

# Exit 61 – I-90 Interchange Modification Justification Study

## Introduction

Exit 61 is a diamond interchange providing the connection between Elk Vale Road and I-90. Figure 1 shows the location of Exit 61. This interchange will connect the completed Heartland Expressway via the Southeast Connector Route (Elk Vale Road) to I-90. The completion of the Southeast Connector, currently under construction, will require that this interchange be modified to allow a more free-flow traffic pattern between these two facilities.

The proposed improvement is part of a series of corridor improvements including the Eglin Street / Elk Vale Road intersection, and other access point modifications which will improve the operation of the interchange and the crossroad. On June 18, 2004, the Department of Transportation and the City of Rapid City agreed to a series of street improvements which include the continuation of Mall Drive from East North Street to Elk Vale Road and the obliteration of Offutt Street between East North Street and Elk Vale Road. All of the traffic analysis was completed before the agreement and future traffic projections assume that Offutt Street would not be removed. The removal of Offutt Street will improve the operation of the crossroad corridor for all alternatives.

This study addresses the policy requirements for new or revised access points to the existing Interstate system published in the Federal Register Volume 63 Number 28 February 11, 1998.

- 1. The existing interchanges and/or local roads and streets in the corridor can neither provide the necessary access nor be improved to satisfactorily accommodate the design year traffic demands while at the same time providing the access intended by the proposal.**

I-90 Exit 61 (Elk Vale Road – SD 437) currently exists as a diamond interchange. Elk Vale Road passes over I-90 on a structure carrying two lanes of traffic (one lane each direction). Although largely undeveloped at this time, increasing development pressures are mounting near this interchange. Increased development will bring additional traffic and travel demands to the interchange and connecting roadways. Figure 2 shows the existing configuration of Exit 61.

Other regional projects are currently being advanced that will also contribute to changing traffic conditions at this intersection. A project to reconstruct Exit 60 (East North Street) will reconfigure that interchange as a single point urban interchange and extend East North Street to an eastward extension of Mall Drive north of I-90. Mall Drive will be extended in 2005 east to intersect with Elk Vale Road. The Southeast Connector project will also provide a new regional connection to Elk Vale Road.

Recently traffic signals were installed on the ramp intersections. Figure 3 shows the projected level of service (LOS) for the current configuration assuming the cross road would be five lane with signalized ramp intersections. The LOS for the interchange will be B/C in 2020.

FIGURE 1  
**Project Location**  
*I-90 - Exit 61 - Rapid City, S. D.*

**Site Location**

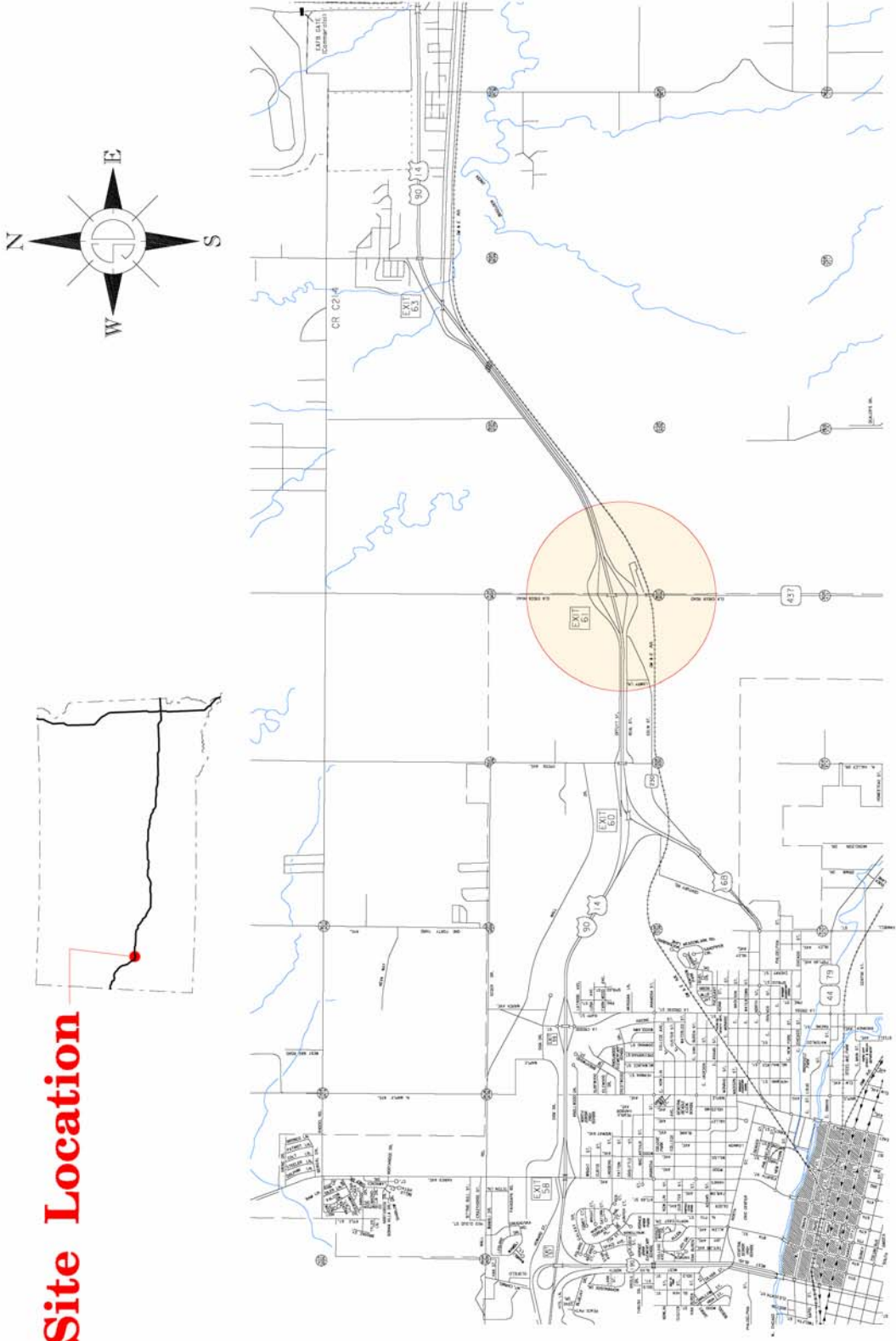
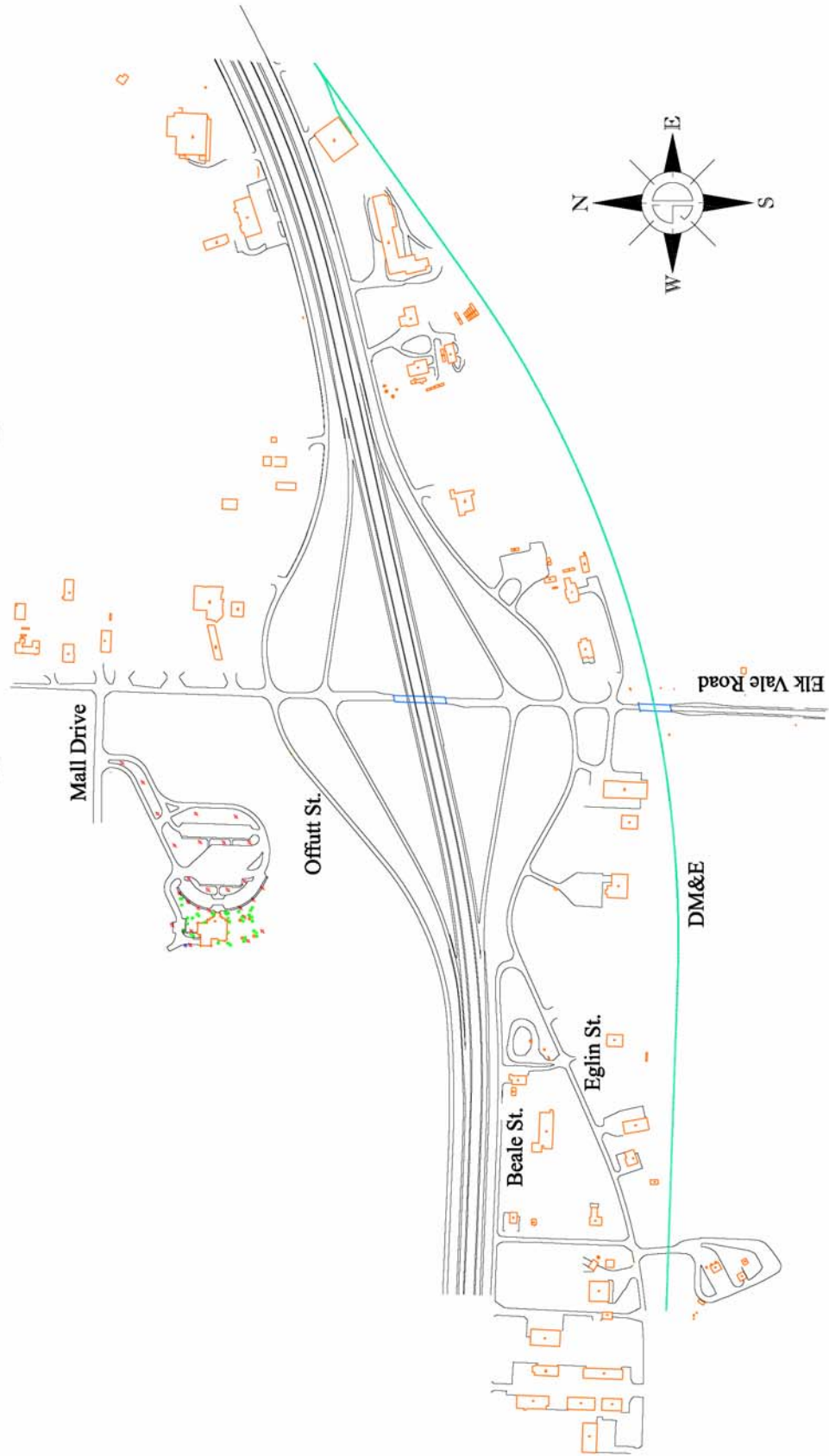
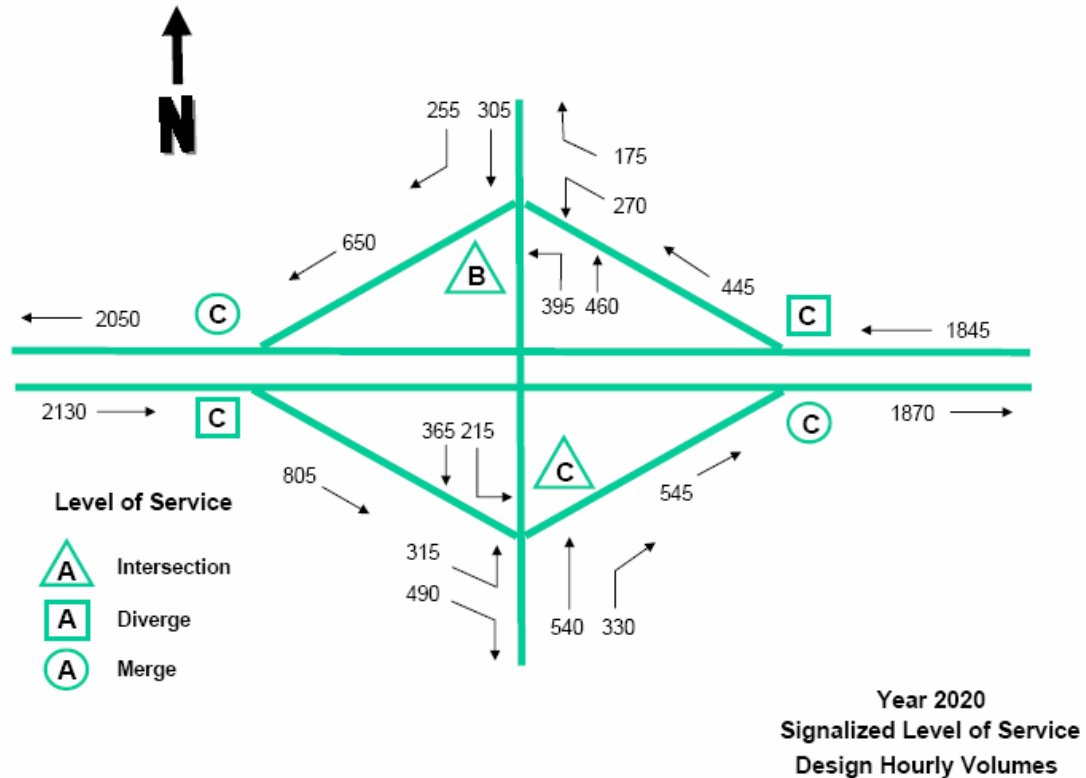


Figure 2  
Exit 61 - Elk Vale Road  
Existing Interchange



The close proximity of the Eglin Street / Elk Vale Road intersection to the south ramp intersection (less than 300 ft.) creates safety problems and adversely impacts the operation of the crossroad corridor.

Figure 3 – Projected Level of Service 2020



SDDOT Interstate Corridor Study

Under future traffic demands, the Eglin Street intersection with Elk Vale Road is expected to operate at LOS E/F for side street (stop controlled) approaches. Delay is expected to reach an average of close to 90 seconds per vehicle for the eastbound approach, with traffic queues of about 150 feet.

Further improvement alternative testing demonstrated that installation of a traffic signal was necessary to improve side street operations to LOS C or better. Due to the close proximity of the Eglin Street intersection to the eastbound I-90 ramp intersection and in an effort to reduce the number of signalized intersections on this “Heartland Expressway” road, installation of a traffic signal at this location is not prudent under existing intersection spacing conditions along Elk Vale Road.

Without traffic signal control, left turn and through movements from the Eglin Street approaches should be prohibited to reduce delay of right turn traffic and to prevent unsafe left turn and through maneuvers (vehicles performing maneuvers without sufficient gaps in through street traffic). The prohibition could take on two forms:

1. A right-turn only intersection, or
2. A  $\frac{3}{4}$  movement intersection.

Under a right turn only intersection, traffic would be allowed to turn right from Elk Vale Road to Eglin Street or from Eglin Street to Elk Vale Road. Left turns would be prohibited through the construction of a continuous raised median on Elk Vale Road. Under the  $\frac{3}{4}$  movement alternative, left turns from Elk Vale Road to Eglin Street would be allowed through a median break, but the break would be constructed in such a manner to prevent left turns from Eglin Street to Elk Vale Road.

Prohibition of left turn and through maneuvers from the Eglin Street approaches somewhat restricts access to/from the Eglin Street corridor. To mitigate this loss of easy access, a connection from Eglin Street to Elk Vale Road has been proposed further south, across the DM& E Railway tracks. The connection would tie into a proposed access road (Cheyenne Boulevard) that intersects Elk Vale Road approximately 1,100 feet south of the eastbound I-90 ramp/Elk Vale Road intersection. The Cheyenne Boulevard / Elk Vale Road intersection is anticipated to operate under traffic signal control.

**2. All reasonable alternatives for design options, location and transportation system management type improvements (such as ramp metering, mass transit, and HOV facilities) have been assessed and provided for if currently justified, or provisions are included for accommodating such facilities if a future need is identified.**

For purposes of this study, five different interchange configurations will be assessed, including the existing diamond interchange configuration. The interchange alternatives considered include:

- Conventional Diamond Interchange (existing condition)
- Tight Diamond Interchange
- Partial Cloverleaf Interchange
- Modified Trumpet Interchange
- Single Point Urban Interchange (preferred option)

Each of the interchange configurations will be discussed separately in the following sections. The physical characteristics of each alternative will be described, followed by a discussion of the operational characteristics. General construction impacts/implications of each alternative, along with a summary list of advantages and disadvantages are also included. The discussions will be focused on how each alternative will function under projected traffic demands, and how each alternative may, or may not impact adjacent intersections and property along Elk Vale Road in close proximity to the interchange.

#### Conventional Diamond Interchange

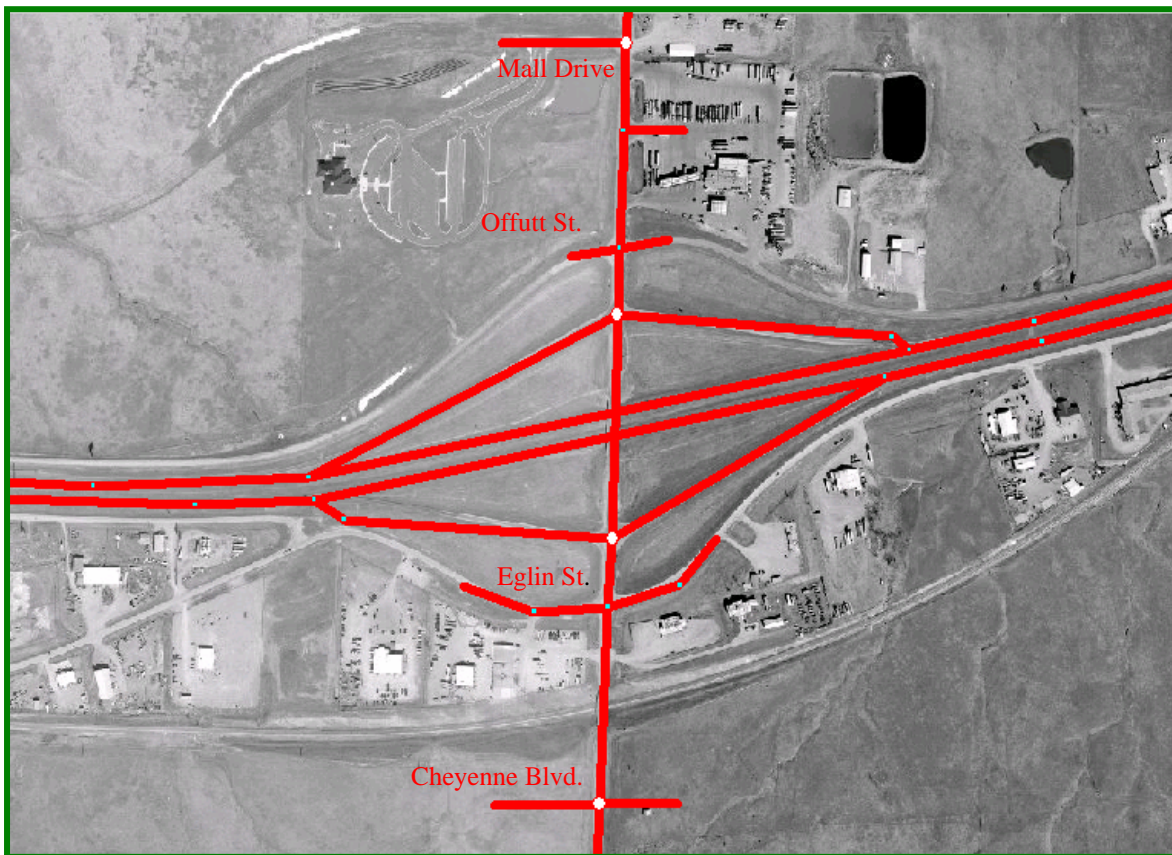
A conventional diamond interchange is the existing condition. I-90 on and off-ramps intersect Elk Vale Road at roughly right angles approximately 500 feet from the centerline of I-90. Traffic signal control has recently been installed at the ramp intersections. On and off ramps are currently single lane facilities with flared approaches at Elk Vale Road. The diamond interchange alternative is shown in Figure 4.

Due to the close proximity of the Eglin Street intersection with the eastbound I-90 ramp intersection, and due to the expected poor level of service expected at the Eglin Street intersection under future traffic conditions, the operational assessment for this alternative was conducted assuming the Eglin Street intersection was limited to a ¾ movement configuration. Under this assumption, left turn and through movements from the Eglin Street approaches are not allowed.

Under this alternative, all signalized intersections are projected to operate at LOS A overall with no single movement or lane group below LOS C (including unsignalized intersections). I-90 off-ramp approaches to Elk Vale Road are assumed to be improved to provide separate lanes for left and right turning traffic and, under this assumption, ramp queues are generally less than 150 feet long. Left turns from Elk Vale Road onto the I-90 on-ramps will function adequately using protected/permitted signal phasing, with left turn queues generally expected to be less than 100 feet long during peak periods.

Even though Offutt Street will be removed from East North Street to Elk Vale road in 2005, for this analysis, the Offutt St. intersection was assumed to remain and was projected to operate at adequate levels of service. The proposed Elk Vale Road / Mall Drive intersection is sufficiently distant from the interchange where it does not affect interchange operations, nor do interchange operations affect the Mall Drive intersection. This intersection (signalized) is expected to operate at LOS A under year 2023 traffic demands.

**Figure 4 – Conventional Diamond Interchange Alternative**



### Construction Impacts:

- Alternative requires a 5-lane bridge structure for Elk Vale Road.
- Future traffic demands require widening on off-ramps at Elk Vale Road approach to accommodate separate left and right turn lanes.
- Median construction on Elk Vale Road at Eglin to enforce  $\frac{3}{4}$  movement or right turn only restrictions.

### Advantages:

- Little interchange construction.
- Little/no reconstruction for I-90 mainline.
- Allows Offutt intersection to remain at current location
- Reduces/eliminates impacts to truck stop access/circulation.

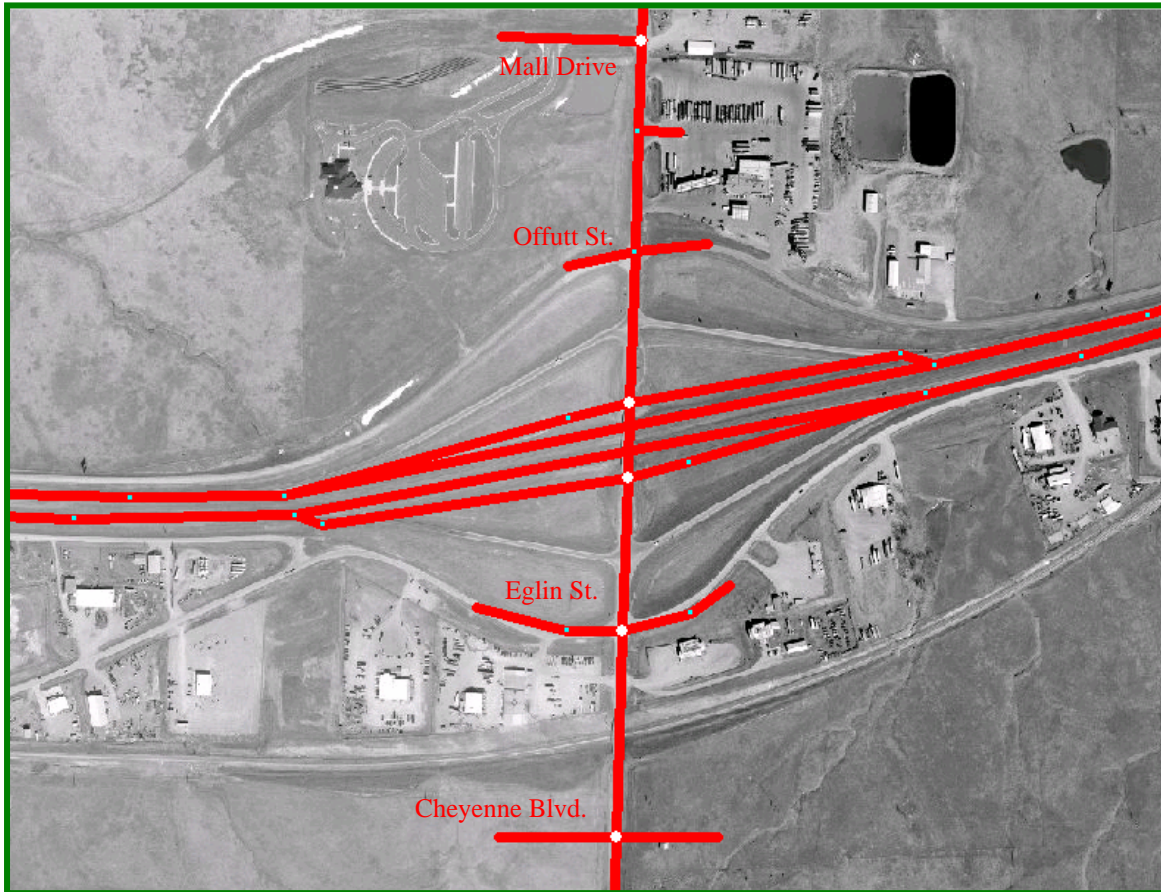
### Disadvantages:

- Limited to  $\frac{3}{4}$  movement or right turn only access at Eglin/Elk Vale Road intersection.
- Offutt intersection still violates SDDOT policy regarding access control near system interchanges. The removal of Offutt Street from East North Street to Elk Vale Road will however, improve the operation of the corridor.
- Places heavier left turn demand at new highway access (south of RR tracks) due to restriction on left turns at Eglin Street/Elk Vale Road.
- Requires the City/Developer/SDDOT construction of two new RR grade crossings for improved property access to Eglin Street corridor at Cheyenne Boulevard.
- Requires traffic to traverse “slow speed” signalized intersections for all system-to-system movements.

### Tight Diamond Interchange:

A “tight diamond” is geometrically similar to the conventional diamond although the ramp intersections with the crossroad are located closer to the I-90 centerline. For this analysis, ramp intersections were assessed with a separation of about 300 feet (about 150 ft. either side of the I-90 centerline). The tight diamond interchange alternative is shown in Figure 5.

**Figure 5 – Tight Diamond Interchange Alternative**



This alternative was set up so that ramp intersections were located about 300 ft. apart. This spacing results with about 620 feet between the eastbound I-90 ramp intersection and the Eglin Street intersection. Due to the increased distance between these two intersections, traffic signal control was assessed for the Eglin Street / Elk Vale intersection. It was found that the addition of a traffic signal at the Eglin Street / Elk Vale Road intersection did not materially impact operations of Elk Vale Road and did not reduce potential for traffic signal coordination along the Elk Vale Road Corridor.

Under the tight diamond configuration, all intersections operate at LOS A-B overall with no single movement or lane group operating below LOS C (including unsignalized intersections). With reconstruction of the I -90 off-ramp approaches to Elk Vale Road, improvements were also assumed to provide separate lanes for left and right turning traffic and, under this assumption, ramp queues are generally less than 110 feet long.

Ramp intersections were assessed assuming they operate under “single intersection” control using the Leading Alternating scheme. This scheme has the following advantages/disadvantages:

Advantages:

- Eliminates stops for most all movements within the interchange.
- Four critical left-turn movements are all timed independently



- Can handle large volumes for all movements without blocking.
- Scales to low cycle lengths with low volumes
- Works well for intersections less than 200 ft. apart.

Disadvantages:

- The close ramp intersections do not provide as much time for the crossroad through traffic.
- Some loss of efficiency since each of the four movements control the entire interchange.

Under this operational scheme, queues on Elk Vale Road at ramp intersections are generally less than 175 ft. long.

This alternative also increases spacing between the westbound I-90 ramp intersection and Offutt St. With increased separation and the removal of Offutt Street from East North Street to Elk Vale Road, the Offutt St. intersection could remain at its existing location, reducing or eliminating impacts to the truck stop accesses.

Construction Impacts:

- This alternative requires a 6-lane bridge for Elk Vale Road over I-90 to accommodate side-by-side left turn storage lanes.
- Elk Vale Road approaches to overpass structure will also need to be 6-lanes wide (transition section).
- Will require wider off ramp approaches to Elk Vale Road to accommodate double left-turn lanes from ramp approaches to Elk Vale Road.

Advantages:

- Little or no re-construction of I-90 mainline.
- Allows Offutt St. to remain east of Elk Vale Road, reducing impacts to truck stop.
- Allows efficient traffic operations at interchange
- Allows Eglin to remain as full-movement (signalized) intersection, negating the need to construct two new RR grade crossings to gain access between Eglin Street and Cheyenne Boulevard.
- Reduces the left-turn demand at Cheyenne Boulevard intersection with Elk Vale Road (when compared to conventional diamond alternative).

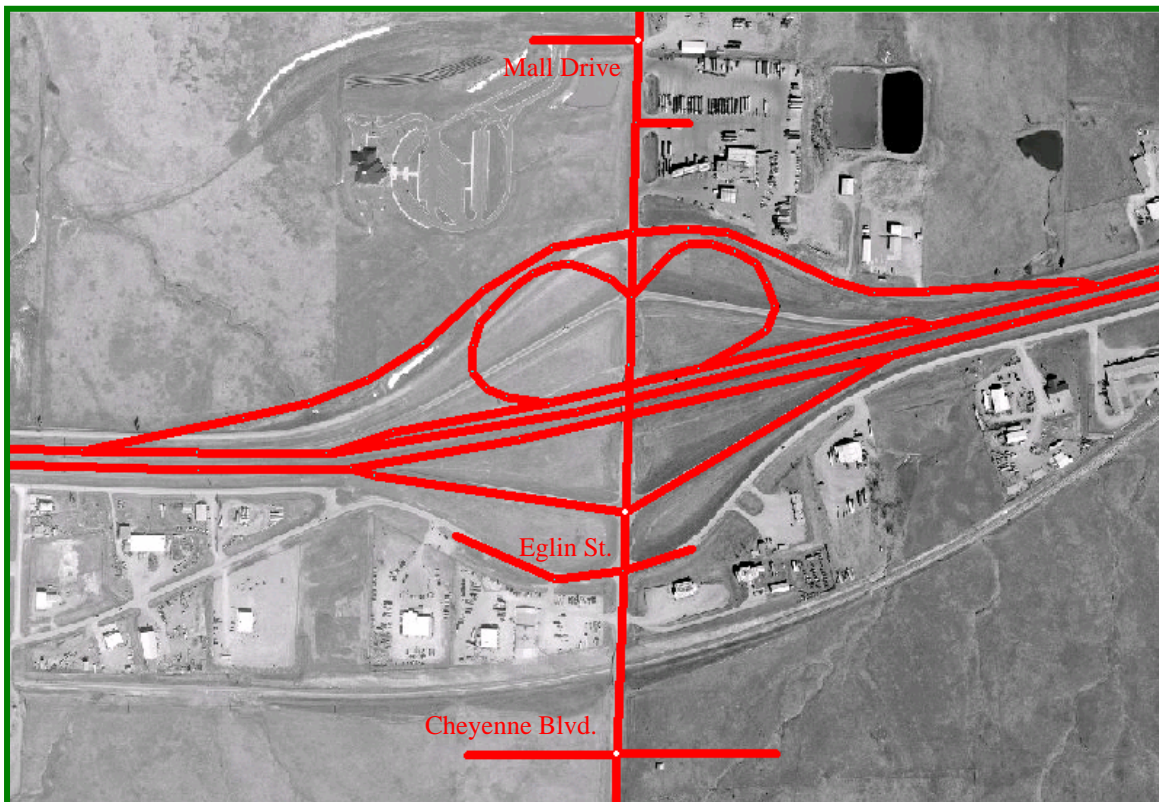
Disadvantages:

- Requires the construction of a 6-lane overpass structure (wider than with conventional diamond).
- Requires a wider roadway approaches to overpass structure (to transition to 6-lane section).
- Will require considerable retaining wall construction to move ramp intersections close together.
- Requires the traffic to traverse “slow speed” signalized intersections for all system-to-system movements.

Partial Cloverleaf Interchange:

A typical cloverleaf interchange combines straight on and off-ramps of the diamond interchange with loop ramps in such a manner that all movements to and from the highway can be made without intersection conflicts requiring the use of traffic signals. As a partial cloverleaf, this application utilizes the attributes of a cloverleaf interchange for westbound I-90 traffic while retaining the existing diamond ramp configuration for eastbound ramps. The partial cloverleaf interchange alternative is shown in Figure 6.

**Figure 6 – Partial Cloverleaf Interchange Alternative**



This alternative is identical to the one recommended in the I-90 Corridor Study, Phase II, including the use of a Collector-Distributor (C-D) road for westbound on and off-ramp movements. Since the eastbound I-90 ramp / Elk Vale Road intersection will remain at its current location, it was assumed that the Eglin Street intersection would be restricted to  $\frac{3}{4}$  movements or right turn movement only. Under this alternative, Offutt St. is eliminated by the new westbound I-90 ramps, requiring substantial revisions to access for the truck stop business in the northeast corner of the interchange. Signalized intersections assumed at Mall Drive, the I-90 Eastbound Ramp intersection, and at Cheyenne Boulevard south of the RR tracks.

Under this alternative, all intersections will operate at LOS A, with no single approach or lane group operating below LOS C (including unsignalized intersections). The weave section on the C-D road is predicted to operate at LOS B, although the weave section is shorter than SDDOT minimums. As proposed by the I-90 Corridor Study, Phase II, the weave section on the C-D road is 700 ft. long whereas SDDOT criteria call for a 1,600 ft. minimum length (per Fig. 13-13, SDDOT Roadway Design Manual).

### Construction Impacts:

- Requires a 6-lane overpass to accommodate the acceleration lane from the westbound off ramp merge.
- Requires the construction of entirely new westbound ramps and loop ramps.
- Requires the elimination of Offutt St. and modification of access/circulation to/from truck stop.
- Requires median construction to enforce  $\frac{3}{4}$  movement or right turn only restrictions at Eglin Street/Elk Vale Road intersection.
- Requires the reconstruction of I-90 to relocate westbound ramps and construct C-D roadway.

### Advantages:

- Allows system-to-system movements to occur with less delay (fewer signalized intersections than with diamond alternatives).
- Removes one signalized intersection for movements between I-90 and the Heartland Expressway.

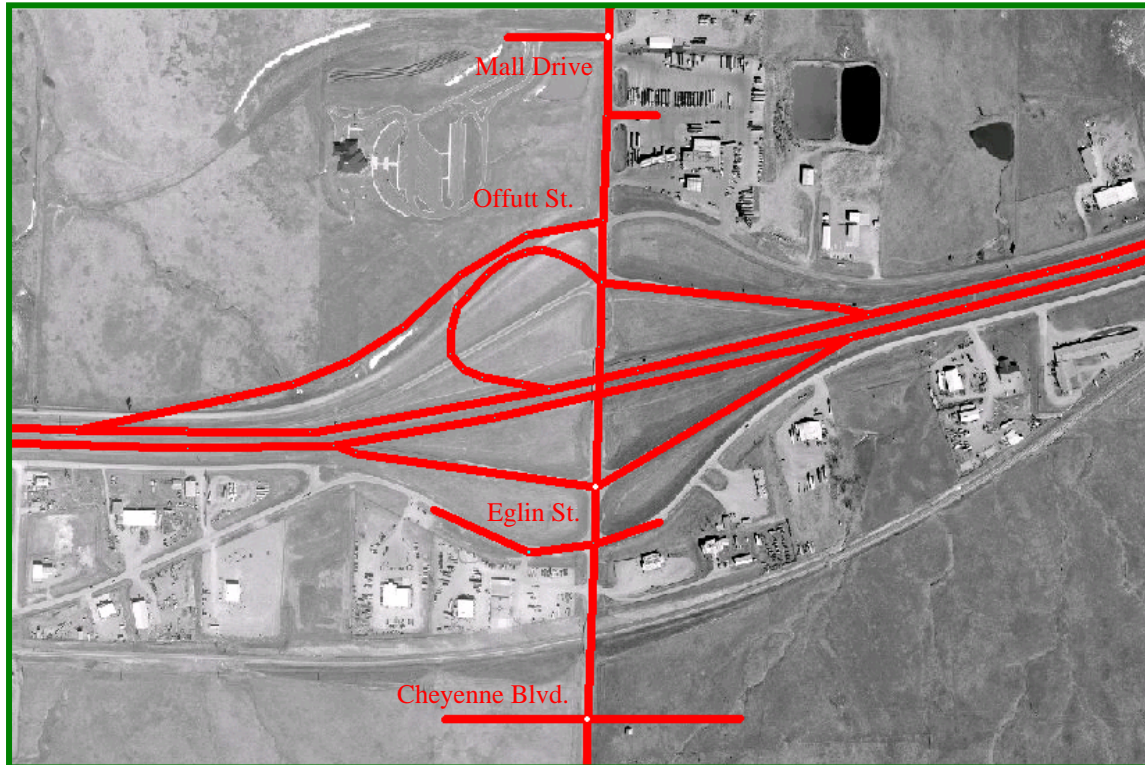
### Disadvantages:

- Requires expensive interstate mainline re-construction.
- Requires expensive ramp and C-D road construction.
- Results with sub-standard weave section length.
- Introduction of weave section and accompanying crash potential, even though crash potential for I-90 is reduced through the use of C-D road.
- Uses slow-speed loop ramps (30 mph).
- Elimination of Offutt St. and required modification of truck stop access and circulation.
- Use of loop ramps increases the friction points on westbound I-90...now have two diverge and two merge areas for westbound mainline I-90 traffic.

### Modified Trumpet Interchange:

A trumpet interchange is primarily utilized to connect two system roadways that intersect at a “T”. Although the study location is not a “T” intersection, a modified trumpet configuration offers system-level connections for the predominate system-level movements (I-90 to SD 437 to the south). Unlike a true trumpet interchange, the modified configuration utilized for this analysis does not employ a “fly-over” and instead requires that the northbound to westbound movement turn left at-grade to access the westbound on-ramp. The modified trumpet interchange alternative is shown in Figure 7.

**Figure 7 – Modified Trumpet Interchange Alternative**



This alternative is offered as way to improve system-to-system movements without introduction of weaving movement or construction of C-D roadway on I-90. Since the eastbound I-90 ramp intersection with Elk Vale Road will remain at its current location as a signalized intersection, the Eglin Street / Elk Vale Road intersection was assumed to be restricted to  $\frac{3}{4}$  or right turn only movements through construction of a raised median on Elk Vale Road. Although not explicitly analyzed, Offutt St. to the east of Elk Vale Road could likely remain at its current configuration to minimize impacts to the truck stop access and circulation patterns.

Under this alternative, traffic signal control was assumed on Elk Vale Road at Mall Drive, I-90 eastbound ramp intersection, and the new Cheyenne Boulevard connection south of the RR tracks. Under this alternative, all intersections are projected to function at LOS A, with no single lane group or movement operating below LOS C (including unsignalized intersections).

Construction Impacts:

- Requires the construction of a new westbound loop off-ramp and a new westbound on ramp.
- Requires a 6-lane overpass structure (for acceleration lane from westbound loop off-ramp).
- Requires the widening of the existing eastbound off-ramp to accommodate separate left and right turn lanes at the Elk Vale Road approach.
- Requires some re-construction of I-90 for westbound loop ramp and for merge lane from new westbound on-ramp.
- Requires the construction of a new westbound on-ramp.

### Advantages:

- Eliminates the weave inherent with partial cloverleaf alternative.
- Provides greater separation of diverges than partial cloverleaf alternative.
- Provides a free-flow between I-90 and the Heartland Expressway for all but one movement (northbound to westbound).
- Requires only one signalized intersection for interchange.
- Single signalized intersection for interchange improves movements over Diamond alternatives.

### Disadvantages:

- Requires limiting Eglin intersection to  $\frac{3}{4}$  or right turn only movements
- Requires the construction of two RR grade crossings for connection to Cheyenne Boulevard to fully serve Eglin Street corridor land uses.
- Requires some reconstruction on I-90 mainline and new construction of westbound off and on-ramps.
- Introduces one additional diverge point on westbound I-90 mainline (when compared to diamond or SPUI alternatives).

### Single Point Urban Interchange (Preferred Alternative):

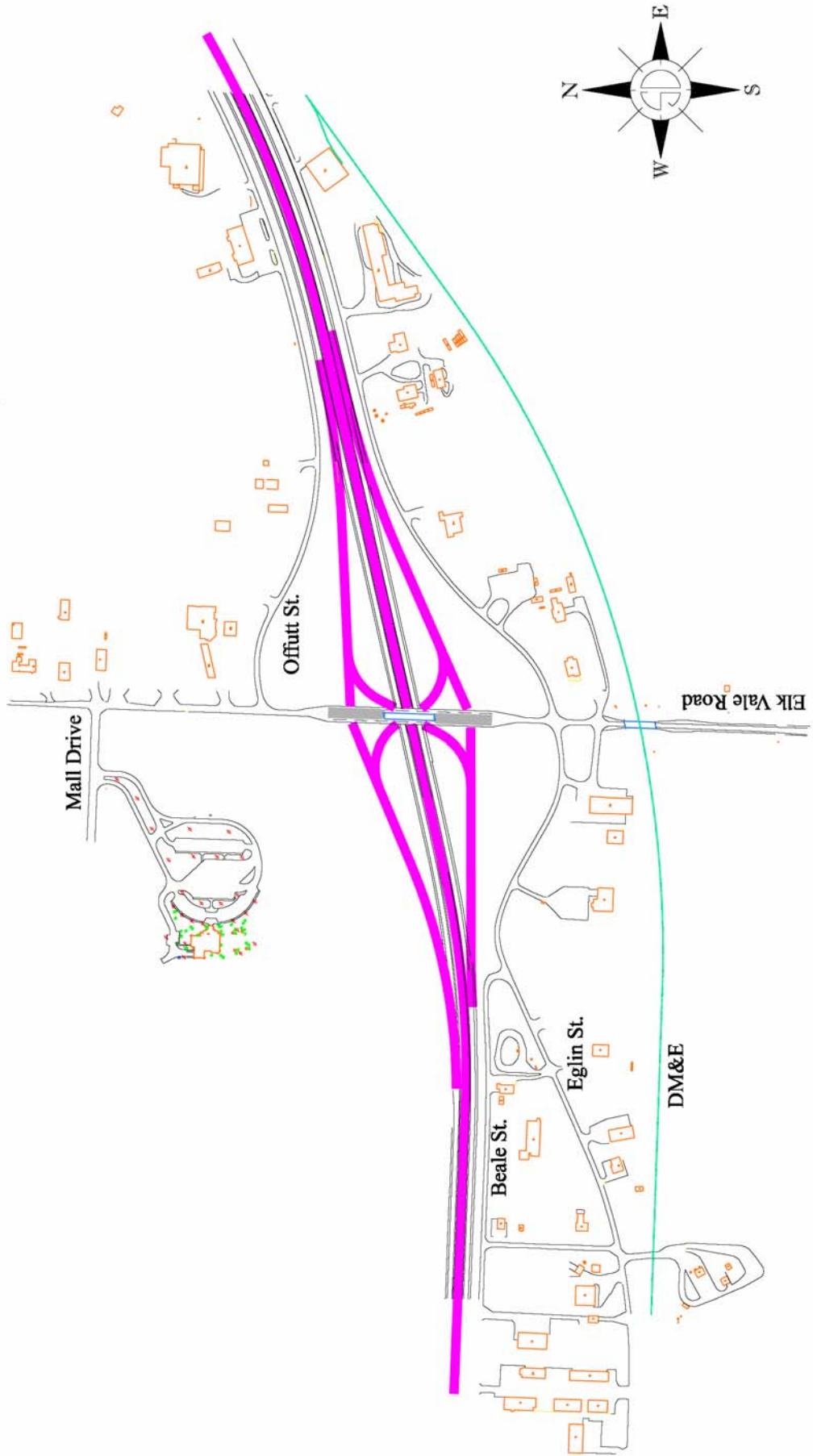
A single point urban interchange (SPUI) utilizes on and off ramps similar to the diamond interchange, but brings them together to intersect the crossing highway at a single point. Developed primarily for developed urban environments where right of way restrictions constrained other interchange configurations, the single point urban interchange also offers increased efficiency through the use of a single signalized intersection to handle the functions of both diamond ramp intersections. The single point urban interchange alternative is shown in Figure 8.

Under the SPUI alternative, intersection spacing along Elk Vale Road between the interchange and Eglin Street is increased to about 730 feet. Due to the increased distance between these two intersections, traffic signal control was assessed for the Eglin Street / Elk Vale intersection. It was found that the addition of a traffic signal at the Eglin Street / Elk Vale Road intersection did not materially impact operations of Elk Vale Road and did not reduce potential for traffic signal coordination along the Elk Vale Road Corridor.

Under this alternative, with the removal of Offutt St. from East North Street to Elk Vale Road, the Offutt St. intersection can remain at its current location due to increased spacing between Offutt St. and the interchange signal along Elk Vale Road. This allows the interchange reconstruction to proceed with little or no impact to the truck stop and its access. Signalized intersections along Elk Vale assumed at Mall Drive, the SPUI, Eglin Street, and the new Cheyenne Boulevard access south of the DM&E Railway tracks. The assessment showed all corridor intersections would operate at LOS A/B, with no single lane group or movement operating below LOS C (including unsignalized intersections).

Figure 8

# Exit 61 - Elk Vale Road Proposed Interchange



#### Construction Impacts:

- Requires the construction of a substantial overpass structure since left turn radii must be accommodated on the structure along with a typical section width of 6-lanes.
- Elevated SPUI will require considerable use of retaining walls.
- Requires a wider roadway section on approach to structure to accommodate transition from 5-lanes section to 6-lane section on structure.
- Will likely require complete reconstruction of I-90 to lower its grade and enable a lower grade for the overpass structure (improved sight distance).

#### Advantages:

- Single signalized intersection for interchange improves movements between I-90 and the Heartland Expressway, and greater capacity compared to diamond alternatives.
- The distance between the ramp intersection and the Eglin Street intersection is increased improving the operation of the cross-road.

#### Disadvantages:

- Expensive interchange type that requires reconstruction of I-90 mainline and ramps.
- Potential sight distance and visibility issues with intersection on crest vertical curve.

The single point interchange design was chosen to accommodate population growth, keep the existing alignment of the service roads, and keep uniformity in interchange types with Exits 58 and 60. The cross road over option was selected for cost savings of approximately \$500,000. Elk Vale Road will go over I-90 with the condition that the northeast service road would not be realigned to connect with Mall Drive. As stated earlier, SDDOT and the City of Rapid City have entered into an agreement to extend Mall Drive from East North Street to Elk Vale Road and obliterate Offutt Street between East North Street and Elk Vale Road. SDDOT and the City of Rapid City are working on the link for Cheyenne Boulevard to Eglin Street and keeping the median continuous at the Eglin Street intersection with Elk Vale Road. The intersection would accommodate right-in and right-out movements only.

- 3. The proposed access point does not have a significant adverse impact on the safety and operation of the Interstate facility based on an analysis of current and future traffic. The operational analysis for existing conditions shall, particularly in urbanized areas, include an analysis of sections of Interstate to and including at least the first adjacent existing or proposed interchange on either side. Crossroads and other roads and streets shall be included in the analysis to the extent necessary to assure their ability to collect and distribute traffic to and from the interchange with new or revised access points.**

The SDDOT Interstate Corridor Study examined the I-90 mainline traffic and level of service (LOS) for I-90 including the sections from Exit 60 east to Exit 61 and continuing east to Exit 63. The table below shows the existing and projected traffic and LOS for interstate without interchange improvements to Exit 60 and Exit 61.

### I-90 Mainline Traffic and Level of Service

Segment	Existing			Year 2010			Year 2020		
	ADT	v/c	LOS	ADT	v/c	LOS	ADT	v/c	LOS
Exit 60 - Exit 61	23,800	0.25	B	35,700	0.38	B	47,100	0.50	C
Exit 61 - Exit 63	21,800	0.23	A	40,800	0.43	C	53,100	0.56	C

In 2020, it is projected that without the planned interchange improvements at Exit 60 and Exit 61 the I-90 mainline will operate at a very acceptable LOS C. The construction of single point interchanges at both Exits 60 and 61 will improve the operation of the mainline.

As discussed in the previous section, the construction of a single point interchange at Exit 61 will improve the operation of the crossroad by expanding the current crossroad configuration to five lanes. In addition, the distance between the ramp intersection and the service road will increase improving the operation of the crossroad intersections with the service roads. The removal of Offutt Street from East North Street to Elk Vale Road will also improve the operation of the crossroad.

4. **The proposed access connects to a public road only and will provide for all traffic movements. Less than “full interchanges” for special purpose access for transit vehicles, or HOV’s or into park and ride lots may be considered on a case by case basis. The proposed access will be designated to meet or exceed current standards for Federal-aid projects on the Interstate system.**

The proposed access improvement connects to a public road only and will provide for all traffic movements. The improvement will meet or exceed current standards for Federal-aid projects on the Interstate system.

5. **The proposal considers and is consistent with local and regional land use and transportation plans. Prior to final approval, all requests for new or revised access must be consistent with the metropolitan and/or statewide transportation plan, as appropriate, the applicable provisions of 23 CFR part 450 and the transportation conformity requirements of 40 CFR parts 51 and 93.**

The proposed interchange improvement is consistent with the STIP and local planning. The project is included in the Rapid City MPO Transportation Improvement Program.

6. **In areas where the potential exists for future multiple interchange additions, all requests for new or revised access are supported by a comprehensive Interstate network study with recommendations that address all proposed and desired access within the context of a long-term plan.**



The South Dakota Interstate Corridor Study completed in February 2001 indicated that there is no potential for future interchange additions along this segment of Interstate 90.

Exit 60 located approximately 1 mile west of Exit 61 will be reconstructed from a partial interchange to a single point interchange. A part of the reconstruction of Exit 60 will be the removal of the westbound on ramp at Dyess Avenue and I-90. This will improve the operation of the mainline of I-90 between Exits 60 and 61.

**7. The request for a new or revised access generated by new or expanded development demonstrates appropriate coordination between the development and related or otherwise required transportation system improvements.**

The proposed interchange modification is not the result of any new or expanded specific development, but is due to the steady growth of the City of Rapid City. The construction of a full movement interchange at Exit 60 will provide access north of I-90. Mall Drive will connect East North Street and Elk Vale Road. This will allow development north of I-90 in Rapid City. The proposed single point interchange will facilitate development in the area.

**8. The request for new or revised access contains information relative to the planning requirements and the status of the environmental processing of the proposal.**

The proposed revised access is included in the STIP and the Rapid City MPO TIP. The status of the environmental processing is a separate part of this request for the revised access.