

NOVEMBER 2018



08/03/2005

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

**MONTHLY
REPORT**



2009/10/20

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 November 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 exceeded +/- 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: 100582 | Passenger Vehicles: 84315 | Heavy Commercial Vehicles: 16267

Monthly Average Daily Traffic (MADT): 3353 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 542

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 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 16267 HCVs, 894 of them were overweight³. These overweight HCVs contributed to 0.9% of total monthly volume, and 5.5% 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 Sundays. 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 52.3% 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 ,49 NB vehicles exceeded 88,000 pounds (38 vehicles were Class 13's; 10 vehicles were Class 10's). Of vehicles traveling SB,

45 NB vehicles exceeded 88,000 pounds (27 vehicles were Class 13's; 9 vehicles were Class 9's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from November 2018.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in November 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 123084 tons of freight was recorded to have crossed the WIM. More freight was shipped SB (50.8%) than NB (49.2%). 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 100582 vehicles with a combined GVW of 1074522 kips (1 kip = 1,000 pounds = 0.5 tons) in November 2018. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 9731 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 52.5% of all ESALs were recorded SB while 47.5% was observed NB. In particular, 68% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 42% 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).

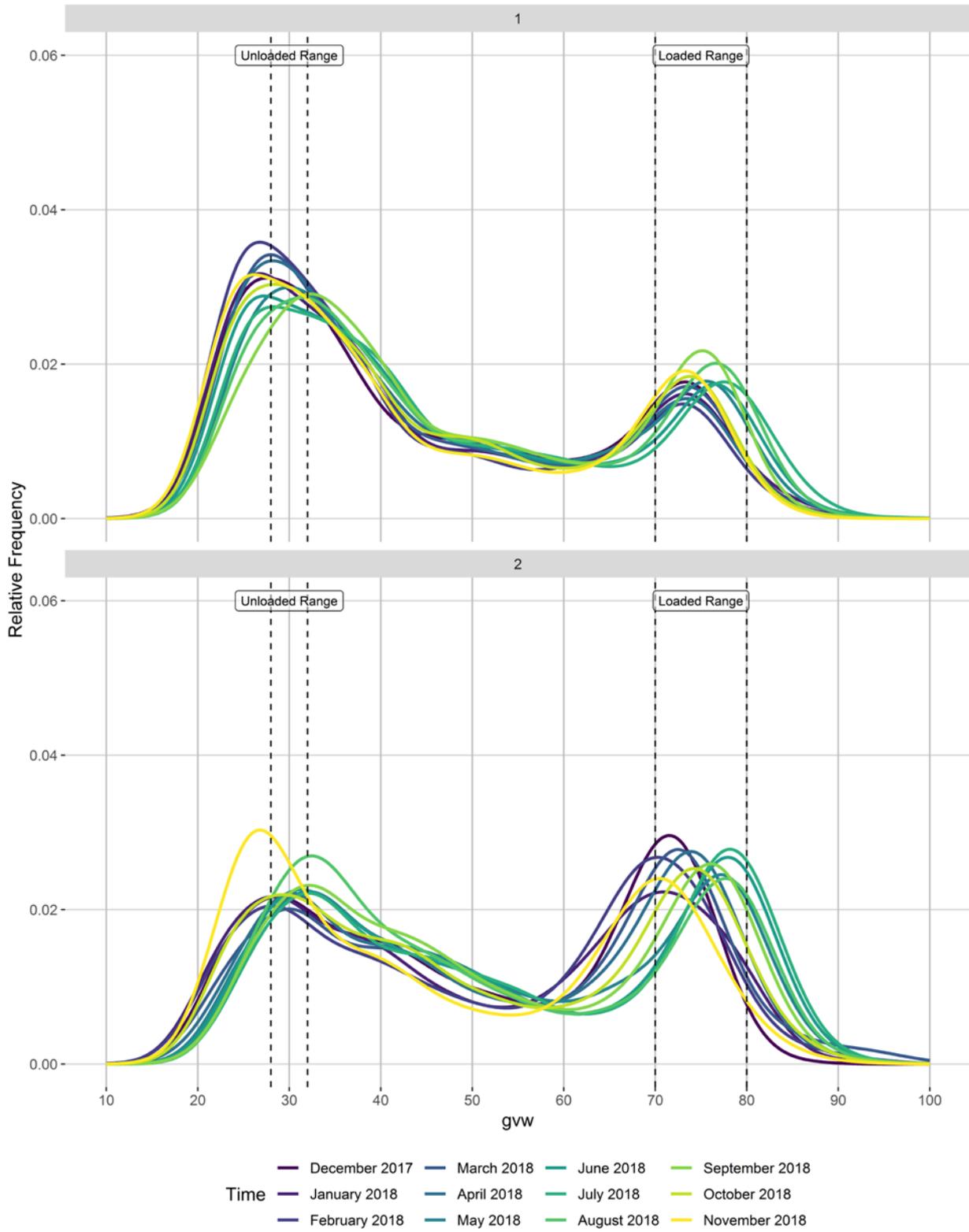
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

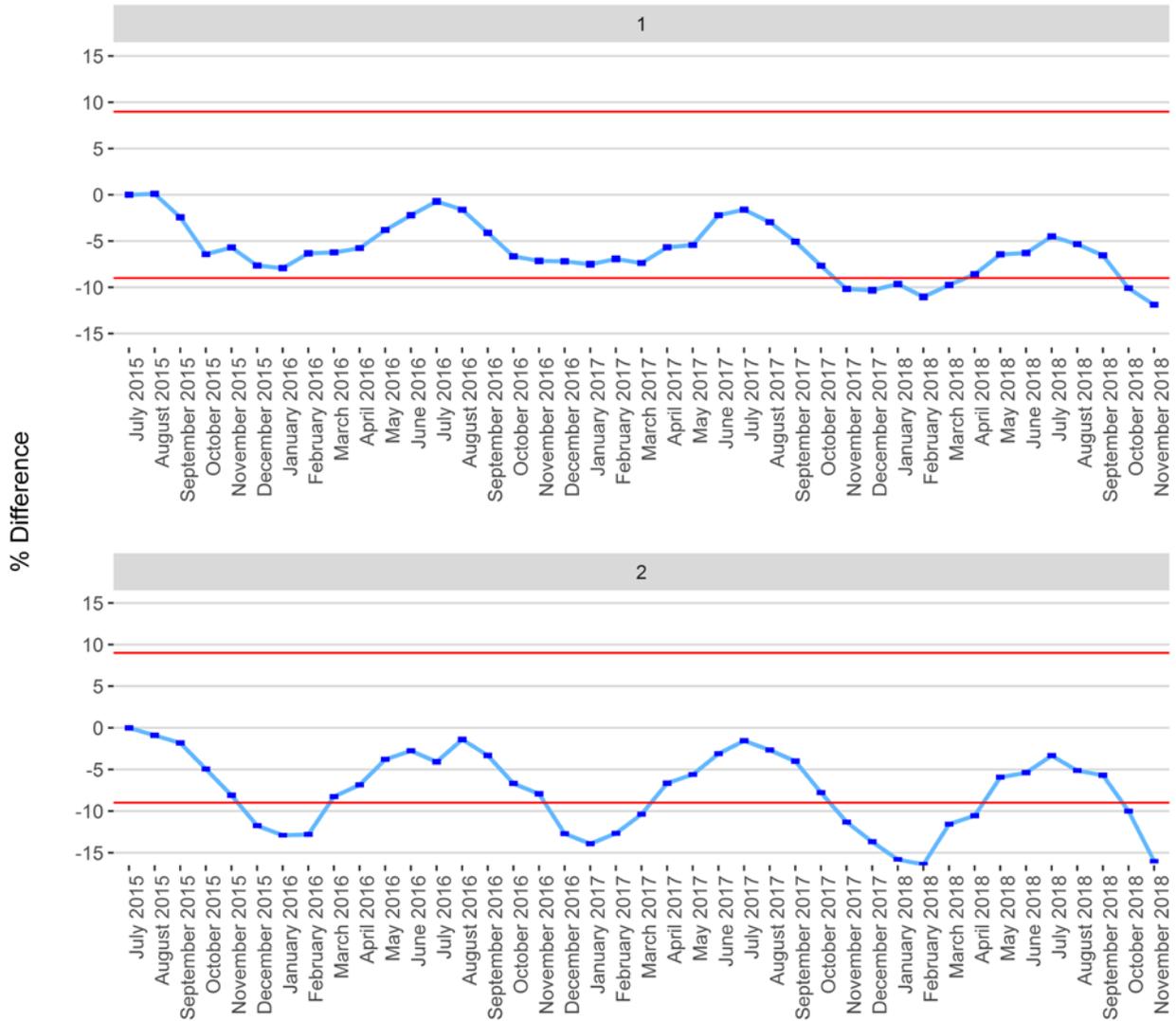
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

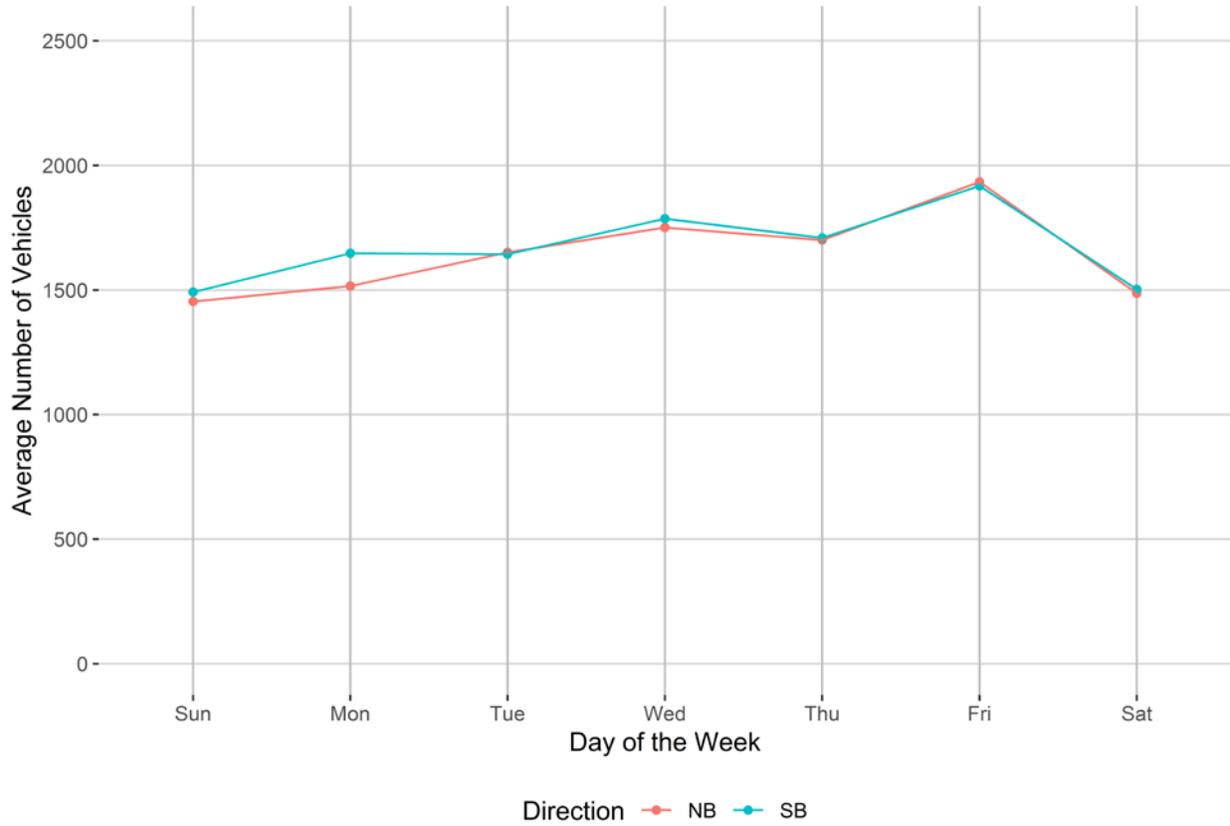


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

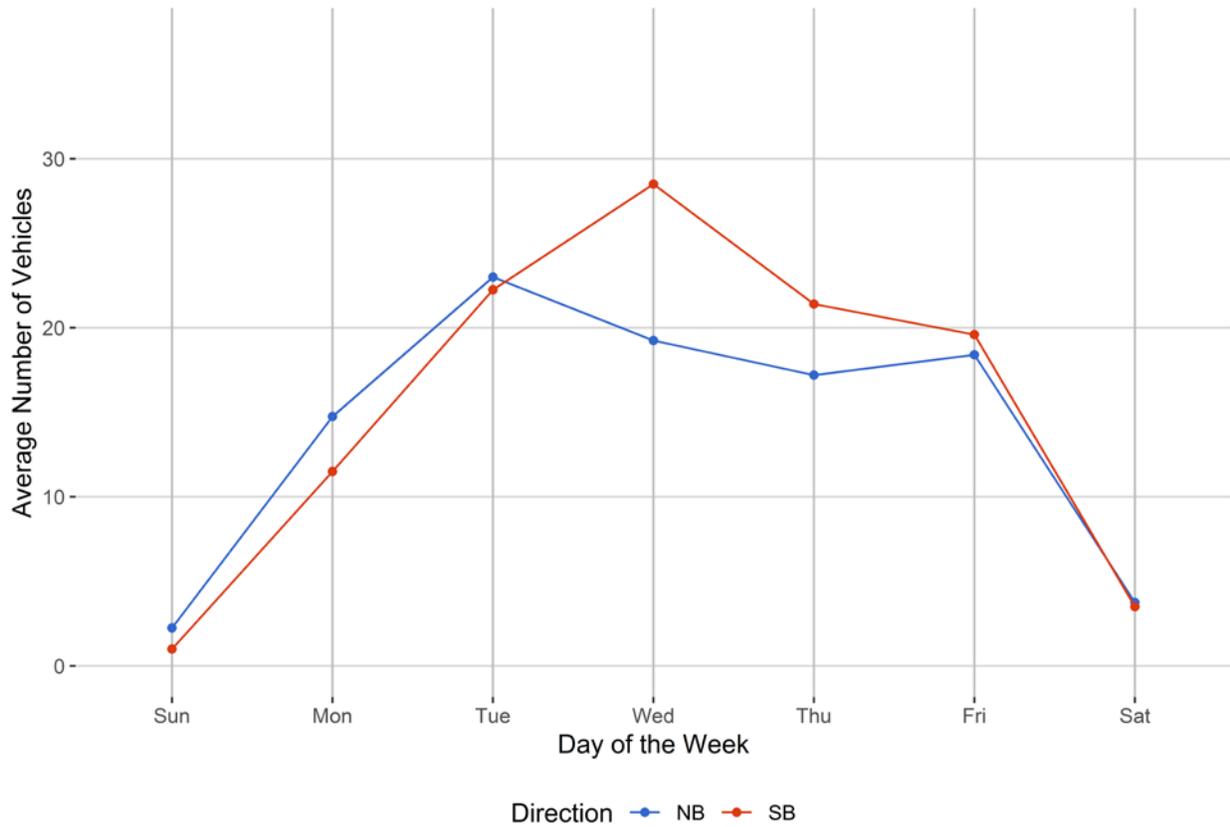


Figure 4 - Passenger Vehicles vs. Hour of the Day

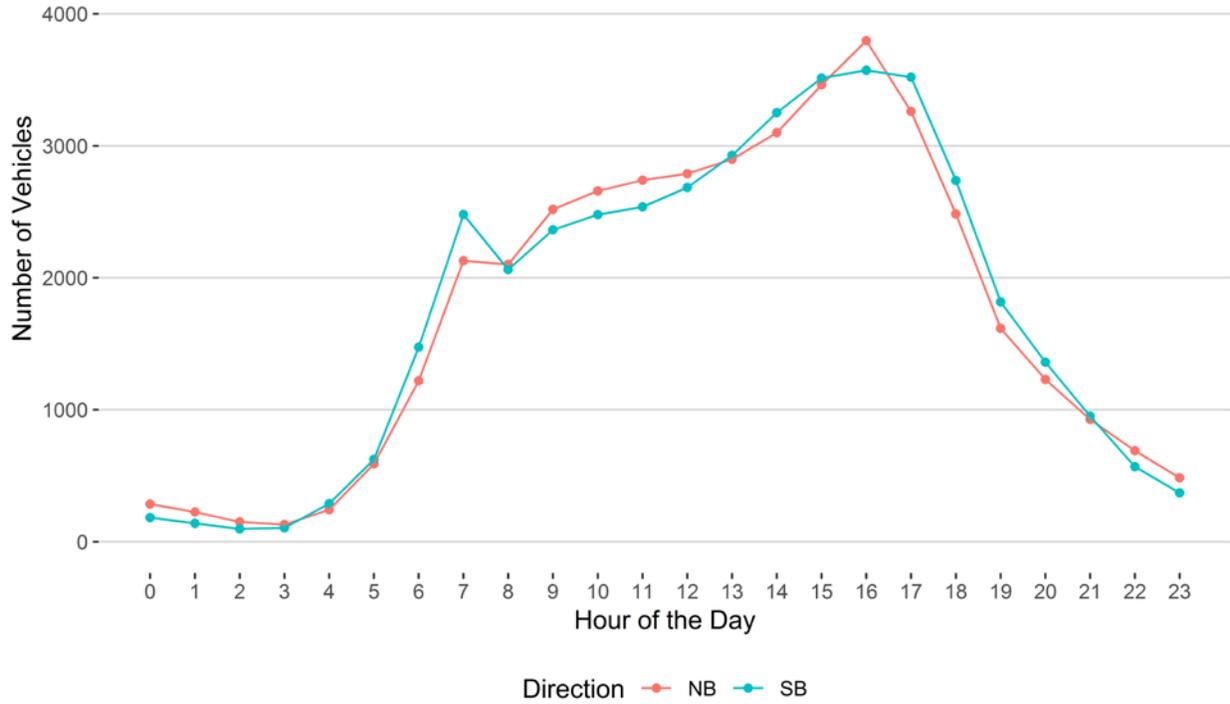


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

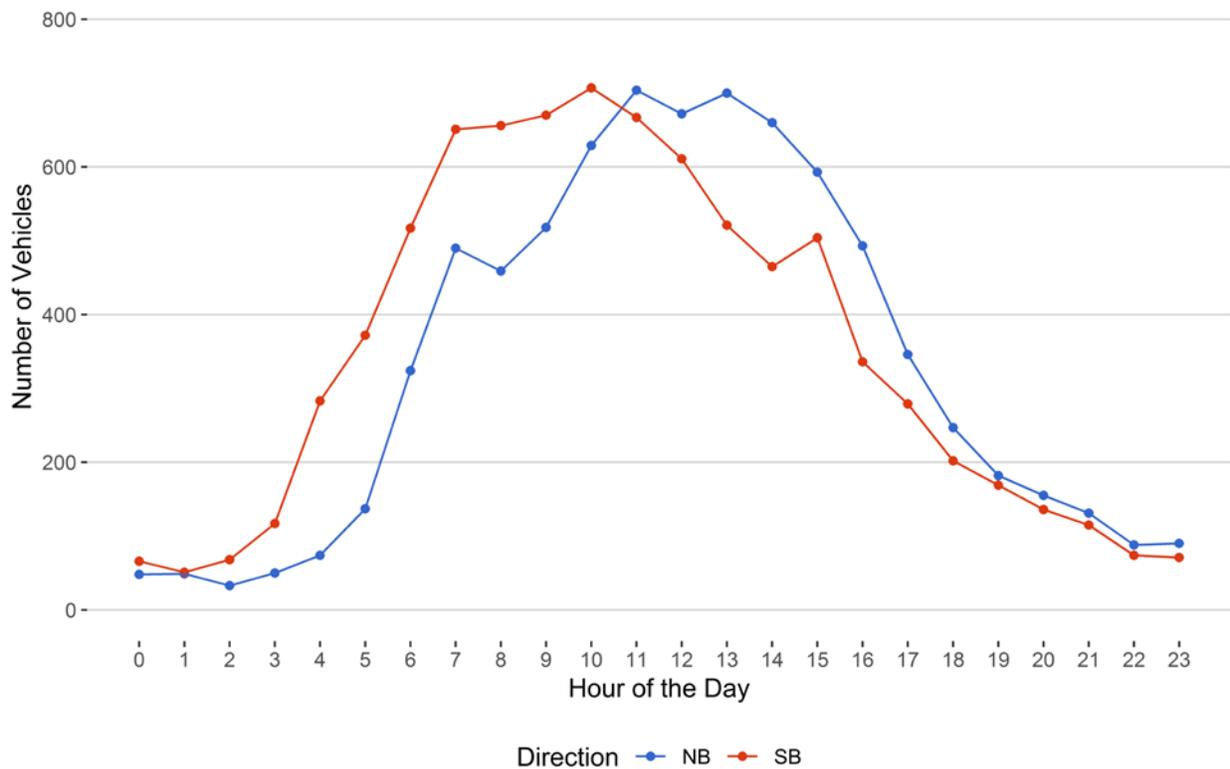


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

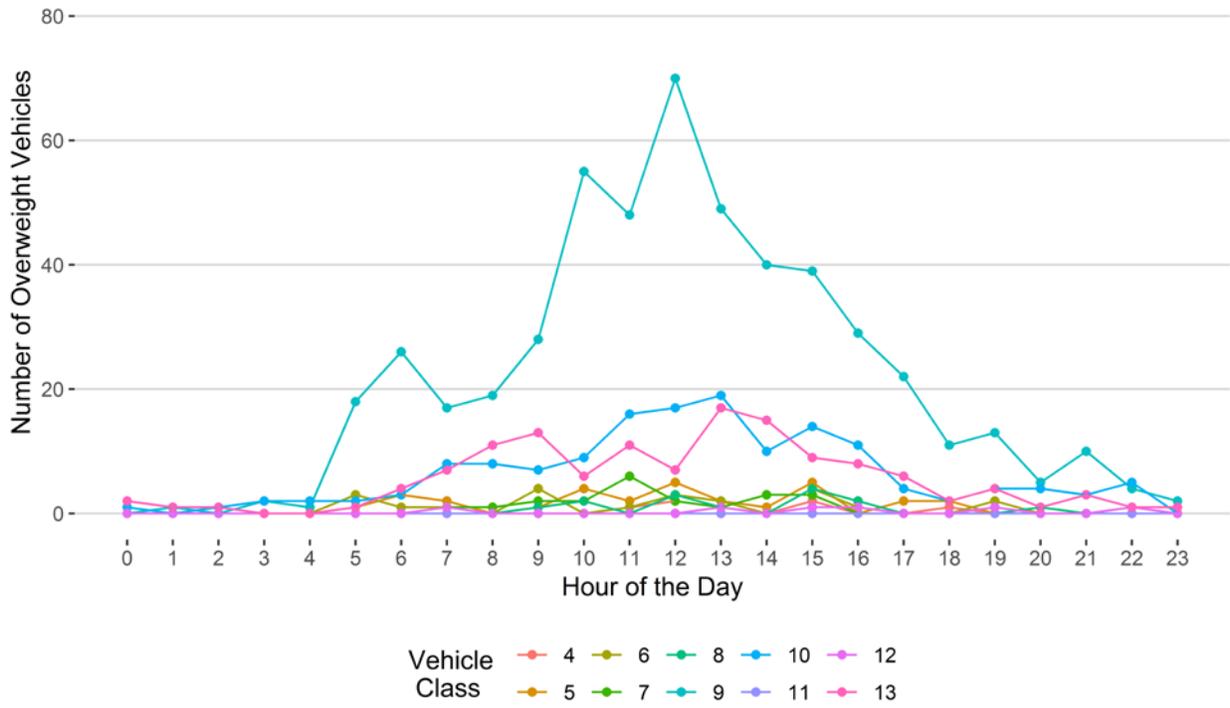


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

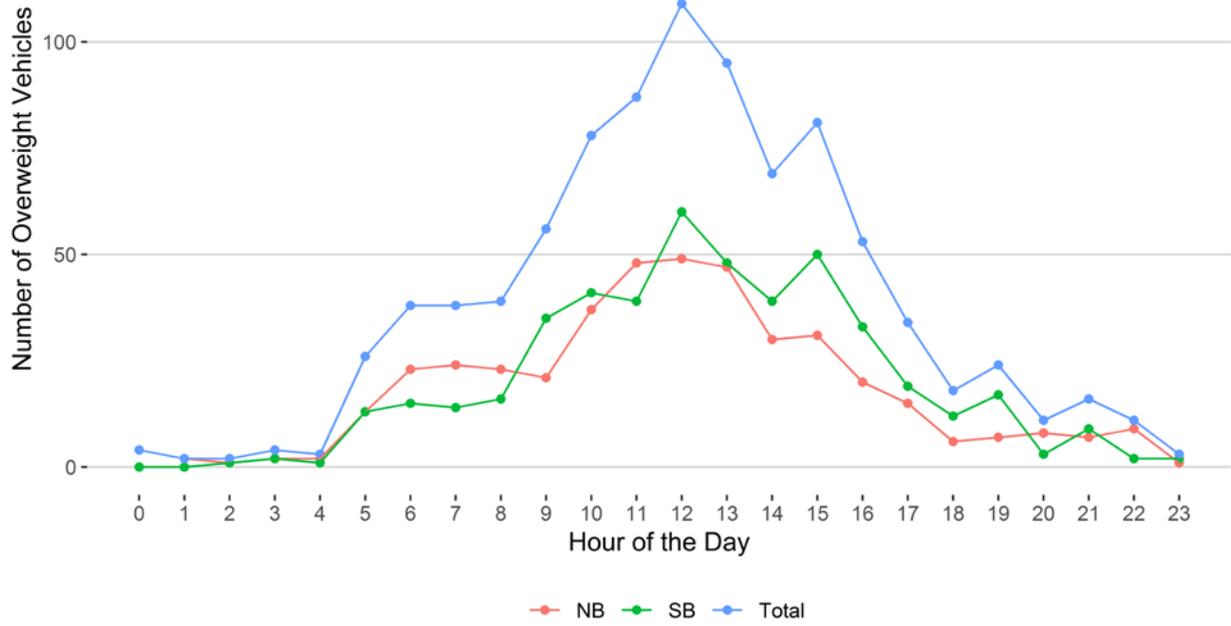
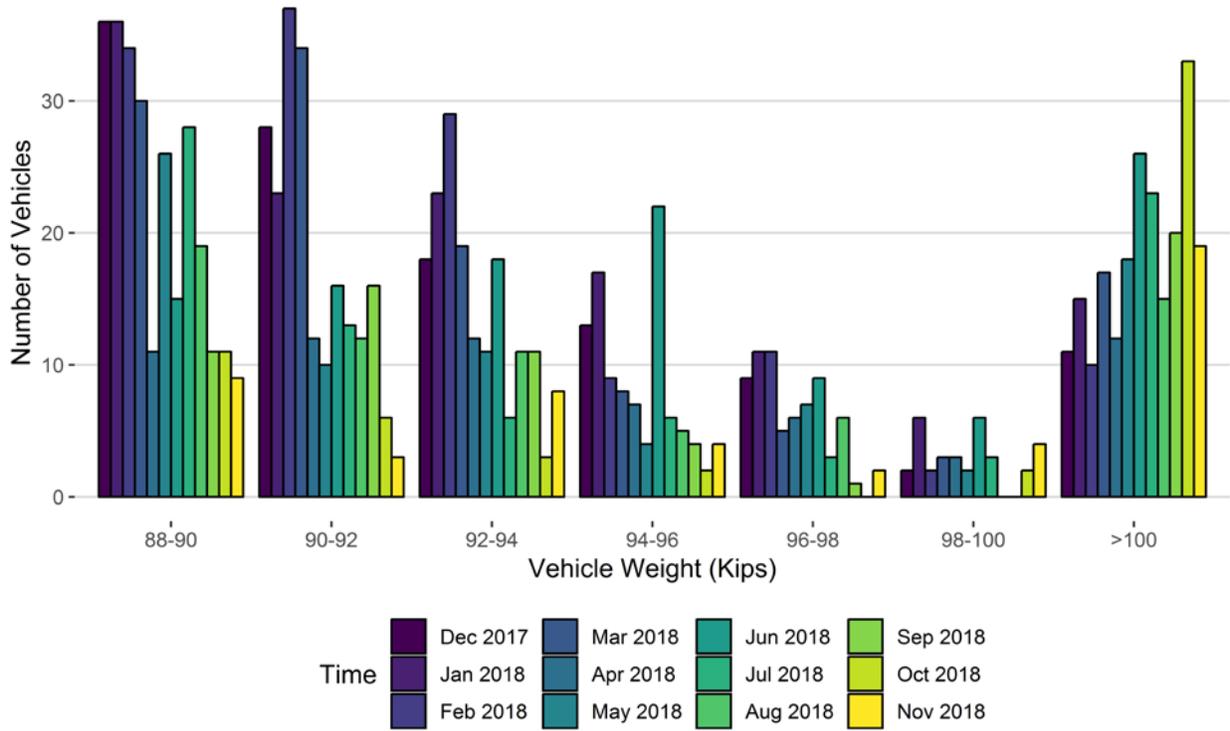
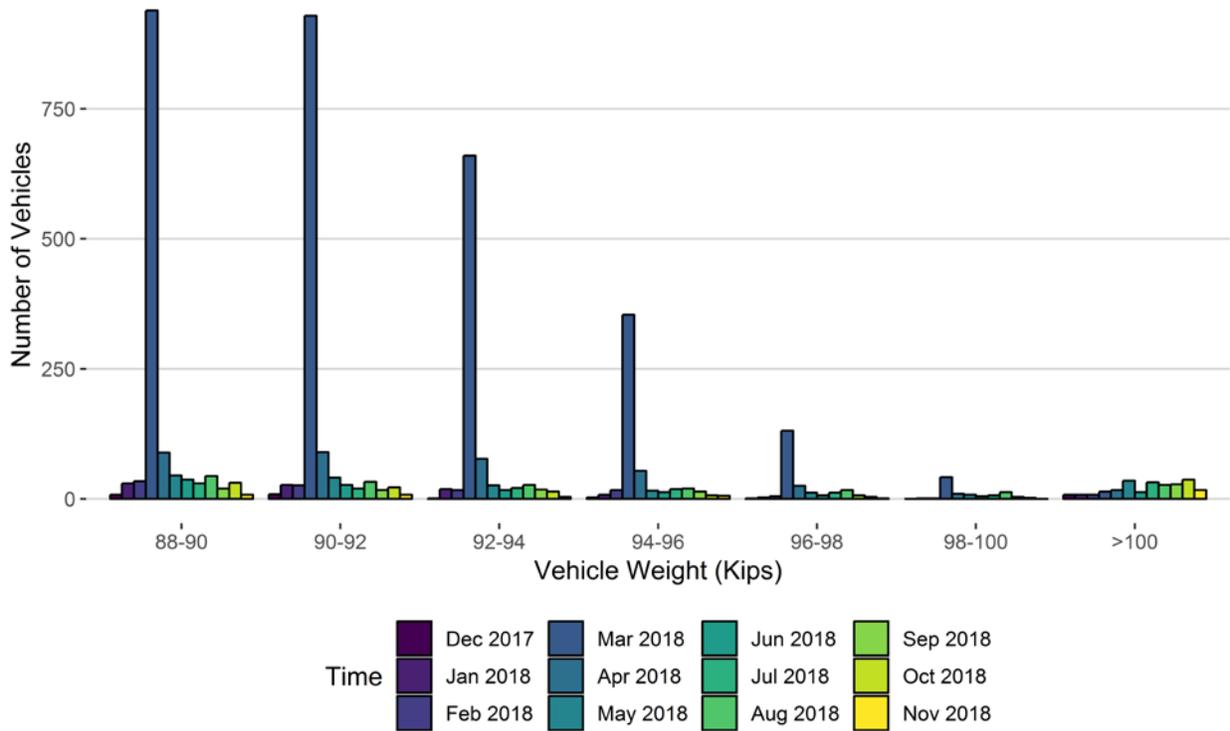


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018
88-90	36	36	34	30	11	26	15	28	19	11	11	9
90-92	28	23	37	34	12	10	16	13	12	16	6	3
92-94	18	23	29	19	12	11	18	6	11	11	3	8
94-96	13	17	9	8	7	4	22	6	5	4	2	4
96-98	9	11	11	5	6	7	9	3	6	1	0	2
98-100	2	6	2	3	3	2	6	3	0	0	2	4
>100	11	15	10	17	12	18	26	23	15	20	33	19
Total	117	131	132	116	63	78	112	82	68	63	57	49

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



Vehicle Weights (Kips)	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018
88-90	8	30	34	939	89	45	37	30	44	20	31	8
90-92	9	27	26	929	90	41	27	20	33	17	22	8
92-94	1	19	17	660	77	26	17	21	27	18	14	4
94-96	3	8	17	354	54	16	13	19	20	14	7	6
96-98	1	3	5	131	25	12	7	12	17	7	4	1
98-100	0	1	1	42	10	8	5	7	13	4	2	0
>100	8	8	8	14	17	35	13	32	27	28	37	17
Total	30	96	108	3069	362	183	119	141	181	108	117	44

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

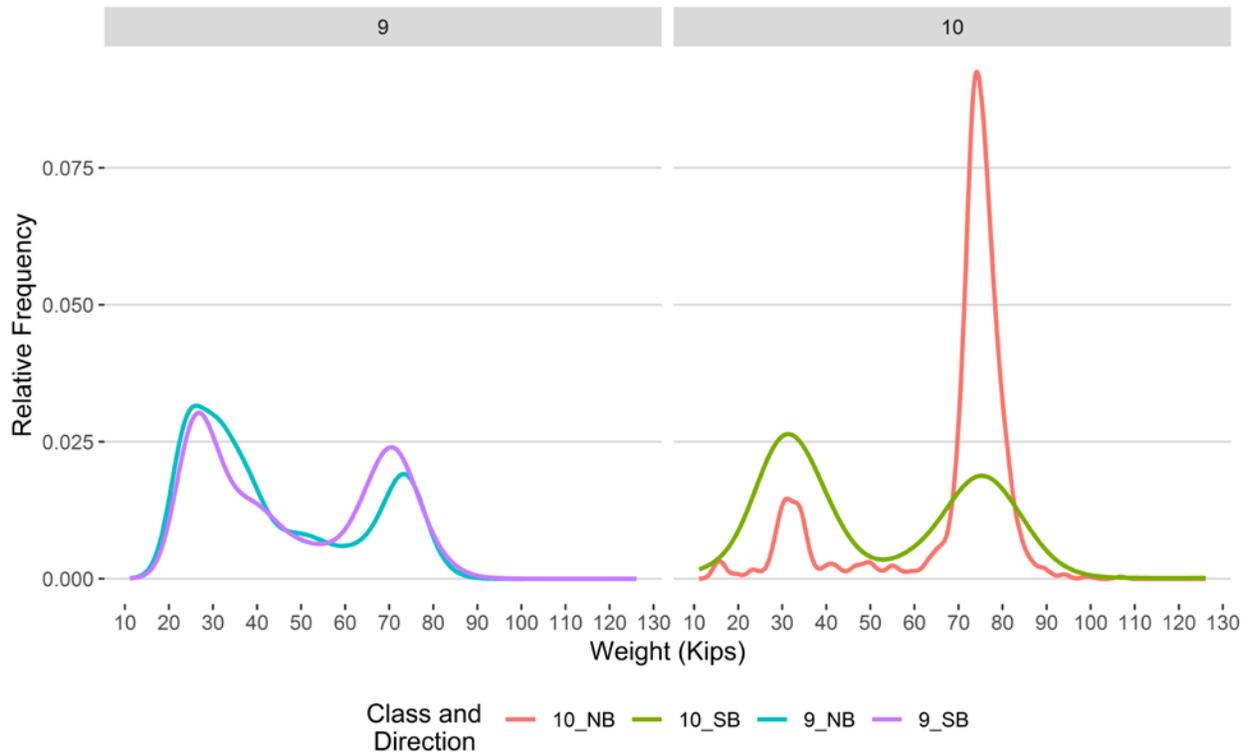


Figure 9 - Freight Percentage by Direction and Class

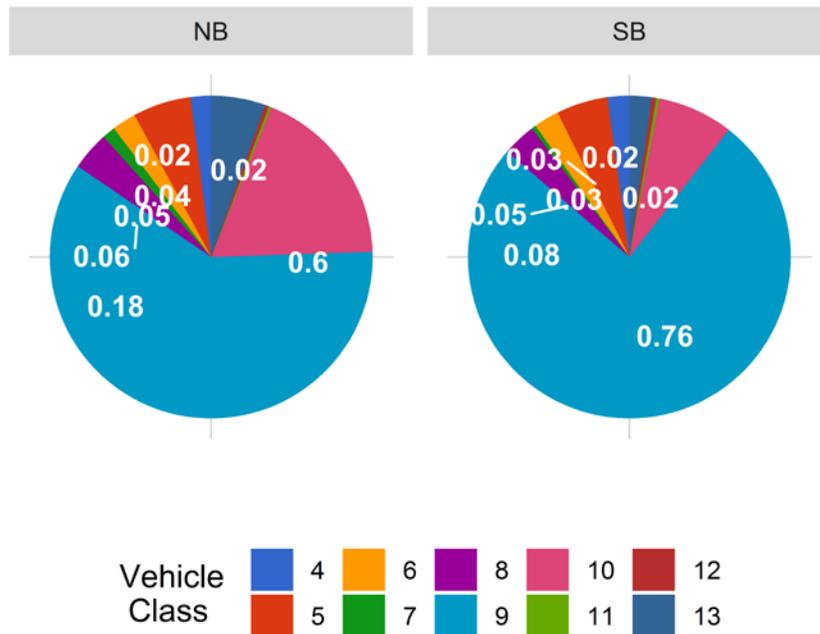


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

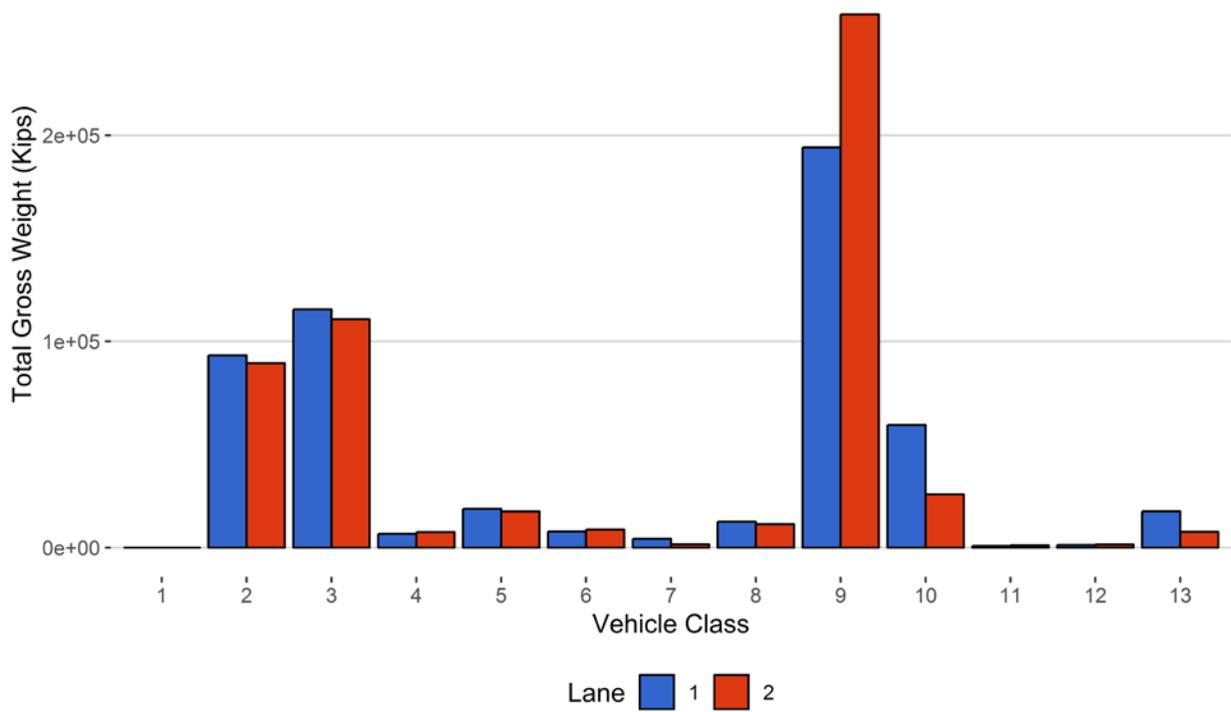


Figure 11 - Total Gross Vehicle Weight t

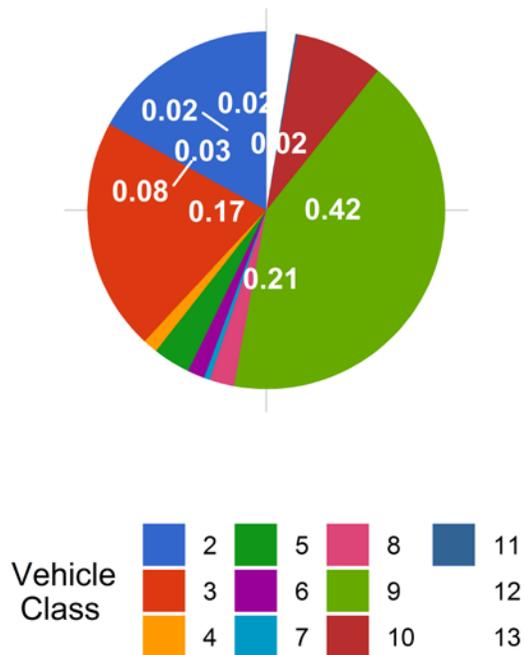


Figure 12 - Total ESALs by Class and Lane

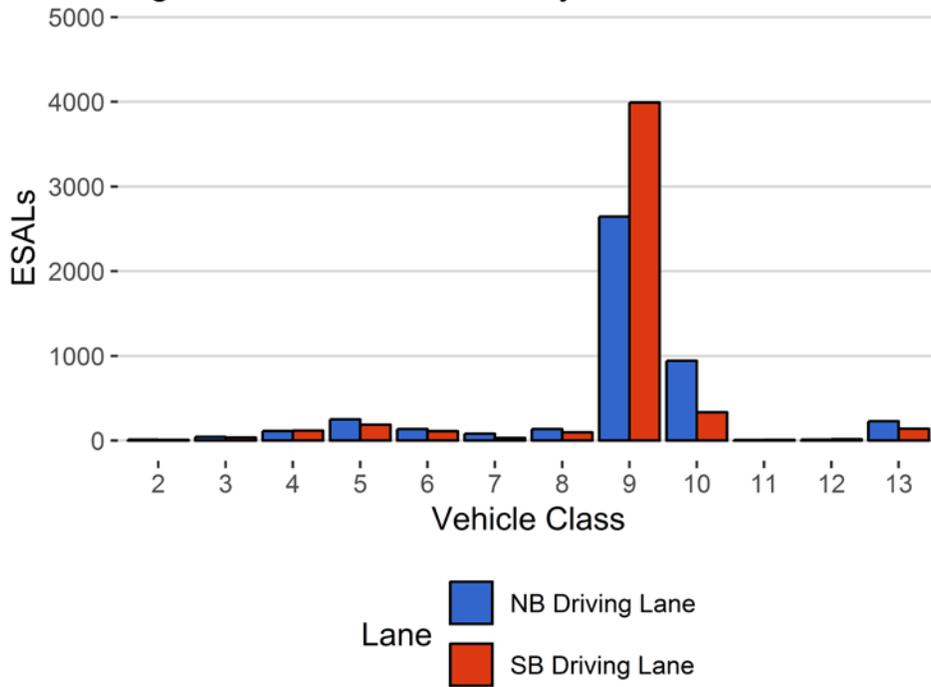


Figure 13 - ESALs by Class

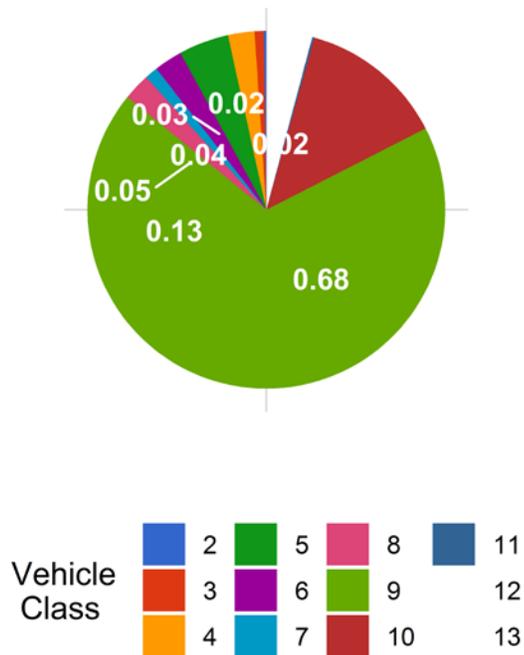


Table 1 Class 9 Front Axle Weight by Lane

<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

October 2018	10.76	-10.10	11.06	-10.01
November 2018	10.54	-11.89	10.32	-16.01

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	1568	47036	46.8	0	0
3	1243	37279	37.1	0	0
4	15	464	0.5	8	0.9
5	89	2666	2.7	30	3.4
6	20	609	0.6	22	2.5
7	3	103	0.1	21	2.3
8	28	834	0.8	15	1.7
9	327	9805	9.7	509	56.9
10	46	1383	1.4	152	17
11	2	45	0	0	0
12	2	47	0	6	0.7
13	10	309	0.3	131	14.7
TOTAL	3353	100582	100	894	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>
2018-11-05	Monday	09:41:25	10	SB	2	126.12
2018-11-16	Friday	21:07:25	10	NB	1	116.65
2018-11-16	Friday	06:55:38	10	NB	1	113.71
2018-11-08	Thursday	00:10:03	10	NB	1	113.34
2018-11-08	Thursday	23:20:01	10	NB	1	110.71
2018-11-07	Wednesday	10:12:57	10	SB	2	109.5
2018-11-27	Tuesday	11:08:00	10	NB	1	106.81
2018-11-08	Thursday	09:05:50	10	NB	1	105.02
2018-11-15	Thursday	21:35:49	10	NB	1	104.15
2018-11-23	Friday	11:36:55	10	NB	1	99.3

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	218	26	11.9	6349	336	1735
5	NB	8	1356	150	11.1	17733	1102	4042
6	NB	19	268	57	21.3	6859	961	1425
7	NB	11.5	72	0	0	4236	0	1704
8	NB	31	426	275	64.6	5772	6776	546
9	NB	33	4396	1797	40.9	146232	47922	30232
10	NB	33.5	873	86	9.9	57024	2432	15330
11	NB	36.5	20	1	5	806	21	56
12	NB	36.5	23	0	0	1271	0	216
13	NB	31.5	220	0	0	17590	0	5330
TOTAL	****	****	7872	2392	****	263872	****	60616
<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	244	35	14.3	7062	434	1964
5	SB	8	1296	234	18.1	15870	1684	3687
6	SB	19	338	80	23.7	7387	1305	1242
7	SB	11.5	30	1	3.3	1512	10	589
8	SB	31	404	243	60.1	5684	5684	347
9	SB	33	5357	1869	34.9	208738	49962	46817
10	SB	33.5	503	174	34.6	20936	4871	4957
11	SB	36.5	25	3	12	1004	68	101
12	SB	36.5	24	0	0	1480	0	302
13	SB	31.5	87	0	0	7667	0	2463
TOTAL	****	****	8308	2639	****	277340	****	62469
GRAND TOTAL	****	****	16180	5031	366	541212	123568	123084

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	93224	89476	182700	17
3	115521	110819	226339	21.1
4	6685	7496	14182	1.3
5	18834	17554	36389	3.4
6	7820	8691	16511	1.5
7	4236	1522	5757	0.5
8	12548	11369	23917	2.2
9	194154	258699	452853	42.2
10	59456	25807	85263	7.9
11	827	1072	1899	0.2
12	1271	1480	2751	0.3
13	17590	7667	25257	2.4
TOTAL	532167	541653	1073819	100
GVW/LANE	49.56	50.44	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	11	10	21	0.2	9e-04
3	44	37	81	0.8	0.0045
4	114	118	232	2.4	1.01
5	251	188	440	4.5	0.33
6	136	112	248	2.5	0.82
7	81	33	115	1.2	2.18
8	138	99	237	2.4	0.58
9	2645	3992	6636	68.4	1.37
10	943	334	1278	13.2	1.86
11	7	10	18	0.2	0.83
12	13	18	31	0.3	1.26
13	230	140	371	3.8	2.37
TOTAL	4614	5093	9706	100	13
ESALS/LANE	47.5	52.5	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>
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
Oct 2018	108346	3495	550	91301	84.3	17045.5	15.7
Nov 2018	100582	3353	542	84315	83.8	16266.5	16.2
TOTAL	1199833	-	-	1020889	-	178945	-
AVERAGE	99986	3284	490	85074	85	14912	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>
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
Oct 2018	4788	6405	11193	3.8
Nov 2018	4625	5107	9731	3.1
TOTAL	50216	-	-	-
AVERAGE	4185	6349	10534	8

Gross Vehicle Weight

<i>Month</i>	<i>GVW NB Driving Lane</i>	<i>GVW SB Driving Lane</i>	<i>Total GVW Kips</i>
Dec 2017	410686	456795	867481
Jan 2018	380931	430105	811036
Feb 2018	433134	867894	1301027
Mar 2018	422404	531030	953434
Apr 2018	542896	581854	1124749
May 2018	559697	574474	1134172
Jun 2018	558833	625054	1183887
Jul 2018	583793	652111	1235903
Aug 2018	502142	546473	1048616
Sep 2018	543677	598248	1141925
Oct 2018	532437	542085	1074522
Nov 2018	417109	450095	867205
TOTAL	5887738	6856217	12743955
AVERAGE	490645	571351	1061996

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>
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
Oct 2018	1281	1.2	7.5	177	77
Nov 2018	901	0.9	5.6	94	40
TOTAL	20137	-	-	5642	601
AVERAGE	1678.1	1.7	11	470.2	50.1

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>
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
Oct 2018	55838	73026	128864	43.3	56.7
Nov 2018	60616	62469	123084	49.2	50.8
TOTAL	595918	904086	1500004	-	-
AVERAGE	49659.9	75340.5	125000.3	41.3	58.7