

SEPTEMBER 2019



**WIM #39
MN 43, MP 45.2
WINONA, MN**

**MONTHLY
REPORT**



Your Destination...Our Priority



WIM Site Location

WIM #39 is located on MN 43 near Winona in Winona county.

System Operation

WIM #39 was operational for the entire month of September 2019. Volume was computed using all monthly data.

System Calibration

WIM #39 was most recently calibrated on 2019-06-02. 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: 327603 | Passenger Vehicles: 308264 | Heavy Commercial Vehicles: 19339

Monthly Average Daily Traffic (MADT): 11010 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 645

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 03 PM and 05 PM. Similarly, SB PVs peaked in volume between 07 AM 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 07 AM 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 19339 HCVs, 3994 of them were overweight ³. These overweight HCVs contributed to 1.2% of total monthly volume, and 20.9% of total monthly

HCV volume. NB overweight vehicles typically reached highest numbers on Tuesdays, with lowest volumes reported on Sundays. SB overweight vehicles tended to reach highest volumes on Thursdays, 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 63.9% 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 April.

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 ,144 NB vehicles exceeded 88,000 pounds (78 vehicles were Class 9's; 27 vehicles were Class 12's). Of vehicles traveling SB,

69 NB vehicles exceeded 88,000 pounds (38 vehicles were Class 9's; 27 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from September 2019.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in September 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 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 168701 tons of freight was recorded to have crossed the WIM. More freight was shipped NB (55.2%) than SB (44.8%). See Table 4 and Figure 11 for more freight information.

####Infrastructure Considerations Bridge. Bridge No. 5930 is approximately 0.1 miles north of WIM #39, and Bridge No. 5900 is 0.3 miles south of WIM #39. WIM #39 recorded a total of 327603 vehicles with a combined GVW of 2212838 kips (1 kip = 1,000 pounds = 0.5 tons) in September 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 16906 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 57.8% of all ESALs were recorded NB while 42.2% was observed SB. In particular, 70% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 25% 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:

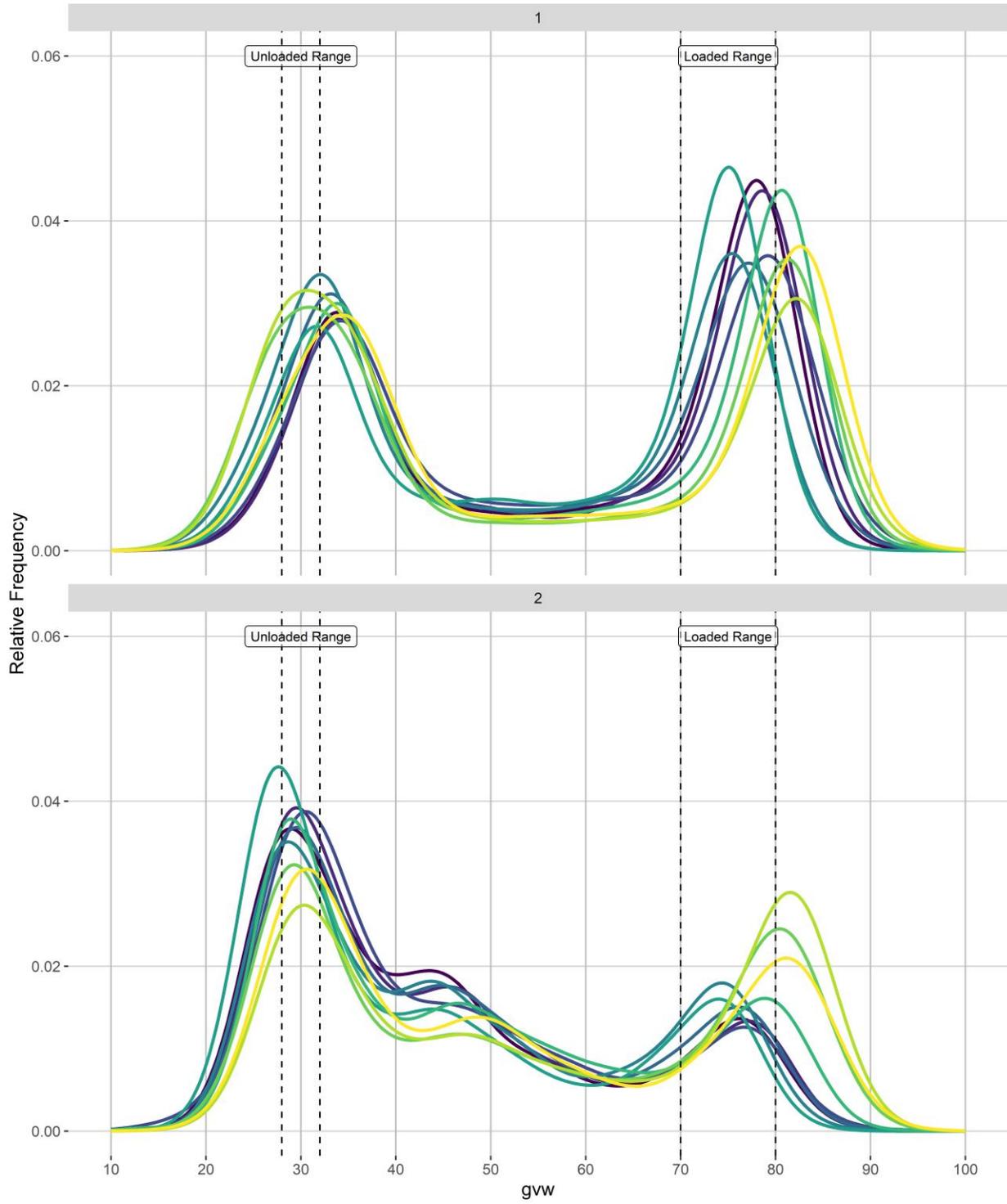
<http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html> MnDOT's vehicle

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

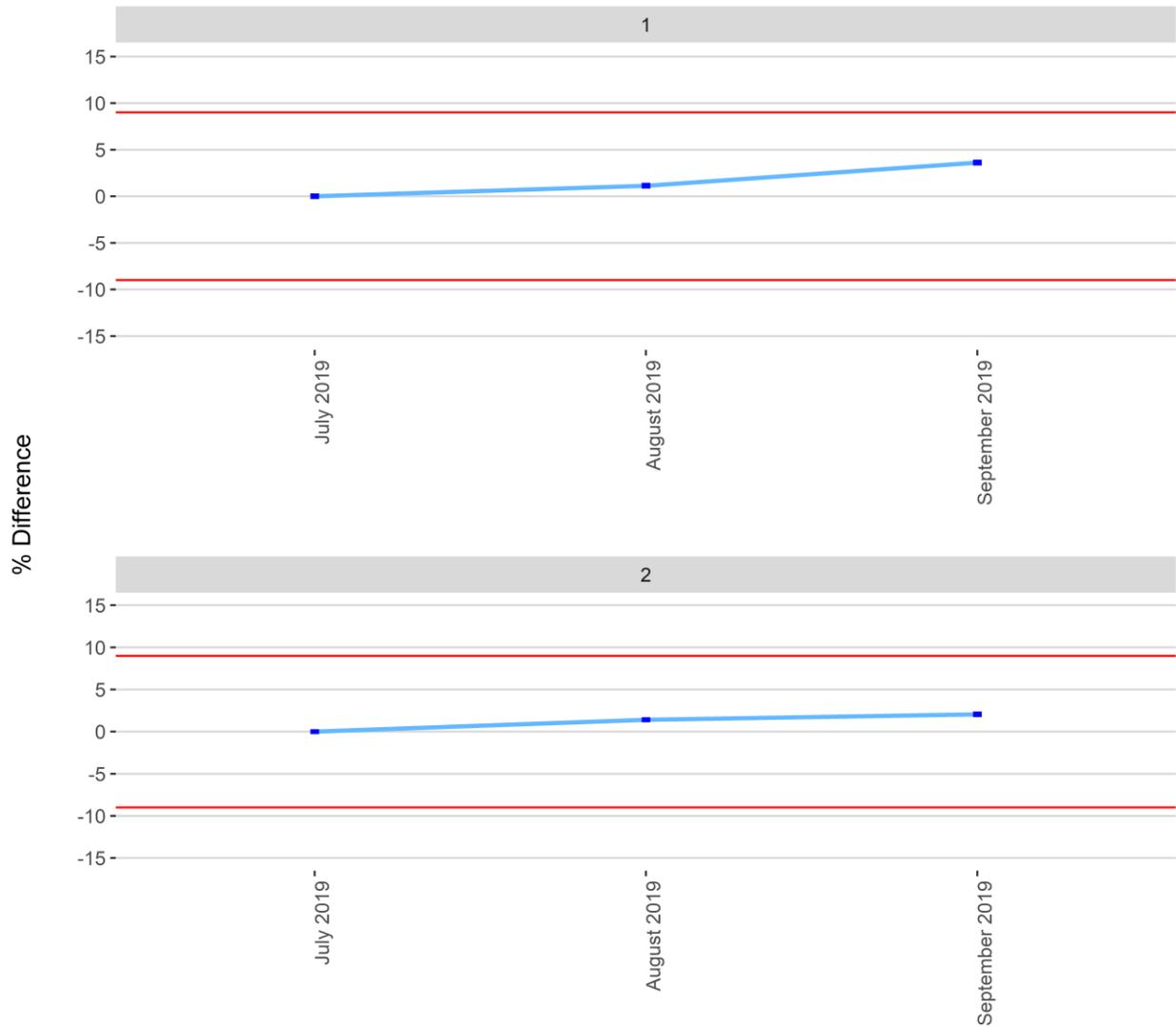


Time

December 2018	February 2019	April 2019	June 2019	August 2019
January 2019	March 2019	May 2019	July 2019	September 2019

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

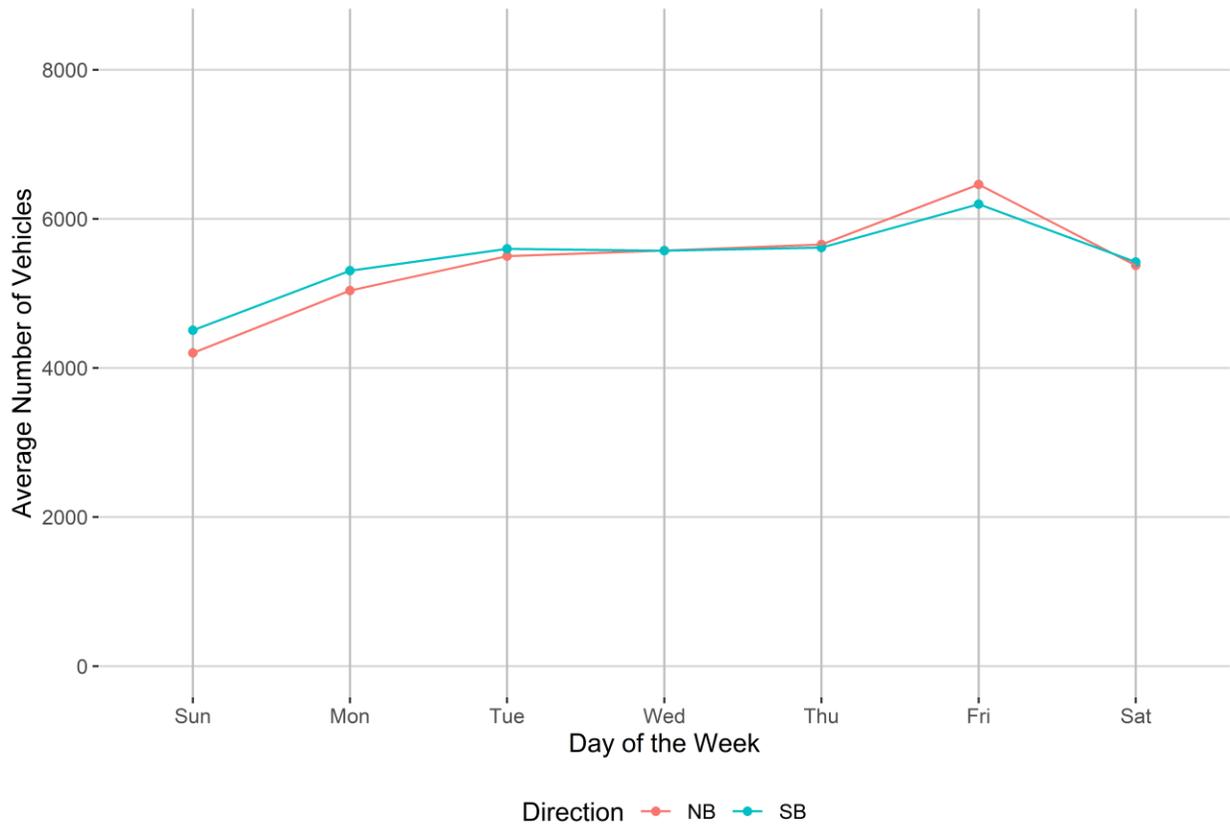


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

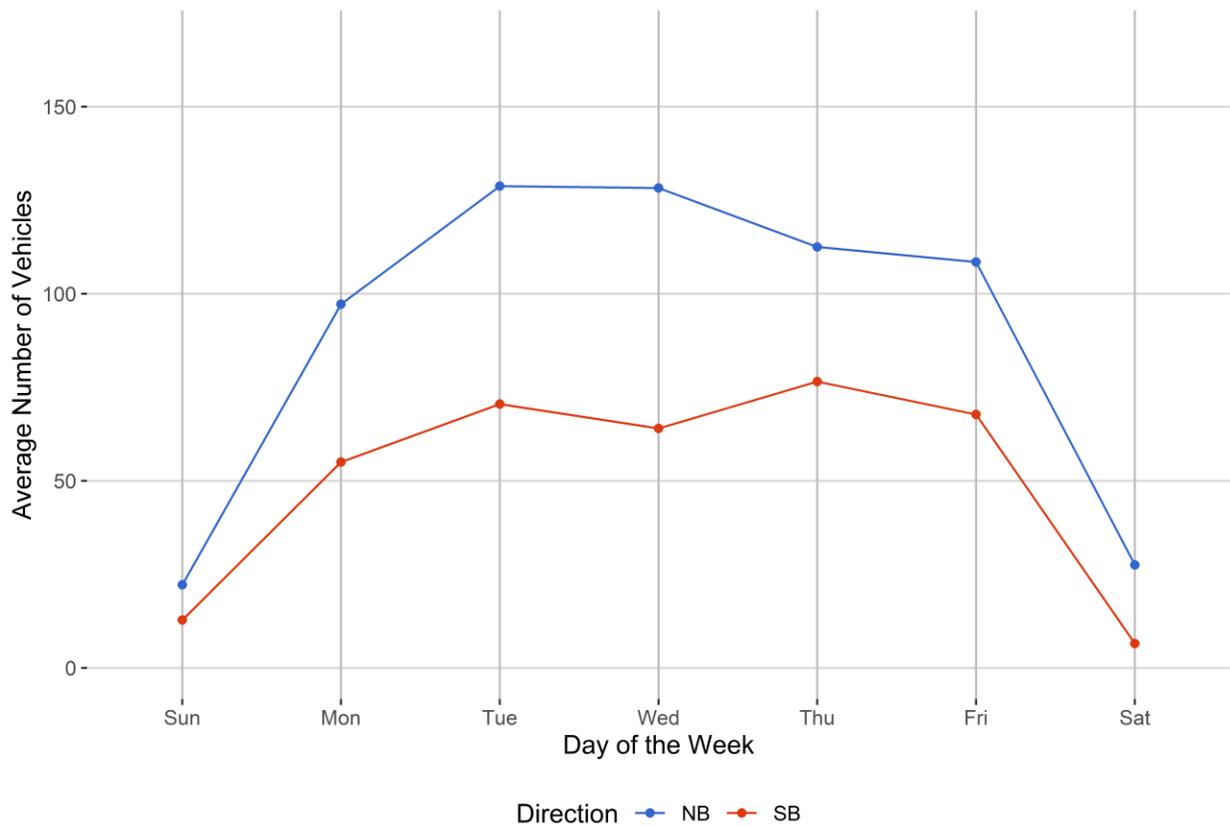


Figure 4 - Passenger Vehicles vs. Hour of the Day

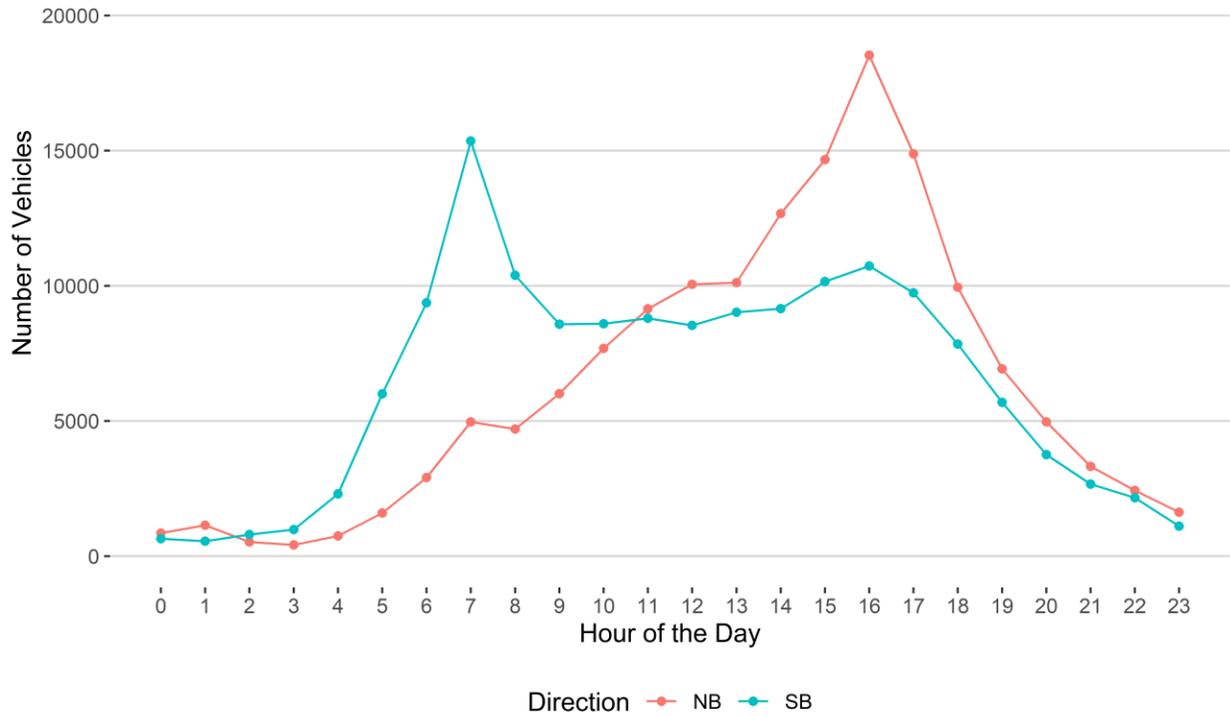


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

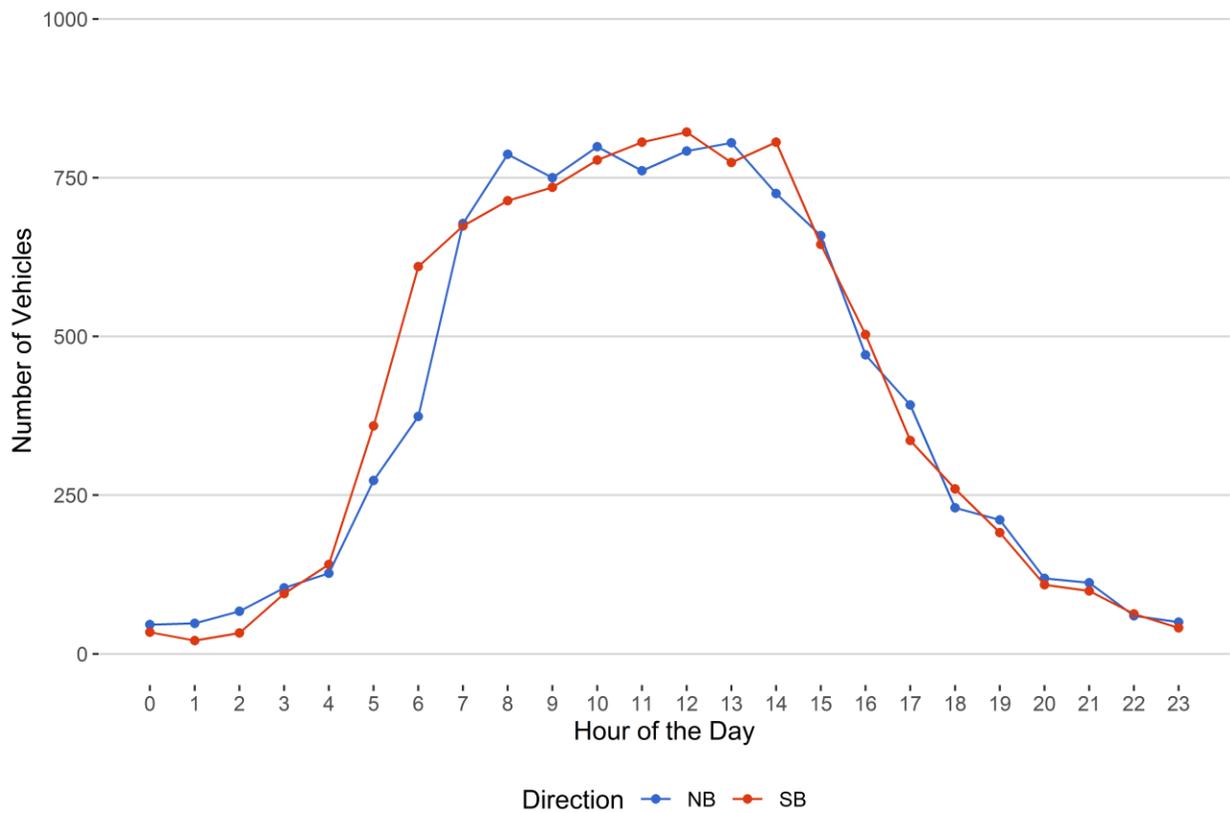


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

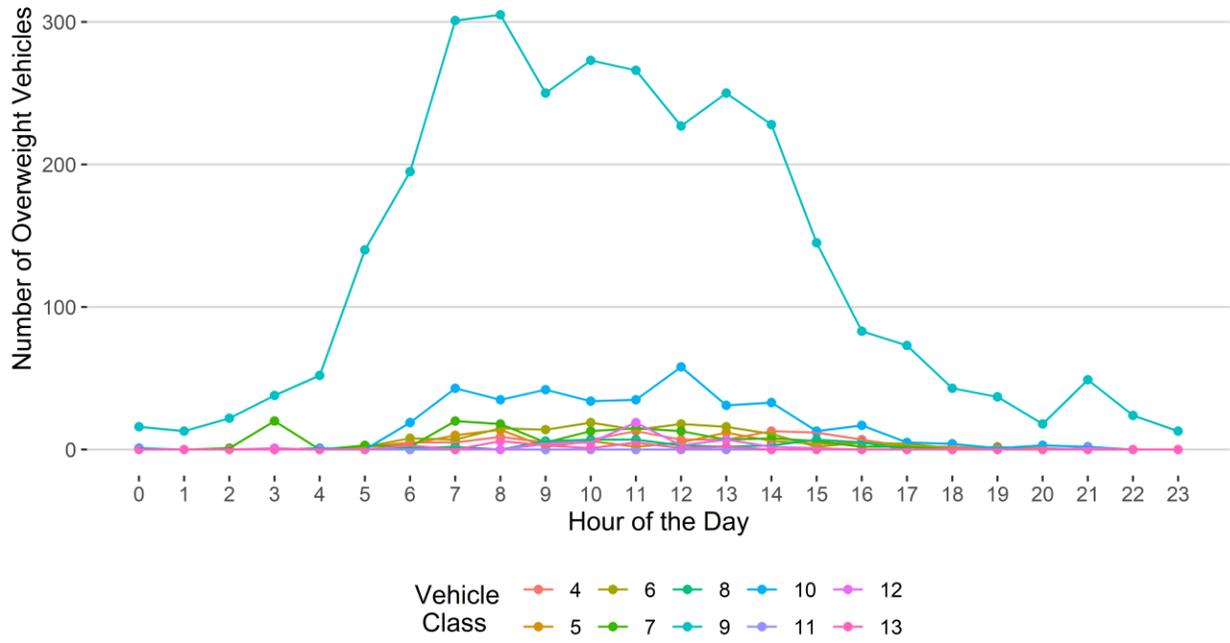


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

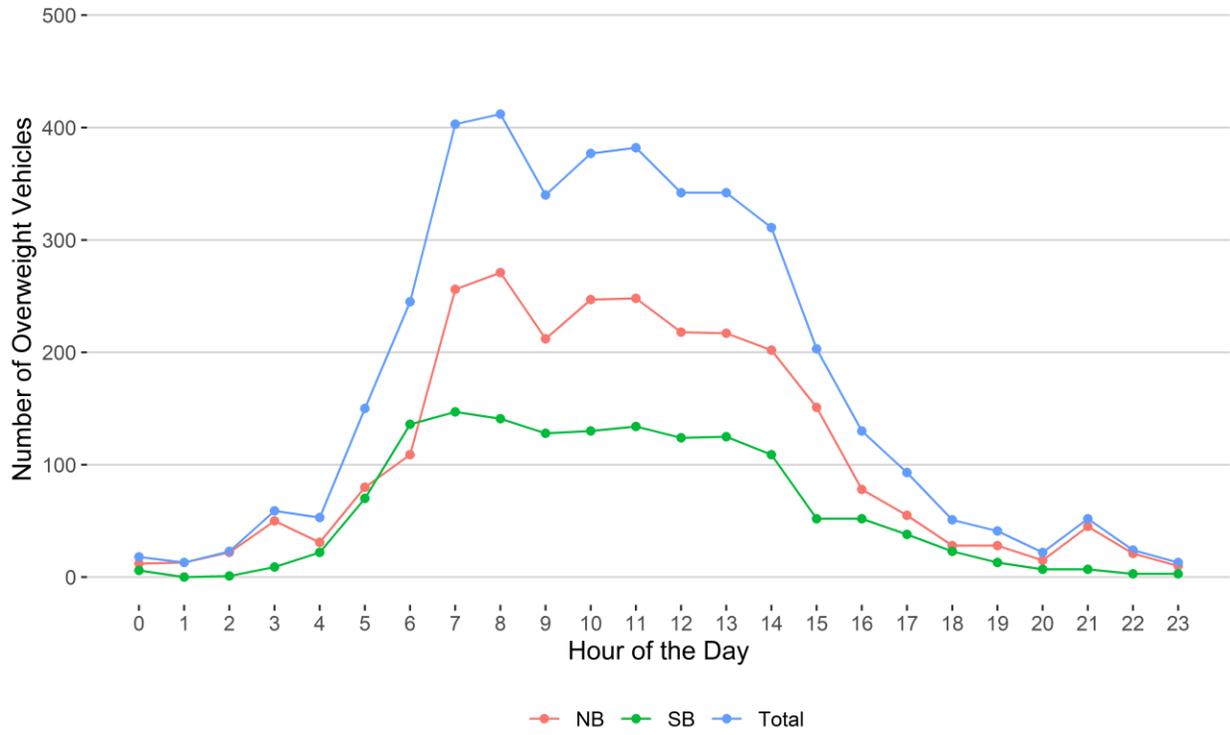
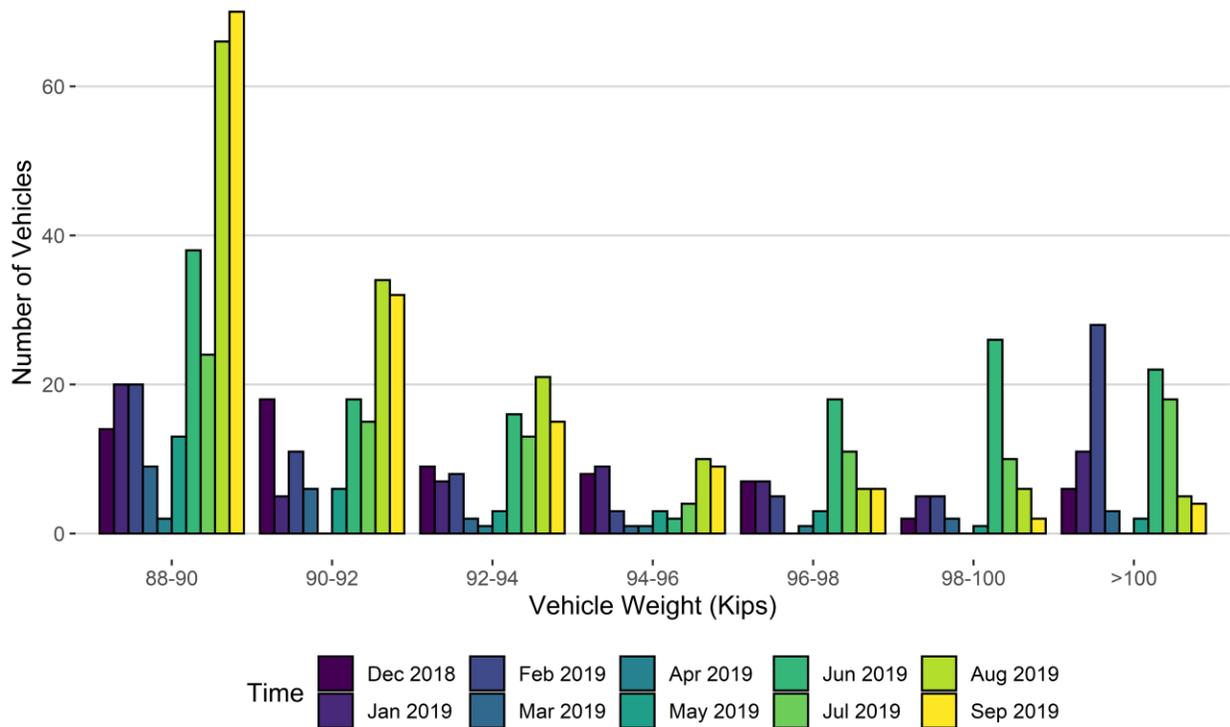
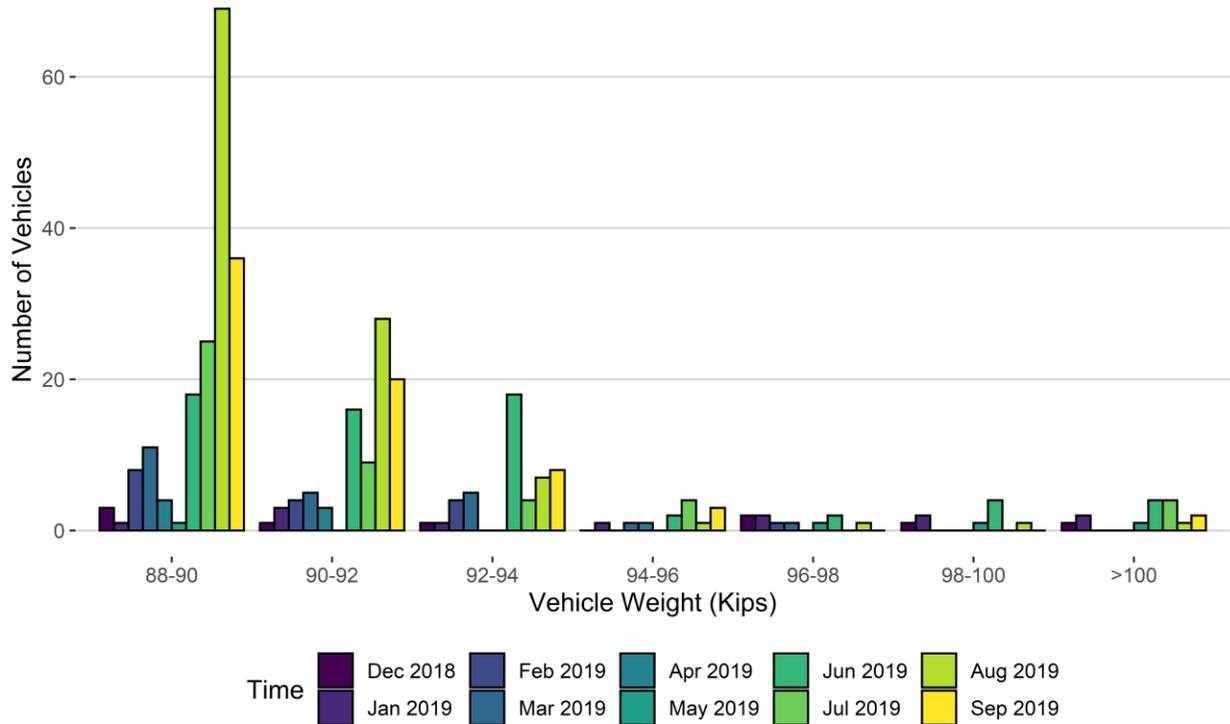


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019	Aug 2019	Sep 2019
88-90	14	20	20	9	2	13	38	24	66	70
90-92	18	5	11	6	0	6	18	15	34	32
92-94	9	7	8	2	1	3	16	13	21	15
94-96	8	9	3	1	1	3	2	4	10	9
96-98	7	7	5	0	1	3	18	11	6	6
98-100	2	5	5	2	0	1	26	10	6	2
>100	6	11	28	3	0	2	22	18	5	4
Total	64	64	80	23	5	31	140	95	148	138

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



Vehicle Weights (Kips)	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019	Aug 2019	Sep 2019
88-90	3	1	8	11	4	1	18	25	69	36
90-92	1	3	4	5	3	0	16	9	28	20
92-94	1	1	4	5	0	0	18	4	7	8
94-96	0	1	0	1	1	0	2	4	1	3
96-98	2	2	1	1	0	1	2	0	1	0
98-100	1	2	0	0	0	1	4	0	1	0
>100	1	2	0	0	0	1	4	4	1	2
Total	9	12	17	23	8	4	64	46	108	69

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

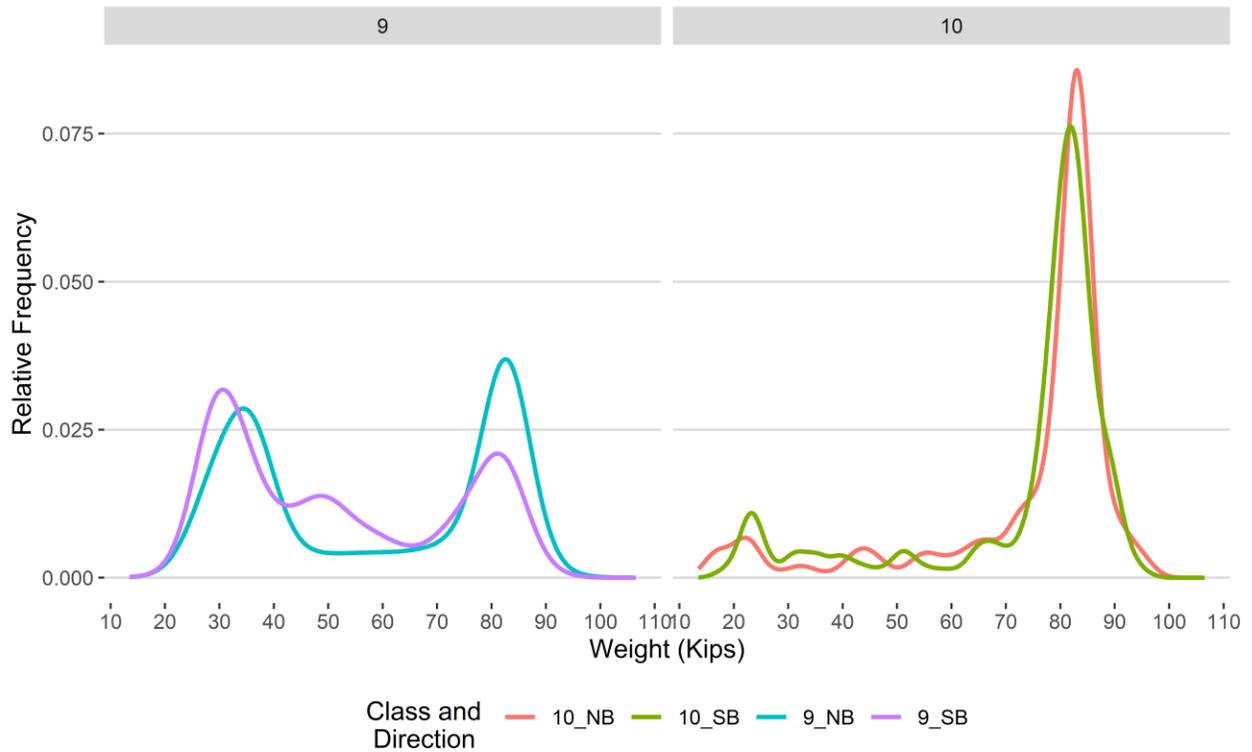


Figure 9 - Freight Percentage by Direction and Class

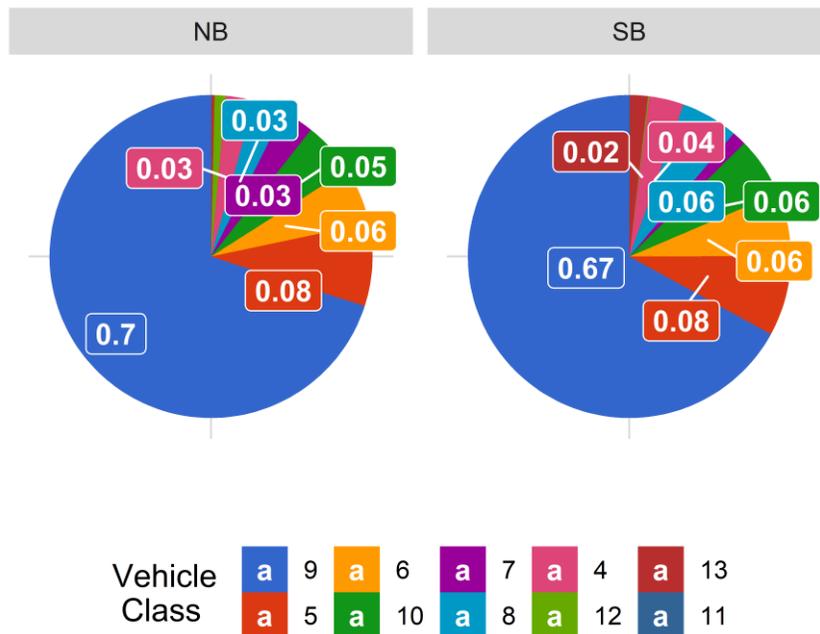


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

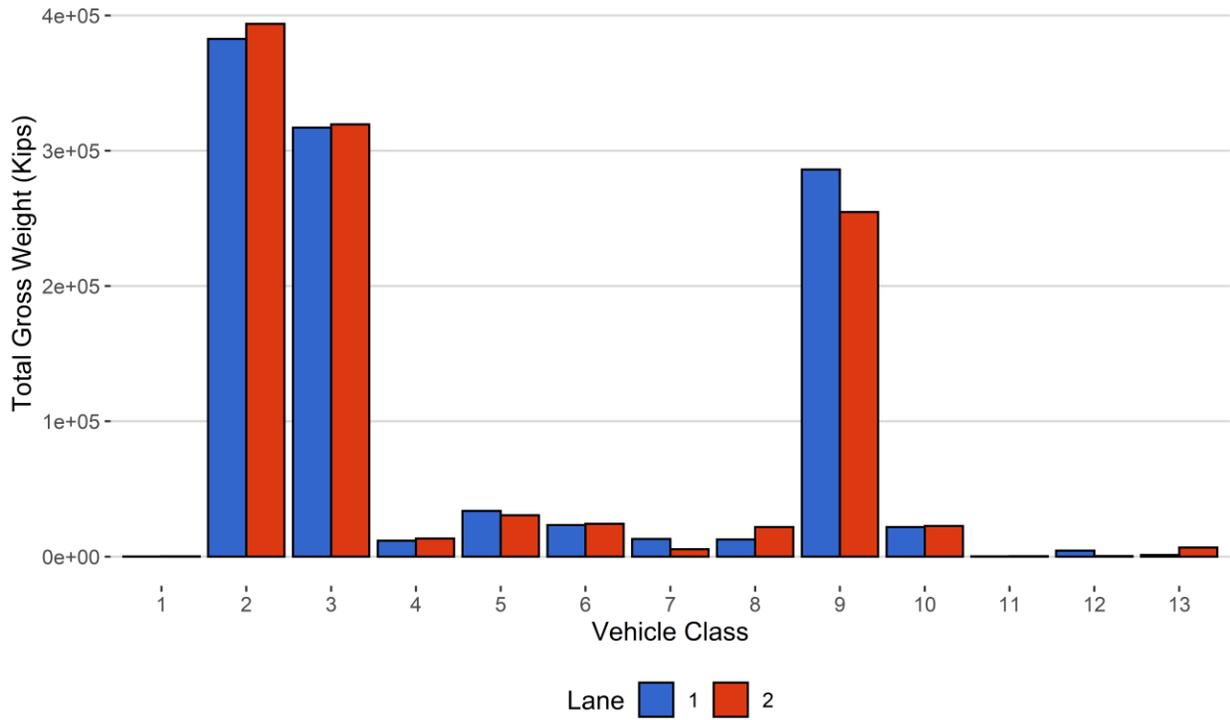


Figure 11 - Total Gross Vehicle Weight t

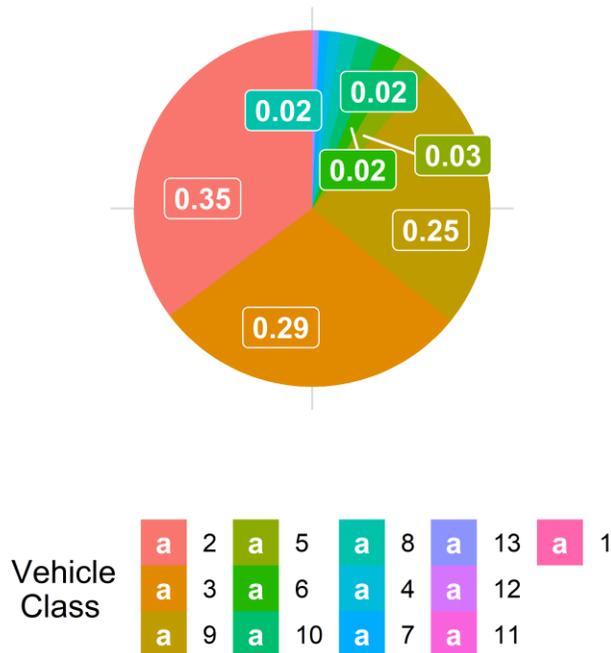


Figure 12 - Total ESALs by Class and Lane

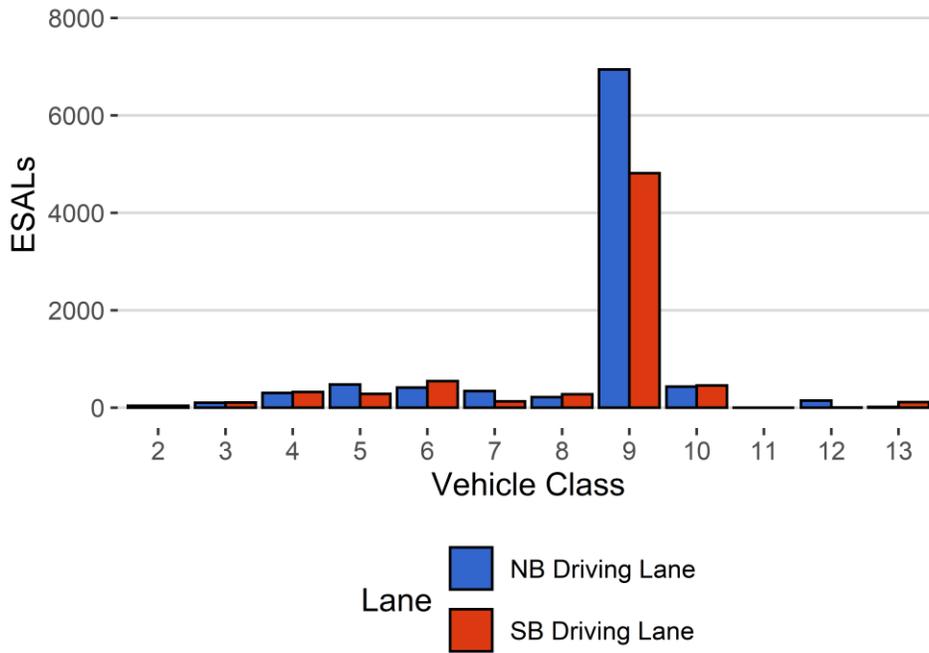


Figure 13 - ESALs by Class

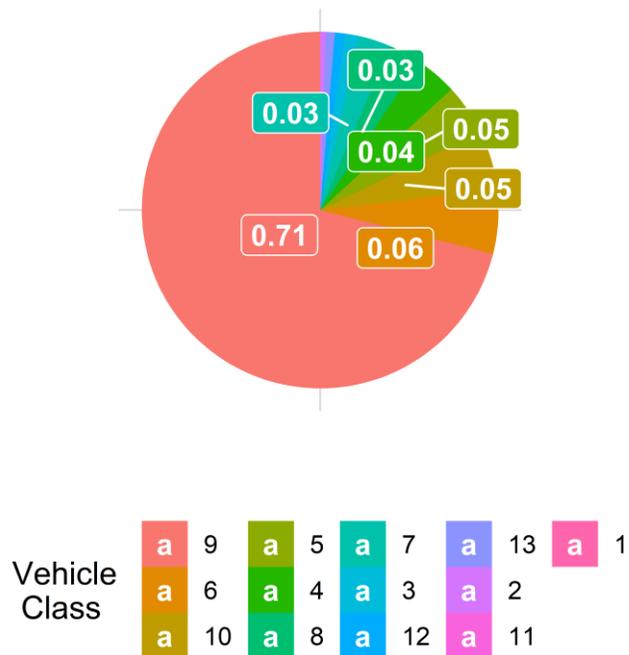


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
July 2019	10.82	0.00	10.95	0.00
August 2019	10.94	1.13	11.10	1.41
September 2019	11.21	3.62	11.17	2.06

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	7	213	0.1	0	0
2	6722	201657	61.6	0	0
3	3546	106395	32.5	0	0
4	27	817	0.2	98	2.5
5	164	4923	1.5	76	1.9
6	52	1551	0.5	136	3.4
7	9	262	0.1	135	3.4
8	35	1057	0.3	44	1.1
9	331	9933	3	3061	76.6
10	20	610	0.2	377	9.4
11	1	16	0	0	0
12	2	63	0	46	1.2
13	4	107	0	21	0.5
TOTAL	10920	327603	100	3994	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>
2019-09-27	Friday	05:10:12	9	NB	1	106.54
2019-09-14	Saturday	13:25:18	9	NB	1	96.94
2019-09-30	Monday	09:41:50	10	NB	1	96.03
2019-09-20	Friday	11:22:59	9	NB	1	95.98
2019-09-26	Thursday	05:03:46	9	NB	1	95.66
2019-09-24	Tuesday	05:03:36	9	NB	1	95.48
2019-09-29	Sunday	17:50:11	10	SB	2	95.38
2019-09-27	Friday	12:27:59	10	NB	1	95.25
2019-09-24	Tuesday	13:18:59	9	SB	2	95.24
2019-09-02	Monday	08:54:38	9	NB	1	95.05

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	373	57	15.3	11063	733	3162
5	NB	8	2477	287	11.6	31716	2076	7098
6	NB	19	763	76	10	22034	1345	4491
7	NB	11.5	176	0	0	13051	0	5513
8	NB	31	385	155	40.3	9416	3265	1143
9	NB	33	4891	847	17.3	261627	24548	64088
10	NB	33.5	294	23	7.8	21330	510	6126
11	NB	36.5	8	6	75	88	129	8
12	NB	36.5	55	2	3.6	4420	46	1243
13	NB	31.5	18	0	0	1221	0	327
TOTAL	****	****	9440	1453	****	375967	****	93197
<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	433	69	15.9	12418	906	3479
5	SB	8	2382	315	13.2	28229	2276	5847
6	SB	19	768	81	10.5	22852	1432	4900
7	SB	11.5	83	0	0	5416	0	2231
8	SB	31	658	276	41.9	15107	6706	1633
9	SB	33	4914	1415	28.8	213540	41153	49037
10	SB	33.5	308	28	9.1	21929	704	6275
11	SB	36.5	8	6	75	112	129	19
12	SB	36.5	7	1	14.3	399	25	90
13	SB	31.5	88	0	0	6761	0	1994
TOTAL	****	****	9649	2191	****	326764	****	75504
GRAND TOTAL	****	****	19089	3644	390	702731	85984	168701

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	115	156	271	0
2	382600	393772	776372	35.3
3	317073	319442	636515	28.9
4	11797	13325	25121	1.1
5	33792	30505	64297	2.9
6	23379	24284	47663	2.2
7	13051	5416	18467	0.8
8	12681	21813	34494	1.6
9	286176	254693	540869	24.6
10	21840	22634	44474	2
11	218	241	458	0
12	4467	424	4890	0.2
13	1221	6761	7982	0.4
TOTAL	1108407	1093466	2201873	100
GVW/LANE	50.34	49.66	100	0

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	0.0047
2	40	42	82	0.5	8e-04
3	105	108	213	1.3	0.0041
4	305	324	628	3.8	1.56
5	478	283	761	4.6	0.31
6	415	549	964	5.8	1.26
7	344	130	474	2.9	3.6
8	216	276	492	3	0.95
9	6942	4814	11756	71	2.4
10	435	457	892	5.4	2.94
11	1	2	3	0	0.62
12	145	6	151	0.9	4.26
13	18	115	133	0.8	2.35
TOTAL	9444	7105	16549	100	20
ESALS/LANE	57.1	42.9	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>
Dec 2018	283227	9136	450	269265	95.1	13962.3	4.9
Jan 2019	265163	8554	466	250711	94.5	14452.3	5.5
Feb 2019	230485	8232	479	217063	94.2	13422.1	5.8
Mar 2019	292495	9435	468	277981	95	14514.1	5
Apr 2019	304912	10164	510	289601	95	15311	5
May 2019	343068	10956	596	324607	94.6	18461.5	5.4
Jun 2019	324777	10826	573	307593	94.7	17184.2	5.3
Jul 2019	348634	11206	732	325932	93.5	22701.9	6.5
Aug 2019	357135	11454	713	335033	93.8	22101.6	6.2
Sep 2019	327603	11010	645	308264	94.1	19338.7	5.9
TOTAL	3077499	-	-	2906050	-	171450	-
AVERAGE	307750	10097	563	290605	94	17145	6

###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>
Dec 2018	6281	3102	9384	0.7
Jan 2019	6958	3377	10335	1.7
Feb 2019	6867	3100	9967	2.7
Mar 2019	5986	3613	9599	1.4
Apr 2019	5142	3547	8689	0.3
May 2019	6985	3777	10762	0.4
Jun 2019	15760	9229	24989	2.2
Jul 2019	10375	8533	18908	2.3
Aug 2019	9916	9751	19667	3.7
Sep 2019	9773	7133	16906	4.9
TOTAL	84044	-	-	-
AVERAGE	8404	5516	13921	2

###Gross Vehicle Weight

<i>Month</i>	<i>GVW NB Driving Lane</i>	<i>GVW SB Driving Lane</i>	<i>Total GVW Kips</i>
Dec 18	897732	839106	1736837
Jan 19	877835	821194	1699029
Feb 19	799415	718048	1517463
Mar 19	909278	879764	1789041
Apr 19	910165	897884	1808050
May 19	1065247	1008542	2073788

Jun 19	2088761	1979618	4068379
Jul 19	1206334	1199906	2406240
Aug 19	1215957	1248274	2464231
Sep 19	1118507	1094331	2212838
TOTAL	11089230	10686667	21775898
AVERAGE	1108923	1068667	2177590

###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>
Dec 2018	1669	0.6	12	73	10
Jan 2019	2033	0.8	14.1	76	20
Feb 2019	2171	1	16.1	97	33
Mar 2019	1543	0.5	10.7	46	5
Apr 2019	878	0.3	5.8	13	0
May 2019	998	0.3	5.4	35	5
Jun 2019	5488	0.9	16.2	206	56
Jul 2019	4621	1.3	20.5	142	32
Aug 2019	4984	1.4	22.7	262	14
Sep 2019	4099	1.3	21.2	213	8
TOTAL	28484	-	-	1163	183
AVERAGE	2848.4	0.8	14.5	116.3	18.3

###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>
Dec 2018	68684	36498	105183	65.3	34.7
Jan 2019	74186	39952	114137	65	35
Feb 2019	75948	36919	112867	67.3	32.7
Mar 2019	66257	43378	109635	60.4	39.6
Apr 2019	61073	46223	107296	56.9	43.1
May 2019	82977	48135	131113	63.3	36.7
Jun 2019	158224	107695	265919	59.5	40.5
Jul 2019	105124	92680	197804	53.1	46.9
Aug 2019	95517	101710	197227	48.4	51.6
Sep 2019	93197	75504	168701	55.2	44.8
TOTAL	881188	628694	1509882	-	-
AVERAGE	88118.8	62869.4	150988.2	59.5	40.5