

SEPTEMBER 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 September 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: 111609 | Passenger Vehicles: 95187 | Heavy Commercial Vehicles: 16422

Monthly Average Daily Traffic (MADT): 3740 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 547

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 Tuesdays. SB vehicles typically reached highest volume levels on Fridays, with lowest volumes reported on Tuesdays (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 03 PM 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 03 PM and 05 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 16422 HCVs, 2385 of them were overweight ³. These overweight HCVs contributed to 2.2% of total monthly volume, and 14.7% 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 Tuesdays, with lowest volumes reported on Saturdays. See Figure 3 .

The top two overweight violators by class were the class 9 and class 10 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 53.7% 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 ,151 NB vehicles exceeded 88,000 pounds (65 vehicles were Class 13's; 43 vehicles were Class 10's). Of vehicles traveling SB,

158 NB vehicles exceeded 88,000 pounds (81 vehicles were Class 13's; 41 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from September 2019.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in September 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 empty class 10 vehicles.

Freight Totals. A total of 140552 tons of freight was recorded to have crossed the WIM. More freight was shipped SB (55.4%) than NB (44.6%). 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 111609 vehicles with a combined GVW of 1198063 kips (1 kip = 1,000 pounds = 0.5 tons) in September 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 13292 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 56.7% of all ESALs were recorded SB while 43.3% was observed NB. In particular, 71% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 40% 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:

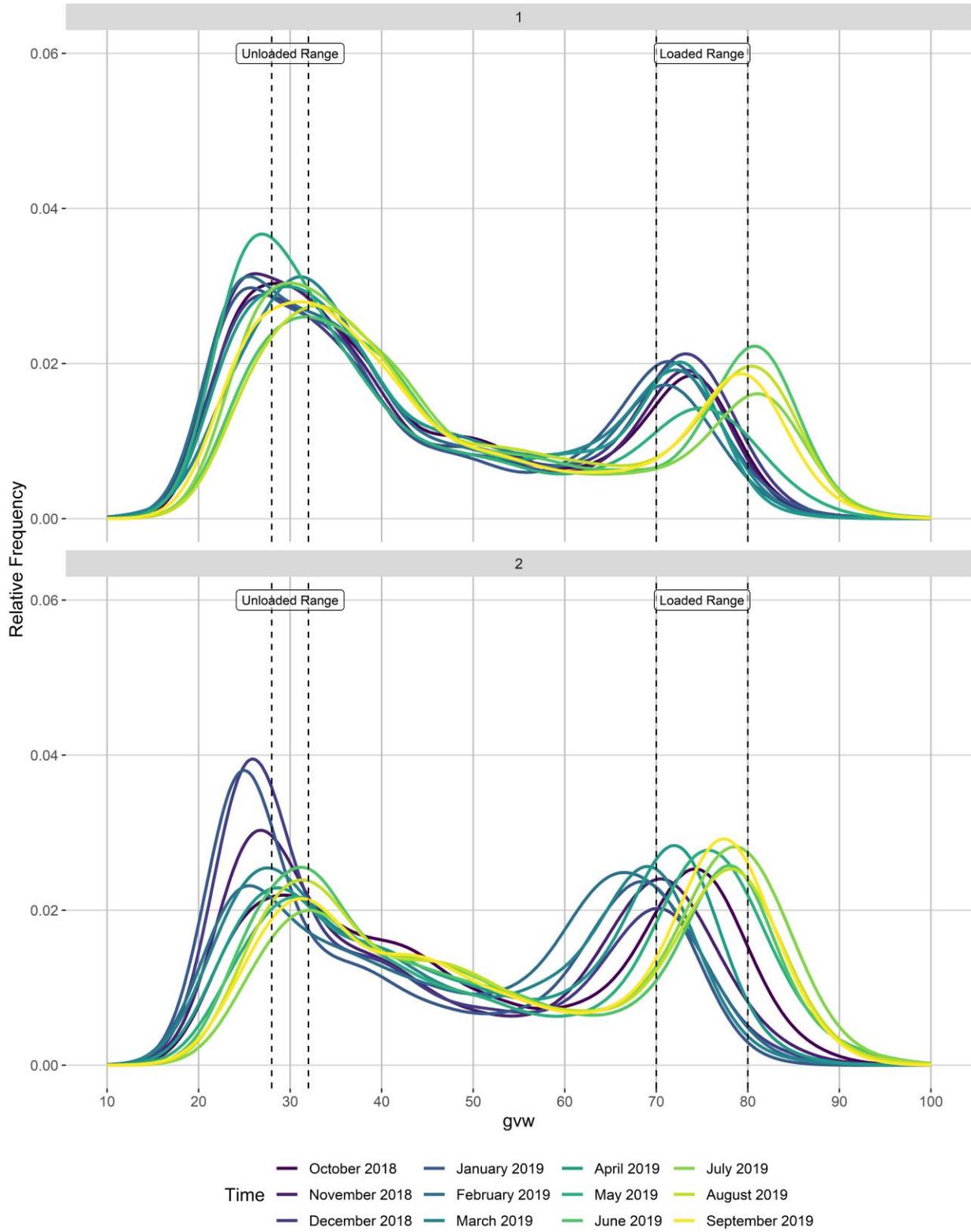
<http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html> MnDOT's vehicle

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.

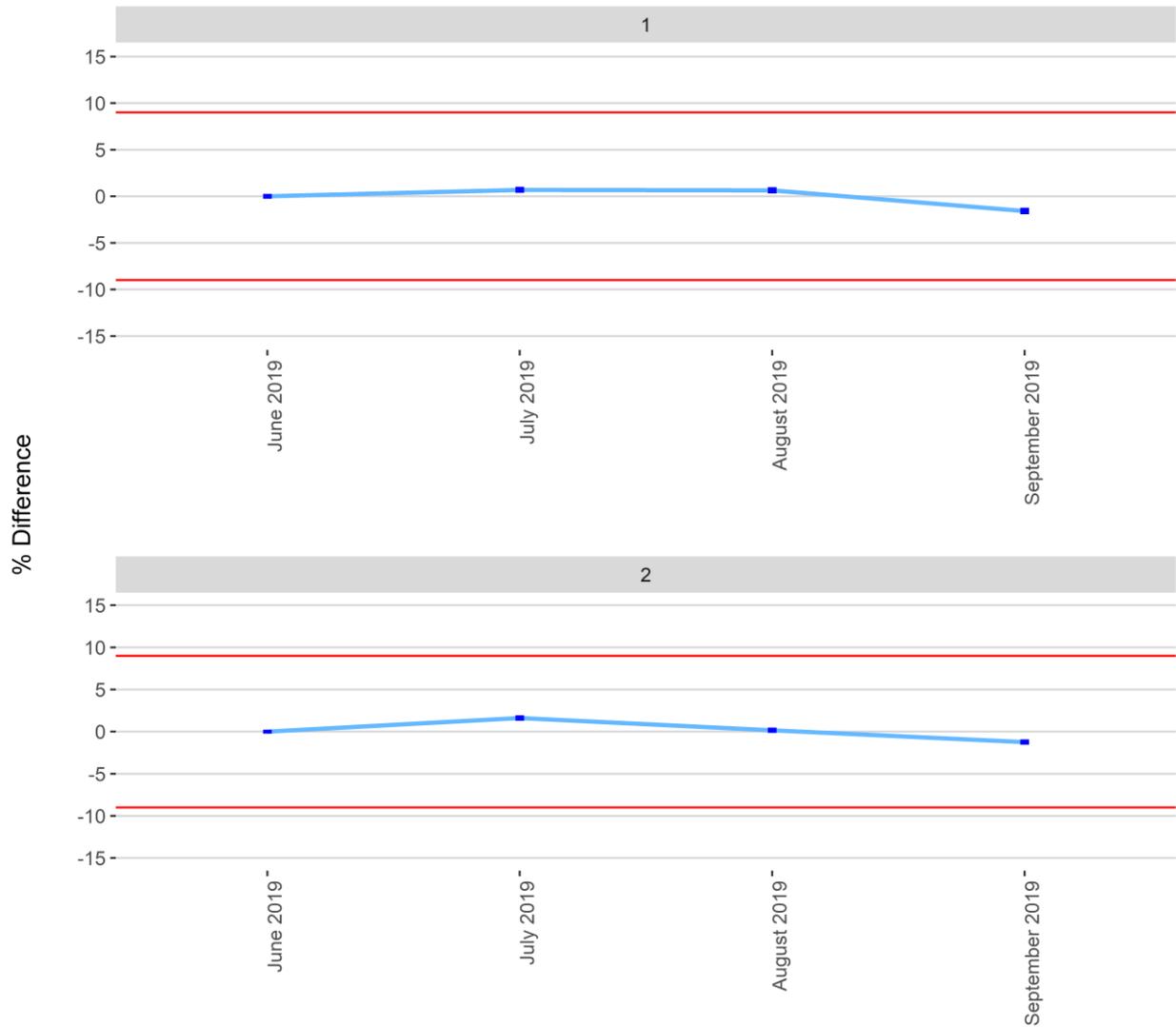
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

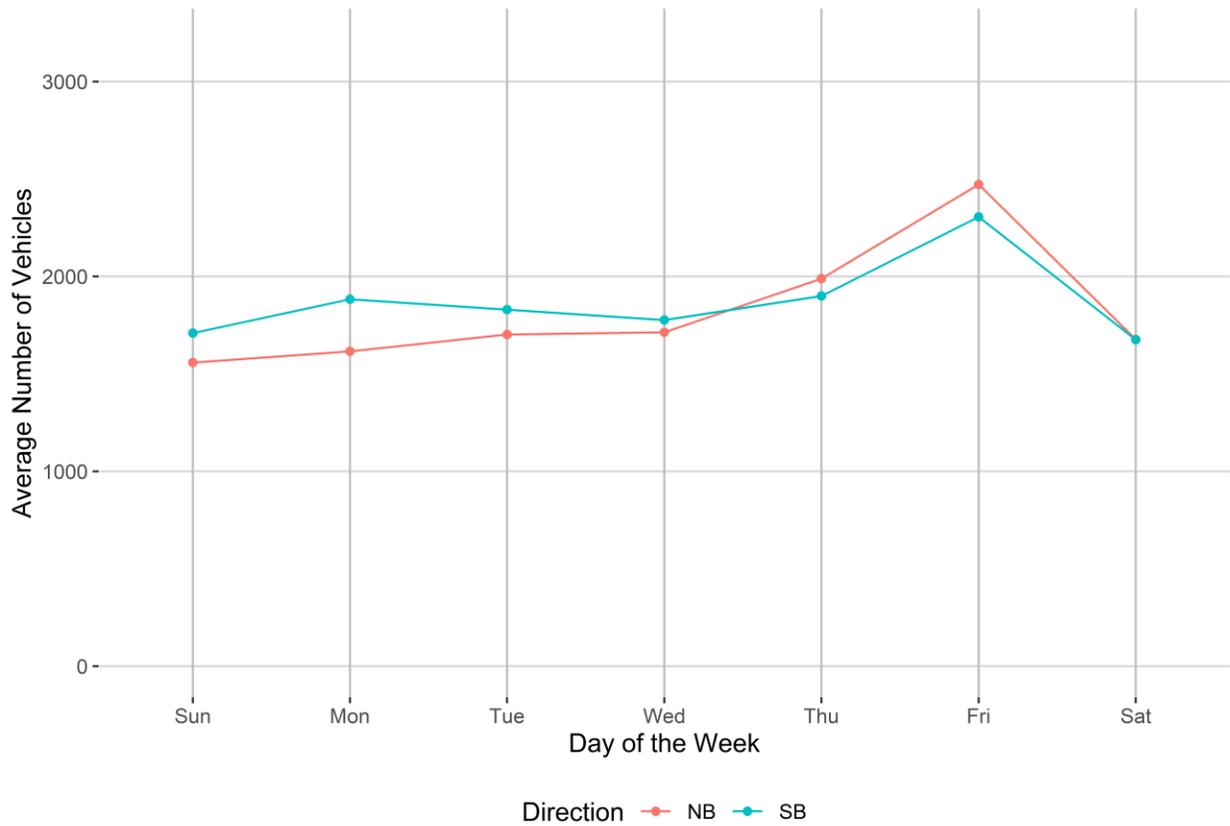


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

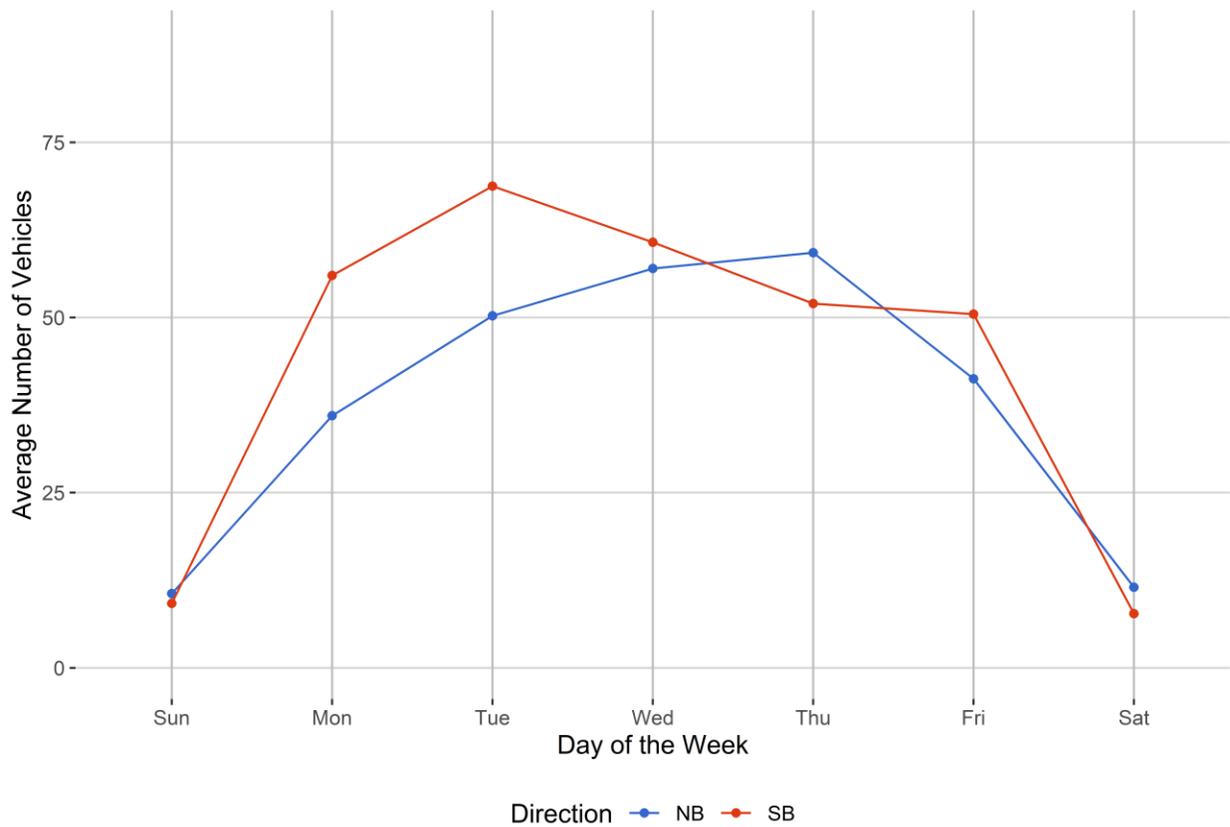


Figure 4 - Passenger Vehicles vs. Hour of the Day

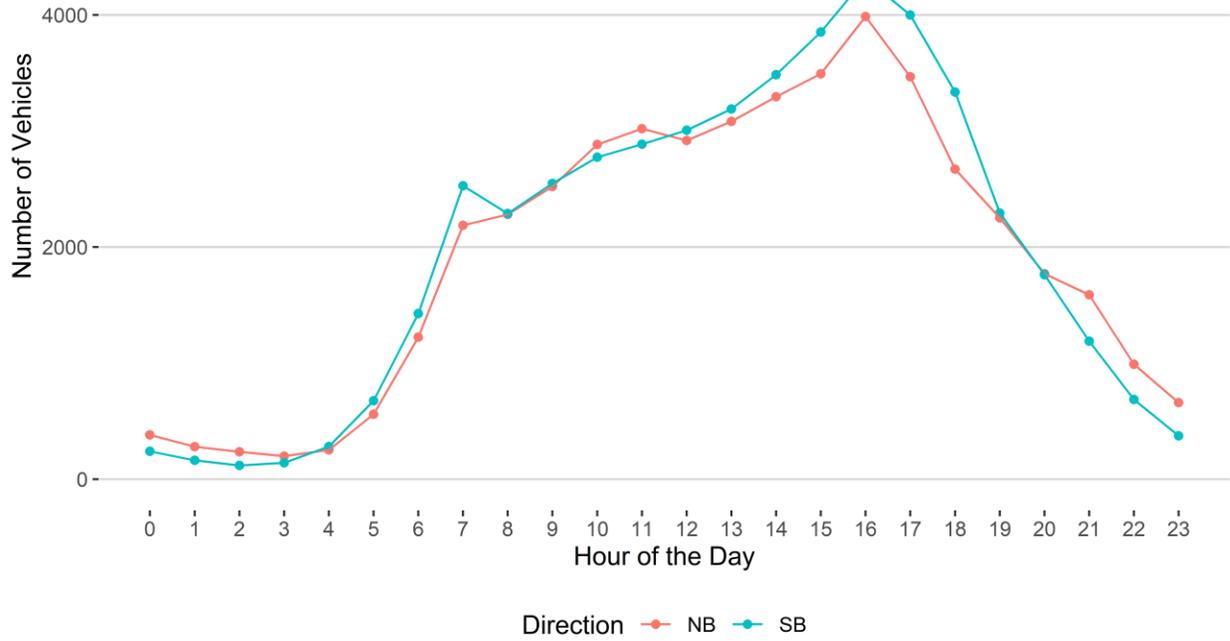


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

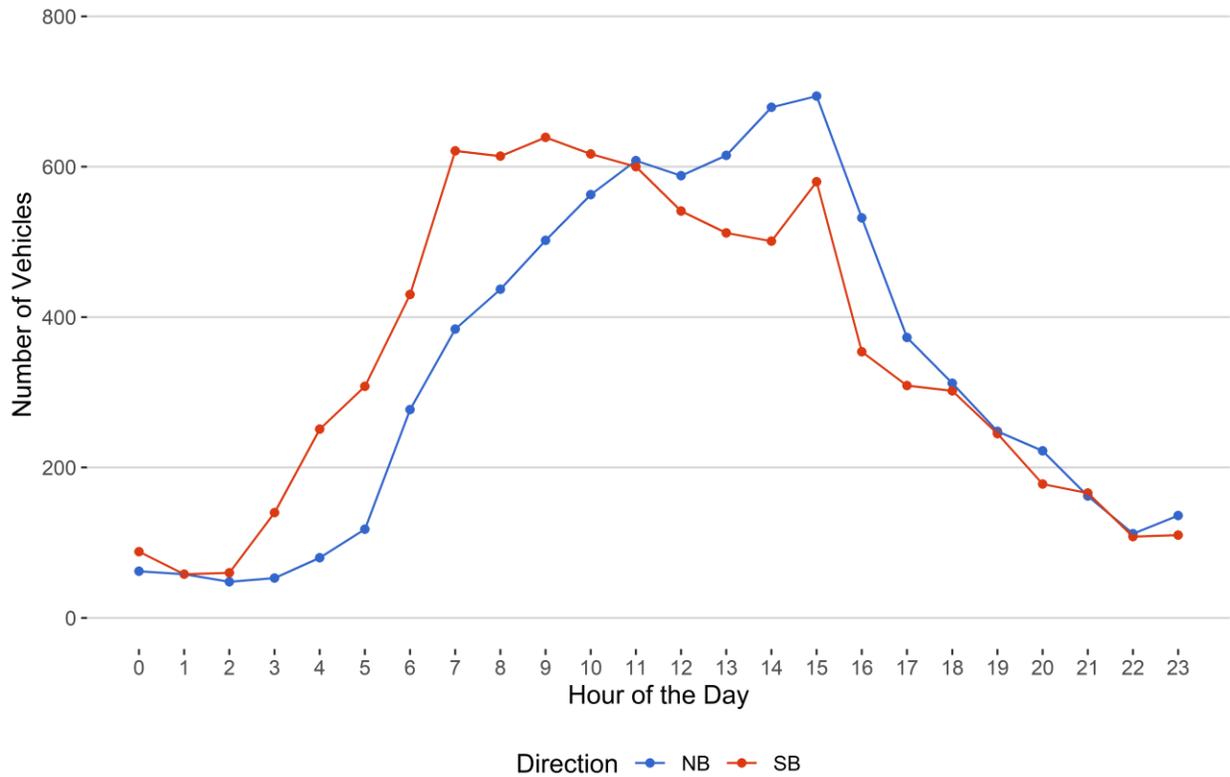


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

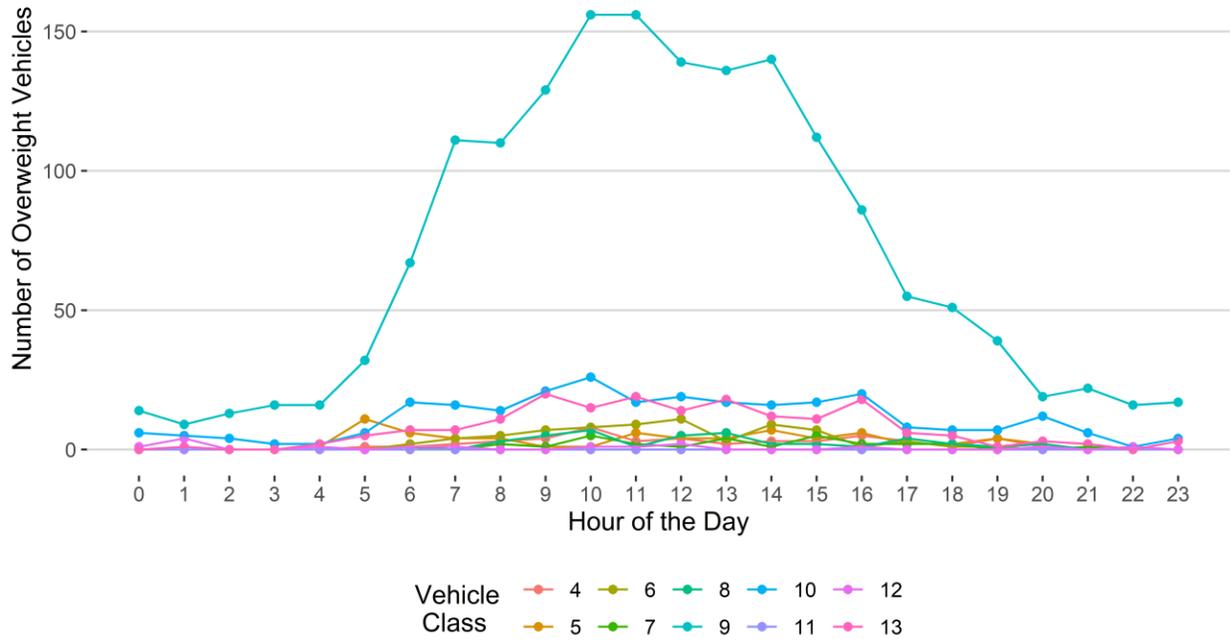


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

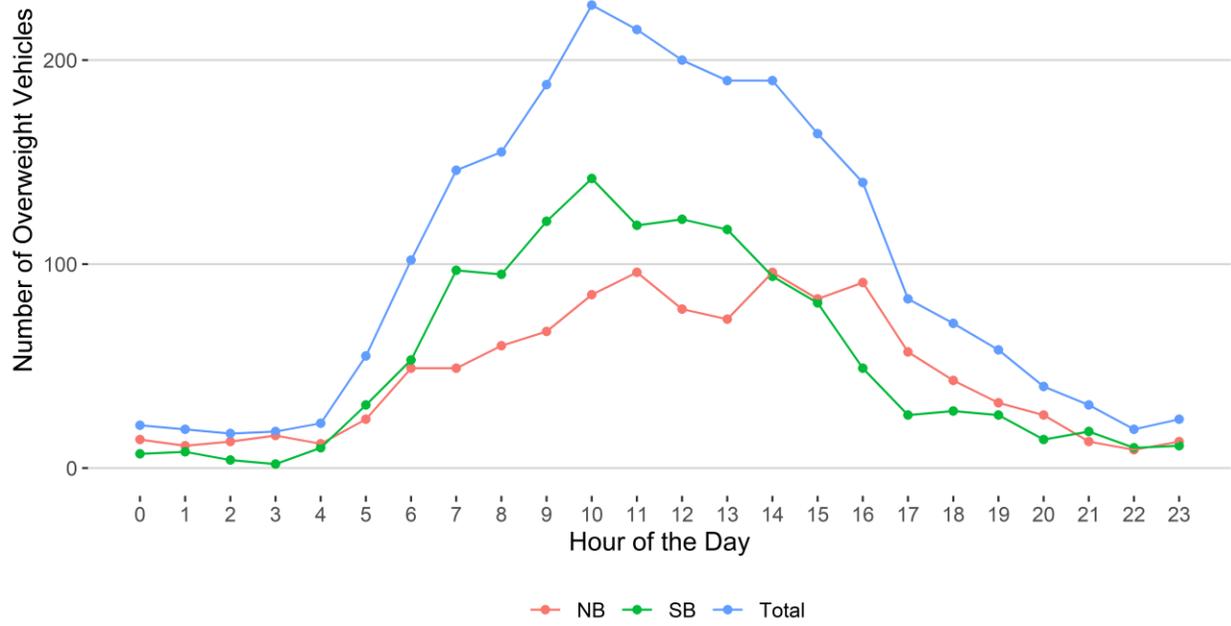
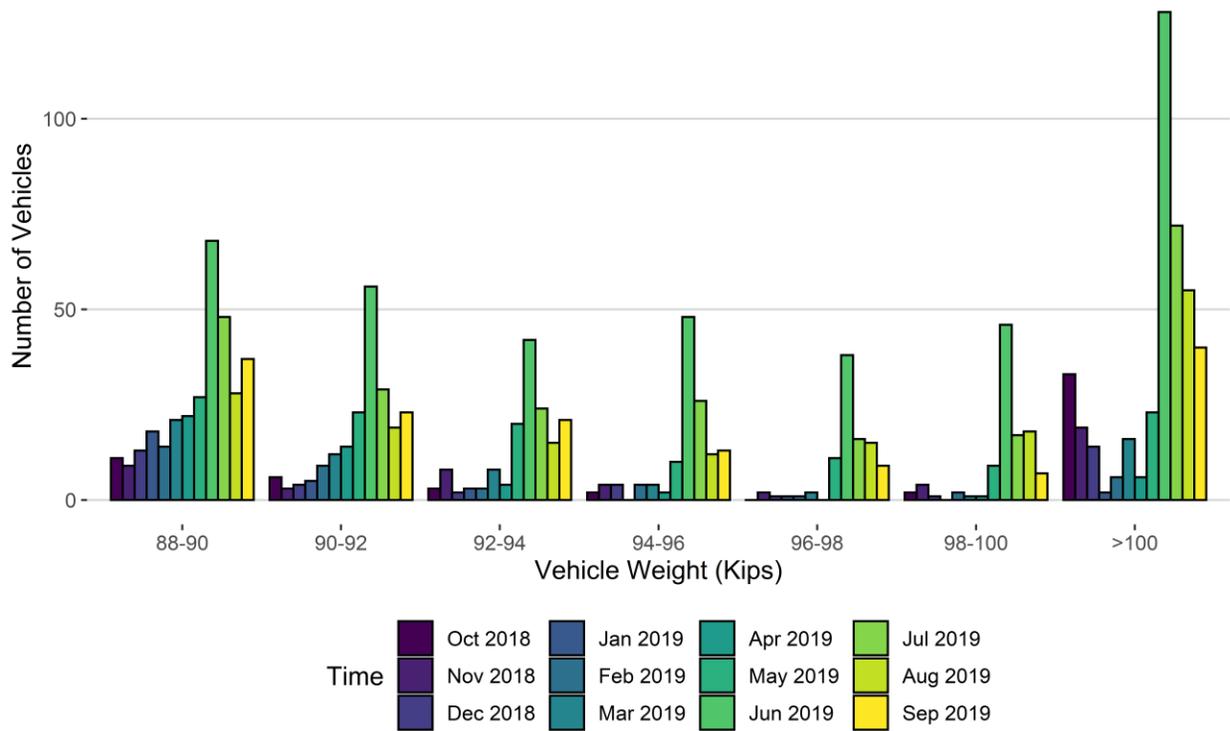
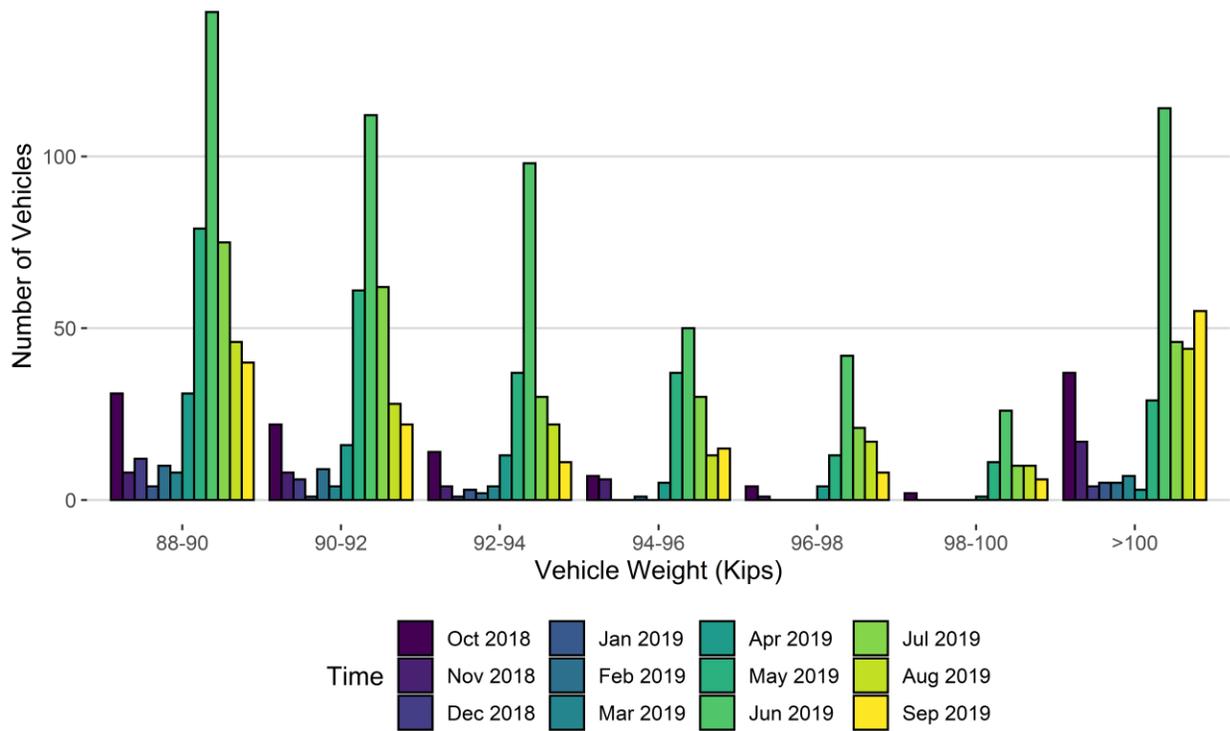


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019	Aug 2019	Sep 2019
88-90	11	9	13	18	14	21	22	27	68	48	28	37
90-92	6	3	4	5	9	12	14	23	56	29	19	23
92-94	3	8	2	3	3	8	4	20	42	24	15	21
94-96	2	4	4	0	4	4	2	10	48	26	12	13
96-98	0	2	1	1	1	2	0	11	38	16	15	9
98-100	2	4	1	0	2	1	1	9	46	17	18	7
>100	33	19	14	2	6	16	6	23	128	72	55	40
Total	57	49	39	29	39	64	49	123	426	232	162	150

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



Vehicle Weights (Kips)	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019	Aug 2019	Sep 2019
88-90	31	8	12	4	10	8	31	79	142	75	46	40
90-92	22	8	6	1	9	4	16	61	112	62	28	22
92-94	14	4	1	3	2	4	13	37	98	30	22	11
94-96	7	6	0	0	1	0	5	37	50	30	13	15
96-98	4	1	0	0	0	0	4	13	42	21	17	8
98-100	2	0	0	0	0	0	1	11	26	10	10	6
>100	37	17	4	5	5	7	3	29	114	46	44	55
Total	117	44	23	13	27	23	73	267	584	274	180	157

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

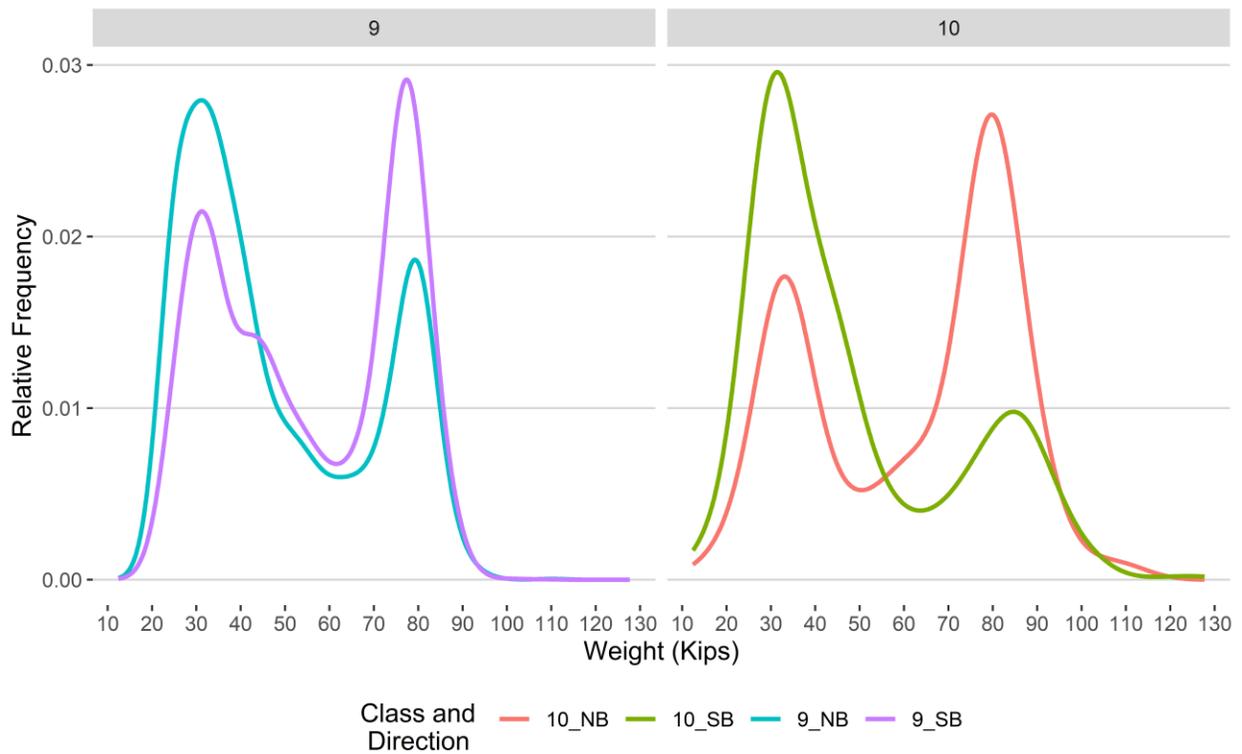


Figure 9 - Freight Percentage by Direction and Class

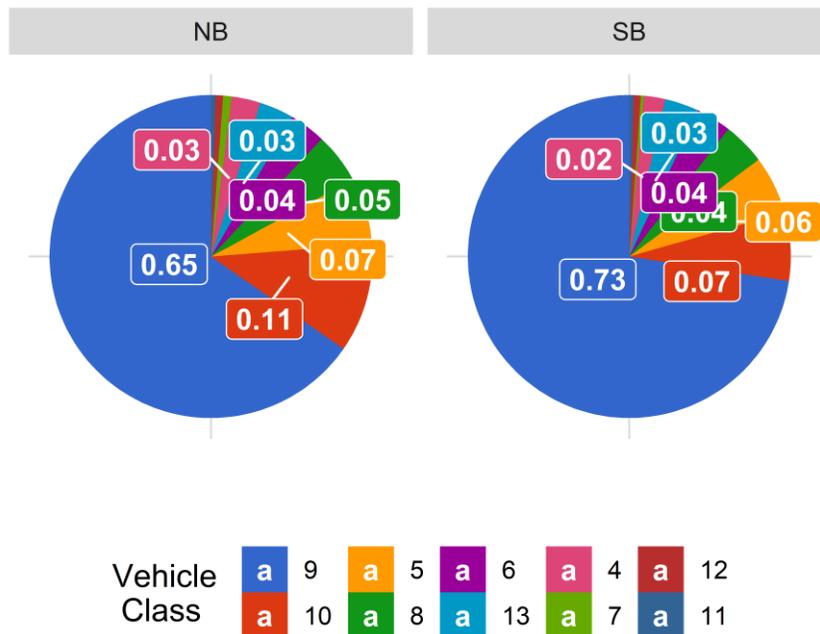


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

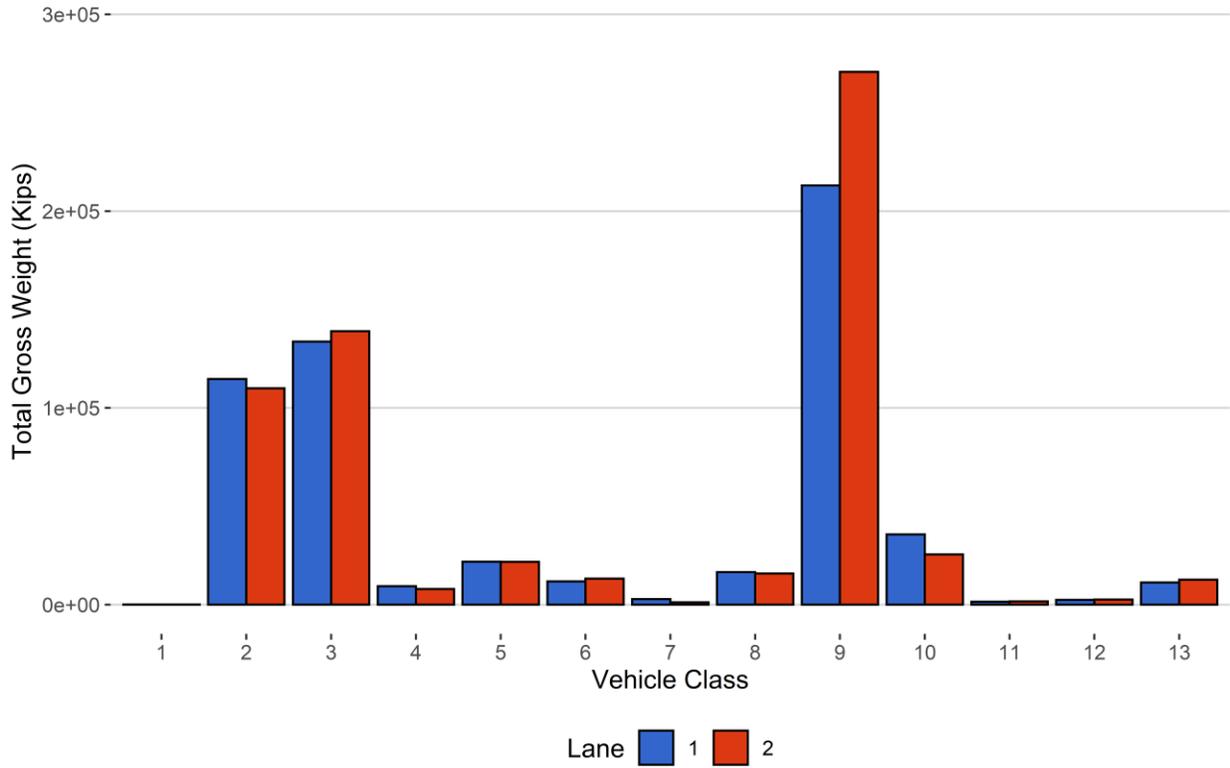


Figure 11 - Total Gross Vehicle Weight t

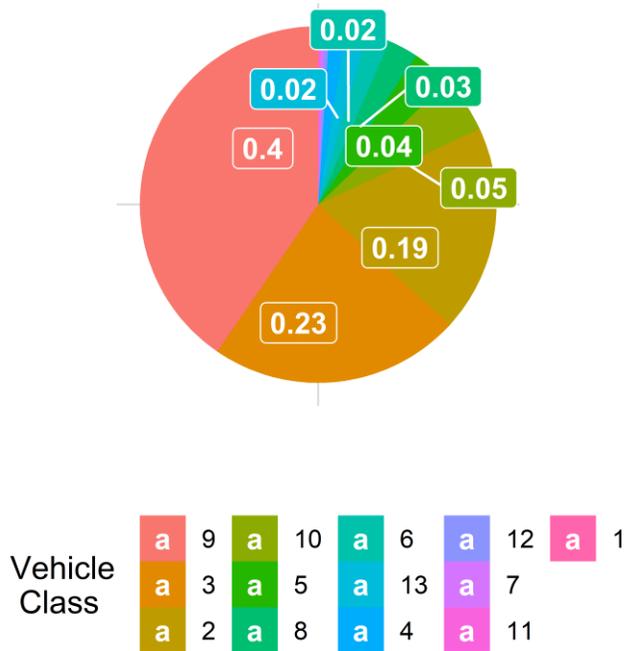


Figure 12 - Total ESALs by Class and Lane

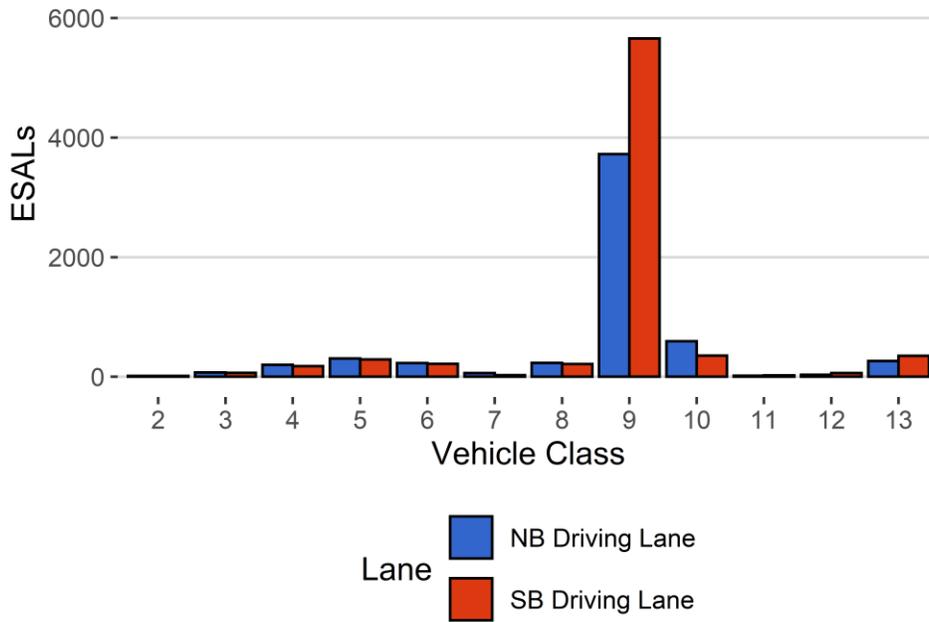


Figure 13 - ESALs by Class

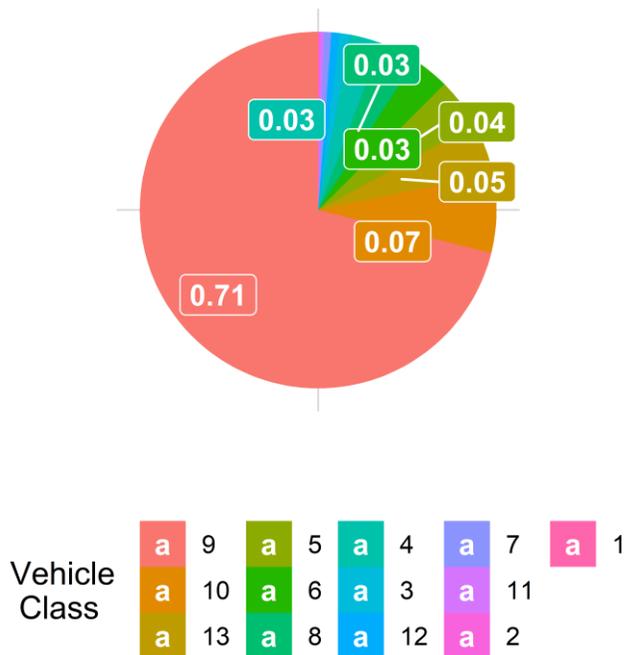


Table 1 Class 9 Front Axle Weight by Lane

<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

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	1	40	0	0	0
2	1841	55220	49.5	0	0
3	1331	39927	35.8	0	0
4	19	564	0.5	49	2.1
5	100	2990	2.7	69	2.9
6	28	844	0.8	71	3
7	3	77	0.1	29	1.2
8	35	1038	0.9	41	1.7
9	313	9388	8.4	1661	69.6
10	37	1114	1	270	11.3
11	3	78	0.1	0	0
12	3	80	0.1	15	0.6
13	8	248	0.2	180	7.5
TOTAL	3720	111609	100	2385	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>
2019-09-06	Friday	09:52:52	10	SB	2	127.71
2019-09-23	Monday	11:38:29	10	SB	2	120.45
2019-09-03	Tuesday	18:21:22	10	SB	2	116.04
2019-09-20	Friday	13:59:56	10	NB	1	112.55
2019-09-08	Sunday	05:00:45	10	NB	1	112.44
2019-09-15	Sunday	17:49:24	9	NB	1	111.15
2019-09-26	Thursday	11:54:10	10	NB	1	109.08
2019-09-07	Saturday	14:14:56	9	SB	2	109.05
2019-09-23	Monday	02:04:48	9	NB	1	108.74
2019-09-04	Wednesday	16:53:50	10	NB	1	108.26

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	286	22	7.7	9099	284	2570
5	NB	8	1456	62	4.3	21360	469	5104
6	NB	19	374	55	14.7	10851	955	2395
7	NB	11.5	50	3	6	2796	29	1128
8	NB	31	524	217	41.4	11576	4936	1029
9	NB	33	4400	1383	31.4	174876	38187	37657
10	NB	33.5	572	107	18.7	32478	3158	8450
11	NB	36.5	36	10	27.8	1211	245	131
12	NB	36.5	43	4	9.3	2365	82	471
13	NB	31.5	122	0	0	11275	0	3716
TOTAL	****	****	7863	1863	****	277887	****	62651
<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	270	31	11.5	7545	415	1980
5	SB	8	1493	123	8.2	20804	918	4922
6	SB	19	458	81	17.7	11812	1390	2324
7	SB	11.5	26	0	0	1156	0	428
8	SB	31	500	198	39.6	11579	4234	1108
9	SB	33	4858	1001	20.6	242257	28496	57488
10	SB	33.5	527	209	39.7	19444	6052	4396
11	SB	36.5	41	17	41.5	1270	376	197
12	SB	36.5	36	1	2.8	2566	27	644
13	SB	31.5	123	1	0.8	12669	19	4413
TOTAL	****	****	8332	1662	****	331102	****	77901
GRAND TOTAL	****	****	16195	3525	344	608989	90273	140552

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>
1	32	20	52	0
2	114643	109935	224578	18.8
3	133695	138985	272681	22.8
4	9384	7960	17344	1.4
5	21829	21722	43550	3.6
6	11806	13202	25008	2.1
7	2825	1156	3981	0.3
8	16512	15812	32324	2.7
9	213063	270753	483816	40.4
10	35636	25497	61133	5.1
11	1455	1646	3101	0.3
12	2447	2593	5040	0.4
13	11275	12688	23963	2
TOTAL	574602	621970	1196572	100
GVW/LANE	48.02	51.98	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>
1	0	0	0	0	0.025
2	15	13	28	0.2	0.0011
3	71	65	136	1	0.007
4	198	178	377	2.9	1.36
5	304	289	594	4.5	0.41
6	228	217	446	3.4	1.07
7	63	26	89	0.7	2.23
8	230	214	444	3.4	0.87
9	3725	5658	9383	71.1	2.03
10	595	353	947	7.2	1.72
11	16	23	39	0.3	1.02
12	32	61	93	0.7	2.19
13	264	350	614	4.7	4.83
TOTAL	5742	7448	13191	100	18
ESALS/LANE	43.5	56.5	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>
Oct 2018	108346	3495	550	91301	84.3	17045.5	15.7
Nov 2018	100582	3353	542	84315	83.8	16266.5	16.2
Dec 2018	89419	2884	461	75130	84	14289	16
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
TOTAL	1212706	-	-	1026199	-	186507	-
AVERAGE	101059	3314	510	85517	85	15542	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>
Oct 2018	4788	6405	11193	3.8
Nov 2018	4625	5107	9731	3.1
Dec 2018	4765	3913	8678	0.9
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
TOTAL	68624	-	-	-
AVERAGE	5719	6575	12294	5

###Gross Vehicle Weight

<i>Month</i>	<i>GVW NB Driving Lane</i>	<i>GVW SB Driving Lane</i>	<i>Total GVW Kips</i>
Oct 18	543677	598248	1141925
Nov 18	532437	542085	1074522

Dec 18	495872	461558	957430
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
TOTAL	6907446	7195677	14103123
AVERAGE	575620	599640	1175260

###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>
Oct 2018	1281	1.2	7.5	177	77
Nov 2018	901	0.9	5.6	94	40
Dec 2018	880	1	6.2	62	19
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
TOTAL	21751	-	-	3221	970
AVERAGE	1812.6	1.5	9.8	268.4	80.8

###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>
Oct 2018	55838	73026	128864	43.3	56.7
Nov 2018	60616	62469	123084	49.2	50.8
Dec 2018	63052	47873	110925	56.8	43.2
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
TOTAL	770320	862078	1632397	-	-
AVERAGE	64193.3	71839.8	136033.1	47	53
