

DECEMBER 2018



**WIM #39
MN 43, MP 45.2
WINONA, MN**

**MONTHLY
REPORT**



Your Destination...Our Priority



WIM Site Location

WIM #39 is located on MN 43 near Winona in Winona county.

System Operation

WIM #39 was operational for the entire month of December 2018. Volume was computed using all monthly data.

System Calibration

WIM #39 was most recently calibrated on 2018-11-28. 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 Class 9 vehicles at this site for the last 12 months of operation 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: 283227 | Passenger Vehicles: 269265 | Heavy Commercial Vehicles: 13962

Monthly Average Daily Traffic (MADT): 9136 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 450

See Table 2 for vehicle class breakdown

Passenger Vehicles (PVs) and Heavy Commercial Vehicles (HCVs)

Volume trends. NB vehicles typically reached highest volume levels on Fridays, with lowest volumes reported on Sundays. SB 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), NB PVs generally reached peak volume levels between 03 PM and 05 PM. Similarly, SB PVs peaked in volume between 07 AM and 04 PM

Heavy Commercial Vehicles (HCVs)

Volume trends. On an average 24-hour day, HCVs traveling NB typically reached peak volume levels between 03 PM and 05 PM, while volume going SB peaked between 07 AM and 04 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 13962 HCVs, 1656 of them were overweight³. These overweight HCVs contributed to 0.6% of total monthly volume, and 12% of total monthly HCV volume. NB overweight vehicles typically reached highest numbers on Tuesdays, with lowest volumes reported on Sundays. SB overweight vehicles tended to reach highest volumes on Thursdays, with lowest volumes reported on Saturdays. See Figure 3 . The top two overweight violators by class were the class 9 and class 7 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 82.4% of all overweight vehicles traveling NB this month (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 October.

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 report⁴.

Using normal load limits ,64 NB vehicles exceeded 88,000 pounds (52 vehicles were Class 12's; 7 vehicles were Class 10's). Of vehicles traveling SB,

9 NB vehicles exceeded 88,000 pounds (6 vehicles were Class 9's; 2 vehicles were Class 10'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 9s and 10s in December 2018. Data suggests that there were greater numbers of fully_loaded Class 9's than empty Class 9's traveling NB, while there were more empty Class 9's than fully_loaded traveling SB. Data also suggests that there were more fully_loaded Class 10's than empty traveling in the NB direction. In the SB direction, there were more fully_loaded class 10 vehicles.

Freight Totals. A total of 105183 tons of freight was recorded to have crossed the WIM. More freight was shipped NB (65.3%) than SB (34.7%). See Table 4 and Figure 11 for more freight information.

Infrastructure Considerations

Bridge. Bridge No. 5930 is approximately 0.1 miles north of WIM #39, and Bridge No. 5900 is 0.3 miles south of WIM #39. WIM #39 recorded a total of 283227 vehicles with a combined GVW of 1736837 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 9384 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 66.9% of all ESALs were recorded NB while 33.1% was observed SB. In particular, 70% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 22% 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).

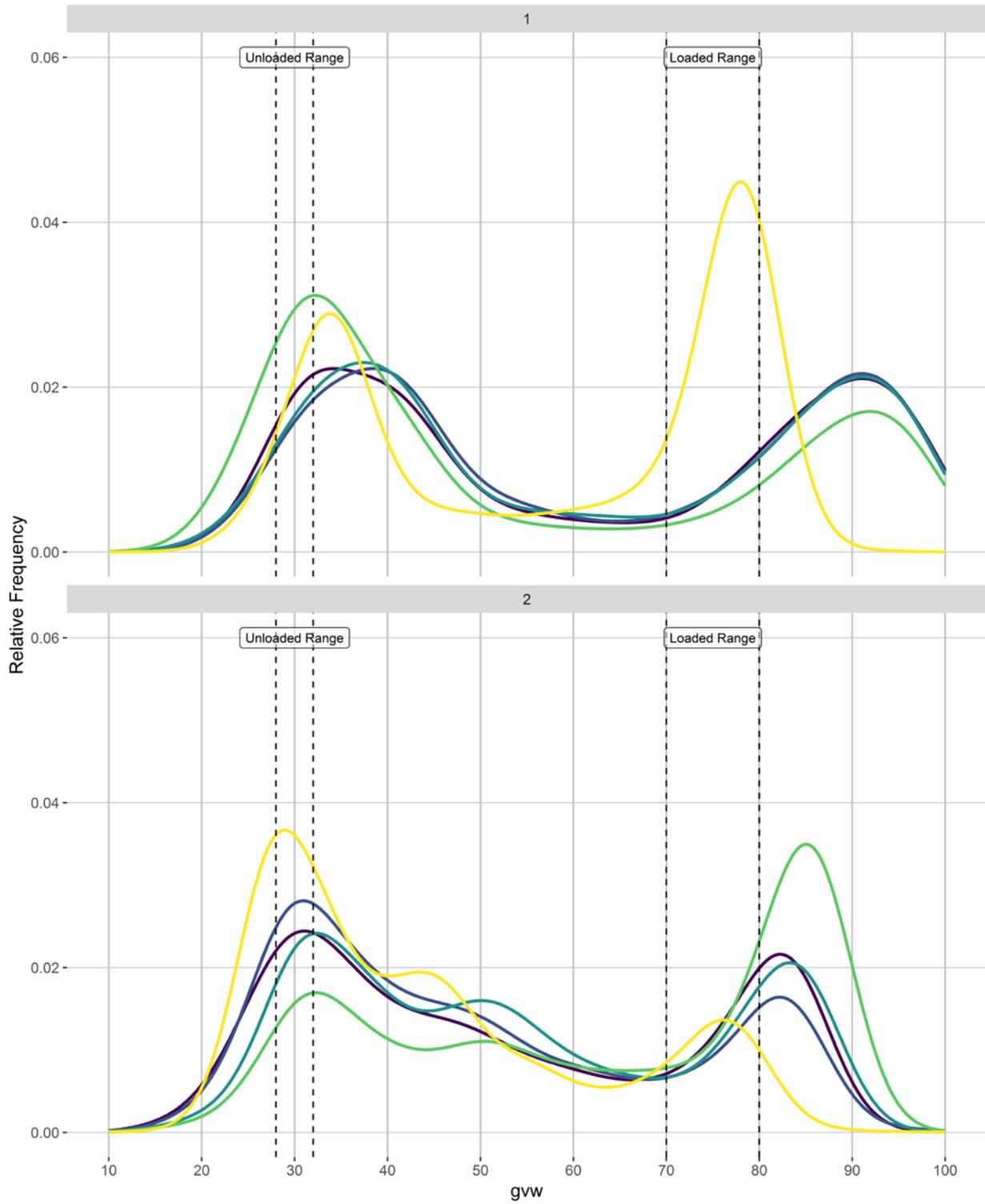
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

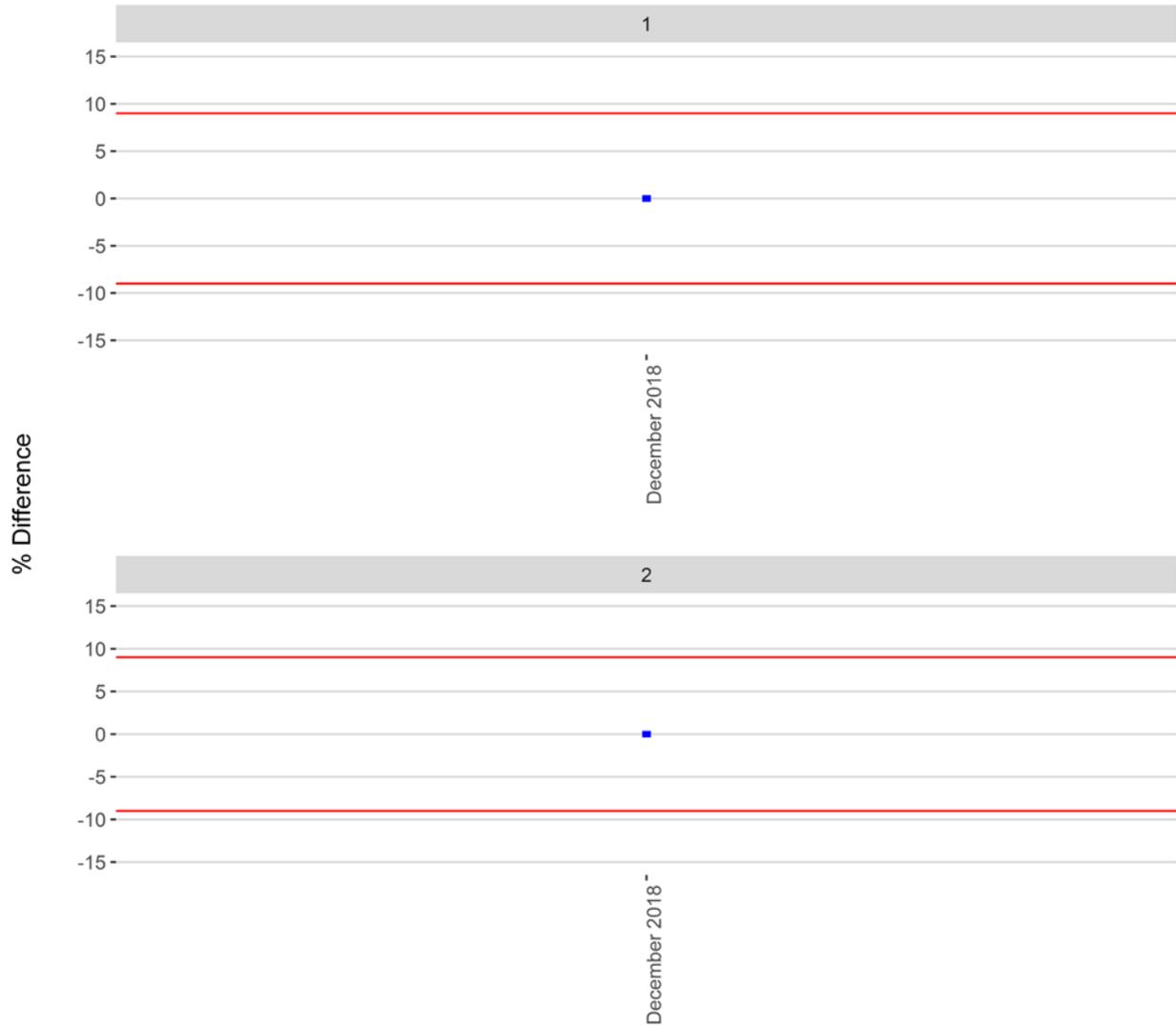
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

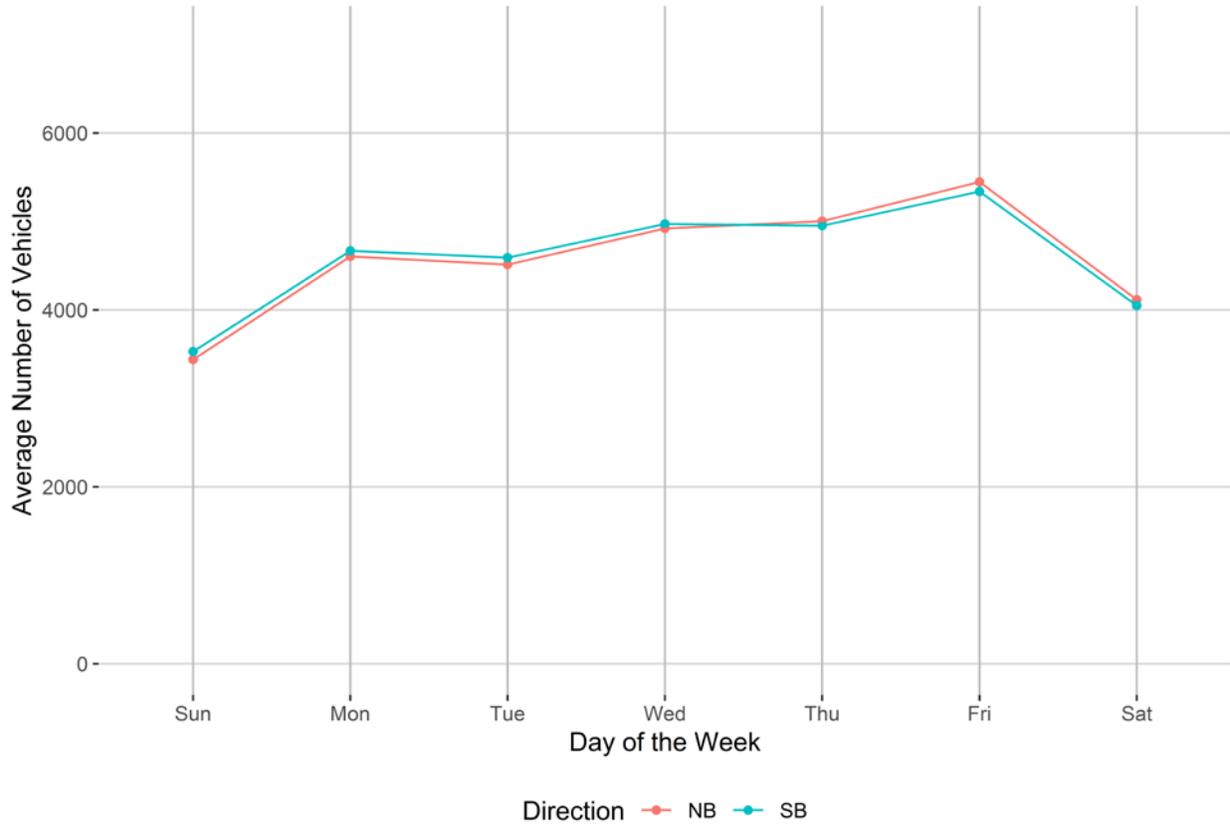


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

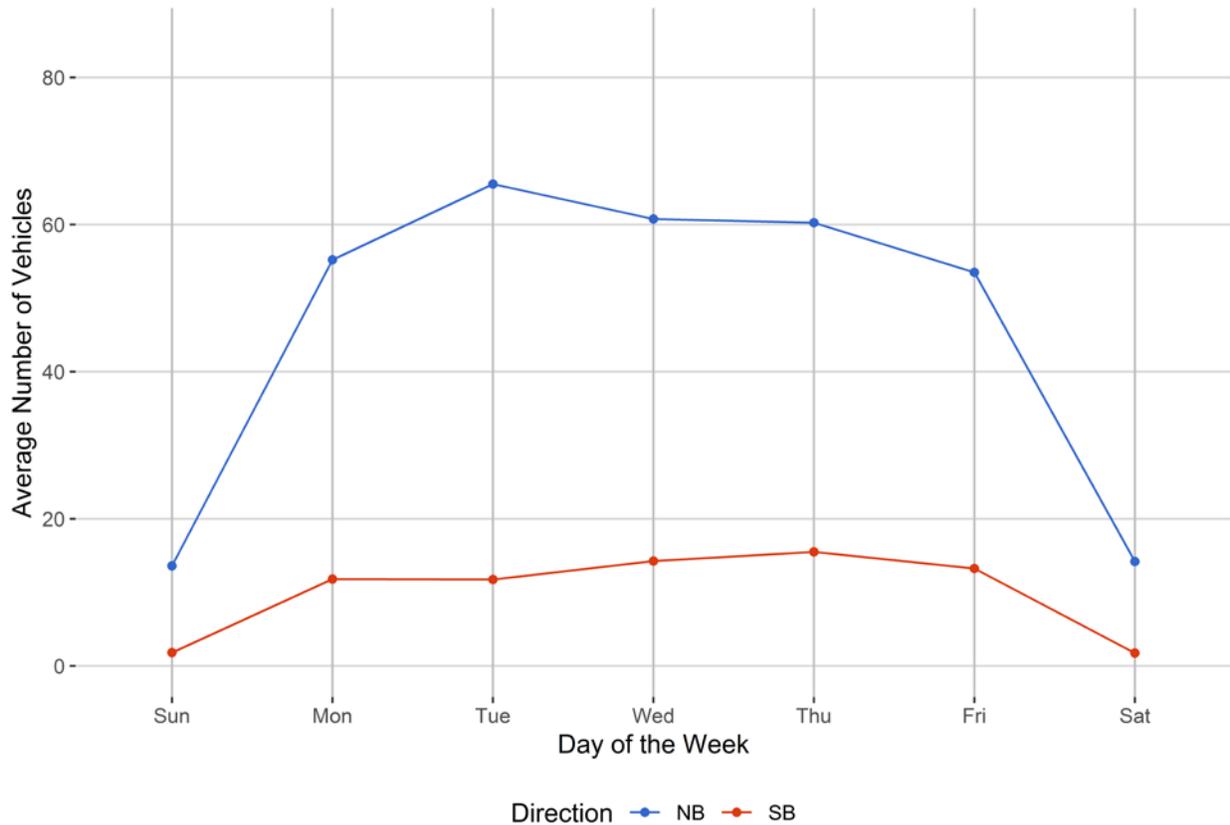


Figure 4 - Passenger Vehicles vs. Hour of the Day

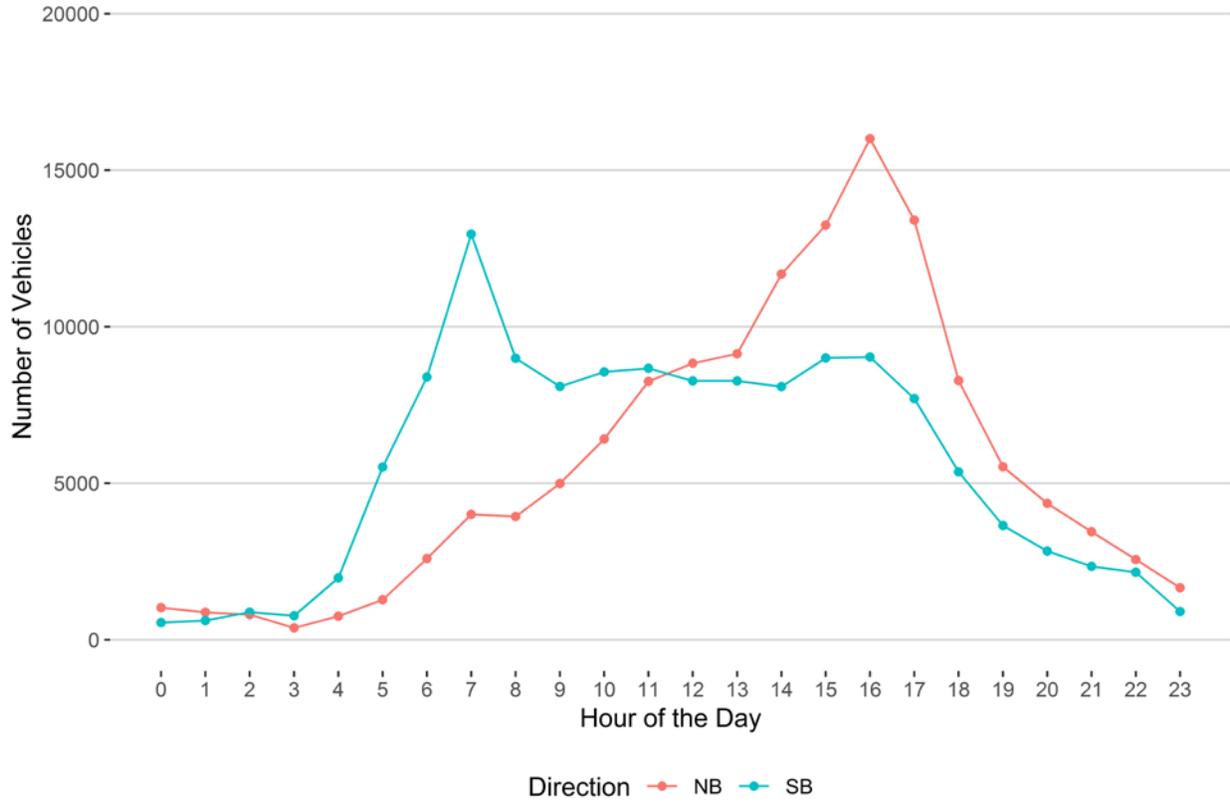


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

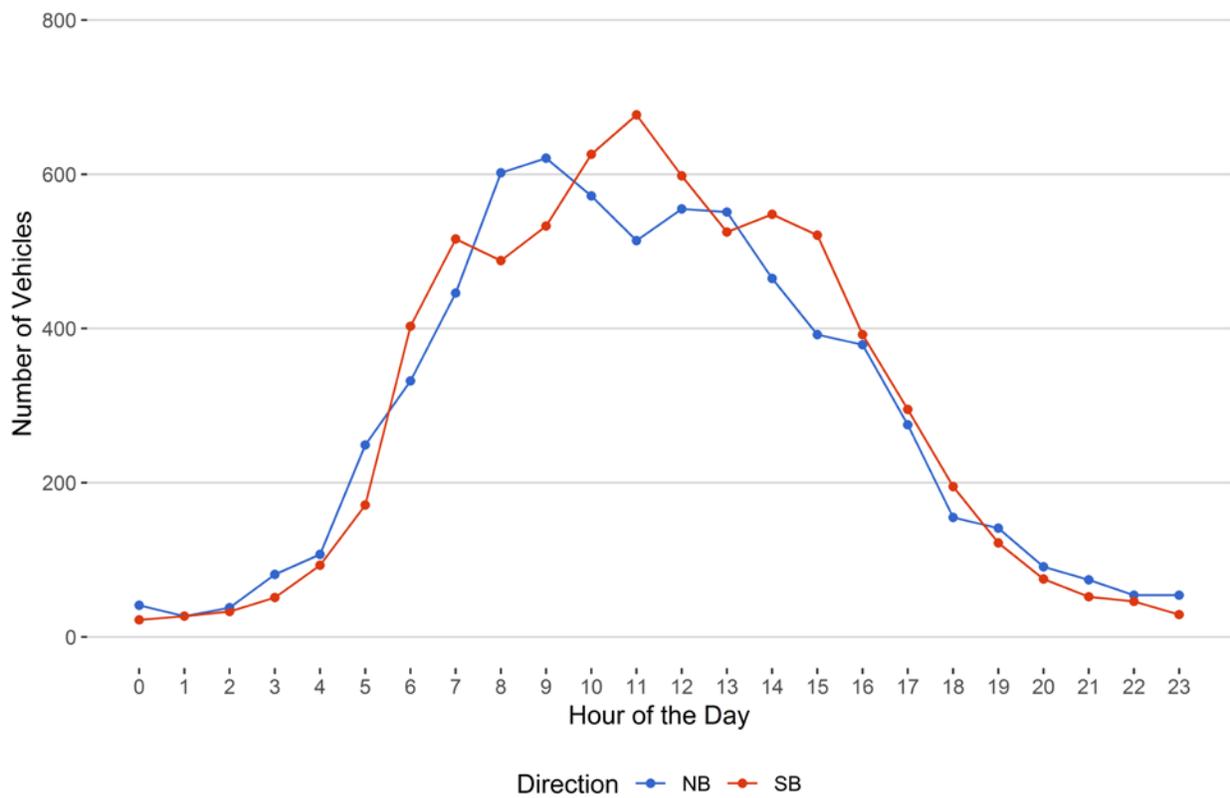


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

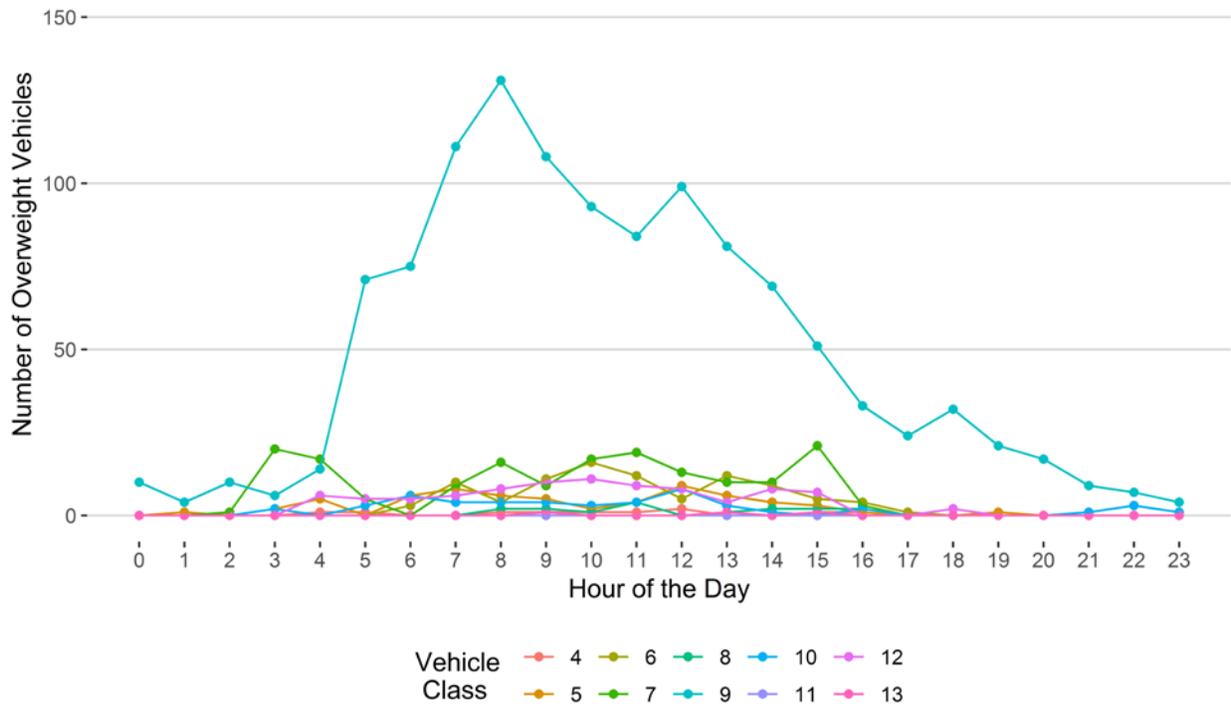


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

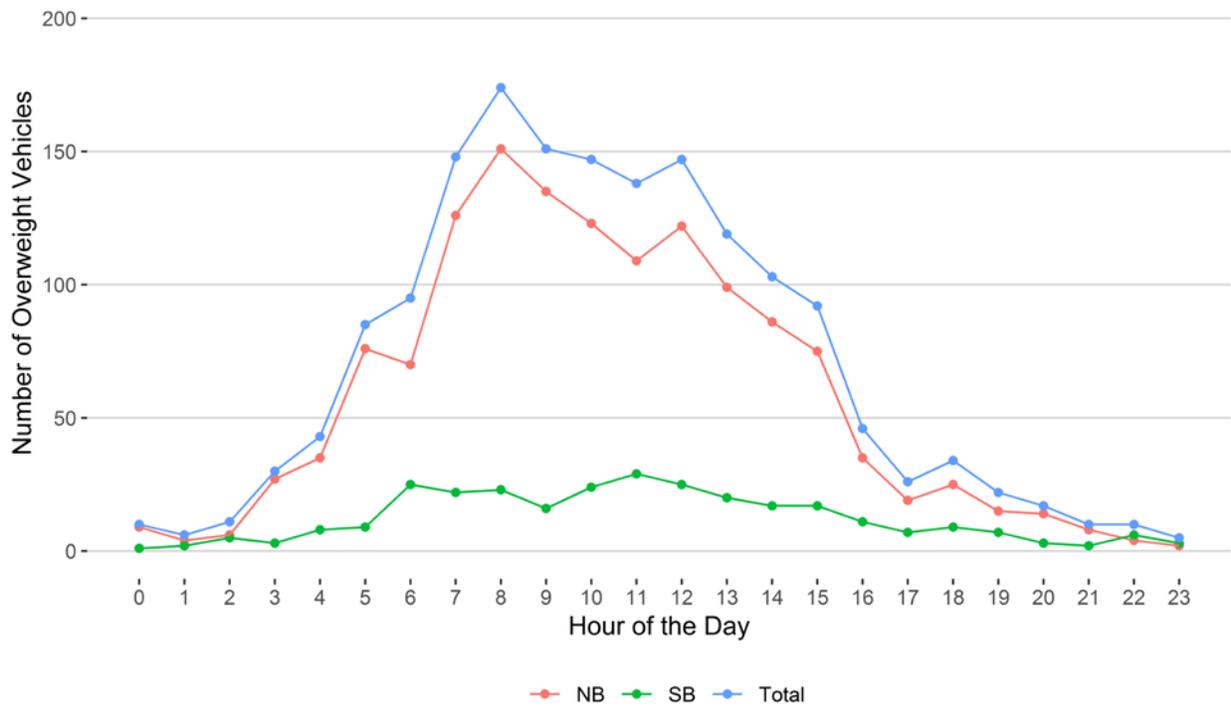
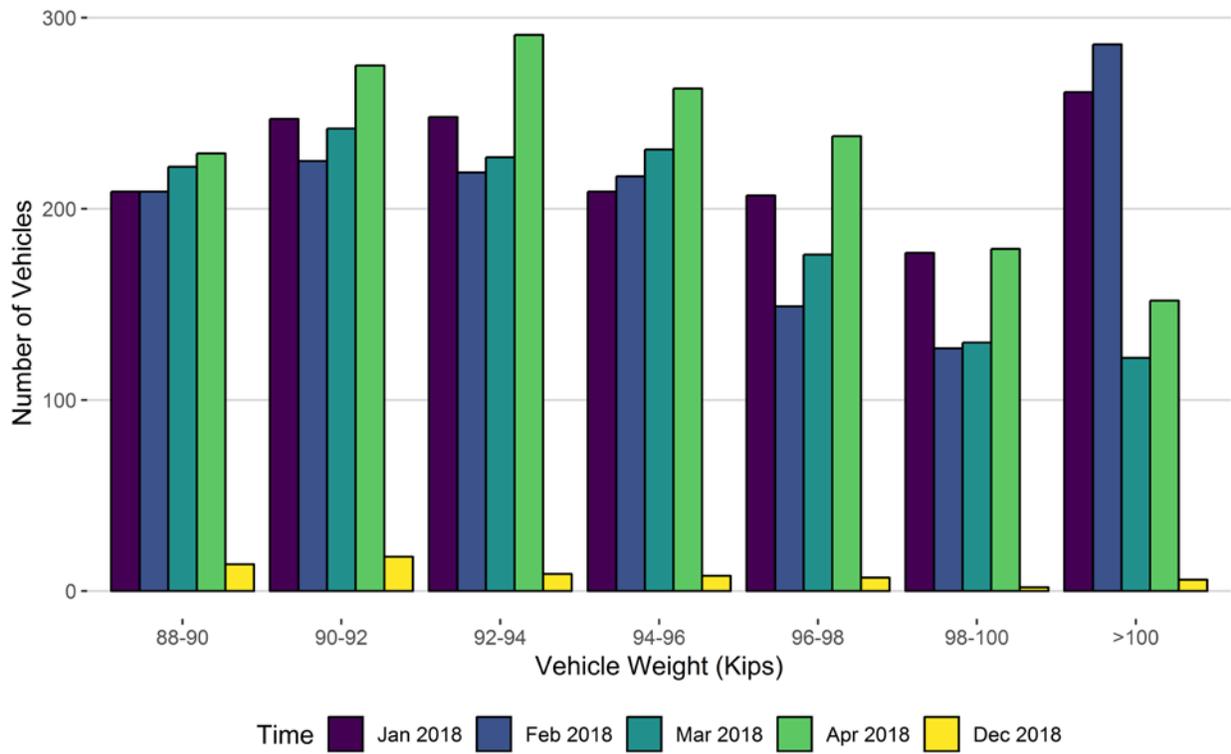
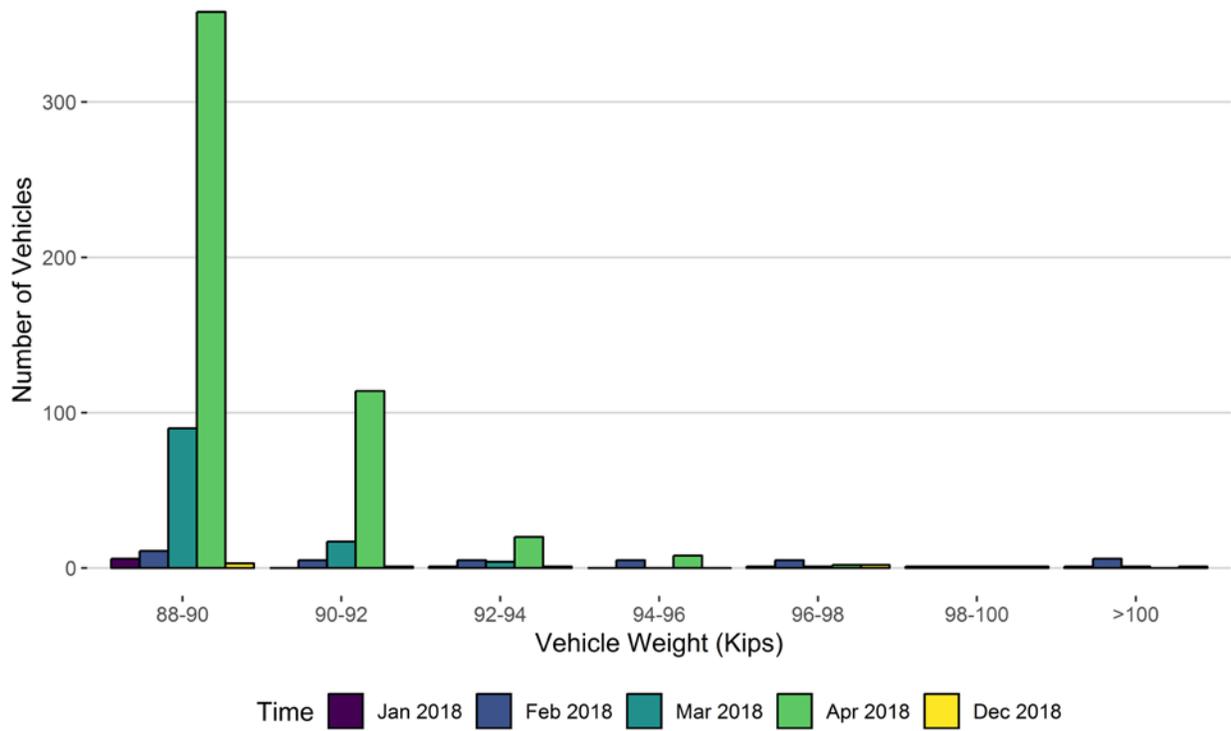


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Jan 2018	Feb 2018	Mar 2018	Apr 2018	Dec 2018
88-90	209	209	222	229	14
90-92	247	225	242	275	18
92-94	248	219	227	291	9
94-96	209	217	231	263	8
96-98	207	149	176	238	7
98-100	177	127	130	179	2
>100	261	286	122	152	6
Total	1558	1432	1350	1627	64

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



Vehicle Weights (Kips)	Jan 2018	Feb 2018	Mar 2018	Apr 2018	Dec 2018
88-90	6	11	90	358	3
90-92	0	5	17	114	1
92-94	1	5	4	20	1
94-96	0	5	0	8	0
96-98	1	5	1	2	2
98-100	1	1	1	1	1
>100	1	6	1	0	1
Total	10	38	114	503	9

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

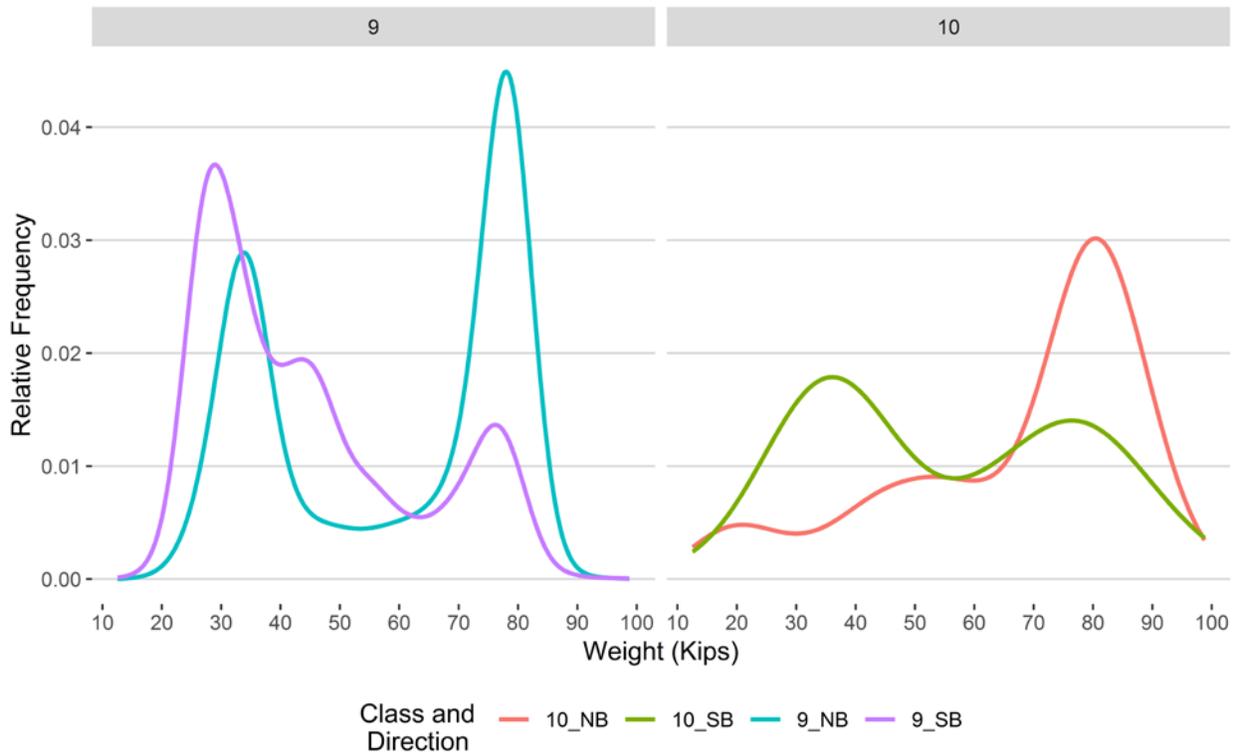


Figure 9 - Freight Percentage by Direction and Class

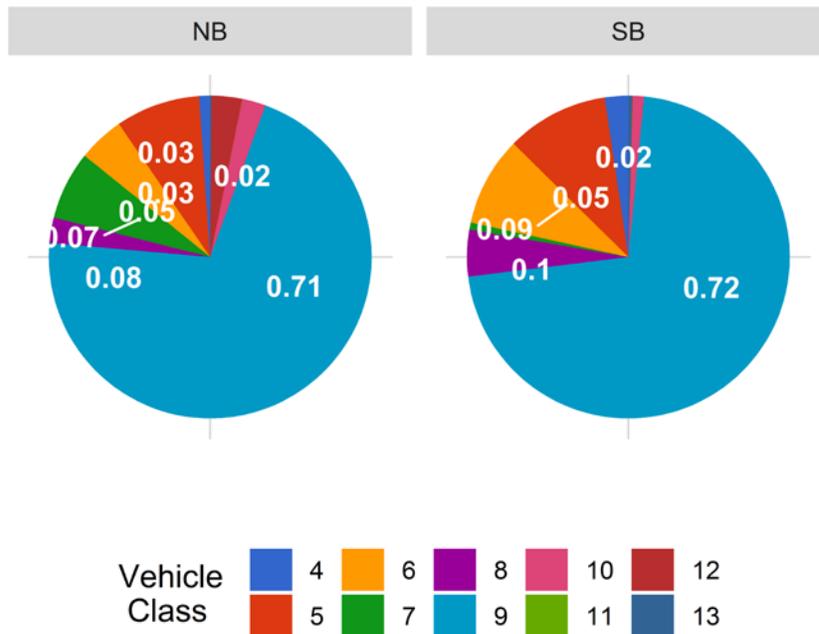


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

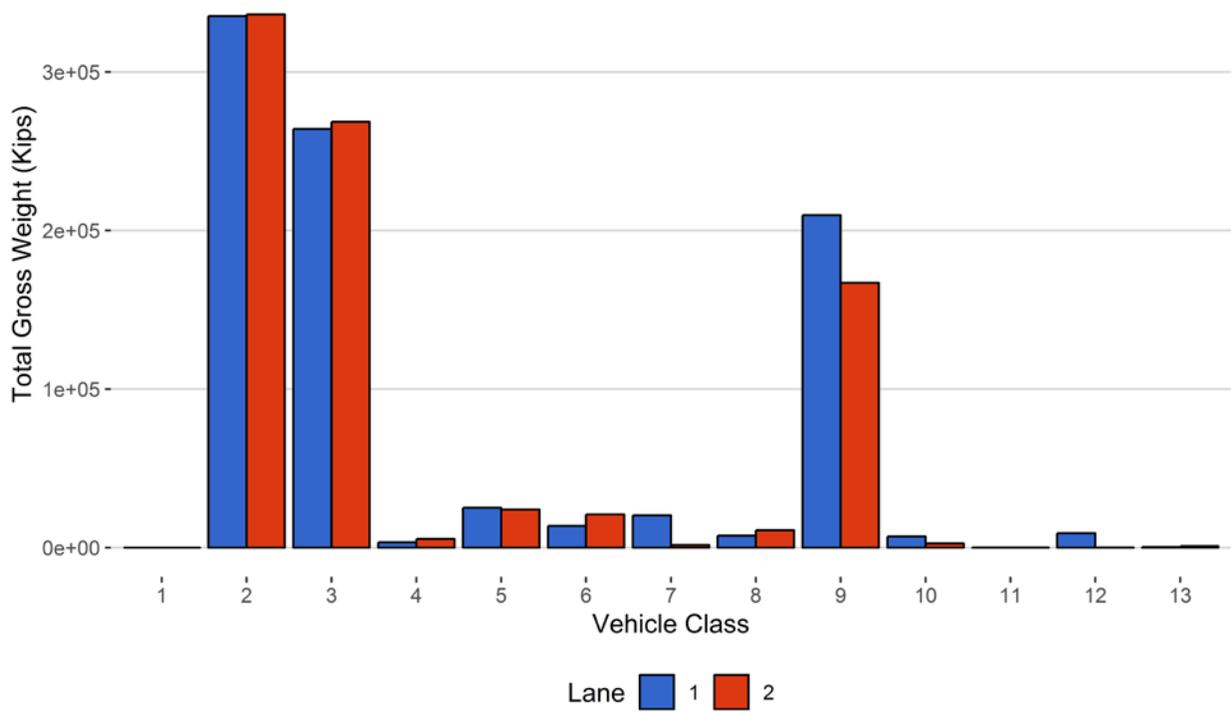


Figure 11 - Total Gross Vehicle Weight t

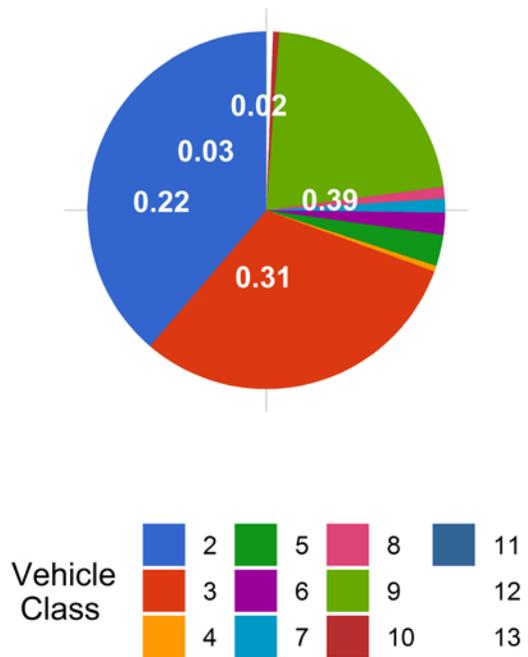


Figure 12 - Total ESALs by Class and Lane

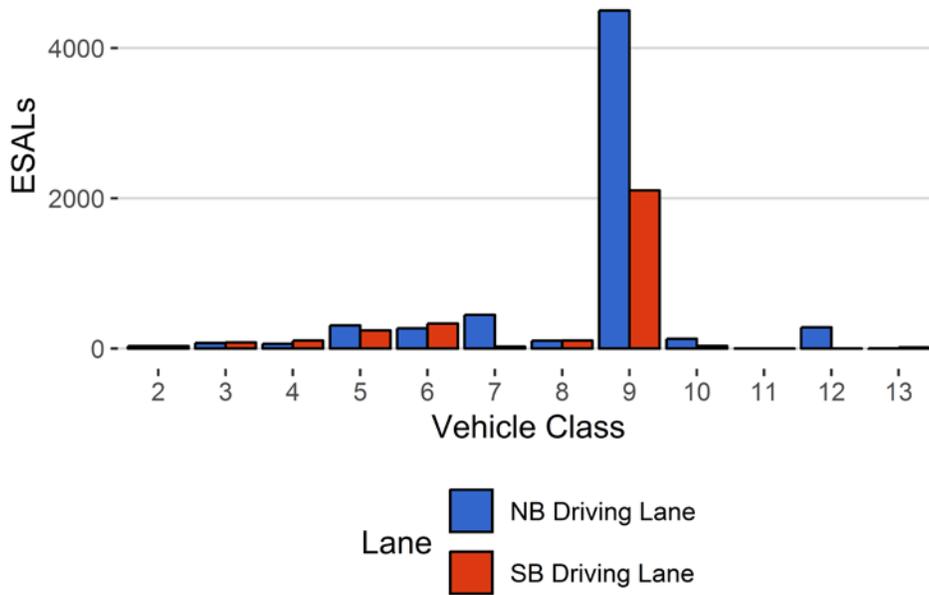


Figure 13 - ESALs by Class

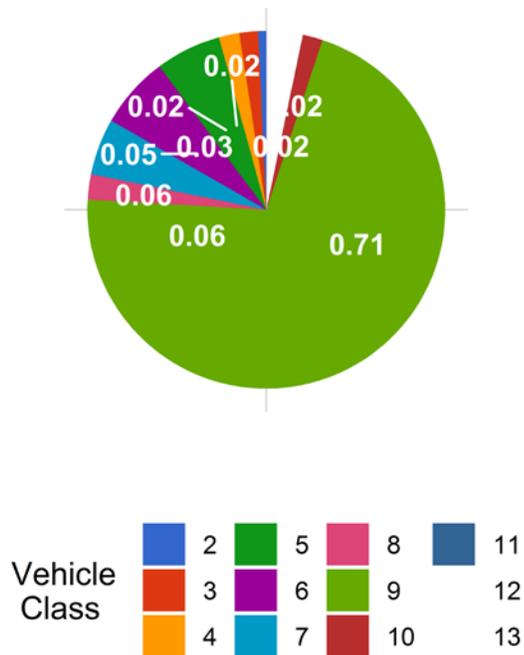


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
December 2018	10.79	0	10.54	0

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	0	0	0	0
2	5680	176095	62.2	0	0
3	3005	93170	32.9	0	0
4	9	285	0.1	10	0.6
5	127	3926	1.4	63	3.8
6	38	1184	0.4	92	5.6
7	10	318	0.1	170	10.3
8	19	596	0.2	16	1
9	238	7375	2.6	1164	70.3
10	5	152	0.1	49	3
11	0	2	0	0	0
12	3	106	0	89	5.4
13	1	17	0	3	0.2
TOTAL	9136	283227	100	1656	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>
2018-12-05	Wednesday	14:25:55	10	SB	2	98.79
2018-12-12	Wednesday	18:07:36	9	SB	2	97.13
2018-12-07	Friday	09:30:33	9	NB	1	96.92
2018-12-20	Thursday	02:28:35	9	SB	2	96.16
2018-12-12	Wednesday	05:01:06	9	NB	1	92.97
2018-12-29	Saturday	12:41:10	10	NB	1	92.26
2018-12-05	Wednesday	15:52:39	9	SB	2	92.16
2018-12-04	Tuesday	14:46:34	9	NB	1	91.6
2018-12-03	Monday	22:25:59	10	SB	2	91.28
2018-12-26	Wednesday	05:09:30	9	NB	1	91.11

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	NB	15	111	22	19.8	2953	289	809
5	NB	8	1955	352	18	22539	2565	4857
6	NB	19	463	99	21.4	11947	1749	2515
7	NB	11.5	285	0	0	20302	0	8512
8	NB	31	232	74	31.9	5945	1600	524
9	NB	33	3556	491	13.8	194962	14735	46908
10	NB	33.5	104	11	10.6	6755	247	1820
11	NB	36.5	1	0	0	39	0	1
12	NB	36.5	104	0	0	9072	0	2638
13	NB	31.5	5	0	0	357	0	100
TOTAL	****	****	6816	1049	****	274870	****	68684
<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	SB	15	172	29	16.9	5104	383	1479
5	SB	8	1941	374	19.3	21202	2727	4333
6	SB	19	712	116	16.3	18954	1989	3815
7	SB	11.5	31	0	0	1651	0	647
8	SB	31	359	201	56	6007	4883	555
9	SB	33	3762	1381	36.7	128259	38697	24843
10	SB	33.5	47	10	21.3	2312	291	536
11	SB	36.5	1	0	0	44	0	4
12	SB	36.5	1	0	0	87	0	25
13	SB	31.5	12	0	0	899	0	261
TOTAL	****	****	7038	2111	****	184520	****	36498
GRAND TOTAL	****	****	13854	3160	282	459390	70155	105183

Table 5 Gross Vehicle Weight by Class and Lane

<i>Vehicle Class</i>	<i>NB</i>	<i>SB</i>	<i>Total</i>	<i>Percentage</i>
2	335244	336310	671554	38.7
3	264062	268570	532632	30.7
4	3243	5487	8729	0.5
5	25103	23928	49032	2.8
6	13696	20944	34639	2
7	20302	1651	21953	1.3
8	7545	10890	18435	1.1
9	209697	166956	376653	21.7
10	7002	2603	9605	0.6
11	39	44	84	0
12	9072	87	9159	0.5
13	357	899	1256	0.1
TOTAL	895360	838370	1733730	100
GVW/LANE	51.64	48.36	100	0.01

Table 6 ESALs by Class and Lane and Flexible ESAL Factors

<i>Vehicle Class</i>	<i>NB</i>	<i>SB</i>	<i>Total</i>	<i>Percentage</i>	<i>Flexible ESAL Factor</i>
2	34	34	68	0.7	8e-04
3	75	82	158	1.7	0.0035
4	64	108	172	1.8	1.22
5	310	243	553	5.9	0.29
6	272	334	606	6.5	1.04
7	450	26	476	5.1	2.98
8	106	107	213	2.3	0.73
9	4498	2105	6603	70.8	1.81
10	132	36	168	1.8	2.16
11	0	0	1	0	0.94
12	284	2	286	3.1	5.01
13	5	15	20	0.2	1.77
TOTAL	6229	3093	9322	100	18
ESALS/LANE	66.8	33.2	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	268418	8659	458	254206	94.7	14212.3	5.3
Feb 2018	248161	8863	485	234584	94.5	13577.4	5.5
Mar 2018	300952	9708	512	285074	94.7	15877.5	5.3
Apr 2018	295692	9856	706	274499	92.8	21192.8	7.2
Dec 2018	283227	9136	450	269265	95.1	13962.3	4.9
TOTAL	1396450	-	-	1317628	-	78822	-
AVERAGE	279290	9244	522	263526	94	15764	6

ESALS

<i>Month</i>	<i>ESALS NB Driving Lane</i>	<i>ESALS SB Driving Lane</i>	<i>Total ESALS</i>	<i>Pavement Life Decrease Months</i>
Jan 2018	13225	63899	77125	1.3
Feb 2018	11909	24119	36029	6.6
Mar 2018	11420	6024	17444	68.7
Apr 2018	13423	12893	26316	74.2
Dec 2018	6281	3102	9384	0.7
TOTAL	56259	-	-	-
AVERAGE	11252	22008	33259	30

Gross Vehicle Weight

<i>Month</i>	<i>GVW NB Driving Lane</i>	<i>GVW SB Driving Lane</i>	<i>Total GVW Kips</i>
Jan 2018	1042006	768108	1810114
Feb 2018	948019	737183	1685202
Mar 2018	1086885	932878	2019763
Apr 2018	1173322	1114993	2288315
Dec 2018	897732	839106	1736837
TOTAL	5147964	4392268	9540231
AVERAGE	1029593	878454	1908046

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	3654	1.4	25.6	1662	489
Feb 2018	3229	1.3	23.6	1516	439
Mar 2018	3678	1.2	23.1	1479	255
Apr 2018	5931	2	27.9	2151	333
Dec 2018	1669	0.6	12	73	10
TOTAL	18161	-	-	6881	1526
AVERAGE	3632.2	1.3	22.4	1376.2	305.2

Freight

<i>Month</i>	<i>NB Freight Tons</i>	<i>SB Freight Tons</i>	<i>Total Freight</i>	<i>NB Freight %</i>	<i>SB Freight %</i>
Jan 2018	99729	40337	140066	71.2	28.8
Feb 2018	90246	41109	131355	68.7	31.3
Mar 2018	91109	62730	153839	59.2	40.8
Apr 2018	104039	121316	225355	46.2	53.8
Dec 2018	68684	36498	105183	65.3	34.7
TOTAL	453808	301990	755798	-	-
AVERAGE	90761.7	60398	151159.6	62.1	37.9