

DECEMBER 2019



**WIM #34
MN 23, MP 122.1
CLARA CITY, MN**

**MONTHLY
REPORT**



Your Destination...Our Priority



WIM Site Location

WIM #34 is located on MN 23 near Clara City in Chippewa county.

System Operation

WIM #34 was operational for the entire month of December 2019. Volume was computed using all monthly data.

System Calibration

WIM #34 was most recently calibrated on 2019-05-16. 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: 89110 | Passenger Vehicles: 75980 | Heavy Commercial Vehicles: 13130

Monthly Average Daily Traffic (MADT): 3116 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 424

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 Mondays. SB vehicles typically reached highest volume levels on Fridays, with lowest volumes reported on Wednesdays (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 02 PM and 04 PM. Similarly, SB PVs peaked in volume between 01 PM and 04 PM

Heavy Commercial Vehicles (HCVs)

Volume trends. On an average 24-hour day, HCVs traveling NB typically reached peak volume levels between 02 PM and 04 PM, while volume going SB peaked between 01 PM 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 13130 HCVs, 786 of them were overweight ³. These overweight HCVs contributed to 0.9% of total monthly volume, and 6.4% of total monthly

HCV volume. NB overweight vehicles typically reached highest numbers on Thursdays, 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 13 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 50.1% 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 June.

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 ,122 NB vehicles exceeded 88,000 pounds (100 vehicles were Class 13's; 18 vehicles were Class 10's). Of vehicles traveling SB,

28 NB vehicles exceeded 88,000 pounds (18 vehicles were Class 13's; 5 vehicles were Class 9's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from December 2019.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in December 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 87949 tons of freight was recorded to have crossed the WIM. More freight was shipped SB (55.8%) than NB (44.2%). See Table 4 and Figure 11 for more freight information.

####**Infrastructure Considerations Bridge.** Bridge No. 12012 is approximately 3.8 miles north of WIM #34, and Bridge No. 12004 is 3.1 miles south of WIM #34. WIM #34 recorded a total of 89110 vehicles with a combined GVW of 822330 kips (1 kip = 1,000 pounds = 0.5 tons) in December 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 10207 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 69.4% of all ESALs were recorded SB while 30.6% was observed NB. In particular, 50% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 44% 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:

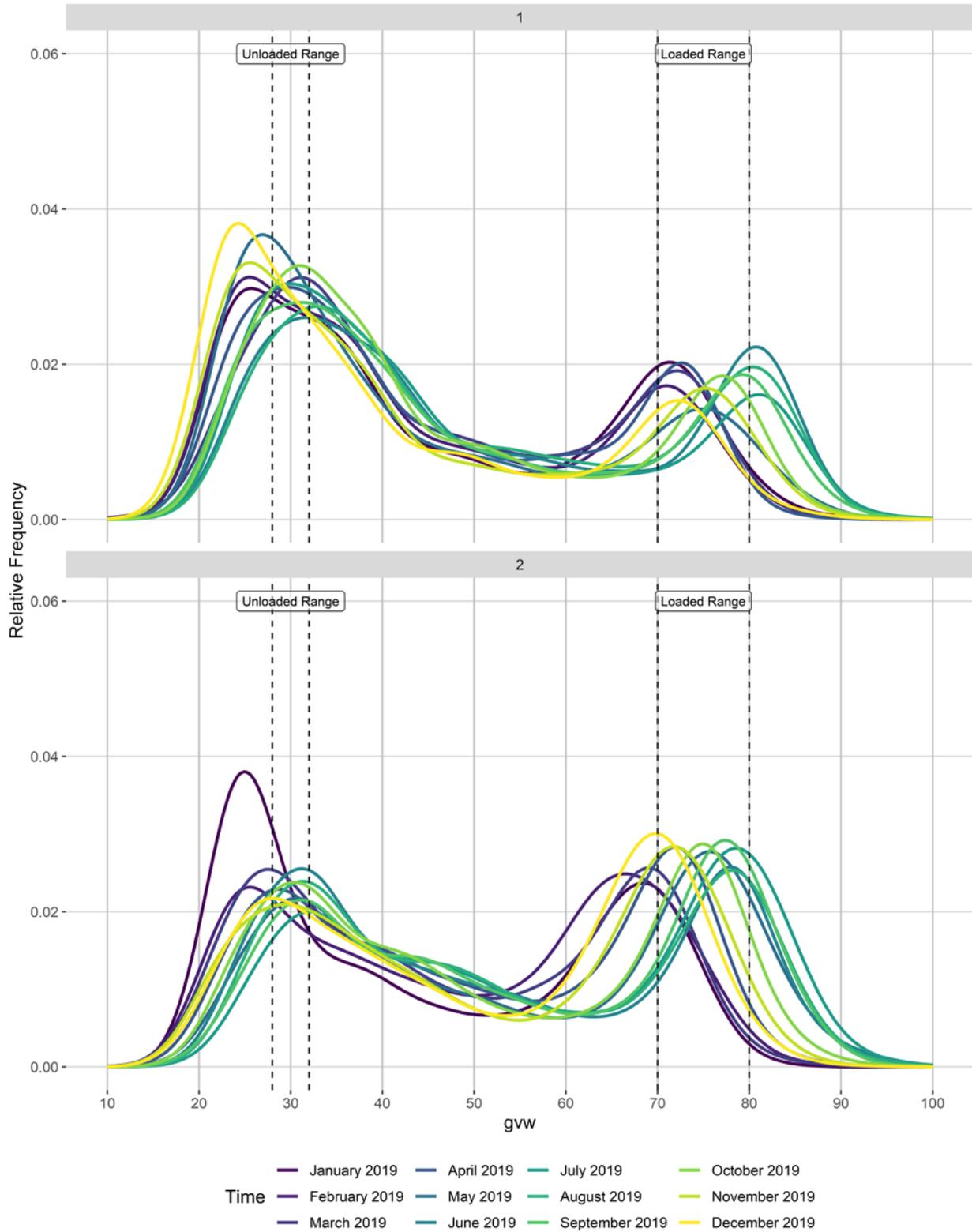
<http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html> MnDOT's vehicle

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.

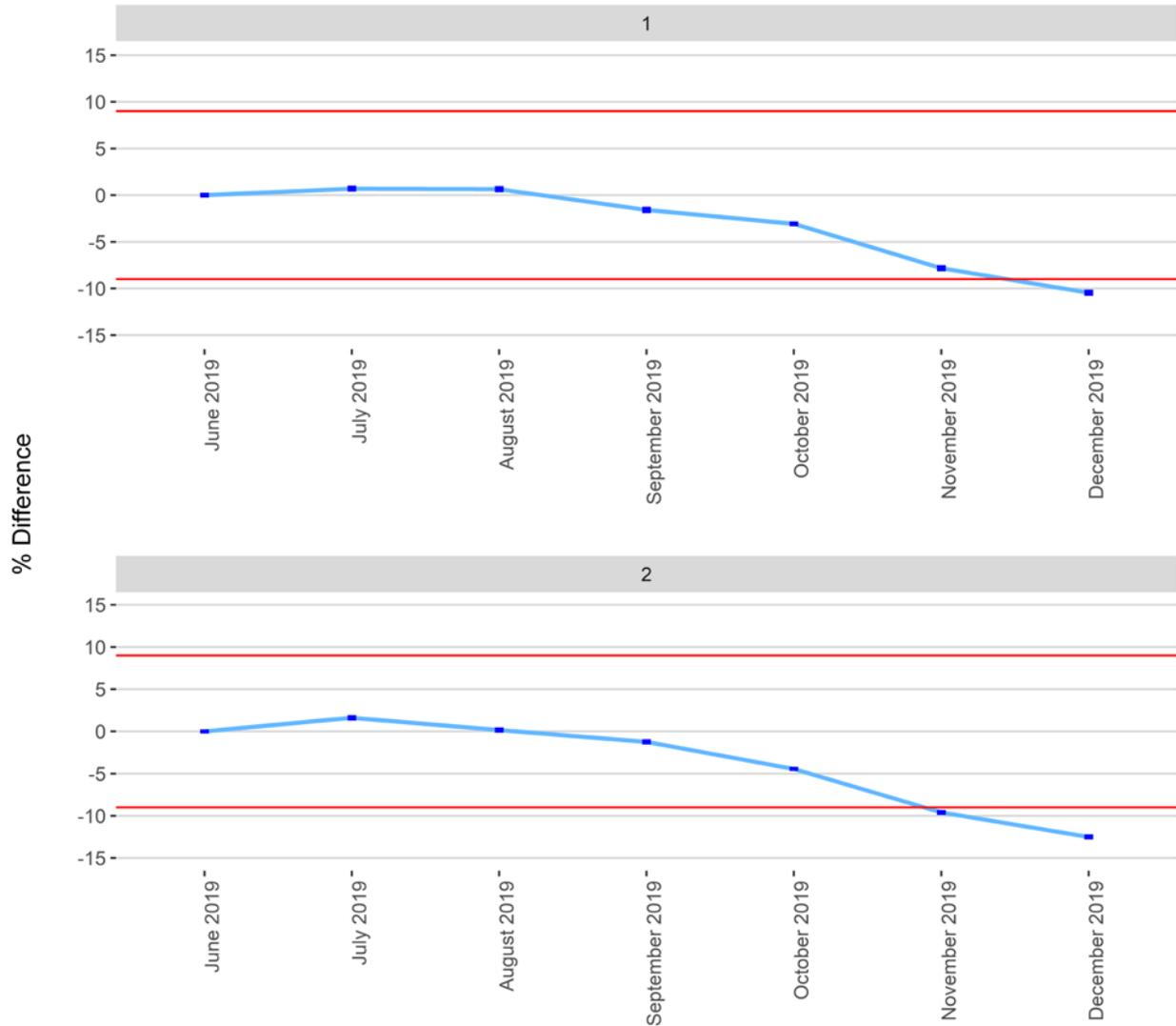
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

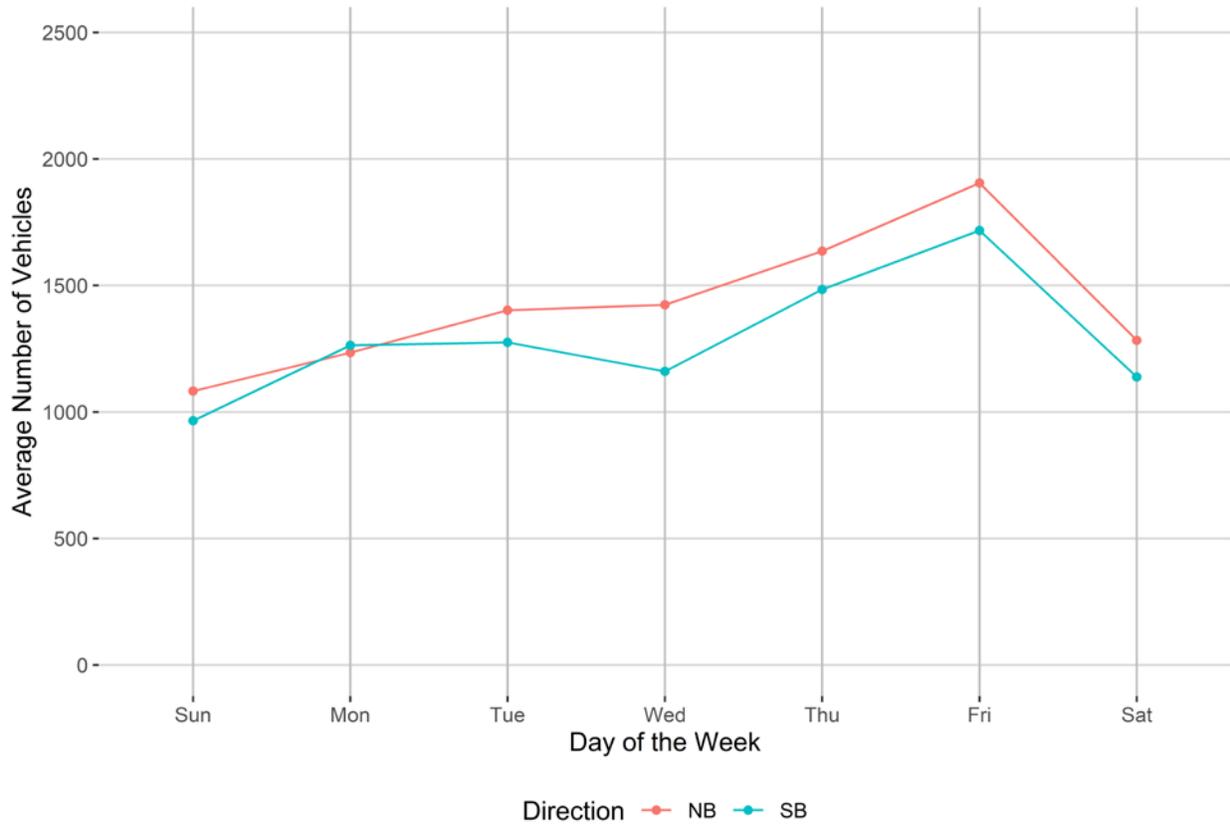


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

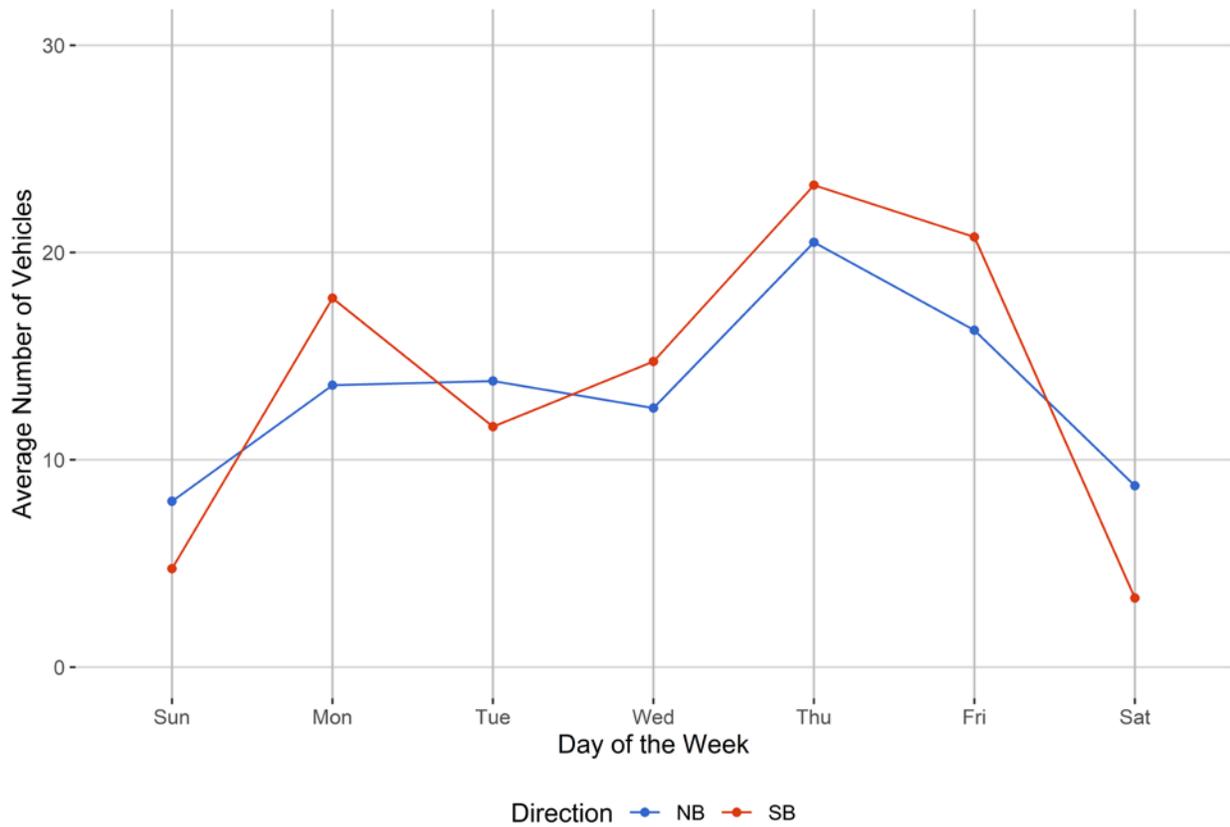


Figure 4 - Passenger Vehicles vs. Hour of the Day

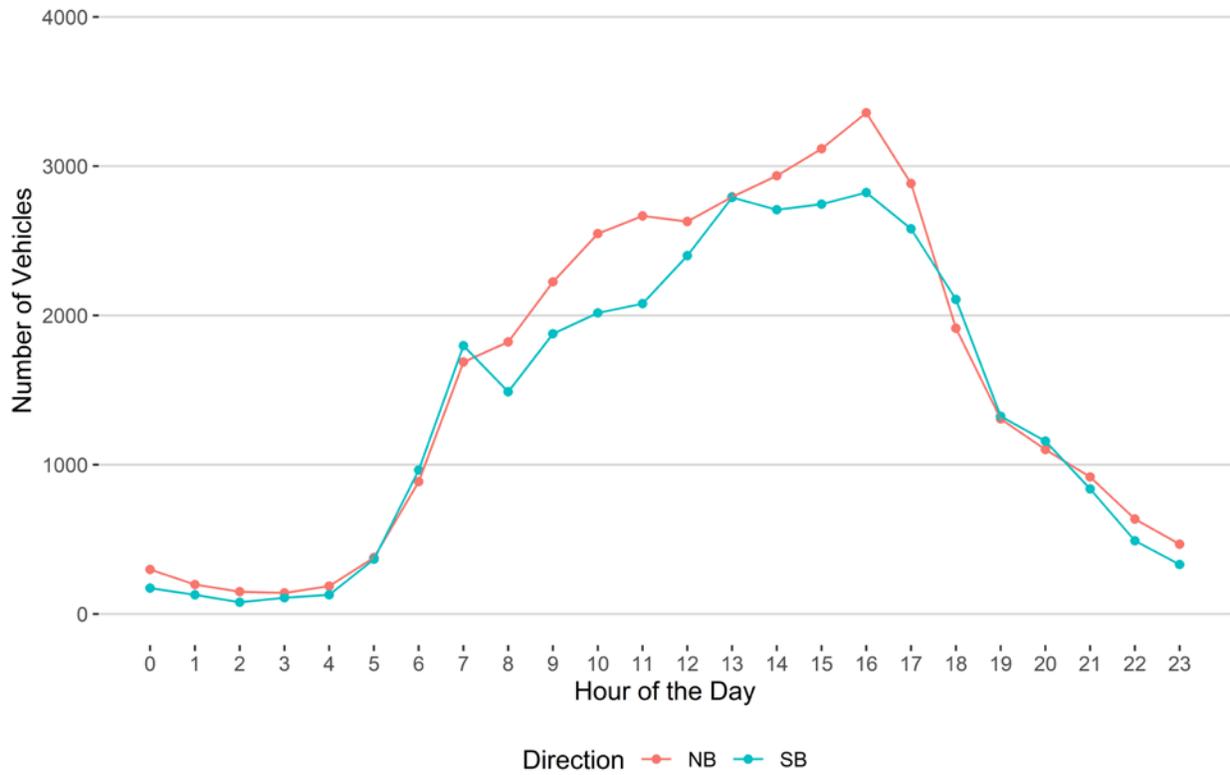


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

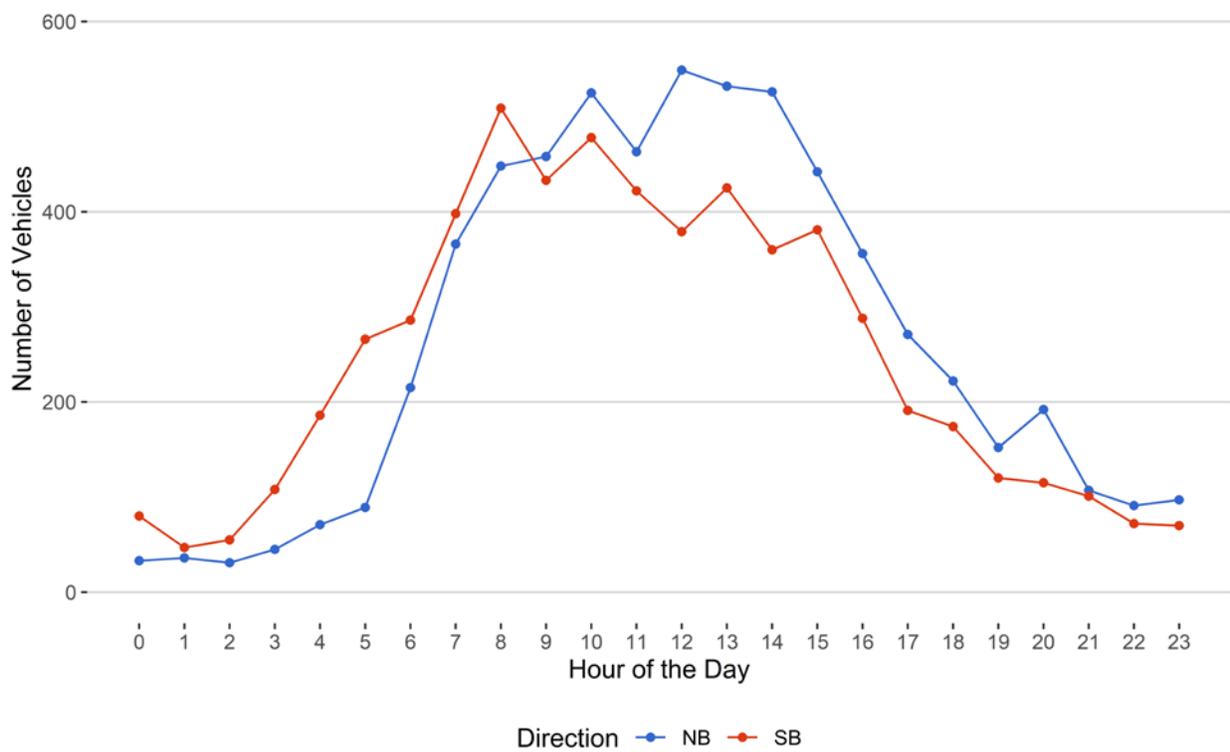


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

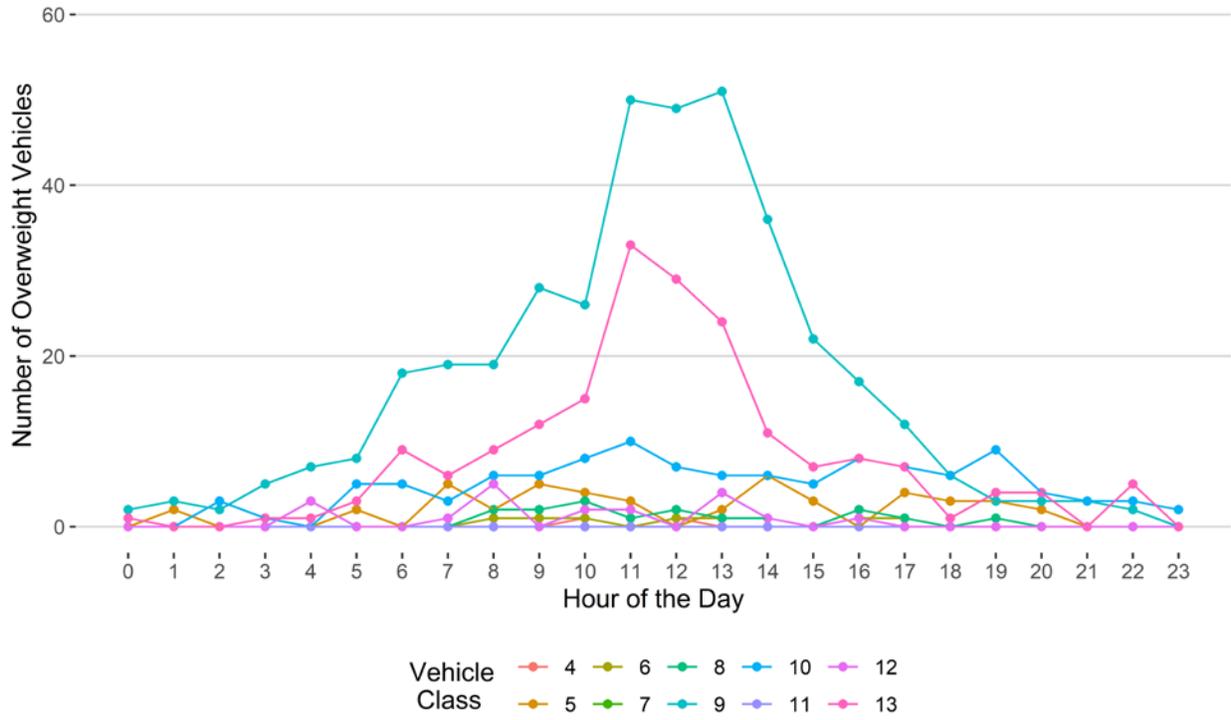


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

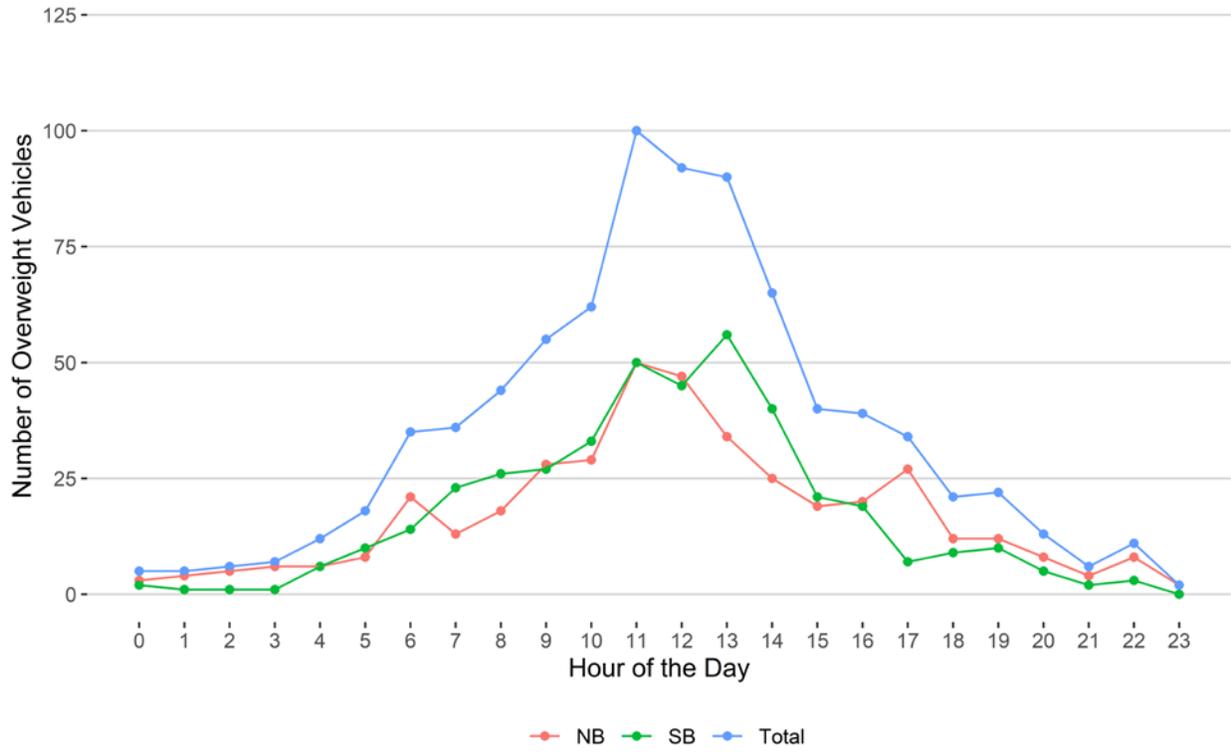
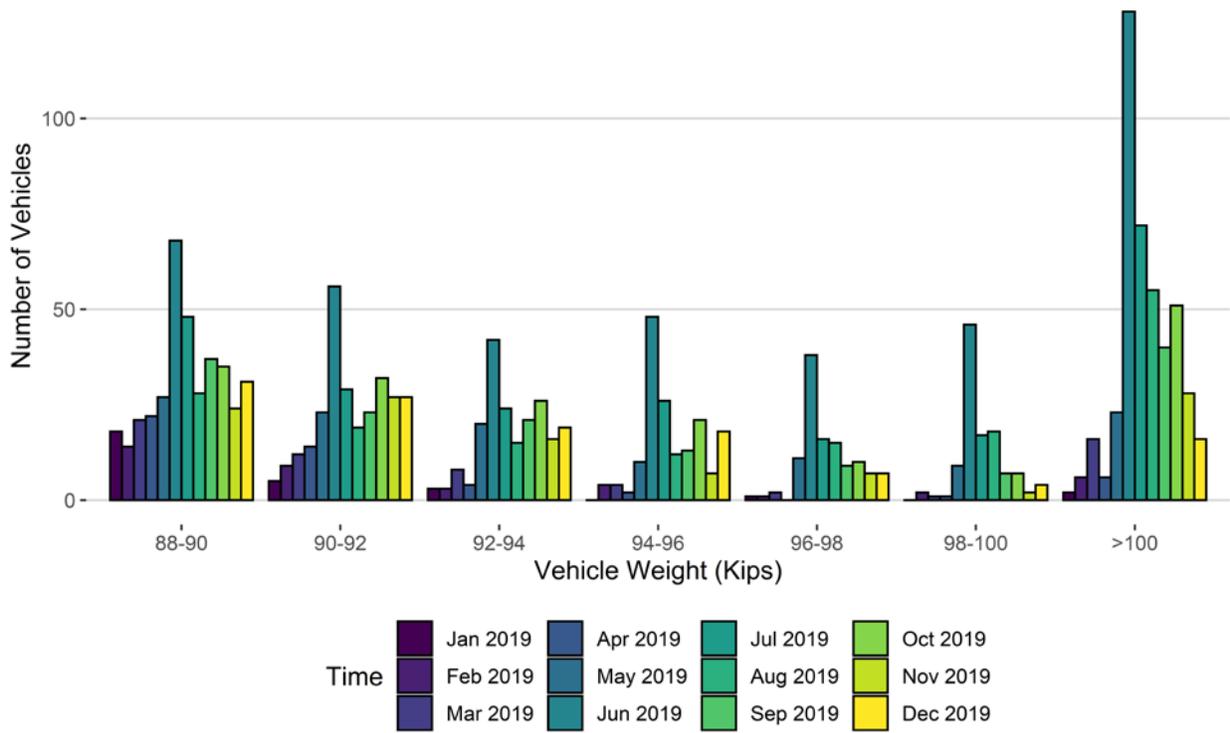
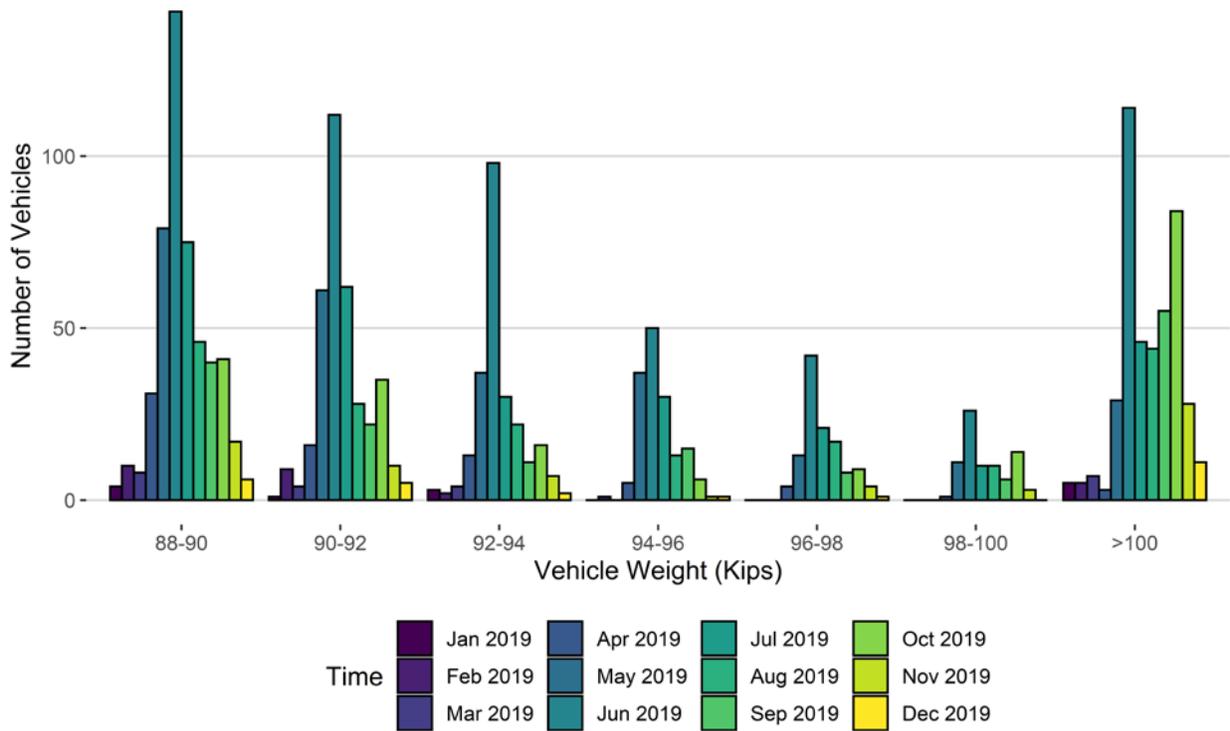


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019	Aug 2019	Sep 2019	Oct 2019	Nov 2019	Dec 2019
88-90	18	14	21	22	27	68	48	28	37	35	24	31
90-92	5	9	12	14	23	56	29	19	23	32	27	27
92-94	3	3	8	4	20	42	24	15	21	26	16	19
94-96	0	4	4	2	10	48	26	12	13	21	7	18
96-98	1	1	2	0	11	38	16	15	9	10	7	7
98-100	0	2	1	1	9	46	17	18	7	7	2	4
>100	2	6	16	6	23	128	72	55	40	51	28	16
Total	29	39	64	49	123	426	232	162	150	182	111	122

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



Vehicle Weights (Kips)	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019	Aug 2019	Sep 2019	Oct 2019	Nov 2019	Dec 2019
88-90	4	10	8	31	79	142	75	46	40	41	17	6
90-92	1	9	4	16	61	112	62	28	22	35	10	5
92-94	3	2	4	13	37	98	30	22	11	16	7	2
94-96	0	1	0	5	37	50	30	13	15	6	1	1
96-98	0	0	0	4	13	42	21	17	8	9	4	1
98-100	0	0	0	1	11	26	10	10	6	14	3	0
>100	5	5	7	3	29	114	46	44	55	84	28	11
Total	13	27	23	73	267	584	274	180	157	205	70	26

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

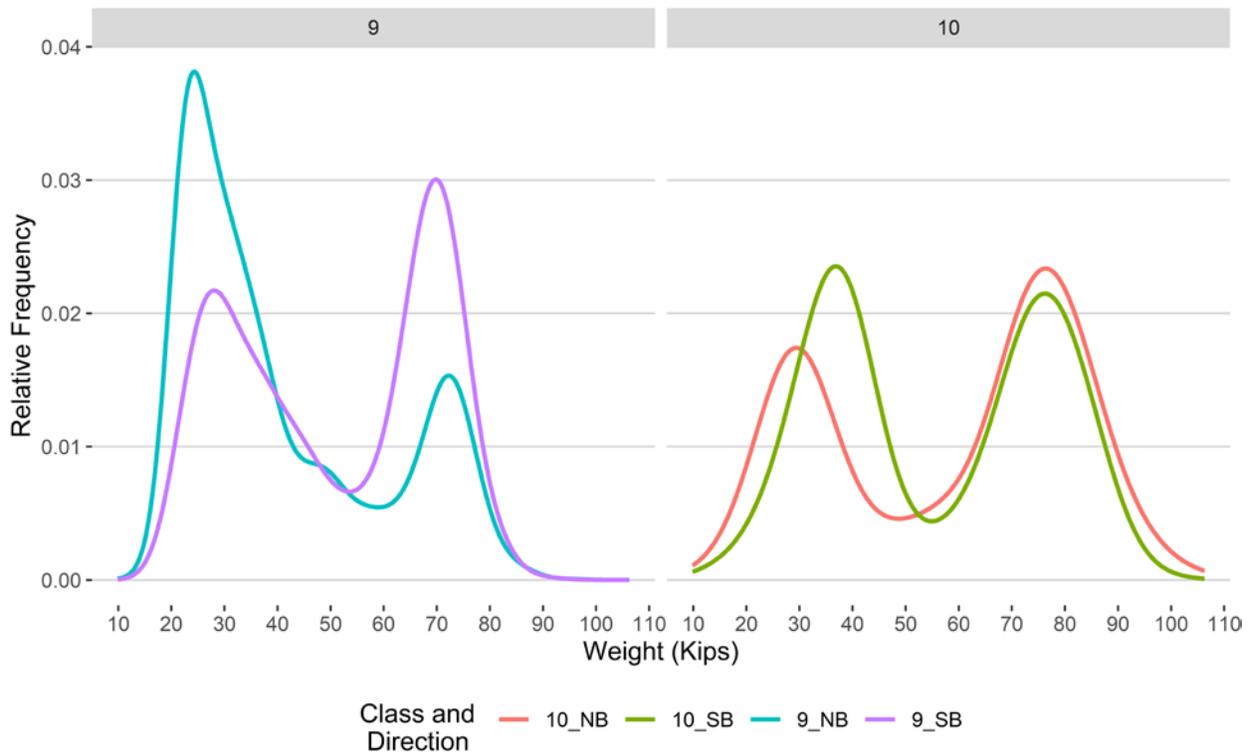


Figure 9 - Freight Percentage by Direction and Class

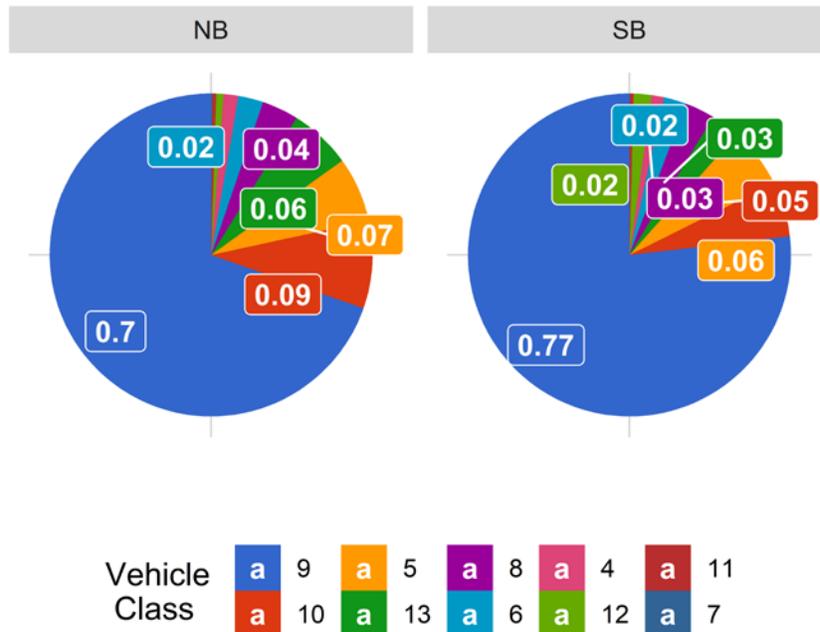


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

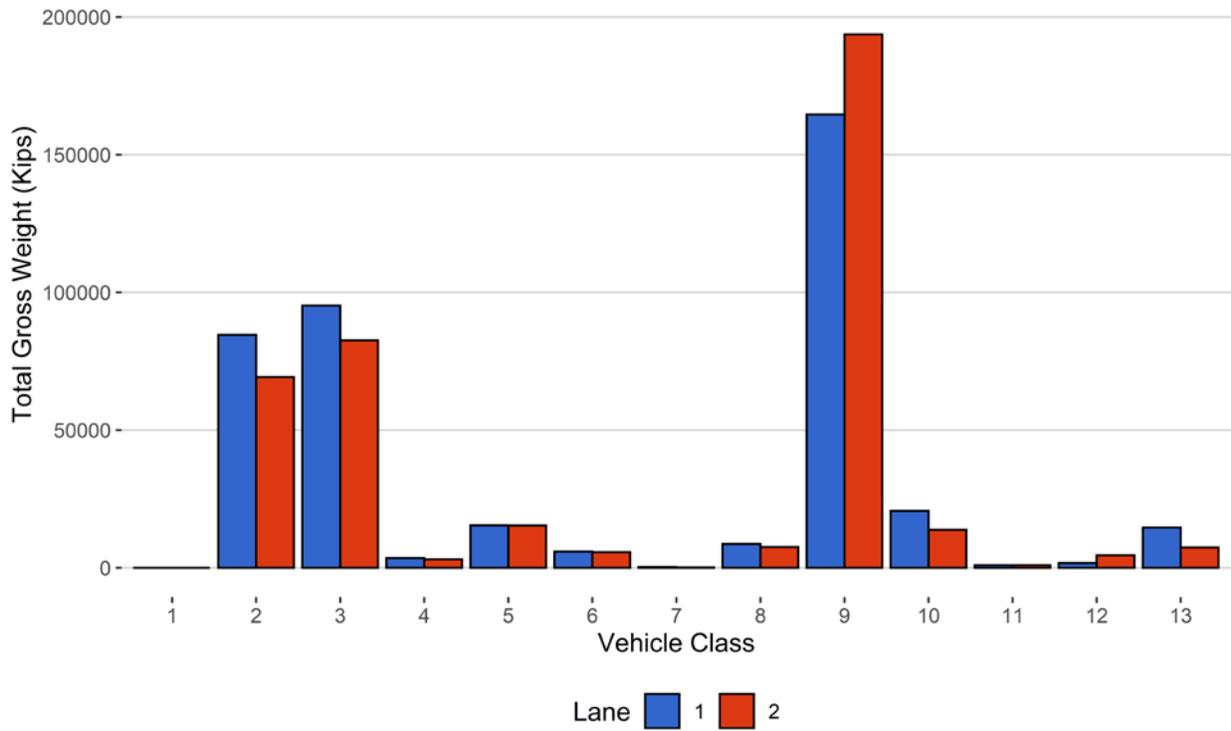


Figure 11 - Total Gross Vehicle Weight t

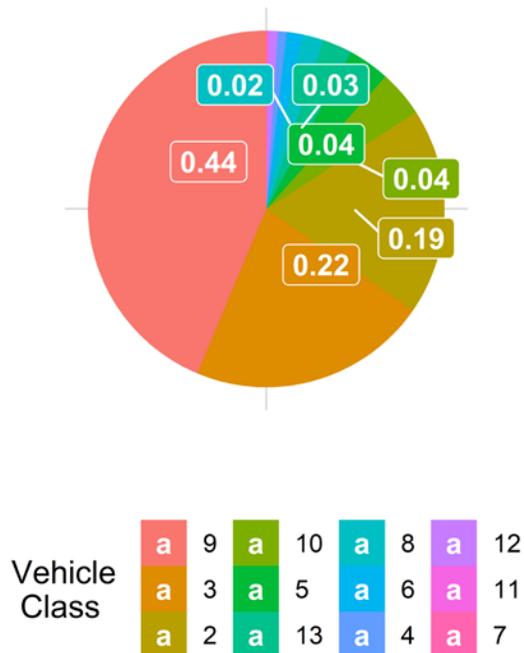


Figure 12 - Total ESALs by Class and Lane

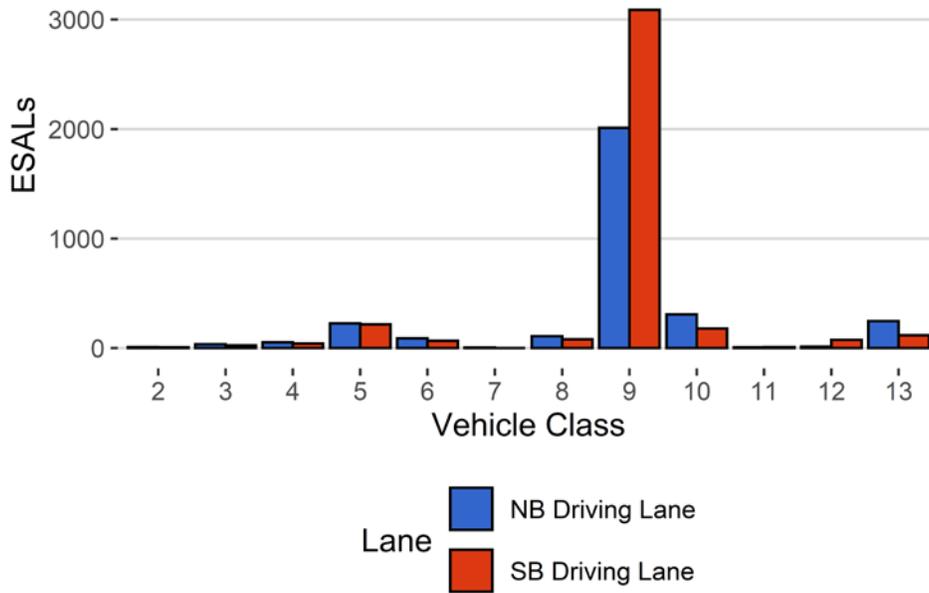


Figure 13 - ESALs by Class

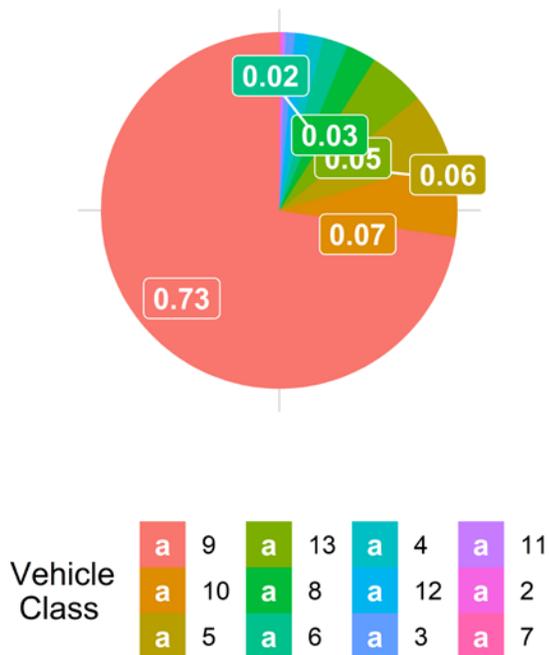


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
June 2019	11.02	0.00	11.18	0.00
July 2019	11.10	0.69	11.36	1.61
August 2019	11.09	0.64	11.19	0.17
September 2019	10.85	-1.58	11.04	-1.24
October 2019	10.68	-3.08	10.68	-4.45
November 2019	10.16	-7.83	10.10	-9.59
December 2019	9.87	-10.46	9.78	-12.51

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	1400	43396	48.7	0	0
3	1051	32584	36.6	0	0
4	8	253	0.3	2	0.3
5	78	2409	2.7	46	5.9
6	15	452	0.5	8	1
7	0	9	0	0	0
8	19	591	0.7	16	2
9	270	8355	9.4	391	49.7
10	21	640	0.7	114	14.5
11	2	49	0.1	0	0
12	3	106	0.1	19	2.4
13	9	266	0.3	190	24.2
TOTAL	2875	89110	100	786	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>
2019-12-28	Saturday	09:03:32	10	SB	2	116.83
2019-12-12	Thursday	06:34:48	10	NB	1	106.29
2019-12-10	Tuesday	23:01:52	9	SB	2	105.12
2019-12-23	Monday	12:00:43	9	SB	2	99.53
2019-12-28	Saturday	10:30:03	10	NB	1	99.14
2019-12-19	Thursday	14:18:29	10	NB	1	98.4
2019-12-28	Saturday	09:59:34	10	NB	1	96.98
2019-12-27	Friday	10:35:04	10	SB	2	96.28
2019-12-27	Friday	15:12:11	9	SB	2	96.11
2019-12-03	Tuesday	19:00:14	9	NB	1	95.97

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	116	23	19.8	3237	280	921
5	NB	8	1109	159	14.3	14282	1166	3341
6	NB	19	203	51	25.1	5041	850	1076
7	NB	11.5	6	0	0	282	0	106
8	NB	31	293	162	55.3	4912	3773	426
9	NB	33	4016	1972	49.1	114042	50541	23295
10	NB	33.5	352	108	30.7	17644	3037	4735
11	NB	36.5	23	5	21.7	758	175	50
12	NB	36.5	35	4	11.4	1583	113	226
13	NB	31.5	164	0	0	14624	0	4729
TOTAL	****	****	6317	2484	****	176403	****	38905
<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	120	36	30	2670	431	705
5	SB	8	1141	230	20.2	13720	1633	3216
6	SB	19	219	80	36.5	4347	1296	853
7	SB	11.5	2	1	50	58	11	23
8	SB	31	259	149	57.5	4023	3531	306
9	SB	33	3786	1007	26.6	166758	26933	37525
10	SB	33.5	246	35	14.2	12798	985	2865
11	SB	36.5	23	5	21.7	839	107	91
12	SB	36.5	64	0	0	4562	0	1113
13	SB	31.5	84	0	0	7338	0	2346
TOTAL	****	****	5944	1543	****	217114	****	49044
GRAND TOTAL	****	****	12261	4027	484	393517	94860	87949

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	84560	69301	153861	18.8
3	95227	82582	177809	21.7
4	3517	3101	6618	0.8
5	15448	15353	30801	3.8
6	5890	5643	11533	1.4
7	282	69	351	0
8	8685	7553	16238	2
9	164582	193691	358273	43.7
10	20681	13783	34464	4.2
11	932	946	1878	0.2
12	1696	4562	6259	0.8
13	14624	7338	21962	2.7
TOTAL	416124	403923	820047	100
GVW/LANE	50.74	49.26	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	10	7	16	0.2	9e-04
3	35	24	60	0.8	0.004
4	52	43	95	1.4	0.81
5	227	217	443	6.3	0.4
6	90	67	157	2.2	0.75
7	5	1	6	0.1	1.28
8	108	82	190	2.7	0.7
9	2012	3087	5100	72.6	1.32
10	308	180	487	6.9	1.63
11	8	10	18	0.2	0.82
12	12	76	88	1.2	1.7
13	247	117	365	5.2	2.86
TOTAL	3115	3910	7025	100	12
ESALS/LANE	44.3	55.7	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 2019	82665	2667	496	67282	81.4	15383.3	18.6
Feb 2019	69157	2470	423	57312	82.9	11844.7	17.1
Mar 2019	88959	2870	393	76774	86.3	12184.6	13.7
Apr 2019	93990	3133	460	80204	85.3	13785.9	14.7
May 2019	114550	3636	595	96108	83.9	18442.1	16.1
Jun 2019	112977	3766	550	96463	85.4	16514	14.6
Jul 2019	117623	3815	556	100380	85.3	17243.1	14.7
Aug 2019	122829	3935	551	105743	86.1	17085.9	13.9
Sep 2019	111609	3740	547	95187	85.3	16422.2	14.7
Oct 2019	111240	3594	544	94374	84.8	16865.8	15.2
Nov 2019	96351	3263	494	81537	84.6	14814.5	15.4
Dec 2019	89110	3116	424	75980	85.3	13129.9	14.7
TOTAL	1211060	-	-	1027344	-	183716	-
AVERAGE	100922	3334	503	85612	85	15310	15

###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 2019	4624	5069	9694	0.5
Feb 2019	3033	3535	6568	1.1
Mar 2019	3076	3597	6674	1.4
Apr 2019	3287	4734	8021	3.5
May 2019	5574	8427	14001	11.1
Jun 2019	15188	14413	29601	9.3
Jul 2019	6532	8499	15031	12.1
Aug 2019	7374	7666	15040	9.4
Sep 2019	5759	7533	13292	6.6
Oct 2019	7588	9522	17109	5.6
Nov 2019	4179	5312	9491	2.6
Dec 2019	3119	7088	10207	1.3
TOTAL	69332	-	-	-
AVERAGE	5778	7116	12894	5

###Gross Vehicle Weight

<i>Month</i>	<i>GVW NB Driving Lane</i>	<i>GVW SB Driving Lane</i>	<i>Total GVW Kips</i>
Jan 19	473918	463320	937238
Feb 19	358035	373880	731916

Mar 19	406564	415689	822254
Apr 19	442890	492577	935467
May 19	590185	669683	1259868
Jun 19	1226663	1231162	2457825
Jul 19	622251	671633	1293884
Aug 19	639515	653216	1292731
Sep 19	575436	622627	1198063
Oct 19	820772	879025	1699797
Nov 19	476509	513882	990391
Dec 19	416311	406019	822330
TOTAL	7049052	7392712	14441764
AVERAGE	587421	616059	1203480

###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 2019	724	0.9	4.8	44	8
Feb 2019	613	0.9	5.3	67	14
Mar 2019	509	0.6	4.2	87	24
Apr 2019	661	0.7	4.9	122	11
May 2019	2320	2.1	12.7	393	73
Jun 2019	5748	2.6	17.6	1016	320
Jul 2019	3049	2.6	17.9	506	145
Aug 2019	2670	2.2	15.8	344	129
Sep 2019	2395	2.2	14.7	309	110
Oct 2019	2543	1.6	10.5	389	158
Nov 2019	1368	1.4	9.4	182	61
Dec 2019	820	1	6.6	150	32
TOTAL	23420	-	-	3609	1085
AVERAGE	1951.7	1.6	10.4	300.8	90.4

###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 2019	60151	52807	112959	53.3	46.7
Feb 2019	36834	46586	83420	44.2	55.8
Mar 2019	38786	43303	82089	47.2	52.8
Apr 2019	43211	58172	101383	42.6	57.4
May 2019	62585	91602	154187	40.6	59.4
Jun 2019	149121	146296	295417	50.5	49.5
Jul 2019	67865	85955	153821	44.1	55.9

Aug 2019	69608	76087	145695	47.8	52.2
Sep 2019	62651	77901	140552	44.6	55.4
Oct 2019	87243	106490	193733	45	55
Nov 2019	48816	63476	112291	43.5	56.5
Dec 2019	38905	49044	87949	44.2	55.8
TOTAL	765776	897720	1663497	-	-
AVERAGE	63814.7	74810	138624.7	45.6	54.4
