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Replacement of Red Deer River Bridge near Morrin (Morrin Bridge)

Presentation prepared for Transportation Connects Alberta Conference
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Presentation Agenda

1. **Project Overview**
2. **Design**
3. **Construction**
4. **Environmental**
    1. Aquatics and vegetation (Offsetting Plan)
    2. Erosion control
    3. Paleontological
5. **Conclusions and Acknowledgements**

Project Overview

Location and Existing Bridge

- BF9551 Carrying Highway 27 over Red Deer River
  - 12 km SW of Morrin, 40 km NW of Drumheller
- Situated in one of Alberta's truly special places
  - Badlands region near Drumheller
  - Home to countless treasures of paleontology
- Existing Bridge
  - Built in 1959
  - Two 61.0 m long through truss spans with 27.4 m long rolled beam spans at each end

Scope of Work

- Engineering services from preliminary design through post construction
  - Replacement of existing bridge (BF9551)
  - 1.6 km roadway improvement including realignment of the bridge

- Environmental requirements
  - Erosion and sediment control
  - Regulatory permitting and applications for river crossing (navigable water and sensitive to fish habitat)
  - Archeological site mitigation

Contributions

- Owner – Alberta Transportation (now Alberta Transportation and Economic Corridors)
- Prime Consultant – Jacobs
  - Structural, hydrotechnical, environmental (aquatics, regulatory permitting, vegetation), construction supervision
- Sub-consultants
  - WSP: Roads, erosion control, survey
  - Thurber: Geotechnical, material engineering
  - SGS: Steel QA inspection and testing
  - Bison Historical Services: Archeology
    - Nautilus Paleontology
- Contractor – Trevcon Enterprises

Project Timeline

- Project award – Jan. 2013
- Tender advertised – Mar. 2017
- Construction start – Sep. 2017
- Bridge open to traffic – Fall 2019
- Construction completion – Oct. 2020
- Warranty inspection – Roads – 2021
- Warranty inspection – Bridge – 2022
- Environmental monitoring completion – Sep. 2023
- Project completion – Feb. 2024

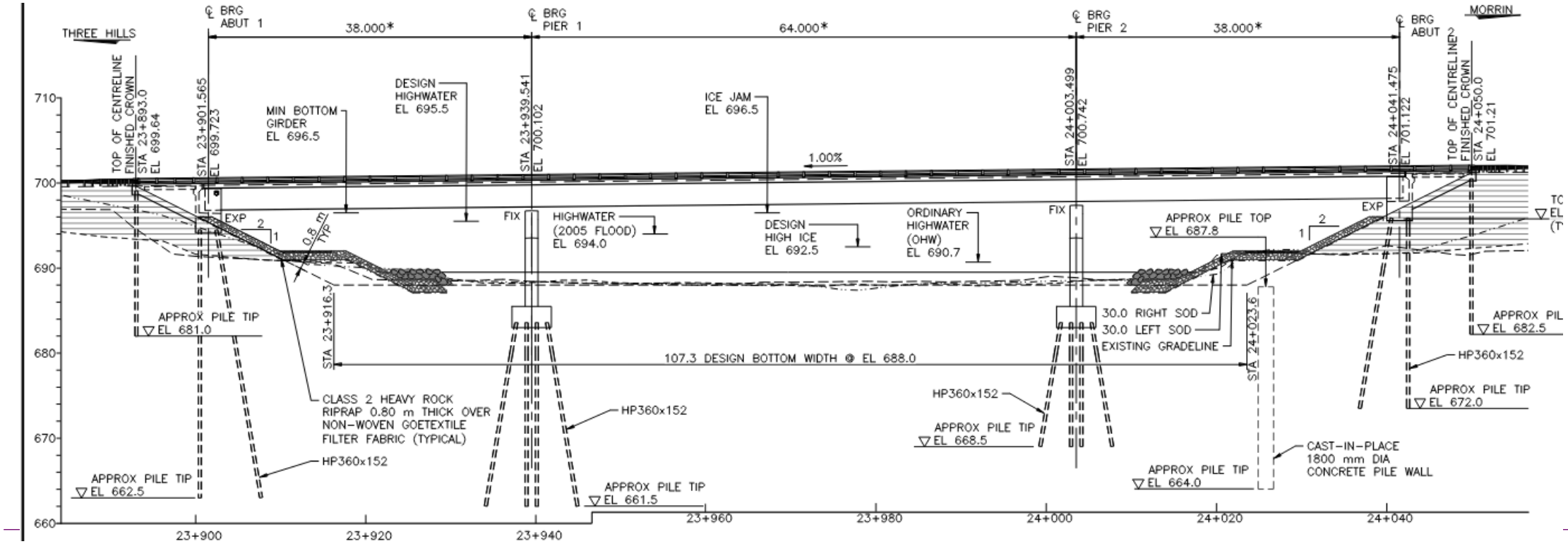
Design

New Alignment

- New alignment with about 25 m centre to centre spacing

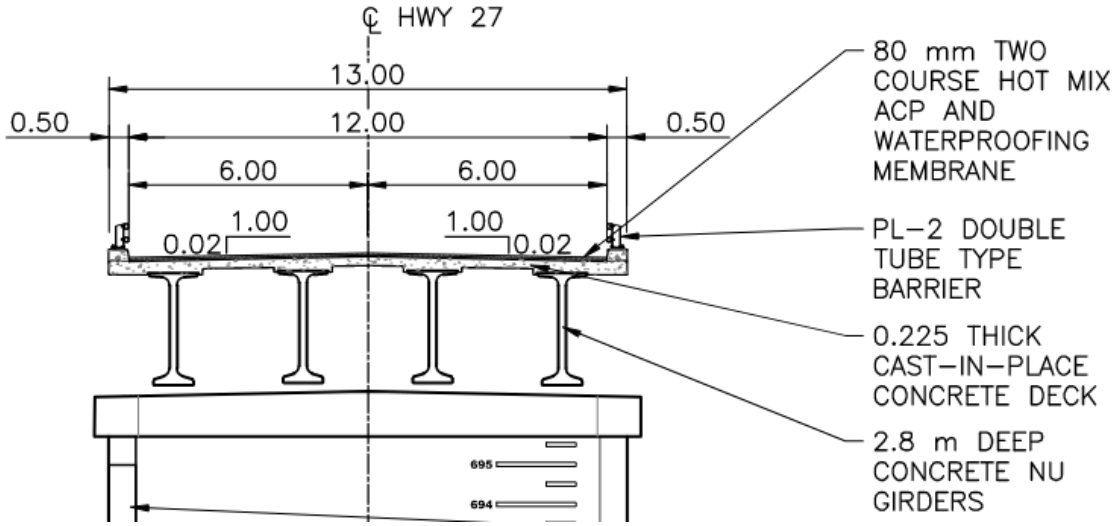
Structure Highlights

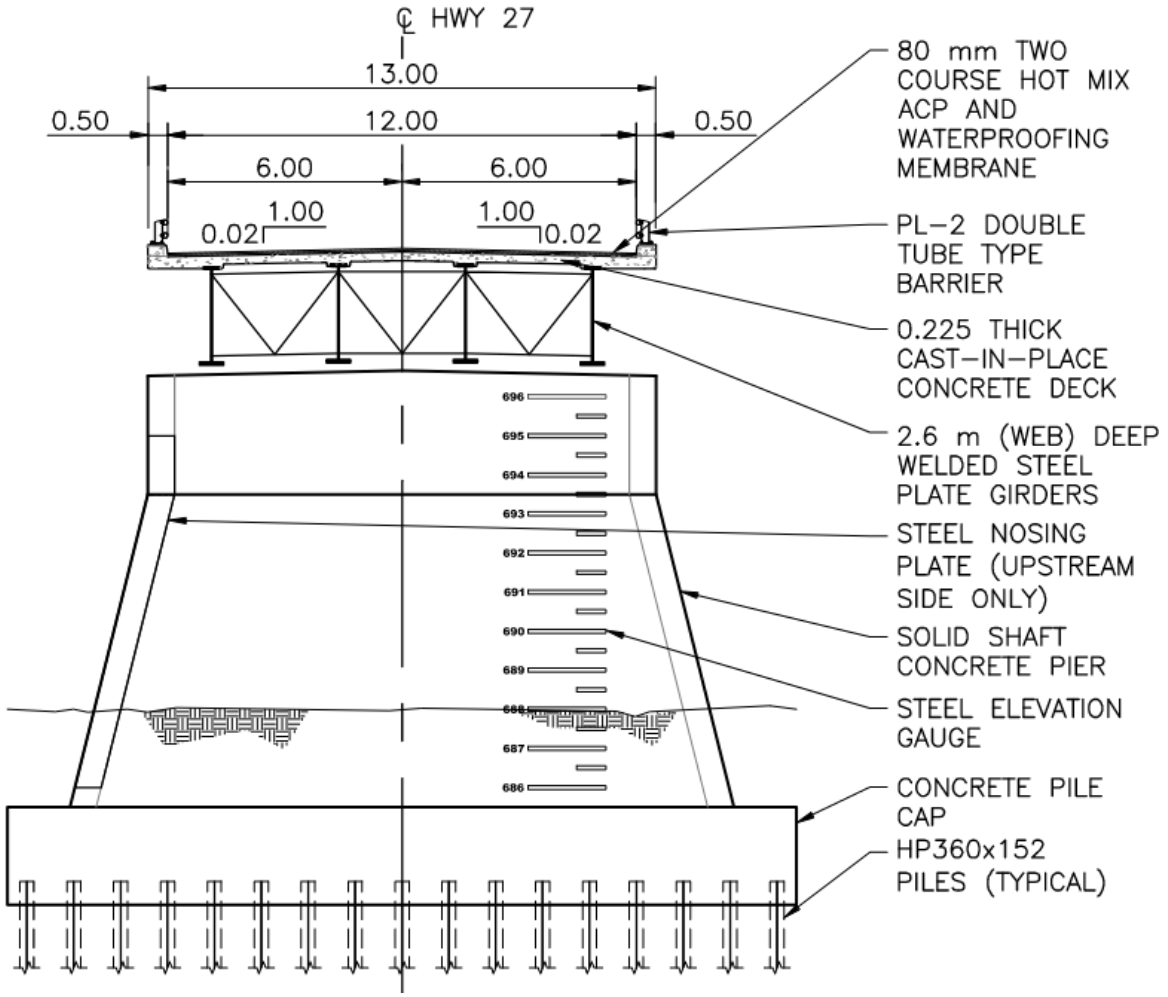
- Detail design for both steel and concrete girder options - Steel option selected after tender
- Three continuous spans with lengths of 38-64-38 m (similar for both options)
- Conventional abutments with H piles at abutments and piers
- Concrete pile wall at east



Section

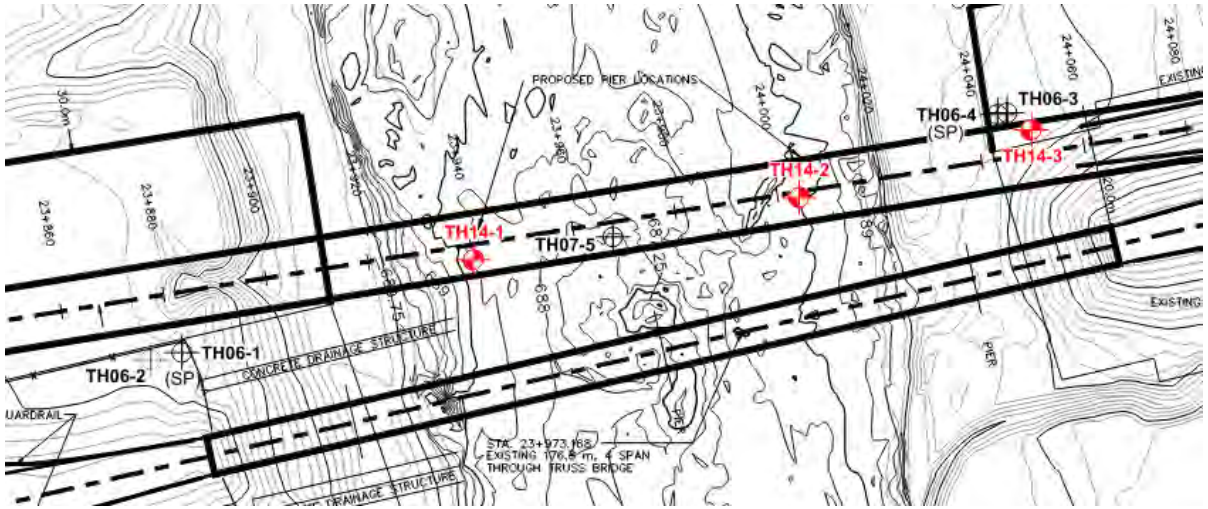
- Two traffic lanes of 3.7 m width with 2.3 m shoulders
- Steel option – Four girders with 2.6 m deep web
- Concrete option – Four 2.8 m deep NU girders
- 0.225 thick cast in place concrete deck with ACP and water proofing
- Solid shaft concrete piers with steel nosing plate and elevation gauge





Geotechnical Investigation (Thurber)

- Preliminary geotechnical investigation carried out in 2007:
  - Two boreholes at each abutment,
  - One in the middle of the river
- Additional boreholes for the bridge in 2014:
  - One at each pier location in the bridge
  - Another one at east abutment
- Boreholes for approach roads in 2016
  - Three boreholes at each side of the bridge
- Drilling for river boreholes conducted in winter through ice bridge



Images from Thurber

Site Geotechnical Issues

- Weak bentonite layer at east abutment which could impact the global stability at the east abutment
  - Installed a pile wall consisting of large diameter tangent piles extending through the bentonite layer
- Considerable dip (more than 20 m) in bed rock elevation from east to west, bedrock not encountered in west abutment within drilling depth of 30 m

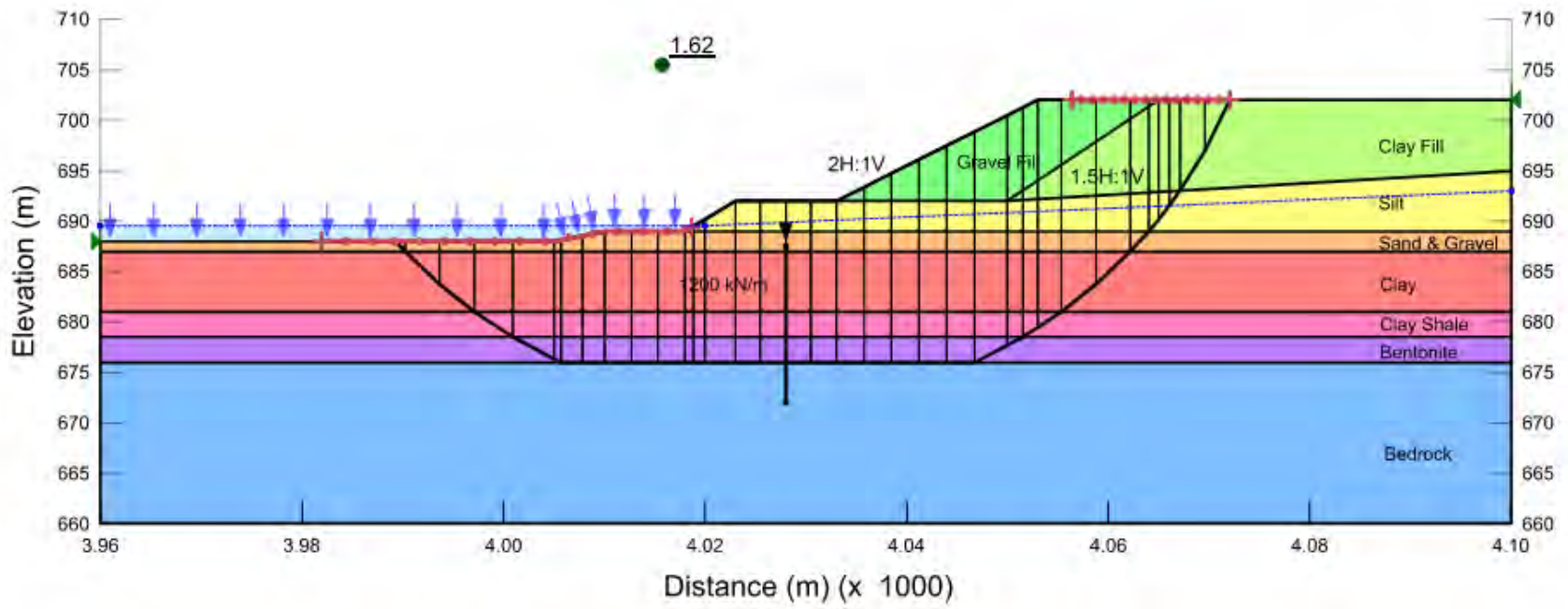
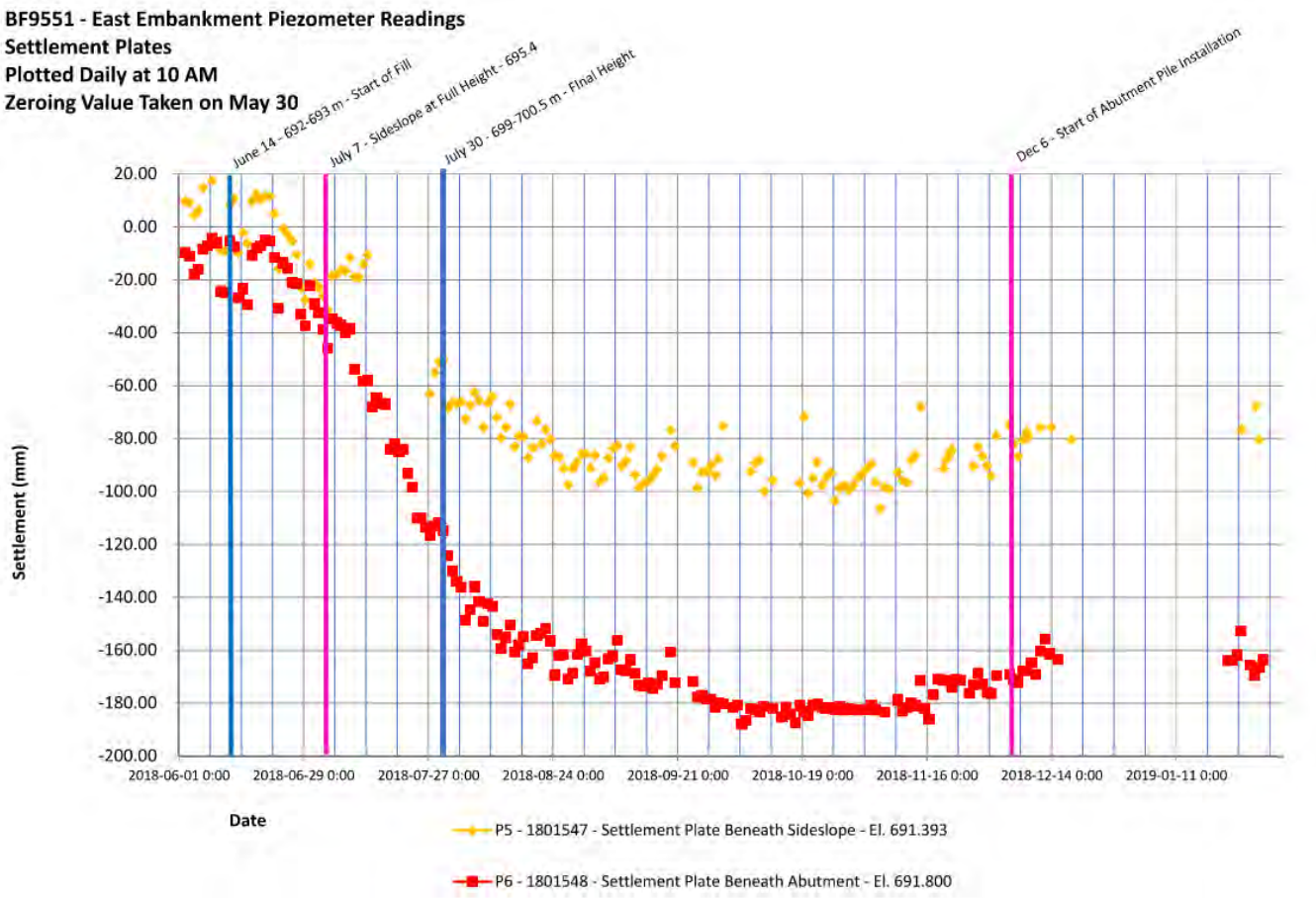


Image from Thurber

Geotechnical Monitoring

- Shear pile wall was mainly constructed in front of head slope (to reduce the cost for the ears with lower risk)
- Instrumentation installed along the flanks of approach fill at east abutment to monitor ground movement and pore pressure (to increase length of shear pile wall if results not favorable)
- Complete abutment fill to full height and let it sit for about six months before installing the abutment piles (to avoid downdrag in the piles).
- Provide instrumentation and monitor settlements



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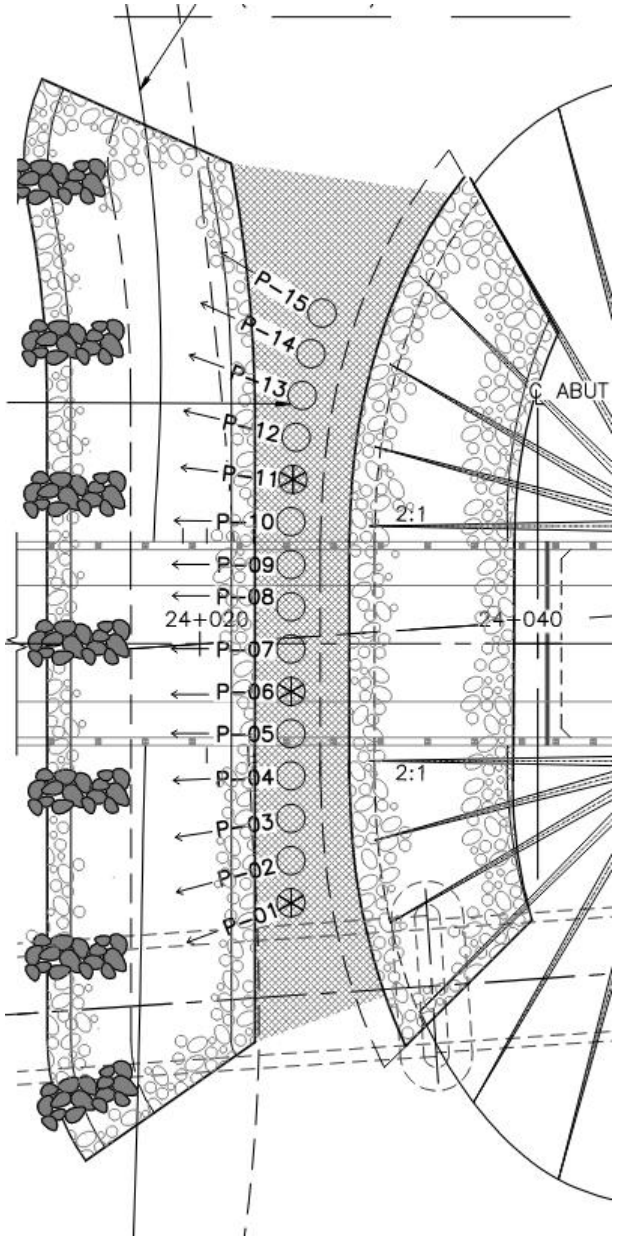
Construction

Sep. – Nov. 2017

- Mobilization – 17/09
- Shear pile wall
  - 1.8 m diameter – 24 m long – CIP Concrete piles
  - CSL tubes installed in all of the piles
  - Challenges with unfavorable CSL results
  - Coring and Pile Integrity Testing (PIT) conducted before accepting the piles



Paleontological Monitoring

- Paleontological monitoring required for major excavations including excavated material from shear pile wall
- Dinosaur bone fossil excavated from P-12

Dec. 2017 to Feb. 2018

- West berm and piling for pier 1
- West Berm installation and removal – 17/12 to 18/04

Mar. - Apr. 2018

- Casting Pier 1 - West
- Working on abutment 1 (west)
- Removing west berm
- Installing east berm
- East berm flooded

May – Oct. 2018

- Completing west abutment
- Bearings on site
- Completing shear pile wall
- Working on pier 2
- Grading, backfilling, and erosion control work on ditches.

Nov. – Dec. 2018

- Finishing Pier 2
- Working on Abutment 2
- Erosion Control work in the ditches

Jan. – Mar. 2019

- Finishing abutment 2
- Placing rip-rap in abutment headslopes
- Installing bearings
- Installing berm at west and shoring tower
- Girder erection from berms and ice bridge
  1. Segment on west pier and shoring tower
  2. Segment between pier and abutment
  3. Move shoring tower to east berm and install middle segment
  4. Segment on east pier
  5. Segment between east pier and abutment
- Working on connections
- Erosion Control work in the ditches

Apr. – Jun. 2019

- Deck formwork and rebar
- Casting deck and curing
- V-Seal Deck joint at west abutment

Jul. – Aug. 2019

- Casting approach slabs and bridge curbs
- Deck waterproofing and asphalt
- Approach roads and boat Launch access

Sep. – Oct. 2019

- Finger joint in east abutment
  - First finger joint to be installed per TEC bulletin 96 (after application of all superimposed dead loads)
- Seals for west abutment joint
- Drain troughs
- Boat launch access near east abutment
- Paving and finishing details

Bridge Open to Traffic

- Oct. 22, 2019 - One lane alternating open to traffic
- Nov. 08, 2019 – Both lanes open to traffic
- Nov. 10 – Jan. 01 - Phase Break

Existing Bridge Demolition, Jan. – Mar. 2020

- Flooded the ice to build ice bridge
- Removed west approach and demolished west abutment
- Removed east approach and demolished east abutment
- Phase break Jan. 27 to Feb. 17
- Demolished the deck
- Demolished the west pier starting from top

Existing Bridge Demolition, Cont.

- Continued with demolishing west pier to allow the truss to fall on the ice from one end
- Dismantled the truss
- Similar process with the second truss
- Finished with demolishing the remaining parts of the piers

Apr. – Oct. 2020

- Phase Break, Apr. 04 to May 25
- Ditch work, erosion repair, road work, paving
- Hydroseeding
- Culvert installations

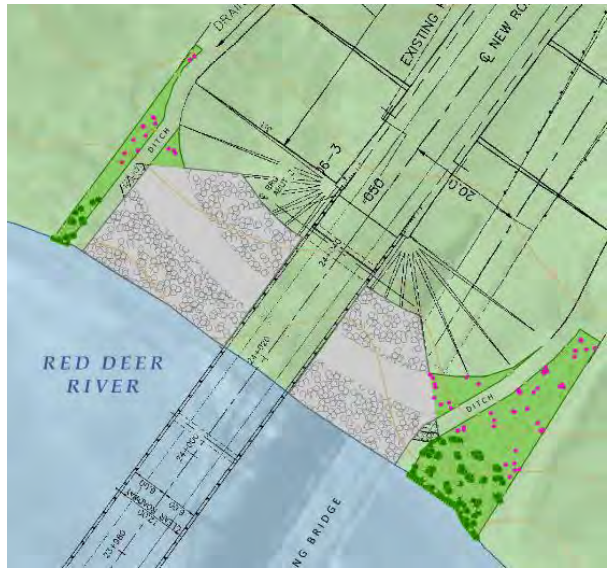
Construction Completion

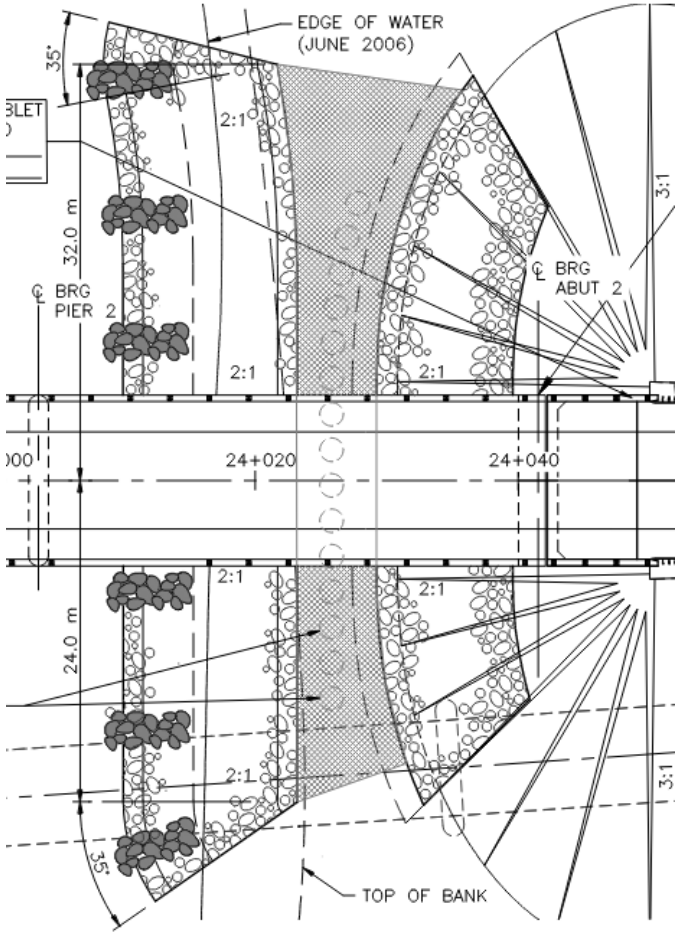
- Construction completion inspection, Oct. 06, 2020
- Warranty inspection, roads, 2021
- Warranty inspection, bridge, 2022
- Environmental monitoring till 2023
- Project completion 2024

Environmental

Offsetting Plan

- Authorization required for permanent instream work under Fisheries Act
- Permanent instream work:
  - Piers in the river (footprint smaller than existing bridge)
  - Protection rip-rap
- Offsetting Plan provided to propose measures to counterbalance any possible serious harm to fish and maintain or improve fisheries productivity
- Proposed Offsetting Plan
  - Instream habitat: Extended keyed in class 3 rip-rap toe to form scalloped shoreline with short spurs
  - Riparian offsets: Riparian area planting including weed removal, seeding, planting, irrigation, and applying deterrent
  - Offsite replacement of a hanging culvert (not in Jacobs scope)



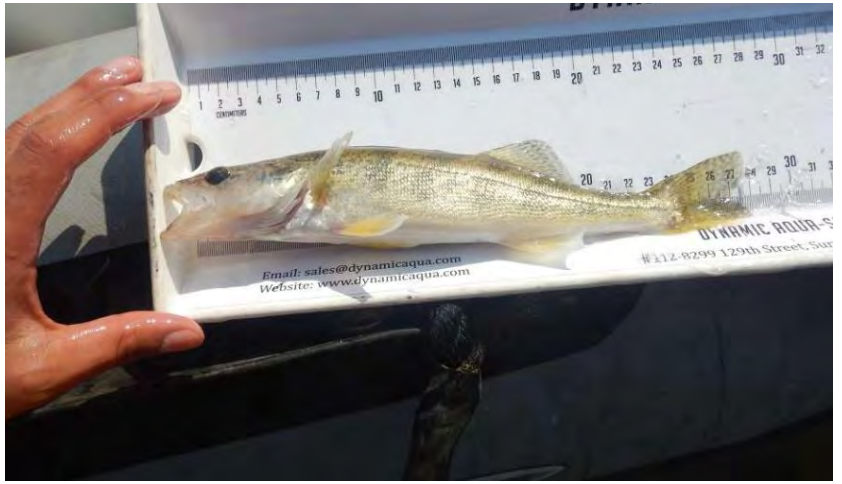


Implementation Monitoring (IM)

- During construction and 3 years after construction
- Objectives:
  - Monitor the installation of habitat enhancement structures.
  - Review and report on the construction results for the completed water quality monitoring and fish salvage operations.
  - Demonstrate the effective implementation and functioning of avoidance and mitigation measures to avoid serious harm to fish
  - Provide details on contingency measures that were followed in the event that standard mitigation measures did not function as described.
  - Prepare an annual implementation monitoring report by December 31 of the year of monitoring.

Post Construction IM – Aquatics – 2021 and 2022

- Objectives:
  - Fish sampling to compare scalloped shoreline and spurs with adjacent unenhanced areas to confirm presence/absence and relative abundance
  - Documenting site conditions for comparison with the as-built design and for year to year comparison of structural integrity
- Fish sampling conducted using a float electrofisher (FLEF) or a backpack electrofisher (BPEF)
- The new instream habitat offsetting was determined to be effective in providing flow breaks, with some small pool creation, and providing complexity that would be of better use to several fish species.



Post Construction IM – Vegetation– 2021 to 2023

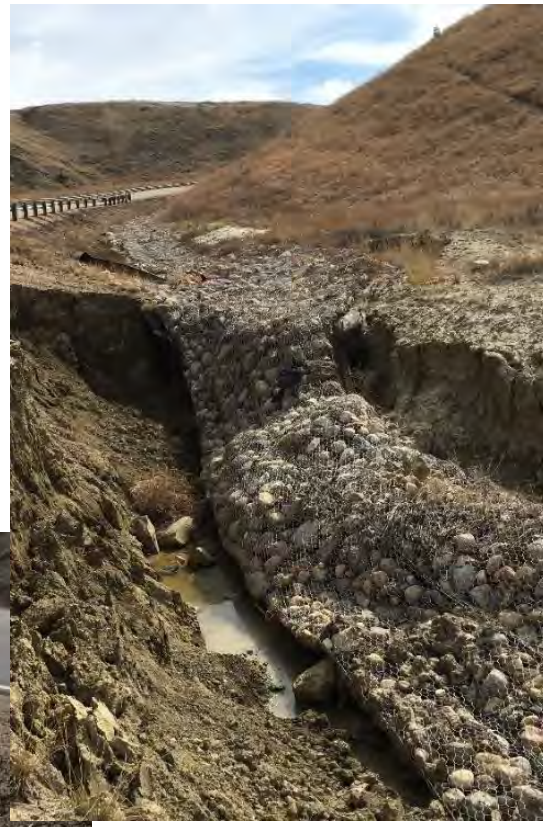
- Assess plant survival using the ratio of number of live plants to number of those installed in 2020 (survivability) – target of 80%
- Low survivability observed in 2021 inspection (27%)
  - Damages due to public access (Vehicles driving through the site, dragging canoes, fire pit under the bridge, irrigation lines cut)
  - Hot and dry season
  - Noxious weeds

Post Construction IM – Vegetation– 2021 to 2023 – Cont.

- Contingency planting offset plan submitted and approved in 2022 and planting conducted Sep. 2022
  - Planting outside the areas accessed by public
  - Planting larger plants in clusters with bark mulch and fencing
  - Emulating the adjacent native vegetation
  - Touching up seeding
- Removed weeds and watered plants in 2022 and 2023
- Healthy growth was observed in 2023 and target was met
- All conditions of authorization were satisfied

Erosion Control - Preconstruction

- On-going erosion on site due to soil condition
- Redesign of erosion control required during tender due to changes in site condition



Images from WSP

Erosion Control

- Extensive erosion control work included in the project

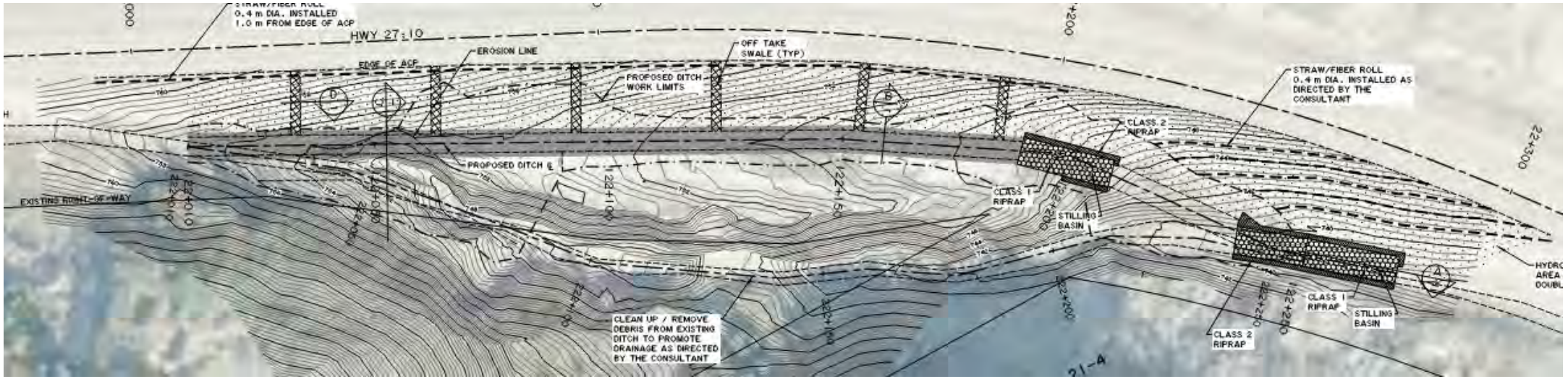
Erosion Control - Landslide

- Landslide in SW in 2019
- Water ponding after landslide

Images from WSP

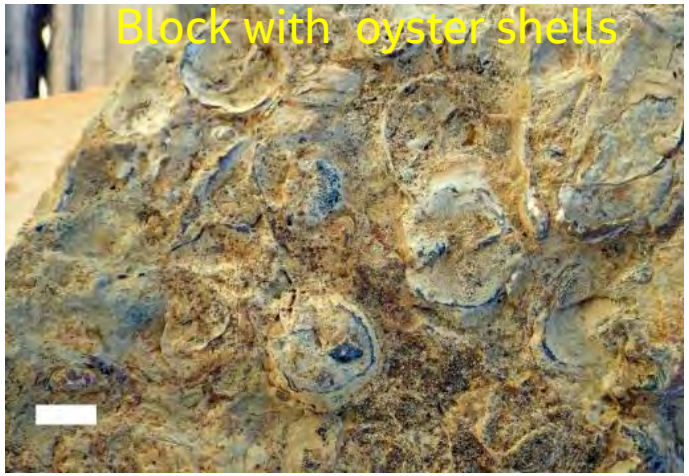
Erosion Control – SW After Land Slide

- Redesign of erosion control in SW ditch after landslide
- Design included stilling basins



Paleontological Monitoring

- Extensive stage I and stage II archeological investigation at design phase
- Concern: Potential to encounter significant fossil material
- Objective: Document and salvage any significant fossil material and recommend subsequent mitigative measures, if needed
- Areas warranted exploration:
  - Concrete pile and bridge pier excavations
  - Roadbed and ditch repair work
  - Coring excavation under the highway
  - Upper east side borrow pit
- Fossils observed on site
  - Dinosaur bones fossils
  - Plant remain fossils
  - Invertebrates fossils



Images from paleontological report prepared by Nautilus Paleontology Inc.

Conclusions and Acknowledgements

Conclusions

- Replacement of Red Deer River Bridge near Morrin (BF09551)
  - 3 Span steel girder bridge with total length of 140 m
  - 1.6 km road improvements including a new bridge alignment and
  - Geotechnical stabilization and monitoring
  - Offsetting plan with instream habitat and riparian offsets
  - Extensive erosion control package
  - Paleontological monitoring
  - Post construction implementation monitoring
  - Warranty inspections
- Construction duration: Sep. 2017 to Oct. 2020
- Project completed on time and under both construction and engineering budgets without any claims

Acknowledgements

- Alberta Transportation and Economic Corridors (owner):
  - Donald Saunders – Project Sponsor
  - Erin Zubot – Project Administrator
  - Steven Smid and Trisha Robertson – Environmental
- Trevcon Enterprises (Contractor)– Trevor Haddow and Lawrence Haddow
- WSP (Roads, erosion control, survey, filed support) – Russell Pinchack
- Thurber (Geotechnical) – Don Proudfoot and Stephen Coulter
- Jacobs team (prime consultant)
  - Jacobs Oresile – Site Resident Engineer
  - Malika Ali – Design Lead
  - Yingyi Li – Bridge EOR
  - John Kerolus – Project Manager (design phase)
  - Mari Decker – Vegetation Specialist
  - Erin Crowford, Joyce Evans, and Zach Southgate - Aquatic Specialists
  - Marty Hill – CAD design
- Photos and images in the presentation from Jacobs and Trevcon unless noted otherwise in the slides.

Questions?

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