Many Islands Pipe Lines (Canada) Limited

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October 23, 2020

**Contingency Plan – Creeks**

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Please find enclosed Contingency Plan for proposed Creek crossing HDDs.

In case the HDD is not successful, the prime contractor will instruct field staff to stop work on the related HDD immediately and contact Eric Morley with Construction Management at (306) 536-6399 for further instructions. Eric Morley will escalate the issue at hand to Zeshan Hyder with Pipeline Engineering at (306) 527-8580 on the day the HDD is deemed unsuccessful for further instructions.

Pipeline Engineering will evaluate the contingency plan encompassed and explore the alternative means of completing the crossing. The alternative methods of crossing will be explored thoroughly and appropriate approvals from all applicable parties will be acquired before proceeding with the crossing.

Yours truly,

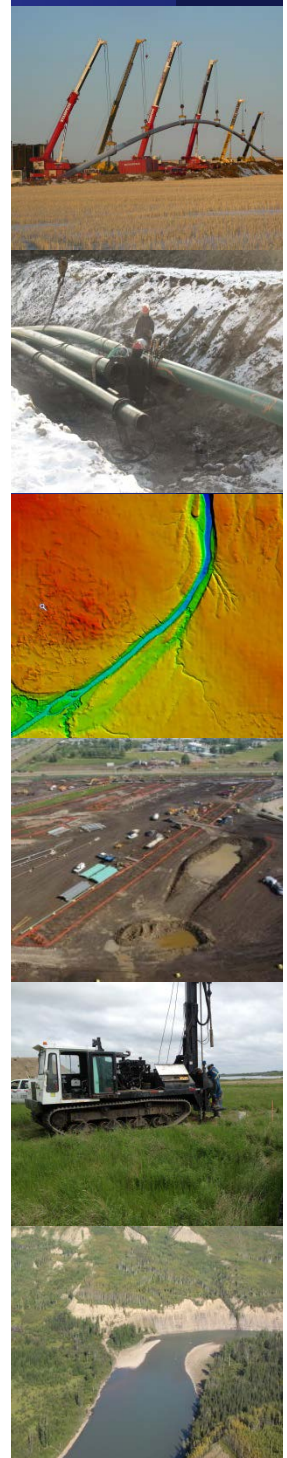
Zeshan Hyder, P.Eng.
Pipeline Engineering

**MANY ISLANDS PIPE LINES (CANADA) LIMITED**

# Cold Lake – Beacon Hill NPS 20 Loop

# HDD Contingency Plan

# Creek Crossings & Road Crossings



Prepared for:

**Many Islands Pipe Lines (Canada) Limited**

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**Cold Lake – Beacon Hill NPS 20 Loop**

**HDD Contingency Plan - Creek Crossings & Road Crossings**

Prepared by:

Chelsea Griffiths, P.Eng. (AB)
Project Manager

Approved by:

Neil MacKinnon
Construction Manager

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# 1 INTRODUCTION

Many Islands Pipe Lines (Canada) Limited (MIPL) is planning to construct 30 km of NPS 20 (508.0 mm O.D.) pipeline in north-western Saskatchewan and north-eastern Alberta. The proposed pipeline, referred to as the Cold Lake – Beacon Hill NPS 20 Loop, will loop an existing NPS 10 pipeline for the majority of the route, which runs from Cold Lake, AB, to Beacon Hill, SK. The proposed scope of the projects includes two (2) identified waterbody crossings and several road crossings. MIPL is planning to complete these crossings using Horizontal Directional Drill (HDD) methodology. This report is submitted as a contingency plan in the event one of the HDD's for the Cold Lake – Beacon Hill NPS 20 Loop is unsuccessful, as well as to highlight the contingencies in place to reduce the risk of failure.

# 2 CONTINGENCY PLANNING

Contingency planning is conducted on every HDD project to minimize the potential for adverse impacts on construction operations and schedules caused by unforeseen events or conditions. While it is not possible to anticipate every scenario, contingency plans have been developed for the most likely scenarios that could have the greatest adverse impacts based on extensive experience. It is important to note that many contingencies are identified within the feasibility assessments completed for the crossings. Contingency planning greatly reduces the potential for an HDD failure.

# 3 HDD EXECUTION RISKS

## 3.1 LOSS OF CIRCULATION

Drilling fluid is circulated within the annulus and will circulate back to surface through the borehole as long as the borehole remains open and preferential paths for fluid are not available. The pressure within the annulus will be monitored and the annular pressure values will be maintained within the operational zone specified in the annular pressure analysis and below the overburden strength pressure of the formation during the pilot hole phase of construction.

In the event the borehole is unstable (non-cohesive formations or borehole swelling), cuttings are not efficiently removed from the borehole, or major fractures are present within the formation, loss of circulation and climbing annular pressures can occur. While it is not possible to determine the exact nature of fluid loss, it is possible to monitor for a loss of fluid. During drilling, the contractor will monitor returns to the entry pit to identify losses. The volume, pressure, and parameters of the drilling fluid are monitored to ensure losses are detected quickly.

Site-specific geotechnical information has been utilized to develop the annular pressure charts that will be used during drilling. The annular pressure tool readings are reviewed continuously to maintain pressures within the crossing specific tolerances. If pressures are climbing, corrective actions are taken to reduce the pressures back to normal operating levels.

Surface monitoring of the drill path is executed for the duration of drilling activities. "Frac walks" are required every 4 hours during normal drilling conditions. In the event there is suspected fluid loss or an increased potential for fluid loss, the frequency of frac walks will be increased. If loss of circulation is identified, steps will be taken as highlighted in the contractors execution plan or specific Fracture Mitigation Plan.

## 3.2 EQUIPMENT MALFUNCTION/FAILURE

Contractors shall reasonably estimate the average life expectancy of the major components of drilling operations under normal operating conditions. The operating hours of the equipment are recorded prior to start of drilling operations and maintained throughout completion of the HDD. Walk-arounds and equipment conditions inspections should be conducted on a regular basis to enable the early identification of equipment that may be showing signs of advanced wear and tear or nearing failure. Documentation and maintenance records are maintained so that replacement of key components can be performed in a timely manner prior to any expected failure. Occasionally, a component of the drilling operation will fail unexpectedly even with stringent maintenance and replacement schedules. The contractor should establish a spare parts inventory accordingly based on the most common failures to reduce lost time and the resulting additional complications. Spare parts kept on site could include hydraulic pumps, motors, and drive gears. In addition, items that are not readily available “off the shelf” should be kept on site.

Spill response material for all types of spills should be maintained on every HDD site. The contractor should identify local sources for commonly available spare parts and equipment prior to job start up. Spare parts not readily available locally should be stored in a contractor warehouse location.

## 3.3 UNCONTROLLABLE CAPTURE OF RETURNS

Although unlikely to occur, uncontrollable capture and containment of drill fluid has been included within HDD contingency planning. If uncontrollable containment of returns occurs during pilot hole drilling due to infiltration by an aquifer, possible grouting of containment casing will be investigated. This should be evident during the pilot hole drilling stage of the crossing. Another possible contingency method to manage infiltration of water is a rotating head. A head can be sourced to manage the volume. This volume will be controlled or contained until either a diversion is created to manage the volume, or the volume is pumped off into a suitable containment. Vacuum trucks will be sourced and notified for availability to clean up potential unexpected volumes.

## 3.4 STUCK PRODUCT PIPE

The following are some of the preventative measures invoked by the driller to reduce the chances for complications while pulling back the product line.

- Utilize drilling equipment capable of supplying adequate pull-force and torque based on calculated values and ream/product pipe size.
- Perform a wiper pass for the purpose of cleaning out the reamed hole and ensuring desired drilling fluid rheology to reduce expected pull.
- Perform additional wiper pass(es) as needed to ensure the hole is clean, taking note of required force and rotary and comparing to expected.
- Reduce torsional and axial loads through use rollers, an adequately sized swivel, and smooth transitions within the product pipe overbend.
- Utilize ballasting to control the weight of the pipe by achieving negative or neutral buoyancy, if/as required.

If above preventative methods fail and the pipe becomes seized in the borehole and the drilling rig is unable to supply the initial thrust to release the seized pipe, side booms, track hoes or pneumatic tools can supply thrusting pressure from the exit side in order to start momentum. If necessary, a larger rig can be mobilized to the site to attempt to dislodge the pullback string. The pipe may also be pulled back out of the hole, if possible, from the exit end to allow further preparation of the borehole.

## 3.5 DAMAGE TO EXISTING UTILITIES

Preventative measures include proper notification of local utilities through the one-call program for the area and site investigation and recording of area markers and valves. Existing utilities within the crossing should be daylighted prior to construction for location verification and minimum separations should be maintained. If crossing in proximity to an existing pipeline sight holes shall be utilized.

Damage to existing utilities or structures may occur during drilling or reaming operations. The utilization of tail-string at all times during reaming operations should limit the potential risk to verified and known lines by ensuring the subsequent reams continue to travel along the pilot hole alignment during hole opening or tripping operations. If this circumstance does occur, the type of utility will be identified so that severity of response can be identified. Emergency personnel for the identified utility are then notified. Pertinent personnel for the Owner and/or Owner's Representative are also notified, following the chain of command. Decisions are then made as to the appropriate actions to take.

## 3.6 GROUND SETTLEMENT

The contractor should ensure settlement is monitored for the road and/or infrastructure crossings. The contractor shall detail site-specific settlement prevention methods as well as procedures they will follow if settlement is noted.

## 3.7 PILOT HOLE MISALIGNMENT

The contractor will confirm adherence to the minimum steering system requirements laid out on the Issued for Construction (IFC) drawings or propose an alternative method for approval prior to mobilization. All steering tracking shall verify left and right of center line, up and down, and will be tracked continuously during drilling operations. The contractor will provide data to the Owner or on-site representative on a continuous basis as required. Deviations from the design drill path should be identified and corrected. If deviation exceeds the steering tolerances limits laid out on the IFC, the drill string will be pulled back to a calculated point and be redirected along the proposed path.

## 3.8 PIPELINE DAMAGE/COLLAPSE

Pipeline collapse during pulling operations is a rare occurrence caused by certain factors, which must be considered before pullback begins. Some of the main factors, which must be considered prior to pipeline pullback operations, include:

- Design profile minimum radius of curvature shall be followed.
- An experienced steering hand shall verify adherence to the steering tolerances.
- Industry standard safety factors are included in the profile and calculations taking into account unknowns.
- Exit and entry angles must be within specified tolerances so that support equipment capabilities are not exceeded.

## 3.9 TOOLING LOSS IN BOREHOLE

Occasionally drill motors, drill stem, drill bits, hole openers, or swivels can fail during construction. The frequency of such failures is minimized by utilizing new or newly inspected tools for each directional drilling project. In addition, the tool manufacturers provide guidelines on maximum recommended hours of use and field inspection/use procedures. During reaming, tail-string shall be maintained in the borehole to minimize the risk of delays related to tooling loss in the borehole.

Should a downhole tool failure occur, drilling operations will be immediately halted, and an attempt will be made to determine the nature of the failure before anything is removed from the borehole or any further action is taken. The tooling in the borehole will be documented at the time of failure (i.e. length of drill stem/failure location). Once as much information as possible is obtained regarding the nature of the failure, the tooling that can be withdrawn from the borehole will be removed. Depending on the nature of the failure alternatives to proceed will be considered. In most cases of tool failure, the tools are retrieved from the borehole, repaired and/or replaced, and drilling or reaming can continue.

# 4 HDD ABANDONMENT

In the event one of the previously discussed events results in failure to successfully complete the HDD, the HDD borehole will be abandoned. Methodologies and procedures for abandonment will be developed based on site-specific constraints.

If the borehole is to be completely abandoned, the HDD Contractor should use a jetting assembly and steering tool to trip into the borehole and "log" the hole. This operation can be used to confirm the condition of the borehole and to assess the requirement for grouting operations or other site-specific strategy.

If it is determined the hole should be grouted, it is expected a bullnose grouting assembly would be installed on the drill string at entry and/or exit and tripped into the borehole (depth will be dependent on-site conditions and HDD failure mechanism). While tripping in drilling fluid will be pumped to ensure the bullnose stays clear of debris. The drill string(s) will act as the tremie line to fully seal the annular space with grout and positively displace the drilling fluid back to the entry and/or exit pits. Grout will be pumped from one or both sides until the borehole is hydrostatically balanced. The overburden formation strength and grout properties will determine the maximum allowable pressure during grouting operations. This may result in the requirement for the grout to be installed in lifts.

Once the hole is abandoned, another attempt to complete the crossing will be made. The methodology for continuing will be dependent on site-specific conditions and the failure mechanism of the original crossing.

# 5 CROSSING RE-DRILL

If the HDD is unsuccessful, an additional attempt at an HDD crossing will be completed. This HDD would utilize offset entry and exit locations as well as a modified depth of cover to achieve separation from the abandoned borehole and minimize the potential for fluid communication between the holes. The offset would attempt to utilize the existing workspaces where possible. A lessons-learned session would be completed with all involved parties to determine reason for past failed attempt and a continuance plan addressing any shortcomings and modifications to the execution plan.

The HDD will be redesigned with input from the involved parties to minimize the potential for reoccurring issues. This may include modified entry/exit angles/locations, surface casing introduction, modified drill direction, tooling and rig requirements, design radius, or steering tolerances. Execution strategies will also be reviewed and modified to maximize the potential for a successful installation.

## 6 OPEN CUT

If HDD methodology attempts are not successful at the watercourse crossings, an open cut methodology should be investigated. If open cut methodologies are utilized, preference will be given to an isolated trench methodology such as flume, dam and pump, high volume pump bypass, or a coffer dam. These methods allow limited sediment release and limited transport of sediment downstream and maintain streamflow. If fish are present, a method that allows for fish passage such as a flume or coffer dam in segments will be investigated.

The open cut methodology is not preferential, and all attempts will be made to complete the crossing by HDD. If open cut is to be used, construction shall take place during periods of lowest sensitivity, all reasonable efforts shall be made to minimize duration of in-stream activity, timing constraints shall be followed, and contingency plans for erosion and storm runoff/floods will be required.

Isolated crossing construction shall ensure the following requirements are met:

- 100% downstream flow is maintained.
- Water from flumes, pump-around, diversions or other methods used to maintain downstream flow must not cause erosions or introduce sediment into the channel.
- If a pump-around method is used to maintain downstream flow, back-up pumps with adequate capacity to maintain 150% of downstream flow must be on site at all times and ready to take over pumping should the operating pumps fail. The operating pumps should be continually monitored to ensure downstream flow is maintained at all times until the dam materials are removed and normal flows restored to the channel.
- Pump intakes must not disturb the streambed. Pump intakes used in fish bearing waters must be screened with a maximum mesh size of 2.54 mm and a maximum screen approach velocity of 0.038 m/s.
- Earthen berms should not be used for isolation.
- All berms and material must be completed removed from the channel and the streambed and bank profiles be returned to preconstruction conditions at the end of the project.
- Sediment laden water in the work area should be discharged to an upland vegetated area prior to removal of the isolation dams.
- Fish salvage should be conducted using a seine net, dip net and/or electrofishing and the fish released unharmed upstream. Fish salvage should be undertaken within any isolated areas prior to and during dewatering activities. In addition, fish salvage should be undertaken on any bypass structures such as diversion channels and flumes prior to them being dewatered after use. Fish salvage may require a permit from the province.

## 7 AUGER BORE

For the shorter road crossings, auger boring may be utilized in the event an HDD is unsuccessful. Auger boring is a trenchless method where rotating auger flights within a steel casing are used to transport excavated material back to a jacking shaft for removal. A clam bucket or excavator is usually used to remove the collected spoil from the shaft. Cutters at the leading edge of the auger flights can be matched for soil or rock conditions. Small boring units (SBU) containing a cutter wheel equipped with disc cutters are used for bedrock boring.

The steel casing pipe is used to house the auger flights and convey material from the face of the machine back to the jacking pit. Alternatively, a smaller steel casing can be placed inside the steel jacking pipe to house the auger flights. The leading edge of the augers is equipped with cutting tools that protrude slightly ahead of the jacking pipe. Hydraulic jacks located within the jacking pit/shaft are used to propel the augers and jacking pipe forward.

Auger boring is not capable of providing continuous face support. Squeezing, running, or raveling soils can lead to over excavation of materials leading to potential settlement issues. The presence of soil inside the augers can be used to provide some face support/stability. Settlement can also be mitigated in loose materials by leaving the auger back from the leading edge of the casing to maintain a soil plug. Cobbles or boulders must be able to fit within the auger flights conveying the excavated spoil back to the shaft. The maximum size of cobble or boulder that can be accommodated is approximately 20 to 25 percent of the auger flight diameter. Particles bigger than this diameter require other means to remove them. In bedrock installations, small boring units (SBU's) are used.

In the event of a guided auger bore, pilot tubes are drilled ahead and steered using a theodolite-based steering system. The maximum steering deviation before losing the ability to steering is +/- 2". As such, proper setup of jacking equipment and guide rails within the jacking pit/shaft are crucial to maintaining alignment. Line and grade tolerances are highly dependent on the experience of the contractor in the encountered materials and the age/technology of the equipment. Line and grade tolerances of 1.0 to 2.0 percent and 0.5 to 1.0 percent, respectively, of the length of the installation are considered achievable. Higher accuracy can be achieved with newer machines equipped with upgraded technology. Soil auger boring machines can install lengths up to approximately 90 m.

The steel jacking pipe may serve as the product pipe or may be sacrificial and replaced by the product pipe (slip bore). The jacking pipe may also be upsized and serve as a casing pipe for separate product pipe installation (two-pass installation). Grout is generally used to fill the annular space between the jacking pipe and product pipe in these scenarios.