

AUGUST 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 August 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 <sup>1</sup>. Figure 1 shows the distribution of gross vehicle weights (GVW) in the Class 9s at this site for the last 12 months <sup>2</sup>. 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: 1146585 | Passenger Vehicles: 957633 | Heavy Commercial Vehicles: 188952

Monthly Average Daily Traffic (MADT): 36987 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 6095

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 Mondays (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 5's and Class 9's.

### Overweight HCVs

**Volume trends.** Of a total of 188952 HCVs, 8862 of them were overweight <sup>3</sup>. These overweight HCVs contributed to 0.9% of total monthly volume, and 5.6% of total monthly HCV volume. WB overweight vehicles typically reached highest numbers on Fridays, with lowest volumes reported on Sundays See Figure 3 .

The top two overweight violators by class were the class 9 and class 14 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 August.

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 <sup>4</sup>.

Using normal load limits ,3322 WB vehicles exceeded 88,000 pounds (1646 vehicles were Class 9's; 1192 vehicles were Class 14'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 9's and 10's in August 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 1149578 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 1146585 vehicles with a combined GVW of 10660726 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 205907 equivalent single axle loads (ESALs) passed over the pavement at this site. In particular, 51% of all ESALs were generated by the Class 14's (Class 14's were also responsible for generating % 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>

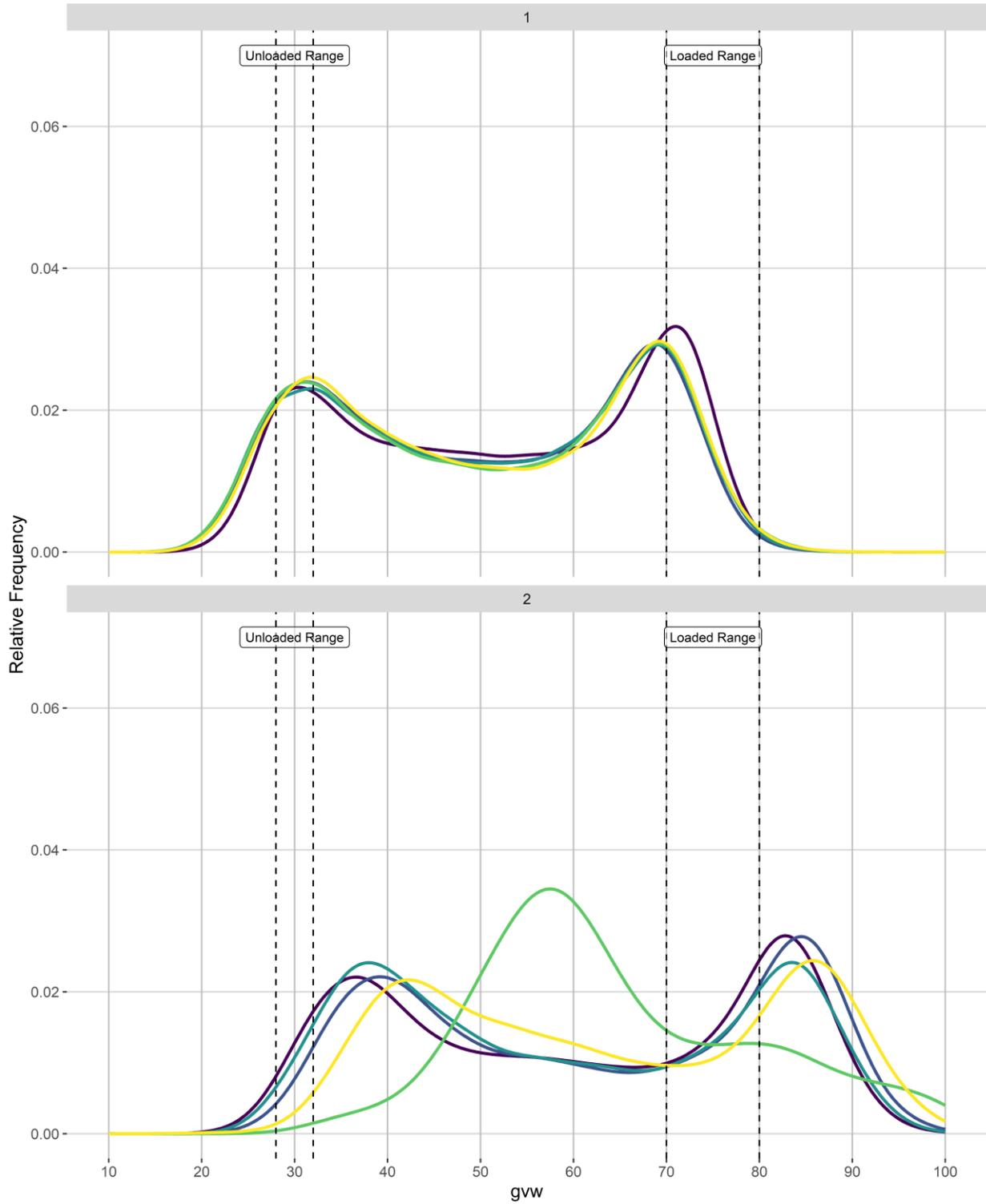
- <sup>1</sup> Front axle weights of Class 9s are monitored on a monthly basis to assure performance between calibrations. The current goal of the WIM scale calibration is to have each individual axle weight stay within a range of +/-9% of baseline calibration values
- <sup>2</sup> Previous WIM research 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.

- <sup>3</sup> 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](http://www.mrr.dot.state.mn.us/research/seasonal_load_limits/sllindex.asp)
- <sup>4</sup> 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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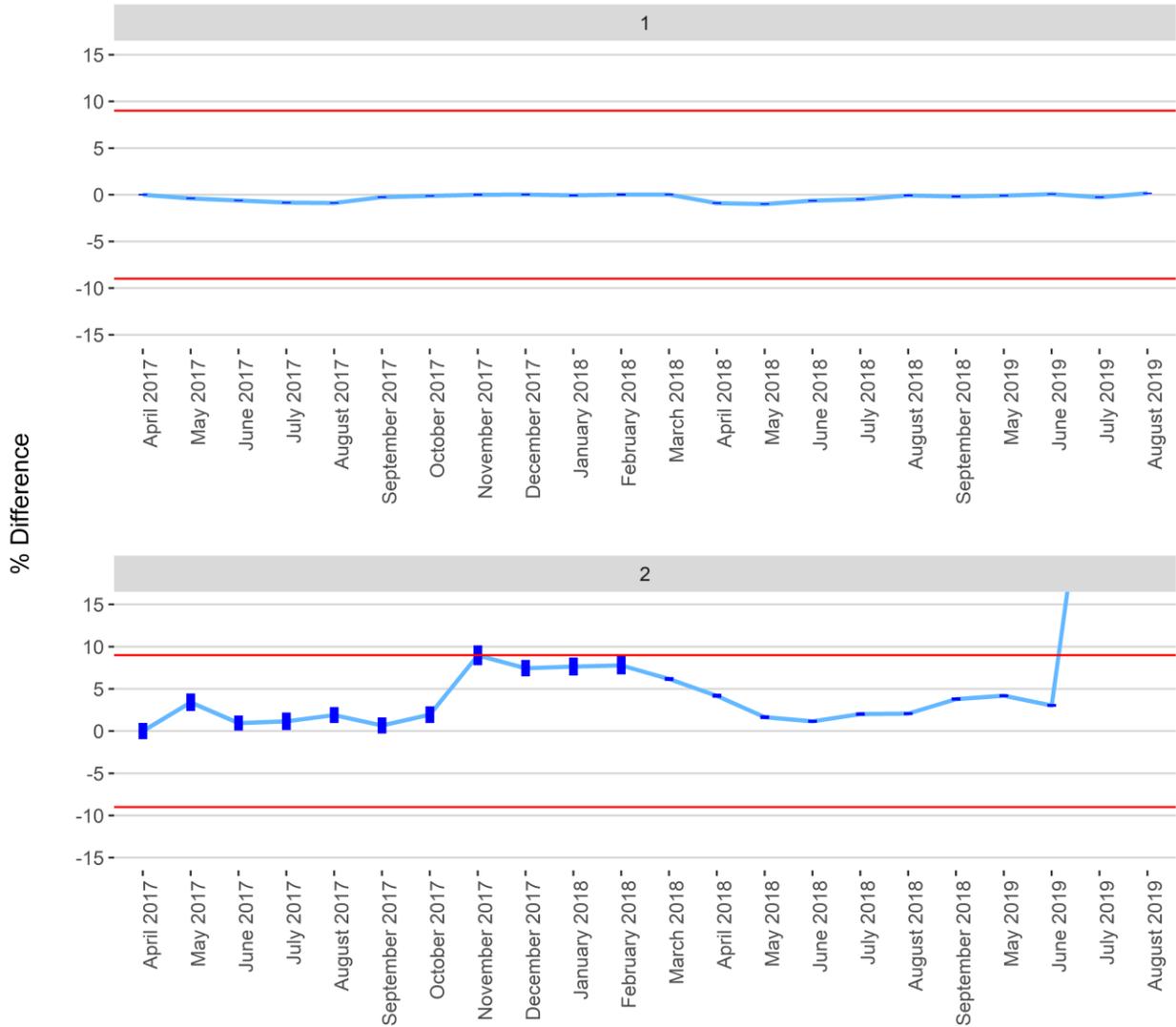
Figure 1 - Monthly Class 9 GVW Histogram



Time — September 2018 — May 2019 — June 2019 — July 2019 — August 2019

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

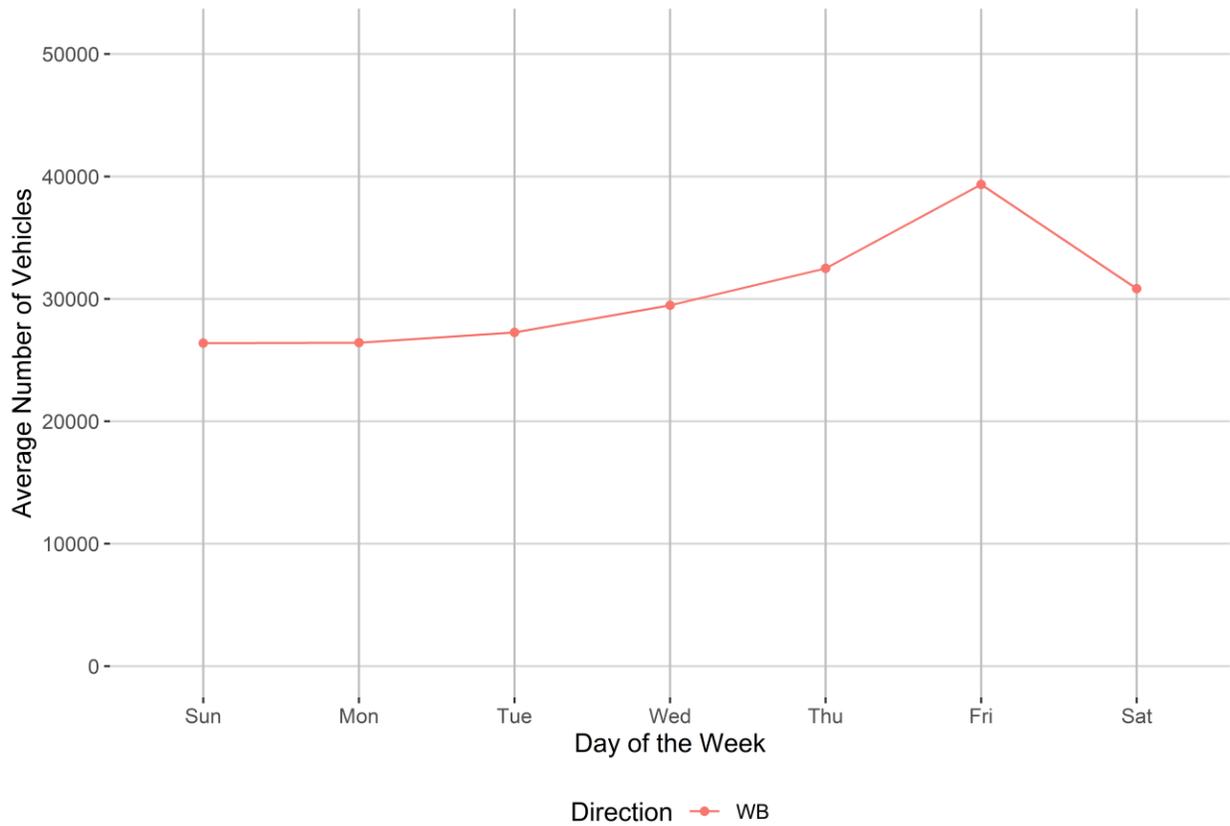


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

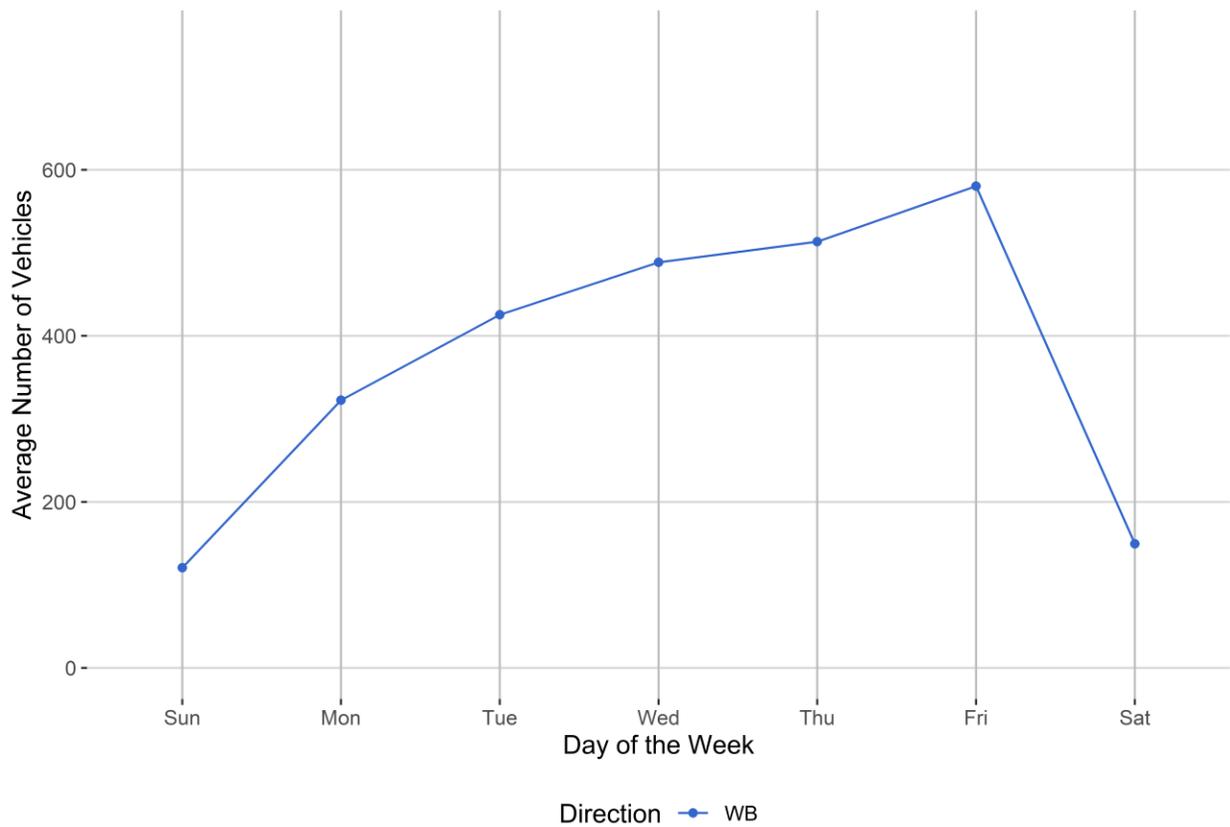


Figure 4 - Passenger Vehicles vs. Hour of the Day

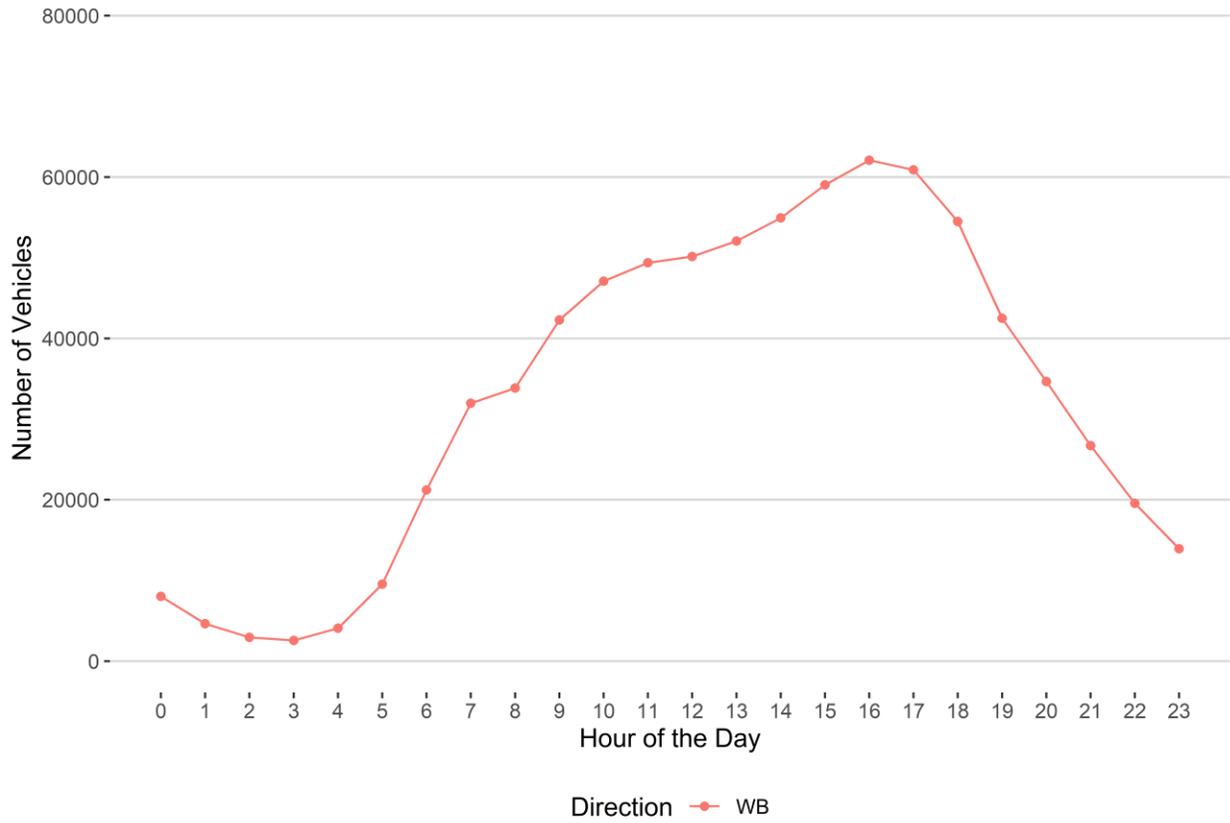


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

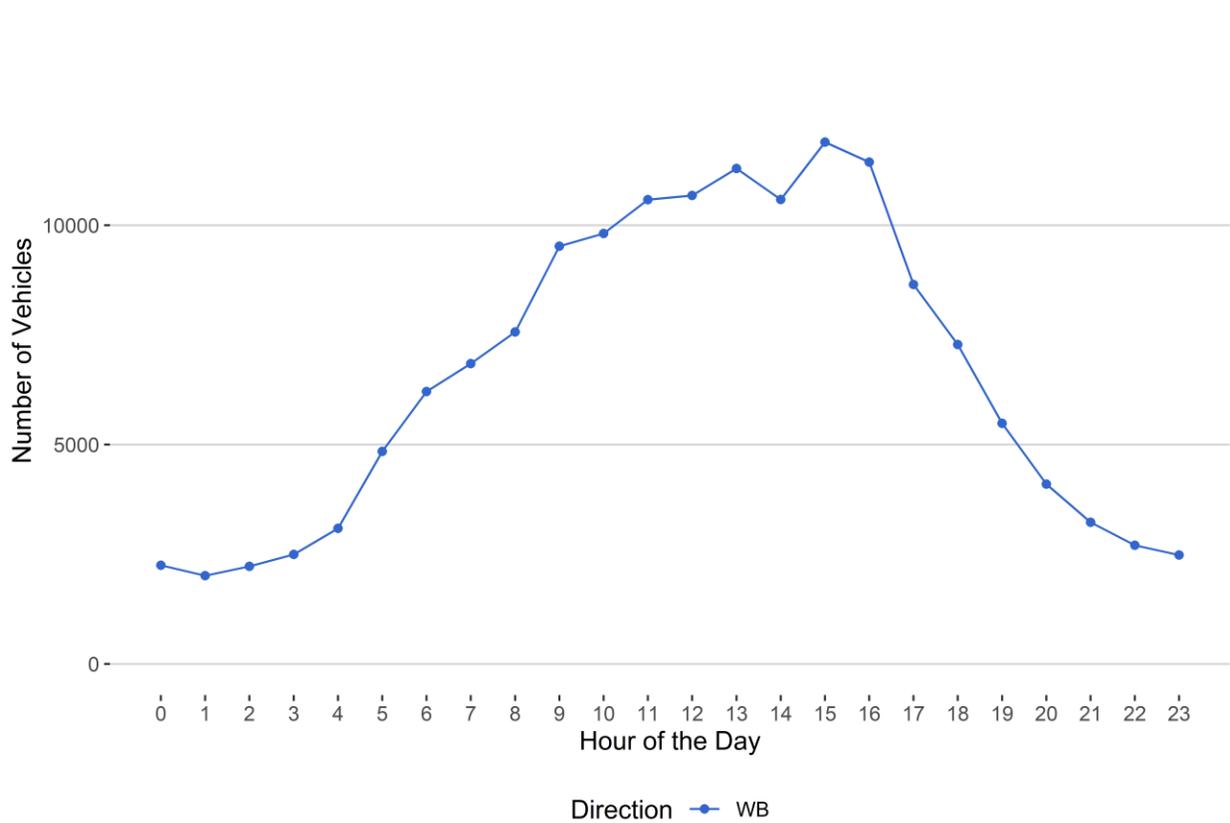


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

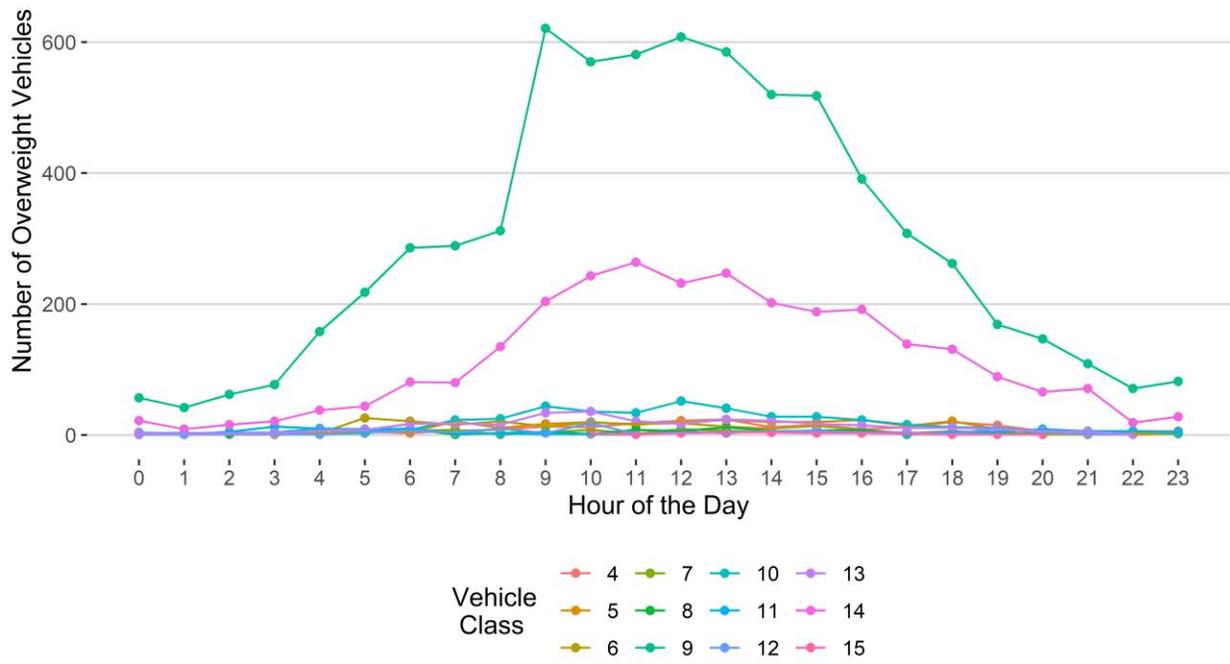


Figure 7 - Overweight Vehicles by Direction  
Hour of the Day

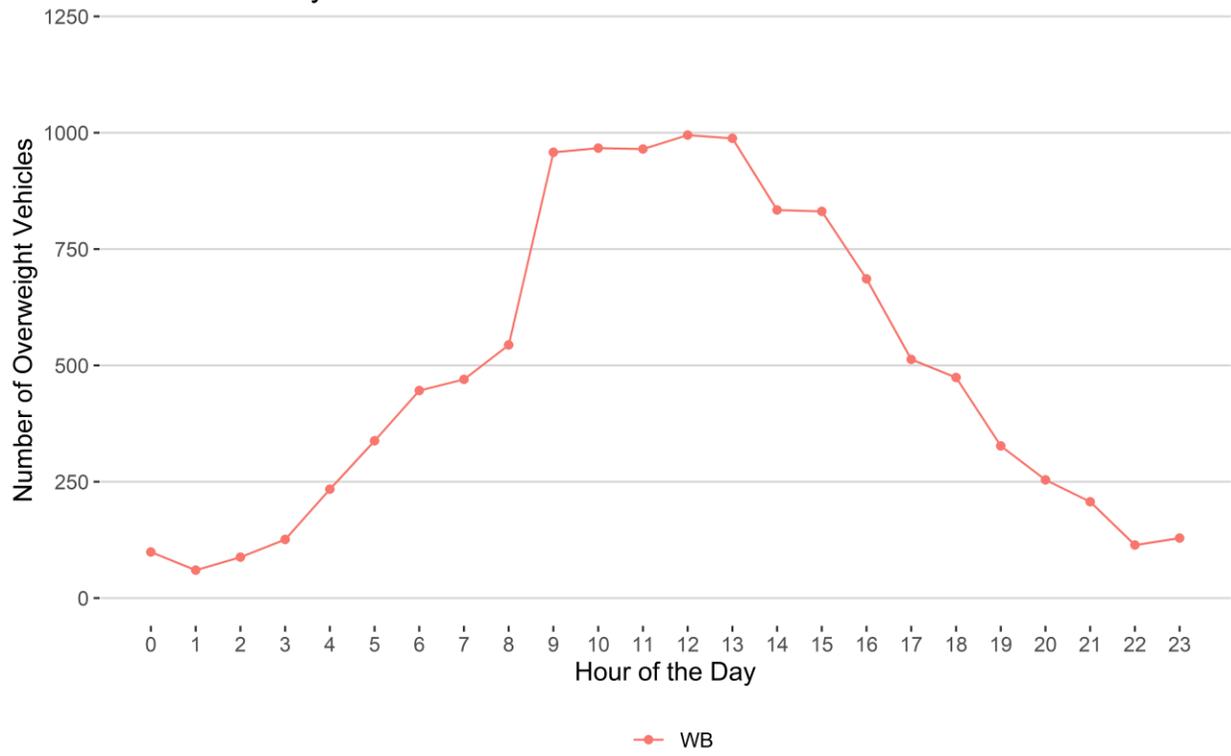
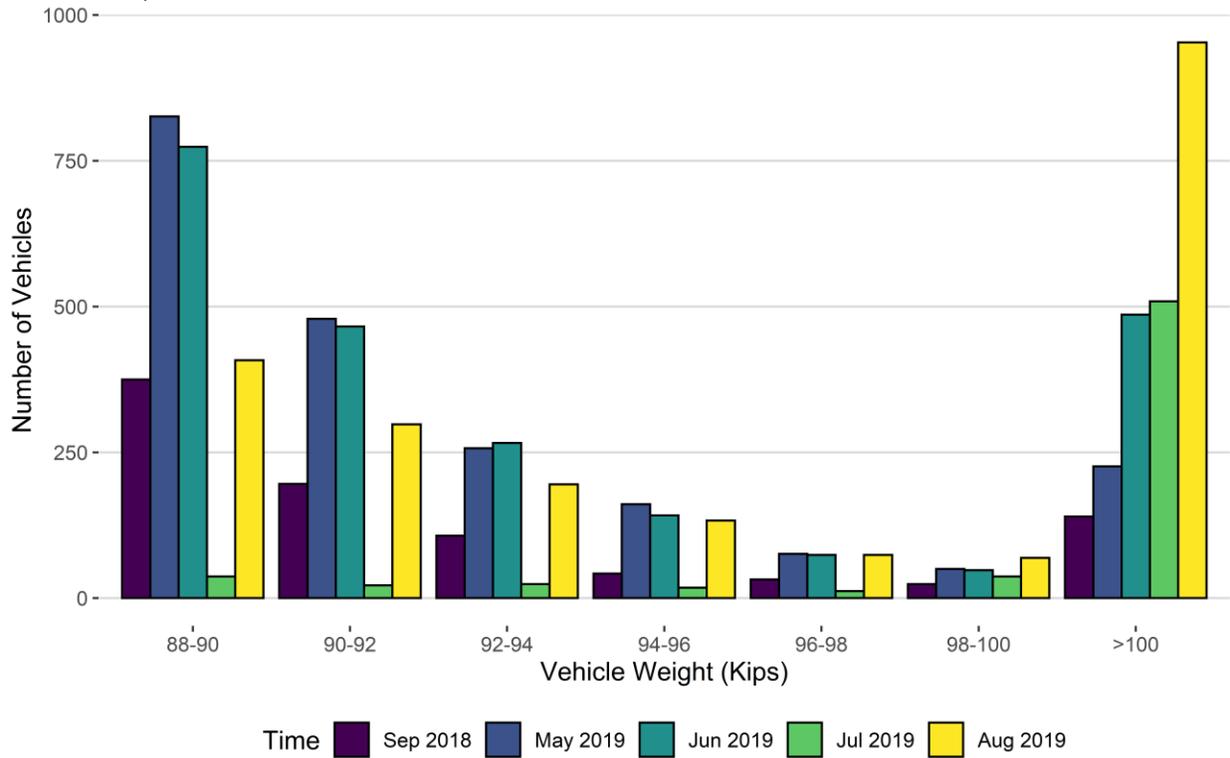


Figure 8 - Histogram of Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Sep 2018	May 2019	Jun 2019	Jul 2019	Aug 2019
88-90	375	826	774	37	408
90-92	196	479	466	22	298
92-94	107	257	266	24	195
94-96	42	161	142	18	133
96-98	32	76	74	12	74
98-100	24	50	48	37	69
>100	140	226	486	509	953
<b>Total</b>	<b>916</b>	<b>2075</b>	<b>2256</b>	<b>659</b>	<b>2130</b>

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

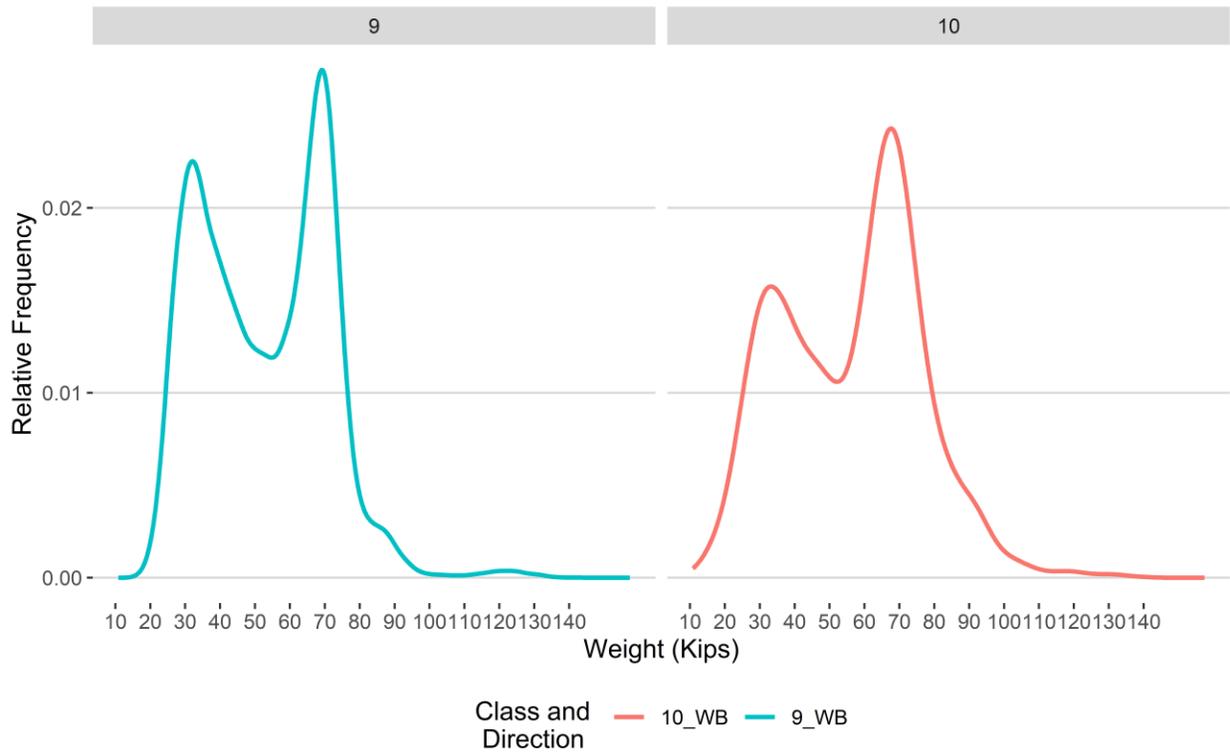


Figure 9 - Freight Percentage by Direction and Class

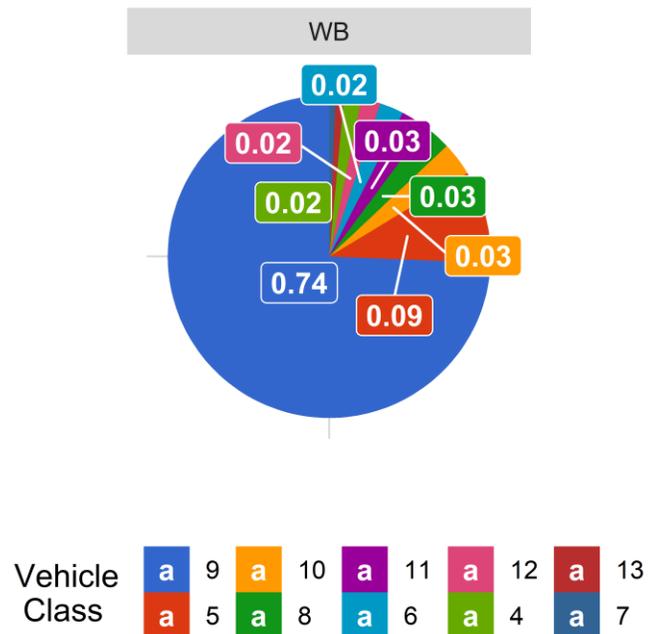


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

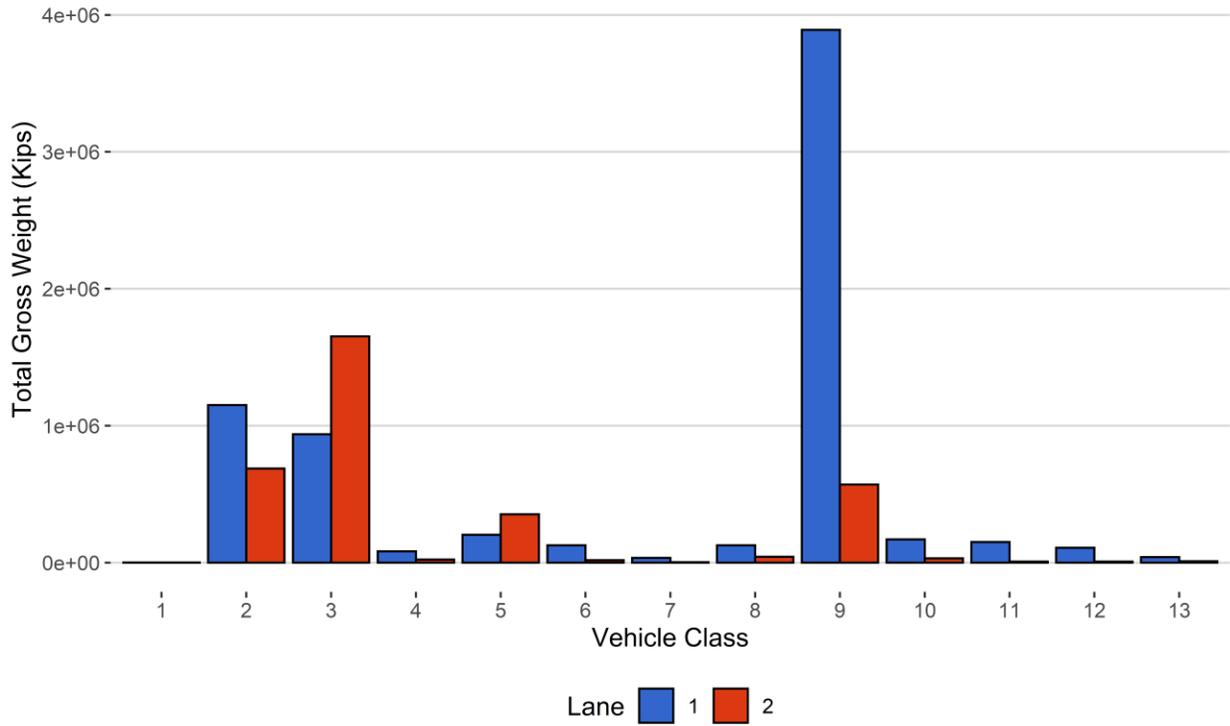


Figure 11 - Total Gross Vehicle Weight t

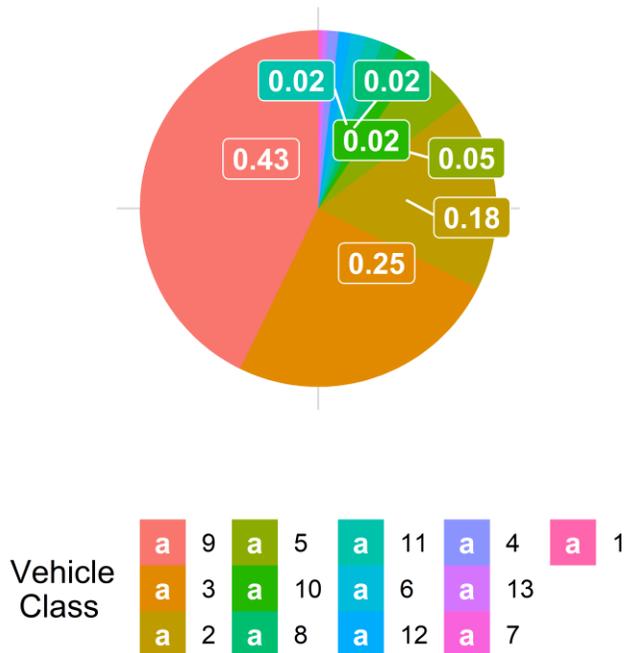


Figure 12 - Total ESALs by Class and Lane

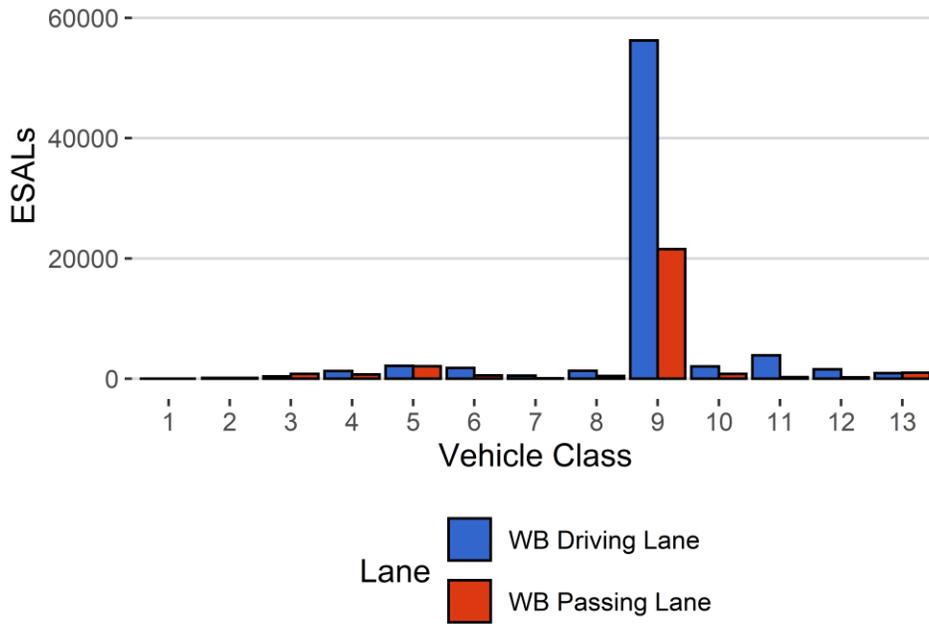
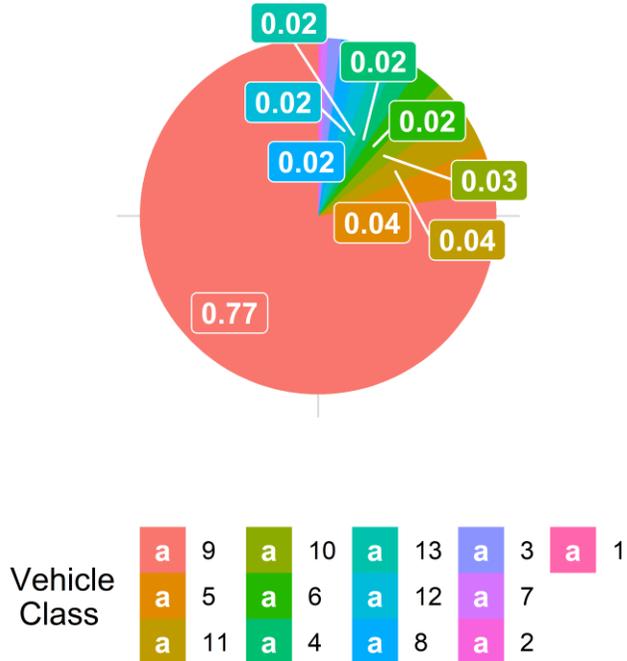


Figure 13 - ESALs by Class



**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	-0.90	12.28	4.18
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
May 2019	10.53	-0.10	12.28	4.19
June 2019	10.55	0.07	12.14	3.04
July 2019	10.52	-0.26	16.99	44.14
August 2019	10.56	0.15	16.65	41.29

**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	16520	512111	44.7	0	0
3	14368	445411	38.8	0	0
4	148	4582	0.4	232	2.6
5	1895	58742	5.1	271	3.1
6	183	5664	0.5	222	2.5
7	31	962	0.1	70	0.8
8	233	7208	0.6	83	0.9
9	3279	101656	8.9	7043	79.5
10	138	4272	0.4	426	4.8
11	98	3026	0.3	118	1.3
12	72	2222	0.2	97	1.1
13	20	616	0.1	300	3.4
<b>TOTAL</b>	<b>36987</b>	<b>1146585</b>	<b>100</b>	<b>8862</b>	<b>100</b>

**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>
2019-08-08	Thursday	10:03:48	10	WB	2	168.63
2019-08-14	Wednesday	09:50:48	10	WB	2	167.71
2019-08-01	Thursday	11:08:02	10	WB	2	165.79
2019-08-14	Wednesday	09:42:03	10	WB	2	165.77
2019-08-14	Wednesday	09:19:43	10	WB	2	165.17
2019-08-02	Friday	07:16:07	9	WB	2	164.65
2019-08-14	Wednesday	08:09:21	10	WB	2	164.21
2019-08-09	Friday	11:57:05	10	WB	2	163.01
2019-08-13	Tuesday	10:28:06	9	WB	2	162.56
2019-08-14	Wednesday	07:40:26	10	WB	2	162.54

**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	3814	434	11.4	97808	5698	23554
5	WB	8	48897	9255	18.9	490204	66380	86534
6	WB	19	4715	333	7.1	138003	5730	27373
7	WB	11.5	801	2	0.2	38025	19	14418
8	WB	31	6000	3701	61.7	89035	79975	8883
9	WB	33	84618	15814	18.7	4012290	449128	870879
10	WB	33.5	3556	615	17.3	184171	16837	42824
11	WB	36.5	2519	70	2.8	156624	1735	33618
12	WB	36.5	1850	25	1.4	115397	743	24392
13	WB	31.5	513	4	0.8	50241	113	17104
<b>TOTAL</b>	<b>****</b>	<b>****</b>	<b>157283</b>	<b>30253</b>	<b>****</b>	<b>5371798</b>	<b>****</b>	<b>1149578</b>

**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	70	51	121	0
2	1150534	687497	1838031	17.6
3	937031	1652427	2589458	24.8
4	81900	21606	103506	1
5	203152	353432	556584	5.3
6	126570	17163	143733	1.4
7	35073	2970	38043	0.4
8	126573	42437	169010	1.6
9	3890862	570557	4461418	42.8
10	169248	31760	201008	1.9
11	150672	7687	158359	1.5
12	108495	7646	116140	1.1
13	40750	9604	50354	0.5
<b>TOTAL</b>	<b>7020932</b>	<b>3404835</b>	<b>10425767</b>	<b>100</b>
<b>GVW/LANE</b>	<b>67.34</b>	<b>32.66</b>	<b>100</b>	<b>0</b>

**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	0.0106
2	148	127	275	0.3	0.0013
3	394	792	1186	1.2	0.0064
4	1284	700	1984	2	1.04
5	2137	2070	4207	4.2	0.17
6	1783	567	2350	2.3	1
7	537	73	610	0.6	1.52
8	1326	451	1776	1.8	0.59
9	56226	21559	77785	77.1	1.84
10	2034	805	2839	2.8	1.6
11	3878	272	4150	4.1	3.29
12	1578	242	1820	1.8	1.96
13	937	984	1921	1.9	7.33
<b>TOTAL</b>	<b>72262</b>	<b>28640</b>	<b>100902</b>	<b>100</b>	<b>20</b>
<b>ESALS/LANE</b>	<b>71.6</b>	<b>28.4</b>	<b>100</b>	<b>-</b>	<b>-</b>

**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	762407	31767	2952	673849	88.4	88558.1	11.6
May 2019	1067629	34440	4742	920637	86.2	146992	13.8
Jun 2019	1087979	36266	4537	951857	87.5	136122.2	12.5
Jul 2019	1118854	36266	5311	954202	85.3	164652.3	14.7
Aug 2019	1146585	36987	6095	957633	83.5	188951.7	16.5
<b>TOTAL</b>	<b>5183454</b>	-	-	<b>4458178</b>	-	<b>725276</b>	-
<b>AVERAGE</b>	<b>1036691</b>	<b>35145</b>	<b>4727</b>	<b>891636</b>	<b>86</b>	<b>145055</b>	<b>14</b>

###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 2018	39826	23509	63334	1.2
May 2019	68732	35483	104215	0.8
Jun 2019	134817	56072	190889	1.3
Jul 2019	69071	60368	129439	1.2
Aug 2019	72413	132894	205307	113.5
<b>TOTAL</b>	<b>384859</b>	-	-	-
<b>AVERAGE</b>	<b>76972</b>	<b>61665</b>	<b>138637</b>	<b>24</b>

###Gross Vehicle Weight

<i>Month</i>	<i>GVW WB Driving Lane</i>	<i>GVW WB Passing Lane</i>	<i>Total GVW Kips</i>
Sep 2018	6660185	4283216	10943402
May 2019	13081229	7191816	20273044
Jun 2019	6767177	2739319	9506497
Jul 2019	7029325	3680142	10709467
Aug 2019	3908977	3125851	7034828
<b>TOTAL</b>	<b>37446893</b>	<b>21020344</b>	<b>58467237</b>
<b>AVERAGE</b>	<b>7489379</b>	<b>4204069</b>	<b>11693447</b>

###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	7285	1	8.6	920	165
May 2019	11556	1.1	8	2156	290
Jun 2019	18260	0.9	6.6	2874	588

Jul 2019	6992	0.8	4.8	1250	1054
Aug 2019	11623	1.2	7.2	3322	2060
<b>TOTAL</b>	<b>55716</b>	<b>-</b>	<b>-</b>	<b>10522</b>	<b>4157</b>
<b>AVERAGE</b>	<b>11143.2</b>	<b>1</b>	<b>7</b>	<b>2104.4</b>	<b>831.4</b>

###Freight

<i>Month</i>	<i>WB Freight Tons</i>
Sep 2018	748630
May 2019	1230391
Jun 2019	2139776
Jul 2019	948115
Aug 2019	1149578
<b>TOTAL</b>	<b>6216490</b>
<b>AVERAGE</b>	<b>1243298</b>