

FEBRUARY 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 February 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: 710107 | Passenger Vehicles: 614668 | Heavy Commercial Vehicles: 95439

Monthly Average Daily Traffic (MADT): 5361 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 3409

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 Wednesdays (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 95439 HCVs, 10427 of them were overweight ³. These overweight HCVs contributed to 1.6% of total monthly volume, and 11.9% of total monthly HCV volume. WB overweight vehicles typically reached highest numbers on Wednesdays, 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 ,3580 WB vehicles exceeded 88,000 pounds (2741 vehicles were Class 9's; 703 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from February 2019.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9's and 10's in February 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 853174 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 710107 vehicles with a combined GVW of 7019736 kips (1 kip = 1,000 pounds = 0.5 tons) in February 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 77600 equivalent single axle loads (ESALs) passed over the pavement at this site. In particular, 78% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 45% 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>

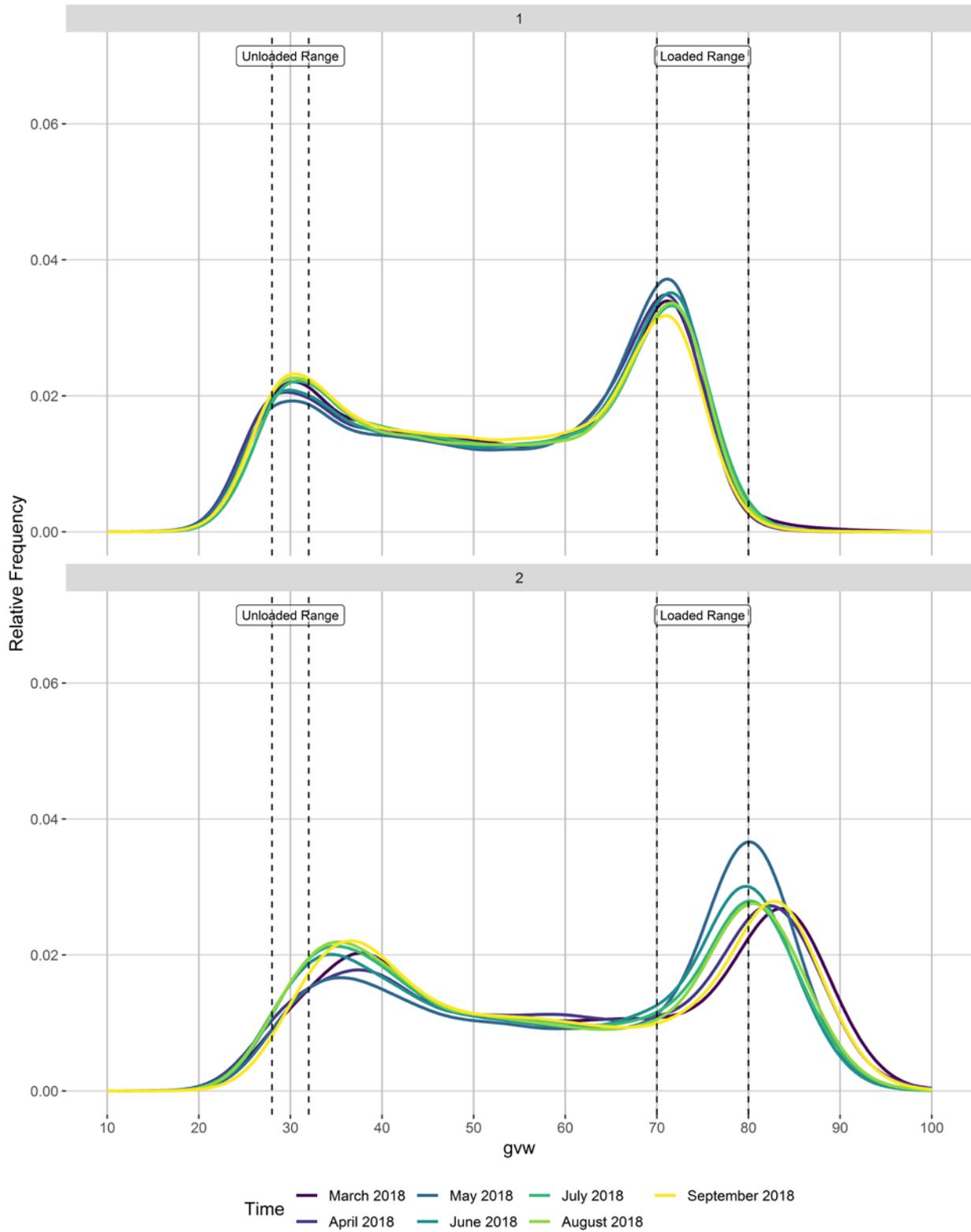
MnDOT's vehicle classification scheme and vehicle class groupings for traffic forecasting can be found at: <http://www.dot.state.mn.us/traffic/data/data-products.html#weight>

- 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.

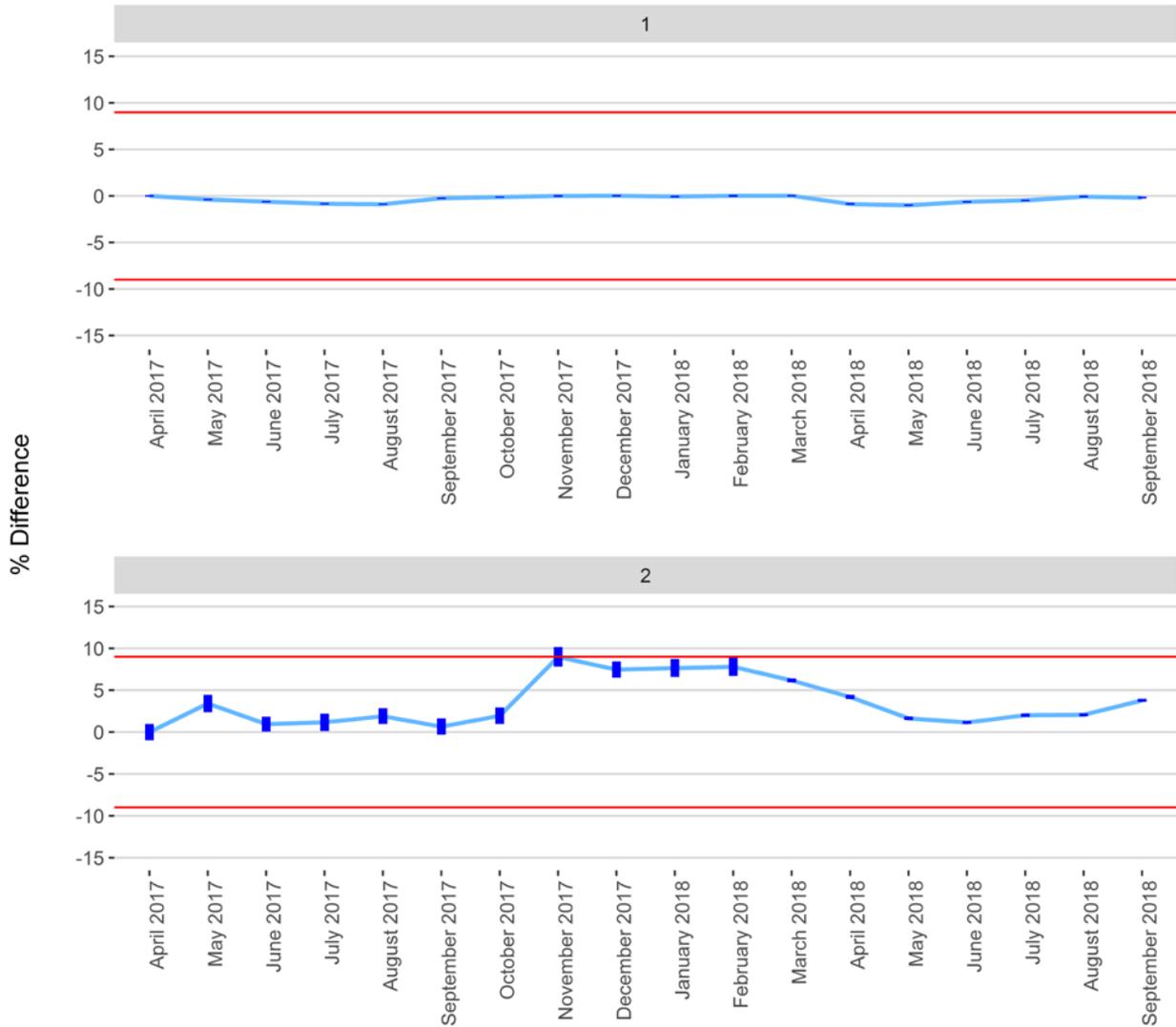
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

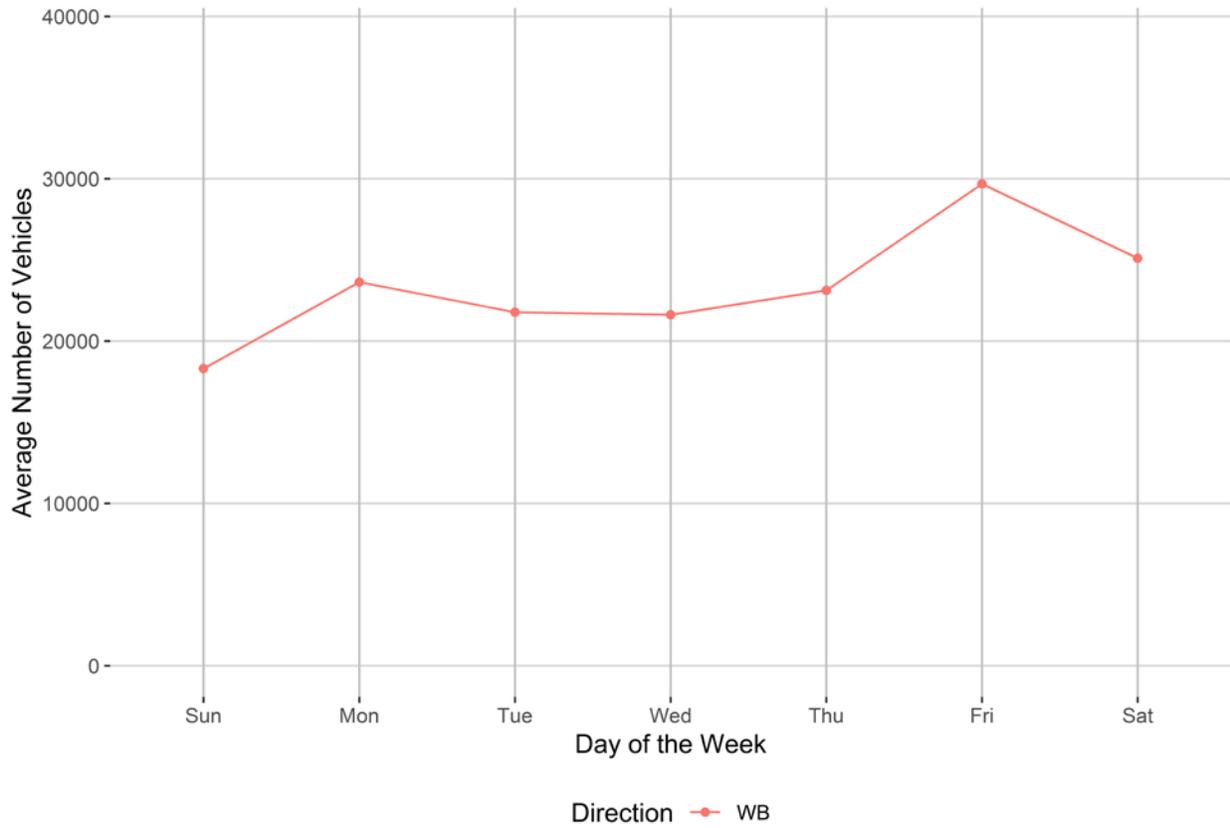


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

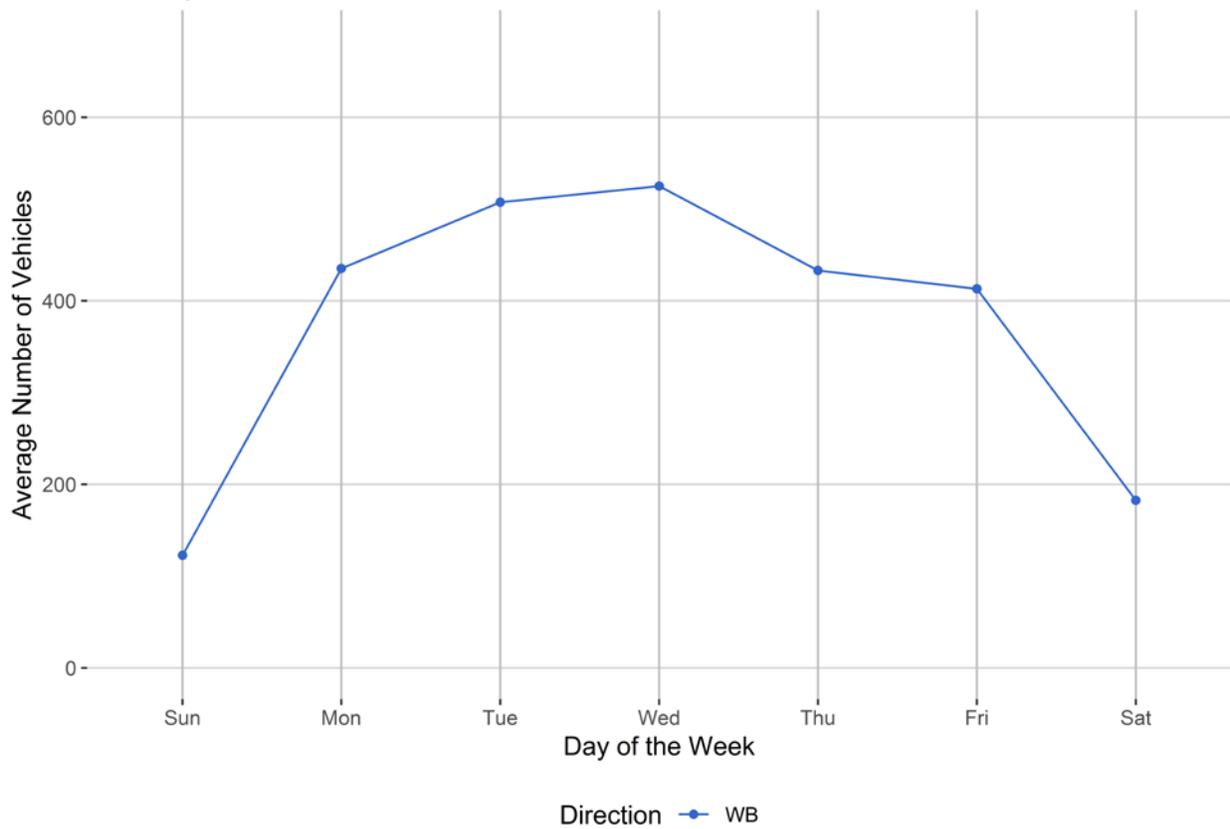


Figure 4 - Passenger Vehicles vs. Hour of the Day

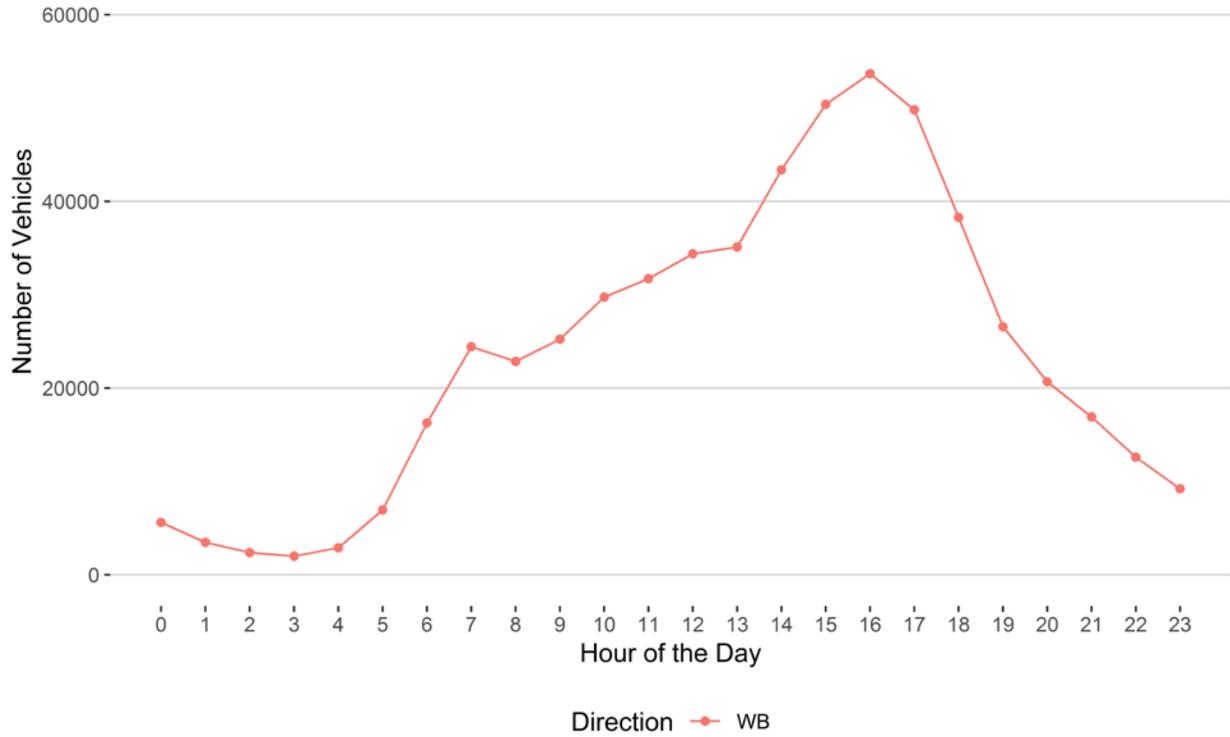


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

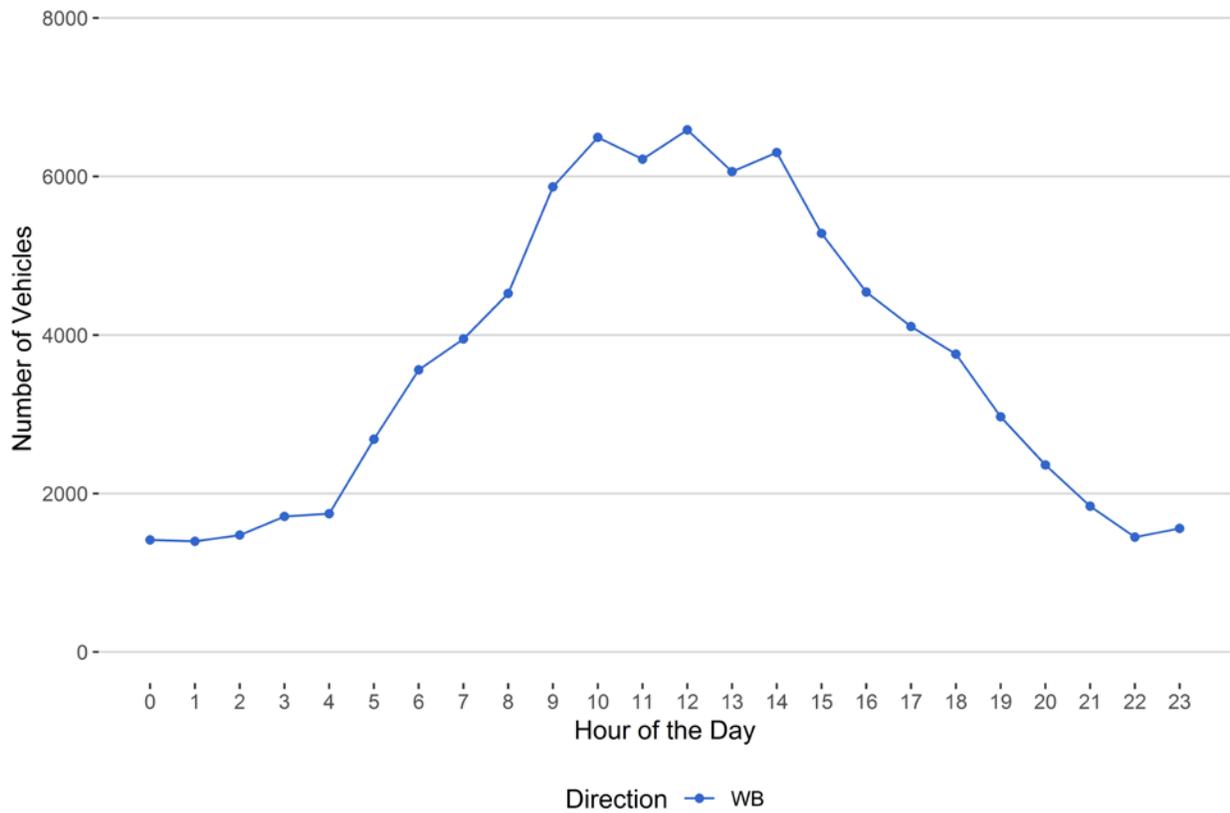


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

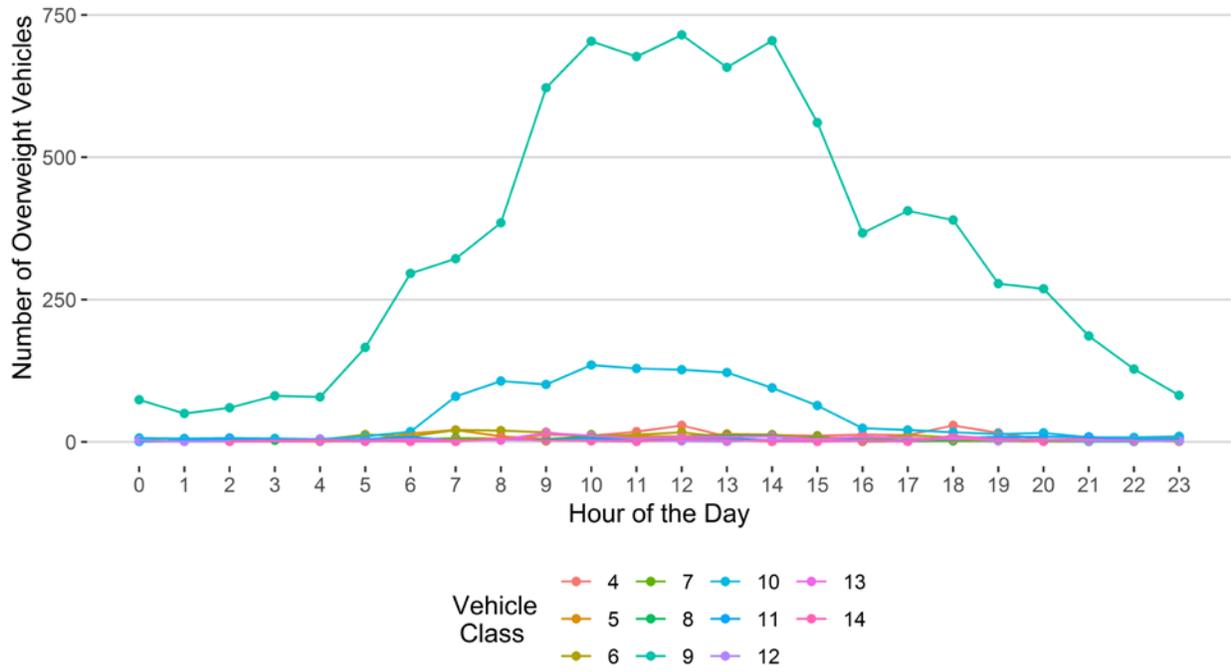


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

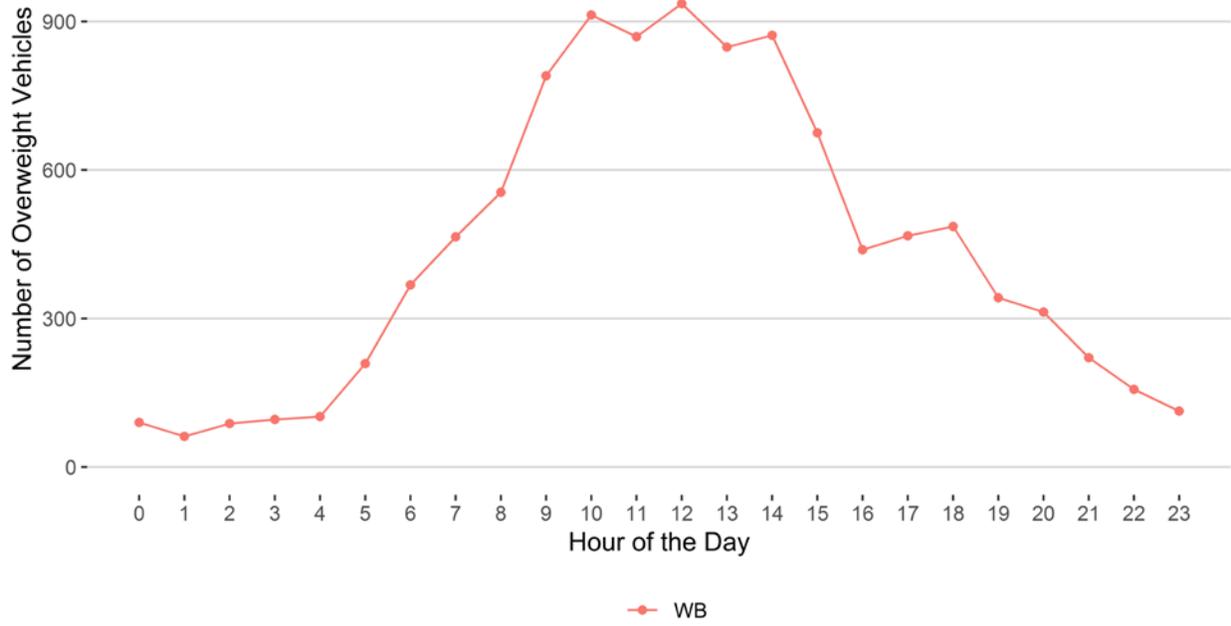
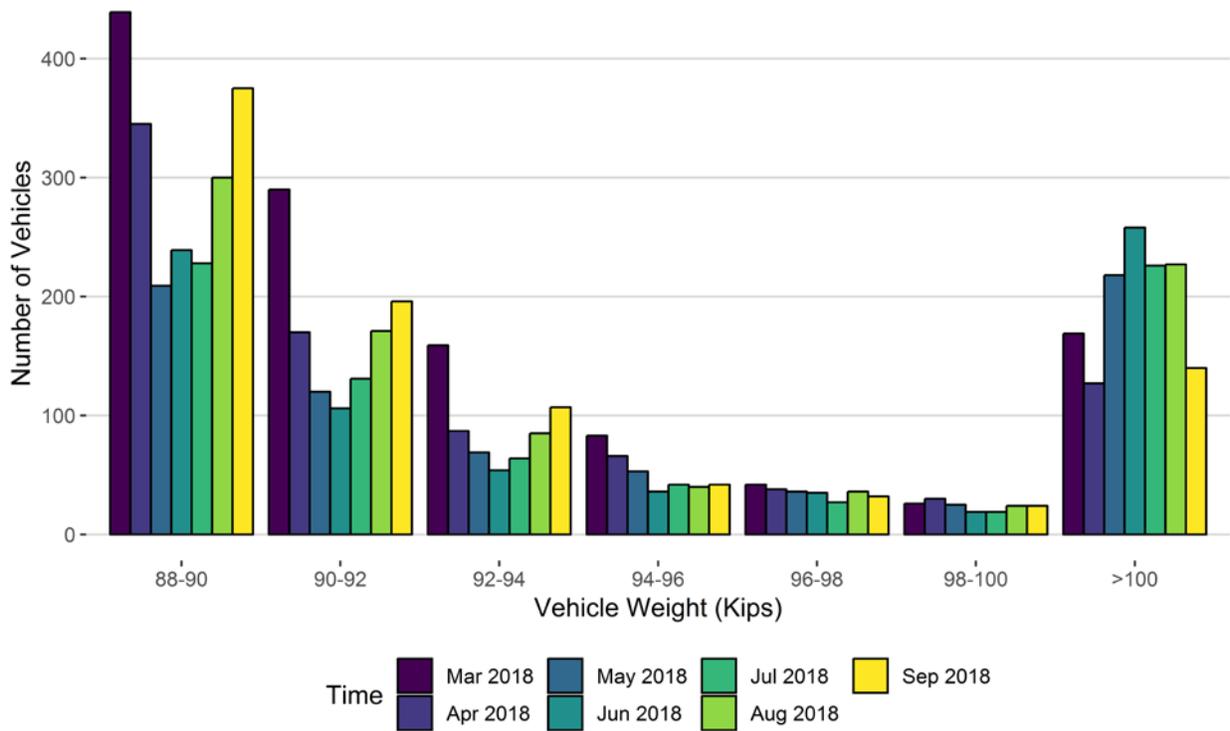


Figure 8 - Histogram of Vehicles Over 88,000 Pounds for Current Month



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

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

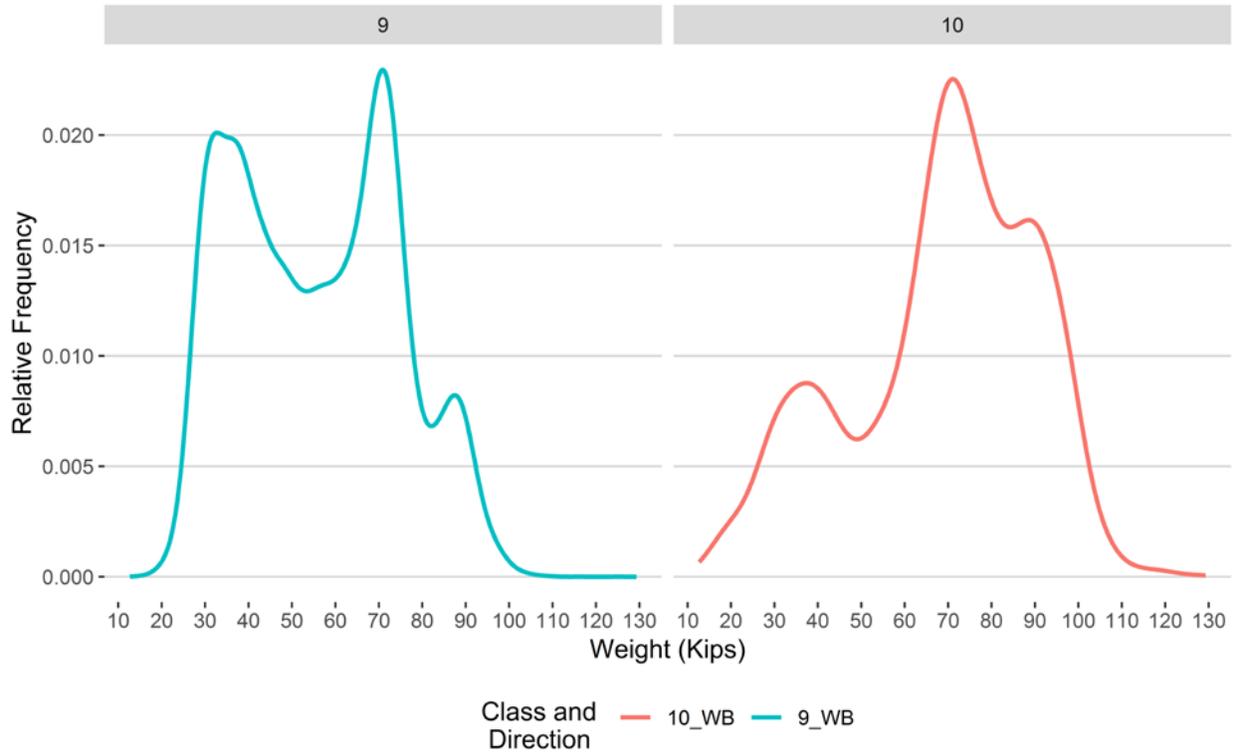


Figure 9 - Freight Percentage by Direction and Class

WB

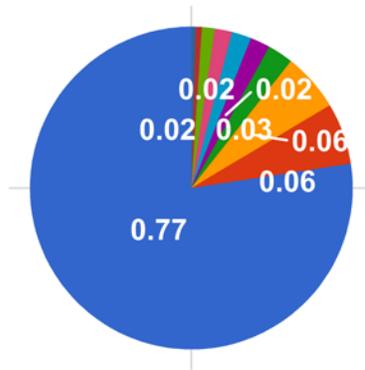


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

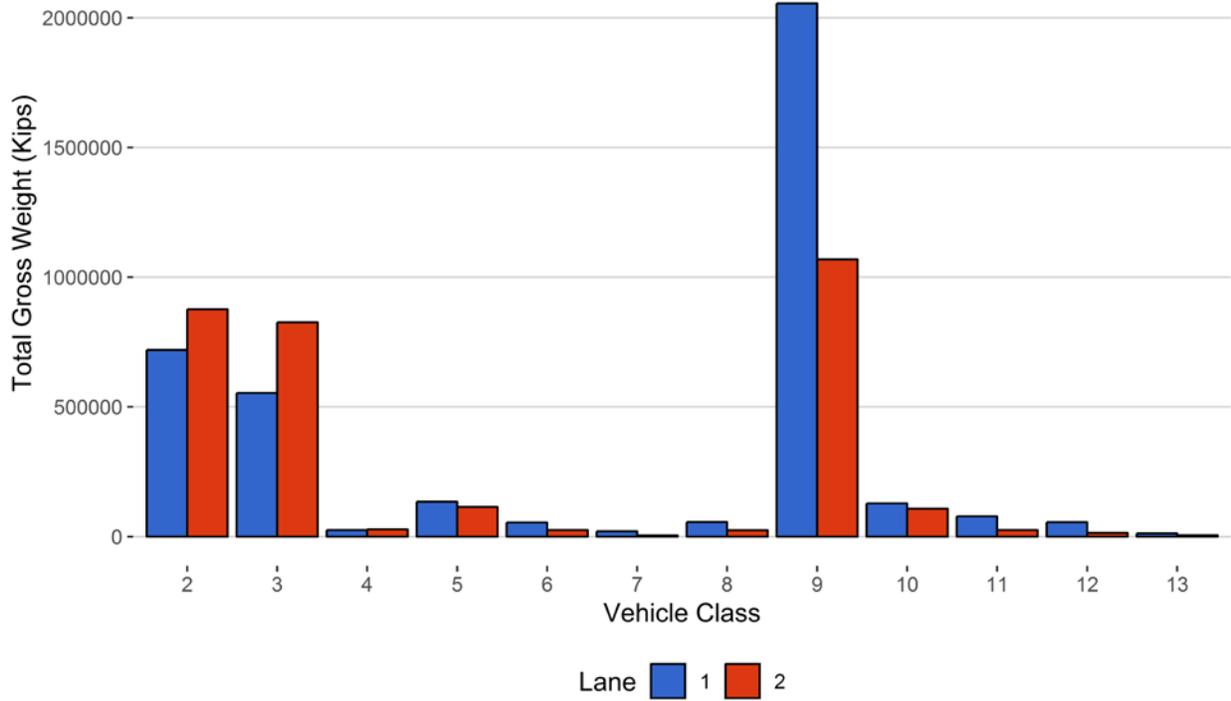


Figure 11 - Total Gross Vehicle Weight t

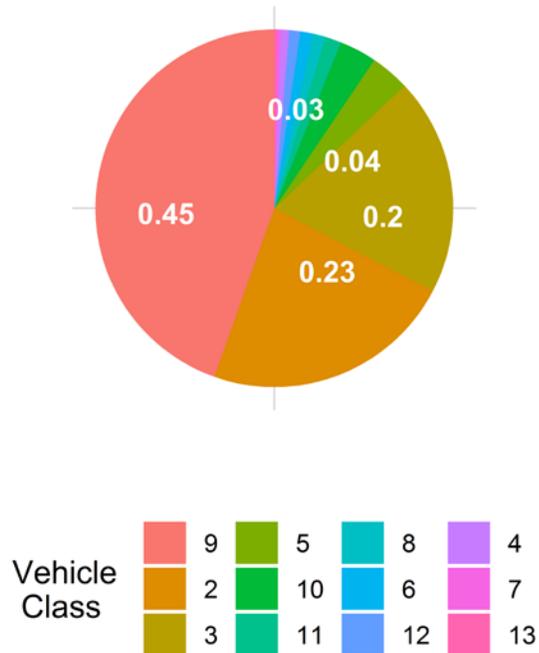


Figure 12 - Total ESALs by Class and Lane

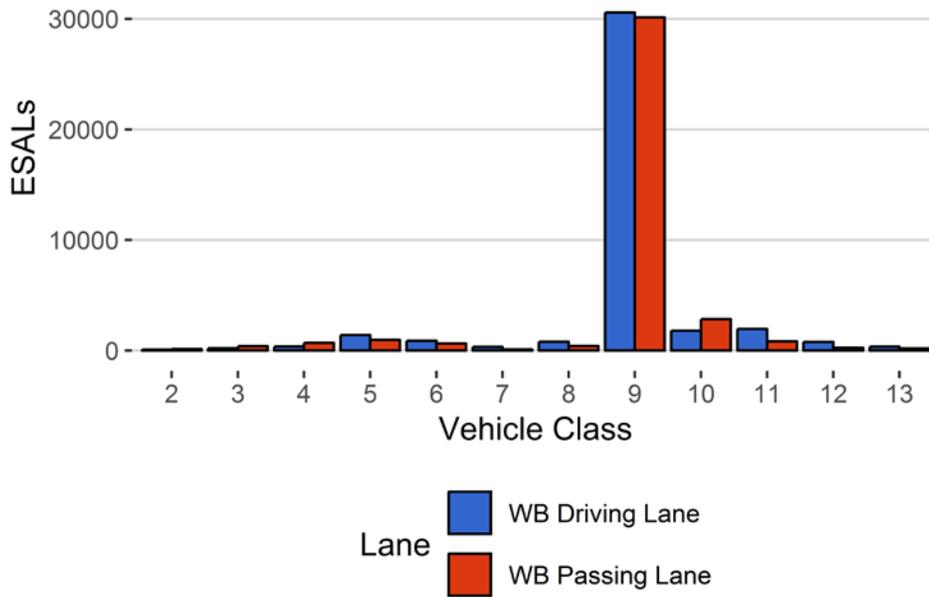


Figure 13 - ESALs by Class

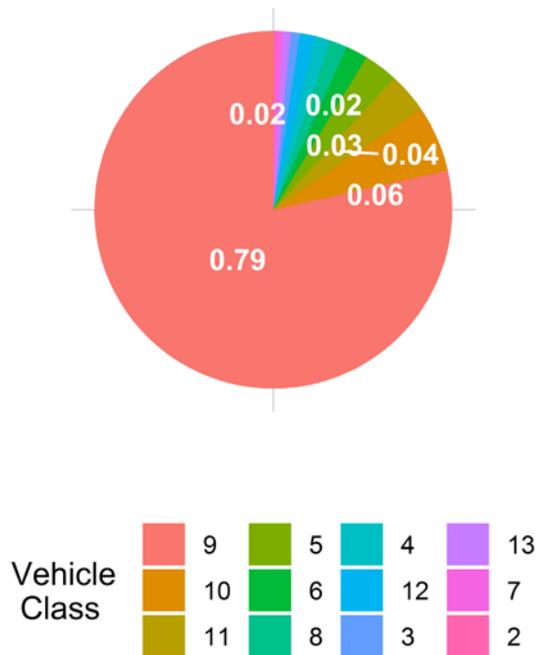


Table 1 Class 9 Front Axle Weight by Lane

<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
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>
2	14111	395100	55.6	0	0
3	7842	219568	30.9	0	0
4	71	1999	0.3	214	2.1
5	706	19778	2.8	149	1.4
6	100	2789	0.4	204	2
7	17	478	0.1	63	0.6
8	97	2728	0.4	105	1
9	2172	60814	8.6	8261	79.2
10	133	3735	0.5	1137	10.9
11	63	1759	0.2	111	1.1
12	42	1167	0.2	59	0.6
13	7	192	0	124	1.2
TOTAL	25361	710107	100	10427	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>
2019-02-19	Tuesday	07:36:33	10	WB	1	129.34
2019-02-11	Monday	07:41:15	10	WB	2	126.13
2019-02-10	Sunday	22:38:51	9	WB	2	125.26
2019-02-28	Thursday	13:38:51	10	WB	2	122.72
2019-02-28	Thursday	07:46:49	10	WB	1	120.88
2019-02-26	Tuesday	16:55:53	10	WB	2	120.71
2019-02-27	Wednesday	08:39:05	10	WB	1	120.58
2019-02-26	Tuesday	12:17:04	10	WB	2	120.17
2019-02-26	Tuesday	14:56:45	10	WB	1	119.98
2019-02-23	Saturday	09:42:45	9	WB	2	119.74

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	1840	240	13	49419	3193	12709
5	WB	8	18206	1051	5.8	240719	7675	51740
6	WB	19	2567	273	10.6	74575	4681	15494
7	WB	11.5	440	0	0	24418	0	9679
8	WB	31	2511	1157	46.1	54807	25544	6417
9	WB	33	55979	7697	13.7	2898749	225202	652722
10	WB	33.5	3438	293	8.5	227854	7861	61248
11	WB	36.5	1619	12	0.7	102795	415	22070
12	WB	36.5	1074	2	0.2	69269	71	15071
13	WB	31.5	177	0	0	17624	0	6024
TOTAL	****	****	87851	10725	****	3760230	****	853174

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>
2	719320	876129	1595449	22.8
3	553536	825924	1379460	19.7
4	24653	27959	52612	0.8
5	134527	113868	248395	3.5
6	54383	24873	79256	1.1
7	19908	4510	24418	0.3
8	55853	24499	80352	1.1
9	2055733	1068218	3123951	44.6
10	128055	107660	235715	3.4
11	78084	25127	103210	1.5
12	55214	14126	69340	1
13	12572	5052	17624	0.3
TOTAL	3891836	3117946	7009781	100
GVW/LANE	55.52	44.48	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>
2	92	146	238	0.3	0.0013
3	224	402	626	0.8	0.0062
4	374	693	1066	1.4	1.16
5	1412	972	2384	3.1	0.26
6	898	640	1538	2	1.2
7	334	108	443	0.6	2
8	811	428	1240	1.6	0.99
9	30563	30124	60687	78.5	2.17
10	1806	2847	4653	6	2.7
11	1958	836	2794	3.6	3.44
12	784	272	1056	1.4	1.96
13	348	191	539	0.7	5.75
TOTAL	39605	37659	77264	100	22
ESALS/LANE	51.3	48.7	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>
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	6804809	-	-	5968160	-	836650	-
AVERAGE	972116	32679	3906	852594	88	119521	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>
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	455915	-	-	-
AVERAGE	65131	25186	90317	1

Gross Vehicle Weight

<i>Month</i>	<i>GVW WB Driving Lane</i>	<i>GVW WB Passing Lane</i>	<i>Total GVW Kips</i>
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	40743771	25132324	65876094
AVERAGE	5820539	3590332	9410871

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>
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	62661	-	-	6124	1552
AVERAGE	8951.6	1	7.7	874.9	221.7

Freight

<i>Month</i>	<i>WB Freight Tons</i>
Mar 2018	1048394
Apr 2018	950237
May 2018	1252655
Jun 2018	1203088
Jul 2018	1158446
Aug 2018	1105836
Sep 2018	748630
TOTAL	7467287
AVERAGE	1066755.3