Interchange Justification Study

I-29 at Benson Road

Sioux Falls, South Dakota

May 2001

Prepared for:

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Introduction

Purpose

The purpose of this report is to investigate the feasibility of constructing an additional interchange on Interstate 29 at Benson Road (Exit 82) 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 (TI) will be located along Interstate 29 at the existing Benson Road alignment in Sioux Falls, South Dakota. Existing traffic interchanges on Interstate 29 adjacent to the Benson Road alignment include the Maple/Russell interchange, 1-mile south, and the SD-38 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, Benson Road is classified as a minor arterial in Year 2015 with the mainline of I-29 will be raised over Benson Road to provide a grade separation.

Study Area

The guidelines for the report are published in the Federal Register by the Federal Highway Administration (FHWA). The FHWA recommends that the first adjacent existing or proposed interchange 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.

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.

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.

South Dakota State Highway 38 / 60th Street, 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 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 mph through he interchange area and to the east.

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.

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 future 5-lane 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 through 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 interchange 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 55 mph in the interchange area and to the east. The speed limit is 65 mph to the west of the interchange area.

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 through the 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 resultant 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 in Table 7.

Figure 4-2025 Roadway Network

Table 7-Proposed 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 Benson Road, 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 Benson Road 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/Benson Peak Hour Traffic Volumes

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

Benson Road 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 Benson Road 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. 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. However, since the I-29 mainline will be traveling over Benson Road, the costs of the structures would only be slightly more than a conventional diamond interchange, due to the longer spans required to accommodate the turning movements to and from the ramps. A preliminary cost estimate was developed for a SPUI interchange at this location. It is estimated that the construction costs would be approximately $5.3 million.

Since there are parallel frontage roads on each side of I-29, the amount of right of way to construct the SPUI is relatively small. It is estimated that the single point interchange can be constructed with the acquisition of approximately 2.5 acres.

A Synchro analysis was conducted for Year 2025 w/Benson volumes and shows that a SPUI is anticipated to operate at LOS C. All movements at the interchange operate at or above LOS C. 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 SD 38 diamond interchange. A diamond configuration is typical of the interchange types within the Sioux Falls area along I-29. While the diamond interchange is more conventional, there are a couple of issues associated with a diamond interchange that must be considered when making a comparison of interchange types. In order to construct a typical diamond interchange at Benson Road, a total of approximately 31 acres of right of way must be acquired to construct the ramps for the interchanges. With the potential development anticipated for the area in the vicinity of the interchange, the additional right of way costs above a single point interchange could be over $500,000.

The South Dakota Department of Transportation has prepared a construction cost estimate for a typical diamond interchange at Benson Road and I-29. The estimated construction costs would be approximately $4.8 million.

A diamond interchange at this location would require two traffic signals located along Benson Road, which provides a less efficient operation than the single traffic signal for the SPUI. Capacity analysis shows that the east side of the diamond interchange would operate at LOS B, and the west side of the interchange would operate at LOS C, due to the heavy westbound to southbound left turn movement.

Partial Cloverleaf Interchange

Another interchange configuration that was considered for this location is a partial cloverleaf interchange. Since the heaviest projected left turning movement is the westbound to southbound movement, the most appropriate location for the loop ramp is in the northwest quadrant. This would eliminate the westbound left turn movement from the intersection, which would improve this level of service from LOS C as a diamond interchange to LOS A. However, in order to accommodate the loop ramp, the southbound off-ramp and on-ramp will need to be constructed further away from the mainline. The ramp intersection would be approximately 800’ west of the mainline centerline, compared to 550’ for a diamond interchange. As a result, a total of approximately 45 acres of right of way would be required to construct this concept, which could increase right of way costs by $250,000 to $300,000 over the diamond configuration.

The SDDOT has also prepared a construction cost estimate for a partial cloverleaf interchange at for Benson Road. The estimated construction costs would be approximately $5.2 million.

Frontage Roads

Frontage roads on both sides of I-29 currently exist from the SD-38 alignment and terminate at the Maple/Russell Street alignment. The frontage roads parallel I-29 and provide access to businesses near the Maple/Russell TI, primarily on the east side of the Interstate. Capacity analysis of the existing system shows that the frontage roads operate at or above LOS B during the peak hour.

According to the 2015 roadway network, the west side frontage road will remain only within the frontage of the industrial park area in the northwest quadrant of the Maple/Russell interchange. It will be terminated at Tickman Street and be connected to Lackey Avenue. The east side

frontage will be eliminated and replaced with Westport Avenue located further to the east. With the proposed roadway network, Westport Avenue and Lackey Avenue will be four-lane divided facilities that will in effect serve as frontage roads for the anticipated development in this area. A detailed capacity analysis of the traffic operations along the proposed arterial system is provided in later sections of this report.

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 single point interchange was selected as the preferred alternative. Although the SPUI has slightly higher construction costs, the reduced amount of right of way required to build this interchange configuration will help to offset those costs. The capacity analysis indicates that the single point interchange will operate with acceptable delay and will provide more capacity to accommodate growth in traffic volumes than the diamond interchange configuration. Only one traffic signal at the interchange will result in

better progression along Benson Road, and provide opportunities for access along Benson Road that would be closer to the interstate mainline.

Interchange Design Criteria

A single point urban interchange is recommended for construction at Benson Road 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 Benson Road 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.

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		

Due to the vertical profile and the topography along the Benson Road alignment it appears that the natural configuration for the interchange is for I-29 to travel over Benson Road. This configuration results in the most efficient layout.

Future Traffic Operations

Capacity analysis was conducted for the study TI’s and intersections for each of the roadway network scenarios. The analysis included comparisons of the 2025 No-Build, 2025 w/Benson 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-Benson Road 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.

2025 w/Benson TI

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

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

Figure 10-2025 No-Build LOS Analysis

Table 9 compares the intersections signal delay associated with the study intersections along SD 38 and along Maple/Russell for the No-Build condition and with the Benson Road interchange. The information provided is based on the Year 2025 PM peak period. As indicated in the table, with the exception of the Lackey Avenue intersection, all of the other signalized intersections realize a reduction in delay ranging from 10% to 35% with the addition of the Benson Road interchange.

Table 9-Intersection Delay Comparison (w/ Benson Road Interchange)

	No-Build	w/ Benson Interchange	
Intersection	Delay (sec)	Delay (sec)	% Reduction
SD 38/Marion Road	47.0	37.6	20%
SD 38/Lackey Ave.	25.9	24.9	4%
SD 38/I-29 SB Off-Ramp	23.9	21.6	10%
SD 38/I-29 NB Off-Ramp	33.5	21.8	35%
SD 38/Westport Ave.	72.6	48.2	34%
Maple/Marion Road	61.5	49.2	20%
Maple/Lackey Ave.	56.9	33.5	41%
Maple/I-29 SB Off-Ramp	17.0	15.1	11%
Maple/I-29 NB Off-Ramp	49.2	33.4	32%
Russell/Westport Ave.	130.1	116.9	10%

Traffic operations on SD-38 show improvement for individual movements as compared to the No-Build scenario. Although the individual intersections still operate at LOS D, several individual movements have improved operations. At the intersection with Marion Road, the total intersection signal delay decreased from 47 seconds per vehicle to 38 seconds per vehicle. Other significant improvements include the intersection with the northbound off-ramp, which improved from 40 seconds of delay per vehicle to 27 seconds. At the intersection with Westport Avenue, the level of service improved from LOS E and 73 seconds of delay in the No-Build condition to LOS D and 48 seconds of delay with the Benson Road interchange.

As noted in the No-Build analysis, much of the significant delay in the study area occurs along the Maple Street/Russell Street corridor. The intersection with Marion Road is projected to improve from LOS E to LOS D with the construction of the Benson Road interchange. The intersection signal delay will reduce from 62 seconds to 49 seconds. The intersection with Lackey Avenue will also see improved traffic operations, from LOS E and 57 seconds of delay to LOS C and 34 seconds of delay. The intersection of the northbound off-ramp and Maple/Russell Street is projected to improve from LOS D to LOS C. The intersection of Westport Avenue with Russell Street will remain at LOS F with the construction of the Benson Road interchange. However, the intersection signal delay will reduce from 130 seconds to 117 seconds.

Results of the interchange analysis shows that the Benson Road TI operates overall at LOS C with all individual movements at or above LOS C. The levels of service at the intersections with Marion Road, Lackey Avenue and Westport Avenue remain constant with the addition of the

new interchange. The impact to the intersections within the study area along Madison Street and along 12th Street is insignificant due to the distance from the new Benson Road interchange.

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

The projected volumes on northbound I-29, north of the SD 38 interchange, indicate a slight anticipated increase compared to the no-build condition. The *SDDOT Interstate Corridor Study* evaluated the level of service for the northbound weaving movement between the SD 38 northbound on-ramp and the northbound off-ramp for the I-90 interchange. Traffic operations for this movement were determined to provide LOS B for the Year 2020. With the additional five years of growth, plus the additional traffic anticipated from the Benson Road interchange, there was concern with regard to the level of service that would be provided for this movement. The weave analysis was modified to reflect the projected Year 2025 volumes. The analysis indicated that this movement would remain at LOS B with the Benson Road interchange and the increase traffic volumes. A copy of the analysis is provided in the Appendix.

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 Madison Street interchange has minimal impact on the traffic operations along the SD 38 and Benson Road corridors, due to the distance from that interchange. The most significant impacts are observed along the Maple Street/Russell Street corridor and along the 12th 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 Benson Road and Madison St.

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

	No-Build	w/ Both Interchanges	
Intersection	Delay (sec)	Delay (sec)	% Reduction
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%
12th Street/Marion Road	46.9	36.5	22%
12th St./I-29 Interchange	20.5	17.4	15%
12th Street/Lyon Blvd.	29.0	16.0	45%
12th Street/Kiwanis Ave.	37.7	31.8	16%

Figure 11-2025 w/Benson TI LOS Analysis

At the intersection of Maple Street with Marion Road, although the level of service remains at LOS D, the intersection signal delay improves from 50 seconds with the Benson Road interchange, to 36 seconds with both interchanges. The northbound off-ramp intersection also experiences considerable improvement, from LOS C and 34 seconds of delay, to LOS B and 16 seconds. The intersection on Russell Street that has the largest improvement is at Westport Avenue. With only the Benson Road interchange, this intersection is at LOS F and 117 seconds of delay. With the addition of the Madison Street interchange, this intersection improves to LOS C and only 21 seconds of delay.

The construction of an interchange on Madison Street results in some diversion of traffic from the 12th Street corridor. As a result, there are some improved traffic operations at the major intersections with 12th Street. At Marion Road, although the level of service remains at LOS D, the intersection signal delay is reduced from 47 seconds to 37 seconds. At the intersections with the single point interchange and Lyon Boulevard, the level of service improves from LOS C with 29 seconds of delay to LOS B with 16 seconds. At the intersection with Kiwanis Avenue, traffic operations improve from LOS D with 38 seconds of delay to LOS C with 32 seconds.

Along Madison Street, with both interchanges, the proposed single point interchange is projected to operate at LOS B. There are a couple of intersections on Madison Street that will experience some reduction in levels of service due to the increase in both through volumes on Madison Street and from increases in turning movements. These include the intersection with Lackey Avenue, which goes from LOS A to LOS B, and Louise Avenue, which goes from LOS B to LOS D.

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 Benson Road 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 Benson Road 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. 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 Benson Road 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 Benson Road 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 Benson Road TI Justification Study is to investigate the feasibility of the construction of an additional access to Interstate 29 at the Benson Road alignment. The future land use plan developed by the City of Sioux Falls for this portion of town indicates considerable growth and development of manufacturing, commercial and office development on the east side of I-29 and residential development on the west side of I-29. By the Year 2025, a total of 2,143 acres of development is projected on the east side of I-29, and another 1,408 acres on the west side the interstate. The majority of this development will be in the manufacturing and distribution of goods. The subsequent shipping demands will need improved access to I-29 and I-90 for safe and efficient transport. The City of Sioux Falls will be constructing three five-lane arterials (Lackey Avenue, Westport Avenue and Benson Road) to distribute the volumes associated with this development.

The City of Sioux Falls has identified the northwest portion of the city as the area with the most potential for development. They have budgeted $18 million over the next five years to improve this area's infrastructure in managing the planned development. Specific capital improvements include the following:

- The Sioux River North Interceptor project is being completed at a cost of $21 million and the Marion Road/70th Street North water tower was $850,000.
- The currently approved TIP lists 23 projects over five years to improve the transportation system in the northwest quadrant of the city. The projects found within the TIP are a compilation of existing plans of the units of government and other agencies participating in the local transportation planning process.
- Two new elementary schools are planned to be constructed with this area in anticipation of the residential development.
- The Sioux Empire Fair Grounds are currently proposing a $24 million renovation to the grounds over the next several years.
- The Southeast Technical Institute/Regents University owns 165 acres and a has a master plan to accommodate 10,000 students and millions of dollars in private and public investment in buildings.

In addition, potential expansion of the Sioux Falls Regional Airport terminal will also impact traffic volumes in this area. The airport's enplanements and freight numbers continue to challenge annual records. Freight volume is up 6% from last year's record. Six to seven large jets each day are arriving and departing from the freight terminal, in addition to numerous feeder planes. The area to the south and east of the airport is reaching capacity for the associated buildings needed to handle expansion of freight related businesses. The need for future development of the light industrial and manufacturing buildings in the west study area is evident.

There may even be some consideration given to construction of a new terminal on the west side of the airport, which would have direct access to the interstate from the Benson Road interchange, greatly improving the existing access via the Maple/Russell Street interchange. This will be evaluated in the next master plan prepared for the airport.

The Benson Road TI will also provide an alternative I-29 access to both Maple/Russell Street and SD-38. Year 2025 traffic volumes show that the construction of the Benson Road TI will divert traffic from Maple/Russell Street and SD-38, improving capacity and traffic operations at those interchanges.

Relationship to other Highway Improvement Plans

Benson Road is defined as a minor arterial according to the City of Sioux Falls criteria. According to the City of Sioux Falls 2015 Growth Management Plan, a grade separation under I-29 was recommended for construction at the Benson Road alignment. 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 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 Benson Road 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 hour and can accommodate larger peak hour volumes due to its efficient operation. The SPUI also results in less delay and better progression along Benson Road since it operates with a single traffic signal.

Frontage roads currently exist along I-29 and Benson Road. 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 replaced by the proposed extension of Westport Avenue, further to the east. The addition of a grade separated crossing at Benson Road is also anticipated to function with few capacity related problems. Due to the vertical profile and the topography along the Benson Road alignment it appears that the natural configuration for the interchange is for I-29 to travel over Benson Road. This configuration results in the most efficient layout.

The primary benefits of an interchange at Benson Road are to provide an alternative I-29 access to the existing SD-38 and Maple/Russell traffic interchanges, relieving congestion and delay at those locations. The amount of growth and development along Benson Road on both sides of I-29 will generate significant traffic volumes. Direct access to the interstate system is important to keep the truck traffic associated with the anticipated manufacturing development off of the arterial street system as much as possible. In addition, there is potential for the Benson Road interchange to provide direct access to additional growth and development associated with the west side of the Regional Airport. The Benson Road TI will provide two eastbound and two westbound through lanes, exclusive left turn lanes onto each I-29 on ramp and single left and 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/Benson 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 Benson Road 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 Benson Road TI will also improve the capacity and reduce intersection delay along the SD 38 and Maple/Russell Street corridors. The intersection delay reduction along SD 38 ranges from 4% to 35%. Along Maple/Russell, the reduction in delay ranges from 10% to 41%.

Brief Environmental Analysis

After review and approval of the Benson Road 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 Benson Road 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. 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 the Benson Road improvements will be funded by the City of Sioux Falls. The preliminary cost estimate for design and construction is $6.1 million for a single point urban interchange. Another element of the project is the cost of elevating the mainline of I-29 over Benson Road. Due to the topography along Benson Road and the grades on I-29, the most feasible option for an interchange is construct bridges on the interstate to pass over the Benson Road alignment. A summary of the preliminary quantities and costs for the construction of the interchange are provided in the Appendix.

The preliminary cost estimate for design and construction is $2.7 million for the elevation of main line I-29, which includes the removal of the existing four-lanes of I-29 and construction of the new six-lane section. This may be constructed as a part of the I-29 widening project through the Sioux Falls area. The limits extend from the south end of the new ramps to the north end of the new ramps. The bridges and approach slabs for the interchange are included in the interchange costs.

After completion and approval of the Benson Road Interchange Justification Study, an Environmental Assessment 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 with construction complete by the end of 2003.

APPENDIX

DEFINITION OF LEVEL OF SERVICE

Signalized Intersections

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 stopped 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 5.0 sec 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 in the range of 5.1 to 15.0 sec 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 in the range of 15.1 to 25.0 sec 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 in the range of 25.1 to 40.0 sec 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 in the range of 40.1 to 60.0 sec 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 in excess of 60.0 sec 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 streets, 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 this level of service is present for a long period, the queue build-up on minor streets 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.