ABCD Central Ohio Virtual Luncheon Series

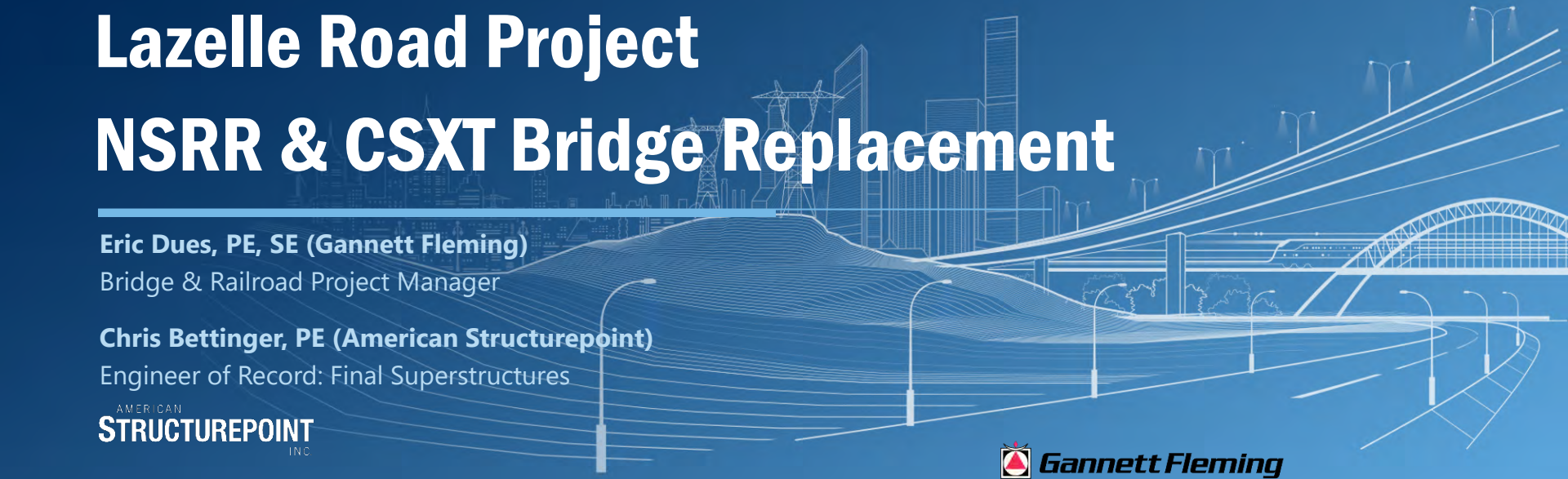
# City of Columbus
# Lazelle Road Project
# NSRR & CSXT Bridge Replacement

**Eric Dues, PE, SE (Gannett Fleming)**
Bridge & Railroad Project Manager

**Chris Bettinger, PE (American Structurepoint)**
Engineer of Record: Final Superstructures

AMERICAN STRUCTUREPOINT INC

**12/16/2020**



Gannett Fleming

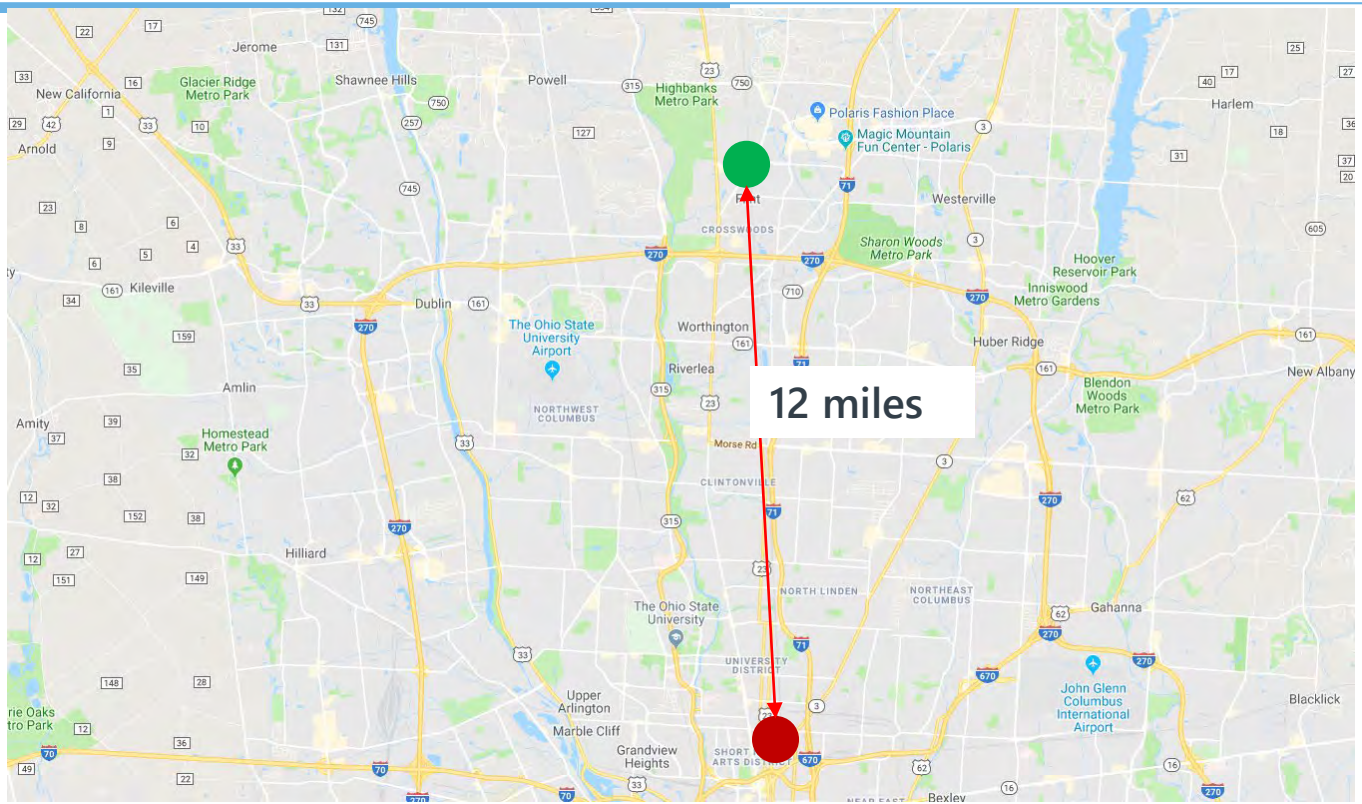
*Excellence Delivered As Promised*

ISO 9001:2015 CERTIFIED

# Where Are We?


MICHIGAN
ONTARIO
CANADA
Lake Erie
Ashtabula
Toledo
Euclid
Lorain
Cleveland
Pymatuning Reservoir
Sandusky
Bowling Green
Parma
Elyria
Fremont
Strongsville
Warren
Defiance
Norwalk
Cuyahoga Falls
Kent
Youngstown
Fostoria
Akron
Findlay
Barberton
Van Wert
Ashland
Alliance
Bucyrus
Wooster
Canton
Lima
Mansfield
Massillon
East Liverpool
INDIANA
Marion
New Philadelphia
Grand Lake
Bellefontaine
Campbell Hill
1549
Mt Vernon
Steubenville
Sidney
Coshocton
Greenville
Westerville
Gahanna
Newark
Cambridge
Springfield
Columbus
Zanesville
Dayton
Kettering
Beavercreek
Lancaster
Circleville
Middletown
Washington Court House
Hamilton
Marietta
Fairfield
Chillicothe
Athens
Cincinnati
Hillsboro
Jackson
WEST VIRGINIA
Gallipolis
Portsmouth
Ohio
KENTUCKY
Ironton
PENNSYLVANIA
Muskingum River

# Where Are We?



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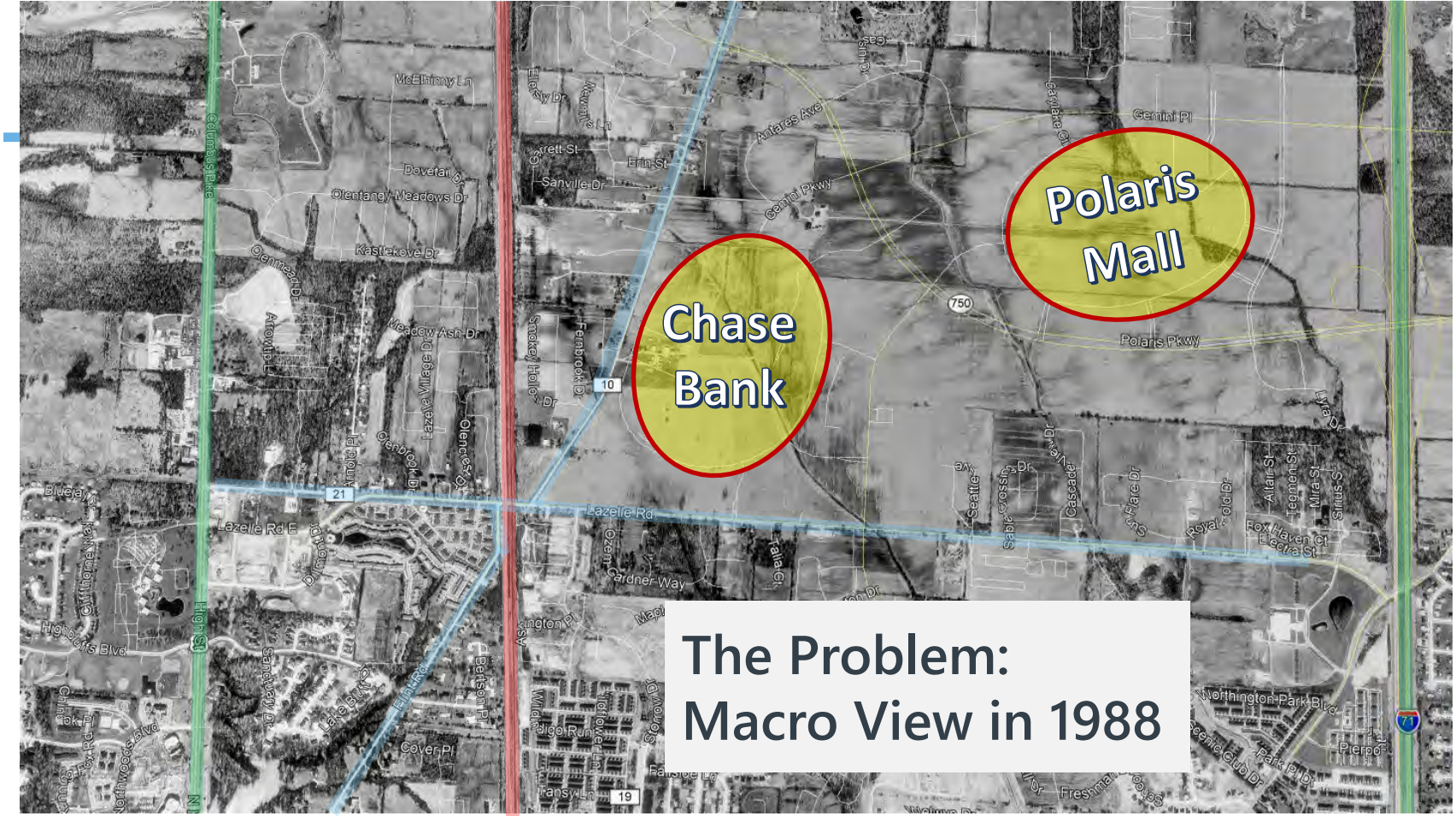
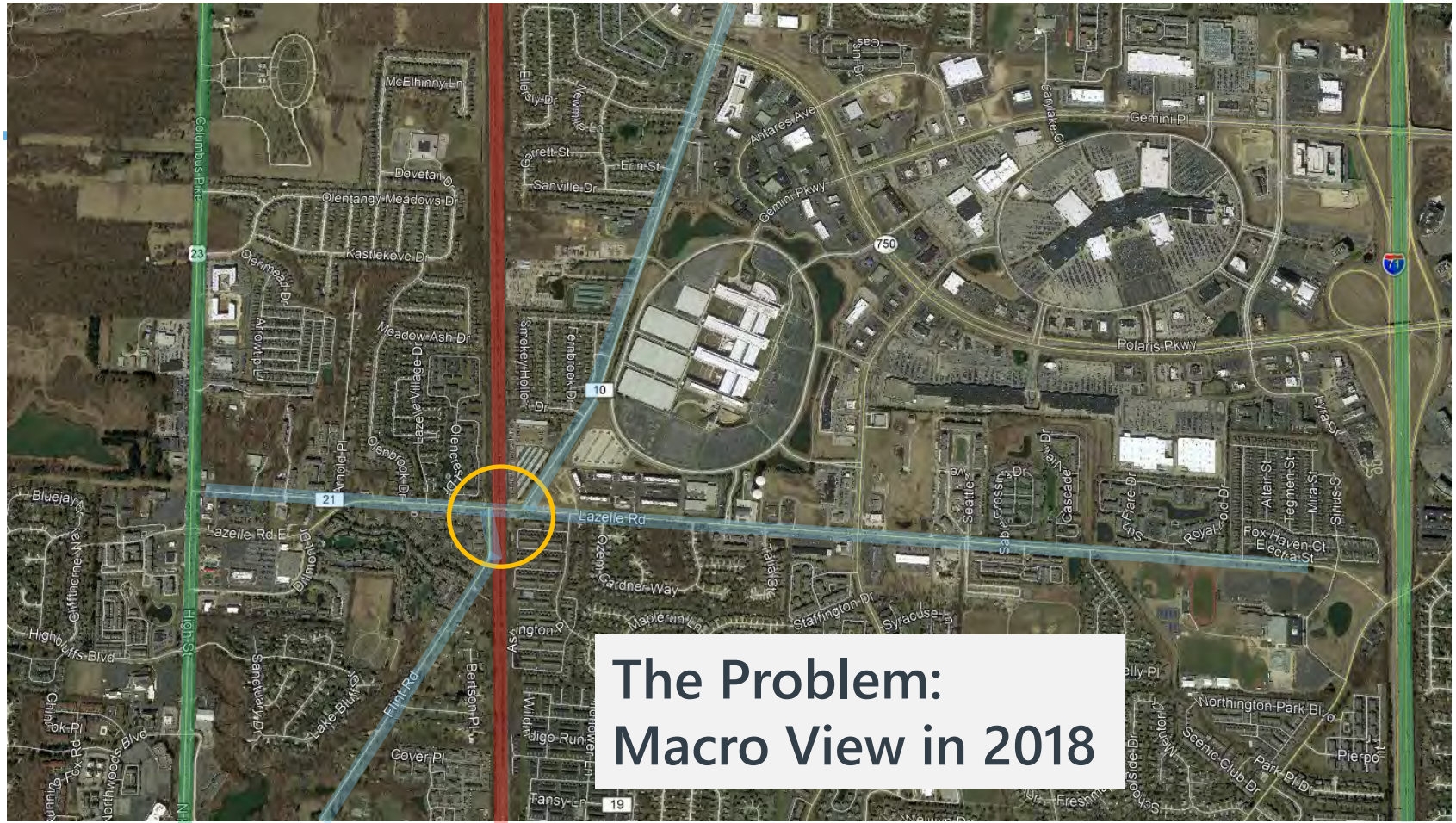
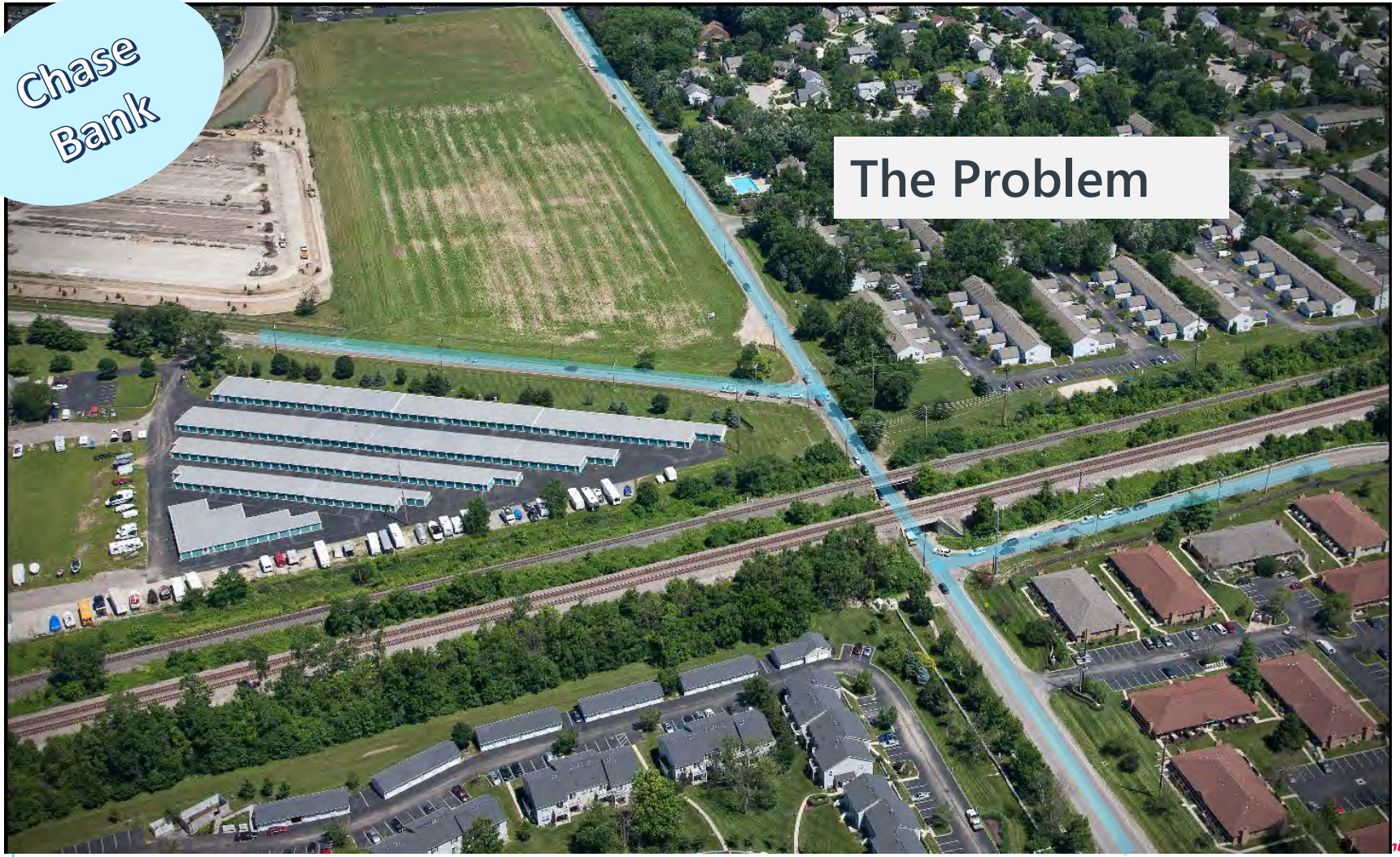



ABCD Central Ohio, 12/16/2020: City of Columbus, NSRR & CSXT over Lazelle Road




# The Problem: Macro View in 2018


Chase Bank
The Problem


# The Problem

# Getting a public project done…


Gannett Fleming

*Excellence Delivered **As Promised***

THE CITY OF COLUMBUS
ANDREW J. GINTHER, MAYOR

- **City of Columbus**:
  Project Sponsor
  Funding, and Construction Oversight
  ODOT State Rail Coordinator facilitated coordination
- **CSX (6 trains daily)**:
  Owner of single mainline track over Lazelle Road
- **Norfolk Southern (60 trains daily)**:
  Owner of dual mainline track over Lazelle Road
- **Gannett Fleming**:
  Prime Consultant (January 2012)
- **American Structurepoint**:
  Primary Subconsultant
- **Shelly & Sands**:
  Prime Contractor (June 2018)

# The Roadway Project: (The Railroad is in the way)

- Widening of the entire Lazelle Road Corridor
  - 3 Phases of Design (A/B/C)
  - Two construction contracts (B/C & A)
- Shared use paths and improved roadway geometrics
- Improved drainage
  - Shale cuts for all lowering and trunk lines
- Significant utility coordination
  - Profile decisions were sometimes driven by utilities (Chase)
- Maintenance of Traffic
  - Nearby fire station

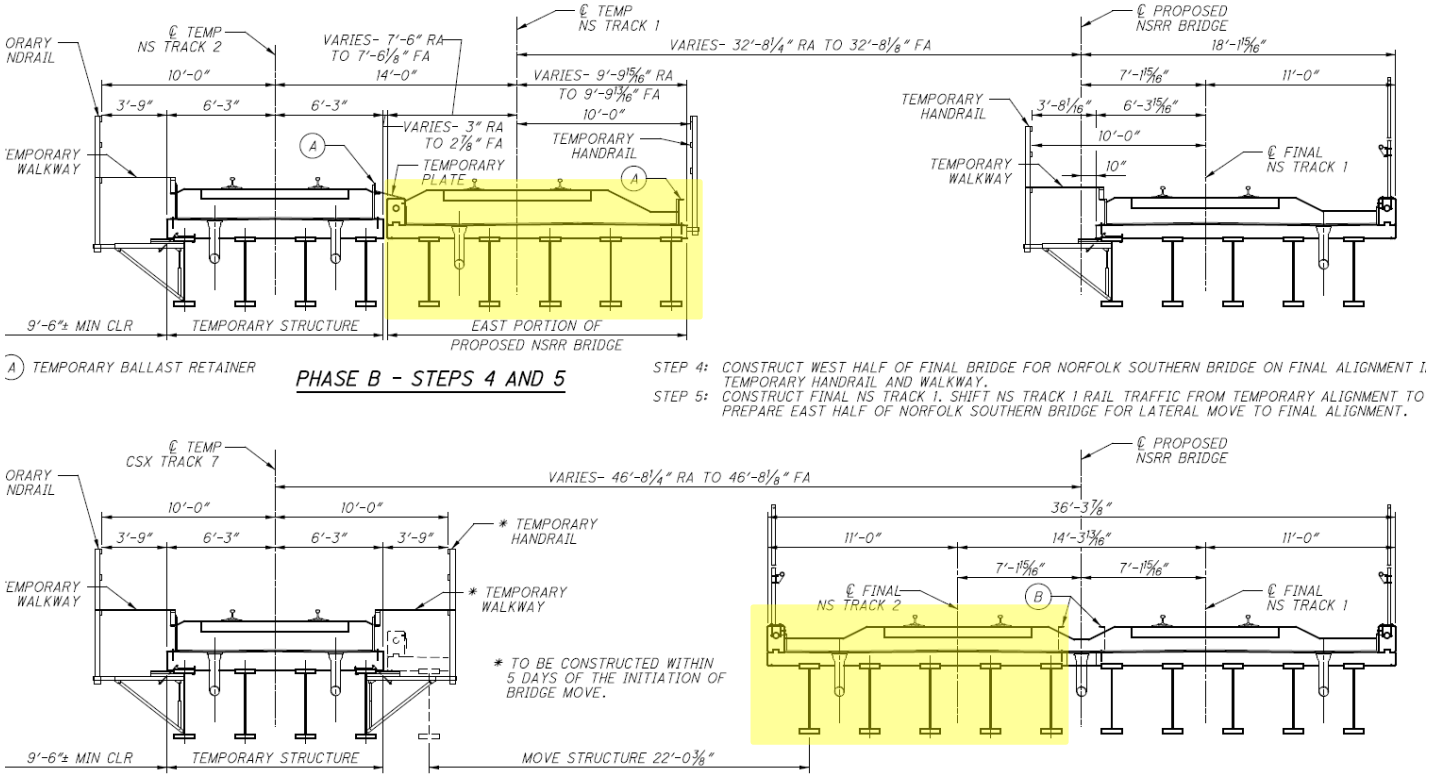
# The Roadway Project: (The Railroad is in the way)

*nised*

# The Rail Projects not constructed

- 50% Plans, No Waste:  Slide bridges into place during closures
  - 24 hour closure of both tracks on Christmas or New Years
- Stage 2 Plans, Partial Waste: Slide NSRR halves during closures
  - 24 hour closure of one track on Christmas or New Years

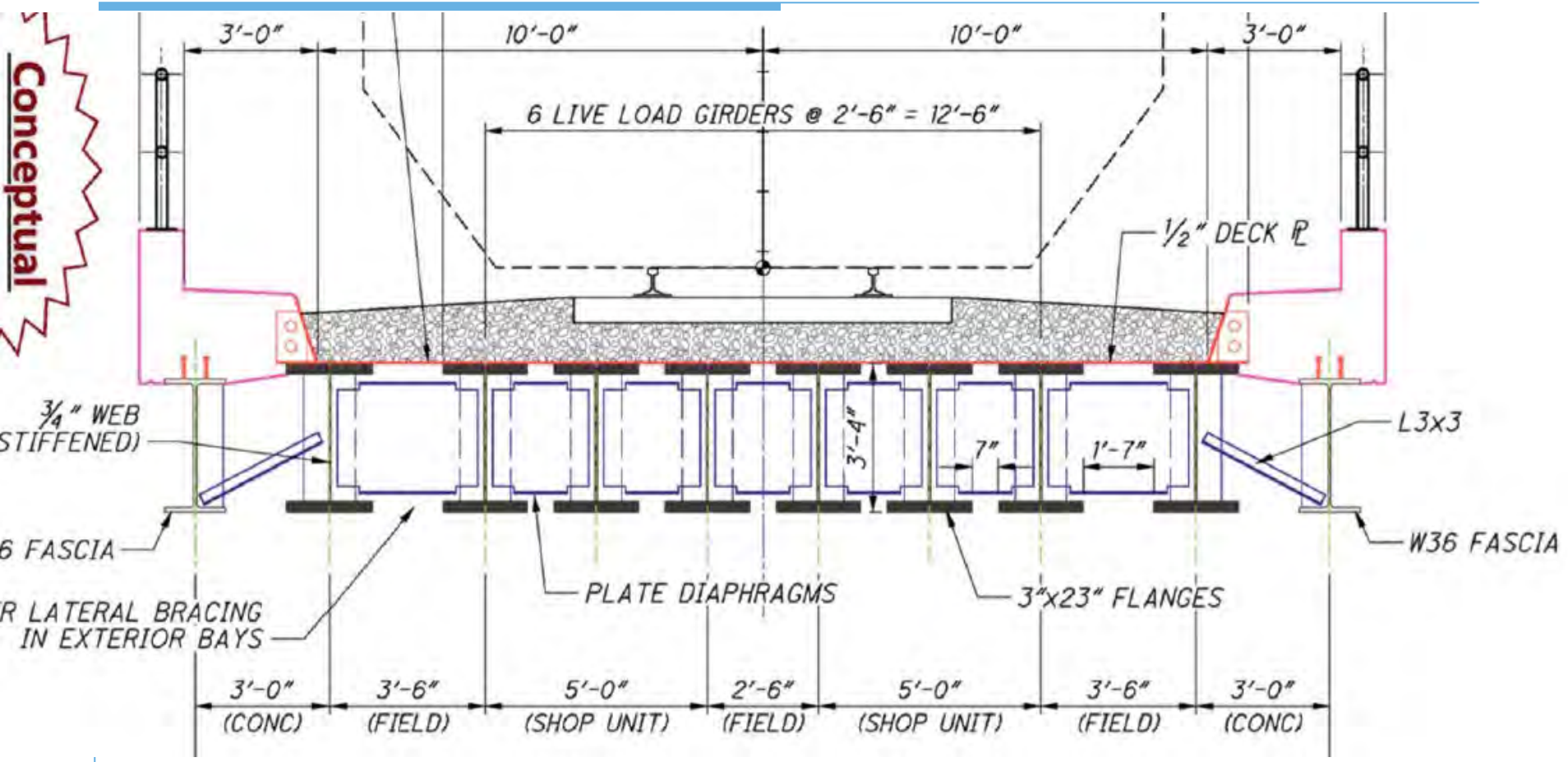
# The Rail Projects not constructed (Stage 2 Plans)



# The Rail Projects not constructed

- 50% Plans, CSX Raising: Eliminate through girder
  - At CSX request
  - Squatty 5 Girder and 6 Girder Sections designed
  - Embankment raise was ultimately deemed not acceptable by CSX

# The Rail Projects not constructed

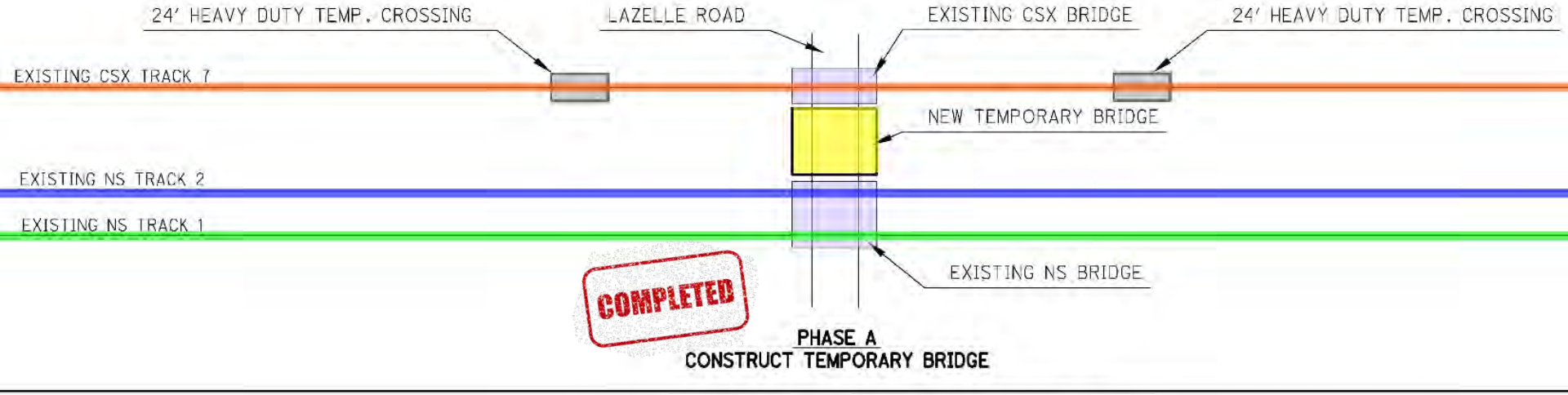


# The Rail Project being constructed

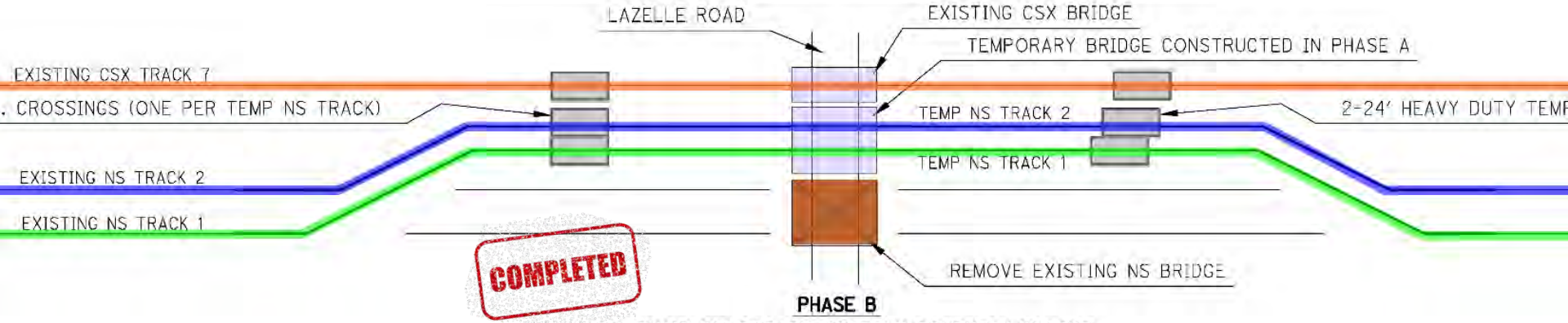
- 4 Phases of top-down construction
  - Tangent Drilled Shafts
- Full Temporary Bridge: Built in Median
  - Acceptable to all
  - Most costly temporary works
- Shoofly tracks in the median (≈ 2500’ long)
  - CSX Property
- Shoring detailed for phased removals and force reversal
  - Support existing tracks to construct median
  - Support median shoofly tracks in later stages

# The Rail Project being constructed

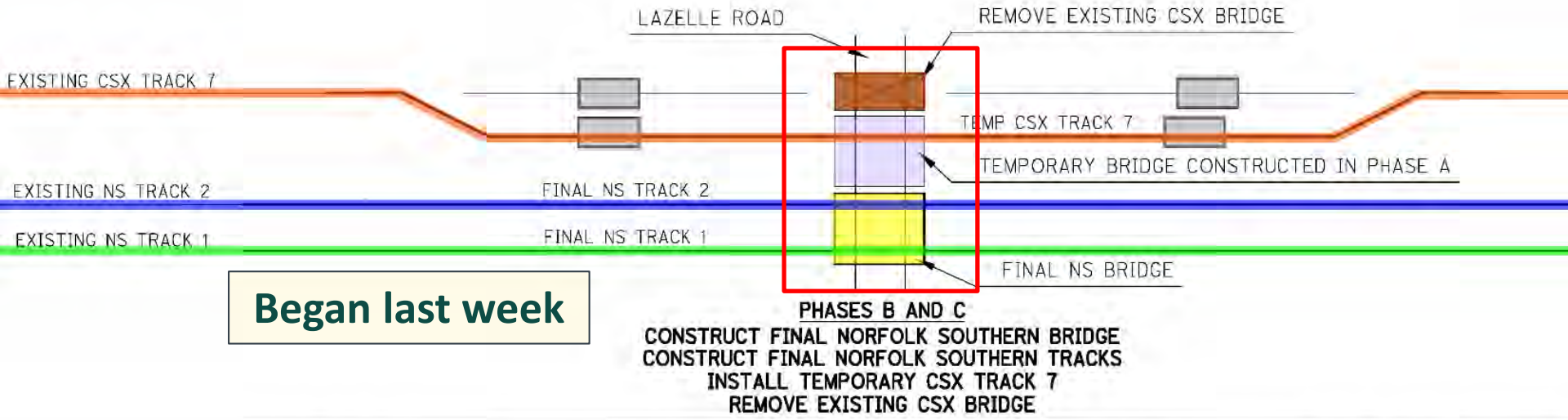
- Temporary at-grade crossings for construction
  - CSX track, and all temporary tracks
  - Access ramps to cross CSX single track
- Temporary Drainage
  - Jack and Bore pipes with catch basin




**PHASE A**
**CONSTRUCT TEMPORARY BRIDGE**

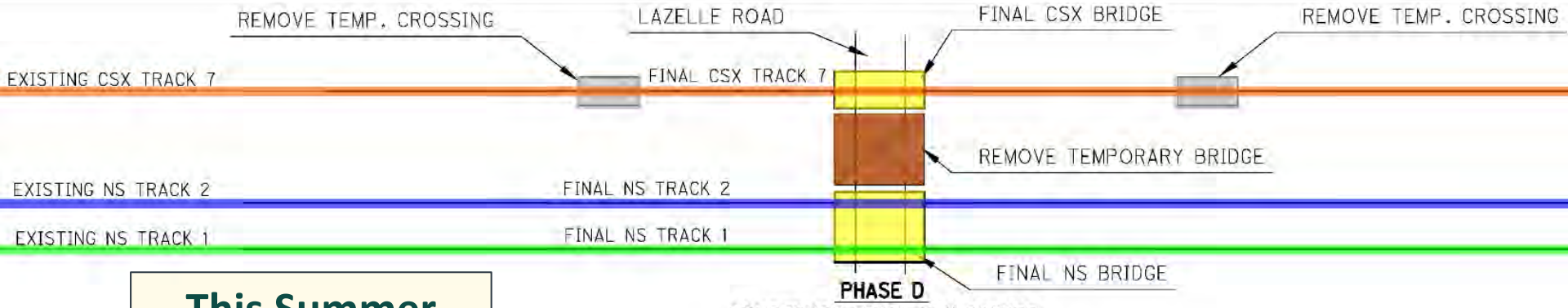



**PHASE B**
**CONSTRUCT TEMPORARY NORFOLK SOUTHERN TRACKS**
**REMOVE EXISTING NORFOLK SOUTHERN BRIDGE**




**Began last week**

**PHASES B AND C**
**CONSTRUCT FINAL NORFOLK SOUTHERN BRIDGE**
**CONSTRUCT FINAL NORFOLK SOUTHERN TRACKS**
**INSTALL TEMPORARY CSX TRACK 7**
**REMOVE EXISTING CSX BRIDGE**



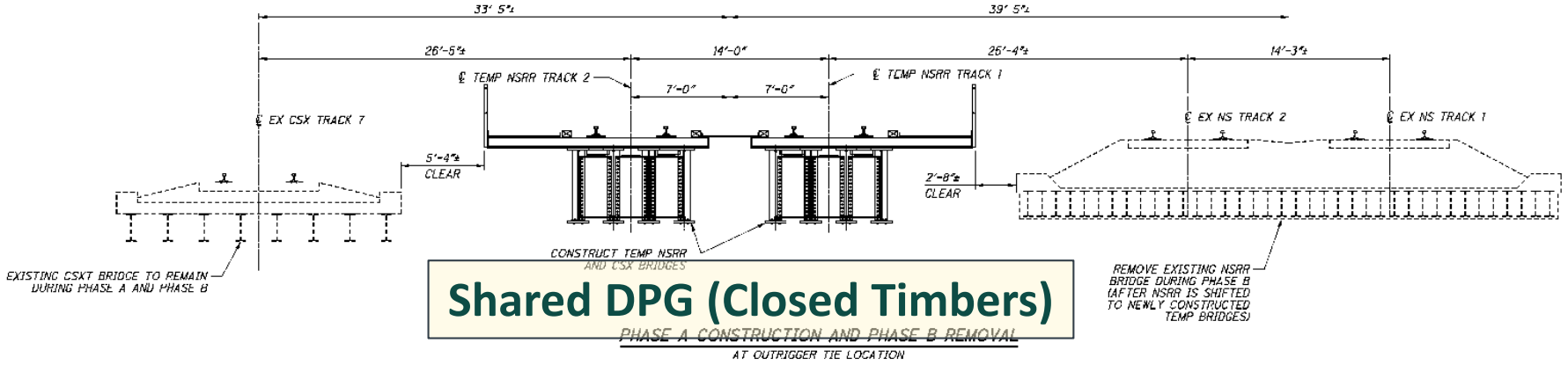

**This Summer**

**PHASE D**
**CONSTRUCT FINAL CSX BRIDGE**
**CONSTRUCT FINAL CSX TRACK 7**
**REMOVE TEMPORARY TRACK AND STRUCTURE**
**COMPLETE FINAL GRADING**


*Genesee Arch Bridge by John Kucko Digital*
*http://www.nscorp.com/content/nscorp/en/news/-norfolk-southern-and-new-york-state-usher-in-a-modern-era-for-f.html*

# The Bridge Project

All proposed bridges 79′-0″ single span with ≈6°25′ skew



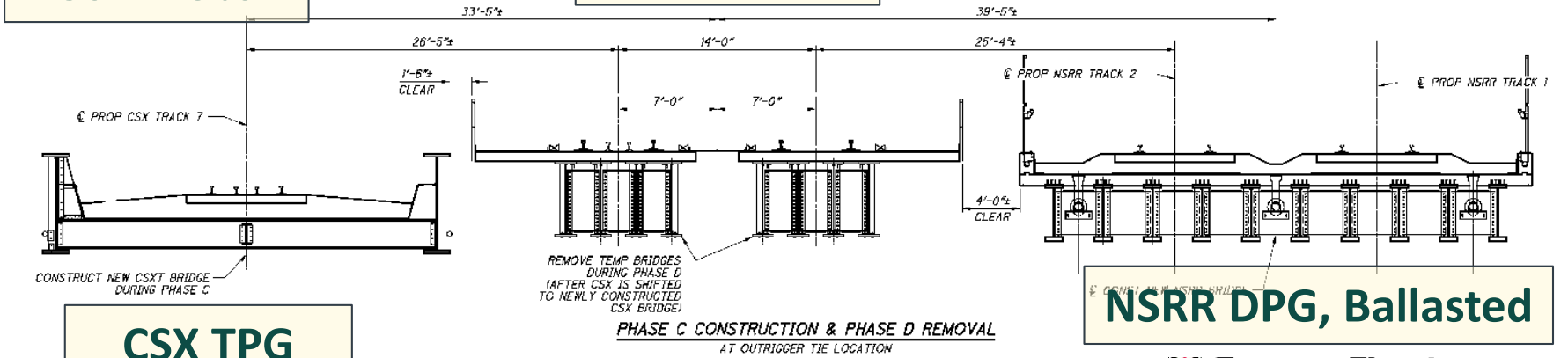

# Shared DPG (Closed Timbers)

PHASE A CONSTRUCTION AND PHASE B REMOVAL
AT OUTRIGGER TIE LOCATION

## 80" Webs

## 60" Webs

## 42" Webs



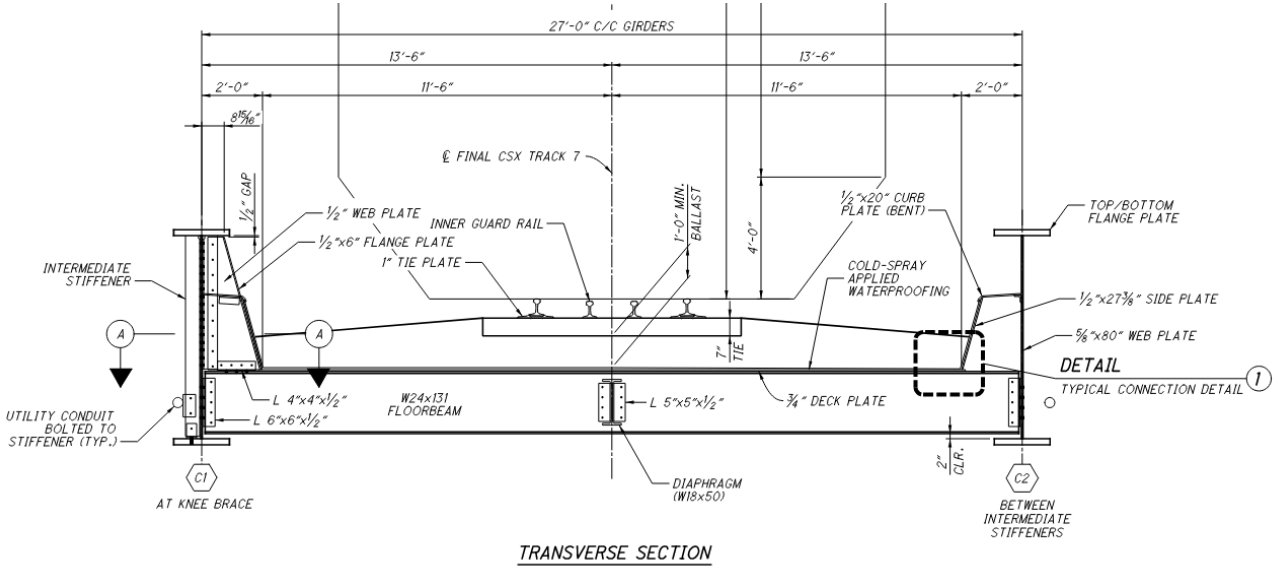

PHASE C CONSTRUCTION & PHASE D REMOVAL
AT OUTRIGGER TIE LOCATION

## CSX TPG

## NSRR DPG, Ballasted

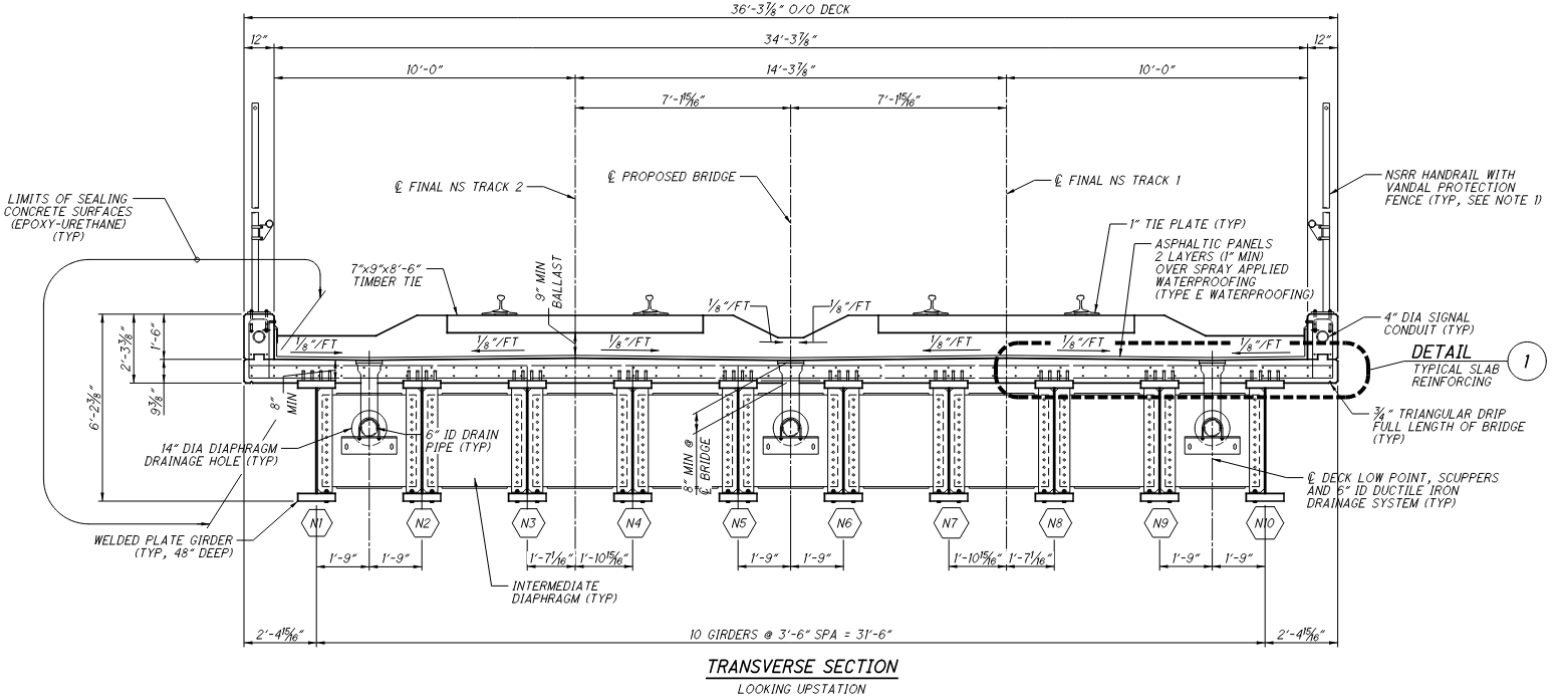
# Superstructure Design

Superstructure designed in ASD as opposed to AASHTO - LRFD




TRANSVERSE SECTION

# Superstructure Design



# Design Criteria

- AREMA is “Recommended Practice”
- Various design loadings dependent on owner
  - Notional E-80 loading typical LL, however CSX now requires E-90

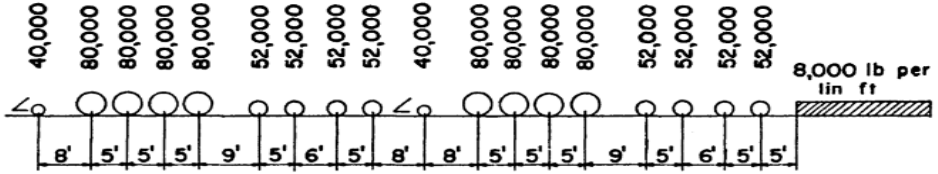



*Figure 15-1-2. Cooper E 80 Load*

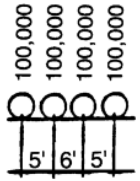



*Figure 15-1-3. Alternate Live Load on 4 Axles*

- Ballast loading, permanent and future varies by owner
- NS requires a derailment loading to be evaluated as well

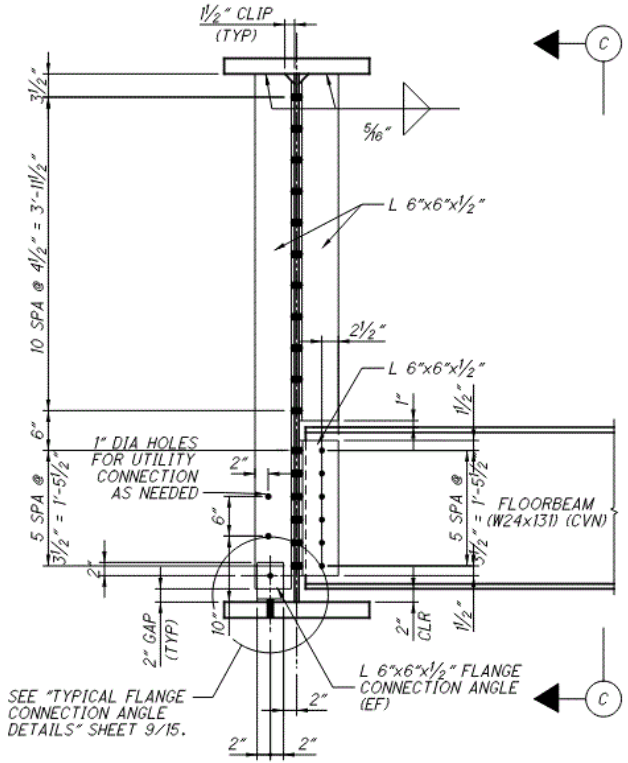
# Deflection Limits

- Deflection limits generally control over stress
  - AREMA - L/640 = 1.5” limit for these structures
    - Actual deflection of the structures approximately 1.2”

- NS allows composite design when looking at deflection but not stresses

# Net Section

- Intermediate stiffeners and diaphragm connection plates bolted to bottom flange
- Calculate net section about gross neutral axis
- Fatigue

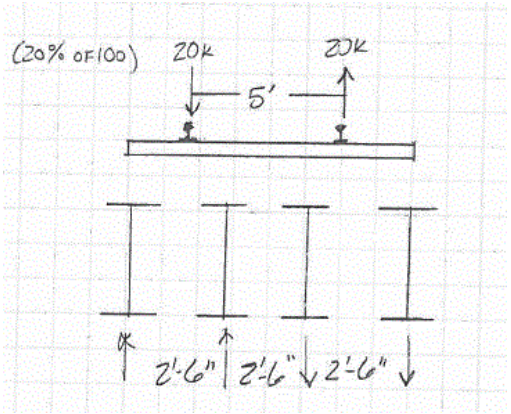



INTERMEDIATE STIFFENER WITH FLANGE CONNECTION ANGLE

# Impact Calculation

- Impact (%)
  - Span < 80’ = $40-(3L^2/1600)$
  - Span ≥ 80’ = $16+[600/(L-30)]$

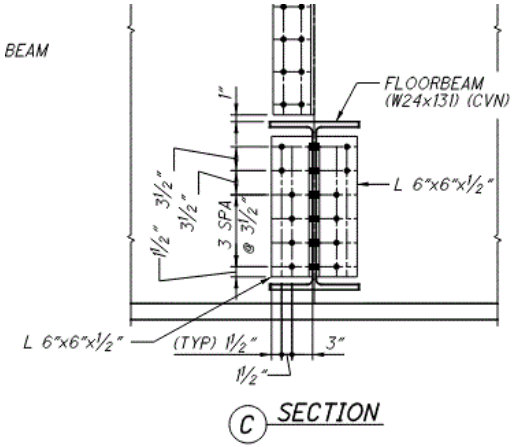
- Rocking effect
  - 20% wheel load force couple



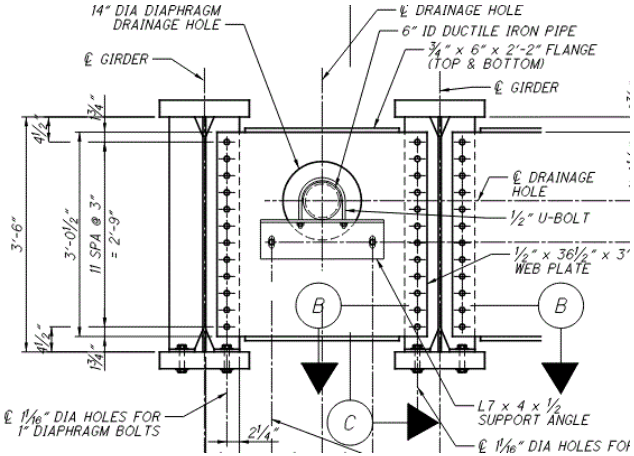

Rocking Effect

# Connections

- Simply supported floor beams
  - 25% increase in load simple shear -Flex leg
  - Design for moment and shear

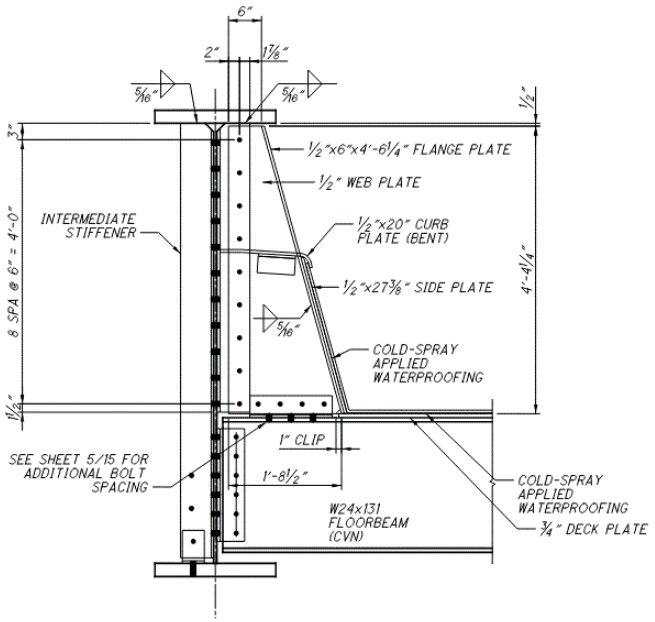



- Secondary and bracing members (diaphragms)
  - Section capacity
  - 150% load



# Knee Brace

- Knee brace design forces
  - Wind
  - 2.5% axial force in compression flange
- Geometry
  - As wide as clearance allows
  - Approximately 3:1

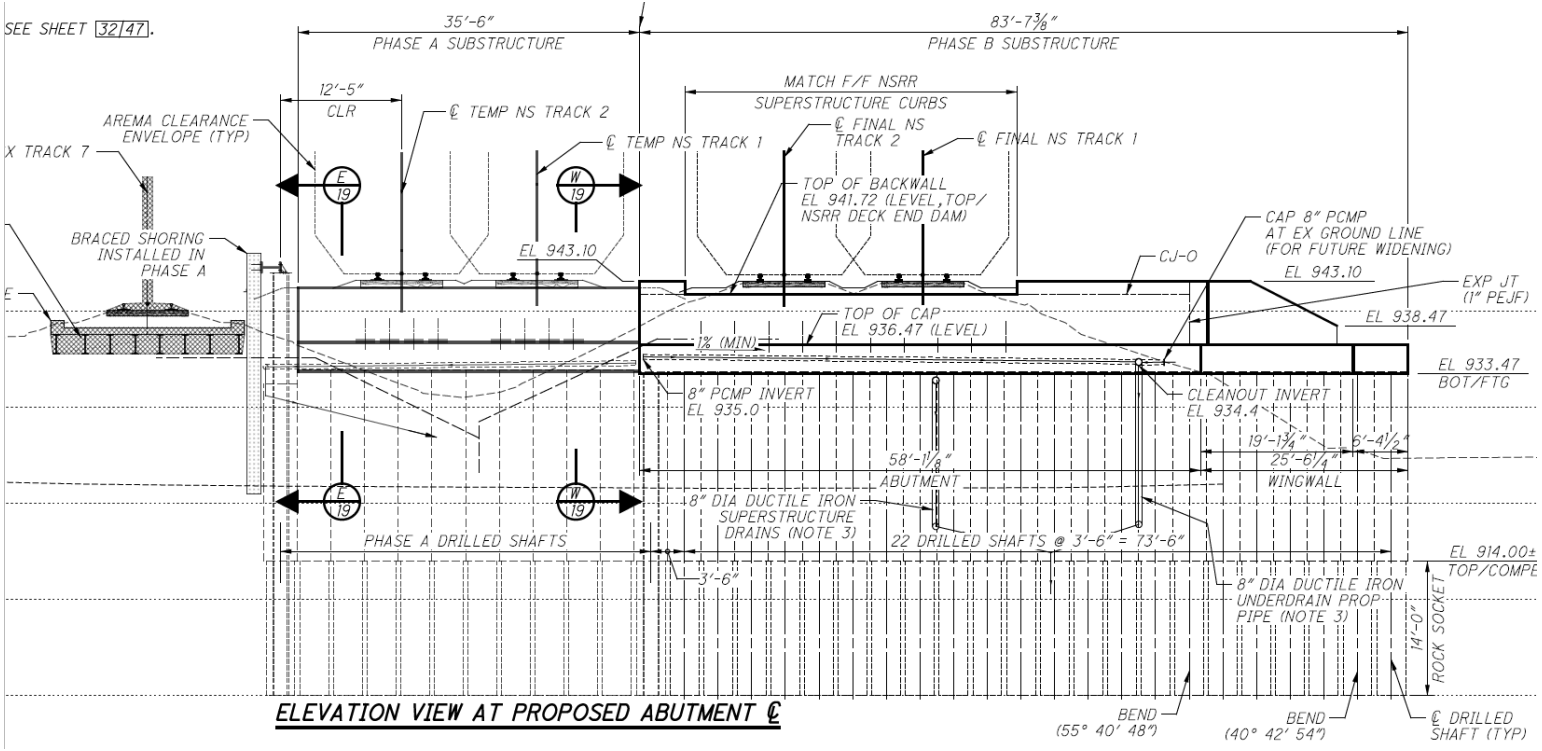



TYPICAL KNEE BRACE DETAIL

# Shared Substructures

- Top-Down Tangent Shafts in Shale
- Differing Elevations per Phase
  - Median: Accommodate DPG with timber deck
  - NSRR: Accommodate DPG with ballasted deck
  - CSX: Accommodate TPG with ballasted deck

# Shared Substructures

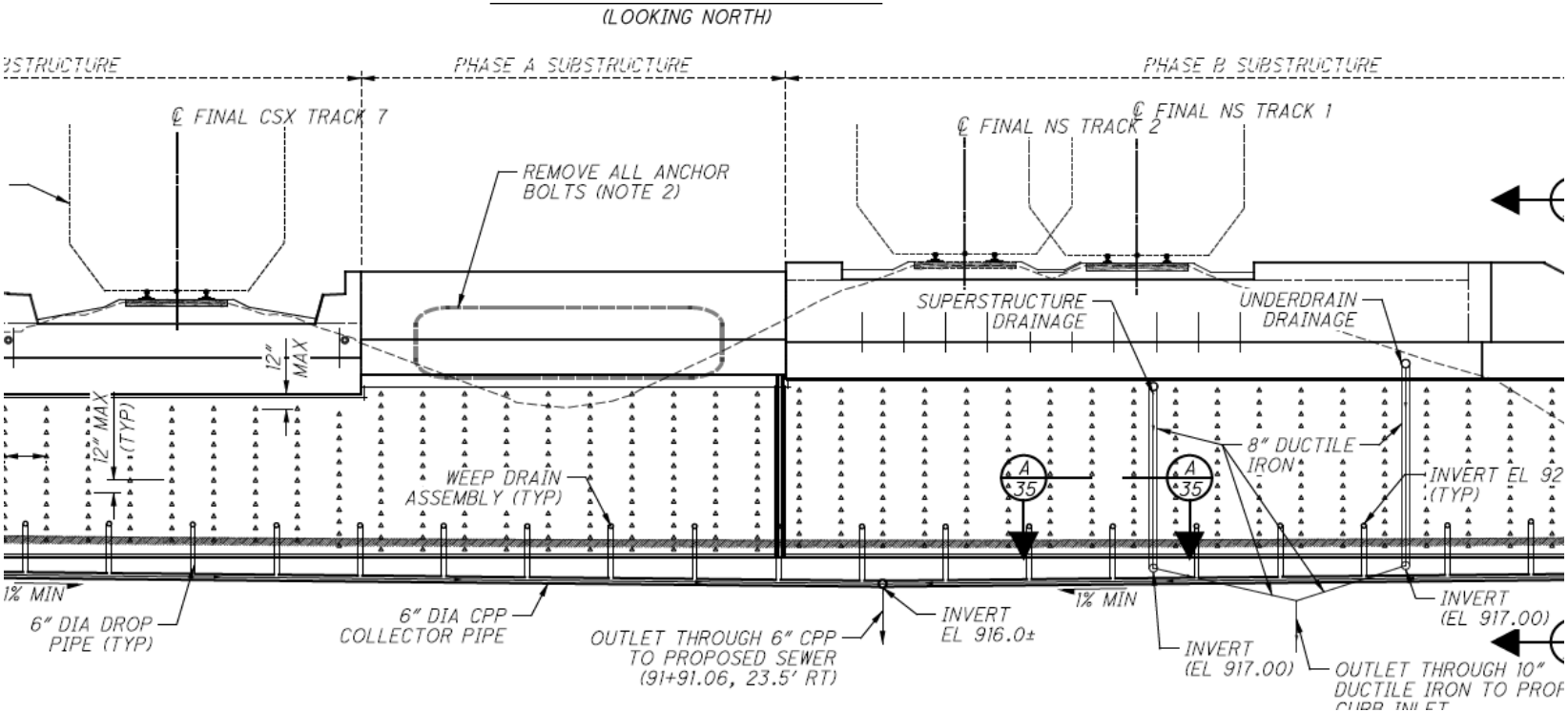


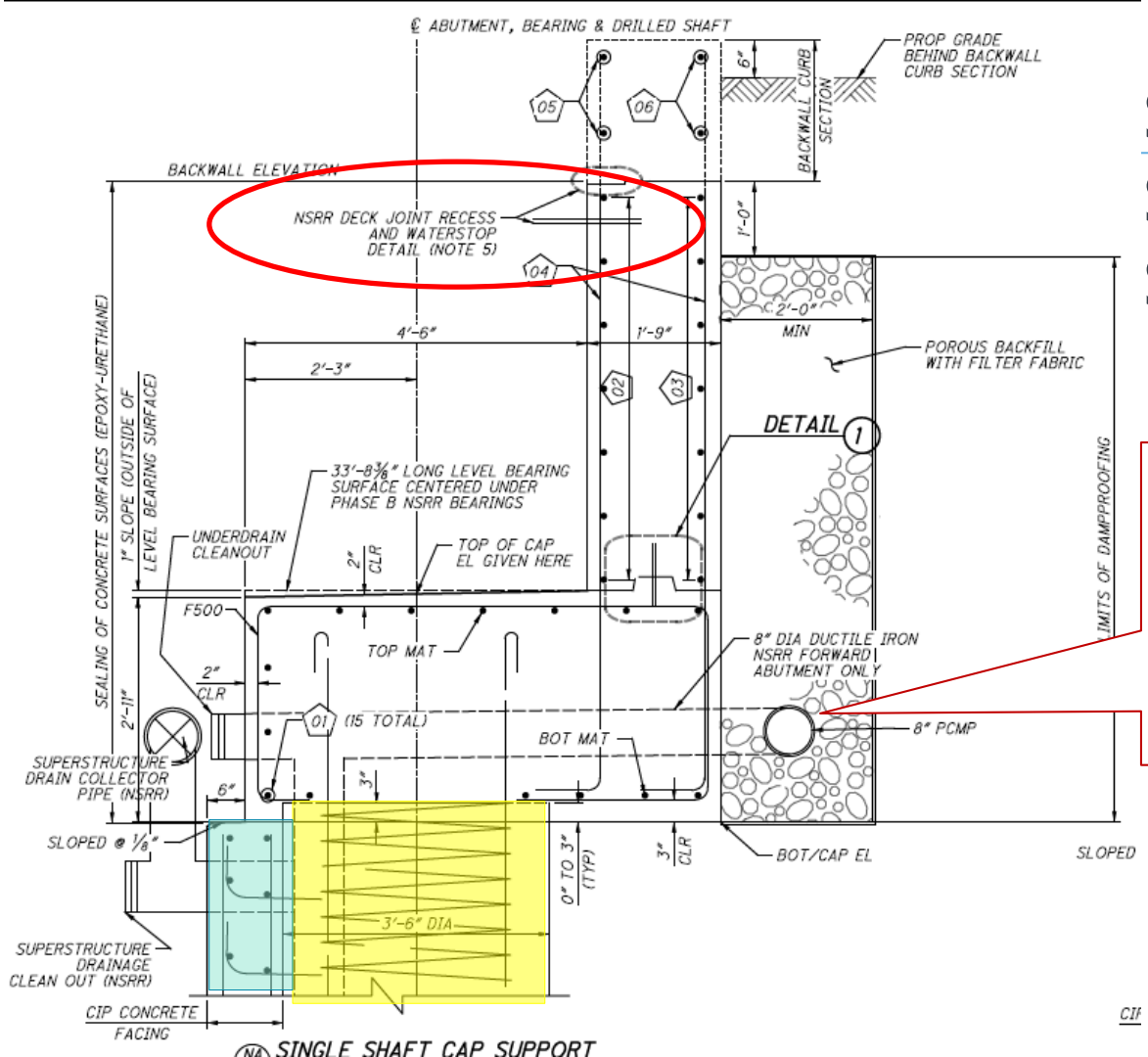
# Shared Substructures

- Final walls faced with CIP concrete (Final Phase)
  - Weep drainage buried in CIP facing
  - Superstructure drainage piped through facing
  - Formliner with Keyway at NSRR/CSX property line

  - **SCHEDULED FOR THIS SUMMER**

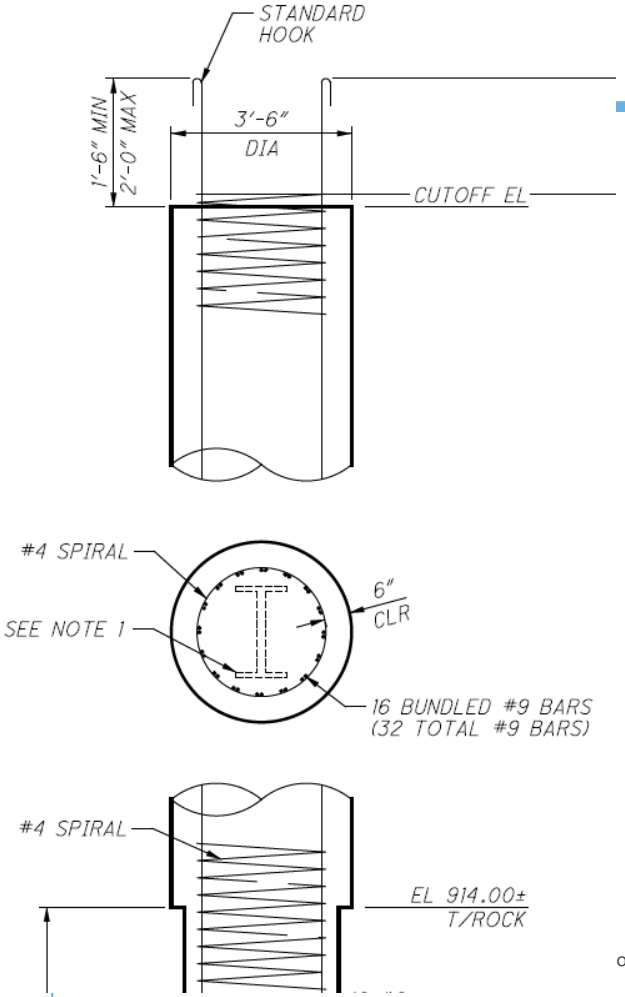
# Shared Substructures






# Shared Substructures Section at Bearings

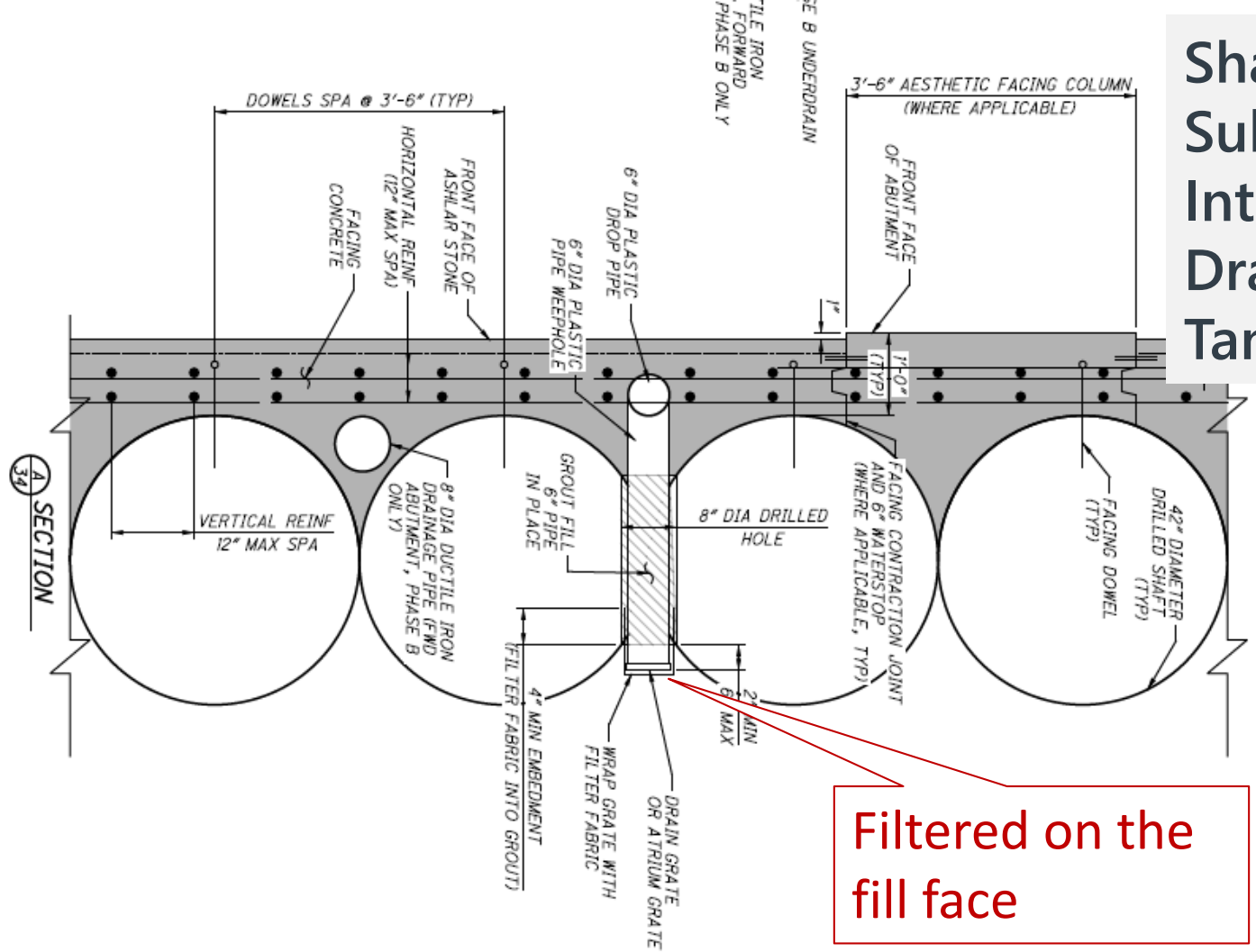
Most drainage and cleanouts in the facing and cap




# Shared Substructures

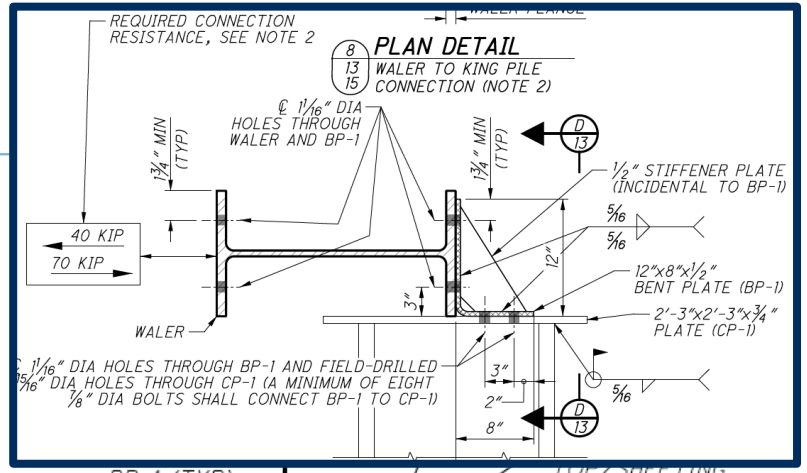
- LFD Concrete Design (ASD also allowed)
- Factored Live Load Surcharge (Increased at top)
- Freight rail horizontal live loads are an order of magnitude larger
  - ~450 kips (2 E-80 Tracks)
  - ~45 kips (2 HL-93 Lanes)

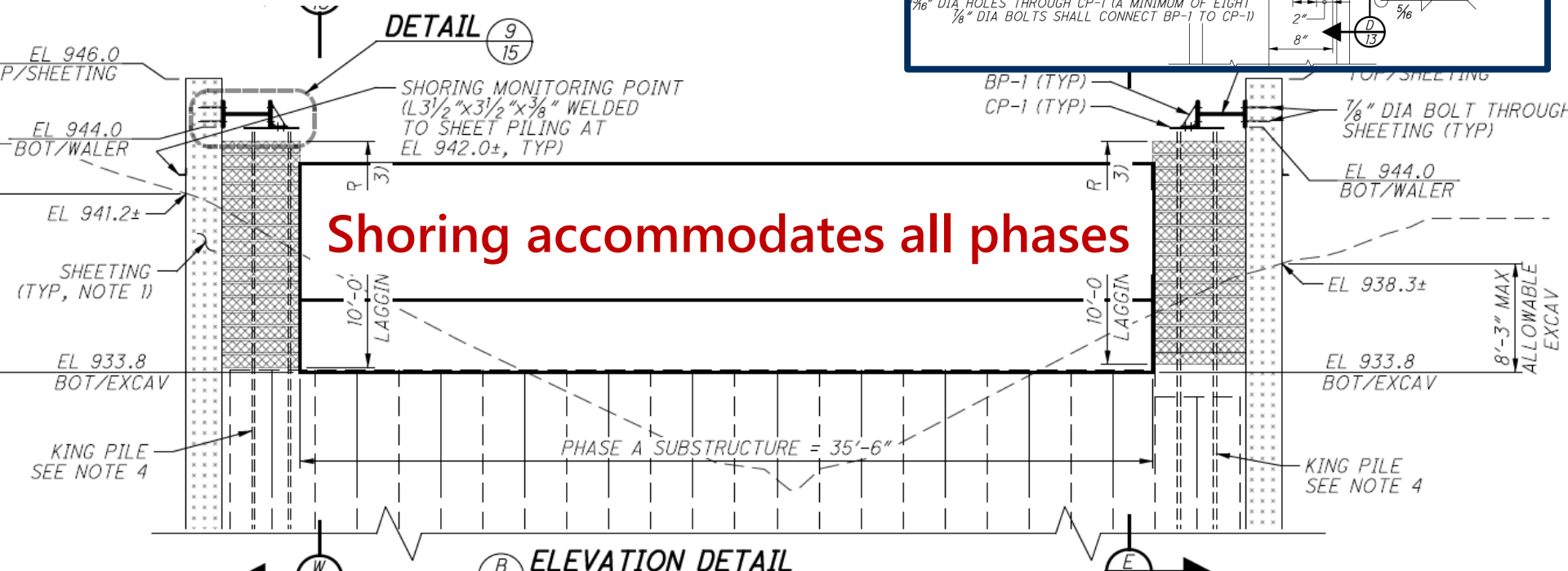
# Shared Substructures – Internal Weep Drainage for Tangent Shafts




Filtered on the fill face

- King pile, walers, and sheeting
- Several king piles incorporated into final tangent wall
- Two concurrent cantilevers with total deflection less than 3/8”

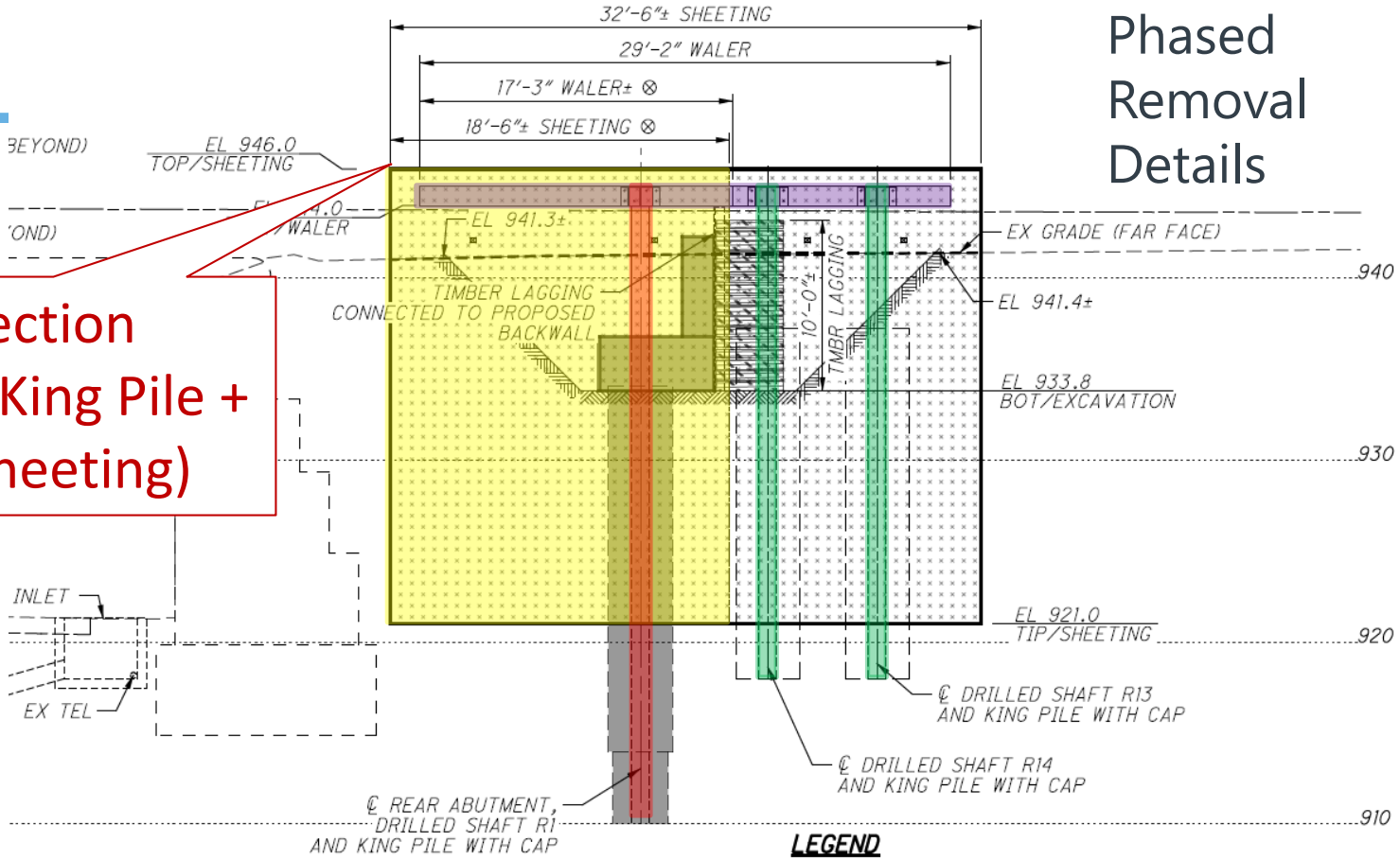


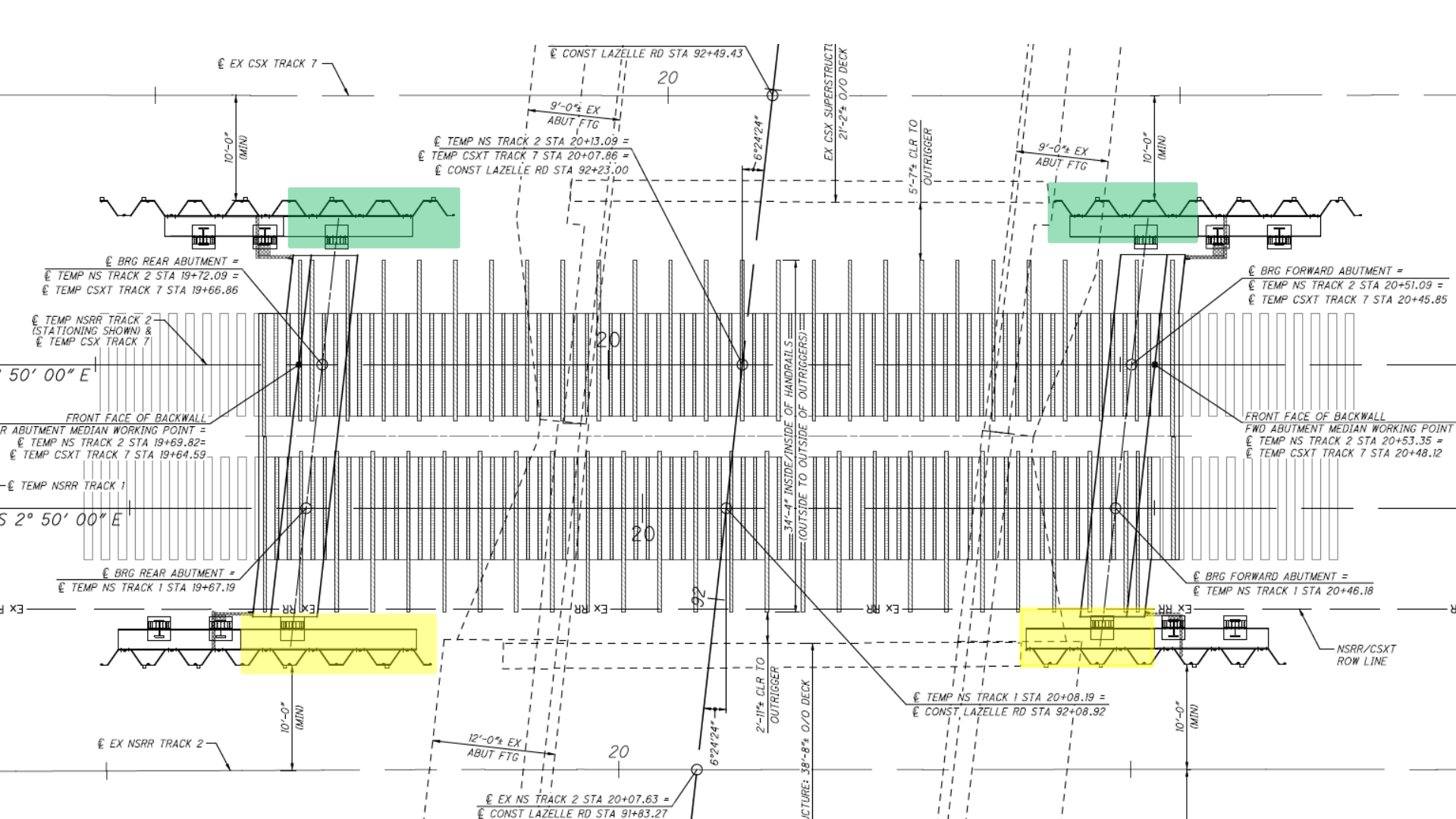




**Shoring accommodates all phases**

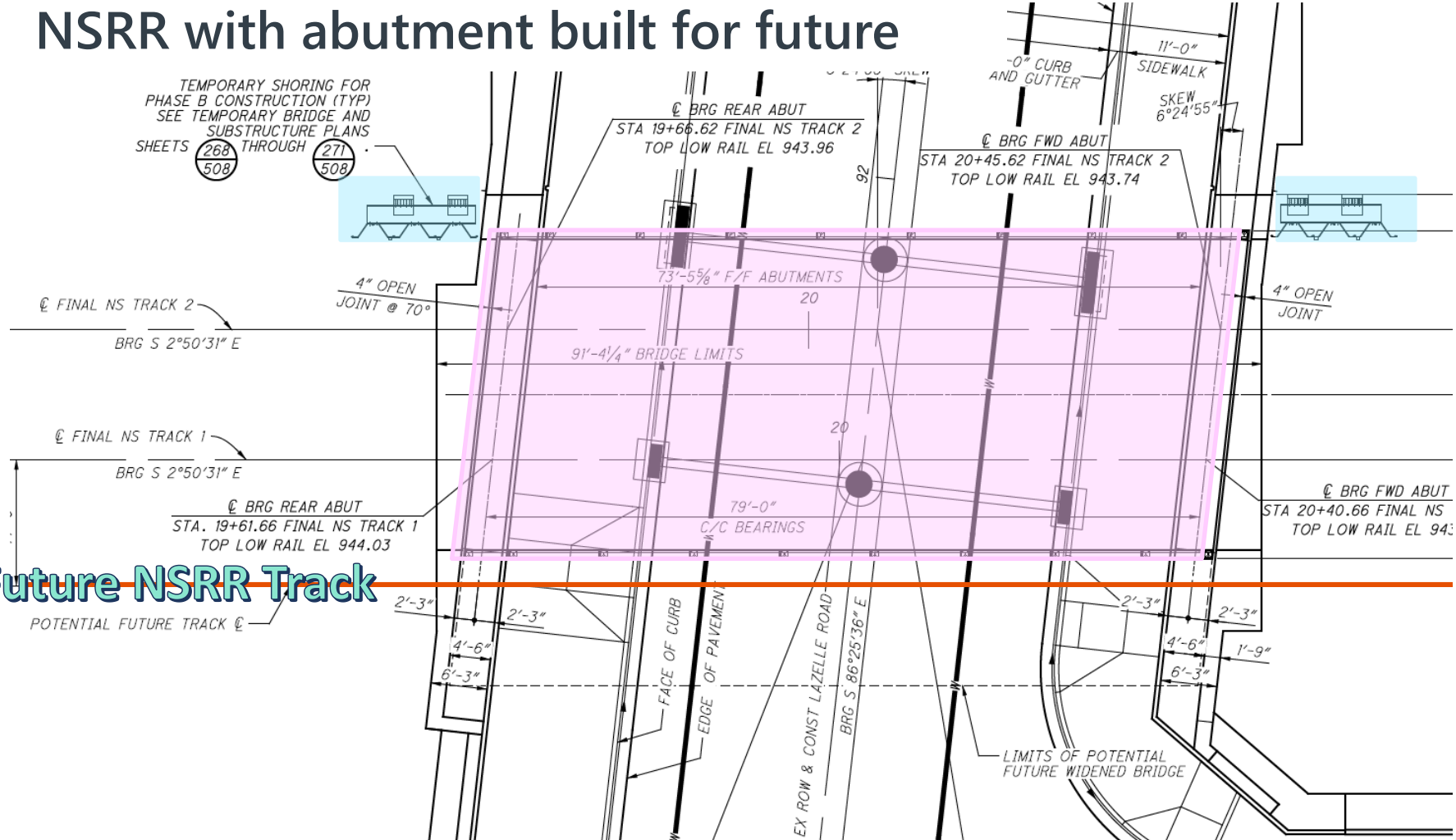
# Phased Removal Details

3/8” Deflection Controls (King Pile + Waler + sheeting)

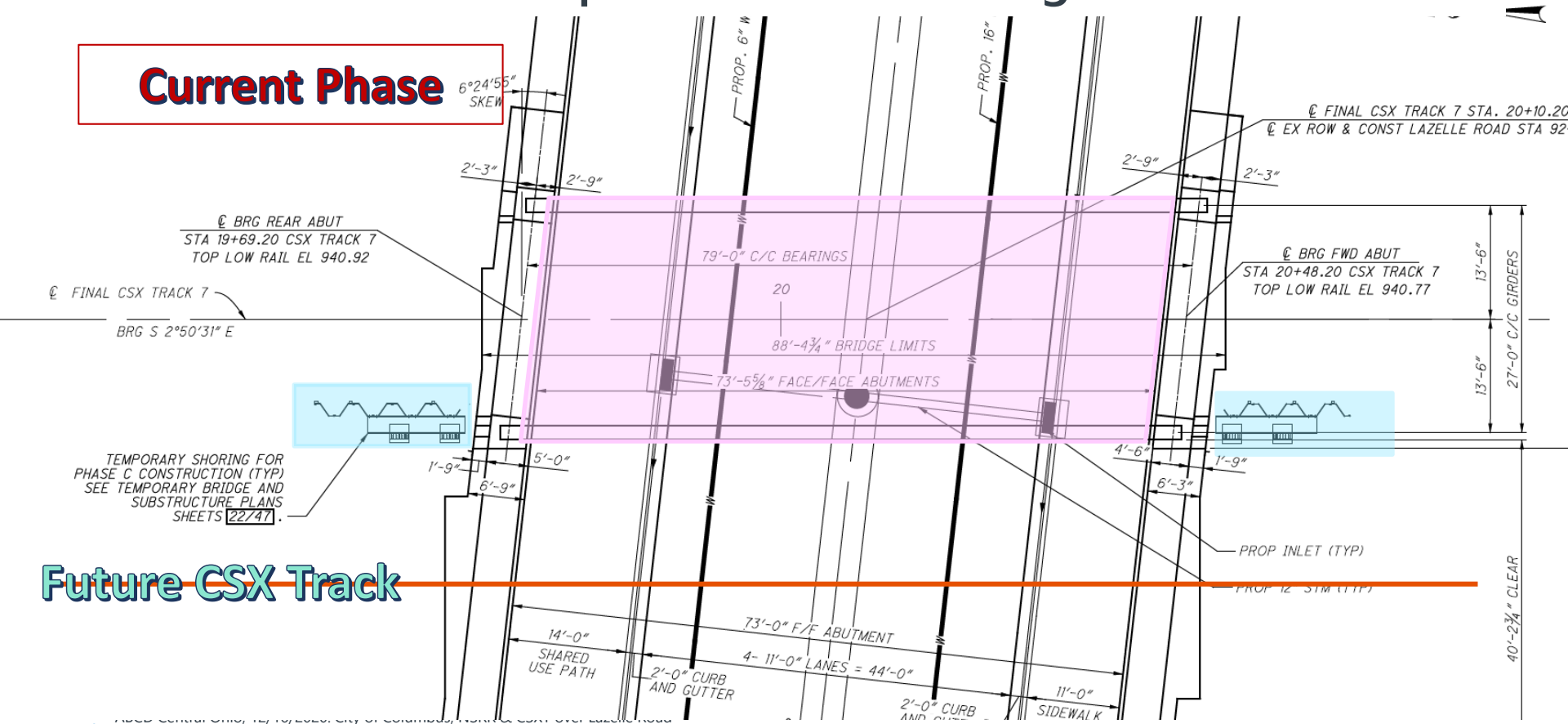



℄ EX CSX TRACK 7
℄ CONST LAZELLE RD STA 92+49.43
20
9'-0"± EX ABUT FTG
10'-0" (MIN)
℄ TEMP NS TRACK 2 STA 20+13.09 =
℄ TEMP CSXT TRACK 7 STA 20+07.86 =
℄ CONST LAZELLE RD STA 92+23.00
6°24'24"
EX CSX SUPERSTRUCTURE
21'-2"± O/O DECK
5'-7"± CLR TO OUTRIGGER
9'-0"± EX ABUT FTG
10'-0" (MIN)
℄ BRG REAR ABUTMENT =
℄ TEMP NS TRACK 2 STA 19+72.09 =
℄ TEMP CSXT TRACK 7 STA 19+66.86
℄ BRG FORWARD ABUTMENT =
℄ TEMP NS TRACK 2 STA 20+51.09 =
℄ TEMP CSXT TRACK 7 STA 20+45.85
℄ TEMP NSRR TRACK 2 (STATIONING SHOWN) & ℄ TEMP CSX TRACK 7
20
50' 00" E
FRONT FACE OF BACKWALL
R ABUTMENT MEDIAN WORKING POINT =
℄ TEMP NS TRACK 2 STA 19+69.82=
℄ TEMP CSXT TRACK 7 STA 19+64.59
34'-4" INSIDE/INSIDE OF HANDRAILS
(OUTSIDE TO OUTSIDE OF OUTRIGGERS)
FRONT FACE OF BACKWALL
FWD ABUTMENT MEDIAN WORKING POINT
℄ TEMP NS TRACK 2 STA 20+53.35 =
℄ TEMP CSXT TRACK 7 STA 20+48.12
℄ TEMP NSRR TRACK 1
S 2° 50' 00" E
20
℄ BRG REAR ABUTMENT =
℄ TEMP NS TRACK 1 STA 19+67.19
92
℄ BRG FORWARD ABUTMENT =
℄ TEMP NS TRACK 1 STA 20+46.18
EX RR
NSRR/CSXT ROW LINE
℄ TEMP NS TRACK 1 STA 20+08.19 =
℄ CONST LAZELLE RD STA 92+08.92
2'-11"± CLR TO OUTRIGGER
10'-0" (MIN)
℄ EX NSRR TRACK 2
12'-0"± EX ABUT FTG
20
6°24'24"
℄ EX NS TRACK 2 STA 20+07.63 =
℄ CONST LAZELLE RD STA 91+83.27
ICTURE: 38'-8"± O/O DECK

# NSRR with abutment built for future



# CSX with median capable of future bridge



# Progress: 5/7/2019

Project Startup

# Progress: 5/7/2019

Crossings In, Clearing Done


Progress: 5/22/2019
Median fill at bridge

# Progress: 6/07/2019

Shoring Plan Delay (Extra design reviews)

# Progress: 6/27/2019

## Sheeting and Piles; Drainage Issues

# Progress: 7/12/2019

Sheeting Done; cap layout

# Progress: 7/12/2019

Sheeting Done; cap layout

# Progress: 7/12/2019

Cap Layout – Ready to Drill

# Progress: 8/2/2019

## Phase A: Abutment Shafts Completed


Progress: 8/2/2019
Phase A: Abutment Shafts Completed

# Progress: 9/9/2019

North Drainage


Progress: 9/9/2019
South Drainage

# Progress: 9/9/2019

550t & 300t Cranes
9/10 & 9/11 Girder Placement


Progress: 9/9/2019
Girder Delivery Area

# Progress: 9/9/2019

Crane setup in progress

# Progress: 9/11/2019

https://www.linkedin.com/posts/eric-f-dues_design-constructability-railroad-activity-6743026455736840192-lN0r

Girder Erection Video (16x)

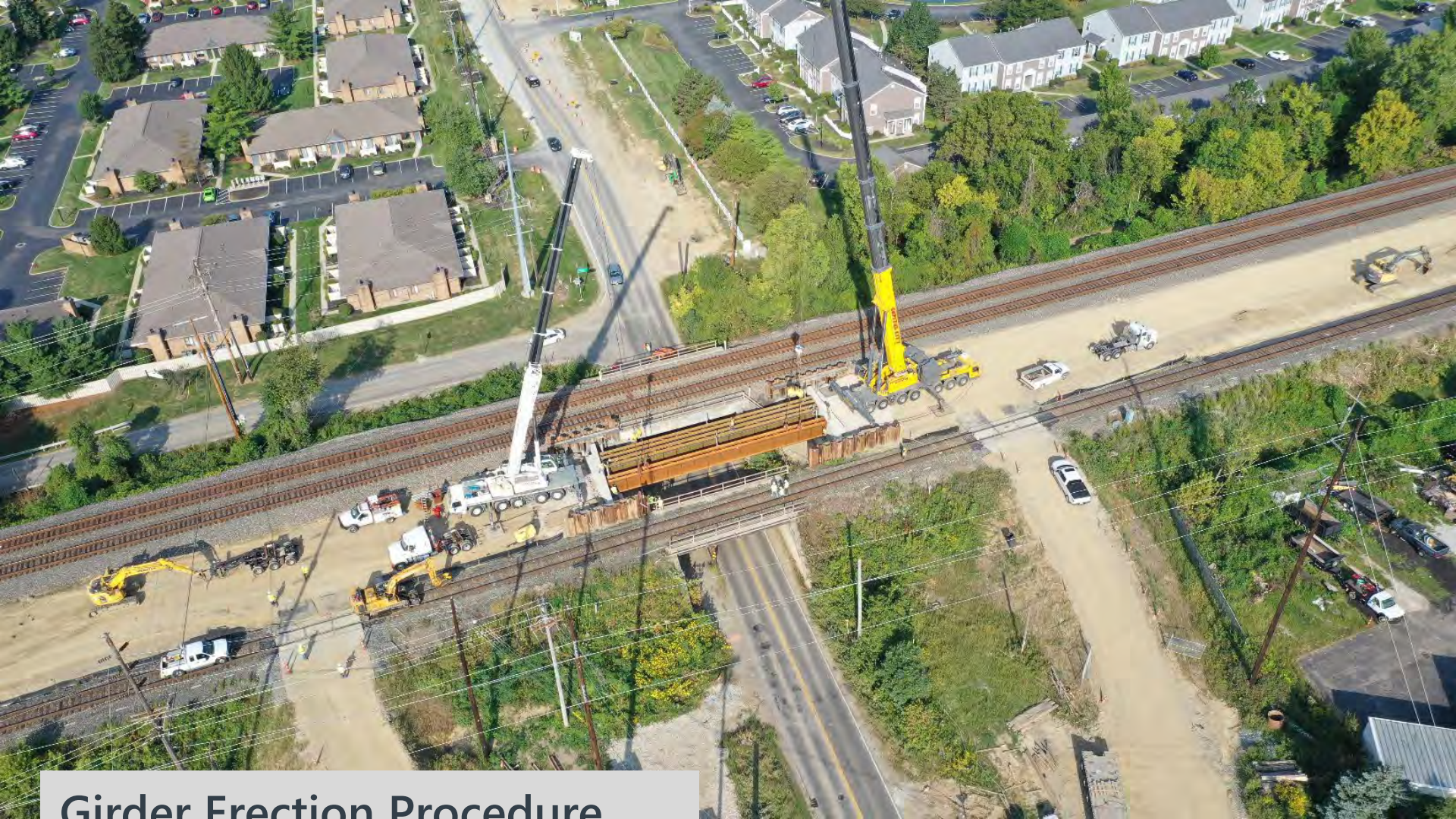

Progress: 9/11/2019
Girder Erection Procedure

# Progress: 9/11/2019

## Girder Erection Procedure

# Progress: 9/11/2019

## Girder Erection Procedure



# Girder Erection Procedure

# Progress: 10/24/2019

Tracks almost in service


Progress: 12/13/2019
Temp bridge in service: Begin Phase B

# Progress: 12/13/2019

Temp bridge in service - Prep for NSRR Demo

# Progress: 4/6/2020

NSRR Superstructure gone

# Progress: 4/6/2020

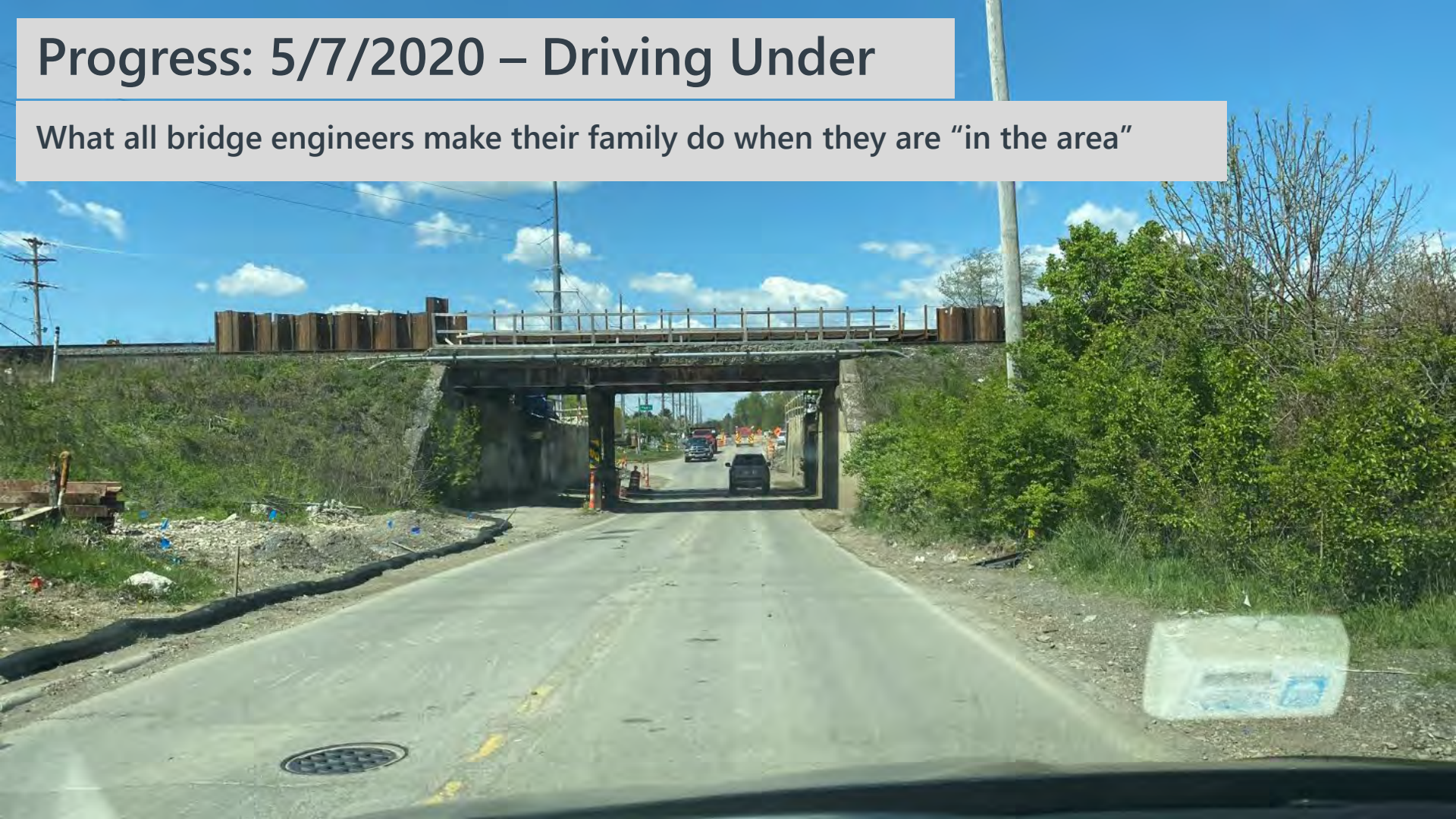
NSRR Superstructure gone

# Progress: 4/6/2020

## Temp Shoring Phase B Removal (And Force Reversal)

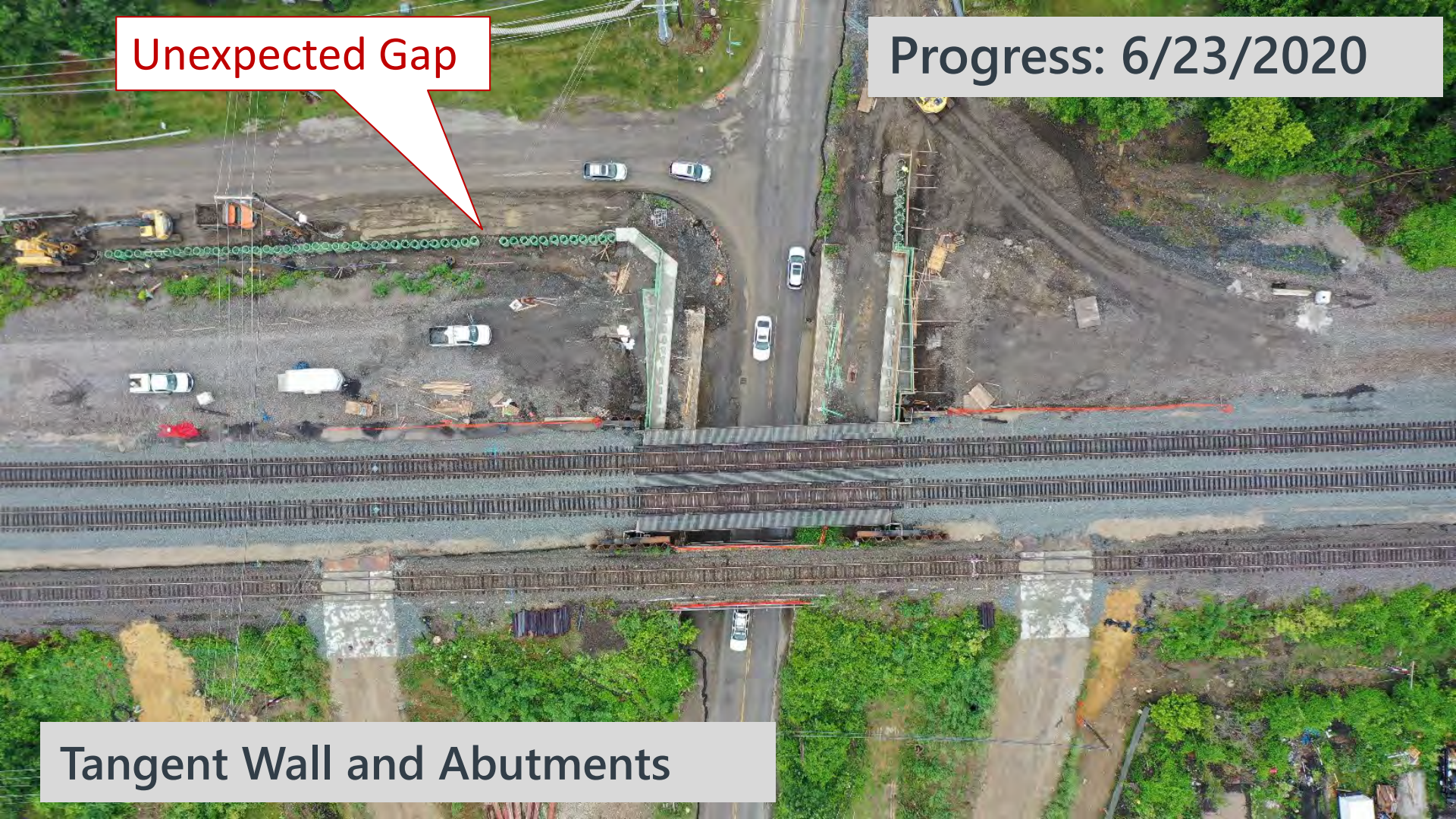
# Progress: 5/7/2020 – Driving Under

What all bridge engineers make their family do when they are “in the area”



# Progress: 6/23/2020


## Tangent Wall and Abutments


Unexpected Gap
Progress: 6/23/2020
Tangent Wall and Abutments

# Progress: 8/20/2020


NSRR Deck forming

# Progress: 8/20/2020

## NSRR Deck forming

# Progress: 8/20/2020

## NSRR Deck forming

# Progress: 8/20/2020

## NSRR Deck forming

# Progress: 10/02/2020

## NSRR Deck Before Waterproofing

# Progress: 10/02/2020

The wall gap and “square” shafts

# Progress: 10/02/2020

Temp Shoring and timber closuresstill going strong

# Progress: 10/12/2020

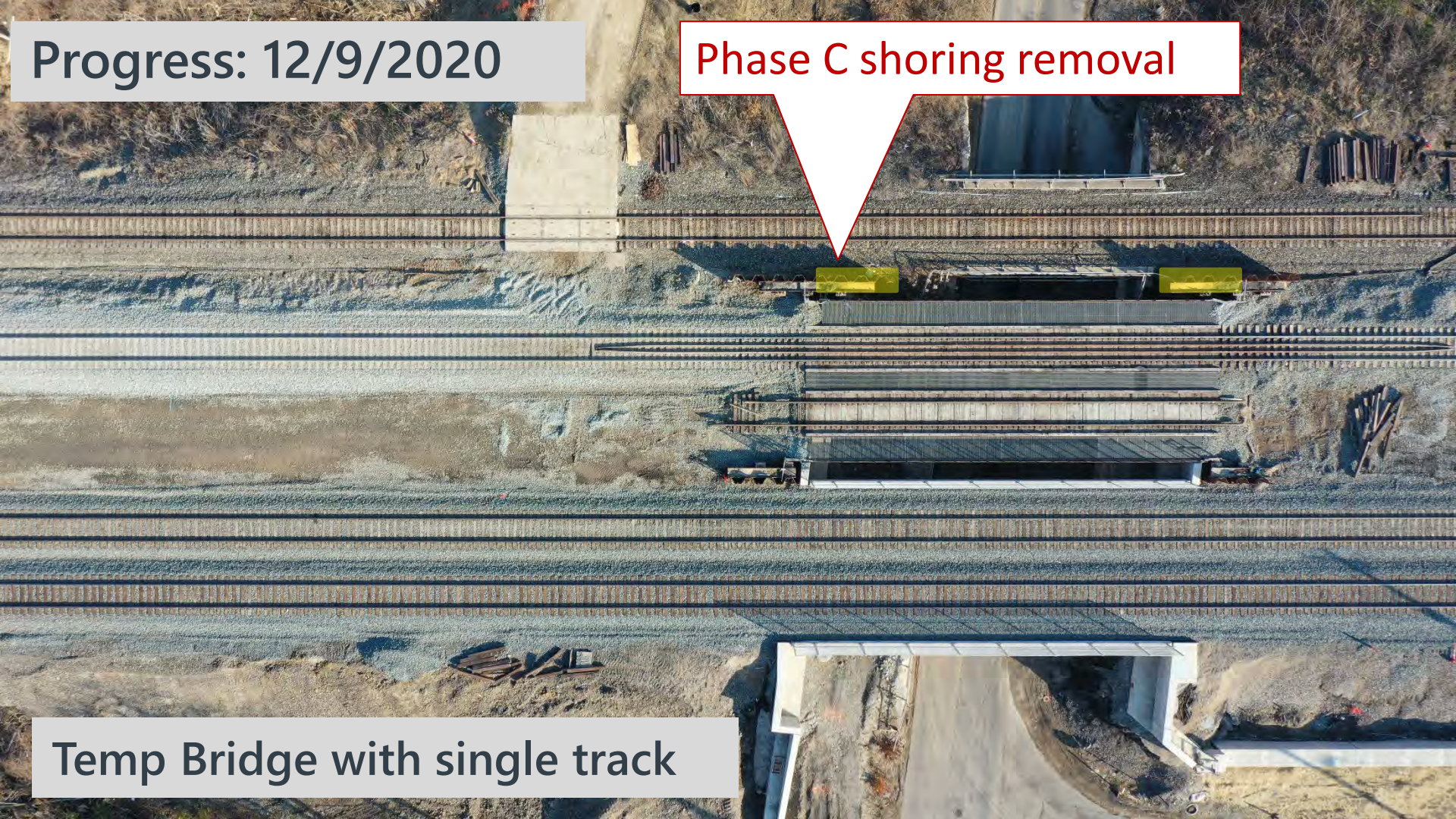

NSRR Deck Spray Applied Waterproofing

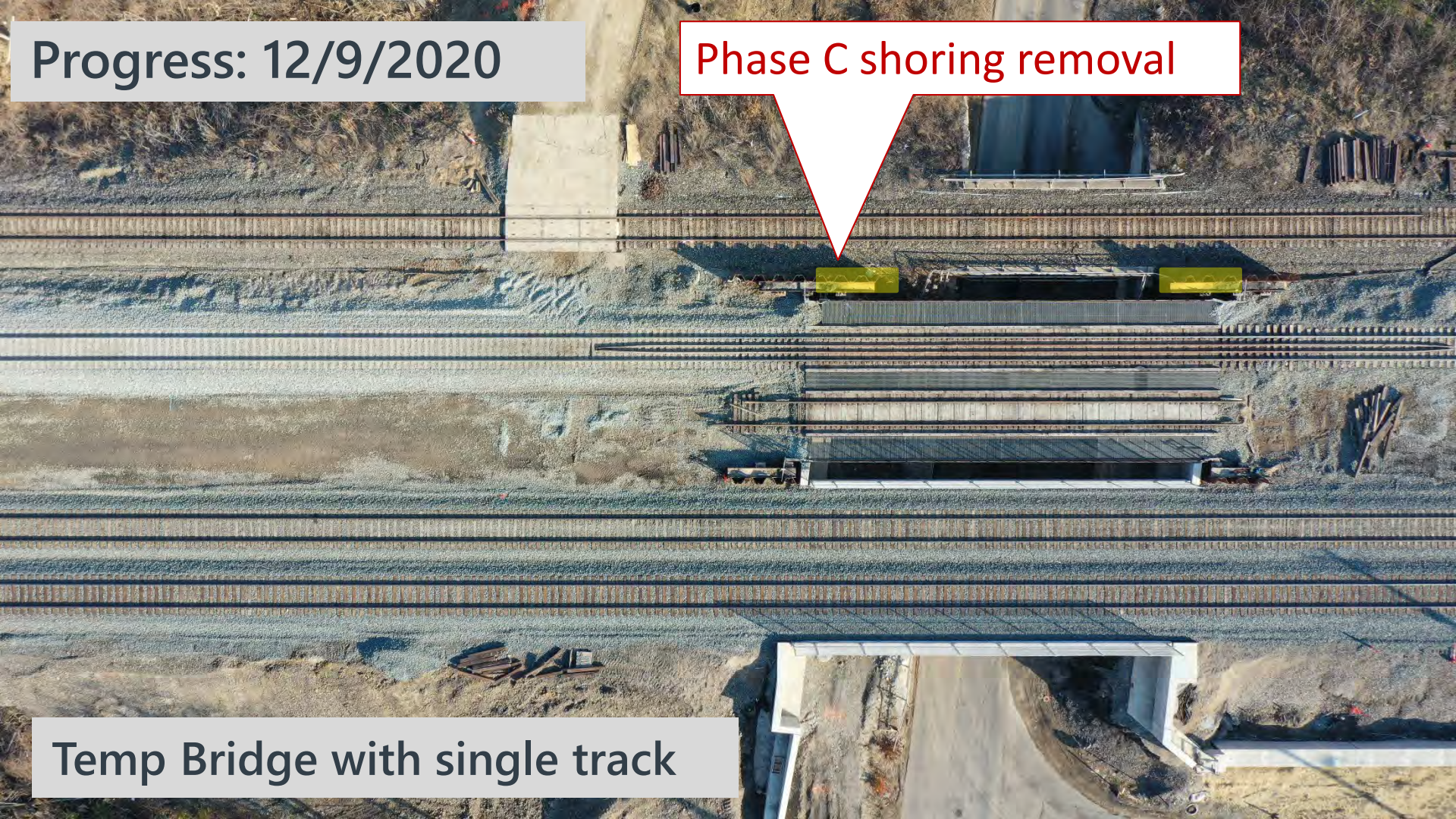
# Progress: 12/9/2020

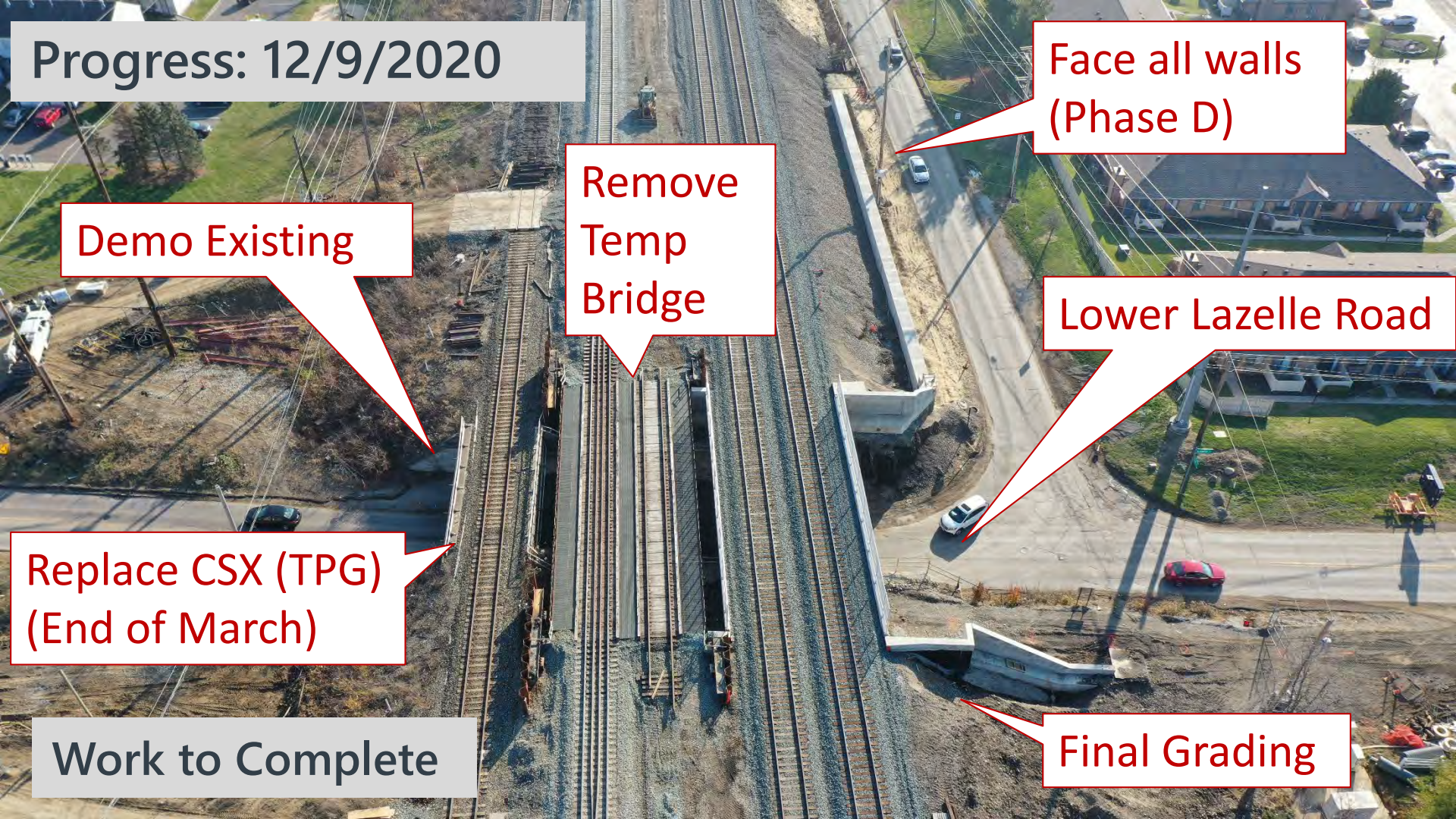
Phase C: Officially Abandoned the original bridges (105 years)

# Progress: 12/9/2020

Phase C: Officially Abandoned the original bridges (105 years)


Progress: 12/9/2020
Phase C shoring removal
Temp Bridge with single track


Progress: 12/9/2020
Phase C shoring removal
Temp Bridge with single track


Progress: 12/9/2020
Face all walls (Phase D)
Remove Temp Bridge
Demo Existing
Lower Lazelle Road
Replace CSX (TPG) (End of March)
Work to Complete
Final Grading

# A few Lessons (of many)

- Dual Coordination requires Clear Communications
  - Structures: Public Projects Manuals and Communications
  - Shared Right of Way = Lawyers!
  - Temporary Crossings = Time
  - Multi-Party Right-Of-Way Transactions = Time & Lawyers!
- Rocking Effect
  - Added nominal steel at the end of the plan process
  - Letter Ballot 15-18-27 (Rejected)
  - New (and less extreme) language proposed and ongoing
- Bronze Bearing “Net Area”
  - Nominal dimensional change to bearings at the end of the plan process
  - Letter Ballot No. 15-18-30 (Approved for publication)

# Questions / Comments / Complaints ?


Progress: 12/9/2020
Current Status