Appendix E. Bridge Type/Foundation Studies Memorandum

To	Neil McLellan, PE, HDR		
From	HDR Road and Bridge Team		
Date	November 23, 2013	Job No.	BA 153-01

RE: Bridge Type/Foundation Studies for LA 23 and MBSD Channel Bridge

The Coastal Protection and Restoration Authority of Louisiana (CPRA) plans to construct a sediment diversion channel in Plaquemines Parish on the Mississippi River near the town of Ironton and the ConocoPhillips Alliance Refinery (see Figure 1). The proposed project, known as the Mid-Barataria Sediment Diversion (MBSD), would divert sediment-laden water from the Mississippi River through a self-contained channel with guide levees for a length of roughly 1.5 miles before outfalling past the back levee into Barataria Basin.

The channel would cut through the existing Belle Chasse Highway (LA 23); therefore, a new highway bridge would be needed to span the channel. The bridge, funded and built by CPRA, would become an asset of the Louisiana Department of Transportation and Development (LADOTD). LADOTD would be responsible for future bridge maintenance and inspections.

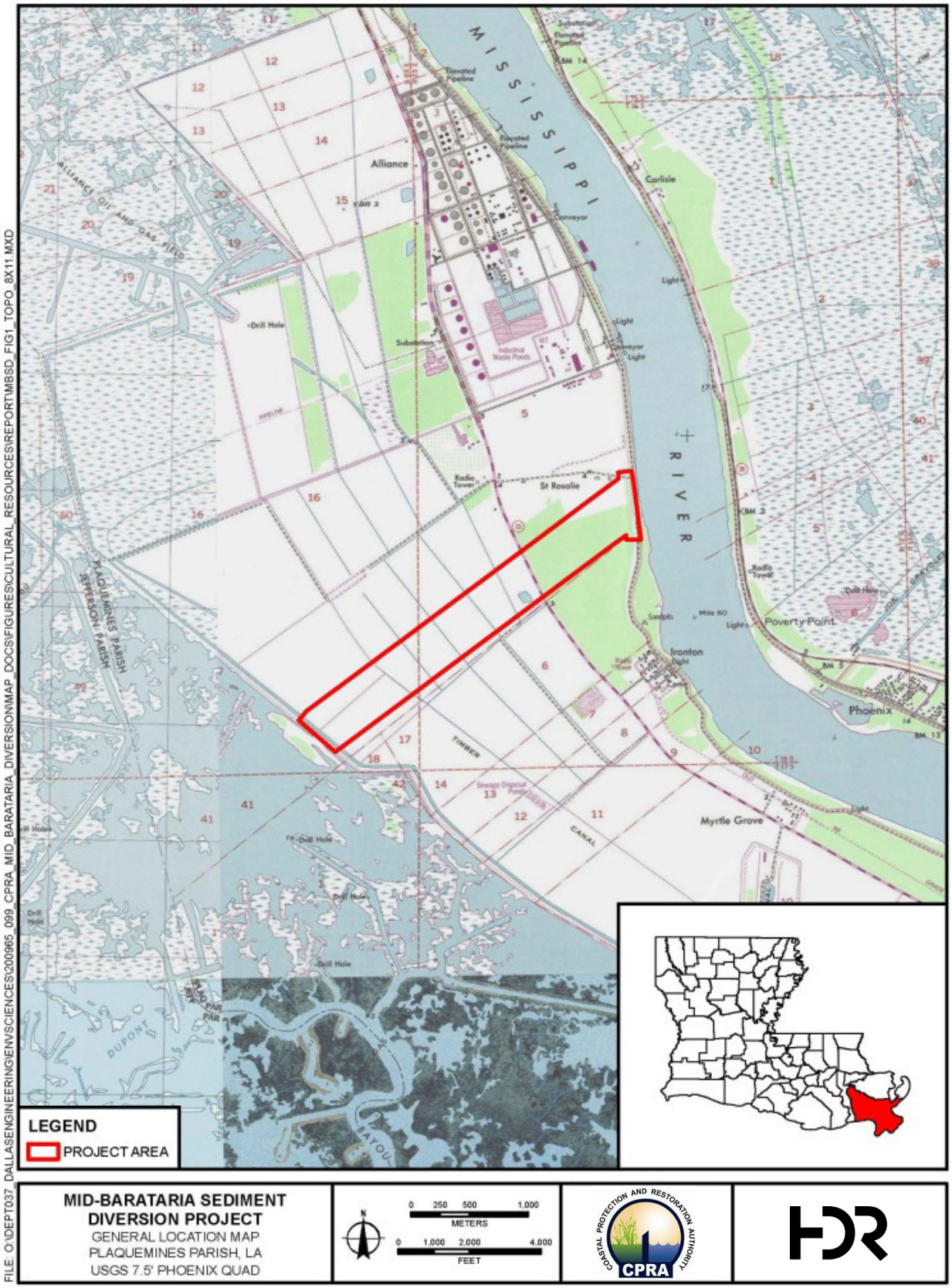
This memorandum describes the proposed bridge structure type, size, and location (TS&L). Options studied are discussed, and the memorandum concludes by providing a recommendation for the proposed bridge option. An outline of this memorandum follows:

- overall project limits and proposed traffic phasing
- description of proposed channel cross section
- hydrologic and hydraulic data
- criteria used for bridge TS&L option
- bridge TS&L summary
- Attachment A: bridge layout/elevation view

Overall Project Limits and Proposed Traffic Phasing

LA 23 is a four-lane, divided highway that serves as the hurricane evacuation route for lower Plaquemines Parish. A four-lane highway bridge would span the conveyance channel and would be centrally located within the existing LA 23 right-of-way, as it is today. LA 23 would remain open to traffic during construction by shifting traffic onto separate temporary detour pavement. A narrative of the traffic phasing plan follows.

Figure 1. MBSD general location



Traffic Phasing

Step 1 – Construct detour ramps and pavement, shifting traffic to the outmost border width. Northbound and southbound traffic would be separated by a distance that defines the construction zone for the new bridge.

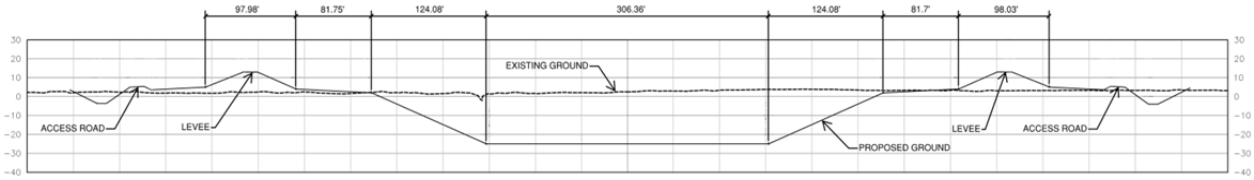
Step 2 – Excavate the proposed channel and construct the new bridge with its centerline alignment at the existing centerline of LA 23.

Step 3 – Complete the main lane pavement connecting existing roadway to new construction. Shift traffic to the new bridge. Demolish and remove the temporary detour.

Description of Proposed Channel Cross Section

Figure 2 shows the channel cross section along LA 23.

Figure 2. MBSD channel cross section



Hydrologic and Hydraulic Data

The MBSD channel is designed to carry sediment from the Mississippi River to Barataria Basin. It is important to note that this is not a drainage channel with the usual associated flooding concerns of rising high water elevations with respect to the bridge low chord. The low chord is above the top of levee, so the water surface elevation would not rise above the low chord of the bridge. Water velocities are the governing hydraulic design criteria for the channel to convey sediment, which is why the rail and roadway bents line up and why solid pier wall bents were selected. Bent placement is analyzed for reduction to the velocity of diversion channel flows but not for tailwater effects.

Criteria Used for Bridge TS&L Option

Two main criteria govern the LA 23 bridge: fixed channel geometry and the adjacent New Orleans and Gulf Coast Railway (NOGC) bridge.

Channel Considerations

The fixed dimension of the channel, coupled with levees that do not allow for foundation penetration, limit span possibilities. From an aesthetic and hydraulic design perspective, it is desirable to use consistent span lengths for both the rail and highway bridges, which is why a typical span of 118 feet was chosen.

Superstructure Considerations

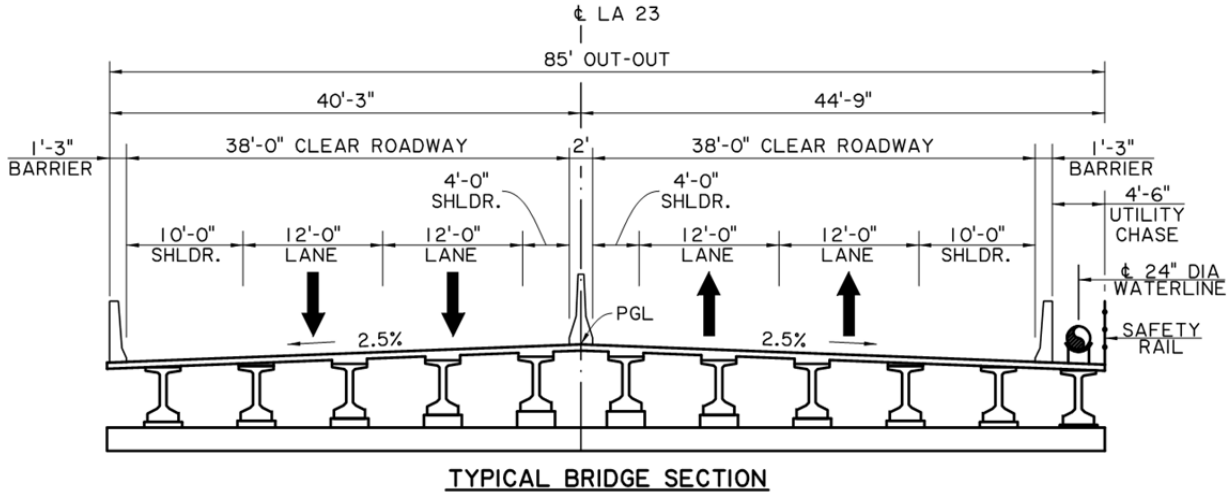
The NOGC bridge would parallel the LA 23 bridge over the diversion channel. For hydraulic efficiency, the piers of both bridges are aligned. Rail bridges have higher loads that limit economical span lengths. The longest economical plate girder span for the rail bridge was determined to be approximately 150 feet. However, in highway bridge terms, a 150-foot span enters the range where steel girder superstructure construction is costly and maintenance-intensive. A meeting with LADOTD representatives revealed that

a steel girder bridge was not desirable given the harsh coastal environment that would lead to future corrosion and maintenance costs. LADOTD's concerns—coupled with the higher cost of steel girder construction—drove the decision making toward a prestressed concrete girder bridge.

Bridge Width

The bridge would be a single structure carrying both directions of traffic. Each traffic direction, northbound and southbound, would consist of two 12-foot traffic lanes, a 4-foot inside shoulder, a 10-foot outside shoulder, a traffic railing, and a centerline barrier. The bridge would be wider by 4.5 feet on the western side to accommodate relocation of a deck-mounted 24-inch-diameter water line. The water line would be deck-mounted to provide superior access for maintenance and inspection. Figure 3 shows the typical bridge section.

Figure 3. LA 23 bridge section



Interior Pier or Bent Type

Interior bents can be separated into two categories: those subject to constant stream flow and those that are not. Interior bents not subject to constant stream flow would be of trestle-style construction using square concrete piling. Interior bents subject to stream flow would be solid wall piers supported by a strip footing, founded with precast square concrete piling. The leading and trailing edges of piers would be half round for hydraulic efficiency.

Relocation of Existing Waterline

The diversion channel would interrupt an existing 24-inch-diameter waterline, which would need relocation. The waterline would be relocated on top of the bridge deck in a dedicated space behind the traffic rail. For worker safety, a safety rail is proposed on the outside edge of the deck.

Other Bridge Criteria

The channel would be lined with articulated concrete blocks to address concerns regarding foundation scour.

Bridge TS&L Summary

Only one bridge option was studied in detail, given the fixed dimension of the channel coupled with the need to align piers of the adjacent and governing rail bridge. Economics dictate that the highway bridge geometry follow the lead of the rail bridge, given that the rail bridge cost would be considerably more than a highway bridge.

Option 1

The proposed bridge option consists of an 18-span, precast, prestressed concrete I-girder bridge. A plan, elevation, and typical section for this option are provided in Attachment A. The abutments and interior piers would be skewed to match the channel orientation. Piers subject to stream flow (within the channel) would be solid pier wall-style construction with a strip footing founded on precast, prestressed square concrete piles. Piers not subject to stream flow would be trestle-style construction using precast, prestressed square concrete piles. End bents would be founded on precast, prestressed square concrete piles with an expansion joint in the deck. Table 1 and the sketches in Attachment A summarize the features of this proposed bridge option.

Table 1. Proposed bridge option

Discussion item	Summary
Bridge description	18-span precast, prestressed concrete I-girder, Type LG-54, 11 degree skew
Advantages	• Lower cost than steel superstructure • Less maintenance than steel superstructure • No painting required
Disadvantages	• More limited span length (not a problem in this case because the railroad bridge also has a limited span)
Total estimated bridge cost (153,170 square feet at $95 per square foot)	$14,551,150

Attachment A. Bridge Layout/Elevation View

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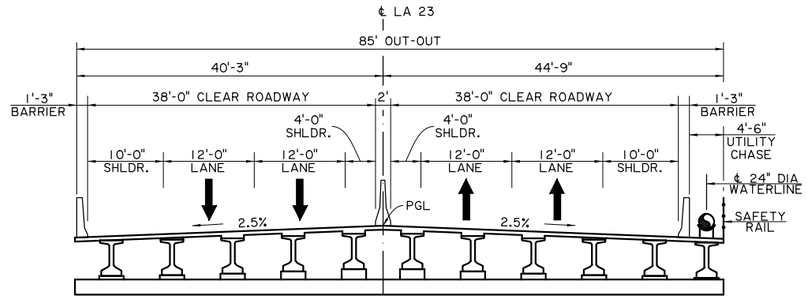
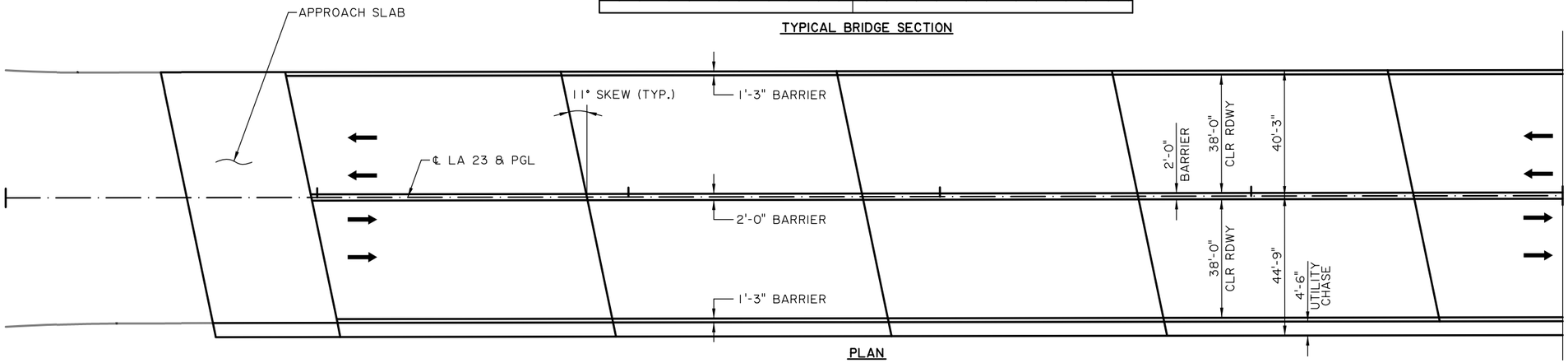


TYPICAL BRIDGE SECTION



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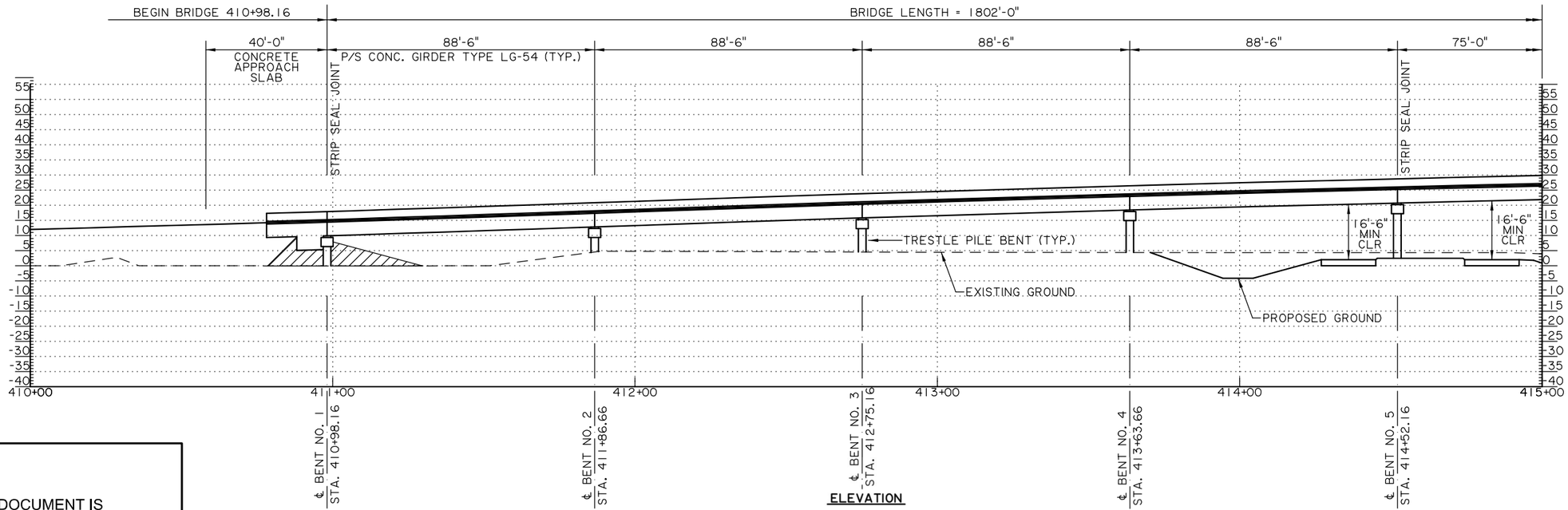

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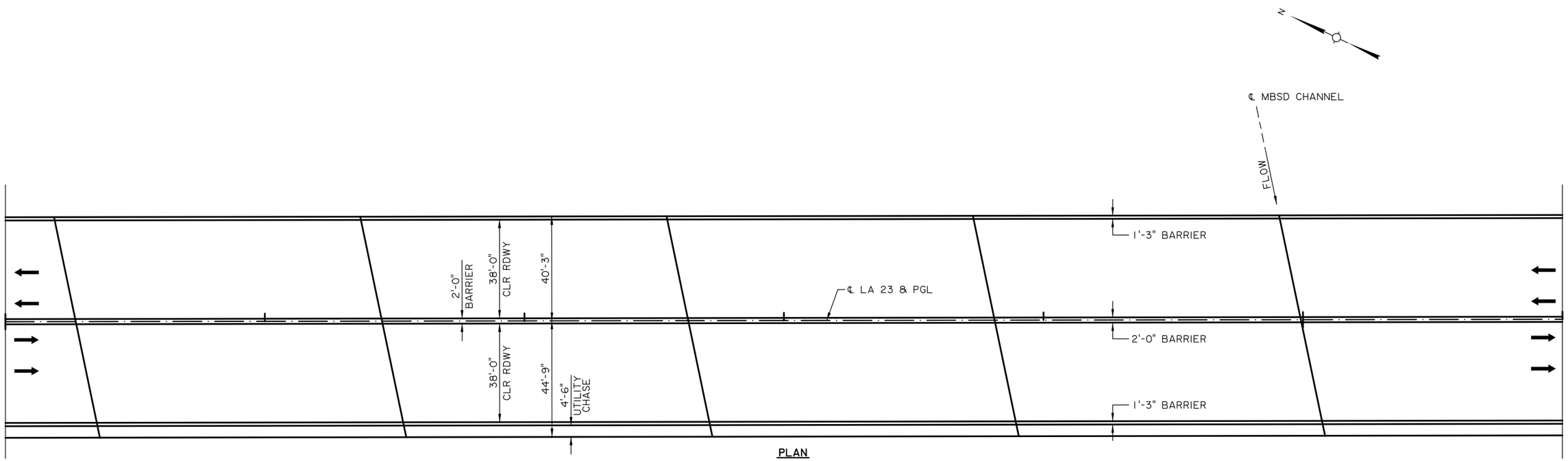

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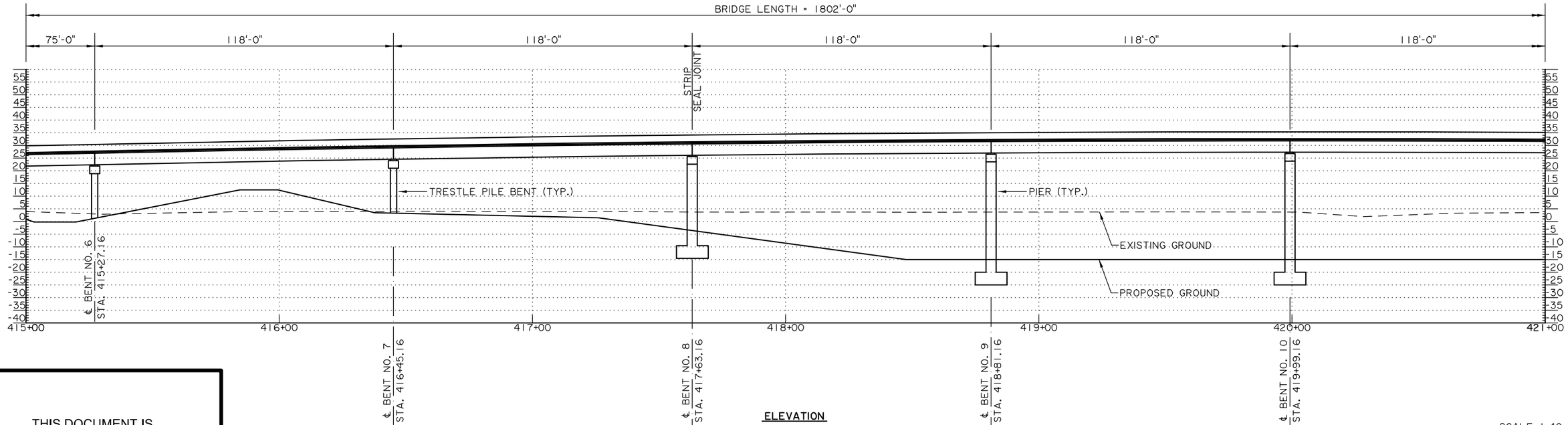

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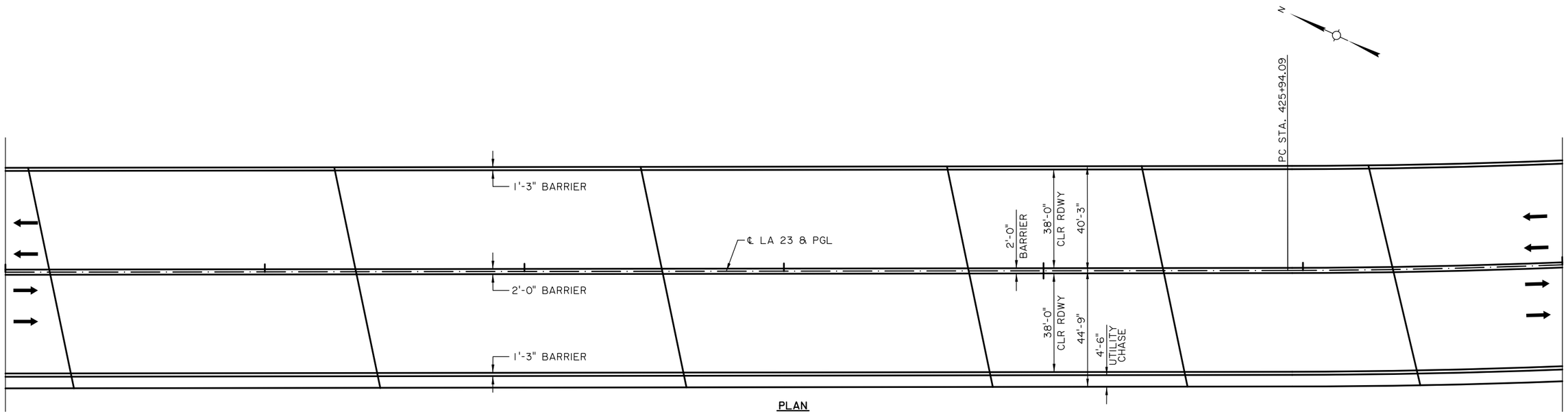

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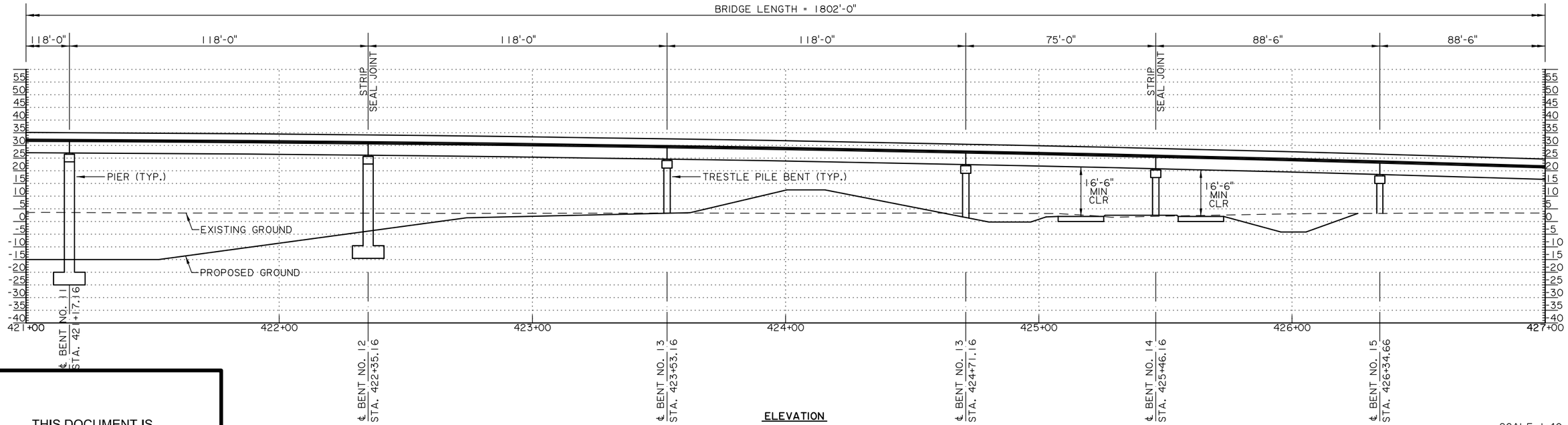

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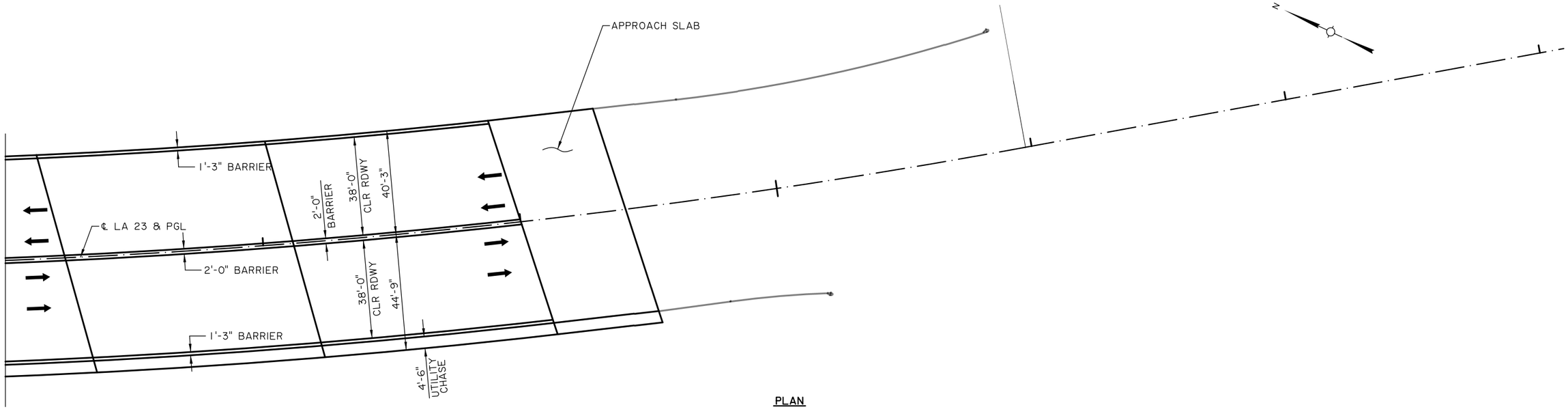

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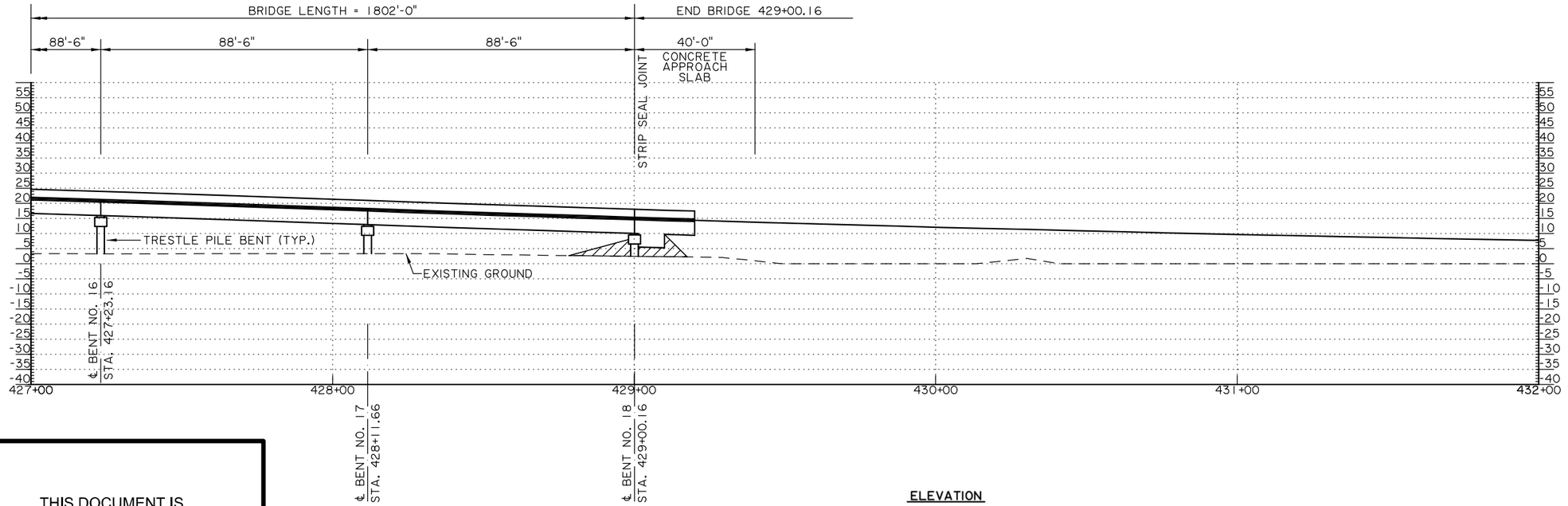

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