

FEBRUARY 2019



**WIM #47
MN 36, MP 202.9
OAK PARK
HEIGHTS, MN**

**MONTHLY
REPORT**

Your Destination... Our Priority



WIM Site Location

WIM #47 is located on MN 36 near Oak Park Heights in Washington county. The WIM is located only on the westbound (WB) side of MN 36, meaning that all data mentioned in this report pertains to WB traffic only (Lanes 1 and 2).

System Operation

WIM #47 was operational for the entire month of February 2019. Volume was computed using all monthly data.

System Calibration

WIM #47 was most recently calibrated on 2018-11-20. 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: 436896 | Passenger Vehicles: 419227 | Heavy Commercial Vehicles: 17669

Monthly Average Daily Traffic (MADT): 15603 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 631

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 Sundays (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 07 AM and 04 PM.

Heavy Commercial Vehicles (HCVs)

Volume trends. On an average 24-hour day, HCVs traveling WB typically reached peak volume levels between 07 AM and 04 PM. See Figure 6. Out of all HCVs, the two highest traffic volumes were generated by Class 5's and Class 15's.

Overweight HCVs

Volume trends. Of a total of 17669 HCVs, 1405 of them were overweight ³. These overweight HCVs contributed to 0.3% of total monthly volume, and 8.2% 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 6 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 November.

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 ,176 WB vehicles exceeded 88,000 pounds (108 vehicles were Class 9's; 41 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 106822 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. 82045 (an extradosed cable stayed) is approximately 1 mile east of WIM #47. WIM #47 recorded a total of 436896 vehicles with a combined GVW of 2464222 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 9993 equivalent single axle loads (ESALs) passed over the pavement at this site. In particular, 52% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 11% 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>

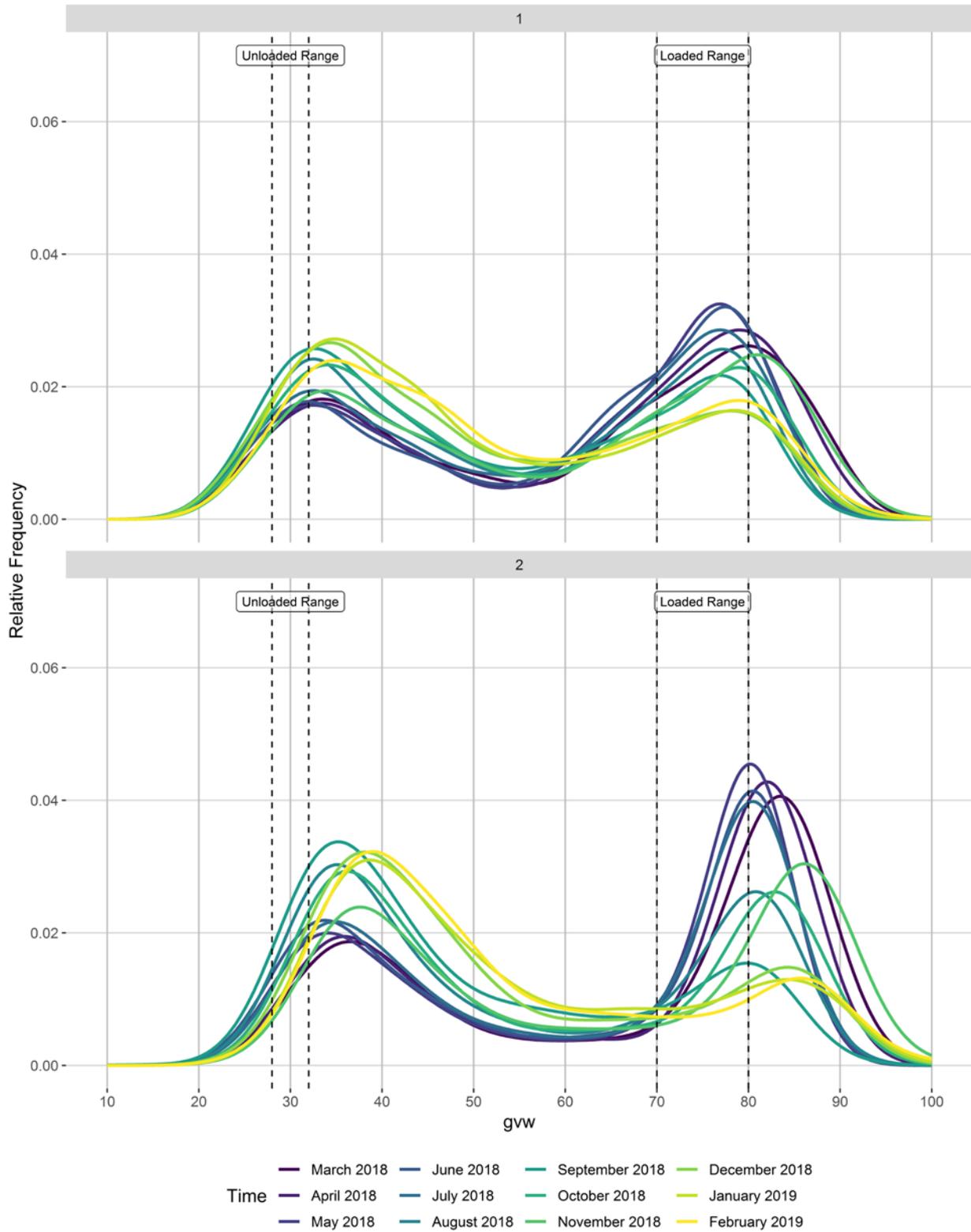
MnDOT's vehicle classification scheme and vehicle class groupings for traffic forecasting can be found at: <http://www.dot.state.mn.us/traffic/data/data-products.html#weight>

- 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.

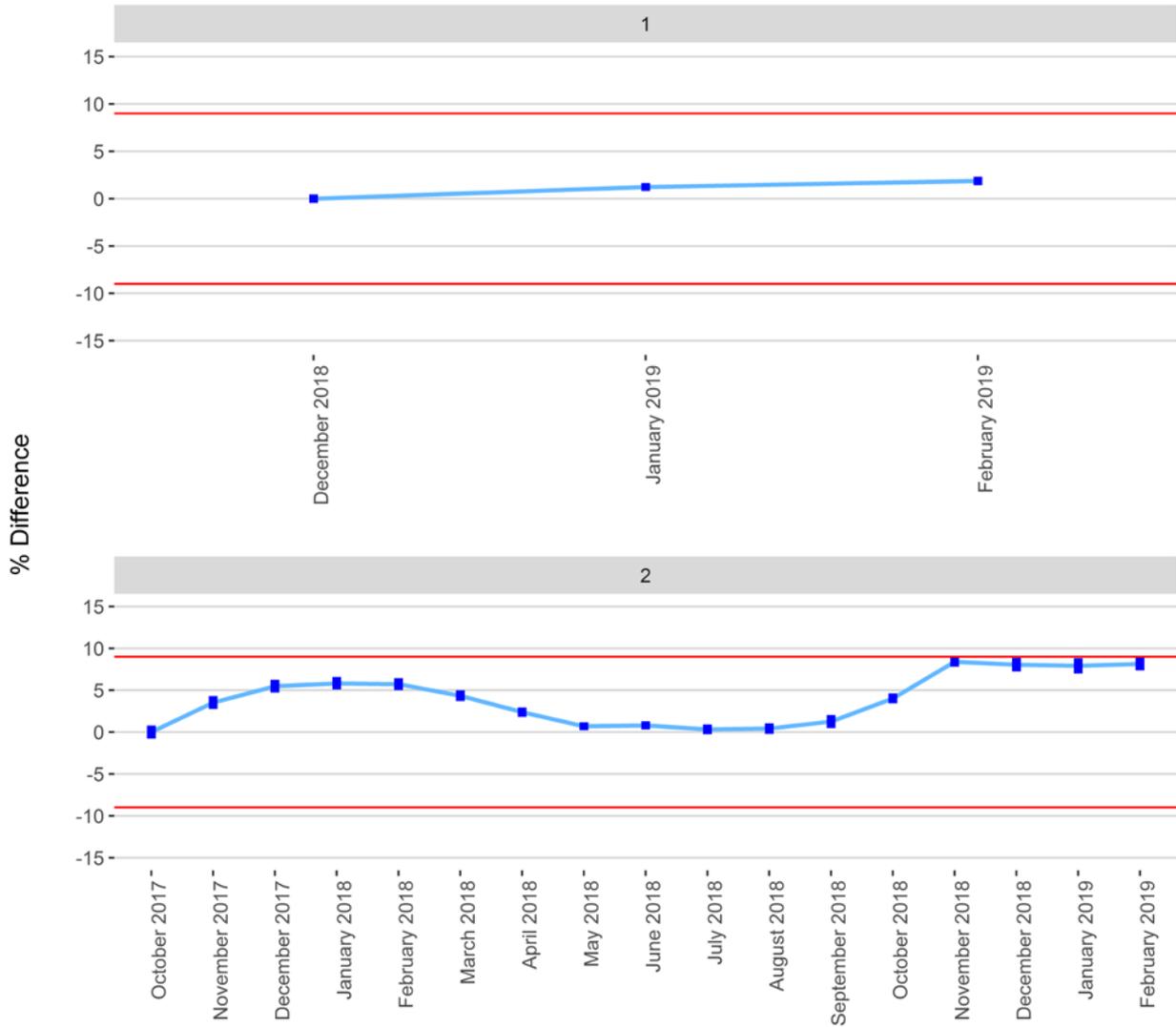
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Figure 1 - Monthly Class 9 GVW Histogram



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

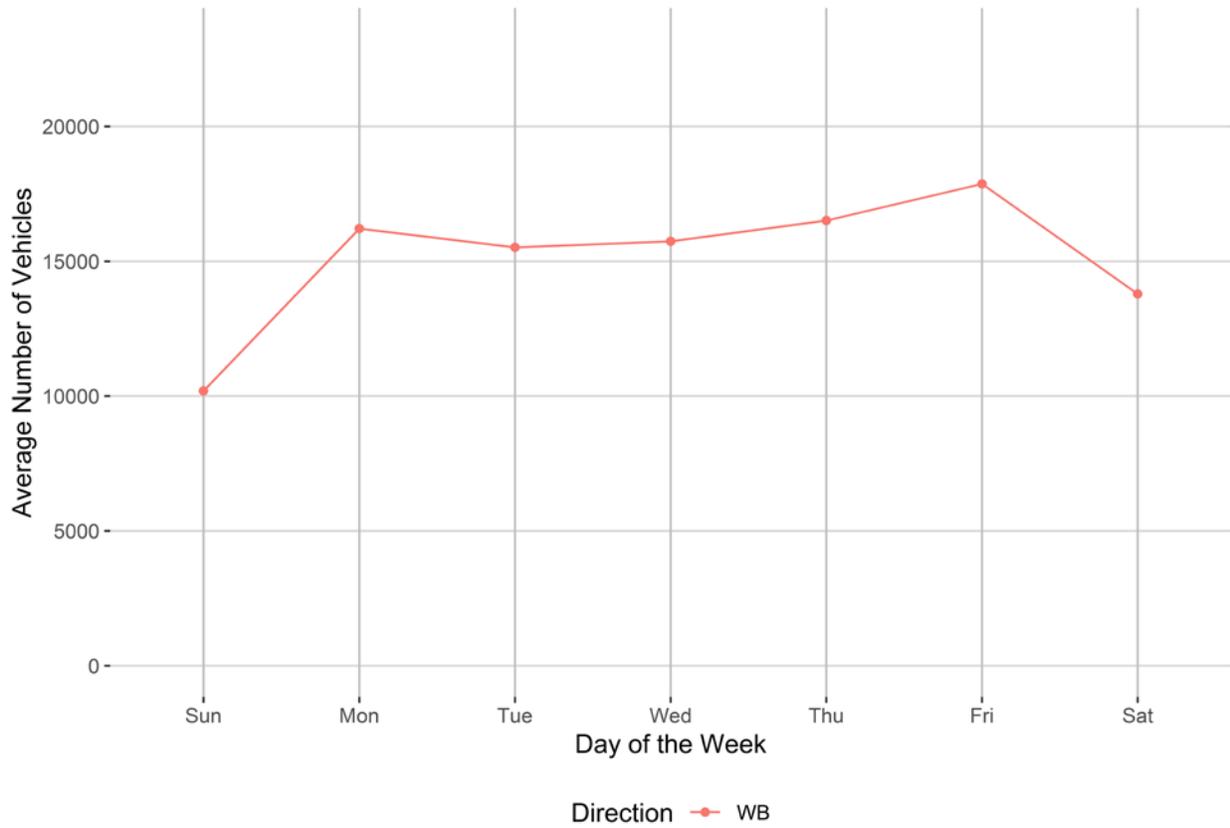


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

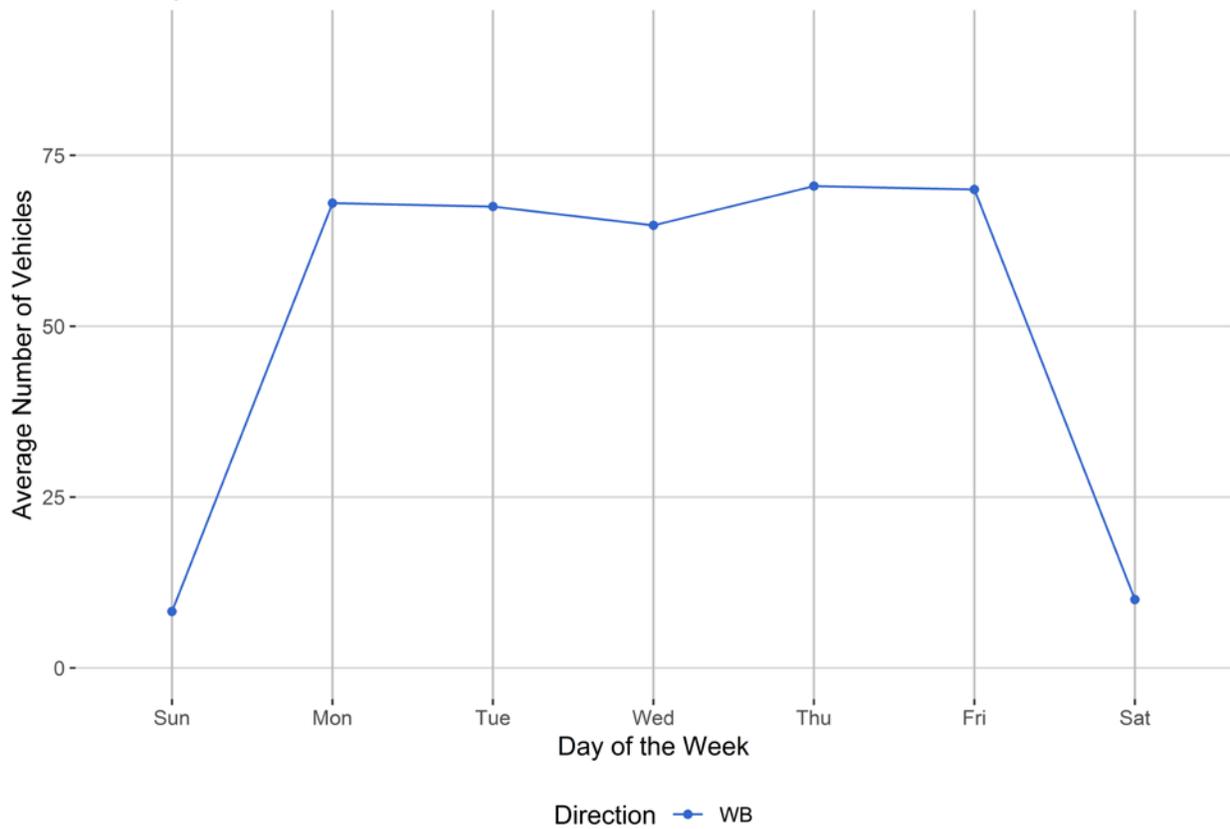


Figure 4 - Passenger Vehicles vs. Hour of the Day

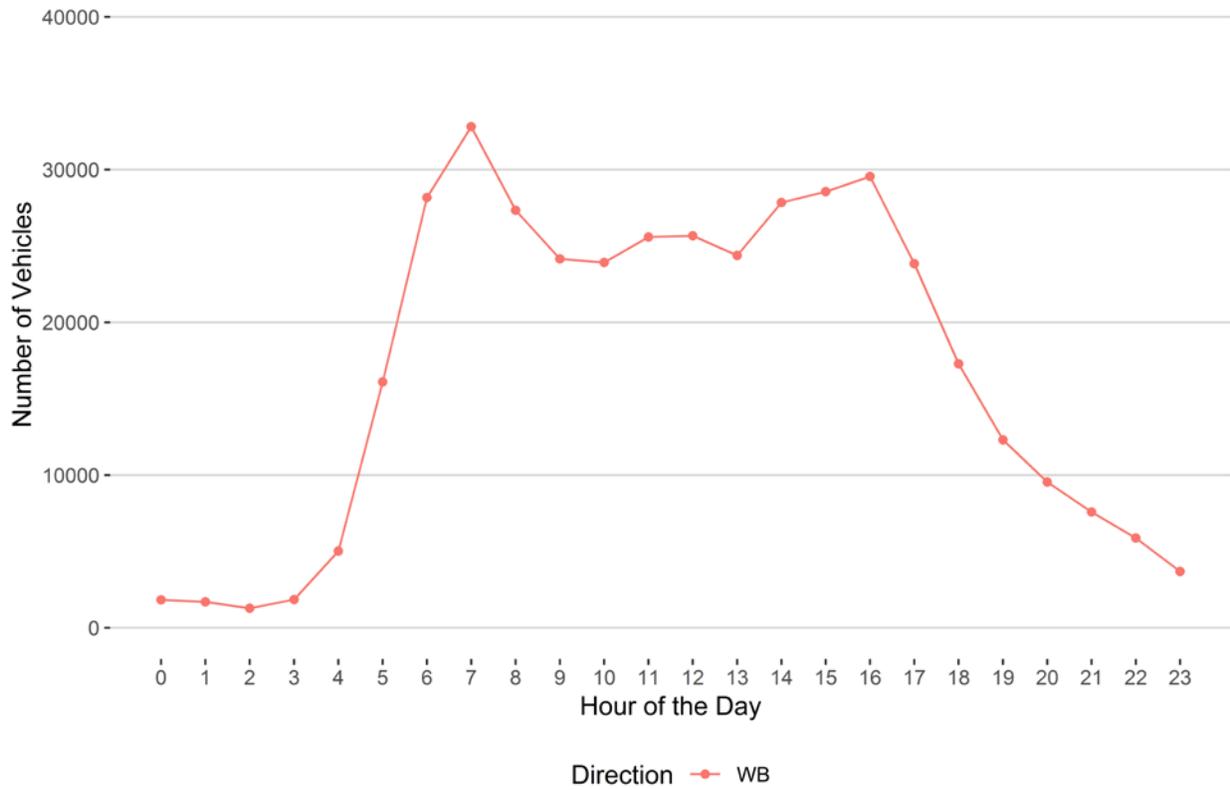


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

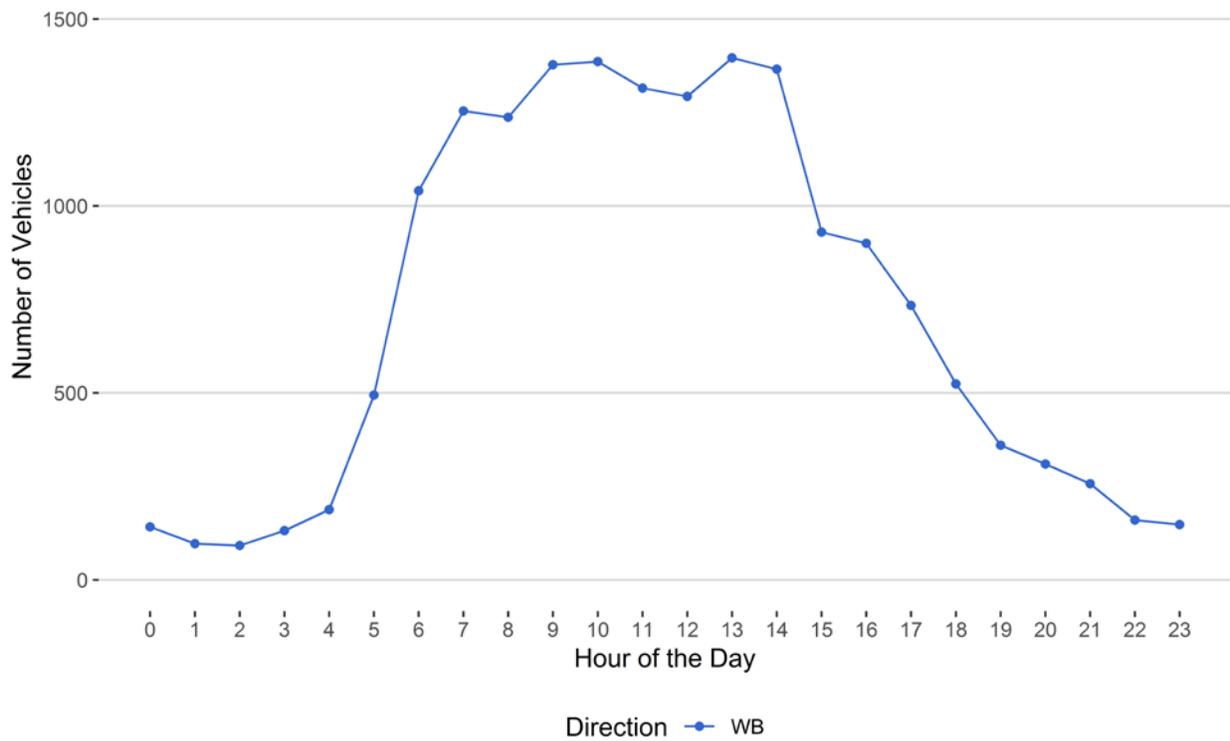


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

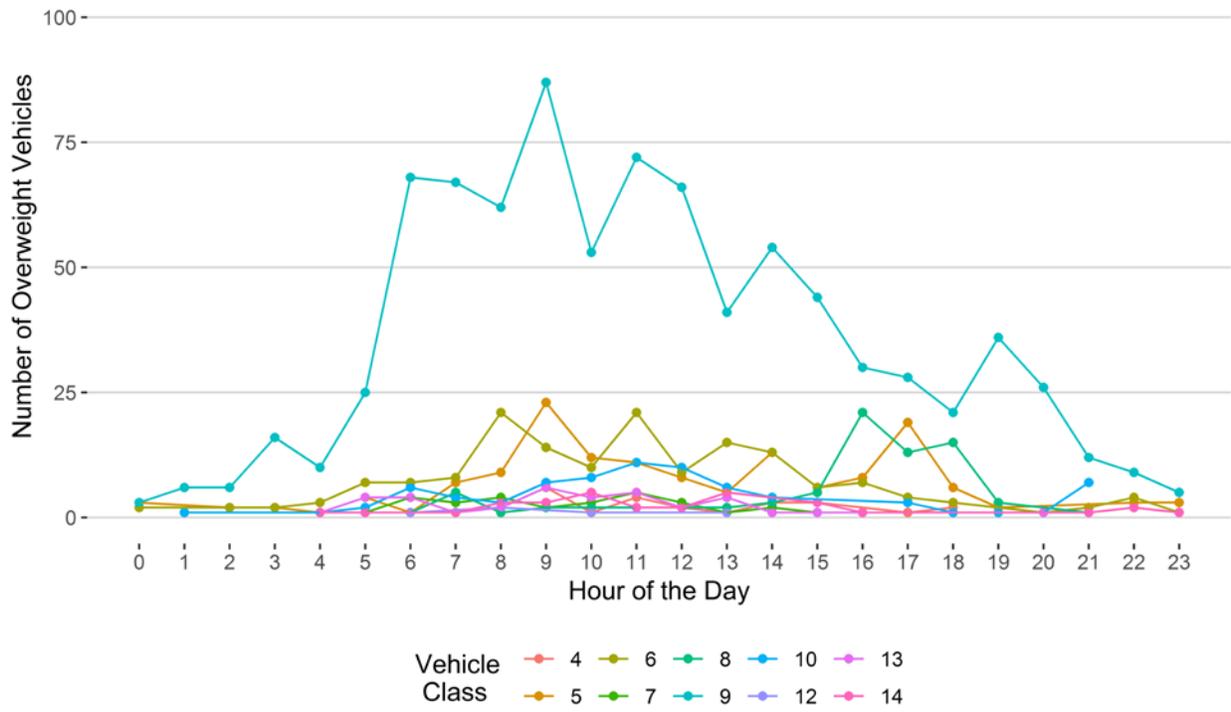


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

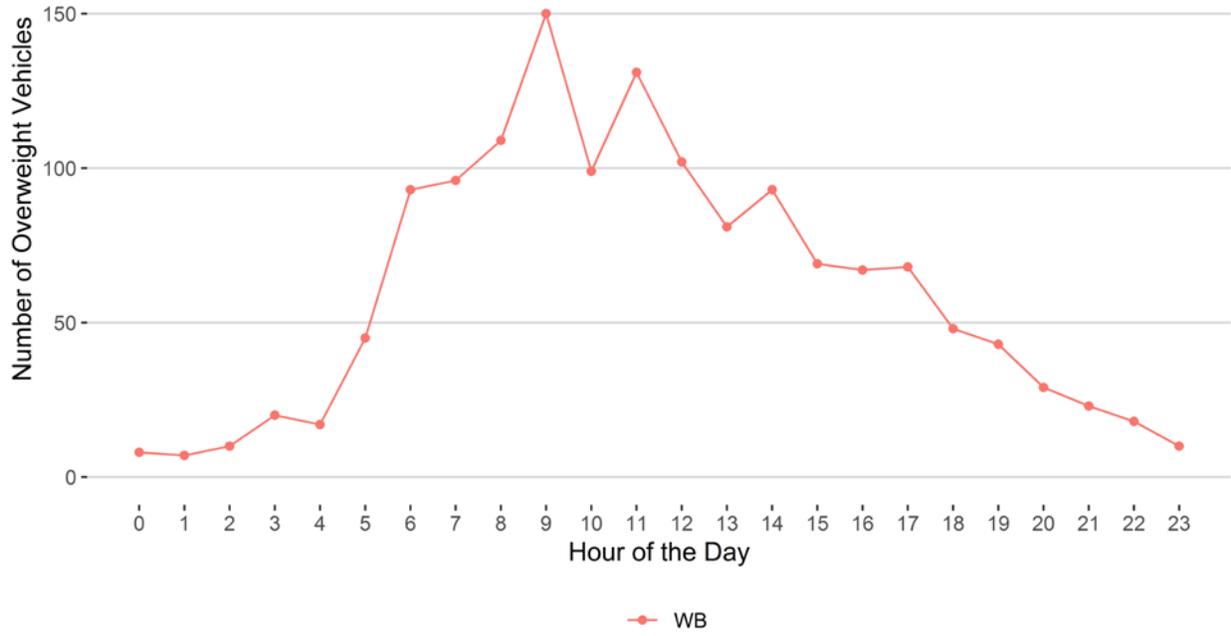
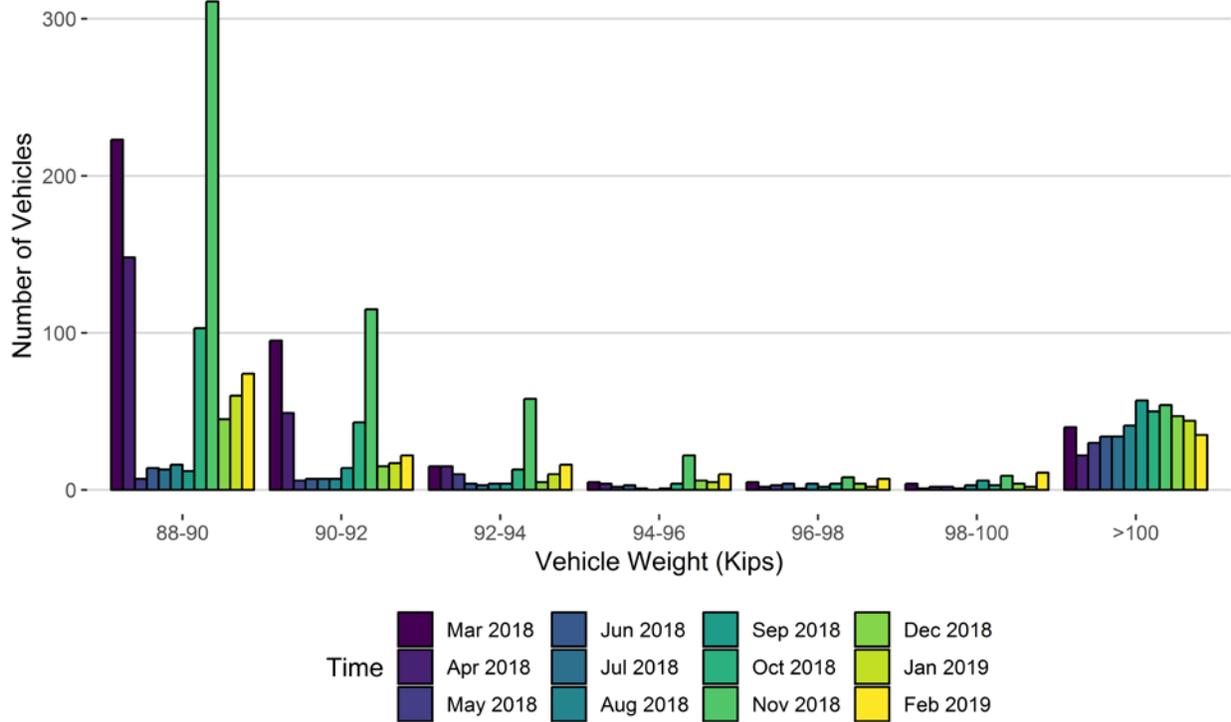


Figure 8 - Histogram of Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019
88-90	223	148	7	14	13	16	12	103	311	45	60	74
90-92	95	49	6	7	7	7	14	43	115	15	17	22
92-94	15	15	10	4	3	4	4	13	58	5	10	16
94-96	5	4	2	3	1	0	1	4	22	6	5	10
96-98	5	2	3	4	1	4	2	4	8	4	2	7
98-100	4	1	2	2	1	3	6	3	9	4	2	11
>100	40	22	30	34	34	41	57	50	54	47	44	35
Total	387	241	60	68	60	75	96	220	577	126	140	175

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

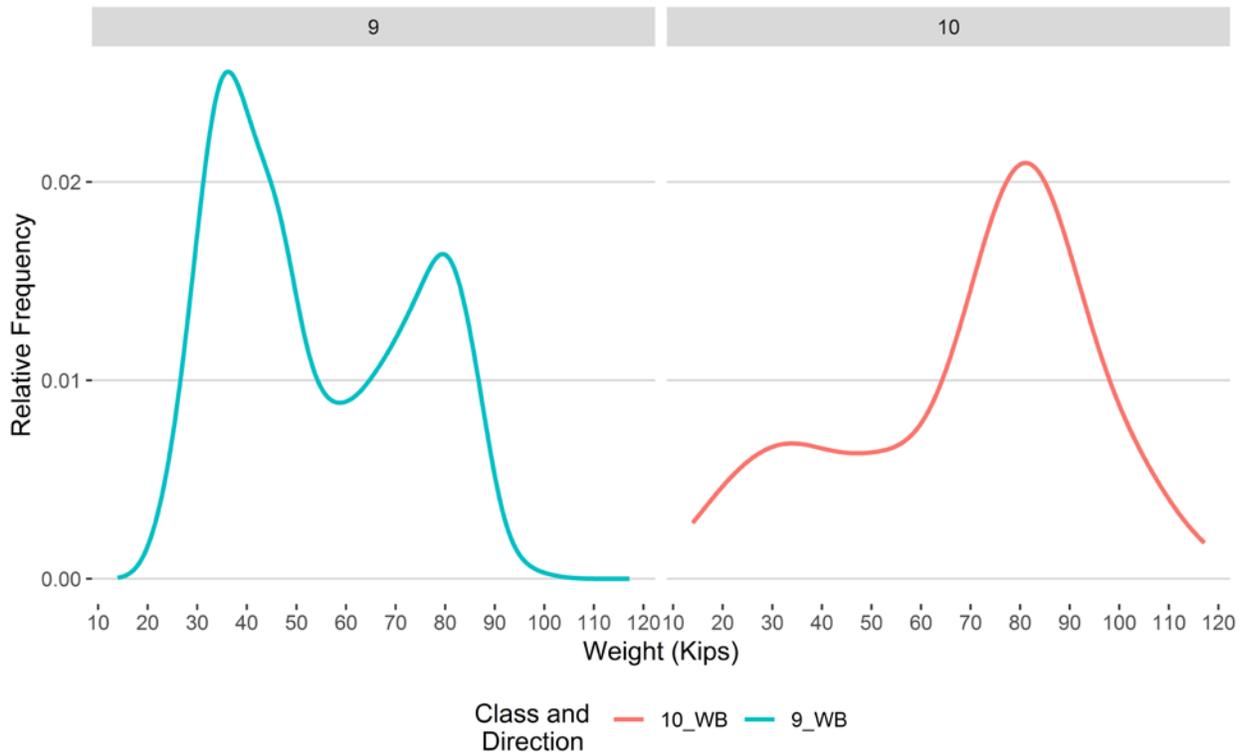


Figure 9 - Freight Percentage by Direction and Class

WB

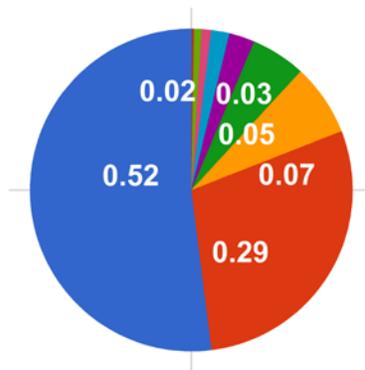


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

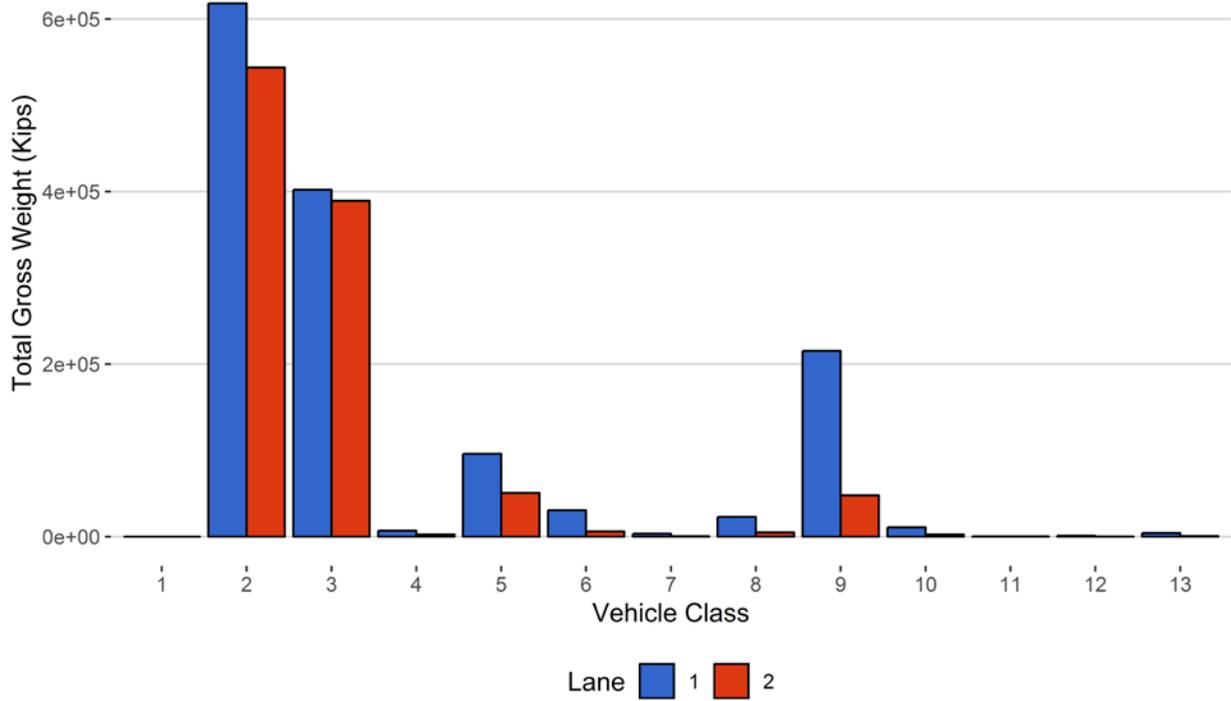


Figure 11 - Total Gross Vehicle Weight t

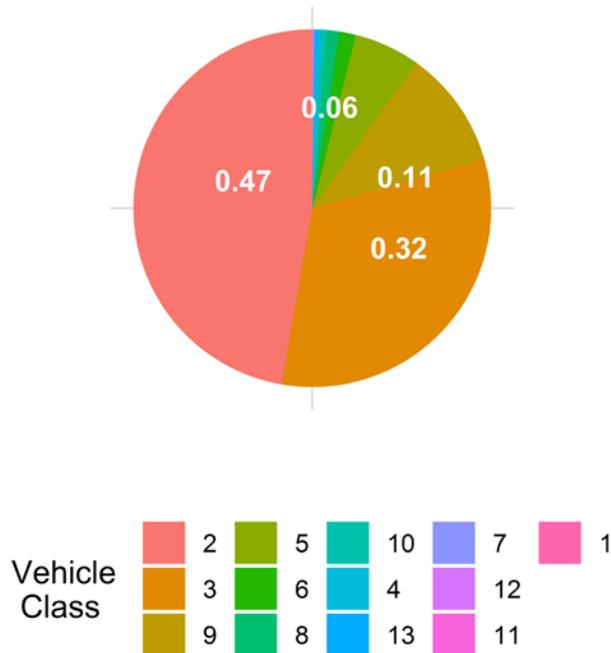


Figure 12 - Total ESALs by Class and Lane

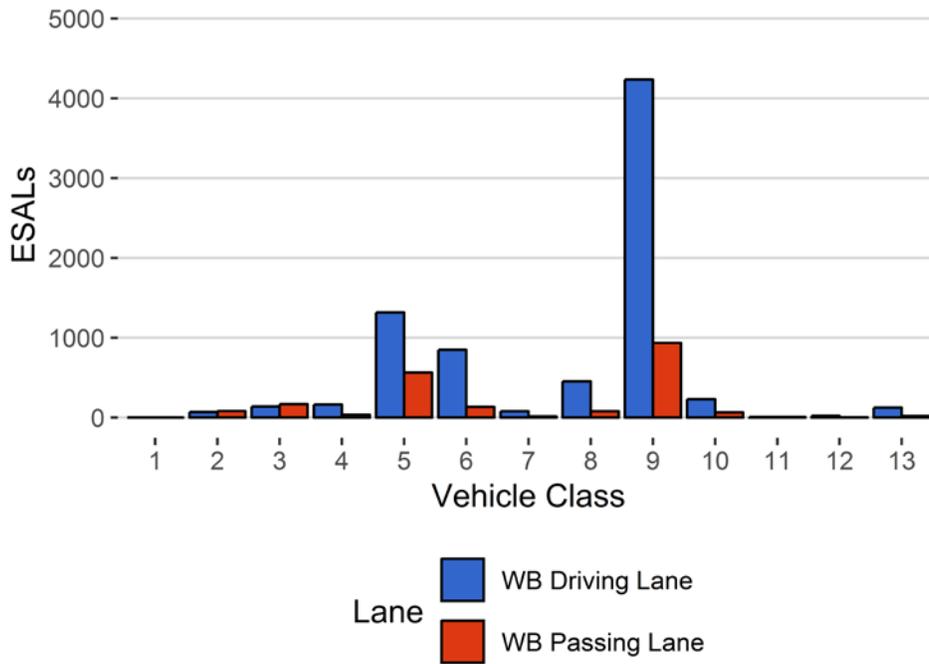


Figure 13 - ESALs by Class

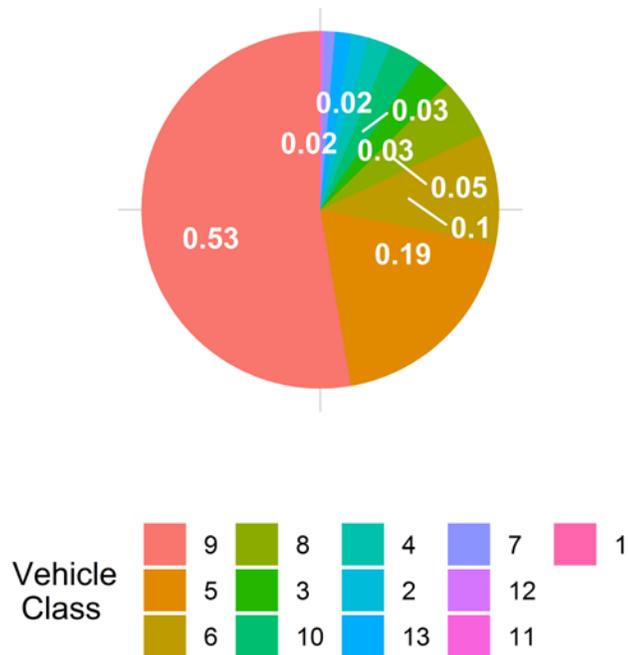


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
October 2017	NA	NA	10.62	0.00
November 2017	NA	NA	10.99	3.53
December 2017	NA	NA	11.20	5.49
January 2018	NA	NA	11.24	5.83
February 2018	NA	NA	11.23	5.72
March 2018	NA	NA	11.08	4.34
April 2018	NA	NA	10.87	2.38
May 2018	NA	NA	10.69	0.70
June 2018	NA	NA	10.70	0.81
July 2018	NA	NA	10.65	0.33
August 2018	NA	NA	10.66	0.42
September 2018	NA	NA	10.75	1.26
October 2018	NA	NA	11.05	4.02
November 2018	NA	NA	11.51	8.40
December 2018	11.51	0.00	11.47	8.05
January 2019	11.65	1.23	11.46	7.91
February 2019	11.72	1.87	11.48	8.13

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	2	0	0	0
2	10350	289809	66.3	0	0
3	4622	129416	29.6	0	0
4	12	333	0.1	27	1.9
5	359	10045	2.3	148	10.5
6	38	1075	0.2	162	11.5
7	2	62	0	30	2.1
8	31	870	0.2	74	5.3
9	179	5019	1.1	847	60.3
10	7	192	0	76	5.4
11	0	3	0	0	0
12	1	16	0	5	0.4
13	2	54	0	36	2.6
TOTAL	15603	436896	100	1405	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>
2019-02-18	Monday	13:44:26	10	WB	1	117.19
2019-02-06	Wednesday	04:56:47	10	WB	1	116.95
2019-02-15	Friday	12:21:46	10	WB	2	110.26
2019-02-19	Tuesday	11:12:59	10	WB	2	109.72
2019-02-21	Thursday	17:38:59	10	WB	1	108.45
2019-02-05	Tuesday	11:18:39	10	WB	1	107.54
2019-02-28	Thursday	06:11:22	10	WB	1	107.53
2019-02-13	Wednesday	05:40:50	10	WB	1	105.05
2019-02-28	Thursday	11:02:30	10	WB	1	102.96
2019-02-04	Monday	09:50:48	10	WB	1	102.81

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	323	50	15.5	8567	632	2236
5	WB	8	9741	506	5.2	142839	3589	34480
6	WB	19	1042	73	7	35252	1245	8420
7	WB	11.5	60	0	0	3840	0	1575
8	WB	31	844	343	40.6	19925	7707	2197
9	WB	33	4867	648	13.3	244196	18861	52484
10	WB	33.5	186	21	11.3	12547	501	3510
11	WB	36.5	3	0	0	224	0	57
12	WB	36.5	16	0	0	1109	0	263
13	WB	31.5	52	0	0	4838	0	1600
TOTAL	****	****	17134	1641	****	473338	****	106822

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	1	0	1	0
2	618177	543807	1161983	47.3
3	402067	389124	791191	32.2
4	6827	2373	9200	0.4
5	95856	50573	146428	6
6	30582	5915	36497	1.5
7	3337	503	3840	0.2
8	22861	4771	27632	1.1
9	215218	47839	263057	10.7
10	10689	2359	13047	0.5
11	224	0	224	0
12	962	147	1109	0
13	4130	708	4838	0.2
TOTAL	1410931	1048118	2459049	100
GVW/LANE	57.38	42.62	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	0.3333
2	71	81	153	1.6	0.0011
3	140	168	308	3.1	0.005
4	164	38	202	2.1	1.25
5	1316	566	1882	19.2	0.39
6	849	136	985	10.1	1.89
7	79	16	95	1	2.95
8	454	79	533	5.4	1.27
9	4235	937	5171	52.8	2.13
10	230	66	296	3	3.09
11	8	0	8	0.1	1.99
12	22	4	26	0.3	2.32
13	125	20	145	1.5	4.68
TOTAL	7693	2111	9804	100	22
ESALS/LANE	78.5	21.5	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	512513	16533	644	492548	96.1	19965.1	3.9
Apr 2018	517859	17262	753	495274	95.6	22584.9	4.4
May 2018	631604	20374	910	603386	95.5	28218.3	4.5
Jun 2018	616280	20543	896	589399	95.6	26881.2	4.4
Jul 2018	629397	20303	816	604106	96	25291	4
Aug 2018	639471	20628	852	613071	95.9	26399.6	4.1
Sep 2018	581367	19379	761	558536	96.1	22831	3.9
Oct 2018	603853	19479	863	577094	95.6	26758.9	4.4
Nov 2018	538746	17958	798	514797	95.6	23948.6	4.4
Dec 2018	516018	16646	556	498770	96.7	17248.3	3.3
Jan 2019	495367	15980	561	477966	96.5	17401.3	3.5
Feb 2019	436896	15603	631	419227	96	17668.9	4
TOTAL	6719371	-	-	6444174	-	275197	-
AVERAGE	559948	18391	753	537014	96	22933	4

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	13230	3173	16403	7.6
Apr 2018	14271	3586	17857	4.5
May 2018	16136	4234	20371	1.3
Jun 2018	16381	4040	20421	0.5
Jul 2018	14428	3471	17899	0.6
Aug 2018	13904	2848	16752	0.8
Sep 2018	10477	2044	12521	1.9
Oct 2018	14490	3770	18259	3.1
Nov 2018	15779	3985	19764	8.3
Dec 2018	7721	1769	9490	3.8
Jan 2019	7975	1784	9759	4.1
Feb 2019	7841	2152	9993	6.1
TOTAL	152632	-	-	-
AVERAGE	12719	3071	15791	4

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	1556468	1153319	2709787
Apr 2018	1413706	1050516	2464222
May 2018	1734424	1179053	2913477
Jun 2018	1792589	1215750	3008338
Jul 2018	2142694	1524224	3666919
Aug 2018	2130628	1470981	3601608
Sep 2018	2091423	1471775	3563198
Oct 2018	2108134	1515344	3623478
Nov 2018	1844835	1368756	3213591
Dec 2018	2061600	1488458	3550057
Jan 2019	1911488	1343033	3254521
Feb 2019	1574809	1218296	2793105
TOTAL	22362796	15999505	38362301
AVERAGE	1863566	1333292	3196858

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	3191	0.6	16.1	388	45
Apr 2018	3374	0.7	15	242	23
May 2018	3328	0.5	11.9	62	32
Jun 2018	3351	0.6	12.6	68	36
Jul 2018	2745	0.4	11	61	36
Aug 2018	2318	0.4	8.9	75	44
Sep 2018	1579	0.3	7	96	63
Oct 2018	3095	0.5	11.7	220	53
Nov 2018	3757	0.7	15.9	578	63
Dec 2018	1337	0.3	7.8	126	51
Jan 2019	1371	0.3	8	140	46
Feb 2019	1436	0.3	8.2	176	46
TOTAL	30882	-	-	2232	538
AVERAGE	2573.5	0.5	11.2	186	44.8

Freight

<i>Month</i>	<i>WB Freight Tons</i>
Mar 2018	171392
Apr 2018	193752
May 2018	241700
Jun 2018	239504
Jul 2018	211420
Aug 2018	203867
Sep 2018	151578
Oct 2018	210014
Nov 2018	213790
Dec 2018	105242
Jan 2019	106411
Feb 2019	106822
TOTAL	2155491
AVERAGE	179624.3