

JANUARY 2019



**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 January 2019. 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. 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: 811524 | Passenger Vehicles: 695851 | Heavy Commercial Vehicles: 115673

Monthly Average Daily Traffic (MADT): 26178 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 3731

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 5's.

Overweight HCVs

Volume trends. Of a total of 115673 HCVs, 9756 of them were overweight ³. These overweight HCVs contributed to 1.3% of total monthly volume, and 8.7% 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 ,2857 WB vehicles exceeded 88,000 pounds (1930 vehicles were Class 9's; 716 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from January 2019.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9's and 10's in January 2019. 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 1046074 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 811524 vehicles with a combined GVW of 8632387 kips (1 kip = 1,000 pounds = 0.5 tons) in January 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 89162 equivalent single axle loads (ESALs) passed over the pavement at this site. In particular, 77% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 46% 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 GVW Histogram

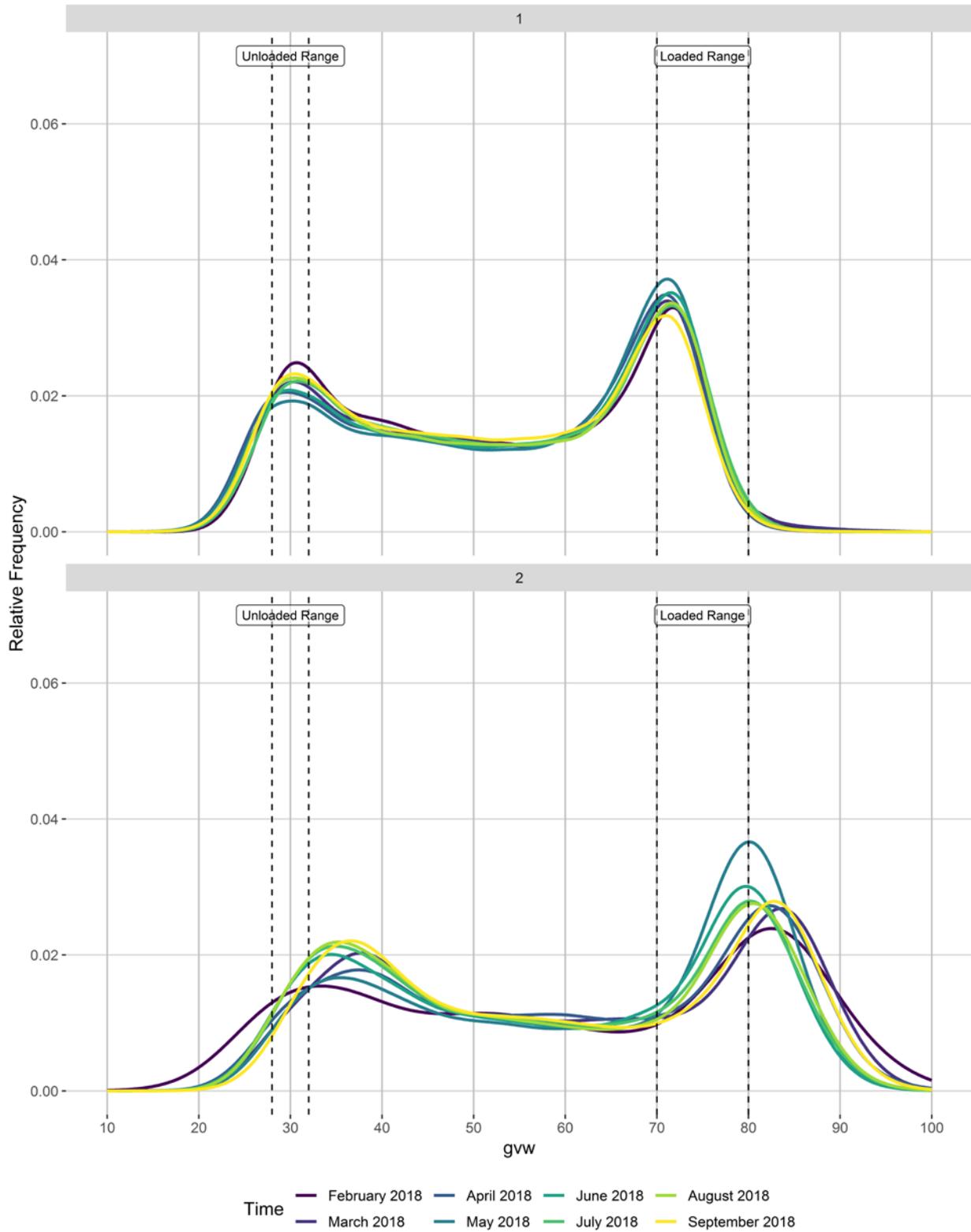
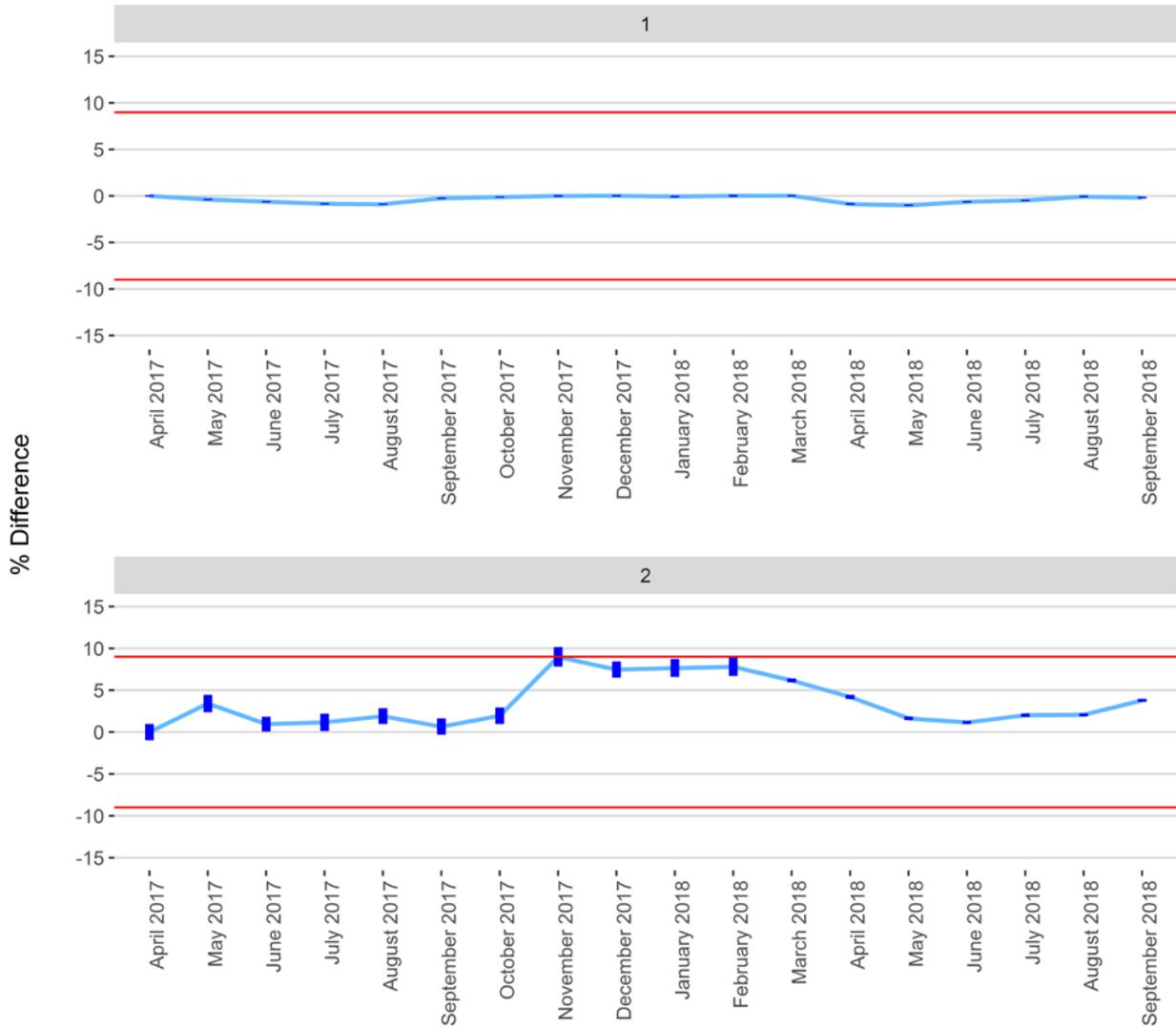


Figure 2 - Percent Difference of Front Axle Weight from Last Calibration (+/- 95% CI)



Months that have not passed QC parameters are not displayed

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

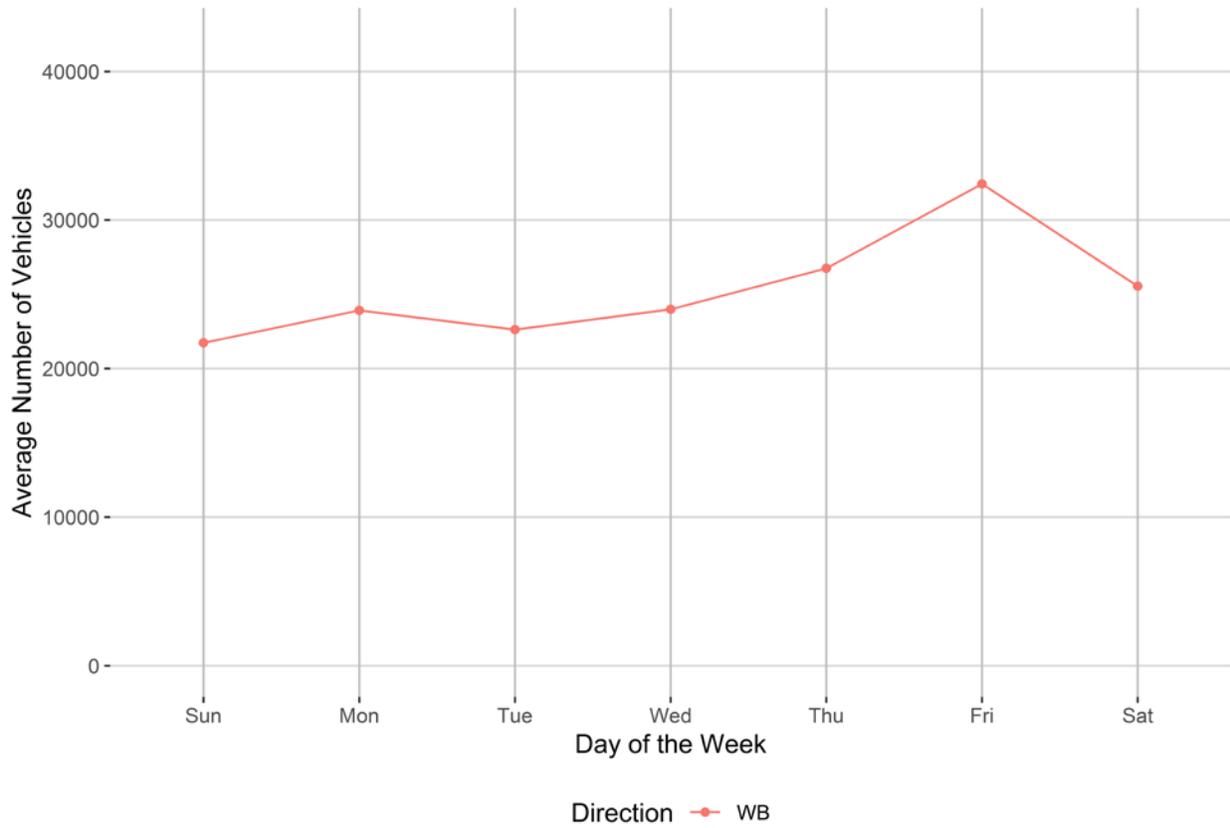


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

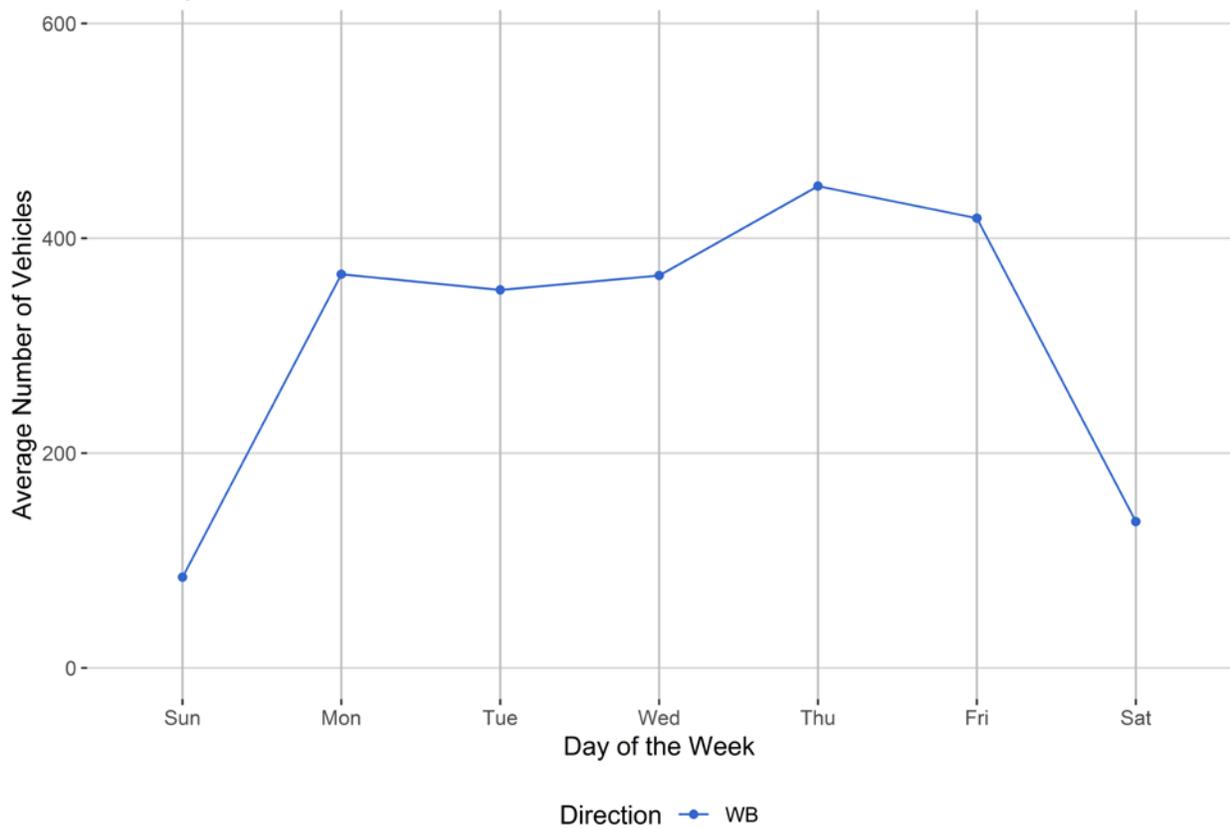


Figure 4 - Passenger Vehicles vs. Hour of the Day

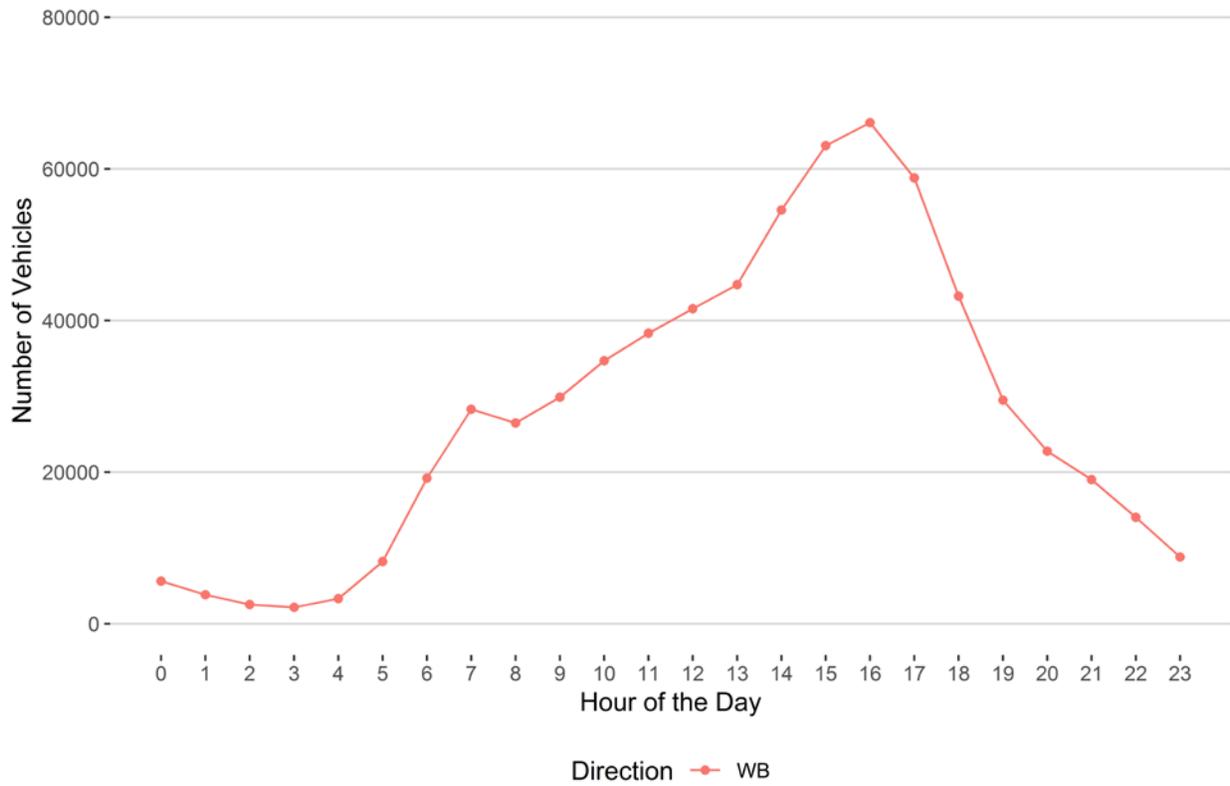


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

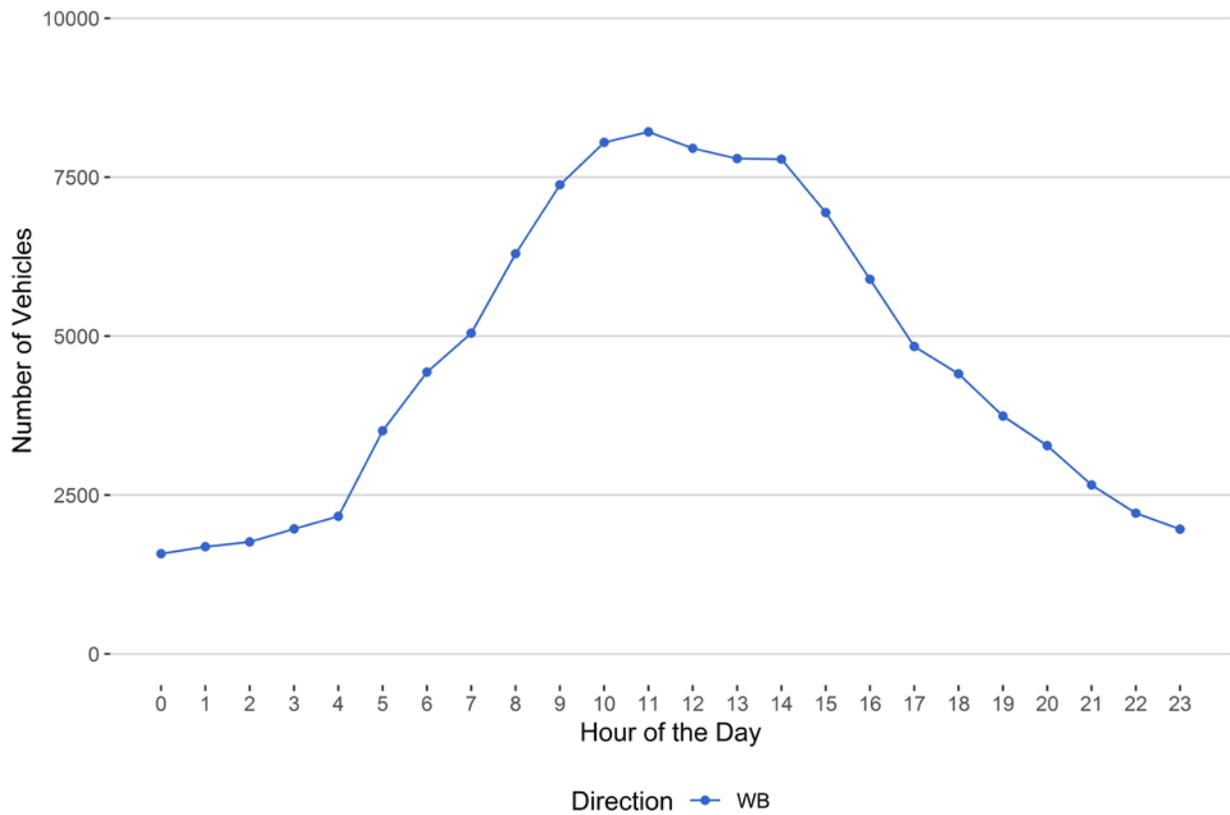


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

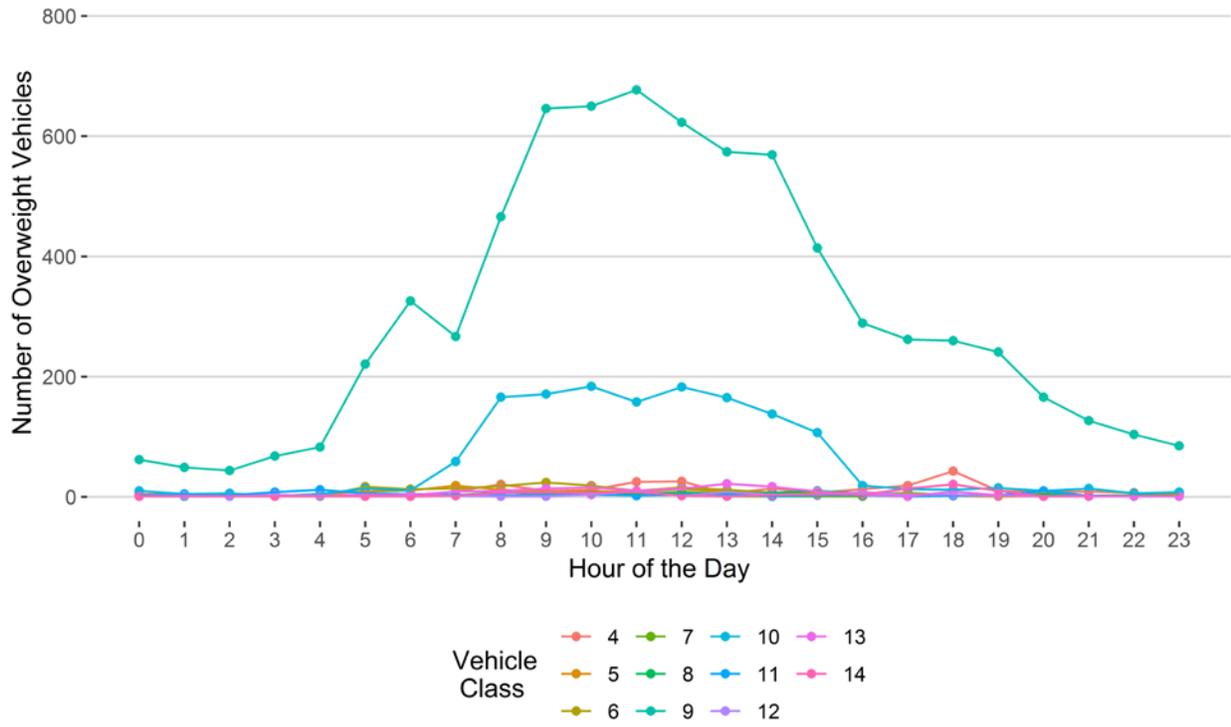


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

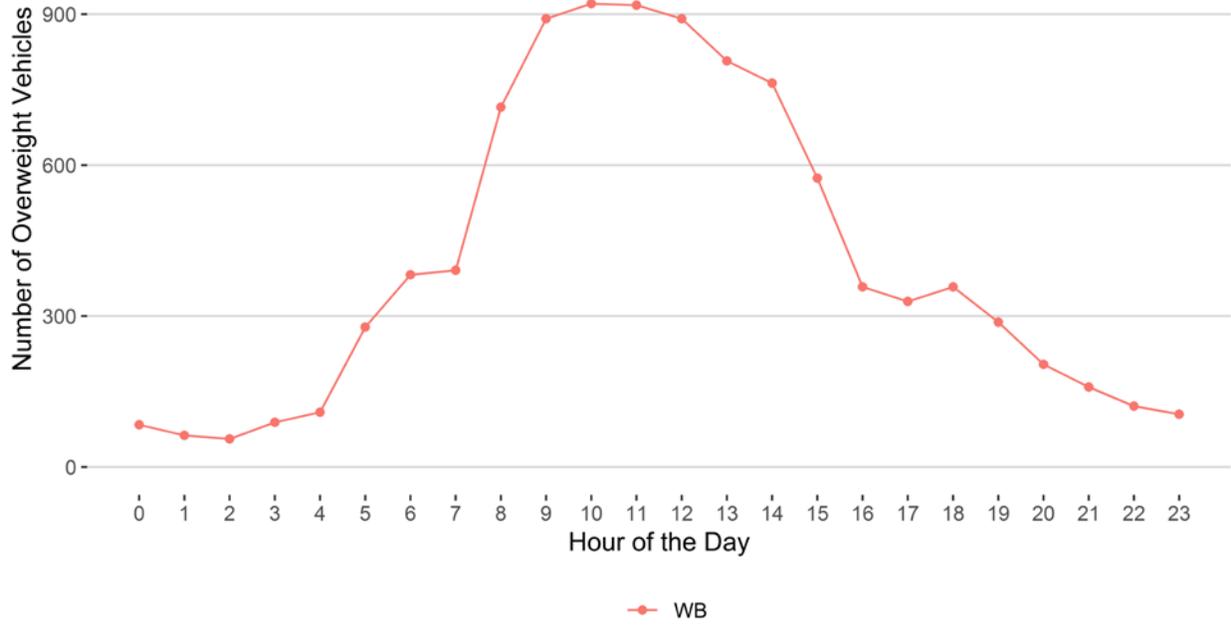
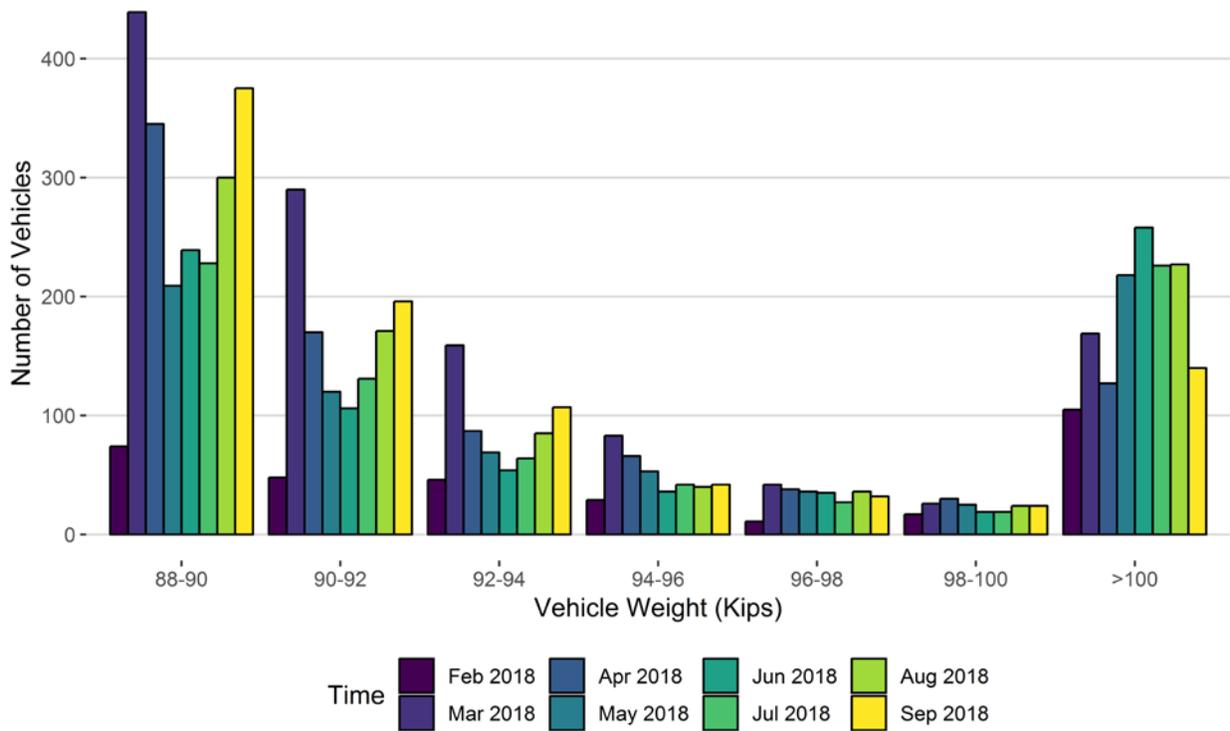


Figure 8 - Histogram of Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018
88-90	74	439	345	209	239	228	300	375
90-92	48	290	170	120	106	131	171	196
92-94	46	159	87	69	54	64	85	107
94-96	29	83	66	53	36	42	40	42
96-98	11	42	38	36	35	27	36	32
98-100	17	26	30	25	19	19	24	24
>100	105	169	127	218	258	226	227	140
Total	330	1208	863	730	747	737	883	916

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

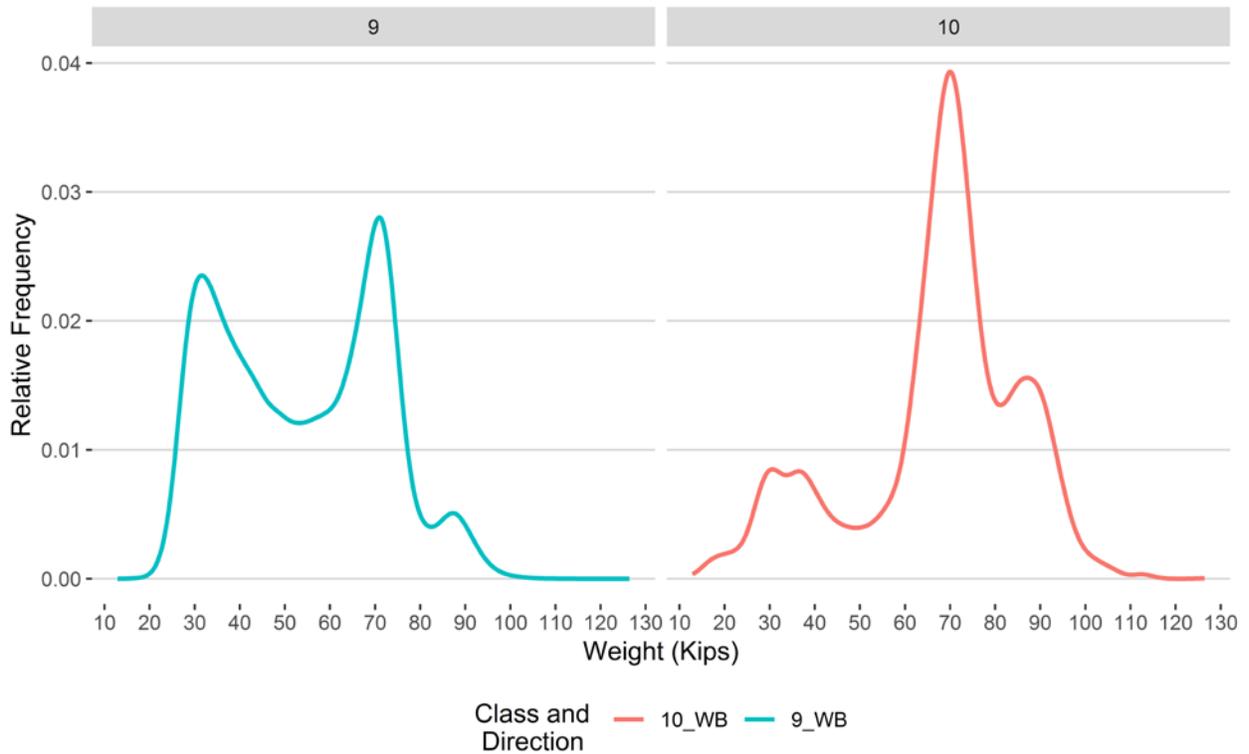


Figure 9 - Freight Percentage by Direction and Class

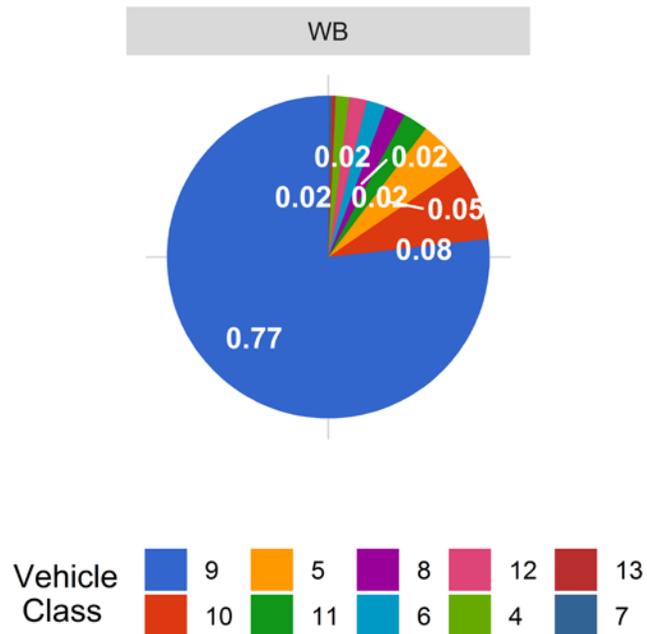


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

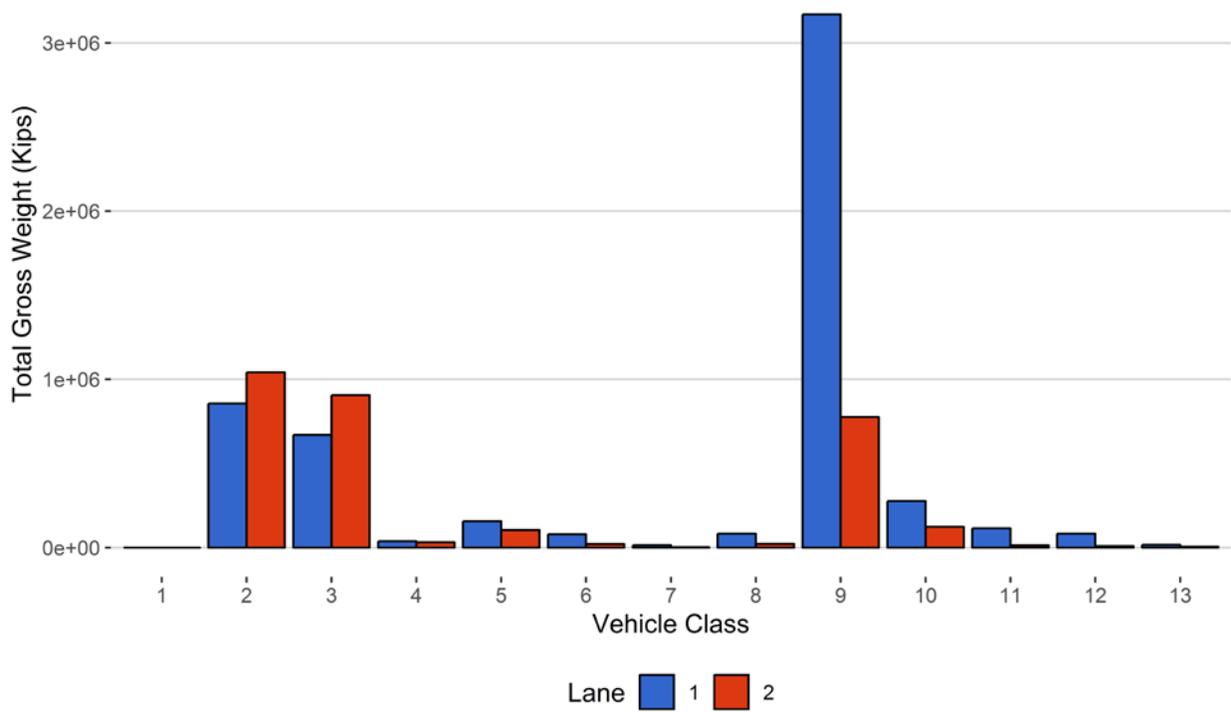


Figure 11 - Total Gross Vehicle Weight t

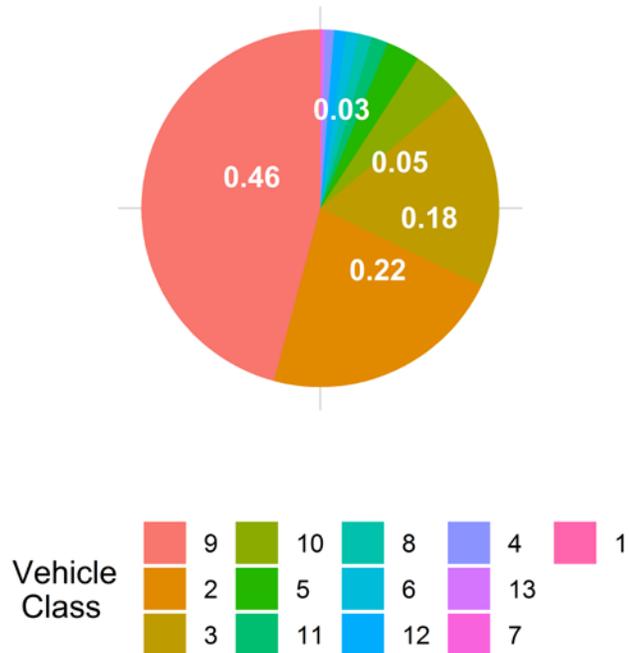


Figure 12 - Total ESALs by Class and Lane

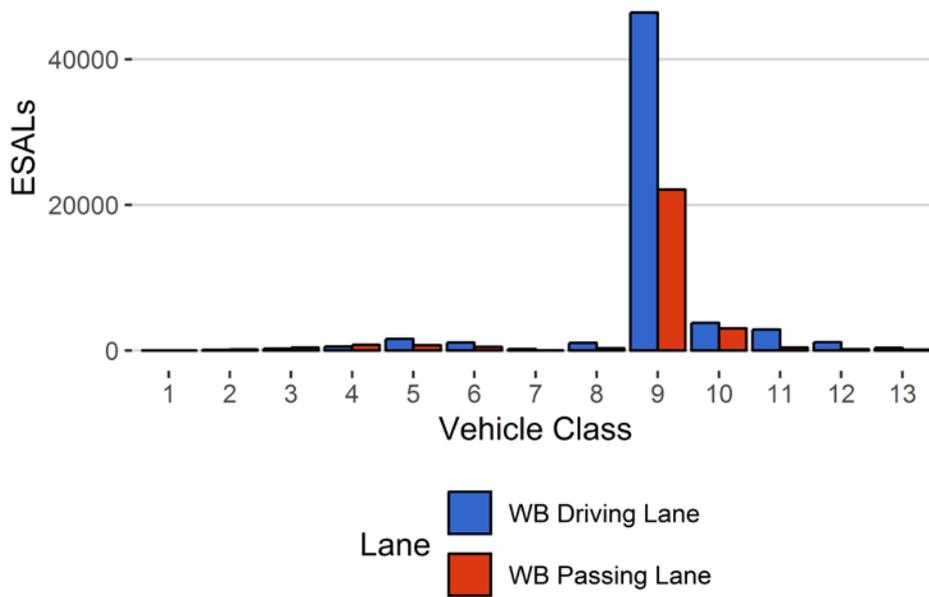


Figure 13 - ESALs by Class

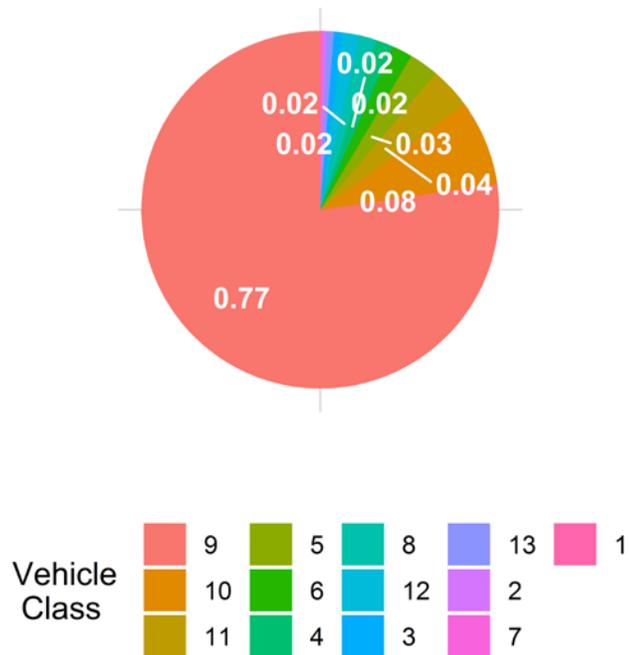


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
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
September 2018	10.52	-0.18	12.23	3.79

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	1	0	0	0
2	14717	456217	56.2	0	0
3	7730	239633	29.5	0	0
4	79	2441	0.3	253	2.6
5	647	20058	2.5	135	1.4
6	112	3464	0.4	183	1.9
7	11	352	0	24	0.2
8	114	3532	0.4	93	1
9	2446	75824	9.3	7273	74.5
10	199	6169	0.8	1481	15.2
11	68	2112	0.3	93	1
12	48	1492	0.2	70	0.7
13	7	228	0	151	1.5
TOTAL	26178	811524	100	9756	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>
2019-01-09	Wednesday	19:40:40	10	WB	2	126.42
2019-01-24	Thursday	12:40:53	10	WB	2	125.55
2019-01-21	Monday	13:55:10	9	WB	2	119.26
2019-01-21	Monday	09:29:42	9	WB	2	117.17
2019-01-18	Friday	06:45:42	10	WB	2	116.06
2019-01-25	Friday	08:16:58	10	WB	2	115.53
2019-01-05	Saturday	21:09:07	9	WB	1	113.56
2019-01-05	Saturday	08:14:18	10	WB	1	113.11
2019-01-27	Sunday	21:01:31	10	WB	2	113.08
2019-01-22	Tuesday	10:58:22	10	WB	2	113.03

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	2354	331	14.1	64599	4422	17127
5	WB	8	19342	1329	6.9	250691	9732	53294
6	WB	19	3340	286	8.6	95086	5035	18530
7	WB	11.5	339	1	0.3	16941	9	6527
8	WB	31	3406	1677	49.2	67034	37849	6718
9	WB	33	73116	12077	16.5	3591614	353806	788663
10	WB	33.5	5949	495	8.3	386266	13594	101779
11	WB	36.5	2037	32	1.6	127085	1067	26951
12	WB	36.5	1439	10	0.7	90908	302	19375
13	WB	31.5	220	0	0	21152	0	7111
TOTAL	****	****	111542	16238	****	4711376	****	1046074

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	0	1	1	0
2	856286	1042084	1898369	22
3	669366	906520	1575885	18.3
4	37791	31230	69021	0.8
5	156174	104249	260424	3
6	79350	20772	100121	1.2
7	14804	2146	16950	0.2
8	83136	21748	104884	1.2
9	3169742	775677	3945419	45.8
10	276274	123586	399860	4.6
11	114529	13623	128152	1.5
12	82360	8850	91210	1.1
13	16412	4740	21152	0.2
TOTAL	5556224	3055224	8611448	100
GVW/LANE	64.52	35.48	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	0.5
2	107	164	271	0.3	0.0012
3	278	423	701	0.8	0.0061
4	575	812	1387	1.6	1.18
5	1617	740	2357	2.7	0.24
6	1123	518	1642	1.8	0.98
7	210	42	252	0.3	1.48
8	1049	318	1368	1.5	0.8
9	46406	22104	68510	77.3	1.87
10	3812	3048	6860	7.7	2.31
11	2894	434	3327	3.8	3.26
12	1173	185	1358	1.5	1.88
13	406	152	558	0.6	4.84
TOTAL	59650	28940	88590	100	19
ESALS/LANE	67.3	32.7	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>
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
Sep 2018	762407	31767	2952	673849	88.4	88558.1	11.6
TOTAL	7536523	-	-	6615856	-	920669	-
AVERAGE	942065	31861	3793	826982	88	115084	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>
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
Sep 2018	39826	23509	63334	1.2
TOTAL	509337	-	-	-
AVERAGE	63667	22962	86629	2

Gross Vehicle Weight

<i>Month</i>	<i>GVW WB Driving Lane</i>	<i>GVW WB Passing Lane</i>	<i>Total GVW Kips</i>
Feb 2018	4627274	1899924	6527198
Mar 2018	5819299	3102304	8921603
Apr 2018	5225627	2958231	8183858
May 2018	6691316	3734069	10425385
Jun 2018	6556272	3927565	10483836
Jul 2018	6501613	3913029	10414641
Aug 2018	6040668	4371275	10411943
Sep 2018	3908977	3125851	7034828
TOTAL	45371045	27032248	72403292
AVERAGE	5671381	3379031	9050412

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>
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
Sep 2018	7285	1	8.6	920	165
TOTAL	66469	-	-	6458	1677
AVERAGE	8308.6	0.9	7.3	807.2	209.6

Freight

<i>Month</i>	<i>WB Freight Tons</i>
Feb 2018	694995
Mar 2018	1048394
Apr 2018	950237
May 2018	1252655
Jun 2018	1203088
Jul 2018	1158446
Aug 2018	1105836
Sep 2018	748630
TOTAL	8162282
AVERAGE	1020285.3