

JANUARY 2018



2009/11/18



2009/10/20

**WIM #40
US 52, MP 126.8
S. ST. PAUL, MN**

**MONTHLY
REPORT**

Your Destination...Our Priority



WIM Site Location

WIM #40 is located on US 52 near South St. Paul in Dakota county.

System Operation

WIM #40 was operational for the entire month of January 2018. Volume was computed using all monthly data.

System Calibration

WIM #40 was most recently calibrated on 2016-11-23. 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: 1653955 | Passenger Vehicles: 1568575 | Heavy Commercial Vehicles: 85380

Monthly Average Daily Traffic (MADT): 53353 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 2754

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 Sundays. SB vehicles typically reached highest volume levels on Fridays, with lowest volumes reported on Sundays (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 07 AM 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 07 AM 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 14's and Class 15's.

Overweight HCVs

Volume trends. Of a total of 85380 HCVs, 2186 of them were overweight ³. These overweight HCVs contributed to 0.1% of total monthly volume, and 2.8% of total monthly HCV volume. NB overweight vehicles typically reached highest numbers on Wednesdays, with lowest volumes reported on Sundays. 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 14 and class 9 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 88.1% 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 December.

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 ,20 NB vehicles exceeded 88,000 pounds (8 vehicles were Class 10's; 7 vehicles were Class 13's). Of vehicles traveling SB,

2472 NB vehicles exceeded 88,000 pounds (2436 vehicles were Class 14's; 15 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from January 2018.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in January 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 empty Class 9's than fully_loaded 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 318336 tons of freight was recorded to have crossed the WIM. More freight was shipped NB (52.7%) than SB (47.3%). See Table 4 and Figure 11 for more freight information.

Infrastructure Considerations

Bridge. Bridge No. 9800 (Lafayette Bridge) is approximately 3.9 miles north of WIM #40. A pair of bridges also exists 0.7 miles south of WIM #40—Bridge No. 19016 on the NB side, and Bridge No. 19015 on the SB side. WIM #40 recorded a total of 1653955 vehicles with a combined GVW of 7301621 kips (1 kip = 1,000 pounds = 0.5 tons) in January 2018. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 2291682 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 99.4% of all ESALs were recorded SB while 0.6% was observed NB. In particular, 99% of all ESALs were generated by the Class 14's (Class 14's were also responsible for generating % 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).

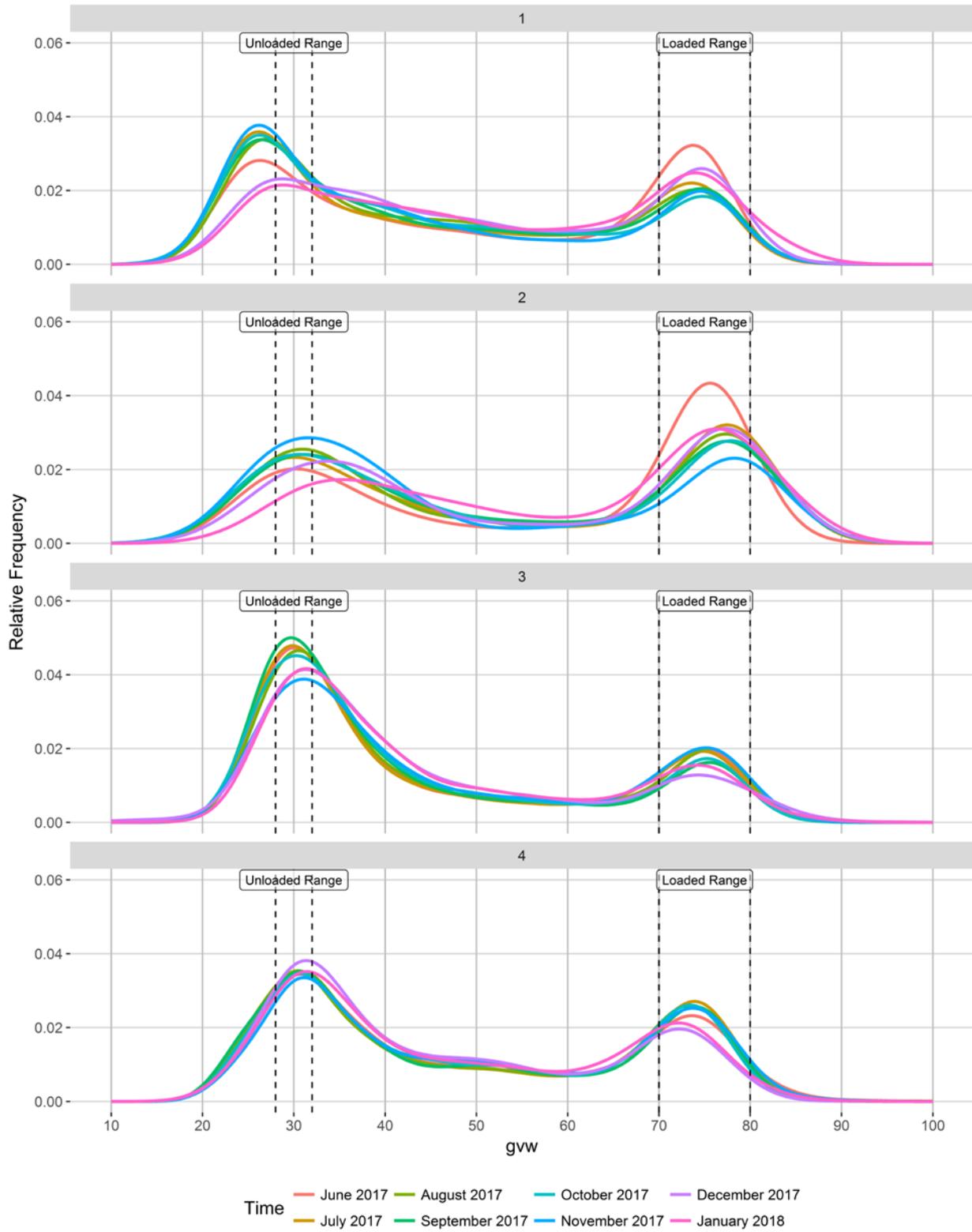
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

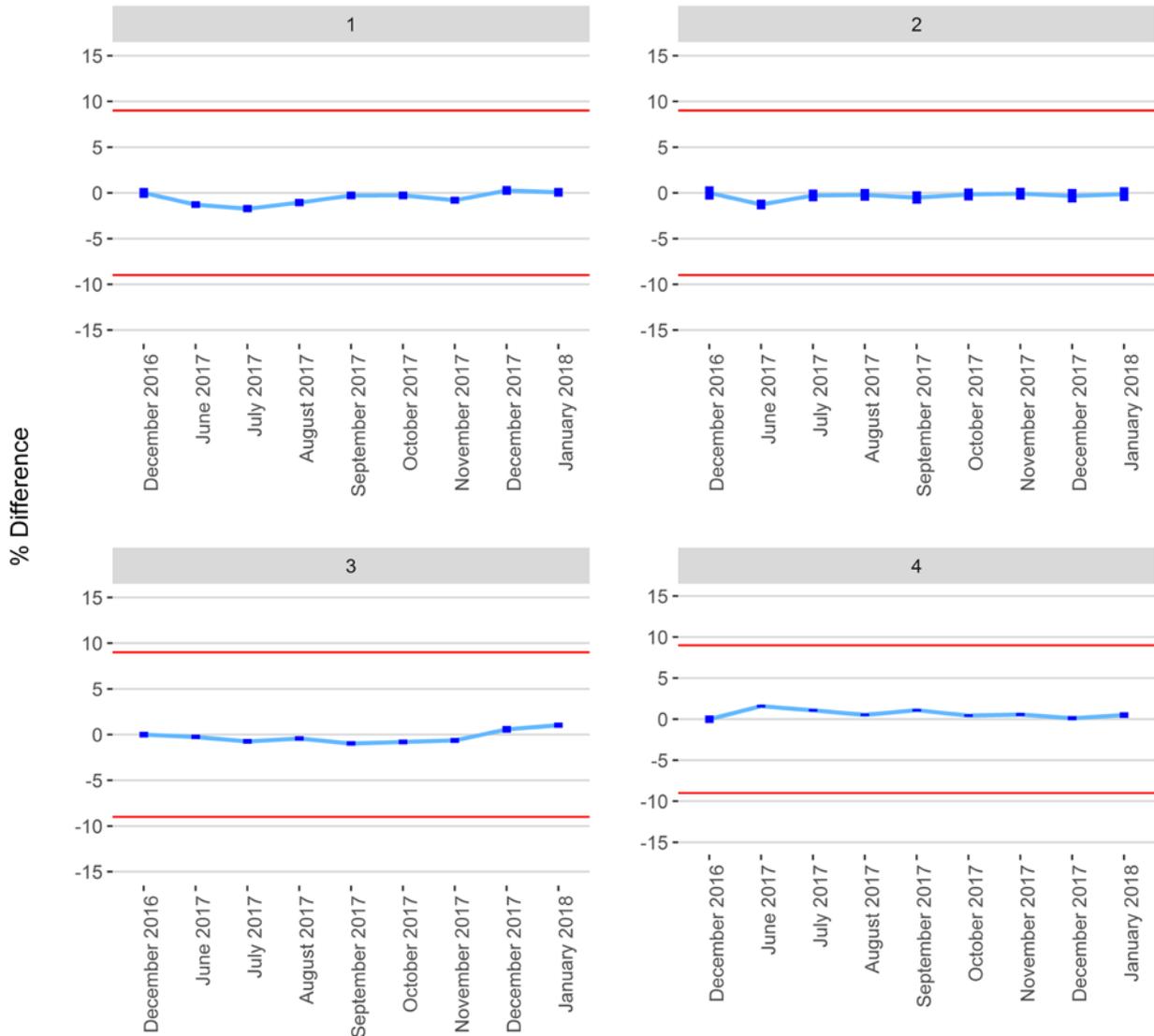
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

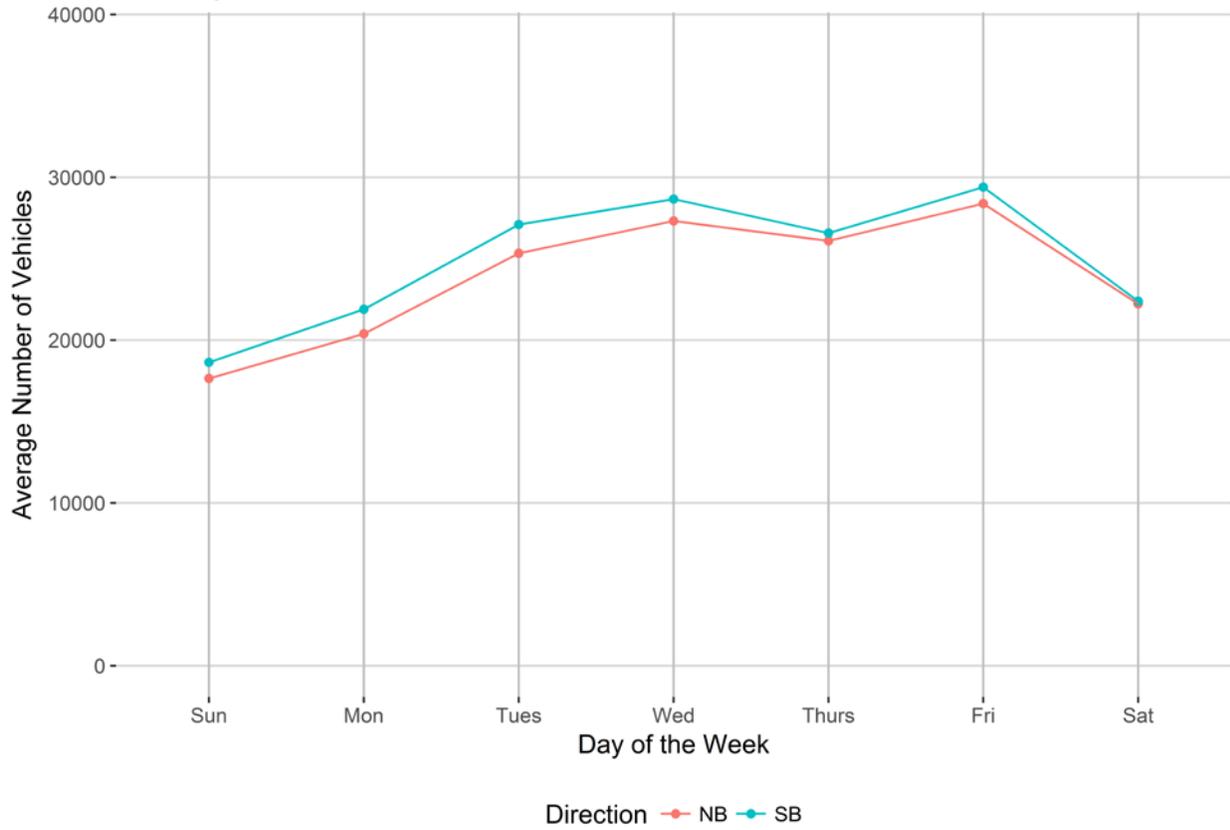


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

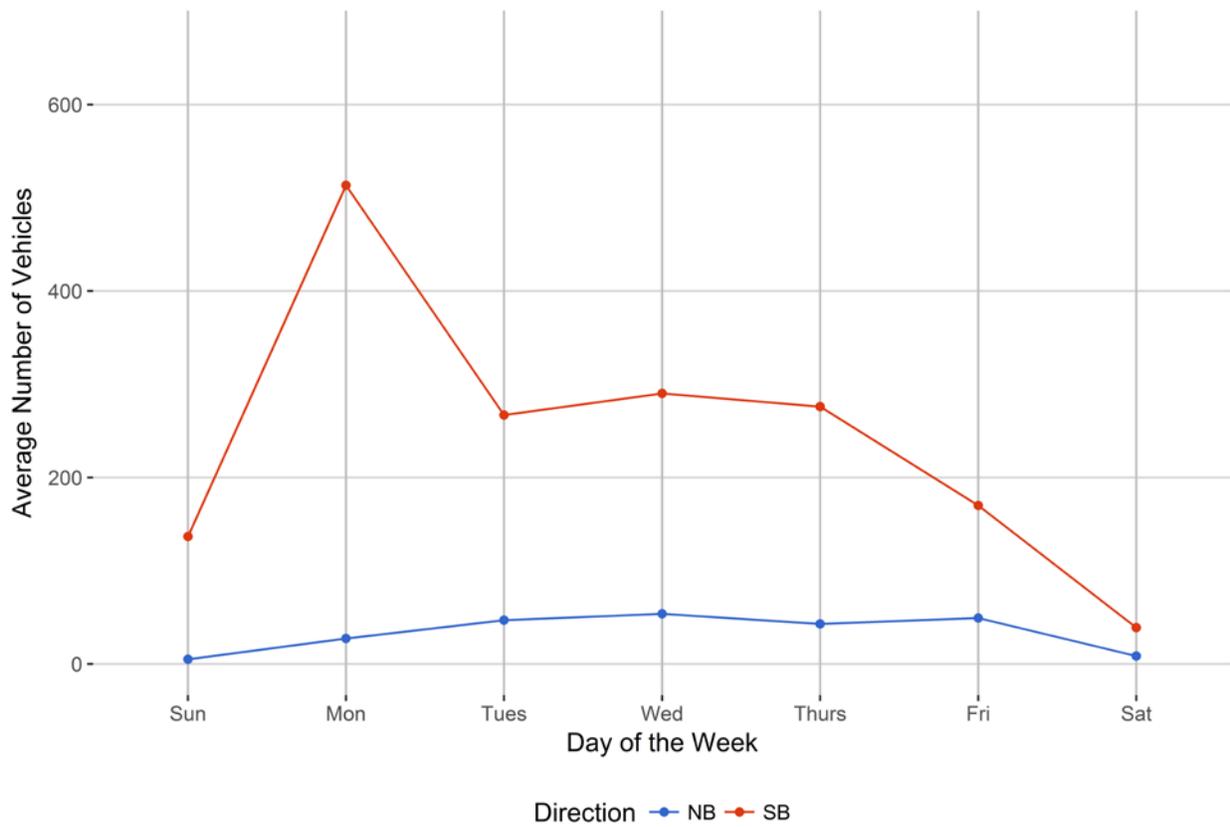


Figure 4 - Passenger Vehicles vs. Hour of the Day

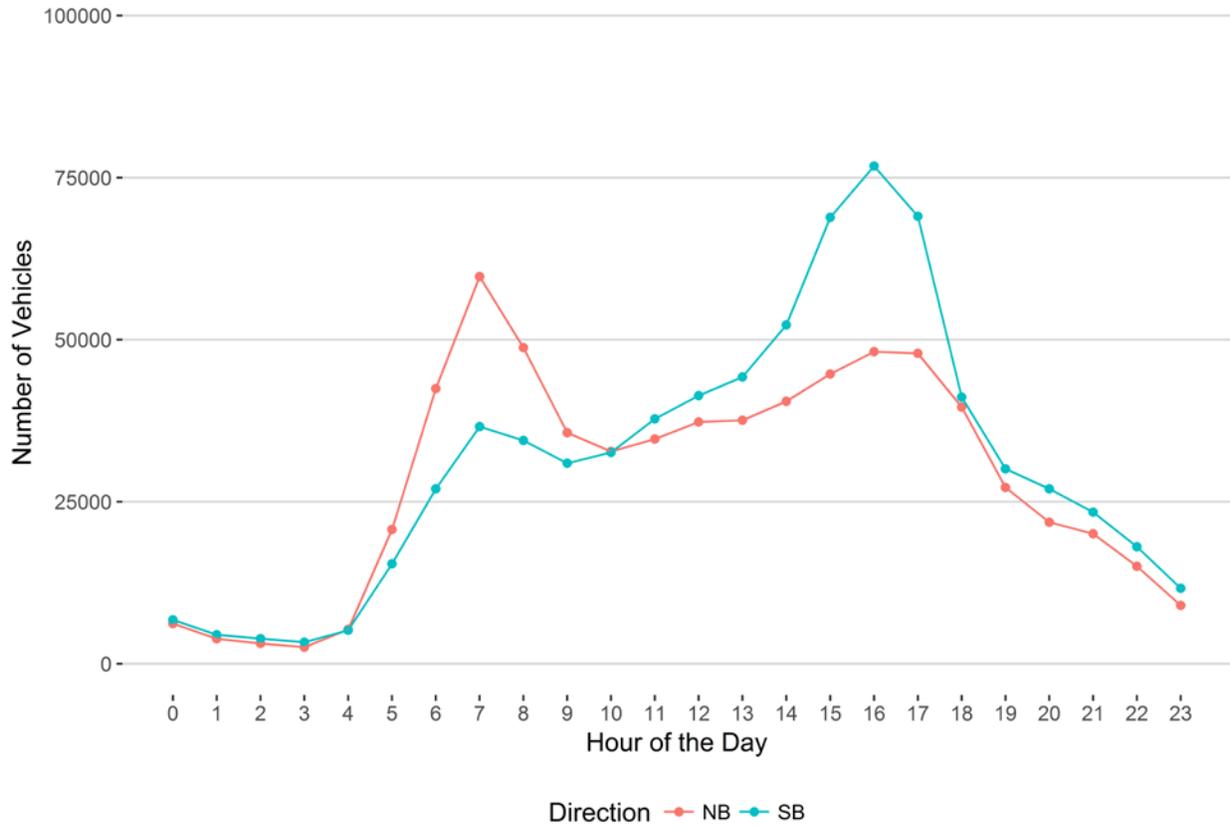


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

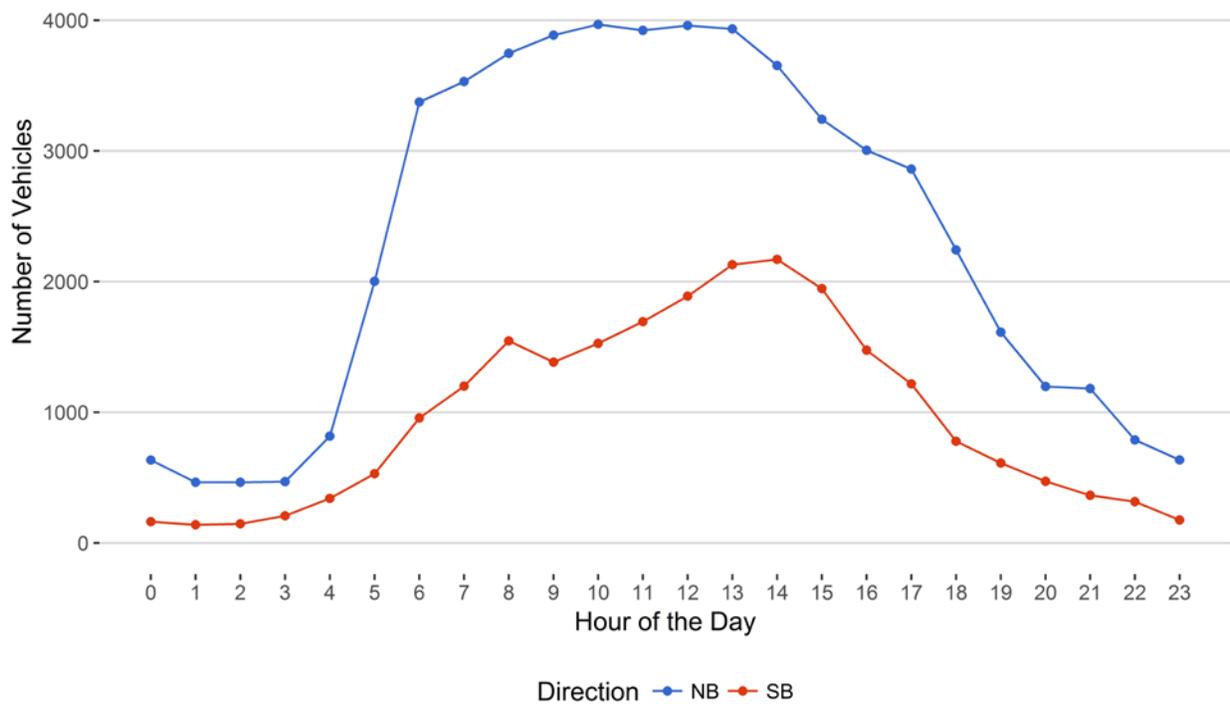


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

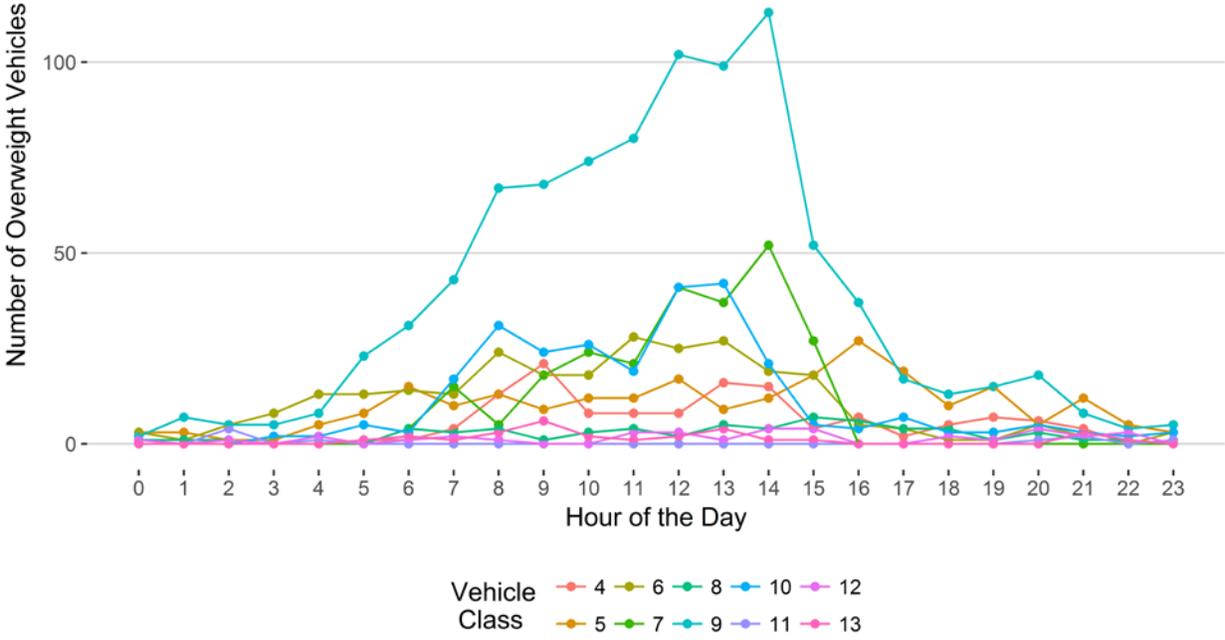


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

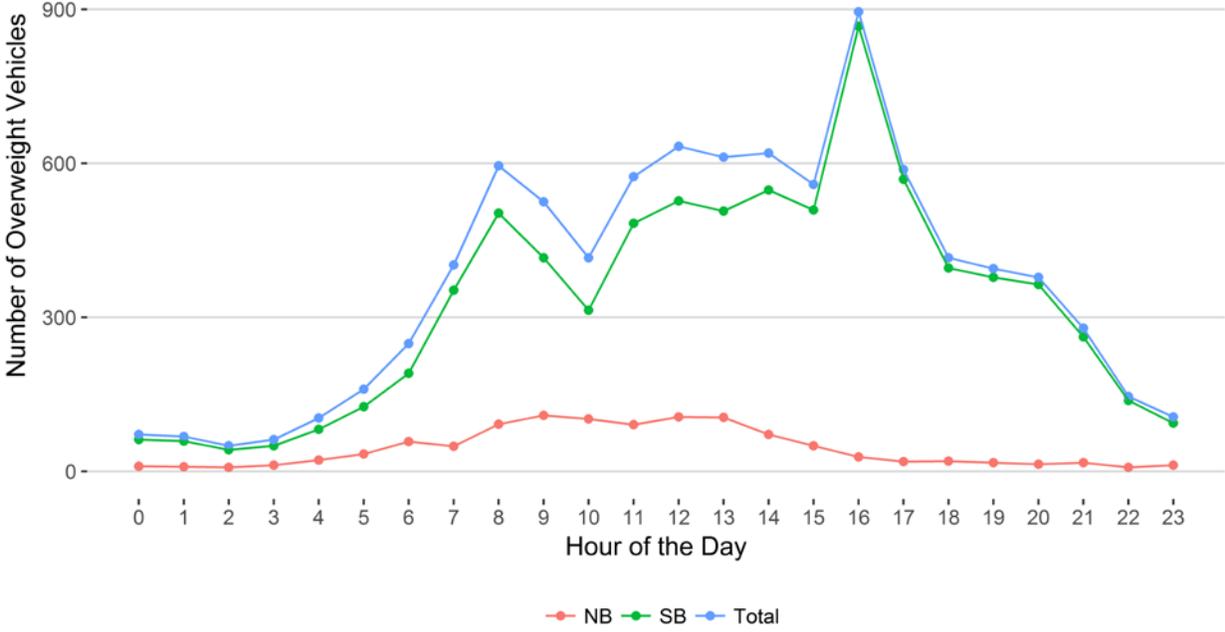
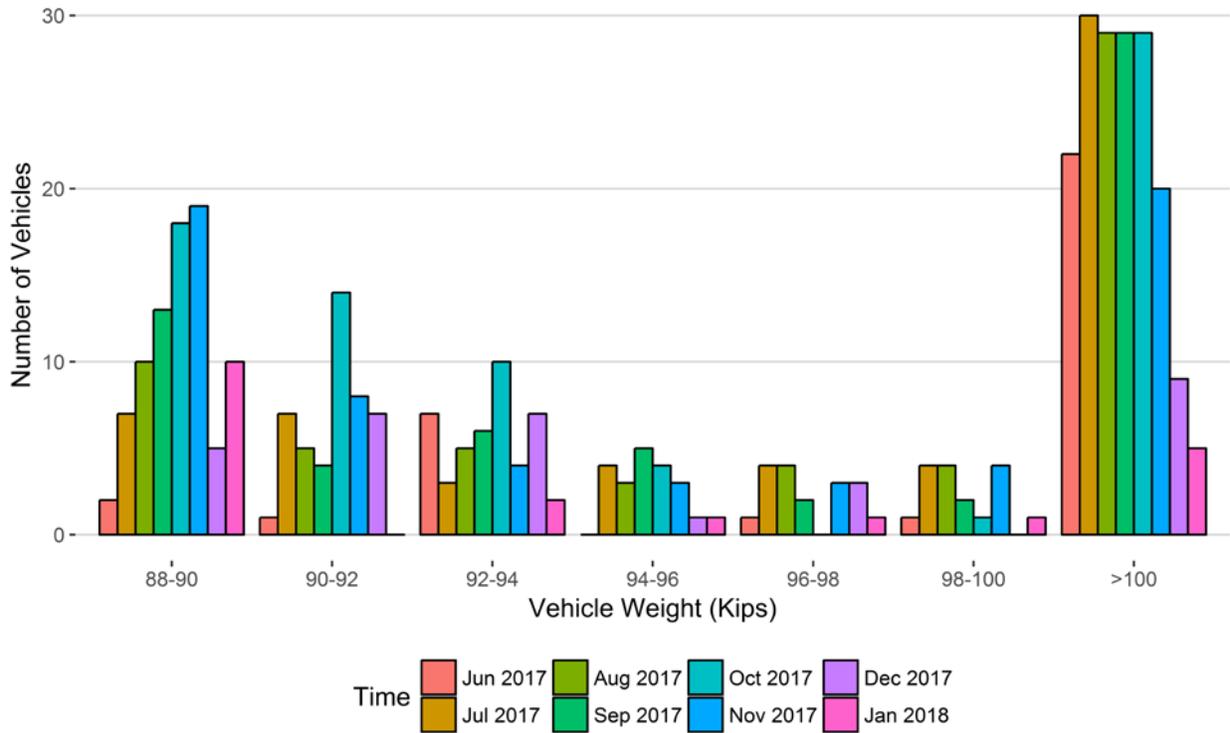
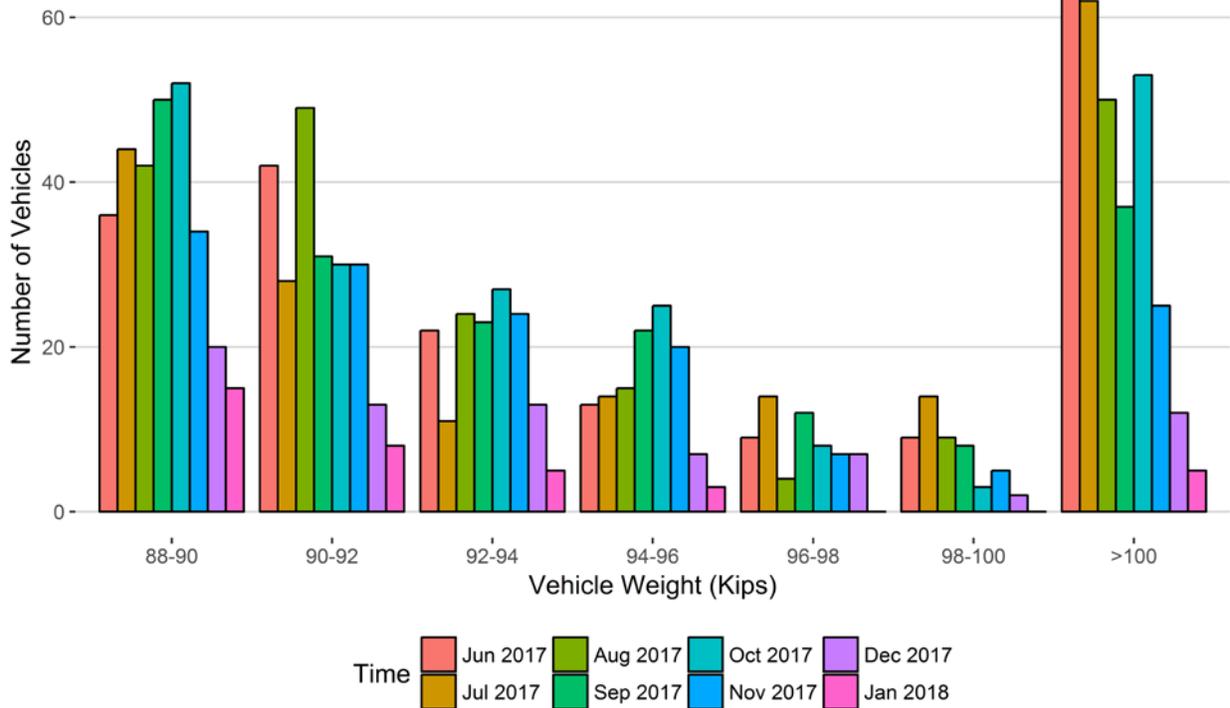


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Jun 2017	Jul 2017	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018
88-90	2	7	10	13	18	19	5	10
90-92	1	7	5	4	14	8	7	0
92-94	7	3	5	6	10	4	7	2
94-96	0	4	3	5	4	3	1	1
96-98	1	4	4	2	0	3	3	1
98-100	1	4	4	2	1	4	0	1
>100	22	30	29	29	29	20	9	5
Total	34	59	60	61	76	61	32	20

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



Vehicle Weights (Kips)	Jun 2017	Jul 2017	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018
88-90	36	44	42	50	52	34	20	15
90-92	42	28	49	31	30	30	13	8
92-94	22	11	24	23	27	24	13	5
94-96	13	14	15	22	25	20	7	3
96-98	9	14	4	12	8	7	7	0
98-100	9	14	9	8	3	5	2	0
>100	63	62	50	37	53	25	12	5
Total	194	187	193	183	198	145	74	36

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

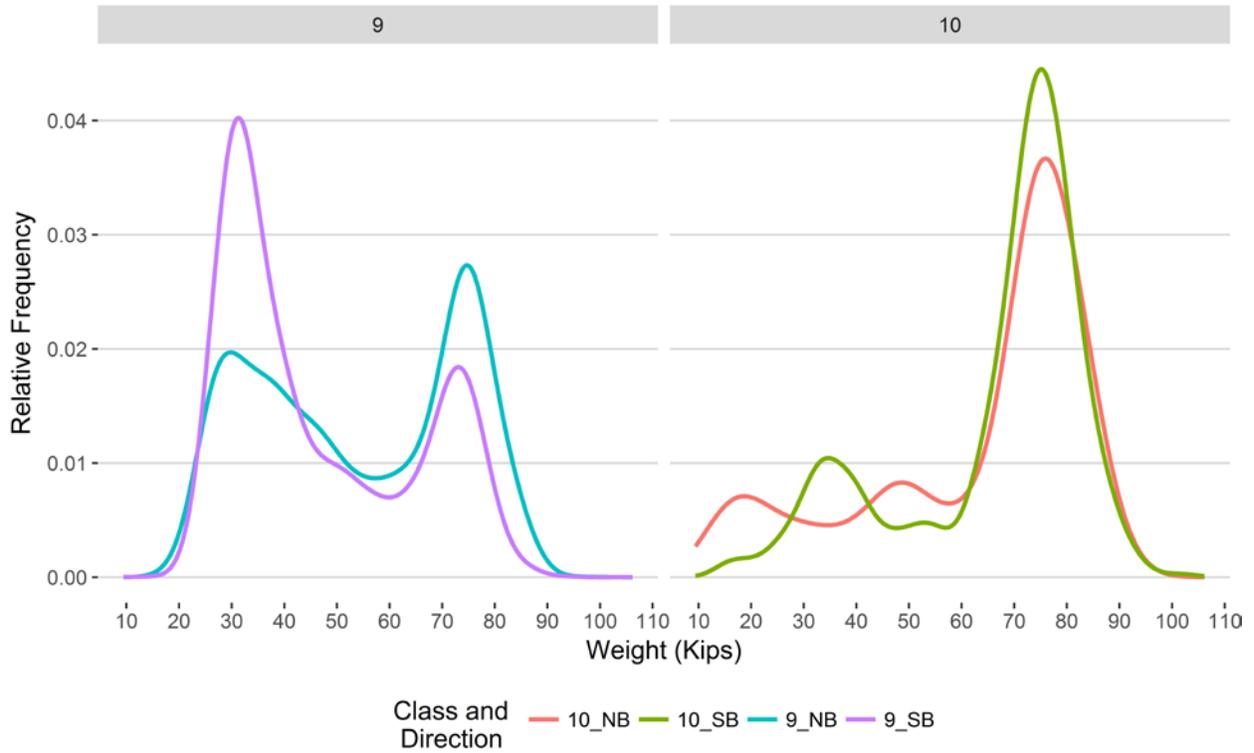


Figure 9 - Freight Percentage by Direction and Class

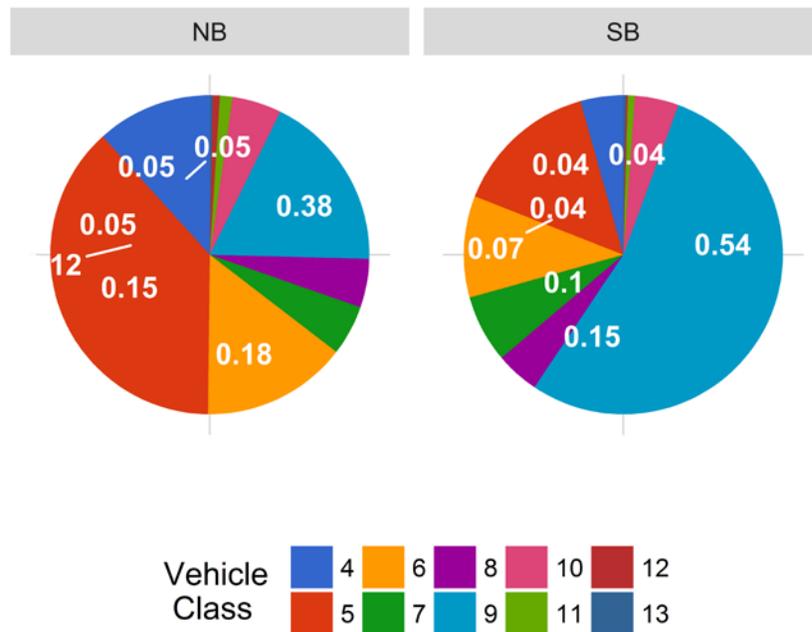


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

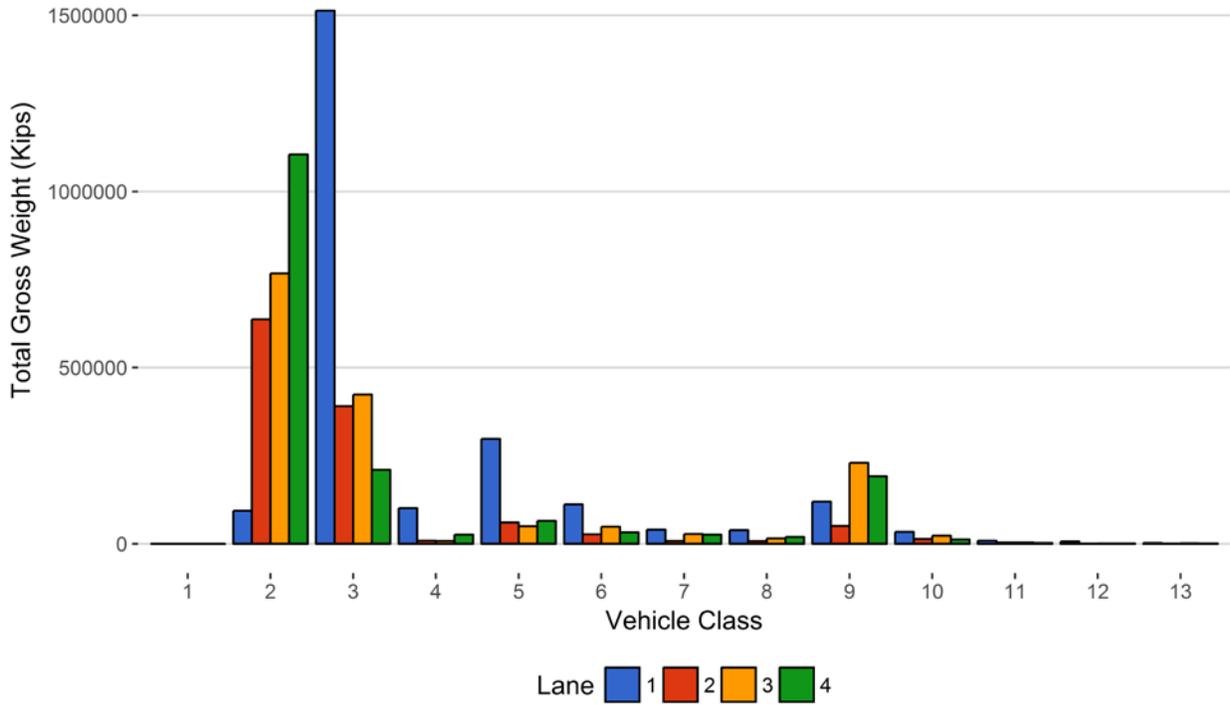


Figure 11 - Total Gross Vehicle Weight I

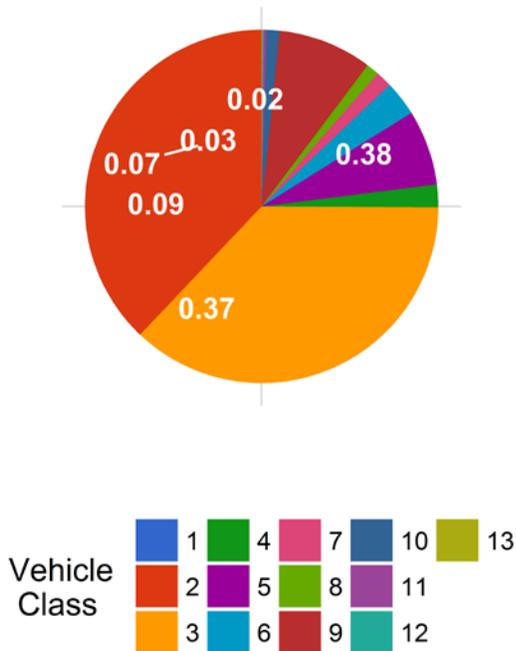


Figure 12 - Total ESALs by Class and Lane

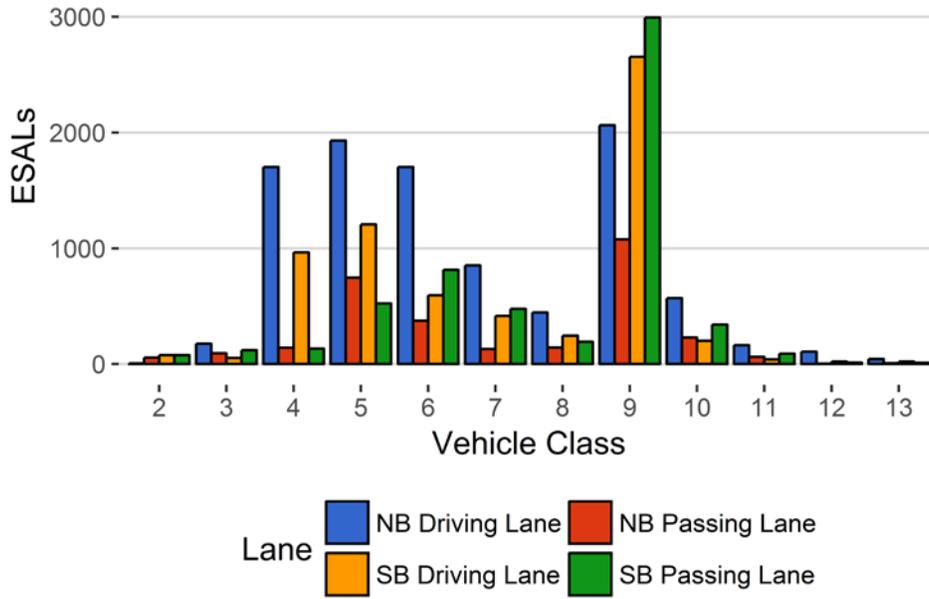


Figure 13 - ESALs by Class

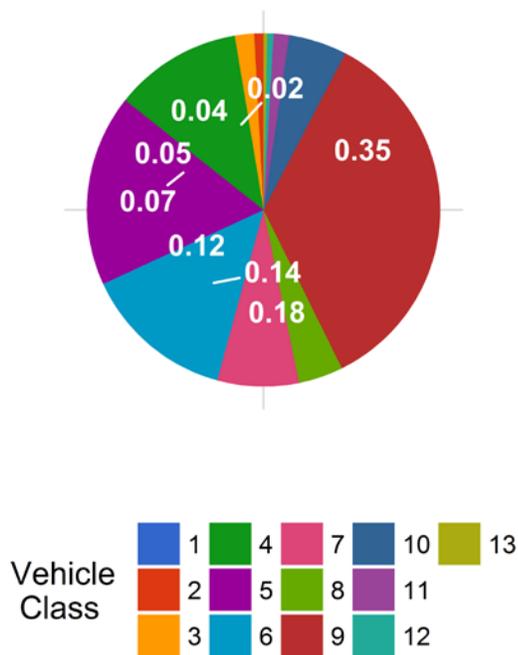


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 3 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 4 (kips)</i>	<i>Front Axle +/- 9%</i>
December 2016	10.56	0.00	10.65	0.00	10.56	0.00	10.49	0.00
June 2017	10.42	-1.28	10.51	-1.27	10.54	-0.25	10.65	1.59
July 2017	10.38	-1.72	10.62	-0.28	10.48	-0.74	10.60	1.07
August 2017	10.45	-1.05	10.62	-0.22	10.52	-0.42	10.54	0.53
September 2017	10.53	-0.27	10.59	-0.50	10.46	-0.96	10.60	1.09
October 2017	10.53	-0.27	10.63	-0.17	10.48	-0.80	10.53	0.43
November 2017	10.47	-0.81	10.64	-0.09	10.50	-0.64	10.55	0.56
December 2017	10.59	0.27	10.61	-0.32	10.62	0.57	10.50	0.12
January 2018	10.56	0.06	10.63	-0.14	10.67	1.04	10.54	0.49

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	1	0	0	0
2	29669	919750	55.6	0	0
3	20930	648824	39.2	0	0
4	204	6335	0.4	131	6
5	1623	50321	3	244	11.2
6	264	8194	0.5	268	12.3
7	59	1838	0.1	244	11.2
8	115	3554	0.2	62	2.8
9	426	13213	0.8	896	41
10	44	1370	0.1	269	12.3
11	11	341	0	9	0.4
12	5	143	0	35	1.6
13	2	71	0	28	1.3
TOTAL	53353	1653955	100	2186	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>
2018-01-08	Monday	13:09:20	9	SB	4	130.18
2018-01-23	Tuesday	15:06:13	10	SB	3	110.71
2018-01-31	Wednesday	14:05:30	9	SB	4	109.26
2018-01-15	Monday	10:27:49	9	SB	3	106.6
2018-01-23	Tuesday	10:31:20	9	SB	3	106.28
2018-01-18	Thursday	14:34:01	9	SB	4	106.19
2018-01-10	Wednesday	19:13:07	9	SB	3	105.32
2018-01-23	Tuesday	14:29:10	9	SB	3	103.34
2018-01-15	Monday	16:27:31	9	SB	3	102.93
2018-01-19	Friday	06:05:03	9	NB	1	102.52

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	4532	510	11.3	103594	6410	21632
5	NB	8	39036	25461	65.2	209093	148934	50246
6	NB	19	4862	925	19	123020	15554	24109
7	NB	11.5	803	4	0.5	47713	41	19262
8	NB	31	2122	1660	78.2	17542	28724	1610
9	NB	33	3140	646	20.6	152137	18092	34918
10	NB	33.5	743	109	14.7	44718	2310	11739
11	NB	36.5	218	11	5	11557	390	2001
12	NB	36.5	108	8	7.4	6552	251	1451
13	NB	31.5	33	0	0	2693	0	827
TOTAL	****	****	55597	29334	****	718618	****	167794
<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	1328	146	11	32034	1884	7152
5	SB	8	7513	735	9.8	109899	5242	27837
6	SB	19	2718	560	20.6	71151	9360	15074
7	SB	11.5	897	1	0.1	53665	7	21680
8	SB	31	1166	697	59.8	17940	16602	1701
9	SB	33	9083	2937	32.3	335735	85388	66459
10	SB	33.5	524	44	8.4	33637	1222	8779
11	SB	36.5	97	6	6.2	5355	202	1017
12	SB	36.5	24	2	8.3	1428	71	313
13	SB	31.5	33	2	6.1	2039	23	531
TOTAL	****	****	23383	5130	****	662883	****	150542
GRAND TOTAL	****	****	78980	34464	384	1381500	340706	318336

Table 5 Gross Vehicle Weight by Class and Lane

<i>Vehicle Class</i>	<i>NB Driving Lane</i>	<i>NB Passing Lane</i>	<i>SB Passing Lane</i>	<i>SB Driving Lane</i>	<i>Total</i>	<i>Percentage</i>
1	0	0	0	0	0	0
2	93633	637224	767266	1105016	2603139	37.9
3	1513330	390307	423401	210140	2537178	37
4	101262	8742	8038	25879	143921	2.1
5	297747	60280	49862	65279	473168	6.9
6	111948	26626	48206	32305	219085	3.2
7	40077	7677	27618	26053	101426	1.5
8	38660	7605	15204	19337	80807	1.2
9	119531	50698	229831	191293	591353	8.6
10	33617	13410	22687	12173	81887	1.2
11	8648	3298	3568	1990	17504	0.3
12	6477	326	580	919	8302	0.1
13	2124	569	1075	986	4754	0.1
TOTAL	2367053	1206764	1597336	1691371	6862524	100
GVW/LANE	34.49	17.58	23.28	24.65	100	0

Table 6 ESALs by Class and Lane and Flexible ESAL Factors

<i>Vehicle Class</i>	<i>NB Driving Lane</i>	<i>NB Passing Lane</i>	<i>SB Passing Lane</i>	<i>SB Driving Lane</i>	<i>Total</i>	<i>Percentage</i>	<i>Flexible ESAL Factor</i>
1	0	0	0	0	0	0	0.5
2	5	56	77	77	215	0.86	5e-04
3	176	94	119	52	441	1.76	0.0015
4	1702	140	132	964	2939	11.71	1.01
5	1930	746	523	1206	4404	17.55	0.19
6	1702	373	815	594	3485	13.89	0.92
7	852	129	476	416	1872	7.46	2.2
8	446	142	192	245	1025	4.09	0.63
9	2063	1077	2993	2655	8788	35.02	1.44
10	569	228	341	200	1339	5.34	2.11
11	163	62	90	41	356	1.42	2.22
12	106	4	12	21	143	0.57	2.08
13	44	7	11	22	84	0.33	2.29
TOTAL	9759	3059	5779	6493	25091	100	16
ESALS/LANE	38.9	12.2	23	25.9	100	--	--

Table 7 Site Summary: Volume and Vehicle Class

<i>Month</i>	<i>Total Volume</i>	<i>Monthly ADT</i>	<i>Monthly HCAD T</i>	<i>Passenger Vehicles</i>	<i>Passenger Vehicles %</i>	<i>Heavy Commercial Vehicles</i>	<i>Heavy Commercial Vehicles %</i>	<i>Heavy Commercial Vehicles in Driving Lane %</i>	<i>Heavy Commercial Vehicles in Passing Lane %</i>
Jun 2017	2048474	68282	4852	1902910	92.9	145564.2	7.1	82	18
Jul 2017	2000587	64535	4300	1867301	93.3	133285.9	6.7	82.3	17.7
Aug 2017	2103371	67851	4818	1954019	92.9	149352.4	7.1	82.4	17.6
Sep 2017	2038674	67956	4582	1901206	93.3	137468.5	6.7	82.7	17.3
Oct 2017	1994930	64353	4586	1852771	92.9	142158.7	7.1	83.3	16.7
Nov 2017	1838411	61280	4052	1716847	93.4	121564.2	6.6	82.8	17.2
Dec 2017	1722547	55566	2975	1630326	94.6	92220.6	5.4	79.1	20.9
Jan 2018	1653955	53353	2754	1568575	94.8	85379.7	5.2	76.2	23.8
TOTAL	15400949	--	--	14393955	--	1006994	--	--	--
AVERAGE	1925119	62897	4115	1799244	94	125874	6	81	19

ESALS

<i>Month</i>	<i>ESALS NB Passing Lane</i>	<i>ESALS NB Driving Lane</i>	<i>ESALS SB Driving Lane</i>	<i>ESALS SB Passing Lane</i>	<i>Total ESALS</i>	<i>Driving Lane ESALS %</i>	<i>Passing Lane ESALS %</i>	<i>Pavement Life Decrease Months</i>
Jun 2017	14517	4645	6807	30511	56481	80	20	3.6
Jul 2017	12325	3931	6254	221992	244502	96	4	3.8
Aug 2017	13225	4133	6741	167722	191822	94	6	2.4
Sep 2017	12021	3738	5808	28483	50051	81	19	1.7
Oct 2017	13559	4112	5753	29613	53036	81	19	2
Nov 2017	10754	3334	6051	1629485	1649624	99	1	1.7
Dec 2017	9884	3097	18277	3126431	3157690	99	1	1.2
Jan 2018	9911	3098	23994	2074787	2111790	99	1	0.8
TOTAL	96196	30089	79686	7309025	7514995	--	--	--
AVERAGE	12024	3761	9961	913628	939374	91	9	2

Gross Vehicle Weight

<i>Month</i>	<i>GVW NB Passing Lane</i>	<i>GVW NB Driving Lane</i>	<i>GVW SB Passing Lane</i>	<i>GVW SB Driving Lane</i>	<i>Total GVW Kips</i>
Jun 2017	2383742	1208296	1602222	2230753	7425012
Jul 2017	3075022	1718969	1951823	3871169	10616984
Aug 2017	2832202	1544765	1887376	4130157	10394500
Sep 2017	2874524	1633526	1988670	4308054	10804773
Oct 2017	2831205	1580992	1944731	4249106	10606035
Nov 2017	2891887	1533025	1851542	4313627	10590081
Dec 2017	2621477	1368329	1715981	3916062	9621849
Jan 2018	2462021	1250570	1598687	2815963	8127241
TOTAL	21972080	11838472	14541032	29834890	78186474
AVERAGE	2746510	1479809	1817629	3729361	9773309

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>
Jun 2017	5257	0.3	3.8	238	102
Jul 2017	5358	0.3	4.2	491	305
Aug 2017	5773	0.3	4.2	411	220
Sep 2017	5053	0.3	3.8	248	78
Oct 2017	5134	0.3	3.8	278	88
Nov 2017	7093	0.4	6	1986	1538
Dec 2017	8930	0.6	9.2	3261	2765
Jan 2018	8291	0.5	9.1	2492	2078
TOTAL	50889	--	--	9405	7174
AVERAGE	6361.1	0.4	5.5	1175.6	896.8

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>
Jun 2017	260761	434550	695311	37.5	62.5
Jul 2017	212073	422661	634733	33.4	66.6
Aug 2017	226167	465453	691620	32.7	67.3
Sep 2017	202982	430992	633974	32	68
Oct 2017	235104	466929	702032	33.5	66.5
Nov 2017	183874	390317	574191	32	68
Dec 2017	167395	192351	359746	46.5	53.5
Jan 2018	167794	150542	318336	52.7	47.3
TOTAL	1656150	2953794	4609944	--	--
AVERAGE	207018.8	369224.2	576243	37.5	62.5