

JANUARY 2018



WIM #33
US 212, MP 78.5
OLIVIA, MN

MONTHLY
REPORT



Your Destination...Our Priority



WIM Site Location

WIM #33 is located on US 212 near Olivia in Renville county.

System Operation

WIM #33 was operational for the entire month of January 2018. Volume was computed using all monthly data.

System Calibration

WIM #33 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: 134369 | Passenger Vehicles: 112230 | Heavy Commercial Vehicles: 22139

Monthly Average Daily Traffic (MADT): 4334 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 714

See Table 2 for vehicle class breakdown

Passenger Vehicles (PVs) and Heavy Commercial Vehicles (HCVs)

Volume trends. EB vehicles typically reached highest volume levels on Fridays, with lowest volumes reported on Sundays. WB 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), EB PVs generally reached peak volume levels between 03 PM and 05 PM. Similarly, WB PVs peaked in volume between 03 PM and 05 PM

Heavy Commercial Vehicles (HCVs)

Volume trends. On an average 24-hour day, HCVs traveling EB typically reached peak volume levels between 03 PM and 05 PM, while volume going WB 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 22139 HCVs, 5585 of them were overweight³. These overweight HCVs contributed to 4.2% of total monthly volume, and 25.4% of total monthly HCV volume. EB overweight vehicles typically reached highest numbers on Wednesdays, with lowest volumes reported on Saturdays. WB 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 13 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 53.6% of all overweight vehicles traveling WB 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 ,469 EB vehicles exceeded 88,000 pounds (172 vehicles were Class 9's; 158 vehicles were Class 13's). Of vehicles traveling WB,

1928 EB vehicles exceeded 88,000 pounds (1803 vehicles were Class 13's; 89 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 EB, while there were more fully_loaded Class 9's than empty traveling WB. Data also suggests that there were more fully_loaded Class 10's than empty traveling in the EB direction. In the WB direction, there were more empty class 10 vehicles.

Freight Totals. A total of 252267 tons of freight was recorded to have crossed the WIM. More freight was shipped WB (55.8%) than EB (44.2%). See Table 4 and Figure 11 for more freight information.

Infrastructure Considerations

Bridge. Bridge No. 6299 (a box culvert) is approximately 13.4 miles east of WIM #33, and Bridge No. 96640 (a box culvert) is 2.5 miles west of WIM #33. WIM #33 recorded a total of 134369 vehicles with a combined GVW of 1666391 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 21537 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 51.3% of all ESALs were recorded EB while 48.7% was observed WB. In particular, 69% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 43% 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).

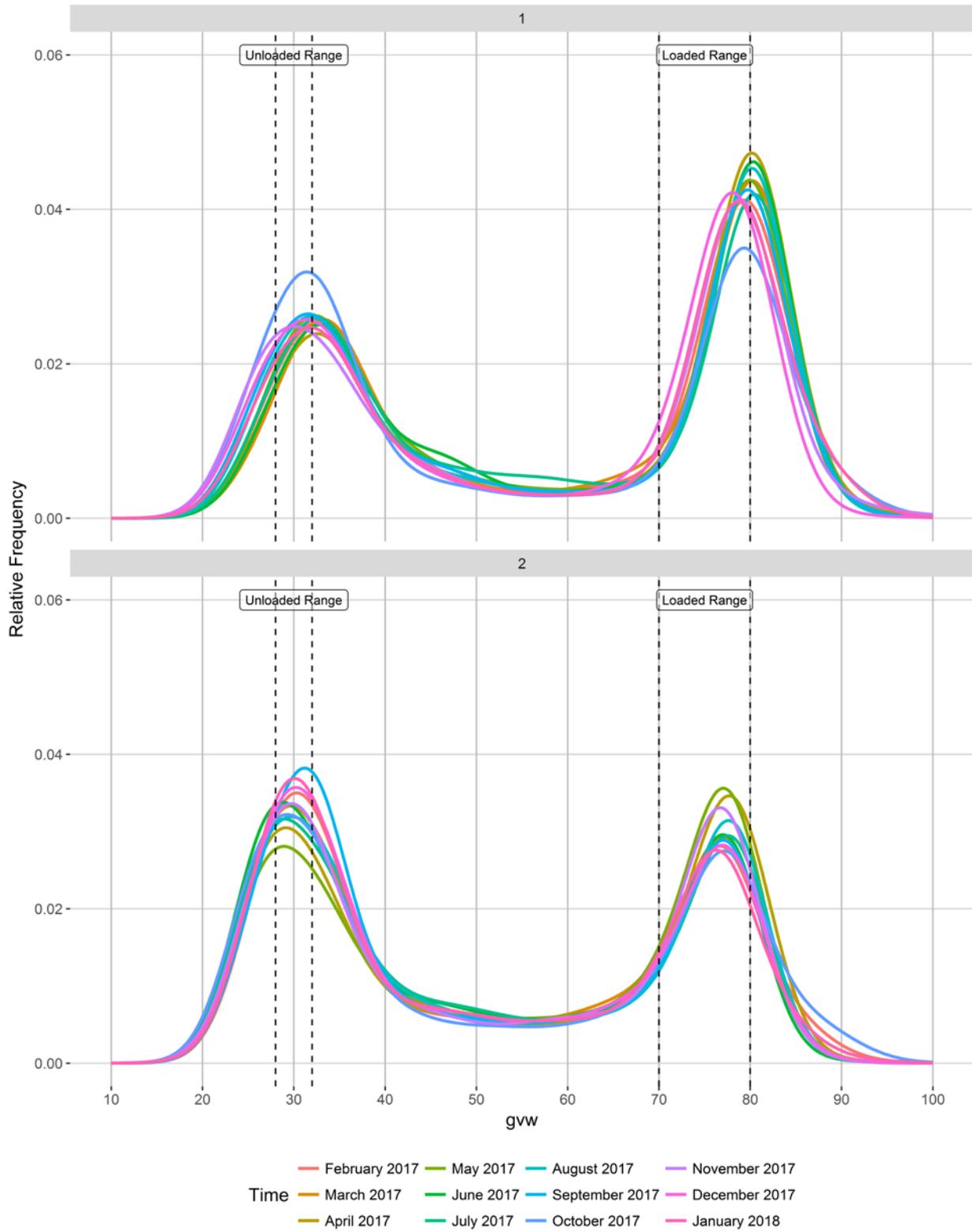
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

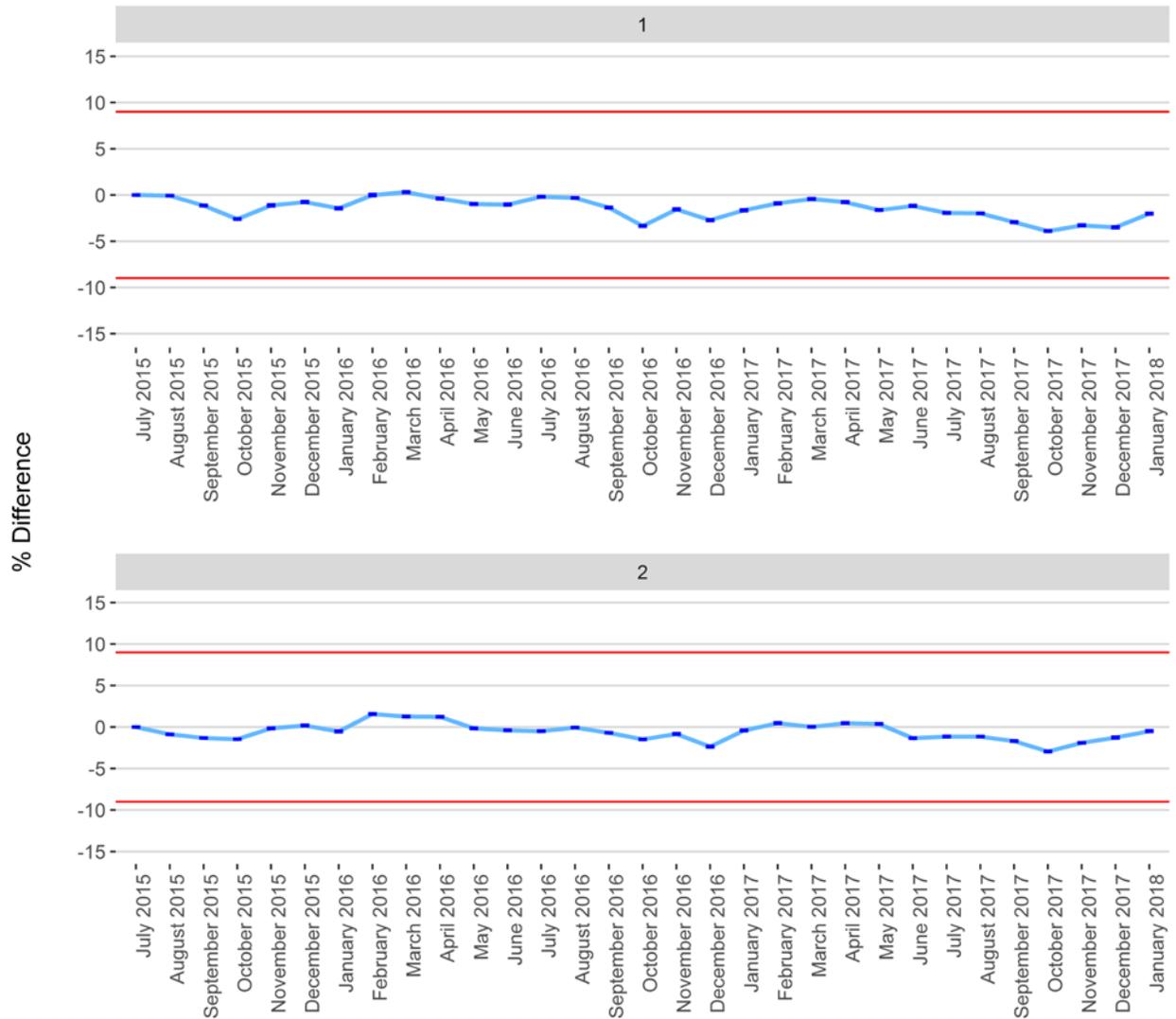
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

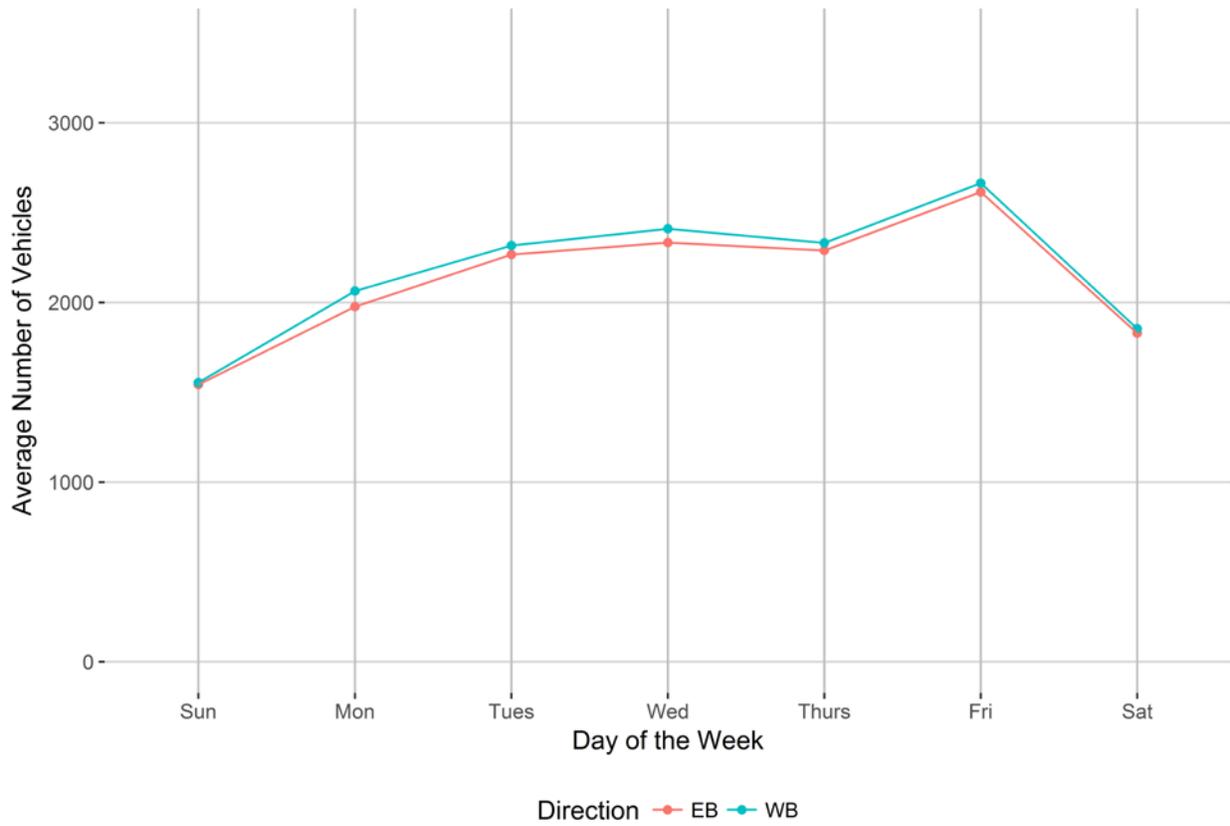


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

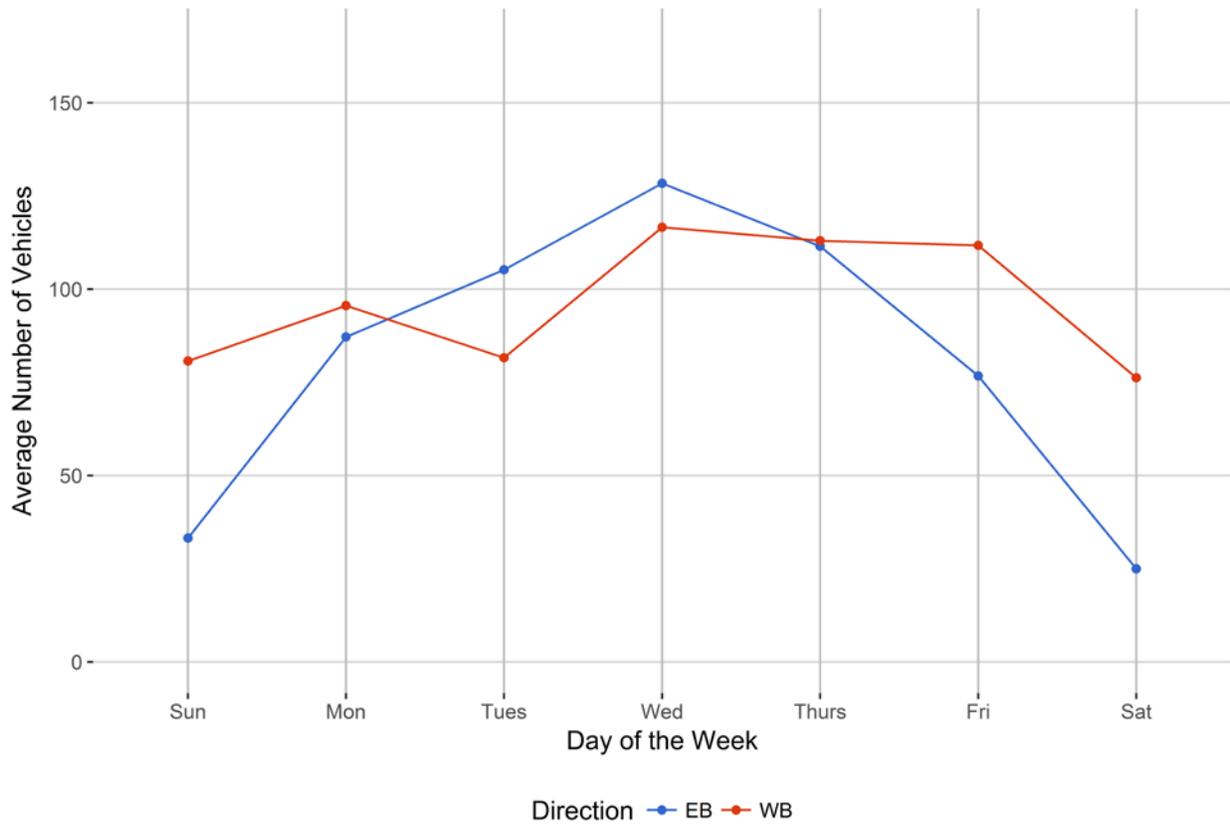


Figure 4 - Passenger Vehicles vs. Hour of the Day

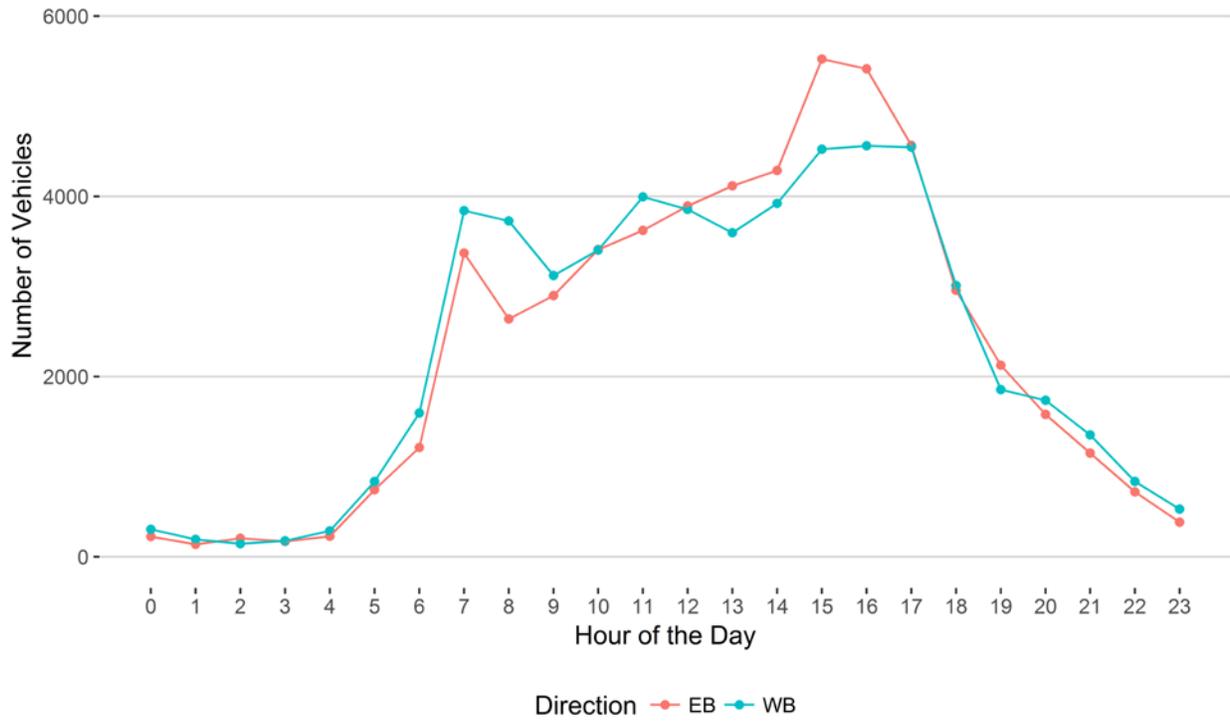


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

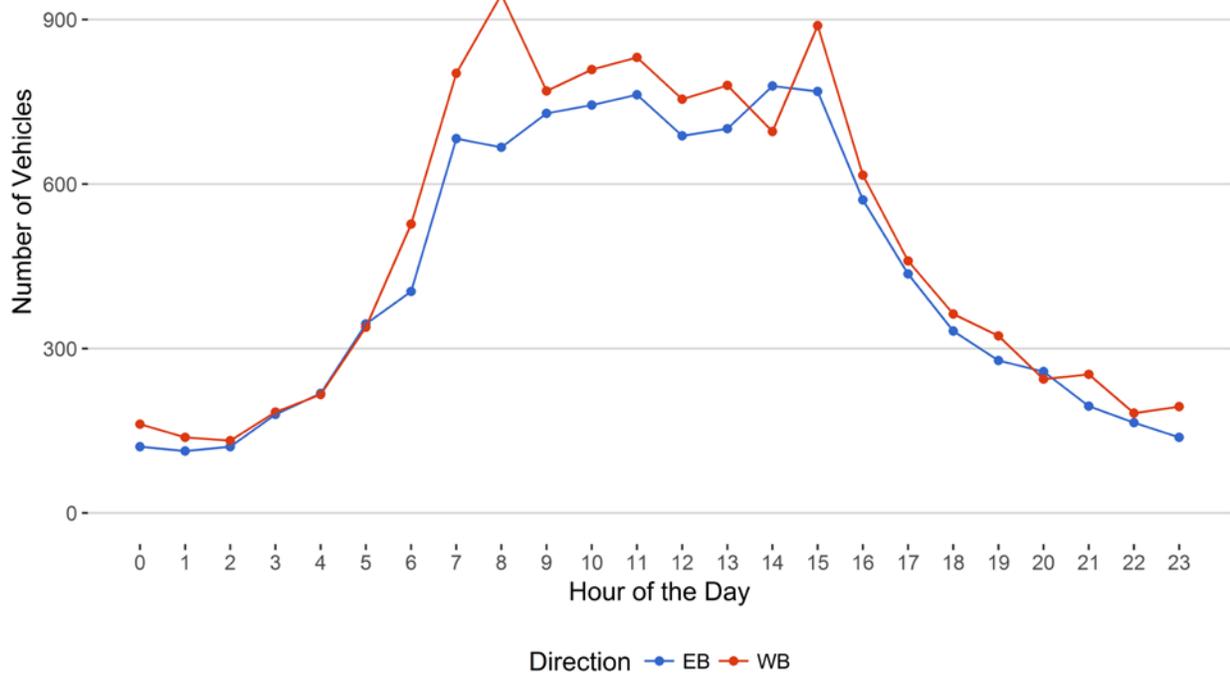


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

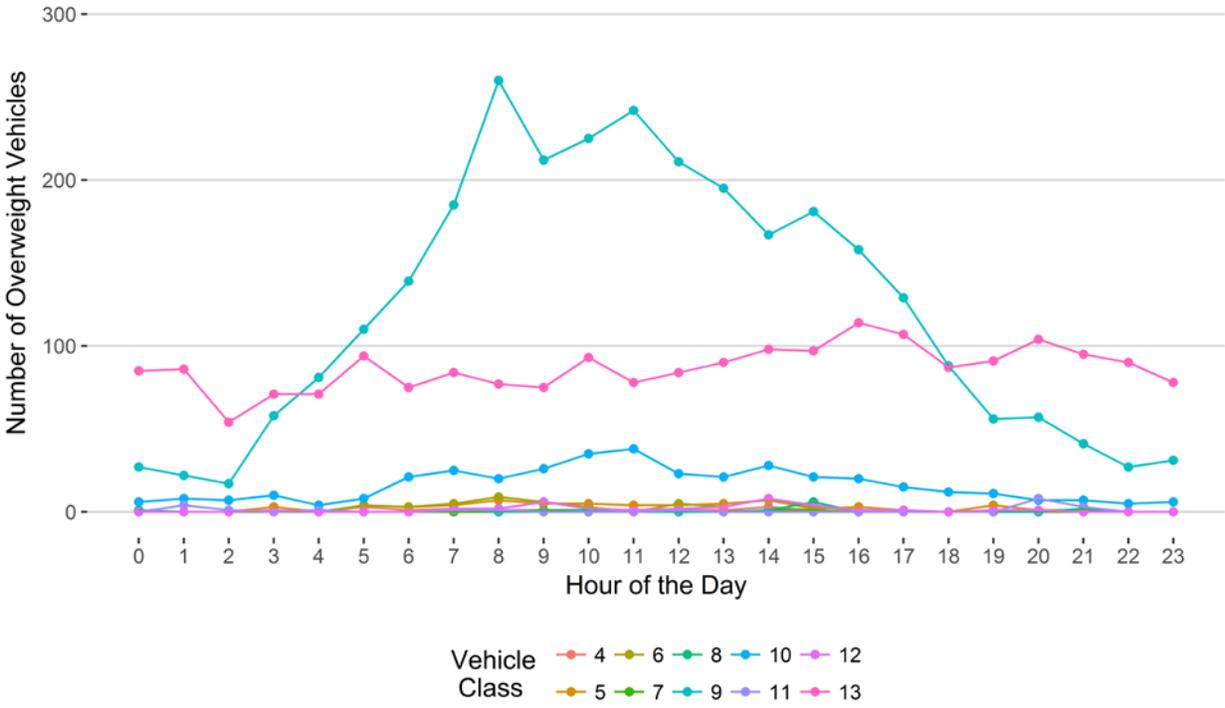


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

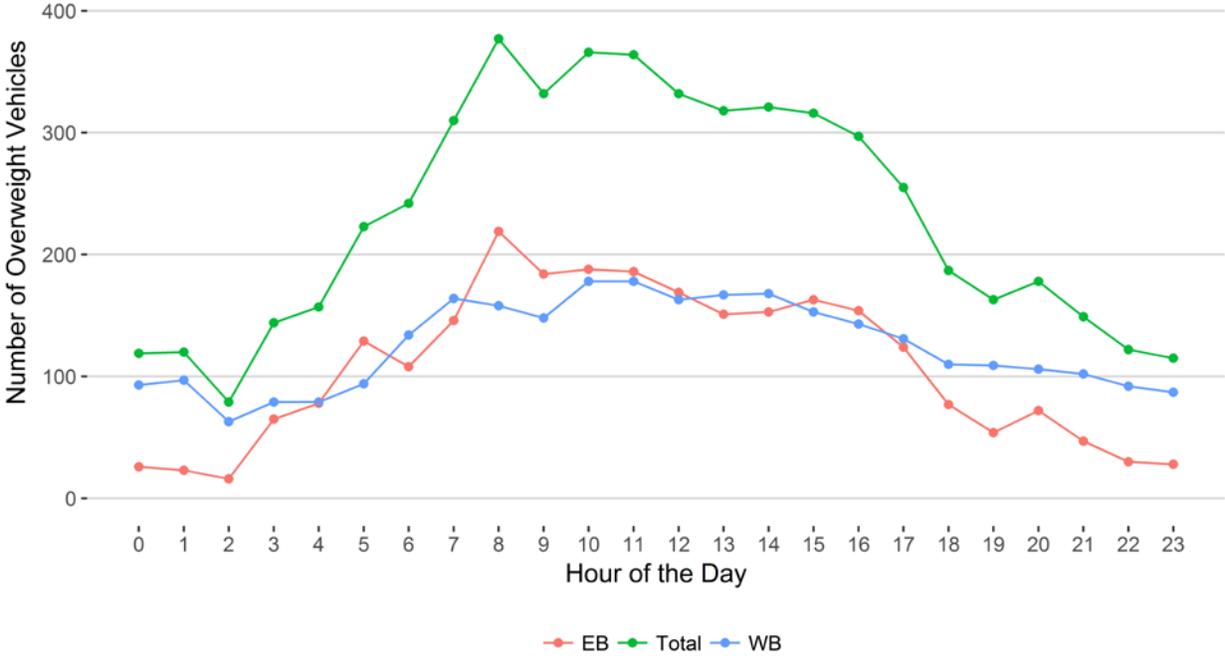
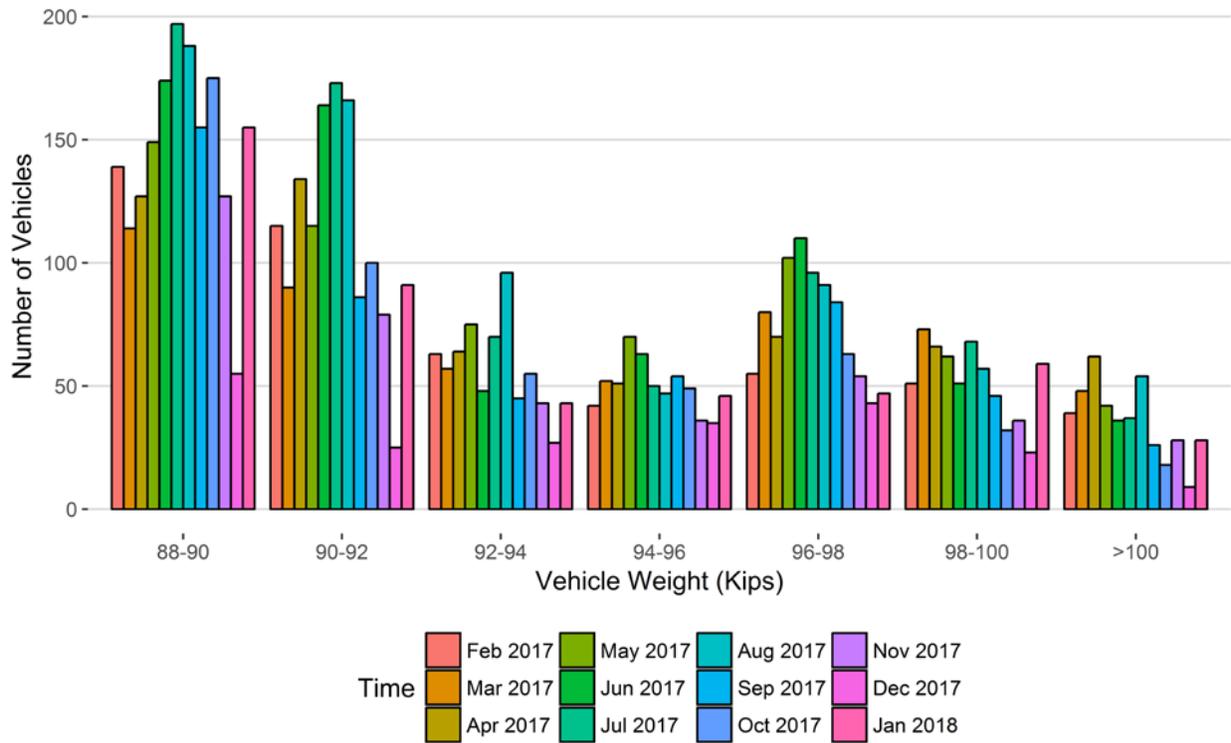
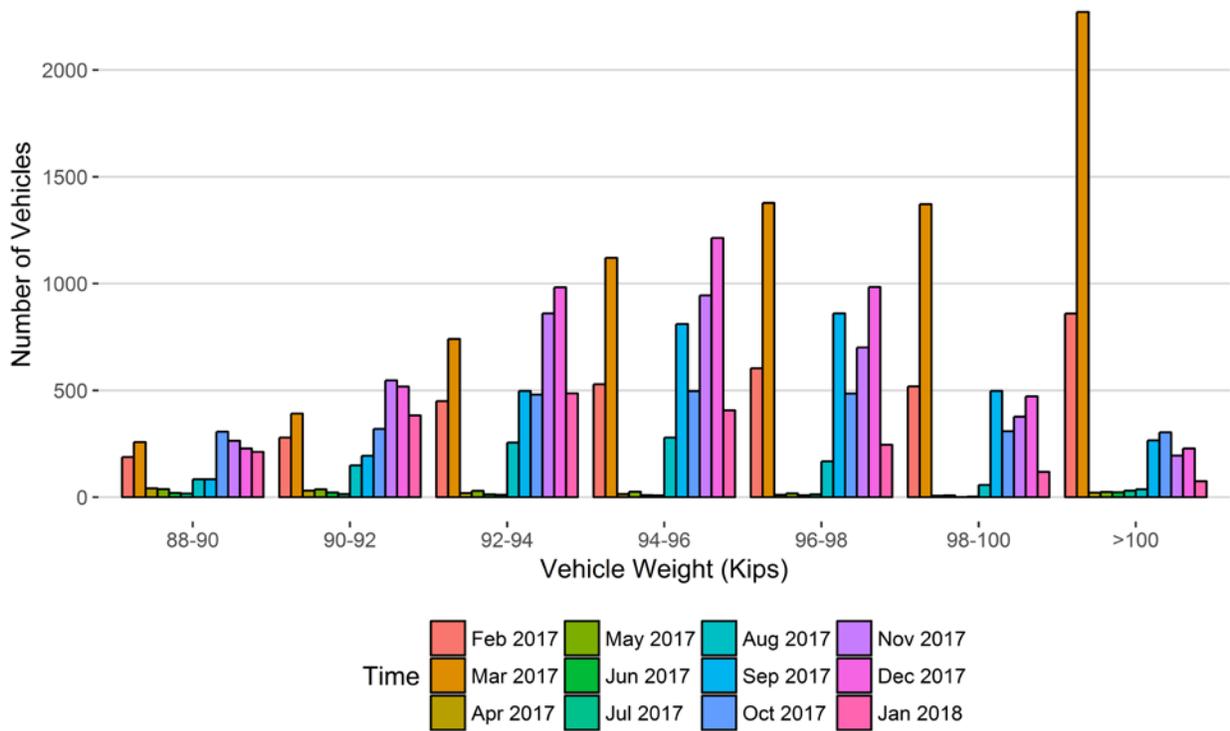


Figure 8 - Histogram of EB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018
88-90	139	114	127	149	174	197	188	155	175	127	55	155
90-92	115	90	134	115	164	173	166	86	100	79	25	91
92-94	63	57	64	75	48	70	96	45	55	43	27	43
94-96	42	52	51	70	63	50	47	54	49	36	35	46
96-98	55	80	70	102	110	96	91	84	63	54	43	47
98-100	51	73	66	62	51	68	57	46	32	36	23	59
>100	39	48	62	42	36	37	54	26	18	28	9	28
Total	504	514	574	615	646	691	699	496	492	403	217	469

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



Vehicle Weights (Kips)	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018
88-90	188	258	42	38	20	17	84	84	307	264	228	212
90-92	279	392	31	37	22	15	149	194	320	547	518	383
92-94	450	741	19	30	13	11	256	498	480	861	983	486
94-96	529	1121	15	26	10	8	279	811	497	945	1214	407
96-98	604	1378	11	18	9	13	168	861	485	701	984	246
98-100	519	1372	7	8	1	3	58	498	309	377	472	119
>100	860	2272	21	24	23	31	37	266	304	195	228	75
Total	3429	7534	146	181	98	98	1031	3212	2702	3890	4627	1928

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

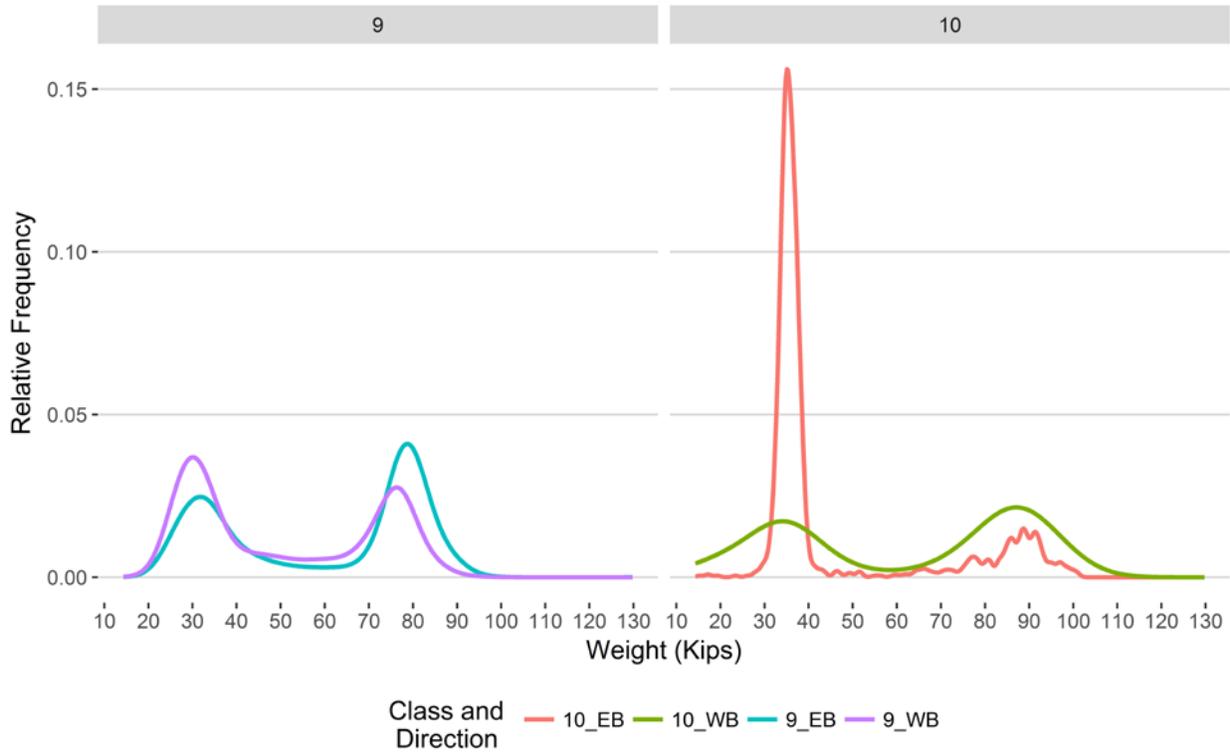


Figure 9 - Freight Percentage by Direction and Class

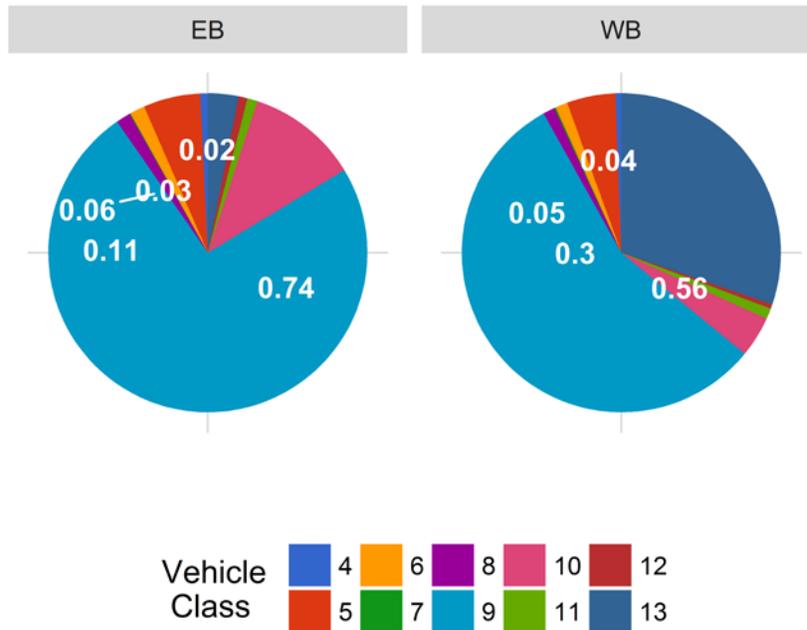


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

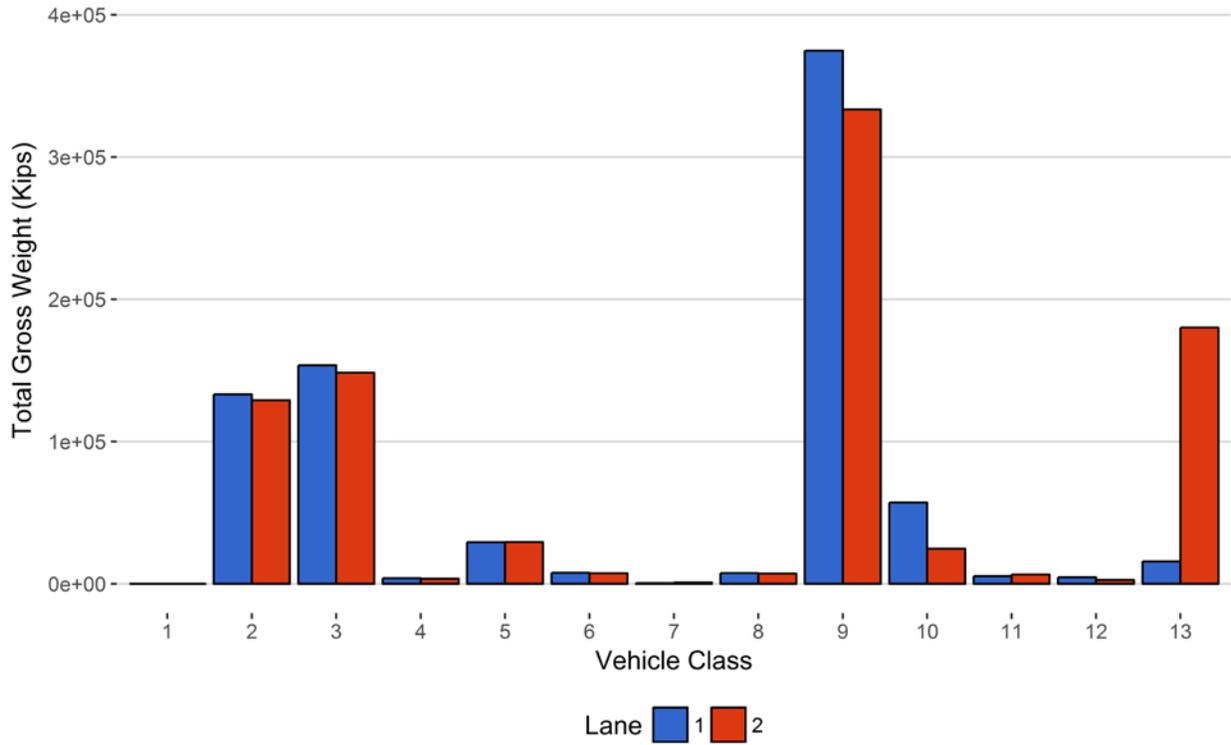


Figure 11 - Total Gross Vehicle Weight I

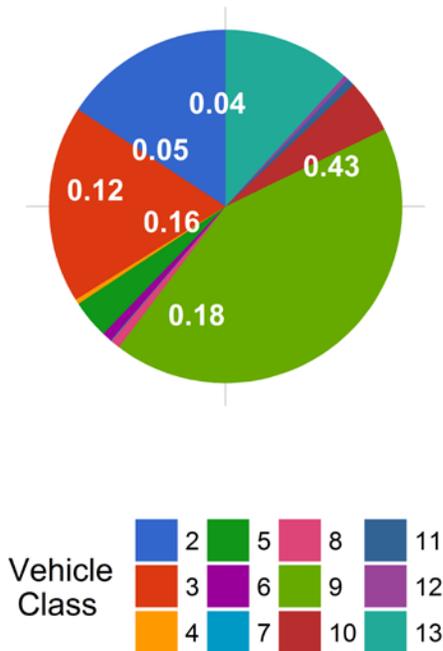


Figure 12 - Total ESALs by Class and Lane

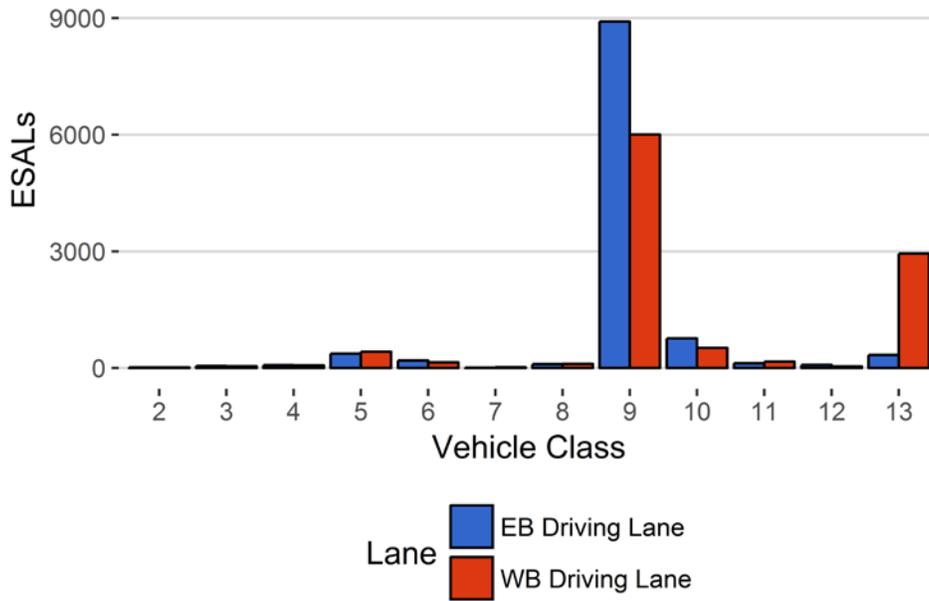


Figure 13 - ESALs by Class

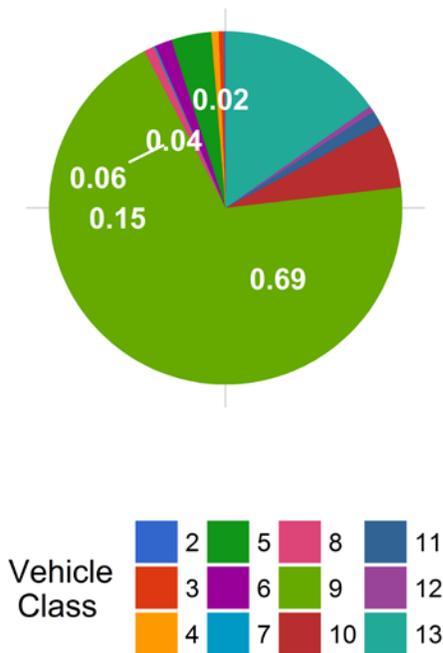


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
July 2015	11.76	0.00	10.98	0.00
August 2015	11.75	-0.07	10.89	-0.88
September 2015	11.62	-1.13	10.84	-1.31
October 2015	11.45	-2.60	10.82	-1.46
November 2015	11.63	-1.12	10.97	-0.15
December 2015	11.67	-0.76	11.00	0.20
January 2016	11.59	-1.44	10.92	-0.53
February 2016	11.76	-0.01	11.16	1.58
March 2016	11.79	0.31	11.12	1.28
April 2016	11.71	-0.37	11.12	1.23
May 2016	11.64	-0.97	10.97	-0.15
June 2016	11.64	-1.04	10.94	-0.39
July 2016	11.74	-0.19	10.93	-0.49
August 2016	11.72	-0.31	10.98	-0.05
September 2016	11.60	-1.36	10.91	-0.69
October 2016	11.36	-3.35	10.82	-1.48
November 2016	11.58	-1.55	10.89	-0.83
December 2016	11.44	-2.72	10.72	-2.35
January 2017	11.56	-1.65	10.94	-0.41
February 2017	11.65	-0.91	11.03	0.47
March 2017	11.71	-0.43	10.99	0.03
April 2017	11.67	-0.77	11.03	0.46
May 2017	11.57	-1.63	11.02	0.37
June 2017	11.62	-1.18	10.84	-1.33
July 2017	11.53	-1.94	10.86	-1.15
August 2017	11.53	-1.98	10.86	-1.15
September 2017	11.41	-2.94	10.80	-1.68
October 2017	11.30	-3.90	10.66	-2.94
November 2017	11.37	-3.28	10.77	-1.89
December 2017	11.35	-3.49	10.84	-1.26
January 2018	11.52	-2.02	10.93	-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	0	0	0	0
2	2021	62659	46.6	0	0
3	1599	49571	36.9	0	0
4	8	233	0.2	15	0.3
5	126	3912	2.9	63	1.1
6	16	497	0.4	51	0.9
7	1	26	0	5	0.1
8	15	467	0.3	15	0.3
9	418	12944	9.6	2919	52.3
10	53	1643	1.2	384	6.9
11	7	207	0.2	20	0.4
12	3	107	0.1	35	0.6
13	68	2103	1.6	2078	37.2
TOTAL	4334	134369	100	5585	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>
2018-01-24	Wednesday	16:06:12	9	EB	1	129.8
2018-01-03	Wednesday	01:28:45	10	WB	2	101.71
2018-01-07	Sunday	01:55:17	10	WB	2	101.38
2018-01-29	Monday	14:18:34	10	EB	1	101.07
2018-01-10	Wednesday	07:58:51	9	EB	1	100.81
2018-01-25	Thursday	11:32:59	10	EB	1	100.81
2018-01-17	Wednesday	18:48:24	10	EB	1	100.42
2018-01-31	Wednesday	02:10:43	10	WB	2	100.32
2018-01-30	Tuesday	02:10:37	10	WB	2	99.86
2018-01-29	Monday	17:11:50	10	EB	1	99.82

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	EB	15	129	9	7	3777	115	989
5	EB	8	1915	171	8.9	27960	1275	7004
6	EB	19	245	55	22.4	6796	969	1593
7	EB	11.5	7	0	0	411	0	165
8	EB	31	237	103	43.5	5039	2431	443
9	EB	33	6299	1335	21.2	336195	38652	86192
10	EB	33.5	1237	134	10.8	52862	4259	7956
11	EB	36.5	100	9	9	4966	315	822
12	EB	36.5	67	0	0	4569	0	1062
13	EB	31.5	162	0	0	15696	0	5297
TOTAL	****	****	10398	1816	****	458272	****	111522
<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	WB	15	103	7	6.8	3455	99	1007
5	WB	8	1974	265	13.4	27353	1953	6841
6	WB	19	249	71	28.5	6164	1232	1391
7	WB	11.5	19	0	0	848	0	315
8	WB	31	227	127	55.9	3912	3234	406
9	WB	33	6569	2339	35.6	266005	67440	63207
10	WB	33.5	396	78	19.7	22564	2030	5956
11	WB	36.5	106	0	0	6491	0	1311
12	WB	36.5	39	1	2.6	2626	36	620
13	WB	31.5	1929	0	0	180146	0	59691
TOTAL	****	****	11611	2888	****	519565	****	140745
GRAND TOTAL	****	****	22009	4704	285	977837	124040	252267

Table 5 Gross Vehicle Weight by Class and Lane

<i>Vehicle Class</i>	<i>EB</i>	<i>WB</i>	<i>Total</i>	<i>Percentage</i>
2	133151	129013	262164	15.7
3	153652	148352	302004	18.1
4	3892	3553	7446	0.4
5	29235	29307	58542	3.5
6	7764	7396	15161	0.9
7	411	848	1260	0.1
8	7470	7146	14617	0.9
9	374847	333444	708292	42.5
10	57121	24594	81715	4.9
11	5281	6491	11772	0.7
12	4569	2662	7232	0.4
13	15696	180146	195842	11.8
TOTAL	793091	872954	1666046	100
GVW/LANE	47.6	52.4	100	0.01

Table 6 ESALs by Class and Lane and Flexible ESAL Factors

<i>Vehicle Class</i>	<i>EB</i>	<i>WB</i>	<i>Total</i>	<i>Percentage</i>	<i>Flexible ESAL Factor</i>
2	18	16	34	0.2	0.0011
3	54	47	102	0.5	0.0042
4	74	70	144	0.7	1.24
5	370	419	789	3.7	0.41
6	192	143	335	1.6	1.35
7	13	19	32	0.2	2.15
8	100	103	203	0.9	0.88
9	8909	6005	14914	69.3	2.32
10	765	520	1285	6	1.57
11	126	162	288	1.3	2.71
12	82	41	123	0.6	2.2
13	338	2945	3283	15.2	3.13
TOTAL	11042	10490	21531	100	18
ESALS/LANE	51.3	48.7	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>
Feb 2017	131229	4687	883	106493	81.2	24735.6	18.8
Mar 2017	152250	4911	941	123065	80.8	29185	19.2
Apr 2017	143723	4791	696	122841	85.5	20882.1	14.5
May 2017	162226	5233	736	139415	85.9	22811.5	14.1
Jun 2017	169392	5646	808	145148	85.7	24243.7	14.3
Jul 2017	175467	5660	756	152027	86.6	23439.6	13.4
Aug 2017	184728	5959	907	156600	84.8	28127.6	15.2
Sep 2017	174582	5819	1022	143917	82.4	30665.3	17.6
Oct 2017	168933	5450	991	138200	81.8	30732.8	18.2
Nov 2017	157271	5242	946	128891	82	28380.1	18
Dec 2017	151645	4892	863	124901	82.4	26744.2	17.6
Jan 2018	134369	4334	714	112230	83.5	22139.3	16.5
TOTAL	1905815	--	--	1593728	--	312087	--
AVERAGE	158818	5219	855	132811	84	26007	16

ESALS

<i>Month</i>	<i>ESALS EB Driving Lane</i>	<i>ESALS WB Driving Lane</i>	<i>Total ESALS</i>	<i>Pavement Life Decrease Months</i>
Feb 2017	10965	14094	25058	11.5
Mar 2017	12092	23137	35228	14.3
Apr 2017	12270	9305	21576	13.5
May 2017	12391	9961	22351	13.3
Jun 2017	14427	8888	23315	12
Jul 2017	13642	9390	23032	15.7
Aug 2017	15767	12453	28221	13.5
Sep 2017	14359	14776	29134	4.4
Oct 2017	13340	16038	29378	10.4
Nov 2017	11998	15611	27609	7.5
Dec 2017	9912	14401	24312	6.4
Jan 2018	11044	10493	21537	13.7
TOTAL	152205	--	--	--
AVERAGE	12684	13212	25896	11

Gross Vehicle Weight

<i>Month</i>	<i>GVW EB Driving Lane</i>	<i>GVW WB Driving Lane</i>	<i>Total GVW Kips</i>
Feb 2017	793221	873170	1666391
Mar 2017	829314	1002607	1831922
Apr 2017	847186	1520249	2367434
May 2017	836328	785120	1621448
Jun 2017	904776	873200	1777976
Jul 2017	1004884	871882	1876766
Aug 2017	1000624	888551	1889175
Sep 2017	1106394	1067194	2173587
Oct 2017	1071249	1199149	2270398
Nov 2017	1012456	1200320	2212776
Dec 2017	927055	1192270	2119325
Jan 2018	890224	1132994	2023218
TOTAL	11223710	12606707	23830417
AVERAGE	935309	1050559	1985868

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	7170	5.5	29.1	3933	1469
Mar 2017	12125	8	41.7	8048	3765
Apr 2017	5011	3.5	24.1	721	157
May 2017	4889	3	21.5	797	137
Jun 2017	5047	3	20.9	746	113
Jul 2017	5248	3	22.5	792	142
Aug 2017	6914	3.8	24.7	1731	207
Sep 2017	8234	4.7	26.9	3710	837
Oct 2017	7755	4.6	25.3	3194	663
Nov 2017	8139	5.2	28.8	4294	637
Dec 2017	7745	5.2	29.1	4844	732
Jan 2018	5586	4.2	25.4	2397	281
TOTAL	83863	--	--	35207	9140
AVERAGE	6988.6	4.5	26.7	2933.9	761.7

Freight

<i>Month</i>	<i>EB Freight Tons</i>	<i>WB Freight Tons</i>	<i>Total Freight</i>	<i>EB Freight %</i>	<i>WB Freight %</i>
Feb 2017	108171	194273	302444	35.8	64.2
Mar 2017	124219	347216	471436	26.3	73.7
Apr 2017	124975	102010	226984	55.1	44.9
May 2017	128781	111767	240548	53.5	46.5
Jun 2017	149152	96741	245893	60.7	39.3
Jul 2017	140199	101769	241969	57.9	42.1
Aug 2017	161829	146070	307899	52.6	47.4
Sep 2017	147260	204769	352029	41.8	58.2
Oct 2017	130713	210740	341452	38.3	61.7
Nov 2017	120349	225464	345812	34.8	65.2
Dec 2017	100081	223681	323763	30.9	69.1
Jan 2018	111522	140745	252267	44.2	55.8
TOTAL	1547251	2105245	3652496	--	--
AVERAGE	128937.6	175437.1	304374.6	44.3	55.7