Appendix 1
Crossing and Design Requirements

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

1 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 such as: poles, anchors, sheds, manholes, catch basins, valves etc., must 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.

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 ensure there are no voids, and to the satisfaction of the SCPL inspector. See *Figure 1*.

Alternatively, an acceptable rock shield material may be used to provide cushioning 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. The compressive strength of the unshrinkable fill must allow for easy removal later by using permitted excavation tools and equipment.

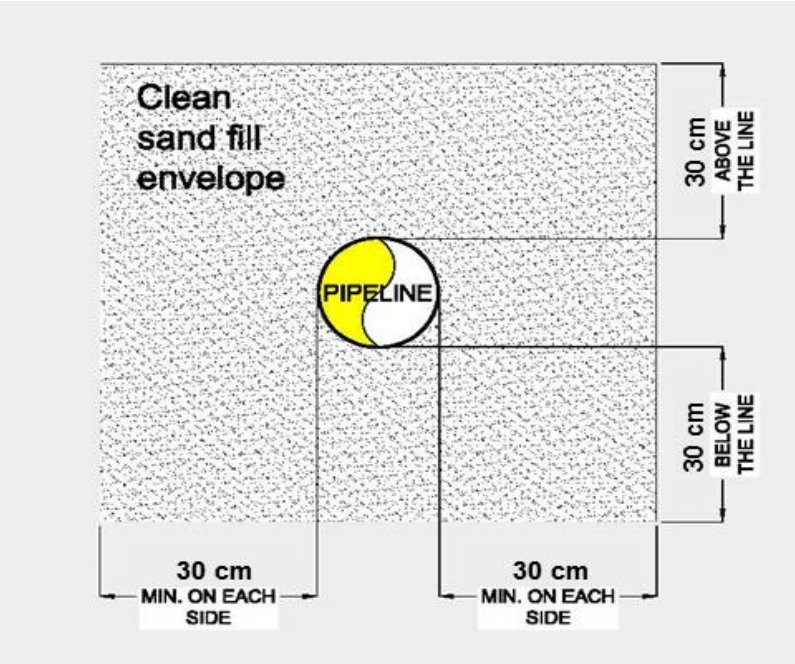

Figure 1: Backfill Requirement

1.7 Temporary Fence

A highly visible temporary fence, securely affixed, must be erected along with proper warning signage to restrict access to the pipeline and easement whenever:

- 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 necessary to protect the public and the pipeline.

1.8 Minimum Cover Requirements

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)

1.9 Overhead Lifting

Any overhead lifts over Sun-Canadian's exposed facilities are prohibited without permission from SCPL. SCPL may request to see lift plans prior to any lifts. The SCPL inspector may also request the use of protective covering in certain cases.

If a lift is to occur near Sun-Canadian property, SCPL requires that equipment is set up outside the SCPL Right-of-Way where possible and SCPL must be notified.

2 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. See *Figure 2*.

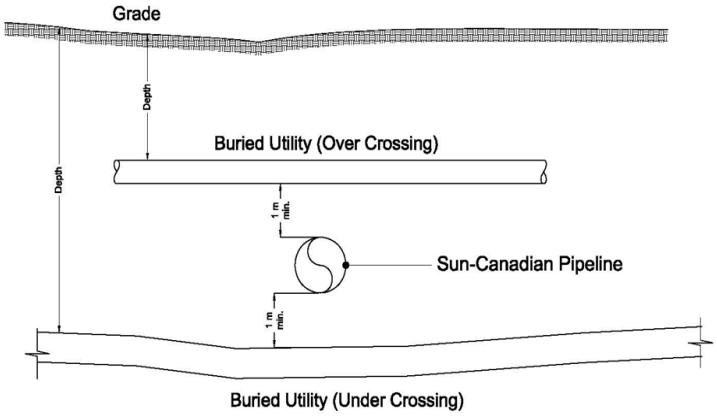

Figure 2: Utility crossing clearance

2.2 Uniform Depth

The proposed utility must maintain a reasonably uniform installation profile with no side bends 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

Where regulated, 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 damage from probing bars.

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.

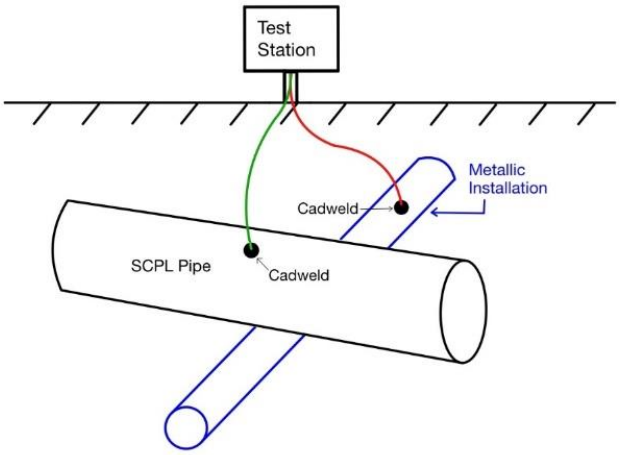

Figure 3: Test Station

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.

2.12 Light Posts and Utility Poles

Light posts and utility poles shall be kept outside the pipeline right-of-way and at least 5 meters (16.4 feet) away from the pipeline, whichever distance is greater. In all cases, SCPL must be contacted for approval for any installations occurring near the pipeline right-of-way. Refer to *Figure 4* for a visual representation.

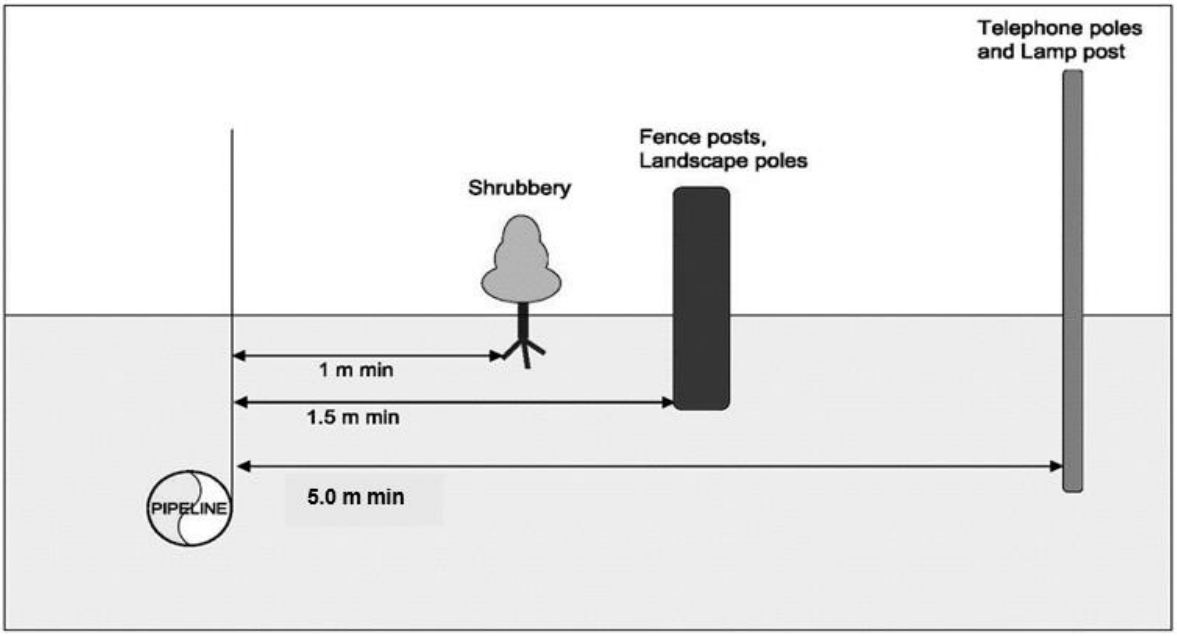

Figure 4: Minimum clearance of poles from the pipeline

3 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. See *Figure 5*.

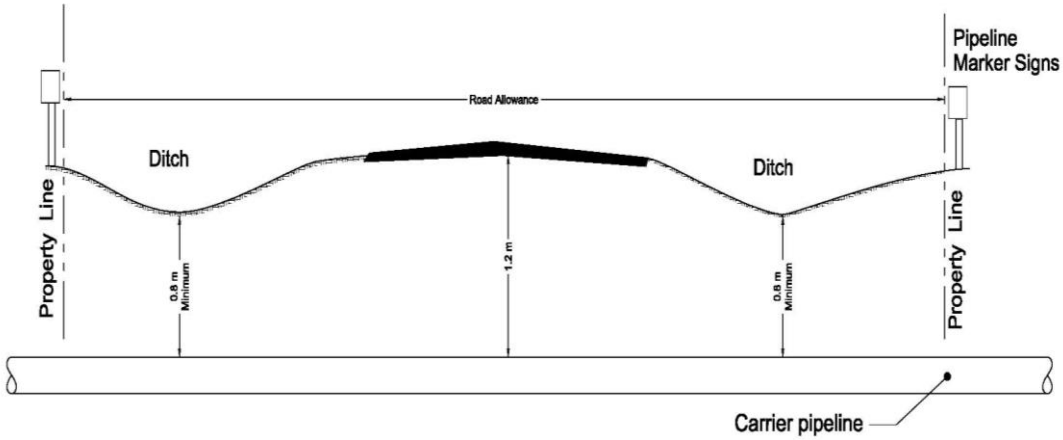

Figure 5: Road and Travelled Surfaces

3.2 Temporary Vehicle and Equipment Crossing

(a) Equipment crossing the pipeline must use one established crossing point.

(b) All equipment crossing the pipeline must be assessed by SCPL. Additional material or adequate protection may be recommended based on the crossing assessment. The means of protection shall be recommended and approved by an SCPL engineer. SCPL inspector has final approval.

(c) No machinery shall be placed on top of the pipeline unless adequate cover has been confirmed by the Sun-Canadian Inspector.

(d) 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 have 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 slab 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 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.

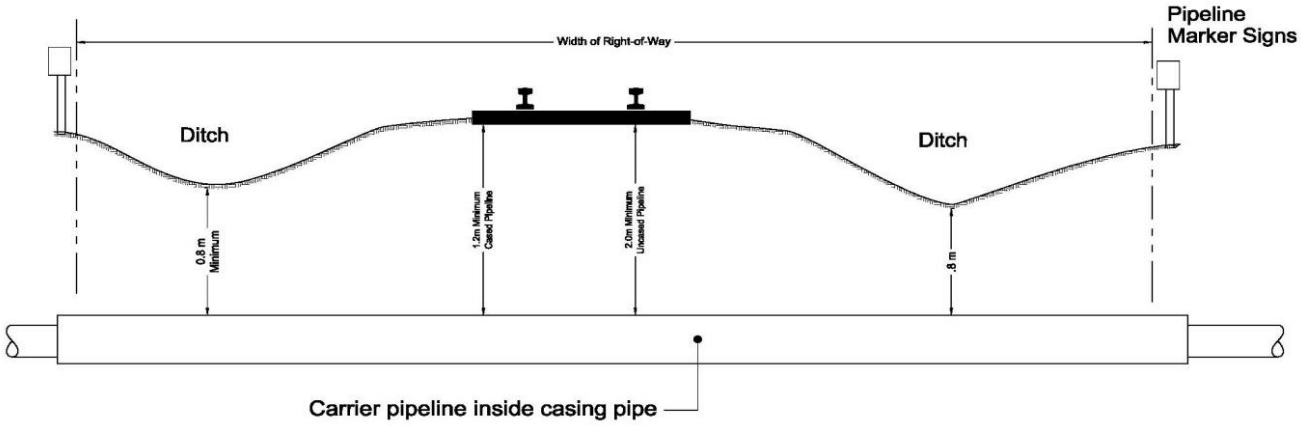

Figure 6: Railway crossing clearance.

5 Drains, Open Drains, and Ditches:

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 Clearance

Clearances from the pipeline to:
- Drain tiles (non-conductive material) ..... 5 cm (2 inches)
- Ditch bottoms ..... 80 cm (30 inches)
- Culverts (conductive drainpipe) ..... 1 m (39 inches)

6 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.

6.3 Trees

The pipeline right-of-way must be kept clear of trees and brush. 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). See *Figure 7* below.

In cases where the recommended clearance cannot be achieved, Sun-Canadian may specify the installation of a root deflector.

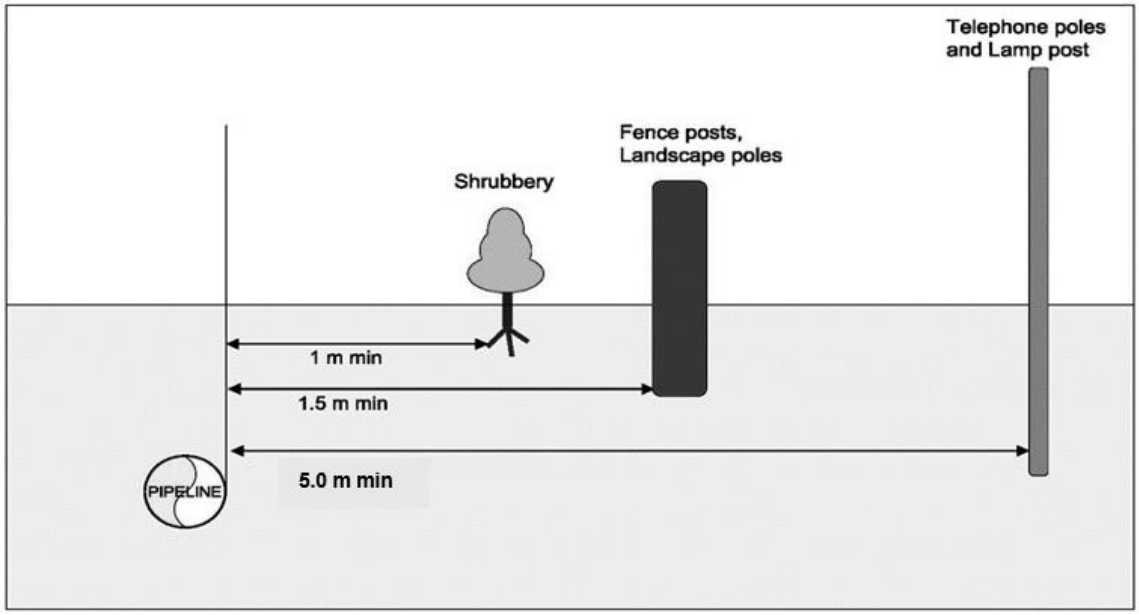

Figure 7: Minimum clearance of landscape fixtures from the pipeline

7 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 Special Project Considerations

8.1 Pipeline Supports – Major Excavations

Pipeline supports and trench shoring as approved by a professional engineer must be provided if the pipeline is exposed above the following limits:

NPS	Maximum Unsupported Span
6”	5.2 m
8”	5.8 m
12”	7 m

8.2 Trenchless Excavation

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

Parallel trenchless excavations

The following guidelines apply to all trenchless excavations occurring parallel to the pipeline:

1. Any trenchless excavation running parallel to the pipeline is strongly encouraged to be outside the pipeline safety zone (typically 7.6m or 25ft).
2. If the parallel trenchless excavation must be done within the pipeline safety zone, the following rules apply:
    a. The minimum clearance between the edge of the pipeline (or the surveyed stake out location of the pipeline) and the edge of the drill/bore path shall be 1m.
    b. In all cases, daylight holes are required for visual confirmation of drill/bore path with actual depth measurements. The daylight holes must be no more than 10m apart. Refer to *Figure 8*.

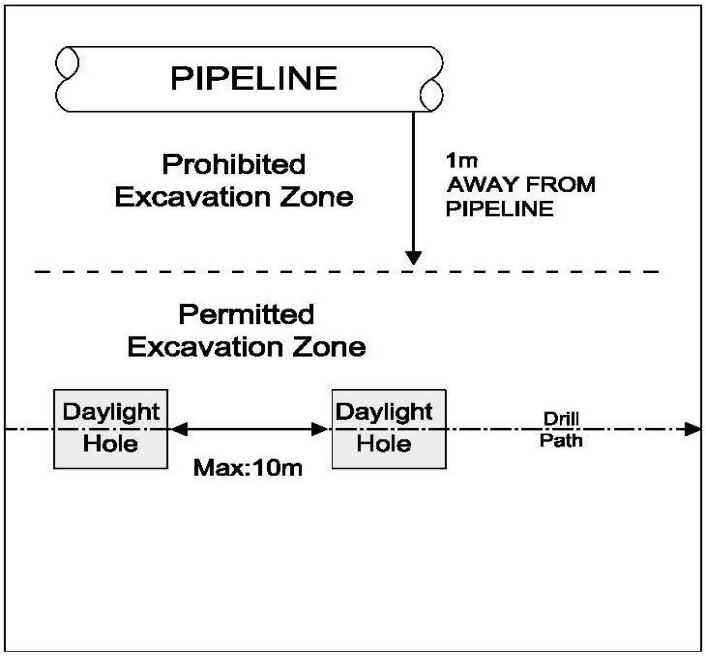

Figure 8: Top view of parallel trenchless construction

Perpendicular trenchless excavations

The following guidelines apply to all trenchless excavations running perpendicular to the pipeline:

1. All perpendicular trenchless excavation must go below the pipeline. SCPL must give special permission for perpendicular trenchless excavations occurring above the pipeline.
2. All perpendicular trenchless excavation is prohibited from occurring within 1m above or below the edge of the pipeline.
3. In all cases, the pipeline shall be exposed (1m horizontally and vertically) by non-destructive methods to verify their horizontal and vertical locations. Refer to figure 9.
4. In all cases, daylight holes are required for visual confirmation of drill/bore path with actual depth measurements. The daylight holes must be no more than 10m apart. Refer to *Figure 9*.

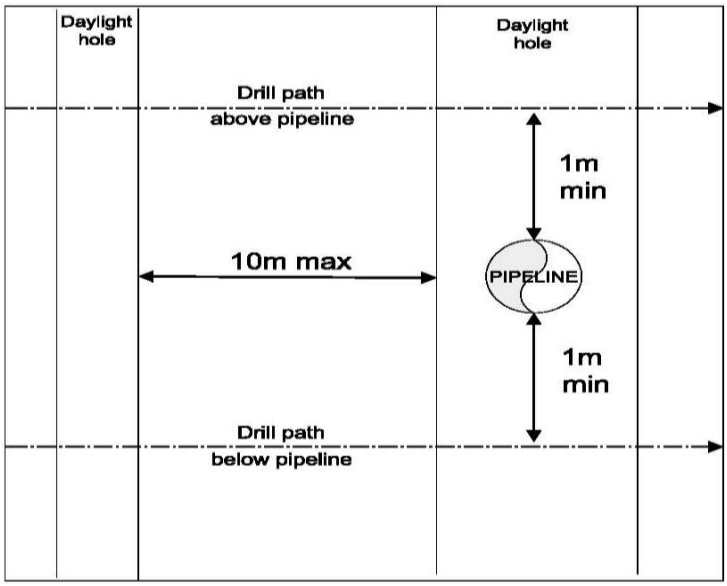

Figure 9: Cross section of perpendicular trenchless construction

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 may 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.

8.5 Load Bearing Structures

Load bearing foundations and other permanent structures are not permitted within SCPL pipelines ROW.

For SCPL ROW areas where easement width is 1.5m, the guidelines below may be utilized.

(a) The minimum horizontal clearances between the pipeline and the edge of load distribution structures such as piles, and/or vertical supports is required to be minimum 3m.

(b) A 3m horizontal clear distance is required between nearest edge of spread footings and the existing pipeline. For foundations over 3m wide and deep foundations, the base of the load bearing is recommended to be lower than the bottom of SCPL pipe elevation to ensure soil pressure from the foundation does not adversely affect the soil support beneath the SCPL pipeline. It is the applicant's responsibility to demonstrate this with proper design calculations.

8.6 Wooden Cribbing

Cribbing can be utilized as a method of support for exposed pipeline. The following guidelines apply to cribbing:

1 The size of hardwood utilized for cribbing is recommended to be 4in x 6in x 4ft.

2 It is strongly recommended that the maximum span of unsupported line should be no greater than 5m. Where not possible, the maximum span of unsupported line should be as follows:

a. For a 12” line the maximum span is 7m
b. For an 8” line the maximum span is 5.8m
c. For a 6” line the maximum span is 5.2m

3 Cribbing shall never be placed within 10 ft of a weld.

4 Typically, a 2x2 perpendicular method is used. Each layer consists of 2 pieces of hardwood layered perpendicularly to the layer above and below it. See *Figure 10*.

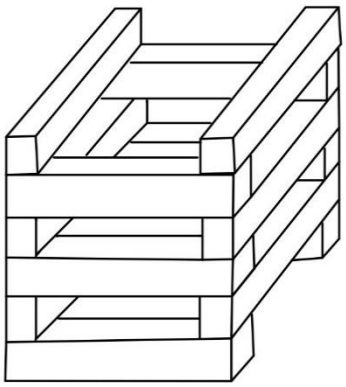

Figure 10

9 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 as per the table below.

NPS	Max Unsupported Span
6”	5.2 m
8”	5.8 m
12”	7 m

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 Pipeline 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 Pipeline 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 Pipeline 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 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 easement may be incorporated into subdivision plans as green space, walkways or bicycle paths, but shall not be incorporated into individual lots.
(b) 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/municipalities.
(c) A minimum setback of 20 meters shall be maintained from the centerline of the pipeline to dwellings intended for human occupancy.
(d) A minimum setback of 200 meters 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.
(e) Limits of the easement parallel to the pipeline shall be identified with fencing or equivalent markings to prevent gradual encroachment by adjacent landowners.
(f) Any proposed additions or renovations to dwelling units that may effectively reduce the set-back distance to the pipeline will not be permitted.

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. The piling of garbage, dirt or industrial waste shall not be permitted at any time.

10.3 Proposed New Facilities

For the design of new facilities (other than hydrocarbon pipelines) designers must refer to section 4.11.4 of CSA Z662:23. This section provides guidelines on required clearances for a buried pipeline system in proximity to other pipelines, structures, conductors, or underground cables.

The following list is a summary of items the designer must consider, taken from section 4.11.4 of CSA Z662:23.

- **(a)** The clearance required to be able to perform construction, maintenance and repair activities on the pipeline
- **(b)** All excavation activities including trenchless excavation in the same corridor
- **(c)** Any pipe movement during operation
- **(d)** Protection and temporary support of the pipeline during construction, maintenance or repair activities
- **(e)** Any interference of the cathodic protection and grounding systems