

FEBRUARY 2019



**WIM #46
CSAH 1,
MP 11.4
WEST
CONCORD, MN**

**MONTHLY
REPORT**



Your Destination... Our Priority



WIM Site Location

WIM #46 is located on CSAH 1 near West Concord in Dodge county.

System Operation

WIM #46 was operational for the entire month of February 2019. Volume was computed using all monthly data.

System Calibration

WIM #46 was most recently calibrated on 2016-12-19. Table 1 summarizes the front axle weights of class 9s by lane ¹. 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: 7714 | Passenger Vehicles: 6604 | Heavy Commercial Vehicles: 1110

Monthly Average Daily Traffic (MADT): 276 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 40

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 05 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 05 PM. See Figure 6. Out of all HCVs, the two highest traffic volumes were generated by Class 9's and Class 14's.

Overweight HCVs

Volume trends. Of a total of 1110 HCVs, 429 of them were overweight ³. These overweight HCVs contributed to 7.6% of total monthly volume, and 51.7% 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 Tuesdays, 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, with 78% of all overweight vehicles traveling SB 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 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 ,85 NB vehicles exceeded 88,000 pounds (75 vehicles were Class 9's; 6 vehicles were Class 13's). Of vehicles traveling SB,

149 NB vehicles exceeded 88,000 pounds (146 vehicles were Class 9's; 3 vehicles were Class 14'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 9s and 10s in February 2019. Data suggests that there were greater numbers of fully_loaded Class 9's than empty Class 9's traveling NB, while there were more fully_loaded Class 9's than empty 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 13114 tons of freight was recorded to have crossed the WIM. More freight was shipped SB (73%) than NB (27%). See Table 4 and Figure 11 for more freight information.

Infrastructure Considerations

Bridge. Bridge No. 91587 (a precast pipe arch) is approximately 4.2 miles south of WIM #46. Bridge No. 91588 (a precast pipe arch) is approximately 7.8 miles south of WIM #46. WIM #46 recorded a total of 7714 vehicles with a combined GVW of 72713 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 2837 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 82.7% of all ESALs were recorded SB while 17.3% was observed NB. In particular, 56% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 57% 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).

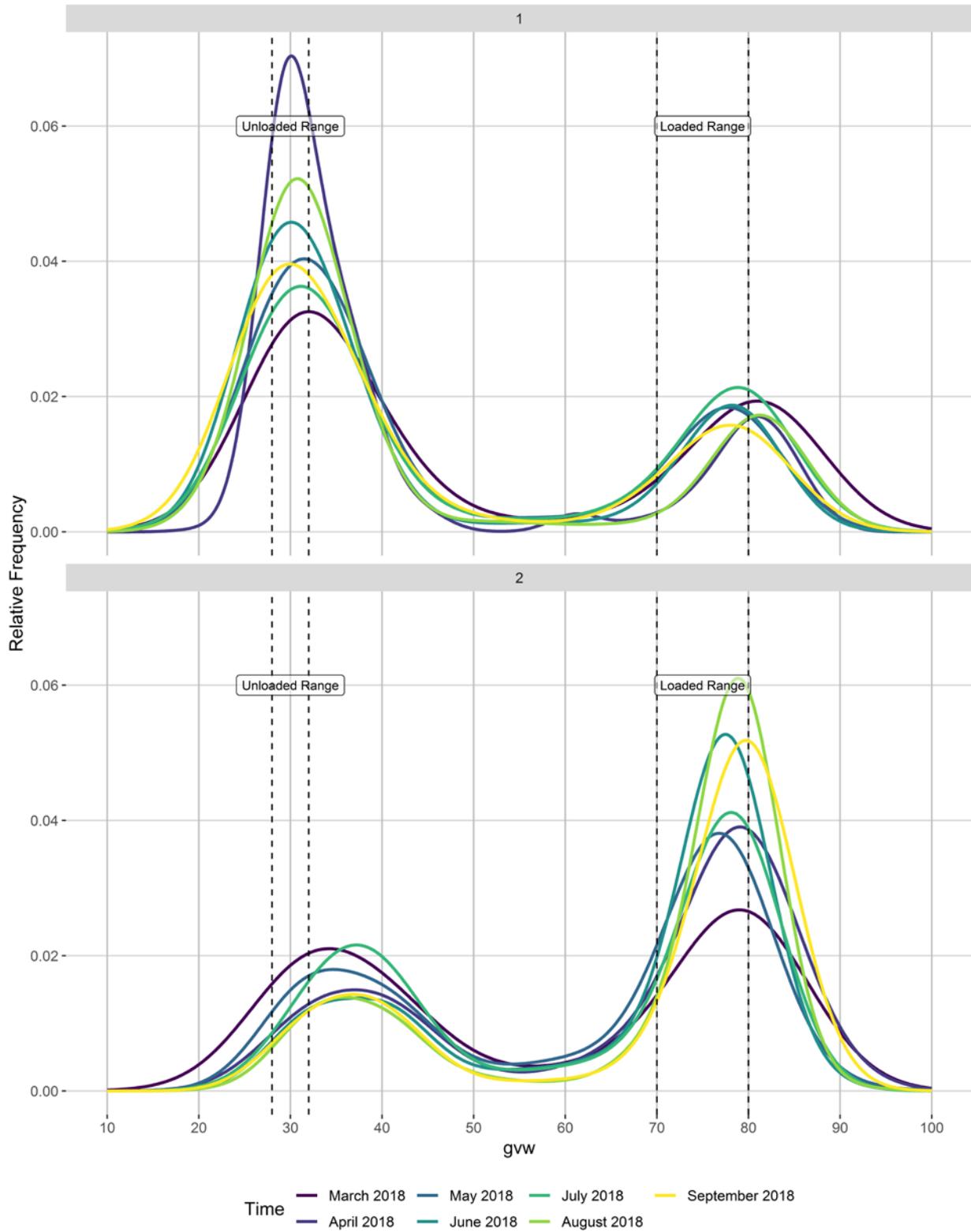
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

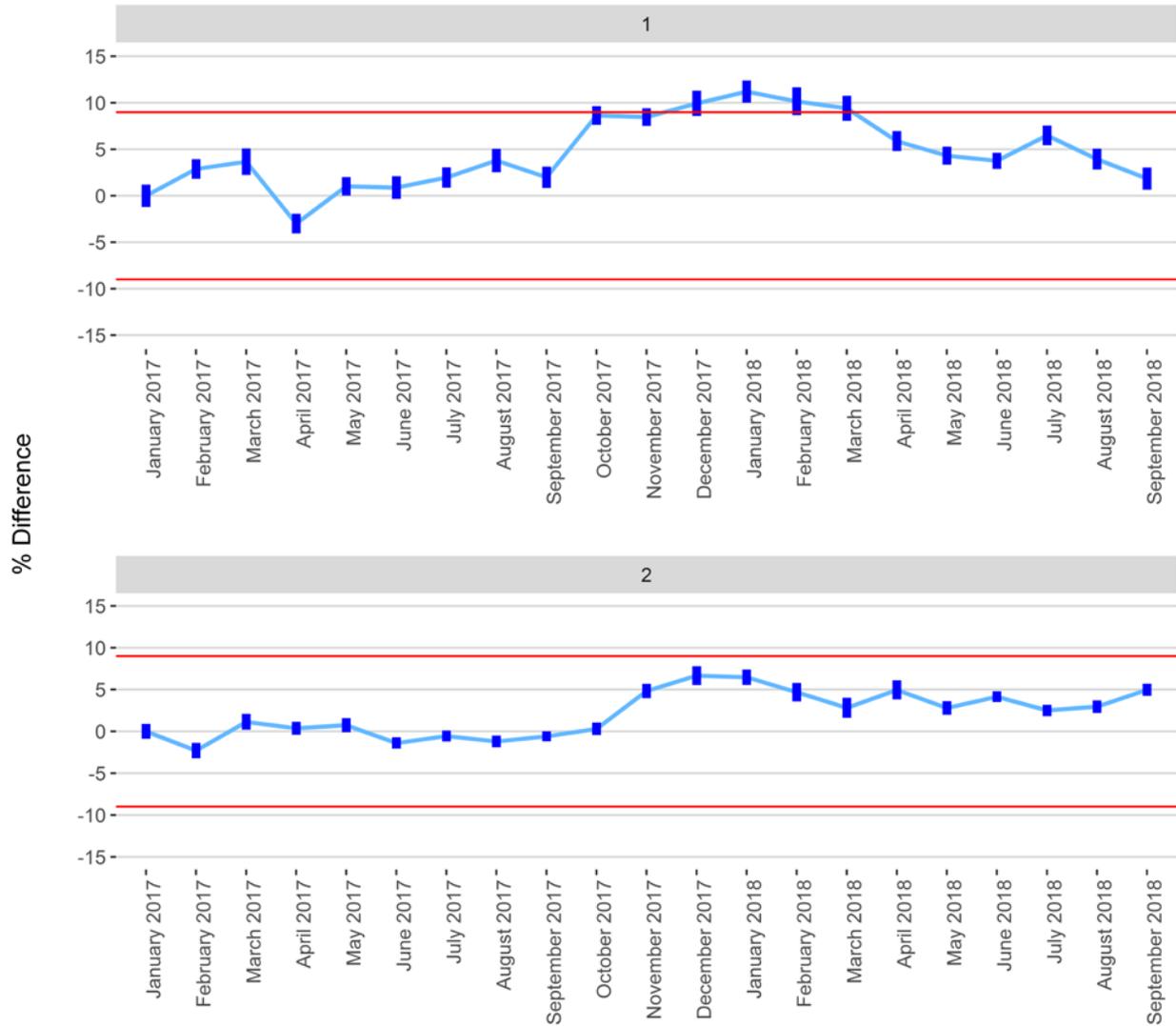
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

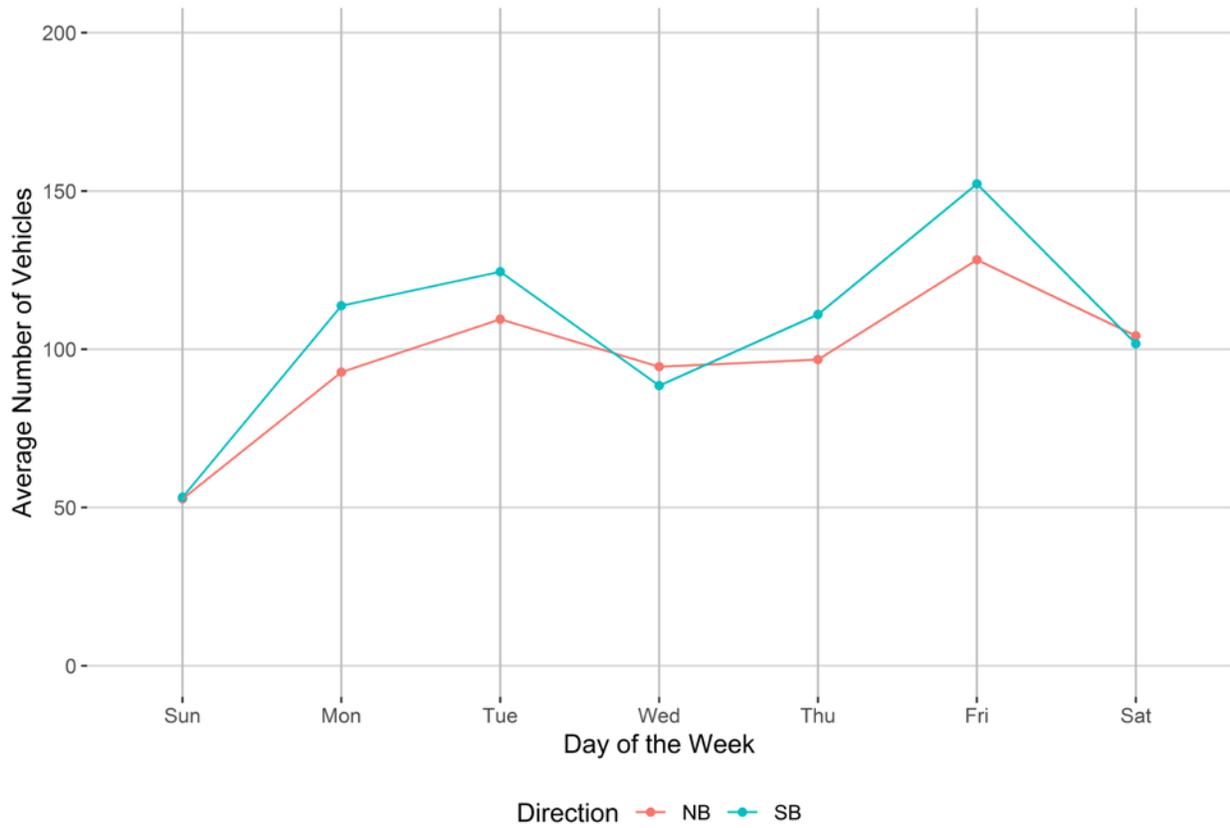


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

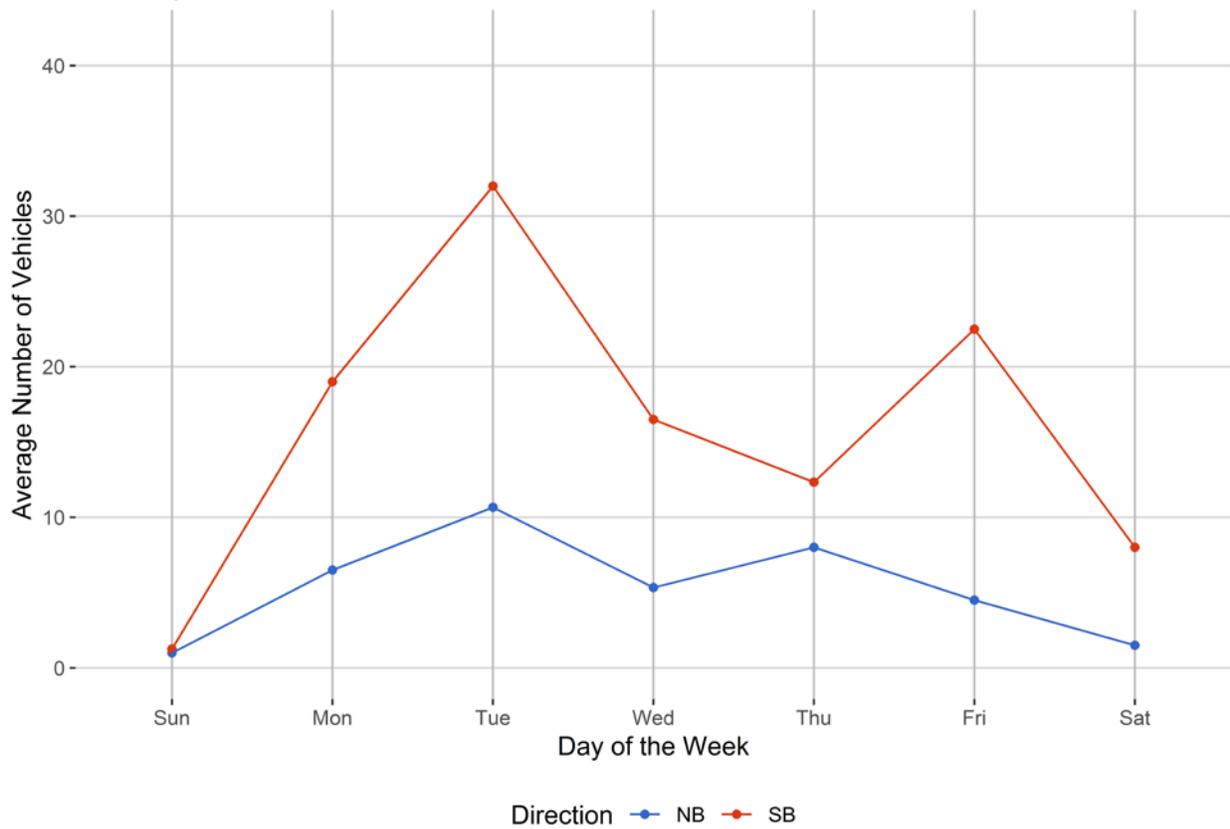


Figure 4 - Passenger Vehicles vs. Hour of the Day

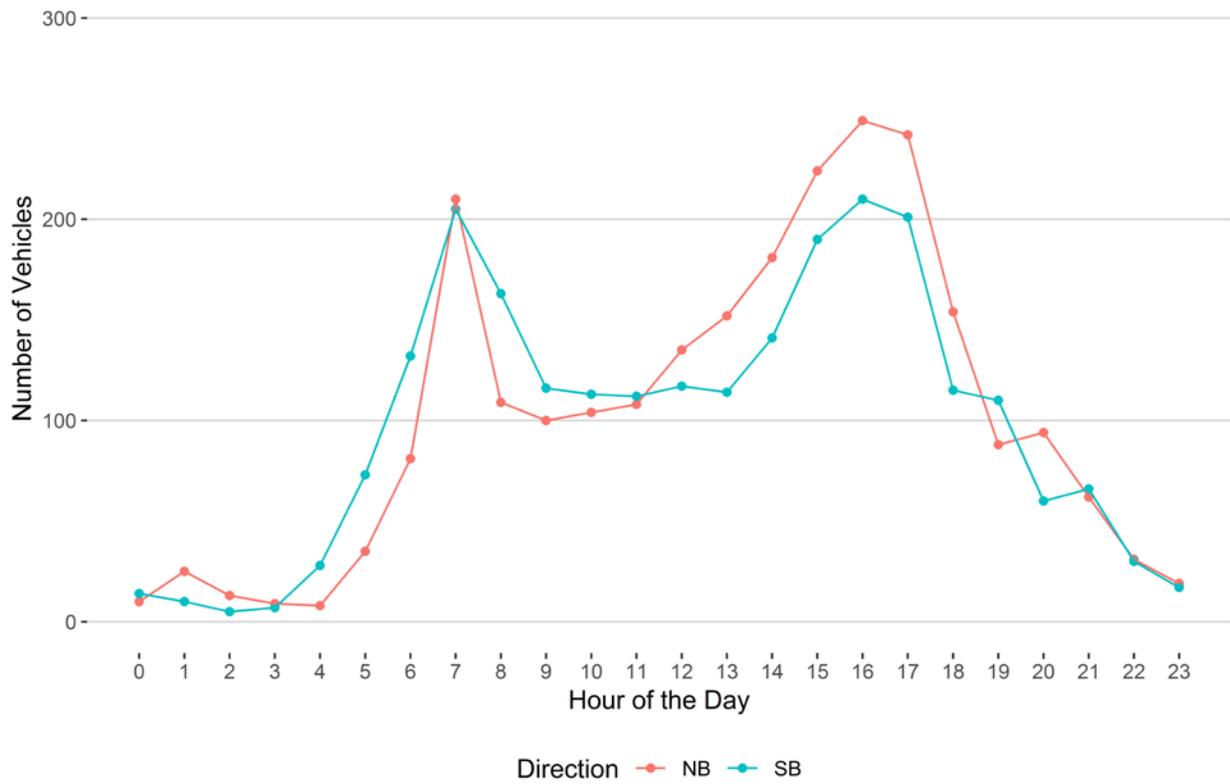


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

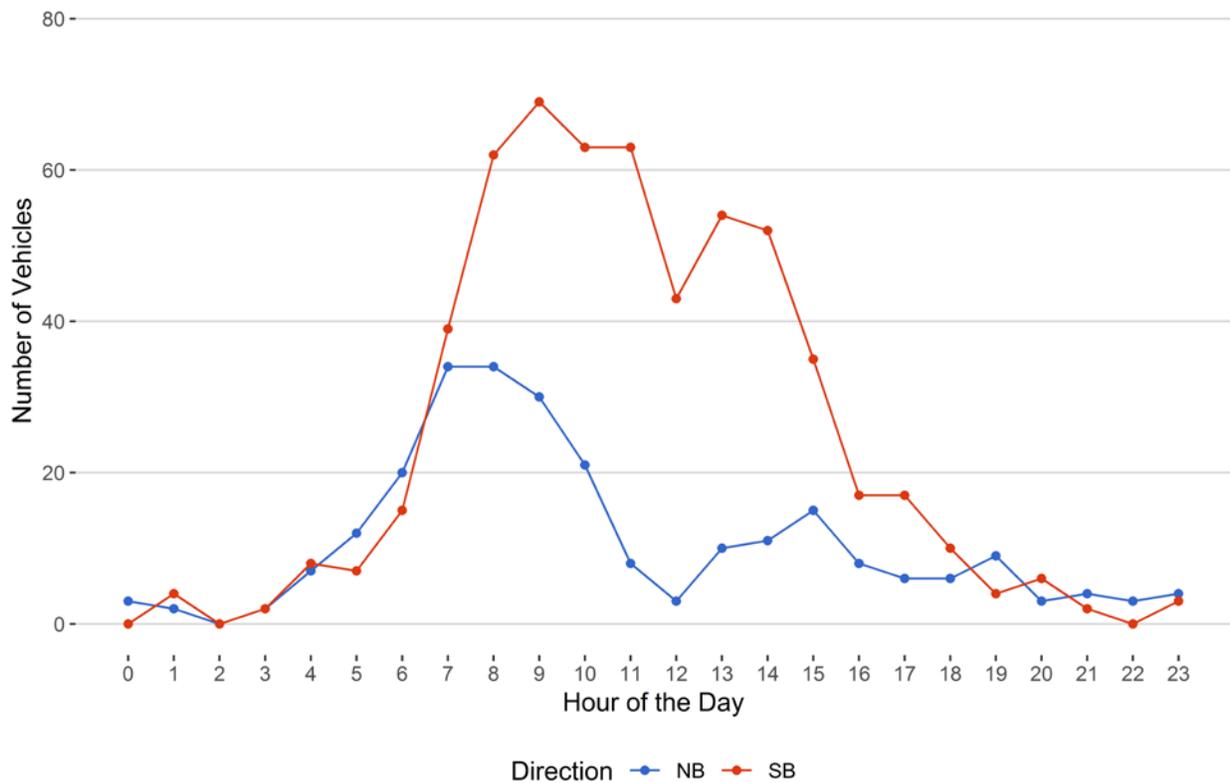


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

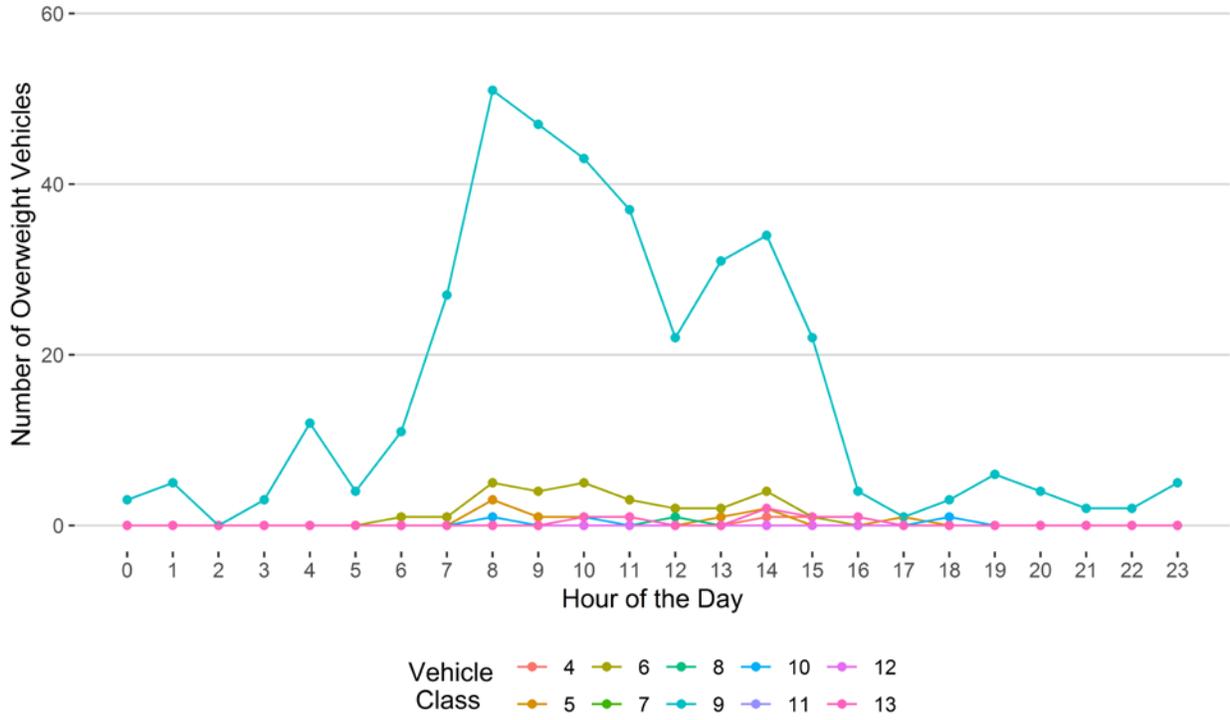


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

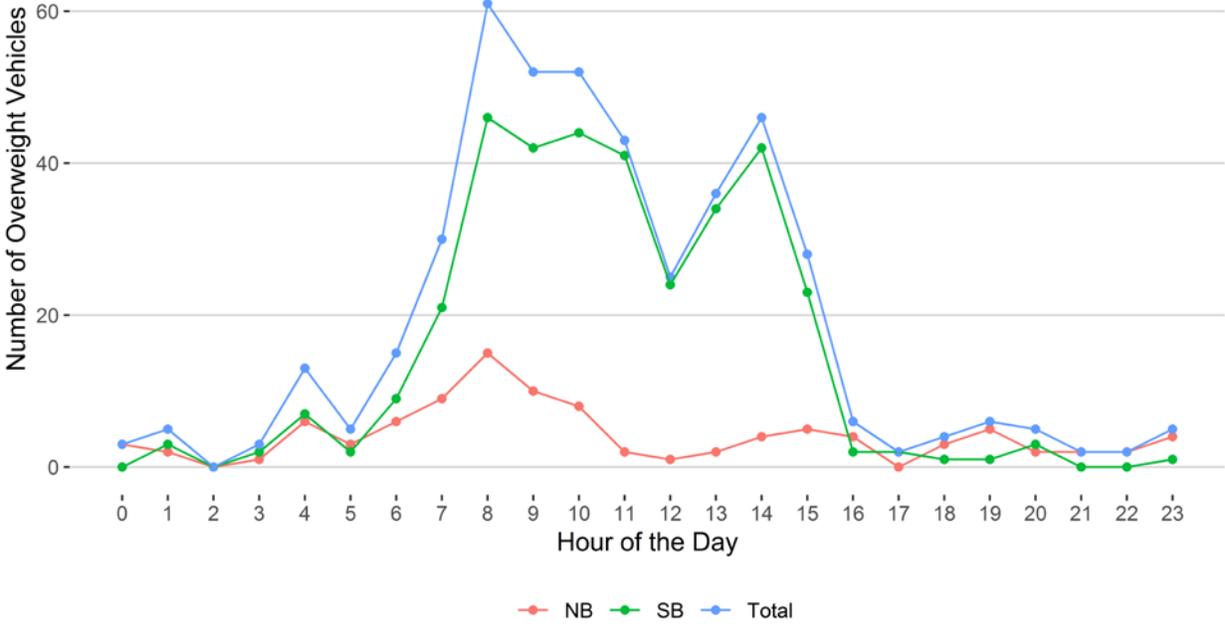
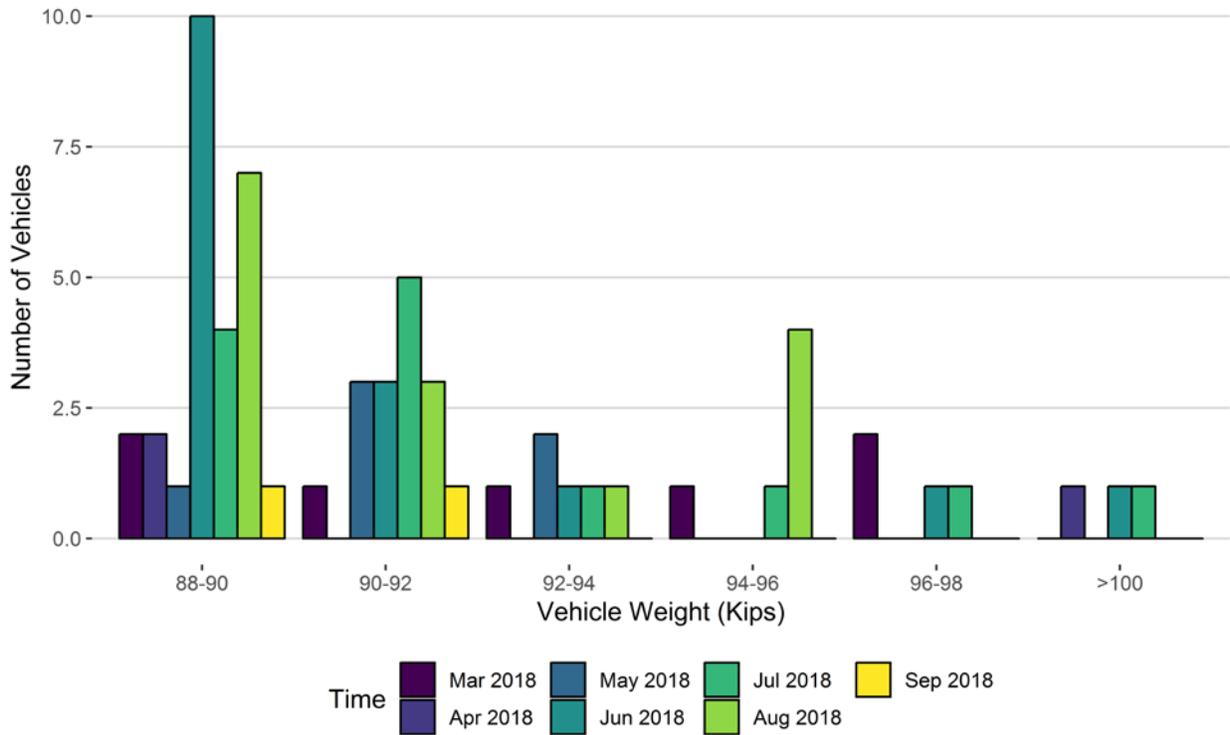
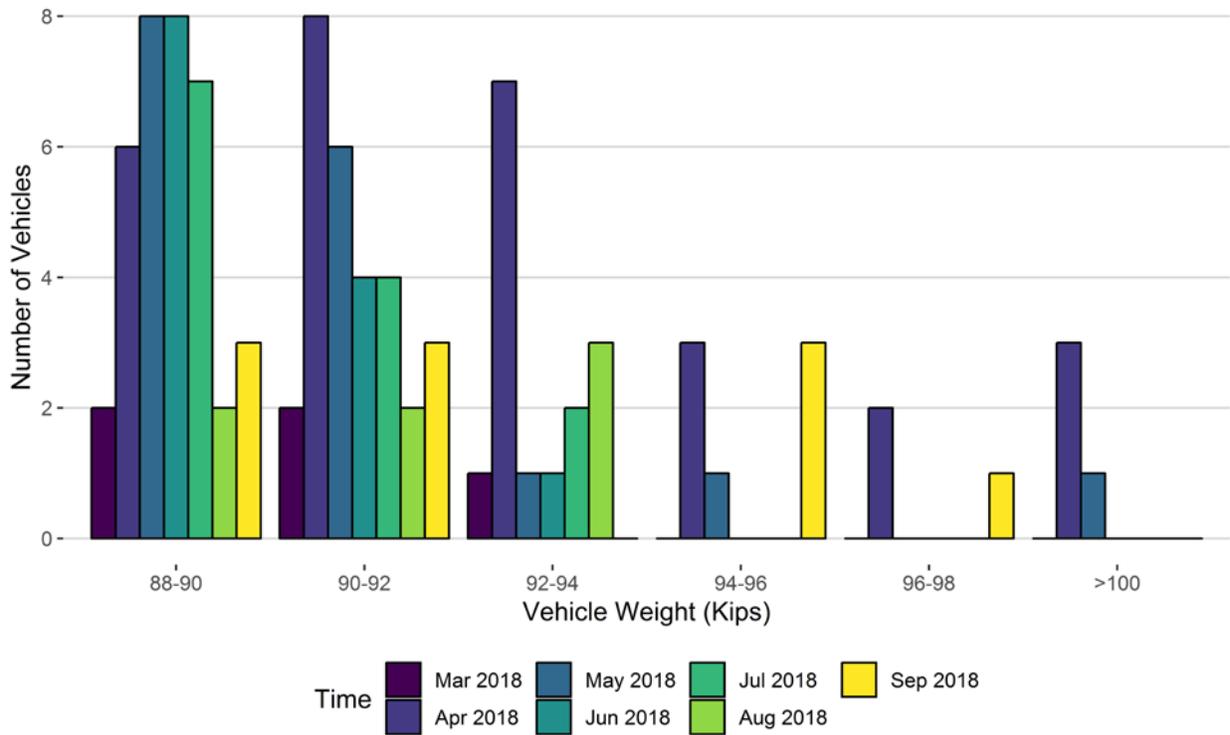


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



<i>Vehicle Weights (Kips)</i>	<i>Mar 2018</i>	<i>Apr 2018</i>	<i>May 2018</i>	<i>Jun 2018</i>	<i>Jul 2018</i>	<i>Aug 2018</i>	<i>Sep 2018</i>
88-90	2	2	1	10	4	7	1
90-92	1	0	3	3	5	3	1
92-94	1	0	2	1	1	1	0
94-96	1	0	0	0	1	4	0
96-98	2	0	0	1	1	0	0
>100	0	1	0	1	1	0	0
Total	7	3	6	16	13	15	2

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



<i>Vehicle Weights (Kips)</i>	<i>Mar 2018</i>	<i>Apr 2018</i>	<i>May 2018</i>	<i>Jun 2018</i>	<i>Jul 2018</i>	<i>Aug 2018</i>	<i>Sep 2018</i>
88-90	2	6	8	8	7	2	3
90-92	2	8	6	4	4	2	3
92-94	1	7	1	1	2	3	0
94-96	0	3	1	0	0	0	3
96-98	0	2	0	0	0	0	1
>100	0	3	1	0	0	0	0
Total	5	29	17	13	13	7	10

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

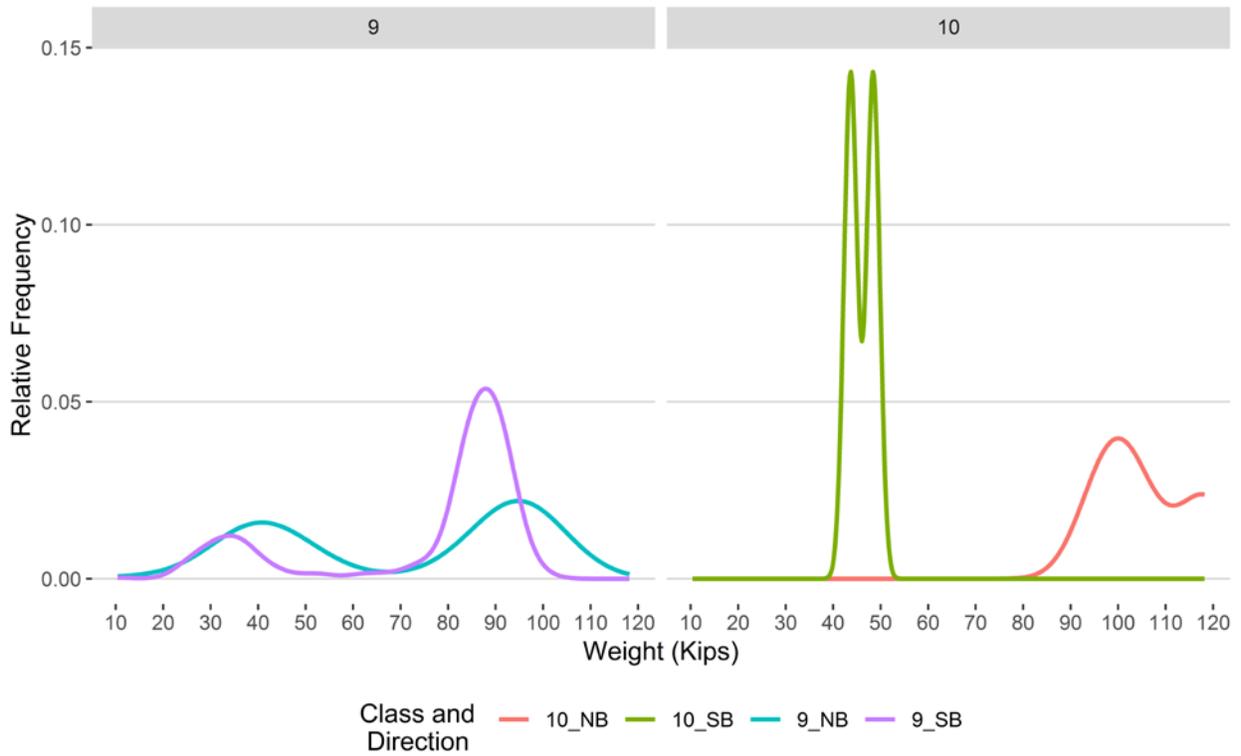


Figure 9 - Freight Percentage by Direction and Class

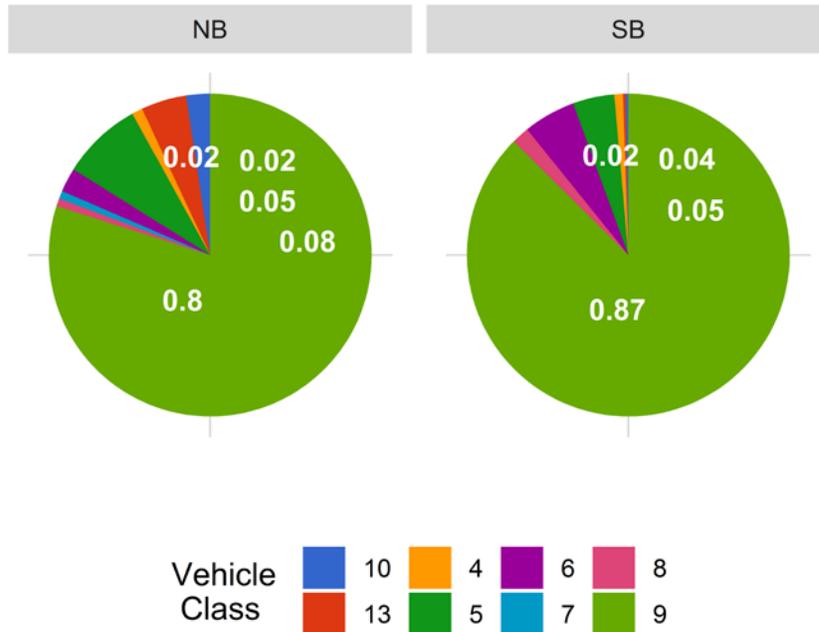


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

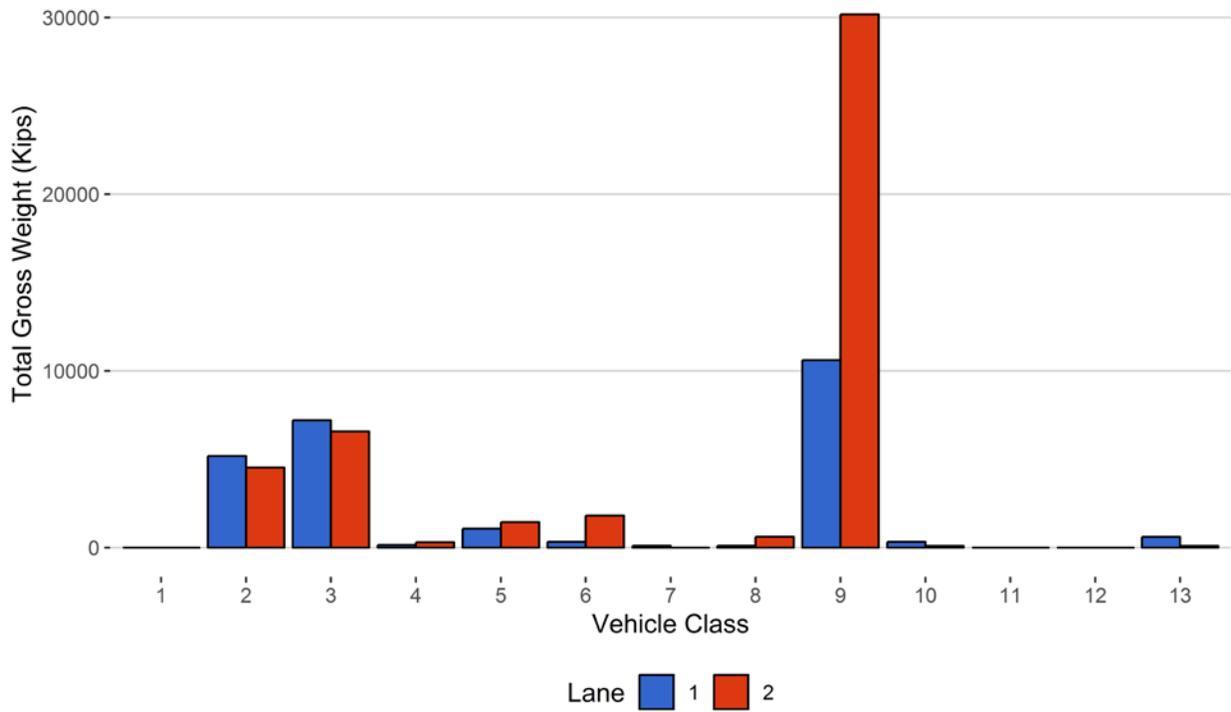


Figure 11 - Total Gross Vehicle Weight by

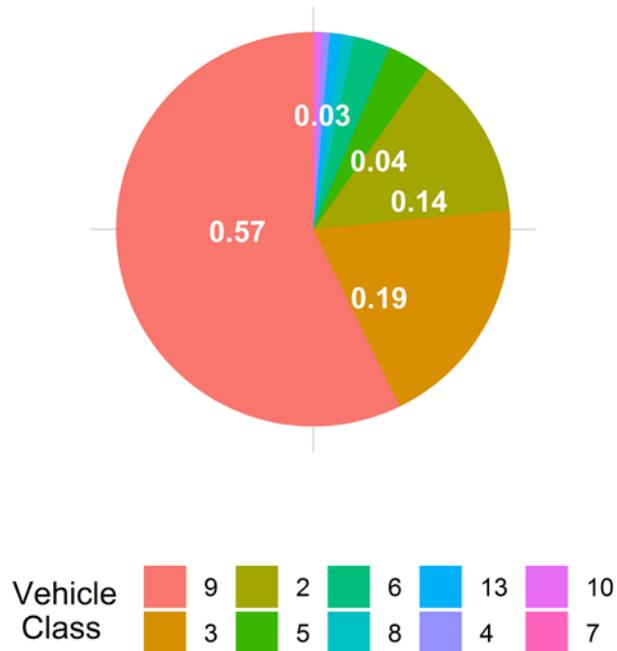


Figure 12 - Total ESALs by Class and Lane

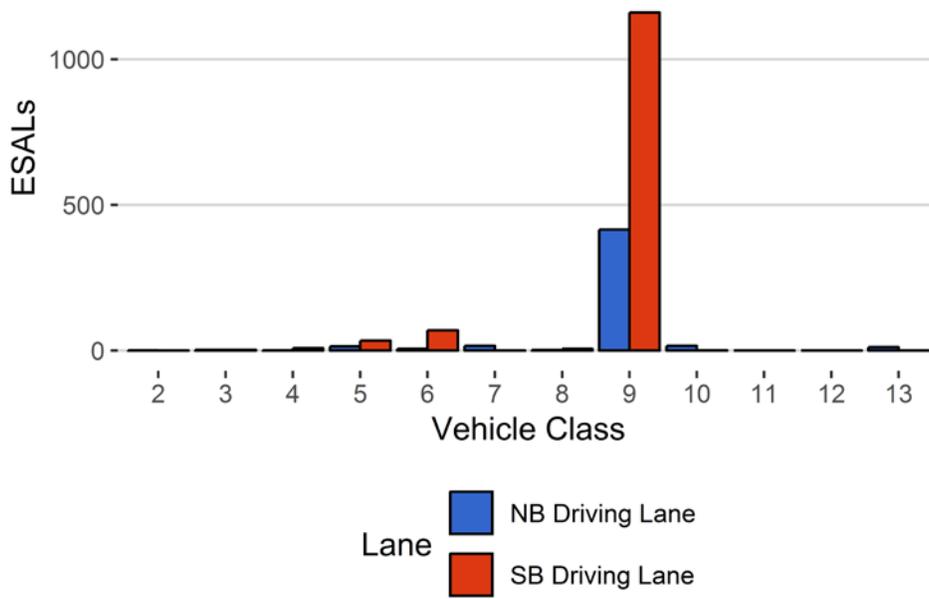


Figure 13 - ESALs by Class

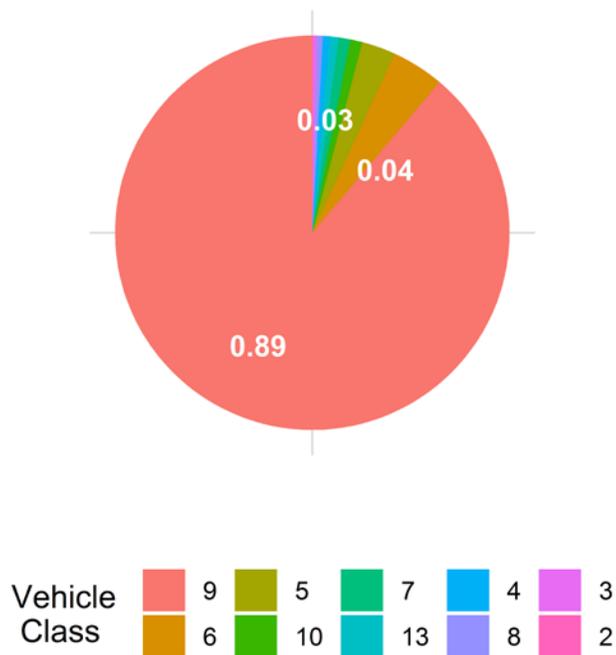


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
January 2017	9.68	0.00	9.86	0.00
February 2017	9.96	2.88	9.63	-2.29
March 2017	10.04	3.66	9.97	1.14
April 2017	9.39	-3.00	9.90	0.37
May 2017	9.78	1.02	9.93	0.74
June 2017	9.77	0.87	9.72	-1.39
July 2017	9.87	1.95	9.80	-0.56
August 2017	10.05	3.79	9.74	-1.21
September 2017	9.87	1.99	9.80	-0.60
October 2017	10.52	8.64	9.89	0.31
November 2017	10.50	8.46	10.34	4.83
December 2017	10.64	9.94	10.52	6.66
January 2018	10.77	11.21	10.50	6.47
February 2018	10.66	10.16	10.32	4.68
March 2018	10.59	9.41	10.14	2.82
April 2018	10.25	5.88	10.35	4.96
May 2018	10.10	4.32	10.14	2.79
June 2018	10.04	3.75	10.27	4.15
July 2018	10.31	6.49	10.11	2.51
August 2018	10.06	3.94	10.15	2.95
September 2018	9.86	1.84	10.35	4.97

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	124	3479	45.1	0	0
3	112	3125	40.5	0	0
4	1	19	0.2	2	0.5
5	8	234	3	9	2.1
6	2	67	0.9	28	6.5
7	0	1	0	1	0.2
8	1	32	0.4	1	0.2
9	26	734	9.5	379	88.3
10	0	7	0.1	3	0.7
11	0	0	0	0	0
12	0	0	0	0	0
13	1	16	0.2	6	1.4
TOTAL	276	7714	100	429	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>
2019-02-19	Tuesday	08:17:27	10	NB	1	118.2
2019-02-04	Monday	10:32:55	10	NB	1	103.09
2019-02-27	Wednesday	20:12:47	9	NB	1	101.87
2019-02-19	Tuesday	08:00:10	9	NB	1	101.75
2019-02-01	Friday	01:14:12	9	NB	1	101.74
2019-02-05	Tuesday	10:03:29	9	SB	2	101.72
2019-02-08	Friday	23:34:44	9	NB	1	100.85
2019-02-13	Wednesday	10:23:06	9	NB	1	100.73
2019-02-05	Tuesday	08:59:05	9	NB	1	100.55
2019-02-28	Thursday	09:07:13	9	NB	1	100.42

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	6	0	0	143	0	26
5	NB	8	74	4	5.4	1045	26	243
6	NB	19	11	1	9.1	303	19	56
7	NB	11.5	1	0	0	104	0	46
8	NB	31	4	3	75	36	68	2
9	NB	33	150	3	2	10543	61	2846
10	NB	33.5	3	0	0	318	0	109
13	NB	31.5	6	0	0	603	0	207
TOTAL	****	****	255	11	****	13094	****	3536
<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	8	1	12.5	281	15	88
5	SB	8	101	12	11.9	1349	86	318
6	SB	19	39	2	5.1	1772	34	535
8	SB	31	20	12	60	299	311	25
9	SB	33	399	39	9.8	29075	1109	8597
10	SB	33.5	2	0	0	92	0	13
13	SB	31.5	6	5	83.3	35	63	2
TOTAL	****	****	575	71	****	32903	****	9578
GRAND TOTAL	****	****	830	82	274	45997	1792	13114

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	5184	4534	9717	13.6
3	7207	6575	13782	19.3
4	143	296	438	0.6
5	1071	1435	2506	3.5
6	322	1806	2127	3
7	104	0	104	0.1
8	104	610	714	1
9	10604	30184	40788	57.2
10	318	92	410	0.6
13	603	97	701	1
TOTAL	25659	45629	71288	100
GVW/LANE	35.99	64.01	100	0.14

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	1	1	1	0.1	0.0019
3	3	3	6	0.3	0.0064
4	1	9	10	0.6	1.36
5	15	35	49	2.8	0.59
6	6	70	76	4.3	2.91
7	17	0	17	1	5.25
8	2	6	8	0.5	0.77
9	415	1160	1575	88.8	5.82
10	17	1	17	1	3.05
13	12	0	13	0.7	1.56
TOTAL	489	1285	1773	100	21
ESALS/LANE	27.6	72.5	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	10822	349	45	9412	87	1410	13
Apr 2018	10759	359	54	9130	84.9	1628.7	15.1
May 2018	14659	473	82	12128	82.7	2530.7	17.3
Jun 2018	14918	497	87	12313	82.5	2604.8	17.5
Jul 2018	13748	444	78	11319	82.3	2429.3	17.7
Aug 2018	13369	431	88	10655	79.7	2714.1	20.3
Sep 2018	12670	422	74	10446	82.4	2223.9	17.6
TOTAL	90945	-	-	75403	-	15541	-
AVERAGE	12992	425	73	10772	83	2220	17

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>
Mar 2018	541	630	1170	3.3
Apr 2018	462	863	1325	3.7
May 2018	753	1132	1885	6
Jun 2018	760	1414	2173	1.1
Jul 2018	931	1121	2053	0.3
Aug 2018	646	1491	2137	1.8
Sep 2018	476	1503	1979	2.5
TOTAL	4568	-	-	-
AVERAGE	652	1165	1818	3

Gross Vehicle Weight

<i>Month</i>	<i>GVW NB Driving Lane</i>	<i>GVW SB Driving Lane</i>	<i>Total GVW Kips</i>
Mar 18	53496	52160	105656
Apr 18	54103	59595	113698
May 18	81509	84194	165703
Jun 18	83916	92328	176243
Jul 18	84746	82653	167398
Aug 18	64139	80654	144793
Sep 18	53654	85064	138718
TOTAL	475563	536647	1012209
AVERAGE	67938	76664	144601

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	316	3.1	23.4	12	0
Apr 2018	365	3.6	23.6	32	4
May 2018	432	3.1	17.8	23	1
Jun 2018	518	3.6	20.5	29	1
Jul 2018	539	4.1	23	26	1
Aug 2018	643	6.2	30.5	22	0
Sep 2018	543	5	28.3	12	0
TOTAL	3356	-	-	156	7
AVERAGE	479.4	4.1	23.9	22.3	1

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>
Mar 2018	5578	6340	11918	46.8	53.2
Apr 2018	4982	9019	14001	35.6	64.4
May 2018	8683	12489	21172	41	59
Jun 2018	8623	15037	23660	36.4	63.6
Jul 2018	10708	12144	22852	46.9	53.1
Aug 2018	6551	14747	21298	30.8	69.2
Sep 2018	5185	14955	20140	25.7	74.3
TOTAL	50309	84732	135042	-	-
AVERAGE	7187.1	12104.6	19291.7	37.6	62.4