Appendix D. Options Charrette Report

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Route 19 at Current River and Spring Valley

Rehab Study of Bridges J0420 and G0804

Design Charrette

Final Report

Prepared by:

HDR Engineering, Inc.

Workshop Date:

September 19, 2019

Report Date:

October 7, 2019

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Executive Summary

Introduction

This report summarizes the events of a design charrette workshop conducted for the Missouri State Department of Transportation (MoDOT) and facilitated by HDR Engineering, Inc. The subject of the workshop was the evaluation of concept-level options for two arch bridge structures on Route 19 over the Current River (G-804A) and Spring Creek (J-420) in the Mark Twain National Forest in Shannon County, Missouri. The workshop was conducted September 19, 2019 in Round Spring, Missouri.

Representatives from the National Park Service and Shannon County participated in a one-day workshop with a team of MoDOT representatives. HDR provided technical subject matter experts on roadway and bridge design as well as a facilitator for the workshop.

Project Overview

MoDOT has two aesthetic and historical arch bridge structures on Route 19 over the Current River (G0804) and Spring Creek (J0420) in the Mark Twain National Forest in Shannon County that are in fair to poor condition. The structures carrying Route 19 through the Ozark National Scenic Riverways are of 1920's vintage reinforced concrete construction. Attractive arch spans command a visitor's attention when the bridges come into view. Filled arches (G0804), skewed arches (J0420), open structural framing, haunched girders and distinctive cantilever brackets supporting the deck slab contribute to the character of the structures.

Both structures are exhibiting signs of increased deterioration and have been rated in poor or fair condition by recent bridge inspections. The existing roadway width is a limiting component of both structures. Wider vehicles such as trucks, busses, recreational vehicles, and those pulling trailers have difficulty crossing the bridge against opposing traffic. G0804 is signed and striped for single-lane traffic.

HDR has been hired by MoDOT to perform a study to identify viable alternatives that will be included in a forthcoming environmental study of the bridges.

Workshop Objectives

The objective of the design charrette workshop was to solicit and incorporate stakeholder and submit matter expert input early in the alternative development process. The workshop was also tasked with developing key functional and performance criteria that could be used to evaluate the current set of construction options relative to which offers the best overall value in terms of performance, cost, schedule and risk. From this analysis, the team was asked to recommend improvements to the concepts which will be included in the forthcoming environmental study.

Key Project Issues

The items listed below are the key drivers, constraints, or issues being addressed by the project and considered during this study to evaluate the various options.

- The Current River Bridge has deck, superstructure, and substructure ratings of 5 – Fair Condition based on the last inspection report dated April, 2019. The Spring Valley Bridge has a 4 – Poor Condition rating for the deck, a 5 – Fair Condition rating for the superstructure, and a 6 – Satisfactory Condition rating for the substructure. The Spring Valley Bridge is considered to be in worse condition. Both bridges will continue to deteriorate requiring additional maintenance until rehab or reconstruction options are completed.
- All construction alternatives need to consider safety and operational improvements from a standard-width roadway.
- Route 19 is a primary north-south roadway in the area. Detour options are limited and would require significant out-of-way travel times. Construction alternatives must maintain a minimum of one lane of traffic at all times.
- Float trips on the rivers are a common occurrence. Construction alternatives will need to consider recreational activity impacts and the ability to maintain river traffic during construction.
- Any construction alternatives need to consider the natural environment, cultural value, and visual aesthetics of the historic bridges.
- The existing pedestrian bridge adjacent to the Current River Bridge accommodates numerous public and private utilities which will need to be maintained throughout construction. Alternatives that impact the pedestrian bridge will need to consider relocation of the utilities. The pedestrian bridge also provides bike/ped access across the Current River. All construction alternatives must provide dedicated pedestrian accommodation and consider the temporary impacts to maintaining pedestrian access.

Conceptual Alternatives

Prior to the workshop, MoDOT provided the following conceptual alternatives:

1. Replace-in-kind on alignment with traffic on temporary bridges.
2. Girder bridge replacement on alignment with traffic on temporary bridges.
3. Girder bridge on offset alignment with traffic maintained on existing alignment.
    a. Without reuse of existing bridge G0804 for pedestrian use.
    b. With reuse of existing bridge G0804 for pedestrian use.
4. Concrete arch on offset alignment with traffic maintained on existing alignment.
    a. Without reuse of existing bridge G0804 for pedestrian use.
    b. With reuse of existing bridge G0804 for pedestrian use.
5. Rehabilitation of existing bridges with traffic on temporary bridges.

Alternative Evaluation Methodology

During the course of the workshop, a number of analytical tools and techniques were applied to develop a better understanding of the conceptual alternatives. A major component of this analysis was the application of Value Metrics which seeks to assess the elements of cost, performance, time, and risk as they relate to the total value presented by a set of options. As part of the Value Metrics process, the stakeholder representatives identified a number of Performance Requirements, defined as the essential, non-discretionary aspects of the project, and Performance Attributes, those aspects of a project's scope that may possess a range of potential values. These were used throughout the workshop to communicate stakeholder priorities and as a format for evaluation of the conceptual alternatives. Key Performance Requirements include the MoDOT Highway Design and Bridge Design Standards, Applicable Environmental Processes and Reviews, Maintaining minimum roadway operations and access points during construction, Accommodating pedestrian/bike access, and Maintaining river traffic operations during construction. The key performance attributes identified for the analysis are listed in the table, "Performance Attributes."

Performance Attributes
Aesthetics
Maintainability
Construction Impacts
Environmental Impacts

Table 1- Major Performance Attributes

Workshop Results

A number of potential alternatives were pre-screened due to conflicts with the identified performance requirements. Once a conceptual alternative was confirmed viable from meeting all performance requirements, it was evaluated using the performance attributes noted in the table above. The results of the performance evaluation are provided in the *Alternatives Evaluation* section of this report.

The following are some of the key lessons learned and take-aways that were captured as a result of the workshop:

- There is a significant interest in maintaining the appearance and character of the existing structures in the parkland setting.
- Identified a modification to Alterative 5 that considers staged rehab construction of the Current River Bridge that maintains one-lane traffic in lieu of a temporary bridge.
- Identified an additional conceptual alternative that rehabs the Current River Bridge with an over-widened section and replacement or rehabilitation of Spring Valley Bridge.
- The existing pedestrian bridge is in need of maintenance. The National Park Service would support removal of the existing pedestrian bridge as long as utility service could be maintained. The National Park Service indicated that it would not be interested in taking

ownership of the existing Current River Bridge for use as a pedestrian bridge given the maintenance implications.

- Bridge railing options were identified and evaluated. All bridge railing options can be accommodated by any construction alternative.
- MoDOT may consider modifying the design criteria relative to the operating vehicle vs. the standard design vehicle.
- The National Park Service indicated a preference for upgraded fencing on the pedestrian walkways in lieu of standard chainlink.
- The National Park Service indicated a preference to be a cooperating agency for the project.

HDR wishes to express its appreciation to the MoDOT, NPS, and County personnel that participated on this workshop and for the excellent support they provided.

Project Information

Background

The Missouri Department of Transportation (MoDOT), like State Departments of Transportation throughout the nation, is faced with the task of addressing an aging transportation infrastructure. Many of today's highways and bridges were constructed during the Great Depression and shortly after World War II. For more than a half century, MoDOT has maintained these facilities ensuring public access to fast and reliable travel and providing Missouri with the means to conduct commerce throughout the State and beyond. As these facilities have aged, costs associated with maintaining them have grown considerably. Many of these facilities require major rehabilitation to bring them up to standards necessary to meet today's travel demands and safety requirements. Bridges of this era are exceeding their design life potentially putting travelers and the State's economy at risk were they to fail. Now, after nearly 100 years, these facilities have served the traveling public well beyond the number years for which they were designed.

Project Description

MoDOT has two aesthetic and historical arch bridge structures on Route 19 over the Current River (G0804) and Spring Creek (J0420) in the Mark Twain National Forest in Shannon County that are in poor condition. The structures carrying Route 19 through the Ozark National Scenic Riverways are of 1920's vintage reinforced concrete construction. Attractive arch spans command a visitor's attention when the bridges come into view. Skewed arches, open structural framing, haunched girders and distinctive cantilever brackets supporting the deck slab contribute to the character of the structures.

MoDOT is currently planning on initiating an environmental study to evaluate options to either rehabilitate or replace both bridges. Currently, there are no less than five potential options under consideration. Due to the resource intensive nature of performing environmental studies, it was decided that preliminary conceptual development was needed to develop information on the options that would be included in the forthcoming environmental study.

Bridge G0804 over Current River

Bridge G0804 spans the Current River and was constructed in 1924 as noted on a plaque near the north abutment. The original construction plans indicate the bridge has five spans with an overall bridge length of 602 ft. from fill face to fill face of abutments. The three center spans are 136 ft. filled concrete arches, with one 14 ft. wide arch rib per span. The two 63 ft. end spans are also filled concrete arch spans. The 21'-4" wide bridge carries an 18 ft. clear roadway. Roadway paving is supported on the earth and gravel fill contained within the arch spans.

All reinforced concrete piers and abutments are founded on spread footings keyed into rock. Deep abutments are 34 ft. long, hollow cell, filled type with internal cross beams supporting side walls.

Bridge G0804 is signed as a one-lane bridge, but no traffic control or signals are currently provided.

A pedestrian/utility bridge parallels the existing bridge approximately 50 ft. east of Bridge G0804. A convenience store is located on the west side of Rte. 19, approximately 180 ft. north of the north end of the bridge. A large camping and picnic area is located west of the bridge, on the north side of the Current River and east of the bridge, south of the Current River. The intersection of Route 19/County Road 324 is located approximately 200 ft. south of the bridge.

Elevation View – Looking Southeast

Roadway – Looking South

Bridge J0420 over Spring Valley

Original construction plans for the existing bridge over Spring Valley are dated 1930. The bridge is skewed at 45 degrees, right advance. Consisting of eight spans, the overall bridge length is 522.75 ft. from fill face to fill face of abutments. The center span is a 155 ft. open spandrel concrete arch, with the two arch ribs staggered to accommodate the large skew. The three approach spans from the north and four approach spans from the south are of cast-in-place concrete girder construction. The deck slab is cast monolithically with the floor beams in the arch span and the two girder system in the approach spans. The 23 ft. wide bridge carries a 20 ft. clear roadway.

Both reinforced concrete piers supporting the arch span are founded on rock, utilizing spread footings embedded at least 18 inches into solid rock. Framed bents on spread footings are embedded at least 6 inches into rock. Abutments are spill-thru type with deep counterforts. The north abutment is supported on two spread footings. South abutment support is provided by a spread footing on the east side, and a timber pile supported footing on the west. The 25 ft. long timber piles extend below the adjacent rock elevation of the eastern footing, most likely due to a sink hole, cavern or drastic change in bedrock elevation.

The 20 ft. roadway width is a limiting component of the structure. Currently, wider vehicles such as trucks, busses, recreational vehicles, and those pulling trailers have difficulty crossing the bridge against opposing traffic. Also, the bridge is posted for 34 tons.

Round Spring is approximately 380 ft. north and 140 ft. east of the north end of the bridge (along Rte 19). Park ranger headquarters, including several buildings, is located southwest of the existing bridge. Access to the headquarters and Round Spring Cave is via a roadway under the existing Rte. 19 bridge. The closest park building is approximately 230 ft. south of the bridge and 100 ft. west of Rte. 19. A low water crossing, carrying vehicular traffic to the Round Spring parking area is located 140 ft. downstream of the Rte. 19 bridge. The intersection of the campground and Spring access roadway is located approximately 200 ft. south of the bridge.

Elevation View – Looking Northeast

Span Over Park Road – Looking East

Conceptual Alternatives

Prior to the workshop, MoDOT provided the following conceptual alternatives to be considered and evaluated:

1. Replace-in-kind on alignment with traffic on temporary bridges.
2. Girder bridge replacement on alignment with traffic on temporary bridges.
3. Girder bridge on offset alignment with traffic maintained on existing alignment.
    a. Without reuse of existing bridge G0804 for pedestrian use.
    b. With reuse of existing bridge G0804 for pedestrian use.
4. Concrete arch on offset alignment with traffic maintained on existing alignment.
    a. Without reuse of existing bridge G0804 for pedestrian use.
    b. With reuse of existing bridge G0804 for pedestrian use.
5. Rehabilitation of existing bridges with traffic on temporary bridges.

Alternative Features

Alternative 1, 2 and 5 - Reconstruct/Rehab existing bridge with temporary alignments connected to mainline Rte. 19 via temp shoo-flys

- Current River crossing
    - Option 1 –
        - Temp alignment – approx. 45' east of existing bridge centerline
        - Temp bridge requires removal of existing ped bridge. No ped crossing during construction. Utility impacts on existing ped bridge.
        - Temp bridge provides two 12' traffic lanes
        - New reconstructed/rehab bridge built with 10' walkway/mixed use path
    - Option 2 –
        - Temp alignment – approx. 80' east of existing bridge centerline
        - Existing ped bridge remains in place
        - Temp bridge provides two 12' traffic lanes
    - Option 3 –
        - Temp alignment – approx. 35' east of existing bridge centerline
        - Temp bridge requires removal of existing ped bridge. No ped crossing during construction. Utility impacts on existing ped bridge.
        - Temp bridge provides one 12' traffic lane. Traffic is signal controlled
        - Temp bridge is used for ped bridge after construction
    - Option 4 –
        - No temp alignment – use existing bridge for one lane traffic. Traffic is signaled controlled.
        - Will require multiple traffic shifts on existing bridge to reconstruct/rehab existing bridge
        - Existing ped bridge remains in place
- Spring Valley crossing
    - One option for all alternatives
        - Temp alignment – approx. 35' west of existing bridge centerline
        - No impacts to Park access

- No impacts to NPS buildings
- Will impact multiple trees on west side of existing bridge

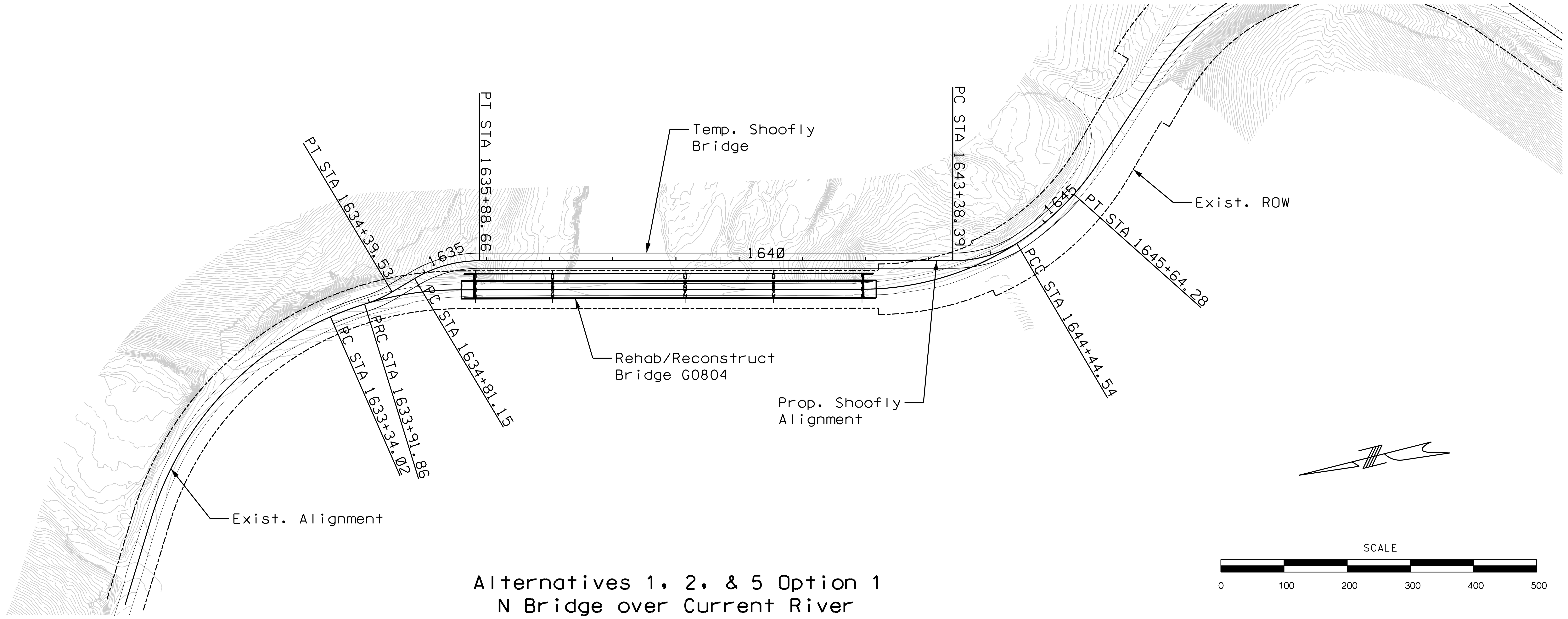
- General
  - Shoo-fly alignments – 225’ minimum radius; no superelevation; maintains minimum 10’ separation from bridge/approach slab construction

Alternative 3a & 4a – Offset alignment (without reuse of existing bridge for pedestrian use)

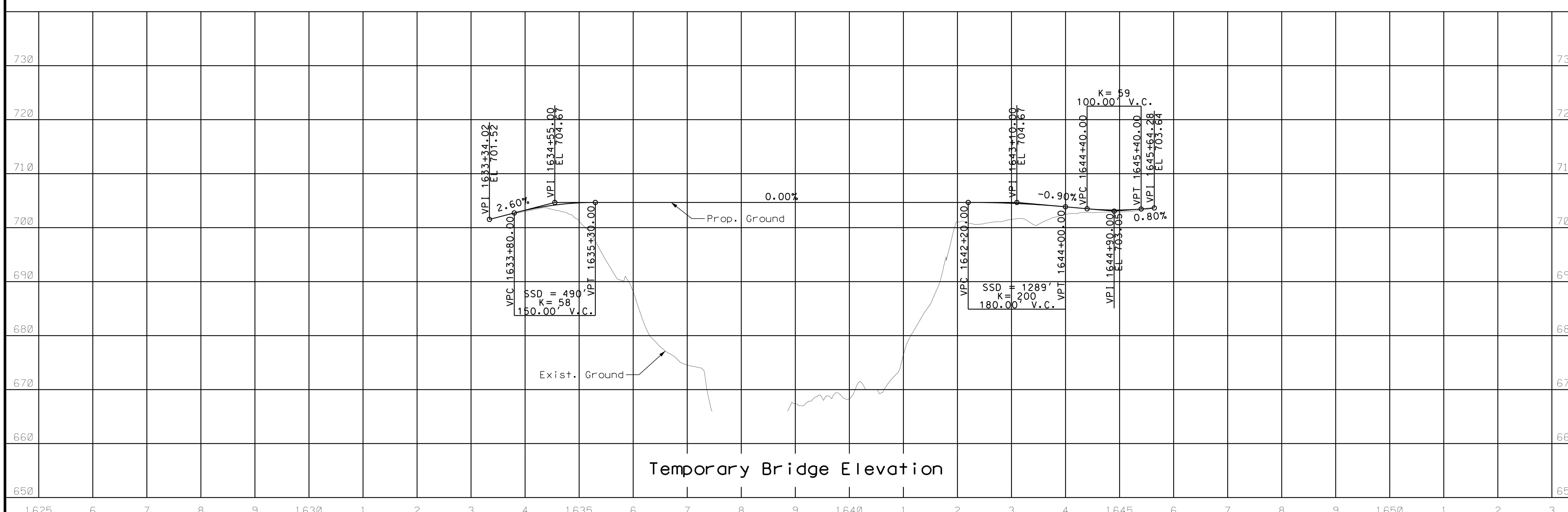
- Current River Crossing
  - Option 1 –
    - Final alignment – approx. 80’ east of existing bridge centerline
    - Existing ped bridge remains in place
    - More roadway impacts – increased costs
  - Option 2 –
    - Final alignment – approx. 35’ east of existing bridge centerline
    - Requires removal of existing ped bridge. No ped crossing during construction. Utility impacts on existing ped bridge.
    - New reconstructed/rehab bridge built with 10’ walkway/mixed use path
- Spring Valley crossing
  - One option for all offset alignment alternatives (including 3a1/4a1, 3a2/4a2, and 3b/4b)
    - Final alignment – approx. 35’ west of existing bridge centerline
    - Will require retaining wall or steepened fill slope to avoid impacting NPS buildings

Alternative 3b & 4b – Offset alignment (with reuse of existing bridge for pedestrian use)

- Current River Crossing
  - One option for 3b/4b
    - Final alignment – approx. 35’ east of existing bridge centerline
    - Requires removal of existing ped bridge. No ped crossing during construction. Utility impacts on existing ped bridge.



Alternatives 1, 2, & 5 Option 1
N Bridge over Current River



Temporary Bridge Elevation

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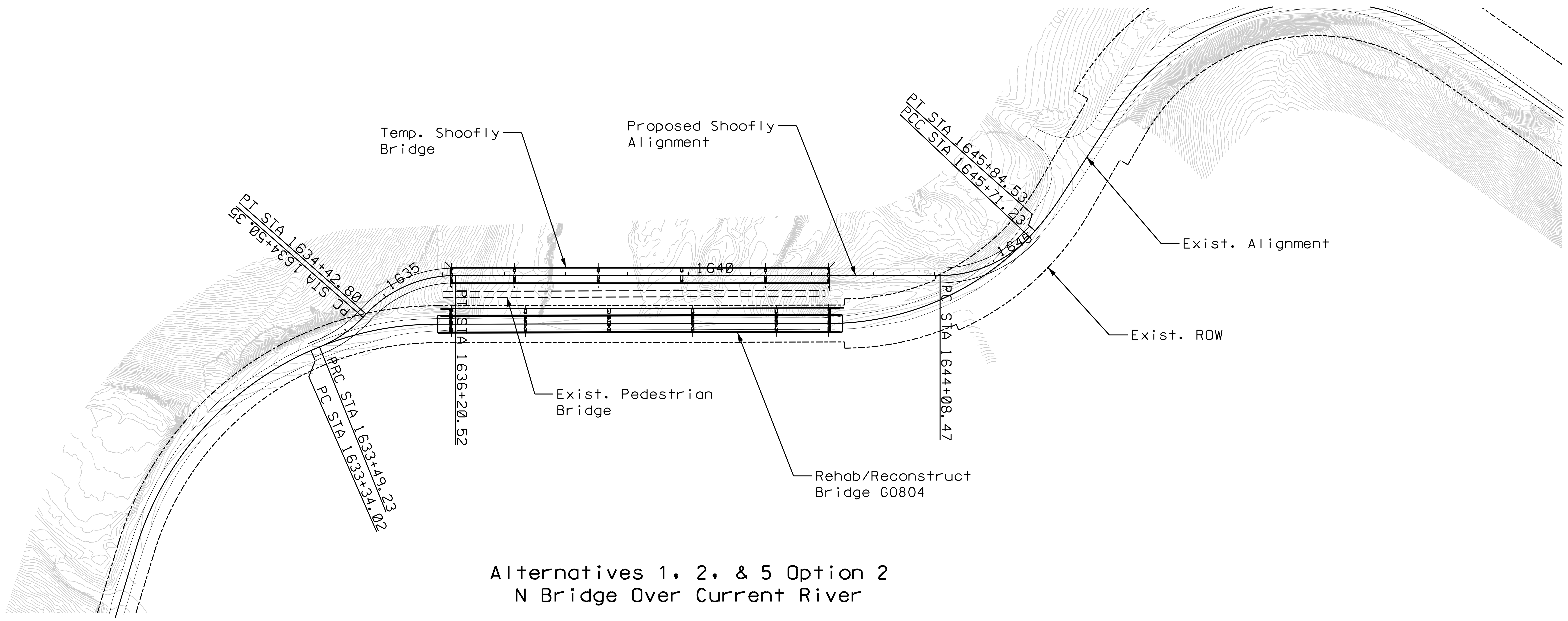

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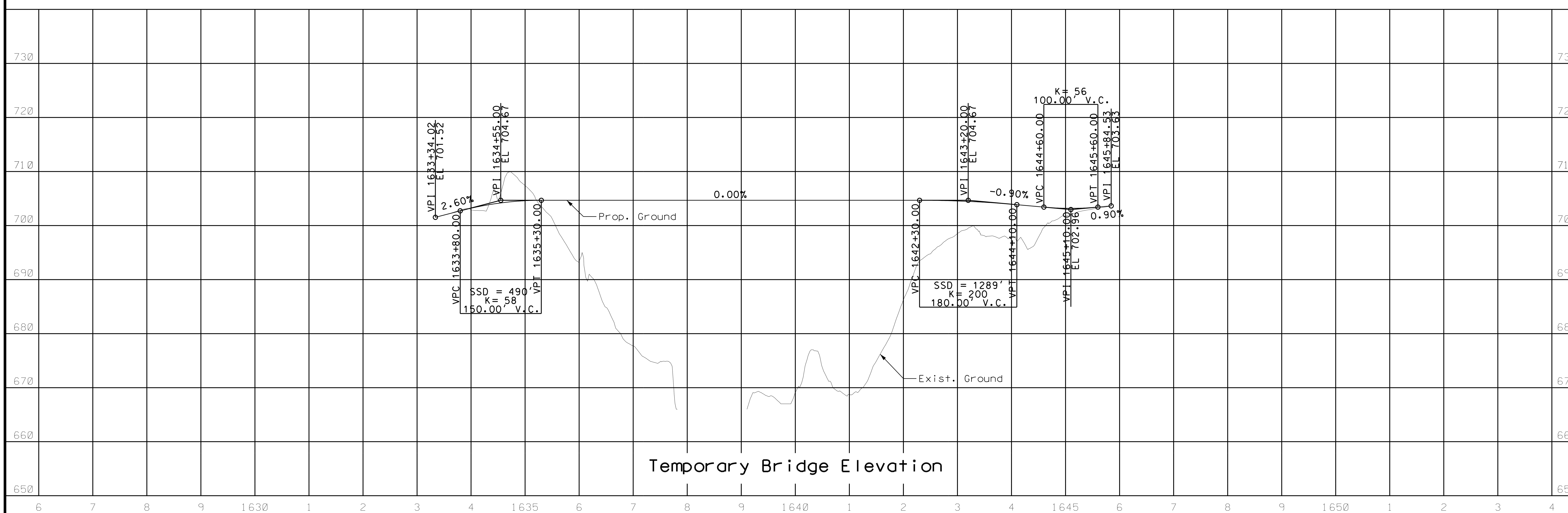

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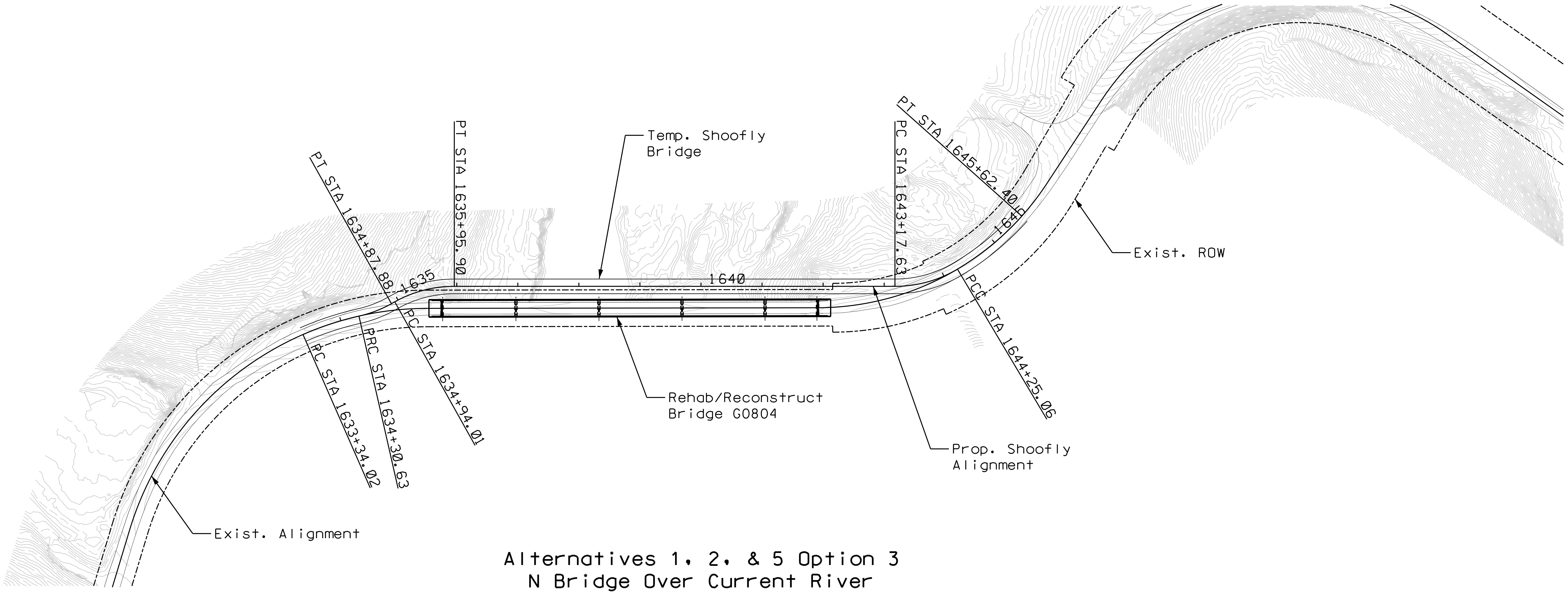
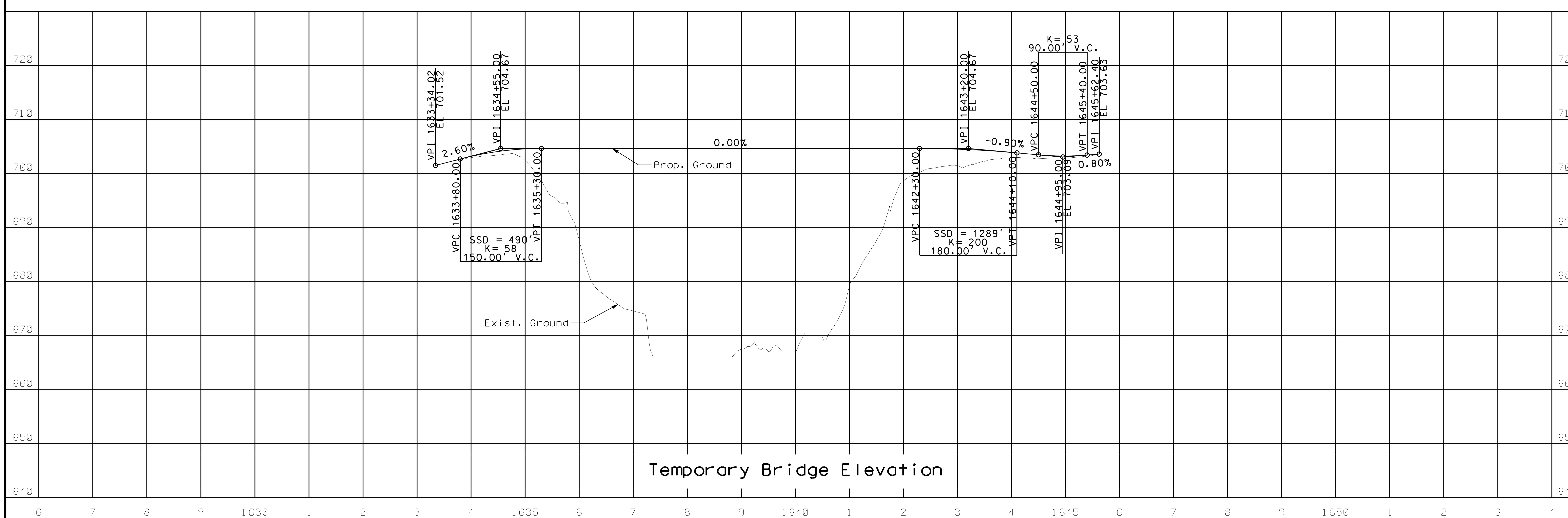


Alternatives 1, 2, & 5 Option 3
N Bridge Over Current River



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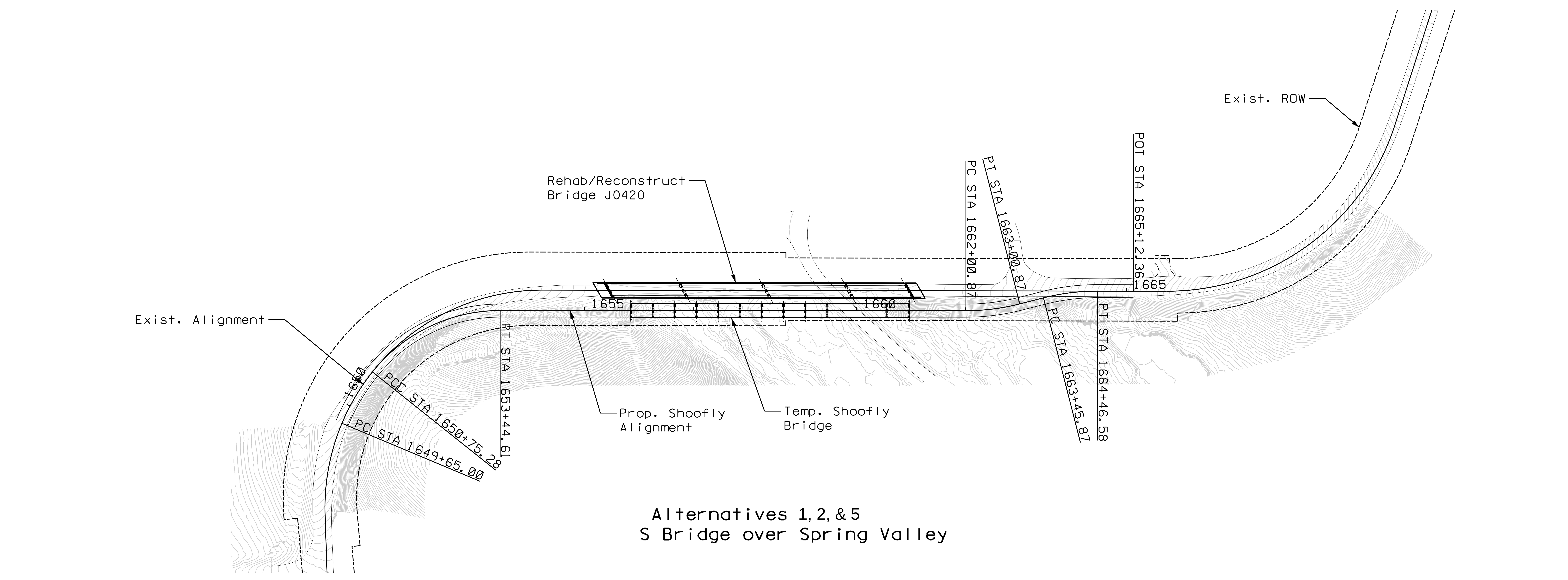

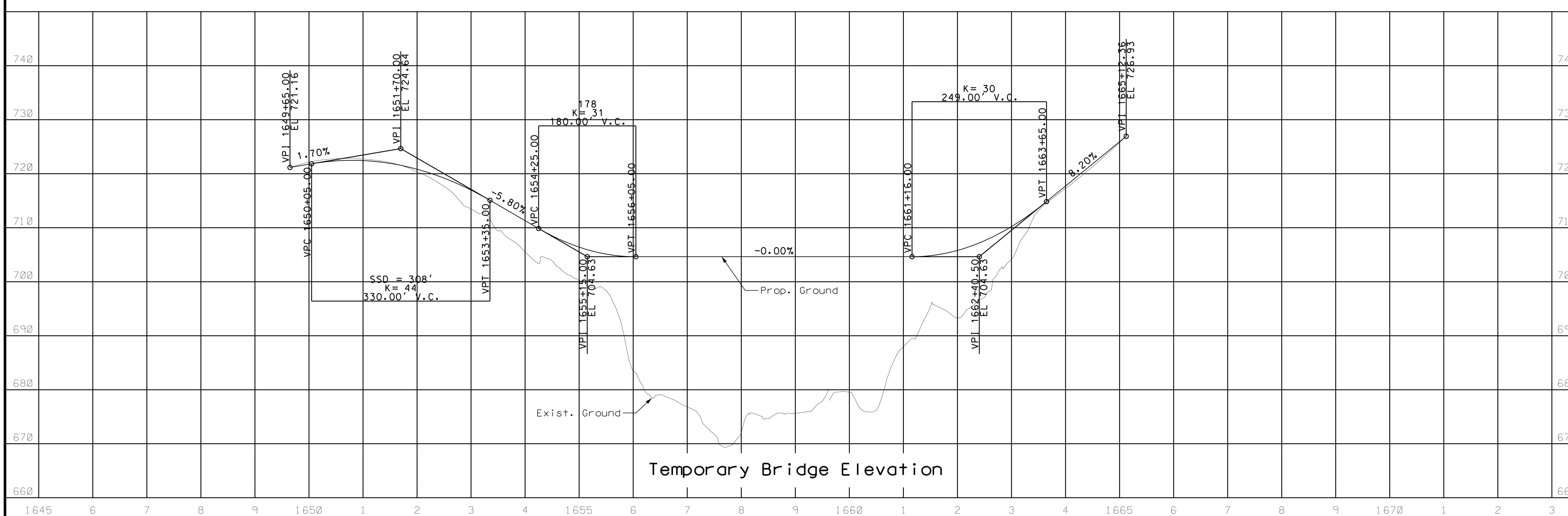

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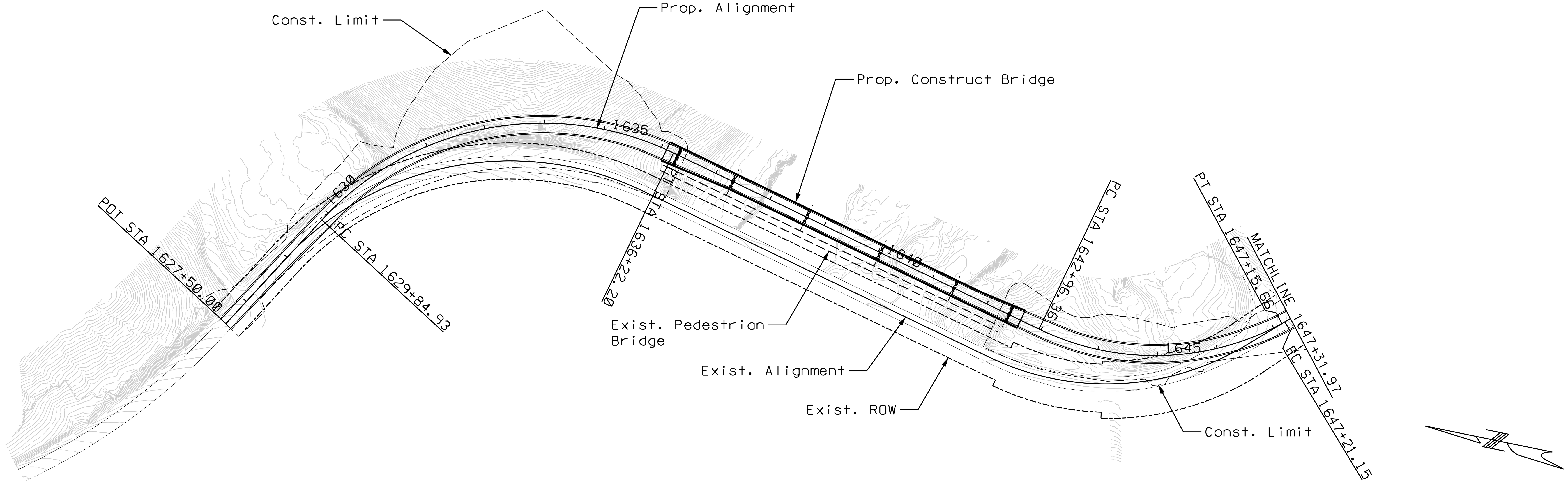
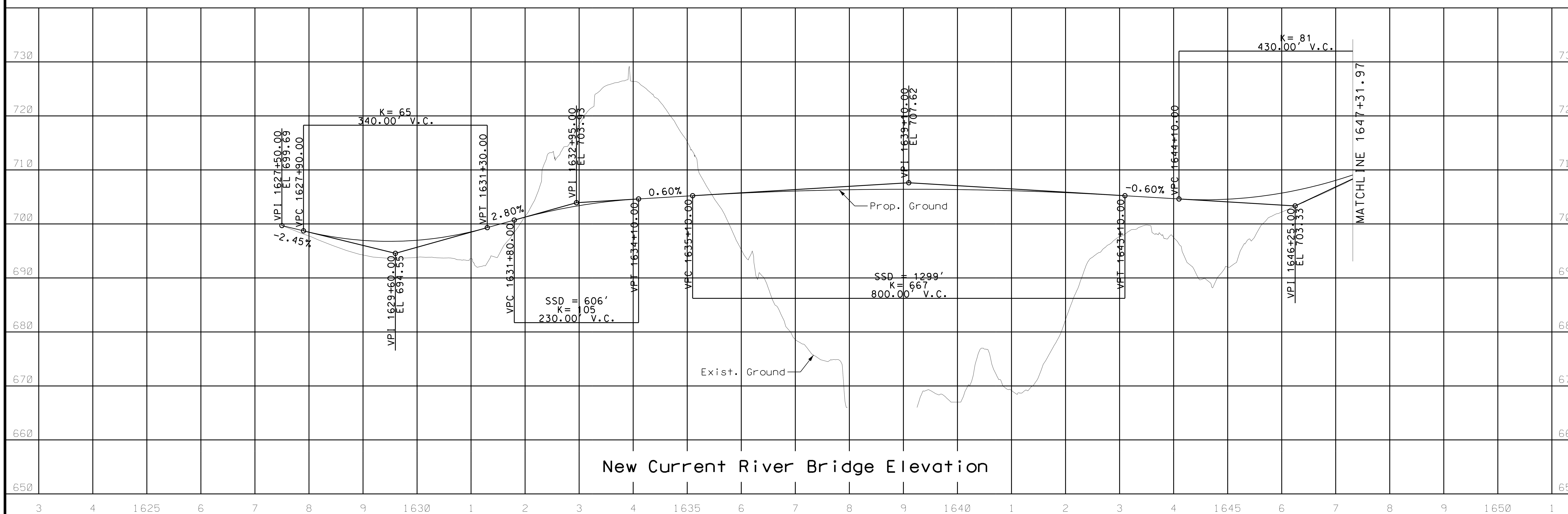


Alternatives 3a & 4a Option 1
N Bridge Over Current River
(Sheet 1 of 2)



New Current River Bridge Elevation

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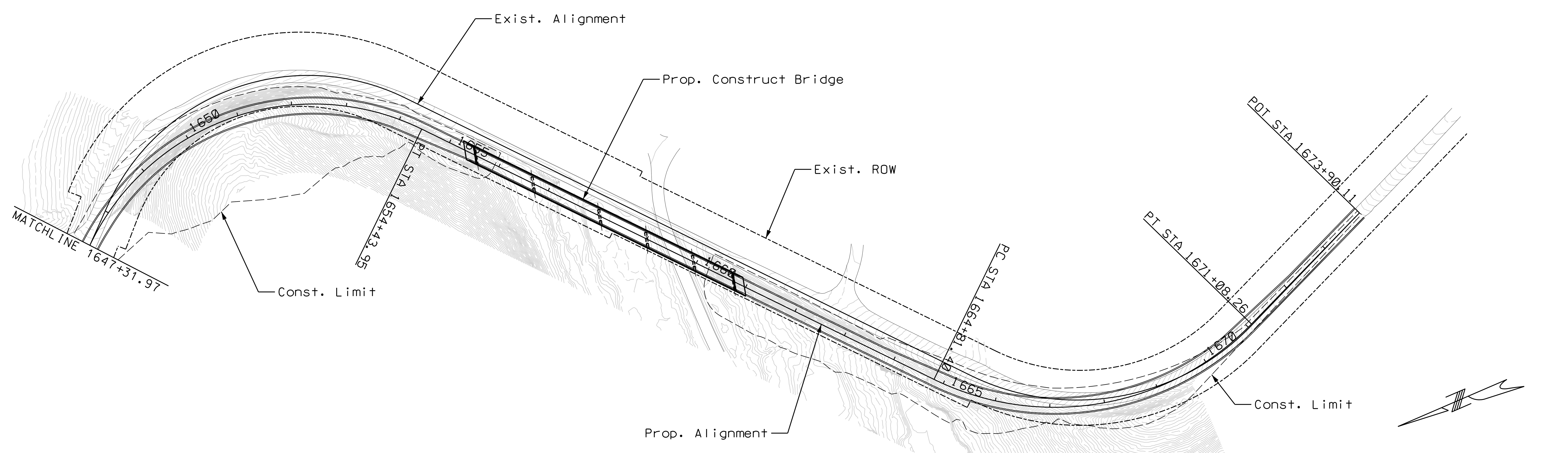
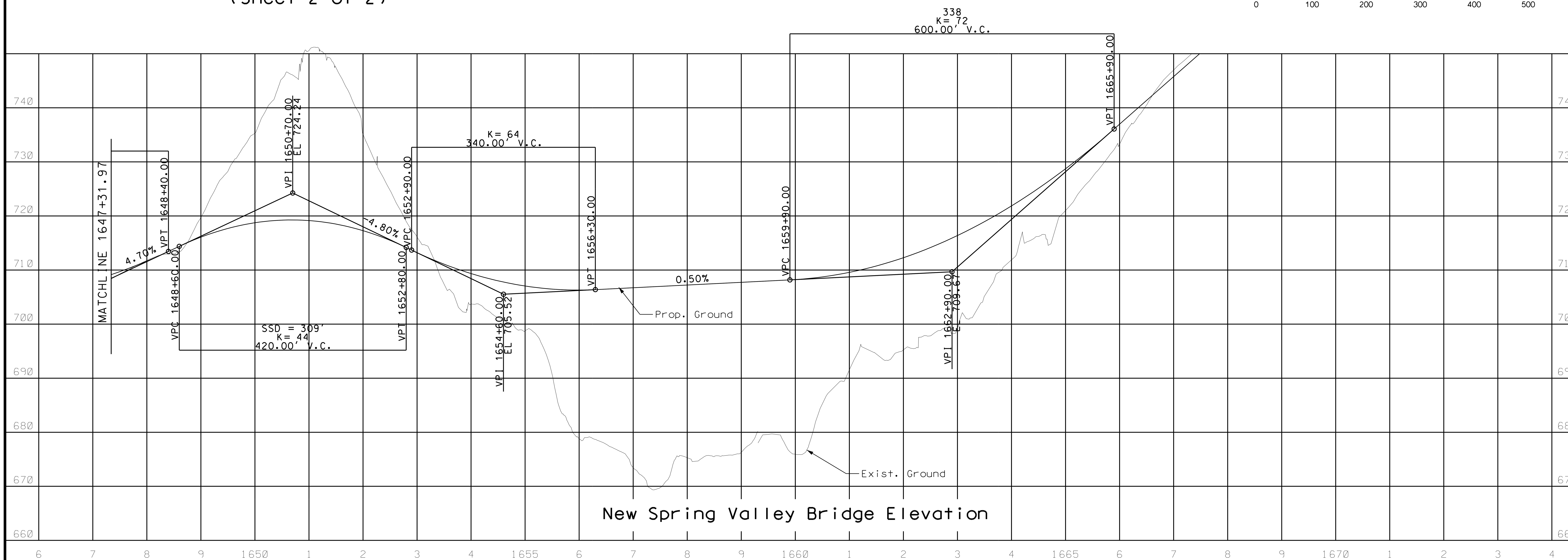


Alternatives 3a & 4a Option 1
S Bridge Over Spring Valley
(Sheet 2 of 2)



New Spring Valley Bridge Elevation

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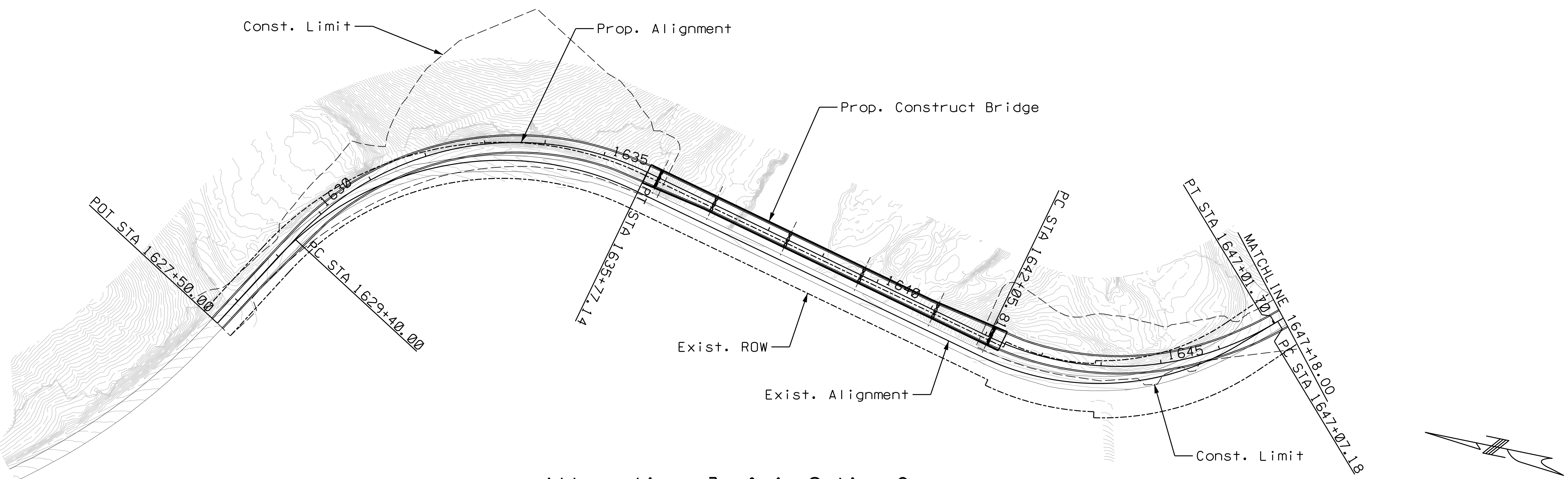
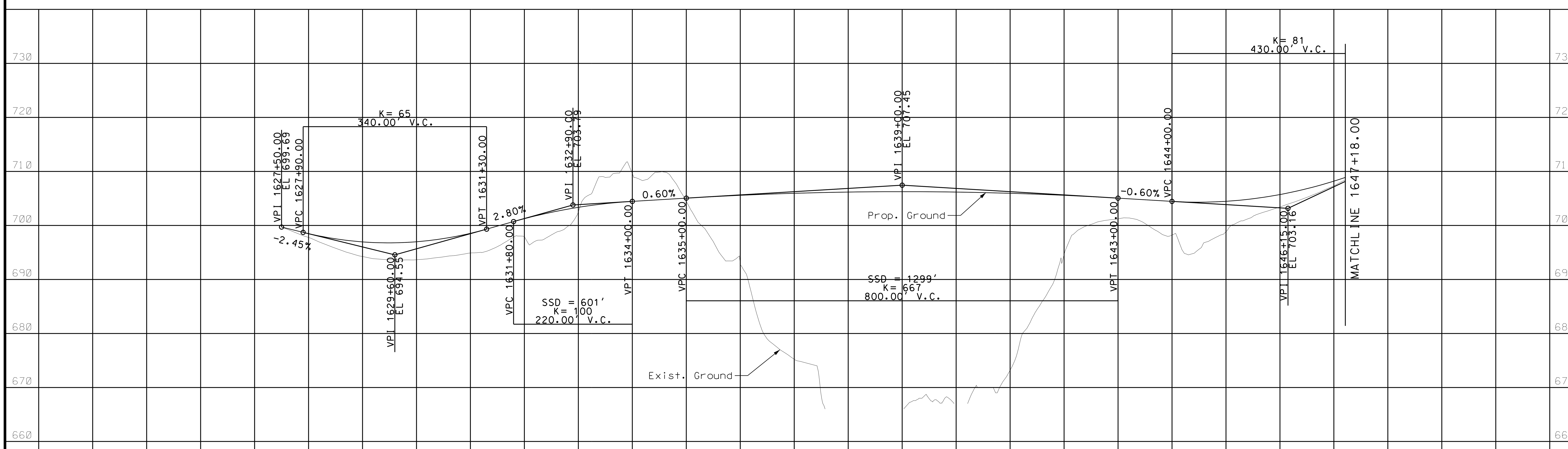


Alternatives 3a & 4a Option 2
Alternatives 3b & 4b
N Bridge Over Current River
(Sheet 1 of 2)



New Current River Bridge Elevation

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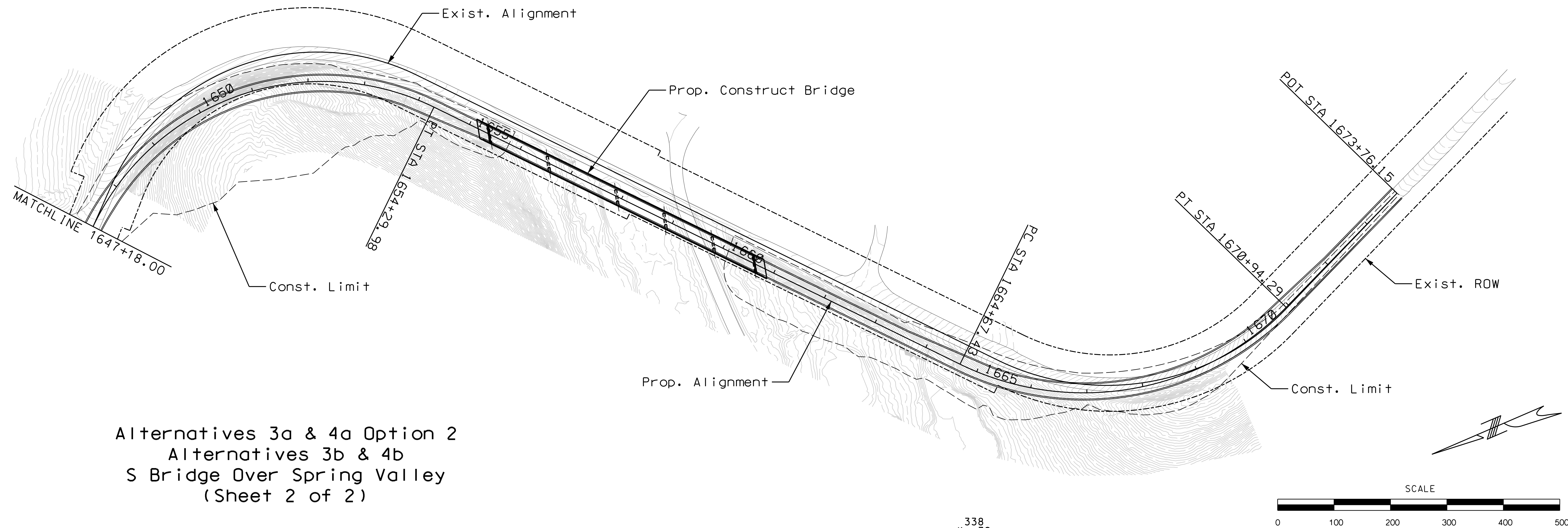

Alternatives 3a & 4a Option 2
Alternatives 3b & 4b
S Bridge Over Spring Valley
(Sheet 2 of 2)

New Spring Valley Bridge Elevation

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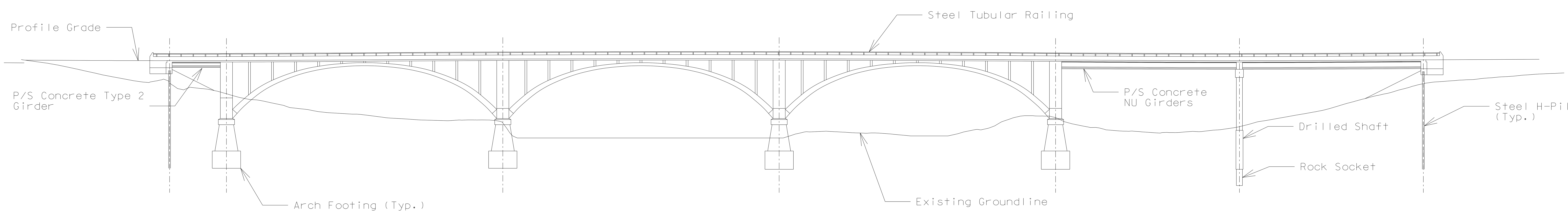
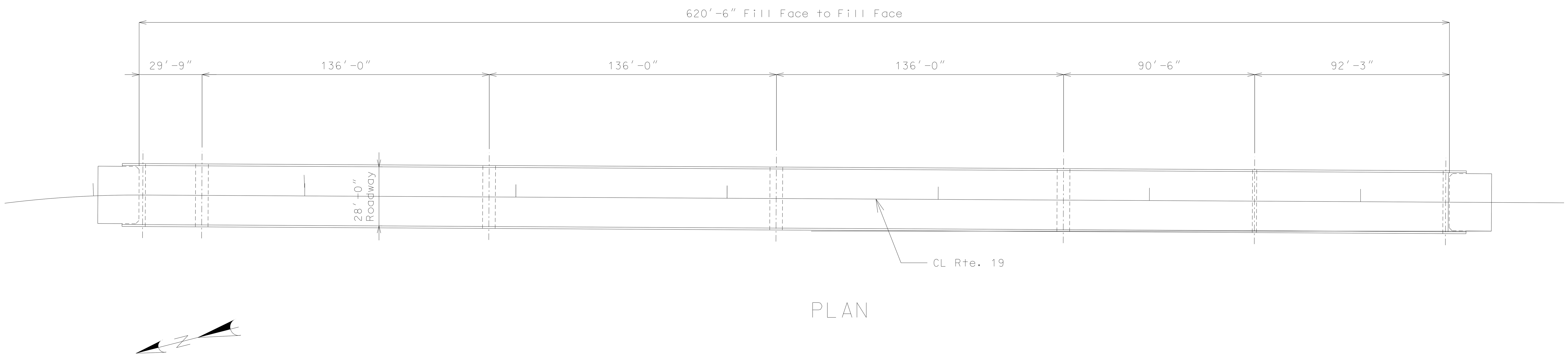


ELEVATION



PLAN

CURRENT RIVER - REPLACE IN KIND ON OFFSET ALIGNMENT OPTION

GENERAL PLAN AND ELEVATION

Note: This drawing is not to scale. Follow dimensions.

Sheet No. of

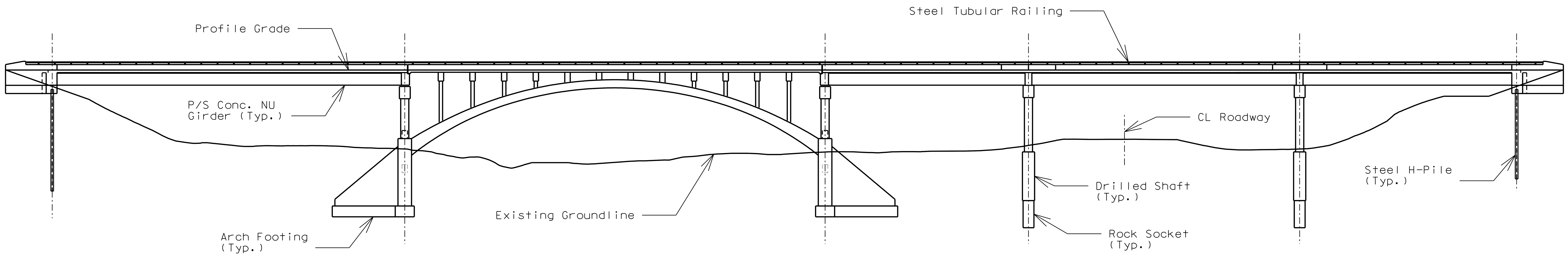
DATE PREPARED 9/18/2019	
ROUTE 19	STATE MO
DISTRICT BR	SHEET NO. 9
COUNTY SHANNON	
JOB NO. J9P3305	
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	

DATE	DESCRIPTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

MoDOT

HDR
HDR Engineering, Inc.
4435 Main Street
Suite 1000
Kansas City, MO 64111-1856
816-360-2700
Certificate of Authority: 000856



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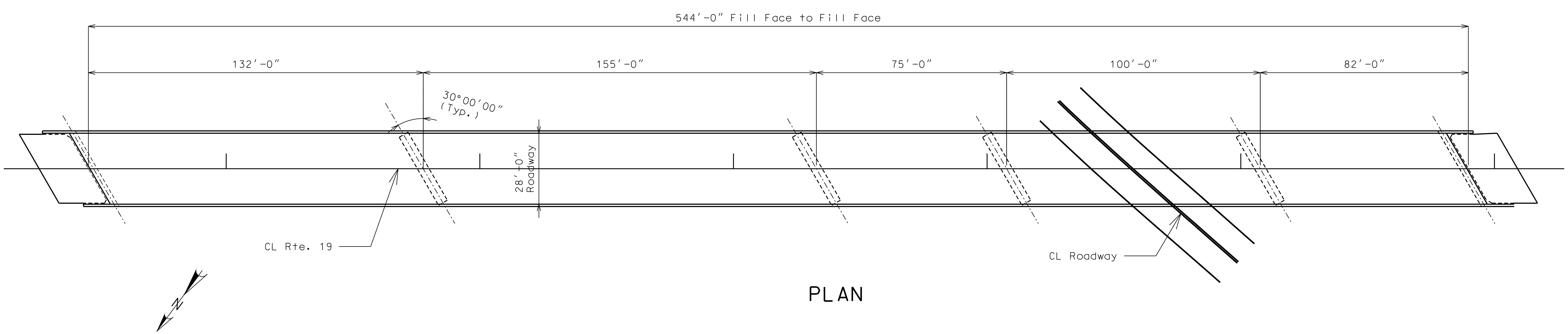

PLAN

SPRING VALLEY - REPLACE IN KIND ON OFFSET ALIGNMENT OPTION

GENERAL PLAN AND ELEVATION

Note: This drawing is not to scale. Follow dimensions. Sheet No. of

DATE PREPARED	
9/18/2019	
ROUTE 19	STATE MO
DISTRICT BR	SHEET NO. 10
COUNTY SHANNON	
JOB NO. J9P3305	
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	

DATE	DESCRIPTION

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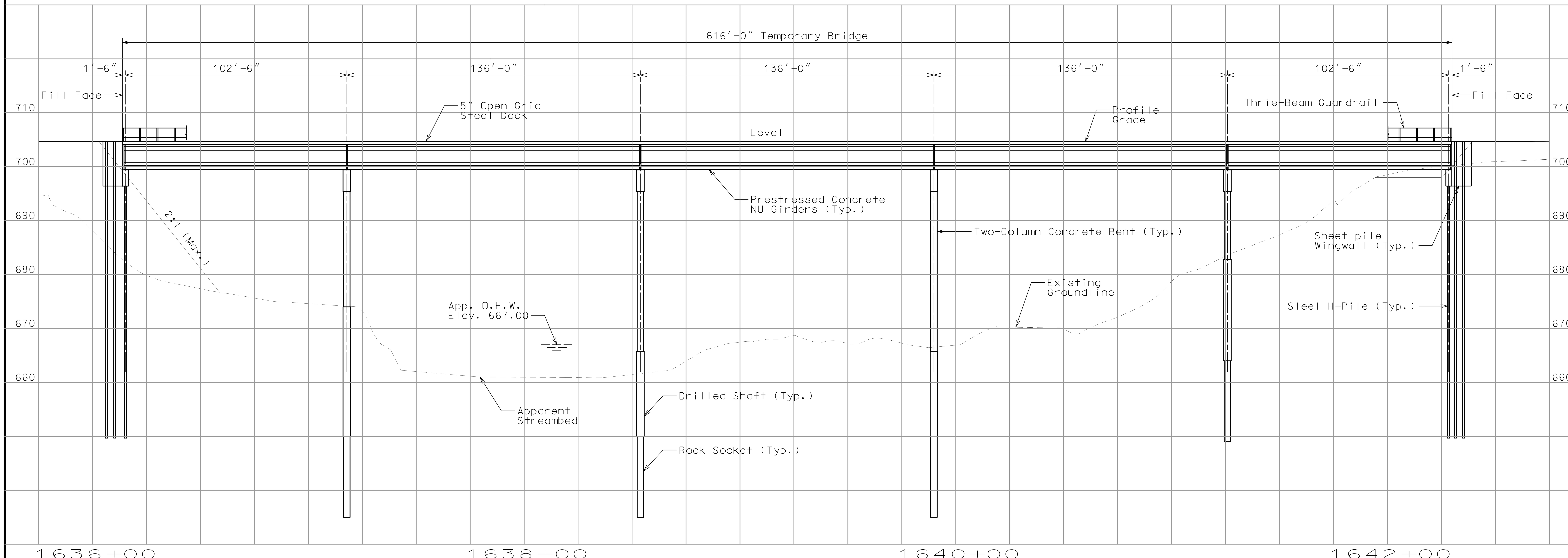
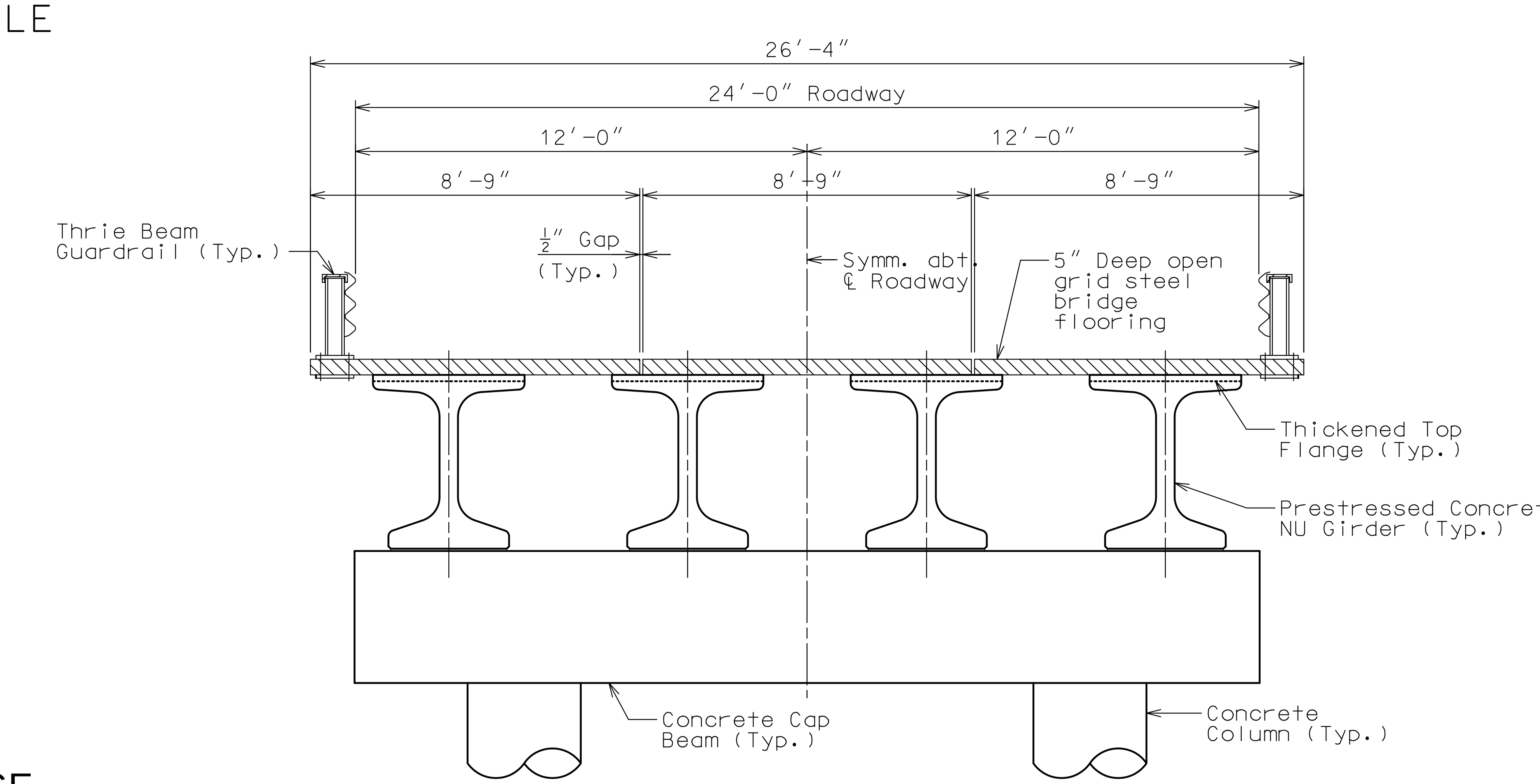
ROUTE 19 ℄ TEMPORARY ROADWAY PROFILE

EXISTING GROUNDLINE



PROFILE



CURRENT RIVER - TEMPORARY BRIDGE

TEMPORARY ROUTE 19 BRIDGE
PROP. TYP. SECTION @ INT. BENT

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 1 of 1

NOT FOR CONSTRUCTION

DATE PREPARED 9/17/2019	
ROUTE 19	STATE MO
DISTRICT BR	SHEET NO. 11
COUNTY SHANNON	
JOB NO. J9P3305	
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO. TEMP. BR.	

DATE	DESCRIPTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

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JEFFERSON CITY, MO 65102
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7301 WEST 133RD STREET
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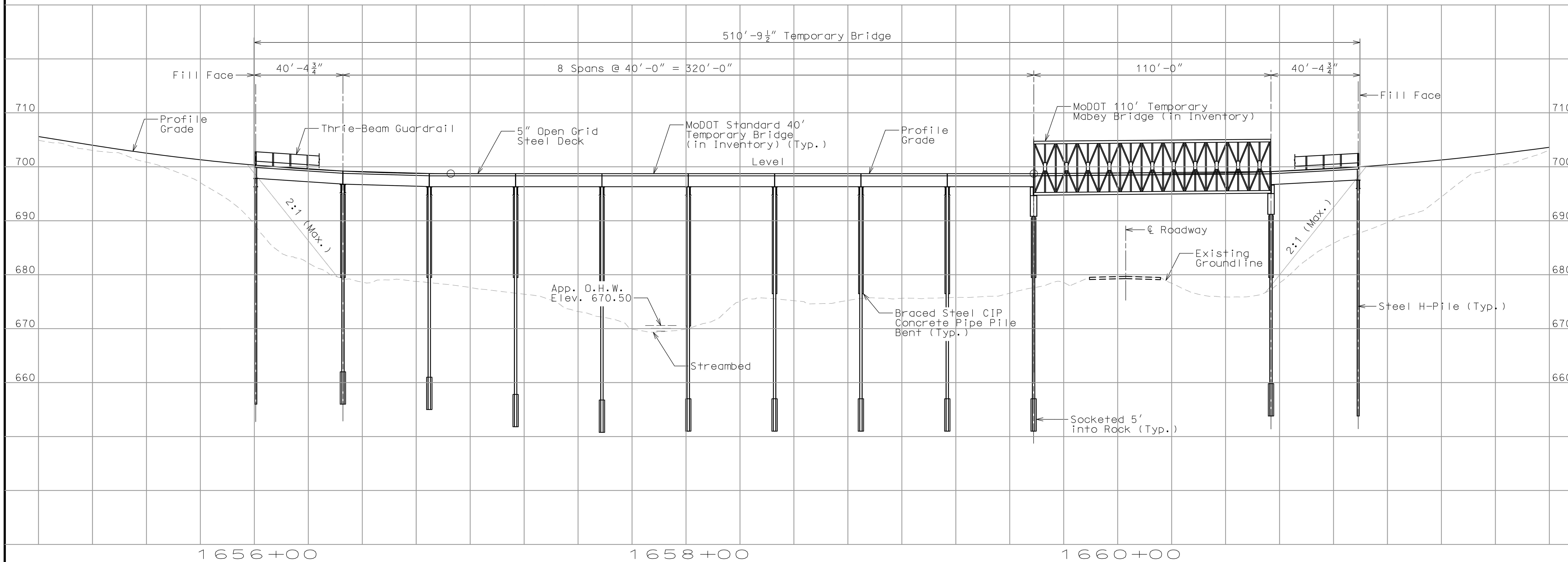
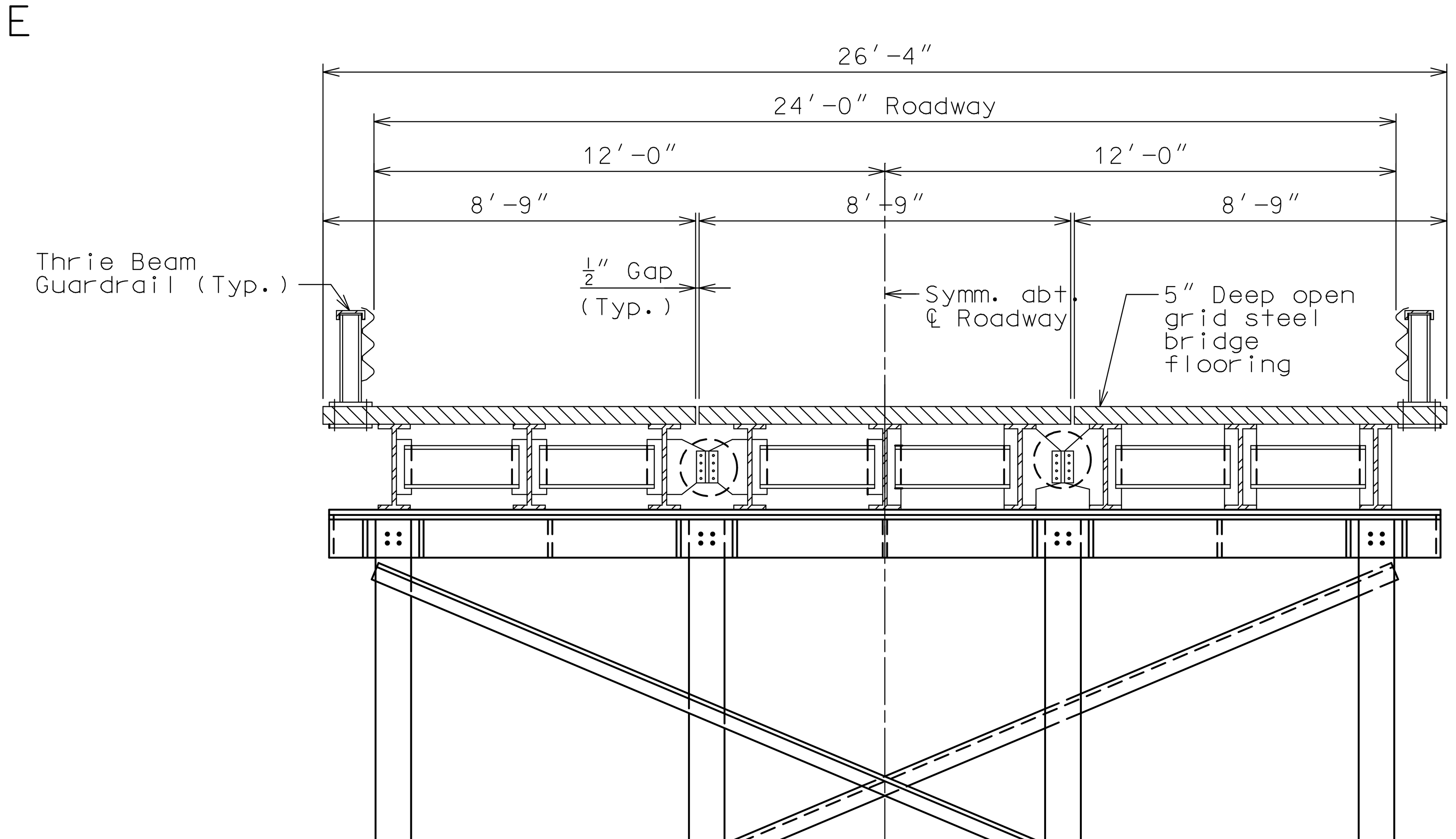
ROUTE 19 ℄ TEMPORARY ROADWAY PROFILE

EXISTING GROUNDLINE



PROFILE



TEMPORARY ROUTE 19 BRIDGE
PROP. TYP. SECTION @ INT. BENT

SPRING VALLEY - TEMPORARY BRIDGE

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 1 of 1

NOT FOR CONSTRUCTION

DATE PREPARED	9/17/2019
ROUTE	19
STATE	MO
DISTRICT	BR
SHEET NO.	12
COUNTY	SHANNON
JOB NO.	J9P3305
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	TEMP. BR.

DESCRIPTION

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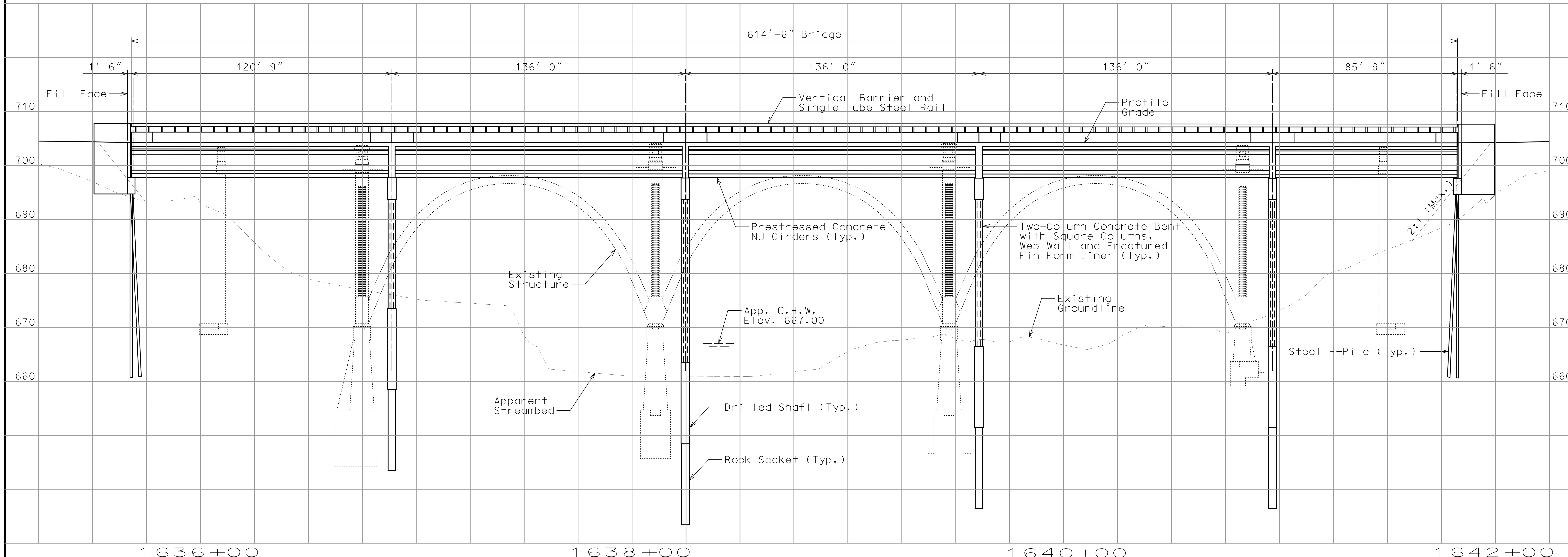
ROUTE 19 ℄ EXISTING ROADWAY PROFILE

EXISTING GROUNDLINE



PROFILE

A new girder bridge option would likely use parabolically haunched steel plate girders similar to those over Sinking Creek instead of the concrete girders as shown.

CURRENT RIVER - GIRDER BRIDGE REPLACEMENT OPTION

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 1 of 1

NOT FOR CONSTRUCTION

DATE PREPARED	
9/18/2019	
ROUTE 19	STATE MO
DISTRICT BR	SHEET NO. 13
COUNTY SHANNON	
JOB NO. J9P3305	
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO. BRIDGE	

DATE	DESCRIPTION

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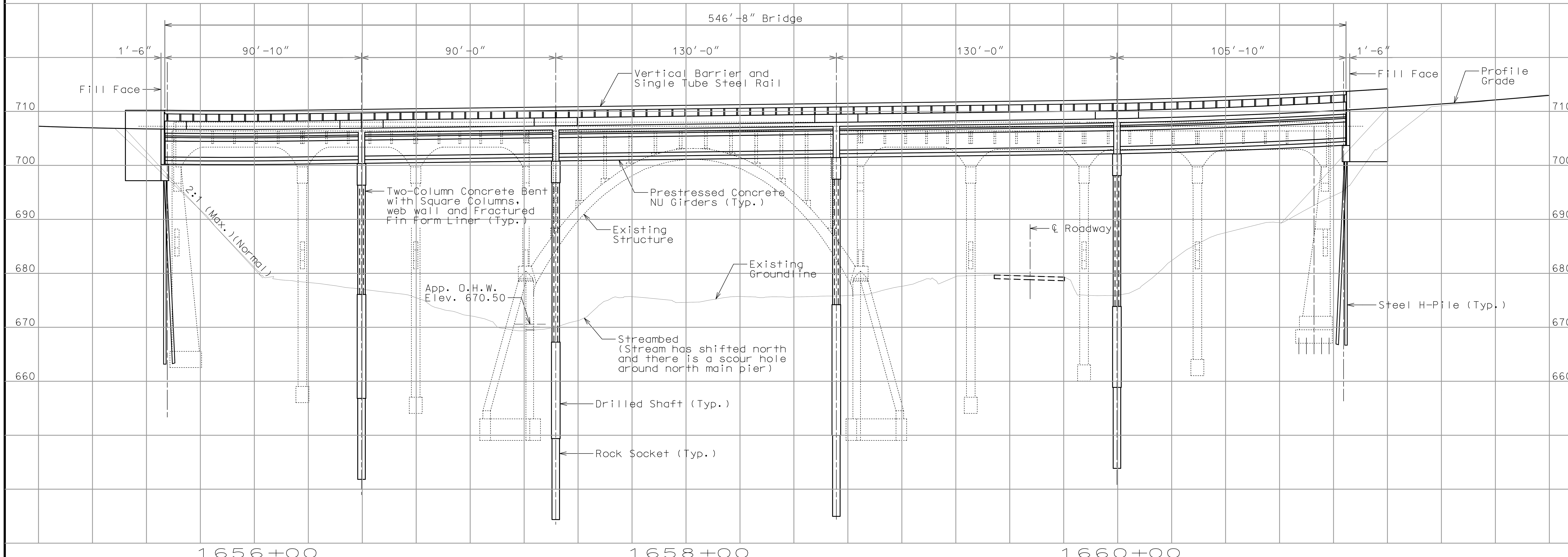
ROUTE 19 ℄ EXISTING ROADWAY PROFILE

EXISTING GROUNDLINE



PROFILE

A new girder bridge option would likely use parabolically haunched steel plate girders similar to those over Sinking Creek instead of the concrete girders as shown.

SPRING VALLEY - GIRDER BRIDGE REPLACEMENT OPTION

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 1 of 1

NOT FOR CONSTRUCTION

DATE PREPARED 9/18/2019	
ROUTE 19	STATE MO
DISTRICT BR	SHEET NO. 14
COUNTY SHANNON	
JOB NO. J9P3305	
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO. BRIDGE	

DATE	DESCRIPTION

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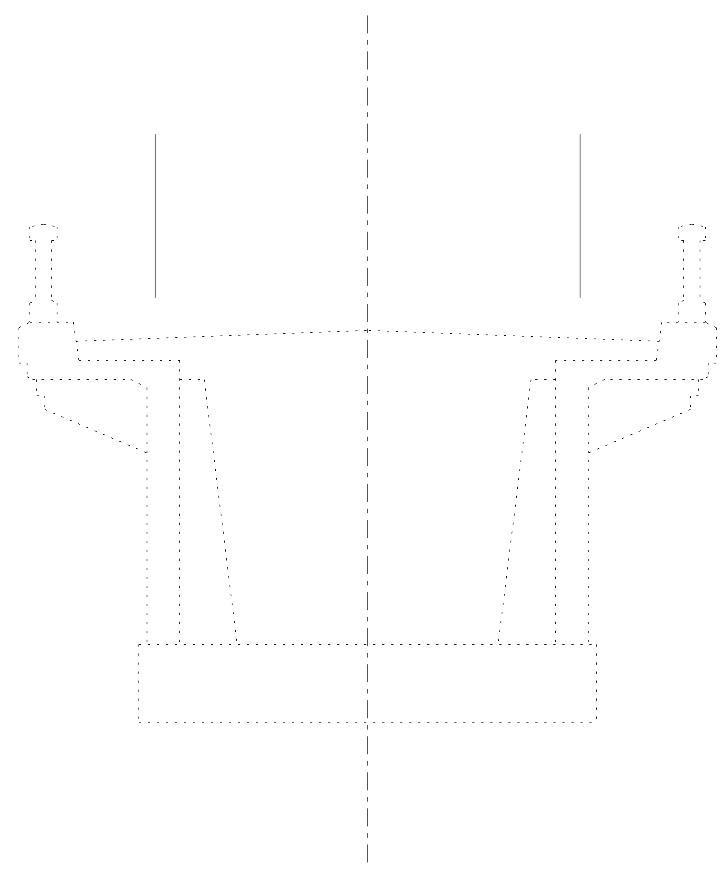
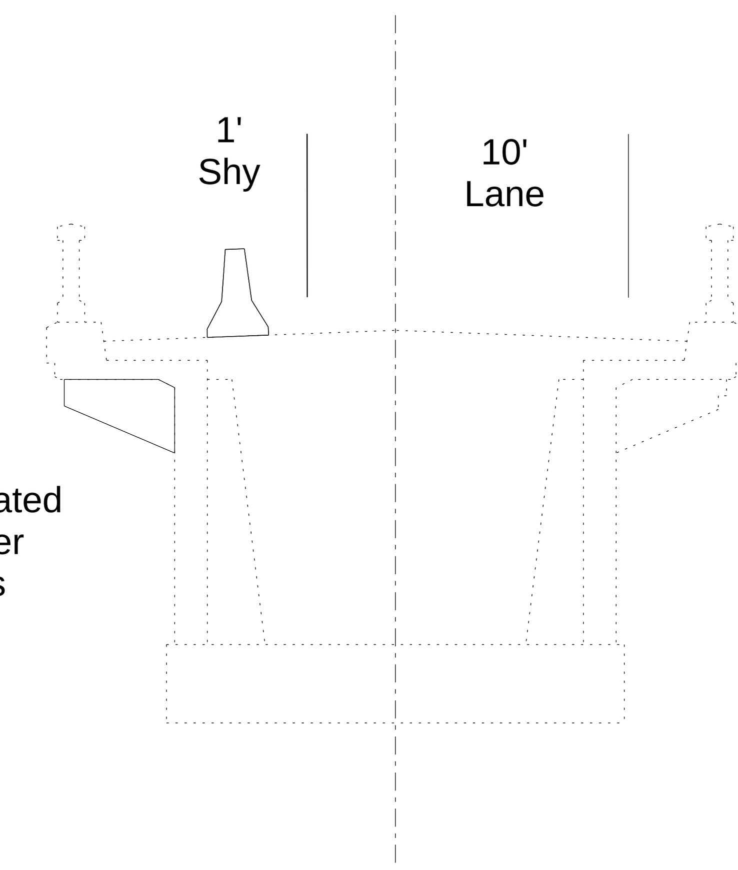


EXISTING CONFIGURATION



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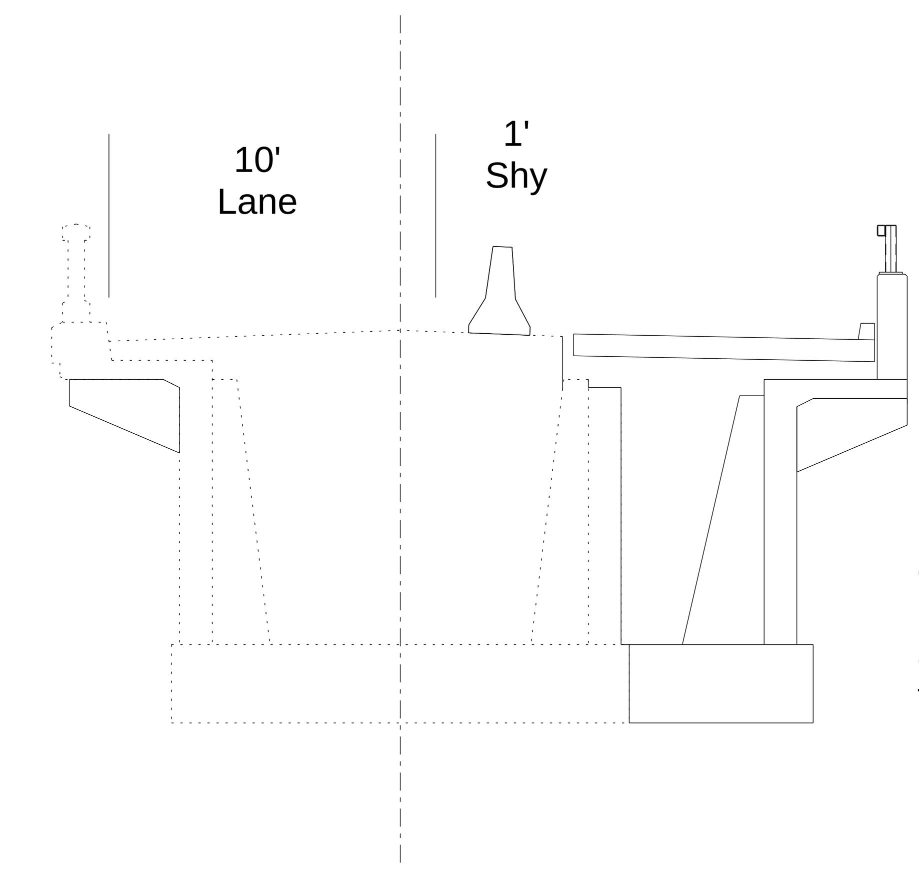

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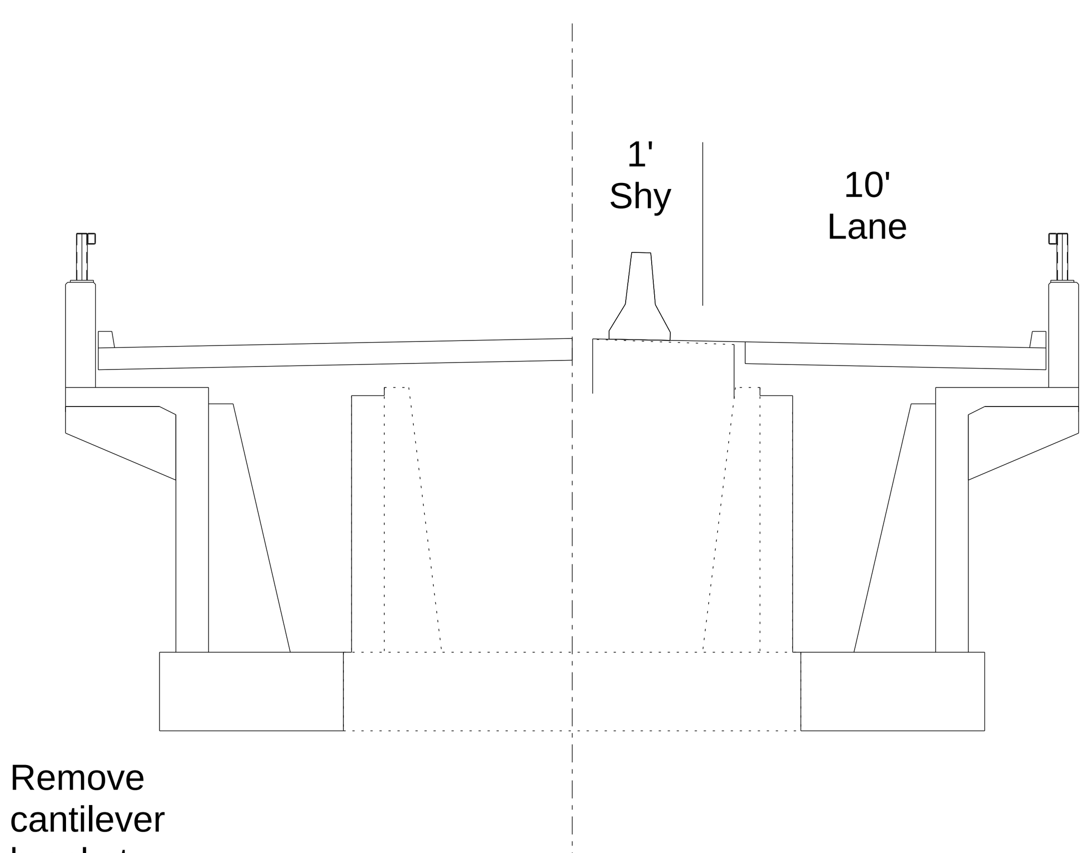

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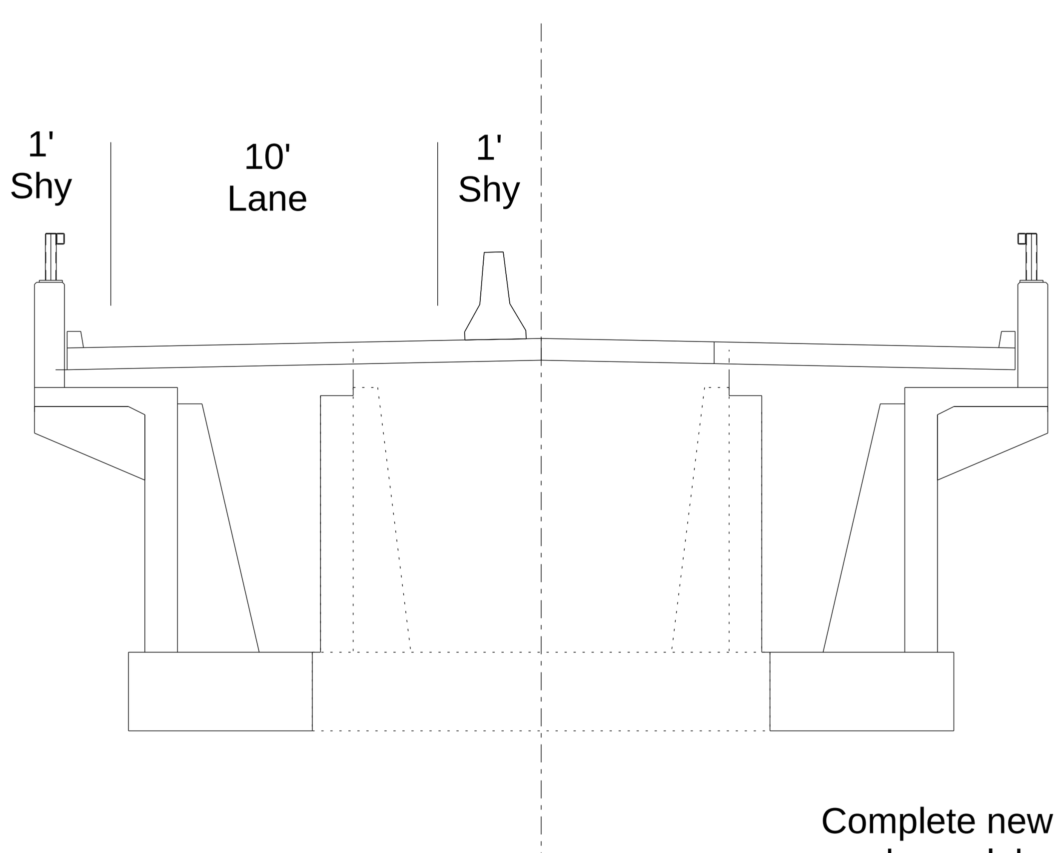

PHASE 4

CURRENT RIVER - PROPOSED REHABILITATION PHASING

Note: This drawing is not to scale. Follow dimensions. Sheet No. of

DATE PREPARED	9/18/2019
ROUTE	19
STATE	MO
DISTRICT	BR
SHEET NO.	15
COUNTY	SHANNON
JOB NO.	J9P3305
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	

DATE	DESCRIPTION

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Route 19 - Alternative Descriptions

Alternative	Option	Existing Bridge				Ped Bridge		Temp Shoofly Bridge			New Bridge		
		Rehab/Reconst. Exist Bridge	Remove Exist Bridge	Use Exist Bridge G0804 for Ped	Add 10' Sidewalk to Exist Bridge	Keep Exist Ped Bridge	Remove Exist Ped Bridge	Use Temp Shoofly Bridge	Use Temp Bridge for Ped After	# Lanes on Temp Shoofly Bridge	Build New Bridge	Add 10' Sidewalk to New Bridge	# Lanes on New Bridge
1, 2, & 5	1N	X			X		X	X		2			
	2N	X				X		X		2			
	3N	X					X	X	X	1			
	S	X						X		2			
3a & 4a	1		X			X					X		2
	2		X				X				X	X	2
3b & 4b	1			X			X				X		2

Cost Summary

Concept Alternatives - Revised

No. 1 - $17.0M - $20.9M

No. 2 - $13.1M - $15.4M

No. 3 - $13.2M - $13.4M

No. 4 - $18.2M - $18.8M

No. 5 - $15.9M - $17.7M

Alternatives Evaluation

The workshop used a performance analysis process to evaluate the conceptual alternatives being considered. The techniques are based on the use of Value Metrics, which is predicated on the logic that value and good value decisions are based on the interrelationship between cost, performance, time and risk.

Value Metrics

Value Metrics is a decision making process that leverages a powerful multi-attribute utility theory (MAUT) known as the Analytic Hierarchy Process (AHP). Stated simply, AHP breaks down complex decisions that include varied and disparate attributes into a series of smaller, pairwise comparisons utilizing a common ratio scale. From this structure, straightforward mathematical priorities may be derived that reflect relative degrees of preference for a set of alternatives.

In making value comparisons, four essential elements must be factored. These include cost, performance, time and risk. Value Metrics provides a standardized means of identifying, defining, evaluating, and measuring performance. Value Metrics can improve group decision making by:

- Building consensus among project stakeholders
- Better informing decision makers regarding differing perspectives
- Making subjective judgments, and their strength of conviction, explicit
- Reducing bias that leads to suboptimal decisions
- Developing a better understanding of a decision's goals and objectives and identifying and aligning decision criteria to them that will result in the desired outcomes
- Developing a deeper understanding of the relationship between performance, cost, time and risk in determining value
- Using value as the basis for making decisions

Value Metrics provides a standardized means of identifying, defining, evaluating, and measuring performance. Performance is quantified in terms of how well a set of attributes contribute to the overall functional purpose of a given project.

The basic equation used for calculating value is:

$$Value = \frac{Performance}{Cost + Time}$$

In other words, value is equivalent to the relationship of the resources needed to provide a certain level of performance for a given function. Performance is defined as a set of requirements and attributes of a project's scope that are pertinent to the project's need and purpose. Participant responses are elicited for a series of paired comparisons in which the performance of alternatives are compared, with consideration of the project need and purpose, while taking into account the relative intensity of preference of one criterion over another.

The following pages describe the steps in the Value Metrics process and evaluation of the conceptual alternatives.

Define Performance Requirements

Any concept that fails to meet the project's performance requirements, regardless of whether it was developed during the project's design process or during the course of the workshop, cannot be considered as a viable solution. It should be noted that in some cases, a performance requirement may also represent the minimum acceptable level of a performance attribute. The following performance requirements were identified for this project.

Table 2 Performance Requirements

Performance Requirement	Description
Highway Design Standards	Project must meet MoDOT's most recent highway standards unless a deviation is approved. Provide minimum 26' roadway width and curve widening per MoDOT's Engineering Policy Guide.
Structural Design Standards	Any structure in the project must comply with current structural design standards.
Bridge Service Life	Any new bridge must be designed to meet minimum service life standards.
Environmental Review Process	Any concept considered must comply with applicable environmental laws and be compatible with the environmental review process.
Maintenance of Traffic	A minimum of one travel lane must be maintained throughout construction. Temporary full roadway closures may be permitted on a limited basis.
Pedestrian Facilities	All scenarios must accommodate pedestrian/bike access with a 10' wide pedestrian/mixed use walkway. Existing Current River bridge will not be accepted by NPS for use as pedestrian bridge.
Utility Impacts	Maintain utility service throughout construction
Carr's Canoe Rental Store	Maintain service and access to Carr's Store throughout construction
River Operation	Ability to maintain operation of river traffic throughout construction. Minor short-term closures and off-season closures could be considered.
Maintain Access Points	A number of access points must be maintained throughout construction. These include access to park service facilities adjacent to Spring Valley Bridge, the Round Spring campgrounds, and park service facilities north of the Current River Bridge.

Define Performance Attributes

Performance attributes represent those aspects of a project's scope that may possess a range of potential values while meeting the project's need and purpose. The following are example performance attributes for transportation-focused projects.

Mainline Operations

The Mainline Operations performance attribute is defined as an assessment of traffic operations on the mainline facilities within the project limits. Operational considerations include level of service relative to the 20-year traffic projections, as well as geometric considerations such as design speed, sight distance, lane widths, and shoulder widths.

The workshop participants determined that, although mainline operations are important, when all of the highway and structural design standard requirements are met, all construction alternatives provide the same level of performance for this attribute.

Aesthetics

An assessment of the permanent visual impacts of the project and ability to maintain visual appeal similar to the existing. This attribute also considers how well it responds to the site, surrounding environment, and the locale.

Maintainability

The performance attribute Maintainability is defined as an assessment of the long-term maintainability of the transportation facility(s). Maintenance considerations include the following factors:

- Overall Durability: Longevity (i.e. service life) and ability to maintain a good state of repair for pavements, structures, and other facility systems.
- Ease of Maintenance Efforts over the Service Life
- Accessibility and Safety Considerations for Maintenance Personnel

Construction Impacts

This performance attribute is defined by an assessment of the construction impacts for the project. These are temporary impacts only observed during the construction phase of the project. Construction impacts should consider the following components:

- Temporary Public Impacts: A measure of the construction effects on the traveling public including ease of traffic management. Also includes impacts to recreational usage during construction.
- Temporary Environmental Impacts: A measure of impacts to the surrounding community in terms of air, noise, vibrations, dust, and water quality.
- Constructability: The relative ease of constructing the proposed facility in term of availability of materials, availability of labor, and complexity of construction operations (such as stage construction complexity, lane restrictions and specialized construction methods).

Environmental Impacts

Defined as an approximation of the concept's overall permanent effects on the natural environment as well as impacts to cultural, recreational, and historic resources. Also considered under this attribute are the following:

- Impacts to Wetlands and Woodlands:
- Impacts to Vegetation
- Impacts to Wildlife habitat and linkages
- Impacts to Surface Water and Watercourses
- Impacts to Drainage and Hydraulic Issues

Prioritize Performance Attributes

The performance attributes of a project are seldom of equal importance. Therefore, a systematic approach must be utilized in order to determine their relative importance in meeting the project's need and purpose.

Once the performance attributes were defined, the stakeholders prioritized them based on their relative importance to the project. The performance attributes were systematically compared in pairs, asking the question: "An improvement to which attribute will provide the greatest benefit relative to the project's need and purpose?" Participants were then asked to indicate their priorities and the relative intensities of their preferences. The chart below provides the results of this analysis and includes the complete breakdown of the priorities, expressed as a percentage of the whole.

Performance Attributes Criteria Matrix

Paired Comparison

					Total points	% of Total
Aesthetics	**A**	**A**	**A**	**A/D**	**3.5**	**33.3%**
Maintainability		**B**	**B**	**D**	**2.5**	**23.8%**
Construction Impacts			**C**	**D**	**1.0**	**9.5%**
Environmental Impacts				**D**	**3.5**	**33.3%**
				Total	**10.5**	**100.0%**

Without emphasis on preference

A = A is of greater importance

A/B = A and B are of equal importance

Figure 1 Paired Comparison Matrix

Evaluate Performance of Conceptual Alternatives

The workshop participants prepared performance assessments of each of the Conceptual Alternatives and the rationale for how the alternative performed for each attribute was recorded.

ALTERNATIVE NO. 1 ***Replace-in-kind on alignment***
PERFORMANCE MEASURES **Attributes and Rating Rationale**
Aesthetics • Replacement of existing bridge with concrete arch spans. • Widening of bridge would have minor impacts to side slopes (varies by options of temporary bridge offset alignment). • Option 1 and 3 remove the existing pedestrian bridge. Option 2 retains existing pedestrian bridge. Preference is to remove existing pedestrian bridge and accommodate pedestrian access on new bridge.
Maintainability • Replaces existing bridge with new concrete arch span bridge. • Open spandrel option would facilitate access for inspections.
Construction Impacts • Option 1 and 3 eliminate pedestrian access during construction. Option 2 maintains pedestrian access. • Concrete arch extends construction time resulting in extended time of impacts. • Temporary bridge requires footings in the channels. • Larger overall footprint for temporary bridge construction and multiple impacts to channel. • Increased amount of falsework in the channel to support concrete arch construction increases river traffic impacts and environmental footprint. • Provides two lanes for traffic during construction (depending upon width of temporary bridge option).
Environmental Impacts • Replaces existing historic bridges with new bridges, but attempts to match current type. • Temporary bridge foundations may impact natural habitat (varies by options of temporary bridge offset alignment). • Temporary bridge would require minor impacts to side slopes (varies by options of temporary offset). • Ground disturbance for temporary bridge may impact unknown archeological sites (varies by options of temporary bridge offset alignment).

ALTERNATIVE NO. 2 Girder bridge replacement on current alignment
PERFORMANCE MEASURES **Attributes and Rating Rationale**
Aesthetics • Replacement of existing bridge with girder bridge. • Widening of bridge would have minor impacts to side slopes (varies by options of temporary bridge offset alignment). • Option 1 and 3 remove the existing pedestrian bridge. Option 2 retains existing pedestrian bridge. Preference is to remove existing pedestrian bridge and accommodate pedestrian access on new bridge.
Maintainability • Replaces existing bridge with new girder bridge. • Girder bridge would facilitate access for inspections. • Girder bridge has increased redundancy of structural support. • Girder structure reduces obstructions to channel flow.
Construction Impacts • Option 1 and 3 eliminate pedestrian access during construction. Option 2 maintains pedestrian access. • Girder bridge can be built in one construction season which limits total time of impacts. • Temporary bridge requires footings in the channels. • Larger overall footprint for temporary bridge construction and multiple impacts to channel. • Reduced amount of falsework in channel lessens river traffic impacts • Provides two lanes for traffic during construction (depending upon width of temporary bridge option).
Environmental Impacts • Replaces existing historic bridges with new girder bridges (more adverse impacts to historic district). • Temporary bridge foundations may impact natural habitat (varies by options of temporary bridge offset alignment). • Temporary bridge would require minor impacts to side slopes (varies by options of temporary offset). • Ground disturbance for temporary bridge may impact unknown archeological sites (varies by options of temporary bridge offset alignment). • Potential for reduced footings and columns in channel.

ALTERNATIVE NO. 3 Girder bridge on offset alignment
PERFORMANCE MEASURES **Attributes and Rating Rationale**
Aesthetics • Replacement of existing arch bridge with girder bridge. • Significant impacts to side slopes and ROW to accommodate permanent offset alignment. • 3A Option 1: Removes existing Current River bridge, but existing pedestrian bridges remains. • 3A Option 2: Removes existing Current River and pedestrian bridges. • 3B: Retains existing Current River bridge for pedestrian use.
Maintainability • Replaces existing bridge with new bridge. • Girder bridge would facilitate access for inspections. • Girder bridge has increased redundancy of structural support. • 3A Option 1: Removes existing Current River bridge but existing pedestrian bridge remains. NPS would continue ownership of existing pedestrian bridge. • 3A Option 2: Removes existing Current River and pedestrian bridges. Preference is to remove deteriorating structures. • 3B: Existing Current River bridge remains for pedestrian traffic, but will require periodic maintenance. • Girder structure reduces obstructions to channel flow.
Construction Impacts • Girder bridge can be built in one construction season which limits total time of impacts. • Limits in-channel work to one new bridge construction. • Reduced amount of falsework in channel. • May eliminate pedestrian access during construction (varies by option of alignment offset).
Environmental Impacts • Significant side slope and ROW impacts to accommodate permanent alignment offset). • Greatest adverse impact to Three Bridges Historic District and Section 4F impacts. • Increased ground disturbance outside existing ROW may impact unknown archeological sites and karst topography (varies by options of offset alignment).

ALTERNATIVE NO. 4 *Concrete Arch on offset alignment*
PERFORMANCE MEASURES **Attributes and Rating Rationale**
Aesthetics • Replacement of existing arch bridge with concrete arch bridge. • Significant impacts to side slopes and ROW to accommodate permanent offset alignment. • 4A Option 1: Removes existing Current River bridge, but existing pedestrian bridges remains. • 4A Option 2: Removes existing Current River and pedestrian bridges. • 4B: Retains existing Current River bridge for pedestrian use.
Maintainability • Replaces existing bridge with new concrete arch span bridge. • Open spandrel option would facilitate access for inspections. • 4A Option 1: Removes existing Current River bridge but existing pedestrian bridge remains. NPS would continue ownership of existing pedestrian bridge. Preference is to remove deteriorating structures. • 4A Option 2: Removes existing Current River and pedestrian bridges. Preference is to remove deteriorating structures. • 4B: Existing Current River bridge remains for pedestrian traffic, but will require periodic maintenance.
Construction Impacts • Concrete arch extends construction time resulting in extended time of impacts. • Increased amount of falsework in the channel to support concrete arch construction increases river traffic impacts and environmental footprint. • May eliminate pedestrian access during construction (varies by option of alignment offset).
Environmental Impacts • Significant side slope and ROW impacts to accommodate permanent alignment offset). • Highway realignment results in significant adverse impact to Three Bridges Historic District and Section 4F impacts. • Increased ground disturbance outside existing ROW may impact unknown archeological sites and karst topography (varies by options of offset alignment).

ALTERNATIVE NO. 5 ***Rehabilitation of existing bridges (Temporary Bridge for Spring Valley, Staged Construction of Current River)***
PERFORMANCE MEASURES **Attributes and Rating Rationale**
Aesthetics • Matches existing aesthetics (structure type, side slopes, pedestrian bridge). • Maintains existing pedestrian bridge. • No impacts to side slopes at Current River. • Side slope impacts at Spring Valley for temporary bridge. • Majority of Spring Valley bridge is replaced. Arch and thrust blocks remain, but not visible.
Maintainability • Retains existing concrete bridge within widened new structure. • Eliminates ability to inspect portions of structure. • Reduced total life of rehabbed structure (vs. new structure).
Construction Impacts • Limits traffic to one signal-controlled lane during construction. • Narrow one-lane widths during select stages. • Concrete arch extends construction time resulting in extended time of impacts. • Increased amount of falsework in the channel to support concrete arch increases river traffic impacts and environmental footprint. • Provides two lanes for traffic during construction (depending upon width of temporary bridge option).
Environmental Impacts • Least amount of environmental disturbance. • Temporary bridge at Spring Valley would require minor impacts to side slopes. • Temporary bridge foundations at Spring Valley may impact natural habitat. • Ground disturbance for temporary bridge at Spring Valley may impact unknown archaeological sites.
Risk • Potential for increased deterioration discovered during construction.

ALTERNATIVE NO. 6 ***Over-widened rehabilitation of Current River Bridge, Staged Construction of Current River, Temporary Bridge for Spring Valley*** ***Option A: Girder Bridge*** ***Option B: Concrete Arch Bridge***
PERFORMANCE MEASURES **Attributes and Rating Rationale**
Aesthetics • Matches existing aesthetics depending upon structure type option. • Removes existing pedestrian bridge. • No impacts to side slopes at Current River. • Side slope impacts at Spring Valley for temporary bridge.
Maintainability • Retains existing concrete bridge within widened new structure. • Removes existing pedestrian bridge. • Girder option reduces obstructions to channel flow.
Construction Impacts • Limits traffic to one signal-controlled lane during construction. • Narrow one-lane widths during select stages. • Eliminates pedestrian access during construction. • Concrete arch option extends construction time resulting in extended time of impacts. • Increased amount of falsework in the channel to support concrete arch option increases river traffic impacts and environmental footprint.
Environmental Impacts • Least amount of environmental disturbance. • Girder option would result in adverse affects to Historic District. • Temporary bridge at Spring Valley would require minor impacts to side slopes. • Removes existing pedestrian bridge from channel reduces flow obstructions. • Temporary bridge foundations at Spring Valley may impact natural habitat. • Ground disturbance for temporary bridge at Spring Valley may impact unknown archaeological sites.

Evaluate Performance of Bridge Railing Alternatives

ALTERNATIVE NO. 1 ***Parapet and Steel Rail***
PERFORMANCE MEASURES **Attributes and Rating Rationale**
Aesthetics • Matches Sinking Creek railing and Texas County Road 17 railing. • Does not match aesthetics of existing bridge railing. • Promotes visibility from roadway to surrounding area.
Maintainability • Steel feature may require some maintenance.
Construction Impacts • Relatively simpler and faster to construct.
Environmental Impacts • N/A
Risk • Very likely to be acceptable under new bridge rail criteria.

ALTERNATIVE NO. 2 *Open Concrete Rail*
PERFORMANCE MEASURES **Attributes and Rating Rationale**
Aesthetics • Closest match to existing bridge railing. • Height of railing and picket spacing reduces visibility to surrounding.
Maintainability • More susceptible to damage after vehicle strikes. • Patch repair less likely to match original. • Increased surface area subject to deterioration.
Construction Impacts • Specialty construction of elements may increase construction complexity and time.
Environmental Impacts • N/A
Risk • May be subject to acceptability limitations under new criteria.

ALTERNATIVE NO. 3 *Concrete Corral Rail with Steel Rail*
PERFORMANCE MEASURES **Attributes and Rating Rationale**
Aesthetics • Restricts viewsheds from structure • Allows use of form liner for lower portion to enhance aesthetics. • Does not match aesthetics of existing bridge railing or Sinking Creek.
Maintainability • Solid concrete is less susceptible to damage from vehicle strikes. • Steel elements may require periodic maintenance.
Construction Impacts • Relatively simpler and faster to construct than open concrete rail.
Environmental Impacts • N/A

ALTERNATIVE NO. 4 *Type D Concrete Parapet Wall*
PERFORMANCE MEASURES **Attributes and Rating Rationale**
Aesthetics • Does not match aesthetics of existing bridge railing or Sinking Creek. • Limits visibility from roadway to surrounding area. • Form liner could be applied to exterior.
Maintainability • Solid concrete is less susceptible to damage from vehicle strikes. • No steel elements to maintain.
Construction Impacts • Easiest construction effort and time.
Environmental Impacts • N/A
Risk • Most likely to be acceptable under new bridge rail criteria.

Appendix

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Workshop Agenda

Date: Thursday, September 19, 2019
Location: NPS Maintenance Facility at Round Spring

08:00 AM	**Charrette Kick-off** • Safety Minute • Introductions • Workshop objectives	**All Participants**
08:15 AM	**Charrette Process Overview** • An instructional presentation on the charrette processes and their application to the project	**Facilitator**
8:30 AM	**Project Overview** • Pre-Workshop Investigation Results • Design Drivers and Constraints • Conceptual Alternatives Presentation	**HDR Design Team**
10:00 AM	**Break**	
10:15 AM	**Project Analysis / Value Metrics** • Function Analysis / Discuss Purpose and Need • Performance Requirements and Attributes • Performance Attribute Prioritization	**All Participants**
12:00 PM	**Lunch Break**	
1:00 PM	**Conceptual Alternative Evaluation** • Evaluate Conceptual Alternatives based on predetermined criteria	**All Participants**
3:00	**Brainstorming Ideas** • Brainstorm alternative ways to address project issues • Brainstorm additional conceptual alternatives	**All Participants**
4:30 PM	**Adjourn**	

Workshop Attendees

Workshop Attendees
Route 19 at Current River and Spring Valley, Rehab Study of Bridges A-420 J-804
Shannon County, MO

NAME	ORGANIZATION	POSITION/DISCIPLINE	TELEPHONE	CELL	E-MAIL
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Workshop Attendees

Route 19 at Current River and Spring Valley, Rehab Study of Bridges A-420 J-804
Shannon County, MO

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