APPENDIX 1
CROSSING AND DESIGN REQUIREMENTS

The below requirements should be adhered to when designing your crossing. Individual requirements or conditions will appear on the crossing consent as required.

1.0 GENERAL CONSIDERATIONS

1.1 ANGLE OF CROSSING

The angle of crossing by railways, highways, or utilities shall be as close as possible to 90 degrees, but not less than 45 degrees in any case.

1.2 FIXTURES

All above ground appurtenances and other support fittings; e.g. poles, anchors, sheds, manholes, catch basins, valves etc., are to be located outside the pipeline right-of-way.

1.3 RESTORATION OF EASEMENT

The surface of the easement shall be restored to its original slope, contour, finish and depth of cover.

1.4 POSITION OF UNDERGROUND INSTALLATIONS

Underground installations that cross within the pipeline right-of-way should be installed below the pipeline. Where impossible, structures that cross above pipelines must be approved by Sun-Canadian.

1.5 CLEAN FILL

Clean fill shall be used around the pipelines and over the right-of-way.

1.6 PROTECTIVE ENVELOPE

An envelope at least 30 cm. (12") thick of sand or clean fill acceptable to the Inspector must be hand compacted around the pipeline to a minimum of 95% standard Proctor density.

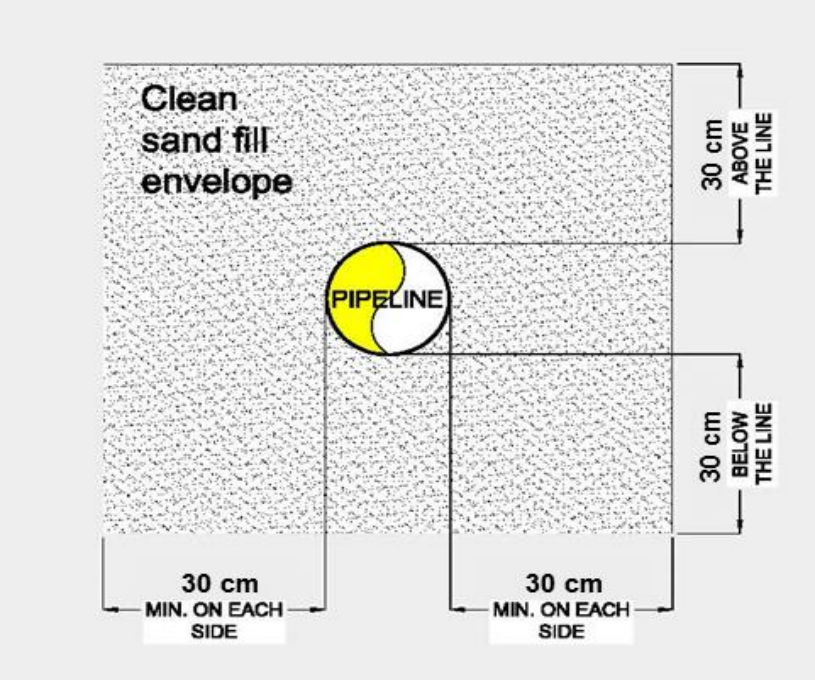

Figure 1: Backfill requirement

Alternatively, an acceptable rock shield material may be used to provide a cushion between the pipe coating and backfill in rocky, coarse and abrasive soils.

Unshrinkable fill can only be installed after the placement of a sand envelope to prevent its direct contact with pipeline. Compressive strength of the unshrinkable fill must be such that it can be easily removed later by permitted excavation tools and equipment.

1.7 TEMPORARY FENCE

A highly visible temporary fence, securely affixed, must be erected to restrict access to the pipeline and easement wherever:

- An open excavation is on the right-of-way and exposes the pipeline.
- Equipment will be working in the vicinity of the pipeline.
- Precautions are required to protect the public and the pipeline.

1.8 MINIMUM COVER REQUIREMENT

Location	Min. Cover m (ft)
General (other than as indicated below)	0.60 m (2 ft)
Below travelled surface (roads)	1.20 m (4 ft)
Right-of-way (road or railway)	0.75 m (2.5 ft)
Railway (Cased pipeline)	1.20 m (4 ft)
Railway (Uncased pipeline)	2.00 m (6.6 ft)
Water crossing	1.20 m (4 ft)
Below drainage or irrigation ditch	0.8 m (2.5 ft)

2.0 UTILITIES

2.1 CLEARANCE

The proposed utility crossing shall be designed to maintain a minimum clearance of 1 m (39 in) either above or below the pipeline.

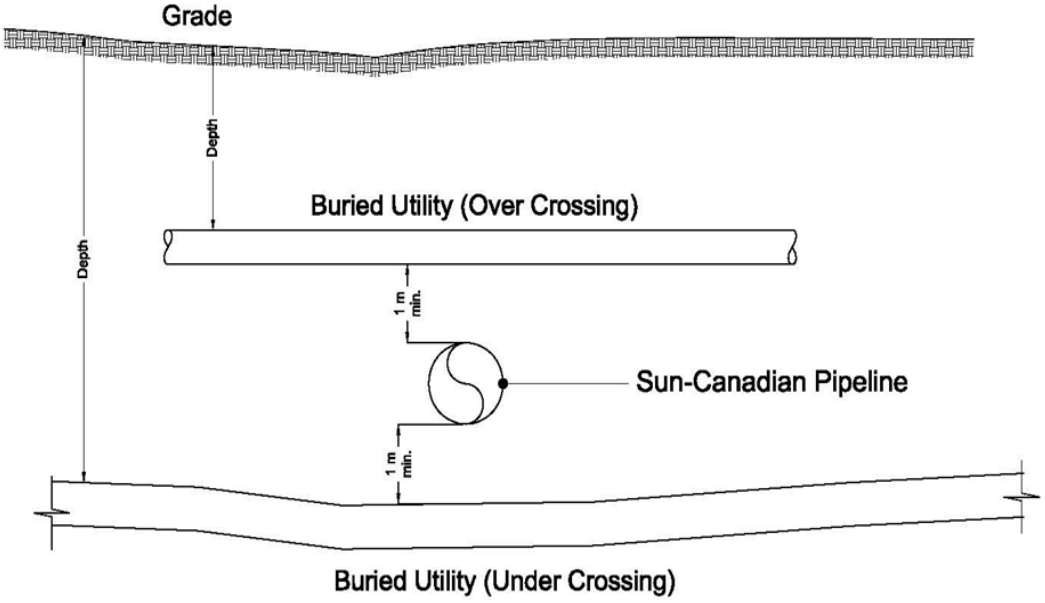

Figure 2: Utility crossing clearance

2.2 UNIFORM DEPTH

The proposed utility must maintain a reasonably uniform installation profile across the full width of the pipeline right-of-way.

2.3 NO CONNECTIONS WITHIN RIGHT-OF-WAY

No splices, joints or other connections shall be made to cables within the pipeline right-of-way. Joints in sewer and water main pipes shall not be made over or under the petroleum pipelines.

2.4 UTILITY MARKERS

Permanent visible warning signs for the utility crossing must be placed and maintained within 3 meters of the point of crossing.

2.5 RIGID CONDUIT

Multiple underground cables must be placed in a concrete or rigid conduit for the full width of the right-of-way, or for a distance of 7.6 meters (25 feet) on either side of the pipeline.

2.6 SELF-SUPPORTING CONDUITS

Conduit duct structures over top of the pipeline must be designed to be self-supporting when exposed for a 3 meter span.

2.7 PROBING PROTECTION

Plastic gas lines and PVC ducts must have a layer of concrete paving stones placed above them at the crossing of the petroleum pipelines to guard against possible probing bar damage.

2.8 INSULATE METALLIC STRUCTURES

All metallic installations must be wrapped with a non-conductive insulating material for a minimum distance of 8 meters on either side of the pipeline.

2.9 CATHODIC PROTECTION

Metallic installations that cannot be adequately insulated are required to be bonded to the pipeline in accordance with the specifications in the accompanying drawing. A new test lead with suitable test point may need to be installed to provide Corrosion control. The design must conform to CSA Standard C22-3, No.4.

2.10 OVERHEAD POWER LINES

Overhead power line crossings must conform to CSA Standard C22-3.- No. 6

2.11 AERIAL MARKERS

Aerial warning devices shall be installed on overhead power lines at the crossing point to facilitate safe aerial patrol of the pipeline.

3.0 ROADS AND PARKING LOTS

3.1 CLEARANCE

The travelled surface of all roadways, trails or access lanes must be at least 1.2 meters (4 feet) above the top of the pipeline or casing pipe.

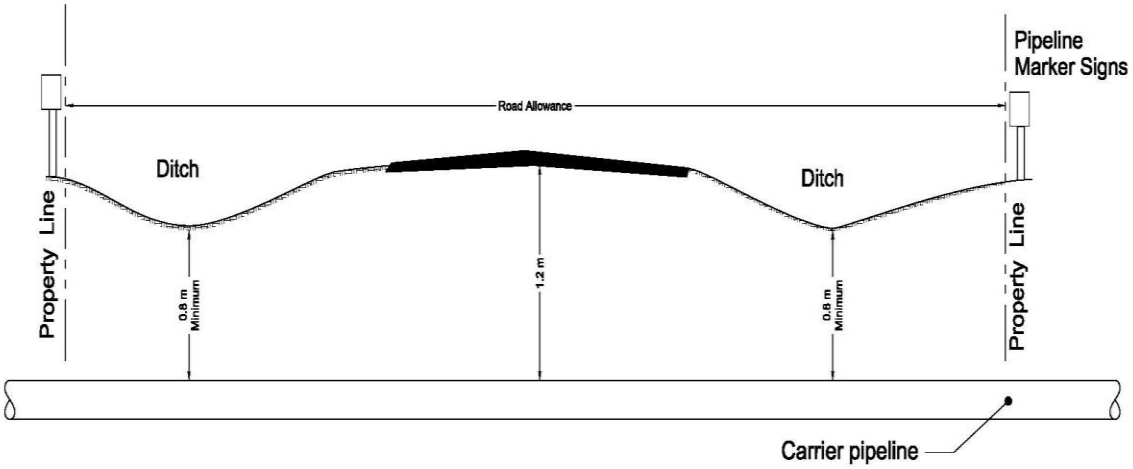

Figure 3: Road and Travelled Surfaces

3.2 TEMPORARY VEHICLE AND EQUIPMENT CROSSINGS

(a) Equipment crossing the pipeline must use one established crossing point with a minimum cover of 1.2 meters or additional material is required to provide adequate depth of cover, or adequate mechanical protection is necessary, to mitigate the stress on the pipeline,

(b) Excavation machinery shall not be placed on top of the pipeline unless an adequate cover has been confirmed by the Sun-Canadian Inspector.

(c) In all cases it is the Applicant's responsibility to prove the adequacy of depth of cover or mechanical protection to avoid introducing additional stress on the pipeline.

3.3 SUBGRADE MATERIAL

All subgrade material shall be of sufficient strength to safely withstand the design loading conditions and resist the transmission of stress to the pipeline. Where materials are not adequate for wheel loads, a suitable protective mat or pre-cast concrete slabs installation may be an acceptable alternative.

Sun-Canadian reserves the right to request the applicant to provide at their expense, an engineering soil loading assessment depending on the nature of the proposed traffic and equipment.

3.4 NOISE WALLS

Noise attenuation walls that cross over the pipeline shall have a removable section over the entire width of the pipeline easement to allow access to the pipeline.

3.5 PARKING LOTS

Wherever possible, parking areas should leave an un-paved or "green" strip over the pipeline right-of-way to allow access to the buried pipeline without disturbing the pavement. Sun-Canadian reserves the right to request the installation of a leak detection system depending on the extent of the hardened surface. Special use conditions will apply to parking lots.

If Sun-Canadian Pipe Line Company Limited is required to break the asphalt driving or parking surface in order to perform normal pipeline maintenance and repairs; it shall be the Applicant's responsibility and cost to repair the surface. EXCEPT IN AN EMERGENCY, Sun-Canadian will consult with the parking lot owner or operating authority prior to undertaking any excavations through the surface area.

4.0 RAILWAY CROSSINGS

All railway crossings shall be laid in accordance with the approval and conditions set by the Transport Canada Standard TC E-10, and C.S.A. Standard Z662. Refer to Section 1.8 for the minimum cover requirement.

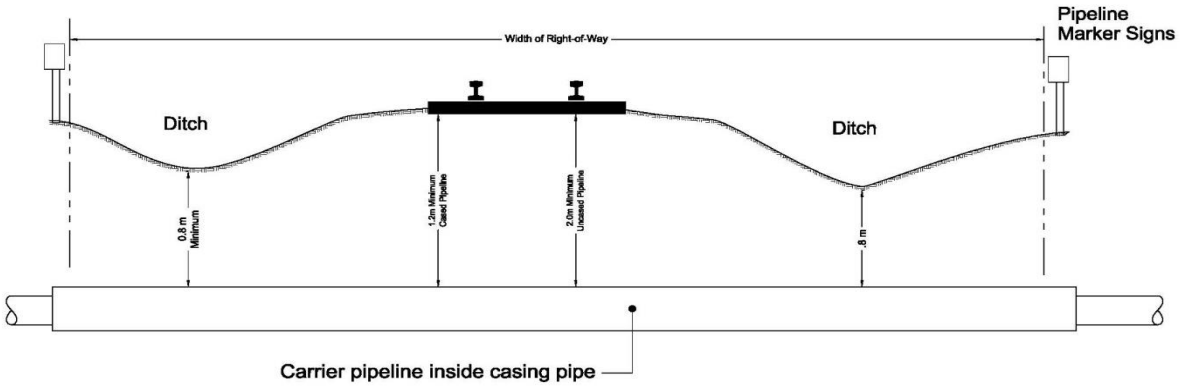

Figure 4: Railway crossing clearance

5.0 DRAIN TILES, OPEN DRAINS, DITCHES AND SWALES:

5.1 INSTALLING DRAIN TILE HEADERS

Drain tiles crossing the right-of-way are to be kept to a minimum by installing headers along the right-of-way boundaries.

5.2 SECONDARY HEADERS

If required to facilitate drainage networks, secondary headers may be installed within the right-of-way, but no closer than 5 meters from the pipeline.

5.3 CLEARANCES

Clearances from the pipeline to:

- Drain tiles (non-conductive material) . 5 cm (2 inches)
- Ditch bottoms .....80 cm (30 inches)
- Culverts (conductive drain pipe).....1 m (39 inches)

6.0 LANDSCAPING

6.1 DEPTH OF COVER

The minimum clearance depth between modified final grade and the pipeline shall be 80 cm (30 inches)

6.2 CLEARANCE TO POSTS

Fence posts and landscape poles shall be kept at least 1.5 meters (5 feet) away from the pipeline. Light posts and telephone poles shall be kept at least 3 meters (10 feet) away from the pipeline.

6.3 TREES

The pipeline right-of-way must be kept clear of trees and berms. Shrubbery is permitted subject to the following restrictions:

- Shrubs, and hedges with a mature growth height of less than 1.5 meters are acceptable
- Minimum clearance distance of 1 m (3 ft).
- In cases where the recommended clearance cannot be achieved, Sun-Canadian may specify the installation of a root deflector.

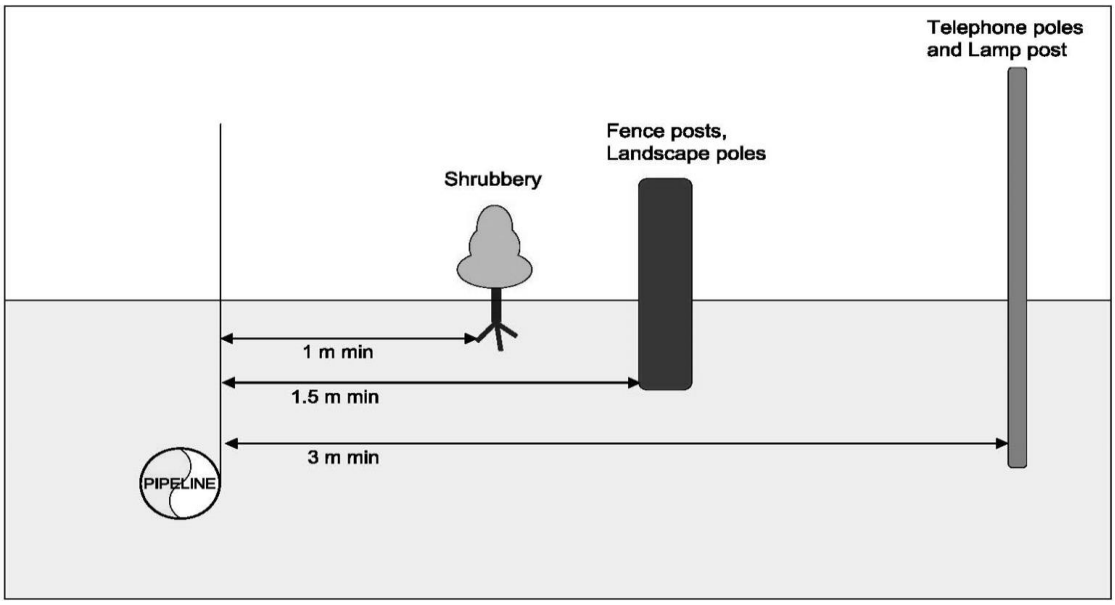

Figure 5: Minimum clearance of landscape fixtures from the pipeline

7.0 EXCAVATION

7.1 MECHANICAL EXCAVATION

Mechanical equipment may excavate NO CLOSER than 60 cm to Sun-Canadian's pipeline, and only after it has been fully exposed by hand digging or vacuum excavation.

7.2 HYDRO EXCAVATION

The following procedures shall be followed at all times when excavating with hydro-excavation technology:

(a) Prior to starting work, obtain the required locates. Operation of hydro-excavation equipment should only be performed by competent and qualified workers.

(b) The straight tip nozzle may be used NO CLOSER than 1m to the pipeline. Maximum water pressure to be used at any time during excavation with a straight tip nozzle is 17,250 kPa (2,500 psi). All pressure measurements must be taken from the hydro-excavator (truck, pump).

(c) The maximum water pressure to be used at any time during excavation with a spinning tip nozzle is 10,350 kPa (1,500 psi). When a spinning tip nozzle is used, pressure measurements must be monitored constantly using a calibrating device mounted on the hydro-excavator (truck, pump) or on the wand.

(d) The wand must never remain motionless during excavation. Avoid aiming directly at the pipeline at all times.

(e) Maintain a distance of 20 cm (8 in.) between the spinning tip nozzle end of the wand and the pipeline and/or subsoil. Never

insert the nozzle into the subsoil while excavating above the pipeline.

(f) Hydro-excavation equipment and nozzles used must have been specifically designed for use above buried pipeline and underground structures.

(g) The wand must be fitted with a device capable of stopping the excavation on demand, such as an automatic trigger or a safety valve

(h) If heated water is used during excavation, the temperature and pressure of the water must not exceed 115°F (45°C) and 17250 kPa (2500 psi), respectively.

(i) If damage to underground facilities and/or coatings on these facilities occurs while using vacuum-excavation technology or any other method of excavation, the excavator shall contact the facility owner/operator.

7.3 AIR EXCAVATION

(a) Maintain a distance of 20 cm (8 in.) between the nozzle end of the wand and the pipeline and/or subsoil. Never insert the nozzle into the subsoil while excavating above the pipeline.

(b) The flow rate should not exceed 680 m^3/hr (290 CFM) to protect pipe coating.

(c) The maximum air pressure should not exceed 1034 kPa (150 psi).

8.0 SPECIAL PROJECT CONSIDERATIONS

8.1 PIPELINE SUPPORTS – MAJOR EXCAVATIONS

Adequate pipeline supports and trench shoring as approved by a professional engineer must be provided if over 7 meters of pipeline is exposed.

8.2 TRENCHLESS INSTALLATION

For trenchless excavations and installations (including Horizontal Directional Drilling (HDD), Jack and Bore, Horizontal Auger Drilling, Pipe Ramming, Microtunnelling) the following guidelines must be adhered to:

(a) No trenchless construction must be done within 1m (3 ft) of the pipeline markers.

(b) In all cases, daylight holes are required for visual confirmation of drill path with actual depth measurement

(c) Daylighting: Pipeline shall be exposed by non-destructive methods to verify their horizontal and vertical locations when the bore path comes within 1.0 m horizontally or vertically of the

pipeline.

(d) Any trenchless excavation running parallel to the pipeline must be outside the pipeline safety zone.

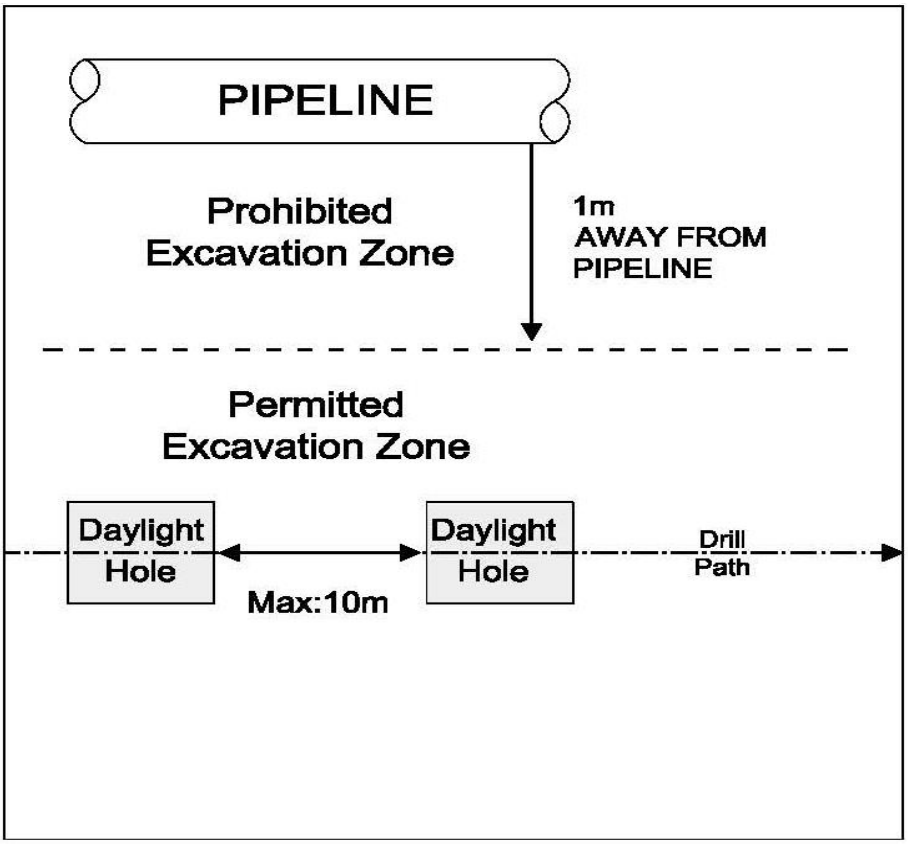

Figure 6: Top view of parallel trenchless construction

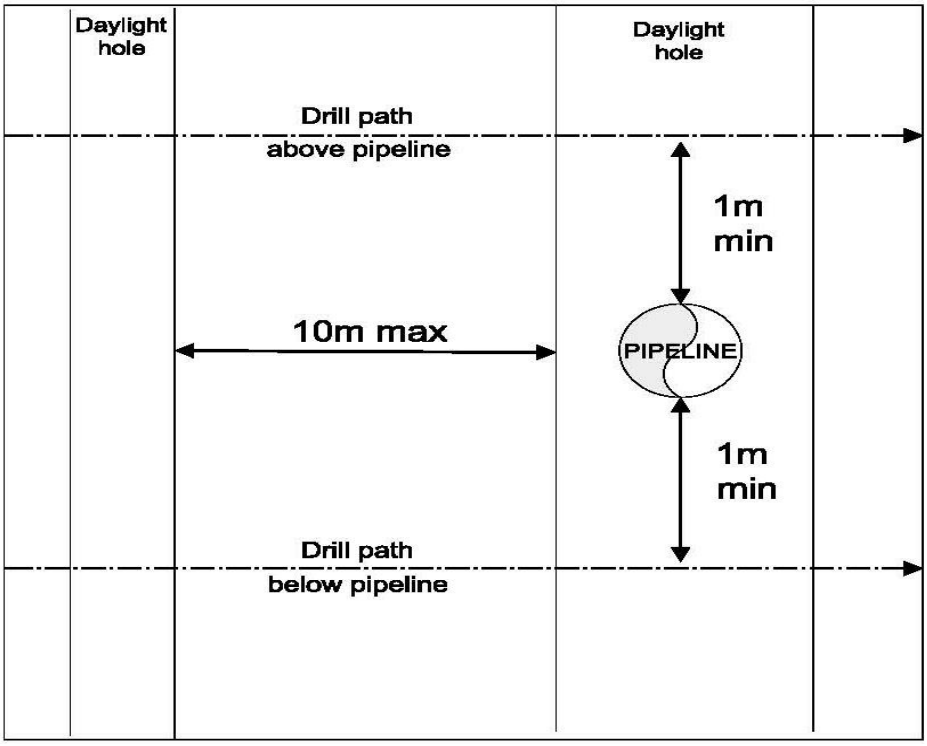

Figure 7: Cross section of perpendicular trenchless construction

8.3 DRAGLINES

Dragline equipment shall not be operated to excavate within 6 meters of the pipeline.

8.4 SPOIL PILES-TEMPORARY

Temporary Spoil piles can be permitted on the right-of-way in cases where absolutely no other alternative is available for a duration no longer than 2 - 3 weeks. Spoil piles must be pushed onto the pipeline and pulled off the pipelines. No working equipment is permitted directly over the pipeline

9.0 VIBRATION AND BLASTING CONTROLS

9.1 BLASTING CLEARANCES

The crossing party should use methods other than blasting on the right-of-way, where possible. No blasting allowed within 1.5 meters (5 feet) of the pipeline.

9.2 LIMITATIONS FOR BLASTING – HOE RAMMING – PILE DRIVING

(a) Maximum amplitude of vibration for explosives: 0.15 mm

(0.006 in.)

(b) Maximum amplitude of vibration for repeated mechanical impacts (hoe ramming, pile driving): 0.076 mm (0.003 in.)

(c) Maximum peak particle velocity:
50 mm/sec (2.0 in./sec.) when frequency ≥ 40 Hz
20 mm/sec (0.8 in./sec.) when frequency < 40 Hz
As measured at the ground surface above the pipeline at the point nearest the blast site.

(d) Delays shall be designed to prevent cumulative readings

9.3 IMPACT PROTECTION

(a) The pipeline must be protected from fly rock and impacts from hoe-rams, drills and other machinery.

(b) All blasts must be controlled with the use matting or other safeguards.

(c) Exposed pipeline must be banded with minimum "2x4" wood lagging and shall have a maximum unsupported span of no more than 7 meters

9.4 VIBRATIONS AND BLASTING SUPERVISION

(a) The crossing party shall notify Sun-Canadian Pipe Line Company Limited prior to any proposed blasting within 300 m of the pipeline.

(b) The crossing party shall retain the services of a registered professional engineer, licensed in the Province of Ontario, to be on site to design, monitor and control all blasting activities within 60 m of the pipeline.

(c) The crossing party shall provide Sun-Canadian Pipe Line Company Limited with a written copy of their plans for blasting within 60 m of the pipeline at least 2 weeks prior to operations within that zone, to allow a Sun-Canadian to coordinate a reduction in operating pressure of the pipeline.

(d) The crossing party shall retain the services of a registered professional engineer, licensed in the Province of Ontario, to be on site to design, monitor and control all blasting, hoe ramming or pile driving activities within 60 m of the pipeline.

(e) No blasting shall take place within 60 meters of the pipeline until Sun-Canadian Pipe Line Company Limited's Inspector or consultant approves each shot.

9.5 TIMING

Blasting close to the pipeline must be pre-arranged and be completed within a single day, if possible.

9.6 RECORDS

Prior to any blasts within the 60 m zone, or pile driving within 10 m of the pipeline, Sun-Canadian Pipe Line Company Limited or its consultant shall be supplied with a copy of seismographs, testifying that the vibration limitations listed above have not been exceeded at the pipeline by any previous blasts or impacts.

10.0 LAND USE PLANNING IN THE VICINITY OF PIPELINES

10.1 CSA GUIDELINES FOR DEVELOPMENT

All proposed commercial and residential buildings shall be situated in accordance with the Land use planning for pipelines: *CSA Z663 Land use Planning in the Vicinity of Pipeline Systems.*
Sun-Canadian requests that any proposed development achieve the following guideline criteria:

(a) The minimum setback between the nearest pipeline and proposed unoccupied buildings should be the edge of the right-of-way, unless otherwise specified by local authorities.
(b) A minimum setback of 20 metres shall be maintained from the centerline of the pipeline to dwellings intended for human occupancy.
(c) A minimum setback of 200 metres shall be maintained from the centerline of pipelines to institutions where rapid evacuation may be difficult, such as hospitals, nursing homes, penal institutions, and institutions for the disabled.

10.2 ROW ENCROACHMENT

An encroachment is any object, facility or structure that has been erected, constructed or installed within the area of the pipeline ROW. (An encroachment may not necessarily involve an excavation. Encroachments that are erected, constructed or installed in conjunction with an excavation, without prior approval, may violate local and provincial laws as well as existing ROW agreements.)

Every attempt should be made to keep the easement free of encroachments. Items placed in the easement may threaten the safe operation and maintenance of pipelines by precluding proper monitoring and prohibiting essential access for maintenance and repair.