Interchange Justification Study

I-29 at Madison Street

Sioux Falls, South Dakota

May 2001

Prepared for:

South Dakota Department of Transportation
Office of Transportation Planning & Programs
700 East Broadway Avenue
Pierre, South Dakota 57501-2586

Prepared by:

Kirkham Michael Consulting Engineers
9110 West Dodge Road
P.O. Box 24129
Omaha, NE 68124-0129

Table of Contents

List of Figures

List of Tables

Introduction

Purpose

The purpose of this report is to investigate the feasibility of constructing an additional interchange on Interstate 29 at Madison Street (Exit 80) in Sioux Falls, South Dakota. The justification study is based on guidelines identified by the Federal Highway Administration (FHWA) in the Federal Register. This report was prepared for submittal to SDDOT and FHWA for approval.

Project Location

The proposed traffic interchange will be located along Interstate 29 at the existing Madison Street alignment in Sioux Falls, South Dakota. Existing traffic interchanges on Interstate 29 adjacent to the Madison Street alignment include the 12th Street interchange, 1-mile south, and the Maple/Russell interchange approximately 1 mile to the north. The location of the proposed interchange along with the existing transportation network is shown in Figure 1.

Project Development

In 1979, the City of Sioux Falls adopted its first comprehensive growth management plan. The plan estimated future land use and infrastructure necessary to support growth to the Year 2000. In 1996, the City updated the comprehensive plan from Year 2000 to Year 2015. In this update, new policies and growth development schemes were adopted. It included estimates of future population, land use, utilities, schools and rural development. The comprehensive plan also provided an estimate of the transportation framework needed to support future traffic in and around the Sioux Falls area. According to the plan, Madison Street is classified as a minor arterial. The Year 2015 transportation plan indicates that Madison Street will continue to function as a minor arterial, and a traffic interchange (TI) is anticipated to be constructed at the intersection with Interstate 29.

Study Area

The guidelines for the report are published in the Federal Register by the Federal Highway Administration (FHWA). The FHWA recommends that the adjacent existing or proposed interchanges be studied for operation/capacity. It is also recommended that crossroads and other streets be included in the analysis to insure their ability to distribute traffic to and from the proposed interchange. A copy of the FHWA requirements is contained in the Appendix.

Figure 1-Vicinity Map

Existing Conditions

This section of the report identifies the existing roadway system, 1995-2000 traffic volumes, a capacity analysis of the existing volumes and a summary of the accident history on Interstate 29 within the study area.

Existing Roadway System

The existing local roadway system in the study area is made up of mostly east/west arterial roadways with continuous routes into central areas of Sioux Falls and north/south roadways currently with little to no regional significance. The majority of land west of the I-29 corridor from 12th Street to the I-90/I-29 interchange is currently undeveloped farmland. The predominate land use east of I-29 is industrial according to the *City of Sioux Falls 2015 Growth Management Plan*, these areas to the west of I-29 are anticipated to be developed with single family and multi-family housing developments with neighborhood commercial areas at intersections of arterial roadways. As this development occurs, existing gravel and asphalt roadways in the study area will be improved to handle the additional traffic these developments are anticipated to generate. A description of the area roadways is provided in the following paragraphs. Lane configurations for study area interchanges are shown in Figure 2.

Madison Street is classified as a minor arterial roadway within the study area. West of Marion Road, Madison Street is a two lane gravel roadway and reverts to a two lane paved roadway east of Marion to North Louise Avenue. East of Louise Avenue, Madison Street is a three-lane roadway with a two-way left turn lane (TWLTL). Currently, a two-lane overpass on Madison Street across the I-29 alignment is provided. The existing two-lane bridge has guardrail on both the north and south sides. Power lines parallel Madison Street along the south side of the roadway from west of Marion Road to Interstate 29. A rock quarry exists along the north and south side of Madison Street approximately 100 feet east of the edge of pavement on I-29. Layering along the west border of the quarry has significantly lowered the ground immediately adjacent to I-29. A field review of the site estimated that the bottom of the quarry was a minimum of 100 feet below the existing grade along I-29. The speed limit on Madison Street is 35 mph.

12th Street / SD-42 is classified as a principal arterial roadway within the study area. 12th Street from Marion Road to I-29 has a five lane paved cross section with a TWLTL, curb, gutter, and sidewalks on both the north and south side. East of I-29, 12th Street is a six lane median divided roadway with curb, gutter and sidewalks. The intersections of 12th Street with Marion Road, Lyon Boulevard and Kiwanis Avenue are signalized with exclusive eastbound and westbound left turn lanes provided at each intersection. The speed limit on 12th Street is 35 mph.

Figure 2-Existing Lane Geometry

Maple Street within the project limits is a two-lane paved roadway. Maple Street is classified as a minor arterial roadway from west of Marion Road to the Russell Street intersection. Currently, Bike Route 30 traverses along Maple Street. However, a draft update bike route plan shows Route 30 moving to Madison Street. Power lines exist along the north side of Maple Street and terminate at the I-29 TI. The intersection of Maple Street and Russell Street is signalized. Maple Street widens at the intersection to provide for an exclusive eastbound right turn lane. All other intersections along Maple Street in the project area are unsignalized and north/south stop controlled. The speed limit on Maple Street is 45 mph.

Within the study area, Benson Road will be classified as a minor arterial in the 2000 Major Street Plan. Benson Road has a two lane gravel cross section to the west of Marion Road, and was recently paved east of Marion Road to the frontage road that runs from SD-38 to Maple Street. At the Interstate, Benson Road terminates and continues again east of I-29. East of Interstate 29, Benson Road is a two-lane gravel roadway and continues until it terminates at the west boundary of the Sioux Falls Airport. Each intersection of Benson Road with the frontage roads is east/west stop controlled and the intersection with Marion Road is north/south stop controlled. According to the City of Sioux Falls 2015 Growth Plan, Benson Road is classified as a minor arterial roadway from west of Marion Road to ¼ mile east of I-29. The 2015 Growth Plan also specifies that a grade separation will be constructed at Benson Road under the I-29 alignment. The speed limit on Benson Road is 35 mph.

South Dakota State Highway 38 / 60th St. North (SD-38) traverses east to west from Mitchell, South Dakota to I-29. SD-38 within the study area is classified as a rural major collector west of Marion Road, an urban minor arterial from Marion Road to I-29 and as a minor arterial to the east of I-29. The majority of SD-38 in the study area is a two lane paved facility that widens at the I-29 TI to a four lane section with a raised median along the overpass. The speed limit on SD-38 is 65 mph west of I-29 and 55 through the interchange and to the east.

Within the project limits, Marion Road will be categorized as a north/south minor arterial in the 2000 Major Street Plan. From SD-38 to the Madison Street intersection, Marion Road is being improved to 3-lanes for a future 5-lane section that follows the natural grade of the land. Just to the south of Madison Street adjacent to a trailer park, a four-lane section of Marion Road exists with curb, gutter and sidewalks. South of Third Street, Marion Road tapers down to a three-lane cross section with a TWLTL, curb, gutter and sidewalks on both sides. Bike Route 13 traverses along Marion Road from 57th Street to SD-38. The intersection of Marion Road/Madison Street was recently signalized. Both the west and north approaches to the intersection have been paved to the curb returns to provide placement of loop detectors into the pavement. The speed limit on Marion Road is 35 mph.

Kiwanis Avenue is an arterial roadway that serves as access for multiple housing units from Russell Street south past 12th Street. The cross section of Kiwanis Avenue within the study area consists of four lanes with curb, gutter and sidewalks on both sides of the street. The speed limit on Kiwanis Avenue varies in the study area.

Russell Street is a four-lane median-divided, principal arterial, with curb and gutter within the project limits. Frontage roads exist along the north and south sides of Russell Street from the Maple Street intersection to Minnesota Avenue. These frontage roads provide access to businesses fronting Russell Street. The speed limit on Russell Street is 45 mph.

Interstate and Traffic Interchanges

There are currently three Interstates and 17 Interstate TI's that provide access to the Sioux Falls roadway network. Interstate 29 and three TI's, including the 12th Street, Maple Street/Russell Street and SD-38 interchanges lie within the study area.

Interstate 29

Interstate 29 (I-29) is a north/south access-controlled freeway that serves the Midwestern portion of the United States. I-29 begins in Kansas City, Missouri, follows the Missouri River on the west edge of Iowa, and continues north to the border of Canada. In the Sioux Falls area, Interstate 29 is a four-lane freeway with a speed limit of 65 mph. From the 41st Street TI to the 26th Street TI, I-29 widens to a six-lane facility. Six lanes are also provided for a short section from the SD-38 TI through the system interchange with I-90.

12th Street Traffic Interchange (Exit 79)

The 12th Street TI is a signalized standard diamond interchange. Single lane on/off ramps exist on both the northbound and southbound approaches, and each off ramp provides an exclusive right-turn and left-turn lane onto 12th Street. Across the Interstate, 12th Street is a four-lane roadway with exclusive left turn lanes at each on ramp. The speed limit on 12th Street is 35 mph. The current 12th Street TI is being redesigned by SDDOT as a single point urban interchange. A copy of the preliminary plan for the proposed TI can be found in the Appendix. In this report, Year 2025 level of service analysis assumed that the 12th Street TI was reconfigured as a single point urban interchange.

Maple/Russell Street Traffic Interchange (Exit 81)

The Maple/Russell Street TI is currently an unconventional diamond interchange with frontage roads extending north to the SD-38 TI. The interchange forms three intersections with Maple/Russell Street. The first is created by the northbound on ramp and southbound off ramp converging to form the north approach to the Maple/Russell Street intersection. The northbound off ramp tees into Maple Street to form the second intersection, which is northbound stop controlled and provides an exclusive northbound right and left turn lane. The third intersection on Maple Street is formed by the southbound on ramp and the west side frontage road. The intersection is eastbound and southbound stop controlled which allows for westbound traffic to flow freely through the intersection. The current Maple/Russell Street TI is being redesigned by SDDOT as a partial cloverleaf intersection with loop ramps in the northwest and southeast quadrants. A copy of the preliminary plan for the proposed TI can be found in the Appendix. In this report, Year 2025 level of service analysis assumed that the Maple/Russell Street TI was reconfigured as a partial cloverleaf interchange.

SD-38 Traffic Interchange (Exit 83)

The SD-38 interchange is a signalized diamond interchange with frontage roads extending south to the Maple/Russell Street TI. The northbound and southbound on/off ramps are single lane ramps from I-29. SD-38 across the interchange is a four-lane median-divided section with exclusive left-turn lanes onto both the Interstate on ramps and the east/west side frontage roads. The speed limit on SD-38 is 65 mph west of I-29 and 55 mph through the interchange and to the east.

Traffic Volumes

Traffic volumes contained in this report were obtained from SDDOT and the City of Sioux Falls. Intersection turning movement counts (TMC's) and 24-hour counts were done on various roadways in the study area. Intersection TMC's and daily counts in the study area were conducted from March 20-April 20, 2000. Historical ADT counts were obtained from the City of Sioux Falls from years 1995-99 on major arterial roadways throughout the city limits. The existing turning movement volumes at each study interchange are shown in Figure 3.

Traffic Operations Analysis

The existing lane configurations and traffic volumes were analyzed using Synchro 5 and are summarized in this section. Synchro is a traffic software program that faithfully replicates the signalized intersection capacity analysis as specified in the 2000 Highway Capacity Manual (HCM). While observations provide an understanding of the general nature of traffic in the area, they are insufficient to indicate either the ability of the street network to carry additional traffic or the quality of service provided by the street facilities. For this reason, the concept of level of service (LOS) has been developed to correlate numerical traffic-volume data to subjective descriptions of traffic performance at intersections.

LOS is a measure of effectiveness for intersection operating conditions, and is based on delay experienced by vehicles passing through an intersection. LOS ranges from "A" to "F", with LOS "A" representing little or no delay, and LOS "F" representing extreme delay. LOS "C", or better, is considered desirable, LOS "D" being acceptable in some urban situations. The qualitative definition of each category can be found in the Appendix. LOS criteria for signalized intersections are shown in Table 1.

Table 1-Signalized Intersection LOS Criteria

Level of Service	Control Delay Range
A	≤ 10 seconds
B	>10 and ≤ 20 seconds
C	>20 and ≤ 35 seconds
D	>35 and ≤ 55 seconds
E	>55 and ≤ 80 seconds
F	>80

Source: 2000 Highway Capacity Manual

Figure 3-Existing PM Peak Hour Traffic Volumes

Freeway sections along Interstate 29 were analyzed using Chapter 3 of the 1997 Highway Capacity Manual, and the ramp merge and diverge analysis were evaluated using Chapter 5 of the 1997 HCM. At the time of this analysis, the Highway Capacity Software utilizing the latest 2000 HCM methodology had not been released. The ranges of density used to define levels of service are shown in Table 2.

Table 2-Freeway Segment and Ramp LOS Criteria

Level of Service	Density Range Freeway Segment	Density Range Ramp Junctions
A	0-10.0 pc/mi/ln	0-10.0 pc/mi/ln
B	10.1-16.0 pc/mi/ln	10.1-20.0 pc/mi/ln
C	16.1-24.0 pc/mi/ln	20.1-28.0 pc/mi/ln
D	24.1-32.0 pc/mi/ln	28.1-35.0 pc/mi/ln
E	32.1-45.0 pc/mi/ln	>35.0 pc/mi/ln
F	>45.0 pc/mi/ln	N/A

Source: 1997 HCM, Table 3-1 and Table 5-2: pc= passenger car, mi=mile, ln=lane

Area Intersections

An analysis of the existing traffic showed that each study intersection operates at or above LOS C with the exception of the NB off ramp at 12th Street and the intersection of 12th and Kiwanis. Several movements at the intersections have significant delays (LOS E or F) for certain movements during the peak hour, but the majority of individual movements at each intersection operate at or above LOS D. Consideration should be given at some point to mitigation for those movements with poor levels of service. The results of the analysis are shown in Table 3.

Traffic Interchanges

An analysis of the existing volumes showed that each Interstate TI is operating with acceptable delays during the peak hour. The northbound right and westbound through movement at the 12th Street NB on/off ramps operate at capacity and the eastbound left is nearing capacity. The Maple Street/Russell Street intersection is nearing capacity, but redesign of the interchange is anticipated to phase out the existing intersection and reduce overall delay at the future intersections. The SD-38 intersection operates at LOS B or better for both the NB and SB ramps during the peak hour. The results of the analysis are also shown in Table 3.

Freeway Segments

Analysis of Interstate 29 within the study area shows that each freeway section operates with acceptable delays during the peak hour. Southbound I-29, south of the 12th Street TI operates at LOS C, but all other I-29 sections in the study area operate at or above LOS B. The results of the analysis are shown in Table 4.

Merge/Diverge Analysis

The merge/diverge movement analyses were performed at all of the TI's in the study area. All of the merge/diverge movements operate at or above LOS C within the study area. The results of the analyses are also shown in Table 4.

Table 3-Existing PM Traffic LOS Analysis

Intersection	Type	Northbound			Southbound			Eastbound			Westbound			Intersection LOS
		LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
12th Street/ Marion Road	Sig.	F	C	C	C	C	-	C	D	-	D	B	-	C
12th Street/ Lyons Blvd.	Sig.	B	B	-	B	B	-	A	A	-	A	B	A	A
12th Street/ Kiwanis Ave.	Sig.	E	C	-	C	E	-	C	C	D	C	D	-	D
Madison St./ Marion Road	Sig.	A	A	-	-	A	-	-	A	-	A	A	-	A
Madison St./ Kiwanis Ave.	Sig.	A	B	-	A	B	-	B	B	-	B	C	-	B
Maple St./ NB Off Ramp	Unsig.	F	-	B	-	-	-	-	-	-	-	-	-	-
12th Street/ SB Off Ramp	Sig.				C	E	-	-	D	-	B	A	-	C
12th Street/ NB Off Ramp	Sig.	C	-	F				D	A	-	-	D	A	E
Maple St./ Russell St.	Sig.	B	A	-	C	C	C	-	C	C	-	C	-	C
SD-38/ SB Off Ramp	Sig.				-	B	-	-	A	-	A	A	-	A
SD-38./ NB Off Ramp	Sig.	-	D	-				A	A	-	-	A	-	B

Table 4-Existing PM Traffic Ramp Analysis

Direction	Ramp Type	Checkpoint	LOS
12th Street Northbound Ramps	Off	Freeway	B
		Diverge	B
	On	Freeway	B
		Merge	B
12th Street Southbound Ramps	Off	Freeway	B
		Diverge	B
	On	Freeway	C
		Merge	C
Maple Street Northbound Ramps	Off	Freeway	B
		Diverge	A
	On	Freeway	B
		Merge	B
Maple Street Southbound Ramps	Off	Freeway	B
		Diverge	B
	On	Freeway	B
		Merge	B
SD-38 Northbound Ramps	Off	Freeway	B
		Diverge	B
	On	Freeway	A
		Merge	B
SD-38 Southbound Ramps	Off	Freeway	A
		Diverge	B
	On	Freeway	B
		Merge	B

Accident History

A detailed accident analysis of the Interstate TI's in the study area was conducted to evaluate the safety and operation of the freeway system. Accidents from 1997-99 were obtained from SDDOT at 62 Interstate traffic interchanges in South Dakota including the three existing TI's in the study area. A summary of the types of accidents and the crash rate per million entering vehicles was calculated for each interchange. An average of the 62 TI's was calculated and compared to the three study interchanges. Due to the high number of rural traffic interchanges contained in the average, high accident locations were identified by having a crash rate higher than 2.12 weighted accidents per million entering vehicles. The results of the accident analysis are shown below in Table 5.

Table 5-Interchange Accident History

I-29 Traffic Interchange	Number of Accidents by Type 1997-1999				Weighted 3-Year Accidents	Crash Rate 3-Year (Wtd. Acc./MEV)
	Fatal	Injury	PDO	Total		
12th Street	1	24	93	118	177	2.27
Maple Street	0	24	60	84	132	2.45
SD-38	0	14	25	39	67	1.54

The analysis shows that the 12th Street and Maple/Russell Street traffic interchanges have a 3-year crash rate exceeding the 2.12 high accident rate. Accidents at these two interchanges were studied further to see if accident patterns existed. The majority of accidents at the 12th Street TI were left turn and rear end collisions. The construction of a single point urban interchange would represent a change from the existing type of interchange and may result in a slight increase at first because of a driver's unfamiliarity with the interchange configuration. However, it is anticipated that the accident frequency will decrease over time as the drivers become more familiar with the new configuration. The new interchange reduces the number of conflict points by eliminating a signalized intersection and providing for more efficient traffic operations.

The Maple/Russell Street TI contained a high number of rear end and out of control vehicle collisions. Most of these accidents can be attributed to the geometric conditions at the interchange. A new partial cloverleaf design developed for this interchange, designed to current standards, has the potential to reduce the total amount of accidents at this location.

Proposed Land Use and Roadway Network

Areas in and around the City of Sioux Falls are anticipated to continue growing with residential, commercial and industrial land uses. The current roadway system will need to be improved to handle the traffic that these developments will generate. The following sections discuss areas of future development and the projected roadway system.

Proposed Land Uses

The *Sioux Falls 2015 Growth Management Plan* outlines areas where future growth is expected. In the northwest portion of Sioux Falls, multiple residential, industrial and commercial developments are planned within the horizon years of this report. The following acreages within the study area have been identified in the development plan. A copy of the projected growth areas in the Year 2015 is contained in the Appendix.

Table 6-Anticipated Year 2025 Development along I-29

Location	Manufacturing (acres)	Commercial (acres)	Office (acres)	Totals
East of I-29	1,429	151	563	2,143
West of I-29	1,018	304	86	1,408
Totals	2,447	455	649	3,551

Over 3,500 acres of new development will be constructed along the east and west sides of I-29 within the next 25 years. The subsequent shipping demands will need improved access of I-29 and I-90 for safe and efficient transport. It is anticipated that the 3,000 acres of office and manufacturing development, immediately accessing the Benson Road interchange, will generate a significant number of trips to the roadway network.

This development is anticipated to be constructed in different phases beginning in Year 2000 to Year 2015. Areas outside of the Year 2015 projected growth area have the potential for growth by Year 2025. Currently the City of Sioux Falls is preparing the 2025 Comprehensive Growth Plan, which will identify future areas of growth outside of the 2015 limits.

Proposed Roadway Network

Future developments built out by Year 2025 will require existing roadways to be improved and new roadways to be constructed to adequately accommodate the traffic volumes generated by the anticipated development. The Year 2025 roadway network is shown in Figure 4. It was assumed that as development adjacent to roadways is constructed, they would be improved to full width. Arterial roadways were assumed to provide four through lanes, with exclusive left-turn lanes. The portions of Lackey Avenue and Westport Avenue within the study area will also provide four through lanes. Major improvements to study area roadways are shown below in Table 7.

Figure 4-2025 Roadway Network

Table 7-Roadway Improvements

Roadway Segment	Improvement (within study area)
12th Street Interchange	Reconstruction of the I-29 Interchange
Maple/Russell Interchange	Reconstruction of the I-29 Interchange
I-29 Mainline	Widen to provide a six-lane section
SD-38/60th Street	4-lane section from Marion Road to Westport Ave.
Westport Avenue	Extended to SD-38 alignment as 4-lanes
Marion Road	4-lane section from SD-38 to 12th Street New interchange with I-90
Benson Road	4-lane section w/underpass at I-29 alignment
Madison Street	4-lane section from Sertoma Ave. to Kiwanis Ave.
Lackey Avenue	4-lane section from Maple Street to SD-38

In addition to the roadway improvements specified in the growth management plan, the Maple/Russell TI, 12th Street TI and I-29 are projected to be reconstructed within the 2025 horizon year. The Maple/Russell TI currently is an unconventional interchange that forms three intersections with Maple Street. Future plans call for a partial cloverleaf interchange to be constructed with ramps in the northwest and southeast quadrants. Maple/Russell will also be reconstructed with the TI to allow for a continuous east/west roadway over I-29. A figure illustrating this proposed concept is also provided in the Appendix.

The 12th Street TI is currently a tight diamond configuration. The 12th Street TI has been recommended in the South Dakota Interstate Corridor Study to be reconstructed to a single point configuration. A figure showing the proposed concept for the interchange is provided in the Appendix. In this report, 12th Street will be analyzed as a single point urban interchange (SPUI). Interstate 29 is programmed by SDDOT to be reconstructed to a 6-lane facility from 41st Street to the southern terminus of the SD-38 interchange in the Year 2005.

Traffic Projections

In order to adequately show the impacts of an additional TI at Madison Street, different factors including future development areas, past traffic growth trends, and future roadway networks were analyzed. From these factors, future traffic volume estimates were developed. Three different volume scenarios were developed. The first was a no-build scenario, which assumed the reconstruction of the Maple/Russell and 12th Street interchanges with I-29. As a part of the no-build scenario, a new interchange at Marion Road with I-90 is included with the base network, along with six-lanes on I-29 and a grade separation on Benson Road under I-29.

The second scenario includes construction of the Madison Street interchange, and the third scenario includes new interchanges at both Madison Street and Benson Road. Discussion on the formation of the three scenarios is contained below.

Historical Traffic Counts

Historical traffic volume counts of study area roadways were obtained from the City in order to estimate existing traffic growth trends throughout the Sioux Falls area. Daily traffic volumes along 12th Street, Madison Street, Maple/Russell Street, Benson Road and SD-38 were analyzed from years 1995-99. Results of the counts show an average 2% rise in traffic per year along the study roadways.

Historical traffic volume counts before and after the construction of the 26th Street TI in 1996 along 12th Street, 26th Street and 41st Street were also obtained from the City of Sioux Falls. Results of volumes taken along these roadways were used to develop a better understanding of travel patterns within this part of the City, and the resultant diversion created by an additional interchange with I-29. The actual amount of anticipated diversion from adjacent interchanges and arterial roadways was based on a variety of factors, including existing and projected traffic volumes, turning movements, and density of existing and projected land use within the study area.

Sioux Falls Growth Management Plan

The *Sioux Falls 2015 Growth Management Plan* was adopted to outline development areas and growth trends in Year 2015. As discussed previously, the majority of growth in the study area is planned to occur west of Interstate 29 and north of 12th Street. However, a significant amount of development is also planned to occur on the east side of I-29. Future development will include approximately 2,143 acres of commercial, manufacturing and office land uses on the east side of the interstate. The trip generation potential and traffic distribution trends of these developments were analyzed in order to estimate future Interstate and arterial roadway volumes in the study area.

The City of Sioux Falls modeled the impacts created by the future development on the roadway system using the T-Model 2 Traffic Modeling software. The traffic model contained estimates of Year 2015 peak hour volumes throughout the entire Sioux Falls metropolitan area and was based on growth areas specified in the 2015 comprehensive plan. Recent modifications to the 2015 land use projections in the area between Maple Street and SD-38 were incorporated into the latest traffic model.

The model analyzed two different scenarios. The first analyzed a no-build scenario, which included the reconstruction of the Maple/Russell TI and the connection of Westport Road to SD-38. The second scenario included all improvements in the first model and an interchange at the Madison Street alignment. Although three different roadway networks are evaluated in this analysis, only two model forecasts were available. The scenario containing an interchange at both Madison Street and Benson Road was not available. In addition, there are a few other proposed roadway improvements that were not included in the model's roadway network. These included a grade separated crossing of I-29 for Benson Road and a new interchange for Marion Road and I-90. As a result, it was necessary to determine the impacts that these roadway network improvements would have on travel patterns and volumes within the study area.

The forecast volumes contained in the two T-Model 2 scenarios were utilized as a base to project the Year 2015 counts to each Year 2025 volume scenario. Additional traffic was added to Year 2025 volumes to account for future growth areas outside of the 2015 boundary specified by the City. Specifically noted were an additional 8,000 students at the Southeast Technical Institute and the future improvements to the Sioux Empire Fair complex south of Madison Road.

Using the historical growth and the traffic model, specific traffic volume estimates were generated for the study TI's for each different scenario. Results of the future traffic operations at the I-29 interchanges for the 2025 No-Build, w/Benson TI and w/Madison TI & Benson TI networks are shown in Figures 5-7. Turning movement forecasts for the PM peak hour for the arterial roadway network are provided in the Technical Appendix.

Figure 5-2025 No-Build Peak Hour Traffic Volumes

Figure 6-2025 w/Madison Peak Hour Traffic Volumes

Figure 7-2025 w/Madison & Benson Peak Hour Traffic Volumes

Madison Street Traffic Interchange

According to the criteria established by the FHWA, it is necessary to evaluate all reasonable alternatives for design options, location and transportation system management improvements. The following section provides an analysis of the different types of alternatives developed for the Madison Street interchange. For all of the concepts discussed in the following section, the base assumptions include the widening of I-29 to a six-lane facility through the study area. It should be noted that the additional through lanes on the interstate will carry through each interchange, as opposed to just providing an auxiliary lane between interchanges. The only exception is between the SD 38 interchange and the I-90 interchange, where an auxiliary lane will be provided due to the proximity of the two interchanges.

Alternative Concepts

The policy developed by the FHWA for access to the Interstate system requires that all reasonable design alternatives be considered. In addition to evaluating alternative interchange configurations, it also includes determining if the existing interchanges, local roads and streets and/or frontage roads in the area can provide the necessary access or be improved to satisfactorily accommodate the design year traffic demands without the construction of a new traffic interchange.

Single Point Urban Interchange

The first concept is a single point urban interchange, similar in configuration to the existing SPUI on I-229 and 10th Street in Sioux Falls. A SPUI can be constructed in a relatively tight right-of-way resulting in potential cost savings with the need for less acquisition of land. A SPUI also operates with a single traffic signal resulting in reduced delay through the ramp intersections. The primary disadvantage of a SPUI is higher construction cost associated with the bridge structure.

Due to the location of a rock quarry on the east side of I-29 on the north and south sides of Madison Street, a single point urban interchange is one of the few interchange types that will fit within the available area. A preliminary construction cost of $6.2 million was estimated for this concept.

A Synchro analysis was conducted for year 2025 w/Madison volumes and shows that a SPUI is anticipated to operate at LOS C for both the AM and PM peak hour conditions. All movements at the interchange are anticipated to operate at or above LOS D. The capacity analysis also shows that single left turn lanes onto the northbound/southbound on ramps will yield adequate LOS. A more detailed discussion of the capacity analysis is provided in later sections of this report.

Diamond Interchange

The second concept is a typical diamond interchange similar in configuration to the 12th Street TI. A diamond configuration is the typical interchange within the Sioux Falls area along I-29. Similar to the SPUI, single left turn and right turn lanes will be required at the

northbound/southbound off ramps. Capacity analysis shows that the east and west side of the diamond operate at LOS B. Each individual movement operates at or above LOS D with the exception of the left turn movement onto the northbound on-ramp, which operates at LOS E. The addition of dual left turn lanes at this location will improve the level of service for this movement.

The construction of a diamond interchange at this location would require two traffic signals located on Madison Street, which provides a less efficient operation that the single traffic signal for the SPUI. The proximity of the rock quarry located east of I-29 will require a tight diamond configuration with distances between the intersections to be less than the ideal 1,000 feet. Due to the conflict with the rock quarry, a diamond interchange at this location was dropped from further consideration.

Frontage Roads

The next alternative considers frontage roads from 12th Street to Maple/Russell Street as opposed to the construction of a new interchange at Madison Street. Frontage roads currently exist from the SD-38 alignment and terminate at the Maple/Russell Street alignment. According to the 2015 roadway network, the west side frontage road will remain only within the frontage of the industrial park area. It is proposed to be terminated at Tickman Street and connected to Lackey Avenue. The east side frontage road will be eliminated and replaced with Westport Avenue, located further to the east.

Room for the construction of frontage roads from 12th Street to Maple/Russell Street is limited by available right of way to the east of I-29. A rock quarry exists approximately 100 feet east of the edge of pavement on I-29 on the north and south sides Madison Street. Due to the lack of room on the east side of I-29, frontage roads were dropped from further consideration.

High Occupancy Vehicles (HOV) Lanes

Another alternative would be to provide HOV lanes along I-29 in the study area. HOV lanes encourage car-pooling by giving an exclusive lane to vehicles with multiple passengers, thus reducing travel time and delay compared to travel in congested lanes. Currently no congestion exists in the state of South Dakota to require HOV lanes, and there are no traffic projections for the time period covered by this study that would require the SDDOT provide HOV lanes within the study area. The provision of HOV lanes would also require additional lanes in this corridor and is therefore deemed to be inappropriate.

Other T.S.M. and T.D.M. Alternatives

Several other Transportation System Management and Transportation Demand Management strategies were considered to reduce the need for interchanges at Madison Street and Benson Road. Several of these were addressed as a group since they are related and the success of each is dependant upon similar travel characteristics. These include employee trip reduction (E.T.R.) strategies such as ridesharing, flextime, transit user subsidies, parking fees and telecommuting. Nation wide studies have shown that these programs are more successful in larger urban areas. As key factors such as trip length, travel time and parking costs increase the incentive and success of promoting employee trip reduction plans increases. Urbanized areas under 200,000

population, such as Sioux Falls, with the average commuting trip distances under 8 miles and travel times less than 15 minutes are less successful in showing significant changes in travel. Telecommuting is likely to be the most successful in areas such as Sioux Falls with a growing service industry.

I.T.S. Alternatives

Several I.T.S. strategies should be reviewed as improvements are made to the I-29 corridor in Sioux Falls. Systems that could prove to be beneficial include variable message signing, electronic surveillance and state of the art signal systems. These strategies can smooth traffic flow and reduce traffic breakdowns due to lane closures, accidents and fluctuating traffic volumes. These measures combined can have a level of service improvement in the capacity of an intersection but are not able to significantly change the need for a highway connection at a given location.

Alternative Selection

After giving consideration to each scenario, the SPUI was selected as the preferred alternative. The single point will operate with acceptable delay and will provide more capacity to accommodate growth in traffic volumes. The SPUI and diamond interchange yield similar LOS, but the restrictions created by the rock quarries located east of I-29 do not allow proper spacing for a conventional diamond interchange. The construction of frontage roads adjacent to I-29 is also restricted by the limited space east of the interstate. Based on these factors, it was determined that the single point urban interchange is the most feasible concept for a new interchange at Madison Street.

Interchange Design Criteria

A single point urban interchange is recommended for construction at Madison Street and I-29. This type of interchange will allow for sufficient intersection capacity while having minimal impact to property directly east and west of the interchange. When designed, the Madison Street TI will utilize current SDDOT and FHWA standards. Typical SDDOT design features for interchanges are shown in Table 8. A functional design layout of the interchange is shown in Figure 8. Based on the vertical profile of Madison Street and I-29, the most feasible configuration for the single point interchange consists of Madison Street passing over the interstate mainline.

Table 8-Design Standards

Interstate 29	**Criteria**	**Interchange Ramps**	**Criteria**
Design Year	2025	Design Year	2025
Design Speed	75 mph	Design Speed	50 mph 30 mph for loops
Superelevation	0.06 ft/ft max	Superelevation	0.04 ft/ft max 0.06 ft/ft for loops
Min. Vertical Curve Length	1,000 ft	Right Shoulder Width	4 ft
Maximum Gradient	3%	Left Shoulder Width	2 ft
Max. Horizontal Curve	2°45’	Max. Degree of Curve	3°
Roadway Width	38 ft	Cross Slope	2%
Lane Width	12 ft	Inslope	6:1
Median Shoulder Width	10 ft w/3 lanes in each direction	Clear Zone	30 ft min.
Outside Shoulder Width	10 ft	Lane Width	19 ft
Clear Zone	30 ft		
Cross-Slope	2%		
Shoulder Type	Min. 3” asphalt		

Future Traffic Operations

Capacity analysis was conducted for the study TI’s and intersections for each of the build out scenarios. The analysis included comparisons of the 2025 No-Build, 2025 w/Madison TI and 2025 w/Madison & Benson TI’s forecast volumes. Analyses for the PM volumes were conducted at all locations identified by the study and AM analyses were completed along the I-29 corridor. The capacity analysis was completed using the procedures and methodology as outlined in the HCM and Synchro 5 traffic analysis software. Complete copies of the capacity analysis for each scenario can be found in the Technical Appendix.

Figure 8-Madison Street Interchange Functional Design

Since the spacing of signalized intersections along the east/west roadways is less than one mile, the capacity analysis for each intersection was performed to optimize the progression and traffic operations along these roadways. As a result, the traffic operations at each intersection show improved levels of service as compared to the analysis of an isolated intersection. This analysis provides a better indication of actual traffic operations for an interconnected signal system.

2025 No-Build

The No-Build scenario assumed that the Maple/Russell TI would be reconstructed to a partial cloverleaf layout and the 12th Street TI to a single point urban interchange. The No-Build scenario also includes the widening of I-29 to a six-lane section, the construction of a new interchange at Marion Road and I-90, and a grade separated crossing of Benson Road with I-29. Our analysis assumed that all of these improvements would be constructed before the horizon year of 2025. The results of the arterial street analysis are shown graphically in Figure 9. All three of the roadway network scenarios were included on this graphic to aid in the review and comparison of traffic operations.

The capacity analysis for each scenario was conducted along each east/west arterial in an effort to model the traffic progression along these roadways. Each roadway contains intersections with Marion Road, Lackey Avenue and Westport Avenue, along with the interchange ramp intersections. On SD 38, all of the intersections are projected to operate at LOS C or D, with the exception of Westport Avenue, which is projected to operate at LOS E during the PM peak hour.

Along Benson Road, the intersections of Marion Road, Lackey Avenue and Westport Avenue are all projected to operate at LOS C or better. Several intersections on Maple Street/Russell Street are projected to operate at capacity under the No-Build scenario. The intersections with Marion Road and with Lackey Avenue are both projected to operate at LOS E during the PM peak hour. The intersection of Westport Avenue with Russell Street is projected to operate at LOS F.

For the No-Build condition, traffic operations along Madison Street at the major intersections are projected to operate at LOS C or better. Along the 12th Street corridor, the intersections with Marion Road and with Kiwanis Avenue are projected to operate at LOS D. The proposed single point interchange is projected to operate at LOS C, as is the intersection with Lyons Boulevard.

The ramp analysis for each interchange shows that both the freeway and merge/diverge movements operate at or above LOS D, and show no capacity related problems. The construction of an additional through lane onto I-29 allows for improved capacity and reduced conflicts at merge/diverge points at each traffic interchange. A summary of the interchange and ramp/freeway LOS analysis are shown graphically in Figure 10.

Figure 9-2025 No-Build PM Peak Hour Intersection LOS

Figure 10-2025 No-Build LOS Analysis

2025 w/Madison TI

The w/Madison scenario assumes the same build-out of the 12th Street, Maple/Russell and SD-38 interchanges with the addition of a SPUI at Madison Street. The interchange LOS analysis is also summarized graphically in Figure 9.

The impacts to traffic operations along SD 38 and on Benson Road are insignificant due to the distance from the proposed Madison Street interchange. The levels of service and intersection signal delays on these roadways are similar to those observed in the No-Build condition.

The most significant improvements noted on the Maple/Russell corridor are at the intersection with Lackey Avenue and at the intersection with the northbound off-ramp. At the intersection with Lackey Avenue, the level of service is projected to improve from LOS E to LOS C with the construction of the Madison Street interchange. At the northbound off-ramp intersection, the traffic operations will improve from LOS D to LOS B. The intersection with Marion Road is projected to remain at LOS E, and the intersection with Westport Avenue is projected to remain at LOS F with the construction of the Madison Street interchange.

Table 9 compares the intersection signal delay associated with the study intersections along Maple/Russell and along 12th Street for the No-Build condition and with the Madison Street interchange. The information provided is based on the Year 2025 PM peak period. As indicated in the table, with the exception of the Marion Road intersection, all of the other signalized intersections realize a reduction in delay ranging from 32% to 60% with the addition of the Madison Street interchange.

Table 9-Intersection Delay Comparison (w/ Madison St. Interchange)

	No-Build	w/ Madison Interchange	
Intersection	Delay (sec)	Delay (sec)	% Reduction
Maple/Marion Road	61.5	61.5	0%
Maple/Lackey Ave.	56.9	34.4	40%
Maple/I-29 SB Off-Ramp	17.0	10.0	41%
Maple/I-29 NB Off-Ramp	49.2	19.5	60%
Russell/Westport Ave.	130.1	88.0	32%
12th St./Marion Road	46.9	36.5	22%
12th St./I-29 Interchange	20.5	17.4	15%
12th St./Lyon Blvd.	29.0	16.0	45%
12th St./Kiwanis Ave.	37.7	31.8	16%

The study intersections along 12th Street also show capacity and delay improvements with the addition of the Madison Street interchange. At the intersection with Lyon Boulevard, the level of service improves from LOS C to LOS B. At Kiwanis Avenue, the projected level of service improves from LOS D to LOS C. Similarly, the new single point urban interchange at 12th Street and I-29 is projected to provide improved traffic operations. This interchange is projected to

improve from LOS C to LOS B. Although the level of service at the Marion Road intersection remains at LOS D with the Madison Street interchange, the intersection signal delay decreases from 47 seconds of delay to 37 seconds. Overall reductions in delay along 12th Street range from 15% to 45% with a new interchange at Madison Street.

Results of the interchange analysis shows that the Madison Street TI operates overall at LOS B with all individual movements at or above LOS D. With the increased volumes along Madison Street, the projected level of service at the intersections adjacent to the new interchange is anticipated to decrease. At the intersection with Lackey Avenue, the intersection will operate at LOS B with 19 seconds of delay with the interchange, as opposed to LOS A with 9 seconds of delay without the interchange. The level of service at the intersection with Louise Avenue is anticipated to reduce to LOS D and 37 seconds of delay from LOS B and 14 seconds of delay.

The results of the ramp and freeway corridor analysis indicates that all movements operate at or above LOS C during the peak hours. The analysis also shows that the addition of the Madison Street TI will not adversely affect operations along the I-29 corridor and ramp movements at each study interchange. Results of the 2025 w/Madison TI LOS analysis are shown graphically in Figure 11.

2025 w/Madison & Benson TI's

The w/Madison & Benson TI scenario assumes future Build roadway conditions with new single point urban interchanges at both Madison Street and Benson Road. The results of the intersection analysis are shown graphically in Figure 9.

The addition of the Benson Road interchange has minimal impact on the traffic operations along the 12th Street and Madison Street corridors, due to the distance from that interchange. The most significant impacts are observed along the SD 38 corridor and along the Maple Street/Russell Street corridor. The information provided in Table 10 compares the intersection signal delay for the No-Build condition with the delay with interchanges at both Madison St. and Benson Road.

Table 10-Intersection Delay Comparison (w/ Both Interchanges)

Intersection	No-Build Delay (sec)	w/ Both Interchanges Delay (sec)	w/ Both Interchanges % Reduction
SD 38/Marion Road	47.0	38.1	19%
SD 38/Lackey Ave.	25.9	25.9	0%
SD 38/I-29 SB Off-Ramp	23.9	23.6	1%
SD 38/I-29 NB Off-Ramp	33.5	21.2	37%
SD 38/Westport Ave.	72.6	52.0	28%
Maple/Marion Road	61.5	36.2	41%
Maple/Lackey Ave.	56.9	26.8	53%
Maple/I-29 SB Off-Ramp	17.0	11.0	35%
Maple/I-29 NB Off-Ramp	49.2	16.3	67%
Russell/Westport Ave.	130.1	21.2	84%

Figure 11-2025 w/Madison TI LOS Analysis

The construction of an interchange on Benson Road results in some diversion of traffic from the SD 38 corridor. As a result, there are some improved traffic operations at the major intersections with SD 38. At Marion Road, although the level of service remains at LOS D, the intersection signal delay is reduced from 47 seconds to 38 seconds. At the intersection with the I-29 northbound off-ramp, the intersection delay is reduced from 33 seconds to 21 seconds. At the intersection with Westport Avenue, traffic operations improve from 73 seconds of delay to 52 seconds.

At the intersection of Maple Street with Marion Road, although the level of service remains at LOS D, the intersection signal delay improves from 62 seconds with the Madison Street interchange, to 36 seconds with both interchanges. The intersection on Russell Street that realizes the largest improvement is at Westport Avenue. With only the Madison Street interchange, this intersection is at LOS F and 88 seconds of delay. With the addition of the Benson Road interchange, this intersection improves to LOS C and only 21 seconds of delay.

Along Benson Road, with both interchanges, the proposed single point interchange is projected to operate at LOS B. The other major intersections on Benson Road are projected to operate at LOS C or better during the PM peak hour in the Year 2025.

Results of the w/Madison & Benson TI ramp analysis show that both the freeway and merge/diverge corridors within the study area show no capacity related problems during the peak hour. The addition of the Madison and Benson TI's do not adversely affect traffic operations along the Interstate 29 corridor. A summary of the w/Madison & Benson LOS analysis are shown graphically in Figure 12.

Environmental Impacts

After review and approval of the Madison Street Interchange Justification Study, the next step is to review the anticipated impacts associated with the proposed interchange in accordance with the National Environmental Policy Act (NEPA) procedures. Based on similar justification studies, it is anticipated that the environmental impacts associated with the construction of the Madison Street TI will not be significant. Some of the key issues that are typically addressed in an environmental assessment include impacts to noise and air quality, wetlands, prime farmland, public and historic lands and environmental justice. Since this proposed interchange is located in a relatively undeveloped area, it is anticipated that the impacts will be minimal. The proposed interchange is designed in a manner to avoid impacts to the lakes and quarries located in the northeast and southeast quadrants of the interchange. In addition, the interstate mainline improvements should occur within the existing right of way, which will minimize any impacts associated with that widening.

Figure 12-2025 w/Madison & Benson TI's LOS Analysis

Summary

The analysis conducted as a part of this study indicates that the addition of a traffic interchange at the Madison Street alignment is not anticipated to create capacity related problems along the Interstate 29 corridor or at ramp movements at adjacent interchanges. Improvements to I-29 along with the reconstruction of the Maple/Russell TI and the 12th Street TI result in few capacity related problems within the study area.

FHWA Criteria

The Madison Street TI Justification Study was developed in a format corresponding with the FHWA criteria for an interchange justification study. To aid in the review process, these eight criteria are discussed in the following sections.

Purpose and Need

The purpose of the Madison Street TI Justification Study is to investigate the feasibility of the construction of an additional access to Interstate 29 at the Madison Street alignment. The expansion of the Sioux Empire Fair complex south of Madison Road and the projected growth in enrollment of the Southeast Technical Institute north of Madison Road, along with the general growth in development for this portion of Sioux Falls will contribute to significant increases in traffic volumes along 12th Street and along Maple/Russell Street, resulting in congestion and poor levels of service along those corridors.

The Madison Street TI will provide an alternative I-29 access to Maple/Russell Street and 12th Street. Year 2025 traffic volumes show that the construction of the Madison Street TI will divert traffic from Maple/Russell Street and 12th Street, improving capacity and traffic operations at those two interchanges, as well as other intersections on these arterials.

Relationship to other Highway Improvement Plans

Madison Street is defined as a minor arterial according to the City of Sioux Falls criteria. The City of Sioux Falls 2015 Growth Management Plan recommends a traffic interchange be constructed at the Madison Street alignment due to future development west of I-29. In addition, SDDOT has programmed the reconstruction of the 12th Street interchange, the Maple/Russell Street interchange and the widening of I-29 to six lanes within the next several years. A new interchange is also proposed for Marion Road and I-90.

Distance to and Sizes of Communities Served

The City of Sioux Falls is South Dakota's largest city with a population of 124,000 persons. The City is currently served by three Interstates, I-29, 1-90 and I-229 and 17 traffic interchanges. The Interstate system provides regional access to and around Sioux Falls, and access to adjacent metropolitan and urbanized areas including Sioux City to the south and Brookings to the north.

Description of Existing and Proposed Access

Existing traffic interchanges along Interstate 29 within the study area are provided at SD-38, Maple/Russell Street and 12th Street. Currently, the 12th Street and SD-38 interchanges are

signalized diamond interchanges. The Maple/Russell TI is currently an unconventional interchange that forms three different intersections with Maple/Russell Street. Within the next several years, the 12th Street TI and Maple/Russell TI will be reconstructed to current design standards and provide additional capacity.

The recommended alternative for the Madison Street interchange is a single point urban interchange. The SPUI was selected as the preferred alternative over a conventional diamond for several reasons. The SPUI provided acceptable LOS during the peak hours and each individual movement operates at or above LOS D. The SPUI also results in less delay since it operates with a single traffic signal. Due to the proximity of the of an existing rock quarry to the east of I-29, a closely spaced interchange was necessary. A conventional diamond would have to be modified with less than ideal spacing between intersections. A SPUI provides a tightly spaced interchange with little impact to the adjacent quarry.

The primary benefit of an interchange at Madison Street is to provide another east/west connection and I-29 access as an alternative to the existing 12th Street and Maple/Russell traffic interchanges. The Madison Street TI will provide two eastbound and westbound through lanes, exclusive left turn lanes onto each I-29 on ramp and dual left turn and single right turn lanes at each off ramp.

Proposed Local Street Network

According to the Sioux Falls Growth Management Plan for 2015, multiple roadway projects will be completed within the horizon years of this report. As development west of Interstate 29 continues, roadways adjacent to that development will be built out to their ultimate width. Major roadway projects that will be completed within the study area before year 2025 are shown in Table 11. The number of lanes included in the table represents the number of through lanes. It is assumed that exclusive left-turn lanes will also be provided as part of these improvements.

Table 11-Major Roadway Improvements

Roadway Segment	Improvement (within study area)
12th Street Interchange	Reconstruction of the I-29 Interchange
Maple/Russell Interchange	Reconstruction of the I-29 Interchange
I-29 Mainline	Widen to provide a six-lane section
SD-38/60th Street	4-lane section from Marion Road to Westport Ave.
Westport Avenue	Extended to SD-38 alignment as 4-lanes
Marion Road	4-lane section from SD-38 to 12th Street New interchange with I-90
Benson Road	4-lane section w/underpass at I-29 alignment
Madison Street	4-lane section from Sertoma Ave. to Kiwanis Ave.
Lackey Avenue	4-lane section from Maple Street to SD-38

Traffic and Operational Analysis

Three different volume scenarios were derived in order to properly evaluate traffic operations in Year 2025. These include the 2025 No-Build, which assumes the reconstruction of the Maple/Russell Street and 12th Street TI's, 2025 w/Madison TI and 2025 w/Madison & Benson TI's. Each study interchange was evaluated for capacity during the three build out scenarios.

The results of the capacity analysis show the addition of an interchange at the Madison Street alignment on Interstate 29 will not adversely affect future roadway, interstate or ramp operations at the study interchanges in Year 2025. The diverted traffic from the addition of the Madison Street TI will improve the capacity and reduce intersection delay along the Maple/Russell Street and 12th Street corridors. The intersection delay reduction along Maple/Russell Street ranges from 32% to 60%. Along 12th Street, the reduction in delay ranges from 15% to 45%.

Brief Environmental Analysis

After review and approval of the Madison Street Interchange Justification Report, the next step is to review the anticipated impacts associated with the proposed interchange in accordance with the National Environmental Policy Act (NEPA) procedures. Based on similar justification studies, it is anticipated that the environmental impacts associated with the construction of the Madison Street TI will not be significant. Some of the key issues that are typically addressed in an environmental assessment include impacts to noise and air quality, wetlands, prime farmland, public and historic lands and environmental justice. Since this proposed interchange is located in a relatively undeveloped area, it is anticipated that the impacts will be minimal. The proposed interchange is designed in a manner to avoid impacts to the lakes and quarries located in the northeast and southeast quadrants of the interchange. In addition, the interstate mainline improvements should occur within the existing right of way, which will minimize any impacts associated with that widening.

Additional Information

The cost associated with design and construction of the new interchange will be funded by the South Dakota Department of Transportation and Madison Street improvements will be funded by the City of Sioux Falls. The preliminary cost estimate for design and construction is $7.1 million for a single point urban interchange. A summary of the preliminary quantities and costs for the construction of the interchange are provided in the Appendix.

After completion and approval of the Madison Street Interchange Justification Study, an EA will be required to identify and evaluate environmental impacts. Preliminary design of the interchange will also coincide with the preparation of the EA. Final design should be complete by March 2002 and construction is planned to be complete by the end of 2003.

APPENDIX

DEFINITION OF LEVEL OF SERVICE

Signalized Intersection

Level of service for signalized intersections is defined in terms of delay. Delay is a measure of driver discomfort, frustration, fuel consumption, and lost travel time. Specifically, level-of-service criteria are stated in terms of the average control delay per vehicle for a 15-minute analysis period. Delay is a complex measure, and is dependent on a number of variables.

Level of Service A - Describes operations with very low delay, i.e., less than 10 seconds per vehicle. Progression is extremely favorable, and no approach phase is fully utilized. Most vehicles do not stop at all and no vehicle waits longer than one red indication.

Level of Service B - Describes operations with delay greater than 10 seconds and less than 20 seconds per vehicle. This generally occurs with good progression. More vehicles stop than for LOS A, causing higher levels of average delay. An occasional phase is fully utilized.

Level of Service C - Describes operations with delay greater than 20 seconds and less than 35 seconds per vehicle. These higher delays may result from fair progression. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping. Occasionally drivers may have to wait through more than one red signal indication.

Level of Service D - Describes operations with delay greater than 35 seconds and less than 55 seconds per vehicle. At level D, the influence of congestion becomes more noticeable. Longer delays may result from unfavorable progression. Many vehicles stop, and the proportion of vehicles not stopping declines. Delays may be substantial during short peaks within the peak period.

Level of Service E - Describes operations with delay greater than 55 seconds and less than 80 seconds per vehicle. This is considered to be the limit of acceptable delay. These high delay values generally indicate poor progression. There may be long queues of vehicles waiting upstream of the intersection. Delays may be as much as several cycles.

Level of Service F - Describes operations with delay greater than 80 seconds per vehicle. This is considered to be unacceptable to most drivers. This condition often occurs with over saturation, i.e., when arrival flow rates exceed the capacity of the intersection. Volumes are not predictable under these conditions.

DEFINITION OF LEVEL OF SERVICE

Unsignalized Intersections

Unsignalized intersections base the level of service on the amount of delay experienced by vehicles turning out of or into the minor, stop sign controlled street. There are no agreed upon quantitative measures of levels of service for unsignalized intersections, but some qualitative measures are given below:

Level of Service A - Little or no delay to vehicles. A very high level of service usually found only in rural areas or during off-peak hours.

Level of Service B - Short delays to vehicles. Still a very good level of service.

Level of Service C - Average delays to vehicles. Waiting time becomes noticeable. Freedom to enter major street traffic is slightly restricted.

Level of Service D - Long delays to vehicles. Due to heavy volumes on major street, vehicles on minor streets are restricted in their ability to enter traffic stream.

Level of Service E - Very long delays to vehicles. Tolerable for short periods of time. If the level of service present for long period, the queue build-up on minor street becomes noticeable.

Level of Service F - Represents jammed conditions. Back-ups from locations down-stream or on the cross street may restrict or prevent movement of vehicles out of the approach under consideration; hence, volumes carried are not predictable.