CEA's Transportation Connects

2025 Mar 3

Bridge Replacement on an Active Landslide – Athabasca River Bridge

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COWI

Outline

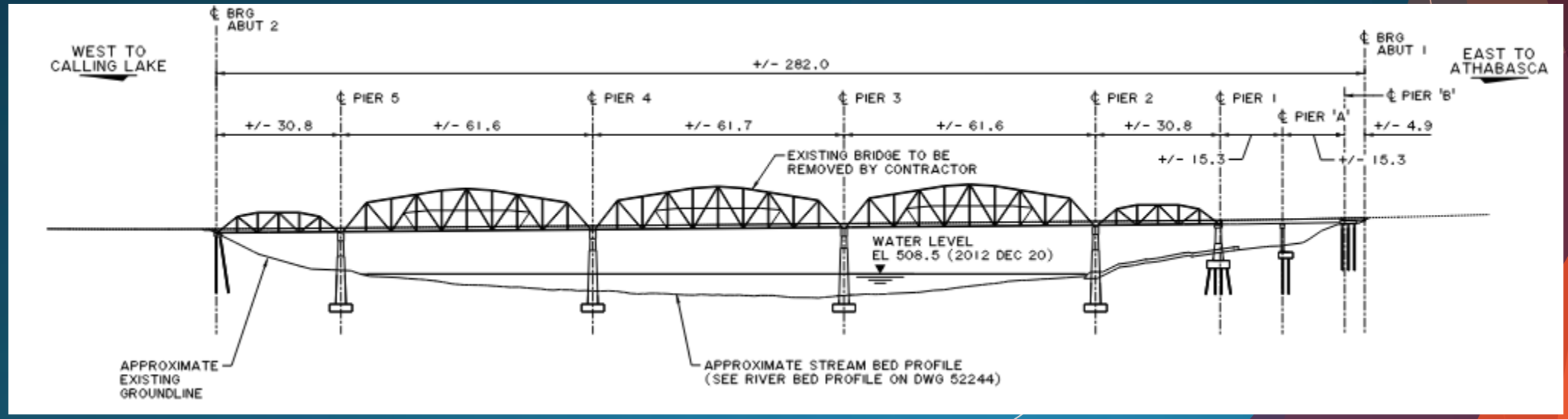
- Introduction & Background Information
- Design Challenges
- Geotechnical Monitoring Program
- Development of Design Approach
- Detailed Design of the Bridge
- Construction Progress

Introduction and Background Information

- History of Bridge Location
  - Town of Athabasca, Alberta
  - Important historical river crossing
  - Regular ferry service establish in 1905

Introduction and Background Information (Cont'd)

- Existing Bridge Structure
  - Eight span bridge with total length of 281. 9 m
    - 1 - 30.5 m Pony Truss span, 3 - 61.0 m Through Truss spans, 1 - 30.5 m Pony Truss span, 3 - Concrete Girder spans
  - 7.3 m wide



Introduction and Background Information (Cont'd)

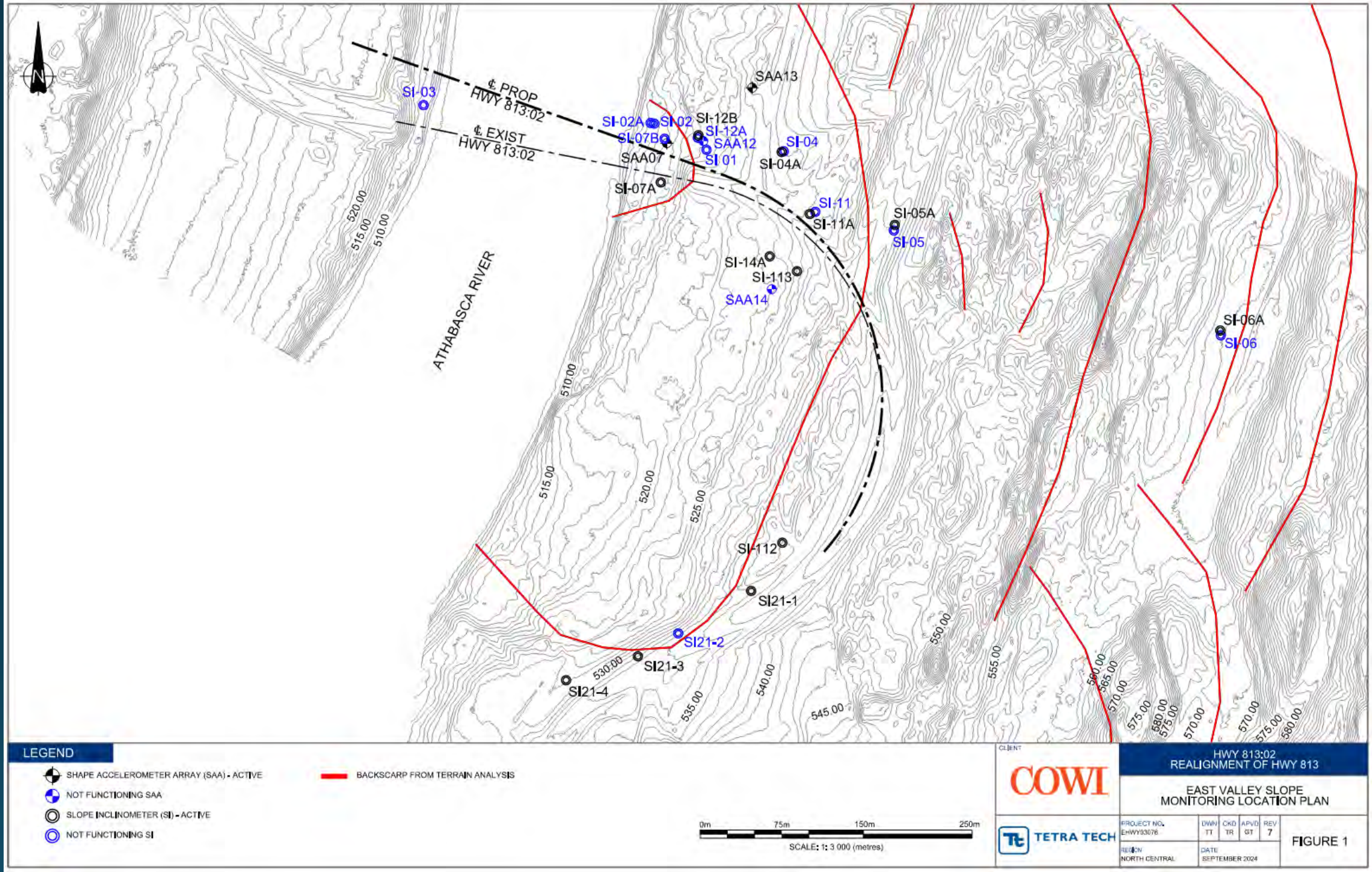
- Geotechnical and Slope Stability Concerns
  - First sign of instability of east bank noted during construction
  - East bank is an active slow moving deep seated translational landslide
  - Ongoing ground movement of the east bank has required significant maintenance of the existing bridge
- Problem Statement
  - Existing bridge is functionally obsolete and requires significant yearly maintenance
  - Alberta Transportation & Economic Corridors (ATEC) retained COWI North America Ltd. to design a replacement bridge structure

Design Challenges

- Most Unique Design Challenge = Instability of the East bank
- Unable to avoid slope stability issues
- Unable to stabilize slope
- COWI tasked with designing a bridge on an active landslide

Geotechnical Monitoring Program

- Geotechnical engineers needed to provide a recommendation on design ground movements over the 75 year design life of bridge
- Limited/discontinuous historical information available
- First two Slope Inclinometers (SI's) in November 2012
- Monitoring ongoing


℄ PROP HWY 813:02
℄ EXIST HWY 813:02
ATHABASCA RIVER
SI-03
SI-02A
SI-02
SI-07B
SAA07
SI-07A
SI-12B
SI-12A
SAA12
SI-01
SAA13
SI-04
SI-04A
SI-11
SI-11A
SI-05A
SI-05
SI-14A
SI-113
SAA14
SI-06A
SI-06
SI-112
SI21-1
SI21-2
SI21-3
SI21-4
520.00
515.00
510.00
525.00
530.00
535.00
540.00
545.00
550.00
555.00
560.00
565.00
570.00
575.00
580.00
LEGEND
SHAPE ACCELEROMETER ARRAY (SAA) - ACTIVE
NOT FUNCTIONING SAA
SLOPE INCLINOMETER (SI) - ACTIVE
NOT FUNCTIONING SI
BACKSCARP FROM TERRAIN ANALYSIS
0m 75m 150m 250m
SCALE: 1: 3 000 (metres)
CLIENT
COWI
TETRA TECH
HWY 813:02
REALIGNMENT OF HWY 813
EAST VALLEY SLOPE
MONITORING LOCATION PLAN
PROJECT NO. EHWY03076
DWN TT
CKD TR
APVD GT
REV 7
REGION NORTH CENTRAL
DATE SEPTEMBER 2024
FIGURE 1

Development of Design Approach

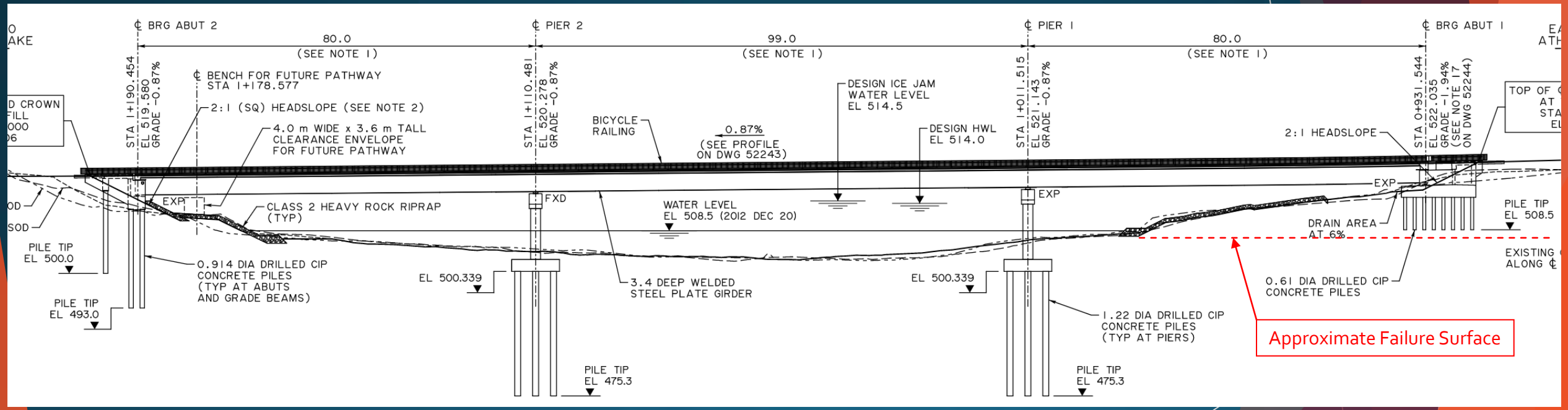
- Final Recommended Design Ground Movement:
  - 2500 mm longitudinal, 1500 mm transverse
- Collaborative approach
- Alternative Strategies considered
  - Design Abutment 1 to move with the ground movement

Development of Design Approach (Cont'd)

- Developed a three-prong approach
  1. Pile walls to eliminate the transverse component of the movement
  2. Design bridge structure to accommodate the following design ground movement:
     - 2500 mm longitudinal, 400 mm transverse, 100 mm vertical settlement
  3. Design Abutment 1 to undergo an intervention that transversely relocates abutment and superstructure 400 mm to the south to reset ability to accommodate further transverse ground movement

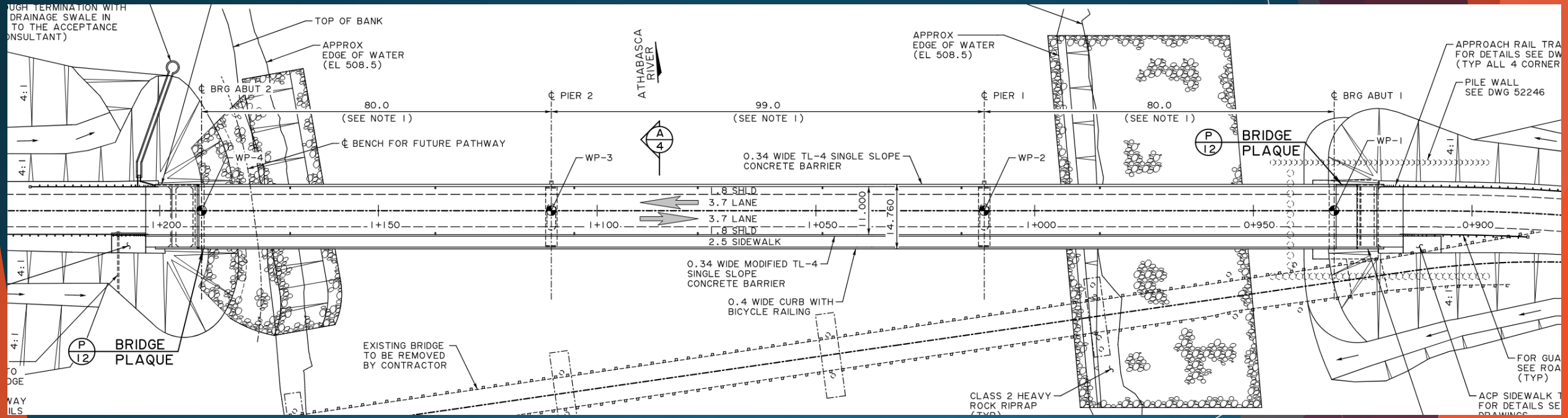
Detailed Design of the Bridge

- General Description of Bridge



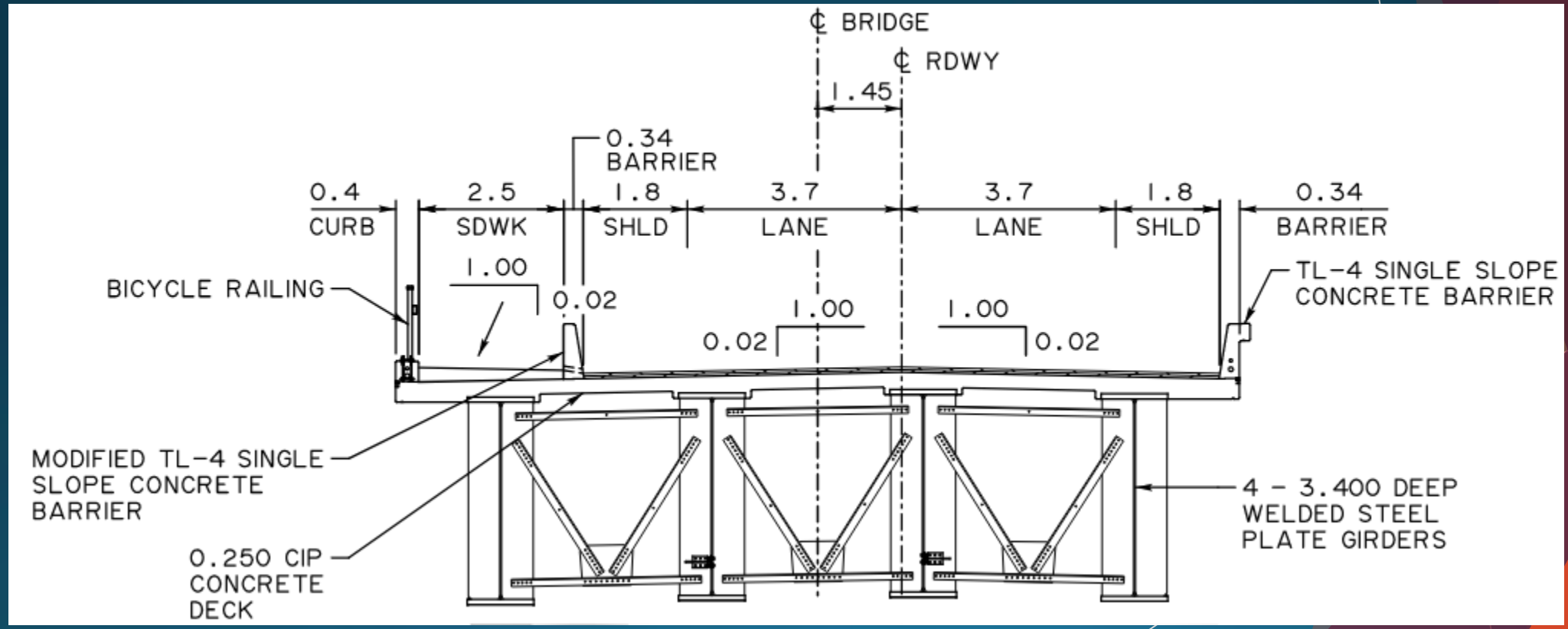
Detailed Design of the Bridge (Cont'd)

- General Description of Bridge



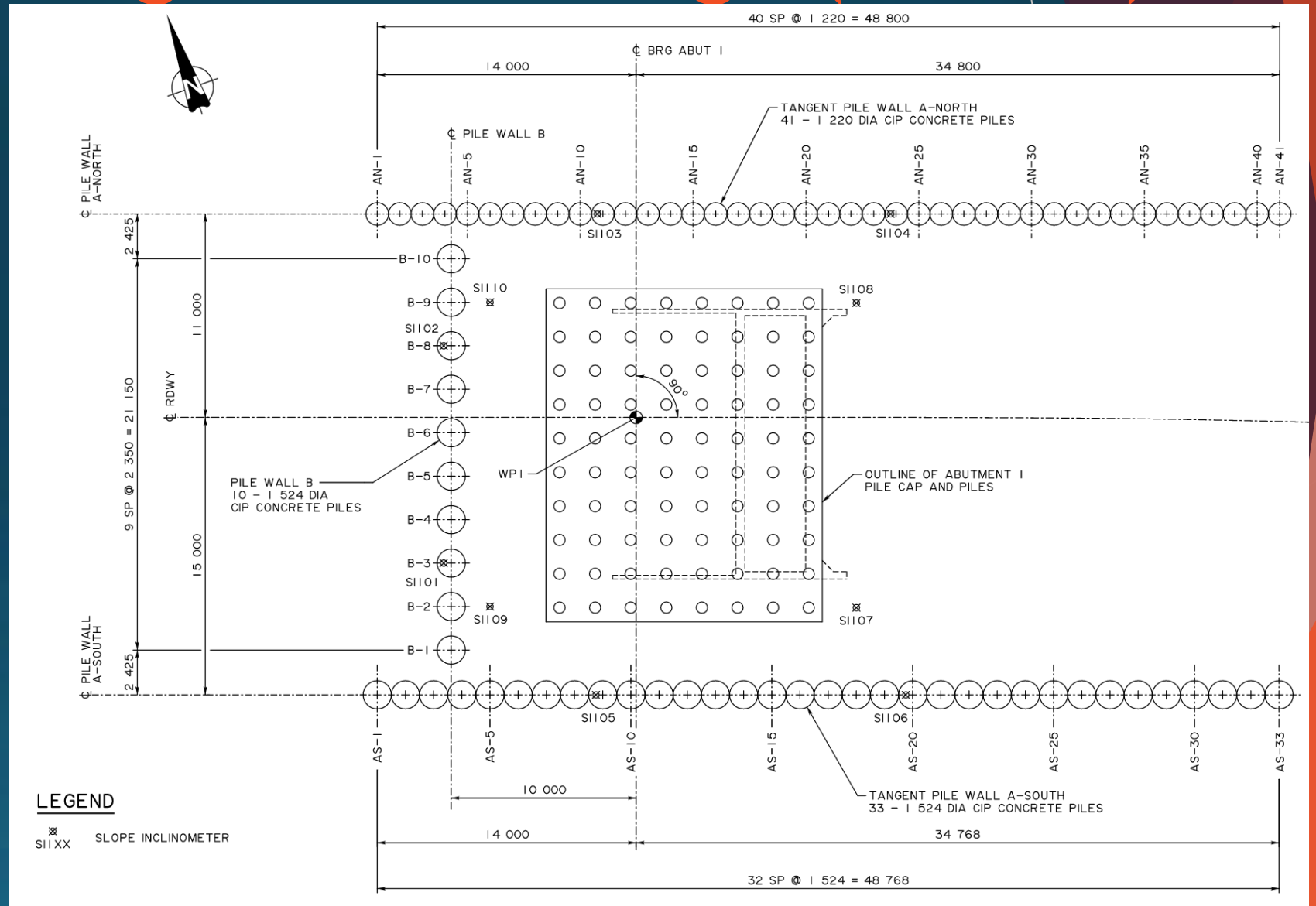
Detailed Design of the Bridge (Cont'd)

- General Description of Bridge



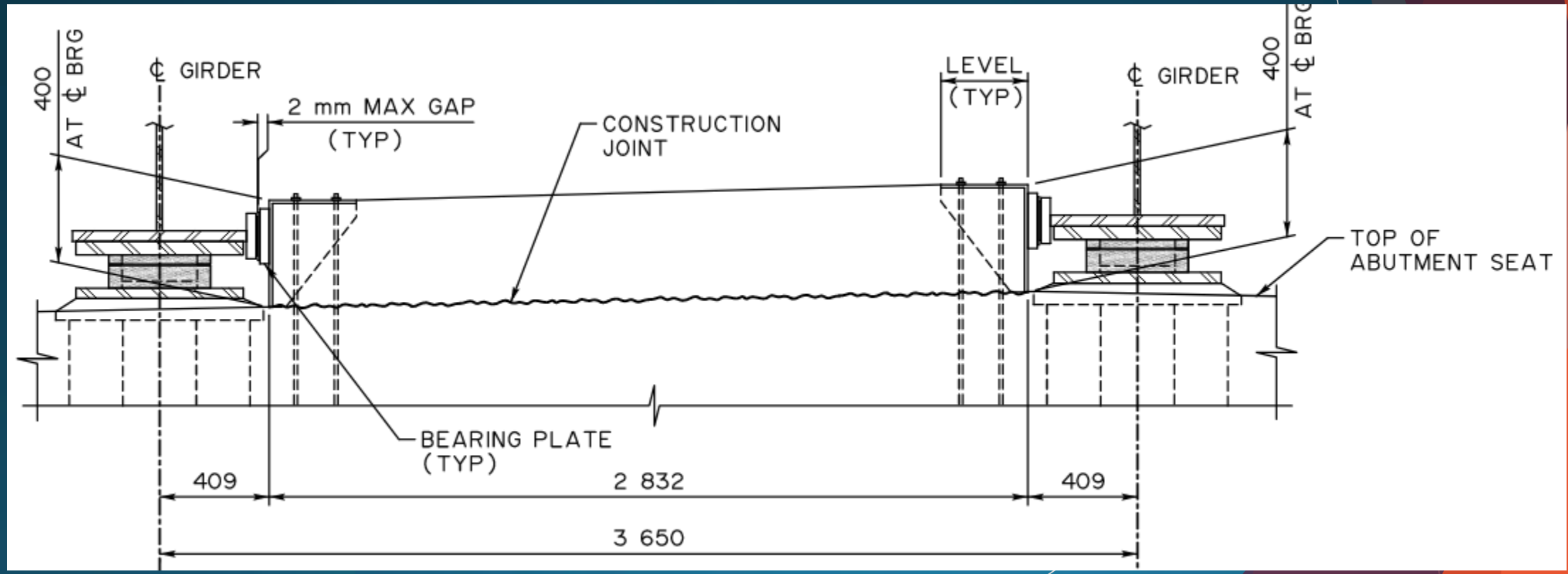
Detailed Design of the Bridge (Cont'd)

- Pile Wall Design



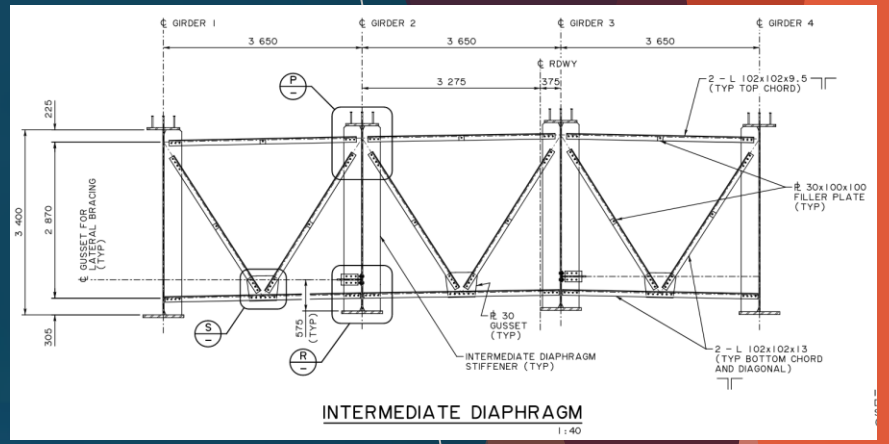
Detailed Design of the Bridge (Cont'd)

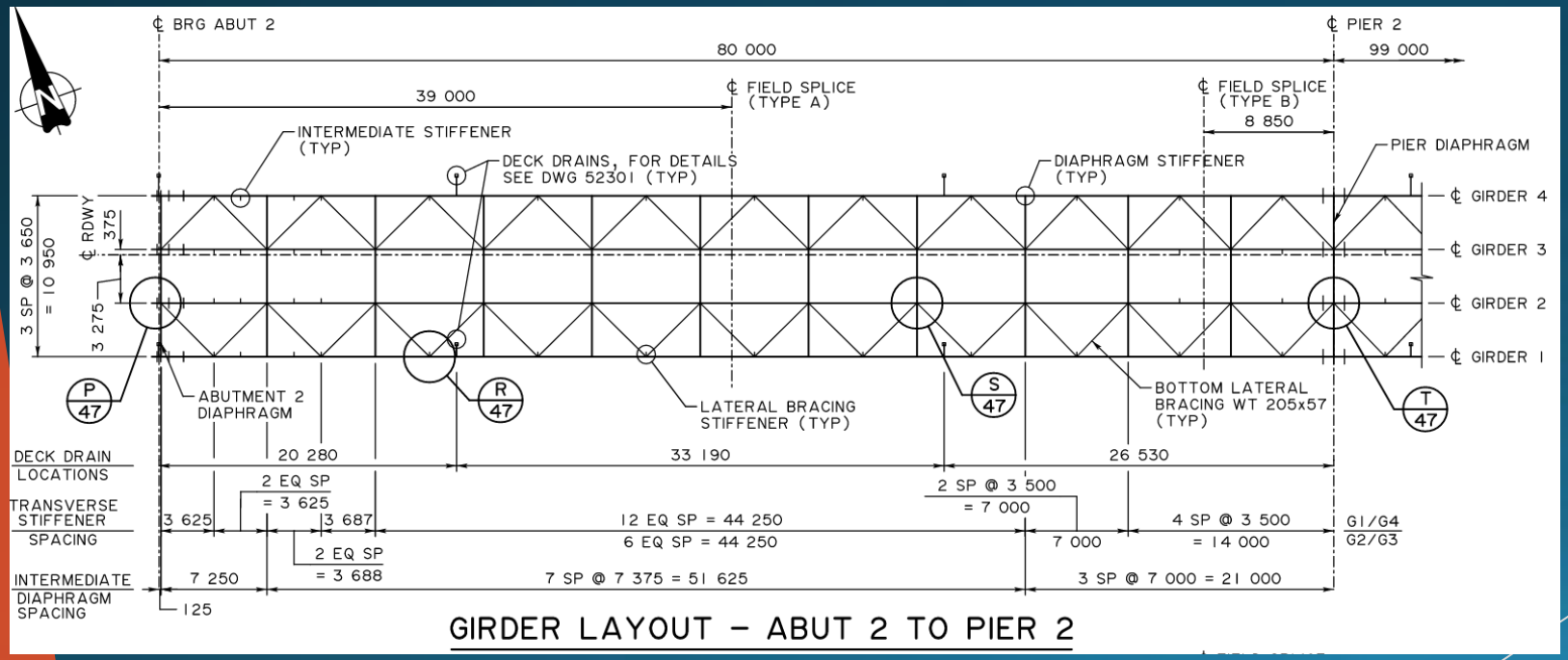
- Bridge Articulation
  - Pot Bearings and Shear blocks

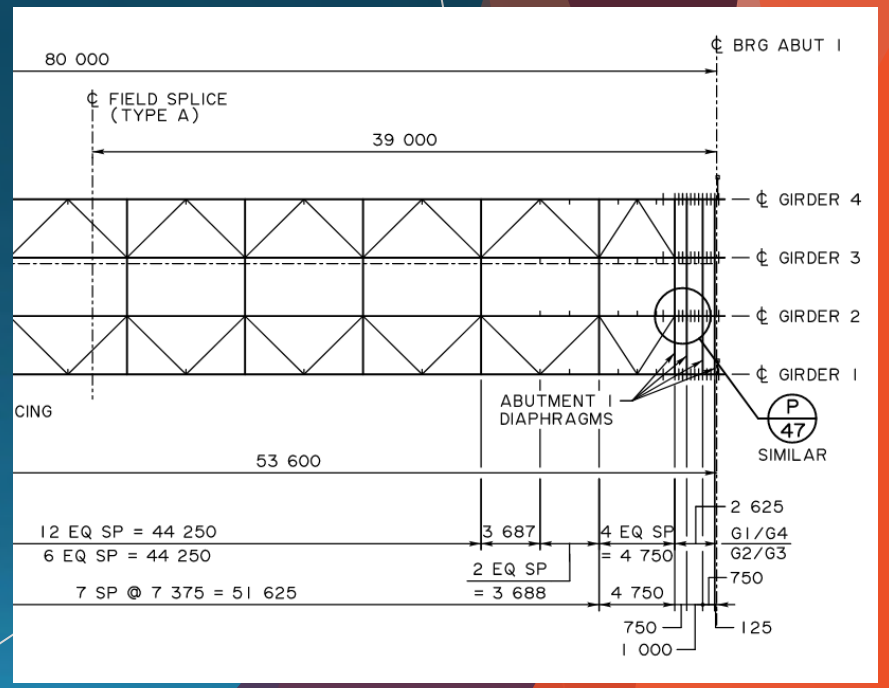


Detailed Design of the Bridge (Cont'd)

- Superstructure Details - Girders and Bracing
  - 22 mm thick web
  - K-bracing at 7.5 m max spacing
  - Bottom lateral bracing

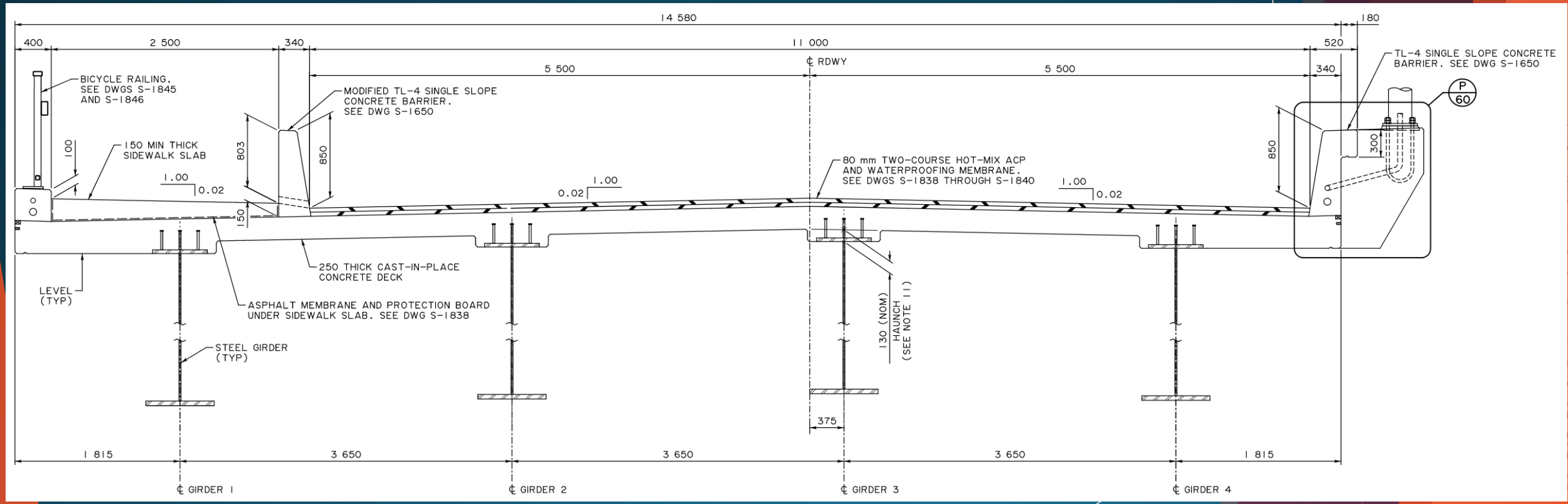






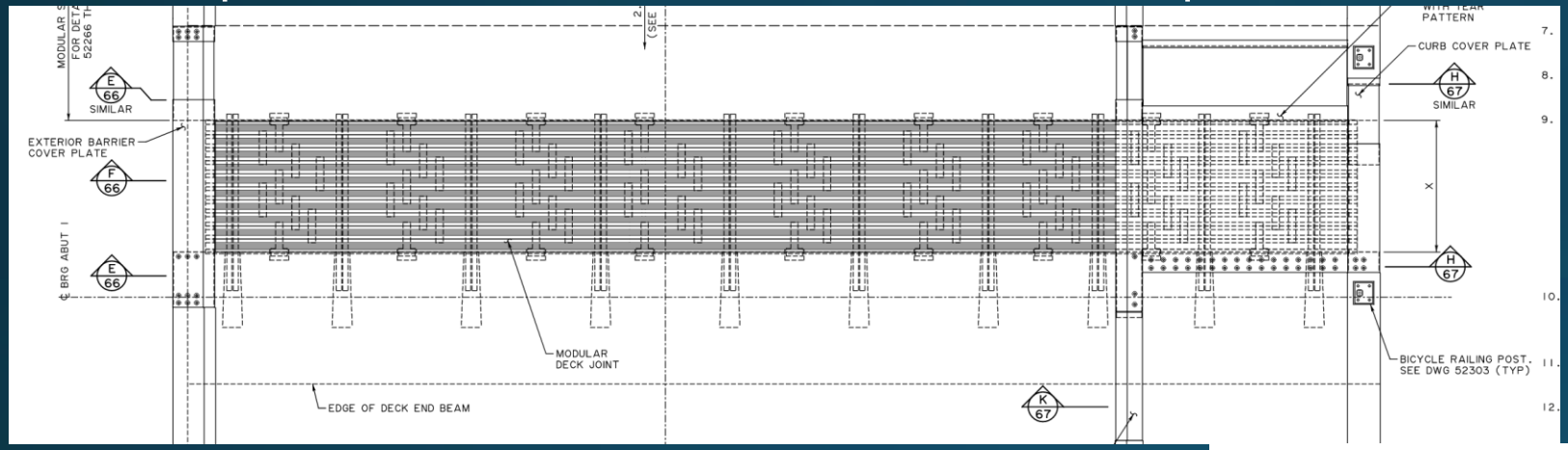
Detailed Design of the Bridge (Cont'd)

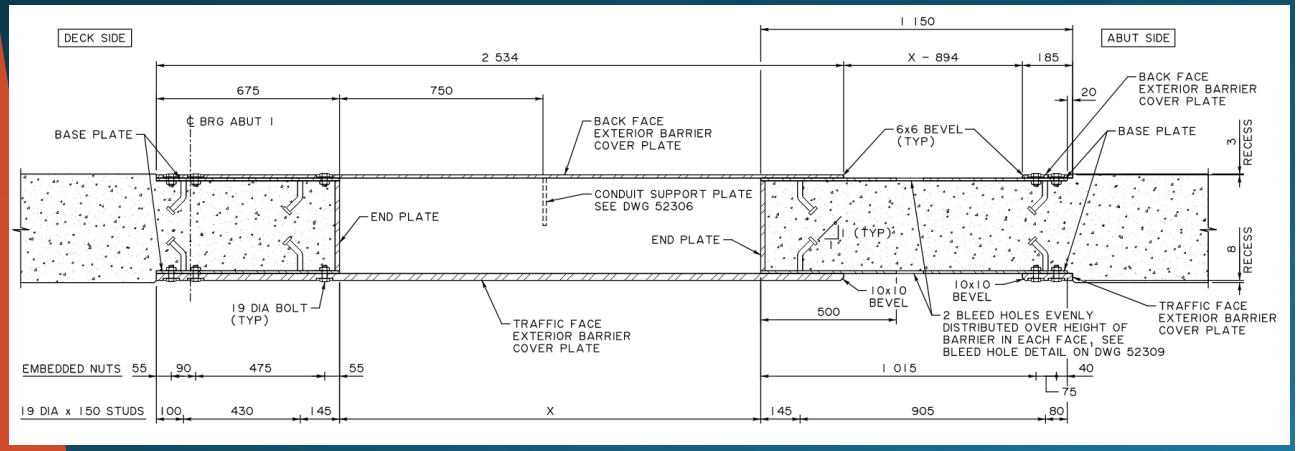
- Superstructure Details - Deck and Barrier Expansion Joints

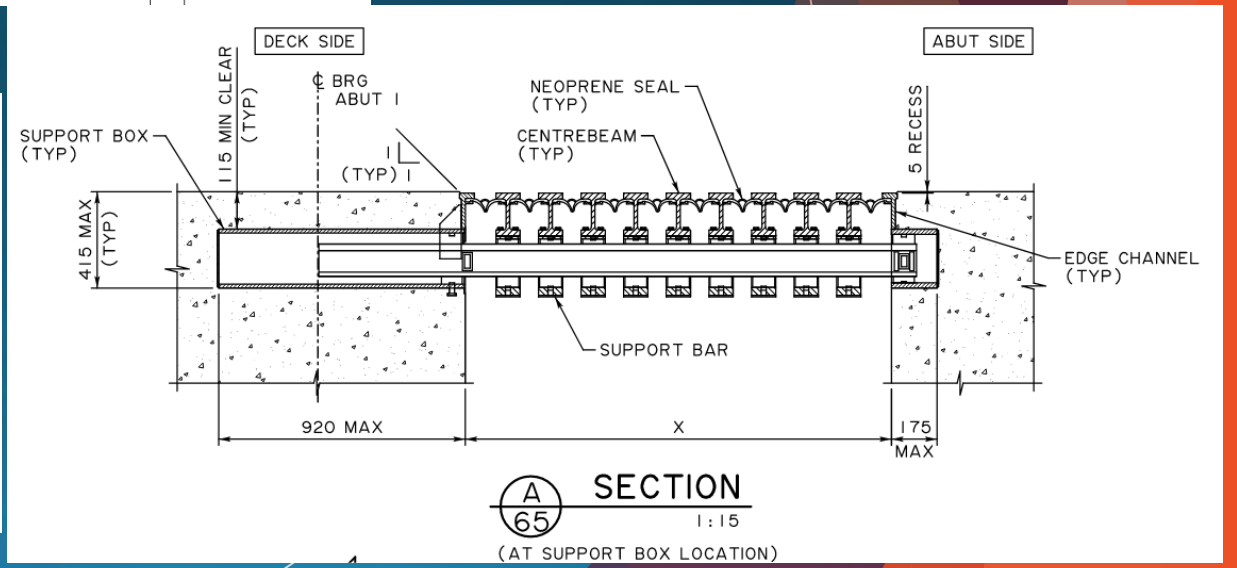


Detailed Design of the Bridge (Cont'd)

- Superstructure Details - Deck and Barrier Expansion Joints

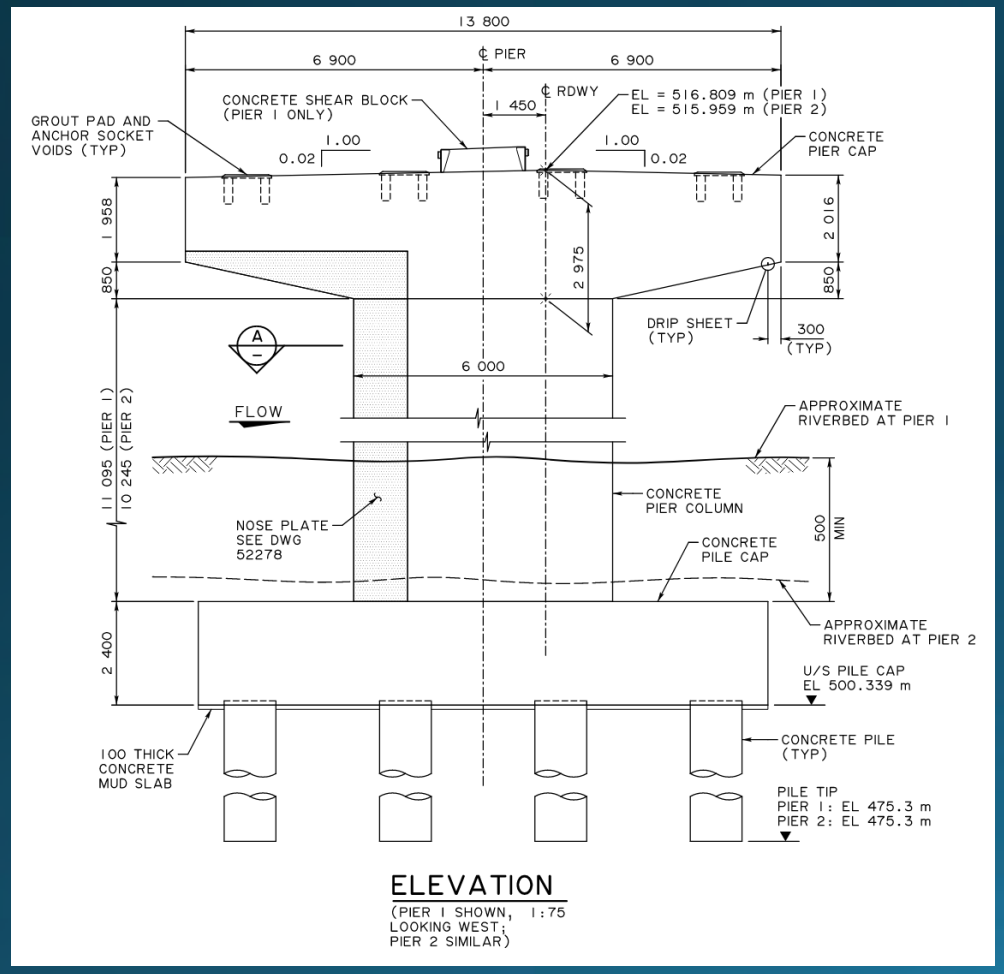


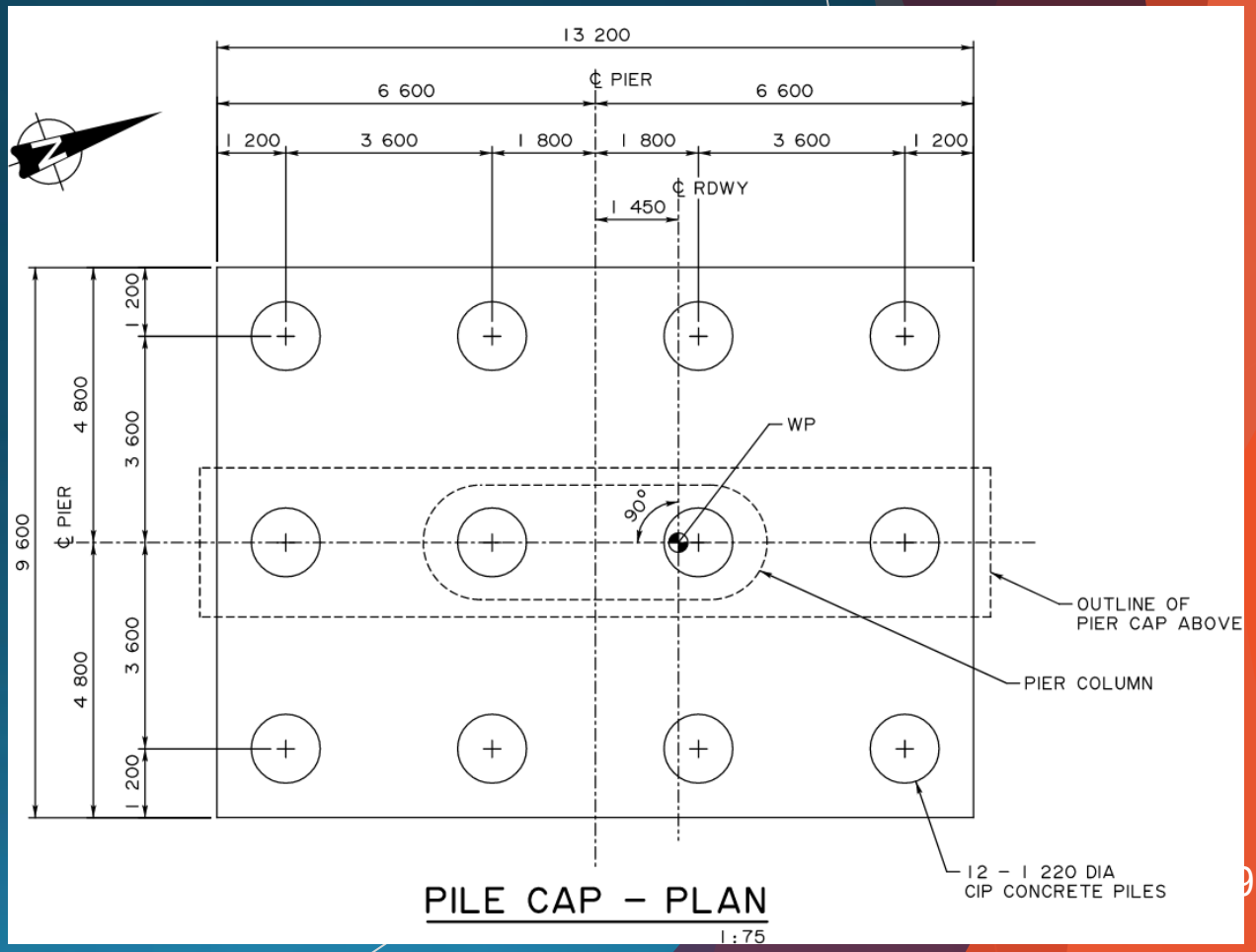




Detailed Design of the Bridge (Cont'd)

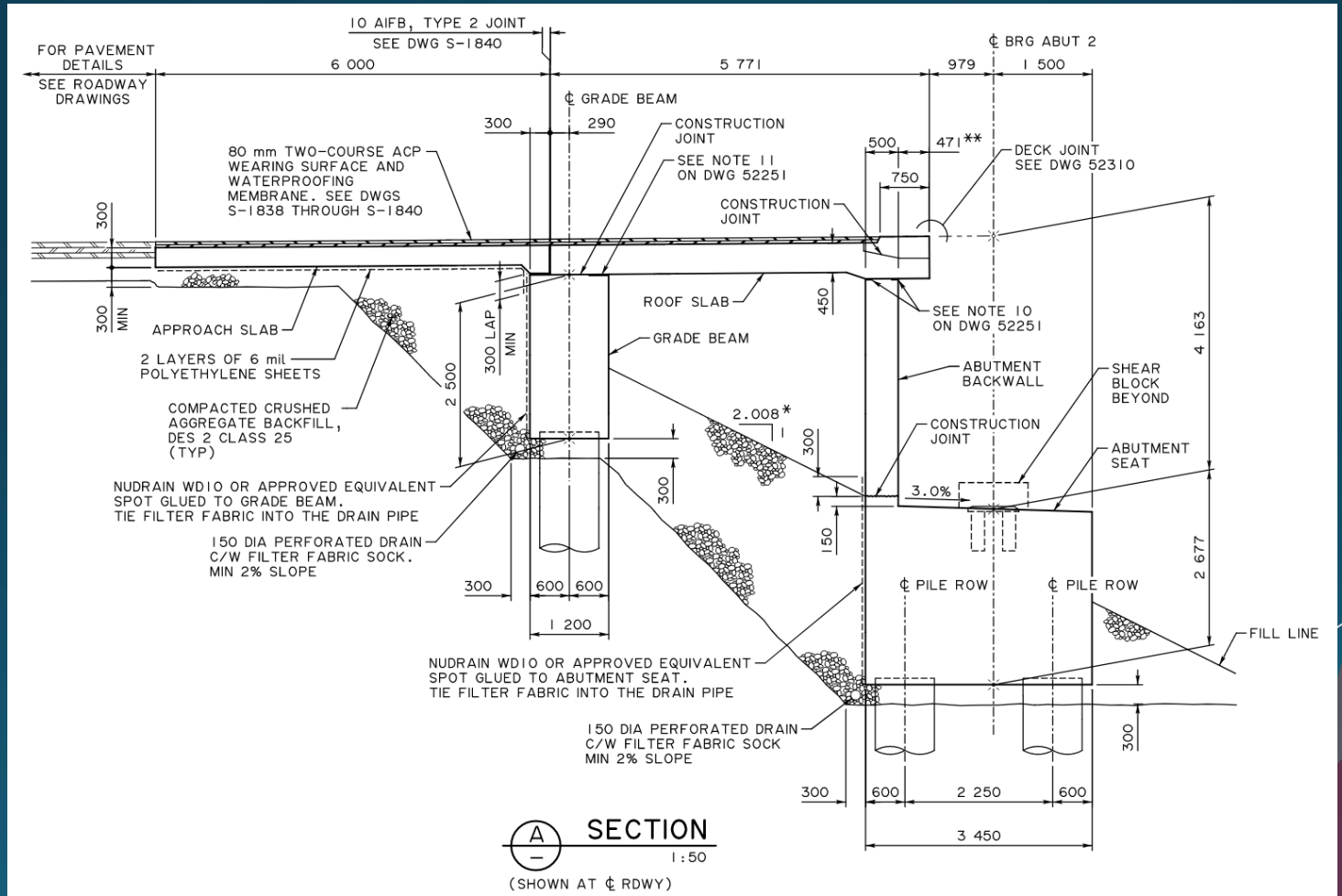
- Substructure Details - Piers





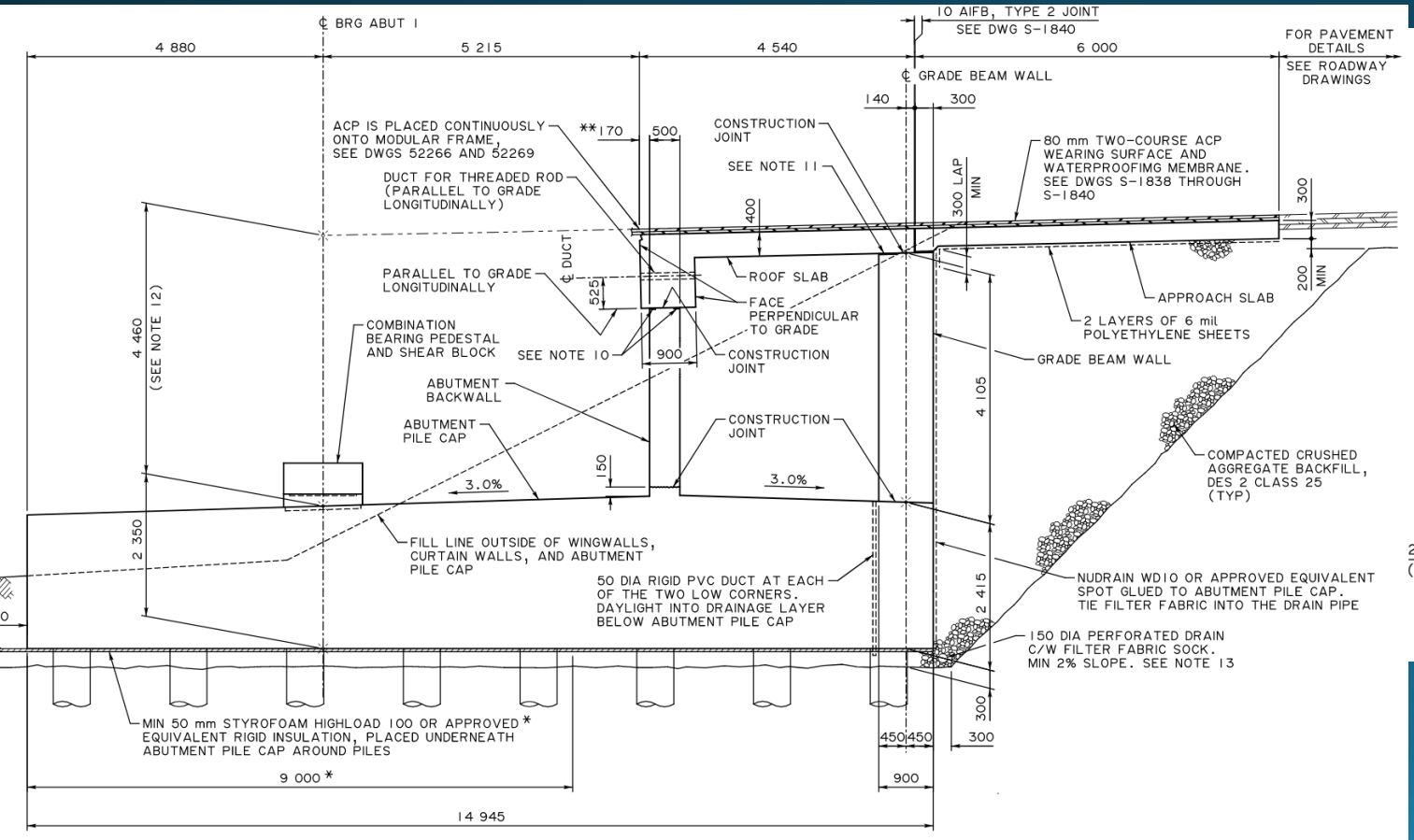
Detailed Design of the Bridge (Cont'd)

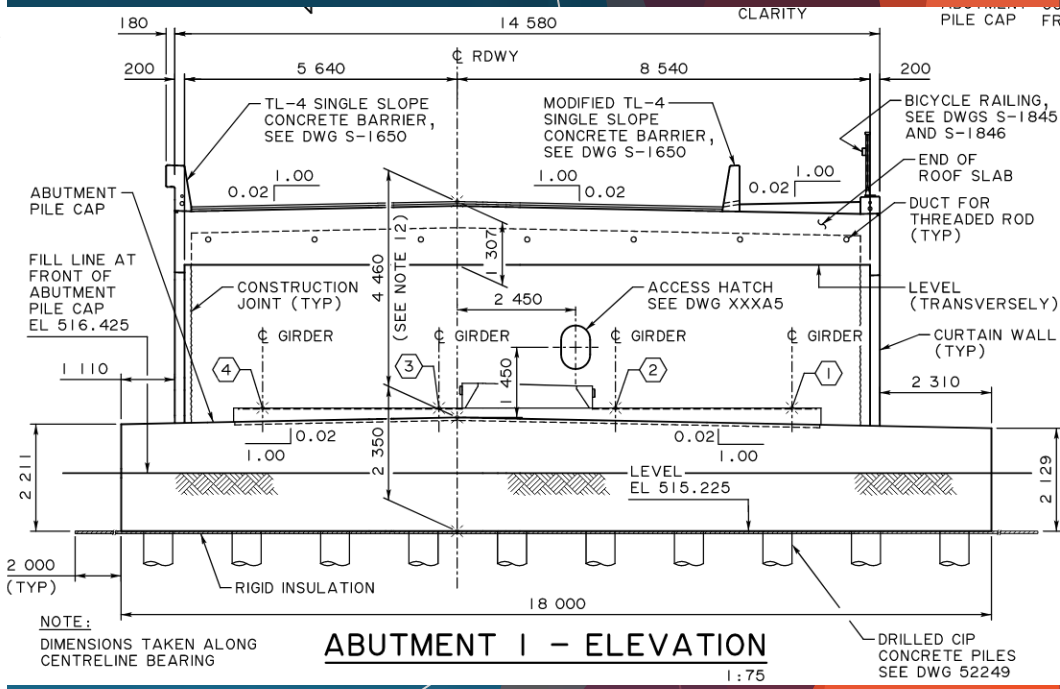
- Substructure Details - Abutment 2



Detailed Design of the Bridge (Cont'd)

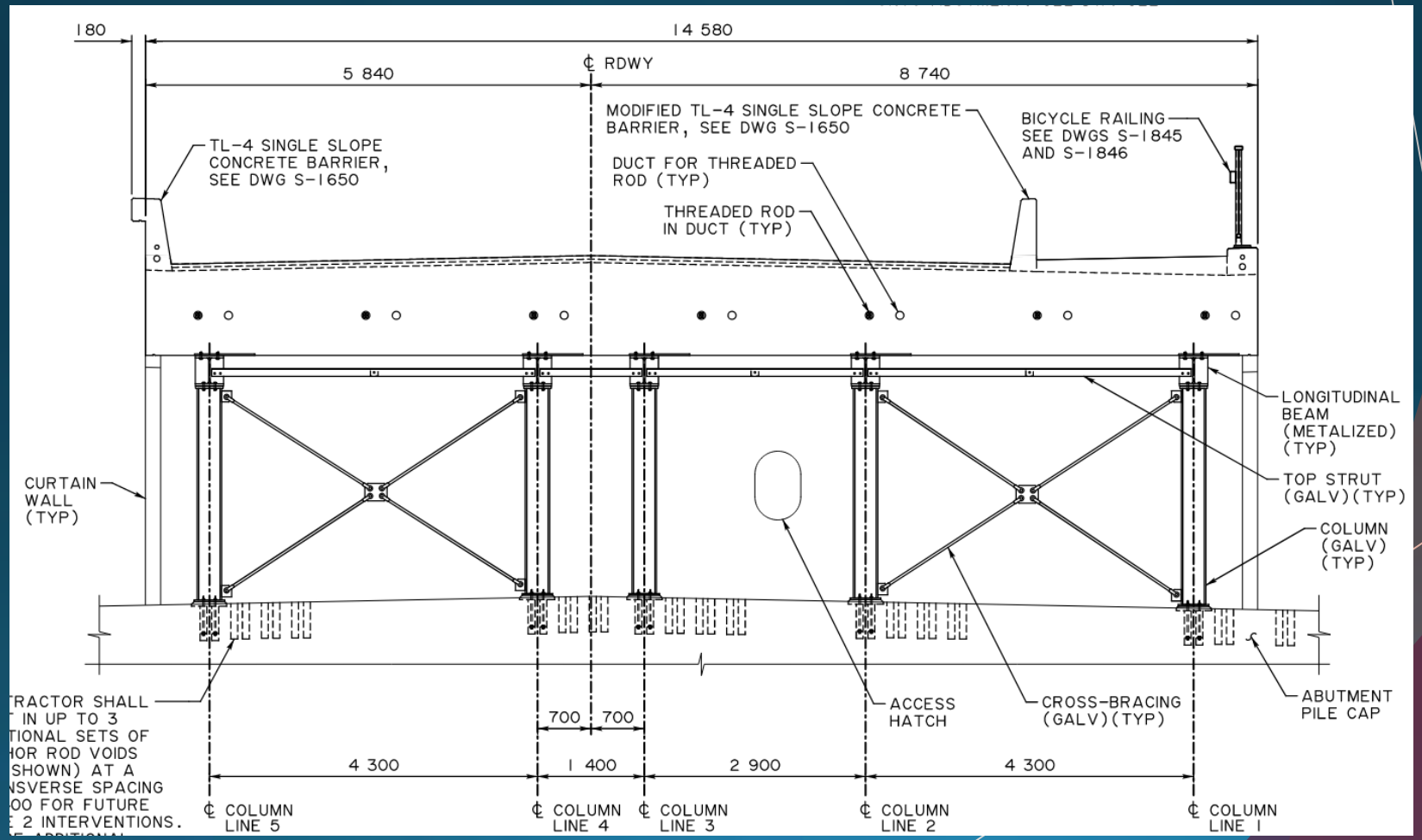
- Substructure Details - Abutment 1 and Modular Frame





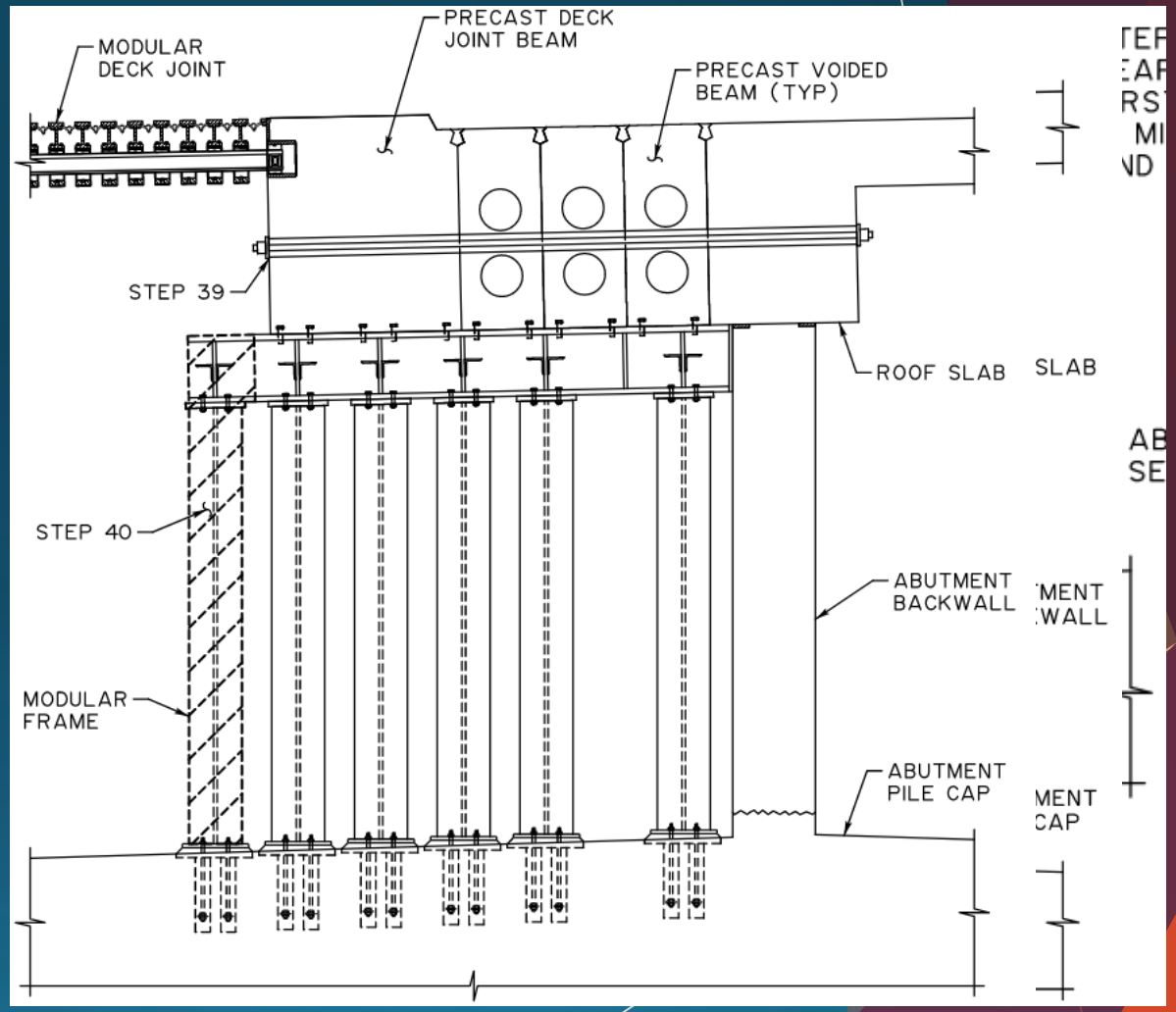
Detailed Design of the Bridge (Cont'd)

- Substructure Details – Abutment 1 and Modular Frame (Cont'd)



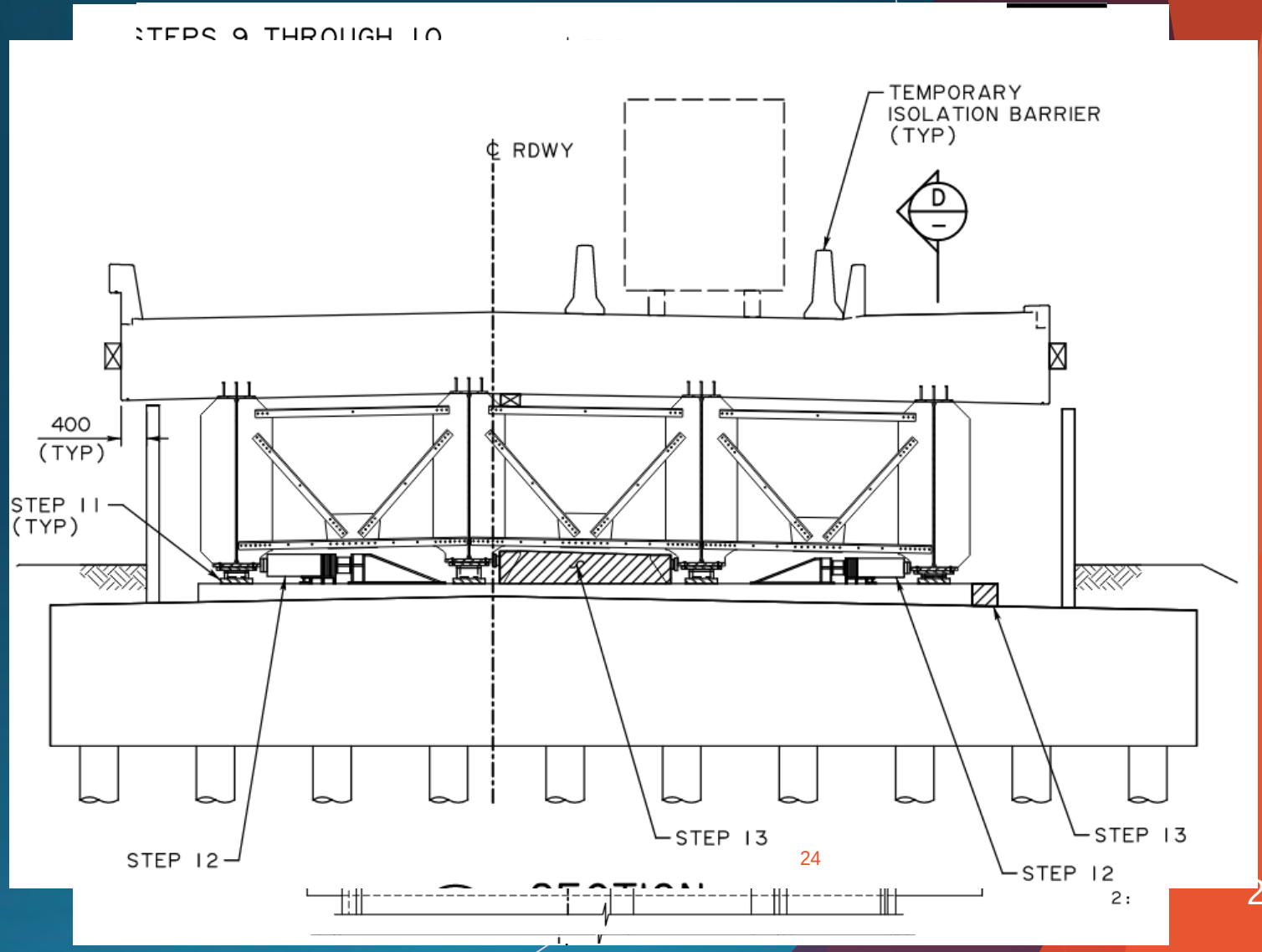
Detailed Design of the Bridge (Cont'd)

- Type 1 Interventions



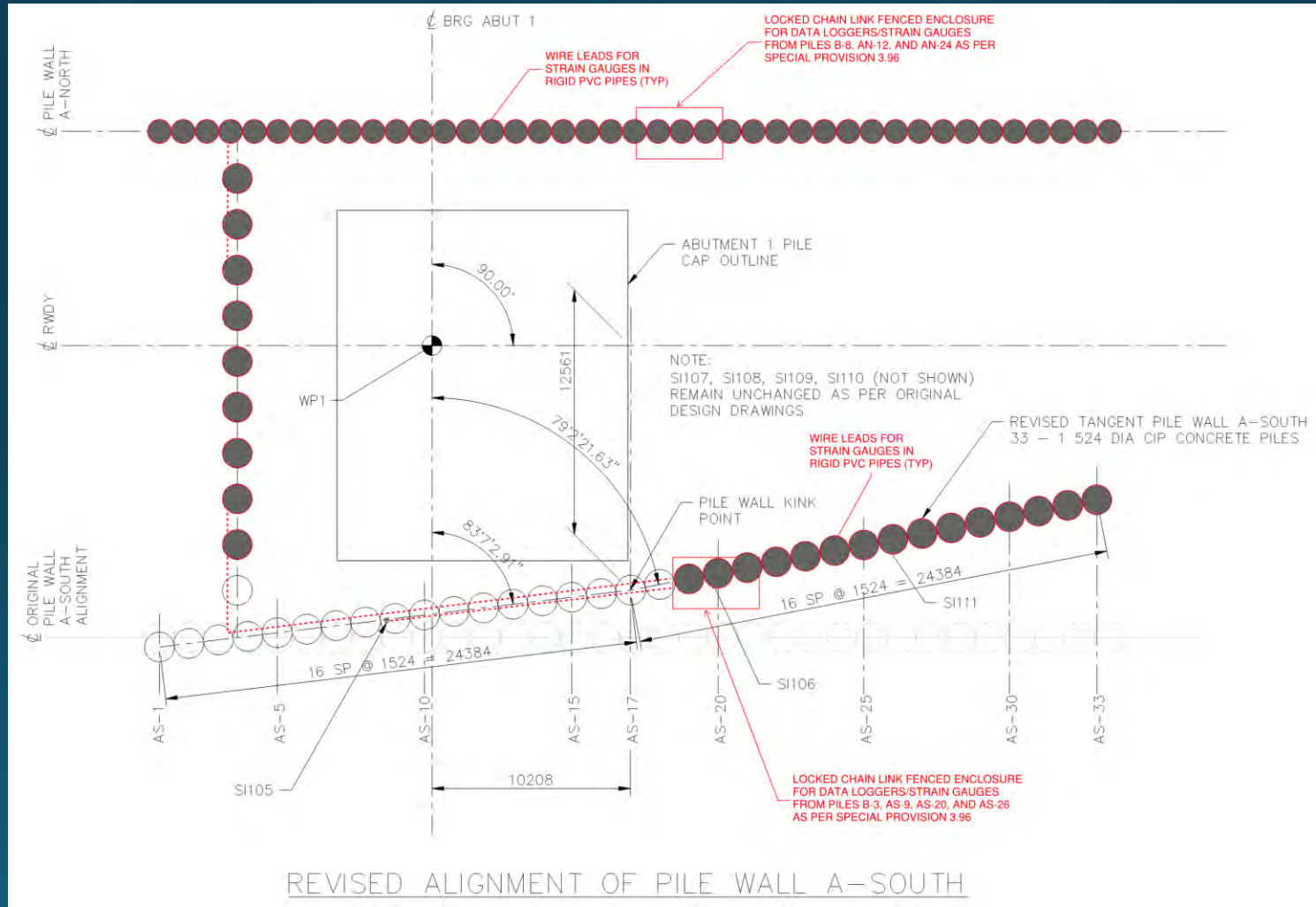
Detailed Design of the Bridge (Cont'd)

- Type 2 Interventions



Construction Progress

- Pile Walls on the East Slope



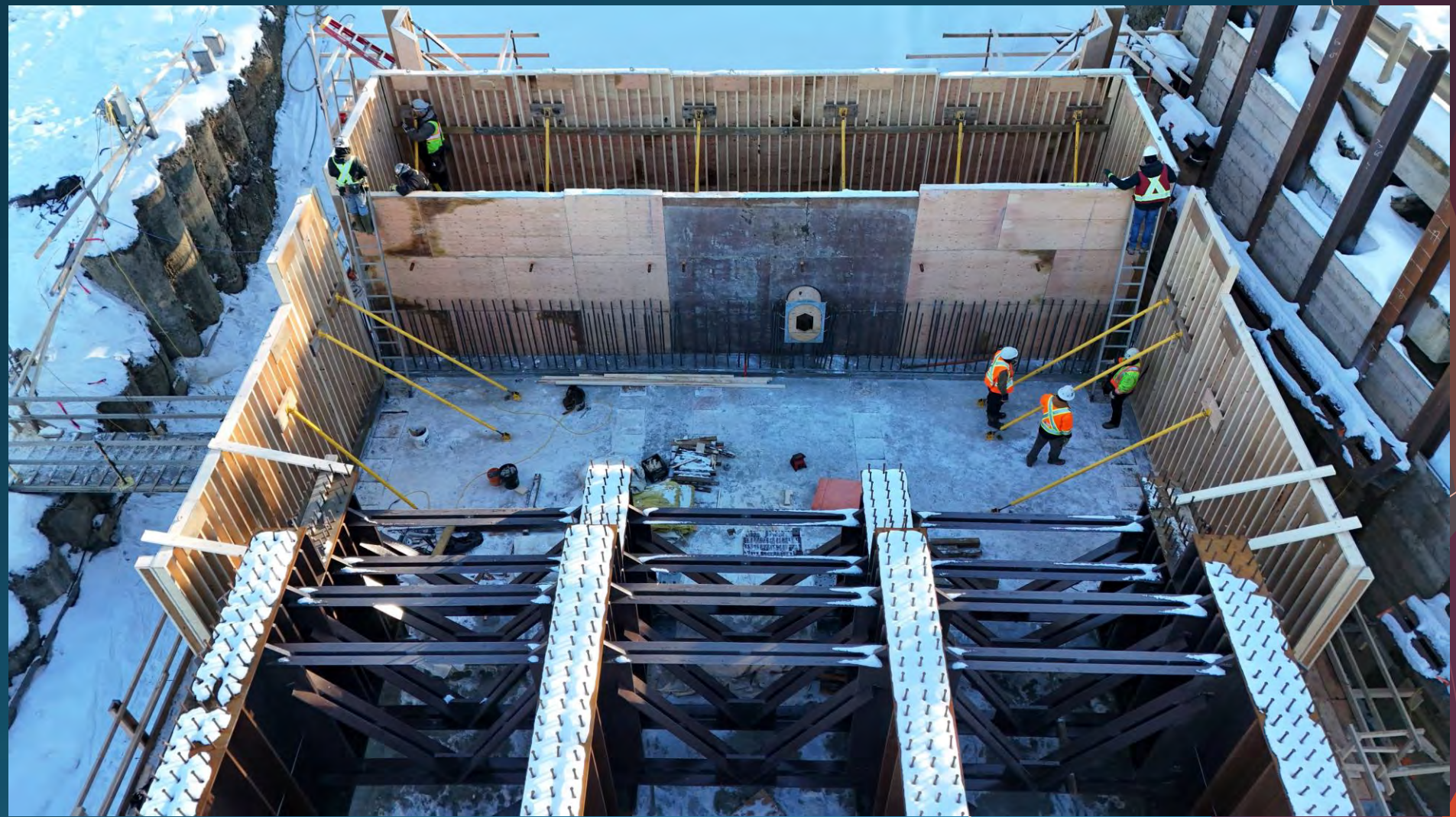
REVISED ALIGNMENT OF PILE WALL A–SOUTH

Construction Progress (Cont'd)

- Abutment 2 Construction

Construction Progress (Cont'd)

- Abutment 1 Construction



Construction Progress (Cont'd)

- Pier Construction

Construction Progress (Cont'd)

- Girder Erection

Acknowledgements

Alberta

COWI

ALBERCO CONSTRUCTION LTD.

TETRA TECH

Questions?