

SEPTEMBER 2018



**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 2018. Volume was computed using all monthly data.

System Calibration

WIM #34 was most recently calibrated on 2015-06-17. 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: 104355 | Passenger Vehicles: 90479 | Heavy Commercial Vehicles: 13876

Monthly Average Daily Traffic (MADT): 3478 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 463

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 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 13876 HCVs, 1168 of them were overweight³. These overweight HCVs contributed to 1.1% of total monthly volume, and 8.5% 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 Wednesdays, 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 64.9% 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 March.

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 ,63 NB vehicles exceeded 88,000 pounds (38 vehicles were Class 13's; 19 vehicles were Class 10's). Of vehicles traveling SB,

108 NB vehicles exceeded 88,000 pounds (54 vehicles were Class 13's; 30 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from September 2018.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in September 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 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 111220 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 104355 vehicles with a combined GVW of 1048616 kips (1 kip = 1,000 pounds = 0.5 tons) in September 2018. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 9749 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 58% of all ESALs were recorded SB while 42% was observed NB. In particular, 71% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 39% 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).

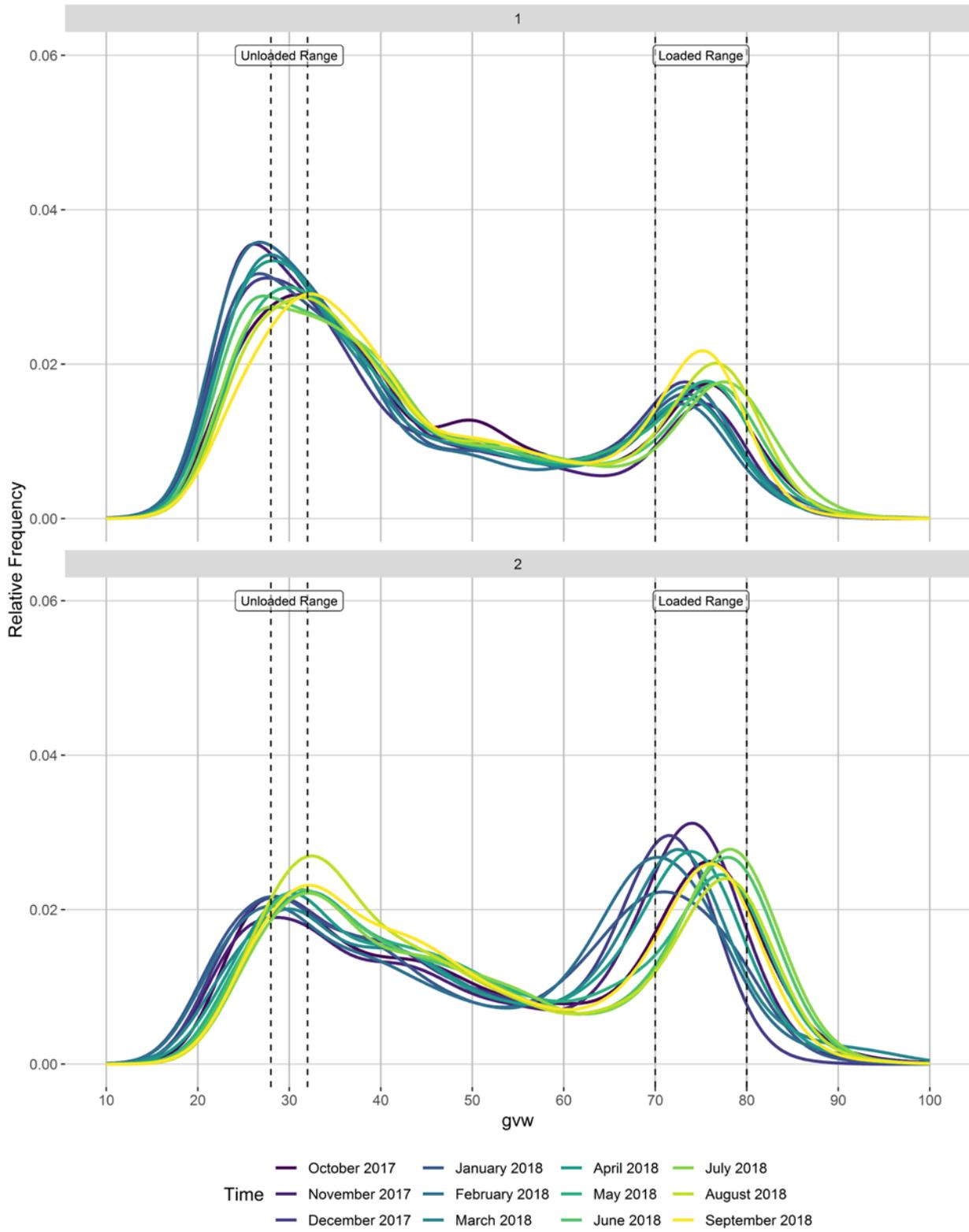
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

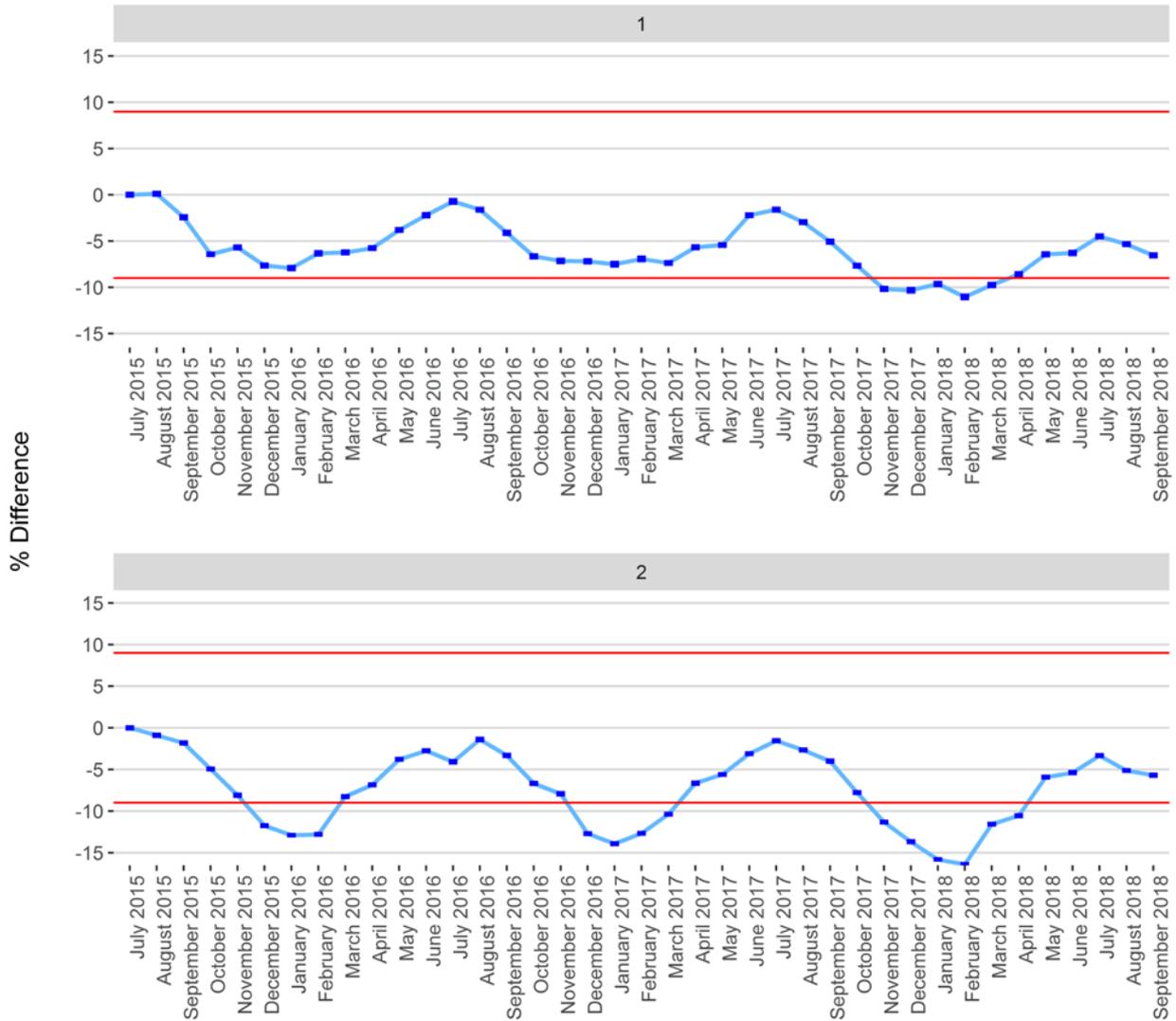
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

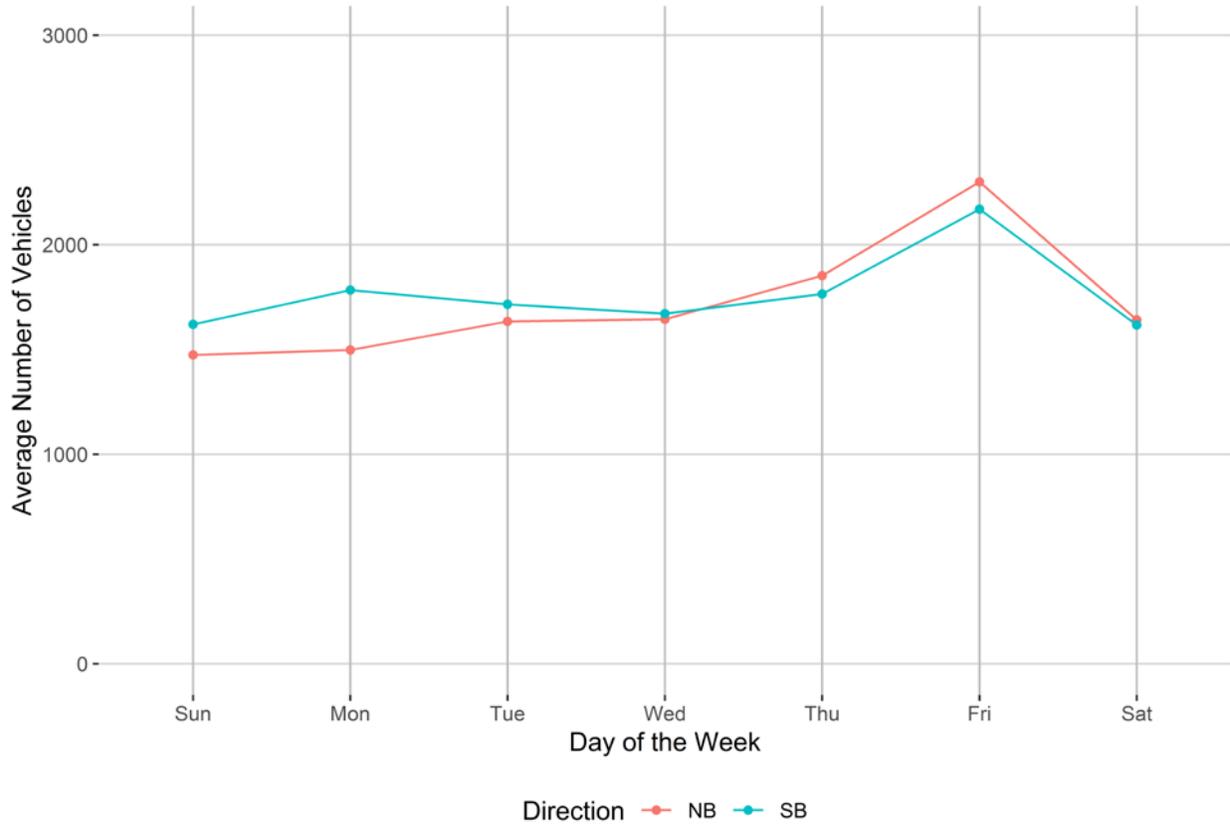


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

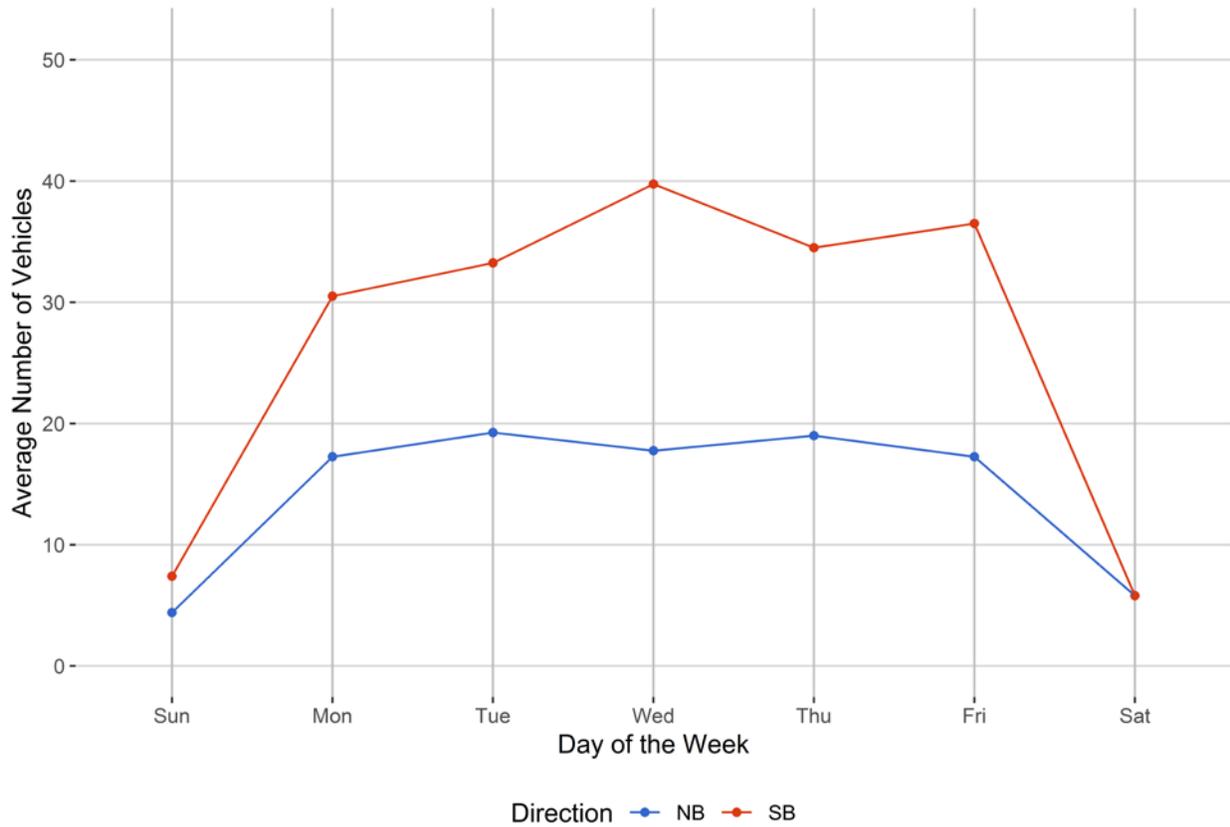


Figure 4 - Passenger Vehicles vs. Hour of the Day

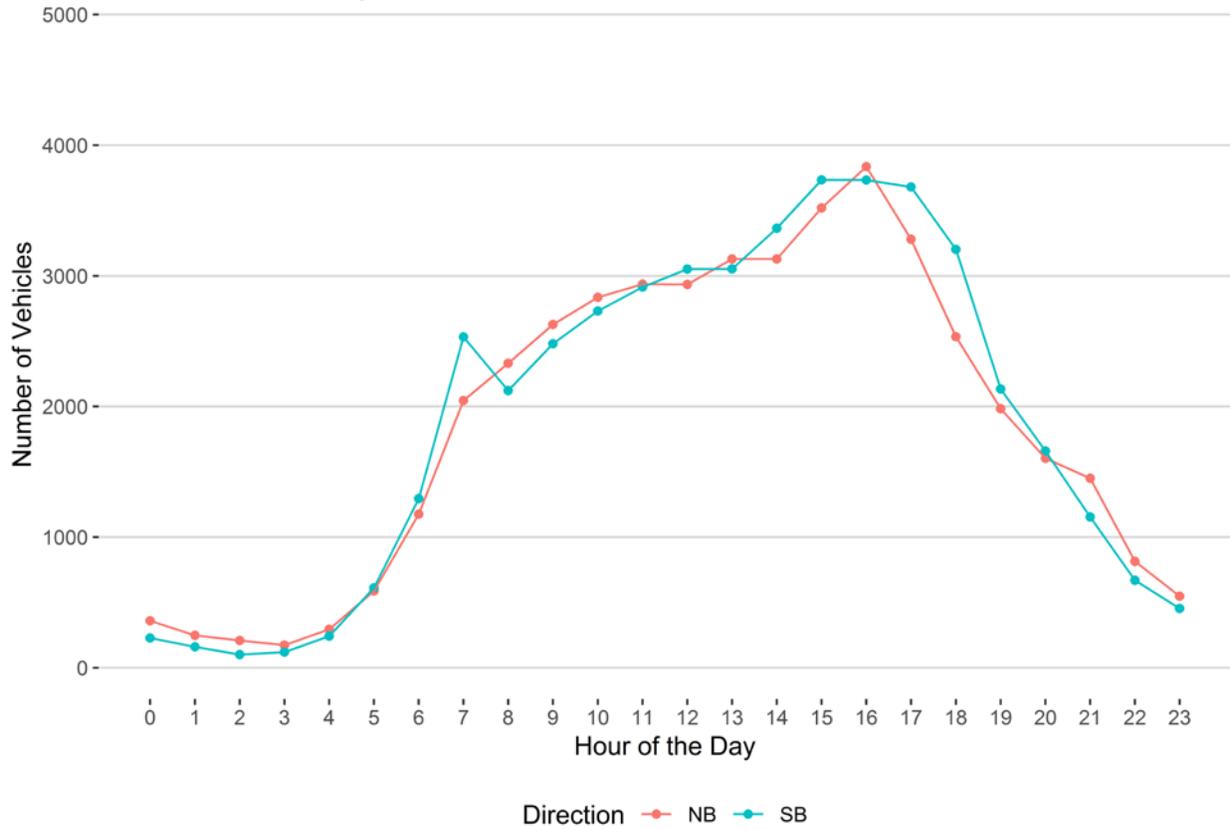


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

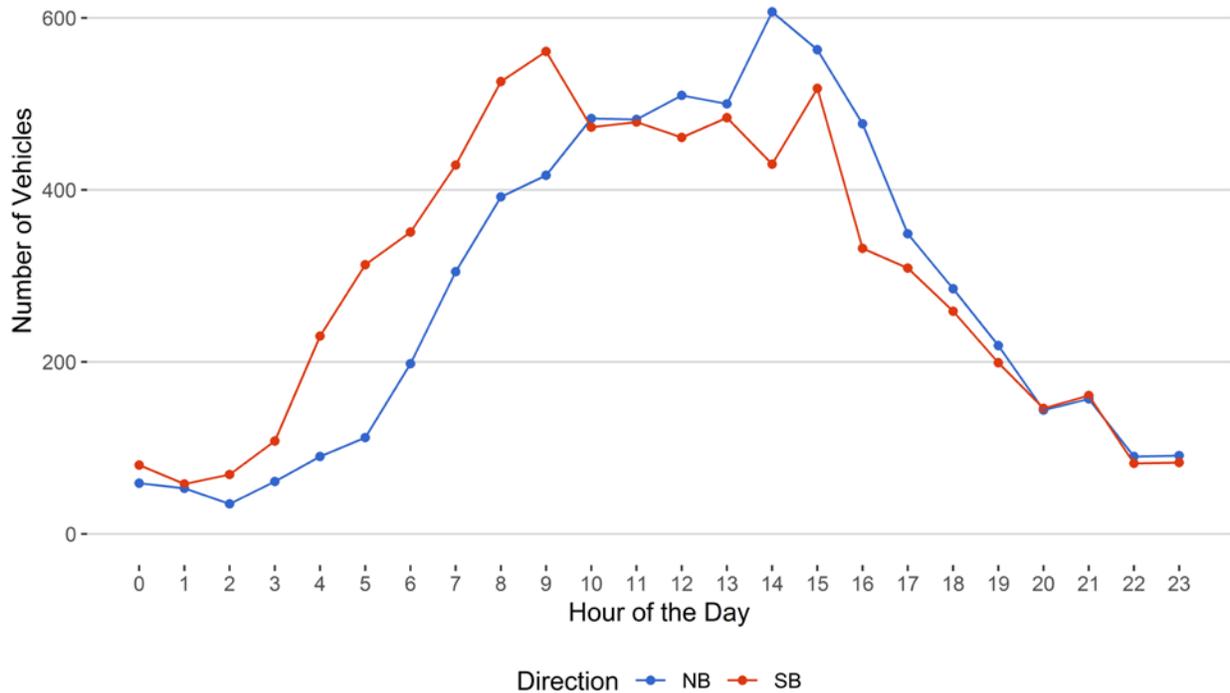


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

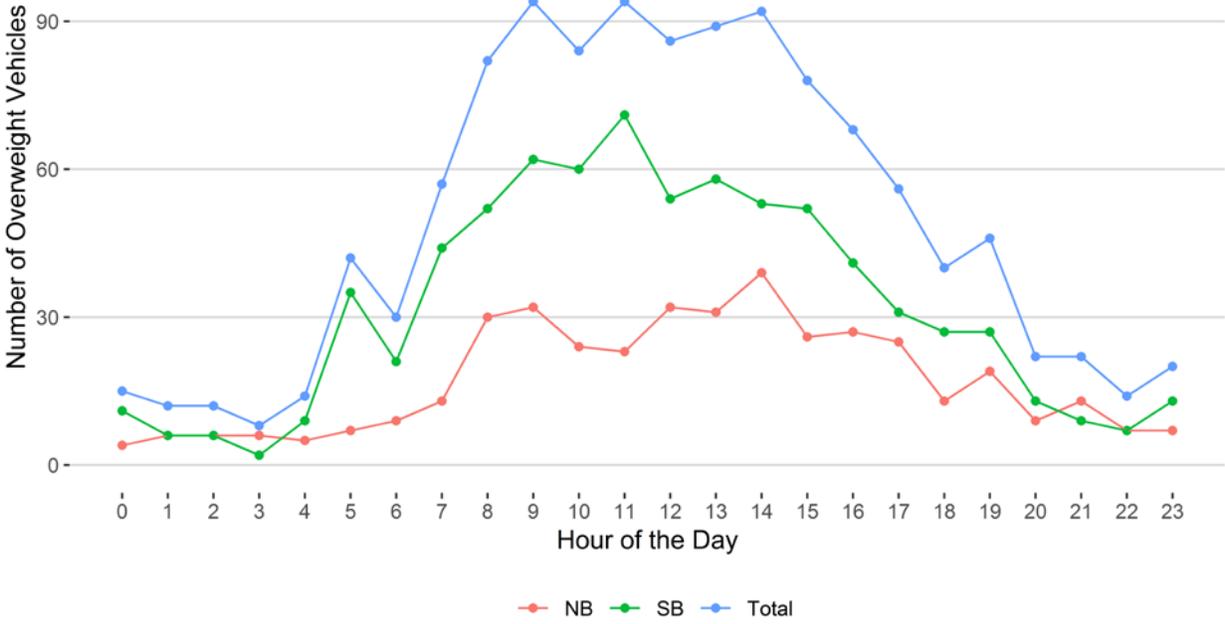
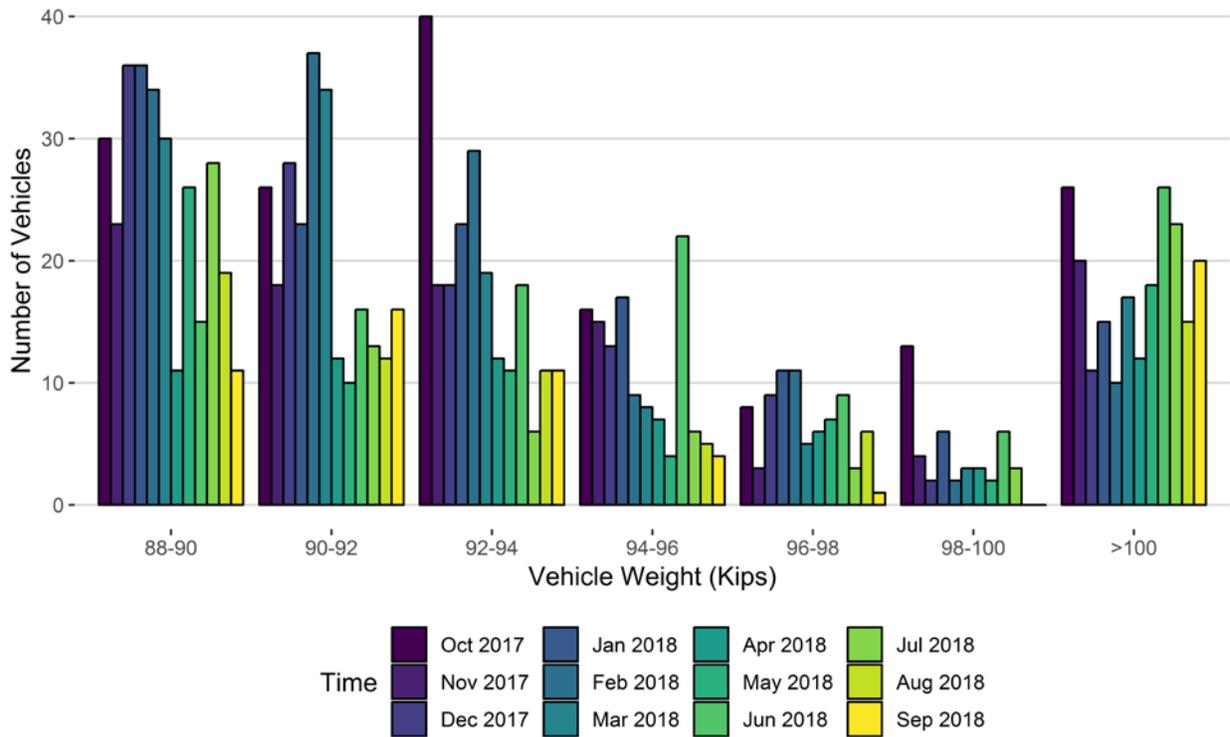
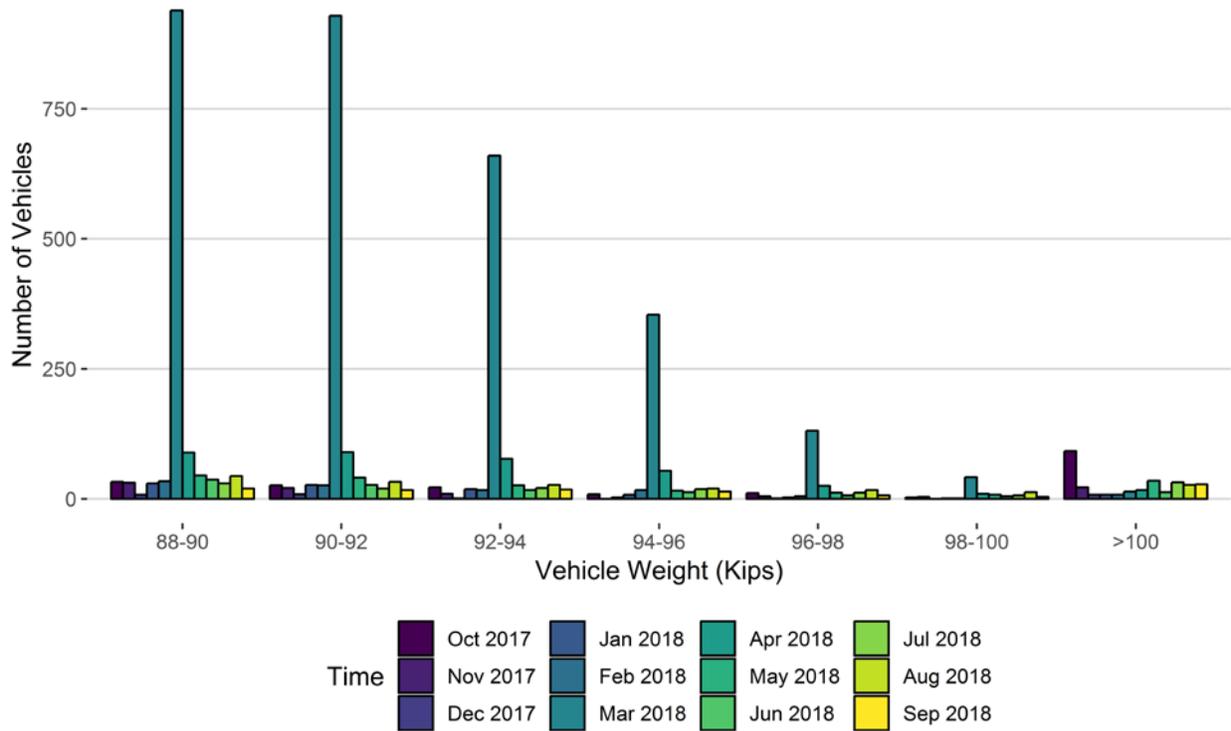


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018
88-90	30	23	36	36	34	30	11	26	15	28	19	11
90-92	26	18	28	23	37	34	12	10	16	13	12	16
92-94	40	18	18	23	29	19	12	11	18	6	11	11
94-96	16	15	13	17	9	8	7	4	22	6	5	4
96-98	8	3	9	11	11	5	6	7	9	3	6	1
98-100	13	4	2	6	2	3	3	2	6	3	0	0
>100	26	20	11	15	10	17	12	18	26	23	15	20
Total	159	101	117	131	132	116	63	78	112	82	68	63

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



Vehicle Weights (Kips)	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018
88-90	33	31	8	30	34	939	89	45	37	30	44	20
90-92	26	21	9	27	26	929	90	41	27	20	33	17
92-94	22	10	1	19	17	660	77	26	17	21	27	18
94-96	9	0	3	8	17	354	54	16	13	19	20	14
96-98	11	5	1	3	5	131	25	12	7	12	17	7
98-100	3	4	0	1	1	42	10	8	5	7	13	4
>100	92	22	8	8	8	14	17	35	13	32	27	28
Total	196	93	30	96	108	3069	362	183	119	141	181	108

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

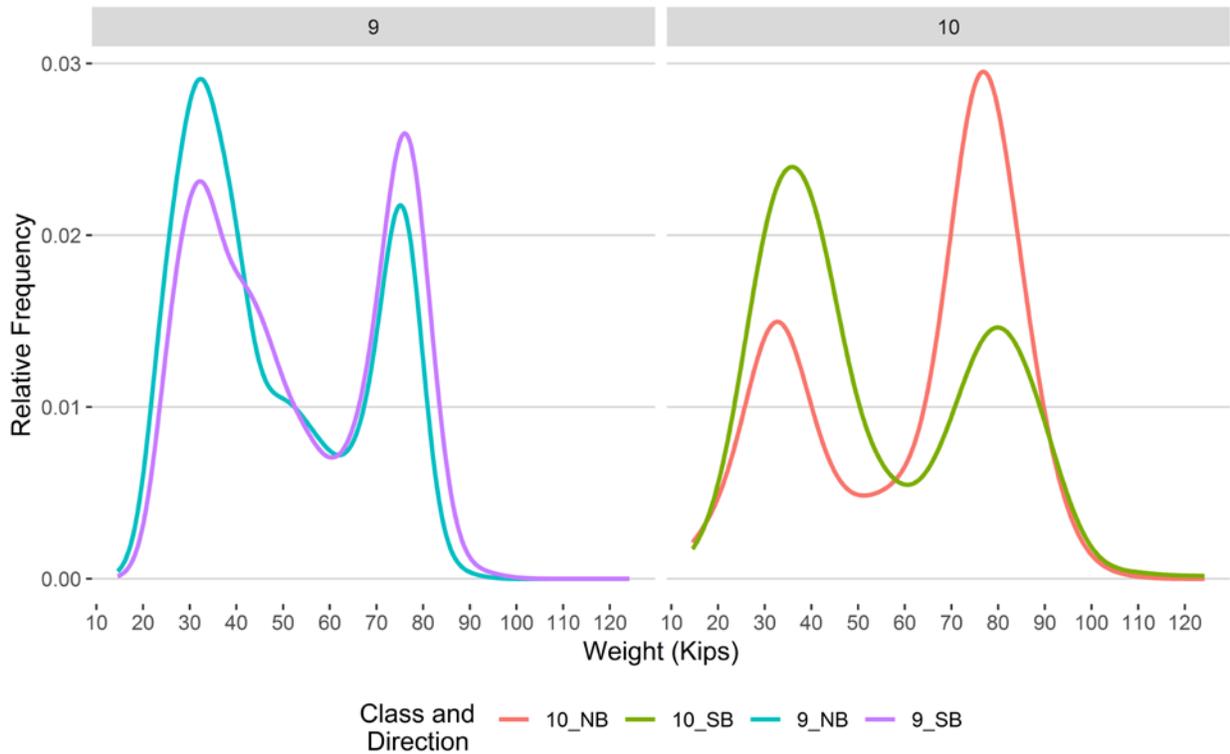


Figure 9 - Freight Percentage by Direction and Class

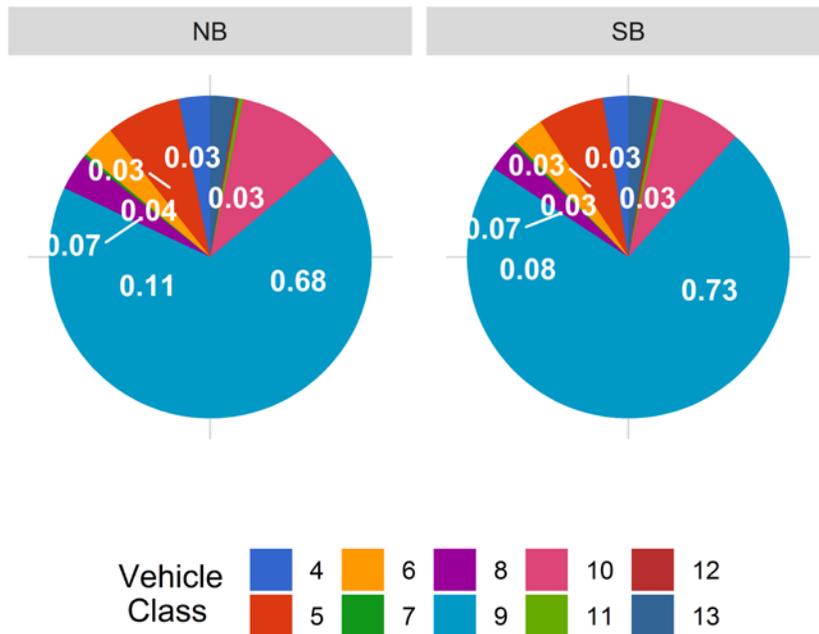


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

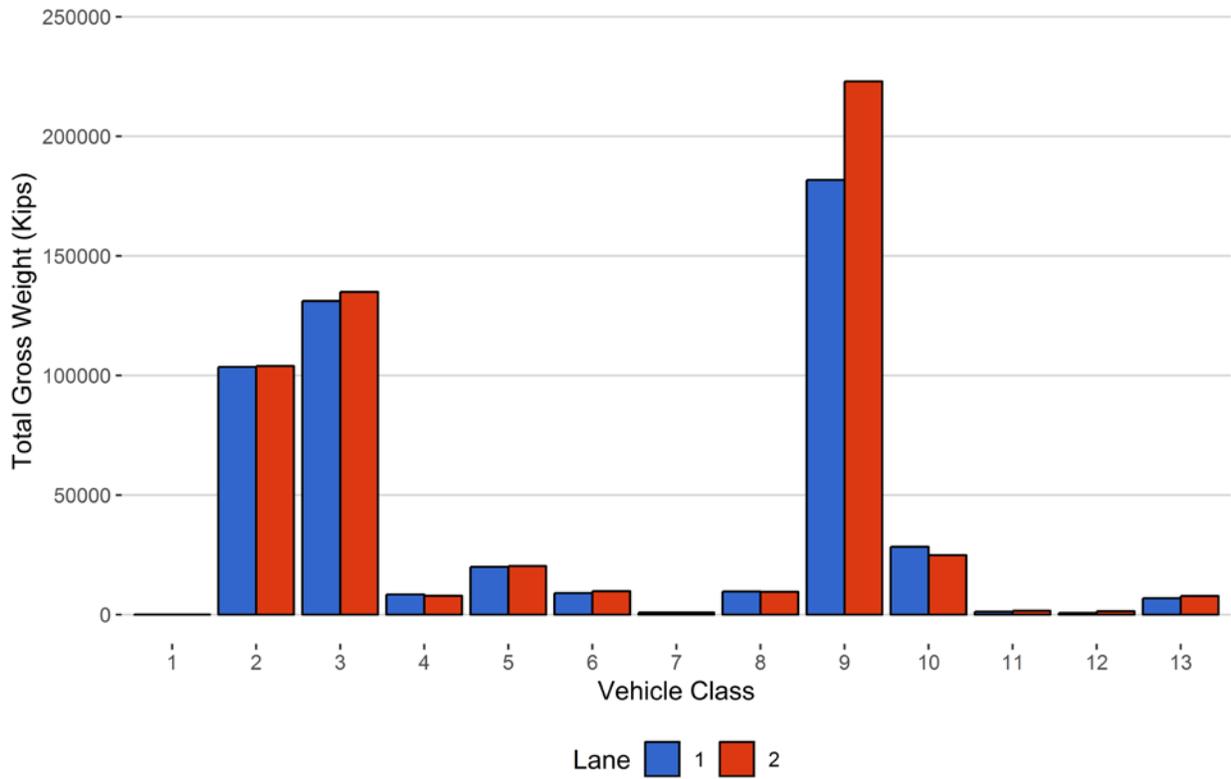


Figure 11 - Total Gross Vehicle Weight t

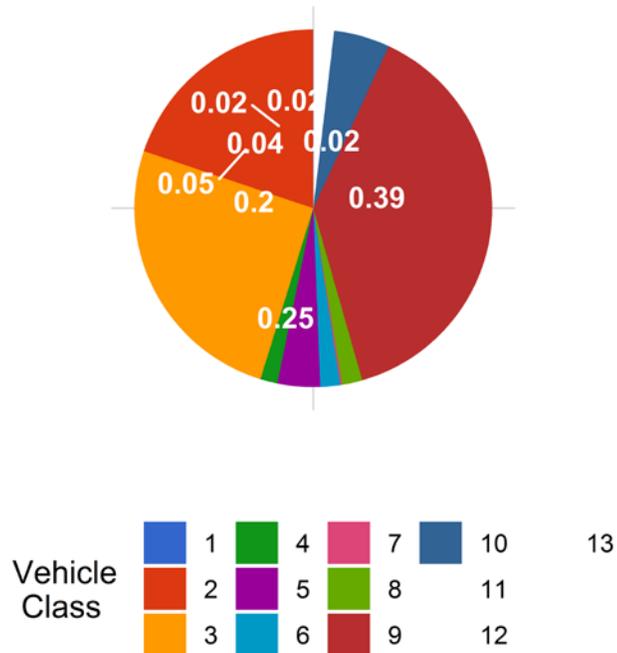


Figure 12 - Total ESALs by Class and Lane

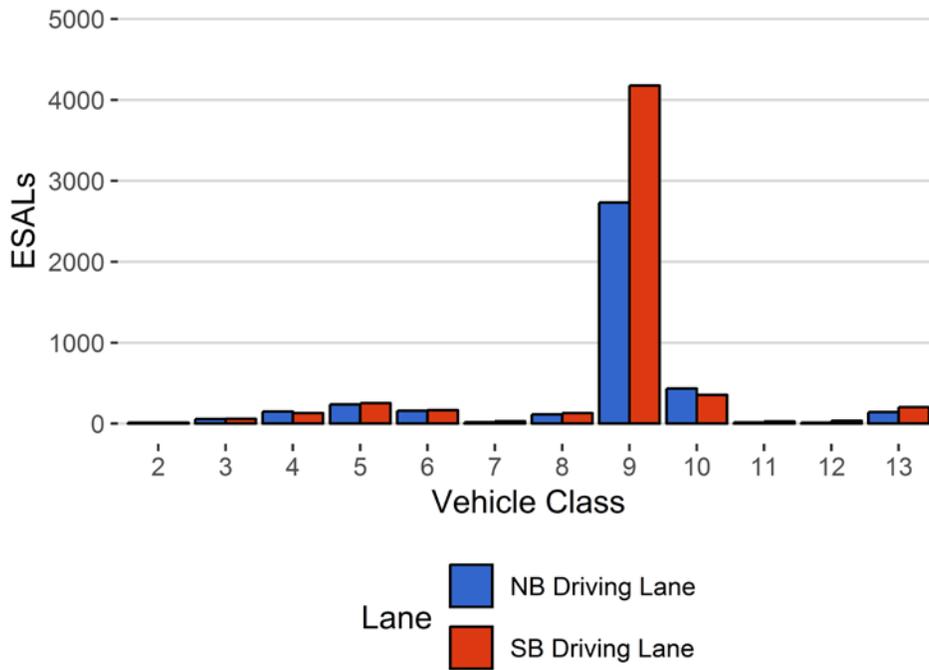


Figure 13 - ESALs by Class

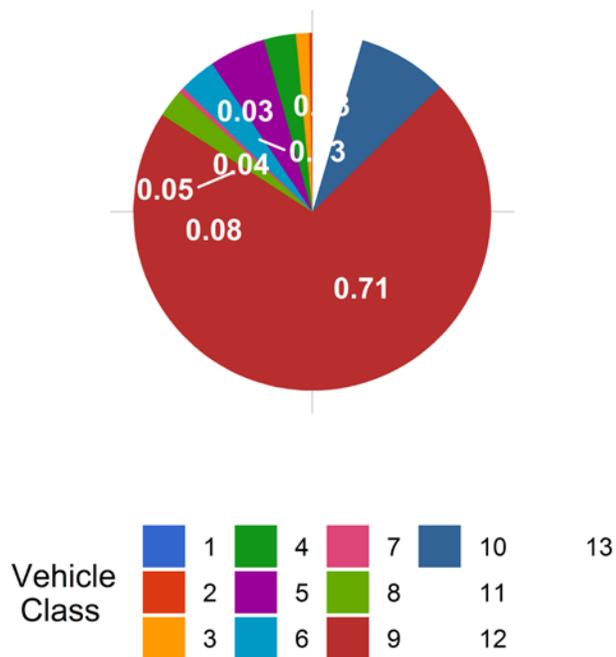


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
July 2015	11.97	0.00	12.29	0.00
August 2015	11.98	0.10	12.18	-0.91
September 2015	11.67	-2.43	12.07	-1.82
October 2015	11.20	-6.43	11.68	-4.95
November 2015	11.28	-5.69	11.29	-8.10
December 2015	11.05	-7.65	10.84	-11.75
January 2016	11.02	-7.92	10.70	-12.91
February 2016	11.21	-6.33	10.71	-12.81
March 2016	11.22	-6.23	11.27	-8.26
April 2016	11.28	-5.77	11.45	-6.85
May 2016	11.51	-3.81	11.82	-3.79
June 2016	11.70	-2.21	11.95	-2.75
July 2016	11.88	-0.72	11.79	-4.08
August 2016	11.77	-1.61	12.12	-1.39
September 2016	11.47	-4.10	11.88	-3.32
October 2016	11.17	-6.65	11.47	-6.67
November 2016	11.11	-7.15	11.31	-7.94
December 2016	11.10	-7.19	10.73	-12.70
January 2017	11.07	-7.51	10.58	-13.92
February 2017	11.14	-6.94	10.73	-12.67
March 2017	11.08	-7.37	11.01	-10.37
April 2017	11.29	-5.67	11.47	-6.64
May 2017	11.32	-5.43	11.60	-5.59
June 2017	11.70	-2.21	11.91	-3.10
July 2017	11.77	-1.60	12.10	-1.55
August 2017	11.61	-2.96	11.96	-2.66
September 2017	11.36	-5.08	11.80	-4.01
October 2017	11.05	-7.67	11.33	-7.77
November 2017	10.75	-10.18	10.90	-11.32
December 2017	10.73	-10.32	10.61	-13.69
January 2018	10.81	-9.63	10.35	-15.81
February 2018	10.64	-11.04	10.27	-16.40
March 2018	10.80	-9.75	10.87	-11.58
April 2018	10.94	-8.59	10.99	-10.55
May 2018	11.19	-6.45	11.56	-5.93
June 2018	11.21	-6.30	11.63	-5.38
July 2018	11.43	-4.50	11.88	-3.33
August 2018	11.33	-5.34	11.66	-5.13
September 2018	11.18	-6.55	11.59	-5.68

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	43	0	0	0
2	1694	50825	48.7	0	0
3	1320	39611	38	0	0
4	20	591	0.6	19	1.6
5	93	2781	2.7	39	3.3
6	22	646	0.6	39	3.3
7	1	42	0	16	1.4
8	22	657	0.6	21	1.8
9	266	7985	7.7	724	62
10	31	925	0.9	186	15.9
11	2	63	0.1	0	0
12	1	33	0	15	1.3
13	5	153	0.1	109	9.3
TOTAL	3478	104355	100	1168	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>
2018-09-16	Sunday	12:07:19	10	SB	2	124.21
2018-09-17	Monday	09:50:24	10	SB	2	111.95
2018-09-13	Thursday	11:16:29	10	SB	2	107.15
2018-09-10	Monday	19:53:06	10	NB	1	103.88
2018-09-13	Thursday	16:33:50	10	SB	2	102.41
2018-09-12	Wednesday	20:32:51	9	SB	2	99.3
2018-09-11	Tuesday	19:01:56	10	NB	1	97.73
2018-09-13	Thursday	12:46:05	10	SB	2	96.55
2018-09-12	Wednesday	08:46:53	9	SB	2	95.97
2018-09-29	Saturday	11:19:13	9	SB	2	95.56

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	294	40	13.6	7898	510	2044
5	NB	8	1385	97	7	19235	713	4466
6	NB	19	300	50	16.7	8114	885	1682
7	NB	11.5	19	0	0	890	0	336
8	NB	31	341	200	58.7	5349	4332	489
9	NB	33	3766	1069	28.4	151780	29972	31389
10	NB	33.5	458	84	18.3	26012	2362	6741
11	NB	36.5	28	7	25	997	186	115
12	NB	36.5	13	4	30.8	608	111	140
13	NB	31.5	75	0	0	6860	0	2249
TOTAL	****	****	6679	1551	****	227742	****	49651
<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	295	49	16.6	7223	626	1767
5	SB	8	1385	106	7.7	19495	787	4632
6	SB	19	343	68	19.8	8596	1156	1685
7	SB	11.5	23	0	0	900	0	318
8	SB	31	313	151	48.2	6383	3151	681
9	SB	33	4187	880	21	197834	25162	44352
10	SB	33.5	463	114	24.6	21514	3330	4911
11	SB	36.5	35	9	25.7	1404	209	228
12	SB	36.5	20	2	10	1323	53	333
13	SB	31.5	77	0	0	7753	0	2664
TOTAL	****	****	7141	1379	****	272426	****	61569
GRAND TOTAL	****	****	13820	2930	372	500169	73545	111220

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	44	19	63	0
2	103570	103928	207498	19.8
3	131188	134954	266142	25.4
4	8407	7850	16257	1.6
5	19948	20282	40231	3.8
6	8999	9752	18751	1.8
7	890	900	1790	0.2
8	9680	9534	19214	1.8
9	181751	222996	404748	38.6
10	28374	24844	53217	5.1
11	1183	1614	2797	0.3
12	719	1376	2095	0.2
13	6860	7753	14614	1.4
TOTAL	501614	545803	1047416	100
GVW/LANE	47.89	52.11	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	0.0227
2	13	13	27	0.3	0.0011
3	57	59	117	1.2	0.006
4	151	130	281	2.9	0.96
5	236	255	491	5.1	0.36
6	160	166	326	3.4	1.02
7	18	30	48	0.5	2.09
8	114	132	246	2.5	0.76
9	2732	4178	6910	71.4	1.75
10	433	356	789	8.2	1.71
11	14	27	41	0.4	1.26
12	13	37	50	0.5	2.48
13	144	204	347	3.6	4.31
TOTAL	4085	5587	9672	100	17
ESALS/LANE	42.2	57.8	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 2017	108353	3495	533	91844	84.8	16509.1	15.2
Nov 2017	98568	3286	494	83733	84.9	14834.6	15.1
Dec 2017	91321	2946	385	79385	86.9	11936.2	13.1
Jan 2018	84152	2715	413	71364	84.8	12787.5	15.2
Feb 2018	77105	2754	435	64926	84.2	12178.7	15.8
Mar 2018	95909	3094	558	78620	82	17289.4	18
Apr 2018	89350	2978	453	75774	84.8	13576.4	15.2
May 2018	108754	3508	506	93068	85.6	15686.4	14.4
Jun 2018	109507	3650	512	94154	86	15353	14
Jul 2018	113876	3673	505	98216	86.2	15660.3	13.8
Aug 2018	116576	3760	558	99287	85.2	17289.3	14.8
Sep 2018	104355	3478	463	90479	86.7	13875.8	13.3
TOTAL	1197826	-	-	1020850	-	176977	-
AVERAGE	99819	3278	485	85071	85	14748	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 2017	4963	7456	12418	6
Nov 2017	3611	7436	11047	2.9
Dec 2017	3215	4055	7270	0.5
Jan 2018	3494	4778	8272	7.6
Feb 2018	3112	5050	8161	10.4
Mar 2018	3482	11316	14797	11.2
Apr 2018	3398	6249	9647	12.1
May 2018	4723	6847	11571	12.2
Jun 2018	4981	6868	11848	6.4
Jul 2018	5036	6999	12035	7.3
Aug 2018	5266	6869	12135	11
Sep 2018	4097	5652	9749	5.7
TOTAL	49377	-	-	-
AVERAGE	4115	6631	10746	8

Gross Vehicle Weight

<i>Month</i>	<i>GVW NB Driving Lane</i>	<i>GVW SB Driving Lane</i>	<i>Total GVW Kips</i>
Oct 2017	410686	456795	867481
Nov 2017	380931	430105	811036
Dec 2017	433134	867894	1301027
Jan 2018	422404	531030	953434
Feb 2018	542896	581854	1124749
Mar 2018	559697	574474	1134172
Apr 2018	558833	625054	1183887
May 2018	583793	652111	1235903
Jun 2018	502142	546473	1048616
Jul 2018	554209	621491	1175700
Aug 2018	472927	566640	1039567
Sep 2018	417109	450095	867205
TOTAL	5838759	6904016	12742775
AVERAGE	486563	575335	1061898

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 2017	1944	1.8	11.7	357	136
Nov 2017	1341	1.4	9	196	52
Dec 2017	773	0.8	6.5	148	22
Jan 2018	1134	1.4	8.9	227	30
Feb 2018	1021	1.3	8.4	241	22
Mar 2018	5264	5.5	30.5	3187	77
Apr 2018	1526	1.7	11.3	426	43
May 2018	1598	1.5	10.2	263	65
Jun 2018	1723	1.6	11.3	233	51
Jul 2018	1960	1.7	12.5	223	65
Aug 2018	1779	1.5	10.3	252	57
Sep 2018	1177	1.1	8.5	171	52
TOTAL	21240	-	-	5924	672
AVERAGE	1770	1.8	11.6	493.7	56

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 2017	60584	79341	139925	43.3	56.7
Nov 2017	43921	72755	116676	37.6	62.4
Dec 2017	39190	50579	89769	43.7	56.3
Jan 2018	42006	57239	99245	42.3	57.7
Feb 2018	36931	56998	93928	39.3	60.7
Mar 2018	42014	184856	226871	18.5	81.5
Apr 2018	39020	76169	115188	33.9	66.1
May 2018	54882	70343	125225	43.8	56.2
Jun 2018	58453	65552	124005	47.1	52.9
Jul 2018	56615	72870	129484	43.7	56.3
Aug 2018	60703	72416	133119	45.6	54.4
Sep 2018	49651	61569	111220	44.6	55.4
TOTAL	583970	920687	1504657	-	-
AVERAGE	48664.1	76723.9	125388.1	40.3	59.7