

MARCH 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 March 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: 876141 | Passenger Vehicles: 793638 | Heavy Commercial Vehicles: 82503

Monthly Average Daily Traffic (MADT): 28263 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 2661

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 9's and Class 5's.

### Overweight HCVs

**Volume trends.** Of a total of 82503 HCVs, 7669 of them were overweight <sup>3</sup>. These overweight HCVs contributed to 1% of total monthly volume, and 10.2% of total monthly HCV volume. WB overweight vehicles typically reached highest numbers on Tuesdays, 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 <sup>4</sup>.

Using normal load limits ,2347 WB vehicles exceeded 88,000 pounds (1889 vehicles were Class 9's; 344 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from March 2019.

**Loaded vs. Unloaded HCVs.** Figure 10 shows the GVW distributions of Class 9's and 10's in March 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 664322 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 876141 vehicles with a combined GVW of 6988041 kips (1 kip = 1,000 pounds = 0.5 tons) in March 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

**Pavement Design.** A total of 64402 equivalent single axle loads (ESALs) passed over the pavement at this site. In particular, 74% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 35% 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>*

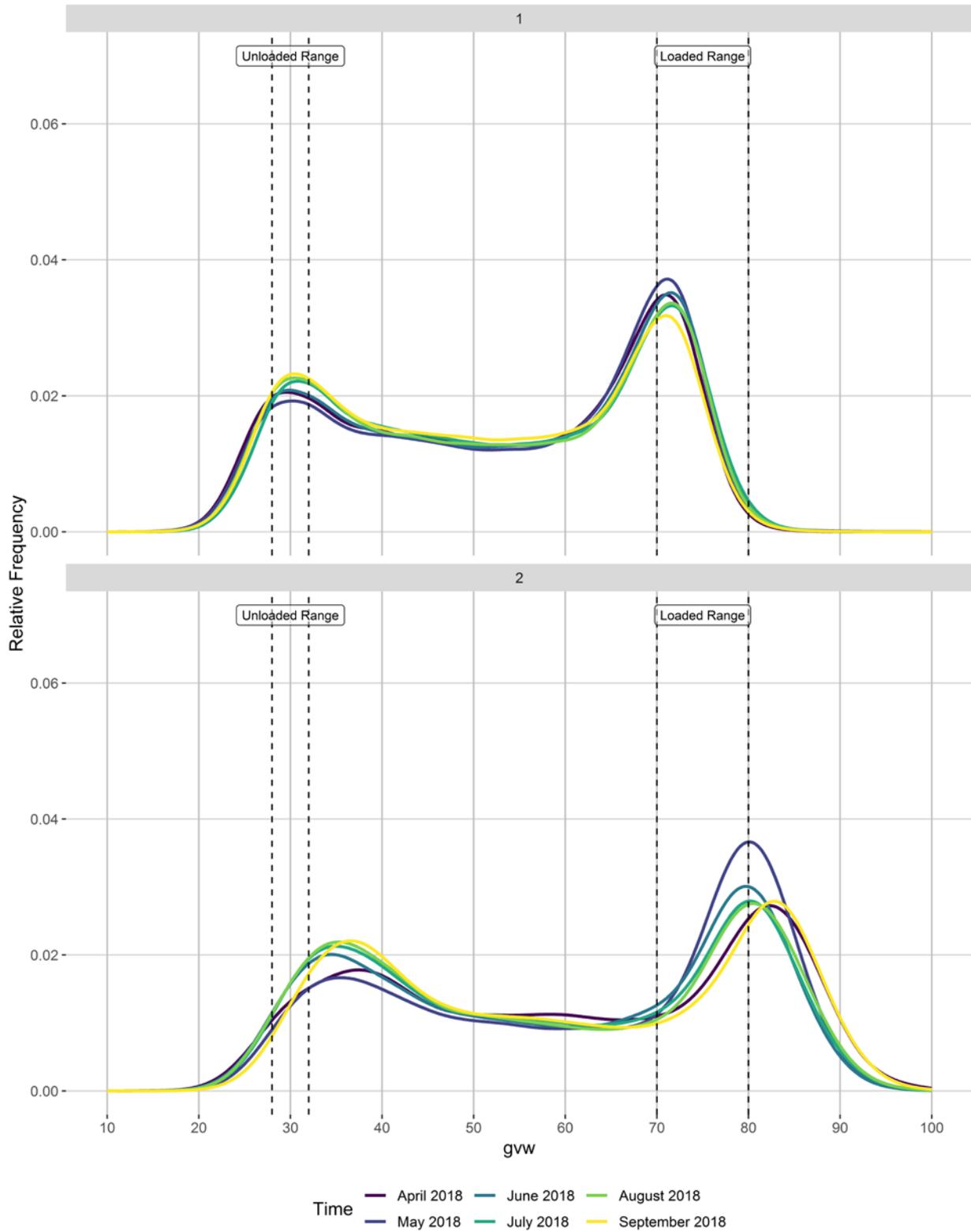
MnDOT's vehicle classification scheme and vehicle class groupings for traffic forecasting can be found at: <http://www.dot.state.mn.us/traffic/data/data-products.html#weight>

- <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.

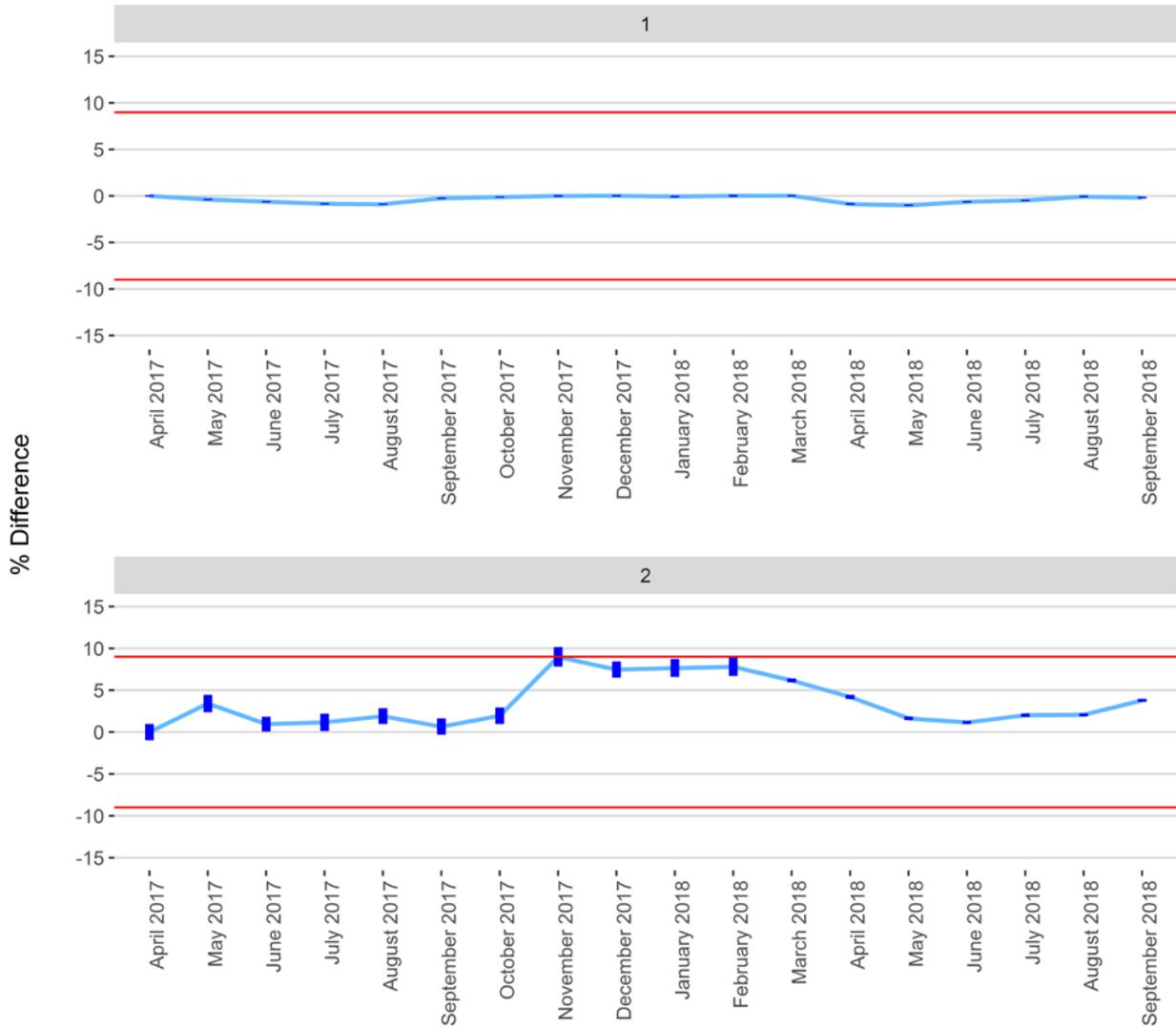
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Figure 1 - Monthly Class 9 GVW Histogram



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

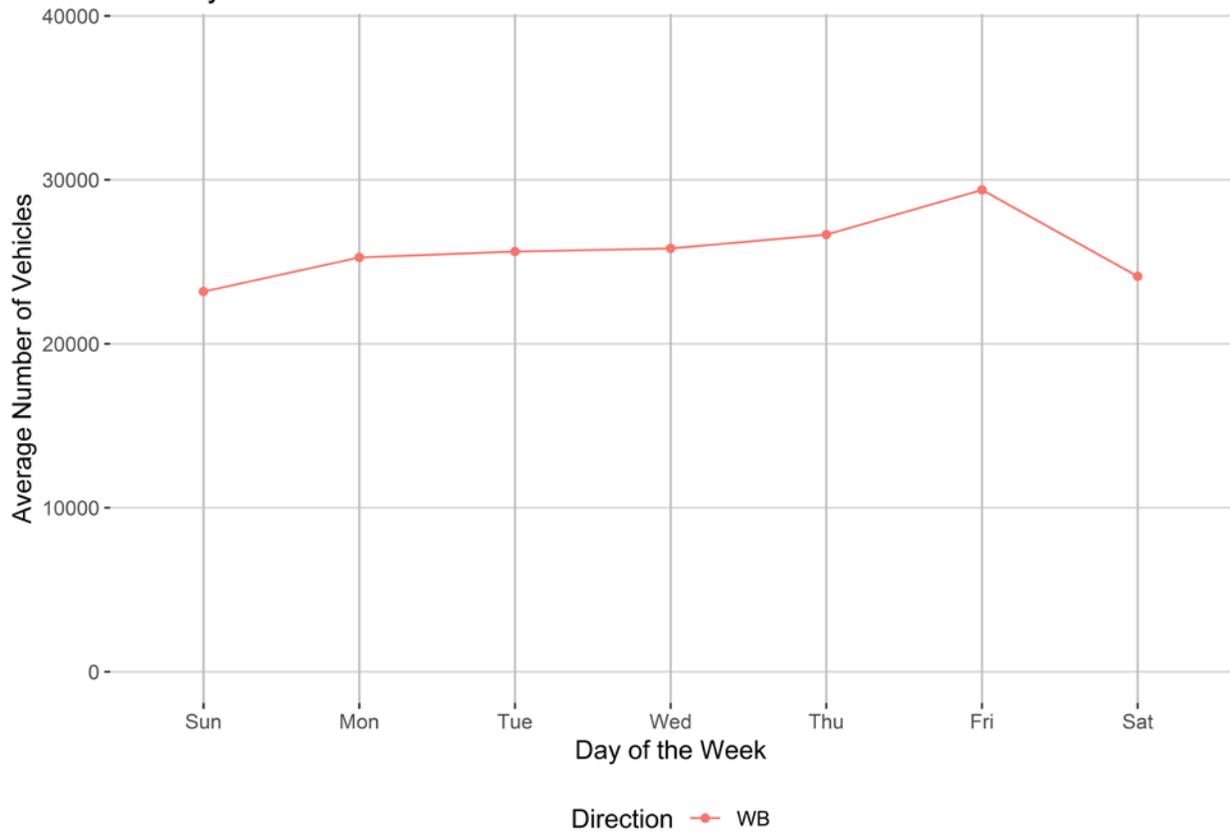


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

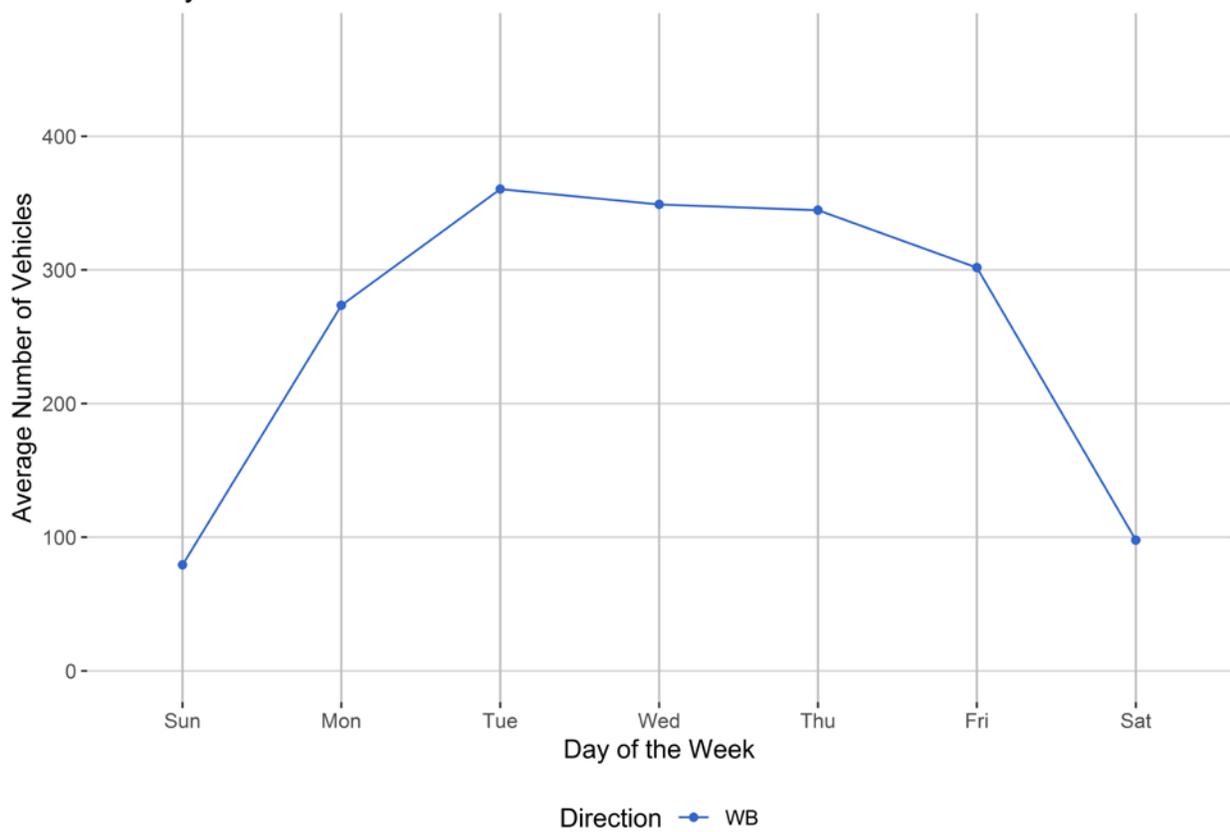


Figure 4 - Passenger Vehicles vs. Hour of the Day

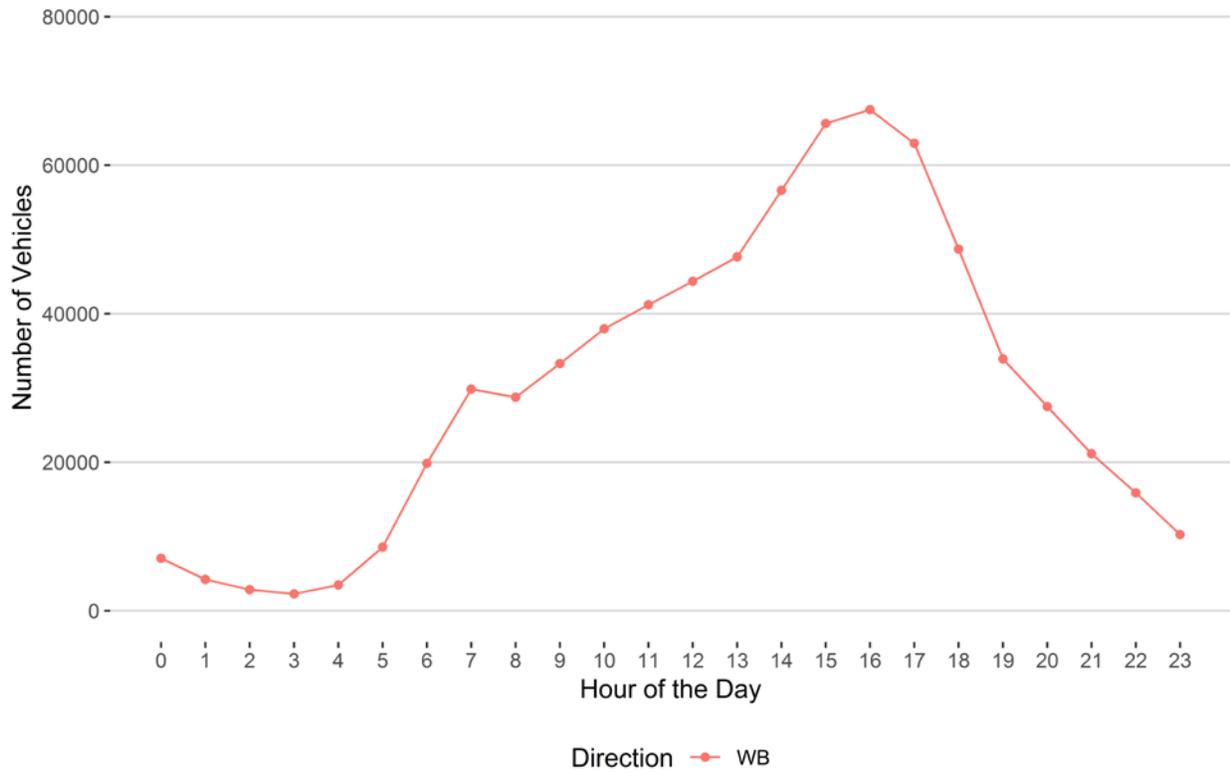


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

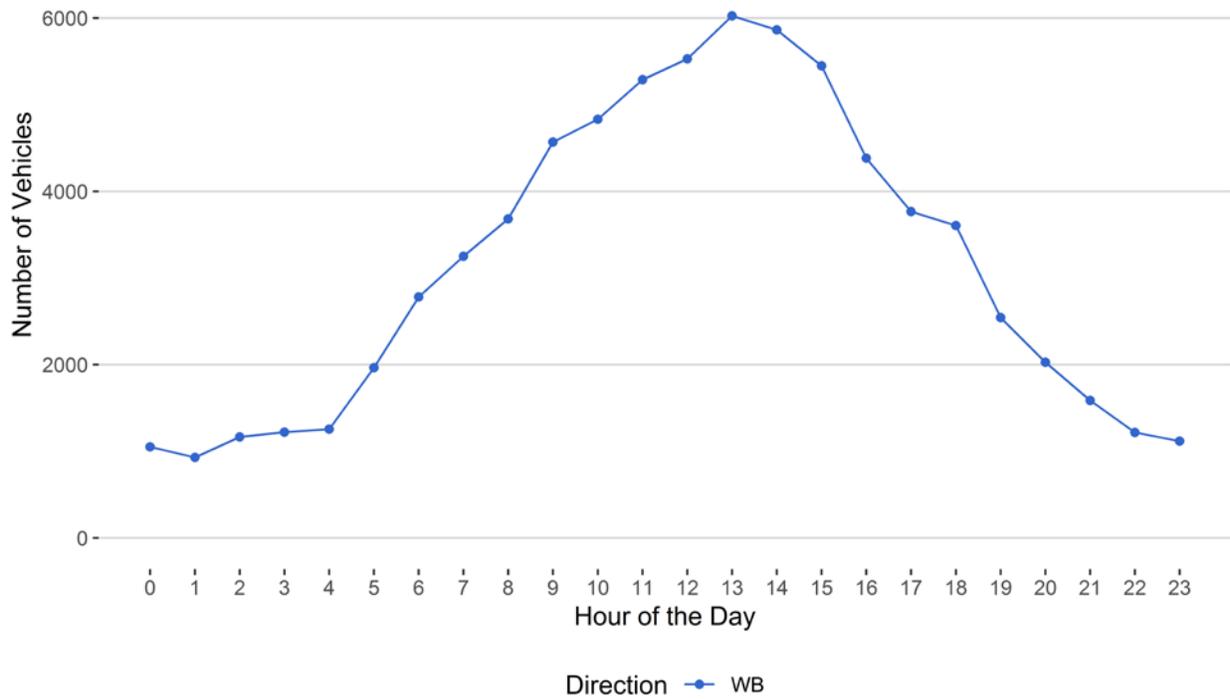


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

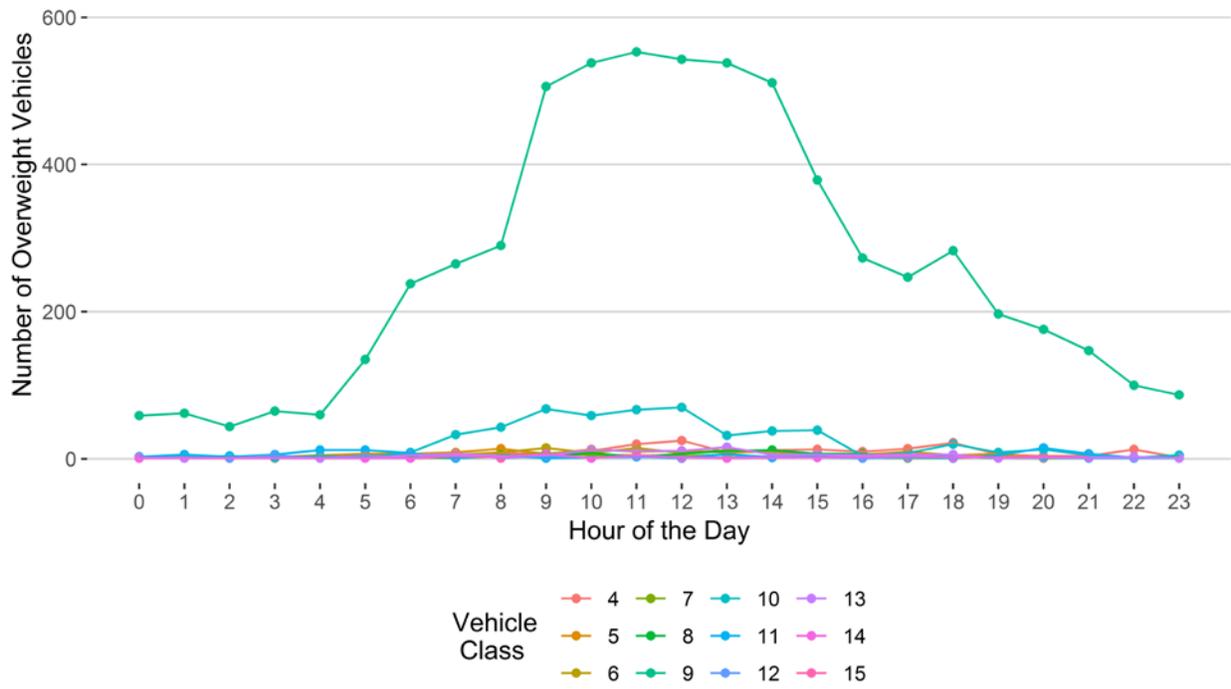


Figure 7 - Overweight Vehicles by Direction  
Hour of the Day

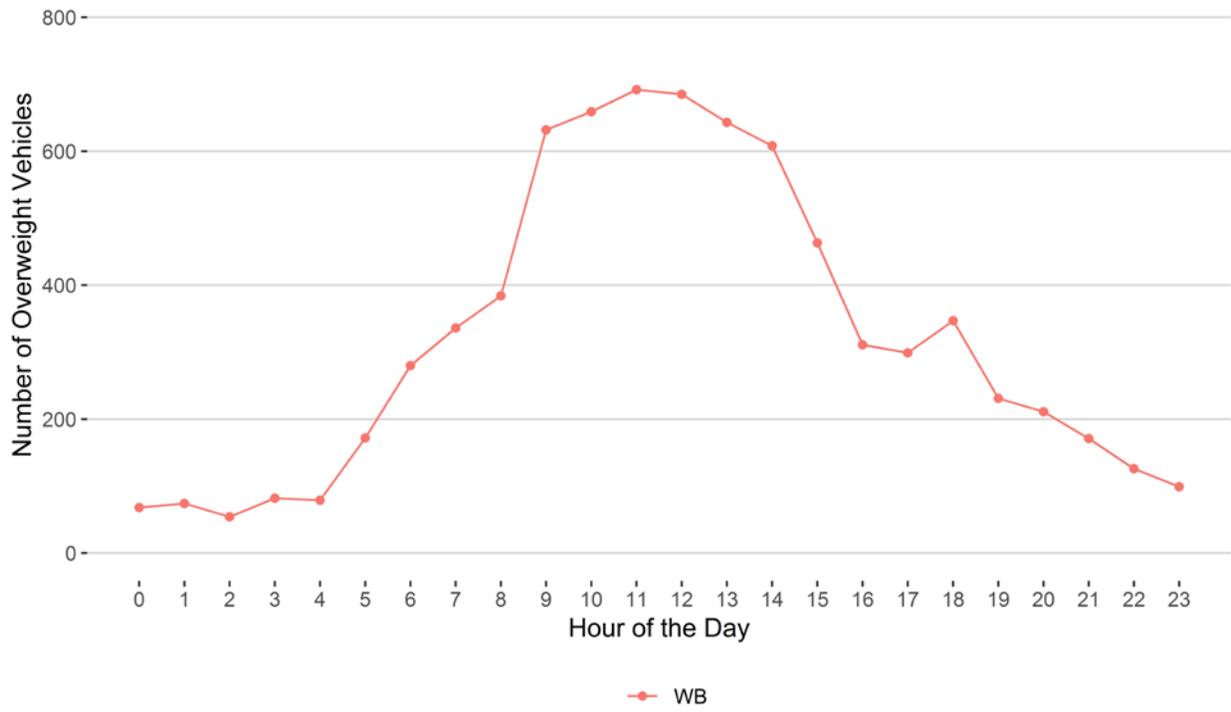
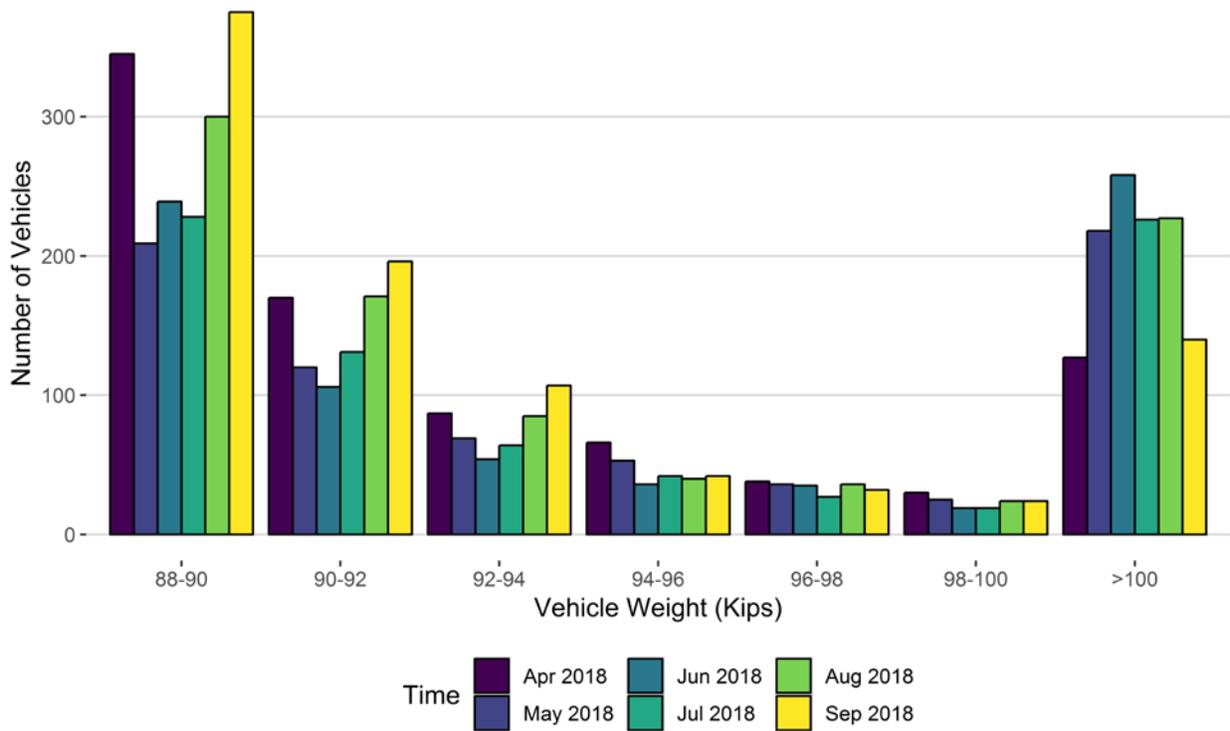


Figure 8 - Histogram of Vehicles Over 88,000 Pounds for Current Month



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

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

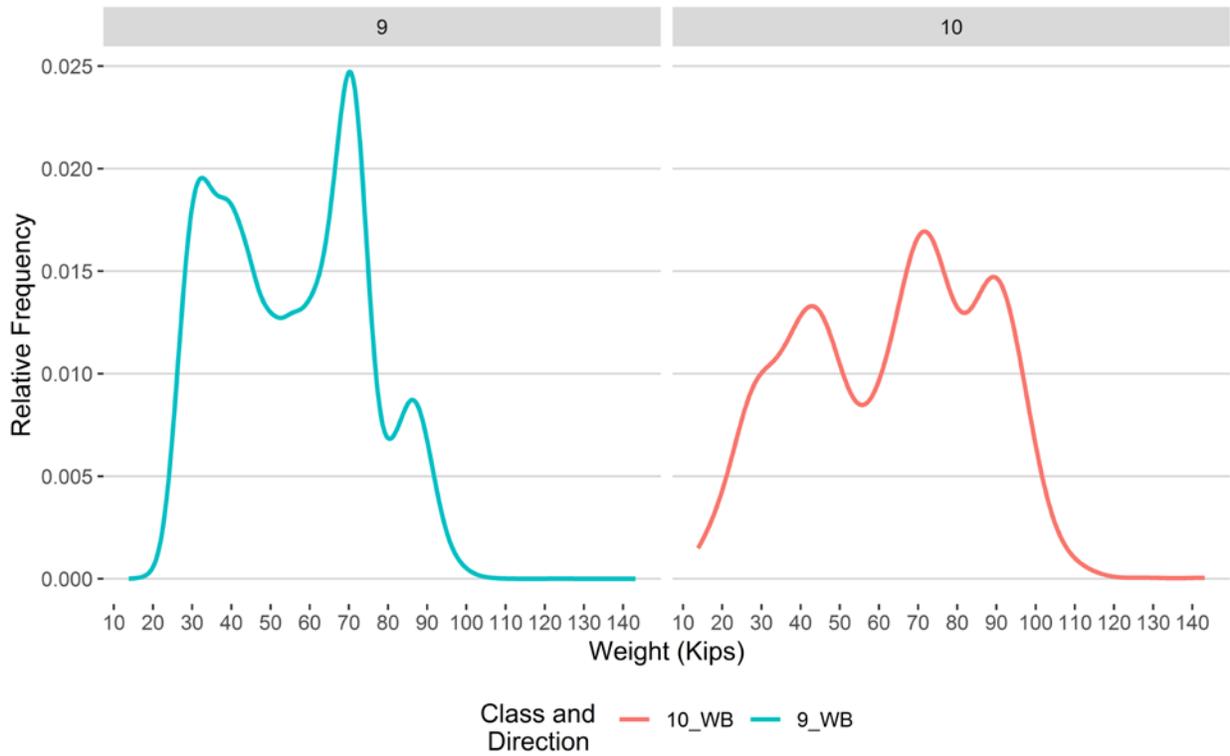


Figure 9 - Freight Percentage by Direction and Class

WB

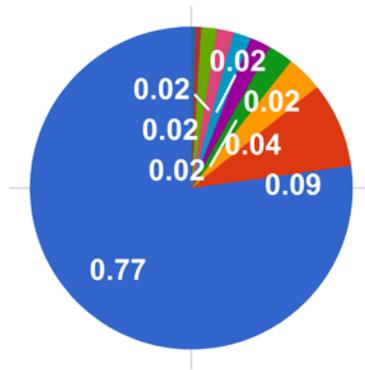


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

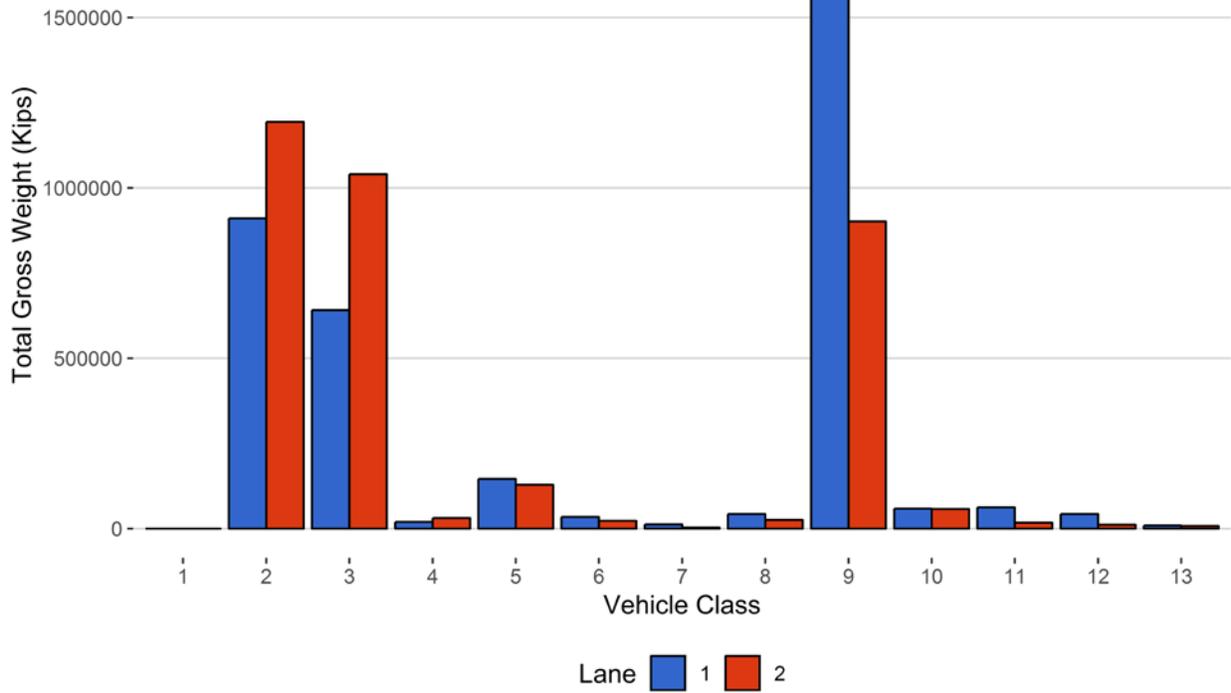
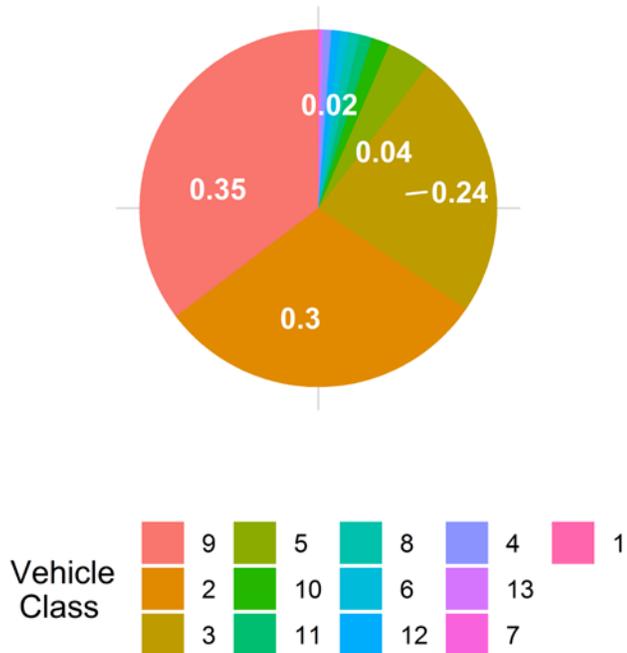


Figure 11 - Total Gross Vehicle Weight t





**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	1	18	0	0	0
2	16841	522085	59.6	0	0
3	8759	271535	31	0	0
4	66	2043	0.2	193	2.5
5	726	22502	2.6	141	1.8
6	67	2086	0.2	114	1.5
7	9	292	0	39	0.5
8	78	2432	0.3	78	1
9	1570	48673	5.6	6296	82.1
10	65	2005	0.2	537	7
11	44	1365	0.2	108	1.4
12	29	908	0.1	55	0.7
13	6	197	0	108	1.4
<b>TOTAL</b>	<b>28263</b>	<b>876141</b>	<b>100</b>	<b>7669</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>
2019-03-27	Wednesday	13:40:54	9	WB	2	152.02
2019-03-01	Friday	20:51:59	10	WB	2	143.18
2019-03-15	Friday	20:42:35	10	WB	2	128.49
2019-03-19	Tuesday	04:53:20	9	WB	2	125.5
2019-03-18	Monday	17:04:19	9	WB	1	122.76
2019-03-02	Saturday	14:48:46	10	WB	2	121.44
2019-03-05	Tuesday	21:04:21	9	WB	1	119.38
2019-03-03	Sunday	21:59:17	10	WB	1	119.15
2019-03-01	Friday	06:38:03	10	WB	1	118.15
2019-03-04	Monday	19:45:40	10	WB	2	116.64

**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	1860	229	12.3	47369	3078	11452
5	WB	8	20484	1250	6.1	264689	9160	55408
6	WB	19	1899	202	10.6	52840	3569	10299
7	WB	11.5	266	0	0	14992	0	5967
8	WB	31	2214	1136	51.3	42846	24813	4714
9	WB	33	44308	6169	13.9	2286926	179816	514170
10	WB	33.5	1825	235	12.9	109377	6171	28056
11	WB	36.5	1243	13	1	79071	360	17088
12	WB	36.5	827	4	0.5	53577	96	11769
13	WB	31.5	179	0	0	16440	0	5401
<b>TOTAL</b>	<b>****</b>	<b>****</b>	<b>75105</b>	<b>9238</b>	<b>****</b>	<b>2968126</b>	<b>****</b>	<b>664322</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	6	15	20	0
2	910424	1193679	2104103	30.1
3	640965	1039843	1680809	24.1
4	19632	30815	50447	0.7
5	145530	128319	273849	3.9
6	33825	22584	56409	0.8
7	11970	3022	14992	0.2
8	42449	25210	67659	1
9	1565113	901629	2466742	35.3
10	58487	57061	115548	1.7
11	62395	17036	79430	1.1
12	42570	11103	53673	0.8
13	8779	7660	16440	0.2
<b>TOTAL</b>	<b>3542146</b>	<b>3437976</b>	<b>6980122</b>	<b>100</b>
<b>GVW/LANE</b>	<b>50.75</b>	<b>49.25</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	0.0588
2	117	198	315	0.5	0.0013
3	243	495	738	1.2	0.006
4	283	625	908	1.5	0.98
5	1421	958	2379	4	0.23
6	439	538	978	1.6	1.03
7	196	67	262	0.4	1.95
8	549	411	960	1.6	0.87
9	22507	24611	47118	79.4	2.13
10	778	1371	2149	3.6	2.35
11	1600	603	2203	3.7	3.53
12	609	248	857	1.4	2.06
13	184	272	456	0.8	4.82
<b>TOTAL</b>	<b>28926</b>	<b>30397</b>	<b>59323</b>	<b>100</b>	<b>20</b>
<b>ESALS/LANE</b>	<b>48.8</b>	<b>51.2</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>
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
<b>TOTAL</b>	<b>5913295</b>	-	-	<b>5190872</b>	-	<b>722425</b>	-
<b>AVERAGE</b>	<b>985549</b>	<b>33333</b>	<b>3943</b>	<b>865145</b>	<b>88</b>	<b>120404</b>	<b>12</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>
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
<b>TOTAL</b>	<b>387224</b>	-	-	-
<b>AVERAGE</b>	<b>64537</b>	<b>25666</b>	<b>90203</b>	<b>1</b>

## Gross Vehicle Weight

<i>Month</i>	<i>GVW WB Driving Lane</i>	<i>GVW WB Passing Lane</i>	<i>Total GVW Kips</i>
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
<b>TOTAL</b>	<b>34924472</b>	<b>22030020</b>	<b>56954492</b>
<b>AVERAGE</b>	<b>5820745</b>	<b>3671670</b>	<b>9492415</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>
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
<b>TOTAL</b>	<b>53909</b>	<b>-</b>	<b>-</b>	<b>4911</b>	<b>1354</b>
<b>AVERAGE</b>	<b>8984.8</b>	<b>1</b>	<b>7.7</b>	<b>818.5</b>	<b>225.7</b>

## Freight

<i>Month</i>	<i>WB Freight Tons</i>
Apr 2018	950237
May 2018	1252655
Jun 2018	1203088
Jul 2018	1158446
Aug 2018	1105836
Sep 2018	748630
<b>TOTAL</b>	<b>6418893</b>
<b>AVERAGE</b>	<b>1069815.5</b>