

APRIL 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 April 2019. 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. 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: 93990 | Passenger Vehicles: 80204 | Heavy Commercial Vehicles: 13786

Monthly Average Daily Traffic (MADT): 3133 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 460

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 Wednesdays. SB vehicles typically reached highest volume levels on Sundays, 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 13786 HCVs, 655 of them were overweight ³. These overweight HCVs contributed to 0.7% of total monthly volume, and 4.8% of total monthly

HCV volume. NB overweight vehicles typically reached highest numbers on Tuesdays, with lowest volumes reported on Saturdays. 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 13 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 67.3% 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 May.

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 ,49 NB vehicles exceeded 88,000 pounds (41 vehicles were Class 13's; 6 vehicles were Class 10's). Of vehicles traveling SB,

73 NB vehicles exceeded 88,000 pounds (47 vehicles were Class 13's; 20 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from April 2019.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in April 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 101383 tons of freight was recorded to have crossed the WIM. More freight was shipped SB (57.4%) than NB (42.6%). 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 93990 vehicles with a combined GVW of 935467 kips (1 kip = 1,000 pounds = 0.5 tons) in April 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 8021 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 59% of all ESALs were recorded SB while 41% was observed NB. In particular, 72% 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).

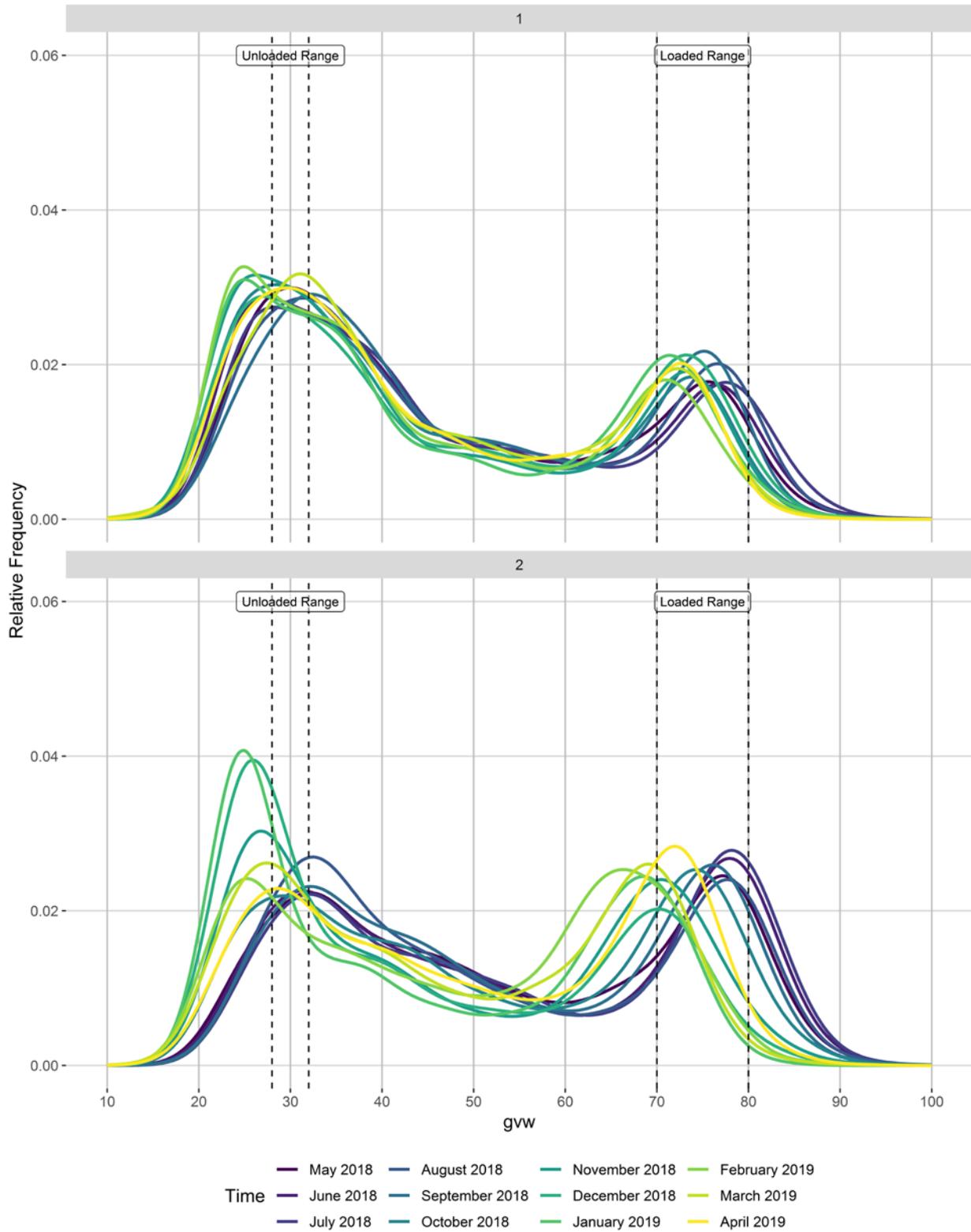
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

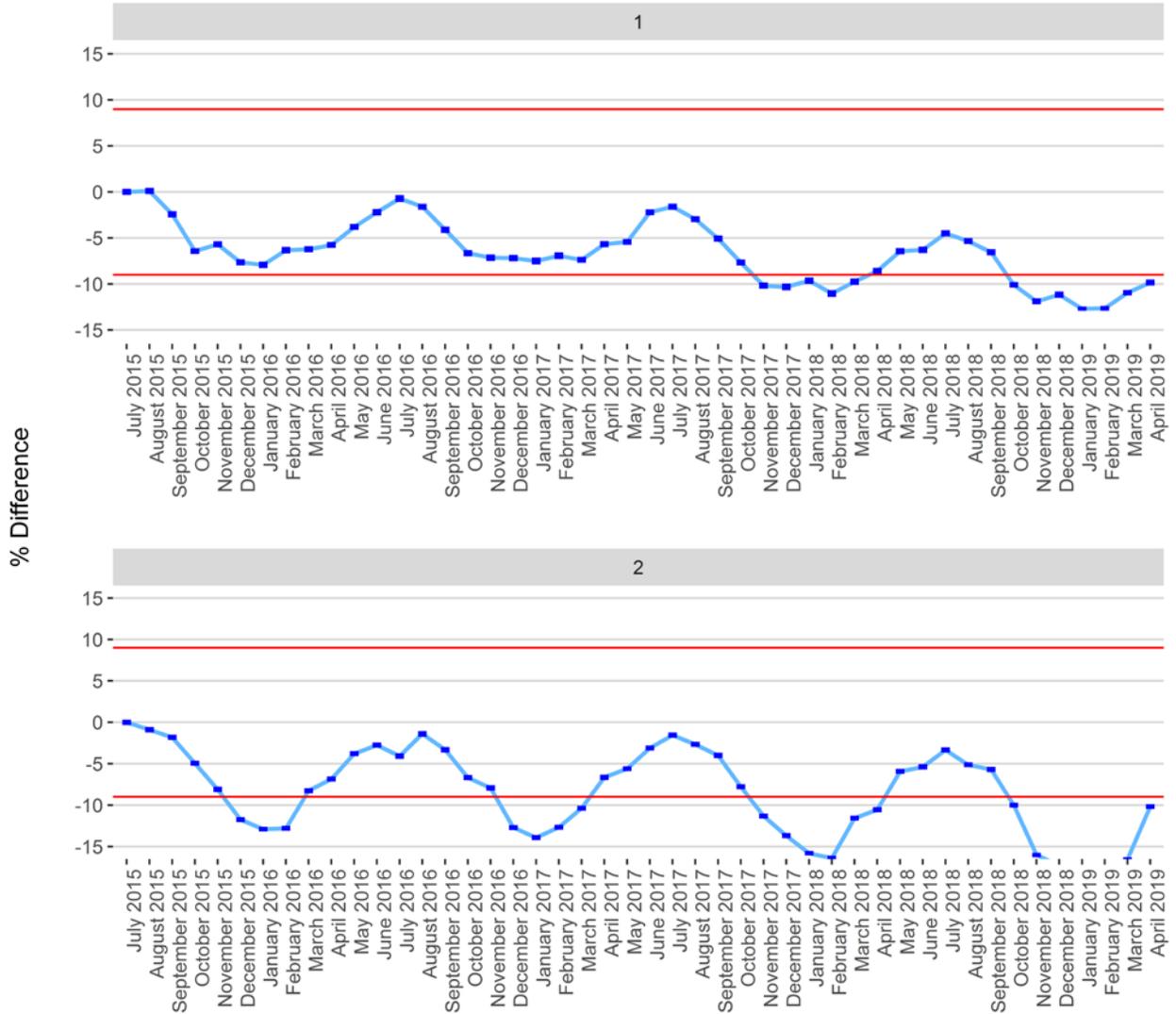
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

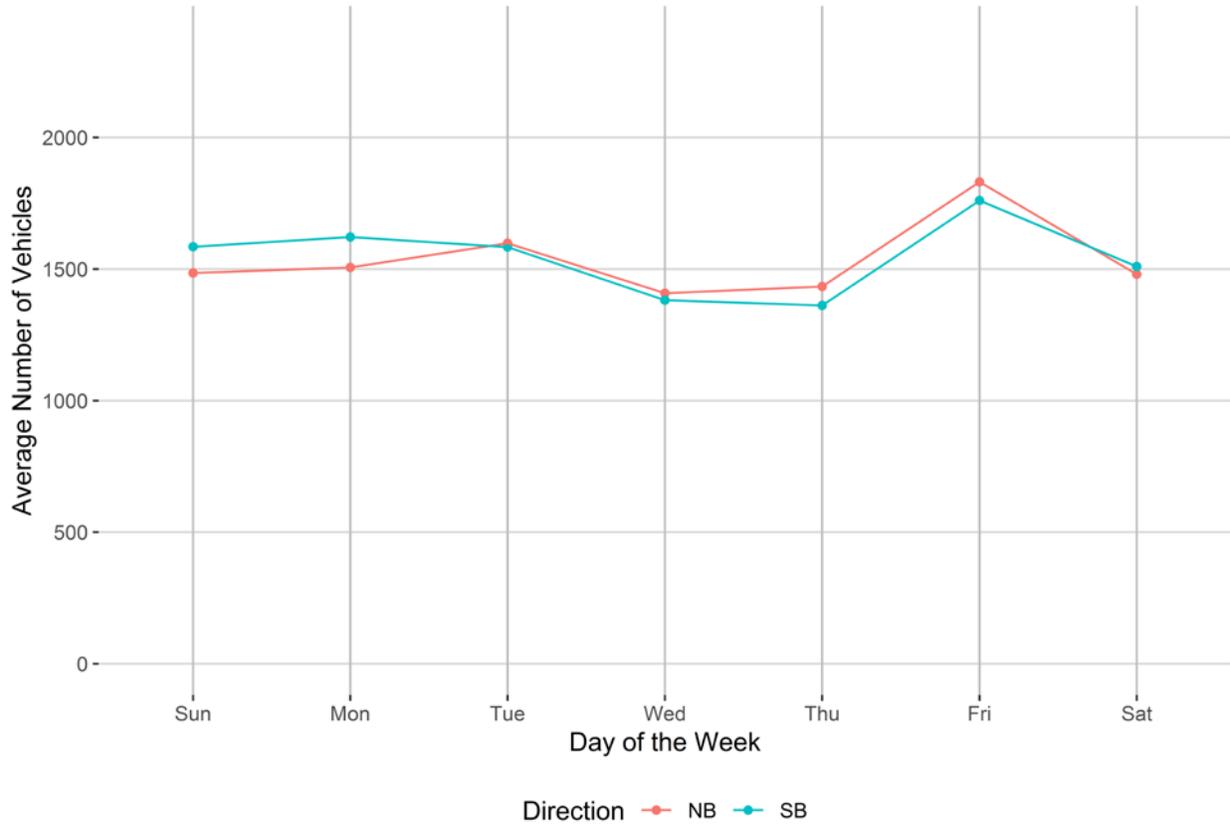


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

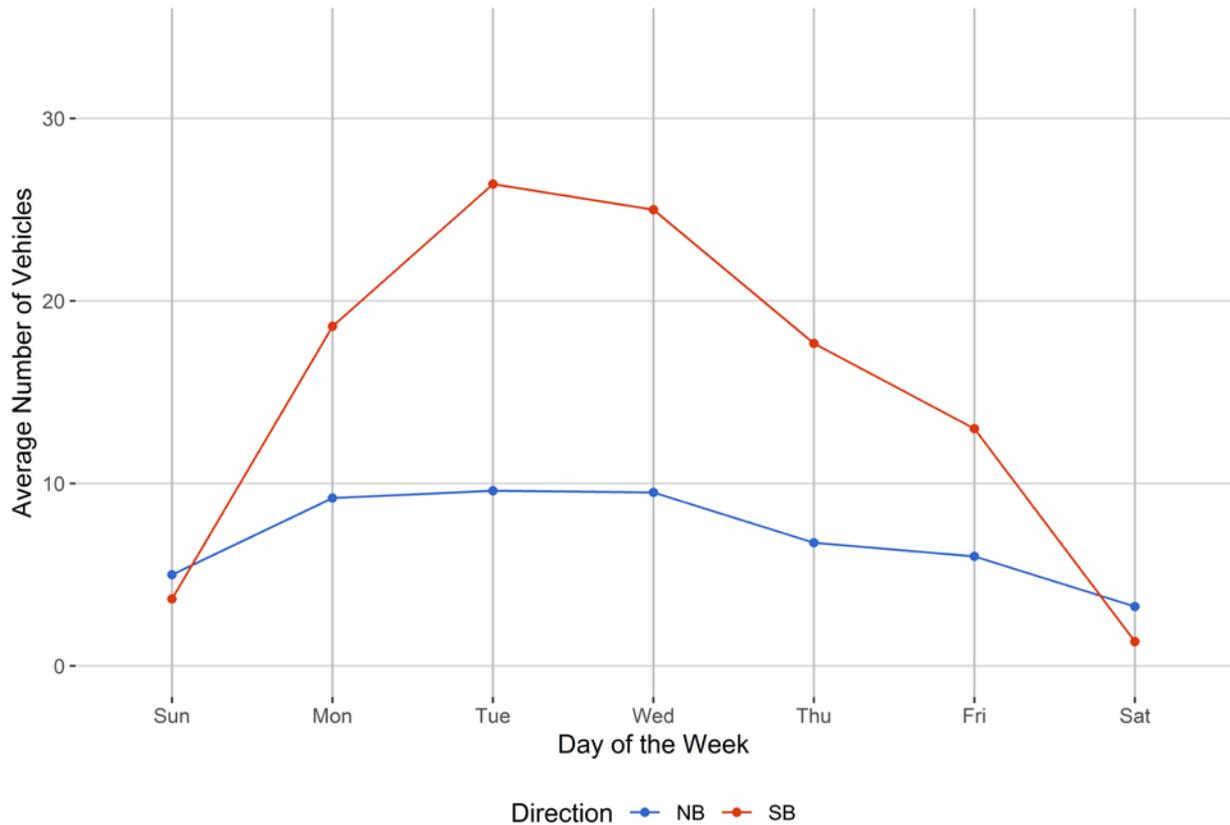


Figure 4 - Passenger Vehicles vs. Hour of the Day

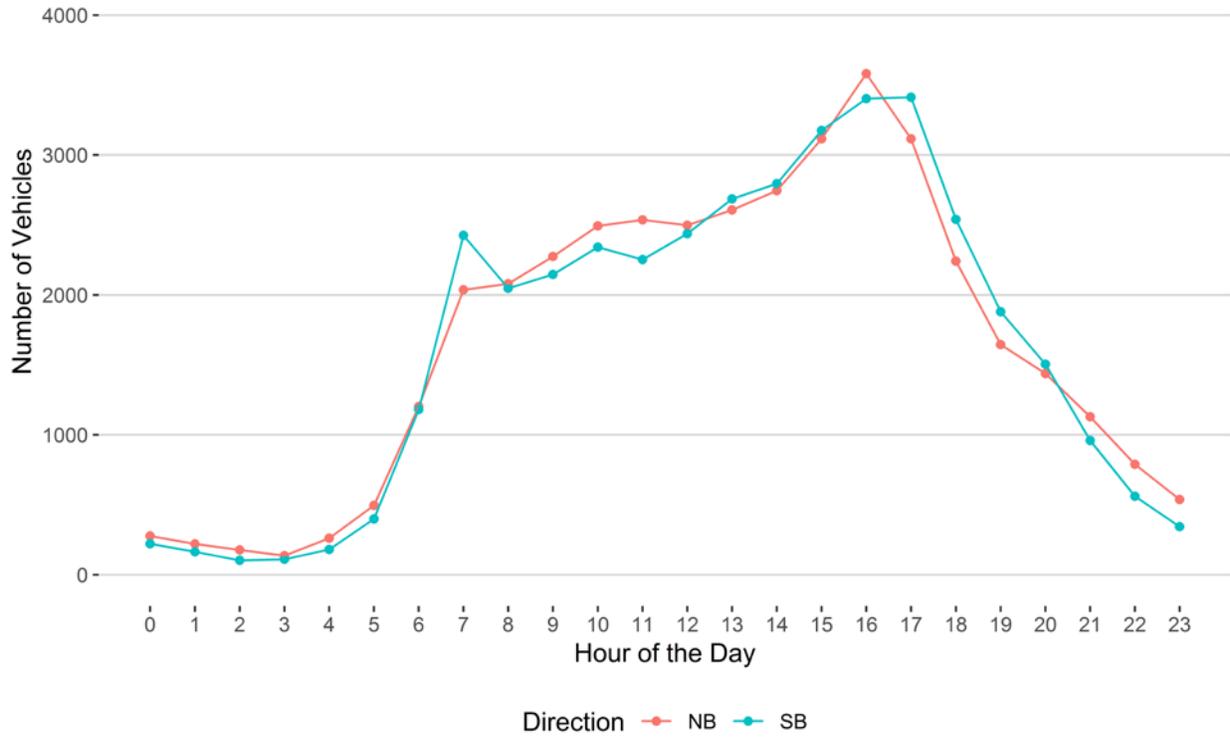


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

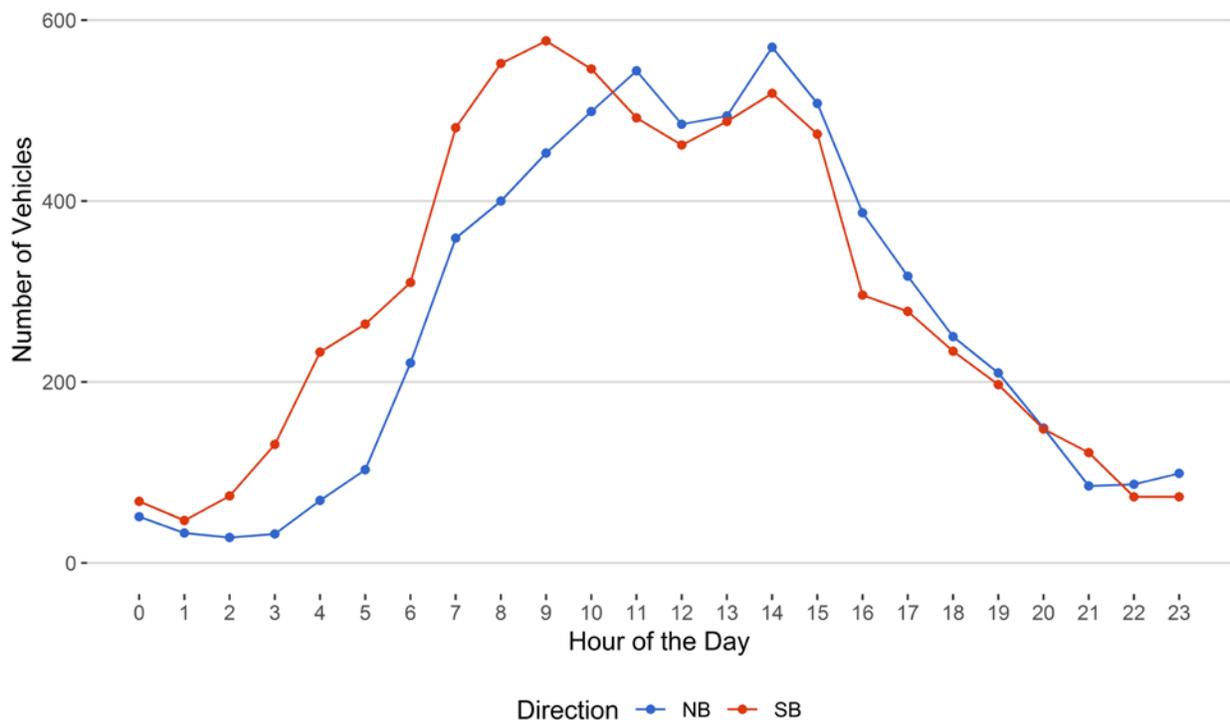


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

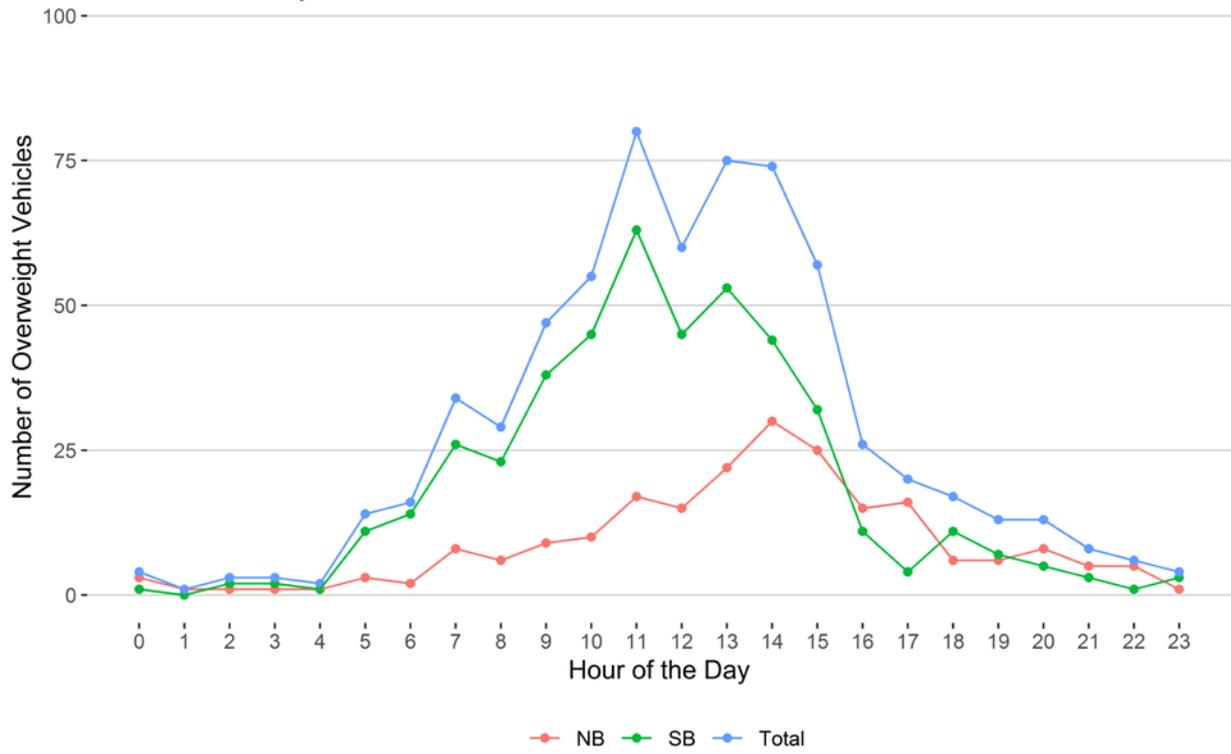
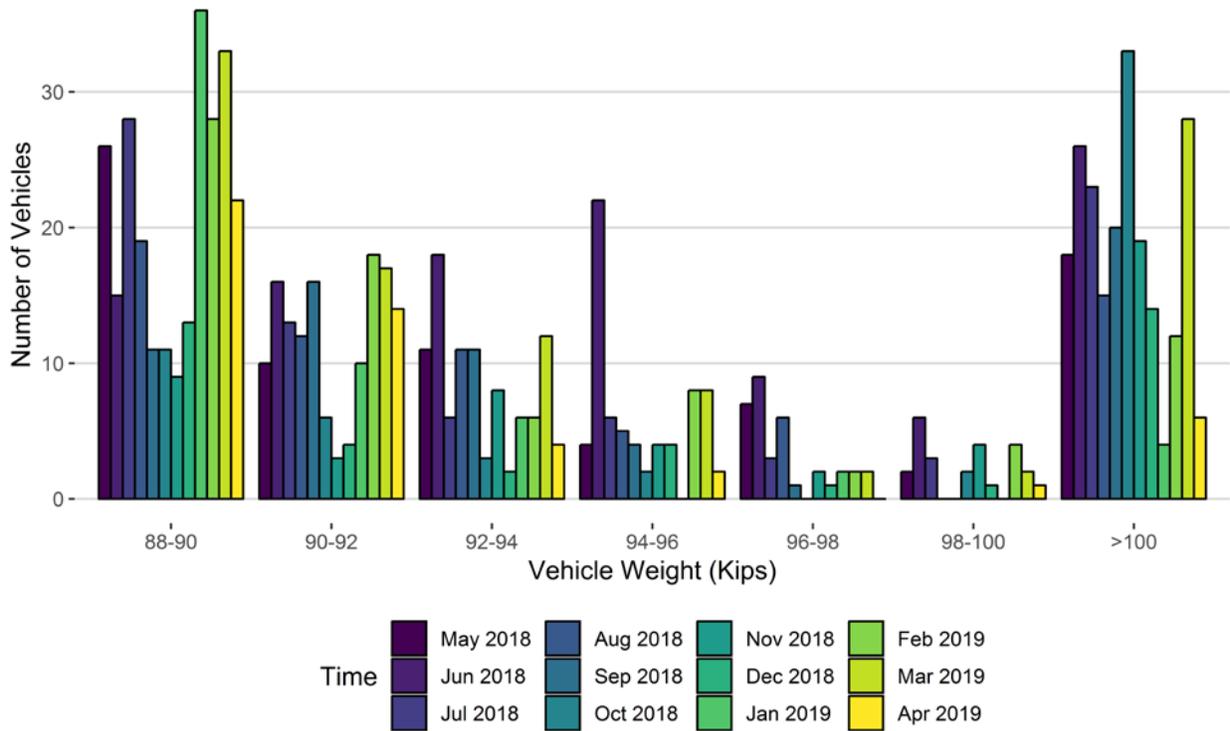
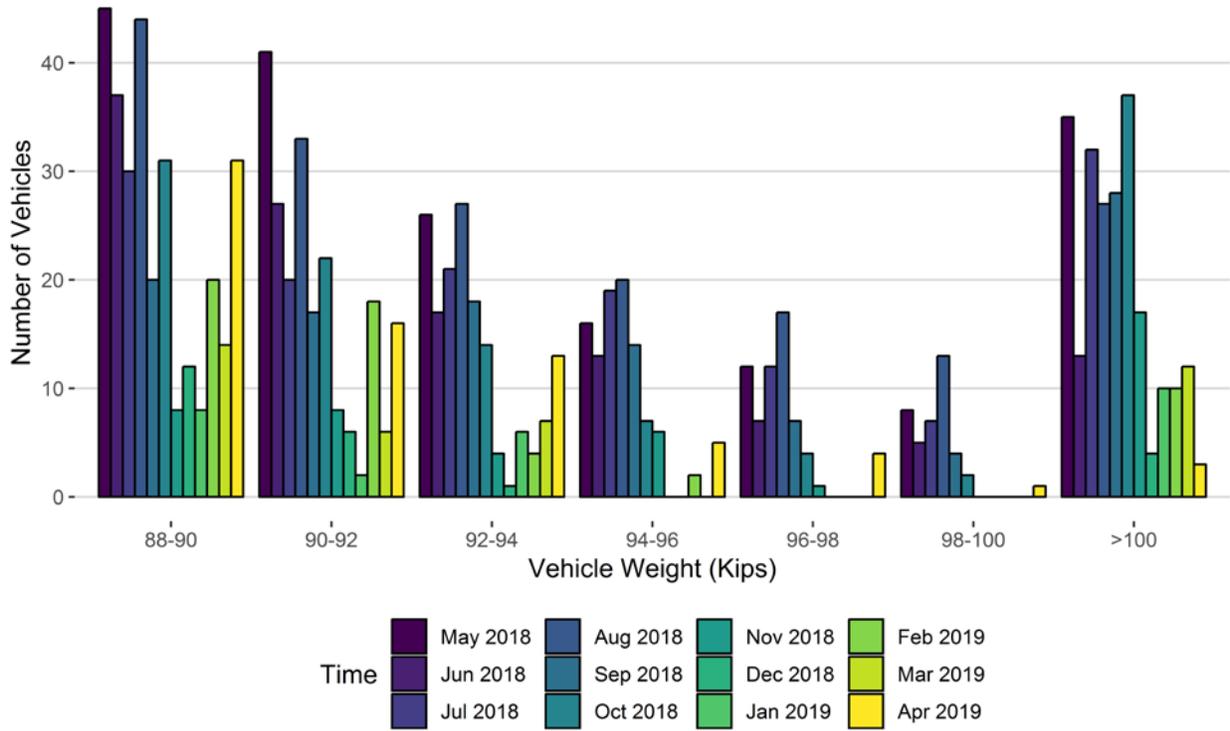


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019
88-90	26	15	28	19	11	11	9	13	36	28	33	22
90-92	10	16	13	12	16	6	3	4	10	18	17	14
92-94	11	18	6	11	11	3	8	2	6	6	12	4
94-96	4	22	6	5	4	2	4	4	0	8	8	2
96-98	7	9	3	6	1	0	2	1	2	2	2	0
98-100	2	6	3	0	0	2	4	1	0	4	2	1
>100	18	26	23	15	20	33	19	14	4	12	28	6
Total	78	112	82	68	63	57	49	39	58	78	102	49

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



Vehicle Weights (Kips)	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019
88-90	45	37	30	44	20	31	8	12	8	20	14	31
90-92	41	27	20	33	17	22	8	6	2	18	6	16
92-94	26	17	21	27	18	14	4	1	6	4	7	13
94-96	16	13	19	20	14	7	6	0	0	2	0	5
96-98	12	7	12	17	7	4	1	0	0	0	0	4
98-100	8	5	7	13	4	2	0	0	0	0	0	1
>100	35	13	32	27	28	37	17	4	10	10	12	3
Total	183	119	141	181	108	117	44	23	26	54	39	73

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

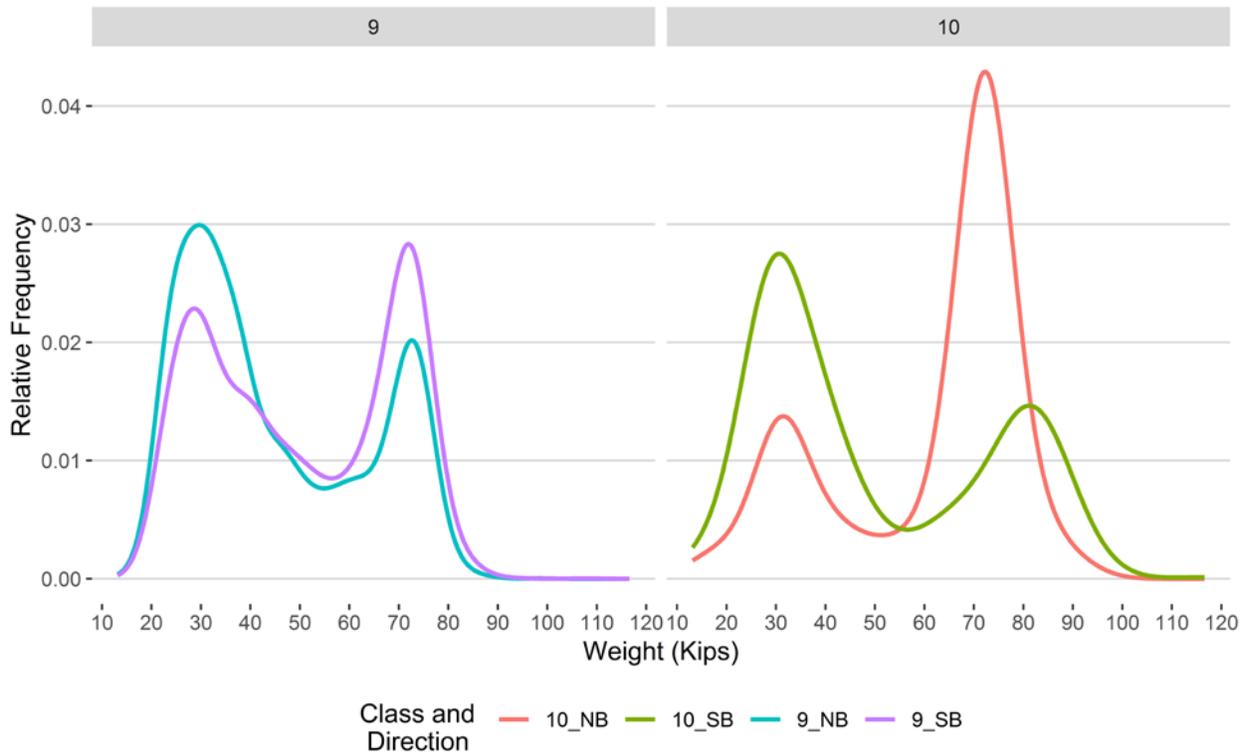


Figure 9 - Freight Percentage by Direction and Class

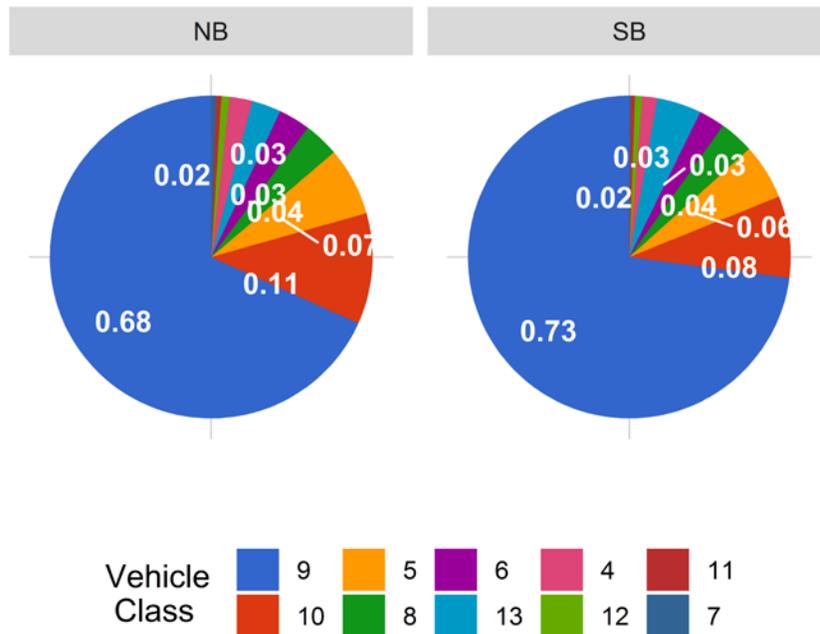


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

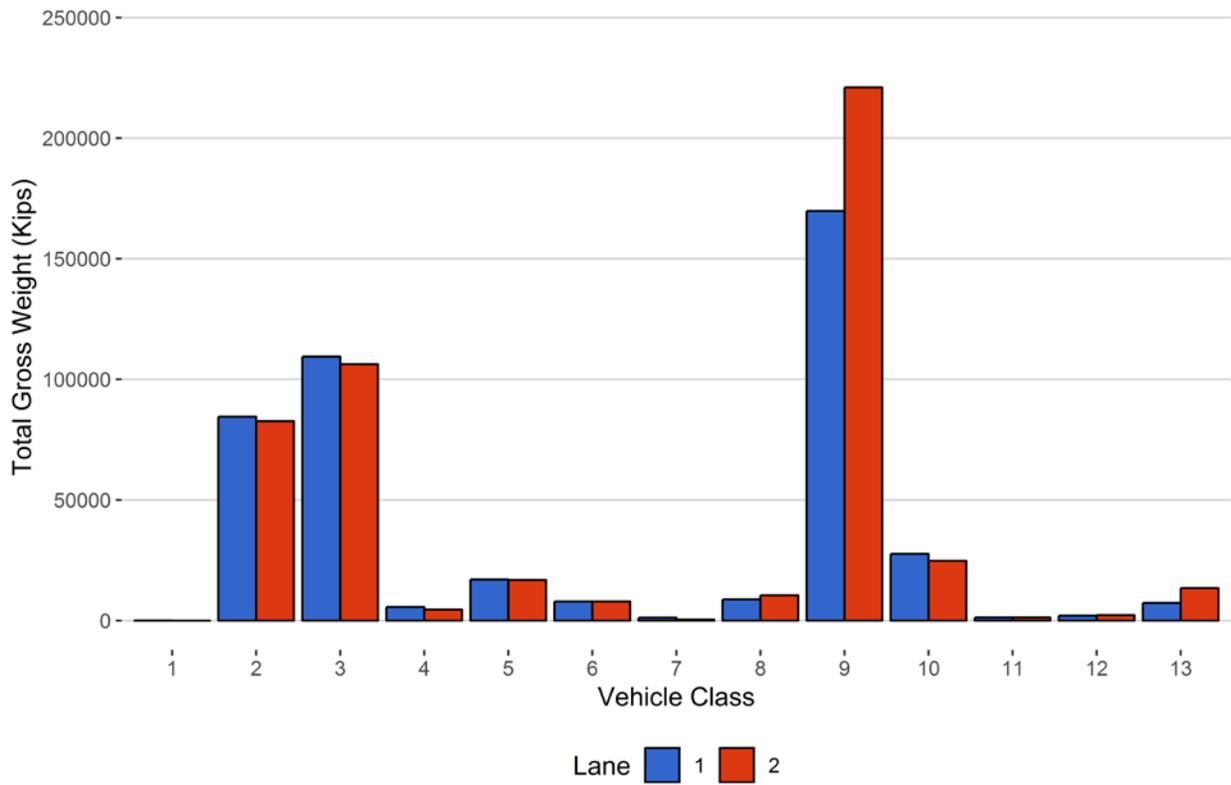


Figure 11 - Total Gross Vehicle Weight t

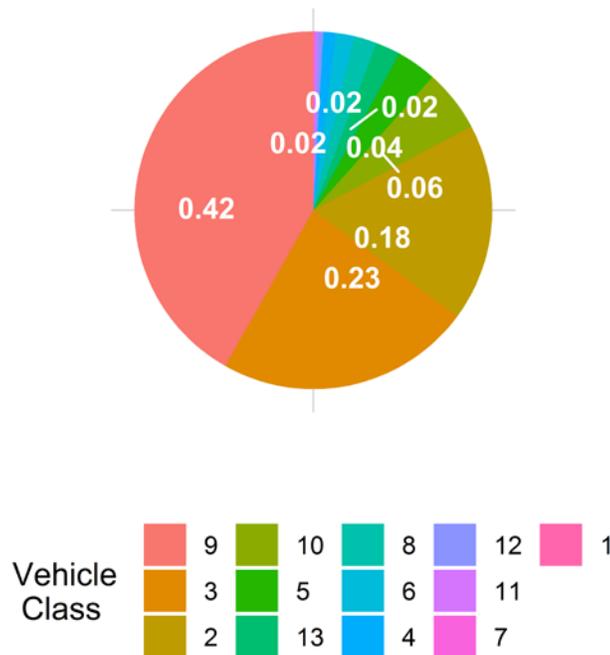


Figure 12 - Total ESALs by Class and Lane

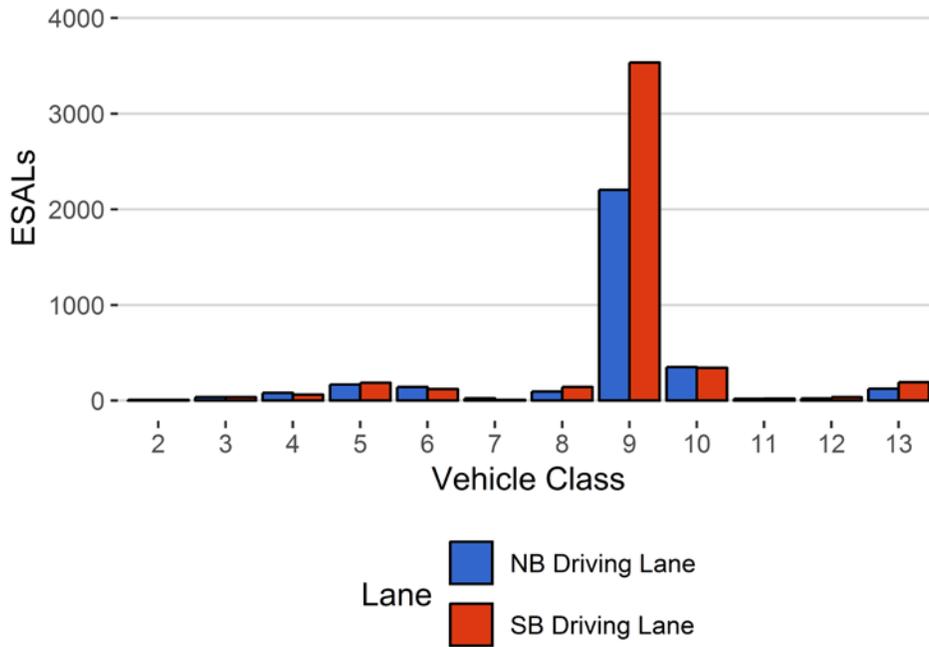


Figure 13 - ESALs by Class

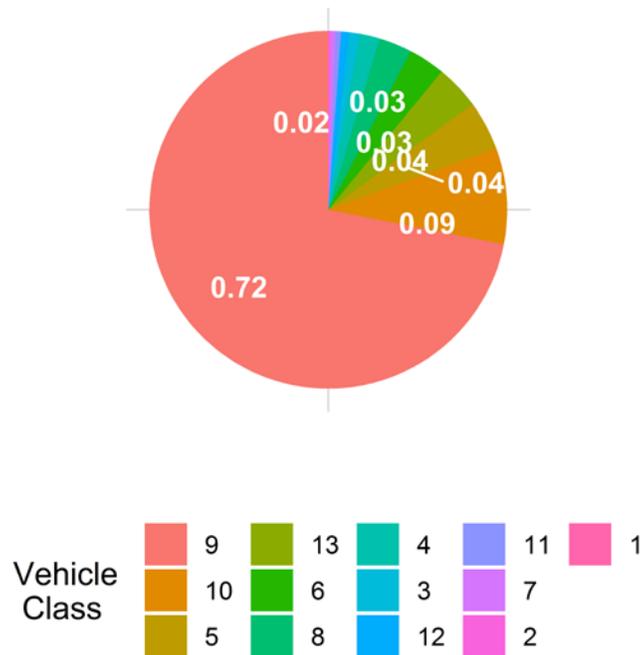


Table 1 Class 9 Front Axle Weight by Lane

<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
December 2018	10.63	-11.16	10.16	-17.30
January 2019	10.45	-12.69	9.92	-19.28
February 2019	10.45	-12.65	9.84	-19.93
March 2019	10.65	-10.95	10.26	-16.54
April 2019	10.79	-9.84	11.04	-10.18

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	7	0	0	0
2	1469	44065	46.9	0	0
3	1204	36132	38.4	0	0
4	13	390	0.4	3	0.5
5	84	2527	2.7	19	2.9
6	19	562	0.6	31	4.7
7	1	33	0	2	0.3
8	22	667	0.7	25	3.8
9	275	8264	8.8	244	37.3
10	32	965	1	117	17.9
11	2	57	0.1	2	0.3
12	2	72	0.1	10	1.5
13	8	249	0.3	202	30.8
TOTAL	3133	93990	100	655	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>
2019-04-08	Monday	15:34:05	10	SB	2	116.61
2019-04-17	Wednesday	11:55:01	10	NB	1	110.82
2019-04-22	Monday	14:50:51	10	NB	1	109.55
2019-04-30	Tuesday	00:18:26	9	NB	1	108.87
2019-04-26	Friday	15:39:00	9	SB	2	107.81
2019-04-11	Thursday	16:03:25	10	NB	1	105.55
2019-04-29	Monday	04:27:48	10	NB	1	102.61
2019-04-23	Tuesday	05:48:14	10	NB	1	102.29
2019-04-10	Wednesday	04:20:42	10	NB	1	98.42
2019-04-12	Friday	09:21:55	9	NB	1	98.11

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	207	36	17.4	5214	456	1325
5	NB	8	1252	151	12.1	15963	1090	3578
6	NB	19	264	66	25	6781	1122	1509
7	NB	11.5	24	0	0	1220	0	472
8	NB	31	308	182	59.1	4643	4169	369
9	NB	33	3775	1382	36.6	132304	37486	26668
10	NB	33.5	452	83	18.4	25333	2354	6486
11	NB	36.5	31	8	25.8	1080	202	120
12	NB	36.5	36	0	0	2041	0	364
13	NB	31.5	84	1	1.2	7257	27	2321
TOTAL	****	****	6433	1909	****	201838	****	43211
<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	177	43	24.3	4061	510	1026
5	SB	8	1236	219	17.7	15276	1590	3570
6	SB	19	289	70	24.2	6726	1178	1282
7	SB	11.5	8	0	0	409	0	159
8	SB	31	349	197	56.4	5899	4596	594
9	SB	33	4361	1187	27.2	188890	32185	42074
10	SB	33.5	498	203	40.8	19049	5734	4583
11	SB	36.5	25	2	8	1194	52	177
12	SB	36.5	35	3	8.6	2143	82	488
13	SB	31.5	161	0	0	13511	0	4220
TOTAL	****	****	7139	1924	****	257158	****	58172
GRAND TOTAL	****	****	13572	3833	403	458996	92833	101383

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	6	3	9	0
2	84488	82673	167161	17.9
3	109432	106251	215682	23.1
4	5670	4571	10241	1.1
5	17053	16866	33919	3.6
6	7903	7903	15806	1.7
7	1220	409	1629	0.2
8	8813	10496	19308	2.1
9	169790	221075	390865	41.8
10	27687	24783	52470	5.6
11	1282	1247	2529	0.3
12	2041	2225	4266	0.5
13	7285	13511	20795	2.2
TOTAL	442669	492012	934681	100
GVW/LANE	47.36	52.64	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	0.125
2	10	9	19	0.2	9e-04
3	38	36	74	0.9	0.0043
4	82	64	145	1.8	0.76
5	168	188	356	4.5	0.29
6	143	120	263	3.3	0.96
7	25	9	34	0.4	1.93
8	95	143	239	3	0.73
9	2204	3535	5738	71.9	1.42
10	352	344	696	8.7	1.47
11	19	20	39	0.5	1.34
12	23	36	59	0.7	1.58
13	124	194	318	4	2.53
TOTAL	3283	4697	7980	100	13
ESALS/LANE	41.1	58.9	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>
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
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	407	76331	85.8	12627.9	14.2
Apr 2019	93990	3133	460	80204	85.3	13785.9	14.7
TOTAL	1186186	-	-	1007079	-	179108	-
AVERAGE	98849	3245	490	83923	85	14926	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>
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
Dec 2018	4765	3913	8678	0.9
Jan 2019	9248	10139	19387	0.5
Feb 2019	6067	7070	13137	1.1
Mar 2019	5206	6163	11368	1.6
Apr 2019	3287	4734	8021	3.5
TOTAL	62089	-	-	-
AVERAGE	5174	6397	11571	5

Gross Vehicle Weight

<i>Month</i>	<i>GVW NB Driving Lane</i>	<i>GVW SB Driving Lane</i>	<i>Total GVW Kips</i>
May 18	542896	581854	1124749
Jun 18	559697	574474	1134172
Jul 18	558833	625054	1183887
Aug 18	583793	652111	1235903
Sep 18	502142	546473	1048616
Oct 18	543677	598248	1141925
Nov 18	532437	542085	1074522
Dec 18	495872	461558	957430
Jan 19	947836	926640	1874476
Feb 19	716071	747761	1463832
Mar 19	676622	693176	1369798
Apr 19	442890	492577	935467
TOTAL	7102766	7442010	14544776
AVERAGE	591897	620167	1212065

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>
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
Dec 2018	880	1	6.2	62	19
Jan 2019	1448	0.9	4.8	88	16
Feb 2019	1226	0.9	5.3	134	28
Mar 2019	868	0.6	4.2	141	42
Apr 2019	661	0.7	4.9	122	11
TOTAL	15502	-	-	1960	523
AVERAGE	1291.8	1.1	7.6	163.3	43.6

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>
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
Dec 2018	63052	47873	110925	56.8	43.2
Jan 2019	120303	105614	225917	53.3	46.7
Feb 2019	73668	93172	166840	44.2	55.8
Mar 2019	65149	73470	138619	47	53
Apr 2019	43211	58172	101383	42.6	57.4
TOTAL	762141	856545	1618686	-	-
AVERAGE	63511.7	71378.8	134890.5	46.8	53.2