



Application Checklist - Utilities 10" or Greater

The Applicant's shall:

- Drawings shall be stamped and signed by an Engineer licensed in the Province where the work is being performed. CN reserves the right to prohibit a certain construction methodology, at its own discretion; however, CN shall not assume any responsibility for the suitability of the accepted method. Open cut methodology shall only be considered where other installation techniques are deemed impractical and where rail traffic volumes are low. Installations using water jet methods shall not be permitted.
- Complete Subsurface Investigation
 - i. Boreholes are required at each end of the crossing and at each entry/exit pit with a maximum spacing between boreholes of 50 m.
 - ii. The boreholes shall be drilled to a depth of 5 m below the proposed crossing depth or to 5 m below the maximum feasible crossing depth if the proposed crossing depth has not yet been determined.
 - iii. Soils samples shall be obtained at 0.75 m intervals to a depth of 4.6 m and also within the proposed tunnel horizon (i.e., from at least 2 m or one pipe/casing diameter above the proposed tunnel invert to at least 2 m or one pipe/casing diameter below the proposed tunnel invert). At other depths, soil samples may be obtained at 1.5 m intervals; No Boreholes will be completed between ties or tracks in double track territory.
 - iv. If bedrock is encountered at the proposed location, the bedrock will be cored to establish the competency and engineering characteristics of the bedrock. The bedrock shall be cored to at least 1 m below the invert of the proposed crossing.
 - v. Soil classification testing (i.e., water content determination, Atterberg Limits testing and grain size distributions) shall be carried out on soil samples obtained from all major soil strata and on soil samples obtained from every layer that the proposed tunnel would intersect.
 - vi. The stabilized groundwater elevation must be established by installation of piezometer/monitoring well(s); at least one piezometer/monitoring well must be maintained in operation and checked prior to construction to confirm the groundwater elevation.
- Submit a Geotechnical Report prepared by a Geotechnical Engineer with experience in trenchless technology. The Report shall include (i) comments and recommendations with respect to construction methodology, (ii) an estimate of the expected extent and magnitude of ground movement over time, (iii) measures to be undertaken to preserve the safety of rail operations and the structural integrity of the track structure, and (iv) a detailed proposal for ground surface and subsurface monitoring.
 - i. Factual subsurface information with all field and laboratory test data.
 - ii. A description of the site and soil stratigraphy including results of soil classification testing.
 - iii. A plan of the proposed crossing with borehole/testing/installation locations.
 - iv. A summary of groundwater conditions encountered during the investigation including the observed groundwater levels within the boreholes and the presence of any perched water levels at the borehole locations.
 - v. Anticipated settlements as well as an assessment of the anticipated settlement through configurations.
 - vi. A detailed monitoring plan to monitor any ground surface and subsurface movements during construction shall be provided. The Review and Alert (work stoppage) levels shall be provided.
 - vii. Submit a contingency plan and notification procedure to be implemented in the event of excessive/unexpected settlement or heave, and unforeseen changes in subsurface conditions, i.e. cobbles and boulders, ravelling /flowing ground.

- Submit a Detailed Work Plan
 - i. Details of the proposed methodology - the installation operations, methods of maintaining and adjusting line and grade, drilled/bored diameter, drill hole stabilization procedures, temporary dewatering measures and any mitigation procedures if sinkholes/settlement above the pipe occurs or excessive movement of the settlement monitors is observed.
 - ii. The design of the crossing - length, diameter and thickness of the casing, elevations of the crossing invert at both ends, excavation shoring details and methods of dealing with cobbles/boulders and obstructions.
 - iii. Provide additional details for specific installation methodologies as follows:
 - i. Jack and Bore: size and location of the auger head relative to the casing, estimated jacking thrust required, method of monitoring casing elevation, thrust block design calculations, record keeping system to document casing advance and jacking pressures, bulkheading, and grouting procedures.
 - iv. Pipe Ramming: length, diameter and thickness of the casing, details of the reinforcing ring used at the leading edge of the pipe
 - v. Hand Mining: method of temporary bulkheading
 - vi. Micro-tunnelling: type of machine
 - vii. HDD: slurry pressure and mitigation measures for frac out if applicable
 - viii. TBM: type of machine, methods of primary ground support, grouting between the casing, ribs and lagging (primary support) and the surrounding soil/rock

- Settlement Monitoring Scheme Requirements:
 - i. Summary of Proposed Settlement Monitoring
 - i. Geographical Location
 - ii. Number of Settlement Monitoring Probes
 - iii. Type of Probe & installation Method
 - iv. Expected Amount of Settlement (mm)
 - v. Frequency of Monitoring
 - vi. Duration of Monitoring
 - ii. Site Plan:
 - i. Site Plan
 - ii. Identify Probe Locations and Offset Distances to Nearest Rails
 - iii. Elevation of Top-of-Probes
 - iii. Probe Detail Drawing:
 - i. Show section through Railway Track Road Bed
 - ii. Existing Ground Line
 - iii. Depth of Bore
 - iv. Distance to Bottom-of-Probe to Top of Casing Pipe
 - iv. Submit a dewatering plan.

- Monitoring During Construction
 - i. Monitoring by a qualified geotechnical personnel and report to CN on a daily basis.
 - ii. Installation in accordance with the Contractor's detailed work plan.
 - iii. Over-excavation does not occur, and the liner / casing is installed tight to the excavation.
 - iv. Report theoretical vs. actual volumes of spoils removed on per meter and total bases.
 - v. The excavation is fully supported until the liner / pipe installation is complete.
 - vi. The bulkhead is installed at the end of every work shift or during any prolonged stoppage of work.
 - vii. Voids are fully grouted to refusal immediately after the completion of liner / pipe installation. Report theoretical vs. actual volumes of grout pumped.

- Reporting to CN during/post Construction
 - i. Progress of the contractor and pipe installation and what work was completed on that day,

- ii. A summary of the daily ground surface and subsurface movements showing a comparison to a baseline reading taken before the start of construction, settlements of greater than 10 mm shall be reported to CN immediately.
 - iii. Any other geotechnical issues that may be of concern to CN.
 - iv. Log of settlement survey results showing
 - i. Station
 - ii. Date and Elevation of Initial Readings
 - iii. Date and Elevation of Subsequent Readings
 - iv. Difference in Elevation
 - v. Submit ground surface and subsurface monitoring reports to CN on a **daily basis**, showing a comparison to baseline readings taken prior to the commencement of construction. Settlement of 5mm is to be reported to CN immediately, and a settlement of 10 mm or greater the work is stopped until a resolution is achieved.
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- Provide, in writing, the name and phone number of the Applicant's qualified site inspector who will be on the job site on a full time basis for the duration of construction.
 - If there are fibre optic cables buried within the ROW, the Contractor shall submit details on the type of equipment to be used for pile driving, and estimate the vibrations that will be induced at ground level during operation.
 - The Contractor may be required to monitor vibrations levels during pile driving operations, for which the Contractor shall submit a procedure and the type of monitoring equipment to be used.
 - i. Induced vibrations shall be limited to a maximum peak particle velocity (PPV) of less than 100mm/sec (measured in 3 mutually perpendicular directions taken at tie level / ground surface). And induced amplitude of movement shall be less than 0.2mm
 - ii. Vibrations undertaken within 50 metres of Bell Canada (360 Networks) fibre optic cables, induced vibrations shall be limited to a maximum of PPV of less than 50mm/sec
 - The nearest point, at which excavation can be undertaken, is as follows: Starting ten (10) feet from the gauge side (inside) of the nearest rail, measured perpendicular to the rail, calculate a slope to the bottom of the proposed pipe at a 1.5:1 slope. If a 1.5:1 slope cannot be maintained or more restrictive conditions occur, approved shoring will be required.
 - During construction, the Applicant shall maintain positive drainage of Railway property. After construction is completed, the Railway's right-of-way shall be restored to its original condition and to the satisfaction of the Railway. Any fencing removed to facilitate construction shall be restored.

*** No construction or access to CN ROW will commence until a Agreement has been entered into between CN and the Utility Owner ***

Monitoring Points Sketch

