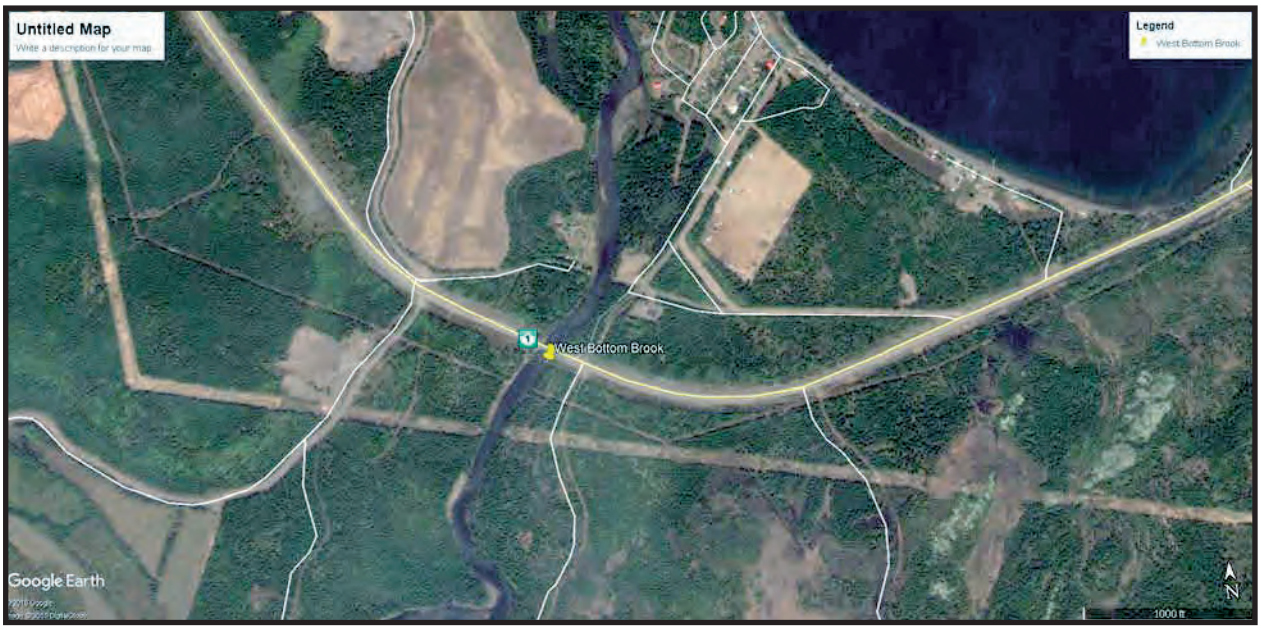
WEST BOTTOM BROOK BRIDGE REPLACEMENT

REGISTRATION PURSUANT TO CHAPTER E-14.2 OF THE *ENVIRONMENTAL PROTECTION ACT*, SNL 2002 FOR THE DEMOLITION OF THE EXISTING BRIDGE AND CONSTRUCTION OF A NEW BRIDGE ON WEST BOTTOM BROOK TCH, ROUTE 1 KM 516.4



DOC/2019/02260

PROPONENT:

(I) Name of Corporate Body

Department of Transportation and Works
Government of Newfoundland & Labrador

(ii) Address

5th Floor, Confederation Building (West Block)
St. John's, NF
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(iii) Chief Executive Officer

Tracy King
Deputy Minister
729-3676

(iv) Principal Contacts for the Purpose of Environmental Assessment

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Director,
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THE UNDERTAKING:

(i) Name of the Undertaking

Project 63-18TSB is the demolition of the current deteriorated bridge and construction of a new bridge, including a temporary bypass bridge, for West Bottom Brook, TCH Route 1.

(ii) Nature of the Undertaking

The construction of a permanent bridge and temporary bridge crossing on West Bottom Brook on the TCH, km 516.4. The temporary bridge and bypass will be constructed and opened to traffic, the existing bridge will be closed and removed, the new bridge will be constructed, and the temporary bridge will be removed upon commissioning of the new bridge

(iii) Purpose / Rationale / Need for the Undertaking

The purpose of this project is to replace the aged and deteriorated bridge on West Bottom Brook.

Description of the Undertaking

Geographic Location

The project location is on the Trans Canada Highway, Route 1, approximately 4 km west of South Brook. The coordinates are 21 U 562513 E 5474567 N.

There are no additional routing alternatives to replacing the bridge. It is an essential link on the Trans Canada Highway and any alternative would not be feasible.

Physical Features.

As West Bottom Brook is a Scheduled Salmon River, detailed design work and existing environmental conditions determine the type of structure, which will be required, and what modifications have to be incorporated into the structure to allow for the necessary fish passage and environmental protection. The bridge will be designed to withstand a minimum of 1:100 year flood events and will be 11m wider than the old bridge. All works will be undertaken outside the water and the stream bottom will be left intact. Special attention will be given to erosion and scour protection at inlet and outlet control areas.

The area needing to be cleared is within the existing Right Of Way and consists of young birch, spruce, and fir with some herbaceous vegetation. The reach of the stream is a migration corridor (Beak Type 4) located at the erosion/depositional section of the stream where streambed substrate is migrating and being deposited at relatively equal rates. The substrate consists of boulders, cobble, rubble and pebbles. The banks are relatively stable with vegetation stabilizing the slopes but with signs of periodic erosion during high flows.

The Department of Transportation and Works will consult with the Water Resources Division of the Department of Municipal Affairs and Environment to ensure that the best available data is utilized to design the bridge. The Water Resources Division's Environmental Guidelines for work around watercourses will be used during the design and construction phases. These guidelines include:

Chapter	Title
3	Watercourse Crossings
4	Bridges
5	Culverts
7	Diversions, New Channels, and Major Alterations
9	Pipe Crossings
13	General Construction Practices

The bridge will be designed and constructed in consultation with Fisheries and Oceans Canada (DFO). A qualitative assessment of Fish habitat along upstream and downstream areas adjacent to the crossing will be carried out. The bridge will be designed and constructed which will have minimal impact on fish and fish habitat and in accordance with

- DFO's Guidelines for Protection of Freshwater Fish Habitat in Newfoundland and Labrador (1998);
- DFO's Measures to avoid causing harm to fish and fish habitat (http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/measures-mesures-eng.html) and
- fish passage guidelines and other applicable guidelines and Fact Sheets (Appendix D).

Construction

The project will encompass two parts:

1) **Temporary Diversion:**

A temporary diversion is proposed to be constructed parallel to existing Trans-Canada Highway within the existing highway right-of-way. The two lane diversion shall have a 9.0 meter subgrade width and is to be constructed out of clean rock fill with 1.5:1.0 side slopes. Total length of the diversion is approximately 240m

(including a 42.7m span temporary panel bridge). The temporary structure is composed of steel binwall abutments, select blast rock bearing pads and a 42.7m x 7.240m Mabey (Panel) Bridge. The proposed temporary bridge design and approaches are such that the abutments and side slopes do not encroach upon the existing channel. The finished elevation of the temporary structure is 10.0m which is comparable to the existing structure, providing ample hydraulic capacity. Upon completion of the permanent structure the temporary panel bridge and rock fill diversions shall be completely removed and any disturbed ground within the existing right of way will be rehabilitated.

2) Existing/Proposed Structure:

The existing structure consists of five prestressed girders spanning approximately 31.5m from bearing to bearing. The width of the existing travel way is approximately 8.3m. The structure is located on the Trans-Canada Highway, 88km west of Grand Falls-Windsor and near the exit to South Brook. The intent of this project is to replace the existing bridge on the same alignment. The horizontal alignment is to remain unchanged. The proposed replacement is comprised of a single 43m span x 14m (overall width) bridge constructed using five (5) CPCI2300 prestressed concrete girders supported by concrete abutments. The span has been lengthened by approximately 11.5m relative to the existing structure due to existing geotechnical constraints. Increasing the span also will serve to eliminate the need to work within the footprint of the existing channel (outside high water mark) reducing the environmental impact of construction activities.

The Contractor shall submit a demolition plan for the old bridge to the Resident Engineer/Senior Environmental Planner for review and approval prior to commencing demolition work. Demolition and removal of the existing structure shall be carried out such that no significant debris enters the river. Busting of the existing structure while in place shall not be permitted. The Contractor shall ensure that all waste material from the bridge demolition is disposed of in accordance with the *Environmental Protection Act, SNL2002 CHAPTER E-14.2* and prior approval by the Department of Environment and Conservation. The Contractor's Demolition Plan shall clearly demonstrate that there is compliance with all environmental requirements for the project and adhere to the Contractor's Responsibilities – Regulatory Agencies Section 805.

All work under this item will be in accordance with Section 919.04 of the Departments
Specifications Book, MAINTENANCE OF TRAFFIC, except where superseded by the requirements of this or another Supplementary General Condition. The Contractor shall construct a temporary paved bypass to a RLU 70 (Modified) standard to accommodate TCH Traffic. This work will also involve the design and installation of a 42.7 meter, two lane temporary bridge. The temporary bridge will be a galvanized steel panel bridge with one span of 42.7m (140ft). The asphalt on the bypass shall be one 60mm lift of surface course asphalt. The temporary bridge and substructure shall be designed in accordance with CAN/ CSA S6-14, "Canadian Highway Bridge Design Code".

Fording or moving equipment through the river, or across any other watercourse, will be strictly prohibited. Temporary culverts or temporary bridging are preferred at such locations where frequent fording would be required.

Bridge construction will be performed by contract forces. The various phases will involve:

(a) field surveys;
(b) temporary crossing installation;
(c) demolition of old bridge
(d) new bridge construction;
(e) clean-up and rehabilitation.

The potential sources of pollution during construction would be limited to the possible siltation of the river during subgrade construction. To prevent siltation within the river during construction the contractor shall use the mitigation in the Specification book, Sections 815, 816, 817, 818 and 845 (Appendix B). In addition, the potential exists for hydrocarbon spillage from temporary fuel storage facilities. Contractors will be advised of the environmental requirements for stream crossings and for hydrocarbon spill reporting and the necessity of strict compliance.

Owner’s Policy (Division 8, General Specifications Book, 2011)

To ensure protection of the environment, the work at all times shall be subject to inspection by the staff of relevant municipal, provincial and federal agencies. Normally, all inspections other than by the Engineer will be arranged in advance through the Engineer. Any specific matters relating to environmental protection will be dealt with between the Contractor and the Engineer.

Any violations of environmental permits or authorizations or any environmental related incidents which are observed by inspectors representing regulatory agencies are to be reported by them prior to leaving the site to the Engineer. Except in emergency situations, environmental protection measures required by other agencies must be approved by the Engineer prior to implementation by the Contractor.

It is Owner's policy to protect the environment along the route of the project, in areas adjacent the route, and in associated work areas such as pit or quarry sites. DTW is committed to cost-effective environmental protection measures that will prevent serious or irreversible environmental damage through the planning and implementation phases of the project.

Protection of Vegetation and Wetlands

The Contractor shall be made aware that the work required in and around water crossings shall be performed with due care and caution so as to prevent undue disturbance to adjacent vegetation and wetlands from construction activities and off Right Of Way travel (Section 850 Appendix B). Immediately following and during some construction activities, the Engineer will identify areas requiring seeding/sodding or stabilization by a method to prevent erosion. Damage or disturbance of vegetation and/or wetlands outside the ROW shall be re-vegetated and/or restored to the satisfaction of the Resident Engineer at the Contractor’s expense (Section 855 Appendix B).

Storage and Handling of Fuels and Other Hazardous, Toxic, or Dangerous Material

All storage tank systems must be registered under and in compliance with Newfoundland Regulation 58/03, The Storage and Handling of Gasoline and Associated Products Regulations, 2003 before commencing operation. Registration does not apply to storage tank systems of a capacity less than 2500 litres that are connected to a heating appliance. Contractors shall supply verification of storage tank registration to the Engineer prior to the commencement of work (Section 820 Appendix B).

Environmental Protection Plan

The Environmental Protection Plan (**EPP**) is produced by DTW and forms part of tender documents and conditions of contract. The **EPP** is a concise field usable document that describes environmental protection measures to be implemented during the preconstruction, construction, and post construction phases of the project. It has been prepared to assist DTW in the supervision of field activities and as a guide for decision making. The **EPP** will clearly outline the location of any environmentally sensitivities known and specify mitigation needed to prevent adverse effects. Rehabilitation measures will also be clearly outlined.

The **EPP** assists DTW with requirements for environmental reporting, auditing, and compliance monitoring. Applicable permits, authorizations, and approvals are required for the project prior to the start of work. The **EPP** facilitates the means by which the contractor and/or sub-contractors will attain permits and comply with environmental legislation. It outlines the responsibilities of the owner and contractor(s) in carrying out work sustainably and in an environmentally responsible manner. It guides management of construction and operation activities with the intent of avoiding or minimizing any adverse effect to the environment of the Province.

Contractor Environmental Mitigation Plan

A Contractor Environmental Mitigation Plan (**CEMP**), completed by the contractor and approved by DTW before work commences, is required for this project.

Elements required in a **CEMP** are:

- Pre-construction planning, including the identification project-environmental interactions (e.g., Valuable Ecosystem Components including: public and worker safety, wildlife, habitat, plants, resource users, etc.);
- Detailed environmental mitigation measures to avoid negative or irreversible environmental impacts;
- Contingency plans for unplanned events;
- List of DTW and Contractor contacts and reporting numbers; and
- Decommissioning Plan that includes site rehabilitation measures.

The potential for adverse environmental impacts during construction will be minimized as all construction activities will be undertaken in accordance with the environmental requirements of the Department of Works, Services and Transportation Specification Book for transportation projects (Appendix B).

Prohibitions

The following are directives for the Owner and Contractor in carrying out this project. Reference is also provided to the Section where this prohibition is located in Division 8, Appendix C herein.

- Contractors, subcontractors and their personnel shall not harass wildlife or waterfowl or unduly disturb fish (Section 805);
- No pesticides or other products shall be used without prior approval of the Owner and the Department of Environment and Conservation (ENVC)

(Section 810);

- The Contractor shall not wash equipment or containers, nor dump herbicides in or near any fresh or salt water bodies, or at any location where the herbicide may enter a body of water (Section 810);
- No person shall discharge into a body of water any sewage or effluent (Section 815);
- The use of equipment or machinery in a watercourse or water body is not permitted (Section 815);
- The contractor shall not ford a watercourse without prior approval from the Resident Engineer (Section 815);
- Silted or muddy water is not permitted to be released into any watercourse or water body or into any ditch or areas that leads directly to a watercourse or waterbody (Section 815.07);
- Smoking shall be prohibited within 10 m of a fuel storage area or during refueling operations (Section 820.03);
- Fueling or servicing of mobile equipment shall not be allowed within 100 m of a watercourse, water body, or designated wetlands (Section 820.03);
- The Contractor shall ensure that no servicing or washing of heavy equipment occurs adjacent to watercourses and designated wetlands. Fueling, servicing or washing of equipment shall not be allowed within 100 m of a watercourse (Section 820.04);
- No waste material shall be deposited in any watercourse or wetland (Section 825.01);
- There shall be no open burning of waste material, slash or grubbing material onsite. Rubber tires, waste oil, or similar material shall not be used to ignite slash or used to maintain the burning operation (Section 835);
- Unnecessary cutting of trees is to be avoided. Care will be taken during construction to prevent damage to trees and shrubs adjacent to the flagged clearing limits which are to remain after construction (Section 850);
- The Contractor shall not use living trees as survey marks and shall not cut blazes or otherwise mark live trees except with removable surveyor's tape and/or tags (Section 850);
- The Contractor shall limit equipment travel to the surveyed right-of-way and existing municipal and provincial roads. Use of equipment of any type is not permitted outside the clearing limits of the right of way without prior approval (Section 850); and

- Should any archaeological remains be encountered, such as stone, bone or iron tools, concentrations of bone, fireplaces, house pits and/or foundations, work in the area of the find shall cease immediately in accordance with the Historic Resources Act (RSNL1990 CHAPTER H-4) (Section 860).

Operation

The bridge is a permanent operation. Winter maintenance will consist of snow clearing and the application of sand and salt for ice control.

The temporary bridge will serve to allow traffic to continue during the construction of the new bridge. It will be removed once the new bridge is open to traffic.

Occupations

The various types of occupations anticipated for this project include:

(a) Civil Engineers;
(b) Structural Engineers; 2231
(c) Engineering Technicians; 2231
(d) Road Surveyors; 2154
(e) Heavy Equipment Operators; 7521
(f) Drillers and Blasters; 7372
(g) Carpenters; 7271
(h) Heavy Equipment Mechanics; 7312
(i) Labourers; 7621
(j) Truck Drivers; 7511
(k) Concrete Finishers; 7282
(l) Concrete Technicians; 7282
(m) Material Technicians and Engineers; 2231
(n) Steel Erectors. 7236
(o) Senior Environmental Planner 2121

Project-related Documents

- Environmental Protection Plan and Contractor Environmental Mitigation

Plan.

- Department of Transportation and Works Specifications Manual

APPROVAL OF THE UNDERTAKING

The following is a list of the permits, licences, approvals that may be necessary for this project:

MAJOR REGULATORY APPROVALS BY TYPE AND AGENCY

Type of Permit	**Agency**
1. Stream crossing approvals	Dept. of Fisheries & Oceans
3. Stream crossing approval	Water Resources
4. Fuel storage & handling	Government Service Centre
5. Solid waste disposal	Government Service Centre
6. Commercial Cutting	Fisheries and Land Resources
7. Environmental Assessment	Municipal Affairs and Environment

SCHEDULE

The Department of Transportation and Works would like to complete the requirements of the Environmental Assessment Act and seek approval for the project by 2019 04 30. A tender call could take place in late Spring of 2019 with construction starting shortly after.

FUNDING

The Federal Government will fund 50% of the construction costs of the project under the Building Canada Plan and the Provincial Government will fund the remaining portion of the project.

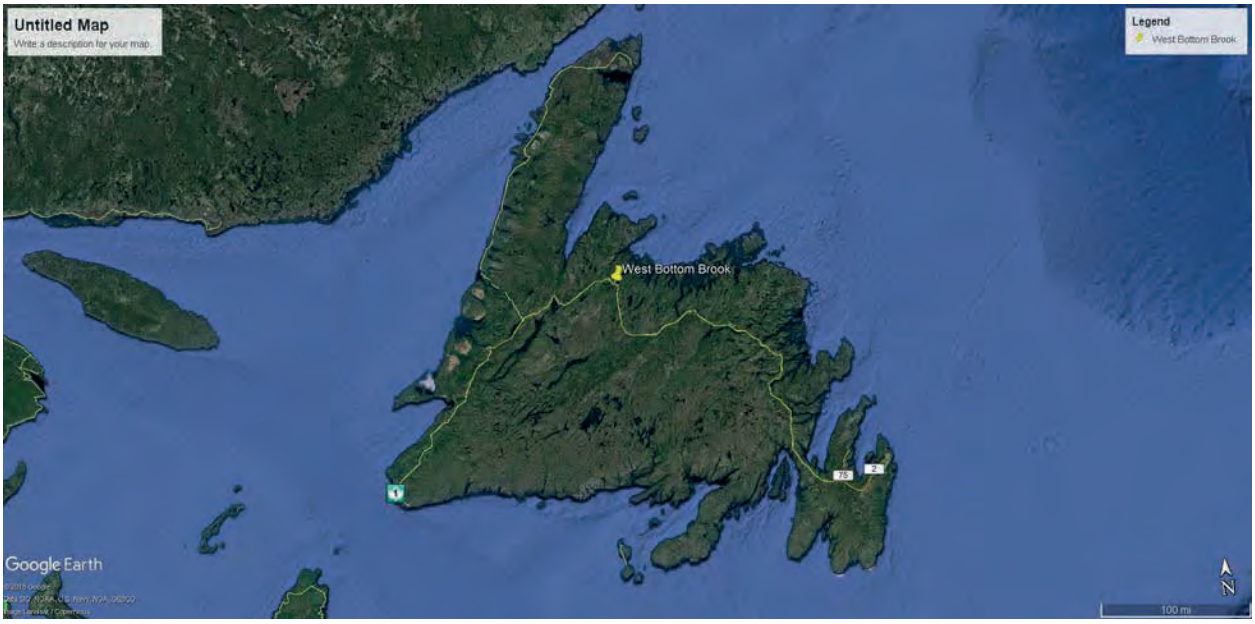
MAR 2 5 2019

Date
Deputy Minister

Tracy King

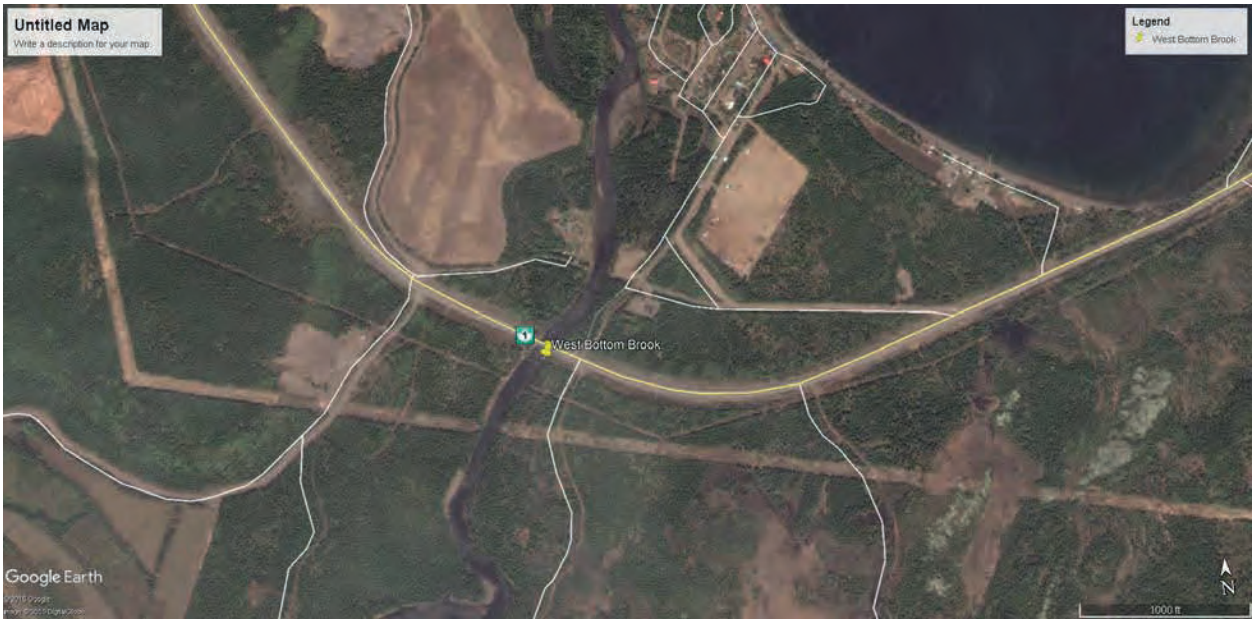
Appendix A

General Project Details



Map 1: Location on Island

Map 2: Regional map



Map 3: Close up of site

Appendix B

Division 8: General Environmental Requirements

DIVISION 8
GENERAL ENVIRONMENTAL REQUIREMENTS

INDEX

SECTION 801
OWNER'S POLICY

To ensure protection of the environment, the work at all times shall be subject to inspection by the staff of relevant municipal, provincial and federal agencies. Normally, all inspections other than by the Engineer will be arranged in advance through the Engineer. Any specific matters relating to environmental protection will be dealt with between the Contractor and the Engineer.

Any violations of environmental permits or authorizations or any environmental related incidents which are observed by inspectors representing regulatory agencies are to be reported by them prior to leaving the site to the Engineer. Except in emergency situations, environmental protection measures required by other agencies must be approved by the Engineer prior to implementation by the Contractor.

SECTION 805
CONTRACTOR'S RESPONSIBILITIES - REGULATORY AGENCIES

The Contractor shall ensure that its employees, Sub-contractors and their employees, machinery and equipment operators, and truckers comply with the conditions of the contract and with all applicable environmental laws, regulations, permits, and requirements of federal, provincial and municipal authorities, and such other rules and regulations as the Owner may establish.

Contractors, Subcontractors and their personnel shall not harass wildlife or waterfowl or unduly disturb fish. Any contravention of environmental requirements, including employee actions accidental or otherwise, resulting in environmental damage shall be reported to the Engineer without delay.

The Contractor may be required to obtain all or some of the following permits where such are required:

MAJOR REGULATORY APPROVALS BY TYPE AND AGENCY

TYPE OF PERMIT	**AGENCY**
1. Stream Crossing Authorizations	Fisheries and Oceans Canada Water Resources Division Department of Environment
2. Wood Cutting/Clearing	Forestry Division, Department of Natural Resources
3. Burning Permit	Forestry Division, Department of Natural

	Resources
4. Fuel Storage/ Handling	Government Services Center, Department of Government Services
5. Water Supply/ Sewage Disposal	Government Services Center, Department of Government Services
6. Asphalt Plants	Government Services Center, Department of Government Services
7. Solid Waste Disposal	Local Municipal Authority
8. Quarry or Pit Operations	Mineral Lands Division, Department of Natural Resources
9. Structures at Navigable Waters	Canadian Coast Guard, Transport Canada
10. Herbicide Application	Pesticide Control Branch, Department of Environment and Conservation
11. Stream Crossings (Designed by the Contractor)	Water Resources Division, Department of Environment and Conservation

The Contractor shall obtain all other permits and approvals which may be necessary to comply with government laws and regulations. Prior to the commencement of specific work elements, the Contractor shall immediately provide the Engineer with two copies of all permits.

Contractor's failure to comply with the regulations of any authority having jurisdiction over the works, or part thereof, or any aspect of the performance of the work and the manner of carrying out the work, will entitle and result in the Owner appointing such engineer, engineers, compliance officer or officers as may be necessary to more fully cause compliance by the Contractor with the requirements of the relevant regulatory authority.

The Owner may thereafter, and for so long as the Owner may keep such engineer, engineers, compliance officer or officers, on the site of the works, deduct from the progress payments otherwise due to the Contractor the costs including but not limited to payroll, payroll burdens, accommodations, meals, and transportation costs associated with the work of such engineer, engineers, compliance officer or officers as the case may be. The Contractor shall have no right to dispute the Owner's right to appoint such engineer, engineers, compliance officer or officers, the reasonableness of the deduction of such costs or the amount thereof and the Engineer's

certificate of the amount of such costs shall be final and binding upon the Contractor and the Owner.

SECTION 815
PROTECTION OF WATERCOURSES AND WATER BODIES

INDEX

815.01 SCOPE

This specification covers the environmental requirements for work being carried out at watercourses and water bodies. It includes references to Federal and Provincial Legislation and prescribed methods and procedures to employ when carrying out such work as culvert or bridge installations, stream diversions, fording, fill placement at water bodies, and any other work which may alter or impact any watercourse or water body, or the quality of the water therein.

815.02 LEGISLATIVE REQUIREMENTS

The Contractor shall be aware of all Federal and Provincial Legislation governing the protection of watercourses and water bodies and all revisions and amendments to this legislation.

815.02.01 PROTECTION OF INLAND FISHERIES ENVIRONMENT

All permanent or temporary works or undertakings which are proposed for watercourses or water bodies constituting fish habitat require authorization from the Fish Habitat Management Branch of the Department of Fisheries and Oceans Canada at least two weeks prior to the commencement of any work. The Contractor is required to obtain approval for all temporary stream crossings and provide the Engineer with two copies prior to any work.

Application forms for authorization for works or undertakings affecting fish habitat are available at Department of Fisheries and Oceans Canada offices located at St. John's, Grand Bank, Grand Falls, Goose Bay, and Corner Brook.

Contractors are referred to the Department of Fisheries and Oceans Canada publication entitled "Resource Road Construction - Environmental Guidelines and Design Criteria", latest edition, (and to other technical information). The DFO “fact sheets” contain recommended guidelines for culvert installations, road and bridge construction, and other works. They include mitigative measures and procedures intended to assist Contractors in minimizing impacts on fish and fish habitat.

Contractors are advised that Environmental and Fisheries regulations require that any work done in or near a watercourse, deemed to be viable fish habitat, must be restricted to the minimum of disturbance. The establishment of temporary and permanent buffer zones are required. (Reference, Standard Drawing No.1237). Great care must be taken during construction not to harmfully alter, disrupt, or destroy fish habitat or to deposit any substance which may be harmful to fish habitat in or near any watercourse where it may enter the watercourse. Culvert pipes must be constructed, according to the requirements of the applicable permits, to allow free movement of fish.

Contractors are advised to refer to the Fisheries Act with particular attention to:

- Section 35 - Outlines required authorization for work or undertaking which may affect fish habitat.
- Section 36 - Prohibits the deposit of a harmful substance of any type into water frequented by fish.
- Section 37 - Powers of the Minister for the provision of information such as: plans, specifications, studies, etc.; and to require any modifications to such plans and/or related information.
- Section 38 - Powers of a Ministerial Inspection.
- Sections 40-42 - Enforcement and Penalties.

815.02.02 THE ENVIRONMENTAL CONTROL (WATER AND SEWAGE) REGULATIONS

Contractors shall maintain compliance with the Environmental Control (Water and Sewage) Regulations, 2003 or latest edition. This legislation is administered by the Water Resources Division of the NL Department of Environment.

No person shall discharge into a body of water any sewage or effluent.

815.02.03 THE WATER RESOURCES ACT DEPARTMENT OF ENVIRONMENT

Where the Contractor must carry out any alteration of a body of water **which is not required specifically as part of the contractual work with the Department of Transportation and Works,** the Contractor must obtain a Permit from the Department of Environment and Conservation before carrying out the work. Alterations to watercourses and water bodies such as culvert installations, bridges, stream diversions, rock fill placement in water bodies, etc., which are typically required as part of the contractual work are authorized and administered by DT&W and do not require separate approval from the Department of Environment and Conservation. All such alterations to bodies of water must be carried out according to established procedures of the regulatory agencies so as to prevent pollution or damage to the environment.

The Contractor is referred to the following **Environmental Guidelines** of the NL Department of Environment and Conservation, Water Resources Division, regarding construction procedures at watercourses:

Chapter	**Title**	**Chapter**	**Title**
3	WATERCOURSE CROSSINGS	7	DIVERSIONS, NEW CHANNELS, AND MAJOR ALTERATIONS
4	BRIDGES	9	PIPE CROSSINGS
5	CULVERTS	13	GENERAL CONSTRUCTION PRACTICES
6	FORDING		

815.03 FORDING OF WATERCOURSES

The use of equipment or machinery in a watercourse or water body is generally not permitted. Should it be necessary for equipment to ford a watercourse, then the approval of the Resident Engineer is required for the specified equipment only and at a designated location. The same crossing point shall be used each time that a fording is required. When extensive or frequent crossing of a watercourse is necessary, a temporary culvert or bridge installation may be required instead of fording. The Contractor is referred to the NL Environmental Guidelines

Chapter 6, “Fording” of the Dept. of Environment and Conservation, regarding the selection, site preparation, and use of fording sites. The Contractor shall discuss all proposed fording sites with DT&W a minimum of 5 working days before any fording activity. Site selection require the written approval of the Engineer.

815.04 CLEARING AND/OR GRUBBING ADJACENT TO WATERCOURSES

The Engineer shall mark limits for clearing and grubbing adjacent to watercourses. Buffer zones of undisturbed vegetation shall be maintained at watercourse crossings as marked in the field. (Reference, Standard Drawing No.1237, Typical Temporary and Permanent Buffer Zones at Stream Crossings.) A permanent buffer zone shall be maintained both sides of the construction zone at watercourse crossings, wherein, no disturbance or cutting of vegetation is to take place. A temporary ungrubbed buffer zone shall be maintained on both sides of the watercourse, unless otherwise directed by the Engineer, within the construction zone at watercourse crossings until such time as the installation of the crossing is to be carried out. The Contractor shall use appropriate mitigative measures such as the use of silt fencing, sedimentation basins and take-off ditches to control sediment laden runoff from entering watercourses.

815.05 GENERAL PROCEDURES FOR INSTALLING WATERCOURSE CROSSINGS

The Contractor shall present to the Engineer for approval, a plan for the construction of unwatering systems including diversion systems, pumping systems, settling and/or filtration systems, a minimum of **3 working days** prior to the start of any work at the site.

A pre-construction meeting shall be convened on-site between the Contractor and the Engineer to review environmental protection measures and associated contract details pertaining to the watercourse crossing, prior to any work being carried out at the proposed crossing site.

All work carried out at watercourses shall be performed in the dry and with due care and caution so as to prevent unnecessary disturbance or impact on adjacent land or downstream areas. Where watercourses are deemed fish habitat, work within the channel is generally prohibited between September 15 and June 1, on the island portion of the province, and between September 1 and June 30 for Labrador, unless otherwise approved by DFO and the Resident Engineer. The Contractor shall carry out all work in and around watercourses in accordance with all Federal and Provincial permits and requirements, the relevant sections of the DT&W Specifications Book, and the contract drawings.

The Contractor shall give **3 working days** notice prior to any in stream or near stream grubbing or excavation.

Buffer zones shall be established and maintained as described in section 815.04.

An approved cofferdam shall be installed at the low end of the construction zone to collect all site water which is to be disposed of in an approved manner. (See Section 815.07 Treatment of Silted Water).

The operation of heavy equipment shall be confined to dry stable areas in order to prevent the generation of mud and silted water. All flow shall be diverted or pumped around or through the

work area, by a means acceptable to the Engineer, so as to maintain flow in the watercourse immediately below the site, prevent erosion, and maintain acceptable water quality. The flow diversion system shall have sufficient freeboard to be capable of accommodating rain events or provision shall be made to safely discharge elevated flows without causing washouts of constructed works, erosion, or siltation in downstream areas. The discharge location of the pumping or diversion system shall be stabilized to prevent erosion. All unwatering operations shall be constantly monitored by the Contractor.

Work should be carried out from the downstream section of the work area and progress to the upstream.

The Contractor shall ensure that fish are not left stranded in the work area at the time the diversion system is made operational. All stranded fish shall be removed by appropriate means and quickly returned to the watercourse below the construction area to prevent mortalities. An impermeable cofferdam of non-erodible material, such as sandbags and sheet plastic, shall be constructed at the outlet area of the construction zone to prevent any silted water from entering downstream areas and to assist in unwatering operations.

The location, size, construction, and operation of sedimentation basins shall be carried out according to Department specifications or as directed by the Engineer and so as to achieve adequate settling parameters within the basins and ensure that discharged water from the basins, which is entering any watercourse, meets the water quality standards set forth in the Environmental Control (Water and Sewage) Regulations, (See Section 815.02.02).

Operation of the sedimentation basins shall be continuously monitored by the Contractor to ensure proper functioning and maintenance.

Excavation shall be carried out to the limits marked in the field by the Engineer. All excavations shall be carried out using a tracked excavator which will operate within the limits of the work area or as directed by the Engineer.

Excavated material shall be removed from the site and stockpiled at an approved location where it will not enter any watercourse.

When corrugated steel pipes are installed, impervious material shall be placed under the invert of the pipe and around the haunches of the pipe at the inlet area so as to ensure that all flow is confined within the pipe, particularly during low flow conditions, and not lost into the porous fill zones outside the pipe.

All sections of newly constructed channel and pipe inlet and outlet areas shall be adequately stabilized so as to prevent destabilization, erosion, or scouring of the channel and fill embankments. Rip-rap on road slopes shall be placed concurrently with backfilling operations on the pipe so that inlet and outlet areas are protected immediately from erosion.

Any disturbed areas or exposed soils within the high water zone of the watercourse shall be stabilized by such means as placing rip-rap or well staked sodding within 48 hours of completion of backfilling operations. Other adjacent disturbed areas shall be rehabilitated by sodding or seeding, or as directed by the Resident Engineer.

Upon completion of the work, flow shall be introduced slowly into the new channel or watercourse crossing. Any silted water generated as a result shall be prevented from entering downstream areas of the watercourse, and pumped or treated as required.

Where baffles are required as part of a culvert installation all activities associated with the baffle pipe installation including the diversion of all water flow from the natural watercourse into the baffled pipe, abandonment of any temporary stream diversion system and rehabilitation of the surrounding disturbed area shall be carried out efficiently without delay so as to not interfere with fish migration.

All construction related waste materials shall be removed from the work site(s).

Sedimentation basins shall be pumped dry and backfilled with the original excavated material and compacted. Hand seeding, hydroseeding and/or sodding of disturbed areas shall be carried out as directed by the Resident Engineer. Additional rehabilitation may be required by the Engineer.

815.06 USE OF FRESH CONCRETE IN OR NEAR BODIES OF WATER

When concrete is placed in or adjacent to a watercourse or water body, all necessary precautions shall be taken to prevent the concrete from adversely affecting water quality. Whenever possible, fresh concrete shall not come in contact directly with the waters of a watercourse. Standing water zones shall be drawn down prior to placing fresh concrete. All form work shall be well secured and made tight to prevent leakage of fresh concrete into any adjacent waters. Where tremmie concrete is required, the work shall be carried out under the specific directions of the Engineer. The washing of concrete delivery trucks or chutes is not permitted within 100 m of any watercourse or water body. All necessary precautions shall be taken when handling related substances such as form coatings and concrete admixtures to prevent any spill or leakage of these substances.

815.07 CONTROL AND TREATMENT OF SILTED WATER

Silted or muddy water is not permitted to be released into any watercourse or water body or into any ditch or area that leads directly to a watercourse or water body. Runoff from adjacent areas shall be channeled, piped, diverted, or confined to prevent the water from entering construction zones and becoming polluted. Where due to rain events, runoff from construction zones and areas of exposed soils contains mud or silt, appropriate measures shall be taken by the Contractor

to confine, settle, or channel such water so that adjacent watercourses or water bodies are not adversely affected. Such measures may include the provision of mud basins, settling basins, ditch blocks, silt fencing, temporary ditching, or other means necessary to prevent pollution. Silted runoff water or water released or pumped from construction zones may be discharged to an approved vegetated area where ground absorption will occur or to an approved settling area or to a settling basin constructed in accordance with contract drawings or as directed by the Engineer.

815.08 FILL PLACEMENT AT WATER BODIES

Fill material placed in or at water bodies shall be clean blasted rock. Where in the opinion of the Engineer, significant silty bottom sediments will disperse with potential of creating water quality problems, the fill zone shall be isolated from the remainder of the water body by such means as a silt curtain as approved by the Engineer. Rock shall be placed into the water zone so as to create the least amount of disturbance of bottom sediments. Rock shall be placed along the outer edge of the fill zone to close off and isolate the fill zone from the rest of the water body. Fill placement shall proceed with runs of rock along the inside of the first outer run of fill. Successive runs of rock fill shall be placed in this manner until the zone is filled back to the inner fill limits. Height of the placed rock fill shall be maintained a minimum of 300 mm above water level during fill operations. Equipment shall not operate in standing water zones. Removal of displaced sediments and/or bog shall be carried out as directed by the Owner. Pumping of water from the fill zone to a designated area may be required by the Owner to reduce water levels in the fill zone and prevent movement of silted water through the rock fill back into the water body.

SECTION 816
SILT FENCE
INDEX

816.01 SCOPE

This specification deals with the requirements for the provision, maintenance, and eventual removal of silt fence. Silt Fences are intended for reducing the amount of silt present in run off from highway projects during the construction process.

816.02 MATERIALS

The silt fence shall consist of a filter fabric fence held in place by posts. The filter fabric shall be of a weight of at least 200g/m^2. The fabric shall be at least 900mm wide. The fence posts shall be of sufficient length to support the fabric, be sturdy and be of dimensions of at least 50mm square. The staples shall be sufficiently sturdy to support the fabric for the required life of the fence.

816.03 CONSTRUCTION

The silt fence shall be constructed as shown on Form 1238 “Typical Silt Fence”, and placed at the location, or locations, as required by the Engineer.

At the location required by the Engineer, the Contractor shall excavate a trench in a crescent shape across the projected flow path with ends pointing up slope. The trench shall have a width of approximately 100mm, and a depth of approximately 100mm.

The posts shall be secured at 3m intervals on the immediate down slope side of the trench.

The filter fabric shall be taken from a continuous roll, and cut to the required length. The filter fabric shall be stapled to the upstream side of the stakes, with 200mm of fabric extending into the trench and spread over the trench bottom.
The trench shall be backfilled and compacted to secure the fabric in the ground. The silt fence shall be properly constructed to ensure continuous protection along its perimeter. Under no circumstances are silt fences to be installed in a watercourse or waterbody.

816.04 MAINTENANCE AND CLEAN OUT

The Contractor shall maintain the silt fence, until such times as the Engineer requires that the silt fence be removed.
The Contractor shall carry out such silt and debris clean out, as required, in order that the silt fence continues to perform its function of reducing the amount of silt present in the run-off. Should the fabric become clogged, and rendered useless, then the Contractor shall replace the fabric with new fabric at his own expense.

816.05 REMOVAL

The Contractor shall remove the silt fence, when required to do so by the Engineer. The posts shall be taken out of the ground and the site cleaned up. Waste materials shall be disposed of in an approved waste disposal area, provided by the Contractor.

816.06 MEASUREMENT FOR PAYMENT

Measurement for payment will be made on the basis of the required length of fence installed, computed in metres rounded to one decimal place.

816.07 BASIS OF PAYMENT

Payment at the contract unit price for silt fence shall be compensation in full for all materials, labour and use of equipment: to supply the filter fabric, posts and staples, to excavate the trench, to install the posts, to secure the fabric to the posts, to backfill and compact the trench, to maintain and clean out the fence, to replace any worn out filter fabric with new fabric provided by the Contractor at his own expense, to remove the silt fence and posts, dispose of waste materials and clean up the site.

SECTION 817
CHECK DAM SEDIMENT TRAP

INDEX

817.01 SCOPE

This specification deals with the requirements for the provision, maintenance, and eventual disposal of a check dam sediment trap. Check dam sediment traps are intended for reducing the amount of silt present in run off from highway cuts during the construction process.

817.02 MATERIALS

The check dam sediment trap shall consist of rock fill with filter fabric on the upstream face held in place with small shot rock.

The filter fabric, and shall be of a weight of at least 200g/m^2.

The rock fill shall be clean rock, with rock fragments sized between 100 and 150mm.

The small shot rock shall be clean rock, with fragments no larger than 120mm.

817.03 CONSTRUCTION

The check dam sediment trap shall be constructed as shown on Form 1239"Typical Check Dam Sediment Trap". The silty water storage area shall be excavated, and the check dam constructed, at the location as required by the Engineer.

817.04 MAINTENANCE AND CLEAN OUT

The Contractor shall maintain the checkdam, until such time as the Engineer requires that the check dam be removed.

The Contractor shall carry out such silt and debris clean outs as are required, in order that the check dam continue to perform its function of reducing the amount of silt present in the run-off.

817.05 DISPOSAL

The Contractor shall remove the check dam sediment trap, when required to do so by the Engineer.

On removal of the check dam, the fabric shall be disposed of in an approved waste disposal area provided by the Contractor. The ditch shall be cleaned up and graded to the required ditch cross section.

817.06 MEASUREMENT FOR PAYMENT

Measurement for payment will be based on the number of required check dam sediment traps constructed.

817.07 BASIS OF PAYMENT

Payment at the contract unit price for each check dam sediment trap shall be compensation in full for all labour, materials and use of equipment to: excavate the silty water storage area, load the rock fill and small shot rock at the source and haul to the check dam site, supply the filter fabric, construct the check dam as required, maintain and clean out the check dam sediment trap as required, and finally remove the check dam, dispose of the waste materials, clean up and grade the site.

The rock fill and small shot rock shall be paid for under: “Excavation hauled 1km or under - Solid Rock”, Excavation hauled 1km or under - Ditching Solid Rock”, or “Excavation hauled 1km or under - Quarried Rock”, as applicable. However, any additional hand work required to sort the rock fill and the small shot rock to obtain the required size of fragments, and to grade the rock to the required check dam dimensions, shall be included in the payment for the check dam sediment trap.

SECTION 818
FLOATING SILT CURTAIN/TURBIDITY BARRIER

INDEX

818.01 SCOPE

This specification covers the supply, installation, and operation of a floating silt curtain or turbidity barrier.

Specific locations the Silt Curtain is to be used shall be designated by the Engineer.

818.01.01 General

The Contractor and Subcontractor(s) are required to comply with environmental protection measures contained in this section and all applicable environmental protection regulations of Federal, Provincial, and Municipal Authorities.

This specification is to be used in applications where a floating silt curtain/turbidity barrier is specified to be used around the leading edge of the advancing fill for construction operations to control any silt that may be generated from the bottom of the fill or other materials that may be used in construction of the road or other structure in a submerged portion of a water body. The turbidity barrier is to be a floating silt curtain (such as Brockton Equipment/Spilldam, Inc. Siltdam Type I) meeting the requirements of the Federal Department of Fisheries and Oceans. This item may be designed locally but must adequately control and prevent the migration of silt or other deleterious substances from the work area to the main water body. The turbidity barrier system must be approved with shop drawings/literature stamped by a professional engineer registered in the province of Newfoundland and Labrador submitted prior to its use.

The turbidity curtain is to consist of the following elements or approved equivalents:304mm diameter flotation, 22oz polyvinylchloride (PVC) float cover, 8mm PVC coated top tension cable, silt film skirt to required depth to reach from water surface to the water body bottom, 9.5mm galvanized ballast chain, polyplate/lacing grommets (ends).

The turbidity barrier is to be anchored at 15m intervals. The anchoring system will consist of Mushroom style anchors or other suitable type anchors for the bottom condition present, yellow inflatable cautionary mooring buoys, and nylon mooring line or approved equivalents. Where navigation conditions are present in the area of the turbidity curtain the cautionary buoys shall be lighted and a plan will be required to be submitted for approval showing where the buoys are to be located.

The turbidity barrier shall be a minimum of 100m in length but may be otherwise specified in the Unit Price Table. The barrier will form a long arc extending from the shoreline approximately 35m, across the work zone (parallel to the shore) approximately 30m, and back to the shoreline for approximately 35m. The barrier is to be installed to reach the bottom of the water body from the water surface. Installation plan can be seen on the drawing titled “Silt and Bubble Curtain”, as shown on Form 1223 of the Specifications.

As the leading edge of the fill advances, and the work site changes, the turbidity barrier will have to be moved and reinstalled. Movement of the turbidity barrier shall be considered incidental to the work and should be included in the price for the turbidity barrier.

In addition to these requirements for use of the turbidity curtain for permanent works in the contract the contractor will be required to use a turbidity barrier for any temporary works requiring installation or removal of fill in the construction in the water body. The contractor may reuse the turbidity barrier required for use for the permanent works installation in the water body for a contract, but at all times during installation or removal of fill in the water a turbidity barrier may be required to be used.

818.02 MEASUREMENT FOR PAYMENT

Measurement will be based on a per contract basis for the Floating Silt Curtain/Turbidity Barrier by the Engineer. Fifty percent of the total of the item will be paid on the progress estimate after which the silt curtain has been deployed for its intended use, and fifty percent will be paid on the last progress estimate where the in water body construction operation has been completed.

818.03 BASIS OF PAYMENT

Payment for the turbidity barrier will be lump sum. Payment shall be for compensation in full for engineering, design, transportation to site, installation, removal, reinstallation, equipment, labour, and all other materials necessary to complete the above, at the locations indicated to be used on the contract.

SECTION 820
STORAGE AND HANDLING OF FUELS AND OTHER HAZARDOUS, TOXIC, OR DANGEROUS MATERIAL

INDEX

820.01 STORAGE TANK REGISTRATION, INSPECTION, AND REMOVAL

All storage tank systems must be registered under and in compliance with Newfoundland Regulation 58/03, The Storage and Handling of Gasoline and Associated Products Regulations, 2003 before commencing operation. Registration does not apply to storage tank systems of a

capacity less than 2500 litres that are connected to a heating appliance. Contractors shall supply verification of storage tank registration to the Engineer prior to the commencement of work.

Storage tank systems shall be operated as per Section 18 of Newfoundland Regulation 58/03 Storage and Handling of Gasoline and Associated Products. This involves, but is not limited to, gauging or dipping, reconciliation of records and the proper maintenance of reconciliation records for a period of two years. Records shall be maintained for inspection by the Engineer, ESO and/or Government Service Centre Inspectors.

The operator of a storage tank system shall, within 30 days of known abandonment, empty the system of all products, remove the tank and associated piping from the ground, remove any contaminated soil, clean the area and restore the site to the satisfaction of the Engineer and in accordance with the criteria of the Government Services Centre.

820.02 SPILL REPORTING & CLEANUP PROCEDURES

The Contractor, Subcontractors, and their personnel shall take all necessary precautions to prevent the spillage, misplacement, or loss of fuels and other hazardous material.
The Contractor and Subcontractors shall abide by the following measures in the event of the detection of a fuel or hazardous material spill of 70 litres or more:

(i) make every effort to stop leakage and contain contaminant flow;
(ii) immediately upon detection, report spill location and size to the Canadian Coast Guard spill report number 772-2083, Pesticides Control Section 729-3395 and to the Owner; follow up with a full written report containing information on the cause of the spill, remedial action taken, damage or contamination estimate, and any further action to be taken;
(iii) remove contaminant from spill site by absorbent, pumping, burning, or whatever method is appropriate and acceptable to Owner. Clean-up the affected area in accordance with the requirements of the Government Services Centre and then dispose of contaminated debris at an approved waste disposal site.
(iv) take all necessary action to ensure the incident does not recur.

The Contractor shall apply the following criteria in reaching decisions on contaminant and clean-up procedures:
(i) minimize danger to persons;
(ii) minimize pollution to watercourses and wetlands;

(iii) minimize the size of the area affected by a spill; and
(Iv) minimize the degree of disturbance to the area and watercourses during clean-up

The Contractor shall dispose of any soil contaminated by small leaks of oil or lubricating fluids from equipment in a manner approved by the Engineer and in accordance with the criteria of the Government Services Centre. The Contractor shall have on site a suitable quantity of absorbent material such as “Oclansorb” or similar product which can be accessed quickly and effectively in the event of any hydrocarbon spill. The contractor shall advise fuel handling staff of its location and application.

820.03 FUEL STORAGE & HANDLING PROCEDURES

Contractor shall ensure that fuels and hazardous materials are handled only by personnel who are trained and qualified in handling these materials in accordance with manufacturers' instructions and government regulations. The Contractor will be required to verify personnel qualifications as they pertain to this item and provide written confirmation of same to the Engineer. The Contractor shall supply a copy of the product safety data sheet to the Engineer of all hazardous, toxic or dangerous materials or substances which will be used during the course of the contract. Refuelling operations shall be supervised at all times. Under no circumstances shall any refuelling procedure be left unattended by the operator.

Handling and fueling procedures shall be carried out to prevent the contamination of soil or water. Smoking shall be prohibited within 10 m of a fuel storage area or during refuelling operations. Fuelling or servicing of mobile equipment shall not be allowed within 100 m of a watercourse, water body, or designated wetlands. Oils, greases, gasoline, diesel, hydraulic and transmission fluids or other fuels shall be stored at least 100m (horizontal distance) from any water course, water body, or designated wetland unless otherwise approved by the Engineer.

Any above ground fuel containers, with the exception of those exempted under Newfoundland Regulation 58/03, shall be self dyked units that are in compliance with the terms and conditions of the approval of the Government Services Center. Fuel storage areas and non-portable transfer lines shall be clearly marked or barricaded to ensure that they are not damaged by moving vehicles. The markers shall be visible under all weather conditions. The storage, handling and disposal of used oils shall be in accordance with the Used Oil Control Regulations (82-02) under the NL Environmental Protection Act.

820.04 EQUIPMENT SERVICING PROCEDURES

All heavy equipment maintenance shall be carried out by using suitable fluid collection equipment and in a manner which ensures all waste material is collected and suitably disposed of. The Contractor shall ensure that all equipment is mechanically sound to avoid leaks of grease, oil, diesel, gasoline, and hydraulic and transmission fluids. The Contractor shall ensure that no servicing or washing of heavy equipment occurs adjacent to watercourses and designated wetlands. Fueling, servicing or washing of equipment shall not be allowed within 100 m of a watercourse except within a refueling site approved by the Engineer where conditions allow for containment of accidentally spilled fuels. The Contractor shall remove from the work area and

properly dispose of all waste oil, filters, containers or other such debris at an approved waste disposal site.

820.05 USE OF HAZARDOUS TOXIC OR DANGEROUS MATERIAL

Toxic construction material e.g., creosote treated timber, shall be stored at least 100 m away from all areas where drainage is directed into any watercourse or wetlands.

Toxic or dangerous substances such as form release agents, fuels, concrete additives (including superplasticisers), and other such substances, shall be transported, stored, and handled with all necessary precautions so as to prevent any spillage from occurring. Drip pans shall be used at locations where such liquids are being drawn off in order to contain any minor spills, and as a safety measure for containment of a significant spillage.

SECTION 825
WASTE MANAGEMENT

INDEX

825.01 SOLID WASTE DISPOSAL

The Contractor shall collect and dispose of all waste produced by its employees and those of its Subcontractors in a manner approved by the Engineer, and in accordance with the Newfoundland and Labrador Environmental Protection Act, 2002. Through the placement of suitable containers at the site, the Contractor shall collect and dispose of rubbish and domestic garbage generated by employees. During the progress of the work, the Contractor shall keep the areas occupied by it and access to such areas in a neat, clean, and safe condition, and free from the accumulation of all waste materials including crating materials, rubbish, drink containers, cigarette cartons, and all other waste. All solid waste shall be removed from the job site and recycled or disposed of at an Approved Waste Disposal Site, with the permission of the municipal authority. No waste material shall be deposited in any watercourse or wetland.
Upon completion of the work the Contractor shall, at its own expense, and to the satisfaction of the Engineer, dispose of or remove from the job site all construction plant, rubbish, unused material, including concrete forms, filter fabric material, sediment fencing, sand bags, and other

equipment and materials belonging to it or used under its direction during the performance of the work. The site shall be left in a neat and clean condition.
In the event of the Contractor's failure to comply with any of the foregoing, the same may be accomplished by the owner within 30 days of the completion of the work and the cost of same may be deducted from any money due or owing to the Contractor whether under this or any other contract.

825.02 SANITARY FACILITIES/ SEWAGE DISPOSAL

The Contractor shall maintain portable latrines on site or systems approved by the Government Services Center. The sanitary facilities shall be used by all Contractor employees and those of subcontractors. The Contractor shall transport the waste from these units, using a collection company (whenever possible) licensed by Government Services Center. Otherwise, transportation and disposal shall be by a means and at a facility or location as approved by the Government Services Center.

SECTION 830
MARSHALING YARDS & TEMPORARY WORK CAMPS

MARSHALING YARDS & TEMPORARY WORK CAMPS

Equipment or material storage yards and temporary work camps shall be located at least **100 m** from any watercourse or designated wetland.
The Contractor is responsible for obtaining **all** appropriate permits from government agencies with legislation and regulations relevant to camp facilities. These permits include, but are not necessarily limited to, those related to: solid and liquid waste disposal, water supply, sewage treatment, development control, Crown Lands, and any Municipal Authority having jurisdiction over the area.
Any site proposed for a marshaling yard or work camp should be of low value with respect to its potential for other uses when compared to other lands in the area. Abandoned gravel pits, abandoned commercial enterprises, or other previously disturbed areas are preferred locations. Any site must be located so as to minimize potential traffic hazards. Incoming and outgoing vehicles should be able to merge safely with other traffic. Prior to the commencement of construction the Contractor will submit a list of candidate sites, which will be reviewed and approved by the Engineer and any other relevant agency.

SECTION 835
FOREST FIRE PREVENTION

FOREST FIRE PREVENTION

The Contractor shall obtain a burning permit as may be required by the Forestry Division of the Department of Natural Resources, where burning is to be conducted, and shall abide by the terms and conditions of the permit.

The Contractor shall take all precautions necessary to prevent fire hazards when working at the job site and shall keep the job site free of all flammable waste.

Fires shall be located a minimum of **10m** from the existing tree line or adjacent piles of slash. Fires and slash piles will be kept to small manageable sizes to prevent igniting or scorching of adjacent vegetation.

The Contractor shall have available, in proper operating condition, sufficient fire fighting equipment, as recommended by the Forestry Division of the Department of Natural Resources, to suit its location, labour force, and construction plant. Such equipment shall comply with the standards of, and have approvals of, Underwriters Laboratories of Canada Limited and shall be maintained in accordance with National Fire Prevention Association Codes.

The Contractor shall ensure that specific employees are assigned to and trained in the use of fire fighting equipment. A list of these personnel shall be available on request by the Owner.

Rubber tires, waste oil, or similar material shall not be used to ignite slash or used to maintain the burning operation.

SECTION 840

DUST CONTROL

The Contractor shall ensure that dust does not become a problem for adjacent property owners or construction site personnel or a hazard to vehicular traffic. When required, or as directed by the Engineer, water or an acceptable dust suppressant such as calcium chloride shall be used by the Contractor on haul routes or other locations on the project to control dust.

SECTION 845
EQUIPMENT OPERATION AND PREVENTION OF EROSION AND SILTATION

INDEX

845.01 STORM WATER MANAGEMENT

The Contractor is responsible for storm water and drainage management during the period of the contract. This includes the collection, channeling, containment, settling, discharge and any other operation to effectively control storm runoff and prevent problems of erosion or siltation of adjacent or downstream areas. (See Section 815.07 Control and Treatment of Silted Water).

845.02 TEMPORARY TRAVEL ROUTES

Linear travel along the right of way by vehicles and equipment shall be restricted to one track or travel route, particularly during the early stages of opening access along the route, unless otherwise approved by the Engineer. The route shall be maintained by the Contractor free of standing water. Surface drainage will not be permitted to run along the route which can generate extensive mud and silt, and adversely affect materials to be excavated such as grubbing, unsuitable material, and overburden. Surface drainage shall be vented off the route at frequent intervals. Where drainage courses are encountered, and frequent crossings are required, temporary pipes (CSP or iron) shall be installed to permit passage of equipment and vehicles in the dry, without causing erosion and siltation. At certain locations fording may be permitted by the Engineer. (See Section 815.03 Fording of Watercourses).

845.03 EROSION & SILT CONTROL MEASURES

845.03.01 GENERAL PROTECTION MEASURES

The Contractor shall minimize terrain disturbance and erosion resulting from its activities. The Contractor shall, as part of its work, implement erosion and silt control measures where its activities result in a blockage of natural drainage, the diversion of natural drainage, or the exposure of soil or subsoil to potential erosion. Particular measures which may be required include:

(i) using an erosion control blanket;
(ii) using an appropriate hydraulic mulch;
(iii) spreading hay over exposed soils;
(iv) spreading a thin layer of brush or slash over disturbed areas;

(v) the installation of baffles or sediment traps at appropriate intervals within the area of disturbance;
(vi) the installation of drainage collectors across the disturbed area to channel drainage into vegetated areas;
(vii) the re-routing of disturbed drainage courses back into the natural course;
(viii) the stabilization of exposed soils at drainage locations with appropriate rip-rap;
(ix) where so directed by the Engineer, to construct check dams to confine mud or slurry at such locations as unsodded ditch lines, catch-basins and culvert inlets.
(x) the pumping of silted water to settling or designated vegetated areas;
(xi) the installation of sedimentation basins of adequate size at run-off locations from exposed areas to contain heavy silt and mud as directed by the Engineer.

845.04 LIMITATION OF OPERATION

During periods of heavy rain, where in the opinion of the Engineer, the movement of excavated material and equipment may give rise to extensive mud conditions, or the potential to seriously impact watercourses, or adjacent land, the Contractor may be required to suspend operations until such time as site conditions allow operations to resume. The Contractor shall not be paid for such downtime.

SECTION 850
PROTECTION OF VEGETATION AND WETLANDS

INDEX

850.01 MAINTAIN NATURAL DRAINAGE PATTERN

Drainage is to be maintained in its natural state wherever possible, with provision being made for spring flooding. Where existing drainage patterns cannot be maintained, alternate drainage will be installed to approximate normal conditions with the approval of the Engineer.

850.02 PROTECTION OF TREES & SHRUBS

Some trees, shrubs and plants within the clearing limits may be required for use by the Owner or other groups. Where necessary, and as directed by the Engineer, such trees, shrubs and plants shall be flagged for removal. Also see Section 855.02 (Planting of Trees and Shrubs).

Where branches of trees are to be removed as a result of damage or where roots 2.5 cm in diameter or larger are exposed as a result of contractors excavation work, the stumps shall be cut cleanly using a saw or lopping tool. The roots shall be cut back level to the surface of the cut slope within 24 hours following their exposure.

The Contractor shall adhere to the following protection measures:

(i) No unnecessary cutting of trees is to be conducted. Care will be taken during construction to prevent damage to trees and shrubs adjacent to the flagged clearing limits which are to remain after construction.
(ii) Care shall be taken when sloping embankments not to expose roots of trees, or put the soil at the base of such trees in danger of future erosion or extensive downslope drainage.
(iii) The Contractor shall not use living trees as survey marks and shall not cut blazes or otherwise mark live trees except with removable surveyor's tape and/or tags.
(iv) Where cutting is necessitated, the Contractor shall stockpile and remove all merchantable timber not required by the Owner. Other wood waste and slash remaining near the uncut zone shall be disposed of by chipping, burning, or removal, as acceptable to the Engineer.

850.03 OFF RIGHT OF WAY TRAVEL

The Contractor shall limit equipment travel to the surveyed right-of-way and existing municipal and provincial roads. Use of equipment of any type is not permitted outside the clearing limits of the right of way without prior approval. To obtain approval for additional or new travel routes, the Contractor shall notify the Engineer a minimum of five working days in advance of such requirements and not commence work until written approval is given by the Engineer.

850.04 BOGS AND WETLANDS

Bogs and wetlands are considered sensitive terrain because of their high disturbance potential. Travel by machinery across bogs and wetlands shall be avoided whenever possible. When such travel is necessary, it shall be carried out as directed by the Engineer. Bog excavation shall conform with good construction practices and be carried out in accordance with other relevant sections of these specifications.

SECTION 855
REVEGETATION
INDEX

855.01 REVEGETATION FOR SURFACE STABILIZATION

Immediately following and during some construction activities, the Engineer will identify areas requiring seeding/sodding or stabilization by a method to prevent erosion. These will include:

(i) Extensive cuts in overburden material. These areas shall be hydro seeded within **three** calender days of a cut being prepared and the work shall be carried out as directed by the Engineer;
(ii) Stream crossing sites. Topsoil placement, sodding, and shrub or tree plantings may be required as directed by the Resident Engineer.
(iii) All remaining disturbed areas, designated, will be hydro seeded or sodded as soon as possible in accordance with the DWST Specification Book - Section 632- Hydroseeding, Section 634 - Soil for Hydroseeding, Section 635- Lime for Hydroseeding, and Section 633- Sodding.

Where the potential for erosion exists, as on steep slopes, long slopes, or soft erodible type material, an appropriate erosion control material shall be applied to the surface. This can be in the form of an erosion control fabric or a sprayed on erosion control product which is approved by the Engineer and which will be in addition to hydroseeding as indicated in the contract documents or as directed by the Resident Engineer. Also see Section 845.03 (Erosion and Silt Control Measures).

The Engineer will inspect all revegetated areas periodically to ensure that adequate results have been achieved. During adverse dry conditions watering of revegetated areas shall be carried out as directed by the Engineer. Additional REVEGATATION work will be undertaken upon direction from the Engineer if the desired results are not achieved.

855.02 PLANTING OF TREES AND SHRUBS

855.02.01 GENERAL INSTRUCTIONS

The planting of trees will be carried out in those areas identified in the contract documents. The types of species, quantity, size, and exact location will be specified in the contract documents or otherwise the Contractor will be advised by the Engineer. **Nursery stock**, (purchased trees and

shrubs in pots), or **site stock**, (trees and shrubs removed from a site and held over or planted out directly), may be used as specified in the contract documents or as directed by the Engineer.

Native species of trees and shrubs are generally preferred, however, non-native species may be specified where, for example, a faster growing species or a disease resistant species or variety is needed.
The following species of trees are recommended:

SCIENTIFIC NAME	**COMMON NAME**	**SCIENTIFIC NAME**	**COMMON NAME**
PICEA	SPRUCE	ACER SPICATUM	MOUNTAIN MAPLE
ABIES BALSAMEA	FIR	ACER RUBRUM	RED MAPLE
BETULA PAPYRIFERA	BIRCH	ACER PLATANOIDES	NORWEGIAN MAPLE
SORBUS	DOG BERRY	SALIX DISCOLOR	WILLOW
LARIX LARICINA	LARCH, JUNIPER	SALIX BEBBIANA	WILLOW
LARIX KAEMPFERI	JAPANESE LARCH	POPULUS TREMULOIDES	TREMBLING ASPEN, POPLAR, APS
PRUNUS PENSYLVANICA	PIN CHERRY	POPULUS BALSAMEA	COTTONWOOD, BALSAM POPLAR

The following species of large shrubs are recommended:

SCIENTIFIC NAME	**COMMON NAME**	**SCIENTIFIC NAME**	**COMMON NAME**
AMELANCHIER	CHUCKLEY PEAR	CORYLUS CORNUTA	HAZELNUT
VIBURNUM CASSINOIDES	NORTHERN WILD RAISON	ARONIA MELANOCARPA	EASTERN CHOKEBERRY, CHOKECHERRY
ALNUS CRISPA	ALDER	ARONIA PRUNIFOLIA	EASTERN CHOKEBERRY, CHOKECHERRY
CORNUS STOLONIFERA	RED OSIER DOGWOOD		

The following species of small shrubs are recommended:

SCIENTIFIC NAME	COMMON NAME	SCIENTIFIC NAME	COMMON NAME
MYRICA GALE	SWEET GALE, BOG MYRTLE	SAMBUCUS PATENS	RED ELDERBERRY
RHODODENDRON CANADENSE	RODORA	ROSA NITIDA	WILD ROSE
NEMOPANTHUS MUCRONATA	MOUNTAIN HOLLY	ROSA VIRGINIANA	WILD ROSE
VIBERNUM EDULE	SQUASHBERRY	RUBUS IDAEUS	RED RASPBERRY
CHAMAEDAPHNE CALICULATA	LEATHERLEAF	SPIRAEA LATIFOLIA	MEADOWSWEET

855.02.02 PLANTING METHODS AND MAINTENANCE

The Contractor is referred to the **Manual for Native Plant Material Recovery**, available from the Department of Transportation and Works, for general information and recommended practices for the removal of trees and shrubs for either planting out directly or holding over for subsequent planting, and other aspects of care and maintenance.

All trees and shrubs do best when planted in early spring prior to the buds opening, but may also be successfully planted in late fall during their dormancy period. While it is possible to plant trees and shrubs at any time of the year, a regular watering program prepared by the Contractor and approved by the Resident Engineer to reduce or prevent mortalities is required during the active growing period. A watering program is required for all planted stock (nursery stock or site stock) in the first year. This should commence as soon as active growth begins, and as determined by the prevailing weather conditions and dryness of the soil throughout the growth season. Watering and other necessary maintenance such as the provision of staking or supports, pruning, mulching, etc. is the responsibility of the Contractor and no extra compensation will be paid for these items.

855.02.03 PAYMENT AND WARRANTY

Measurement for payment shall be by the number of individual trees of the specified species and size planted. The Contractor is responsible for preventing mortalities in planted stock. Trees and

shrubs which die within 18 months of being planted shall be replaced by the Contractor at no additional cost to the Owner.

SECTION 860

PROTECTION OF HISTORIC RESOURCES

The Contractor shall be aware that the Historic Resources Act (1985) requires the protection of archaeological sites and artifacts, and sets forth procedures to be followed in the event that either are found. The Contractor shall be aware of the following sections of the Act:

Section 10(1) - A person who discovers an archaeological object in, on, or forming part of the land within the province shall report the discovery forthwith to the Minister stating the nature of the object, the location where it was discovered and the date of the discovery.

Section 10(2) - No person, other than the one to whom a permit has been issued under this Act, who discovers an archaeological object shall move, destroy, damage, deface or obliterate, alter, add to, mark or in any other way interfere with, remove or cause to be removed from the province that object.

Section 11(1) - The property in all archaeological objects found in, on or taken from the land within the province, whether or not these objects are in the possession of Her Majesty is vested in Her Majesty.

Should any archaeological remains be encountered, such as stone, bone or iron tools, concentrations of bone, fireplaces, house pits and/or foundations, work in the area of the find shall cease immediately. The Contractor shall immediately notify the Owner through the Engineer, or the Senior Environmental Planner, or the Environmental Surveillance Officer immediately upon discovery of any historic resources. The Owner shall immediately notify the Historic Resources Division.

SECTION 865
OTHER ENVIRONMENTAL REQUIREMENTS

The Contractor shall be aware that other environmental requirements are contained in other sections. The attention of the Contractor is directed to:

SECTION 180	**UNWATERING INCIDENTAL TO WORK**
SECTION 201	**CLEARING AND GRUBBING**
SECTION 202	**CLEARING**
SECTION 203	**GRUBBING**
SECTION 204	**GRADING OF FILL**
SECTION 207	**BORROW**
SECTION 208	**EXCAVATION OF DITCHES**
SECTION 305	**APPLICATION OF CALCIUM CHLORIDE**
SECTION 310	**USE OF PITS, QUARRIES, AND STOCKPILES FOR PRODUCTION OF MATERIALS SUPPLIED BY CONTRACTOR**
SECTION 317	**WINTER SAND**
SECTION 320	**TACK COAT**
SECTION 330	**HOT MIX ASPHALTIC CONCRETE**
SECTION 401	**DITCHING FOR OF STREAMS**
SECTION 402	**PERMANENT DIVERSION OF STREAMS**
SECTION 403	**EXCAVATION FOR FOUNDATIONS**
SECTION 405	**TEMPORARY DIVERSION OF STREAMS**
SECTION 421	**INSTALLATION OF PIPE CULVERTS**
SECTION 423	**SUPPLY AND INSTALLATION OF STRUCTURAL PLATE PIPE**
SECTION 424	**SUPPLY AND INSTALLATION OF STRUCTURAL PLATE ARCH**
SECTION 426	**DESIGN, SUPPLY, AND INSTALLATION OF LONG SPAN STRUCTURAL PLATE ARCH**
SECTION 520	**STORAGE OR DISPOSAL OF OLD ASPHALTIC PAVEMENT**
SECTION 521	**DEMOLITION AND REMOVAL OF SIDEWALKS, CURB AND GUTTER, MANHOLES, CATCH BASINS, DITCH INLETS, FENCES, GUIDE RAIL AND GUIDE POSTS**
SECTION 522	**DISPOSAL OR SALVAGE OF CULVERT OR PIPE**
SECTION 634	**SOIL FOR HYDROSEEDING**
SECTION 635	**LIME FOR HYDROSEEDING**
SECTION 632	**HYDROSEEDING**
SECTION 902	**EXCAVATION FOR FOUNDATION, UNWATERING AND EXTRA BACKFILL FOR STRUCTURES**
SECTION 914	**BRIDGE DECK WATERPROOFING**

919.04 MAINTENANCE OF TRAFFIC

919.04.01 General

The Contractor shall pay particular attention to the flow of traffic through the construction zone. Any damage incurred to vehicles or their cargo or injury sustained to their occupants as direct or indirect result of the Contractor's actions, procedures or negligence, shall be the sole responsibility of the Contractor.

The Contractor shall indemnify and save harmless the Department with regard to claims arising from damages or injury. The Contractor shall maintain at least one lane of traffic through the construction zone for the duration of the project. The Contractor shall be responsible for the placement and maintenance of all traffic signs, barricades and other traffic control devices deemed necessary as per Division 7 "Temporary Conditions, Signs and Devices".

Three copies of a detailed drawing shall be submitted by the Contractor for approval showing the following:

1. The sign and barricade layout.
2. The structure across the river.

919.04.02 Temporary By-pass

For certain projects a temporary by-pass will be required, and it shall be stated in the Supplementary General Conditions detailing span and load carrying capacity.

FORM 919

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The Contractor shall be responsible for the location and route of the by-pass, the hydrological, hydraulic, and structural design of the river crossing, the maintenance and upkeep, and the placement and maintenance of all traffic control devices as stated above.

Section 140, "Environmental Requirements" shall be adhered to by the Contractor.

Three copies of a detailed drawing signed and sealed by a Professional Engineer licensed to practise in the Province of Newfoundland, shall be submitted by the Contractor for approval to the Engineer showing the following:

1. The proposed route of the by-pass.
2. The structure.
3. The sign and barricade layout.
4. Design and posted speed through the construction zone

All repairs to the by-pass deemed necessary by the Department shall be implemented by the Contractor immediately after written notification by the Engineer. If after notification the Contractor fails to initiate repairs, repairs will be done by others. The cost of such repairs will be deducted from progress payments.

919.04.03 Traffic Resumption

Under normal circumstances, curing time required for deck concrete is wet curing for seven (7) days and a further thirty (30) days for air drying. Also, the specified design strength must be obtained.

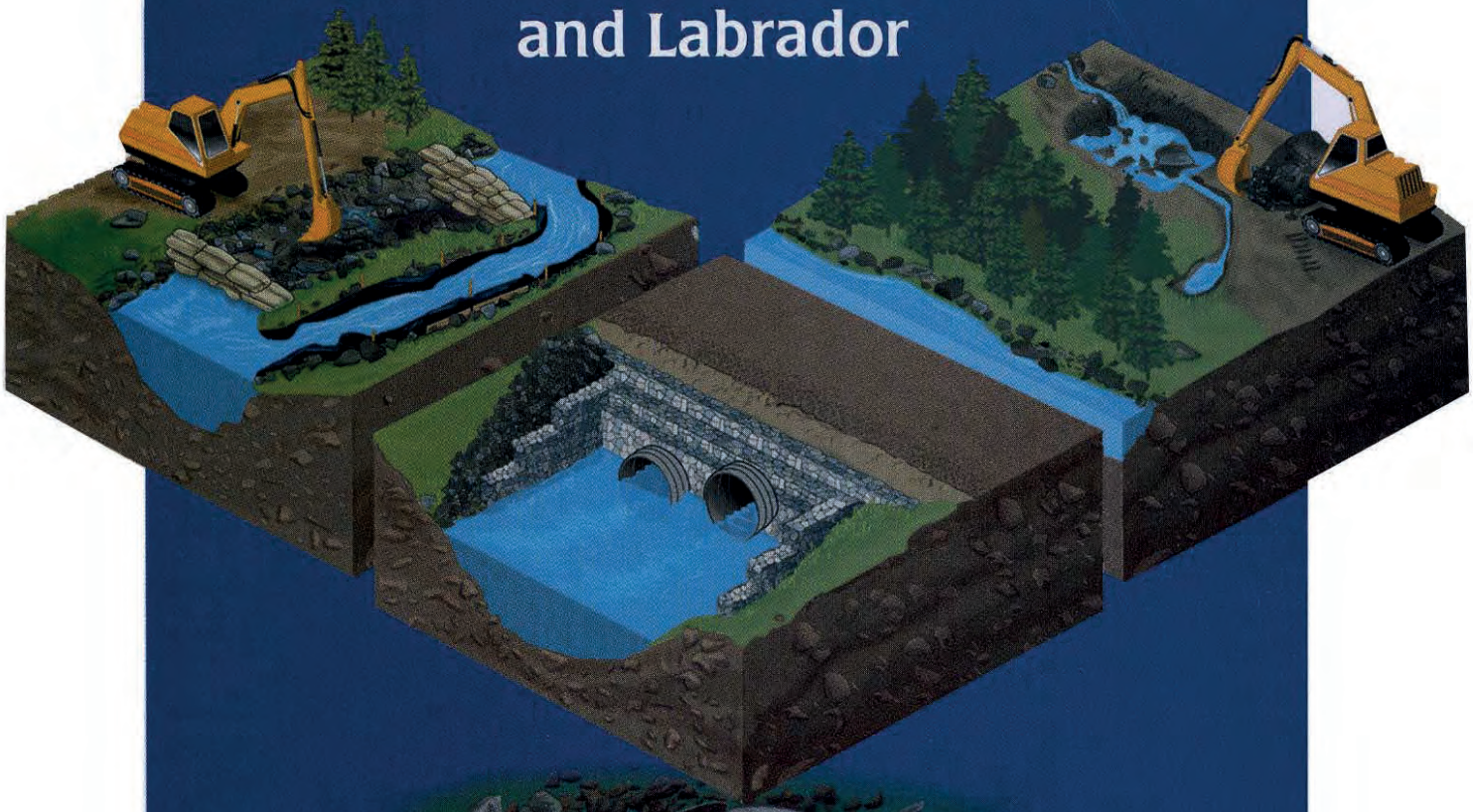
Until the above conditions are satisfied, no traffic will be permitted on a new deck or overlay. If it is not practical to achieve this, as there is no temporary by-pass, the above curing times may be reduced only at the discretion of the Engineer but in no case will traffic be allowed onto a new deck or overlay until seven (7) days of wet curing and an additional seven (7) days of air drying have elapsed. The area used as a route for the by-pass must be returned to its original condition.

Appendix C

Fisheries and Oceans Guidelines for Protection of Freshwater Fish Habitat

Guidelines for Protection of Freshwater Fish Habitat

in Newfoundland and Labrador



Fisheries and Oceans
Pêches et Océans
Canada

Department of Fisheries & Oceans
Marine Environment and Habitat Management Division
Science Branch

Guidelines for Protection of Freshwater Fish Habitat in Newfoundland and Labrador

by

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Preface

Guidelines for Protection of Freshwater Fish Habitat in Newfoundland and Labrador has been developed to serve as a reference for planners, developers, contractors and regulatory agencies in addressing freshwater fish and fish habitat protection issues arising as a result of proposed project development activities. This document has been generated following reviews of existing guidelines from local and other jurisdictions, field observations and recommendations from experts in both the environmental and construction fields. This guideline updates and combines the information contained in the previous Department of Fisheries & Oceans (DFO) guideline documents entitled *Resource Road Construction Fish Habitat Protection Guidelines* (McCubbin et al. 1990) and *Urban Development Guidelines for Protection of Fish Habitat in Insular Newfoundland* (DFO and LGL Ltd. 1990). Guidance provided in this document is intended to assist planners, developers and contractors in providing appropriate fish and fish habitat information to regulators for use in the comprehensive review of project development proposals.

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1.0 Introduction

These guidelines have been developed to serve as a reference for planners, developers, contractors, and regulatory agencies in addressing freshwater fish and fish habitat protection issues arising as a result of proposed project development activities. This document has been generated following reviews of existing guidelines from local and other jurisdictions, field observations, and recommendations from experts in both the environmental and construction fields. This guideline updates and combines the information contained in the previous Department of Fisheries and Oceans (DFO) guideline documents entitled *Resource Road Construction Fish Habitat Protection Guidelines* (McCubbin et al. 1990) and *Urban Development Guidelines for Protection of Fish Habitat in Insular Newfoundland* (DFO and LGL Ltd. 1990).

Protection is an essential step in maintaining the productivity of fish habitat. Habitat protection contributes to the conservation and enhancement of commercial, recreational, and subsistence fisheries resources. Specific requirements for protection of fish habitat are set out in Canada's *Fisheries Act* and its associated regulations. Other federal, provincial, or municipal legislation addressing fish and fish habitat protection may also apply to proposed developments.

Canada's *Fisheries Act* provides for the protection of fish and fish habitat.

Most problems associated with development-related activities, regardless of scale, are often the result of poor planning and design, improper site location, and inappropriate construction practices. This document identifies common project development activities that have the potential to adversely impact the aquatic environment and offers guidance on measures to reduce or eliminate these harmful impacts. The proper implementation of appropriate mitigative techniques can prevent or minimize impacts on productive fish habitat and fish populations.

1.1 Purpose and Scope

The purpose of these guidelines is to provide direction to planners, developers, contractors, and regulatory agencies in addressing freshwater fish and fish habitat protection issues arising from proposed project development activities. The following highlights the format of this document:

- Section One outlines the purpose of this document within the context of fish habitat management in Newfoundland and Labrador. A description of key fish habitat requirements is provided to illustrate the linkage between fish and fish habitat and to emphasize the importance of habitat protection.
- Section Two provides an overview of the DFO's legislative responsibilities under the *Fisheries Act* and the *Policy for the Management of Fish Habitat*.
- Section Three outlines the general information requirements of DFO that enable the review and evaluation of the predicted impacts of a proposed development on fish and fish habitat and the mitigative measures that should be incorporated into the development plan to protect fish and fish habitat.
- Section Four outlines mitigative techniques aimed at reducing or eliminating the potential harmful impacts of project development and operation activities on fish and fish habitat.

1.2 Fish and Fish Habitat

The freshwater fishery resource of Newfoundland and Labrador is unique among areas of comparable latitude in North America since salmonids are predominant in virtually all waterbodies. Salmonid species include Atlantic salmon, brook trout, brown trout, rainbow trout, lake trout, and white fish. Other freshwater fish found in the province include eel, stickleback, smelts, northern pike, and others.

In order for fish populations to thrive and reproduce, fish habitat should provide shelter, security and nourishment. All salmonids have similar freshwater habitat requirements: clear, clean water; cool water temperatures; a high oxygen supply; shelter; food from both aquatic and terrestrial sources; a combination of appropriate habitat types; suitable substrates; adequate stream flow; and access to a variety of habitats for various life processes (Figure 1.1).

Figure 1.1 *Freshwater habitat requirements for salmonids.*

Fish require a healthy habitat to survive and reproduce.

Water clarity is important for various reasons. Suspended sediment reduces visibility, making it difficult for fish to locate and capture prey. Suspended sediment (Figure 1.2) can also damage fish gills causing injury, mortality, and increased susceptibility to disease and predation. Settled sediments can infill pools and riffles, reducing the availability and quality of spawning and rearing habitat for fish (Figure 1.3). Infilling occurring during spawning, incubation, or hatching periods can smother eggs and alevins. Sediment deposits can also reduce the food supply by displacing insect larvae that reside on the stream bottom.

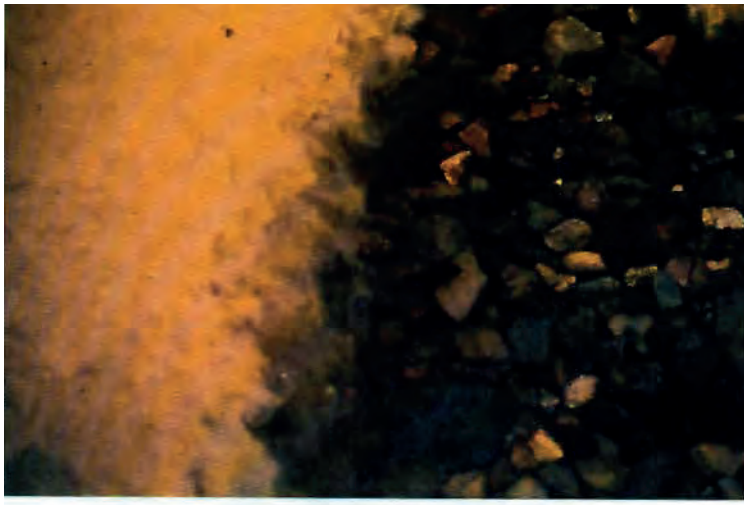


Figure 1.2 *Development activities can introduce suspended sediment into watercourses.*

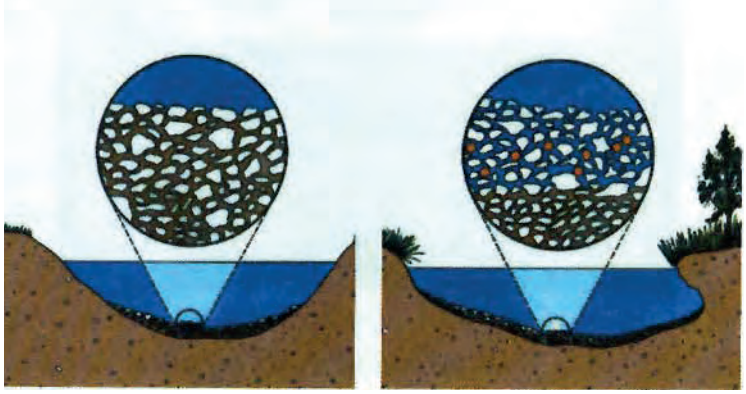


Figure 1.3 *Suspended sediment can settle on the bottom of water-courses, filling interstitial spaces in gravel substrate used for spawning and incubation.*

Clean water, free of toxins and pollutants, is essential for healthy and productive fish populations. The introduction of pollutants into the aquatic environment can seriously affect plants, animals, and micro-organisms, thereby altering the structure of the aquatic ecosystem. Pollutants can be directly lethal to fish, can make fish more susceptible to other stressors, or can accumulate in fish tissues making them unsafe for human consumption.

Water temperature is a critical factor in salmonid survival. Fish may display signs of stress at temperatures above 22°C and mortalities have been recorded at 27°C. Developing eggs also have strict cool temperature requirements and hatching success can be greatly affected by increases in temperature. Factors that help to maintain cool water temperatures include deep, flowing steadies and pools, shading by streamside vegetation, and intact groundwater sources.

Dissolved oxygen in the water is absorbed by fish through the gills and transported around the body in the blood. Aquatic plants and algae introduce oxygen into the water as a product of photosynthesis. Turbulence is also important for oxygenating water. Dissolved oxygen levels are reduced in warm water, another important reason for cool water maintenance.

Shelter is necessary for avoiding predators and accessing shaded areas during periods of warm temperatures. Stumps, logs, and other instream debris make excellent hiding places. Fish rest behind instream boulders or in undercut streambanks, and dart out into the current to catch drifting food. These areas are also velocity shelters that enable fish to conserve energy.

Food supply in the aquatic environment must be plentiful and diverse to sustain the productivity of a watershed. A healthy pond or stream contains hundreds of varieties of plant and animal life, much of which is microscopic. Leaf litter and woody debris that fall into a stream are broken down and decomposed by microorganisms and insect larvae. These insect larvae, in turn, may be eaten by juvenile fish. Larger fish may prey upon worms, amphipods, and smaller fish.

Habitat variety is important for providing key habitat components to all life stages within a fish population. Salmonids use different sections of a stream at different life cycle stages. The usefulness of

these sections is determined by substrate size, water depth, and flow.

Suitable substrate is essential for fish productivity. Fish need well-aerated, gravel-bottomed areas for spawning. Rearing areas require larger substrates, which provide young fish with resting areas and shelter from predators

Adequate stream flow is required by fish to ensure that habitat is accessible. Stream flow also influences other habitat factors such as water temperature and dissolved oxygen levels. Flow is required to provide oxygen to developing eggs and remove wastes. Deeper, slow-moving stream sections make good nursery and rearing areas for newly-hatched and growing salmonids. Excessive flow and high water velocities can displace fish from habitat and create migration barriers. Pools and ponds are used for overwintering. Flow ultimately determines the available space (wetted area) for fish.

Access to habitat is crucial in maintaining fish populations. Obstructions to fish passage can alienate large areas of productive spawning and rearing habitat.

2.0 Legislation and Policy

In Newfoundland and Labrador, fish habitat protection falls under the jurisdiction of the Department of Fisheries and Oceans (DFO). It is recommended that DFO be consulted early in the planning stages of any development that has the potential to affect freshwater fish and fish habitat. The following provides an overview of relevant federal fish and fish habitat legislation and policy. Other federal (e.g. *Navigable Waters Protection Act),* provincial or municipal legislation and policy may also apply to proposed developments. Proponents, developers and contractors are advised to contact the appropriate regulatory agencies regarding approvals and permits.

2.1 Fisheries Act

The Habitat provisions of the *Fisheries Act* apply to all projects and activities that have the potential to alter, disrupt or destroy marine or freshwater fish or fish habitat through chemical, biological, or physical means. Under the *Fisheries Act* there are sections specific to fish habitat that address such aspects as physical disruption of fish habitat, discharge of pollutants (or deleterious substances), fish passage, fishways, explosives, and intake screens, among others.

The *Fishery (General) Regulations,* as made pursuant to the *Fisheries Act,* also have habitat provisions. Section 58 of the Regulations addresses the harmful alteration, disruption, or destruction of fish habitats as a result of developments. It is in this Section of the Regulations that the Department of Fisheries and Oceans (DFO) Authorizations For Works or Undertakings Affecting Fish Habitat is identified and Authorization is given under Sub-Section 35(2) of the *Fisheries Act*.

For project developments or activities that have the potential to impact on freshwater (or marine) fish or fish habitat, it is recommended that the Department of Fisheries and Oceans be contacted. Recommendations, via a Letter of Advice, are provided where any

potential harmful alteration, disruption, or destruction of fish habitats can be properly mitigated. In cases where harmful alteration, disruption, or destruction of fish habitats cannot be appropriately mitigated, then a Section 35(2) Authorization under the *Fisheries Act* may be issued with any associated fish habitat compensation, as required. Project developments may include: general in-stream work, stream crossings, blasting in or near waterbodies, quarries in proximity to waterbodies, water withdrawal, onland site development activities potentially resulting in siltation, infilling or other freshwater (or marine) project activities to name a few.

The *Policy for the Management of Fish Habitat* applies to habitats supporting fish stocks or populations that sustain commercial, recreational, or subsistence fisheries. The Policy is not a statutory requirement to be met at all costs, rather it is a guide for DFO officials and other interested individuals (eg., proponents/developers).

The Marine Environment and Habitat Management Division of DFO has many documents /pamphlets available addressing legislation and policy, and identifying types of mitigative measures that may be applicable to project activities involving freshwater (or marine) fish or fish habitat. Referrals should be forwarded to the appropriate Area Habitat Biologist (See Appendix A).

For information and reporting of environmental emergencies and chemical or hydrocarbon spills see Appendix B.

.

DFO should be contacted regarding activitics in or near aquatic environments.

2.2 Policy for the Management of Fish Habitat

The Department of Fisheries and Oceans' *Policy for the Management of Fish Habitat* provides a comprehensive framework for the conservation, restoration, and development of fish habitats and strategies for the implementation of policy components.

The overall objective of the Policy (as outlined in Figure 2.1) is a **net gain** of the productive capacity of fish habitats for Canada's fisheries resources. The policy is intended to:

Increase the natural productive capacity of habitats for the nation's fisheries resources to benefit present and future generations of Canadians.

No Net Loss is a key element in DFO's *Policy foi' the Management of Fish Habitat.*

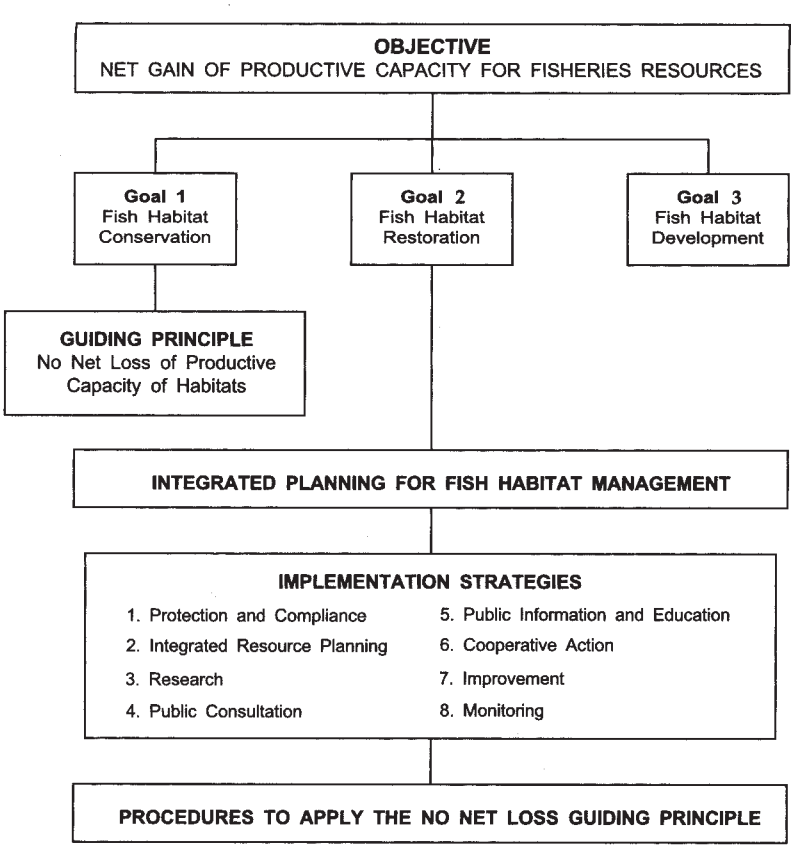


Figure 2.1 *Schematic diagram of the Department of Fisheries and Oceans Policy for the Management of Fish Habitat*

This objective is supported by three goals covering the conservation, restoration, and development of fish habitat. Specifically, the three goals are:

1) **Conservation** - Maintain the current productive capacity of fish habitats supporting Canada's fisheries resources, so that fish suitable for consumption may be produced (This goal is implemented using a no net loss guiding principle).
2) **Restoration - Rehabilitate** the productive capacity of fish habitats in selected areas where economic or social benefits can be achieved through the fisheries resource.
3) **Development** - Create and improve fish habitats in selected areas where the production of fisheries resources can be increased for the social or economic benefit of Canadians.

The **no net loss** guiding principle of the conservation goal is applied in terms of a hierarchy of preferences. This goal can be achieved by avoiding any habitat loss or alteration at the site of a proposed project or activity through project redesign, selection of alternate sites or the implementation of measures to mitigate potential damage. Only after it proves impossible or impractical to maintain the same level of habitat productive capacity using the forementioned approaches will compensatory options (like-for-like compensation, off-site replacement habitat, or an increase in the productivity of existing habitat for the affected stock) be considered.

3.0 Information Requirements

Project-specific information is required to address the potential impacts of a proposed development on fish and fish habitat. The types of information that may be required by DFO are highlighted in the following section. While this listing is not intended to be all inclusive, it indicates information that may be necessary to enable DFO and other regulatory agencies to review a proposed project development. Note the level of detail to be provided may vary with the complexity of the proposed project and site-specific characteristics.

Provision of comprehensive project information is necessary to facilitate review.

3.1 Types of Information

Project Specific Information

- project rationale/ purpose
- detailed description of the project, project structures and any associated construction, operation or decommissioning activities
- project/ activity schedule (time of year, duration, frequency, magnitude, and extent of activities)
- site plans/sketches indicating the location of project development activities (detailed on a 1:50,000 topographic map)
- engineering design details (when applicable)

General Site Information

- type of watercourse (e.g. pond or stream)
- gazetted or common name of watercourse
- location of the watercourse (preferably latitude and longitude or military grid reference)
- general photographs /video of the site

Biophysical Information

- fish presence, species, size(s) and type of fish habitat at the project site
- physical description of the watercourse at the project site (e.g. channel width and depth, direction and velocity of water movement, variations in water levels, flow regime at various times of the year, debris loading, etc.)
- location, orientation, and proximity of the development in relation to surrounding watercourses
- description of natural site features and characteristics
- commercial, recreational and/or subsistence fisheries (or potential fisheries) in the area

Water Withdrawal Information (where applicable)

- purpose of the water withdrawal;
- average rate, or ranges of rates, of withdrawal from the water course;
- duration and time of the withdrawal; estimates of ranges of flow (e.g. daily, weekly, monthly) in the watercourse during times of withdrawal with dates and times of the year (with particular con sideration to periods of low flow);
- expected effects of withdrawal on existing conditions in the water course (e.g. drawdown, downstream dewatering, etc.);
- description and location of structures or activities associated with the development of the intake;
- whether the application is for a new intake, or re-development or upgrading of an existing structure;
- screen area (both open and effective areas); physical screen param eters with respect to the intake and the watercourse;
- screen material, method of installation, and supporting structures; and
- screen maintenance, clearing, or other special requirements.

Blasting/Explosives Information (where applicable)

- total quantity of and type of explosives;
- cross-section of blast hole detail;
- individual weight of charge(s);
- magnitude of charge weight to be detonated instantaneously;
- any decking of charges (e.g. several charges within a hole);
- amount of millisecond delay between charges;
- information on the type of material requiring blasting (e.g. rock, saturated soil, unsaturated soil);
- proposed blasting methodology;
- location of blasting;
- proposed time of year for undertaking; and
- biophysical information on fish habitat and fishery resources in the area.

Other Information

- otential impacts of the proposed development and associated activities on freshwater fish and fish habitat in the area
- details of proposed mitigation
- need for, adequacy of, or design of proposed monitoring (e.g. environmental effects monitoring, etc.) programs to be implemented to address the impacts of the proposed development and associated activities on fish and fish habitat

Note: *A Standard Methods Guide for Freshwater Fish and Fish Habitat Surveys in Newfoundland and Labrador: Rivers and Streams* (Sooley et al. 1998) is available from DFO. The document details the types of information that may be required by DFO in the project review process as well as a guide to the standard methods for the collection of required fish and fish habitat information.

3.2 How this Information will be Used

The above information is used by DFO to assist in the review of the proposed project development. Based on the information provided, DFO determines the accuracy of a proponent's assessment of potential impacts, and the adequacy of proposed mitigative measures and monitoring programs. It is essential that potential environmental impacts, mitigative measures, and monitoring programs that will be in place throughout the life of a project be fully identified/addressed to enable a comprehensive understanding of the implications of the project on fish and fish habitat.

4.0 Habitat Protection Mitigation Techniques

For many project developments and associated activities there are issues that typically have to be addressed with respect to freshwater fish and fish habitat protection. Issues such as erosion/sedimentation control, site stabilization, site clearing, buffer zones, watercourse crossings, and fish passage are common to many project developments regardless of overall project scale (i.e. small or large). The following section presents both general construction activity related and project specific mitigative techniques aimed at reducing or eliminating potentially harmful impacts on fish and fish habitat; these techniques are often used most effectively in combination.

4.1 Erosion/Sedimentation Control

Land development activities, such as clearing land, grading slopes, road building, and excavating and stockpiling materials, can lead to the erosion of soils into nearby watercourses that contain fish and fish habitat (Figure 4.1). Sedimentation of watercourses can have detrimental effects on fish and fish habitat. Suspended sediment reduces water clarity and can cause damage to gills. Sediment can also settle onto the bottom of watercourses, smothering eggs and/or rendering gravel substrate unsuitable for spawning. Even after the replacement and compaction of slopes and surfaces, gully and channel formation can occur and lead to subsequent erosion. Therefore, on- and off-site runoff management is a key factor in erosion and sediment control. Management techniques, such as preparing and covering disturbed soils, revegetating slopes, and lining runoff ditches early in the project assist in reducing the potential for erosion.

Silt is harmful to fish and fish habitat.

Figure 4.1 *Development activities can lead to the erosion of soils into nearby watercourses.*

In general, provision of appropriate erosion and sedimentation control should consider the following:

- Plan the development to suit the existing terrain and site condtions.
- Schedule development to minimize potential impacts associated with erosion.
- Retain existing vegetation where possible (Figure 4.2).
- Re-vegetate/protect denuded areas and bare soils, and divert runoff away from denuded areas.
- Minimize the length and steepness of slopes, where possible, and provide erosion protection for temporary and longterm/ permanent slopes.
- Minimize runoff velocities and erosive energies by utilizing interceptor ditches, minimizing gradients, and maximizing lengths of conveyance ditches.
- Design development to minimize or control runoff associated with project construction, operation, and decommissioning or abandonment activities.
- Retain eroded sediments on site with erosion and sediment con trol structures.

Avoid deposition of silt into fish bearing water.

- Plan, inspect, and maintain erosion and sediment control structures to ensure effective and efficient operation.

Figure 4.2 *Existing vegetation should be retained around watercourses whenever possible. Riparian (streamside) vegetation provides bank stabilization, thereby reducing the potential for erosion.*

In addition to the above general guidelines, Sections 4.1.1 through 4.1.8 provide details on some specific erosion/ sedimentation control mitigative techniques (i.e. silt fence, filter fabric dam, rock check dam, settling ponds, ditches, stabilized access to site, straw barrier/ bale structure, matting and vegetation, and grading). When using manufactured erosion control materials, manufacturer's specifications should also be consulted. Further, appropriate and timely stabilization of disturbed areas, as presented in Section 4.2, can facilitate sedimentation and erosion control. Section 3.0 of this document should be consulted to determine the information required by DFO for review of proposed developments.

4.1.1 Silt Fence/Filter Fabric Dam

Silt fences and filter fabric dams are temporary barriers that provide an effective filter for sediment-laden runoff from disturbed slopes and surfaces. Silt fences are constructed with filter fabric

and posts or stakes, and are typically installed at the bottom of slopes in development areas. Silt fences surround a disturbed site or contoured exposed slope (maximum steepness 2:1), effectively trapping the sediment close to the erosion source and preventing sedimentation of the aquatic environment via site runoff. Filter fabric dams are used in ditches to remove sediment from collected water prior to the release of this water into a natural watercourse. Silt fences and filter fabric dams have a limited retention capacity and are not designed for long term control of sedimentation. These structures also require ongoing maintenance. To use filter fabric structures effectively, the following guidance is provided:

a. Filter fabric structures are designed for temporary use only.

b. More than one filter fabric dam should be installed to ensure maximum removal of sediment prior to the entry of collected water into the receiving watercourse and filter fabric dams should be installed in series (Figure 4.3).

Figure 4.3 *Filter fabric dams used in series maximize the effectiveness of the removal of suspended sediment from collected water.*

c. Filter fabric structures should not be used in natural watercourses and have minimal effectiveness when placed in locations of continuous flow and/or moderate to high water velocities.

Filter Fabric fences are only temporary siltation control structures.

d. Use should be limited to situations in which only surface runoff is expected.

e. Filter fabric/silt fences should be installed on the lower perimeter of slopes (lower 1 /3 to 1 /2 of site) and in areas where the erodibility is high and/or it is desirable to contain waterborne movement of eroded soils (i.e. the bottom of cut or fill slopes, material stockpiles, and disturbed natural areas).

f. For ditch installations, the filter fabric dam should be appropriately embedded in the ditch bottom and sides (e.g. 100 mm minimum) to prevent the movement of fines under or around the dam (Figure 4.4). Wooden stakes should be installed on the downstream side of the trench and filter fabric attached to the upstream side of the stakes. Adjoinments of sections of filter fabric should be sufficiently overlapped (e.g. minimum 150 mm) to prevent the movement of fines around or through the seam area.

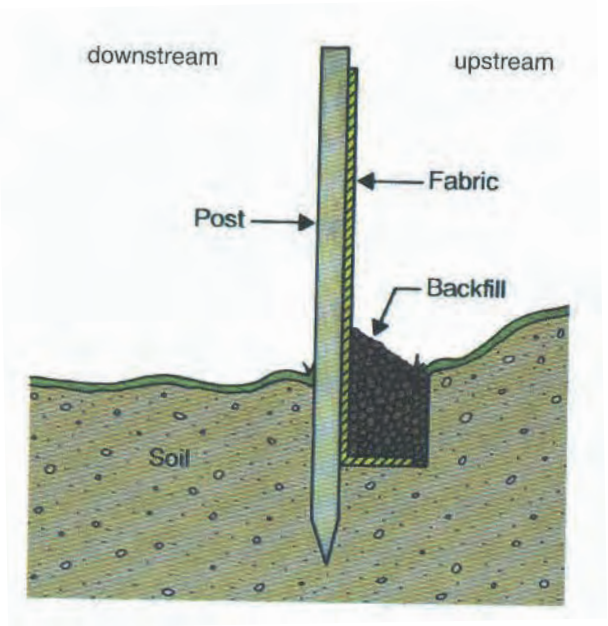


Figure 4.4 *Filter fabric should be embedded in the ditch bottom and sides. Fabric should be supported by wooden posts/stakes.*

g. Accumulated sediment should be removed regularly from the silt fence or filter fabric dam and disposed of in a manner that prevents subsequent entry into any watercourses (e.g. material should be disposed of at a landfill approved by the appropriate regulatory agency).

h. Damaged sections of fabric should be repaired or replaced. Dams should be inspected to ensure that water is not flowing under or around the filter fabric and that the structure is appropriately functioning to retain sediment.

j. Filter fabric dams and silt fences should not be removed until all site work has been completed and disturbed areas stabilized. All accumulated sediment should be removed and disposed of in an appropriate manner (e.g. at a landfill approved by the appropriate regulatory agency) prior to removing the filter fabric structure.

4.1.2 Check Dam

Check dams (Figure 4.5) can be temporary or permanent and are used to prevent erosion and control sedimentation arising from roadside ditches. Check dams are structures used to prevent the erosion of ditch bottoms by slowing the velocity of concentrated runoff and by collecting and holding moisture and sediment in the ditch bottom. These structures are generally constructed with consideration for the availability of materials and whether the check dams are to be permanent or temporary. Check dams can be constructed of locally available materials and are relatively easy and economical to construct. Materials typically used include: brush, rock, gabion baskets, planks, sodded earth fill, or sandbags. When utilizing check dams, the following guidance is provided:

Rock check dams can be constructed of locally available materials.

a. Check dams are typically limited to treating runoff from small drainage areas and should not be used in natural watercourses. Therefore, several small check dams may be preferable to a few larger dams to reduce runoff and maximize the sediment-trapping capacity.

Figure 4.5 *Check dams can be constructed from a variety of readily available materials, including rocks.*

b. Check dams should be constructed to provide an impermeable structure, including lining with impermeable material, such as plastic or polyethylene sheeting, if only larger stones are available. The center of the check dam should be lower than the sides to enable the movement of accumulated water over the dam, while settled sediment is retained by the sides and lower portion of the dam (Figure 4.6).

c. The check dam and ditch should be stabilized with riprap or other non-erodible material.

d. The check dam should be regularly inspected and accumulated sediment removed. Material removed from the check dam should be disposed of in an appropriate manner (e.g. at a landfill approved by the appropriate regulatory agency) to ensure that sediment does not enter the aquatic environment. Ensure that accumulated sediment is removed and disposed of prior to the removal of a temporary check dam.

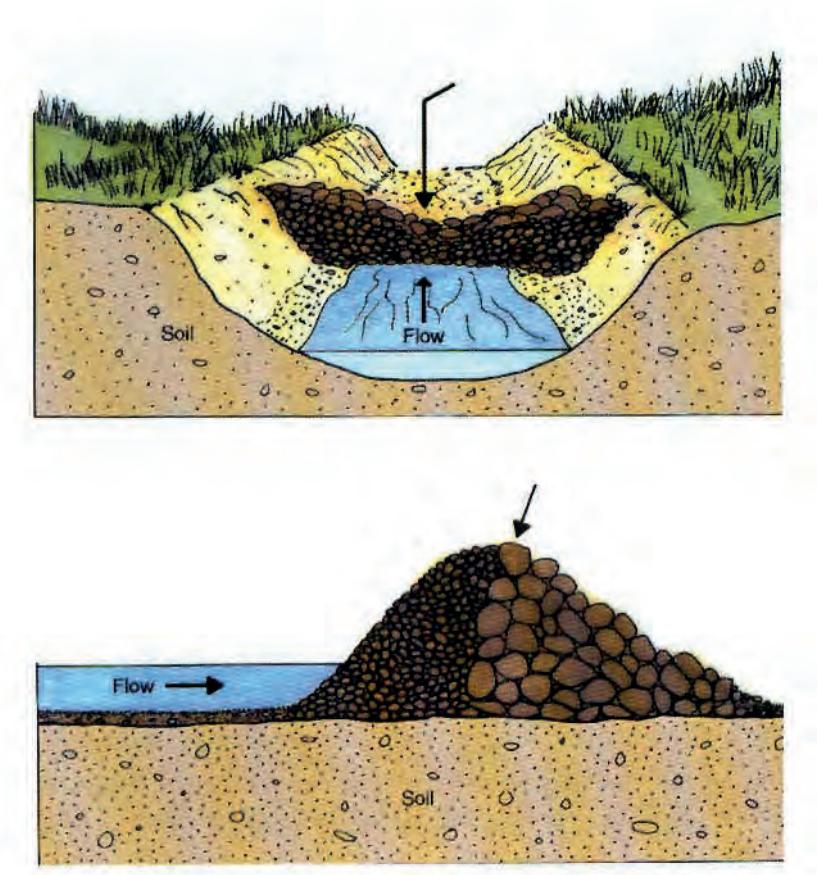


Figure 4.6 *Side and oblique views of a well-constructed rock check dam.*

4.1.3 Settling Ponds

Settling ponds/basins (Figure 4.7) are used to intercept and retain sediment-laden runoff. These structures allow sediment to settle out, thereby reducing the amount of sediment leaving the disturbed area and protecting fish habitat into which runoff is flowing. The effectiveness of settling ponds is influenced by particle size, settling characteristics, settling time, and surface area. Settling ponds should be installed at the development area prior to any excavation or other construction related activities. These ponds are most effective for sedimentation control on a relatively short-term basis. When using settling ponds, the following guidance is provided:

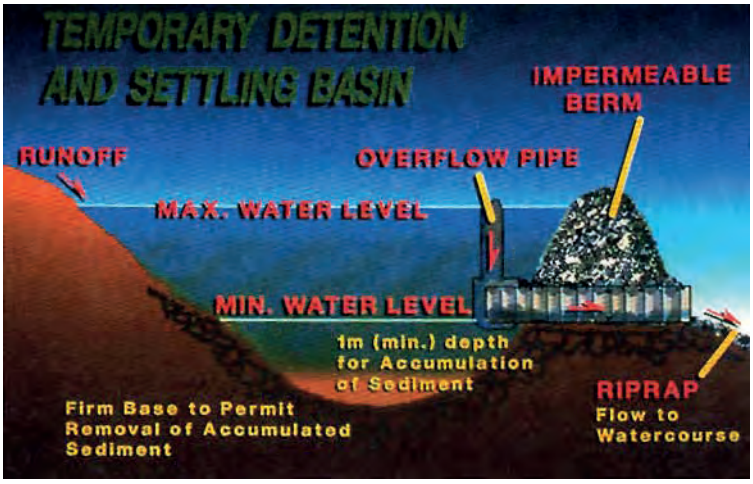


Figure 4.7 *Features of a well-constructed settling pond/basin.*

a. Settling ponds should be installed during initial site development before any grubbing of the area occurs.

b. Settling ponds should be constructed so that the length is at least four times the width.

c. Settling ponds are most effective when several are used in series, particularly if long-term activity of several weeks or more is planned. A minimum of two ponds should be provided.

d. The bottoms of settling ponds should be lined with a material, such as plastic, to retain sediment and water (Figure 4.8).

Settling ponds should be used in series.

e. A pipe should be installed near the top of a settling pond in such a manner that water is discharged from the top of the water column. There are a number of alternatives to this method of settling pond construction involving the use of various detention devices such as pre-cast manholes and using natural topographic features.

f. A chemical additive, known as flocculant, may increase the rate at which sediment particles settle out of the water column. Any questions regarding the use of chemicals should be directed to the appropriate regulatory agencies.

g. It may be necessary to remove and dispose of accumulated sediment from settling ponds in order to maintain operating capacity.

h. Settling ponds should be filled in and stabilized when no longer required. Impermeable liners, such as plastic, should be removed and appropriately disposed of.

Figure 4.8 *Settling ponds should be lined with an impermeable material, such as plastic, to prevent the generation of silt from the excavated settling pond.*

4.1.4 Ditches

Ditches collect runoff from roads, development sites, or slopes. Roadside ditching allows drainage of the roadbed, restricts vegetative growth, and corrects for deficiencies such as: erosion; nonconformity in grade, line, or cross section; and water ponding on the roadway. Interceptor ditches are temporary or permanent structures designed to intercept and carry clean surface runoff away from erodible slopes, reducing potential surface erosion and limiting the amount of runoff requiring treatment. Alternatively, these ditches can collect sediment laden runoff from slopes and carry it, without further erosion, to treatment areas or settling ponds.

Ditches should be stabilized and not discharge open ended into aquatic environments.

Interceptor ditches usually have to be excavated and should be stabilized to prevent erosion and sedimentation.

Ditches, particularly new ditches, can transport large volumes of sediment. Sediment discharged into watercourses can adversely affect fish habitat and aquatic life. When using ditches, the following guidance is provided:

a. Ditches should be stabilized and should not discharge open ended into a watercourse. Ditches should flow into vegetated areas located upslope of watercourses to allow the trapping of sediment prior to the entry of the runoff into the watercourse (Figure 4.9).

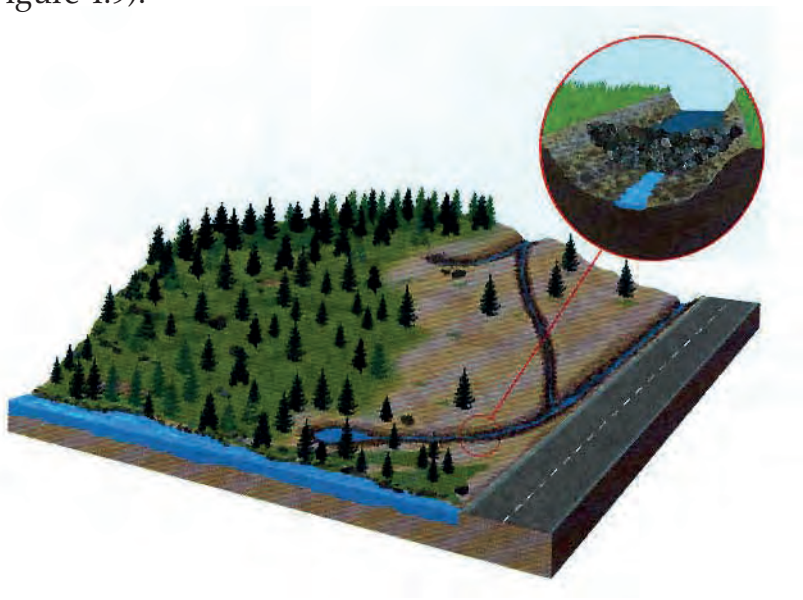


Figure 4.9 *Features of a well-designed ditch system.*

b. The location of and access to ditches should be determined following review of the topography, the existing or planned drainage pattern, and subgrade conditions. Ditches should be laid out following the site contours, if possible, and constructed during the initial site clearing.

c. In sidehills or similar areas, ditches should be installed on uphill sides of roads to intercept seepage and runoff.

d. Where ditches have been excavated in areas with erosion-prone soils, the ditches should be immediately lined with non-erodible material.

e. Cross drainage culverts and take-off ditches (Figure 4.10) should be incorporated to carry water away from the road and into the surrounding vegetation, where sediments can be filtered.

Figure 4.10 *Cross drainage culverts and take-off ditches carry water away from the road and into surrounding vegetation.*

f. In addition to take-off ditches, road side ditches with long slopes may require rock check dams to reduce water velocity in the ditch, control erosion, and prevent sedimentation of nearby watercourses.

g. Where the topography does not permit the construction of take-off ditches, settling ponds should be used to trap sediment and prevent sedimentation of nearby watercourses.

h. A regular maintenance program is necessary to keep ditches in good working order. Sediment has to be removed from rock check or filter fabric dams; these structures may have to be adjusted or repaired; and additional stabilization may be necessary. In addition to regular inspections, all ditches and structures should be inspected after heavy rainfall or during periods of sustained precipitation.

i. Temporary ditches should be filled and vegetated when no longer required.

4.1.5 Stabilized Site Access

Significant releases of sediments to drainage systems and receiving waters can be caused by site access development. Site access road construction requires the removal of vegetation, which exposes soils to erosion. Improperly designed drainage ditches can aid in transporting sediments to nearby watercourses. When addressing potential erosion/ sedimentation control issues associated with site access, the following guidance is provided:

a. Construction of site accesses should be restricted in number and to locations that will serve as permanent access after development.

b. Access to a construction/ development site should be covered with a layer of clean stone/granular material.

c. When transporting excavated materials from the site, care should be taken to minimize the dropping of loose soils in the form of dust or mud from wheels, tracks, and undercarriages of equipment.

4.1.6 Straw Barrier/Bale Structure

Straw barrier/bale structures should be installed in runoff paths and other possible locations of concentrated flow to inhibit the migration of erodible soils. The number and spacing of bales will depend upon the nature of the construction operations; however, these structures are effective at controlling sediment close to the source. When utilizing straw barrier/bale structures, the following guidance is provided:

a. Straw barriers should not be used in natural watercourses.

b. These barriers are short-term measures and are effective only when treating runoff from very small drainage areas (less than 1 ha).

c. Straw barriers can be used in shallow ditches or along the side of waterways or property boundaries during construction of other erosion control measures.

d. Straw barriers should be staked into the ground to ensure stability.

e. The maximum life is approximately 3 months, and may be consid erably less under wetter conditions and successive storms.

f. Accumulated sediment should be removed regularly and disposed of in an appropriate manner (e.g. a landfill approved by the appropriate regulatory agency) to prevent entry into the aquatic environment.

4.1.7 Matting and Vegetation

Temporary matting, such as jute mat, glass fibre mat, polyethylene sheeting, woven paper mat, and vegetative mat (commonly called erosion control blankets), is used to provide stabilization for the surface of steep slopes and ditches, and to protect newly-seeded soil from erosion. These mats act as mulch to hold moisture in and allow grass to grow through (Figure 4.11). The mats absorb raindrop impact, reduce runoff velocity, improve infiltration, bind soil particles with roots, and provide immediate erosion control until permanent vegetation can be established.

Vegetative matting prevents erosion.

The rapid establishment of a vegetation cover is generally recognized as the most effective form of surface erosion control. Seeding, hydro-seeding, sodding, shrubs, and/or small trees or vegetative mats are some natural forms of stabilization methods that offer permanent surface protection.

When utilizing matting and vegetation as forms of erosion control, the following guidance is provided:

a. When immediate protection is required or other protective mea sures are not feasible, polyethylene sheeting or tarps can

be used. Sheeting or tarps should be well anchored and repaired immediately if maintenance is required.

b. If a biodegradable pre-seeded erosion control mat is used, the mat should be stapled to the soil surface and anchored at the top.

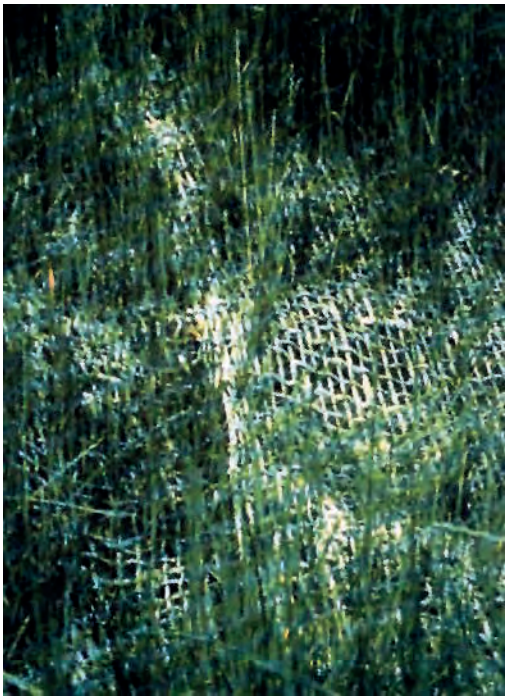


Figure 4.11 *Temporary matting provides erosion protection for newly-seeded areas. Moisture is held in and grass grows through the mat.*

c. When seeding, soil surfaces should be rough. Areas should be covered with mulch immediately after seeding.

d. Selection of the type of vegetative cover depends upon the amount of surface water runoff across the disturbed area. Vegetative protection may be ineffective unless seepage is controlled. Site conditions and time of year should also be considered when selecting the most appropriate type of vegetative cover.

e. Hydro seeding should be carried out as soon as possible after completion of the surface preparation. Final preparation of slopes and other exposed earth should be done as cut and fill

areas are completed, to enable seeding to be done in stages as work progresses.

f. Sods should be appropriately staked in.

4.1.8 Grading

Temporary graded areas should be protected from erosion through the use of straw mulch and/or polyethylene tarps in non-traffic areas and a gravel cap in zones of construction traffic. Final graded or landscaped areas should have the appropriate permanent surface protection or landscaping in place as soon as possible. Guidance on grading is provided below:

a. Grading work and disturbed/ exposed soil should be stabilized and completed as early during site development as possible.

b. To the extent possible, cuts and fills should be kept on as flat a slope as possible (e.g. less than 2 horizontal to 1 vertical).

c. Terraces can be used to form a series of diversions down a slope or to change a steep slope to a series of smaller ones.

4.2 Streambank Stabilization

Streambanks are composed of a variety of materials (such as sand, soil and gravel) that are easily erodible when exposed or disturbed by construction activities (Figure 4.12). Streambank erosion can result in the deposition of large amounts of sediment into the freshwater environment. Sedimentation can have a variety of negative effects on fish and fish habitat, such as damaging fish gills, smothering eggs and infilling important spawning habitat. Streambank stability is maintained in a natural state by the living network of roots and vegetation. Disturbed areas require additional stabilization measures to ensure that bank slopes are stable and resist erosion.

Stabilization prevents erosion and sedimentation.

Figure 4.12 *Development activities can de-stabilize streambanks, resulting in streambank erosion and considerable sedimentation of watercourses.*

In general, efforts to stabilize streambanks should consider the following:

- Stabilize or rebuild disrupted streambanks as quickly as possible after disturbance. Shape streambanks so that the bank slope is stable and conforms to the existing topography.
- Streambank stabilization should not result in a decrease in the cross sectional width of streams. Place stabilization materials outside the wetted perimeter of the stream, from the toe of the bank slope to a height on the streambank equal to the anticipated high water level (or to the top of the bank slope, as appropriate).
- The effectiveness of stabilization can be increased if bank slopes are supplemented with the planting of vegetation such as grasses, corduroy and brushmats, small shrubs, etc. together with the placement of stabilization materials.
- Exercise care when stabilizing the outside bends of meanders since such areas are subject to increased erosion pressures.

To protect against the potential impacts of sedimentation resulting from a disturbed streambank, stabilization techniques should be

used in combination with erosion/ sedimentation control measures. (Figure 4.13).

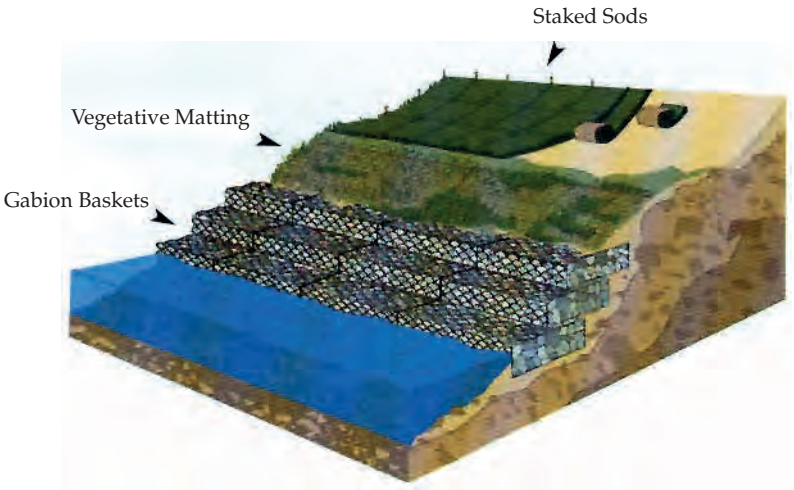


Figure 4.13 *Examples of stabilization techniques.*

Sections 4.2.1 through 4.2.4 provide guidance on streambank stabilization (i.e. riprap, gabions, geotextile and timber cribwork). When using manufactured stabilization materials, manufacturer's specifications should also be consulted. Further, some erosion control measures (e.g. matting) also provide stabilization. Section 3.0 of this document should be consulted to determine the information required by DFO for review of proposed developments.

4.2.1 Riprap

Log and rock riprap are utilized to stabilize eroding streambanks. Riprap should be used only when vegetation cannot provide adequate bank support. The type of riprap used depends on the individual situation and the availability of materials (Figure 4.14).

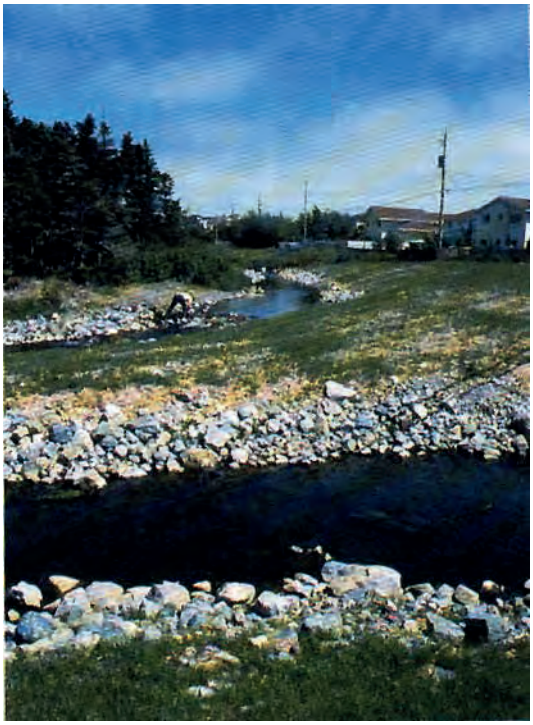


Figure 4.14 *Rock riprap prevents erosion.*

When utilizing riprap for stabilization, the following guidance is provided:

a. Rock riprap should be of a blocky, angular shape, rather than elongated or round.

b. Rock riprap should be comprised of a mixed gradation so that smaller stones fill the voids between the larger ones to provide compaction and stability. A layer of filter stones may be required depending upon the type of underlying soil and the size of the protective riprap.

c. Typical riprap stone sizes that may be used for various stream flow velocities are highlighted in Table 4.1. (Buchanan et. al. 1989).

d. Rock riprap should not be used for banks exceeding 3 m high and a grade of more than 2:1. (Buchanan et. al. 1989).

Table 4.1 *Riprap Stone Sizes for Various Stream Flow Velocities.*

Stream Flow m/sec	Mean Stone Diameter (mm)
less than 3.0	200 - 460
3.0 - 4.0	200 - 770
4.0 - 4.60	500 - 1220

e. Rock riprap should be clean, free of fine materials, and of sufficient size to resist displacement during peak flood events.

f. Log riprap can be used in streams with a low to moderate gradient, with light to moderate flooding and where the bank requiring stabilization is not more than 1.0 m high.

4.2.2 Gabions

Gabions, gabion baskets, or gabion mats are pre-constructed steel wire type baskets filled with rocks. Gabions are used to protect streambanks from the erosive action of stream flow and to provide retaining wall support for an unstable soil bank. To prevent toe failure along a streambank, a line of gabion baskets built at the mean stream level can act as a protective apron or form a gabion mattress. This technique can be used when slopes are too steep for riprap stabilization techniques. When utilizing gabions for stabilization, the following guidance is provided:

a. Gabions should be used for stabilization on streambanks less than 3 m high, with the flattest possible bank slope greater than 2:1 and when there are no suitable sizes and types of rock available for rock riprap.

b. Gabions can be used as an alternative to riprap where bank slopes are not at a stable angle of repose.

c. Gabions must be embedded or buried in the substrate to protect against anticipated scour.

d. A seepage drain should be installed if there is a seepage problem. A filter fabric can be used if the existing bank material is not granular; however, granular material should be placed between the filter and the gabion basket or mat.

e. Gabions should be tied into the streambank to ensure stability. Gabions should be terraced to form "steps" up the side of the streambank (refer to Figure 4.13).

4.2.3 Geotextiles

Geotextile filter fabrics are used to serve as a soil stabilizer, allowing water to flow through the lining, while preventing underlying soil from being washed away. The type of geotextile material used is site-specific and takes into consideration factors such as soil type, hydraulic conditions, and construction conditions and techniques. When choosing and installing geotextiles, professional advice (e.g. soils engineer or manufacturer's representative) and manufacturer's specifications should be considered. Guidance on the use of geotextiles is provided below:

a. Geotextile should be laid by running up and down or across the slope to be stabilized. Adjacent rolls of geotextile should be overlapped (minimum 300 mm).

b. Pins may be required to secure geotextile on steep slopes.

c. Rips or tears in geotextile should be repaired by placing a new piece of geotextile over the torn area. The new piece of geotextile should extend beyond the rip or tear (minimum of 1m).

d. When installing geotextile, care should be taken to ensure that material is laid or rolled into place, rather than dragged. When geotextile is dragged, exposed soil can smear the material and decrease filtering properties.

4.2.4 Timber Cribwork

Timber cribs are used as erosion control/ stabilization structures. When utilizing timber cribwork, the following guidance is provided.

a. Material used to fill a submerged timber crib structure should be free of fines or sediment; suitable materials may include clean blasted rock or boulders (Figure 4.15).

Figure 4.15 *Infill materials for timber cribs should be blocky, angular and free of fines or sediment.*

b. Material should never be removed directly from any water-course, from any shoreline, or from any streambank area for use as ballast.

c. Shoreline or streambank disturbance should be restricted to the immediate work area. Disturbed shorelines or streambanks should be stabilized.

d. Untreated wood or pressure treated wood is recommended for use in or near freshwater environments (Figure 4.16). Manually applied wood treatments may also be used. Freshly treated preserved wood should be avoided. The appropriate regulatory agencies (Environment Canada) should be contacted regarding the use of wood treatment products, weathering,

and the location of treatment sites for manually applied preservatives.

Figure 4.16 *Untreated or pressure treated wood should be used for timber crib construction.*

e. Regular maintenance should be carried out on timber cribs to prevent collapsing and possible shifting of the crib or ballast. Any timber crib material moved by ice or wave action should be recovered.

4.3 Watercourse Crossings

Stream crossings should be installed to ensure provision of fish passage and habitat protection.

During the course of projects such as exploratory drilling, forest harvesting, mining, hydroelectric developments, or works associated with linear development (e.g. transmission lines, road construction, etc.), it will often be necessary to cross watercourses (Figure 4.17). Any watercourse crossing has the potential to alter the existing natural flow regime for the entire range of flow conditions. Improperly installed crossings (i.e. culverts, bridges, etc.) can result in impeded fish passage and/or the alteration, disruption or destruction of fish habitat. In addition to addressing *Fisheries Act* related issues, other applicable legislation (eg. *Navigable Waters Protection Act*, etc.) should be addressed.

(a) Bottomless arch installation.

(b) Permanent bridge.

(c) Portable temporary bridge.

(d) Fording.

Figure 4.17 *Methods of watercourse crossings. (a) bottomless arch installation; (b) permanent bridge; (c) portable temporary bridge; and (d) fording.*

The preferred option for mitigation of the potential adverse effects of watercourse crossings is avoidance of crossing where possible. In general, with respect to watercourse crossings, the following guidance is provided:

- Plan linear development routes so as to minimize the number of crossings, avoid wetlands or floodplain areas, and maintain substantial buffer strips along watercourses.
- When selecting a site for a proposed watercourse crossing, examine the physical characteristics of the watercourse and associated drainage basin to identify the site that will provide the best features and conditions for the crossing.
- Crossing sites should be located where the stream is straight, unobstructed and well-defined.
- Where possible, crossings should be at right angles to streams. Watercourse crossing structures should be installed in advance of other road construction activities.

- Crossing sites should be placed where stable geological and soil conditions exist and a minimum of scour, deposition or displacement of sediments are expected to occur at or near a crossing.
- Crossings should be located away, and preferably downstream, from areas such as fish spawning sites or water use intakes. If a crossing must occur in the vicinity of sensitive fish habitat, a bridge with a high approach, rather than a culvert, should be used to limit disturbance to the channel.
- Crossings should be constructed where possible effects on other existing bridges and hydraulic structures can be avoided and where it is possible to minimize the risk of damage from environmental hazards such as floods or landslides.
- The type of crossing structure selected and the design of the crossing structure should consider natural site features, hydraulic conditions at the site, hydraulic performance needs and the relative amount of environmental disturbance with each type of installation.
- Construct approaches to watercourse crossings with erosion resistant materials, and keep approach grades to a minimum for at least 15 m on each side of a watercourse.
- Crossing structures that maintain natural watercourse bottom and hydraulic conditions (e.g. bridges, bottomless arch culverts) are preferred over structures that alter fish habitat, flow regime, and constrict watercourse width.
- All of the environmental considerations and mitigative efforts involved in watercourse crossings apply to watercourse crossings by all-terrain vehicles, or other such vehicles.

Sections 4.3.1 through 4.3.5 present specific guidance related to types of watercourse crossings (i.e. fording, bridges, culverts, underground watercourse crossings, and causeways). Section 3.0 of this document should be consulted to determine the information required by DFO for review of proposed developments.

4.3.1 Fording

Under certain circumstances, properly designed fords may be used as watercourse crossings. The use of a fording site is usually limited to periods when low flow conditions prevail and the number of crossings at the fording site is restricted. Fording must be kept to a minimum and if repeated fording at one site is anticipated then the use of temporary bridges or permanent crossing structures is required (Scruton et. al. 1997). The appropriateness of fording may depend upon the type of vehicle using the site. While vehicles with low pressure tires may ford a stream with little disruption, tracked machinery may result in considerable environmental damage and as such may not be generally suited for fording watercourses (Figure 4.17(d)). The appropriate Area Habitat Biologist should be contacted regarding sensitivities concerning the habitat and habitat utilization of various fish species in the proposed fording area (See Appendix A).

When fording, the following guidance is provided:

a. Fording must be avoided in potential spawning areas.

b. Fording sites should be situated where streambanks are stable and where approaches to the crossing have low slopes. Steep or unstable slopes should be stabilized to prevent erosion.

c. Fording sites should be selected on a site specific basis after a survey of the stream. Where possible, fording should be scheduled to avoid potential adverse impacts on spawning activities, spawning habitat, egg incubation, and fish migration.

d. Fording sites should be situated in areas of instream bedrock outcrop, or stable streambed substrate.

e. Crossings should be restricted to a single location and should occur at right angles to the stream to minimize disturbance.

f. Fording sites should be prepared and used during low flow conditions.

g. Approaches to the fording site should be stabilized using non-erodible materials such as corduroy, brush mats, or clean stone materials.

h. Equipment should be mechanically sound to avoid leaks of oil, gas, and/or hydraulic fluids.

i. Fording sites should be monitored to ensure that approaches to the site are not eroding and substrate is not being disturbed to the extent that obstructions to fish passage are created.

j. When a fording site is no longer required, the stream channel and banks should be restored to original condition. Any wheel ruts or other damage that may cause sedimentation in the stream should also be repaired.

4.3.2 Bridges

Bridges are the preferred crossing structure for all crossings, for areas where ice blockage or rapid runoff may cause the structural failure of a culverted crossing, as well as for any watercourses that support anadromous (sea-run) and/or resident fish populations. A well-designed bridge allows for a natural stream bottom at a crossing site and should not result in any increased water velocities that may impede fish passage or cause stream bed scour (Figure 4.18). When utilizing bridges for watercourse crossings, the following guidance is provided:

a. Bridges should be located on straight sections of a stream, where the stream channel is narrow, having low banks and firm, non-erodible soils.

b. Concrete aprons under bridges are not recommended since fish passage can be impeded at low flows.

c. Bridge abutments should be located outside the wetted perimeter of the stream.

d. Instream piers should be aligned with the stream flow; where necessary, streambank protection should be provided.

Bridges maintain natural stream habitat.

Figure 4.18 *A well-designed bridge allows for a natural stream bottom at a crossing site.*

e. Equip bridges with wing-walls to prevent bank erosion.

f. Instream work (i.e. abutment construction) should be scheduled to avoid potential adverse impacts on spawning activities, spawning habitat, egg incubation, and fish migration. The appropriate Area Habitat Biologist should be contacted regarding sensitivities cocerning the habitat and activities of various fish species in the proposed work area.

g. All instream works should be carried out in the dry and in such a manner that no harmful substance (e.g. lime, cement or fresh concrete) enters the water.

h. Fill material for bridges should not be taken from stream beds, banks or riparian areas.

i. To the extent possible, bridges should not be replaced with other structures (e.g. culverts).

j. Where it becomes necessary to demolish or remove a bridge every effort should be made to avoid "dropping the bridge" into rivers/streams. This could be done by "sawing" appropriate sections of the bridge and using cranes to lift these sections or by constructing a platform onto which the bridge could be dropped. Disturbed areas should be stabilized to prevent erosion.

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.

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

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:

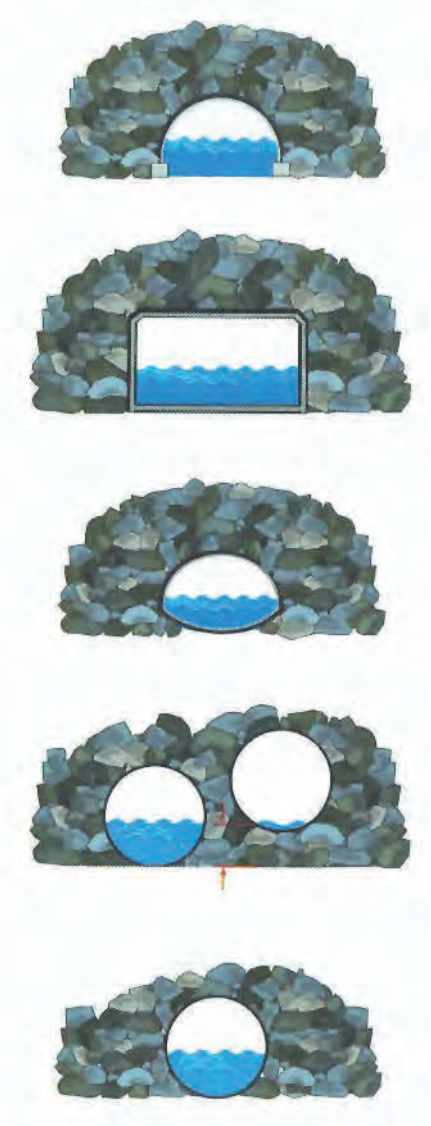
a. Improperly selected and sized culverts can become obstructions to fish migration and can cause upstream flooding. Culvert size should be based on the capacity to handle peak flows. It may be necessary to have a hydrologic and hydraulic analysis performed in order to determine the correct size culvert 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

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



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.

Figure 4.19 *Culvert Shapes*

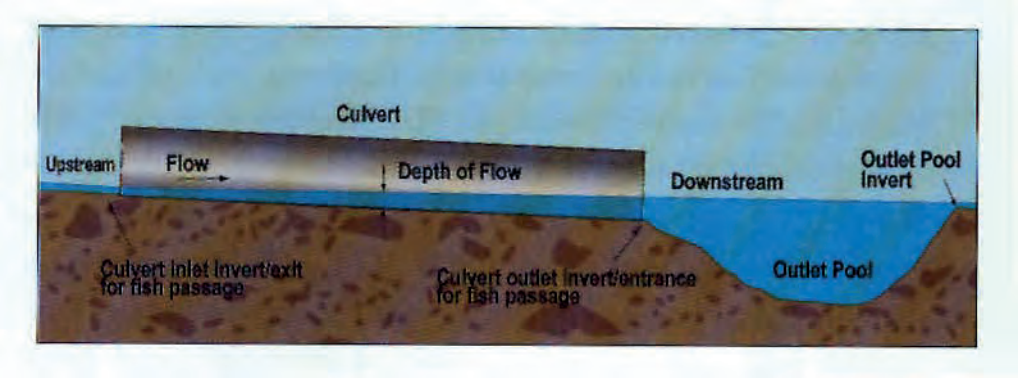


Figure 4.20 *Illustration of General Culvert Terms.*

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).

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

1. 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.

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).

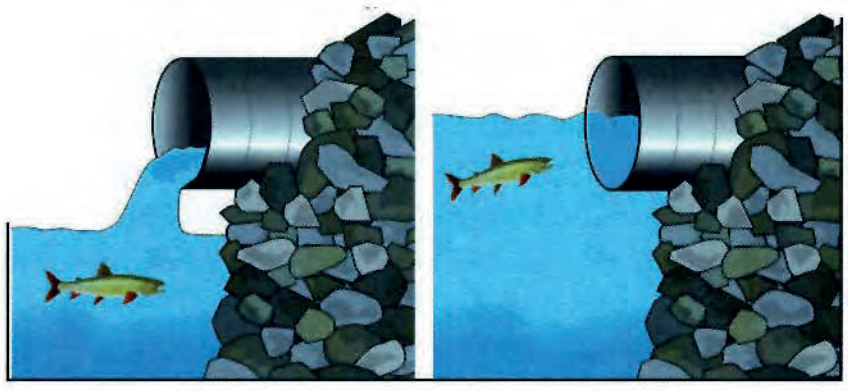


Figure 4.23 *Perched Entrance and Properly Installed Culvert Entrance*

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.

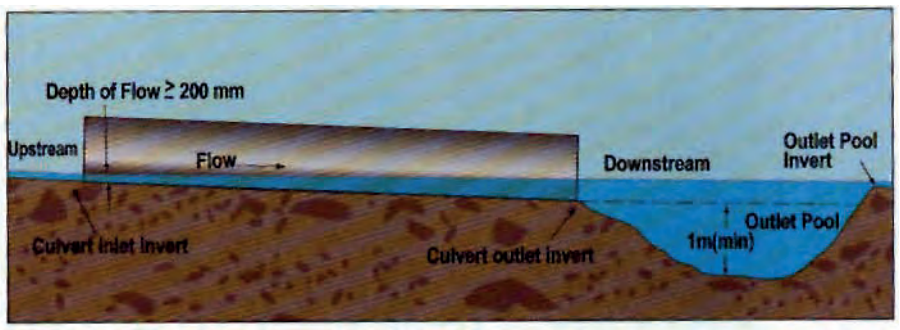


Figure 4.24 *Culvert Installation Showing Downstream Pool to Maintain Minimum 200 mm Water Elevation Throughout Culvert.*

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. Depend-ing 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).

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.

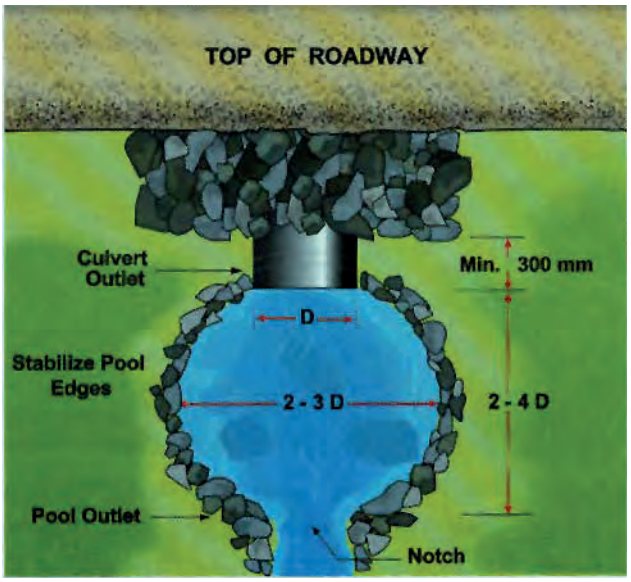


Figure 4.25 *Recommended Pool Dimensions.*

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.

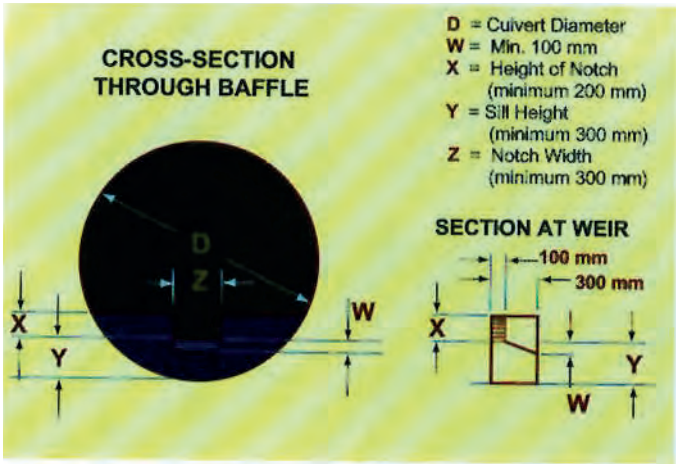


Figure 4.26 *Baffle Sizing.*

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).

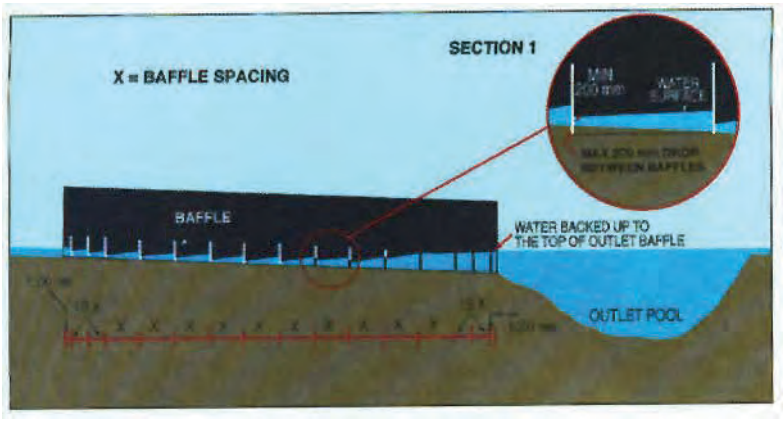


Figure 4.27 *Culvert Baffle Spacing Requirements.*

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

using a topping of clean, non-erodible materials containing a minimum of fines (Figure 4.28).

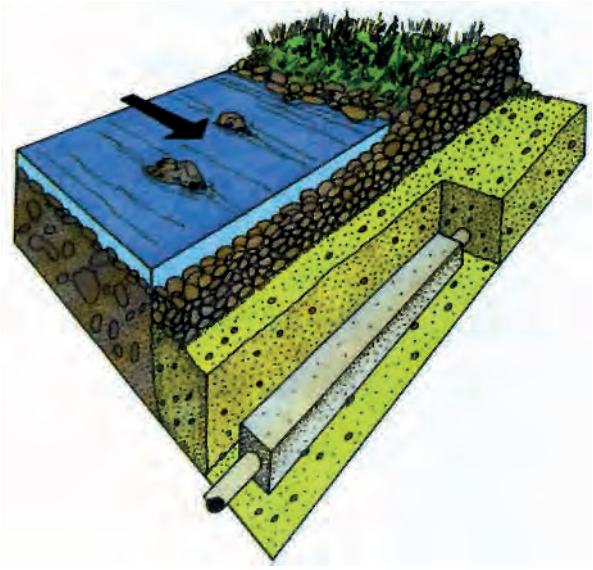


Figure 4.28 *A properly installed underground stream crossing is constructed in the dry, backfilled and topped with appropriate substrate to retain the original characteristics of the stream bottom.*

c. The materials used for the "topping" in the crossing area should be consistent with the material substrate of the stream in this area and should be large enough to resist displacement by peak flows.

d. Once the stream crossing has been properly completed and the crossing area sufficiently stabilized, regular maintenance is usually not required unless site specific problems arise; any subsequent requirements for excavation should be carried out as described above.

e. Streambanks and approaches to or from crossing areas disturbed as a result of underground crossing construction activities should be stabilized immediately after the crossing has been completed.

f. Excess materials resulting from stream bed/streambank excavation should be disposed of or stockpiled so as to prevent entry into any watercourse.

4.3.5 Causeways

A causeway for linear development should only be constructed when alternate routes prove to be unfeasible. If causeway installation is necessary, the causeway should cross the shortest possible length of the water body or wetland area.

When constructing a causeway, the following guidance is provided:

a. Avoid infilling small wetland areas.

b. Avoid causeway construction at the peak of fish migration and schedule construction so as not to interfere with sensitive periods of aquatic species life cycles.

c. Structures required for the maintenance of fish passage and flow of water (e.g. culverts) should be installed during, rather than after, causeway construction. This will eliminate the need for future construction activities in the area.

d. Design causeways and associated culverts to permit fish passage over the full range of natural flows. Causeway openings should have sufficient clearance to handle peak flows without interference to fish movement.

e. Causeways should be built in areas with a solid, stable bottom to prevent shifting of bottom substrate and subsequent lifting of the watercourse bottom in areas adjacent to the causeway.

f. Instream use of heavy equipment should be minimized. Equipment should be operated from dry, stable areas, such as the advancing causeway fill material.

g. Use causeway construction materials such as clean granular fill material, boulders, blasted rock, and armour stone.

h. Protect causeway embankments against erosion due to waves, ice and currents. Armour stone or rip-rap should be provided for in such areas.

Avoid causeway construction to the extent possible.

4.4 Site Preparation, buffer Zones and Abandonment

Buffer zones of undisturbed vegetation should be maintained around aquatic environments.

When carrying out activities associated with the preparation and abandonment of development sites, fish habitat protection should be considered. Site preparation activities, such as clearing and grubbing, can release sediment into nearby watercourses, resulting in damage to fish and fish habitat. Much of the impact of site preparation activities can be reduced or eliminated by a preliminary site visit, the development of an erosion control program and the implementation of proper site preparation procedures. Buffer zones should always be considered prior to the preparation of project sites, since these areas provide considerable protection to adjacent watercourses from the impacts of nearby activities. Upon abandoning a project site, consideration should be given to the provision of long-term erosion protection and the proper removal of roads, ditches and stream crossing structures. General considerations for site preparation, buffer zones and abandonment are:

- Site reconnaissance should be undertaken early in project planning stages to identify the location of watercourses and fish and fish habitat in relation to the proposed development.
- The activities to be carried out at the site should be identified in the project planning stages to ensure that adequate buffer zones are maintained between watercourses and the development site.
- Abandonment plans should be considered early in the project development. Planning of abandonment activities in these early development stages will ensure that the abandoned site is returned as closely as possible to pre-development conditions.

The project description and associated mitigation measures to be implemented should be discussed with DFO. Sections 4.4.1 through 4.4.4 provide detailed guidance on site preparation, buffer zones and abandonment. Section 3.0 of this document should be

consulted to determine the information required by DFO for review of proposed developments.

4.4.1 Stockpiling

Material stripped from a construction site during site preparation is often stockpiled. Stripping involves the removal of topsoil and overburden before the construction of an access road or facilities. Topsoil and organic material are often kept at the construction site for use in revegetation following the completion of construction activities. Stockpiled overburden material is often removed from the site and should be disposed of at a landfill approved by the appropriate regulatory agencies. Guidance on stockpiling is provided below:

a. All stockpiles should be easily accessible, located on well drained ground, and separated from watercourses by a minimum distance of 50 m.

b. A working space of at least 5 m around stockpiles is recom mended.

c. Topsoil and organic material should be stored in low (e.g. 1 to 2 m high) stable piles to decrease compaction effects. When stored for extended periods, these materials should be vegetated to minimize nutrient loss and erosion of fines.

4.4.2 Buffer Zones

Buffer zones should be maintained along watercourses for erosion protection (Figures 4.29 and 4.30). The width of the buffer will depend on soil characteristics, the steepness of the slope leading to bodies of water, the type and quality of habitat being protected, and the type of activity being buffered. Table 4.2 outlines recommended buffer zone widths for a variety of activities when carried out near water bodies. For specific details regarding buffer zones with respect to forestry operations the *"Forestry Guidelines for the Protection of Fish Habitat in Newfoundland and Labrador"* (Scruton et.

al. 1997) should be consulted. Despite differences in the design criteria, buffer zones generally function to:

- Protect riparian vegetation to provide shading, bank stability, food supply for fish, etc.
- Protect water quality by acting as a sediment trap between the watercourse and an area of significant land disturbance.
- Stop the erosion of soils, and dampen the impacts of excessive rainwater runoff and snow melt upon watercourses (i.e. reduces peak runoffs to watercourses, thereby decreasing instream erosion).

a)

b)

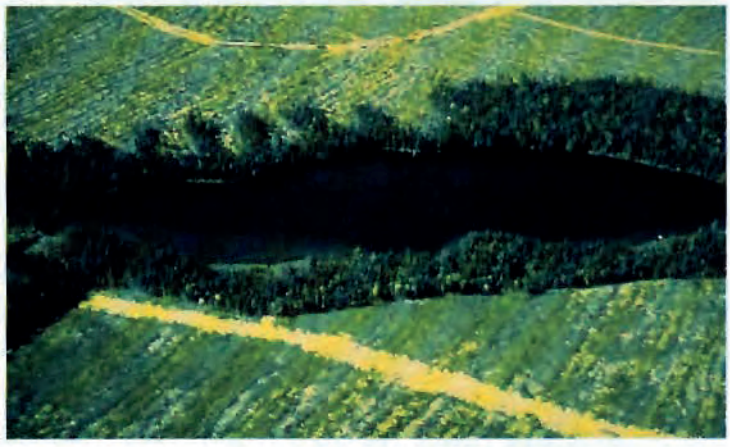


Figure 4.29 *Buffer zones of undisturbed vegetation should be maintained between watercourses and development activities.*

Figure 4.30 *Illustration of a well-maintained buffer zone.*

When planning and maintaining buffer zones, the following guidance is provided:

a. The degree of protection required for a poorly defined watercourse should be determined early in the planning stage through consultation between the proponent and DFO.

b. If a steep or unstable bank is present on one or both sides of the watercourse, the buffer zone should be measured from the top of the bank.

c. Linear facilities (e.g. transmission lines, roads, pipelines, water and sewer lines) paralleling the watercourse should be outside the buffer zone, but under some circumstances the buffer zone may be utilized to access these facilities for infrequent maintenance. If facilities require frequent maintenance, an access road should be constructed outside the buffer zone.

Table 4.2 *Recommended Minimum Buffer Zone Requirements for Activities Near Watercourses.*

Activities	Recommended Buffer Widths
1. Development around watercourses in urban or other developed areas.	15m depending upon site specific considera-tions
2. Timber Harvesting 3. Silvicultural activities involving extensive land disturbance.	Minimum of 20 m no cut buffer zone with slopes <30%. For slopes >30% use formula: 20 m + 1.5 X slope (%).
4. Resource roads and high-ways running adjacent to water bodies.	20 m + 1.5 X slope (%).
5. Piling of wood and slash. 6. Sawdust storage (sawmills). 7. Grubbing. 8. Single recreation cottage lot development.	30m.
9. Construction of site camps. 10. Fuel storage. 11. Quarries/borrow pits.	100m

Note: Site specific considerations may warrant modification of the above guidance, as deemend appropriate and in consultation with the appropriate Area Habitat Biologist.

4.4.3 Right-of-way Clearing and Grubbing

The clearing, removal and disposal of vegetation (trees, logs and brush) is often accompanied by grubbing activities, which involve the removal and disposal of roots and stumps (Figure 4.31). These activities are common practices in many construction-related operations and are important issues to address when such developments are adjacent to a watercourse. The extent of clearing and grubbing associated with creating right-of-way widths depends upon the type of project and the vegetation cover present.

Avoid debris deposition in aquatic environments.

Figure 4.31 *Right-of-way clearing and grubbing is commonly associated with many construction developments, including roads, pipelines and transmission lines.*

Guidance on right-of-way clearing and grubbing is provided below:

a. Keep right-of-way widths at water crossings to a minimum. Right-of-way widths at watercourse crossings should not exceed the minimum specified for that road class. Ground vegetation is essential to erosion control and care should be taken to minimize destruction of vegetation during right of way construction.

b. Right-of-way boundaries should be clearly marked prior to the commencement of clearing operations, particularly no-grub (buffer) zones adjacent to watercourse crossings.

c. Right-of-way cutting should not extend to the perimeter of watercourses; a buffer zone of undisturbed vegetation (Table 4.2) should be maintained for all activities adjacent to a watercourse.

d. Fell trees away from all watercourses. Leaners should be removed; slash and debris should be piled above the high water mark so that this material cannot enter watercourses during periods of peak flow.

4.4.4 Site Reclamation and Abandonment

To ensure the protection of fish and fish habitat, site reclamation for any development activity is an issue that should be addressed during the planning stage. The following guidance is provided with respect to site reclamation and abandonment:

a. All slopes of the site should be reduced as much as possible. Long slopes should be benched or terraced to interrupt the flow of water and minimize erosion.

b. Vegetative growth should be restored on all denuded areas by seeding or laying sod.

c. Once all decommissioning activity is completed and vegetation has been re-established, sediment traps (e.g. silt fences, filter fabric dams) and any accumulated sediment should be removed.

d. Ditches, settling ponds and stream diversions should be filled in and stabilized when no longer in use.

e. Fuel and hazardous materials should be removed from the area.

f. When it is determined that an access road is to be abandoned the road surface should be scarified to promote the natural regeneration of a productive forest. Surface erosion can be controlled with ditching. These ditches intercept surface

runoff and redirect runoff away from the road surface and into surrounding vegetation.

g. Upon road abandonment, bridges and culverts that require ongoing maintenance should be removed when the road is aban doned. Streambanks around the disturbed area should be stabi lized to ensure erosion protection.

4.5 Instream Work in the Dry

Instream work should be avoided, where possible. Potential adverse effects of improperly conducted instream work include sedimentation of downstream habitat and alteration, disruption or destruction of habitat at the work site. However, it is recognized that at times it may be necessary to perform instream work as part of a project development. Work is defined as "instream" when it is performed anywhere within the high water mark. This includes work outside the wetted perimeter of a stream during periods of low flow. Some potential adverse impacts of improperly conducted instream work include entrapment of fish in dry work areas, increased erosion and sedimentation and obstruction of fish passage.

Work areas should be isolated from stream flow.

When conducting instream work in the dry, the following should be considered:

- Provision of fish passage should be maintained throughout the period of instream work.
- Any fish entrapped in the dry work area should be removed and relocated to an appropriate area of the stream.
- Instream work should be scheduled to avoid potential adverse impacts on spawning activities, egg incubation, spawning habitat and fish migration. The appropriate Area Habitat Biologist should be contacted regarding sensitivities concerning the habi tat and habitat utilization of various fish species in the proposed work area.
- The duration of instream activities should be minimized.

- Substrate and/or bank material should not be removed from the stream or streambanks.
- It is preferable that instream work be carried out by heavy equipment working from dry land. Where it is necessary to have heavy equipment in waterways, such equipment should be rubber tired and free of leaks of fuel, oil and hydraulic fluids. Equipment should be steam cleaned prior to use instream. Equipment should not be serviced or washed in areas adjacent to watercourses.
- Frequent inspections of any instream structures, especially during periods of high runoff, are important to determine whether repairs or modifications are necessary to reduce any environ- mental impacts such as erosion and sedimentation.

Sections 4.5.1 through 4.5.3 provide guidance on specific methods of conducting instream work in the dry through the use of diversion channels or elevated piping in combination with cofferdams. Section 3.0 of this document should be consulted to determine the information required by DFO for review of proposed developments.

4.5.1 Cofferdams

This technique is recommended for relatively short term projects on smaller streams or during low flow periods, but can also be applied in larger rivers, ponds or lakes. Essentially, a cofferdam extends from the shore, encircles the area of the stream to be closed off and then returns to the shore. Cofferdams can be used alone to isolate work areas along stream margins from stream flow (Figure 4.32), or in conjunction with temporary diversion channels or elevated piping to create a dry work area that spans the full width of a stream (Figure 4.33). A cofferdam usually consists of a double row of sand bags with plastic between the rows. Only clean, sediment free materials should be used as fill and all bags and materials must be removed after construction is completed.

Figure 4.32 *Cofferdams can be used to isolate stream margin work areas from stream flow.*

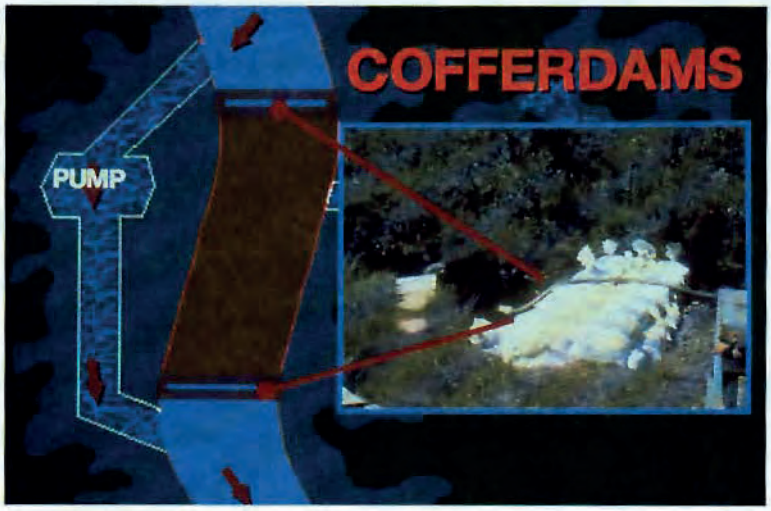


Figure 4.33 *Cofferdams can be used in conjunction with temporary diversion channels to create a dry work area.*

Cofferdams are usually constructed of a double wall of sand bags with plastic in between.

Guidance on cofferdams is provided below:

a. Consideration should be given to maintaining fish passage and downstream flow throughout the area.

b. Cofferdams should be sufficiently high to prevent overtopping in the event of sudden increases in water levels.

c. To prevent sediment from entering the stream, a pump should be used to remove sediment-laden water from the work area inside the cofferdams. This water should be treated by discharging to settling ponds, vegetated areas or sediment traps (e.g. silt fences, filter fabric dams, etc.) prior to release to streams.

d. If pumps are used to route streams around cofferdams for more than one day, the pump operation should be monitored during periods when no work is occurring at worksites.

e. Care should be taken to seal leaks in cofferdams. Sand bags damaged during the course of work should be replaced.

f. When the work is complete and the area fully stabilized, the downstream cofferdam should be removed first, followed by the upstream cofferdam.

g. All cofferdam materials should be removed from the stream and disposed of at a landfill approved by the appropriate regulatory agency, or, if possible, reused or recycled.

4.5.2 Temporary Diversion Channel

A temporary diversion (Figure 4.34) is one method used to conduct instream work in the dry. This method is usually limited only by the availability of space within which to construct a diversion. The water is diverted into an excavated stream bypass lined with plastic and secured with crushed stone. These diversions should always be excavated in isolation from stream flow, starting from the bottom end of the diversion channel and working upstream to minimize sediment production.

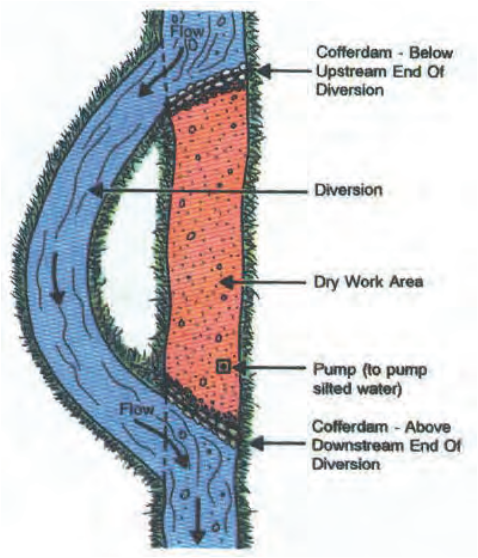


Figure 4.34 *Features of a well-constructed temporary diversion.*

Temporary diversions should be lined and stabilized

Stream diversions should commence only after prior consultation with DFO and should be completed as quickly as possible, preferably within a single day during the low flow period. Upon completion of the instream work, the stream should be restored to original configuration and stabilized to prevent bank erosion around the temporary diversion. When utilizing temporary diversion channels, the following guidance is provided:

a. Care should be exercised in the excavation of the diversion channel to ensure that the diversion is capable of accommodating peak flows from the stream that is being diverted.

b. Temporary diversions should be excavated from the downstream end toward the upstream point of diversion, where a "plug" of earth should be left to prevent the entry of streamflow into the diversion before channelization. The channel should be lined with plastic that is weighted down with crushed stone and staked into the top of the channel slopes (Figure 4.35). Once the channel has been lined and the lining secured, the "plug" of earth referred to earlier can be removed.

c. Do not direct flow into diversion channels until construction is complete. DFO and other regulatory agencies, as appropriate, should be advised of such temporary diversions.

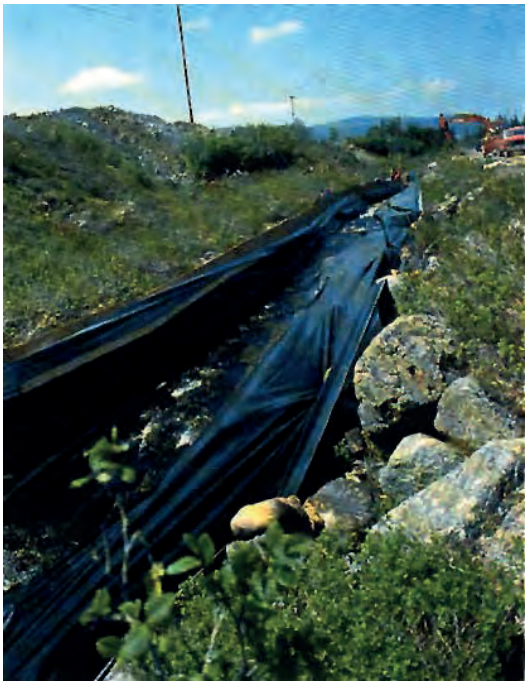


Figure 4.35 *Temporary diversion channels should be lined with plastic that is weighted down with stone.*

d. To connect a diversion channel, a cofferdam should be placed immediately below the upstream point of diversion to reroute the flow of water into the diversion. Another cofferdam should then be placed immediately above the downstream point of diversion to isolate the work area and prevent sediment-laden water from escaping into the stream. In this manner the work area is effectively isolated from the stream and instream work can proceed in the dry.

e. A pump is usually required to remove sediment-laden site water arising in dewatered work areas. This water should be treated to remove sediment (i.e. discharge to vegetated areas, settling ponds, filter fabric dams, etc.).

f. The plastic lining the diversion should be kept in good state of repair to ensure that streamflow does not get under or behind the channel liner and cause erosion of the channel banks and

subsequent downstream sedimentation. At increased water levels and velocities it may be necessary to further secure the channel liner.

g. Constant maintenance of temporary diversion channels may be required.

h. The temporary diversion should be filled in and stabilized to prevent erosion when no longer in use and any construction materials may be disposed of appropriately.

4.5.3 Elevated Piping

Elevated pipes (Figure 4.36) can be used to carry out instream work in the dry as an alternative to the use of cofferdams and pumps or in circumstances where site constraints preclude the construction of a temporary diversion.

Figure 4.36 *Elevated pipe.*

Guidance on elevated piping is provided below.

a. Use of elevated pipes should consider stream flows and the provision of fish passage. Low stream flows are most suitable for use of this technique. Further, elevated pipes may impede fish passage.

b. The inlet and outlet of an elevated pipe are usually seated on cofferdams (e.g. double walls of sandbags with plastic placed between the walls). Upstream and downstream cofferdams should be placed into the stream and the pipe placed onto the cofferdams (Figure 4.37). Additional sandbags should then be placed on top of the pipe inlet and outlet to hold the pipe in place. If more than one pipe section is necessary to carry streamflow over the instream work area then consideration should be given to the impermeability of the area(s) where the pipe sections are coupled.

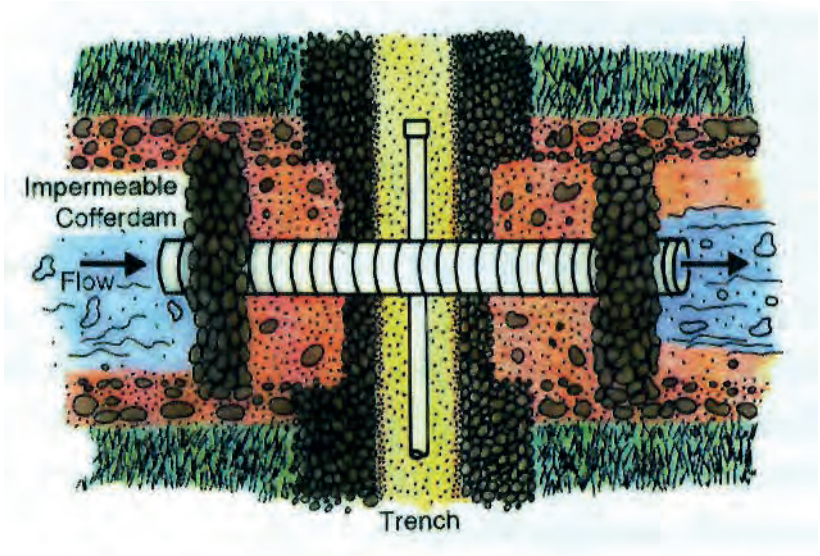


Figure 4.37 *Stream crossing dewatered by means of an elevated pipe*

c. Cofferdams should be checked periodically to ensure that water is not leaking into the work area or from the work area into the stream. Any such leaks should be repaired as soon as possible.

d. The instream work area should be fully stabilized and brought back to grade prior to removing the elevated pipe.

e. Sand bags, pipe sections, etc. should be removed upon project completion.

f. Sediment-laden water within the work area should be pumped out and treated by discharging to settling ponds, vegetated areas or sediment traps (e.g. silt fences, filter fabric dams, etc.) prior to release to streams.

4.6 Dams

Dams are frequently constructed across streams or lake outlets to create larger or deeper waterbodies or to divert streamflow for other purposes. Dams are utilized for such project activities as the creation of reservoirs, flood control to protect downstream areas by controlling release from headwater areas, forming or deepening lakes or lagoons for water supply, and diverting streamflow for industrial or recreational use.

Fish passage and maintenance of downstream flow should be addressed for dam installations.

Dams may affect fish populations by preventing normal migration between feeding, rearing and spawning areas and may have a direct physical effect on habitat. In addition, the reservoir created behind the dam may inundate incoming streams, potentially resulting in the loss of important spawning or rearing habitat. In addition to addressing *Fisheries Act* related issues, other applicable legislation (eg. *Navigable Waters Protection Act*, etc.) should be addressed. Section 3.0 of this document should be consulted to determine the information required by DFO for review of proposed developments. Guidance related to dam construction and the protection of fish and fish habitat is provided below:

a. The location and design of a proposed dam should consider fish, fish habitat, fish passage, hydrology and hydraulic conditions, and the need for provision of downstream minimum flows. Each of these issues should be detailed.

b. The extent of the flooded area and the potential for increased mercury levels should be considered.

c. Dams should be constructed in the dry with erosion and sedimentation control incorporated into construction activities.

d. Dams and approaches to dams should be stabilized to prevent erosion.

e. For systems directing or withdrawing water, a water balance of the area under varying flow regimes should be considered in terms of habitat protection, fish passage and provision of minimum downstream flows.

4.7 Water Withdrawl

Improper design and/or construction of a water withdrawal structure can result in such adverse effects as dewatering of downstream areas, obstruction of fish passage and entrainment or impingement of fish on fish screens. Water withdrawal should be planned with consideration for maintenance of downstream flows and intakes should be equipped with fish screens (screening, netting or mesh) designed and installed in such a manner as to prevent potential losses of fish due to entrainment or impingement.

Screens should be installed on water intakes

The installation and maintenance of a fish screen (Figure 4.38) at freshwater intakes is the responsibility of the proponent. This requirement is intended to limit the potential negative impacts that water extraction may have on a fishery resource, the severity of which depends upon the abundance, distribution, size, swimming ability, and behavior of fish in the vicinity of the intake. As well, water velocity, flow and depth, intake design, screen mesh size, installation and construction procedures and other physical factors need to be considered.

Section 3.0 of this document should be consulted to determine the information required by DFO for review of proposed water withdrawal. Guidance related to water withdrawal is provided below:

a. Detailed guidelines for the provision of fish screens at small-scale water withdrawals up to 125 L/s (e.g. for small

municipal, construction, irrigation and private water supply projects) can be found in the *Freshwater End-of-Pipe Fish Screen Guideline* (DFO 1995).

b. Fish screen requirements for larger-scale water withdrawals will be considered by DFO and other regulatory agencies on a site specific basis.

c. Flow regime and water balance in the area, as well as the need for provision of minimum downstream flows, when designing and constructing any water withdrawal system should be considered.

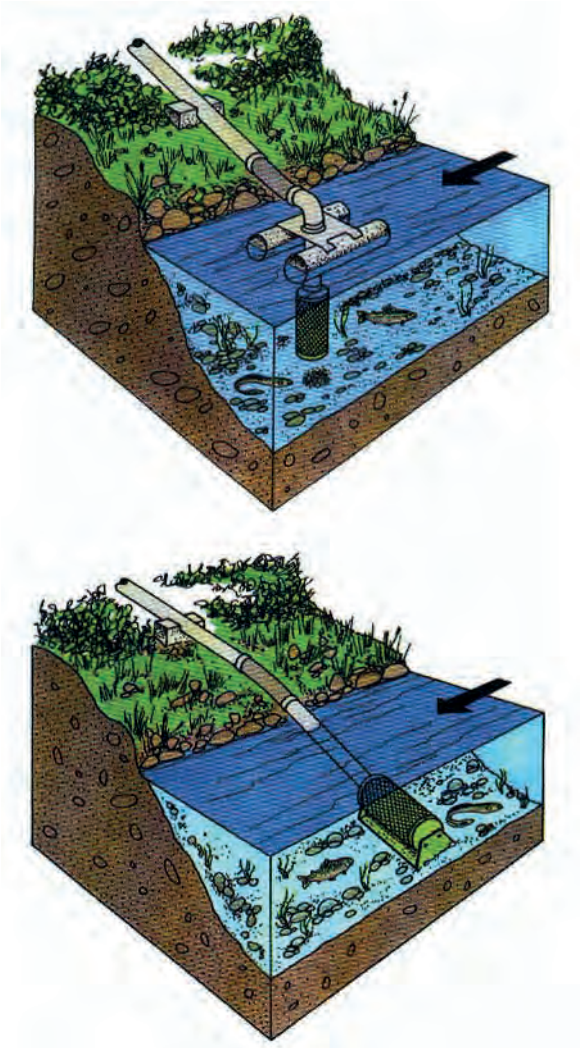


Figure 4.38 *Examples of typical applications and features of end-of-pipe fish screens.*

4.8 Stormwater Drains

Storm drains are used to conduct storm water away from developed lots, buildings and housing developments, etc. Water enters storm sewers from impervious structures such as parking lots, roads and building roofs as well as through soil percolation and inflow. Storm sewers frequently directly discharge into the nearest watercourse without any treatment or storage.

Stormwater drainage can have implications on stream basin hydrology and water quality of the receiving watercourse. An inflow of storm sewer water can change stream basin hydrology both in the rate and the quality of runoff. Rapid runoff during storms may cause bank destabilization, erosion, sedimentation, and displacement of fish. Reduced base flow conditions between storm events may decrease the amount of usable fish habitat and may cause a reduction in the standing stock of fish within a watercourse. Urban runoff can contain many contaminants including bacteria, heavy metals, road salt, sediment, pesticides /herbicides, and a variety of organic compounds such as petroleum hydrocarbons. The introduction of such substances into the freshwater environment can negatively affect fish populations.

Section 3.0 of this document should be consulted to determine the information required by DFO for review of proposed developments. Guidance on the design, installation and maintenance of stormwater drains is provided below:

a. Stormwater drainage channels should be of sufficient size to accommodate peak storm events.

b. Storm drainage outlet structures should not be constructed directly on watercourse banks, but should be constructed some distance back and a channel excavated from the outlet structure to the watercourse. This channel should be constructed so that the general orientation of storm water discharge is parallel with stream flow (Figure 4.39).

c. Sediment-laden water arising within work areas should be treated to remove sediment prior to release into a watercourse.

d. During construction, the inlets of storm sewer and drainage systems should be blocked or equipped with sediment traps (e.g. rock check dams, filter fabric dams, etc.).

Figure 4.39 *Storm drainage outlets should be connected to the receiving watercourse by a channel with orientation parallel to the flow of the receiving watercourse.*

e. All excess materials resulting from excavation of the storm drainage channel and construction of the storm water outlet should be removed and disposed of at a site approved by the appropriate regulatory agencies.

f. The channel should be lined with clean stones to reduce the velocity of the water exiting the outlet structure. This will help to avoid streambed and streambank erosion.

g. Storm drains should discharge onto riprap energy dissipators followed by a vegetated buffer zone rather than directly into a watercourse.

h. Once storm drain outlets have been properly constructed and stabilized, regular maintenance should be provided as necessary. Storm drains should be kept free of debris to avoid blockage of flow.

Avoid release of silted water from sites into aquatic environments.

4.9 Borrow Sites/Quarries and Asphalt/Cement Plants

Gravel or other materials should not be removed from watercourses and watercourse banks due to potential negative effects on fish and fish habitat. Removal of stream bed materials can destroy fish habitat and create siltation that can have negative impacts downstream. Runoff from gravel removal sites on hillsides or near small feeder streams can contribute substantial quantities of sediment laden water into a watercourse.

The location of borrow sites/quarries and asphalt/cement plants should consider local drainage patterns, fish and fish habitat, and nearby watercourses. All proposed sources of borrow material should be approved by the appropriate regulatory agencies. Borrow sites/quarries and sites for asphalt/cement plant operations should allow for:

- controlled access in and out of the pit;
- working space in which to move equipment;
- storage areas for stockpiling topsoil and overburden separately;
- space to form a final grade;
- visual screening;
- dust control by washing, etc., when required;
- space for an acceptable settling pond system(s) to remove suspended solids from any water used; and
- maintenance of a buffer zone of undisturbed vegetation between activities and natural watercourses (see Table 4.2).

Section 3.0 of this document should be consulted to determine the information required by DFO for review of proposed developments. Guidance on borrow sites, quarries, and sites for asphalt/cement plant operations is provided below:

a. No gravel or other borrow materials should be removed from watercourse banks, stream beds, or within the buffer zone (buffer zones are discussed in Section 4.4.2).

b. Materials should not be quarried from active flood plains.

c. Aggregate quarrying operations should be limited to areas above the design flood high water mark and no closer than 100 m from all watercourses. The vegetation within this buffer zone should remain undisturbed.

d. No excavations should encroach within watercourse boundaries or result in slope failure.

e. Small drainage channels should be diverted around borrow sites to avoid sedimentation.

f. Where site access roads cross a watercourse, a bridge or culvert should be installed (see Sections 4.3.2 and 4.3.3).

g. Any water withdrawal requirements for the purpose of gravel washing should be reviewed by DFO (water withdrawal is discussed in Section 4.7).

h. Runoff control devices or sediment traps (e.g. filter fabric dams, settling ponds, ditches, etc.) should be used to prevent the entry of sediment laden water into nearby watercourses.

i. The site should be appropriately rehabilitated and stabilized upon completion of quarrying, borrowing and asphalt/cement plant operations.

Blasting Plans should be developed to eliminate or minimize impacts on fish and fish habitat.

4.10 Blasting/Explosives

Blasting in or near water produces shock waves that can damage fish swim bladders and rupture internal organs. Blasting vibrations may also kill or damage fish eggs or larvae. Chemical explosives may only be used when other, less detrimental methods are not feasible, and mitigation should be implemented to protect fish and fish habitat during blasting activities that occur in or near a watercourse. Section 3.0 of this document should be consulted to determine the information required by DFO for review of pro-

posed blasting activities. Guidance on blasting activities in or near the freshwater environment is provided below:

a. Large charges should be subdivided into a series of smaller charges and time delayed to reduce the overall detonation to a series of smaller detonations.

b. For multiple charges, time-delay (e.g. blasting caps) should be used to reduce the overall detonation to a series of single explosions separated by a minimum of 25 millisecond delay between charge detonations.

c. The on-land set-back distance from the blast site to the watercourse and the set-back distance (zone) around the blast site in the watercourse are based on the maximum weight of the charge to be detonated at one instant in time and the type of fish and fish habitat in the area of the blast. Blasting activities are to take place at a minimum set distance from the watercourse as indicated in Table 4.3. A sample blasting arrangement is shown in Figure 4.40.

Table 4.3 *Minimum Required Distances From a Watercourse for Blasting (Confined Charges).*

Habitat	Weight of Explosive Charge (kg)					
	0.5	1	5	10	25	50
H1	7m	10m	15m	20m	35m	50m
H2	15m	20m	45m	65m	100m	143m

H1 = rearing/general fish habitat

H2 = spawning habitat where egg or early fish development is occurring.

d. If on-land blasts are required nearer to the watercourse than indicated in Table 4.3, then additional mitigative measures should be initiated which include, but are not limited to, the following:

(i) installation of bubble/air curtains to disrupt the shock wave. When a bubble curtain is used, the curtain should

surround the blast site and be started up only after fish have been moved outside of the surrounded area;

(ii) blasting should be undertaken at the time of least biological activity or biological sensitivity;

(iii) isolation of the work area from fish movement;

(iv) detonation of small scaring charges set off one minute prior to the main charge to scare fish away from the site; and

(v) use of noise generators to move fish out of the area.

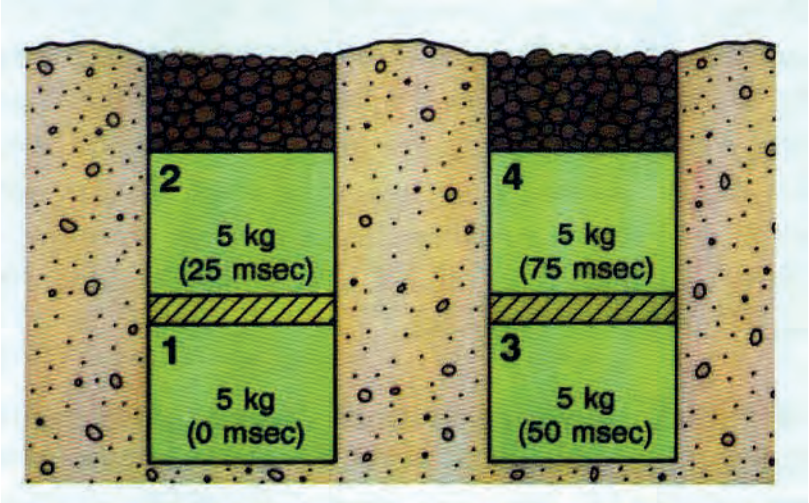


Figure 4.40 *Sample blasting arrangement consisting of: 20 kg total weight of charge; 25 msecs delay between charges and blast holes; and decking of charges within holes. As per Table 4.3, for the 5 kg weight of charge shown here, a 15 m set-back from rearing habitat and a 45 m setback from spawning habitat should be provided.*

e. To confine the blast, sand or gravel should be used to backfill blast holes to grade or to streambed/water interface.

f. Blasting mats should be placed atop the blasting holes to minimize the scattering of blast debris around the area.

g. Ammonium nitrate based explosives (i.e. Ammonium Nitrate Fuel Oil mixtures, or ANFO) should not be used in or near water due to the production of toxic by-products (ammonia).

h. All blasting and other associated equipment and products are to be removed from the blast area, including any debris that may have entered the aquatic environment.

4.11 Seismic Activities

Seismic activities are associated with petroleum exploration and ground geophysical operations in mineral exploration. As with other project developments, activities associated with seismic exploration (such as watercourse crossings, cuttings, etc.) should include the implementation of mitigative measures to address fish and fish habitat protection. Sections 4.3 and 4.10 of this document, which discuss watercourse crossings and blasting, respectively may be applicable to seismic activities. Section 3.0 of this document should be consulted to determine the information required by DFO for review of proposed development activities. Guidance on seismic activities is provided below:

a. Geophysical operations should be conducted so as to avoid sen sitive or important fish habitat.

b. Proponents should plan seismic programs well in advance and take advantage of winter freeze-up, whenever possible.

c. When commencing operations, the energy level of the output should begin at low levels and gradually increase to the operat ing range to permit fish to move away from the source of the sound without being unduly startled.

d. Appropriate buffer zones, stream crossings and erosion/ sedimentation control should be provided. Any disturbed areas should be stabilized.

4.12 Dredging

Dredging requires the removal of material from the bed of a watercourse by mechanical means and has the potential to harmfully impact fish and fish habitat. Dredging often occurs in areas where the water depth precludes working in the dry. Section 3.0 of this

document should be consulted to determine the information required by DFO for review of proposed development activities.

In order to minimize the effects of dredging in standing freshwater, the following guidance is provided.

a. Time dredging activities to avoid periods where fish may be migrating through or near the work area. Dredging at low flow periods reduce the amount of sedimentation.

b. A floating silt barrier should be installed to control sedimentation. These are impervious, floating barriers orientated vertically from the water surface to the substrate and restrict the spread of siltation from the work area to the surrounding water. The barrier should be anchored /weighted to the substrate bottom profile, be appropriately floated at the surface, and, as necessary, be fastened into the shoreline.

c. Sensitive or important fish habitat should be avoided.

Depending on the time of year, dredging activities in estuaries could interfere with the seaward or return migration of anadromous (sea-run) salmonid species. This could have implications on fish survival or on spawning success (if the dredging activities interfere with return spawning migration). Guidance on dredging in estuary regions of rivers is provided below

a. Time activities to avoid periods when migrating fish are passing through the area to be dredged.

b. Dredge on a receding tide only.

c. Dredging activities should cease when migrating fish (eg. salmon, trout) are in the dredge area in significant numbers.

d. Sensitive or important fish habitat should be avoided.

Note: An ocean dumping permit may be required if dredged material is to be disposed of in the marine environment. Environment Canada should be contacted before carrying out any dredging activities in estuaries, in order to determine if a permit is required.

4.13 Forest Harvesting and Related Activities

The growing mechanization of the logging/timber harvesting sector and the accelerated construction of access roads has increased the potential for these activities to negatively impact fish and fish habitat.

Potential adverse impacts of forestry activities on fish and fish habitat include: sedimentation resulting from erosion of exposed soils on watercourse banks; obstruction of fish movements in watercourses by deposition of logs and slash; depletion of the oxygen supply due to decomposition of organic material such as sawdust, bark, slash and sunken logs; destruction of spawning and rearing areas by the instream use of heavy equipment; leaching of fertilizers and herbicides; and destruction of streambank vegetation.

The Forestry Guidelines for the Protection of Fish Habitat in Newfoundland and Labrador (Scruton et al. 1997) should be consulted for detailed forestry-related guidelines. General guidance for forest harvesting is provided below:

- A buffer zone of undisturbed vegetation should be maintained between harvesting activities and watercourses.
- Slash, tops or any other logging debris should not be left within the high water mark of any watercourse.
- Skid trails and landings should not be located in or adjacent to watercourses.
- Watercourses should not be used for the driving or towing of logs.
- Bridges are preferred for watercourse crossings. Portable bridges can be constructed using two sections of poles and two hardwood bedlogs. The poles are lashed together at both ends with a section of chain and then placed on the bedlogs.

- Scarification of silviculture plots should be carried out parallel to the natural contours of the land. Scarification at right angles to the land will lead to erosion of unstable soils.
- Prescribed burning treatments should be carried out so as to ensure that riparian (streamside) vegetation is not burned as part of the treatment.
- In areas where fertilizers are prescribed, treatment zones should be located outside of buffer zones to prevent direct entry of fertilizers into fish habitat.

Section 4.13.1 provides guidance on fish and fish habitat protection measures that should be incorporated into the use of forwarder trails. Section 3.0 of this document should be consulted to determine the information required by DFO for review of proposed development activities.

4.13.1 Forwarder Trails

Forwarder trails are used to transport timber to roadside. When the forest floor is compacted by machinery operating on trails, the natural filtering action of the soil is destroyed. Surface water is no longer absorbed, but is collected by wheel ruts, which act as drainage ditches (Figure 4.41). As the water flows into these ruts, soil is eroded and large volumes of sediment can be discharged into nearby watercourses, damaging fish habitat and aquatic life. A forwarder trail that has been left unprotected may continue to wash out and create sedimentation problems long after the harvesting operation has been completed.

Guidance on forwarder trails is provided below:

a. The location of forwarder trails should be planned to minimize the number of watercourse crossings. Where watercourse crossings are necessary, temporary bridges should be installed.

Figure 4.41 *Wheel ruts in forwarder trails can facilitate the movement of sediment-laden water into nearby watercourses.*

b. To ensure that sediment laden water does not collect in wheel ruts and discharge into watercourses, mudlogs should be installed across trails before ruts develop. Mudlogs divert water and mud out of the forwarder track and onto the forest floor

c. Mudlogs (Figure 4.42) should be installed close to where the water is entering the forwarder trail and where the ground slopes to one side. A small earthen dam is pushed up with the forwarder blade on an angle across the trail, and a 30 cm diameter log is placed immediately in front of the dam, on the uphill side. If conditions are extremely wet, several of these logs may have to be placed along the trail.

d. If mudlogs become compacted into the ground and are no longer effective, new mudlogs should be installed.

Figure 4.42 *Mudlogs divert water off of the trail and onto the forest floor.*

e. Mudlogs should be maintained in place to ensure that surface water is intercepted and deflected into surrounding vegetation.

4.14 Linear Development

The construction of linear developments (e.g. highways, resource roads, transmission lines, pipelines, and fibre optics cable development) involves a variety of activities. Earlier sections of this document have presented fish and fish habitat protection measures for several activities that are often associated with linear developments (i.e. ditching, watercourse crossings, right-of-way clearing, storm-water drains, borrow sites/quarries and blasting/explosives). All of these sections should be consulted when planning and designing a proposed linear development.

Fish and fish habitat protection measures should he implemented for linear developments.

Due to the large number of activities involved in linear development, there are a variety of potential adverse effects that may result from poor design and construction of these facilities. Failure to consider fish and fish habitat protection measures during activities associated with linear developments can result in sedimentation of fish habitat. Blasting operations require mitigation to protect fish

from injury. Inadequately designed watercourse crossings and stormwater drains can have implications on stream hydraulic characteristics and fish passage.

When designing and constructing linear developments, the following general guidelines should be considered:

- A buffer zone of undisturbed vegetation should be maintained between linear developments and watercourses (see Table 4.2).
- Design watercourse crossings and storm drainage systems with consideration for flow regime and water balance in the area of the crossing.
- Developments should incorporate erosion and sediment control plans and all disturbed areas should be stabilized.

Sections 4.14.1 through 4.14.3 present general guidance for various types of linear development. Section 3.0 of this document should be consulted to determine the information required by DFO for review of proposed developments.

4.14.1 Highways/Resource Roads

Roads can cause negative environmental effects that degrade rather than enhance the natural environment. Unless roads are properly designed and planned, and care is exercised in construction, undesirable disturbances to aquatic environments are likely to occur (McCubbin et. al. 1990). Guidance on road construction is provided below:

a. Determine road locations during the spring when seeps and springs are most noticeable.

b. Plan the road network layout so that the number of watercourse crossings is minimized.

c. Work should not be undertaken on easily erodible materials, during or immediately following heavy rainfalls.

d. Aggregate (fill) materials for road construction should not be removed from watercourses. This includes any area within the historical floodplain of a watercourse.

e. Where road construction or associated activities (e.g. grubbing, right-of-ways, etc.) take place adjacent to a watercourse, appropriate buffer zones of undisturbed vegetation should be maintained between the road or activities and the watercourse.

f. Roads should be adequately ditched to allow for good drainage. Roadside ditches should not open directly into a watercourse but should end blindly in vegetated or forested areas. Planning and construction of ditches should be carried out early in the road development process to ensure proper drainage throughout road construction.

g. Keep ditches at the same gradient as the road, wherever possible, and design to convey peak flows.

h. Prevent ditch flow into watercourses by constructing ditch run-outs or takeoff ditches on road approaches a minimum of 30 m from watercourses.

i. Prevent flooding in wetland areas through the use of collector ditches and culverts to provide cross-drainage.

j. Frequently divert ditch flows into cross-drainage culverts to prevent erosion or overflow.

k. Provide appropriate watercourse crossing structures that consider protection of fish habitat and maintain fish passage. Bridges and culverts that require ongoing maintenance should be removed when the road is abandoned. Permanent maintenance-free structures should be left in place.

1. Inspect watercourse crossing structures prior to and during spring ice breakup. Debris caught on piers and at the entrance to culverts should be promptly removed to prevent obstruction to fish passage and upstream flooding. These regular inspections will also ensure that culverts and take off ditches are maintaining proper drainage.

m. Check watercourse crossing sites after the first heavy rain subsequent to installation to ensure that no erosion or sedimentation problems are developing.

n. Consideration should be given to regeneration of the right-of-way to make the area productive for growing trees and to prevent erosion.

o. Stabilize erosion prone cuts and fills with vegetation or other suitable material.

p. Siltation control structures, such as silt fences, filter fabric dams and rock check dams, should be installed.

q. Clean and provide regular maintenance for areas designated for sediment trapping.

r. Store all de-icing and dust-control agents in areas where these substances cannot enter water bodies.

s. The use of mechanical brush control in the vicinity of water bodies is preferred over chemical methods (i.e. herbicides). The appropriate regulatory agencies should be contacted regarding the use of any chemicals in proximity to freshwater environments.

4.14.2 Transmission Lines

Like other linear developments, the activities involved in the construction of transmission line developments (watercourse crossings, right-of-way clearing, etc.) can have negative impacts on fish and fish habitat, such as habitat destruction or alteration and sedimentation. However, when properly managed, these harmful effects can be effectively mitigated. Guidance on transmission line development is provided below:

a. Proposed transmission line routes and station locations should minimize the number of watercourse crossings.

b. Poles and towers should be located so as to minimize poten tial environmental damage and should not be located within watercourses or flood plains.

c. Right-of-way travel should be restricted to minimize watercourse crossings.

d. Watercourse crossings, including temporary bridges or fordings, should be appropriately designed, installed and implemented to provide protection of fish and fish habitat.

e. Activities associated with transmission line development (e.g. right-of-way cuttings, grubbing, etc.) should maintain an appropriate buffer zone of undisturbed vegetation from watercourses.

f. All drainage channels and watercourse banks should be left in a stable condition at the end of construction.

g. As soon as possible following construction activities, disturbed areas should be appropriately stabilized by revegetation or other means.

4.14.3 Fibre Optic Cable Development

The activities involved in the construction of fibre optic cable developments (watercourse crossings, right-of-way clearing, etc.) can have negative impacts on fish and fish habitat, such as habitat destruction or alteration and sedimentation. However, when properly managed, these harmful effects can be effectively mitigated. When planning and constructing fibre optic cable developments, the following guidance is provided:

a. Proposed fibre optic cable routes should minimize the number of watercourse crossings.

b. Underground watercourse crossings should be appropriately designed, installed and implemented to provide protection of fish and fish habitat.

c. Activities associated with fibre optic cable development (e.g. right-of-way cuttings, grubbing, etc.) should maintain an appropriate buffer zone of undisturbed vegetation from watercourses.

d. All drainage channels and watercourse banks should be left in a stable condition at the end of construction.

e. As soon as possible following construction activities, disturbed areas should be appropriately stabilized by revegetation or other means.

4.15 Mineral Exploration

Without proper planning and implementation of mitigative measures, mineral exploration activities can result in a variety of chemical and physical impacts on fish and fish habitat. Chemical pollution of the freshwater environment can result from such releases as acid mine drainage, sewage discharge and accidental hydrocarbon spills. Physical impacts can be caused by mineral exploration activities if waste rock, particulate material, sand or gravel is dumped or washed into watercourses. In mineral exploration activities, the removal of vegetation and soil overburden is often necessary to gain access to the mineral deposit; topsoil and foliage can then wash into the river resulting in siltation or obstruction of watercourses.

Common practices associated with mineral exploration include clearing and timber salvage, stripping and stockpiling, quarries and borrow areas, blasting, access road construction, watercourse crossings, and abandonment and rehabilitation. Mitigation practices associated with these activities are addressed throughout this document. Section 3.0 of this document should be consulted to determine the information required by DFO for review of proposed developments. Guidance on mineral exploration is provided below:

a. Careful planning should be undertaken to minimize the length and number of access roads/trails and watercourse crossing sites. This will help reduce potential erosion problems.

b. Water lines and access routes to drill sites should be located in areas that create the least amount of disturbance to fish and fish habitat.

c. If clearing and levelling are required, disturbed areas should be no larger than absolutely necessary.

d. Appropriate buffer zones should be maintained between watercourses and project development activities (e.g. grubbing and clearing zones).

e. If trenches are to be left open for a period of time, excavated material should be contoured and stabilized to prevent erosion and sediment entering watercourses. Trenches and ditches should not be drained directly into a watercourse.

f. Drilling wastes should not be allowed to enter watercourses.

g. If drilling is undertaken through an ice covered watercourse, all debris that is frozen into the ice/snow should be removed and discarded upon abandonment. Debris (Figure 4.43) should be discarded at a disposal site approved by the appropriate regulatory agencies. Material should not be deposited in a watercourse due to ice thaw.

h. Measures to protect fish and fish habitat should be implemented during any blasting or water withdrawal activities.

Figure 4.43 *Debris/waste from exploration activities should be removed upon project completion.*

4.16 Urban Development

Watercourses in urban areas are altered for a variety of reasons ranging from flood control to maximizing land area available for development. Roads, sewers, watermains, power lines and telephone cables cross watercourses within urban areas and, in most cases, do so more or less at random. Ideally, all developments, both residential and industrial, should be designed to retain the natural state of watercourses and to minimize stream diversions and crossings.

Mitigative techniques for watercourse crossings, diversions, dams, erosion/ sedimentation control, restoration of disturbed areas, installation of water intake structures, and other urban development related activities are addressed in previous sections of this document. Physical habitat concerns associated with urban development include erosion, sedimentation, loss of riparian vegetation and obstruction of fish passage. The implications of urbanization on water quantity and quality should also be considered in addressing and implementing measures to mitigate potential impacts on fish and fish habitat.

Section 3.0 of this document should be consulted to determine the information required by DFO for review of proposed developments. General guidance for urban development include:

- Buffer zones of undisturbed vegetation should be maintained between watercourses and development areas.
- Erosion/ sedimentation control, runoff management and stormwater drainage systems should be incorporated into any development plan.
- Urban road routes should be designed so as to minimize the number of watercourse crossings required.

4.17 Hydroelectric Developments

There is an increasing demand in Newfoundland and Labrador on available streams and rivers that can be used for hydroelectric development. Activities associated with hydroelectric developments (dam construction, flooding/ inundation, dewatering, etc) can have a negative impact on fish and fish habitat. Depending on the capacity of the storage basin and the quality of flows that are being diverted, the construction and operation of a hydroelectric facility can have the following impacts:

- Disruption of the existing hydraulic regime.
- Obstruction of fish passage.
- Water quality upstream and downstream of the dam may be degraded (increase in the bioaccumulation of mercury by fish) due to stagnation of the reservoir/ headpond.
- Increase in water temperature upstream caused by interrupted flow and possibly an increase downstream due to a reduced volume of water present.
- Interruption of the food chain by the retention of nutrients in the reservoir/ headpond area.
- Loss of habitat due to the conversion of upstream free flowing water to a headpond or reservoir and inadequate flows downstream of the structure.

When planning, operating or constructing hydroelectric developments, the following guidance is provided.

a. Maintenance /minimum flows should be provided downstream during construction of the dam and filling of the reservoir dependent ultimately on the sensitivity of the downstream fish habitat.

b. Appropriate minimum flows should be determined based on the appropriate instream flow needs methodologies and in consultation with DFO and other appropriate regulatory agencies (Jacques Whitford Environment et. al. 1996c,1997).

c. Detailed hydrological information (mean monthly flows, mean annual flows, daily flows, flow duration information, water levels, runoff characteristics, etc.) should be used to assess the potential impacts upon fish, fish habitat, stream morphology, and hydrology.

d. Trees should be cut to approximately 10 centimetres above the ground and removed from the area to be flooded. Grubbing should not be carried out.

e. All exposed erodible surfaces should be stabilized against erosion before the reservoir/ headpond is flooded.

f. The predicted flushing rate of proposed headpond or reservoir should be determined to address the bioaccumulation of mercury by resident fish.

g. Impacts of the entrainment/impingement of fish into the intake- and trailrace should be determined and mitigated by using an intake screen or other appropriate methods.

h. The quantity and quality of fish habitat which may be impacted by flooding, dewatering and altered flow regimes should be determined. The fish species which utilize these habitats should also be identified. This information should be used to address DFO's No Net Loss guiding principle of DFO's *Policy for the Management of Fish Habitat*.

i. Provision of fish passage via provision of appropriate flows, installation of a fishway, etc. should be addressed, as appropriate.

j. Measures to mitigate siltation and provide erosion control should be implemented.

Fish and fish habitat protection measures associated with linear developments such as transmission facilities and access roads associated with hydroelectric developments should also be addressed.

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6.0 Glossary

Alevins: The newly hatched salmon with yolk sac still attached.

Anadromous: Fish which migrate to freshwater to spawn but live all or part of adult life at sea.

Baffle: A barrier or obstruction that deflects, checks or dampens water flow. Culvert baffles are flow interference structures usually in the form of low weirs.

Ballast: Broken stone, gravel, slag, or similar material used to fill timber cribwork.

Bank: The rising ground bording a stream channel.

Bed Load: Sediment moving on or near the stream bed and frequently in contact with it.

Berm: Mound of earth that can be used to direct or divert surface water.

Buffer Zone: Undisturbed border of vegetation (trees, shrubs, grass, etc.) along a stream or pond which isolates and protects the aquatic environment from nearby construction activities.

Checkdam: Impermeable dam constructed within a ditch to reduce water velocity, retain sediment, and prevent erosion.

Cofferdam: An impermeable barrier consisting of a double wall of sand bags with plastic in between. Used to isolate disturbed work areas from adjacent streams or ponds, or to divert flow.

Culvert: A fibreglass, metal, concrete, plastic or wooden conduit used to pass water under an access route.

Culverts are used to provide permanent or temporary access across a watercourse.

Deleterious Substance: Any substance that, if added to any water, would degrade or alter or form part of a process of degradation or alteration of the quality of that water so that it is rendered or is likely to be rendered deleterious to fish or fish habitat or to the use by man of fish that frequent that water.

Dissolved Oxygen: The concentration of oxygen dissolved in the water, expressed in mg/L or as percent saturation, where saturation is the maximum amount of oxygen that can theoretically be dissolved in water at a given altitude and temperature.

Entrainment: Occurs when a fish is drawn into a water intake and cannot escape.

Erosion: The process of soil and rock weathering caused by natural means (e.g. water, wind, ice, etc.) or byconstruction related disturbance.

Filter Fabric: Synthetic fabric used to remove suspended sediment in runoff from disturbed work areas; also used in the construction of some bank stabilization structures to prevent erosion.

Fisheries Resource: Fish stocks or populations that sustain commercial, recreational or subsistence fishing activities of benefit to Canadians.

Flocculant: Chemical additive that holds minute suspended particles together.

Flood Plain: Flat land bordering a stream that is subject to flooding during high water events.

Flow Regime: Seasonal variations in the hydraulic characteristics of stream flows.

Fording: A place where a river or other body of water is shallow enough to be crossed by wading.

Gabion: A rock filled metal cage or basket used for bank or slope stabilization.

Geotextile: Synthetic fabric used to stabilize banks & slopes; allows water to flow through but prevents the erosion of underlying soil.

Grubbing: The removal of vegetation, stumps, debris, etc. from a development site.

Hydrology: The study of water as it occurs on, over, and under the earth surface as streamflow, water, vapour, precipitation, soil moisture, and groundwater.

Impermeable: Any material that will not permit passage of a fluid.

Impingement: Occurs when an entrapped fish is held in contact with the intake screen and is unable to break free.

Invert: The lowest point in the internal cross section of an artificial or natural channel.

Mitigation: Actions taken during the planning, design, construction and operation of works and undertakings to reduce or eliminate potential adverse impacts of construction and operation activities on fish and fish habitat.

Pool: A deep, slow moving, quiet portion of a stream.

Rearing Area: Shallow riffles or pools in a stream which provide young fish with adequate shelter and food.

Riffle: A section of stream or river of shallow depth and rapid current with surface flow broken by gravel, rubble, or boulders. Usually separated by deeper pools.

Riparian: Dwelling on the bank of a stream or pond.

Riprap: Angular rock used for bank and slope stabilization.

Runoff: That part of precipitation appearing in surface streams.

Salmonid: Of the Salmonidae family of fishes; including the salmon, trout and char species.

Scarify: To break up and loosen the surface of the ground.

Sedimentation: The settling and accumulation of material out of the water column and onto the stream bed. Occurs when the energy of flowing water is unable to sup port the load of suspended sediment

Settling Pond: Basin constructed to collect run-off from disturbed work areas and allow settling of sediment prior to release into the aquatic environment; often used in series.

Slash: The residue left on the ground after trees are felled or accumulated there as a result of storm, fire or silvicultural treatment.

Spawning Area: Section of stream offering the appropriate size gravel, water velocity, and water depth for spawning and egg development.

Straw Barrier: Straw bales used in ditches to reduce water velocity, retain sediment, and prevent erosion.

Swim Bladder: A hydrostatic organ present in most fishes that consists of a gas-filled sac lying dorsal to the ali mentary canal. Also known as the air bladder of a fish.

Terrace: Sloping ground cut into a succession of benches for purposes of controlling surface runoff, minimizing soil erosion and encouraging revegetation.

Topography: A general term to include characteristics of the ground surface such as plains, hills, and mountains, degree of relief, steepness of slopes, and other physiographic features.

Undermining: The seepage or loss of water under a culvert, or other structure.

Water Balance: The balance between water entering a watershed and water leaving a watershed (i.e. precipitation minus all vapour and liquid transport losses out of a watershed).

Wetted Perimeter: The boundary of the channel cross section that is in contact with stream flow.

% Exceedence: Refers to the percentage of time a particular flow within a watercourse is equalled or exceeded with respect to flow duration data. For example, a 90% exceedence value is in reference to the flow being equalled or exceeded 90% of the time.

APPENDIX A

Area Habitat Biologists
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APPENDIX B

The Environment Emergencies 24-Hour Report Line number (1-800-563-2444) should be utilized to report a chemical or hydrocarbon spill. Spills greater than 70 litres must be reported. However, it is recommended that spills less than 70 litres also be reported. Additionally, for any work in or near fresh water, in order to ensure that a quick and effective response to a spill event is possible, spill response equipment should be readily available on-site. Response equipment, such as adsorbents and open-ended barrels for collection of cleanup debris, should be stored in an accessible location on-site. Personnel working on the project should be knowledgeable about response procedures.

Appendix D

Department of Fisheries and Oceans

FACTSHEETS

FACTSHEET

Effects of Silt on Fish and Fish Habitat

Department of Fisheries and Oceans

Silt refers to the fine grained sediment particles which are sometimes transported in the water column. Turbidity is a term used to refer to the "cloudiness" created in the water column by the suspended sediment (silt) particles.

Some of the adverse impacts of suspended sediment include:

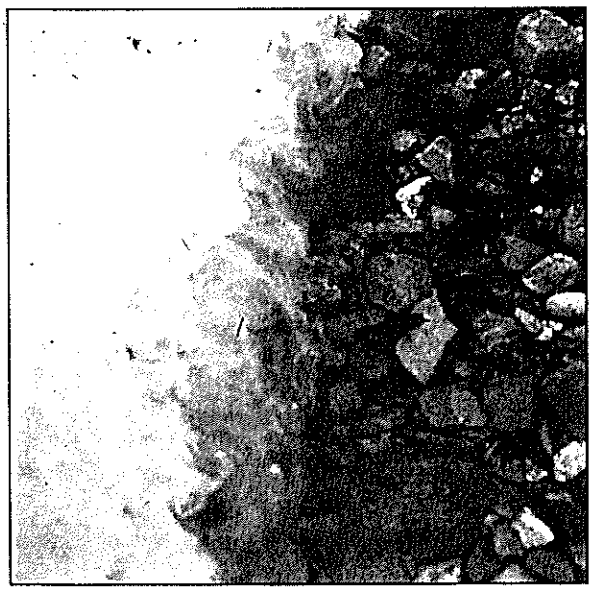
- Abrasion of gill membranes.
- Impairment of feeding due to increased turbidity (salmon and trout are visual feeders).
- Fatal impacts to small aquatic animals which are food organisms for trout and salmon.

Some effects of deposited silt particles include:

- Clogging of small spaces between gravel particles preventing the free flow of oxygenated water and removal of waste products from developing eggs deposited in the gravels. This often causes suffocation and egg mortalities and may leave such gravel beds unsuitable for future deposition of eggs.
- Destruction of the habitat of small stream bottom dwelling animals that provide food for trout and salmon.
- Elimination of sheltered areas between boulders and gravel particles which are important features for juvenile fish.

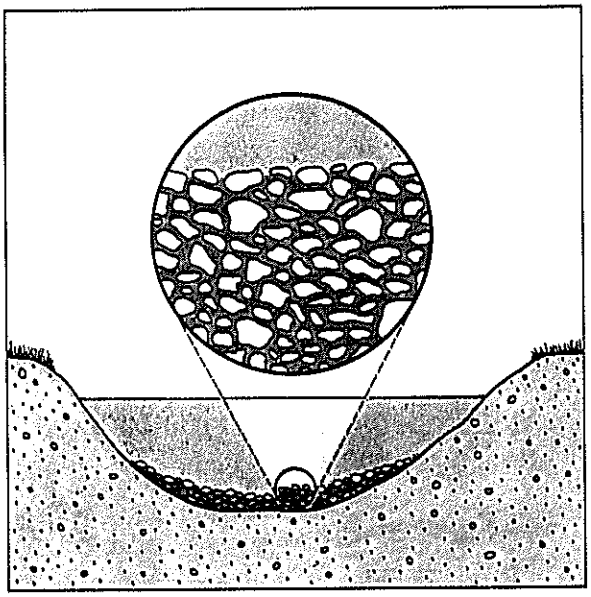
Silt can enter a waterbody as a result of:

- Erosion of exposed soils, often as a result of disturbance by man (eg. improper stream crossings or instream works such as utilization of stream beds as traffic routes by heavy equipment).
- Release of fine particles from some sort of mechanical process (i.e. mine tailings or rock crushing).

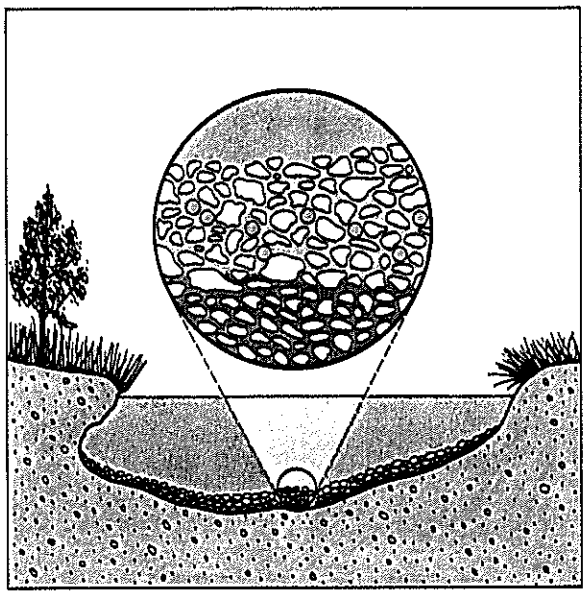


Effects of Silt on Fish and Fish Habitat

For most construction or development projects which cause production of silt, there are methods which are effective for removing suspended sediment from site water and preventing it from entering streams or lakes. Specific methods are outlined in other DFO fact sheets in this series.



Silted gravel stream bottom.



Clean gravel stream bottom.

This Fact Sheet does not constitute DFO approval; other mitigative strategies may be required. The proponent is advised to contact all other appropriate regulatory agencies.

For more information contact the nearest Department of Fisheries and Oceans office.

Fisheries and Oceans Pêches et Océans

Canada

FACTSHEET

Blasting - Fish and Fish Habitat Protection

Department of Fisheries and Oceans • Newfoundland Region

CONDITIONS WHERE APPLICABLE

Fish and fish habitat protection should be provided for blasting activities that are planned in or near a freshwater or marine waterbody. Blasting in or near water produces shock waves that can damage a fish swim bladder and rupture internal organs. Blasting vibrations may also kill or damage fish eggs or larvae.

CONSIDERATIONS

- Blasting plans should be developed such that the weight of charge (in kilograms (kg)) to be detonated at any precise moment is small.

- For multiple charges, time-delay detonators (eg., blasting caps) should be used to reduce the overall detonation to a series of single explosions separated by a minimum 25 milliseconds (1/1000 seconds) delay (see Figure 1).

- Large charges should be subdivided into a series of smaller charges (ie. decking) in blast holes with a minimum 25 millisecond delay between charge detonations (see Figure 1).

- The on-land set-back distance from the blast site to the waterbody or the set-back distance (zone) around the blast site in the waterbody are based on the maximum weight of charge to be detonated at one instant in time (see Table 1) and the type of fish and fish habitat in the area of the blast.

- Blast holes should be back-filled (stemmed) with sand or gravel to grade or to streambed/water interface to confine the blast.

- Blasting mats should be placed atop the holes to minimize scattering of blast debris around the area.

- Ammonium nitrate based explosives must not be used in or near water due to the production of toxic by-products.

- Blasting activities are not to be carried out in the marine environment within 500m of marine mammals (additional mitigative measures may also be necessary).

IMPLEMENTATION PROCEDURES

- Blasting activities are to take place at a set-back distance from the waterbody as indicated on Table 1. If on-land blasts are required nearer to the waterbody than indicated on Table 1, then additional mitigative measures should be put in place.

Mitigative measures for blasting in or near a waterbody may include, but are not limited to; installation of bubble/air curtains (ie. a column of bubbled water extending from the substrate to the water surface as generated by forcing large volumes of air through a perforated pipe/hose) to disrupt the shock wave, blasting during less sensitive fishery periods, isolation of the work area from fish movement, detonation of small scaring charges (ie., detonator caps or short lengths of detonating cord) set off one minute prior to the main charge to scare fish away from the site or the use of noise generators to move fish out of the area. When a bubble curtain is used, it should surround the blast site and be started-up only after fish have been moved outside of the surrounded area.

DFO should be contacted regarding the proposed blasting program prior to start-up.

MAINTENANCE / ABANDONMENT

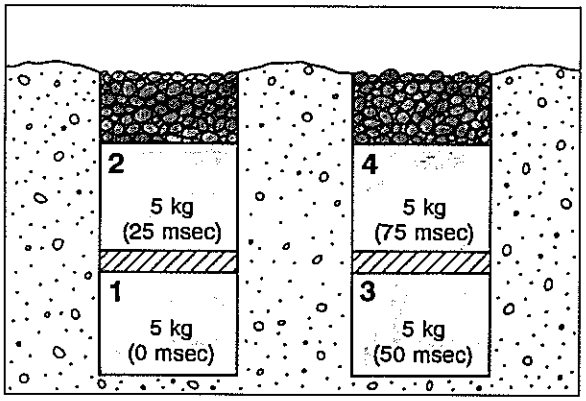
- All blasting debris and other associated equipment/products are to be removed from the blast area, including any debris that may have entered the freshwater or marine waterbodies.

Table 1. Set-back Distance in Metres (m) from Blast Site to Fish Habitat for Rock Removal*

	Weight of Explosive Charge(kg)					
Habitat	0.5	1	5	10	25	50
H1	7	10	15	20	35	50
H2	15	20	45	65	100	143

** Set-back distances may vary slightly depending upon specific circumstances. Habitat H1 includes rearing/general fish habitat. H2 includes spawning habitat where eggs or early fish development are occuring.*

Figure 1. Sample Blasting Arrangement



Per Fig. 1: 20 kg total weight of charge; 25 msecs delay between charges and blast holes; and decking of charges within holes. As per Table 1, for Fig. 1 example, for a 5 kg weight of charge a 15 m set-back from rearing habitat and a 45 m set-back from spawning habitat should be provided.

This Fact Sheet does not constitute DFO approval; other mitigative strategies may be required. The proponent is advised to contact all other appropriate regulatory agencies.

For more information contact the nearest Department of Fisheries and Oceans office.

FACTSHEET

Ditching

Department of Fisheries and Oceans

CONDITIONS WHERE APPLICABLE

All roads require proper drainage in order to support traffic. The manner in which ditching is carried out not only affects drainage, but fish habitat as well.

CONSIDERATIONS

- Roadside ditches, particularly new ditches, can transport large volumes of silt and sediment. If this material is discharged into streams it adversely affects fish and other aquatic life.

IMPLEMENTATION PROCEDURES

In order to avoid damage to fish habitat, the following measures should be implemented:

- Cross drainage culverts and take-off ditches should be incorporated to carry water away from the road and into the surrounding vegetation, where sediments can be filtered from the water.

- In addition to take-off ditches, road side ditches with long slopes may require checkdams to reduce flow velocity, control erosion, and prevent siltation of nearby streams.

- Where the topography does not permit the construction of take-off ditches, settling basins should be used to trap silt before it enters nearby streams.

- Where ditches have been excavated in areas with erosion prone soils, the ditches should be immediately lined with non-erodible material.

MAINTENANCE

- Maintenance of drainage ditches includes regular inspection and the removal of accumulated sediments.

REFERENCES

Anon. 1988. Erosion and Sediment Control - Handbook for Construction Sites. N.S. Dept. of the Environment.

Anon. 1990. Environmental Guidelines for Access Roads and Water Crossings. Ontario Ministry of Natural Resources. 64p.

McCubbin, R.N. et al. 1990.(Revised) Resource Road Construction - Fish Habitat Protection Guidelines. DFO. 78p.

This Fact Sheet does not constitute DFO approval; other mitigative strategies may be required. The proponent is advised to contact all other appropriate regulatory agencies.

For more information contact the nearest Department of Fisheries and Oceans office.

FACTSH

Temporary Ford

Department of Fisheries a

CONDITIONS WHERE APPLICABLE

Where there is a need for infrequent crossings and a suitable site exists, fording or travelling through a water course, may be an acceptable method of crossing streams.

CONSIDERATIONS

- Approaches to the crossing site should be stable and have low slope.
- The streambed at the proposed crossing site should consist of bedrock or large rubble material. Known spawning areas must be avoided.
- All activity must be conducted in such a manner that silt does not enter streams.
- Equipment must be mechanically sound to avoid leaks of oil, gas and/or hydraulic fluids.
- Crossings should be restricted to a single location.
- Fords should be constructed and used during the driest time of the year.

IMPLEMENTATION PROCEDURES

- Crossings should be at right angles to the stream.
- Approaches may be stabilized by using non-erodable materials, such as corduroy, brush mats, or clean stone materials.

MAINTENANCE

- The fording site should be monitored to ensure that the approaches to the site are not eroding. If erosion is taking place the appropriate corrective action should be taken.

ABANDONMENT

- When the fording site is no longer required, the stream channel and banks should be restored to their original condition. Any wheel ruts or other damage that may cause siltation in the stream must also be repaired to prevent silt from being discharged into the stream.

REFERENCES:

Anon. 1990. Environmental Guidelines for Access Roads and Water Crossings. Ontario Ministry of Natural Resources. 64p.

McCubbin, R.N. et al. 1990. (Revised) Resource Road Construction - Fish Habitat Protection Guidelines. DFO. 78p.

This Fact Sheet does not constitute DFO approval; other mitigative strategies may be required. The proponent is advised to contact all other appropriate regulatory agencies.

For more information contact the nearest Department of Fisheries and Oceans office.

FACTSHEET

Forwarder Trails

Department of Fisheries and Oceans • Newfoundland Region

CONDITIONS WHERE APPLICABLE

Forwarder trails are utilized to transport timber to roadside. The mitigations outlined in this fact sheet can be used on all forwarding operations, and may be modified to work on skidding operations.

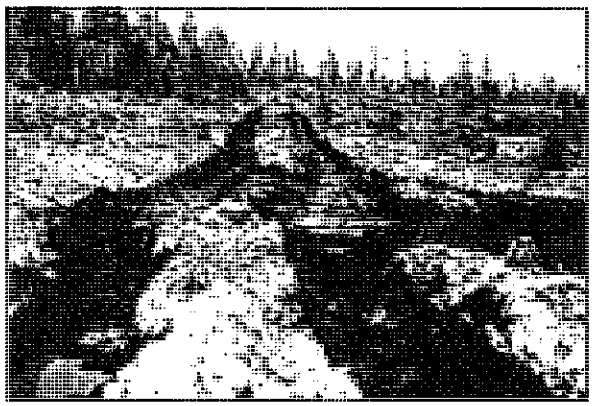
CONSIDERATIONS

- When the forest floor is compacted by machinery operating on trails, the natural filtering action of the soil is destroyed. Surface water is no longer absorbed, but is collected by wheel ruts which act as drainage ditches. As the water flows in these ruts, it erodes the soil and can discharge large volumes of silt into nearby streams, damaging fish habitat and aquatic life.

IMPLEMENTATION PROCEDURES

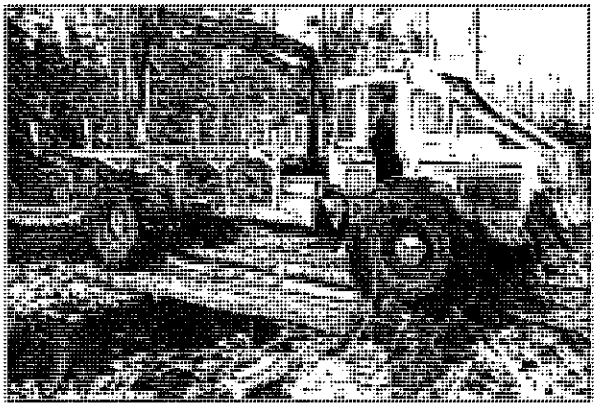
- The location of forwarder trails should be planned in advance to minimize the number of stream crossings.
- To ensure that sediment laden water does not collect in wheel ruts and discharge into streams, mudlogs should be installed across trails before ruts develop. The mudlogs should be installed close to where the water is entering the forwarder trail and the ground slopes to one side. A small earthen dam is pushed up with the forwarder blade on an angle across the trail, and a 30 cm (12 inch) diameter log is placed immediately in front of the dam, on the uphill side. If conditions are extremely wet, several of these may have to be placed along the trail.

Wheel ruts act as drainage ditches to transport sediment laden water.



Mudlogs deflect water off the forwarder trail and unto the forest floor.

- Where stream crossings are necessary, temporary bridges should be installed.



Portable bridges are economical, easy to install, and protect fish habitat.

MAINTENANCE

- If mudlogs become compacted into the ground and are no longer effective, new mudlogs should be installed along the trail.

ABANDONMENT

- Mudlogs should be maintained in place to ensure that surface water is intercepted and deflected into the surrounding vegetation.

- Approaches to stream crossings should be stabilized with slash.

- Temporary bridges can be removed to be used at the next harvesting site.

- These measures may also be employed on abandoned skidder trails.

REFERENCES

Anon. 1990. Environmental Guidelines for Access Roads and Water Crossings. Ontario Ministry of Natural Resources. 64p.

Brathwaite, Glen C. 1992. Woodlot Roads Stream Crossings. Canada\N.S. Cooperation Agreement for Forestry Development. 34p.

McCubbin, R.N. et al. 1990.(Revised) Resource Road Construction - Fish Habitat Protection Guidelines. DFO. 78p.

This Fact Sheet does not constitute DFO approval; other mitigative strategies may be required. The proponent is advised to contact all other appropriate regulatory agencies.

For more information contact the nearest Department of Fisheries and Oceans office.

FACTSHEET

Filter Fabric

Department of Fisheries and Oceans • Newfoundland Region

CONDITIONS WHERE APPLICABLE

This type of temporary barrier is commonly referred to as a silt fence or filter fabric dam. Its purpose is to prevent silt from entering waterbodies. These structures are not designed for long term control of siltation. Filter fabric should not be used in natural watercourse. It can be used in ditches and to surround a disturbed site to control site water runoff.

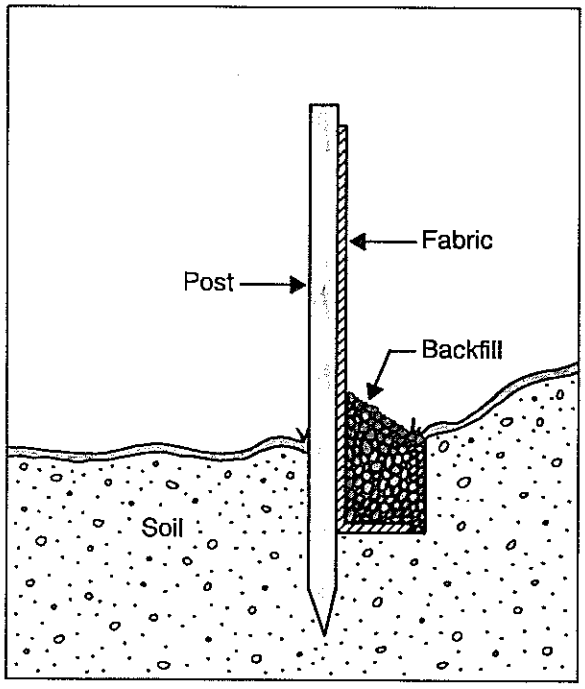
CONSIDERATIONS

- More than one filter fabric dam may be required.
- Filter fabric is designed for temporary use only.
- Further stabilization of disturbed areas may be required prior to filter fabric removal.

IMPLEMENTATION PROCEDURES

- For ditch installations filter fabric should be keyed in to the ditch bottom and sides a minimum of four inches.
- Keying in may be accomplished by excavating a minimum 4" x 4" trench in the ditch bottom and sides.

Wooden stakes should be installed a maximum of 1m apart on the downstream side of the trench and filter fabric attached to the upstream side of the stakes. The trench should then be backfilled. Installation for other disturbed areas should be similar with respect to trenching, stakes and backfilling.



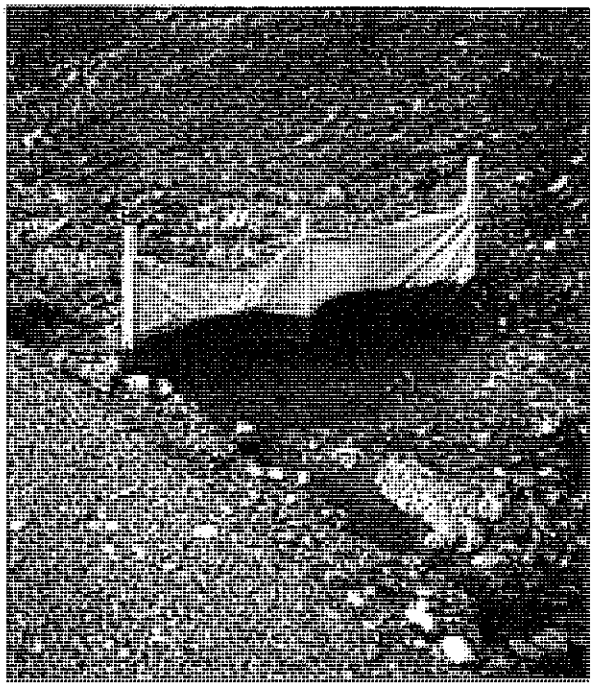
MAINTENANCE

- Clean out accumulated silt at regular intervals as required and dispose of material so that it cannot subequently run into any waterbodies containing fish.

- Repair or replace any damaged section(s) of fabric as well as any undercut or end flow areas where water flows freely around the filter fabric.

ABANDONMENT

- Filter fabric should not be removed until all site work has been completed and disturbed areas stabilized.
- Ensure all accumulated silt is removed and disposed of in an appropriate manner prior to removing fabric.
- All materials should be disposed of at an approved dumpsite.



Failure to key the dam into the ditch sides allowed water to wash around the dam.

REFERENCES

Anon. 1988. Erosion and Sediment Control - Handbook for Construction Sites. N.S. Dept. of the Environment.

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For more information contact the nearest Department of Fisheries and Oceans office.

FACTSHEET

Rock Check Dam

Department of Fisheries and Oceans

CONDITIONS WHERE APPLICABLE

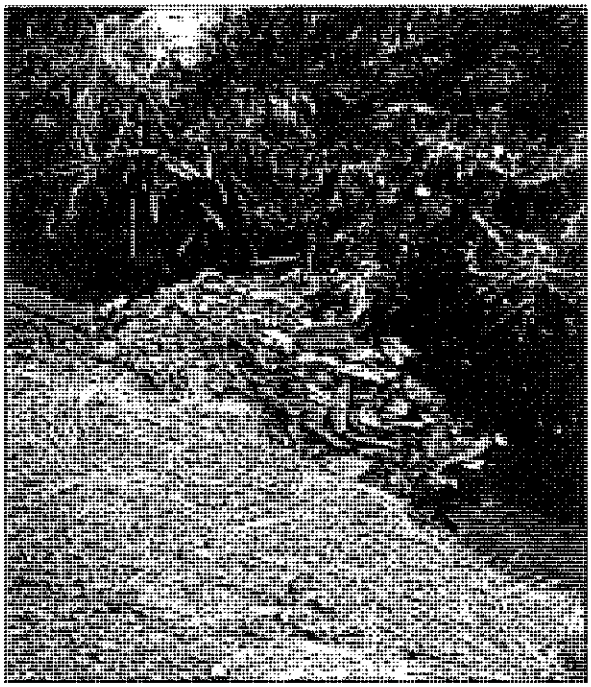
Rock check dams can be used to prevent erosion and control siltation arising from roadside ditches.

CONSIDERATIONS

- These structures must never be used in natural watercourses.
- They can be constructed of locally available materials.
- Rock dams are relatively easy and economical to construct.
- If only larger stones are available, the dam should be lined with impermeable material.
- More than one dam may be necessary.

IMPLEMENTATION PROCEDURES

- Where drainage areas are larger and/or slopes are greater, 100 - 150 mm (4-6in) stones should be used to protect the back and sides of the dam.
- The center of the dam must be lower than the sides.
- The ends of the dam should be stabilized with rip-rap.

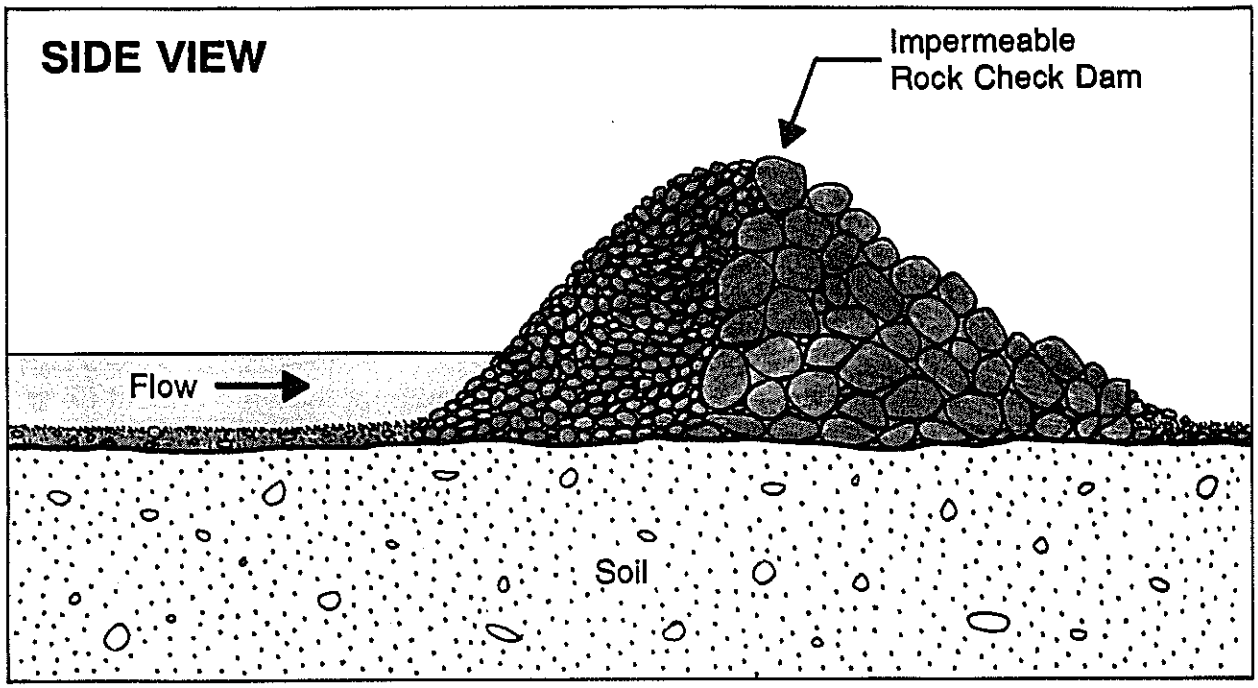


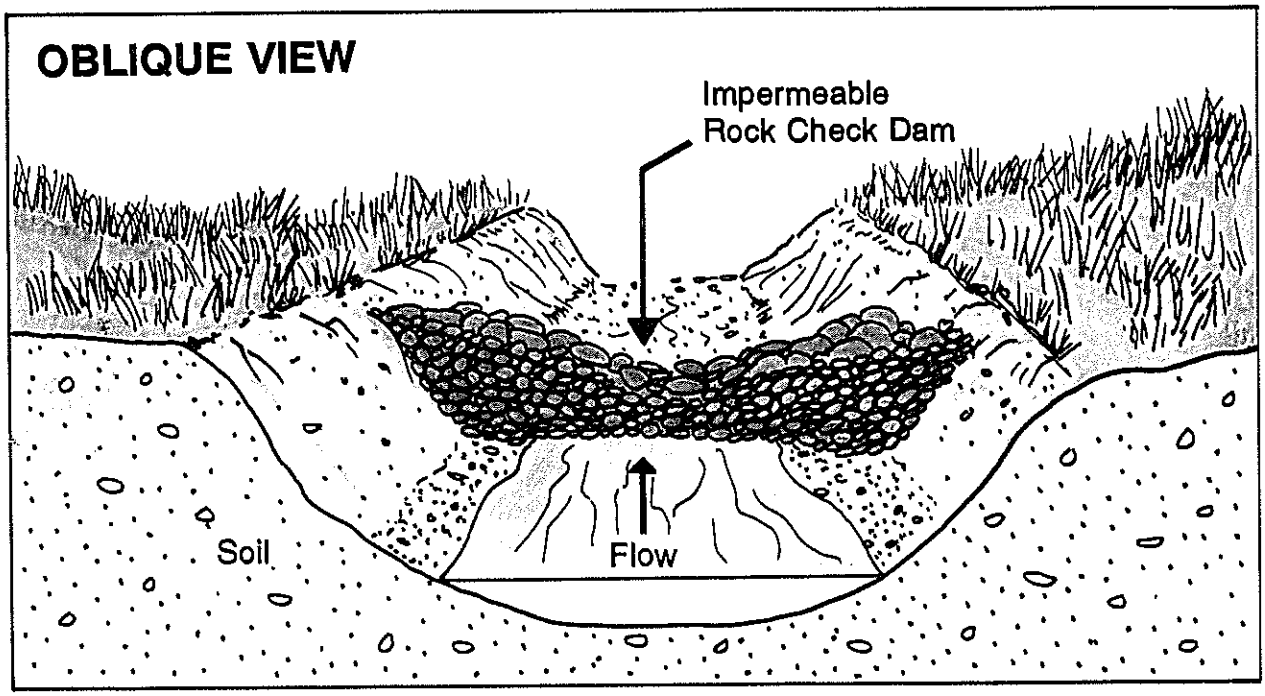
MAINTENANCE

- The dam should be regularly inspected, and accumulations of sediment removed.

REFERENCES

Anon. 1988. Erosion and Sediment Control - Handbook for Construction Sites. N.S. Dept. of the Environment.





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For more information contact the nearest Department of Fisheries and Oceans office.

FACTSHEET

Temporary Bridges

Department of Fisheries and Oceans

CONDITIONS WHERE APPLICABLE

Temporary bridges are constructed to cross waterways on a short term basis, primarily for forestry and mineral exploration, where more permanent structures cannot be justified.

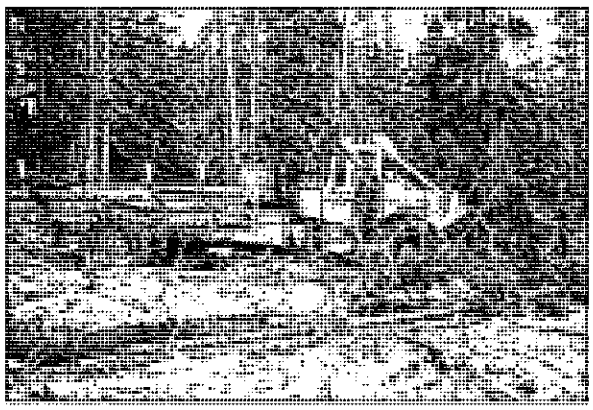
CONSIDERATIONS

- Construction must be carried out in such a manner that silt does not enter the stream.
- The instream use of heavy equipment should be avoided.
- Bridges can be installed where the stream banks are stable and have low slope.

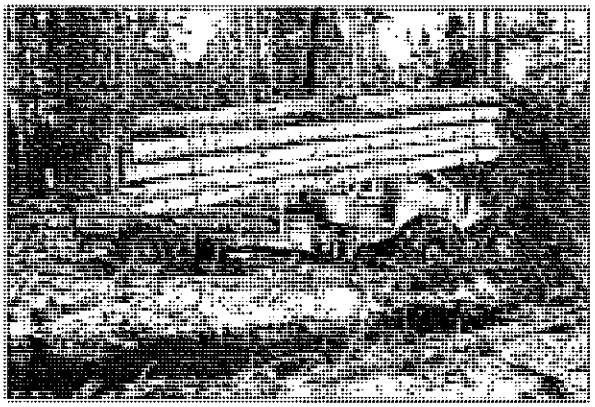
IMPLEMENTATION PROCEDURES

- Bridges are constructed of two sets of 5 meter long logs (3 - 5 in a set), and two bedlogs.
- The logs in each section are lashed together on the ends with chain.
- In preparation for the installation, some brush may have to be removed from the crossing site.
- A forwarder transports the bridge to the site, and installs the bridge by:

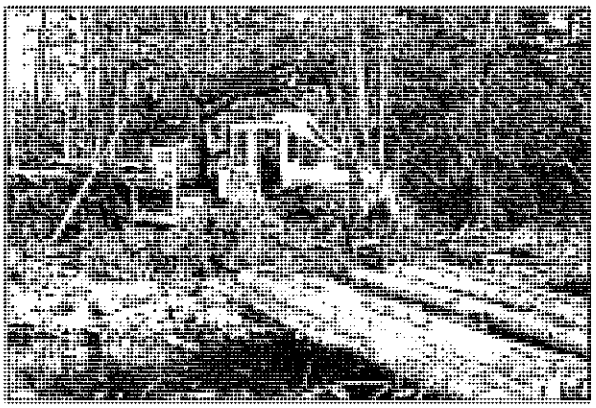
1. Placing the bedlogs on the stream banks, parallel to the stream.



2. Placing each section of the bridge.



3. Stabilizing the approaches with slash.



MAINTENANCE

- Approaches to the bridge should be maintained regularly by placing additional slash to prevent erosion.

ABANDONMENT

- When the bridge is no longer required, the bridge sections are removed. The bedlogs are maintained in place to prevent further disruption of the stream banks.

- When the structure is removed, wheel ruts and any other damage that may cause siltation in the stream should be repaired.

REFERENCES

Anon. 1990. Environmental Guidelines for Access Roads and Water Crossings. Ontario Ministry of Natural Resources. 64p.

Brathwaite, Glen C. 1992. Woodlot Roads Stream Crossings. Canada/N.S. Cooperation Agreement for Forestry Development. 34p.

McCubbin, R.N. et al. 1990. (Revised) Resource Road Construction - Fish Habitat Protection Guidelines. DFO. 78p.

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For more information contact the nearest Department of Fisheries and Oceans office.

FACTSHEET

Resource Road Construction

Department of Fisheries and Oceans

CONDITIONS WHERE APPLICABLE

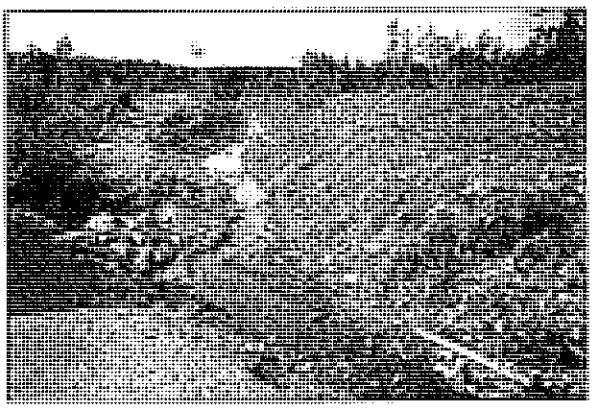
Resource access roads are constructed to provide access to forestry or mineral resources.

CONSIDERATIONS

- Resource roads should be located and built in an environmentally sound manner. The implications of such roads on fish habitat should be considered.
- The road layout should be planned such that the number of stream crossings is minimized.

IMPLEMENTATION PROCEDURES

- Where road construction takes place adjacent to a watercourse, a buffer zone of undisturbed vegetation should be maintained between the road and the stream.
- Aggregate materials for road building must not be removed from any stream.
- Side casting should be carried out in such a manner that sediment does not enter any stream.
- Roadside ditches should end blindly in vegetated areas, never directly into a stream.



- Right-of-ways should not be grubbed within 30 metres of stream crossings.
- Siltation control measures, such as sediment traps and check dams should be installed.

MAINTENANCE

The level of maintenance required for resource roads is dependent on the road's use at any given time.

- Regular inspections should be carried out to ensure that culverts and take-off ditches are maintaining proper drainage.
- Roads should be graded and properly crowned to shed water.

- Sediment control measures should receive regular maintenance.

ABANDONMENT

- Consideration should be given to regeneration of the road right-of-way to make the area productive for growing trees and to prevent erosion.

- Surface erosion can be controlled with water bars or transverse ditches excavated across the road surface. These ditches intercept surface run-off and deflect it off the road surface and into the surrounding vegetation.

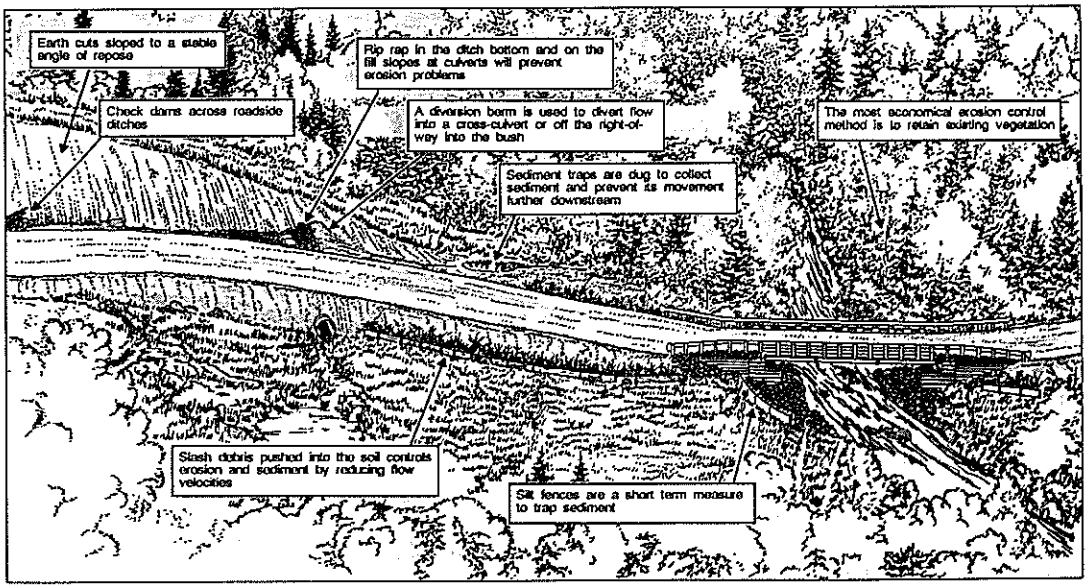
- Bridges and culverts that require ongoing maintenance should be removed when the road is abandoned. Permanent maintenance free structures should be left in place.

REFERENCES

Anon. 1990. Environmental Guidelines for Access Road Construction and Water Crossings. Ontario Ministry of Natural Resources. 64p.

Brathwaite, Glen C. 1992. Woodlot Roads Stream Crossings. Canada/N.S. Cooperation Agreement for Forestry Development. 34p.

McCubbin, R.N. et. al. 1990. (Revised) Resource Roads Construction - Fish Habitat Protection Guidelines. DFO. 78p.



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For more information contact the nearest Department of Fisheries and Oceans office.

FACTSHEET

Instream Work in the Dry
Cofferdams

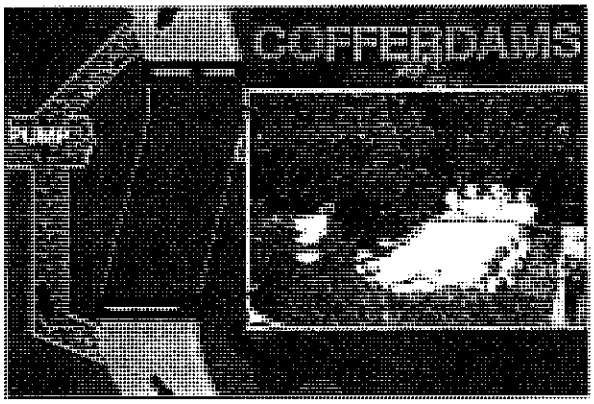
Department of Fisheries and Oceans

CONDITIONS WHERE APPLICABLE

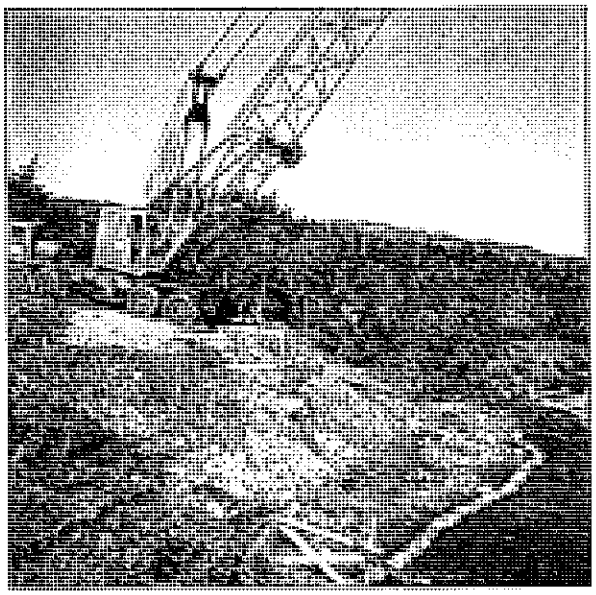
A cofferdam usually consists of a double row of sand bags with plastic placed between the rows. They are used to isolate stream sections from stream flow to carry out work under dry conditions. Cofferdams can be used alone (for example to isolate work areas along stream margins from stream flow) or in conjunction with pumps to conduct work(s) within stream channels. If possible, cofferdams should only be used in streams during periods when streamflow is low.

CONSIDERATIONS

- Cofferdams sometimes leak, allowing water to enter work areas. In these circumstances the use of a pump to remove silted water contained within cofferdams is necessary to prevent siltation of downstream areas.
- Cofferdams should be sufficiently high to prevent overtopping in the event of sudden increases in water levels.
- Cofferdams should be removed from streams when no longer required.
- If pumps are used to route streams around cofferdams for more than one day their operation should be monitored during periods when no work is occurring at worksites.



Instream work in the dry using cofferdams.



Cofferdam isolating stream margin work area from stream flow.

Instream Work in the Dry - Cofferdams

IMPLEMENTATION PROCEDURES

- In cases where it is necessary to carry out work within a stream channel a cofferdam should be first placed into the stream at or above the upstream limit of the work area. A pump should be placed upstream of this cofferdam to pump streamflow around the work area and back into the stream. A second cofferdam can then be placed into the stream at or below the downstream limit of the work area, thereby isolating the work area from streamflow and permitting work to be carried out in the dry.

- In order to prevent silt from entering the stream a second pump is used to remove silted water from the work area inside the cofferdams. This silted water should be treated by discharging to settling basins, vegetated areas or sediment traps prior to release to streams.

MAINTENANCE

- Sand bags damaged during the course of a work should be replaced.

- Care should be taken to seal leaks in cofferdams.

ABANDONMENT

- Cofferdams should not be removed from streams until instream work areas have been fully stabilized.

- All cofferdam materials should be removed from the stream and disposed of at an approved dump area.

This Fact Sheet does not constitute DFO approval; other mitigative strategies may be required. The proponent is advised to contact all other appropriate regulatory agencies.

For more information contact the nearest Department of Fisheries and Oceans office.

FACTSHEET

Streambank Stabilization

Department of Fisheries and Oceans

CONDITIONS WHERE APPLICABLE

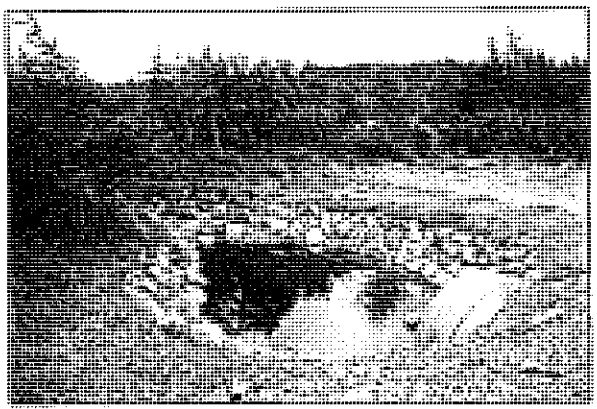
Streambank stabilization is appropriate where:

- An area of streambank is undergoing "natural" erosion and causing deposition of sediments in spawning and rearing habitat downstream.
- An area of streambank has been disrupted or destroyed during the conduct of a work or undertaking and the area in question requires "rebuilding".

Stream bank stabilization using rip rap and hydroseed.

CONSIDERATIONS

- Rip rap, the usual material type employed for riverbank stabilization, should be clean, free of fine materials, and of sufficient size to resist displacement during peak flood events.
- Stream banks to be stabilized or rebuilt should be shaped so that they are at a stable slope.
- Gabion baskets can be used as an alternative to rip rap where bank slopes are not at a stable angle of repose.
- Streambank stabilization should not result in a decrease in the cross sectional width of streams.



Rebuilt stream banks - rip rap, sod and natural vegetation.

IMPLEMENTATION PROCEDURES

- Rip rap or gabion basket placement should be carried out in the dry (e.g. using cofferdams consisting of double walls of sand bags with plastic placed between the walls to isolate streambank areas from streamflow) The planting of trees (e.g. alders, willows) and other vegetation (for example grass, small shrubs, etc.) on streambanks can enhance stabilization measures.

- Stabilization materials used should be placed from the toe of the bank slope to a height on the streambanks equal to the anticipated high water level or to the top of the bank slope, as appropriate.

- The effectiveness of streambank stabilization can be increased if the top of bank slopes are seeded, sodded, or hydroseeded in conjunction with the placement of rock, rip rap, or gabions.

- In river sections where the stream channel meanders particular care should be exercised in stabilizing the outside bends of meanders since such areas are subject to increased erosion pressures.

MAINTENANCE

- Once stream banks have been properly restored maintenance is not often required.

ABANDONMENT

- Excess materials left over from stream bank rehabilitation and cofferdam materials, etc. should be disposed of at an approved dump site.

This Fact Sheet does not constitute DFO approval; other mitigative strategies may be required. The proponent is advised to contact all other appropriate regulatory agencies.

For more information contact the nearest Department of Fisheries and Oceans office.

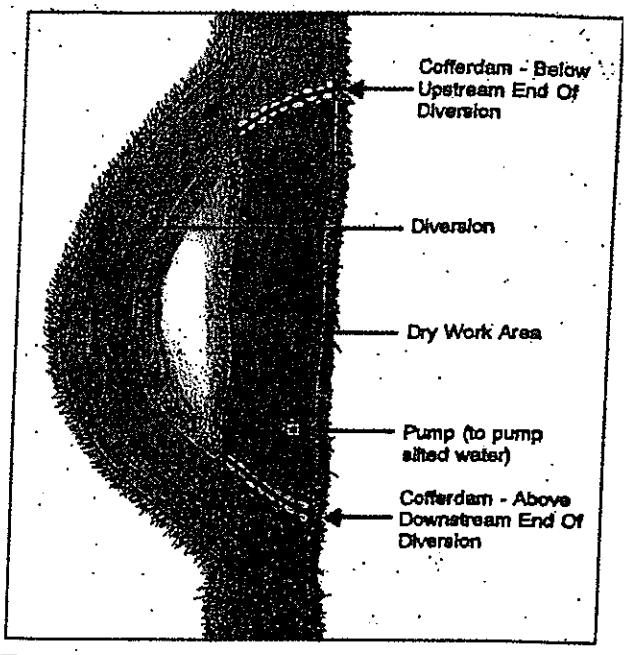
FACTSHEET

Instream Work in the Dry
Temporary Diversion

Department of Fisheries and Oceans

CONDITIONS WHERE APPLICABLE

A temporary diversion is used to conduct instream work in the dry. This method is usually limited only by the availability of space within which to construct a diversion.



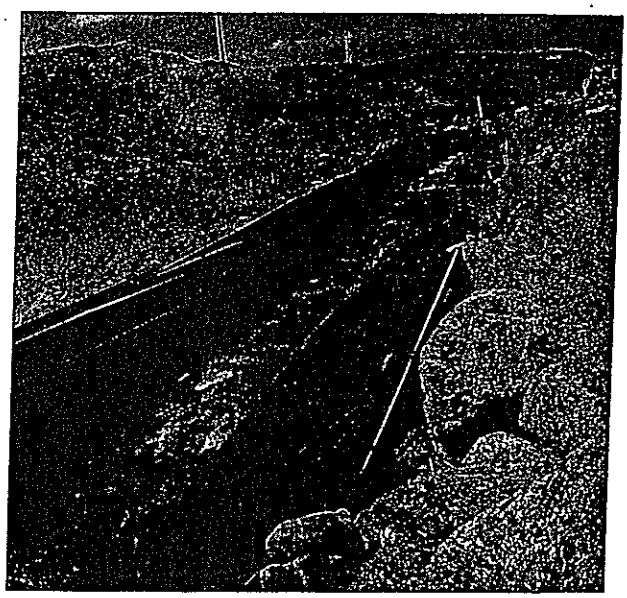
Temporary diversion.

CONSIDERATIONS

- Constant maintenance of diversion channels may be required.
- Care must be exercised in the excavation of the diversion channel to ensure that it is capable of accommodating peak flows from the stream which is being diverted.
- A pump is usually required to remove silted site water arising in dewatered work areas.

IMPLEMENTATION PROCEDURES

- Temporary diversions should be excavated from the downstream end toward the upstream point of diversion, where a "plug" of earth should be left to prevent the entry of streamflow into the diversion channel before it is stabilized. Strong plastic sheathing can be used to line the channel bottom and slopes. This sheathing should be weighted down with crushed stone and staked into the top of the channel slopes. Once



Temporary diversion - channel liner.

Instream Work in the Dry - Temporary Diversion

the channel has been lined and the lining secured, the "plug" of earth referred to earlier can be removed.

- A cofferdam (recommended double walls of sand bags with plastic placed between the walls) should then be placed immediately below the upstream point of diversion to re-route the flow of water into the diversion. Another cofferdam should then be placed immediately above the downstream point of diversion to isolate the work area and prevent silted water from escaping into the stream. In this manner the work area is effectively isolated from the stream and instream work can proceed in the dry. Silted water arising within the work area should be treated by discharging to vegetated areas, sediment traps or settling basins.

MAINTENANCE

- Plastic used to line the diversion must be kept in a good state of repair.
- Care must be exercised to ensure that streamflow does not get under or behind the channel liner and cause erosion of the channel banks and subsequent downstream siltation.
- At increased water levels and velocities it may be necessary to further secure the channel liner.

ABANDONMENT

- The diversion should be filled in and stabilized when no longer in use.

This Fact Sheet does not constitute DFO approval; other mitigative strategies may be required. The proponent is advised to contact all other appropriate regulatory agencies.

For more information contact the nearest Department of Fisheries and Oceans office.

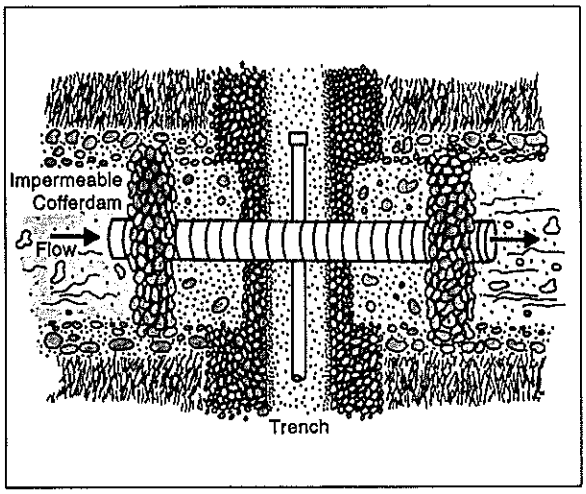
FACTSHEET

Instream Work in the Dry
Elevated Pipes

Department of Fisheries and Oceans • Newfoundland Region

CONDITIONS WHERE APPLICABLE

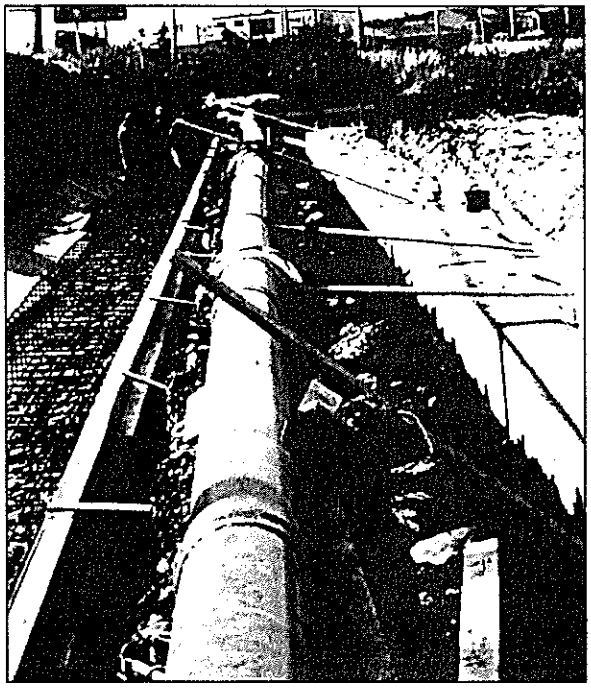
This method can be used to carry out instream work in the dry as an alternative to the use of cofferdams (and pumps) or in circumstances where site constraints preclude the construction of a temporary diversion. The use of elevated pipes should be restricted to times of year when streamflows are low and fish species are not undergoing spawning migrations (elevated pipes can impede the migration of fish).



Stream crossing dewatered by means of an elevated pipe.

CONSIDERATIONS

- It will usually be necessary to have completed instream work and have elevated pipes removed prior to migration periods.
- Elevated pipes should be of a size capable of accommodating sudden increases in streamflow to prevent flooding of work sites.
- It may be necessary to pump streamflow around work sites in cases where the capacity of elevated pipes is exceeded and flooding of work sites is imminent.



Elevated pipe.

IMPLEMENTATION PROCEDURES

- The inlet and outlet of an elevated pipe is usually seated on cofferdams (e.g. double walls of sandbags with

plastic placed between the walls). Upstream and downstream cofferdams should be placed into the stream and the pipe placed onto the cofferdams. Additional sandbags should then be placed on top of the pipe inlet and outlet to hold it in place. If more than one pipe section is necessary to carry streamflow over the instream work area then consideration should be given to the impermeability of the area(s) where the pipe sections are coupled.

MAINTENANCE

- Cofferdams should be checked periodically to ensure that water is not leaking through them and into the work area or from the work area into the stream. Any such leaks should be repaired as soon as possible.

ABANDONMENT

- The instream work area should be fully stabilized and brought back to grade prior to removing the elevated pipe.

- Sand bags, pipe sections, etc. should be removed upon project completion.

This Fact Sheet does not constitute DFO approval; other mitigative strategies may be required. The proponent is advised to contact all other appropriate regulatory agencies.

For more information contact the nearest Department of Fisheries and Oceans office.

FACTSHEET

Culvert Stabilization

Department of Fisheries and Oceans • Newfoundland Region

CONDITIONS WHERE APPLICABLE

Stabilization of culvert inlets and outlets should be undertaken when culverts are installed. This prevents the erosion of materials from around culverts and subsequent downstream siltation and possible loss of the culverts due to washouts.

Culvert rip rap stabilization.

CONSIDERATIONS

- Materials used for stabilization purposes should be clean and non erodible (e.g. blasted rock, or rip rap, or gabion baskets).
- Materials used for stabilization should completely cover unstabilized materials (e.g. road fill, gravel) at culvert inlets and outlets.
- Fill slopes should be stable to ensure that roadbed materials do not enter watercourses.

Stabilization of culvert outlets - rip rap.

IMPLEMENTATION PROCEDURES

- When a culvert has been installed gabions, rip rap, or large, clean rock should be placed at the culvert inlets and outlets. All materials used for stabilization should be of sufficient size to prevent erosion under anticipated operating levels for the culvert.

Culvert Stabilization

MAINTENANCE

- Culverts should be inspected regularly to assess the adequacy of stabilization measures. Areas from which stabilization materials have become dislodged should be repaired.

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For more information contact the nearest Department of Fisheries and Oceans office.

Fisheries and Oceans Pêches et Océans

Canada

FACTSHEET

Storm Drain Outlets

Department of Fisheries and Oceans • Newfoundland Region

CONDITIONS WHERE APPLICABLE

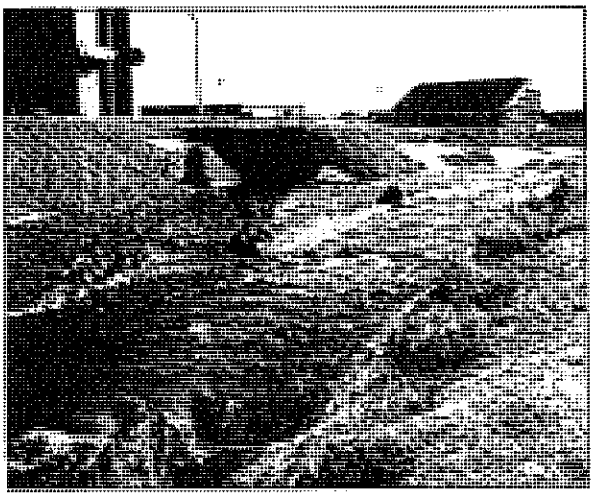
Storm drain outlets are used to conduct storm-water away from developed lots, buildings, housing developments, etc. and usually discharge into the nearest stream.

CONSIDERATIONS

- Storm drainage channels should be of a size capable of accommodating peak storm events.
- Storm drainage outlet structures should not be constructed directly on stream banks, but should be constructed some distance back and a channel excavated from the outlet structure to the stream.

IMPLEMENTATION PROCEDURES

- Storm drain outlet structures should be constructed after excavating a channel to the stream; this channel should be constructed so that it is generally oriented parallel to the direction of flow of the receiving stream. This channel should be lined with clean stones to reduce the velocity of water exiting the outlet structure before the water enters the stream in order to avoid streambed and stream bank erosion. The channel should be fully stabilized prior to the entry of storm water into it to prevent erosion and consequent downstream siltation.



Storm drain outlet - orientation to stream-flow.

Storm drain outlet channel - stabilization.

Storm Drain Outlets

MAINTENANCE

- Once storm drain outlets have been properly constructed and stabilized regular maintenance is usually not required.

ABANDONMENT

- All excess materials resulting from excavation of the storm drainage channel and construction of the storm water outlet structure should be removed and disposed of at an approved site.

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For more information contact the nearest Department of Fisheries and Oceans office.

Fisheries and Oceans Pêches et Océans

Canada

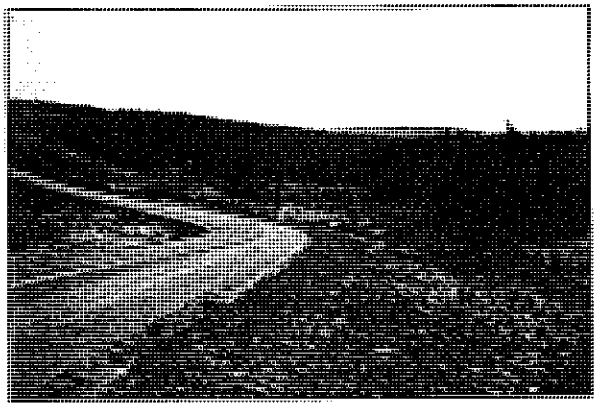
FACTSHEET

Highway Construction
Low Point Protection

Department of Fisheries and Oceans • Newfoundland Region

CONDITIONS WHERE APPLICABLE

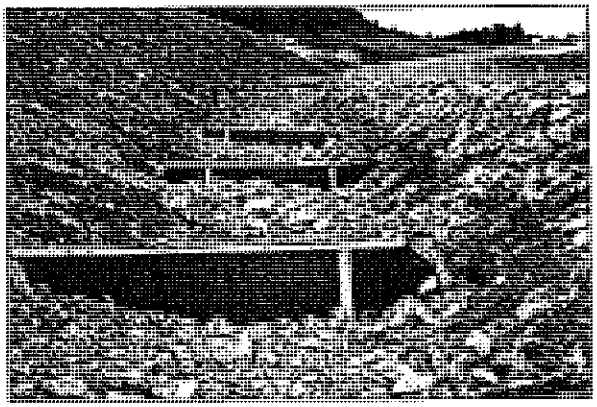
Low point protection is advisable where a stream or drainage into a watercourse on a highway construction project is situated so that it receives sediment bearing drainage from disturbed areas uphill on both sides of the low point.



Highway low point (centre).

CONSIDERATIONS

- If filter fabric is used for low point protection it should be installed properly to maximize its efficiency.
- Ditch blocks consisting of materials such as crushed stone, brush, etc. can be used in place of filter fabric and require much less maintenance.
- A series of siltation control structures is recommended for the proper treatment of sediment bearing water.
- Ditch blocks, etc. are temporary measures put in place until drainage ditches and associated disturbed areas have been fully stabilized; such areas should be stabilized as soon as possible after having been disturbed and normally within the same construction season.



Filter fabric used for low point protection.

Ditch block (rock dam) used for low point protection.

Highway Construction - Low Point Protection

IMPLEMENTATION PROCEDURES

- If drainage ditches are being excavated from disturbed areas toward the low point, siltation control structures (e.g., ditch blocks, etc.) should be installed before the ditch terminates some distance from the low point, preferably in a vegetated area. Where road ditches already exist, siltation control devices should be installed before the commencement of construction activities.

MAINTENANCE

- If filter fabric dams are used to protect low points from siltation, these filter fabric dams should be maintained in good operating condition.

- It will be necessary to remove sediment accumulated behind ditch blocks periodically.

ABANDONMENT

- Ditches and adjacent disturbed areas should be stabilized as soon as possible after they have been excavated/disturbed, normally within the same construction season.

- Filter fabrics, if used, should be removed and disposed of at an approved site when no longer required.

This Fact Sheet does not constitute DFO approval; other mitigative strategies may be required. The proponent is advised to contact all other appropriate regulatory agencies.

For more information contact the nearest Department of Fisheries and Oceans office.

FACTSHEET

Temporary Settling Basins

Department of Fisheries and Oceans • Newfoundland Region

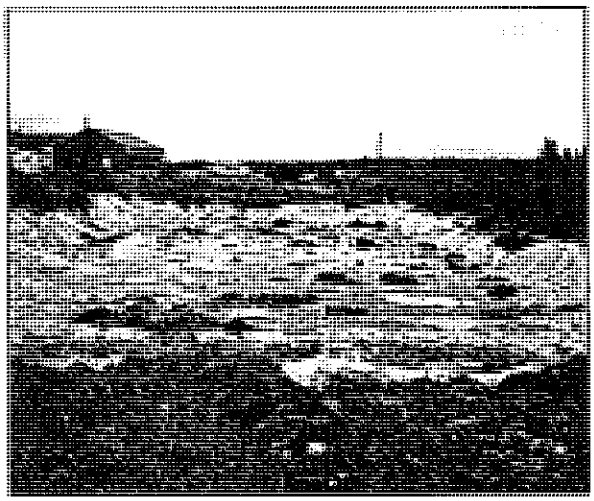
CONDITIONS WHERE APPLICABLE

These basins are used (on a relatively short term basis) for the treatment of silted water prior to release to water-courses.

Settling basin construction details.

CONSIDERATIONS

- These basins are often most effective when they are constructed so that their length is four times their width.
- The bottoms of settling basins should be lined (e.g. with plastic).
- Settling basins are often most effective when several are used in series.



Settling basin lined with plastic.

IMPLEMENTATION PROCEDURES

- A pipe should be installed near the top of a settling basin in such a manner that it discharges water from the top of the water column. There are a number of alternatives to this method of settling basin construction involving the use of various detention devices such as pre-cast manholes, and utilizing natural topographic features.

Temporary Settling (Detention) Basins

MAINTENANCE

- It may be necessary to remove and dispose of accumulated sediment from settling basins in order to maintain their operating capacity.

ABANDONMENT

- Settling basins should be filled in and stabilized when no longer required.

Series of rough settling basins intended for short term use.

This Fact Sheet does not constitute DFO approval; other mitigative strategies may be required. The proponent is advised to contact all other appropriate regulatory agencies.

For more information contact the nearest Department of Fisheries and Oceans office.

FACTSHEET

Bridge Construction

Department of Fisheries

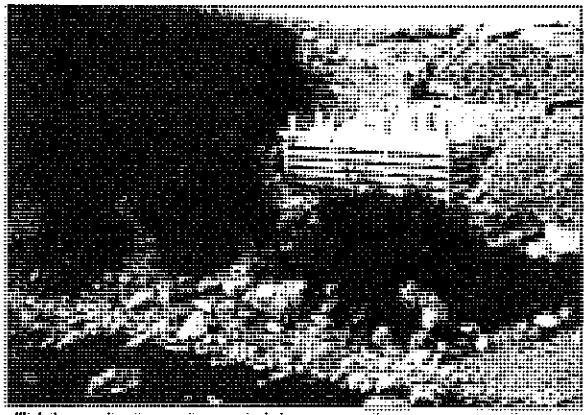
CONDITIONS WHERE APPLICABLE

The construction of permanent bridge structures is the preferred method for stream crossings, especially for crossings of large streams or rivers. Demolition of old existing bridges in sensitive areas should be carried out so as to minimize impacts on fish and fish habitat.

Bridge construction.

CONSIDERATIONS

- All instream works should be carried out in the dry (see Factsheets # 10, 12, and 13 regarding mitigations for instream work in the dry) and in such a manner that no silt enters watercourses / waterbodies (see Factsheets # 6, 7, 10, and 17 regarding measures to control siltation).

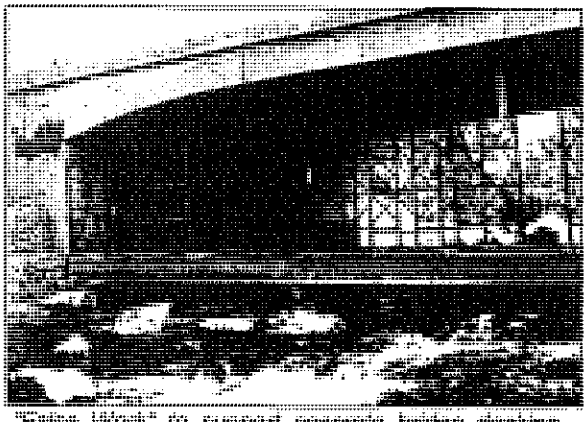


Bridge abutments outside wetted stream perimeter.

IMPLEMENTATION PROCEDURES

Construction

- Bridges should be constructed at right angles to waterways and on straight stretches of watercourses.
- Bridge abutments should be located outside the normal wetted stream perimeter.
- Gabions, or wing walls, should be used to prevent the erosion of road/ road shoulder materials into watercourses.
- "False Work," if used to support concrete bridge decking while the



"False Work" to support concrete bridge decking.

Bridge Construction / Demolition

decking "cures," should allow for fish passage at all times.

- Every precaution is to be taken to prevent the entry into watercourses/ waterbodies of chemicals, such as lime and cement, which could be very toxic to aquatic life.

MAINTENANCE

- Routine abutment and deck maintenance is usually required where bridges have been properly constructed. Standard procedures to protect fish and fish habitat should be followed.

DEMOLITION

- Where it becomes necessary to demolish or remove a bridge every effort should be made to avoid "dropping the bridge" into rivers/ streams. This could be done by "sawing" appropriate sections of the bridge and using cranes to lift these sections.

- Where the only alternative is "dropping" a bridge into a river, and depending upon the fish habitat in the affected area, it may be necessary to construct a platform onto which the bridge could be dropped.

- If a new bridge is not to be constructed in the area, as much as possible of the abutments and wing walls should be left in place in order to prevent the slippage of unstable materials into watercourses. Failing this, unstable materials on both sides of the bridge approaches should be removed prior to abutment removal, and the disturbed areas stabilized to prevent erosion. (See Factsheet # 11 regarding streambank stabilization.)

ABANDONMENT

- All excess materials should be removed and disposed of at an approved dump site.

This Fact Sheet does not constitute DFO approval; other mitigative strategies may be required. The proponent is advised to contact all other appropriate regulatory agencies.

For more information contact the nearest Department of Fisheries and Oceans office.

FACTSHEET

Habitat Requirements

Department of Fisheries

CONDITIONS WHERE APPLICABLE

Fish habitat is defined as those parts of the environment on which fish depend, directly or indirectly, in order to carry out their life processes. This includes spawning grounds, rearing habitat, migration and feeding areas.

SPAWNING AREAS

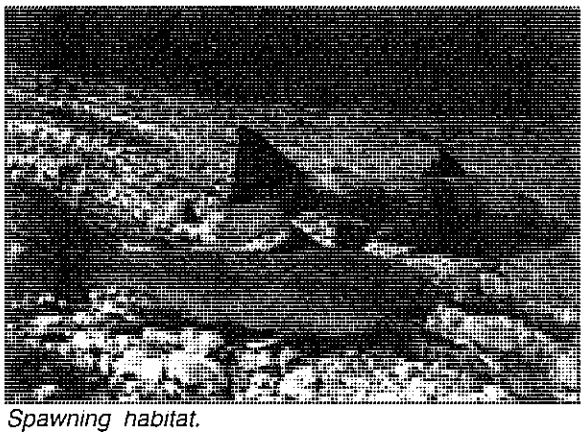
Salmonids require a stretch of stream with clean gravel and good water flow. This type of habitat is most often found in headwater areas (the uppermost stream reaches), where there is typically finer substrates and relatively stable water flows. However, salmonids also spawn in the lower reaches of streams. For successful spawning, salmonids require clean, stable gravel of 1 cm to 15 cm in diameter depending on fish size. These stream conditions provide a stable supply of clean, cool, well oxygenated water for the successful incubation of eggs deposited in the gravels, and rearing of young.

REARING AREAS

Rearing habitat varies from areas of low stream velocity and small substrate to areas of larger (cobble/boulder) substrate and higher velocities. Streams supporting successful salmonid populations are usually associated with a high proportion of riffles and pools, thus offering a variety of habitat cover types. Shelter is provided by undercut banks, deep pools, turbulence, rocky areas, instream debris, and overhanging (riparian) vegetation.

MIGRATION AREAS

Migration areas consist of stream reaches that provide corridors for fish movement from one area of the watershed to another or, for anadromous (sea-run) salmonids, access to and from the sea. Migration areas must permit fish movement to critical habitats. The lack of barriers to migration in the main stream and tributaries, as well as adequate water flow are essential.



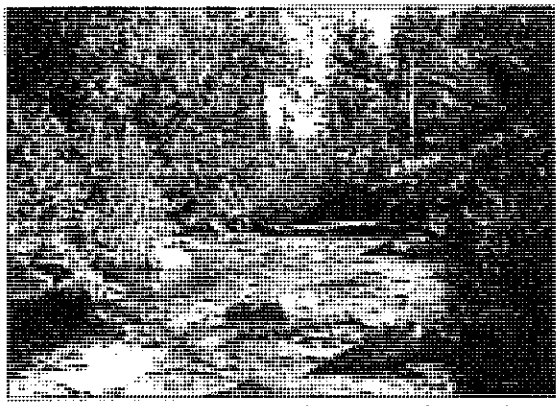
Spawning habitat.

Spawning gravels.

FEEDING AREAS

Insect life is the major food supply for salmonids. The available food supply of a stream depends on clean, cool, well oxygenated water flowing over a clean bottom of gravel, cobble or boulders.

Salmonids are primarily sight feeders and water clarity influences feeding ability. Streams must be clear enough to permit sunlight to penetrate and permit adequate algal growth which, in turn, maintain a healthy aquatic insect population as a food supply for fish. Beneath the surface of a stream, among the rocks and boulders, there is an abundance of insects in their immature forms. A variety of stream bottom materials is required for production of aquatic insects. Insects falling into the stream from overhanging vegetation also provide food for salmonids.



Riffle area containing rearing, spawning and feeding habitat.

Optimum fish production is contingent upon a combination of a variety of conditions, including adequate food supply, suitable dissolved oxygen levels, cool stream temperatures, shelter (cover), and clear, clean water.

The above factors combine to make salmon and trout very sensitive to various environmental changes. These factors are all necessary to support a productive salmonid population. Loss of any one of these critical habitat components usually results in severe reductions or total loss of salmonid stocks from a given area.

This Fact Sheet does not constitute DFO approval; other mitigative strategies may be required. The proponent is advised to contact all other appropriate regulatory agencies.

For more information contact the nearest Department of Fisheries and Oceans office.

FACTSHEET

Highway Construction / Upgrading
Infilling, Stabilization & No-grub Zones

Department of Fisheries and Oceans

CONDITIONS WHERE APPLICABLE

The following mitigation options are recommended wherever highways are being constructed or upgraded across watercourses and across or through small ponds.

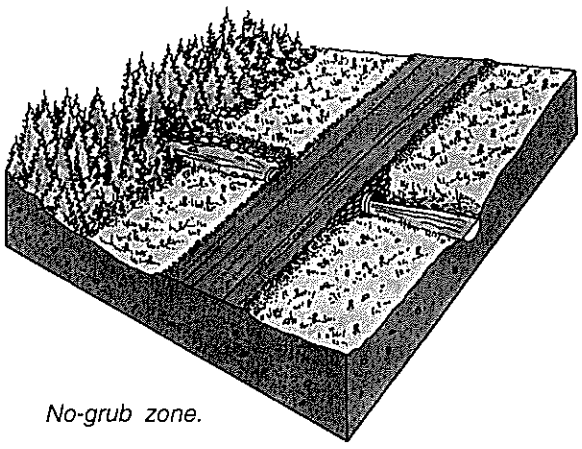
CONSIDERATIONS

- Construction/upgrading should be carried out in such a manner that silt does not enter watercourses/ waterbodies (see Factsheets # 6, 7, 10 and 17 regarding measures to control siltation).

- Instream works associated with highway construction/upgrading should be carried out in the dry (see Factsheets # 10, 12 and 13 regarding instream work in the dry).

IMPLEMENTATION PROCEDURES

- A no-grub buffer zone (recommend 30 metres) should be maintained adjacent to all watercourses in crossing areas; there should be no grubbing within this zone except for road approaches. Grubbing for road approaches should only be done immediately prior to subgrade construction.



No-grub zone.

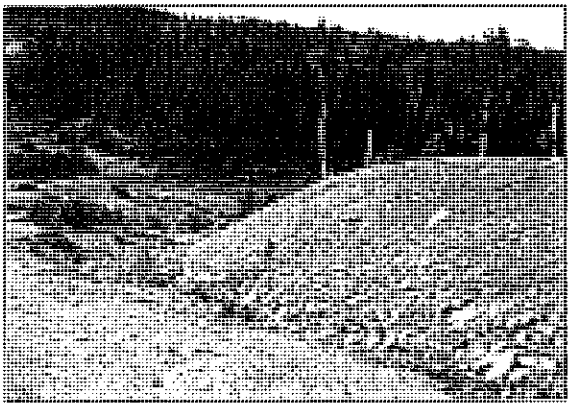
- Where infilling of small gullies or small ponds cannot be avoided by adjusting road alignments, then such waterbodies should be isolated from streamflow (recommend using cofferdams and pumps - see Factsheet # 10). Water can be pumped from these waterbodies until they are dry. In situations where only a portion of a waterbody is to be infilled, attempts should be made to isolate the infill area from the rest of that waterbody while infilling is ongoing (e.g., geotextile materials, plastic, rock berms, etc.).

- Only clean, non-erodible materials should be used for infilling waterbodies (e.g., blasted rock containing no, or a minimum of, fines).

- Stabilization of stream crossing areas should be carried out as soon as possible after the crossing structure has been installed and certainly within the same construction season (see Factsheet # 11 regarding stream bank stabilization).

- Disturbed areas along highway right-of-ways, which could lead to ongoing siltation to watercourses/ waterbodies, should be stabilized or re-vegetated as soon as possible after they have been disturbed and

certainly within the same construction season.



Stabilization.

- It is recommended that DFO be contacted prior to the onset of construction/upgrading regarding appropriate approvals of works or undertakings which may impact on fish and fish habitat.

MAINTENANCE

- Stabilization failures at stream crossing areas or along right-of-ways should be re-stabilized as quickly as possible.

ABANDONMENT

- Once construction has been completed and before contractors abandon construction sites all excess materials should be removed so as not to enter adjacent watercourses/ waterbodies.

This Fact Sheet does not constitute DFO approval; other mitigative strategies may be required. The proponent is advised to contact all other appropriate regulatory agencies.

For more information contact the nearest Department of Fisheries and Oceans office.

FACTSHEET

Freshwater Intake End-Of-Pipe Fish Screen

Department of Fisheries and Oceans

CONDITIONS WHERE APPLICABLE

Fish protection should be provided for activities involving extraction of fresh water. An intake should be screened to prevent potential losses of fish due to entrainment or impingement. Entrainment occurs when an organism is drawn into a water intake and cannot escape. Impingement occurs when an entrapped organism is held in contact with the intake screen and is unable to free itself.

CONSIDERATIONS

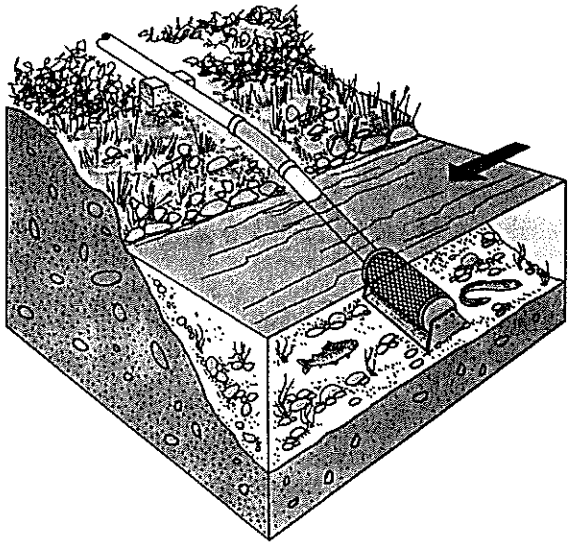
- For small permanent and temporary freshwater withdrawals up to 125 litres/second (L/s) (2000 US gallons per minute (gpm)), associated with irrigation, construction, small municipal and private water supplies, etc., end-of-pipe intake screen designs are often used for the protection of fish.
- Open screen area requirements for freshwater intake end-of-pipe fish screens differ depending upon swimming mode (i.e., subcarangiform - fish that swim like trout/salmon; or anguilliform - fish that swim like an eel).
- Freshwater fish of 25 mm (i.e., fry stage) or more in length should be protected from entrainment and impingement due to water extraction activities, unless site-specific circumstances, as addressed with DFO, indicate otherwise.

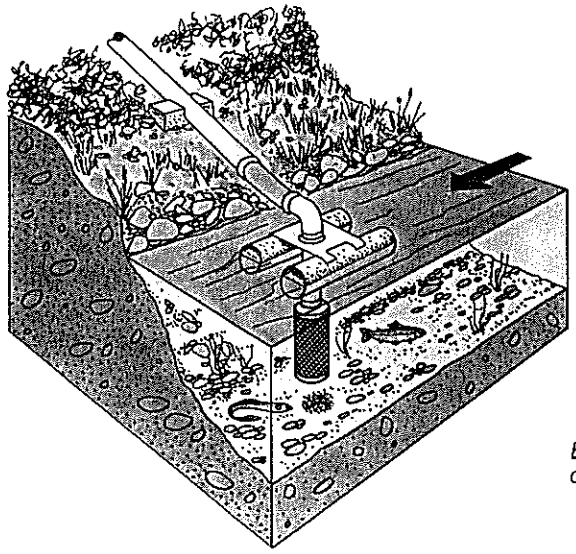
IMPLEMENTATION PROCEDURES

- The required screen area (i.e., the area of all open spaces on the screen available for the free flow of water) varies depending upon rate of water withdrawal. The narrowest dimension of any opening on the screen, regardless of opening shape, for fish of 25 mm is estimated at 2.54 mm. DFO should be contacted regarding specific requirements.
- Screen openings may be round, square, rectangular, or any combination thereof, and should not have any protrusions that could injure fish.
- Where possible, screens should be located in areas and depths of water with low concentrations of fish throughout the year, away from natural or constructed structures which may attract fish that are migrating/spawning or in rearing habitat, and at a minimum of 300 mm above the bottom of the watercourse/ waterbody to prevent entrainment of sediment and aquatic organisms associated with the bottom area.
- The screen face should be oriented in the same direction as the flow.
- Flow should be evenly distributed over the screen surface.
- Heavier cages or trash racks can be fabricated out of bar or grating to protect the finer fish screen, especially in areas of debris movement.

ater Intake End-Of-Pipe Fish Screen

- DFO should be contacted regarding proposed water withdrawal activities prior to start-up.





Examples of typical applications and features of end-of-pipe screens.

MAINTENANCE

- Regular maintenance should be provided, including the removal, inspection, and cleaning of screens to prevent debris fouling and impingement of fish.
- Pumps should be shutdown when fish screens are removed for inspection and cleaning.

ABANDONMENT

- Consideration should be given to the removal of the intake screen and associated infrastructure.

For more specific technical information refer to:

Department of Fisheries and Oceans. 1995. Freshwater Intake End-of-Pipe Fish Screen Guideline. Communications Directorate, Department of Fisheries and Oceans.

This Fact Sheet does not constitute DFO approval; other mitigative strategies may be required. The proponent is advised to contact all other appropriate regulatory agencies.

For more information contact the nearest Department of Fisheries and Oceans office.

FACTSH

Diamond Drillin
Explorati

Department of Fisheries a

CONDITIONS WHERE APPLICABLE

The following mitigations are recommended for activities associated with exploratory mineral drilling operations (e.g., access roads, trenching, etc.), which could impact on fish and fish habitat if not carefully planned.

CONSIDERATIONS

- Water lines and access routes to drill sites should be located in areas which will create the least amount of disturbance to fish and fish habitat.
- Careful planning should be undertaken to minimize the length and number of access roads/trails and stream crossing sites in order to reduce potential erosion problems. (See Factsheets # 4 and 9 for information pretaining to resource roads and fording sites). This could also simplify site restoration when an area is abandoned. Stream crossing sites should be discussed with DFO.

IMPLEMENTATION PROCEDURES

- If clearing and levelling are required, disturbed areas should be no larger than absolutely necessary.
- It is recommended that buffer zones of 12 m + 1.5 x slope (%) be maintained adjacent to all watercourses for access roads.

Disturbed areas larger than necessary.

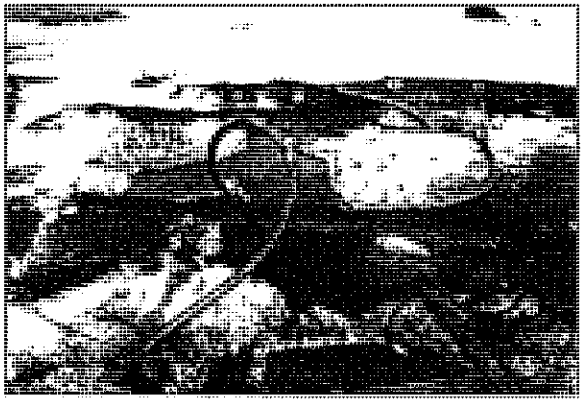
Poorly constructed access road.

- Buffer zones of 30 m are recommended for grubbing and clearing zones.
- Campsites should not be located within 100 m of any waterbody/ watercourse.
- If trenches are to be left open for a period of time, excavated material should be contoured and stabilized to prevent erosion and silt entering waterbodies. Trenches and ditches

should not be drained directly into a waterbody/watercourse. (See Factsheets #6, 7, 10 and 17 regarding measures to control siltation).

- Screens are recommended for a water withdrawal intake in fish bearing waters. (See Factsheet # 21 for information regarding freshwater intake end-of-pipe fish screens).

- Drilling wastes should not be allowed to enter waterbodies. Adequate closed circuit facilities should be provided for drilling mud and flocculating agents.



Debris/waste should be removed upon project completion.

- All fuel and hazardous materials present on site must be handled with care in order to minimize spills. Fuel should be properly stored a minimum of 100 m from any waterbodies/watercourses.

- If drilling is undertaken through a ice covered watercourse/waterbody only sufficient fuel for one refuelling should be brought on the ice at any one time. In addition, when the drill site is abandoned all debris which is frozen into the ice/snow should be removed and discarded in an approved disposal site.

- Contingency plans should be in place to deal with any environmental emergency.

- All maintenance of drill rigs and other equipment, other than emergency repairs, should be carried out on land at least 100 m from the nearest waterbody/watercourse.

ABANDONMENT

- Upon termination of exploratory/ drilling operations, all fuel or hazardous materials are to be removed from the area, the site resloped and revegetated if natural revegetation appears unlikely.

- All wastes shall be collected, transported and disposed of at an approved disposal site.

- When backfilling trenches, the material should be replaced in the order it was removed. After backfilling and compaction is completed, the surface should be stabilized. If natural regeneration is unlikely, the site should be revegetated.

This Fact Sheet does not constitute DFO approval; other mitigative strategies may be required. The proponent is advised to contact all other appropriate regulatory agencies.

For more information contact the nearest Department of Fisheries and Oceans office.

FACTSHEET

Stream Clean-up

Department of Fisheries and

CONDITIONS WHERE APPLICABLE

Stream clean-up is sometimes required in streams that have had man made materials introduced into them from various activities/sources. These materials could cause the following problems:

- obstructions to fish migration
- scouring of the natural stream bottom sometimes removing spawning gravels or causing siltation of spawning gravels downstream
- alteration of the natural flow of a stream resulting in streambank erosion or excessive water velocities preventing fish migration
- filling in of the natural bottom substrate resulting in the loss of access to suitable fish spawning/rearing habitat.

Instream barriers to fish migration.

CONSIDERATIONS

- Trees, bushes, shrubs, weeds or tall grasses should not be removed along any streambank. In addition, mats of floating algae or vegetation should not be removed from any section of the stream. These important habitat features provide shade and cover for fish, keeping water temperatures cool, providing insect food for fish and offering protection from predators.
- Woody debris which is not causing any apparent damage to the bottom substrate may be left in place as it provides cover for fish. As woody debris decomposes it becomes a food source for small microorganisms and invertebrates which, in turn, are eaten by trout and young salmon. Decomposition also renews the energy cycle with nutrients.

Overhanging vegetation should not be removed.

- Activities associated with stream clean-up must not alter the flow characteristics of the stream as this may cause streambank erosion, bottom scouring and possible downstream deposition of sediments.

Stream Clean-up

In addition, increased water velocities may act as a barrier to fish migration.

- Streambanks must not be disturbed such that underlying soils are exposed. This could cause silt to enter the stream resulting in a loss of fish habitat. Any streambank that is disturbed should be immediately stabilized by re-vegetating. (See Factsheet # 11 regarding streambank stabilization).

IMPLEMENTATION PROCEDURES

- Instream activity should be scheduled to take place between June 1 and September 30, in order to reduce impacts to fish habitat during fish spawning and incubation periods.
- Instream debris should be removed by hand. Heavy equipment should not be used instream.
- All necessary measures must be taken to avoid the release of silt into the stream. (See Factsheets # 6, 7, 10 and 17 regarding measures to control silt).
- The natural stream bottom substrate must not be altered or disturbed in any way.
- Instream clean-up activities should be carried out during times of low flow.
- All surplus or waste material should be removed from the project area and disposed of at an approved dump-site.
- DFO should be consulted regarding any stream clean-up project prior to start-up.

This Fact Sheet does not constitute DFO approval; other mitigative strategies may be required. The proponent is advised to contact all other appropriate regulatory agencies.

For more information contact the nearest Department of Fisheries and Oceans office.

Fisheries and Oceans Pêches et Océans

Canada

FACTSHEET

Timber Cr

Department of Fisheries a Oceans

CONDITIONS WHERE APPLICABLE

Timber cribs are utilized as a component of marine infrastructure (wharves, slipways, sea walls, etc.) and sometimes as erosion control structures in inland waterways (i.e., abutments).

CONSIDERATIONS

- Construction of timber crib structures, if done improperly, can result in degradation of fish habitat. If improper fill of ballast material is used, silt can be released into waterbodies/watercourses, resulting in potential negative impacts on fish and fish habitat. The location of timber cribs could also result in the physical disturbance or loss of fish habitat.

IMPLEMENTATION PROCEDURES

In order to avoid damage to fish habitat, the following measures should be implemented:

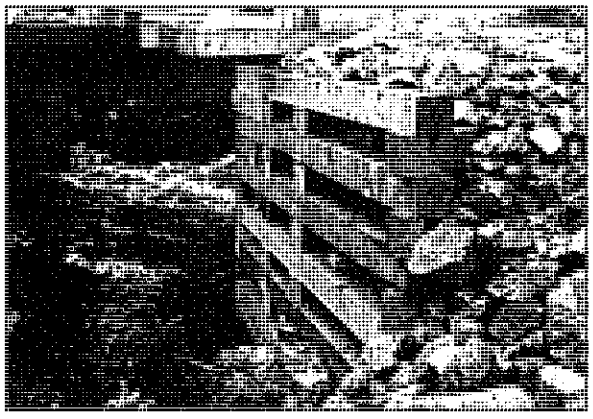
- Any material used to fill a submerged timber crib structure should be free of fines or sediment (e.g., material such as blasted rock or boulders) to a level above the extent of highest normal water levels.

- Material designated as ballast to fill any timber crib structure should never be removed directly from any watercourse or waterbody, from any shoreline below the high water mark, or from any streambank area.

- During all construction and associated activities, the alteration, disruption or destruction of fish habitat (e.g., removal of bottom substrate) in any waterbody should be avoided and siltation kept to an absolute minimum (see Factsheets # 6, 7, 10 and 17 regarding measures to control siltation).

- Shoreline or streambank disturbance should be restricted to the immediate work area. Disturbed shorelines or streambanks must be stabilized by the use of rip-rap, seeding or sodding (see Factsheet # 11 regarding stream bank stabilization in freshwater environments).

- Untreated wood or pressure treated wood is recommended for use in or near freshwater and marine environments. Manually applied wood treatments may also be utilized. Preservatives such as pentachlorophenol (PCP) should not be used in freshwater or marine

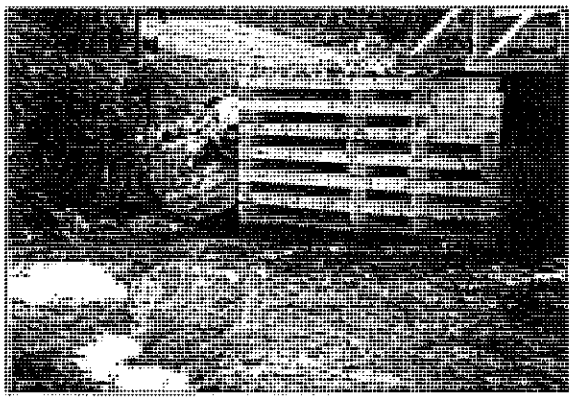


Infill materials for timber cribs.

environments; Creosote should not be used in freshwater but may be used in marine environments; chromium copper arsenate (CCA) can be used in freshwater. Freshly treated preserved wood should be avoided. Environment Canada should be contacted regarding wood preservatives, weathering, and the location of treatment sites for manually applied preservatives.

MAINTENANCE

- Regular maintenance must be carried out on timber cribs to prevent collapsing and possible shifting of the crib or ballast. Any timber crib material moved by ice or wave action should be recovered by the owner.



Timber crib construction: untreated/pressure treated wood.

Timber crib construction for marine environment.

This Fact Sheet does not constitute DFO approval; other mitigative strategies may be required. The proponent is advised to contact all other appropriate regulatory agencies.

For more information contact the nearest Department of Fisheries and Oceans office.

FACTSHEET

Water & Sewer In
Stream Cross

Department of Fisheries a

CONDITIONS WHERE APPLICABLE

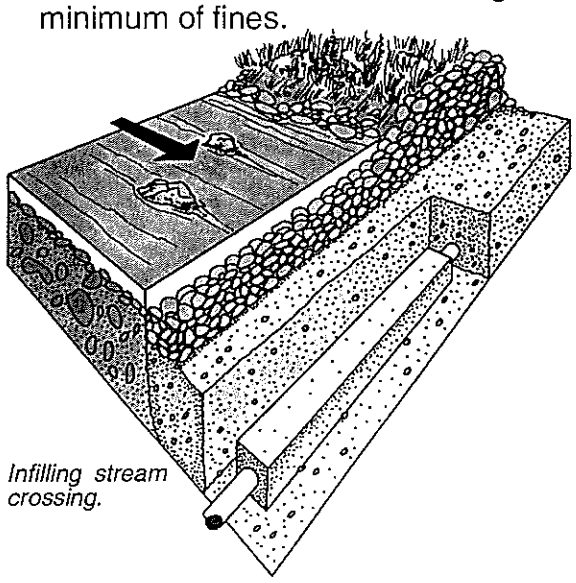
The following mitigation procedures/ options are recommended wherever lines or pipes of any sort (water lines, sewer lines, communications or power cables, etc.) are to be installed under the substrate of any watercourse.

CONSIDERATIONS

- Instream works associated with these types of activities must be carried out in the dry (see Factsheets # 10, 12 and 13 regarding instream work in the dry).
- Silted water arising within work areas should be treated to remove silt prior to release into watercourses/ waterbodies. (See Factsheets # 6, 7, 10, and 17 regarding measures to control siltation).
- Stream banks and approaches to or from crossing areas disturbed as a result of these activities should be stabilized immediately after the crossing has been completed (see Factsheet # 11 regarding stream bank stabilization).

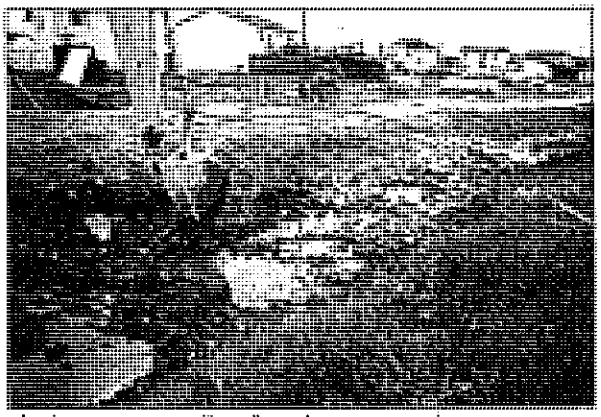
IMPLEMENTATION PROCEDURES

- 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 using a 15-20 cm topping of clean non-erodible materials containing a minimum of fines.



Infilling stream crossing.

- The materials to be used for the "topping" in the crossing area should be consistent with the material substrate of the stream in this area and should be large enough to resist displacement by peak flows.



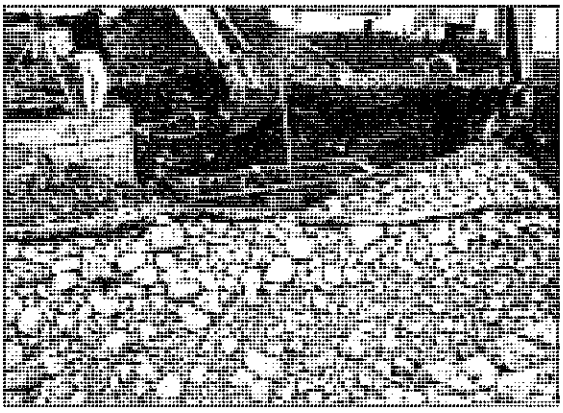
Instream excavation for stream crossing.

MAINTENANCE

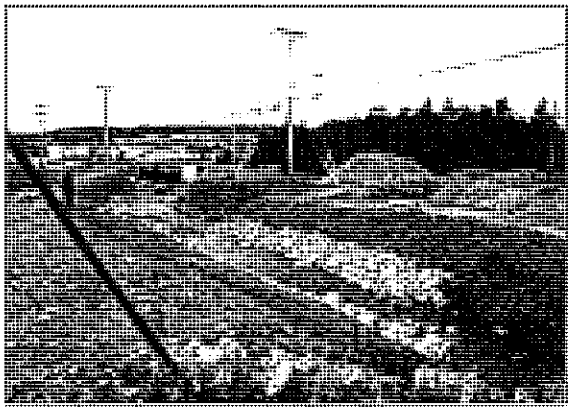
- Once the stream crossing has been properly completed and the crossing area sufficiently stabilized, regular maintenance is usually not required unless site specific problems arise; any subsequent requirements for excavation should be carried out as noted.

ABANDONMENT

- Excess materials resulting from stream bed/stream bank excavation, mitigation procedures, etc., should be disposed of or stockpiled so as to prevent their entry into any watercourse/ waterbody.



Stream bed restored.



Stream crossing completed.

This Fact Sheet does not constitute DFO approval; other mitigative strategies may be required. The proponent is advised to contact all other appropriate regulatory agencies.

For more information contact the nearest Department of Fisheries and Oceans office.

FACTSHEET

Culvert Installations

Department of Fisheries and Oceans

CONDITIONS WHERE APPLICABLE

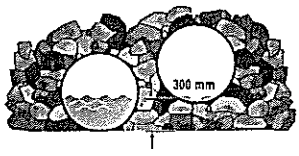
Culverts are the most commonly used method for providing access over a watercourse, and particularly for small and medium sized streams. Several types of culverts are used including; open bottom/bottomless arch, pipe arch, box, and circular/cylindrical. Box type culverts are generally made from wood or concrete while other types are made from plastic, concrete or, most commonly, corrugated steel. Figure 1 identifies various culvert shapes.

Figure 1 Culvert Shapes

Open Bottom Culvert
Maintains natural bottom substrate. Water velocities do not significally change.

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



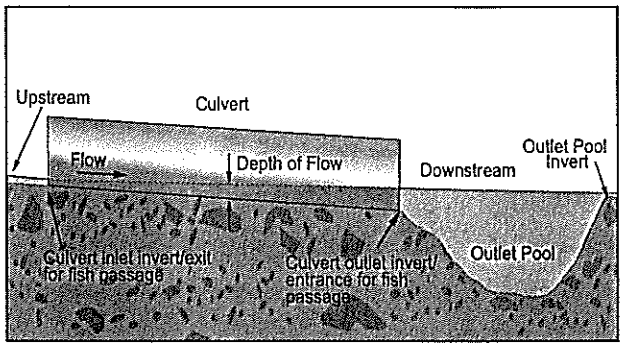
Stacked/Multiple Culvert
Can provide fish passage over a wider range of flows, depths, and water velocities.

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

CONSIDERATIONS

- Sufficient depth of flow and appropriate water velocities for fish passage should be provided in culvert installations.
- 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 of the 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.
- The type 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. Figure 2 illustrates some common terms associated with culvert crossings.

Figure 2. General Culvert Terms



- Natural bottom substrate and hydraulic capacity of watercourses are best maintained using open bottom/bottomless arch culverts; these are the preferred type of culvert crossings.

- 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.

- For installation of cylindrical culverts in fish bearing streams, a minimum culvert diameter of 1000 mm should be provided and designed/sized according to site specific considerations.

- 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 with diameters exceeding 2000 mm should be countersunk a minimum of 15% of the diameter below the streambed elevation. Note: Countersinking reduces the hydraulic capacity of the culvert, therefore the required diameter of the culvert must be adjusted accordingly (Figure 3).

Figure 3. Countersunk Culvert

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

- The culvert should be placed on firm ground and be countersunk to the appropriate depth. In sites where soft foundations are present the unsuitable material 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.

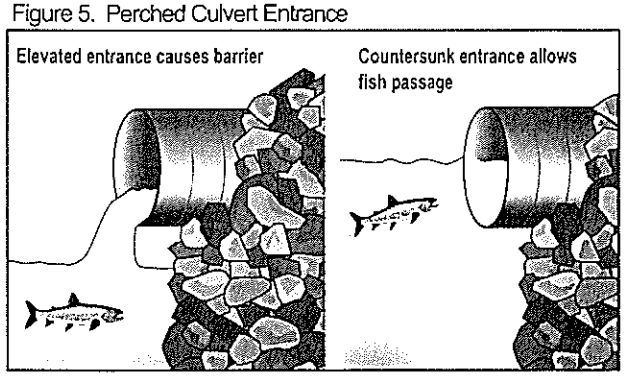
- A culvert should extend beyond the upstream and downstream toe of the fill (eg., a minimum of 300 mm, see Figure 7).

- 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 a minimum of 300 mm above the invert of the fish passage culvert. (Figure 4).

Figure 4. Multiple Culvert Installation

- 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 can cause scouring which may create an obstruction for migrating fish (Figure 5).

Figure 5. Perched Culvert Entrance



- 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. In some cases, an upstream pool may also be necessary.

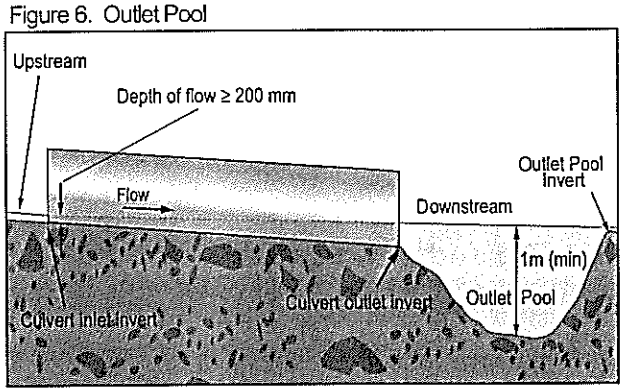
Culvert Installations

- 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 6).

- The culvert slope should follow the existing streambed slope where possible. Excessive 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 allow fish passage and pass peak flows.

- Pools should be designed so that there is a smooth transition of flow from the culvert to the natural stream width.

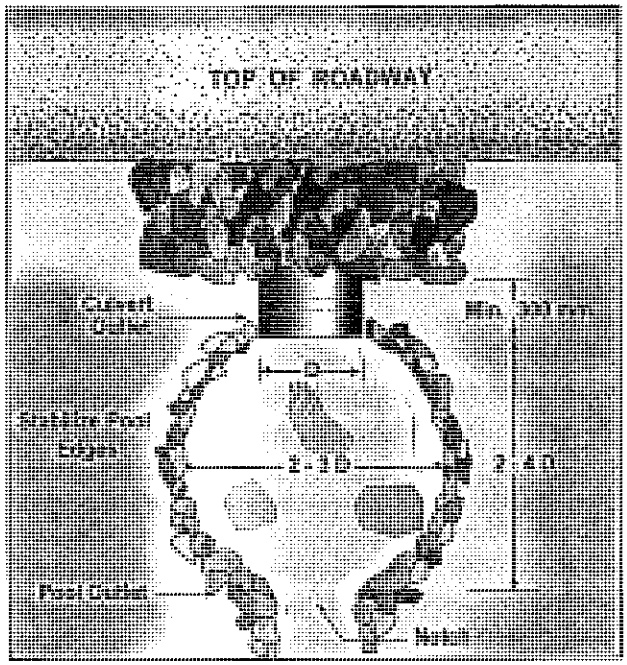
Figure 6. Outlet Pool



- 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. The pool outlet may need to be v-notched to enable fish passage at low flow periods. More than one pool may be required.

- Pools should be pear shaped and sized such that: pool length = 2 to 4 times culvert diameter; pool width = 2 to 3 times culvert diameter; pool depth = 0.5 times the culvert diameter, 1 metre minimum. (Figure 7). The culvert diameter referred to the above is that of the fish passage culvert.

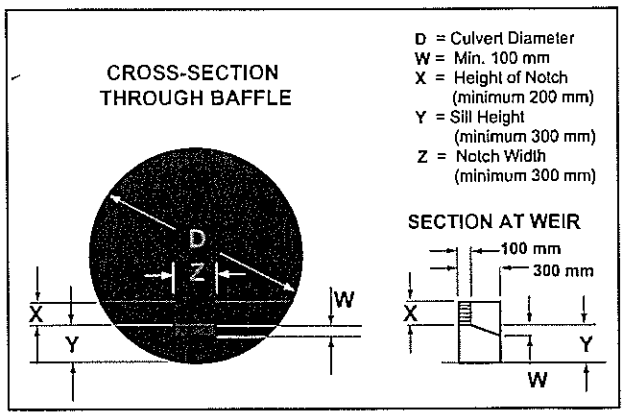
Figure 7. Pool Sizing



- 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.

- Depending on site-specific conditions (eg., 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 should be provided as per Figure 8.

Figure 8. Baffle Sizing



Culvert Installations

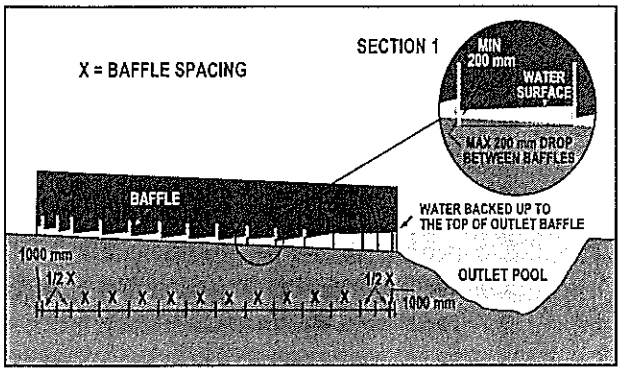
- A minimum depth of flow of 200 mm should be provided throughout the culvert and baffled sections. The drops between adjacent baffles should be a maximum of 200 mm.

- 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. The remaining baffle 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 the 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 large enough to dissipate the kinetic energy produced by the water falling over the weir; and consider high flows (i.e., 10% exceedence based on flow duration) during the fish migration period. Baffle spacing is illustrated in Figure 9.

- The invert elevation of the outlet pool should be set to back water up to the top of the outlet baffle.

- The upstream culvert invert, in some site specific situations, can be countersunk to facilitate depth of flow provided that the head differential is accounted for.

Figure 9. Culvert Baffle Spacing Requirements



Maintenance

Culvert installations should be suitably stabilized to prevent erosion, seepage, and undermining and maintained in good repair and operating condition.

Special Considerations

Modifications of the above criteria/guidance 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.

This factsheet concerning culvert installations is generic and has been developed to apply to a variety of different circumstances. Some site specific situations may warrant modification of the above guidance, as deemed appropriate and in consultation with the appropriate Area Habitat Biologist. In some site specific situations, a professional engineer and/or biologist should be consulted.

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