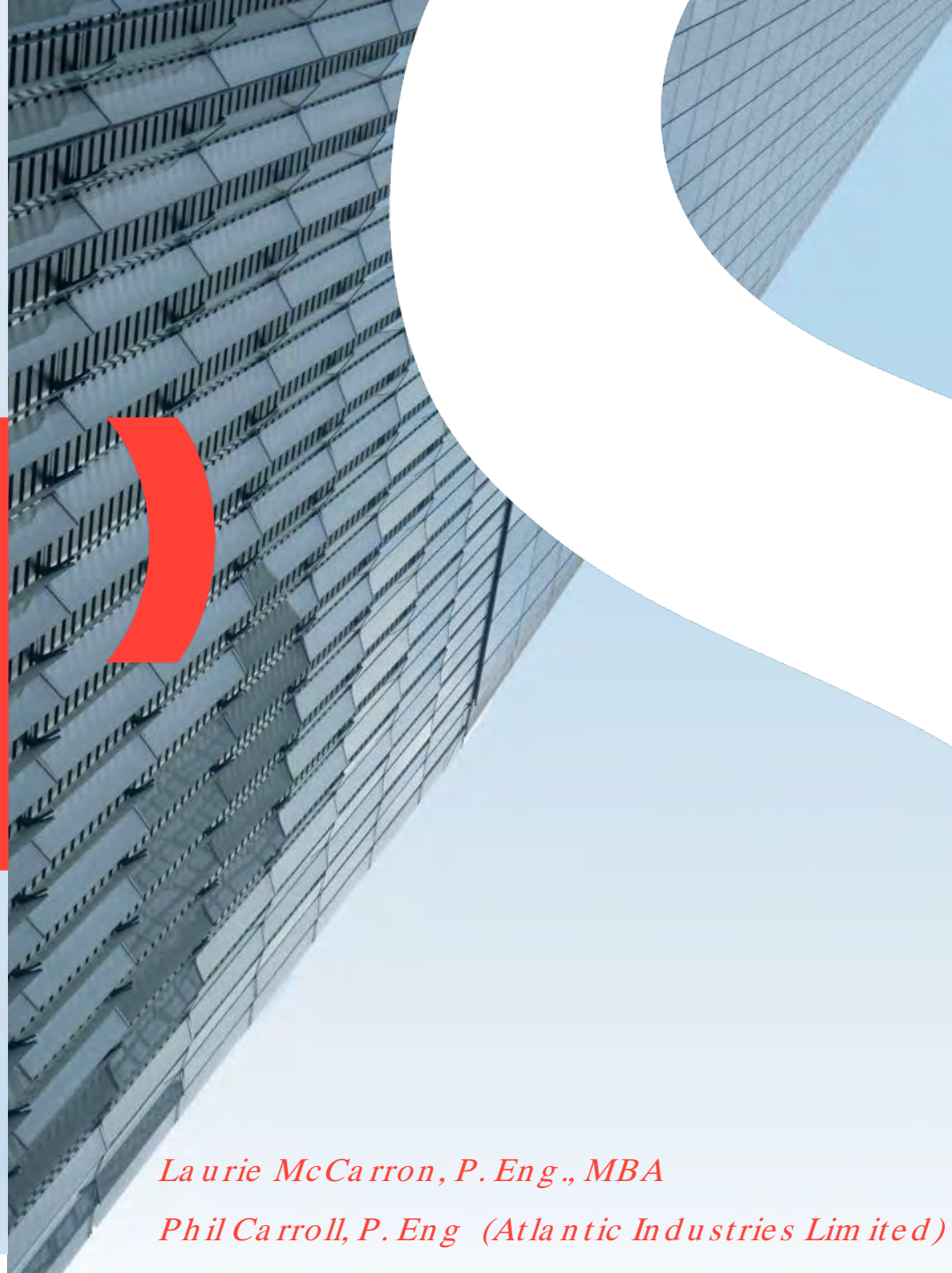


**Josephine Creek
Innovative Structural
Plate Culvert Solution**



Laurie McCarron, P. Eng., MBA
Phil Carroll, P. Eng (Atlantic Industries Limited)

Tan'si, Oki, Aba Washde, Taanishi and Halu! Amiskwaciwâskahikan, also known as Edmonton, is located on Treaty 6 Territory, home to many nations including the Cree, Saulteaux, Blackfoot, Sioux and Métis People. Edmonton is lucky to boast the second largest Indigenous population in Canada, full of talented performers, artisans, musicians and entrepreneurs. Immerse yourself in culture at Métis Crossing, take an Indigenous-led tour, discover the stories that have shaped Treaty 6 Territory at the Royal Alberta Museum, or taste the inventive meals created by trailblazing Indigenous chefs. And that is just the beginning.

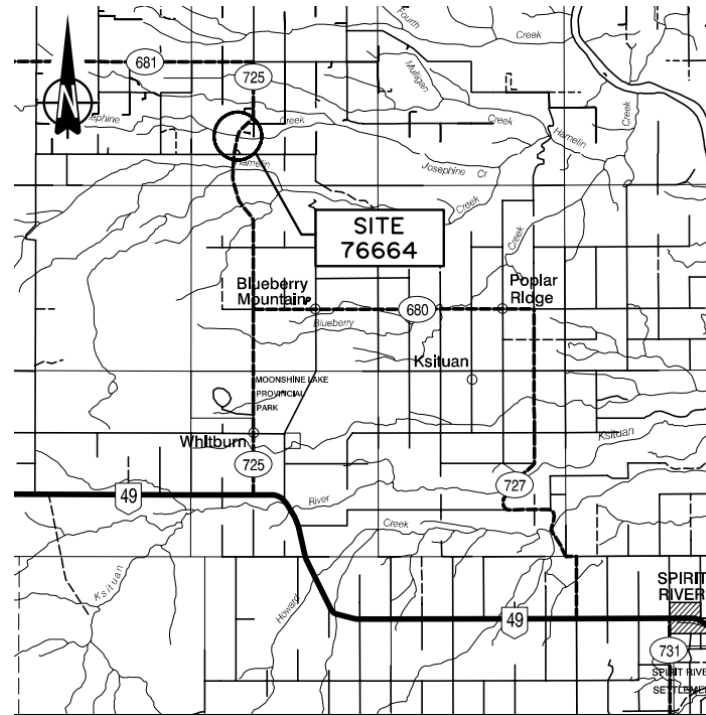
<https://exploredmonton.com/articles/indigenou-s-experiences-in-edmonton>

Outline

1. Project Overview
2. Design Parameters
3. Previous Experience with Deep Corrugated Structural Plate (DCSP)
4. Project Timeline
5. Project Drawings and Special Provisions
6. DCSP Innovation / Fabrication / On-site Assembly
7. Lessons Learned / Next Steps
8. Questions

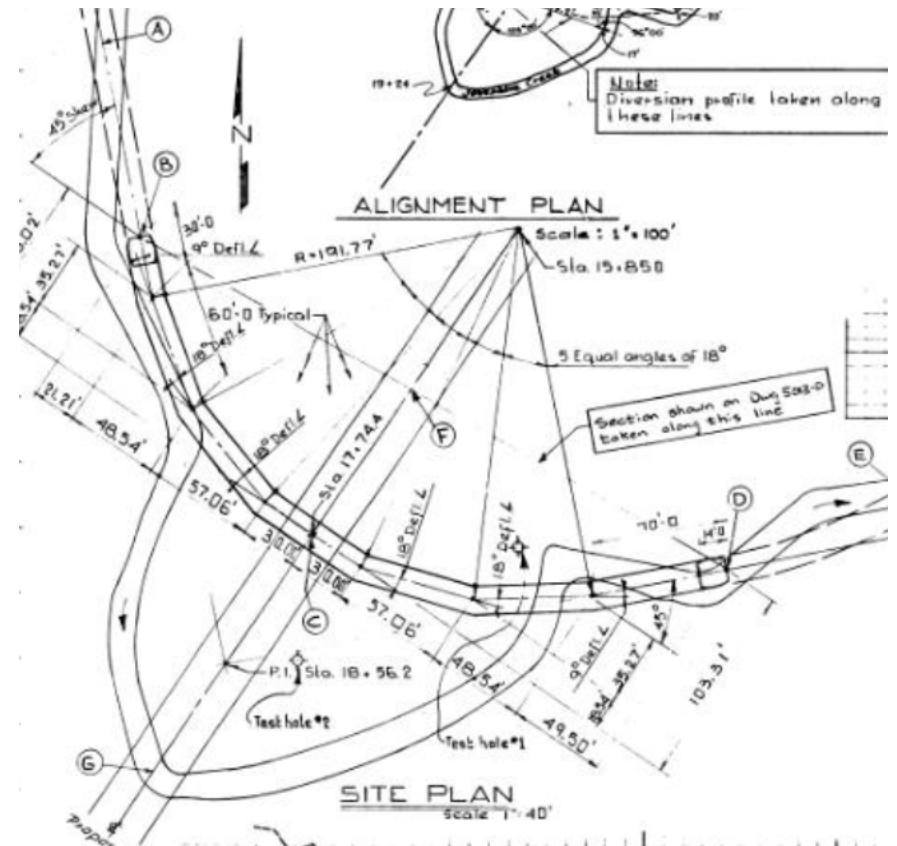
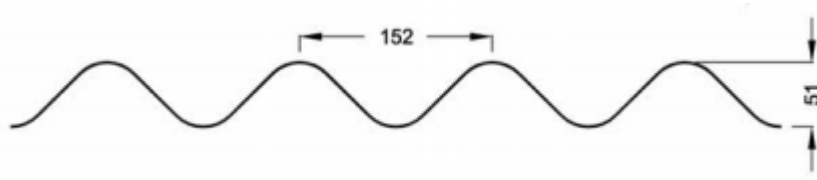
1. Project Overview

- Location – 43km NW of Spirit River, Alberta
- Two lane paved highway over deep ravine



Project Overview

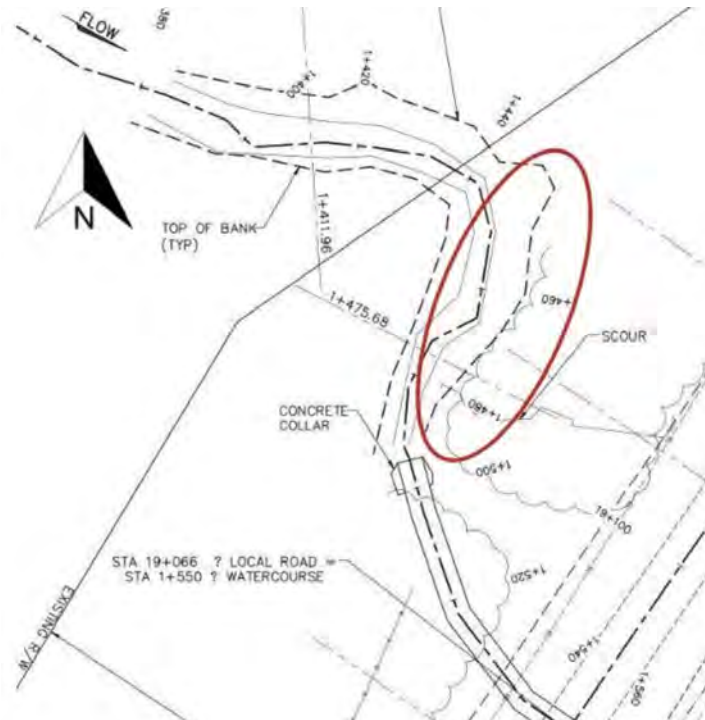
- Pre-Project Conditions (4.3m diameter SPCSP)
 - 121.9m long with 6 horizontal elbows, installed 1970
 - 12m of cover
 - SPCSP corrugation





Project Overview

- Original culvert inlet was aligned with the upstream channel
- Over 47 years, the channel moved eastward
- Result – upstream erosion.

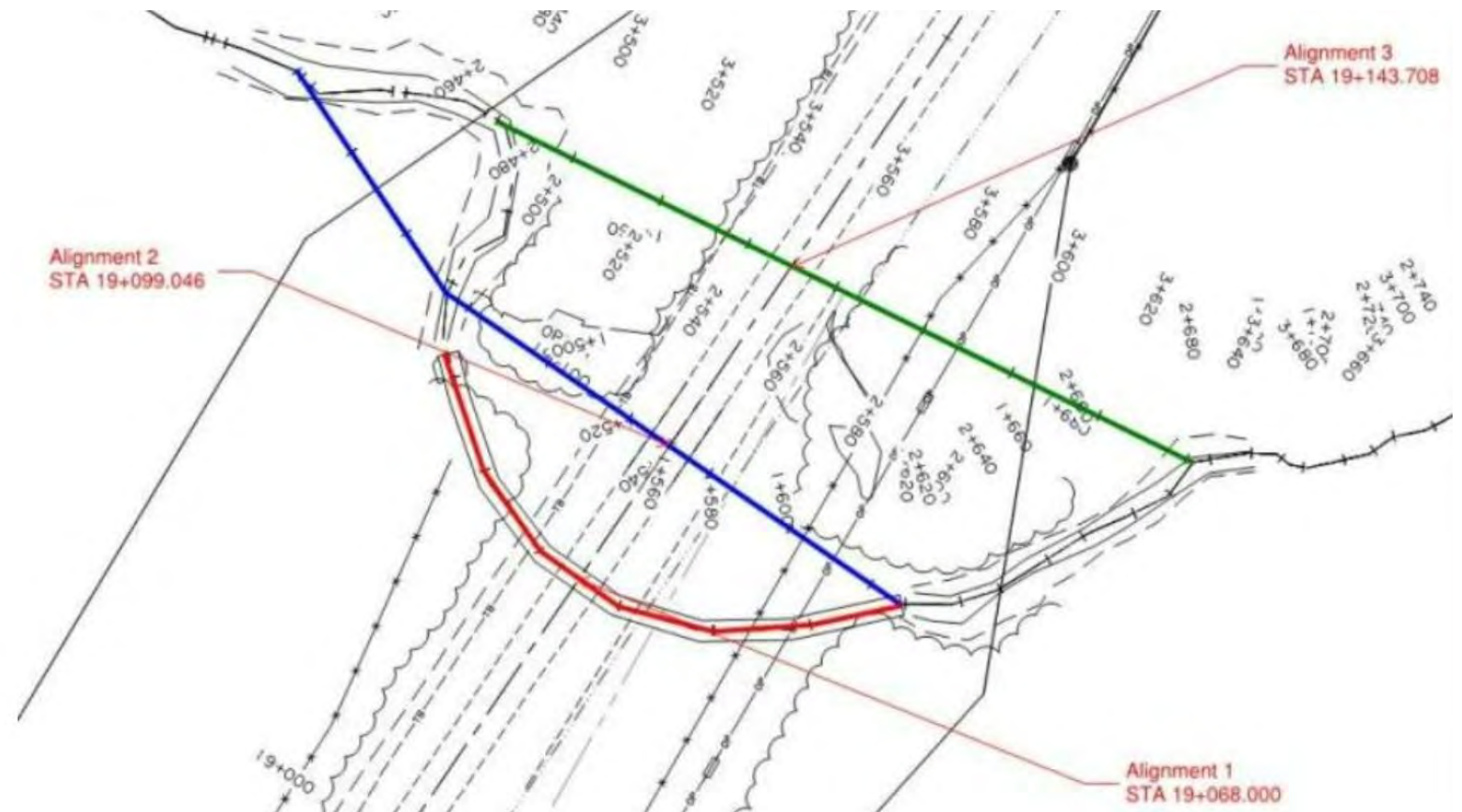


2. Design Parameters

- Design Discharge = $35 \text{ m}^3/\text{s}$; Unit Discharge = $0.54 \text{ m}^3/\text{s}/\text{km}^2$
- Channel Velocity = $2.2 \text{ m}^3/\text{s}$
- Depth of Flow (Y) = 2.3m (using 0.8m overbank flow)
- Depth of Cover = 12m

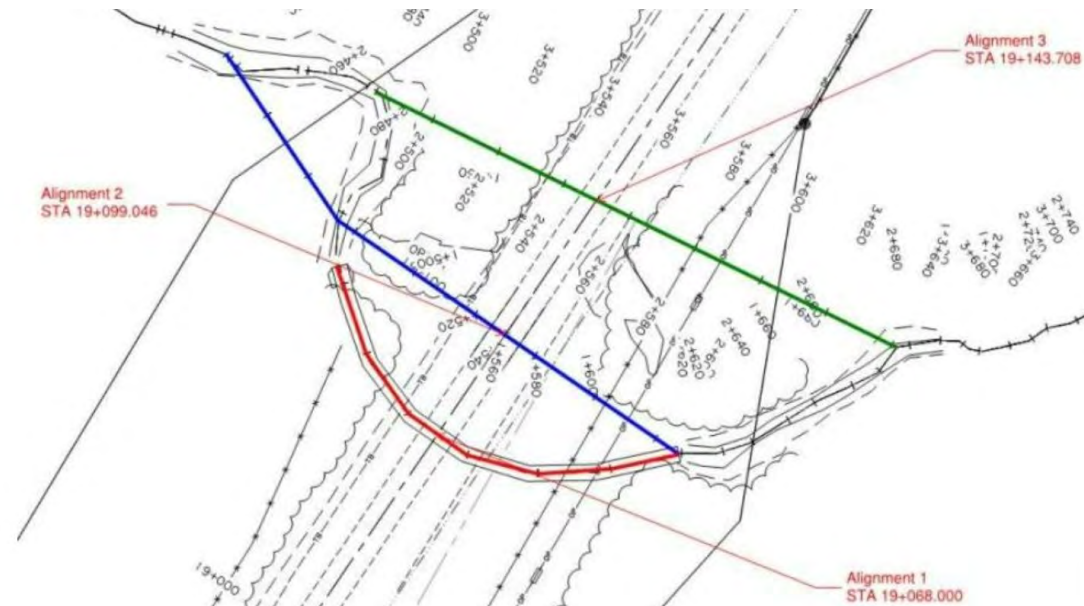
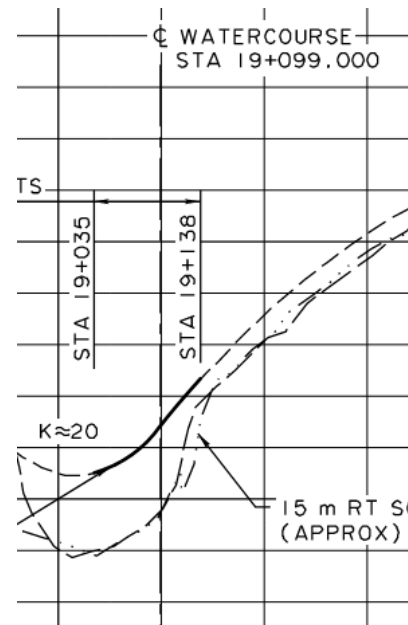
Design Parameters

— 3 Alignments Considered



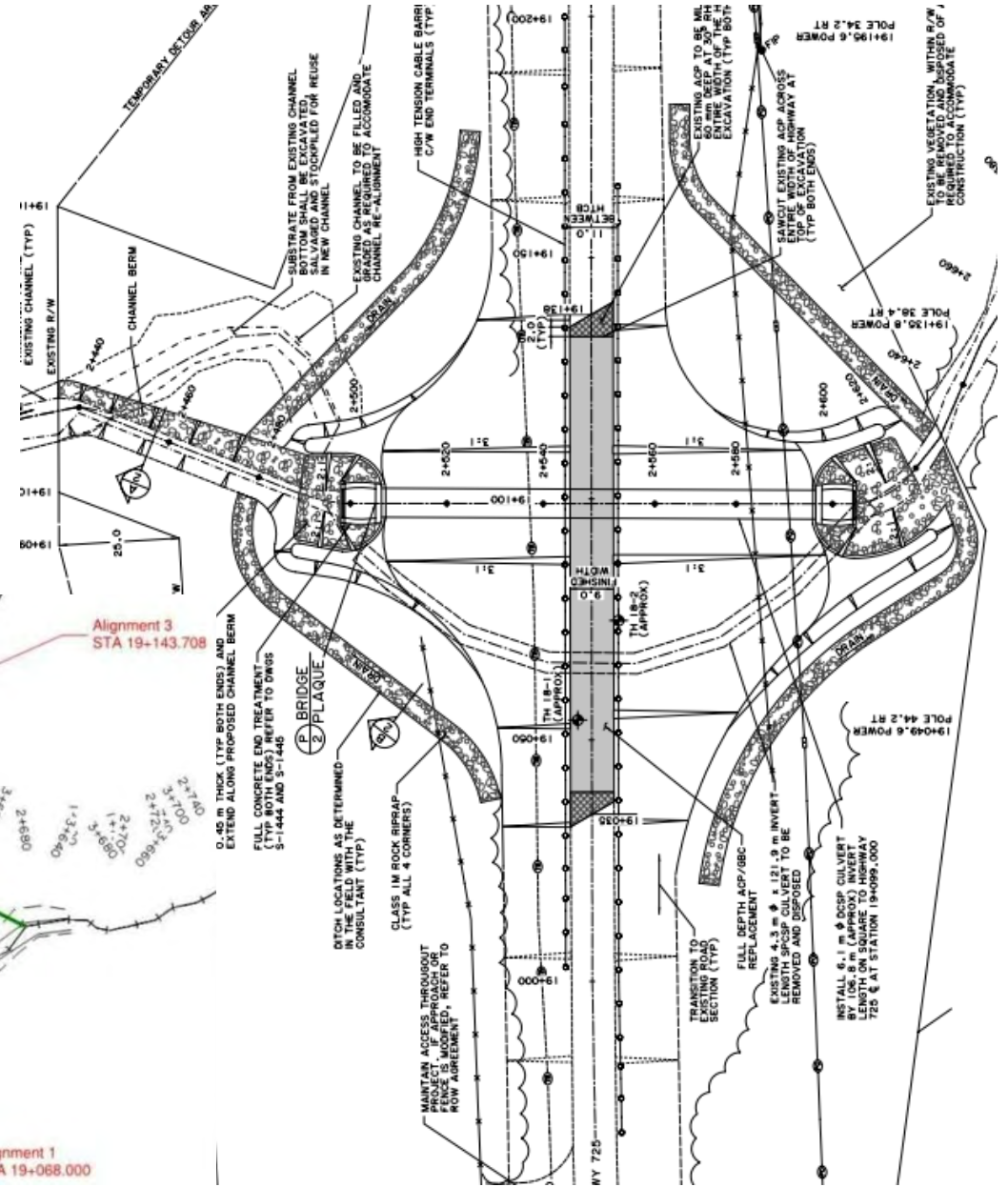
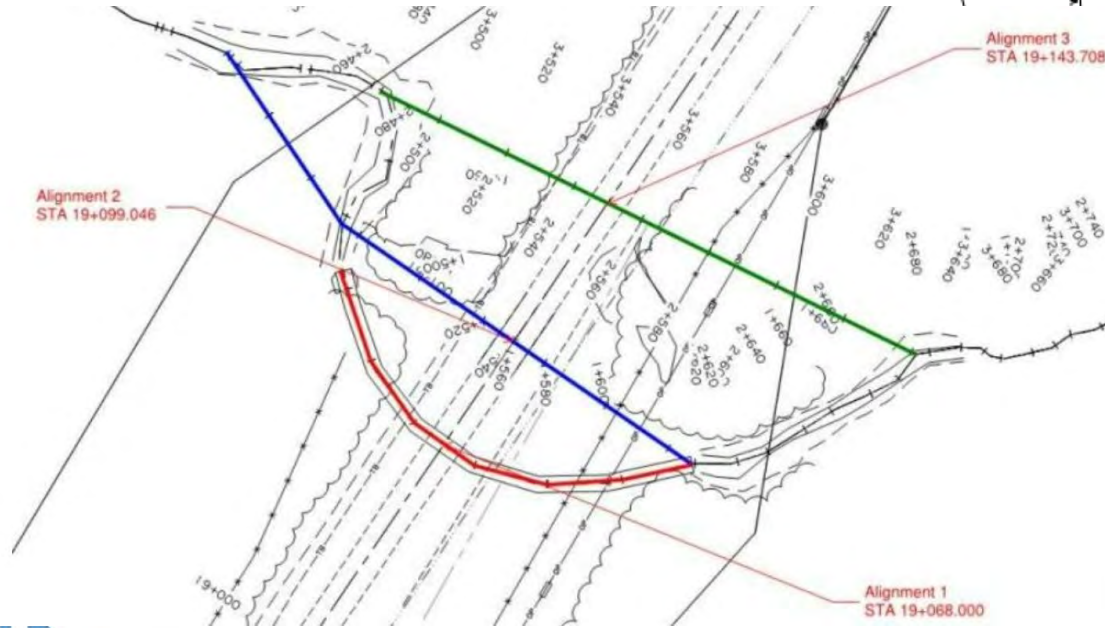
Design Parameters

- Alignments
 - 1 – *Elbows not preferred, did not address erosion*
 - 2 & 3 – *Excessive cover for SPCSP*
 - Lightweight fills considered
 - Concrete box culverts considered



Design Parameters

- Result
 - Alignment 2 Selected



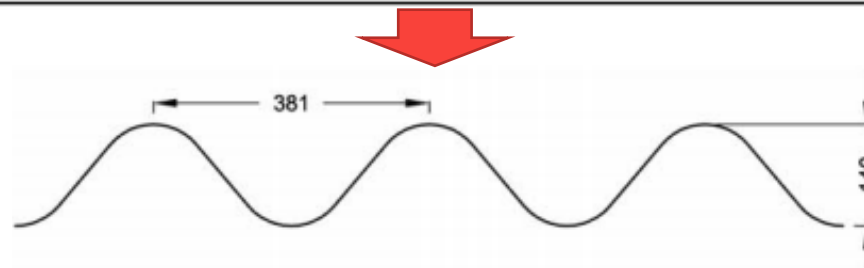
Design Parameters

– Result

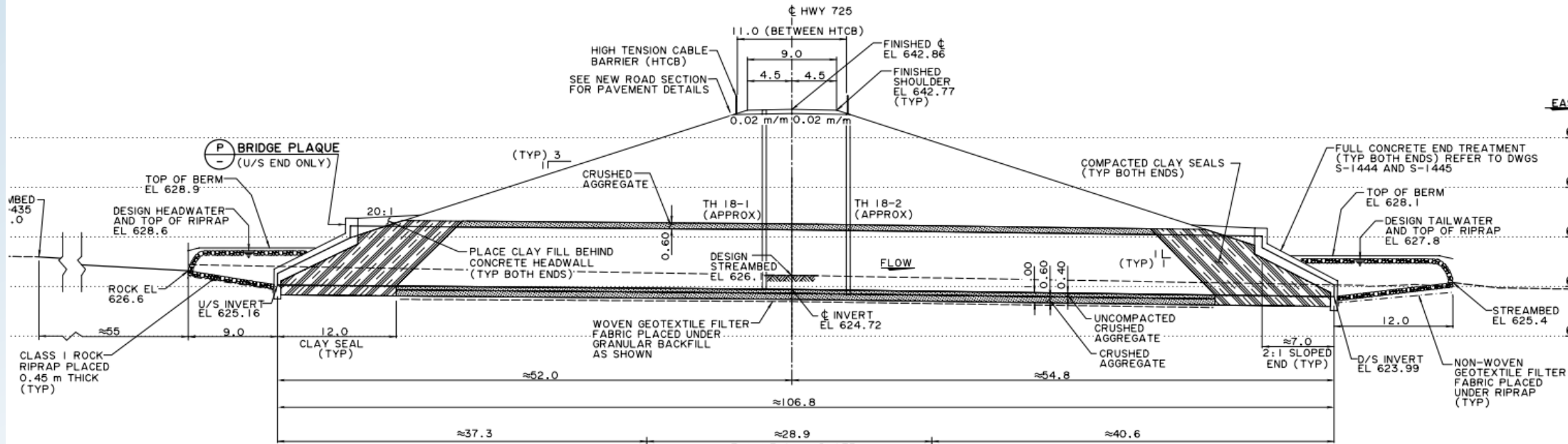
- *Alignment 2 Selected.*
- *Type 1 or 2 DPCSP Selected, smallest diameter for DCSP was around 6 m. Oversized for flow, but necessary based on height of cover.*

DCSP	TYPE 1	TYPE 2
INSIDE DIAMETER	6 030 mm	6 075 mm
CORRUGATION	381 mm x 140 mm	400 mm x 150 mm
RING LENGTH	0.762 m (2.5')	1.20 m
BEVEL LENGTH	6.86	7.20
NUMBER OF RINGS	140	89
TOTAL LENGTH	106.68 m (350')	106.80 m
PLATE THICKNESS/LENGTH	5.5 / 77.75 (255')	5.0 / 78.0
	7.1 / 28.96 (95')	7.0 / 28.8

CULVERT STRUCTURAL DETAILS



Design Parameters



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3. Previous Experience with DCSP

- Full periphery DCSP structures can be challenging to assemble – ie. plate is much stiffer than SPCSP.
- Tender called for:
 - *Inspection by Consultant of Pre-Assembled DCSP at the Plant*
 - *Manufacturer's Rep on-site for Plate Assembly and Backfill*
 - *Addendum Required 6 Plates per Ring (Minimum)*
- Importance to not have features unique to one manufacturer

4. Project Timeline

- Tender Closed October 13, 2021
- Awarded to Greenfield Construction Limited
 - *Selected Atlantic Industries Limited – Type 1 (Super-Cor)*
- Construction Completion to be October 15, 2022

5. Type 1 (Super-Cor) Innovation

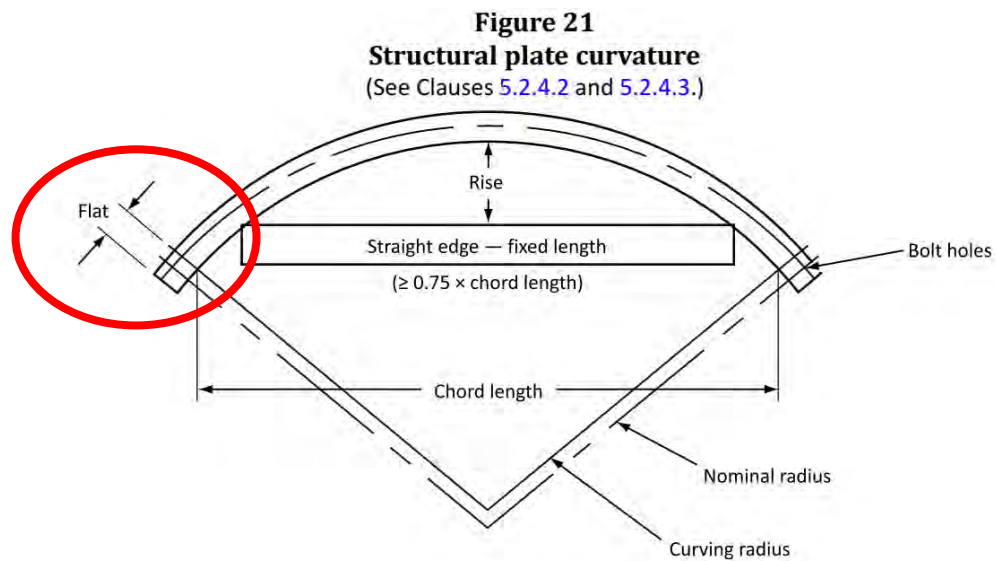
- First Step – Analyze the Potential Fit-up Issues with Small Diameter DCSP



Type 1 (Super-Cor) Innovation

— The Flat Spot on Plate Ends – Let's remove them.

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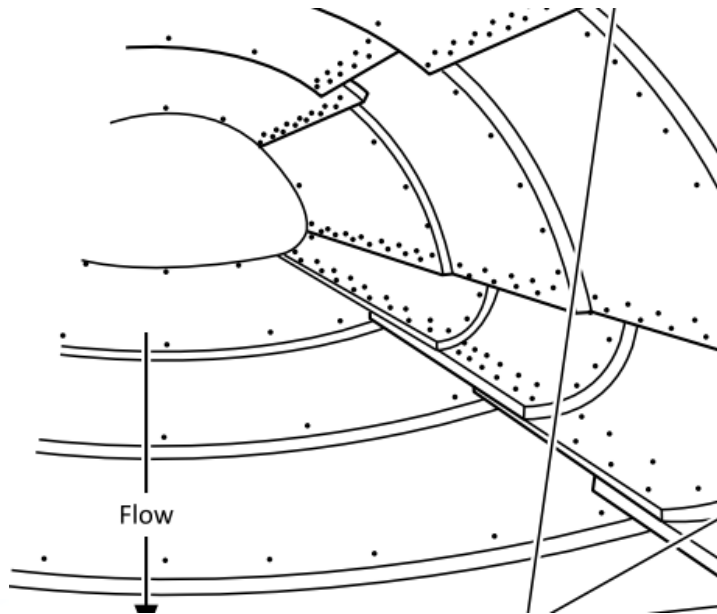
CSA G401



Previous 4.8m dia Round DCSP

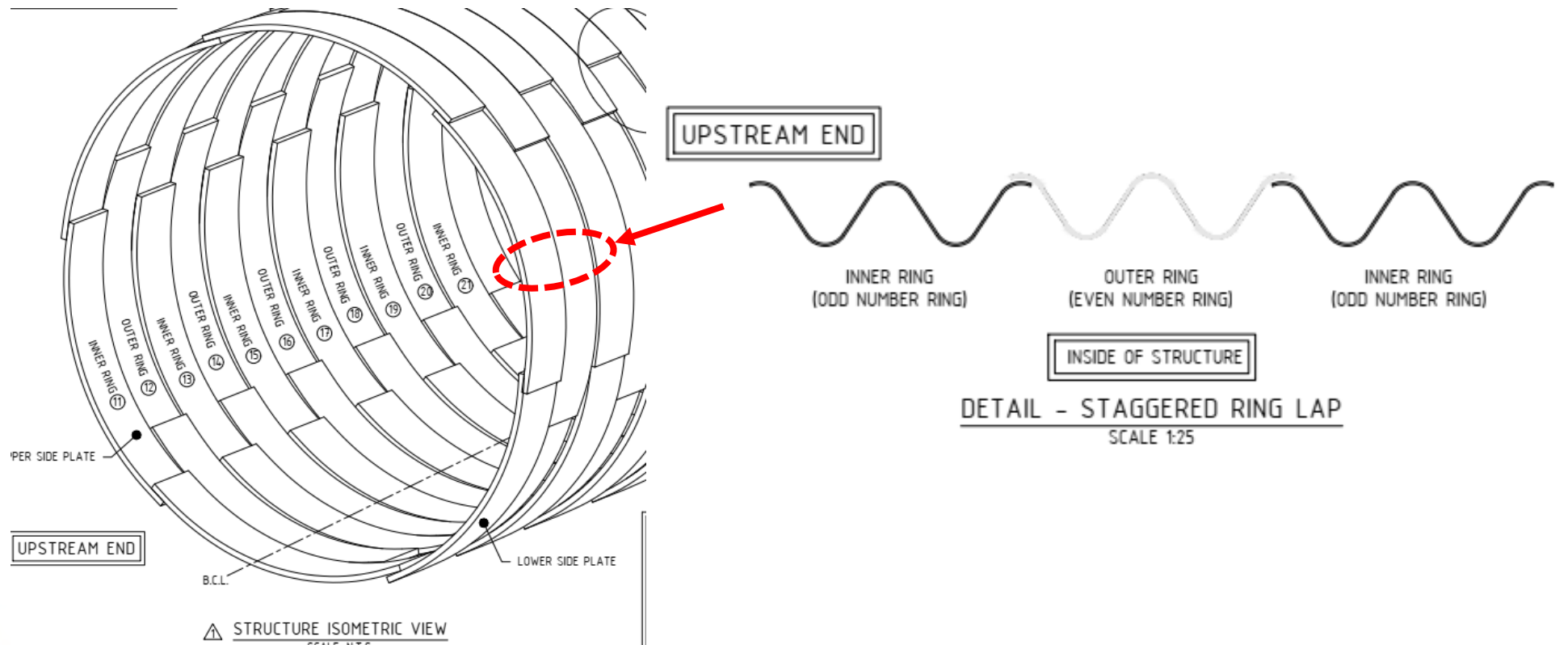
Type 1 (Super-Cor) Innovation

- Let's Re-Think How Rings are Assembled
- Conventional Assembly very similar to SPCSP Assembly



Type 1 (Super-Cor) Innovation

— Fabricate “Inner” and “Outer” Rings



Type 1 (Super-Cor) Fabrication - Ontario

- Fabrication at the Ontario Plant
 - *Assembled a 3.5m (minimum) length*
 - *Developed a New Assembly Procedure*
 - Documented Step-by-Step in the Shop Drawings with Photos
 - AIL's Site Representative (based in Alberta) helped with the Ontario assembly
 - 100% Confidence in Improved Plate Fit-up and Ease of Assembly



Assembling 1st Inner
Ring on Flat Ground





Inner Rings

Placing Outer Rings

7. Type 1 (Super-Cor) Plate Assembly On-site

- Pre-construction Meeting
- Full Day of Hands-on Start-up Assembly Support by the AIL Field Representative
 - *Initial learning curve by Plate Assembler – RB Multi-Steel Limited*

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Type 1 (Super-Cor) Plate Assembly On-site

- Result – Structure Assembled in 25 days (30% less than estimated)
- Faster Assembly helped with “shoulder season” construction – getting backfilled before cold weather



Type 1 (Super-Cor) Plate Assembly On-site

- Addition of Oakum to Plug 3 Plate Laps
- Worked well.





8. Lessons Learned / Next Steps

- Fabrication / Assembly Innovation had a Positive Impact
- Same Innovation could be used other Full Periphery Shapes like Horizontal Ellipses.
- Is there a need to work with AB Transportation to Capture this Innovation ?



Oct 12, 2022 at 10:57 AM

Questions



Thank you!

