Creativity & Innovation

Bring a Distinctive Solution to the Eldean Road Widening & Railroad Bridge Replacement Project

MIA-CR33-1.81

PID 84154

TranSystems

EXPERIENCE | Transportation

KORDA

KORDA/NEMETH ENGINEERING

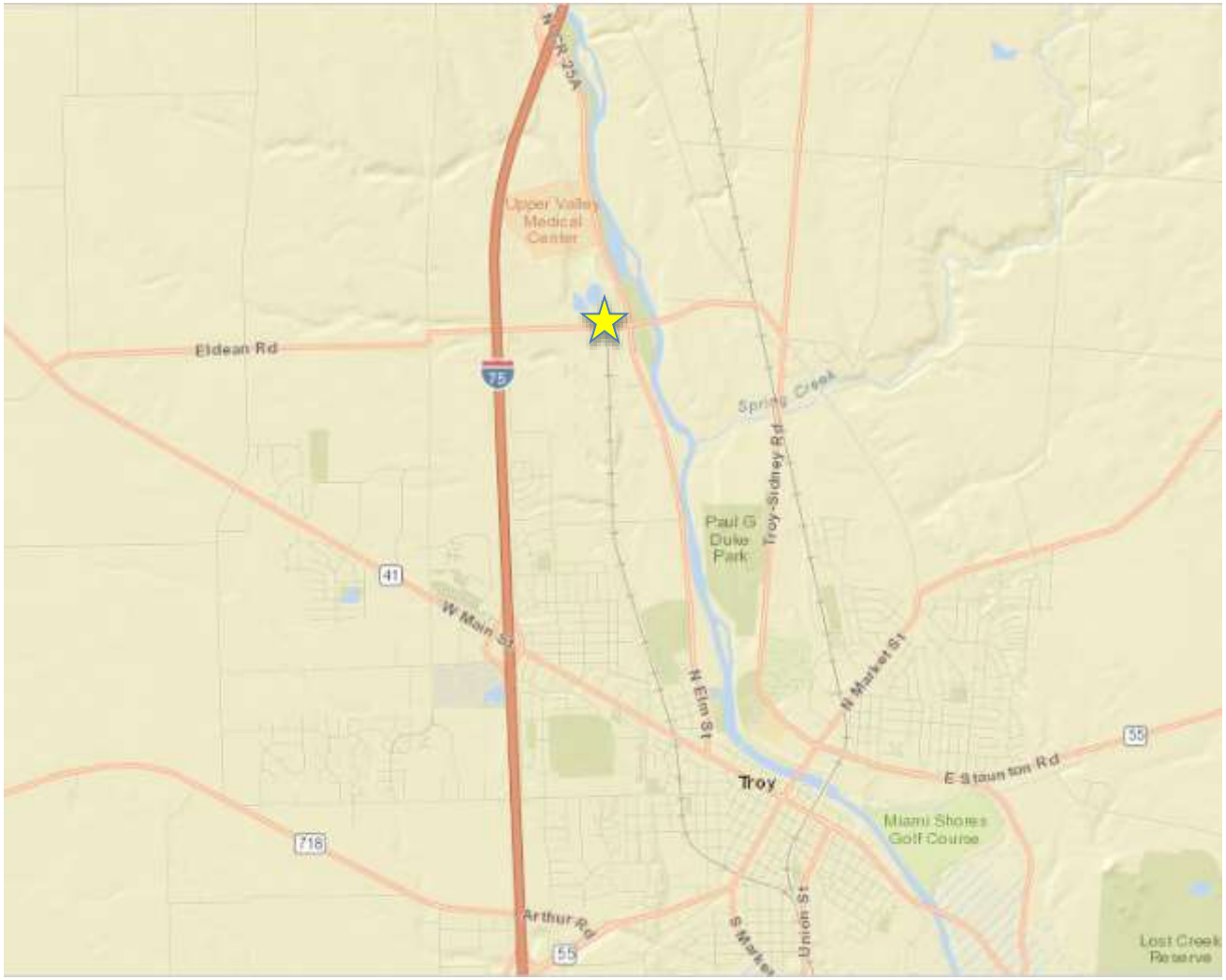
Brooks Vogel, PE
Partner – Korda/Nemeth Engineering

- **Purpose, Need & Roadway Design**
- Structure Design Issues/Challenges
- Railroad Coordination/Track Design
- Construction

Project Team/Stakeholders

- Miami County Engineer (Owner)
- Korda/Nemeth Engineering (Prime)
- TranSystems (Bridge/Rail Subconsultant)
- Eagle Bridge (Contractor)
- CSXT (Track owner)
- HDR (CSX consultant reviewer)
- ODOT (ODOT Let LPA)
- Mennel Milling Co. (Troy Grain Elevator)
- MVRPC (Funding)
- CEAO (Funding)

Project Location & Context



- Northern bypass
- GMR crossing
- IR75 crossing
- CR25A interchange
- Troy-Piqua convergence
- Future land use
- Superfund Site

Project Location

Roadway Design

- Rural major collector
- Current ADT 5,300
- Design ADT 7,000
- 55 mph design speed
- 4% trucks
- 3-lane section with center turn lane

Existing CSX Bridge

- Through girder on stone abutments
- Built in 1905
- Vertical clearance 9’-8”

Existing CSX Bridge

- ~4 strikes per year reported
- Likely 15-20 per year

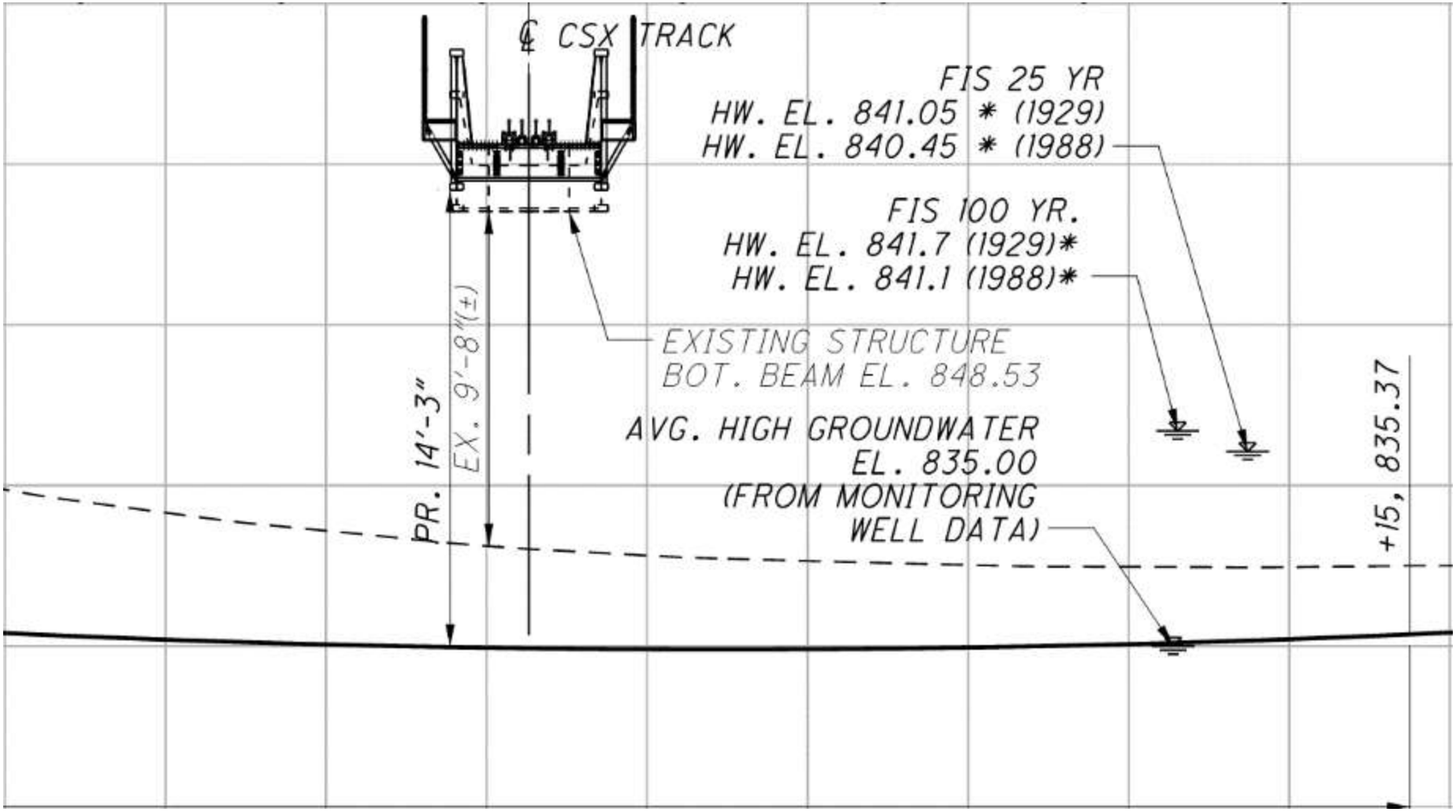
PE Study (by others)

- At-grade Crossing
  - Safety concerns
  - Roadway delays
  - Constraints on Troy Elevator operations
  - Drive impacts
  - Mitigation – 3 off-site, at-grade closures
- Grade Separation
  - More trackwork
  - Flooding
  - Groundwater infiltration

Design Constraints

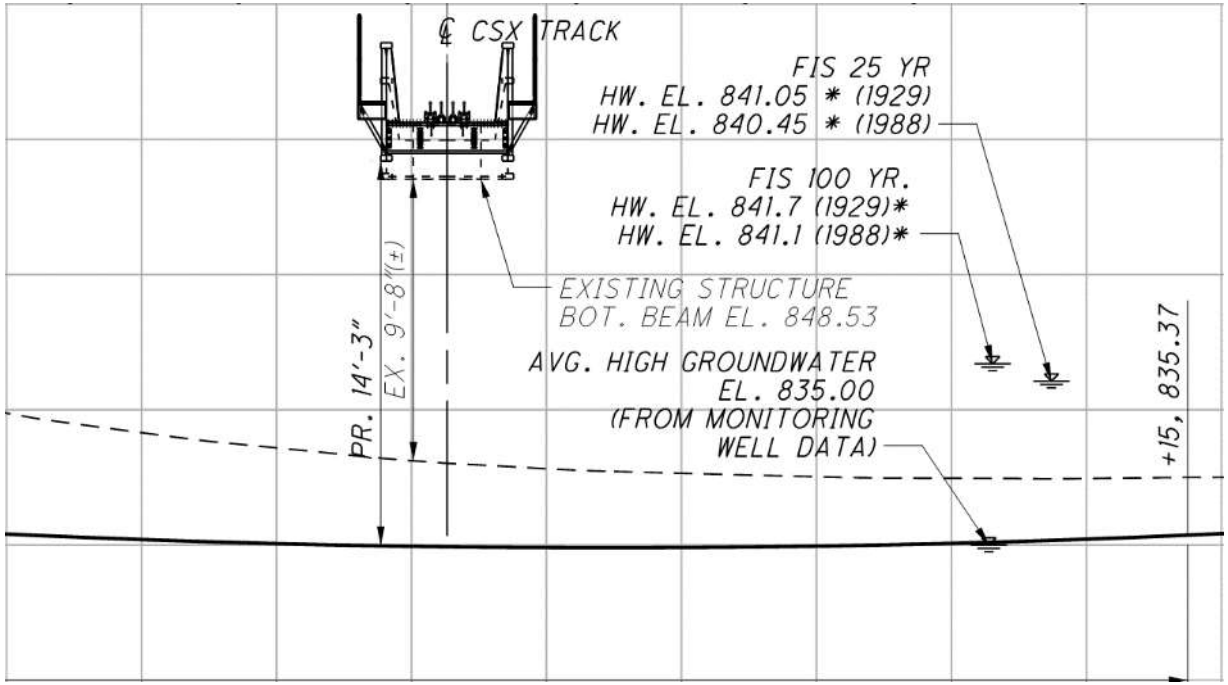
Groundwater & Flooding

Design Approach



Design Approach

- Maximize vertical clearance (N.D.C. = 14’-6”)
  - Future overlays
- Minimize track rise
- Minimize profile lowering (groundwater/ flooding)



Final Design Benefits

- Roadway profile – 45 mph vs. 55 mph
- Shallow bridge was key

	Existing	PE Study	Delta	Final	Delta
Top of Track	850.53	853.47	2.94	851.53	1.00
Bottom of Structure	848.53	850.47	1.94	849.20	0.67
Roadway Low point	837.48	834.59	-2.89	834.90	-2.58

- Reduce flooding frequency
- Maintain gravity stormwater outlet
- Significant roadway and track cost savings

Cost Savings

APPROXIMATE COSTS COMPARISON (CORRECTED)					
	PE Study At-Grade	PE Study Grade Sep	Constructed	Delta vs. PE Study	
Roadway	$ 1,281,800	$ 1,316,662	$ 1,053,330	$ (263,332)	-20.0%
Bridge	$ 68,000	$ 1,239,773	$ 1,177,773	$ (62,000)	-5.0%
Track	$ 591,600	$ 1,034,960	$ 514,027	$ (520,933)	-50.3%
ROW	$ 25,500	$ 23,000	$ 23,000	$ -	0.0%
Utilities	$ 354,000	$ 416,000	$ 376,299	$ (39,701)	-9.5%
TOTAL	$ 2,320,900	$ 4,030,395	$ 3,144,429	$ (885,966)	-22.0%

*Constructed project was a grade separation
*Additional track work for reconfiguring the yard was above and beyond these costs

ODOT Conway Partnership Award

- Concurrent project - Bridge replacement over Great Miami River (other side of CR25A)
- MVRPC loan CEAO $4 MM, repay following fiscal year
- Expedited schedule by 1 year
- MOT impacts for only 1 season

MCEO
MIAMI COUNTY ENGINEER'S OFFICE

STATE OF OHIO DEPARTMENT OF TRANSPORTATION

COUNTY ENGINEERS ASSOCIATION OF OHIO
"ALL TRAVEL STARTS AND ENDS ON A LOCAL ROAD"

MIAMI VALLEY
Regional Planning Commission

Completed Corridor

Nabil Farah, PE

Ohio Bridge Team Leader - TranSystems

Existing Structure

- Steel Riveted Through Girder with integrally framed stringers and floorbeams
- Stone masonry abutments with a cast in place concrete cap
- Span: 46 feet
- Vertical Clearance: ***9'-8"*** – High Crash Location almost 40 known reported collisions hitting the bridge
- Date Built: 1905 by the Cincinnati Hamilton & Dayton Railroad
- Track is low speed with flat grade

Existing Structure

Existing Structure

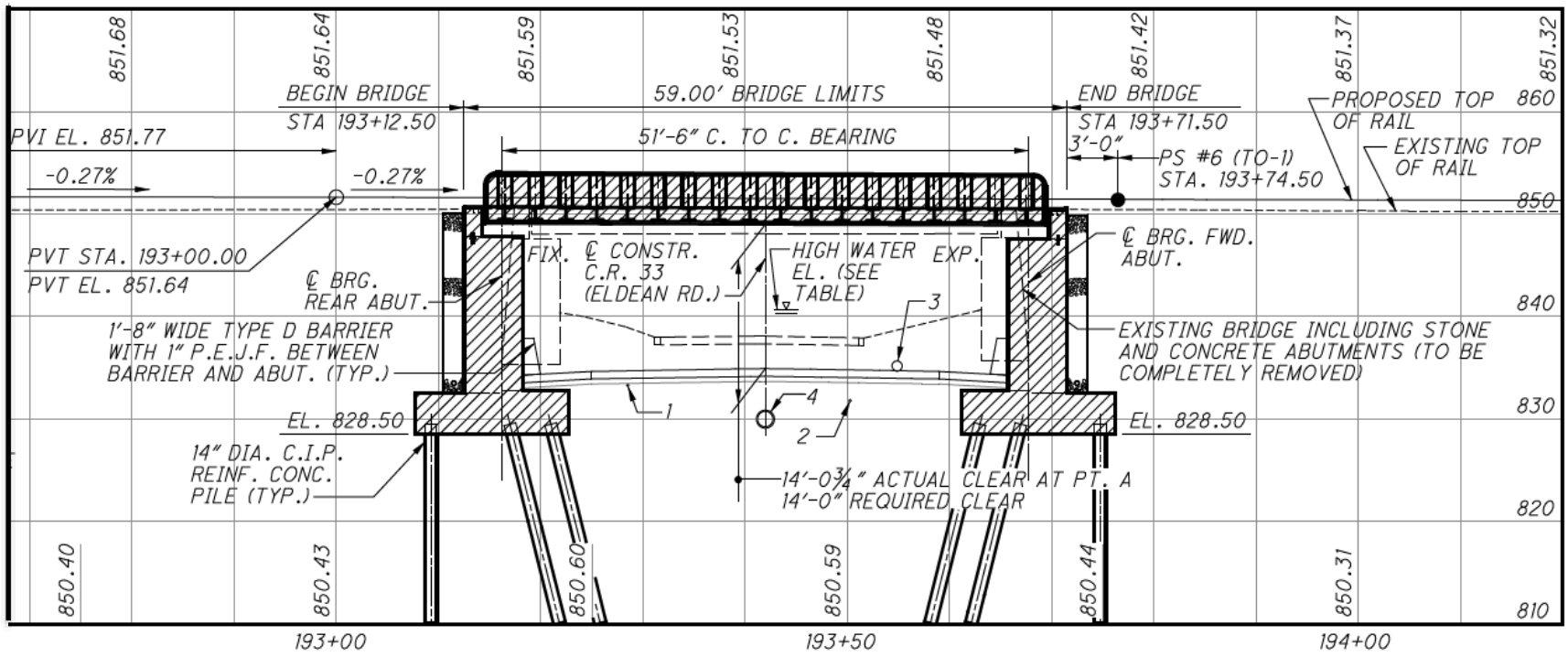
Proposed Structure

- Track can be closed during offseason
- Bridge need to be built in one season
- Bridge need to provide for 14’-0” Vertical Clearance
- Innovation need to be approved by CSX
- Track Turnouts need to be outside bridge limits- will affect the bridge width and therefore the bridge cost
- Bridge need to be designed for E80 loading

Proposed Structure - Geometrics

- Span: 51.5 feet
- Alignment: Tangent
- Track is low speed with 0.27% grade
- Vertical Clearance: ***14'-2 5/8"*** – 14'-0" required
- Substructure:
  - CIP Full Height Concrete Abutments
  - Supported on 14" CIP Reinforced Concrete Piles

Proposed Structure - Geometrics

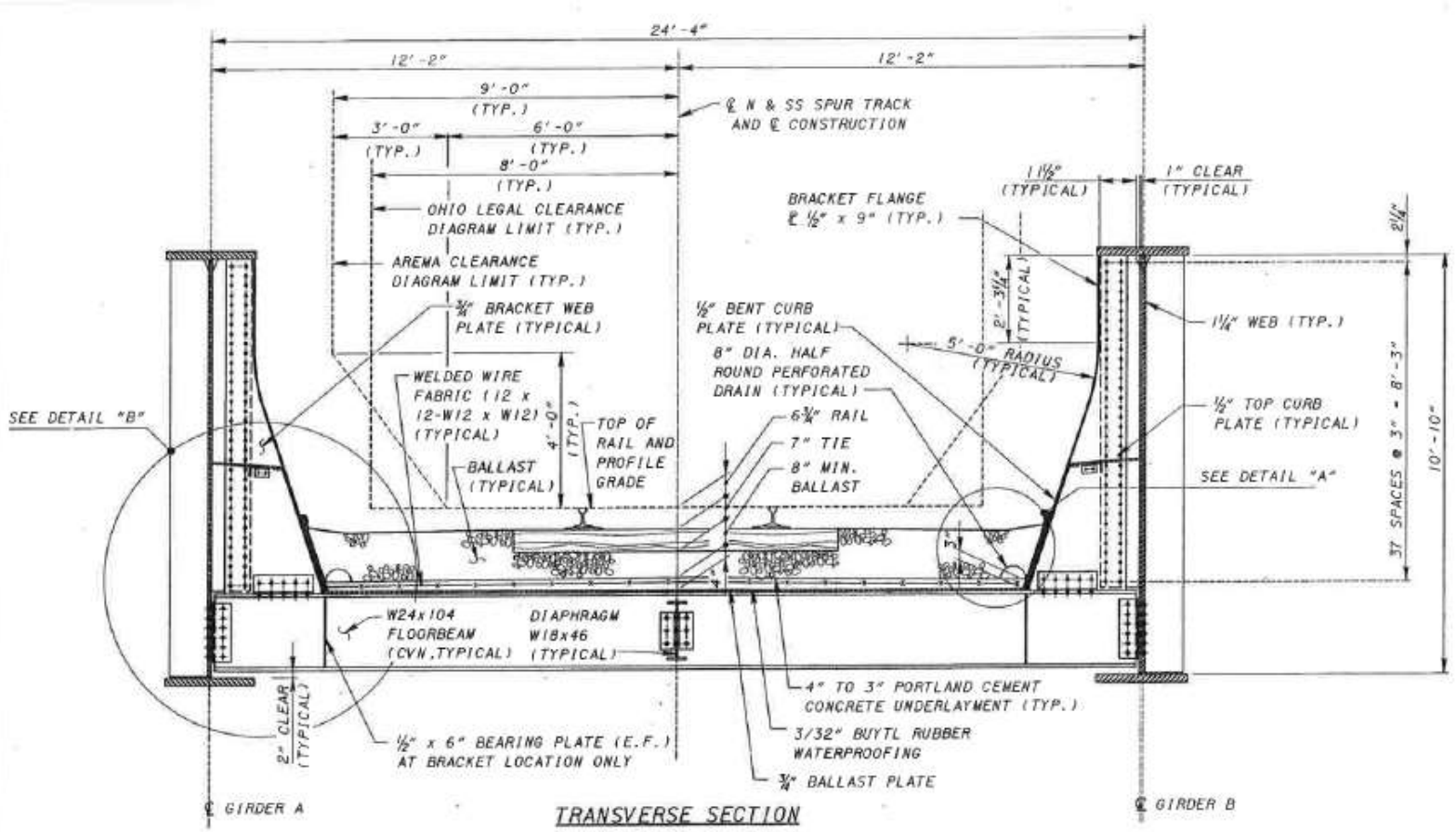


ELEVATION

Replacement Methods Alternates Studied - Superstructure

- Ballasted Deck Bridge (RR Preferred):
  - **Through Girders:**
    - Two Thru Steel Plate Girders placed 24 ft. apart with closely spaced (approximately 2 ft center to center) transverse floor beams, and a steel floor plate to create a trough retaining the ballast supporting the track ties and rails.
    - Structure Depth from Top of Track = 4.25 feet

Proposed Structure – Ballasted Deck Bridge



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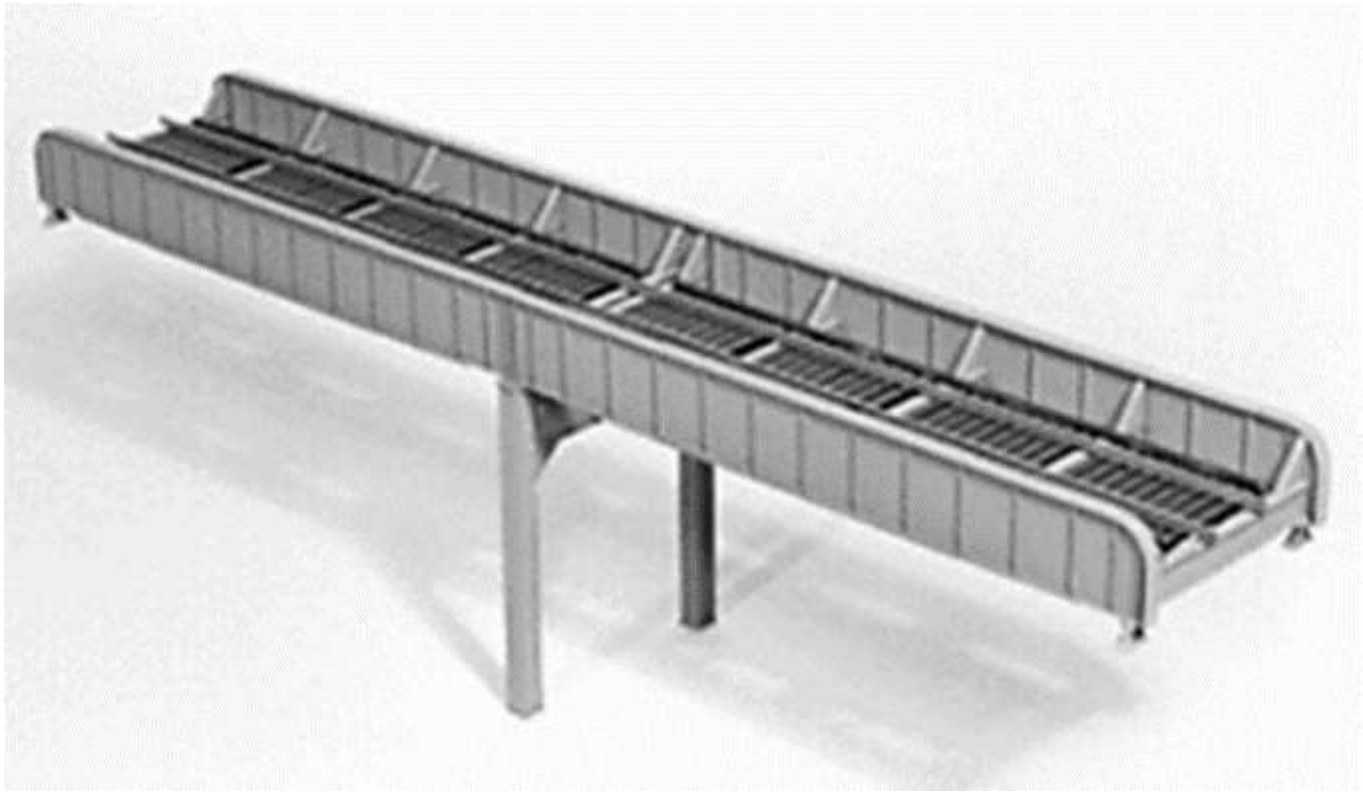

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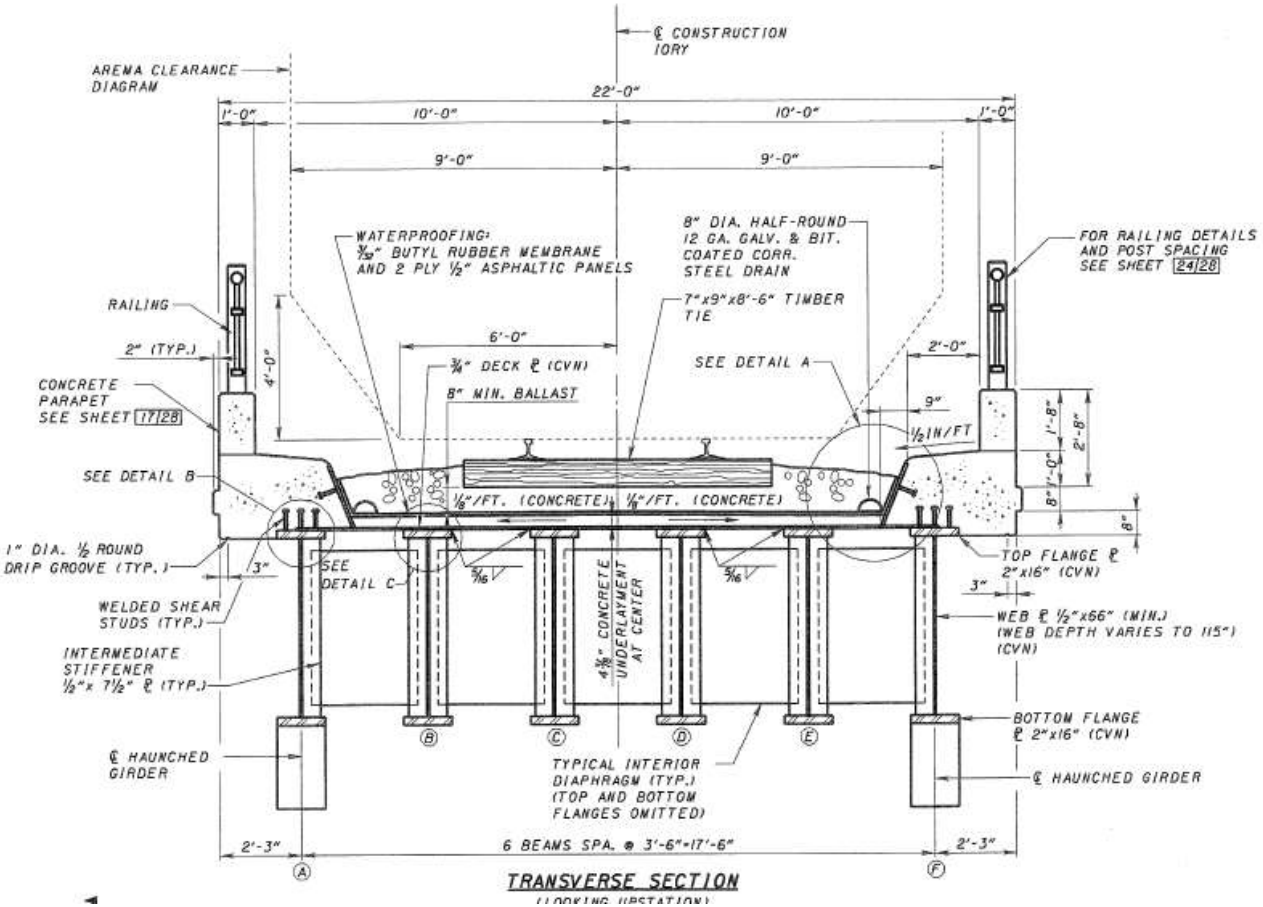
    - Structure Depth from Top of Track = 4.25 feet
  - **Multiple Girders:**
    - Multiple Plate Girders spaced 3.5' ft. apart with 4 girders under the track.
    - Structure Depth from Top of Track = 6 to 7 feet

Proposed Structure – Multiple Girders



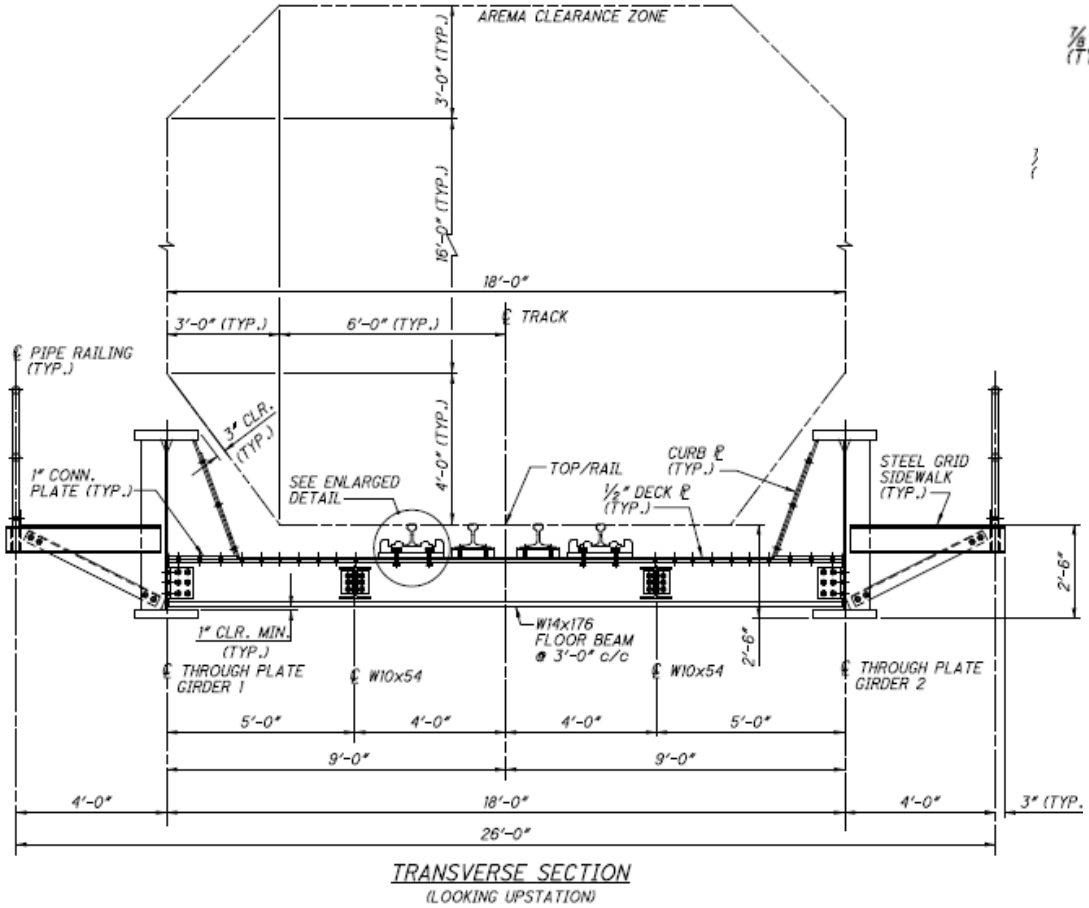
Replacement Methods Alternates Studied - Superstructure

- Innovation: With the limitation on lowering CR33, we needed a design that truly minimize structure depth

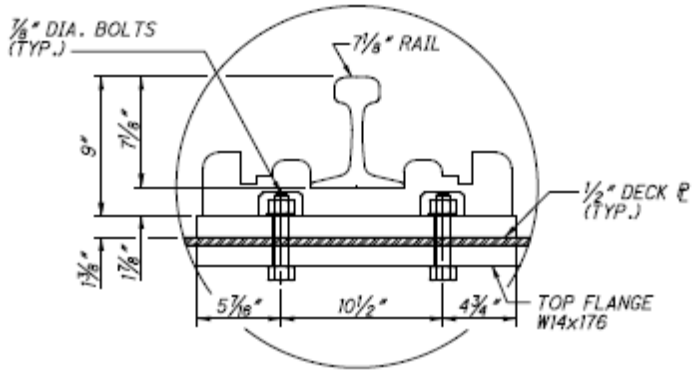
  - **Direct Fixation:**

    rail fastening systems that are attached to the structure using either cast-in-place or post-installed fasteners or anchors.
    Direct fixation is used in tunnel inverts, bridge decks, concrete crossings, and slab on grade track sections.

Proposed Structure: Direct Fixation Alternate - Stage 1 Plans

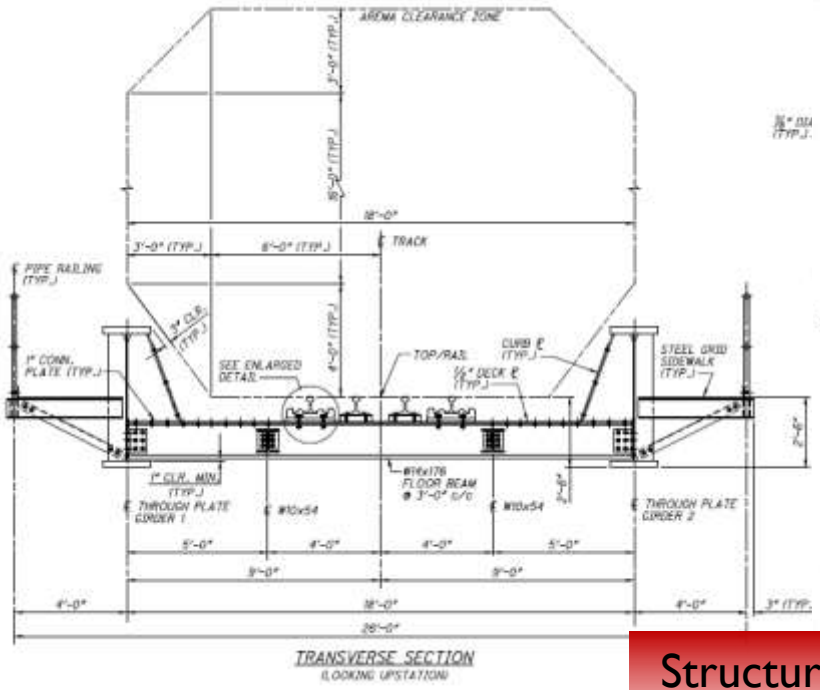


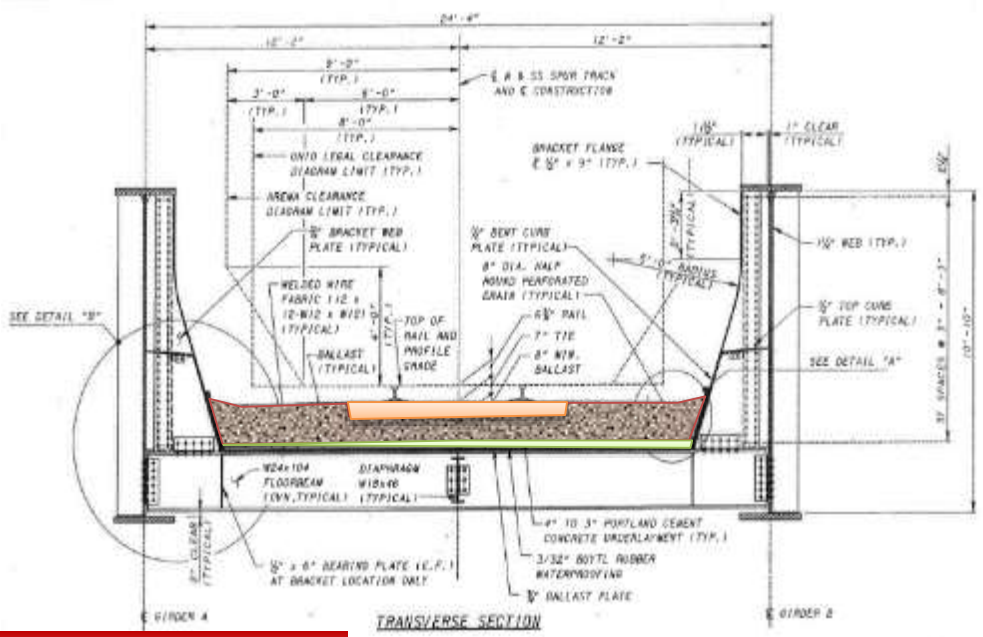
TRANSVERSE SECTION
(LOOKING UPSTATION)



DIRECT FIXATION DETAIL

Proposed Structure: Direct Fixation Alternate - Comparison



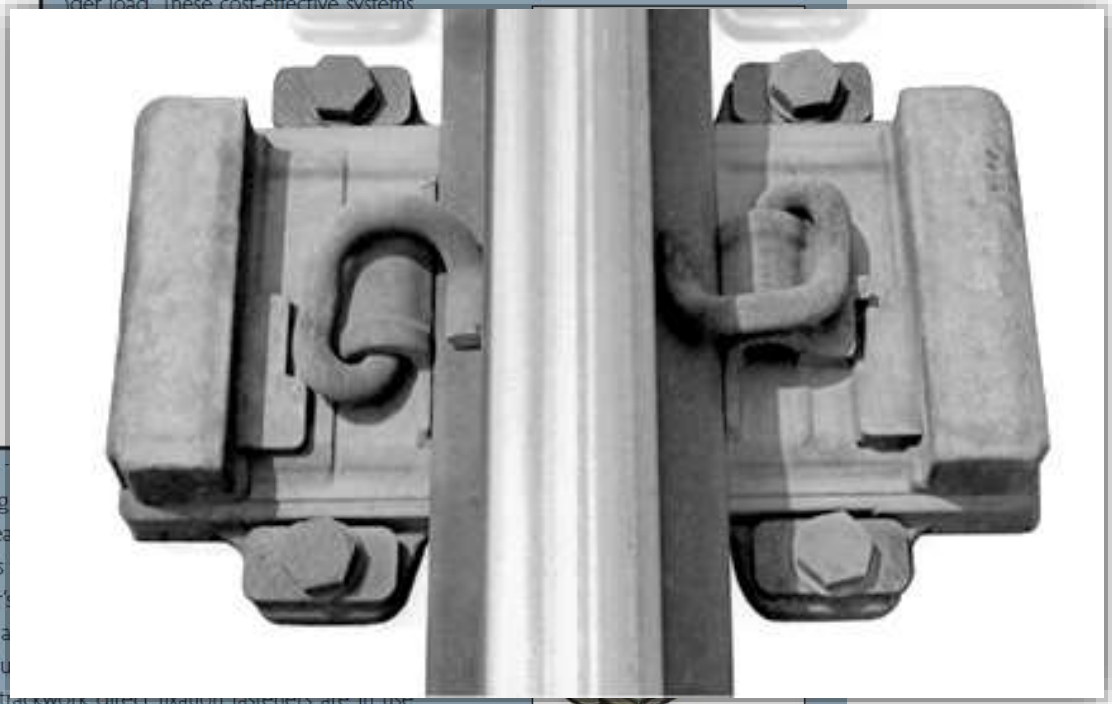


Structure Depth Savings
= 19" (1'-7")

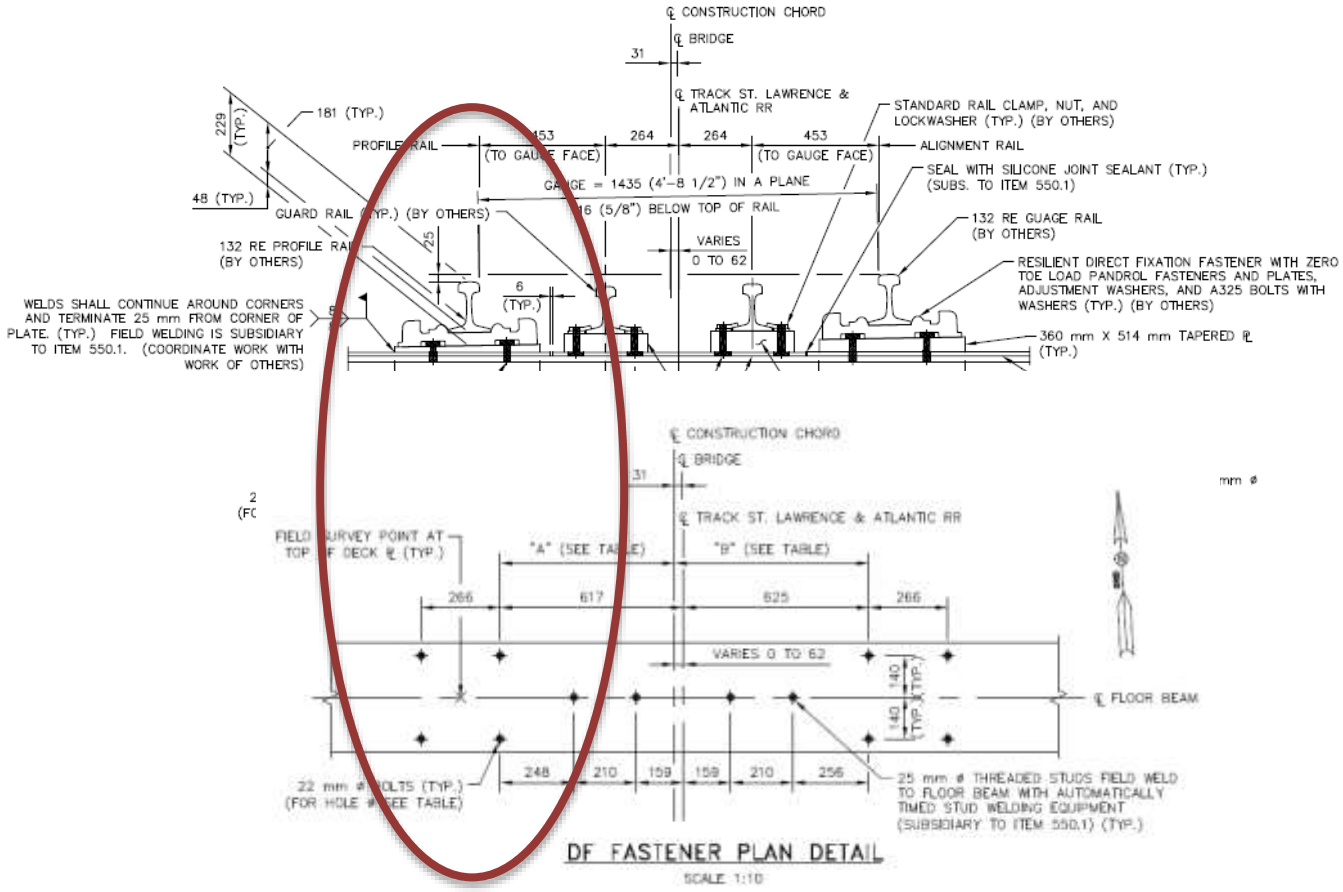
Direct Fixation

Ballasted Deck

Proposed Structure: Direct Fixation Alternate - Stage 1 Plans



Proposed Structure: Direct Fixation Alternate - Stage 1 Plans



Replacement Methods Alternates Studied - Superstructure

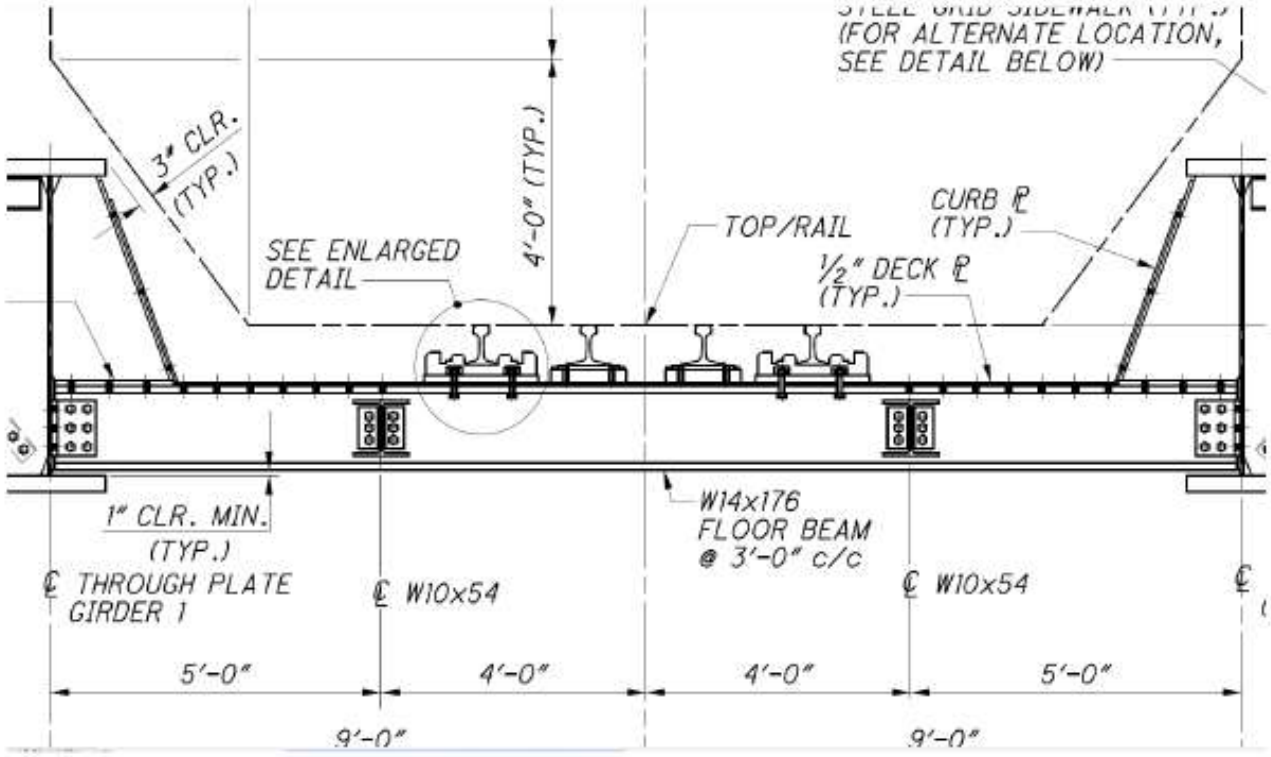
- Innovation: **Pre-Stage 1 Meeting** with CSX/HDR to discuss Project, Funding and Design Approach
  - **Direct Fixation:**
    - Regarding the newly proposed direct fixation bridge, the designers felt that it was good application of this type of bridge given that there was a low number of train traffic traveling at a low speed to serve the current grain facility. Also, there will be a profile raise of 1 FT above the existing track on the north side of the bridge.
    - More discussions about the direct fixation bridge will be needed with HDR and CSX as this type of bridge not generally approved for replacement since future maintenance is a concern, different equipment is needed to maintain, different fasteners, surfacing, etc.

Preliminary Plans - Superstructure

- Proceed with the Direct Fixation Preliminary Design
- Stage 1 Submittal Review Comment
  - **Direct Fixation Comment:**
    - The plan shows the direct fixation of the track to the deck. We understand there is still a question if the direct fixation will be approved. Other track standards would apply if it is determined that the direct fixation is not approved. An alternate timber open deck is preferred and is recommended for development.
  - **CSX hesitated on the use of Direct Fixation on their Tracks**

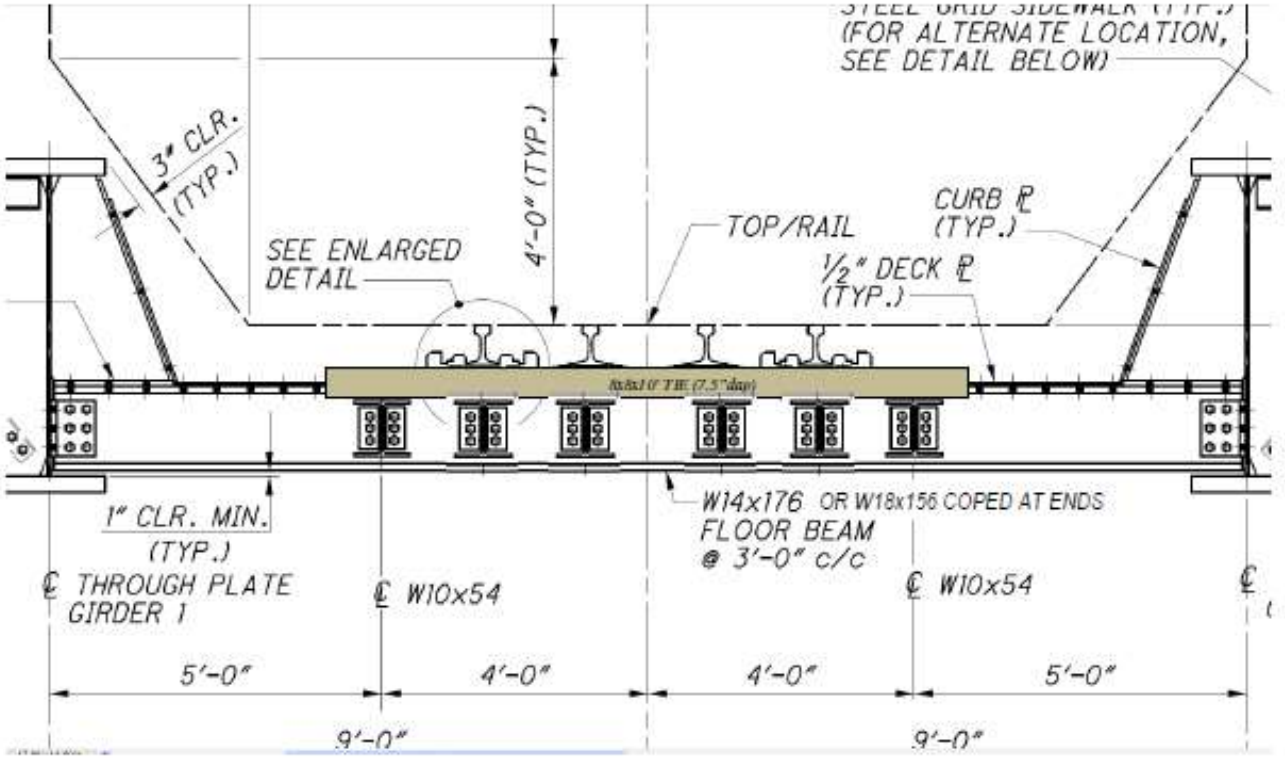
    - Time to explore the Alternate Timber Open Deck Alternative

Preliminary Plans - Superstructure



OPTION 1: DIRECT FIXATION STEEL DECK

Preliminary Plans - Superstructure



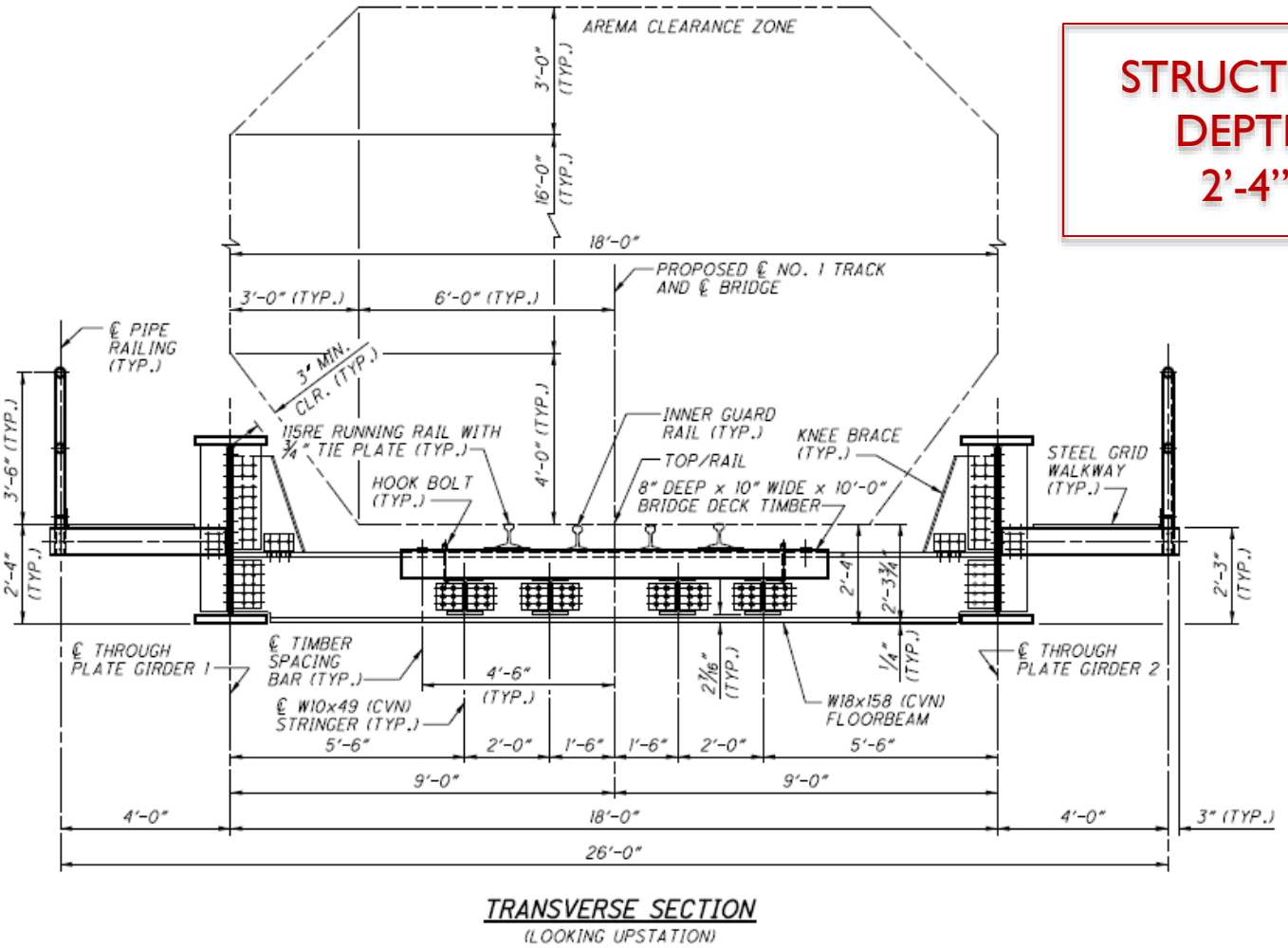
OPTION 2: TIMBER OPEN DECK

Preliminary Plans - Superstructure

- Worked with HDR/RR/Korda/County to use the following Alternative
  - **Open Deck Alternative:**
    - Allowed by AREMA.
    - CSX does not have a design criteria for open deck bridges
    - Design and Details will need to follow AREMA specification
    - Drainage on the structure will need to be collected on the road below

    - One **advantage of ballasted decks** is that they make it easier to keep the track across the bridge in surface (vertical alignment) with the tracks to either side when the MOW forces clean or add ballast.

Final Plans - Superstructure

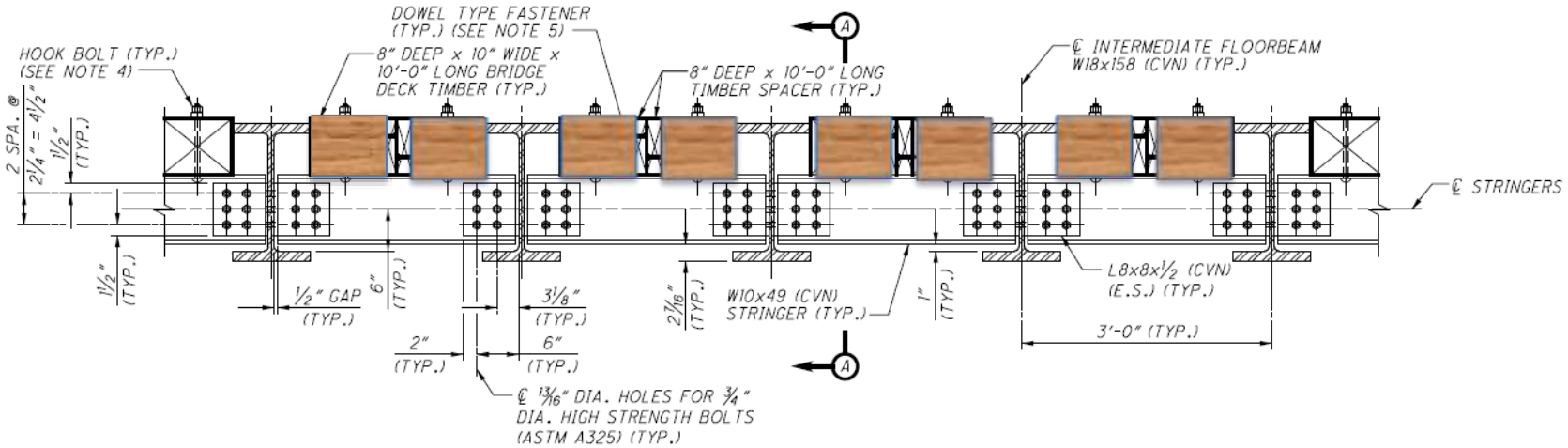


TRANSVERSE SECTION
(LOOKING UPSTATION)

STRUCTURE DEPTH 2'-4"

Final Plans - Superstructure

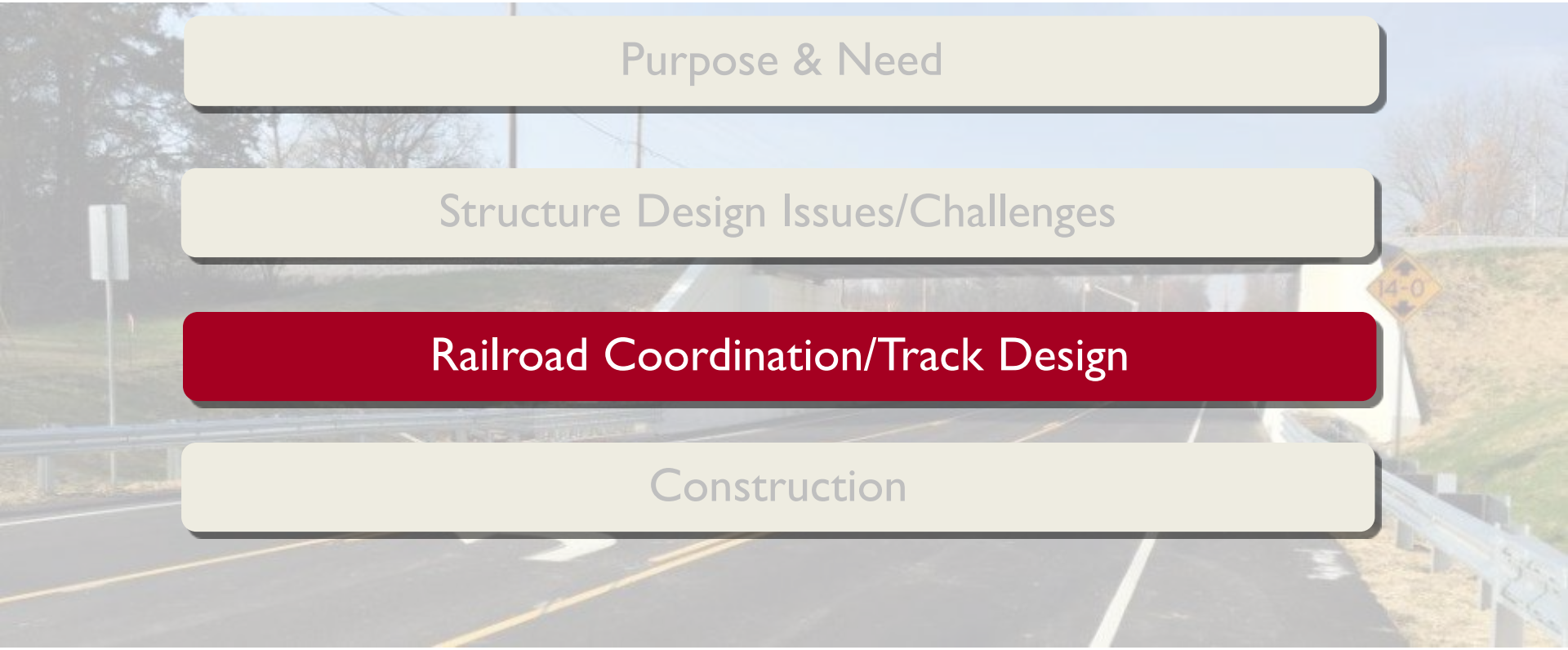
Final Plans - Superstructure



STRINGER TO INTERMEDIATE FLOORBEAM CONNECTION DETAIL

Tom Taylor, PE

Railroad Coordination - TranSystems



Track Design
Preliminary Engineering Design

- Suggested Raising the Rail Elevation approx. 3.25 ft.
- Four Alternatives Presented
  - Reconfigure tracks at the North end of the existing yard
  - Build Additional Tracks accessed from North end of existing yard
  - Build Additional Tracks on the South side of the bridge
  - Relocate the rail yard to the south side of the bridge
    - Add a Conveyor from the new yard to the existing elevator

Track Design
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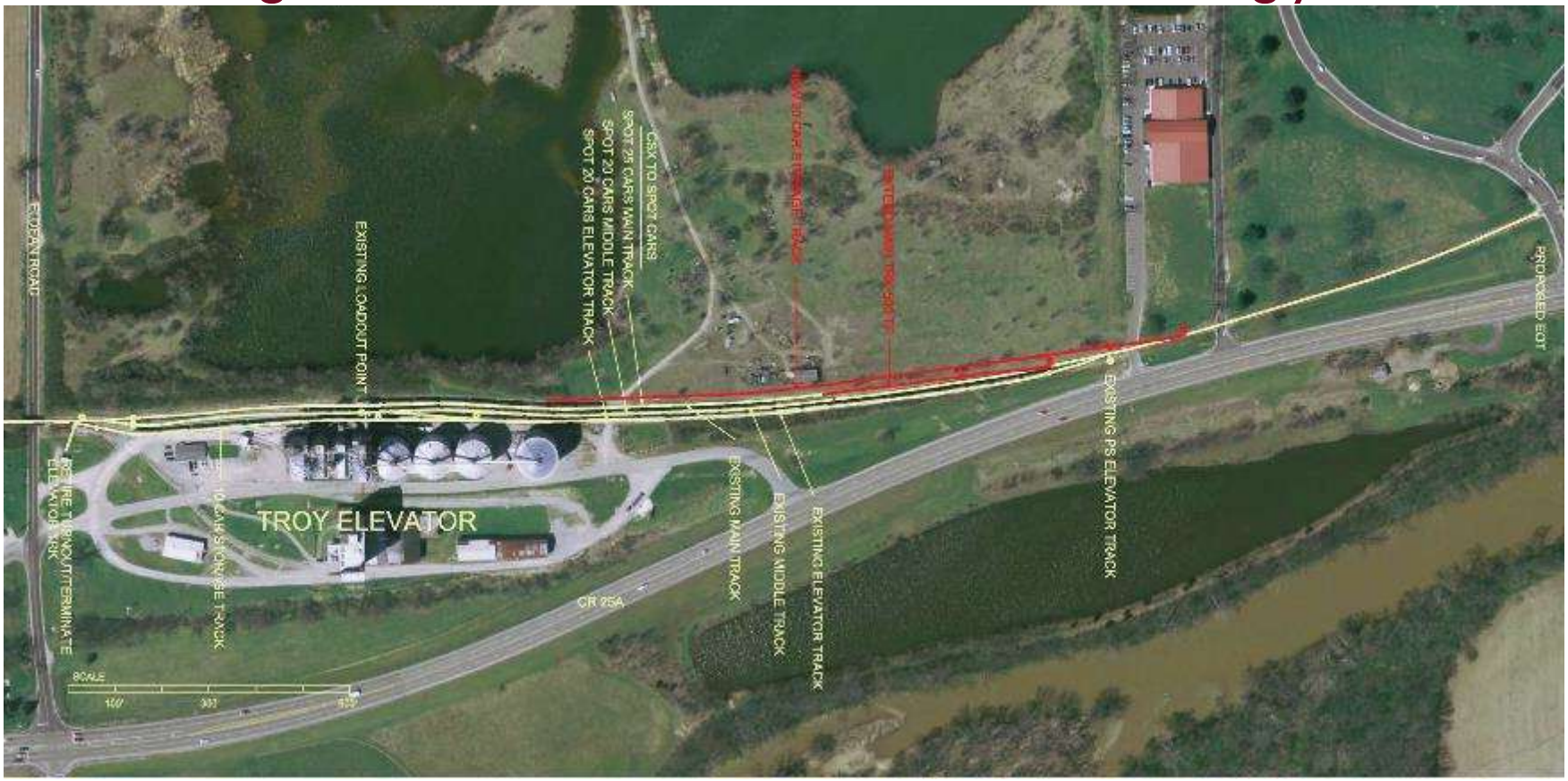

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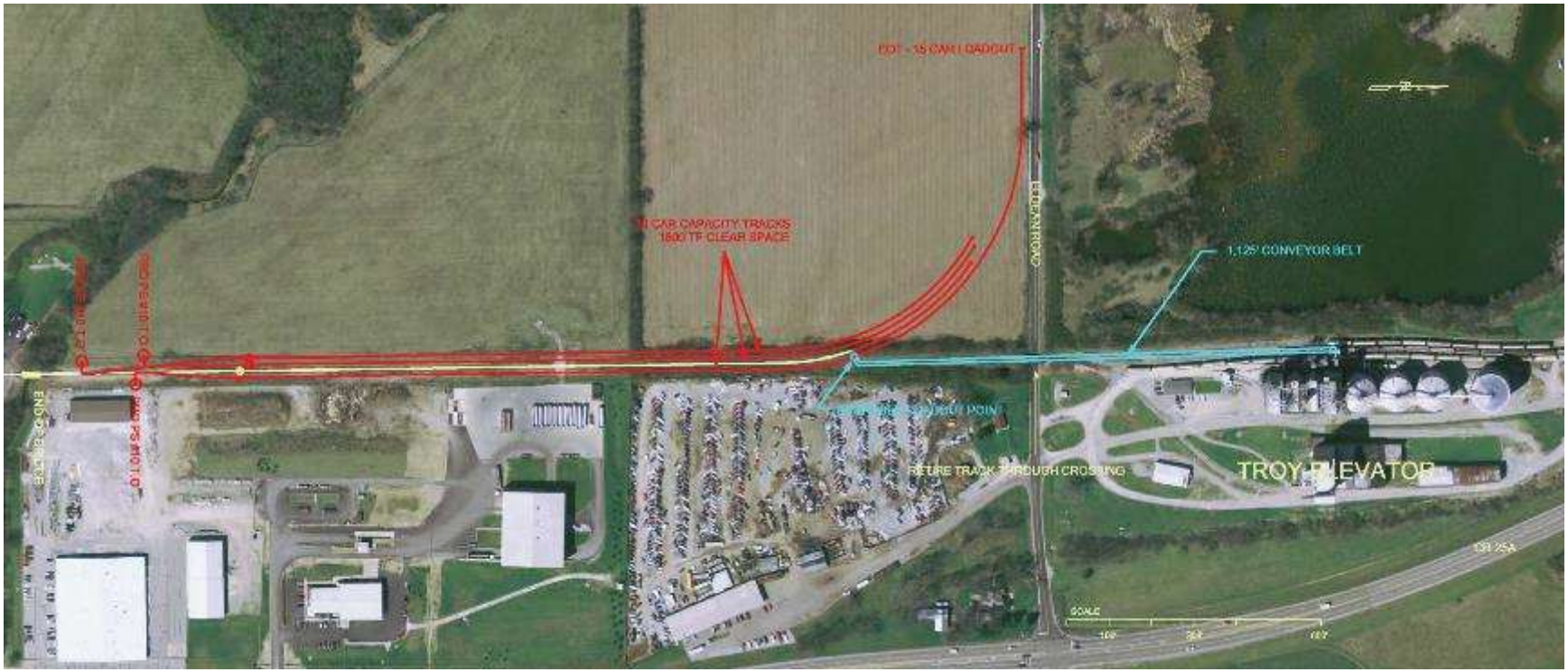


Track Design
Preliminary Engineering Design

- Suggested Raising the Rail Elevation approx. 3.25 ft.
- Four Alternatives Presented Required
  - Significant reconfiguration to the Rail Yard and Operations
  - Extreme Lengths of New Trackwork
  - Property Acquisition of a known Superfund Site
    - 32,000 CY of Crushed Battery Cases had been discovered
  - Increased Rail Traffic Blocking Hospital Emergency Access Roadway
  - Extreme Costs to maintain existing Capacity and Function

Track Design

- Preliminary Engineering Study Alternatives were Unacceptable
- Change in Top of Rail Elevation must be Minimized
- Bridge Group Investigated Structure Types to Decrease Structure Depth
- Roadway Group Investigated Lowering the Roadway Profile

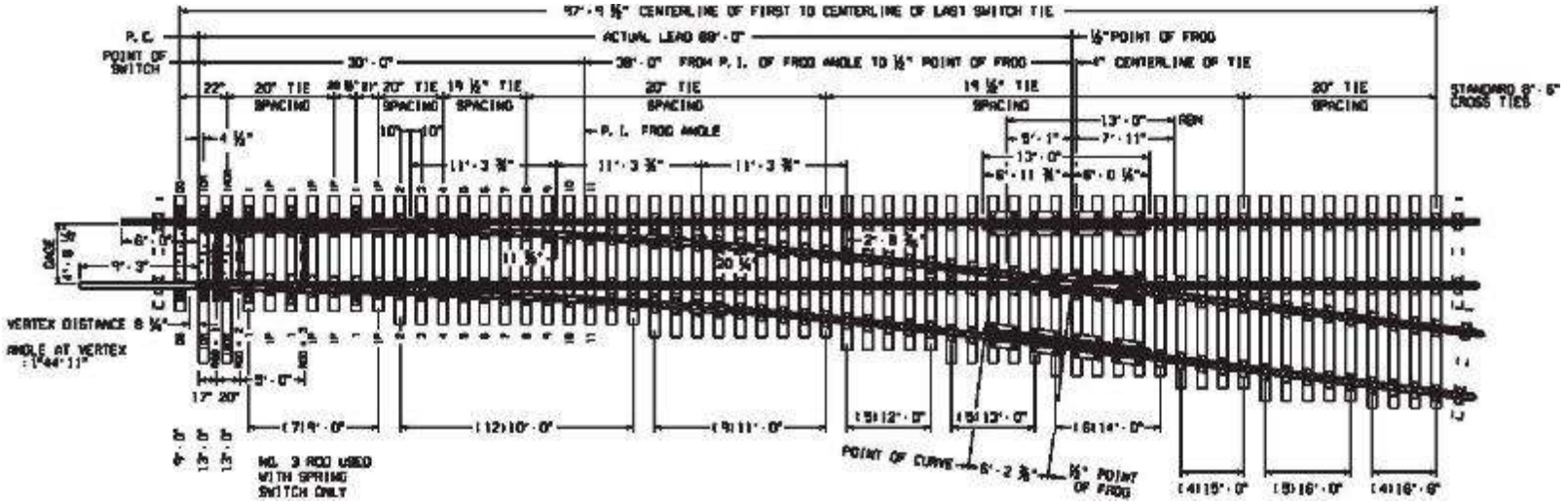
- **Final Track Raise = 1 Foot**
- TranSystems Rail Team gets to Work!

Track Design

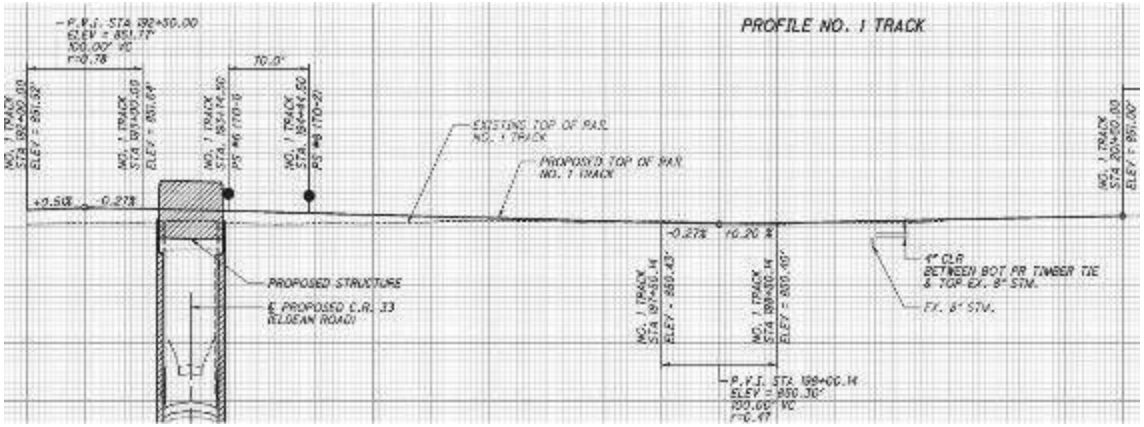
- Operations
  - Empties
    - Tracks1, 2 & 4
  - Loading (From South)
    - Tracks 2 & 3
  - Fulls
    - Tracks 1, 2 & 3
- Existing Operations had Empty Cars on Vertical Grade

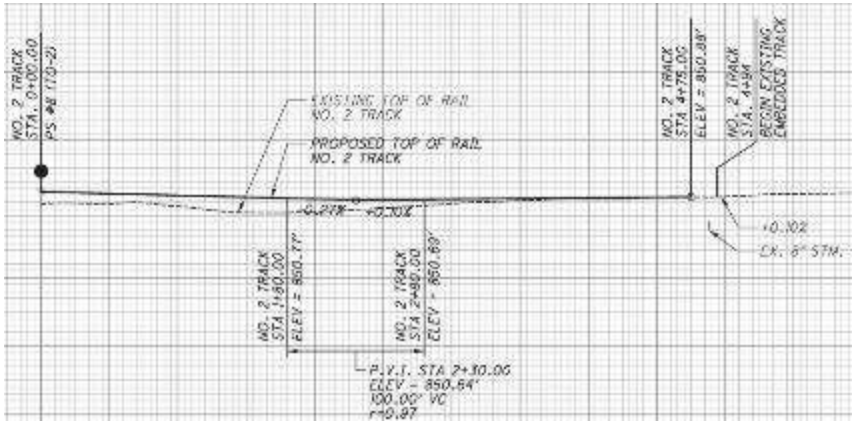
Track Design Constraints

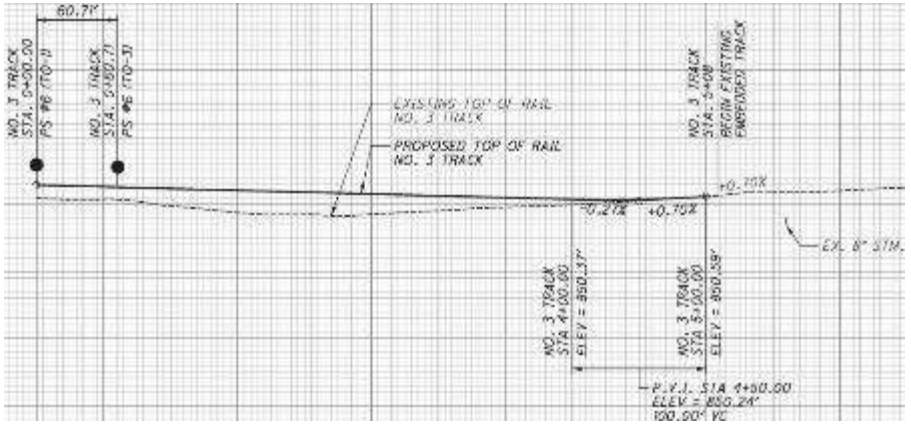
- Any Single Rail Car curving in Two Separate Directions Simultaneously will result in Two Separate Trains moving Independently from Each Other.
  - Minimum Vertical Curve Length = 100 ft. (2 Cars)
  - Minimum Tangent Between Curves = 100 ft. (2 Cars)
- Car Loading and Storage Track Must be Flat < 0.1% grade Maximum
- No Vertical Curves within Track Turnouts



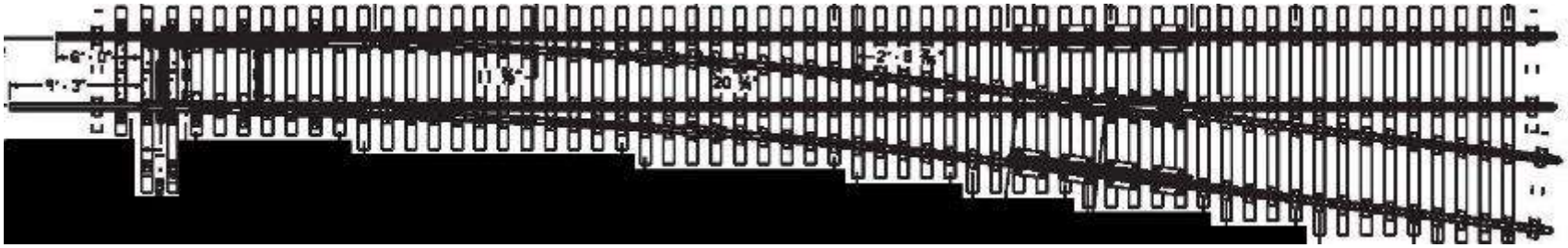
Track Design
Profiles

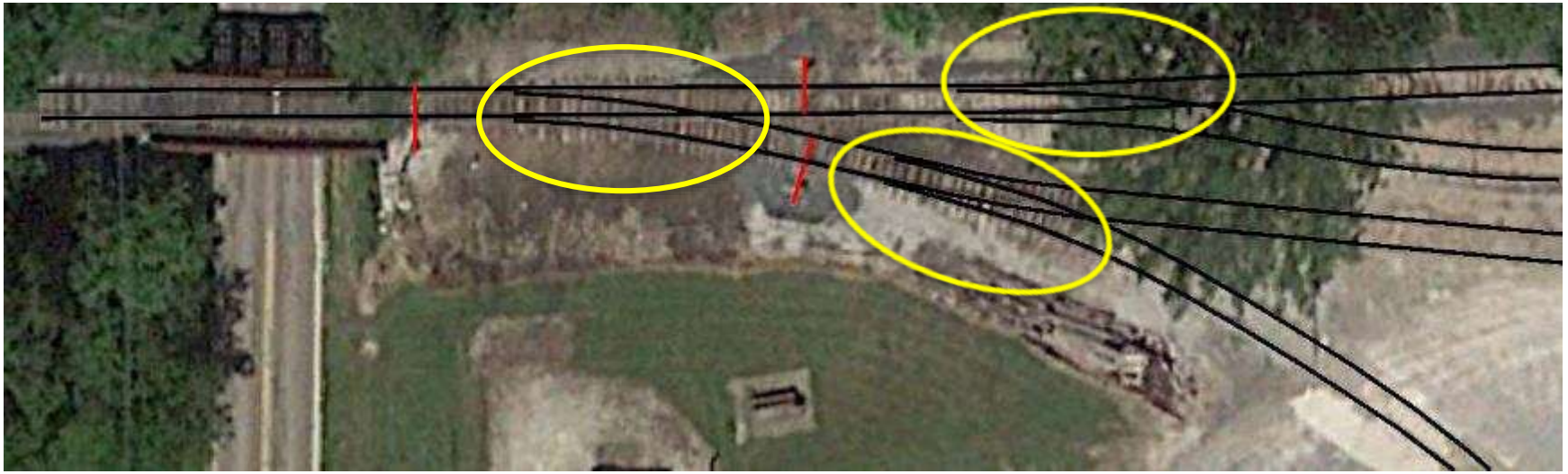






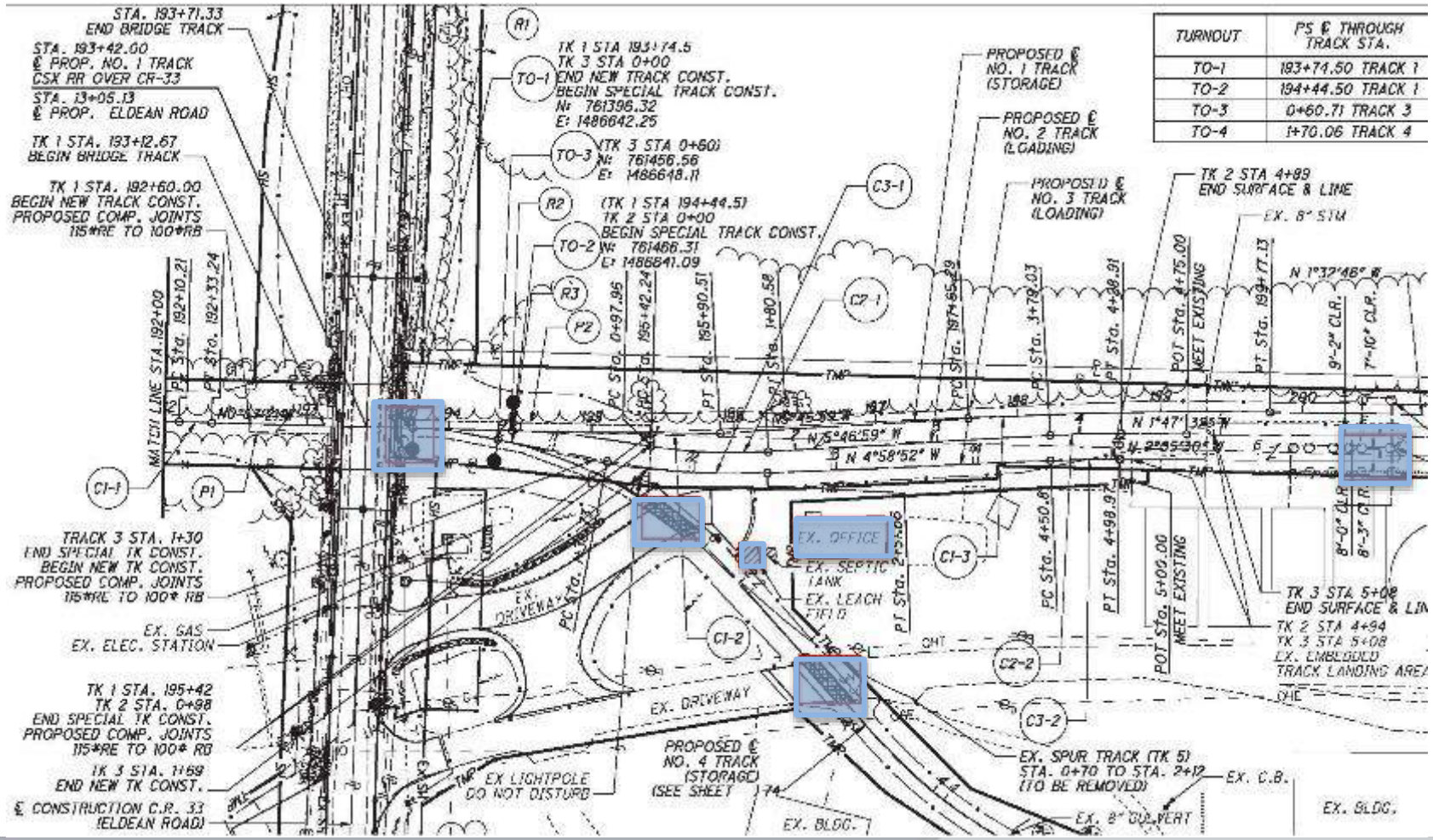
Track Design Solutions





Track Design Solutions

Track Design Constraints



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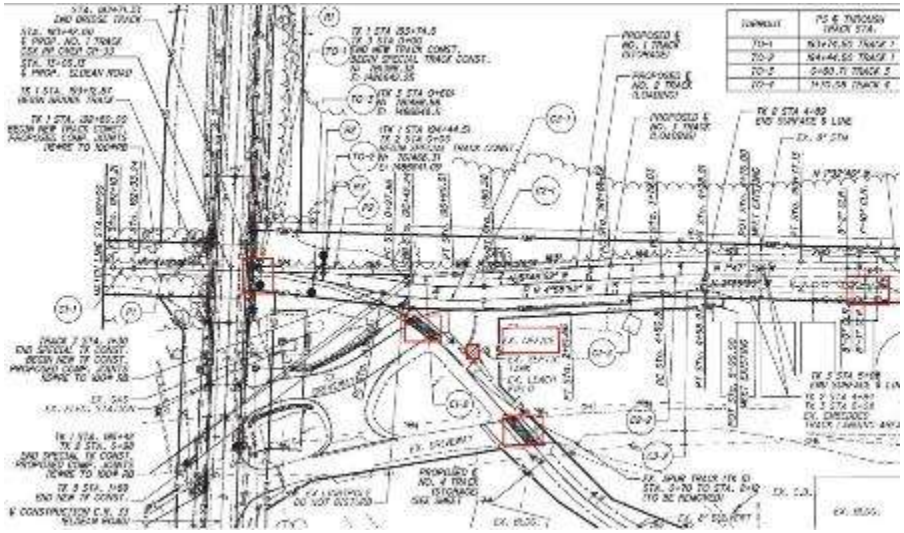
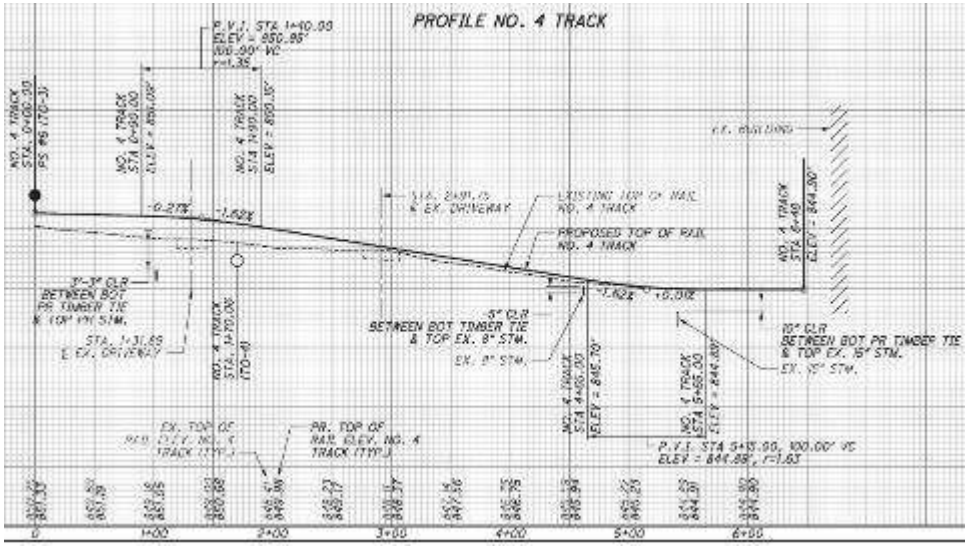
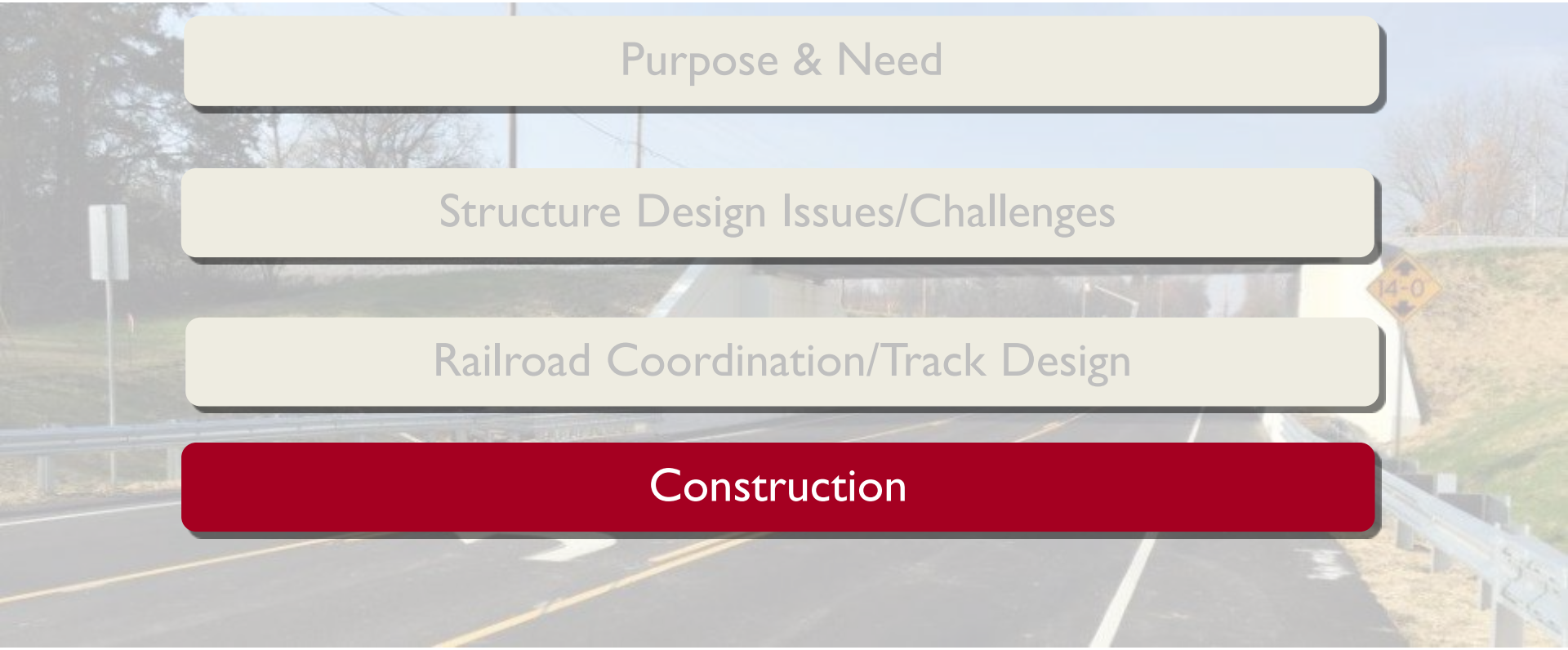




Brooks Vogel, PE



Construction

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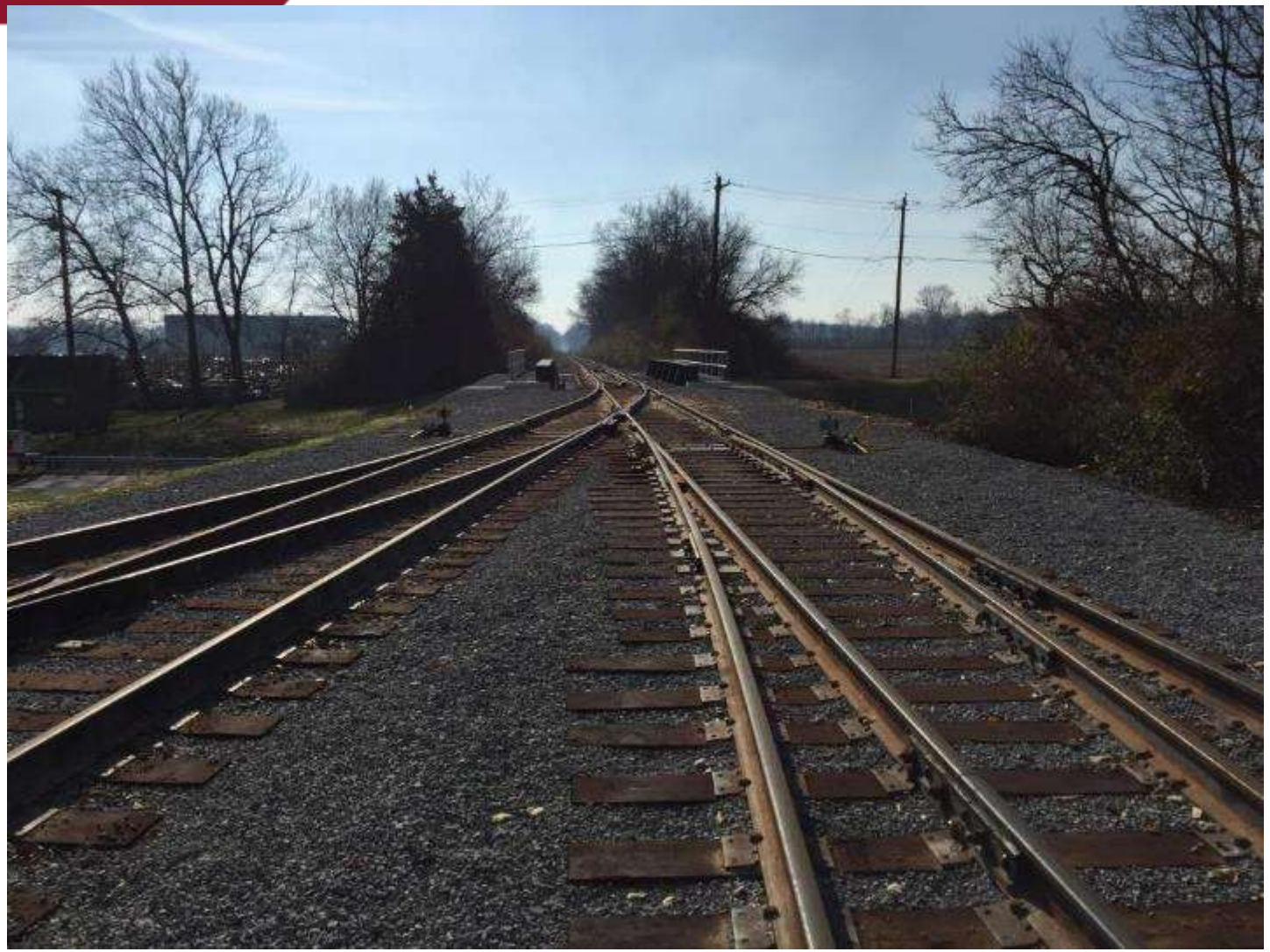

Construction

Construction

Results

- The Players:
  - Miami County
  - KORDA
  - TranSystems
  - CSX
  - HDR
  - ODOT
  - CEAO
  - MVRPC

- Communication and Trust
- Everyone Communicated, Everyone Benefitted