

APPENDIX F

**Environmental Approval Applications for
Culvert Installation and Bridges,
Water Resources Management Division,
Department of Environment and Conservation**



GOVERNMENT OF
NEWFOUNDLAND AND LABRADOR

Department of Environment

Application for Environmental Permit for Culvert Installation

As required under **Section 48** of the *Water Resources Act*, SNL 2002 c W-4.01, approval is requested for:

All pertinent information relating to engineering, hydrologic and hydraulic design, site features, construction operations and anticipated environmental implications of the project are provided herewith to enable assessment of environmental feasibility of the project and to issue a Permit.

A. JUSTIFICATION: Please indicate reason(s) why this project is proposed.

B. LOCATION: Show location on largest scale topographic map available and outline the watershed boundary.

C. DRAINAGE BASIN:

Watershed Area	_____	(km ²)
Basin Perimeter	_____	(km)
Length of Main Channel	_____	(km)
Basin Slope	_____	(%)
Land Use:		
Barren	_____	(%)
Forest	_____	(%)
Wetland	_____	(%)
Urban	_____	(%)

D. CHANNEL DESCRIPTION AT PROPOSED CULVERT LOCATION:

(I) DIMENSIONS: (a) Please provide cross-sectional plan or drawing.
(b) Please provide general site plan or drawing.

- These should show:
- bottom width of channel.
 - top width of channel.
 - depth of channel.
 - shape & slope of channel embankments.
 - normal depth of water.
 - low water level.
 - high watermark or levels.
 - slope of channel.
 - extent of floodplain.

note: plans or drawings must show the above in relation to the proposed structure and any proposed training works. Also, please show any relevant natural or other features such as buildings, roads, other crossings, sewers, ponds, etc.

(II) HYDRAULIC DESCRIPTION:

Minimum Flow: _____ (m³/s)
Minimum Velocity: _____ (m/s)
Maximum Flow: _____ (m³/s)
Maximum Velocity: _____ (m/s)

(III) PROPOSED HYDROLOGIC DESIGN CRITERIA:

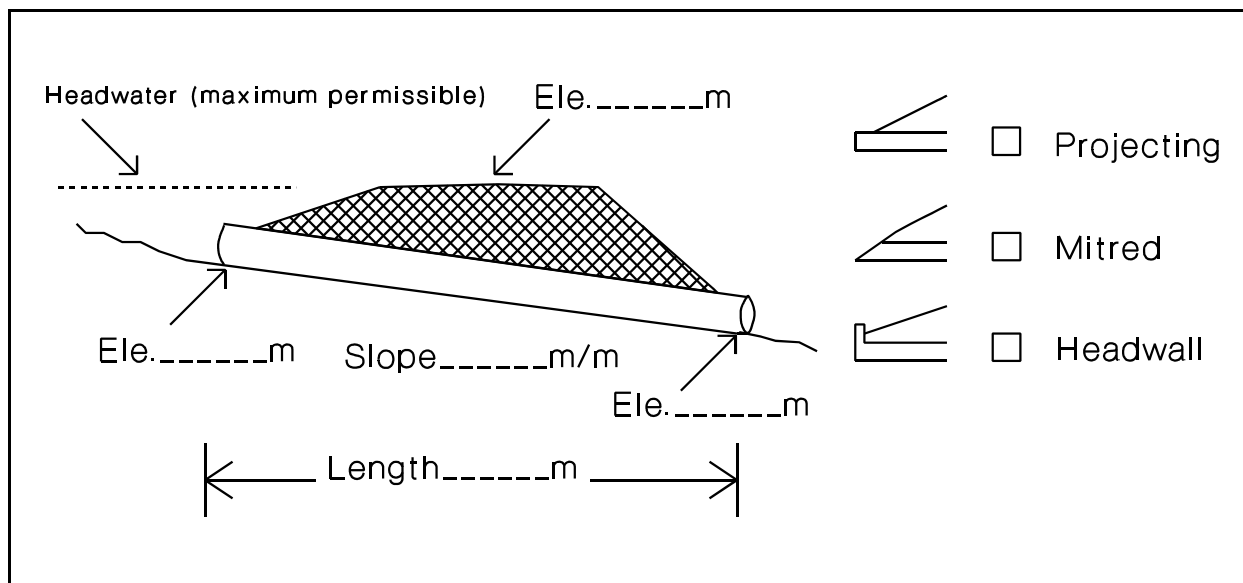
Return Period: _____ (yrs)
Design Flow: _____ (m³/s)

Please state method used to estimate design flow and give sample calculation below or on a separate sheet.

E. CULVERT DIMENSIONS & DESIGN:

Type of Culvert (steel) (concrete) (round) (pipe-arch) (other) _____
Headwall Type: (none) (concrete) (wood) (rip-rap) (other) _____
Culvert Dimensions: _____ Number of Pipes: _____
Maximum Flow Velocity: _____ (m/s)
Flow Capacity of Culvert Installation: _____ (m³/s)

Please complete the diagram below and check entrance type:



F. CONSTRUCTION DETAILS:

Describe all construction operations in relation to their effects on channel stability, erosion, physical damage to landscape, stream crossing and movement by heavy machinery, treatment of wood, disposal of construction wastes and excavated material, disposal of wastewater from foundation and other construction areas, diversion of flow during construction, etc. Also indicate the proposed construction schedule.

G. EROSION CONTROL AND STABILIZATION:

All sites vulnerable to erosion such as channel bed, embankment slopes, floodplains, etc., must be stabilized by vegetation and/or rocks. Describe all control measures including location of sites and specifications. Give details of culvert outlet and any energy dissipators.

H. SITE RESTORATION:

All areas affected by this project such as approach roads, burrow pits, filled in areas, diversions, etc., must to be restored to conditions conducive to adequate rehabilitation. All proposed measures must be described.

I. ENVIRONMENTAL IMPACTS:

Any possible environmental concerns must be addressed. A brief comment on measures proposed to minimize or eliminate environmental disruption must be provided.

J. APPLICANT INFORMATION: Please ensure that the following is completed:

Applicant's Name (Please Print):	_____
Company/Agency Name	_____
Applicants Address:	_____ _____ _____
Applicant's Telephone Number:	_____ Fax: _____
Applicant's E-mail Address:	_____
Date: _____	Signature: _____

This application is being submitted by:	
Owner	<input type="checkbox"/>
Agent representing the owner	<input type="checkbox"/>
Name, address and telephone number of owner.	
_____ _____ _____ _____	

Technical guidelines, departmental policies and additional application forms are available at:
www.gov.nf.ca/env/water

Please mail completed form along with all maps, plans and specifications to:

**Department of Environment
Water Resources Division
PO Box 8700
St. John's NL A1B 4J6**



GOVERNMENT OF
NEWFOUNDLAND AND LABRADOR

Department of Environment
Application Fee Schedule

In accordance with Section 21 of the *Executive Council Act*, the following application fee(s) must be paid to obtain a Permit as required under Section 48 of the *Water Resources Act*, SNL 2002 cW-4.01:

Bridges:	(a)	A bridge spanning less than 5 metres	\$100
	(b)	A bridge spanning 5 metres or more but less than 10 metres	\$200
	(c)	A bridge spanning 10 metres or more but less than 30 metres	\$500
	(d)	A bridge spanning 30 metres or more	\$1000
Culverts:	(e)	A culvert less than 1200 mm in diameter or width	\$50
	(f)	A culvert greater than or equal to 1200 mm in diameter or width	\$100
Dams & Related Works:	(g)	A hydro-electric power project control dam	\$2,000
	(h)	All other control dams including dykes and berms	\$500
	(i)	A water intake greater than 100 mm diameter or an infiltration gallery	\$500
	(j)	A pipe or conduit installed under any body of water including intakes less than 100 mm in diameter	\$50
Drainage Works:	(k)	A storm drainage work involving discharge into a body of water	\$200
	(l)	A ditching system for peat mining or agriculture	\$200
	(m)	A settling basin	\$100
Marine Works:	(n)	A wharf, dock, boathouse or slipway or dredging for same	\$100
Other Construction:	(o)	A water course diversion, channelization or infilling,	\$500
	(p)	Exploratory drilling through or under water (per site)	\$100
	(q)	Use of winter or ice roads across any body of water	\$50
	(r)	Fording (per site), transmission line inspection, ATV or pedestrian bridge	\$50
	(s)	Any construction, grubbing, clearing or installation of structures within 15 m of the high water mark of a body of water if not specifically carried out in conjunction with any other category of this fee schedule.	\$50

The above fees must accompany each separate application for approval and the fee is non-refundable. Please enclose your cheque or money order made out to the Newfoundland Exchequer Account or attach a cashier's receipt for the correct amount. The application cannot be reviewed until payment in full has been received.

<i>This section must be completed so that a receipt can be issued</i>	
Applicant's Name (Please Print):	_____
Applicant's Address:	_____ _____
Type of Project: _____	_____
Location: _____	_____
Fee: \$ _____ +15% HST: \$ _____ Total Enclosed: \$ _____	
For Department's Use Only	
Revenue Centre #: <u>1226 500 4150 2764</u>	
Payment Enclosed: _____ Verified by: _____ Date: _____ Receipt#: _____	



GOVERNMENT OF
NEWFOUNDLAND AND LABRADOR

Department of Environment

Application for Environmental Permit for Bridges

As required under **Section 48** of the *Water Resources Act*, SNL 2002 c W-4.01, approval is requested for:

All pertinent information relating to engineering, hydrologic and hydraulic design, site features, construction operations and anticipated environmental implications of the project are provided herewith to enable assessment of environmental feasibility of the project and to issue a Permit.

A. JUSTIFICATION: Please indicate reason(s) why this project is proposed.

B. LOCATION: Show location on largest scale topographic map available and outline the watershed boundary.

C. DRAINAGE BASIN:

Watershed Area	_____	(km ²)
Basin Perimeter	_____	(km)
Length of Main Channel	_____	(km)
Basin Slope	_____	(%)
Land Use: Barren	_____	(%)
Forest	_____	(%)
Wetland	_____	(%)
Urban	_____	(%)

D. CHANNEL DESCRIPTION AT THE PROPOSED BRIDGE LOCATION:

(I) DIMENSIONS: (a) Please provide cross-sectional plan or drawing.
(b) Please provide longitudinal plan or drawing.
(c) Please provide general site plan or drawing.

- These should show:
- bottom width of channel.
 - top width of channel.
 - depth of channel.
 - shape & slope of channel embankments.
 - normal depth of water.
 - low water level.
 - high watermark or levels.
 - slope of channel.
 - extent of floodplain.

note: plans or drawings must show the above in relation to the proposed structure and any proposed training works. Also, please show any relevant natural or other features such as buildings, roads, other crossings, sewers, ponds, etc.

(II) PHYSICAL DESCRIPTION:

Type of Material: (clay) (sand) (gravel) (rock) (boulder)
Presence of Vegetation: (none) (sparse) (moderate) (heavy)
Particle Size: _____ (mm)
Depth to Bedrock: _____ (m)
Manning's n: _____
Shape of Channel: to be shown on plan or sketch.

(III) HYDRAULIC DESCRIPTION:

Minimum Flow: _____ (m^3/s)
Minimum Velocity: _____ (m/s)
Maximum Flow: _____ (m^3/s)
Maximum Velocity: _____ (m/s)

(IV) PROPOSED HYDROLOGIC DESIGN CRITERIA:

Return Period: _____ (yrs.)
Design Flow: _____ (m^3/s)

Please state the method used to estimate design flow and give a sample calculation below or separately.

E. BRIDGE DIMENSIONS & DESIGN:

Type of Bridge (timber, concrete, steel, etc.): _____
Bridge Span (abutment to abutment): _____ (m)
Height of Bridge above Streambed: _____ (m)
Abutment Setback from High Water Mark: _____ (m)
Footing Depth below Sub-Stratum: _____ (m)
Area of Opening: _____ (m^2)
Maximum Flow Depth with Bridge: _____ (m)
Maximum Flow Velocity with Bridge: _____ (m/s)
Flow Capacity of Bridge: _____ (m^3/s)

F. CONSTRUCTION DETAILS:

Describe all construction operations in relation to their effects on channel stability, erosion, physical damage to landscape, stream crossing and movement by heavy machinery, treatment of wood, disposal of construction wastes and excavated material, disposal of wastewater from foundation and other construction areas, diversion of flow during construction, etc. Also indicate the proposed construction schedule.

G. EROSION CONTROL AND STABILIZATION:

All sites vulnerable to erosion such as channel bed, embankment slopes, floodplains, etc., must be stabilized by vegetation and/or rocks. Describe in detail all such control measures including location of sites and specifications.

H. SITE RESTORATION:

All areas affected by this project such as approach roads, burrow pits, filled in areas, diversions, etc., must to be restored to conditions conducive to adequate rehabilitation. All proposed measures must be described.

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Applicant's E-mail Address:	_____
Date: _____	Signature: _____

This application is being submitted by:	
Owner	<input type="checkbox"/>
Agent representing the owner	<input type="checkbox"/>
Name, address and telephone number of owner.	
_____ _____ _____ _____	

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	(q)	Use of winter or ice roads across any body of water	\$50
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	(s)	Any construction, grubbing, clearing or installation of structures within 15 m of the high water mark of a body of water if not specifically carried out in conjunction with any other category of this fee schedule.	\$50

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Payment Enclosed: _____	Verified by: _____ Date: _____ Receipt#: _____

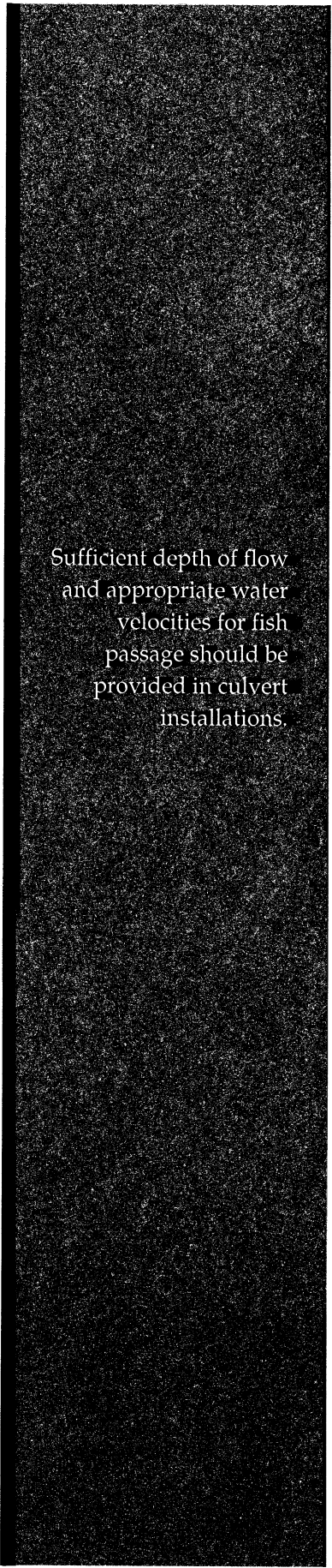
4.3.3 Culverts

Culverts are the most commonly used method for providing access over a watercourse, and particularly for small and medium sized streams. Several types of culverts are used including; open bottom/bottomless arch, pipe arch, box, and circular/cylindrical. Box type culverts are generally made from wood or concrete while other types are made from plastic, concrete or, most commonly, corrugated steel. Figure 4.19 identifies culvert shapes and Figure 4.20 illustrates some culvert crossing related terms used in this guideline.

The following guidance concerning culvert installations is generic and has been developed to apply to a variety of different circumstances. In some site specific situations a professional engineer and/or biologist should be consulted. Where fish passage is required, sufficient depth of flow and appropriate water velocities for the fish species and size of fish at the site/area should be provided in culvert installations. Swimming performance of some fish species, relative to fish passage, is provided in Scruton et al., 1998.

When utilizing culverts, the following guidance is provided:

- a. Improperly selected and sized culverts can become obstructions to fish migration and can cause upstream flooding. Culvert size should be based on the capacity to handle peak flows. It may be necessary to have a hydrologic and hydraulic analysis performed in order to determine the correct size culvert to be used. The hydrologic analysis is used to determine the peak flow and the hydraulic analysis is used to calculate the capacity of the culvert to adequately pass the peak flows.
- b. Selection of the type of culvert should consider site specific characteristics such as: cross-section of watercourse at the crossing site (e.g. wide and shallow, narrow and deep, etc.), fish habitat characteristics/substrate types (e.g. spawning habitat, boulders, gravels, etc.), hydrologic factors (e.g. flashy system, low flows and high flows, ice conditions, etc.). The type



Sufficient depth of flow and appropriate water velocities for fish passage should be provided in culvert installations.

of culvert selected and installed should minimize potential impacts on fish habitat, maintain fish passage, and sufficiently accommodate watercourse flows. To the extent possible, natural stream conditions (i.e. widths, habitat, etc.) should be maintained.

- c. Open bottom/bottomless arch culverts are the preferred type of culvert installation. These culverts maintain the natural bottom substrate and hydraulic capacity of the watercourse when footings are installed outside the wetted perimeter of the stream.



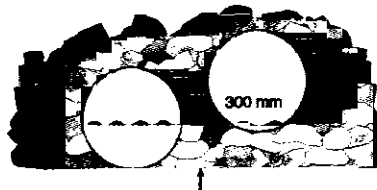
Open Bottom Culvert
Maintains natural bottom substrate and hydraulic capacity of a watercourse (ie. minimal effects on natural water velocity)



Box Culvert
Can be designed to accommodate natural stream width.



Pipe Arch Culvert
Good for low clearance installations. Wide bottom area allows for retention of natural substrates.



Stacked/Multiple Culvert
Can provide fish passage over a wider range of flows, depths, and water velocities.



Cylindrical Culvert
If properly designed and installed does not limit fish passage. Can constrict stream width and create high velocities.

Open bottom or bottomless arch culverts are the preferred type of culvert installation.

Figure 4.19 Culvert Shapes

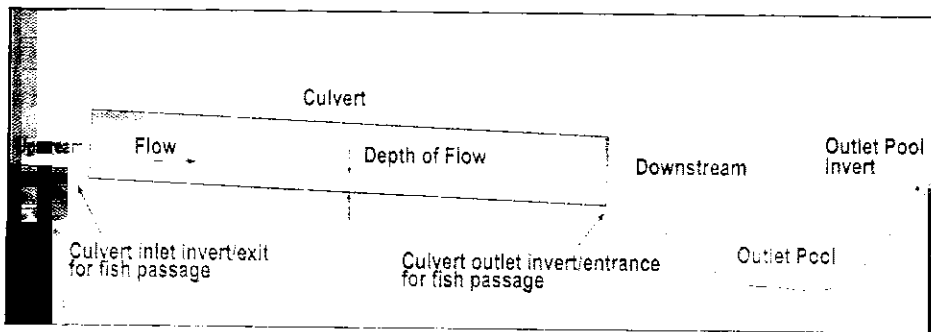


Figure 4.20 Illustration of General Culvert Terms.

- d. Footings for open bottom culverts should be installed outside the normal wetted perimeter of the watercourse and tied into the bedrock or sufficiently stabilized to prevent erosion around the footing or undermining.
- e. Pipe arch culverts often maintain the hydraulic capacity of the natural channel and are preferred over cylindrical culverts. Cylindrical culverts usually reduce the cross-sectional area of water entering the culvert which may result in: (1) an increase in water velocity which may make it difficult for upstream migration of fish; (2) undermining at the culvert inlet or streambed scouring at the culvert outlet; (3) an area where free flow of debris may be restricted which results in obstructing fish migration as well as flooding of upstream areas.
- f. To allow fish passage, cylindrical culverts should have a minimum diameter of 1000 mm and be designed/sized according to site specific, including hydrologic/hydraulic, considerations.
- g. Cylindrical culverts should be installed to simulate open bottom or pipe arch culverts. Culverts up to 2000 mm in diameter should be countersunk a depth of 300 mm below the streambed elevation. Culverts having a diameter equal to or exceeding 2000 mm should be countersunk a minimum of 15% of the diameter below the streambed elevation (Figure 4.21).
- h. Countersinking reduces the hydraulic capacity of the culvert, therefore, the required diameter of the culvert must be adjusted for countersinking.

- i. Culverts should be aligned parallel to the existing natural channel and located on a straight stream section of uniform gradient.

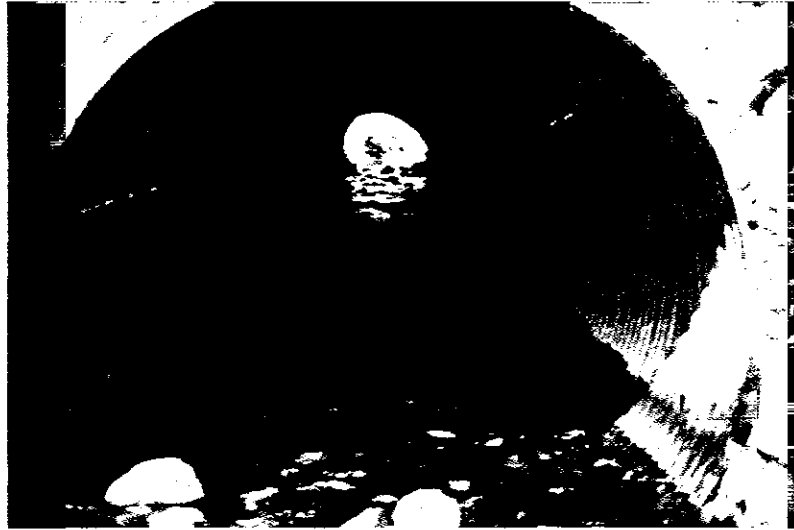


Figure 4.21 Countersunk Culvert.

- j. The culvert should be placed on firm ground and be countersunk to the appropriate depth. In sites where a soft foundation is present it should be removed and replaced by clean granular material to prevent the culvert from sagging. Water movement under or around a culvert installation should be prevented through the use of headwalls, or other means, as necessary.
- k. A culvert should extend beyond the upstream and downstream toe of the fill (e.g., a minimum of 300mm).
- l. For multiple culvert installations, the culvert intended to provide fish passage should be placed in the deepest part of the channel and be countersunk to the required depth. The remaining culvert(s) should be placed 300 mm above the invert of the fish passage culvert (Figure 4.22).
- m. Culverts should be sufficiently sized and installed such that scouring of the outlet streambed does not occur as a result of increased water velocities in the culvert. Elevated culvert entrances may result in streambed scouring and can become an obstruction for migrating fish as illustrated in Figure 4.23.

In multiple culvert installations, the countersunk culvert should be designed to provide fish passage.

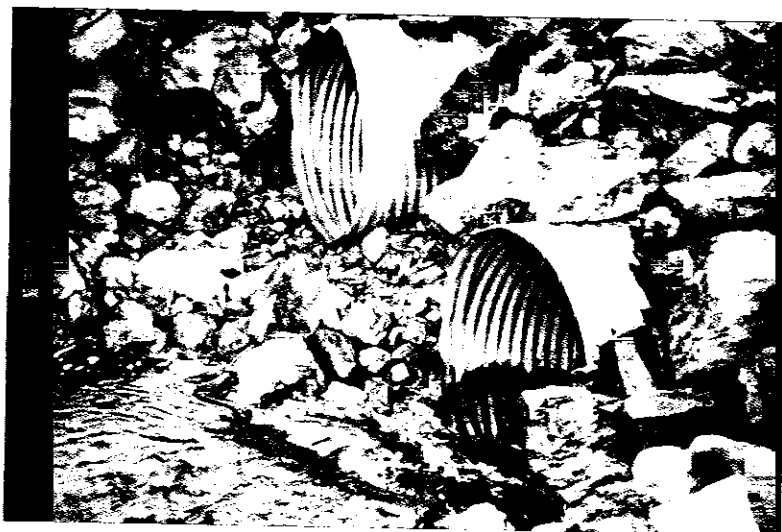


Figure 4.22 Multiple Culvert Installation

- n. A minimum water depth of 200 mm should be provided throughout the culvert length. To maintain this water depth at low flow periods an entrance/downstream pool can be constructed. A downstream pool is of particular importance for long culverts or culverts to be installed on steep slopes, in some cases, an upstream pool may also be necessary.
- o. The invert of the pool outlet should be at an elevation that maintains a minimum of 200 mm of water depth up to the inlet or upstream end of the culvert (Figure 4.24).

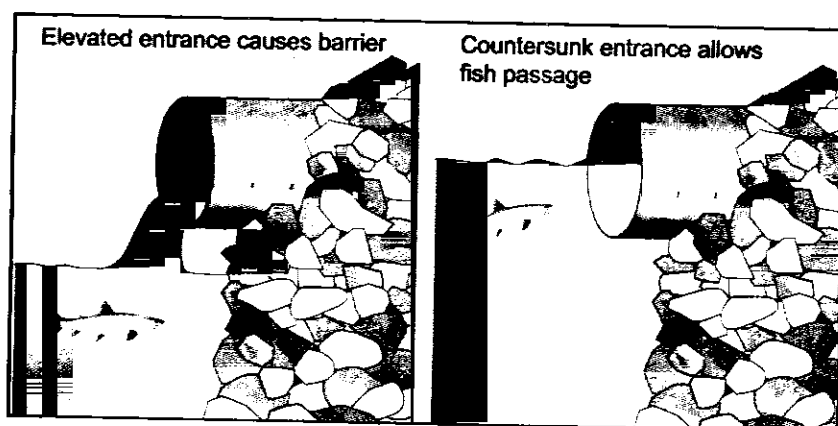


Figure 4.23 Perched Entrance and Properly Installed Culvert Entrance

- p. The culvert slope should follow the existing stream gradient slope where possible. Increasing culvert slope, reduced culvert capacity due to countersinking and maintenance of the 200 mm minimum depth of flow, and back watering due to the creation of an outlet pool should be considered when selecting the required culvert diameter to meet fish passage and hydraulic criteria such as passing peak flows.

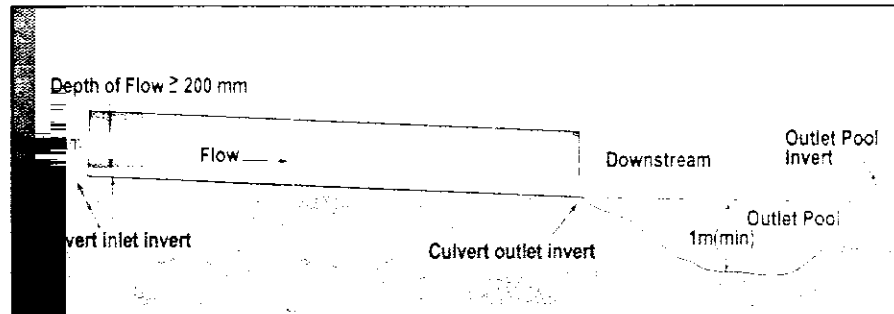


Figure 4.24 Culvert Installation Showing Downstream Pool to Maintain Minimum 200 mm Water Elevation Throughout Culvert.

- q. Pools should be designed so that there is a smooth transition of flow from the culvert to the natural stream width.
- r. The natural streambed elevation should be used as the pool outlet invert; however, depending on site specific conditions, a pool outlet may need to be constructed. It is essential that the invert elevation of the pool outlet be stable and, if necessary, well maintained to ensure a minimum water level in the culvert. Clean, non-erodible riprap or gabions should be used to stabilize the pool edges. If a pool outlet is constructed, care should be taken not to introduce blockage to fish passage. For example, the pool outlet may need to be v-notched to enable fish passage at low flow periods. Depending on site specific features (eg. gradient) more than one pool may be required.
- s. Pools should be pear shaped and sized such that
 pool length = 2 to 4 times the fish passage culvert diameter;
 pool width = 2 to 3 times the fish passage culvert diameter;
 pool depth = 0.5 times the fish passage culvert diameter, 1 metre minimum. (Figure 4.25).

Provision of a properly designed downstream pool can maintain a minimum depth of water throughout the culvert length.

- t. For stacked/multiple culverts, pools should be installed with the fish passage culvert orientated to the centre of the pool to allow for a smooth transition of water from the culvert to the watercourse.

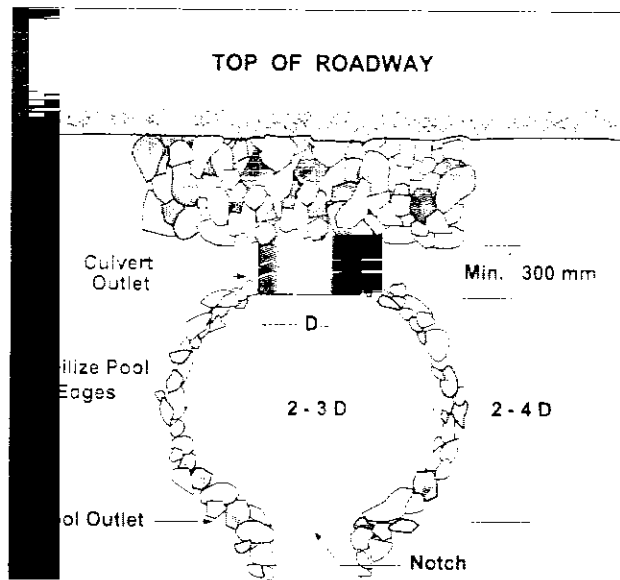


Figure 4.25 Recommended Pool Dimensions.

- u. Depending on site-specific conditions (e.g. steep slopes, long crossings, constricted streams resulting in high water velocities, etc.), baffles/weirs may need to be installed in the fish passage culvert. Baffles/weirs can provide an adequate depth of flow and reduce the water velocity in the culvert in order to facilitate fish passage. Baffle dimensions are provided as per Figure 4.26.
- v. A minimum depth of flow of 200 mm should be provided throughout the culvert and baffled sections. The drops between adjacent baffles should be a maximum of 200 mm.
- w. Baffles should be placed approximately 1 metre from the inlet and outlet ends of the culvert, the next baffles should be placed at 1/2 the baffle spacing. Baffle size and spacing should be determined by using the low flow (flow at the time of fish migration, i.e. lesser of flow at 90% exceedance via flow duration analysis or 7 day, 10 year low flow) as a basis for meeting the above depth of flow and drop between baffles criteria.

Baffle spacing should also provide a pool volume between baffles large enough to dissipate the kinetic energy produced by the water falling over the weir; and consider high flows (i.e. 10% exceedance based on flow duration) during the fish migration period. Baffle spacing is presented in Figure 4.27.

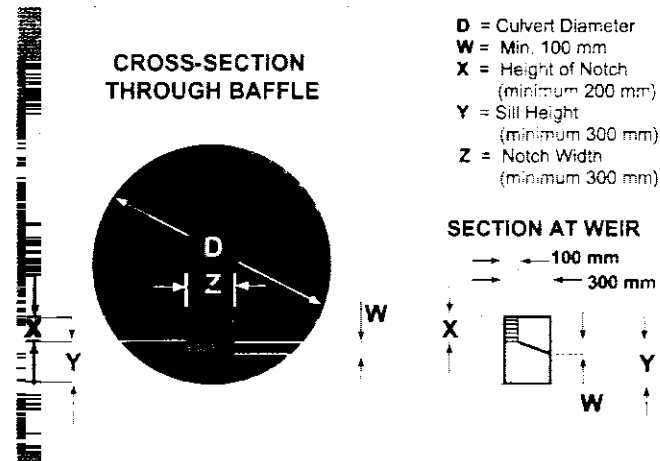


Figure 4.26 Baffle Sizing.

- x. The baffle culvert should be installed such that the invert elevation of the outlet pool backs water up to the top of the outlet baffle (i.e. entrance baffle); that is, set the elevation of the top of the entrance baffle to be the same as that of the pool outlet invert elevation. Baffled culverts should be countersunk approximately 100 mm below the streambed elevation. If countersinking exceeds 100 mm then the baffle system arrangement/design may need to be adjusted accordingly.
- y. The upstream culvert invert can, in some site specific situations, be countersunk to facilitate depth of flow provided that the head differential is accounted for.
- z. Culvert installations should be suitably stabilized to prevent erosion, seepage, and undermining, and maintained in good operating condition. Headwalls or other appropriate means should be installed to ensure that all water is directed through the culvert system.

Note: Modifications of the above criteria in consultation with the Department of Fisheries and Oceans, may be required to address

the passage of fish species other than salmon, brook trout, and brown trout in culvert installations. Further, site specific considerations may warrant modification of the above guidance, as deemed appropriate and in consultation with the appropriate Area Habitat Biologist (Appendix A).

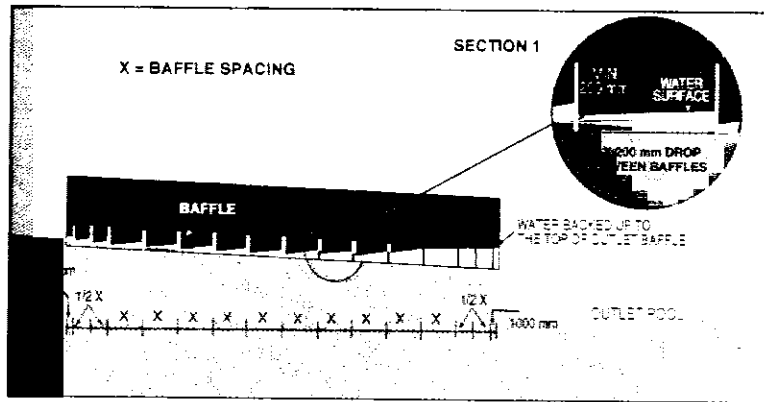


Figure 4.27 Culvert Baffle Spacing Requirements.

4.3.4 Underground Watercourse Crossings

Project developments sometimes require that streams be crossed by water pipes, sanitary sewers, underground cables, etc. The number of crossings should be minimized. Necessary crossings should follow roads, thereby reducing the overall impact on the stream. Construction of underground facilities results in disturbance to the stream bed and may produce downstream sedimentation. When undertaking developments beneath the streambed, the following guidance is provided:

- a. Instream works associated with underground stream crossings should be carried out in the dry.
- b. Once the pipe installation has been completed, the "trench" created in the stream bed should be partially filled with suitable materials; these materials can then be compacted and the stream bed brought back to its previous elevation and grade