

DECEMBER 2018



**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 December 2018. 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. Table 1 indicates that the class 9 front axle weights were all within +/- 9% of baseline calibration values for all lanes. 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: 516018 | Passenger Vehicles: 498770 | Heavy Commercial Vehicles: 17248

Monthly Average Daily Traffic (MADT): 16646 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 556

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 02 PM and 04 PM.

Heavy Commercial Vehicles (HCVs)

Volume trends. On an average 24-hour day, HCVs traveling WB typically reached peak volume levels between 02 PM 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 17248 HCVs, 1329 of them were overweight ³. These overweight HCVs contributed to 0.3% of total monthly volume, and 7.9% 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 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 ,126 WB vehicles exceeded 88,000 pounds (56 vehicles were Class 9's; 41 vehicles were Class 13's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from December 2018.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9's and 10's in December 2018. 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 105242 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 516018 vehicles with a combined GVW of 2793105 kips (1 kip = 1,000 pounds = 0.5 tons) in December 2018. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 9490 equivalent single axle loads (ESALs) passed over the pavement at this site. In particular, 53% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 10% 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>

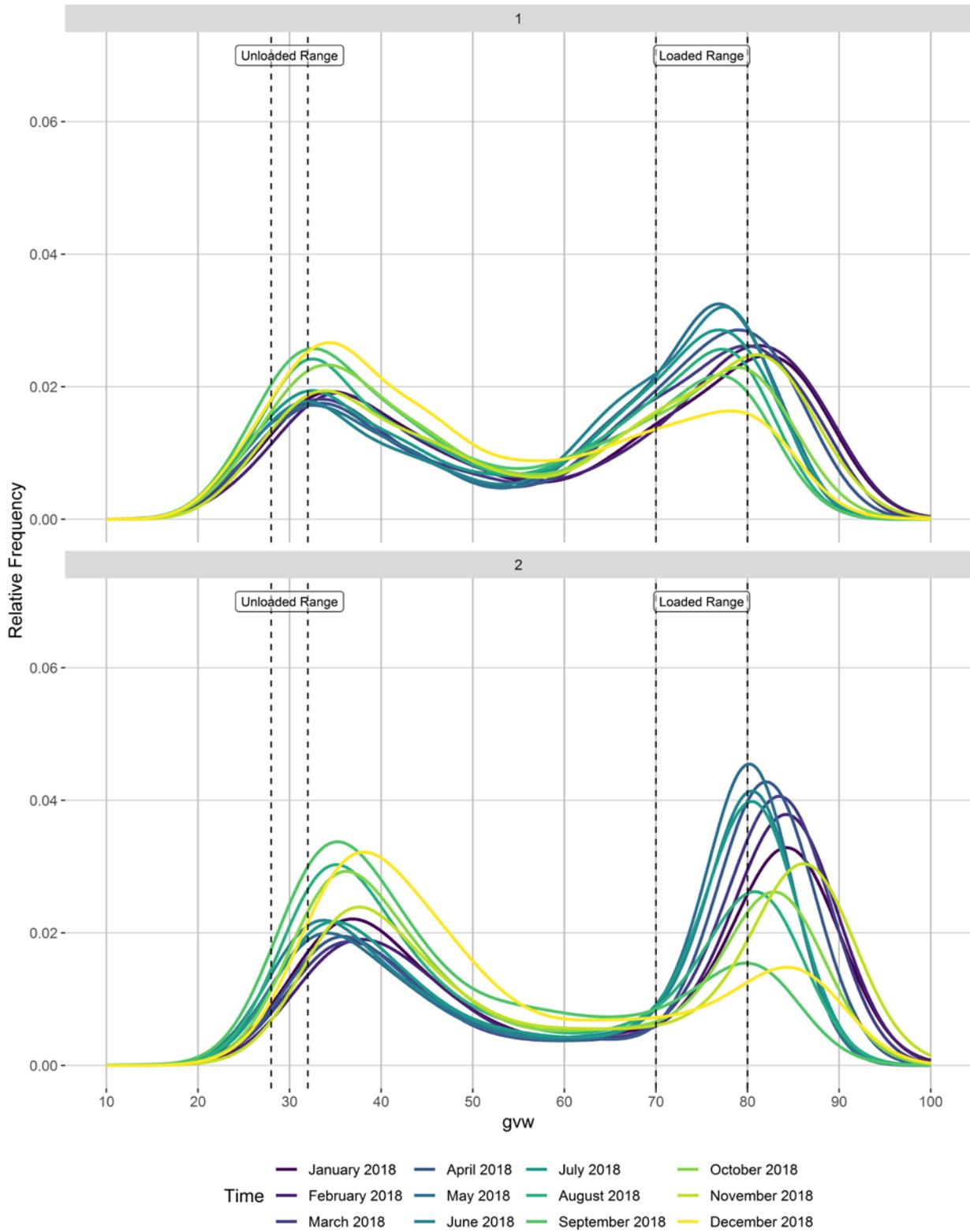
- ¹ Front axle weights of Class 9s are monitored on a monthly basis to assure performance between calibrations. The current goal of the WIM scale calibration is to

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.

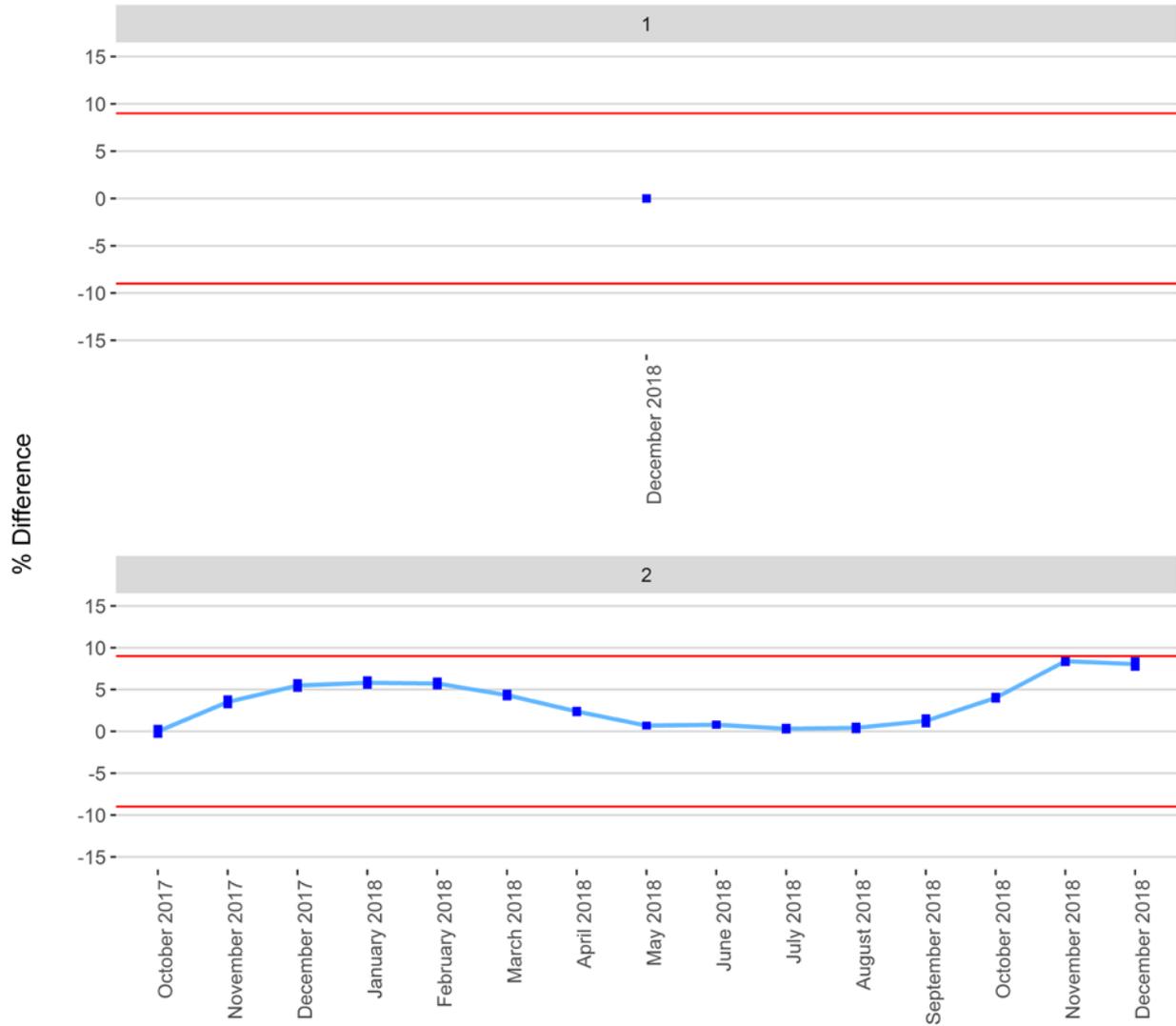
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Figure 1 - Monthly Class 9 GVW Histogram



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

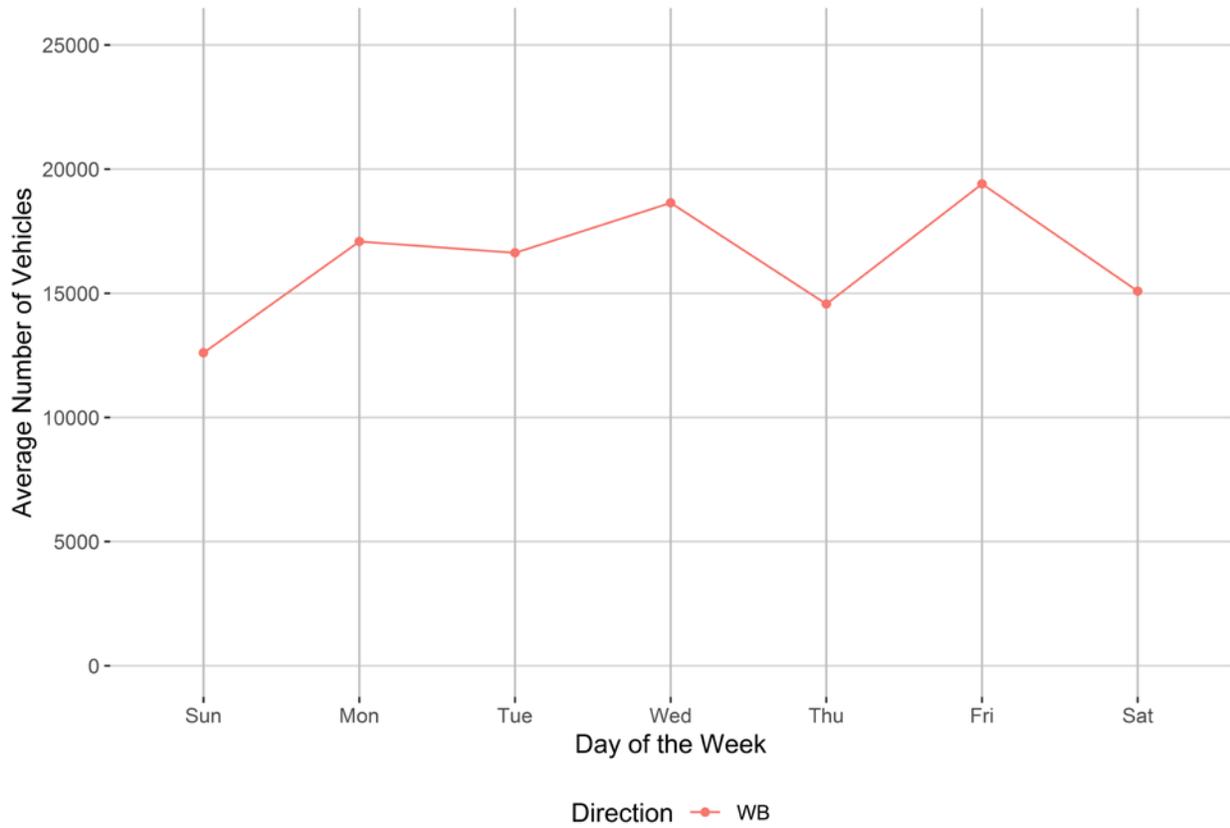


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

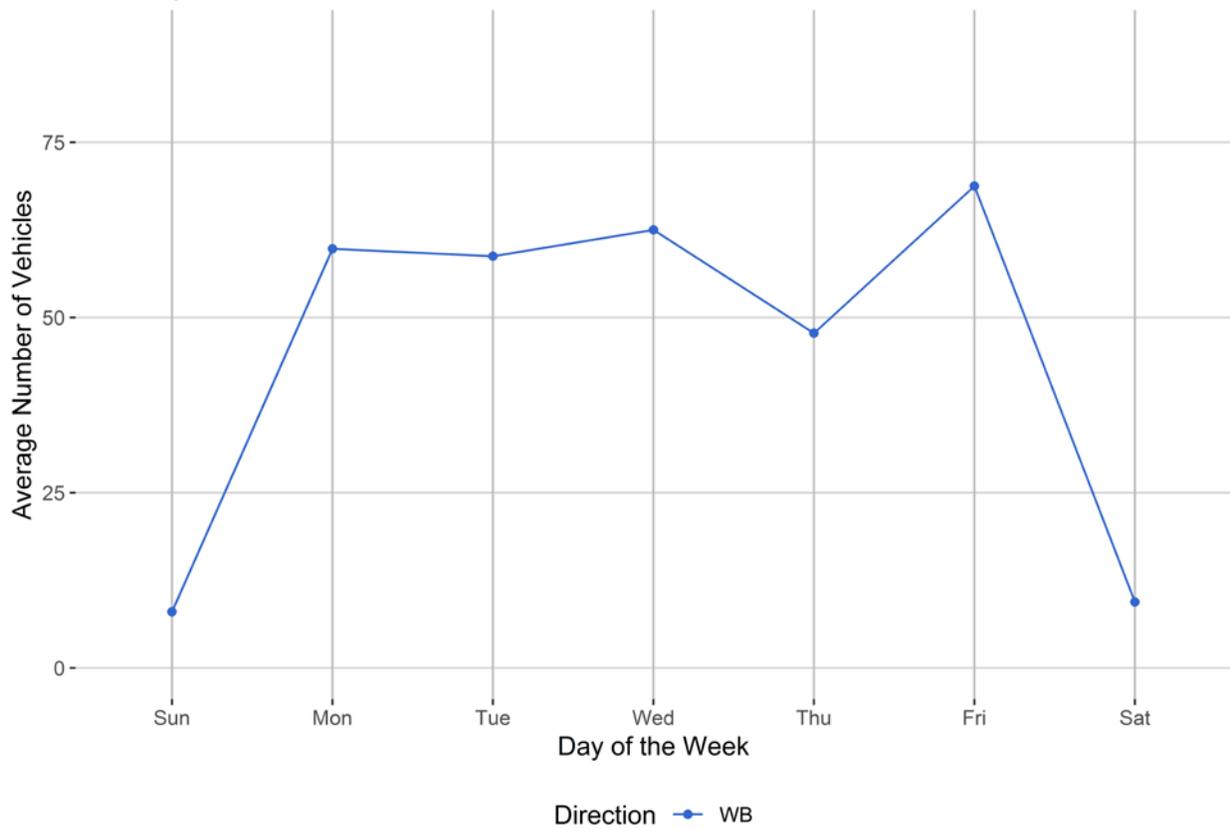


Figure 4 - Passenger Vehicles vs. Hour of the Day

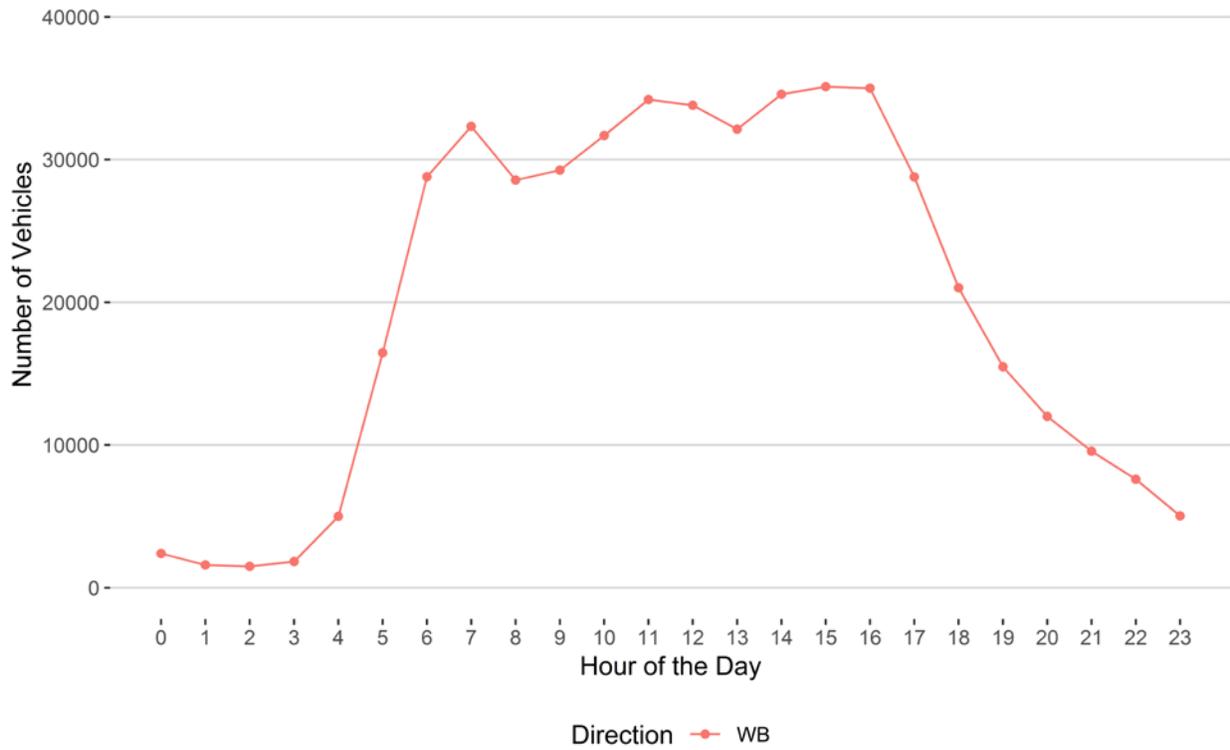


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

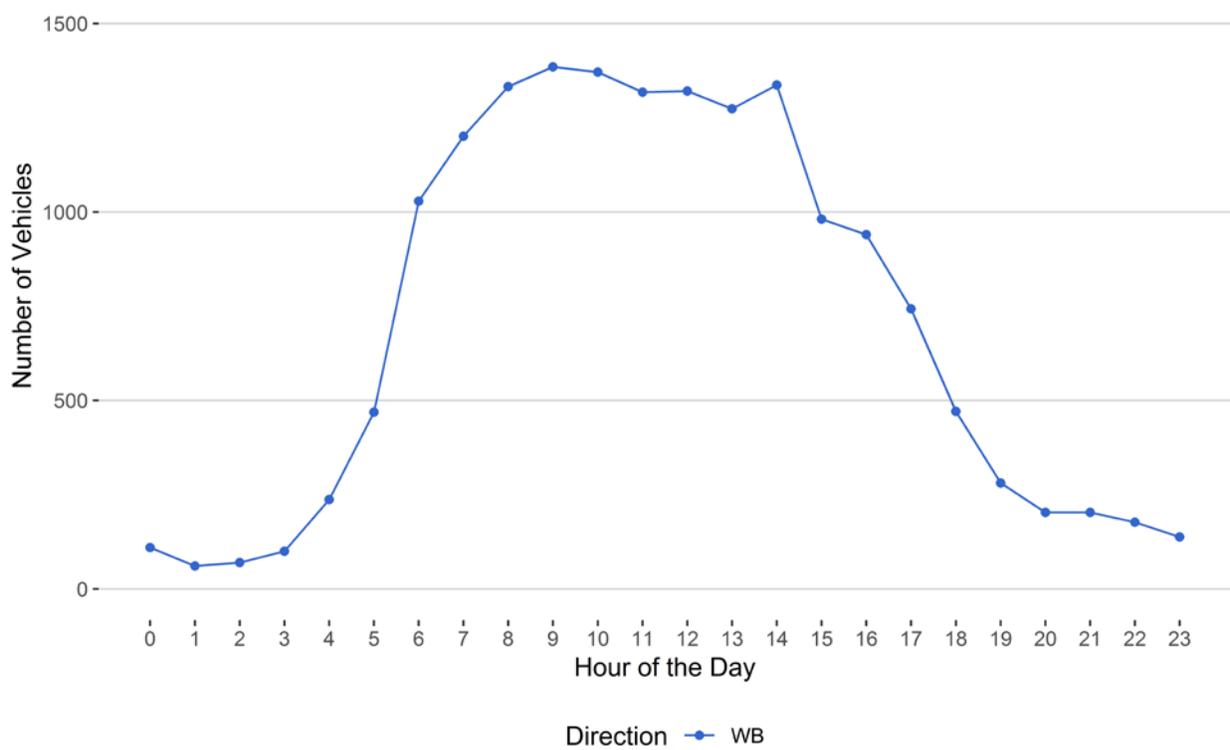


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

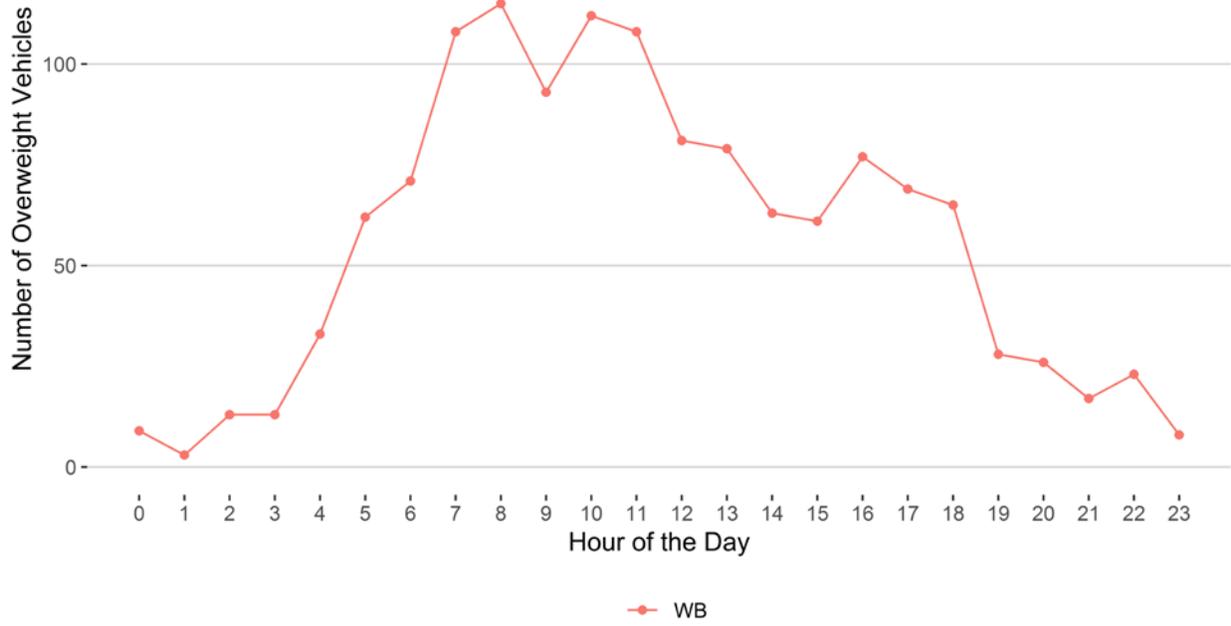
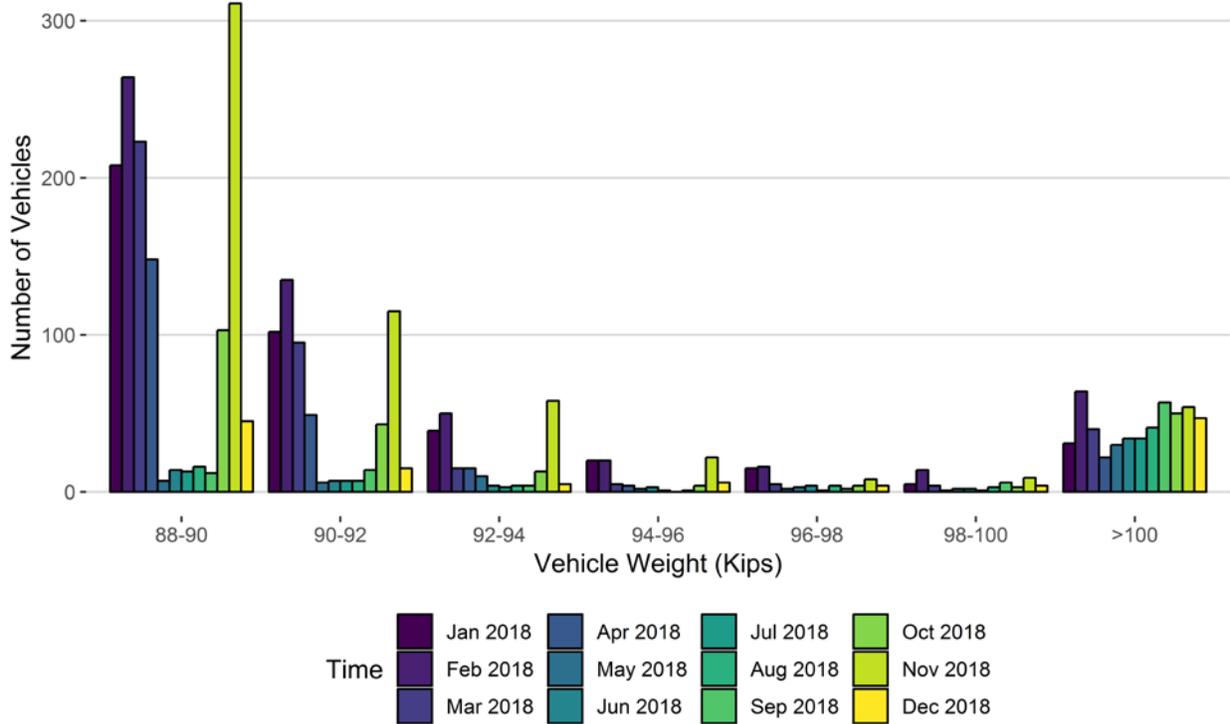


Figure 8 - Histogram of Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018
88-90	208	264	223	148	7	14	13	16	12	103	311	45
90-92	102	135	95	49	6	7	7	7	14	43	115	15
92-94	39	50	15	15	10	4	3	4	4	13	58	5
94-96	20	20	5	4	2	3	1	0	1	4	22	6
96-98	15	16	5	2	3	4	1	4	2	4	8	4
98-100	5	14	4	1	2	2	1	3	6	3	9	4
>100	31	64	40	22	30	34	34	41	57	50	54	47
Total	420	563	387	241	60	68	60	75	96	220	577	126

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

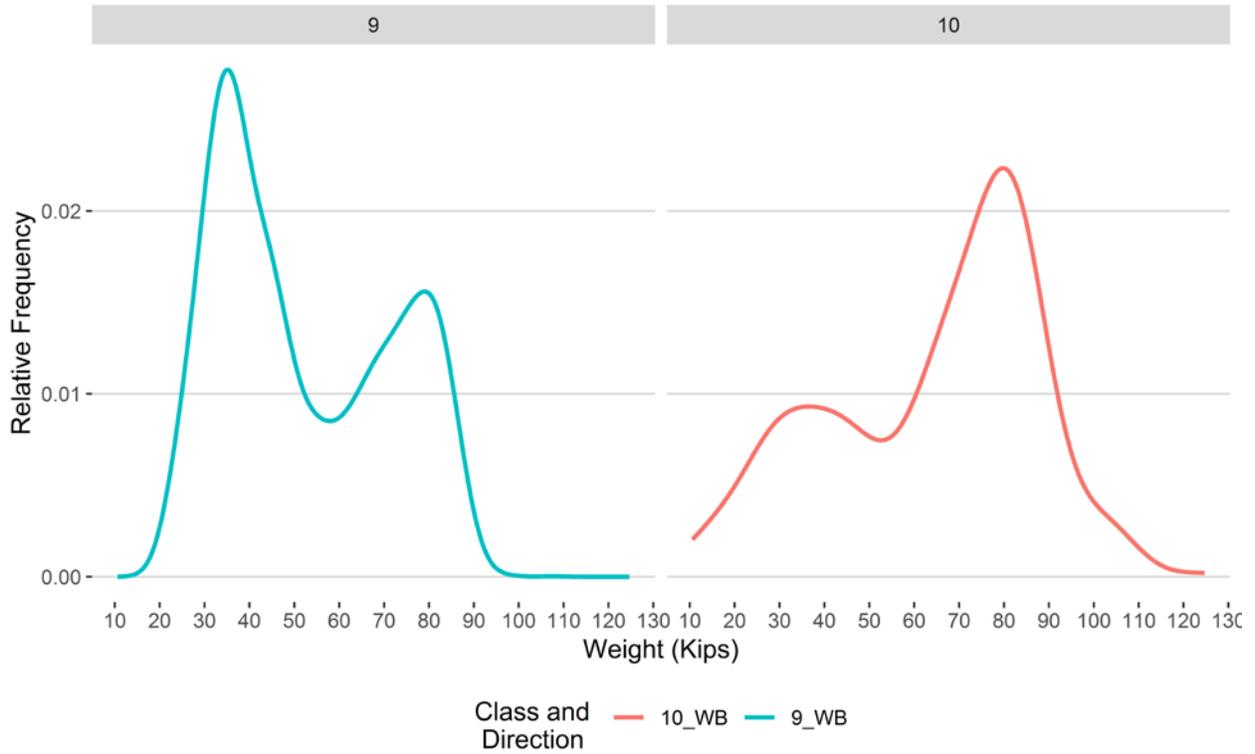
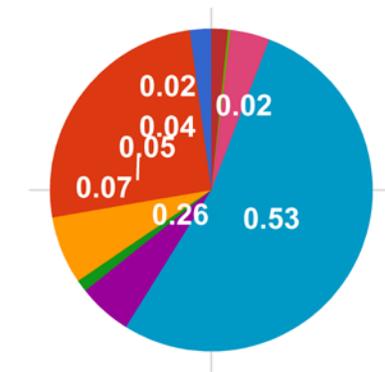


Figure 9 - Freight Percentage by Direction and Class

WB



Vehicle Class: 4, 5, 6, 7, 8, 9, 10, 12, 13

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

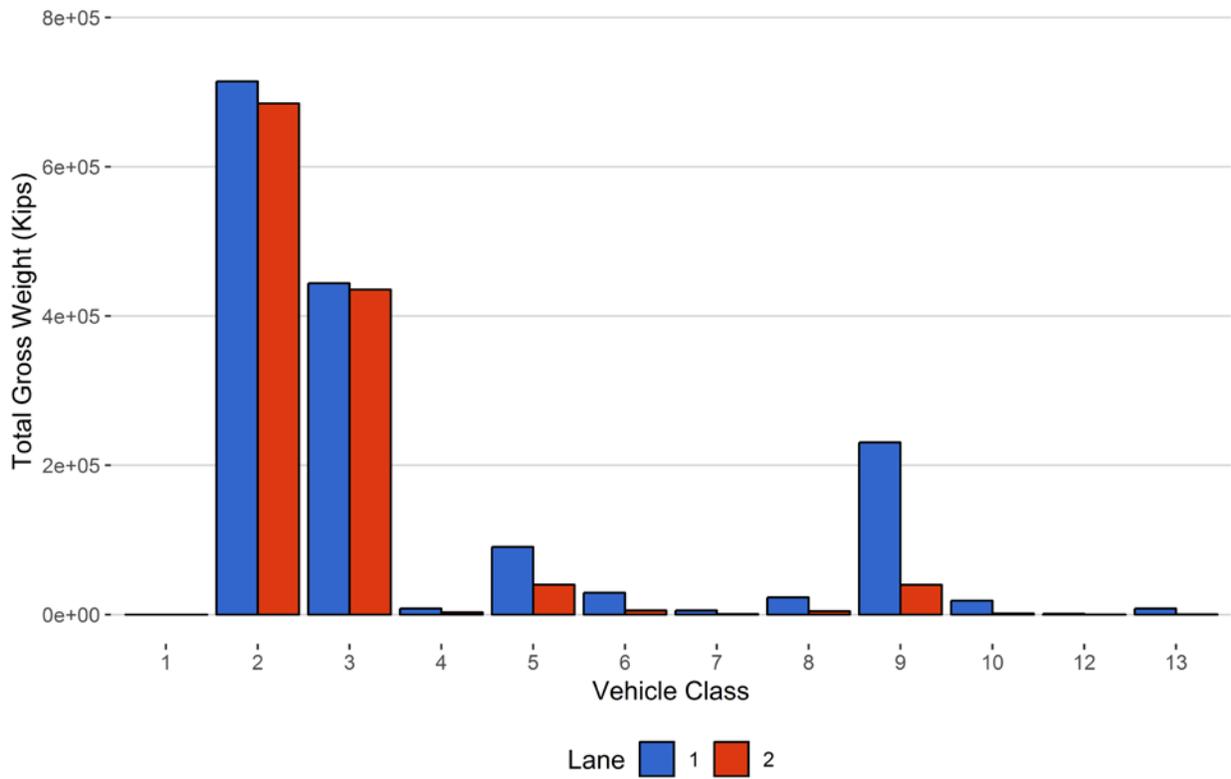


Figure 11 - Total Gross Vehicle Weight t

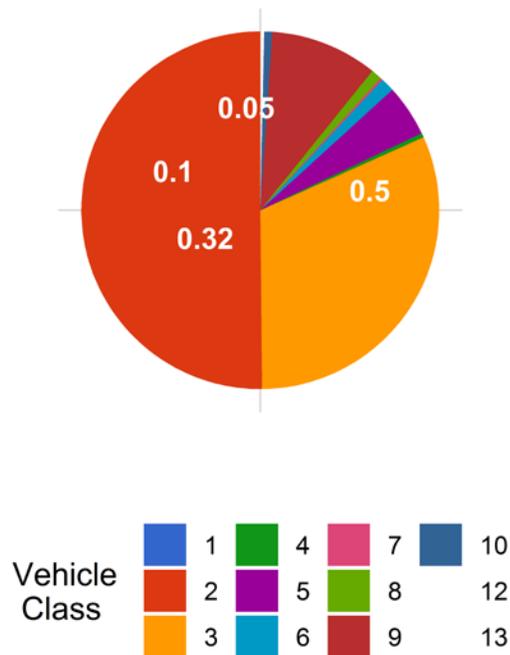


Figure 12 - Total ESALs by Class and Lane

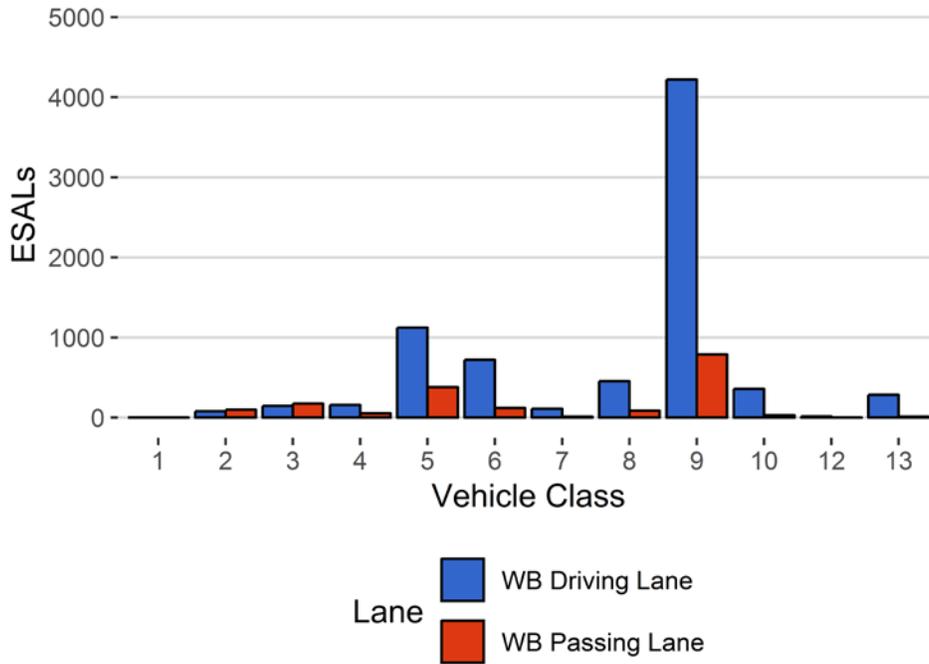


Figure 13 - ESALs by Class

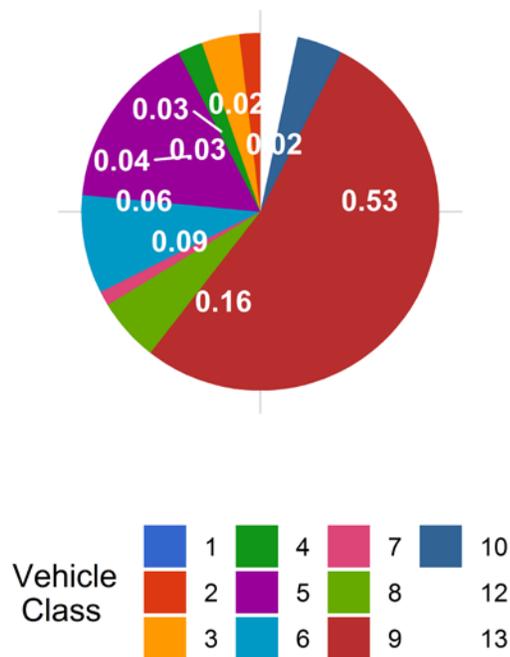


Table 1 Class 9 Front Axle Weight by Lane

<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	11.47	8.05

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	3	0	0	0
2	11354	351981	68.2	0	0
3	4735	146785	28.4	0	0
4	13	388	0.1	26	2
5	291	9017	1.7	104	7.8
6	34	1056	0.2	125	9.4
7	3	104	0	39	2.9
8	29	903	0.2	80	6
9	172	5347	1	794	59.7
10	10	322	0.1	98	7.4
12	1	23	0	2	0.2
13	3	89	0	61	4.6
TOTAL	16646	516018	100	1329	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>
2018-12-07	Friday	12:57:04	10	WB	1	124.68
2018-12-10	Monday	18:29:38	9	WB	1	107.53
2018-12-18	Tuesday	05:13:20	10	WB	1	106.27
2018-12-12	Wednesday	11:20:48	10	WB	1	105.36
2018-12-21	Friday	05:56:33	10	WB	1	105.09
2018-12-12	Wednesday	11:51:20	10	WB	1	104.89
2018-12-13	Thursday	05:44:39	10	WB	1	103.69
2018-12-18	Tuesday	08:19:02	10	WB	1	103.52
2018-12-14	Friday	05:39:45	10	WB	1	103.35
2018-12-01	Saturday	08:21:03	10	WB	1	102.93

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	377	73	19.4	10028	926	2734
5	WB	8	8758	618	7.1	126245	4403	30563
6	WB	19	1026	74	7.2	33458	1278	7685
7	WB	11.5	101	0	0	6109	0	2474
8	WB	31	877	430	49	17930	9634	2037
9	WB	33	5193	928	17.9	243946	26702	51601
10	WB	33.5	313	45	14.4	19026	1114	5024
12	WB	36.5	22	1	4.5	1297	23	265
13	WB	31.5	86	0	0	8430	0	2860
TOTAL	****	****	16753	2169	****	466468	****	105242

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	2	1	3	0
2	714460	684887	1399347	50.2
3	443912	435494	879406	31.5
4	7993	2960	10953	0.4
5	90602	40046	130648	4.7
6	29159	5576	34736	1.2
7	5462	647	6109	0.2
8	23019	4545	27564	1
9	230703	39946	270649	9.7
10	18584	1556	20140	0.7
12	1233	87	1320	0
13	8078	352	8430	0.3
TOTAL	1573207	1216097	2789305	100
GVW/LANE	56.4	43.6	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	0.25
2	80	99	179	1.9	0.0011
3	147	176	323	3.4	0.0046
4	159	53	212	2.2	1.13
5	1123	381	1505	15.9	0.35
6	722	121	842	8.9	1.65
7	112	13	125	1.3	2.39
8	455	86	541	5.7	1.24
9	4221	790	5011	53.1	1.94
10	359	30	390	4.1	2.46
12	16	2	18	0.2	1.43
13	286	12	298	3.1	6.18
TOTAL	7681	1763	9444	100	19
ESALS/LANE	81.3	18.7	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>
Jan 2018	490255	15815	599	471697	96.2	18557.6	3.8
Feb 2018	448352	16013	653	430066	95.9	18285.5	4.1
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
TOTAL	6725715	-	-	6448744	-	276970	-
AVERAGE	560476	18411	758	537395	96	23081	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>
Jan 2018	11608	2729	14337	12.2
Feb 2018	12022	3161	15184	15.1
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
TOTAL	160446	-	-	-
AVERAGE	13370	3234	16605	5

Gross Vehicle Weight

<i>Month</i>	<i>GVW WB Driving Lane</i>	<i>GVW WB Passing Lane</i>	<i>Total GVW Kips</i>
Jan 2018	1645395	1122207	2767602
Feb 2018	1554529	1047637	2602167
Mar 2018	1734424	1179053	2913477
Apr 2018	1792589	1215750	3008338
May 2018	2142694	1524224	3666919
Jun 2018	2130628	1470981	3601608
Jul 2018	2091423	1471775	3563198
Aug 2018	2108134	1515344	3623478
Sep 2018	1844835	1368756	3213591
Oct 2018	2061600	1488458	3550057
Nov 2018	1911488	1343033	3254521
Dec 2018	1574809	1218296	2793105
TOTAL	22592547	15965514	38558061
AVERAGE	1882712	1330459	3213172

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>
Jan 2018	2708	0.6	14.6	420	36
Feb 2018	3040	0.7	16.6	565	78
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
TOTAL	33823	-	-	2901	560
AVERAGE	2818.6	0.5	12.4	241.8	46.7

Freight

<i>Month</i>	<i>WB Freight Tons</i>
Jan 2018	144984
Feb 2018	153149
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
TOTAL	2240392
AVERAGE	186699.3