



# **CIMARRON/BIJOU INTERCHANGE STRUCTURE TYPE SELECTION REPORT**

**CDOT Project No. IM. 0252-334**

**Prepared for:**

Colorado Department of Transportation  
Region 2  
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## TABLE OF CONTENTS

	<u>Page</u>
EXECUTIVE SUMMARY	
1.0 INTRODUCTION-----	1
2.0 HISTORIC CORRIDOR DATA-----	6
3.0 PROJECT BRIDGES-----	7
4.0 BRIDGE RECOMMENDATIONS-----	20
5.0 PROJECT RETAINING WALLS-----	22
6.0 GEOTECHNICAL CONSIDERATIONS-----	24
7.0 RETAINING WALL EVALUATIONS-----	25
8.0 RETAINING WALL RECOMMENDATIONS-----	26
 APPENDIX A	
Project Location Map	
I-25 Mainline Bridges	Figures 1 - 14
Creek Bridges	Figures 15 - 22
Bijou Street Bridges	Figures 23 - 35
 APPENDIX B	
Retaining Wall Location Map	Figures 1 - 3
Typical Retaining Wall Sections	Figures 4 - 22
I-25 Retaining Wall Layouts	Figures 8 - 15
Ramp Retaining Wall Layouts	Figures 16 - 23 and 32
Creek Retaining Wall Layouts	Figures 24 - 31
 APPENDIX C	
Bridge Alternatives, Opinion of Construction Costs	
Retaining Wall Alternatives, Opinion of Construction Costs	
 APPENDIX D	
Preliminary Geotechnical Results	

## EXECUTIVE SUMMARY

The Cimarron/Bijou Interchange project will replace eight existing structures. Proposed new structures for the project include seven bridges and fifteen retaining walls. The bridge types have been combined by location / use into three primary categories; I-25 Mainline Bridges, Creek Bridges, and Bijou Street Bridges. The retaining walls have also been combined by location into three categories; I-25 Retaining Walls, Ramp Retaining Walls, and Creek Retaining Walls. The following is a summary of the recommended alternative for each structure:

### **I-25 Mainline Bridges:**

I-25 over Bear Creek – Precast Prestressed Concrete Bulb Tee Girder  
I-25 over Cimarron Street – Precast Prestressed Concrete Colorado U Girder  
I-25 over Colorado Avenue – Precast, Prestressed Concrete Colorado U-Girder

### **Creek Bridges:**

On/Off Ramps over Fountain Creek – Precast Prestressed Concrete Bulb Tee Girder  
Cimarron Street over Fountain Creek – Precast Prestressed Concrete Bulb Tee Girder

### **Bijou Street Bridges:**

Bijou Street over I-25 – Cast-in-Place Post-Tensioned Concrete Box Girder  
Bijou Street over UPRR – Variable Depth Welded Steel Plate Girder

### **I-25 Retaining Walls:**

Wall 2 and Wall 3 - CIP Concrete Cantilever Wall founded on Steel H-Piles  
Wall 1, Wall 4, Wall 5, and Wall 6 – MSE with a Concrete Panel Facing

### **Ramp Retaining Walls:**

Ramp C-1, Ramp C-2 Upper and Lower Walls, Ramp B-3L, Ramp B-4L,  
and Cimarron Street Wall – MSE with a Concrete Panel Facing

### **Creek Retaining Walls:**

Ramp C-3 and Ramp B-4R - CIP Concrete Cantilever Wall founded on Steel H-Piles  
Ramp B-3R - CIP Concrete Cantilever Wall founded on Spread Footings



## 1.0 INTRODUCTION

The Colorado Department of Transportation (CDOT) Project IM 0252-334 includes the reconstruction of two diamond interchanges, additional I-25 travel lanes, and new HOV lanes for the I-25 Cimarron/Bijou interchange in Colorado Springs, Colorado.

The project starts at approximately station 500+00 (at the end of the Nevada/Tejon project) and ends at approximately station 599+70 (halfway between Bijou Street and Uintah Street). Refer to Appendix A for the project location map.

Felsburg, Holt & Ullevig (FHU) and Wilson & Company have collaborated on this Structure Type Selection Report. FHU provided a detail study for the south end of the project which extends from the north end of the Nevada/Tejon project to just before I-25 over Colorado Avenue.

Wilson & Company provided a detail study for the north end of the project which extends from half way between Bijou Street and Uintah Street to I-25 over Colorado Avenue (including I-25 over Colorado Avenue bridge).

Section 1 of report is the Introduction describing the existing structures to be replaced as well as providing background information for Roadway Phasing, Geotechnical, Hydraulics, and Bridge Design Criteria. Section 2 gives information on the Historic Corridor that this project is a part of. Section 3 describes the proposed bridges and presents alternatives for their construction. Section 4 provides the recommended alternative for each bridge. Sections 5, 6 and 7 describe the retaining walls and evaluate options with section eight providing the actual recommendations.

### 1.1 Project Objective

The primary objective of this project is capacity, safety, and operational improvement for the I-25 Cimarron/Bijou interchange in Colorado Springs which will bring it up to current roadway standards and meet the projected traffic needs to the year 2020. The capacity improvement study completed by Felsburg, Holt & Ullevig is included in the Technical Memorandum for I-25 Bijou Street/Cimarron Street interchange Traffic Operation dated March 2001.

### 1.2 Description of Existing Structures

There are eight existing structures in the project area that will be replaced. According to the current CDOT Bridge Management records, the present structures are substandard and/or have deficiencies. The structure locations along with their Sufficiency Rating, Inventory Rating, and Operating Rating are listed in the table below.

Structure Location	Structure Number	Sufficiency Rating	Inventory Rating	Operating Rating
Bijou over I-25	I-17-DN	67.0	22	37
I-25 over Colorado Avenue	I-17-DL & DM	74.3 & 62.4	24 & 24	40 & 40
I-25 over Cimarron Street	I-17-DF & DG	56.9	25	42
I-25 NB Ramp over Fountain Creek	I-17-DH	62.9	23	38
Cimarron Street over Fountain Creek	CSG-F.85-08.23 Formerly I-17-DI	84	37	62
Two Cell Concrete Box Culvert at I-25/ Bear Creek	I-17-EI	70.0		

The existing structures are in acceptable condition and are adequate to remain in service and carry present traffic during the construction phase.

#### 1.2.1 Structure Numbers I-17-DF (SB) and I-17-DG (NB)

I-25 over Cimarron Street structures have six spans at 53'-4" and are composite concrete slabs on precast prestressed I girders (AASHTO Type) having roadway widths of 46'-0" (NB) and 34'-0" (SB). Originally built in 1959, it was widened and the median closed between northbound and southbound in 1978. At that time the structure numbers were consolidated into I-17-DG. Structure I-17-DG is classified as functionally obsolete according to CDOT Bridge Management records.

#### 1.2.2 Structure Numbers I-17-DL and I-17-DM

I-25 over Colorado Avenue is classified as functionally obsolete per CDOT Bridge Management records. Structure number I-17-DL has six spans measuring 60'-0", 75'-0", 70'-0", 62'-6", 70'-0", 56'-0" and is 34'-7" wide carrying northbound I-25 over Colorado Avenue. Structure number I-17-DM has eight spans measuring 59'-9", 75'-0", 70'-0", 60'-0", 62'-0", 62'-0", 70'-0", 55'-9" and is 34'-7" wide carrying southbound I-25 over Colorado Avenue. The bridge was built in 1959.

Both I-17-DL and I-17-DM are cast-in-place continuous concrete slab and girder structures. The concrete girders are parabolic in shape, with a depth that varies from 2'-8" at the abutments and center of the middle span, to 5'-4" at the piers. The piers consist of multiple trapezoidal columns supported on 13 -12" diameter pipe piles per column with a varied length of 20' to 26'. The stubby abutments are supported on 12" pipe piles 12 3/4" in diameter and are 42' to 52' long.

#### 1.2.3 Structure Number I-17-DH

Structure I-17-DH consists of three spans at 35'-6" carrying I-25 northbound ramp over Fountain Creek. The bridge is a composite concrete slab on precast prestressed I girders (AASHTO Type) having a roadway width of 34'-0". The spread footing of the wall piers was constructed on the top of the blue shale bedrock and is approximately 8 feet below the finish grade. The abutments are supported on two rows steel H-piles. The bridge was built in 1959.



**1.2.4 Structure Number CSG-F.85-08.23 (formerly I-17-DI)**

Cimarron Street over Fountain Creek consists of four span lengths of 72'-7". The bridge is a composite concrete slab on precast prestressed I girders carrying eastbound and westbound Cimarron Street over Fountain Creek. The bridge is 88'-0" wide with a 4'-0" median separating eastbound and westbound traffic. The multi-column piers have each column supported on a 6' x 6' spread footing. The multi-column abutments are supported on 8' x 10' spread footings on top of the blue shale bedrock. The bridge was built in 1959.

**1.2.5 Structure Number I-17-DN**

Bijou Street over I-25, consists of three spans at 57'-0" and is a cast-in-place continuous concrete slab and girder structure having a roadway width of 100'-0" out-to-out with 6'-0" shoulders and a 4'-0" median separating eastbound and westbound of Bijou Street. The concrete girders are parabolic in shape, with a depth that varies from 4'-0" at the abutments and center of the middle span, to 6'-0" at the piers. The multi-column piers are supported on 7' x 7' spread footings. The full height abutment at the west side (Abutment 1) is supported on a 14'-6" wide spread footing on top of blue shale bedrock. The stubby abutment at the east side (Abutment 4) is supported on two rows of pipe piles 10" in diameter and 25' long. The bridge was built in 1959.

**1.2.6 Structure Number CSG-G.15-08.84E (formerly I-17-AP) and Structure Number CSG-G.15-08.84W (formerly I-17-DO)**

Bijou Street eastbound over the RR and Monument Creek consists of 7 spans 96', 99', 40', 60', 90', 60', and 33'-6". Bijou Street westbound over the RR and Monument Creek consists of 7 spans 95'-4 1/2", 98', 40', 54'-6", 85', 61', and 49'-9". Both structures have cast-in-place continuous concrete slabs on welded steel plate girders and standard rolled sections. The bridge width varies significantly from eastbound being 43'-4" to 66'-4" and westbound being 38'-11" to 73'-6". All piers and abutments are founded on spread footings. The spread footing of the west abutment on the eastbound Bridge is beginning to be undermined by Monument Creek. Eastbound was built in 1937. Westbound was built and eastbound widened in 1958. The eastbound west abutment is the abutment from a previous bridge, date unknown.

**1.2.7 Structure Number I-17-DJ and I-17-DK**

I-25 over the abandon RR at Midland Crossing was two bridge that have had the median closed into a single bridge that consists of 3 spans 49', 49', and 49'. The structures are cast-in-place continuous concrete slabs on prestressed concrete I girders. The bridge width is 70'. All piers and abutments are founded on driven piles. The structures were built in 1958 and widened in 1978.

**1.2.8 WPA Retaining Wall**

During the 1930's a Public Works project (the WPA) constructed slope protection along both side of Monument Creek from well north of Colorado Spring to approximately half way between Colorado Ave. and Cimarron Street. The slope protection is grouted stone paving about 10 feet high and 20 feet horizontally on the slope, with a short concrete retaining wall at the toe of the wall. The slope paving has a few gaps in it, but generally is continuous from Bijou Street to Colorado Ave. The slope protection, which we refer to as the WPA wall, is in the process of being designated as Historic. The proposed construction will require the removal of some of the WPA wall. Because it is Historic a significant effort will be made to limit the amount of the removal. This will cause limitations on the construction of the Bijou Street bridges over I-25 and Monument Creek, the I-25 bridge over Colorado Avenue and the retaining walls along Monument Creek. These limitations are discussed with each structure affected.

**1.3 Roadway**

Existing I-25 operates with two through lanes in each direction. Proposed I-25 will have three through lanes, an HOV lane and auxiliary (Accel/Decel) lanes in each direction.

Cimarron Street currently has two through lanes in each direction, left-turn lanes at intersections and right-turn auxiliary lanes. Proposed Cimarron Street will have three westbound through lanes, two eastbound through lanes, multiple left-turn lanes at intersections and multiple right-turn auxiliary lanes.

**1.3.1 Construction Phasing**

The Cimarron / Bijou Interchange project has a well-defined area near the Colorado Avenue Bridge where the project could easily be phased into two projects. The proposed horizontal and vertical alignment of I-25 coincide with existing I-25 such that either the north half or the south half could be constructed independent of the other half. The phasing discussed below is therefore discussed in two pieces: (1) the south half from the south limits of the project to the south edge of the Colorado Avenue Bridge (including the Cimarron Interchange), and (2) the north half from the Colorado Avenue Bridge to the north limits of the project (including the Colorado Avenue Bridge and the Bijou Interchange).

**South Half Phasing**

**Phase 1**

**Traffic**

Generally maintain existing configuration of traffic.

**Construction**

Build I-25 southbound from project limit to Colorado Avenue.

For bridge phase construction of I-25 over Bear Creek bridge and I-25 over Cimarron Street bridge, refer to Figure 3 & Figure 6 respectively in Appendix A.



**Phase 2**

**Traffic**

Move northbound and southbound I-25 traffic to new southbound alignment. Maintain Cimarron configuration.

**Construction**

Build northbound I-25 from project limit to Colorado Avenue.

For bridge phase construction of I-25 over Bear Creek bridge and I-25 over Cimarron Street bridge, refer to Figure 3 & Figure 7 respectively in Appendix A.

**Phase 3**

**Traffic**

Move northbound and southbound I-25 to final location. Maintain Cimarron configuration.

For bridge phase construction of I-25 over Bear Creek bridge and I-25 over Cimarron Street bridge, refer to Figure 3 & Figure 7 respectively in Appendix A.

**Construction**

Build eastbound Cimarron from Fountain Creek bridge to railroad bridge.

For Cimarron Street over Fountain Creek bridge phase construction, refer to Figure 21 in Appendix A.

**Phase 4**

**Traffic**

Move eastbound and westbound Cimarron traffic to new eastbound alignment.

**Construction**

Build westbound Cimarron from Fountain Creek bridge to railroad bridge.

For Cimarron Street over Fountain Creek bridge phase construction, refer to Figure 22 in Appendix A.

Upon completion of Phase 4 move Cimarron traffic to final configuration.

*North Half Phasing*

**Phase 1A**

**Traffic**

In general traffic remains on existing I-25 and the existing ramps at the Bijou Street Interchange during this phase.

**Construction**

Construct the southbound on-ramp from Bijou Street. Construct temporary widening adjacent to this ramp for southbound I-25 in Phase 1B. Construct temporary widening in the median of I-25 north of Bijou Street.

**Phase 1B**

**Traffic**

I-25 traffic near Colorado remains on existing lanes. I-25 traffic through the Bijou Interchange and north of Bijou is placed on existing southbound I-25 and temporary pavement. Southbound on-ramp traffic is placed on the newly constructed ramp. Other ramp traffic remains on existing ramps. Bijou Street traffic is placed on the north half of the existing Bijou Street and bridges.

**Construction**

Construct the east side of northbound I-25 from Colorado Avenue to the north end of the project. Construct portions of the remaining three ramps at the Bijou Street Interchange. Construct the south half of both Bijou Street bridges and associated roadway.

**Phase 1C**

**Traffic**

All traffic remains similar to Phase 1B.

**Construction**

Construction in Phase 1C completes fast-track areas where new ramp and Bijou Street construction transitions to the existing ramps and existing Bijou Street.

**Phase 2A**

**Traffic**

Northbound I-25 traffic is placed on newly constructed northbound I-25. Ramp traffic for the three Bijou ramps partially constructed in Phase 1B is placed on the newly constructed sections.

**Construction**

Construct the remainder of the three Bijou ramps.

**Phase 2B**

**Traffic**

All I-25 traffic is placed on the newly constructed northbound I-25. All Bijou Street ramp traffic is placed on the newly constructed ramps. Bijou Street traffic is placed on the newly constructed south half of Bijou Street.

**Construction**

Construct southbound I-25 mainline, including the remainder of the Colorado Avenue bridge. Construct the north half of both Bijou Street bridges and associated roadway.



## 1.4 Geotechnical

Exploratory borings have been taken at the site of the proposed bridges and a preliminary report has been completed regarding the subsurface conditions and recommendations. A copy of the preliminary soil report and boring location is included in Appendix D of this report for reference.

The clayey and sandy clay embankment fill depth ranges from approximately 2'-6" to 40'-0" underlain by native silty to clayey sand and sandy clay. The claystone bedrock is located at approximately 11'-0" to 53'-0" underlying the native soil. Groundwater was encountered at a depth ranging from approximately 9'-0" to 44'-0".

Steel piling driven to virtual refusal or caissons drilled into bedrock have been recommended as an appropriate foundation type for the bridges and retaining walls of this project.

The steel piling will be designed as end bearing with a maximum capacity as it will be recommended by the geotechnical engineer for LRFD design method. The caissons will be designed for an allowable bearing pressure of 40,000 to 60,000 psf and skin friction will likely be 10 percent of the end bearing pressure for the portion of the caisson in the bedrock. Due to the presence of water in the soil, casing and dewatering equipment may be required.

## 1.5 Hydraulic Design and Scour Potential

### 1.5.1 Hydraulic Design

Hydraulic design will be accomplished according to the Colorado Department of Transportation design criteria. Major structures such as box culverts and bridges will be sized to pass the peak design discharges that have been adopted by the Federal Emergency Management Agency (FEMA) for the 100-year return frequency. The structures will be designed using the following guidelines:

- The structure designs will consider the maximum allowable backwater. Coordination with current FEMA criteria will be taken into consideration.
- All structures will have adequate freeboard requirements analyzed. If adequate freeboard is not available due to site constraints, there will be coordination between the structural and hydraulic engineers to develop the appropriate design. This will occur with the I-25 ramp bridges at Cimarron Street. Site constraints for matching the existing roadway grade at Cimarron Street will not allow adequate freeboard, requiring a modification of the bridge design.

The FEMA 100-year peak discharge is 42200 cubic feet per second for Fountain Creek downstream of the confluence with Monument Creek, 20500 cubic feet per second for Fountain Creek upstream of the confluence, and 32000 cubic feet per second for Monument Creek upstream of the confluence. A HEC-RAS computer analysis of the existing 100-year floodplain has been completed. Results of this analysis indicate the portion of Fountain Creek parallel with I-25 and Monument Creek have flow depths that vary between 10 and 22 feet, with velocities of 7 to 22 feet

per second in the main channel and 3 to 20 feet per second along the side banks. Fountain Creek between the confluence with Monument Creek and the existing U.S. Highway 24 bridge to the west of I-25 has a flow depth of about 12 feet, with velocities of about 15 feet per second in the main channel and about 6 feet per second along the side banks.

### 1.5.2 Scour Potential

There has been a preliminary evaluation of the scour potential of Fountain Creek and Monument Creek related to structure type selection for the project through coordinated efforts of the CDOT Region 2 and CDOT Engineering Geology staff, and the project hydraulic, structural, and roadway design engineering and geology consultant team. Existing available mapping and hydraulics reports have been reviewed, existing field conditions have been inspected, existing condition floodplain hydraulics have been analyzed, and there has been considerable discussion of the issues by the overall engineering and geology team. The following is a summary of this preliminary evaluation and resulting recommendations related to scour potential.

The existing channels of Fountain Creek and Monument Creek in the project reach have shallow alluvial beds of fine sand to sand and gravel over shale bedrock. The overall existing channel slope of the creeks adjacent to I-25 is about 0.7 percent, and the slope of Fountain Creek between the confluence and the U.S. Highway 24 bridge is about 1.1 percent. The existing side banks of the channels are predominantly clayey sand and sandy clay on about 2 to 1 slopes. There is dense vegetation along the channels in many areas. The beds of the channels have degraded over time to form a base flow channel about 3 to 4 feet deep. The depth to bedrock in the bottom of this base flow channel varies between about 1 and 8 feet, with an average of about 4 feet. There is little evidence of lateral migration of the channels.

There are several existing old vertical concrete drop structures and several existing concrete encased utilities that cross the channel bottom. Significant local scour is evident at most of these structures, and some of the old drop structures have been damaged or have failed. Vertical gabion retaining walls along the north bank of Fountain Creek below the I-25 bridges and a short vertical concrete drop structure were constructed by CDOT in the late 1990's to mitigate scour under the bridges. Sediment deposition is evident further west near and under the U.S. Highway 24 bridge.

Between just south of Colorado Avenue and Bijou Street the banks of Monument Creek were lined with thick flagstone grouted in place as part of a WPA work program in the 1930's. A vertical concrete retaining wall was constructed on the west bank north of Bijou Street, as part of the original I-25 project in the early 1960's. Recently three major grouted boulder sloping drop structures were constructed by the City of Colorado Springs across the channel bottom in the reach from just downstream of Cimarron Street to just downstream of Colorado Avenue. Construction plans and field review indicate all these structures were tied into the shale bedrock. These structures appear to be very stable, with only a few isolated locations of minor local scour adjacent to these structures, and minor local displacement of the WPA lining.

City drainage basin planning studies for Fountain Creek and Monument Creek have included sediment transport analyses to evaluate the stability of the channels. These studies have estimated the equilibrium slope of the reaches of Fountain Creek and Monument Creek that parallel



I-25 in the project area to range between 0.2 and 0.4 percent, and to be about 1.5 percent for the reach of Fountain Creek between the confluence and the U.S. Highway 24 bridge. Comparison of these estimated equilibrium slopes with the existing channel slopes indicates the channel reaches parallel with I-25 are degrading and the channel reach west of I-25 is aggrading slightly. These results are verified by the stability conditions observed currently along the channels. The three drop structures recently constructed by the City are the first phase of a program to construct many drop structures along these channels to stabilize the streambeds to the equilibrium slopes and limit degradation and aggradation.

Total scour includes long-term degradation, and contraction and local scour. Contraction and local scour should not be a significant design factor for the structure foundations of this project, considering the shallow depth to bedrock of the alluvial streambeds and the short flood discharge periods typical of the Front-Range of Colorado. Long-term degradation can be reasonably estimated based on straight line extrapolation of observed trends. Comparison of current topographic mapping with previous FEMA studies and original I-25 construction plans indicates the beds of Fountain Creek and Monument Creek along the project have degraded between 1 and 8 feet over the last 50 years, with an average of about 5 feet or about 0.1 foot per year. Long-term degradation is normally estimated over a 100-year period. Based on the straight line extrapolation of the observed trend, the alluvial beds of the channels could degrade about 10 feet more in the next 100 years. This does not appear reasonable, since the depth to bedrock is about 4 feet. The existing shale bedrock is also erodable due to weathering and slaking, but at a much slower rate than alluvial bed material. It is probable the phased drop structure construction program of the City will also significantly limit the long-term degradation.

The engineering and geology team that evaluated the scour potential for this project has reached the following conclusions. New structures for the project that are adjacent to Fountain Creek and Monument Creek should consider the scour potential of the streams. Bridge abutments and piers should have deep foundations that penetrate into bedrock below the estimated total scour depth. New retaining walls below the base flood elevations should have rigid solid surfaces (except in backwater areas). New retaining walls adjacent to natural streambanks should have deep foundations into bedrock below the estimated total scour depth to prevent structure failure in the event of bed or bank scour. New retaining walls above the existing WPA bank lining or the existing retaining wall near Bijou Street should not be susceptible to scour since the existing bank lining and retaining wall appear stable. However, these new retaining walls should also have deep foundations into bedrock to reduce or prevent surcharge loads that could have negative impacts on the stability of the existing bank lining and retaining wall. Considering the scour potential and the stability improvements planned for the streams, it is likely the foundations of the new structures will need to penetrate into bedrock less than 5 feet more than required for normal structural design. Revetments will be constructed where necessary to protect the toes of the new and existing structures that support the roadways along the streams.

During final design the total scour potential, including long-term degradation and contraction and local scour, will be estimated more analytically for each of the structures so the depth of penetration into bedrock for the deep foundations can be designed. Long-term degradation will be estimated for a 100-year period, and local scour will be estimated for a 500-year return frequency peak

discharge. Revetments will be designed for local scour considering a 100-year peak discharge. All improvements will be designed to limit environmental impacts, as practical.

### 1.6 Bridge Design Criteria

Based on the latest CDOT design memorandums and current AASHTO specifications for bridge design, the following design criteria has been used in the preparation of the Bridge Type Selection Report and preliminary design:

Specification:	AASHTO, LRFD Bridge Design, Second Edition, as amended by the 1999, 2000, and 2001 interims
Live Load:	AASHTO HL-93 (Design Truck or Tandem with Design Lane Load)
Bridge Rail:	Bridge Rail Type 10M (Special) or Bridge Rail Type 10M (Except at Bijou Street which include pedestrian rail)
Approach Slab:	Required
Roadway Pavement:	Concrete
Deck Protection:	Waterproofing membrane with 3" asphalt overlay (for Bijou Street bridges)
Future Overlay:	(36 psf) for future 3" Hot Bituminous Pavement (for I-25 mainline and ramp bridges)
Reinforcing Steel:	Epoxy coated reinforcing steel for new structures (assuming high exposure level per CDOT bridge design memos) 3" clear cover to top reinforcing



## 2.0 HISTORIC CORRIDOR DATA

### 2.1 Corridor Structure Type

The I-25 Corridor has established a set of Corridor Standards (I-25 Corridor Improvement Management Study & Design Guidelines by Wilson & Company dated January 1, 2001; Volume I) with the intent of providing the corridor an appearance of continuity and architectural appeal. The type of structure that is shown in the Corridor Standards is a semi-tall abutment, multiple rectangular pier columns and closed box type girders with tapered exterior sides. The types of superstructures that meet this criteria are:

- Post-tensioned cast-in-place concrete boxes (PT Box)
- Precast concrete spaced boxes with tapered sides (Precast Box)
- Precast concrete Colorado U Girders (Tub Girders)
- Steel Boxes

Superstructures must comply with the Corridor Standards if they are visible from the I-25 mainline. However, if the superstructure is not visible from the I-25 mainline, it is not necessary to comply with these standards.

The I-25 Corridor has a number of bridges that are under construction or are already completed. These projects and the type of bridges used are:

Project	Number of Bridges	Corridor Type (Visible)	Non-Corridor Type (Non-Visible)
Circle/Lake	1	PT Box	None
Bijou to Fillmore	4	PT Box	None
Nevada/Tejon	4	U Girders [VE]*	Side by side Precast Concrete Box
Woodman	6	U Girders [VE]*	Bulb-T and Steel Frame

\*[VE] refers to the fact that the design was changed by value engineering during construction.

There is another project that is currently under design and has set the bridge type as:

Project	Number of Bridges	Corridor Type (Visible)	Non-Corridor Type (Non-Visible)
Nevada/Rockrimmon	7	U Girders	Precast Concrete Box

North and South of the Corridor are also a number of bridges that are under construction or are recently completed that do not follow the corridor standards. These are:

Project	Number of Bridges	Corridor Type (Visible)	Non-Corridor Type (Non-Visible)
Fountain	1		Bulb-T
Interquest	1		Bulb-T
Monument	3		Bulb-T, Steel I

As can easily be seen, the dominant type of superstructure used in the corridor when it is visible from the I-25 mainline is U Girders and the dominant type of superstructure used when it is not visible from the I-25 mainline is Bulb-T.



### 3.0 PROJECT BRIDGES

#### 3.1 I-25 Mainline Bridges

I-25 mainline bridges include the following:

- I-25 over Bear Creek
- I-25 over Cimarron Street and
- I-25 over Colorado Avenue

##### 3.1.1 I-25 over Bear Creek

Structure No. I-17-OL carrying I-25 Southbound and Northbound over Bear Creek at approximate mile post 10.20 in Colorado Springs will replace Structure No. I-17-EI.

##### Bridge Layout Requirements

###### Bridge Length

The proposed length of the new bridge as shown in the bridge general layout is approximately 100'-0" from back face of Abutment 1 to back face of Abutment 2. The bridge length was determined by the required width opening for the 100 year water flow, a 10'-0" wide bike path, and a 2:1 slope at each abutment to place the abutment outside the 100 year water surface. For General Layout refer to Figure 1 in Appendix A.

###### Bridge Width

The proposed bridge will provide two 2'-0" Bridge Rail Type 10M (Special), two 8'-0" shoulders, eight 12'-0" traffic lanes, two 12'-0" HOV lanes, and two 12'-0" shoulders for the southbound and northbound traffic. The southbound and northbound traffic lanes are separated by 2'-4" Type 7 Rail (Special). The total bridge width is 166'-4" out-to-out. Refer to Figure 2 in Appendix A for typical section alternatives detail.

###### Utilities

An existing overhead power line is located close to Abutment 1; Colorado Springs Utilities will relocate the overhead power line prior to construction.

###### Substructure

###### Abutments

Integral abutments founded on steel H-piles are proposed for the I-25 over Bear Creek bridge. The minimum vertical clearance distance from the superstructure soffit to the top of the Riprap is 2'-0". Based on the preliminary soil investigations, the end bearing H-pile should be driven to refusal into the bedrock. The Claystone bedrock is located approximately 27 feet below the existing ground line. Draft Geotechnical information can be found in Appendix D.

###### Structure Options

The following alternatives were considered for the construction of the proposed new bridge: Precast Prestressed Concrete Bulb-Tee Girders (Alternative A), Precast Prestressed Concrete U Girders (Alternative B), and Composite Rolled Steel Wide Flange Girders (Alternative C). Three

other alternatives were eliminated from consideration. The Cast in Place Post-Tensioned alternative was eliminated because extensive shoring and forming is necessary with this type of construction and the bridge being located over Fountain Creek would cause additional construction difficulties. The Cast in Place 7 Cell 14'-0"X10'-0" Box Culvert (construct 5 new cells attached to the existing double cell box culvert) and Cast in Place 7 Cell 12'-0"X10'-0" New Box Culvert (to replace the existing) alternatives were eliminated due to high cost. Alternatives A, B, and C were evaluated equally on their esthetics, cost, and constructability.

##### Alternative A: Precast Prestressed Concrete Bulb Tee Girder

The Precast Prestressed Concrete Bulb-Tee Girder alternative is a single span bridge with a span length 97'-6" from center bearing of Abutment 1 to center bearing of Abutment 2. The superstructure will consist of eighteen BT 54 girders spaced at 9'-3" on center with 4'-6 1/2" overhangs and 8 1/2" thick composite concrete pavement placed on the top of the girders for a total structure depth of approximately 5'-7". The following data were used in the preliminary design of the girders: initial concrete strength f'ci = 6,000 psi, final concrete strength f'c = 6,500 psi, and 32-0.6" diameter low relaxation strands. The construction cost of this alternative is estimated to be \$1,207,000 or \$73 per square foot. For typical section refer to Figure 2 in Appendix A.

##### Alternative B: Precast Prestressed Concrete Colorado U Tub Girders

The Precast Prestressed Colorado U Tub Girder alternative is a single span bridge with a span length of 97'-6". The superstructure consists of twelve lines of Precast Prestressed Concrete U48 girders spaced at 13'-9" on center with 8 1/2" concrete deck placed on top of the girders for a total structure depth of 5'-0". The following data were used in the initial design of the girders: initial concrete strength f'ci = 6,500 psi, final concrete strength f'c = 7,500 psi, and 56-0.6" diameter low relaxation straight strands. The construction cost for this alternative is estimated to be \$1,275,000 or \$77 per square foot. For typical section refer to Figure 2 in Appendix A.

##### Alternative C: Composite Rolled Steel Wide Flange Girders

The Composite Rolled Steel Wide Flange Girder alternative is also a single span bridge with a span length of 97'-6" from center bearing of abutment 1 to center bearing of abutment 2. The superstructure will consist of 18 lines of girders spaced at 9'-3" on center with 4'-6 1/2" overhangs. Grade 50 steel and W40x277 was used for the initial design of the wide flange steel girder. An 8 1/2" thick composite concrete deck on top of the girders was assumed. The total structure depth is 4'-5". The construction cost for this alternative is estimated to be \$1,477,000 or \$89 per square foot. For typical section refer to Figure 2 in Appendix A.

##### 3.1.2 I-25 over Cimarron Street

Structure No. I-17-OM carrying I-25 Southbound and Northbound over Cimarron Street and Fountain Creek at mile post 10.20 in Colorado Springs will replace Structure No. I-17-DF and I-17-DG.

Replacing the bridge will provide the opportunity to raise the profile and widen the structure from 3 traffic lanes in each direction to 4 traffic lanes in each direction.



**Bridge Layout Requirements**

**Roadway Considerations**

*Cimarron Street:* The horizontal alignment of Cimarron Street is on a tangent. Currently, Cimarron Street is two 12'-0" northbound lanes and two 12'-0" southbound lanes separated by an approximately 5'-0" raised median. The new Cimarron Street will require a 2'-6" Curb and Gutter, three 12'-0" through traffic lanes northbound, one 12'-0" left turn lane into I-25 southbound, two 12'-0" through traffic lanes southbound, two 12'-0" left turn lanes into I-25 northbound, and another 2'-6" Curb and Gutter. The northbound lanes and southbound lanes are separated by a 10'-0" median at the bridge location for a total roadway width of 111'-0".

*I-25:* The horizontal alignment of I-25 at the location of the bridge is on a tangent and at approximately a 75 degree skew with Cimarron Street. The I-25 horizontal alignment is controlled by several constraints. Along the east side of I-25 the alignment must avoid the Monument Creek and Fountain Creek 100-year floodway. Along the west side of I-25 the alignment is constrained by the existing businesses. To avoid major right of way costs the alignment must avoid Motor City and Wal-Mart to the south of Cimarron and the VA Clinic and El Paso County buildings just south of Bijou Street.

**Bridge Length**

The proposed length of the new bridge as shown in the bridge general layout is approximately 518'-1 3/4" from back face of abutment 1 to back face of abutment 5. This length is required to span future Cimarron Street changes (two 2'-6" Curb & Gutter, four eastbound and four westbound 12'-0" traffic lanes separated by a 10'-0" median for a total width of 111'-0" at a skew of 75 degrees with I-25 horizontal alignment). The required hydraulic opening is approximately 250' to accommodate the 100 year flood of Fountain Creek with a 10'-0" bike path and a 2:1 slope embankment. For General Layout refer to Figure 4 in Appendix A.

**Bridge Width**

The anticipated bridge will provide one 2'-0" Bridge Rail Type 10M (Special), two 12'-0" shoulders, three 12'-0" travel lanes, and one 12'-0" HOV lane for I-25 southbound and one 2'-0" Bridge Rail Type 10M (Special), two 12'-0" shoulders, three 12'-0" travel lanes and one 12'-0" HOV lane for I-25 northbound. I-25 southbound lanes and northbound lanes are separated by a 2'-4" Type 7 (Special) median barrier for a total bridge width of 150'-4" out-to-out. Refer to Figure 5 in Appendix A for typical section alternatives detail.

**Utilities**

Existing utilities identified to be present include an overhead power line located between pier 4 and abutment 5 at the northwest corner of the bridge and a sanitary sewer line located near abutment 5. Colorado Springs Utilities will relocate the overhead power line prior to construction.

**Substructure**

**Abutments**

Following the I-25 corridor standards, a semi-tall abutment will be utilized for the I-25 over Cimarron Street structure. The vertical clearance distance from the superstructure soffit to the slope paving is 8'-6". The bridge abutments will be supported on steel H-piles or drilled caissons. Based on the preliminary soil investigations, the end bearing H-pile should be driven to refusal into the bedrock.

The Claystone bedrock is located approximately 42 feet below the existing ground line. Draft Geotechnical information can be found in Appendix D.

**Piers**

The pier alternative for this bridge will also follow the I-25 corridor standards with one modification to the shape of the column. It is recommended to use an elliptical (Race Track) shape column to improve the flow of Fountain Creek and minimize drift build-up. Each column will be supported on either end bearing steel H-piles driven to refusal into the Claystone bedrock at approximately 42 feet below the existing ground line or drilled caissons embedded approximately 15'-0" into the bedrock. An inverted pier cap similar to I-25 over Nevada presently under construction will be used for this bridge.

**Structure Options**

The following alternatives were considered for the construction of the proposed new bridge: Cast-in-Place Post-Tensioned Concrete Box Girder (Alternative A) and Precast Prestressed Colorado U Tub Girders (Alternative B). The Steel Box Girder was eliminated from consideration due to its historical high cost compared to Alternatives A and B. The Cast-in-Place Post-Tensioned Box Girder and the Precast Prestressed Colorado U Tub Girders were considered for this location in compliance with the developed I-25 corridor standards.

**Alternative A: Cast-in-Place Post-Tensioned Concrete Box Girder**

The Cast-in-Place Post-Tensioned Box Girder alternative will produce a four (4) span bridge, with span lengths of 106'-0", 151'-0", 151'-0", and 106'-0". The superstructure will consist of four tubs with each tub containing four 6'-6" wide by 4'-10" deep cells (inside dimensions) for a total structure depth of 6'-0". The thickness of the exterior web is 1'-2" and the thickness of the interior web is 1'-0". A preliminary design was completed using Bridge Design System and the following information was determined: three ducts per web are required and each duct will be filled with fifteen (15) 0.60" diameter low relaxation strands for a total jacking force of 9,887 kips per tub. The initial concrete strength at transfer is  $f'_{ci} = 4,000$  psi and the final concrete strength is  $f'_{c} = 4,500$  psi. The construction cost is estimated to be \$6,190,000 or \$79 per square foot. For typical section refer to Figure 5 in Appendix A.

**Alternative B: Precast Prestressed Concrete Colorado U Tub Girders**

The Precast Prestressed Colorado U Tub Girder alternative will also generate a four (4) span bridge with span lengths of 106'-0", 151'-0", 151'-0", and 106'-0". The superstructure will consist of ten lines of Precast Prestressed Concrete U72 girders spaced at 15'-0" on center with an 8 1/2" concrete deck placed on the top of the girders for a total structure depth of 7'-4 1/2". Using Ldfac program to determine the distribution factor and Conspan AL for a preliminary design of the girder, the following data were determined: initial concrete strength  $f'_{ci} = 6,000$  psi, final concrete strength  $f'_{c} = 7,500$  psi, and 72-0.6" diameter low relaxation strands. The construction cost for this alternative is estimated to be \$5,135,000 or \$66 per square foot. For typical section refer to Figure 5 in Appendix A.



**3.1.3 I-25 over Colorado Avenue**

Structure No. I-17-OO carrying I-25 southbound and northbound over Colorado Avenue at milepost 10.56 in Colorado Springs will replace Structure Nos. I-17-DL and I-17-DM.

Replacing the existing bridges will provide the opportunity to improve the profile of I-25, and improve the operational characteristics of the Cimarron and Bijou interchanges immediately south and north of the site, respectively. The additional width of the new structure enables an increase from the present 3 traffic lanes in each direction (including auxiliary lanes) to 5 lanes northbound and 6 lanes southbound (including auxiliary lanes).

**Bridge Layout Requirements**

**Roadway Considerations**

Colorado Avenue: The horizontal alignment of Colorado Avenue is on a tangent. Currently, Colorado Avenue is two 12-foot eastbound lanes and two 12-foot westbound lanes separated by an approximately 12-foot raised median. Realignment of Colorado Avenue is not required, but several construction impacts are anticipated, and are described in this section of the report.

The proposed alignment of I-25 and the Cimarron and Bijou interchange ramps will require construction overhead of the City of Colorado Springs' Colorado Avenue bridge over Monument Creek. The configuration on this bridge of four traffic lanes (two in each direction), raised median, bike lanes, and sidewalks is represented by the City to be an ultimate design, to be carried beyond the west abutment and approach slab of this bridge, beneath I-25 at some time in the future. It is also noted that the design of the City's bridge includes provisions for the future operation of rail transit vehicles.

The location of structural elements of the new I-25 bridge, such as abutments and piers, must not conflict with or hinder the application of this ultimate Colorado Avenue section, although it will be possible to locate piers in the median of Colorado Avenue.

The new I-25 bridge will provide 16'-6" minimum vertical clearance for Colorado Avenue traffic. No further vertical clearance provision will be made for rail transit vehicles.

In the vicinity of the west approach slab of the City's bridge over Monument Creek, it may be necessary to relocate a 24" steel water main.

Spruce Street: The existing I-25 structures also cross Spruce Street, which intersects westbound Colorado Avenue in the short distance between the Monument Creek bridge and I-25. Spruce Street is proposed to be closed just north of I-25, thus eliminating its intersection with Colorado Avenue. Minor reconstruction of pavement, curb and gutter, and sidewalk along Colorado Avenue will be required.

I-25: The horizontal alignment of I-25 at the location of the bridge is in a reverse curve (spirals) and at approximately a 48-degree skew with Colorado Avenue. The I-25 horizontal alignment is controlled by several constraints. Along the east side of I-25 the alignment must avoid the Monument Creek 100-year floodway, and mitigate any impacts to the WPA wall and recreational trails. Along the west side of I-25 the alignment is constrained by existing businesses and

government office buildings. To avoid major right-of-way costs the alignment will avoid these properties.

The required width of I-25 and the interchange ramps in the vicinity of Colorado Avenue exceeds the space permitted by these constraints. A design decision was made to cantilever the roadway on the east side of I-25 out from the face of the retaining walls beneath. (See Section 5.0, Project Retaining Walls.) This condition affects the layout and design of the substructure of the I-25 bridge.

**Bridge Length**

The length that was initially considered for the new bridge was developed from the minimum pier spacing that would allow a clear span of Colorado Avenue (no median pier). This pier spacing of 140'-0" was to be the center span of a three-span bridge, with end spans of 110'-0" each for balance. Total length from back face of abutment to back face of abutment was 365'-3½". A four-span alternate (of the same total length and abutment locations as the three-span but placing a pier in the median of Colorado Avenue) was developed to enable the consideration of additional girder types for the resulting shorter spans.

For a general layout of the three-span alternate refer to Figure 8 in Appendix A. For a general layout of the four-span alternate refer to Figure 9 in Appendix A.

Preliminary evaluation of girder types/number of spans showed a four-span alternate with precast concrete U girders to be most economical. (See Structure Options discussion.) After discussing these initial findings it was directed to further investigate the issues of abutment location and bridge skew, in light of the many unusual and difficult site constraints. (See Additional Issues discussion.)

**Bridge Width**

The anticipated bridge will provide 2'-0" Bridge Rail Type 10 (Special) along the outside edge of both northbound and southbound I-25, and a 2'-4" Type 7 (Special) median barrier to separate northbound and southbound I-25.

A constant bridge width will be provided for northbound I-25. The roadway consists of a 12-foot inside shoulder, 12-foot HOV lane, three 12-foot travel lanes, one 12-foot auxiliary (ramp) lane, and an 8-foot outside shoulder. The dimension from centerline of I-25 (center of median barrier) to outside edge of deck (back side of bridge rail) is 83'-2".

The same shoulder, HOV lane, and travel lane widths are used for southbound I-25. However, a variable bridge width is necessary for southbound I-25, due to the presence of the lanes and gore for the off-ramp to Cimarron Street (ramp C-2). The roadway at the north abutment of the bridge over Colorado Avenue includes one full (12'-0") and one partial ramp lane. The roadway at the south abutment includes two full ramp lanes plus the gore, which transitions in width. The dimension from centerline of I-25 to outside edge of deck varies from approximately 91 feet at the north abutment to 102 feet at the south abutment. Total bridge width (out-to-out of deck) varies from approximately 174 feet at the north abutment to 185 feet at the south abutment.

Refer to Figures 11 through 14 in Appendix A for typical section details.



### Utilities

Existing utilities identified to be present include storm sewers, water, gas, telephone, fiber optic, street lighting, and landscape irrigation.

### Construction Staging

The new I-25 bridge is proposed to be constructed in two stages. During the first stage, traffic remains on the existing I-25 structures while the first portion of the new bridge—to the east of existing northbound I-25—is built. During the second stage, traffic is shifted to the portion of the new bridge built in Stage 1, allowing the existing structures to be removed, and the remainder of the new bridge to be built.

There is essentially no way to reconfigure traffic lanes on the existing structures then remove a section of these structures in order to construct a greater portion of the new bridge in Stage 1. Existing conditions that conspire against such a plan include limited bridge roadway widths (both southbound and northbound), a split roadway profile, proximity to interchanges (weave movements), and a non-redundant substructure design.

The proposed alignment allows a 67-foot width of structure to be constructed in Stage 1. This width would allow five 11-foot lanes to carry traffic in Stage 2 (add four 1-foot shoulders, three 2-foot barriers, and a 2-foot work space at the construction joint).

### Substructure

#### Abutments

All four abutment corners (wingwalls) of the I-25 over Colorado Avenue bridge will tie into roadway retaining walls. Semi-tall abutments and slope paving in compliance with the I-25 corridor standards are viable, but at three of the four corners the roadway retaining walls will be greater than the corridor standard height of 8'-6", necessitating a cutoff wall triangular in elevation view at the lateral limits of the slope paving. At the fourth corner, the southwest, the slope paving could match the embankment grading.

At the two corners on the east side, it will be necessary to cantilever a portion of the concrete cap beam on which the girders rest. This is because the roadway retaining walls, normally located at the edge of a roadway, must be located to avoid the Monument Creek floodway. The roadway pavement slab (beyond the bridge) will therefore cantilever out from the face of these retaining walls. The combination of the cantilever condition and the abutment skew will require a special configuration and design of the bridge approach slabs and expansion devices.

The bridge abutments will be supported on steel H-piles or drilled caissons. Based on the preliminary soil investigations, the end bearing H-pile should be driven to refusal into the bedrock. The claystone bedrock is located approximately 50 feet below the existing ground line (I-25). Preliminary geotechnical information can be found in Appendix D.

### Piers

The Monument Creek floodway and the City of Colorado Springs' Colorado Avenue bridge over Monument Creek restrict the potential locations for bridge piers and pier columns. The presence of the floodway means the east side exterior column at each pier cannot be located as close to the edge of the roadway as is normally possible. Pier cap cantilevers of up to 40 feet (measured along centerline of pier) are necessary to adapt to this condition.

The three-span alternate layout described above would push the piers outside of the ultimate Colorado Avenue section, and place the east side exterior columns very close to (and possibly impacting) the abutment wingwalls of the City's bridge. The northwest wingwall of the City's bridge may require reconstruction under this alternate, as it is angled approximately 70 degrees from the street, thus occupying an ideal column location.

The four-span alternate layout enables piers to be located a greater distance from the wingwalls of the City's bridge, but requires a pier to be constructed in the median of Colorado Avenue. The same pier cap cantilever condition exists with the four-span alternate; the exterior column of the median pier would be located in the approach slab of the City's bridge. This is also the location of a 24" steel water main.

The piers for the I-25 over Colorado Avenue bridge will follow the I-25 corridor standards, with two potential exceptions:

- 1) Wider columns may be necessary for the east side exterior columns, due to the length of the pier cap cantilever, and
- 2) Drop pier caps may be necessary to support certain girder types, and to provide space for transverse post-tensioning ducts (needed to accommodate the cantilever).

Each column will be supported on end bearing steel H-piles or drilled caissons. The claystone bedrock is located approximately 27 feet below the existing ground line (Colorado Avenue).

### Structure Options

The following alternatives were considered for the construction of the proposed I-25 over Colorado Avenue bridge: Three-Span Steel Box Girder (Alternative A), Three-Span Precast, Spliced, Post-Tensioned Concrete U-Girder (Alternative B), Three-Span Cast-in-Place, Post-Tensioned Concrete Box Girder (Alternative C), and Four-Span Precast, Pre-Tensioned Concrete U-Girder (Alternative D). All four of these alternatives comply with the I-25 corridor standards.

These four alternatives used common abutment locations and were therefore of identical total length. Because of the common abutment locations, the cost of construction items such as slope paving, abutment backfill, and approach slabs was assumed to be equal for all four alternatives, and was therefore omitted from the cost comparison.



**Alternative A: Three-Span Steel Box Girder**

The steel box girder was investigated to see if its lighter-weight girder system would result in substructure cost savings, due to the unusual cantilevered pier cap condition and high exterior column loading. Span lengths for this alternative were 110'-0", 140'-0", and 110'-0". The superstructure will consist of eleven lines of continuous, composite box girders spaced a maximum 17'-6" on center with an 8 1/2" concrete deck for a total structure depth of 5'-5". A preliminary design was derived using the SIMON program (AISC). The comparison-level cost for this alternative is estimated to be \$5,260,000, or \$79 per square foot. For typical section refer to Figure 12 in Appendix A.

**Alternative B: Three-Span Precast, Spliced, Post-Tensioned Concrete U-Girder**

Span lengths for this alternative were 110'-0", 140'-0", and 110'-0". The superstructure will consist of eleven lines of precast, spliced, post-tensioned U48 girders spaced a maximum 17'-0" on center with an 8 1/2" concrete deck for a total structure depth of 5'-0 1/2". A preliminary design was derived from the U-girder optimization table and chart developed by CDOT Staff Bridge, for an initial concrete strength  $f'_{ci}$  of 6,500 psi and a final concrete strength of 8,500 psi. Quantity of longitudinal post-tensioning was estimated using quantity-per-linear-foot-per-web values from completed post-tensioned box girder designs. The comparison-level cost for this alternative is estimated to be \$4,360,000, or \$66 per square foot. For typical section refer to Figure 13 in Appendix A.

**Alternative C: Three-Span Cast-in-Place, Post-Tensioned Concrete Box Girder**

Span lengths for this alternative were 110'-0", 140'-0", and 110'-0". The superstructure will consist of five tubs, four of which contain three cells and the fifth, the westerly, transitioning from three to four cells to accommodate the varying roadway width. Total structure depth is 6'-0". Quantity of longitudinal post-tensioning was estimated using quantity-per-linear-foot-per-web values from completed post-tensioned box girder designs. The comparison-level cost for this alternative is estimated to be \$3,810,000, or \$58 per square foot. For typical section refer to Figure 14 in Appendix A.

**Alternative D: Four-Span Precast, Pre-Tensioned Concrete U-Girder**

Span lengths for this alternative were four equal 90'-0" spans. The superstructure will consist of eleven lines of precast, pre-tensioned U48 girders spaced a maximum of 17'-0" on center with an 8 1/2" concrete deck for a total structure depth of 5'-0 1/2". A preliminary design was derived using the Consplix PT program (LEAP) and the optimization table developed by CDOT Staff Bridge, for an initial concrete strength of 5,000 psi and a final concrete strength of 6,000 psi. The comparison-level cost for this alternative is estimated to be \$3,390,000, or \$51 per square foot. For typical section refer to Figure 13 in Appendix A.

**Additional Issues**

CDOT requested to further investigate several layout-related issues at the I-25 over Colorado Avenue site. These included the I-25 profile, the bridge skew and length, and details such as girder haunches and bearings. This section of the discussion describes the findings of those investigations and their influence on the final recommendations.

**I-25 Profile**

Redesign of the I-25 superelevation transitions for non-structure-related reasons, plus a small measure of flexibility in the profile of I-25 in the vicinity of Colorado Avenue prompted a check of whether a slightly deeper bridge superstructure would produce a more economical structure. The combination of a one-foot increase in profile and the revised superelevation enabled a superstructure depth increase of two feet to be investigated.

The most economical girder system (precast, pre-tensioned U-girders) was applied to the prior three-span layout using eleven lines of U72 girders. The comparison-level cost for this layout is estimated to be \$3,440,000. This is \$50,000 more expensive than Alternative D, not including the costs associated with the higher I-25 profile (taller retaining walls, for example). Thus it is concluded that a deeper superstructure, made possible by raising the profile of I-25, will not be more economical than the proposed design.

**Skew**

The alignments of I-25 and Colorado Avenue intersect at an angle of approximately 48 degrees. The presence of Monument Creek on the east, urban development on the west, plus the nearby Cimarron and Bijou interchanges prevents significant improvement of this condition. The proposed bridge design has its abutments and piers parallel to Colorado Avenue, resulting in a high skew, which complicates design, construction, and maintenance of the bridge.

It was determined that non-skewed pier lines are not feasible, due to the great column spacing that would be necessary to span Colorado Avenue. Also, drop pier caps cannot be used over Colorado Avenue without raising the I-25 profile several feet. However, using cast-in-place, post-tensioned box girders can work around these problems. Each multi-celled tub can have its own non-skewed, integral pier cap (excepting the east-side cantilever, where skewed drop caps would still be needed). Also, the preliminary girder analysis showed cast-in-place construction to be fairly economical.

Two separate alternatives with non-skewed abutments were checked. The first used abutment locations of Sta. 557+00 (south) and Sta. 560+50 (north). The resulting deck area is 93% of the proposed area. The pier lines are still skewed (i.e. parallel to Colorado Avenue), creating a wide variety of girder lengths. (The economy of the precast U-girders would likely disappear as a result of this variety. Five cast-in-place, post-tensioned multi-celled box girders were assumed instead.)

Advantages of this alternative are a decreased length of abutments for about the same length of roadway retaining walls, and simplified roadway cantilever slab details. Disadvantages include the creation of a large vacant space beneath the structure, especially north of Colorado Avenue, and inefficient girder designs (three of the five boxes have an end span as their longest span). The comparison-level cost of this alternative is estimated to be \$3,800,000.

The second alternative used staggered abutments to decrease the northbound bridge length to 300 feet and the southbound length to 250 feet. Advantages are a decreased deck area (74% of the proposed area), simplified cantilever slab details, and relatively efficient girder designs. Disadvantages include the need to incorporate the stagger at the I-25 centerline, additional roadway retaining wall length, and the creation of large, concealed corners beneath the bridge in a



neighborhood with high pedestrian traffic. Pier lines are still skewed, and cast-in-place, post-tensioned box girders are assumed again. The comparison-level cost of this alternative is estimated to be \$3,400,000, not including the cost of additional roadway retaining walls.

The comparison-level cost of Alternative D is \$3,390,000; therefore neither non-skewed alternative is more economical. Further consideration of a non-skewed alternative is not recommended.

**Bridge Length (Abutment Location)**

The original abutment locations were established based on a balanced three-span bridge layout, with the center span clearing Colorado Avenue. The identification of precast, pre-tensioned concrete girders, with their simple-span erection procedure, as the most economical structure type allows flexibility to select individual span lengths while maintaining economy. CDOT requested to investigate the issue of bridge length (number and length of spans) to see if cost benefits to the project could be found.

As all four corners of the bridge tie into roadway retaining walls, moving the abutments changes the retaining wall lengths. The longitudinal extent of the roadway cantilever slabs along the east side of I-25 is also affected. If, for example, the bridge was shortened (decreasing its costs), the increased cost of retaining walls and cantilever slabs must be checked against the change in bridge costs to see if an overall cost savings had been created.

Also, keeping the abutments reasonably close to the existing I-25 bridge abutments would reduce the quantities of unclassified excavation and roadway embankment.

Cost-per-linear-foot-of-roadway values for the entire roadway cross section were developed for locations in the vicinity of the proposed bridge abutments. Construction items included in these values were retaining walls, cantilever slabs, structural backfill, plus roadway embankment, base course, and pavement. A cost-per-linear-foot of bridge superstructure was also developed, based on the most economical structure type. (Abutment costs were assumed to remain constant regardless of location.) The cost-per-linear-foot values are:

South abutment	Roadway, walls, slab	\$6,000 per linear foot
	Bridge	\$6,360 per linear foot
North abutment	Roadway, walls, slab	\$6,820 per linear foot
	Bridge	\$6,360 per linear foot

The initial conclusion from these numbers is that total cost could be reduced by using additional roadway and walls at the south abutment (save \$360 per linear foot), and by using additional bridge at the north abutment (save \$460 per linear foot). However, the percent differences in costs (6 to 7%) do not provide a strong basis for making such adjustments. In practical terms, the per-linear-foot costs of bridges and roadway/walls are equal.

It is observed, though, that the cost of each bridge pier is quite high, due to the length necessary to accommodate the width of I-25 and the skew. For the four-span layout of Alternative D, the average estimated pier cost is \$244,000. Eliminating such a pier would thus provide a much greater cost savings than would minor adjustment of the abutments.

The longitudinal section of the four-span layout (see Figure 9, Appendix A) shows a large amount of excavation of existing embankment beneath the south end span. If the south abutment could be shifted a significant distance to the north, to the vicinity of Pier 2, most of this existing embankment could remain. The south end span of the bridge is effectively replaced by roadway materials, retaining walls, and cantilevered slab. As noted above, the per-linear-foot costs of bridges and roadway/walls are practically equal, so this switch is cost-neutral. However, because the south abutment has moved to the vicinity of Pier 2, Pier 2 can be eliminated, resulting in significant cost savings, and a three-span bridge.

Precast, pre-tensioned concrete U-girders, the most economical structure type, are still used. One reason for this economy is the ability to use near-uniform-length beams. The revised, three-span layout of Alternative D retains this ability. The span and beam lengths were actually increased, so that the south abutment is located closer to the existing abutment, and to decrease the length of retaining walls at the north abutment (as noted above, roadway and walls were slightly more expensive than bridge superstructure in that area). A pier remains in the median of Colorado Avenue.

**Girder Haunches and Bearings**

The geometry of the I-25 over Colorado Avenue bridge is not ideal, thereby adding complexity to its design, detailing, and construction. Geometric issues include high skew, roadway width transition, horizontal curvature with superelevation transition, vertical curvature, and cantilevered substructure elements. Although the layout and structure type investigations identified ways to minimize these complexities, certain structural elements are affected.

The girder haunches will vary in thickness both longitudinally and transversely. The longitudinal variation is necessary because of girder camber, dead load deflections, and finished deck elevation. Transverse variation in thickness is necessary because of superelevation transition. In contrast, a constant rate of superelevation (or standard crown) would allow the girders to be rotated to match the deck surface, and the haunches to be of uniform thickness in the transverse direction. The best way to incorporate the superelevation transition is to fabricate and set the girders at zero cross slope, and adjust the haunch thicknesses during the setting of deck forms. Although the transverse variation in thickness is an unusual condition, it is noted that longitudinal variation in thickness is always necessary to accommodate girder camber, dead load deflections, and roadway profile.

The most economical girder type, the precast concrete U-girder, employs a bottom flange 4'-6" in width. Bearing pads and plates are customarily located at each edge of this flange, beneath the girder webs. If the girders are designed at zero cross slope, it follows that, at each end of a single U-girder, the concrete bearing seats beneath the bearing pads should be set at a common elevation. It is noted that because of the skew, and the difference in elevation between the two ends of a single girder, tapered bearing pads will be required.



### 3.2 Creek Bridges

Creek bridges include the following:

- I-25 SB Off Ramp over Fountain Creek
- I-25 NB On Ramp over Fountain Creek
- Cimarron Street WB over Fountain Creek and
- Cimarron Street EB over Fountain Creek

#### 3.2.1 Ramp C-2 (I-25 SB off Ramp over Fountain Creek) and Ramp C-3 (I-25 NB on Ramp over Fountain Creek)

Structure No. I-17-OR and Structure No. I-17-ON carrying I-25 Southbound off Ramp and I-25 Northbound on Ramp over Cimarron Street and Fountain Creek at mile post 10.20 in Colorado Springs will replace Structure No. I-17-DH.

##### Bridge Layout Requirements

###### Bridge Length

The proposed length of the new bridge as shown in the bridge general layout is approximately 225'-6 1/2" from back face of abutment 1 to back face of abutment 4. This bridge length is required to provide for the needed opening for the 100 year water flow, a 10'-0" wide bike path, and a minimum of 10' vertical clearance measured from the top of the bike path to the bottom of the bottom flange while also providing a 2:1 slope at each abutment. For General Layout refer to Figures 15 and 17 in Appendix A.

###### Bridge Width

The proposed bridge will provide two 1'-6" Bridge Rail Type 10M, one 8'-0" shoulder, two 12'-0" travel lanes, and one 4'-0" shoulder for a total bridge width of 39'-0" out-to-out for the Southbound Off Ramp and the Northbound On Ramp. Refer to Figures 16 and 18 in Appendix A for typical section alternatives detail.

###### Utilities

Existing utilities located between pier 3 and abutment 4 running from east to west for Structure No. I-17-OR (SB off Ramp) include an overhead power line, sanitary sewer, water, and gas. The sanitary sewer line is located approximately 3' below the existing ground line.

###### Substructure

###### Abutments

Integral abutments founded on steel H-piles are proposed for the Southbound Off Ramp and the Northbound On Ramp. The minimum vertical clearance distance from the bottom of the girder to top of the Riprap is 2'-0". Based on the preliminary soil investigations, the end bearing H-piles should be driven to refusal into the bedrock that is located approximately 24 feet below the existing ground line. Draft Geotechnical information can be found in Appendix D.

###### Piers

Two pier alternatives were developed for the Southbound off Ramp and Northbound on Ramp. The first pier alternative has multiple round columns with each column supported on drilled caissons embedded 15'-0" into the bedrock. The second pier alternative considered for this location is a hammer head pier with an elliptical shaped (Race Track) column, as shown in Appendix A, Figure 16 and 18. The pier will either be supported on end bearing steel H-piles driven to refusal into the bedrock at approximately 24 feet below the existing ground line or drilled caissons embedded approximately 15'-0" into the bedrock. The recommended alternative for this structure is the hammer head pier in order to be consistent with the I-25 corridor standards.

###### Structure Options

The following alternatives were considered for the construction of the proposed new bridges: Precast Prestressed Concrete Bulb-Tee Girders (Alternative A), Composite Rolled Steel Wide Flange Girders (Alternative B) and Precast Prestressed Concrete Box Girders (Alternative C). The Cast in Place Post-Tensioned alternative was eliminated from consideration since extensive shoring and forming is necessary for this type of construction and the bridge is located over Fountain Creek which would cause some difficulties during construction. The three alternatives were evaluated equally on their esthetics, cost, and constructability.

###### Alternative A: Precast Prestressed Concrete Bulb Tee Girder

The Precast Prestressed Concrete Bulb-Tee Girder alternative will produce a 3 span bridge with span lengths of 84'-0", 85'-0", and 84'-0". The superstructure will consist of four BT 42 girders spaced at 10'-0" on center and 4'-6" overhangs; 8 1/2" thick composite concrete pavement will be placed on the top of the girders for a total structure depth of approximately 4'-6". The following data were used in the preliminary design of the girders: initial concrete strength f'ci = 6,500 psi, final concrete strength f'c=7,500 psi, and 30-0.6" diameter strands. The construction cost of this alternative is estimated to be \$572,000 or \$59 per square foot for the I-25 Northbound on Ramp Bridge and \$532,000 or \$55 per square foot for the I-25 Southbound off Ramp Bridge. For typical section refer to Figures 16 and 18 in Appendix A.

###### Alternative B: Composite Rolled Steel Wide Flange Girders

The Composite Rolled Steel Wide Flange Girder alternative also will produce a 3 span bridge with span lengths of 84'-0", 85'-0", and 84'-0". The superstructure consists of four lines of girders spaced at 10'-0" on center and 4'-6" overhangs. Each girder line will consist of W40x249 for the positive moment region and W40X277 for the negative moment region for a total structure depth of approximately 4'-5". An 8 1/2" thick composite concrete deck on top of the girders was assumed for this alternative. The construction cost is estimated to be \$702,000 or \$72 per square foot for the I-25 Northbound on Ramp Bridge and \$661,000 or \$68 per square foot for the I-25 Southbound off Ramp Bridge. For typical section refer to Figures 16 and 18 in Appendix A.

###### Alternative C: Precast Prestressed Concrete Box Girders

The Precast Prestressed Concrete Bulb-Tee Girder alternative will produce a 3 span bridge with span lengths of 84'-0", 85'-0", and 84'-0". The superstructure will consist of four 64x44 Precast Prestressed Concrete Box Girders spaced at 10'-0" on center and 8 1/2" thick composite concrete pavement placed on the top of the girders for a total structure depth of approximately 4'-9". The following data were used in the preliminary design of the girders: initial concrete strength f'ci =



5,500 psi, final concrete strength  $f'c = 6,000$  psi, and 36-0.6" diameter strands. The construction cost of this alternative is estimated to be \$643,000 or \$66 per square foot for the I-25 Northbound on Ramp Bridge and \$602,000 or \$62 per square foot for the I-25 Southbound off Ramp Bridge. For typical section refer to Figures 16 and 18 in Appendix A.

**3.2.2 Cimarron Street over Fountain Creek**

Structure No. CSG-F.85-08.23W and Structure No. CSG-F.85-08.23E carrying Cimarron Street Westbound and Eastbound over Fountain Creek at mile post 10.20 in Colorado Springs will replace Structure No. CSG-FG.85-08.23 formerly I-17-DI.

**Bridge Layout Requirements**

**Bridge Length**

The proposed length of the new bridges as shown in the bridge general layout is approximately 296'-5 1/2" from back face of abutment 1 to back face of abutment 4. The bridge length is required to provide for the needed opening for the 100 year water flow, a 10'-0" wide bike path, and a minimum of 10' vertical clearance measured from the top of the bike path to the bottom of the bottom flange while also providing a 2:1 slope at each abutment. For General Layout refer to Figure 19 in Appendix A.

**Bridge Width**

The proposed Westbound bridge will provide two 1'-6" Bridge Rail Type 10M, two 4'-0" shoulders, three 12'-0" through traffic lanes and one 12'-0" right turn lane to I-25 Northbound for a total bridge width of 59'-0" out-to-out. The Eastbound bridge will provide two 1'-6" Bridge Rail Type 10M, two 4'-0" shoulders, and two 12'-0" traffic lanes for a total width of 35'-0" out-to-out. Refer to Figure 20 in Appendix A for typical section alternatives detail.

**Utilities**

Existing sanitary sewer and water lines are located approximately 3' below the existing ground line between abutment 1 and pier 2. An overhead power line is located close to the south corner of abutment 4 for Cimarron Street Eastbound. Colorado Springs Utilities will relocate the overhead power line prior to construction.

**Substructure**

**Abutments**

Integral abutments founded on steel H-piles is proposed for the Eastbound and Westbound bridges, minimum clearance vertical distance from the bottom of the girder to top of the Riprap is 2'-0". Based on the preliminary soil investigations, the end bearing H-Pile should be driven to refusal into the bedrock. The Claystone bedrock is located approximately 28 feet below the existing ground line. Draft Geotechnical information can be found in Appendix D.

**Piers**

Two pier alternatives were developed for the Eastbound and Westbound bridges. The first pier alternative has multiple round columns with each column supported on drilled caisson embedded 15'-0" into the bedrock. The second pier alternative considered for this location is a hammer head pier with an elliptical shaped column as shown in Appendix A, Figure 20. The pier will either be supported on end bearing steel H-piles driven to refusal into the Claystone bedrock at

approximately 28 feet below the existing ground line or drilled caissons embedded approximately 15'-0" into the bedrock. The recommended alternative for this structure is the hammer head pier in order to be consistent with the I-25 corridor standards.

**Structure Options**

Two alternatives were considered for the construction of the proposed new bridges: Precast Prestressed Concrete Bulb-Tee Girders (Alternative A) and Composite Rolled Steel Wide Flange Girders (Alternative B). The Cast in Place Post-Tensioned alternative was eliminated from consideration since extensive shoring and forming is necessary for this type of construction and the bridge is located over Fountain Creek which would cause some difficulties during the construction. The two alternatives were evaluated equally on their esthetics, cost, and constructability.

**Alternative A: Precast Prestressed Concrete Bulb Tee Girder**

The Precast Prestressed Concrete Bulb-Tee Girder alternative will produce a 3 span bridge with span lengths of 84'-0", 85'-0", and 84'-0". The superstructure will consist of four BT 54 girders spaced at 10'-0" on center and 4'-6" overhangs for the Westbound and 9'-0" on center and 4'-0" overhangs for the Eastbound. An 8 1/2" thick composite concrete pavement will be placed on the top of the girders for a total structure depth of approximately 5'-6". The following data were used in the preliminary design of the girders: initial concrete strength  $f'ci = 6,000$  psi, final concrete strength  $f'c = 6,500$  psi, and 32-0.6" diameter strands. The construction cost of this alternative is estimated to be \$999,000 or \$57 per square foot for the Westbound bridge and \$654,000 or \$63 per square foot for the Eastbound bridge. For typical section refer to Figure 20 in Appendix A.

**Alternative B: Composite Rolled Steel Wide Flange Girders**

The Composite Rolled Steel Wide Flange Girder alternative also will produce a 3 span bridge with span lengths of 84'-0", 85'-0", and 84'-0". The superstructure consists of four lines of girders spaced at 10'-0" on center and 4'-6" overhangs for the Westbound and 9'-0" on center and 4'-0" overhangs for the East bound. Each girder line will consist of W40x249 for the positive moment region and W40X277 for the negative moment region for total structure depth of approximately 4'-5". An 8 1/2" thick composite concrete deck on top of the girders was assumed for this alternative. The construction cost for this alternative is estimated to be \$1,367,000 or \$78 per square foot for the Westbound bridge and \$910,000 or \$88 per square foot for the Eastbound bridge. For typical section refer to Figure 20 in Appendix A.



### 3.3 Bijou Street Bridges

Bijou Street bridges include the following:

- Bijou Street over I-25 and
- Bijou Street over UPRR

#### 3.1.1 Bijou Street over I-25

Structure No. I-17-OQ Carrying Bijou Street over I-25 in Colorado Springs will replace Structures No. I-17-DN.

Replacement of the current structure with a wider structure is the primary purpose of the new bridge. The new bridge will also be higher than the existing structure to allow I-25 to be raised as much as possible, so it is not practical to widen the existing structure. The new bridge will allow a triple left turn from Southbound I-25 to Eastbound Bijou. Two through lanes for Westbound Bijou will be included along with the one left turn lane each direction from Bijou onto I-25. The width also includes 5 foot bike lanes each side of the road way and 5 foot wide sidewalks.

#### Bridge Layout Requirements

##### General Considerations

The tight physical limits placed on the geometry of the bridge have the most significant impact on the design of the Bijou Bridge over I-25.

*Bijou Street Profile:* On the west end of the bridge, businesses and street access limit the elevation change that is possible with the roadway.

On the east end, a bridge passes over Monument Creek. This bridge is not to be replaced at the time that the bridge over I-25 is replaced. Thus, the east end of the bridge over I-25 must match the existing bridge deck elevation of the bridge over Monument Creek.

Moreover, when the bridge over Monument Creek is built, it will need to be higher than the existing bridge. But just as the elevation of the existing bridge over Monument Creek restricts the elevation of the bridge over I-25, the elevation of the I-25 bridge will restrict the elevation of the bridge over Monument Creek when it is replaced. One solution to this situation is to build the bridge over I-25 with enough strength to carry an earth fill and allow the bridge to be raised by adding fill and a new asphalt roadway at the time that the bridge over Monument Creek is built.

*Span Lengths:* The bridge is spanning I-25 and needs to be as thin as possible to allow I-25 to be raised as much as possible. To accomplish this, the bridge should have the shortest spans possible. Thus, the bridge will be a 2 span bridge with the pier in the center of I-25 and the abutments as close to the edge of I-25 as safety will allow. On the west end, the abutment will be placed to give 30 feet of clear zone to the traveled land and result in a 93.5 foot span. On the east end, the abutment will project into the 30 foot clear zone, so guard rail be required on the face of the abutment. The span here will be 88.6 feet.

#### Geometric Constraints

*Horizontal width limitations:* The new bridge is not restricted in width, but the condition upon completion of the bridge is that the bridge over Monument Creek will still be in use for some time before it is replaced. Thus, the usable width is limited to the width accessible from the existing bridge over Monument Creek. That is 2 through lanes each way with sidewalks each side. The triple left turn lanes on the bridge and the bike lanes will not be useable until the bridge over Monument Creek is completed.

*Bridge Length:* The proposed length for the new bridge is 187'-1 5/8". The new bridge will utilize the existing west abutment as a form for the new abutment. The new west abutment will be a tall abutment on deep foundations, set just in front of the existing abutment. The new east abutment will be placed behind the existing abutment to allow for the widening of I-25 to the east.

The most significant feature of the Bijou Street Bridge over I-25 is that the vertical alignment of I-25 is forced down to fit under the structure. The existing level of I-25 is about at the elevation of Monument Creek. This requires the continuous pumping of the depression to keep I-25 free of water. In the new construction it is planned to outfall a storm sewer system far enough down stream of the depression to allow free draining of I-25. An extensive underdrain system is required to collect the water. The cost of these systems is estimated to be on the order of \$100,000 per foot of depth below the water table. The alignment of I-25 also takes it over Colorado Ave. a short distance to the south. This requires a significant slope up to get high enough to clear Colorado Ave.

Note that the structure depth on Alternative 1 is one foot less than the other alternatives. This not only saves money on the drainage system, it allows a better grade on I-25. The cast-in-place alternative also is a more flexible structure type dimensionally such that in final design some variation in depth and width may allow even a short structure depth at the critical location.

One objection to the cast-in-place system over a freeway is that the shoring may restrict the vertical clearance during construction. In this particular case, the shorter depth of structure allows the bridge to be built higher than required above the existing freeway so that vertical clearance is not restricted during construction. After completion of the bridge, I-25 will be raised in elevation to the higher level (as well as move horizontally) to take full advantage of the increase in vertical clearance.

#### Structure Alternatives

The following alternatives were considered for the construction of the proposed new bridge: Cast-in-place post-tensioned concrete box girder (Alternative 1), Steel box girders (Alternative 2), and Precast prestressed Colorado U-girders (Alternative 3). Structure types such as Precast Bulb-tees and Rolled steel wide flanges were not considered because they do not meet the Corridor Guidelines for appearance. All the alternatives have the same span arrangement, 93.5' and 88.6'. For the General Layout refer to Figure 23 and for the Architectural Elevation refer to Figure 24 in Appendix A.

##### Alternative 1: Cast-in-place Post-tensioned Concrete Box Girder

The superstructure will consist of a single cast-in-place concrete girder with 14 webs that are 8'-2" on center. This girder will be variable depth with a minimum depth of 3'-0" and have a top flange that is 8" thick with a 3" asphalt overlay. The following data were used in the initial design of the box: initial concrete strength  $f'_{ci}$  = 4,500 psi, final concrete strength  $f'_{c}$  = 6,000 psi. The construction cost for this alternative is



estimated to be \$2,185,000 or \$102 per square foot. For the Typical Section refer to Figure 25 in Appendix A.

**Alternative 2: Steel Box Beams**

The superstructure will consist of 8 lines of variable depth steel box beams that are a minimum of 4'-0" deep and spaced 14'-0" on center. An 8" composite concrete deck with 3" of asphalt overlay will be placed on top of the beams. Grade 50 welded plates will be used for the beams. The construction cost for this alternative is estimated to be \$2,640,000 or \$123 per square foot. For the Typical Section refer to Figure 26 in Appendix A.

**Alternative 3: Precast Prestressed Colorado U-girders**

The superstructure will consist of 8 lines of U48 girders (that are 4'-0" deep) and that are 14'-4" on center. An 8" composite concrete deck with 3" of asphalt overlay will be placed on top of the girders. The following data were used in the initial design of the girders: initial concrete strength f'ci = 6,500 psi, final concrete strength f'c = 7,500 psi, and 56-0.6" diameter low relaxation strands. The construction cost for this alternative is estimated to be \$1,955,000 or \$91 per square foot. For the Typical Section refer to Figure 27 in Appendix A.

**3.3.2 Bijou Street over UPRR**

Structure No. CSG-G.15-08.84A carrying Bijou Street over the Union Pacific Railroad and Monument Creek in Colorado Springs will replace Structures No. CSG-G.15-08.84E and W.

Replacement of the deteriorating current structure is the primary purpose of the new bridge. The new bridge will also be widened to allow 3 traffic lanes in both directions, 5' bicycle lanes, and 5' sidewalks on each side of the road. Acceleration and deceleration lanes will be added for the right turn movements on to and off of the ramps to I-25.

For General Layouts, Sections at Piers and Architectural Elevation refer to Figures 28 to 35 in Appendix A. For detailed cost estimates refer to Appendix C.

**Bridge Layout Requirements**

**General Considerations**

The tight physical limits placed on the geometry of the bridge have the most significant impact on the design of the Bijou Bridge over Monument Creek and the Railroad.

*Bijou Street Profile:* On the east and west ends of the bridge, businesses and street access limit the elevation change that is possible with the roadway.

On the east side, the bridge passes over Monument Valley Park. A stone archway frames one of the main entrances to the park, which lies adjacent to the east end of the bridge. The City of Colorado Springs does not want the arch to be disturbed. Since the arch stands about two feet from the roadway of Bijou Street, only a small amount of vertical change in the roadway profile is permissible at the east end of the bridge.

Over the railroad, the clearance from the railroad to the bridge is required to be a minimum of 23 feet, and the railroad cannot be lowered without significant and costly impacts to railroad structures

and operations. The existing bridge does not meet the required 23 feet of vertical clearance making it necessary to raise the bridge over the railroad while maintaining little changes at the ends. The design speed and slope at the intersections of the ramps off I-25 and Bijou restrict the maximum slope that the roadway profile can be changed. The depth left for structure is therefore extremely limited.

Moreover, it has been determined that due to budgetary constraints, this bridge will not be built until much later in the construction process. Consequently, the existing bridge will remain in service for a significant length of time after the bridge over I-25 at Bijou is complete. As such, the bridge at I-25 must match the vertical elevation of the existing bridge at the west abutment. When the new bridge over the railroad is constructed, its west end vertical placement is limited by its close proximity to the bridge over I-25. To maintain a smooth vertical profile over both bridges, the west end cannot be raised significantly.

*Span Lengths:* One of the simplest ways to reduce structure depth is to limit span lengths. Ideally, the bridge should span the railroad tracks without having to alter their position. However, eight tracks run beneath the current bridge. To span them all would require an expensive structure considering the depth available. The existing bridge has a pier in the middle of the tracks. But placing a new pier in this existing location is not possible because it violates current clearance requirements. The existing clear distance of about 10' from the tracks to the piers would need to be increased to 18 feet. The tracks must therefore move to make clearance, and they must be spaced further apart than their current condition – 20' spacing instead of 14'. Additionally, the bridge spans must allow for the placement of a future track. If we meet all of these conditions, the span lengths over the tracks changes from the existing 54'-6" and 85'-0", spanning eight tracks, to 102'-0" and 104'-0" to span the relocated nine tracks.

The additional cost to span all the tracks is about \$700,000, which would seem to eliminate this as a reasonable alternative. However, it was discovered that to move the tracks will cost about 1 1/2 million dollars.

**Geometric Constraints:**

*Horizontal width limitations:* The bridge passes over Monument Valley Park on the east end. Due to both Federal and City restrictions on highway use of parkland, the bridge width in the park area is limited to the width of the current bridge. For a bridge-widening project, this limiting condition makes this a difficult project.

The plan layout of the bridge is very wide at the west end; 210' where the I-25 ramps join Bijou Street. At the east end, where the park is, the width is 94'. The majority of the bridge is 138'. The bridge tapers from the west abutment to the majority width and then tapers again to the width at the park.



**Bridge Length:** The proposed length for the new bridge of 478'-4 1/2" is approximately the same as the existing bridge lengths of 487'-3" and 485'-0". The new bridge will utilize the existing west abutment as a retaining wall. The new west abutment will be a short abutment on deep foundations, set behind the existing abutment. The new east abutment will be placed in front of the existing abutment, and the existing abutment will be buried in the approach roadway fill. In effect, the new bridge is a slightly shorter version of the existing bridge that is shifted to the west.

Another item that limits pier and abutment locations is a stone slope paving that is on both sides of Monument Creek just south of Bijou Street. This work was done under the WPA in the 1930's and is historic. It can only be disturbed where absolutely necessary. This structure that we call the WPA wall is not under the present Bijou Bridge, but will be under the widened section of the proposed Bijou Bridge.

Due to the imposed restrictions, it is necessary to use the minimum possible depth of structure at the critical point. Because the depth requirement is not uniform over the length of the bridge, a variable depth structure is the simplest solution to the problem. Variable depth structures are easiest to build using cast-in-place concrete or steel structures. A variable depth precast concrete structure is possible, but much more complicated to accomplish.

Because of the variation in width, it is necessary to have a structure that will be accommodating to the situation. Cast-in-place concrete provides the greatest flexibility in this regard. Steel beams are very flexible in configuration, but they have a significant cost impact when used for complex designs. Generally, precast concrete performs best in straight alignments, and does not lend itself well to complicated shapes.

Construction on railroad property is difficult and expensive because of the railroad limitations. To keep the time on railroad property at a minimum, it is best to use a structural system that can be built off site and then erected in the largest pieces possible. Steel and precast concrete are both systems that meet this goal well. Cast-in-place concrete requires shoring in the field, which can require shutting down some tracks for a significant length of time while construction is in progress, thus making cast-in-place concrete a very expensive alternative.

From looking at these two items, variable geometry and railroad time limitations, precast concrete is not a good choice because of geometry and cast-in-place concrete is not good because of long field time requirements. Steel beams appear to be the structure type of choice. They offer a reasonable flexibility with a speedy erection time.

**Structure Alternatives**

Because of the complexity of this bridge project, we are considering 9 alternatives as possible structure arrangements. There are 3 possible arrangements of the tracks below the bridge and 3 alternatives for each of these.

The three possible track arrangements are:

- A. Leave the existing tracks as they are and span over them, with consideration given for a future track in another span. This results in a 5 span bridge.

- B. Leave the existing tracks as they are and span over them with enough excess span length to allow a future track to be built in this main span. This results in a 4 span bridge.
- C. Move some of the existing yard tracks so a pier can be placed in the middle of the yard to reduce the span lengths. This results in a 5 span bridge.

The following table gives a quick overview of the Alternatives.

**Bridge Alternatives**

Group		No. Spans	Railroad Coordination	Structure Type Investigation
A	Alternative 1	5 spans	Span existing tracks	Variable depth steel beams
	Alternative 2	5 spans	Span existing tracks	Girder above deck
	Alternative 3	5 spans	Span existing tracks	Cantilever Girder above deck
B	Alternative 4	4 spans	Span existing tracks plus future	Variable depth steel beams
	Alternative 5	4 spans	Span existing tracks plus future	Girder above deck
	Alternative 6	4 spans	Span existing tracks plus future	Cantilever Girder above deck
C	Alternative 7	5 spans	Pier in yard, move tracks once	Build on temporary pier
	Alternative 8	5 spans	Pier in yard, move tracks once	Build quickly
	Alternative 9	5 spans	Pier in yard, move tracks twice	Straight steel beams

The next table shows the span lengths and the pier locations from the Abutment for each alternative. The last line indicates the location of the WPA wall and the Railroad property line at the south edge of the proposed bridge. This is to show how this limiting factor is missed by these span arrangements.

**Span Lengths**

Alt.	Spans over Monument Creek		Spans over Railroad			Spans over Park	Pier Locations from Abutment						
	1	2	1	2	3		1	2	3	4	5	6	
1	102	102	56	148		70	102-	204-		260-		408-	478
2	102	102	49	59	96	70	102-	204-		253-		408-	478
3	102	102	49	59	96	70	102-	204-		253-		408-	478
4	115	115		178		70	115-		230-			408-	478
5	115	115		82	96	70	115-		230-			408-	478
6	115	115		82	96	70	115-		230-			408-	478
7	100	100	102	106		70	100-	200-			302-	408-	478
8	100	100	102	106		70	113-	200-			302-	408-	478
9	100	100	102	106		70	100-	200-			302-	408-	478
WPA and Property Line:			206	18	3	172	206-	224-227			399-		
Utility Lines			230	60	140			230-	290-	430-			
Note: The WPA, Property Lines and Utility Lines fall very close to some of the pier lines. This will influence the constructability and cost of those alternatives.													



**Reasons For and Against**

Alternative	For		Against	
Alternative 1	No RR or Util. Move		Bent, variable beam	
Alternative 2	No RR or Util. Move		Pier 4 near RR	Visual impact
Alternative 3	No RR or Util. Move		Bent beam	Visual impact
Alternative 4	No RR Move		<b>Spans too long</b>	
Alternative 5	No RR Move	Save one span	Move Fiber Optic	Visual impact
Alternative 6	No RR Move	Can be Dynamic	Move Fiber Optic	Visual impact
Alternative 7	Move RR once		High Risk	RR Coordin.
Alternative 8	Quick Completion	Move RR once	<b>Tight RR Coord.</b>	
Alternative 9			<b>Move RR twice</b>	

The items in bold for Alternatives 4, 8 & 9 eliminate these from consideration.

In determining the Bridge Costs, a number of sources were used. The Bridge and Extra Support figures come from the CDOT Cost Data Book and the summaries of these are included in the Attachments. The moving of the Railroads comes from an estimate of costs prepared by Wilson & Company, Kansas City, Missouri. They estimate the cost of new track for the relocated track at \$600,000. The cost to signalize the switches that are being moved is another \$800,000. There is roughly another \$50,000 in supervision, track control, inspection and design for such a change. This figure is approximately in agreement with the figure Sue Grabler of the UPRR gave at \$4,000,000 per mile of track. The utility cost comes from HP and they indicate that it will cost \$6,300 to move their Fiber Optic line out of the way of the bridge pier. Alternative 7 requires the moving of 3 fiber optic lines, so the number is tripled to \$18,900. Use \$5,000 and \$20,000 to round the numbers. Round other numbers to \$5,000.

**Bridge Costs in Thousands of Dollars**

Alternative	Bridge	Extra Support	Moving RR Tracks	Moving Utilities	Total
Alternative 1	6,745	0	0	0	\$6,745
Alternative 2	6,040	1060	0	0	\$7,100
Alternative 3	6,040	920	0	0	\$6,960
Alternative 4	NA				
Alternative 5	6,040	905	0	6	\$6,945
Alternative 6	6,040	760	0	6	\$6,805
Alternative 7	6,040	0	1,120	20	\$7,180
Alternative 8	NA				
Alternative 9	NA				

Other Items to consider:

**Value Scaled Comparison – 4 High 1 Low**

Alternative	Constructibility	Architectural Appearance	Maintenance	Safety	Total
1	4	3	4	3	14
2	3	2	3	2	10
3	3	1	3	2	9
4	1	4	4	4	13
5	3	3	2	4	12
6	2	4	1	4	11
7	2	2	3	1	8
8	1	2	3	1	7
9	3	2	3	1	9

The shaded numbers indicate alternatives that have been eliminated from consideration.

**Alternative 1: Variable depth steel beams below the deck**

This alternative is intended to limit the impact on the railroad as much as possible. All the existing tracks will remain as they currently are. The pier west of the existing tracks will be placed at the minimum distance allowed from the track of 18 feet. The railroad would like 25 feet from the track to a pier to allow for an access road on each side of the yard. This will be accomplished by allowing a 25 foot wide space on the opposite side of the pier from the tracks and the pier will not be a solid pier. Thus the railroad will have a continuous path for an access road and will be able to service the tracks through the openings in the pier. On the east side of the existing tracks the pier will be placed at 25 feet from the existing tracks. For General Layout refer to Figure 28 in Appendix A. For Pier Sections refer to Figures 32 and 33 in Appendix A. For an Architectural Elevation refer to Figure 35 in Appendix A.

This arrangement results in the main span of 148 feet to clear all the tracks by a minimum of 18 feet on the West and 25 feet on the East. The future track will be accommodated in the first span to the west of the main span. From the pier to the future track must be at least 25 feet as discussed above to allow for an access road. On the other side of the future track another 25 feet is required for the access road in that span. This span would be 50 feet except that would place the pier in the WPA wall. So the pier is moved a few feet to the west to allow the WPA to be cleared. This all sound proper except the Railroad has sold that property on the west so there is really no room for an access road west of the future track. As a matter of fact, the railroad has sold all the property both north and south of the bridge such that not only is there no room for an access road, there is no room for a future track and no room for some of the existing track, which had to be removed because it was partially off railroad property. Thus, the span arrangements of the bridge are such that if in the future the railroad should purchase enough property to allow the addition of an access road and future track, the bridge can accommodate it and will not need to be modified. On the east side of the Main span, the distance from the last track to the Property Line is only about 21 feet. The current bridge pier arrangement is such that the pier is only about 18 feet from the center of the last track. The access along the railroad track is obtained by driving on City of Colorado Springs property behind the pier until one is beyond the bridge. Placing the new pier so that it is about 25 feet from the centerline of the last track, will give the railroad the opportunity to access all of there property from Railroad property.



The vertical clearance of the railroad tracks is critical to railroad operations and must be maintained. The property on the east and west end of the bridge restrict raising the bridge, so the vertical room available for the structure is limited to 4 feet. A span of 148 feet cannot be reasonably done in only 4 feet. To accomplish this, a variable depth girder will be used. Outside the tracks the girder can be as deep as necessary to make the span. Within the tracks, not all the tracks are at the highest elevation and the highest tracks are at the center of the span. So the taper of a variable depth beam will allow a 148' span in only 4 feet of depth.

Because this span is varying in width and depth, precast concrete is not a reasonable solution. Because the bridge is over a railroad yard, shoring for cast-in-place concrete is not an attractive alternative. Welded steel plate girders seem the best alternative here.

**Alternative 2: Steel girders spanning above the deck**

This is a similar arrangement to alternative one except the girders can be above the deck. Because they are above the deck they can only be in the median and on each side of the deck. Because the bridge is built in 2 phases, the girders are required in the median and on the sides. Because the railroads require a 5 foot high solid barrier above the deck, and the depth below the deck is 4 feet, a 9 foot high girder can be used without resulting in a visual barrier any higher than would be required otherwise. AASHTO requires that a bridge structure not restrict the ability of a bridge to be widened unless the bridge cannot be widened in the future. In this case, the Park restrictions mean the bridge is already as wide as will be allowed and should the Park restrictions be overcome for some reason in the future, part of the bridge will most likely be built further to the south so it lines up with Kiowa Street. Thus, restrictions to widening are not a problem. For General Layout refer to Figure 29 in Appendix A. For Pier Sections refer to Figure 34 in Appendix A.

Rather than changing the basic nature of the bridge so that the floor beams run transverse to the direction of the bridge between the girders above the deck, the best way would be to run a single transverse pier between the outside girders at the location of the present pier in the middle of the railroad yard. The floor beams could then be continuous beams with the beams in the other spans of the bridge. Using the suspended pier as simply another pier location allows shorter spans so the beams can meet the limited depth requirement.

With a 9 foot depth possible, the main span can be increased such that the 18 feet each side of the track can be increased to 25 feet as the railroads prefer. This results in a 155 foot main span that is broken into two portions of 59' and 96' for the floor beams to span to the suspended pier. The future track can still run in the next span to the west with the same relationship to the property lines that existed in alternative 1. This suspended pier would be built near the existing mainline railroad tracks. This is a coordination issue that would increase the difficulty of this alternative.

Because of the suspended pier, there are only 5 spans for the bridge, but 6 spans for the floor beams. Steel beams would be the most logical option to match the steel girders of the structure supporting the suspended pier, but precast concrete girders could be used because the shorter spans would not require variable depth.

**Alternative 3: Steel girders cantilevered above the deck**

This alternative is vary much like alternative 2, with the exception that the suspended pier is supported by a cantilever from the west end of the bridge, rather than a span between the piers on each side of the tracks. For General Layout refer to Figure 29 in Appendix A. For Pier Sections refer to Figure 34 in Appendix A.

**Alternative 4: Steel girders below the deck**

This alternative continues the intent of alternative 1. All the existing tracks were spanned in alternative 1, but in this alternative all the existing tracks plus the future track will be spanned and 25 feet each side will be given for access roads. This results in a main span of 178 feet. The longer span allows for the elimination of one pier. The controlling vertical clearance will be for the future track, assuming it is at the same elevation as the track next to it. This will result in a structure depth available of just over 4 feet. This depth will not be at the center as it was in alternative 1, but near the pier west of the tracks. This means a span to depth ratio of about 45. This is not really a practical structure. It will not be investigated further, but it is presented here because it is the beginning point for alternatives 5 and 6. For General Layout refer to Figure 30 in Appendix A.

**Alternative 5: Steel girders spanning above the deck**

This alternative is a variation of alternative 2, but uses the spans from alternative 4. The differences between alternative 2 and 5 are that the spans are 82 and 96 feet rather than 59 and 96 feet and the bridge is 4 spans and the floor is 5 spans. This alternative does have the advantage of placing the future track about 20 feet closer to the existing tracks. That means the future track would be about 28 feet from the property line. This is enough for an access road, but only under the bridge. Both north and south of the bridge the space quickly narrows and there is no room for either an access road or a future track. For General Layout refer to Figure 31 in Appendix A. For Pier Sections refer to Figure 35 in Appendix A.

This pier arrangement does place the second pier on top of the existing fiber optic line. This will complicate coordination because the line will need to be moved.

**Alternative 6: Steel girders cantilevered above the deck**

This alternative is a variation of alternative 3, but uses the spans from alternative 4. It is very similar to alternative 5 except that the support for the suspended pier is cantilevered from the piers to the west by steel girders placed on each side of the bridge and in the median between the directions of traffic. For General Layout refer to Figure 30 in Appendix A. For Pier Sections refer to Figure 34 in Appendix A.

**Alternative 7: Steel girders spanning below the deck, temporary piers**

This alternative assumes the railroad tracks can be moved to allow the best span arrangement for the structure. The 3 west most tracks that are currently on the west of the existing pier would need to be moved. The remaining 5 tracks would be left as is. Once a new pier is added, it must meet the current railroad requirements, even if the existing pier does not. The existing pier is about 10 feet from the mainline track just to the east. The current railroad requirement is 18 feet. With an additional 18 feet to the next track to the west that will be relocated, 20 feet more to the second track to be relocated, and relocating the switch from the second to the third track far enough to the south to avoid moving the third track even further west, the last track to the west will be about 10

feet further to the west than the current existing track. With 20 feet to the future track, the future track will be about 18 feet from the property line. For General Layout refer to Figure 31 in Appendix A.

This span arrangement is basic enough, but it has one construction problem. The bridge will need to be built in 2 phases if Bijou Street is to be kept open during construction. This means that at some point the new piers for one half of the bridge will be in place while the existing piers for the other half are still in place. But the spans arrangements are such that there is not enough room between some of the piers to allow the existing tracks that are to be relocated to clear both sets of piers.

For this alternative the solution is to not build the new piers in the first phase, but to support the first phase on temporary piers. Once this phase is in service, the other half of the bridge can be removed, the tracks relocated and the bridge replaced. With all this done, the final piers for phase one can be built and the temporary piers removed.

**Alternative 8: Steel girders spanning below the deck, build quickly**

This alternative is the same as alternative 7, except for the method of dealing with the new and existing piers that interfere with the tracks. In this alternative the bridge will be built in one phase. This will mean that Bijou Street will not remain open during construction. To avoid a major traffic problem, the bridge would need to be built very quickly. A bridge of this size could be built in a week. But this would require very close coordination with the Railroad because shut down of the railroads would be required for such operations as setting bridge girders. In general, the railroads could not be expected to limit their operations for a week that is out of their control. So this alternative is probably not practical. For General Layout refer to Figure 31 in Appendix A.

**Alternative 9: Steel girders spanning below the deck, move tracks twice**

This alternative is the same as alternative 7, except for the method of dealing with the new and existing piers that interfere with the tracks. In this alternative the tracks would need to be moved twice. In the first phase of construction the tracks would be moved to a location that would clear both the new and existing piers by allowable construction clearances. This is part way between the existing location and the final location. After the second phase of the bridge construction is complete, the tracks would be moved to the final location that would give the allowable permanent clearances and allow for the future track to be built. The only draw back to this alternative is the cost and coordination of moving the track twice. Because the railroad will be doing the moving of the tracks, it is unlikely that the railroad can fully cooperate in 2 moves and significant delays are possible. So this alternative is probably not practical. For General Layout refer to Figure 31 in Appendix A.

## 4.0 BRIDGE RECOMMENDATIONS

### 4.1 I-25 Mainline Bridges

#### 4.1.1 I-25 over Bear Creek

The alternatives were evaluated equally on esthetics, cost, and constructability. The superstructure is not visible from I-25 mainline, thus need not comply with corridor superstructure guidelines. Alternative A, the Precast Prestressed Concrete Bulb Tee Girder, is recommended as the most viable alternative for the construction of the bridge. The depth of all alternatives is about the same; the constructability is also about equal, easy to construct and widen in the future if necessary. Lastly, the cost of Alternative A is the lowest of the alternatives, and on that basis, Alternative A is recommended.

#### 4.1.2 I-25 over Cimarron Street

The two alternatives were evaluated equally on esthetics, cost, and constructability. The superstructure is visible from I-25 mainline, thus needs to comply with corridor superstructure guidelines. Alternative B, the Precast Prestressed Concrete Colorado U Tub Girder, is recommended as the most viable alternative for the construction of the bridge. With this alternative no false work and extensive forming is needed and the construction period is somewhat shorter than Alternative A. The cost of Alternative B is also lower than Alternative A by \$1,055,000.

#### 4.1.3 I-25 over Colorado Avenue

The four alternatives were evaluated equally on aesthetics, cost, and constructability. The superstructure is visible from I-25 mainline, thus needs to comply with corridor superstructure guidelines. Alternative D, the Precast, Pre-Tensioned Concrete U-Girder, is recommended as the most viable alternative for the construction of the bridge. This alternative emerged from the comparison-level cost estimates as the most economical of the four; after this determination had been made, the span layout and length of the bridge were modified to achieve additional economy. The Complete cost estimate is \$4,050,000. This equals \$70 per sq. ft. of bridge area.

With this alternative, neither formwork nor falsework should be necessary for construction/erection of the girders, although falsework likely will be necessary for the cantilevered substructure elements.



## 4.2 Creek Bridges

### 4.2.1 Ramp C-2 (I-25 SB off Ramp over Fountain Creek) and Ramp C-3 (I-25 NB on Ramp over Fountain Creek)

The three alternatives were evaluated equally on esthetics, cost, and constructability. The superstructure is not visible from I-25 mainline, thus need not comply with corridor superstructure guidelines. Alternative A, the Precast Prestressed Concrete Bulb Tee Girder, is recommended as the most viable alternative for the construction of the bridge. The depth of the three alternatives is about the same; the constructability is also about equal, easy to construct and widened in the future if necessary. Lastly, the cost of Alternative A is the lowest of the three, and on that basis, Alternative A is recommended.

### 4.2.2 Cimarron Street over Fountain Creek

The alternatives were evaluated equally on esthetics, cost, and constructability. The superstructure is not visible from I-25 mainline, thus need not comply with corridor superstructure guidelines. Alternative A, the Precast Prestressed Concrete Bulb Tee Girder, is recommended as the most viable alternative for the construction of the bridge. The depth of both alternatives is about the same; the constructability is also about equal, easy to construct and widen in the future if necessary. Lastly, the cost of Alternative A is lower, and on that basis, Alternative A is recommended.

## 4.3 Bijou Street Bridges

### 4.3.1 Bijou Street over I-25

The recommended alternative is Alternative 1: Cast-in-place Post-tensioned Concrete Box Girders. This system is not the least expensive structure, but does offer savings in the drainage system, reduces the complexity of the drainage system and improves the grade on I-25. It will allow the Corridor Architectural Standards to be followed, it will allow the ramps to join into I-25 slightly quicker, it will allow the retaining walls to be shorter by the reduced depth of the bridge and it will allow the retaining walls to be slightly shorter because the ramps are slightly shorter. All of these reasons combine to out weigh the slight cost difference.

### 4.3.2 Bijou Street over UPRR

Alternative 1 is the highest ranking alternative over all. This alternative necessitates variable depth welded steel plate girders.

The alternatives not eliminated as being impractical are 1, 2, 3, 5, 6 and 7.

The cost for the alternatives places alternative 7 as the most expensive and alternative 1 as the least expensive, with the other 4 at almost the same cost. However, the difference between the highest and lowest cost estimate is only \$435,000 out of \$6,745,000 or less than 7%. A cost estimate at this level is unlikely to be accurate to 7% so the costs are really not significantly different.

From the comments in table of reasons for and against, alternatives 5, 6 and 7 require moving a fiber optic line or the Railroad. Each of these requires significant coordination issues that could delay the project.

The table of reasons for and against shows alternative 1 as the highest with 14, alternative 5 second at 12, alternative 6 at 11, alternative 2 at 10, alternative 3 at 9, and alternative 7 at 8.



## 5.0 PROJECT RETAINING WALLS

### 5.1 Introduction

This wall study and selection report has been prepared for the following retaining walls:

- I-25 Retaining Wall 1, Structure No. Wall-I-17-CA.
- I-25 Retaining Wall 2, Structure No. Wall-I-17-CC.
- I-25 Retaining Wall 3, Structure No. Wall-I-17-CD.
- I-25 Retaining Wall 4, Structure No. Wall-I-17-CG.
- I-25 Retaining Wall 5, Structure No. Wall-I-17-CI.
- I-25 Retaining Wall 6, Structure No. Wall-I-17-BP.
- Ramp C-1 Retaining Wall, Structure No. Wall-I-17-CE.
- Ramp C-2 Upper Retaining Wall, Structure No. Wall-I-17-CJ.
- Ramp C-2 Lower Retaining Wall, Structure No. Wall-I-17-CL.
- Ramp B-3L Retaining Wall, Structure No. Wall-I-17-CQ.
- Ramp B-4L Retaining Wall, Structure No. Wall-I-17-CR.
- Ramp C-3 Retaining Wall, Structure No. Wall-I-17-CM.
- Ramp B-4R Retaining Wall, Structure No. Wall-I-17-BQ.
- Ramp B-3R Retaining Wall, Structure No. Wall-I-17-CP.
- Cimarron Street Retaining Wall, Structure No. Wall-I-17-BZ.

The purpose of this report is to select a default wall for the above locations in accordance with Colorado Department of Transportation (CDOT) Staff Bridge polices 5.1 through 5.8.

The walls were evaluated based on the wall attributes and corridor standards, as well as site specific considerations in an effort to select the retaining wall type that best meets the evaluation criteria. Acceptable alternative wall types, if any, will also be indicated for the default wall. The criteria developed for the default wall will dictate the requirement for the alternate wall type should the contractor propose to construct the alternate.

Station, elevation, wall height, and wall lengths used for this report are based on the I-25 horizontal and vertical alignment in the FIR roadway plan set.

### 5.2 Wall Descriptions And Locations

As part of the capacity improvement of the I-25 corridor, the I-25 interchange at Bijou Street will be replaced, and I-25 will be widened to ten to twelve (10-12) lanes. This will require many retaining walls to be constructed. The wall descriptions and locations are as follows:

#### 5.2.1 I-25 Retaining Walls

##### **I-25 Retaining Wall 1 (Structure No. Wall-I-17-CA)**

Retaining Wall 1 is located at the west side of I-25 Southbound. The wall is required to support the I-25 Southbound embankment fill from encroaching on nearby buildings and businesses (Motor City) and stay within CDOT Right-of-Way. The proposed retaining wall is approximately 1090'-0" in length with a wall height varying from 13'-0" maximum to 8'-0". The proposed retaining wall will contain approximately 11,445 square feet of wall. The proposed retaining wall will be built parallel to the I-25 horizontal control line at a constant offset of 82.08' left, from station 500+23.00 to station 511+13.00. Refer to Figure 4 for retaining wall typical section and Figures 8 and 9 for retaining wall layout in Appendix B.

##### **I-25 Retaining Wall 2 (Structure No. Wall-I-17-CC)**

Retaining Wall 3 is located at the east side of I-25 Northbound. The wall is needed to support the I-25 Northbound embankment fill near I-25 over Bear Creek bridge and prevent the embankment fill from encroaching on nearby Fountain Creek and stay off the 100 year flood plane. The proposed retaining wall is approximately 298'-0" in length with a wall height varying from 12'-10" maximum to 4'-5". The proposed retaining wall will contain approximately 2,570 square feet of wall. The proposed retaining wall will be built parallel to the I-25 horizontal control line at an offset of 82.67' right, from station 515+55.00 to station 518+53.00. Refer to Figure 4 for retaining wall typical sections and Figure 10 for retaining wall layout in Appendix B.

##### **I-25 Retaining Wall 3 (Structure No. Wall-I-17-CD)**

Retaining Wall 4 is placed at the east side of I-25 Northbound. The wall is required to support the I-25 embankment fill near I-25 over Bear Creek bridge and prevent the embankment fill from encroaching on Bear Creek, existing trail, and stay off the 100 year flood plane. The proposed retaining wall is approximately 75'-0" in length with a wall height varying from 7'-3" maximum to 4'-10". The proposed retaining wall will contain approximately 453 square feet of wall. The proposed retaining wall will be built parallel to the I-25 horizontal control line at an offset of 82.67' right, from station 519+82.00 to station 520+57.00. Refer to Figure 4 for retaining wall typical sections and Figure 11 for retaining wall layout in Appendix B.

##### **I-25 Retaining Wall 4 (Structure No. Wall-I-17-CG)**

Retaining Wall 5 is located at the east side of I-25 Northbound. The wall is needed to support the I-25 embankment fill near the proposed I-25 over Cimarron Street bridge, stay in CDOT Right of way, and prevent the embankment from encroaching the I-25 Northbound off Ramp. The proposed retaining wall is approximately 348'-4" in length with a wall height varying from 10'-7" maximum to 3'-3". The proposed retaining wall will contain approximately 2,409 square feet of wall. The proposed retaining wall will be constructed parallel to the I-25 horizontal control line from station



534+50.00 to station 537+98.33 at a constant offset of 74.58' right. Refer to Figure 6 for retaining wall typical sections and Figure 12 for retaining wall layout in Appendix B.

**I-25 Retaining Wall 5 (Structure No. Wall-I-17-CI)**

Retaining Wall 6 is located at the west side of I-25 Southbound. The wall is required to support the I-25 embankment fill near the proposed I-25 over Cimarron Street bridge and prevent the embankment from encroaching on I-25 Southbound off Ramp. The proposed retaining wall is approximately 669'-4" in length with a wall height varying from 9'-10" maximum to 6'-4". The proposed retaining wall will contain approximately 5,410 square feet of wall in order to support the I-25 Southbound embankment from encroaching into the I-25 Southbound off Ramp. The proposed retaining wall will be constructed parallel to the I-25 horizontal control line from station 550+50.00 to station 557+19.33 at a constant offset of 74.58' left. Refer to Figure 6 for retaining wall typical sections and Figures 13 and 14 for retaining wall layout in Appendix B.

**I-25 Retaining Wall 6 (Structure No. WALL-I-17-BP)**

Retaining Wall 6 is located at the west side of I-25 Southbound. The wall is needed to support the proposed I-25 embankment fill north of Colorado Avenue from encroaching on to the buildings and building access that are not being acquired by CDOT for new Right of Way. The wall is approximately 199 feet in length with a height varying from 8' to 29'. The proposed wall will be constructed parallel to the I-25 Southbound edge of pavement from approximate Station 559+90 (the north abutment of proposed Structure No. I-17-OO) to approximate station 562+00. The wall offset from the I-25 horizontal control line varies from 82'-6" to 89'-0" due to the geometry of the southbound off ramp to Cimarron Street. Preliminary wall elevations indicate approximately 4,000 square feet of exposed area. Refer to Appendix B, Figure 7 for the typical section and Figure 15 for the layout.

**5.2.2 Ramp Retaining Walls**

**Ramp C-1 Retaining Wall (Structure No. Wall-I-17-CE)**

Ramp C-1 retaining wall at the west side of I-25 Southbound On Ramp is required to support the embankment fill of I-25 Southbound On Ramp from infringing on the Humane Society, Pet Cemetery, and Wal-Mart property lines. The proposed retaining wall is a approximately 670'-0" in length with wall height varying from 18'-4" maximum to 6'-10". The proposed retaining wall will contain approximately 8,431 square feet of wall. The retaining wall will be constructed parallel to I-25 Southbound On Ramp and I-25 southbound horizontal control lines from station 1527+05.00 to station 1533+75.00. Refer to Figure 5 for retaining wall typical sections and Figures 16 and 17 for retaining wall layout in Appendix B.

**Ramp C-2 Lower Retaining Wall (Structure No. Wall-I-17-CL)**

The lower tier of Ramp C-2 retaining walls at the west side of I-25 Southbound Off Ramp are required to support I-25 Southbound Off Ramp embankment fill from encroaching on the existing industrial buildings, and Walnut Avenue. The proposed lower wall is approximately 1,039'-0" in length with a height varying from 23'-9" maximum to 4'-4". The lower wall will contain approximately 14,588 square feet of wall in order to support the Southbound Off Ramp embankment from encroaching into the existing businesses, Walnut Avenue, and limit the purchase of additional Right-of-Way. The proposed lower wall retaining wall will be constructed parallel to the upper tiered retaining wall from station 2544+39 to station 2554+78 at a constant offset of 10.92' left (2'-0" from

the upper tiered wall). Refer to Figure 5 for retaining wall typical sections and Figures 18, 19, and 20 for retaining wall layout in Appendix B.

**Ramp C-2 Upper Retaining Wall (Structure No. Wall-I-17-CJ)**

The upper tier of Ramp C-2 retaining walls at the west side of I-25 Southbound Off Ramp are required to support I-25 Southbound Off Ramp embankment fill from encroaching into the existing industrial buildings and Walnut Avenue. The proposed upper wall is approximately 1,230'-0" in length with a height varying from 25'-9" maximum to 11'-10". The proposed upper wall will contain approximately 23,114 square feet of wall in order to support the Southbound off Ramp embankment from encroaching on the existing businesses, Walnut Avenue, and limit the purchase of additional Right-of-Way. The proposed upper wall will be built parallel to the horizontal control line of I-25 Southbound Off Ramp from station 2543+75 to wall station 2556+05 at a constant offset of 8.92' right. Refer to Figure 5 for retaining wall typical sections and Figures 21, 22, and 23 for retaining wall layout in Appendix B.

**Ramp B-3 Retaining Wall B-3L (Structure No. WALL I-17-CQ)**

Retaining wall B-3L is located at the left side (the west side) of I-25 Northbound On Ramp. The wall is required to support the embankment fill of the I-25 Northbound On Ramp where the ramp is grade-separated from mainline I-25. The wall is approximately 366 feet in length, extending to the east abutment of Structure No. I-17-OQ, with a height varying from 4 feet to 19 feet. The proposed wall will be constructed parallel to the I-25 Northbound On Ramp from Station 3576+60 to station 3580+25, offset 25 feet left of the ramp horizontal control line Preliminary wall elevations indicate approximately 4000 square feet of exposed area. Refer to Appendix B, Figure 7 for the typical section and Figure 31 for the layout.

**Ramp B-4 Retaining Wall B-4L (Structure No. WALL-I-17-CR)**

Retaining wall B-4L is located at the left side (the west side) of the I-25 Northbound Off Ramp. The wall is required to support the embankment fill of the I-25 Northbound Off Ramp where the ramp is grade-separated from mainline I-25. The wall is approximately 256 feet in length, extending to the east abutment of Structure No. I-17-OQ, with a height varying from 3 feet to 19 feet. The proposed wall will be constructed parallel to the I-25 Northbound Off Ramp from Station 4573+60 to station 4576+16, offset 25 feet left of the ramp horizontal control line. Preliminary wall elevations indicate approximately 2000 square feet of exposed area. Refer to Appendix B, Figure 7 for the typical section and Figure 29 for the layout.

**Cimarron Street Retaining Wall (Structure No. Wall-I-17-BZ)**

The Cimarron Street retaining wall is located at the south side of Cimarron Street Eastbound. The wall is required to support the embankment fill of the Cimarron Street Eastbound from encroaching on the right of way of the power plant. The proposed retaining wall is approximately 315'-0" in length with a wall height varying from 19'-9" maximum to 9'-6". The proposed retaining wall will contain approximately 4,607 square feet of wall. The proposed retaining wall will be constructed parallel to the Cimarron Street Eastbound horizontal control line from station 215+98.00 to station 519+13.00 at a constant offset of 28.50' right. Refer to Figure 5 for retaining wall typical sections and Figure 32 for retaining wall layout in Appendix B.

### 5.2.3 Creek Retaining Walls

#### Ramp C-3 Retaining Wall (Structure No. WALL-I-17-CM)

Ramp C-3 retaining wall is located at the right side (the east side) of I-25 Northbound On Ramp from Cimarron Street. The wall is required to support the embankment fill of I-25 and the I-25 Northbound On Ramp to keep it from encroaching on the bike path, the WPA Wall (a historic element) and the 100-year flood plain. The wall is approximately 746 feet in length with a height varying from 8 feet to 32 feet. In general, the proposed wall will be constructed parallel to the east edge of the roadway, with a roadway cantilever designed along reaches of the wall to minimize impacts to the WPA Wall. A portion of the proposed wall directly impacts the WPA wall, while a portion may temporarily impact the WPA Wall, due to contractor construction methods. Construction specifications will limit contractor encroachment onto the WPA Wall during the construction of the roadway and proposed retaining wall. Preliminary wall elevations indicate approximately 14,300 square feet of exposed area. Refer to Appendix B, Figure 7 for the typical section and Figures 24 & 25 for the layout.

#### Ramp B-4 Retaining Wall B-4R (Structure No. WALL-I-17-BQ)

Ramp B-4 retaining wall B-4R is located at the right side (the east side) of I-25 Northbound Off Ramp at Bijou. The wall is required to support the embankment fill of I-25 and the Bijou I-25 Northbound Off Ramp to keep it from encroaching on the WPA Wall (a historic element) and the 100-year flood plain. The wall is approximately 1450 feet in length with a height varying from 9 feet to 32 feet. In general, the proposed wall will be constructed parallel to the east edge of the roadway, with a roadway cantilever designed along reaches of the wall to minimize impacts to the WPA Wall. A portion of the proposed wall directly impacts the WPA wall, while a portion may temporarily impact the WPA Wall, due to contractor construction methods. Construction specifications will limit contractor encroachment onto the WPA Wall during the construction of the roadway and proposed retaining wall. Preliminary wall elevations indicate approximately 23,000 square feet of exposed area. Refer to Appendix B, Figure 7 for the typical section and Figures 26-28 for the layout.

#### Ramp B-3 Retaining Wall B-3R (Structure No. WALL-I-17-CP)

Ramp B-3 retaining wall B-3R is located at the right side (the east side) of I-25 Northbound On Ramp. The wall is required to support the embankment fill of the Bijou Northbound On Ramp where the ramp profile is significantly above an existing retaining wall approximately 15 feet east of the proposed wall location. The existing wall is the barrier that defines the west bank of Monument Creek for approximately 500 feet north of Bijou Street. The proposed wall is approximately 246 feet in length with a height varying from 6 feet to 17 feet. The proposed wall will be constructed parallel to the Bijou I-25 Northbound On Ramp from Station 3577+04 to station 3579+50, offset 20 feet right of the ramp horizontal control line. Preliminary wall elevations indicate approximately 1600 square feet of exposed area. Refer to Appendix B, Figure 7 for the typical section and Figure 30 for the layout.

## 6.0 GEOTECHNICAL CONSIDERATIONS

Kumar and Associates submitted a draft geotechnical report of the Subsurface Exploration and geotechnical recommendations. Design recommendations are as follows:

#### Mechanical Stabilized Earth (MSE) Wall

- Design Equivalent Fluid pressure = 38 pcf for granular backfill
- Angle of Internal Friction " $\phi$ " = 33 °
- Soil Unit Weight (Wet) " $\gamma$  wet" = 130 pcf
- Coefficient of Active Pressure " $K_a$ " = .29
- Design Allowable Bearing = 2000 - 4000 psf
- Design for traffic surcharge

#### Cast-in-Place (CIP) Wall

- Design Equivalent Fluid Pressure = 38 pcf for granular backfill
- Angle of Internal Friction " $\phi$ " = 33 °
- Soil Unit Weight (Wet) " $\gamma$  wet" = 130 pcf
- Coefficient of Active Pressure " $K_a$ " = .29
- Design Allowable Bearing = 2000 - 4000 psf
- Design for traffic surcharge



## 7.0 RETAINING WALL EVALUATIONS

### Alternatives

CDOT Bridge Design Manual Subsection 5.5, Worksheets for Earth Retaining Wall, lists 24 retaining walls to compare. Most of these alternatives can be eliminated directly as they are clearly inappropriate for this application. The eliminated alternatives are unjustifiably expensive, require more width than can be accommodated everywhere, are not suitable for tall walls on this site, or not required for the foundation conditions.

The alternatives that are applicable for this project include cast-in-place concrete retaining walls supported on spread footings, deep foundation (CIP) and metal reinforced mechanically stabilized earth walls (MSE). A plan drawing showing the wall alternatives is included in Appendix B, Figures 4 through 7.

### Attributes

#### Appearance

Aesthetics of the retaining walls on this project is important because the retaining walls will be visible to commuters, pedestrians, and shoppers. The standard corridor form liner and color will be used in this project to be consistent and uniform with previous corridor projects constructed thus far. Both CIP and MSE wall alternatives were rated five (5) to reflect this equality of expectation.

#### Schedule

The potential disruption to the traveling public during construction of this project and building the retaining wall in the least amount of time will be critical. CIP retaining walls require more time to construct than the MSE walls due to the fact that forms have to be placed, reinforcing steel placed and tied, concrete poured and reaching design strength before backfilling and compacting can take place. The mechanical stabilized earth wall will require less time and labor to build, the precast panels are set as the backfill is placed and reinforced.

#### Design Life

It is our understanding that the MSE wall proprietors believe that the components of their retaining walls will provide as long of a life and satisfactory service as the CIP walls. In general, each of the wall types has been rated five (5) to reflect this quality expectation. However, some MSE walls have been rated as three (3) due to their proximity to the flood plane.

#### Standard Design

Cast-in-Place walls consist of reinforcing steel, concrete, and backfill. The same construction materials are used for buildings, box culverts, and substructures. Every experienced contractor has performed this type of construction and is familiar with its requirements so all Cast-in-Place walls have been rated a five (5).

MSE walls require a qualified supplier and contractor to build a satisfactory product. There are also special construction considerations due to the proximity to the flood plane and therefore MSE walls have been rated a three (3).

### Proven Experience

We know from history that reinforced concrete, with adequate mix design and structural design, is capable of long satisfactory service. Current design may include air entrainment for freeze-thaw resistance, use of fly ash or silica fume in mixes for reducing permeability, and epoxy-coated reinforcing steel for resistance to corrosion.

MSE walls do not have as long of a historical record as CIP walls. They are a relatively new technology. The rating for this attribute reflects the reduced experience record for the MSE walls.

### Maintenance

Maintenance includes consideration for the ease with which the wall can be repaired if subjected to impact or vandalism and dealing of natural aging of the wall such as settlement.

Impact and vandalism repairs of both systems will be similar. Visual affects of the wall settlement will be less with the MSE wall. The MSE walls, which have frequent joints in their facing, can generally articulate to permit relative movement without distress. Since the movement is divided among many joints, each joint movement is minimized so that the displacement of the wall is less visible. CIP wall joints are placed less frequently than in MSE walls. Because of this, movement in CIP wall joints to accommodate differential settlement will be more visible than in a MSE wall.

### Constructability

A successful structure must not only serve its structural purpose, it must instill confidence in the observer that it is able to do so. A structure that appears unsound is not satisfactory.

In recent years successful construction of MSE walls which perform well and appear sound has been a common occurrence in this area. Many experienced contractors are available in Colorado that have built MSE walls. The quality of this type of construction is assured by well-defined and established construction specifications. Many standard details have been developed over the years to aid in the design and construction of this type of wall.

### Probable Construction Cost

Included in the Appendix C are tables showing the development of the comparative costs of the CIP concrete and MSE walls. Unit prices are similar for the two alternatives; however the MSE walls are less expensive per square foot than the CIP walls. The MSE wall is rated five (5) and the CIP rated three (3) for this attribute.



### 8.0 RETAINING WALL RECOMMENDATIONS

A Wall Decision Matrix was constructed comparing the Cast-in-Place (CIP) and Mechanical Stabilized Earth (MSE) wall alternatives. The matrix lists each attribute along with a corresponding score for each wall type. The CIP wall on H-Piles alternative has a higher score and is recommended for the following retaining walls: Wall 2, Wall 3, Wall Ramp C-3 and Wall Ramp B-4R.

The MSE wall alternative has a higher score and is recommended for the following retaining walls: Wall 1, Wall 4, Wall 5, Wall 6, Wall Ramp C-1, Wall Ramp C-2 upper and lower walls, Wall Ramp B-3L, Wall Ramp B-4L, and Cimarron Street Wall.

The CIP on spread footing alternative has a higher score and is recommended for retaining wall Ramp B-3R.

#### Wall Decision Matrix Wall 2 & Wall 3

Attribute	Weight	Cast-in-Place		Mechanical stabilized earth	
	(%)	Rating	Score	Rating	Score
Appearance	5	5	25	5	25
schedule	7	3	21	5	35
Design Life	15	5	75	3	45
Standard Design	12	5	60	3	36
Proven Experience	12	5	60	4	48
Maintenance	12	4	48	4	48
Constructibility	12	5	60	4	48
Probable Construction Cost	25	3	75	5	125
Total Score	100		424		410

#### Wall Decision Matrix- Wall1, Wall 4, Wall 5, Wall Ramp C-1, Wall Ramp C-2 & Cimarron Street Wall

Attribute	Weight	Cast-in-Place		Mechanical Stabilized Earth	
	(%)	Rating	Score	Rating	Score
Appearance	5	5	25	5	25
schedule	7	3	21	5	35
Design Life	15	5	75	5	75
Standard Design	12	5	60	4	48
Proven Experience	12	5	60	4	48
Maintenance	12	4	48	4	48
Constructibility	12	5	60	4	48
Probable Construction Cost	25	3	75	5	125
Total Score	100		424		452

#### Wall Decision Matrix – Wall Ramp C-3 and B-4R

Attribute	Weight	Cast-in-Place on Caissons		Cast-in-Place on H-Piles		Cast-in-Place on Spread		MSE	
	(%)	Rating	Score	Rating	Score	Rating	Score	Rating	Score
Appearance	5	5	25	5	25	5	25	5	25
schedule	7	3	21	3	21	3	21	5	35
Design Life	15	5	75	5	75	3	45	3	45
Standard Design	12	3	36	5	60	5	60	3	36
Proven Experience	12	4	48	5	60	5	60	4	48
Maintenance	12	4	48	4	48	4	48	4	48
Constructibility	12	5	60	4	48	3	36	3	36
Probable Construction Cost	25	2	50	4	100	4	100	5	125
Total Score	100		363		437		395		398



**Wall Deck Matrix Wall Ramp B-3L & B-4L, and I-25 Wall 6**

Attribute	Weight (%)	Cast-in-Place on Caissons		Cast-in-Place on H-Piles		Cast-in-Place on Spread		MSE	
		Rating	Score	Rating	Score	Rating	Score	Rating	Score
Appearance	5	5	25	5	25	5	25	5	25
schedule	7	3	21	3	21	3	21	5	35
Design Life	15	5	75	5	75	5	75	5	75
Standard Design	12	3	36	5	60	5	60	4	48
Proven Experience	12	4	48	5	60	5	60	4	48
Maintenance	12	4	48	4	48	4	48	4	48
Constructibility	12	5	60	5	60	4	48	5	60
Probable Construction Cost	25	2	50	4	100	3	75	5	125
<b>Total Score</b>	<b>100</b>		<b>363</b>		<b>449</b>		<b>412</b>		<b>464</b>

**Wall Decision Matrix –Wall Ramp B-3R**

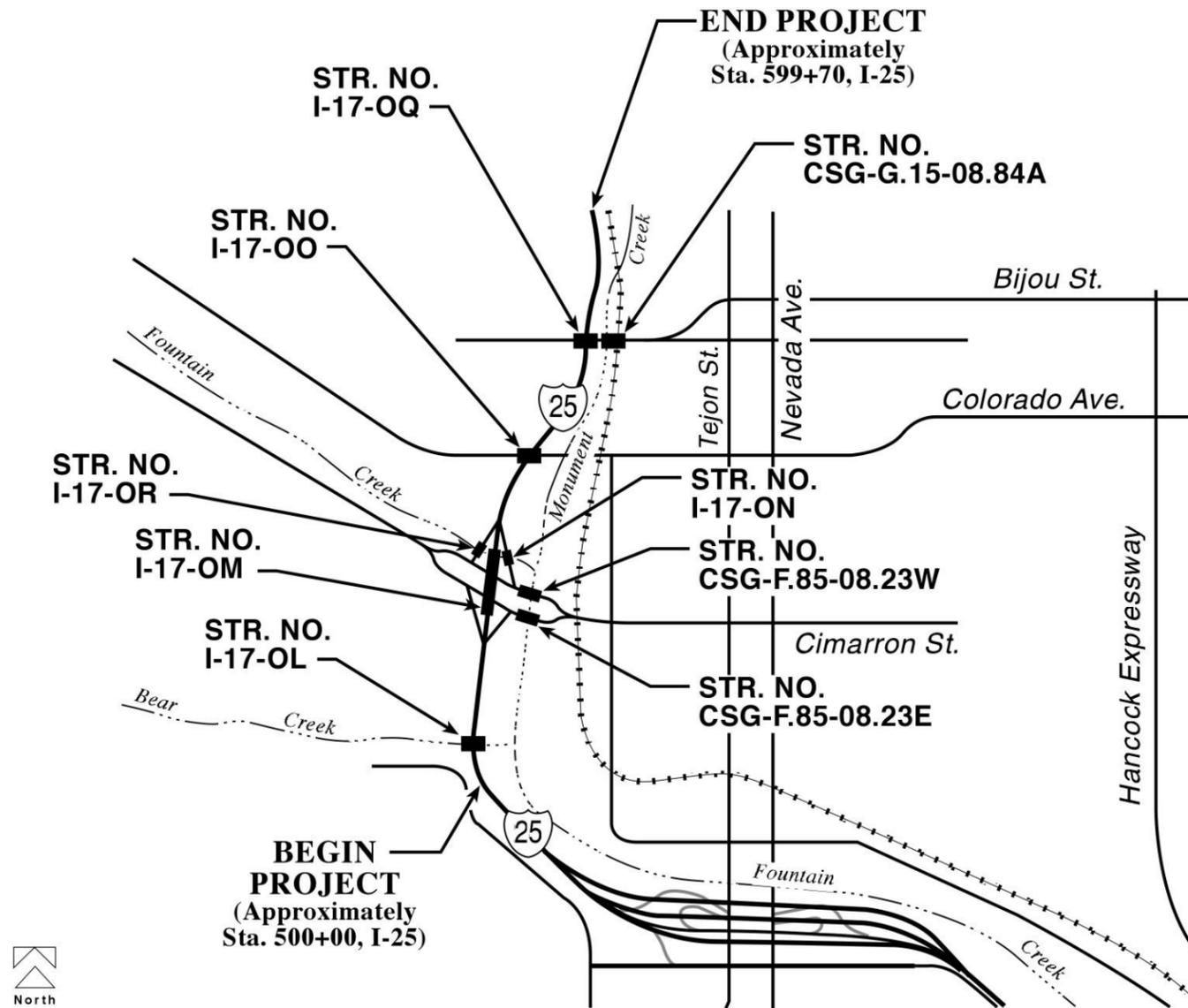
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		Rating	score	Rating	score	Rating	score
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schedule	7	3	21	3	21	5	35
Design Life	15	5	75	5	75	5	75
Standard Design	12	5	60	5	60	4	48
Proven Experience	12	5	60	5	60	4	48
Maintenance	12	4	48	4	48	4	48
Constructibility	12	5	60	4	48	4	48
Probable Construction Cost	25	4	100	5	125	5	125
<b>Total Score</b>	<b>100</b>		<b>449</b>		<b>462</b>		<b>452</b>



**Appendix A**

**Project Location Map**  
**I-25 Mainline Bridges**  
**Creek Bridges**  
**Bijou Street Bridges**

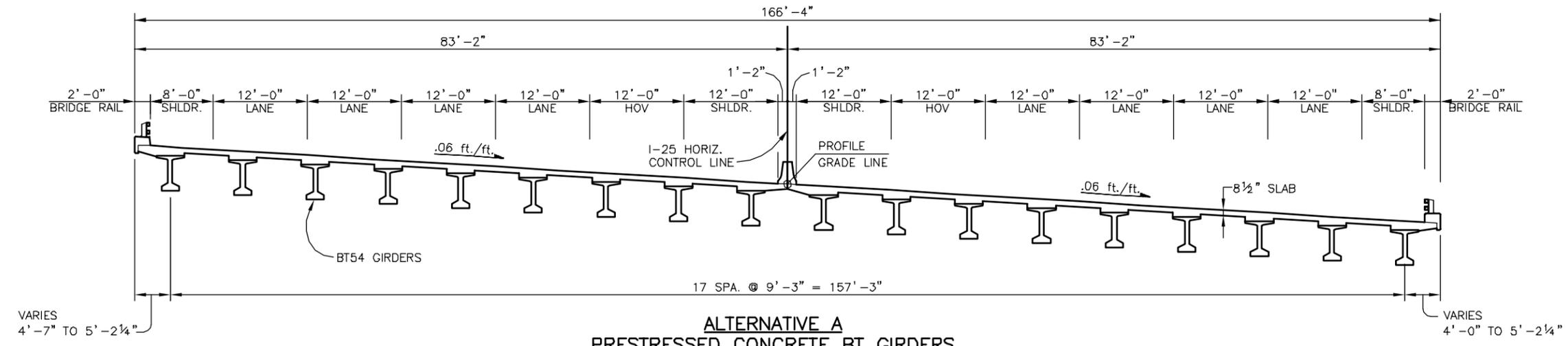
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**Figures 15 - 22**  
**Figures 23 - 35**



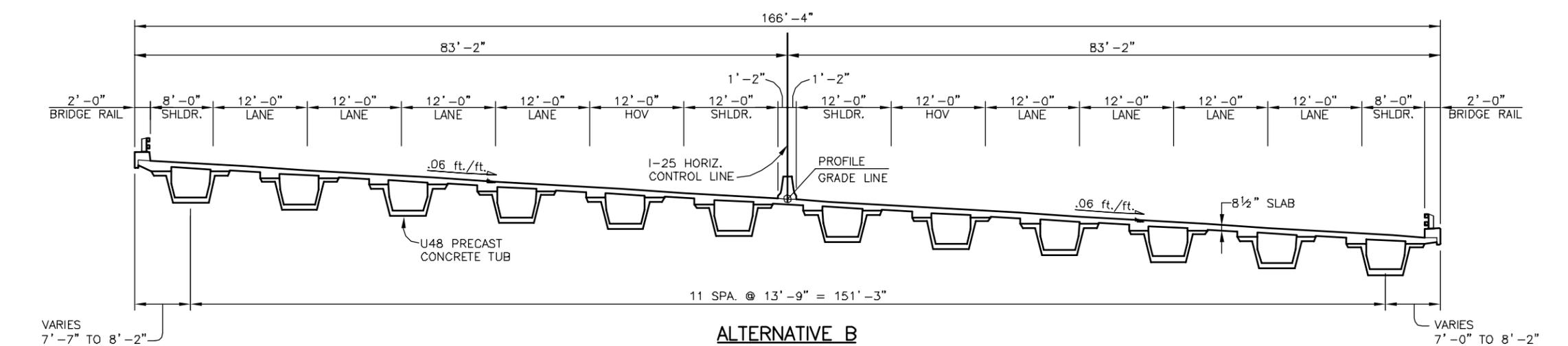
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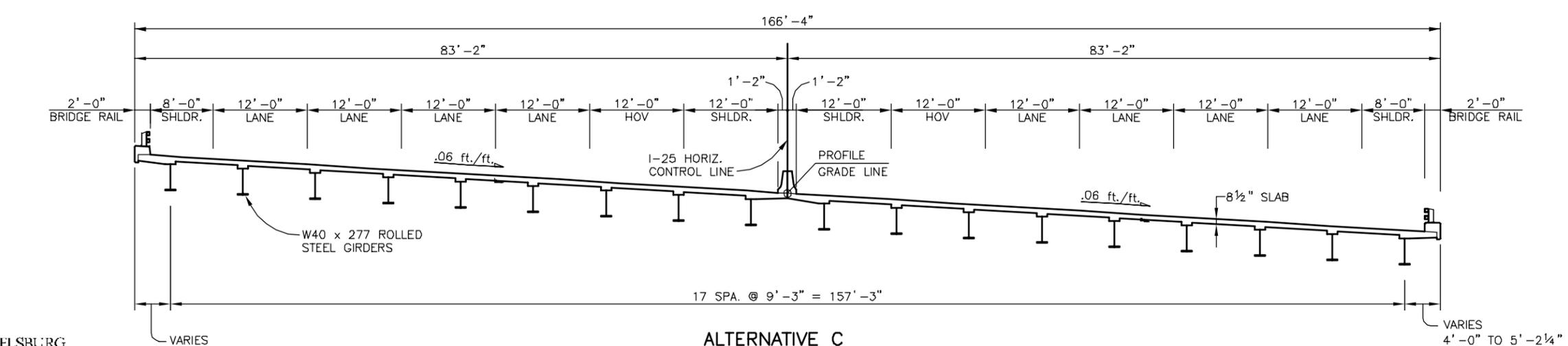
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**ALTERNATIVE A  
PRESTRESSED CONCRETE BT GIRDERS**



**ALTERNATIVE B  
PRESTRESSED CONCRETE U-GIRDER**



**ALTERNATIVE C  
ROLLED STEEL GIRDERS**

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Quantities by	Checked by	Quantities by	Checked by
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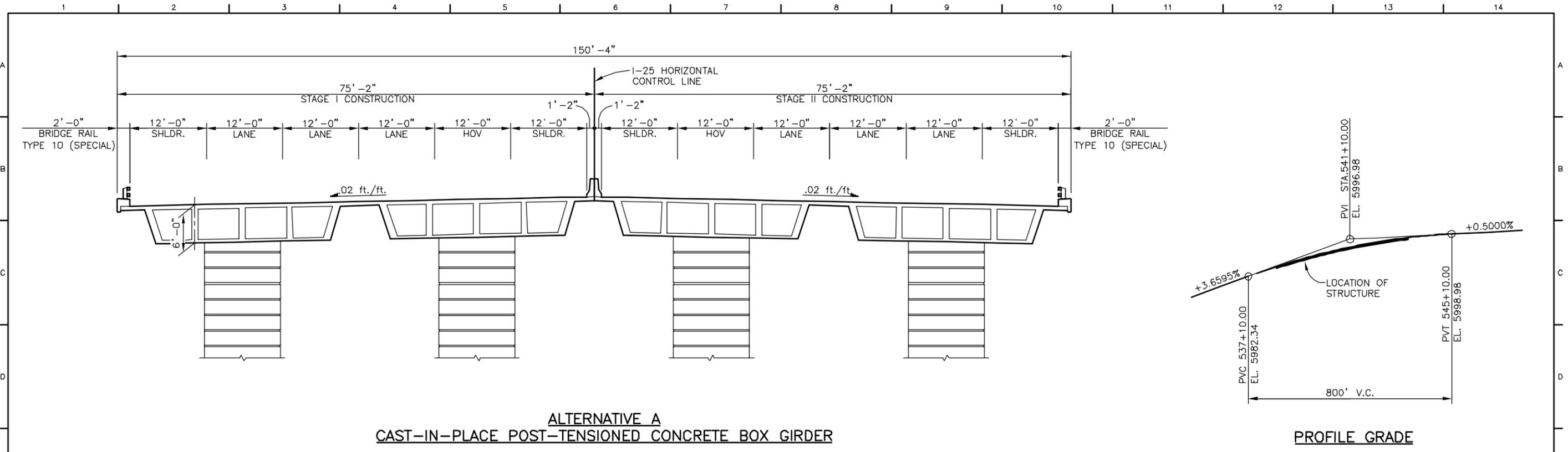
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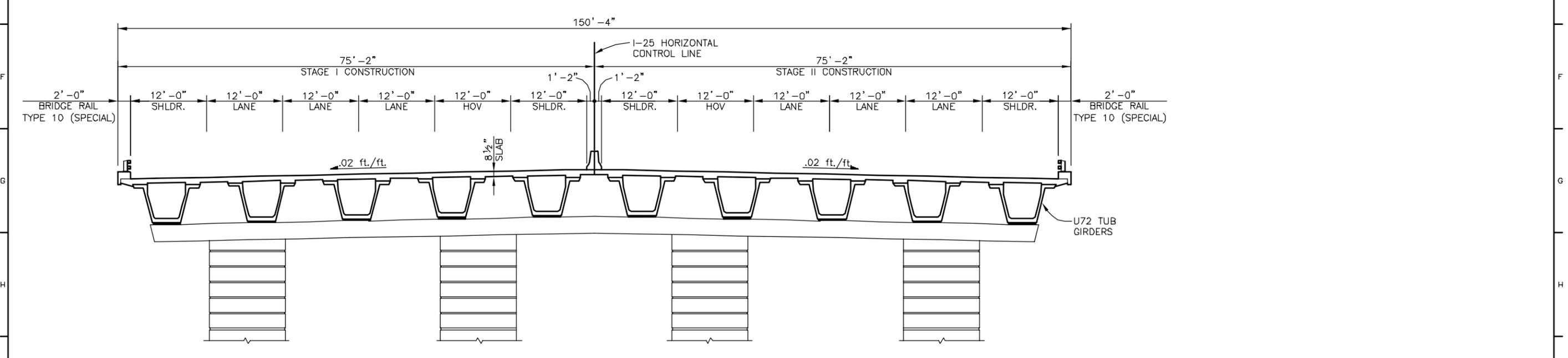
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**ALTERNATIVE A**  
**CAST-IN-PLACE POST-TENSIONED CONCRETE BOX GIRDER**



**ALTERNATIVE B**  
**PRECAST TUB GIRDERS**  
(10 GIRDERS @ 15'-0" O.C.)

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 Colorado Springs, Colorado 80906  
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Region 2 James Flohr

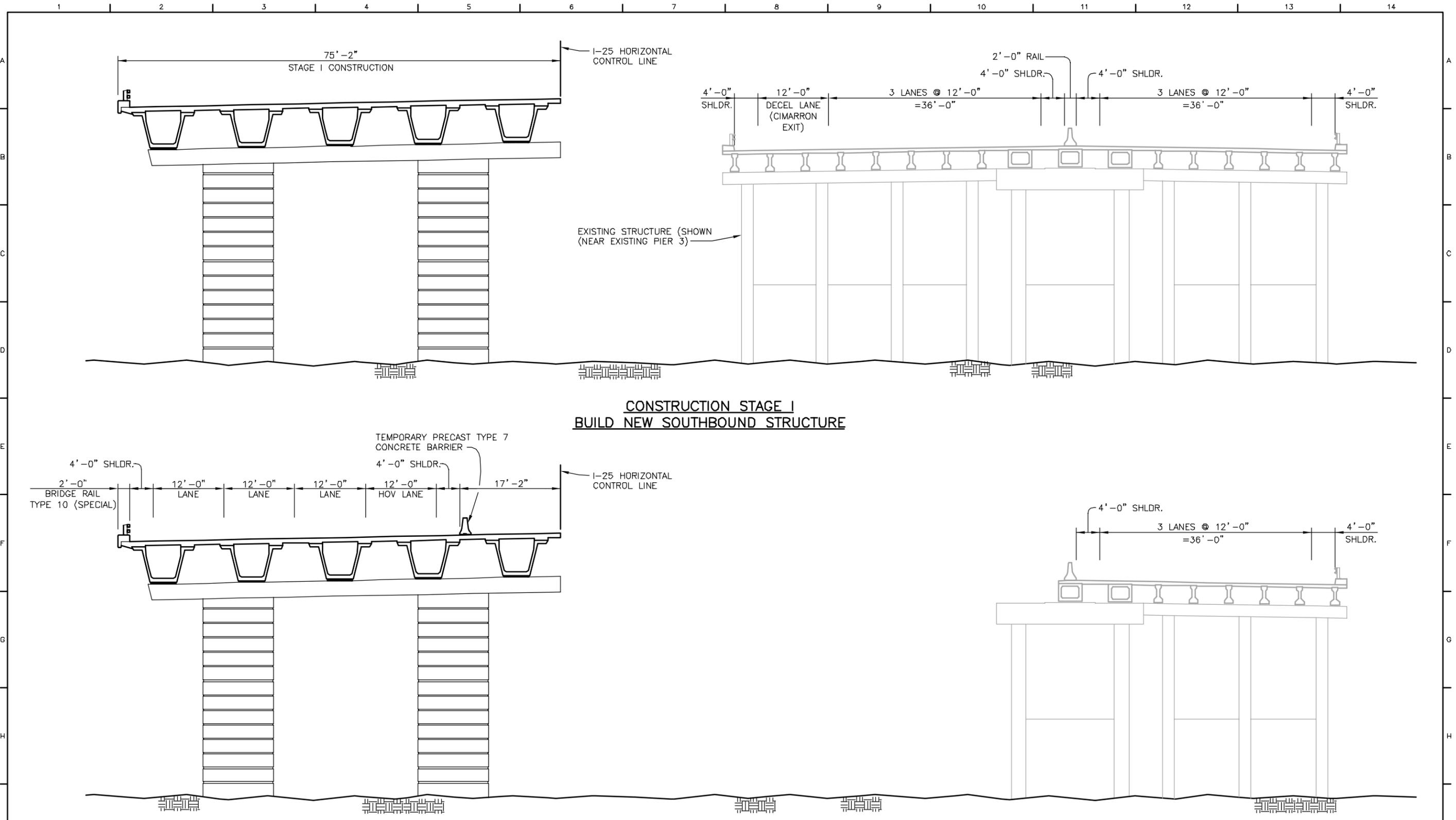
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Detailer: P. HELM	Numbers
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Sheet Number	

**FIGURE NO. 5**

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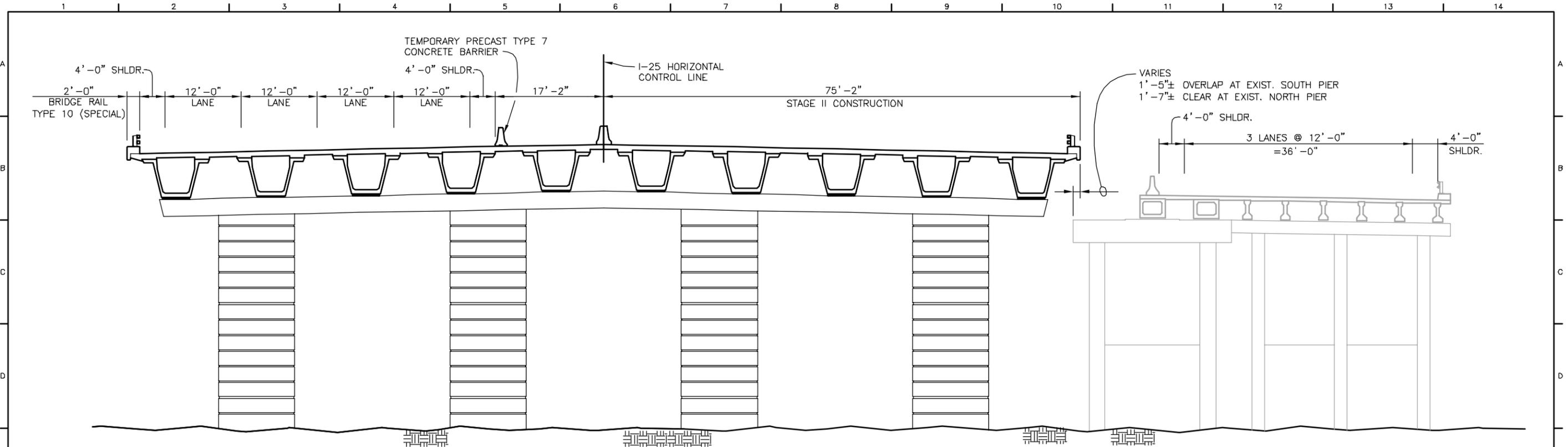
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**CONSTRUCTION STAGE II  
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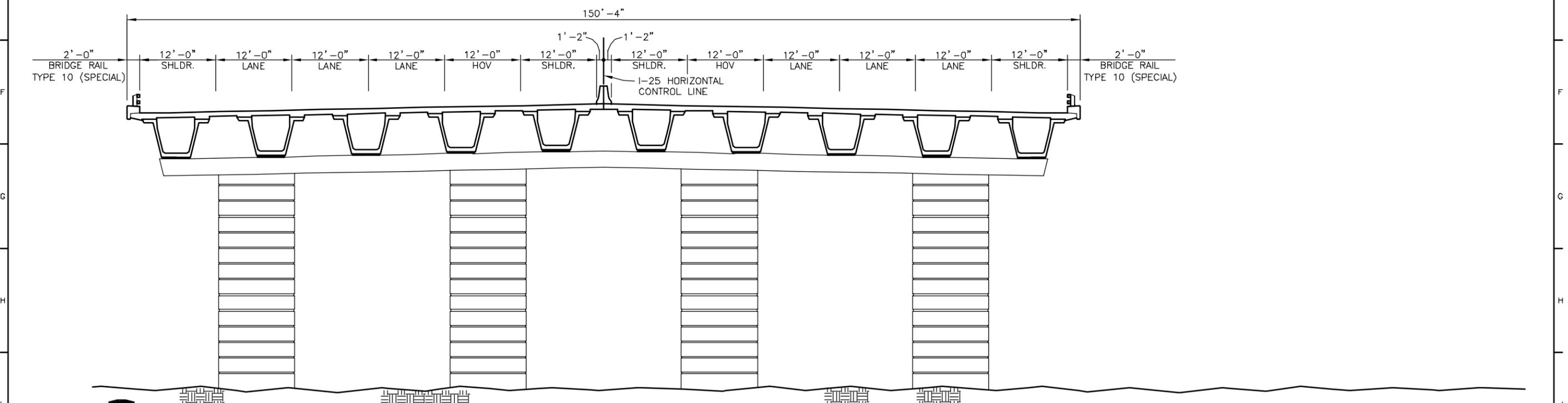


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**CONSTRUCTION STAGE III  
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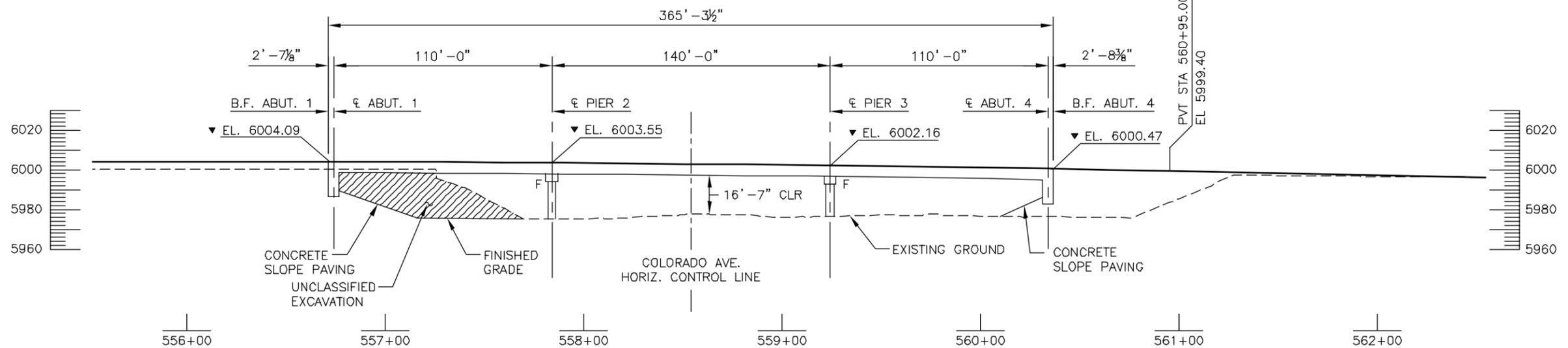
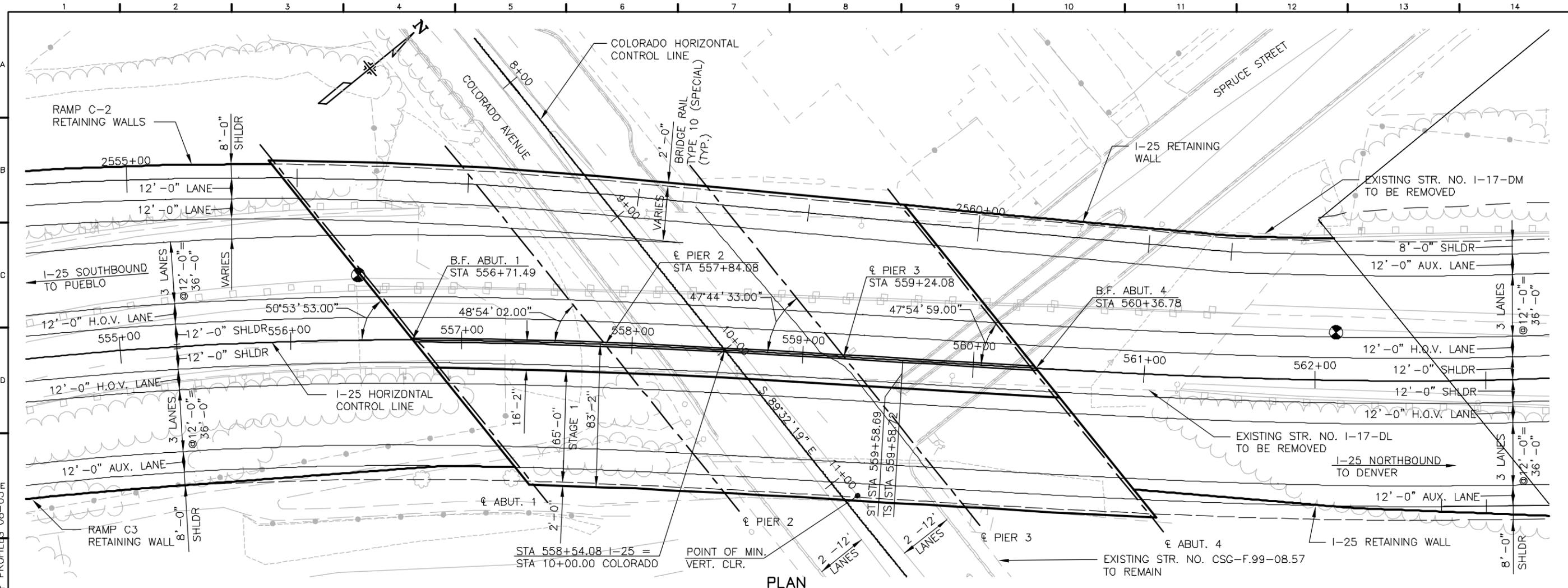
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(Preliminary Stage Only)				
Revision Dates				
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**WILSON & COMPANY**  
**FELSBURG HOLT & ULLEVIG**

**FIGURE NO. 7**

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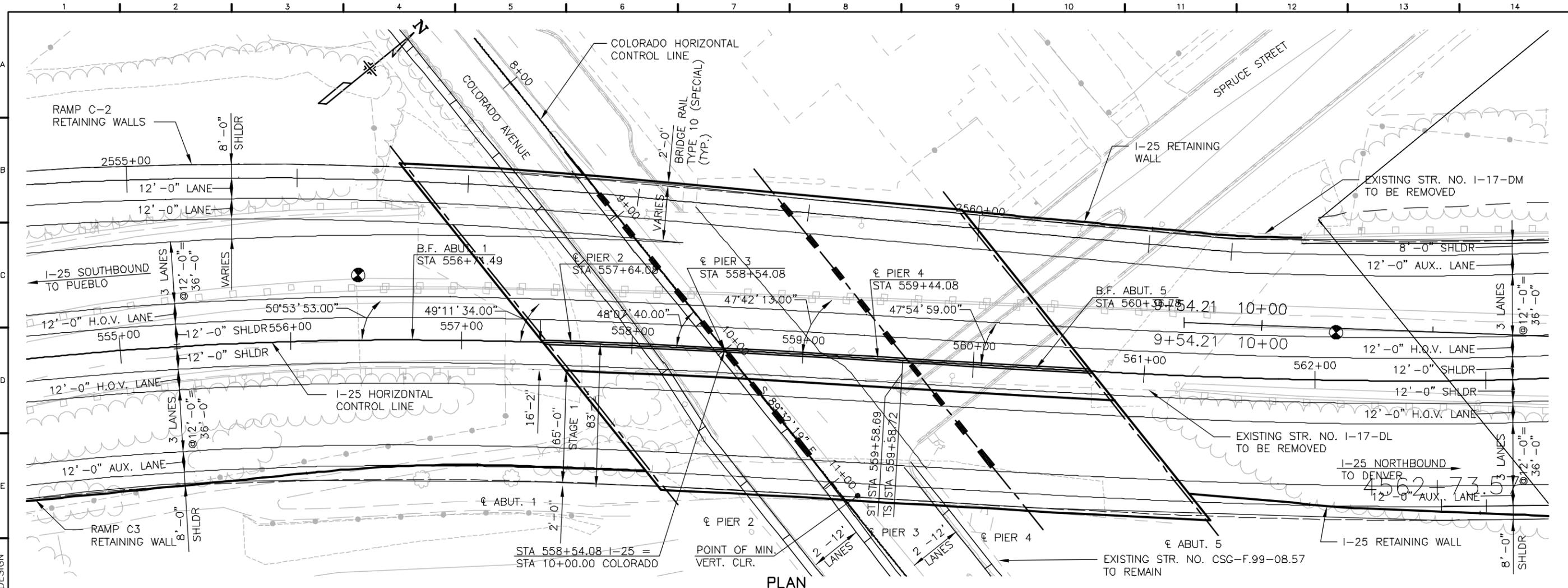
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**FIGURE NO. 8**

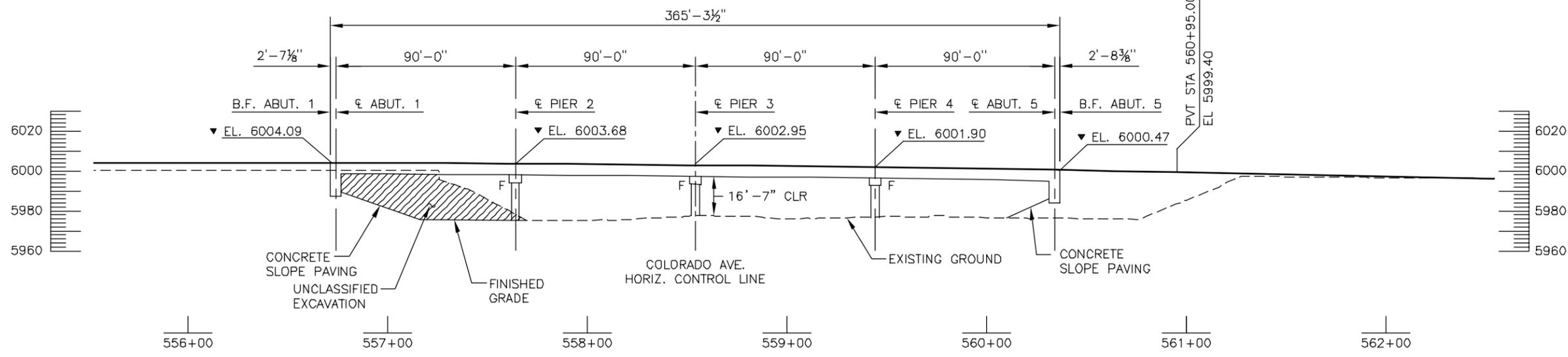
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Region 2 James Flohr



PLAN



LONGITUDINAL SECTION  
(TAKEN AT I-25 HORIZONTAL CONTROL LINE)

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Revision Dates (Preliminary Stage Only)	



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Index of Revisions			

Colorado Department of Transportation  
 1480 Quail Lake Loop  
 Colorado Springs, Colorado 80906  
 Phone: 719-634-2323 FAX: 719-227-3298

**Corridor Improvements**  
**I-25**  
 Pikes Peak Region

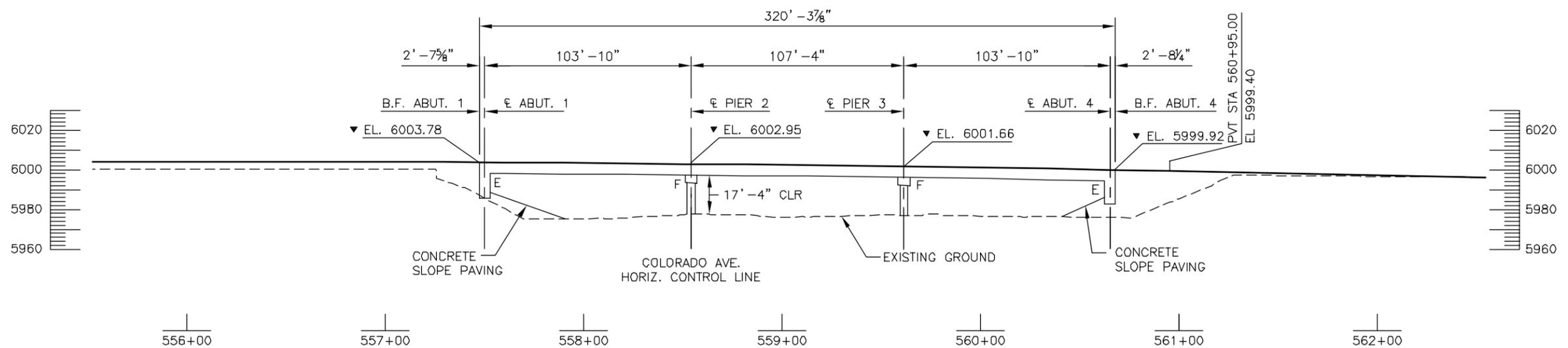
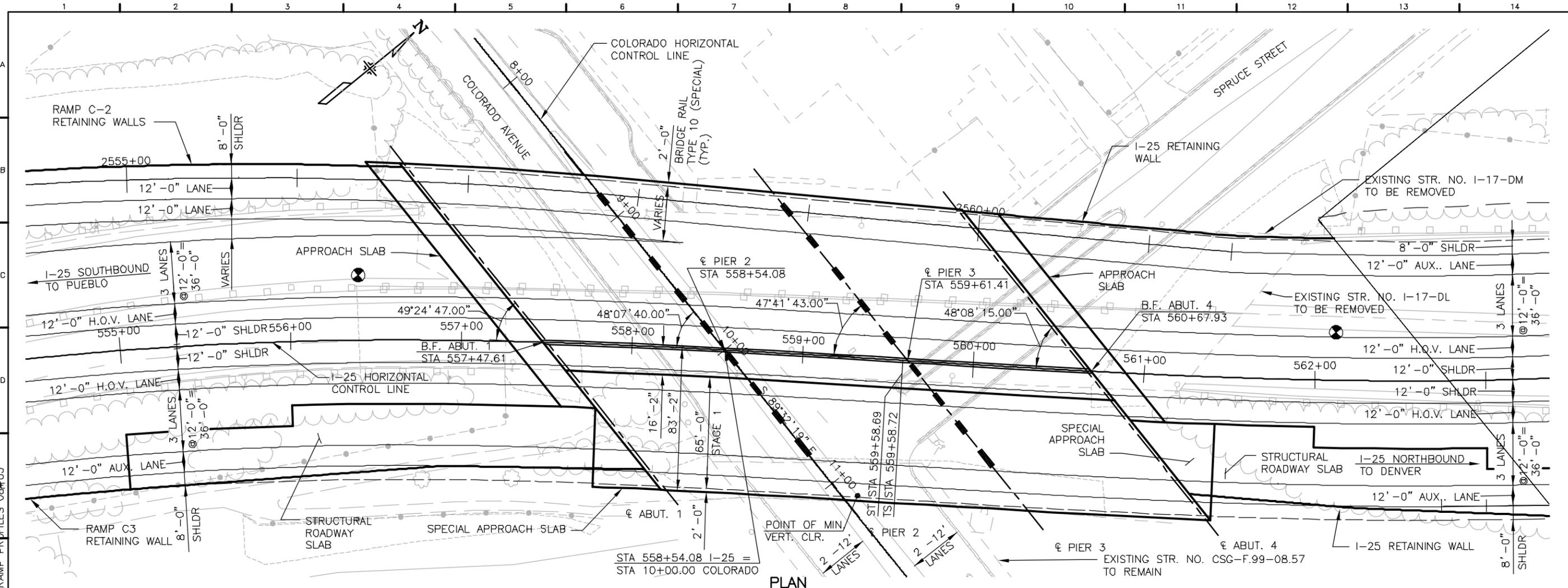
Region 2 James Flohr

As Constructed
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Detailer:	DBW	Sheet Subset:	Bridge
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Project No./Code	
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Sheet Number	

FIGURE NO. 9



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▼ FINISHED GRADE ELEVATION AT I-25 HORIZONTAL CONTROL LINE

**LONGITUDINAL SECTION**  
(TAKEN AT I-25 HORIZONTAL CONTROL LINE)

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Index of Revisions	

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 1480 Quail Lake Loop  
 Colorado Springs, Colorado 80906  
 Phone: 719-634-2323 FAX: 719-227-3298  
**Region 2** James Flohr

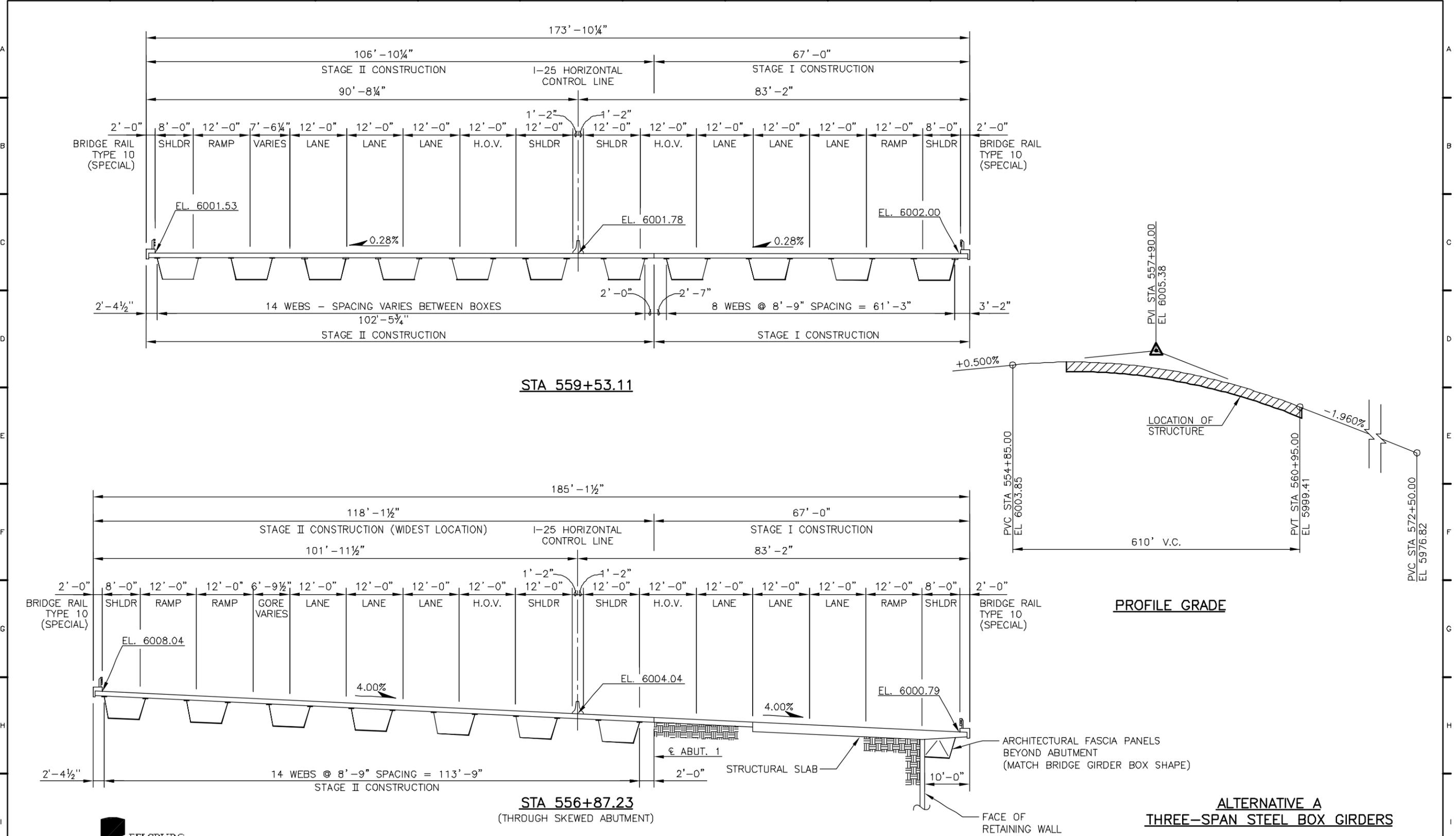
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Subst. Sheets:		of	

Project No./Code
IM 0252-334
13126
Sheet Number



1 2 3 4 5 6 7 8 9 10 11 12 13 14



PROFILE GRADE

ALTERNATIVE A  
THREE-SPAN STEEL BOX GIRDERS

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DETAIL		DESIGN	
Initial	Date	Initial	Date

**WILSON & COMPANY** FELSBERG HOLT & ULLEVIG

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Index of Revisions			

Colorado Department of Transportation  
1480 Quail Lake Loop  
Colorado Springs, Colorado 80906  
Phone: 719-634-2323 FAX: 719-227-3298

**I-25**  
CORRIDOR IMPROVEMENTS  
PIRES PEAK REGION

Region 2 James Flohr

As Constructed	
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Revised:	
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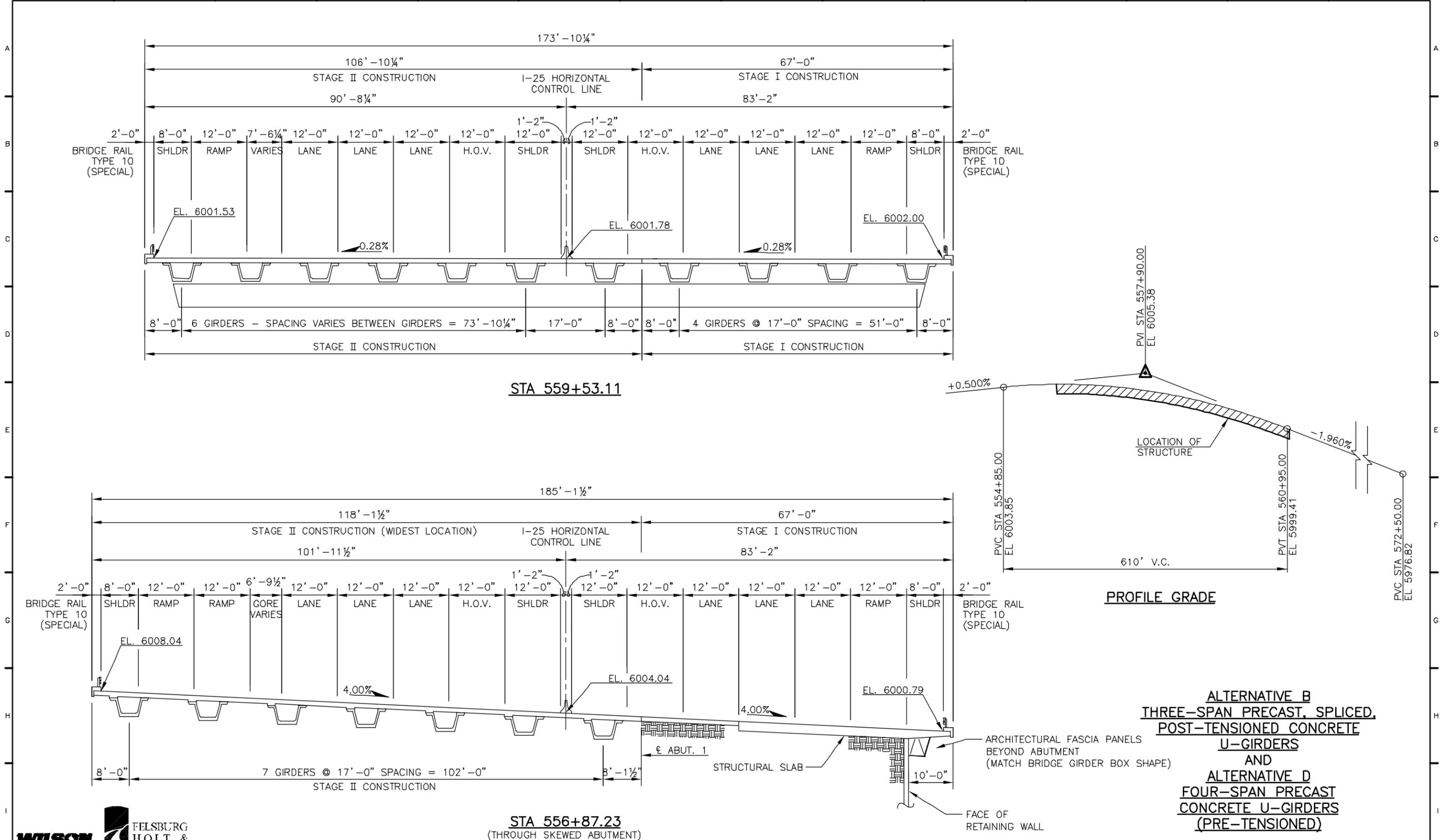
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13126	
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1 2 3 4 5 6 7 8 9 10 11 12 13 14



**ALTERNATIVE B**  
**THREE-SPAN PRECAST, SPICED,**  
**POST-TENSIONED CONCRETE**  
**U-GIRDERS**  
**AND**  
**ALTERNATIVE D**  
**FOUR-SPAN PRECAST**  
**CONCRETE U-GIRDERS**  
**(PRE-TENSIONED)**

QUANTITIES		REVISION DATES	
Initial	Date	Initial	Date

DESIGN		DETAIL	
Initial	Date	Initial	Date



**STA 556+87.23**  
 (THROUGH SKEWED ABUTMENT)

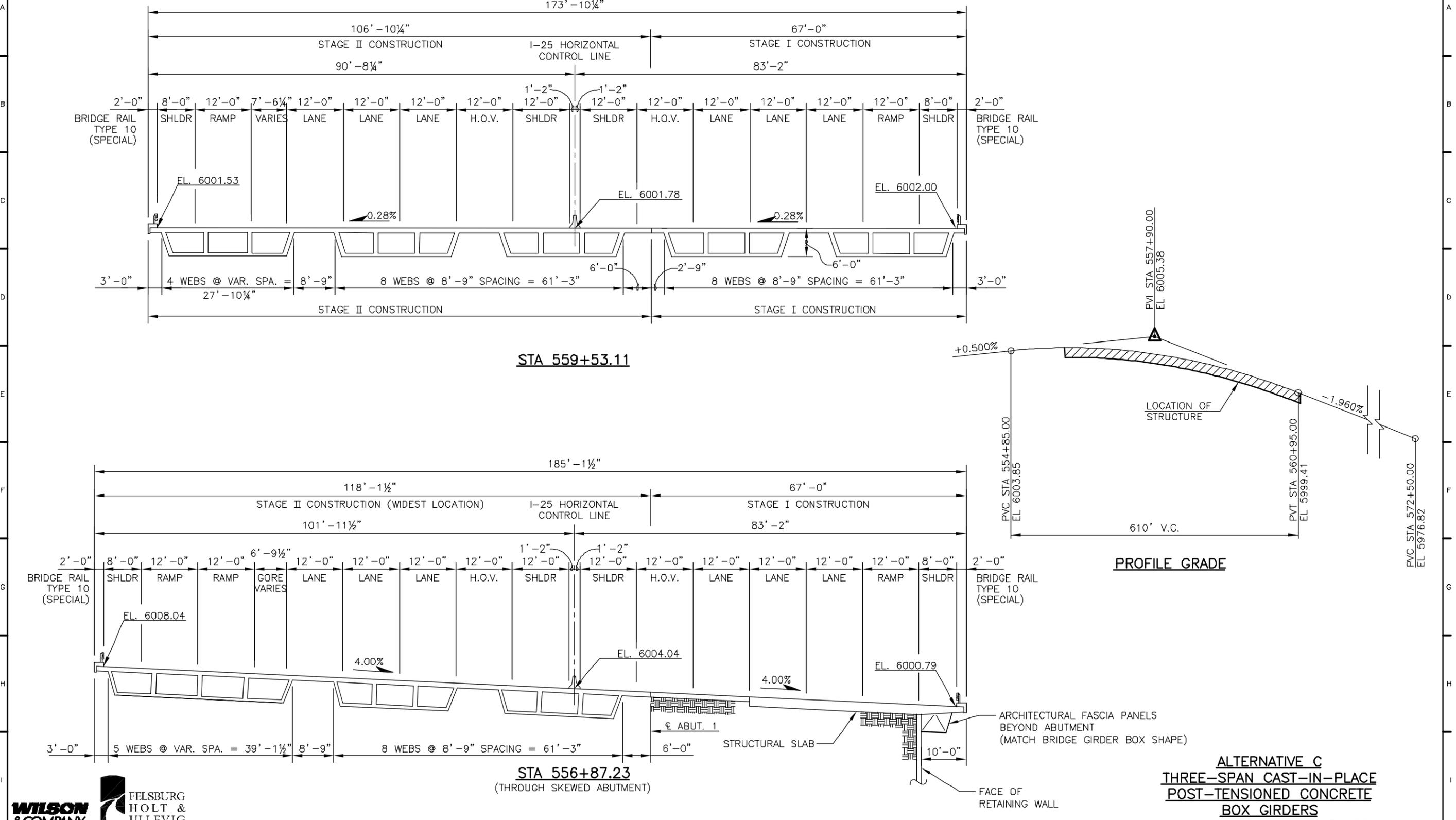
**FIGURE NO. 13**

<b>Computer File Information</b>		<b>Index of Revisions</b>		<b>Colorado Department of Transportation</b>		<b>As Constructed</b>		<b>I-25 CIMARRON/BIJOU INTERCHANGE</b>		<b>Project No./Code</b>		
Creation Date:	03/03/03	Initials:	DAL		1480 Quail Lake Loop		No Revisions:		I-25 OVER COLORADO AVENUE		IM 0252-334	
Last Modification Date:	05/19/03	Initials:	FSW		Colorado Springs, Colorado 80906		Revised:		ALTERNATIVE TYPICAL SECTIONS		13126	
Full Path:	Q:\X031000320\ACAD\Sheet\Struct\I-25 over Colorado\				Phone: 719-634-2323 FAX: 719-227-3298		Void:		Designer: GRT		Structure Number	I-17-00
Drawing File Name:	Colorado-01.DWG				Region 2		James Flohr		Detailer: DAK		Sheet Number	of
Acad Ver.	R2002	Scale:	1"=20'	Units:	English			Sheet Subset: Bridge		Subset Sheets:	of	

XREF = J

1 2 3 4 5 6 7 8 9 10 11 12 13 14

1 2 3 4 5 6 7 8 9 10 11 12 13 14



QUANTITIES		Revision Dates	
Initial	Date	Initial	Date

DESIGN		DETAIL	
Initial	Date	Initial	Date

Computer File Information			
Creation Date:	03/03/03	Initials:	DAL
Last Modification Date:	05/19/03	Initials:	FSW
Full Path:	Q:\X031000320\ACAD\Sheet\Struct\I-25 over Colorado\		
Drawing File Name:	Colorado-01.DWG		
Acad Ver.	R2002	Scale:	1"=20'
Units:	English		

Index of Revisions			



Colorado Department of Transportation  
 1480 Quail Lake Loop  
 Colorado Springs, Colorado 80906  
 Phone: 719-634-2323 FAX: 719-227-3298  
 Region 2 James Flohr

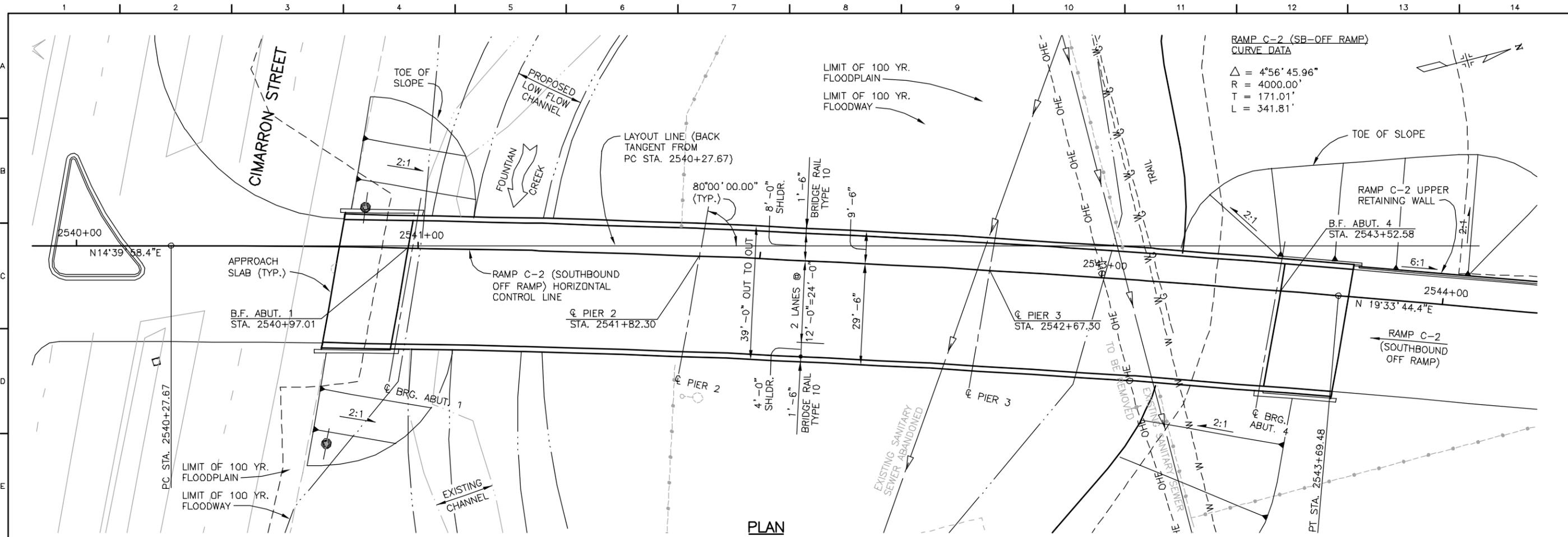
As Constructed	No Revisions:	Revised:	Void:
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I-25 CIMARRON/BIJOU INTERCHANGE I-25 OVER COLORADO AVENUE ALTERNATIVE TYPICAL SECTIONS	
Designer: GRT	Structure Number: I-17-00
Detailer: DAK	
Sheet Subset: Bridge	Subset Sheets: of

Project No./Code	IM 0252-334
Sheet Number	13126

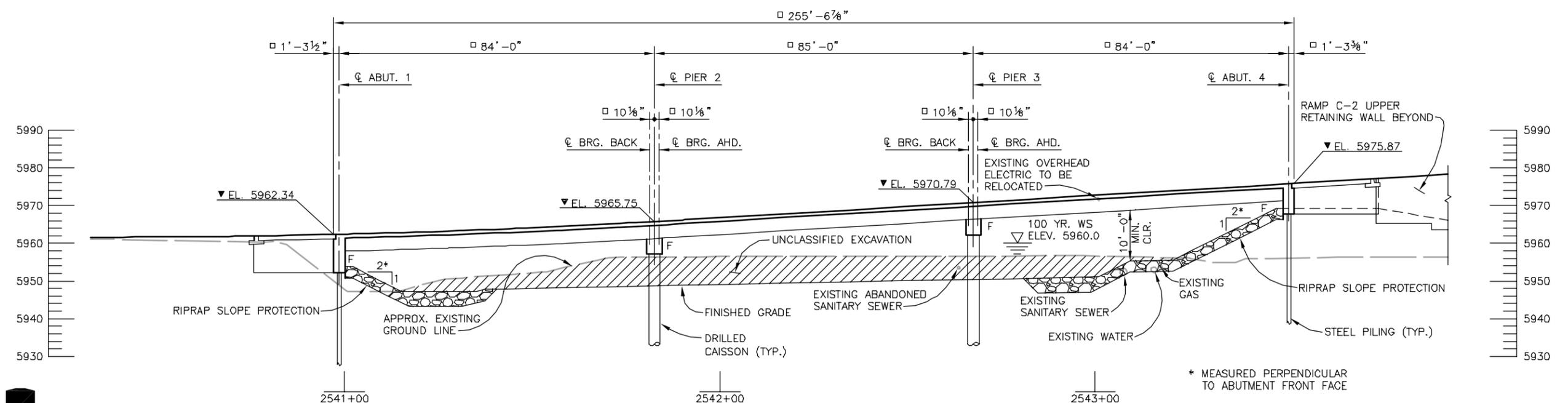
XREF = J

1 2 3 4 5 6 7 8 9 10 11 12 13 14



**RAMP C-2 (SB-OFF RAMP) CURVE DATA**

$\Delta = 4^{\circ}56'45.96''$   
 $R = 4000.00'$   
 $T = 171.01'$   
 $L = 341.81'$



QUANTITIES (Preliminary Stage Only)

Revision	Date	Initial	Quantity	Checked by

DESIGN

Initial	Date	Checked by

DETAIL

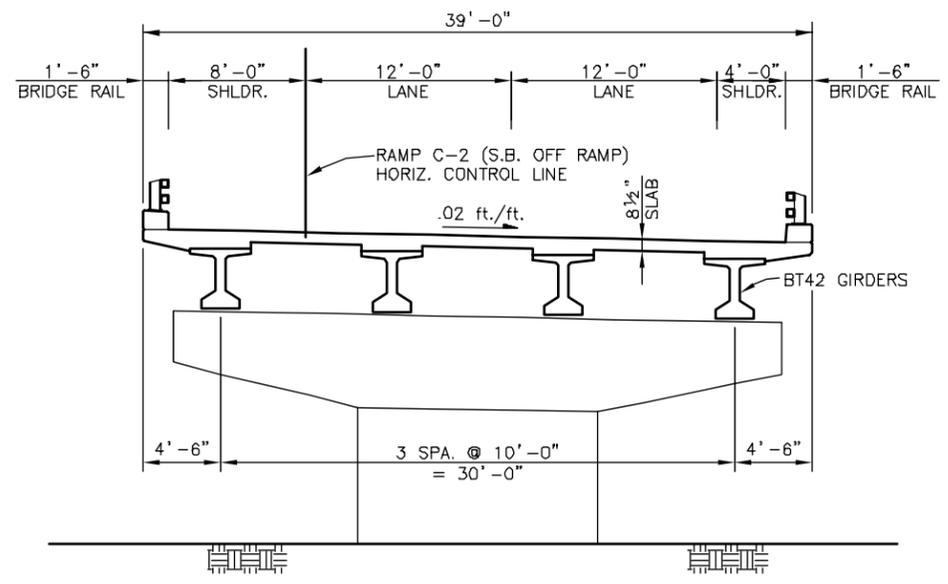
Initial	Date	Checked by



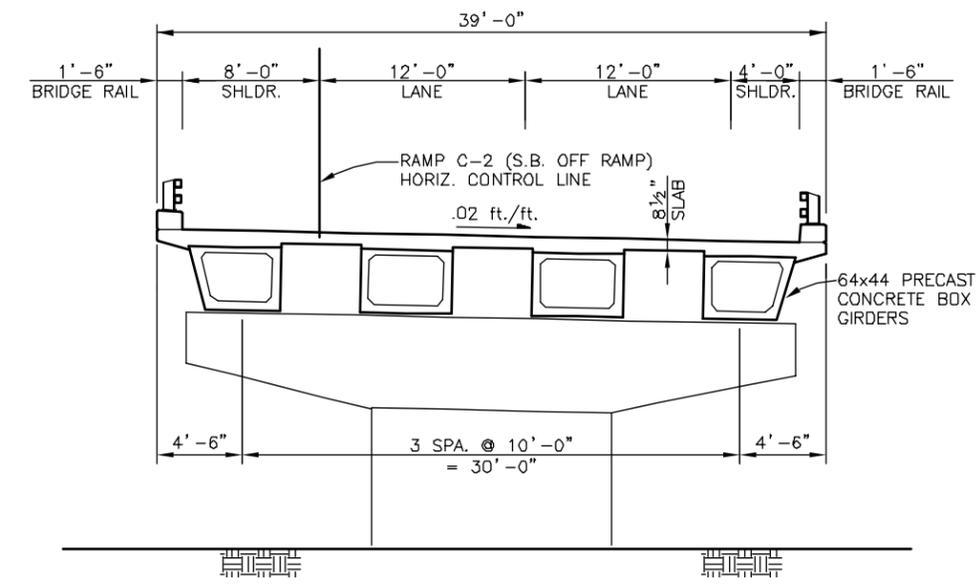
▼ FINISHED GRADE ELEVATION AT HORIZONTAL CONTROL LINE  
 □ DIMENSION MEASURED ALONG HORIZONTAL CONTROL LINE

<b>Computer File Information</b>		<b>Index of Revisions</b>		<p>Colorado Department of Transportation          1480 Quail Lake Loop          Colorado Springs, Colorado 80906          Phone: 719-634-2323 FAX: 719-227-3298</p>	<p><b>As Constructed</b></p> <p>No Revisions:</p> <p>Revised:</p> <p>Void:</p>	<p><b>1-25/CIMARRON/BIJOU INTERCHANGE RAMP C-2 OVER FOUNTAIN CREEK GENERAL LAYOUT</b></p> <p>Designer: K. ALKANANI          Detailer: P. HELM          Sheet Subset: BRIDGE</p>		Project No./Code	
Creation Date: 04/17/02 Initials: PRH								IM 0252-334	
Last Modification Date: 08/18/03 Initials: RAD								13126	
Full Path: J:\99163\ACAD\DISPLAY\STR. SELECT\SB OFF RAMP\								Sheet Number	
Drawing File Name: B399163GLA01.DWG				Region 2 James Flohr		Structure Numbers		1-17-OR	
Acad Ver. R2000i Scale: 1"=30' Units: FEET						Subset Sheets: of			

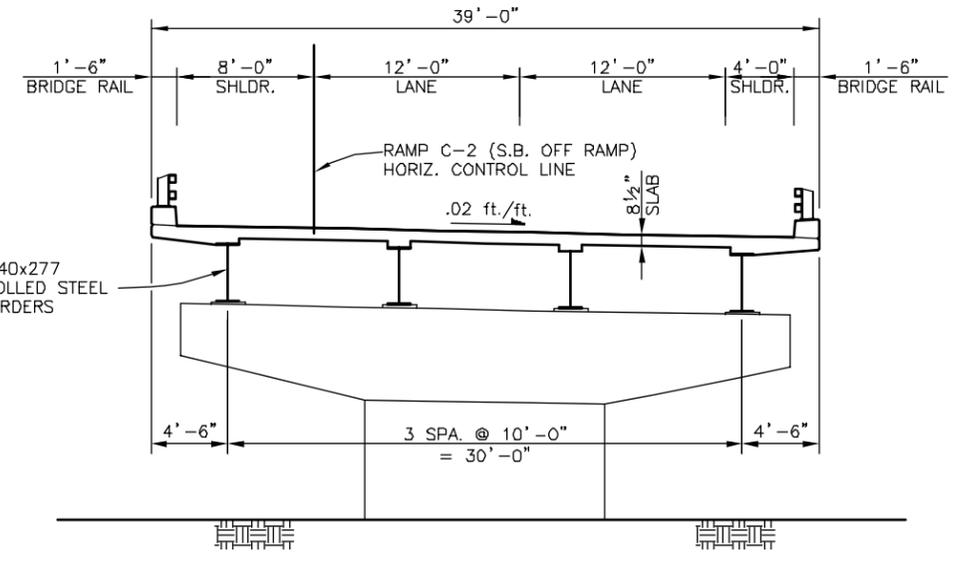
**FIGURE NO. 15**



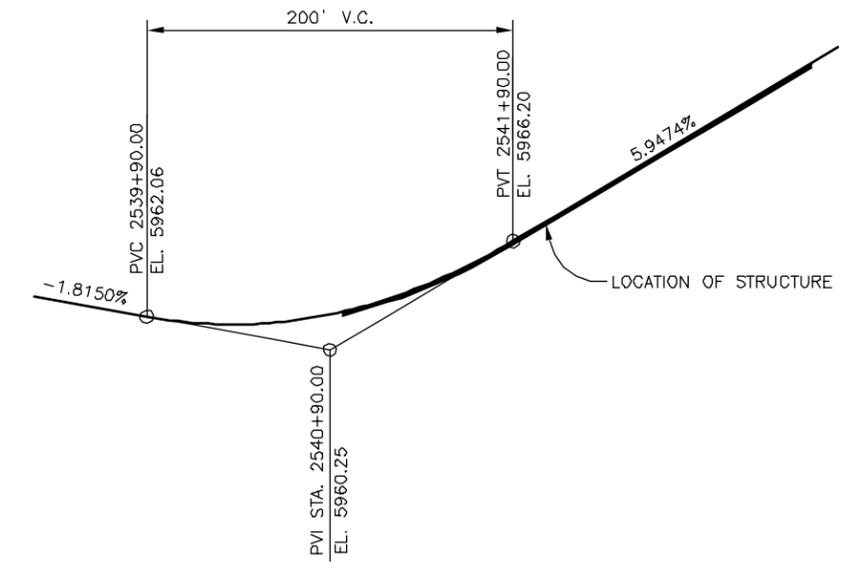
**ALTERNATIVE A  
BT GIRDERS**



**ALTERNATIVE C  
PRECAST BOX GIRDERS**



**ALTERNATIVE B  
STEEL GIRDERS**



**PROFILE GRADE**

QUANTITIES (Preliminary Stage Only)

Revision	Date	Initial	Quantity	Checked by

DESIGN		DETAIL		QUANTITIES	
Designed by	Checked by	Initial	Date	Initial	Date



**Computer File Information**

Creation Date:	04/17/02	Initials:	PRH
Last Modification Date:	05/27/03	Initials:	RAD
Full Path:	J:\99163\ACAD\DISPLAY\STR. SELECT\SB OFF RAMP\		
Drawing File Name:	B399163TYP01.DWG		
Acad Ver.	R2000i	Scale:	VARIES
Units:	FEET		

**Index of Revisions**

No.	Description	By	Date

Colorado Department of Transportation  
 1480 Quail Lake Loop  
 Colorado Springs, Colorado 80906  
 Phone: 719-634-2323 FAX: 719-227-3298

**Region 2** James Flohr

**As Constructed**

No Revisions:	
Revised:	
Void:	

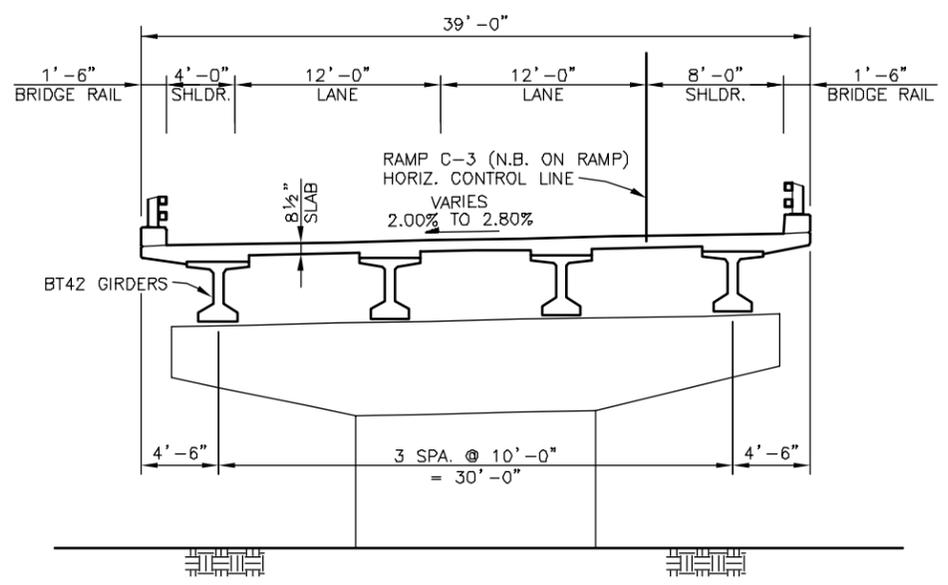
**I-25/CIMARRON/BIJOU INTERCHANGE  
RAMP C-2 OVER FOUNTAIN CREEK  
TYPICAL SECTION ALTERNATIVES**

Designer:	K. ALKANANI	Structure Numbers:	I-17-OR
Detailer:	P. HELM	Sheet Subset:	BRIDGE
Subst. Sheets:		Subst. Sheets:	of

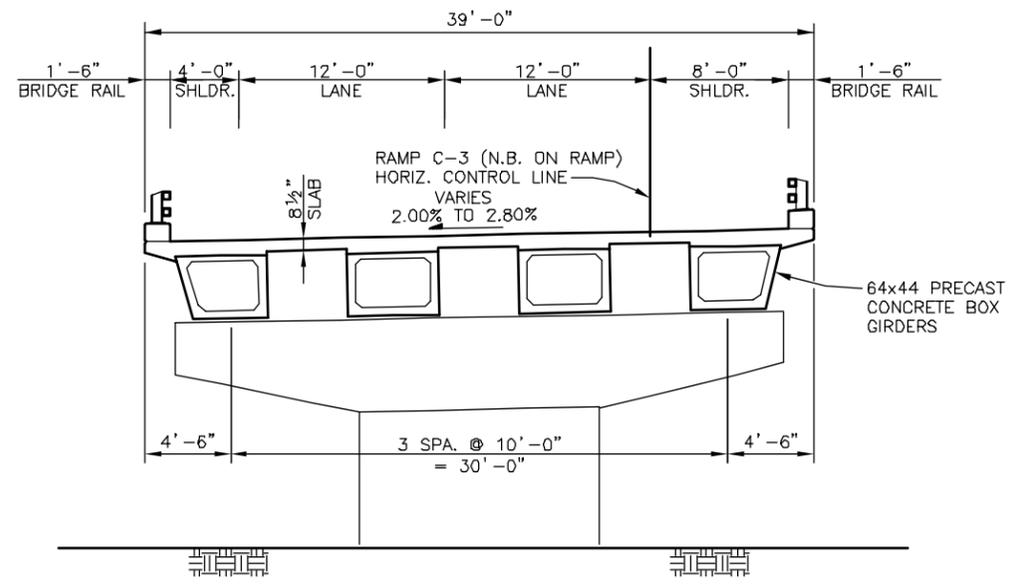
**FIGURE NO. 16**

Project No./Code	IM 0252-334
Sheet Number	13126

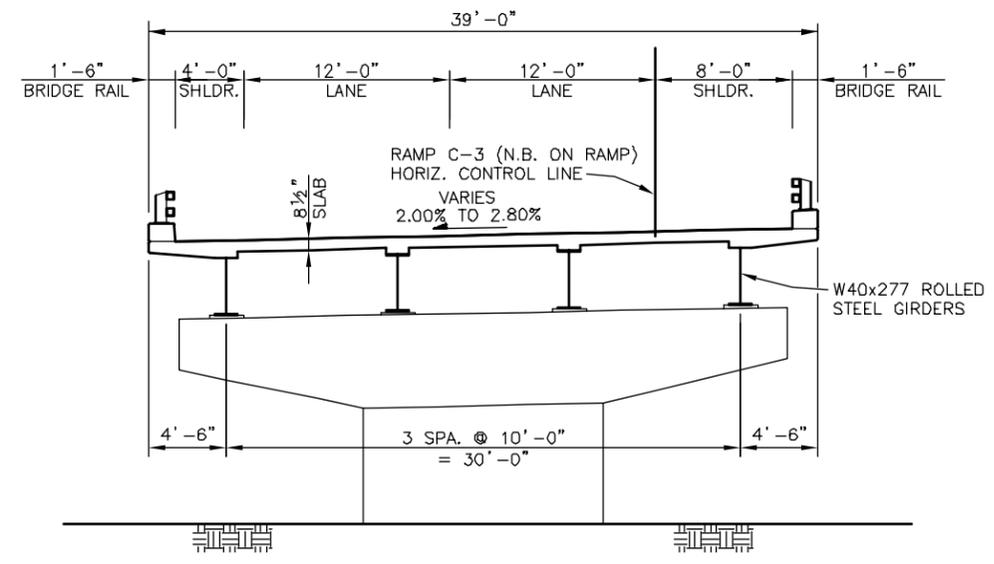




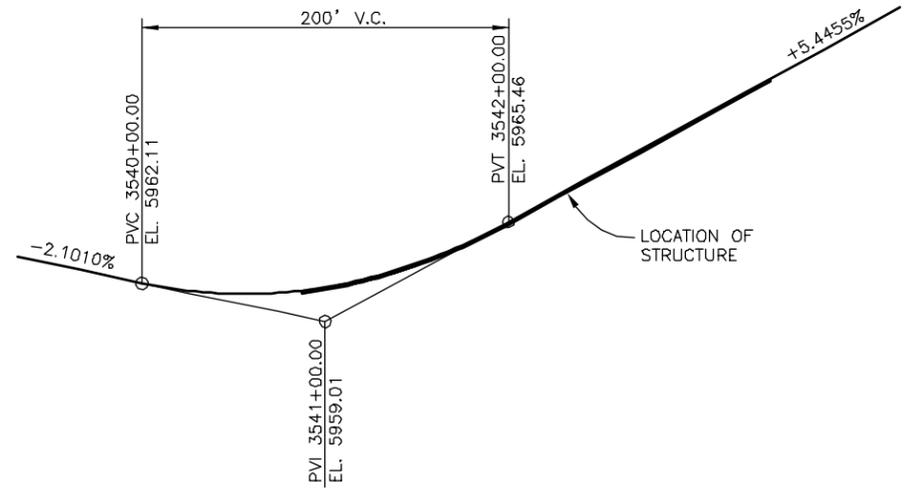
**ALTERNATIVE A  
BT GIRDERS**



**ALTERNATIVE C  
PRECAST BOX GIRDERS**



**ALTERNATIVE B  
STEEL GIRDERS**



**PROFILE GRADE**

DESIGN		DETAIL		QUANTITIES	
Designed by	Checked by	Initial	Date	Initial	Date
X	X	X	X	X	X
X	X	X	X	X	X
X	X	X	X	X	X
X	X	X	X	X	X
X	X	X	X	X	X
X	X	X	X	X	X



Computer File Information	
Creation Date:	04/17/02 Initials: PRH
Last Modification Date:	05/27/03 Initials: RAD
Full Path:	J:\99163\ACAD\DISPLAY\STR. SELECT\NB ON RAMP\
Drawing File Name:	B499163TYP01.DWG
Acad Ver. R2000i	Scale: VARIES Units: FEET

Index of Revisions	



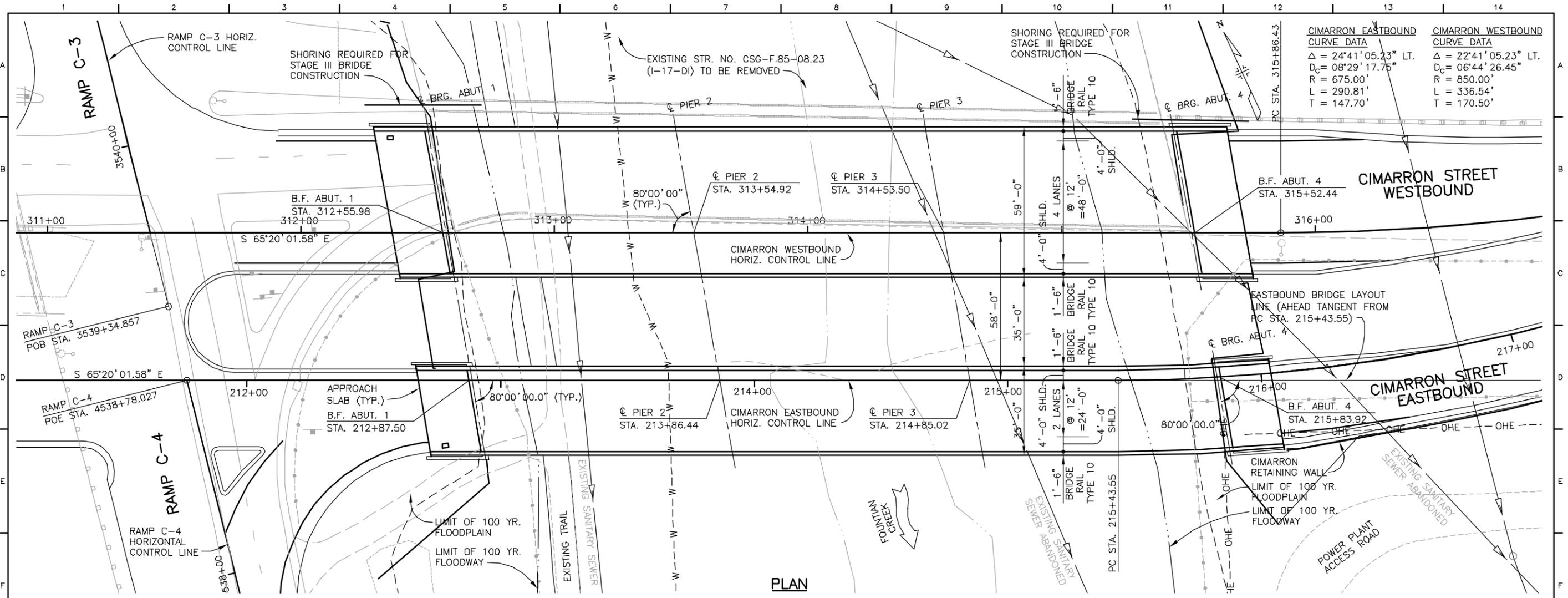
Colorado Department of Transportation  
 1480 Quail Lake Loop  
 Colorado Springs, Colorado 80906  
 Phone: 719-634-2323 FAX: 719-227-3298  
**Region 2**  
**James Flohr**

As Constructed
No Revisions:
Revised:
Void:

I-25/CIMARRON/BIJOU INTERCHANGE RAMP C-3 OVER FOUNTAIN CREEK TYPICAL SECTION ALTERNATIVES	
Designer: K. ALKANANI	Structure: I-17-ON
Detailer: P. HELM	Numbers:
Sheet Subset: BRIDGE	Subset Sheets:    of

Project No./Code
IM 0252-334
13126
Sheet Number

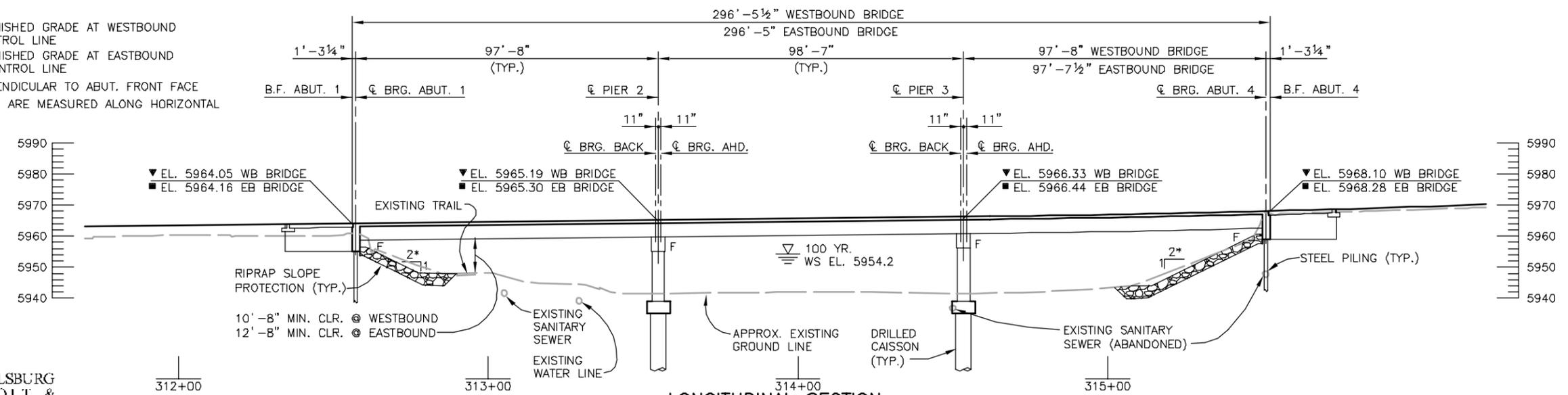
**FIGURE NO. 18**



CIMARRON EASTBOUND CURVE DATA		CIMARRON WESTBOUND CURVE DATA	
$\Delta = 24^{\circ}41'05.23''$ LT.	$\Delta = 22^{\circ}41'05.23''$ LT.		
$D_c = 08^{\circ}29'17.75''$	$D_c = 06^{\circ}44'26.45''$		
$R = 675.00'$	$R = 850.00'$		
$L = 290.81'$	$L = 336.54'$		
$T = 147.70'$	$T = 170.50'$		

DESIGN	QUANTITIES		DETAIL		REVISION DATES	
	Initial	Date	Initial	Date	Initial	Date
Designed by	X	X	X	X	X	X
Checked by	X	X	X	X	X	X
Detailed by	X	X	X	X	X	X
Checked by	X	X	X	X	X	X

- NOTES:**
- ▼ ELEVATION AT FINISHED GRADE AT WESTBOUND HORIZONTAL CONTROL LINE
  - ELEVATION AT FINISHED GRADE AT EASTBOUND HORIZONTAL CONTROL LINE
  - \* MEASURED PERPENDICULAR TO ABUT. FRONT FACE
  - DIMENSIONS SHOWN ARE MEASURED ALONG HORIZONTAL CONTROL LINES



**LONGITUDINAL SECTION**  
(TAKEN AT WESTBOUND BRIDGE HORIZONTAL CONTROL LINE, EASTBOUND BRIDGE SIMILAR)



Computer File Information	
Creation Date:	04/15/02 Initials: PRH
Last Modification Date:	08/18/03 Initials: RAD
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Drawing File Name:	B599163GLA02.DWG
Acad Ver. R2000i	Scale: 1"=40' Units: FEET

Index of Revisions	

Colorado Department of Transportation  
1480 Quail Lake Loop  
Colorado Springs, Colorado 80906  
Phone: 719-634-2323 FAX: 719-227-3298

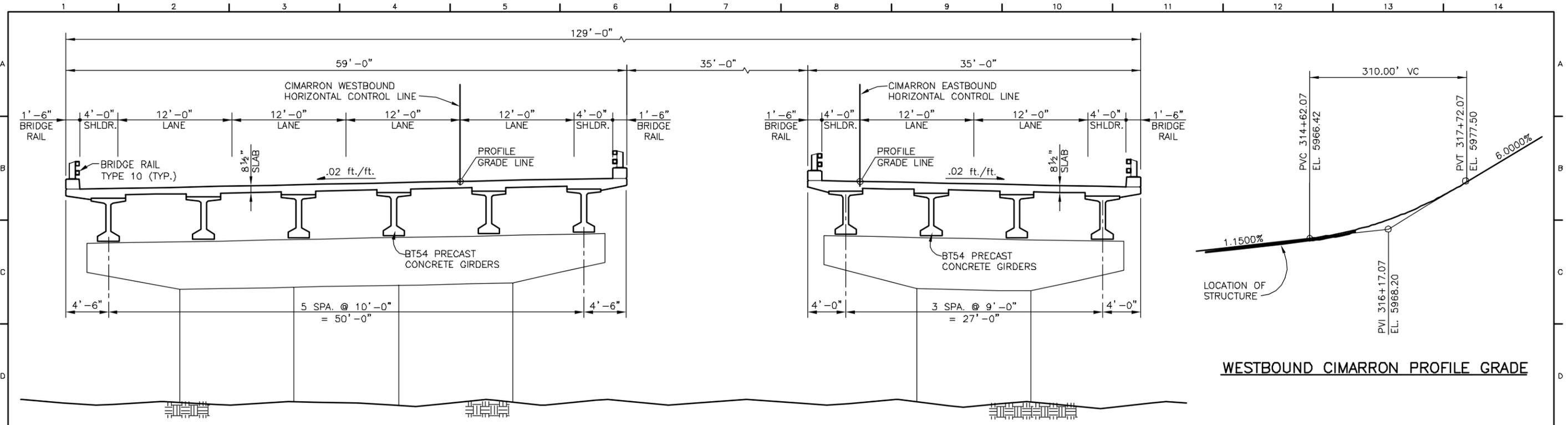
**Region 2** James Flohr

As Constructed	
No Revisions:	
Revised:	
Void:	

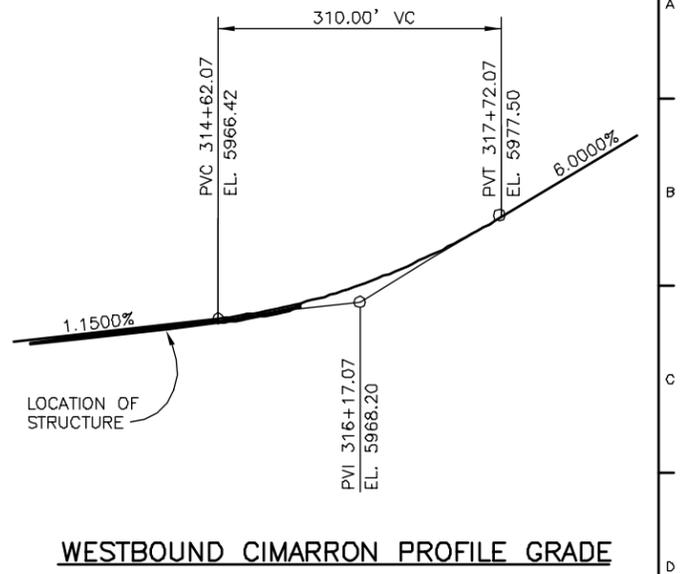
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Designer:	K. ALKANANI
Detailer:	P. HELM
Sheet Subset:	BRIDGE

Project No./Code	
IM 0252-334	
13126	
Sheet Number	

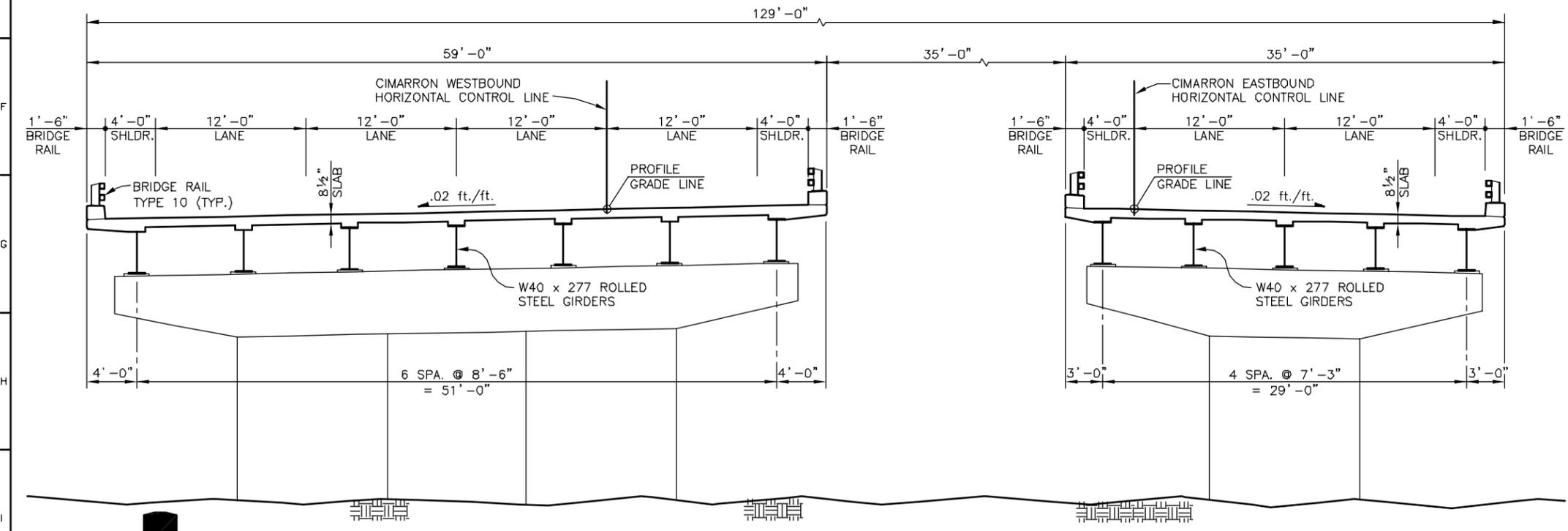
**FIGURE NO. 19**



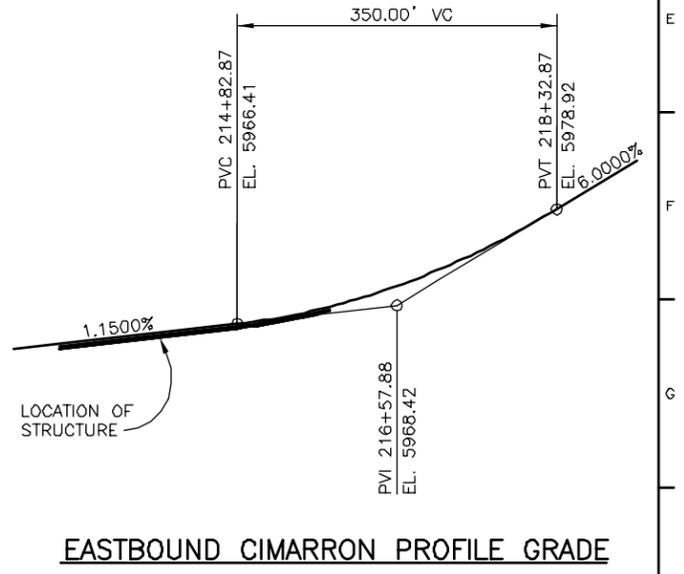
**ALTERNATIVE A  
PRESTRESSED CONCRETE BT GIRDERS**



**WESTBOUND CIMARRON PROFILE GRADE**



**ALTERNATIVE B  
ROLLED STEEL GIRDERS**



**EASTBOUND CIMARRON PROFILE GRADE**

DESIGN	DETAIL		QUANTITIES	
	Initial	Date	Initial	Date
Designed by	X	X	X	X
Checked by	X	X	X	X
Revision Dates (Preliminary Stage Only)				



Colorado Department of Transportation  
 1480 Quail Lake Loop  
 Colorado Springs, Colorado 80906  
 Phone: 719-634-2323 FAX: 719-227-3298  
 Region 2 James Flohr

Computer File Information	
Creation Date:	04/17/02 Initials: PRH
Last Modification Date:	05/27/03 Initials: RAD
Full Path:	J:\99163\ACAD\DISPLAY\STR_SELECT\CIM.-FOUNTAIN\
Drawing File Name:	B599163TYP01.DWG
Acad Ver. R2000i	Scale: VARIES Units: FEET

Index of Revisions	

As Constructed	
No Revisions:	
Revised:	
Void:	

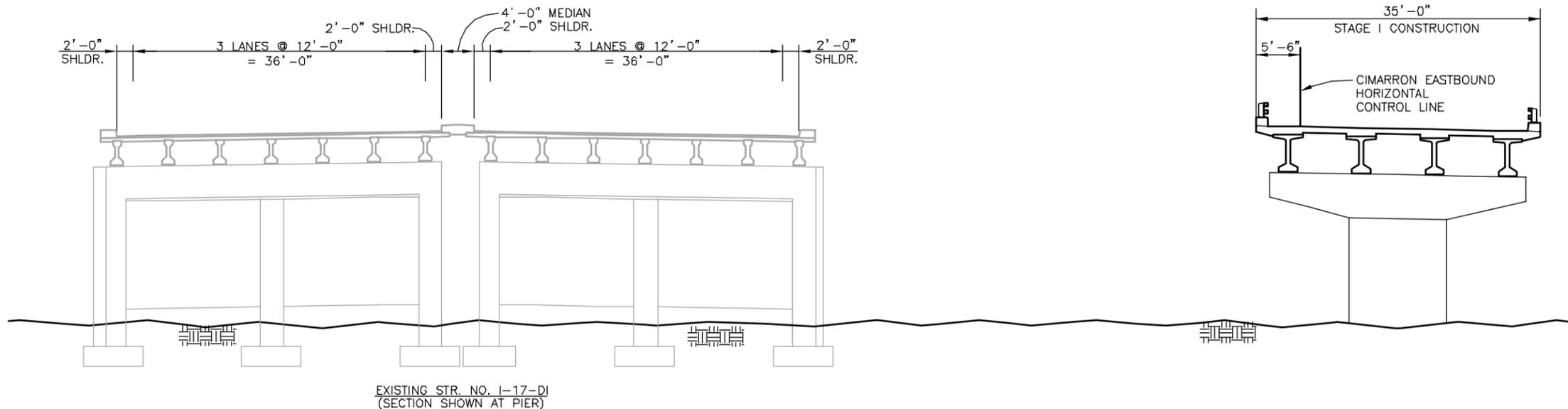
I-25/CIMARRON/BIJOU INTERCHANGE CIMARRON OVER FOUNTAIN CREEK TYPICAL SECTION ALTERNATIVES	
Designer:	K. ALKANANI
Detailer:	P. HELM
Sheet Subset:	BRIDGE

Project No./Code	
IM 0252-334	
13126	
Sheet Number	

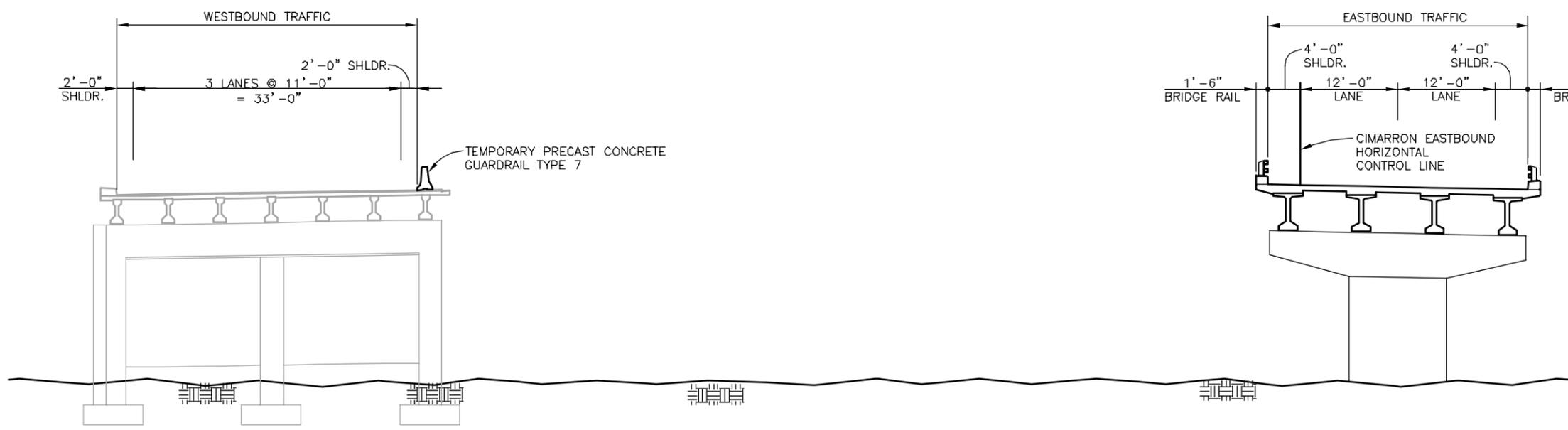
**FIGURE NO. 20**

QUANTITIES		DETAIL		DESIGN	
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		X	X	X	X
		X	X	X	X

DESIGN		DETAIL		QUANTITIES	
Designed by	Checked by	Initial	Date	Quantity	Checked by
		X	X		
		X	X		
		X	X		
		X	X		



**CONSTRUCTION STAGE I  
BUILD EASTBOUND CIMARRON STRUCTURE**



**CONSTRUCTION STAGE II  
SHIFT EASTBOUND CIMARRON TRAFFIC TO NEW STRUCTURE & REMOVE EXISTING EASTBOUND STRUCTURE**



**FIGURE NO. 21**

<b>Computer File Information</b> Creation Date: 09/24/02 Initials: RAD Last Modification Date: 05/27/03 Initials: RAD Full Path: J:\99163\ACAD\DISPLAY\STR_SELECT\CIM.-FOUNTAIN\ Drawing File Name: B599163TYP01.DWG Acad Ver. R2000i Scale: VARIES Units: FEET			<b>Index of Revisions</b> <table border="1"> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </table>															Colorado Department of Transportation 1480 Quail Lake Loop Colorado Springs, Colorado 80906 Phone: 719-634-2323 FAX: 719-227-3298 <b>Region 2</b> James Flohr			<b>As Constructed</b> No Revisions: Revised: Void:			<b>I-25/CIMARRON/BIJOU INTERCHANGE CIMARRON OVER FOUNTAIN CREEK SUGGESTED PHASED CONST. (1 of 2)</b> Designer: K. ALKANANI Detailer: P. HELM Sheet Subset: BRIDGE			Project No./Code <b>IM 0252-334</b> <b>13126</b> Structure Numbers Subst Sheets: of Sheet Number		







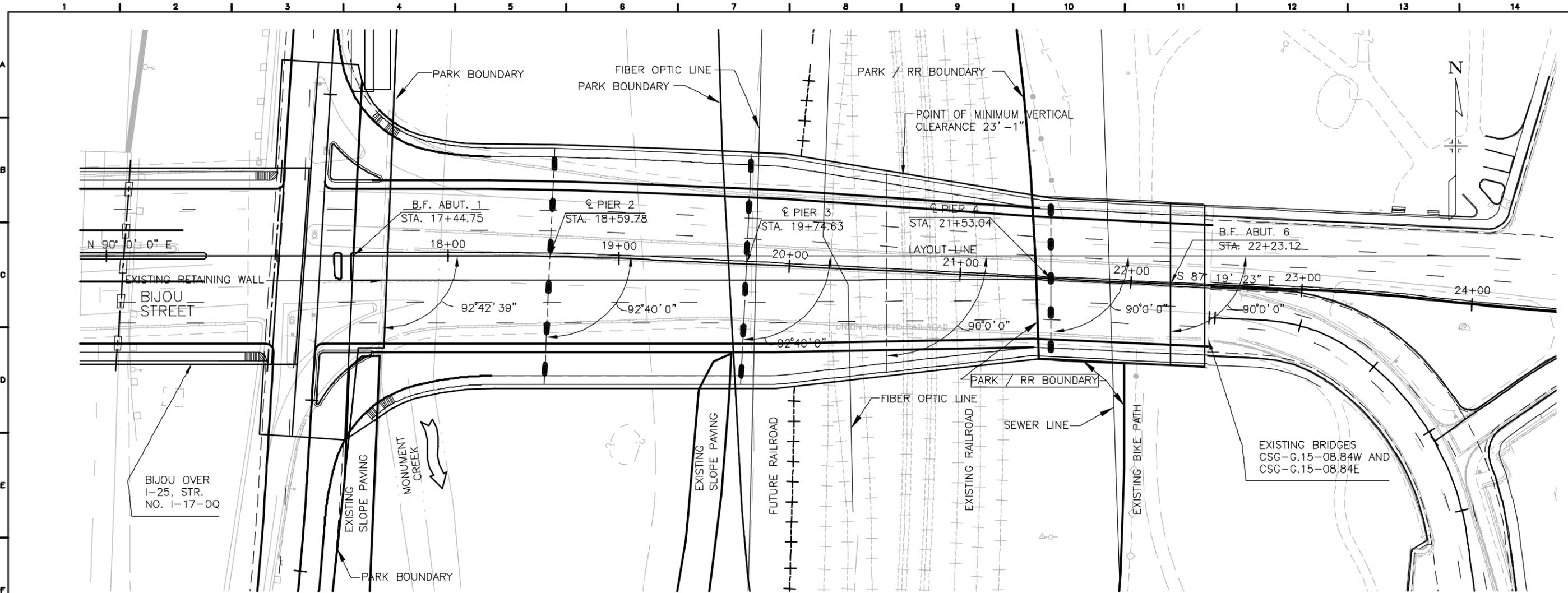




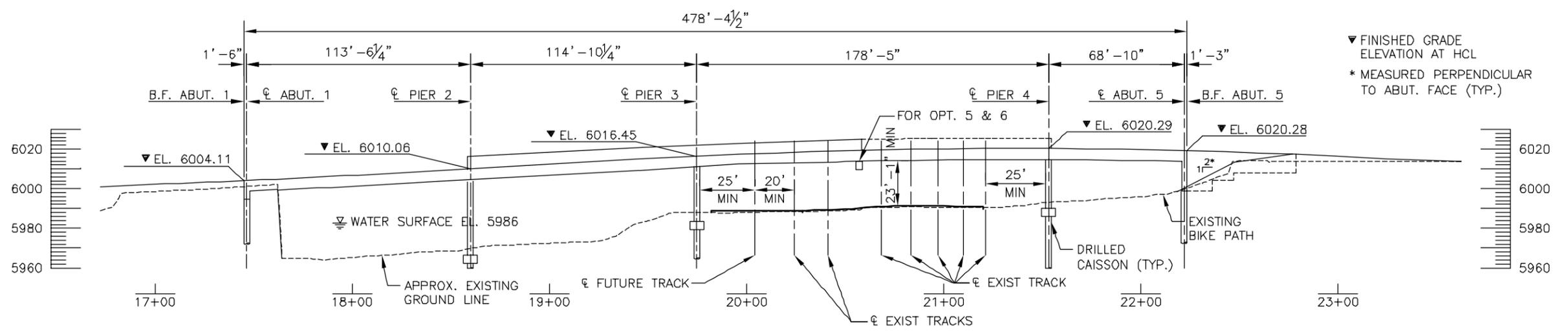








**PLAN**



**LONGITUDINAL SECTION**  
(TAKEN AT HORIZONTAL CONTROL LINE)

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Designed By	Date	Initial	Date	Initial	Date
BIJ-RR-PIERS	WPA_SURVEYED_EAST	PARK LINE	UTILITIES	BIJ_125_STRUCT	BIJ_RR_STRUCT
BIJ-RR-PIERS	WPA_SURVEYED_EAST	PARK LINE	UTILITIES	BIJ_125_STRUCT	BIJ_RR_STRUCT

XREF = TOPO-MASTER  
BIJ-RR-PIERS WPA\_SURVEYED\_EAST PARK LINE UTILITIES BIJ\_125\_STRUCT BIJ\_RR\_STRUCT BIJDESIGN

Computer File Information	
Creation Date:	12/09/02 Initials: DBW
Last Modification Date:	08/25/03 Initials: DAK
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Drawing File Name:	bijou over rr genlayout.DWG
Acad Ver. R2002 Scale: 1"=60' Units: ENGLISH	

Index of Revisions	



Colorado Department of Transportation  
1480 Quail Lake Loop  
Colorado Springs, Colorado 80906  
Phone: 719-634-2323 FAX: 719-227-3298  
Region 2 James Flohr

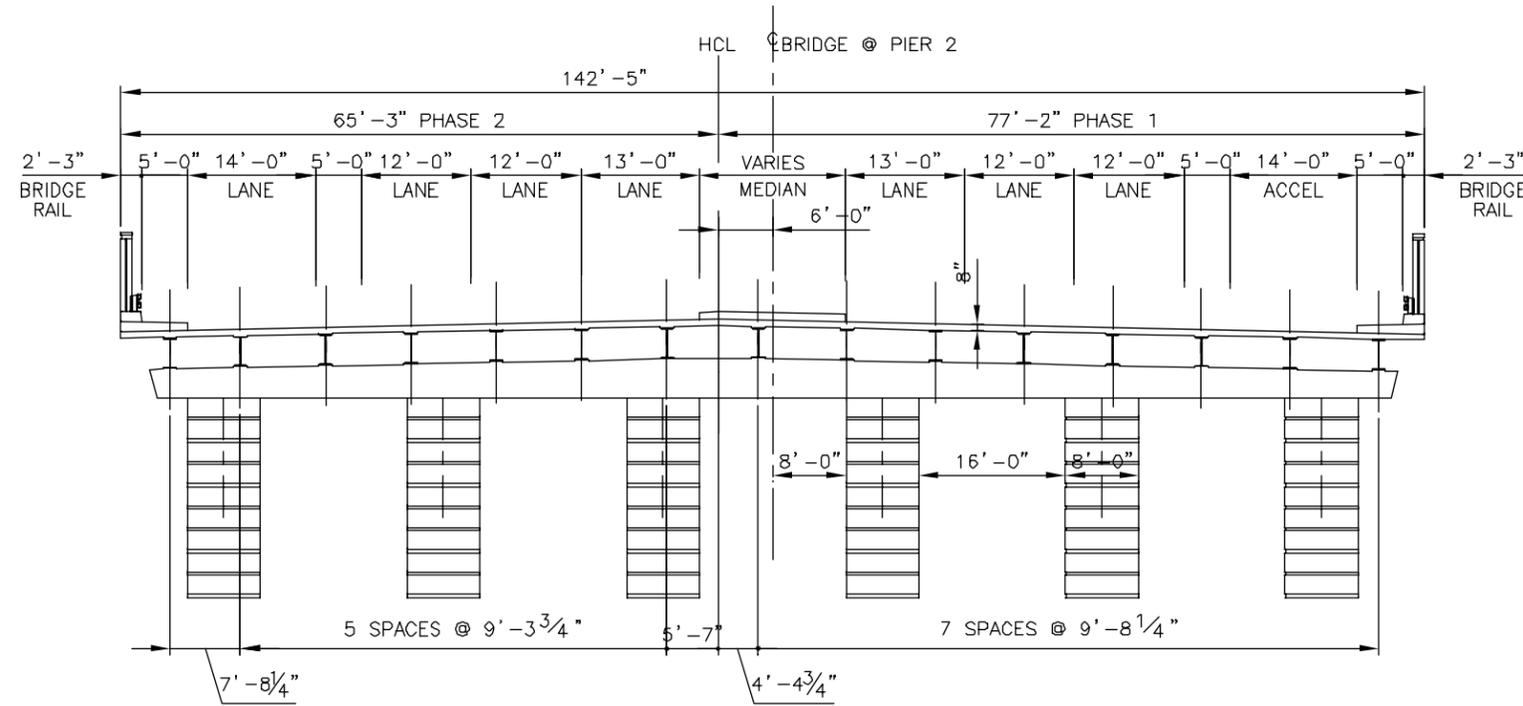
As Constructed  
No Revisions:  
Revised:  
Void:

I-25/CIMARRON/BIJOU INTERCHANGE  
BIJOU OVER UPRR  
GENERAL LAYOUT-ALTS. 4, 5, & 6  
Designer: DBW/DAK  
Detailer: DAK  
Sheet Subset: BRIDGE

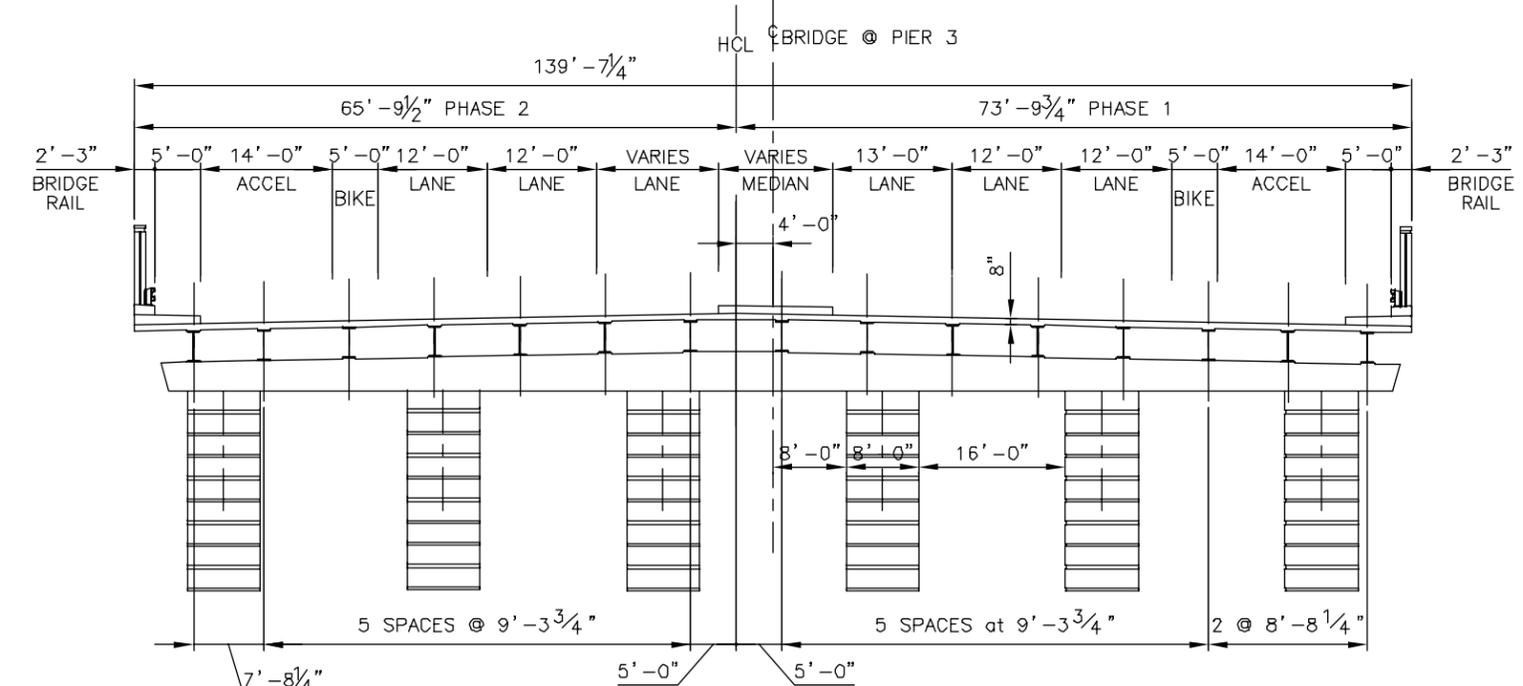
Project No./Code  
IM 0252-334  
13126  
Sheet Number

**FIGURE NO. 30**

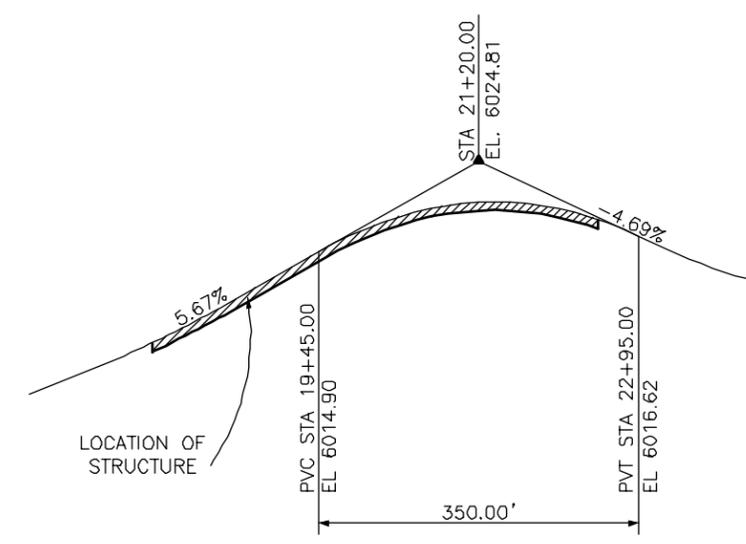




**SECTION @ STA 18+46.75**  
(LOOKING EAST)



**SECTION @ STA 19+48.66**  
(LOOKING EAST)



**PIER SECTIONS**  
**STEEL I GIRDER ALTERNATIVE**

**FIGURE NO. 32**

DESIGN	Initial	Date	Designed by	Checked by	DETAIL	Initial	Date	Detailed by	Checked by	QUANTITIES	Initial	Date	Quantities by	Checked by	Revision Dates	
															Checked by	Date



Computer File Information			
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Last Modification Date:	08/25/03	Initials:	DAK
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Drawing File Name:	Bijou over RR Stl I Xsec.DWG		
Acad Ver.	R2002	Scale:	1"=20'
Units:	ENGLISH		

Index of Revisions			

Colorado Department of Transportation  
 1480 Quail Lake Loop  
 Colorado Springs, Colorado 80906  
 Phone: 719-634-2323 FAX: 719-227-3298

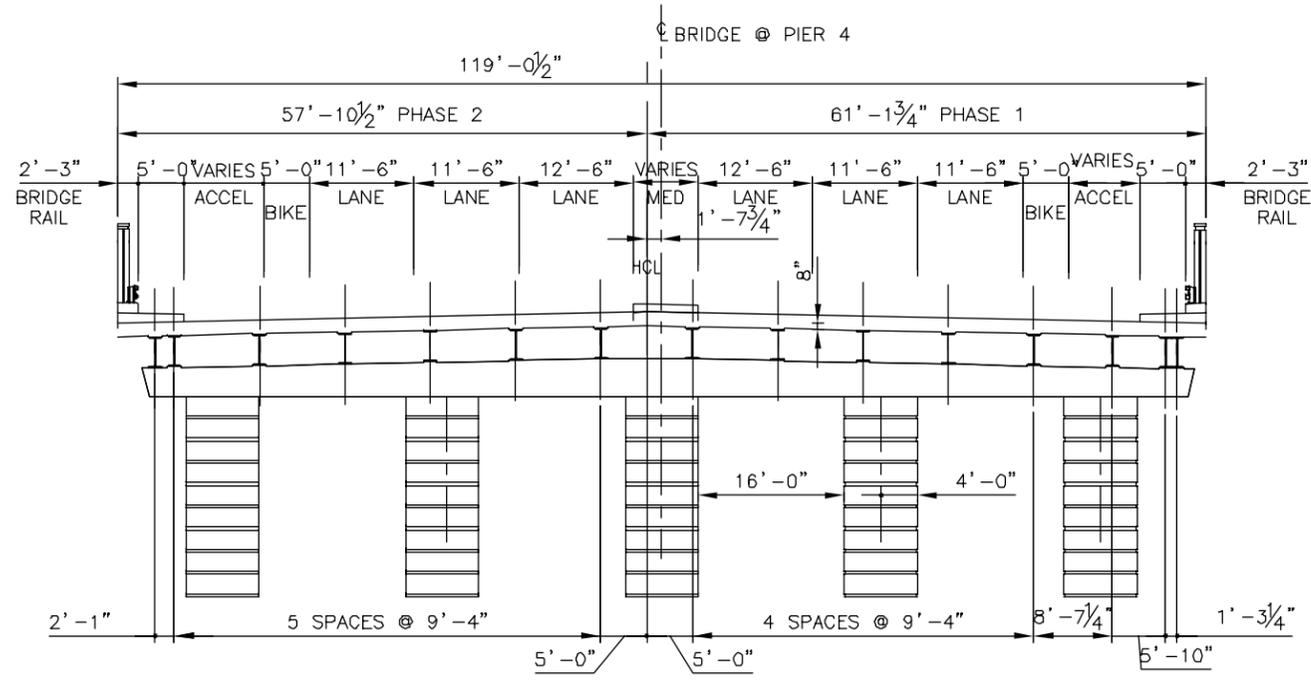
**I-25**  
CORRIDOR IMPROVEMENTS  
PIRES PEAK REGION

Region 2 James Flohr

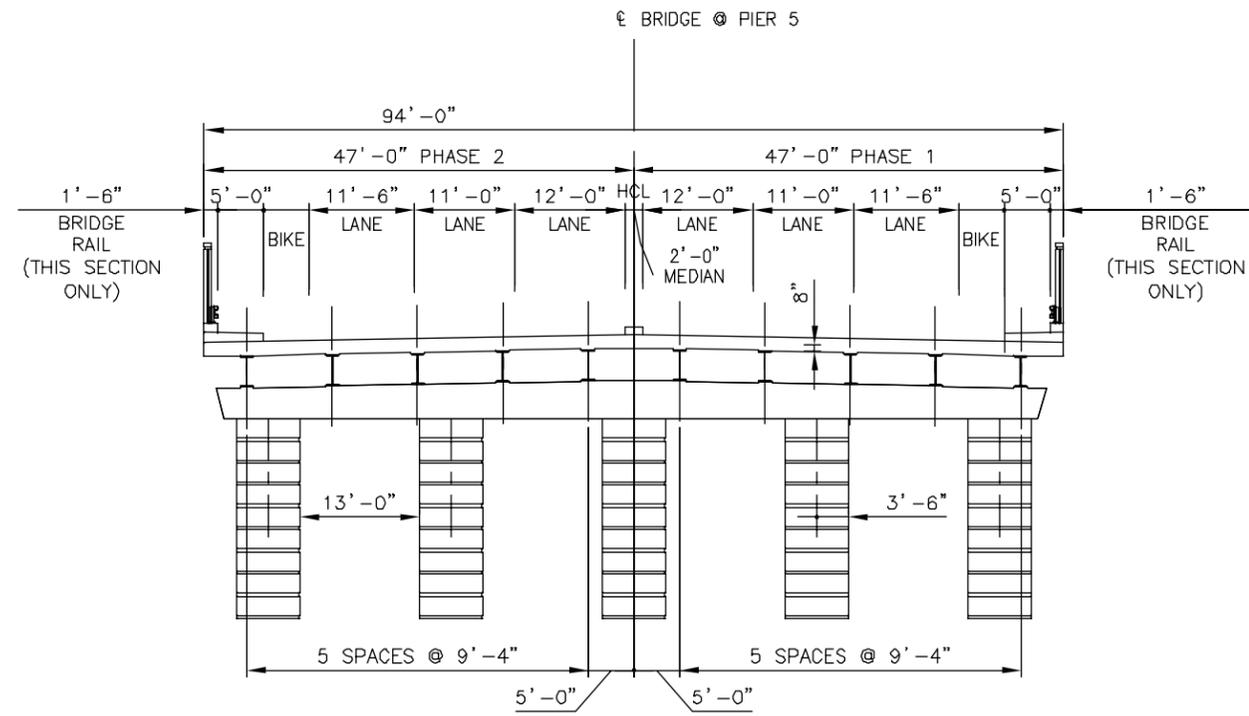
As Constructed
No Revisions:
Revised:
Void:

I-25/CIMARRON/BIJOU INTERCHANGE BIJOU OVER UPRR PIER SECTIONS - ALTERNATIVE 1	
Designer: DBW/DAK	Structure Number: CSG-G.15-08.84A
Detailer: DAK	
Sheet Subset: BRIDGE	Subset Sheets: of

Project No./Code	IM 0252-334
Sheet Number	13126



**SECTION @ STA 20+04.88**  
(LOOKING EAST)



**SECTION @ STA 21+53.04**  
(LOOKING EAST)

**PIER SECTIONS**  
**STEEL I GIRDER ALTERNATIVE**

**FIGURE NO. 33**

DESIGN		DETAIL		QUANTITIES	
Designed by	Initial	Date	Checked by	Initial	Date
Checked by				Checked by	
				Revision Dates	
				(Preliminary Stage Only)	

Computer File Information		
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Last Modification Date:	08/25/03	Initials: DAK
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Drawing File Name:	Bijou over RR Stl I Xsec.DWG	
Acad Ver.	R2002	Scale: 1"=20' Units: ENGLISH

Index of Revisions		

Colorado Department of Transportation  

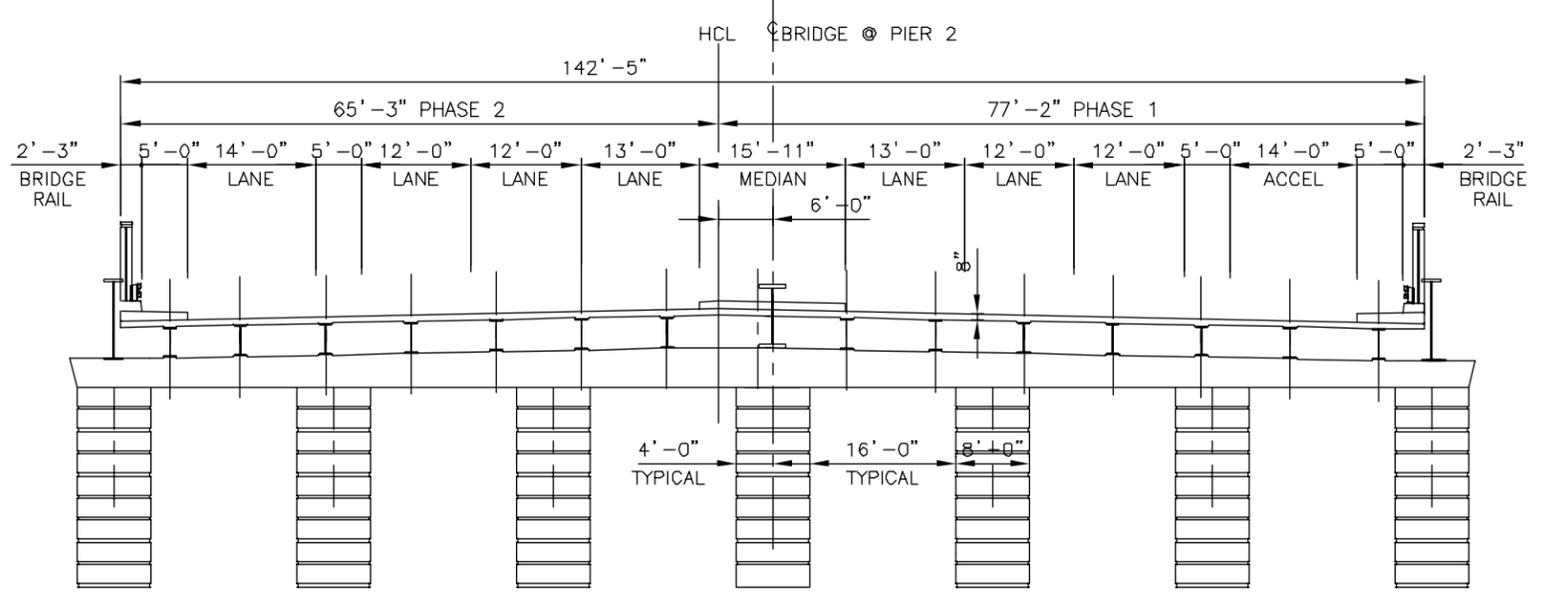
 1480 Quail Lake Loop  
 Colorado Springs, Colorado 80906  
 Phone: 719-634-2323 FAX: 719-227-3298  
 Region 2 James Flohr

As Constructed
No Revisions:
Revised:
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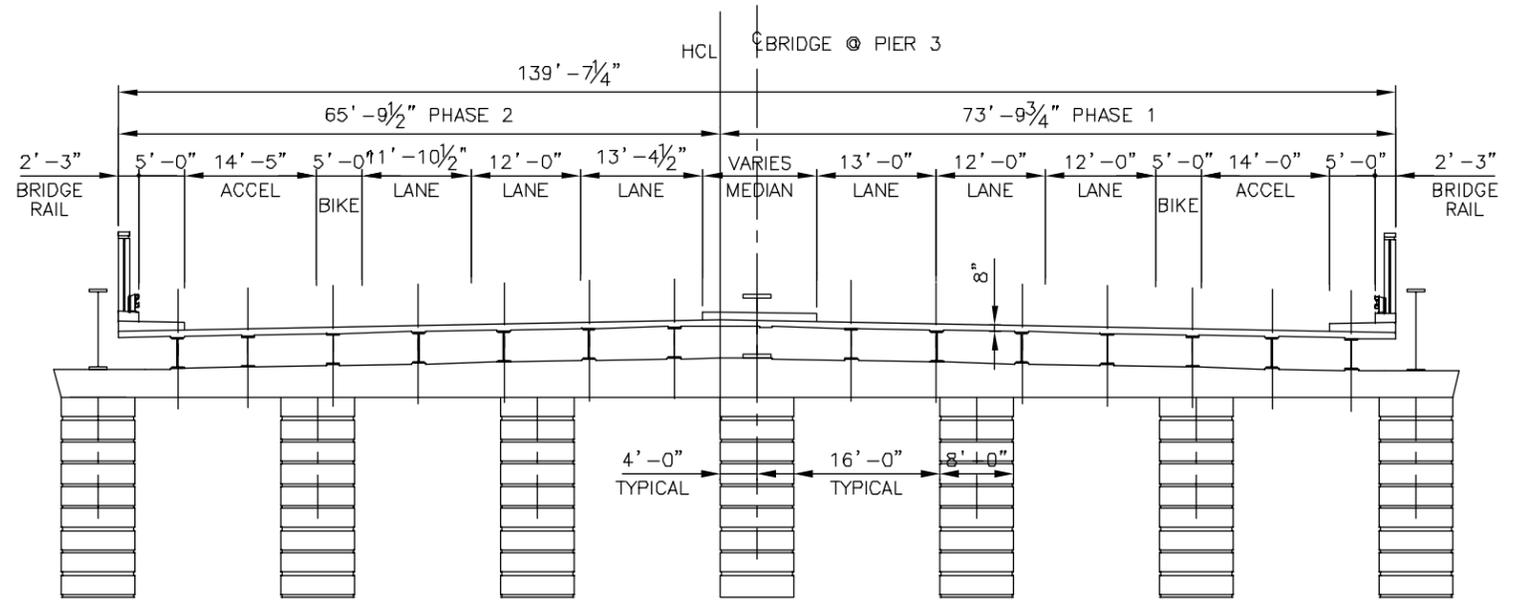
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Designer: DBW/DAK	Structure Number: CSG-G.15-08.84A
Detailer: DAK	
Sheet Subset: BRIDGE	Subset Sheets: of

Project No./Code	IM 0252-334
Sheet Number	13126

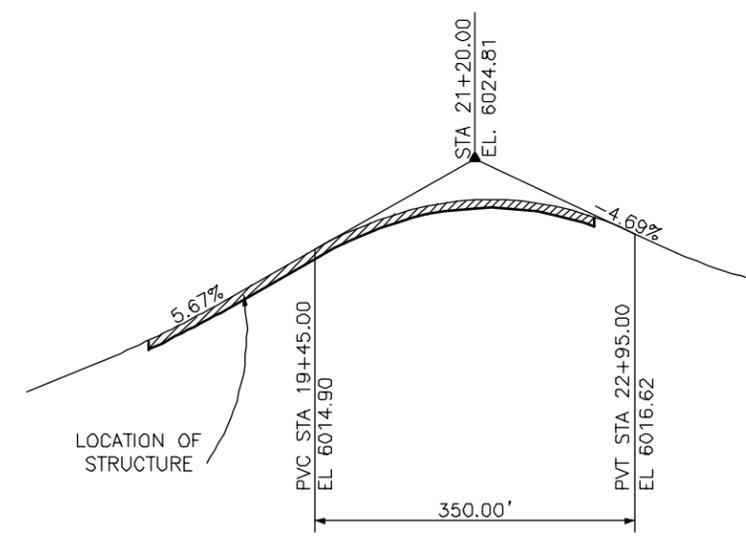
XREF



**SECTION @ STA 18+59.78**  
(LOOKING EAST)



**SECTION @ STA 19+74.63**  
(LOOKING EAST) (PIER 4 SIMILAR)



**PIER SECTIONS**  
**OUTSIDE AND CENTER GIRDER ALTERNATIVE**

**FIGURE NO. 34**

DESIGN		DETAIL		QUANTITIES	
Designed by	Initial	Detailed by	Initial	Quantities by	Initial
Checked by	Date	Checked by	Date	Checked by	Date

Computer File Information	
Creation Date:	03/18/03 Initials: DAK
Last Modification Date:	08/25/03 Initials: DAK
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Drawing File Name:	Bij-RR Cable-Stl Xsec.DWG
Acad Ver.	R2002 Scale: 1"=20' Units: ENGLISH

Index of Revisions	

Colorado Department of Transportation  
 1480 Quail Lake Loop  
 Colorado Springs, Colorado 80906  
 Phone: 719-634-2323 FAX: 719-227-3298

**Region 2** James Flohr

As Constructed
No Revisions:
Revised:
Void:

I-25/CIMARRON/BIJOU INTERCHANGE BIJOU OVER UPRR PIER SECTIONS - ALT. 2, 3, 5, & 6	
Designer: DBW/DAK	Structure Number: CSG-G.15-08.84A
Detailer: DAK	
Sheet Subset: BRIDGE	Subset Sheets: of

Project No./Code	IM 0252-334
Sheet Number	13126

XREF





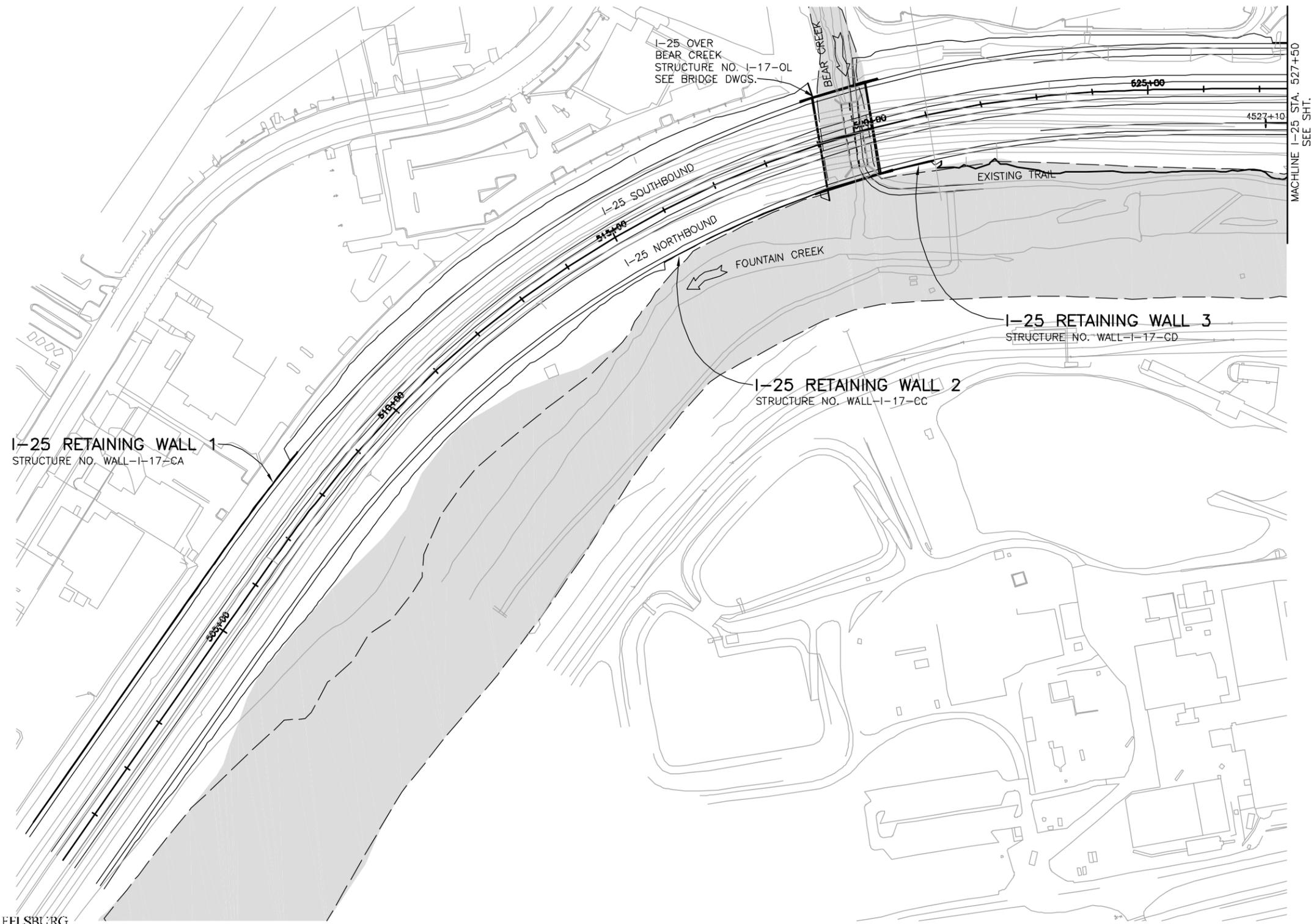
**Appendix B**

Retaining Wall Location Map  
Typical Retaining Wall Sections  
I-25 Retaining Wall Layouts  
Ramp Retaining Wall Layouts  
Creek Retaining Wall Layouts

Figures 1 - 3  
Figures 4 - 7  
Figures 8 - 15  
Figures 16 – 23 and 32  
Figures 24 - 31

1 2 3 4 5 6 7 8 9 10 11 12 13 14

A  
B  
C  
D  
E  
F  
G  
H  
I  
J



100 YR. FLOODWAY

DESIGN		DETAIL		QUANTITIES	
Designed by	Checked by	Initial	Date	Initial	Date

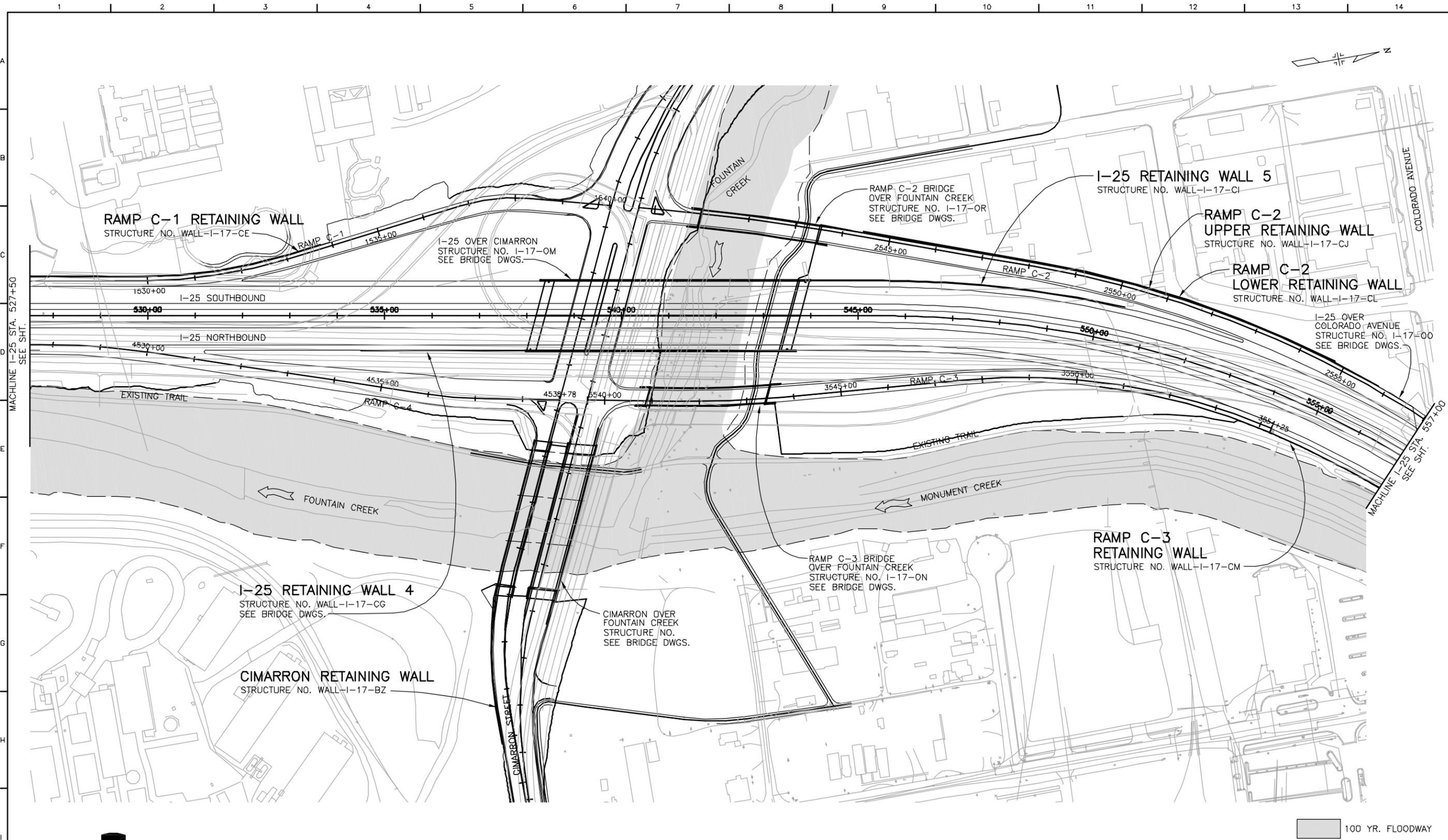
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Designed by	Checked by	Initial	Date	Initial	Date



FIGURE NO. 1

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1 2 3 4 5 6 7 8 9 10 11 12 13 14



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Designed by	Date	Detailed by	Date	Quantities by	Date
Checked by		Checked by		Checked by	

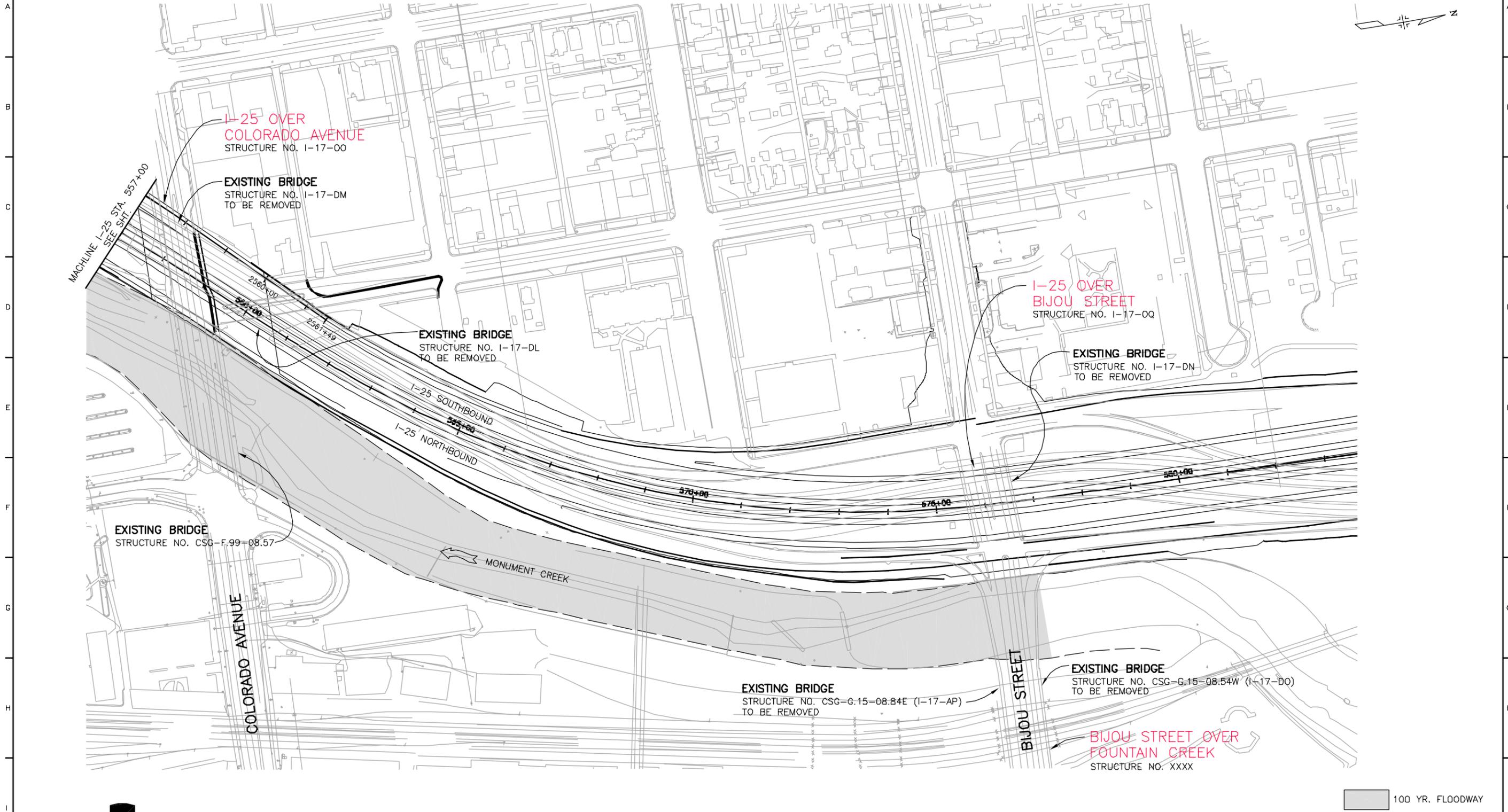
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Checked by		Checked by		Checked by	



100 YR. FLOODWAY

FIGURE NO. 2

<b>Computer File Information</b> Creation Date: 11/22/02 Initials: RAD Last Modification Date: 05/15/03 Initials: RAD Full Path: J:\99163\ACAD\SHEETS\ Drawing File Name: W99163SLM01.dwg Acad Ver. R2000i Scale: 1"=200' Units: FEET			<b>Index of Revisions</b> <table border="1"> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </table>															Colorado Department of Transportation 1480 Quail Lake Loop Colorado Springs, Colorado 80906 Phone: 719-634-2323 FAX: 719-227-3298 <b>Region 2</b> James Flohr			<b>As Constructed</b> No Revisions: Revised: Void:			<b>I-25/CIMARRON/BIJOU INTERCHANGE RETAINING WALL LOCATION MAP</b> (2 OF 3) Designer: K. ALKANANI Detailer: R. DILLON Sheet Subset:			Project No./Code <b>IM 0252-334</b> <b>13126</b> Sheet Number		



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Revision	Date	Initial	Date

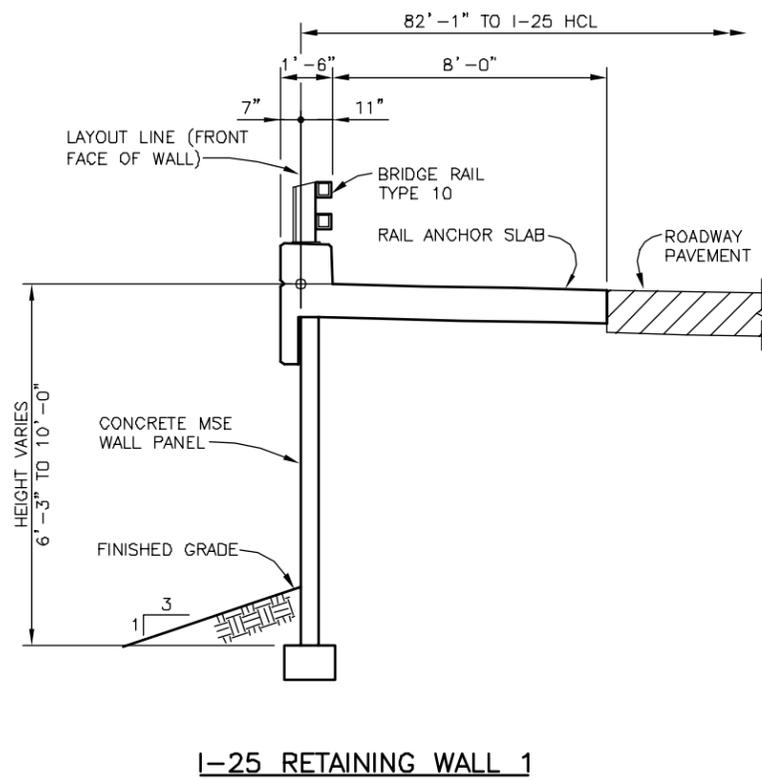
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Designed by	Date	Detailed by	Date	Checked by	Date



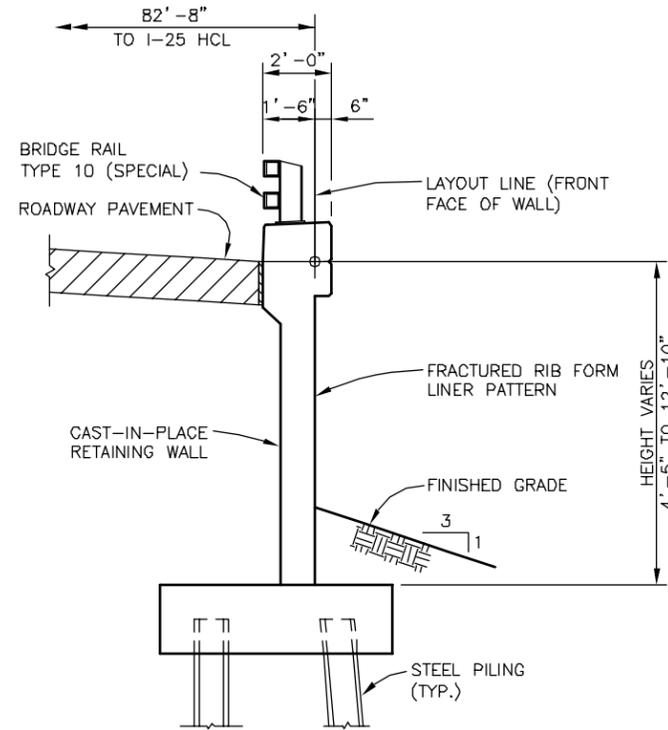
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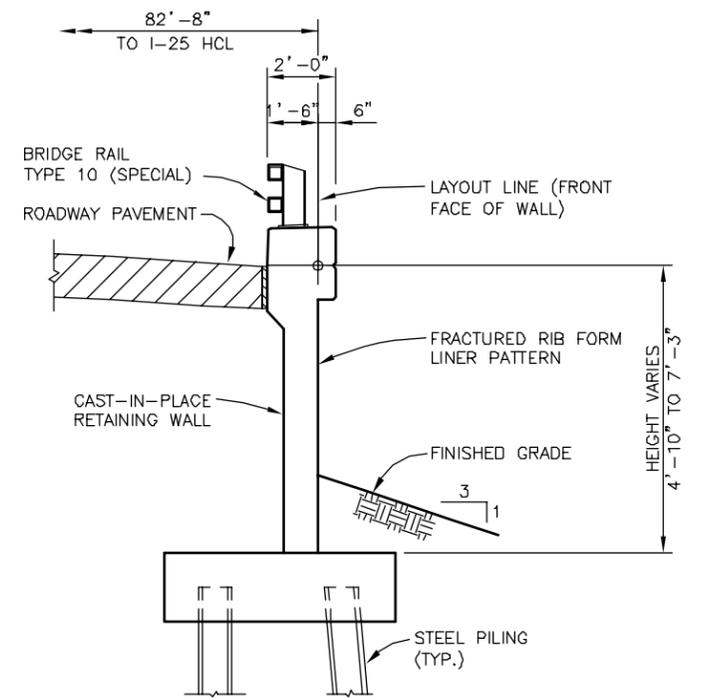
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Quantities by	Checked by	Initial	Date	Initial	Date	Initial	Date
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I-25 RETAINING WALL 1



I-25 RETAINING WALL 2



I-25 RETAINING WALL 3



FIGURE NO. 4

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Acad Ver. R2000i	Scale: VARIES Units: FEET

Index of Revisions	

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Revised:
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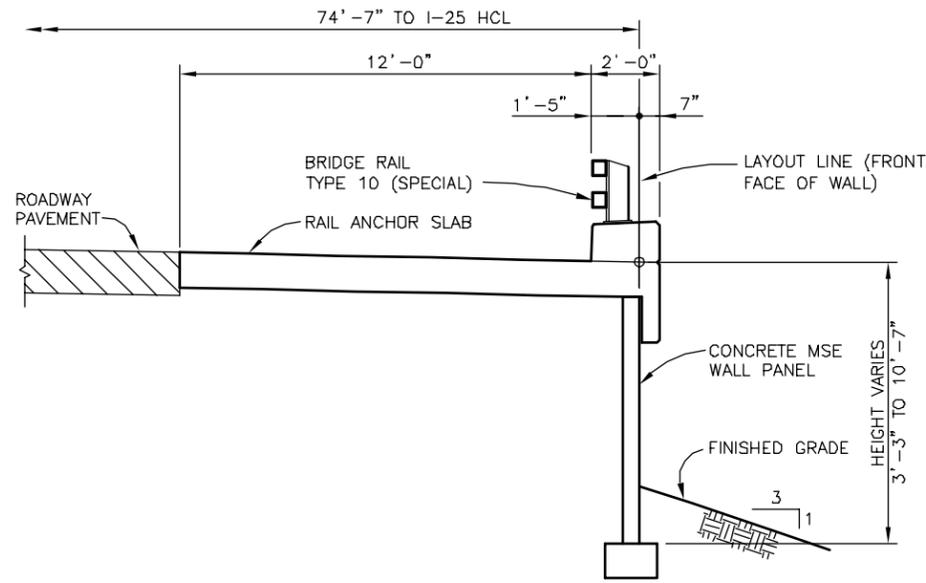
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(1 OF 3)	
Designer:	R. DILLON
Detailer:	P. HELM
Sheet Subset:	

Project No./Code	IM 0252-334
	13126

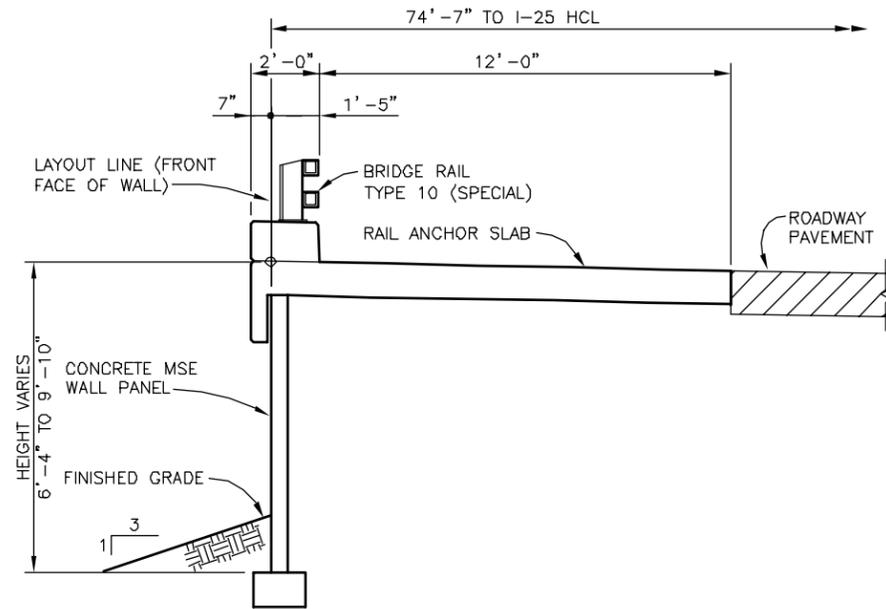


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Designed by	Date	Detailed by	Date
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Checked by	Checked by	Checked by	Checked by
X	X	X	X



I-25 RETAINING WALL 4



I-25 RETAINING WALL 5



FIGURE NO. 6

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Colorado Department of Transportation  
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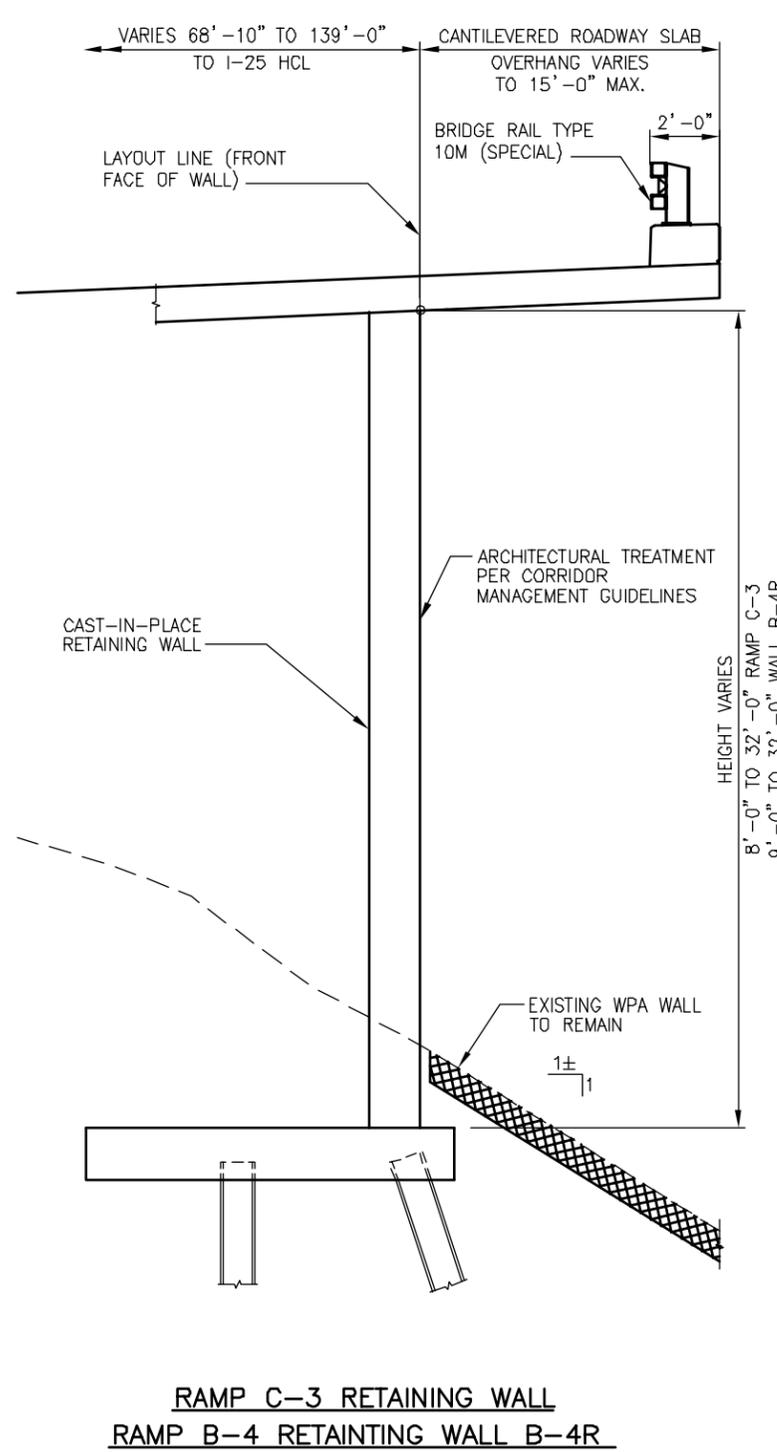
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No Revisions:
Revised:
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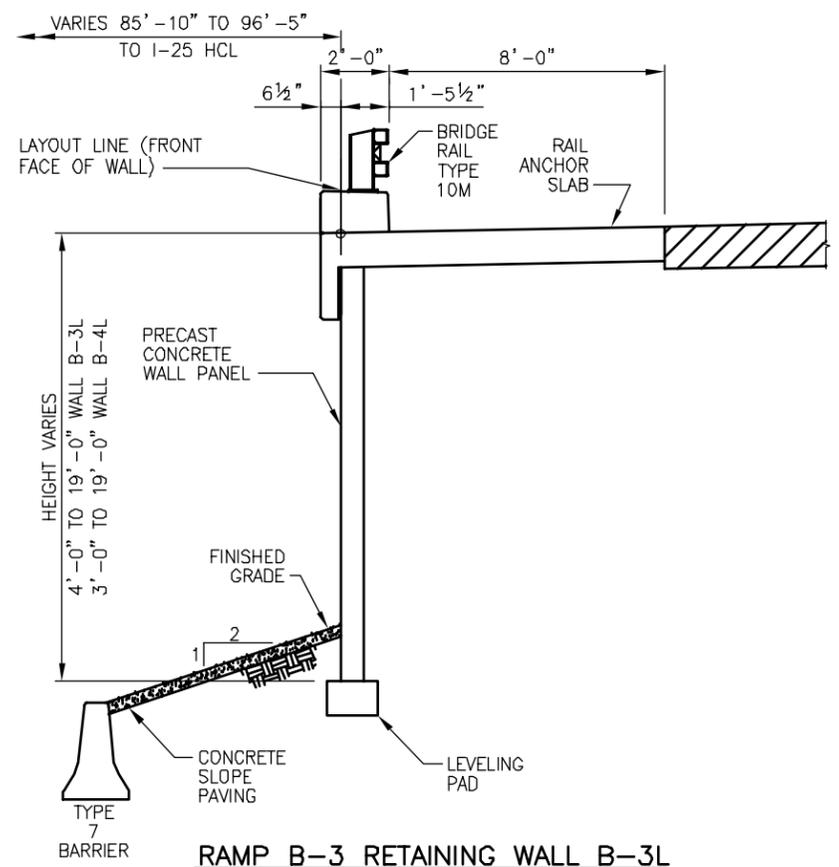
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(3 OF 3)	
Designer:	R. DILLON
Detailer:	P. HELM
Sheet Subset:	

Project No./Code	IM 0252-334
	13126

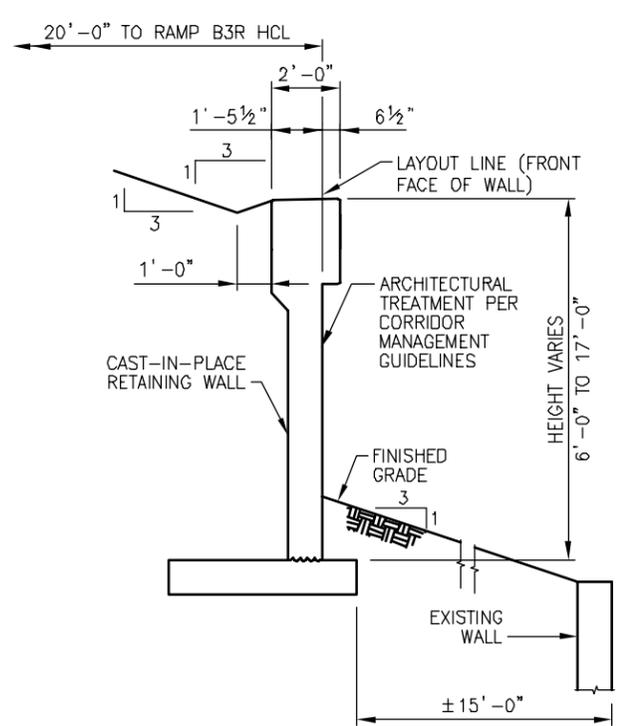
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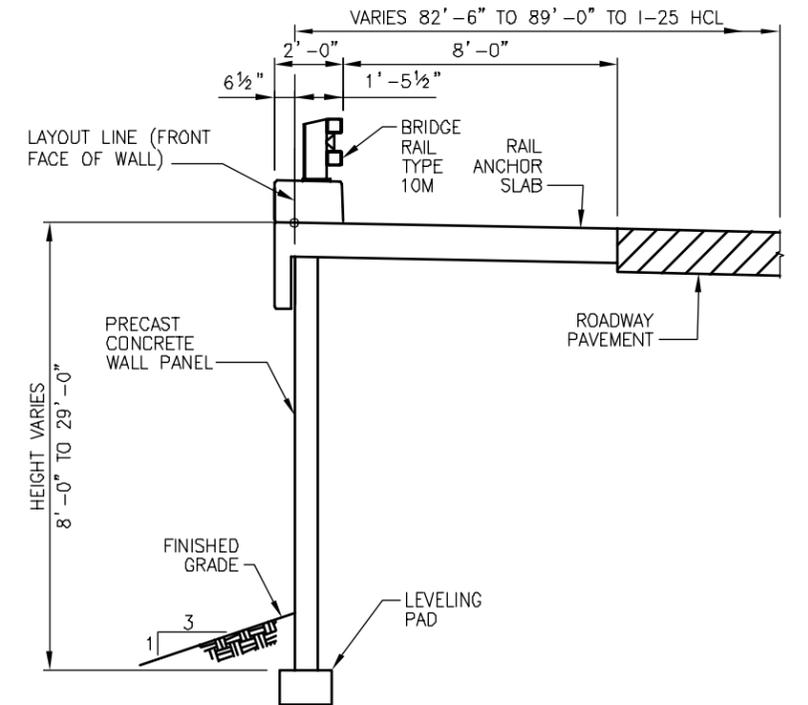
**RAMP C-3 RETAINING WALL**  
**RAMP B-4 RETAINING WALL B-4R**



**RAMP B-3 RETAINING WALL B-3L**  
**RAMP B-4 RETAINING WALL B-4L**



**RAMP B-3 RETAINING WALL B-3R**



**I-25 RETAINING WALL 6**



Computer File Information			
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Last Modification Date:	08/25/03	Initials:	DAK
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Units:	ENGLISH		

Index of Revisions			

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1480 Quail Lake Loop  
Colorado Springs, Colorado 80906  
Phone: 719-634-2323 FAX: 719-227-3298

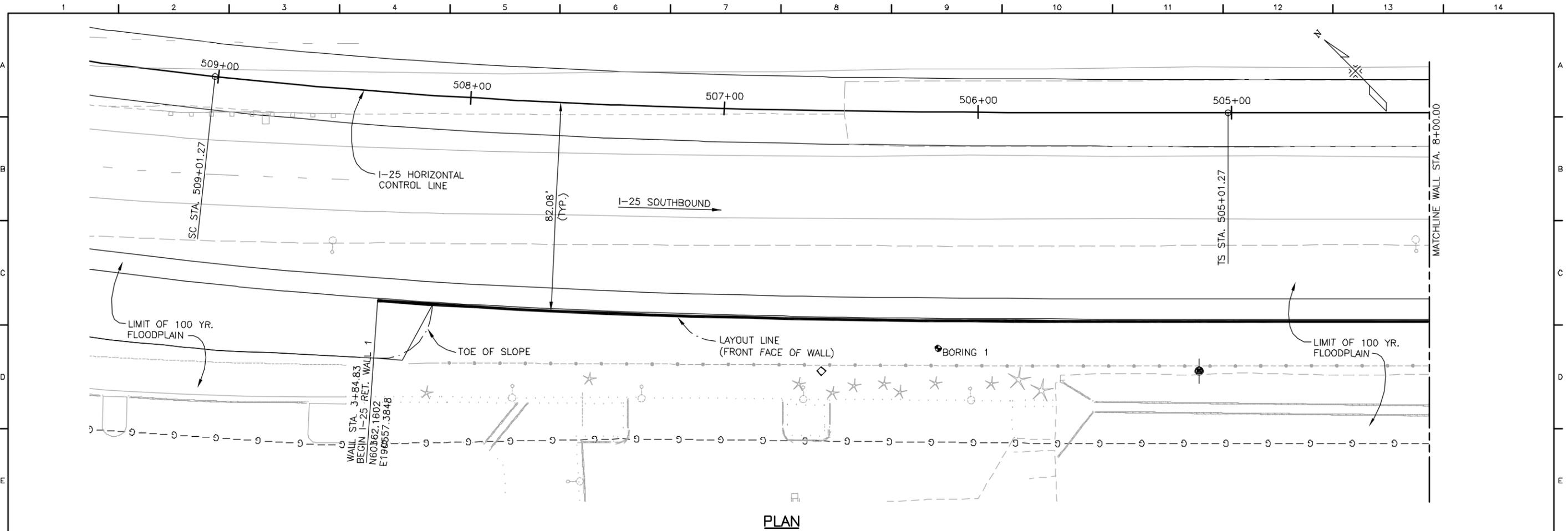
Region 2 James Flohr

As Constructed
No Revisions:
Revised:
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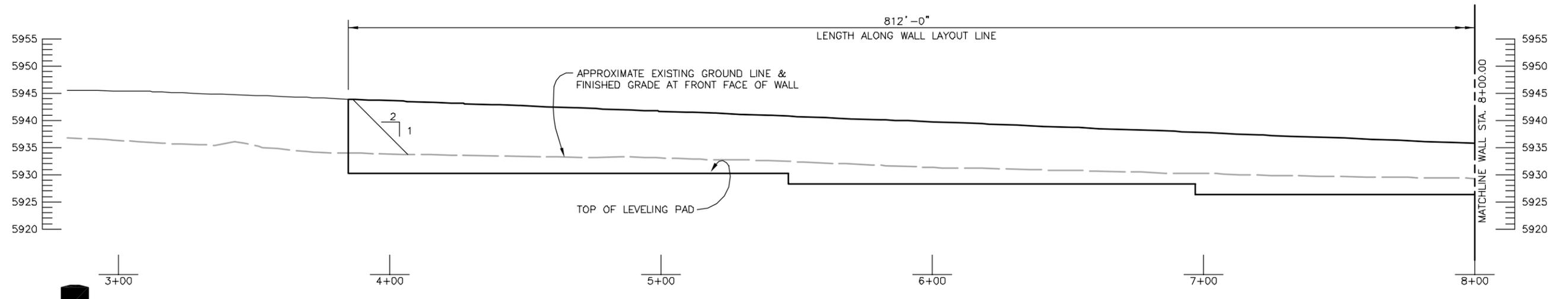
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Detailer:	DAK	Structure Number	MULTIPLE
Sheet Subset:	WALLS	Subset Sheets:	of

Project No./Code	IM-0252-334
Sheet Number	13126

**FIGURE NO. 7**



PLAN



ELEVATION

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Designed by	Checked by	Initial	Date	Initial	Date

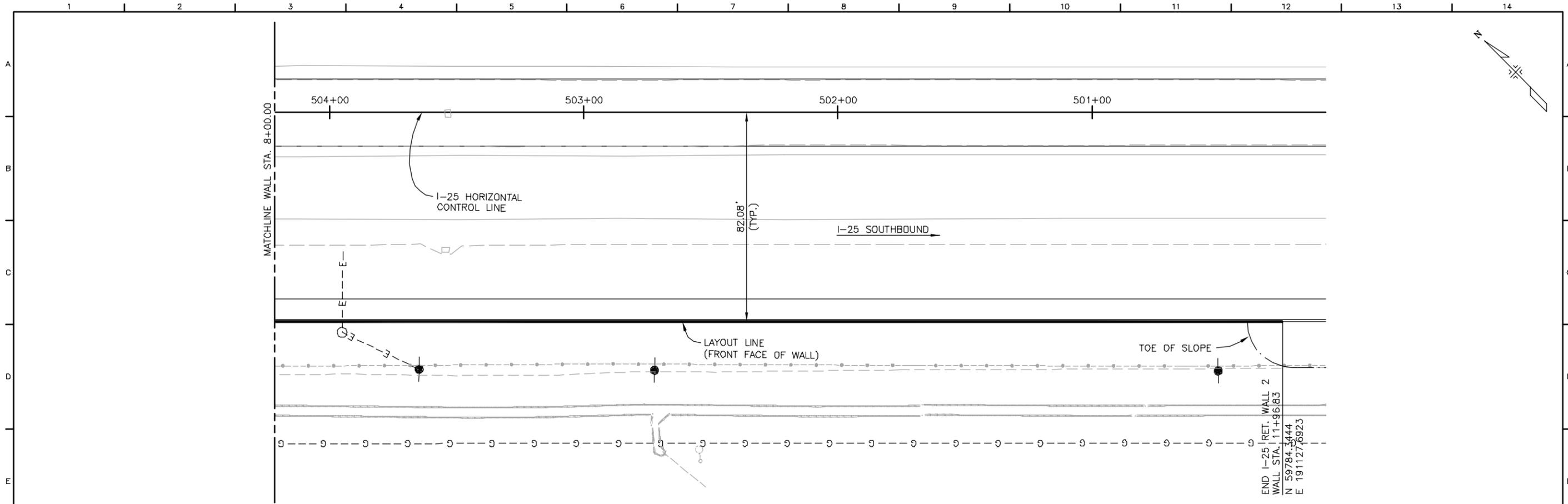


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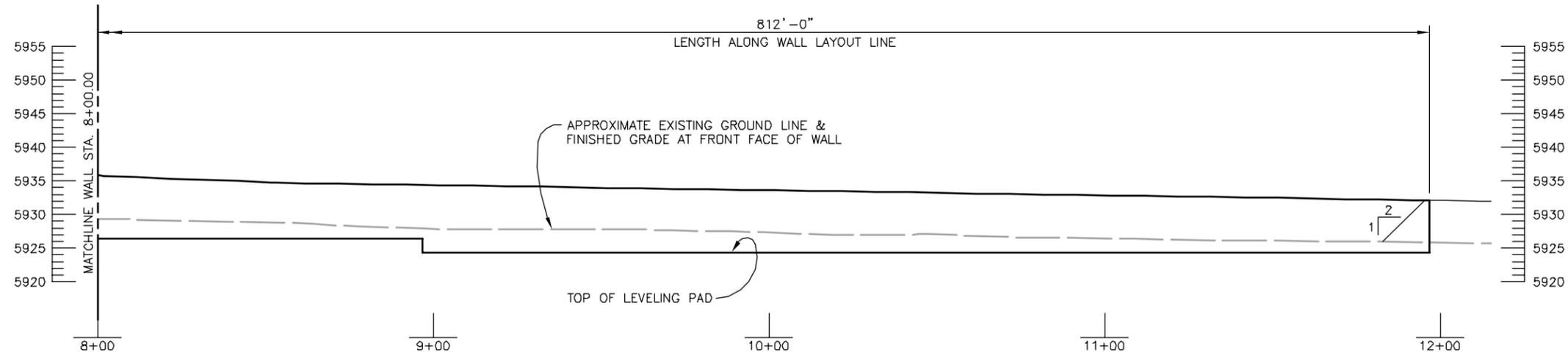
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PLAN



ELEVATION



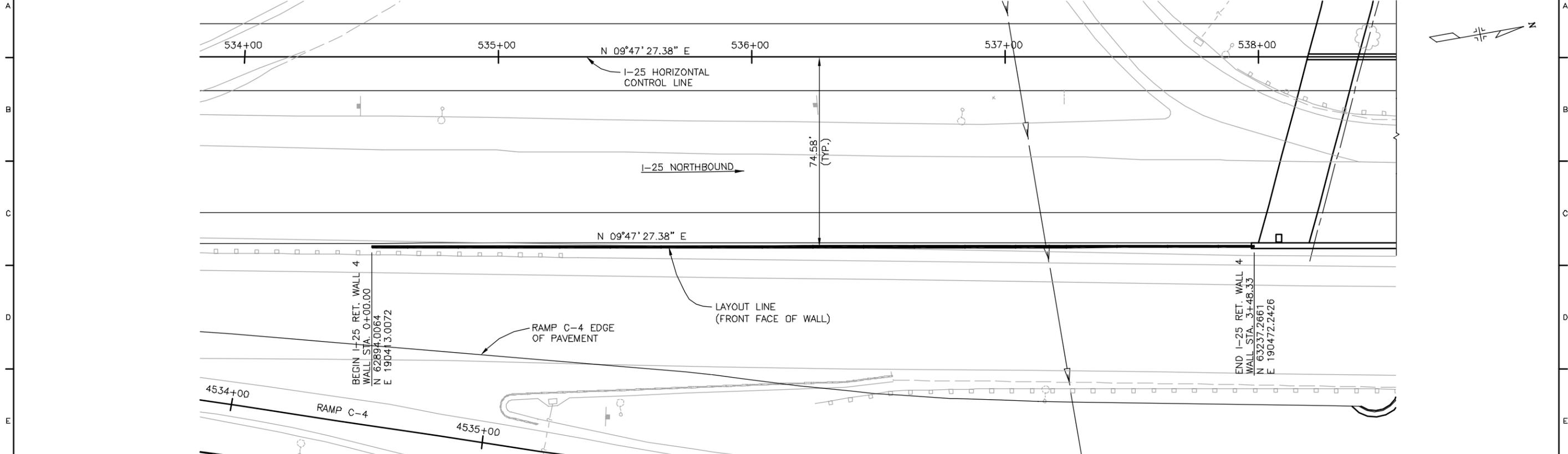
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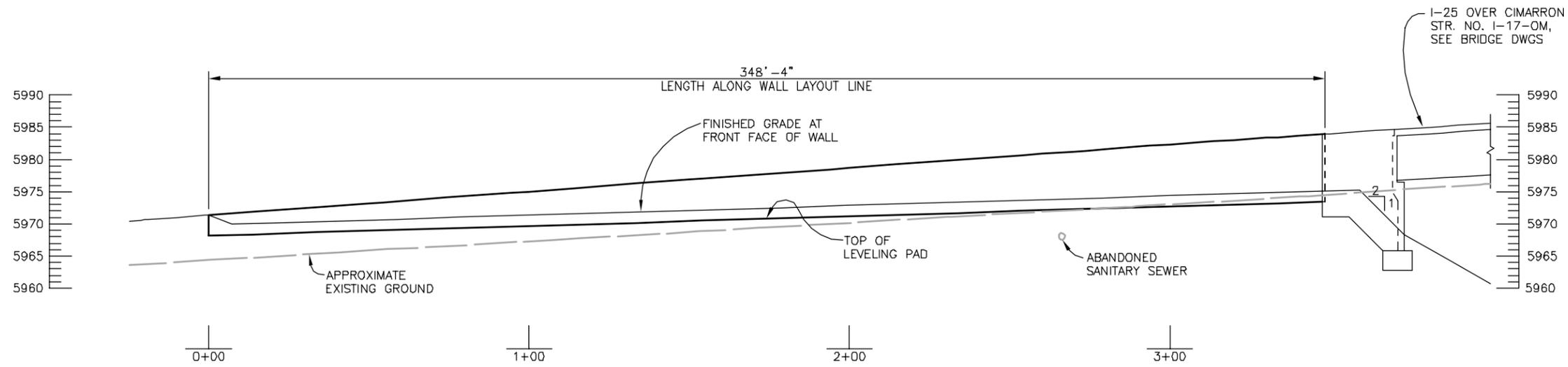




1 2 3 4 5 6 7 8 9 10 11 12 13 14



PLAN



ELEVATION

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FIGURE NO. 12

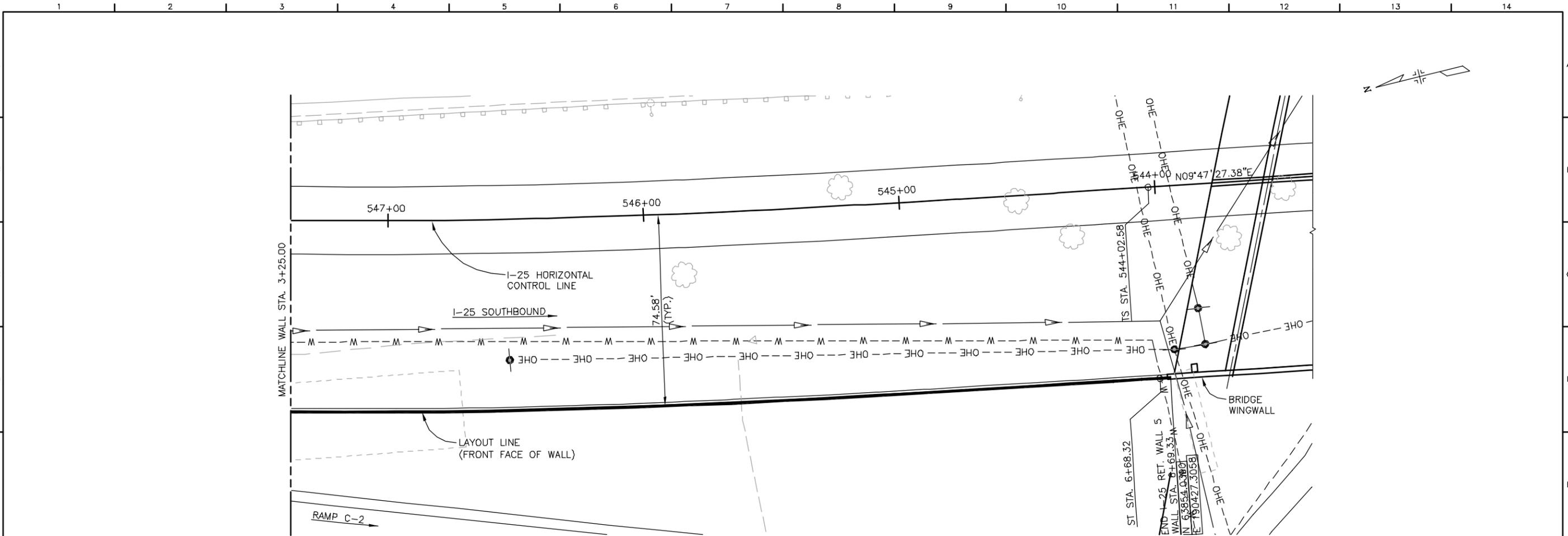
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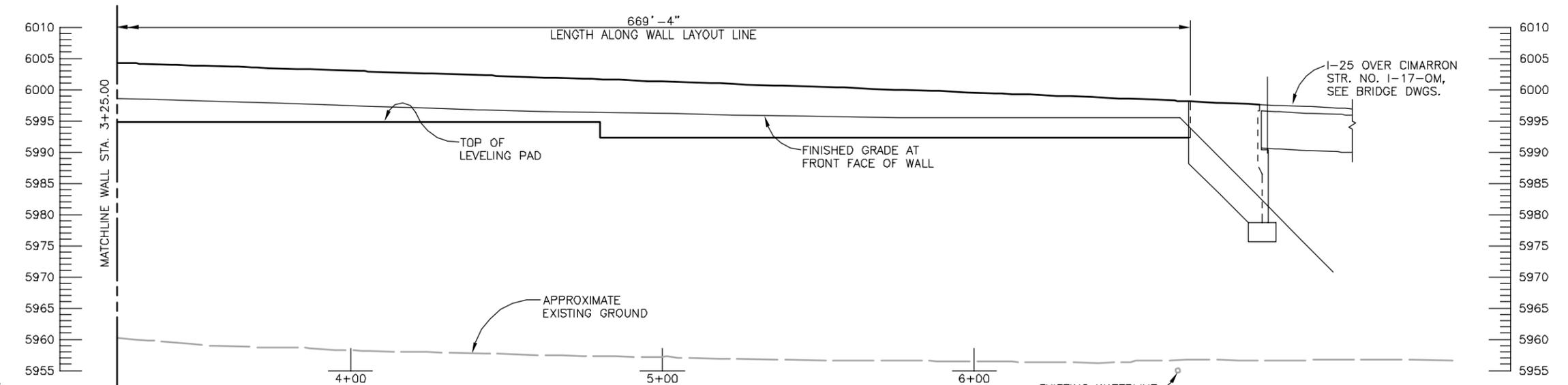


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**PLAN**



**ELEVATION**

**FIGURE NO. 14**



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Index of Revisions	

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**Region 2** James Flohr

As Constructed	
No Revisions:	
Revised:	
Void:	

I-25/CIMARRON/BIJOU INTERCHANGE I-25 RETAINING WALL 5 GENERAL LAYOUT (2 of 2)	
Designer: K. ALKANANI	Structure Numbers: WALL-I-17-CI
Detailer: R. DILLON	
Sheet Subset: WALL	Subset Sheets: of

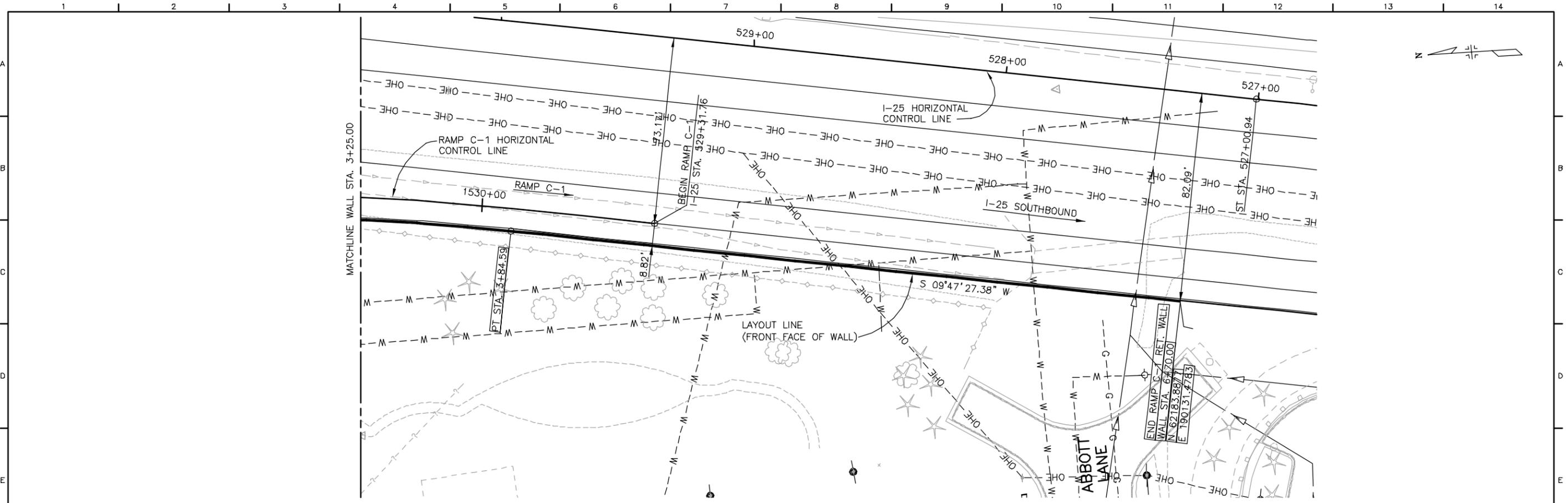
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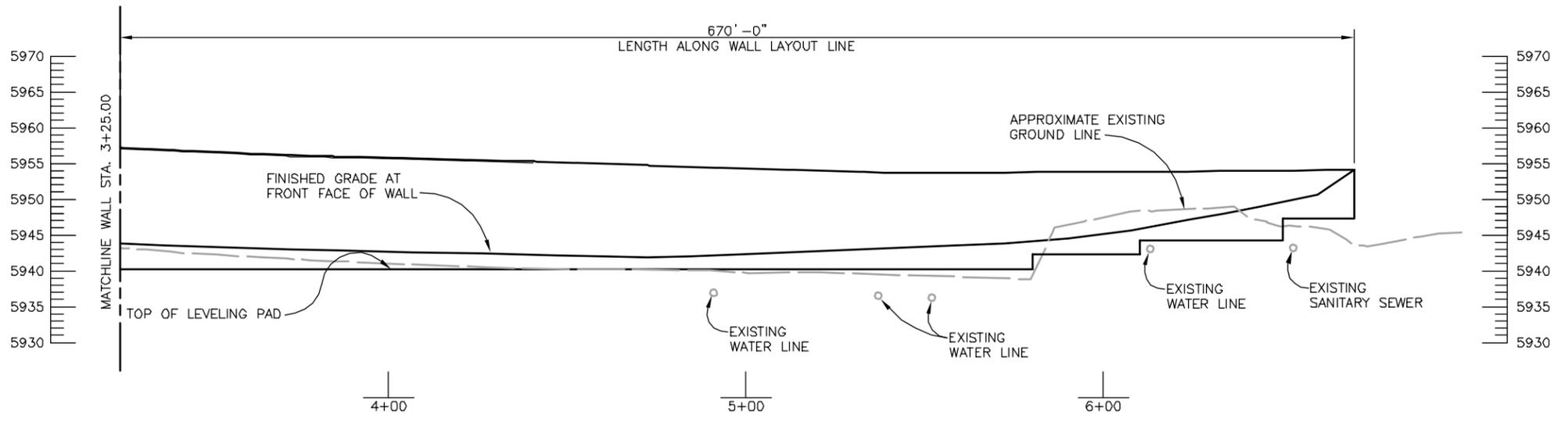


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PLAN



ELEVATION



FIGURE NO. 17

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Index of Revisions	

Colorado Department of Transportation  
 1480 Quail Lake Loop  
 Colorado Springs, Colorado 80906  
 Phone: 719-634-2323 FAX: 719-227-3298

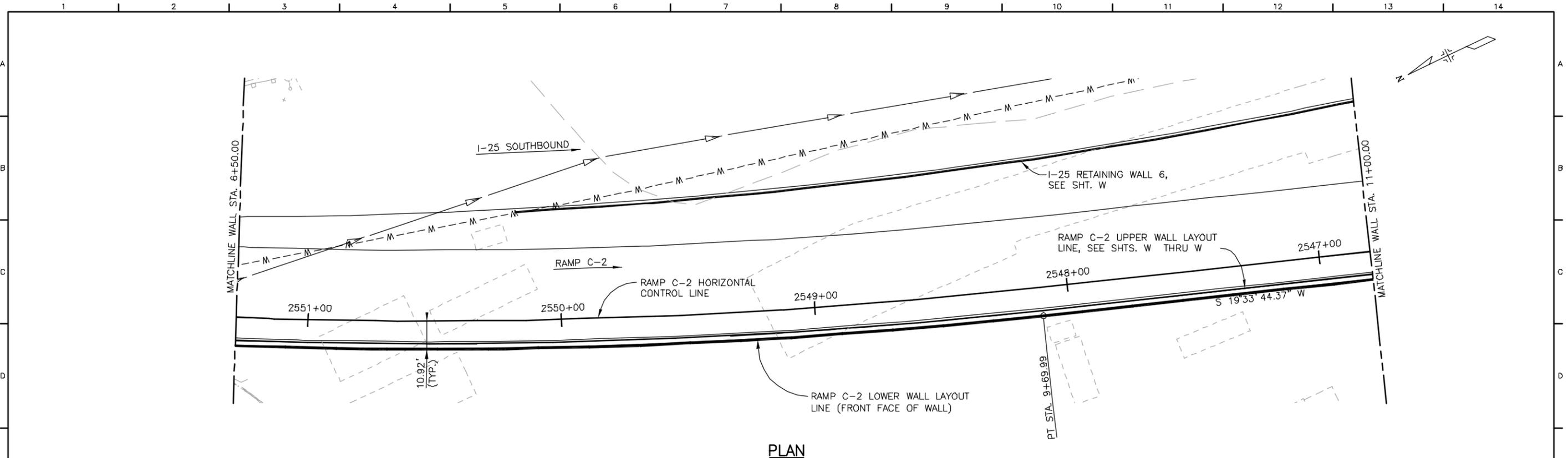
Region 2 James Flohr

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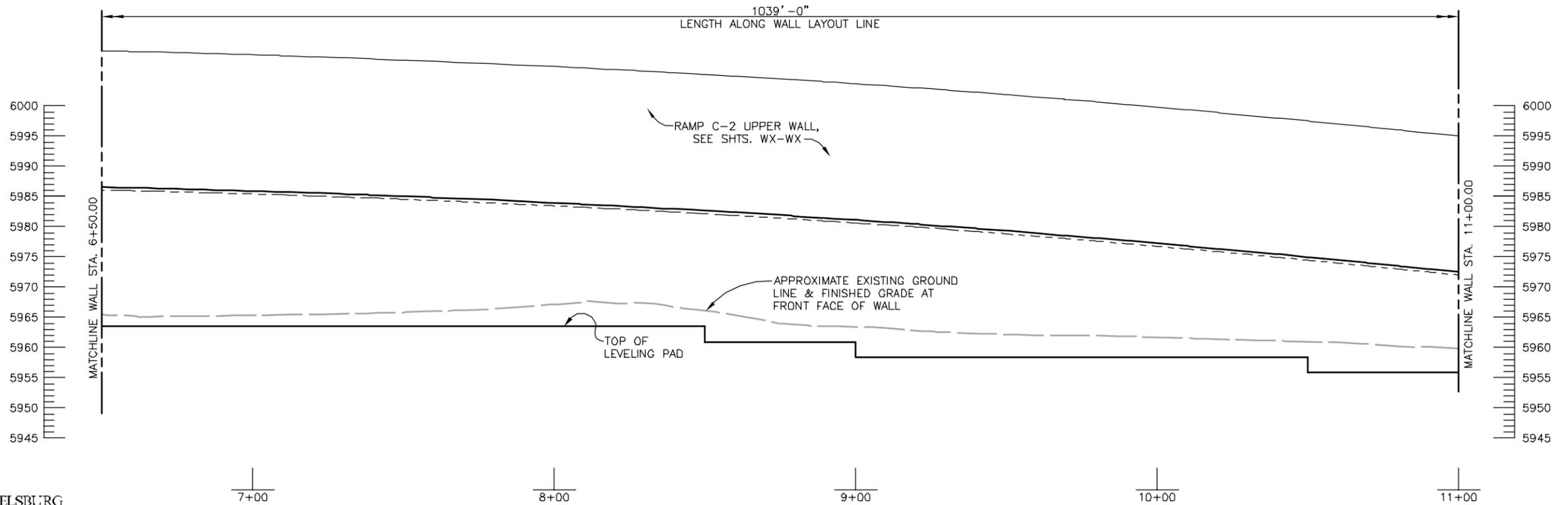
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Designer: K. ALKANANI	Structure: WALL-I-17-CE
Detailer: R. DILLON	Numbers:
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13126	
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PLAN



ELEVATION

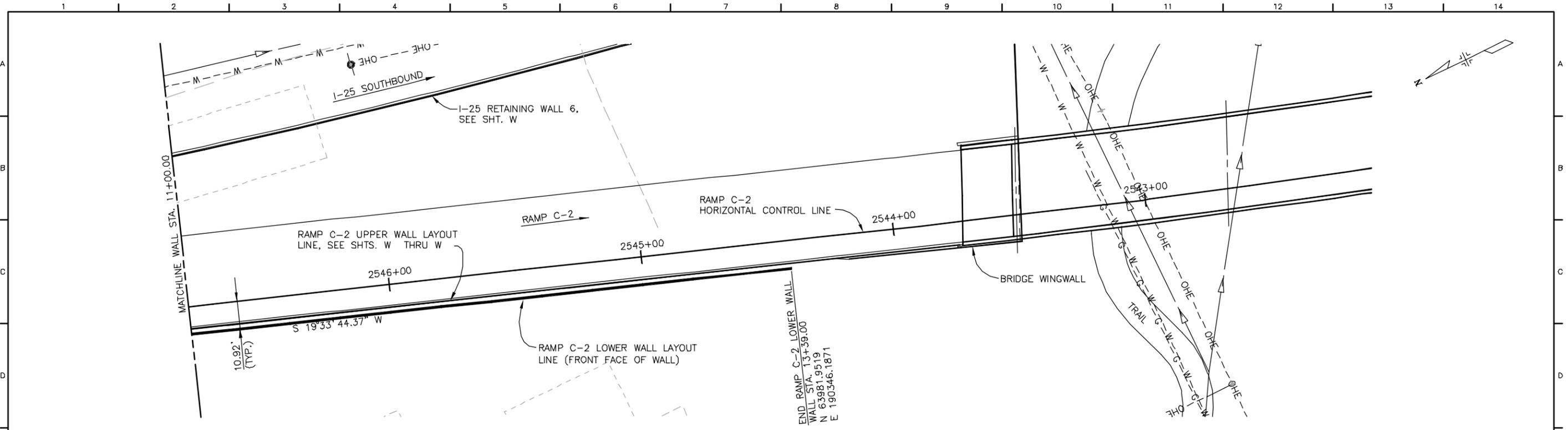
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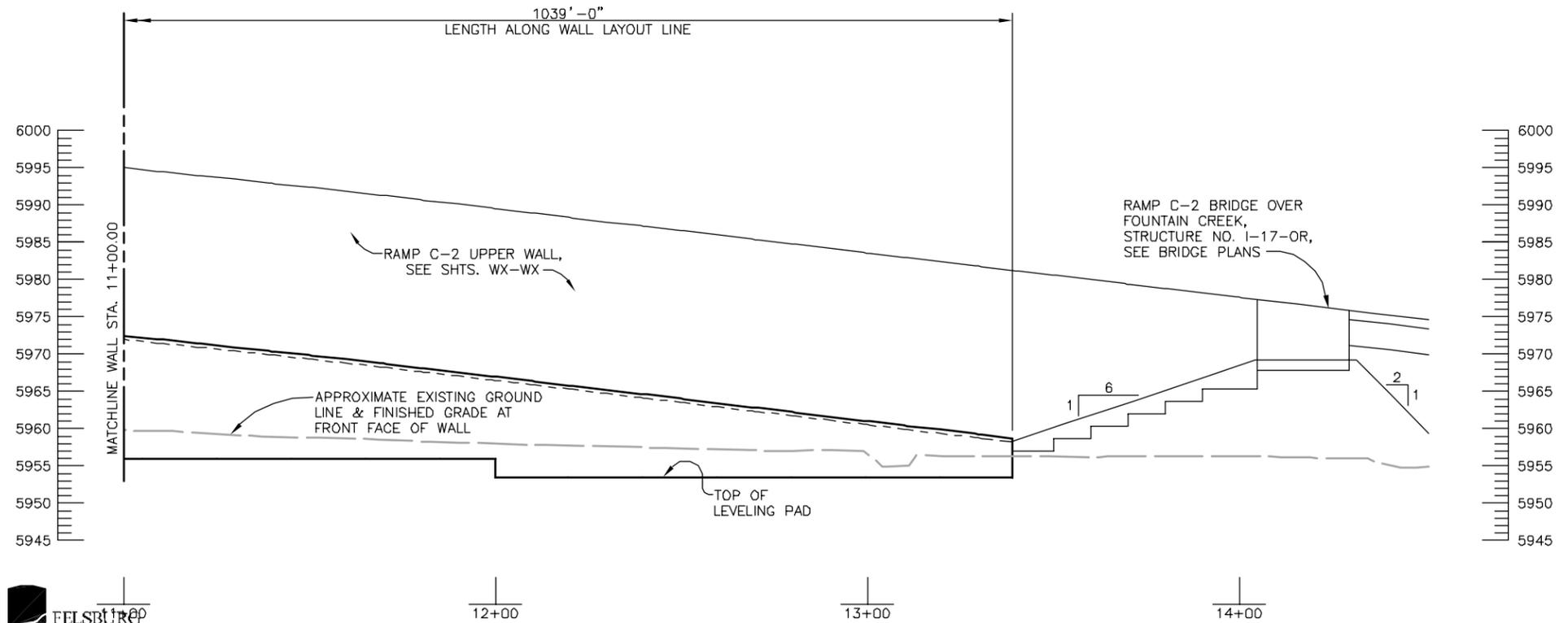


FIGURE NO. 19

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**ELEVATION**

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Revision Dates		Revision Dates		Revision Dates	

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Index of Revisions	

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 Colorado Springs, Colorado 80906  
 Phone: 719-634-2323 FAX: 719-227-3298

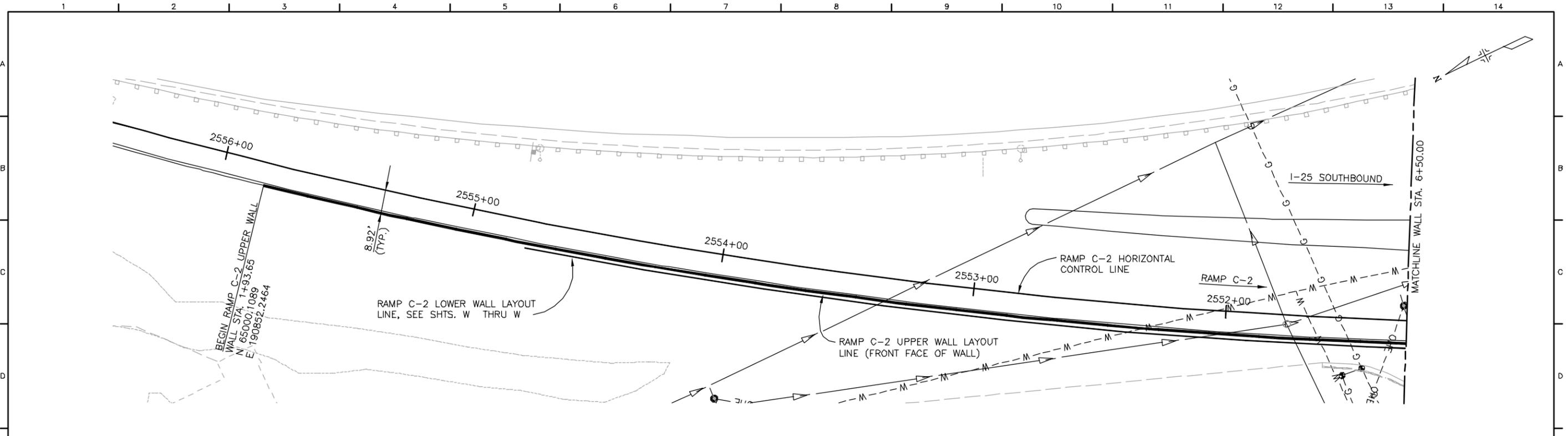
Region 2 James Flohr

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No Revisions:
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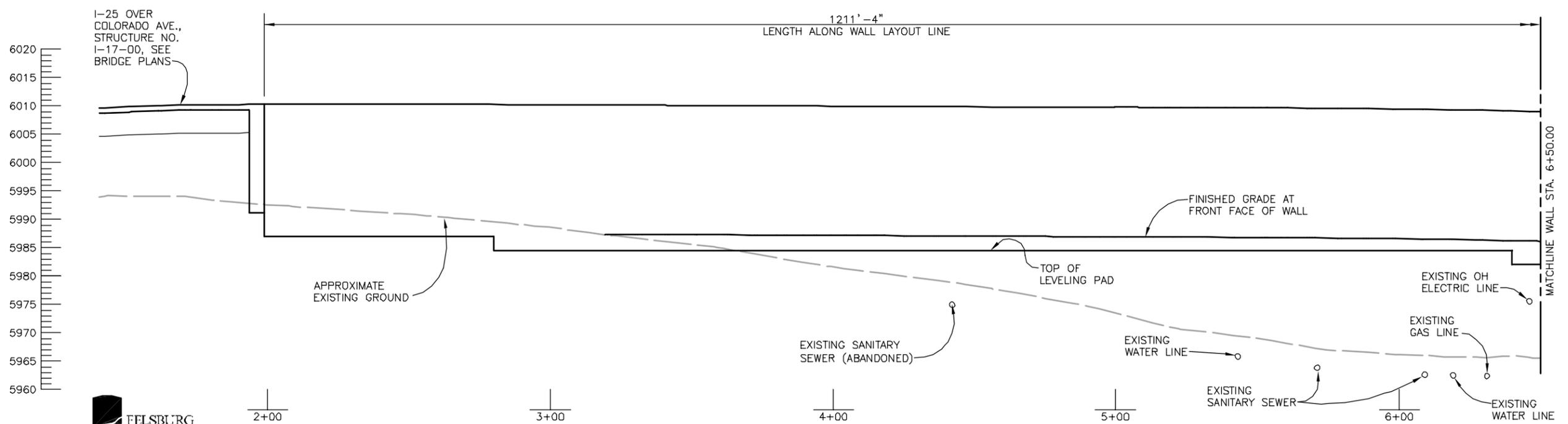
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Designer: K. ALKANANI	Structure Numbers: WALL-I-17-CL
Detailer: R. DILLON	
Sheet Subset: WALL	Subset Sheets: of

Project No./Code	IM 0252-334
	13126
Sheet Number	

**FIGURE NO. 20**



PLAN



ELEVATION

FIGURE NO. 21

QUANTITIES (Preliminary Stage Only)			
Initial	Date	Initial	Date
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X	X	X	X

DESIGN		DETAIL	
Initial	Date	Initial	Date
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Last Modification Date:	05/23/03	Initials:	RAD
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Drawing File Name:	W99163GLA02.DWG		
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Index of Revisions			

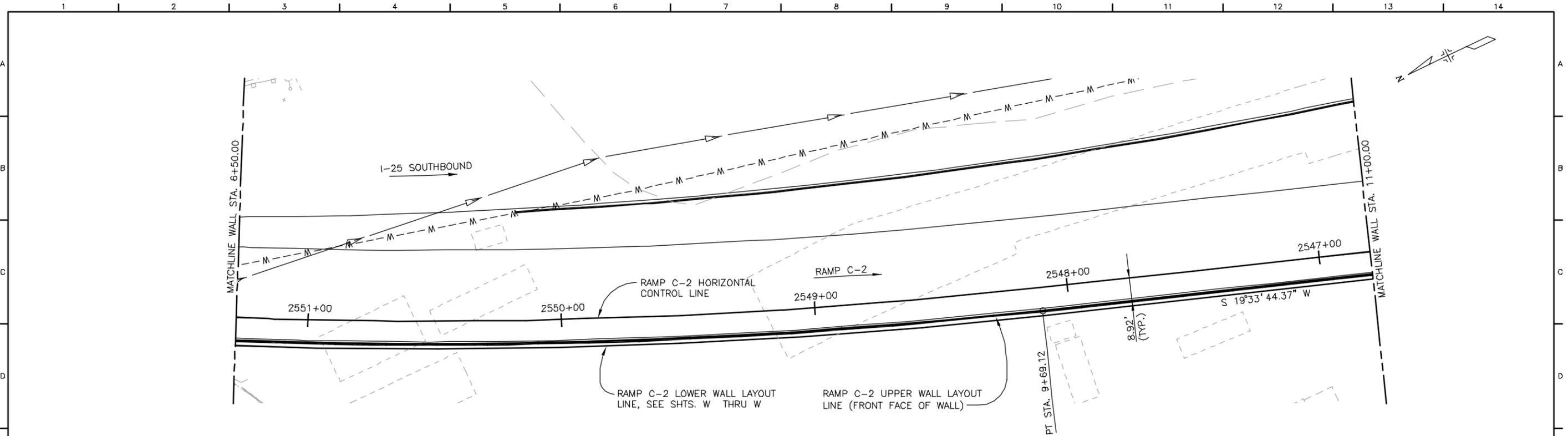


Colorado Department of Transportation  
 1480 Quail Lake Loop  
 Colorado Springs, Colorado 80906  
 Phone: 719-634-2323 FAX: 719-227-3298  
**Region 2**  
**James Flohr**

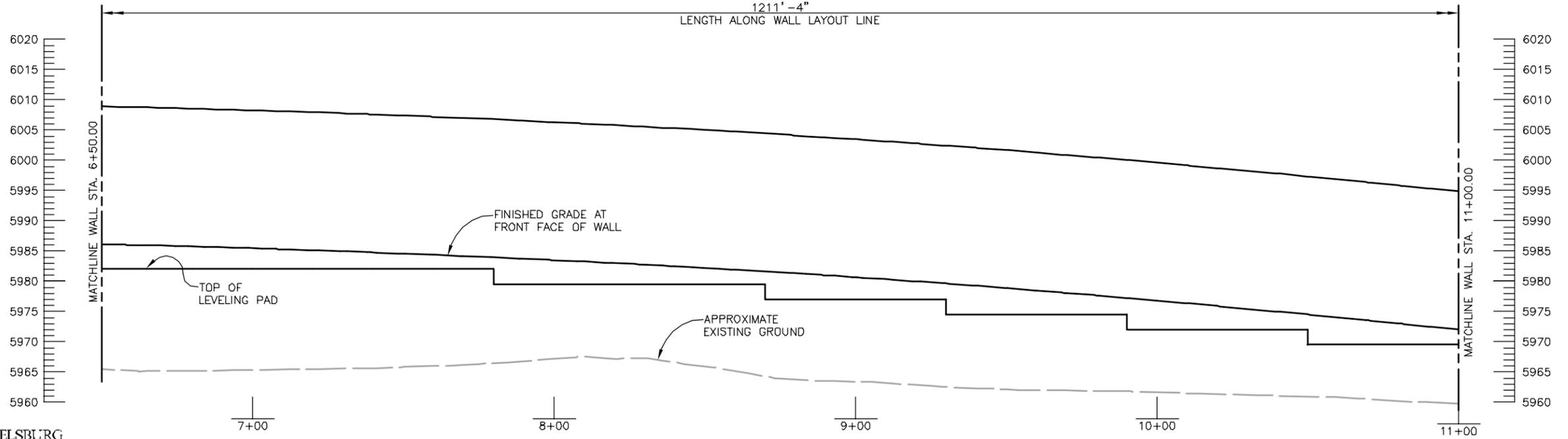
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No Revisions:	
Revised:	
Void:	

I-25/CIMARRON/BIJOU INTERCHANGE RAMP C-2 UPPER RETAINING WALL GENERAL LAYOUT (1 of 3)			
Designer:	K. ALKANANI	Structure Numbers:	WALL-I-17-CJ
Detailer:	P. HELM	Sheet Subset:	WALL
Subsets:		Subsets:	

Project No./Code	
IM	0252-334
<b>13126</b>	
Sheet Number	



**PLAN**



**ELEVATION**

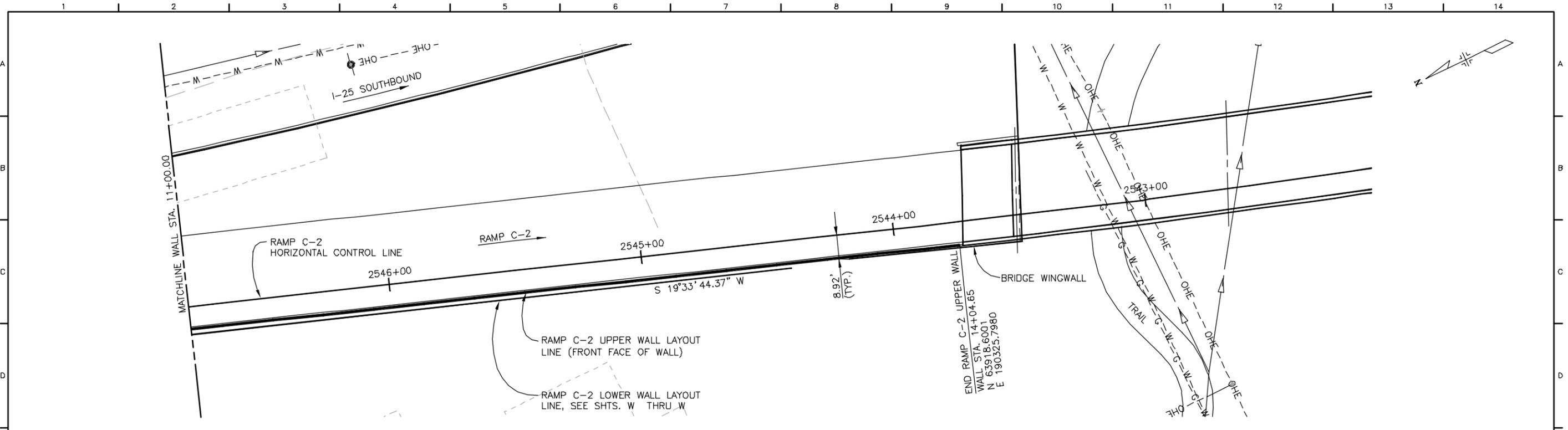
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Revision	Date	Initial	Quantity

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Designed by	Checked by	Initial	Date	Initial	Date
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X	X	X	X	X	X

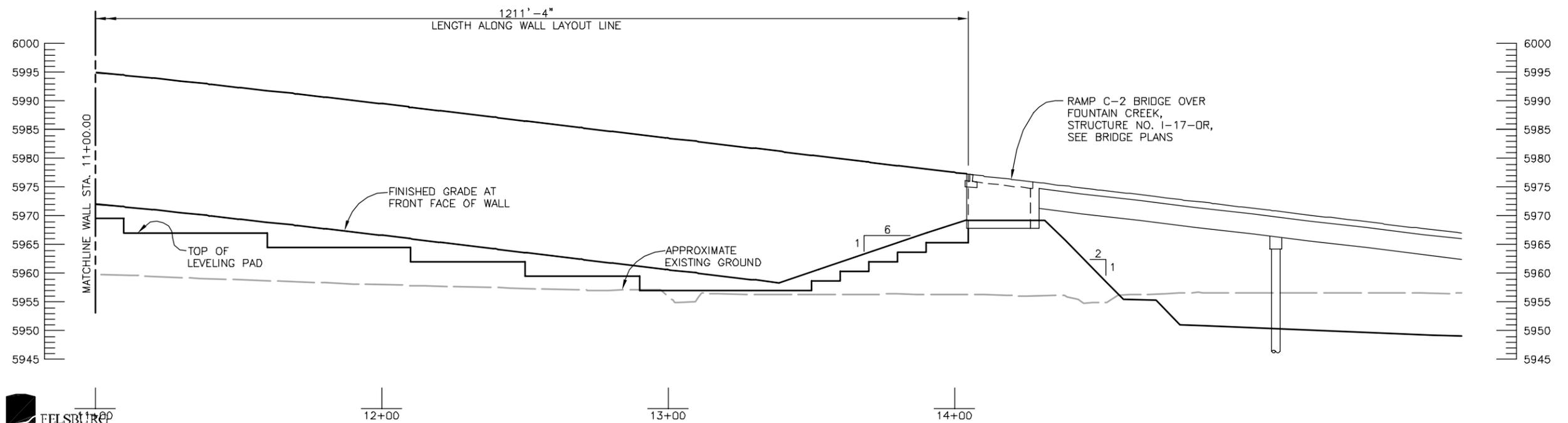


**FIGURE NO. 22**

<b>Computer File Information</b> Creation Date: 04/18/02 Initials: PRH Last Modification Date: 05/23/03 Initials: RAD Full Path: J:\99163\ACAD\SHEETS\ Drawing File Name: W99163GLA02.DWG Acad Ver. R2000i Scale: VARIES Units: FEET		<b>Index of Revisions</b> <table border="1"> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </table>											Colorado Department of Transportation  1480 Quail Lake Loop Colorado Springs, Colorado 80906 Phone: 719-634-2323 FAX: 719-227-3298 <b>Region 2</b> James Flohr		<b>As Constructed</b> No Revisions: Revised: Void:		<b>I-25/CIMARRON/BIJOU INTERCHANGE          RAMP C-2 UPPER RETAINING WALL          GENERAL LAYOUT (2 of 3)</b> Designer: K. ALKANANI Detailer: P. HELM Sheet Subset: WALL		<b>Project No./Code</b> IM 0252-334 <b>13126</b> Structure Numbers Subst Sheets: of Sheet Number	



PLAN



ELEVATION

QUANTITIES (Preliminary Stage Only)			
Revision	Date	Initial	Quantity

DESIGN		DETAIL		QUANTITIES	
Designed by	Date	Initial	Date	Initial	Date



FIGURE NO. 23

<b>Computer File Information</b> Creation Date: 04/18/02 Initials: PRH Last Modification Date: 05/23/03 Initials: RAD Full Path: J:\99163\ACAD\SHEETS\ Drawing File Name: W99163GLA02.DWG Acad Ver. R2000i Scale: VARIES Units: FEET		<b>Index of Revisions</b> <table border="1"> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </table>											Colorado Department of Transportation 1480 Quail Lake Loop Colorado Springs, Colorado 80906 Phone: 719-634-2323 FAX: 719-227-3298 <b>Region 2</b> James Flohr		<b>As Constructed</b> No Revisions: Revised: Void:		<b>I-25/CIMARRON/BIJOU INTERCHANGE          RAMP C-2 UPPER RETAINING WALL          GENERAL LAYOUT (3 of 3)</b> Designer: K. ALKANANI Detailer: P. HELM Sheet Subset: WALL		Project No./Code <b>IM 0252-334</b> <b>13126</b> Structure Numbers Subst Sheets: of Sheet Number	

DESIGN		DETAIL		QUANTITIES	
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125DESIGN CIMDESIGN CIMBIU_WALLS FLOODWAY					
BIJ_125_STRUCT BIJ_125_STRUCT BIJ_125_STRUCT BIU_COLO_STRUCT BIUDESIGN					
Revision Dates (Preliminary Stage Only)					

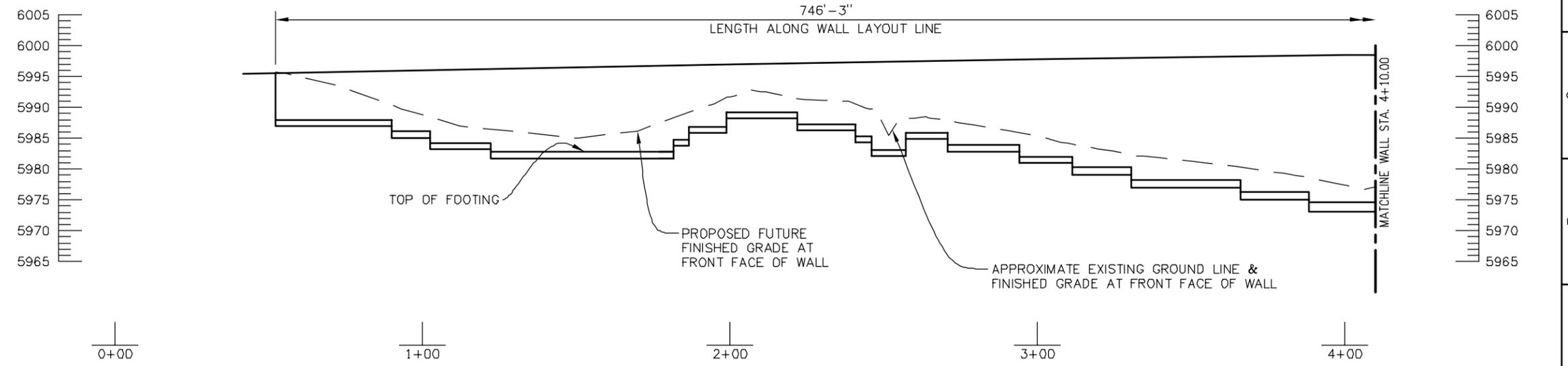
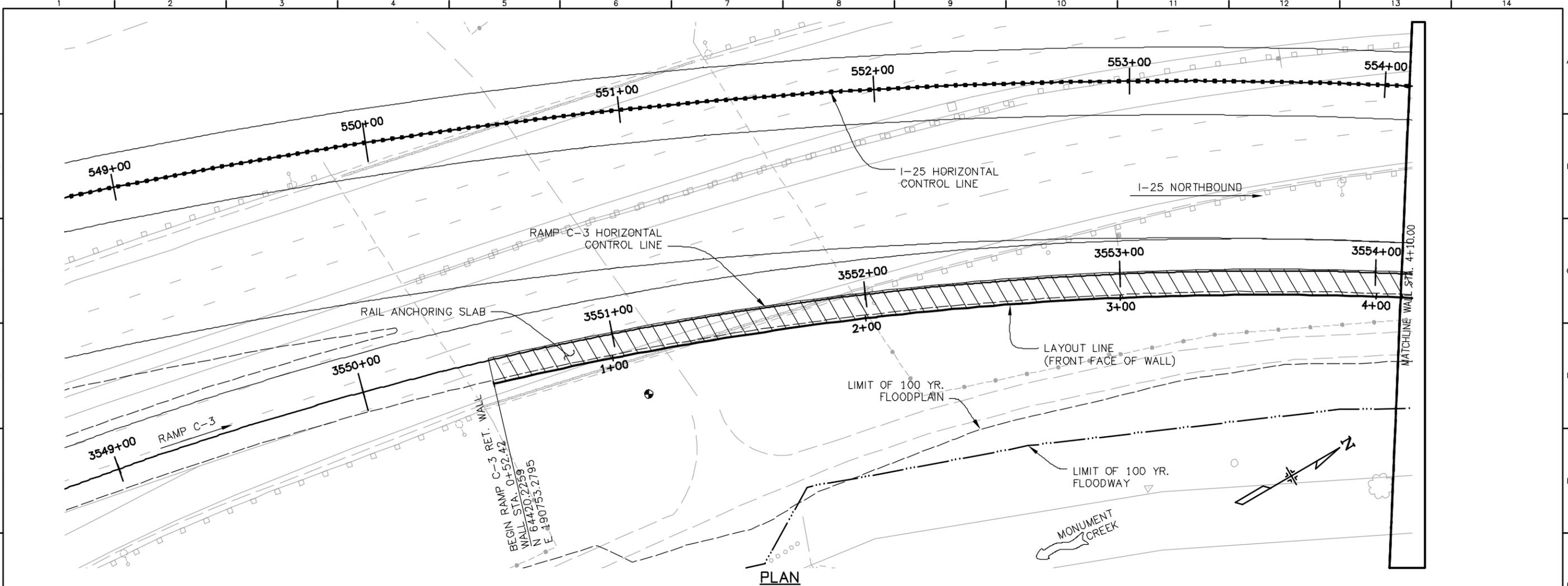
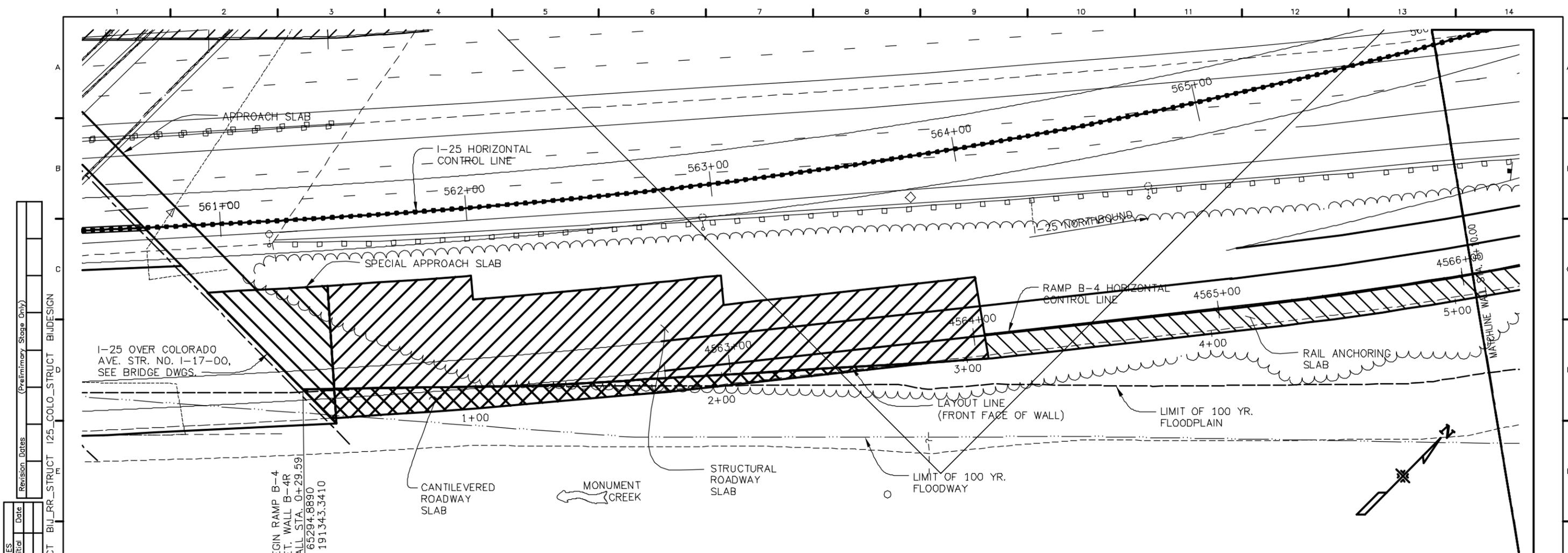


FIGURE NO. 24

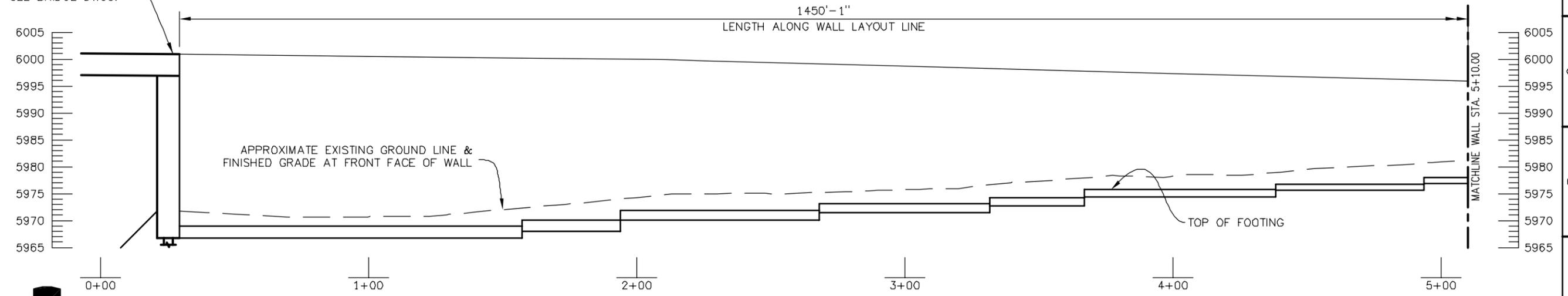
Computer File Information			Index of Revisions			Colorado Department of Transportation			As Constructed			1-25 CIMARRON/BIJOU INTERCHANGE RAMP C-3 RETAINING WALL GENERAL LAYOUT (1 of 2)			Project No./Code	
Creation Date:	03/28/03	Initials: DAK				1480 Quail Lake Loop Colorado Springs, Colorado 80906 Phone: 719-634-2323 FAX: 719-227-3298			No Revisions:			Designer: AAP			IM 0252-334	
Last Modification Date:	08/25/03	Initials: DAK				Region 2			Revised:			Detailer: DAK			13126	
Full Path:	Q:\X031000320\ACAD\Sheet\Struct\Walls\					James Flohr			Void:			Structure Number: WALL-I-17-CM			Sheet Number	
Drawing File Name:	wall_plnelev.DWG											Sheet Subset: WALLS			Subset Sheets: W03 of 11	
Acad Ver.:	R2000	Scale: 1" = 40'	Units:	English												

XREF = TOPO-MASTER





**PLAN**



**ELEVATION**

DESIGN	Designed by	CIMDESIGN	DATE	Initial	
	Checked by			Initial	
DETAIL	Detailed by	CIMBU_WALLS	DATE	Initial	
	Checked by			Initial	
QUANTITIES	Quantities by	BIJ_125_STRUCT	DATE	Initial	
	Checked by			Initial	
REVISION DATES	Revision Dates	BIJ_125_STRUCT	DATE	Initial	
				Initial	

Computer File Information			
Creation Date:	03/28/03	Initials:	DAK
Last Modification Date:	08/25/03	Initials:	DAK
Full Path:	Q:\X031000320\ACAD\Sheet\Struct\Walls\		
Drawing File Name:	wall_plnelev.DWG		
Acad Ver.	R2000	Scale:	1" = 40'
Units:	English		

Index of Revisions			

**Colorado Department of Transportation**

1480 Quail Lake Loop  
Colorado Springs, Colorado 80906  
Phone: 719-634-2323 FAX: 719-227-3298

**Region 2** James Flohr

As Constructed
No Revisions:
Revised:
Void:

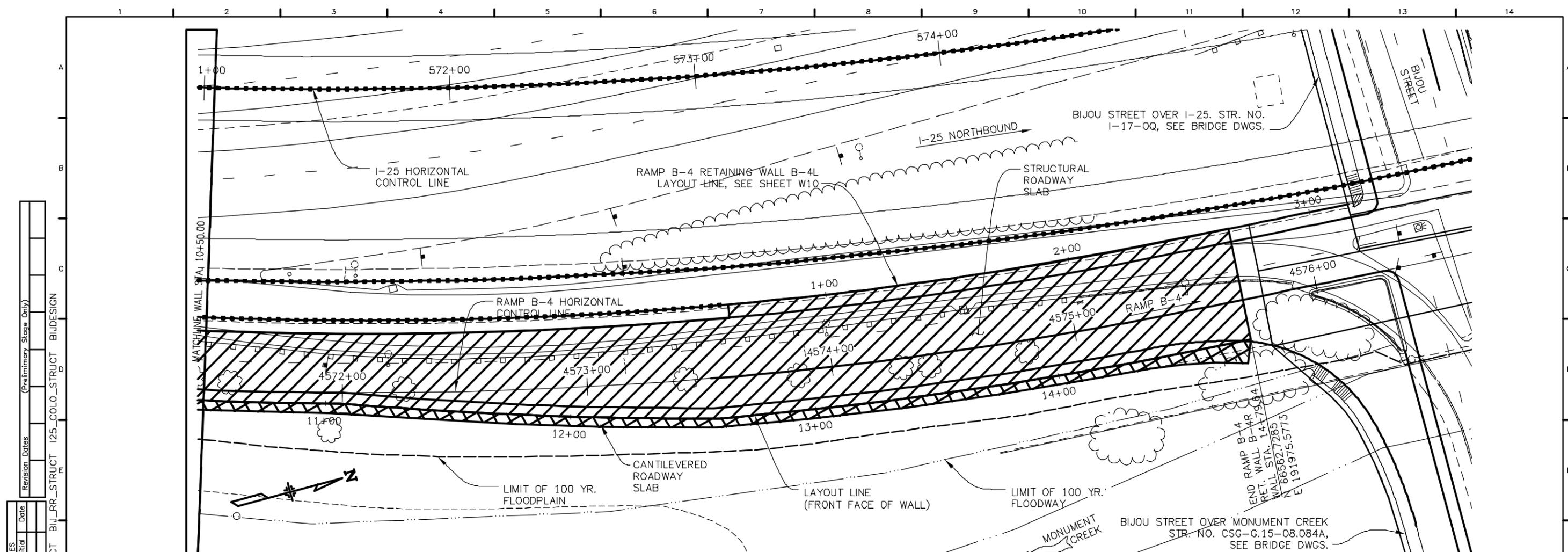
I-25 CIMARRON/BIJOU INTERCHANGE RAMP B-4 RETAINING WALL B-4R GENERAL LAYOUT (1 of 3)			
Designer:	AAP	Structure Number	WALL-I-17-BQ
Detailer:	DAK		
Sheet Subset:	WALLS	Subset Sheets:	W07 of 11

Project No./Code	IM 0252-334
Sheet Number	13126

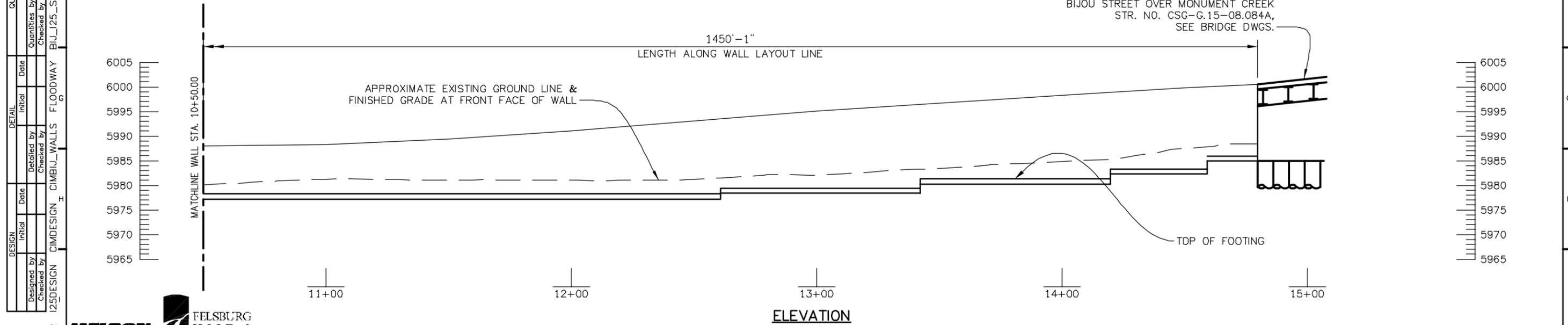
**FIGURE NO. 26**

XREF = TOPO-MASTER





PLAN



ELEVATION

DESIGN		DETAIL		QUANTITIES	
Designed by	Date	Initial	Date	Initial	Date
CIMDESIGN					
Checked by		Checked by		Checked by	

Computer File Information			
Creation Date:	03/28/03	Initials:	DAK
Last Modification Date:	08/25/03	Initials:	DAK
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Drawing File Name:	wall_plnelev.DWG		
Acad Ver.	R2000	Scale:	1" = 40'
Units:	English		

Index of Revisions			


**Corridor Improvements**  
 Colorado Department of Transportation  
 1480 Quail Lake Loop  
 Colorado Springs, Colorado 80906  
 Phone: 719-634-2323 FAX: 719-227-3298  
 Region 2 James Flohr

As Constructed	
No Revisions:	
Revised:	
Void:	

1-25 CIMARRON/BIJOU INTERCHANGE RAMP B-4 RETAINING WALL B-4R GENERAL LAYOUT (3 of 3)			
Designer:	AAP	Structure Number	WALL-I-17-BQ
Detailer:	DAK		
Sheet Subset:	WALLS	Subset Sheets:	WO9 of 11

Project No./Code	
IM	0252-334
13126	
Sheet Number	

FIGURE NO. 28

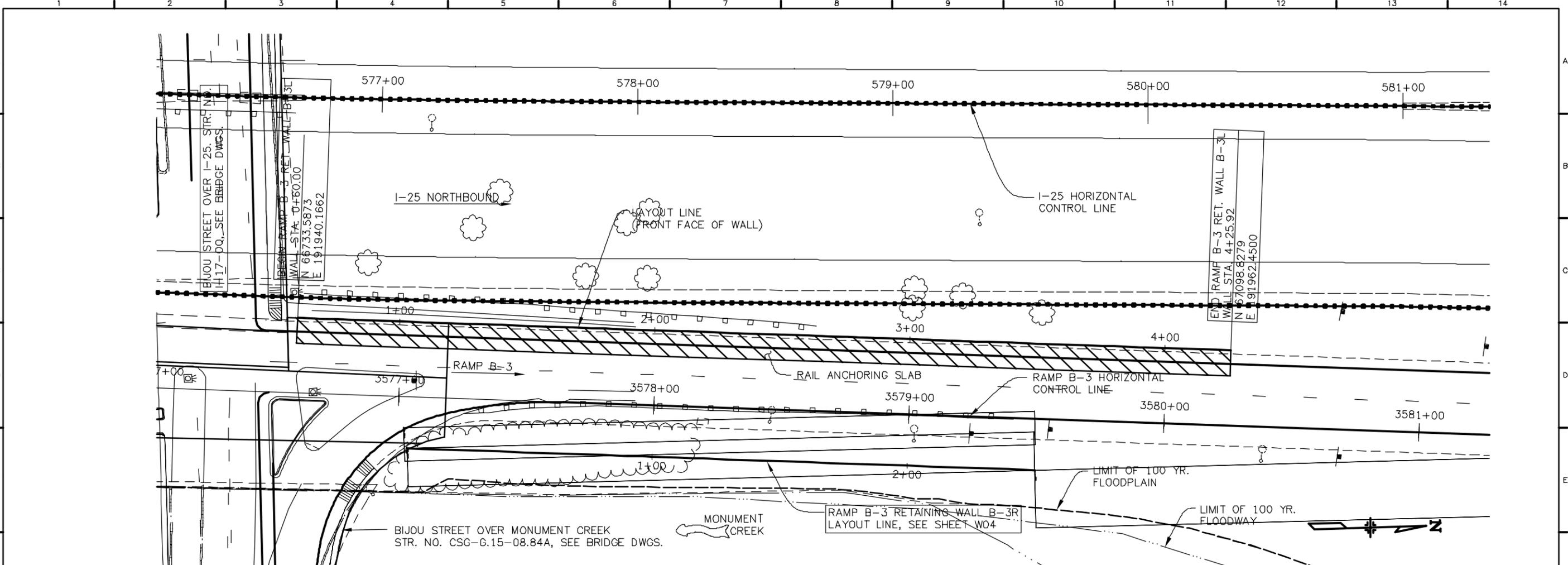
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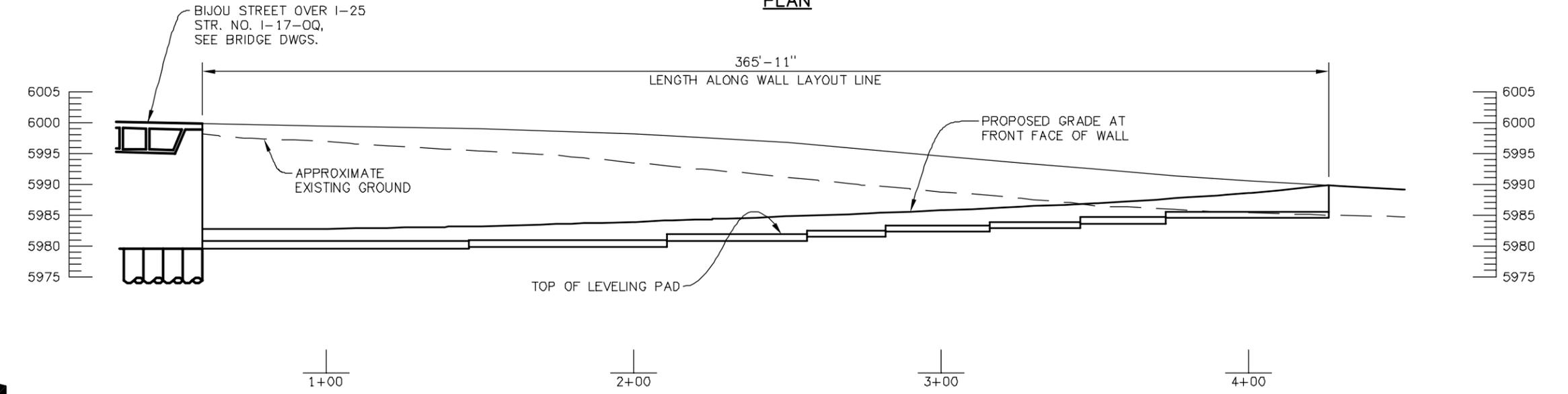


DESIGN		DETAIL		QUANTITIES	
Designed by	Date	Initial	Date	Initial	Date
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Checked by		Detailed by		Checked by	

XREF = TOPO-MASTER  
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 BIU\_125\_STRUCT BIU\_125\_STRUCT BIU\_125\_STRUCT BIU\_125\_STRUCT BIUDESIGN  
 BIU\_17-0Q, SEE BRIDGE DWGS.  
 BIU\_17-0Q, SEE BRIDGE DWGS.  
 (Preliminary Stage Only)



**PLAN**



**ELEVATION**



Computer File Information			
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Last Modification Date:	08/25/03	Initials:	DAK
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Acad Ver.	R2000	Scale:	1" = 40'
Units:	English		

Index of Revisions			

Colorado Department of Transportation  
 1480 Quail Lake Loop  
 Colorado Springs, Colorado 80906  
 Phone: 719-634-2323 FAX: 719-227-3298  

 Region 2 James Flohr

As Constructed	
No Revisions:	
Revised:	
Void:	

I-25 CIMARRON/BIJOU INTERCHANGE RAMP B-3, RETAINING WALL B-3L GENERAL LAYOUT			
Designer:	AAP	Structure Number	WALL-I-17-CQ
Detailer:	DAK		
Sheet Subset:	WALLS	Subset Sheets:	W06 of 11

Project No./Code	
IM	0252-334
13126	
Sheet Number	

**FIGURE NO. 31**





**Appendix C**

**Bridge Alternatives Opinion of Construction Costs**

**Retaining Wall Alternatives Opinion of Construction Costs**



**I-25 MAINLINE BRIDGES**

**Opinion of Probable Construction Costs  
I-25 over Bear Creek  
Alternative B: Prestressed Concrete U Tub Girder (U48)**

Item #	Description	Unit	Totals	Cost/Unit	Cost
202	Removal of Structure	LS	1	\$ 20,000.00	\$ 20,000.00
206	Structure Excavation	CY	5,340	\$ 7.00	\$ 37,380.00
206	Structure Backfill (Special)	CY	1,530	\$ 35.00	\$ 53,550.00
502	Pile Tip	EA	50	\$ 90.00	\$ 4,500.00
502	Steel Piling (HP 12X74)	LF	1,588	\$ 28.00	\$ 44,470.00
506	Riprap (24 Inch)	CY	2,175	\$ 47.00	\$ 102,230.00
515	Concrete Sealer	SY	2,600	\$ 5.00	\$ 13,000.00
518	Bridge Expansion Device (0-4 Inch)	LF	336	\$ 138.00	\$ 46,370.00
601	Concrete Class D (Bridge)	CY	1,050	\$ 325.00	\$ 341,250.00
601	Bridge Deck Finish (Sawed Grooves)	SY	2,470	\$ 9.00	\$ 22,230.00
602	Reinforcing Steel (Black)	LB	235,232	\$ 0.50	\$ 117,620.00
602	Reinforcing Steel (Epoxy Coated)	LB	58,800	\$ 0.60	\$ 35,280.00
606	Bridge Rail Type 7 (Special)	LF	140	\$ 61.00	\$ 8,540.00
606	Bridge Rail Type 10 (Special)	LF	281	\$ 92.00	\$ 25,860.00
618	Precast Concrete U Girder (Pre-Tensioned)	LF	1,180	\$ 200.00	\$ 236,000.00

**Subtotal** \$ 1,108,280.00  
**Misc. Items & Contingency (15%)** \$ 166,242.00  
**Total** \$ 1,274,522.00

**SUMMARY:**

**Total Estimate of Probable Construction Cost** \$ **1,275,000**  
 Cost/SF \$77

**Opinion of Probable Construction Costs  
I-25 over Bear Creek  
Alternative A: Precast Prestressed Girder (BT54)**

Item #	Description	Unit	Totals	Cost/Unit	Cost
202	Removal of Structure	LS	1	\$ 20,000.00	\$ 20,000.00
206	Structure Excavation	CY	5,340	\$ 7.00	\$ 37,380.00
206	Structure Backfill (Special)	CY	1,530	\$ 35.00	\$ 53,550.00
502	Pile Tip	EA	50	\$ 90.00	\$ 4,500.00
502	Steel Piling (HP 12X74)	LF	1,588	\$ 28.00	\$ 44,470.00
506	Riprap (24 Inch)	CY	2,175	\$ 47.00	\$ 102,230.00
515	Concrete Sealer	SY	2,600	\$ 5.00	\$ 13,000.00
518	Bridge Expansion Device (0-4 Inch)	LF	336	\$ 138.00	\$ 46,370.00
601	Concrete Class D (Bridge)	CY	1,050	\$ 325.00	\$ 341,250.00
601	Bridge Deck Finish (Sawed Grooves)	SY	2,470	\$ 9.00	\$ 22,230.00
602	Reinforcing Steel (Black)	LB	235,232	\$ 0.50	\$ 117,620.00
602	Reinforcing Steel (Epoxy Coated)	LB	58,800	\$ 0.60	\$ 35,280.00
606	Bridge Rail Type 7 (Special)	LF	140	\$ 61.00	\$ 8,540.00
606	Bridge Rail Type 10 (Special)	LF	281	\$ 92.00	\$ 25,860.00
618	Prestressed Concrete I (BT54)	LF	1,770	\$ 100.00	\$ 177,000.00

**Subtotal** \$ 1,049,280.00  
**Misc. Items & Contingency (15%)** \$ 157,392.00  
**Total** \$ 1,206,672.00

**SUMMARY:**

**Total Estimate of Probable Construction Cost** \$ **1,207,000**  
 Cost/SF \$73





**Opinion of Probable Construction Costs  
I-25 over Bear Creek  
Alternative C: Wide Flange Steel Girder (W40X277 )**

Item #	Description	Unit	Totals	Cost/Unit	Cost
202	Removal of Structure	LS	1	\$ 20,000.00	\$ 20,000.00
206	Structure Excavation	CY	5,340	\$ 7.00	\$ 37,380.00
206	Structure Backfill (Special)	CY	1,530	\$ 35.00	\$ 53,550.00
502	Pile Tip	Each	50	\$ 90.00	\$ 4,500.00
502	Steel Piling (HP 12X74)	LF	1,588	\$ 28.00	\$ 44,470.00
506	Riprap (24 Inch)	CY	2,175	\$ 47.00	\$ 102,230.00
509	Structural Steel	LB	514,810	\$ 0.80	\$ 411,850.00
515	Concrete Sealer	SY	2,600	\$ 5.00	\$ 13,000.00
518	Bridge Expansion Device (0-4 Inch)	LF	336	\$ 138.00	\$ 46,370.00
601	Concrete Class D (Bridge)	CY	1,050	\$ 325.00	\$ 341,250.00
601	Bridge Deck Finish (Sawed Grooves)	SY	2,470	\$ 9.00	\$ 22,230.00
602	Reinforcing Steel (Black)	LB	235,232	\$ 0.50	\$ 117,620.00
602	Reinforcing Steel (Epoxy Coated)	LB	58,800	\$ 0.60	\$ 35,280.00
606	Bridge Rail Type 7 (Special)	LF	140	\$ 61.00	\$ 8,540.00
606	Bridge Rail Type 10 (Special)	LF	281	\$ 92.00	\$ 25,860.00

**Subtotal** \$ 1,284,130.00  
**Misc. Items & Contingency (15%)** \$ 192,619.50  
**Total** \$ 1,476,749.50

\*Note: Excavation beneath bridge was included for comparison purposes to the CBC

**SUMMARY:**

**Total Estimate of Probable Construction Cost** \$ **1,477,000**  
**Cost/SF** \$**89**

**Opinion of Probable Construction Costs  
I-25 over Cimarron Street  
Alternative A: Cast-in-Place Post-Tensioned Box Girders**

Item #	Description	Unit	Totals	Cost/Unit	Cost
202	Removal of Bridge	LS	1	\$ 40,000.00	\$ 40,000.00
206	Structure Excavation	CY	2,205	\$ 7.00	\$ 15,440.00
206	Structure Backfill (Class 1)	CY	3,816	\$ 16.00	\$ 61,060.00
206	Structure Backfill (Class 2)	CY	1,218	\$ 10.00	\$ 12,180.00
206	Mechanical Reinforcing of Soil	CY	3,053	\$ 20.00	\$ 61,060.00
502	Pile Tip	EA	64	\$ 90.00	\$ 5,760.00
502	Steel Piling (HP 12X74)	LF	3,200	\$ 28.00	\$ 89,600.00
503	Drilled Caisson (54 inch)	LF	1,440	\$ 245.00	\$ 352,800.00
507	Slope and Ditch Paving (Special)	CY	180	\$ 421.00	\$ 75,780.00
515	Concrete Sealer	SY	9,321	\$ 5.00	\$ 46,610.00
518	Bridge Expansion Device (0-4 Inch)	LF	315	\$ 138.00	\$ 43,470.00
601	Concrete Class D (Bridge)	CY	8,200	\$ 385.00	\$ 3,157,000.00
601	Bridge Deck Finish (Sawed Grooves)	SY	9,321	\$ 9.00	\$ 83,890.00
602	Reinforcing Steel (Black)	LB	579,445	\$ 0.50	\$ 289,730.00
602	Reinforcing Steel (Epoxy Coated)	LB	805,605	\$ 0.60	\$ 483,370.00
606	Bridge Rail Type 7 (Special)	LF	560	\$ 61.00	\$ 34,160.00
606	Bridge Rail Type 10M (Special)	LF	1,120	\$ 92.00	\$ 103,040.00
618	Prestressing Steel Wire or Strand	MKFT	20,330	\$ 21.00	\$ 426,930.00

**Subtotal** \$ 5,381,880.00  
**Misc. Items & Contingency (15%)** \$ 807,282.00  
**Total** \$ 6,189,162.00

**SUMMARY:**

**Total Estimate of Probable Construction Cost** \$ **6,190,000**  
**Cost/SF** \$**79**





**Opinion of Probable Construction Costs  
I-25 over Cimarron Street  
Alternative B: Precast Prestressed Concrete U Tub Girders**

**Project:** Cimmaron / Bijou Interchange  
**Location:** I-25 Over Colorado Avenue  
**Alternative:** 3-Span Precast U-Girder (Pre-tensioned)  
**Estimate:** Preliminary Cost Estimate - Complete

Wilson & Company

By: GRT

Date: 5/29/03

Item #	Description	Unit	Totals	Cost/Unit	Cost
202	Removal of Bridge	LS	1	\$ 40,000.00	\$ 40,000.00
206	Structure Excavation	CY	2,205	\$ 7.00	\$ 15,440.00
206	Structure Backfill (Class 1)	CY	3,816	\$ 16.00	\$ 61,060.00
206	Structure Backfill (Class 2)	CY	1,218	\$ 10.00	\$ 12,180.00
206	Mechanical Reinforcing of Soil	CY	3,053	\$ 20.00	\$ 61,060.00
502	Pile Tip	EA	64	\$ 90.00	\$ 5,760.00
502	Steel Piling (HP 12X74)	LF	3,200	\$ 28.00	\$ 89,600.00
503	Drilled Caisson (54 inch)	LF	1,440	\$ 245.00	\$ 352,800.00
507	Slope and Ditch Paving (Special)	CY	180	\$ 421.00	\$ 75,780.00
515	Concrete Sealer	SY	9,321	\$ 5.00	\$ 46,610.00
518	Bridge Expansion Device (0-4 Inch)	LF	315	\$ 138.00	\$ 43,470.00
601	Concrete Class D (Bridge)	CY	4,930	\$ 325.00	\$ 1,602,250.00
601	Bridge Deck Finish (Sawed Grooves)	SY	9,321	\$ 9.00	\$ 83,890.00
602	Reinforcing Steel (Black)	LB	223,655	\$ 0.50	\$ 111,830.00
602	Reinforcing Steel (Epoxy Coated)	LB	751,760	\$ 0.60	\$ 451,060.00
606	Bridge Rail Type 7 (Special)	LF	560	\$ 61.00	\$ 34,160.00
606	Bridge Rail Type 10M (Special)	LF	1,120	\$ 92.00	\$ 103,040.00
618	Prestressed Concrete U Girder (Pre-Tensioned)	LF	5,100	\$ 250.00	\$ 1,275,000.00

Subtotal \$ 4,464,990.00  
 Misc. Items & Contingency (15%) \$ 669,748.50  
**Total \$ 5,134,738.50**

**SUMMARY:**

**Total Estimate of Probable Construction Cost \$ 5,135,000**  
 Cost/SF \$66

ITEM	DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
202	Removal of Bridge	EA	2	\$ 50,000.00	\$ 100,000
206	Structure Excavation	CY	336	\$ 7.00	\$ 2,352
206	Structure Backfill (Class 1)	CY	5,262	\$ 16.00	\$ 84,192
206	Structure Backfill (Class 2)	CY	277	\$ 10.00	\$ 2,770
206	Mechanical Reinforcing of Soil	CY	5,262	\$ 20.00	\$ 105,240
503	Drilled Caisson (36 Inch)	LF	1,506	\$ 140.00	\$ 210,840
503	Drilled Caisson (48 Inch)	LF	86	\$ 230.00	\$ 19,780
503	Drilled Caisson (60 Inch)	LF	480	\$ 300.00	\$ 144,000
503	Drilled Caisson (84 Inch)	LF	60	\$ 600.00	\$ 36,000
507	Conc. Slope & Ditch Paving (Reinf.)	CY	158	\$ 421.00	\$ 66,518
515	Concrete Sealer	SY	6,395	\$ 5.00	\$ 31,975
518	Bridge Expansion Device (0-4 Inch)	LF	482	\$ 160.00	\$ 77,120
601	Concrete Class B (Wall)	CY	66	\$ 400.00	\$ 26,400
601	Concrete Class D (Bridge) (substr.)	CY	1,531	\$ 325.00	\$ 497,575
601	Concrete Class D (Bridge) (super.)	CY	2,590	\$ 325.00	\$ 841,750
601	Bridge Deck Finish (Sawed Grooves)	SY	6,395	\$ 9.00	\$ 57,555
602	Reinforcing Steel	LB	203,306	\$ 0.50	\$ 101,653
602	Reinforcing Steel (Epoxy Coated)	LB	414,328	\$ 0.60	\$ 248,597
606	Bridge Rail Type 7 (Special)	LF	360	\$ 61.00	\$ 21,960
606	Bridge Rail Type 10M (Special)	LF	724	\$ 92.00	\$ 66,608
618	P/S Steel Wire or Strand (transv.)	MKFT	1,240	\$ 60.00	\$ 74,400
618	Precast Concrete U Girder (Pre-Tensioned)	LF	3,524	\$ 200.00	\$ 704,800

Subtotal \$ 3,522,085  
 Misc. Items & Contingency 15% \$ 528,313

**Total \$ 4,050,398**

**Total Estimate of Probable Construction Cost \$ 4,050,000**  
 Structure Area (SF) 57,552

Cost / SF \$ 70





**Project:** Cimarron / Bijou Interchange  
**Location:** I-25 Over Colorado Avenue  
**Alternative:** A - 3 Span Steel Box Girder  
**Estimate:** Preliminary Cost Estimate - Comparison

Wilson & Company  
 By: GRT  
 Date: 5/29/03

ITEM	DESCRIPTION	UNIT	TOTALS	COST/UNIT	COST
503	Drilled Caisson (30 Inch)	LF	1,482	\$ 130.00	\$ 192,660
503	Drilled Caisson (48 Inch)	LF	85	\$ 230.00	\$ 19,550
503	Drilled Caisson (60 Inch)	LF	472	\$ 300.00	\$ 141,600
503	Drilled Caisson (84 Inch)	LF	59	\$ 600.00	\$ 35,400
509	Structural Steel	LB	2,772,000	\$ 1.05	\$ 2,910,600
512	Bearing Device (Type III)	EA	44	\$ 6,000.00	\$ 264,000
515	Concrete Sealer	SY	7,374	\$ 5.00	\$ 36,870
601	Concrete Class D (Bridge) (substr.)	CY	1,559	\$ 325.00	\$ 506,675
601	Concrete Class D (Bridge) (super.)	CY	1,917	\$ 325.00	\$ 623,025
601	Bridge Deck Finish (Sawed Grooves)	SY	7,374	\$ 9.00	\$ 66,366
602	Reinforcing Steel	LB	194,826	\$ 0.50	\$ 97,413
602	Reinforcing Steel (Epoxy Coated)	LB	306,765	\$ 0.60	\$ 184,059
606	Bridge Rail Type 7 (Special)	LF	365	\$ 61.00	\$ 22,265
606	Bridge Rail Type 10M (Special)	LF	731	\$ 92.00	\$ 67,252
618	P/S Steel Wire or Strand (transv.)	MKFT	1,515	\$ 60.00	\$ 90,900

**Subtotal** \$ **5,258,635**

**Misc. Items & Contingency** 0% \$ -

**Total** \$ **5,258,635**

**Total Estimate of Probable Construction Cost** \$ **5,260,000**

**Structure Area (SF)** **66,362**

**Cost / SF** \$ **79.2**

**Project:** Cimarron / Bijou Interchange  
**Location:** I-25 Over Colorado Avenue  
**Alternative:** B - 3-Span Precast U-Girder (Spliced, Post-tensioned)  
**Estimate:** Preliminary Cost Estimate - Comparison

Wilson & Company  
 By: GRT  
 Date: 5/29/03

ITEM	DESCRIPTION	UNIT	TOTALS	COST/UNIT	COST
503	Drilled Caisson (36 Inch)	LF	1,482	\$ 140.00	\$ 207,480
503	Drilled Caisson (48 Inch)	LF	85	\$ 230.00	\$ 19,550
503	Drilled Caisson (66 Inch)	LF	472	\$ 350.00	\$ 165,200
503	Drilled Caisson (96 Inch)	LF	59	\$ 800.00	\$ 47,200
512	Bearing Device (Type II)	EA	44	\$ 2,500.00	\$ 110,000
515	Concrete Sealer	SY	7,374	\$ 5.00	\$ 36,870
601	Concrete Class D (Bridge) (substr.)	CY	1,559	\$ 325.00	\$ 506,675
601	Concrete Class D (Bridge) (super.)	CY	2,340	\$ 325.00	\$ 760,500
601	Bridge Deck Finish (Sawed Grooves)	SY	7,374	\$ 9.00	\$ 66,366
602	Reinforcing Steel	LB	194,826	\$ 0.50	\$ 97,413
602	Reinforcing Steel (Epoxy Coated)	LB	374,463	\$ 0.60	\$ 224,678
606	Bridge Rail Type 7 (Special)	LF	365	\$ 61.00	\$ 22,265
606	Bridge Rail Type 10M (Special)	LF	731	\$ 92.00	\$ 67,252
618	P/S Steel Wire or Strand (transv.)	MKFT	1,968	\$ 60.00	\$ 118,080
618	P/S Steel Wire or Strand (longit.)	MKFT	24,109	\$ 21.00	\$ 506,289
618	Prestressed Concrete Unit (Special)	LF	4,018	\$ 350.00	\$ 1,406,300

**Subtotal** \$ **4,362,118**

**Misc. Items & Contingency** 0% \$ -

**Total** \$ **4,362,118**

**Total Estimate of Probable Construction Cost** \$ **4,360,000**

**Structure Area (SF)** **66,362**

**Cost / SF** \$ **65.7**



**Project:** Cimarron / Bijou Interchange  
**Location:** I-25 Over Colorado Avenue  
**Alternative:** C - 3-Span Cast-in-place Box Girder (Post-tensioned)  
**Estimate:** Preliminary Cost Estimate - Comparison

Wilson & Company  
 By: GRT  
 Date: 5/29/03

ITEM	DESCRIPTION	UNIT	TOTALS	COST/UNIT	COST
503	Drilled Caisson (36 Inch)	LF	1,465	\$ 140.00	\$ 205,100
503	Drilled Caisson (54 Inch)	LF	84	\$ 275.00	\$ 23,100
503	Drilled Caisson (96 Inch)	LF	295	\$ 800.00	\$ 236,000
515	Concrete Sealer	SY	7,374	\$ 5.00	\$ 36,870
601	Concrete Class D (Bridge) (substr.)	CY	1,270	\$ 325.00	\$ 412,750
601	Concrete Class D (Bridge) (super.)	CY	4,615	\$ 385.00	\$ 1,776,775
601	Bridge Deck Finish (Sawed Grooves)	SY	7,374	\$ 9.00	\$ 66,366
602	Reinforcing Steel	LB	158,778	\$ 0.50	\$ 79,389
602	Reinforcing Steel (Epoxy Coated)	LB	738,387	\$ 0.60	\$ 443,032
606	Bridge Rail Type 7 (Special)	LF	365	\$ 61.00	\$ 22,265
606	Bridge Rail Type 10M (Special)	LF	731	\$ 92.00	\$ 67,252
618	P/S Steel Wire or Strand (transv.)	MKFT	2,025	\$ 60.00	\$ 121,500
618	P/S Steel Wire or Strand (longit.)	MKFT	15,342	\$ 21.00	\$ 322,182

<b>Subtotal</b>	<b>\$ 3,812,581</b>
<b>Misc. Items &amp; Contingency 0%</b>	<b>\$ -</b>
<b>Total</b>	<b>\$ 3,812,581</b>
<b>Total Estimate of Probable Construction Cost Structure Area (SF)</b>	<b>\$ 3,810,000</b> <b>66,362</b>
<b>Cost / SF</b>	<b>\$ 57.5</b>

**Project:** Cimarron / Bijou Interchange  
**Location:** I-25 Over Colorado Avenue  
**Alternative:** D - 4-Span Precast U-Girder (Pre-tensioned)  
**Estimate:** Preliminary Cost Estimate - Comparison

Wilson & Company  
 By: GRT  
 Date: 5/29/03

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
503	Drilled Caisson (36 Inch)	LF	1,482	\$ 140.00	\$ 207,480
503	Drilled Caisson (48 Inch)	LF	85	\$ 230.00	\$ 19,550
503	Drilled Caisson (54 Inch)	LF	712	\$ 275.00	\$ 195,800
503	Drilled Caisson (78 Inch)	LF	89	\$ 450.00	\$ 40,050
515	Concrete Sealer	SY	7,374	\$ 5.00	\$ 36,870
601	Concrete Class D (Bridge) (substr.)	CY	1,926	\$ 325.00	\$ 625,950
601	Concrete Class D (Bridge) (super.)	CY	2,587	\$ 325.00	\$ 840,775
601	Bridge Deck Finish (Sawed Grooves)	SY	7,374	\$ 9.00	\$ 66,366
602	Reinforcing Steel	LB	240,809	\$ 0.50	\$ 120,405
602	Reinforcing Steel (Epoxy Coated)	LB	413,953	\$ 0.60	\$ 248,372
606	Bridge Rail Type 7 (Special)	LF	365	\$ 61.00	\$ 22,265
606	Bridge Rail Type 10M (Special)	LF	731	\$ 92.00	\$ 67,252
618	P/S Steel Wire or Strand (transv.)	MKFT	1,542	\$ 60.00	\$ 92,520
618	Precast Concrete U Girder (Pre-Tensioned)	LF	4,018	\$ 200.00	\$ 803,600

<b>Subtotal</b>	<b>\$ 3,387,254</b>
<b>Misc. Items &amp; Contingency 0%</b>	<b>\$ -</b>
<b>Total</b>	<b>\$ 3,387,254</b>
<b>Total Estimate of Probable Construction Cost Structure Area (SF)</b>	<b>\$ 3,390,000</b> <b>66,362</b>
<b>Cost / SF</b>	<b>\$ 51.0</b>



**RAMP BRIDGES**

**Opinion of Probable Construction Costs  
Ramp C-2 (I-25 SB off Ramp over Fountain Creek)  
Alternative A: Precast Prestressed Girders (BT42)**

Item #	Description	Unit	Totals	Cost/Unit	Cost
206	Structure Excavation	CY	424	\$ 7.00	\$ 2,970.00
206	Structure Backfill (Special)	CY	358	\$ 35.00	\$ 12,530.00
502	Pile Tip	EA	18	\$ 90.00	\$ 1,620.00
502	Steel Piling (HP 12X74)	LF	393	\$ 28.00	\$ 11,010.00
503	Drilled Caisson (42 inch)	LF	88	\$ 185.00	\$ 16,280.00
515	Concrete Sealer	SY	1,230	\$ 5.00	\$ 6,150.00
518	Bridge Expansion Device (0-4 Inch)	LF	76	\$ 138.00	\$ 10,490.00
601	Concrete Class D (Bridge)	CY	551	\$ 325.00	\$ 179,080.00
601	Bridge Deck Finish (Sawed Grooves)	SY	1,104	\$ 9.00	\$ 9,940.00
602	Reinforcing Steel (Black)	LB	8,552	\$ 0.50	\$ 4,280.00
602	Reinforcing Steel (Epoxy Coated)	LB	130,613	\$ 0.60	\$ 78,370.00
606	Bridge Rail Type 10M	LF	593	\$ 73.00	\$ 43,290.00
618	Prestressed Concrete Girders (BT42)	LF	1,010	\$ 85.00	\$ 85,850.00

**Subtotal** \$ 461,860.00  
**Misc. Items & Contingency (15%)** \$ 69,279.00  
**Total** \$ 531,139.00

**SUMMARY:**

**Total Estimate of Probable Construction Cost** \$ **532,000**  
 Cost/SF \$55

**Opinion of Probable Construction Costs  
Ramp C-2 (I-25 SB off Ramp over Fountain Creek)  
Alternative B: Wide Flange Steel Girders (W40X249-277)**

Item #	Description	Unit	Totals	Cost/Unit	Cost
206	Structure Excavation	CY	424	\$ 7.00	\$ 2,970.00
206	Structure Backfill (Special)	CY	358	\$ 35.00	\$ 12,530.00
502	Pile Tip	EA	18	\$ 90.00	\$ 1,620.00
502	Steel Piling (HP 12X74)	LF	393	\$ 28.00	\$ 11,010.00
503	Drilled Caisson (42 inch)	LF	88	\$ 185.00	\$ 16,280.00
509	Structural Steel	LB	272,515	\$ 0.80	\$ 218,020.00
515	Concrete Sealer	SY	1,230	\$ 5.00	\$ 6,150.00
518	Bridge Expansion Device (0-4 Inch)	LF	76	\$ 138.00	\$ 10,490.00
601	Concrete Class D (Bridge)	CY	513	\$ 325.00	\$ 166,730.00
601	Bridge Deck Finish (Sawed Grooves)	SY	1,104	\$ 9.00	\$ 9,940.00
602	Reinforcing Steel (Black)	LB	8,311	\$ 0.50	\$ 4,160.00
602	Reinforcing Steel (Epoxy Coated)	LB	118,433	\$ 0.60	\$ 71,060.00
606	Bridge Rail Type 10M	LF	593	\$ 73.00	\$ 43,290.00

**Subtotal** \$ 574,250.00  
**Misc. Items & Contingency (15%)** \$ 86,137.50  
**Total** \$ 660,387.50

**SUMMARY:**

**Total Estimate of Probable Construction Cost** \$ **661,000**  
 Cost/SF \$68





**Opinion of Probable Construction Costs  
Ramp C-2 (I-25 SB off Ramp over Fountain Creek)  
Alternative C: Precast Prestressed Box Girders (Bx 64X36)**

Item #	Description	Unit	Totals	Cost/Unit	Cost
206	Structure Excavation	CY	424	\$ 7.00	\$ 2,970.00
206	Structure Backfill (Special)	CY	358	\$ 35.00	\$ 12,530.00
502	Pile Tip	EA	18	\$ 90.00	\$ 1,620.00
502	Steel Piling (HP 12X74)	LF	393	\$ 28.00	\$ 11,010.00
503	Drilled Caisson (42 inch)	LF	88	\$ 185.00	\$ 16,280.00
515	Concrete Sealer	SY	1,230	\$ 5.00	\$ 6,150.00
518	Bridge Expansion Device (0-4 Inch)	LF	76	\$ 138.00	\$ 10,490.00
601	Concrete Class D (Bridge)	CY	544	\$ 325.00	\$ 176,800.00
601	Bridge Deck Finish (Sawed Grooves)	SY	1,104	\$ 9.00	\$ 9,940.00
602	Reinforcing Steel (Black)	LB	8,339	\$ 0.50	\$ 4,170.00
602	Reinforcing Steel (Epoxy Coated)	LB	111,309	\$ 0.60	\$ 66,790.00
606	Bridge Rail Type 10M	LF	593	\$ 73.00	\$ 43,290.00
618	Prestressed Concrete Box Girders (64X36)	LF	1,008	\$ 160.00	\$ 161,280.00

**Subtotal** \$ 523,320.00  
**Misc. Items & Contingency (15%)** \$ 78,498.00  
**Total** \$ 601,818.00

**SUMMARY:**

**Total Estimate of Probable Construction Cost** \$ **602,000**  
**Cost/SF** **\$62**

**Opinion of Probable Construction Costs  
Ramp C-3 (I-25 NB on Ramp over Fountain Creek)  
Alternative A: Precast Prestressed Girders ( BT42)**

Item #	Description	Unit	Totals	Cost/Unit	Cost
202	Removal of Structure	LS	1	\$ 30,000.00	\$ 30,000.00
206	Structure Excavation	CY	378	\$ 7.00	\$ 2,650.00
206	Structure Backfill (Special)	CY	317	\$ 35.00	\$ 11,100.00
502	Pile Tip	EA	18	\$ 90.00	\$ 1,620.00
502	Steel Piling (HP 12X74)	LF	526	\$ 28.00	\$ 14,730.00
503	Drilled Caisson (42 inch)	LF	96	\$ 185.00	\$ 17,760.00
515	Concrete Sealer	SY	1,230	\$ 5.00	\$ 6,150.00
518	Bridge Expansion Device (0-4 Inch)	LF	76	\$ 138.00	\$ 10,490.00
601	Concrete Class D (Bridge)	CY	556	\$ 325.00	\$ 180,700.00
601	Bridge Deck Finish (Sawed Grooves)	SY	1,104	\$ 9.00	\$ 9,940.00
602	Reinforcing Steel (Black)	LB	8,634	\$ 0.50	\$ 4,320.00
602	Reinforcing Steel (Epoxy Coated)	LB	131,003	\$ 0.60	\$ 78,610.00
606	Bridge Rail Type 10M	LF	593	\$ 73.00	\$ 43,290.00
618	Prestressed Concrete Girders (BT42)	LF	1,010	\$ 85.00	\$ 85,850.00

**Subtotal** \$ 497,210.00  
**Misc. Items & Contingency (15%)** \$ 74,581.50  
**Total** \$ 571,791.50

**SUMMARY:**

**Total Estimate of Probable Construction Cost** \$ **572,000**  
**Cost/SF** **\$59**





**Opinion of Probable Construction Costs  
Ramp C-3 (I-25 NB on Ramp over Fountain Creek)  
Alternative B: Wide Flange Steel Girders (W40X249-277)**

**Opinion of Probable Construction Costs  
Ramp C-3 (I-25 NB on Ramp over Fountain Creek)  
Alternative C: Precast Prestressed Box Girders (BX 64X36)**

Item #	Description	Unit	Totals	Cost/Unit	Cost
202	Removal of Structure	LS	1	\$ 30,000.00	\$ 30,000.00
206	Structure Excavation	CY	387	\$ 7.00	\$ 2,710.00
206	Structure Backfill (Special)	CY	317	\$ 35.00	\$ 11,100.00
502	Pile Tip	EA	18	\$ 90.00	\$ 1,620.00
502	Steel Piling (HP 12X74)	LF	526	\$ 28.00	\$ 14,730.00
503	Drilled Caisson (42 inch)	LF	96	\$ 185.00	\$ 17,760.00
509	Structural Steel	LB	272,550	\$ 0.80	\$ 218,040.00
515	Concrete Sealer	SY	1,230	\$ 5.00	\$ 6,150.00
518	Bridge Expansion Device (0-4 Inch)	LF	76	\$ 138.00	\$ 10,490.00
601	Concrete Class D (Bridge)	CY	518	\$ 325.00	\$ 168,350.00
601	Bridge Deck Finish (Sawed Grooves)	SY	1,104	\$ 9.00	\$ 9,940.00
602	Reinforcing Steel (Black)	LB	8,693	\$ 0.50	\$ 4,350.00
602	Reinforcing Steel (Epoxy Coated)	LB	119,089	\$ 0.60	\$ 71,460.00
606	Bridge Rail Type 10M	LF	593	\$ 73.00	\$ 43,290.00

**Subtotal** \$ 609,990.00  
**Misc. Items & Contingency (15%)** \$ 91,498.50  
**Total** \$ 701,488.50

**SUMMARY:**

**Total Estimate of Probable Construction Cost** \$ **702,000**  
**Cost/SF** **\$72**

Item #	Description	Unit	Totals	Cost/Unit	Cost
202	Removal of Structure	LS	1	\$ 30,000.00	\$ 30,000.00
206	Structure Excavation	CY	378	\$ 7.00	\$ 2,650.00
206	Structure Backfill (Special)	CY	317	\$ 35.00	\$ 11,100.00
502	Pile Tip	EA	18	\$ 90.00	\$ 1,620.00
502	Steel Piling (HP 12X74)	LF	526	\$ 28.00	\$ 14,730.00
503	Drilled Caisson (42 inch)	LF	96	\$ 185.00	\$ 17,760.00
515	Concrete Sealer	SY	1,230	\$ 5.00	\$ 6,150.00
518	Bridge Expansion Device (0-4 Inch)	LF	76	\$ 138.00	\$ 10,490.00
601	Concrete Class D (Bridge)	CY	548	\$ 325.00	\$ 178,100.00
601	Bridge Deck Finish (Sawed Grooves)	SY	1,104	\$ 9.00	\$ 9,940.00
602	Reinforcing Steel (Black)	LB	8,713	\$ 0.50	\$ 4,360.00
602	Reinforcing Steel (Epoxy Coated)	LB	111,926	\$ 0.60	\$ 67,160.00
606	Bridge Rail Type 10M	LF	593	\$ 73.00	\$ 43,290.00
618	Prestressed Concrete Box Girders (64X36)	LF	1,008	\$ 160.00	\$ 161,280.00

**Subtotal** \$ 558,630.00  
**Misc. Items & Contingency (15%)** \$ 83,794.50  
**Total** \$ 642,424.50

**SUMMARY:**

**Total Estimate of Probable Construction Cost** \$ **643,000**  
**Cost/SF** **\$66**





**Opinion of Probable Construction Costs  
Cimarron Street over Fountain Creek- Eastbound  
Alternative A: Precast Prestressed Girder (BT 54)- 35'-0" Wide Bridge**

Item #	Description	Unit	Totals	Cost/Unit	Cost
202	Removal of Bridge	LS	0.5	\$ 40,000.00	\$ 20,000.00
206	Structure Excavation	CY	310	\$ 7.00	\$ 2,170.00
206	Structure Backfill (Special)	CY	430	\$ 35.00	\$ 15,050.00
206	Structure Backfill (Class 2)	CY	30	\$ 10.00	\$ 300.00
502	Pile Tip	EA	12	\$ 90.00	\$ 1,080.00
502	Steel Piling (HP 12X74)	LF	600	\$ 28.00	\$ 16,800.00
503	Drilled Caisson (42 inch)	LF	160	\$ 185.00	\$ 29,600.00
515	Concrete Sealer	SY	1,310	\$ 5.00	\$ 6,550.00
518	Bridge Expansion Device (0-4 Inch)	LF	70	\$ 138.00	\$ 9,660.00
601	Concrete Class D (Bridge)	CY	610	\$ 325.00	\$ 198,250.00
601	Bridge Deck Finish (Sawed Grooves)	SY	1,200	\$ 9.00	\$ 10,800.00
602	Reinforcing Steel (Black)	LB	7,700	\$ 0.50	\$ 3,850.00
602	Reinforcing Steel (Epoxy Coated)	LB	145,780	\$ 0.60	\$ 87,470.00
606	Bridge Rail Type 10M	LF	673	\$ 73.00	\$ 49,130.00
618	Prestressed Concrete I (BT 54)	FT	1,177	\$ 100.00	\$ 117,700.00

**Subtotal** \$ 568,410.00  
**Misc. Items & Contingency (15%)** \$ 85,261.50  
**Total** \$ 653,671.50

**SUMMARY:**

**Total Estimate of Probable Construction Cost** \$ **654,000**  
 Cost/SF **\$63**

**Opinion of Probable Construction Costs  
Cimarron Street over Fountain Creek- Westbound  
Alternative A: Precast Prestressed Girder (BT 54)- 59'-0" Wide Bridge**

Item #	Description	Unit	Totals	Cost/Unit	Cost
202	Removal of Bridge	LS	0.5	\$ 40,000.00	\$ 20,000.00
206	Structure Excavation	CY	650	\$ 7.00	\$ 4,550.00
206	Structure Backfill (Special)	CY	800	\$ 35.00	\$ 28,000.00
206	Structure Backfill (Class 2)	CY	40	\$ 10.00	\$ 400.00
502	Pile Tip	EA	18	\$ 90.00	\$ 1,620.00
502	Steel Piling (HP 12X74)	LF	1,000	\$ 28.00	\$ 28,000.00
503	Drilled Caisson (42 inch)	LF	240	\$ 185.00	\$ 44,400.00
515	Concrete Sealer	SY	2,206	\$ 5.00	\$ 11,030.00
518	Bridge Expansion Device (0-4 Inch)	LF	118	\$ 138.00	\$ 16,290.00
601	Concrete Class D (Bridge)	CY	985	\$ 325.00	\$ 320,130.00
601	Bridge Deck Finish (Sawed Grooves)	SY	2,094	\$ 9.00	\$ 18,850.00
602	Reinforcing Steel (Black)	LB	11,455	\$ 0.50	\$ 5,730.00
602	Reinforcing Steel (Epoxy Coated)	LB	239,790	\$ 0.60	\$ 143,880.00
606	Bridge Rail Type 10M	LF	673	\$ 73.00	\$ 49,130.00
618	Prestressed Concrete I (BT 54)	FT	1,766	\$ 100.00	\$ 176,600.00

**Subtotal** \$ 868,610.00  
**Misc. Items & Contingency (15%)** \$ 130,291.50  
**Total** \$ 998,901.50

**SUMMARY:**

**Total Estimate of Probable Construction Cost** \$ **999,000**  
 Cost/SF **\$57**  
**Total Cost (Two Bridges)** \$ **1,653,000**





**Opinion of Probable Construction Costs  
Cimarron Street over Fountain Creek- Eastbound  
Alternative B: W40X277 Steel Girder- 35'-0" Wide Bridge**

Item #	Description	Unit	Totals	Cost/Unit	Cost
202	Removal of Bridge	LS	0.5	\$ 40,000.00	\$ 20,000.00
206	Structure Excavation	CY	310	\$ 6.00	\$ 1,860.00
206	Structure Backfill (Special)	CY	430	\$ 35.00	\$ 15,050.00
206	Structure Backfill (Class 2)	CY	30	\$ 10.00	\$ 300.00
502	Pile Tip	EA	12	\$ 90.00	\$ 1,080.00
502	Steel Piling (HP 12X74)	LF	600	\$ 28.00	\$ 16,800.00
503	Drilled Caisson (42 inch)	LF	160	\$ 185.00	\$ 29,600.00
509	Structural Steel	LB	425,200	\$ 0.80	\$ 340,160.00
515	Concrete Sealer	SY	1,310	\$ 5.00	\$ 6,550.00
518	Bridge Expansion Device (0-4 Inch)	LF	70	\$ 138.00	\$ 9,660.00
601	Concrete Class D (Bridge)	CY	610	\$ 325.00	\$ 198,250.00
601	Bridge Deck Finish (Sawed Grooves)	SY	1,200	\$ 9.00	\$ 10,800.00
602	Reinforcing Steel (Black)	LB	7,700	\$ 0.50	\$ 3,850.00
602	Reinforcing Steel (Epoxy Coated)	LB	145,780	\$ 0.60	\$ 87,470.00
606	Bridge Rail Type 10M	LF	673	\$ 73.00	\$ 49,130.00

**Subtotal** \$ 790,560.00  
**Misc. Items & Contingency (15%)** \$ 118,584.00  
**Total** \$ 909,144.00

**SUMMARY:**

**Total Estimate of Probable Construction Cost** \$ **910,000**  
 Cost/SF \$88

**Opinion of Probable Construction Costs  
Cimarron Street over Fountain Creek- Westbound  
Alternative B: W40X277 Steel Girder- 59'-0" Wide Bridge**

Item #	Description	Unit	Totals	Cost/Unit	Cost
202	Removal of Bridge	LS	0.5	\$ 40,000.00	\$ 20,000.00
206	Structure Excavation	CY	650	\$ 6.00	\$ 3,900.00
206	Structure Backfill (Class 1)	CY	800	\$ 21.00	\$ 16,800.00
206	Structure Backfill (Class 2)	CY	40	\$ 13.00	\$ 520.00
206	Mechanical Reinforcing of Soil	CY	680	\$ 14.00	\$ 9,520.00
502	Pile Tip	EA	18	\$ 100.00	\$ 1,800.00
502	Steel Piling (HP 12X74)	LF	1,000	\$ 30.00	\$ 30,000.00
503	Drilled Caisson (42 inch)	LF	240	\$ 230.00	\$ 55,200.00
509	Structural Steel	LB	595,250	\$ 0.80	\$ 476,200.00
515	Concrete Sealer	SY	2,206	\$ 5.00	\$ 11,030.00
518	Bridge Expansion Device (0-4 Inch)	LF	118	\$ 120.00	\$ 14,160.00
601	Concrete Class D (Bridge)	CY	985	\$ 325.00	\$ 320,130.00
601	Bridge Deck Finish (Sawed Grooves)	SY	2,094	\$ 6.00	\$ 12,570.00
602	Reinforcing Steel (Black)	LB	11,455	\$ 0.55	\$ 6,310.00
602	Reinforcing Steel (Epoxy Coated)	LB	239,790	\$ 0.65	\$ 155,870.00
606	Bridge Rail Type 10	LF	673	\$ 73.00	\$ 49,130.00

**Subtotal** \$ 1,183,140.00  
**Misc. Items & Contingency (15%)** \$ 177,471.00  
**Total** \$ 1,360,611.00

**SUMMARY:**

**Total Estimate of Probable Construction Cost** \$ **1,361,000**  
 Cost/SF \$78  
**Total Cost (Two Bridges)** \$ **2,271,000**



**BIJOU STREET BRIDGES**

**Project:** Cimarron / Bijou Interchange  
**Location:** Bijou Street over I-25  
**Alternative:** 2-Span Cast-in-place Box (Post-tensioned)  
**Estimate:** Preliminary Cost Estimate

Wilson & Company  
 By: AAP  
 Date: 5/29/03

ITEM	DESCRIPTION	UNIT	TOTAL	UNIT COST	COST
202	REMOVAL OF BRIDGE	EA	1	\$ 40,000.00	\$ 40,000
206	STRUCTURE EXCAVATION	CY	301	\$ 7.00	\$ 2,107
206	STRUCTURE BACKFILL (CLASS 1)	CY	150	\$ 16.00	\$ 2,400
206	STRUCTURE BACKFILL (CLASS 2)	CY	65	\$ 10.00	\$ 650
403	HBP	TON	375	\$ 55.00	\$ 20,625
503	DRILLED CAISSON (48"DIAM)	LF	1,570	\$ 230.00	\$ 361,100
513	BRIDGE DRAIN	EA	4	\$ 3,000	\$ 12,000
514	PEDESTRIAN RAIL (STEEL)(SPECIAL)	LF	460	\$ 188.00	\$ 86,480
515	WATERPROOFING MEMBRANE	SY	2,350	\$ 8.00	\$ 18,800
518	BRIDGE EXPANSION DEVICE	LF	230	\$ 138.00	\$ 31,740
519	ARCHITECTURAL PANELS	SF	7,760	\$ 28.00	\$ 217,280
601	CONCRETE CLASS D	CY	575	\$ 250.00	\$ 143,750
601	CONCRETE CLASS S	CY	1,200	\$ 385.00	\$ 462,000
602	REINFORCING STEEL	LB	41,100	\$ 0.50	\$ 20,550
602	REINFORCING STEEL (EPOXY COATED)	LB	365,830	\$ 0.60	\$ 219,498
606	BRIDGE RAIL TYPE 10M	LF	460	\$ 92.00	\$ 42,320
618	PRESTRESSING STEEL WIRE OR STRAND	MKFT	10,500	\$ 21.00	\$ 220,500

	<b>Subtotal</b>	<b>\$ 1,901,800</b>
<b>Misc. Items &amp; Contingency 15%</b>		<b>\$ 285,270</b>
	<b>Total</b>	<b>\$ 2,187,070</b>
<b>Total Estimate of Probable Construction Cost</b>		<b>\$ 2,185,000</b>
<b>Structure Area (SF)</b>		<b>21,487</b>
<b>Cost / SF</b>		<b>\$ 102</b>

**Project:** Cimarron / Bijou Interchange  
**Location:** Bijou Street over I-25  
**Alternative:** 2-Span Steel Box Girder  
**Estimate:** Preliminary Cost Estimate

Wilson & Company  
 By: AAP  
 Date: 5/29/03

ITEM	DESCRIPTION	UNIT	TOTAL	UNIT COST	COST
202	REMOVAL OF BRIDGE	EA	1	\$ 40,000.00	\$ 40,000
206	STRUCTURE EXCAVATION	CY	301	\$ 7.00	\$ 2,107
206	STRUCTURE BACKFILL (CLASS 1)	CY	150	\$ 16.00	\$ 2,400
206	STRUCTURE BACKFILL (CLASS 2)	CY	65	\$ 10.00	\$ 650
403	HBP	TON	375	\$ 55.00	\$ 20,625
503	DRILLED CAISSON (48"DIAM)	LF	1,570	\$ 230.00	\$ 361,100
509	STRUCTURAL STEEL	LB	634,550	\$ 1.50	\$ 951,825
513	BRIDGE DRAIN	EA	4	\$ 3,000	\$ 12,000
514	PEDESTRIAN RAIL (STEEL)(SPECIAL)	LF	460	\$ 188.00	\$ 86,480
515	WATERPROOFING MEMBRANE	SY	2,350	\$ 8.00	\$ 18,800
518	BRIDGE EXPANSION DEVICE	LF	230	\$ 138.00	\$ 31,740
519	ARCHITECTURAL PANELS	SF	7,760	\$ 28.00	\$ 217,280
601	CONCRETE CLASS D	CY	1,165	\$ 325.00	\$ 378,625
602	REINFORCING STEEL	LB	41,100	\$ 0.50	\$ 20,550
602	REINFORCING STEEL (EPOXY COATED)	LB	182,830	\$ 0.60	\$ 109,698
606	BRIDGE RAIL TYPE 10M	LF	460	\$ 92.00	\$ 42,320

	<b>Subtotal</b>	<b>\$ 2,296,200</b>
<b>Misc. Items &amp; Contingency 15%</b>		<b>\$ 344,430</b>
	<b>Total</b>	<b>\$ 2,640,630</b>
<b>Total Estimate of Probable Construction Cost</b>		<b>\$ 2,640,000</b>
<b>Structure Area (SF)</b>		<b>21,487</b>
<b>Cost / SF</b>		<b>\$ 123</b>



**Project:** Cimarron / Bijou Interchange  
**Location:** Bijou Street over I-25  
**Alternative:** 2-Span Precast U-Girder (Pre-tensioned)  
**Estimate:** Preliminary Cost Estimate

Wilson & Company  
 By: AAP  
 Date: 5/29/03

ITEM	DESCRIPTION	UNIT	TOTAL	UNIT COST	COST
202	REMOVAL OF BRIDGE	EA	1	\$ 40,000.00	\$ 40,000
206	STRUCTURE EXCAVATION	CY	450	\$ 7.00	\$ 3,150
206	STRUCTURE BACKFILL (CLASS 1)	CY	195	\$ 16.00	\$ 3,120
206	STRUCTURE BACKFILL (CLASS 2)	CY	65	\$ 10.00	\$ 650
403	HBP	TON	375	\$ 55.00	\$ 20,625
503	DRILLED CAISSON (48"DIAM)	LF	1,570	\$ 230.00	\$ 361,100
513	BRIDGE DRAIN	EA	4	\$ 3,000	\$ 12,000
514	PEDESTRIAN RAIL (STEEL)(SPECIAL)	LF	460	\$ 188.00	\$ 86,480
515	WATERPROOFING MEMBRANE	SY	2,350	\$ 8.00	\$ 18,800
518	BRIDGE EXPANSION DEVICE	LF	230	\$ 138.00	\$ 31,740
519	ARCHITECTURAL PANELS	SF	7,760	\$ 28.00	\$ 217,280
601	CONCRETE CLASS D	CY	1,275	\$ 325.00	\$ 414,375
602	REINFORCING STEEL	LB	41,100	\$ 0.50	\$ 20,550
602	REINFORCING STEEL (EPOXY COATED)	LB	233,530	\$ 0.60	\$ 140,118
606	BRIDGE RAIL TYPE 10M	LF	460	\$ 92.00	\$ 42,320
618	PRECAST CONCRETE U GIRDER (PRE-TENSIONED)	LF	1,450	\$ 200.00	\$ 290,000

**Subtotal** \$ 1,702,308  
**Misc. Items & Contingency 15%** \$ 255,346  
**Total** \$ 1,957,654

**Total Estimate of Probable Construction Cost** \$ 1,955,000  
**Structure Area (SF)** 21,487  
**Cost / SF** \$ 91

**Project:** Cimarron / Bijou Interchange  
**Location:** Bijou Street over the UPRR and Monument Creek  
**Alternative:** 5-Span Rolled Steel I-Girders  
**Estimate:** Preliminary Cost Estimate

Wilson & Company  
 By: DBW  
 Date: 5/29/03

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
202	REMOVAL OF BRIDGE	LS	1	\$ 200,000.00	\$ 200,000
206	STRUCTURE EXCAVATION	CY	6,221	\$ 7.00	\$ 43,547
206	STRUCTURE BACKFILL (CLASS 1)	CY	8,208	\$ 16.00	\$ 131,328
206	STRUCTURE BACKFILL (CLASS 2)	CY	1,242	\$ 10.00	\$ 12,420
206	MECHANICAL REINFORCEMENT OF SOIL	CY	6,588	\$ 20.00	\$ 131,760
403	HBP	TON	1,161	\$ 55.00	\$ 63,873
503	DRILLED CAISSON (36 IN)	LF	780	\$ 140.00	\$ 109,200
504	PRECAST PANEL FACING	SF	2,624	\$ 120.00	\$ 314,880
509	STRUCTURAL STEEL	LB	0	\$ 0.80	\$ -
514	PEDESTRIAN RAILING (STEEL)	LF	1,032	\$ 188.00	\$ 194,016
515	WATERPROOFING MEMBRANE	SY	7,374	\$ 8.00	\$ 58,988
518	BRIDGE EXPANSION DEVICE (0-4 IN)	LF	312	\$ 138.00	\$ 43,056
601	CONCRETE CLASS D (BRIDGE)	CY	3,930	\$ 325.00	\$ 1,277,250
601	STRUCTURAL CONCRETE COATING	SY	3,251	\$ 5.00	\$ 16,255
602	REINFORCING STEEL	LB	337,000	\$ 0.50	\$ 168,500
602	REINFORCING STEEL (EPOXY COATED)	LB	623,000	\$ 0.60	\$ 373,800
606	BRIDGE RAIL TYPE 10M (SPECIAL)	LF	1,032	\$ 92.00	\$ 94,944

**Subtotal** \$ 3,233,818  
**Misc. Items & Contingency 15%** \$ 485,073  
**Total** \$ 3,718,891

**Total Estimate of Probable Construction Cost** \$ 6,040,000  
**Structure Area (SF)** 66,362  
**Cost / SF** \$56



**Project:** Cimarron / Bijou Interchange  
**Location:** Bijou Street over the UPRR and Monument Creek  
**Alternative:** 4-Span Steel Plate Girders  
**Estimate:** Preliminary Cost Estimate

Wilson & Company  
 By: DBW  
 Date: 5/29/03

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
202	REMOVAL OF BRIDGE	LS	1	\$ 200,000.00	\$ 200,000
206	STRUCTURE EXCAVATION	CY	6,221	\$ 7.00	\$ 43,547
206	STRUCTURE BACKFILL (CLASS 1)	CY	8,208	\$ 16.00	\$ 131,328
206	STRUCTURE BACKFILL (CLASS 2)	CY	1,242	\$ 10.00	\$ 12,420
206	MECHANICAL REINFORCEMENT OF SOIL	CY	6,588	\$ 20.00	\$ 131,760
403	HBP	TON	1,161	\$ 55.00	\$ 63,873
503	DRILLED CAISSON (36 IN)	LF	780	\$ 140.00	\$ 109,200
504	PRECAST PANEL FACING	SF	2,624	\$ 120.00	\$ 314,880
509	STRUCTURAL STEEL	LB	3,000	\$ 1.10	\$ 3,300
514	PEDESTRIAN RAILING (STEEL)	LF	1,032	\$ 50.00	\$ 51,600
515	WATERPROOFING MEMBRANE	SY	7,374	\$ 8.00	\$ 58,988
518	BRIDGE EXPANSION DEVICE (0-4 IN)	LF	312	\$ 138.00	\$ 43,056
601	CONCRETE CLASS D (BRIDGE)	CY	3,920	\$ 325.00	\$ 1,274,000
601	STRUCTURAL CONCRETE COATING	SY	3,251	\$ 5.00	\$ 16,255
	REINFORCING STEEL	LB	337,000	\$ 0.50	\$ 168,500
602	REINFORCING STEEL (EPOXY COATED)	LB	623,000	\$ 0.60	\$ 373,800
606	BRIDGE RAIL TYPE 10M (SPECIAL)	LF	1,032	\$ 92.00	\$ 94,944

<b>Subtotal</b>		<b>\$ 3,091,452</b>
<b>Misc. Items &amp; Contingency</b>	<b>15%</b>	<b>\$ 463,718</b>
<b>Total</b>		<b>\$ 3,555,170</b>
<b>Total Estimate of Probable Construction Cost</b>		<b>\$ 6,745,000</b>
<b>Structure Area (SF)</b>		<b>66,362</b>
<b>Cost / SF</b>		<b>\$54</b>



**Project:** Cimarron / Bijou Interchange  
**Location:** Bijou Street over the UPRR and Monument Creek  
**Alternative:** Base Additive Costs for Above Deck Structures  
**Estimate:** Preliminary Cost Estimate

Wilson & Company  
 By: DBW / DAK  
 Date: 5/29/03

*Computations:*

The Superstructure of the Bridge will be the same for this option. The difference will come in the substructure and new elements added to the superstructure in order to remove Pier 4. Initial computations and inspections suggest that a rolled wide flange section can be used as a supporting beam interlaced with or under the rolled girders described in preliminary design.

One option was to cable stay this beam with masts on the outside of the bridge deck and a central mast passing through the deck. The main mast (central) was designed after analysis showed the highest reaction forces occurred on this support.

Another option was to use spandrel girders/ beams in place of the cable stay.

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
<b>Credits: Removal of Pier</b>					
206	STRUCTURE EXCAVATION	CY	279	\$ (7.00)	\$ (1,953)
206	STRUCTURE BACKFILL (CLASS 1)	CY	274	\$ (16.00)	\$ (4,384)
503	DRILLED CAISSON (36 IN)	LF	220	\$ (140.00)	\$ (30,800)
601	CONCRETE CLASS D (BRIDGE)	CY	199	\$ (325.00)	\$ (64,675)
601	STRUCTURAL CONCRETE COATING	SY	128	\$ (5.00)	\$ (640)
602	REINFORCING STEEL (EPOXY COATED)	LB	92,070	\$ (0.60)	\$ (55,242)
<b>Total credits to remove pier</b>					<b>(\$157,694)</b>
<b>Additional: New Beam and Foundation</b>					
206	STRUCTURE EXCAVATION	CY	258	\$ 7.00	\$ 1,806
206	STRUCTURE BACKFILL (CLASS 1)	CY	96	\$ 16.00	\$ 1,536
503	DRILLED CAISSON (30 IN)	LF	480	\$ 95.00	\$ 45,600
509	STRUCTURAL STEEL (W40x431)	LB	54,953	\$ 1.20	\$ 65,943
<b>Total added costs to support bridge at removed pier</b>					<b>\$114,885</b>
<b>Additional: Steel Spandrels</b>					
509	STRUCTURAL STEEL (Spandrels)	LB	637,000	\$ 1.10	\$ 700,700
601	CONCRETE CLASS D (BRIDGE)	CY	294	\$ 625.00	\$ 183,750
601	STRUCTURAL CONCRETE COATING	SY	312	\$ 5.00	\$ 1,560
602	REINFORCING STEEL (EPOXY COATED)	LB	101,400	\$ 0.60	\$ 60,840
<b>Total added costs for spandrels</b>					<b>\$946,850</b>
<b>Additional: Cable Stay</b>					
601	CONCRETE CLASS D (BRIDGE)	CY	369	\$625.00	\$230,625
601	STRUCTURAL CONCRETE COATING	SY	312	\$5.00	\$1,560
602	REINFORCING STEEL (EPOXY COATED)	LB	123,645	\$0.60	\$74,187
618	PRESTRESSED STEEL WIRE OR STRAND	MKFT	4,404	\$112.50	\$495,450
<b>Total added costs for cable stay</b>					<b>\$801,822</b>
<b>Alternative 2, Add new beam and spandrels</b>					<b>\$1,061,735</b>
<b>Alternative 3, Add new beam and cable stay</b>					<b>\$916,707</b>
<b>Alternative 5, Credit for pier removal, add new beam and spandrels</b>					<b>\$904,041</b>
<b>Alternative 6, Credit for pier removal, add new beam and cable stay</b>					<b>\$759,013</b>

**Cable Stay Option: 3 Mast configuration**

This option places a mast at Pier 3 and anchor piers at the Pier 2. The outside piers and masts are located beside the bridge deck, and the central mast lies on the HCL. This is a rudimentary design, not a wishbone cable stay design, although that could be investigated, should this prove to be a viable option (or combination option below. This is for a basic cost-effective evaluation only. Basic volumes should be in the same order of magnitude.

**Adds: 3 masts, three anchor piers, cable, support beam**

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
206	STRUCTURE EXCAVATION	CY	258	\$ 7.00	\$ 1,806
206	STRUCTURE BACKFILL (CLASS 1)	CY	96	\$ 16.00	\$ 1,536
503	DRILLED CAISSON (30 IN)	LF	480	\$ 95.00	\$ 45,600
509	STRUCTURAL STEEL (W40x431)	LB	54,953	\$ 1.20	\$ 65,943
601	CONCRETE CLASS D (BRIDGE)	CY	369	\$ 625.00	\$ 230,625
601	STRUCTURAL CONCRETE COATING	SY	312	\$ 5.00	\$ 1,560
602	REINFORCING STEEL (EPOXY COATED)	LB	123,645	\$ 0.60	\$ 74,187
618	PRESTRESSED STEEL WIRE OR STRAND	MKF	4,404	\$ 112.50	\$ 495,450

**Subtotal: \$916,707**  
**Deduct from above: (\$157,694)**

**Total Add to Original options: \$759,013**

**Spandrel Beam Option**

This option places utilizes steel beams that will perform the same function the cable stays. In place of the masts and cables, large beams would extend from Pier 2 to the supporting beam where Pier 4 used to be. The effect for the outside beams to be incorporated into the splash guard, limiting the height of depth of the beam to be used. Additional Pier columns would be required as well to support the new beams.

**Adds: 3 Beams, three anchor piers, cable, support beam**

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
206	STRUCTURE EXCAVATION	CY	258	\$ 7.00	\$ 1,806
206	STRUCTURE BACKFILL (CLASS 1)	CY	96	\$ 16.00	\$ 1,536
503	DRILLED CAISSON (30 IN)	LF	480	\$ 95.00	\$ 45,600
509	STRUCTURAL STEEL (Spandrels)	LB	637,000	\$ 1.10	\$ 700,700
509	STRUCTURAL STEEL (W40x431)	LB	54,953	\$ 1.20	\$ 65,943
601	CONCRETE CLASS D (BRIDGE)	CY	294	\$ 625.00	\$ 183,750
601	STRUCTURAL CONCRETE COATING	SY	312	\$ 5.00	\$ 1,560
602	REINFORCING STEEL (EPOXY COATED)	LB	101,400	\$ 0.60	\$ 60,840

**Subtotal: \$1,061,735**  
**Deduct from above: (\$157,694)**

**Total Add to Original options: \$904,041**





**Combination Cable Stay / Spandrel Beam Option**

This option will incorporate elements of both single system concept. In the center of the road, a mast cable stay will support the majority of the load, and running along the outside of the bridge, spandrels will support the lesser outside loads.

Adds: 2 Beams, three anchor piers, 1 Mast, cable, support beam

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
206	STRUCTURE EXCAVATION	CY	258	\$ 7.00	\$ 1,806
206	STRUCTURE BACKFILL (CLASS 1)	CY	96	\$ 16.00	\$ 1,536
503	DRILLED CAISSON (30 IN)	LF	480	\$ 95.00	\$ 45,600
509	STRUCTURAL STEEL (Spandrels)	LB	303,800	\$ 1.10	\$ 334,180
509	STRUCTURAL STEEL (W40x431)	LB	54,953	\$ 1.20	\$ 65,943
601	CONCRETE CLASS D (BRIDGE)	CY	341	\$ 625.00	\$ 213,125
601	STRUCTURAL CONCRETE COATING	SY	312	\$ 5.00	\$ 1,560
602	REINFORCING STEEL (EPOXY COATED)	LB	101,400	\$ 0.60	\$ 60,840
618	PRESTRESSED STEEL WIRE OR STRAND	MKF	1,468	\$ 112.50	\$ 165,150

<b>Subtotal:</b>	<b>\$889,740</b>
<b>Deduct from above:</b>	<b>(\$157,694)</b>
<b>Total Add to Original options:</b>	<b>\$732,046</b>

**Project:** Cimarron / Bijou Interchange  
**Location:** Bijou Street over the UPRR and Monument Creek  
**Alternative:** Alternative 7, 8 & 9  
**Estimate:** Preliminary Cost Estimate - Relocation of UPRR Yard Tracks

Wilson & Company  
 By: DBW / FSW  
 Date: 5/29/03

*Computations:*

This preliminary cost estimate identifies the construction costs associated with the relocation of three yard tracks to accommodate the proposed pier placements for Alternative 7, 8 & 9. The estimate includes costs associated with the rail itself (ballast, ties, and track), three new yard switches, and a magnitude estimate for signalization which the UPRR requested for the new switches. The construction process may require the relocation of these tracks twice, although the costs associated with the second move would be minimal, compared to the costs associated with the initial move. The initial move costs included below identify all new facilities for the yard tracks being relocated.

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
	136# Track, ties, & ballast	TF	1,300	\$ 130	\$ 169,000
	No. 11 Switch / Turnout	EA	3	\$ 151,000	\$ 453,000
*	Signalization	LS	1	\$ 500,000	\$ 500,000
<b>Total Initial Track Relocation</b>					<b>\$ 1,122,000</b>

\* - Signalization costs cannot be identified completely until the UPRR reviews a design involving the construction of new signalization. The cost shown above for signalization is based on magnitude estimates provided by the UPRR and verified by the rail design group within Wilson & Company. This signalization cost could be as high as \$1 million, should the facility improvements be very extensive.



### I-25 RETAINING WALLS

Cimarron/Bijou Interchange  
I-25 Retaining Walls

Item No.	Description	Unit	Cost/Unit	Quantities		Costs	
				Retaining Wall 1	Retaining Wall 1	Retaining Wall 2	Retaining Wall 2
206	Structure Excavation	CY	\$ 7.00	525	\$ 3,675.00	550	\$ 3,850.00
206	Structure Backfill (Class 1)	CY	\$ 16.00	995	\$ 15,920.00	590	\$ 9,440.00
502	Steel Piling (HP 12x74)	LF	\$ 28.00	0	\$ -	3000	\$ 84,000.00
601	Concrete Class D (Wall)	CY	\$ 350.00	190	\$ 66,500.00	265	\$ 92,750.00
602	Reinforcing Steel	LB	\$ 0.50	19,000	\$ 9,500.00	24175	\$ 12,087.50
				<b>Total @ Wall 1 = \$</b>	<b>95,595.00</b>	<b>Total @ Wall 2 = \$</b>	<b>202,127.50</b>
				<b>Total /ft<sup>2</sup> @ Wall 1 = \$</b>	<b>37.36</b>	<b>Total /ft<sup>2</sup> @ Wall 2 = \$</b>	<b>78.65</b>

Item No.	Description	Unit	Cost/Unit	Quantities		Costs	
				Retaining Wall 3	Retaining Wall 3	Retaining Wall 4	Retaining Wall 4
206	Structure Excavation	CY	\$ 7.00	100	\$ 700.00	206	\$ 1,442.00
206	Structure Backfill (Class 1)	CY	\$ 16.00	105	\$ 1,680.00	540	\$ 8,640.00
502	Steel Piling (HP 12x74)	LF	\$ 28.00	460	\$ 12,880.00	0	\$ -
601	Concrete Class D (Wall)	CY	\$ 350.00	50	\$ 17,500.00	170	\$ 59,500.00
602	Reinforcing Steel	LB	\$ 0.50	4600	\$ 2,300.00	16150	\$ 8,075.00
				<b>Total @ Wall 3 = \$</b>	<b>35,060.00</b>	<b>Total @ Wall 4 = \$</b>	<b>77,657.00</b>
				<b>Total /ft<sup>2</sup> @ Wall 3 = \$</b>	<b>77.40</b>	<b>Total /ft<sup>2</sup> @ Wall 4 = \$</b>	<b>32.24</b>

Item No.	Description	Unit	Cost/Unit	Quantities	Costs	Total Quantity	Total Costs
				Retaining Wall 5	Retaining Wall 5		
206	Structure Excavation	CY	\$ 7.00	0	\$ -	1381	\$ 9,667.00
206	Structure Backfill (Class 1)	CY	\$ 16.00	1300	\$ 20,800.00	3530	\$ 56,480.00
502	Steel Piling (HP 12x74)	LF	\$ 28.00	0	\$ -	3460	\$ 96,880.00
601	Concrete Class D (Wall)	CY	\$ 350.00	375	\$ 131,250.00	1050	\$ 367,500.00
602	Reinforcing Steel	LB	\$ 0.50	35625	\$ 17,812.50	99550	\$ 49,775.00
				<b>Total @ Wall 5 = \$</b>	<b>169,862.50</b>		<b>\$ 580,302.00</b>
				<b>Total /ft<sup>2</sup> @ Wall 5 = \$</b>	<b>31.40</b>		

Cimarron/Bijou Interchange  
I-25 Retaining Walls

Item No.	Description	Unit	Cost/Unit	Quantities		Costs	
				Retaining Wall 1	Retaining Wall 1	Retaining Wall 2	Retaining Wall 2
206	Structure Excavation	CY	\$ 7.00	265	\$ 1,855.00	846	\$ 5,922.00
206	Structure Backfill (Class 1)	CY	\$ 16.00	1,355	\$ 21,680.00	1345	\$ 21,520.00
206	Mechanical Reinforcement of Soil	CY	\$ 18.00	581	\$ 10,458.00	569	\$ 10,242.00
504	Precast Panel Facing	SF	\$ 20.00	2,560	\$ 51,200.00	2570	\$ 51,400.00
				<b>Total @ Wall 1 = \$</b>	<b>85,193.00</b>	<b>Total @ Wall 2 = \$</b>	<b>89,084.00</b>
				<b>Total /ft<sup>2</sup> @ Wall 1 = \$</b>	<b>33.28</b>	<b>Total /ft<sup>2</sup> @ Wall 2 = \$</b>	<b>34.66</b>

Item No.	Description	Unit	Cost/Unit	Quantities		Costs	
				Retaining Wall 3	Retaining Wall 3	Retaining Wall 4	Retaining Wall 4
206	Structure Excavation	CY	\$ 7.00	165	\$ 1,155.00	590	\$ 4,130.00
206	Structure Backfill (Class 1)	CY	\$ 16.00	191	\$ 3,056.00	960	\$ 15,360.00
206	Mechanical Reinforcement of Soil	CY	\$ 18.00	74	\$ 1,332.00	390	\$ 7,020.00
504	Precast Panel Facing	SF	\$ 20.00	453	\$ 9,060.00	2409	\$ 48,180.00
				<b>Total @ Wall 3 = \$</b>	<b>14,603.00</b>	<b>Total @ Wall 4 = \$</b>	<b>74,690.00</b>
				<b>Total /ft<sup>2</sup> @ Wall 3 = \$</b>	<b>32.24</b>	<b>Total /ft<sup>2</sup> @ Wall 4 = \$</b>	<b>31.00</b>

Item No.	Description	Unit	Cost/Unit	Quantities	Costs	Total Quantity	Total Costs
				Retaining Wall 5	Retaining Wall 5		
206	Structure Excavation	CY	\$ 7.00	0	\$ -	1,866	\$ 13,062.00
206	Structure Backfill (Class 1)	CY	\$ 16.00	2410	\$ 38,560.00	6,261	\$ 100,176.00
206	Mechanical Reinforcement of Soil	CY	\$ 18.00	1020	\$ 18,360.00	2,634	\$ 47,412.00
504	Precast Panel Facing	SF	\$ 20.00	5410	\$ 108,200.00	13,402	\$ 268,040.00
				<b>Total @ Wall 5 = \$</b>	<b>165,120.00</b>		<b>\$ 428,690.00</b>
				<b>Total /ft<sup>2</sup> @ Wall 5 = \$</b>	<b>30.52</b>		





**Project:** Cimarron / Bijou Interchange

Wilson & Company

**Location:** I-25 Retaining Wall 6

By: AAP

**Estimate:** Preliminary Cost Estimates

Date: 5/29/03

**CAST-IN-PLACE CONCRETE ON H-PILES**

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
	Temp. Excavation Support (Soil Nail)	SF	76	\$ 30.00	\$ 2,269
203	Embankment Material	CY	109	\$ 12.00	\$ 1,303
206	Structure Excavation	CY	339	\$ 7.00	\$ 2,371
206	Structure Backfill (Class 1)	CY	1,844	\$ 16.00	\$ 29,502
502	Steel Piling (HP 12 X 74)	LF	3,588	\$ 28.00	\$ 100,458
502	Pile Tip	EA	99	\$ 90.00	\$ 8,918
601	Concrete Class D (Wall)	CY	354	\$ 350.00	\$ 124,070
602	Reinforcing Steel	LB	68,934	\$ 0.50	\$ 34,467
	Formliner	SF	4,673	\$ 1.00	\$ 4,673

Total Cost **\$ 308,031**  
 Cost per SQ FT (EXPOSED) 4,081 \$ 75  
 Cost per SQ FT (Design Height) 4,673 \$ 66

**CAST-IN-PLACE CONCRETE ON SPREAD FOOTINGS**

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
	Temp. Excavation Support (Soil Nail)	SF	91	\$ 30.00	\$ 2,719
203	Embankment Material	CY	110	\$ 12.00	\$ 1,322
206	Structure Excavation	CY	607	\$ 7.00	\$ 4,246
206	Structure Backfill (Class 1)	CY	1,697	\$ 16.00	\$ 27,156
601	Concrete Class D (Wall)	CY	548	\$ 350.00	\$ 191,846
602	Reinforcing Steel	LB	72,518	\$ 0.50	\$ 36,259
	Formliner	SF	4,673	\$ 1.00	\$ 4,673

Total Cost **\$ 268,222**  
 Cost per SQ FT (EXPOSED) 4,081 \$ 66  
 Cost per SQ FT (Design Height) 4,673 \$ 57

**MSE**

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
	Temp. Excavation Support (Soil Nail)	SF	116	\$ 30.00	\$ 3,488
203	Embankment Material	CY	100	\$ 12.00	\$ 1,204
206	Structure Excavation	CY	314	\$ 7.00	\$ 2,196
206	Structure Backfill (Class 1)	CY	3,382	\$ 16.00	\$ 54,115
206	Mechanical Reinforcement of Soil	CY	3,088	\$ 18.00	\$ 55,588
504	Precast Panel	SF	4,673	\$ 20.00	\$ 93,460
601	Concrete Class D (Wall)	CY	6	\$ 350.00	\$ 2,061

Total Cost **\$ 212,113**  
 Cost per SQ FT (EXPOSED) 4,081 \$ 52  
 Cost per SQ FT (Design Height) 4,673 \$ 45





**RAMP RETAINING WALLS**

**Cimarron/Bijou Interchange  
Ramp Retaining Walls**

Item No.	Description	Unit	Cost/Unit	Quantities		Costs	
				Retaining Wall Ramp C-1	Retaining Wall Ramp C-1	Retaining Wall Ramp C-2 Lower	Retaining Wall Ramp C-2 Lower
206	Structure Excavation	CY	\$ 7.00	900	\$ 6,300.00	1755	\$ 12,285.00
206	Structure Backfill (Class 1)	CY	\$ 16.00	2860	\$ 45,760.00	4360	\$ 69,760.00
502	Steel Piling (HP 12x74)	LF	\$ 28.00	0	\$ -	0	\$ -
601	Concrete Class D (Wall)	CY	\$ 350.00	685	\$ 239,750.00	1637	\$ 572,950.00
602	Reinforcing Steel	LB	\$ 0.50	64885	\$ 32,442.50	155375	\$ 77,687.50
				<b>Total @ Wall Ramp C-1=</b>	<b>\$ 324,252.50</b>	<b>Total @ Wall Ramp C-2 Lower =</b>	<b>\$ 732,682.50</b>
				<b>Total /ft<sup>2</sup> @ Wall Ramp C-1 =</b>	<b>\$ 38.46</b>	<b>Total /ft<sup>2</sup> @ Wall Ramp C-2 Lower =</b>	<b>\$ 50.23</b>

Item No.	Description	Unit	Cost/Unit	Quantities		Total Quantity	Total Costs
				Retaining Wall Ramp C-2 Upper	Retaining Wall Ramp C-2 Upper		
206	Structure Excavation	CY	\$ 7.00	1295	\$ 9,065.00	3950	\$ 27,650.00
206	Structure Backfill (Class 1)	CY	\$ 16.00	7075	\$ 113,200.00	14295	\$ 228,720.00
502	Steel Piling ( HP 12x74)	LF	\$ 28.00	0	\$ -	0	\$ -
601	Concrete Class D (Wall)	CY	\$ 350.00	2245	\$ 785,750.00	4567	\$ 1,598,450.00
602	Reinforcing Steel	LB	\$ 0.50	213000	\$ 106,500.00	433,260	\$ 216,630.00
				<b>Total @ Wall Ramp C-2 Upper =</b>	<b>\$ 1,014,515.00</b>		<b>\$ 2,071,450.00</b>
				<b>Total /ft<sup>2</sup> @ Wall Ramp C-2 Upper =</b>	<b>\$ 44.57</b>		

**Cimarron/Bijou Interchange  
Ramp Retaining Walls**

Item No.	Description	Unit	Cost/Unit	Quantities		Costs	
				Retaining Wall Ramp C-1	Retaining Wall Ramp C-1	Retaining Wall Ramp C-2 Lower	Retaining Wall Ramp C-2 Lower
206	Structure Excavation	CY	\$ 7.00	2660	\$ 18,620.00	4915	\$ 34,405.00
206	Structure Backfill (Class 1)	CY	\$ 16.00	590	\$ 9,440.00	10495	\$ 167,920.00
206	Mechanical Reinforcement of Soil	CY	\$ 18.00	2460	\$ 44,280.00	5015	\$ 90,270.00
504	Precast Panel Facing	SF	\$ 20.00	8431	\$ 168,620.00	14588	\$ 291,760.00
				<b>Total @ Wall Ramp C-1 =</b>	<b>\$ 240,960.00</b>	<b>Total @ Wall Ramp C-2 Lower =</b>	<b>\$ 584,355.00</b>
				<b>Total /ft<sup>2</sup> @ Wall Ramp C-1 =</b>	<b>\$ 28.58</b>	<b>Total /ft<sup>2</sup> @ Wall Ramp C-2 Lower =</b>	<b>\$ 40.06</b>

Item No.	Description	Unit	Cost/Unit	Quantities		Total Quantity	Total Costs
				Retaining Wall Ramp C-2 Upper	Retaining Wall Ramp C-2 Upper		
206	Structure Excavation	CY	\$ 7.00	4320	\$ 30,240.00	11,895	\$ 83,265.00
206	Structure Backfill (Class 1)	CY	\$ 16.00	20750	\$ 332,000.00	31,835	\$ 509,360.00
206	Mechanical Reinforcement of Soil	CY	\$ 18.00	10565	\$ 190,170.00	18,040	\$ 324,720.00
504	Precast Panel Facing	SF	\$ 20.00	22763	\$ 455,260.00	45,782	\$ 915,640.00
				<b>Total @ Wall Ramp C-2 Upper =</b>	<b>\$ 1,007,670.00</b>		<b>\$ 1,832,985.00</b>
				<b>Total /ft<sup>2</sup> @ Wall Ramp C-2 Upper =</b>	<b>\$ 44.27</b>		





**Project:** Cimarron / Bijou Interchange  
**Location:** Ramp B4-L Retaining Wall  
**Estimate:** Preliminary Cost Estimates  
 Wilson & Company  
 By: AAP  
 Date: 5/29/03

**CAST-IN-PLACE ON TOP OF CAISSON CURTAIN**

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
206	Structure Backfill (Class 1)	CY	71	\$ 16.00	\$ 1,138
502	Caisson 36" diam. (8' o.c.)	LF	1,625	\$ 125.00	\$ 203,163
504	Precast Panels	SF	2,020	\$ 20.00	\$ 40,404
601	Concrete Class D (Wall)	CY	62	\$ 350.00	\$ 21,778
602	Reinforcing Steel	LB	8,232	\$ 0.50	\$ 4,116

Total Cost \$ **270,598**  
 Cost per SQ FT (EXPOSED) 1,810 \$ 149  
 Cost per SQ FT (Design Height) 2,020 \$ 133

**CAST-IN-PLACE CONCRETE ON H-PILES**

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
	Temp. Excavation Support (Soil Nailing)	SF	105	\$ 30.00	\$ 3,150
203	Embankment Material	CY	489	\$ 12.00	\$ 5,863
206	Structure Excavation	CY	701	\$ 7.00	\$ 4,906
206	Structure Backfill (Class 1)	CY	524	\$ 16.00	\$ 8,379
502	Steel Piling (HP 12 X 74)	LF	987	\$ 28.00	\$ 27,624
502	Pile Tip	EA	28	\$ 90.00	\$ 2,485
601	Concrete Class D (Wall)	CY	126	\$ 350.00	\$ 44,268
602	Reinforcing Steel	LB	14,244	\$ 0.50	\$ 7,122
	Formliner	SF	2,140	\$ 1.00	\$ 2,140

Total Cost \$ **105,938**  
 Cost per SQ FT (EXPOSED) 1,810 \$ 59  
 Cost per SQ FT (Design Height) 2,140 \$ 50

**CAST-IN-PLACE CONCRETE ON SPREAD FOOTINGS**

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
	Temp. Excavation Support (Soil Nailing)	SF	268	\$ 30.00	\$ 8,025
203	Embankment Material	CY	704	\$ 12.00	\$ 8,448
206	Structure Excavation	CY	943	\$ 7.00	\$ 6,600
206	Structure Backfill (Class 1)	CY	746	\$ 16.00	\$ 11,931
601	Concrete Class D (Wall)	CY	189	\$ 350.00	\$ 66,114
602	Reinforcing Steel	LB	21,968	\$ 0.50	\$ 10,984
	Formliner	SF	3,000	\$ 1.00	\$ 3,000

Total Cost \$ **115,102**  
 Cost per SQ FT (EXPOSED) 1,810 \$ 62  
 Cost per SQ FT (Design Height) 3,000 \$ 37

**MSE**

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
	Temp. Excavation Support (Soil Nailing)	SF	299	\$ 30.00	\$ 8,970
203	Embankment Material	CY	366	\$ 12.00	\$ 4,394
206	Structure Excavation	CY	806	\$ 7.00	\$ 5,642
206	Structure Backfill (Class 1)	CY	837	\$ 16.00	\$ 13,385
206	Mechanical Reinforcement of Soil	CY	675	\$ 18.00	\$ 12,153
504	Precast Panel	SF	2,040	\$ 20.00	\$ 40,800
601	Concrete Class D (Wall)	CY	7	\$ 350.00	\$ 2,333

Total Cost \$ **87,678**  
 Cost per SQ FT (EXPOSED) 1,810 \$ 48  
 Cost per SQ FT (Design Height) 2,040 \$ 43

**Project:** Cimarron / Bijou Interchange  
**Location:** Ramp B3-L Retaining Wall  
**Estimate:** Preliminary Cost Estimates  
 Wilson & Company  
 By: AAP  
 Date: 5/29/03

**CAST-IN-PLACE ON TOP OF CAISSON CURTAIN**

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
206	Structure Backfill (Class 1)	CY	113	\$ 16.00	\$ 1,801
206	Caisson 36" diam. (8' o.c.)	LF	2,705	\$ 125.00	\$ 338,094
504	Precast Panels	SF	4,723	\$ 20.00	\$ 94,460
601	Concrete Class D (Wall)	CY	99	\$ 350.00	\$ 34,481
602	Reinforcing Steel	LB	13,034	\$ 0.50	\$ 6,517

Total Cost \$ **475,354**  
 Cost per SQ FT (EXPOSED) 3,983 \$ 119  
 Cost per SQ FT (Design Height) 4,723 \$ 101

**CAST-IN-PLACE CONCRETE ON H-PILES**

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
	Temp. Excavation Support (Soil Nailing)	SF	571	\$ 30.00	\$ 17,130
203	Embankment Material	CY	1,192	\$ 12.00	\$ 14,305
206	Structure Excavation	CY	1,686	\$ 7.00	\$ 11,803
206	Structure Backfill (Class 1)	CY	1,349	\$ 16.00	\$ 21,583
502	Steel Piling (HP 12 X 74)	LF	2,117	\$ 28.00	\$ 59,272
502	Pile Tip	EA	65	\$ 90.00	\$ 5,825
601	Concrete Class D (Wall)	CY	281	\$ 350.00	\$ 98,312
602	Reinforcing Steel	LB	39,801	\$ 0.50	\$ 19,901
	Formliner	SF	4,860	\$ 1.00	\$ 4,860

Total Cost \$ **252,990**  
 Cost per SQ FT (EXPOSED) 3,983 \$ 64  
 Cost per SQ FT (Design Height) 4,860 \$ 52

**CAST-IN-PLACE CONCRETE ON SPREAD FOOTINGS**

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
	Temp. Excavation Support (Soil Nailing)	SF	1,148	\$ 30.00	\$ 34,425
203	Embankment Material	CY	1,602	\$ 12.00	\$ 19,229
206	Structure Excavation	CY	2,502	\$ 7.00	\$ 17,514
206	Structure Backfill (Class 1)	CY	1,764	\$ 16.00	\$ 28,220
601	Concrete Class D (Wall)	CY	484	\$ 350.00	\$ 169,260
602	Reinforcing Steel	LB	61,617	\$ 0.50	\$ 30,808
	Formliner	SF	6,220	\$ 1.00	\$ 6,220

Total Cost \$ **305,676**  
 Cost per SQ FT (EXPOSED) 3,983 \$ 77  
 Cost per SQ FT (Design Height) 6,220 \$ 49

**MSE**

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
	Temp. Excavation Support (Soil Nailing)	SF	1,050	\$ 30.00	\$ 31,500
203	Embankment Material	CY	1,010	\$ 12.00	\$ 12,123
206	Structure Excavation	CY	2,008	\$ 7.00	\$ 14,055
206	Structure Backfill (Class 1)	CY	2,218	\$ 16.00	\$ 35,489
206	Mechanical Reinforcement of Soil	CY	1,879	\$ 18.00	\$ 33,813
504	Precast Panel	SF	4,720	\$ 20.00	\$ 94,400
601	Concrete Class D (Wall)	CY	11	\$ 350.00	\$ 3,694

Total Cost \$ **225,076**  
 Cost per SQ FT (EXPOSED) 3,983 \$ 57  
 Cost per SQ FT (Design Height) 4,720 \$ 48



### CREEK RETAINING WALL

**Project:** Cimarron / Bijou Interchange  
**Location:** Ramp C3 Retaining Wall  
**Estimate:** Preliminary Cost Estimates

Wilson & Company  
 By: AAP  
 Date: 5/29/03

**CAST-IN-PLACE ON TOP OF CAISSON CURTAIN**

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
206	Structure Backfill (Class 1)	CY	5,911	\$ 16.00	\$ 94,577
502	Caisson 36" diam. (4' o.c.)	LF	8,797	\$ 125.00	\$ 1,099,594
601	Concrete Class D (Wall)	CY	774	\$ 350.00	\$ 271,071
602	Reinforcing Steel	LB	102,465	\$ 0.50	\$ 51,232
	Formliner	SF	14,261	\$ 1.00	\$ 14,261

Total Cost **\$ 1,530,736**  
 Cost per SQ FT (EXPOSED) 14,261 \$ 107  
 Cost per SQ FT (Design Height) 14,261 \$ 107

**CAST-IN-PLACE CONCRETE ON H-PILES**

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
	Temp. Excavation Support (Soil Nailing)	SF	2,664	\$ 30.00	\$ 79,913
203	Embankment Material	CY	4,153	\$ 12.00	\$ 49,835
206	Structure Excavation	CY	3,512	\$ 7.00	\$ 24,583
206	Structure Backfill (Class 1)	CY	5,717	\$ 16.00	\$ 91,474
502	Steel Piling (HP 12 X 74)	LF	10,883	\$ 28.00	\$ 304,736
502	Pile Tip	EA	294	\$ 90.00	\$ 26,445
601	Concrete Class D (Wall)	CY	1,144	\$ 350.00	\$ 400,295
602	Reinforcing Steel	LB	212,805	\$ 0.50	\$ 106,403
	Formliner	SF	15,150	\$ 1.00	\$ 15,150

Total Cost **\$ 1,098,833**  
 Cost per SQ FT (EXPOSED) 14,261 \$ 77  
 Cost per SQ FT (Design Height) 15,150 \$ 73

**CAST-IN-PLACE CONCRETE ON SPREAD FOOTINGS**

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
	Temp. Excavation Support (Soil Nailing)	SF	4,204	\$ 30.00	\$ 126,120
203	Embankment Material	CY	4,382	\$ 12.00	\$ 52,590
206	Structure Excavation	CY	5,401	\$ 7.00	\$ 37,806
206	Structure Backfill (Class 1)	CY	6,377	\$ 16.00	\$ 102,031
601	Concrete Class D (Wall)	CY	1,846	\$ 350.00	\$ 646,086
602	Reinforcing Steel	LB	244,220	\$ 0.50	\$ 122,110
	Formliner	SF	15,550	\$ 1.00	\$ 15,550

Total Cost **\$ 1,102,293**  
 Cost per SQ FT (EXPOSED) 14,261 \$ 77  
 Cost per SQ FT (Design Height) 15,550 \$ 71

**MSE**

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
	Temp. Excavation Support (Soil Nailing)	SF	4,148	\$ 30.00	\$ 124,425
203	Embankment Material	CY	3,762	\$ 12.00	\$ 45,143
206	Structure Excavation	CY	5,005	\$ 7.00	\$ 35,033
206	Structure Backfill (Class 1)	CY	10,409	\$ 16.00	\$ 166,541
206	Mechanical Reinforcement of Soil	CY	9,402	\$ 18.00	\$ 169,243
504	Precast Panel	SF	15,150	\$ 20.00	\$ 303,000
601	Concrete Class D (Wall)	CY	22	\$ 350.00	\$ 7,778

Total Cost **\$ 851,163**  
 Cost per SQ FT (EXPOSED) 14,261 \$ 60  
 Cost per SQ FT (Design Height) 15,150 \$ 56

**Project:** Cimarron / Bijou Interchange  
**Location:** Ramp B4-R Retaining Wall  
**Estimate:** Preliminary Cost Estimates

Wilson & Company  
 By: AAP  
 Date: 5/29/03

**CAST-IN-PLACE ON TOP OF CAISSON CURTAIN**

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
206	Structure Backfill (Class 1)	CY	7,846	\$ 16.00	\$ 125,534
502	Caisson 36" diam. (4' o.c.)	LF	11,851	\$ 125.00	\$ 1,481,320
601	Concrete Class D (Wall)	CY	1,168	\$ 350.00	\$ 408,775
602	Reinforcing Steel	LB	154,517	\$ 0.50	\$ 77,258
	Formliner	SF	22,707	\$ 1.00	\$ 22,707

Total Cost **\$ 2,115,595**  
 Cost per SQ FT (EXPOSED) 22,707 \$ 93  
 Cost per SQ FT (Design Height) 22,707 \$ 93

**CAST-IN-PLACE CONCRETE ON H-PILES**

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
	Temp. Excavation Support (Soil Nailing)	SF	3,686	\$ 30.00	\$ 110,580
203	Embankment Material	CY	6,799	\$ 12.00	\$ 81,590
206	Structure Excavation	CY	5,799	\$ 7.00	\$ 40,595
206	Structure Backfill (Class 1)	CY	8,751	\$ 16.00	\$ 140,008
502	Steel Piling (HP 12 X 74)	LF	12,819	\$ 28.00	\$ 358,926
502	Pile Tip	EA	434	\$ 90.00	\$ 39,022
601	Concrete Class D (Wall)	CY	1,798	\$ 350.00	\$ 629,356
602	Reinforcing Steel	LB	309,738	\$ 0.50	\$ 154,869
	Formliner	SF	25,960	\$ 1.00	\$ 25,960

Total Cost **\$ 1,580,907**  
 Cost per SQ FT (EXPOSED) 22,707 \$ 70  
 Cost per SQ FT (Design Height) 25,960 \$ 61

**CAST-IN-PLACE CONCRETE ON SPREAD FOOTINGS**

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
	Temp. Excavation Support (Soil Nailing)	SF	6,465	\$ 30.00	\$ 193,958
203	Embankment Material	CY	7,553	\$ 12.00	\$ 90,635
206	Structure Excavation	CY	9,462	\$ 7.00	\$ 66,237
206	Structure Backfill (Class 1)	CY	11,262	\$ 16.00	\$ 180,198
601	Concrete Class D (Wall)	CY	3,189	\$ 350.00	\$ 1,116,117
602	Reinforcing Steel	LB	421,892	\$ 0.50	\$ 210,946
	Formliner	SF	27,740	\$ 1.00	\$ 27,740

Total Cost **\$ 1,885,832**  
 Cost per SQ FT (EXPOSED) 22,707 \$ 83  
 Cost per SQ FT (Design Height) 27,740 \$ 68

**MSE**

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
	Temp. Excavation Support (Soil Nailing)	SF	6,746	\$ 30.00	\$ 202,365
203	Embankment Material	CY	6,227	\$ 12.00	\$ 74,725
206	Structure Excavation	CY	8,294	\$ 7.00	\$ 58,059
206	Structure Backfill (Class 1)	CY	15,798	\$ 16.00	\$ 252,766
206	Mechanical Reinforcement of Soil	CY	14,050	\$ 18.00	\$ 252,891
504	Precast Panel	SF	25,960	\$ 20.00	\$ 519,200
601	Concrete Class D (Wall)	CY	41	\$ 350.00	\$ 14,194

Total Cost **\$ 1,374,201**  
 Cost per SQ FT (EXPOSED) 22,707 \$ 61  
 Cost per SQ FT (Design Height) 25,960 \$ 53





**Project:** Cimarron / Bijou Interchange  
**Location:** Ramp B3-R Retaining Wall  
**Estimate:** Preliminary Cost Estimates

Wilson & Company  
 By: AAP  
 Date: 5/29/03

**CAST-IN-PLACE CONCRETE ON H-PILES**

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
	Temp. Excavation Support (Soil Nailing)	SF	139	\$ 30.00	\$ 4,175
203	Embankment Material	CY	486	\$ 12.00	\$ 5,834
206	Structure Excavation	CY	581	\$ 7.00	\$ 4,067
206	Structure Backfill (Class 1)	CY	530	\$ 16.00	\$ 8,482
502	Steel Piling (HP 12 X 74)	LF	758	\$ 28.00	\$ 21,224
502	Pile Tip	EA	28	\$ 90.00	\$ 2,537
601	Concrete Class D (Wall)	CY	136	\$ 350.00	\$ 47,459
602	Reinforcing Steel	LB	15,463	\$ 0.50	\$ 7,731
	Formliner	SF	2,332	\$ 1.00	\$ 2,332

Total Cost \$ **103,840**  
 Cost per SQ FT (EXPOSED) 1,574 \$ 66  
 Cost per SQ FT (Design Height) 2,332 \$ 45

**CAST-IN-PLACE CONCRETE ON SPREAD FOOTINGS**

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
	Temp. Excavation Support (Soil Nailing)	SF	167	\$ 30.00	\$ 5,003
203	Embankment Material	CY	489	\$ 12.00	\$ 5,870
206	Structure Excavation	CY	607	\$ 7.00	\$ 4,251
206	Structure Backfill (Class 1)	CY	523	\$ 16.00	\$ 8,363
601	Concrete Class D (Wall)	CY	155	\$ 350.00	\$ 54,330
602	Reinforcing Steel	LB	16,399	\$ 0.50	\$ 8,199
	Formliner	SF	2,332	\$ 1.00	\$ 2,332

Total Cost \$ **88,348**  
 Cost per SQ FT (EXPOSED) 1,574 \$ 56  
 Cost per SQ FT (Design Height) 2,332 \$ 38

**MSE**

ITEM	DESCRIPTION	UNIT	TOTALS	UNIT COST	COST
	Temp. Excavation Support (Soil Nailing)	SF	198	\$ 30.00	\$ 5,934
203	Embankment Material	CY	371	\$ 12.00	\$ 4,452
206	Structure Excavation	CY	775	\$ 7.00	\$ 5,423
206	Structure Backfill (Class 1)	CY	905	\$ 16.00	\$ 14,480
206	Mechanical Reinforcement of Soil	CY	735	\$ 18.00	\$ 13,229
504	Precast Panel	SF	2,186	\$ 20.00	\$ 43,720
601	Concrete Class D (Wall)	CY	7	\$ 350.00	\$ 2,392

Total Cost \$ **89,629**  
 Cost per SQ FT (EXPOSED) 1,574 \$ 57  
 Cost per SQ FT (Design Height) 2,186 \$ 41





**Appendix D**  
**Preliminary Geotechnical Results**



**Kumar & Associates, Inc.**  
Geotechnical and Materials Engineers  
and Environmental Scientists

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Office Locations: Denver, Colorado, Fort Collins, Colorado  
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January 10, 2003

Mr. Robert Refvem  
Felsburg, Holt, and Ullevig, Inc.  
7951 East Maplewood Avenue, Suite 200  
Greenwood Village, Colorado 80111

Subject: Preliminary Results of Geotechnical Engineering Study, Proposed Improvements to  
Interstate 25 from Bijou Street to Cimarron Street, Colorado Springs, Colorado

Project No. 012-266

Dear Mr. Refvem:

This letter presents preliminary results of the geotechnical engineering study currently underway for the subject project.

Subsurface Conditions: Preliminary information on the subsurface conditions at the proposed structure sites was obtained by drilling one boring for each structure. The approximate boring locations are shown on the attached Figures 1 and 2. Logs of the borings are presented on Figures 3, 4 and 5. Legend and notes for the borings are presented on Figure 6. The results of laboratory testing performed on selected soils samples from the borings are presented on Figures 3, 4 and 5 and are summarized on Table I.

The subsoils encountered in the borings predominantly consisted of approximately 2.5 to 40 feet of clayey sand and sandy clay embankment fill underlain by native silty to clayey sand and sandy clay. Sampler penetration tests indicate the sands are loose to dense and the clays are medium stiff to stiff in consistency. Claystone bedrock was encountered underlying the native soils at depths ranging from 11 to 53 feet. The ground-water level was measured at depths of approximately 9 to 44 feet at the time of drilling.

Felsburg Holt & Ullevig  
January 10, 2003  
Page 2

Preliminary Bridge Foundation Recommendations: Based on the subsurface conditions encountered in the exploratory borings and the depth of fills at the site, we anticipate the recommended foundations for the bridge structures will likely consist of drilled piers or driven steel H-piles end bearing on the claystone bedrock beneath the site.

We anticipate recommendations for design of drilled caissons will include allowable end bearing pressures in the range of 40,000 to 60,000 psf. Skin frictions will likely be 10 percent of the end bearing for the portion of the caisson in bedrock. A minimum caisson diameter of 24 inches and a maximum length to diameter ratio of 25 will also likely be recommended. Recommendations for the design of driven steel H-piles will be in accordance with Section 502 of the Colorado Department of Transportation "Standard Specifications for Road and Bridge Construction", 1999 Edition.

Preliminary Retaining Wall Recommendations: Because the compaction history of the existing fill at the site is unknown, it should be considered unsuitable for support of foundations. We anticipate the recommended foundations for retaining walls at the site will likely consist of spread footings placed on a layer of new structural fill. Spread footings placed on a layer of new structural fill will likely have allowable bearing pressures between 2,000 and 4,000 psf. Because the existing fill appears to be relatively compact, all or a portion of the fill may remain in place if in-place density testing at the time of construction reveals the existing fill is adequate. MSE retaining walls will be less sensitive to movement if the existing fill left in place settles subjecting the walls to differential movement.

Additional Study: The recommendations presented above are based on the results of a limited field and laboratory study. Therefore, they should be assumed to be preliminary until the final geotechnical engineering study is performed.

Please call us if you have any questions or require additional information.

Sincerely,

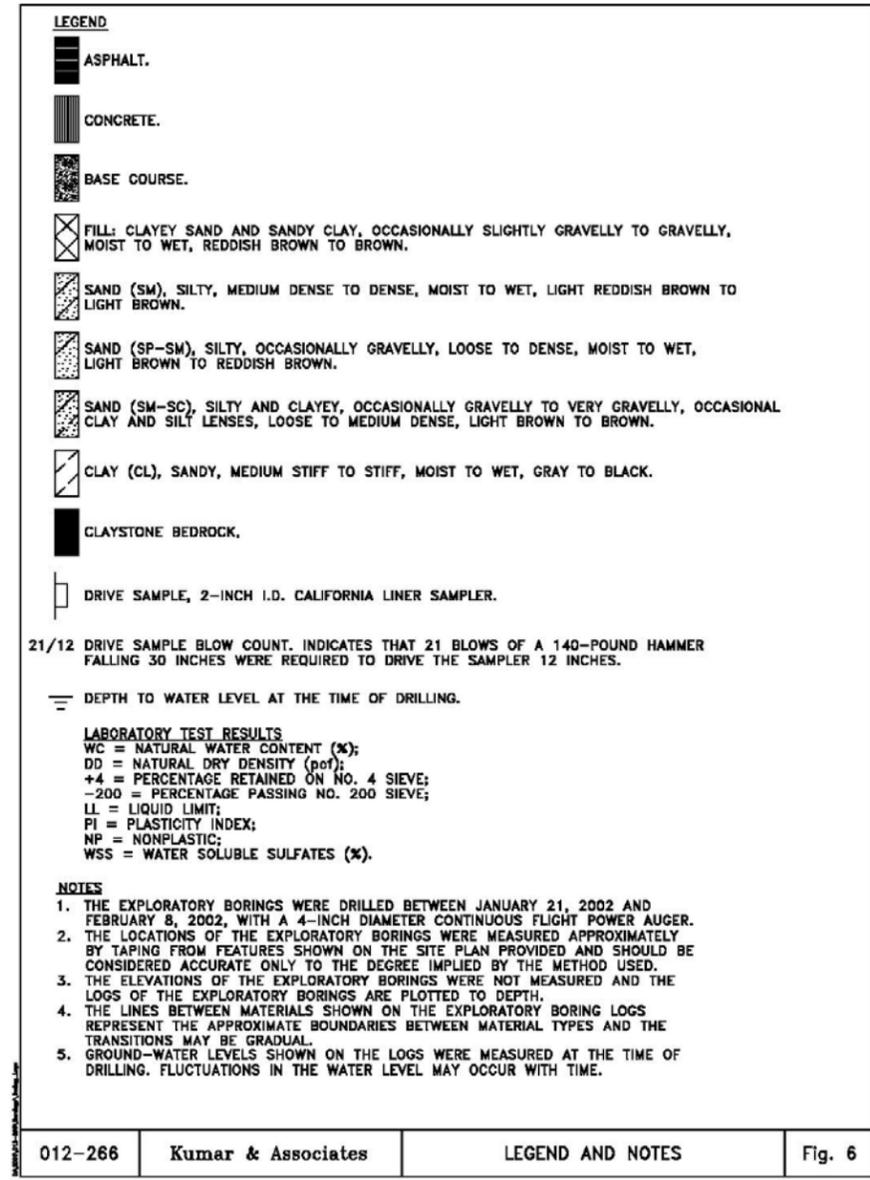
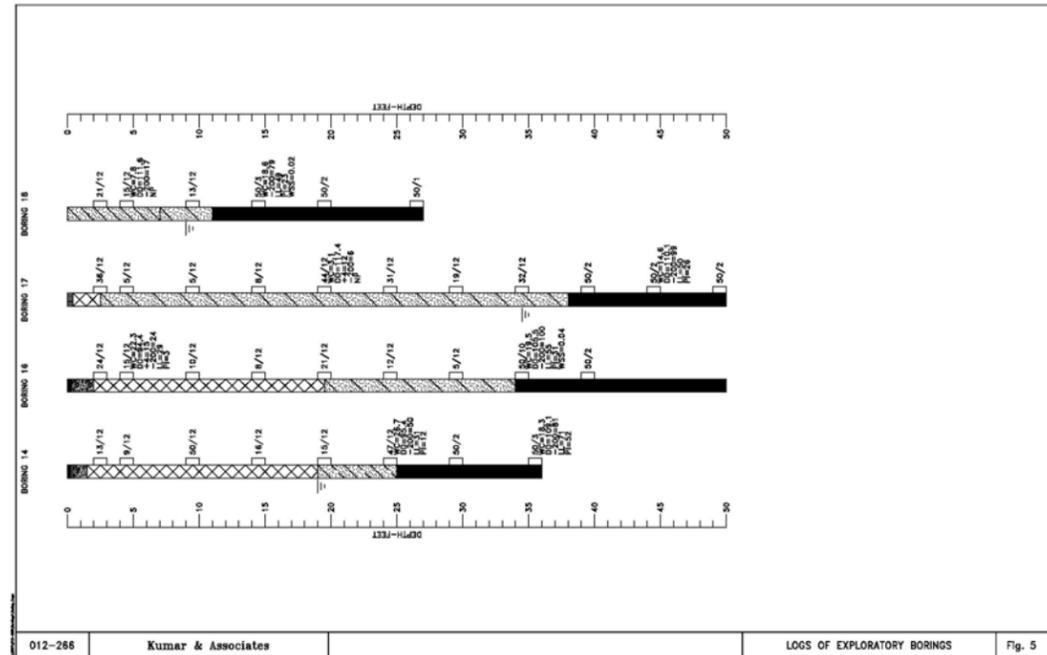
KUMAR & ASSOCIATES, INC.

By \_\_\_\_\_  
Timothy S. Biolchini, P.E.

TSB: tb  
Rev. by: BEB  
Attachments







**LEGEND**

- ASPHALT.
- CONCRETE.
- BASE COURSE.
- FILL: CLAYEY SAND AND SANDY CLAY, OCCASIONALLY SLIGHTLY GRAVELLY TO GRAVELLY, MOIST TO WET, REDDISH BROWN TO BROWN.
- SAND (SM), SILTY, MEDIUM DENSE TO DENSE, MOIST TO WET, LIGHT REDDISH BROWN TO LIGHT BROWN.
- SAND (SP-SM), SILTY, OCCASIONALLY GRAVELLY, LOOSE TO DENSE, MOIST TO WET, LIGHT BROWN TO REDDISH BROWN.
- SAND (SM-SC), SILTY AND CLAYEY, OCCASIONALLY GRAVELLY TO VERY GRAVELLY, OCCASIONAL CLAY AND SILT LENSES, LOOSE TO MEDIUM DENSE, LIGHT BROWN TO BROWN.
- CLAY (CL), SANDY, MEDIUM STIFF TO STIFF, MOIST TO WET, GRAY TO BLACK.
- CLAYSTONE BEDROCK.
- DRIVE SAMPLE, 2-INCH I.D. CALIFORNIA LINER SAMPLER.

21/12 DRIVE SAMPLE BLOW COUNT. INDICATES THAT 21 BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE THE SAMPLER 12 INCHES.

DEPTH TO WATER LEVEL AT THE TIME OF DRILLING.

**LABORATORY TEST RESULTS**  
 WC = NATURAL WATER CONTENT (%);  
 DD = NATURAL DRY DENSITY (pcf);  
 +4 = PERCENTAGE RETAINED ON NO. 4 SIEVE;  
 -200 = PERCENTAGE PASSING NO. 200 SIEVE;  
 LL = LIQUID LIMIT;  
 PI = PLASTICITY INDEX;  
 NP = NONPLASTIC;  
 WSS = WATER SOLUBLE SULFATES (%).

**NOTES**

- THE EXPLORATORY BORINGS WERE DRILLED BETWEEN JANUARY 21, 2002 AND FEBRUARY 8, 2002, WITH A 4-INCH DIAMETER CONTINUOUS FLIGHT POWER AUGER.
- THE LOCATIONS OF THE EXPLORATORY BORINGS WERE MEASURED APPROXIMATELY BY TAPING FROM FEATURES SHOWN ON THE SITE PLAN PROVIDED AND SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.
- THE ELEVATIONS OF THE EXPLORATORY BORINGS WERE NOT MEASURED AND THE LOGS OF THE EXPLORATORY BORINGS ARE PLOTTED TO DEPTH.
- THE LINES BETWEEN MATERIALS SHOWN ON THE EXPLORATORY BORING LOGS REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN MATERIAL TYPES AND THE TRANSITIONS MAY BE GRADUAL.
- GROUND-WATER LEVELS SHOWN ON THE LOGS WERE MEASURED AT THE TIME OF DRILLING. FLUCTUATIONS IN THE WATER LEVEL MAY OCCUR WITH TIME.



Kumar & Associates, Inc.

TABLE I

SUMMARY OF LABORATORY TEST RESULTS

Project No. 012-266

SAMPLE LOCATION		NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	GRADATION		PERCENT PASSING NO. 200 SIEVE	ATTERBERG LIMITS		WATER SOLUBLE SULFATES (%)	HVEEM R-VALUE	SOIL OR BEDROCK DESCRIPTION
BORING	DEPTH (ft)			GRAVEL (%)	SAND (%)		LIQUID LIMIT	PLASTICITY INDEX			
1	9	5.4	108.2	21	67	12	24	5		Slightly silty, gravelly sand	
	24	19.1	108.3			99	53	25	0.03	Claystone	
2	4	11.9	115.7	19	54	27	29	12		Fill: gravelly, clayey sand	
	19	7.1	130.3	59	38	3		NP	0.05	Sandy gravel	
3	4	9.4	121.1	28	39	33	37	23	<0.02	Fill: gravelly, clayey sand	
	14	7.5	128.8	17	58	25	28	11		Fill: gravelly, clayey sand	
	24	12.3	118.5	1	61	38	28	7	0.05	Clayey sand	
	39	21.2	104.4			99	55	26		Claystone	
4	14	18.0	108.2	22	58	20	27	6		Clayey, gravelly sand	
	24	13.5	118.7			45	43	23	<0.02	Claystone	
5	9	20.2	105.3	9	27	64	50	29	0.25	Fill: slightly gravelly, sandy clay	
	39	8.9	130.1			19	40	22		Sandstone	
6	2	5.0	122.7	26	64	10	21	6		Fill: slightly clayey, gravelly sand	
	19	18.9	105.3	9	67	24	34	16		Slightly gravelly, clayey sand	

7	9	9.7	111.7	13	57	30	38	26	1.07	Fill: gravelly, clayey sand
	24	13.9	109.4			29	27	7		Clayey sand
	39	14.5	101.2			99	52	26		Claystone
9	4	18.6	108.2			63	48	27		Fill: sandy clay
	29	22.1	103.0			88	54	31		Fill: slightly sandy clay
	34	15.4	112.0						0.07	Silty sand
	44	9.9	110.6	25	71	4		NP		Gravelly sand
	57	15.8	113.6			94	54	35		Claystone
10	9	14.9	100.4			45	25	5		Very silty sand
	24	14.0	109.8			50	44	20	0.14	Claystone
11	9	1.1	99.7			4		NP		Sand
	29	16.7	111.8			93	57	31		Claystone
12	14	19.4	103.4	5	22	73	51	31		Fill: slightly gravelly, sandy clay
	44	25.7	95.2			49	25	5		Very silty sand
	54	11.1	118.4			82	42	22	0.04	Claystone
13	9	14.1	117.0			38	31	10		Fill: clayey sand
	49	14.6	109.0			98	46	23	0.04	Claystone
14	24	26.7	95.4			50	31	12		Very sandy clay
	35	18.3	109.1			81	71	52		Claystone
16	4	22.3	94.4	15	61	24	29	3		Fill: gravelly, silty sand
	34	19.5	105.5			100	55	31	0.04	Claystone
17	19	3.1	117.4	12	82	6		NP		Slightly silty, slightly gravelly sand
	44	14.6	110.1			99	50	26		Claystone
18	4	7.8	111.6			17		NP		Silty sand
	14	18.6				79	49	23	0.02	Claystone