

To:	Steve Gramm, SDDOT	
From:	HDR	Project: SDDOT I-190 Silver Street Interchange Study Rapid City, SD HDR Project No. 000000000137390
Date:	December 27, 2011	

RE: Replacement of Existing I-190 Twin Bridges at I-190/Silver Street Interchange, Rapid City, SD

Background

SDDOT has requested a study to evaluate the design and operations of replacing the Silver Street interchange on I-190 in Rapid City. I-190 crosses over Silver Street/North Street with twin bridges that carry northbound (NB) and southbound (SB) traffic. The adjacent terrain is not conducive to changing the profiles of I-190 and North Street, therefore, preliminary design alternatives were developed maintaining I-190 traffic over North Street through the interchange. For each of the interchange alternatives, the bridge(s) are on a tangent which would not require curved structures or superelevation.

The study has been spurred by structural deficiencies with the Silver Street Interchange bridges; therefore these existing 2-lane bridges will be replaced. The structure alternatives documented in this technical memo are part of a comprehensive study of the I-190 Silver Street interchange which includes preparation of an interchange modification justification report (IMJR) and an environmental assessment (EA). Project administration is through the South Dakota Department of Transportation Office of Project Development.

The purpose of this memo is to describe the preliminary structure options studied for the replacement bridges. An outline of this memo is as follows:

- Overall Project Limits and Proposed Traffic Phasing
- Description of the Existing Bridges
- Criteria used for Preliminary Bridge Options
- Bridge Option Summary
- Conclusions
- Appendix

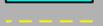
Overall Project Limits and Proposed Traffic Phasing

Bridge inspections continue to show structural deterioration in the existing I-190 bridges at Exit 1C that requires maintenance to keep the structures open to the traveling public. The deterioration and added maintenance costs show that the existing structures are reaching the end of their useful life. The SDDOT Statewide Transportation Improvement Program indicates a project for the replacement of the bridges programmed for 2015. In addition to the bridge replacements, a total interchange reconstruction is also being planned. The overall project limits for the proposed modified interchange layouts are being addressed in the Environmental Analysis (Alternative 1, 1a, and 2a) and shown on pages 2 - 4.

During project construction, traffic is expected to be maintained on the existing roadway while the proposed structure(s) are constructed adjacent to and to the west of the existing bridges. Periodic lane closures will be necessary to allow for work to occur adjacent to the existing roadway and a closure of I-190 may be necessary to tie each end of the proposed alignments to the existing alignments. All traffic will be moved to the new roadway alignment and bridges after they are completed so that the existing bridges can be demolished.

I-190 / Silver Street Preliminary Plan / Profile Design - Alternative 1

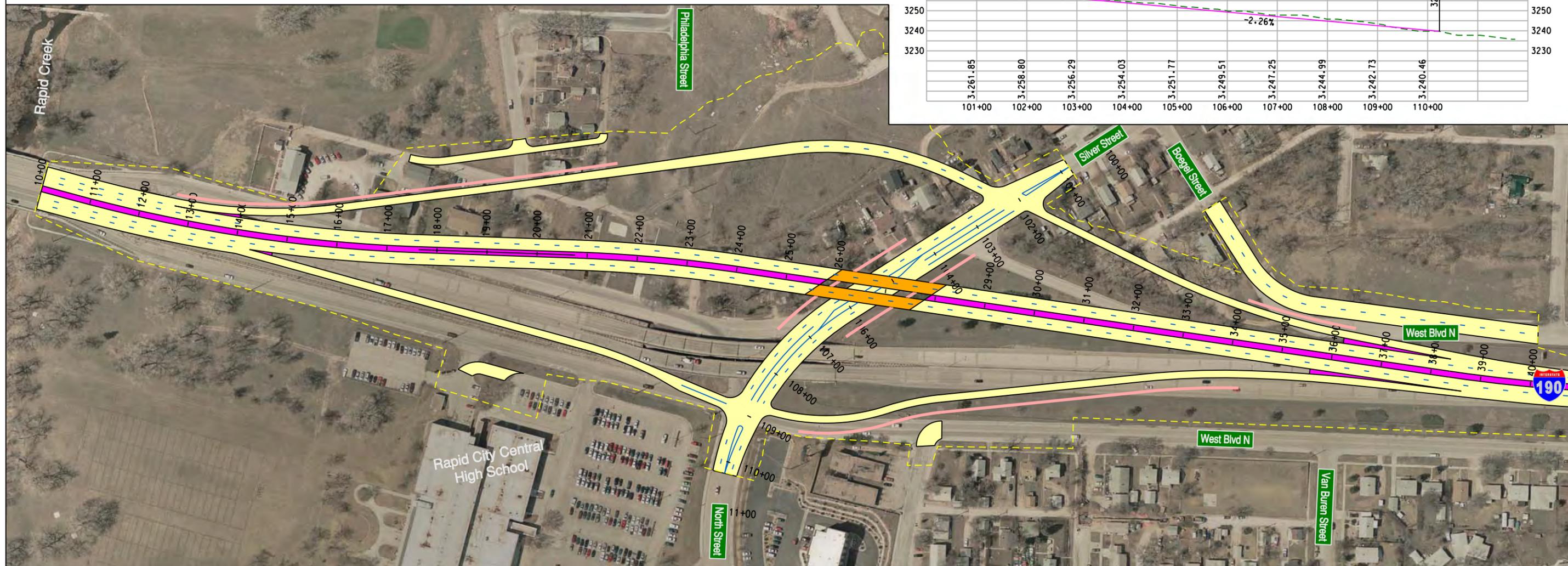
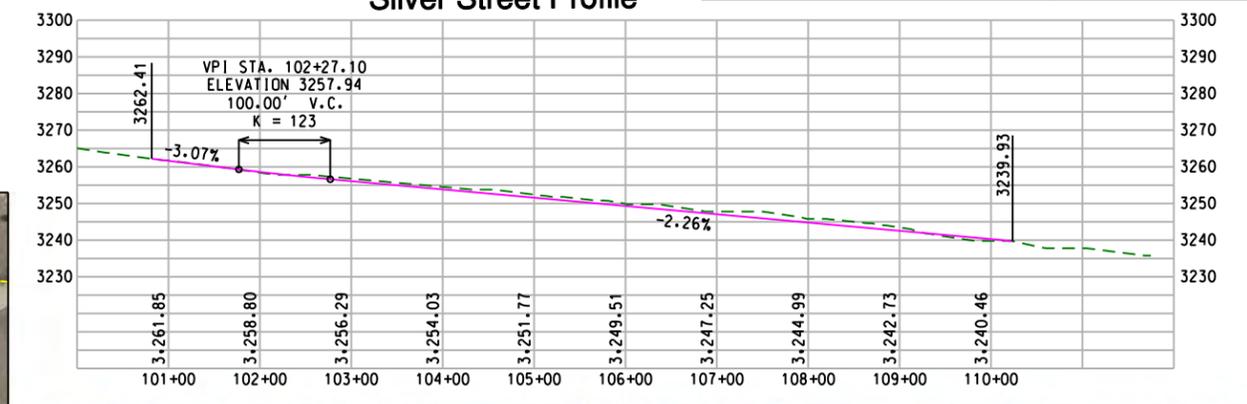
STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	HP 5596(12)	1	2
FILE: Alternative 1.dgn PLOTTING DATE: 08/18/2011		REV DATE: INITIAL:	

Legend	
	Roadway
	Bridge
	Raised Island / Median
	Local Access Option
	Construction Limit
	Retaining Wall

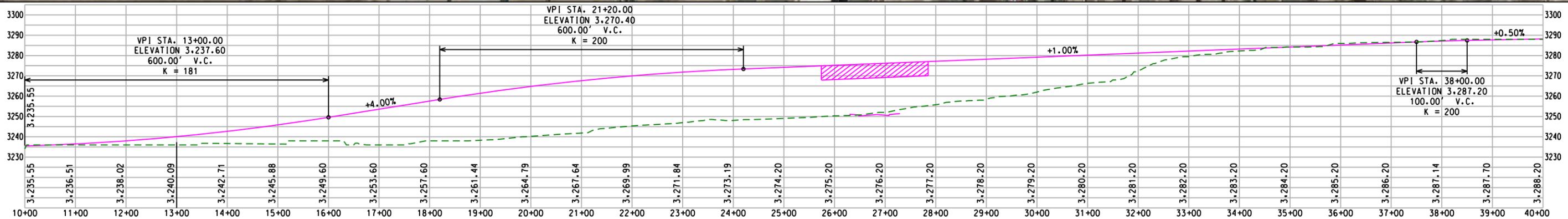


SCALE: 1" = 200'

Silver Street Profile



I-190 Profile



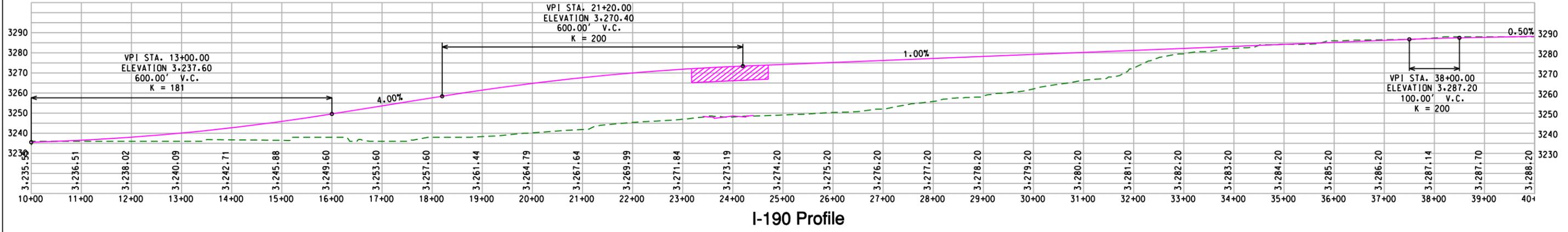
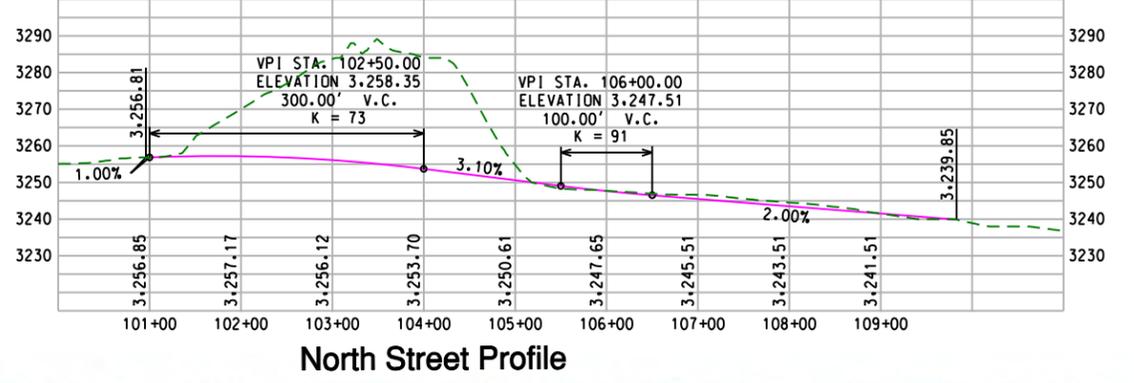
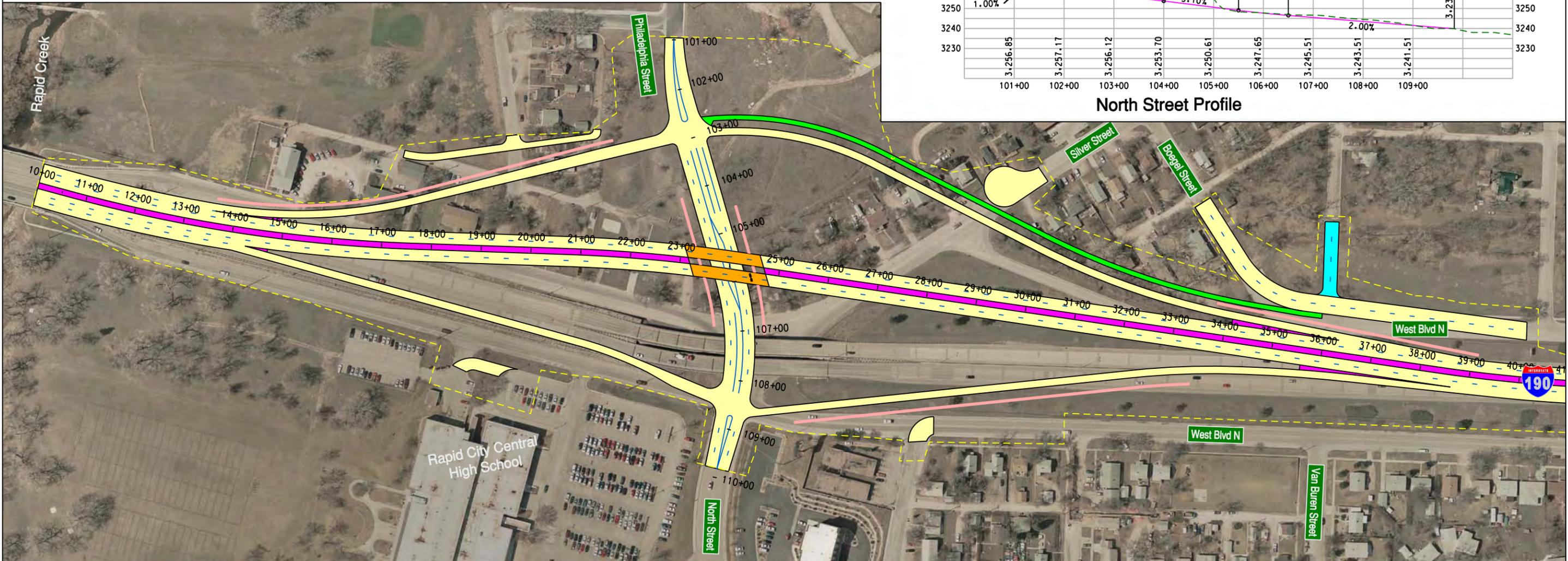
I-190 / Silver Street Preliminary Plan / Profile Design - Alternative 1A

STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	HP 5596(12)	1	2
FILE: Alternative 1a.dgn		REV DATE: INITIAL:	
PLOTTING DATE: 08/18/2011			

Legend	
	Roadway
	Bridge
	Raised Island / Median
	Recreation Trail
	Local Access Option
	Construction Limit
	Retaining Wall



SCALE: 1" = 200'



I-190 Profile

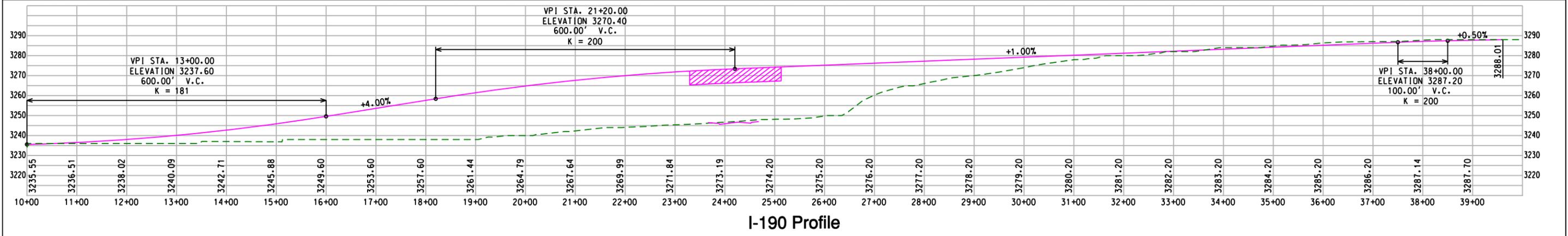
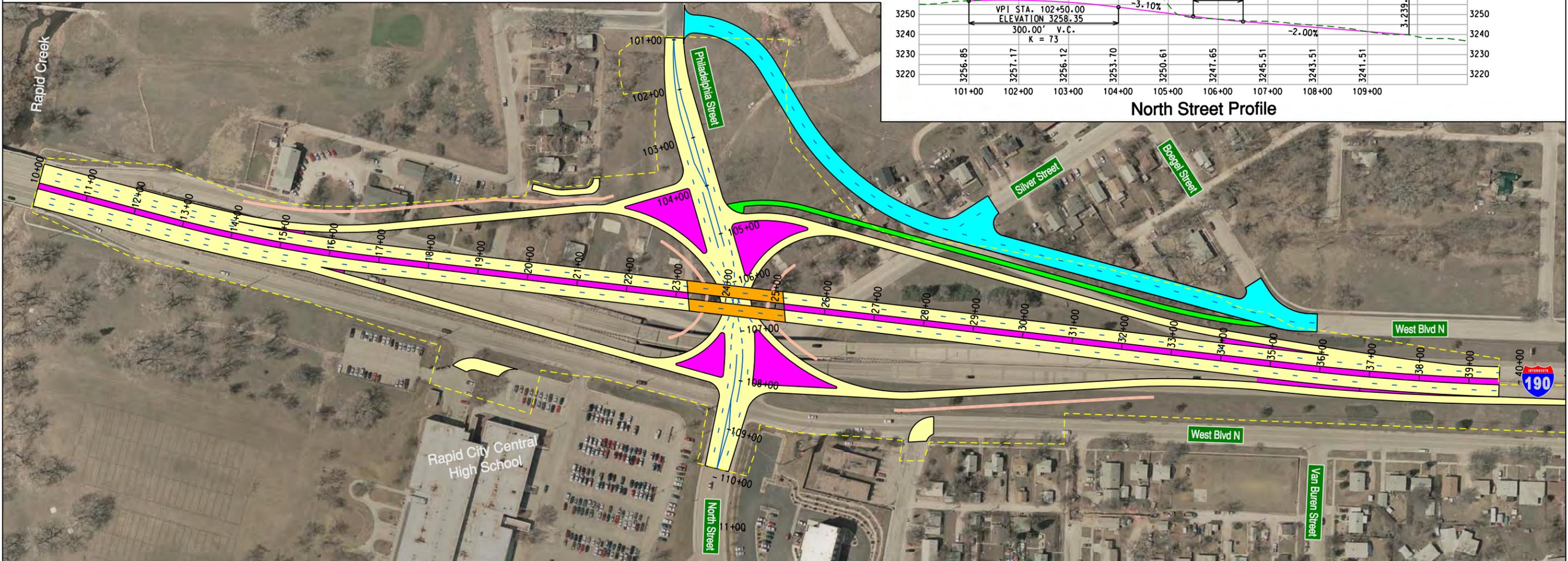
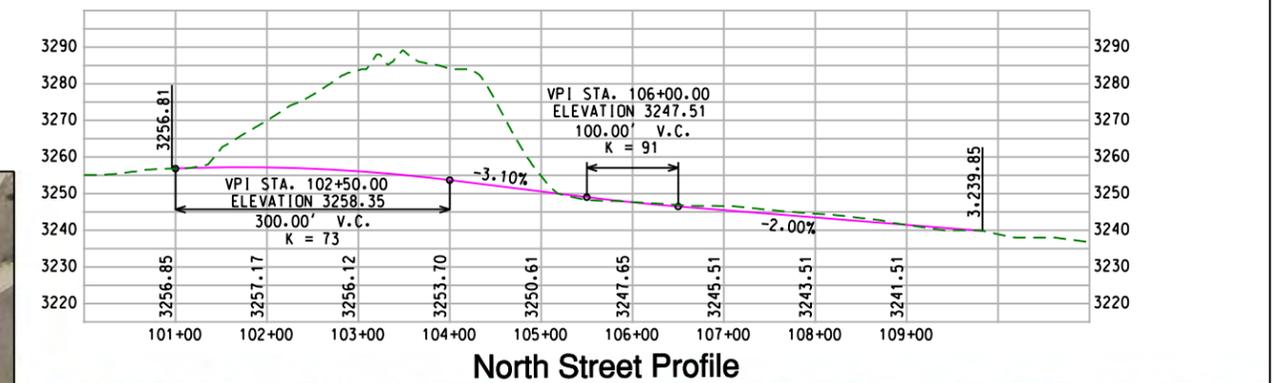
I-190 / Silver Street Preliminary Plan / Profile Design - Alternative 2A

STATE OF SOUTH DAKOTA	PROJECT	SHEET NO.	TOTAL SHEETS
	HP 5596(12)	1	2
FILE: Alternative 2a.dgn		REV DATE: INITIAL:	
PLOTTING DATE: 08/18/2011			

Legend	
	Roadway
	Bridge
	Raised Island / Median
	Recreation Trail
	Local Access Option
	Construction Limit
	Retaining Wall

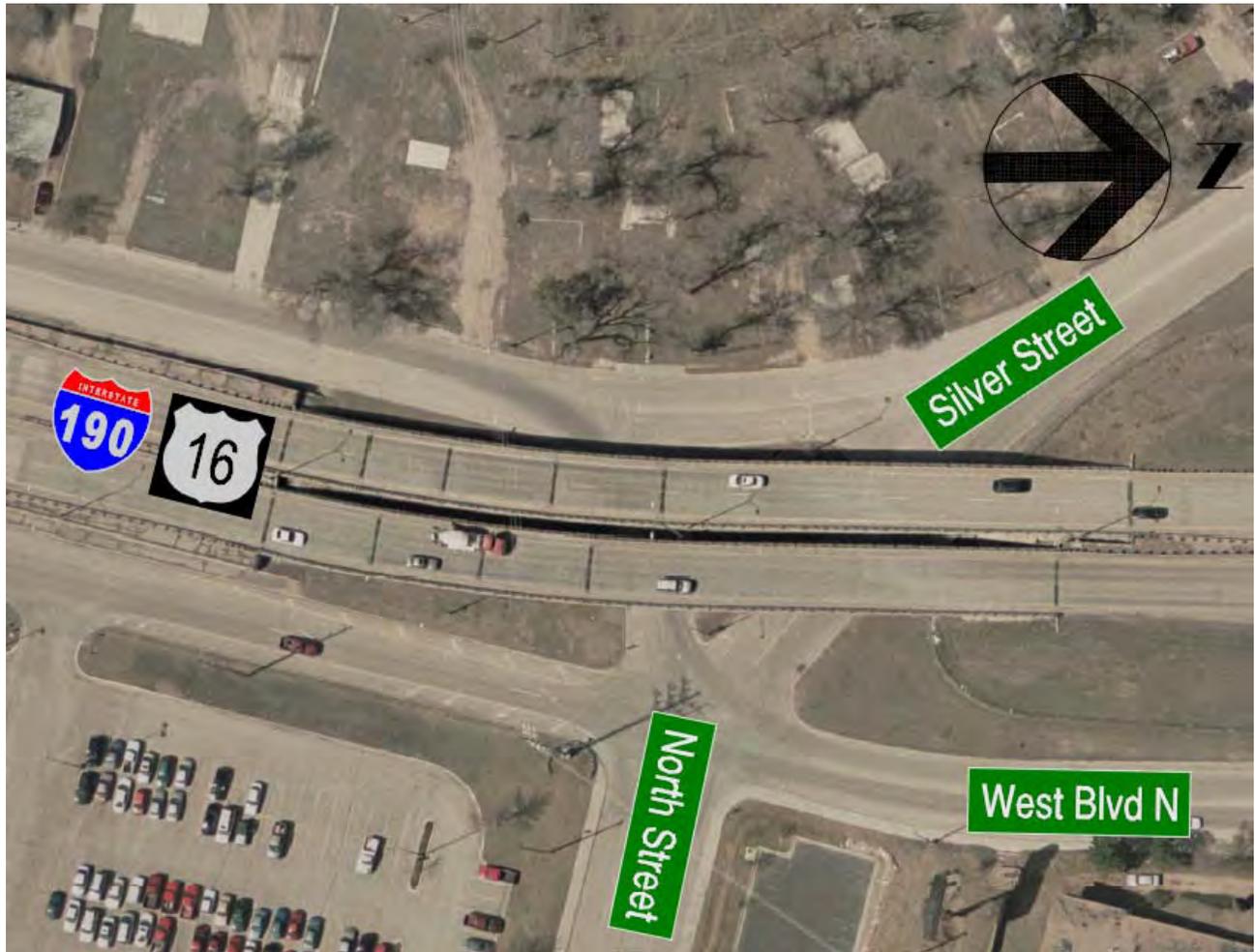


SCALE: 1" = 200'



Description of the Existing Bridges

Per the 2011 SDDOT bridge inspection, the existing NB I-190 6 span bridge over Silver Street was built in 1959 having a total length of 394'-0" and an overall bridge width of 34'-4". The existing SB I-190 7 span bridge was built in 1959 having a total length of 421'-0" and an overall bridge width of 34'-4". Each roadway width is 30' which carries two lanes of traffic on each structure. The twin bridges are approximately 40' apart from centerline of roadways and are parallel to each other. The superstructure is a continuous steel girder with a substandard clearance height of 12' above Silver Street. The substructure consists of two-column piers and sill type abutments. An aerial photograph is shown below and general pictures of the bridges are shown on page 6.



Aerial Photograph of Existing Bridges



Looking southeast at existing bridges from Silver Street.



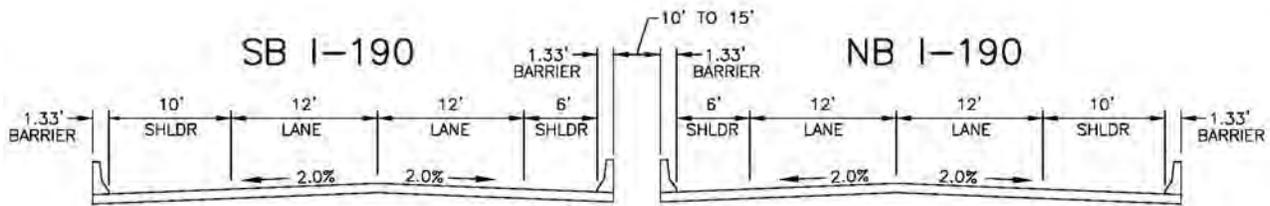
Looking southwest at existing bridges from Howard Johnson parking lot.

➤ **Criteria used for Preliminary Bridge Options**

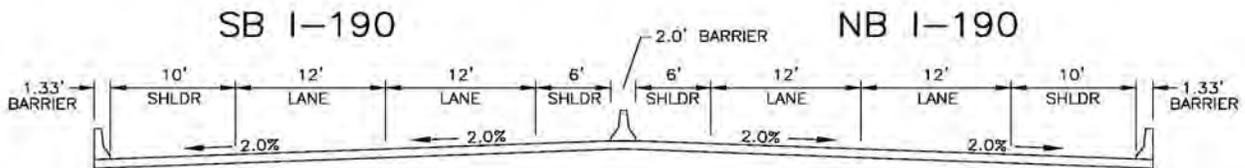
Preliminary designs for potential interchange Alternatives allow for either a single bridge structure handling NB and SB traffic or separate structures for each direction of traffic. Specific structure types were not considered in these planning stages, only the general deck area of the bridge structures required for the interchange alternatives are being covered in this memo.

▪ **Bridge Width**

The proposed bridge section for Alternatives 1, 1a and 2a will carry two lanes of traffic utilizing 12' wide lanes with a 6' inside shoulder and a 10' outside shoulder. The proposed sections for the 2 bridge section and single bridge section can be found below. Each bridge in the 2 bridge section will have a width of 42.7' for a combined width of 85.4' for both structures. The single bridge section will have a width of 85.1'.



PROPOSED 2 BRIDGE SECTION



PROPOSED SINGLE BRIDGE SECTION

Bridge Length

City of Rapid City North/Philadelphia Street crosses under the I-190 mainline in the proposed interchange layouts. The proposed section for the cross street in all alternatives is five lanes with a sidewalk on each side. Alternative 1 maintains the existing skewed connection of North Street and Silver Street with a standard diamond interchange having a proposed bridge length of 212'. The proposed bridge length of Alternative 1a, standard diamond interchange with a modified North Street to Philadelphia Street connection, is 154'. Alternative 2a, a single point urban interchange with the North/Philadelphia connection, requires more sight distance under the structure having a proposed length of 194'.

➤ Bridge Option Summary

The following table summarizes estimated structure construction costs as compared in the three interchange Alternative options:

PRELIMINARY BRIDGE COMPARISON SUMMARY						
Alternative	1		1a		2a	
Bridge Section	2 Bridges	Single Bridge	2 Bridges	Single Bridge	2 Bridges	Single Bridge
Total Bridge Length (feet)	424	212	308	154	388	194
Total Bridge Width (feet)	42.7	84.7	42.7	84.7	42.7	84.7
Deck Area (square feet)	18,104.8	17,956.4	13,151.6	13,043.8	16,567.6	16,431.8
Unit Cost (\$/sq ft)	\$110.00	\$110.00	\$110.00	\$110.00	\$110.00	\$110.00
Total Bridge Cost (\$ 1 M)	\$1.992	\$1.975	\$1.447	\$1.435	\$1.822	\$1.807

➤ Conclusions

HDR recommends the single bridge section and maintaining/extending the median barrier section currently in place to the north of the interchange along I-190. This option alleviates potential hazards of guardrail and other barriers that would be needed to transition to the two bridge section. The single structure also minimizes the project area footprint potentially reducing costs including retaining wall and right of way. Based on preliminary estimated structure costs, the single bridge structure is also slightly more economical.

Alternative 1a requires the shortest bridge length, therefore the least expensive structure. Although 1a has the least expensive structure cost, Alternative 2a has the least expensive overall interchange construction cost. Detailed cost estimates for each interchange alternative can be found in the appendix.

Once the preferred interchange alternative is selected through the Interchange Modification Justification Report and Environmental Analysis processes, a more detailed cost comparison can be developed to compare single span versus multiple span bridge costs.