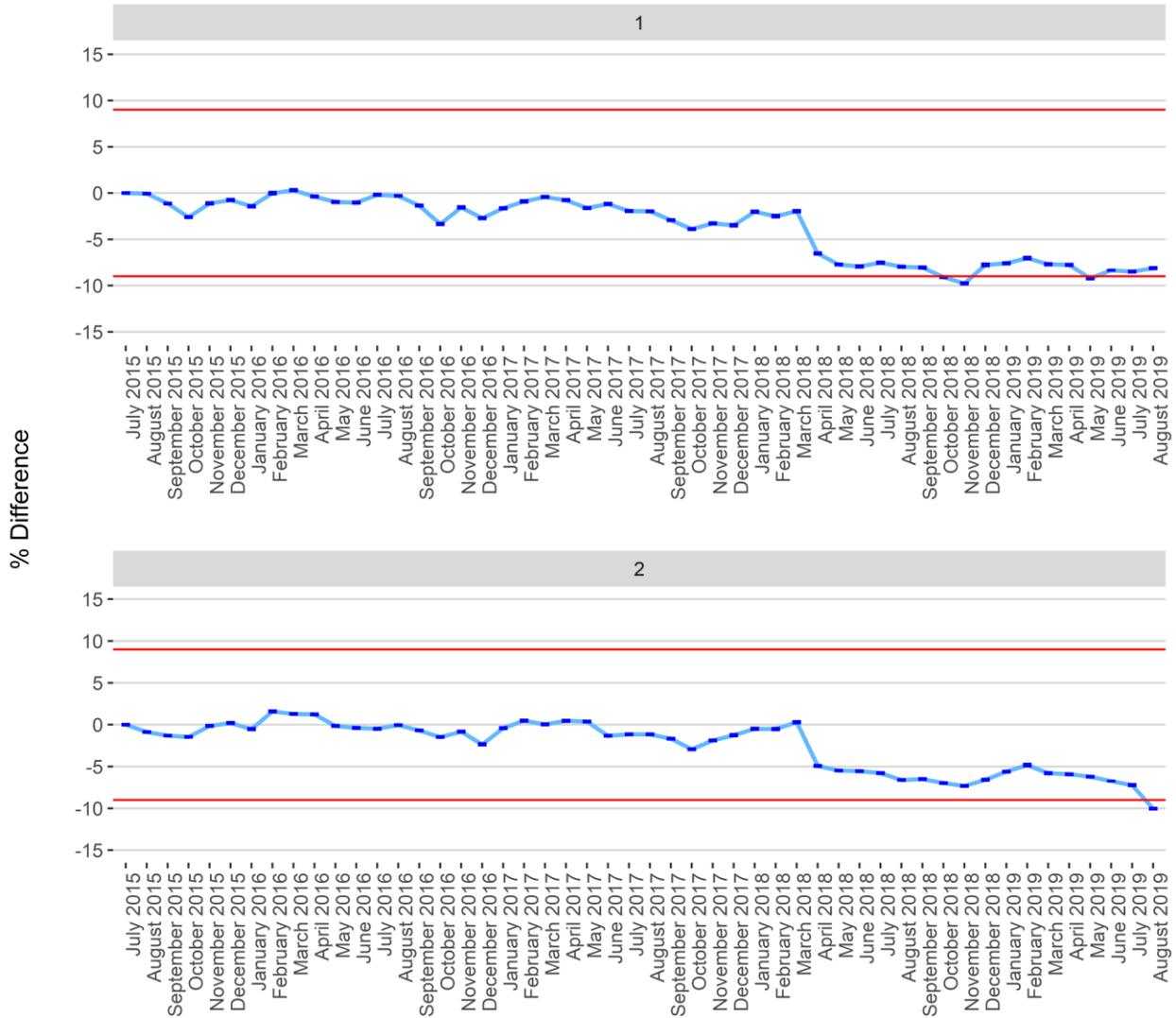


Figure 2 - Percent Difference of Front Axle Weight from Last Calibration (+/- 95% CI)



Months that have not passed QC parameters are not displayed

Figure 2 - Average Vehicle Volume vs. Day of the Week

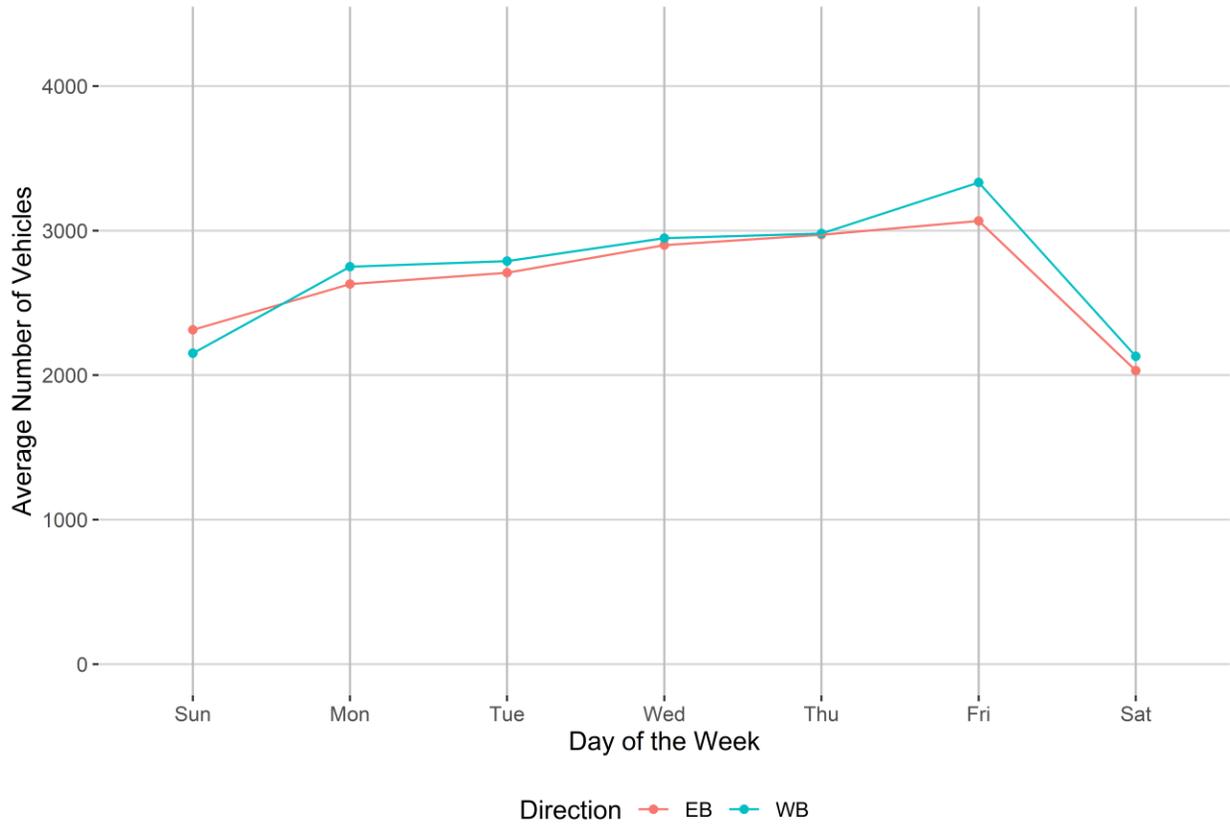


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

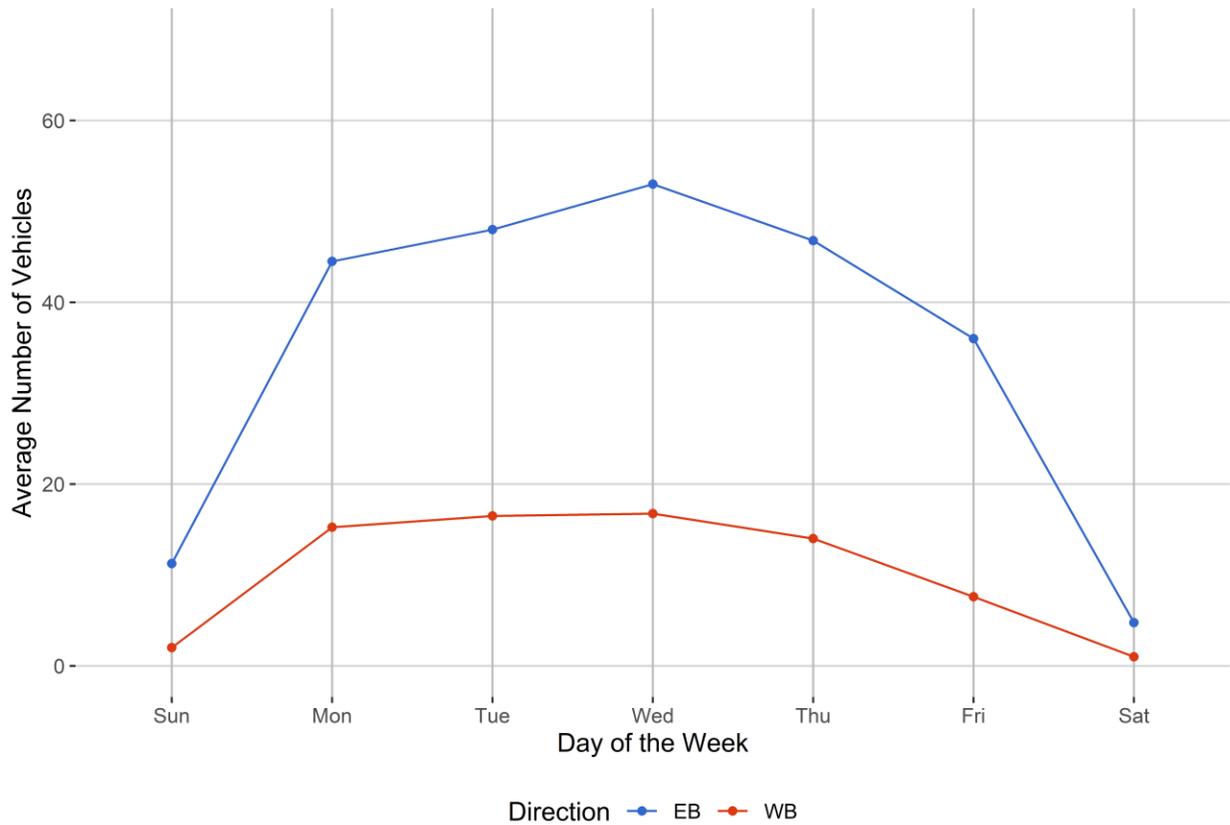


Figure 4 - Passenger Vehicles vs. Hour of the Day

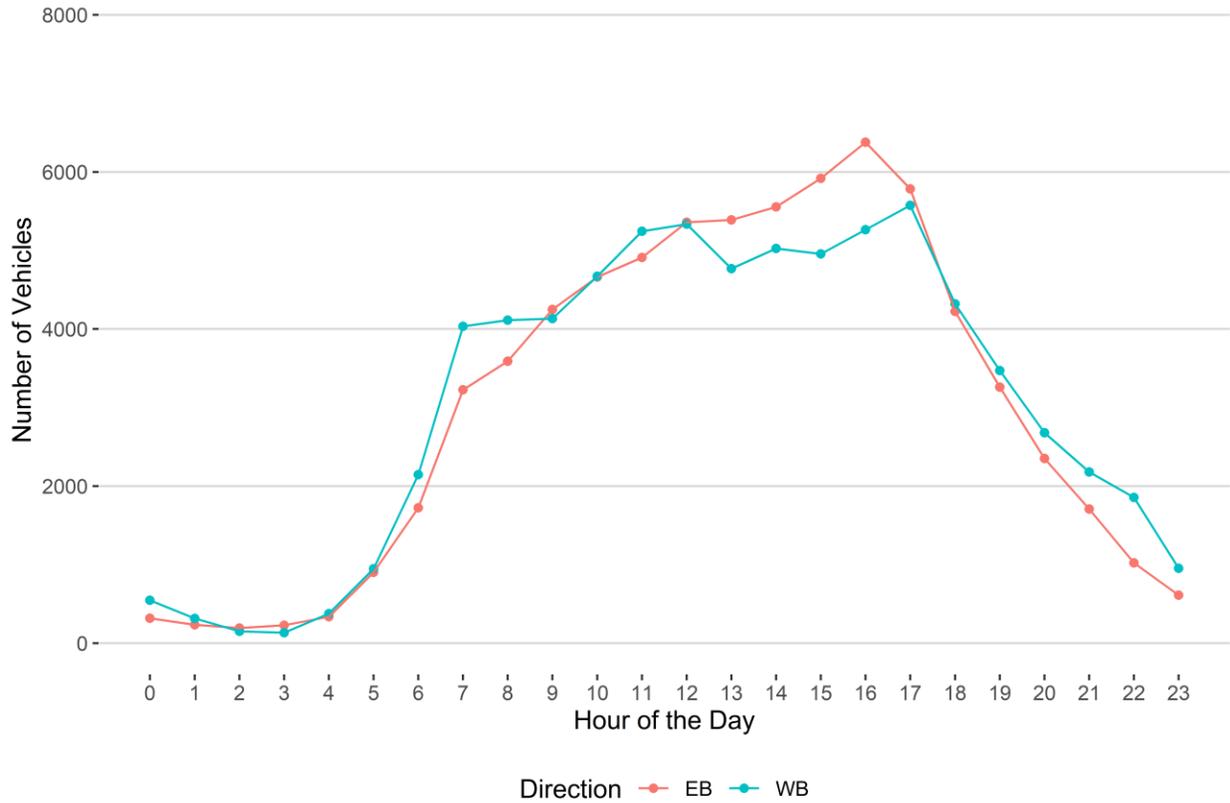


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

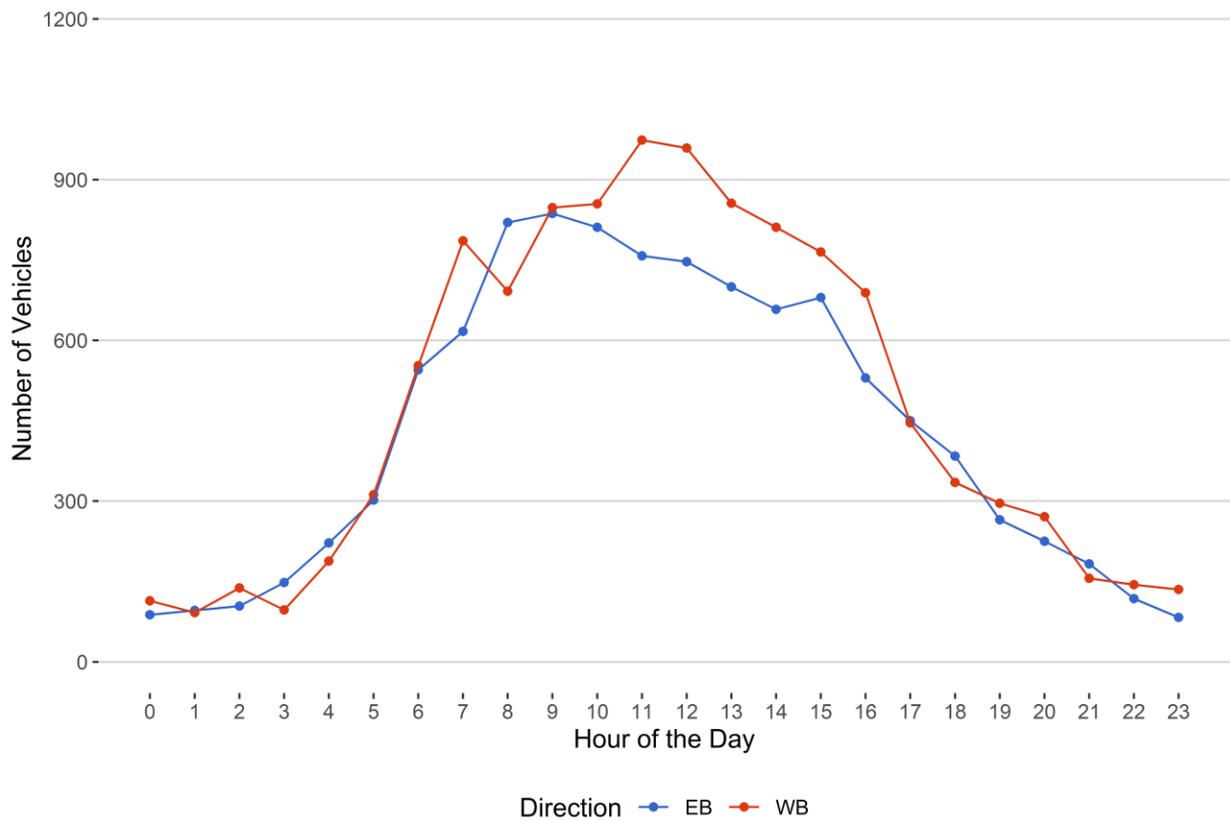


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

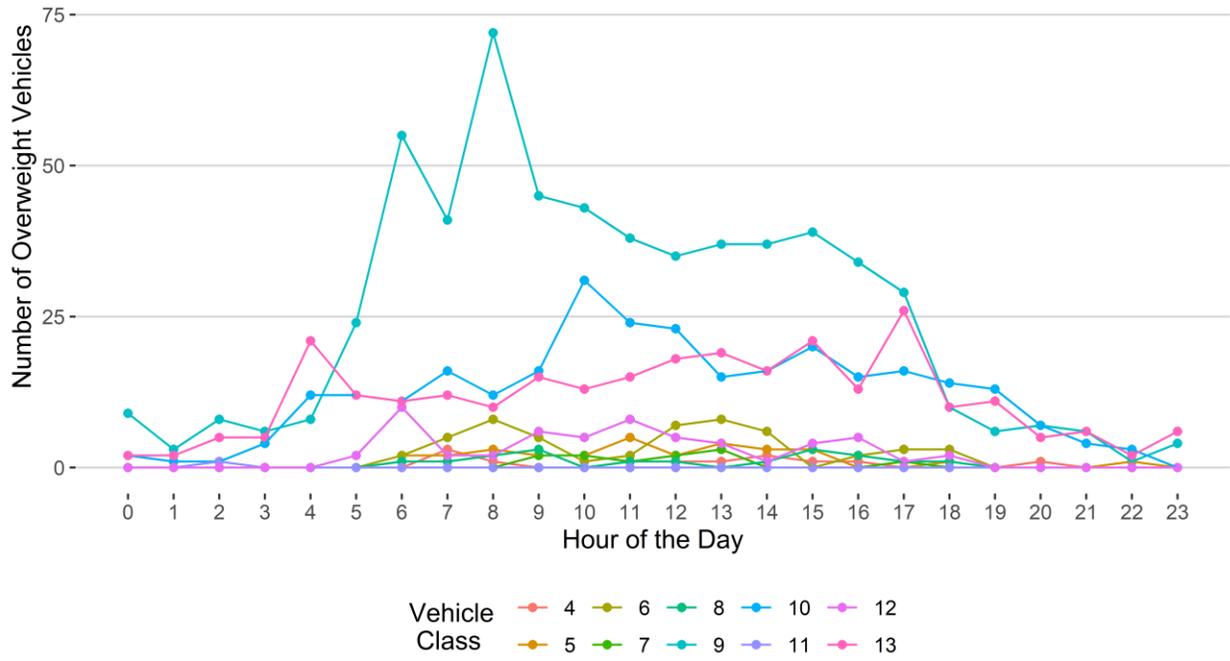


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

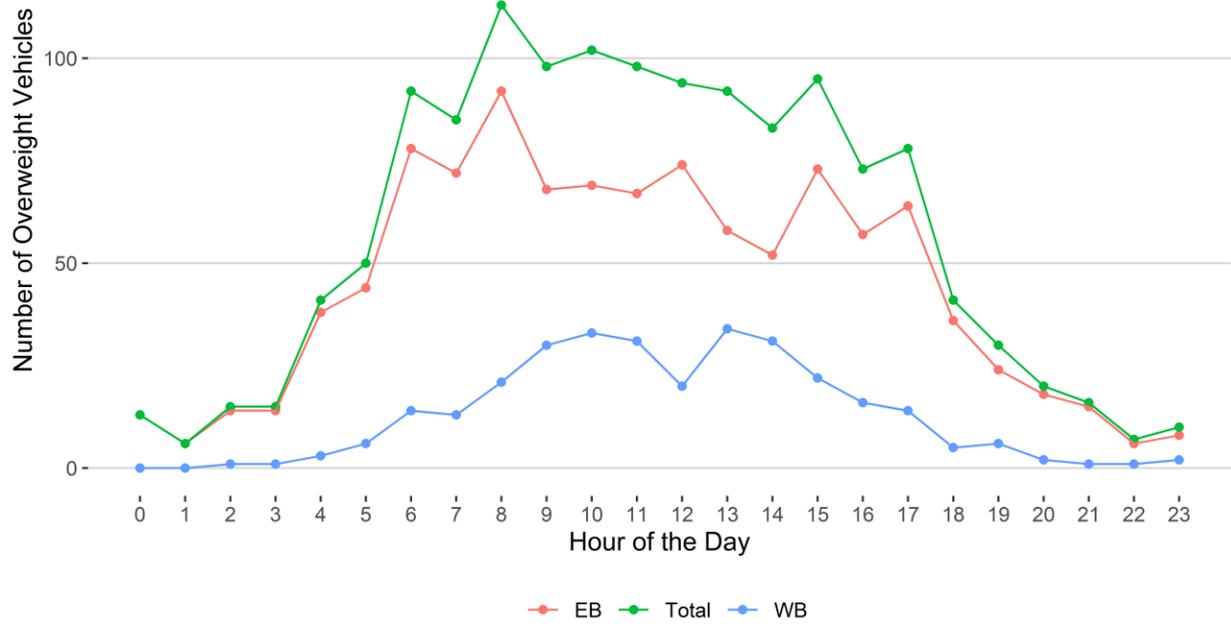
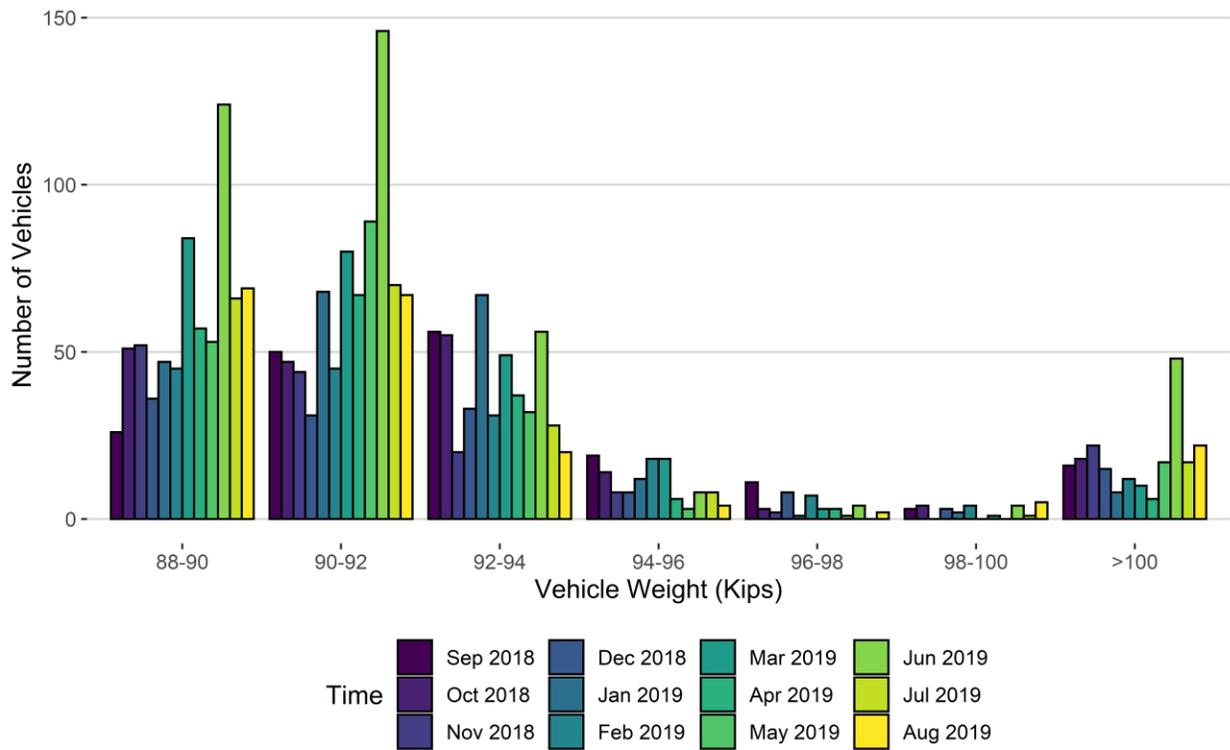
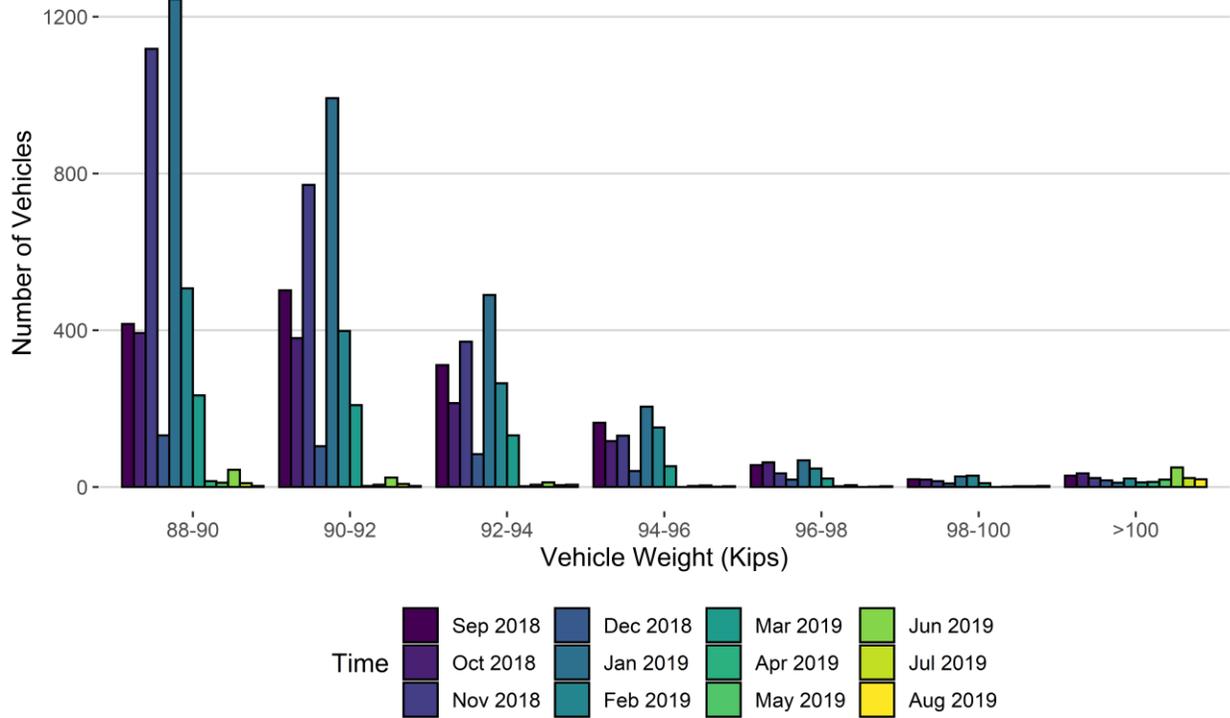


Figure 8 - Histogram of EB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019	Aug 2019
88-90	26	51	52	36	47	45	84	57	53	124	66	69
90-92	50	47	44	31	68	45	80	67	89	146	70	67
92-94	56	55	20	33	67	31	49	37	32	56	28	20
94-96	19	14	8	8	12	18	18	6	3	8	8	4
96-98	11	3	2	8	1	7	3	3	1	4	0	2
98-100	3	4	0	3	2	4	0	1	0	4	1	5
>100	16	18	22	15	8	12	10	6	17	48	17	22
Total	181	192	148	134	205	162	244	177	195	390	190	189

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



Vehicle Weights (Kips)	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019	Aug 2019
88-90	416	393	1118	132	1245	507	234	15	11	44	10	3
90-92	502	380	771	104	992	398	209	3	6	24	8	3
92-94	311	214	371	84	490	265	132	2	6	12	5	6
94-96	164	117	131	41	205	152	53	0	3	4	1	2
96-98	56	63	35	19	68	47	22	2	5	0	1	2
98-100	20	19	15	9	27	29	10	0	1	2	2	3
>100	29	35	23	17	11	22	12	13	19	50	23	20
Total	1498	1221	2464	406	3038	1420	672	35	51	136	50	39

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

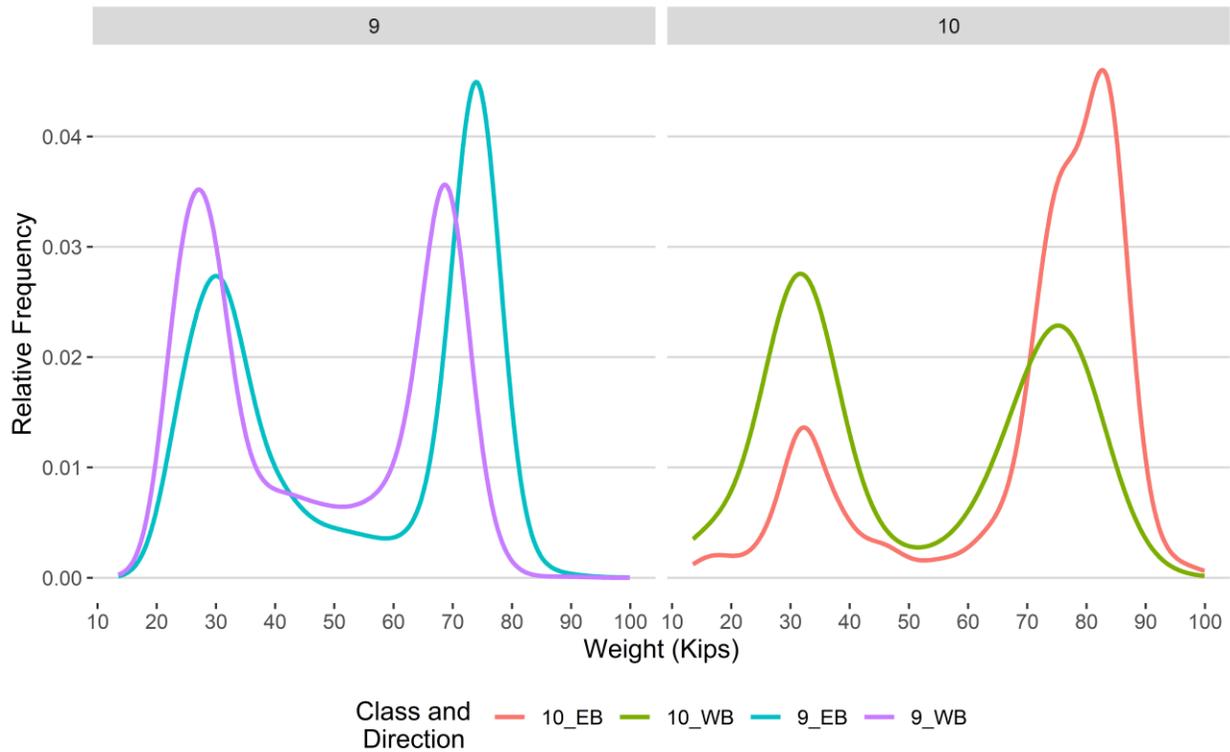


Figure 9 - Freight Percentage by Direction and Class

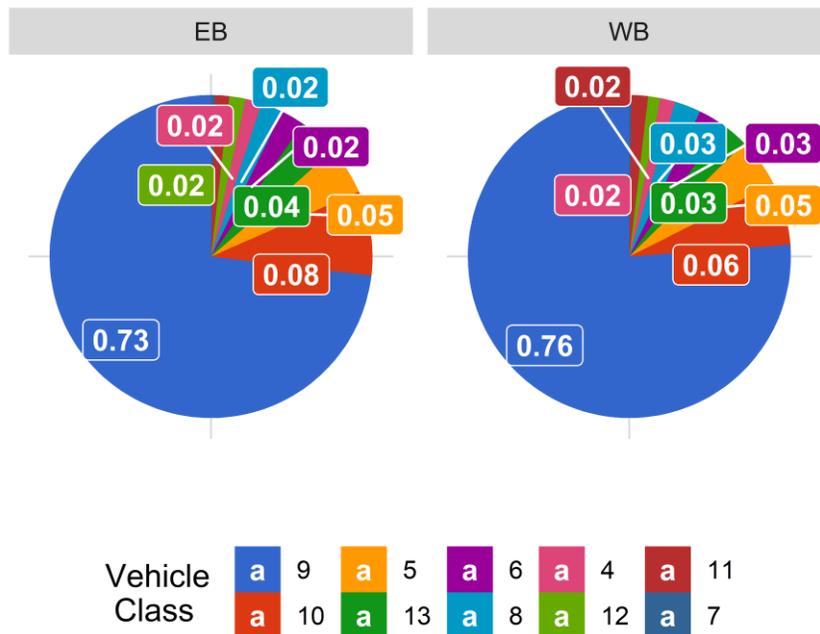


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

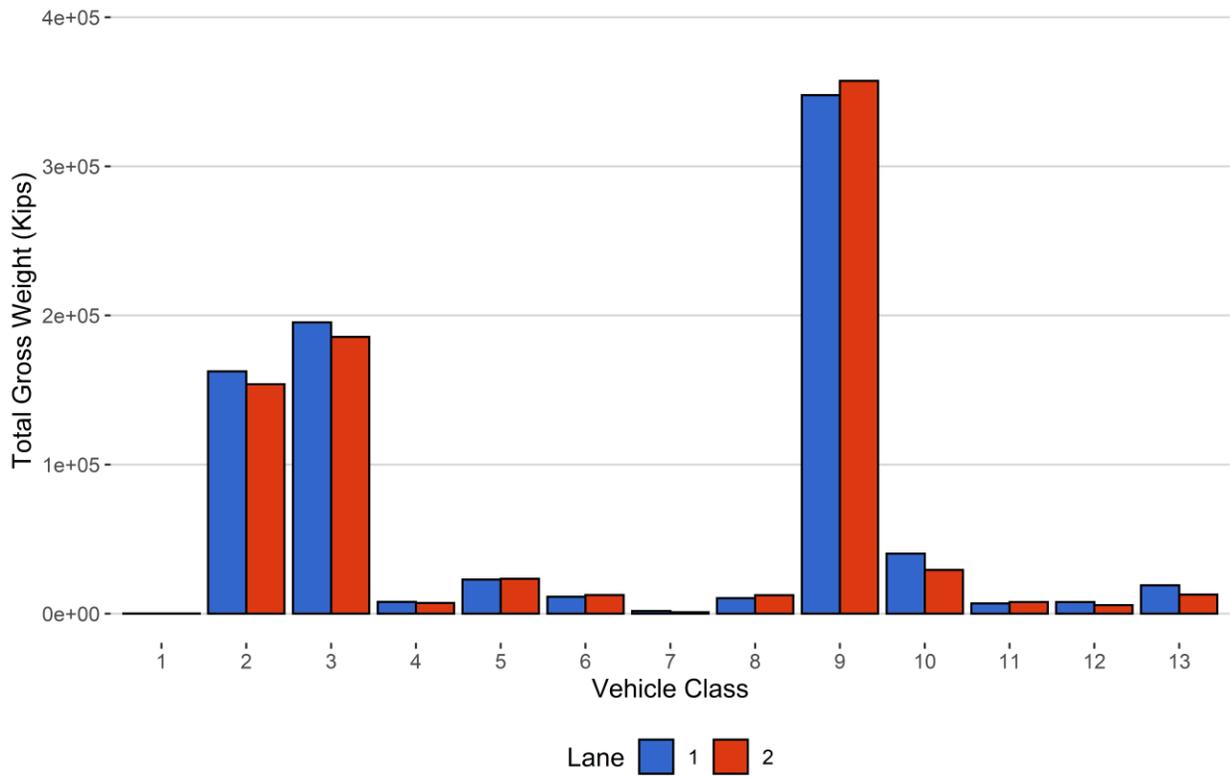


Figure 11 - Total Gross Vehicle Weight t

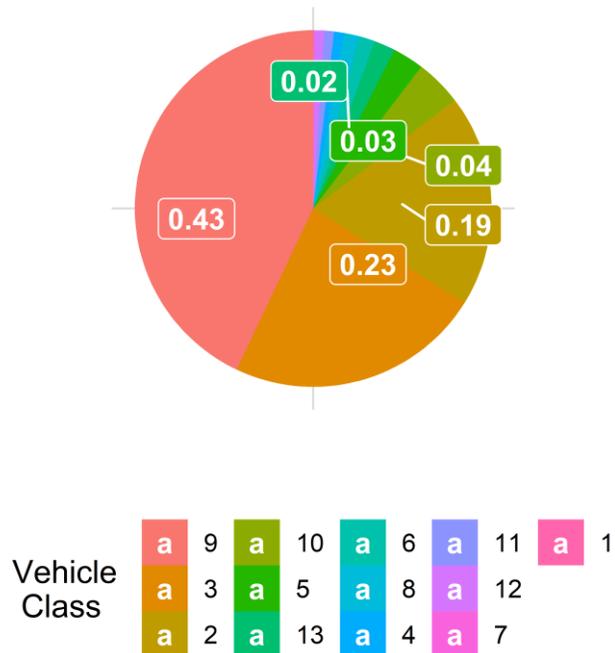


Figure 12 - Total ESALs by Class and Lane

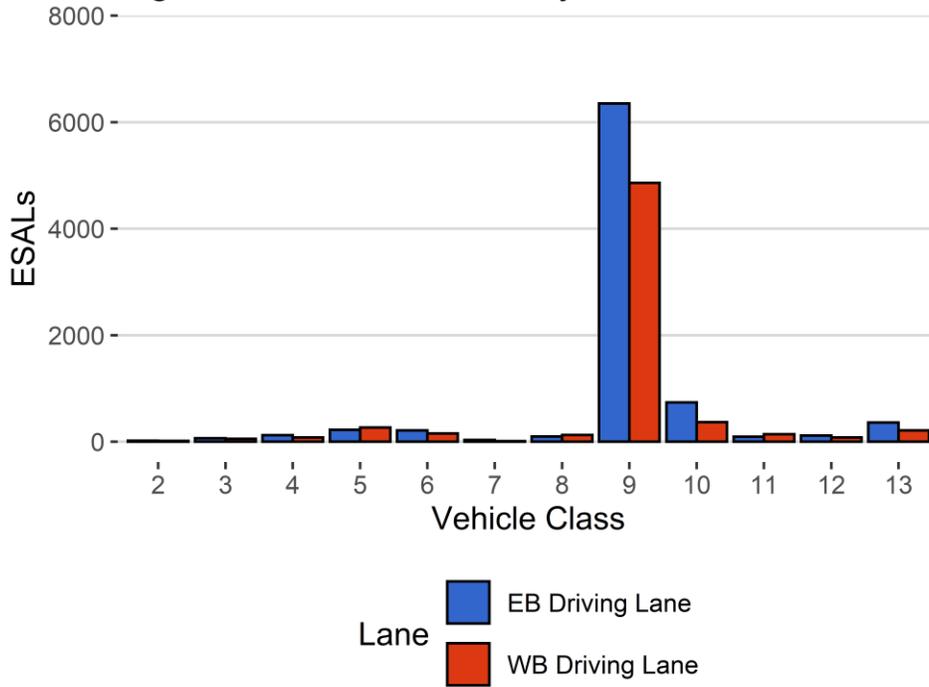


Figure 13 - ESALs by Class

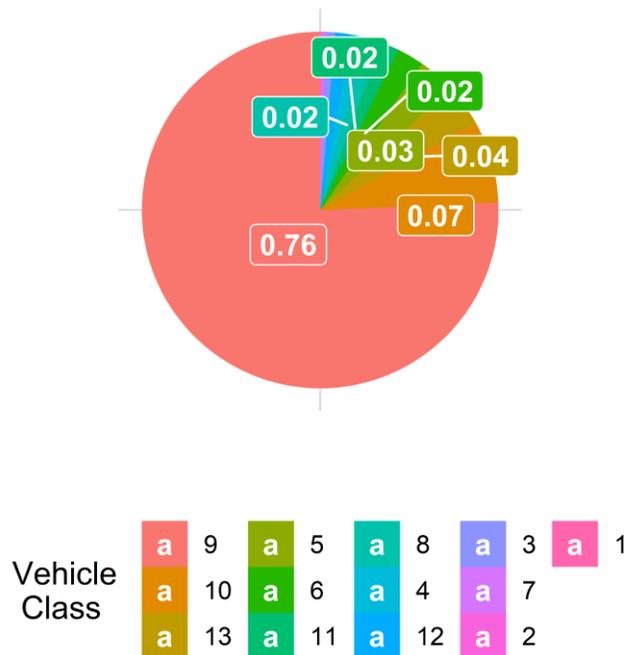


Table 1 Class 9 Front Axle Weight by Lane

<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
August 2019	10.80	-8.12	9.88	-10.04

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	2	69	0	0	0
2	2654	82279	48.6	0	0
3	2090	64776	38.3	0	0
4	19	576	0.3	12	0.9
5	115	3560	2.1	30	2.2
6	28	863	0.5	52	3.9
7	2	56	0	11	0.8
8	27	826	0.5	17	1.3
9	458	14194	8.4	597	44.5
10	37	1158	0.7	288	21.5
11	10	301	0.2	1	0.1
12	7	218	0.1	57	4.3
13	12	366	0.2	276	20.6
TOTAL	5459	169242	100	1341	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>
2019-08-06	Tuesday	06:31:17	9	WB	2	120.58
2019-08-24	Saturday	14:27:04	9	EB	1	99.92
2019-08-16	Friday	03:55:46	10	EB	1	98.71
2019-08-26	Monday	14:28:30	10	EB	1	97.94
2019-08-27	Tuesday	13:00:51	10	EB	1	96.93
2019-08-23	Friday	15:51:03	10	EB	1	94.24
2019-08-22	Thursday	11:21:24	10	WB	2	93.91
2019-08-05	Monday	18:35:18	9	EB	1	93.73
2019-08-02	Friday	10:18:42	10	EB	1	93.29
2019-08-14	Wednesday	02:55:06	10	EB	1	92.96

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	287	46	16	7244	592	1815
5	EB	8	1733	270	15.6	20900	1948	4598
6	EB	19	385	89	23.1	9721	1528	2048
7	EB	11.5	33	0	0	1744	0	682
8	EB	31	376	272	72.3	4081	6268	429
9	EB	33	6489	1922	29.6	294095	53719	71692
10	EB	33.5	579	72	12.4	38165	2060	10590
11	EB	36.5	153	46	30.1	5367	1467	731
12	EB	36.5	127	3	2.4	7715	56	1594
13	EB	31.5	209	0	0	18994	0	6205
TOTAL	****	****	10371	2720	****	408025	****	100384
<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	283	65	23	6273	835	1501
5	WB	8	1789	374	20.9	20707	2644	4694
6	WB	19	469	125	26.7	10384	2072	1924
7	WB	11.5	22	0	0	927	0	337
8	WB	31	441	294	66.7	5544	6842	494
9	WB	33	7554	3008	39.8	276718	80658	63350
10	WB	33.5	567	220	38.8	23016	6320	5696
11	WB	36.5	145	8	5.5	7609	170	1304
12	WB	36.5	89	5	5.6	5575	122	1254
13	WB	31.5	153	0	0	12744	0	3962
TOTAL	****	****	11512	4099	****	369496	****	84516
GRAND TOTAL	****	****	21883	6819	428	777521	167300	184900

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	61	30	91	0
2	162459	153826	316286	19.3
3	195341	185616	380957	23.2
4	7836	7108	14943	0.9
5	22848	23351	46199	2.8
6	11248	12456	23704	1.4
7	1744	927	2671	0.2
8	10349	12386	22735	1.4
9	347813	357375	705189	42.9
10	40225	29337	69561	4.2
11	6833	7779	14612	0.9
12	7771	5697	13468	0.8
13	18994	12744	31737	1.9
TOTAL	833523	808632	1642155	100
GVW/LANE	50.76	49.24	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	0.0145
2	19	15	34	0.2	9e-04
3	66	54	120	0.8	0.0038
4	123	80	203	1.4	0.72
5	225	266	490	3.3	0.28
6	212	155	367	2.5	0.86
7	34	11	46	0.3	1.59
8	100	128	228	1.5	0.56
9	6351	4859	11211	75.7	1.6
10	737	369	1106	7.5	1.93
11	95	141	236	1.6	1.57
12	118	82	200	1.4	1.81
13	360	213	573	3.9	3.1
TOTAL	8440	6374	14814	100	14
ESALS/LANE	57	43	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 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
Aug 2019	169242	5447	713	147124	86.9	22117.7	13.1
TOTAL	1803340	-	-	1538047	-	265294	-
AVERAGE	150278	4937	727	128171	85	22108	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>
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
Aug 2019	8503	6385	14889	2.2
TOTAL	99511	-	-	-
AVERAGE	8293	8574	16867	2

###Gross Vehicle Weight

<i>Month</i>	<i>GVW EB Driving Lane</i>	<i>GVW WB Driving Lane</i>	<i>Total GVW Kips</i>
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
Aug 19	836256	809778	1646034
TOTAL	9923171	10900950	20824121
AVERAGE	826931	908413	1735343

###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 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
Aug 2019	1367	0.8	6.2	229	51
TOTAL	35737	-	-	13444	653
AVERAGE	2978.1	2	12.4	1120.3	54.4

###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 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
Aug 2019	100384	84516	184900	54.3	45.7
TOTAL	1155235	1502310	2657545	-	-
AVERAGE	96269.6	125192.5	221462.1	45.2	54.8