



## 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 – S 68<sup>th</sup> Street Intersection Improvements

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### **Project Background**

In December 2018, Felsburg Holt & Ullevig (FHU) completed a safety analysis for S 68<sup>th</sup> Street between the intersections of Firth Road and Saltillo 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 – S 68<sup>th</sup> 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 S 68<sup>th</sup> Street with Roca Road. The additional work includes an updated safety analysis of the studied 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**

S 68<sup>th</sup> Street with Road Road is a two-way stop-controlled intersection. Roca Road, running east-west, is a two-lane undivided highway. It has left-turn lanes on each approach. The posted speed limit is 55 mph in both directions. S 68<sup>th</sup> Street, running north-south, is a two-lane undivided highway. It also has left-turn lanes on both approaches. S 68<sup>th</sup> Street has a posted speed limit of 55 mph in both directions. There is an overhead flashing beacon at the intersection.

Average daily traffic was assessed during the original study. The daily entering vehicles (DEV) at 68<sup>th</sup> Street with Roca Road is 6,813.

### **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 four (4) crashes were reported at S 68<sup>th</sup> Street with Roca Road. This amounts to a crash rate of 0.257 acc/mvmt, which is 1.09 times the Nebraska average.

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

**Table 1. S 68<sup>th</sup> Street with Roca Road Intersection Crash Summary by Type**

Intersection	Rear End	Side Swipe (Same)	Right-Angle	Total
Roca Road	-	1	3	4

**Table 2. S 68<sup>th</sup> Street with Roca Road Intersection Crash Summary by Severity**

Intersection	Fatal	Injury			N-R	PDO	Total
		INJ-A	INJ-B	INJ-C			
Roca Road	-	1	-	2	-	1	4

Other intersections along S 68<sup>th</sup> Street were reviewed during this study, but few were considered to have a significant crash history or potential for an impactful safety improvement. Those that did were known to be undergoing analysis and/or implementation currently, such as the intersections of Olive Creek Road, Princeton Road, and Saltillo Road.

### ***Proposed Improvements***

Based on the existing traffic operations and crash patterns at the intersections, the following countermeasure was developed to improve safety at the location.

#### *Construct a Roundabout*

This countermeasure would reconstruct the current two-way stop-controlled intersection at S 68<sup>th</sup> Street with Roca Road as a single-lane roundabout.

### ***Project Costs***

A preliminary cost estimate was developed by FHU for the proposed counter measure. The roundabout countermeasure at S 68<sup>th</sup> Street with Roca Road is estimated to cost approximately \$2.6 million. A full breakdown of the cost estimate is attached to this memo.

### ***Benefits of Project***

The observed crash patterns identified at the intersection will be directly addressed with the intersection improvements proposed. The roundabout design would eliminate right angle conflicts points, as well as reduce overall crash rates.

It should be noted that the recommended roundabout improvement may increase delay for certain movements, 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 3a, b, and c** show the Federal Highway Administration's estimated societal cost of crashes by type and severity, for crashes on rural roadways.

**Table 3. 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 the proposed improvement. 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.

**Roca Road Countermeasure – Construct a Roundabout**

The cost of this countermeasure was estimated at \$3.1 million with a project life of 20 years. This includes an initial construction cost of \$2.6 million and an operational/maintenance cost of \$26,165 per year. A CMF of 0.290 / CRF of 0.710 was used for crash type and a CMF of 0.170 / CRF of 0.830 was used for crash severity analysis.

**Table 4** summarizes the benefit-cost calculations for the countermeasure by crash type and **Table 5** for crash severity. Based on the factors discussed above, the project would be expected to provide a benefit-cost ratio of **1.62** based on crash type and **0.84** for crash severity.

**Table 4. Roca Road Countermeasure: Benefit-Cost Calculation by Crash Type**

Average Cost/Mitigated Crash (2013 through 2019 average weighting crash type)	\$561,481
Present Value of Avoided Crashes, <b>BENEFIT</b>	\$5,094,584
Present Value Cost, <b>COST</b>	\$3,139,800
<b>Crash Type Benefit/Cost Ratio</b>	<b>1.62</b>

**Table 5. Roca Road Countermeasure: Benefit-Cost Calculation by Crash Severity**

Average Cost/Mitigated Crash (2013 through 2019 average weighting crash type)	\$247,850
Present Value of Avoided Crashes, <b>BENEFIT</b>	\$2,628,953
Present Value Cost, <b>COST</b>	\$3,139,800
<b>Crash Type Benefit/Cost Ratio</b>	<b>0.84</b>



**Countermeasure 2**  
**Roca Road & 68th Street Roundabout**  
**FHU Project No. 18-122**  
**Engineer's Opinion of Probable Cost**  
**Monday, July 15, 2019**

<b>Grading Items</b>				
	Units	2019 Estimate		
		Qty	Unit Price	Total
GENERAL CLEARING AND GRUBBING	LS	1.00	\$ 2,500.00	\$ 2,500.00
EARTHWORK	CY	15,000.00	\$ 10.00	\$ 150,000.00
REMOVE PAVEMENT	SY	9,000.00	\$ 9.00	\$ 81,000.00
<b>Group Total</b>				<b>\$ 233,500.00</b>

<b>Pavement Items</b>				
	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
<b>Group Total</b>				<b>\$ 710,000.00</b>

<b>Storm Sewer &amp; Culverts</b>				
	Units	2019 Estimate		
		Qty	Unit Price	Total
DRAINAGE	%	50%	\$	471,750.00
<b>Group Total</b>				<b>\$ 471,750.00</b>

<b>Signing &amp; Striping</b>				
	Units	2019 Estimate		
		Qty	Unit Price	Total
SIGNING	%	5%	\$	35,500.00
STRIPING	%	5%	\$	35,500.00
<b>Group Total</b>				<b>\$ 71,000.00</b>

<b>Project Related Items</b>				
	Units	2019 Estimate		
		Qty	Unit Price	Total
MOBILIZATION	LS	1.00	\$ 118,900.00	\$ 118,900.00
TRAFFIC CONTROL	LS	1.00	\$ 74,300.00	\$ 74,300.00
RIGHT OF WAY	SF	5,000	\$ 10.00	\$ 50,000.00
RIGHT OF WAY DESIGN( TITLE SEARCHES & ACQUISITION)	EA	6	\$ 4,000.00	\$ 24,000.00
UTILITIES	%	5%	\$	47,175.00
<b>Group Total</b>				<b>\$ 314,375.00</b>

## Project Totals

	Category	Total
	GRADING	\$ 233,500.00
	PAVEMENT	\$ 710,000.00
	STORM SEWER & CULVERTS	\$ 471,750.00
	SIGNING & STRIPING	\$ 71,000.00
	MOBILIZATION	\$ 118,900.00
	TRAFFIC CONTROL	\$ 74,300.00
	RIGHT OF WAY	\$ 74,000.00
	UTILITIES	\$ 94,350.00
	<b>Construction Subtotal</b>	<b>\$ 1,847,800.00</b>
	<b>Contingency</b> 20%	<b>\$ 369,600.00</b>
	<b>Survey</b> 0.0%	<b>\$ -</b>
	<b>Engineering Services</b> 10%	<b>\$ 221,700.00</b>
	<b>Construction Services</b> 8%	<b>\$ 177,400.00</b>
	<b>Project Total</b>	<b>\$ 2,616,500.00</b>

### 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

**B/C Analysis by Crash Type**  
**Intersection of 68th Street and Roca Road**  
**Supplemental Safety Study**



	<b>Unit</b>	
Facility Location		Rural
Service Life	Years	20
Crash History Provided	Years	6.26

Data Entry Required  
Data Calculated

<b>Costs</b>		
Construction	Dollars	\$ 2,616,500.00
Operations & Maint.	Dollars per Year	\$ 26,165.00
Other Capital Costs	Dollars	\$ -
Other Continual Costs	Dollars per Year	\$ -

Improvement(s):  
**Convert to Roundabout**

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ADT	Vehicles per Year	6800
Crash Modification Factor (CMF) Average		0.290

<b>Crash Mitigation</b>									
(Enter as many as necessary, However limit to only ONE treatment for any single historical accident)									
Accident Involvement	Accident Type	Facility Type	Number of Crashes	Societal Cost	Treatment	CMF	CMF ID	Number Mitigated	Value Mitigated
Multi_VehicleR	Right Angle	Intersection	3.0	\$ 1,447,047.13	Roundabout	0.290	229	6.8	\$ 3,282,439.18
Multi_VehicleR	Sideswipe (Opposite Direction)	Intersection	1.0	\$ 798,874.91	Roundabout	0.290	229	2.3	\$ 1,812,144.36

<b>Calculations</b>	
Million Vehicles per Year	2.482
Crashes Mitigated	9.1
Crashes Mitigated/Year	0.453674121
Crashes Mitigated per Million Vehicles	0.18279
Total Historical Societal Cost	\$ 2,245,922
Total Cost Mitigated Over Service Life	\$ 5,094,584
Average Cost per Mitigated Crash	\$ 561,481
Costs total	\$ 3,139,800
Benefits total	\$ 5,094,584
<b>B/C</b>	<b>1.62</b>

**B/C Analysis by Crash Severity**  
**Intersection of 148th Street and Roca Road**  
**Supplemental Safety Study**



	Unit	
Facility Location		Rural
Service Life	Years	20
Crash History Provided	Years	6.26

Data Entry Required
Data Calculated

Costs		
Construction	Dollars	\$ 2,616,500.00
Operations & Maint.	Dollars per Year	\$ 26,165.00
Other Capital Costs	Dollars	\$ -
Other Continual Costs	Dollars per Year	\$ -

Improvement:  
**Convert to Roundabout**

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ADT	Vehicles per Year	6800
Crash Modification Factor (CMF) Average		0.170

Crash Mitigation									
(Enter as many as necessary, However limit to ONLY ONE treatment for any single historical accident)									
	Accident Severity	Facility Type	Number of Crashes	Societal Cost	Treatment	CMF	CMF ID	Number Mitigated	Value Mitigated
	Fatal	Intersection	0.0	\$ -	Roundabout	0.290	229	0.0	\$ -
	A-Injury	Intersection	1.0	\$ 676,377.56	Roundabout	0.130	230	2.8	\$ 1,880,027.08
	B-Injury	Intersection	0.0	\$ -	Roundabout	0.130	230	0.0	\$ -
	C-Injury	Intersection	2.0	\$ 259,409.04	Roundabout	0.130	230	5.6	\$ 721,041.09
	Non Reportable	Intersection	0.0	\$ -	Roundabout	0.290	229	0.0	\$ -
	Property Damage Only	Intersection	1.0	\$ 12,292.90	Roundabout	0.290	229	2.3	\$ 27,884.85

Calculations	
Million Vehicles per Year	2.482
Crashes Mitigated	10.6
Crashes Mitigated/Year	0.530351438
Crashes Mitigated per Million Vehicles	0.21368
Total Historical Societal Cost	\$ 948,079
Total Cost Mitigated Over Service Life	\$ 2,628,953
Average Cost per Mitigated Crash	\$ 247,850
Costs total	\$ 3,139,800
Benefits total	\$ 2,628,953
<b>B/C</b>	<b>0.84</b>





## CMF / CRF Details

CMF ID: 229

Convert intersection with minor-road stop control to modern roundabout

Description:

Prior Condition: *No Prior Condition(s)*

Category: Intersection geometry

Study: [NCHRP Report 572: Applying Roundabouts in the United States, Rodegerdts et al., 2007](#)

Star Quality Rating:



### Crash Modification Factor (CMF)

Value: 0.29

Adjusted Standard Error: 0.05

Unadjusted Standard Error: 0.04

### Crash Reduction Factor (CRF)

Value: 71 (This value indicates a **decrease** in crashes)

Adjusted Standard Error: 5

**Unadjusted Standard Error:**

4

### Applicability

**Crash Type:**

All

**Crash Severity:**

All

**Roadway Types:**

Not Specified

**Number of Lanes:**

1

**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:**

**Minor Road Traffic Volume:**

### Development Details

**Date Range of Data Used:**

**Municipality:**

**State:**

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

<b>Other Details</b>	
<b>Included in Highway Safety Manual?</b>	Yes. HSM lists this CMF in <b>bold</b> font to indicate that it has the highest reliability since it has an adjusted standard error of 0.1 or less.
<b>Date Added to Clearinghouse:</b>	Dec-01-2009
<b>Comments:</b>	Countermeasure name changed from "convert two-way stop-controlled intersection to roundabout" to match HSM

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## CMF / CRF Details

CMF ID: 230

Convert intersection with minor-road stop control to modern roundabout

Description:

Prior Condition: *No Prior Condition(s)*

Category: Intersection geometry

Study: [NCHRP Report 572: Applying Roundabouts in the United States, Rodegerdts et al., 2007](#)

Star Quality Rating:



### Crash Modification Factor (CMF)

Value: 0.13

Adjusted Standard Error: 0.04

Unadjusted Standard Error: 0.03

### Crash Reduction Factor (CRF)

Value: 87 (This value indicates a **decrease** in crashes)

Adjusted Standard Error: 4

**Unadjusted Standard Error:**

3

### Applicability

**Crash Type:**

All

**Crash Severity:**

A (serious injury),B (minor injury),C (possible injury)

**Roadway Types:**

Not Specified

**Number of Lanes:**

1

**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:**

**Minor Road Traffic Volume:**

### Development Details

**Date Range of Data Used:**

**Municipality:**

**State:**

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

<b>Other Details</b>	
<b>Included in Highway Safety Manual?</b>	Yes. HSM lists this CMF in <b>bold</b> font to indicate that it has the highest reliability since it has an adjusted standard error of 0.1 or less.
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