Watercourse and Wetland Alteration Technical Guidelines

Province of New Brunswick
Department of Environment

Sustainable Development, Planning and Impact Evaluation Branch

Watercourse and Wetland Alteration Technical Guidelines

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Canada

New Nouveau Brunswick

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Fisheries and Oceans Canada

The New Brunswick Department of Natural Resources

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Preface

These Guidelines have been prepared to complement the **Watercourse and Wetland Alteration Regulation 90-80** under the New Brunswick **Clean Water Act** C-6.1, Acts of New Brunswick, 1989.

The Guidelines contain explanatory information which is intended to provide guiding principles for planning a watercourse or wetland alteration or reviewing a proposed alteration. These guidelines should not be considered as a code for the design or construction of any type of watercourse or wetland alteration.

It should be recognized that review and revision of these guidelines will be required from time to time. The information provided has been prepared on a project-type basis. Comments and constructive criticism of these guidelines is encouraged. As appropriate, amendments will be issued, on an as needed basis, to individual portions of the guidelines.

Table of Contents

Introduction

New Brunswick is blessed with many beautiful rivers, lakes and streams which provide sanctuary for an abundance of fish and wildlife and which are increasingly used by humans for recreation and water supply.

Unfortunately, activities are often undertaken which affect our water resources by people who fail to realize that changes made to or near a watercourse may result in damage to property and the aquatic environment and could place our fish and wildlife resources at risk, as well as diminish the quality of our water.

To ensure that property rights are protected and no unnecessary damage to the aquatic habitat occurs, the **Watercourse and Wetland Alteration Regulation** has been proclaimed under the authority of New Brunswick's **Clean Water Act**. The regulation stipulates that a permit be obtained from the *New Brunswick Department of Environment* for all watercourse and wetland alterations. In addition, watercourse and wetland alterations must comply with the habitat provisions of the **Fisheries Act**. Every permit application is carefully evaluated to ensure that the potential effects of a watercourse or wetland alteration are adequately considered at the design stage.

The *New Brunswick Department of Environment* acts as the regulatory body, responsible for processing and issuing all Watercourse and Wetland Alteration Permits. *Fisheries and Oceans Canada* and the *New Brunswick Department of Natural Resources* are routinely requested to comment as advisory agencies on the possible effects on fish habitat of some of the proposed watercourse alterations. In order to simplify the application process, for specific alterations, it is only necessary to apply for a permit through the *New Brunswick Department of Environment*. The federal **Fisheries Act** provides for the protection of fish habitat. Under this Act, no one may carry out any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat (HADD), unless authorized by the Minister of *Fisheries and Oceans Canada*. Some projects are a potential HADD and will require an Application for the Authorization to Harmfully Alter, Disrupt or Destroy Fish Habitat to be submitted to *Fisheries and Oceans Canada*. These applications can be obtained from *Fisheries and Oceans Canada* offices or web site.

The federal **Species at Risk Act** (SARA) provides for the protection and recovery of species at risk, their residences, and their critical habitat. *Fisheries and Oceans Canada* is responsible under SARA for the protection and recovery of aquatic species at risk. Under SARA, no one may harm, harass, capture, take or kill an individual or individuals of species at risk; damage or destroy the residence of a species at risk; or, destroy the critical habitat of a species at risk. The Technical Guidelines contained herein may not apply in areas where species at risk are found. Information about the presence of aquatic species at risk in your area can be obtained by contacting the *Fisheries and Oceans Canada* office in your area or by visiting the following SARA websites: www.sararegistry.gc.ca and/or www.speciesatrisk.gc.ca. If there is an aquatic species at risk found in your project area, you should contact the *Fisheries and Oceans Canada* office in your area if you wish to obtain *Fisheries and Oceans Canada*'s opinion on the possible options you should consider to avoid contravention of the SARA.

The Canadian **Environmental Assessment Act** (CEAA) review may be required for projects reviewed under any Federal legislation. These reviews may require an environmental assessment. Information on this aspect of project reviews can be obtained from Federal government agencies.

The Technical Guidelines contained herein were developed with the goal of promoting environmentally acceptable design and construction methods for alterations which are permitted by the program.

What is a Watercourse?

A watercourse is the full width and length, including the bed, banks, sides and shoreline, or any part of a river, creek, stream, spring, brook, lake, pond, reservoir, canal, ditch, or other natural or artificial channel, open to the atmosphere, the primary function of which is the conveyance or containment of water whether the flow is continuous or not.

What is a Wetland?

A wetland means land that

(a) either periodically or permanently, has a water table at, near or above the land's surface or that is saturated with water, and
(b) sustains aquatic processes as indicated by the presence of hydric soils, hydrophytic vegetation and biological activities adapted to wet conditions.

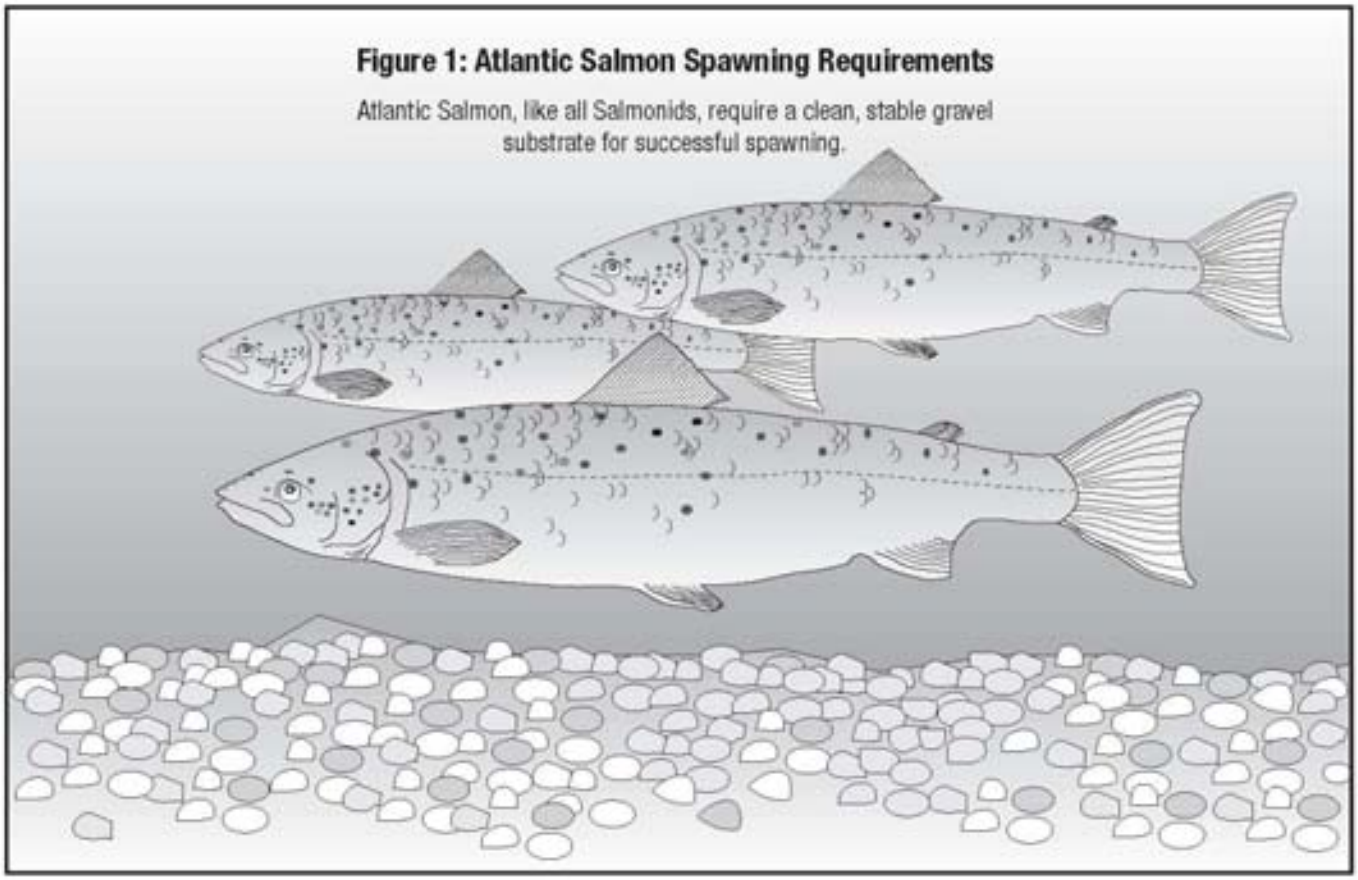
What is an Alteration?

A watercourse and wetland alteration is any temporary or permanent change made at, near or to a watercourse or wetland or to water flow in a watercourse or wetland and includes:

(a) any change made to existing structures in a watercourse or wetland including repairs, modifications or removal, whether the water flow in the watercourse is altered or not,
(b) the operation of machinery on the bed of the watercourse other than at a recognized fording place,
(c) the operation of machinery in or on a wetland,
(d) any deposit or removal of sand, gravel, rock, topsoil or other material into or from a watercourse or wetland or within 30 metres of a wetland or the bank of a watercourse,
(e) any disturbance of the ground within 30 metres of a wetland or the bank of a watercourse except grazing by animals; the tilling, plowing, seeding, and harrowing of land; the harvesting of vegetables, flowers, grains, and ornamental shrubs; and any other agricultural activity prescribed by regulation for the purposes of this paragraph, that occurs more than 5 metres from a wetland or the bank of a watercourse,
(f) any removal of vegetation from the bed or bank of a watercourse,
(g) any removal of trees within 30 metres of the bank of a watercourse,
(h) any removal of vegetation from a wetland or from within 30 metres of a wetland except the harvesting of vegetables, flowers, grains and ornamental shrubs and any other agricultural activity prescribed by the regulation for the purposes of this paragraph, that occur more than 5 metres from a wetland.

What are we Protecting?

The aims of the Surface Water Protection Section are to **preserve our watercourses and wetlands** and **protect aquatic habitat** with mandates to **prevent sedimentation of wetlands and watercourses, prevent property damage, and ensure public safety**.



Preserving our watercourses and wetlands means:

- maintaining water quality;
- maintaining channel capacity;
- maintaining stable banks and riparian vegetation;
- maintaining and promoting aquatic habitat;
- maintaining fish passage.

Aquatic Habitat

Aquatic habitat refers to the living and non living components of the aquatic environment upon which aquatic life, including fish, depend directly or indirectly to carry out their life processes. Fish habitat is a large and important component of aquatic habitat. Wetland habitat is an essential ecosystem component required by both aquatic and terrestrial life.

The **Fisheries Act** defines fish habitat as "spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes". Destruction of fish habitat is a cumulative process which can progress undetected because it is often not visible until it has reached an advanced state.

New Brunswick supports a healthy population of fish throughout its lakes, rivers, and streams. The most well known are members of the salmonid family which includes several species of trout and char, and Atlantic salmon.

Many species of salmonids are hatched and reared in fresh water and migrate to the ocean to grow, returning to fresh water to reproduce. Each species has different requirements for every stage in their life cycle.

Wetland Habitat & Function

Wetlands are critical habitat for a variety of aquatic plants, animals and birds. By definition, wetlands are associated with such features as ponds, swamps, bogs, coastal marshes, inland marshes, floodplains and other related aquatic environments. A considerable amount of New Brunswick's wetlands have been lost, thereby making the protection of remaining wetlands that much more important. Some wetlands are of provincial, national and international significance.

Wetlands perform many important functions, such as:

- protecting human health by storing and purifying ground and surface water;
- maintaining ecosystem health by providing habitats and nutrients for many economically important fish and wildlife species;
- providing habitat for endangered species and other species of special status;
- providing important repositories for biodiversity;
- providing protection from flooding and storm surges; stabilizing shoreline of rivers and along the coast; providing areas for recreation, food production and commercial products.

Basic Requirements Common to Many Salmonids

Water Clarity and Suspended Sediment

Turbidity is a function of the concentration of suspended sediment in water. Suspended sediment is undissolved matter ranging from clay size particles to fine pebble size (2-4 millimetres). Most of this material is made up of soil particles released due to erosion of the banks of a watercourse or disturbed upland areas.

Highly turbid water interferes with the feeding habits of fish. Many fish feed by sight; water clarity is necessary for them to see their food. Turbidity also prevents sunlight from reaching the bottom of the watercourse where most of the primary production in the food chain begins.

The suspended sediment in highly turbid water can interfere with the breathing processes or migration patterns of fish.

Dissolved Oxygen

Salmonids require water with a high dissolved oxygen content. It is especially critical during egg incubation, hatching and in the first few weeks of life. The levels of dissolved oxygen in water are decreased by increases in temperature.

Temperature

Salmonids prefer cooler water temperatures of 12°C to 18°C. Temperatures of 24°C or more are considered lethal. Warmer water holds less dissolved oxygen than water at colder temperatures. Migrations have been delayed by temperatures in watercourses being either too warm or too cold.

Gravel Substrate

Salmonids require clean gravel, approximately 1-15 centimetres in size, for successful spawning. See Figure 1. They bury their eggs 15-35 centimetres into the gravel in autumn. The eggs remain there and develop over the winter. They hatch into the larval form called alevins. The alevins remain in the gravel until their yolk sacks have dissolved and they emerge from the gravel in late spring.

Passage

Salmonids migrate at different times of the year in response to a variety of needs. They may migrate to spawn and reproduce, find food, escape predators, or find different habitats as they grow older. Unobstructed migration routes are necessary for these vital functions in order for the life cycle of the population to continue.

Riparian Vegetation

Riparian zones are those zones of land immediately adjacent to the watercourse or wetland, including the banks. The vegetation in these zones is crucial for maintaining and nurturing fish habitat by providing the following:

Shade - The vegetation along the banks of the watercourse scatters the sunlight and shades the water, protecting it from the heating effects of the direct sun.

Food - Riparian vegetation contributes insects and detritus such as leaf litter into the watercourse which act as food sources for the fish.

Shelter - Riparian vegetation, in the form of tall grasses, shrubs and trees, protects fish from predators.

Erosion Control - The root system of vegetation contributes to bank stability and intercepts runoff which limits erosion and sedimentation, protecting fish habitat from harmful effects of sedimentation

Filter - Vegetation and root systems act to filter out pollutants such as pesticides, bacteria, fertilizers, heavy metals, sediment, and hydrocarbons.

Table 1: The Potential for Negative Impact of Various Types of Watercourse and Wetland Alterations

	TYPES OF WATERCOURSE AND WETLAND ALTERATIONS										
CONCERNS	Bridge	Culvert	Erosion Control	Vegetation Removal	Debris Removal	Land Extension	Water Intake	Ford	Dredging	Dams	Pipeline/ Cable
Fish Passage	•	•	•	•	•	•	•	•	•	•	•
Riparian Vegetation	•	•	•	•		•	•	•			•
Substrate		•	•	•	•	•	•	•	•	•	•
Dissolved Oxygen				•	•		•	•	•	•	•
Temperature				•			•		•	•	•
Sedimentation	•	•	•	•	•	•	•	•	•	•	
Flooding	•	•			•			•	•	•	
Water Quality	•			•			•		•	•	•
Volume of Water		•					•			•	
Navigational Hazard	•	•	•	•		•	•	•	•	•	•
Destruction of Property	•	•	•	•		•		•	•	•	•

Impacts of Watercourse and Wetland Alterations

Table 1 shows where various types of watercourse and wetland alterations may have a negative impact on basic fish habitat requirements as well as other concerns relating to public safety and protection of property.

Erosion and Sedimentation

Some of the most common and serious consequences of an improperly planned watercourse or wetland alteration are caused by erosion and sedimentation.

Erosion is the removal and loss of surface material by the action of water, ice, gravity, or wind. Sedimentation is the deposition of fine particles which have been eroded from an exposed surface and transported by water. In a natural setting, a balance exists between erosion and deposition; a section of land erodes, the eroded particles are deposited downstream or deposition occurs during a low flow period followed by erosion at the same location the next time high flows occur.

Most alterations involve disturbance to the banks and adjacent land, or to the bed of the watercourse, or both. The rate of erosion of disturbed surfaces can be thousands of times the rate from an undisturbed setting. As a result, the natural balance between erosion and deposition cannot be maintained, and vast quantities of sediment may end up in our watercourses.

Sediment can vary in size between fine clay to small pebbles. The amount that remains suspended in water depends on the particle size and flow velocities in the watercourse. The deposition of suspended sediment occurs when the velocity of water can no longer transport the sediment. See Table 2.

Table 2: Transport velocities for various sizes of bed materials

	Transport Velocity (cm/s)	Material Size (mm)
Clay	> 15	< 0.002
Silt	15 - 30	0.002 - 0.02
Sand	30 - 65	0.02 - 2.0
Gravel	80 - 120	5.0 - 15
Pebble	140 - 240	25 - 75
Cobble	270 - 390	100 - 200

Most of the sedimentation and siltation problems are caused by fine sand size (0.25 millimetres) to silt size (0.002 millimetres) particles. Fine clay particles can stay in suspension for a very long time (i.e. in excess of one year).

Almost all alterations have the potential to introduce sediment into watercourses. One of the mandates of the Surface Water Protection Section is to avoid sedimentation of watercourses by requiring that preventative measures be taken during the construction phases of the project.

Sedimentation of watercourses is destructive to fish habitat whether the sediment remains suspended in the water or settles out. The following conditions are the result of excess sediment entering the watercourse:

1) Suspended solids entering the watercourse may coat and abrade the body surfaces of fish, including their sensitive gill areas. It may cause them to overproduce mucous, blocking the absorption of dissolved oxygen, or accumulate on the gill surfaces, causing them to hyperventilate or smother.

2) Fine particles blanket the bed of the watercourse, filling in and eliminating the interstitial spaces in the gravel beds where eggs are incubating, or where the alevins are resting and feeding, eventually smothering and killing them.
3) The turbidity caused by suspended sediments prevents sunlight from reaching the bottom of the watercourse reducing photosynthesis in algae and rooted aquatic plants, leading to a reduced food supply for all aquatic animals.
4) Deposition of sediment in the watercourse on existing clean gravel bottoms renders them unsuitable for spawning or resting grounds.
5) Accumulation of suspended sediment can lead to a decrease in water depth, causing overheating of the water, resulting in temperatures above the acceptable ranges for fish habitat.
6) Increased turbidity levels can cause changes in fish feeding behaviour, since salmonids feed by sight and prey is less visible. It could result in starvation of fish in the affected area.
7) Bottom dwelling organisms, upon which fish depend for food, such as aquatic insect larvae or other aquatic invertebrates, may be smothered and killed or their habitats destroyed.
8) Sediment may scour invertebrates and aquatic plants from their substrates in the watercourse.

Other impacts resulting from excess sedimentation include:

1) Deposition of sediment resulting in unstable watercourse substrate.
2) Culverts may become plugged with sediment or other material resulting from slope failure, leading to flooding, road washouts and introduction of debris into the watercourse.
3) Introducing sediment into a watercourse may diminish drinking water quality, and reduce channel and reservoir capacity. If the flow capacity is lowered by a reduction of channel capacity, the potential for flooding is increased.

Some of the harmful effects of erosion include:

1) Erosion reduces the stability of the banks of a watercourse which could lead to slope failure and loss of adjacent property.
2) Erosion of the banks of a watercourse and adjacent areas may destroy the riparian vegetation.
3) Eroded soil particles may be washed into the watercourse. These particles, particularly if they originate from agricultural land, contain nitrogen, phosphorous and other nutrients which can lead to development of thick algal blooms, reducing oxygen content and water clarity for the fish population.
4) Thousands of dollars every year may be spent repairing badly eroded watercourse banks, washed out roads, blocked culverts or on fish habitat restoration projects.

Specific measures to control surface erosion and sedimentation are discussed in a later chapter.

What Else Can Go Wrong?

Improperly designed structures such as bridges or culverts which are incapable of passing high water flows can cause flooding and result in property and watercourse damage downstream.

Changes made to the bed or banks of a watercourse may cause unstable channel conditions causing erosion, meandering, increased potential for flooding and bed material transport, which may result in property damage adjacent to the watercourse.

Improperly constructed or designed dams could fail, resulting in flooding, property damage, or even loss of life downstream. Alterations may also cause substantial changes in the availability of water suitable for domestic and industrial consumption as well as for a number of other uses including agriculture, forestry, fishing, mineral development, tourism, outdoor recreation, and power production.

Alterations may have a negative impact on wildlife habitat by causing changes which affect waterfowl nesting areas or other fauna.

Fish Passage

Adult fish migrate to spawn, to find food, to escape predation, or to reside in deeper pools before the winter freeze-up occurs. Juvenile fish migrate to rearing areas which are often small creeks and channels. Unobstructed pathways and water characteristics conducive to swimming are necessary for migrations to occur. Adult salmonids must reach spawning grounds at the proper times and with enough energy to complete the life cycle. Swimming ability of fry and juvenile fish are limited by their body length making it more difficult for them to swim if confronted with an obstruction.

Dams with no fishways, blocked culverts, or debris jams present physical obstructions to fish passage. Other barriers, such as increased flow velocities, may not be immediately apparent.

Barriers created by improperly designed or installed culverts are common. These barriers are created by conditions which impede fish swimming ability and include the following:

- culvert slope greater than 0.5%, or variable slope;
- perched outlet;
- channelization of flow leading to increased velocity;
- inadequate water depth caused by an oversized culvert;
- excessive culvert length.

Other impediments to fish passage resulting from improperly planned or performed alterations include:

- reduced concentrations of dissolved oxygen;
- high turbidity;
- high temperatures;
- low temperatures.

Activities Which Require a Permit

Watercourse and wetland alterations not only involve actual physical alterations of the watercourse or wetland, they include all activities taking place within 30 metres of the shoulders of any watercourse or the upland edge of a wetland that is either 1 hectare or larger in area or contiguous with a watercourse involving the removal, deposit or disturbances of the water, soil, or vegetation. Some examples of common watercourse and wetland alterations include:

- bridge and culvert installation and repair;
- use or construction of a ford;
- road construction, landscaping, and the removal of trees and shrubs within 30 metres of the shoulder of a watercourse or the upland edge of wetlands that are either 1 hectare or larger in area or contiguous with a watercourse;

- addition of any material including clean fill, sand, gravel or rocks to the bed, shoreline or within 30 metres of the shoulders of any watercourse or the upland edge of wetlands that are either 1 hectare or larger in area or contiguous with a watercourse;
- draining, pumping, excavating, or removing: water, soil, mud, sand, gravel, aggregate of any kind, or debris from any watercourse or wetland;
- construction and installation of breakwaters, retaining walls, wharves, groins;
- operation of heavy machinery within 30 metres of the shoulders of any watercourse or the upland edge of wetlands that are either 1 hectare or larger in area or contiguous with a watercourse;
- installation or modification of a dam and/or any water level control structure;
- installation or modification of any pipeline crossing;
- pond creation, by-pass or dug out.

Activities Which Do Not Require a Permit

1) Watercourse and Wetland Alteration Permits are usually not issued for watercourses which are not depicted on the *New Brunswick Department of Natural Resources* digital water layer or represented on the black and white 1:10,000 scale orthophoto hard copy maps.

   In each case the proponent must be informed of this policy in a letter bearing the Section manager's signature, which includes the PID # of the property bordering the reach of watercourse where the proposed alteration(s) are to take place and provisions intent on minimizing any negative impacts on the watercourse and its water quality.

   It is the responsibility of the proponent to comply with the **Fisheries Act** of Canada. If fish are present, at any time during the year, contact *Fisheries and Oceans Canada*, Habitat Management Division, prior to commencement of work. The **Watercourse and Wetland Alteration Regulation** does not have jurisdiction over watercourses subject to tidal variations in level and flow. However, wetlands that are subject to variations in level and flow are under the jurisdiction of the **Watercourse and Wetland Alteration Regulation**.

   The Navigable Waters Protection Program of *Transport Canada*, the Habitat Management Division of *Fisheries and Oceans Canada*, and the *New Brunswick Department of Natural Resources* should be contacted regarding any activities involving coastal waters.

2) Exemptions - There are a limited number of activities exempt from obtaining a Watercourse and Wetland Alteration Permit, even though they fall under the definition of an alteration. These activities are:

   Any alteration of or to a wetland that is less than 1 hectare in area and is not contiguous to a watercourse.

   The harvesting of aquatic plants or the removal of aquatic plants by physical means for recreation, navigation or gathering food and the use of aquatic plant harvesting equipment in the area of harvesting.

   Repair of a structure if no modification is made to the size, shape, materials, and alignment and the repair does not involve any instream work.

   Withdrawing water at a rate of less than 45 litres per minute for exploration drilling as long as permission had been received from the Mining Recorder to proceed with the work under paragraph 109 (1) (d) or 110(1)(b) of the **Mining Act**, and the terms and conditions under which the permission is granted are followed.
   Installation of drainage tile for agricultural land, provided standards agreed upon by the *Department of Agriculture, Aquaculture and Fisheries* are followed and the project has been approved by the *Department of Agriculture, Aquaculture and Fisheries*.
   The installation and removal of seasonal wharves that do not require any construction or excavation during installation or removal.

   Any activity within 30 metres of a wetland or the banks of a watercourse that requires an approval under the **Water Quality Regulation - Clean Environment Act**, provided the applicant is issued an approval prior to commencing the activity and they complete the activity according to the required conditions within the time frame for which the approval is valid.

   The construction of a roadway, railway, or agricultural drainage ditch if there is no danger of pollution as a result of the construction and operation of the ditch and if the ditch does not break the bank of a watercourse.

   The maintenance of a roadway, railway or agricultural drainage ditch if the ditch does not break the bank of a watercourse, no change is made to the alignment of the ditch, there is no deposit of any material in a wetland, and there is no danger of pollution as a result of maintenance.

3) Crown Lands - Unless it is deemed necessary by the *New Brunswick Department of Environment*, on Crown Lands, alterations undertaken on a watercourse that drains an area of 600 hectares or less at the site of the alteration or to a wetland do not require a Watercourse and Wetland Alteration Permit provided that an operating plan approved by a Regional Director of the *New Brunswick Department of Natural Resources* is in place.

Drinking Water Supply Watersheds

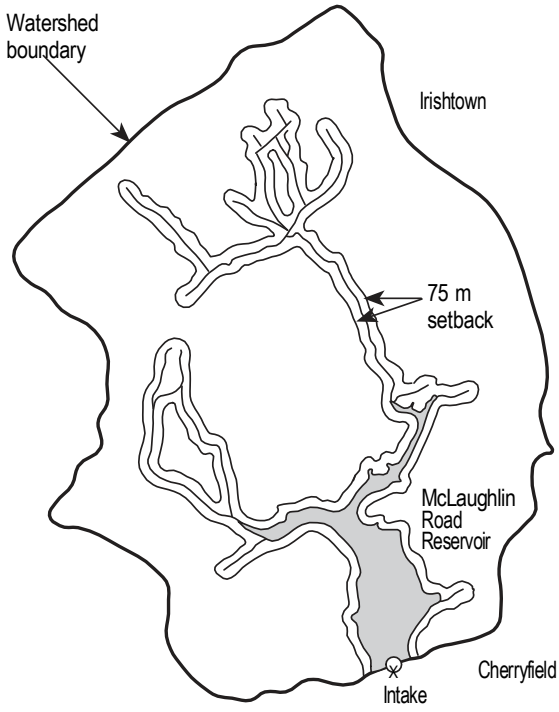
In New Brunswick, 30 surface watersheds used for municipal drinking water supplies are protected under the **Clean Water Act**. The **Watercourse Setback Designation Order** came into effect on November 8th, 1990 and protected the 75-metre riparian buffer zone within these areas. See Figure 2. On November 1st, 2001, the second phase of the Watershed Protection Program came into effect with the enactment of the **Watershed Protected Area Designation Order - Regulation 2001-83, Clean Water Act**. This regulation places standards on land and water uses within 3 zones of protection within the designated watersheds: Zone A - designated watercourses, Zone B - the 75-metre riparian setback, and Zone C - the balance of the watershed area.

The **Watershed Protected Area Designation Order** requires individuals to apply for a Ministerial Exemption in order to undertake or continue a restricted or prohibited activity. Therefore, applications for watercourse and wetland alterations taking place within a protected watershed are also reviewed under the terms of the **Watershed Protected Area Designation Order**. As a result, a permit and a Ministerial Exemption may be granted with more stringent conditions to protect the quality of the water supply. Occasionally, an application for a Watercourse and Wetland Alteration Permit will be refused if the Minister feels the work constitutes a risk to the drinking water supply.

Maps of the protected watersheds and information on the **Watershed Protected Area Designation Order** may be obtained from regional offices of the *Department of Environment* or on the Watershed Protection Program website at: http://www2.gnb.ca/content/gnb/en/services/services_renderer.201091.html. Further information can also be obtained from:

Drinking Water Source Protection Section
Sustainable Development, Planning and Impact Evaluation Branch
New Brunswick Department of Environment
PO Box 6000, 20 McGloin Street
Fredericton, New Brunswick
E3B 5H1
Telephone (506) 444-4599
Fax (506) 457-7805

Figure 2: Example of Drinking Water Supply Watershed



Watercourse and Wetland Alteration Permits

The requirement to obtain a Watercourse and Wetland Alteration Permit before undertaking an alteration became law by way of the **Watercourse Alteration Regulation** under the **Clean Environment Act** in 1977. The regulation was proclaimed under the **Clean Water Act** in 1990 and modified in 2003 to include wetlands. The name of the regulation was changed to the **Watercourse and Wetland Alteration Regulation - Clean Water Act**.

Watercourse and Wetland Alteration Permits are issued with strictly enforced "Conditions of Approval" in order to control activities that fall under the definition of alterations in an effort to preserve and protect watercourses and wetlands.

Types of Permits

Standard - issued for a single alteration. Standard applications are subject to review by the *Department of Environment* and, in some cases, the *New Brunswick Department of Natural Resources*, and *Fisheries and Oceans Canada* before approval is granted.

Multiple - a single permit issued for the alteration of more than one site. Alterations in an application for a multiple permit must have a common factor (e.g. applicant, type of alteration, etc.). Under the Watercourse Alteration Certification process for "Watercourse Crossings - Forestry Operations" certified individuals are entitled to submit an application for certain types of watercourse alterations for multiple sites. Once the course is successfully complete, the certified individual can undertake watercourse crossing installations on freehold and private property under a multiple permit. On Crown Land, installations on watercourses with a drainage area less than 600 ha must be part of an approved Operating Plan. Installations/alterations on watercourses draining areas in excess of 600 ha require approval from the *New Brunswick Department of Natural Resources* and a Watercourse and Wetland Alteration Permit. certified individual must apply for a permit which will cover all planned activities for the period of June 1 to September 30. Any unforeseen installation requires that a notification be sent to the *New Brunswick Department of Environment* as soon as the permittee becomes aware of them. By October 20th of each year, every certified individual with a valid permit is required to submit a report detailing the installation and the design parameters of all watercourse crossings installed that construction season.

Provisional - issued for alterations that have little or no potential for detrimental impact on a watercourse or wetland provided the prescribed conditions are followed. These types of permits are typically
issued for the low flow period of June 1st - September 30th of the same year. Due to the nature of the permitted alterations, Provisional Permit applications are not subject to the same regulatory review process as standard and multiple applications. If the information submitted with the Provisional Permit is acceptable, the proposed alteration may be promptly approved through this process. The notification form, which includes the acknowledgement signed by the Regional Director of the *New Brunswick Department of Environment* and Conditions of Approval, constitutes a permit. Alterations which **may** be undertaken under a Provisional Permit are:

a) Beaver dam management and removal
b) By-pass pond
c) Centreline clearing
d) Cutting non-marketable woody vegetation
e) Dug-out ponds
f) Existing boat launching ramps, ferry landings, and recognized fords
g) Geotechnical investigations
h) Instream data collection devices
i) Pipeline and cable crossings and outfall pipes
j) Removal of man-made obstructions and alterations
k) Retaining walls
l) Rip-rap/Armour stone
m) Selective harvesting
n) Surface runoff and drainage changes
o) Water Intake Structures

***NOTE: The above alterations are only eligible for a Provisional Permit if the Applicability Criteria listed on the "Provisional Permit Notification Form" can be met and the applicable "Conditions of Approval" can be satisfied.**

Provisional Permits may be obtained from any regional office of the *Department of Environment*.

Emergency - issued in an emergency situation prior to the submission of the application. The *New Brunswick Department of Environment* determines whether or not the situation is deemed an emergency.

Renewal - if the proponent was unable to carry out or complete the alteration within the specified period, a renewal may be requested within two years of the original issue date. After this time period, a new permit application must be submitted. Permits may be renewed a maximum of twice in five years.

Fee Schedule

The following fees are required for processing applications pursuant to the **Watercourse and Wetland Alteration Regulation**, Section 15(1) and (2).

1) A Standard application respecting one alteration - $25.00
2) A Multiple application respecting more than one alteration - $20.00 for each up to a maximum of $200.00
3) An Emergency application - $50.00
4) A Provisional Permit application - $10.00
5) A Permit renewal - $10.00

NOTE: Fees must accompany each application and be in the form of a cheque or money order payable to the Minister of Finance for New Brunswick.

Municipal, Provincial and Federal agencies, and Crown Corporations are **EXEMPT** from the processing fee.

How to Apply for a Watercourse and Wetland Alteration Permit

Application forms for Watercourse and Wetland Alteration Permits can be obtained from:

Surface Water Protection Section
N.B. Department of Environment
3rd Floor, 20 McGloin Street
P.O. Box 6000, Fredericton, NB E3B 5H1

Direct inquiries: Telephone: (506) 457-4850, Fax: (506) 453-6862, or from one of the District/Regional offices of the following agencies:

New Brunswick Department of Environment

New Brunswick Department of Natural Resources

New Brunswick Department of Agriculture, Aquaculture and Fisheries

New Brunswick Department of Transportation

Fisheries and Oceans Canada

The completed application form, the required documents and the application fee should be submitted to the Surface Water Protection Section of the Sustainable Development, Planning and Impact Evaluation Branch, (address above) at least 2 months in advance of the anticipated starting date to ensure sufficient time for review of the application. Figure 3 displays the decision framework applied to applications.

Information on the Surface Water Protection Section can be found at the following websites:

English:
http://www2.gnb.ca/content/gnb/en/services/services_renderer.2935.html

French:
http://www2.gnb.ca/content/gnb/fr/services/services_renderer.2935.html

Application forms for a Watercourse and Wetland Alteration Permit can be printed from the above web site. Applications can also be obtained from any Regional Offices of the *New Brunswick Department of Environment*.

Provisional Permit Notification Forms are only available from the Regional Offices of the *New Brunswick Department of Environment*. See Table 3. The Provisional Permit Notification Forms are to be submitted to and will be issued from the Regional Office that is responsible for the site of the alteration.

Table 3: Regional Offices, New Brunswick Department of Environment

Region	Physical Address	Mailing Address	Telephone	Fax	Email
Region 1 Bathurst	159 Main Street Bathurst, NB E2A 1A6	P.O. Box 5001 Bathurst, NB E2A 3Z9	(506) 547-2092	(506) 547-7655	elg.egl-region1@gnb.ca
Region 2 Miramichi	316 Dalton Avenue Industrial park Miramichi, NB E1V 3N9	316 Dalton Avenue Industrial park Miramichi, NB E1V 3N9	(506) 778-6032	(506) 778-6796	elg.egl-region2@gnb.ca
Region 3 Moncton	Provincial Building 325 Dieppe Blvd Moncton, NB E1A 8L5	P.O. Box 5001 Moncton, NB E1C 8R3	(506) 856-2374	(506) 856-2370	elg.egl-region3@gnb.ca
Region 4 Saint John	8 Castle Street Saint John, NB E2L 3B8	P.O. Box 5001 Saint John, NB E2L 4Y9	(506) 658-2558	(506) 658-3046	elg.egl-region4@gnb.ca
Region 5 Fredericton	Priestman Centre 565 Priestman St. Fredericton, NB E3B 5X8	Priestman Centre P.O. Box 6000 Fredericton, NB E3B 5H1	(506) 444-5149	(506) 453-2893	elg.egl-region5@gnb.ca
Region 6 Grand Falls	65 Broadway Boulevard Grand-Sault/Falls, NB E3Z 2J6	P.O. Box 5001 Grand-Sault/Falls NB E3Z 1G1	(506) 473-7744	(506) 475-2510	elg.egl-region6@gnb.ca

Documents Required with the Submittal of Watercourse and Wetland Alteration Applications

The following table (Table 4) gives a listing, by alteration type, and of the documents required with the submittal of an application for a Watercourse and Wetland Alteration Permit. The documents are required to allow fair and adequate review of proposed watercourse and wetland alteration projects.

Applications must be accompanied by one copy of the application form and three copies of all other documents. Failure to submit required documents could result in the return of the application without it being processed.

Definitions of the Required Documents

Engineering Scale Drawings
Fully dimensioned scale drawings prepared with the use of drafting instruments and showing all dimensions necessary to describe the size, shape and location of the proposed alteration, relative to the watercourse or wetland. These drawings must be prepared by or under the direct supervision of a person licensed to practice as a Professional Engineer in New Brunswick, pursuant to the **Engineering and Geoscience Professions Act**. The drawings must bear the seal of the Professional Engineer.

Drawings to Scale
Fully dimensioned scaled drawings and showing all dimensions necessary to describe the size, shape, and location of the proposed alteration, relative to the watercourse or wetland.

Dimensioned Sketches
Freehand drawings with all the dimensions necessary to describe the size, shape, and location of the proposed alteration, relative to the watercourse or wetland.

Map
This is not meant to be a hand drawn sketch. Road maps, topographical maps, etc., or copies thereof are acceptable. If LRIS maps, legal surveys or air photos are used, it is the applicant's responsibility to be sure that they clearly show the location of the project footprint relative to well known (labelled) landmarks such as watercourses, railways, roads and/or transmission lines, etc.

Property Identification Number (PID)
The application requires that the Property Identification Number (PID #) be included. This will assist in property location and ownership confirmation.

Coordinates
Coordinates obtained from a GPS unit are preferable as an additional piece of information to confirm project location.

*** NOTE: A map is required with every application.**

Table 4: List of Activities Requiring Regulatory or Regulatory and Advisory Review

Alteration Type	Regulatory & Advisory	Regulatory*	Required Documentation	Provisional Permit	Certification
Beach construction	X		Drawings to scale (plan, profile) Map & PID #		
Beaver dam management and removal - No wetland characteristics and causing infrastructure damage (See WWATG for details) - All others	 X	 X	Dimensioned sketches Map & PID #	 X	 X
Boat launching ramps ferry landings and fords		X X X	Bed material analysis Drawings to scale (plan, profile, x-section) Map & PID #	X X X Existing	
By-pass ponds		X	Drawings to scale (plan, profile, x-section) Stream flow information Map & PID # Environmental Impact Assessment (Volume dependent)	X	
Causeways	X		Specifications Drawings to scale (plan, profile, x-section)** Map & PID # Environmental Impact Assessment		
Channel cleaning	X		Drawings to scale (plan, profile, x-section) Map & PID #		
Dams	X		Specifications Engineering scale drawing** (plan, profile, x-section) Map & PID #		

Alteration Type	Regulatory & Advisory	Regulatory*	Required Documentation	Provisional Permit	Certification
Debris removal - Minimal disturbance - Potential HADD	 X	 X	Dimensioned sketches Map & PID #	 X	
Diversions and cut-offs	X X		Bed material analysis Drawings to scale (plan, profile, x-section)** Map & PID #		
Draining - lakes - ponds and - wetlands	 X X X		Drawings to scale Environmental Impact Assessment Map & PID #		
Dredging	X		Bed material analysis Drawings to scale (plan, profile, x-section) Map & PID #		
Dug-out ponds		X	Drawings to scale (plan, profile, x-section) Map & PID #	X	
Erosion control works		X	Dimensioned sketches Map & PID #	X	
Fish habitat improvement works	X		Drawings to scale (plan, profile, x-section) Map & PID #		
Flood protection works	X		Bed material analysis Drawings to scale (plan, profile, x-section) Map & PID #		
Floodwater diversion channels	X		Bed material analysis Drawings to scale (plan, profile, x-section)** Map & PID #		
Instream data collection devices		X	Drawings to scale (plan, profile, x-section) Map & PID #	X	
Land extensions	X		Drawings to scale (plan, profile, x-section) Map & PID #		
Pipeline/cable crossings - open cut - working in isolation of stream flow - cofferdam method - channel diversion method - trenchless - aerial - non-buried	 x x 	 x x x x	Bed material analysis Drawings to scale (plan, profile, x-section) Map & PID #	 x For some activities	
Removal of major obstructions	X		Drawings to scale (plan, profile, x-section) Map & PID #		
Removal of minor obstructions		x	Dimensioned sketches Map & PID #		
Salmon pool - restoration - creation and - rock placement	 x x x		Bed material analysis Drawings to scale (plan, profile, x-section) Map & PID #		
Subdivisions and linear development projects - New construction - Maintenance	 x 	 x	Drawings to scale (plan, profile, x-section) Map & PID #		
Surface runoff and drainage changes	X		Dimensioned sketches Map & PID # Environmental Impact Assessment	x	

Alteration Type	Regulatory & Advisory	Regulatory*	Required Documentation	Provisional Permit	Certification
Tree, bush and shrub removal		x	Dimensioned sketches Map & PID #	x	
Water control structures	X		Specifications Drawings to scale (plan, profile, x-section) Map & PID #		
Watercourse crossing **- Bridge**	x	x (Clear span)	Drawings to scale (plan, profile, x-section)** Dimensioned sketches showing size,		x
- Culvert	x	x	shape alignment and slope		x
- Temporary crossings	x	x	Map & PID #		
Water intake structures	X	X	Drawings to scale (plan, profile, cross-section) Pumping rates and schedule Equipment and construction Maintenance flow analysis Map & PID #	x	
Wharves and piers		x	Drawings to scale (plan, profile, x-section) Map & PID #		

* In some situations, Advisory review may be required. See respective sections in the Guidelines. Most projects will become Regulatory and Advisory if the alteration is to be undertaken outside the preferred June 1st to September 30th construction period.

** Plans submitted for those alteration types indicated by ** may be required to bear the seal of a person licensed to practice as a **Professional Engineer pursuant to the Engineering Profession Act**, depending on the size and/or potential impact of the project.

NOTE: Additional documentation or information may be requested by the *Department of Environment*. All projects require a full description of the proposed construction methods and materials.

NOTE: The federal Fisheries Act provides for the protection of fish habitat. Under this Act, no one may carry out any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat (HADD), unless authorized by the Minister of *Fisheries and Oceans Canada*. Some project reviews under the process of Regulatory and Advisory are potential HADD.

If You Do Not Receive a Permit

If your proposed works are considered to have a negative impact on the environment, the water resource, or the aquatic habitat, you will receive a letter from the Regional Services Branch of the *Department of Environment*, explaining why your proposal was not approved.

If you are not satisfied with any explanation you receive from the Department, you may appeal to the Minister of the Environment.

If You Do Not Comply with the Clean Water Act

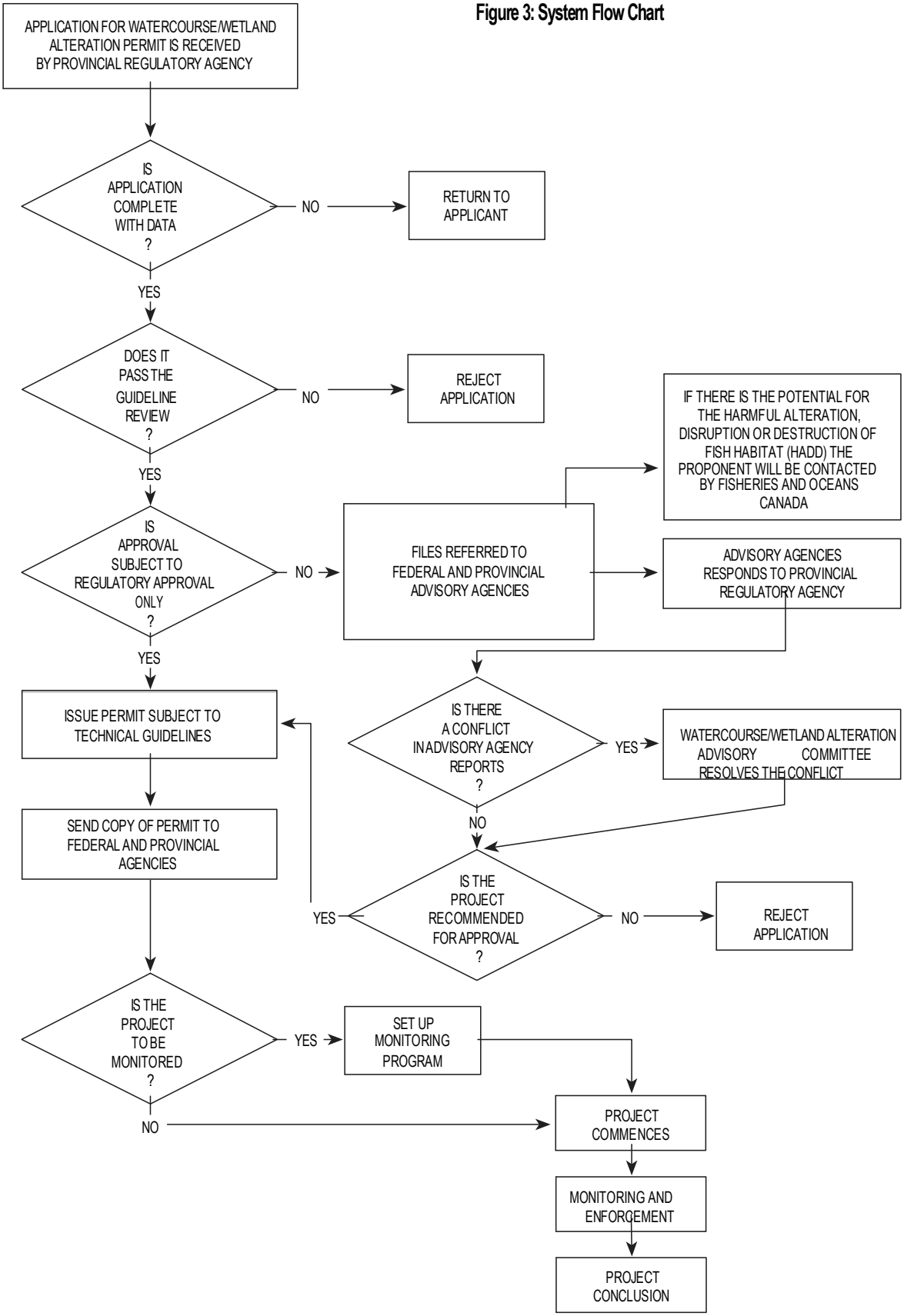
When carrying out a watercourse or wetland alteration you must have obtained a valid permit, and carry out only the work included in the "Description of Watercourse/Wetland Alteration" in compliance with all the "Conditions of Approval" included in the permit. Failure to fulfill any of the above requirements could result in a prosecution under the **Clean Water Act**. In the case of a conviction under the Act, the following fines can be levied:

1) In the case of an individual, a fine of not less than five hundred dollars ($500) and not more than fifty thousand dollars ($50,000), and
2) In the case of a person other than an individual, a fine of not less than one thousand dollars ($1,000) and not more than one million dollars ($1,000,000).

If you plan an alteration within an incorporated municipality or within the boundaries of a Planning District, you should make certain that your proposed watercourse and wetland alteration does not violate any municipal or planning by-laws. It is the applicant's responsibility to obtain the necessary approvals.

The *New Brunswick Department of Agriculture, Aquaculture and Fisheries* may be involved with the review of the Watercourse and Wetland Alteration Permit applications for agricultural projects.

Figure 3: System Flow Chart



Construction sites and activities constantly deal with the challenges of water management. These challenges may be due to groundwater or surface water, along with wet weather conditions. Understanding a construction site prior to initiating ground disturbance is essential in order to plan for water control measures, erosion control and sediment control.

Effective mitigation measures can simplify site management and reduce the potential of watercourse impacts as described in the section entitled Surface Erosion and Sedimentation Control. A site risk assessment should be undertaken for all sites to determine the potential for problems and identify solutions which include best management practices (BMP's). Once completed, the project managers must address these issues. All stages of construction should include effective water control measures, erosion control measures and sediment control measures.

Water Control Measures

Water control is essential on any construction site as water must be kept clean. Upland surface runoff should be diverted around the site and the construction site isolated from the stream flow so that clean water does not become contaminated with sediment or negatively impact the construction site. Otherwise, contamination of the water will result in additional costs and measures in order to treat this water.

Upland surface water runoff should be controlled by diverting the flow away from the construction site. This can be accomplished by using berms, off-take ditches, sediment fences or hay bales wrapped with fabric. Construction sites should be prepared to handle overland flow to reduce the potential of clean water becoming contaminated with sediment from the construction activities.

Construction activities within and immediately adjacent to the channel or a watercourse must be isolated from the stream flow. This can be done with the use of cofferdams, temporary diversions and pump-around techniques.

When cofferdams are used to isolate the work area from flowing water, approximately two-thirds of the cross-sectional area of the channel should remain open at all times. Cofferdams should consist of: sheet piling or a layer of 6 mil plastic sandwiched between an inner wall of in situ earth fill and an outer wall of either rocks, sandbags, or a steel H-beam attached to the bottom of a sheet of plywood. If pier(s) are constructed in the wetted portion of the watercourse where it is not possible to build a cofferdam, a floating sediment barrier anchored to the bottom with a medium that readily conforms to the substrate profile, should be placed around the work area.

No excavation may be carried out inside the cofferdam or sediment filtering curtain until the cofferdam/curtain is completely closed. Water pumped from inside the cofferdam should be pumped into a settling pond, behind a silt filtering medium, or onto an adjacent vegetated area sufficient in size to filter any water returning to the watercourse, such that the concentration of suspended solids in the watercourse does not increase more than 25 mg/litre above background levels.

The cofferdam material must be completely removed immediately upon completion of all work in the wetted portion of the watercourse and the watercourse substrate shall be restored to closely resemble pre-installation grades and profiles. Water diversion activities can also be accomplished by one of the following methods:

(a) constructing a temporary plastic lined diversion. The diversion channel must not be any longer than absolutely necessary to efficiently accomplish the planned project and shall be excavated from the downstream end;

(b) stemming the flow upstream of the in-channel work area and pumping the flow around the site to a point immediately downstream of the work area. An impermeable cofferdam must be constructed to block the flow upstream and downstream, if necessary to prevent backflooding, of the construction site and arrangements made to ensure the flow is constantly pumped around the site until the installation is completed.

Other techniques may be utilized as approved by the Regulatory and Advisory agencies.

Surface Erosion and Sedimentation Control

Erosion is the wearing away of an exposed surface; sedimentation is the deposition of eroded particles. Erosion control prevents or minimizes erosion, and sediment control involves trapping suspended particles.

All surface erosion and sedimentation control undertakings may not fall under the definition of a watercourse and wetland alteration (see introductory chapter). It is worthwhile, however, to devote a discussion of the general practices and some specific measures used to prevent and control these processes, since many of the harmful impacts caused by watercourse alterations are a direct result of excess sedimentation. Most impacts can be minimized or avoided through proper planning and by implementing simple preventative measures.

The techniques discussed below are often assigned as part of the "Conditions of Approval" in permits for those watercourse and wetland alterations known to produce excess sediment.

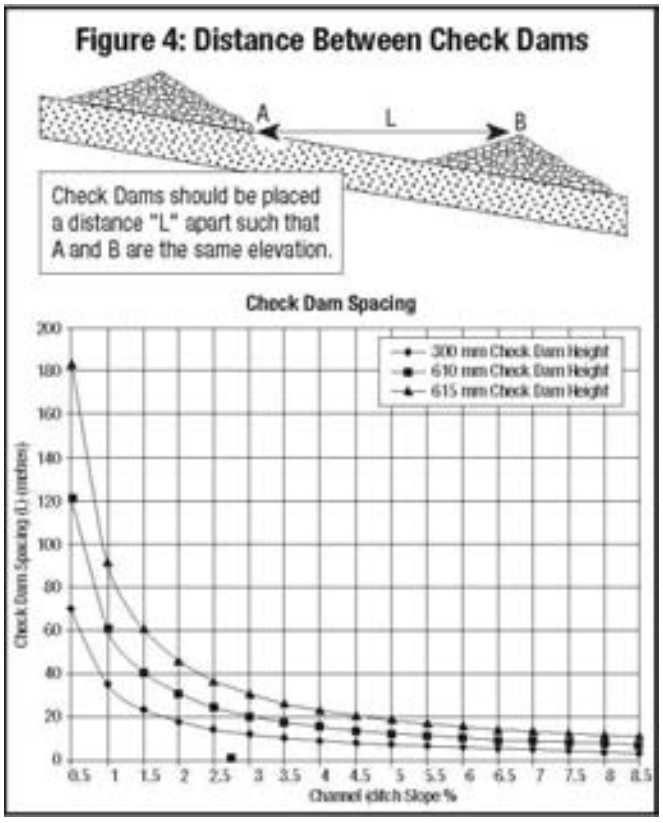
Design Principles

If basic principles for prevention of surface erosion and sedimentation are considered at the design stages of the project, potential problems will be minimized. These principles are as follows:

1) Limit the size of the disturbed area.
2) Limit the time the disturbed area is exposed.
3) Plan construction to coincide with the low flow period from June 1st to September 30th of any year.
4) Retain existing vegetation wherever feasible. Erosion is minimal on a surface covered with natural vegetation.
5) Encourage re-vegetation of exposed areas.
6) Divert upland surface runoff away from exposed areas. Dykes and constructed swales may be used to divert runoff.
7) Keep the velocity of surface runoff low. This can be accomplished by:
   - limiting the slope and gradient of disturbed areas;
   - covering erodible soils with mulch, vegetation or rip-rap;
   - constructing check dams or similar devices in constructed swales and ditches.

Construction Techniques

It is essential to place sediment control devices before the construction phase of a watercourse or wetland alteration begins in order to intercept and trap sediment before it reaches the watercourse. These devices must remain in place until permanent vegetation has been established or the site is otherwise stabilized. Specific sediment control measures are listed below.



Check Dams

Ditches or man-made swales are used to concentrate flow beside a road, adjacent to a disturbed or newly seeded area, or towards a sediment pond or vegetated area. This concentrated flow may erode the ditch. Check dams are temporary structures made from stones, straw bales, sandbags, or logs constructed across a ditch to reduce the velocity of the concentrated flow and thereby the potential for erosion and sedimentation until permanent stabilization of the disturbed area has been established. The following criteria apply to the use of check dams:

1) The drainage area of the ditch or man-made swale must not be greater than 4 hectares.
2) The check dams should be installed before runoff is allowed to flow through the ditch.
3) The dams should be constructed so that the centre of the dam is at least 15 centimetres lower than the elevation at which the ends of the dam tie into the existing ground. This may be accomplished with a notch in the centre of the dam.
4) The dams must be embedded into the bottom and banks of the ditch to prevent undercutting and runaround.
5) Check dams spacing depends on the slope of the ditch, erodibility of the soil and drainage area. See Figure 4.
6) Regular inspections are necessary to ensure that sediment does not accumulate to an elevation of more than half of the height of the dam at which point the accumulated sediment should be removed.
7) Before removal of the check dam, all accumulated sediment must be removed and disposed of in an area such that it cannot re-enter any watercourse.
8) Check dams should be removed when they are no longer needed or when the ditch becomes permanently stabilized with vegetation or a non erodible lining.

Stone Check Dams (Figure 5) are usually constructed with stones having a minimum dimension of approximately 50 millimetres. A geotextile filter should be placed under the stones to provide a stable foundation and to facilitate removal of the stones with minimal disturbance to the original ground. This filter should be keyed into the base of the dam to prevent flow beneath the fabric and sandwiched between the stones on the vertical section of the dam. Stone check dams vary in height up to 1 metre, depending on the size and drainage area of the ditch and should be placed such that the elevation of the toe of the upstream dam is the same elevation as the top of the next downstream dam.

Log Check Dams (Figure 6) should be constructed with logs of 10-15 centimetres diameter salvaged from clearing operations if possible. The logs should be embedded at least 45 centimetres into the soil.

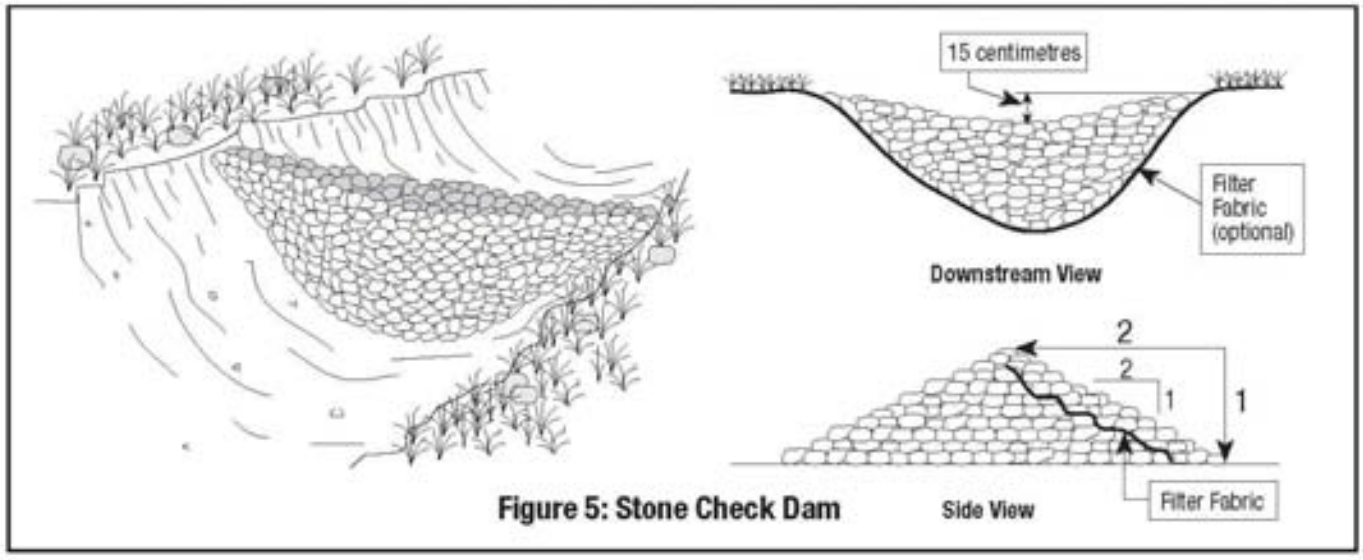


Figure 5: Stone Check Dam

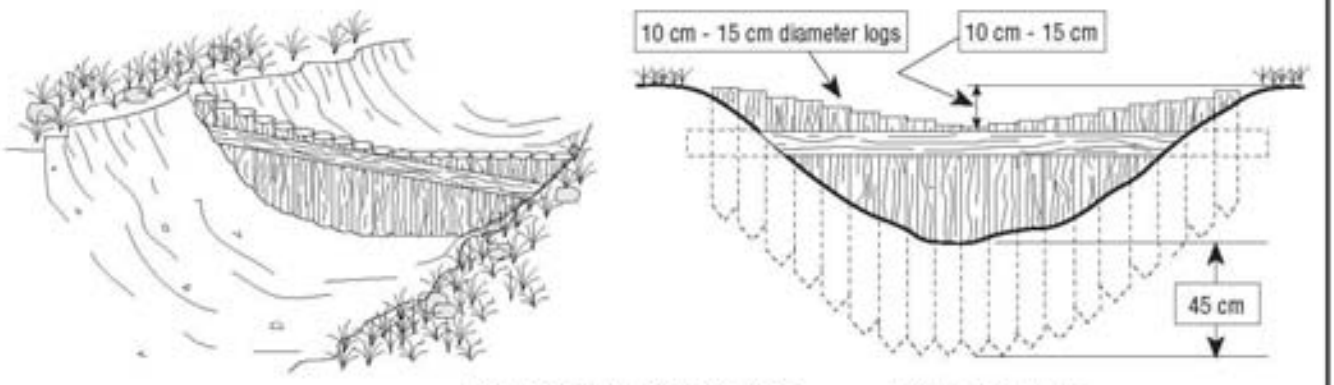


Figure 6: Log Check Dam

Straw Bales are often used for check dams. Their use must be limited to ditches with drainage areas less than 0.8 hectares. They must be keyed into the ditch and staked with two stakes angled towards the adjacent bale. Straw bales must be checked on a regular basis as they can deteriorate in 30 to 60 days. Straw bales are recommended over hay bales because they do not deteriorate as quickly.

Straw Bales and Silt Fences

Straw bale barriers and silt fences function as sediment barriers which are placed around the downslope perimeter of a disturbed area or along the bank of a watercourse in order to intercept and filter runoff, trapping the sediment before it reaches a watercourse.

The following criteria apply to the use of straw bale barriers and silt fences:

1) The contributing drainage area must be less than 0.1 hectares per 30 metres of barrier or fence.
2) The slope behind the barrier should be no steeper than 2 horizontal to 1.
3) The runoff being intercepted is in the form of sheet or rills.
4) These sediment barriers should be erected prior to any soil disturbance of the upland area.
5) Sediment deposits should be removed when they reach one half the height of the filtering medium.

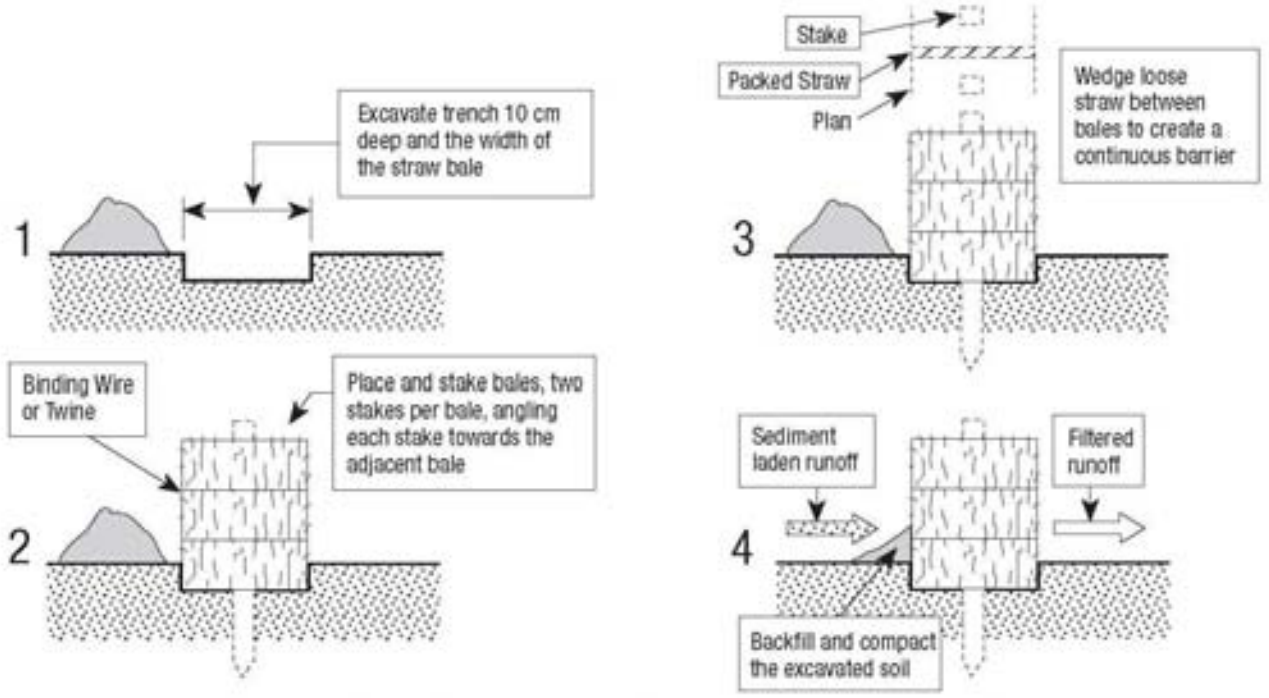


Figure 7: Cross-Sectional View of Straw Bale Barrier Installation

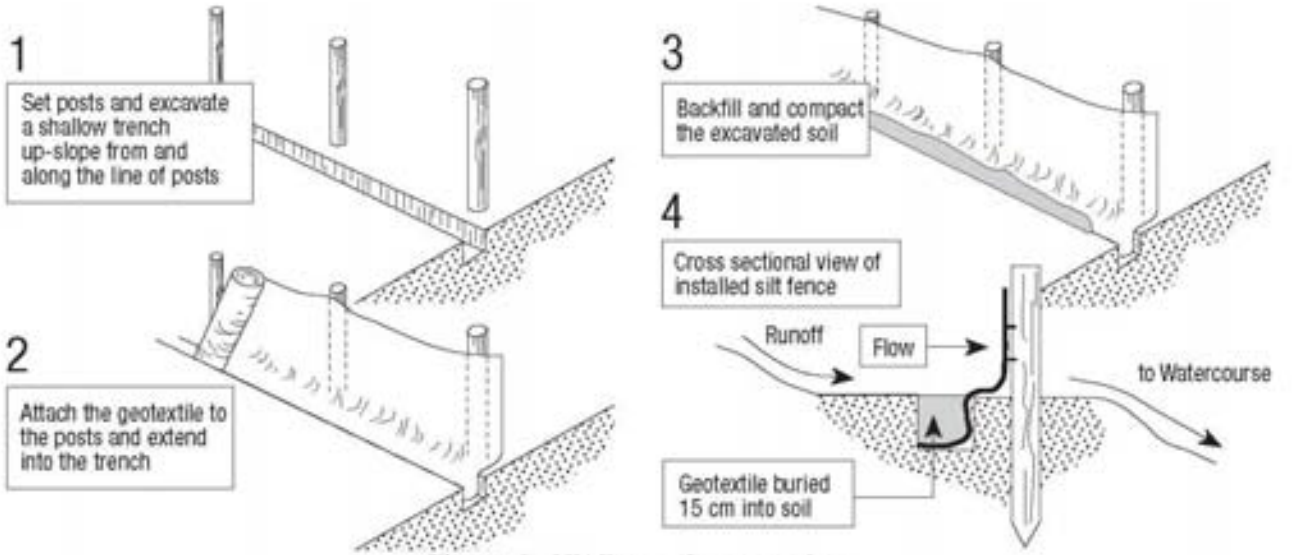


Figure 8: Silt Fence Construction

Straw Bales (Figure 7) may be used if they are bound with wire or string. They should be placed lengthwise in a trench, staked, (at least 2 stakes per bale), and a small bank of fill placed against the downslope side. Straw bale barriers should be checked regularly and immediately after each rainfall for repair or replacement if necessary. These barriers should be removed after approximately 60 days or sooner if deteriorating.

Silt Fences (Figure 8) Woven and non woven synthetic fabrics are available for use as silt fences. The fabric is erected, to a height no greater than 0.9 metres above ground level, using wooden or steel posts. Reinforcement of the fabric may be necessary. The bottom of the fabric should be embedded. Seams must be over-lapped and secured. Silt fences are more costly than straw bales but usually last longer (up to 6 months) and are more effective.

Water Diversion

These temporary channels or dykes are constructed across the slope for the purpose of diverting surface runoff from upslope drainage areas away from disturbed areas to a stabilized outlet or a sediment trapping facility until permanent stabilization has occurred.

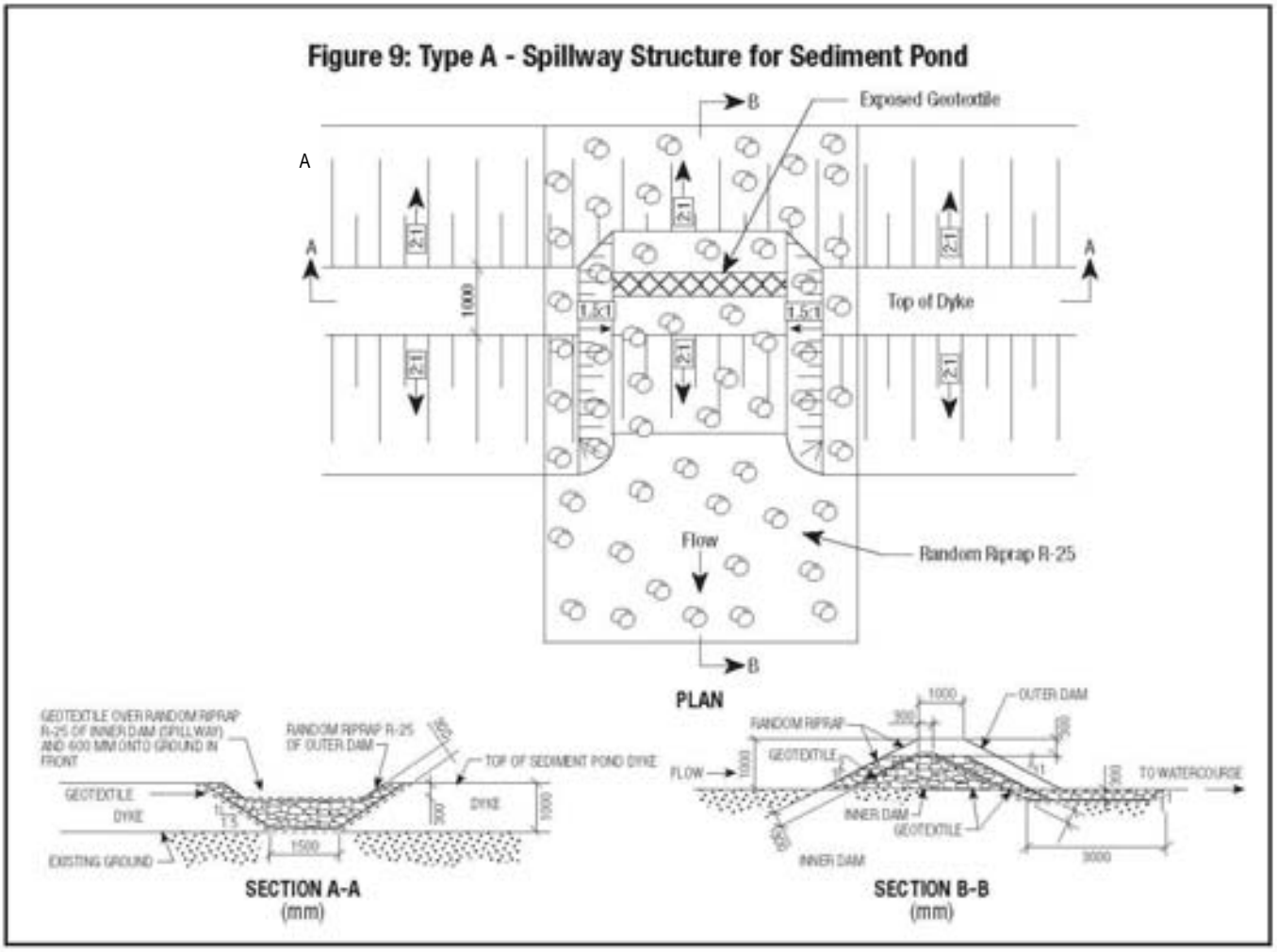
Diversion Channels are excavated channels with a supporting ridge on the lower side. The channels can be parabolic, V-shaped or trapezoidal. The dyke should be stabilized immediately with temporary or permanent vegetation. The channel may be stabilized with vegetation or rip-rap. The diversion must have an outlet that conveys the outflow to a point where the discharge will not cause any erosion or sedimentation. The outlet may be a grassed waterway, a vegetated or paved swale or a stable ditch. Maintenance is necessary to maintain diversion capacity, storage, ridge height, vegetative cover, and the outlet. When constructed properly, these structures are durable, economical, effective, and require little maintenance.

Re-Vegetation

The above techniques are temporary measures aimed at preventing sedimentation of watercourses resulting from erosion by surface runoff of a disturbed area. These techniques should only be maintained until permanent vegetation is established on the disturbed area. Re-vegetating disturbed areas for long term protection should be a part of erosion control plans for every project where feasible.

The following guidelines apply to re-vegetation:

1) Site preparation:
   - Utilize erosion and sediment control techniques where needed.
   - Grade the disturbed area to a stable uniform slope. Vegetative cover will never develop on an unstable slope until it has eroded back to a stable angle. This angle is generally accepted as 2 horizontal to 1 vertical.
   - Remove stones or debris.
   - Loosen the soil by hand raking.
   - Fertilize where necessary.
2) Plant when the weather will permit suitable temperatures and moisture for plant growth. Spring plantings give the best results. Seeds should not be planted within 45 days of the first killing frost. Germination may occur but the seeds would not likely survive the winter.
3) Mulch must be used. It increases the odds of successful re-vegetation by conserving moisture, modifying soil temperatures, and preventing soil compaction.
4) Choose a low cost, low maintenance seed mixture that is adapted to the local climate and soil conditions and which is fast growing.
5) Hydroseeding is an acceptable process where a slurry of seed, fertilizer, wood fibre mulch and water is sprayed on the exposed area.
6) Regular maintenance including irrigation and fertilization must be included in all erosion control plans.



New Brunswick Department of Transportation Erosion Control Measures

The *New Brunswick Department of Transportation* has standardized measures for erosion control which are included in their official tenders for proposals. These methods include erosion control measures categorized as, Type A, Type B and Type C.

Type A functions as a temporary ponding area located at points of discharge from a disturbed area, drainage ditch or a culvert inlet. It is constructed by excavating a hole adjacent to an embankment for impounding runoff. Sediment laden runoff from disturbed areas is detained long enough for the majority of the sediment to settle out before it can enter a watercourse. The discharge from the impoundment is filtered by rip-rap which lines the outlet. See Figure 9.

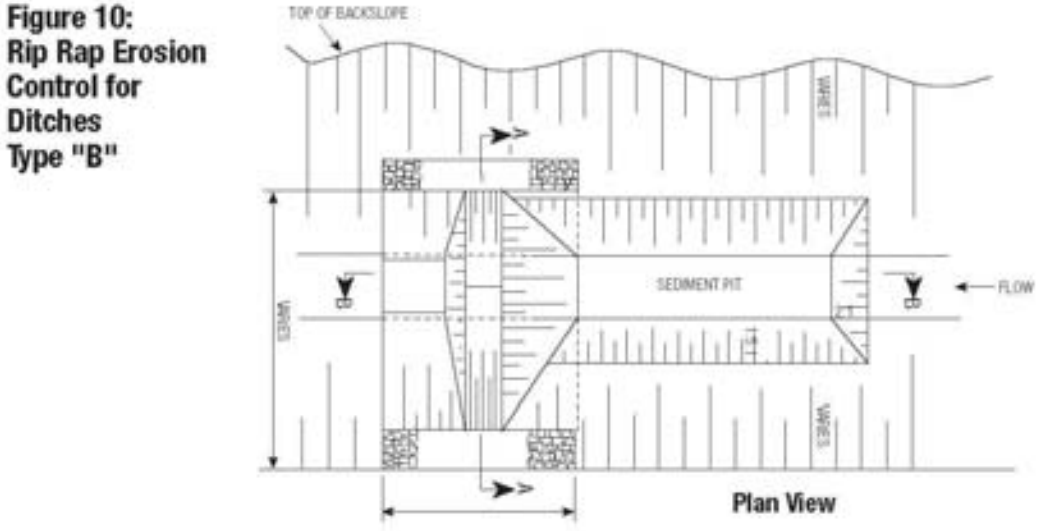
Regular maintenance includes removal of sediment when it accumulates to a depth equal to half of the design depth of the trap.

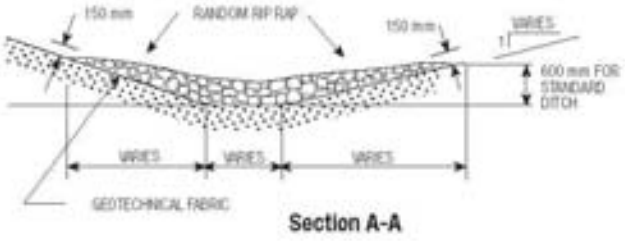
Type B and Type C function similar to the check dams discussed previously. They consist of a small dam constructed across a ditch. A small detention pond is excavated adjacent to the upstream side of the dam where the runoff is detained before discharging through a depression which must be incorporated into the top of the dam. The outlet for Type B consists of rock with an impermeable membrane sandwiched between the rocks. See Figure 10. Type C outlet consists of straw bales. See Figure 11.

These measures for erosion and sediment control are successfully used in the province by the *Department of Transportation* and have been adopted by many other government agencies and private industries.

These measures are maintained until vegetation on the seeded slopes is sufficiently established to be an effective erosion deterrent.

Figure 10:
Rip Rap Erosion Control for Ditches Type "B"





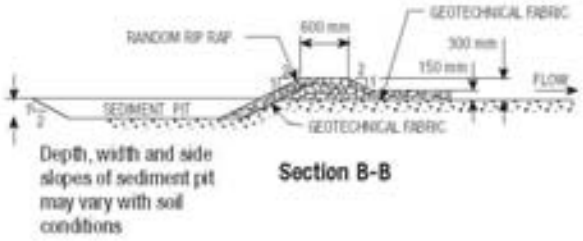
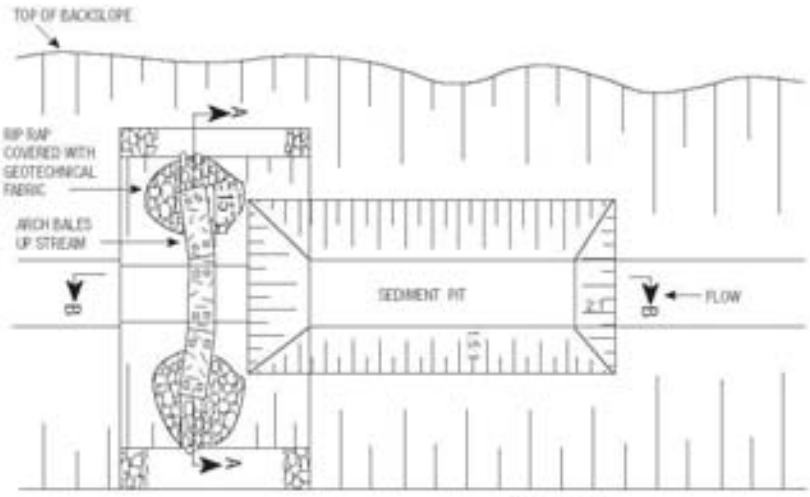
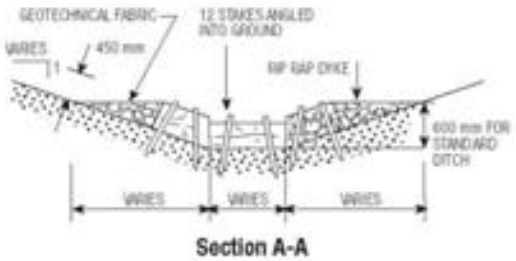
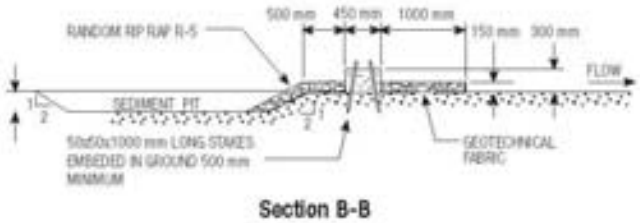


Figure 11:
Straw Bale Erosion Control for Ditches Type "C"







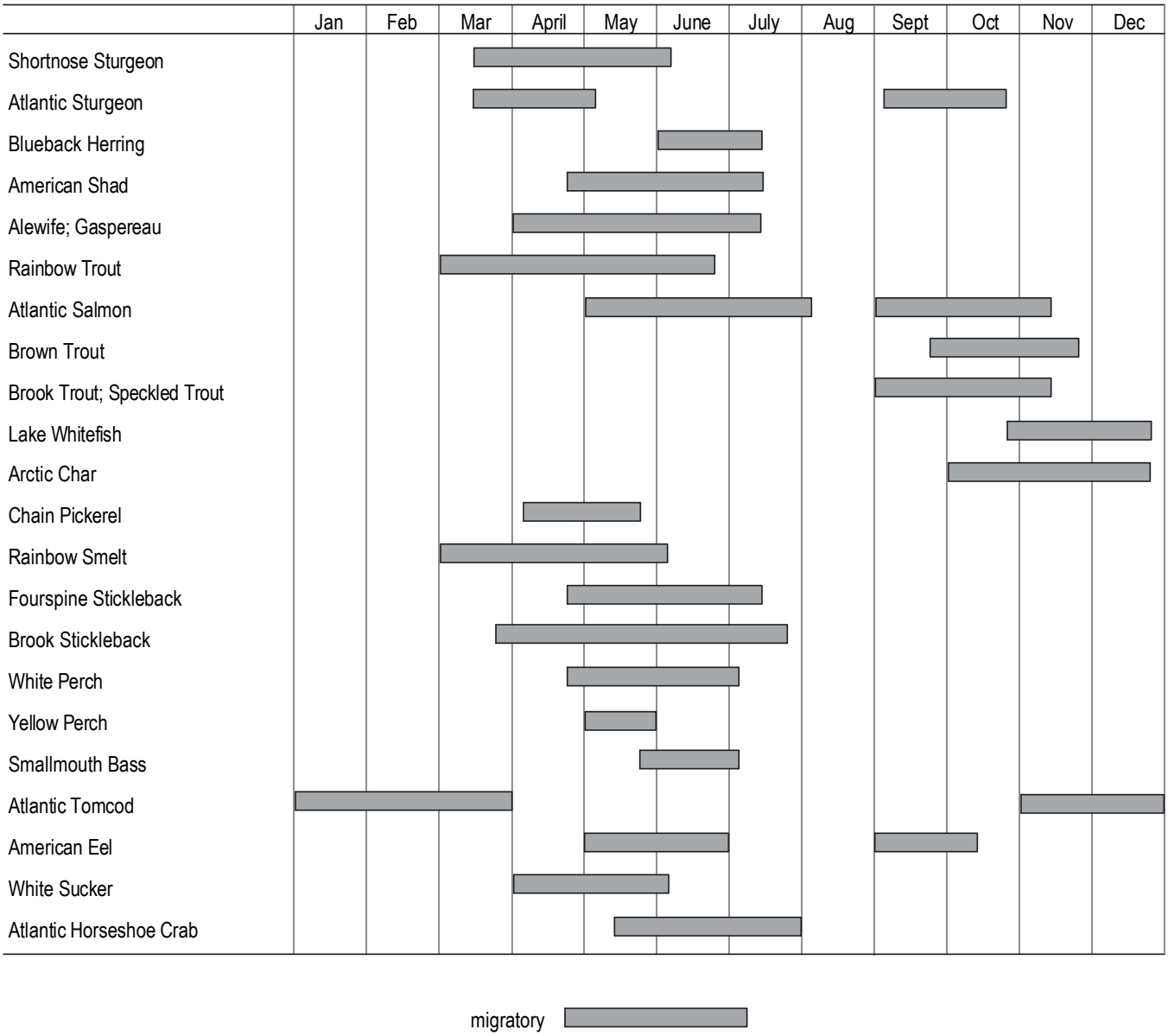
1) Machinery and pollutants must be located or stored in areas not in danger of floodwaters. Machinery in use shall be located such that in the case of a flash flood, it can be removed from the flood areas.
2) All necessary precautions shall be taken to prevent the discharge or loss of any harmful material or substance into the watercourse, including but not limited to; creosote, hydrocarbons, biocides, fresh cement, lime, paint, or concrete.
3) Any debris and excavated material resulting from construction activities shall be removed from the watercourse/wetland and adjacent areas and be disposed of, or placed in a location where it cannot be returned to the watercourse/wetland. Sites must be cleaned up and stabilized against erosion.
4) If any equipment is used in the watercourse/wetland, it must be mechanically sound, having no leaking fuel tanks or hydraulic systems, and be steam cleaned free of petroleum products and dirt.
5) No washing of tools, forms, or machinery may occur in or adjacent to a watercourse/wetland.
6) All work operations must be done in such a way that sedimentation of the watercourse and disturbance to the project area is minimized.
7) If the banks of the watercourse are disturbed by any activity associated with a project, they must be immediately stabilized to prevent sedimentation.
8) No soil shall be disturbed during any period when it is saturated with water.
9) The permittee must take the necessary precautions to ensure public safety.

Timing of Instream Work

Any works carried out in watercourses, particularly with heavy machinery, may have adverse effects on the fish resources of these watercourses, as well as on the use of these resources by the public. With judicious timing of instream work, adverse effects may be reduced. Instream work with heavy machinery can never be regarded as harmless. The adverse effects of instream works with heavy machinery occur in a variety of ways but some of the more significant are: obstruction of the watercourse during the spawning migration of anadromous fish species, including salmon, trout gaspereau, shad, smelt and in a few areas brown and rainbow trout; heavy sedimentation of spawning beds following egg deposition, leading to smothering of the eggs; injurious effects of excessive sediment on resident populations of trout and juvenile Atlantic salmon, filling in of established trout and salmon pools; and the destruction of aquatic invertebrates which fish require for food. The following tables (Table 5 & 6) illustrate when the sensitive periods occur for various aquatic species in New Brunswick. For a listing of the spawning and migration time periods, and other variables for some notable aquatic species in New Brunswick, please refer to Appendix A.

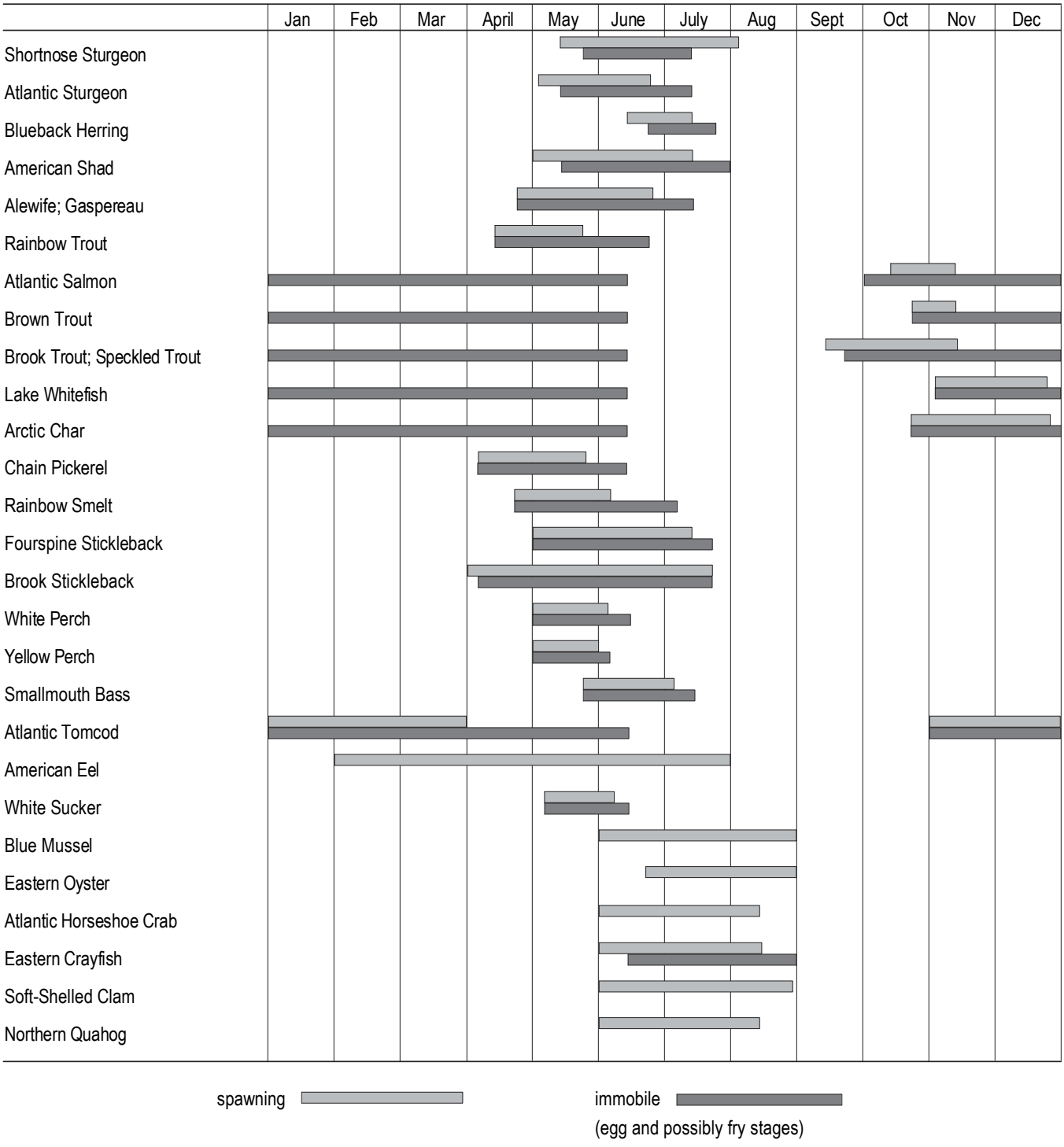
It is recommended that watercourse and wetland alterations involving instream work of any nature be carried during the summer low flow period which occurs between June 1st to September 30th of each year. Working during low flows will reduce the amount of sediment entering the watercourse, and make the construction/installation process more efficient thus reducing the potential conflict and damage during sensitive life cycle periods of the fisheries resource.

Table 5: Migratory Periods of Some Aquatic Species in New Brunswick



NOTE: See Appendix A for additional information on additional fish species and behaviour characteristics.

Table 6: Sensitive Periods of Some Aquatic Species in New Brunswick



NOTE: See Appendix A for additional information on additional fish species and behaviour characteristic.

Limitations of the Guidelines

The following limitations are placed on the use of these guidelines:

1) The guidelines are not to be interpreted as a method of design or a design code.
2) Following these guidelines does not exempt a person from liability for any damage resulting from the alteration of a watercourse or wetland, or from the requirement to obtain a permit as stipulated in the **Watercourse and Wetland Alteration Regulation**.
3) Following these guidelines places no liability for the design, planning or construction of any watercourse or wetland alteration on the Minister and/or the *Department of Environment*.

NOTE: These guidelines are not regulations. They are general recommendations which may not be applicable to every situation. Specific conditions pertaining to individual watercourse and Wetland Alteration Permits will vary with each project. In some cases, supplemental mitigation measures are necessary to resolve site specific problems.

Use of the Guidelines

The following technical guidelines pertain to specific watercourse and wetland alteration types. A definition is provided to define and explain each type of alteration. The objectives of the section for each alteration type are to explain the environmental concerns being addressed by these guidelines. Planning and construction considerations are meant to provide applicants with the guidelines necessary for the design and execution of each category of alteration.

The required application review process is given for each alteration type as either regulatory or regulatory and advisory. An application that requires regulatory review is reviewed solely by the *New Brunswick Department of Environment*, if the work is being carried out between June 1st and September 30th.

Those which are reviewed by both the regulatory and advisory agencies will be reviewed through inter-departmental consultation between the *New Brunswick Department of Environment*, the *New Brunswick Department of Natural Resources*, and *Fisheries and Oceans Canada*. In many cases, advisory agencies are invited to comment on applications and permits which are categorized as regulatory only. Also, representatives from municipalities, government, planning districts, and other agencies are often involved in the review process.

It is the intent of these guidelines to provide adequate information for the planning and designing of watercourse and wetland alterations, with the belief that it is much less expensive and more effective to prevent or minimize the impacts of an alteration at the design stage, rather than trying to control or mitigate the harmful effects of a poorly planned alterations.

These Technical Guidelines may not apply in areas where aquatic species at risk list in the Federal **Species at Risk Act** (SARA) are found. Information about the presence of aquatic species at risk in your area can be obtained by contacting the *Fisheries and Oceans Canada* office in your area or by visiting the following SARA websites: www.sararegistry.gc.ca and/or www.speciesatrisk.gc.ca. If there is an aquatic species at risk found in your project area, you should contact the *Fisheries and Oceans Canada* office in your area if you wish to obtain *Fisheries and Oceans Canada*'s opinion on the possible options you should consider to avoid contravention of the SARA.

Alteration Type: Beach Construction

Definition

Beach construction is the addition of clean sand and gravel material to the bank and land adjacent to a watercourse to create a beach for recreational purposes.

Objectives

To create a stable beach area resistant to hydraulic forces from the watercourse and erosive forces of upland surface runoff.

To preserve the fish habitat in the shallow water areas of lakes and rivers.

Planning Considerations

General

Attempts at constructing a sand beach where none exists naturally are unlikely to succeed. In many cases, yearly replenishment of sand would be necessary to sustain the beach area and permission to do so would not be granted. Sand will not stay in place on a solid rock shoreline with heavy wave action. Areas with high concentrations of organics in the substrate will not be able to support the addition of sand either, because organics will eventually displace or cover the beach area. Alternative suggestions for recreational swimming, such as building a seasonal wharf are suggested for areas such as these.

Environmental Considerations

Beach construction may have significant effects on fish habitat and is only permitted under special circumstances.

One concern with beach construction is the possibility of destroying or degrading feeding, spawning, nursery, or rearing areas as a result of influxes of sand into the shallow areas.

The Littoral Zone

The near shore areas of lakes and rivers where light penetrates to the bottom are referred to as littoral zones. These shallow water areas are often zones of high food production. Through complex food chains, virtually all organisms are dependent upon these highly productive areas during at least one stage of their life cycle. Rocky shores or shallow, weedy, mud bottomed areas are often the most productive shorelines. If these rocky or mud bottomed areas are changed to sandy beaches, the area becomes akin to a desert and vital food organisms will be lost.

The littoral zone serves as a spawning and nursery area for many fish species. Deposition of sand or other materials in this zone can permanently destroy spawning substrate. Eggs and fry are particularly sensitive to impacts during these stages since they cannot escape to deeper parts of the watercourse.

Other concerns include constricting the channel in a flowing watercourse which may result in increased flow velocity and erosion of downstream areas.

Application Requirements

In addition to the standard information required on the application form, **three copies** of the following must be included:

- fully dimensioned sketches of a plan and profile view of the proposed beach and a detailed description of the existing vegetation, water level (where necessary) and type of material to be used;
- a map and PID number.

Other Government Agencies Involved

Approval from the *New Brunswick Department of Natural Resources*, Crown Lands Branch, may be required for any proposed work located on Crown Land, in tidal water, submerged land and below the ordinary high water mark. The proponent must receive permission prior to undertaking the activity.

Application Review Process

Regulatory and Advisory

Applications for beach construction will be assessed on a site specific basis, considering the following:

a) Whether the construction is planned above or below the high water mark;
b) The type and stability of watercourse substrate;
c) The extent of current shoreline development;
d) Species of fish and/or wildlife which utilize the shoreline during some stage of their life cycle;
e) Timing of construction;
f) Hydraulic conditions (floods, ice damage, draw downs, etc.).

Construction

Materials

Coarse sand or pea sized gravel, rather than fine sand, should be added to create or improve a beach as it may provide a suitable substrate for fish spawning or rearing areas if washed into the water. Materials with larger grain sizes are also less susceptible to erosive action than fine grained material.

Only clean material obtained from a non-watercourse source is considered acceptable for use.

Methods

1) Addition of clean material to the area above the high water mark.

In almost every case, this is the only type of beach construction method permitted. A permit for this method may not be approved if the existing material is not considered conducive to beach construction. Examples include bedrock or rocky surfaces or wet, marshy areas.

An undisturbed buffer must be left between the high water mark and the upland limit of deposited material, or erosion control works must be erected to prevent the material from washing into the watercourse.

No material may be added to the watercourse.

2) Addition of clean material below the high water mark.

This practice is strongly discouraged and applications for beach construction of this nature are generally refused.

The only type of watercourse that this method would be applied to is a man-made lake excavated solely for swimming purposes with a beach area created along the shoreline. This type of watercourse is not intended to support fish and would have limited potential to become fish habitat in the future.

Guidelines

The material added to a beach must be clean coarse sand and gravel obtained from a non-watercourse source.

Machinery shall not enter the wetted portion of the watercourse.

No material may be excavated from the watercourse.

Work must be conducted in a manner so as not to result in any siltation or disturbance to downstream or adjacent areas.

Alteration Type: Beaver Dam Management and Removal

Definition

A beaver dam is a barrier across a watercourse constructed by beavers to impound water, control the flow or raise the level of water. This barrier or dam is usually constructed of wood, organic matter, mud, gravel and rocks.

Objectives

To minimize impacts on aquatic habitats when beaver dams are removed for the protection of infrastructure or property (e.g. roads, landscaping, septic systems, wells, basements, etc.).

The partial or complete removal of beaver dams to allow anadromous fish passage and/or improve fish habitat.

General Planning Considerations

Environmental Considerations

Beaver dams are important for providing valuable ecological diversity and are a primary natural method of creating new wetland habitat for a variety of fish and wildlife. Wetlands constructed by beaver can:

- reduce downstream flooding and sediment loading during storm events by trapping and storing excess water;
- reduce channel scouring and stream bank erosion during high water events;
- form natural lakes and ponds, and maintain existing ponds;
- supply summer and winter habitat for fish.

Beaver dams can also disrupt the habitat of other wildlife species, flood upstream property or threaten downstream property. Beaver dams can:

- reduce spawning habitat;
- create barriers to fish migration;
- increase water temperatures;
- alter riparian vegetation;
- cause contamination of watercourses with *Giardia lamblia* ("beaver fever");
- obstruct watercourse crossing structures, which can result in the flooding and erosion of roadways;
- cause flooding which can have a negative impact on landscaping, septic systems, wells, basements and the use of private properties;
- cause increased erosion, destruction of stream channel and banks due to beaver activity.

Uncontrolled beaver dam removal could result in:

- a flush of sediment that can smother downstream habitats and incubating or emerging fish;
- flooding and erosion of downstream properties;
- a rapid reduction in pond depth, that can result in stranding and killing species of fish, amphibians, birds as well as aquatic and terrestrial plants;
- scouring and erosion of the downstream channel and banks;
- rapid changes to downstream water temperatures;
- potential contamination of downstream wells.

Beaver dam removals will not be permitted where:

- there is no risk to property or infrastructure;
- the dam is on the outlet of a lake unless it can be demonstrated that the lower water level will be beneficial to wildlife;
- the impoundment has established a wetland that is being utilized by breeding waterfowl. Removal may be permitted after the broods have left.

Alternatives

In areas of recurring problems, use of beaver dam management devices such a pond levellers, culvert screening devices, etc. should be considered. These devices must maintain both water flow and fish passage.

The careful selection of a watercourse crossing structure may reduce the occurrence of beaver dam blockages. Bridges and open-bottom culverts are less likely to be dammed as often as circular pipes.

Application Requirements

- Determining that a beaver pond is a wetland must be completed prior to the issuance of a permit and subsequent removal of the dam. The determination that the beaver pond is or is not a wetland can be made by checking the *New Brunswick Department of Natural Resources* wetlands inventory, the Canadian Wildlife Service Wetlands Atlas, aerial photography, and/or consulting with wetland biologists;
- a map and PID number.

Other Government Agencies Involved

1) Alteration of a wetland exceeding 2 hectares in size is listed as an undertaking requiring registration under the New Brunswick **Environmental Impact Assessment Regulation (87-83) - Clean Environment Act (C-6)**.
2) Approval from the *New Brunswick Department of Natural Resources*, Crown Lands Branch, may be required for any proposed work activities located on Crown Land, in tidal water, submerged land and below the ordinary high water mark. The proponent must receive permission prior to undertaking the activity.

Application Review Process

The removal of a beaver dam which is impounding water that is resulting in flooding and damage or an immediate threat of damage to infrastructure can be approved through submission of a Provisional Permit Notification Form. The Provisional approval process will permit removal of beaver dams during the ice-free period, approximately from May through November.

Beaver dam removal and breaching for the purposes of improving or restoring fish passage or for fish habitat management requires an application for a standard Watercourse and Wetland Alteration Permit and will be reviewed by the Regulatory agency and its Advisory agencies.

Guidelines

Beaver dams can only be removed if the dam and associated flooding is causing damage or is an immediate threat of damage to property or infrastructure.

The beaver must be removed prior to undertaking the removal of the beaver dam. Their removal must be undertaken in compliance with all Acts and Regulations. A licensed Nuisance Wildlife Control Operator or a licensed trapper should be contacted to undertake the removal.

Non-mechanical (by hand) removal of beaver dams is the preferred method. This method minimizes disturbances to the bed and banks of the watercourse and should be considered wherever possible. Removal by hand can include using hand tools and winching the material out.

Removal of dams during the period from October 1st to May 31st should be avoided in order to reduce the risk of sediment transport downstream when fish eggs and juvenile fish are in the gravel.

The removal of the beaver dam will be limited to the debris used to build the structure. Original watercourse bed and bank material may not be removed or disturbed.

The impounded water should be released over an extended period so as to minimize silt flushing from the impounded area and reduce channel erosion downstream due to the increased discharge and water velocities. The maximum allowable depth of water spilling over the structure at the drainage point is 10 centimetres. The width of the opening created shall be no greater than the width of the watercourse downstream of the dam. It is recommended that it take a minimum of 1 day per 0.5 hectare of ponded surface area to drain the impoundment.

Debris removed from the beaver dam must be placed above the high water mark or disposed of in such a way so that it does not get washed back into the watercourse by floodwaters.

No heavy equipment will be allowed in the water body or on its banks to do work. Material must be cabled or chained out of the channel by machinery or equipment stationed a minimum safe distance of 15 metres from the immediately adjacent stream bank.

Excavators and backhoes are recommended for the removal of beaver dams due to their ability to remove only the debris without disturbing the bed or banks of the watercourse. They are also well suited for working from the road surface.

Once the pond has been drained, the exposed sediment should be seeded and blanketed with hay/straw mulch for stabilization purposes. This will help reduce the amount of sediment washed downstream in subsequent runoff events.

Definition

Boat Launching Ramps
Constructed ramps extending down over the bank into a watercourse for the purpose of loading and unloading boats from trailers.

Ferry Landings
A location on the shoreline utilized by ferries to load and unload vehicles, pedestrians or animals.

Ford
A crossing located in a stream, river, creek or brook where the following criteria are met:

1) the water is shallow enough at that point along the channel to be traversed by motorized vehicles;
2) the banks and the bed of the channel are stable enough that use of the crossing will not result in any damage to them. Acceptable fording sites can occur naturally, but in most cases, the approaches must be upgraded.

Objectives

To provide areas along a watercourse shoreline for watercraft to be launched and removed under controlled and stable conditions.

To provide access across the watercourse while minimizing disturbance to the aquatic habitat.

To prevent siltation of the watercourse.

Planning Considerations

General

Public boat launching ramps are preferable in order to minimize their number and impact on a lake or watercourse.

Ferry landings require stable approaches at grades lower than 5 horizontal to 1 vertical to facilitate the loading and unloading of vehicles and animals.

A ford should only be considered as an alternative to constructing a bridge or installing a culvert if the number of crossings is to be kept to a minimum and confined to the low flow period between June 1st and September 30th each year. The construction of a ford should not be considered if the crossing would be subjected to extensive and/or year round use.

A Watercourse and Wetland Alteration Permit is required to construct or upgrade a ford, the approaches to it or to use a fording site that is not a recognized fording place.

Recognized Fording Place

Vehicles crossing a watercourse at a recognized fording place do not require a Watercourse and Wetland Alteration Permit provided that there is no damage occurring as a result of this use and they comply with the guidelines below. The **Clean Water Act** defines a recognized fording place as a "ford as indicated on the most recent 1 to 50,000 scale maps of the National Topographic System or a place where persons have been fording a river, brook stream, creek, or other flowing body of water for a period of at least five consecutive years". If any modification to the banks or streambed is required in order to meet these guidelines and facilitate using the ford, a Watercourse and Wetland Alteration Permit is required.

Environmental Considerations

Structures placed or built in the shallow waters bordering the banks of a watercourse may pose a threat to the sensitive **littoral zone**. The littoral zone is the near shore section of water where light penetrates to the bottom. These zones are often areas of high food productivity, because primary food production is initiated by the penetration of light, acting as a source of energy for algae and aquatic plants.

The littoral zone also provides important spawning and nursery habitat for many species of fish. The installation and use of approaches and ramps may damage this sensitive littoral zone. This could occur by generating suspended sediment and/or introducing toxic substances during both the construction process and while using the facility.

Boat launching ramps require a stable travel surface to ensure vehicles do not become stuck while utilizing the ramp. Ferry landings for vehicles require a good access ramp in order for vehicles to load and unload.

With proper site selection, use and maintenance, fording should have little impact on the aquatic environment. Negative impacts are primarily a result of siltation due to the banks and/or bed of the watercourse being destabilized, and/or pollution of the water from the equipment using the ford.

Location

Boat launch ramps and ferry landings should be located at stable sites along a watercourse to ensure shoreline erosion and sedimentation can be controlled. Approaches should be fairly flat to reduce the chances of vehicles spinning and destabilizing the travel surface.

The bed and the banks of the channel at the fording site must be stable and non-erodible. A natural bedrock or coarse rock substrate is preferable for a fording site, but coarse rocks may be added to an otherwise stable channel bottom to level the crossing. Fording a watercourse having a silty or sandy substrate can result in increased turbidity caused by the suspension of fine particles.

The slope of the natural bank descending down to the proposed fording site should be relatively low, so that creating the approaches to the ford can be accomplished with minimal excavation at the site.

Application Requirements

In addition to the standard information required on the application form, the following must be included:

- a fully dimensioned sketch;
- a full description of the construction materials and proposed methodology;
- a description of the ford, including watercourse substrate information, the nature of the ford (temporary or permanent), the vehicles that will be using the ford;
- a map and PID number.

Other Government Agencies Involved

Approval from the *New Brunswick Department of Natural Resources*, Crown Lands Branch, may be required for any proposed work activities located on Crown Land, in tidal water, submerged land and below the ordinary high water mark. The proponent must receive permission prior to undertaking the activity.

Application Review Process

Construction: Regulatory Only between June 1st - September 30th. Regulatory and Advisory outside this time period.

Maintenance: A Provisional Permit may be obtained for the upgrading of the approaches to existing boat launching ramps, ferry landings, and recognized fords, which involve the excavating, depositing, and/or re-sloping of mineral soil located landward of the water's edge and at an elevation completely above the water level at the time that the project is carried out if the applicability clause and conditions on the Provisional Permit Notification Form can be met. The footprint that is located below the water line cannot be altered in any way.

Construction

General

Construction of a boat launching ramp or ferry landing should be done in a manner that minimizes the amount of excavation required. This will reduce the risk of sediment entering the watercourse. The ramps and landings can be stabilized by adding clean gravel, concrete slabs or planks. Asphalt and cast-in-place concrete can be utilized above the high water mark.

Construction of a ford should not result in major alteration of natural conditions. Creation of a fording site should only be considered if the site displays most of the suitable characteristics. If a location with a bedrock bottom cannot be found, addition of suitable material such as clean, non-erodible rock, of baseball to basketball size, preferably angular should be added to create a stable bottom so it does not raise the water level upstream. Approaches to the ford can be stabilized by adding clean gravel, concrete slabs, or constructing a corduroy road using round timbers placed cross-ways on the approaches.

Guidelines

The approaches to the boat launch, ferry landing and ford must be at right angles to the watercourse and shall be no steeper than 5 horizontal to 1 vertical.

Boat Launch Ramps

Boat launch ramps should lead to a gravel lined parking lot onto which any water from the trailer, boat, etc, can drain after being pulled from the watercourse, to reduce the risk of the water washing sediment into the watercourse.

The equipment shall be located landward of the water's edge. Boat launch ramps must be surfaced with clean, non-erodible, non-ore bearing granular material.

Ferry Landings

Ferry landings will require limited shoreline protection to reduce erosion due to the wake produced by the ferry as it approaches the landing.

The equipment shall be located landward of the water's edge.

Ferry ramps must be surfaced with clean, non-erodible, non-ore bearing granular material.

Fords (See Figure 12)

The fording must take place at one location in a watercourse where the bottom material is suitable for fording.

The fording site must not contain gravel bars or deep channel sections requiring the manipulation or excavation of the bed material.

The ford may be lined with clean, non-ore bearing, angular shaped stone, obtained from a non-watercourse source, with a minimum dimension of 15 centimetres, or gabion mats where the natural bed material does not consist of bedrock or cobbles.

A minimum of 15 centimetres of water shall overtop the structure at all times or flow channels must be built into the ford and that these channels must be placed and maintained in such a manner so as not to impede fish migration.

The ford should have a maximum width of 1.5 times the width of the equipment crossing it.

No chemical sprayers or equipment carrying chemicals may use the ford.

Vehicles using the ford must be in good working condition, and not losing fuel, lubricating oil, hydraulic fluids, or their cargo. Nothing may be skidded, twitched or dragged across the ford.

All soil material must be removed from heavy equipment prior to fording a watercourse.

The ford must not be used if the water depth is greater than the axle height of the vehicle.

Material in the wetted portion of the watercourse must not be manipulated when fording the watercourse.

The removal of material from a temporary ford must be done by hand.

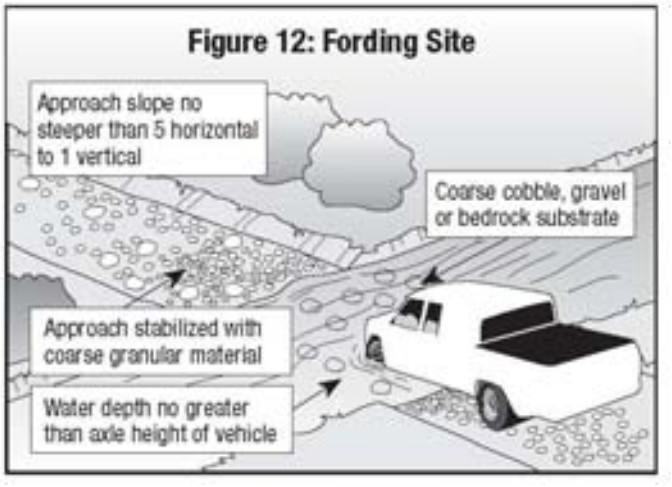


Figure 12: Fording Site

Alteration Type: By-Pass Ponds

Definition

A by-pass pond is connected to a watercourse by an inlet and an outlet pipe so as to be supplied with water for: recreation, irrigation, fire fighting, fish rearing, or other purposes.

Objectives

To construct a reservoir of water with suitable water quality and volume to meet the needs of the intended use.

To maintain adequate quantity and quality of water in the watercourse for the protection of aquatic habitat and fish passage.

To prevent the impact of construction from degrading aquatic habitat and water quality.

Planning Considerations

General

Construction of by-pass ponds adjacent to watercourses is often permitted, whereas permission to excavate ponds in the bed of a watercourse is generally not granted.

Excavating a pond in the bed of a watercourse has the potential to generate and introduce excessive quantities of silt and other sediments into the watercourse.

In addition, if a small watercourse is dammed to create a pond, access to any spawning, nursery, and feeding areas may be obstructed. Optimal conditions for spawning and nursery exist in small watercourses, because they are usually well shaded, cool, spring fed, and often contain abundant food sources. These watercourses are small enough for fry and juveniles yet not deep enough to support larger, predatory fish. Year round access to these smaller brooks may not be necessary, but if it is denied during the sensitive period, it could have devastating effects on the fish population.

Environmental Considerations

Potential threats to water resources and aquatic habitat as a result of this type of alteration include:

1) Sedimentation of the watercourse - Improper construction techniques or upland surface runoff may cause sedimentation leading to degradation of water quality and fish habitat;
2) Blockage of fish passage and degradation of fish habitat as a result from diminished flows or volumes of water in the watercourse;
3) Contamination of the watercourse by disease from organisms inhabiting the pond or pollutants which may discharge to the watercourse;
4) Thermal effects - water in ponds tend to warm up significantly due to the smooth surface and penetration of sunlight. Discharge of this water can warm up the stream substantially and alter the stream habitat characteristics, decreasing its quality for salmonids.

Proper site selection and carefully designed construction techniques will help to minimize damage to the adjoining watercourse.

Location

By-pass ponds should be located in an area with impervious soils capable of holding water in order to minimize seepage problems, thereby preventing a high water demand from the watercourse. Where possible, the water supply should be augmented by groundwater springs or surface runoff to decrease demands from the watercourse.

To minimize sedimentation of the pond and thus a reduction of capacity, the pond should be located in a gently sloping, relatively erosion resistant, vegetated area.

The area draining into the pond should not include potential sources of contaminated water, such as septic tanks, barnyards, or waste disposal areas.

Maintenance Flow Requirements

Maintenance flow requirements in the watercourse will be imposed for the water intake structure. Please refer to the guidelines for “Alteration Type: Water Intake Structures” at page 101.

Future Considerations

Applicants should keep in mind that once a pond has been created, it falls under the definition of a watercourse, and subsequent alterations within 30 metres of the pond will require a permit under the provisions of the **Watercourse and Wetland Alteration Regulation**.

Application Requirements

In addition to the standard information required on the application form, **three copies** of the following must be included:

- drawings to scale of the plan, profile, and cross sectional views;
- all dimensions including length, width, depth and volume of the pond;
- distance from the watercourse;
- detailed description of the inlet and outlet structures;
- description of the proposed construction methods;
- specifications of inlet and outlet screens;
- elevation of intake and outflow pipes relative to the pond;
- plan to fill with water while providing a maintenance flow in the stream;
- a map and PID number.

NOTE: Any waterworks with a capacity of greater than 50 cubic metres of water daily requires registration under the New Brunswick Environmental Assessment Program.

Other Government Agencies Involved

1) If the plans include stocking the pond with fish, an “Inland Aquaculture License”, is required from the *Department of Agriculture, Aquaculture and Fisheries*. This is required to control the possible spread of disease between the stocked fish and those naturally inhabiting the natural watercourse. If issued, this license grants the authority to culture fish. Currently, operations include the culture of Brook Trout, Rainbow Trout, and Atlantic Salmon, under prescribed conditions. Applications for other species may be considered.

2) *Fisheries and Oceans Canada* must be contacted before any fish are placed in the pond.
3) Impact Management Branch, *New Brunswick Department of Environment*.

Application Review Process

Regulatory and Advisory. If water withdrawal requirements exceed 10 litres/minute/km^2 of drainage area, the proposed project may be forwarded for Advisory review.

A Provisional Permit may be obtained for this activity if the applicability clause and the conditions on the Provisional Permit Notification Form can be met.

Construction

Distance from Watercourse

In order to minimize the potential to introduce sediment from the pond to the watercourse as a result of upland surface runoff, the minimum distance from the top of the bank of the watercourse to the top of the bank of the pond must be 15 metres. See Figure 13. If a site with an impervious substrate cannot be found, the selected site can be sealed by one of the following methods:

1) Compaction by heavy machinery is possible provided the substrate consists of well graded soils.
2) Addition of clay blankets to cover the entire pond area up to the normal high water mark. The blanket should consist of well graded, coarse grained material containing a minimum of 20% clay with minimum thickness of 30 centimetres.
3) Addition of bentonite is effective in soils with a high percentage of coarse grained particles. Bentonite, a colloidal clay, fills tiny voids in the soil and swells up to 20 times its original volume when wet.
4) Waterproof linings such as thin films of polyethylene or vinyl can be used to line the pond but must be carefully protected from mechanical damage.

Inlet and Outlet Structures

Inlet and outlet structures must consist of screened pipes. Screens must be present to ensure that fish will not be exchanged between the pond and the watercourse which could lead to competition and the spread of disease. Screens must conform to the same specifications required for all water intake structures. Please refer to the guidelines for "Alteration Type: Water Intake Structures" at page 101. Ditches or trenches are not acceptable means of connecting the pond to the watercourse, because they can be a source of sediment and are difficult to screen.

The by-pass pond overflow structure should include an outlet pipe. In addition, an emergency spillway should be constructed in the embankment to handle excess runoff and prevent the pond from overtopping during periods of high flow. The need for either one or both of these structures is usually assessed on a site specific basis.

The outlet pipe is often a vertical section of metal or plastic standpipe connected to a horizontal section of the outlet pipe. The top of the standpipe should be equipped with a trash rack or debris guard to help prevent blockage caused by floating debris. See Figure 14.

The water level in the pond can be controlled by raising or lowering the height of the standpipe.

Emergency spillways are often constructed as a back-up to the overflow pipe in the event of overtopping. These consist of shallow broad-crested weir excavated in the embankments of the pond discharging into a vegetated area away from the watercourse. The crest of the spillway must be lined with rip-rap.

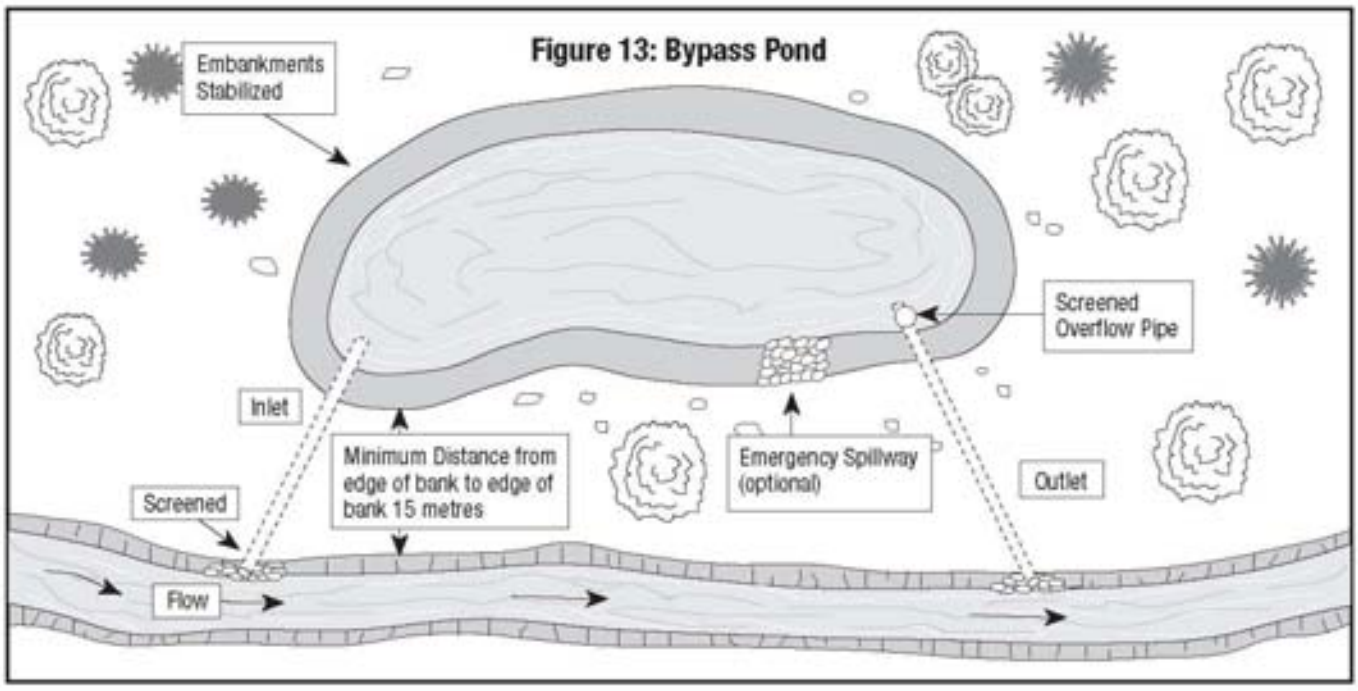


Figure 13: Bypass Pond

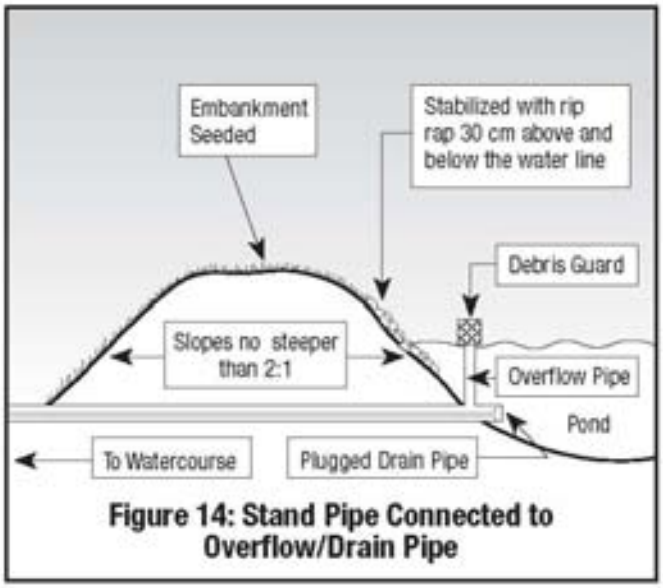


Figure 14: Stand Pipe Connected to Overflow/Drain Pipe

Guidelines

The site must be cleared of all vegetation, slash, roots, sod and loose topsoil and the spoil material disposed of where it cannot be returned to the watercourse by storm runoff.

The pond should be excavated in non-porous subsoil or sealed to prevent water seepage.

The volume of the proposed pond should be proportional to the available water supply to minimize the potential of water stagnation.

The area draining into the pond must not include sources of pollution.

The excavation of the pond must be carried out in isolation of stream flow.

The pond must be excavated prior to installing the inlet pipe(s).

The banks of the watercourse must not be disturbed prior to the installation of the intake and outlet structures and bank disturbance must be kept to a minimum during these installations and immediately stabilized.

The ends of the inlet and outlet pipes adjoining the watercourse must be screened.

For **fish ponds**, both ends of the inlet and outlet pipes must be screened.

The inlet and outlet pipes should be oriented in a downstream direction to minimize the chance of blockage.

Large rocks must be placed around the ends of the inlet and outlet structures for erosion protection.

Any discharge from by-pass pond(s) should be filtered through a sediment trap before entering the watercourse until all exposed soil is stabilized against erosion.

The side slopes of the pond should be no steeper than two horizontal to one vertical to a depth of 0.3 metres below the water line. Below this elevation, the slope should be no flatter than one horizontal to one vertical. This should prevent the excessive growth of unwanted vegetation in the edge of the pond.

The embankments and any other exposed soil within 30 metres of a watercourse must be seeded with appropriate vegetation immediately after the final grades have been reached. If the water is to be extracted from a by-pass pond for irrigation purposes, for example, the inlet should be closed during the extraction. When the inlet is re-opened, it should be done gradually to prevent rapid depletion of the flow in the watercourse and allow gradual refilling of the pond.

Water Intake Structures

Please refer to the guidelines for “Alteration Type: Water Intake Structures” at page 101.

Alteration Type: Causeways

Definition

A causeway is a raised road or path, usually built across a shallow, wide body of water or wetland and includes a flow-through structure which is not designed to impound water.

Objectives

To provide an economical, durable access across a wide body of water or wetland while minimizing the disturbance to the existing hydraulic regime.

To minimize loss of wetland or fish habitat.

To maintain water quality.

To maintain navigation.

Planning Considerations

Environmental Impacts

1) Loss of Aquatic Habitat

This may occur directly as a result of infilling and the placement of material in-water, or on the approaches, or indirectly as a result of heavy usage of the structure. "Aquatic" includes species of: fish, invertebrates, and shellfish.

2) Obstruction of Fish Passage

These structures may present an obstruction to fish passage.

3) Interference of Hydraulic Regime

The presence of the causeway in the watercourse may have the following effects:

- Increase in the potential for ice jamming;
- Restriction of the movement of water enhancing the potential for upstream flooding;
- Interruption of the normal current patterns which may result in increased erosion or sedimentation;
- Disruption of the natural transportation and deposition of bed material by fluvial action.

4) Loss of Wetlands Habitat

If the causeway is constructed over a wetland area, direct loss of habitat will occur as a result of constriction and infilling for the structure. Waterfowl habitat may be affected by the causeway or disrupted by use of the structure.

5) Diminished Water Quality

The water quality may be affected by a number of processes:

- If construction involves excavation for the structure or approaches to the structure in a wetland area, exposed sediments may release toxic hydrogen sulphide or ammonia gases;
- Construction of the causeway, approaches and in-channel placement of fill may result in sedimentation of the watercourse;
- Water pollution may result from vehicular usage of the causeway or by the introduction of debris into the watercourse by humans;
- Stagnation of water upstream of the structure will diminish water quality.

6) Inadequate Tidal Flushing

If the structure is located across a tidal river or estuary, it may pose an obstruction to adequate tidal flushing which will result in changed salinity as well as major sedimentation and infilling.

Other Impacts

- Interference with navigation.
- Interference with fishing activities.
- Modification of water levels upstream and downstream of the structure.
- Noise and dust pollution during construction.

General

The construction of a causeway has the potential to significantly impact the hydraulic conditions of a watercourse. The upstream water levels may be increased. Permission from the landowners who may be affected by changes in water level must be obtained.

Application Requirements

In addition to the standard information required on the application form, **three copies** of the following must be included:

- a drawing to scale with all the dimensions necessary to describe the size, shape, and alignment of the proposed causeway including a cross section across the watercourse at the site of the proposed causeway;
- a drawing to scale showing any culverts or other flow through structures in the causeway giving their location, size, and type;
- a description of the proposed construction methods including both an erosion and water control plan;
- a map and PID number.

Depending on the size and potential impact of the causeway, it may be a requirement that the plans bear the seal of a person licensed to practice as a Professional Engineer subject to the provisions of the **New Brunswick Engineering and Geoscience Professions Act**.

Other Government Agencies Involved

1) The approval of the *Transport Canada* which administers the **Navigable Waters Protection Act** is required when a structure is to be placed in or across any navigable watercourse.
2) All causeways, as stated in Schedule A of the **Environmental Impact Assessment Regulation**, must be registered with the Minister of Environment. Inquiries should be directed to the Manager of the Environmental Assessment Section of the Sustainable Development, Planning and Impact Evaluation Branch of the *Department of Environment*.

Application Review Process

Regulatory and Advisory

Construction

Construction procedures must be planned on a site specific basis and must involve inter-departmental consultation and thorough and rigorous pre-construction testing and studies to determine and minimize the environmental impacts of the structure.

Guidelines

The embankments must be stabilized against erosion caused by waves, ice or currents.

The waterway openings must be sized to handle flood flows without flood damage to the causeway, the watercourse, or adjacent property.

The waterway openings must be designed to prevent any water stagnation in the separated bodies of water.

The waterway openings must be sufficient to prevent adverse modifications to water levels. Limits of water level fluctuations will be specified for individual projects as required by local conditions.

The material used to construct the causeway must be non-toxic to aquatic life.

Sediment control measures must be installed prior to construction, added wherever necessary to control sedimentation, and maintained until permanent stabilization has been established.

Fish passage must be maintained at all times.

Alteration Type: Channel Cleaning

Definition

Channel cleaning is the removal of material foreign to the natural composition of the stream bed and/or fluvial deposits to improve hydraulic conditions for conveyance of flow and the passage of ice.

Objectives

To minimize loss of aquatic habitat.

To minimize sedimentation as a result of in-channel activities.

Planning Considerations

General

As stated in section 4 of the **Watercourse and Wetland Alteration Regulation**, material excavated from a watercourse may not be used for commercial purposes:

"Notwithstanding any other provision of this Regulation, no person shall remove or cause the removal of sand, gravel, rock or similar material from a watercourse for sale, gain or commercial use or for the purpose of processing or manufacturing such sand, gravel, rock or similar material into another product."

The removal of fluvial deposits will often not be of a permanent nature; therefore, it will only be considered if flooding or erosion problems can be directly attributed to a change in the channel cross sectional area due to the deposits and no reasonable alternatives are available.

Environmental Considerations

Stream gravel is essential for nursery, spawning, and feeding areas for certain fish species therefore removing it could constitute a loss of fish habitat.

Removal of unstable material from the bed or banks of a watercourse can lead to destabilization which may result in watercourse degradation.

Changing the cross sectional area of a channel can disturb the equilibrium of the watercourse which may increase the erosion potential upstream and downstream of the project area.

Application Requirements

In addition to the standard information required on the application form, **three copies** of the following must be included:

- a plan, profile, and cross sectional drawing to scale of the existing and proposed channel extending a distance of 10 channel widths upstream and downstream of the work area;
- a description of the project which includes the following:
  1) bed material;
  2) the type of machinery to be used;
  3) how the removed material will be disposed of;
  4) sediment and water control plans;
  5) the cause of the channel infilling.
- present day photography and aerial photography to show existing and previous conditions to verify that conditions have changed.

Application Review Process

Regulatory and Advisory

Other Government Agencies Involved

1) *Transport Canada*, which administers the **Navigable Waters Protection Act**, should be contacted when proposing an activity on a navigable watercourse.
2) Crown Lands Branch, *New Brunswick Department of Natural Resources*, should be contacted regarding any activity located on Crown Land, in tidal water, submerged land and below the ordinary high water mark.

Guidelines

Except for large rocks and boulders, all material removed from the watercourse must be placed above the high water mark or disposed of in such a way that it cannot be washed back into the watercourse.

If rocks, stumps or logs need to be moved on the bed of the watercourse or shoreline to accommodate the activity, they should be relocated to an area of similar depth but not removed from the wetted portion or shoreline of the watercourse. The rock, stumps or logs moved should be placed so as not to create a navigation hazard.

Loose rocks generated by the activities undertaken must remain in the water and be distributed randomly throughout the project area.

Channel cleaning by a riparian landowner, if permitted, is restricted to that portion of the watercourse bordering the property of the riparian owner.

The deepening of existing or creation of new fish resting pools is not considered to be channel cleaning.

Channel cleaning must be restricted to the months between June and September, except in rare emergencies cases.

Channel cleaning or removal of sand, silt, or gravel from the bed or banks of a watercourse for the purpose of bridge or culvert maintenance, when permitted, is generally restricted to 15 metres upstream and downstream of the structure.

All material removed from the watercourse must be disposed of in the proper manner such that it will not be washed back into the watercourse during periods of high flow.

Materials removed from the watercourse during the process of channel cleaning cannot be used for commercial or private gain.

Definition

A dam is a barrier constructed across a watercourse for impounding or diverting water. Some of the reasons can be the following:

1) Storage - to impound water during periods of surplus water supply for use during periods of low flow for hydroelectric power generation, irrigation, recreation, or water supply;

2) Diversion - to divert part or all of the water from a watercourse through or into another conveyance structure or watershed;

3) Detention - to retard peak flows and minimize the effect of flash floods downstream;

- as part of a wildlife habitat enhancement project.

Objectives

To maintain unobstructed fish passage.

To maintain adequate maintenance flows downstream of the structure.

To minimize sedimentation as a result of construction.

To maintain water quality upstream and downstream of the structure.

To maintain or enhance aquatic and wildlife habitat.

Planning Considerations

General

All proposals for dams and reservoirs require inter-departmental consultation and detailed project review because of the significant effect most dams and reservoirs have on the natural environment. A poorly constructed dam carries the potential for considerable damage such as flooding, severe erosion, habitat destruction, loss of property and/or human lives. Dams which impound large quantities of water or structures that are of significant height require a flood hydrology study.

The extent to which the water will flood an area is also an important aspect of planning considerations. It must be demonstrated that the reservoir will not illegally encroach upon public or private ownership rights. The land ownership upstream of the structure must be verified and permission of the affected landowners must be obtained.

Natural water flows can be significantly affected by dams, therefore, all water usage upstream and downstream of the dam must be taken into consideration to prevent future conflicts. Figure 15 displays 4 types of dams.

Environmental Impacts

Depending on the capacity of the storage basin or the quantity of the flows that are being diverted, the construction of a dam has the potential to significantly impact the environment.

Environmental impacts include the following:

1) Disruption of the existing hydraulic regime. The normal flow of water and ice movement will be severely affected and may result in ice jamming problems. Disruption of the existing current patterns will interfere with the natural transportation and deposition of bed material.
2) Obstruction of fish passage. The dam design must include approved fish passage facilities when deemed necessary by *Fisheries and Oceans Canada*.
3) Increase in water temperature upstream caused by interrupted flow and possibly downstream of the structure at times by a reduction in discharge volume.
4) Water quality upstream and downstream and in the impoundment may be degraded due to stagnation.
5) Sedimentation as a result of dam construction and flooding of the headpond.
6) Loss of habitat.
   a) Converting a portion of a free flowing body of water to a standing body of water may significantly impact the aquatic habitat in the headpond area.
   b) Flows downstream of the structure at times may become inadequate for the maintenance of fish habitat.
   c) Riparian zone vegetation and wildlife habitat may be severely affected or destroyed as a result of inundation of water when the headpond is flooded.
7) Interruption of the food chain. Retention of nutrients in the reservoir/headpond area will interrupt the transfer of nutrients from smaller watercourses and may adversely affect all or part of the area downstream.

Application Requirements

In addition to the standard information required on the application form, **three copies** of the following must be included:

- a plan, profile, and cross sectional drawing to scale of the dam including the water control structure and fish passage facilities;
- a full description of the proposed construction methods including a water and sediment control plan;
- a map.

***NOTE: All dams which could impound 30,000 cubic metres of water or more and/or are 2.5 metres or more in height must:**

a) be designed and stamped by a person licensed to practice as a Professional Engineer pursuant to the Engineering and Geoscience Profession Act and experienced in hydrotechnical design;

b) include specifications on the materials and workmanship;

c) include a description of the normal operation of the dam noting the maximum drawdown and normal operating level of the reservoir.

Other Government Agencies Involved

1) Authorization must be obtained from *Fisheries and Oceans Canada* for:
   a) any work that may impede fish passage;
   b) fish guards and fish screen requirements at water intake structures;
   c) maintenance flow requirements.
2) The approval of *Transport Canada*, which administers the Navigable Waters Protection Act, must be obtained when a structure is to be placed in or across any navigable watercourse.
3) Crown Lands Branch, *New Brunswick Department of Natural Resources*, should be contacted regarding any activity located on Crown Land, in tidal water, submerged land and below the ordinary high water mark.

Application Review Process

Regulatory and Advisory

All water reservoirs with a storage capacity of more than 10 million cubic metres must be registered with the Minister of Environment. Inquiries should be directed to the Manager of the Environmental Assessment Section of the Sustainable Development, Planning and Impact Evaluation Branch of the *New Brunswick Department of Environment*.

Guidelines

Dams not designed to be overtopped by flood waters or wind generated waves must have a freeboard of at least one half metre. Dams not designed to be overtopped must have sufficient spillway capacity to pass the maximum flood discharge as determined below:

a) freeboard less than 1 metre

   $Q = 6.93\ A^{3/4}$ (Q in m^3 and A in km^2)

b) freeboard greater than 1 metre

   $Q = 3.465\ A^{3/4}$ (Q in m^3/sec and A in km^2)

Lesser spillway capacity will only be accepted if the design engineer has proven through a hydrotechnical study that the probable maximum flood (PMF) is less than calculated above.

All alders and trees must be cut approximately 10 centimetres above the ground and removed from the area to be flooded but grubbing must not be carried out.

A maintenance flow, at least two-thirds (2/3) of the prevailing flow, or the authorized maintenance flow must be maintained below the structure during construction and filling of the reservoir.

All exposed erodible surfaces shall be stabilized against erosion before the headpond is flooded.

The maintenance flow specified in the Watercourse and Wetland Alteration Permit, Conditions of Approval must be maintained in the watercourse downstream of the structure at all times.

Earthen or Hydraulic Fill Dams

Exposed soil must be stabilized with clean quarried rock up to the normal high water level, and all remaining exposed soil should be seeded and blanketed with mulch before allowing the headpond area to be flooded.

The combined slope of the upstream and downstream embankments should not be less than 5 horizontal to 1 vertical and neither slope be steeper than 2 horizontal to 1 vertical.

The fill material around the spillway must be compacted and protected to prevent washout during high flows.

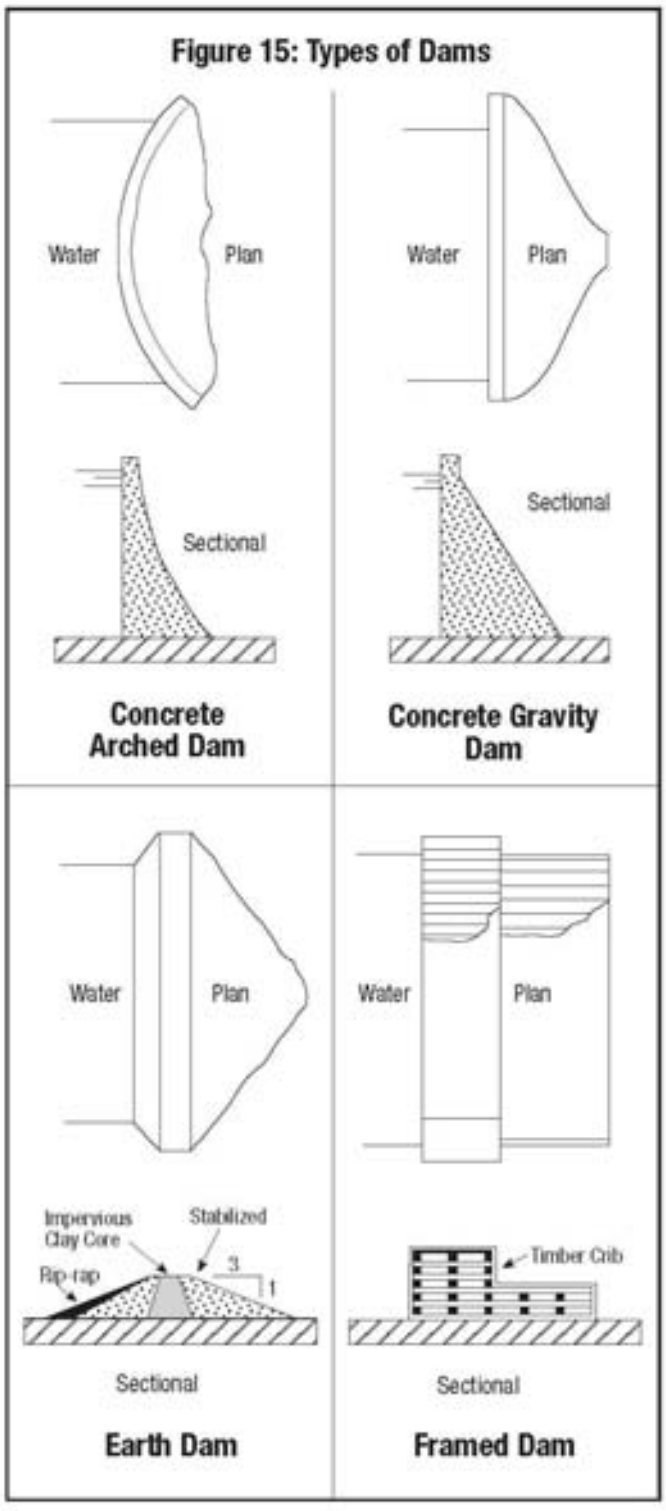


Figure 15: Types of Dams

Alteration Type: Debris Removal

Definition

Debris removal is the removal of material foreign to the natural composition of a watercourse. Examples of debris include: car bodies, empty containers, and some branches, logs, and fallen trees.

Objectives

To remove debris from a watercourse which has caused or may lead to blockage, disruption of fish passage and habitat, or flooding. To restore the watercourse to its natural state so as not to disturb or degrade the bed, banks, or aquatic habitat.

Planning Considerations

Environmental Considerations

Not all debris, as defined above, needs to be removed from watercourses; however, all unnatural substances, such as metals and plastics, should be removed to maintain a healthy fish habitat. Excessive amounts of woody debris have potential to be harmful because it may:

- become a barrier to fish migration;
- lower the water's oxygen content through decay;
- trap silt, creating deposits leading to decreased flow, or upstream flooding;
- cover and destroy clean gravel substrate.

Not all logs or tree root systems in a watercourse need to be removed. Often logs and roots become sheltering areas for trout and other species of fish.

If the debris has remained in the watercourse for a long period of time, it may have become so deeply embedded that removing it would cause more damage than leaving it in place. Disturbing firmly embedded logs, branches, or other debris not only releases sediment into the water but may disrupt the fish habitat of which they have become a part.

Debris which has been damming the flow of a watercourse may cause flooding downstream if removed.

Consideration should be given to the consequences of removing trees which are securely fastened to the banks of a watercourse. The root systems may be preventing erosion of the bank.

Garbage removal does not require a Watercourse and Wetland Alteration Permit if it does not result in streambed disturbance or cutting or removal of organic debris.

Beaver Dams

Beaver dams are not considered to be debris.

For details on the approval process for removing and managing beavers and beaver dams refer to the guidelines for "Alteration Type: Beaver Dam Management and Removal" at page 31.

Application Requirements

In addition to the standard requirements as stated on the application form, an application for a Watercourse and Wetland Alteration Permit for debris removal must include:

- a fully dimensioned sketch;
- a description of the debris to be removed;
- a full description of the proposed methods.

Other Government Agencies Involved

Approval from the *New Brunswick Department of Natural Resources*, Crown Lands Branch, may be required for any proposed work activities located on Crown Land, in tidal water, submerged land and below the ordinary high water mark. The proponent must receive permission prior to undertaking the activity.

Application Review Process

Regulatory, and in some cases, Regulatory and Advisory

Guidelines

No heavy equipment, such as bulldozers, tractors, or back hoes, is allowed in the watercourse or on the banks to do the work. Material must be winched out of the stream bed by machinery or equipment stationed on the roadbed or a minimum of 15 metres from the shoulder of the watercourse.

Badly damaged or dead trees which could fall into the watercourse should be removed, but trees containing active nest cavities should be left.

Trees leaning over the water such that the trunk is at an angle of 30^{o} or less measured from the water surface should be removed. Branches from overhanging trees which would catch debris floating in the watercourse should be trimmed.

Alders, weeds, or small trees growing on or within the banks of the watercourse should not be removed, as they augment natural fish cover, contribute to food input from terrestrial insects, and control erosion.

It is important that as little of the forest canopy as possible be removed.

All debris that is removed should be disposed of where it will not be washed back into the watercourse by floodwaters. Accumulations of sand, silt, or gravel are not considered to be debris, even if they originate from an upstream location in the watercourse.

Alteration Type: Diversions and Cutoffs

Definition

Diversions or cutoffs are constructed to relocate or straighten an existing watercourse in order to help prevent erosion, flooding, or loss of property or to accommodate development of the bordering property.

Diversion - A new channel excavated to change the position of the bed of the watercourse.

Cutoff - A new channel created to straighten an oxbow or meandering reach of channel thereby shortening the channel and often relieving an area subject to ongoing channel erosion and regular flooding.

Objectives

To minimize disruption to the aquatic habitat and hydraulic regime.

To minimize downstream sedimentation.

To maintain unobstructed fish passage.

To prevent unravelling of the watercourse substrate.

Planning Considerations

It is extremely difficult to recreate the characteristics of a natural channel; therefore, diversions and cutoffs should only be considered if no reasonable alternative is available.

Temporary diversions constructed to facilitate the construction or installation of a structure in the watercourse in isolation of stream flow are subject to the same consideration and guidelines as a permanent diversion.

Proposals for cutoffs and diversions which significantly decrease the length, steepen the profile, or alter the cross-sectional area of the existing channel may require a hydrotechnical study.

The natural sinuosity and physical characteristics of the channel upstream and downstream may be used a guide in the design of a stable diversion channel provided these sections of the channel are stable.

Environmental Impacts

1) **Erosion**

   Since a cutoff is shorter than the meander it replaces, the slope of the new channel will be steeper resulting in an increase in water velocities. An increase in water velocities may result in erosion of the new channel and downstream reaches of the watercourse.

2) **Loss of Habitat**

   Cutoffs and diversions eliminate a reach of natural channel which may contain productive aquatic habitat that would be difficult to recreate.

3) **Sedimentation**

   Unless carefully designed, constructed and stabilized, diversion and cutoff channels may be a major source of sediment which can result in extensive downstream degradation of water quality and aquatic habitat.

Application Requirements

In addition to the standard information required on the application form, **three copies** of the following must be included:

- a description of the bed and bank material of the existing channel;
- a geotechnical survey along the new channel;
- plan, profile, and cross sectional drawing to scale clearly showing the size, shape, and alignment of the new and existing channel extending a minimum distance of 10 channel widths upstream and downstream of the reach to be altered;
- a full description of proposed construction methods including an erosion, sediment and water control plan;
- a map and PID number.

Application Review Process

Regulatory and Advisory

Guidelines

The new channel must be excavated in isolation of stream flow from the downstream end.

The existing channel must be left untouched until the new channel is completed and stabilized.

All fish occupying a reach of watercourse to be dewatered or abandoned must be rescued and relocated out of harm's way prior to any permanent or temporary dewatering operation. The upstream end of the existing channel must be closed off with non-porous material, and stabilized with non-erodible material. The approach angle at which the flow enters the new channel must never exceed 25 degrees with 15 degrees being the recommended maximum.

The old channel should be backfilled following diversion of the flow into the new channel.

The bank of the existing channel, directly across from its confluence with the new channel, must be stabilized with sufficient rip-rap to prevent erosion.

The natural sinuosity, depth and width of the watercourse should be maintained throughout the new channel as it exists upstream and downstream of the proposed diversion.

The bottom of the new channel should be deeper in the centre along the straight sections and along the outside edge of bends at meanders.

Construction of the new channel should take place during low flow conditions (between June 1st and September 30th).

Alteration Type: Draining or Infilling of Ponds, Lakes and Wetlands

Definition

The lowering of the water level, draining and/or infilling of water bodies for the purpose of land development, impoundment management, reclamation, agriculture, mining or dredging.

Objectives

To minimize the loss of aquatic and wetland habitat.

To minimize any impacts on water supply and water retention.

Planning Considerations

General

The draining of ponds, lakes and wetlands is a high risk activity with regards to potential damage to fish habitat, wetland habitat, wetland function and water supply. Given these risks, careful and thorough planning is required prior to the submittal of an application. Discussions with Regulatory and Advisory agencies must occur early in the planning stages. Draining or infilling of lakes, natural ponds and wetlands is strongly discouraged and applications of this nature are generally refused.

Environmental Considerations

Ponds, lakes and wetlands form an integral part of the nature's water supply. Draining or infilling of these areas disrupts natural hydraulic patterns, destroys habitat and decreases ecosystem productivity. Due to the potential for significant impacts, draining or infilling of ponds, lakes and wetlands will only be permitted under special circumstances.

Application Requirements

A detailed environmental assessment is required to be completed which will assess current and future conditions and ecosystem productivity.

Other Governmental Agencies Involved

Approval from the *New Brunswick Department of Natural Resources*, Crown Lands Branch, may be required for any proposed work activities located on Crown Land, in tidal water, submerged land and below the ordinary high water mark. The proponent must receive permission prior to undertaking the activity.

Application Review Process

Regulatory and Advisory. In some cases, may be Regulatory only.

Environmental Impact Assessment Process

Guidelines

The infilling of a portion or all of a lake, pond or wetland must result in a net benefit to the environment while permitting sustainable development. Careful planning must be undertaken with the infilling of any portion of a lake or pond, or any portion of a wetland that is greater than 1 hectare in size as considerable review will be required by Regulatory and Advisory agencies. Impacts on aquatic habitat must be minimized.

Definition

Dredging is the excavation of material from the bed of a watercourse by mechanical means.

Dredging is carried out for a number of reasons including the following:

1) Navigation - to deepen channels, lakes, canals, harbours, or inlets for use by boats
2) Foundation preparation - to remove unsuitable material at proposed locations for supporting structures such as piers
3) Environmental - excavation of unwanted or polluted materials such as mine tailings or contaminated sediments
4) Construction - to excavate or mine aggregate, gravel, or sand for use on beaches, land extensions, or land improvement
5) Water reservoir - to increase the size of an existing reservoir or to create a new water reservoir for domestic or fire fighting purposes or to remove accumulated sediment in existing reservoirs
6) Mining - to mine minerals such as manganese or gold from the bed of a watercourse

Objectives

To minimize the impact of the dredging operation on fish habitat and fish passage.

To minimize sedimentation of the watercourse.

To prevent contamination of the water.

To avoid degradation of shorefront properties and disruption of fisheries and aquaculture operations.

Planning Considerations

The possible negative consequences of a poorly planned dredging operation can be significant. These operations have the potential to alter and/or destroy fish and fish habitat, water quality and private property. Every dredging proposal is unique, and the possible impacts must be carefully considered at the design stage taking into account the potential for impact on the:

a) dredging site;
b) disposal site;
c) transportation route.

Equipment

The selection of the type of dredging equipment is determined by the following factors:

- physical characteristics of sediments;
- quantities to be dredged;
- water depth;
- dredging depth;
- water and weather conditions;
- contamination level of sediments;
- disposal method;
- timing constraints;
- disposal location;
- cost.

Dredging equipment commonly used for watercourse and wetland alterations in the province can be divided into two different types:

1) Mechanical dredging equipment (Figure 16) excavates the material intact, with some form of mechanically manoeuvred

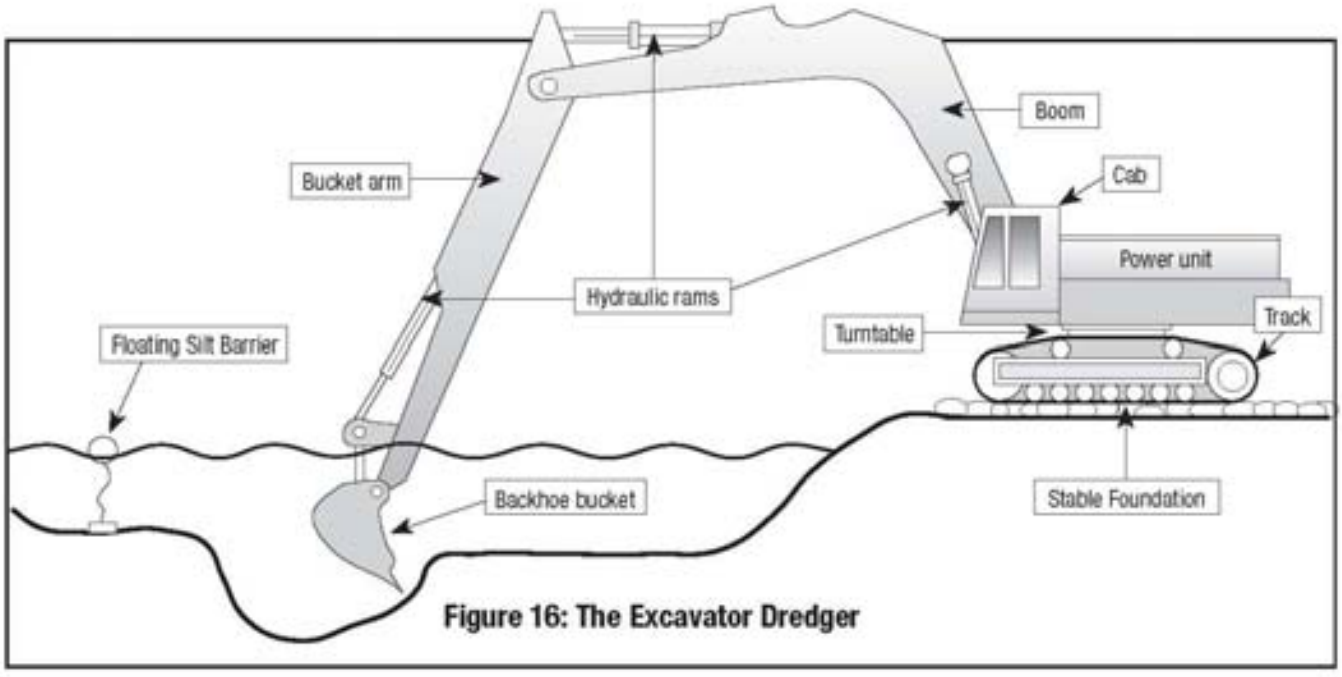


Figure 16: The Excavator Dredger

bucket, depositing it onto a barge, scow, truck or a land based containment site. Mechanical dredges are generally used to remove bed material, blasted rock, boulders or wood debris from shallow or deep waters. They have the advantage of being able to operate in restricted and/or shallow areas.

Examples of mechanical dredges include: the clamshell, dragline and hydraulic hoe dredges. These may operate from a barge, the shore or a wharf/pier.

2) **Suction or Hydraulic** air lift or hydrojet dredges are characterized by the entrainment and transport of bed material as a slurry of water and soil in a high velocity water stream. The dredged material is pumped through a floating pipeline, to a suitable dumping site. Suction/hydraulic dredges are able to pump mud, clay, fine silt, and gravel from shallow and deep marine waterways. They are generally used for larger scale projects.

Examples of suction dredges include the plain suction dredge, the suction hopper dredge, and the cutter suction dredge.

Other types of dredging equipment such as the propeller wash, hydro-jet, used in coastal environments, or the pneumatic dredger, used in ocean environments, or specialized equipment used to remove contaminated sediments, are available but will not be discussed.

Environmental Impacts

A) Physical Impact to the bottom substrate

Disruption of the benthic habitats caused by excavation or burial can result in a direct loss of fish habitat. Organisms may also become entrapped by the dredging equipment or buried during the operation.

B) Turbidity and Sedimentation

This can occur at the dredging site, during transportation to the disposal site, or at the disposal site. Increased levels of suspended sediment can interfere with the necessary functions of aquatic species, such as migration and feeding, and can be lethal, if concentrated.

Turbidity and sedimentation can also result in diminished water quality or decreased shorefront property values.

C) Decrease in concentration of dissolved oxygen

Disturbance and exposure of anoxic sediments can deplete oxygen from the surrounding waters. The chemical oxidation of metals and other inorganic compounds uses dissolved oxygen present in the water. This process can occur at the dredging site and/or at an underwater disposal site.

D) Release of toxic substances

Toxic hydrogen sulphide gas is often trapped in sediments and can be released by disturbance to these sediments. In particular, sediments high in organic content such as wood or debris have the potential to promote the formation of hydrogen sulphide and ammonia.

Trace elements, which are often found in association with finer grained sediments, can be introduced into the water when the sediments are dredged, and may be taken up by aquatic organisms.

Dredging of contaminated sediments may release contaminants directly during the dredging process or as a result of runoff, leakage, or leaching from the spoils at the disposal site.

E) Disruption of hydraulic regime at the disposal site

Dredged spoils are often disposed of behind a containment dyke at or near the bank of a watercourse. The containment dyke must be capable of retaining the spoils inside the reclamation area.

Introduction of excessive amounts of sediments into the watercourse could affect the existing hydraulic regime. Sediment may be returned to the watercourse by the erosive action of wind, runoff, and currents or by mass movement or slippage of the material caused by instability of the dumped spoils or the underlying ground.

Other Possible Impacts

1) Disturbance to fishing and aquaculture operations by the movement and actions of the dredging equipment.
2) Disruption or damage to underwater cables.
3) Diminished quality of shoreline property caused by; the appearance or odour of dredged spoils, increased turbidity, or contamination of a water supply.
4) Disruption of navigable channel.
5) Disruption of water current patterns and the natural transportation and deposition of bed material.

Application Requirements

In addition to the standard information required on the application form, **three copies** of the following must be included:

- a plan, profile and cross sectional drawing(s) to scale of:
  a) the area to be dredged, clearly indicating the amount of material to be excavated and;
  b) the disposal area in relation to existing landmarks.
- a description of all equipment to be used;
- an analysis of the material to be dredged;
- a map.

Other Government Agencies Involved

1) *Transport Canada* must be contacted by the proponent for screening under the **Navigable Waters Protection Act**
2) The *New Brunswick Department of Natural Resources*
   a) Crown Lands Branch must be contacted regarding any dredging or disposal below the ordinary high water mark.
   b) Minerals and Petroleum Development Branch. Movement and/or removal of material in submerged areas is subject to approval under the **Quarriable Substances Act**.
3) Ocean disposal of dredge spoils must be approved by *Environment Canada* under the **Ocean Dumping Regulation** of the **Canada Environmental Protection Act**.
4) *Fisheries and Oceans Canada* must authorize the destruction of fish habitat and blasting in or near water.
5) The disposal of sediments on land must be approved by the Remediation and Materials Management Branch of the *New Brunswick Department of Environment* (see below).

Application Review Process

Regulatory and Advisory

Construction

Sediment Control

Silt curtains are often used to control sedimentation of the watercourse during some dredging operations. These are pervious, floating barriers oriented vertically in the water from the surface to the bed of the watercourse restricting the migration of turbidity and suspended solids from a dredging or disposal operation. They must be installed in such a way that they fit the bottom contours of the watercourse and are of sufficient height to be able to adjust to fluctuating water levels. A chain threaded through the bottom helps to ensure an effective barrier by following the bottom contour.

Scheduling of work during periods of low flows, June 1st to September 30th, will reduce the amount of sedimentation. This low flow period also generally corresponds to the period of least sensitivity for aquatic organisms.

Disposal of Dredged Material

Alternatives for Disposal Include:

1) **Open water disposal** is the placement of dredged spoils in watercourses or the ocean by means of a pipeline or release from a barge. Although the easiest and the most economical means of disposal, this option is not permitted in provincial waters because of the potential significant impact on:
   - hydraulic regime of the watercourse involved;
   - aquatic habitat;
   - water quality in the case of polluted spoils and high turbidity.
2) **Beneficial use** is practiced when the material is suitable for some purpose such as beach replenishment, construction (aggregate), habitat development, top soil, or land fill. This choice should be encouraged whenever possible but should not be the purpose of the dredging.
3) **Confined disposal** involves placement of material within a dyked or confined upland area. The material may be piped or deposited directly by machinery operating on shore or transported and dumped by trucks. The dykes generally consist of stabilized earth fill or rock fill embankments. They must be designed to retain the solid particles and pond water while allowing the release of clean effluent to the watercourse as well as withstand erosive action of wind, waves, and currents. Please refer to the section on "Surface Erosion and Sedimentation Control" at page 19 and the guidelines for "Alteration Type: Erosion Control Works" at page 51.

Contamination and Odour Control

The sediments must be thoroughly analyzed before disposal to ensure that they are not contaminated. Land based disposal of contaminated sediments is beyond the scope of this chapter. For more information regarding disposal of contaminated sediments, contact the Remediation and Materials Management Branch of the *New Brunswick Department of Environment*:

Remediation and Materials Management Branch
Impact Management Division
Department of Environment
P.O. Box 6000
Fredericton, N.B.
E3B 5H1
(506) 453-7945

Guidelines

The limits of the underwater area to be excavated must be physically identified prior to commencement of the project.

Any disturbed bank material must be stabilized against erosion during and upon completion of the dredging operation.

Any future dredging will be contingent on the stability of the new dredged areas and will require a comprehensive review by all regulatory agencies and a new Watercourse and Wetland Alteration Permit before commencement of the work.

Unless otherwise approved by the Regulatory agencies, the area to be dredged must be contained by an effective siltation curtain installed prior to the commencement of the dredging.

Infilling of a land based containment area should be carried out beginning at the upland edge and progress towards the watercourse to facilitate drainage of the spoils.

No blasting is to be carried out in or near the water without authorization by *Fisheries and Oceans Canada*.

Alteration Type: Dug-Out Ponds

Definition

A dug-out pond is an excavated pond, using groundwater or surface runoff as a water supply for: recreation, irrigation, livestock watering, fire fighting, fish rearing, or other purposes.

Objectives

To construct and maintain a reservoir of water with a quality acceptable for the intended use.

To prevent sedimentation of a natural watercourse during construction.

Planning Considerations

Location

A site should be chosen with soils capable of retaining water in order to minimize seepage problems and maintain an adequate water supply.

The pond should be located in a gently sloping, relatively erosion resistant, vegetated area.

The area draining into the pond should not include potential sources of contaminated water such as septic tanks, barnyards, or waste containment areas.

Water Supply

If the source is groundwater, the pond can be excavated in saturated soil to create a storage structure. Water will flow into the pond from the water bearing strata. If the pond is to be excavated in a wetland that is less than 1 hectare in area, the proponent is exempt from the requirement to obtain a Watercourse and Wetland Alteration Permit as long as the guidelines below are followed. Surface runoff may also supply water to a dug-out pond if the drainage area with respect to the pond is small and the pond is located in an area that is gently rolling.

Future Considerations

Applicants should keep in mind that once a pond has been created, it falls under the definition of a watercourse, and subsequent alterations in or within 30 metres of the pond will require a permit under the provisions of the **Watercourse and Wetland Alteration Regulation**.

Application Requirements

In addition to the standard information required on the application form, **three copies** of the following must be included:

- proposed source of water;
- drawings to scale of the plan, profile, and cross sectional views;
- construction methods and materials;
- all dimensions including length, width, depth of the pond, and distance from any watercourses;
- for fish rearing - an indication of the water volume and quality necessary for the species and numbers to be reared.

Other Government Agencies Involved

1) If the plans include stocking the pond with fish, an "Inland Aquaculture License", is required from the *Department of Agriculture, Aquaculture and Fisheries*. If issued, this license grants the authority to culture fish. Currently, operations include the culture of Brook Trout, Rainbow Trout, and Atlantic Salmon, under prescribed conditions. Applications for other species may be considered.
2) *Fisheries and Oceans Canada* must be contacted before any fish are placed in a pond.

Application Review Process

Regulatory

Construction

To minimize the potential of introducing sediment from the pond to the watercourse, the minimum distance from the top of the bank of the watercourse to the top of the bank of the pond must be 15 metres.

If a site with a non-porous substrate cannot be found, the selected site may be sealed by employing one of the following methods:

1) Compaction by heavy machinery on compactable soils.
2) Addition of clay blankets to cover the entire pond area up to the high water mark. The blanket should consist of well graded, coarse grained material containing a minimum of 20% clay with minimum thickness of 30 centimetres.
3) Addition of bentonite to soils with a high percentage of coarse grained particles. Bentonite, a colloidal clay, fills tiny voids in the soil and swells up to 20 times its original volume when wet.
4) Waterproof linings such as thin films of polyethylene or vinyl can be used to line the pond but must be carefully protected from mechanical damage.

To avoid stagnation of the water in the pond and to minimize losses from evaporation and seepage, the pond should have a minimum average depth of 1 metre.

Maintenance

Maintenance of a dug-out pond can be performed under a permit and requires an application and review by the *New Brunswick Department of Environment*. Care must be taken to ensure that any sediment or muddy water generated during the maintenance activities is contained and disposed off in a manner that does not result in water containing suspended solids reaching a watercourse. The outlet must be blocked during dredging activities. Activities must not result in additional water flow to the dug out pond from a natural watercourse.

Guidelines

The area draining into the pond must not include sources of pollution.

The site must be cleared of all vegetation, slash, roots, sod and loose topsoil and the spoil material disposed of where it cannot be returned to the watercourse by storm runoff.

The pond should be excavated in non-porous subsoil or sealed to prevent water seepage.

The minimum distance from the pond to a watercourse should be 15 metres as measured from top of bank to top of bank.

The average depth of the dugout pond must not be less than 1 metre.

The side slopes of the pond should be no steeper than two horizontal to one vertical to a depth of 0.3 metres below the water line. Below this elevation, the slope should be no flatter than 1 horizontal to 1 vertical. This should prevent the excessive growth of unwanted vegetation in the edge of the pond.

No water shall be withdrawn from a watercourse to supply the pond(s).

An "Inland Aquaculture License" must be obtained from the *Department of Agriculture, Aquaculture and Fisheries* to license the pond for fish. An "Introductions and Transfers Permit" must be obtained from *Fisheries and Oceans Canada* before stocking the pond(s) with fish.

The pond should be fenced to control access by livestock and people.

All work must be carried out in a manner which would minimize sedimentation and disturbance to the surrounding area.

The portion of the embankments above the waterline and any other exposed soil within 30 metres of a watercourse must be seeded immediately after the pond has been excavated.

Definition

Erosion control works are structures or vegetation used to stabilize and protect the banks of a watercourse from the scouring and erosive action of water, ice, or floating debris within the stream flow or surface runoff from the land bordering the watercourse.

Objectives

To prevent loss of material from the banks of the watercourse and property adjacent to the banks of the watercourse.

To control channel meander and prevent undermining of structures.

To prevent sedimentation of the watercourse.

Planning Considerations

The rate and extent of erosion is influenced by the magnitude of the erosive forces from within the watercourse, soil characteristics, topography, and ground cover. The erosion control works must be designed to modify at least one of these variables.

General

Common measures used to control erosion along the banks of a watercourse include:

1) **Vegetative Measures**
   - Vegetation - in the form of grasses, shrubs, trees, vines and live cuttings
   - Live Fascine (wattles) - stabilize eroding banks and provide shade and leaf fall for fish. They can be used on slopes that are no steeper than 1 horizontal to 1 vertical. See Figure 17.

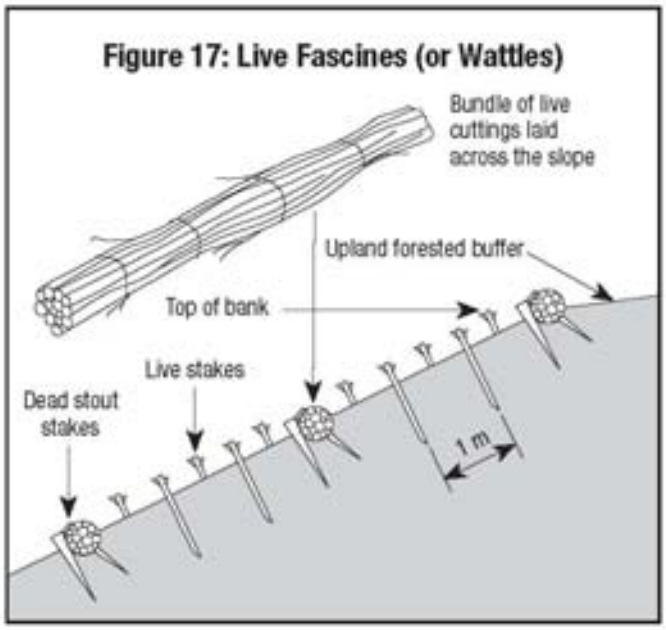


Figure 17: Live Fascines (or Wattles)

2) **Structural Measures**
   - rip-rap - a layer of boulders, cobbles or rock fragments placed over an exposed slope to help prevent erosion
   - wire baskets or cages filled with rock
   - timber crib, steel or concrete retaining walls

The method used depends on the magnitude of the erosive forces and economic feasibility. Vegetative measures and rip-rap are the least expensive alternatives, although they may not be applicable if the banks are excessively steep or the wave or ice action is excessive or if the soils, such as sand or heavy clay, do not allow vegetation to become established.

Environmental Considerations

Other types of erosion control works should be avoided if vegetation can be used, or they should be used in combination with vegetation wherever possible. The shade provided by the vegetation helps prevent rip-rap and the stones used in the rock filled wire baskets from heating up, which in turn helps reduce thermal pollution of the water.

Vegetation also provides food and cover for aquatic animals and wildlife.

Mulch, consisting of plant residue or synthetic materials, is often used to temporarily protect the sites from erosive forces of rainfall and to aid in the germination and growth of vegetation until the vegetation becomes well established or the site is permanently stabilized by another means. It can be used in combination with vegetation providing temporary protection to denuded slopes during the early phases of plant growth or can be used alone during the non-growing season where plant growth is impossible. Mulch improves water infiltration, reduces rainfall impact, and reduces surface runoff. Materials commonly used as mulch include: straw, hay, corn stalks, wood or bark chips, soil binders, nets, and mats. Chemical mulches, consisting of emulsions of vinyl compounds, rubber or other substances, are mixed with water and then sprayed on the exposed soil.

All techniques require that the erosion control works begin and end at a stable point on the banks of the watercourse to prevent failure at the upstream and downstream limits.

Application Requirements

In addition to the standard information required on the application form, the following must be included:

- description - a full description including proposed construction methods and materials, an indication of which bank is to be stabilized (left or right, looking downstream), an indication of the direction of flow and the extent of the area to be stabilized;
- dimensioned sketches - including length and height of bank affected and height, length, width, and depth of proposed works, where applicable;
- a photograph is to be provided along with a description of the shoreline and upland vegetation;
- a map.

A Provisional Permit may be obtained for rip-rap if the activity is restricted to the time period between June 1st and September 30th, and if the applicability clause and the conditions on the Provisional Permit Notification Form can be met.

Other Government Agencies Involved

Unless riparian rights have been granted, lands below the ordinary high water mark are provincial Crown Lands. Approval from the *New Brunswick Department of Natural Resources*, Crown Lands Branch, may be required for any proposed work activities located on Crown Land, in tidal water, submerged land and below the ordinary high water mark. The proponent must receive permission prior to undertaking the activity.

Application Review Process

Regulatory, and in some cases, Regulatory and Advisory. Any activity that results in land reclamation will be reviewed by both Regulatory and Advisory agencies.

Vegetation

Definition

Trees, shrubs, vines, grasses or other plants used to stabilize and protect the banks of a watercourse from the erosive action of the stream flow, waves, ice and debris within the watercourse.

Objectives

To protect the banks of a watercourse while providing and promoting habitat for fish and wildlife.

To minimize thermal pollution of the water.

Planning Considerations

General

If the banks are made up of soil which can sustain plant growth and have slopes of 2 horizontal to 1 vertical or flatter, vegetation provides excellent protection against soil erosion. It also promotes animal habitat along the banks of the watercourse and in the water by providing shade and by depositing leaf litter and insects into the water which act as food sources for fish and aquatic insects.

The degree of erosion protection offered by vegetative measures increases as the plants and root system grow and spread. Advantages of using vegetation as an erosion control measure include the following:

1) Vegetation shields the soil from raindrop impact and slows the velocity of runoff thereby protecting the watercourse from sedimentation.
2) The root systems hold soil particles in place and maintain the soil's capacity to absorb water.
3) It is less costly than other measures and requires little or no maintenance.
4) Vegetation is more compatible with the natural watercourse characteristics.
5) It helps regulate the water temperature and provides cover for the fish in the water and wildlife on the shoreline.

Guidelines

Plants chosen for erosion control should require little maintenance and be suited for the climate and soils at the site. Conditions throughout the province vary greatly and plans for vegetative stabilization must be adapted on a site specific basis. In general, the plants should have fibrous roots and be capable of attaining dense growth, thereby providing a complete soil cover. The selected species should be easy to plant, fast growing, requiring little or no irrigation, fertilizer, or mowing. Examples of plants used for vegetative stabilization include: alders, willows, poplars, shrub willow, shrub dogwood, lupine, clover, timothy and trefoil. A local nursery could be consulted for species of plants that are adapted to specific conditions.

Many types of plants are used for vegetative stabilization in New Brunswick. Species of grasses, legumes, vines, shrubs, or trees are used depending on slope stability, soil type, and moisture conditions. Only non-invasive plant species native to New Brunswick are to be used for stabilization purposes. Staff from the offices of the *New Brunswick Department of Agriculture, Aquaculture and Fisheries* or the *New Brunswick Department of Natural Resources* may be able to suggest plant species that are suitable for use as erosion control. A variety of species should be planted rather than a single species of plant.

The vegetation should be checked and maintained on a regular basis until growth is established. The plants may have to be watered and fertilized to promote growth initially.

Rip-Rap

Definition

Rip-rap is heavy broken rock, cobbles, or boulders placed over a denuded or exposed soil providing a permanent, erosion resistant cover. Rip-rap is used to armour the banks of watercourses for the following reasons:

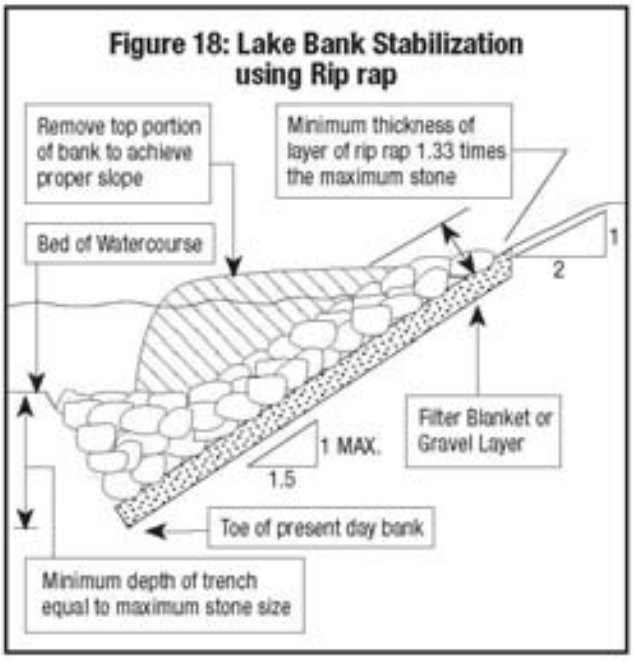
1) to protect the banks and adjacent upland areas from the erosive action of the stream flow, waves, ice, or floating debris;
2) to control channel meander thereby protecting downstream or adjacent facilities or resources;
3) to protect the banks in the vicinity of a bridge or culvert where erosion could undermine the structure.

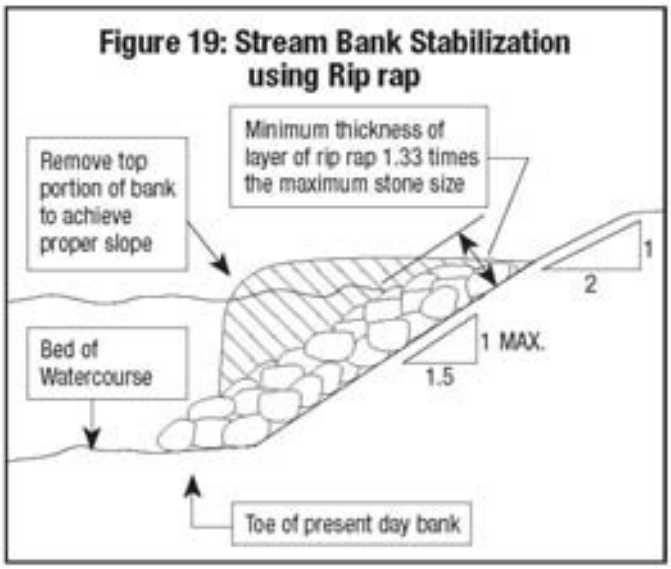
Planning Considerations

General

Rip-rap can be used to prevent erosion on the banks of a watercourse if they are no steeper than 1.5 horizontal to 1 vertical and if the velocity of the flowing water prevents the use of vegetation. Rip-rap depends on the soil beneath it for support; therefore it must be founded on solid ground. If the banks are unstable, crumbling, excessively steep or vertical, rock filled wire baskets or retaining walls may need to be used to maintain the amount of the proponent's property bordering the shoulder of the watercourse, Otherwise the top of the bank may be cut-back/contoured to achieve the slope prescribed above.

The effect of adding rip-rap is immediate, and it can be used during any season. Rip-rap is often placed in the bed of the watercourse at





the outfall of a storm sewer or around bridge abutments and piers to prevent scour, and is deposited around the ends of a culvert to help prevent erosion of the foreslopes.

Environmental Considerations

Rip-rap can provide instream cover for the fish.

Construction

The sequence for construction includes uniformly grading the surface of the banks, followed by placement of the rip-rap. In standing water environments, placement of a filter layer, such as geotechnical fabric and/or a layer of clean gravel may be used.

Guidelines (See Figures 18 & 19)

The rip-rap should be clean, durable, non-ore-bearing, non-toxic material from a non-watercourse source.

The rip-rap should be placed on the banks, by hand or with machinery capable of controlling the drop of the rock, rather than dumped over the shoulder of the watercourse.

The rip-rap should be placed such that it must not encroach upon the channel beyond the thickness of the rip-rap.

The rip-rap should be angular in shape, hard, and resistant to weathering.

Because the potential for erosion where rip-rap is being used is generally high, it should be deposited immediately following preparation of the banks. When the rip-rap is used for outlet or foreslope protection around the ends of the culvert, it should be in place before water is allowed to flow through the pipe. The slopes where the rip-rap is to be placed should be graded to a slope no steeper than 1.5 horizontal to 1 vertical. A uniform slope may be created by removing material from the top portion of the bank as needed and smooth grading the slope.

Minimum thickness of layer of rip-rap 1.33 times the maximum stone size.

The rip-rap should be deposited to the full thickness in one operation; it should not be placed in layers. Above the high water mark, rip-rap should be placed as a dense, well graded mass of stone with minimal voids. Below the high water mark, voids are permissible as they can be utilized as fish habitat. Rip-rap used to control erosion along the banks of a standing body of water should be anchored at the base of the existing bank by placing the bottom row of rock in a trench excavated to a depth at least equal to the height of the largest rock. This is not a requirement for flowing watercourses.

The placement of the rip-rap should be carried out starting at the upstream end.

Once the rip-rap is installed, it requires minimal maintenance but it should be checked periodically to ensure that any movement of the stones does not result in exposing the slope increasing the risk of failure.

When rip-rap/armour stone is placed for the protection of agricultural land, a buffer strip of vegetation of at least 6 metres between the shoulder of the rip-rap and the area used for agricultural purposes shall be established and maintained.

Rock Filled Wire Baskets

Definition

Woven wire baskets filled with rocks large enough that they will not pass through the openings in the baskets which are used to armour the eroding or slumping banks of a watercourse or to divert the flow of water away from an eroding channel section. Rock filled wire baskets are used to:

1) protect the banks from the erosive action of the stream flow, waves, ice or floating debris;
2) control channel meander, protecting adjacent or downstream facilities or resources.

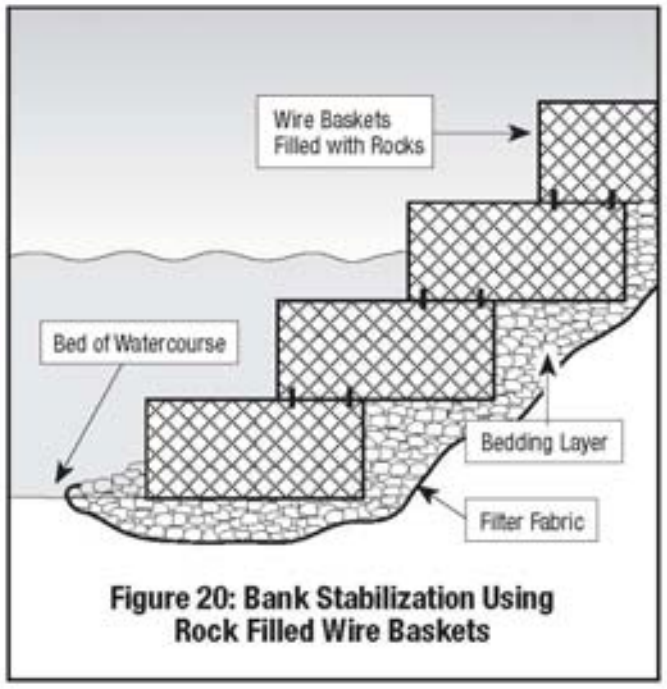


Figure 20: Bank Stabilization Using Rock Filled Wire Baskets

Planning Considerations

General

Rock filled wire baskets can be used where the velocity of the water is high or where the banks are steeper than 1.5 horizontal to 1 vertical. They are also used at culvert outlets and bridge abutments to prevent undermining of the structures.

If properly installed using proper materials, rock filled wire baskets have a long life span.

Guidelines

Because the potential for erosion where rock filled wire baskets are being used is high, preparation of the banks should only take place immediately before the installation of the baskets only.

The rock filled wire baskets must be designed to withstand water forces from high velocity, wave action and ice movement.

The wire baskets must be filled with clean stone material which is larger than the mesh size and obtained from a non-watercourse source.

When more than one tier is used, the wire baskets must be terraced and tied together to add stability to the structure. See Figure 20. The backfill material behind the wire baskets must be compacted to help prevent future washout due to high flows.

The wire baskets must be keyed into the bed of the watercourse at the base of the present day bank to prevent undermining.

Retaining Walls

Definition

Retaining walls are walls consisting of timber cribwork, concrete, or metal built to lend stability to the banks of a watercourse in order to:

1) protect the banks of a watercourse from the erosive action of the stream flow, waves, ice, or floating debris;
2) prevent bank failure.

Planning Considerations

General

Retaining walls can be used on steep or vertical banks.

The retaining wall shall be founded at the base of the present day bank.

Guidelines

To prevent bottom scour, the retaining wall should be keyed into the bed of the watercourse below the anticipated depth of scour at the base of the present day bank. The retaining wall should be well anchored to the bank for stability.

The wall can be lined with geotechnical fabric to prevent the release of fine sediments. Drainage must be provided for water that accumulates behind the retaining wall using a perforated pipe that penetrates the wall or other such means.

If timber cribwork is constructed, all treated timbers must be air dried for the length of time specified by the manufacturer for safe use in, over or near aquatic environment before being placed in the watercourse. Timber used in, over or near aquatic environment must not be treated with creosote or pentachlorophenol.

The backfill material behind the wall must be compacted to help prevent future washout due to high flows.

The retaining wall must be designed to withstand water forces from high velocity, wave action and ice movement.

Retaining walls should be placed immediately following site preparation.

Alteration Type: Fish Habitat Improvement Works

Definition

Fish habitat improvement works are activities and structures utilized in watercourses with the objective of improving and enhancing fish habitat. Structures can be used to reduce erosion rates, provide cover and habitat for fish and/or assist in natural channel formation.

Objectives

To improve fish habitat.

General

Types of Habitat Improvement Works

Types of habitat improvement works include:

1) **Floating Trees** - Trees oriented with the tops facing downstream can be secured to the bank of the watercourse to provide shade and cover habitat for fish in areas where this is required. See Figure 21.
2) **Digger Logs** - This common habitat improvement technique has been shown to mimic natural fallen log processes in a stream environment. After assessing the stream and determining their best location, digger logs can utilize the streams energy to create a scour pool for trout rearing and feeding, assist in re-establishing the meander pattern of a watercourse, sorting the streambed material for potential spawning sites and provide oxygen entrapment to improve water quality. See Figure 22.

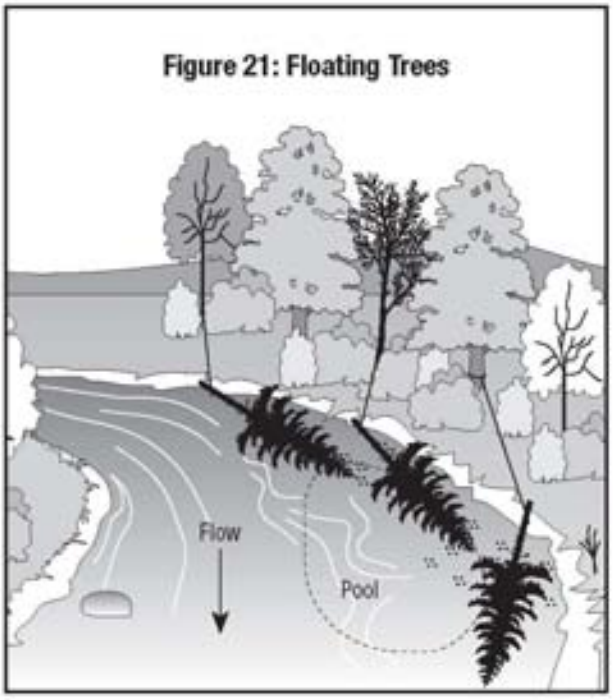


Figure 21: Floating Trees

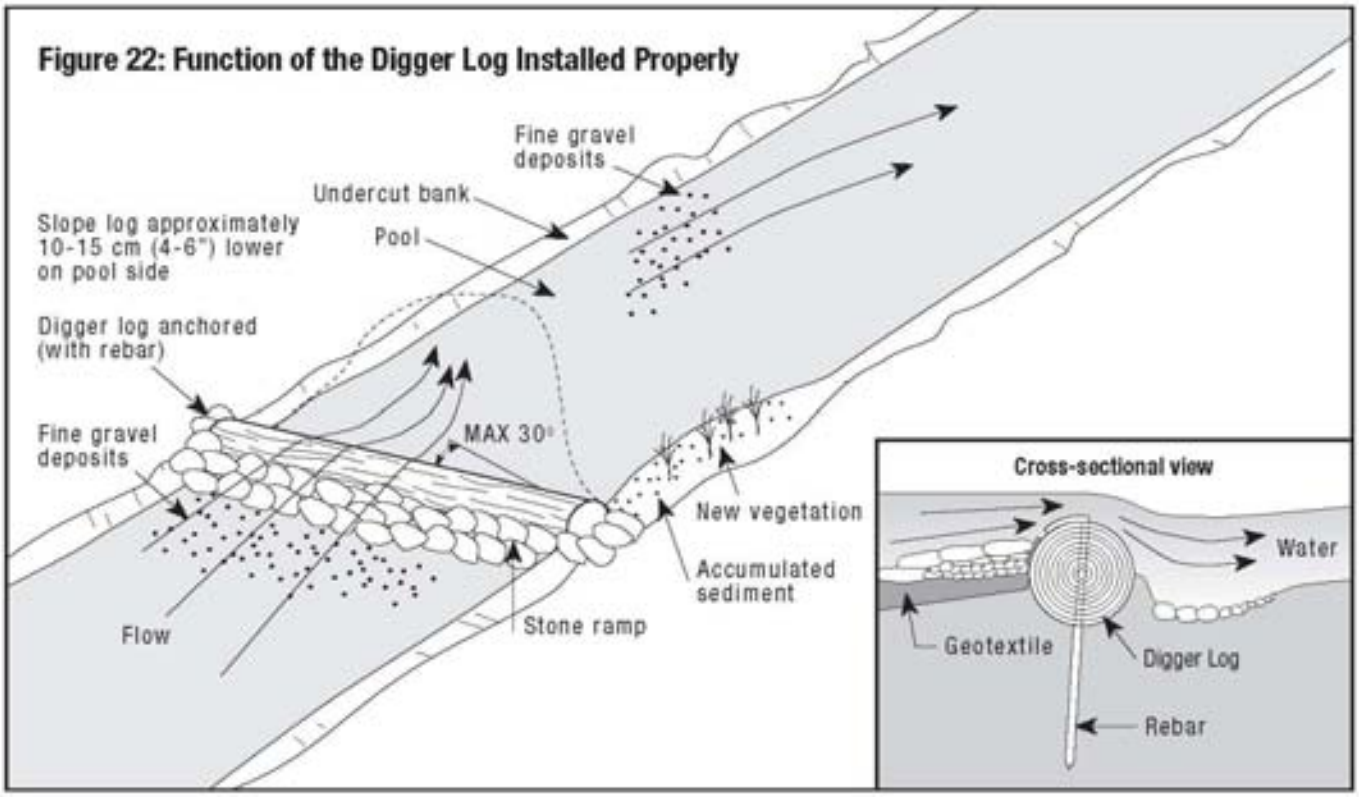
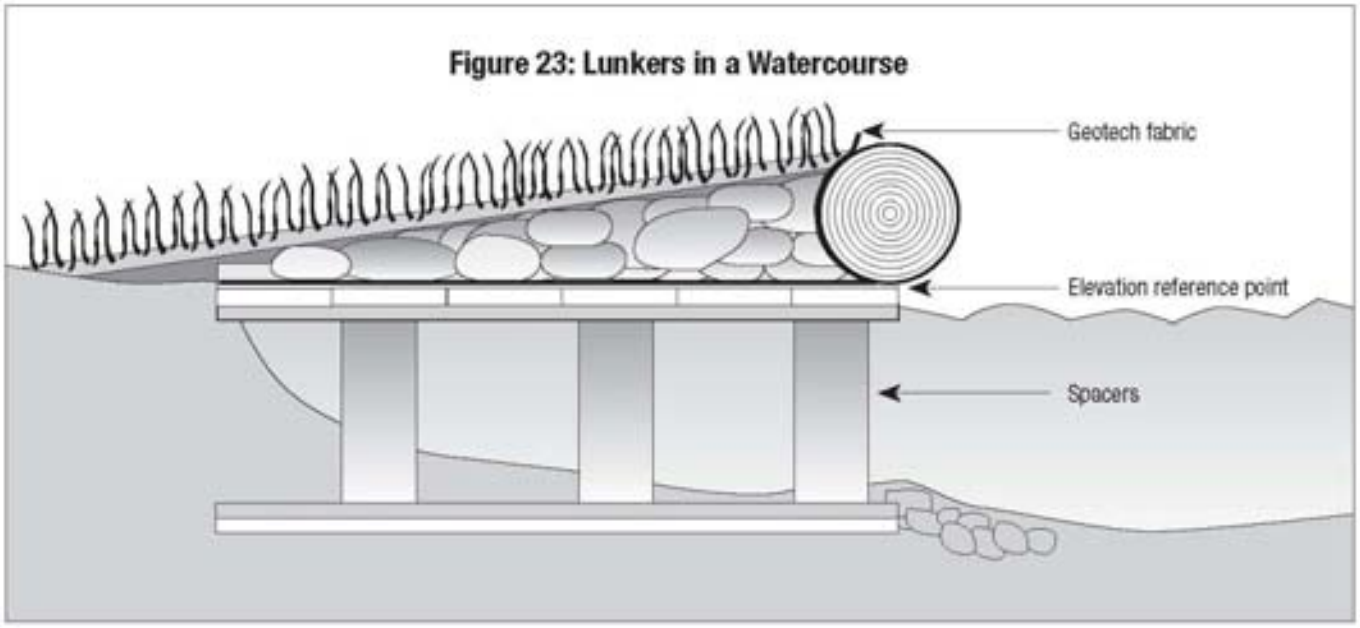
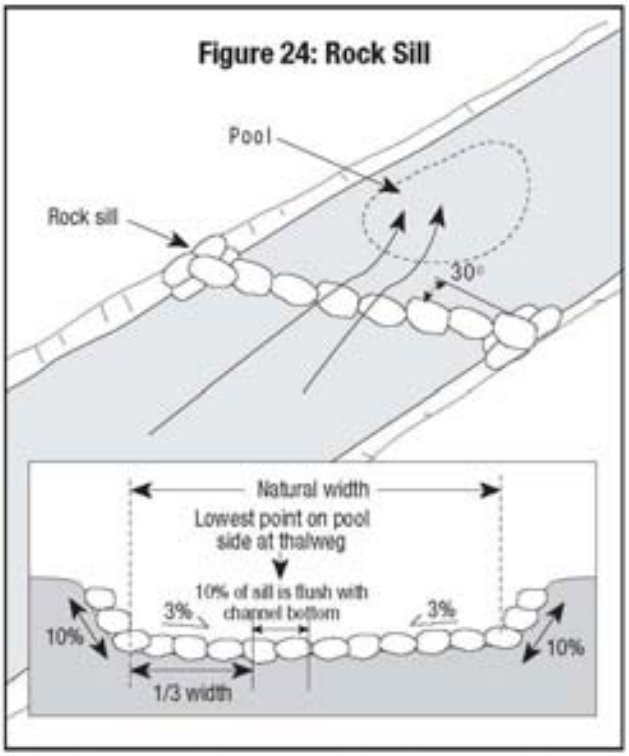


Figure 22: Function of the Digger Log Installed Properly



3) **Lunkers** - These are wooden structures constructed on the outside of a bend in a watercourse to provide cover and structure. They are used to mimic bank undercutting. See Figure 23.
4) **Rock Sills** - These structures can provide streambed scour action, grade control and help in the sorting of streambed material. Their use and function are similar to digger logs, but they tend to be used in larger river systems where digger logs would be impractical. See Figure 24.



5) **Deflectors** - Structures can be built using coniferous trees, logs or rocks secured to the bank to assist in sediment redistribution and deposition, point bar development, bank reformation and assist in re-establishing a natural meander pattern. See Figure 25.
6) **Root Wads** - Installed to provide instream cover and bank stabilization. A typical site would use 6 to 9 metre long trees with 2 metres diameter root wads. The tree trunk is buried in the bank or driven into the bank so that the base of the root wad faces the current. See Figure 26.

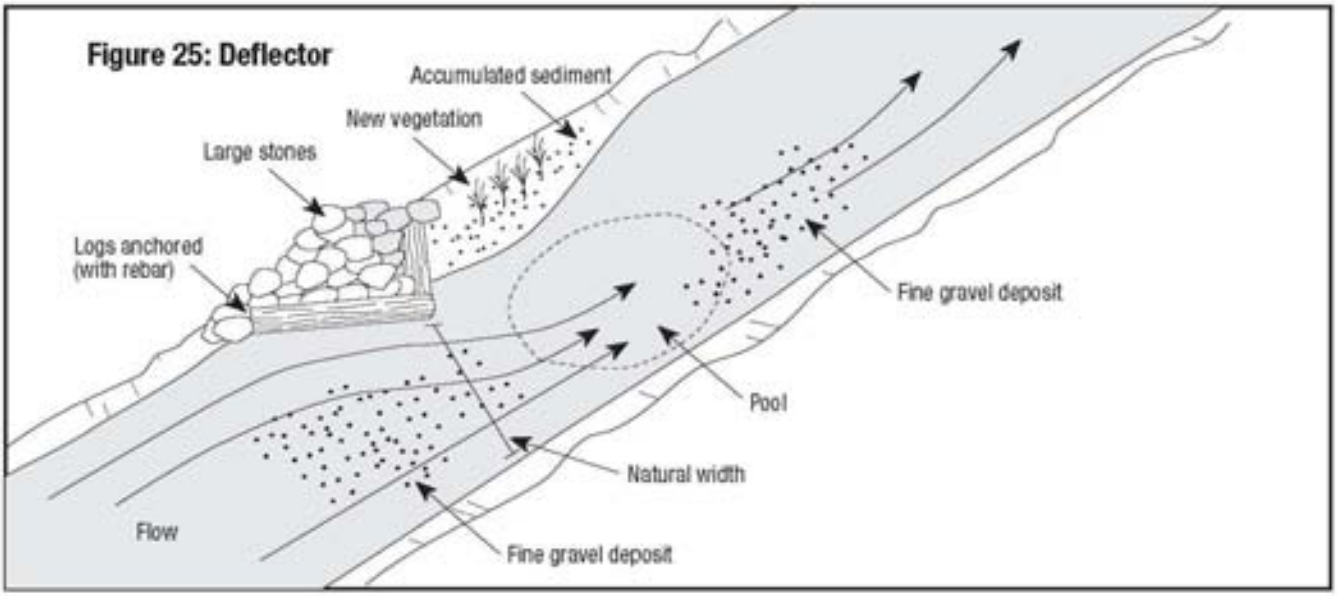
Planning Considerations

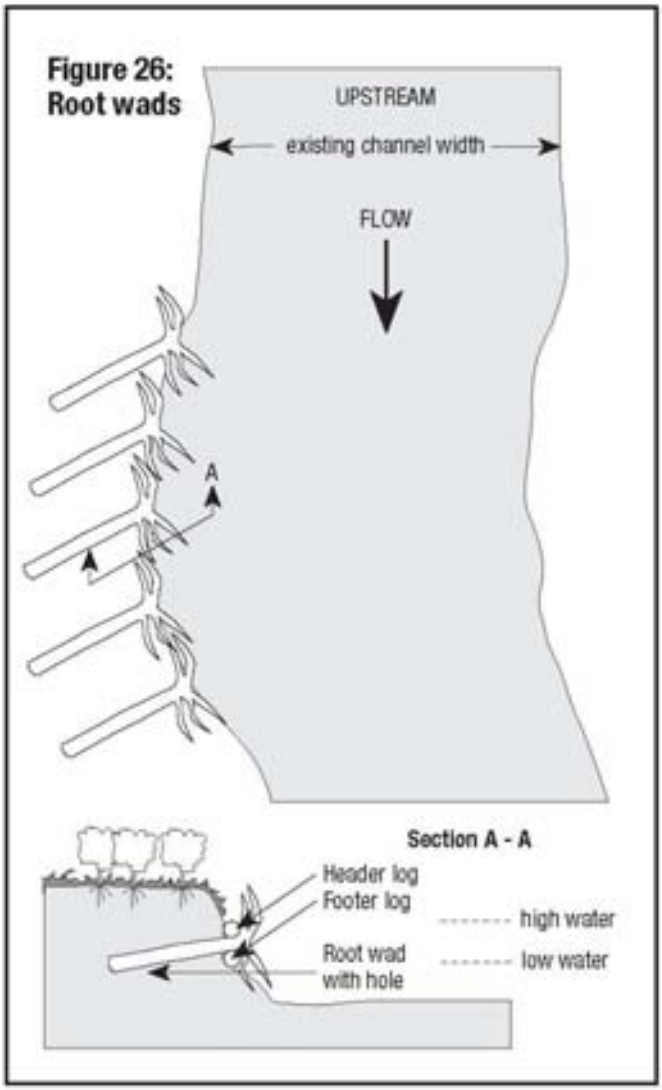
The planning of habitat improvement works must be undertaken in consideration of habitat biology, stream hydrology and hydraulics in order to ensure the intended objectives can be met. Most projects will require a habitat survey to identify limiting or controlling factors which will need to be addressed. It is advised that contact be made with *Fisheries and Oceans Canada* and *New Brunswick Department of Natural Resources* well in advance of the anticipated commencement of work.

Application Requirements

In addition to the standard information required on the application form, **three copies** of the following documents must be included:

- a full description of the technique(s) to be used;
- a layout of the proposed works;
- a document containing:
  - an explanation of the complete project and its objectives;
  - information on the design flows and stream characteristics (hydrological and hydraulic where possible);
  - and location of habitat improving structures;
- pictures of the proposed site;
- a map and PID number.





Other Government Agencies Involved

1) Navigable Waters Program of *Transport Canada* may become involved should the structure be located on navigable waterway.
2) Activities on Provincial Crown Land will require review by various sections of the *New Brunswick Department of Natural Resources* and activities on Federal Crown Land may require further screening under the Canadian **Environmental Assessment Act** (CEAA). However, small scale habitat improvement projects are normally excluded under CEAA if they are not on federal Crown Land.

Application Review Process

Regulatory and Advisory

Guidelines

The techniques covered by this category can be utilized to improve existing watercourse characteristics or as part of a plan for the construction of a new channel.

Standard sediment and erosion control measures must be utilized to reduce potential negative impacts on the watercourse.

Definition

Flood protection works involve the construction and maintenance of flood reservoirs, channel alterations, dykes and levees, or other engineering works to keep flood waters away from specific developments and/or populated areas.

Objectives

To ensure that reasonable protection is afforded to people and property against floods while preventing the transfer of the damage to other landowners or the environment.

Background Information

Flood Plains

A flood plain is low land adjoining a watercourse or coastal body of water which has been or may be inundated by flood water. Flood plains are often developed due to their proximity to navigable waterways, or because they provide flat land for agriculture and development. However, during periods of flooding, all or a portion of the flood plain may convey floodwater. Development on the flood plain may, therefore, be susceptible to flood damage.

The Flooding Problem

Floods in New Brunswick have been recorded since 1696. They have occurred throughout the Province and during every month of the year. The average annual cost of flood damages has risen to over $6 million per year and will continue to rise unless flood susceptible development on flood plains decreases.

Flooding can occur both in "open water" situations or as a result of ice jams. Ice jams and ice runs during mid-winter thaws or spring breakup have resulted in extensive damages along New Brunswick rivers. Upstream of ice jams, floodwater may rise and inundate low-lying lands not prone to flooding during ice-free periods. Ice runs, due to the upstream breakup of an ice cover or release of an ice jam, result in ice impacting on structures, including buildings on the flood plain.

Flood Damage Reduction

Flood damage reduction encompasses all structural and non-structural activities which reduce or eliminate flood damage. These activities fall under different categories of action including water and land use control. Avoiding non-conforming development on flood prone land is usually the most appropriate approach to flood damage reduction in New Brunswick.

Flood plain management, a subset of flood damage reduction activities, includes all planning and action done to ensure that no flood-related problems arise due to the development and use of areas subject to flooding. The goal is to strike a balance between the values obtainable from using flood plains and the potential losses to individuals and society arising from such use. During the planning of flood protection works, any relevant Provincial flood plain management policies should be considered.

Planning Considerations

Flood Information

When planning any flood protection works, an assessment must be made of the flood hazard. This assessment should be based on statistical interpretation of hydrologic records, and on information about past flooding.

Stream flow and water level data has been collected at several hydrometric gauging stations in New Brunswick. By applying regional analysis to the data, estimates of flood frequency can be obtained at non-gauged sites. Flood frequency, often used interchangeably with "recurrence interval" and "return period", is a statistical expression of the average time period between floods equalling or exceeding a given magnitude. For example, a 100-year flood has a magnitude expected to be equalled or exceeded on the average of once every hundred years; such a flood has a one-percent chance of being equalled or exceeded in any given year.

Information on past flooding can be obtained from:

- descriptions of flood events contained in newspaper accounts, government files and reports;
- interviews with local residents who have experienced past flood events;
- photographs or descriptive accounts of flood levels preserved by local libraries, historical societies and photographers;
- locations of ice scars and other physical evidence of past flooding.

Flood risk mapping is an important activity upon which flood plain management can be based. Several Flood Risk Areas in New Brunswick have been mapped and designated. A Flood Risk Area is the flood plain, or portion thereof, mapped and designated as an area subject to occasional flooding for the purposes of administering public policy and programs. The Flood Risk Area is usually defined by a major past flood event, an envelope of past flooding, or by the statistically-defined flood which would occur on average once in 100 years.

The Protective Approach

The protective approach involves the construction of dams, dykes, channels, diversions and other flood control works designed to protect development located in the flood plain. These structural measures can be used to reduce flood damages, but for most New Brunswick flood plains they are not feasible due to their high construction and maintenance costs.

The result of flood protection works is to reclaim land which would probably not be used intensively without it. It, therefore, fosters the use of flood plain land, and often development which is susceptible to flood damage. Flood plain occupants may see the protective works as providing complete protection against all floods. Therefore, flood protection works may give the owner(s) of flood plain property a greater sense of protection than actually provided by the protective structures. Flooding experiences in Canada, the United States and Europe have amply demonstrated the limitations of flood control structures (e.g. dykes, levees, floodwalls) for protecting populations and lands from flooding unless combined with wise use of flood plain land. Alternative land use or relocation

of the developments from the flood plain may be more appropriate than the construction of flood protection works.

Application Requirements

In addition to the standard information required on the application form, **three copies** of the following documents stamped by a person licensed to practice as a Professional Engineer must be included:

- a full description of the flood risk;
- a plan, profile and cross sectional drawing to scale of the proposed works;
- an analysis of the degree of protection that may be afforded by the protective works once built;
- a study of the effect of the flood protection works on riparian and flood plain property and on the ecological qualities of the flood plain.

Application Review Process

Regulatory and Advisory

Guidelines

Flood protection works must be capable of withstanding the maximum flood on record, i.e. the greatest flood for which there is a measurement of stage (flood water height) at or near the proposed alteration site.

The design flood shall not be less than the open water flood having a one-percent chance of occurring in any given year.

The impact of ice on a flood protection work must be considered during design.

Alteration Type: Floodwater Diversion Channels

Definition

Floodwater diversions channels are constructed to divert floodwater from an area that would otherwise be subject to flooding. It is a type of flood control in that flood waters are kept away from specific developments and/or populated areas.

NOTE: Floodwater diversion channels are often referred to as floodways. The term "floodway" may also be used to refer to the channel and adjacent lands required for the conveyance of floodwater, which, for the purposes of flood plain management, is often taken as the flood with a 20 year return period. A 20 year return period flood has a magnitude expected to be equalled or exceeded on the average of once every 20 years over a long period; such a flood has a 5% chance of being equalled or exceeded in any given year.

Objectives

To ensure that flood diversion channels do not aggravate flood damage downstream of the diversion.

To ensure that when flood diversion channels are constructed, reasonable protection is afforded to people and property against floods.

Planning Considerations

Flood Plains - please refer to the *background information* on *flood plains* in the guidelines for "Alteration Type: Flood Protection Works" at page 58.

Flood plains have value from a water resource standpoint (e.g. moderation of floods, water quality maintenance and groundwater recharge), from an ecological standpoint (e.g. wildlife and plant resources and habitat), and from a resource utilization (e.g. open space, agriculture, and forestry). Some of the value of the flood plain may arise as a result of occasional flooding. The loss of value of the flood plain due to a flood water diversion channel should be considered.

Floodwater diversion channels may encourage greater development of flood plain land. Often this development is susceptible to flood damage. Flood plain occupants may see flood water diversion channels as providing complete protection against all floods. The level of flood protection depends upon the chosen design flood. Diversion channels may give the owner(s) of flood plain property a greater sense of protection than actually provided by the protective structures.

Flood Information

When planning any flood protection works, an assessment must be made of the flood hazard. This assessment should be based on statistical interpretation of hydrologic records and information about past flooding. See *flood information* in the guidelines for "Alteration Type: Flood Protection Works" at page 58.

Level of Protection

The desired level of protection depends upon the type and value of the property being protected, as well as the risk to human life, the susceptibility of the property to flood damage, the degree to which flood damage can be tolerated, and the cost of the floodwater diversion channel.

When protecting subdivisions or entire communities, floodwater diversion channels, in conjunction with the natural channel, should generally be capable of passing the maximum flood of record, i.e. the greatest flood for which there is a measurement of flow or stage (flood water height) at or near the proposed alteration site. The design flood, defining the upper limit of protection afforded by the floodwater diversion channel, should not be less than the open water flood having a one-percent chance of occurring in any given year.

Application Requirements

In the processing of applications for Watercourse and Wetland Alteration Permits, a distinction is made between floodwater diversion works providing protection to a single piece of land (owned by one individual) and floodwater diversion channels providing protection to more than one property, a subdivision or a community.

Protection of Single Pieces of Land

In addition to the standard information required on the application form, an application for a Watercourse and Wetland Alteration Permit for the construction of swales or other small floodwater diversion channels must include a full description of the flood risk, and a plan of the proposed channel. The proponent should demonstrate an understanding of the degree of protection that would be afforded by the floodwater diversion channel.

Protection of Several Properties, Subdivisions, Communities

In addition to the standard information required on the application form, an application for a Watercourse and Wetland Alteration Permit for the construction of Floodwater Diversion Channel must include **three copies** of the following documents stamped by a person licensed to practice as a Professional Engineer:

- an assessment of the flood risk;
- a plan, profile and cross sectional drawing to scale of the proposed channel;
- an analysis of the degree of protection that may be afforded by the floodway once built;
- a study of the effect of the flood protection works on riparian and flood plain property and on the ecological qualities of the flood plain.

Application Review Process

Regulatory and Advisory

Guidelines

The design capacity of the floodwater diversion channel must be chosen in regards to the desired level of protection. The hydraulic gradeline of the floodwater diversion shall tie into the elevation of water in the outlet expected for the design flood. There must be no diversion of water from the watercourse through the floodwater diversion channel outside of flood periods.

The bed slope of the floodwater diversion channel must be in the direction of flow and should not result in a velocity that will cause excessive erosion or sedimentation.

The bed of the floodwater diversion channel should not contain depressions which could trap water and/or fish once the flood is over.

Alteration Type: Instream Data Collection Devices

Definition

Instream date collection devices are natural or artificial sites on watercourses where measurement devices are used for hydro-technical purposes. Counting fences and smolt wheels used for biological assessment and scientific purposes are also included.

Objectives

To obtain a systematic record of water level and flow in a watercourse at a site with a stable cross-section and/or which is sheltered from wind and wave action.

To avoid interference with navigation.

To minimize sedimentation of the watercourse.

To maintain the stability of the banks of the watercourse.

To install a temporary structure in order to assess biological parameters.

Planning Considerations

The quality of the data obtained from a hydrometric station is dependent on the stability of the bed and banks of the watercourse. It is essential to gather both maximum instantaneous and low flow data. The recording device and shelter should be located above the maximum flood level and sheltered from or protected against ice damage.

Counting fences, fish weirs and smolt wheels should be located in areas that are stable so that its influence on water flow patterns does not negatively impact on the watercourse. The location should be readily accessible for inspection and supervision by trained personnel.

Environmental Impacts

1) Destabilization of the bed and bank of the watercourse may result in the movement of sediment entering the watercourse and being washed downstream resulting in degradation of fish habitat.
2) Disturbance to the banks of the watercourse may be substantial; disturbance to the bed of the watercourse will normally be limited to a narrow trench.
3) The installation process or the instrument may impede fish migration.

Application Requirements

In addition to the information required on the Provisional Permit Notification Form, the following must be included:

- a plan, profile and cross sectional drawing to scale of the layout of the device;
- a full description of construction materials and proposed construction methods;
- a map.

Other Government Agencies Involved

1) The approval of the *Transport Canada* which administers the **Navigable Waters Protection Act** must be obtained for any structure to be placed in or across any navigable watercourse.
2) A Scientific Collection Permit is required from *Fisheries and Oceans Canada* for counting fences, smolt wheels and other instruments that may retain or impede fish.
3) Approval from the *New Brunswick Department of Natural Resources*, Crown Lands Branch, may be required for any proposed work activities located on Crown Land, in tidal water, submerged land and below the ordinary high water mark. The proponent must receive permission prior to undertaking the activity.

Application Review Process

Regulatory only

A Provisional Permit may be obtained for this activity if the applicability clause and conditions on the Provisional Permit Notification Form can be met.

Guidelines

An instrument pool or well must be secured or protected from ice and other debris in the flow.

Material removed from the bank of the watercourse must be stockpiled and the bank restored and stabilized against erosion immediately following installation of the device.

Excess backfill material shall be disposed of such that it cannot enter or be washed into the watercourse during periods of high flow or by surface runoff.

A trench in and adjacent to the watercourse must be backfilled with the material that was excavated and the channel restored such that is closely resembles its pre-construction profile and cross-section.

Equipment used in the watercourse must be mechanically sound having no leaking fuel tanks or hydraulic systems and should be steam cleaned free of petroleum products and dirt.

Periodical checks are required to ensure that the device is not negatively impacting to the watercourse or aquatic environment. Proper marking and signage is required for counting fences and smolt wheels. The Navigable Waters Protection Program of *Transport Canada* must be contacted by the applicant directly.

The counting fences and smolt wheels must be secured against debris being propelled by the flow of the watercourse.

Scientific equipment installed on an annual basis will only be in place during ice-free conditions.

Alteration Type: Land Extensions

Definition

Land extensions are extensions of the natural shoreline/banks as a result of a planned partial infilling of a watercourse.

Objectives

To produce a stable, erosion resistant extension of the existing shoreline while minimizing the destruction of fish habitat.

To maintain fish passage.

To minimize sedimentation of the watercourse and prevent erosion as a result of the encroachment into the watercourse.

Planning Considerations

Environmental Considerations

Land extensions may be used to replace land lost to erosion. Before they are permitted by the Surface Water Protection Section, they are subject to advisory review and if approved, will have stringent conditions placed upon them.

Some of the environmental concerns regarding land extensions are listed below:

1) Sedimentation, as a result of placing material into the watercourse, and from erosion of the exposed surface of the newly created shoreline by wind, water or wave action.
2) Destruction of aquatic habitat through deposition of material directly in resting pools, spawning grounds and other important habitats.
3) Erosion and scour - Reducing channel capacity may result in alteration of the flow regime which leads to increased flow velocity and downstream erosion and scour. In standing bodies of water, deforming the natural shoreline increases erosion of the shoreline adjacent to the land extension.
4) Water quality impacts caused by the use of unsuitable fill materials.
5) The loss of a portion of the littoral zone due to infilling.

Application Requirements

In addition to the standard information required on the application form, **three copies** of the following must be included:

- a drawing to scale of the plan, profile and cross sectional views;
- a description of the proposed construction materials and methods;
- a detailed reasoning for the project to provide justification for the activity;
- aerial photographs should be provided to show past and existing conditions;
- a map.

Other Government Agencies Involved

1) Land extensions must not illegally impinge on public or private ownership rights. Unless riparian rights have been granted, lands below the ordinary high water mark are provincial Crown Lands. Approval from the *New Brunswick Department of Natural Resources*, Crown Lands Branch, may be required for any proposed work activities located on Crown Land, in tidal water, submerged land and below the ordinary high water mark. The proponent must receive permission prior to undertaking the activity.
2) The approval of the *Transport Canada*, which administers the **Navigable Waters Protection Act** is required for any structure to be placed in or across any navigable watercourse.
3) If a land extension is proposed within an incorporated municipality, municipal officials must be contacted.

Application Review Process

Regulatory and Advisory

Guidelines

Land extensions are to be constructed so as to not interfere with fish migration routes.

The fill material used must be clean, non-ore-bearing, inorganic, non-toxic material and must not contain wood wastes, automobile bodies or other material detrimental to aquatic life or water quality.

The fill material used for a land extension should not be obtained from or within 30 metres of a watercourse.

During construction, the land extension must be separated from the wetted portion of the watercourse using an approved cofferdam or curtain. This structure shall be removed only after the structure has been stabilized and protected so as to prevent erosion.

Fill material must be covered with topsoil and seeded within 48 hours or stabilized to prevent erosion and if necessary reseeded until a vegetated mat is established.

The sloped face of the land extension bordering the watercourse must be stabilized with rip-rap. Please refer to the guidelines for “Alteration Type: Erosion Control Works” at page 51.

Alteration Type: Pipeline/Cable Crossings

Definition

Pipeline and cable crossings are locations where distribution or transmission pipelines carrying petroleum products, sewage or water, or where fibre optic, or electrical cables cross a wetland or break the bank of a watercourse.

Objectives

To place a seamless pipeline or cable across the watercourse without creating a barrier to fish passage.

To prevent the harmful impacts from the installation methodology on fish and fish habitat.

Planning Considerations

Route Selection

Alignments should be planned to minimize the number of watercourse crossings.

General

An in-depth assessment of the proposed crossing sites must be undertaken before a route is chosen to determine site suitability and to help in the selection of appropriate construction methodology. The following variables must be included in the evaluation:

- Approach slope within the 30 metre buffer and bank stability
- Riparian vegetation
- Bed and bank material
- Height of banks
- Channel width
- Water depth
- Flow characteristics
- Channel bottom characteristics
- Erosion potential

Environmental Considerations

The proposed crossing site will be evaluated by advisory agencies for sensitivity with respect to aquatic resources including the following:

- fish habitat;
- spawning habitat potential;
- overwintering potential;
- aquatic vegetation;
- water quality;
- quality of bed material.

Sensitivity is based on the potential impacts of construction on the variables listed above and their tolerance to sediment loading.

Environmental Impacts

The harmful impacts resulting from constructing a pipeline/cable crossing can be significant. Concerns include:

1) Loss of habitat - resulting from trenching, backfilling, and associated operations in the watercourse and riparian areas
2) Turbidity and sedimentation - as a result of surface runoff and in-water work. Unless the installation methodology involves no in-channel work, the potential for sedimentation is severe.
3) Degradation of water quality - from leaking pipelines or fuel spills
4) Contamination of soils - caused by a leaking pipeline

Other Impacts

Interference with navigation.

Diminished value of shorefront properties due to turbidity and sedimentation.

Interference with fishing activities caused by equipment and sedimentation.

Application Requirements

In addition to the standard information required on the application form, **three copies** of the following must be included:

- a plan, profile, and cross sectional drawing to scale;
- a complete description of the proposed construction methodology;
- a map.

Other Government Agencies Involved

1) The approval of the *Transport Canada* which administers the **Navigable Waters Protection Act** is required for any structure to be placed in or across any navigable waters.
2) *Fisheries and Oceans Canada* must authorize the use of any explosives in Canadian fisheries waters.
3) All pipelines exceeding 5 kilometres in length, except water, steam, or domestic wastewater pipelines and pipelines that are the subject of an application under the **Gas Distribution Act** or the **Pipe Line Act** as stated in Schedule A of the **Environmental Impact Assessment Regulation**, must be registered with the Minister of Environment. Inquiries should be directed to the Manager of the Environmental Assessment Section of the Sustainable Development, Planning and Impact Evaluation Branch of the *New Brunswick Department of Environment*.
4) Approval from the *New Brunswick Department of Natural Resources*, Crown Lands Branch, may be required for any proposed work activities located on Crown Land, in tidal water, submerged land and below the ordinary high water mark. The proponent must receive permission prior to undertaking the activity.

Application Review Process

1) Open Cut Category - Regulatory and Advisory
2) Working in Isolation of Stream Flow Category - Regulatory
3) Diversion Category
   - Cofferdam Method - Regulatory
   - Channel Diversion - Regulatory and Advisory
4) Trenchless Category - Regulatory
5) Aerial Category - Regulatory
6) Non Buried Category - Regulatory

Construction

There are six categories of pipeline crossing construction techniques with different methods in each category. The method chosen depends on habitat sensitivity, size of watercourse, approach slopes, channel and flow characteristics. Emphasis should be placed on habitat sensitivity. Highly sensitive areas should not be considered for a crossing site. Pipeline characteristics and cost will also influence the technique chosen. A brief description of each method and the advantages and disadvantages **from an environmental standpoint** are outlined below:

1) OPEN CUT CATEGORY

Plow Method - involves plowing in the pipeline, where the pipeline is placed or dragged into the furrow created by the plow. This method is used on soft bottom watercourses for small diameter lines/cables where limited sedimentation is tolerated. See Figure 27.

Advantages:
- fast
- minimizes the time in watercourse
- short period of sedimentation
- short period of instream work
- maintains channel flow
- maintains fish passage

Disadvantages:
- bank grading required
- potential sedimentation during bank grading
- potentially high sedimentation during instream work

Bucket Wheel Trencher Method - involves trenching through the watercourse with a bucket wheel. This technique is used in low flow, low sensitivity watercourses where sedimentation is not a concern.

Advantages:
- fast
- minimizes time in watercourse
- short period of sedimentation
- short period of instream work
- maintains channel flow

Disadvantages:
- potentially high sedimentation
- spoil pile may block flow
- trench may slough-in
- requires extensive grading of banks
- may block fish passage

Back Hoe Method - is the most commonly used technique which involves trenching through the watercourse with a hydraulic hoe. The back hoe method is used in shallow watercourses where sedimentation is not a concern.

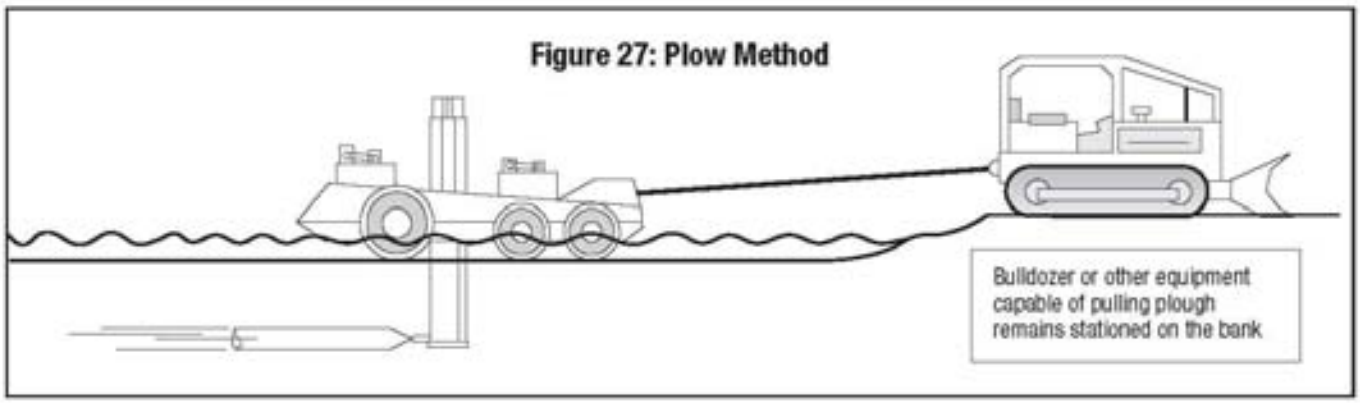
Advantages:
- fast
- minimizes time in watercourse
- maintains channel flow
- maintains fish passage

Disadvantages:
- potentially high sedimentation during excavation and backfilling
- instream stockpiling of spoil on wide watercourses

Dragline Method - is used in wide, deep watercourses. It involves trenching through the watercourse with a yo-yo bucket from either bank.

Advantages:
- equipment not stationed in the watercourse
- spoil on banks
- maintains channel flow
- maintains fish passage

Disadvantages:
- potentially high sedimentation
- slow



- long duration of sedimentation
- safety concern with cables strung across watercourse

Dredging Method - is used in wide channels or lakes where sedimentation is not a concern. It is accomplished by dredging a trench through the watercourse with suction and pumping the slurry onshore or to tanks on barges.

Advantages:

- minimal sedimentation during trenching
- maintains channel flow
- maintains fish passage
- no instream spoil storage

Disadvantages:

- settling ponds required for slurry
- disposal of settled solids
- possible damage to fish and fish habitat

2) WORKING IN ISOLATION OF STREAM FLOW CATEGORY

These methods all involve blocking or damming the flow using non porous material covered with an impervious liner to prevent sedimentation.

Flume Method - involves stemming the water upstream from the crossing and conveying the flow past the site in pipes lying in the stream bed. The watercourse is dammed downstream from the site to prevent backflow. The by-pass method is used on smaller watercourses where sedimentation and fish passage are concerns and should be carried out during low flow periods. See Figure 28.

Advantages:

- minimize sedimentation
- maintains channel flow
- maintains fish passage

Disadvantages:

- sedimentation during dam construction, removal and as water flushes over construction area
- susceptible to washout
- slow to install
- dries up short reach of stream bed
- fish salvage required from dewatered reach
- flume pipes can be crushed or blocked
- some bank and stream bed disturbance may be required
- conditions in flume pipes, such as slope and velocity of flow, may prevent fish passage

Dam and Pump Method - stemming the flow upstream and downstream of the construction site and pumping the stream flow around the site using hoses. This method is formidable for high flows; it is most efficient in relatively small, low flow watercourses, where sedimentation is a concern.

Advantages:

- limited sedimentation
- maintains channel flow

Disadvantages:

- sedimentation during dam construction, dam removal and as water flushes over construction area
- susceptible to washout
- slow to install
- dries up short reach of stream bed
- fish salvage required from dewatered reach
- barrier to fish
- pumping must be carried out 24 hours a day

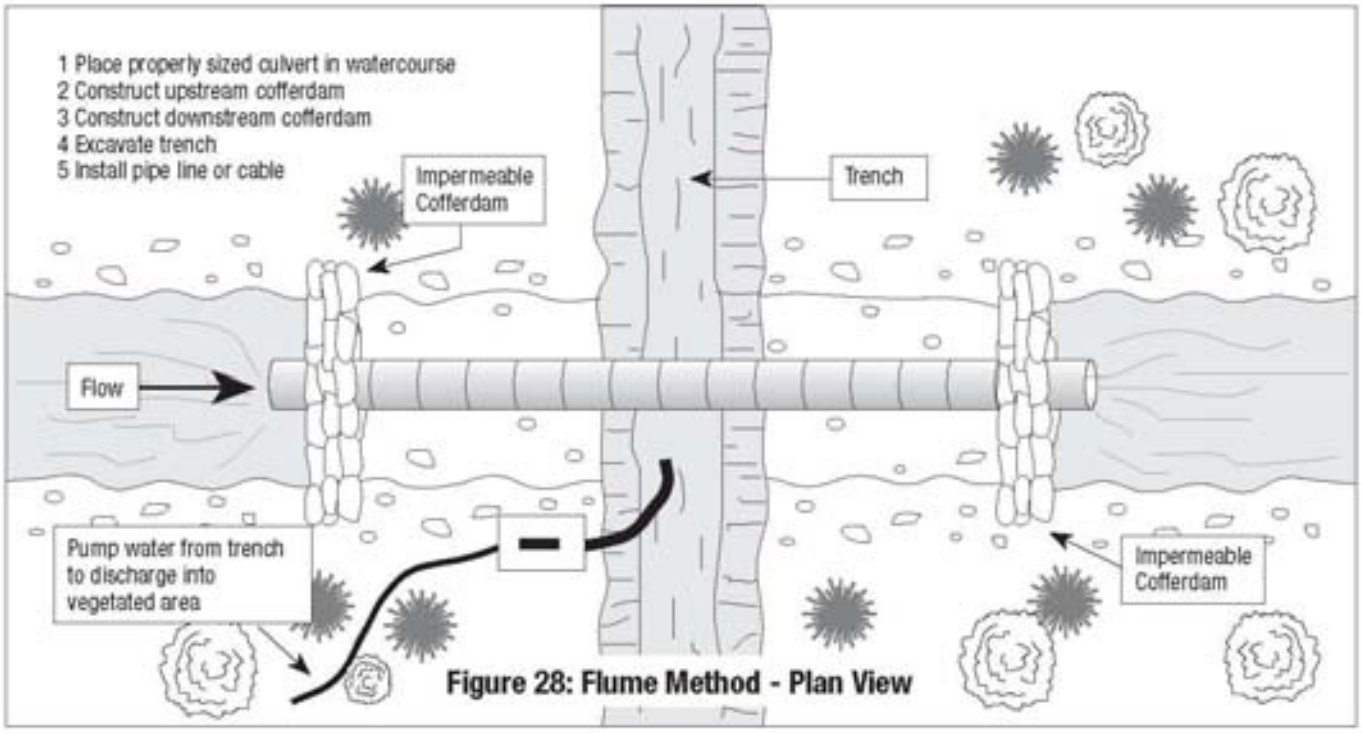


Figure 28: Flume Method - Plan View

3) DIVERSION CATEGORY

Cofferdam Method - involves installing a cofferdam the minimum distance necessary out into the watercourse to facilitate the installation of the line slightly past the midway point across the wetted portion of the channel, pumping the work area dry, installing the line, and repeating the procedure on the other side of the watercourse. Sand bags or rocks faced with plastic, sheet piling, or other materials can be used for cofferdams provided that they do not pose a risk of introducing sediment into the watercourse. This method is suitable for moderate to large watercourses where sedimentation and fish passage are a concern.

Advantages:

- maintains channel flow
- maintains fish passage

Disadvantages:

- possible moderate sedimentation depending on amount of instream work
- dries up large portion of the channel cross-section
- increased water velocity
- possible increased erosion on opposite bank
- potential washout of cofferdam
- slow
- uses large area of right-of-way and creates terrain disturbance
- results in a joint in the line, prone to rupture, near mid-channel

Channel Diversion Method - involves constructing a temporary plastic lined diversion channel around the worksite and diverting the flow from the stream flow into it. It is appropriate for larger watercourses where it is not feasible to pipe or pump the flow around the site and where sedimentation and fish passage are a concern.

Advantages:

- maintains channel flow
- maintains fish passage

Disadvantages:

- dries up long reach of watercourse
- slow
- potential washout of diversion dam
- terrestrial damage

All trenching methods require the trench to be backfilled and stabilized after the pipeline/cable has been placed.

4) TRENCHLESS CATEGORY

Boring Method - involves boring under the watercourse from a pit on one side of the watercourse to a pit on the other side, with, or without casing. This method is suitable in situations where the bed of the watercourse cannot be disturbed and where the water table is low. See Figure 29.

Advantages:

- no sedimentation
- no disturbance of stream bed
- no bank disturbance
- maintains normal channel flow
- maintains fish passage

Disadvantages:

- pits may need dewatered onto surrounding land
- possibility of sump water causing sedimentation of watercourse
- deep pits cause disturbance of approach slopes
- possibility of pits caving in

Directional Drilling - accomplished by setting up a drill rig on one approach slope and drilling to a target on the opposite approach slope. Can be used in large watercourses with sensitive aquatic habitat and where there is no instream activity allowed. See Figure 30.

Advantages:

- no sedimentation
- no bank disturbance
- no stream bed disturbance
- maintains normal channel flow
- maintains fish passage
- can be used to avoid working on unstable approach slopes

Disadvantages:

- disposal of drilling fluids
- fractures in substrate may release pressurized drilling fluids into watercourse

5) AERIAL CATEGORY

Bridge Attachment Method - involves attaching a line to an existing bridge structure or trestle. This method is used on large watercourses with unstable approach slopes and sensitive habitat where there should be no instream activity. Often used in deep gorges, or canyons or in urban areas where numerous bridges already exist.

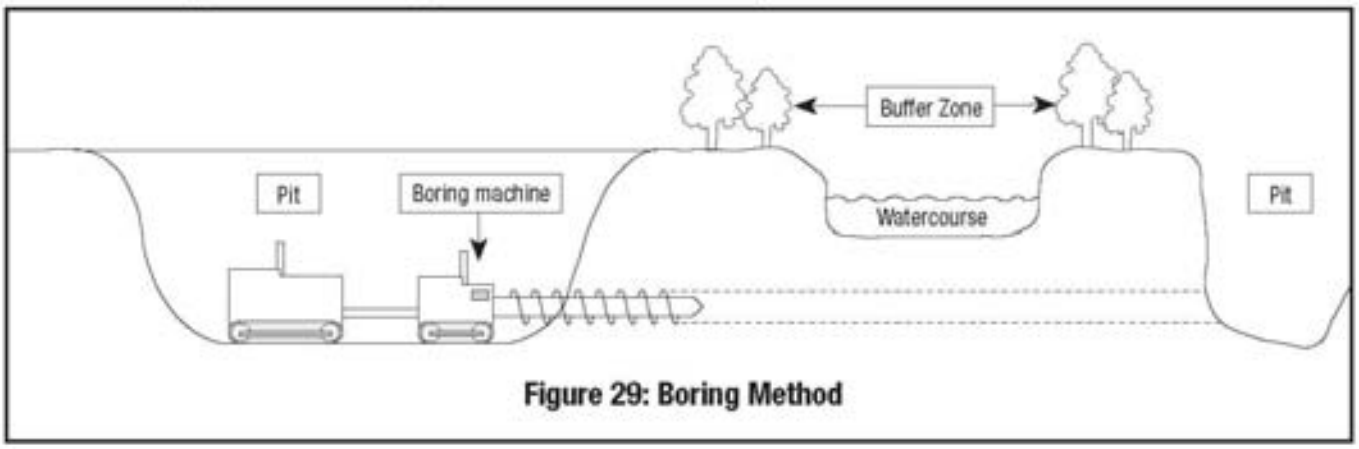


Figure 29: Boring Method

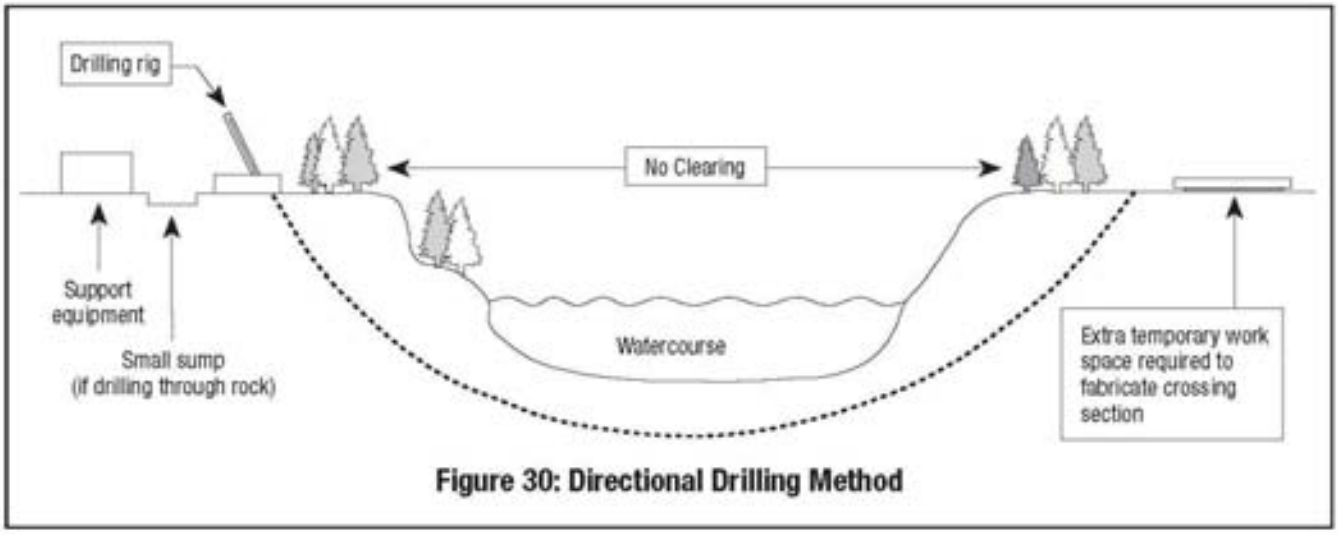


Figure 30: Directional Drilling Method

Advantages:

- no sedimentation
- no stream bed disturbance
- maintains normal channel flow
- maintains fish passage

Disadvantages:

- possible visual impact
- safety
- visibility of pipeline may lead to vandalism by third party and introduction of product into water

Self Supporting Bridge or Span Method - involves constructing a bridge or abutments to carry line. Used in large watercourses with sensitive habitat where no instream activity is allowed and in deep canyons or gorges.

Advantages:

- no sedimentation
- no stream bed disturbance
- no bank disturbance
- maintains normal channel flow
- maintains fish passage

Disadvantages:

- visual impact
- safety and introduction of product into watercourse due to third party damage

6) NON BURIED CATEGORY

Only part of the cable/pipeline is buried in these two methods.

Approach Slopes Method - involves laying the pipes or cables on the surface of the valley slopes and burying it under the watercourse. This method is usually used as a temporary measure.

Advantages:

- little bank disturbance

Disadvantages:

- visual impact
- safety and introduction of product into watercourse due to third
- party damage
- barrier to wildlife/livestock movement
- maintenance impacts
- potentially high sedimentation

River/lake bed method - involves laying the weighted line on the bed of the watercourse. The cable/line is buried only on the approach slopes and banks. This method is used in deep watercourses where there is no chance of damage from anchors or dredging activity and no chance of obstruction of fish passage or navigation.

Advantages:

- little bed disturbance
- limited sedimentation
- maintains channel flow
- maintains fish passage

Disadvantages:

- safety and introduction of product into watercourse due to third party damage
- maintenance impacts

Sediment Control

All instream work should be scheduled to be performed during periods of low flow unless the installation technique involves no in-channel work such as the directional drilling or boring method.

Surface erosion must be minimized by stabilizing the backfilled trench as quickly as possible and installing sediment control devices to trap sediment until permanent vegetation has been established.

Guidelines

Material removed from the bank of the watercourse must be stockpiled and the bank restored and stabilized to prevent erosion after the pipe is installed.

The portions of the backfilled trench within 30 metres of the watercourse upon which vegetation cannot be established must be covered with rip-rap to help prevent erosion of the fill material.

The excavated trench on the landward side of the rip-rapped area is to be seeded and mulched to prevent erosion.

Excess backfill material is to be disposed of such that it cannot enter the watercourse during periods of high flow or be carried to the watercourse by surface runoff.

Grubbing upstream and downstream of the centre line of the conduit within 30 metres of the watercourse must be limited to the width of equipment required to carry out the project.

If it is not buried, the pipeline must be ballasted to prevent it from floating.

A 30 metre wide buffer strip along both sides of the watercourse must not be grubbed until all material and equipment is on site ready to begin the actual crossing work.

Water from conduit trenches draining to a watercourse must be trapped and pumped to a settling pond or filtered through a vegetated area.

The trench in and adjacent to the watercourse must be backfilled with material that was excavated and the grades and elevations restored to closely resemble either the original or a more stable cross-section; where rock was removed, gravel fill or clean quarried rock material may be used.

Alteration Type: Removal of Major Obstructions

Definition

Major obstructions is a general term which includes dams, causeways, water control structures such as fishways and weirs, and other hydraulic structures which impound water. This alteration type involves the removal of these structures from the watercourse which may have a significant impact on the aquatic environment.

Objectives

To remove the obstruction while minimizing impacts to the environment.

To minimize sedimentation during and after removal of the obstruction.

To minimize erosion resulting from removal of the obstruction.

To avoid significant drops in water levels throughout the removal.

Planning Considerations

Environmental Impacts

Removing major obstructions has the potential for significant impact on the aquatic habitat. The removal of a dam, for example, could have severe effects downstream and upstream if the water is not released gradually. The sudden release of water and accumulated sediments could erode the banks of the watercourse, destroy property, destroy or alter important components of fish habitat or endanger human life.

The removal of major obstructions should only be carried out when the benefits of the removal exceed the cumulative effects of the associated environmental impacts. Planning for this type of alteration must not only involve choice of machinery and timing but also an analysis of the positive and negative effects of the removal of the structure on the environment.

Site restoration work upstream of the obstruction should be considered as part of the planning considerations.

This type of alteration can vary greatly depending on the size and type of obstruction. Each project of this nature will require input from our advisory agencies and if permitted, will be subjected to intensive fish habitat protection measures.

Application Requirements

In addition to the standard information required on the application form, **three copies** of the following must be included:

- a proposal outlining the need for removal of the structure;
- a drawing to scale clearly indicating the size, shape and alignment of the structure to be removed;
- a detailed description of the proposed removal procedure;
- a map and PID number.

Other Government Agencies Involved

Depending on the scope of the project, one or all of the following may be involved:

1) *Fisheries and Oceans Canada*
2) *New Brunswick Department of Natural Resources*
3) *Transport Canada*
5) *Environment Canada*
6) The Environmental Assessment Branch of the *New Brunswick Department of Environment*

Application Review Process

Regulatory and Advisory

Construction

The construction techniques and guidelines for this alteration type will be determined according to the conditions specific to each site.

Alteration Type: Removal of Minor Obstructions

Definition

Minor obstructions is a general term which includes single span bridges, culverts, water intake structures or other structures which do not impound water. This alteration involves the removal of these structures from the watercourse or from within 30 metres of the shoulder of a watercourse.

Objectives

To remove the obstruction while minimizing impacts to the environment.

To minimize sedimentation during and after removal of the obstruction.

To minimize erosion resulting from removal of the obstruction.

Planning Considerations

Application Requirements

In addition to the standard information required on the application form, the following must be included:

- a proposal outlining the reason for removing the structure;
- a fully dimensioned sketch clearly showing the size, shape and configuration of the structure to be removed;
- a full description of the proposed removal method;
- a map and PID number are required.

Application Review Process

Regulatory Only

Guidelines

The watercourse must be restored to closely resemble the original cross section. The removal and restoration must be limited to the minimum required work area.

After the removal is complete, the work area and any associated disturbed soil within 30 metres of the shoulder of the watercourse must be completely stabilized to prevent erosion.

Any debris and sediment generated from this project must be prevented from entering the watercourse and disposed of in the proper manner such that it will not be washed into the watercourse during periods of high flow.

For closed-bottom culvert removal, a dam and pump-around or temporary diversion are two of the techniques that can be utilized to perform work in isolation of the stream flow and to ensure the natural flow of water downstream is uninterrupted and its quality maintained. The banks must be restored to closely resemble the channel cross-section and completely stabilized to prevent erosion and sedimentation. The approaches are to be removed from the floodplain.

Alteration Type: Salmon Pool Restoration, Pool Creation and Rock Placement

Definition

The restoration, creation and enhancement of pools, runs and riffles for fish habitat.

Objectives

To allow for the restoration of salmon pools in an environmentally sustainable manner while enhancing fish habitat.

To permit fish habitat enhancement activities that will be beneficial to the ecosystem.

Planning Considerations

General

The following guiding principles will be respected at all times during the evaluation of proposals submitted for review as per these guidelines:

1) **No net loss of the productive capacity of fish habitats** - No loss of highly productive habitat will be permitted by altering nursery and rearing areas, food supplies, migration routes and spawning grounds. All proposals may be considered a harmful alteration, disruption or destruction of fish habitat (HADD).
2) **Restoration and development based on fisheries conservation goals** - The rehabilitation and creation of habitats, including pools, may be permitted in selected areas to increase the natural productive capacity of the habitat.

Additional information on this category can be obtained through the document entitled "Restoration and Creation of Salmon Pools in New Brunswick (1996)". This is a joint paper developed by the *New Brunswick Department of Environment*, the *New Brunswick Department of Natural Resources* and *Fisheries and Oceans Canada*.

Environmental Considerations

Alteration of watercourses for the purposes of restoring, enhancing or creating pools requires careful and thorough planning. Understanding of the watercourse dynamics is required to ensure that the proposed alteration does not negatively impact on fish habitat, watercourse hydraulics, and adjacent property. The rivers and streams in New Brunswick are constantly changing due to hydrological events, fluvial geomorphological characteristics, ice conditions and anthropogenic (land-based) influences. Access to cold water is recognized as a vital component in ensuring the health and survival of Atlantic salmon. Consideration will be given to proposals that involve the enhancement and distribution of naturally occurring surface and groundwater flows.

Application Requirements

In addition to the standard information required on the application form, the following must be included:

- A Pool Restoration Application Package must be completed for all proposed alterations in this category. They can be obtained from the Surface Water Protection Section, Sustainable Development, Planning and Impact Evaluation Branch, *New Brunswick Department of Environment*, Fredericton, NB;
- Survey, design and construction information is required along with historic records of the proposed alteration site. A minimum of 5 cross-sections of the channel are required. These are to be located at the upstream limit of the pool, middle of the pool, downstream limit of the pool, 10-20 metres upstream of the pool and 10-20 metres downstream of the pool. A profile of the bed of the watercourse is also required and it should extend from above the pool to below the pool and show the streambed elevations, water surface, and direction of water flow. Accurate and reliable information must be provided at the application stage or further processing of the application cannot take place.

Other Government Agencies Involved

Unless riparian rights have been granted, lands below the ordinary high water mark are provincial Crown Lands. Approval from the *New Brunswick Department of Natural Resources*, Crown Lands Branch, may be required for any proposed work activities located on Crown Land, in tidal water, submerged land and below the ordinary high water mark. The proponent must receive permission prior to undertaking the activity.

Application Review Process

Regulatory and Advisory. A site visit will be required during the review process to undertake an on-site evaluation. Any excavation and infilling in running water may constitute a HADD and the proponent will have to apply to *Fisheries and Oceans Canada* for a formal review to determine whether a Section 35(2) Authorization under the **Federal Fisheries Act** is necessary.

Guidelines

Salmon pool restoration activities must be limited to that defined in the historic records or the survey of the last restoration and will be limited to once every five years.

For the purposes of defining the dimensions of a pool, areas of depth in excess of 76 to 92 centimetres during normal summer low flows will be considered as pool area. Each application will be evaluated on a case by case basis to allow for consideration of site specific conditions.

The mechanical removal of bed load material is to be carried out by an excavator, preferably stationed outside the wetted portion of the watercourse.

Proponents are encouraged to develop and implement measures which will help ensure the non-mechanical maintenance of the pool (e.g. rock clusters, deflectors, cribs, etc.).

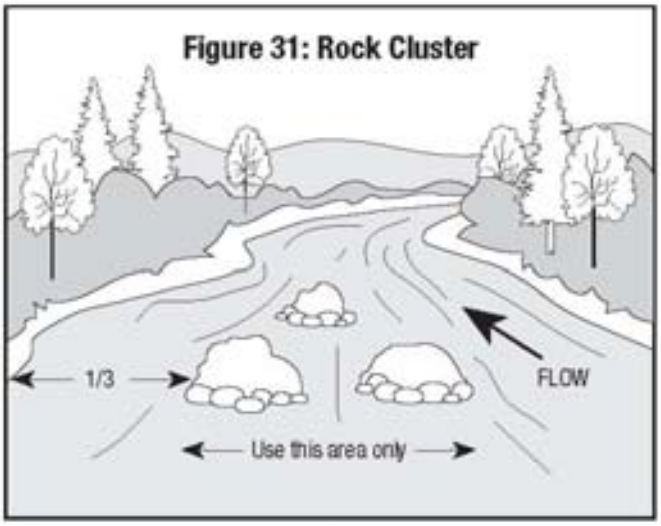
The provisions of suitable holding areas for adult salmon is not meant to be achieved through the alteration of habitat which is utilized by other life stages of developing salmon. For this reason, the substrates underlying riffle and run areas upstream and downstream from an existing pool are not to be altered. Pools, riffles and runs containing unstable bed load materials, spawning gravels and unconsolidated clays may not be altered. The creation of holding pools will be supported when it is determined that an insufficient number of pools limit migratory or spawning success and pool stability can be assured.

Creation of angling pools may be supported where the action is consistent with a watershed fisheries management plan developed by a watershed committee and sanctioned by stakeholder government agencies.

Rock placement can be utilized to stabilize bars and assist in the movement of gravel through pools as long as they are designed to address the hydrological parameters of the site. See Figure 31.

It is the responsibility of the proponent to contact adjacent landowners and inform them of the activity if there is a possibility that they may be affected by the alteration or construction activity. The proponent must obtain written approval from the landowners that will be directly affected by the alteration. Adjacent landowners can contact the *New Brunswick Department of Environment* with regards to any application to provide input to the review process.

Figure 31: Rock Cluster



Alteration Type: Subdivisions and Linear Development

Definition

The development of land which results in the removal of the vegetative surface for construction purposes, such as the development of a residential subdivision and commercial/industrial developments. Linear developments include transportation, electrical and natural gas corridors.

Objectives

To provide for an orderly planned development in a way that facilitates the subdivision of a parcel of land and the development of individual lots while minimizing the environmental impact.

Planning Considerations

General

Subdivisions require careful planning to minimize erosion during the construction activity. See Schedule A of the **Environmental Impact Assessment Regulation - New Brunswick Clean Environment Act**. Linear developments exceeding 5 kilometres in length will require a review by the New Brunswick Environmental Assessment Section.

Environmental Considerations

A surface water management plan must be developed formulating how surface water management will be addressed. A sediment and erosion control plan must include a strategy for preventing sediment discharge from disturbed areas during each phase of construction and must be included as part of the application package. Sediment discharge potential can be greatest during the topsoil stripping and cut and fill phases, prior to surface runoff control and temporary stabilization of exposed erodible soil and the routing of surface water flows into appropriate areas.

Maintenance activities along corridors and right-of-ways must be undertaken to minimize the potential of soil erosion and resulting sedimentation of watercourses.

Application Requirements

In addition to the standard information required on the application form, the following must be included:

- drawings to show surface water management and sediment and erosion control plans. In addition to obtaining a Watercourse and Wetland Alteration Permit, the Municipality or the Local Service District must approve any proposed subdivision'
- a map and PID numbers;
- subdivision layout with respect to existing watercourses, wetlands, and other land use features is required. If watercourses are to be re-aligned to facilitate street layout and the proponents proposed subdivision plans require diversion work, please refer to the guidelines for "Alteration Type: Diversions and Cutoffs" at page 44.

Application Review Process

Regulatory and Advisory for new construction/developments

Regulatory only for maintenance activities

Guidelines

The locating of infrastructure must take into consideration environmental factors and should avoid watercourses.

Ground disturbances should be minimized and where unavoidable, be followed by immediate stabilization.

Site runoff controls must be put in place to minimize the risk of sediment laden water entering a watercourse or wetland.

Wetlands must be avoided.

Watercourse crossings should be at right angles to the watercourse channel.

A detailed sediment control plan must be prepared and approved.

Alteration Type: Surface Runoff and Drainage Changes

Definition

The term surface runoff and drainage changes is intended to describe minor adjustments to the drainage pattern of an area within 30 metres of the shoulders of a watercourse which are required as part of the development of an area.

Activities occurring within 30 metres of the shoulder of a watercourse that may fall under this definition are as follows:

- construction or maintenance of drainage ditches that break the bank of a watercourse;
- removing or disturbing in situ material, depositing fill, seeding, landscaping;
- excavating a foundation for a home, cottage or other building;
- constructing roads, pathways, or parking areas;
- digging/drilling a well;
- re-sloping, grading or levelling the present day topography;
- creating post holes;
- tilling, plowing, seeding, harrowing and cultivating land and uprooting crops that takes place within 5 metres of the shoulders of a watercourse;
- daylighting of buried services.

Objectives

To prevent an increase in the amount of surface runoff entering the watercourse.

To prevent sedimentation of the watercourse and destruction of aquatic habitat.

Planning Considerations

An alteration categorized as a surface runoff/drainage change seldom has the potential to produce a serious environmental impact. Complications may arise from the cumulative effect of many minor changes which may result in a change in the drainage pattern of a large area.

To help prevent the introduction of saturated soil or suspended sediment into the watercourse, it will generally be required that a buffer zone of undisturbed land be left between the shoulder of the watercourse and projects that alter surface runoff and drainage patterns.

Application Review Process

Regulatory Only

A Provisional Permit may be obtained for activities in the 15 to 30 m zone landward of the shoulder of the watercourse if the applicability clause and conditions on the Provisional Permit Notification Form can be met and the project limited to the period between June 1st and September 30th.

Guidelines

Please refer to the section on “Surface Erosion and Sedimentation Control” at page 19.

Definition

The harvesting or felling of trees, bushes and shrubs within 30 metres of the shoulders of the bank of a watercourse or wetland.

Objectives

To maintain a viable buffer by controlling activities within 30 metres of a watercourse or wetland in order to:

1) maintain and promote healthy aquatic habitat;
2) prevent sedimentation of the watercourse;
3) ensure bank stability;
4) minimize disturbance to terrestrial habitats.

Planning Considerations

General

To maintain the protection offered to our watercourses by a natural buffer zone of vegetation in forests, harvesting activities are controlled within 30 metres measured horizontally from the shoulder of the bank of the watercourse. Within this zone, permitted activities generally fall into the following categories:

Selective harvesting – involves harvesting a percentage of the merchantable trees. The total merchantable trees removed from the 30 metre buffer zone is normally limited to 30%. The trees must be evenly distributed, and harvesting is limited in the same area to only once every 10 years. The harvesting activity must not present a threat to stand viability.

Replacement of undesirable vegetation - involves removing nuisance species of woody vegetation and replacing it with desirable species. This is usually done for aesthetic reasons. Permits for this activity are granted if replacing the existing vegetation will not adversely affect fish habitat.

Cutting of non-marketable woody vegetation adjacent to a watercourse - involves removing a strip of vegetation less than 6 metres in width, for the purpose of providing access to the water, creating an unobstructed view of the water, or installing services. Removal of trees or other vegetation within 30 metres of a watercourse or wetland may be permitted to facilitate other types of alterations such as road construction, pipeline/cable crossings, and boat launching ramps.

Pre-Commercial Thinning - also called spacing, involves cutting trees from an immature stand to provide the remaining trees with optimal growing space so they will mature faster. The cut trees must not be used for commercial purposes. Pre-commercial thinning does not require a Watercourse and Wetland Alteration Permit; however, at no time should brush/slash be allowed to enter the watercourse. If removal is required for chipping, a permit is required.

Environmental Considerations

Buffer Zone

An adequate buffer zone of vegetation maintained along a watercourse will protect the riparian zone, which is the zone of vegetation bordering a watercourse. See Figure 23. The benefits of a healthy riparian zone are listed below:

Food supply - Insects and organic debris dropping from the vegetation provide food sources for wildlife and aquatic species.

Shelter - Vegetation along the banks of a watercourse provide protection to wildlife inhabiting the vegetated zone adjacent to the watercourse. The shelter provides wildlife with secure cover

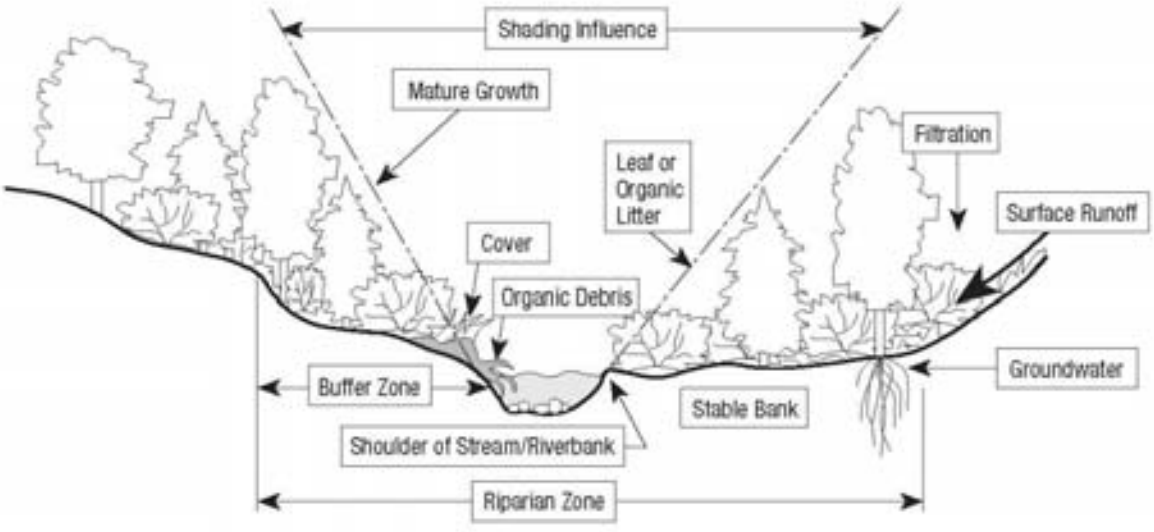


Figure 32: Importance of the Riparian Zone to Aquatic Habitat

to gain access to the water throughout the year and migration corridors along watercourses.

Shade - Vegetation shades the water from direct sunlight, thereby controlling water temperature and preventing excessive fluctuations. By keeping the temperatures cool, the dissolved oxygen content in the water is maintained.

Filter - The vegetation and root systems effectively filter and help purify the upland surface runoff by slowing it down and by allowing sediments to settle out or by acting as a filter, thus preventing suspended sediments and pollutants from entering the watercourse.

Erosion control and stability - Root systems bind soil particles in place thus preventing slope failure and erosion of the watercourse banks which in turn helps preserve channel stability.

The amount of stormwater runoff is decreased by leaves which intercept rain and transpire water. Root systems increase the soil's ability to absorb water. These two factors combine to reduce the amount of surface runoff, prevent sedimentation of the watercourse, and reduce soil moisture content that can prevent bank failure from occurring.

Harvesting Activities

Riparian zone vegetation, aquatic habitat and water quality can be severely impacted by the following timber harvesting activities:

Clear cutting increases the amount of runoff and sediment entering the watercourse by reducing the vegetative canopy, exposing bare soil, and allowing increased snow deposition adjacent to the watercourse. Clear cutting also introduces more debris into the water which may block the watercourse creating barriers to fish passage or causing channel shifts. Dissolved oxygen content is decreased as a result of the high demand for oxygen by decaying organic matter. Gravel substrates may become clogged by fine organic or inorganic particles introduced into the watercourse as a result of clear cutting practices.

Landings are not permitted within 15 metres of the watercourse. They develop relatively hard, impermeable surfaces decreasing the amount of water percolating through the soil. Landings and loading areas within 30 metres of a watercourse should be located close to the proposed roadway and on firm high ground where possible to avoid rutting and blockage of drainage paths.

Skidding or twitching cut trees has the potential to destroy the immature vegetation, compact the soil and make large ruts in the ground surface creating conditions that cause erosion and sedimentation.

Use of heavy machinery such as skidders and porters are not permitted within 15 metres of the shoulders of a watercourse unless the equipment is constructing or travelling on an access road which extends cross the watercourse. See Figure 33. This will prevent negative impacts of heavy equipment on the stem, limbs, and roots of the buffer zone vegetation. It will also avoid soil compaction, rutting, and decrease the possibility of debris entering the watercourse.

Roadbuilding may accelerate runoff and sedimentation. Roads disrupt the natural drainage patterns and their hard surfaces do not allow water to percolate through. Sediment laden runoff can be funnelled towards the watercourses by the road if off-take ditches are not constructed and oriented to direct the surface drainage water away from the watercourse and into the vegetated buffer zone(s).

Application Requirements

In addition to the standard information required on the application form, the following must be included:

- a fully dimensioned sketch clearly showing the scope of the proposed alteration within the 30 metre zone bordering the watercourse;
- a full description of equipment and methodology to be used;
- a description of the vegetation to be removed;
- a map and PID number.

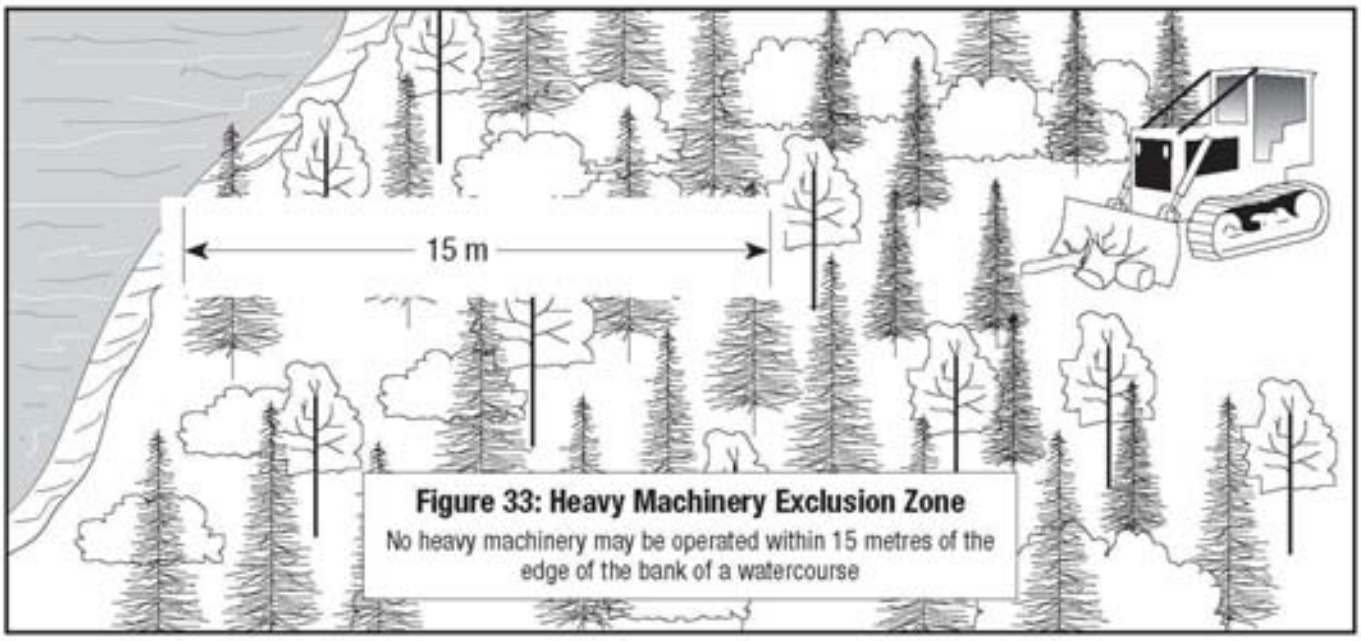


Figure 33: Heavy Machinery Exclusion Zone
No heavy machinery may be operated within 15 metres of the edge of the bank of a watercourse

A Provisional Permit for cutting of non-marketable woody vegetation adjacent to a watercourse and selective harvesting within 30 metres of a watercourse or wetland may be obtained for these activities if the applicability clause and conditions on the Provisional Permit Notification Form can be met.

Application Review Process

Regulatory Only

Construction

Selective Harvesting

To ensure that an adequate buffer zone is maintained, a Watercourse and Wetland Alteration Permit will usually only be issued for the selective harvesting of 30% of the merchantable trees bordering watercourses that are depicted on the *New Brunswick Department of Natural Resources* digital water layer or represented on the black and white 1:10,000 scale orthophoto maps. Trees that are harvested must be evenly distributed within this buffer zone and harvesting may only occur once every ten years.

All harvesting taking place within 15 metres of the shoulders of any watercourse must be undertaken by manual methods, without tracking heavy equipment inside the zone.

On freehold and private land, all merchantable trees may be removed up to 3 metres of the shoulders of watercourses that are **not** depicted on the *New Brunswick Department of Natural Resources* digital water layer or represented on the black and white 1:10,000 scale orthophoto maps.

On Crown Land, all merchantable trees may be removed up to 3 metres of the shoulders of watercourses that measure less than 0.5 metres in width, from shoulder to shoulder.

It is important to note that although existing policy allows clear cutting up to 3 metres of the shoulders of a watercourse **not** depicted on the *New Brunswick Department of Natural Resources* digital water layer or represented on the black and white 1:10,000 scale orthophoto maps, the channel is still considered to be a watercourse and as such, is subject to all requirements of the **Watercourse and Wetland Alteration Regulation** under the **Clean Water Act** and the fish habitat provisions of the Federal **Fisheries Act**.

Replacement of Undesirable Vegetation

This practice applies to the cutting of nuisance vegetation from privately owned residential or recreational property within 30 metres of the edge of the bank of a watercourse and replacing it with a desirable species. Grubbing is not permitted and the undesirable material may not be utilized as a commercial product.

Cutting of Non-marketable Woody Vegetation Adjacent to a Watercourse

The above term applies to the removal of all vegetation from a strip not exceeding 6 metres in width for the following purposes: to facilitate access to the water; to provide a view of the water (from a cottage or home); to install services provided that there is no grubbing within 30 metres of the edge of the bank of a watercourse. See Figure 34.

Figure 34: Cutting of Non-Marketable Woody Vegetation Bordering a Watercourse

Road Construction – Please refer to the guidelines on "Alteration Type: Watercourse Crossings" at page 81.

Guidelines

All Tree, Bush and Shrub Removal

No trees may be felled across or into the watercourse.

No primary forest product is to be stacked within 15 metres of a watercourse.

No heavy machinery shall track within 15 metres of the shoulder of the watercourse when removing trees, bushes and shrubs within this zone.

Vegetation must be maintained along the banks of the watercourse in sufficient quantity to maintain adequate shade to prevent a rise of water temperature which could adversely affect the fish, fish food and fish habitat.

Vegetation must be maintained along the banks of the watercourse in sufficient quantity to provide for bank stability.

All slash and felled trees lying in a watercourse or within 15 metres of the shoulders of a watercourse must be removed and disposed of such that it cannot be washed into the watercourse during high flow.

Any debris generated during the project must be prevented from washing downstream and must be removed from the watercourse. Disposal of debris must be in conformance with the **Water Quality Regulation** under the **Clean Environment Act** which is administered by the N*ew Brunswick Department of Environment*.

No in-channel work is to be carried out at anytime during this project.

Selective Harvesting

Where alders border a watercourse, no felling or grubbing is to be carried out.

The clearing limits must be marked with ribbons or flagging. No tops, slash, debris or primary forest product from a harvesting operation shall be allowed to enter a watercourse.

Harvesting operations within 30 metres of the shoulders of a watercourse must not result in exposing erodible soil.

Replacement of Undesirable Vegetation

Mulch or other temporary erosion control measures must be applied and maintained until vegetation is established over the entire disturbed area or the site is permanently stabilized with other permanent erosion control measures.

No work below the ordinary high water line of a watercourse may be done during periods of elevated water levels resulting from spring runoff, storm events or dam operations, except where necessary to protect work in progress. Work shall otherwise be limited to a period of low water levels or low flow.

If the banks of the watercourse are disturbed by any activity associated with this project, they must be immediately stabilized to prevent erosion.

Undesirable vegetation must be replaced with a sufficient quantity of desirable species of trees to provide bank stability and adequate shade to prevent a rise of water temperature which could adversely affect the fish, fish food and fish habitat.

Cutting of Non-marketable Woody Vegetation Adjacent to a Watercourse

Prior to starting the activity, erosion control measures must be installed and maintained to prevent the discharge of sediment into a watercourse.

Mulch or other temporary erosion control measures must be maintained until a catch of vegetation is established over the entire disturbed area or the site is permanently stabilized with other permanent erosion control measures.

If the banks of the watercourse are disturbed as a result of any activity associated with this activity, they must be immediately stabilized to prevent erosion.

Definition

Water control structures are designed to handle water, including retention, conveyance, control, regulation and dissipation.

These structures may be used for:

1) the regulation of water storage facilities to improve available water quantities for water supply or for the preservation of aquatic and wildlife habitat;
2) the control or regulation of instantaneous runoff to prevent flooding or erosion;
3) the purpose of providing free, unobstructed passage for fish past a dam or barrage.

Objectives

To minimize disruption to the existing hydraulic regime.

To minimize disturbance to aquatic habitat or other man-made structures in or near the watercourse.

To maintain or improve water quality.

General

Types of Water Control Structures

1) Water level control structures

Water level control structures must have the capacity to maintain the reservoir at a safe level and to discharge design flood flows without damage to the dam and associated structures. Nearly all water level control structures are based on one of the following or combinations thereof: spillway, gates and orifice; trough and chute, or siphon. See Figure 35.

An overflow spillway may have a crest formed to fit the shape that overflowing water needs to take.

2) Flow energy dissipators

Means of dissipating the energy of water spilling over a dam or other structure include plunge pools, deflector buckets, and stilling basins. These structures must be carefully designed to prevent undermining which affects stability of the energy dissipater and possibly the dam. Therefore, all flow energy dissipaters downstream of water level control structures must be designed by a Professional Engineer with experience in hydrotechnical design.

3) Gates and valves

Outlet gates and valves serve to control flow from a headpond created by a dam. A gate is a construction device in which a barrier is moved across the path of discharge to control the flow and elevation of water. Gates and valves can also be classed as regulating or safe guard. Regulating gates and valves operate under a full range of flow and pressure conditions. Sage guard gates and valves usually function as a secondary device for shutting off the flow of water should a primary device become inoperative. All gates and valves on major structures must be designed by a Professional Engineer.

4) Stoplogs

Stoplogs are usually installed and removed for fluctuating flow conditions. Considerations during the design include the number of stoplogs to be installed, the on-site storage of stoplogs (so that they are available when needed), and the flow criteria on which addition or removal will be based. They should be operated so as to provide the required fish passage or maintenance flow.

5) Fishways

Fishways are a means of passing fish around an obstruction. Important considerations in the design of these structures include site conditions, the behaviour and swimming abilities of the fish to be passed, flow conditions during each month of fish migration, and the hydraulic characteristics of the various types of fishways. All fishways must be authorized and the designs approved by the *Fisheries and Oceans Canada*.

6) Flow Diversion Weirs

The purpose of these water control structures is to raise the water levels high enough to allow for controlled flow diversion into a water supply channel. Flow diversion weirs are widely used for irrigation purposes.

7) Flow Conveyance Structures

These structures convey flow in artificial channels, such as flumes, chutes, and tunnels. They are usually built of concrete, timber, steel or other structural material.

Chutes may be pipes or other lined channels which incorporate a relatively long inclined section with a considerable drop in elevation. Chutes are often used on steep slopes where a single drop or series of drops in water level are not practical.

Planning Considerations

Water control structures must have adequate design capacity for the following reasons:

- failure of water control structures can result in damage to downstream property and to the environment;
- water control structures may result in changes in flood discharge velocity, flood stage, stream bank erosion, and sediment deposition which may affect riparian and flood plain landowners;
- design of water control structures requires consideration of technical issues such as the magnitude and duration of flooding, soil and other geotechnical considerations, ice and water forces on the structures, maintenance flow and fish passage requirements.

Application Requirements

In addition to the standard information required on the application form, three copies of the following documents stamped by a person licensed to practice as a Professional Engineer** must be included:

- a full description of the water control structure;
- plan, profile and cross-sectional drawings to scale of the proposed structure;
- a document containing:
  - an explanation of the design approach;
  - information on the design flows (and, where appropriate, water levels);
  - statements on the intended range of operating conditions (and the likely consequences of operating outside that range);
  - the effect of flow regulation and diversion on high, medium and low flow conditions in the watercourse;
- a map and PID number.

**This requirement may be waived if authorization is received from *Fisheries and Oceans Canada*.

In many cases, water control structures are integral parts of other watercourse and wetland alterations, and therefore may be included under one application. However, there may be instances where a separate Watercourse and Wetland Alteration Permit will be required, for example, when spillways, gates, valves or fishways are replaced or installed in existing dams.

Other Government Agencies Involved

1) The approval of the *Transport Canada* which administers the **Navigable Waters Protection Act** is required for all structures to be placed in or across any navigable watercourse.
2) All water control structures that divert more that 50 cubic metres of water per day from a watercourse, as stated in Schedule A, of the **Environmental Impact Assessment Regulation** must be registered with the Minister of Environment. Inquiries should be directed to the Manager of the Environmental Assessment Section of the Sustainable Development, Planning and Impact Evaluation Branch of the *New Brunswick Department of Environment*.
3) Approval from the *New Brunswick Department of Natural Resources*, Crown Lands Branch, may be required for any proposed work activities located on Crown Land, in tidal water, submerged land and below the ordinary high water mark. The proponent must receive permission prior to undertaking the activity.

Application Review Process

Regulatory and Advisory

Guidelines

Fishways must be constructed as approved by *Fisheries and Oceans Canada*.

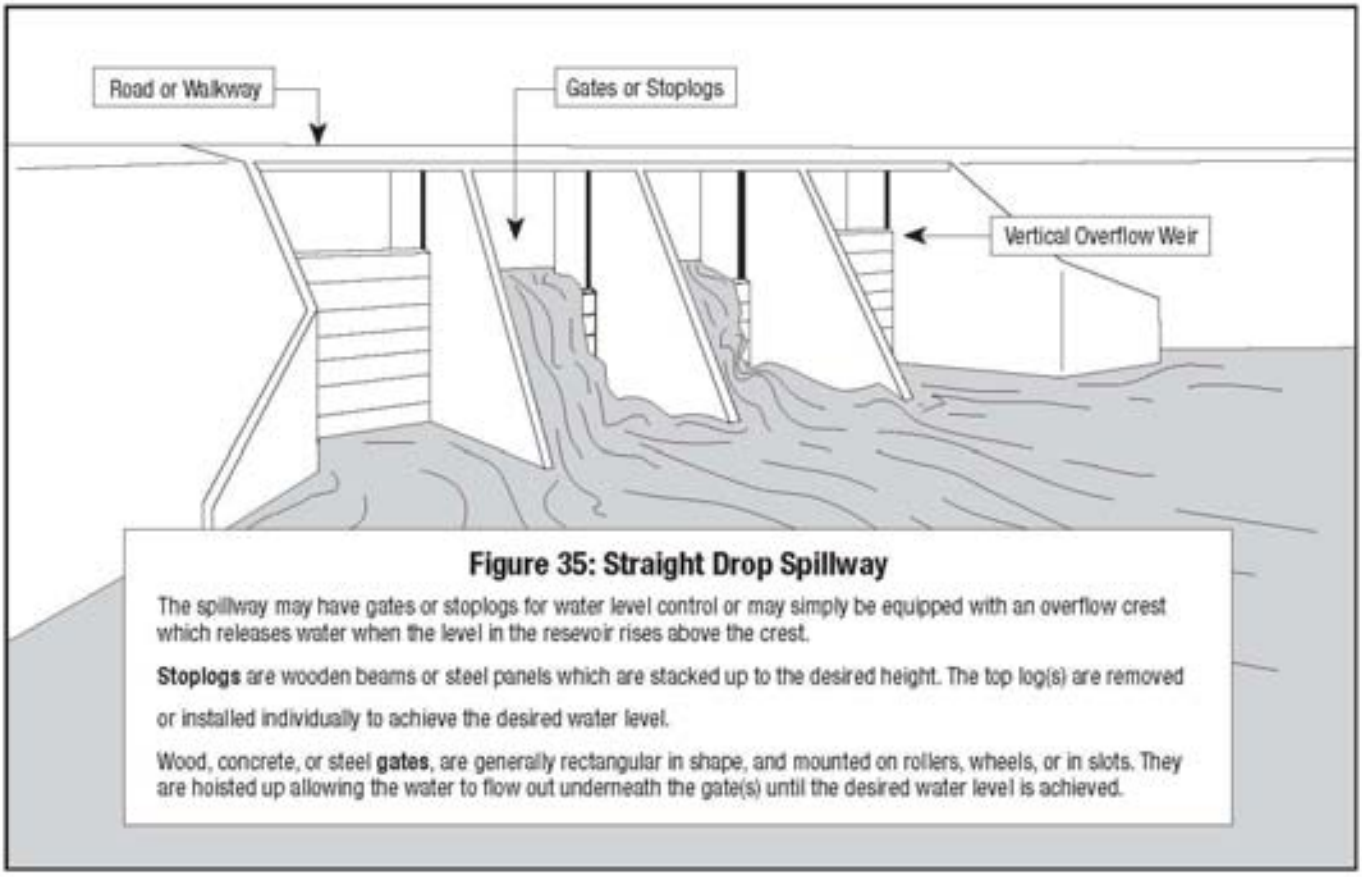


Figure 35: Straight Drop Spillway

The spillway may have gates or stoplogs for water level control or may simply be equipped with an overflow crest which releases water when the level in the resevoir rises above the crest.

Stoplogs are wooden beams or steel panels which are stacked up to the desired height. The top log(s) are removed or installed individually to achieve the desired water level.

Wood, concrete, or steel **gates**, are generally rectangular in shape, and mounted on rollers, wheels, or in slots. They are hoisted up allowing the water to flow out underneath the gate(s) until the desired water level is achieved.

Definition

Watercourse crossings are structures or locations where an access route meets and traverses a watercourse. These generally consist of bridges and culverts. Most crossings are built for vehicular traffic, but many are constructed for pedestrians, trains, pipelines, timber harvesting equipment, recreational vehicles, farm machinery or livestock.

Objectives

To provide a safe, sturdy, low maintenance and environmentally sound crossing structure with a waterway opening large enough to pass peak flows and prevent ice or debris jams.

To maintain free, unobstructed fish passage through the crossing allowing fish to migrate to spawning, rearing, feeding and wintering habitat.

To prevent sedimentation of the watercourse and erosion of the banks and bed as a result of the construction and installation of the structure.

Planning Considerations

All crossings impact the environment to some degree; careful planning and design can minimize this impact.

Environmental Considerations

All watercourse crossings should be designed to minimize any alteration of the flow in the watercourse, to retain natural stream morphology, and to preserve fish habitat and fish passage. Poorly designed crossings can result in inadequate capacity leading to increased velocity or blockage followed by flooding, erosion and washouts which could damage aquatic habitat and physical property, endanger human life, and prevent the utilization of upstream habitat.

Bridges and open-bottom culverts have less impact on aquatic habitat than culverts and are the preferred method for providing access across a watercourse. Structures which maintain the natural bank and bed have the least impact.

Location

Route selection for access roads should endeavour to minimize the number of watercourse crossings. Along public highways, interchange ramps and merging lanes should be located as far as possible from watercourses. The length of all watercourse crossing structures should also be minimized by designing them to cross at right angles to the watercourse.

The structure should cross the watercourse where the channel is straight and narrow and the banks are high and steep.

Sites to Avoid

Any site where the bed and banks are unstable or eroding or the watercourse meanders should be avoided.

Sizing

The recommended capacity for culverts and bridges in New Brunswick is based on a 100 year return period flow, which means that the waterway opening should be large enough to pass a peak flow or flood which has a 1% chance of occurring in any given year. Peak flow is influenced by the following factors:

1) Drainage area
2) Rainfall intensity
3) Type of soil
4) Ground cover and land use

When an application for a watercourse crossing is reviewed by the *New Brunswick Department of Environment*, a design flow is calculated which represents the anticipated peak flow expected at the location of the crossing. The design flow is based on the drainage area (Figure 36) with consideration given to factors such as precipitation and physiography. The waterway opening proposed in the application must accommodate this design flow. In some circumstances, historic data from hydrometric stations located throughout the province is used to estimate the peak flow. When determining the minimum waterway opening necessary for the crossing site without the benefit of credible hydrometric data or drainage area, the waterway opening required to pass the peak flow can be roughly estimated using indications of flood levels which can be observed on the banks of the watercourse such as ice scour marks or changes in vegetation. The proposed size will be evaluated when the application for a Watercourse and Wetland Alteration Permit is processed.

Application Review Process

Regulatory and in some cases, Regulatory and Advisory

Construction

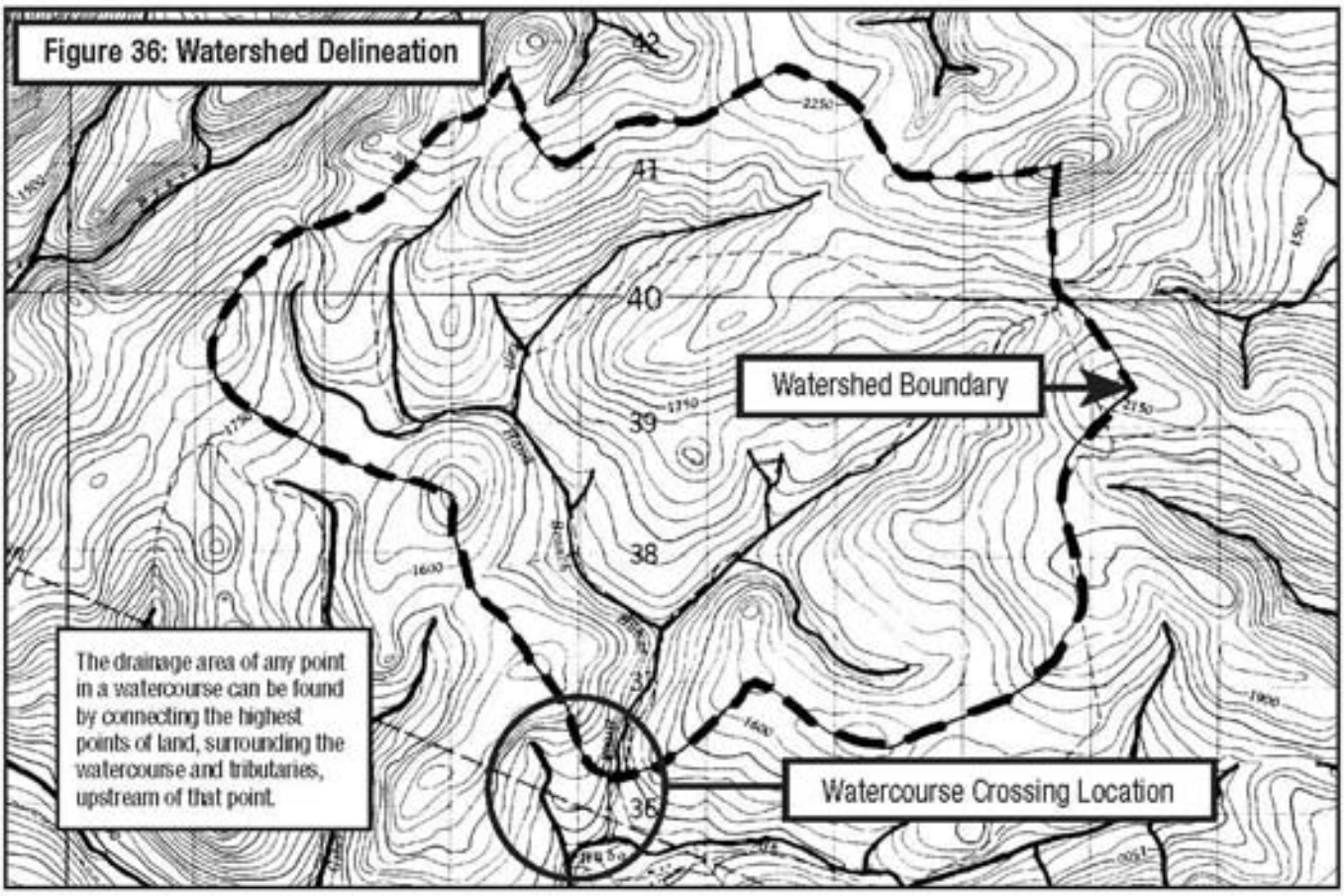
It is important to minimize disturbances caused by the construction phase and to stabilize the site without delay to prevent siltation of the watercourse.

Instream Work

To minimize environmental impacts caused by erosion and sedimentation, the length of time it takes to carry out the permitted alterations must be minimized and planned so as not to coincide with periods of increased sensitivity for fish, such as spawning and egg incubation periods.

Specific conditions will vary for different areas throughout the province depending on the number and species of fish involved. Generally, the construction period is best planned to take place during the normal low flow period which is between June 1st and September 30th, every year. The reasons for this are listed below:

1) There will be less impact on fish activities during this timeframe.
2) It is easier to isolate low flows in order to work in isolation of stream flow. Isolating high flows could lead to flooding and increase the risk of introducing sediment into the watercourse.



3) There should be adequate warm weather after this period to re-establish vegetation on the disturbed footprint bordering the construction site.
4) It is easier and less expensive to move and stabilize soil during this period. Soils are often either frozen or saturated at other times of the year making them more difficult and costly to move.

All instream work should be done in isolation of stream flow to avoid introducing sediment into the watercourse. A dam and pump-around or temporary diversion are two of the techniques that can be utilized to perform work in isolation of the stream flow and to ensure the natural flow of water downstream is uninterrupted and its quality maintained.

All fish occupying a reach of watercourse to be dewatered or abandoned must be rescued and relocated out of harm's way prior to any permanent or temporary dewatering operation.

Sediment Control

Excessive quantities of sediment entering the watercourse can severely impact the aquatic environment. Fine particles settling on the bed of the watercourse smother and choke the organisms living there and destroy fish spawning and rearing habitat. Large quantities of sediment may affect the hydraulic capacity of a watercourse by reducing the cross sectional area thereby increasing the potential for flooding.

Construction plans must take into account sediment control during all phases of the alteration on an ongoing basis until all exposed erodible soil has been permanently stabilized to ensure that suspended sediment in surface runoff is trapped or filtered and prevented from entering the aquatic environment.

Some simple and basic principles can be practiced when selecting and preparing a crossing site which will dramatically reduce the amount of suspended sediment in surface runoff. One such principle is to avoid sites with erodible and unstable banks. Another involves leaving as much undisturbed vegetation as possible when clearing the site for the roadway approaches crossing structure. Vegetation acts as a natural filter, keeping fine particles from entering the watercourse, therefore clearing and grubbing for the road right of way should be kept to a minimum. Scheduling work to take place during the dry season when the least number of rainfall events are likely to occur which will decrease erosion at the disturbed area.

Water Control Measures

Water control measures such as temporary diversions, sediment control ponds, off-take structures and filtration areas are essential tools in controlling surface water flow and minimizing impacts on construction sites. All work activities shall be isolated from the stream flow.

Road Construction

The potential to introduce sediment into the watercourse is extremely high during road construction. Proper drainage and buffer zone maintenance should help to minimize sedimentation.

1) Road Drainage

As the road is being constructed, proper drainage must be maintained by using roadside ditches and cross drainage culverts to prevent runoff from running over the road and washing sediment into the watercourse. A well drained road will reduce the amount of sediment entering the watercourse and be capable of supporting heavier loads.

Forest road construction plans often do not include steps to stabilize roadside ditches. To reduce sedimentation as a result of the exposed channels, roadside ditches should not be constructed within the 30 metre buffer zone for forest roads but must be designed to empty into off-take ditches outside this zone.

Off-take ditches should be directed into a vegetated area to filter out the sediment before it enters the watercourse. For public access roads, excavation of roadside ditches may take place within the 30 metre zone provided they are stabilized against erosion.

If the slope of the roadside ditch is steep, the sediment laden water should be routed through a series of check dams, settling ponds or sediment traps to remove particles before the runoff enters the watercourse. See Figure 37.

Water bars can be used to control sheet runoff and impede erosion of an unpaved road surface. They are combinations of ridges and channels constructed diagonally across a road surface to intercept runoff and deflect it towards the roadside ditches instead of allowing it to flow on down the road surface. The outlet of a water bar should consist of or be extended to an erosion resistant area. The suggested spacing for water bars depends on the slope of the road as outlined below:

Slope of Road (%)	Spacing (m)
<5	38
5 to 10	30
10 to 20	23
20 to 3	15
>35	7.6

Cross drainage culverts (Figure 38) should be placed across the road to dissipate excess concentrated flows resulting from the road construction. The recommended spacing for cross drainage culverts is as follows:

- 90 metres on gentle slope (1% to 2%)
- 45 metres on moderate slopes (3% to 9%)
- 30 metres or less on steep slopes (≥10%)

The minimum acceptable diameter for a cross drainage culvert is 300 millimetres.

The cross drainage culverts should be installed at a 30 degree angle downslope and they should slope approximately 4%.

2) 30 Metre No Grub Zone.

Where a watercourse crossing is to be constructed, grubbing within the 30 metre buffer bordering the watercourse shall be kept to an absolute minimum necessary to accomplish the intended alteration. For forest roads, no ditches are to be excavated within 30 metres of the watercourse and grubbing is to be limited to the area directly beneath the roadbed. For public highways and access roads, where roadside ditches must be equipped with sediment control devices until all exposed erodible soil has been stabilized, grubbing is restricted to the width of the roadbed, foreslopes, ditches and backslopes. If a road is being constructed adjacent to a watercourse, sediment barriers should be placed between the roadway and the watercourse to intercept runoff as it flows down the slope and acts as a strainer, filtering out sediment when the water passes through. Many types of sediment barriers are available for use such as: silt fences (woven geotextile fabric), hay bales, or brush barriers, made up of logs, brush or slash debris. These barriers should be placed on and at the base of exposed upland surfaces, fill slopes, or any surface that might discharge loose soil or suspended sediment into the watercourse.

Figure 37: Treatment of Concentrated Runoff Where Road Construction Transitions From Cut to Fill

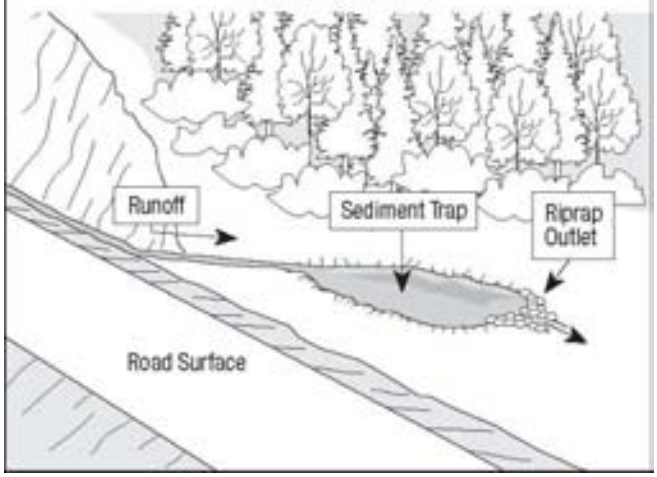
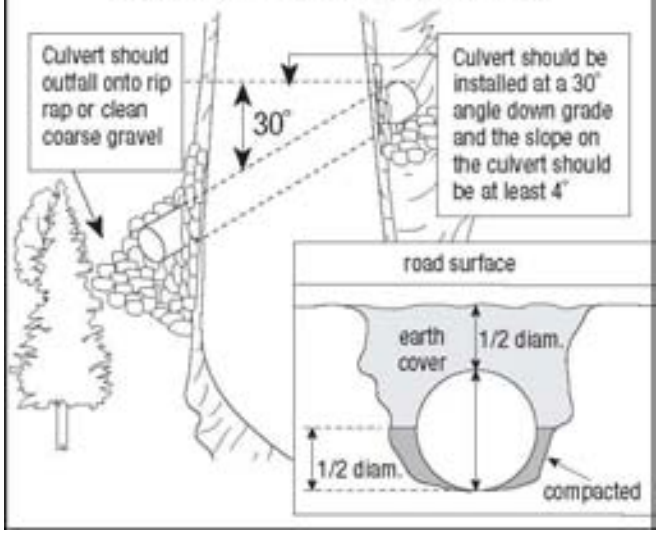


Figure 38: Cross Drainage Culvert



Guidelines

Design

The structure should cross the watercourse where the channel is straight, unobstructed and narrow, and where the banks are stable.

If the gradient of the watercourse at the point of crossing exceeds 2%, the crossing must consist of a structure which will maintain the natural streambed such as a bridge or an arch on footings.

The crossing should be designed to have the structural capacity to carry the loads expected to traverse it.

Construction

Materials used in the construction of the crossing and the approaches should not be obtained within the 30 metre zone bordering the watercourse.

No machinery may be stationed in the wetted portion of the channel.

All instream work should be done in isolation of stream flow to avoid introducing sediment into the watercourse. A dam and pump-around or temporary diversion are two of the techniques that can be utilized to perform work in isolation of the stream flow and to ensure the natural flow of water downstream is uninterrupted and its quality maintained.

All fish occupying a reach of watercourse to be dewatered or abandoned must be rescued and relocated out of harm's way prior to any permanent or temporary dewatering operation.

Construction debris generated during the project must be removed from the watercourse and project area and disposed of in a proper manner.

No washing of tools, forms or machinery may take place in or adjacent to a watercourse.

All treated timbers must be air dried for the length of time specified by the manufacturer for safe use in, over, or near aquatic environment. Timber used in, over or near aquatic environment must not be treated with creosote or pentachlorophenol.

Sediment barriers, such as silt fences or hay bales, must be placed along the toe of the slope of the fill material used to construct the approaches to the structures.

During construction all exposed erodible soil resulting from cut and fill operations within 30 metres of the watercourse must be temporarily stabilized to prevent siltation and upon final grades being achieved, permanent stabilization must be carried out. All exposed soil must be stabilized within 30 days.

Road Construction

No grubbing may be carried out within 30 metres of the watercourse until construction of the crossing is ready to begin. The width of the grubbed area may be no greater than the total width of the roadway, foreslopes, ditches and backslopes.

Right-of-way clearing at watercourses should be kept to a minimum.

Roads should be graded and crowned seasonally to fill wheel ruts and potholes.

Road construction should be avoided in areas of steep slopes or unstable soils.

Definition

Bridges are structures built over a watercourse, the deck of which forms a link in the road, footpath or railbed.

Planning Considerations

General

Bridges must be constructed from durable materials that provide safe access across the watercourse. If properly designed and constructed they offer few risks of failure and little interruption of natural hydraulic characteristics.

Environmental Considerations

Bridges and open-bottom culverts are preferred as watercourse crossings from an environmental and fisheries standpoint rather then closed bottom culverts for the following reasons:

1) They retain the natural watercourse bed, thereby allowing uninhibited movement of bedload material.
2) Bridges help preserve the natural cross sectional area of the channel thereby maintaining the flow regime.
3) Fish pass more freely through these structures; they rarely provide a barrier to migration.
4) The construction of these types of structures requires less instream activity, therefore less environmental impact.

Because the potential for significant environmental impact caused by culvert installation is great, bridges are generally recommended for major crossings.

Size

The hydraulic capacity of the bridge is dictated by the waterway opening, which is a product of the average rise and span of the structure. The structures must be designed to ensure that they will pass a 1 in 100 year discharge event at a maximum velocity of 1.8 m/sec.

Components

The main components of a single span bridge include abutments, stringers, deck and railings. See Figure 39.

Abutments are the structures the other bridge components are founded on which sustain the pressure of the abutting earth and the traffic using the bridge.

Stringers are the members spanning the abutments forming the connection between them, and used to support the deck of the bridge.

The **deck** material usually consists of timbers placed on top and perpendicular to the stringers; which constitutes the floor of the bridge.

Railings are often placed at the sides of the bridge to be used as a guide for traffic.

Watercourse and Wetland Alteration Permits for bridges generally stipulate the minimum rise and span of the structure or the minimum waterway opening. In these instances, the rise and/or span is often dictated by existing conditions at the crossing site. Several factors must be considered:

- The design must take into account the amount of ice that may pass under the bridge to ensure that the structure will not become blocked.
- The rise must provide sufficient clearance to keep the roadbed from being inundated by flood waters which could overtop the structure endangering the road and adversely affecting aquatic habitat.
- The rise may also need to provide sufficient clearance for navigation.

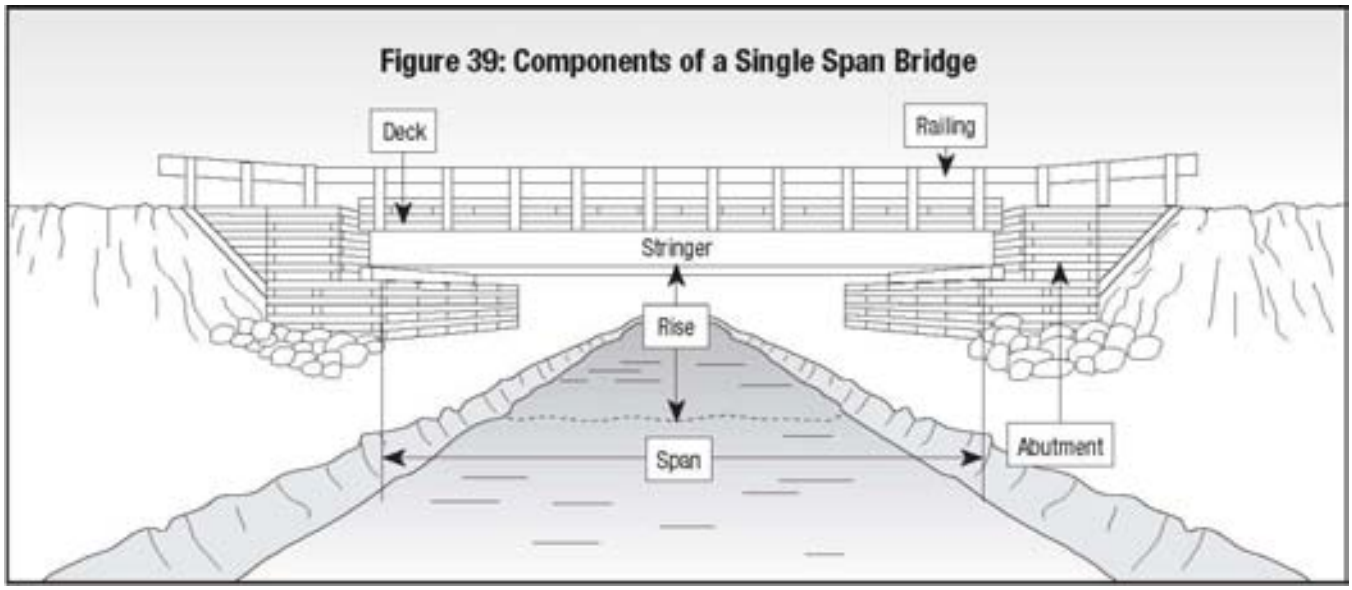


Figure 39: Components of a Single Span Bridge

Application Requirements

In addition to the standard information required on the application form, the following should be included:

- proposed size, shape and alignment including the rise and span;
- plan and cross sectional drawings to scale of the channel and proposed structure;
- proposed construction methods and materials used for each component of the bridge;
- a map pinpointing the bridge location.

Other Government Agencies Involved

1) Projects involving multiple span bridges as stated in Schedule A, of the **Environmental Impact Assessment Regulation**, must be registered with the Minister of Environment. Inquiries should be directed to the Manager of the Environmental Assessment Section of the Sustainable Development, Planning and Impact Evaluation of the *New Brunswick Department of Environment*.
2) The approval of the *Transport Canada* which administers the **Navigable Waters Protection Act** must be obtained when a structure is to be placed in or across any navigable watercourse.

Application Review Process

Regulatory for single span bridges that do not encroach inside the shoulders of the watercourse.

For multi span bridges that constrict the channel of the watercourse, Regulatory and Advisory.

Bridge Repairs

Repairs to a bridge do not require a Watercourse and Wetland Alteration Permit provided that **the following conditions** are met and **there is no instream work involved**:

1) that there is no modification of the size, shape, type of materials or alignment of the structure;
2) that no pollutants, particulates, construction materials or debris are allowed to enter the watercourse.

Construction

Abutments and Piers

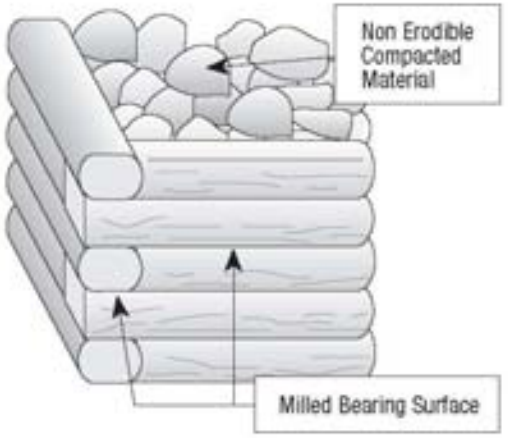
Bridge abutments should not constrict the width of the channel and the face of the abutments must be parallel with the banks of the watercourse.

Abutments and piers are usually made from concrete or timber cribbing. If the abutments are made from timbers, the abutting surfaces must be squared to create a tightly laminated structure. See Figure 40. Cribs should be backfilled with non-erodible or free draining material compacted in layers. If fresh concrete is to be used it should be:

1) precast and air dried for a period of at least 21 days before being placed in the water or;
2) poured in place in forms in isolation of stream flow and cured for at least one week prior to form removal.

The abutments must be founded on solid ground. If the foundation material is soft, it should be pre-excavated in isolation of the stream flow and replaced with clean pit run gravel or rock.

Figure 40: Rock-Filled Timber Crib Abutment



The face of the abutments should be set back from the wetted portion of the channel. All work necessary for abutment and pier construction must be carried out in isolation of stream flow using cofferdams to isolate the work areas from the flowing water.

Fish Passage

At all times during the construction period at least two thirds (2/3) of the channel cross-section must remain unobstructed to allow fish passage.

Guidelines

Design

The bridge abutments should be aligned so that they do not direct the flow into the banks of the watercourse.

The bridge should be designed so that the span does not constrict the flow of the water.

Construction

Loose rocks propelled by the stream flow may undercut or scour the base of the abutments. To prevent this, the abutments and pier(s) should be set below the possible depth of scour.

Rip-rap or wingwalls should be placed at both the upstream and downstream corners of the abutments to help prevent erosion.

The construction must be carried out in isolation of the stream flow using cofferdams. See Figure 41.

Excavated materials must not be allowed to enter the watercourse. Care must be taken during the placement and removal of the cofferdam(s) to prevent cofferdam material from washing downstream.

Lumber milled on the abutting sides (edges) must be used to construct bridges consisting of timber crib abutments and/or wooden decking to prevent soil particles from falling through the cracks into the water.

Figure 42 depicts the features of a well constructed bridge crossing not confined by right-of-way limits.

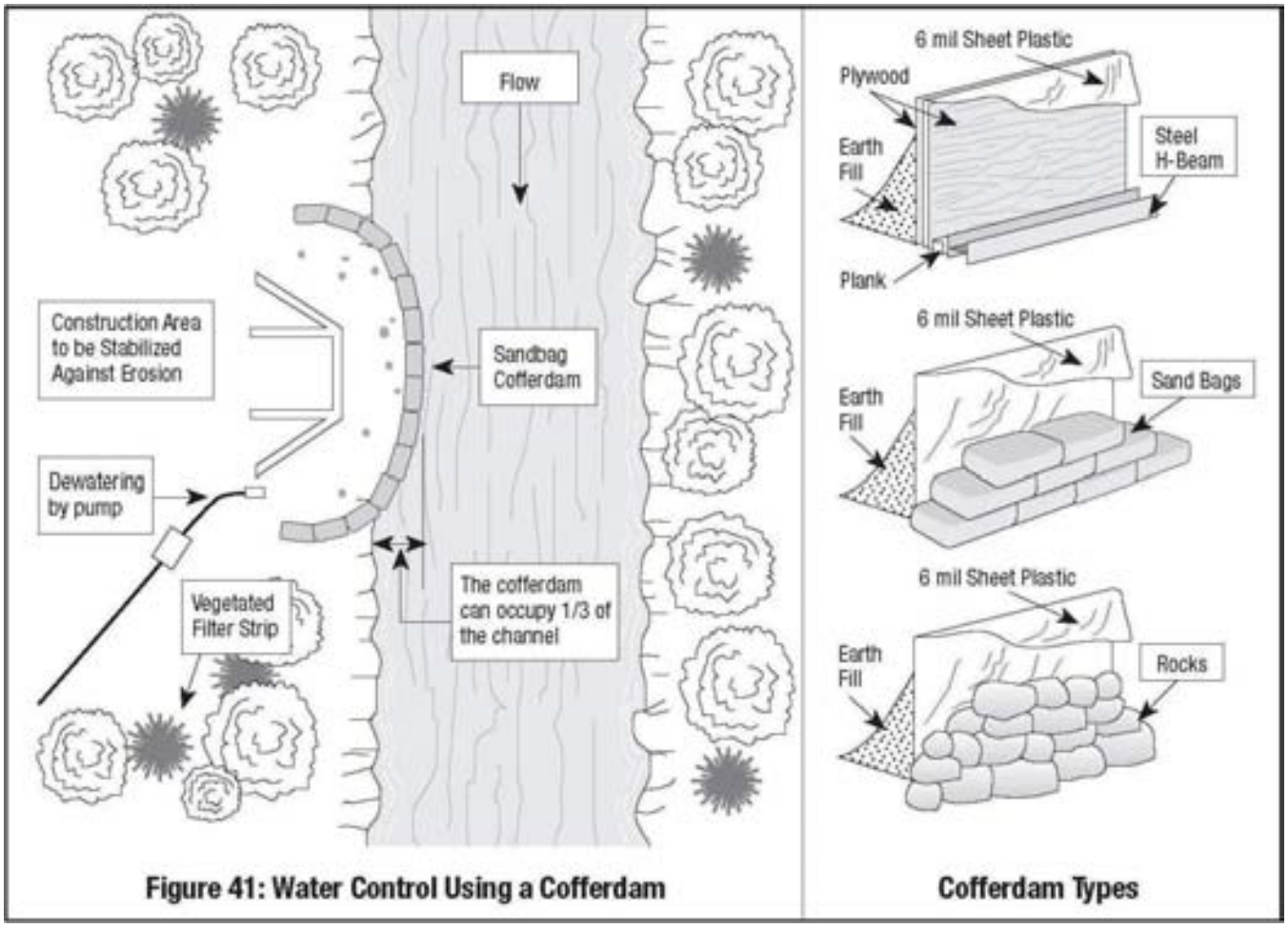
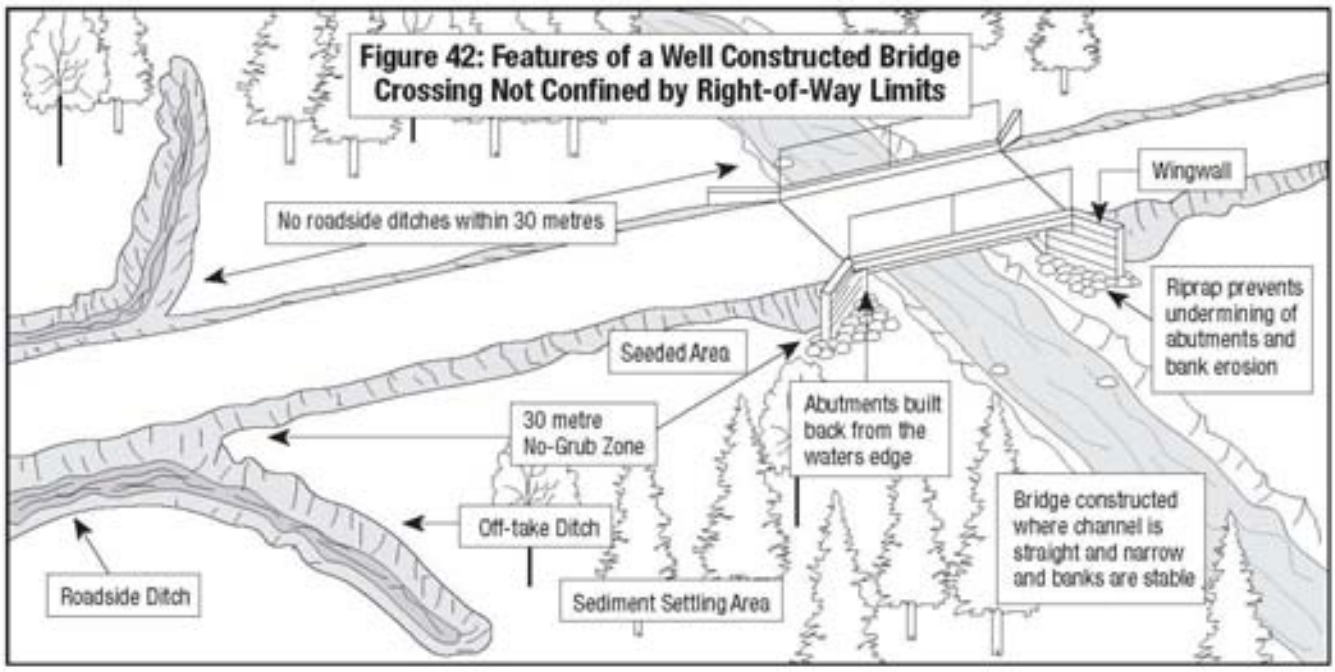


Figure 41: Water Control Using a Cofferdam

Cofferdam Types



I) Culvert Alteration Type: Closed-Bottom

a) Closed-Bottom Culverts: New Installations

Definition

A culvert is a covered structure which conveys the flow in a watercourse under a road or railbed whereby the top of the cover material is graded to form the travel surface.

Planning Considerations

General

Culverts are often used because they provide an efficient and inexpensive means of crossing a watercourse. They are the most commonly used crossing structures for forest roads and can be used in areas where difficult terrain prevents bridge construction. Several shapes of culverts are used including: circular, box, elliptical, and pipe arch. Box culverts are generally constructed of wood or concrete while the other types are most often made from steel, concrete, fibreglass, and plastic.

All culverts must be made of materials which are durable, weather resistant and strong enough to support the weight of the traffic which will be using the crossing.

Environmental Considerations

Culvert installation can result in the loss of natural streambed and an alteration of the natural flow regime which can have a negative impact on aquatic habitat and resources. An inadequately sized culvert, a perched culvert or a steep sloped culvert may result in a barrier to fish passage and/or flooding. For these reasons, bridges and open-bottom culverts are recommended for crossing fish bearing watercourses.

If properly designed, installed, and maintained at suitable locations, the resulting impact on aquatic habitat or threat to the environment posed by a culvert can be minimal. Open-bottom culverts which retain the natural morphological features of the watercourse, such as width and slope do not result in the elimination of aquatic habitat as is the case with closed-bottom culverts.

Where closed bottom culverts are utilized, a single pipe is preferred due to its simplicity.

Single culverts are preferred.

Size

The importance of properly sizing the culvert cannot be overemphasized. An undersized culvert results in increased water velocity within the pipe creating a barrier to fish passage and causing scour at the outlet. An oversized circular pipe or pipe arch culvert may result in decreased water depth within the pipe which may also act as a barrier to fish migration. As with any watercourse crossing, the recommended capacity is based on a peak flow with a 100 year return period. If you are designing to the maximum of 1.5 HWD/D (Headwater depth/ Diameter of the round culvert), than the depth of cover over the top of a culvert must be at least half the diameter of the culvert. This requires that the height of the road bed must not be less than half the diameter of the culvert above the top of the culvert. For pipe arches, this ratio may not exceed 1 if the height of the cover is a limiting factor. The minimum acceptable culvert that may be placed in a natural watercourse or an artificial channel that was constructed to replace a natural watercourse which is depicted on the *New Brunswick Department of Natural Resources* digital water layer or represented on the black and white 1:10,000 scale orthophoto hard copy maps is a circular pipe 750 millimetres in diameter. When sizing a culvert, embedment reduces the end area and must be accounted for in the design. See Table 7.

Application Requirements

In addition to the standard information required on the application form, the following must be included:

- a sketch showing culvert dimensions, shape, length, slope, diameter/end area and alignment;
- a full description of construction methods, materials and equipment to be used;
- a profile of the bed of the watercourse from the first riffle upstream and the riffle establishing the streambed elevation and controlling the water level at the location of the proposed culvert which is located at least three culvert diameters downstream of the outlet of the proposed culvert location provided no permanent channel re-alignment will occur. The profile does not need to extend beyond 10 culvert diameters downstream. See Figure 44.
- the relationship of the elevation of the bed of the watercourse to the invert of the culvert;
- a map pinpointing the culvert location.

Other Government Agencies Involved

1) The approval of the *Transport Canada*, Navigable Waters Protection Program which administers the **Navigable Waters Protection Act** must be obtained when any structure is to be placed in or across navigable waters.
2) The approval of *Fisheries and Oceans Canada*, which administers the **Fisheries Act**, must be obtained for culverts that require special fish passage considerations. Authorization under Section 35 of the **Fisheries Act** may also be required if the work will result in the Harmful alteration, Disruption or Destruction of Fish Habitat.

Application Review Process

Regulatory only if the culvert is less than 20 metres in length, and;

- the watercourse slope between the first riffle upstream and the first riffle located at least 3 times the culvert diameter downstream of the culvert location is less than or equal to 0.5%, or
- the difference in elevation between these riffles is less than or equal to 0.2 metres and the riffle to riffle distance as described above is less than or equal to 40 metres.

Regulatory and Advisory for all other culverts.

NOTE: Culvert crossings on watersheds greater than 20 square kilometres must undergo a thorough hydraulic analysis involving factors such as channel gradient, velocity of flow, cross sectional area of the channel, flood frequency, and ice formation.

Construction

Fish Passage

Fish passage must be taken into account at all times when installing the culvert. Figure 43 shows the necessity for embedding culverts. Special measures to provide fish passage through the crossing once the culvert has been installed, such as fish baffles or resting pools, may be required. In the case of sloping bedrock substrate, an arch on footings may require additional fish passage measures.

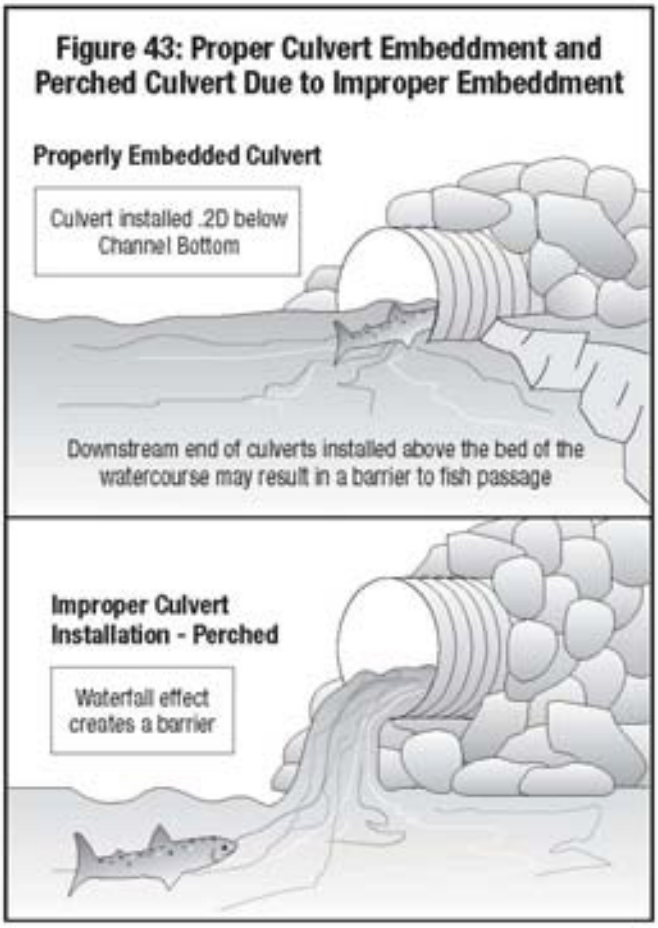


Figure 43: Proper Culvert Embeddment and Perched Culvert Due to Improper Embeddment

The ability of a fish to pass through a culvert is limited by the following factors:

1) Entrance conditions
2) Water depth and flow velocity
3) Culvert length and slope
4) Fish swimming ability

Fish migration may be obstructed if a culvert is installed above the level of the natural streambed or if scour lowers the streambed at the outlet of the culvert creating a waterfall effect. The resulting vertical drop could prevent fish from entering the downstream end of the culvert.

Fish swimming speed must exceed the water velocity in order for it to be able to pass through a culvert. Fish swimming ability will vary depending on species, size, water quality, and hydraulic conditions.

Fish passage provisions

Fish passage provisions are achieved when:

a) an open-bottom culvert is used and the footings are located outside the shoulders of the channel so that the original bed and banks of the watercourse remain intact following all construction activities; or,

b) the riffle to riffle slope is less than or equal to 0.5%. See Figure 44; or,

c) the difference in elevation between the riffles is less than or equal to 0.2 metres and the riffle to riffle distance is less than or equal to 40 metres provided it is installed as illustrated in Figure 46(b). This method of installation will encourage the deposition of a layer of natural substrate, thereby re-establishing fish habitat and providing adequate fish passage.

In all other cases, a comprehensive, detailed plan for fish passage design must be approved by *Fisheries and Oceans Canada* prior to installation. The requirement for baffles is based on streambed slope and culvert slope.

The following briefly describes the minimum requirements when determining fish baffle design. Baffled culverts need to be embedded to assist the fishway in meeting its objective. The recommended minimum culvert diameter with baffles is 1.2 metres. Baffles require notches that pass water under flow conditions that can permit fish passage. The notch size and drop between baffles can be determined using Table 8. Table 9 gives examples of baffle spacings based on culvert size.

The baffle furthest downstream is usually placed between 0.5 metres and 1.25 metres from the downstream end. The top of this baffle must also be at the same elevation as the downstream control point A (riffle used to determine stream slope located at least 3D downstream or the outlet of a constructed energy dissipation pool). The invert of the culvert at the upstream end can be either at the same elevation as the upstream control B (riffle) or embedded up to 0.2D (max. 0.45 metres). See Table 7.

Elevation difference between upstream and downstream is found by subtracting the downstream control elevation (A) from the upstream control elevation (B). See Figure 44. This gives you the difference between the two.

$\Delta H = B - A$

Stream slope is found by dividing the elevation difference (ΔH) by the distance between the two points (L):

$\frac{\Delta H}{L}$ = stream slope

Pipe slope is found by dividing the elevation difference (ΔH) by the length of the pipe (l)

$\frac{\Delta H}{l}$ = pipe slope

Once these elevations are determined, the slope of the culvert can be calculated and the appropriate baffle spacing can be determined (See Figure 47)

Baffles occupy a portion of the cross-sectional area of the culvert barrel and as such, the culvert must be up-sized to accommodate the cross-sectional area the baffle occupies, while maintaining the end area required for the design discharge.

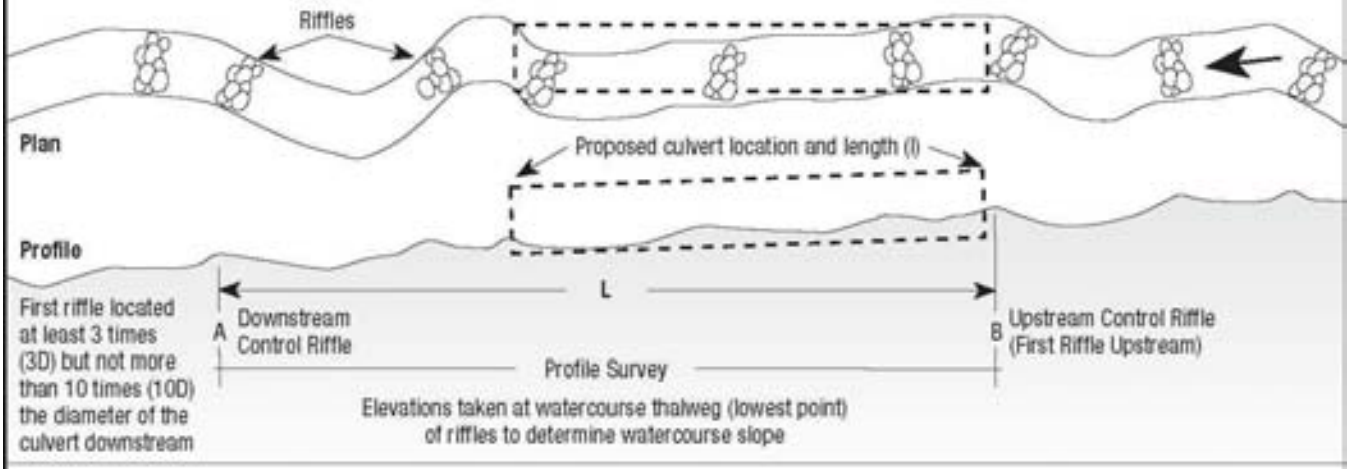
A rock-lined designed energy-dissipation pool is recommended for the proper construction of a culvert greater than 900 mm in diameter. The height of the tailwater is controlled by elevation of the control riffle which is located at least 3D downstream of the culvert.

The width of the energy dissipation pool should be 2 times the diameter of the culvert(s); the length of the pool should be 3 times the culvert(s) diameter but should not extend beyond the control riffles which must be left intact. The downstream end of the pool will blend into the streambed elevation. The depth of the pool should be a minimum of 1 metre. Three boulders or boulder clusters should be added to the pool to provide shelter and structure for fish and other aquatic invertebrates. See Figure 48.

Table 7: End Reduction Area

Culvert Size (mm)	Depth of the bed material in the pipe @ 0.2* diam (mm)	End area of the culvert (m^2)	Area occupied by the bed material	Area remaining (m^2)
900	180	0.636	0.0085	0.551
1000	200	0.785	0.112	0.673
1200	240	1.131	0.161	0.970
1400	280	1.539	0.219	1.320
1500	300	1.767	0.252	1.515
1600	320	2.011	0.286	1.725
1800	360	2.545	0.368	2.183
2000	400	3.142	0.447	2.695
2100	420	3.464	0.493	2.971
2200	440	3.801	0.541	3.2600
2300	450*	4.155	0.573	3.582
2400	450*	4.524	0.587	3.937

Figure 44: Determining the Profile of the Bed of the Watercourse



Notes:

- The elevation difference (ΔH) between the Upstream Control Riffle (B) and the Downstream control Riffle (A) is determined by the formula: (ΔH) = B-A
- The watercourse slope is found by dividing the elevation difference (ΔH) by the distance between points A and B (L):

$\frac{\Delta H}{L}$ = Watercourse slope x 100% = Watercourse slope in percent

- The pipe slope is found by dividing the elevation difference (ΔH) by the length of the pipe (l):

$\frac{\Delta H}{l}$ = Culvert slope x 100% = Culvert slope in percent

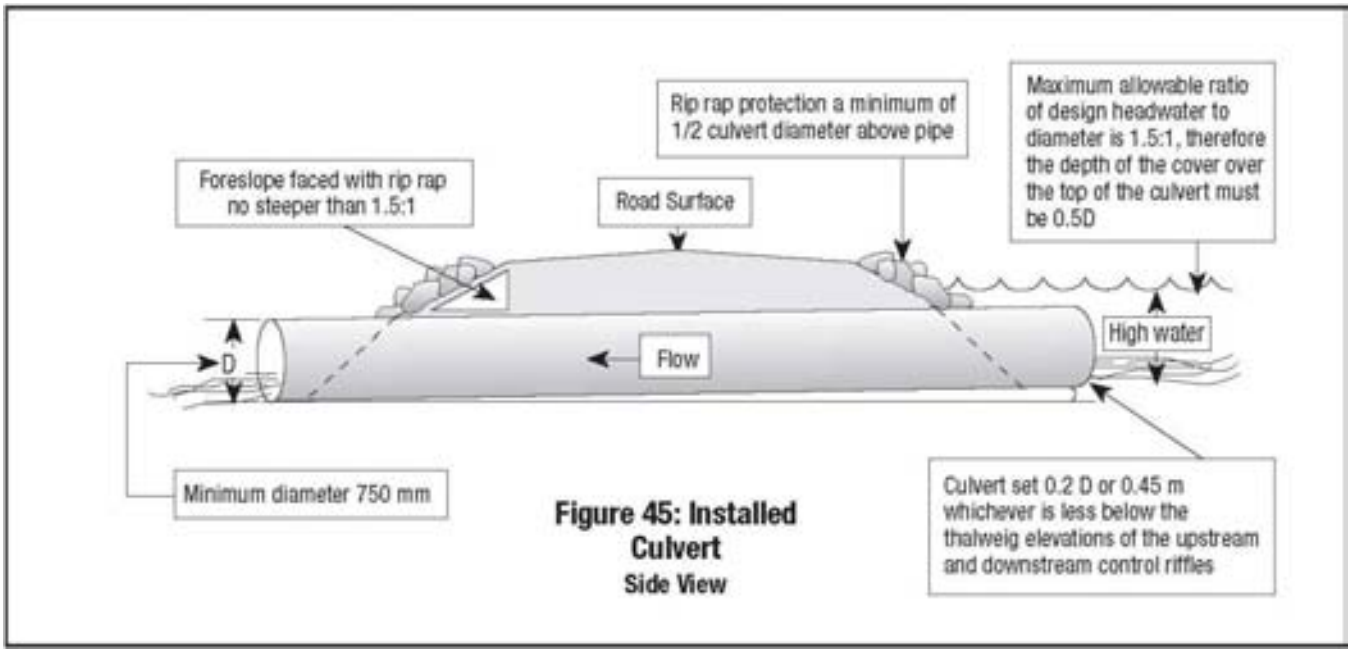


Figure 45: Installed Culvert
Side View

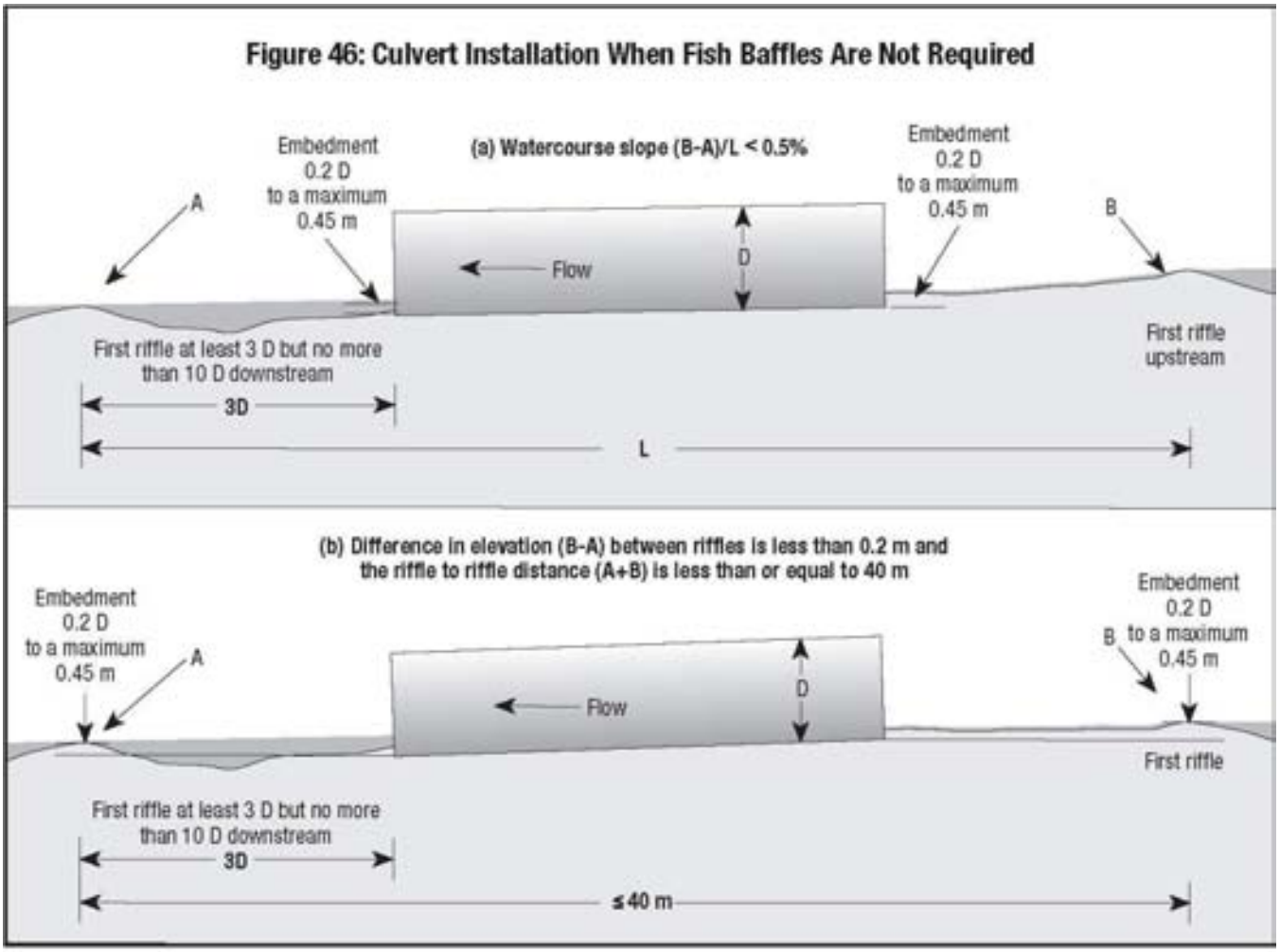
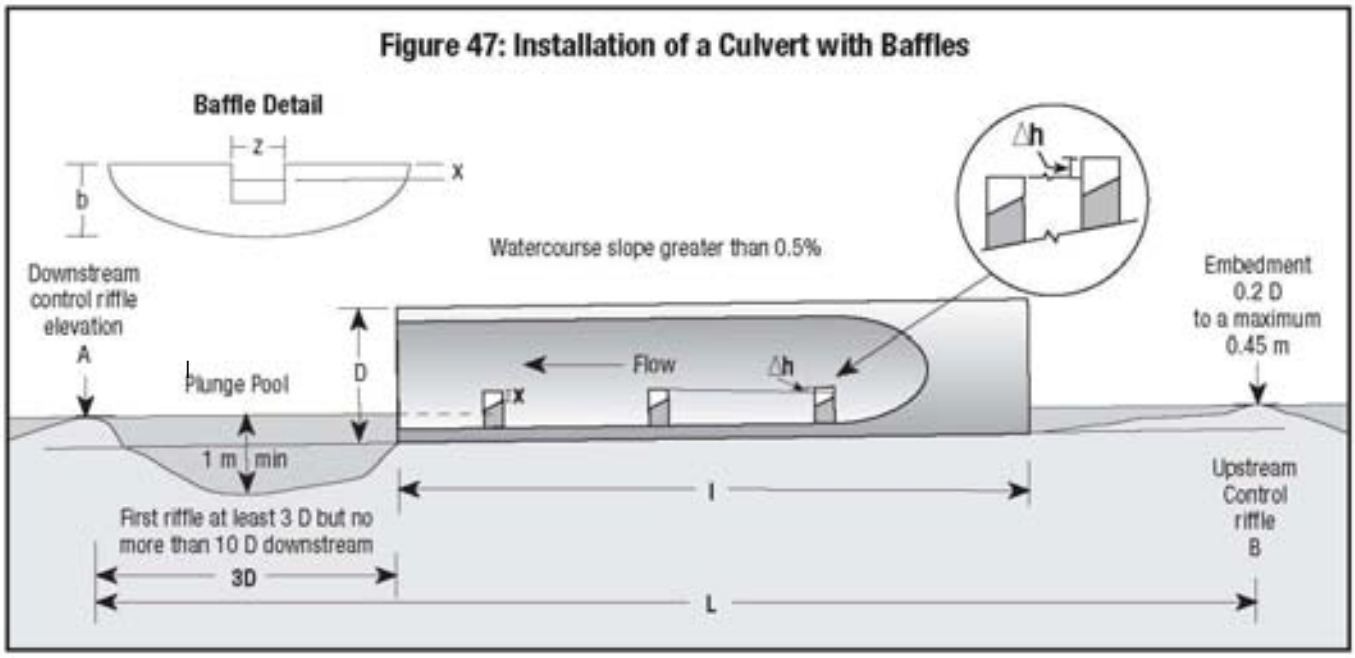


Figure 46: Culvert Installation When Fish Baffles Are Not Required



Baffles are to be designed as follows based on watershed size.

Table 8: Notch size for New Brunswick

Watershed size	Notch width (z) cm	Notch depth (x) cm	Baffle height (b) cm	Max. drop between baffles (Δh) cm
Less than 2.5 km^2	20	15	50	15
2.5 to less than 4 km^2	20	20	50	15
4 to less than 6 km^2	30	20	50	15
6 to less than 10 km^2	30	25	50	20
10 to less than 15 km^2	50	25	50	20
15 to 20 km^2	60	25	50	20

Culverts being installed in watercourses where the drainage is greater than 20 km^2 at the point of the installation will require additional planning and consultation with *Fisheries and Oceans Canada* to determine the appropriate notch size. If smelt utilize this watershed the drop between baffles must not exceed 15 centimetres.

The spacing of the baffles is determined by pipe slope (%) and the maximum drop between baffles. The top of the furthest downstream baffle must be set at the same elevation as the downstream control riffle.

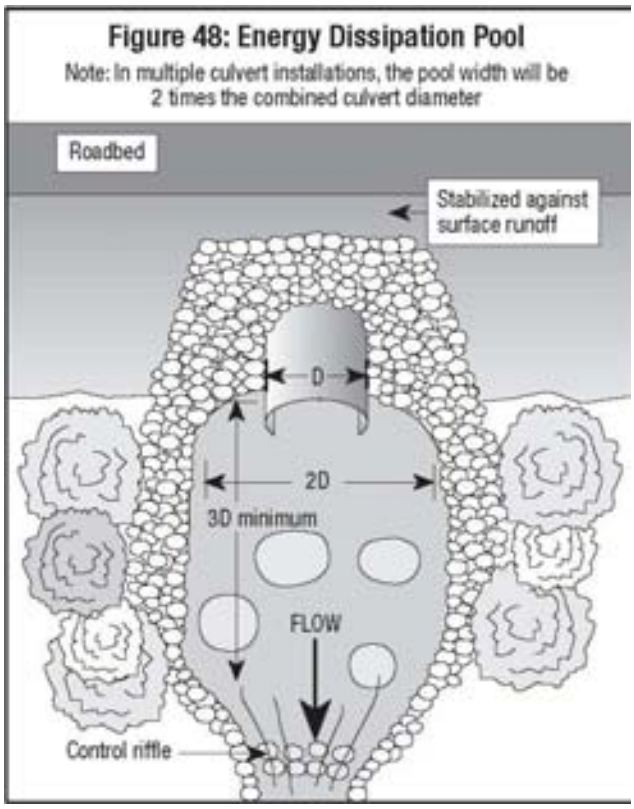
Table 9: Examples of Baffle Spacing Based on Pipe Slop and Maximum Drop between Baffles

Pipe slope (%)	Baffle Spacing (m) at 15 cm drops	Baffle spacing (m) at 20 cm drops
2	7.5	10.0
3	5.0	6.7
4	3.8	5.0
5	3.0	4.0
6	2.5	3.3
7	2.1	2.9
8	1.9	2.5
9	1.7	2.2

Table 10: Opened and covered areas by culvert size

Culvert size (mm)	Area of the culvert (m^2)	Area covered by the baffle* (m^2)	Remaining area* (m^2)
900	0.636	0.363	0.273
1000	0.785	0.393	0.392
1100	0.950	0.420	0.530
1200	1.131	0.446	0.685
1300	1.327	0.470	0.857
1400	1.539	0.494	1.093
1500	1.767	0.516	1.251
1600	2.011	0.537	1.474
1700	2.270	0.557	1.713
1800	2.545	0.577	1.968
1900	2.835	0.596	2.239
2000	3.142	0.614	2.528
2100	3.464	0.632	2.832
2200	3.801	0.649	3.152
2300	4.155	0.666	3.489
2400	4.524	0.683	3.841
2500	4.909	0.699	4.210

* assuming that the baffle is 500 mm high for all culverts



Site and Water Management

The length of the instream construction period necessary to install the culvert should be minimized to reduce environmental impact. Isolation of the worksite from the flowing water is necessary to prevent the release of suspended sediment into the stream flow and promote ease of installation. If the installation takes more than one day, the exposed soil must be mulched at the end of each day that work takes place.

Standard techniques for sediment control, such as the use of temporary check dams and/or silt fences, must be employed to prevent surface runoff from disturbed areas from washing sediment into the watercourse.

Guidelines

Design

The culvert should be designed so as to avoid excessive ponding at the entrance which may cause property damage, accumulation of floating debris, culvert clogging, saturation of tills, or detrimental upstream deposits of debris and alterations to of the fish habitat. The outlet should be designed to resist undermining and scour. The culvert should be aligned with the present day channel. This is typical of forestry roads and property access roads. In circumstances of long culverts, in order to minimize the culvert length, it may be advantageous to install the structure perpendicular to the road, resulting in a permanent diversion(s) adjacent to the inlet or outlet or both. See Figure 49. The site selected for the culvert crossing should have a uniform gradient.

When sizing a culvert, embedment reduces the end area and must be accounted for in the design. See Table 7.

Construction

Prior to the onset of the culvert installation, sediment control works should be installed to prevent sedimentation of the watercourse and maintained, as required, until a vegetative cover is established on all exposed erodible soil bordering both the watercourse and road surface. Please refer to the section on "Surface Erosion and Sedimentation Control" at page 19.

The in-channel work shall be carried out in isolation of the stream flow. See Figures 51 and 52.

If pump around technique is used, all fish occupying a reach of watercourse to be dewatered or abandoned must be rescued and relocated out of harm's way prior to any permanent or temporary dewatering operation.

Any excavation required for the culvert installation must be performed with a backhoe or an excavator.

To provide fish passage when the difference in elevation between the riffles is less than or equal to 0.2 metres and the riffle to riffle distance is less than or equal to 40 metres, the following installation criteria will apply:

- The downstream invert elevation of the culvert is embedded 0.2D (maximum of 0.45 metres) below the thalweg elevation of the streambed at the control riffle which is located at least 3 times the culvert diameter downstream the culvert. See Figure 46(b) and Table 7.
- The invert end of the culvert at the upstream end shall also be embedded 0.2D (maximum 0.45 metres) below the thalweg elevation of the streambed at the first riffle upstream of the culvert. In no case is the invert of the culvert to be set above the stream bed elevation at the inlet end of the pipe. See Figure 46(b) and Table 7.

The culvert must extend a minimum of 0.3 metres beyond the upstream and downstream toe of the fill placed around the structure. The culverts must be long enough to allow a stable foreslope no steeper than 1.5 horizontal to 1 vertical to be developed. The foreslopes must be stabilized against erosion with rip-rap or other non erodible material. Rip-rap or headwall erosion protection must extend along the foreslope on both sides of the culvert a minimum distance of 1D. Erosion protection must also extend to the shoulder of the road or 0.5D above the top of the pipe, whichever is less. If the rip-rap does not extend up to the road shoulder, the remainder of the foreslopes above the rip-rap shall be no steeper than 2 horizontal to 1 vertical and must be stabilized against surface runoff. See Figure 53.

All exposed erodible soil resulting from cut and fill operations within 30 metres of the watercourse must be immediately stabilized to prevent siltation.

An energy dissipation pool, if utilized, should be lined with a layer or rock/rip-rap having a thickness of at least 1.5 times the largest rock size. The rock should have a largest dimension not exceeding 600 millimetres and a breadth and thickness of at least one third of its longest dimension. Three to five boulders should be staggered in the energy dissipation pool. The top of the boulders should not protrude above the elevation of the outlet control riffle.

Shrubs, bushes and/or trees, interspersed with willow, dogwood or alder live stakes, are to be transplanted at 1 metre spacings along the sides of the energy dissipation pool. These will be planted within the 3-metre wide zone bordering the shoulder of the pool.

Any destabilization or disturbance to the banks of the watercourse must be stabilized immediately to prevent sedimentation of the watercourse. If two or more culverts are installed side by side, one culvert should be located in the thalweg of the channel with the invert set 0.2D (see table 7) to a maximum of 0.45 metres below the upstream and downstream riffle (see above) and the invert of the other pipe(s) be set at least 150 millimetres higher than the upstream and downstream riffles so that during low flow conditions all the water will flow through the lower culvert. See Figure 50.

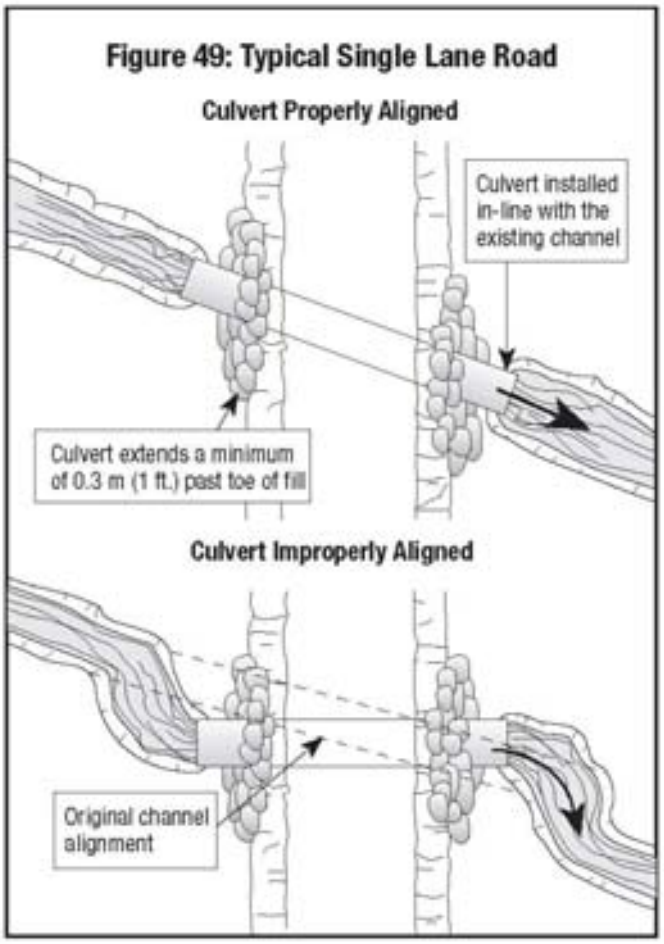


Figure 49: Typical Single Lane Road
Culvert Properly Aligned
Culvert installed in-line with the existing channel
Culvert extends a minimum of 0.3 m (1 ft.) past toe of fill
Culvert Improperly Aligned
Original channel alignment

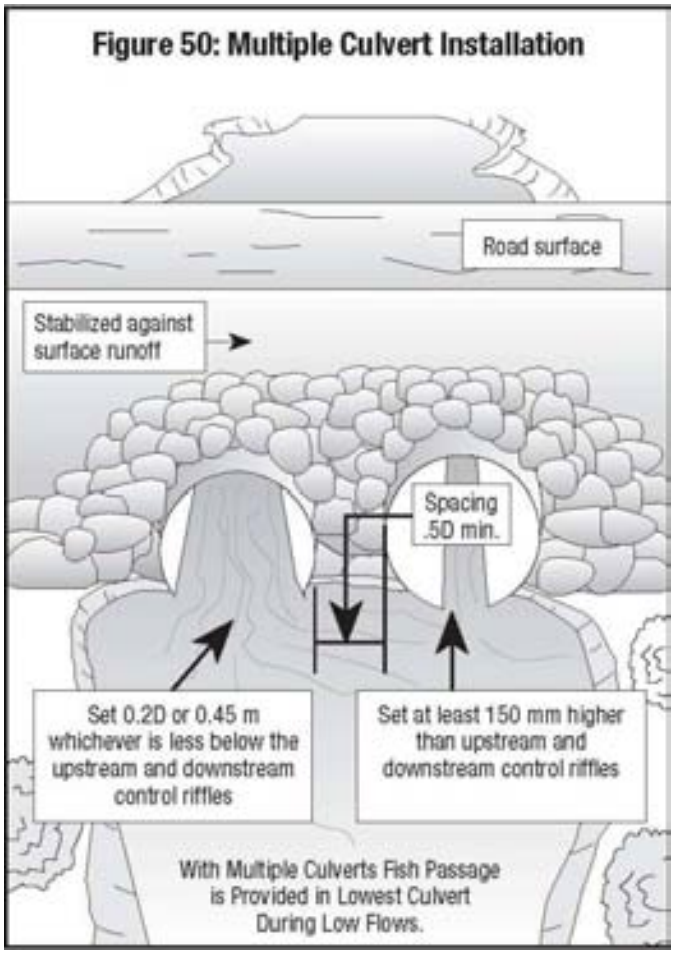
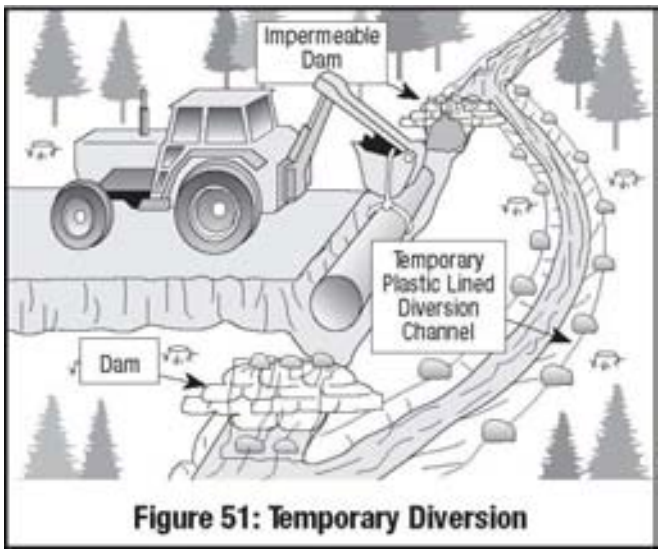


Figure 50: Multiple Culvert Installation
Road surface
Stabilized against surface runoff
Spacing .5D min.
Set 0.2D or 0.45 m whichever is less below the upstream and downstream control riffles
Set at least 150 mm higher than upstream and downstream control riffles
With Multiple Culverts Fish Passage is Provided in Lowest Culvert During Low Flows.


Impermeable Dam
Temporary Plastic Lined Diversion Channel
Dam
Figure 51: Temporary Diversion

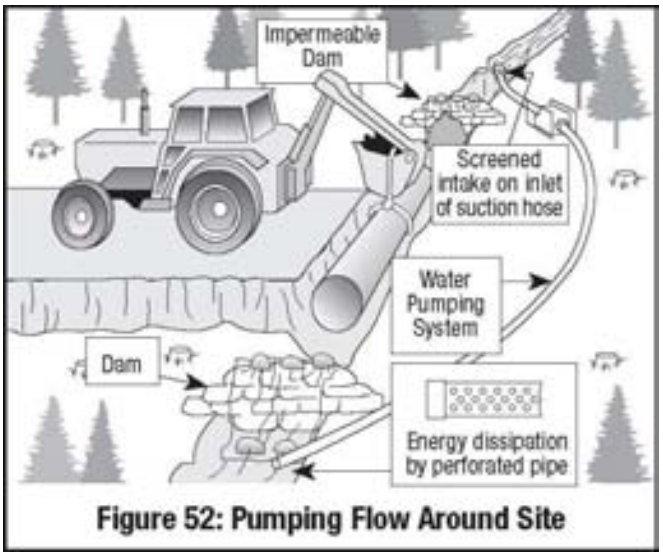
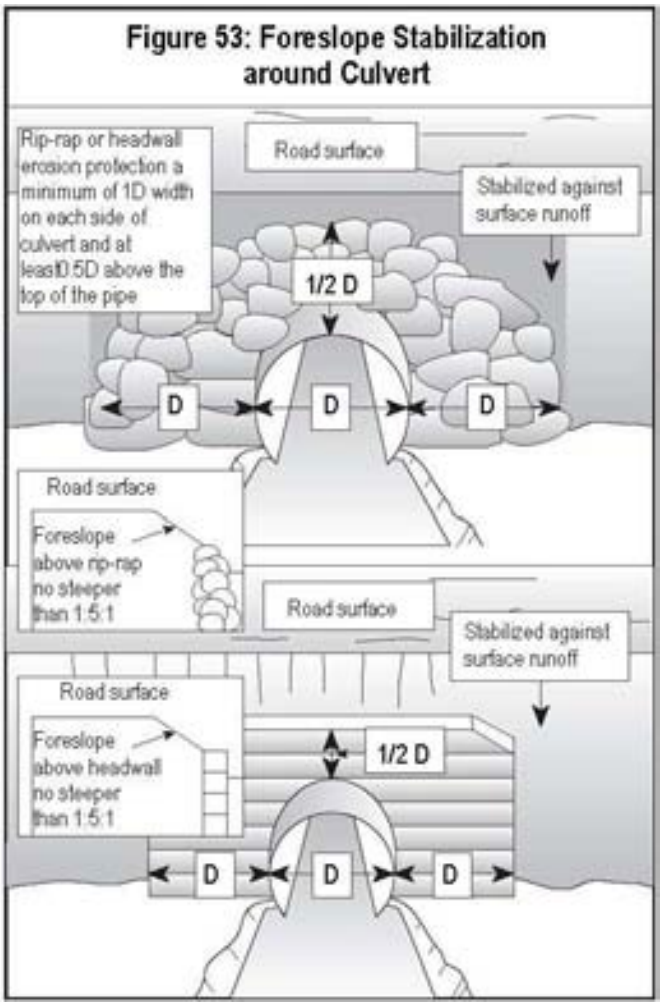

Impermeable Dam
Screened intake on inlet of suction hose
Water Pumping System
Dam
Energy dissipation by perforated pipe
Figure 52: Pumping Flow Around Site

Figure 53: Foreslope Stabilization around Culvert



b) Closed-Bottom Culverts: Maintenance

Definition

Culvert maintenance includes any minor repairs to a culvert that does not alter the invert.

Application Review Process

Regulatory

c) Closed-Bottom Culverts: Extensions

Definition

Culvert extension requires careful planning due to potential fish passage issues.

Application Review Process

Regulatory and Advisory

d) Closed-Bottom Culverts: Culvert Lining

Definition

Culvert lining is the re-enforcing of a closed-bottom culvert necessitated by a failure of the structural integrity of the structure. This would include replacing the bottom of corroded steel culverts with concrete or other material or inserting sleeves inside weakened or deformed culverts.

Application Review Process

Regulatory and Advisory

II) Culvert Alteration Type: Closed-Bottom Culvert Replacement

Culvert sizing and application requirements will be the same as for a new culvert installation. Please refer to the guidelines for "Watercourse Crossing Type: Culverts" at page 88.

Application Review Process

Regulatory only if:

- the new culvert is less than 50% longer than the culvert it replaces and the increased length is not more than 10 metres to a maximum length of 30 metres, and
- if the watercourse slope between the upstream riffle and the control riffle which is located at least 3 times the culvert diameter downstream is less than or equal to 0.5% or the difference in elevation between these riffles is less than 0.2 metres and the riffle to riffle distance is less than 40 metres.

Guidelines

Excavated materials associated with the structure being replaced are generally at least partially saturated and should not be used to backfill around the new culvert. Excavated materials should be removed and replaced with imported clean, dry backfill material suitable for compacting.

III) Culvert Alteration Type: New Installation of Open-Bottom

Definition

Open-bottom culverts installed over watercourses to allow the free, unobstructed flow of water under cover material graded to form a travel surface. This type of structure is founded on various types of footing support structures.

Objectives

This activity permits the utilization of open-bottom culverts in watercourses as a feasible means of conveying water flow under a roadbed while minimizing impacts on the stream channel, fish habitat and maintaining the existing fish passage conditions.

Planning Considerations

General

These standards are not prescriptive. They are intended as conceptual performance standards for river and stream crossings. Use of these standards alone will not satisfy the need for proper engineering and design. In particular, appropriate engineering is required to ensure that watercourse crossings are sized and designed to provide adequate capacity and structural stability. The culvert shall be designed such that **after installation**, the waterway opening is adequate to ensure that the stream flow velocity does not exceed 1.8 m/s during a 1 in 100 year discharge event.

Open-bottom culverts should not be used at sites where soils are unstable or incapable of supporting the structure.

Environmental Considerations

Erosion/sedimentation and fish passage are two of the environmental issues that must be addressed with this type of installation. An open-bottom culvert avoids the requirement for fish passage facilities provided it is installed such that the placement of

the structure, including the foundation and any associated excavation, takes place outside the shoulders of the stream channel. See Figure 55.

Stability of the banks and bed of the watercourse is a concern and must be considered during installation.

There are various footing and support structures (e.g. metal plates, precast concrete pads, timbers, stemwalls, etc.) available for use under a variety of field conditions which can be installed without encroaching into the natural channel.

This type of structure may be less likely to be dammed by beavers than closed-bottom (i.e. circular culverts).

Application Requirements

- dimensioned drawings of the proposed site which provide the shoulder to shoulder width and cross-section of the channel. See Figure 55;
- a full description of construction methodology and materials must be provided;
- shape material and dimensions of structure to be installed;
- a map pinpointing the location.

Application Review Process

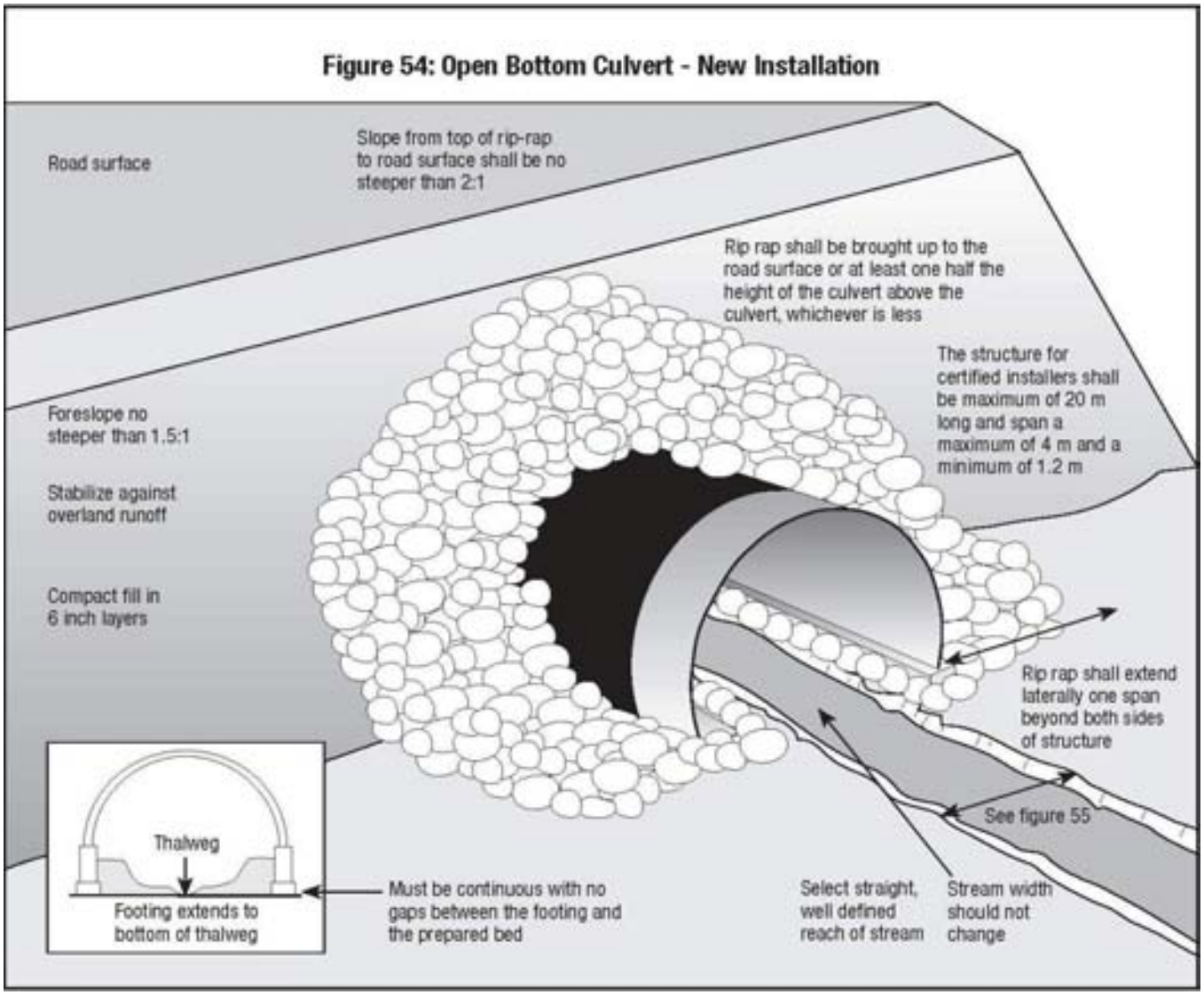
Regulatory only if:

- the length of the culvert is 20 metres or less;
- the span of the structure is at least 0.6 metres plus 1.2 times the shoulder to shoulder channel width. See Figure 55;
- all work is carried out in isolation of the stream flow;
- the existing channel does not need to be modified;
- the span of the open-bottom culvert is at least 1200 millimetres but no greater than 4000 millimetres.

Regulatory and Advisory for all other open-bottom culverts.

***NOTE: Culvert crossings on watersheds greater 20 square kilometres must undergo a thorough hydraulic analysis involving factors such as channel gradient, velocity of flow, cross-sectional area of the channel, flood frequency, and ice formation.**

Figure 54: Open Bottom Culvert - New Installation



Construction

Clearing activities within 30 metres of the watercourse shall be limited to the absolute minimum required to install the structure and where ditches are constructed, to stabilize the foreslopes and backslopes. On forestry roads, grubbing activities should be restricted to that portion of the right-of-way which underlies the actual road surface.

All work is carried out in isolation of the stream flow. All fish occupying a reach of watercourse to be dewatered or abandoned must be rescued and relocated out of harm's way prior to any permanent or temporary dewatering operation.

Prefabricated structures should be installed using machinery that can lift the components into place. Prefabricated structures should not be dragged across the watercourse into position.

A prefabricated open-bottom should be placed so that there are no voids between the ground and the footings.

Guidelines

The open-bottom culvert should be installed over a reach of stream channel that is relatively straight and well defined.

A person planning to construct a new crossing consisting of an open bottom arch should abide by the manufacturer's design recommendations.

The arch must consist of corrugated bolted annular steel sheets, concrete or other products that are designed by the manufacturers of engineered arches and/or are stamped with the approval of a registered professional engineer licensed to practice in New Brunswick.

An open-bottom culvert must be founded on continuous footings/support structures. These structures may be steel, concrete, wood that is rot resistant such as hemlock and tamarack, rigid plastic or other materials which will provide adequate support for the structure. The footings should be placed on a compacted bed of gravel to provide uniform support.

A rule of thumb recommendation is to bury the footing below the thalweg such that the bottom of the footing is below the possible depth of scour. Otherwise a foundation designed by an engineer, which may include a thorough scour analysis, is typically necessary.

All backfill material over the footing or against the stemwall should be capped with rock without constricting the channel.

The height of fill and compaction around the structure must be in accordance with manufacturer's specifications.

Rip-rap or headwall erosion protection must extend along the foreslope on both sides of the culvert a minimum distance of one span width. Erosion protection must also extend to the shoulder of the road or 0.5D above the top of the arch, whichever is less. If the rip-rap does not extend up to the road shoulder the remainder of the foreslopes above the rip-rap shall be no steeper than 2 horizontal to 1 vertical and must be stabilized against surface runoff.

IV) Culvert Alteration Type: Replacement of a Closed-Bottom Culvert with an Open-Bottom Culvert

Definition

Open-bottom culverts installed over watercourses to allow the free unobstructed flow of water under cover material graded to form a travel surface. This type of structure is founded on various types of footing support structures. Closed-bottom culverts can be replaced with open-bottom culverts.

Objectives

In certain instances, it may be appropriate to replace a closed-bottom with an open-bottom culvert due to their ease of installation or to re-establish a natural channel or to improve fish passage.

This activity permits the replacement of structures and the utilization of open-bottom culverts in watercourses as a feasible means of conveying water flow under a roadbed.

Planning Considerations

General

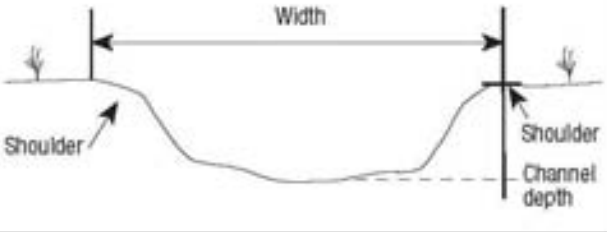
The removal of a closed-bottom culvert or other structure requires careful planning to ensure that the removal does not impact on the watercourse. The use of open-bottom culverts as a replacement requires the re-establishment of the watercourse channel. Ensuring the channel is properly sized is of the utmost importance. Please refer to the section on "Environmental Considerations" at page 88.

The culvert shall be designed such that after it is installed, the end area available is adequate to ensure that the stream flow velocity does not exceed 1.8 m/s during a 1 in 100 year discharge event.

These standards are not prescriptive. They are intended as conceptual performance standards for river and stream crossings. Use of these standards alone will not satisfy the need for proper engineering and design. In particular, appropriate engineering is required to ensure that watercourse crossings are sized and designed to provide adequate capacity and structural stability. The culvert shall be designed such that **after installation**, the waterway opening is adequate to ensure that the stream flow velocity does not exceed 1.8 m/sec during a one in 100 year discharge event.

Open-bottom culverts should not be used at sites where soils are unstable or incapable of supporting the structure.

Figure 55: Watercourse Channel Cross Section



Environmental Considerations

Downstream sedimentation, proper design and construction of a new stream channel, erosion, and fish passage are four of the environmental concerns that must be addressed for this type of installation.

Downstream sedimentation can occur if proper controls are not in place during the removal of the existing structure. A dam and pump-around or temporary diversion are two of the techniques that can be utilized to perform work in isolation of the stream flow and to ensure the natural flow of water downstream is uninterrupted and its quality maintained.

The **new channel** under the open-bottom culvert shall **be constructed** with a depth and width similar to the existing natural channel in the vicinity of the crossing. The channel size, width and depth, can be determined by averaging five measurements upstream of the proposed site. The channel width is determined by measuring the distance between the shoulders of the watercourse. The channel depth is the difference in elevation between the shoulders and the streambed. See Figure 55. These measurements should be made in a reach of channel that was not altered as a result of the installation of the existing structure.

Fish passage facilities are not required if the open-bottom culvert meets the following design criteria together with the "Construction" guidelines below:

- a maximum length of 30 metres;
- the span of an open-bottom culvert is at least 1200 millimetres but no greater than 4000 millimetres;
- the new open-bottom culvert is installed along the same alignment as the culvert it replaced;
- a low flow thalweg (channel) is created to provide fish passage. See Figure 56.

Erosion of the banks and streambed of the newly constructed structure is of concern and must be considered during planning. If in-situ soft, organic bed material is exposed when the existing culvert is removed, the site may not provide adequate support for the new structure and may be susceptible to erosion. An open-bottom culvert may not be the most appropriate structure to use at this location.

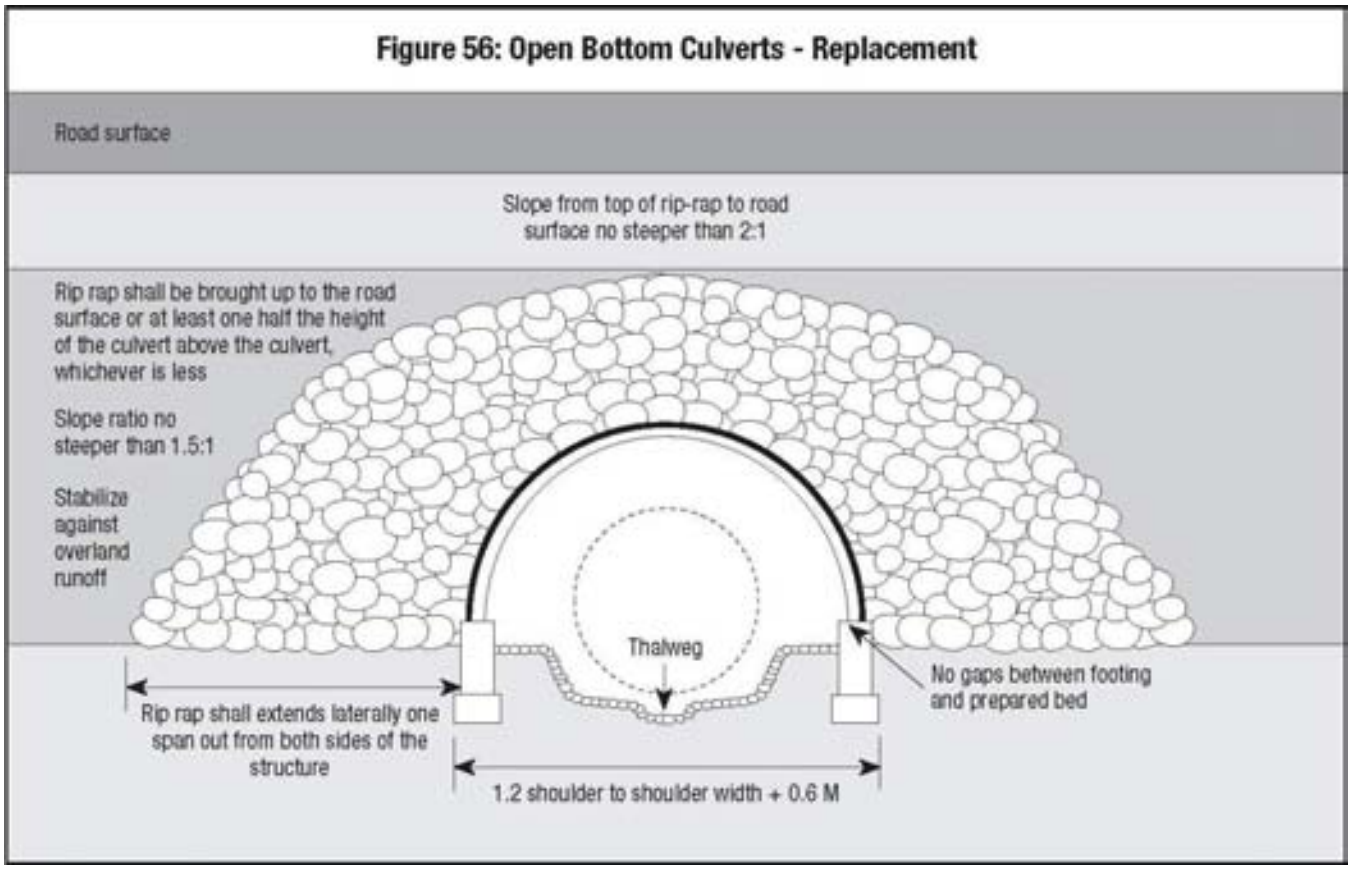
This type of replacement structure is less likely to be dammed by beavers compared to closed-bottom culverts.

Application Requirements

In addition to the standard information required on the application form, the following must be included:

- drawings of the proposed site showing the shoulder to shoulder width, the culvert length, and watercourse slope extending from the first riffle upstream to the riffle located at least 3 times the span of the open-bottom culvert downstream of the culvert location;
- a map pinpointing the location of the work.

Figure 56: Open Bottom Culverts - Replacement



Application Review Process

Regulatory if:

- an existing culvert is replaced with a culvert of equal length, or
- the replacement culvert does not exceed 1.5 times the length of the existing culvert. The overall length of the replacement cannot exceed 30 metres. See Table 11;
- the work is done between the period of June 1st and September 30th;
- the span of an open-bottom culvert is at least 1200 millimetres but no greater than 4000 millimetres;
- the span of the structure is at least 0.6 metres plus 1.2 times the shoulder to shoulder channel width. See Figure 55;
- the new open-bottom culvert is to be installed along the same alignment as the culvert it replaces;
- no fording is necessary;
- a low flow thalweg (channel) is created within the newly constructed channel to provide fish passage.

Table 11: Maximum length of replacement culverts

Existing length (m)	Replacement length (m)
8	12
10	15
12	18
14	21
16	24
18	27
20	30
21	30
22	30

Regulatory and Advisory in all other situations.

Construction

The removal of the existing structure shall be done in isolation of the stream flow.

A dam and pump-around or temporary diversion are two of the techniques that can be utilized to perform work in isolation of the stream flow and to ensure the natural flow of water downstream is uninterrupted and its quality maintained.

The new defined channel shall be lined and the banks stabilized with clean rock to provide stability. The lining should be at least 200 millimetres thick and the material can be cobble, rock, R5 and/or R25 mixed. The material used must increase in size as the watercourse slope and/or depth of water increases. See Figure 56.

Fish passage must be provided.

The rock must be clean, not containing clay or fines that may be detrimental to the aquatic life present in the watercourse. The open-bottom culvert should be placed on a continuous footing with no voids between the prepared bed and the footings.

Guidelines

The removal of the existing structure must be carried out in isolation of stream flow. See Figures 51 and 52.

The reconstructed channel must be of similar depth and width as the existing watercourse in the immediate vicinity of the structure. See Figure 55.

Rock and cobble shall be used to line the new channel to ensure stability and diverse hydraulic conditions in the channel. A low flow channel must be established.

The stream banks must be solid and be able to support the structure and the loads traveling over them.

An open-bottom culvert must be founded on continuous footings/support structures. These structures may be steel, concrete, wood that is rot resistant such as hemlock and tamarack, rigid plastic or other materials which will provide adequate support for the structure. The footings should be placed on a compacted bed of gravel to provide uniform support.

A rule of thumb recommendation is to bury the footing below the thalweg such that the bottom of the footing is below the possible depth of scour. Otherwise a foundation designed by an engineer, which may include a thorough scour analysis, is typically necessary.

All backfill material over the footing or against the stemwall should be capped with rock without constricting the channel.

The height of fill and compaction around the structure must be in accordance with manufacturer's specifications.

Rip-rap or headwall erosion protection must extend along the foreslope on both sides of the culvert a minimum distance of 1 span width. Erosion protection must also extend to the shoulder of the road of 0.5D above the top of the arch, whichever is less. If the rip-rap does not extend up to the road shoulder the remainder of the foreslopes above the rip-rap shall be no steeper than 2 horizontal to 1 vertical and must be stabilized against surface runoff.

Definition

Temporary crossings are constructed or prefabricated structures that provide access across the watercourse for a limited period of time. They are generally used:

1) to provide heavy equipment with working access to a crossing under construction;
2) to maintain traffic flow for the general public while an existing structure is being repaired or replaced;
3) to provide temporary access across a watercourse for short term use.

Planning Considerations

General

Temporary bridges must not be left in place past the expiry date on the Watercourse and Wetland Alteration Permit because the waterway opening was designed for a limited period of time, during normal flow conditions outside the spring freshet, and the construction materials may not be appropriate for a permanent crossing. They are often constructed from untreated timbers which may collapse due to deterioration if left in place.

Environmental Considerations

Temporary bridges should be used instead of temporary culverts because their installation results in minimal impact to aquatic habitat and disturbance to the bed and banks of the watercourse. They also have the least potential of creating a barrier to fish migration.

Size

Temporary crossings are designed to accommodate peak flows, but only those expected to occur during the period the crossing is required which must not include the spring freshet period. Permits for temporary crossings are generally granted for the low flow period in the summer months and it is essential that they be removed immediately after the specified time period.

Ice Bridges

Ice bridge construction involves flooding the existing ice surface in layers to build up the ice thickness so that it will support the weight of the machinery that will use the crossing. Because water is withdrawn from the watercourse to flood the surface, a permit is required.

Where feasible, the ice bridge should be located so as to minimize the length of the crossing and the amount of approach grading and bank disturbance.

Ensure clean snow is used and that the approaches are not grubbed.

When the crossing season is over and where it is safe to do so, the ice should be weakened by creating a v-notch in the center of the ice bridge to allow it to melt from the center in order to help prevent an ice jam, an obstruction to fish passage, channel erosion and flooding.

Ice Crossings

A Watercourse and Wetland Alteration permit is not required to cross a frozen watercourse provided that the ice surface is not broken, the banks are not disturbed and no water is withdrawn from the watercourse to build up the ice thickness. If water is withdrawn to reinforce an ice bridge, a permit is required.

Application Review Process

Regulatory

Regulatory and Advisory for temporary closed-bottom culvert proposals

Construction

The conditions placed on construction activities are influenced by the time of year during which the crossing is to be installed and the length of time that the crossing will be in use. If the crossing is to be in use for a period which interferes with fish migration, spawning, or egg incubation, the installation and maintenance of the crossing must be given the same environmental considerations as a permanent crossing. If the crossing is installed and used during a period of time which poses little threat to the aquatic habitat then conditions pertaining to the installation will be less stringent.

Guidelines

All temporary crossings should be constructed at right angles to the watercourse. Where necessary, they may deviate up to a maximum of 15 degrees from a line drawn perpendicular to the centre line of the watercourse at the intended crossing.

For temporary bridges, the bedlogs, cribwork or other types of foundation materials should be placed back from the edge of the channel a minimum of 0.5 metres. See Figure 57.

When it is no longer needed, the crossing structure and all construction and approach materials must be removed from the bed and banks of the watercourse, such that the channel closely resembles its pre-construction cross-section and all exposed erodible soil stabilized against erosion either by rip-rapping, hydro-seeding or seeding by conventional means and blanketing with straw/hay mulch.

The span of the temporary bridge must be wide enough to ensure that any work required to prepare a stable foundation does not result in any material entering the watercourse.

Temporary bridges composed of a single sill log on each side of the watercourse must have spacers attached to the underside of the stringers to maintain the span between the sill logs.

Evergreen boughs or straw bales must be placed across the approaches to the bridge after the structure is removed to help trap the sediment before the runoff enters the watercourse.

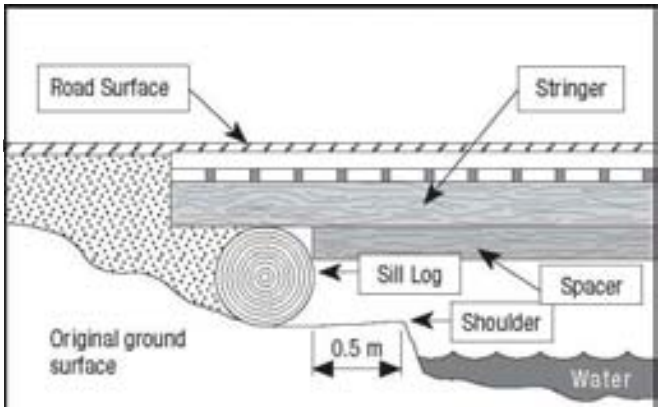


Figure 57: Temporary Bridge with Single Sill Log

Definition

Structures used to withdraw water from a watercourse for the purpose of irrigation, domestic supply, manufacturing, fire fighting, aquaculture facilities, or other uses.

Objectives

To withdraw a volume of water from a watercourse while maintaining sufficient flow and depth of water to ensure that fish habitat is protected, and fish passage is maintained.

To maintain downstream water quality.

To minimize disturbance to the bed and banks of the watercourse during installation.

Planning Considerations

Environmental Considerations

Whether the water is withdrawn from a flowing watercourse such as a stream, creek, river, or brook, or a standing body of water such as a lake or a pond, the following concerns must be addressed before the project begins:

1) The water withdrawal must not cause any fish or other aquatic organism to be removed from their habitat. The intake must be screened to prevent these organisms from entering the structure. Sufficient screen area must be provided with openings to ensure that approach velocities are less than 0.15 metres per second.
2) The volume of water remaining in the watercourse must be adequate for the maintenance of aquatic habitat and fish passage. Decreasing the volume of water in the watercourse may result in an increase in temperature, making it intolerable for some species of fish. A decrease in water level or flow can also diminish suitable living space for fish, reduce the habitat and production and delivery of food organisms and accelerate sediment deposition.

   If the depth of water is decreased, it may pose a barrier to fish passage. Depth of water required by fish for swimming varies, but on the average, 15-23 centimetres are considered the minimum depth of water required.
3) Water intake structures must be installed so that they do not present an obstruction to migrating fish.
4) Installation must not destroy fish habitat. Any bed or bank disturbance caused by installation must be stabilized immediately to prevent the sedimentation of the watercourse which could negatively impact fish habitat.
5) The quality of the water at the site and downstream of the site must be maintained during and after water withdrawal. If water is returned to the watercourse via an overflow pipe, the effluent must conform with the **Water Quality Regulation** under the **Clean Environment Act**.

Maintenance Flows

For flowing bodies of water such as streams, creeks, rivers, or brooks, the acceptable rate of water removal or the pumping rate is dependent upon the average annual flow in the channel throughout the withdrawal period. A certain rate of flow must be maintained downstream of the water intake. This rate is known as maintenance flow and is specific to each site. Since channel flows fluctuate on a seasonal basis, acceptable rates of maintenance flows are based on the mean flow in the watercourse throughout the desired withdrawal period and specific criteria regarding water withdrawal during periods of low flow may be necessary.

If water is withdrawn and returned to the watercourse upstream of the intake, maintenance flows will not be required.

The effect of water removal from a standing body of water is site specific, and each case must be considered on an individual basis.

One method of determining maintenance flow requirements can be calculated as about 70% of the Monthly Median Flow, as derived from the nearest *Environment Canada* gauging station. From Table 12, there is a significant difference of flows on a per square km basis. In a case of large difference in flow, *Fisheries and Oceans Canada* requires that the largest of the flow derived from the two nearest gauging stations be utilized for calculations.

Water Requirements

Determination of allowable pumping or water withdrawal rates must consider the time period for which the water is needed. Many irrigation projects require water during dry seasons, during which the required maintenance flow may not allow for the removal of any water. In these cases, planning should include a reservoir, to be filled during periods of higher flows.

If the water is to be withdrawn on a continuous basis for example in a fish hatchery, a calculation of the low flows expected for the watercourse at the point of withdrawal would be useful to predict whether or not the maintenance flows allow for any water removal during the low flow period.

Hydrometric data is not available for every watercourse in the province; therefore, the low flow is estimated from hydrometric data from a nearby watercourse.

Exploration Drilling

If the water is being withdrawn for drilling exploration work at a rate of less than 45 litres per minute and permission has been obtained from the Mining Recorder to proceed with the work, a Watercourse and Wetland Alteration Permit is not required. Compliance with the terms and conditions to which the permission is subject is mandatory.

Table 12: Specific Monthly Median Flow (Q50/A, $m^3/s.km$) in New Brunswick

RIVER	A (km^2)	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
Grande Rivière	339.0	0.0045	0.0032	0.0039	0.0568	0.0460	0.0136	0.0085	0.0063	0.0058	0.0090	0.0162	0.0089
Limestone Stream	199.0	0.0051	0.0044	0.0064	0.0560	0.0253	0.0102	0.0067	0.0062	0.0066	0.0091	0.0132	0.0104
Mamozekel River	230.0	0.0050	0.0037	0.0038	0.0373	0.0436	0.0145	0.0074	0.0067	0.0055	0.0085	0.0110	0.0086
Becaguimec Stream	350.0	0.0065	0.0051	0.0093	0.0569	0.0299	0.0098	0.0058	0.0042	0.0040	0.0104	0.0185	0.0104
Shogomoc Stream	234.0	0.0103	0.0077	0.0105	0.0630	0.0321	0.0116	0.0049	0.0026	0.0026	0.0058	0.0181	0.0174
Mid. Branch Nashwaaksis	26.9	0.0052	0.0046	0.0104	0.0551	0.0223	0.0072	0.0028	0.0024	0.0023	0.0095	0.0158	0.0117
Nashwaak River	641.0	0.0087	0.0079	0.0099	0.0639	0.0332	0.0134	0.0082	0.0075	0.0070	0.0119	0.0213	0.0134
North Branch Oromocto R.	557.0	0.0110	0.0095	0.0163	0.0555	0.0260	0.0098	0.0039	0.0026	0.0020	0.0059	0.0157	0.0143
Castaway Stream	34.4	0.0089	0.0069	0.0155	0.0618	0.0308	0.0141	0.0074	0.0071	0.0059	0.0120	0.0197	0.0144
Burpee Millstream	93.2	0.0080	0.0056	0.0131	0.0661	0.0224	0.0117	0.0046	0.0045	0.0036	0.0142	0.0233	0.0146
Canaan River	668.0	0.0068	0.0056	0.0121	0.0499	0.0221	0.0076	0.0034	0.0025	0.0028	0.0073	0.0140	0.0111
Lepreau River at Lepreau	239.0	0.0182	0.0139	0.0239	0.0592	0.0319	0.0127	0.0067	0.0050	0.0063	0.0136	0.0300	0.0255
Dennis Stream	115.0	0.0101	0.0088	0.0190	0.0512	0.0263	0.0102	0.0036	0.0024	0.0026	0.0081	0.0200	0.0180
Jacquet River	510.0	0.0047	0.0035	0.0040	0.0326	0.0781	0.0143	0.0066	0.0050	0.0044	0.0070	0.0111	0.0080
Eel River	88.6	0.0044	0.0037	0.0041	0.0328	0.0877	0.0150	0.0069	0.0056	0.0063	0.0145	0.0124	0.0094
Bass River	175.0	0.0025	0.0028	0.0034	0.0518	0.0384	0.0078	0.0022	0.0019	0.0017	0.0042	0.0104	0.0070
Rivière Caraquet	173.0	0.0080	0.0065	0.0075	0.0452	0.0479	0.0191	0.0111	0.0083	0.0063	0.0081	0.0145	0.0112
Catamaran Brook	28.7	0.0089	0.0062	0.0071	0.0437	0.0536	0.0146	0.0082	0.0043	0.0039	0.0064	0.0200	0.0111
Northwest Miramichi River	948.0	0.0070	0.0056	0.0067	0.0423	0.0630	0.0162	0.0085	0.0067	0.0057	0.0094	0.0153	0.0116
Kouchibouguac River	177.0	0.0074	0.0068	0.0106	0.0620	0.0351	0.0136	0.0072	0.0056	0.0042	0.0071	0.0144	0.0109
Coal Branch River	166.0	0.0075	0.0057	0.0124	0.0600	0.0284	0.0096	0.0042	0.0029	0.0027	0.0060	0.0143	0.0117
Turtle Creek	129.0	0.0137	0.0119	0.0199	0.0621	0.0408	0.0144	0.0066	0.0041	0.0037	0.0066	0.0177	0.0187
Palmers Creek	34.2	0.0105	0.0074	0.0192	0.0436	0.0281	0.0114	0.0062	0.0048	0.0052	0.0122	0.0196	0.0200
Point Wolfe River	130.0	0.0179	0.0156	0.0250	0.0672	0.0507	0.0196	0.0107	0.0093	0.0096	0.0223	0.0346	0.0285

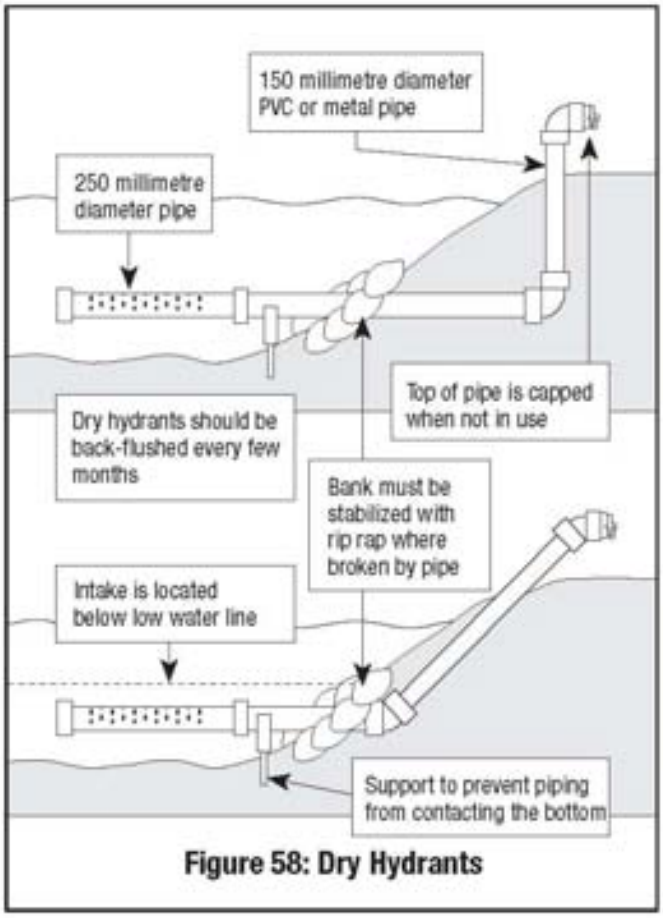


Figure 58: Dry Hydrants

Dry Hydrants

Dry Hydrants are water intake structures consisting of a standpipe buried in the bank of a watercourse with a horizontal pipe connected to the bottom end which extends into the watercourse. The end of the pipe must be screened in accordance with the specifications outlined for all water intake structures, and the structure is subject to all rules and regulations governing water intake structures. Water is withdrawn from a dry hydrant on an 'as needed' basis by a mobile pump carried on a fire truck. See Figure 58

Application Requirements

In addition to the standard information required on the application form, the following must be included:

- pumping rates and schedule with dates and times specified;
- description of equipment including type and size of pipe;
- description of construction methods planned;
- elevation of intake;
- a map and PID number.

Hydrological data and calculations may have to be submitted in order for the regulatory agencies to determine the appropriate maintenance flows.

If a "Certificate of Approval" under the **Water Quality Regulation** is issued for a project which includes a water intake structure, a separate Watercourse and Wetland Alteration Permit is not required.

The Conditions of Approval will be addressed in the "Certificate of Approval".

The installation and maintenance of permanent or temporary water intake pipes which will not significantly affect the level, flow, or quality of water in a watercourse are permitted under the Provisional Permit system if the activity is restricted to June 1st to September 30th, the applicability clause, and conditions in the Provisional Permit Notification Form are met. Examples of these activities include water supply for single family residences, and dry hydrants.

Other Government Agencies Involved

1) In some cases, a representative from either *Fisheries and Oceans Canada* or the *New Brunswick Department of Natural Resources* may visit the site to determine maintenance flow requirements or allowable pumping rates from a standing body of water.
2) Screening requirements for water intakes must be in accordance with *Fisheries and Oceans Canada*'s "Freshwater Intake End-of-Pipe Fish Screen Guideline".

Application Review Process

Regulatory and in some cases, Regulatory and Advisory

Construction

Screens

Screens are generally constructed on a rectangular frame as shown on the following page. See Figure 59.

Installation of Water Intake

The Watercourse and Wetland Alteration Permit may require that a staff gauge be placed in the watercourse immediately downstream of the water intake. A relationship between discharge and gauge measurements must be developed in order for the flow in the watercourse to be monitored during periods of low flow. Any disturbance to the banks or bed caused by installation of the water intake structure must be immediately stabilized to prevent sedimentation of the watercourse.

Guidelines

The water intake and outfall structures must be constructed with bed and bank reinforcement to adequately protect the watercourse and intake works from local erosion.

The water intake and outlet pipes must be screened to prevent entrance of fish.

The design and location of the intake structure must ensure that a uniform flow distribution is maintained through the total screen area.

The screen material must be stainless steel, galvanized steel, aluminum, brass, or bronze. Stainless steel is preferred since corrosion is greatly reduced.

An open area of 1 square metre of screen must be provided for each 0.15 cubic metre per second of water being withdrawn.

The clear opening between the vertical grids in the screen must not exceed 7 millimetres in width.

A trash rack should be installed to protect the screen panels from damage caused by floating debris or ice.

The screen must be readily accessible for cleaning and inspection. Screen panels or screen assemblies must be removable for cleaning, inspection and repairs.

A double set of guide slots positioned back to back are to be provided for the screen panels. The screen panels should fit snugly in the guides so that spaces larger than the clear openings in the mesh do not occur.

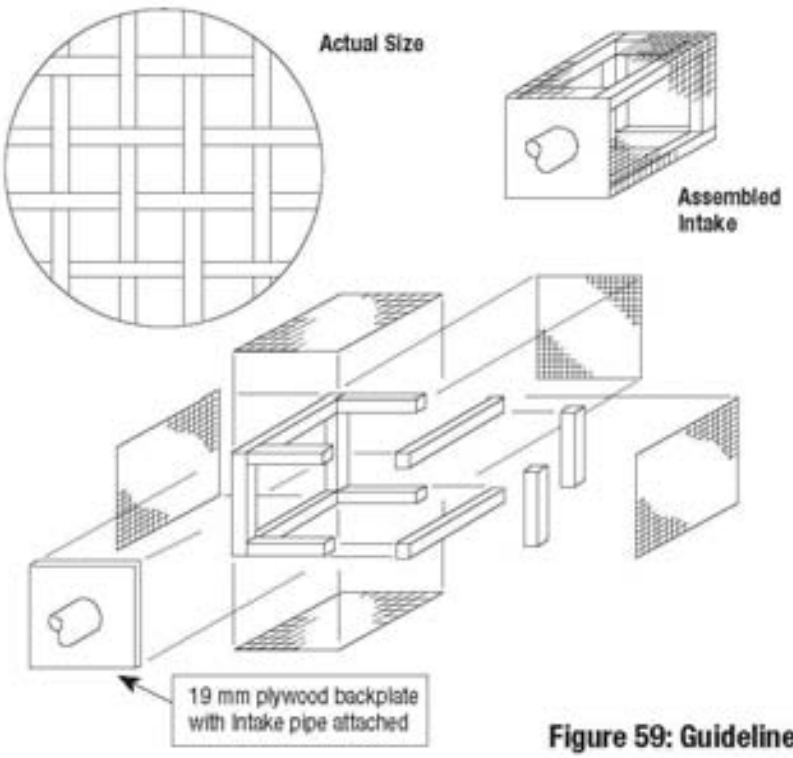
A spare screen must be available for maintenance purposes.

The screen must be cleared of debris at regular intervals.

All disturbances to the ground within 30 metres of the shoulders of the watercourse, caused by burying the piping must be immediately stabilized to prevent erosion.

The water intake structure must not pose a hazard to navigation.

The flow, specified in the Watercourse and Wetland Alteration Permit, "Conditions of Approval", must be maintained in the watercourse downstream of the water intake structure at all times. See Figures 59, 60 and 61.



1 Dimensions of the assembled structure will vary according to the rate of intake.

2 1 square metre of open area of screen is required for each 0.15 cubic metres per second of water extracted.

3 Velocity through the screen must not exceed 15 centimetres per second.

4 Wire mesh with a horizontal distance between the openings of no greater than 7.5 millimetres is attached to the wooden frame using steel staples.

5 Treated wood must be completely dry before being immersed in water.

6 Attach intake pipe to backplate.

7 Intake must be elevated to allow flow through screen bottom or other dimensions must be increased to ensure that sufficient screen is available.

Figure 59: Guidelines for Temporary Intake Screens

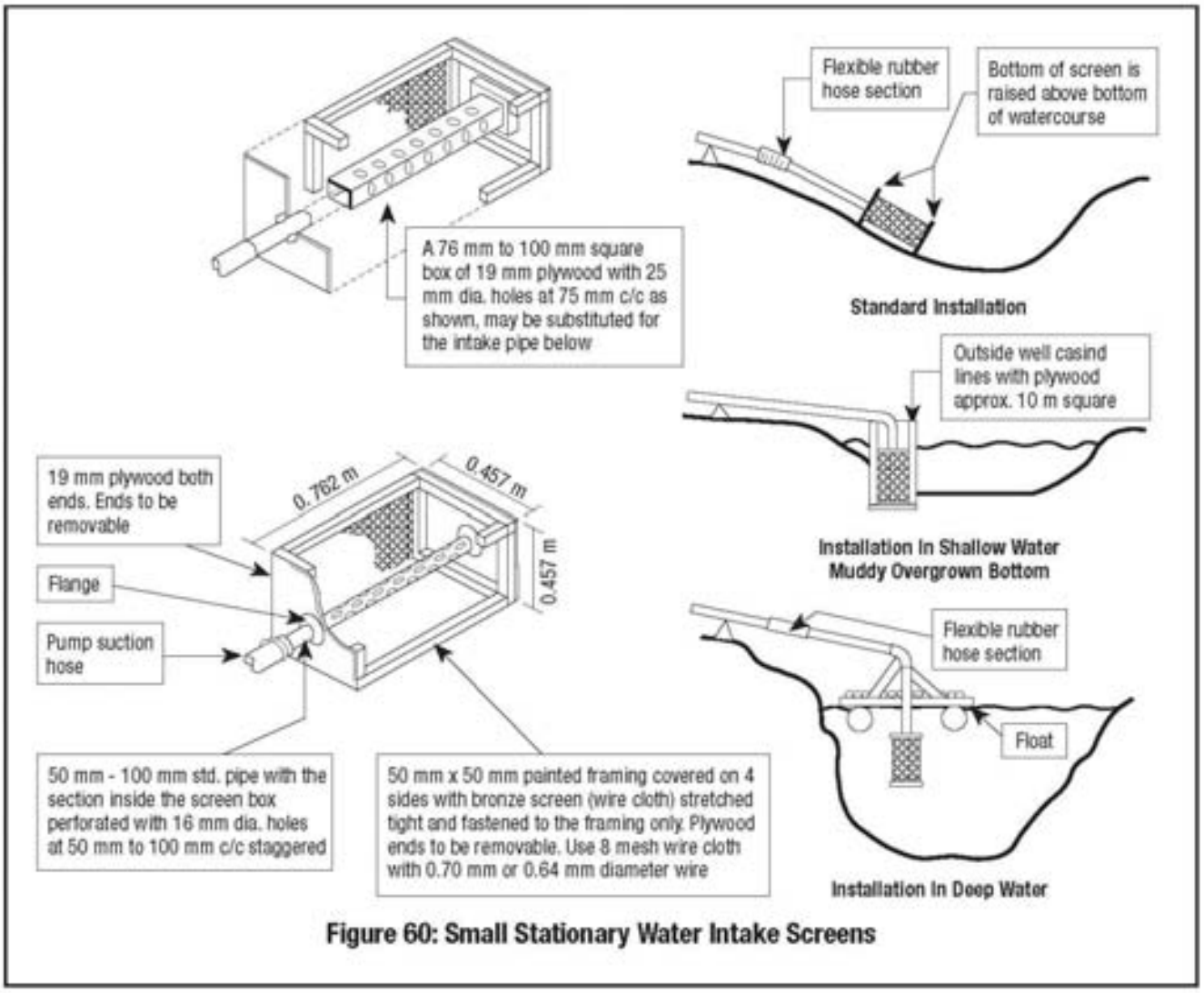


Figure 60: Small Stationary Water Intake Screens

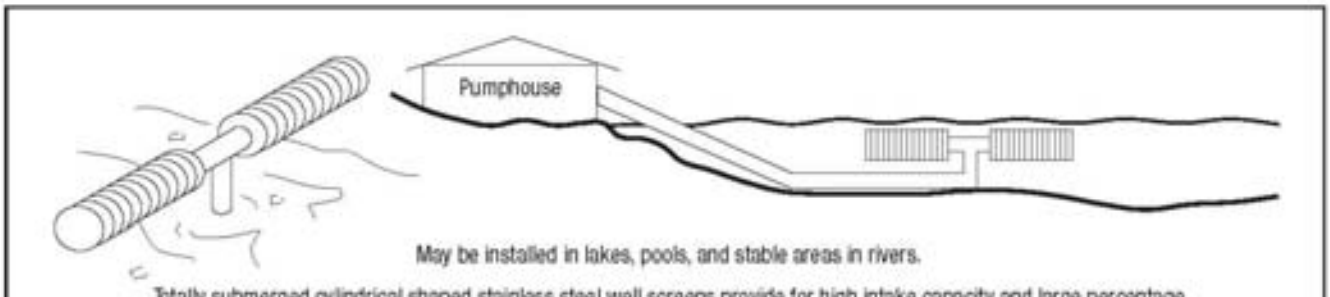


Figure 61: Shallow Water Well Screen

Alteration Type: Wharves and Piers

Definition

Wharves and piers are permanent or removable structures located along the shore of navigable waters used for swimming and/or boat mooring. The terms wharves and piers are used interchangeably with docks. A wharf is built parallel to the bank of a watercourse, whereas a pier extends into the watercourse perpendicular to the shoreline.

Objectives

To construct a durable facility without creating a navigational hazard or an obstruction to fish passage.

To prevent erosion and sedimentation as a result of the construction process.

To prevent loss of fish habitat or degradation of water quality.

Planning Considerations

Environmental Considerations

Structures placed or built in the shallow waters bordering the edge of a watercourse may pose a threat to the sensitive littoral zone. The **littoral zone** is the near shore section of water where light penetrates to the bottom. These zones are often areas of high food productivity, because primary food production is dependent on the penetration of light, acting as a source of energy for algae and aquatic plants.

The littoral zone also provides important spawning and nursery habitat for many species of fish. The installation and use of wharves and piers may damage the sensitive littoral zone. This could occur as a result of suspended sediment, introducing toxic chemicals during the construction process, and/or introducing toxic substances such as fuel or garbage when the facility is being used.

The installation of the wharf or pier might infill critical fish habitat or the natural movement of water and sediment may be interrupted by the structure, resulting in erosion or sedimentation of nearby habitat.

If the amount of sediment put into suspension by the installation of the structure is excessive, fish habitat can be degraded and private beach or shoreline swimming areas could be affected by the sediment when it settles.

In some instances, the wharf or pier may provide shelter for some fish species.

The wharf or pier may have the following effects on the hydraulic regime:

- Water current patterns could be changed and, if the structure occupies a significant portion of the channel cross-section, the backwater effects upstream of the structure must be taken into consideration.
- Wharves or piers may increase the possibility of ice jamming.

If you would like more detailed information on fish-friendly dock construction and maintenance practices to help you plan your project, please refer to the following website:

http://www.dfo-mpo.gc.ca/habitat/habitat-eng.htm

This website has several useful guides.

Location

Some species of fish return to a specific location in a watercourse for spawning. Shoreline construction and increased recreational activities may interfere with these spawning sites or may diminish water quality which will subsequently affect the spawning area. In some littoral areas where the fish habitat is unique or critical, no shoreline development may be permitted. For other near shore areas, shoreline development should be limited or designed such that there is a minimal impact on habitat.

Recreational development of the shoreline for wharves or piers should be limited. Where possible, public facilities should be utilized or boat docking facilities should be shared by neighbouring property owners.

Types of Structures

1) **Floating Wharves or Piers**

   Floating structures have the least effect on the littoral zone. There may be a small impact caused by the anchoring device and a slight reduction of light penetration beneath the structure. These structures are installed after ice-out and removed prior to freeze up. These activities are exempted from requiring a Watercourse and Wetland Alteration Permit.

2) **Wharves or Piers Supported by Posts**

   These structures generally have little impact on the littoral zone depending on the number and size of the supports, quality of fish habitat present and construction methods.

3) **Wharves or Piers Supported by Cribs**

   Crib supports may impact the littoral zone because of the relatively large footprint that they occupy. They may also interfere with water movement potentially leading to a degradation of water quality.

4) **Solid Structures**

   Solid structures supported by concrete, sheet piling or cribbing are constructed so that there is no open space between the supporting members. Area lost when covered by these structures could constitute a loss of fish habitat. Water movement is also inhibited by these structures which may affect water quality, erosion and deposition patterns, and food availability for the littoral zone.

   Please refer to the guidelines for "Alteration Type: Boat Launching Ramps, Ferry Landings and Fords" at page 33.

Application Requirements

In addition to the standard information required on the application form, the following must be included

- plan, profile and cross sectional drawings to scale;
- a full description of the proposed construction method and materials to be used;
- a map and PID number.

An assessment of the fish habitat and hydraulic conditions should be undertaken before plans for constructing the wharf or pier are made. This assessment must be conducted by a qualified individual or consultant.

Installation of seasonal wharves or piers does not require a Watercourse and Wetland Alteration Permit if the following conditions are met:

1) The wharf or pier is removed prior to freeze up.
2) Installation of the wharf or pier does not require any excavation or infilling within 30 metres of the watercourse.
3) The wharf or pier is constructed from materials which are not toxic to aquatic life.

Other Government Agencies Involved

1) Approval from the *New Brunswick Department of Natural Resources*, Crown Lands Branch, may be required for any proposed work activities located on Crown Land, in tidal water, submerged land and below the ordinary high water mark. The proponent must receive permission prior to undertaking the activity.
2) The approval of *Transport Canada*, which administers the **Navigable Waters Protection Act** must also be obtained when a structure is to be placed in or across any navigable watercourse.

Application Review Process

Regulatory and in some cases, Regulatory and Advisory

Construction

Materials

The use of recycled materials such as old metal or plastic drums or tires is not encouraged, because they may contain substances harmful to water quality and aquatic life.

Untreated wood is ideal from a water quality perspective and, if submerged completely underwater, will last indefinitely. Some wood, such as cedar, contains natural preservatives and is an excellent material for building wharves or piers.

Reinforced concrete is acceptable for use in the water, as it does not seem to have any effects on water quality. It is recommended that it be pre-cast on dry land and allowed to dry completely before placement in the water or cast in place in isolation of stream flow within a cofferdam.

Plastics are inert substances, durable in water, and provide excellent flotation.

Styrofoam, when used as a flotation device, is relatively stable in the water but may break up. If used, it must be enclosed. It is a potential hazard to the fish if mistaken for food.

Construction Techniques

Guidelines for construction activities are site specific. Excavation for supports, where necessary, may require the installation of a cofferdam to prevent siltation of the watercourse. In some cases, working during low water periods without the use of heavy machinery is sufficient to protect the watercourse and aquatic habitat in a particular area.

Permanent posts should be placed below the possible depth of scour.

If rocks, stumps or logs need to be moved on the bed of the watercourse or shoreline to accommodate the dock, they should be relocated to an area of similar depth but not removed from the wetted portion or shoreline of the watercourse.

Guidelines

The materials used to construct the wharf or pier must not be detrimental to aquatic life or water quality.

The wharf or pier must not encroach into the main channel or provide an obstruction to navigation.

All treated timbers must be air dried for the length of time specified by the manufacturer for safe use in, over or near aquatic environment. Timber used in, over or near aquatic environment must not be treated with creosote or pentachlorophenol.

Any disturbance to the banks of the watercourse must be immediately stabilized to prevent sedimentation of the watercourse.

All fresh concrete must be placed in forms and cured for at least one week prior to form removal.

Any precast concrete must be cured for a period of at least 3 weeks before being placed in the watercourse.

abutment - a wall or mass supporting the end of a bridge, arch or span, and sustaining the pressure of the abutting earth

alignment - the fixing of points on the ground for the laying out of a culvert, bridge, abutment or pier

alteration (legal) - A watercourse and wetland alteration is any temporary or permanent change made at, near or to a watercourse or wetland or to water flow in a watercourse or wetland and includes:

(a) any change made to existing structures in a watercourse or wetland including repairs, modifications or removal, whether the water flow in the watercourse is altered or not,

(b) the operation of machinery on the bed of the watercourse other than at a recognized fording place,

(c) the operation of machinery in or on a wetland,

(d) any deposit or removal of sand, gravel, rock, topsoil or other material into or from a watercourse or wetland or within 30 metres of a wetland or the bank of a watercourse,

(e) any disturbance of the ground within thirty metres of a wetland or the bank of a watercourse except grazing by animals; the tilling, plowing, seeding, and harrowing of land; the harvesting of vegetables, flowers, grains, and ornamental shrubs; and any other agricultural activity prescribed by regulation for the purposes of this paragraph, that occurs more than 5 metres from a wetland or the bank of a watercourse,

(f) any removal of vegetation from the bed or bank of a watercourse,

(g) any removal of trees within 30 metres of the bank of a watercourse,

(h) any removal of vegetation from a wetland or from within thirty metres of a wetland except the harvesting of vegetables, flowers, grains and ornamental shrubs and any other agricultural activity prescribed by the regulation for the purposes of this paragraph, that occur more than 5 metres from a wetland.

anadromous - a behavioural characteristic of certain species in which they migrate from saltwater to freshwater to spawn

aquatic - living or growing in, on or near water; aquatic life refers to organisms that live in water and can include fish, invertebrates and shellfish

arch - a curved structure designed to exert horizontal forces on its supports when subjected to vertical loads; commonly used as a bridge or support for a roadway or railroad track

area - a measure of the size of a two-dimensional surface, or of a region or tract on that surface

armour - the artificial surfacing of bed, banks, shore or embankment to resist erosion or scour; armour devices include the following:

- rigid - sacked concrete, asphaltic slope paving, pneumatically applied asphaltic mixtures
- flexible - gabions, willow mattresses, salvaged pavement slabs
- self-adjusting flexible - rockslope protection, uncoursed broken concrete, precast concrete sections

backslope - slope between bottom of the ditch and original ground

backwater - raised water levels as a result of the constricting or obstructing effects of a watercourse crossing structure

baffle - a barrier or obstruction that deflects, checks or dampens water flow

bank - any elevated slope of earth that borders a body of water, especially the rising ground that confines a watercourse to its channel

bank, left (right) - the bank on the left (right) side of the channel looking downstream

bar - a site in a channel where sand and gravel deposits have accumulated; also includes the deposits themselves

beach - a gently sloping zone of unconsolidated material that extends landward from the low-water line to the permanent terrestrial vegetation line or to where there is a distinct change in material or physiographic form

bed - the ground beneath a body of water

bed load - soil particles carried by the natural flow of a watercourse on or immediately above its bed

berm - a small dyke

boat launching ramp - constructed ramps extending down over the bank into a watercourse for the purpose of loading and unloading boats from trailers

bog - area of soft, wet, spongy ground consisting chiefly of decayed or decaying moss or vegetation

box culvert - a culvert of rectangular or square cross-section

breakwater - a wall or barrier built into a watercourse to break the force of waves

bridge - a structure built over a watercourse, the deck of which forms a link in the road, footpath or railbed

brook - a small stream of flowing water, especially one that flows swiftly over a rocky bed

brush - a thick growth of shrubs, bushes, small trees, etc.

by-pass pond - a pond connected to a watercourse by an inlet and an outlet pipe so as to be supplied with water for recreation, irrigation, fire fighting, fish rearing, or other purposes

cable crossing - the location where fibre optic or electrical cables cross a wetland or break the bank of a watercourse

catadromous - a behavioural characteristic of certain species of fish in which they migrate from freshwater to saltwater to spawn

causeway – raised road or path, usually built across a shallow, wide body of water or wetland and includes a flow-through structure which is not designed to impound water

channel - the open depression in which water may or does flow; the space above the bed and between the banks of a watercourse

channel capacity - the maximum flow that can be carried by a given channel cross-section without overflowing its banks

channel cleaning - removal of material foreign to the natural composition of the stream bed and/or fluvial deposits to improve hydraulic conditions for conveyance of flow and the passage of ice

channelization - changes to an existing channel's width and/or depth, or straightening of meanders by cutoffs, or construction of a completely new channel

check dam - a low fixed structure constructed of hay bales, timber or loose rock to control water flow in an erodible channel or ditch

chute - a conduit for conveying free-flowing water at high velocity to a lower level

chipping - forest products; to mechanically cut into smaller pieces

Clean Environment Act - an Act of the Legislature of New Brunswick, Chapter C-6 of the Revised Statutes of the Province of New Brunswick 1973, relating to environmental protection

Clean Water Act - an Act of the Legislature of New Brunswick, Chapter C-6.1, Acts of New Brunswick 1989, relating to the protection of the waters of the Province

clear cutting - felling and removing all trees in a forest region

cobble - somewhat rounded rock fragments larger than gravel and smaller then boulders ranging in size from 100-200 millimetres

cofferdam - a temporary structure constructed around an excavation to exclude water so that work in or adjacent to a watercourse can be carried out in isolation of stream flow

confluence - the place where two or more watercourses come together

constriction - narrowing of a channel to less than its normal or average width as a result of man-made or natural slide controls

corduroy road - a roadway constructed across a soft or wet area by placing one or more layers of small logs perpendicular to the direction of the travel to help support the traffic using it

cribwork, crib - and open-frame structure loaded with earth or stone ballast

Crown Land - all land (including submerged land) held by the Province

culvert - a covered structure which conveys the flow in a watercourse under a road or railbed whereby the top of the cover material is graded to form the travel surface

cut-off - a new channel created to straighten a loop or meandering reach of channel, thereby shortening the channel and often relieving an area subject to ongoing channel erosion and regular flooding

dam - a barrier constructed across a watercourse for impounding or diverting water

Types of dams:

arched dam - a curved dam, convex upstream, that depends on arch action for its stability. The load is transferred by the arch to the canyon walls, or other abutments

diversion dam - a barrier built for the purpose of diverting part or all the water from a watercourse into a different course

earth dam - a barrier composed of earth, clay, sand or sand and gravel, or a combination of sand and rock

framed dam - a barrier generally built of timber framed to form a water face, supported by struts

gravity dam - a solid masonry dam, with a transverse cross-section approximately triangular in shape which depends upon its own weight for stability against overturning or horizontal movement, the mass being such that the horizontal thrust on the upstream face is transmitted to a point within its foundation, usually within the middle third

hydraulic-fill dam - a dam composed of earth, sand, gravel, etc. sluiced into place; generally the fines are washed towards the center of greater imperviousness

multiple-arch dam - a barrier consisting of a series of arches supported by buttresses or piers. The load is transferred by several arches to the foundation through the buttresses

rock dam - a barrier composed of loose rock, usually dumped in place, often with the upstream part constructed of hand-placed or derrick-placed rock and faced with rolled earth or with an impervious surface of concrete, timber or steel

debris - floating or sunken trash (including car bodies, empty containers, and garbage) and dead or decaying vegetation

debris removal - removal of material foreign to the normal composition of a watercourse

degradation - the vertical erosion of a watercourse to establish or maintain uniformity of grade

design flow - the discharge which a structure is designed to accommodate without exceeding the adopted design constraints

design headwater - the vertical distance from the culvert invert at the inlet end to the energy line of the headwater pool

discharge - the flow rate of a fluid at a given point in time expressed as volume per unit of time, such as cubic metres per second, gallons per minute, etc.

discharge, bankfull - flow of a watercourse that fills a channel to the point of overflowing

ditch - an small artificial channel excavated through the earth's surface for drainage, irrigation or to bury pipes, wires or cables or for various other purposes

diversion - a new channel created to change the position of the bed of a watercourse

downstream - in the direction of the normal flow of a watercourse

drainage - removal of surplus groundwater or surface water from an area by artificial means; the manner in which water is removed from an area

drainage area - the area of land drained by a watercourse

drainage pattern - the configuration of a natural or artificial drainage system reflecting the topography or rock patterns of the area

dredging - the excavation of material from the bed of a watercourse by mechanical means

dry hydrant - a water intake structure consisting of a standpipe buried in the bank of a watercourse with a horizontal pipe connected to the bottom end which extends into the watercourse. Water is withdrawn on a "as needed" basis by a mobile pump carried on a fire truck

dug-out pond - an excavated pond, using groundwater or surface runoff as a water supply for recreation, irrigation, livestock watering, fire fighting, fish rearing, or other purposes

dyke - an impervious embankment constructed along the bank of a watercourse to prevent the overflow of water onto lowlands and to retain floodwaters

environment - the sum of all external conditions and influences affecting the existence and development of living organisms

erosion - the loosening, wearing away and transportation from one place to another of materials from the earth's surface by the action of wind, water and ice

erosion control work - structures or vegetation used to stabilize and protect the banks of a watercourse from the scouring and erosive action of water, ice or floating debris within the stream flow or surface runoff from the land bordering the watercourse

estuary - tidal reach at the mouth of a river

fascine (wattle) - used to stabilize eroding banks and provide shade and leaf fall for fish. Live cuttings are tied into bundles, installed in trenches dug parallel to the stream. Staked in place and covered with a thin layer of soil. Typical spacing of trenches is 1-1.5 metres apart

ferry landing - a location on the shoreline utilized by ferries to load and unload vehicles, pedestrians or animals

filter - a device or porous structure through which a liquid is passed in order to remove solids or impurities

fish – The federal Fisheries Act defines fish to include all phases of life as,

(a) parts of fish

(b) shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals, and

(c) the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals

fisheries - commercial or recreational harvesting or catching of fish in watercourses; the fish stocks

fish ponds - impoundments of water primarily used to hold fish for rearing, or for recreational fishing

fishway, fish ladder - a series of stepped baffles or weirs which facilitate the migration of fish past a dam or other obstruction in a watercourse

fish screen - a screen set across a water intake, outlet or pipe to prevent the entrance or exit of fish

flood - the condition that occurs when water overflows its natural or artificial boundaries and covers adjoining land that is not usually underwater; to inundate or overflow flood, annual - the highest flow at a point on a watercourse during any given year; the flood that is equalled or exceeded once each year on average

flood plain - flat land bordering a watercourse which is subject to flooding

flood protection works – involve the construction and maintenance of flood reservoirs, channel alterations, dykes and levees, or other engineering works to keep flood waters away from specific developments and/or populated areas

floodway - a channel built to divert flood water from the main channel

flume - an open conduit of timber, concrete, metal, etc. on a prepared grade, trestle or bridge used to convey water, usually for industrial purposes

fluvial - pertaining to or produced by the water flow in a watercourse

ford - a crossing located in a stream, river, creek or brook where:

a) the water is shallow enough at that point along the channel to be traversed by motorized vehicles; and

b) the banks and the bed of the channel are stable enough that use of the crossing will not result in any damage to them

foreslope - slope between the road shoulder to the bottom of the ditch or base of slope where there is no ditch

freeboard - the vertical distance between the elevation of the design headwater and the top of a dam, levee or diversion ridge

freshet - rapid temporary rise in discharge and level caused by melting of snow and ice

gabions - wire baskets filled with coarse gravel or rock used especially to support the bank of a watercourse or an abutment

gauging station - a site on a watercourse where systematic records of stage or stage and discharge are obtained; also called a "hydrometric station"

grade - the slope of a roadway, ditch or bed of a watercourse expressed as a function of the amount of vertical drop over a given distance; also, to prepare a roadway or other land surface of uniform slope

gravel - rounded pebbles larger than sand and smaller than cobble ranging in diameter from 5-15 millimetres

groin - a bank or shore protection structure in the form of an obstruction placed oblique to the direction of flow to control movement of bed load

grubbing - clearing stumps and roots

habitat - fish habitat is defined in the **Federal Fisheries Act** as spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes

HADD - Harmful alteration, disruption or destruction of fish habitat - Any change in fish habitat that reduces its capacity to support one or more life processes of fish. In assessing a project for its potential to cause a HADD, habitat managers identify changes to the bio-physical attributes of fish habitat that would be of a type and magnitude sufficient to render the habitat less suitable, for supporting a fish's life process

head - the height of water above any point or place of reference

headwall - a retaining wall at the inlet and/or outlet of a culvert serving as protection against scouring and erosion of the foreslope

headwater - the water upstream from a dam or other such impoundment; the source and upstream waters of a watercourse

head pond - an impoundment of water behind a man-made dam whose primary function is providing a head of water to facilitate gravity flow

hydraulic - pertaining to fluid in motion and the mechanics of that motion

hydrologic - pertaining to the cyclic phenomena of the waters of the earth, successively as precipitation, and quantitatively as distribution and concentration

hydrotechnical - pertaining to water related sciences and technologies

impervious - not permitting water or other fluid to pass through

in isolation of stream flow - separated from the wetted portion of the channel

instrument pools or wells - natural or artificial sites on a watercourse where measurement devices may be used for hydrotechnical purposes in sheltered or preferred conditions

invert - the floor or bottom of a pipe, pipe arch or artificial channel

jam - accumulation of debris, ice or other material which has become wedged in the channel of a watercourse forming a partial or complete obstruction

lake - any inland body of water exposed to the atmosphere which is naturally occurring and having a surface area in excess of 4 hectares

land extension - an extension of the natural shoreline/banks as a result of a planned partial infilling of a watercourse

landing - any place where round timber is stacked for further transport

levee - an artificial embankment on or along the bank of a watercourse to protect adjacent lowlands from inundation; a dyke or embankment for the purpose of confining stream flow

littoral zone - the near shore section of water where light penetrates to the bottom, these zones are often highly productive because primary food production is initiated by the penetration of light

maintenance flow - the quantity of flow prescribed by regulation or guidelines to be retained in a watercourse downstream of a point of withdrawal required to maintain the integrity of the aquatic ecosystem or to meet downstream water demands

major obstruction – includes dams, causeways, water control structures such as fishways and weirs, and other hydraulic structures which impound water

marsh - a track of treeless wetland that supports a dense variety of vegetation, principally grasses

mattress - bank protection structure consisting of a broad, flat, wire cage or network of cages filled with stone and other local materials

meanders - a series of bends, loops or curves in a watercourse formed by the action of flowing water

merchantable trees - any softwood tree at least 12.7 centimetres in diameter at breast height; any hardwood tree at least 7.6 centimetres in diameter at breast height

minor obstruction - structures that do not create a hydraulic head

mulch - a protective covering, such as hay or straw, that is spread over exposed soil to prevent erosion and evaporation, maintain an even soil temperature, control weeds and enrich soil

navigation - any or all of the various processes used in determining position and directing the movement of a craft in water

Navigable Waters Protection Act - an Act, administered by *Transport Canada*, developed to protect the public right of navigation in a navigable watercourse

navigable watercourse - includes any body of water capable, in its natural state, of being navigated by floating vessels of any description for the purpose of transportation, recreation or commerce; any body of water created or altered to replace the function of a natural watercourse, as well as any waterway where the public right of navigation exists by dedication of the waterway for public purposes, or by the public having acquired the right to navigate through long use

obstruction - those watercourse alterations which involve the construction of structures on the watercourse which impede or prevent the flow of water and/or fish migration

open-bottom culverts - semi-circle, rectangular or elliptical corrugated metal, concrete, wooden or plastic arches founded on footings, with the sides and top encased in earth fill, designed to carry water under a travel surface. This type of structure is founded on various types of footing support structures

ordinary high water mark - the visible high water mark of a watercourse where the presence and action of water are so usual and so long continued in ordinary years as to mark upon the bed a character distinct from that of the bank thereof with respect to vegetation and the nature of the soil

peak - maximum instantaneous stage or discharge of a watercourse in flood

physiography - the physical features of the landscape

peak flow - the maximum instantaneous value of discharge over a specified period of time

pier - on bridges of more than one span, the intermediate supports between abutments; a structure extending out into a body of water from shore and perpendicular to the shoreline, used as a landing place for boats

pile, piling - a columnar timber, steel or reinforced concrete post that has been driven or jacked into the ground or bed of a watercourse to support a load or resist lateral pressure

pipe - a hollow tube made of metal, clay, plastic, fibreglass or concrete used to conduct fluids or gasses

pipe arch - a type of culvert with a shape of greater span than rise, an arch-shaped top and a curved integral bottom

pipeline crossing - location where distribution or transmission pipelines carrying petroleum products, sewage or water cross a wetland or break the bank of a watercourse

pond - a natural body of standing freshwater occupying a depression in the earth's surface regarded as smaller than a lake

pools - depressions in a bed of a watercourse, frequently a resting place for fish

probable maximum flood (PMF) - the greatest flood that may reasonably be expected, taking into account all pertinent conditions of location, meteorology, hydrology and terrain

Professional Engineer/Geoscientist - a person who is a member or licensee of the Association of Professional Engineers and Geoscientists of the Province of New Brunswick, as described in the New Brunswick Engineering and Geoscience Professions Act

R5 rip-rap - solid, well-mixed rock containing approximately the following size distribution: 100% <220 millimetres, 70-90% <190 millimetres, 40-55% < 150 millimetres, 0-15% <70 millimetres in approximate diameter

recurrence (return period) interval - the average period of years between observed or predicted occurrences of a hydrologic event, such as a flood, equalling or exceeding a given magnitude

regime - the existence in a watercourse (over a period of years) of a state of equilibrium between erosion and deposition; the condition of a watercourse with respect to its average flow rate, determined by measuring the volume of water passing different cross-sections in a given period of time

reservoir - an artificial impoundment of water for the purpose of storage for later use. Reservoirs are distinguished by monthly and/or annual regulation of flows while head ponds cater to daily and weekly fluctuations only

retaining walls - a retaining wall which protects land from inundation by floodwaters

retard - a permeable bank protection structure situated at the toe of a slope and projecting into a watercourse, which is designed to check riparian velocity and induce the deposition of sediment

riffle - shallow water extending across the bed of a flowing watercourse with rapid current and with surface flow broken into waves by submerged obstructions such as gravel and cobble

rill - small irregular channels resulting from small trickling streams of water

riparian - relating to or situated on the bank of a river or stream

rip-rap - cobbles, boulders, broken stone or other hard materials dumped or placed along the bank of a watercourse as protection against erosion by water or the elements. NBDOT specification states that rip-rap is a well-graded mixture that consists of clean, hard, sound, durable rock having a density of not less than 2.6 t/m^3

rise - the distance from the bed of the watercourse to the underside of the stringers of a bridge, or the vertical dimension of an arched pipe

run - a swiftly flowing stream reach with little surface agitation

salmonid - related to the salmonidae family of fishes, including salmon, trout and char

sand - loose mineral and rock particles ranging in diameter from 0.02-2 millimetres

scour - an erosion process resulting in the abrading of the bed of a watercourse or the undermining of a foundation by the action of flowing water and/or ice

seepage - the slow movement of water through small openings or a porous medium

settling ponds - artificial ponds designed to collect suspended sediment and separate suspended particles from water by gravity settling

sheet flow - the overland flow of surface runoff over a relatively smooth land surface in the form of a thin continuous film that is not concentrated in channels larger then rills

shoulder of the watercourse - the point in the bank of a watercourse where the sharpest break in slope occurs and the steep sides slope down to meet the exposed mineral bed of the watercourse

silt fence - specially designed synthetic fabrics fastened on supporting posts which are designed to efficiently control and trap sediment runoff from construction sites

skidding - the short distance movement of tree lengths or segments over unimproved terrain to loading points on transportation routes

span - the horizontal distance between the abutments or supports of a bridge

spring - any place where a concentrated, natural discharge of groundwater issues forth as a definite flow onto the surface of the land or into a body of water

stream - a body of running water moving under the influence of gravity to lower levels in a narrow, clearly defined natural channel

substrate - the materials making up the bed of the watercourse

swamp - a general term for an area that is waterlogged and covered with abundant vegetation especially shrubs and trees

thalweg - the line joining the lowest points lengthwise of the bed of a watercourse

tree removal - harvesting or cutting and taking away trees within thirty metres of a watercourse

trestle - a steel, timber or reinforced concrete structure, usually consisting of many short spans, used to support a temporary bridge or construction platform

upstream - towards the source or against the current of a watercourse

water control structures – structures designed to handle water, including retention, conveyance, control, regulation and dissipation

watercourse (legal) - the full width and length, including the bed, banks, sides and shoreline, or any part of a river, creek, stream, spring, brook, lake, pond, reservoir, canal, ditch or other natural or artificial channel open to the atmosphere, the primary function of which is the conveyance or containment of water whether the flow be continuous or not

Watercourse and Wetland Alteration Regulation - a regulation under the New Brunswick **Clean Water Act** respecting watercourse and wetland alterations

Watercourse and Wetland Alteration Permit - a permit signed by the Minister of Environment and issued according to the **Watercourse and Wetland Alteration Regulation**

water intake structure - structures used to withdraw water from a watercourse for the purpose of irrigation, domestic supply, manufacturing, fire fighting, aquaculture facilities, or other uses

waterway - a navigable channel for the escape or passage of water

waterway opening - the cross-sectional area under a bridge available for the passage of water

weir (measuring) - a spillway-like device in a waterway over which water flows used to measure flow in a channel

wetlands - a wetland means land that

a) either periodically or permanently, has a water table at, near or above the land's surface or that is saturated with water, and
b) sustains aquatic processes as indicated by the presence of hydric soils, hydrophytic vegetation and biological activities adapted to wet conditions

These lands are transitional between terrestrial and aquatic systems.

wharves - structures built parallel to the shoreline for vessels to lie alongside and tie up while loading and unloading

wingwall - a lateral wall built onto an abutment serving to retain earth in the embankment

wire baskets - a basket or cage filled with coarse gravel or rock material and placed as means of bank protection

Appendix A: Freshwater Habitats and Behavioural Patterns of Some Notable Aquatic Species of New Brunswick

FAMILY	GENUS SPECIES	NB LOCATION	NB HABITAT	MIGRATORY BEHAVIOUR	MIGRATORY PERIOD	SPAWNING PERIOD	IMMOBILE PERIOD (egg & possibly fry stages)	SPAWNING TEMPERATURE (°C)	YEARS TO SEXUAL MATURITY
Acipenseridae (Sturgeons)	Acipenser brevirostrum Shortnose Sturgeon	Saint John River (the only place in Canada recommended for addition to the list of rare or endangered species)	Usually spawns in large tidal rivers, but sometimes in brackish or salt water	anadromous/ freshwater	mid-March to early June; early Sept. to late Oct.	mid May to mid-June	late May to late June	10-15	7-11
	Acipenser oxyrhynchus Atlantic Sturgeon	coastal water systems	Spawns in deep pools	anadromous	mid-March to May; early Sept. to late Oct.	early May to late June	late May to late June	13-17.8	22-28
Clupidae (Herrings)	Alosa aestivalis Blueback Herring	most coastal rivers with unrestricted access	Usually spawn in fast-flowing water just above the head of the tide	anadromous	June to mid-July	mid-June to mid-July	late June to late July	20-22	3-4
	Alosa sapidissima	most coastal rivers with unrestricted access	slow-moving water	anadromous	late April to mid-July	May to mid-July	mid-May to end of July	12-18	4-5
	Alosa pseudoharengus Alewife; Gaspereau	most coastal rivers with unrestricted access	Usually spawn in lakes, and estuaries and slow-moving water just above the head of the tide	anadromous	April to mid-July	late April to late June	late April to mid-July	14-21	3-4
Salmonidae (Trout and Salmon)	Oncorhynchus mykiss (Walbaum) Rainbow Trout	Big Presque Isle Stream, Shepody R Systems, Dicks Lake and scattered throughout the Saint John and Fundy watersheds	open water; fast-moving, spawn in gravel riffle above a pool (the coarser the gravel the better the survival rate)	anadromous/ freshwater	March to late June	mid-April to late May	mid-April to late June	10-10.5	3-4
	Salmo salar Atlantic Salmon	various - approx. 90% of the province's major river systems	large, cool rivers and small brooks with a gravelly bottom; may ascend smaller streams immediately prior to spawning, especially during high water; spawn in gravel riffle and pool tail outs	anadromous	May to early August; Sept. to mid-Nov.	mid-Oct. to mid-Nov.	October to mid-June	7.5-10.5	3-5

FAMILY	GENUS SPECIES	NB LOCATION	NB HABITAT	MIGRATORY BEHAVIOUR	MIGRATORY PERIOD	SPAWNING PERIOD	IMMOBILE PERIOD (egg & possibly fry stages)	SPAWNING TEMPERATURE (^{o}C)	YEARS TO SEXUAL MATURITY
Salmonidae (Trout and Salmon) Continued...	Salmo salar ouananiche Land-locked	various, including Magaguadavic River and a number of lakes	lakes; spawn in gravel riffle and pool tail outs	freshwater	May to early August; Sept. to mid-Nov. most do not migrate from lakes to tributary streams until just prior to spawning (Oct.-Nov.)	late Oct. to mid-Nov.	October to mid-June	7.5-10.5	3-5
	Salmo trutta Brown Trout	various, (esp. Meduxnekeag River, and Mispec and Little River systems and East Musquash Reservoir in Saint John County)	spawn in shallow gravelly headwaters	anadromous/ freshwater	late Sept. to late Nov.	late Oct. to mid-Nov.	late Oct. to mid-June	6.7-8.9	4-5
	Salvelinus frontinalis Brook Trout; Speckled Trout	various	Inhabit cool, clear streams and lakes; spawn in gravelly or rocky bottoms, slow-flowing or spring fed water with tree lined banks	anadromous/ freshwater	Sept. to mid-Nov.; anadromous populations generally migrate upstream from Tide Water mid-May to end of June	mid-Sept. to mid-Nov.	late Sept. to mid-June	5-10	2-3
	Coregonus clupeaformis (Mitchill) Lake Whitefish	Western NB	spawn in shallow water with a hard or stoney bottom; live in deeper water	freshwater	late Sept. to late Nov.	late Oct. to late Dec.	early Nov. to late May	< 7.8	3-4
	Salvelinus alpinus Arctic Char	land locked in: Portage Lakes, Upsalquitch Lake, Walton Lake, Louis Lake	spawn in gravel shoals in lakes	freshwater	Oct. to late Dec.	late Oct. to late Dec.	late Oct. to early June	4	3-4
	Salvelinus namaycush (Walbaum) Lake Trout; Lake Char; Togue	found in 12 NB lakes	spawn over rocks and crevices; in shallow water in early spring, but move to deeper, cooler water in summer	freshwater	mid-Sept. to mid-Nov.	October to mid-Nov.	October to mid-May	8.9-13.9	6-7

FAMILY	GENUS SPECIES	NB LOCATION	NB HABITAT	MIGRATORY BEHAVIOUR	MIGRATORY PERIOD	SPAWNING PERIOD	IMMOBILE PERIOD (egg & possibly fry stages)	SPAWNING TEMPERATURE (°C)	YEARS TO SEXUAL MATURITY
Ecodidae (Pikes)	Esox niger (Lesueur) Chain Pickerel	various (esp. Saint John R. and Portobello Marshes)	weedy, backwater areas usually less than 10 feet deep	freshwater	early April to late May	early April to late May	early April to mid-June	8.3-11.1	3-4
Osmeridae (Smelts)	Osmerus mordax (Mitchill) Rainbow Smelt	various (esp. Miramichi River)	spawn in gravel bottomed brooks and streams	anadromous/ land-locked	March to early June	late April to early June	late April to early July	8.9-18.3	2-3
Gasterosteidae (Sticklebacks)	Apeltes quadracus (Mitchill) Fourspine Stickleback	usually a marine species, but lives in freshwater in the Saint John River	live in vegetated areas (esp. eel-grass); male constructs small nest in shallow water for spawning	freshwater/ marine	late April to mid-July	May to mid-July	May to late July	18	< 1
	Culeae inconstans (Kirkland) Brook Stickleback	various waters in Western NB	live in cool; clear water; (esp. eel-grass); male spawn in marshy areas	freshwater	late March to late July	April to late July	early April to late July	8-19	< 1
Percichthyidae (Temperate Basses)	Monrone americana (Gmelin) White Perch	various	Shallow water in lakes and rivers; can tolerate low salinity and high temperatures, but prefers cool backish water; any bottom type	anadromous/ land-locked	late April to early July	May to early June	May to mid-June	11-15	2-3
	Monrone saxatilis (Walbaum) Striped Bass	various NB estuaries	Marine and estuaries, coastal rivers of Northumberland St, Bay of Fundy, Miramichi and Tabusintac, spawn in tidal current	anadromous	May to early July (spawning migration)	early June	June	15-19	4-6
Percidae (Perches)	Perca flavescens (Mitchill) Yellow Perch	various including Miramichi watershed	Shallow water with vegetation, submerged brush, or fallen trees; sandy or gravelly bottom	freshwater	May	May	May to early June	8.9-12	3-4
Centrarchidae (Sunfishes)	Micropterus dolomieui (Lacepede) Smallmouth Bass	various waters in Southern and Western NB	spawn in sand and gravel, dormant during the winter	freshwater	late May to early July	late May to early July	late May to mid-July	12-20	3-6
Cyprinidae (Minnows)	Couesius plumbeus (Agassiz) Lake Chub	various (very common)	spawn among rocks in stream shallows	freshwater	April to early May	June	June to mid-July	14	3-4
	Pimephales promelas (Rafinesque) Fathead Minnow	Upper Saint John River drainage near Edmundston	spawn in slow-moving waters with rocky bottoms	freshwater	March to late April	June to July	June to mid-August	15.6	1-2

FAMILY	GENUS SPECIES	NB LOCATION	NB HABITAT	MIGRATORY BEHAVIOUR	MIGRATORY PERIOD	SPAWNING PERIOD	IMMOBILE PERIOD (egg & possibly fry stages)	SPAWNING TEMPERATURE (°C)	YEARS TO SEXUAL MATURITY
Gadidae (Cods)	Microgadus tomcod (Walbaum) Atlantic Tomcod	various coastal waters	sandy-gravelly bottom at the head of the tide	anadromous	November to end of March	November to end of March	November to mid-June	0-3.9	2-3
Auguillidae (Freshwater Eels)	Anquilla rostrata (Lesueur) American Eel	various	N/A	catadromous	May & June; Sept. to	February to end of July			8
Catostomidae (suckers)	Catostomus commersoni (Lacepede) White Sucker	various	spawn in gravelly bottomed streams or lake margins, estuaries	freshwater	April to early June	early May to early June	early May to mid-June	10-15	5-8
Mytilidae (Mussels)	Mytilus edulis Blue Mussel	various	live in colonies attatched to sand, gravel, pilings, wharves, etc. by strong byssal threads			June to end of August		15-20	< 1
Ostreidae (oysters)	Crassostrea virginica (Gmelin) Eastern Oyster	warm, shallow bays and estuaries of the Gulf of St. Lawrence	Attatched to a hard-rock or semi-hard mud bottom			late June to end of July		20	4-5
Xiphosura (Horseshoe Crabs)	Limulus polyphemus Atlantic Horseshoe Crab	various bays and estuaries	Shallow water with a sandy bottom	enter shallower shoreline water	mid-May to end of July	June to mid-August		18-20	8-10
Astacidae (Crayfishes)	Cambarus bartonii (Fabricius) Eastern Crayfish	various streams, lakes and ponds	under rocks or in mud; cool, shaded areas			June to mid-August	mid-June to end of August	15-20	1
Myidae (Soft Shelled Clams)	Mya arenaria Soft-Shelled Clam	various estuarine areas	Burrows in sand, mud or gravel			June to end of August		25-28	1-2
Veneridae (Hard Clams)	Mercenaria mercenaria Northern Quahog	various estuarine areas, especially shallow bays and coves	Burrows in sand or sandy clay			June to mid-August		20-25	1-2

Appendix B: Legislation Applicable to Watercourse and Wetland Alterations

Constraints placed on projects through legislation are those relating to the design or construction or the carrying out of a watercourse and wetland alteration by specific clauses in various Acts and Regulations of the Legislature of New Brunswick and the Parliament of Canada.

A. Provincial Legislation

The Watercourse and Wetland Alteration Regulation

Watercourse and wetland alterations and the operation of the Surface Water Protection Section are, in part, controlled by the **Watercourse and Wetland Alteration Regulation**, Regulation 90-80 under the New Brunswick **Clean Water Act**, Chapter C6.1, Acts of New Brunswick, 1989. It is administered by the *New Brunswick Department of Environment*.

The requirement that a permit be obtained before commencing a project is stated in subsection 15(1) of the **Clean Water Act**:

> "15(1) A person planning a hydro-electric power project, a control dam, a river diversion, a drainage diversion or any other project or structure that alters a watercourse or wetland or diverts all or part of a watercourse or of the water flowing in a watercourse or wetland shall, before undertaking or proceeding with the project,

(a) provide the Minister with copies of the plans and such documents or information as the Minister may require, and

(b) subject to subsection(1.1), obtain a permit issued by the Minister.

"15(1.01) The Minister may impose such terms and conditions as the Minister considers appropriate on a permit issued under paragraph (1)(b), including those requiring the maintenance of a designated rate of water flow.

"15(1.1) Paragraph (1)(b) does not apply to a person or a member of a class of persons who is exempted, in accordance with the regulations, from the requirement to obtain a permit or for whom the requirement has been waived in accordance with the regulations.

"15(1.2) The owner of a project or structure referred to in subsection (1) shall ensure that all the original specifications of the project or structure that were provided to the Minister under subsection (1), any terms and conditions imposed on any permit issued in relation to the project or structure and any additional or amended specifications subsequently approved by the Minister upon the request of the permit, are met at all times. "15(2) The owner of a project or structure referred to in subsection (1) or of any other structure that lies within or crosses all or part of a watercourse or wetland shall maintain the project or structure in good repair at all times.

The Watershed Protect Area Designation Order

In New Brunswick, 30 surface watersheds used for municipal drinking water supplies are protected under the **Clean Water Act**. The **Watercourse Setback Designation Order** came into effect on November 8th, 1990, which protected the 75-metre riparian buffer zone within these areas. On November 1st, 2001, the second phase of the Watershed Protection Program came into effect with enactment of the **Watershed Protected Area Designation Order** - regulation 2001-83, **Clean Water Act**. This regulation places standards on land and water uses within three zones of protection within the designated watersheds: Zone A: designated watercourses, Zone B: the 75-metre riparian setback, and Zone C: the balance of the watershed area.

The **Watershed Protected Area Designation Order** requires individuals to apply for a Ministerial Exemption in order to undertake or continue a restricted or prohibited activity. Therefore, applications for watercourse and wetland alterations taking place within a protected watershed are also reviewed under the terms of the **Watershed Protected Area Designation Order**. As a result, a permit and a Ministerial Exemption may be granted with more stringent conditions to protect the quality of the water supply. Occasionally, an application for a Watercourse and Wetland Alteration Permit will be refused, if the Minister feels the work constitutes a risk to the drinking water supply.

Maps of the protected watersheds and information on the **Watershed Protected Area Designation Order** may be obtained from regional offices of the DENV, or on the Watershed Protection Program website at

http://www2.gnb.ca/content/gnb/en/services/services_renderer.201091.html.

New Brunswick Crown Lands and Forest Act

Crown Lands mean all or any part of the lands vested in the Crown that are under the administration and control of the Minister of Natural Resources and include any water upon or under the surface of such lands. The Minister of Natural Resources and his designates are responsible for the administration and control of Crown Lands under the **Crown Lands and Forests Act**, Chapter C-38.1.

> "3(1) ...The Minister is responsible in accordance with this Act and the regulations for the Development, utilization, protection and integrated management for the resources on Crown lands..."
> "17(1) No person shall erect or create a barrier or obstacle to impede the free passage of the general public along the bank or shore of a river, lake or stream over which there is a public right to pass and repass..."

If there is any use or occupation of Crown Lands, a "Letter of Authority to Occupy" under the **Crown Lands and Forest Act** must be obtained from the Crown Lands Branch of the *New Brunswick Department of Natural Resources* according to subsection 26.

> "26(1) Subject to subsection (2), the Minister may authorize any person to occupy and use Crown Lands for a period not exceeding ten years, upon such terms and conditions and subject to such reservations as he considers advisable.
> "26(3) Notwithstanding subsections (1) and (2), the Minister may
> a) authorize any person to occupy and use Crown Lands for such a period of time as the Minister considers necessary,
>
> b) renew the authorization under paragraph (a) as many times as the Minister considers necessary."
>
> "71(a) No person shall make an improvement on Crown lands except with the consent of the Minister..."

New Brunswick Fish and Wildlife Act

The *Department of Natural Resources* of the Province of New Brunswick has the responsibility for the administration and enforcement of the **Fish and Wildlife Act**, chapter F-14.1 of the Acts of New Brunswick, 1980 and its Regulations. The Department is represented by the Minister of Natural Resources and all those persons he appoints to act on his behalf.

The New Brunswick **Fish and Wildlife Act** authorizes the appointment of Conservation Officers and Assistant Conservation Officers who are responsible for the enforcement of the **Fish and Wildlife Act** and Regulations. Those persons holding a Conservation Officer appointment are ex-officio fishery officers under the Federal **Fisheries Act**. Persons holding a Conservation Officer appointment are Game Officers for the purpose of the **Migratory Birds and Convention Act**.

The *Department of Natural Resources* has a proprietary responsibility to protect fish and wildlife by virtue of the legislation contained in section 3(1) of the **Fish and Wildlife Act**.

> "3(1) The property of all wildlife and fish within the Province, while in the state of nature, is hereby declared to be vested in the Crown in right of the Province, and no person shall acquire any right or property therein otherwise than in accordance with this Act and the regulations."

The *New Brunswick Department of Natural Resources* is, moreover, vitally concerned with the damage or loss of fish and wildlife habitat as well as with water quality for human use. The management and protection of fish and wildlife habitats on Crown Land is carried out under the **Crown Lands and Forest Act**, through Forest Management Agreements with the Licensees. The *New Brunswick Department of Natural Resources* actively cooperates with the *New Brunswick Department of Environment* in the Surface Water Protection Section to fulfill its legislative responsibilities and to assist in minimizing or eliminating damage to the aquatic environment.

Selected field staff has been appointed as Inspectors under the **Clean Water Act**, subsection 17(1) for the purpose of enforcing the **Watercourse and Wetland Alteration Regulation**.

Quarriable Substances Act

The Minister of Natural Resources controls the extraction of all quarriable substances on Crown Lands and that area of the shore that lies within 300 metres above and 300 metres below the ordinary high water mark through the **Quarriable Substances Act and Regulation 93-92**. This is administered by the Minerals and Petroleum Development Branch of the *New Brunswick Department of Natural Resources*.

Definition of "Shore" and "Shore Area"

> 1(1) "Shore" means the lands lying between the ordinary high water mark and the ordinary low water mark of a pond, lake, river or body of water; and
>
> "Shore Area" means that portion of land lying within three hundred metres above and three hundred metres below the ordinary high water mark of any pond, lake, river or body of water and includes any bed, bank, beach, shore, dune, bar, flat, or mud flat lying in that portion of land.

Designation of Shore Area

The following shore areas are designated to be subject to the Act:

> (a) all the shore area lying outside Crown Lands that lies on either side of the ordinary high water mark, commencing at the point where the border between the Province of Quebec and the Province of New Brunswick intersects the ordinary high water mark of Chaleur Bay; thence southerly along the ordinary high water mark of the Gulf of St. Lawrence and Northumberland Strait to the point where the ordinary high water mark intersects the border of the Province of Nova Scotia, including the ordinary high water mark of all creeks, streams, rivers, inlets, harbours, bays and estuaries opening into and all the islands in the Gulf of St. Lawrence, Chaleur Bay and Northumberland Strait; and
>
> (b) all the shore area lying outside Crown Lands that lies on either side of the ordinary high water mark, commencing at the point where the ordinary high water mark of Cumberland Basin meets the border between the Province of Nova Scotia and the Province of New Brunswick; thence south-westerly following the ordinary high water mark of Cumberland Basin, Shepody Bay, Chignecto Bay, Bay of Fundy and Passamaquoddy Bay to the border of the State of Maine, including the ordinary high water mark of all creeks, streams, rivers, inlets, harbours, bays and estuaries opening into and all the islands in the Cumberland Basin, Bay of Fundy, Shepody Bay, Chignecto Bay and Passamaquoddy Bay.
>
> 4(2) No person shall remove or take a quarriable substance from a shore area designated under subsection (1) unless the person has been issued a quarry permit.

Engineering and Geoscience Professions Act

The **Engineering and Geoscience Professions Act**, administered by The Association of Professional Engineers and Geoscientists of the Province of New Brunswick, is intended to regulate and govern the profession of engineering to protect and serve the public interest. The **Engineering and Geoscience Professions Act** places restrictions on who can design engineering works and systems.

Section 2(1) of this Act in part states:

> "...the "practice of engineering" means the provision of services for another as an employee or by contract; and such services shall include consultation, investigation, evaluation, planning, design, inspection, management, research and development of engineering works and systems."
>
> "...the "practice of geoscience" means the provision of services for another as an employee or by contract, including reporting, advising, acquiring, processing, evaluating, interpreting, geological surveying, sampling or examining related to ant activity that requires the professional application of the principles of the geological sciences..."
>
> "2(2) Without restricting the generality of the definition of "practice of engineering", engineering works and systems shall include:
>
> (a) transportation systems and components related to the movement of goods or people by air, water, land or outer space;

(b) works related to the location, mapping, improvement, control and utilization of natural resources;

(c) works and components of an electrical, mechanical, hydraulic, aeronautical, electronic, thermic, nuclear, metallurgical, geological or mining character and others dependent on the utilization of the application of chemical or physical principles;

(d) works related to the protection, control and improvement of the environment including those of pollution control, abatement and treatment;

(e) the structural, electrical, mechanical, communications, transportation and other utility aspects of building components and systems;

(f) structures and enclosures accessory to engineering works and intended to support or house them;

(g) systems relating to surveying and mapping;

(h) investigations, evaluations, consultations or management, relating to geoscientific properties, conditions or processes that may affect the well-being of the general public;

(i) the discovery or development of water resources, and investigation of surface or sub-surface geological conditions;

(j) the use of computer systems and software relating to any engineering performed under paragraphs (a) to (i)."

Drawings relating to engineering works shall be marked with the seal of a Licensed Professional Engineer or a Licensed Professional Geoscientist as stated in subsection 9(4):

"9 (4) No person shall use drawings, plans and documents pertaining to engineering works or systems in the Province except where the same have been affixed thereto the seal and signature of an engineer."

B. Federal Legislation

Fisheries Act

The **Fisheries Act** enables *Fisheries and Oceans Canada* to protect fish and the natural environmental systems that support fish.

The **Fisheries Act** defines "fish" to include all phases of life as

(a) parts of fish;

(b) shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals, and;

(c) the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals.

It is a requirement to provide fish passage facilities at obstructions where the need is determined by the Minister of Fisheries under the authority of the Federal **Fisheries Act**.

Section 20 and 21 of the **Fisheries Act** relates to fish passage.

"20 (1) Every obstruction across or in any stream where the Minister determines it to be necessary for the public interest that a fish-pass should exist shall be provided by the owner or occupier with a durable and efficient fishway or canal around the obstruction, which shall be maintained in a good and effective condition by the owner or occupier, in such a place and in such form and capacity as will in the opinion of the Minister satisfactorily permit the free passage of fish through it."

"20 (3) The place, form and capacity of the fishway or canal to be provided pursuant to subsection (1) must be approved by the Minister before construction thereof is begun and, immediately after the fishway is completed and in operation, the owner or occupier of any obstruction shall make such changes and adjustments at his own cost as will in the opinion of the Minister be necessary for its efficient operation under actual working conditions."

"20 (4) The owner or occupier of every fishway or canal shall keep it open and unobstructed and shall keep it supplied with such sufficient quantity of water as the Minister considers necessary to enable the fish frequenting the waters in which the fishway or canal is placed to pass through it during such times as are specified by any fishery officer, and, where leaks in a dam cause a fishway therein to be inefficient, the Minister may require the owner or occupier of the dam to prevent the leaks therein."

"21 (3) Where an unused obstruction or a thing detrimental to fish exists and the owner or occupier thereof does not after notice given by the Minister remove it, or if the owner is not resident in Canada, or his exact place of residence is unknown to the Minister, the Minister may, without being liable to damages, or in any way to indemnify the owner or occupier, cause the obstruction or thing detrimental to fish to be removed or destroyed and, where notice has been given to the owner or occupier, may recover from the owner or occupier the expense of the removal or destruction."

Minimum flow requirement is covered in Section 21 and 22.

"21 (4) The Minister may require the owner or occupier of any obstruction to install and maintain such fish stops or diverters, both above and below the obstruction, as will in his opinion be adequate to prevent the destruction of fish or to assist in providing for their ascent."

"22 (1) At every obstruction, where the Minister determines it to be necessary, the owner or occupier thereof shall, when required by the Minister, provide a sufficient flow of water over the spillway or crest, with connecting sluices into the river below, to permit the safe and unimpeded descent of fish."

"22 (2) The owner or occupier of any obstruction shall make such provision as the Minister determines to be necessary for the free passage of both ascending and descending migratory fish during the period of construction thereof."

"22 (3) The owner or occupier of any obstruction shall permit the escape into the river bed below the obstruction of such quantity of water, at all times, as will, in the opinion of the Minister, be sufficient for the safety of fish and for the flooding of the spawning grounds to such depth as will, in the opinion of the Minister, be necessary for the safety of the ova deposited thereon."

The subject of fish guards and screens is covered in Section 30.

"30 (1) Every water intake, ditch, channel or canal in Canada constructed or adapted for conducting water from any Canadian fisheries waters for irrigating, manufacturing, power generation, domestic or other purposes shall, if the Minister deems it necessary

in the public interest, be provided at its entrance or intake with a fish guard or a screen, covering or netting so fixed as to prevent the passage of fish from any Canadian fisheries waters into the water intake, ditch, channel or canal."

"30 (2) The fish guard, screen, covering or netting referred to in subsection (1) shall

(a) have meshed or holes of such dimensions as the Minister may prescribe; and

(b) be built and maintained by the owner or occupier of the water intake, ditch, channel or canal referred to in subsection (1), subject to the approval of the Minister or of such officer as the Minister may appoint to examine it."

The protection of fish habitat is covered in Section 35.

"35 (1) No person shall carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat."

"35 (2) No person contravenes subsection (1) by causing the alteration, disruption or destruction of fish habitat by any means or under any conditions authorized by the Minister or under regulations made by the Governor in Council under this Act."

The deposit of deleterious substances is covered by Section 36 of the Canada **Fisheries Act** as follows:

"36 (3) Subject to subsection 36(4), no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish or in any place under any conditions where the deleterious substance or any other deleterious substance that results from the deposit of the deleterious substance may enter any such water."

Fisheries and Oceans Canada is prepared to provide engineering advice and assistance in the design and construction of fishways.

Copies of the **Fisheries Act** are available on request from any office of *Fisheries and Oceans Canada*.

In planning a watercourse or wetland alteration, applicants should familiarize themselves with the requirements under the **Fisheries Act**.

Species at Risk Act

The **Species at Risk Act** enables *Fisheries and Oceans Canada* to protect and recover aquatic species at risk, their residences, and their critical habitat.

The **Species at Risk Act** includes the following measures to protect listed wildlife species. These prohibitions apply automatically upon listing.

General Prohibitions

"32 (1) No person shall kill, harm, harass, capture or take an individual of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species."

"32 (2) No person shall possess, collect, buy, sell or trade an individual of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species, or any part or derivative of such an individual."

"32 (3) For the purposes of subsection (2), any animal, plant or thing that is represented to be an individual, or a part or derivative of an individual, of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species is deemed, in the absence of evidence to the contrary, to be such an individual or a part or derivative of such an individual."

"33 No person shall damage or destroy the residence of one or more individuals of a wildlife species that is listed as an endangered species or a threatened species, or that is listed as an extirpated species if a recovery strategy has recommended the reintroduction of the species into the wild in Canada."

The protection of critical habitat is covered in section 58

"58 (1) Subject to this section, no person shall destroy any part of the critical habitat of any listed endangered species or of any listed threatened species -- or of any listed extirpated species if a recovery strategy has recommended the reintroduction of the species into the wild in Canada – if

(a) the critical habitat is on federal land, in the exclusive economic zone of Canada or on the continental shelf of Canada;

(b) the listed species is an aquatic species; or

(c) the listed species is a species of migratory birds protected by the **Migratory Birds Convention Act**, 1994.

Navigable Waters Protection Act

Transport Canada administers the **Navigable Waters Protection Act**. This Act was developed to protect navigable waters for the purposes of navigation. The Minister of Transport must approve of any project involving the construction or placement of any structure in, upon, over, under, through, or across any navigable water.

NOTE: Permits for Watercourse and Wetland Alterations may be refused for non-compliance with the above Acts. It is the applicant's responsibility to ensure compliance with the above Acts, and any other applicable Acts of the Legislature of New Brunswick or the Parliament of Canada.

Appendix C: The Committees

The Watercourse and Wetland Alteration Advisory Committee:

The **Watercourse and Wetland Alteration Regulation** is intended to protect the environment in particular, to control man-made changes to watercourses and wetlands which may adversely affect the aquatic habitat and riparian property.

In order to coordinate the activities of the various government agencies in administering their respective Acts and to provide a more efficient service to the people of New Brunswick, the Watercourse and Wetland Alteration Advisory Committee was formed.

The Watercourse and Wetland Alteration Advisory Committee deals chiefly with procedures and policy. It reviews the operation and effectiveness of the Surface Water Protection Section, and provides advice to the regulatory agency.

The Advisory Committee reviews proposals which would affect more than one agency. These may include changes in forms, application review requirements, documentation requirements and regulation revisions. The Advisory Committee does not become involved with the review of applications for Watercourse and Wetland Alteration Permits or the revision of guidelines in the Technical Guidelines, unless to resolve serious conflicts between the agencies involved.

Representation:

Senior civil servants, or their delegates, from:

- Community Planning and Environmental Protection Division, *New Brunswick Department of Environment*.
- Land Development Branch, *New Brunswick Department of Agriculture, Aquaculture and Fisheries*
- Fish and Wildlife Branch, *New Brunswick Department of Natural Resources*
- *Fisheries and Oceans Canada*
- *New Brunswick Department of Tourism and Parks*
- Design Branch, *New Brunswick Department of Transportation*

The Watercourse and Wetland Alteration Technical Committee:

The Watercourse and Wetland Alteration Technical Committee should be referred to only by its full name to avoid confusion with other technical committees.

The Watercourse and Wetland Alteration Technical Committee is intended to be a forum for the exchange of information, ideas and suggestions on the criteria and precautions to be utilized during the design and execution of watercourse and wetland alterations. The responsibilities of the Technical Committee are twofold. Its primary function is to make revisions or additions to the Technical Guidelines, providing that these alterations do not involve procedural changes directly affecting more than one department. Its second function is to make recommendations to the Watercourse and Wetland Alteration Advisory Committee regarding procedural aspects of the program dealing with the processing of applications, enforcement of the regulation, and public information. Upon instruction from the Advisory Committee, the Technical Committee may be charged with responsibility of preparing public information brochures and documents to supplement the Technical Guidelines.

The New Brunswick Watercourse and Wetland Alteration Technical Committee consists of representatives of various government departments having an interest in watercourse and wetland alterations and the protection of the Province's streams, rivers, lakes and wetlands. These representatives may include those employees who work regularly on the Surface Water Protection Section.

Agencies regularly represented on the Watercourse and Wetland Alteration Technical Committee are:

1) **New Brunswick Department of Environment**
   Sustainable Development, Planning and Impact Evaluation Branch
2) **New Brunswick Department of Agriculture, Aquaculture and Fisheries**
   Land Development Branch
   Operations and Services Branch
3) **New Brunswick Department of Natural Resources**
   Fish and Wildlife Branch
   Mineral and Petroleum Development Branch
4) **New Brunswick Department of Transportation**
   Design Branch
5) **New Brunswick Department of Investment and Exports**
   Technical Services Branch
6) **Fisheries and Oceans Canada**
7) **Environment Canada**
   Inland Waters Directorate
   Water Resources Branch

Policy for the Management of Fish Habitat:

An Overview

This policy represents the guideline by which *Fisheries and Oceans Canada* will manage Canada's freshwater and marine fisheries so as to ensure that fish stocks continue to produce economic and social benefits throughout the country.

The policy objective is for a **NET GAIN** of habitat for Canada's fisheries resources. To achieve this objective, they have established three goals:

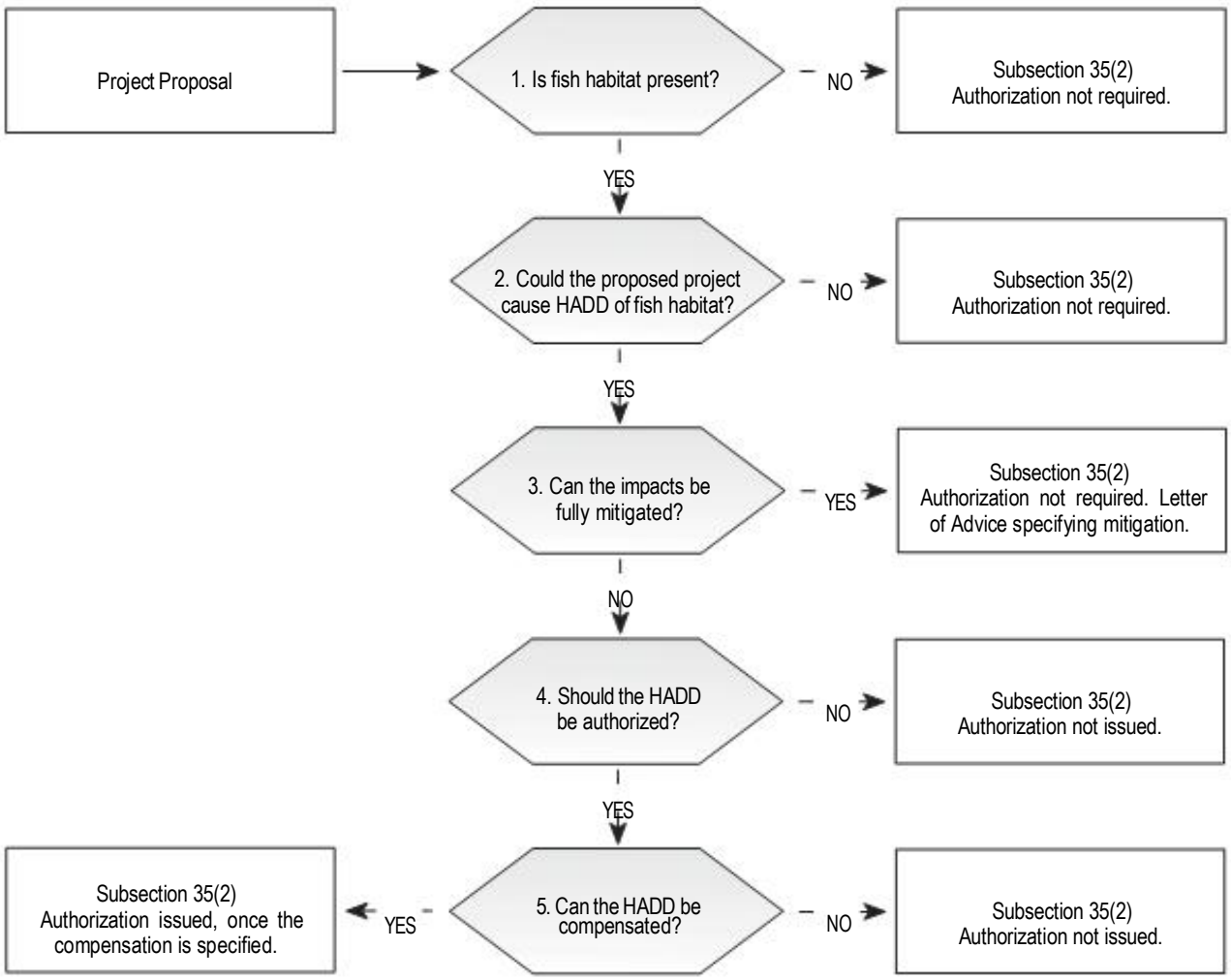
1) fish habitat conservation;
2) fish habitat restoration;
3) fish habitat development.

It is under the first of these goals that *Fisheries and Oceans Canada* is required to review watercourse alteration projects that may impact fish habitat.

In reviewing projects submitted for Watercourse and Wetland Alteration Permits, *Fisheries and Oceans Canada* is guided by a **NO NET LOSS** principle to ensure conservation requirements are met. Under this guideline, the Department will strive to balance unavoidable habitat loss with habitat replacement on a project by project basis. Should it be determined that a proposed alteration would result in the loss of productive fish habitat, the Department would review measures required to ensure **NO NET LOSS**. These measures will then be incorporated into the conditions upon which a Watercourse and Wetland Alteration Permit would be granted.

Figure D-1 displays the HADD decision framework. A copy of this policy may be obtained at any *Fisheries and Oceans Canada* office.

Figure D-1: A decision framework for the determination and authorization of harmful alteration, disruption of destruction of fish habitat



APPLICATION FOR A WATERCOURSE and WETLAND ALTERATION PERMIT

(In accordance with the Watercourse and Wetland Alteration Regulation under the Clean Water Act, Chapter C-6.1, Acts of New Brunswick, 1989.)

I have submitted this application on behalf of: (**PLEASE PRINT**)

NAME OF APPLICANT
(Dept/Company/Group/Person) _____

Mailing Address _____

_____ Postal Code _____

Telephone Bus.:_____ Home: _____ Fax: _____
E-mail: _____

If different from above:

Contact Person: _____ Telephone: _____
E-mail: _____ Fax: _____

The applicant accepts the liability for any damage done while commencing, carrying out or completing the watercourse or wetland alteration(s) described herein.

Name of Watercourse/Wetland _____ County _____

Tributary to _____ Parish _____

PID # of property where alteration is to be performed: _____

For Office Use Only

_____ Accepted for processing. Required fee of $_____ enclosed.
_____ Not accepted for processing. Cheque or Money Order # _____
_____ Resubmitted for processing. **FILE #** _____

Category _____ Type _____ 1:50,000 Map _____

Easting _____ Northing _____ Zone _____ NAD _____

DNR Region _____ DELG Region _____ DFO Region _____

EIA Screen _____ Water Supply _____ Water Quality Certificate _____

Wetland _____ Coastal _____

Copies sent to: _____

Date_____ Reviewed by _____
Day Month Year

A. Description of Alteration

Please include a detailed description of the project: type of activity, description of construction method, including materials used, disturbed surface area within 30 metres of the watercourse or wetland and the purpose of the project. This project description should focus attention on the following:

(1) is soil being disturbed, added to, or removed from the watercourse or wetland, or within 30 metres, of a wetland or the shoulder(s) of the watercourse?

(2) is vegetation being added to, or removed from, the watercourse or wetland, or within 30 metres, of a wetland or the shoulder(s) of the watercourse?

(3) are any structures to be installed, constructed, modified or removed from the watercourse or wetland or within 30 metres, of a wetland or the shoulder(s) of the watercourse?

(4) what is the size (length, width and/or height/depth) of the area in or within 30 metres of the watercourse or wetland to be altered in any of the ways exemplified in question (1)?

(5) precisely where will the proposed alteration(s) take place or be situated (located) relative to the watercourse or wetland or the shoulder(s) of the watercourse?

(6) what stabilization and erosion control techniques are to be employed during and upon completion of the proposed project including final slopes and material to be used to blanket all exposed erodible soil in order to minimize the runoff of suspended sediment from the area being altered?

(7) does project access already exist or what alteration(s) exemplified in question (1) are necessary within 30 metres of the wetland or of the shoulder(s) of the watercourse to facilitate the proposed undertaking?

NOTE: If your project involves a culvert installation, you must include culvert shape, type, length and diameter or span and rise. If your alteration involves a bridge, you must include the rise (distance from stream bed to the underside of the stringers), span (the distance between abutments) and type and average size of bed material.

Equipment to be operated in the wetted portion of the channel _____

NOTE: Instream work should be completed during the low water period, which is between June 1st and September 30th, in order to lessen potential damage to the environment. **All requests for permits outside this time frame will require input from our advisory agents and may be rejected, or subjected to intensive fish habitat protection measures.**

Desired period of construction: _____ to _____
Month Day Year Month Day Year

Desired period of instream work: _____ to _____
Month Day Year Month Day Year

The period for instream work is necessary beyond the June 1st to September 30th period because:

B. Sketch of the Project

Please enclose the required documents for the proposed project, including all dimensions and distances relative to the watercourse or wetland (see pages v and vi). These documents are not intended to be a location sketch (see section C.)

C. Location

Please submit a **map** (not a hand drawn sketch), which clearly shows the location of your proposed project relative to well known and labeled landmarks such as watercourses, railways, roads and/or transmission lines, etc. Whenever possible, please include the PID# for the property where the alteration is to take place.

Copies of relevant maps may be obtained from any office of:

New Brunswick Department of the Environment and Local Government
New Brunswick Department of Natural Resources
New Brunswick Department of Agriculture, Fisheries and Aquaculture
New Brunswick Department of Transportation
The Federal Department of Fisheries and Oceans

D. Description of Watercourse or Wetland (please submit photographs)

Are the banks of the watercourse or wetland eroding in the vicinity of the proposed project?

If this structure replaces an existing structure, give details on the existing structure (see section A).

What is the width of the watercourse from edge of bank to edge of bank (for flowing watercourses only)?

What is the height of the right bank (looking downstream for flowing watercourses)?

What is the height of the left bank (looking downstream for flowing watercourses)?

E. Property Ownership

Are you the legal owner of the property on which the project will take place? Yes _____ No _____

If "No", attach a letter of consent signed by the property owner, indicating that the property owner approves of the proposed project.

F. Application Fee

I have enclosed the required fee of $_____ in the form of a ____ money order, ____ cheque made payable to the **Minister of Finance.**

F. Declaration of Applicant

I hereby request a permit to commence, make or perform the watercourse or wetland alteration as described on this application form. It is understood that the submission of this application does not allow me to commence, make or perform the alteration as described in this application.

It is understood that the issuance of a permit does not exempt me from the provisions of any Act of the Legislature of New Brunswick or the Parliament of Canada or any due process of law, including any municipal by-laws. It is acknowledged that the issuance of the permit does not serve to deprive any person of his rights either under statute or common law to claim damages for loss or injury caused to him or his property by reason of the watercourse or wetland alteration. It is understood that the issuance of a permit places no liability upon the Minister or the Department of the Environment and Local Government.

If I am issued a permit, I agree that only such work as approved on the permit shall be carried out, and all such work shall be done so as to cause a minimum of disturbance to the watercourse or wetland.

It is also understood that it is my responsibility to obtain the approval of the landowner(s) where the alteration is to take place, and that I may be requested by the Minister to obtain the approval of the adjacent landowner(s) who might be affected by the alteration. If the land is owned by the crown in the right of the Province of New Brunswick, I will obtain the approval of the New Brunswick Department of Natural Resources, Crown Lands Branch and submit proof of such before a permit is issued. If the alteration is to take place within an incorporated municipality or within the boundaries of a Planning District, I will obtain the necessary approvals and ensure that the municipal and planning by-laws are not violated.

I certify to the best of my knowledge that the information stated in this form is correct.

Date: _____ Signature of Applicant _____

NOTE: Please enclose the required documents. Failure to submit adequate information in each section of this application will result in the application either being returned or rejected.

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