6. Summary and Recommendations

6.1 Project Description

The proposed new bridge is approximately 1,100 feet long. In this short distance, the bridge crosses the Arkansas River Trail, the Arkansas River, a floodwall, the Union Pacific and Burlington Northern Santa Fe Railroad Yard (approximately 30 tracks) and a minor two-lane road. The UPRR and BNSF railroad yard constitutes a physical challenge to the crossing. The tracks are in general spaced very close together (13 feet to 14 feet) causing difficulties in pier placement to meet minimum railroad requirements. Horizontal clearances to the piers are a major consideration.

The Arkansas River and floodwall are also important obstacles. The City of Pueblo and U.S. Army Corps Of Engineers recently started design on the Legacy Project, which strives to re-establish the riverine environment and improve recreation in and around the river. Modifications to the river channel, re-introduction of wildlife and fish, and changes to the river to allow kayaking and boating are all possible.

6.2 Existing Conditions

The existing 4th St. Bridge was last rated by CDOT in February 2001 and given a sufficiency rating of 44.5, “functionally obsolete.” The sufficiency rating is a function of the structural adequacy, safety, serviceability, functional obsolescence, and public use of the bridge. The most significant items to consider are the inadequate horizontal clearance between the face of piers and the centerline of adjacent railroad tracks, the substandard deck geometry due to tight curvature at each end of the bridge, the onset of structural deterioration of the superstructure and substructure, and the inadequate load carrying capacity of the bridge deck and the girders in spans 3 through 5.

Railroad standards require 18’-0” minimum horizontal clearance between the face of a pier and the centerline of an adjacent track when pier crash walls are provided. Without pier crash walls the minimum clearance is increased to 25’-0”. The minimum existing clearance is 8’-3” which is a major concern for the public and the railroads. The rating report describes the situation as “less than the minimum tolerable” and “requires corrective action.”

Roadway and bridge geometry at the east and west ends are substandard by current design practice. The downgrade of the bridge combined with tight curvature at each end has been blamed for unsafe driving conditions especially during inclement weather. The reverse curve on the west approach is undesirable and also a concern for motorists. The bridge deck cross section consists of narrow 11-foot lanes, 2-foot maximum shoulders, and substandard 4 foot combined use sidewalks.

The overall structural condition is described as “somewhat better than the minimum adequacy to tolerate being left in place as is.” This rating considers both the superstructure and the substructure condition and indicates deterioration such as steel corrosion, leaking joints, flaking lead paint, and concrete cracking, spalling, and delamination with exposed corroding reinforcing.

Load rating of the existing bridge indicates that the concrete deck is performing at 65% of HS20 at inventory level and 100% of HS20 at operating level. The girders in spans 3 through 5 load rated at 75% of HS20 at inventory level and 125% of HS20 at operating level. Current design practice dictates that a new bridge will rate at or above 125% of HS20 at inventory level (HS25 or approximately HL93).

The proposed corrective action in the Structure Inspection Inventory Report for the existing 4th St. Bridge is replacement of the bridge due to “substandard load carrying capacity and substandard bridge roadway geometry.”

6.3 Recommended Scope of Bridge Improvements

Construction of a new bridge and widening of the existing bridge were both studied and evaluated based on all of the project goals and critical issues. Costs associated with widening are similar to those for construction of a new bridge. Costs to consider include structure cost, rehabilitation and retrofit of the existing bridge, lead paint abatement, future maintenance costs, future structure replacement, maintenance of traffic, and approach roadway costs. The recommended solution is construction of a new bridge and removal of the existing bridge. The preferred alignment for the bridge is parallel to and north of the existing bridge.

6.4 Structure Options

Several layout options and associated structure types were studied for the proposed north alignment. A wide variety of span arrangements, pier locations, and structure types were considered. For each layout option, the most likely structure types were included for further study. The options and associated structure types studied are shown in Table 6.1,the summary evaluation matrix.

All the bridge options studied are conventional and can be constructed by a wide range of contractors. The options feature span lengths ranging from 108 feet to 374 feet and between three (3) and seven (7) piers. Steel plate girders, steel box girders, precast bulb-T, and precast U girders were studied for options with shorter spans. Spliced girders are necessary to accommodate spans greater than 145 feet for these options. For longer span lengths, steel plate girders, steel box girders, and cast-in-place concrete box girders were studied. The cast-in-place box girders would be primarily constructed from above with form travelers in balanced cantilever from the piers.

6.5 Structure Evaluation

Each structure option and type was evaluated against the project goals, critical issues, and constraints of the site. Selection of the structure types and layouts to be studied further in the next phase is based on which options provide the best overall value to the project in terms of a diverse set of evaluation criteria. The evaluation criteria are based on the structural and functional requirements of the bridge facility and include the following:

- Impact to the Arkansas River Floodwall
- Impact to the UPRR and BNSF Railroad Yard
- Arkansas River Impacts
- Bridge Aesthetics
- Bridge Cost
- Constructibility
- Durability / Maintainability

Table 6.1 is a summary of the conceptual level evaluation of the selected options. Each layout option and structure type is given a rating of satisfactory, good, excellent, or unacceptable for each of the evaluation criteria. An overall rating is then given for each option. Those options receiving the best overall ratings are recommended for further study. These options will be studied in depth in the preliminary design phase and a final structure type will be recommended for the project.

6.6 Summary and Recommendations

Long Span 3 utilizes cast-in-place construction from above with form travelers. Traditional falsework may be used near the ends of the bridge where space below is available. The number of piers and construction operations for this option are the least of any studied. Long Span 3 is also the only option that results in meeting the 18’-0” minimum horizontal railroad clearance requirement from the face of pier to the centerline of track at all pier locations. Long Span 3 also has the added benefit of placing a pier between the river and the trail where construction can occur in dry conditions.

Moderate Span 2 is similar to Long Span 3 except that a pier is added in the railroad yard to reduce the long span to 235 feet. This span range can be accomplished with either steel plate girders or steel box girders and is outside the range of precast post-tensioned concrete bulb-T and U girders. Cast-in-place concrete with form travelers is better suited for the long span options studied. Construction including ground-based erection and girder splicing, as well as long-term durability and maintenance of steel structures are important considerations for this option.

The two options that match the spans in the railroad yard are best built with steel girders or spliced post tensioned precast concrete bulb-T or U girders. Of the two options, the option that matches the existing railroad spans and reduces the river spans is the better solution. This option rated lower overall due to impacts to the railroad yard, impacts to the Arkansas River, and constructibility. After elimination of Moderate Span 1, the greatest number of piers and construction activities in the railroad yard are with this option. However, structure cost is typically lower for these types of structures. More accurate costs associated with railroad flagging, track delays, railroad construction requirements, and track removal or relocation determined in the next phase of the project will better evaluate this option.

The three long span options have the highest overall rating in the evaluation matrix. Of these three options, Long Span 3 has the best overall ratings. Long Span 2 is also an excellent solution, but not as good as Long Span 3, and similar in cost. Moderate Span 2 is a good solution while Moderate Span 1 and Moderate Span 3 have been eliminated due to unacceptable ratings associated with impacts to the railroads and floodwall, respectively. The option of matching the existing railroad spans and reducing the river spans also rated good. Long Span 3, Moderate Span 2, and Match Existing with Modified River Spans are recommended for further study during the preliminary design phase of the project.

Table 6.1 Summary of Evaluation of Structure Options

Evaluation of Structure Options

● Excellent ⊖ Good ○ Satisfactory
⊗ Unacceptable

			Evaluation Criteria								
	Layout Option	Structure Type	Impact to Floodwall	Impact to UP & BNSF Railroads	Impact to Arkansas River	Bridge Aesthetics	Bridge Cost	Constructibility	Durability/ Maintainability	Overall	
1	Match Existing	Steel Plate Girder	⊖	○	⊖	○	⊖	○	○	○	
2		Steel Box Girder	⊖	○	⊖	⊖	○	○	○	○	
3	Match Existing w/ Mod. River Spans	Precast Spliced Bulb-T	⊖	○	○	○	●	○	⊖	⊖	✳
4		Precast Spliced U Girder	⊖	○	○	⊖	●	○	⊖	⊖	✳
5	Moderate Span 1	Precast Bulb-T	⊖	⊗	○	○	●	○	⊖	⊗	
6		Precast U Girder	⊖	⊗	○	⊖	●	○	⊖	⊗	
7	Moderate Span 2	Steel Plate Girder	⊖	⊖	●	○	●	⊖	○	⊖	✳
8		Steel Box Girder	⊖	⊖	●	⊖	⊖	⊖	○	⊖	✳
9	Moderate Span 3	C.I.P. Box w/Travelers	⊗	⊖	●	●	●	○	●	⊗	
10		Steel Plate Girder	⊗	⊖	●	○	●	⊖	○	⊗	
11		Steel Box Girder	⊗	⊖	●	⊖	⊖	⊖	○	⊗	
12	Long Span 1	C.I.P. Box w/Travelers	●	⊖	⊖	●	⊖	⊖	●	●	
13	Long Span 2	C.I.P. Box w/Travelers	●	⊖	⊖	●	●	⊖	●	●	
14	Long Span 3	C.I.P. Box w/Travelers	⊖	●	●	●	●	●	●	●	✳

✳ Recommended for Further Study

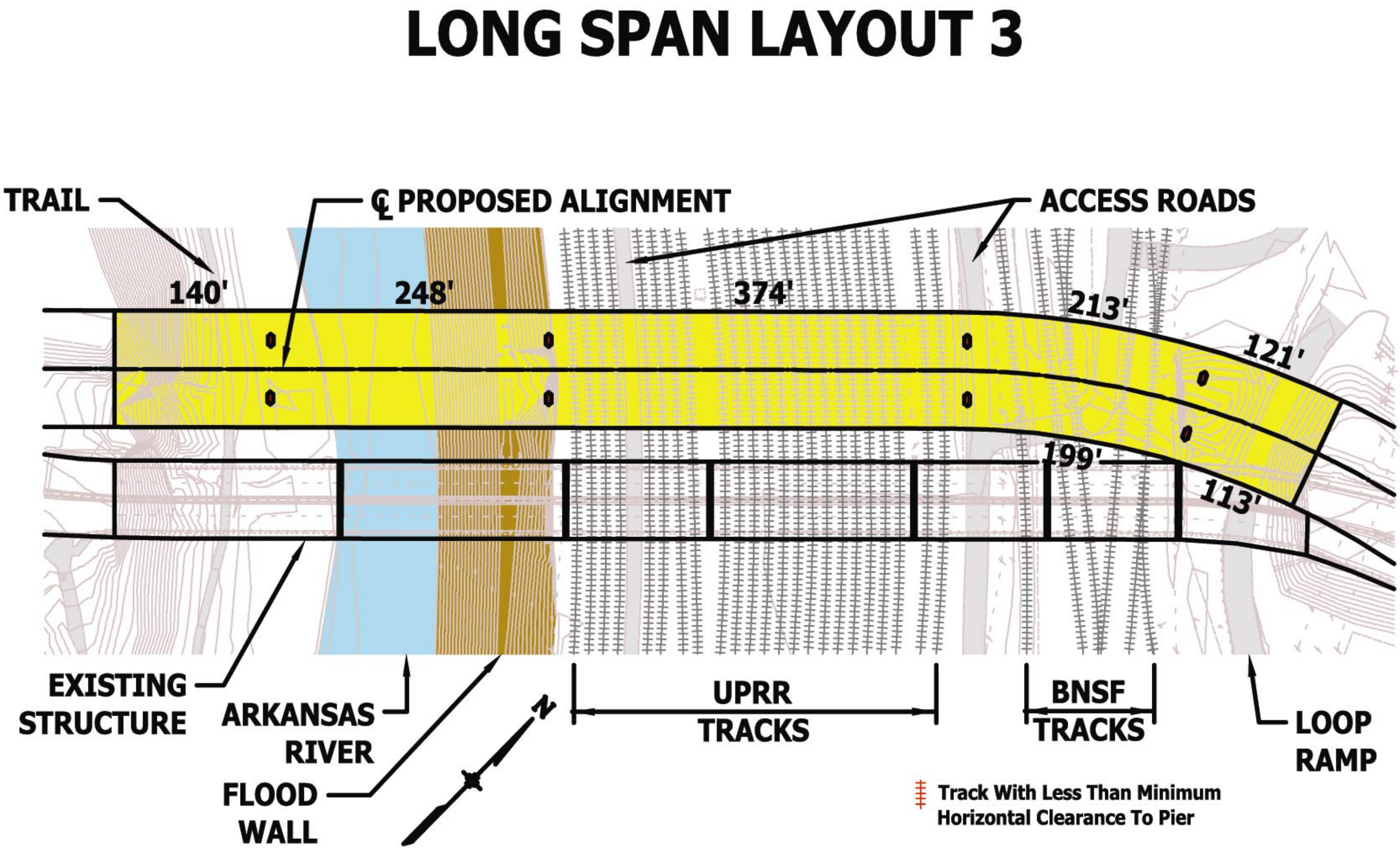


Figure 6.1 Long Span Layout 3 - Plan

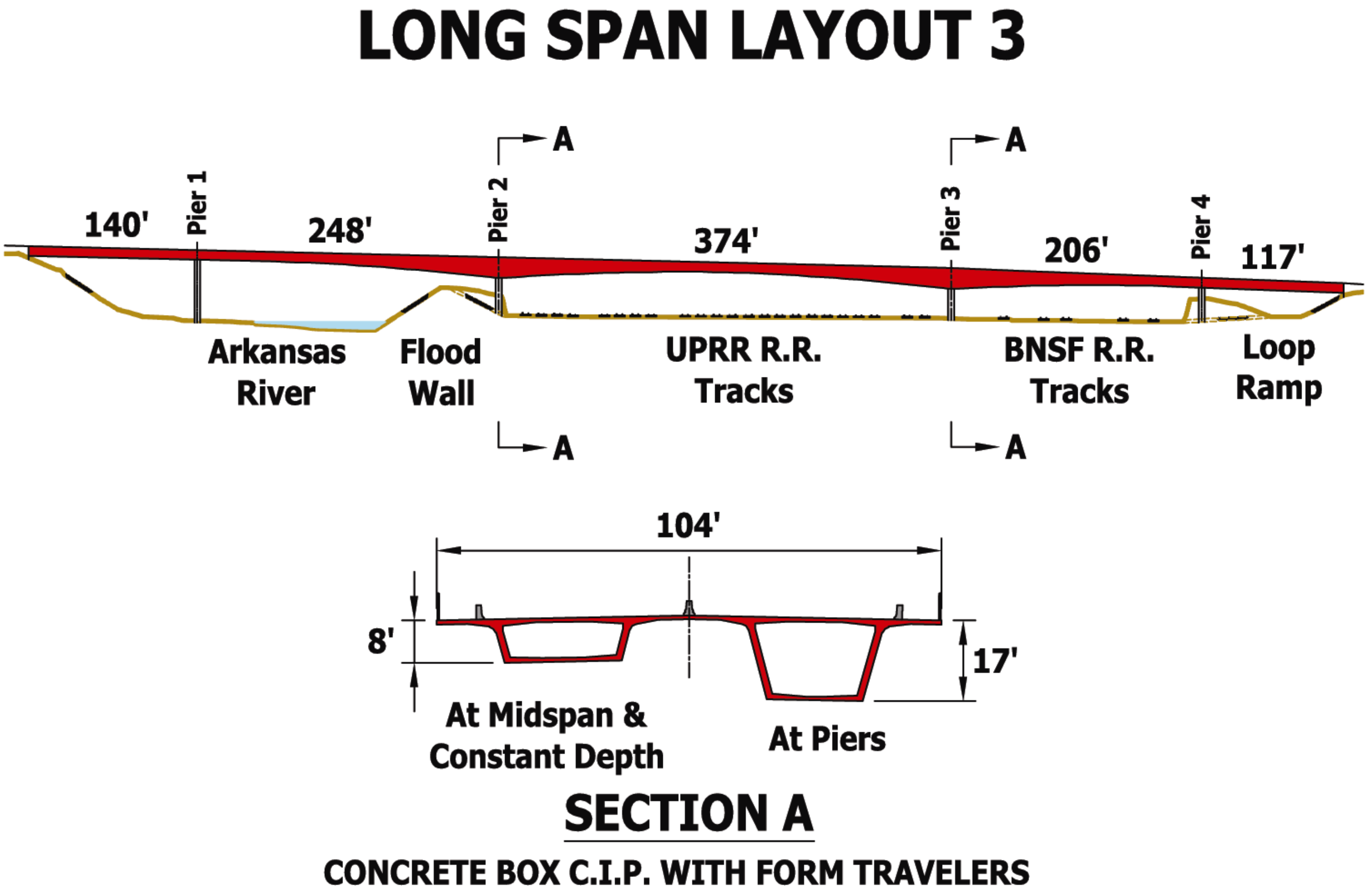


Figure 6.2 Long Span Layout 3 - Elevation

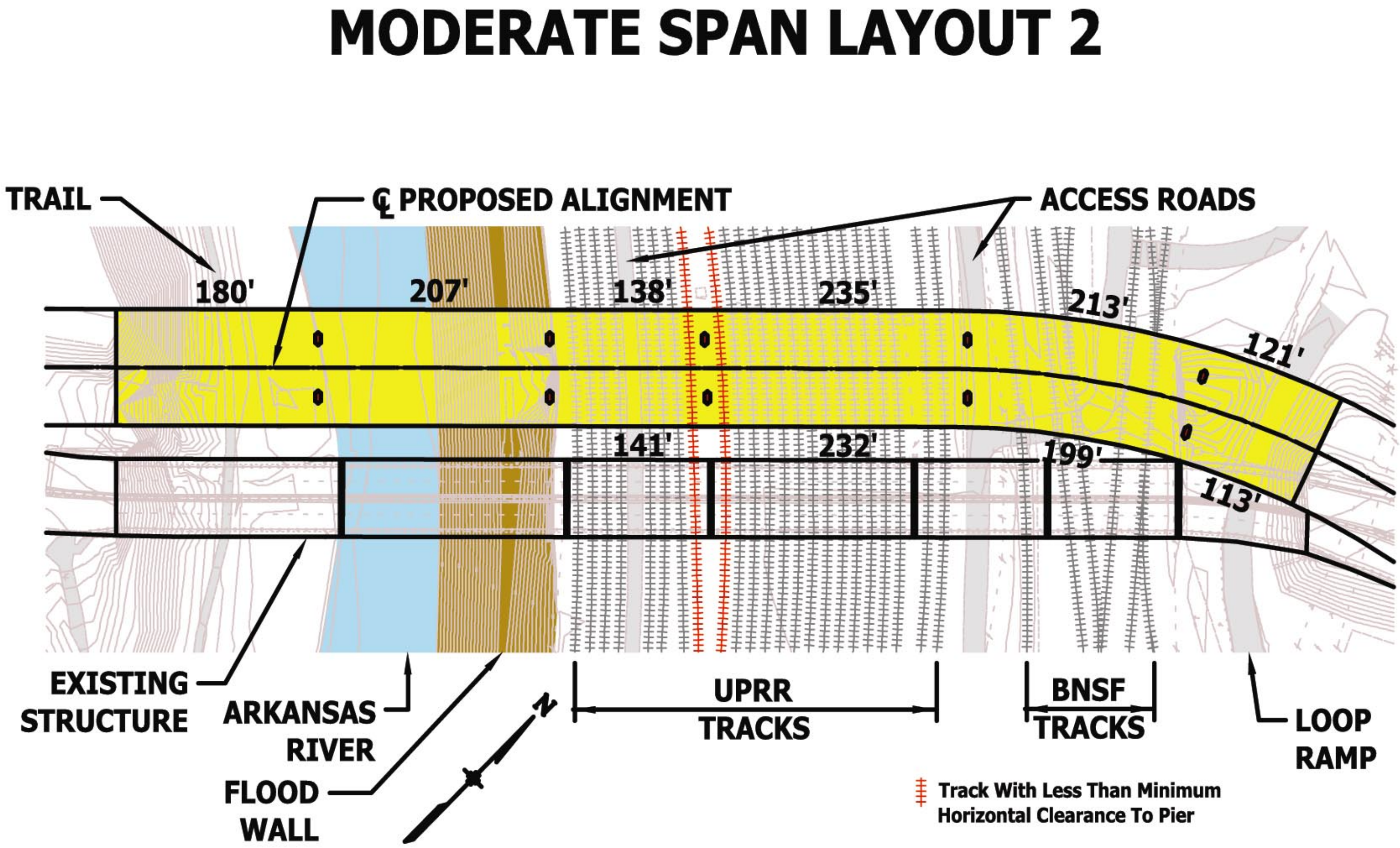


Figure 6.3 Moderate Span Layout 2 - Plan

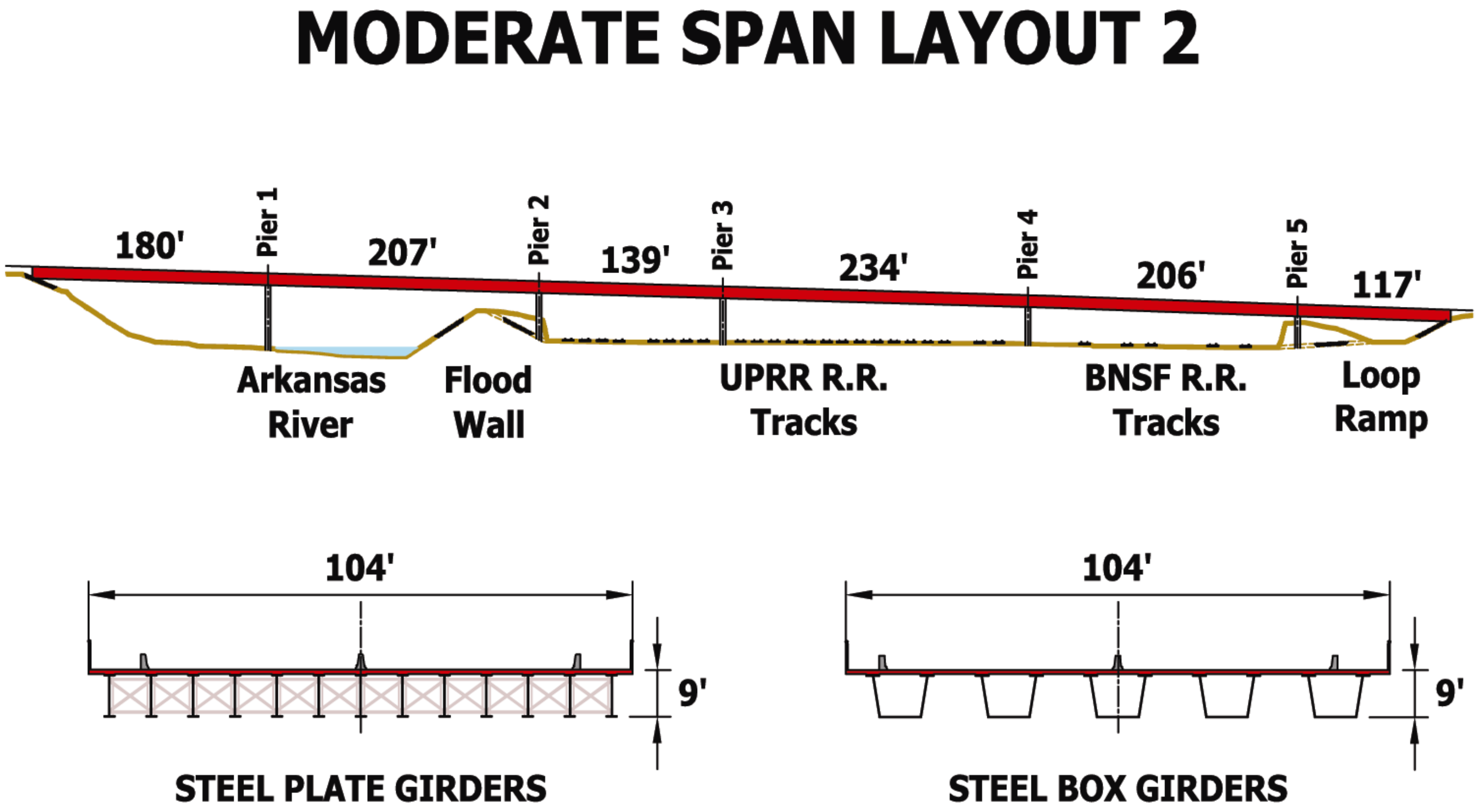


Figure 6.4 Moderate Span Layout 2 - Elevation

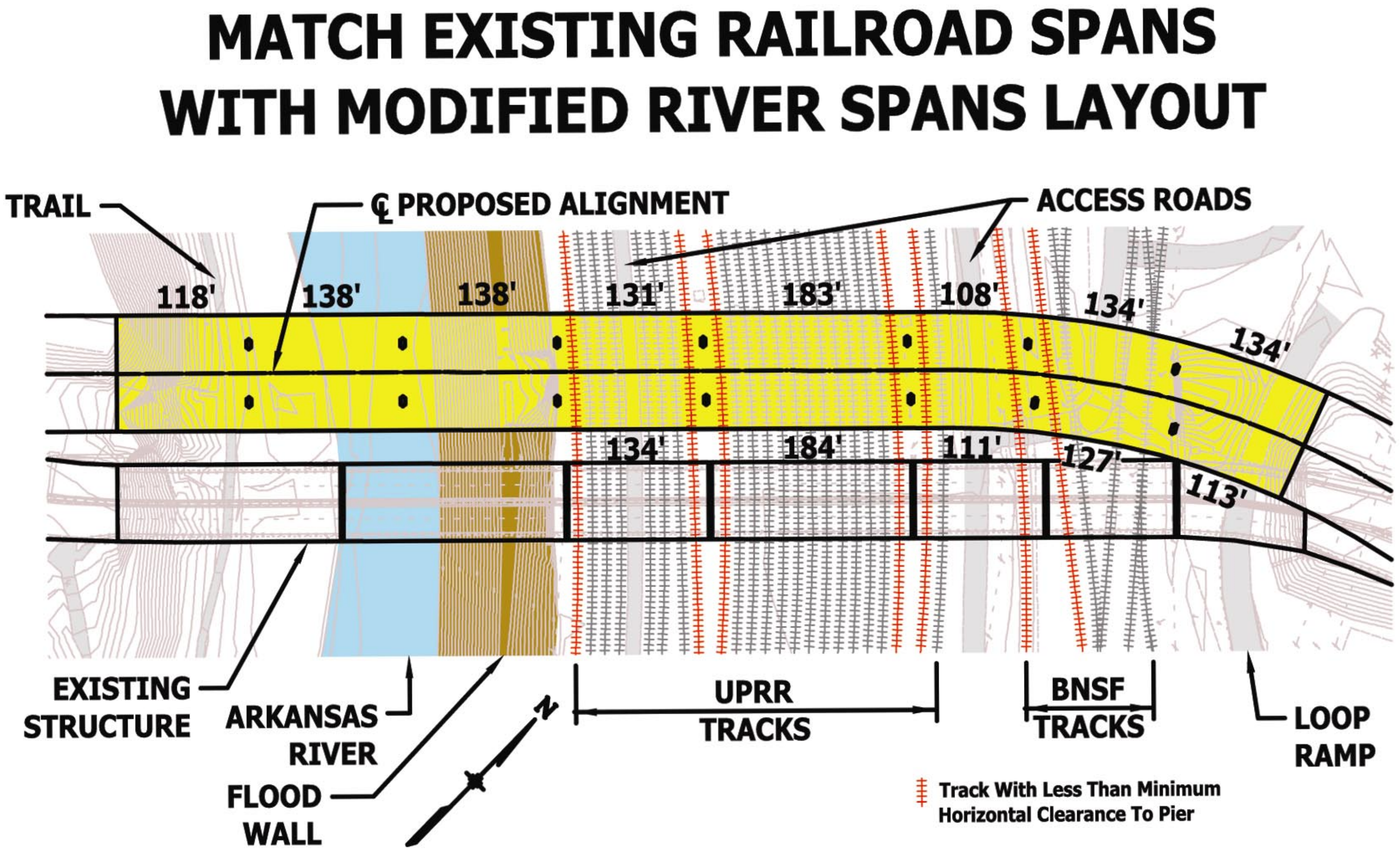
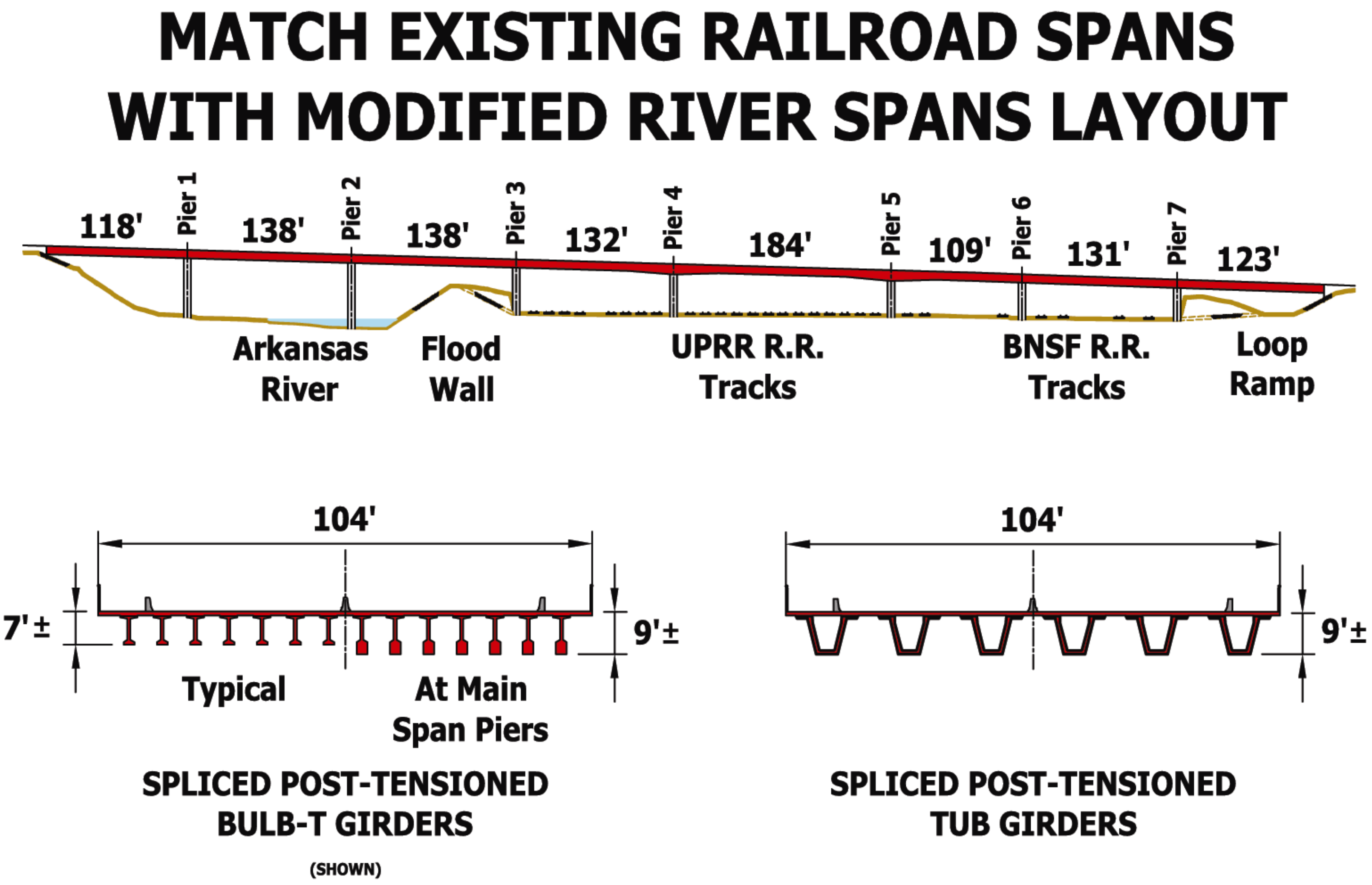


Figure 6.5 Match Existing RR Spans w/ Modified River Spans - Plan



MATCH EXISTING RAILROAD SPANS WITH MODIFIED RIVER SPANS LAYOUT

SPLICED POST-TENSIONED BULB-T GIRDERS

(SHOWN)

SPLICED POST-TENSIONED TUB GIRDERS

Figure 6.6 Match Existing RR Spans w/ Modified River Spans - Elevation