

JANUARY 2018



WIM #30
MN 61, MP 16.3
TWO HARBORS,
MN

MONTHLY
REPORT



Your Destination...Our Priority



WIM Site Location

WIM #30 is located on MN 61 near Two Harbors in Lake county.

System Operation

WIM #30 was operational for the entire month of January 2018. Volume was computed using all monthly data.

System Calibration

WIM #30 was most recently calibrated on 2017-01-20. 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: 203332 | Passenger Vehicles: 190447 | Heavy Commercial Vehicles: 12885

Monthly Average Daily Traffic (MADT): 6559 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 416

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 Sundays, with lowest volumes reported on Thursdays (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 12 PM and 04 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 12 PM and 04 PM. See Figure 6. Out of all HCVs, the two highest traffic volumes were generated by Class 5's and Class 9's.

Overweight HCVs

Volume trends. Of a total of 12885 HCVs, 2097 of them were overweight³. These overweight HCVs contributed to 1.1% of total monthly volume, and 16.6% of total monthly HCV volume. NB overweight vehicles typically reached highest numbers on Thursdays, 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 54.2% 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 November.

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 ,378 NB vehicles exceeded 88,000 pounds (241 vehicles were Class 9's; 126 vehicles were Class 10's). Of vehicles traveling SB,

693 NB vehicles exceeded 88,000 pounds (572 vehicles were Class 10's; 92 vehicles were Class 9'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 fully_loaded Class 9's than empty traveling SB. Data also suggests that there were more empty Class 10's than fully_loaded traveling in the NB direction. In the SB direction, there were more fully_loaded class 10 vehicles.

Freight Totals. A total of 109866 tons of freight was recorded to have crossed the WIM. More freight was shipped SB (54.5%) than NB (45.5%). See Table 4 and Figure 11 for more freight information.

Infrastructure Considerations

Bridge. Bridges No. 9341 and No. 9339, which are respectively on the NB and SB side of MN 61, are approximately 1.5 miles north of WIM #30. Bridge No. 9333 (a box culvert) is approximately 1.8 miles south of WIM #30. WIM #30 recorded a total of 203332 vehicles with a combined GVW of 1403875 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 11538 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 52.1% of all ESALs were recorded SB while 47.9% was observed NB. In particular, 49% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 17% 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).

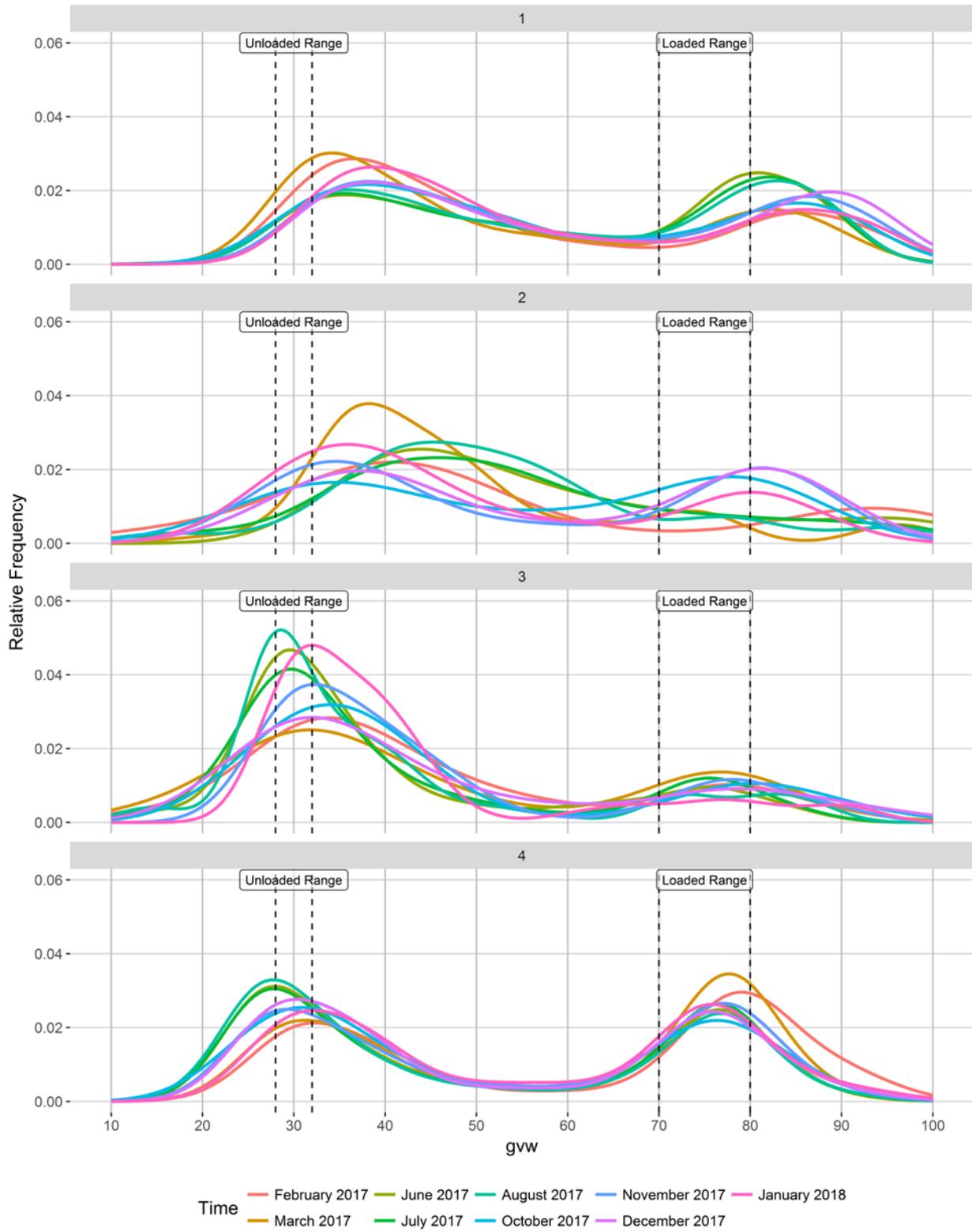
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

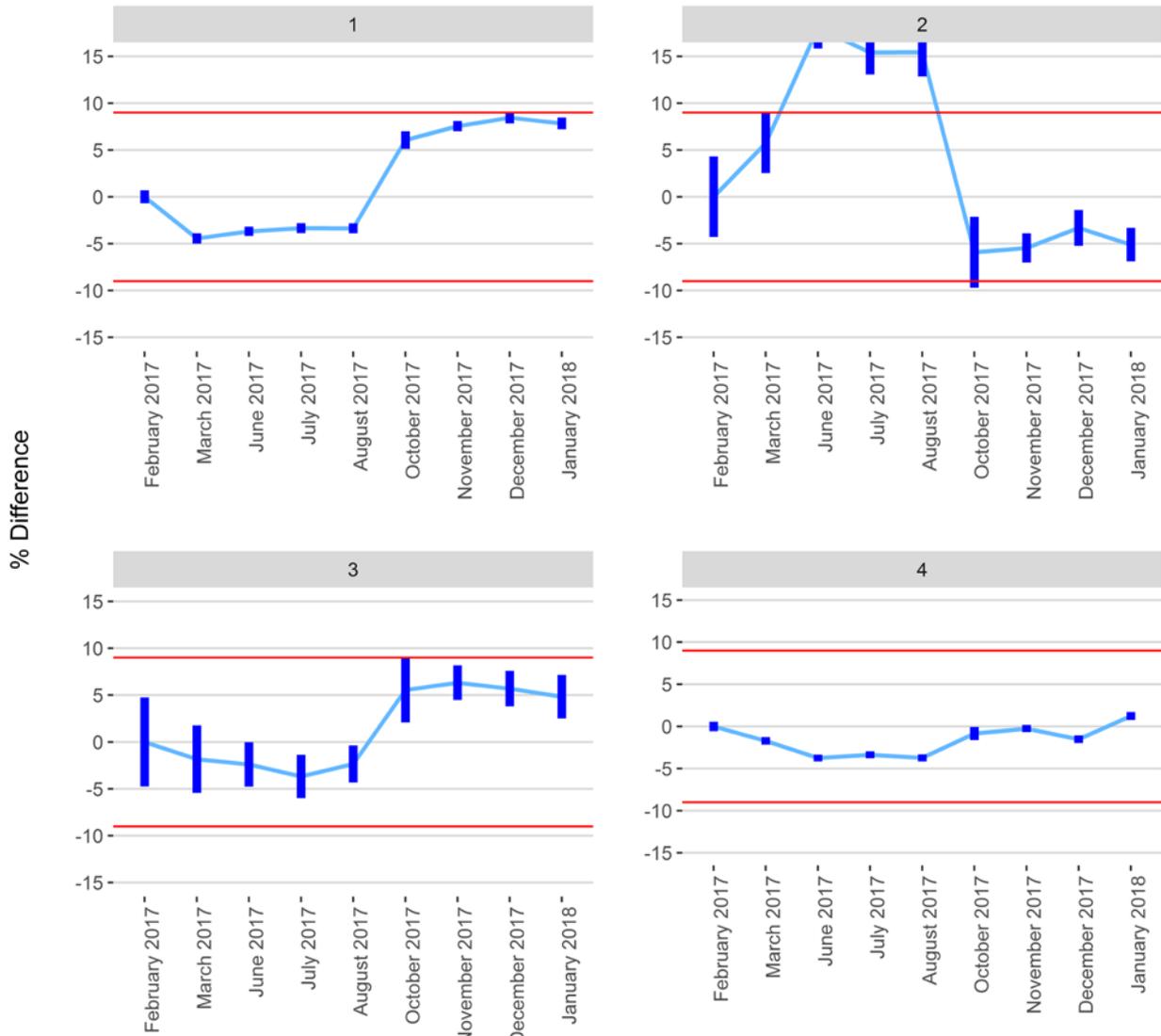
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

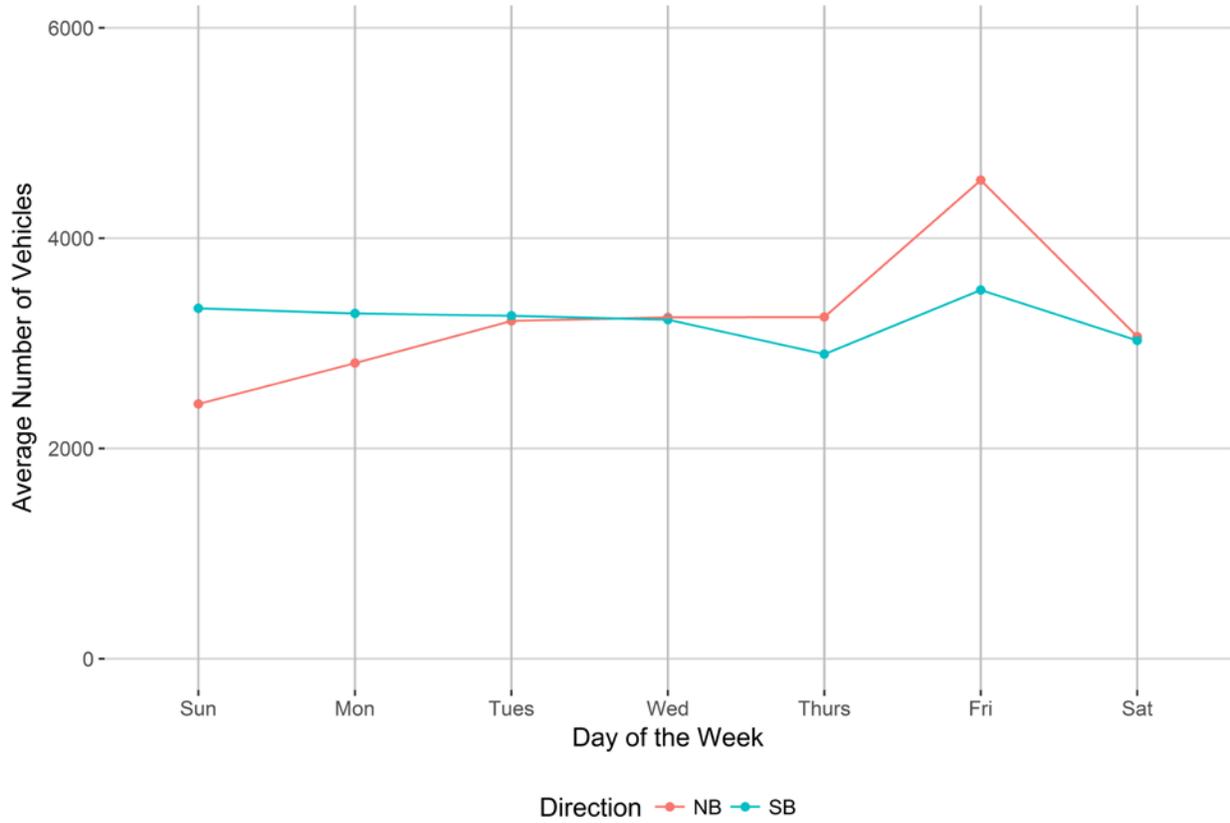


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

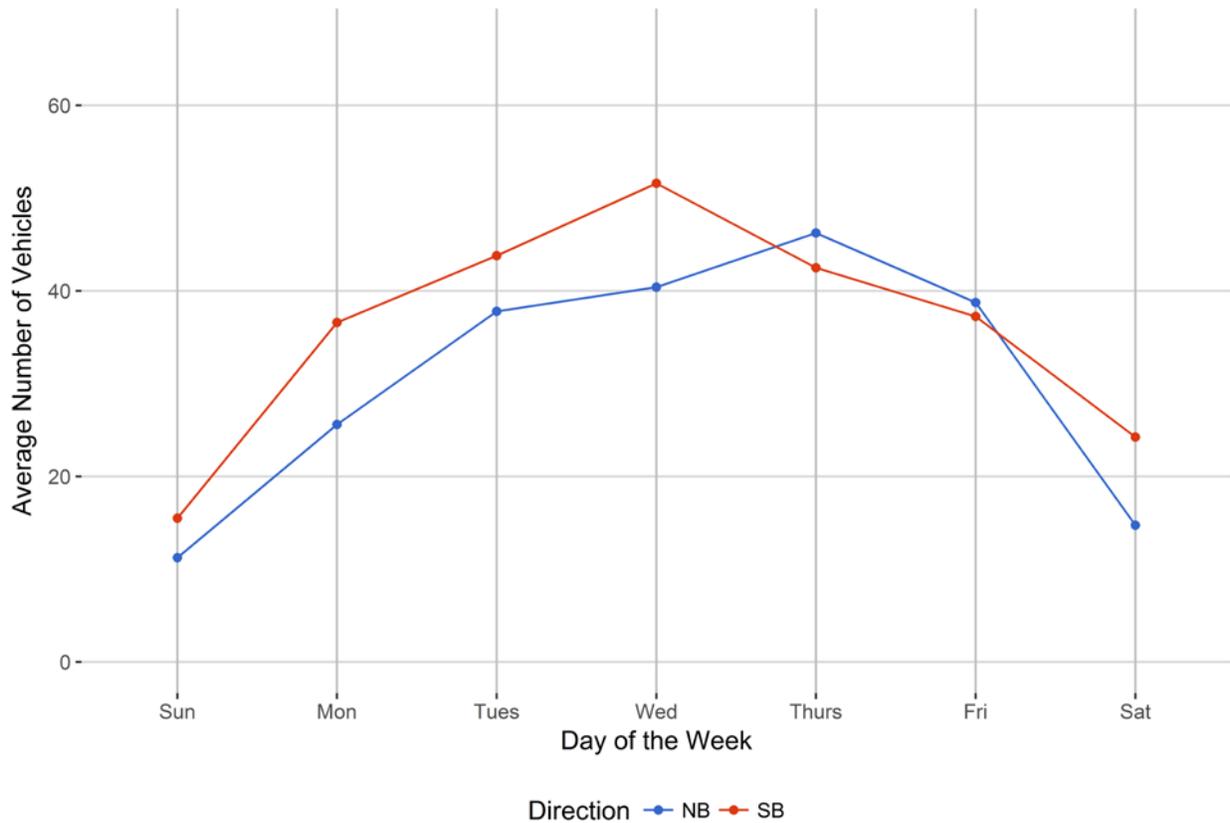


Figure 4 - Passenger Vehicles vs. Hour of the Day

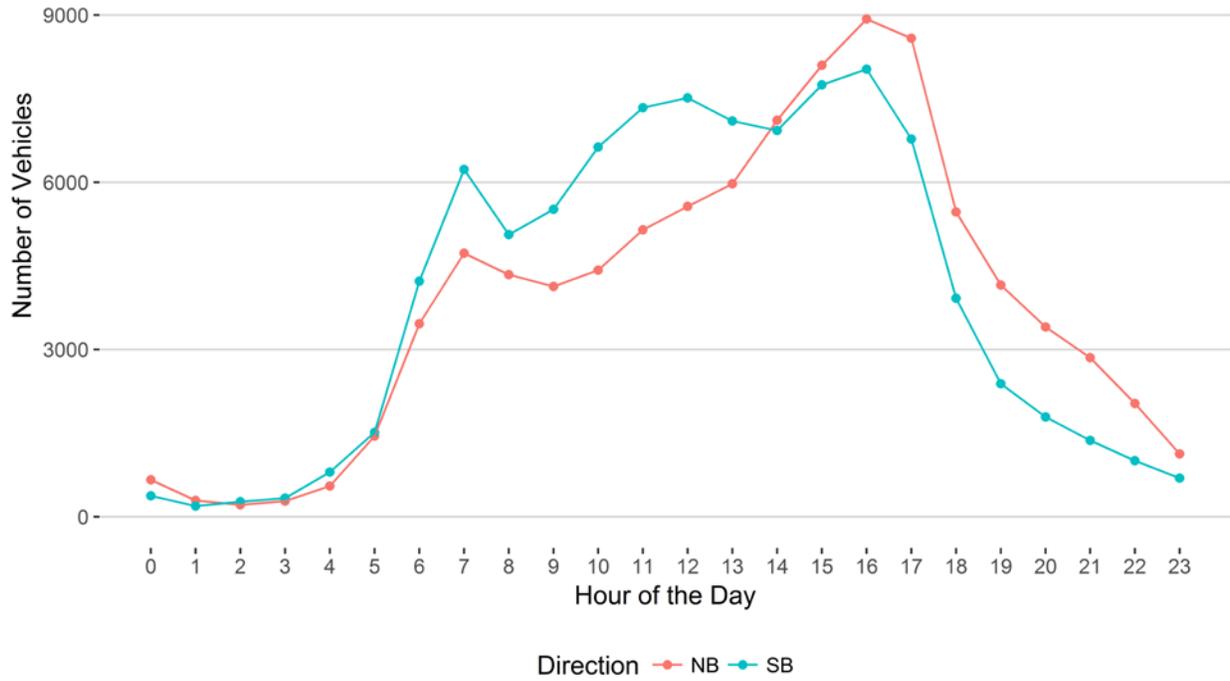


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

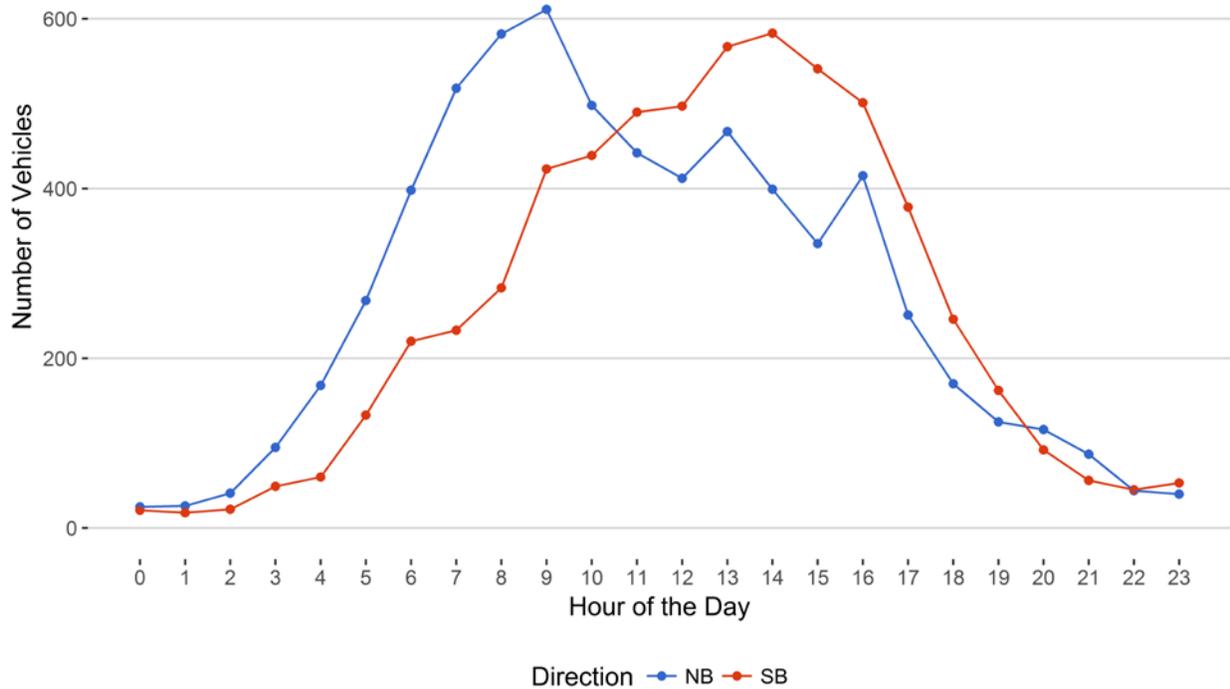


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

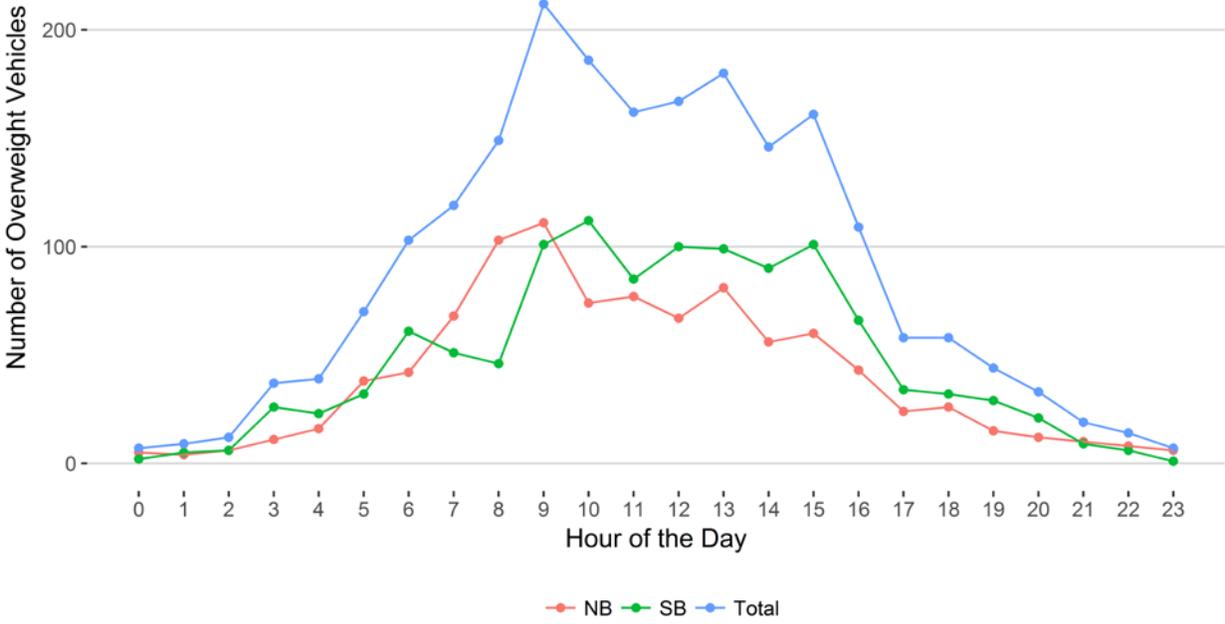
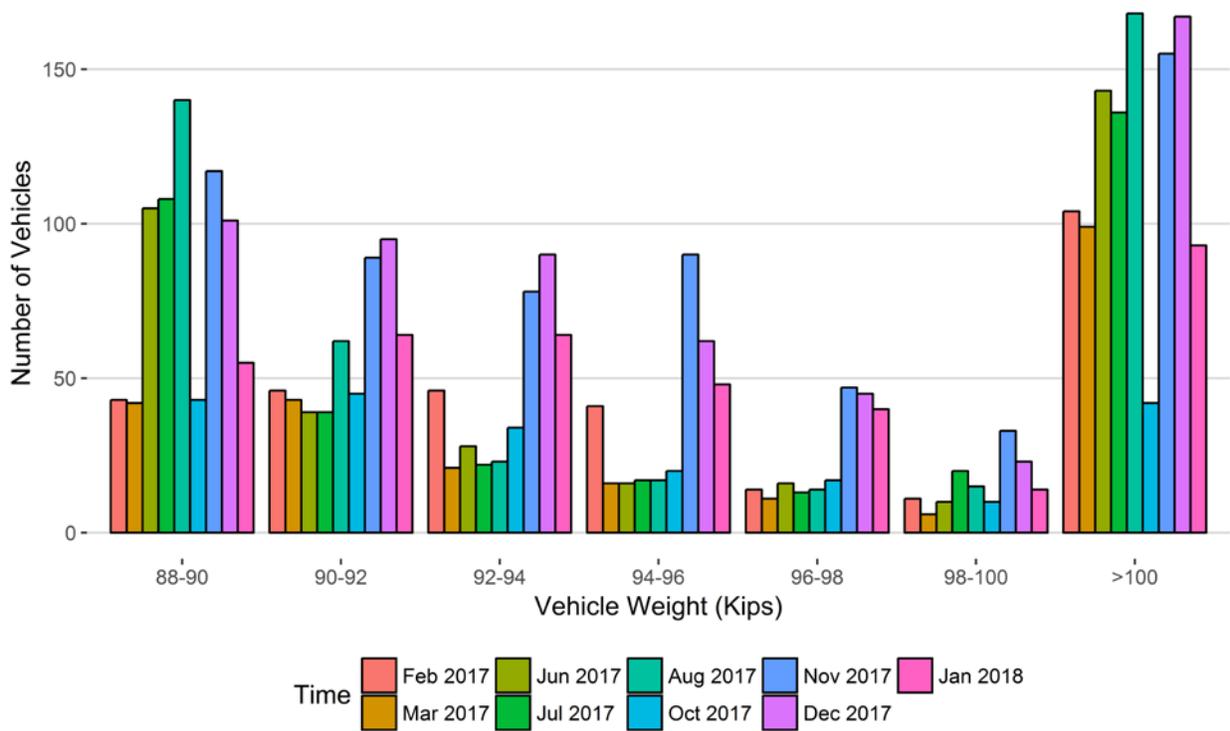
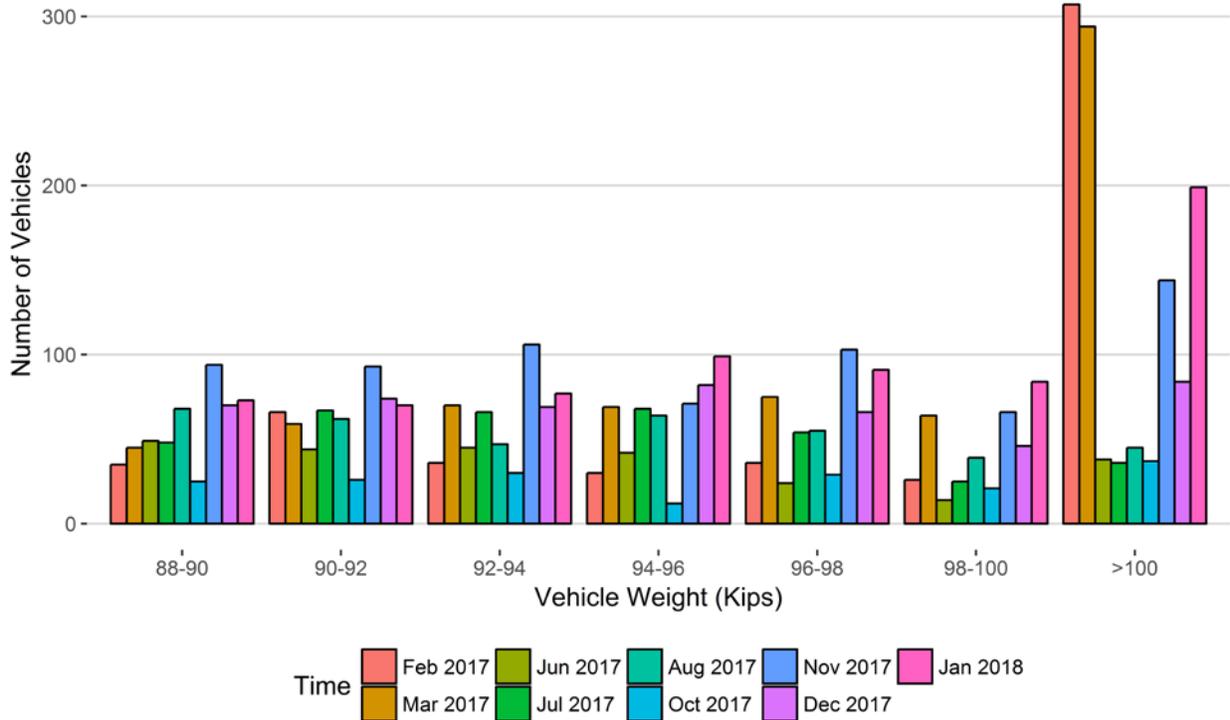


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Feb 2017	Mar 2017	Jun 2017	Jul 2017	Aug 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018
88-90	43	42	105	108	140	43	117	101	55
90-92	46	43	39	39	62	45	89	95	64
92-94	46	21	28	22	23	34	78	90	64
94-96	41	16	16	17	17	20	90	62	48
96-98	14	11	16	13	14	17	47	45	40
98-100	11	6	10	20	15	10	33	23	14
>100	104	99	143	136	168	42	155	167	93
Total	305	238	357	355	439	211	609	583	378

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



Vehicle Weights (Kips)	Feb 2017	Mar 2017	Jun 2017	Jul 2017	Aug 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018
88-90	35	45	49	48	68	25	94	70	73
90-92	66	59	44	67	62	26	93	74	70
92-94	36	70	45	66	47	30	106	69	77
94-96	30	69	42	68	64	12	71	82	99
96-98	36	75	24	54	55	29	103	66	91
98-100	26	64	14	25	39	21	66	46	84
>100	307	294	38	36	45	37	144	84	199
Total	536	676	256	364	380	180	677	491	693

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

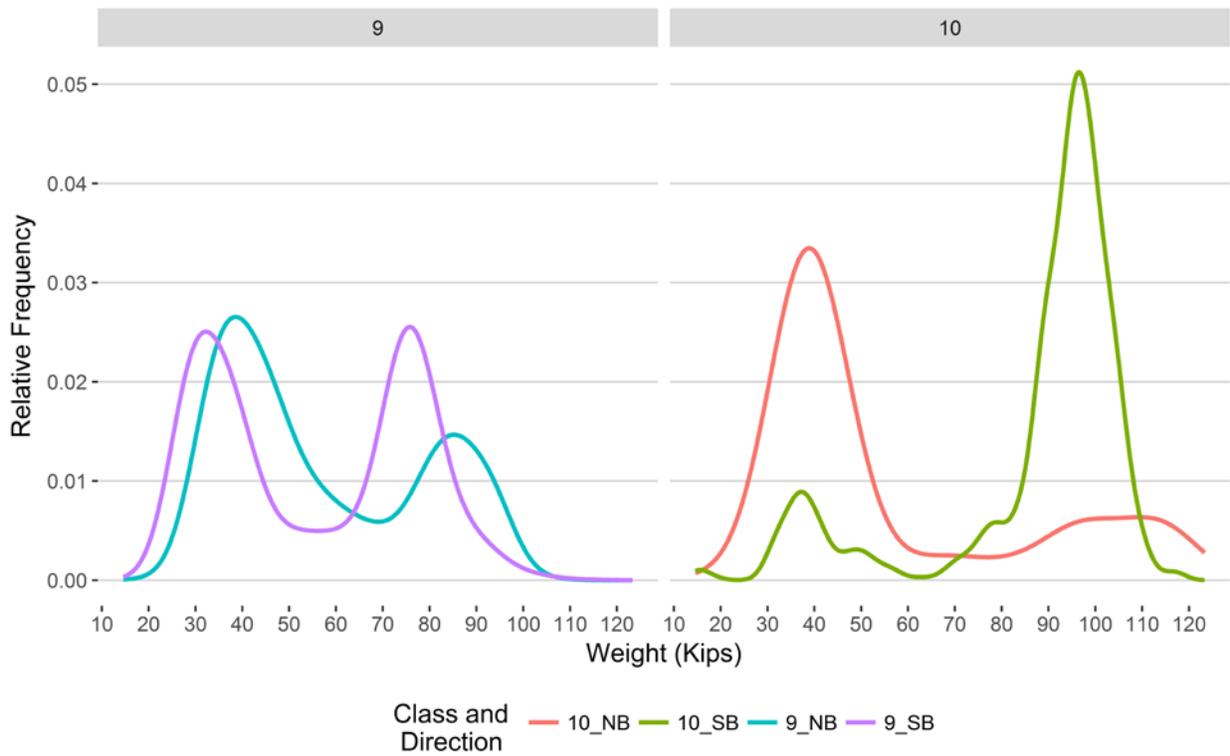


Figure 9 - Freight Percentage by Direction and Class

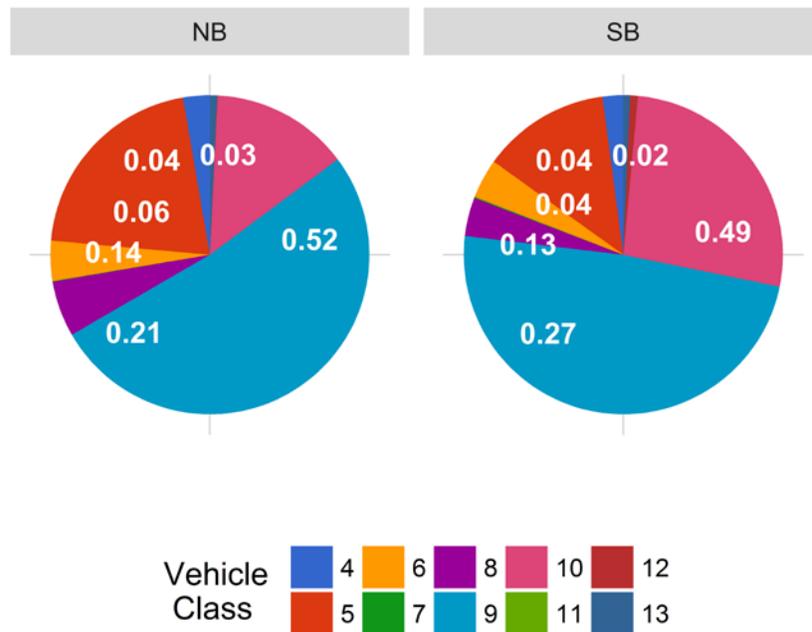


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

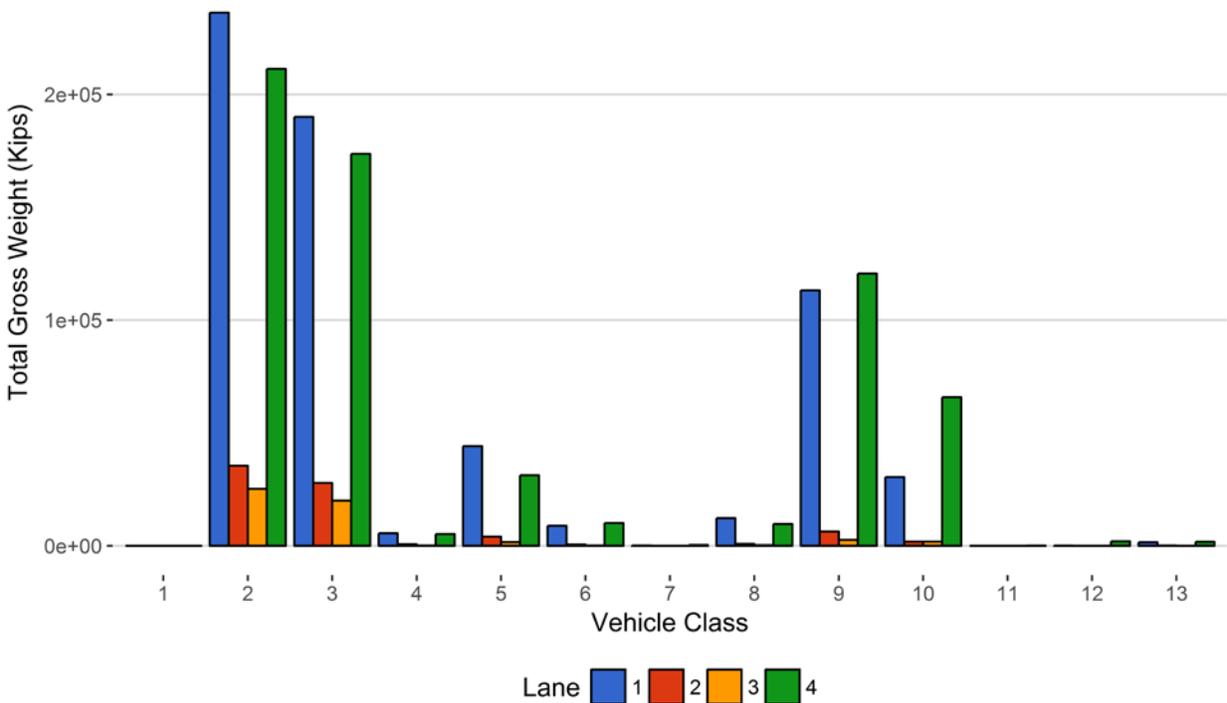


Figure 11 - Total Gross Vehicle Weight I

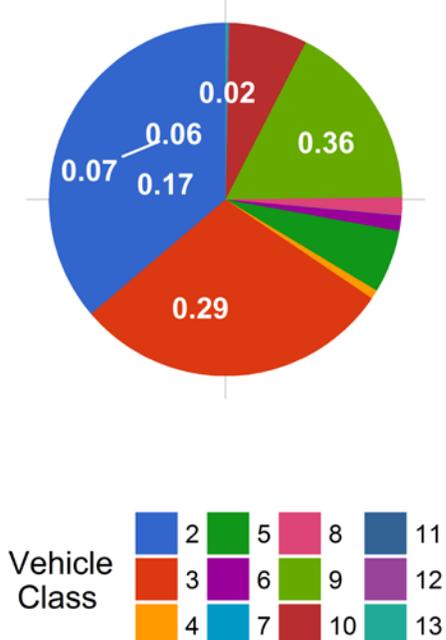


Figure 12 - Total ESALs by Class and Lane

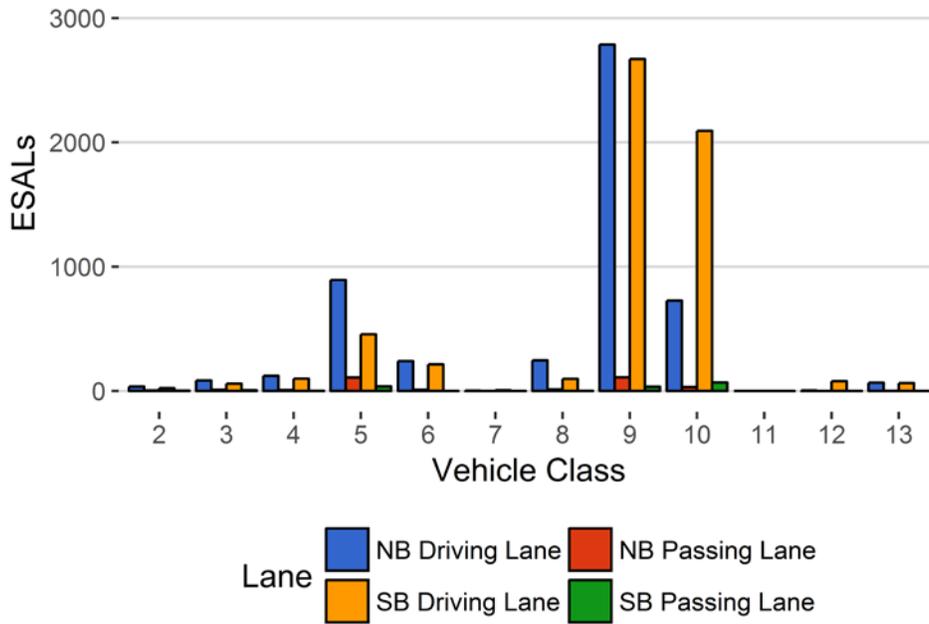


Figure 13 - ESALs by Class

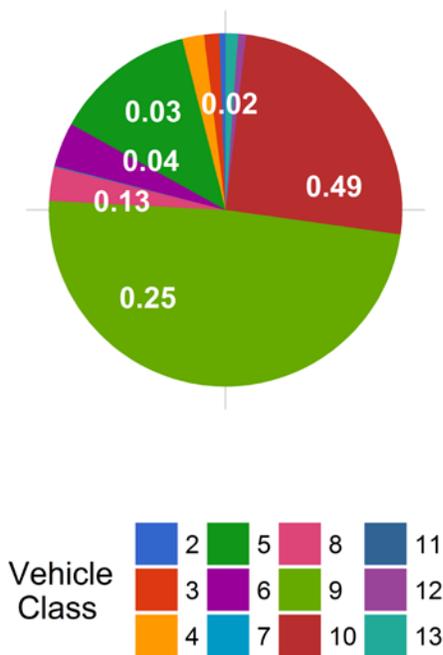


Table 1 Class 9 Front Axle Weight by Lane

<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>
February 2017	11.62	0.00	12.12	0.00	10.33	0.00	11.31	0.00
March 2017	11.10	-4.45	12.82	5.74	10.14	-1.83	11.11	-1.71
June 2017	11.19	-3.68	14.31	18.03	10.08	-2.40	10.88	-3.75
July 2017	11.23	-3.35	13.99	15.41	9.95	-3.68	10.93	-3.36
August 2017	11.23	-3.36	13.99	15.43	10.09	-2.35	10.89	-3.73
October 2017	12.32	6.06	11.40	-5.91	10.91	5.55	11.21	-0.85
November 2017	12.49	7.54	11.46	-5.46	10.99	6.32	11.28	-0.25
December 2017	12.60	8.45	11.72	-3.32	10.92	5.69	11.14	-1.52
January 2018	12.53	7.84	11.50	-5.10	10.83	4.84	11.45	1.24

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	4045	125410	61.7	0	0
3	2098	65037	32	0	0
4	13	403	0.2	35	1.7
5	172	5327	2.6	216	10.3
6	18	546	0.3	79	3.8
7	0	8	0	3	0.1
8	25	764	0.4	38	1.8
9	142	4399	2.2	912	43.5
10	44	1379	0.7	767	36.6
11	0	1	0	0	0
12	1	22	0	21	1
13	1	36	0	26	1.2
TOTAL	6559	203332	100	2097	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>
2018-01-01	Monday	13:48:09	10	NB	1	123.35
2018-01-03	Wednesday	13:12:27	10	NB	1	121.47
2018-01-02	Tuesday	12:09:10	10	NB	1	121.19
2018-01-05	Friday	09:10:15	10	NB	1	120.87
2018-01-25	Thursday	14:17:05	10	NB	1	120.37
2018-01-03	Wednesday	15:14:09	10	NB	1	120.11
2018-01-08	Monday	13:00:33	10	NB	1	119.25
2018-01-09	Tuesday	13:05:53	10	NB	1	119.23
2018-01-14	Sunday	12:23:32	10	NB	1	119.21
2018-01-17	Wednesday	08:23:33	10	NB	1	118.95

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	216	32	14.8	5805	419	1522
5	NB	8	2988	132	4.4	47168	966	12160
6	NB	19	246	9	3.7	9242	142	2369
7	NB	11.5	2	0	0	128	0	52
8	NB	31	388	141	36.3	10340	2691	1342
9	NB	33	2095	193	9.2	113563	5910	25398
10	NB	33.5	580	61	10.5	30435	1869	6524
12	NB	36.5	1	0	0	89	0	26
13	NB	31.5	17	0	0	1722	0	593
TOTAL	****	****	6533	568	****	218490	****	49987
<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	179	46	25.7	4703	599	1354
5	SB	8	2240	314	14	30610	2245	7601
6	SB	19	290	3	1	10117	57	2332
7	SB	11.5	6	0	0	306	0	118
8	SB	31	362	227	62.7	4947	4930	381
9	SB	33	2222	503	22.6	108670	14511	25971
10	SB	33.5	773	21	2.7	67058	589	20933
11	SB	36.5	1	1	100	0	22	0
12	SB	36.5	21	0	0	1970	0	602
13	SB	31.5	18	0	0	1739	0	586
TOTAL	****	****	6112	1115	****	230120	****	59879
GRAND TOTAL	****	****	12645	1683	308	448610	34949	109866

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>
2	236224	35471	25208	211346	508250	36.2
3	190046	27825	19963	173632	411466	29.3
4	5580	643	120	5182	11526	0.8
5	44108	4025	1631	31224	80988	5.8
6	8857	528	116	10057	19557	1.4
7	128	0	0	306	433	0
8	12244	787	288	9588	22908	1.6
9	113179	6294	2592	120589	242654	17.3
10	30458	1845	1842	65805	99951	7.1
11	0	0	0	22	22	0
12	89	0	0	1970	2058	0.1
13	1599	122	0	1739	3461	0.2
TOTAL	642512	77541	51760	631461	1403275	100
GVW/LANE	45.79	5.53	3.69	45	100	0.01

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>
2	36	5	3	23	66	0.57	0.0011
3	86	10	6	58	160	1.39	0.0051
4	121	8	2	99	230	2	1.17
5	893	109	37	456	1495	12.98	0.57
6	241	10	1	214	465	4.04	1.74
7	3	0	0	7	10	0.08	1.75
8	247	13	2	98	360	3.12	0.96
9	2786	109	34	2670	5599	48.61	2.6
10	726	32	68	2093	2919	25.34	4.31
11	0	0	0	0	0	0	0.92
12	5	0	0	80	85	0.74	5.36
13	66	2	0	64	131	1.14	5.76
TOTAL	5210	297	153	5860	11520	100	25
ESALS/LANE	45.2	2.6	1.3	50.9	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>
Feb 2017	137158	6234	413	125601	91.6	11556.7	8.4	82.4	17.6
Mar 2017	200186	6673	500	184674	92.3	15512.4	7.7	83.6	16.4
Jun 2017	303289	10110	767	280277	92.4	23012.5	7.6	76.9	23.1
Jul 2017	351544	11340	754	328181	93.4	23363.1	6.6	75.3	24.7
Aug 2017	350278	11299	800	325471	92.9	24806.8	7.1	75.2	24.8
Oct 2017	79225	7922	171	73909	93.3	5315.5	6.7	91.8	8.2
Nov 2017	214234	7141	488	199588	93.2	14646	6.8	92.7	7.3
Dec 2017	210731	6798	402	198277	94.1	12454.1	5.9	93.2	6.8
Jan 2018	203332	6559	416	190447	93.7	12885.2	6.3	94.4	5.6
TOTAL	2049977	--	--	1906425	--	143552	--	--	--
AVERA GE	227775	8231	523	211825	93	15950	7	85	15

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>
Feb 2017	3520	421	249	5231	9422	93	7	85.4
Mar 2017	3848	426	294	6820	11388	94	6	66.6
Jun 2017	5791	1165	571	5331	12860	86	14	18.6
Jul 2017	5657	1255	367	5539	12818	87	13	20.6
Aug 2017	6093	1231	310	5649	13284	88	12	24.6
Oct 2017	2404	157	213	1939	4714	92	8	40.8
Nov 2017	6711	379	332	6211	13634	95	5	53.5
Dec 2017	6031	297	262	4744	11333	95	5	62.1
Jan 2018	5226	297	153	5862	11538	96	4	70
TOTAL	45281	5630	2752	47328	100991	--	--	--
AVERAGE	5031	626	306	5259	11221	92	8	49

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>
Feb 2017	642847	77552	51867	631608	1403875
Mar 2017	345392	44814	45511	387436	823153
Jun 2017	450117	64680	77822	609994	1202612
Jul 2017	668090	130691	158883	817641	1775306
Aug 2017	718725	157727	191477	889237	1957166
Oct 2017	735483	162845	184034	862884	1945246
Nov 2017	246018	34262	43177	241343	564799
Dec 2017	698717	96530	89621	663298	1548165
Jan 2018	675664	81599	69056	602852	1429172
TOTAL	5181053	850700	911448	5706293	12649494
AVERAGE	575673	94522	101272	634033	1405499

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>
Feb 2017	1754	1.6	18.9	842	448
Mar 2017	2106	1.2	15.8	914	463
Jun 2017	2304	0.9	11.6	613	205
Jul 2017	2347	0.8	11.7	723	221
Aug 2017	2449	0.8	11.7	820	268
Oct 2017	998	1.3	18.8	392	110
Nov 2017	2780	1.3	19	1289	398
Dec 2017	2132	1	17.2	1074	320
Jan 2018	2101	1.1	16.5	1071	390
TOTAL	18971	--	--	7738	2823
AVERAGE	2107.9	1.1	15.7	859.8	313.7

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>
Feb 2017	32819	46088	78906	41.6	58.4
Mar 2017	39723	66250	105973	37.5	62.5
Jun 2017	64202	60259	124461	51.6	48.4
Jul 2017	63358	60634	123992	51.1	48.9
Aug 2017	67447	59958	127406	52.9	47.1
Oct 2017	25289	21734	47024	53.8	46.2
Nov 2017	65328	66591	131919	49.5	50.5
Dec 2017	55298	50890	106189	52.1	47.9
Jan 2018	49987	59879	109866	45.5	54.5
TOTAL	463451	492284	955735	--	--
AVERAGE	51494.6	54698.2	106192.8	48.4	51.6