

DRY GULCH HDD CROSSING

Pipeline Pullback Design,
Engineering and Execution



*Excellence
in project execution
Award 2024*



Canada - Trans Mountain Expansion Project (Spread 5b) & Dry Gulch Crossing

Introduction - TMEP Project Spread 5B

- The existing NPS 24 crude oil Trans Mountain Pipeline (TMPL), spanning approximately 1,176 km from Edmonton, AB to Burnaby, BC.
- The Trans Mountain Expansion Project (TMEP) involves looping the existing TMPL system.
- Spread 5B covers the construction of 89 km of 914 mm diameter pipeline.
- Bonatti, in joint venture with Kiewit Corporation, is responsible for constructing the segment from KP 987+100 to KP 1,038+100.



Dry Gulch Crossing Overview

- Located in the challenging terrain of British Columbia, the pipeline intersects a deep V-shaped canyon known as Dry Gulch, near Hope, BC.
- The canyon has a total depth of 100 m, length of 300 m, and a maximum slope angle of 47°.
- Bonatti developed the strategy for executing the crossing.

Challenges and Execution Concerns:

- Limited accessibility
- Weather constraints in winter and high avalanche risk
- Steep slope angle
- Rockfall hazard
- Significant environmental and visual impact if open cut execution is necessary
- Schedule impacted by weather conditions: limited work expected in winter



Construction schedule restriction & method selection

Schedule Constraints

- The Dry Gulch crossing aimed for completion by summer 2023, aligned with the project's end date of 2023.
- ***Winter conditions in the area are challenging due to low temperatures, snow, and high avalanche risk.***

Methodology Assessment

- The feasibility of the crossing was carefully assessed considering the complex geomorphological, geological, and geotechnical settings.
- Various technologies were compared, including HDD, Direct Pipe, Microtunnel, and Raise boring.

Selected Method: Horizontal Directional Drilling (HDD)

- HDD was identified as the most sustainable method for the crossing.
- The chosen perforation profile is 1,842 m long with a horizontal distance of 1,800 m.

Feasibility Confirmation

- HDD feasibility was confirmed in August 2021 with a successful 1,622 m exploration borehole drilled along the pilot hole alignment.
- Low-to-moderate risk of frack out and bore collapse was confirmed.

HDD preparation works design

Design Challenges

- Uneven terrain, steep slopes, creeks, and winding Right-of-Way (ROW) due to environmental constraints around Dry Gulch.

Selected Option

- Pulling three pipeline strings, with the longest being approximately 1,100 m, from the Southern side.
- Driven by limitations in earthworks and environmental considerations.

Challenges in Pullback ROW

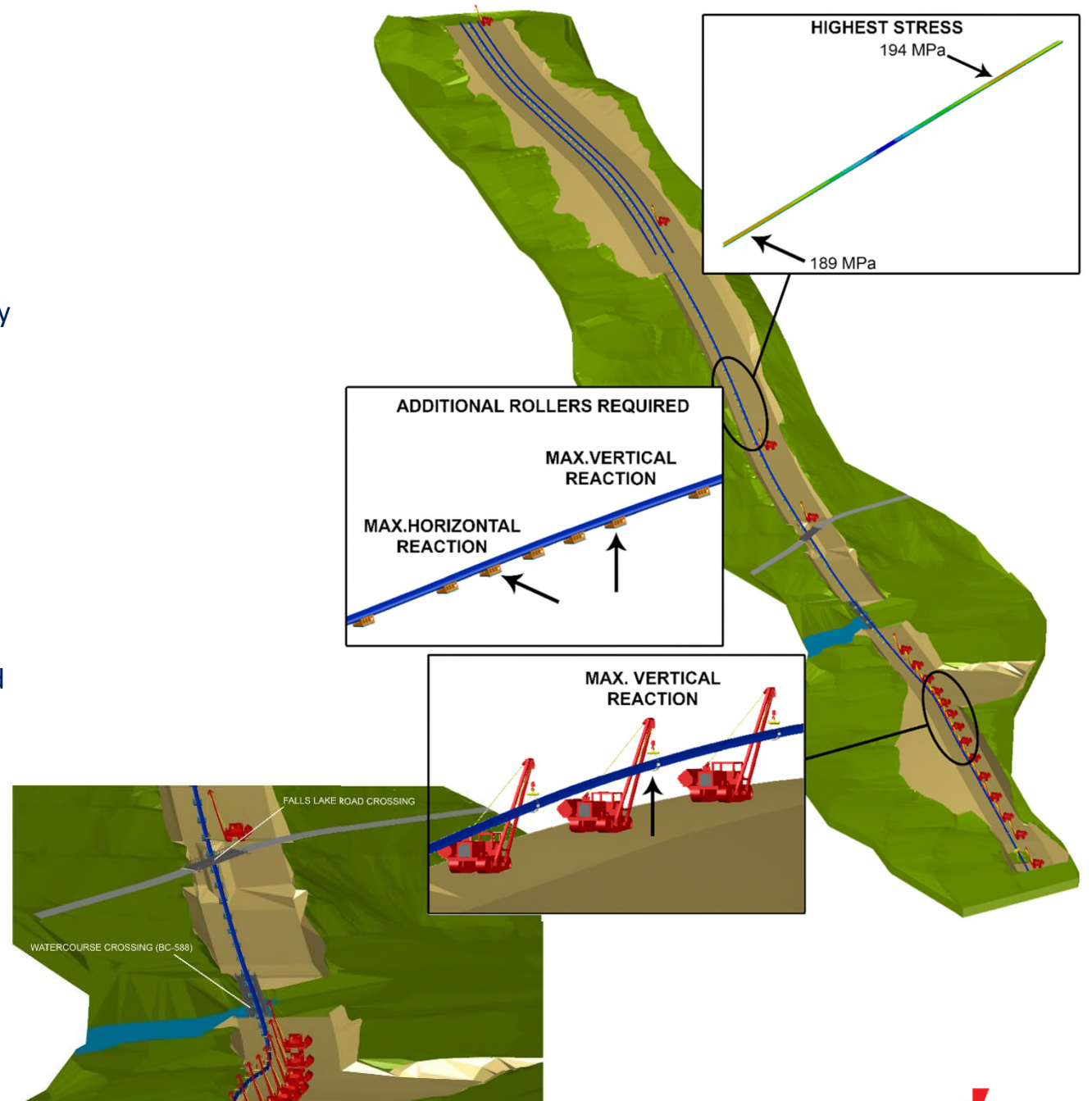
- Hilly and rocky terrain with horizontal and vertical deviations.
- 17° slope over 220 m, crossing two watercourses and one road.

String Preparation Study

- Integrated 3D Model/FEM Analysis conducted to predict static and dynamic behavior during pullback.

3D Simulation Results

- Verified maximum stress during lifting and pulling operations.
- Defined equipment distribution and required vertical and lateral loads.
- Optimized roller supports and designed their foundations for pullback and hydrotest conditions.
- Positioned the tie-in station for two strings.
- Calculated potential longitudinal or vertical uplift displacement, considering additional restraints or anchors if needed.





Pipeline strings and rollers way preparation

Project Timeline

- Bonatti/Kiewit developed a schedule to meet deadlines by employing different teams working simultaneously.

HDD Execution

- Pilot hole confirmed low risk of bore collapse along most of the alignment.
- Reaming phase began in late October 2022 and continued through winter.

Preparation Works

- Prefabricated string and associated working ROW preparation carried out in parallel.
- Significant earthworks between Falls Lake Rd and Drilling Pad for a 10 m high launching pad.
- 91,000 cm of earthworks and 16,000 cm of imported material used for pullback ROW.

Foundation and Bridge Installation

- Foundations and bridges on Falls Lake Rd. and Falls Lake Creek completed by Fall 2022.
- Drag section grading completed by late 2022.

Stringing and Welding

- First two strings (2 of 378 m) completed by end of January 2023.
- Main string (1,100 m) fabrication completed by March 2023.

Hydrotest and Pullback

- Preliminary hydrotest planned for April 2023.
- Pullback started end of May and completed early June 2023.
- Final tie-ins by July 2023 in line with targeted schedule.



Pullback execution

Preparation Activities

- Mobilization of 8 cranes and 17 sidebooms in September 2023.
- Installation of HDPE buoyancy control pipe inside the 36" pipeline strings.

Pullback Process

- Started on October 18th and completed safely in 52 hours.
- 30 hours allocated for 2 tie-ins.
- Average pulling rate between 80m/h to 120m/h, surpassing best estimate scenario.

Pulling Force and Load Monitoring

- Maximum pulling force within expected range.
- Continuous monitoring of vertical and lateral loads on cranes and sidebooms showed loads consistently within acceptable limits.

Conclusion

Project Significance

- Dry Gulch Crossing was a critical point in the Trans Mountain Expansion Project.
- Presented a compelling challenge for Bonatti/Kiewit since their involvement in Spread 5B.

Engineering and Coordination

- Extraordinary effort and multidisciplinary coordination were required for HDD pullback.
- Aimed to meet high safety and quality standards, minimize environmental impact, and optimize schedule.

Engineered Pullback Details

- Required 3 pipeline strings: 1,100m, 380m, and 380m in length.
- Snaked across a 900m rollers way across challenging terrain.
- Crossed 2 watercourses and 1 road, lifted at about 15m elevation for a 200m over-break section.

Preparation and Execution

- Civil works for rollers way completed.
- Pipeline strings welded, hydro tested, and positioned on rollers.

Successful Pullback

- Smooth and safe execution in just 52 hours.
- Deployed 8 cranes and 17 Bonatti SAFE T-Rex sidebooms.

Final Thoughts

- Detailed planning and design identified a reliable and efficient solution.
- Met challenging schedule constraints despite the extraordinary technical challenge.