

**TRAFFIC SAFETY EVALUATION**

**Using the**  
**Highway Safety Manual**  
**and the**  
**Interactive Highway Safety Design Model**

**Intersection of US 95 at SR 117 in Fallon**

Prepared for:



Nevada Department of Transportation  
Safety Engineering

Prepared by:



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# US 95 and SR 117 Intersection - Safety Evaluation

## SAFETY EVALUATION

### 1.1 Analysis Overview

A safety analysis has been performed on the rural intersection of United States (US) 95 and State Route (SR) 117 near Fallon in Churchill County. This intersection has experienced a high number of crashes over the previous five years based on average annual daily traffic. Immediately adjacent to the US 95 and SR 117 intersection there is another intersection. The intersection of South Maine Street and Wildes Road is so close to the intersection of US 95 and SR 117 they could be considered a single intersection for installation of a single lane roundabout. For the purposes of this evaluation they have been analyzed for crashes separately and compared as a single intersection for the Benefit Cost (B/C) Analysis.

Using the American Association of State & Highway Transportation Officials Highway Safety Manual (HSM) Predictive Method, expected crash totals were estimated using the Interactive Highway Safety Design Model (IHSDM) to evaluate safety improvement for the intersections. The effect on traffic safety was analyzed to determine the safety benefit of constructing a single roundabout at the intersection. The roundabout would combine the two intersections into a single lane – five leg roundabout.

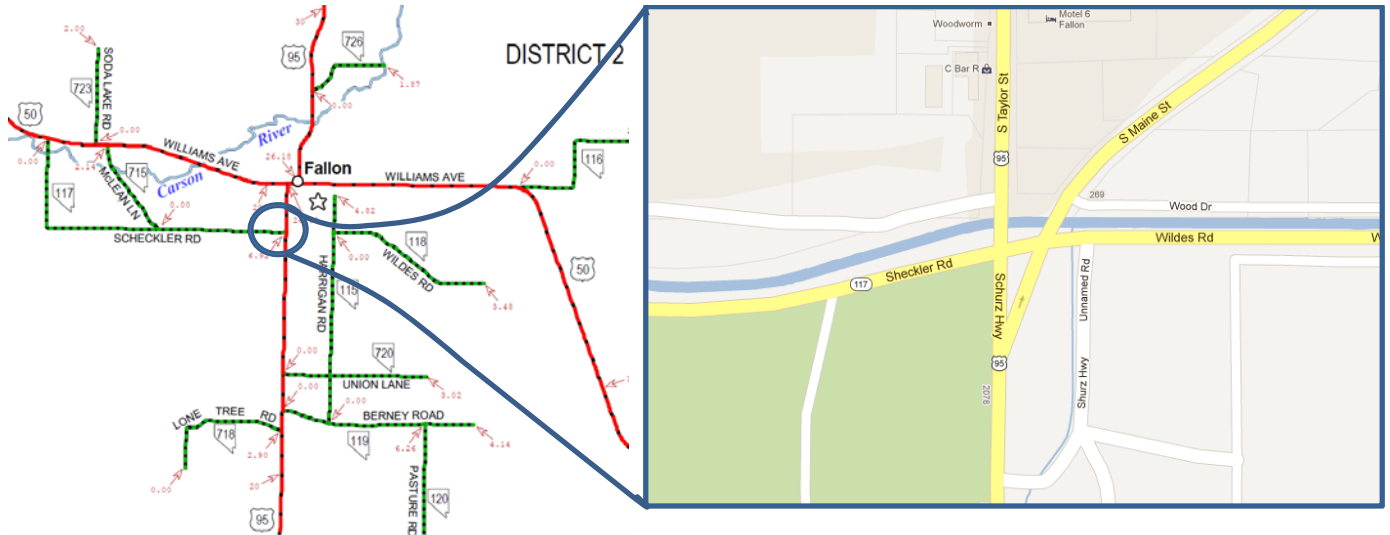


Figure 1. Vicinity Map and Blow Up of Intersections



**Figure 2. Aerial View of the Intersections**

## 1.2 Expected Crash Analysis

Using the IHSDM to complete the HSM Predictive Method, the safety improvements of the alternative was quantified and compared to the existing condition of the intersections for the 20-year evaluation period. The Safety Performance Function for a Rural Two Lane intersection with Four-legged, minor road stopped controlled base conditions requires the following data for predictive analysis:

- Number of approaches with right turn lanes on the major roadway
- Number of approaches with left turn lanes on the major roadway
- Intersection skew angles
- Presence of lighting

The intersections existing conditions, as seen in **Table 1**, were entered into the model.

Type	Highway	Site Description	Major AADT		Minor AADT
4ST	US 95	SR 117 intersection	2013-2032: 5300		2013-2032: 2300
4ST	Maine Street	Wildes Road Intersection	2013-2032: 3000		2013-2032: 1000
Number of Approaches with Left-Turn Lanes		Number of Approaches with Right-Turn Lanes	Skew Angle 1 (deg)	Skew Angle 2 (deg)	Presence of Lighting
2		2	10	10	no
0		0	30	30	no

**Table 1. Base Conditions for the Intersection Analysis**

Observed crashes at the intersections were used in a site specific Empirical-Bayes analysis to further refine the predictive results. The crashes associated the intersection are listed in **Table 2**. A complete summary of the crash data can be found in **Appendix A**.

Site No. *	Year	Severity	Type
1	2008	Property damage only	Multi Vehicle
2	2008	Property damage only	Multi Vehicle
1	2009	Property damage only	Multi Vehicle
1	2009	Property damage only	Multi Vehicle
1	2009	Property damage only	Multi Vehicle
1	2009	Property damage only	Multi Vehicle
1	2009	Property damage only	Multi Vehicle
1	2009	Property damage only	Multi Vehicle
1	2009	Fatal or nonfatal injury	Single Vehicle
1	2009	Property damage only	Single Vehicle
1	2010	Fatal or nonfatal injury	Multi Vehicle
1	2012	Property damage only	Multi Vehicle
*Site No. 1 is the intersection of US 95 and SR 117, Site No. 2 is the intersection of Maine Street and Wildes Road			

**Table 2. Observed Crashes at the Corridor between 2008 and 2012**

The expected crash totals for the next 20 years for the existing condition, “Do Nothing Alternative,” of the intersections are summarized in **Table 3**. In **Table 4** is the expected crash totals for the next 20 years replacing the intersections with a single lane roundabout. The expected number of crashes for the single lane roundabout was calculated by applying a crash modification factor (CMF) of 0.29 for roundabouts before applying the Empirical Bayes weighting of observed crashes was applied in the predictive analysis. This CMF is found in table 14.4 of the Highway Safety Manual.

Site No.	Type	Highway	Site Description	Expected No. Crashes for Evaluation Period	Expected No. Crashes/Year (crashes/million veh)	Expected Crash Rate (crashes/yr)
1	4ST	US 95	SR 117 intersection	34.56	0.62	1.7282
2	4ST	Maine Street	Wildes Road Intersection	12.54	0.43	0.6268
			<b>Total</b>	47.10		

**Table 3. Expected Crash Totals for the “Do Nothing Alternative”**

Site No.	Type	Highway	Site Description	Expected No. Crashes for Evaluation Period	Expected No. Crashes/Year (crashes/million veh)	Expected Crash Rate (crashes/yr)
1	4ST	US 95	SR 117 intersection	19.48	0.35	0.9739
2	4ST	Maine Street	Wildes Road Intersection	7.52	0.26	0.3762
			<b>Total</b>	27.00		

**Table 4. Expected Crash Totals for the Roundabout Intersection Improvement**

The installation of a roundabout to consolidate the two intersections has a Crash Reduction Factor of 43%, and seen in **Table 5**. Complete results from the IHSDM Predictive Method can be found in **Appendix B**.

	2013-2033 Expected Total Number of Crashes	
	Existing Conditions	Alt. 1
		Roundabout
<i>Total</i>	47.1	27.0
<i>Reduction in Total Crashes over Existing Conditions</i>	N/A	20.1
<i>Crash Reduction Factor (CRF)</i>	N/A	43%

**Table 5. Summary of Roundabout Crash Reduction**

### 1.3 Benefit-Cost Ratio Economic Analysis

The following B/C Ratio found in **Table 6** was calculated using the HSM severity distribution for crashes, as shown in Table 10-3 of the HSM. Construction costs were estimated by NDOT scoping. A detailed estimate can be found in **Appendix C**. Complete results from the B/C analysis can be found in **Appendix D**.

	Alt. 1
	Roundabout
<i>Total Alternative Cost</i>	\$4,378,865
<i>Total Annual Benefit including 2% Growth per year</i>	\$114,092
<i>Total Annualized Cost</i>	\$301,173
<i>Benefit-Cost Ratio</i>	0.37
<i>Average Annual Net Return</i>	(\$192,081)

**Table 6. Annual Benefits, Annual Costs, and B/C Ratio**



## 1.4 Results

Consolidating the two intersections by building a single roundabout is estimated to reduce crashes by 43% annually. A B/C Ratio of 0.37 is not a cost effective safety improvement and does not meet the general minimum B/C Ratio of 1.0. The Federal Highway Administration requires a ratio of 1.0 or higher in order for a project to be eligible for Highway Safety Improvement Project funding. Physical constraints at the project site increase the cost of the improvement significantly. See **Appendix C** for a break out of project cost and preliminary design. There is an irrigation channel that will need to be bridged over and right of way costs causing the project to be more expensive in this case than a typical roundabout installation.

## 1.5 Considerations

Other considerations not contained in the HSM Predictive Method or B/C Ratio analysis should be taken into account by decision makers in order to proceed with design and construction of this alternative such as operational improvements, environmental constraints and funding.

## 1.6 Conclusions

The predictive method and the B/C Ratio is an effective tools to evaluate the future effects of safety improvements for the intersection of US 95 and SR 117. A roundabout would improve safety, but would not be a cost effective safety improvement to the intersection. NDOT should use results contained within this report, other monetary/non-monetary considerations, and project funding/budget to determine how to proceed and improve the intersection.

**APPENDIX A**  
**Intersection Crash Data**

INTERSECTION DETAIL

US95/TAYLOR ST @ SCHECKLER RD SR117/WILDES RD/MAINE ST

01 SEP 07 - 01 DEC 12

County: CHURCHILL

Crash Severity	Crash_Date	Crash Year	Crash_Time	Primary_Street	Distance	Dir	Secondary_Street	Weather	Fatalities	Injured	Property_Damage_Only	Injury_Type	Crash_Type	Total Vehicles
PROPERTY DAMAGE	02-Oct-2009	2009	02:10 PM	SR117		AT INT	US95	CLEAR			PDO		BACKING	2
INJURY ACCIDENT	18-Oct-2010	2010	01:15 PM	US95		AT INT	WILDES RD	CLEAR		1		C	ANGLE	2
PROPERTY DAMAGE	09-Nov-2009	2009	08:00 AM	US95		AT INT	WILDES RD	CLOUDY			PDO		ANGLE	2
PROPERTY DAMAGE	14-Sep-2007	2007	08:05 AM	US95		AT INT	SHECKLER RD	CLEAR			PDO		ANGLE	2
PROPERTY DAMAGE	03-Feb-2009	2009	05:10 PM	US95		AT INT	WILDES RD	CLEAR			PDO		ANGLE	2
PROPERTY DAMAGE	30-Jun-2009	2009	05:00 PM	US95		AT INT	WILDES RD	CLOUDY			PDO		ANGLE	2
PROPERTY DAMAGE	12-May-2008	2008	08:10 AM	MAINE ST		AT INT	WILDES RD	CLEAR			PDO		BACKING	2
PROPERTY DAMAGE	11-Jun-2009	2009	11:01 AM	S TAYLOR ST	500	N	SHECKLER RD	CLOUDY			PDO		REAR-END	2
PROPERTY DAMAGE	29-Aug-2009	2009	11:20 PM	WILDES RD	1	E	US95	CLEAR			PDO		ANGLE	2
INJURY ACCIDENT	11-Jun-2009	2009	05:05 PM	WILDES RD		AT INT	US95	CLEAR		1		B	NON-COLLISION	1
PROPERTY DAMAGE	03-Oct-2009	2009	02:51 PM	WILDES RD		AT INT	US95	CLEAR			PDO		NON-COLLISION	1
PROPERTY DAMAGE	17-Sep-2012	2012	07:03 PM	WILDES RD		AT INT	US95	CLEAR			PDO		ANGLE	2
									Sum: 0	Sum: 2	Count: 10			

12

Count: 0	Count: 2
TOTAL	Count: 12

**APPENDIX B**  
**IHSDM Predictive Method Results**

*Interactive Highway Safety Design Model*

**Crash Prediction Evaluation Report**

May 13, 2013

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## Report Overview

**Report Generated:** May 13, 2013 3:43 PM

**Report Template:** System: Multi-Page [System] (sscpm2, Apr 30, 2013 9:41 AM)

**Evaluation Date:** Thu May 09 13:20:40 PDT 2013

**IHSDM Version:** v8.1.0 (Feb 13, 2013)

**Site Set Crash Prediction Module:** v|ModuleInfo.moduleVersion| (|ModuleInfo.moduleDate|)

**User Name:** michael.mosley

**Organization Name:**

**Phone:**

**E-Mail:**

**Project Title:** US 95 and SR 117(a)- corrected AADT

**Project Comment:** Created Tue May 07 14:37:12 PDT 2013

**Project Unit System:** U.S. Customary

**Site Set:** Intersections

**Site Set Comment:** Created Tue May 07 14:39:39 PDT 2013

**Site Set Version:** v1

**Evaluation Title:** Do Nothing Alternative - 20 Years

**Evaluation Comment:** Created Thu May 09 13:18:13 PDT 2013

**Policy for Superelevation:** AASHTO 2011 U.S. Customary

**Calibration:** HSM Configuration

**Crash Distribution:** HSM Configuration

**Model/CMF:** HSM Configuration

**Empirical-Bayes Analysis:** Site-Specific

**First Year of Analysis:** 2013

**Last Year of Analysis:** 2032

**First Year of Observed Crashes:** 2007

**Last Year of Observed Crashes:** 2012

## **Rural Two Lane Site Set CPM Evaluation**

**Type:** 4ST

**Calibration Factor:** 1

**Table 1. Evaluation Intersection Sites**

Site No.	Type	Highway	Site Description	Major AADT	Minor AADT	Number of Approaches with Left-Turn Lanes	Number of Approaches with Right-Turn Lanes	Skew Angle 1 (deg)	Skew Angle 2 (deg)	Presence of Lighting
1	4ST	US 95	SR 117 intersection	2013-2032: 5300	2013-2032: 2300	2	2	10.0000	10.0000	no
2	4ST	Maine Street	Wildes Road Intersection	2013-2032: 3000	2013-2032: 1000	0	0	30.0000	30.0000	no

**Table 2. Expected Crash Frequencies and Rates by Site**

Site No.	Type	Highway	Site Description	Expected No. Crashes for Evaluation Period	Expected No. Crashes/Year (crashes/million veh)	Expected Crash Rate (crashes/yr)
1	4ST	US 95	SR 117 intersection	34.56	0.62	1.7282
2	4ST	Maine Street	Wildes Road Intersection	12.54	0.43	0.6268

*Interactive Highway Safety Design Model*

**Crash Prediction Evaluation Report**

May 13, 2013

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## Report Overview

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**Report Template:** System: Multi-Page [System] (sscpm2, Apr 30, 2013 9:41 AM)

**Evaluation Date:** Thu May 09 13:22:12 PDT 2013

**IHSDM Version:** v8.1.0 (Feb 13, 2013)

**Site Set Crash Prediction Module:** v|ModuleInfo.moduleVersion| (|ModuleInfo.moduleDate|)

**User Name:** michael.mosley

**Organization Name:**

**Phone:**

**E-Mail:**

**Project Title:** US 95 and SR 117(a)- corrected AADT

**Project Comment:** Created Tue May 07 14:37:12 PDT 2013

**Project Unit System:** U.S. Customary

**Site Set:** Intersections

**Site Set Comment:** Created Tue May 07 14:39:39 PDT 2013

**Site Set Version:** v1

**Evaluation Title:** Roundabout CMF of 0.29

**Evaluation Comment:** Created Thu May 09 13:21:31 PDT 2013

**Policy for Superelevation:** AASHTO 2011 U.S. Customary

**Calibration:** MSM Copy of HSM Configuration

**Crash Distribution:** HSM Configuration

**Model/CMF:** HSM Configuration

**Empirical-Bayes Analysis:** Site-Specific

**First Year of Analysis:** 2013

**Last Year of Analysis:** 2032

**First Year of Observed Crashes:** 2007

**Last Year of Observed Crashes:** 2012

## **Rural Two Lane Site Set CPM Evaluation**

**Type:** 4ST

**Calibration Factor:** 0.5385

**Table 1. Evaluation Intersection Sites**

Site No.	Type	Highway	Site Description	Major AADT	Minor AADT	Number of Approaches with Left-Turn Lanes	Number of Approaches with Right-Turn Lanes	Skew Angle 1 (deg)	Skew Angle 2 (deg)	Presence of Lighting
1	4ST	US 95	SR 117 intersection	2013-2032: 5300	2013-2032: 2300	2	2	10.0000	10.0000	no
2	4ST	Maine Street	Wildes Road Intersection	2013-2032: 3000	2013-2032: 1000	0	0	30.0000	30.0000	no

**Table 2. Expected Crash Frequencies and Rates by Site**

Site No.	Type	Highway	Site Description	Expected No. Crashes for Evaluation Period	Expected No. Crashes/Year (crashes/million veh)	Expected Crash Rate (crashes/yr)
1	4ST	US 95	SR 117 intersection	19.48	0.35	0.9739
2	4ST	Maine Street	Wildes Road Intersection	7.52	0.26	0.3762

## **APPENDIX C**

### **Cost Estimation**

Item #	Description	Quantity	Unit	Unit Price	Total
2020990	REMOVAL OF BITUMINOUS SURFACE (COLD MILLING)	5973	SQYD	\$ 5	\$29,865.00
2030140	ROADWAY EXCAVATION	4110	CUYD	\$ 30	\$123,300.00
3020130	TYPE 1 CLASS B AGGREGATE BASE	1865	TON	\$ 50	\$93,250.00
4020190	PLANTMIX SURFACING (TYPE 2C)(WET)	1393	TON	\$ 70	\$97,510.00
4030110	PLANTMIX OPEN-GRADED SURFACING (3/8 INCH)(WET)	550	TON	\$ 90	\$49,500.00
5020760	CLASS AA CONCRETE (ISLAND PAVING)	200	CUYD	\$ 250	\$50,000.00
5020770	CLASS AA CONCRETE (ISLAND PAVING)(SPECIAL)	200	CUYD	\$ 400	\$80,000.00
6130810	CLASS AA CONCRETE CURB AND GUTTER (TYPE 4)	300	LINFT	\$ 25	\$7,500.00
6130830	CLASS AA CONCRETE CURB AND GUTTER (TYPE 5)	5000	LINFT	\$ 15	\$75,000.00
6130880	CLASS AA CONCRETE CURB AND GUTTER (TYPE 7)(MODIFIED)	400	LINFT	\$ 25	\$10,000.00
					\$0.00
	NEW STRUCTURE FOR US 95	9000	SQFT	\$200	\$1,800,000.00
	NEW STRUCTURE FOR WOOD DR.	1250	SQFT	\$200	\$250,000.00
				SUB TOTAL	\$2,665,925.00
	LANDSCAPING			3%	\$79,977.75
	TEMPORARY CONSTRUCTION EASEMENT			5%	\$133,296.25
	R/W ACQUISITION		LS		\$300,000.00
	TRAFFIC CONTROL			15%	\$266,592.50
	CONTINGENCY			20%	\$399,888.75
	INCIDENTAL ITEMS			15%	\$266,592.50
	MOBILIZATION				\$266,592.50
				TOTAL	\$4,378,865.25

**APPENDIX D**  
**Benefit Cost Analysis**



# COST EFFECTIVENESS ANALYSIS ACCIDENT REDUCTION BENEFITS

(2012 DOLLAR FIGURES)

03/13/14

ENGINEERING AUTHORIZATION NO. Not Known  
 PROJECT NO. Not Known  
 PROJECT LOCATION US 95 and SR 117 Intersection  
 ALTERNATIVE NO. Alt 1  
 COUNTERMEASURE Replace intersection with a single lane roundabout



AADT - Segment or Main St & Cross St \_\_\_\_\_  
 ROADWAY CHARACTERISTICS 2 LANE UNDIVIDED  
 DEMOGRAPHIC DESIGNATION RURAL RTL-4ST  
 FUNCTIONAL CLASSIFICATION 3 OTHER PRINCIPLE ARTERIAL  
 IMPLEMENTED COSTS \$4,378,865.25  
 ANNUAL MAINTENANCE COSTS \$5,000.00  
 CURRENT PRIME INTEREST RATE 3.25%  
 PERCENTAGE OF GROWTH 2.00%  
 ESTIMATED SERVICE LIFE &  
 NUMBER OF YEARS PREDICTED 20 YEAR(S)  
 NUMBER OF YEARS OF CRASH  
 HISTORY DATA 5 YEAR(S)

### CALCULATION OF REDUCTIONS USING IHSDM

IHSDM (Interactive Highway Safety Design Model)

<http://www.ihsdm.org/>

	2012 CRASH COSTS	HSM DISTR. OF CRASHES (A)	EXISTING CONDITION EXPECTED CRASHES (B)	ALTERNATIVE EXPECTED CRASHES (C)	EXPECTED CRF (%) (D)	CRASHES SAVED ANNUALLY (E)
FATAL	\$5,339,711.00	1.3	0.6	0.4	43%	0.01
INJURY A	\$285,349.00	5.4	2.5	1.5	43%	0.05
INJURY B	\$104,302.00	10.9	5.1	2.9	43%	0.11
INJURY C	\$59,037.00	14.5	6.8	3.9	43%	0.15
PDO	\$9,638.00	67.9	32.0	18.3	43%	0.68

### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (E)	SOCIETAL COST (F)	SOCIETAL BENEFIT (G)
FATAL	0.01	\$5,339,711	\$69,763
INJURY A	0.05	\$285,349	\$15,486
INJURY B	0.11	\$104,302	\$11,426
INJURY C	0.15	\$59,037	\$8,603
PDO	0.68	\$9,638	\$6,577

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$111,855
TOTAL ANNUAL BENEFITS (Including Growth )	\$114,092
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$301,173
TOTAL ANNUALIZED COSTS	\$306,173
AVERAGE ANNUAL NET RETURN	(\$192,081)
<b>BENEFIT/COST</b>	<b>0.37</b>