

JULY 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 July 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: 113876 | Passenger Vehicles: 98216 | Heavy Commercial Vehicles: 15660

Monthly Average Daily Traffic (MADT): 3673 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 505

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 Sundays, 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 01 PM and 04 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 01 PM and 04 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 15660 HCVs, 1953 of them were overweight³. These overweight HCVs contributed to 1.7% of total monthly volume, and 12.5% of total monthly HCV volume. NB overweight vehicles typically reached highest numbers on Mondays, with lowest volumes reported on Saturdays. SB overweight vehicles tended to reach highest volumes on Mondays, 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 61.4% 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 ,82 NB vehicles exceeded 88,000 pounds (32 vehicles were Class 13's; 30 vehicles were Class 10's). Of vehicles traveling SB,

141 NB vehicles exceeded 88,000 pounds (56 vehicles were Class 10's; 50 vehicles were Class 13's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from July 2018.

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

Freight Totals. A total of 129484 tons of freight was recorded to have crossed the WIM. More freight was shipped SB (56.3%) than NB (43.7%). 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 113876 vehicles with a combined GVW of 1183887 kips (1 kip = 1,000 pounds = 0.5 tons) in July 2018. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 12035 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 58.2% of all ESALs were recorded SB while 41.8% was observed NB. In particular, 72% 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).

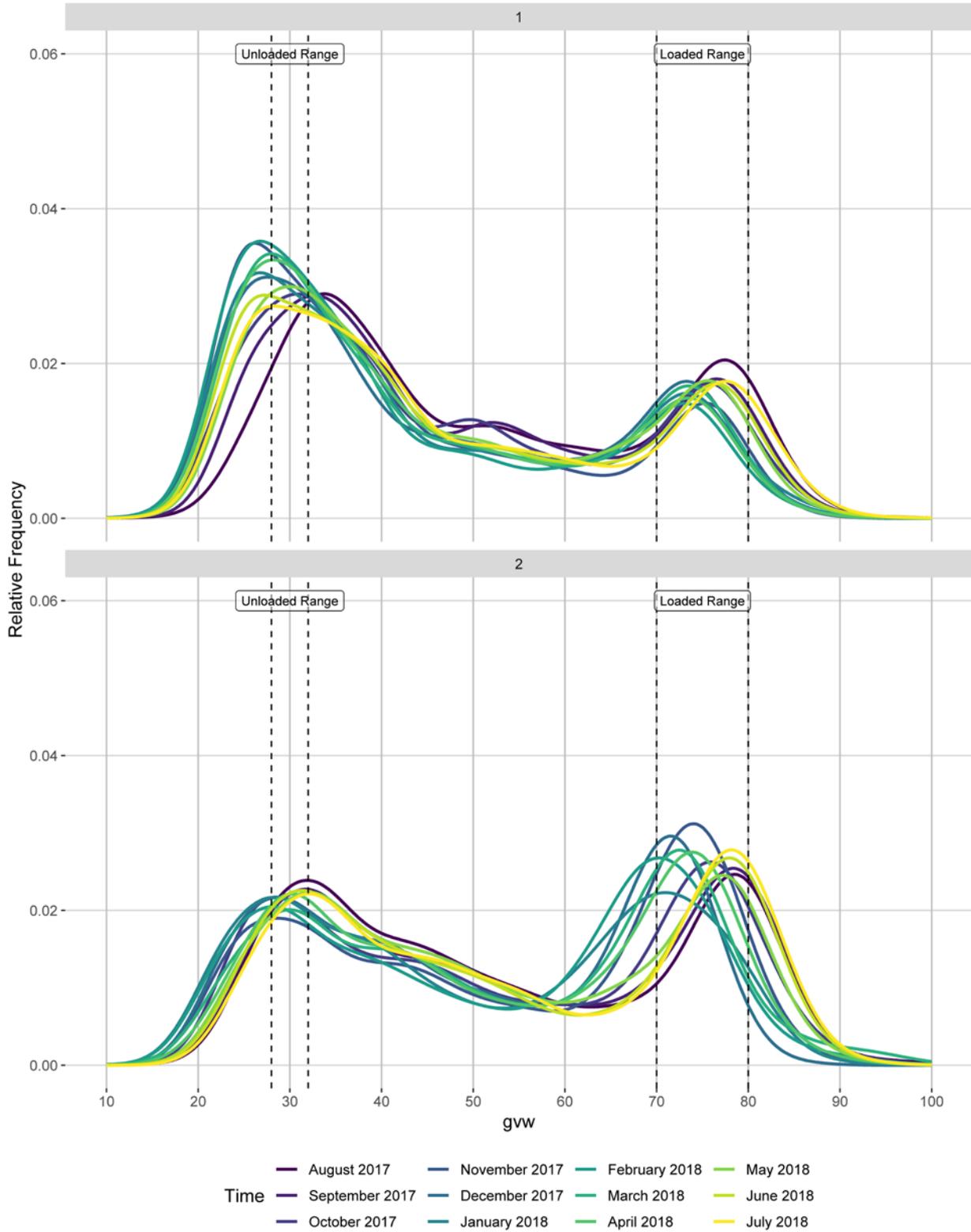
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

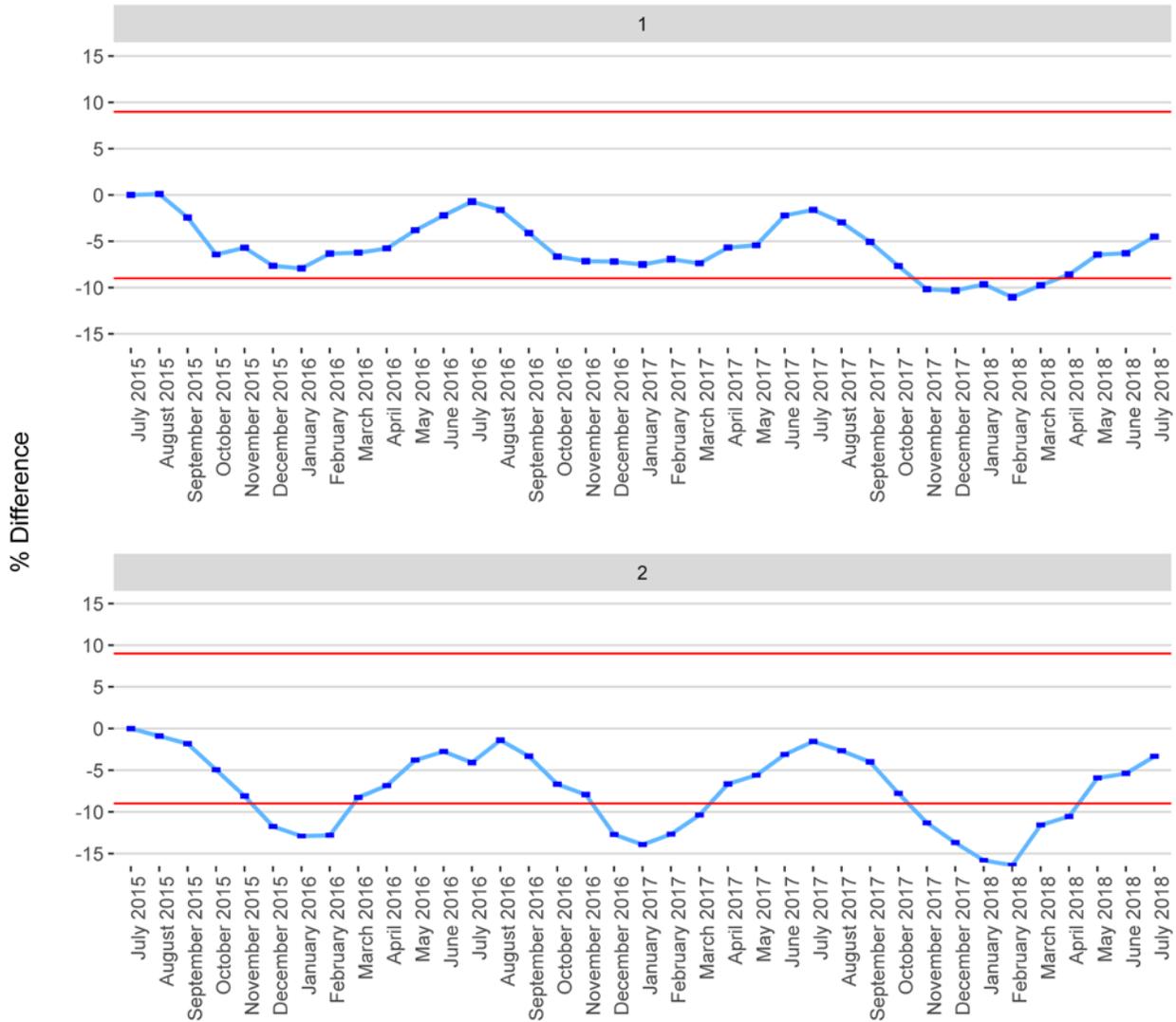
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

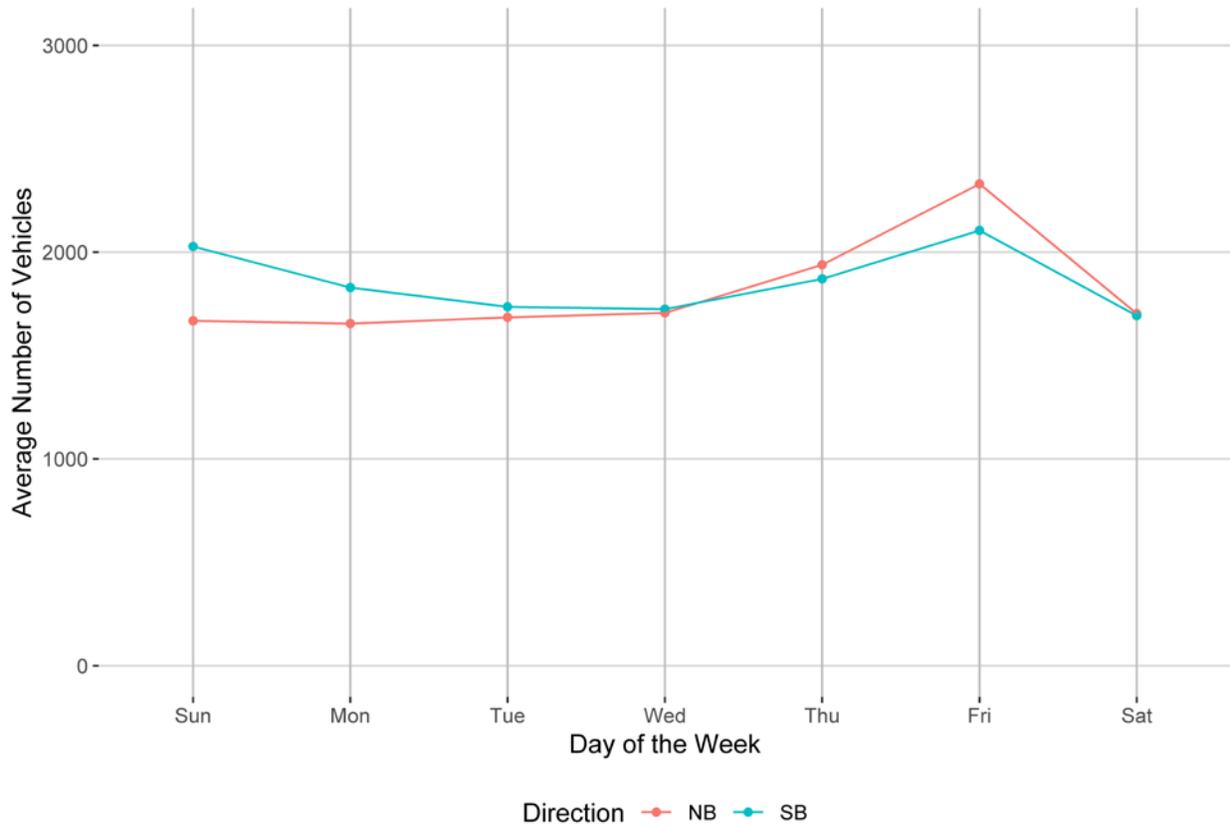


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

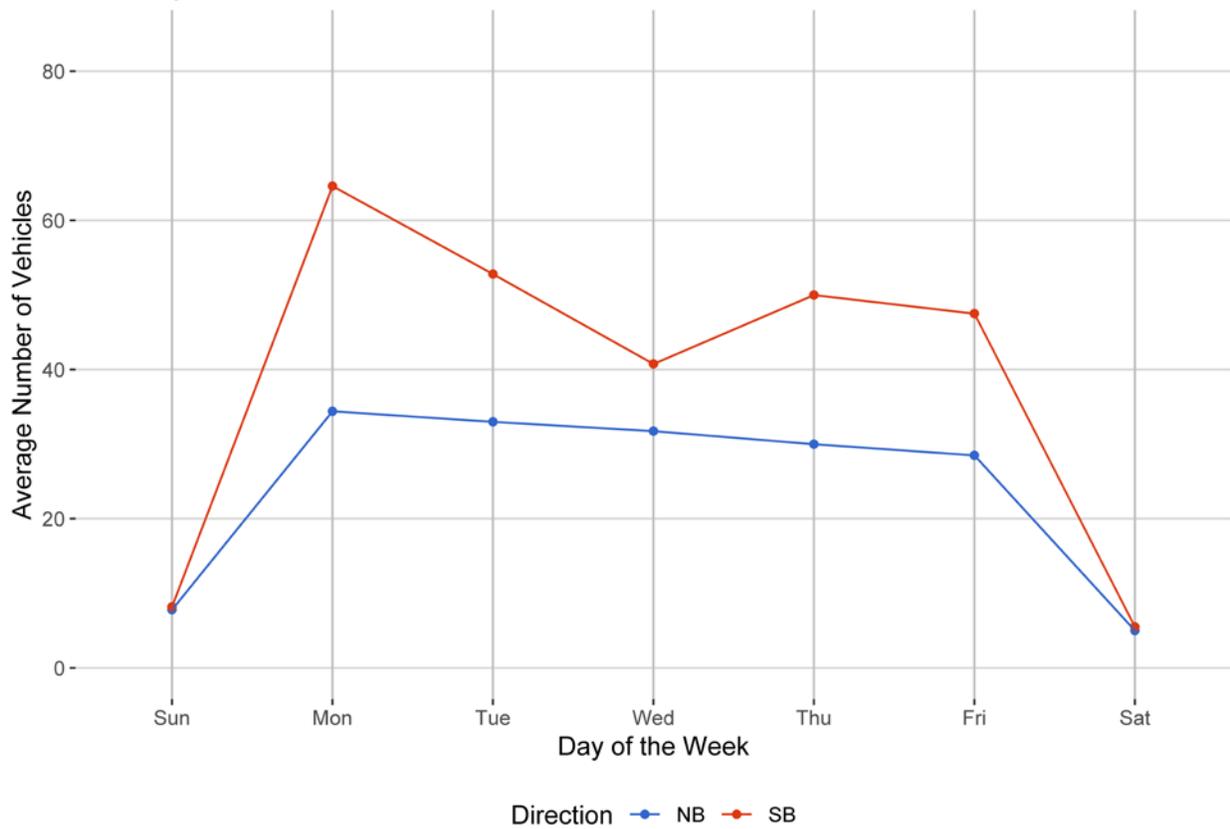


Figure 4 - Passenger Vehicles vs. Hour of the Day

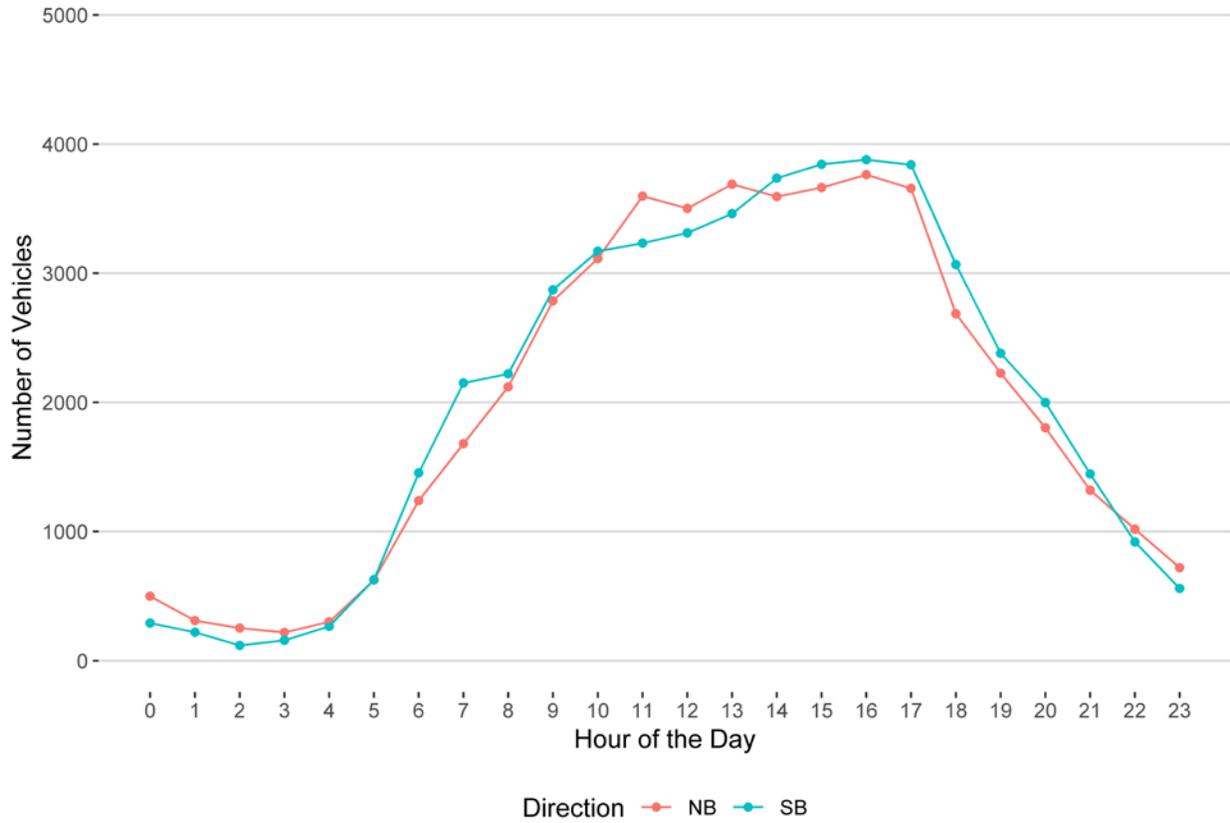


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

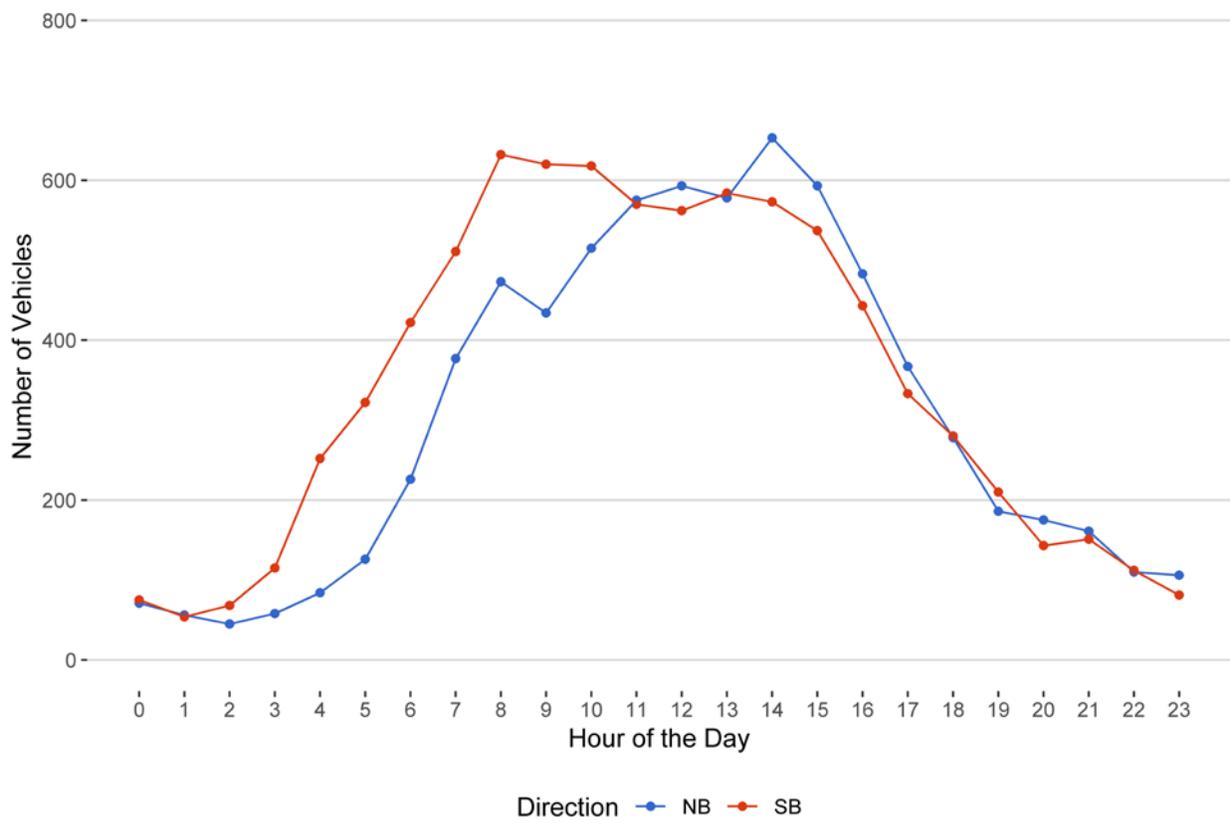


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

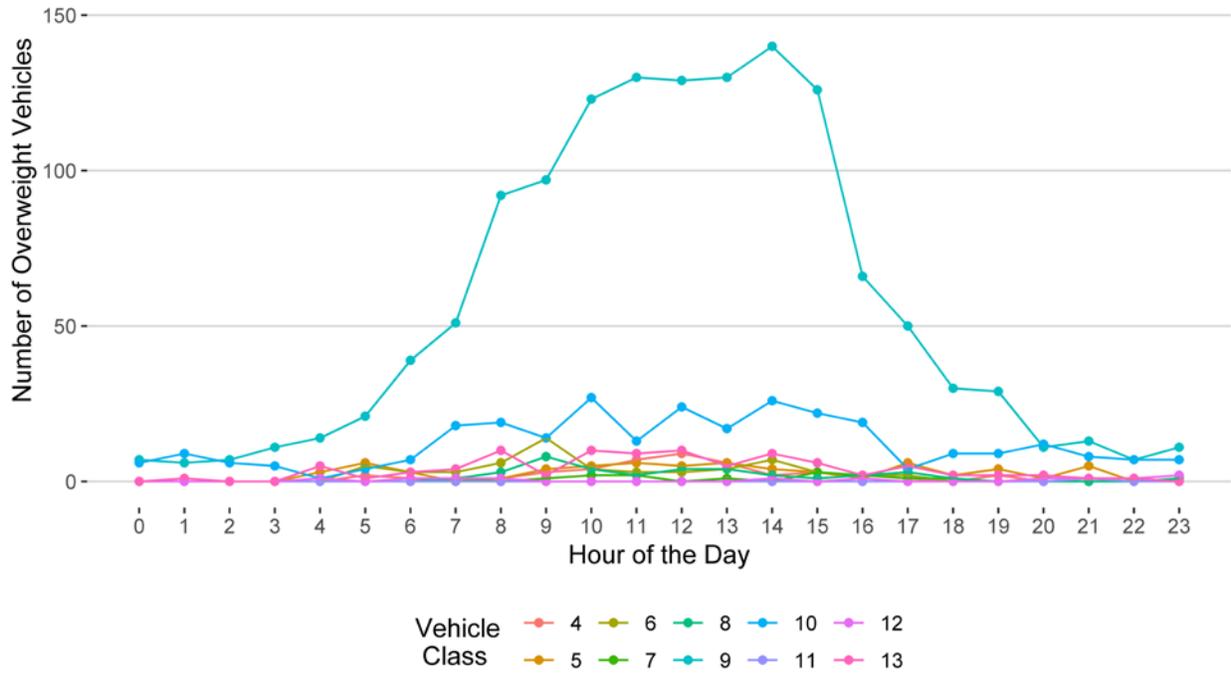


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

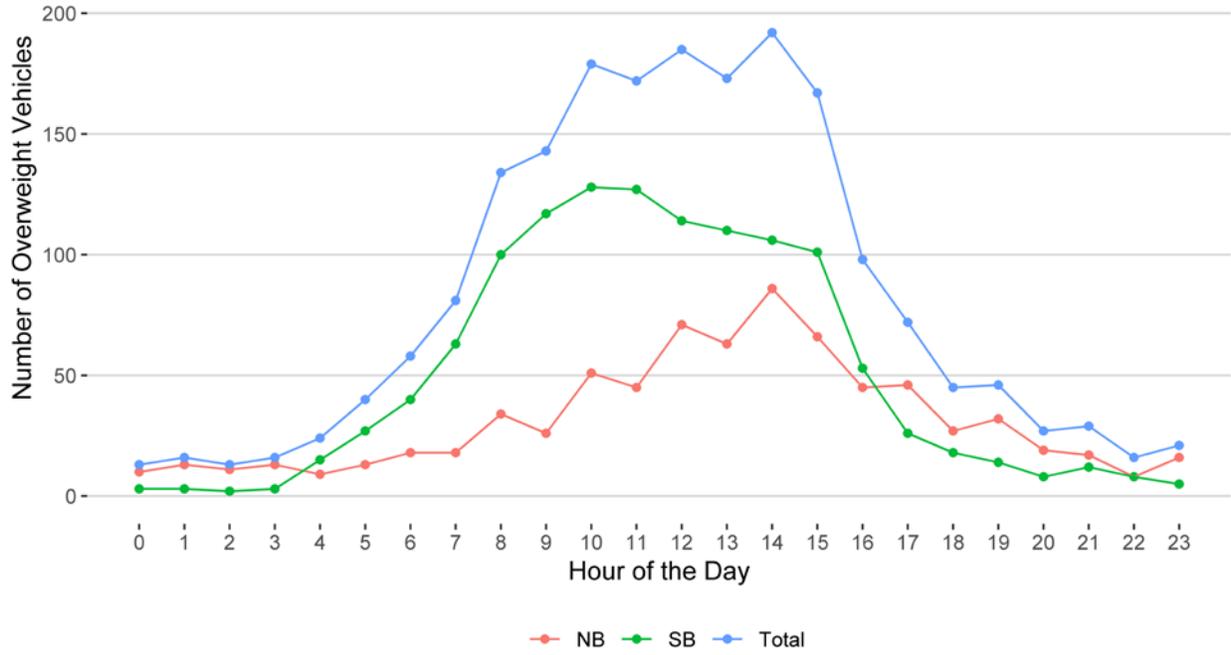
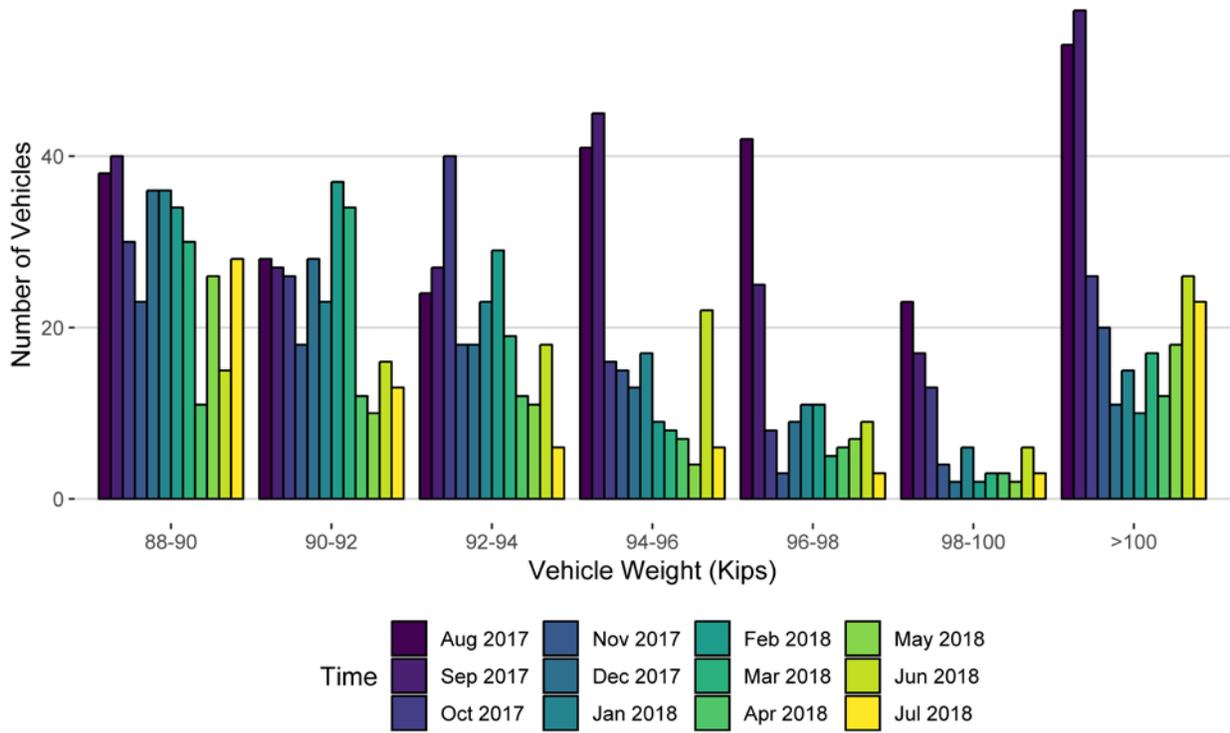
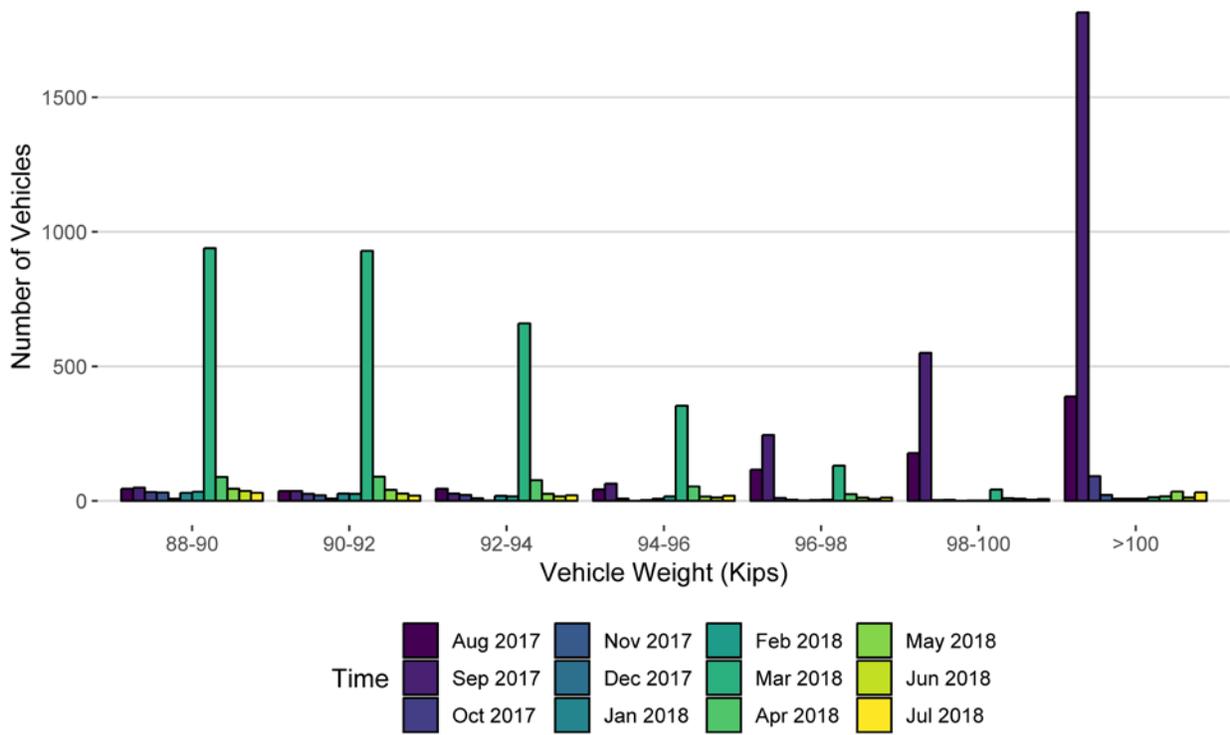


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018
88-90	38	40	30	23	36	36	34	30	11	26	15	28
90-92	28	27	26	18	28	23	37	34	12	10	16	13
92-94	24	27	40	18	18	23	29	19	12	11	18	6
94-96	41	45	16	15	13	17	9	8	7	4	22	6
96-98	42	25	8	3	9	11	11	5	6	7	9	3
98-100	23	17	13	4	2	6	2	3	3	2	6	3
>100	53	57	26	20	11	15	10	17	12	18	26	23
Total	249	238	159	101	117	131	132	116	63	78	112	82

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



Vehicle Weights (Kips)	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018
88-90	45	49	33	31	8	30	34	939	89	45	37	30
90-92	37	37	26	21	9	27	26	929	90	41	27	20
92-94	45	27	22	10	1	19	17	660	77	26	17	21
94-96	43	64	9	0	3	8	17	354	54	16	13	19
96-98	116	245	11	5	1	3	5	131	25	12	7	12
98-100	178	550	3	4	0	1	1	42	10	8	5	7
>100	388	1815	92	22	8	8	8	14	17	35	13	32
Total	852	2787	196	93	30	96	108	3069	362	183	119	141

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

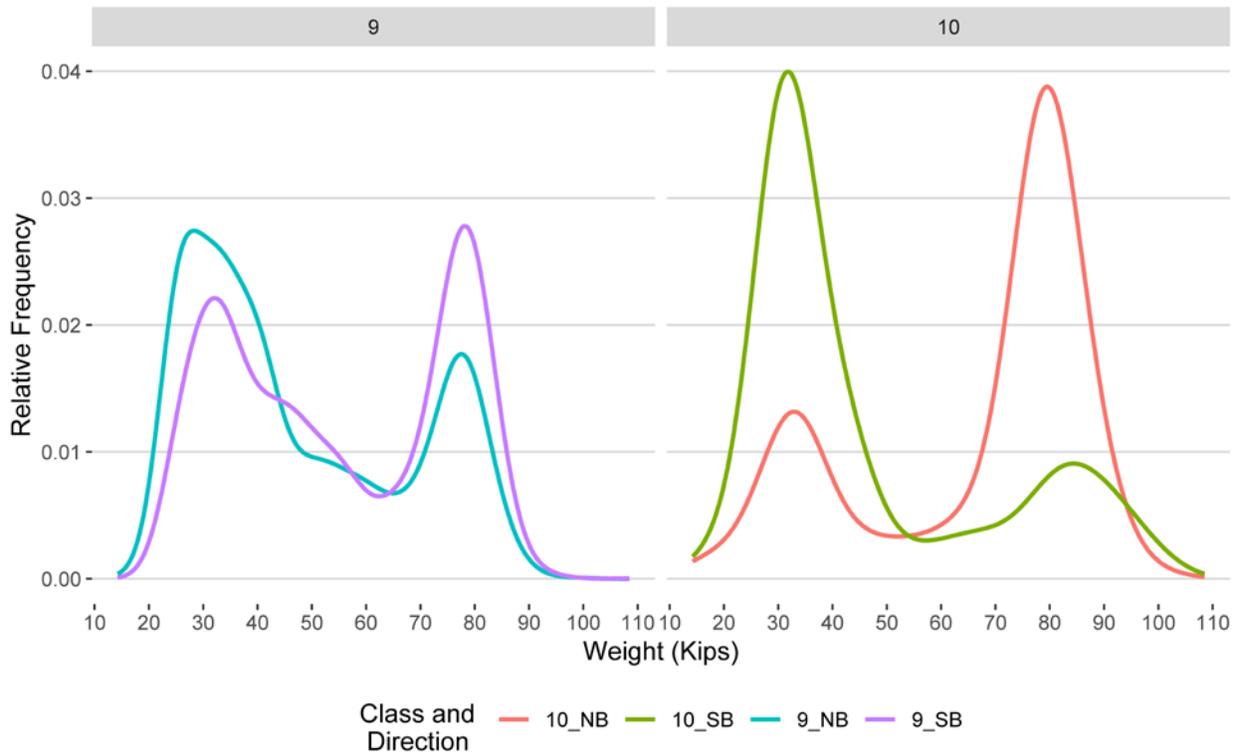


Figure 9 - Freight Percentage by Direction and Class

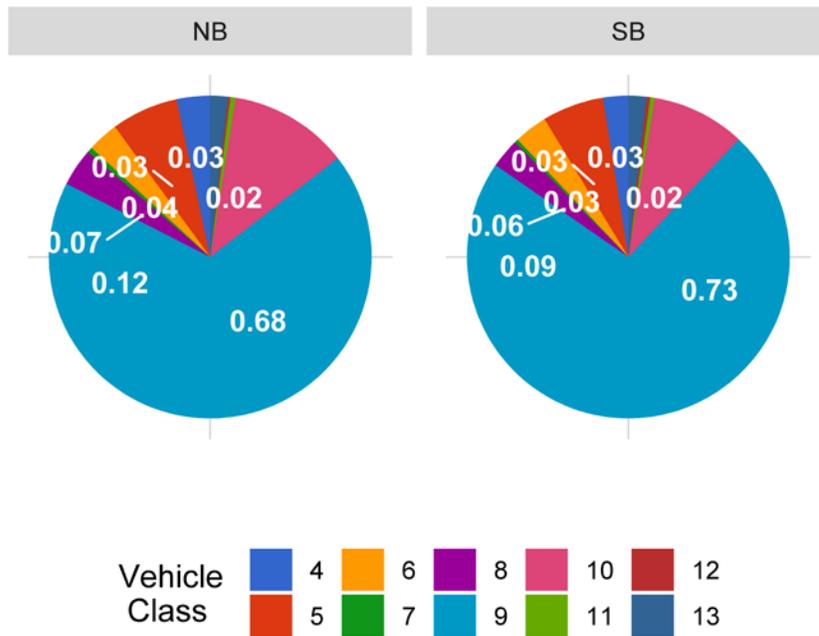


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

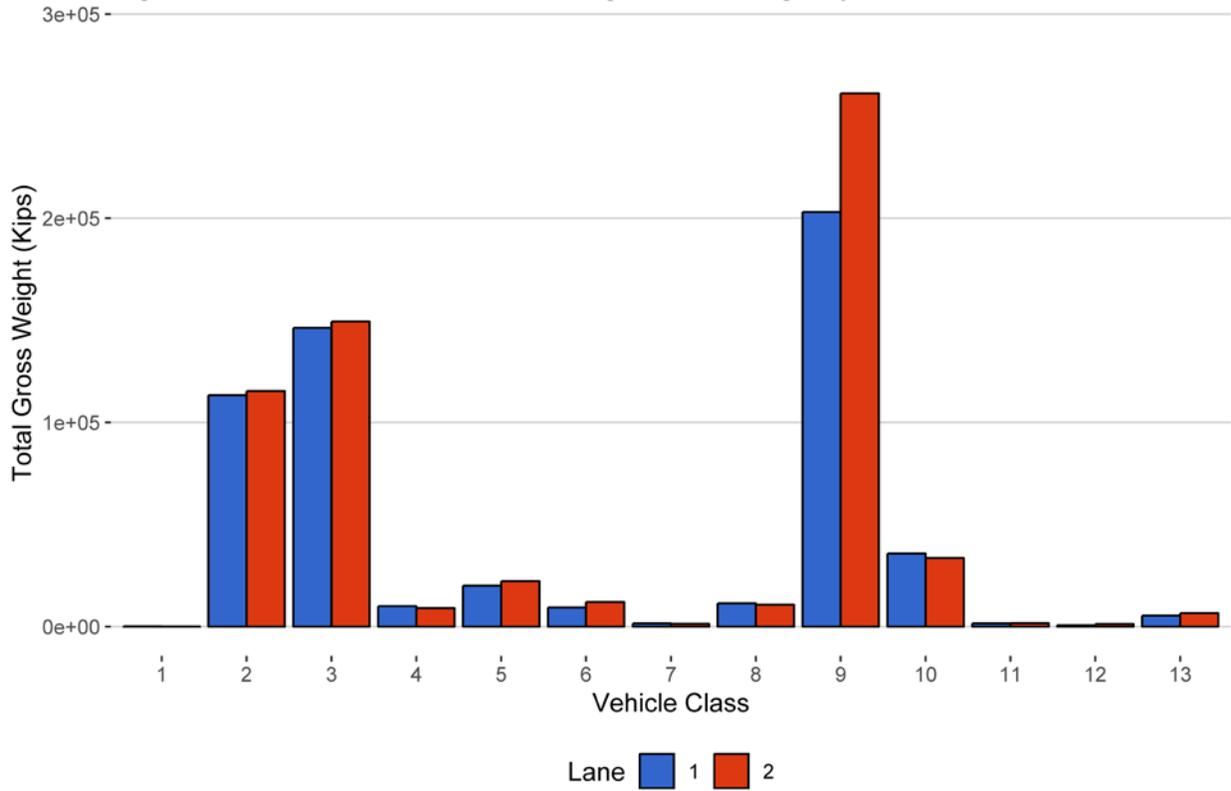


Figure 11 - Total Gross Vehicle Weight t

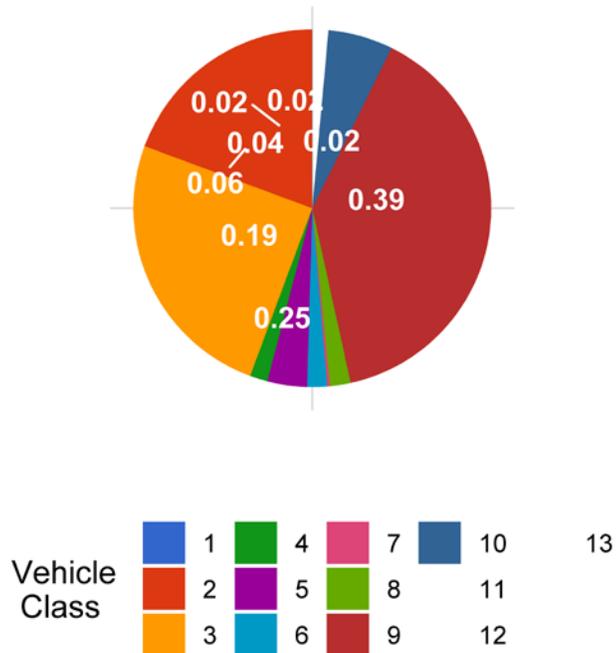


Figure 12 - Total ESALs by Class and Lane

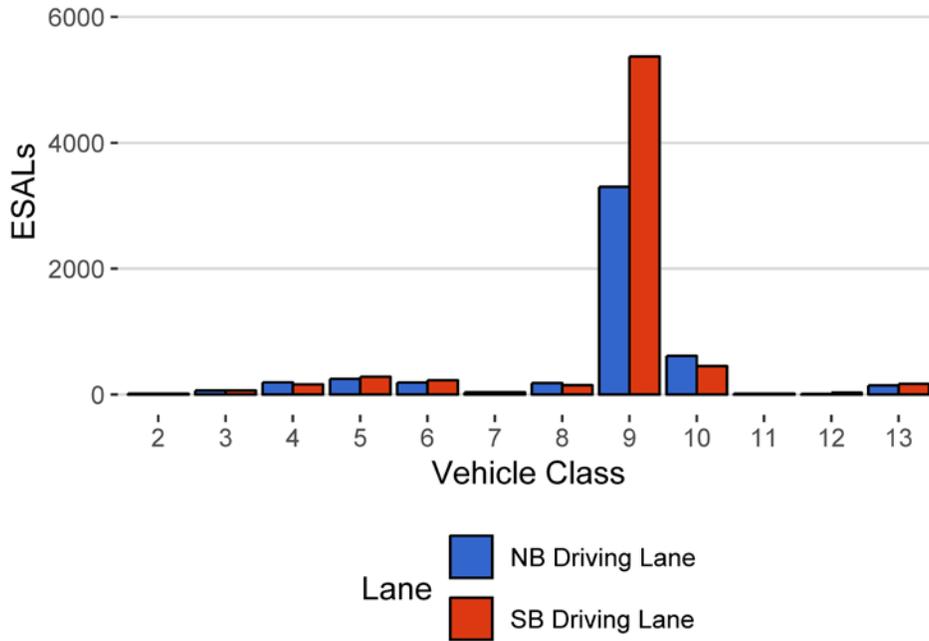


Figure 13 - ESALs by Class

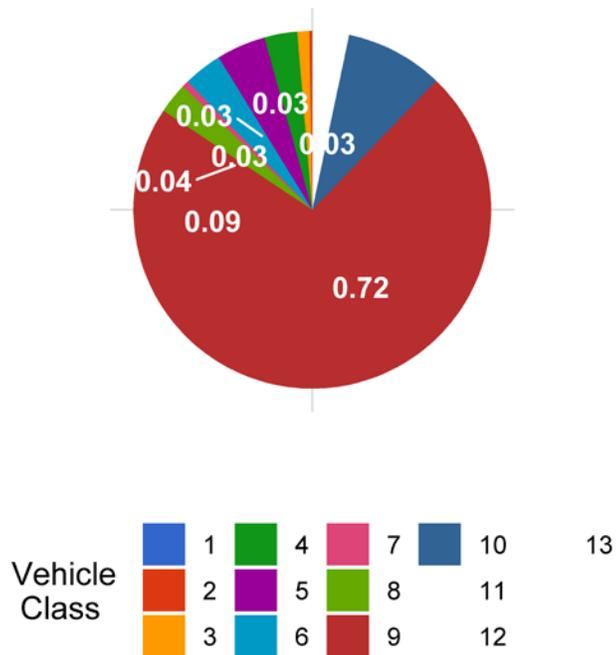


Table 1 Class 9 Front Axle Weight by Lane

<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

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	4	129	0.1	0	0
2	1778	55118	48.4	0	0
3	1386	42969	37.7	0	0
4	22	685	0.6	43	2.2
5	95	2942	2.6	65	3.3
6	23	713	0.6	59	3
7	2	57	0.1	15	0.8
8	24	736	0.6	36	1.8
9	291	9009	7.9	1340	68.6
10	41	1271	1.1	293	15
11	3	94	0.1	1	0.1
12	1	34	0	11	0.6
13	4	119	0.1	90	4.6
TOTAL	3673	113876	100	1953	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>
2018-07-09	Monday	11:53:58	9	SB	2	108.5
2018-07-13	Friday	15:45:31	10	SB	2	103.01
2018-07-31	Tuesday	10:11:49	10	SB	2	102.88
2018-07-11	Wednesday	07:21:55	10	NB	1	101.74
2018-07-11	Wednesday	09:22:33	10	SB	2	101.45
2018-07-25	Wednesday	08:52:58	10	NB	1	100.66
2018-07-27	Friday	15:47:14	10	SB	2	99.96
2018-07-02	Monday	14:04:15	10	SB	2	99.94
2018-07-08	Sunday	19:24:15	9	NB	1	99.93
2018-07-02	Monday	10:25:29	10	SB	2	99.83

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	333	38	11.4	9484	503	2529
5	NB	8	1396	82	5.9	19444	599	4466
6	NB	19	294	53	18	8404	901	1912
7	NB	11.5	30	0	0	1560	0	607
8	NB	31	375	188	50.1	7268	4100	736
9	NB	33	4245	1322	31.1	166827	36256	35184
10	NB	33.5	535	78	14.6	33502	2258	9096
11	NB	36.5	48	26	54.2	1080	518	138
12	NB	36.5	14	7	50	472	170	108
13	NB	31.5	53	0	0	5342	0	1836
TOTAL	****	****	7323	1794	****	253384	****	56615
<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	349	48	13.8	8413	641	1949
5	SB	8	1533	78	5.1	21639	582	5000
6	SB	19	416	81	19.5	10603	1403	2119
7	SB	11.5	27	0	0	1318	0	504
8	SB	31	358	180	50.3	6855	3814	668
9	SB	33	4724	936	19.8	234408	26785	54702
10	SB	33.5	730	341	46.7	23448	10163	5208
11	SB	36.5	46	22	47.8	1229	450	177
12	SB	36.5	20	4	20	1166	92	291
13	SB	31.5	65	0	0	6551	0	2252
TOTAL	****	****	8268	1690	****	315631	****	72870
GRAND TOTAL	****	****	15591	3484	458	569015	89232	129484

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	119	63	182	0
2	113314	115385	228699	19.3
3	146326	149431	295757	25
4	9986	9054	19041	1.6
5	20043	22221	42264	3.6
6	9304	12006	21310	1.8
7	1560	1318	2878	0.2
8	11368	10669	22037	1.9
9	203083	261193	464276	39.2
10	35759	33611	69371	5.9
11	1598	1679	3276	0.3
12	643	1258	1901	0.2
13	5342	6551	11893	1
TOTAL	558446	624439	1182885	100
GVW/LANE	47.21	52.79	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	0.0078
2	15	16	31	0.3	0.0012
3	66	66	132	1.1	0.0063
4	195	162	356	3	1.05
5	251	283	534	4.5	0.37
6	192	228	420	3.5	1.19
7	38	36	74	0.6	2.43
8	183	149	333	2.8	0.91
9	3298	5369	8668	72.2	1.94
10	614	454	1068	8.9	1.69
11	18	17	35	0.3	0.77
12	12	32	44	0.4	2.18
13	148	170	318	2.6	4.98
TOTAL	5029	6983	12013	100	18
ESALS/LANE	41.9	58.1	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>
Aug 2017	116450	3756	564	98963	85	17487.3	15
Sep 2017	111812	3727	661	91971	82.3	19840.6	17.7
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
TOTAL	1205157	-	-	1022018	-	183139	-
AVERAGE	100430	3299	502	85168	85	15262	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>
Aug 2017	6362	8803	15164	9.2
Sep 2017	5677	12779	18455	6.5
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
TOTAL	52053	-	-	-
AVERAGE	4338	7386	11724	8

Gross Vehicle Weight

<i>Month</i>	<i>GVW NB Driving Lane</i>	<i>GVW SB Driving Lane</i>	<i>Total GVW Kips</i>
Aug 2017	410686	456795	867481
Sep 2017	380931	430105	811036
Oct 2017	433134	867894	1301027
Nov 2017	422404	531030	953434
Dec 2017	542896	581854	1124749
Jan 2018	559697	574474	1134172
Feb 2018	558833	625054	1183887
Mar 2018	613330	711571	1324900
Apr 2018	611951	868853	1480804
May 2018	554209	621491	1175700
Jun 2018	472927	566640	1039567
Jul 2018	417109	450095	867205
TOTAL	5978105	7285856	13263961
AVERAGE	498175	607155	1105330

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>
Aug 2017	2972	2.6	16.9	1101	642
Sep 2017	4799	4.3	24.1	3027	2439
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
TOTAL	26055	-	-	9629	3644
AVERAGE	2171.2	2.1	13.4	802.4	303.7

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>
Aug 2017	72589	98882	171472	42.3	57.7
Sep 2017	63832	164954	228787	27.9	72.1
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
TOTAL	610037	1050538	1660576	-	-
AVERAGE	50836.5	87544.9	138381.3	38.6	61.4