

FEBRUARY 2019



05/18/2010

**WIM #26
I-35, MP 30.1
OWATONNA, MN**

**MONTHLY
REPORT**



06/28/2010

Your Destination...Our Priority



WIM Site Location

WIM #26 is located on I-35 near Owatonna in Steele county.

System Operation

WIM #26 was operational for the entire month of February 2019. Volume was computed using all monthly data.

System Calibration

WIM #26 was most recently calibrated on 2018-11-09. 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: 416210 | Passenger Vehicles: 316874 | Heavy Commercial Vehicles: 99336

Monthly Average Daily Traffic (MADT): 14865 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 3548

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 Fridays, 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 02 PM and 04 PM. Similarly, SB PVs peaked in volume between 02 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 02 PM and 04 PM, while volume going SB peaked between 02 PM and 04 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 99336 HCVs, 19482 of them were overweight ³. These overweight HCVs contributed to 5.3% of total monthly volume, and 22.1% of total monthly

HCV volume. NB overweight vehicles typically reached highest numbers on Wednesdays, with lowest volumes reported on Saturdays. SB overweight vehicles tended to reach highest volumes on Wednesdays, with lowest volumes reported on Saturdays. See Figure 3

The top two overweight violators by class were the class 9 and class 11 vehicles. Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 88.1% of all overweight vehicles traveling NB 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 January.

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, 4153 NB vehicles exceeded 88,000 pounds (3730 vehicles were Class 9's; 222 vehicles were Class 10's). Of vehicles traveling SB,

119 NB vehicles exceeded 88,000 pounds (48 vehicles were Class 13's; 39 vehicles were Class 9's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from February 2019.

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

Freight Totals. A total of 1075289 tons of freight was recorded to have crossed the WIM. More freight was shipped NB (72.2%) than SB (27.8%). See Table 4 and Figure 11 for more freight information.

Infrastructure Considerations

Bridge. Bridge No. 91086 (a box culvert) is approximately 0.5 miles north of WIM #26, and Bridge No. 91095 (also a box culvert) is 6.9 miles south of WIM #26. WIM #26 recorded a total of 416210 vehicles with a combined GVW of 6179098 kips (1 kip = 1,000 pounds = 0.5 tons) in February 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 106321 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 77.2% of all ESALs were recorded NB while 22.8% was observed SB. In particular, 83% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 65% 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).

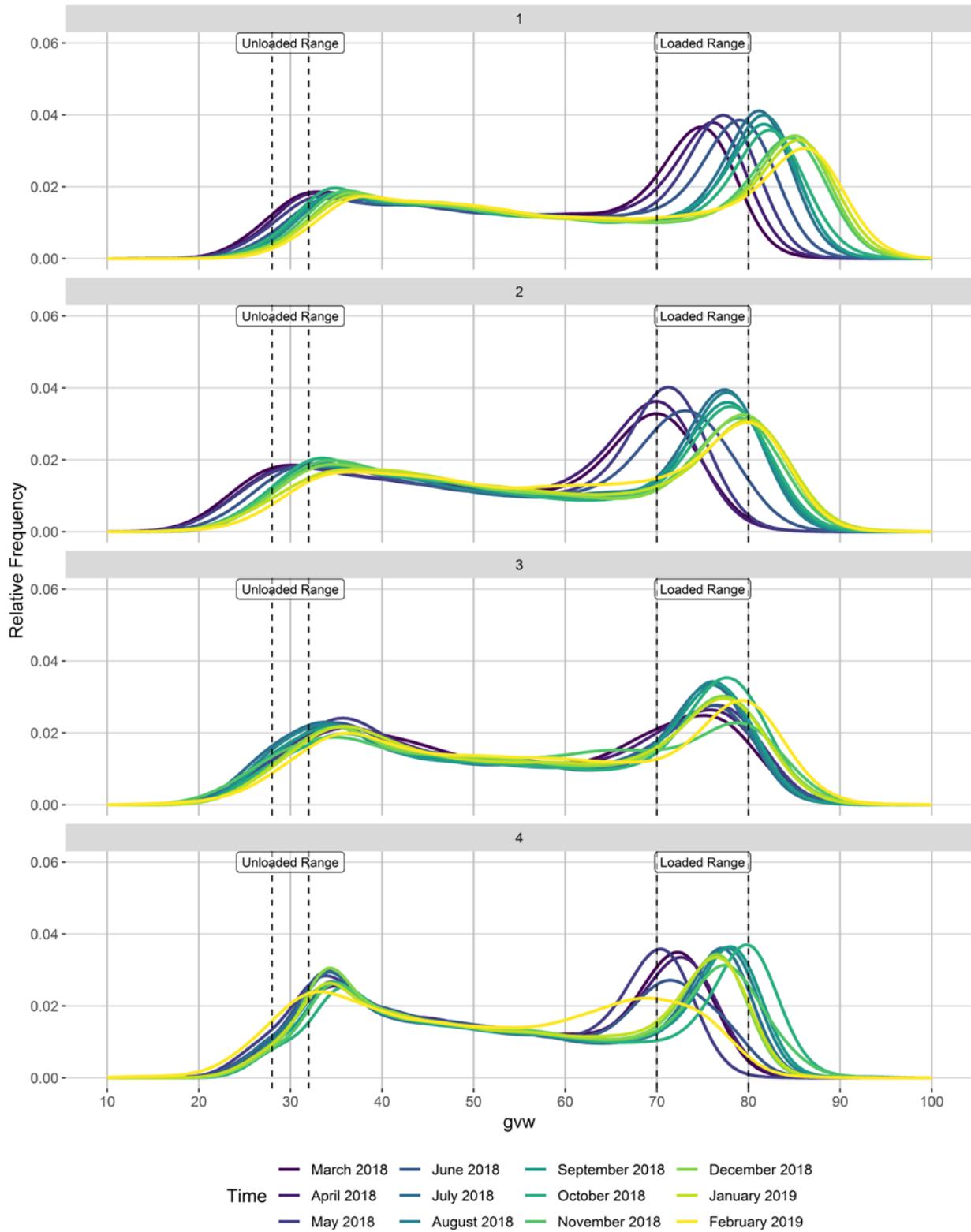
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

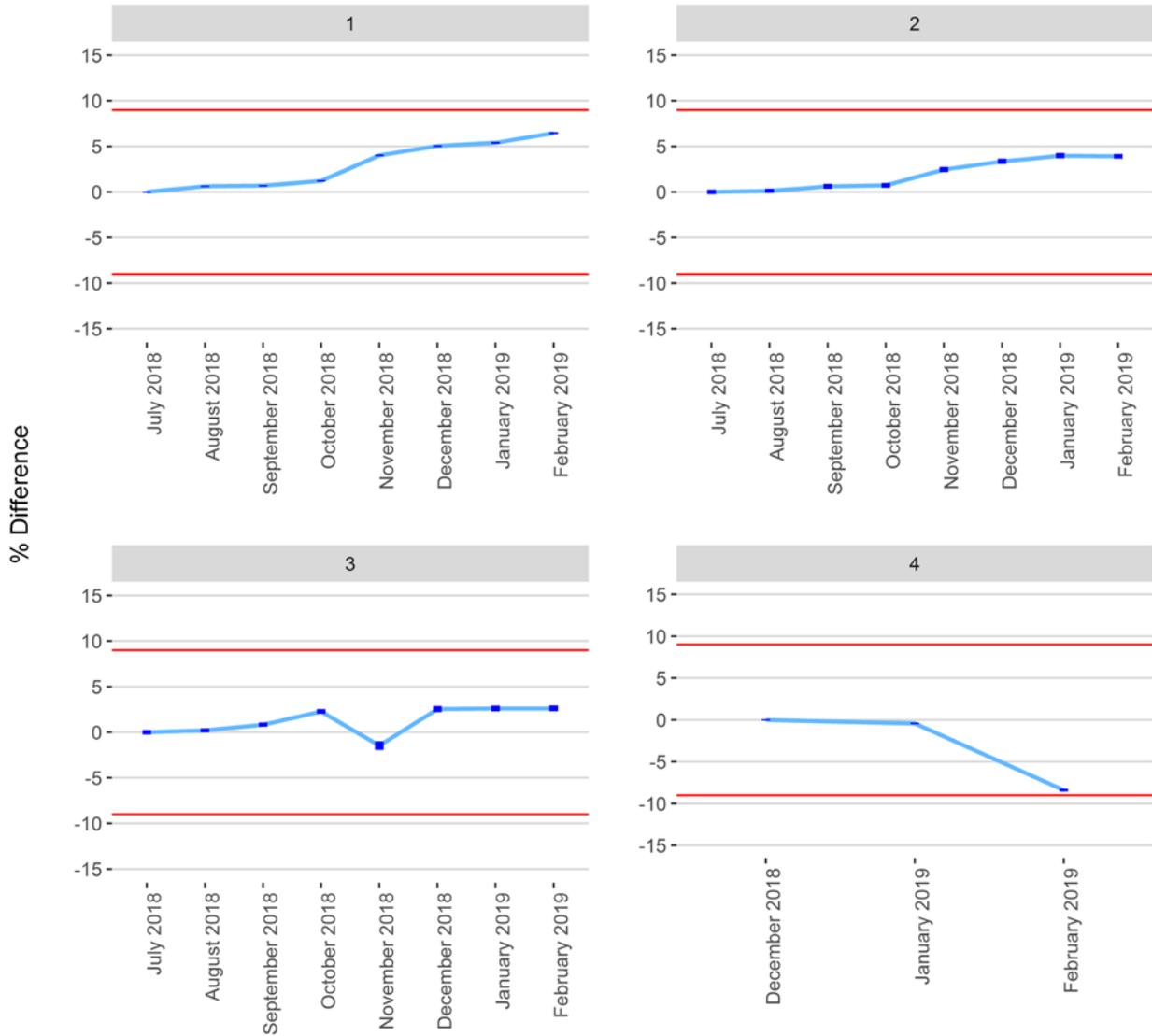
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

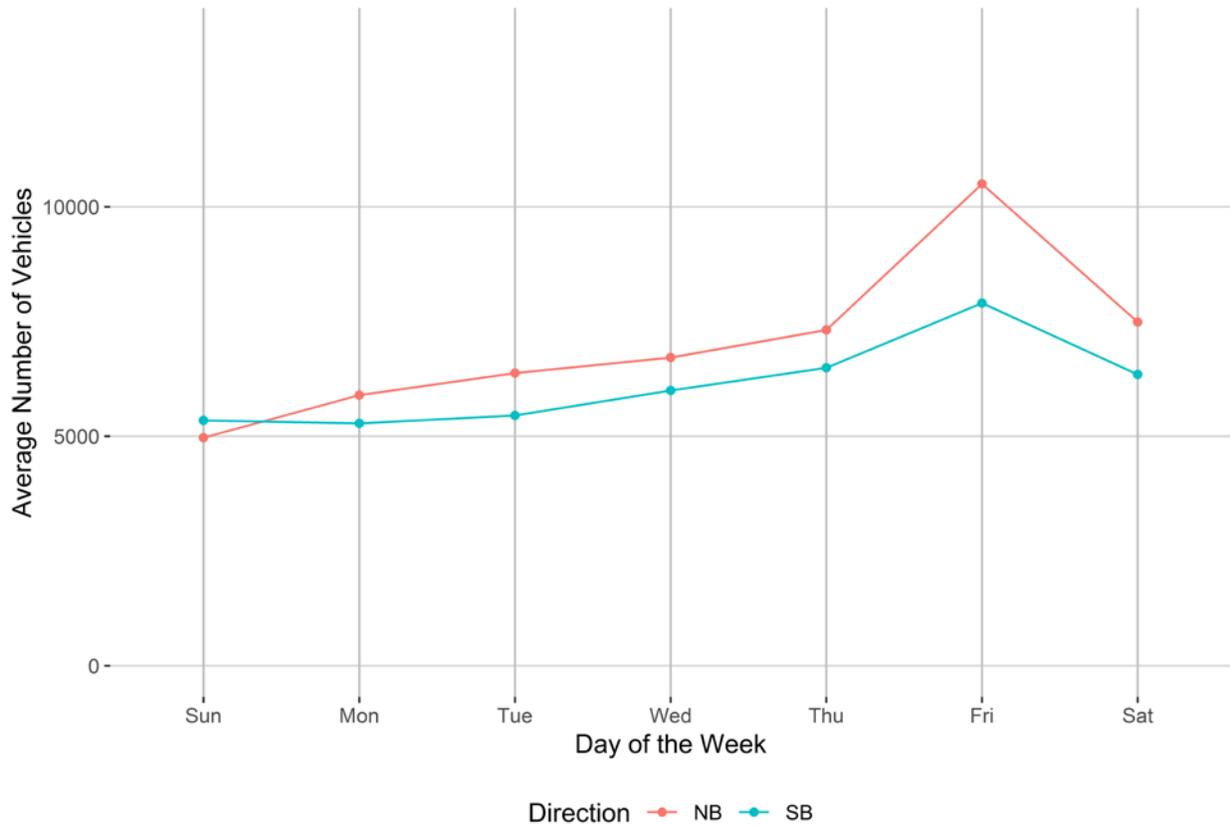


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

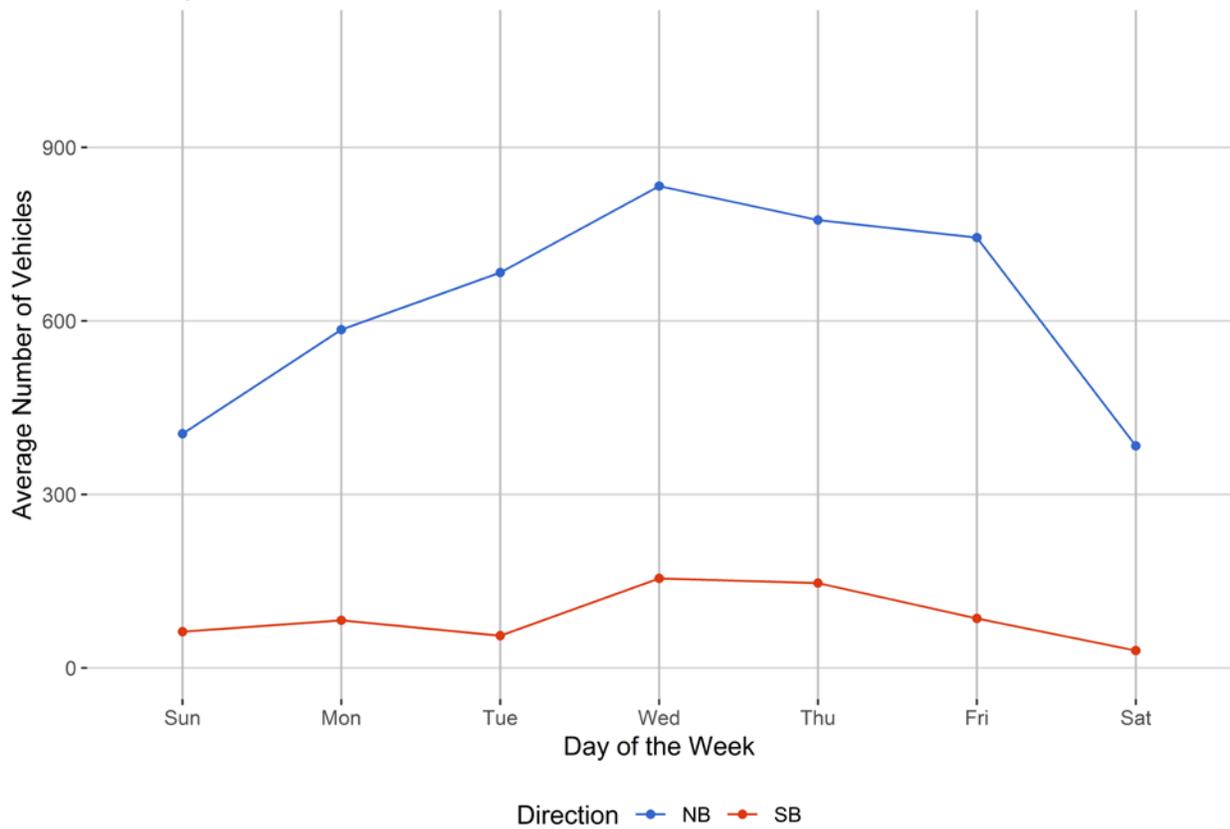


Figure 4 - Passenger Vehicles vs. Hour of the Day

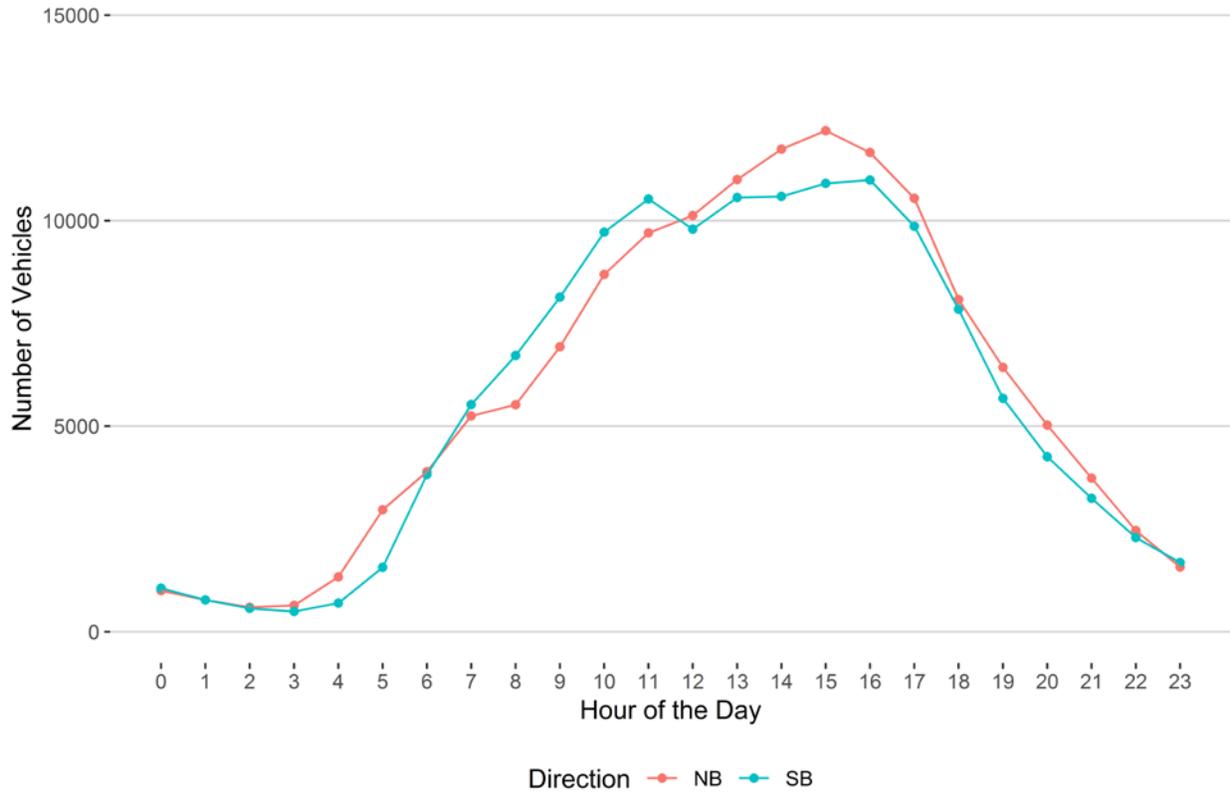


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

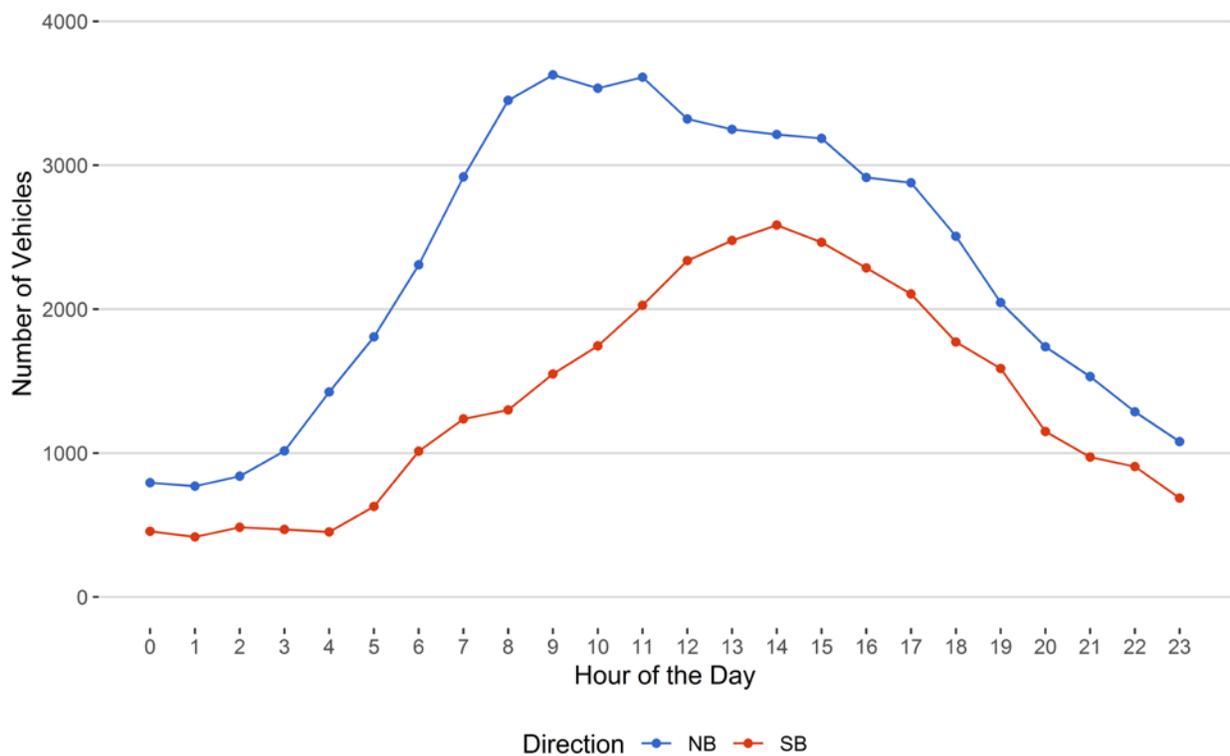


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

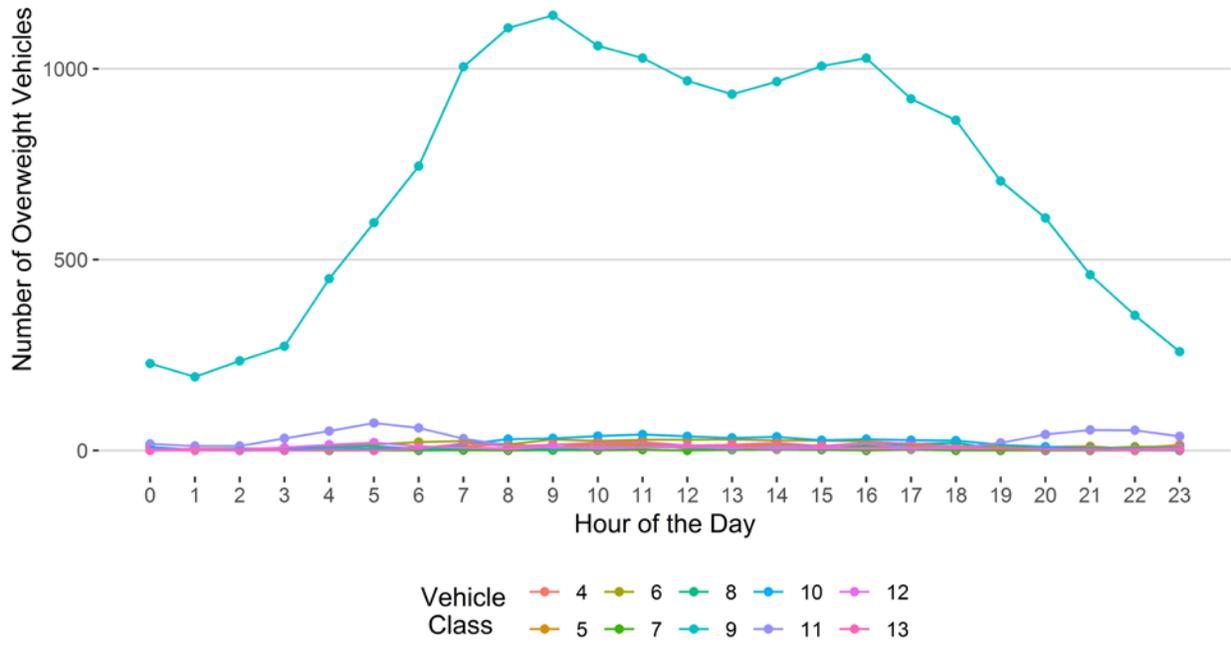


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

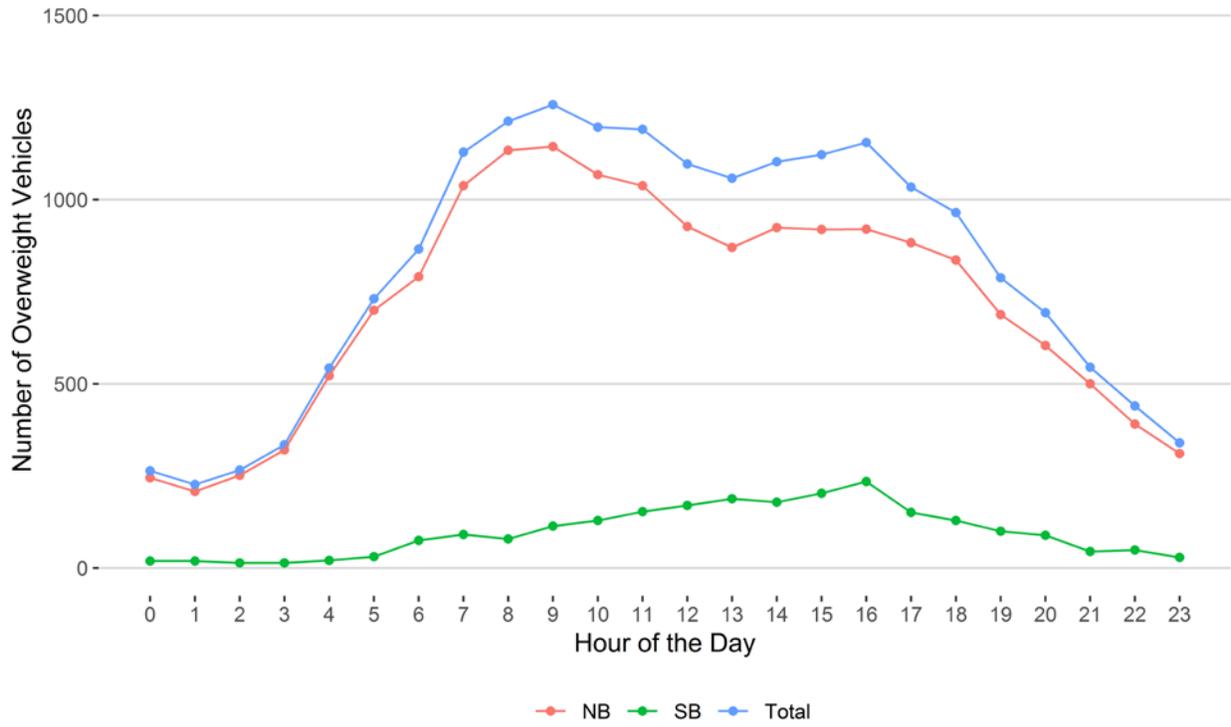
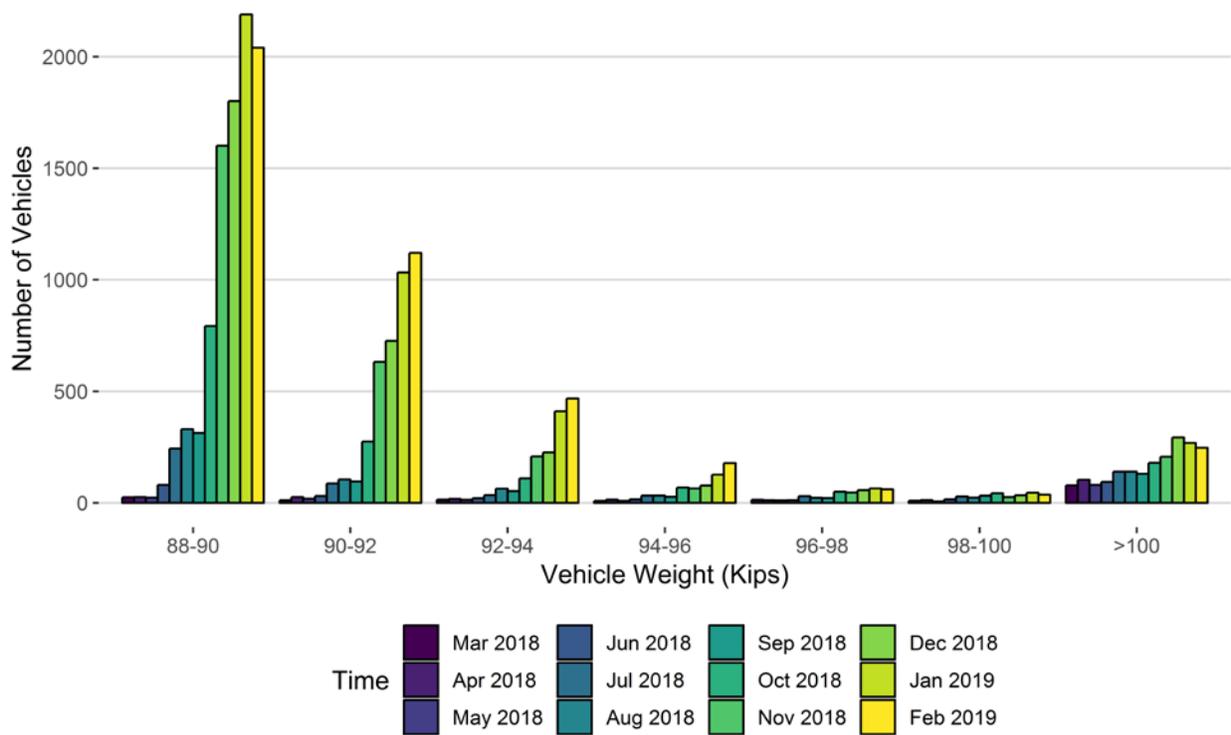
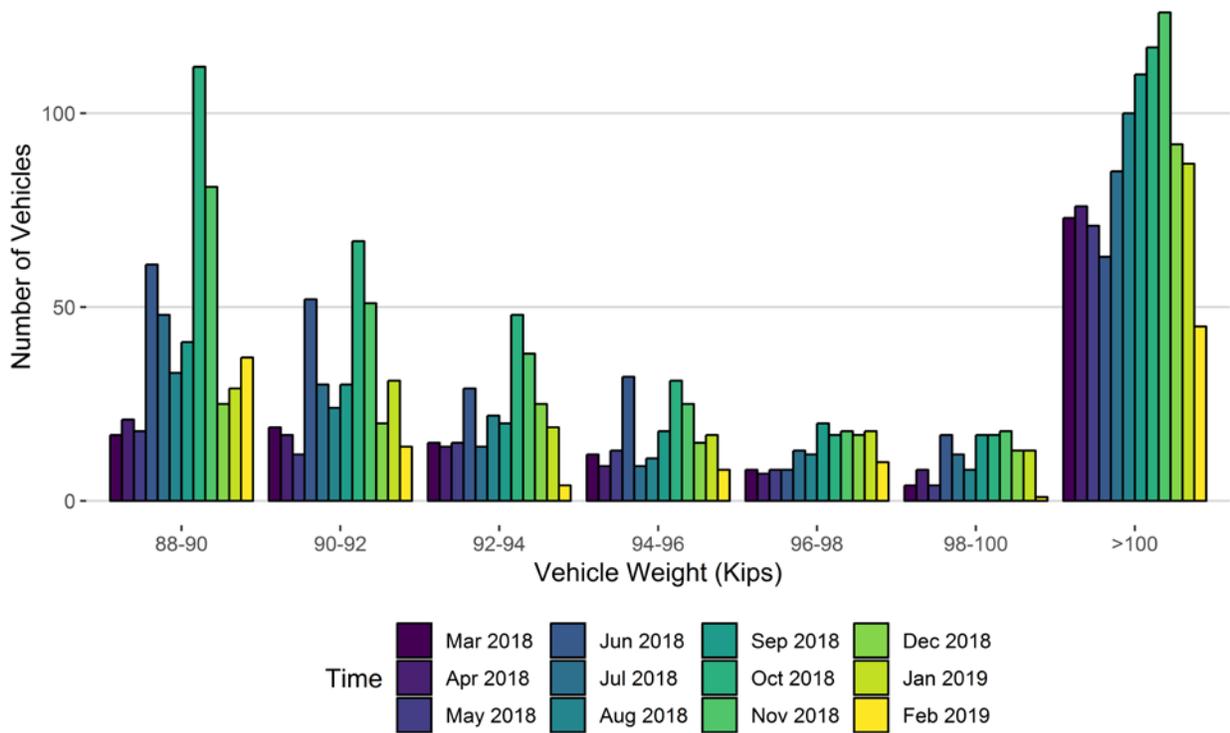


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019
88-90	25	26	24	81	244	331	313	793	1601	1801	2189	2040
90-92	12	26	19	31	87	105	96	275	632	726	1033	1121
92-94	15	18	14	21	35	64	53	110	208	226	411	468
94-96	9	15	9	16	33	33	27	69	65	78	127	178
96-98	14	12	11	12	30	23	22	50	47	57	65	61
98-100	10	13	7	16	29	24	32	43	26	34	46	37
>100	79	104	81	94	140	140	130	180	207	293	269	247
Total	164	214	165	271	598	720	673	1520	2786	3215	4140	4152

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



Vehicle Weights (Kips)	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019
88-90	17	21	18	61	48	33	41	112	81	25	29	37
90-92	19	17	12	52	30	24	30	67	51	20	31	14
92-94	15	14	15	29	14	22	20	48	38	25	19	4
94-96	12	9	13	32	9	11	18	31	25	15	17	8
96-98	8	7	8	8	13	12	20	17	18	17	18	10
98-100	4	8	4	17	12	8	17	17	18	13	13	1
>100	73	76	71	63	85	100	110	117	126	92	87	45
Total	148	152	141	262	211	210	256	409	357	207	214	119

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

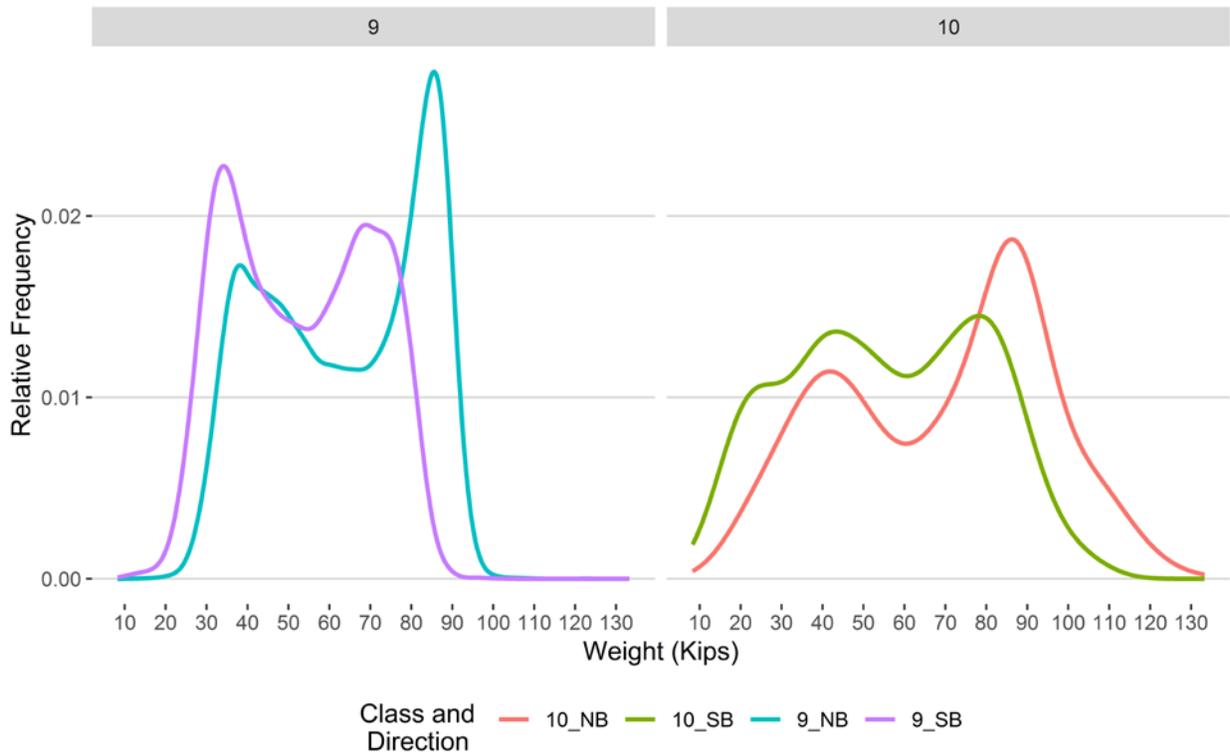


Figure 9 - Freight Percentage by Direction and Class

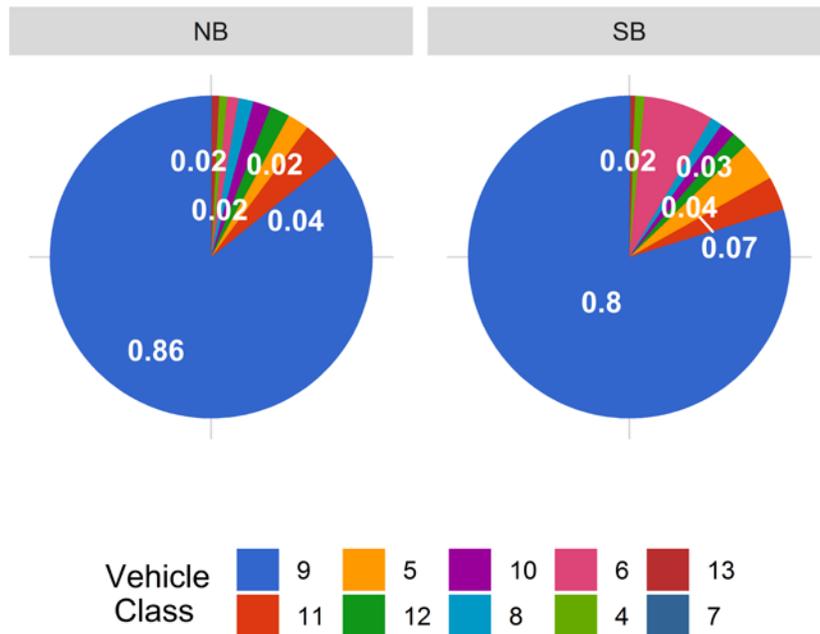


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

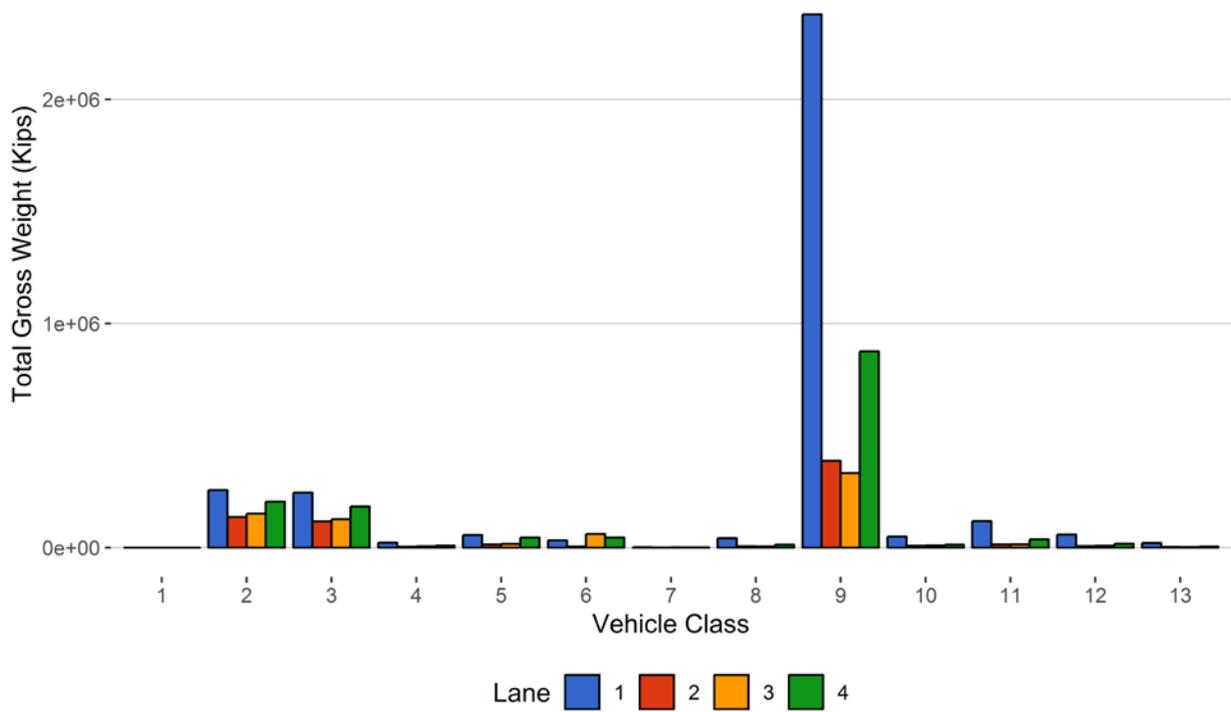


Figure 11 - Total Gross Vehicle Weight t

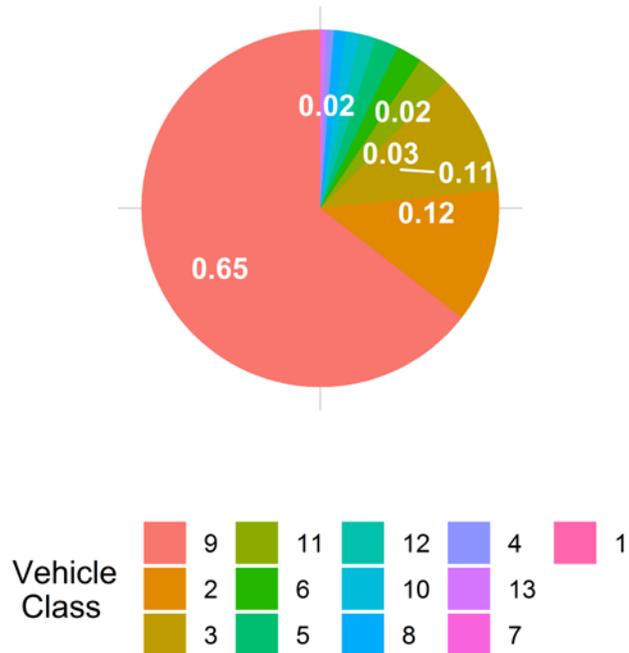


Figure 12 - Total ESALs by Class and Lane

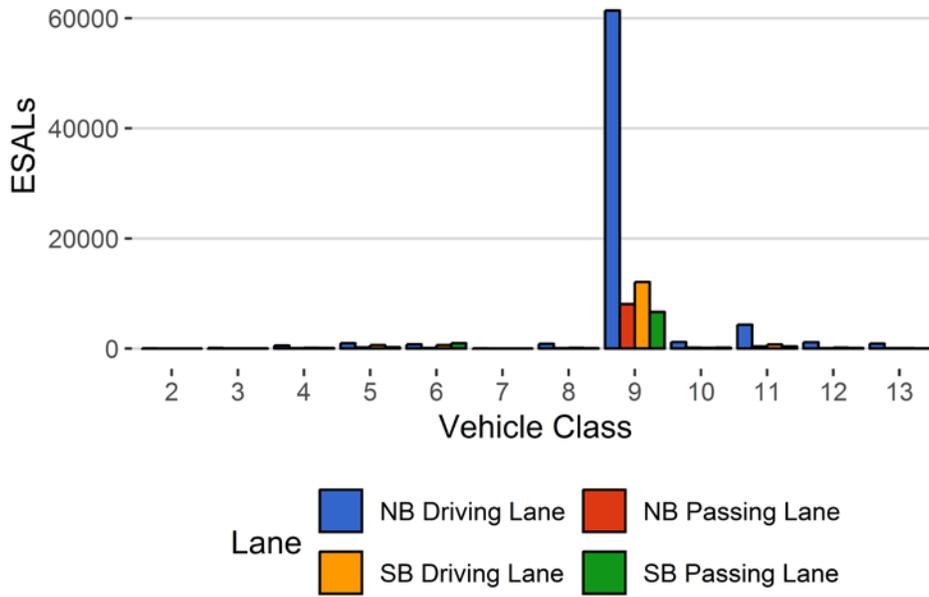


Figure 13 - ESALs by Class

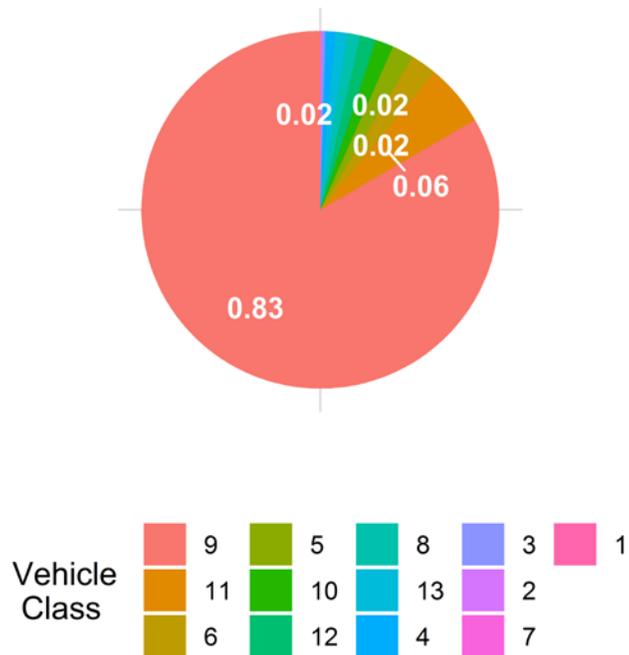


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 3 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 4 (kips)</i>	<i>Front Axle +/- 9%</i>
July 2018	11.67	0.00	11.30	0.00	11.46	0.00	NA	NA
August 2018	11.75	0.62	11.31	0.12	11.49	0.20	NA	NA
September 2018	11.75	0.68	11.37	0.61	11.56	0.83	NA	NA
October 2018	11.82	1.21	11.38	0.71	11.72	2.28	NA	NA
November 2018	12.14	4.01	11.58	2.45	11.30	-1.46	NA	NA
December 2018	12.26	5.04	11.68	3.35	11.75	2.54	11.30	0.00
January 2019	12.30	5.39	11.75	3.97	11.76	2.60	11.25	-0.42
February 2019	12.43	6.46	11.74	3.90	11.76	2.61	10.35	-8.40

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	8	0	0	0
2	7208	201814	48.5	0	0
3	4109	115052	27.6	0	0
4	52	1466	0.4	150	0.8
5	341	9547	2.3	209	1.1
6	187	5222	1.3	395	2
7	4	99	0	15	0.1
8	75	2113	0.5	136	0.7
9	2662	74548	17.9	17137	88
10	49	1375	0.3	461	2.4
11	112	3129	0.8	596	3.1
12	55	1540	0.4	162	0.8
13	11	297	0.1	221	1.1
TOTAL	14865	416210	100	19482	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>
2019-02-11	Monday	00:04:52	10	NB	1	133.28
2019-02-09	Saturday	09:39:10	10	NB	1	127.39
2019-02-14	Thursday	21:46:43	10	NB	1	125.99
2019-02-04	Monday	18:33:29	9	NB	1	122.87
2019-02-03	Sunday	12:49:51	10	NB	1	122.8
2019-02-18	Monday	16:41:04	10	NB	1	122.56
2019-02-08	Friday	08:05:18	10	NB	1	122.54
2019-02-14	Thursday	10:12:52	10	NB	1	121.35
2019-02-26	Tuesday	14:53:28	10	NB	1	120.04
2019-02-10	Sunday	08:30:52	10	NB	1	119.93

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	815	58	7.1	25533	774	7089
5	NB	8	4392	211	4.8	67903	1504	17228
6	NB	19	1202	135	11.2	34148	2394	6937
7	NB	11.5	46	0	0	2213	0	842
8	NB	31	1295	307	23.7	40877	7139	5125
9	NB	33	43442	1744	4	2714285	52564	669126
10	NB	33.5	820	84	10.2	54706	2213	15025
11	NB	36.5	1897	6	0.3	131339	175	31159
12	NB	36.5	954	3	0.3	64773	80	15031
13	NB	31.5	198	0	0	23270	0	8516
TOTAL	****	****	55061	2548	****	3159047	****	776077
<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	486	62	12.8	13792	814	3716
5	SB	8	4081	407	10	57933	2876	14270
6	SB	19	3433	404	11.8	98819	6679	20634
7	SB	11.5	42	0	0	2007	0	762
8	SB	31	580	279	48.1	12016	6482	1342
9	SB	33	22721	3448	15.2	1109925	98734	236958
10	SB	33.5	400	83	20.8	20407	1945	4894
11	SB	36.5	880	37	4.2	49812	1142	9521
12	SB	36.5	413	8	1.9	24532	246	4875
13	SB	31.5	66	0	0	6559	0	2240
TOTAL	****	****	33102	4728	****	1395801	****	299212
GRAND TOTAL	****	****	88163	7276	186	4554848	185760	1075289

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	1	7	8	0
2	255911	136327	151187	204739	748164	12.1
3	245374	117117	126534	183269	672293	10.9
4	22112	4194	5793	8814	40913	0.7
5	55547	13861	16219	44590	130216	2.1
6	32218	4323	60477	45021	142040	2.3
7	1766	447	908	1098	4220	0.1
8	41748	6268	5518	12980	66514	1.1
9	2379994	386855	332627	876033	3975509	64.5
10	48766	8153	9727	12625	79271	1.3
11	118163	13351	14483	36471	182468	3
12	58241	6612	7751	17026	89631	1.5
13	20400	2870	2164	4394	29829	0.5
TOTAL	3280239	700379	733390	1447067	6161074	100
GVW/LANE	53.24	11.37	11.9	23.49	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	0.125
2	37	20	21	24	102	0.1	0.0012
3	134	50	52	66	302	0.29	0.0059
4	554	77	120	164	916	0.87	1.41
5	996	212	248	630	2087	1.97	0.49
6	787	103	982	647	2519	2.38	1.09
7	39	6	20	15	80	0.08	1.76
8	877	91	85	146	1199	1.13	1.28
9	61383	8066	6638	12119	88206	83.37	2.67
10	1206	178	190	159	1732	1.64	2.83
11	4375	393	408	751	5926	5.6	4.26
12	1164	89	118	177	1548	1.46	2.26
13	919	99	64	100	1182	1.12	8.58
TOTAL	72471	9384	8945	15000	105799	100	27
ESALS/LANE	68.5	8.9	8.5	14.2	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>
Mar 2018	610968	19709	4160	482021	78.9	128946.7	21.1	93.1	6.9
Apr 2018	580205	19340	4325	450468	77.6	129736.9	22.4	91.8	8.2
May 2018	719401	23206	4783	571124	79.4	148276.5	20.6	91.1	8.9
Jun 2018	747544	24918	4473	613365	82.1	134179	17.9	90.9	9.1
Jul 2018	778261	25105	4938	625188	80.3	153073.3	19.7	90	10
Aug 2018	761407	24562	5156	601556	79	159850.7	21	87.3	12.7
Sep 2018	657910	21930	4758	515162	78.3	142748	21.7	89	11
Oct 2018	661987	21354	5213	500370	75.6	161617.4	24.4	89.5	10.5
Nov 2018	597456	20602	4368	466424	78.1	131032	21.9	91.9	8.1
Dec 2018	589786	19025	4062	463876	78.7	125910	21.3	91.5	8.5
Jan 2019	487834	15737	4015	363372	74.5	124461.6	25.5	90.2	9.8
Feb 2019	416210	14865	3548	316874	76.1	99336	23.9	79.5	20.5
TOTAL	7608969	-	-	5969800	-	1639168	-	-	-
AVERA GE	634081	20863	4483	497483	78	136597	22	90	10

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>
Mar 2018	51869	2660	4158	45512	104199	93	7	0.8
Apr 2018	53425	3150	5206	45592	107375	92	8	1.2
May 2018	65022	3953	6376	43927	119277	91	9	0.8
Jun 2018	65146	4085	5477	43627	118334	92	8	1.6
Jul 2018	84400	6449	5875	59420	156145	92	8	3.5
Aug 2018	87730	8168	7986	62288	166172	90	10	4
Sep 2018	78475	5239	7369	58608	149690	92	8	4.4
Oct 2018	90986	6433	8273	76282	181974	92	8	8.5
Nov 2018	82693	5342	3406	58572	150013	94	6	16.2
Dec 2018	81402	4851	4543	49094	139891	93	7	19.3
Jan 2019	86706	5499	5287	42673	140165	92	8	24.5
Feb 2019	72647	9385	9155	15133	106321	83	17	28.9
TOTAL	900501	65214	73110	600729	1639554	-	-	-
AVERAGE	75042	5434	6092	50061	136630	91	9	10

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>
Mar 18	3711268	525438	606268	3615881	8458855
Apr 18	3624977	545528	630879	3546495	8347880
May 18	4186867	740631	818945	3906425	9652869
Jun 18	4025326	788976	859885	3638548	9312736
Jul 18	4721860	908715	910021	4255066	10795661
Aug 18	4778193	996057	1037615	4252269	11064134
Sep 18	4333349	700326	885304	3901307	9820285
Oct 18	4750482	755225	896476	4525612	10927794
Nov 18	4161406	658051	585158	3812142	9216758
Dec 18	4046068	610727	643364	3568946	8869105
Jan 19	4012005	511041	576641	3010193	8109880
Feb 19	3284544	700572	739086	1454897	6179098
TOTAL	49636346	8441287	9189642	43487780	110755054
AVERAGE	4136362	703441	765803	3623982	9229588

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>
Mar 2018	5137	0.9	4.1	314	166
Apr 2018	6713	1.2	5.4	367	201
May 2018	8892	1.3	6.2	310	163
Jun 2018	13748	1.9	10.7	534	191
Jul 2018	25547	3.4	17	823	274
Aug 2018	28197	3.8	17.9	935	276
Sep 2018	26035	4	18.5	932	289
Oct 2018	36341	5.6	22.9	1950	369
Nov 2018	27732	4.7	21.4	3156	384
Dec 2018	23996	4.1	19.3	3432	435
Jan 2019	25015	5.4	21.2	4357	418
Feb 2019	19560	5.3	21.9	4272	330
TOTAL	246913	-	-	21382	3496
AVERAGE	20576.1	3.5	15.5	1781.8	291.3

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>
Mar 2018	650592	625947	1276539	51	49
Apr 2018	658557	636211	1294768	50.9	49.1
May 2018	777383	660394	1437777	54.1	45.9
Jun 2018	752229	604505	1356734	55.4	44.6
Jul 2018	944419	750020	1694439	55.7	44.3
Aug 2018	986853	794470	1781322	55.4	44.6
Sep 2018	864472	740989	1605461	53.8	46.2
Oct 2018	986542	909358	1895900	52	48
Nov 2018	857231	693612	1550843	55.3	44.7
Dec 2018	830135	627727	1457862	56.9	43.1
Jan 2019	875454	561053	1436507	60.9	39.1
Feb 2019	776077	299212	1075289	72.2	27.8
TOTAL	9959944	7903499	17863443	-	-
AVERAGE	829995.4	658624.9	1488620.2	56.1	43.9