

MEMORANDUM

To: Larry Legg, PE
From: Adam Denney, PE
Mark Meisinger, PE, PTOE
Timothy Adams, EIT
Date: 15 July 2019
RE: Lancaster County Supplemental Study – 148th Street Intersection Improvements

Project Background

In December 2018, Felsburg Holt & Ullevig (FHU) completed a safety analysis for 148th Street between the intersections of Amberly Road and Old Cheney Road in Lancaster County, Nebraska. The analysis identified improvements that should be implemented to increase safety and accommodate the future growth and travel within the study area. The completed, *Lancaster County Safety Study – 148th Street*, report is attached with this memo.

At the request of the Lancaster County Engineer, FHU carried out this supplemental study to assess intersection improvements at the following locations:

- 148th Street with Holdrege Street
- 148th Street with Adams Street

The additional work includes turning movement counts at 148th Street with Holdrege Street and 148th Street with Adams Street, an updated safety analysis of both intersections, and a benefit cost analysis of safety recommendations. This report is based on the comprehensive analysis of over 6 years of crash data from January 1, 2013 to April 4, 2019, provided by Lancaster County.

Roadway Geometrics

148th Street with Holdrege Street is a two-way stop-controlled intersection. 148th street and the west leg of Holdrege Street are paved two-lane undivided highways. The east leg of Holdrege Street turns into a gravel road just after the intersection. The intersection is characterized by its steep incline from east to west. 148th Street has a posted speed limit of 55 mph on each approach, and no observed posted speed limit on Holdrege Street, thus a statutory limit of 55 mph west of 148th Street and 50 mph east of 148th Street is assumed for this study.

148th Street with Adams Street is a two-way stop-controlled intersection. 148th Street is a paved two-lane undivided highway. Adams Street is a gravel road to the east and was recently paved to the west in 2018. This has led to a significant increase in traffic volumes. 148th Street and Adams Street have a posted speed limit of 55 mph on all approaches.

The supplemental study called for counts at both intersections, taken on February 13, 2019. The AM peak hour for 148th Street with Holdrege Street was determined to be 7:30 AM to 8:30 AM and for 148th Street with Adams Street it was 7:15 AM to 8:15 AM. The PM peak hour was 4:30 PM to 5:30 PM for 148th Street with Holdrege Street and 4:15 PM to 5:15 PM for 148th Street with Adams Street. A detailed report of the traffic count data is attached to this memo.

Average daily traffic was assessed at each location during the original study. The daily entering vehicles (DEV) at 148th Street with Holdrege Street is 6,388. This equates to 14.6 million entering vehicles (MEV) during the 6-year, 3-month study period. 148th Street with Adams Street has a DEV of 5,240 and a MEV of 12.0 million.

Crash History

The crash history for the period of January 1, 2013 to April 4, 2019 was examined at each intersection to assess crash patterns. The statewide average crash rate for rural Nebraska intersections is 0.235 acc/MEV (accidents per million entering vehicles) for non-shouldered intersections between the years of 2012-2014. Over the 6-year 3-month analysis period, eleven (11) crashes were reported at 148th Street with Holdrege Street and two (2) crashes at 148th Street with Adams Street. This amounts to a crash rate of 0.754 acc/MEV at 148th Street with Holdrege Street, which is 321% of the Nebraska average. At 148th Street with Adams Street the crash rate was 0.167 acc/MEV equating to 71% of the state average.

Table 1 summarizes the crash history by type at the two intersections and **Table 2** by crash severity. The data shows all recorded crashes during the 6-year, 3-month study period.

Table 1. 148th Street Intersections Crash Summary by Type

Intersection	Rear End	Side Swipe (Same)	Right-Angle	Left Turn Leaving	Run Off Road	Totals
Holdrege Street	4	1	1	1	4	11
Adams Street	1	-	-	-	1	2

Table 2. 148th Street Intersections Crash Summary by Severity

Intersection	Fatal	Injury			N-R	PDO	Totals
		INJ-A	INJ-B	INJ-C			
Holdrege Street	-	-	3	2	1	5	11
Adams Street	-	-	-	1	-	1	2

Figures 1 graphically displays the breakdown of crashes by severity and type over the 6-year, 3-month analysis period for 148th Street with Holdrege Street. The two crashes at the intersection of 148th Street and Adams Street is not depicted.

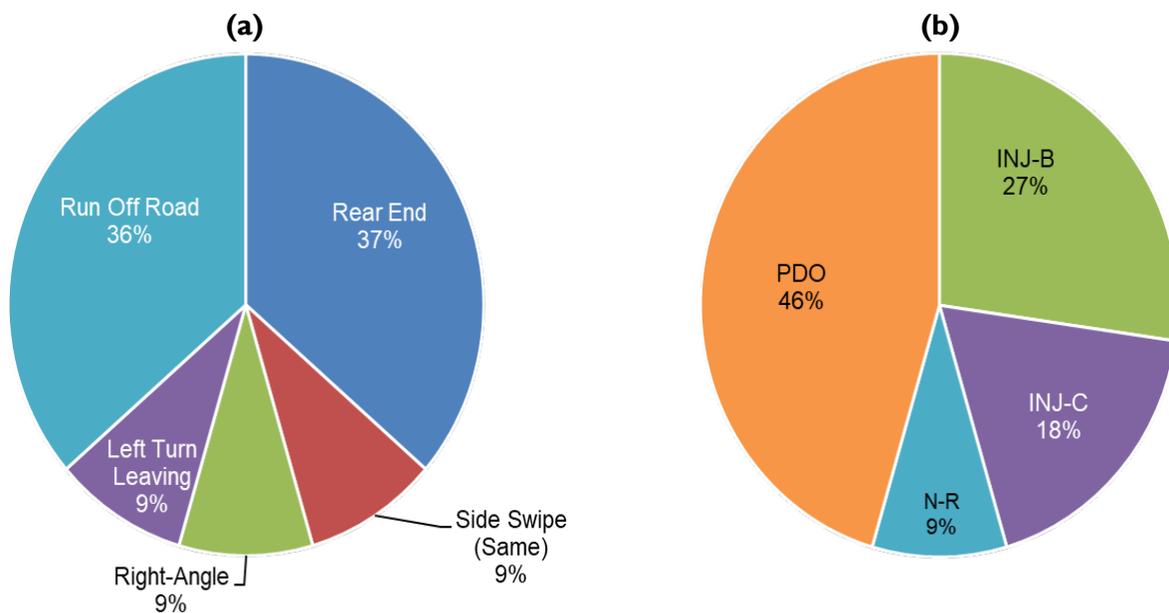


Figure I. Crashes at I48th Street with Holdrege Street by Type (a) and Severity (b)

Proposed Improvements

Based on the existing traffic operations and crash patterns at the intersections, the same two countermeasures were developed to improve safety at each location. A description is provided below:

Left-turn Lanes Installation

This countermeasure would involve the installation of left-turn lanes on the north and southbound approaches of I48th Street at the intersections with Holdrege Street and Adams Street.

Reconstruction as a Roundabout

This countermeasure would reconstruct the current two-way stop-controlled intersection as a single-lane roundabout for both the Holdrege Street and Adams Street on I48th Street.

Project Costs

Preliminary cost estimates were developed by FHU and Lancaster County for the proposed countermeasures. The countermeasures at I48th Street with Holdrege Street are estimated to cost approximately \$500,000 for the Left-turn Lanes Improvement and just under \$3.8 million for the Roundabout Improvement. At I48th Street with Adams Street, the improvements are estimated to cost approximately \$360,000 for the Left-turn Lanes Improvement and just over \$1.8 million for the Roundabout Improvement. Both estimates are for construction and right-of-way costs. **Table 3** breaks down the cost estimates. A full breakdown of the cost estimates is attached to this memo.

Table 3. Construction & Right-of-Way Cost Estimates

Location	Left-turn Lanes	Roundabout
I48 th Street with Holdrege Street	\$500,000	\$3,765,600
I48 th Street with Adams Street	\$361,110	\$1,816,350

Benefits of Project

The observed crash patterns identified at the intersection will be directly addressed with the intersection improvements proposed. The left-turn lanes at both locations would potentially reduce crashes, especially rear-end, from cars slowing and stopping to turn onto the minor road. The roundabout design would eliminate right angle conflicts points, as well as reduce overall crash rates.

Additionally, the traffic at the intersection of I48th Street with Adams Street is anticipated to substantially increase in the near future. A predictive crash analysis was conducted to forecast crashes due to traffic growth. Accounting for a 4.5% annual growth on I48th Street and a 2.5% annual growth on Adams Street over the next 20 years, the crashes at the intersection are predicted to increase by 230%. A detailed report of the predictive crash analysis is attached to this memo.

It should be noted that some of the recommended improvements may increase delay for certain movements, specifically the roundabout countermeasure, but it is paramount to improve the safety of the traveling public. The safety benefits associated with these projects outweigh the effect on traffic operations. **Tables 4a, b, and c** show the Federal Highway Administration's estimated societal cost of crashes by type and severity, for crashes on rural roadways.

Table 4. FHWA Societal Cost of Traffic Accidents

Crash Type (Multi-Vehicle)	Societal Cost	Crash Type (Single-Vehicle)	Societal Cost	Crash Severity (All)	Societal Cost
Right Angle	\$ 103,180	Collision w/ Train	\$ 451,095	Fatal	\$ 11,608,336
Rear End	\$ 81,801	Collision w/ Pedestrian	\$ 592,281	A-Injury	\$ 673,148
Sideswipe (Same Dir.)	\$ 55,947	Collision w/ Bicycle	\$ 263,261	B-Injury	\$ 203,999
Sideswipe (Opposite Dir.)	\$ 127,084	Collision w/ Animal	\$ 25,485	C-Injury	\$ 129,085
Head On	\$ 384,577	Collision w/ Parked Vehicle	\$ 34,906	All Injury Combined	\$ 344,252
Left Turn	\$ 140,078	Collision w/ Fixed Object	\$ 164,238	Property Damage Only	\$ 12,234
Other	\$ 28,738	Overturn	\$ 357,481	Non-Reportable	\$ 1,026

(a)

(b)

(c)

Benefit Cost Analysis

A Benefit Cost Analysis (BCA) was completed for each of the proposed improvements at both locations. The BCA was completed based on the lifespan of the project, assuming an improvement life period, construction costs, and maintenance costs for each project. The BCA looked at the societal cost of traffic accidents by crash type and crash severity. In general, projects with a B/C ratio of 1.0 or greater have larger benefits than costs over the analysis time period. Only crashes directly affected by the proposed improvement were used in the benefit/cost calculations. Detailed calculations of the benefit cost analysis are attached to this memo.

For the BCA analysis, Crash Modification Factors (CMF) / Crash Reduction Factors (CRF) were obtained from the Crash Modification Factors Clearinghouse (<http://www.cmfclearinghouse.org>). When more than one CMF/CRF applied to a specific project a composite CRF factor was developed. All CMF/CRF calculations are attached to this memo.

Holdrege Street Countermeasure – Installation of Left-turn Lanes

The cost of this countermeasure was estimated at \$600,000 with a project life of 20 years. This includes an initial construction cost of \$500,000 and an operational/maintenance cost of \$5,000 per year. A CMF of 0.520 / CRF of 0.480 was used for both crash type and severity analysis.

Table 5 summarizes the benefit-cost calculations for the countermeasure by crash type and **Table 6** for crash severity. Based on the factors discussed above, the project would be expected to provide a benefit-cost ratio of **7.14** based on crash type and **2.39** for crash severity.

Table 5. Holdrege Street Countermeasure: Benefit-Cost Calculation by Crash Type

Average Cost/Mitigated Crash (2013 through 2019 average weighting crash type)	\$254,062
Present Value of Avoided Crashes, BENEFIT	\$4,285,779
Present Value Cost, COST	\$600,000
Crash Type Benefit/Cost Ratio	7.14

Table 6. Holdrege Street Countermeasure: Benefit-Cost Calculation by Crash Severity

Average Cost/Mitigated Crash (2013 through 2019 average weighting crash severity)	\$84,167
Present Value of Avoided Crashes, BENEFIT	\$1,436,685
Present Value Cost, COST	\$600,000
Crash Severity Benefit/Cost Ratio	2.38

Holdrege Street Countermeasure – Construct a Roundabout

The cost of this countermeasure was estimated at \$4.5 million with a project life of 20 years. This includes an initial construction cost of \$3.8 million and an operational/maintenance cost of \$37,656 per year. A CMF of 0.290 / CRF of 0.710 was used for crash type and a CMF of 0.217 / CRF of 0.783 was used for crash severity analysis.

Table 7 summarizes the benefit-cost calculations for the countermeasure by crash type and **Table 8** for crash severity. Based on the factors discussed above, the project would be expected to provide a benefit-cost ratio of **1.40** based on crash type and **0.57** for crash severity.

Table 7. Holdrege Street Countermeasure: Benefit-Cost Calculation by Crash Type

Average Cost/Mitigated Crash (2013 through 2019 average weighting crash type)	\$254,062
Present Value of Avoided Crashes, BENEFIT	\$6,339,382
Present Value Cost, COST	\$4,518,720
Crash Type Benefit/Cost Ratio	1.40

Table 8. Holdrege Street Countermeasure: Benefit-Cost Calculation by Crash Severity

Average Cost/Mitigated Crash (2013 through 2019 average weighting crash type)	\$93,502
Present Value of Avoided Crashes, BENEFIT	\$2,572,045
Present Value Cost, COST	\$4,518,720
Crash Severity Benefit/Cost Ratio	1.18

Adams Street Countermeasure – Installation of Left-turn Lanes

The cost of this countermeasure was estimated at \$433,332 with a project life of 20 years. This includes an initial construction cost of \$361,110 and an operational/maintenance cost of \$3,611 per year. A CMF of 0.520 / CRF of 0.480 was used for both crash type and severity analysis.

Table 9 summarizes the benefit-cost calculations for the countermeasure by crash type and **Table 10** for crash severity. Based on the factors discussed above, the project would be expected to provide a benefit-cost ratio of **1.60** based on crash type and **0.50** for crash severity.

Table 9. Adams Street Countermeasure: Benefit-Cost Calculation by Crash Type

Average Cost/Mitigated Crash (2013 through 2019 average weighting crash type)	\$226,099
Present Value of Avoided Crashes, BENEFIT	\$693,465
Present Value Cost, COST	\$433,332
Crash Type Benefit/Cost Ratio	1.60

Table 10. Adams Street Countermeasure: Benefit-Cost Calculation by Crash Severity

Average Cost/Mitigated Crash (2013 through 2019 average weighting crash severity)	\$70,999
Present Value of Avoided Crashes, BENEFIT	\$217,760
Present Value Cost, COST	\$433,332
Crash Severity Benefit/Cost Ratio	0.50

Adams Street Countermeasure – Construct a Roundabout

The cost of this countermeasure was estimated at \$2.2 million with a project life of 20 years. This includes an initial construction cost of \$1.8 million and an operational/maintenance cost of \$18,163 per year. A CMF of 0.290 / CRF of 0.710 was used for crash type and a CMF of 0.210 / CRF of 0.790 was used for crash severity analysis.

Table 11 summarizes the benefit-cost calculations for the countermeasure by crash type and **Table 12** for crash severity. Based on the factors discussed above, the project would be expected to provide a benefit-cost ratio of **0.47** based on crash type and **0.18** for crash severity.

Table 11. Adams Street Countermeasure: Benefit-Cost Calculation by Crash Type

Average Cost/Mitigated Crash (2013 through 2019 average weighting crash type)	\$226,099
Present Value of Avoided Crashes, BENEFIT	\$1,025,751
Present Value Cost, COST	\$2,179,620
Crash Type Benefit/Cost Ratio	0.47

Table 12. Adams Street Countermeasure: Benefit-Cost Calculation by Crash Severity

Average Cost/Mitigated Crash (2013 through 2019 average weighting crash type)	\$76,944
Present Value of Avoided Crashes, BENEFIT	\$388,405
Present Value Cost, COST	\$2,179,620
Crash Severity Benefit/Cost Ratio	0.18

Although the current BCA results do not justify the proposed countermeasures (BCA greater than 2.0), the predictive crash analysis completed for this intersection identified that crashes are anticipated to more than double with the increased traffic demand in the future. As such, it is recommended that as a preventative countermeasure, turn-lanes be added on 148th Street at Adams Street. With this improvement, it is recommended it be graded and ROW purchased to accommodate a future roundabout.



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Count Name: 148th St & Holdrege St
Site Code: 148
Start Date: 02/13/2019
Page No: 1

Turning Movement Data

Start Time	Holdrege St Eastbound				Holdrege St Westbound				148th St Northbound				148th St Southbound				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
7:00 AM	2	0	5	7	0	3	1	4	16	64	0	80	0	49	3	52	143
7:15 AM	2	0	3	5	0	3	2	5	17	76	0	93	0	49	4	53	156
7:30 AM	2	0	8	10	1	3	2	6	24	69	0	93	1	77	4	82	191
7:45 AM	5	2	5	12	0	2	1	3	11	73	0	84	0	35	4	39	138
Hourly Total	11	2	21	34	1	11	6	18	68	282	0	350	1	210	15	226	628
8:00 AM	4	0	8	12	1	1	3	5	15	76	0	91	0	33	5	38	146
8:15 AM	1	0	7	8	0	1	3	4	9	73	1	83	2	58	6	66	161
8:30 AM	0	0	5	5	0	2	0	2	4	33	0	37	2	55	10	67	111
8:45 AM	1	0	3	4	0	0	1	1	6	26	0	32	1	30	4	35	72
Hourly Total	6	0	23	29	1	4	7	12	34	208	1	243	5	176	25	206	490
9:00 AM	2	1	7	10	0	0	1	1	9	27	0	36	0	36	2	38	85
9:15 AM	3	0	5	8	0	3	0	3	5	24	0	29	0	23	2	25	65
9:30 AM	1	1	5	7	1	0	0	1	6	23	0	29	0	29	2	31	68
9:45 AM	0	0	9	9	1	0	0	1	4	30	0	34	1	20	5	26	70
Hourly Total	6	2	26	34	2	3	1	6	24	104	0	128	1	108	11	120	288
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2:00 PM	7	1	8	16	0	5	0	5	8	22	0	30	2	38	2	42	93
2:15 PM	4	1	6	11	0	2	0	2	3	36	1	40	1	42	1	44	97
2:30 PM	7	1	9	17	2	2	2	6	6	39	1	46	0	41	2	43	112
2:45 PM	3	0	9	12	0	0	0	0	9	26	1	36	1	38	6	45	93
Hourly Total	21	3	32	56	2	9	2	13	26	123	3	152	4	159	11	174	395
3:00 PM	8	1	19	28	0	0	1	1	8	44	1	53	0	32	4	36	118
3:15 PM	4	0	17	21	0	1	1	2	9	45	0	54	1	45	1	47	124
3:30 PM	11	2	18	31	0	0	0	0	5	37	1	43	3	59	8	70	144
3:45 PM	8	0	15	23	0	0	2	2	7	44	0	51	1	79	10	90	166
Hourly Total	31	3	69	103	0	1	4	5	29	170	2	201	5	215	23	243	552
4:00 PM	0	3	14	17	0	0	0	0	12	50	0	62	0	84	10	94	173
4:15 PM	5	2	21	28	0	2	0	2	17	38	0	55	2	65	7	74	159
4:30 PM	10	4	29	43	0	1	0	1	8	44	0	52	0	69	7	76	172
4:45 PM	14	2	14	30	0	2	1	3	13	55	1	69	1	77	5	83	185
Hourly Total	29	11	78	118	0	5	1	6	50	187	1	238	3	295	29	327	689
5:00 PM	7	1	15	23	0	5	2	7	7	54	0	61	3	54	12	69	160
5:15 PM	15	2	14	31	0	1	1	2	13	55	0	68	2	64	6	72	173
5:30 PM	6	2	26	34	0	0	1	1	14	51	1	66	2	65	2	69	170
5:45 PM	11	3	23	37	0	0	1	1	7	48	0	55	5	54	2	61	154
Hourly Total	39	8	78	125	0	6	5	11	41	208	1	250	12	237	22	271	657
6:00 PM	6	5	15	26	0	2	0	2	3	37	0	40	2	38	6	46	114
6:15 PM	5	1	17	23	1	0	1	2	5	44	0	49	1	37	3	41	115

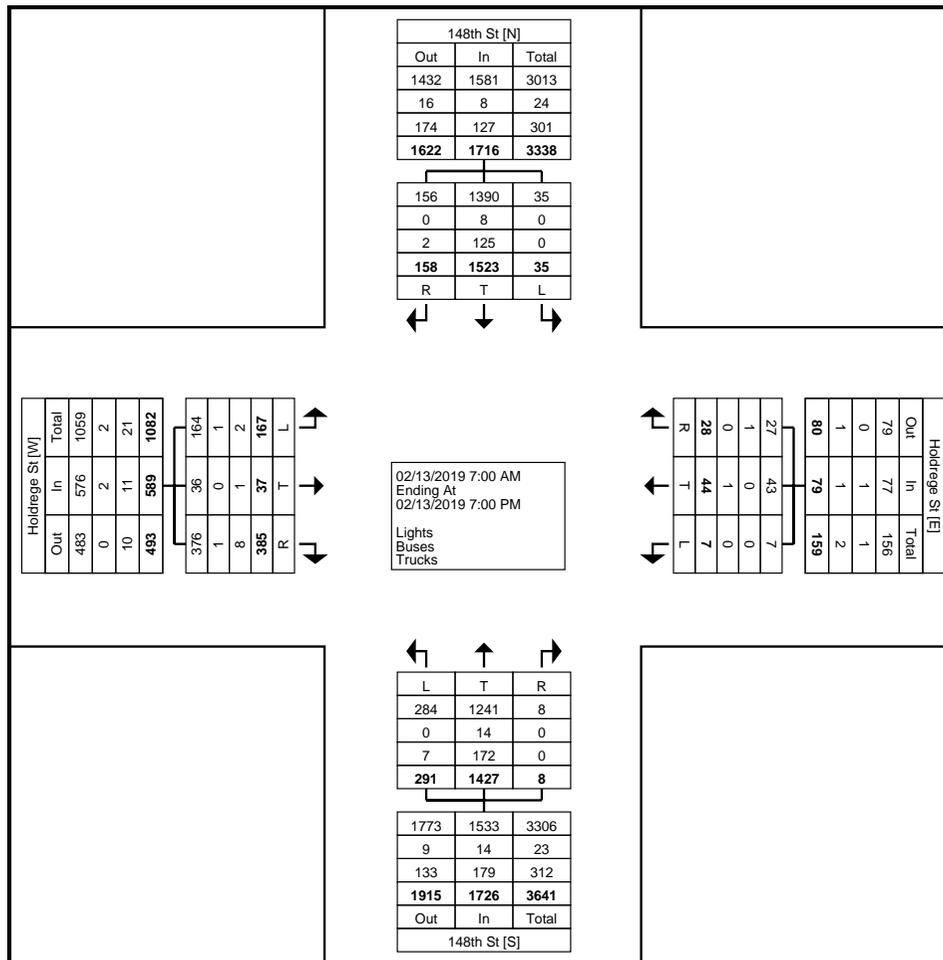
6:30 PM	6	0	11	17	0	1	1	2	6	34	0	40	0	32	8	40	99
6:45 PM	7	2	15	24	0	2	0	2	5	30	0	35	1	16	5	22	83
Hourly Total	24	8	58	90	1	5	2	8	19	145	0	164	4	123	22	149	411
Grand Total	167	37	385	589	7	44	28	79	291	1427	8	1726	35	1523	158	1716	4110
Approach %	28.4	6.3	65.4	-	8.9	55.7	35.4	-	16.9	82.7	0.5	-	2.0	88.8	9.2	-	-
Total %	4.1	0.9	9.4	14.3	0.2	1.1	0.7	1.9	7.1	34.7	0.2	42.0	0.9	37.1	3.8	41.8	-
Lights	164	36	376	576	7	43	27	77	284	1241	8	1533	35	1390	156	1581	3767
% Lights	98.2	97.3	97.7	97.8	100.0	97.7	96.4	97.5	97.6	87.0	100.0	88.8	100.0	91.3	98.7	92.1	91.7
Buses	1	0	1	2	0	0	1	1	0	14	0	14	0	8	0	8	25
% Buses	0.6	0.0	0.3	0.3	0.0	0.0	3.6	1.3	0.0	1.0	0.0	0.8	0.0	0.5	0.0	0.5	0.6
Trucks	2	1	8	11	0	1	0	1	7	172	0	179	0	125	2	127	318
% Trucks	1.2	2.7	2.1	1.9	0.0	2.3	0.0	1.3	2.4	12.1	0.0	10.4	0.0	8.2	1.3	7.4	7.7



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Count Name: 148th St & Holdrege St
Site Code: 148
Start Date: 02/13/2019
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Turning Movement Data Plot



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Count Name: 148th St & Holdrege St
Site Code: 148
Start Date: 02/13/2019
Page No: 4

Turning Movement Peak Hour Data (7:30 AM)

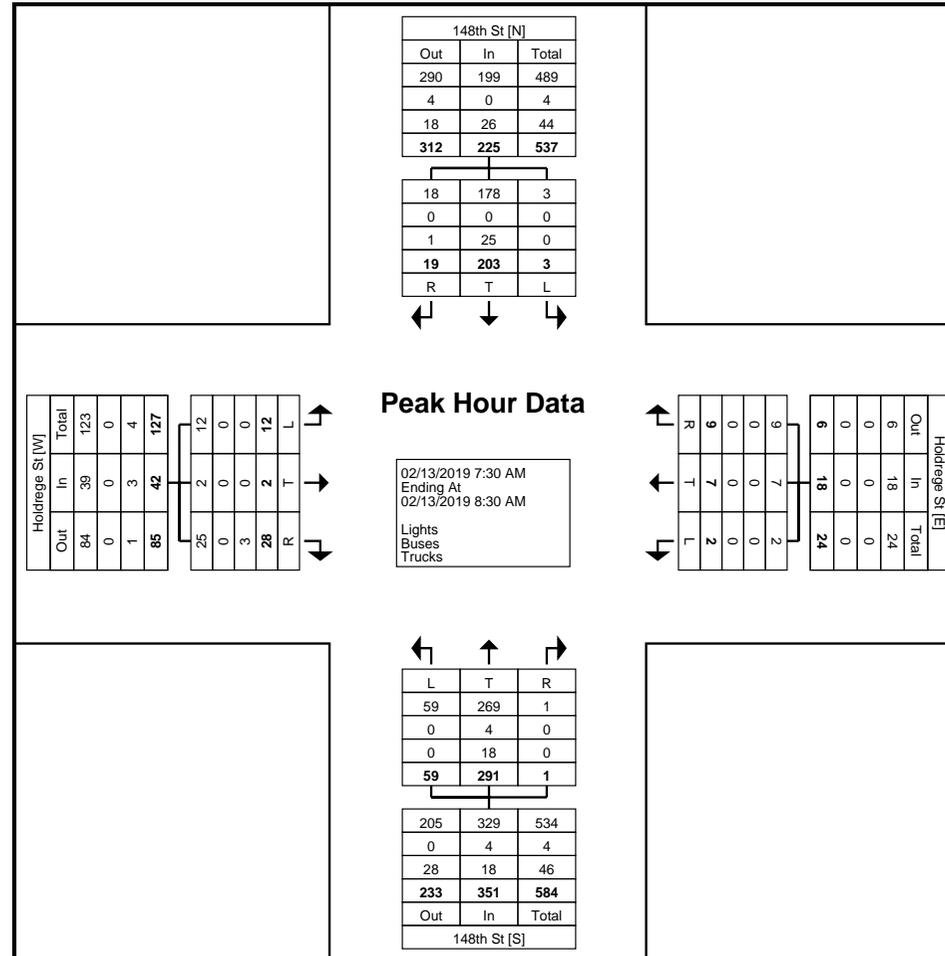
Start Time	Holdrege St Eastbound				Holdrege St Westbound				148th St Northbound				148th St Southbound				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
7:30 AM	2	0	8	10	1	3	2	6	24	69	0	93	1	77	4	82	191
7:45 AM	5	2	5	12	0	2	1	3	11	73	0	84	0	35	4	39	138
8:00 AM	4	0	8	12	1	1	3	5	15	76	0	91	0	33	5	38	146
8:15 AM	1	0	7	8	0	1	3	4	9	73	1	83	2	58	6	66	161
Total	12	2	28	42	2	7	9	18	59	291	1	351	3	203	19	225	636
Approach %	28.6	4.8	66.7	-	11.1	38.9	50.0	-	16.8	82.9	0.3	-	1.3	90.2	8.4	-	-
Total %	1.9	0.3	4.4	6.6	0.3	1.1	1.4	2.8	9.3	45.8	0.2	55.2	0.5	31.9	3.0	35.4	-
PHF	0.600	0.250	0.875	0.875	0.500	0.583	0.750	0.750	0.615	0.957	0.250	0.944	0.375	0.659	0.792	0.686	0.832
Lights	12	2	25	39	2	7	9	18	59	269	1	329	3	178	18	199	585
% Lights	100.0	100.0	89.3	92.9	100.0	100.0	100.0	100.0	100.0	92.4	100.0	93.7	100.0	87.7	94.7	88.4	92.0
Buses	0	0	0	0	0	0	0	0	0	4	0	4	0	0	0	0	4
% Buses	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	1.1	0.0	0.0	0.0	0.0	0.6
Trucks	0	0	3	3	0	0	0	0	0	18	0	18	0	25	1	26	47
% Trucks	0.0	0.0	10.7	7.1	0.0	0.0	0.0	0.0	0.0	6.2	0.0	5.1	0.0	12.3	5.3	11.6	7.4



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Count Name: 148th St & Holdrege St
Site Code: 148
Start Date: 02/13/2019
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Turning Movement Peak Hour Data Plot (7:30 AM)



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Count Name: 148th St & Holdrege St
Site Code: 148
Start Date: 02/13/2019
Page No: 6

Turning Movement Peak Hour Data (4:30 PM)

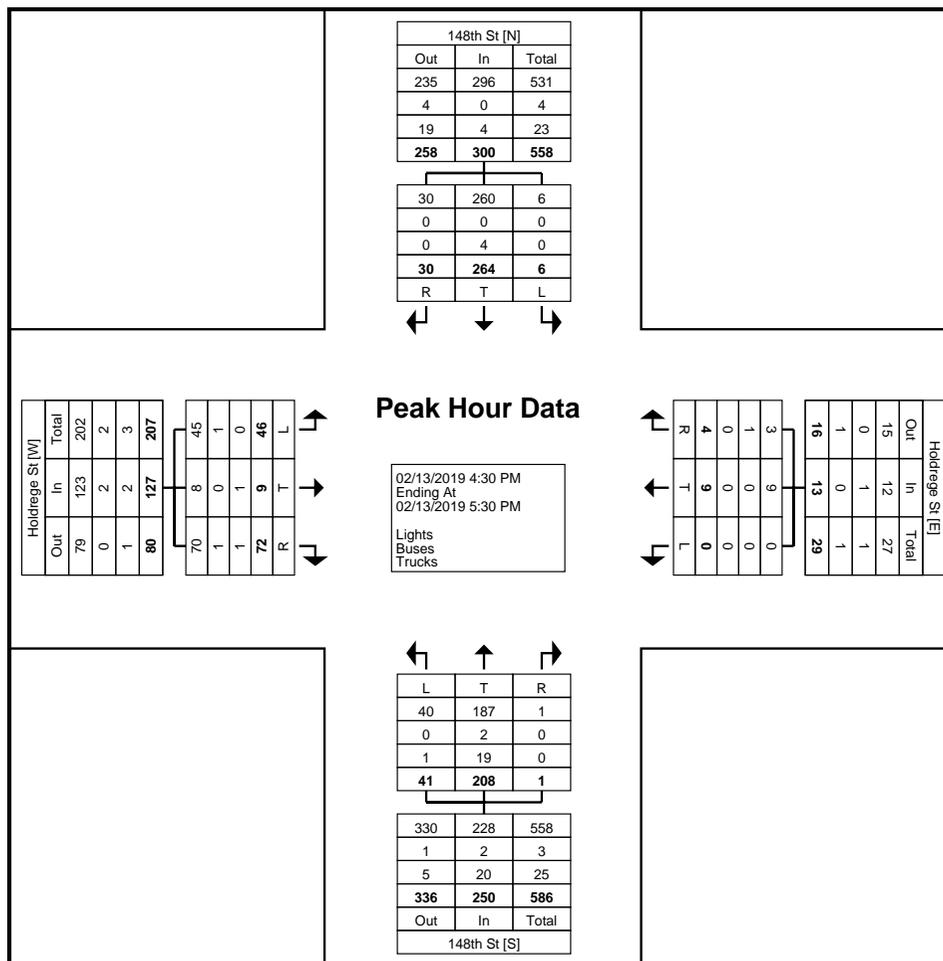
Start Time	Holdrege St Eastbound				Holdrege St Westbound				148th St Northbound				148th St Southbound				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
4:30 PM	10	4	29	43	0	1	0	1	8	44	0	52	0	69	7	76	172
4:45 PM	14	2	14	30	0	2	1	3	13	55	1	69	1	77	5	83	185
5:00 PM	7	1	15	23	0	5	2	7	7	54	0	61	3	54	12	69	160
5:15 PM	15	2	14	31	0	1	1	2	13	55	0	68	2	64	6	72	173
Total	46	9	72	127	0	9	4	13	41	208	1	250	6	264	30	300	690
Approach %	36.2	7.1	56.7	-	0.0	69.2	30.8	-	16.4	83.2	0.4	-	2.0	88.0	10.0	-	-
Total %	6.7	1.3	10.4	18.4	0.0	1.3	0.6	1.9	5.9	30.1	0.1	36.2	0.9	38.3	4.3	43.5	-
PHF	0.767	0.563	0.621	0.738	0.000	0.450	0.500	0.464	0.788	0.945	0.250	0.906	0.500	0.857	0.625	0.904	0.932
Lights	45	8	70	123	0	9	3	12	40	187	1	228	6	260	30	296	659
% Lights	97.8	88.9	97.2	96.9	-	100.0	75.0	92.3	97.6	89.9	100.0	91.2	100.0	98.5	100.0	98.7	95.5
Buses	1	0	1	2	0	0	1	1	0	2	0	2	0	0	0	0	5
% Buses	2.2	0.0	1.4	1.6	-	0.0	25.0	7.7	0.0	1.0	0.0	0.8	0.0	0.0	0.0	0.0	0.7
Trucks	0	1	1	2	0	0	0	0	1	19	0	20	0	4	0	4	26
% Trucks	0.0	11.1	1.4	1.6	-	0.0	0.0	0.0	2.4	9.1	0.0	8.0	0.0	1.5	0.0	1.3	3.8



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402-708-9175 mark@mnrg.us

Count Name: 148th St & Holdrege St
Site Code: 148
Start Date: 02/13/2019
Page No: 7



Turning Movement Peak Hour Data Plot (4:30 PM)



MNRG - Omaha
1753 S. 107th St

Omaha, Nebraska, United States 68124
402-708-9175

Count Name: 148th St & Adams St
Site Code: 1484
Start Date: 04/19/2018
Page No: 1

Turning Movement Data

Start Time	148th St Southbound				Adams St Westbound				148th St Northbound				Adams St Eastbound				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
6:00 AM	0	14	0	14	0	2	0	2	15	23	0	38	3	0	6	9	63
6:15 AM	1	17	0	18	1	5	0	6	28	23	0	51	3	0	4	7	82
6:30 AM	0	32	0	32	1	1	1	3	39	38	0	77	0	0	5	5	117
6:45 AM	0	35	1	36	0	0	0	0	34	50	0	84	2	1	7	10	130
Hourly Total	1	98	1	100	2	8	1	11	116	134	0	250	8	1	22	31	392
7:00 AM	0	41	5	46	2	2	1	5	23	35	0	58	6	1	5	12	121
7:15 AM	1	53	4	58	2	2	0	4	33	52	0	85	4	1	14	19	166
7:30 AM	0	71	5	76	1	1	2	4	47	52	0	99	8	3	15	26	205
7:45 AM	0	49	5	54	2	0	1	3	30	53	0	83	10	3	7	20	160
Hourly Total	1	214	19	234	7	5	4	16	133	192	0	325	28	8	41	77	652
8:00 AM	0	45	8	53	1	3	4	8	25	70	0	95	7	3	8	18	174
8:15 AM	1	48	5	54	1	1	5	7	19	62	0	81	4	3	6	13	155
8:30 AM	1	45	2	48	0	3	1	4	19	29	0	48	3	0	12	15	115
8:45 AM	0	30	4	34	0	3	1	4	6	26	0	32	2	0	3	5	75
Hourly Total	2	168	19	189	2	10	11	23	69	187	0	256	16	6	29	51	519
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2:00 PM	0	19	3	22	0	0	0	0	3	24	0	27	3	0	7	10	59
2:15 PM	0	28	0	28	0	0	0	0	9	28	0	37	4	1	6	11	76
2:30 PM	3	32	2	37	0	1	0	1	11	31	0	42	4	0	5	9	89
2:45 PM	0	34	1	35	0	0	3	3	6	36	0	42	1	3	4	8	88
Hourly Total	3	113	6	122	0	1	3	4	29	119	0	148	12	4	22	38	312
3:00 PM	0	44	4	48	0	1	0	1	5	37	1	43	1	3	5	9	101
3:15 PM	0	31	1	32	0	2	1	3	9	49	0	58	3	1	15	19	112
3:30 PM	1	64	3	68	1	2	1	4	13	46	1	60	0	1	23	24	156
3:45 PM	2	60	3	65	0	0	0	0	13	53	2	68	7	1	19	27	160
Hourly Total	3	199	11	213	1	5	2	8	40	185	4	229	11	6	62	79	529
4:00 PM	2	61	5	68	0	2	0	2	2	50	3	55	0	2	22	24	149
4:15 PM	2	59	2	63	1	1	1	3	6	64	2	72	7	4	22	33	171
4:30 PM	1	59	5	65	0	0	1	1	12	58	1	71	1	2	19	22	159
4:45 PM	1	68	1	70	0	1	0	1	13	52	0	65	7	4	25	36	172
Hourly Total	6	247	13	266	1	4	2	7	33	224	6	263	15	12	88	115	651
5:00 PM	0	87	2	89	2	1	0	3	6	56	0	62	3	1	17	21	175
5:15 PM	1	58	0	59	0	1	2	3	7	71	0	78	6	0	24	30	170
5:30 PM	3	60	3	66	0	2	1	3	9	53	0	62	5	2	13	20	151
5:45 PM	0	45	1	46	1	3	0	4	11	65	0	76	2	4	19	25	151
Hourly Total	4	250	6	260	3	7	3	13	33	245	0	278	16	7	73	96	647
6:00 PM	1	39	2	42	1	2	0	3	8	59	0	67	4	2	14	20	132
6:15 PM	0	33	3	36	1	2	2	5	8	59	4	71	6	6	12	24	136

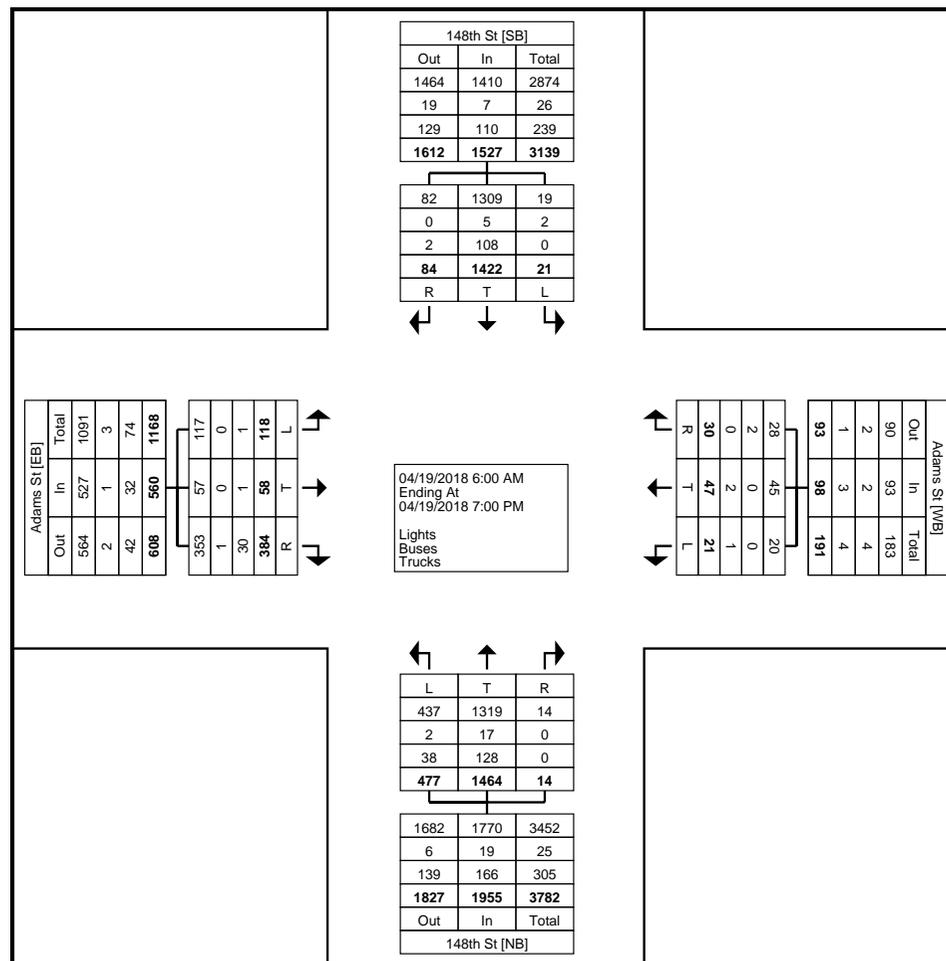
6:30 PM	0	28	2	30	2	1	0	3	4	29	0	33	0	1	11	12	78
6:45 PM	0	33	2	35	1	2	2	5	4	31	0	35	2	5	10	17	92
Hourly Total	1	133	9	143	5	7	4	16	24	178	4	206	12	14	47	73	438
Grand Total	21	1422	84	1527	21	47	30	98	477	1464	14	1955	118	58	384	560	4140
Approach %	1.4	93.1	5.5	-	21.4	48.0	30.6	-	24.4	74.9	0.7	-	21.1	10.4	68.6	-	-
Total %	0.5	34.3	2.0	36.9	0.5	1.1	0.7	2.4	11.5	35.4	0.3	47.2	2.9	1.4	9.3	13.5	-
Lights	19	1309	82	1410	20	45	28	93	437	1319	14	1770	117	57	353	527	3800
% Lights	90.5	92.1	97.6	92.3	95.2	95.7	93.3	94.9	91.6	90.1	100.0	90.5	99.2	98.3	91.9	94.1	91.8
Buses	2	5	0	7	0	0	2	2	2	17	0	19	0	0	1	1	29
% Buses	9.5	0.4	0.0	0.5	0.0	0.0	6.7	2.0	0.4	1.2	0.0	1.0	0.0	0.0	0.3	0.2	0.7
Trucks	0	108	2	110	1	2	0	3	38	128	0	166	1	1	30	32	311
% Trucks	0.0	7.6	2.4	7.2	4.8	4.3	0.0	3.1	8.0	8.7	0.0	8.5	0.8	1.7	7.8	5.7	7.5



MNRG - Omaha
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Count Name: 148th St & Adams St
Site Code: 1484
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Turning Movement Data Plot



MNRG - Omaha
1753 S. 107th St

Omaha, Nebraska, United States 68124
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Count Name: 148th St & Adams St
Site Code: 1484
Start Date: 04/19/2018
Page No: 4

Turning Movement Peak Hour Data (7:15 AM)

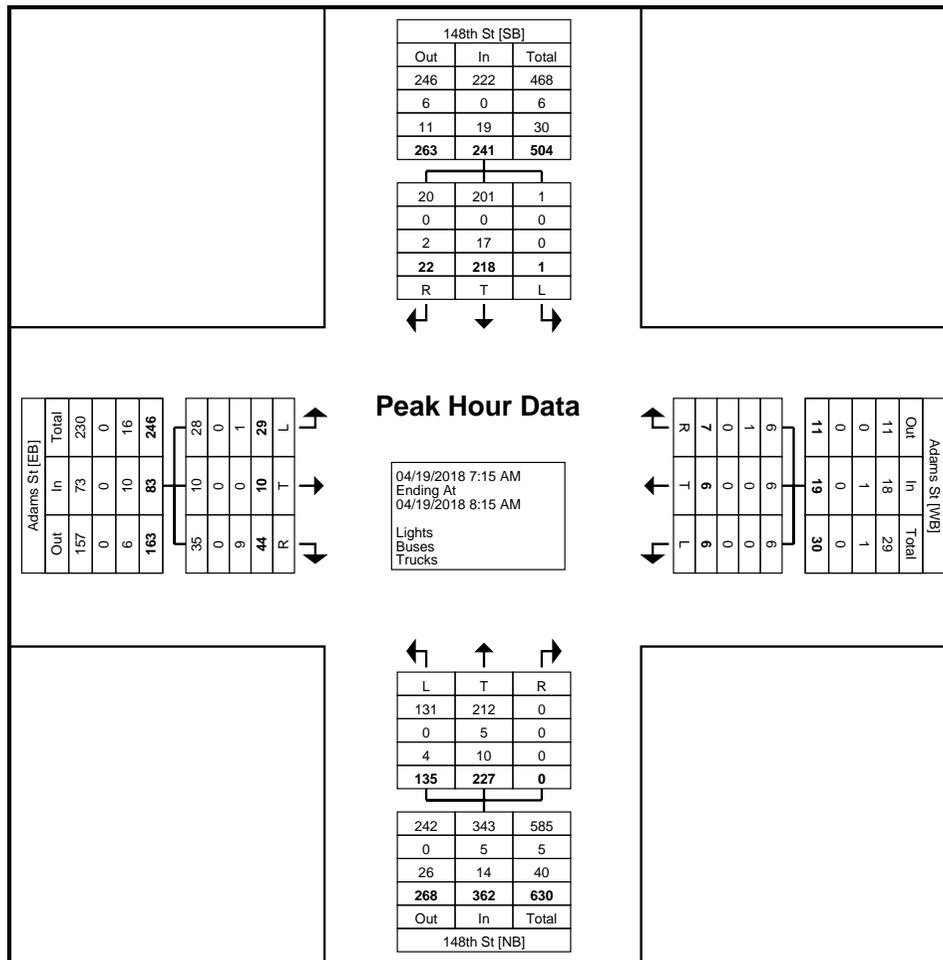
Start Time	148th St Southbound				Adams St Westbound				148th St Northbound				Adams St Eastbound				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
7:15 AM	1	53	4	58	2	2	0	4	33	52	0	85	4	1	14	19	166
7:30 AM	0	71	5	76	1	1	2	4	47	52	0	99	8	3	15	26	205
7:45 AM	0	49	5	54	2	0	1	3	30	53	0	83	10	3	7	20	160
8:00 AM	0	45	8	53	1	3	4	8	25	70	0	95	7	3	8	18	174
Total	1	218	22	241	6	6	7	19	135	227	0	362	29	10	44	83	705
Approach %	0.4	90.5	9.1	-	31.6	31.6	36.8	-	37.3	62.7	0.0	-	34.9	12.0	53.0	-	-
Total %	0.1	30.9	3.1	34.2	0.9	0.9	1.0	2.7	19.1	32.2	0.0	51.3	4.1	1.4	6.2	11.8	-
PHF	0.250	0.768	0.688	0.793	0.750	0.500	0.438	0.594	0.718	0.811	0.000	0.914	0.725	0.833	0.733	0.798	0.860
Lights	1	201	20	222	6	6	6	18	131	212	0	343	28	10	35	73	656
% Lights	100.0	92.2	90.9	92.1	100.0	100.0	85.7	94.7	97.0	93.4	-	94.8	96.6	100.0	79.5	88.0	93.0
Buses	0	0	0	0	0	0	1	1	0	5	0	5	0	0	0	0	6
% Buses	0.0	0.0	0.0	0.0	0.0	0.0	14.3	5.3	0.0	2.2	-	1.4	0.0	0.0	0.0	0.0	0.9
Trucks	0	17	2	19	0	0	0	0	4	10	0	14	1	0	9	10	43
% Trucks	0.0	7.8	9.1	7.9	0.0	0.0	0.0	0.0	3.0	4.4	-	3.9	3.4	0.0	20.5	12.0	6.1



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Count Name: 148th St & Adams St
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Turning Movement Peak Hour Data Plot (7:15 AM)



MNRG - Omaha
1753 S. 107th St

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Count Name: 148th St & Adams St
Site Code: 1484
Start Date: 04/19/2018
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Turning Movement Peak Hour Data (4:15 PM)

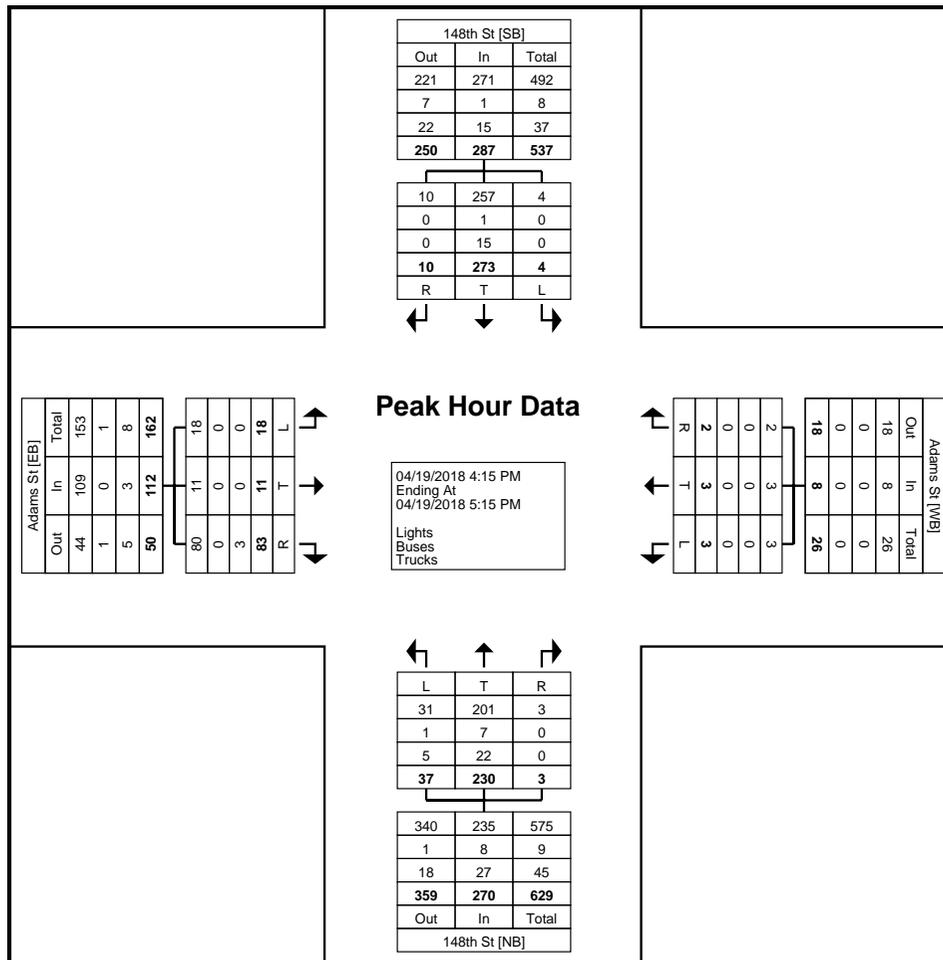
Start Time	148th St Southbound				Adams St Westbound				148th St Northbound				Adams St Eastbound				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
4:15 PM	2	59	2	63	1	1	1	3	6	64	2	72	7	4	22	33	171
4:30 PM	1	59	5	65	0	0	1	1	12	58	1	71	1	2	19	22	159
4:45 PM	1	68	1	70	0	1	0	1	13	52	0	65	7	4	25	36	172
5:00 PM	0	87	2	89	2	1	0	3	6	56	0	62	3	1	17	21	175
Total	4	273	10	287	3	3	2	8	37	230	3	270	18	11	83	112	677
Approach %	1.4	95.1	3.5	-	37.5	37.5	25.0	-	13.7	85.2	1.1	-	16.1	9.8	74.1	-	-
Total %	0.6	40.3	1.5	42.4	0.4	0.4	0.3	1.2	5.5	34.0	0.4	39.9	2.7	1.6	12.3	16.5	-
PHF	0.500	0.784	0.500	0.806	0.375	0.750	0.500	0.667	0.712	0.898	0.375	0.938	0.643	0.688	0.830	0.778	0.967
Lights	4	257	10	271	3	3	2	8	31	201	3	235	18	11	80	109	623
% Lights	100.0	94.1	100.0	94.4	100.0	100.0	100.0	100.0	83.8	87.4	100.0	87.0	100.0	100.0	96.4	97.3	92.0
Buses	0	1	0	1	0	0	0	0	1	7	0	8	0	0	0	0	9
% Buses	0.0	0.4	0.0	0.3	0.0	0.0	0.0	0.0	2.7	3.0	0.0	3.0	0.0	0.0	0.0	0.0	1.3
Trucks	0	15	0	15	0	0	0	0	5	22	0	27	0	0	3	3	45
% Trucks	0.0	5.5	0.0	5.2	0.0	0.0	0.0	0.0	13.5	9.6	0.0	10.0	0.0	0.0	3.6	2.7	6.6



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Count Name: 148th St & Adams St
Site Code: 1484
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Turning Movement Peak Hour Data Plot (4:15 PM)



Countermeasure 2
148th Street & Holdrege St Roundabout
FHU Project No. 18-122
Engineer's Opinion of Probable Cost
Monday, July 15, 2019

Grading Items				
	Units	2019 Estimate		
		Qty	Unit Price	Total
GENERAL CLEARING AND GRUBBING	LS	1.00	\$ 10,000.00	\$ 10,000.00
EARTHWORK	CY	65,000.00	\$ 10.00	\$ 650,000.00
REMOVE PAVEMENT	SY	4,000.00	\$ 7.50	\$ 30,000.00
Group Total				\$ 690,000.00

Pavement Items				
	Units	2019 Estimate		
		Qty	Unit Price	Total
9" CONCRETE PAVEMENT	SY	10,000	\$ 60.00	\$ 600,000.00
11" CONCRETE PAVEMENT - TRUCK APRON	SY	1,000	\$ 110.00	\$ 110,000.00
Group Total				\$ 710,000.00

Storm Sewer & Culverts				
	Units	2019 Estimate		
		Qty	Unit Price	Total
DRAINAGE	%	50%	\$	700,000.00
Group Total				\$ 700,000.00

Signing & Striping				
	Units	2019 Estimate		
		Qty	Unit Price	Total
SIGNING	%	5%	\$	35,500.00
STRIPING	%	5%	\$	35,500.00
Group Total				\$ 71,000.00

Project Related Items				
	Units	2019 Estimate		
		Qty	Unit Price	Total
MOBILIZATION	LS	1.00	\$ 173,700.00	\$ 173,700.00
TRAFFIC CONTROL	LS	1.00	\$ 108,600.00	\$ 108,600.00
RIGHT OF WAY	SF	5,000	\$ 10.00	\$ 50,000.00
RIGHT OF WAY DESIGN(TITLE SEARCHES & ACQUISITION)	EA	4	\$ 4,000.00	\$ 16,000.00
UTILITIES	%	5%	\$	70,000.00
Group Total				\$ 418,300.00

Project Totals

	Category	Total
	GRADING	\$ 690,000.00
	PAVEMENT	\$ 710,000.00
	STORM SEWER & CULVERTS	\$ 700,000.00
	SIGNING & STRIPING	\$ 71,000.00
	MOBILIZATION	\$ 173,700.00
	TRAFFIC CONTROL	\$ 108,600.00
	RIGHT OF WAY	\$ 66,000.00
	UTILITIES	\$ 140,000.00
	Construction Subtotal	\$ 2,659,300.00
	Contingency 20%	\$ 531,900.00
	Survey 0.0%	\$ -
	Engineering Services 10%	\$ 319,100.00
	Construction Services 8%	\$ 255,300.00
	Project Total	\$ 3,765,600.00

Assumptions:

- **This estimate is based on Conceptual Layout**
- Drainage Cost is estimated at 50% of Pavement and Grading includes culverts and channels
- Utility Cost is estimated at 10% of Pavement and Grading
- Contingency of 20% used
- Survey is not estimated and understood to be provided by Sarpy County Public Works Department
- Engineering Services are estimated at 10% of Construction Cost and Contingency
- Construction Services are estimated at 8% of Construction Cost and Contingency



Countermeasure 2
148th Street & Adams St Roundabout
FHU Project No. 18-122
Engineer's Opinion of Probable Cost
Monday, July 15, 2019

Grading Items				
	Units	2019 Estimate		
		Qty	Unit Price	Total
GENERAL CLEARING AND GRUBBING	LS	1.00	\$ 5,000.00	\$ 5,000.00
EARTHWORK	CY	20,000.00	\$ 10.00	\$ 200,000.00
REMOVE PAVEMENT	SY	5,000.00	\$ 7.50	\$ 37,500.00
Group Total				\$ 242,500.00

Pavement Items				
	Units	2019 Estimate		
		Qty	Unit Price	Total
9" CONCRETE PAVEMENT	SY	7,500	\$ 60.00	\$ 450,000.00
11" CONCRETE PAVEMENT - TRUCK APRON	SY	1,000	\$ 110.00	\$ 110,000.00
Group Total				\$ 560,000.00

Storm Sewer & Culverts				
	Units	2019 Estimate		
		Qty	Unit Price	Total
DRAINAGE	%	20%	\$	160,500.00
Group Total				\$ 160,500.00

Signing & Striping				
	Units	2019 Estimate		
		Qty	Unit Price	Total
SIGNING	%	5%	\$	28,000.00
STRIPING	%	5%	\$	28,000.00
Group Total				\$ 56,000.00

Project Related Items				
	Units	2019 Estimate		
		Qty	Unit Price	Total
MOBILIZATION	LS	1.00	\$ 81,500.00	\$ 81,500.00
TRAFFIC CONTROL	LS	1.00	\$ 51,000.00	\$ 51,000.00
RIGHT OF WAY	SF	3,500	\$ 10.00	\$ 35,000.00
RIGHT OF WAY DESIGN(TITLE SEARCHES & ACQUISITION)	EA	4	\$ 4,000.00	\$ 16,000.00
UTILITIES	%	5%	\$	40,125.00
Group Total				\$ 223,625.00

Project Totals

	Category	Total
	GRADING	\$ 242,500.00
	PAVEMENT	\$ 560,000.00
	STORM SEWER & CULVERTS	\$ 160,500.00
	SIGNING & STRIPING	\$ 56,000.00
	MOBILIZATION	\$ 81,500.00
	TRAFFIC CONTROL	\$ 51,000.00
	RIGHT OF WAY	\$ 51,000.00
	UTILITIES	\$ 80,250.00
	Construction Subtotal	\$ 1,282,750.00
	Contingency 20%	\$ 256,600.00
	Survey 0.0%	\$ -
	Engineering Services 10%	\$ 153,900.00
	Construction Services 8%	\$ 123,100.00
	Project Total	\$ 1,816,350.00

Assumptions:

- **This estimate is based on Conceptual Layout**
- Drainage Cost is estimated at 20% of Pavement and Grading
- Utility Cost is estimated at 10% of Pavement and Grading
- Contingency of 20% used
- Survey is not estimated and understood to be provided by Sarpy County Public Works Department
- Engineering Services are estimated at 10% of Construction Cost and Contingency
- Construction Services are estimated at 8% of Construction Cost and Contingency



Countermeasure 2
148th Street & Adams St Left Turn Lanes
FHU Project No. 18-122
Engineer's Opinion of Probable Cost
Monday, July 15, 2019

Grading Items					
	Units	2018 Estimate			
		Qty	Unit Price	Total	
GENERAL CLEARING AND GRUBBING	LS	1.00	\$ 5,000.00	\$ 5,000.00	
EARTHWORK	CY	5,000.00	\$ 10.00	\$ 50,000.00	
REMOVE PAVEMENT	SY	750.00	\$ 7.50	\$ 5,625.00	
Group Total				\$ 60,625.00	

Pavement Items					
	Units	2018 Estimate			
		Qty	Unit Price	Total	
9" CONCRETE PAVEMENT	SY	1,500	\$ 60.00	\$ 90,000.00	
Group Total				\$ 90,000.00	

Storm Sewer & Culverts					
	Units	2018 Estimate			
		Qty	Unit Price	Total	
DRAINAGE	%	20%		\$ 30,125.00	
Group Total				\$ 30,125.00	

Signing & Striping					
	Units	2018 Estimate			
		Qty	Unit Price	Total	
SIGNING	%	5%		\$ 4,500.00	
STRIPING	%	5%		\$ 4,500.00	
Group Total				\$ 9,000.00	

Project Related Items					
	Units	2018 Estimate			
		Qty	Unit Price	Total	
MOBILIZATION	LS	1.00	\$ 15,200.00	\$ 15,200.00	
TRAFFIC CONTROL	LS	1.00	\$ 9,500.00	\$ 9,500.00	
RIGHT OF WAY	SF	1,750	\$ 10.00	\$ 17,500.00	
RIGHT OF WAY DESIGN(TITLE SEARCHES & ACQUISITION)	EA	2	\$ 4,000.00	\$ 8,000.00	
UTILITIES	%	5%		\$ 7,531.25	
Group Total				\$ 57,731.25	

Project Totals

	Category	Total
	GRADING	\$ 60,625.00
	PAVEMENT	\$ 90,000.00
	STORM SEWER & CULVERTS	\$ 30,125.00
	SIGNING & STRIPING	\$ 9,000.00
	MOBILIZATION	\$ 15,200.00
	TRAFFIC CONTROL	\$ 9,500.00
	RIGHT OF WAY	\$ 25,500.00
	UTILITIES	\$ 15,062.50
	Construction Subtotal	\$ 255,010.00
	Contingency 20%	\$ 51,000.00
	Survey 0.0%	\$ -
	Engineering Services 10%	\$ 30,600.00
	Construction Services 8%	\$ 24,500.00
	Project Total	\$ 361,110.00

Assumptions:

- **This estimate is based on Conceptual Layout**
- Drainage Cost is estimated at 20% of Pavement and Grading
- Utility Cost is estimated at 10% of Pavement and Grading
- Contingency of 20% used
- Survey is not estimated and understood to be provided by Sarpy County Public Works Department
- Engineering Services are estimated at 10% of Construction Cost and Contingency
- Construction Services are estimated at 8% of Construction Cost and Contingency

Worksheet 2A -- General Information and Input Data for Rural Two-Lane Two-Way Roadway Intersections				
General Information		Location Information		
Analyst	TJA	Roadway	148th Street	
Agency or Company	FHU	Intersection	148th Street with Adams Street	
Date Performed	07/15/19	Jurisdiction	Lancaster County	
		Analysis Year	2039	
Input Data		Base Conditions	Site Conditions	
Intersection type (3ST, 4ST, 4SG)		--	4ST	
AADT _{major} (veh/day)	AADT _{MAX} = 14,700 (veh/day)	--	5,850	
AADT _{minor} (veh/day)	AADT _{MAX} = 3,500 (veh/day)	--	1,850	
Intersection skew angle (degrees) [If 4ST, does skew differ for minor legs?]	No	0	Skew for Leg 1 (All): 0	Skew for Leg 2 (4ST only): 0
Number of signalized or uncontrolled approaches with a left-turn lane (0, 1, 2, 3, 4)		0	0	
Number of signalized or uncontrolled approaches with a right-turn lane (0, 1, 2, 3, 4)		0	0	
Intersection lighting (present/not present)		Not Present	Not Present	
Calibration Factor, C _i		1.00	1.00	

Worksheet 2B -- Crash Modification Factors for Rural Two-Lane Two-Way Roadway Intersections				
(1)	(2)	(3)	(4)	(5)
CMF for Intersection Skew Angle CMF ₁₁ from Equations 10-22 or 10-23	CMF for Left-Turn Lanes CMF ₂₁ from Table 10-13	CMF for Right-Turn Lanes CMF ₃₁ from Table 10-14	CMF for Lighting CMF ₄₁ from Equation 10-24	Combined CMF CMF _{COMB} (1)*(2)*(3)*(4)
1.00	1.00	1.00	1.00	1.00

Worksheet 2C -- Intersection Crashes for Rural Two-Lane Two-Way Roadway Intersections							
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	N _{spt 3ST, 4ST or 4SG}	Overdispersion Parameter, k	Crash Severity Distribution	N _{spt 3ST, 4ST or 4SG} by Severity Distribution	Combined CMFs	Calibration Factor, C _i	Predicted average crash frequency, N _{predicted int}
	from Equations 10-8, 10-9, or 10-10	from Section 10.6.2	from Table 10-5	(2) _{TOTAL} * (4)	from (5) of Worksheet 2B		
Total	3.433	0.24	1.000	3.433	1.00	1.00	3.433
Fatal and Injury (FI)	--	--	0.431	1.480	1.00	1.00	1.480
Property Damage Only (PDO)	--	--	0.569	1.954	1.00	1.00	1.954

Worksheet 2D -- Crashes by Severity Level and Collision Type for Rural Two-Lane Two-Way Road Intersections						
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Collision Type	Proportion of Collision Type _{TOTAL}	N _{predicted int (TOTAL)} (crashes/year)	Proportion of Collision Type _{FI}	N _{predicted int (FI)} (crashes/year)	Proportion of Collision Type _{PDO}	N _{predicted int (PDO)} (crashes/year)
	from Table 10-6	(8) _{TOTAL} from Worksheet 2C	from Table 10-6	(8) _{FI} from Worksheet 2C	from Table 10-6	(8) _{PDO} from Worksheet 2C
Total	1.000	3.433	1.000	1.480	1.000	1.954
		(2)x(3) _{TOTAL}		(4)x(5) _{FI}		(6)x(7) _{PDO}
SINGLE-VEHICLE						
Collision with animal	0.010	0.034	0.006	0.009	0.014	0.027
Collision with bicycle	0.001	0.003	0.001	0.001	0.001	0.002
Collision with pedestrian	0.001	0.003	0.001	0.001	0.001	0.002
Overturned	0.005	0.017	0.006	0.009	0.004	0.008
Ran off road	0.122	0.419	0.094	0.139	0.144	0.281
Other single-vehicle collision	0.008	0.027	0.004	0.006	0.010	0.020
Total single-vehicle crashes	0.147	0.505	0.112	0.166	0.174	0.340
MULTIPLE-VEHICLE						
Angle collision	0.431	1.480	0.532	0.787	0.354	0.692
Head-on collision	0.040	0.137	0.060	0.089	0.025	0.049
Rear-end collision	0.242	0.831	0.210	0.311	0.266	0.520
Sideswipe collision	0.101	0.347	0.044	0.065	0.144	0.281
Other multiple-vehicle collision	0.039	0.134	0.042	0.062	0.037	0.072
Total multiple-vehicle crashes	0.853	2.929	0.888	1.314	0.826	1.614

Worksheet 2E -- Summary Results for Rural Two-Lane Two-Way Road Intersections		
(1)	(2)	(3)
Crash severity level	Crash Severity Distribution (proportion)	Predicted average crash frequency (crashes / year)
	(4) from Worksheet 2C	(8) from Worksheet 2C
Total	1.000	3.4
Fatal and Injury (FI)	0.431	1.5
Property Damage Only (PDO)	0.569	2.0

Worksheet 2A -- General Information and Input Data for Rural Two-Lane Two-Way Roadway Intersections				
General Information		Location Information		
Analyst	TJA	Roadway	148th Street	
Agency or Company	FHU	Intersection	148th Street with Adams Street	
Date Performed	07/15/19	Jurisdiction	Lancaster County	
		Analysis Year	2039	
Input Data		Base Conditions	Site Conditions	
Intersection type (3ST, 4ST, 4SG)		--	4ST	
AADT _{major} (veh/day)	AADT _{MAX} = 14,700 (veh/day)	--	14,100	
AADT _{minor} (veh/day)	AADT _{MAX} = 3,500 (veh/day)	--	3,050	
Intersection skew angle (degrees) [If 4ST, does skew differ for minor legs?]	No	0	Skew for Leg 1 (All): 0	Skew for Leg 2 (4ST only): 0
Number of signalized or uncontrolled approaches with a left-turn lane (0, 1, 2, 3, 4)		0	0	
Number of signalized or uncontrolled approaches with a right-turn lane (0, 1, 2, 3, 4)		0	0	
Intersection lighting (present/not present)		Not Present	Not Present	
Calibration Factor, C _i		1.00	1.00	

Worksheet 2B -- Crash Modification Factors for Rural Two-Lane Two-Way Roadway Intersections				
(1)	(2)	(3)	(4)	(5)
CMF for Intersection Skew Angle CMF _{i1} from Equations 10-22 or 10-23	CMF for Left-Turn Lanes CMF _{i2} from Table 10-13	CMF for Right-Turn Lanes CMF _{i3} from Table 10-14	CMF for Lighting CMF _{i4} from Equation 10-24	Combined CMF CMF _{COMB} (1)*(2)*(3)*(4)
1.00	1.00	1.00	1.00	1.00

Worksheet 2C -- Intersection Crashes for Rural Two-Lane Two-Way Roadway Intersections							
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crash Severity Level	N _{spt 3ST, 4ST or 4SG} from Equations 10-8, 10-9, or 10-10	Overdispersion Parameter, k from Section 10.6.2	Crash Severity Distribution from Table 10-5	N _{spt 3ST, 4ST or 4SG} by Severity Distribution (2) _{TOTAL} * (4)	Combined CMFs from (5) of Worksheet 2B	Calibration Factor, C _i	Predicted average crash frequency, N _{predicted int} (5)*(6)*(7)
Total	7.896	0.24	1.000	7.896	1.00	1.00	7.896
Fatal and Injury (FI)	--	--	0.431	3.403	1.00	1.00	3.403
Property Damage Only (PDO)	--	--	0.569	4.493	1.00	1.00	4.493

Worksheet 2D -- Crashes by Severity Level and Collision Type for Rural Two-Lane Two-Way Road Intersections						
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Collision Type	Proportion of Collision Type _{TOTAL} from Table 10-6	N _{predicted int (TOTAL)} (crashes/year) (8) _{TOTAL} from Worksheet 2C	Proportion of Collision Type _{PI} from Table 10-6	N _{predicted int (PI)} (crashes/year) (8) _{PI} from Worksheet 2C	Proportion of Collision Type _{PDO} from Table 10-6	N _{predicted int (PDO)} (crashes/year) (8) _{PDO} from Worksheet 2C
Total	1.000	7.896 (2)x(3) _{TOTAL}	1.000	3.403 (4)x(5) _{PI}	1.000	4.493 (6)x(7) _{PDO}
SINGLE-VEHICLE						
Collision with animal	0.010	0.079	0.006	0.020	0.014	0.063
Collision with bicycle	0.001	0.008	0.001	0.003	0.001	0.004
Collision with pedestrian	0.001	0.008	0.001	0.003	0.001	0.004
Overturned	0.005	0.039	0.006	0.020	0.004	0.016
Ran off road	0.122	0.963	0.094	0.320	0.144	0.647
Other single-vehicle collision	0.008	0.063	0.004	0.014	0.010	0.045
Total single-vehicle crashes	0.147	1.161	0.112	0.381	0.174	0.782
MULTIPLE-VEHICLE						
Angle collision	0.431	3.403	0.532	1.810	0.354	1.590
Head-on collision	0.040	0.316	0.060	0.204	0.025	0.112
Rear-end collision	0.242	1.911	0.210	0.715	0.266	1.195
Sideswipe collision	0.101	0.797	0.044	0.150	0.144	0.647
Other multiple-vehicle collision	0.039	0.308	0.042	0.143	0.037	0.166
Total multiple-vehicle crashes	0.853	6.735	0.888	3.022	0.826	3.711

Worksheet 2E -- Summary Results for Rural Two-Lane Two-Way Road Intersections		
(1)	(2)	(3)
Crash severity level	Crash Severity Distribution (proportion) (4) from Worksheet 2C	Predicted average crash frequency (crashes / year) (8) from Worksheet 2C
Total	1.000	7.9
Fatal and Injury (FI)	0.431	3.4
Property Damage Only (PDO)	0.569	4.5



CMF / CRF Details

CMF ID: 268

Provide a left-turn lane on both major-road approaches

Description:

Prior Condition: *No Prior Condition(s)*

Category: Intersection geometry

Study: [*Safety Effectiveness of Intersection Left- and Right-Turn Lanes, Harwood et al., 2002*](#)

Star Quality Rating:



Crash Modification Factor (CMF)

Value: 0.52

Adjusted Standard Error: 0.04

Unadjusted Standard Error: 0.03

Crash Reduction Factor (CRF)

Value: 48 (This value indicates a **decrease** in crashes)

Adjusted Standard Error: 4

Unadjusted Standard Error:

3

Applicability

Crash Type:

All

Crash Severity:

All

Roadway Types:

Not Specified

Number of Lanes:

Road Division Type:

Speed Limit:

Area Type:

Rural

Traffic Volume:

Time of Day:

If countermeasure is intersection-based

Intersection Type:

Roadway/roadway (not interchange related)

Intersection Geometry:

4-leg

Traffic Control:

Stop-controlled

Major Road Traffic Volume:

1500 to 32400 Average Daily Traffic (ADT)

Minor Road Traffic Volume:

50 to 11800 Average Daily Traffic (ADT)

Development Details

Date Range of Data Used:

Municipality:

State:

Country:	
Type of Methodology Used:	Before/after using empirical Bayes or full Bayes
Sample Size Used:	

Other Details	
Included in Highway Safety Manual?	Yes. HSM lists this CMF in bold font to indicate that it has the highest reliability since it has an adjusted standard error of 0.1 or less.
Date Added to Clearinghouse:	Dec-01-2009
Comments:	Countermeasure name changed to match HSM

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CMF / CRF Details

CMF ID: 4224

Convert signalized intersection to modern roundabout

Description:

Prior Condition: Four-leg signalized intersection at interchange ramp terminal converted to a four-leg, one-lane, non-circular “eye drop” roundabout.

Category: Intersection geometry

Study: [Performance Evaluation of Roundabouts for Traffic Flow Improvements and Crash Reductions at a Highway Interchange in Oxford, MS, Uddin, Headrick, and Sullivan, 2012](#)

Star Quality Rating:



[\[View score details\]](#)

Crash Modification Factor (CMF)

Value: 0.625

Adjusted Standard Error:

Unadjusted Standard Error:

Crash Reduction Factor (CRF)

Value: 37.5 (This value indicates a **decrease** in crashes)

Adjusted Standard Error:

Unadjusted Standard Error:

Applicability

Crash Type:

All

Crash Severity:

All

Roadway Types:

Principal Arterial Other

Number of Lanes:

1

Road Division Type:

Undivided

Speed Limit:

Area Type:

Rural

Traffic Volume:

Time of Day:

Not specified

If countermeasure is intersection-based

Intersection Type:

Roadway/roadway (interchange ramp terminal)

Intersection Geometry:

4-leg

Traffic Control:

Signalized

Major Road Traffic Volume:

Minor Road Traffic Volume:

Development Details

Date Range of Data Used:

2005 to 2009

Municipality:

Oxford

State:	MS
Country:	United States
Type of Methodology Used:	Before/after using empirical Bayes or full Bayes
Sample Size Used:	Site-years
Before Sample Size Used:	2.5 Site-years
After Sample Size Used:	2.5 Site-years

Other Details	
Included in Highway Safety Manual?	No
Date Added to Clearinghouse:	Nov-01-2012
Comments:	Countermeasure name has been slightly modified for consistency across Clearinghouse

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