

AUGUST 2018



**WIM #37
I-94, MP 200.1
OTSEGO, MN**

**MONTHLY
REPORT**



Your Destination...Our Priority



WIM Site Location

WIM #37 is located on I-94 near Otsego in Wright county. The WIM is located only on the westbound (WB) side of I-94, meaning that all data mentioned in this report pertains to WB traffic only (Lanes 1 and 2).

System Operation

WIM #37 was operational for the entire month of August 2018. Volume was computed using all monthly data.

System Calibration

WIM #37 was most recently calibrated on 2017-03-23. 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 the Class 9s at this site for the last 12 months 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: 1122311 | Passenger Vehicles: 995460 | Heavy Commercial Vehicles: 126851

Monthly Average Daily Traffic (MADT): 36204 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 4092

See Table 2 for vehicle class breakdown

Passenger Vehicles (PVs) and Heavy Commercial Vehicles (HCVs)

Volume trends. 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), WB PVs generally reached peak volume levels between 03 PM and 05 PM.

Heavy Commercial Vehicles (HCVs)

Volume trends. On an average 24-hour day, HCVs traveling WB typically reached peak volume levels 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 15's.

Overweight HCVs

Volume trends. Of a total of 126851 HCVs, 9818 of them were overweight ³. These overweight HCVs contributed to 0.9% of total monthly volume, and 7.9% of total monthly

HCV volume. WB overweight vehicles typically reached highest numbers 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 (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 March.

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 ,888 WB vehicles exceeded 88,000 pounds (474 vehicles were Class 9's; 266 vehicles were Class 13'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 9's and 10's in August 2018. Data suggests that there were greater numbers of fully_loaded Class 9's than empty Class 9's traveling WB Data also suggests that there were more NA Class 10's than NA traveling in the WB direction.

Freight Totals. A total of 1105836 tons of freight was recorded to have crossed the WIM. See Table 4 and Figure 11 for more freight information.

Infrastructure Considerations

Bridge. Bridge No. 86817 is approximately 1.2 miles east of WIM #37 and Bridge No. 86813 is approximately 4.7 miles west of WIM #37. WIM #37 recorded a total of 1122311 vehicles with a combined GVW of 10411943 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 92289 equivalent single axle loads (ESALs) passed over the pavement at this site. In particular, 76% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 39% 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>

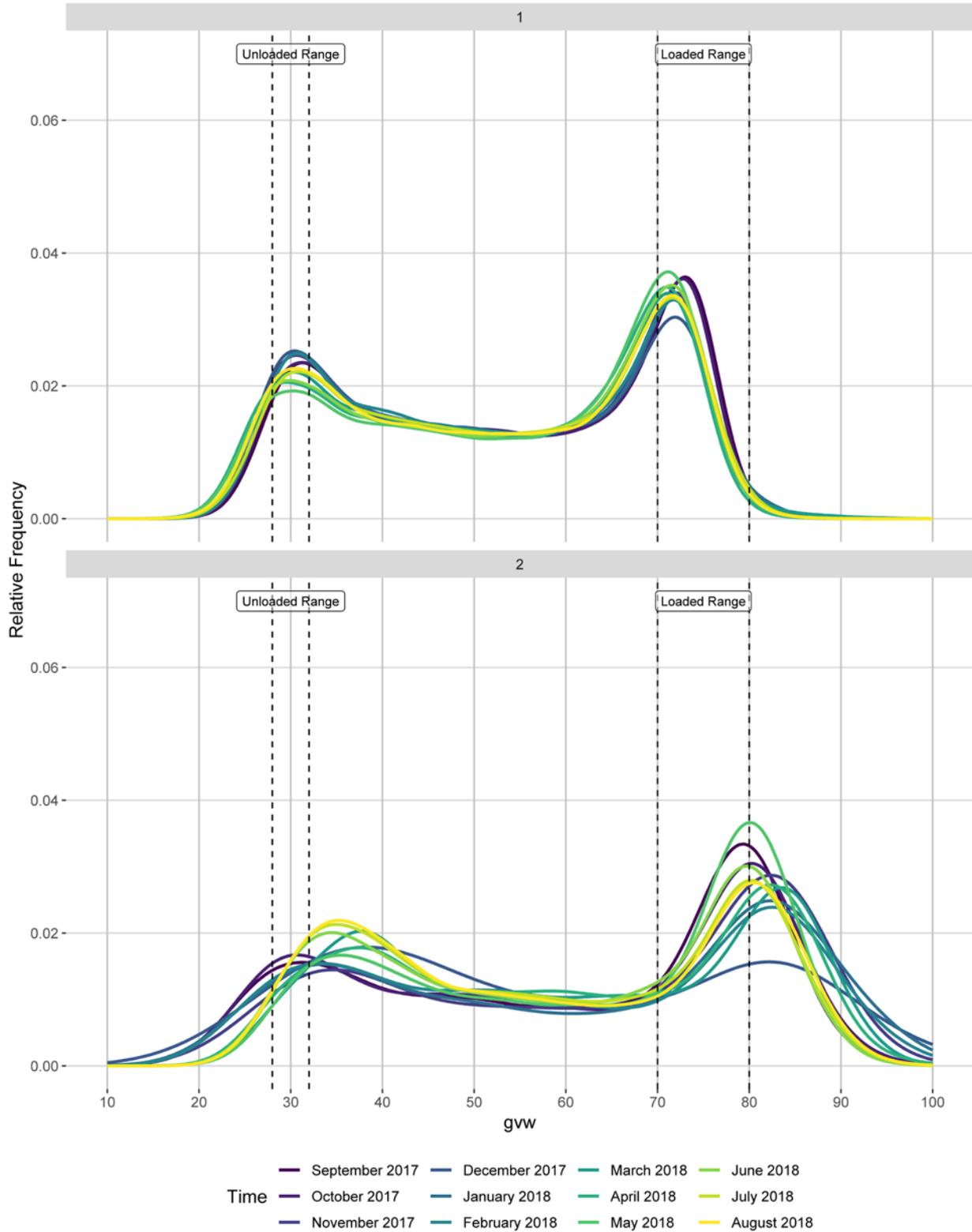
- ¹ Front axle weights of Class 9s are monitored on a monthly basis to assure performance between calibrations. The current goal of the WIM scale calibration is to

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.

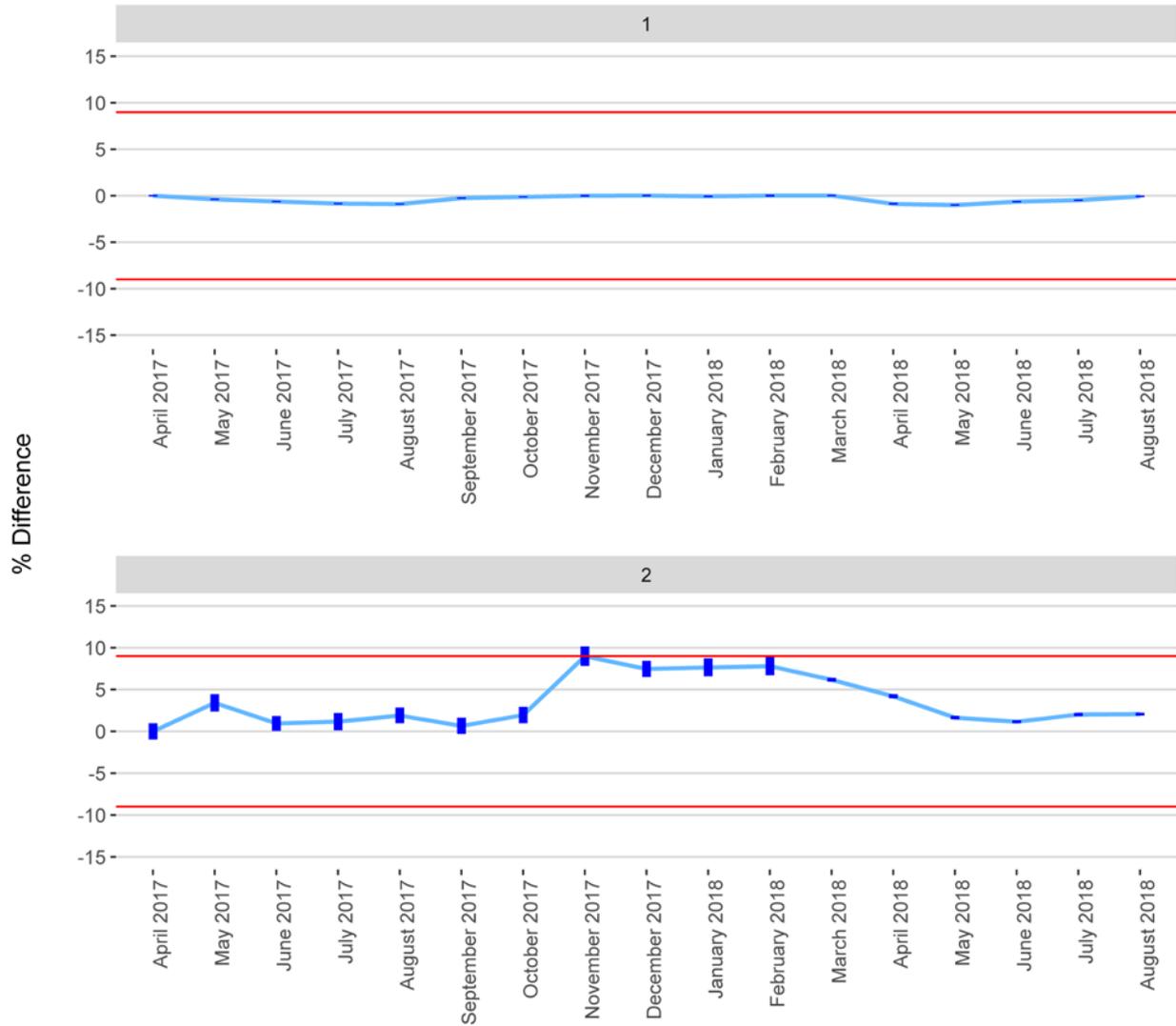
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Figure 1 - Monthly Class 9 GWW Histogram



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

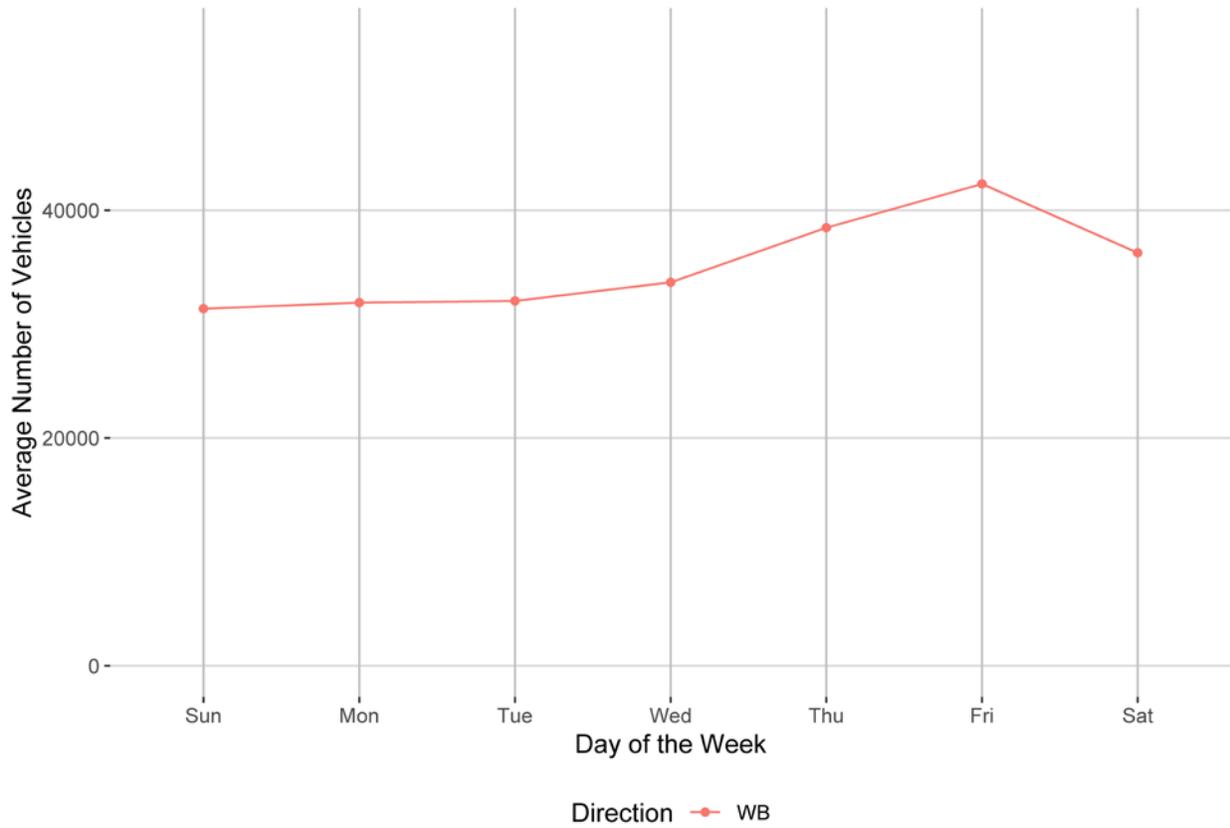


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

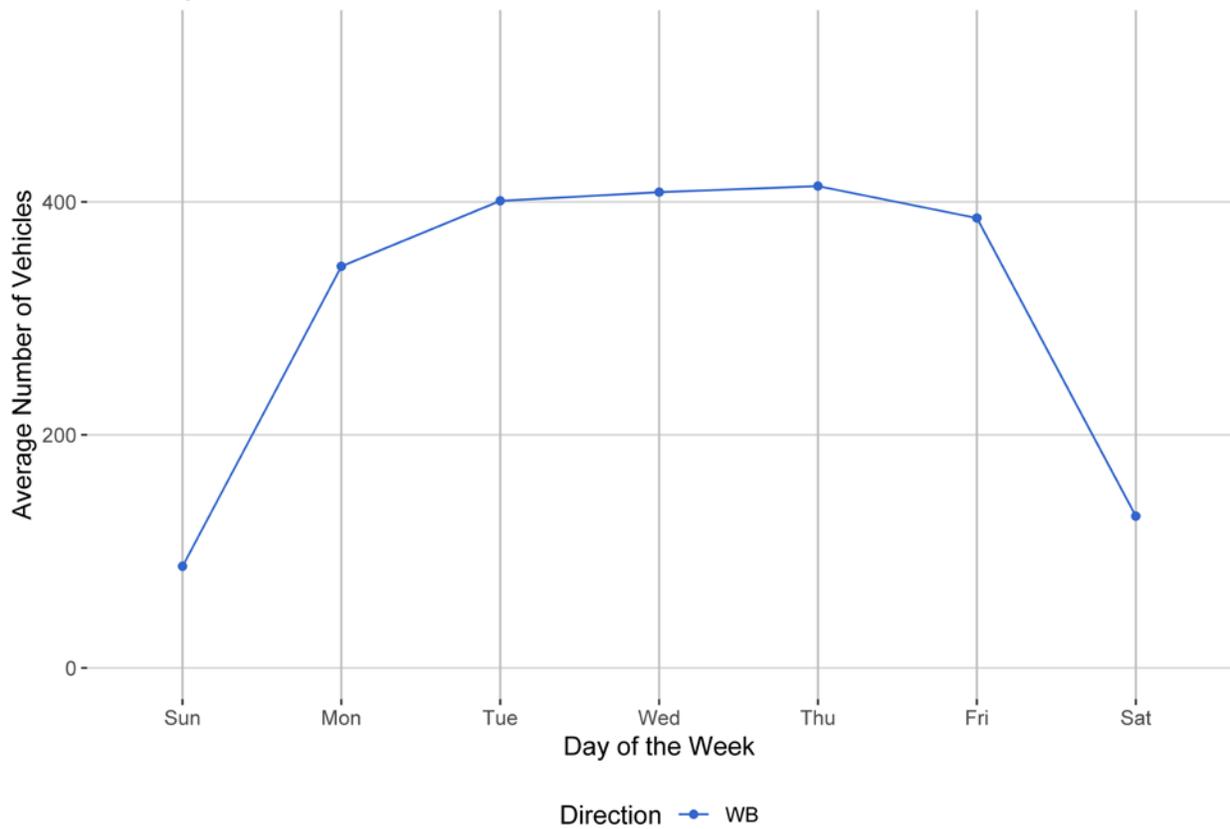


Figure 4 - Passenger Vehicles vs. Hour of the Day

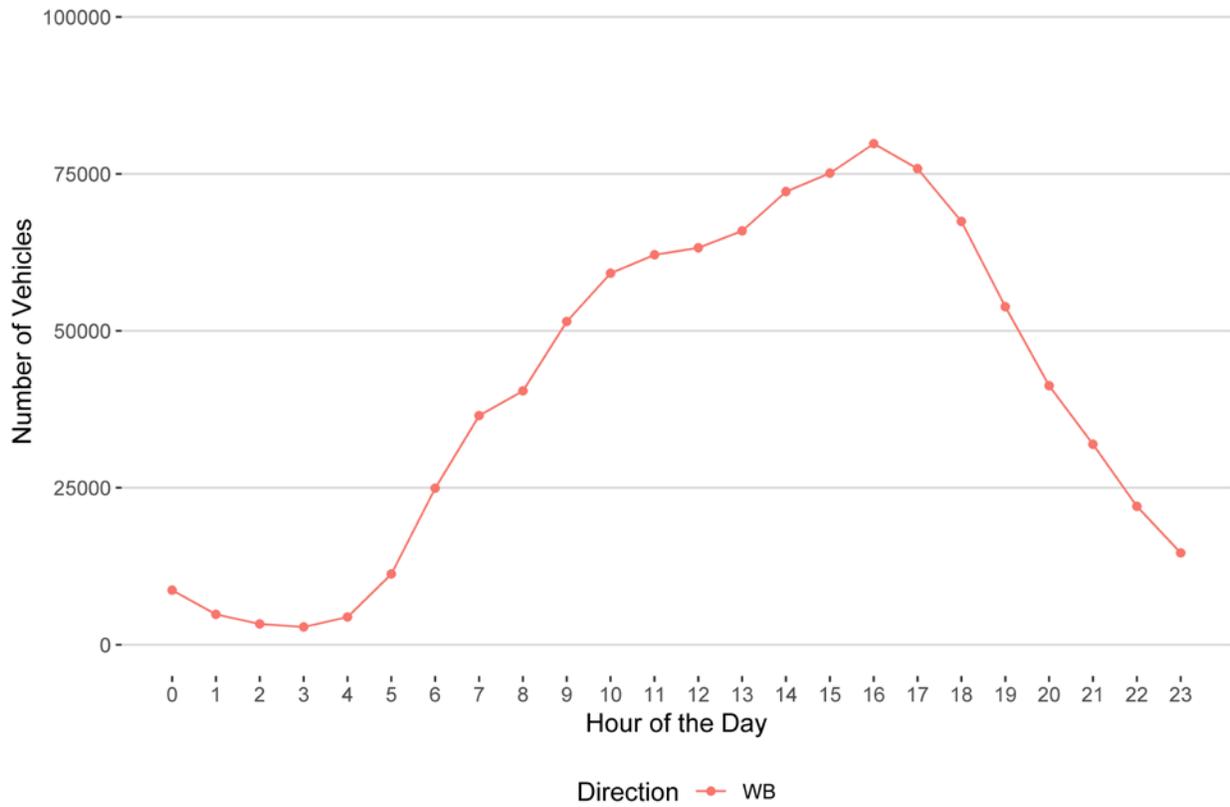


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

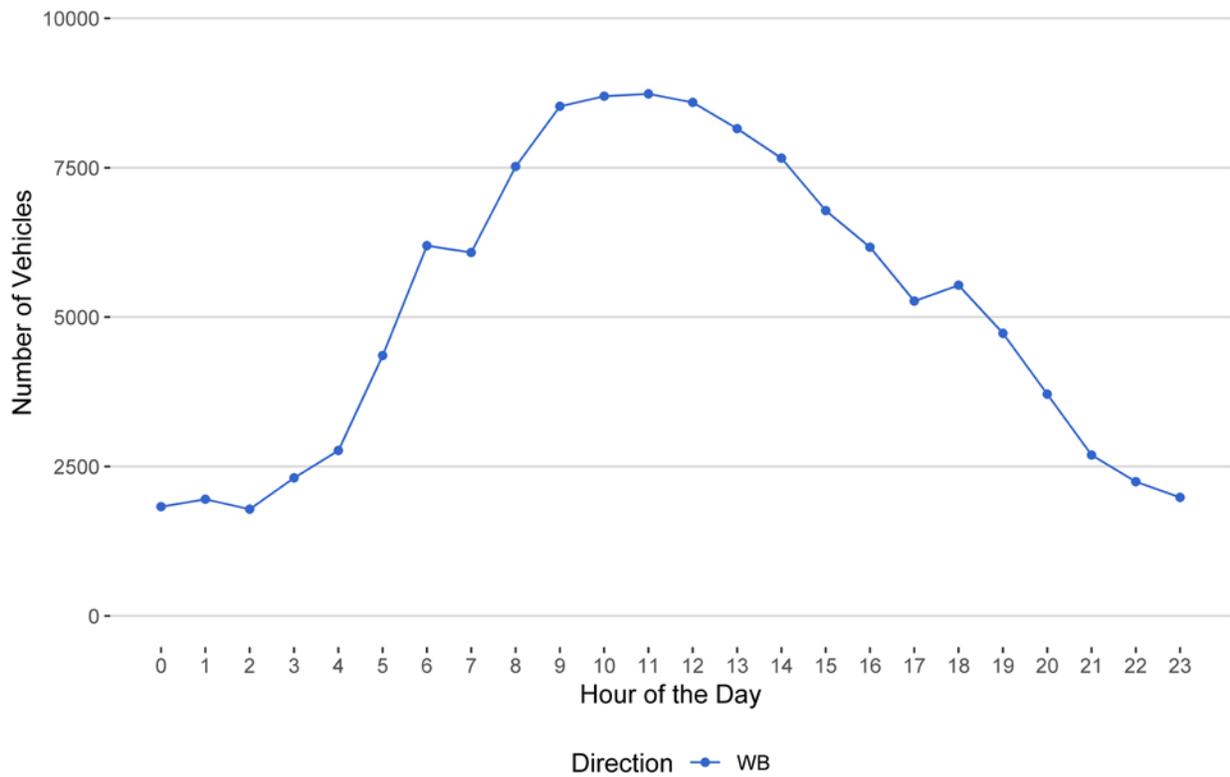


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

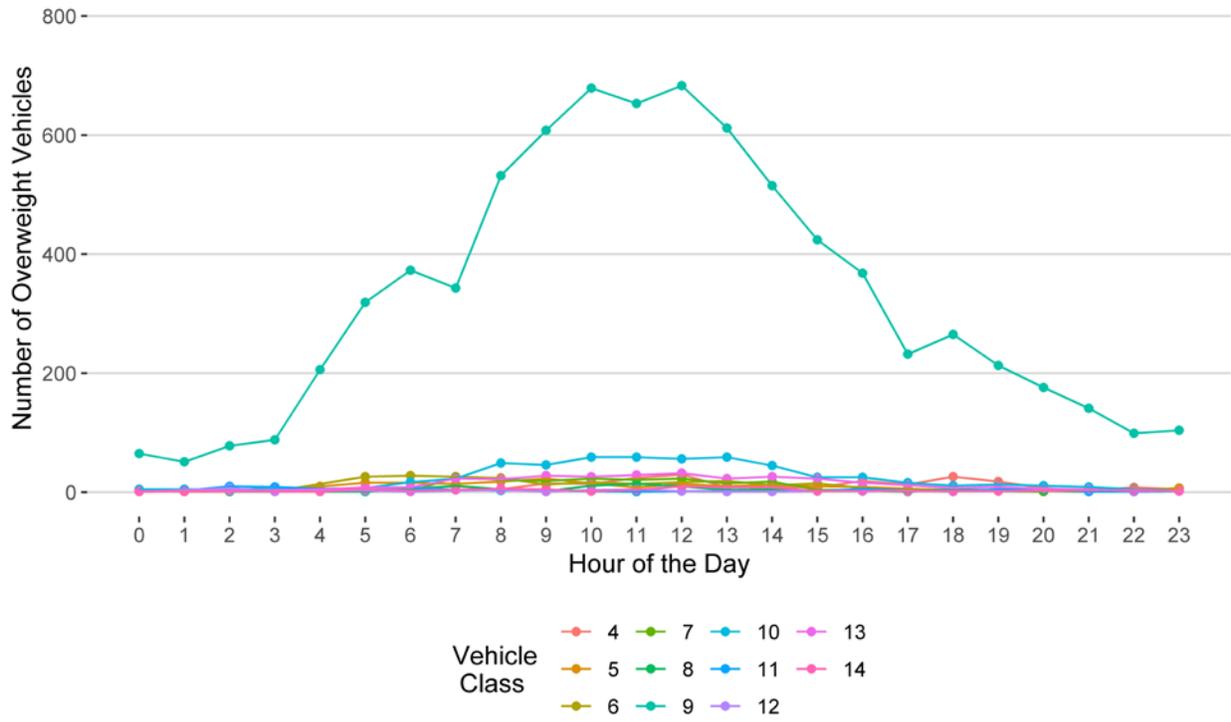


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

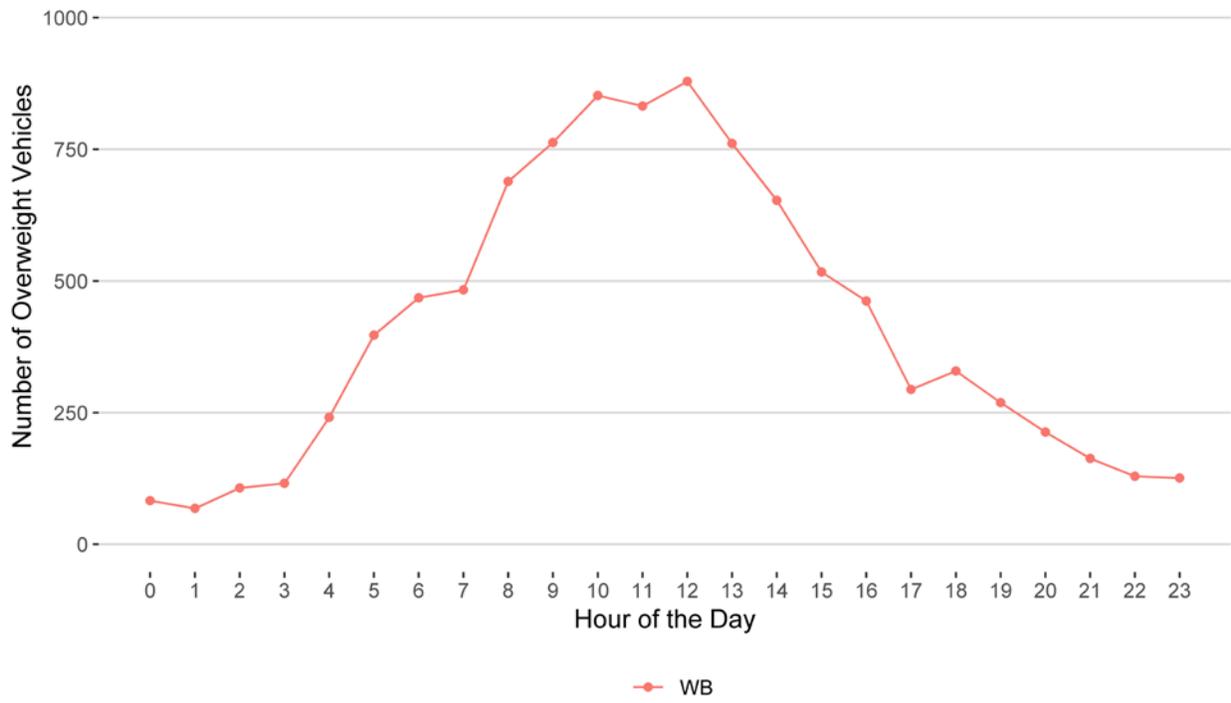
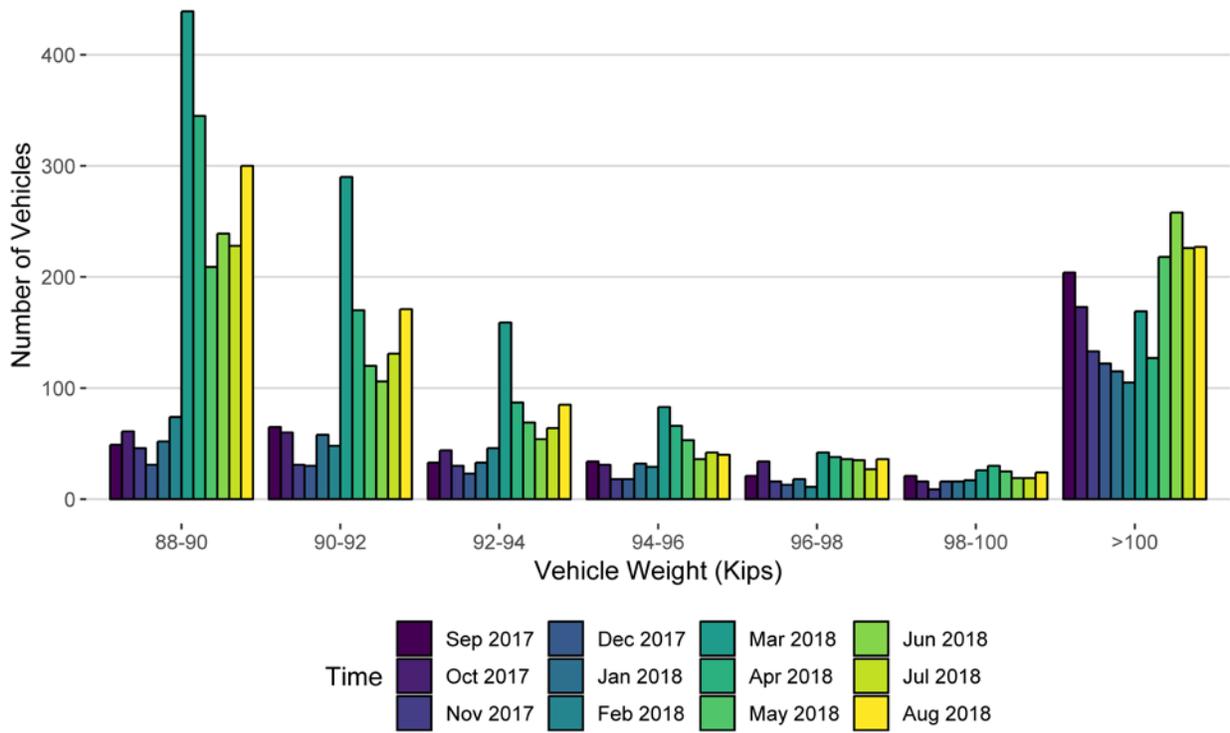


Figure 8 - Histogram of Vehicles Over 88,000 Pounds for Current Month



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	49	61	46	31	52	74	439	345	209	239	228	300
90-92	65	60	31	30	58	48	290	170	120	106	131	171
92-94	33	44	30	23	33	46	159	87	69	54	64	85
94-96	34	31	18	18	32	29	83	66	53	36	42	40
96-98	21	34	16	13	18	11	42	38	36	35	27	36
98-100	21	16	9	16	16	17	26	30	25	19	19	24
>100	204	173	133	122	115	105	169	127	218	258	226	227
Total	427	419	283	253	324	330	1208	863	730	747	737	883

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

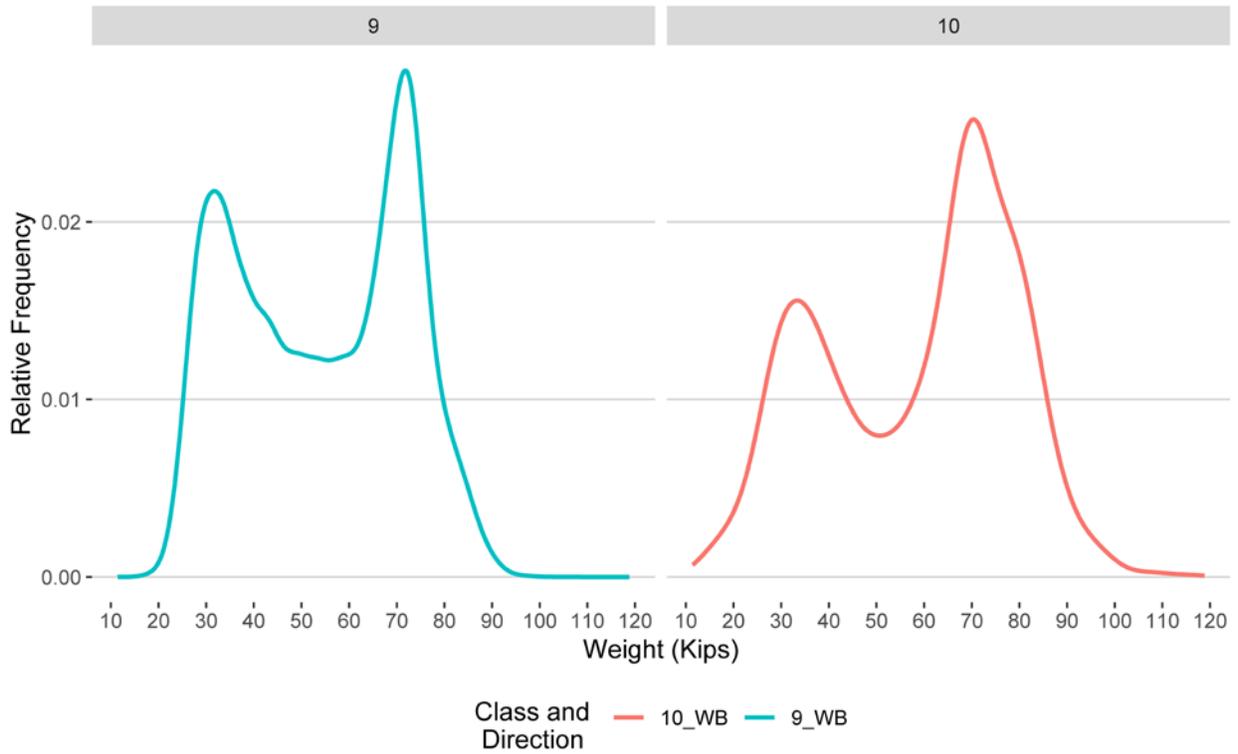


Figure 9 - Freight Percentage by Direction and Class

WB

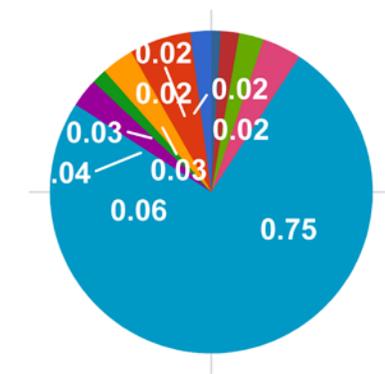


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

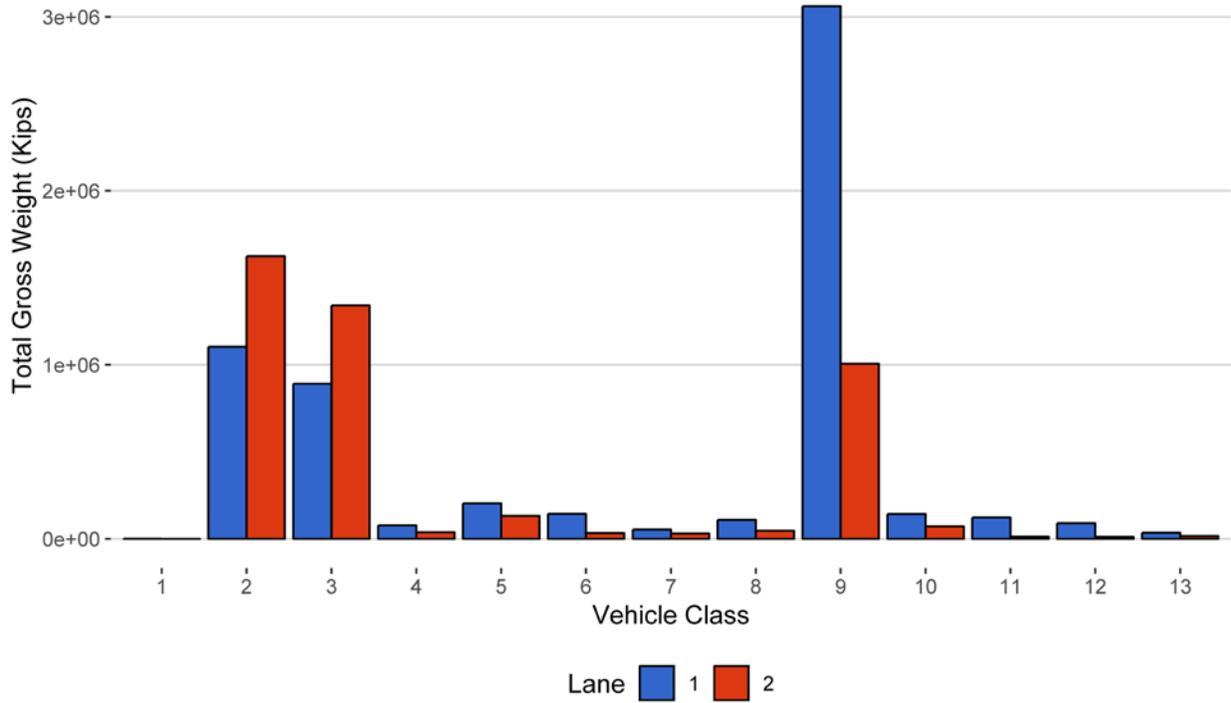


Figure 11 - Total Gross Vehicle Weight t

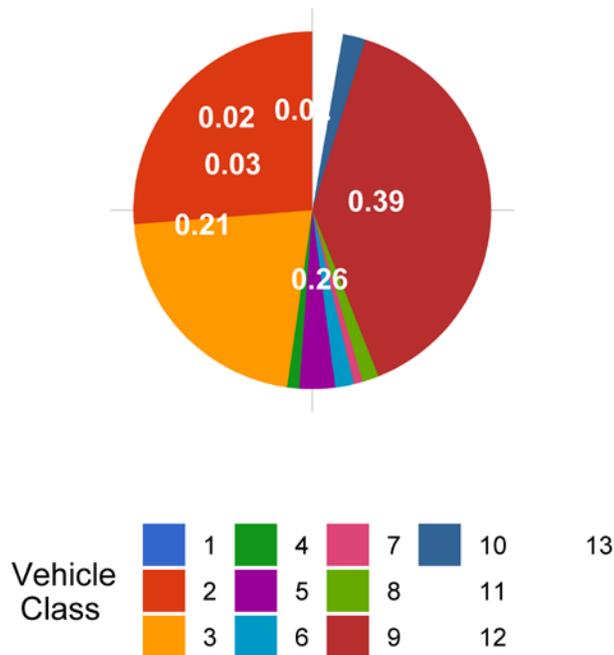


Figure 12 - Total ESALs by Class and Lane

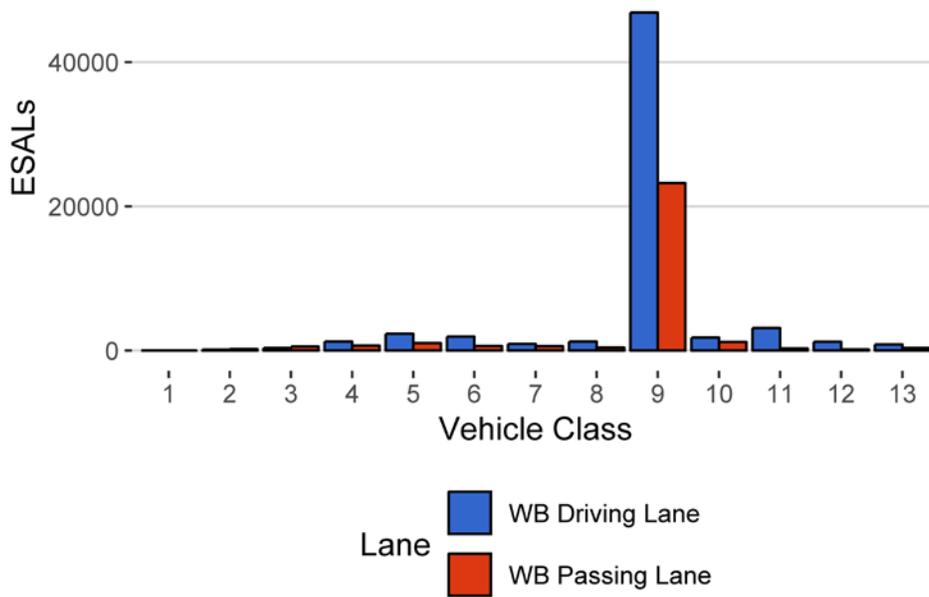


Figure 13 - ESALs by Class

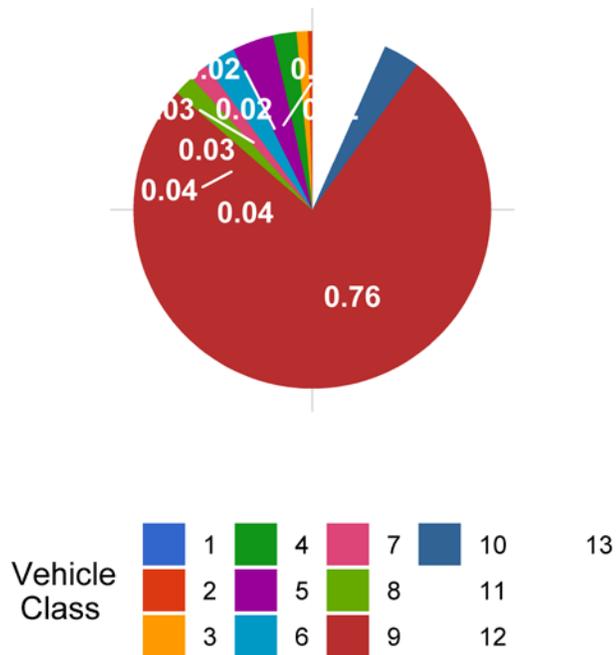


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
April 2017	10.54	0.00	11.79	0.00
May 2017	10.50	-0.39	12.19	3.41
June 2017	10.48	-0.62	11.90	0.95
July 2017	10.45	-0.84	11.92	1.16
August 2017	10.45	-0.89	12.01	1.90
September 2017	10.52	-0.26	11.86	0.67
October 2017	10.53	-0.12	12.02	1.94
November 2017	10.54	0.00	12.84	8.98
December 2017	10.55	0.02	12.67	7.46
January 2018	10.54	-0.06	12.69	7.65
February 2018	10.55	0.02	12.70	7.79
March 2018	10.55	0.02	12.51	6.17
April 2018	10.45	-0.87	12.28	4.20
May 2018	10.44	-0.99	11.98	1.65
June 2018	10.48	-0.64	11.92	1.16
July 2018	10.49	-0.48	12.02	2.01
August 2018	10.54	-0.07	12.03	2.06

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	112	0	0	0
2	21248	658703	58.7	0	0
3	10860	336645	30	0	0
4	137	4237	0.4	244	2.5
5	792	24551	2.2	210	2.1
6	195	6035	0.5	241	2.5
7	59	1842	0.2	189	1.9
8	177	5493	0.5	88	0.9
9	2470	76569	6.8	7827	79.7
10	119	3698	0.3	563	5.7
11	71	2215	0.2	91	0.9
12	53	1630	0.1	41	0.4
13	19	581	0.1	324	3.3
TOTAL	36204	1122311	100	9818	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>
2018-08-31	Friday	10:53:45	9	WB	1	147.27
2018-08-27	Monday	11:39:40	10	WB	1	145.76
2018-08-31	Friday	11:49:46	9	WB	1	145.26
2018-08-31	Friday	14:17:15	9	WB	1	144.79
2018-08-01	Wednesday	13:51:20	9	WB	2	144.27
2018-08-31	Friday	13:02:44	9	WB	1	143.42
2018-08-31	Friday	17:41:20	9	WB	1	143.29
2018-08-31	Friday	11:43:22	9	WB	1	142.76
2018-08-27	Monday	15:24:27	9	WB	1	141.92
2018-08-24	Friday	16:07:21	10	WB	1	141.74

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	WB	15	4151	515	12.4	106718	6863	26089
5	WB	8	24051	1607	6.7	323082	11631	71765
6	WB	19	5912	595	10.1	165631	10390	32304
7	WB	11.5	1804	18	1	83042	190	31251
8	WB	31	5381	3172	58.9	85384	69507	8453
9	WB	33	75009	12684	16.9	3702058	365529	822666
10	WB	33.5	3623	568	15.7	197818	15567	47738
11	WB	36.5	2170	53	2.4	133589	1213	28159
12	WB	36.5	1597	21	1.3	99800	566	21138
13	WB	31.5	569	7	1.2	50250	201	16273
TOTAL	****	****	124267	19240	****	4947371	****	1105836

Table 5 Gross Vehicle Weight by Class and Lane

<i>Vehicle Class</i>	<i>WB Driving Lane</i>	<i>WB Passing Lane</i>	<i>Total</i>	<i>Percentage</i>
1	92	46	138	0
2	1103565	1623565	2727130	26.3
3	891530	1341097	2232627	21.5
4	76933	36648	113581	1.1
5	203515	131198	334713	3.2
6	143479	32542	176020	1.7
7	53451	29781	83231	0.8
8	108818	46074	154891	1.5
9	3061138	1006448	4067587	39.2
10	142434	70950	213385	2.1
11	122875	11927	134802	1.3
12	89415	10951	100365	1
13	34430	16021	50450	0.5
TOTAL	6031674	4357246	10388920	100
GVW/LANE	58.06	41.94	100	0

Table 6 ESALs by Class and Lane and Flexible ESAL Factors

<i>Vehicle Class</i>	<i>WB Driving Lane</i>	<i>WB Passing Lane</i>	<i>Total</i>	<i>Percentage</i>	<i>Flexible ESAL Factor</i>
1	0	0	0	0	0.009
2	135	228	364	0.4	0.0011
3	376	567	943	1	0.0057
4	1264	692	1956	2.1	0.94
5	2356	1042	3398	3.7	0.28
6	1946	659	2605	2.8	0.88
7	927	624	1552	1.7	1.72
8	1261	442	1703	1.9	0.63
9	46860	23212	70073	76.4	1.87
10	1815	1205	3019	3.3	1.67
11	3152	307	3459	3.8	3.18
12	1236	179	1414	1.5	1.77
13	864	382	1246	1.4	4.3
TOTAL	62192	29539	91731	100	17
ESALS/LANE	67.8	32.2	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	971749	32392	3802	857703	88.3	114045.8	11.7
Oct 2017	964314	31107	3898	843483	87.5	120831.4	12.5
Nov 2017	870827	29028	2971	781684	89.8	89143	10.2
Dec 2017	861735	27798	2856	773186	89.7	88548.6	10.3
Jan 2018	786355	25366	2885	696926	88.6	89429.4	11.4
Feb 2018	731714	26133	3001	647696	88.5	84018.2	11.5
Mar 2018	891514	28758	3685	777288	87.2	114225.9	12.8
Apr 2018	865392	28846	3643	756114	87.4	109278.3	12.6
May 2018	1028083	33164	4372	892548	86.8	135535.5	13.2
Jun 2018	1062451	35415	4414	930017	87.5	132434.5	12.5
Jul 2018	1072651	34602	4186	942884	87.9	129767	12.1
Aug 2018	1122311	36204	4092	995460	88.7	126851.1	11.3
TOTAL	11229096	-	-	9894989	-	1334109	-
AVERAGE	935758	30734	3650	824582	88	111176	12

ESALS

<i>Month</i>	<i>ESALS WB Driving Lane</i>	<i>ESALS WB Passing Lane</i>	<i>Total ESALS</i>	<i>Pavement Life Decrease Months</i>
Sep 2017	71448	17904	89353	1.1
Oct 2017	74092	13806	87898	1
Nov 2017	52468	12005	64473	1.7
Dec 2017	56619	5356	61975	1.9
Jan 2018	68067	10039	78106	1.2
Feb 2018	53421	7393	60815	1.6
Mar 2018	68692	22307	90998	2.7
Apr 2018	65405	21901	87305	1.3
May 2018	76544	26734	103278	1.3
Jun 2018	72524	26971	99496	1.2
Jul 2018	70515	25002	95518	1.3
Aug 2018	62410	29879	92289	1
TOTAL	792205	-	-	-
AVERAGE	66017	18275	84292	2

Gross Vehicle Weight

<i>Month</i>	<i>GVW WB Driving Lane</i>	<i>GVW WB Passing Lane</i>	<i>Total GVW Kips</i>
Sep 2017	5022577	2017371	7039948
Oct 2017	4627274	1899924	6527198
Nov 2017	5819299	3102304	8921603
Dec 2017	5225627	2958231	8183858
Jan 2018	6691316	3734069	10425385
Feb 2018	6556272	3927565	10483836
Mar 2018	6501613	3913029	10414641
Apr 2018	6040668	4371275	10411943
May 2018	6264517	2813582	9078098
Jun 2018	6472379	2845191	9317570
Jul 2018	5031471	2309308	7340779
Aug 2018	5296388	2102076	7398464
TOTAL	69549400	35993925	105543325
AVERAGE	5795783	2999494	8795277

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	6376	0.7	5.5	435	229
Oct 2017	6672	0.7	5.4	423	189
Nov 2017	4048	0.5	4.6	286	142
Dec 2017	3927	0.5	4.5	254	139
Jan 2018	4659	0.6	5.3	344	141
Feb 2018	3808	0.5	4.6	334	125
Mar 2018	8752	1	7.8	1213	198
Apr 2018	7541	0.9	7.2	872	164
May 2018	9894	1	7.3	733	245
Jun 2018	9918	1	7.6	754	280
Jul 2018	9377	0.9	7.3	744	247
Aug 2018	9894	0.9	7.9	888	253
TOTAL	84866	-	-	7280	2352
AVERAGE	7072.2	0.8	6.2	606.7	196

Freight

<i>Month</i>	<i>WB Freight Tons</i>
Sep 2017	1013502
Oct 2017	1063947
Nov 2017	728121
Dec 2017	735210
Jan 2018	745526
Feb 2018	694995
Mar 2018	1048394
Apr 2018	950237
May 2018	1252655
Jun 2018	1203088
Jul 2018	1158446
Aug 2018	1105836
TOTAL	11699959
AVERAGE	974996.5