



Planning Study Final Executive Summary

Final Planning Study Report
February 2018





Planning Study Final Executive Summary

**US 14 / US 83 EUCLID AVENUE RECONSTRUCTION
PLANNING STUDY
Sioux Avenue to 1700 Feet West of South Dakota Highway 1804
Pierre, SD**

Prepared for:

South Dakota Department of Transportation
Becker-Hansen Building
700 East Broadway Avenue
Pierre, SD 57501

Prepared by:

Felsburg Holt & Ullevig
11422 Miracle Hills Drive, Suite 115
Omaha, NE 68154

Principal in Charge: Lyle DeVries, PE, PTOE
Project Manager: Rick Haden
Project Traffic Engineer: David Andersen, PE, PTOE
Project Traffic Engineer: Mark Meisinger, PE, PTOE
Project Environmental Scientist: Allison Sambol

FHU Reference No. 16-314-01

February 2018



I. INTRODUCTION

A. Project Background

The South Dakota Department of Transportation (SDDOT) is proposing a roadway reconstruction project through the central part of Pierre, Hughes County, South Dakota. The proposed project would reconstruct US Highway 14 (US 14 / US 83 / Euclid Avenue) from Sioux Avenue to the beginning of the divided highway southwest of the intersection of state highway SD 1804. US 14 is also known locally as Euclid Avenue. The project setting is an urban corridor through historic downtown Pierre on the south end, with a mixture of commercial and residential land uses throughout the remainder of the middle and north ends.

The SDDOT commissioned a corridor planning study to evaluate existing and future traffic operations and establish a preferred design alternative in accordance with the National Environmental Policy Act (NEPA) for US 14 / US 83 / Euclid Avenue

B. Study Area

The limits of the study and the location of the project in relation to the surrounding roadway network in the vicinity are shown in **Figure 3**, with a broader environmental study area was defined for the project.

C. Purpose and Need

The purpose of this project is to preserve the transportation asset, improve the reliability of the transportation system and enhance the safety and mobility of the traveling public on US 14 / US 83 in the City of Pierre, Hughes County, South Dakota.

The need for this project is based on information from the SDDOT's Pavement Management System. The SDDOT has determined that the pavement distresses present on this section of US 14 are significant enough to warrant reconstruction. The underlying pavement is 50-86 years old and therefore, beyond the end of its anticipated service life.

There have also been 19 rear-end, sideswipe, and left turning collisions occurring along the Euclid corridor from Pleasant Drive to the 8th Street over five years. These crashes are attributable to the lack of separate left turn lanes along the corridor. This contributes to turbulence in travel and frequent lane changing due to conflicts between stopped vehicles and through traffic.

Storm sewer, sidewalk, and curb ramp modifications are normally impacted in an urban pavement reconstruction segment. The existing street lighting and traffic signals would be impacted.

D. Project Process

Survey data, traffic and safety analysis, as well as context sensitive considerations were used to develop design alternatives for reconstructing the roadway. The design alternatives analysis also considered the typical planning horizon of 20 years beyond the proposed project build year of 2022. The design alternatives are included in the environmental review and documentation conducted in accordance with the National Environmental Policy Act (NEPA).

The proposed project would provide for multimodal travel with at least one through lane in each direction and turn lanes. Auxiliary right turn lanes may be supported at some intersections.



Planning Study Final Executive Summary

Right-of-way impacts were minimized to the extent possible particularly adjacent to historic properties or districts. Based on the proposed improvements, some temporary and permanent easements are expected. Permanent easements/property acquisition for street right-of-way is only anticipated at the major intersections. At Euclid Avenue and 4th Street, the plan would require approximately 6,500 square feet of right-of-way / permanent easements and an estimated 8,700 square feet of temporary easements on the four quadrants of the intersection. Removal of 750 square feet of the commercial building on the northeast corner would also be necessary for construction of the improvements.



Commercial Building on NE Corner of Euclid Avenue at 4th Street

It is estimated that less than 100 square feet of right-of-way / permanent easements and 275 feet of temporary easements would be necessary at the intersection of Euclid Avenue and Elizabeth Street.

The traffic and safety analysis evaluated baseline conditions in the year 2016, estimated year of opening conditions in 2022, and future year conditions in 2042 to determine traffic operations and safety on the US 14 corridor. In addition to looking at the overall corridor, this study also analyzed the following intersections in greater detail:

Signalized Intersections

- US 14/83 (Pierre Street) & US 14/83-US14B/SD 34 (Sioux Avenue)
- US 14/83 (Euclid Avenue) & Capitol Avenue
- US 14/83 (Euclid Avenue) & Broadway Avenue
- US 14/83 (Euclid Avenue) & Elizabeth Street

Unsignalized Intersections

- US 14/83 (Euclid Avenue) & Fourth Street

II. DATA COLLECTION, DEVELOPMENT, AND ANALYSIS

A. 2016 Traffic Counts and Future Traffic Volumes

Intersection turning movement counts (TMCs) were collected for a separate study conducted in the Pierre area in September 2016. The TMCs were conducted from 6:00 AM to 6:00 PM for the five study intersections. Average daily traffic (ADT) volumes for 2016, as well as forecasted ADT values for build year 2022 and future year 2042, can be seen in **Figure 3**.



B. Roadway LOS Thresholds

For roadways, LOS is a qualitative assessment of traffic operational conditions within a traffic stream. It is based on travel speed as a percentage of base free-flow speed and volume to capacity ratio of the downstream boundary intersection through movement. A planning level roadway segment LOS was developed for the study area roadway network as shown below in **Table 4**.

Table 4. Roadway Segment LOS Thresholds

Facility Type	LOS Threshold (ADT)*		
	C	D	E
3 - Lane Urban w/ TWLTL	11,200	14,000	16,800
4 - Lane Urban Undivided	18,700	23,400	28,100
5 - Lane Urban w/ TWLTL	24,700	30,900	37,100

Source: SUDAS Design Manual, 2017 Edition

** Moderate (Mixed Zoning) Side Friction*

Using the LOS thresholds in **Table 4** a planning level traffic operations analysis was conducted along the Euclid Avenue corridor. All segments are projected to operate at LOS C or better in 2016, 2022, and 2042. The current and projected traffic growth (**Figure 3**) along US 14 (Euclid Avenue) over the next 25 years vary from 7,770 to 11,050 vehicles per day and can be handled with 3-lanes.

LEGEND

- XXXX** = 2016 Average Daily Traffic
- XXXX** = 2022 Average Daily Traffic
- XXXX** = 2042 Average Daily Traffic

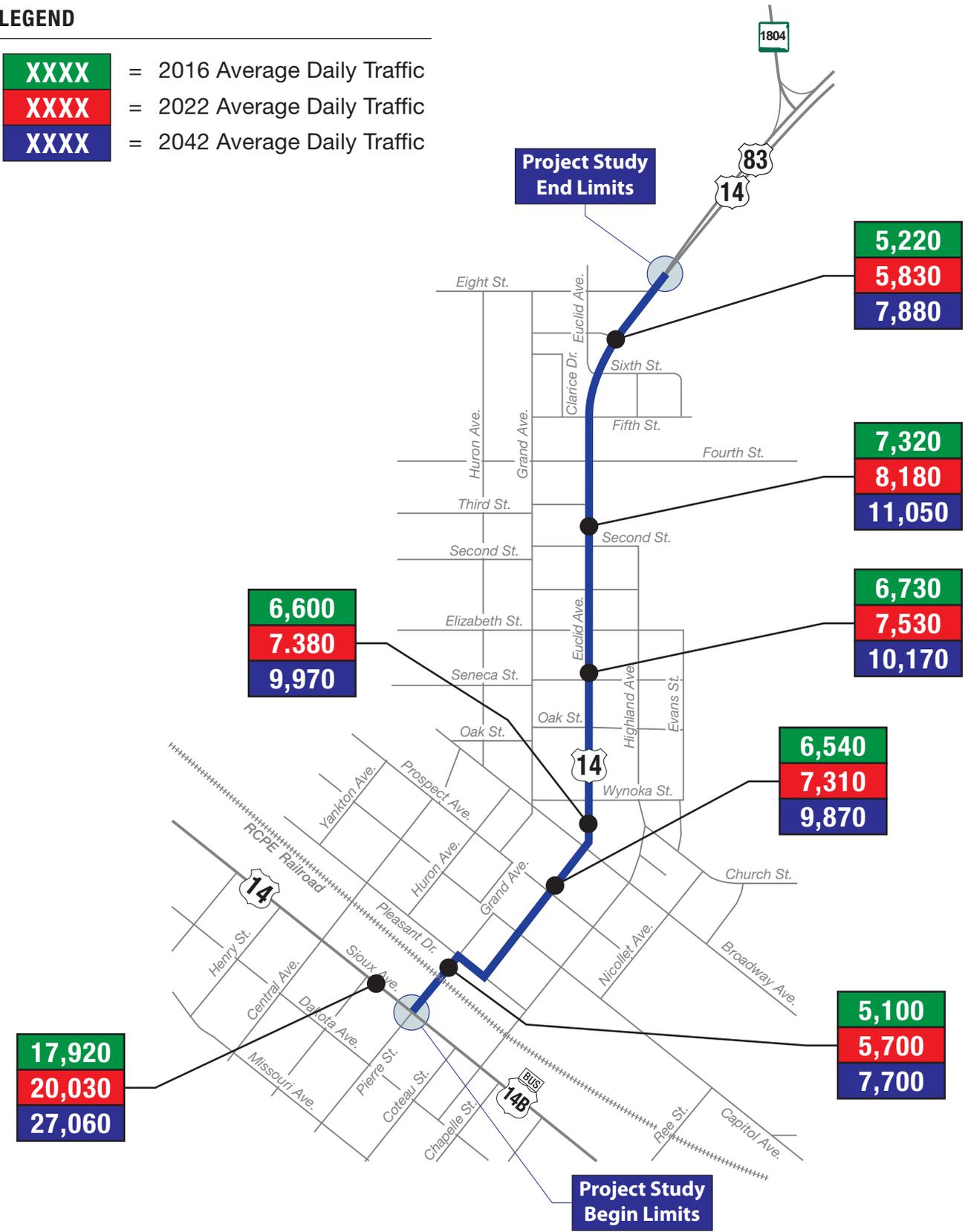


Figure 3
US 14 Corridor ADT Volumes





Planning Study Final Executive Summary

C. Intersection Capacity Analysis

A detailed intersection traffic operations analysis was conducted for the major intersections along the US 14 corridor. Base year 2016, build year 2022, and future year 2042 traffic volumes were analyzed for the current four-lane cross section and possible three and five-lane cross section scenarios.

Euclid Avenue at Broadway Avenue, Capitol Street, & Sioux Avenue

The intersection of Euclid Avenue with Broadway Avenue is projected to operate at LOS B or better, with an approach LOS of C or better, for the AM and PM peak hours through analysis year 2042 with the existing cross section and traffic signal control. The intersections of Euclid Avenue with Capitol Street and Pierre Street with Sioux Avenue are also projected to continue to operate at acceptable levels of service through build year 2042.

D. Traffic Signal Warrant Analysis

The intersections of Euclid Avenue at Elizabeth Street and Euclid Avenue with Fourth Street were evaluated to determine if MUTCD traffic signal warrants are satisfied in base year 2016, build year 2022, or future year 2042. Unwarranted signals increase delay, cost money to maintain, and can potentially affect safety by creating unexpected stops or leading to disobedience of the signal indications.

Euclid Avenue & Fourth Street

The intersection of Euclid Avenue with Fourth Street was evaluated to determine if any volume-based MUTCD traffic signal warrants are satisfied in 2016, 2022, or 2042. Based on current traffic projections, a traffic signal would not be warranted until the year 2030 with a three-lane cross section.

Euclid Avenue & Elizabeth Street

The intersection of Euclid Avenue with Elizabeth Street was evaluated. Warrants were not satisfied for the intersection of Euclid Avenue with Elizabeth Street in any year under any cross-section scenario up to the year 2042. Therefore, signal removal and operational analysis of other traffic control alternatives were considered.

E. Euclid Avenue & 5th Street Pedestrian Crossing Treatments

A rectangular rapid flashing beacon (RRFB) is in place at the intersection of Euclid Avenue with Fifth Street to assist pedestrians in crossing Euclid Avenue. The primary justification for the RRFB is for students from nearby housing on the east side of Euclid Avenue to reach Jefferson Elementary School to the west.

Based on recent research published in the ITE Journal certain roadway and traffic characteristics were identified as associated with high or low driver yielding rates at pedestrian crosswalks with an RRFB. Characteristics associated with higher driver yielding rates were shorter crossing distances, presence of a median refuge island, and the crossing having only two approach legs rather than four (midblock location).

III. Alternatives Analysis

A. Safety Benefits of 3-lanes vs. 4-lanes

The crash history along US14 / Euclid Avenue was analyzed over a recent 5-year period from 2011 -2015. The greatest frequency is the RCPE bridge with 22 oversize vehicles striking the bridge in 5 years. This is followed by 16 at the intersection of Sioux Ave.



Table shows the number of crashes by various crash patterns for Sioux Avenue, the railroad bridge and all other segments. Right Angle and Left Turning crashes are the most significant patterns. The ones highlighted in green in the Other column are patterns which would be susceptible to correction by converting from 4-lanes to 3-lanes, 19 out of 42.

Table 12. US 14 Euclid Avenue Correctable Crash Summary

Crash Pattern	Number of Crashes (5-years)			Total
	Sioux Ave.	RCPE Bridge	All Other	
Right Angle	3		15	18
Left Turn Leaving	6		15	21
Rear-End (thru)	4		1	5
Sideswipe			3	3
Fixed Object		22	1	23
Parked Vehicle			4	4
Pedestrian	3		1	4
Animal			2	2
Total	16	22	42	80

Correctable converting from 4-lanes to 3-lanes = 19

Pedestrian Safety

Pedestrian Safety is also enhanced with fewer lanes to cross, narrower pavement, less passing traffic to watch, and an increased buffer between sidewalk and parallel traffic.

C. Screening of Segment Alternatives

Several alternatives were considered for reconstructing the existing 68-foot wide pavement in US 14. The existing roadway has four 12-foot wide lanes with an additional 10 feet on each side for parking. This excessive width provides a challenge for persons attempting to cross US 14.

The five distinct concepts that were initially evaluated are shown in **Figures 28-29** and summarized below:

Alternative 1 is a 4-lane 64-foot roadway with parking on both sides like the existing roadway.

Alternative 2 is a 5-lane 64-foot roadway, the same width as the current street, but would restrict parking to one side to accommodate a center left turn lane.

Alternative 3 is a 3-lane roadway 64-foot wide, the same width as the current street with parking on both sides, and would provide 16-foot outside lanes to accommodate bicyclists.

Alternative 4 is a 3-lane roadway with parking on both sides but is only 54-foot wide, with a 10-foot wide off-street trail the east side.

Alternative 5 is also 3-lane roadway with parking on both sides and is only 54-foot wide, with no separate provisions for bicyclists.



Planning Study Final Executive Summary

The input received as part of and following the June 1, 2017 public information meeting became part of the evaluation criteria used to screen the various alternatives down to two, Alternatives 3 and 4. Another public meeting was held on August 29, 2017 where the screening results were presented as well as detailed plans for the two remaining alternatives. Following that meeting a more detailed analysis was conducted of driver delay and fuel consumption along the US 14 (Euclid Avenue) corridor for the 3-lane, 4-lane, and 5-lane concepts.

The results of the further analysis and public input were added to the prior screening and are shown in the final screening **Table 16**. Alternative 4 rated the best in the categories of Pedestrian Safety, Bike Provisions, Delay & Fuel Consumption, and Crash Savings. It also had the few impacts to adjoining properties and received the greatest public support, including the City of Pierre (letter of September 6, 2017).

Table 16. US 14 Euclid Avenue Alternative Final Screening

ALTERNATIVE	LANES	STREET WIDTH (FEET)	PARKING	PEDESTRIAN SAFETY (WIDTH - FT)	BIKE PROVISIONS	CONSTRUCTION COST ESTIMATE	DELAY & FUEL COSTS	BENEFITS CRASH REDUCTION	MEETS PURPOSE & NEED	IMPACTS	PUBLIC SUPPORT
Existing	4	68	Both Sides	62/68	None	N/A	N/A	N/A	No	Pavement Failures	None
1	4	64	Both Sides	50/50	None	\$8,453,000	\$22,076,200	-\$225,500	No		Drop (4) Keep (5)
2	5	68	Only One Side	57/61	None	\$8,720,000	\$15,639,000	-\$73,500	Partial	Parking Loss	Keep (5)
3	3	64	Both Sides	50/50	Added Width	\$8,453,000	\$19,090,000	\$2,819,000	Yes		Drop (3) Keep (4)
4	3	54	Both Sides	40/40	Trail East Side	\$8,033,000	\$19,090,000	\$2,819,000	Yes		Keep (11)
5	3	54	Both Sides	40/40	None	\$7,567,000	\$19,090,000	\$2,819,000	Partial		Drop (2)

Best
Better
Less
Least

** ALL MEET 2045 VOLUME / CAPACITY NEEDS AT LOS B / C

This final screening showed Alternative 4, a three-lane cross section, to be the multimodal design that best accommodates drivers, bicyclists, and pedestrians along the US 14 (Euclid Avenue) corridor. It is therefore recommended for the US 14 (Euclid Avenue) corridor through Pierre based on the detailed analysis and alternative screening.

D. Intersection Alternative Analysis

One very successful treatment to increase safety at urban intersections is the modern roundabout, which reduces the potential vehicle conflict points from 32 to only 8. The most severe traffic crashes resulting in injuries involve crossing conflicts depicted. These conflicts are eliminated in a roundabout from the 16 typically found in a traditional intersection. By converting the higher speed crossing movements to all right turns the most severe crashes are avoided by design, making roundabouts far safer than either stop signs or traffic signals.

Roundabouts increase safety reducing injury crashes by 76% and overall crashes by 35% according to FHWA statistics. By slowing all traffic entering the intersection pedestrian crossings are also safer.

Figure 28. Concepts North Area - Existing, Alternative 1, and Alternative 2



Figure 29. Concepts North Area - Alternate 3, Alternate 4, and Alternate 5



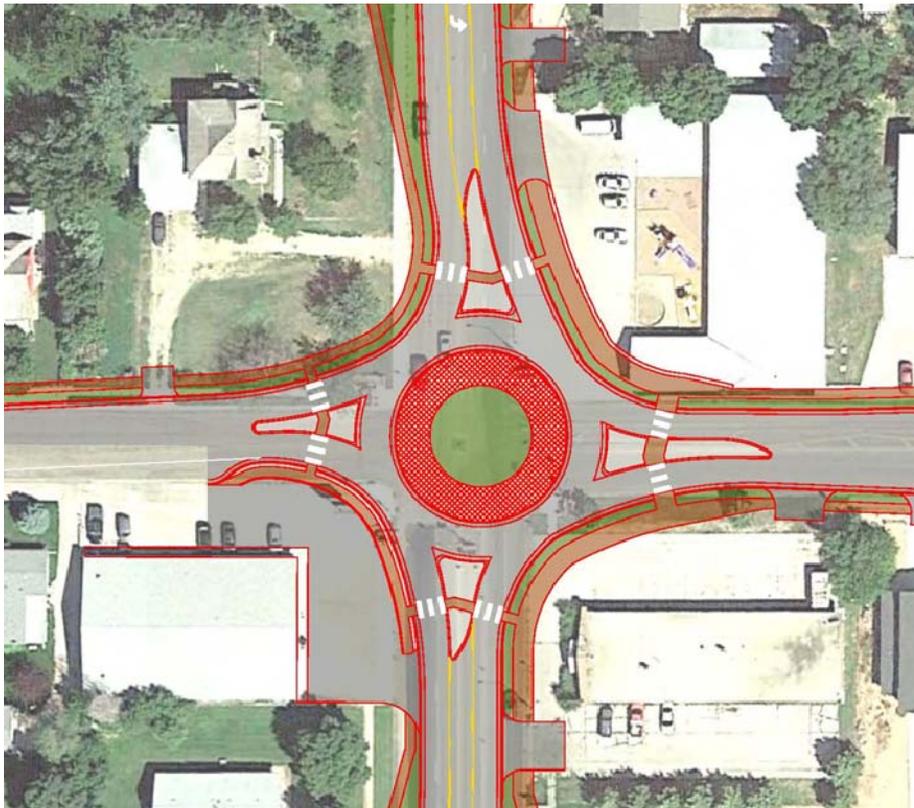
Euclid Avenue & 4th Street

The intersection of Euclid with 4th Street was considered as a solid candidate for a roundabout given the nature of traffic at the intersection with heavy left turns westbound to southbound. A traffic signal was also evaluated but the forecasted traffic volumes would not meet the minimum MUTCD warrants until late in the planning period (2030).

A roundabout at that location would provide a visual sign for southbound drivers entering Pierre from the higher speeds of a divided highway that they need to lower their speeds for an urban area. The benefits of a roundabout in allowing continuous movement at lower speeds would be a savings of \$1.5 million in delay, while the projected cost would be \$415,000 more than a conventional intersection, resulting in net benefits of \$1,085,000 or 3.6 times higher than costs.

The roundabout concept went through multiple refinements to address the thoughts of adjacent stakeholders, eventually settling on the design shown in **Figure 35**. This plan accommodates all truck maneuvers, as well as campers pulling trailers (a common travel mode in the summer months through Pierre). The plan also to the extent possible provides reasonable and safe access to and from the adjacent parcels. The concept was presented at the August 29, 2017 public meeting and while 11 persons attending the meeting supported retaining a traditional Intersection with a future signal, 15 persons favored the roundabout, including the City of Pierre (letter of September 6, 2017).

Figure 35. Roundabout US 14 (Euclid Avenue) at 4th Street



It is recommended that a roundabout be constructed at Fourth Street with the reconstruction of US 14 (Euclid Avenue) as a three-lane cross section.

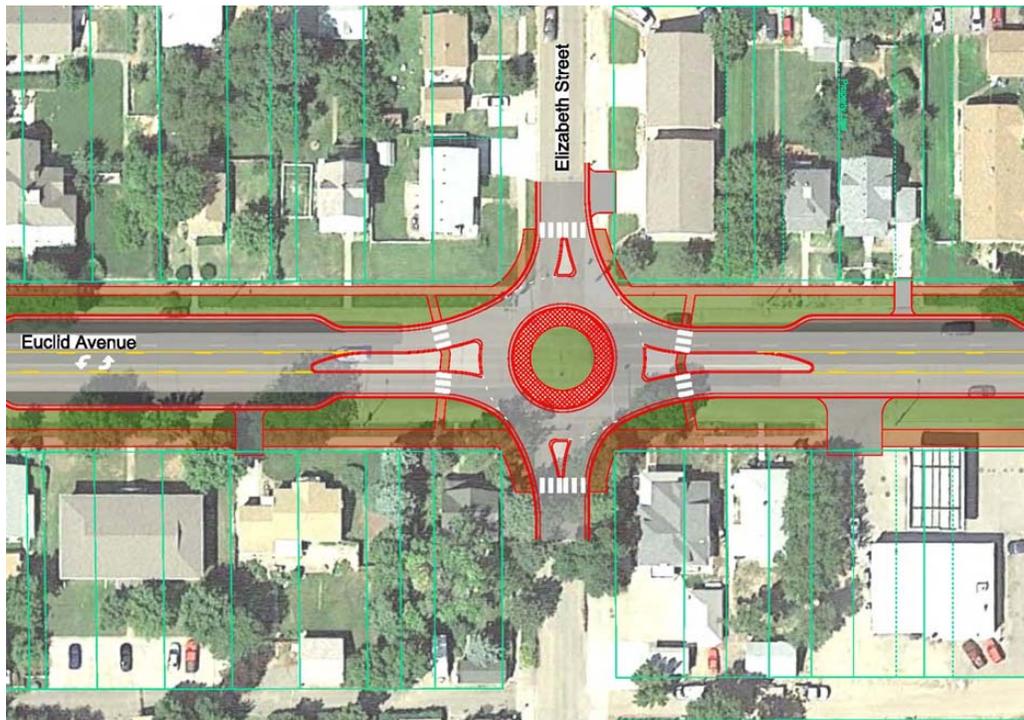
Euclid Avenue & Elizabeth Street

The traffic signal at Elizabeth does not meet current national (MUTCD) standards for need nor Americans With Disabilities Act (ADA) accommodations. It was thus considered for removal and replacement with Stop sign control for traffic entering from Elizabeth Street. Concerns were expressed by area residents at the public meetings regarding the difficulty pedestrians would have crossing US 14 without the traffic signal.

Two options were developed to address these concerns. The first option would install a signed and marked pedestrian crossing on the north crosswalk with a raised center median. The elevated concrete median would prohibit southbound to eastbound left turns in the crosswalk and provide a refuge for pedestrians to cross the roadway one half at a time.

The second design option (**Figure 37**) for US 14 (Euclid Avenue) at Elizabeth was a mini-roundabout of smaller diameter than the design at 4th Street. This design would provide safer opportunities for pedestrians crossing US 14 and vehicles entering from Elizabeth Street to do so focusing on a single direction of traffic at a time. The roundabout would also require north-south traffic to lower their speeds approaching Elizabeth Avenue. It would accommodate through truck movements but not left turns or U-Turns. It would allow all movements of campers pulling trailers.

Figure 37. Mini-Roundabout (Euclid Avenue) at Elizabeth Street



The traffic signal at the intersection of Euclid Avenue with Elizabeth Street is not currently warranted and is not projected to be warranted through the year 2042, therefore removal of the traffic signal is recommended and a mini-roundabout be constructed at the intersection.

Euclid Avenue & 5th Street

The pedestrian crossing on Euclid at 5th Street was reviewed for potential treatments and upgrades to increase safety and comfort of pedestrians using the crossing. The current 55-foot crosswalk requires a gap in traffic approximately 15 seconds in length for a younger pedestrian to cross without traffic stopping.

Recent national studies have shown that driver respect for pedestrian crosswalks can be achieved by constructing a raised median in this case from the north approach of Fifth Street to approximately 140 feet north of Fifth Street. The concept shown here includes installing a center raised median refuge island and additional pedestrian crossing signs and flashing beacons in the center to draw driver’s attention and increase compliance with the pedestrian’s right-of-way.

The crossing distance is also significantly reduced to two 16-foot wide segment allowing a pedestrian to cross each direction in gaps less than 5 seconds each. Southbound to eastbound left turns would be prohibited to reduce conflicts since that light movement can be made one block north.

Figure 39. Euclid & 5th Street Rectangular Rapid Flashing Beacon (RRFB)



The RRFB at the intersection of US 14 (Euclid Avenue) with Fifth Street is recommended to be replaced with MUTCD compliant beacons and supplemental treatments to increase driver compliance and pedestrian safety.

E. US 14 Overheight Truck Movements and RCPE Bridge

There are currently advance signs provided in both directions on US-14 alerting drivers of the restricted 11’ 3” clearance under the RCPE Bridge, with advance sensors and flashers that are activated to warn drivers approaching the bridge if they exceed allowable height. As indicated earlier in the safety analysis the RCPE bridge has been struck 22 times over the five-year period of January 1, 2011 to December 31, 2015 despite the extensive signing. The trucks



Planning Study Final Executive Summary

striking have sustained considerable damage to the trailers and loads while the bridge does not appear to have sustained any structural damage.

An option was studied to increase clearance for vehicles driving under RCPE railroad bridge from the current 11'-3" to 14'-6" clearance by raising the railroad bridge structure and lowering the Pierre Street paving. The number of crashes continue despite efforts to get truck drivers' attention through detection, signing, and flashing beacons. After deliberations and discussions with SDDOT and City officials it was determined that there was not support for modifying the existing historic structure.

The cost of this option is estimated to be \$1,283,000 while the projected crash savings to road users (truckers) would be \$1,231,000 over the life of the project.

US 14 (Pierre Street) at RCPE Railroad Bridge- It is recommended that a wider median with additional signing be provide at the RCPE bridge to get drivers' attention.

VI. Environmental Overview

The National Environmental Policy Act (NEPA) requires detailed environmental investigations on projects which have potential impacts. Several studies have been completed along or within one block of the study corridor. These were used in the evaluation and screening of the various alternatives.

To determine if any social, economic, or environmental issues exist within the environmental study area, known and potential environmental resources have been identified for use in the alternatives evaluation. Resources included Cultural Resources, Hazardous Materials, Parks and Recreational Areas, Environmental Justice and Civil Rights Act, Floodways and 100-year Floodplains, Wetlands and Other Waters of the U.S, Wildlife/Threatened and Endangered Species, Air Quality and Mobile Source Air Toxins (MSAT), Noise Analysis, and Temporary Construction Impacts

Based on findings in the Environmental Overview, no fatal flaws or issues were identified that might preclude transportation improvements in the environmental study area.

VII. Public Involvement

Two public open house meetings were planned during the study. The first meeting, held on June 1, 2017, was scheduled early in the process to allow stakeholders and the general public to provide input and concerns before the study team developed any concepts. The meeting was attended by 47 people. Public response was generally in support of finding solutions to improve safety by reducing or eliminating conflicts between trucks and vehicles/bicycles/pedestrians, as well as addressing travelling speeds through the corridor.

A second meeting was held on August 29, 2017, to provide an overview of the alternatives evaluated for the corridor and obtain comments and concerns relating to those alternatives. The meeting was attended by 89 people and the results of the initial Alternatives Screening were described, and feedback was solicited from attendees to use to further screen down to a single build alternative.