

WATERCOURSE ALTERATIONS  
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Province of New Brunswick  
Department of the Environment  
and Local Government

Regional Services Branch

**Watercourse Alterations  
Technical Guidelines**



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## Acknowledgements

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The Department of Fisheries and Oceans.

The New Brunswick Department of Natural Resources and Energy.

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## Preface

*These Guidelines have been prepared to complement the Watercourse 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 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 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.*



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## 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 man 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 Alteration Regulation has been proclaimed under the authority of New Brunswick's Clean Water Act. The regulation stipulates that a permit be obtained for all watercourse alterations from the Department of the Environment and Local Government. In addition, watercourse 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 alteration are adequately considered at the design stage.

The New Brunswick Department of the Environment and Local Government acts as the *regulatory* body, responsible for processing and issuing all watercourse alteration permits. The Department of Fisheries and Oceans and the New Brunswick Department of Natural Resources and Energy 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, it is only necessary to apply for a permit through the New Brunswick Department of the Environment and Local Government.

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.

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## 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 to convey or contain water whether the flow is continuous or not.

## What is a Watercourse Alteration?

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

any change made to existing structures in a watercourse including repairs, modifications or removal, whether the water flow in the watercourse is altered or not,

the operation of machinery on the bed of the watercourse other than at a recognized fording place,

any deposit or removal of sand, gravel, rock, topsoil or other material into or from a watercourse or within 30 metres of the bank of a watercourse,

disturbance of the ground within 30 metres of the bank of a watercourse except grazing by animals; the tilling, ploughing, seeding, and harrowing of land; the harvesting of vegetables, flowers, grains, and ornamental shrubs; and any other agricultural activity prescribed by regulation that occurs more than 5 metres from the bank of a watercourse,

any removal of vegetation from the bed or bank of a watercourse, any removal of trees within 30 metres of the bank of a watercourse.

## What are we Protecting?

The aims of the Watercourse Alteration Program are to **preserve our watercourses** and **protect aquatic habitat** with mandates to **prevent sedimentation of watercourses**, **prevent property damage**, and **ensure public safety**.

Preserving our watercourses means:

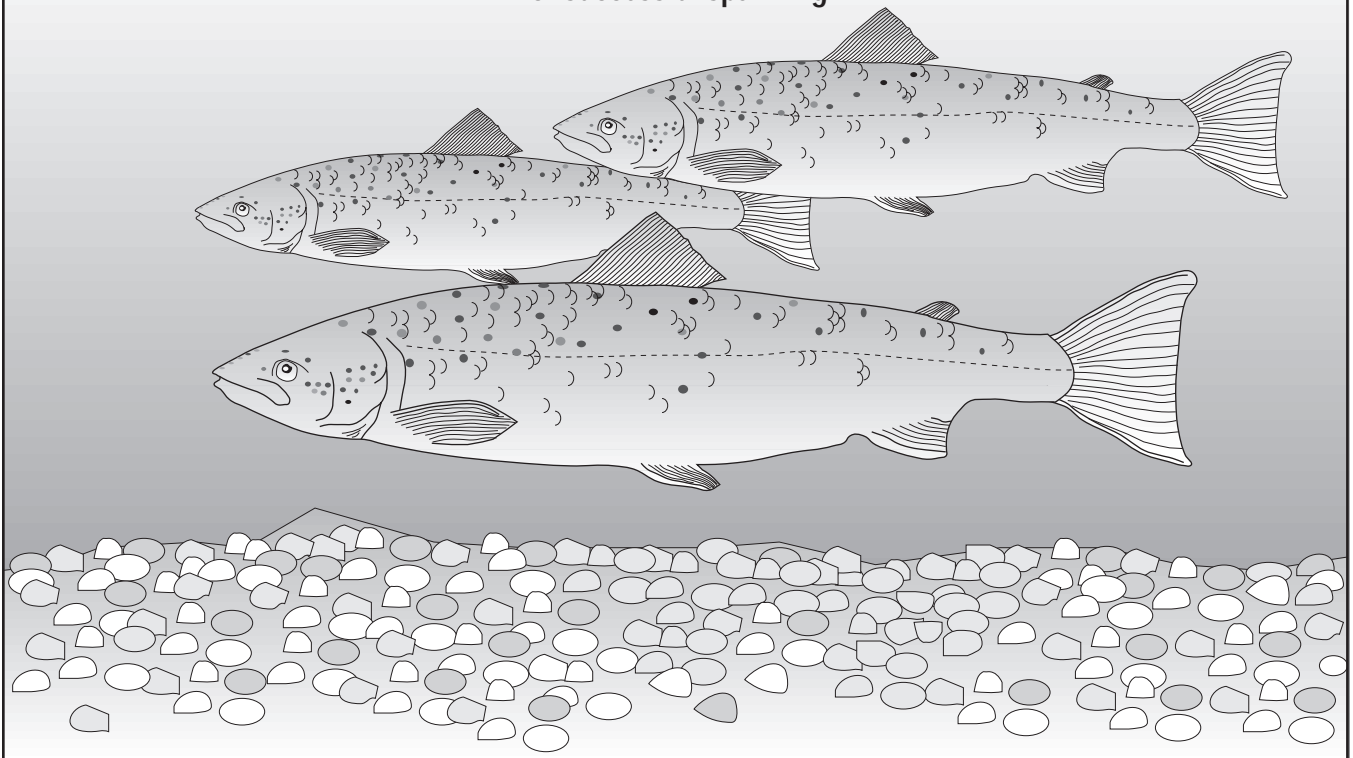
- \*maintaining water quality
- \*maintaining channel capacity
- \*maintaining stable banks and riparian vegetation
- \*maintaining and promoting aquatic habitat
- \*maintaining fish passage

## 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.

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

**Atlantic Salmon, like all Salmonids, require a clean, stable gravel substrate for successful spawning.**



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 brooks. The most well known are members of the salmonid family which includes several species of trout and char, and the 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.

## Basic Requirements Common to Many Salmonoids

### Water Clarity and Suspended Sediment

Turbidity is a function of the concentration of suspended sediment. Suspended sediment is undissolved matter ranging from clay size particles to fine pebble size (2-4mm). 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 fishes' breathing processes or migration patterns.

### 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 14°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 1cm to 15cm in size, for successful spawning. They bury their eggs 15 to 35 cm into the gravel in autumn which remain there until they hatch into the larval form called alevins. The alevins remain in the gravel until the following 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, 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.

**Table 1: The Potential For Negative Impact of Various Types of Watercourse Alterations**

ALTERATION CONCERNS	Bridge	Culvert	Erosion Control	Tree 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	•	•	•	•		•		•	•	•	•

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

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

## Impacts of Watercourse Alterations

Table 1. shows where various types of watercourse alterations may have a negative impact on basic 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 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 when high flows return the following season.

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. The natural balance between erosion and deposition can not 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 Material (cm/s)	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 (.25mm) to silt size (.002mm) particles. Fine clay particles can stay in suspension for up to 200 days.

Almost all alterations have the potential to introduce sediment into watercourses. One of the mandates of the Watercourse Alteration Program 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:

Deposition of sediment resulting in unstable watercourse substrate.

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.

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:

Erosion reduces the stability of the banks of a watercourse which could lead to slope failure and loss of adjacent property.

Erosion of the banks of a watercourse and adjacent areas may destroy the riparian vegetation.

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.

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.

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## What Else Can Go Wrong?

Poorly designed structures such as bridges or culverts which are incapable of passing high water flows can cause flooding and result in damages downstream.

Changes made to the bed or banks of a watercourse may cause unstable channel conditions creating 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 operations, 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 fluctuating slope
- outfall barriers
- channelization of flow leading to increased velocity
- inadequate water depth caused by oversized culvert
- culvert length

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

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

## Activities Which Require a Permit

Watercourse Alterations not only involve actual physical alterations of the watercourse, such as damming, re-routing or dredging, they include all activities taking place within 30 metres of the bank of any watercourse involving a disturbance of the water, soil, or vegetation. Some examples of common watercourse alterations include:

- bridge and culvert installation and repair;
- use or construction of a ford;
- road construction, landscaping, and tree removal within 30 metres of the edge of the bank of a watercourse;
- addition of any material including clean fill, sand, gravel or rocks to the bed, shoreline or within 30 metres of the edge of the banks of any 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 bank of any 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

A) Exemptions - There are a limited number of activities exempt from obtaining a watercourse alteration permit, even though they fall under the definition of a watercourse alteration. These activities are:

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, 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 are followed and the project has been approved by the Department of Agriculture.

The installation and removal of seasonal wharves that do not require any construction or excavation during installation.

Any activity within 30 metres of 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 permit 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 the watercourse.

B) Coastal Waters - These waters are not under the jurisdiction of the **Watercourse Alteration Regulation** and therefore do not require a watercourse alteration permit. The Canadian Coast Guard - Marine Navigation Services, the Department of Fisheries and Oceans, and the New Brunswick Department of Natural Resources and Energy should be contacted regarding any activities involving coastal waters.

C) Crown Lands - Unless it is deemed necessary by the New Brunswick Department of the Environment and Local Government, on Crown Lands, watercourse alterations undertaken on a watercourse that drains an area of six hundred hectares or less at the site of the alteration, do not require a watercourse alteration permit provided that an operating plan approved by a Regional Resource Manager of the Department of Natural Resources and Energy is implemented.

## Drinking Water Supply Watersheds

In New Brunswick, 31 surface watersheds used for municipal drinking water supplies are specially protected under the **Clean Water Act**. The Watercourse Setback Designation, which came into effect on November 8, 1990, set aside protected areas in these watersheds. The protected areas consist of the land within 75 metres measured horizontally from the banks of all watercourses in the designated watersheds. Within these protected areas certain developments or activities are restricted or prohibited which might otherwise be permitted under the Watercourse Alteration Regulation. These restrictions are outlined in the **Watercourse Setback Designation Order** and include additional controls on land use activities taking place within the defined protected areas.

The Watercourse Setback Designation requires individuals to apply for a Ministerial Exemption in order to carry out or continue to carry out a restricted or prohibited activity. Therefore, applications for

watercourse alterations taking place within a protected watershed are also reviewed under the terms of the **Watercourse Setback 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, a permit for a watercourse alteration permit will be refused, if the minister feels that the work constitutes a risk to the drinking water supply.

Maps of the protected watersheds may be obtained from the regional offices of the New Brunswick Geographical Information Corporation (NBGIC) throughout the province. Additional information on the Watercourse Setback Designation may be obtained from:

Sustainable Planning Branch  
New Brunswick Department of Environment and  
Local Government  
P.O. Box 6000, 364 Argyle Street  
Fredericton, New Brunswick  
E3B 5H1  
Telephone: (506) 457-4846  
Fax: (506) 457-7823

## Watercourse Alteration Permits

The requirement to obtain a watercourse alteration permit before undertaking a watercourse 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.

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

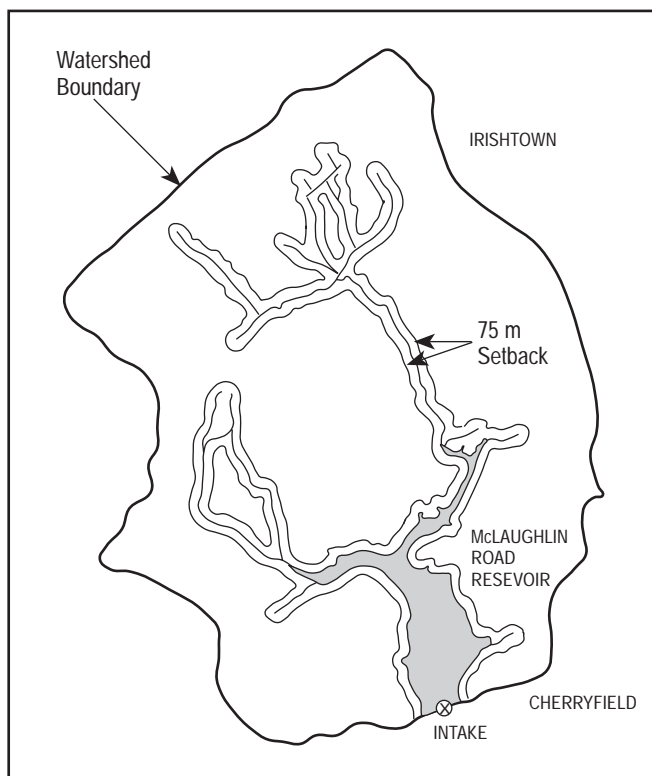
## Types of Permits

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

**Multiple** - a single permit issued for more than one alteration. Alterations in a multiple permit application must have a common factor, eg. general location.

**Provisional** - issued for alterations that have little or no detrimental effect on the watercourse. These types of permits are only 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 review process as the standard and multiple applications. If the information submitted with the provisional permit is satisfactory, a set of standard conditions will be issued to the applicant along with a letter of acknowledgement. The notification form, together with the acknowledgement and the conditions, constitute a permit. Alterations which **may** be undertaken utilizing the provisional permit are:

- a) rip-rap
- b) adding to or replacing an existing culvert or single span bridge
- c) soil disturbance adjacent to a watercourse
- d) intake pipes and instrument pools or wells



- e) maintenance and stabilization of existing structures
- f) debris removal
- g) road construction adjacent to a watercourse
- h) replacement of undesirable vegetation
- i) bush cutting adjacent to a watercourse
- j) storm sewer outfall pipes
- k) selective timber harvesting within 30 metres of a watercourse

**\*Note: The above alterations will only be eligible for a provisional permit if the Applicability Criteria listed on the provisional permit form are met and other application requirements are satisfied.**

More information regarding provisional permits may be obtained from any regional office of the Department of the Environment and Local Government.

**Emergency** - issued in an emergency situation prior to the submission of the application. The Department of Environment and Local Government 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 Alteration Regulation**, Section 15(1) and (2).

- |   |  |
|---|--|
| 1. A <i>Standard</i> application respecting one alteration.           | \$25.00                                      |
| 2. A <i>Multiple</i> application respecting more than one alteration. | \$20.00 for each up to a maximum of \$200.00 |
| 3. An <i>Emergency</i> application.                                   | \$50.00                                      |
| 4. A <i>Provisional</i> Permit application.                           | \$10.00                                      |
| 5. A <i>Permit</i> 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 Alteration Permit

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

Local Government and Regional Services  
 N.B. Department of the Environment and Local Government  
 3rd Floor, 20 McGloin Street  
 P.O. Box 6000,  
 Fredericton, NB

E3B 5H1

direct inquiries to: Mr. John B. Beunders  
 Telephone: (506) 457-7363  
 Fax: (506) 453-2390

or from one of the district offices of the following agencies:

- New Brunswick Department of the Environment
- New Brunswick Department of Natural Resources and Energy
- New Brunswick Department of Agriculture
- New Brunswick Department of Transportation
- The Department of Fisheries and Oceans

The completed application form, the required documents and the application fee should be submitted to the Technical Approvals Section of the Assessment and Approvals Branch, (address below) at least 2 months in advance of the anticipated starting date to ensure sufficient time for review of the application.

## Documents Required with the Submittal of Watercourse Alteration Applications

The following table gives a listing, by watercourse alteration

**Table 3: Application Review Requirements**

Alteration Type	Regulatory & Advisory	Regulatory Only	Required Documentation
Dams	X		Specifications Engineering scale drawings (plan, profile, x-section)
*Water Control Structures	X		Specifications Drawings to scale (plan, profile, x-section)
*Causeways	X		Specifications Drawings to scale (plan, profile, x-section)
Land Extensions	X		Drawings to scale (plan, profile, x-section)
Bridges		X	Drawings to scale (plan, profile, x-section)
Wharves and Piers		X	Drawings to scale (plan, profile, x-section)
Culverts and Pipe Arches		X	Dimensioned sketches showing size, shape, alignment and slope
Dredging	X		Bed material analysis Drawings to scale (plan, profile, x-section)
*Cutoffs *Channelization *Diversions	X		Bed material analysis Drawings to scale (plan, profile, x-section)
Channel Cleaning	X		Bed material analysis Drawings to scale (plan, profile, x-section)
Debris Removal		X	Dimensioned sketches

**Table 3 continued**

Alteration Type	Regulatory & Advisory	Regulatory Only	Required Documentation
Tree and Brush Removal		X	Dimensioned sketches
Instrument Pools and Wells		X	Drawings to scale (plan, profile, x-section)
Water Intake Structures		X	Drawings to scale (plan, profile, x-section)
Pipeline/Cable Crossings	X		Bed material analysis Drawings to scale (plan, profile, x-section)
By-Pass and Dugout Ponds	X		Drawings to scale (plan, profile, x-section)
Erosion Control Works		X	Dimensioned sketches
Flood Protection Works Floodwater Diversion Channels	X		Bed material analysis Drawings to scale (plan, profile, x-section)
*Removal of Major Obstructions	X		Drawings to scale (plan, profile, x-section)
Removal of Minor Obstructions		X	Dimensioned sketches
Miscellaneous Drainage Changes		X	Dimensioned sketches
Subdivisions and Alignments	X		Drawings to scale (plan, profile, x-section)

Applications for those alteration types which are indicated as being Regulatory and Advisory must be accompanied by **3 copies** of the required documents, while those indicated as being Regulatory only require **1 copy**.

\*Plans submitted for those alteration types indicated by \* may be required to bear the seal of a person licensed to practise 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 the Environment and Local Government.

All projects require a full description of the proposed construction methods and materials.

type, of the documents required with the submittal of an application for a Watercourse Alteration Permit. The documents are required to allow fair and adequate review of proposed watercourse alteration projects.

**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. 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 Profession Act. The drawings must bear the seal of the Professional Engineer.

**Drawings to Scale**

Fully dimensioned scaled drawings prepared with the use of drawing instruments and showing all dimensions necessary to describe the size, shape, and location of the proposed alteration, relative to the watercourse.

**Dimensioned Sketches**

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

**Map**

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 position of the project area relative to well known (labelled) landmarks such as watercourses, railways, roads and/or transmission lines, etc.

**\* NOTE: A MAP IS REQUIRED WITH EVERY APPLICATION**

**If You Do Not Receive a Permit**

If your proposed works are considered to have a negative impact on the best interest of the public, the water resource, or the aquatic habitat, you will receive a letter from the Regional Services Section of Local Government and Regional Services, Department of the Environment and Local Government, 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 and Local Government.

**If You Do Not Comply with the Clean Water Act**

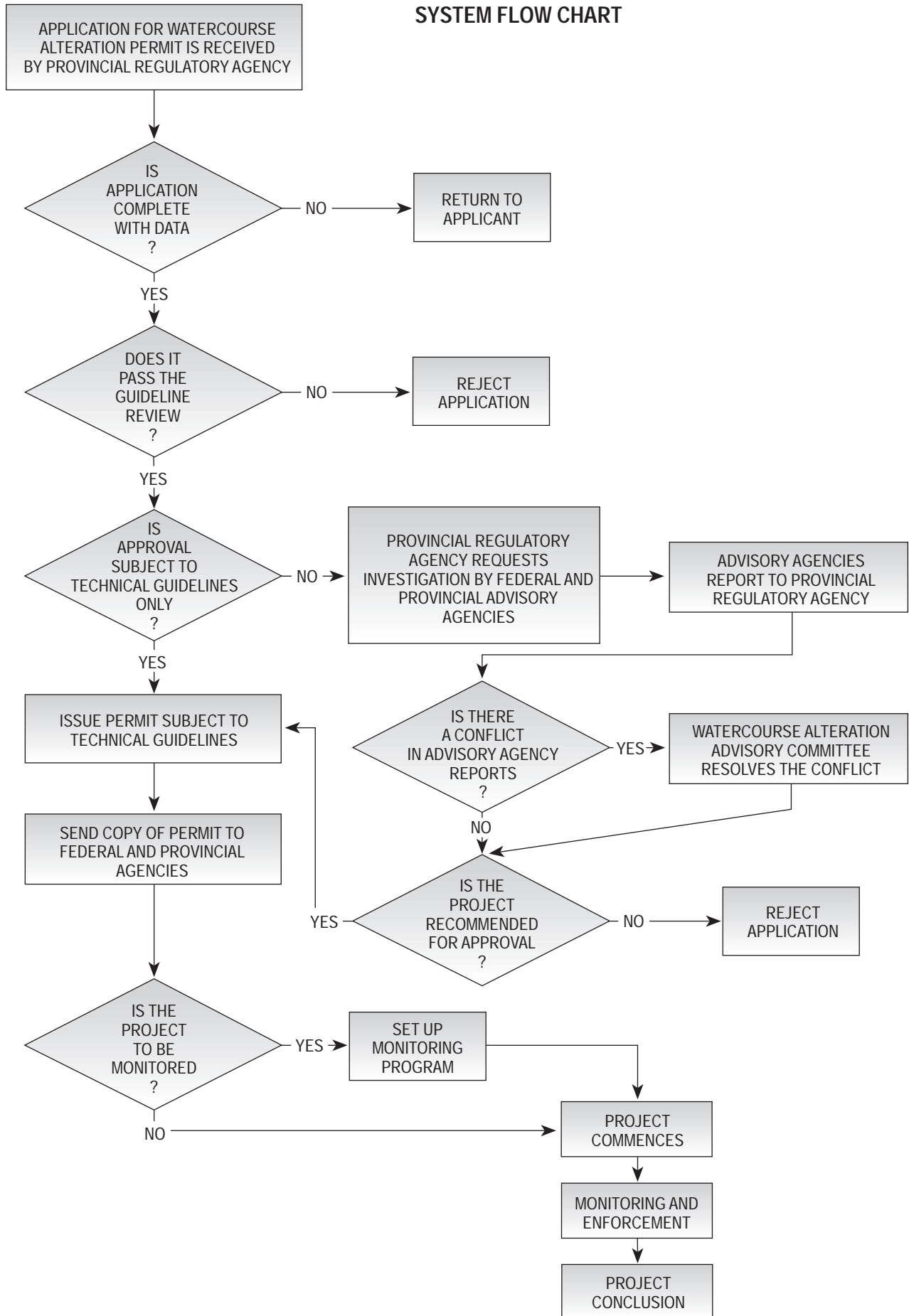
When carrying out a watercourse alteration you must have obtained a valid permit, and carry out only the work included in the "Description of Watercourse Alteration" in compliance with all the "Conditions of Approval" included in the permit. Failure to fulfil any of the above requirements could result 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, in default of payment, liability to imprisonment in accordance with Subsection 31(3) of the Summary Convictions Act, 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 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 may be involved with the review of the watercourse alteration applications for agricultural projects.

## SYSTEM FLOW CHART







# 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 alteration (see introductory chapter). It is worthwhile, however, to devote a discussion of the general practises 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 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 every year.
- 4) Retain existing vegetation wherever feasible. Erosion is minimized on a surface covered with natural vegetation.
- 5) Encourage re-vegetation of exposed areas.
- 6) Divert upland surface runoff away from exposed areas. Dykes or ditches 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 ditches

## Construction Techniques

It is essential to place sediment control devices before the construction phase of a watercourse 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.

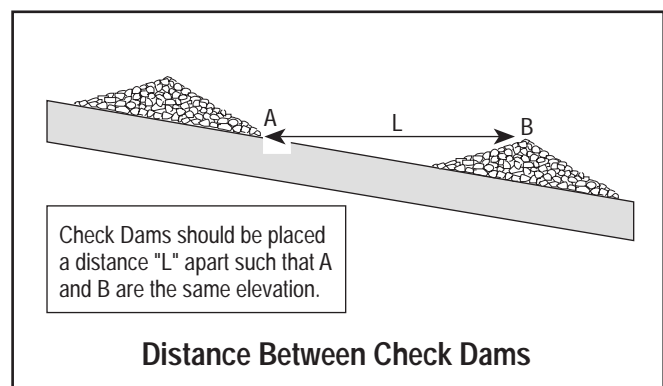
### Check Dams

Ditches or swales are used to concentrate flow beside a road, away from a disturbed or newly seeded area, or towards a sediment pond or vegetated area. This concentrated flow can erode the ditch. Check dams are *temporary structures* made from stones, straw bales, sandbags, or logs constructed across the ditches to reduce the velocity of the concentrated flow and thereby the potential for erosion until permanent stabilization of the disturbed area has been established.

The following criteria apply to the use of check dams:

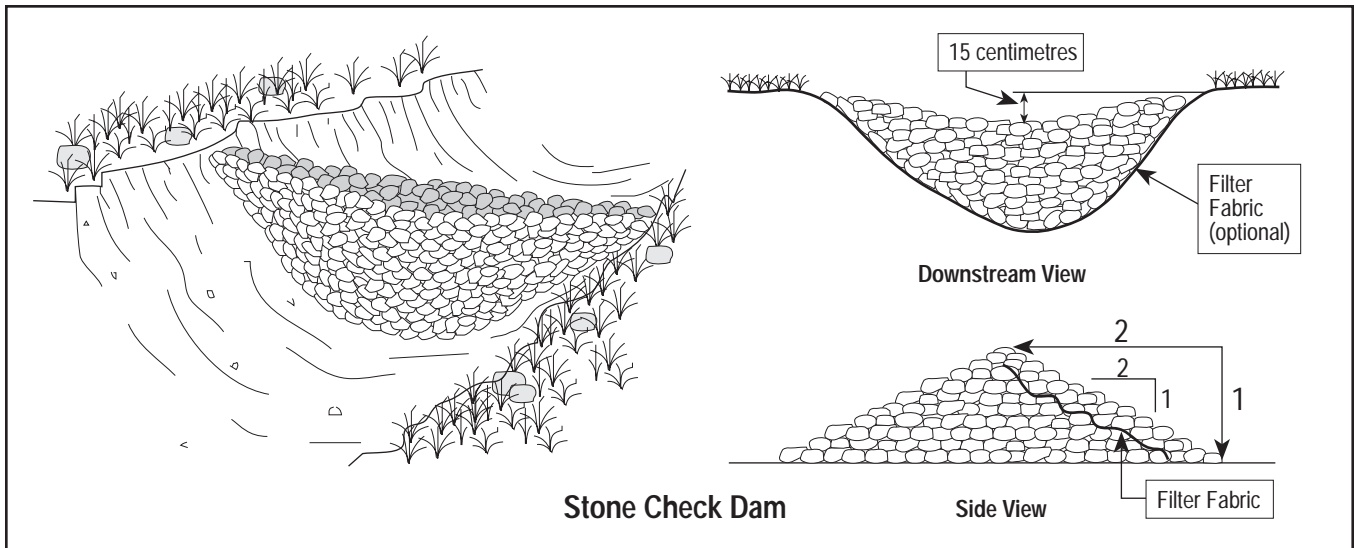
- 1) The drainage area of the ditch or swale must not be greater than 4 hectares.
- 2) The check dams should be installed before drainage is allowed to flow through the ditch.
- 3) The dams should be constructed so that the centre of the dam is at least 15 centimetres lower than the ends of the dam. 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 should be placed between 15 to 200 metres apart depending on the slope of the ditch and erodibility of the soil.
- 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 will not 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** 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. 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 1.0 metres, 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 downstream dam.

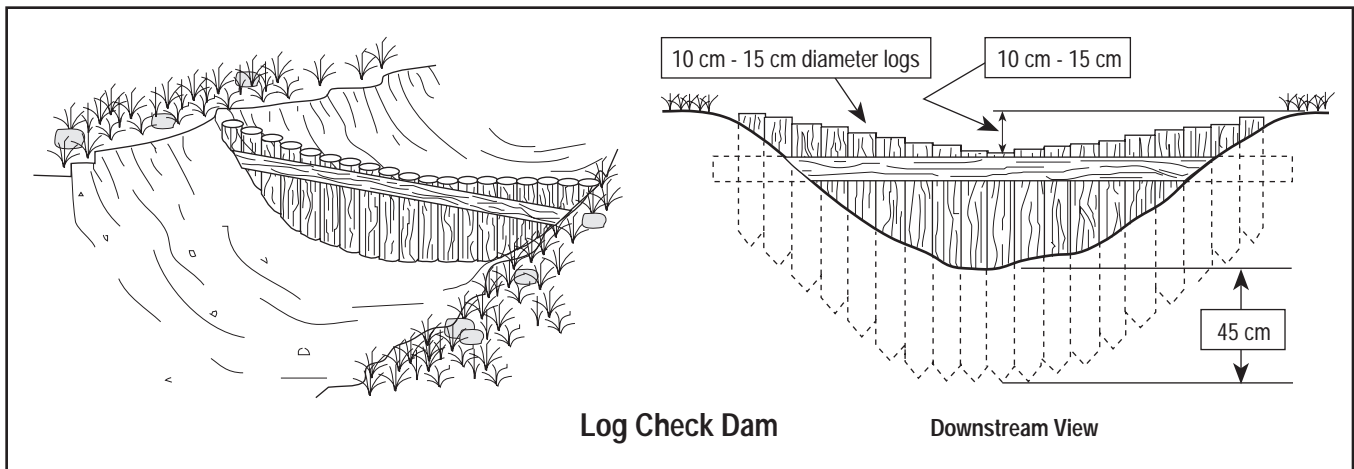


**Log Check Dams** should be constructed with logs of 10cm to 15cm diameter salvaged from clearing operations if possible. The logs should be embedded at least 45 cm into the soil.

**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



Stone Check Dam



Log Check Dam

on a regular basis, 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 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 2:1.
- 3) The runoff to be 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 barrier.

**Straw Bales** may be used if they are bound with wire or string. They should be placed lengthwise in a trench, staked, (at least

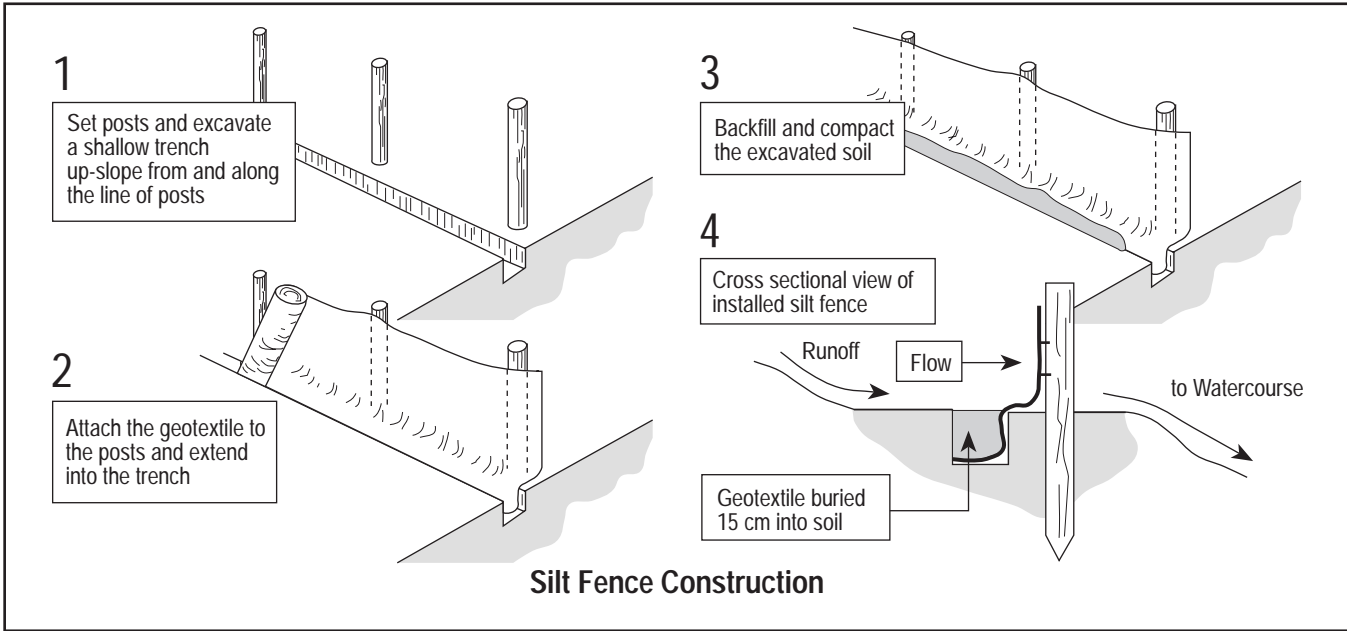
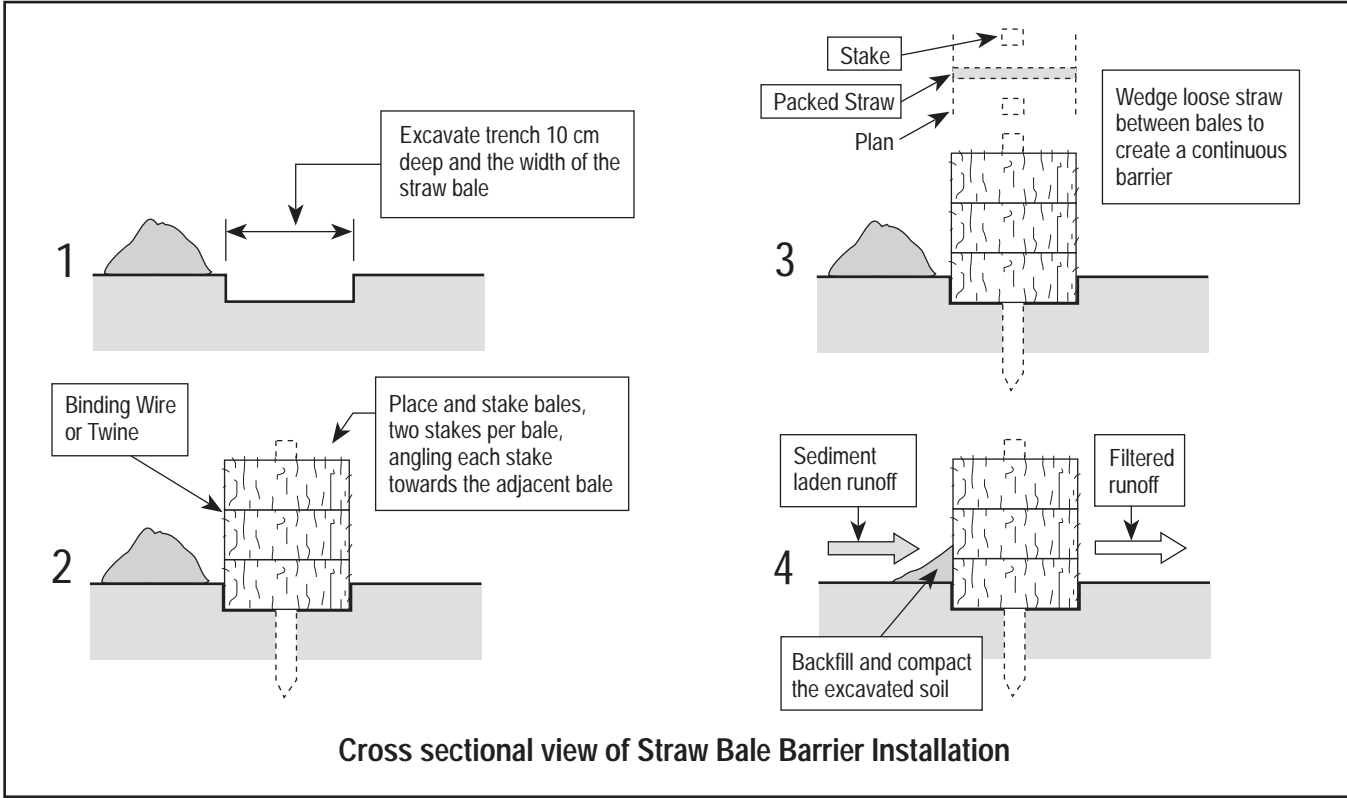
2 stakes per bale), and back filled. Straw bale barriers should be checked regularly and immediately after each rainfall for repair or replacement if necessary. These barriers should be removed after approximately 60 days.

**Silt Fences.** 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 buried in a trench and backfilled. 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 to convey water to a point where the outflow will not



cause any damage. The outlet may be a grassed waterway, a vegetated or paved area or a stable watercourse. 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:

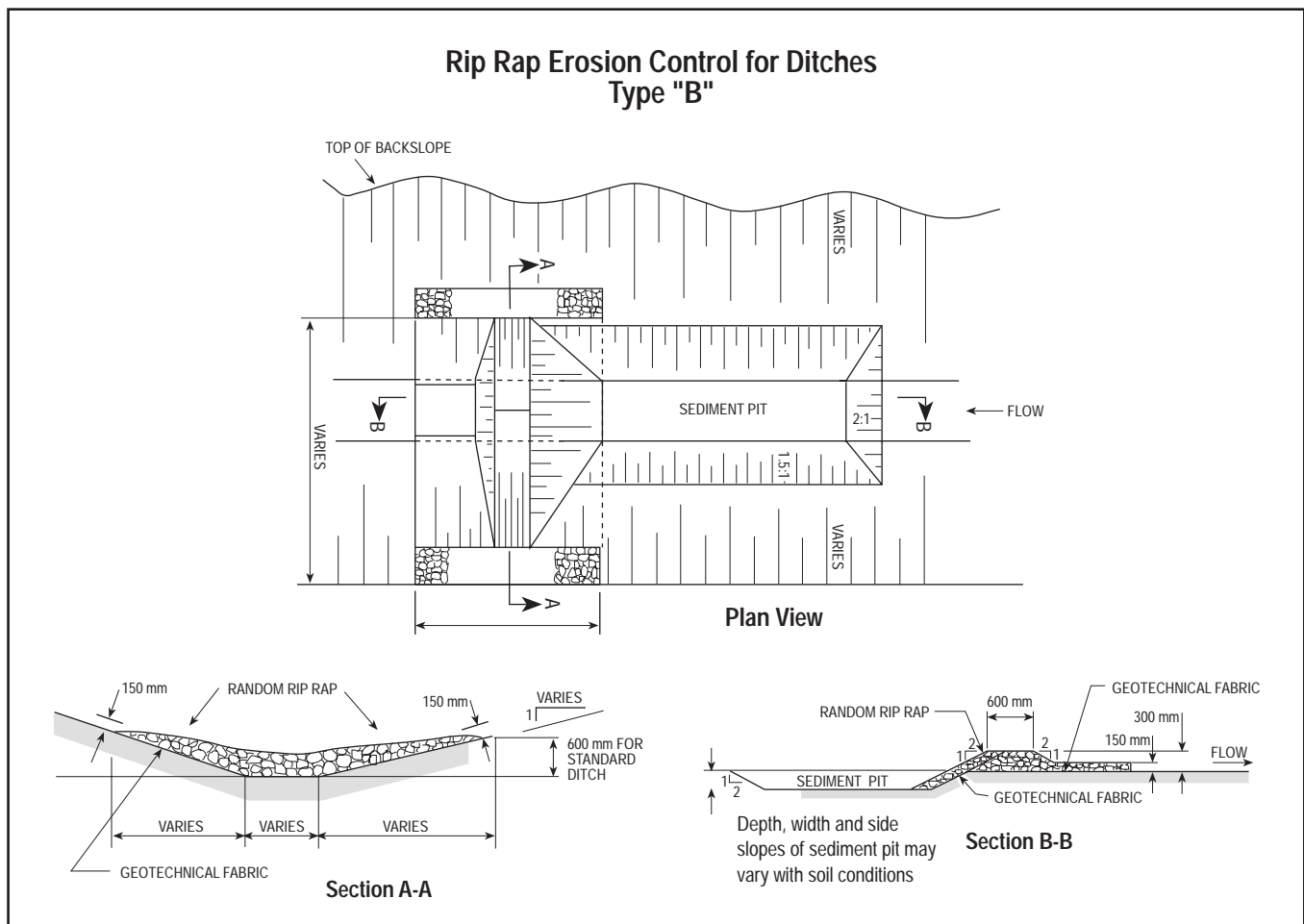
- 1) Site preparation - Utilize erosion and sediment control techniques where needed.
  - Grade the disturbed area to a stable slope. Vegetative cover will never develop on an unstable slope until it has eroded back to a stable angle. This angle is generally accepted as 2 horizontal to 1 vertical.
  - 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 and easy to plant.
- 5) Hydroseeding is an acceptable process where a slurry of seed, fertilizer, wood fibre mulch and water is sprayed on the disturbed 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 be carried downstream to a watercourse. The discharge from the ponding area is filtered by rip rap which lines the outlet.

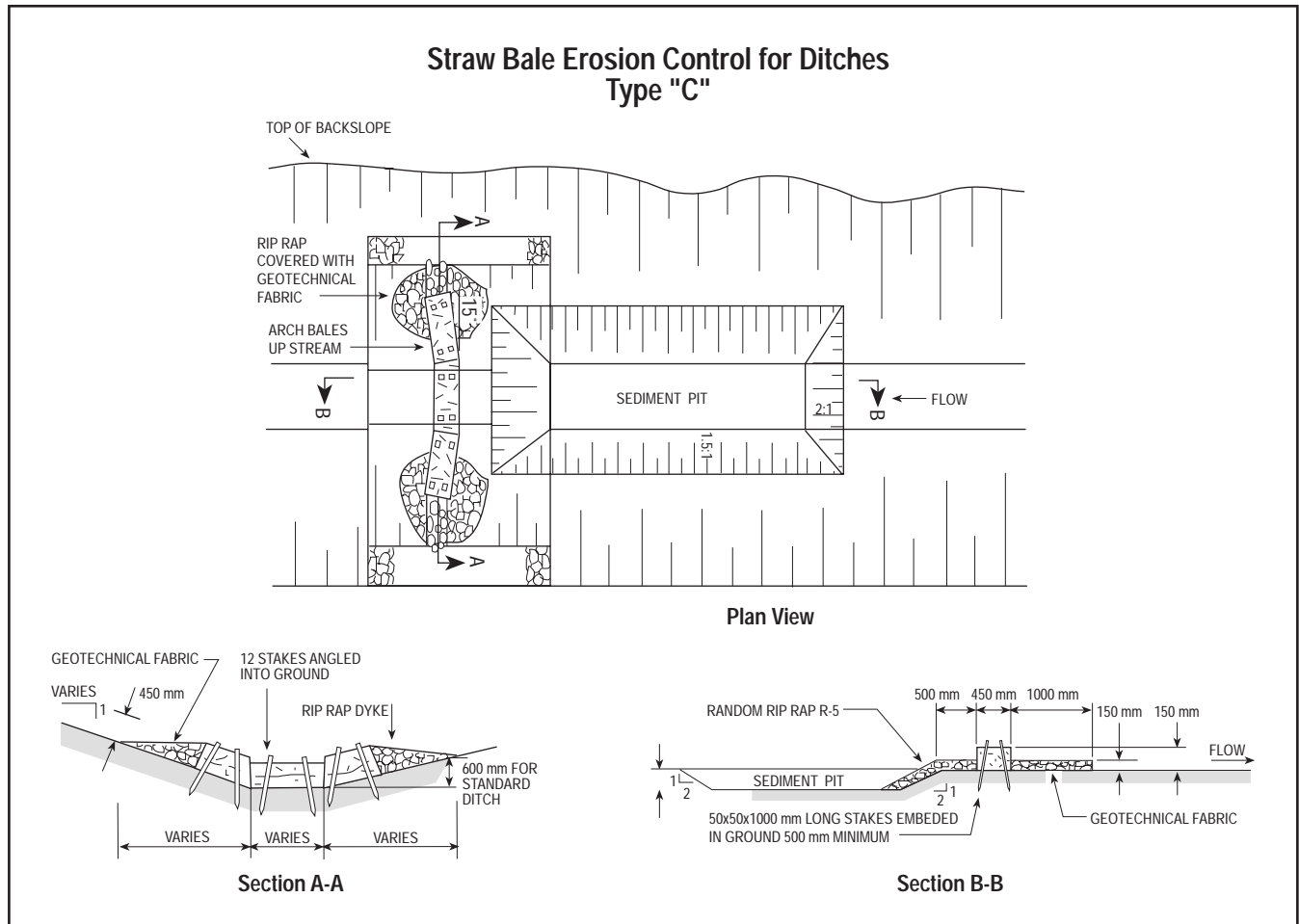
Regular maintenance includes removal of sediment when it accumulates to a level equal to half of the design depth of the trap.

Type B and Type C function similar to the check dams discussed previously. They consist of a small dams constructed across a ditch. A small ponding area is excavated behind 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. Type C outlet consists of straw bales.

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 grass on the seeded slopes is sufficiently established to be an effective erosion deterrent.





## Guidelines Applicable to All Watercourse Alterations

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 and adjacent areas and be disposed of, or placed in a location where it cannot be returned to the watercourse. Sites must be cleaned up and stabilized against erosion.
4. If any equipment is used in the watercourse, 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.
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 watercourses** during the spawning migration of anadromous fish species, including salmon, trout and gaspereau, shad, smelt and in a few areas brown and rainbow trout; **heavy sedimentation** of fish spawning beds after 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.

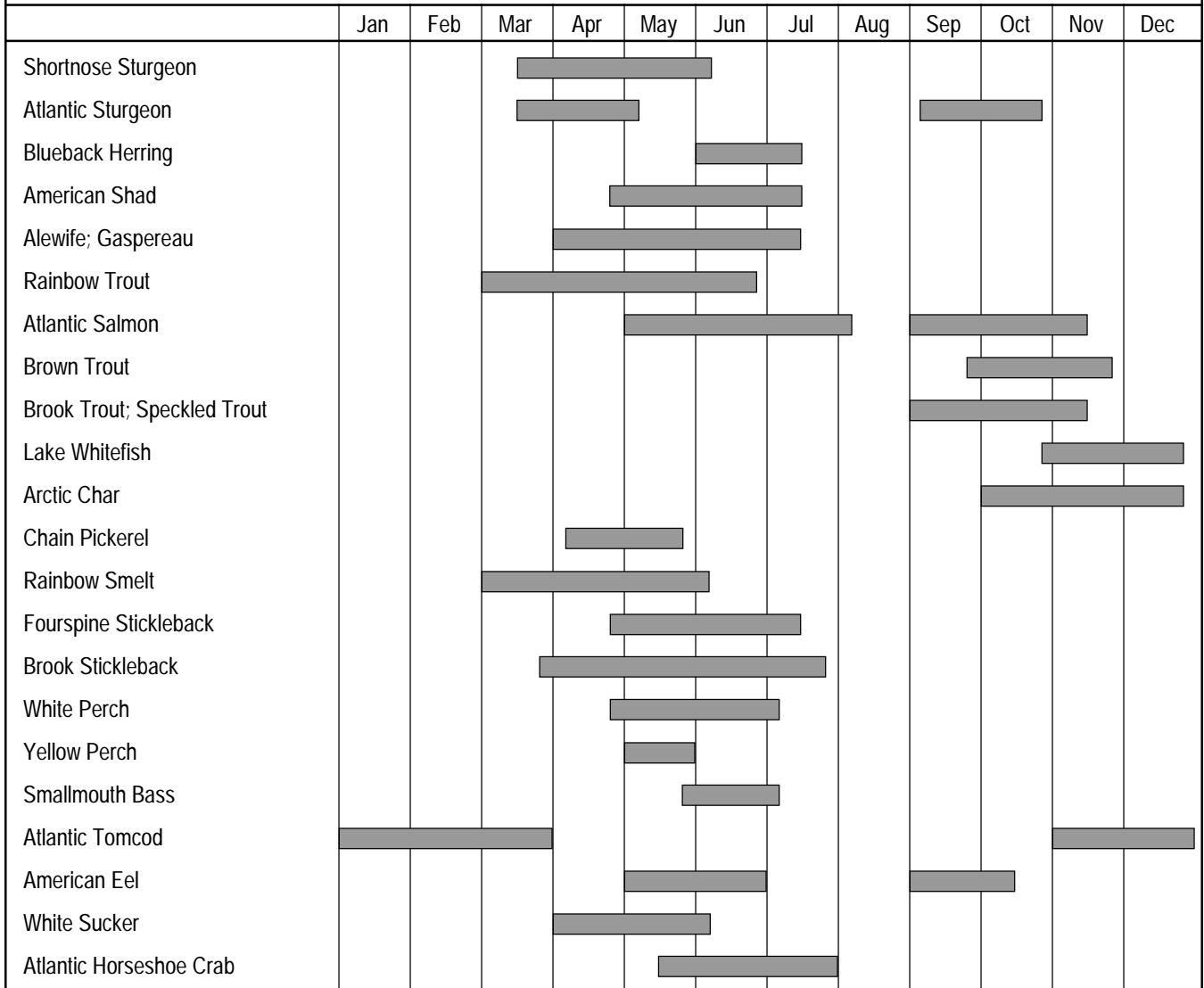
The following charts illustrate when the sensitive periods occur for various aquatic species in New Brunswick.

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

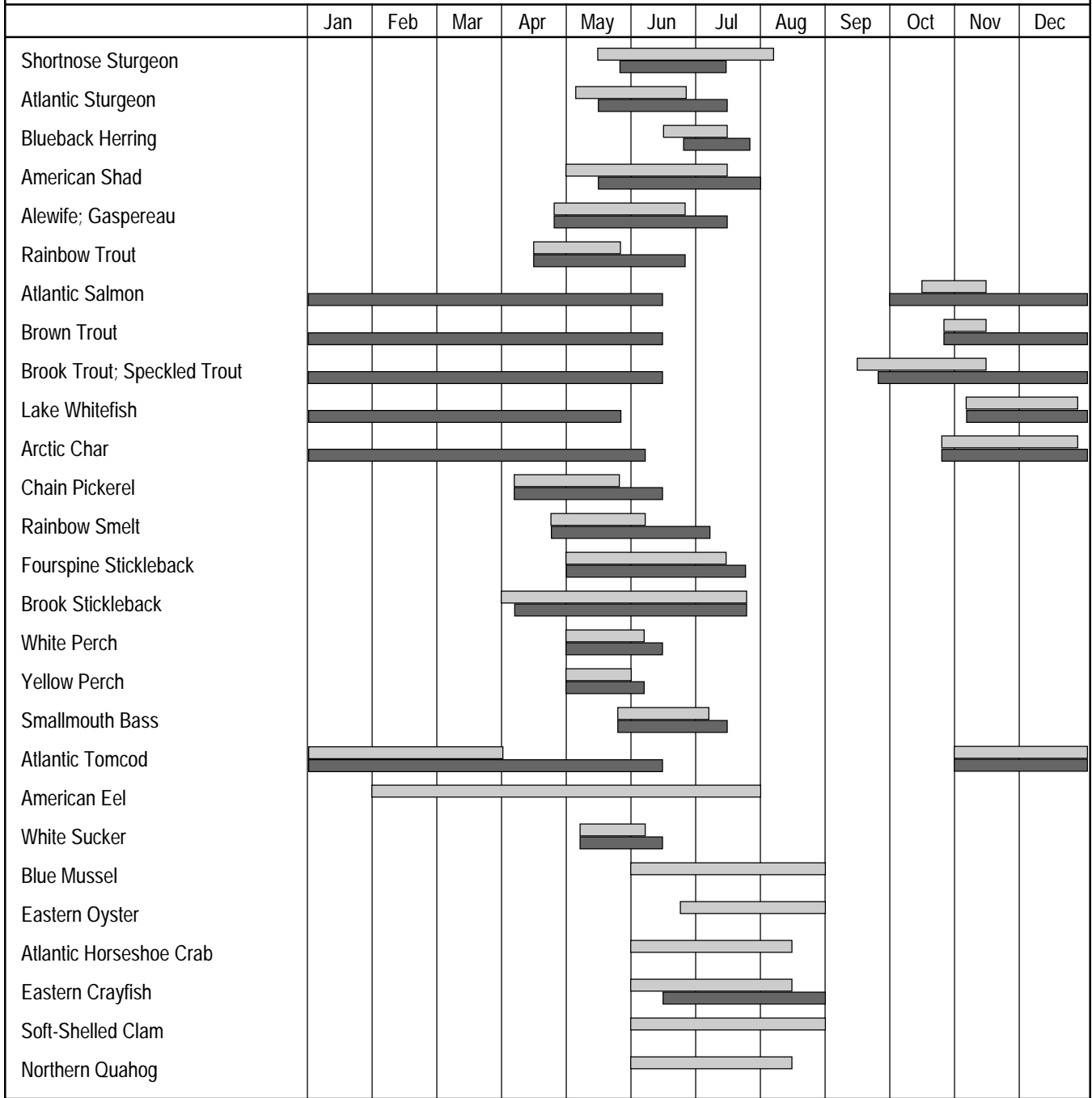


## Migratory Periods of Some Aquatic Species in New Brunswick



migratory    ■

## Sensitive Periods of Some Aquatic Species in New Brunswick



spawning
  immobile  
 (egg and possibly fry stages)



## 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 completion of the watercourse alteration project, or from the requirement to obtain a permit as stipulated in the **Watercourse Alteration Regulation**.
3. Following these guidelines places no liability for the design, planning or construction of any watercourse alteration on the Minister, Department of the Environment and Local Government.

NOTE: These guidelines are not regulations. They are general recommendations which may not be applicable to every situation. Specific conditions pertaining to individual watercourse 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 alteration types. A *definition* is provided to define and explain each form of alteration. The *objectives* for each alteration explain the environmental concerns being addressed by the guidelines for each alteration type. *Planning* and *construction* considerations are given to provide applicants with the guidelines necessary for the design and implementation of each watercourse 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 the Environment and Local Government. Those which are reviewed by the regulatory and advisory bodies, will be reviewed through inter-departmental consultation

between the New Brunswick Department of the Environment and Local Government, the New Brunswick Department of Natural Resources and Energy, and the Department of Fisheries and Oceans. In many cases, advisory agencies are routinely 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 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 watercourse alteration.



# Alteration Type: Beach Construction

## Definition

*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 construction of 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 removable 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 and outlying 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 can not escape to deeper parts of the watercourse.

Other concerns include constriction of 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.

## 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 used for the beach material 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 more stable to erosive action than fine grained material.

Only clean material obtained from a non-watercourse source is considered suitable 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 considered unsuitable for beach construction. Examples include bedrock or rocky surfaces or wet, marshy areas.

A buffer zone of undisturbed area must be left between the high water mark and the outer limit of added 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 practise 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.

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## Guidelines

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

Machinery is not permitted to 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 produce any siltation or disturbance to downstream or adjacent areas.

## Alteration Type: By-Pass Ponds

### Definition

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.

### 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 introduce excessive quantities of silt and other sediments into the watercourse.

In addition, if small watercourses are 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. Therefore, excavating a pond in the bed of a watercourse has the potential to introduce excessive quantities of silt and other sediments into the watercourse.

To determine whether or not a watercourse in the province is capable of supporting fish, a representative from the New Brunswick Department of Natural Resources and Energy or the Department of Fisheries and Oceans must be contacted.

#### 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 spread to the watercourse.

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 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, barns, or waste disposal areas.

### Maintenance Flow Requirements

Maintenance flow requirements for the watercourse will be imposed for the water intake structure. (refer to Guidelines for "Water Intake Structures")

### Future Considerations

Applicants should bear 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 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 of the pond,
- distance from the watercourse,
- detailed description of the inlet and outlet structures,
- description of the proposed construction methods,
- description of inlet and outlet screens,
- elevation of intake and outflow pipes relative to the pond,

### Other Government Agencies Involved

- 1) If the plans include stocking the pond with fish, an *"Inland Aquaculture License"*, is required from the *Department of Fisheries and Aquaculture*. This is required to control the possible spread of disease between the stocked fish and those naturally inhabiting the 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) The *Department of Fisheries and Oceans* must be contacted before any fish are placed in the pond.

### Application Review Process

Regulatory and Advisory.



## 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.

If a site with an impervious substrate can not be found, the selected site can be sealed by one of the following methods:

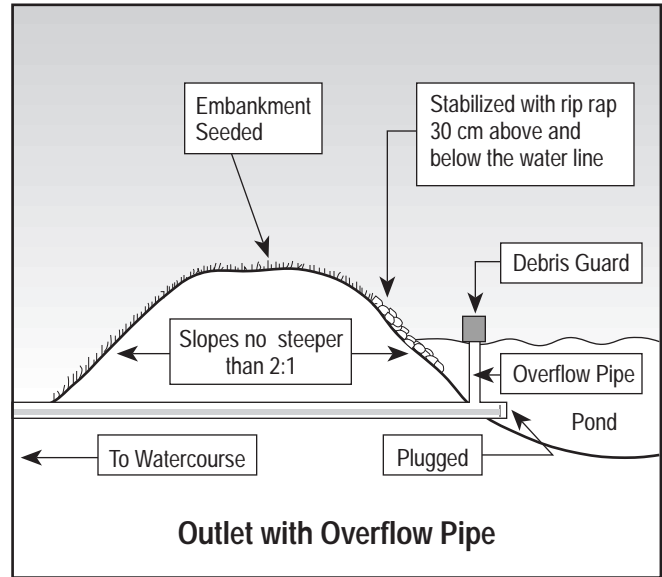
- 1) Compaction by heavy machinery is possible provided the substrate consists of well graded soils.
- 2) Addition of clay blankets to cover the entire pond area up to the normal high water mark. The blanket should consist of well graded, coarse grained material containing a minimum of 20% clay with 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 it's 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. (Refer to Guidelines for "Water Intake Structures") 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.

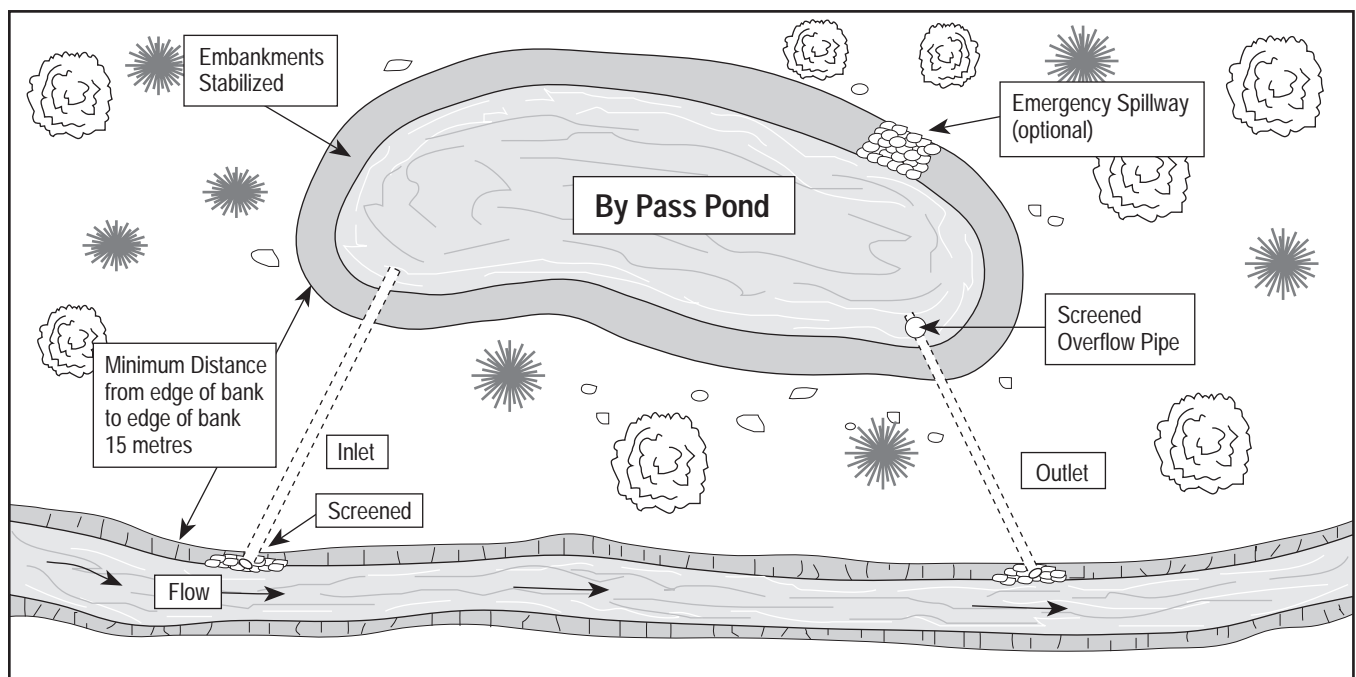
The by-pass pond outlet structure should include an overflow pipe. In addition, an emergency spillway should be constructed in the embankment to pass excess runoff and prevent the pond from overtopping during periods of high flow. The need for either one or both of these structures is usually assessed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

The overflow pipe is usually a vertical section of metal or plastic pipe set in concrete connected to a horizontal section of the outlet pipe. The top of the overflow pipe should be equipped with a trash rack or debris guard to protect the pipe from blockage caused by



floating debris.

This configuration directs all water flowing out of the pond to be drawn below the surface preventing the fish barrier screen from becoming plugged with debris. The water level in the pond can be



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controlled by adding to or lowering the height of the overflow pipe.

Emergency spillways are often constructed as a 'back up' to the overflow pipe in the event of overtopping. These consist of shallow rock lined channels excavated in the embankments of the pond discharging into a vegetated area away from the watercourse. The channel must be lined with rip rap.

## 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.

To keep the water quality high, the pond should be designed with an area which is small relative to the water supply.

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

The excavation of the pond must be carried out in the dry.

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 which adjoin the water-

course must be screened.

In **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 one half metre 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 on the sides 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 from a by pass pond is to be discharged over a short period of time, for irrigation purposes, for example, the inlet should be closed during the discharge. 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 "Water Intake Structures".



## Alteration Type: Causeways

### Definition

A raised road or path, usually built across a shallow, wide body of water or wetland.

### 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 the in-water or approach structures or indirectly as a result of heavy usage of the structure. "Aquatic" includes species of: fish, invertebrates, and shellfish, if the structure is located across an estuary.

##### 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 instream placement of fill will 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 from 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 operations.
- 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 an erosion control plan.

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 practise as a Professional Engineer subject to the provisions of the *New Brunswick Engineering Profession Act*.

### Other Government Agencies Involved

- 1) The approval of the *Canadian Coast Guard*, Marine Navigation Services 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 Environmental Impact Assessment in New Brunswick** must be registered with the Minister of the Environment and Local Government. Inquiries should be directed to the Manager of the Project Assessment Section of the Environmental Management Branch of the *Department of the Environment and Local Government*.
- 3) The *Department of Fisheries and Oceans* must be contacted if the project will negatively impact fish habitat.

### Application Review Process

Regulatory and Advisory.

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## Construction

Construction procedures will be determined on a site specific basis and will involve interdepartmental 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 causeway material 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 provided at all times.

# Alteration Type: Channel Cleaning

## Definition

*Removal of debris 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 instream activities.

## Planning Considerations

### General

As stated in section 4 of the **Watercourse 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 should 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 stream 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) the method of disposal of the removed material;
  - 4) sediment and water control plans;
  - 5) the cause of the channel infilling.

## Application Review Process

Regulatory and Advisory.

## 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 can not re-enter the watercourse. Large rocks and boulders removed from the channel may be placed along the banks to help provide stabilization.

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 of June to September, except in cases of rare emergencies.

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 restricted to 15 metres upstream and downstream of the structure.

All material removed from the watercourse must be disposed of in the proper manner and in such a way that it will not re-enter 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 purposes.



# Alteration Type: Dams

## Definition

A dam is a barrier constructed across a watercourse for impounding or diverting water for one of the following reasons:

- 1) **Storage** - to impound water during periods of surplus water supply for use during periods of low flow for hydro-electric power generation, irrigation, recreation, or water supply.
- 2) **Diversion** - to divert part or all of the water from a watercourse into another conveyance structure.
- 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 interdepartmental 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.

### 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 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.
3. Increase in water temperature upstream caused by interrupted flow and possibly downstream of the structure by reducing the volume of water.
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 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 the downstream sections.

### Application Requirements

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

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

**\* 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 Profession Act and experienced in hydrotechnical design;**
- b) **include specifications on the materials and workmanship;**
- c) **include a description of the operation of the dam noting the maximum drawdown and operating schedule of the reservoir.**

### Other Government Agencies Involved

1. Authorization must be obtained from the *Department of Fisheries and Oceans* 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 the *Canadian Coast Guard*, Marine Navigation Services, which administers the **Navigable Waters Protection Act** must be obtained when a structure is to be placed in or across any navigable watercourse.



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3. The Crown Lands Branch of the *New Brunswick Department of Natural Resources and Energy* must be contacted if any Crown lands will be affected.

### Application Review Process

Regulatory and Advisory.

### 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 one metre  
 $Q = 6.93 A^{3/4}$  (Q in m<sup>3</sup> and A in km<sup>2</sup>)
- b) freeboard greater than one metre  
 $Q = 3.465 A^{3/4}$  (Q in m<sup>3</sup>/sec and A in km<sup>2</sup>)

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 (<sup>2</sup>/<sub>3</sub>) 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 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 completely covered with seed and hay 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 should be compacted and protected to prevent washout during high flows.

## Alteration Type: Debris Removal

### Definition

*Debris removal is the removal of material foreign to the normal composition of a watercourse. Examples of debris include: car bodies, empty containers, garbage, branches and logs, tires and some 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 the 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 has potential to be harmful because it may:

- become a barrier to fish migration;
- lower the water's oxygen content through decay;
- trap silt, creating build-ups leading to decreased flow, or up-stream 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 uprooted trees which are securely fastened to the banks of a watercourse. The root systems may be preventing erosion of the bank.

### Beaver Dams

Beaver dams are not considered to be debris. When carried out manually by a representative of the New Brunswick Department of Natural Resources and Energy, removal of nuisance beaver dams does not require a permit.

If removed by mechanical methods, a watercourse alteration permit is required.

The nearest office of the New Brunswick Department of Natural Resources and Energy should be contacted for more information regarding beaver dams.

### Application Requirements

In addition to the standard requirements as stated on the application form, an application for a watercourse 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.

### 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 a minimum of 15 metres from the edge of the bank 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° 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 return to the watercourse.

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 natural or man-made channel shortening the reach of an oxbow or meander(s) in an existing channel.*

### 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 the dry 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 existing sinuosity and physical characteristics of the upstream and downstream channels may be used as 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 other reaches of the watercourse.

#### 2) Loss of Habitat.

Cutoffs and diversions eliminate sections of natural watercourse which may contain productive aquatic habitat and would be difficult to recreate.

#### 3) Sedimentation.

Unless carefully 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 soil survey along the new channel;
- a plan, profile, and cross sectional drawing to scale clearly showing the size, shape, and alignment of the new and existing channel extending a distance of a minimum of 10 channel widths upstream and downstream of the proposed work area;
- a full description of the proposed construction methods including a sediment and water control plan.

### Application Review Process

Regulatory and Advisory.

### Guidelines

The new channel must be excavated in the dry from the downstream end.

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

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 after 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 on the outside banks in the meanders.

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

A rock apron must be constructed at the confluence of the existing channel and the diversion channel; the apron must extend up both sides of the diversion channel.



# Alteration Type: Dredging

## 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, trenches, harbours, or inlets for use by boats.
- 2) *Pipelines/cables* - to dig channels for laying pipelines or cables.
- 3) *Foundation Preparation* - to remove unsuitable material at proposed locations for supporting structures such as piers.
- 4) *Environmental* - excavation of unwanted or polluted materials such as mine tailings or contaminated sediments.
- 5) *Construction* - to excavate or mine aggregate, gravel, or sand for use on beaches, land extensions, or land improvement.
- 6) *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.
- 7) *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 avoid 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 situation is unique, and the possible impacts must be carefully considered at the design stage taking into account the potential for impact at the:

- a) dredging site
- b) disposal site
- c) transportation route

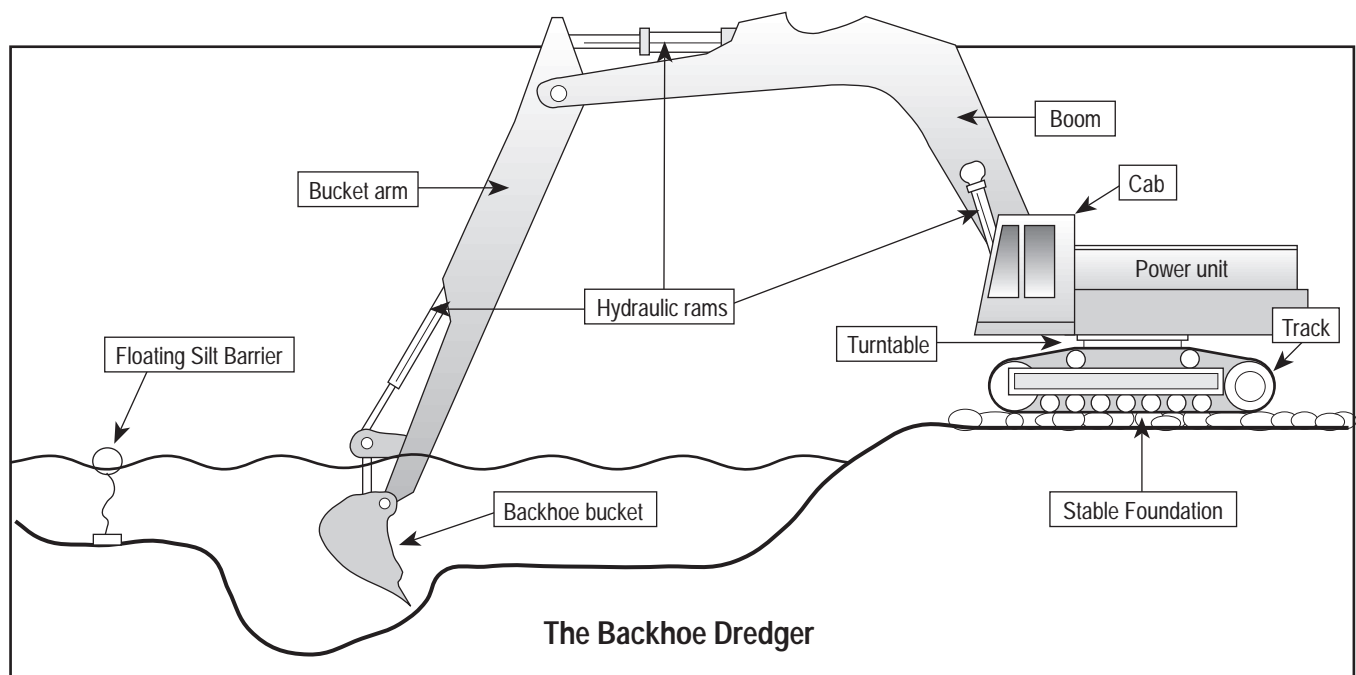
## Equipment

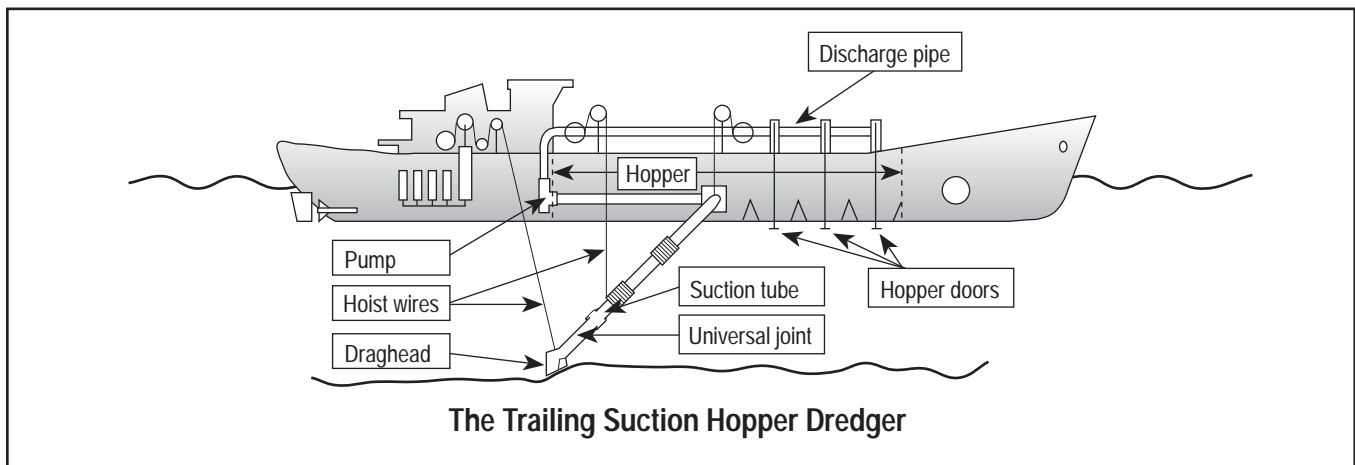
The selection of dredging equipment is determined by the following factors:

- 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 alterations in the province can be divided into two different types:

1. **Mechanical** dredging equipment excavates the material intact, with some form of bucket, depositing it onto a barge, scow, truck





or 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 back hoe dredges. These may operate from a barge, the shore or wharf.

2. **Suction or Hydraulic** dredges are characterized by the entrainment and transport of bottom material as a slurry of water and soil in a high velocity water stream. The dredged material is pumped through a floating pipeline, (with a diameter of 25 to 30 cm), 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, 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.

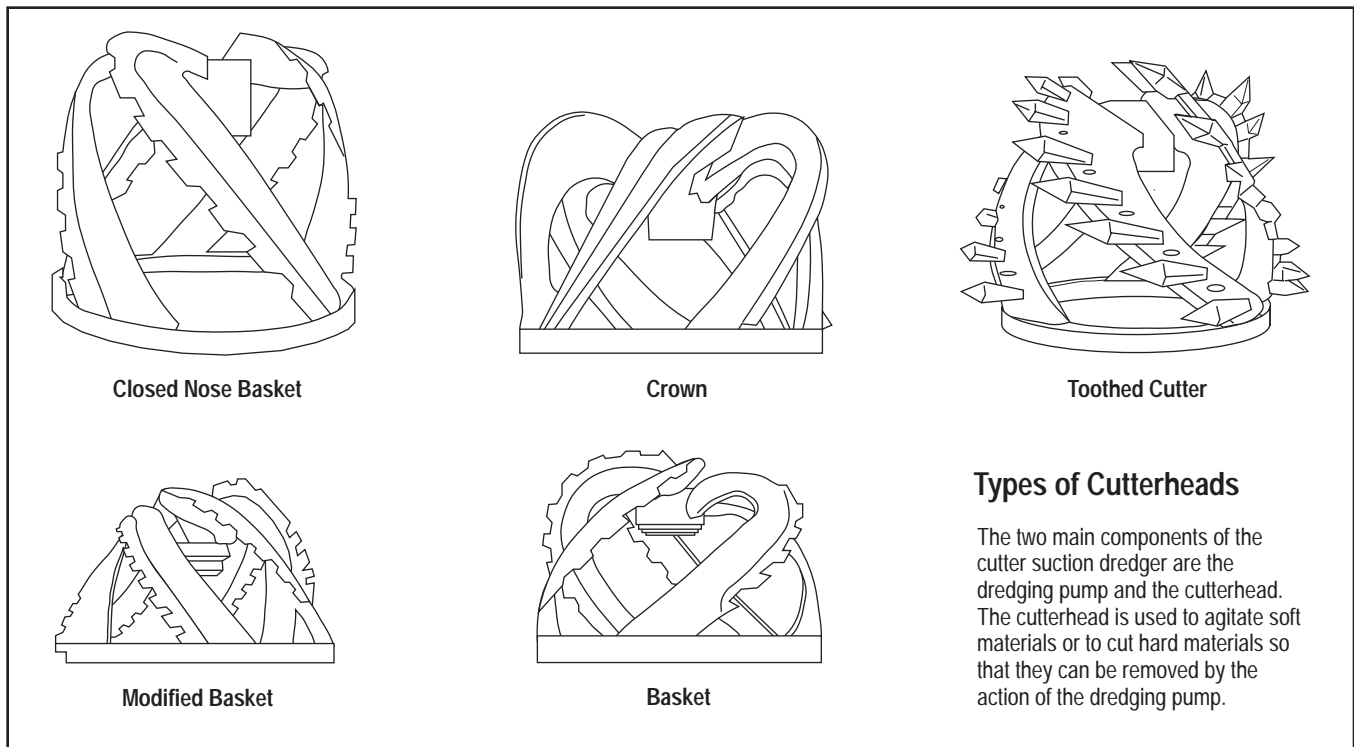
Trace elements, which are often found in association with finer grained sediments, can be introduced into the water when the sediments are dredged, and may be taken up by aquatic organisms.

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, currents or by mass movement or slippage of the material caused by instability of the dumped spoils or underlying ground.

## Other Possible Impacts

- 1) disturbance to fishing and aquaculture operations by movement and actions of 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 contaminated water supply.
- 4) disruption of navigable channels.
- 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 to scale of:
  - a) the area to be dredged, clearly indicating the amount of material to be excavated;
  - b) the disposal area.
- a complete description of the equipment to be used;
- an analysis of the material to be dredged.

### Other Government Agencies Involved

- 1) The *Canadian Coast Guard*, Marine Navigation Services must approve of the dredging and disposal site under the **Navigable Waters Protection Act**.
- 2) The *New Brunswick Department of Natural Resources and Energy*:
  - a) Crown Lands Branch must be contacted regarding any dredging or disposal below the high water mark.
  - b) Minerals Branch. Movement 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) The *Department of Fisheries and Oceans* 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 Solid Waste Engineer of the *New Brunswick Department of the Environment and Local Government* (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 spread of turbidity 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 varying water levels. A chain attached to 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 practised 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.
  - 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, currents. Please refer to the chapter on Surface Erosion and Sedimentation Control and the Guidelines for "Erosion Control Works".

### **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 **Assessment and Approvals Branch** of the New Brunswick Department of the Environment, (see below).

Stewardship Section  
Environmental Management Branch  
Department of the Environment and Local Government  
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 channel and will require a comprehensive review by all regulatory agencies and a new "Watercourse Alteration Permit" before commencement of the work.

When the dredging method produces an unacceptable amount of turbidity, the area to be dredged must be contained by an effective siltation curtain installed prior to the commencement of work.

Infilling of a land based containment area should be carried out from upland areas towards the watercourse to facilitate drainage of the spoils.

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

## Alteration Type: Dug Out Ponds

### Definition

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 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 holding water in order to minimize seepage problems and maintain a constant 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, barns, 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.

Surface runoff will also supply water for 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 bear 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 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 Fisheries and Aquaculture*. 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) The *Department of Fisheries and Oceans* must be contacted before any fish are placed in a pond.

#### Application Review Process

Regulatory and Advisory.

#### 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 15.0 metres.

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

- 1) Compaction by heavy machinery on well graded 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.

#### 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 one metre 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 on the sides of the pond.

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

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A "Inland Aquaculture License" must be obtained from the Department of Fisheries and Aquaculture 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 embankments and any other exposed soil within 30 metres of a watercourse must be seeded immediately after the pond has been excavated.

## Alteration Type: Erosion Control Works

### 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 debris within the watercourse.*

### Objectives

To prevent loss of bank material 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:

#### Vegetative Measures

- vegetation - in the form of grasses, shrubs, trees and vines.

#### Structural Measures

- rip rap - which is a layer of boulders, cobbles or rock fragments placed over an exposed surface 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, will not allow vegetation to become established.

### Environmental Considerations

Other 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 plants prevents the rip rap and stones used in the rock filled wire baskets from overheating, which in turn helps prevent 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 and rainfall and to aid in the growth of vegetation until the vegetation becomes well established or the site is permanently stabilized. 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 a cold season where plant growth is impossible. Mulch improves water infiltration, reduces rainfall impact, and re-

duces 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 area.

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, right, north, south, east, west), 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 **provisional permit** may be obtained for rip rap if the activity is restricted to the time period between June 1st and September 30th and all other specifications included in the application package are met.

### Other Government Agencies Involved

Unless riparian rights have been granted, lands below the normal high water mark are provincial Crown lands and the *New Brunswick Department of Natural Resources and Energy* should be contacted to verify this.

### Application Review Process

Regulatory, and in some cases, Regulatory and Advisory.

## Vegetation

### Definition

*Trees, shrubs, vines, grasses or other plants used to stabilize and protect the banks of a watercourse from the erosive action of 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 prevent thermal pollution of the water.

### Planning Considerations

#### General

If the banks are stable and have slopes of 2:1 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.

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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 regulates the water temperature and provides cover for the fish in the water and wildlife on the shoreline.

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.

## Guidelines

Plants chosen for erosion control should require little maintenance and be suited for the soils and climate of the site. Conditions throughout the province vary greatly and plans for vegetative stabilization must be adapted to each specific site. In general, the plants must be capable of having dense growth and fibrous roots 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 may be adapted to specific conditions.

Staff from the offices of the New Brunswick Department of Agriculture or the New Brunswick Department of Natural Resources and Energy 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 plant type.

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 on an exposed surface 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 action of waves, ice, or 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 2:1 or if the velocity of the flowing water prevents the use of vegetation. Rip rap depends on the soil beneath it for support, therefore it can not be used on unstable slopes. If the banks are unstable, excessively steep or vertical, rock filled wire baskets or retaining walls must be used.

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 culvert 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 grading the surface of the banks, placement of a filter layer followed by placement of the rip rap. The filter layer is used to prevent washout of the soils underlying the rip rap. A light, woven geotextile material, pulled flat or a layer of clean gravel may be used. This will also support the stones, prevent settling, and allow groundwater to drain through the structure.

## Guidelines

The rip rap should be clean, inorganic, 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 edge of the bank.

The rip rap should be placed such that it does not encroach upon the main channel.

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 protection, it should be in place before water is allowed to flow through the pipe.

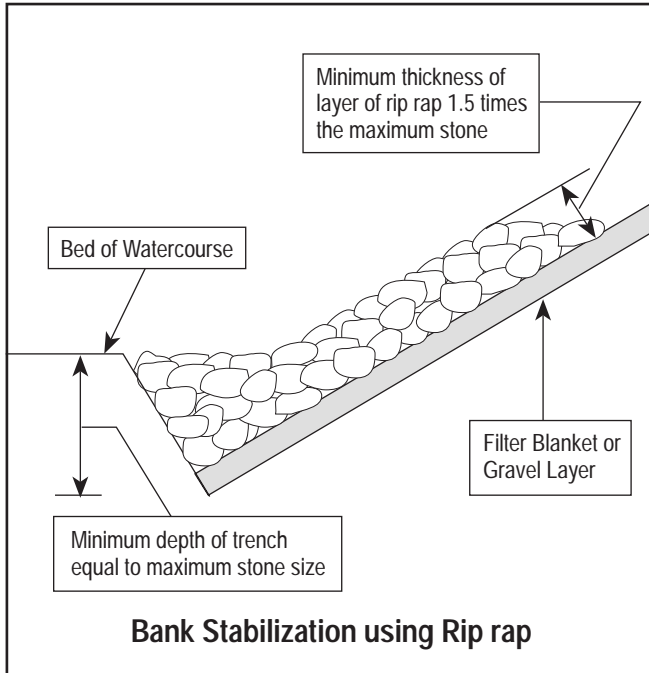
The slopes where the rip rap is to be placed should be graded to a slope no steeper than 2 horizontal to 1 vertical. A uniform grade may be obtained with clean, well graded fill material which can be added and compacted as needed.

The minimum thickness of the layer of rip rap should be 1.5 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. It should be placed as a dense, well graded mass of stone with minimal voids.

Rip rap used to control erosion along the banks of a flowing watercourse 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.

The rip rap should be installed in a downstream direction.



Once the rip rap is installed, it requires minimal maintenance but it should be checked periodically to ensure that none of the stones have become dislodged.

## Rock Filled Wire Baskets

### Definition

*Woven wire baskets filled with rocks large enough that they will not pass through the openings of 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 action of waves, ice or debris.*
- 2) *control channel meander, protecting adjacent or downstream facilities or resources.*

### 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 2:1. They are also used at culvert outlets and bridge abutments and piers to prevent undermining of the structures.

If properly installed using suitable materials, rock filled wire baskets have a life span of approximately 30 to 50 years.

### 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.

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

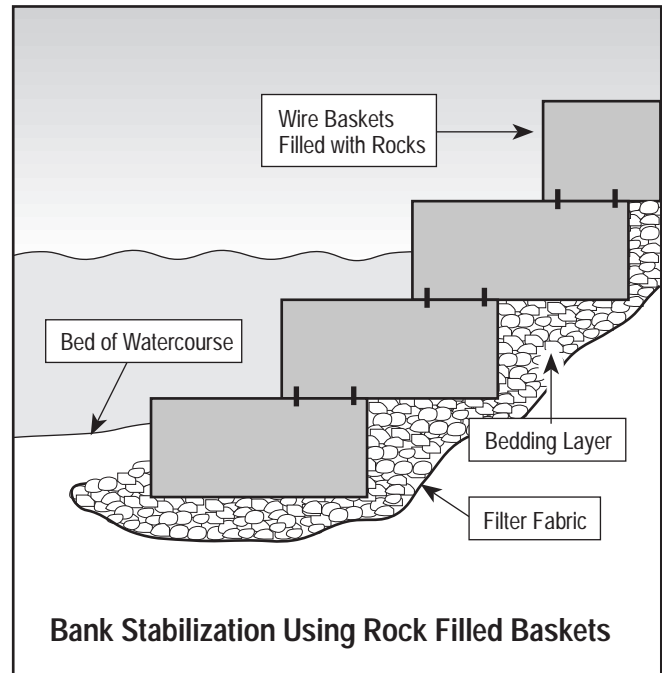
The wire baskets must be filled with clean stone material which is larger than the mesh size and obtained from a non-watercourse source.

When more than one tier is used, the wire baskets must be terraced and tied together to add stability to the structure.

The backfill material behind the wire baskets must be compacted to prevent future washout during high flows.

The wire baskets must be keyed into the bed of the watercourse to prevent undermining.

Filter fabric should be placed under the baskets if underlain by exposed soil.



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## 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 waves, ice, or debris.*
- 2) *prevent bank failure.*

### Planning Considerations

#### General

Retaining walls can be used on steep or vertical banks.

### Guidelines

To prevent bottom scour, the retaining wall should be buried into the bottom of the bank below the anticipated depth of scour.

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, no wood treated with creosote or pentachlorophenol should be used below the normal high waterline.

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

Because the potential for erosion where retaining walls are being used is high, they should be placed immediately following bank preparation.

The retaining wall should be well anchored to the bank for stability.

# Alteration Type: Flood Protection Works

## Definition

*Flood protection works involve to the construction and maintenance of flood reservoirs, channel alterations, dikes 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 has 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.

Streamflow and water level data has been collected at several stream gauging stations in New Brunswick. By applying regional analysis to the data, estimates of flood frequency can be obtained at ungauged 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, and
- 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. dikes, 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



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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 practise 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.

A combination of proposed measures to provide flood protection to an area could be presented as having a "Factor in Common", and thus an application for a multiple permit can be made.

### **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 against a flood protection work must be considered during design.

# Alteration Type: Floodwater Diversion Channels

## Definition

*A Floodwater Diversion Channel is a channel 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 twenty year return period. A 20 year return period flood has a magnitude expected to be equalled or exceeded on the average of once every twenty years over a long period; such a flood has a five-percent 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, when flood diversion channels are constructed, that 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 "Flood Protection Works".

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, Guidelines for "Flood Protection Works".

## 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 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 alteration 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 alteration permit for the construction of Floodwater Diversion Channel must include **three copies** of the following documents stamped by a person licensed to practise 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.

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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: Fords

## Definition

*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 in 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 disturbance to them.*

*Acceptable fording sites can occur naturally, but in most cases, the site must be upgraded.*

## Objectives

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

To prevent siltation of the watercourse.

## Planning Considerations

### General

A ford should only be considered as an alternative to bridge or culvert construction if crossing is to be kept to a minimum and confined to the low flow period between *June 15th and September 15th* every year. A ford should not be considered if the crossing would be subjected to extensive and/or year round use.

A watercourse alteration permit is required to construct or upgrade a ford, 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 alteration permit provided that there is no damage occurring as a result of this use. 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".

The Technical Approvals Section of the Department of the Environment and Local Government should be contacted prior to using any ford.

### Environmental Considerations

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

It is the responsibility of those using the ford to ensure that no damage occurs to the watercourse or to the bed and banks of the watercourse.

### Location

The bottom and the banks of the channel at the fording site must be stable and nonerodible. A natural bedrock or coarse rock channel

bottom is preferable for a fording site, but coarse rocks may be added to an otherwise stable channel bottom. Fording a watercourse that has a silty or sandy bottom can result in increased turbidity caused by the suspension of fine particles.

The slope of the bank and approaches to the crossing should be low, so that creating an access 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 methods;
- a description of the ford, including information on the bed of the watercourse, the nature of the ford, (temporary or permanent), the vehicles that will be using the ford.

### Application Review Process

Regulatory Only.

## Construction

### General

Construction of a ford should not result in major alteration of existing 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, nonerodible rock, of baseball to basketball size, preferably angular should be added to create a stable bottom.

Approaches to the ford can be stabilized by adding clean gravel, concrete slabs, or constructing a corduroy road from round timbers.

Complete removal of temporary fords is required when their use is no longer necessary. If left in longer than required, temporary fords can block fish migration during low flows and eventually become dams by collection of debris. Approaches to the ford left unrestored erode with serious consequences to downstream aquatic life.

### Guidelines

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 channel material.

The approaches to the ford must be at right angles to the watercourse.

The ford may be lined with clean, non-ore bearing, angular shaped stone, obtained from a non-watercourse source, with a minimum dimension of 150 millimetres, or gabion mats where the natural bed material does not consist of bedrock or cobbles.

A minimum of 150 millimetres of water must overtop the structure

at all times or flow channels 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 loosing fuel, lubricating oil, hydraulic fluids, or their cargo.

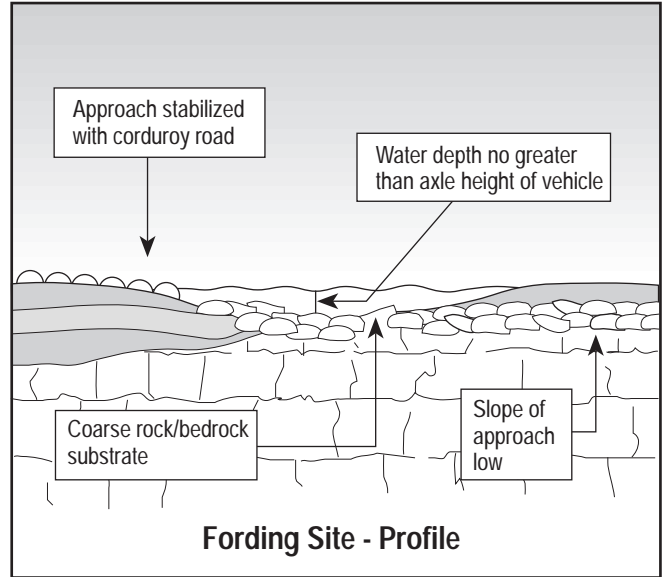
Nothing may be skidded or dragged across the ford.

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.

No material in the wetted portion of the watercourse may be manipulated when fording the watercourse.

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



# Alteration Type: Instrument Pools and Wells

## Definition

*Instrument Pools and Wells are natural or artificial sites on watercourses where measurement devices are used for hydro technical purposes in sheltered or preferred conditions.*

## Objectives

To obtain a systematic record of water level and flow in 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.

## 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.

## Environmental Impacts

- 1) Destabilization of the bed and bank of the watercourse may result in the movement of sediment 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 standard information required on the application form, the following must be included:

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

## Other Government Agencies Involved

The approval of the *Canadian Coast Guard*, Marine Navigation Services, which administers the **Navigable Waters Protection Act** must be obtained for any structure to be placed in or across any navigable watercourse.

## Application Review Process

Regulatory Only.

## 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 upon completion of the project.

Excess backfill material is to 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 original channel profile and cross-section restored.

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 causing any damage to the watercourse or aquatic environment.



## Alteration Type: Land Extensions

### Definition

*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 without destroying aquatic habitat.

To maintain fish passage.

To minimize sedimentation of the watercourse and prevent erosion as a result of the construction of the land extension.

### Planning Considerations

#### Environmental Considerations

Land extensions may be used to replace land lost to erosion. Although they are permitted by the Watercourse Alteration Program, they are subject to advisory review and if approved, 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, or productive spawning grounds.
- 3) Erosion and scour - Reducing channel capacity results in alteration of the flow regime which leads to increased flow velocity and downstream erosion and scour. In standing bodies of water, disrupting 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 portions 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.

### Other Government Agencies Involved

- 1) Artificially created land extensions must not illegally impinge on public or private ownership rights. Most lands below the high water mark are Crown Lands. Some are privately owned. To verify land ownership rights, the original grant documents should be checked or the Crown Lands Branch of the *New Brunswick Department of Natural Resources and Energy* be contacted.
- 2) The approval of the *Canadian Coast Guard*, Marine Navigation Services, which administers the **Navigable Waters Protection Act** is required for any structure to be placed in or across any navigable watercourse.
- 3) The officials of the incorporated municipality in which a land extension is proposed 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 bark wastes, automobile bodies or other material detrimental to aquatic life or water quality.

The fill material used for a land extension must 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. This structure must be removed only after the structure is stable and not subject to 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 side of the land extension facing the watercourse must be stabilized with rip rap. Please refer to Guidelines for "Erosion Control Works".





## Alteration Type: Miscellaneous Drainage Changes

### Definition

*The term miscellaneous drainage changes is intended to describe minor adjustments to the drainage pattern of an area within thirty metres of the edge of the bank of a watercourse which are required in the development of an area.*

*Activities occurring within 30 metres of the edge of the bank 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;*
- *depositing fill, seeding, landscaping;*
- *excavating a foundation for a home, cottage or other building;*
- *constructing roads, pathways, or parking areas;*
- *digging a well;*
- *re-grading an embankment or levelling the natural topography;*
- *installing a fence;*
- *grazing by animals, tilling, plowing, seeding, and harrowing of land and harvesting of plants that occurs within 5 metres of the edge of the bank of a watercourse;*
- *installing storm sewers.*

### Objectives

- 1) To prevent an increase in the amount of surface runoff entering the watercourse;
- 2) To prevent sedimentation of the watercourse or destruction of aquatic habitat.

### Planning Considerations

A watercourse alteration categorized as a miscellaneous 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 prevent the introduction of fill or other sediment into the watercourse, it will generally be required that a buffer zone of undisturbed land be left between the watercourse and landscaping projects.

### Application Review Process

Regulatory Only.



## Alteration Type: Pipeline/Cable Crossings

### Definition

*Locations where distribution or transmission pipelines carrying petroleum products, sewage or water, or where fibre optic, or electrical cables cross a watercourse.*

### Objectives

To provide a continuation of the pipeline or cable across the watercourse without creating a barrier to fish passage.

To prevent the harmful impacts from the installation technique 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 techniques. The following variables must be included in the evaluation:

- approach slope 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 bottom sediments

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

### 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 erosion and instream work. Unless the installation method involves no instream 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 caused by turbidity and sedimentation.

Interference with fishing operations 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 method.

### Other Government Agencies Involved

- 1) The approval of the *Canadian Coast Guard*, Marine Navigation Services which administers the **Navigable Waters Protection Act**, is required for any structure to be placed in or across any navigable waters.
- 2) The *Department of Fisheries and Oceans* must authorize the use of any explosives in Canadian fisheries waters.
- 3) All pipelines exceeding five kilometres in length, except water, steam, or domestic wastewater pipelines as stated in **Schedule A, of Environmental Impact Assessment in New Brunswick** must be registered with the Project Assessment Section of the Environmental Management Branch of the New Brunswick Department of the Environment and Local Government.

### Application Review Process

Regulatory and Advisory.

### 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

**Plough Method** - involves ploughing in the pipeline, where the pipeline is fed or dragged into the furrow created by the plough. This method is used on soft bottomed watercourses where limited sedimentation is tolerated and for small diameter lines/cables.

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

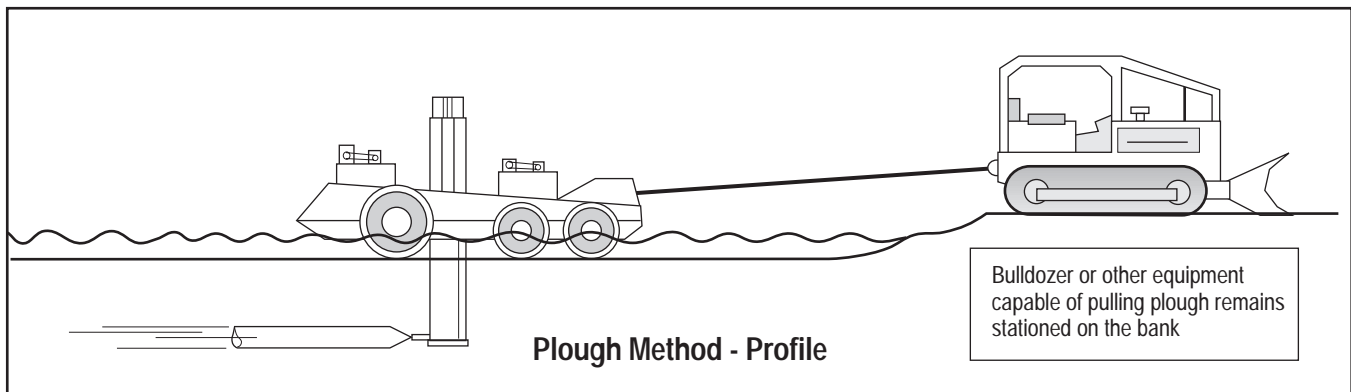
**Back Hoe Method** - is the most commonly used technique which involves trenching through the watercourse with a hydraulic hoe. The Back Hoe method is used in shallow watercourses where sedimentation is not a concern.

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



**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

**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 to the banks or tanks on barges.

Advantages:

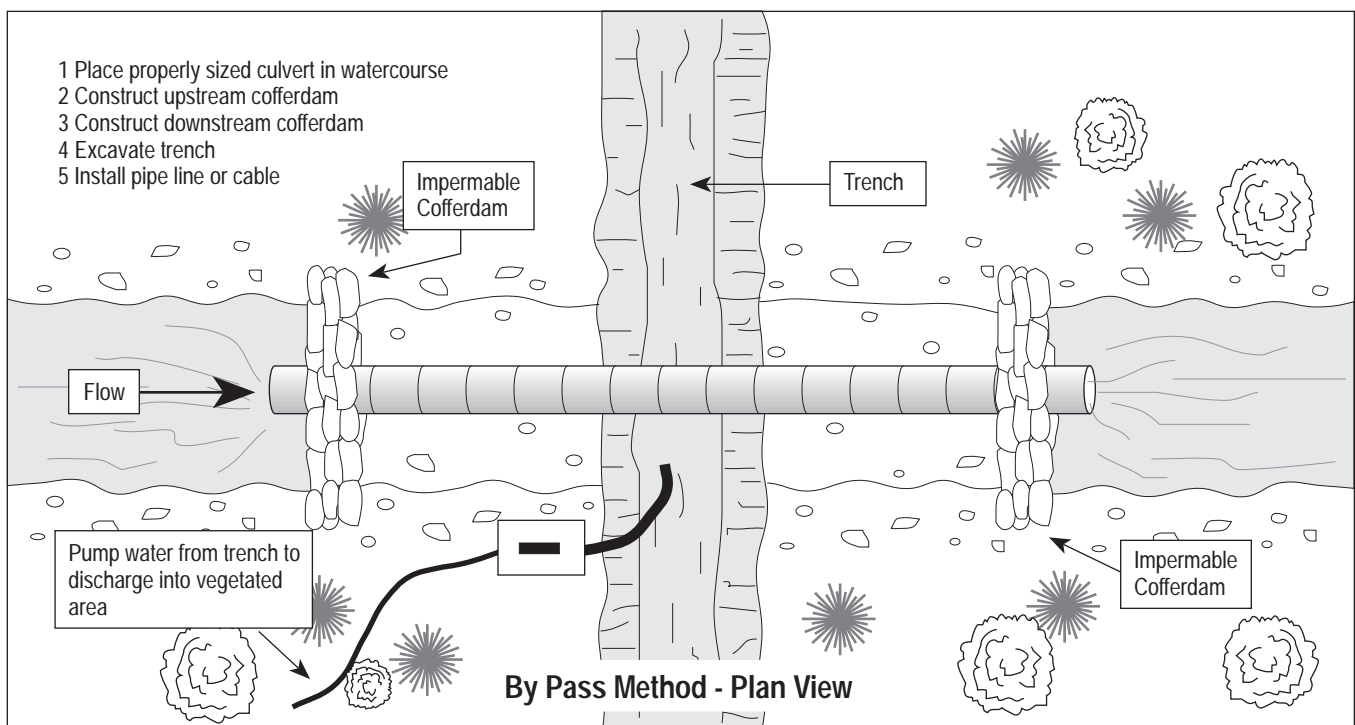
- minimal sedimentation during trenching
- maintains channel flow
- maintains fish passage
- no instream spoil storage

Disadvantages:

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

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 dried up reach
- by pass pipes can be crushed or blocked
- some bank and stream bed disturbance may be required
- conditions in by-pass pipe, such as slope and velocity of flow, may prevent fish passage



## 2) WORKING IN THE DRY

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

**By-Pass Method** - involves blocking the water upstream from the crossing and diverting the flow past the site in pipes laying 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 a concern and should be carried out during low flow periods.

Advantages:

- limited sedimentation
- maintains channel flow
- capable of maintaining fish passage

**Dam and Pump Method** - damming the flow upstream and downstream of the construction site and pumping the water around the site using hoses. This method can not be used for high flows; it must be used in 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 dried up reach
- barrier to fish
- pumping must be carried out 24 hours a day

### 3) DIVERSION CATEGORY

**Coffer Dam Method** - involves installing a coffer dam approximately two thirds of the way out into the watercourse, 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 coffer dams 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 wide section of watercourse
- increased water velocity
- possible increased erosion on opposite bank

- terrestrial damage

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

### 4) TRENCHLESS CATEGORY

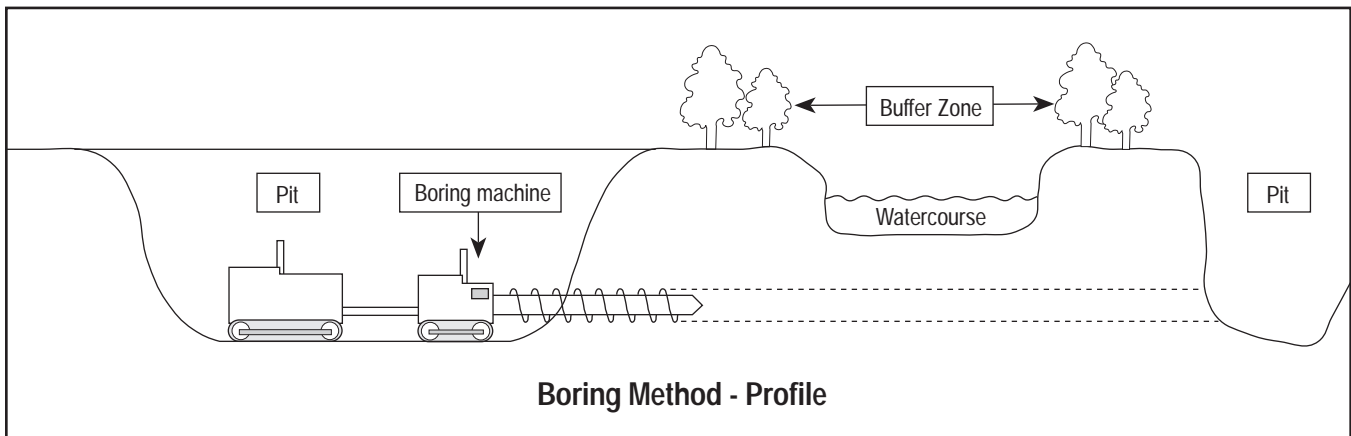
**Boring Method** - involves boring under the watercourse from a pit on one side of the watercourse to a pit on the other side, with, or without casing. This method is suitable in situations where the bed of the watercourse cannot be disturbed and where the water table is low.

Advantages:

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

Disadvantages:

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



- potential washout of coffer dam
- slow
- uses large area of right-of-way and creates terrain disturbance

**Channel Diversion Method** - involves constructing a temporary plastic lined diversion channel around the worksite and diverting the flow from the watercourse 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

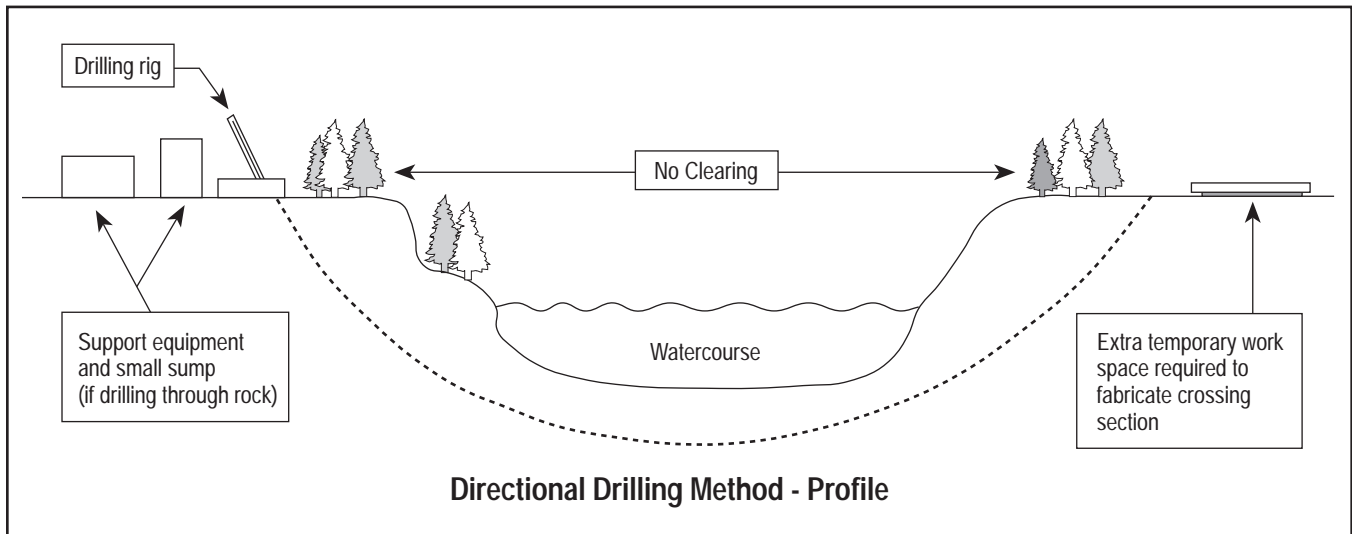
**Directional Drilling** - accomplished by setting up a drill rig on one approach slope and drilling to a target on the opposite approach slope. Can be used in large watercourses with sensitive aquatic habitat and where there is no instream activity allowed.

Advantages:

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

Disadvantages:

- disturbance of drilling and target area
- disposal of drilling fluids
- fractures in substrate may release pressurized drilling fluids into watercourse



## 5) AERIAL CATEGORY

**Bridge Attachment Method** - involves attaching line to an existing bridge structure. 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 bridges are abundant.

Advantages:

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

Disadvantages:

- possible visual impact
- safety
- visibility of pipeline may lead to damage 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 walls 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 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.

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 instream 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.



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## 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 refilled with material that was excavated and the original grading and elevation restored; 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 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 fluctuations in water levels as a result of 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 destroy the banks of watercourses and 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 full description of the proposed removal procedure.

### Other Government Agencies Involved

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

- 1) The *Department of Fisheries and Oceans*.
- 2) The Fish and Wildlife Branch of the *New Brunswick Department of Natural Resources and Energy*.
- 3) The Crown Land Branch of the *New Brunswick Department of Natural Resources and Energy*.
- 4) The *Canadian Coast Guard*, Marine Navigation Services.
- 5) *Environment Canada*.
- 6) The Project Assessment Section of the *New Brunswick Department of the Environment and Local Government*.

### 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 edge of the bank 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

In general, minor obstructions should not have to be removed except for temporary or deteriorated crossing structures. The need for the removal of these structures is discussed in Guidelines for "Watercourse Crossings and Bridges".

### Application Requirements

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

- a proposal outlining the need for removing the structure;
- a fully dimensioned sketch clearly showing the size, shape and alignment of the structure to be removed;
- a full description of the proposed removal method.

### Application Review Process

Regulatory Only.

### Guidelines

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

After the removal is complete, the work area and any associated disturbed soil within 30 metres of the edge of the bank 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 and in such a way that it will not be returned to the watercourse during periods of high flow.

For culvert removal, the flow must be pumped around the site or diverted through a temporary plastic lined channel while the pipe is being removed. The banks must be completely stabilized to prevent sedimentation.



## Alteration Type: Tree and Brush Removal

### Definition

The harvesting or cutting of trees or brush within 30 metres of the edge of the bank of the watercourse.

### Objectives

To maintain a buffer zone by controlling activities within 30 metres of a watercourse 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 (for reptiles, amphibians, birds, wildlife)

### Planning Considerations

#### General

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

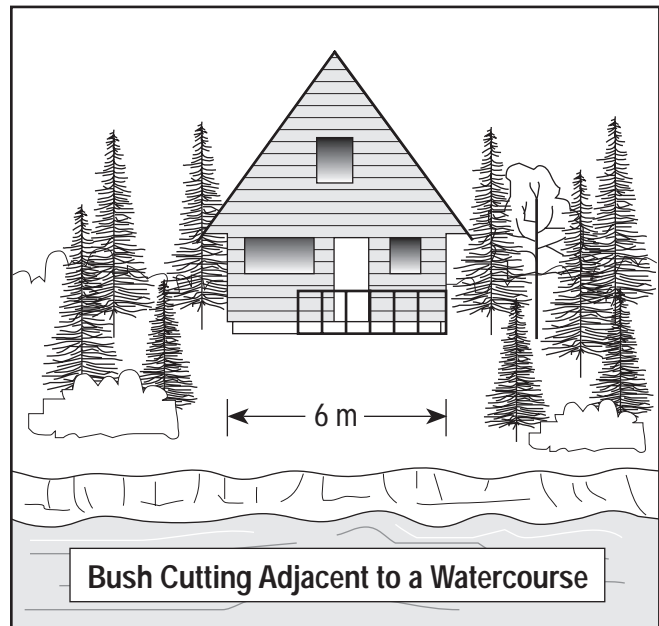
**Selective Harvesting** - is harvesting of some of the merchantable trees. Only 30% of the total merchantable trees may be removed from the 30 metre buffer zone. The harvested trees must be evenly distributed, and harvesting is only permitted in the same area once every ten years. The harvesting activity must not present a threat to stand stability.

**Replacement of Undesirable Vegetation** - involves removing nuisance species of 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 would not adversely affect fish habitat.

**Bush Cutting Adjacent to a Watercourse** - involves removal of a strip of vegetation less than 6 metres in width, for the purpose of providing access to the water, creating a view of the water, or installing telephone or power cables.

Removal of trees or other vegetation within 30 metres of a watercourse may be permitted to facilitate other types of watercourse alterations such as *Road Construction* and *Pipeline/Cable Crossings*.

**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 Alteration Permit. 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. The benefits of a healthy riparian zone are listed below:

**Food Supply** - Insects and organic debris dropping from the vegetation act as food sources for wildlife and aquatic species.

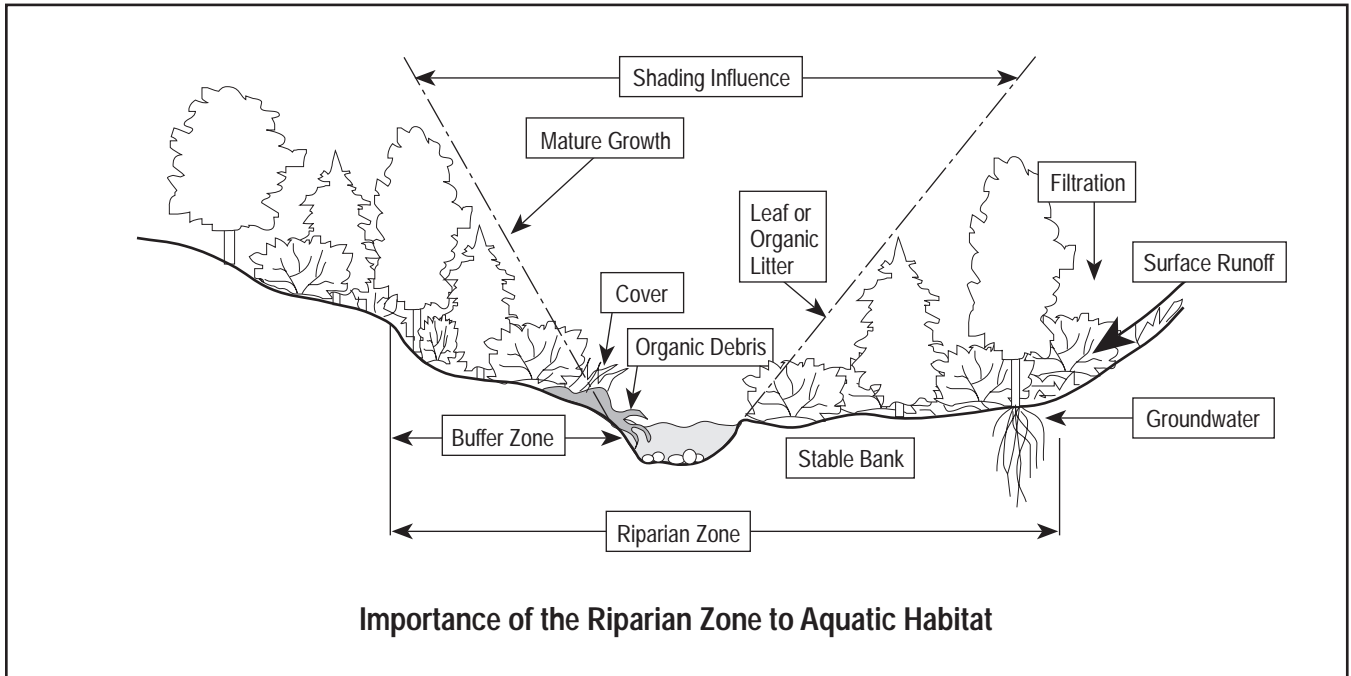
**Shelter** - Vegetation along the banks of a watercourse provide protection to wildlife inhabiting the vegetated zone adjacent to the watercourse. The shelter provides wildlife with secure cover to gain access to the water throughout the year and migration corridors along watercourses.

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

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

**Erosion Control and Stability** - Root systems bind soil particles in place preventing slope failure and erosion of the watercourse banks which in turn preserves 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 which can prevent bank failure.



### Harvesting Activities

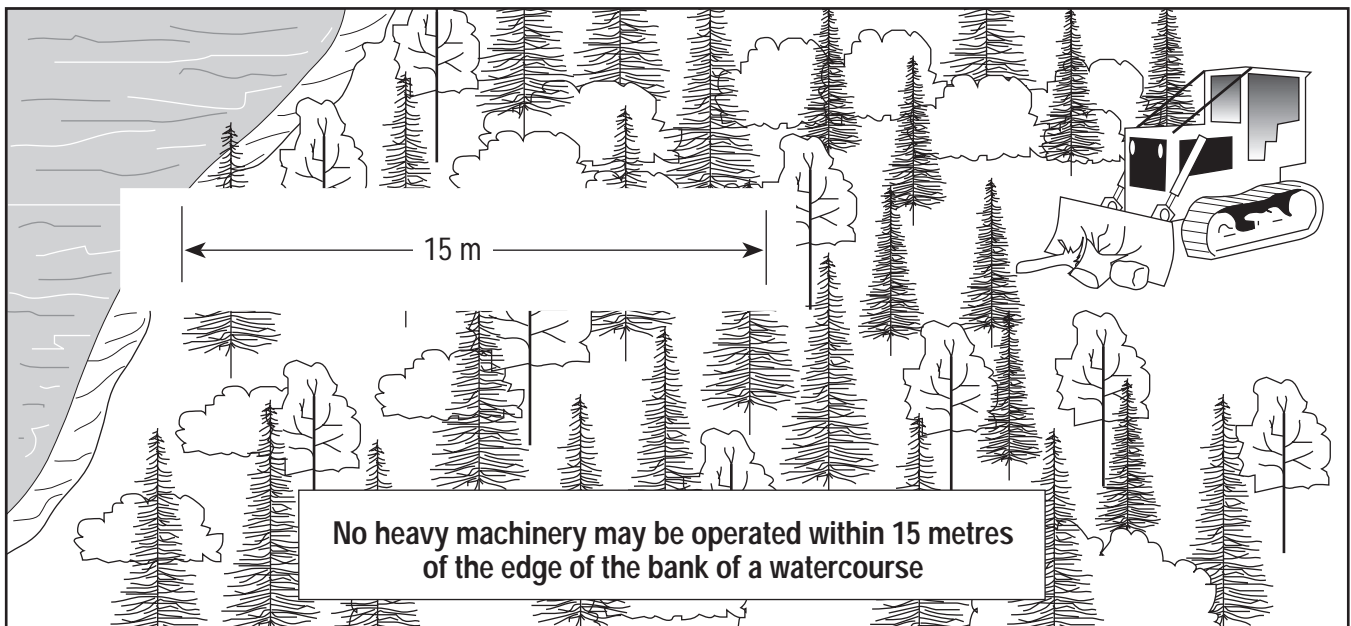
Riparian zone vegetation, aquatic habitat and water quality can be severely impacted by the following timber harvesting activities:

**Clear Cutting** increases the amount of runoff and sediment entering the watercourse by reducing the vegetative canopy and roots, 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 producing 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 and the amount of water percolating through the soil is decreased. Landings and loading areas within 30 metres of a watercourse should be located close to the proposed roadway and on high ground where possible to avoid rutting and blockage of drainage paths.

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

Use of *heavy machinery* such as skidders and porters are not permitted within 15 metres of the edge of the bank of a watercourse unless the equipment is constructing or travelling on an access road which should cross the watercourse at right angles.



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This will prevent the negative impacts of heavy equipment on the trunks, limbs, and roots of the buffer zone vegetation. It will also avoid soil compaction, rutting, and decrease the possibility of depositing debris in 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 or designed to direct the surface drainage water away from the watercourse and into the vegetated buffer zones.

## 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 extent of the proposed project;
- a full description of equipment and methods to be used;
- a description of the vegetation to be removed.

A **provisional permit** may be obtained for *Selective Harvesting*, *Replacement of Undesirable Vegetation*, and *Bush Cutting Adjacent to a Watercourse*, if the activity is restricted to the time period between June 1st and September 30th and all other specifications in the application package are met.

## Application Review Process

Regulatory Only.

## Construction

### Selective Harvesting

To ensure that an adequate buffer zone is maintained, a watercourse alteration permit will usually only be issued for the selective harvesting of 30 % of the merchantable trees bordering watercourses. 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 edge of the bank of any watercourse must be undertaken by manual methods, without the use of heavy equipment.

### Replacement of Undesirable Vegetation

This practise 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.

### Bush Cutting Adjacent to a Watercourse

The above term applies to the removal of all vegetation for the following purposes: to facilitate access to the water; to provide for a view of the water (from a cottage or home); to install telephone or power cables provided that there is no grubbing within 30 metres of the edge of the bank of a watercourse.

**Road Construction** - refer to Guidelines on "Watercourse Crossings".

## Guidelines

### All Tree and Brush 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 can be operated within 15 metres of the bank of the watercourse.

Grappling, bucking, winching and manual methods are to be used when removing trees and brush within 15 metres of the banks of a watercourse.

Vegetation must be maintained along the banks of the watercourse in sufficient quantity to provide 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 trees and slash laying in a watercourse or laying on the ground within 15 metres of the edge of the bank of a watercourse must be removed and disposed of such that it cannot enter 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 Department of the Environment.

No material is to be deposited in or removed from the watercourse.

No instream work is to be carried out at anytime during this project.

### Selective Harvesting

Where alders border a watercourse, no cutting 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 edge of the bank of a watercourse must not result in the exposure of erodible soil material.

### Replacement of Undesirable Vegetation

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.

No work below the normal 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.



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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.

### **Bush Cutting Adjacent to a Watercourse**

Prior to starting the activity, erosion control measures must be installed and adequately 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 by any activity associated with this project, they must be immediately stabilized to prevent erosion.

# Alteration Type: Water Control Structures

## Definition

A structure 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 around 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 water quality.

## General

### Types of Water Control Structures

Water control structures include:

#### 1) Water Release Structures

Water release structures must have the capacity to maintain the reservoir at a safe level and to discharge design floods without damage to the dam and associated structures. Nearly all water release structures are based on one of the following or combinations thereof: spillway, gates and orifice; trough and chute, or siphon.

An overflow spillway may have a crest formed to fit the shape that overflowing water would take.

#### 2) Flow Energy Dissipators

Means of dissipating the energy of falling water over a dam or other structure include plunge pools, deflector buckets, and stilling basins. These structures must be carefully designed to prevent undercutting which affects stability of the energy dissipator and possibly the dam. Therefore, all flow energy dissipators downstream of water release 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 reservoir created by a dam. A gate is a closure device in which a barrier is moved across the path of flow to control the flow and elevation of water. Gates and valves can also be classed as regulating or guard. Regulating gates and valves operate under a full range of flow and pressure conditions. 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 during 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 obstacle. 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 *Department of Fisheries and Oceans*.

#### 6) Flow Diversion Weirs

The purpose of these water control structures is to raise the water levels high enough to allow for controlled diversion into a water supply channel. Flow diversion weirs are widely used for irrigation purposes.

#### 8) Flow Conveyance Structures

These structures convey flow in artificial channels, such as flumes, chutes, and tunnels. They are usually built of concrete, timber or other structural material.

Chutes may be pipes or other lined channels which incorporate a relatively long inclined section with a considerable drop in water level. Chutes are often used on steep slopes where a single drop or series of drops in water level are not practical.

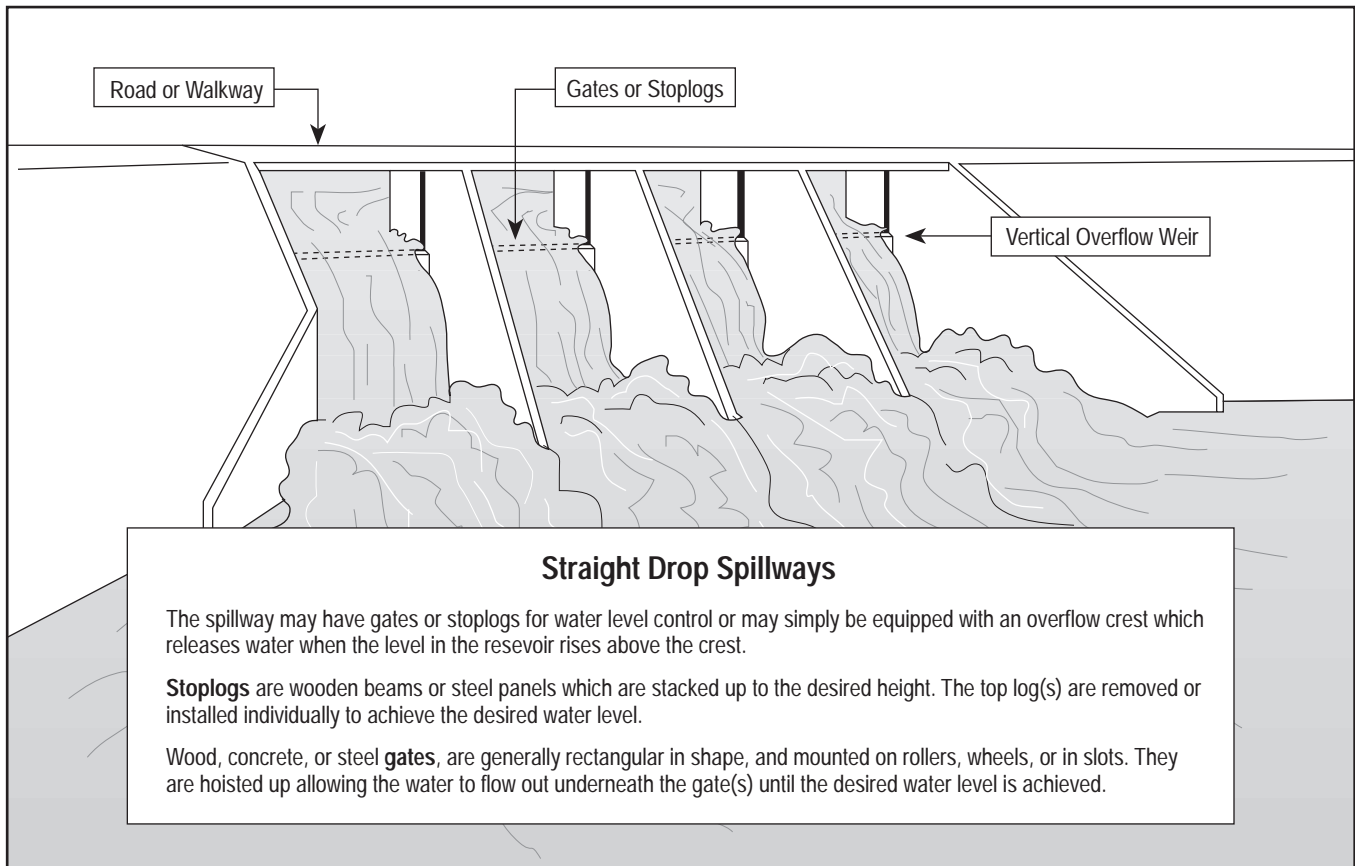
#### 9) Other Regulating Structures

For the purpose of the Watercourse Alteration Program, regulating structures other than those mentioned above are also considered under the category of water control structures.

## Planning Considerations

Adequate design of water control structures is required for the following reasons:

- failure of water control structures can result in damage to property and to the environment
- water control structures may result in changes in flood water velocity, flood stage, streambank erosion, and sediment deposition which may affect other riparian and flood plain landowners
- design of water control structures requires consideration of technical matters 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 practise as a Professional Engineer\*\*** must be included:

- (1) a full description of the water control structure;
- (2) a plan, profile and cross-sectional drawing to scale of the proposed works;
- (3) 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), and
  - the effect of flow regulation and diversion on high, medium and low flow conditions in the watercourse.

**\*\*This requirement may be waived if authorization is received from the Department of Fisheries and Oceans**

In many cases, water control structures are integral parts of other watercourse alterations, and therefore may be included under one application. However, there may be instances where a separate watercourse alteration permit will be required, for example, when new spillways, gates, valves or fishways are constructed for existing dams.

### Other Government Agencies Involved

- 1) The approval of the *Canadian Coast Guard*, Marine Navigation Services 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 than 50 cubic metres of water per day from a watercourse, as stated in **Schedule A, of Environmental Impact Assessment in New Brunswick** must be registered with the Minister of the Environment. Inquiries should be directed to the Manager of the Project Assessment Section of the Environmental Management Branch of the *Department of the Environment and Local Government*.

### Application Review Process

Regulatory and Advisory.

### Guidelines

Fishways must be constructed as authorized by the Habitat Management Branch, of the Department of Fisheries and Oceans.

# Alteration Type: Watercourse Crossings

## Definition

*Watercourse crossings are structures or locations where an access route meets and traverses a watercourse. These generally consist of bridges, culverts, and fords. The following discussion pertains to bridges and culverts. Fords are discussed in a separate chapter. Most crossings are built for vehicular traffic, but many are constructed for pedestrians, trains, pipelines, and recreational vehicles.*

## 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 providing fish with migration paths for spawning, rearing, feeding and wintering.

To prevent sedimentation of the watercourse and erosion of the banks and bed as a result of 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 alter the flow of the watercourse as little as possible, to retain natural stream morphology, and to preserve fish habitat and fish passage. Poorly designed crossings can result in inadequate capacity leading to 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.

The construction and use of bridges and bridge type structures have less impact on aquatic habitat than culverts and are the preferred method for crossing a watercourse. Bridges which maintain the natural bank and bed have the least impact.

## Location

Route selection for access roads should be designed to minimize the number of watercourse crossings. For public access roads, interchanges and merging lanes should be located as far as possible from watercourses. The length of all watercourse crossings should also be minimized by planning to construct them at right angles to the watercourse.

The banks at the location for the crossing should be high and straight.

### Sites To Avoid

Any site where the banks are unstable or eroding or the watercourse meanders should be avoided. Sites where the soils are unstable or erodible (fine sand, silt, or clay) should be avoided if possible.

## 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 Department of the Environment, a design flow is calculated which represents the actual peak flow expected at the location of the crossing. The design flow is based on the drainage area with consideration given to factors such as precipitation and physiography. The waterway opening proposed in the application must accommodate the design flow. In some circumstances, historic data from hydrometric stations located throughout the province is used to estimate the peak flow.

When estimating the waterway opening necessary for the crossing site without the benefit of hydrometric data or the size of the drainage basin, 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 alteration permit is processed.

## Application Review Process

Regulatory, and in some cases, Regulatory and Advisory.

## Construction

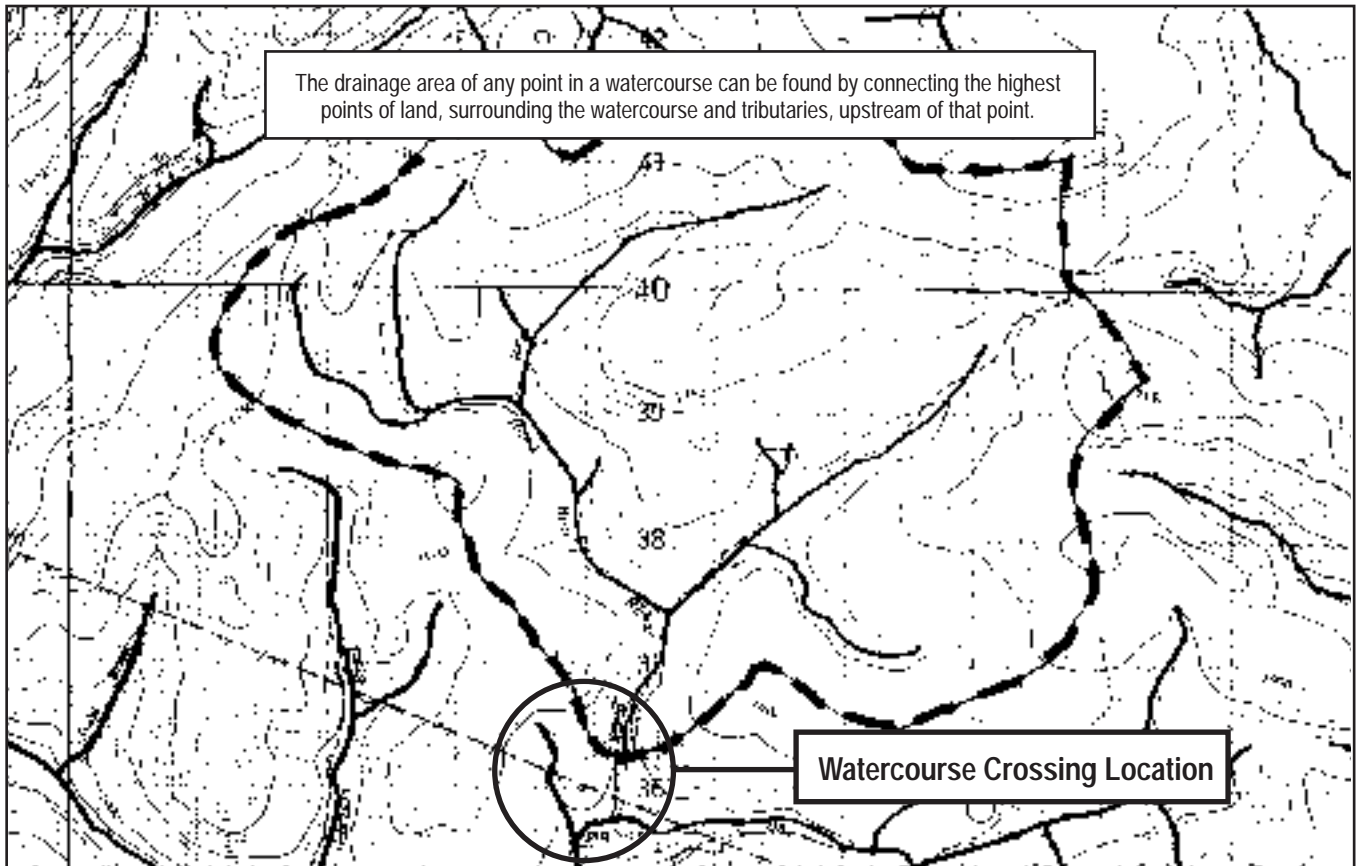
It is important to minimize disturbances caused by the construction phase and to stabilize the site without delay to prevent siltation of the watercourse.

## Instream Work

To minimize environmental impacts caused by erosion and sedimentation the length of the construction period must be kept to a minimum and planned so as not to coincide with periods of increased sensitivity for fish, such as spawning and egg incubation times.

There will be variation in specific conditions 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 low flow period recommended for all watercourse alterations 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 time frame.
- 2) It is easier to isolate low flows in order to work in the dry. Diverting high flows could lead to flooding and the introduction of sediment into the watercourse.
- 3) There will be adequate warm weather after this period to establish vegetation on the disturbed portions of the construction site.



- 4) It is easier and cheaper to move and stabilize soil during this period. Soils are generally either frozen or water saturated at other times of the year making them more difficult and costly to move.

All instream work should be done in the dry to avoid introducing sediment into the watercourse. Use of cofferdams, temporary diversions, or pumping the flow around the site are techniques used to isolate the work area from the flowing water thus keeping the sediment out of the watercourse and providing unobstructed fish passage during the entire construction phase.

### 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 and continue until all disturbed ground has been permanently stabilized to ensure that suspended soil particles in surface runoff water are trapped before being discharged into the aquatic environment.

Some simple and basic principles can be practised 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 natural vegetation as possible when clearing the site for the road and 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 will limit the periods of rainfall on the site and decrease erosion of the disturbed area.

### Road Construction

The potential to introduce sediment into the watercourse is extremely high during road construction. Proper drainage and buffer zone maintenance should help minimize sedimentation.

#### 1) Road Drainage.

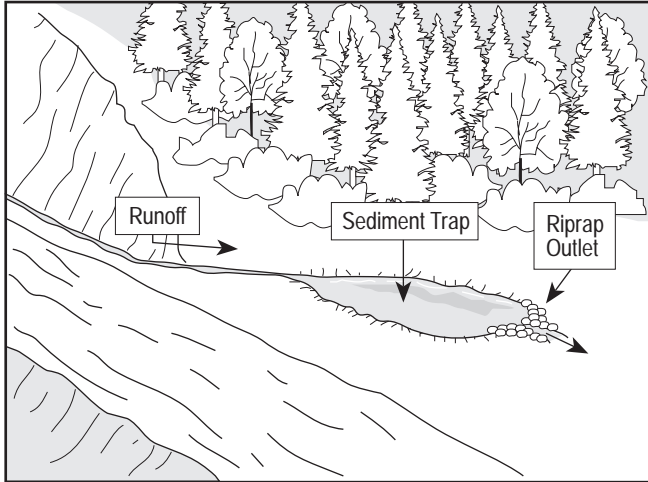
Once the road has been constructed, proper drainage must be maintained by using roadside ditches and cross drainage culverts to prevent excess precipitation from washing across the road and introducing sediment into the watercourse. A well drained road will reduce the amount of sediment entering the watercourse and be capable of supporting heavier loads as well.

Forest roads are often temporary and construction plans do not usually include steps to stabilize roadside ditches. To reduce sedimentation as a result of the exposed channels, roadside ditches are not permitted 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 towards 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 settling pond or sediment trap to remove particles before the water enters the watercourse.



Water bars can be used to control runoff and impede erosion of the road surface and fill. They are ridges or channels constructed diagonally across a road surface to intercept runoff and deflect it towards the ditches instead allowing it to flow down the road surface. The outlet of a water bar should be extended to an erosion resistant area. The suggested spacing for water bars depends on the slope of the road and is given 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 should be placed across the road to dissipate excess runoff flows which have been channelized by the road construction. The recommended spacing for cross drainage culverts is as follows:

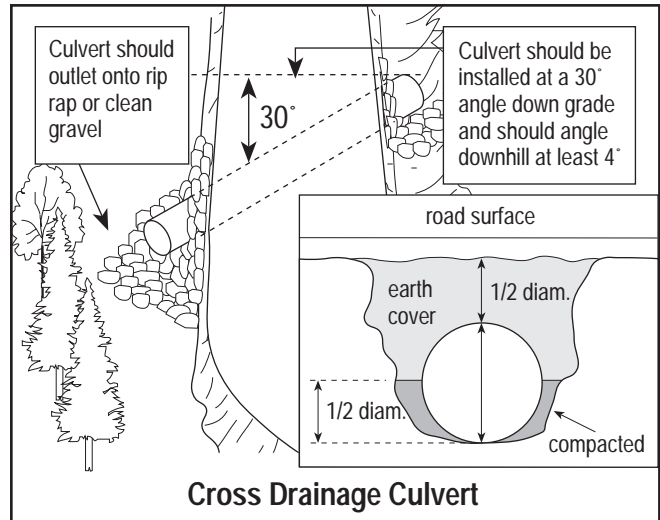
90 metres on gentle (1% to 2%)

45 metres on moderate slopes (3% to 9%)

30 metres or less on steep slopes ( $\geq 10\%$ )

The minimum acceptable diameter for a cross drainage culvert is 300 millimetres (12 inches).

The cross drainage culverts should be installed at a 30 degree angle downslope and they should slope approximately 4 percent.



## 2) 30 Metre No Grub Zone.

Where a watercourse crossing is located, a buffer strip of ungrubbed area at least 30 metres wide must be maintained on either side of the watercourse. For forest roads, with no ditches within 30 metres of the watercourse, grubbing is limited to the area directly beneath the roadbed. For public access roads, where roadside ditches must be equipped with sediment control devices until all areas have been stabilized, grubbing is restricted to the width of the roadbed, fill embankments, and ditches.

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 act as a strainer, filtering out sediment while the water passes through. Many types of sediment barriers are available for use such as: silt fences, (woven geotextile fabric), hay bales, mulch, 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 into the watercourse.

## 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 two percent, the crossing must consist of a structure which will maintain the natural streambed such as a bridge or a pipe arch on concrete footings.

The crossing should be designed to have the structural capacity to carry the loads expected to traverse it.

Crossings should be located upstream of natural barriers to fish migration, such as waterfalls, where possible.

### Construction

Fish passage must be maintained around the work site at all times.

Materials used in the construction of the crossing and the approaches should not be obtained within 30 metres of a watercourse.

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No machinery may be stationed in the wetted portion of the channel; machinery operating from the shore, a trestle or a barge may reach into the water with an extension.

The width of the grubbed zone within 30 metres of the watercourse should be no more than the total width of the roadway, fill embankments and ditches.

Construction debris generated during the project must be prevented from washing downstream, removed from the watercourse and project area and disposed of in the 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 a minimum of six months before being placed in the watercourse.

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.

All exposed erodible material resulting from cut and fill operations within 30 metres of the watercourse must be immediately stabilized to prevent siltation.

All exposed soil must be stabilized within 30 days.

## Road Construction

No grubbing may be carried out within 30 metres of the watercourse except where necessary to remove stumps under the road bed and then not 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, fill embankments and ditches.

Right-of-way widths at stream crossings should be kept to a minimum.

Roads should be graded seasonally to fill wheel ruts and potholes.

Road construction should be avoided in areas of steep slopes or unstable soils.

## Watercourse Crossing Type: Temporary Crossings

### Definition

*Temporary crossings are structures placed in watercourses to 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 the purposes of short term timber harvesting.*

## Planning Considerations

### Environmental Considerations

Where possible, temporary bridges should be used instead of culverts because their installation results in less impact to the aquatic habitat and less disturbance to the bed and banks, and because they pose the least potential for creating a barrier to fish migration.

### Size

Temporary crossings are designed to accommodate peak flows, but only those expected to occur for a specified time 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 Crossings

No watercourse alteration permit is required to cross a frozen watercourse provided that the ice surface is not broken and no water is withdrawn from the watercourse to create a crossing. If water is withdrawn to create an ice bridge, a permit is required.

### Application Review Process

Regulatory, and in some cases, Regulatory and Advisory.

## 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 stream at the intended crossing.

When it is no longer needed, the crossing structure and all construction materials must be removed from the watercourse, the banks and all exposed soil stabilized against erosion, and the channel restored to the original condition.

# Watercourse Crossing Type: Bridges

## Definition

Bridges are structures erected to span a watercourse which supports a roadway or footpath for vehicle traffic or pedestrians. The top of the bridge forms a part of the road surface.

## Planning Considerations

### General

Bridges must be constructed from durable materials providing 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 are preferred as watercourse crossings from an environmental and fisheries standpoint when compared with culverts for the following reasons:

- 1) Bridges retain the natural watercourse bed, thereby allowing uninhibited movement of bedload material.
- 2) Bridges help preserve the natural cross sectional area of the channel therefore maintaining the flow regime.
- 3) Fish pass more freely through bridge crossings; they rarely provide a barrier to migration.
- 4) Bridge construction 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

Bridges must be designed with a hydraulic capacity large enough to pass a peak flow with a 100 year return period. 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.

## Components

The main components of a single span bridge include abutments, stringers, deck and railings.

**Abutments** are the foundation of the bridge, supporting the structure and protecting the banks of the watercourse from the pressure of the traffic using the bridge.

**Stringers** are the pieces spanning the abutments forming a 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; it 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 alteration permits for bridges generally dictate the minimum rise and span of the structure. Permits are sometimes issued specifying the minimum waterway opening only. In these instances, the rise and span must be planned according to 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;

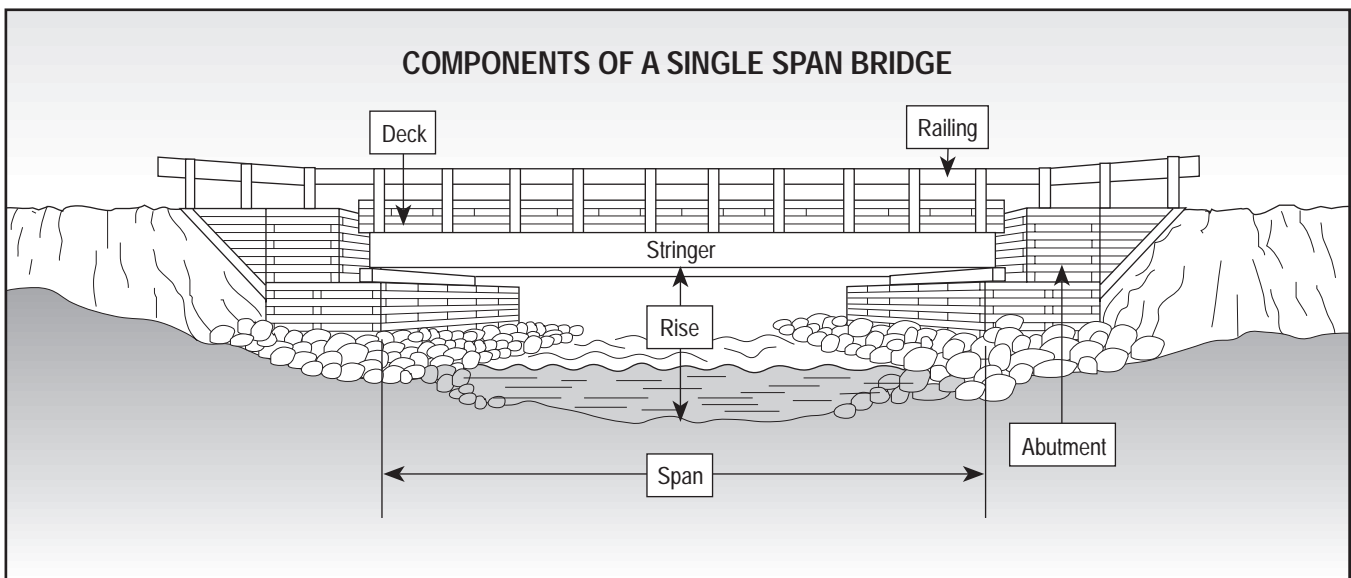
The rise must provide sufficient clearance to keep the roadbed free from flowing waters which may overtop the structure during periods of high flow endangering the road and the aquatic habitat;

The rise must also provide for sufficient clearance for navigation.

## Application Requirements

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

- proposed size, shape and alignment including the rise and span;
- plan, profile, and cross sectional drawings to scale;
- proposed construction methods and materials for each component of the bridge.





A **provisional permit** may be obtained for *replacement* of a single span bridge with another bridge with *equal or greater capacity* if the activity is restricted to the time period between June 1st and September 30th and all other criteria specified in the application package are met.

### Other Government Agencies Involved

- 1) Projects involving multiple span bridges as stated in **Schedule A, of Environmental Impact Assessment in New Brunswick** must be registered with the Project Assessment Section of the Environmental Planning Branch of the *New Brunswick Department of the Environment and Local Government*.
- 2) The approval of the *Canadian Coast Guard*, Marine Navigation Services 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 and in some cases, Regulatory and Advisory.

### Bridge Repairs

Repairs to a bridge do not require a watercourse alteration permit provided that **the following conditions** are met and **there is no instream work involved**:

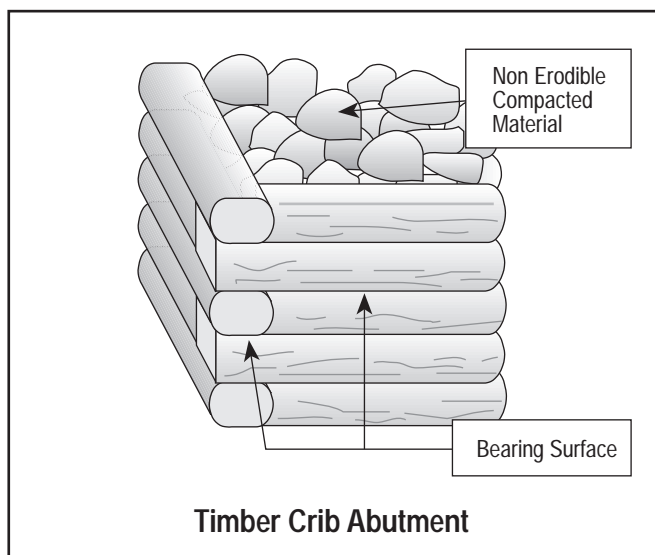
- 1) there is no modification of the size, shape, materials or alignment of the structure.
- 2) that no pollutants, particulates, construction materials or debris be allowed to enter the watercourse.

### Construction

#### Abutments and Piers

Bridge abutments should not constrict the width of the channel and must be aligned 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 bearing surfaces must be squared to create a tightly packed structure. The



cribs should be backfilled with non-erodible material compacted in layers. If concrete is to be used it should be:

- 1) precast and air dried for a period of at least twenty one days before being placed in the water or;
- 2) poured in place in the dry 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 replaced with clean pit run gravel or rock.

### Fish Passage

At all times during the construction period at least two thirds of the channel cross section must remain open to maintain fish passage.

### Sediment Control

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 the dry using cofferdams to isolate the work areas from the flowing water. At least two-thirds of the cross-sectional area of the channel must be open at all times. Cofferdams should consist of: sheet piling or a layer of 6 mil plastic sandwiched between an inner wall of insitu 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 piers are constructed in open water where it is not possible to build a cofferdam, a floating sediment barrier anchored to the bottom should be placed around the work area.

Water pumped from inside the cofferdam should be pumped into a settling pond, behind a filter fabric dam, or onto an adjacent vegetated area where it can be filtered so that any water re-entering the watercourse has a concentration of suspended solids less than 25mg/litre.

### 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.

Bank protection must be provided if bridge alignment results in deflection of flow against either bank.

#### Construction

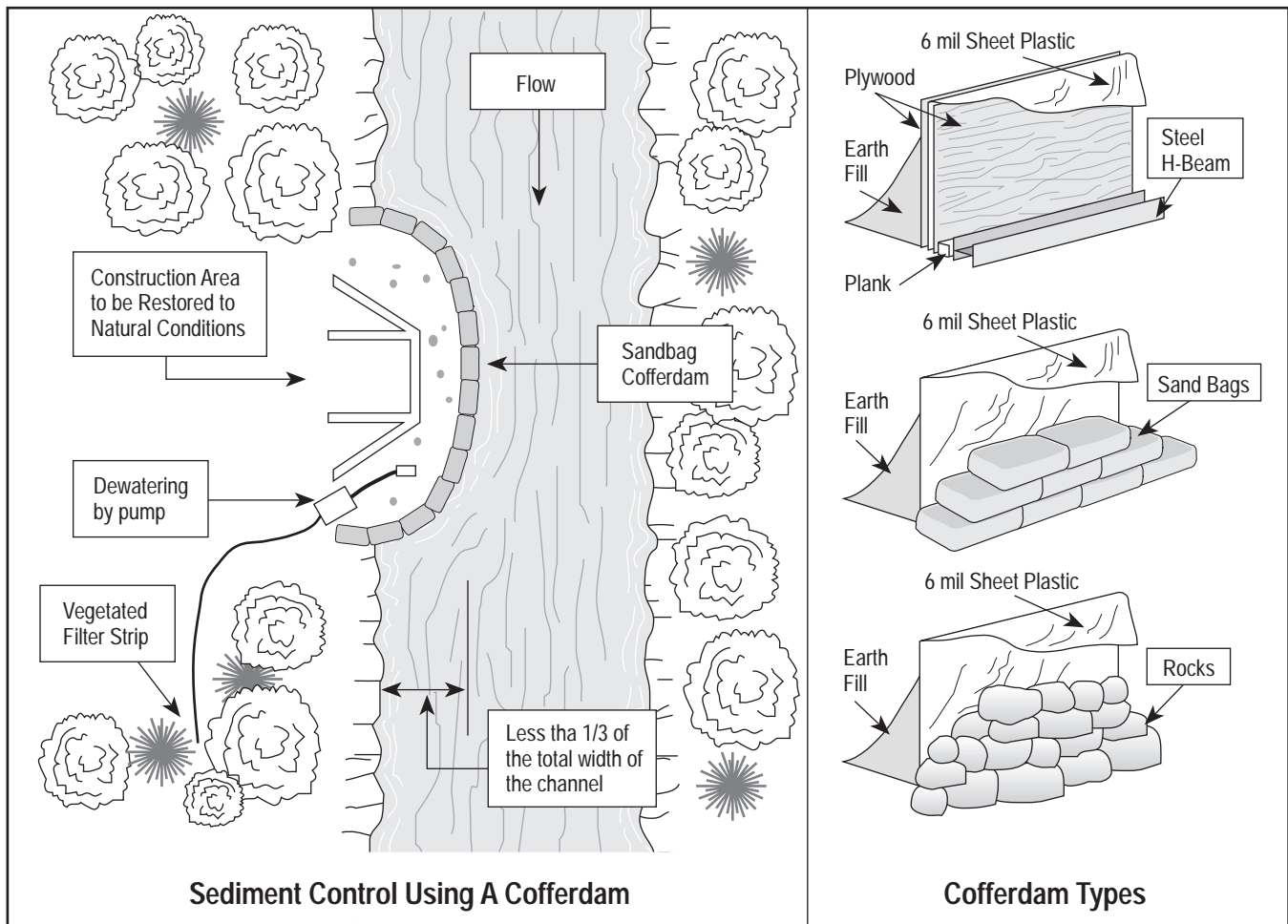
Loose rocks propelled by wave action may undercut or scour the base of the abutments. To prevent this, the abutments and pier(s) should be set below the possible depth of scour.

Rip rap or wingwalls should be placed at both the upstream and downstream ends of the structure to help prevent erosion.

The construction must be separated from the flowing water using cofferdams ensuring that two thirds of the channel cross section remain open at all times.

No excavation may be carried out inside the cofferdam until the cofferdam is completely closed.

The cofferdam material must be completely removed immediately upon completion of the abutments and pier(s) and the substrate of the watercourse restored.



Excavated materials must not be allowed to enter the watercourse. Care must be taken during the placing and removal of the cofferdams to prevent cofferdam material from washing downstream.

Squared lumber must be used to construct bridges consisting of timber crib abutments and wooden decking to prevent soil particles from falling through the cracks into the water.

## Watercourse Crossing Type: Temporary Bridges

### Definition

*Temporary bridges are constructed or prefabricated structures used to provide short term access across a watercourse.*

### Planning Considerations

#### General

Temporary bridges should not be left in the water past the expiry date on the watercourse alteration permit, because the waterway opening was designed for a limited amount of time, possibly during low flow conditions, and the construction materials may not be appropriate for a permanent crossing. They are often constructed from untreated timbers which may collapse or deteriorate over time if left in place.

### Ice Bridges and Ice Crossings

Crossing an ice covered watercourse does not require a watercourse alteration permit as long as the banks are not disturbed and the ice surface remains intact. 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. Logs are sometimes incorporated into the ice layers for extra support.

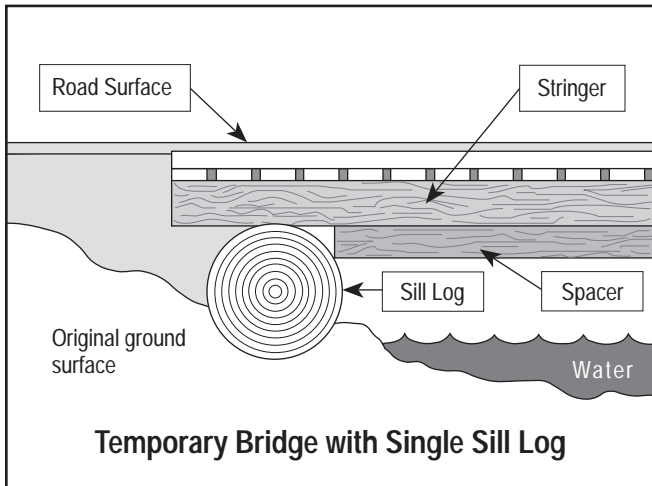
### Guidelines

The span of the temporary crossing 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.

Temporary bridges composed of more than one tier of sill logs on each side of the watercourse must have spacers placed on the bed of the watercourse which fill the space between the bottom sill logs.

The structure must be *completely removed* when the project is completed, the approach material removed back to the original banks of the watercourse, the channel restored to its original cross-section and all erodible material stabilized with rock, hydro-seeding or hay mulch.



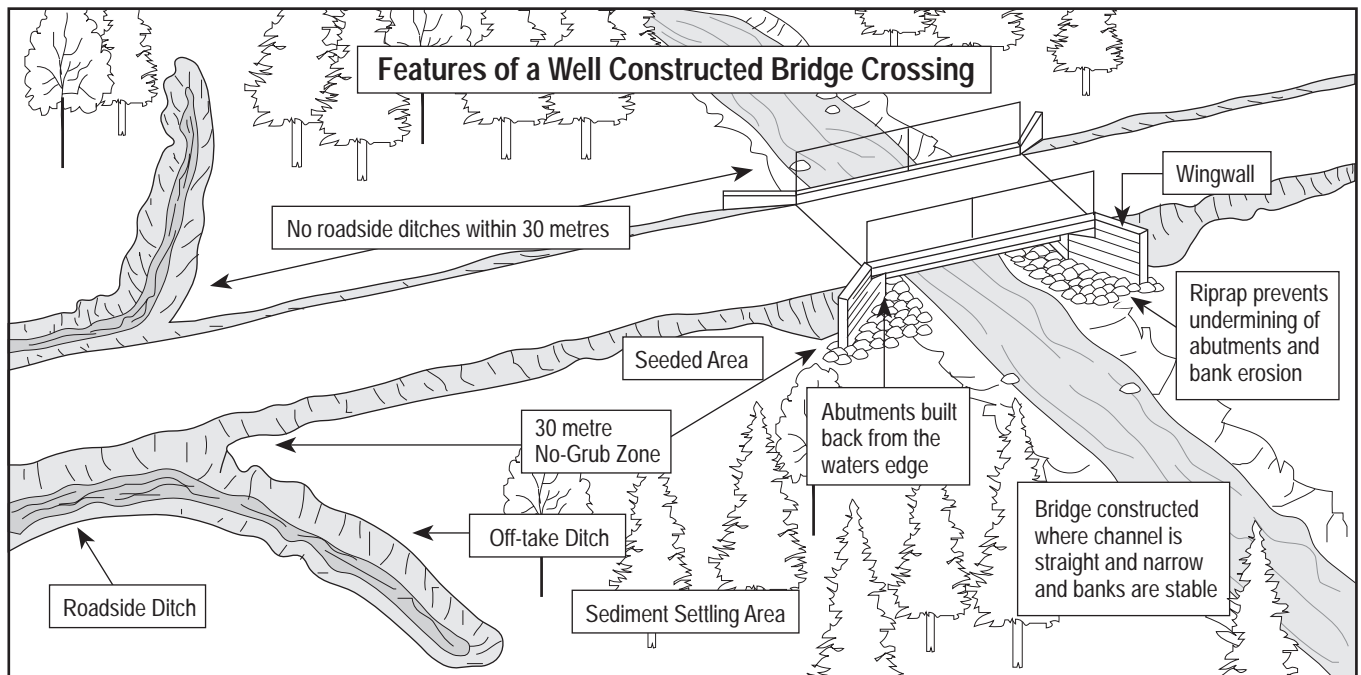
Evergreen boughs or straw bales must be placed across the approaches to the bridge after the structure is removed to help trap the sediment before the runoff enters the watercourse.

### Ice Bridges

Ice bridges that may cause jams, flooding, or impede fish passage must be removed before spring breakup.

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.

If logs (tied together) are used to reinforce the ice bridge, they must be removed before spring breakup.



# Watercourse Crossing Type: Culverts

## Definition

A culvert is a fiberglass, metal, concrete, plastic or wooden conduit used to convey water under an access route. Culverts are used to provide temporary or permanent access across a watercourse.

## 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 are also 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, fiberglass, 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

Installation of culverts results in the loss of natural streambed and an alteration of the natural flow regime which has a negative impact on aquatic habitat. A improperly sized culvert may result in blockage of fish passage and/or flooding. For these reasons, bridges are recommended for major crossings.

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. Culvert designs which retain the natural morphological features of the watercourse, such as width and slope, are better at providing protection for aquatic habitat than circular pipes which constrict the natural flow.

### Size

The importance of properly sizing the culvert cannot be overemphasized. An undersized culvert results in increased water velocity within the pipe providing a barrier to fish passage and produces scouring at the outlet. An oversized 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. The allowable ratio of headwater depth to diameter of any circular culvert may not exceed 1.5. For pipe arches, the ratio may not exceed 1.0 if the height of the cover is limited. The minimum acceptable culvert that may be placed in a natural watercourse or in an artificial channel that was constructed to replace a natural channel is a circular pipe 750 millimetres in diameter.

### Shape

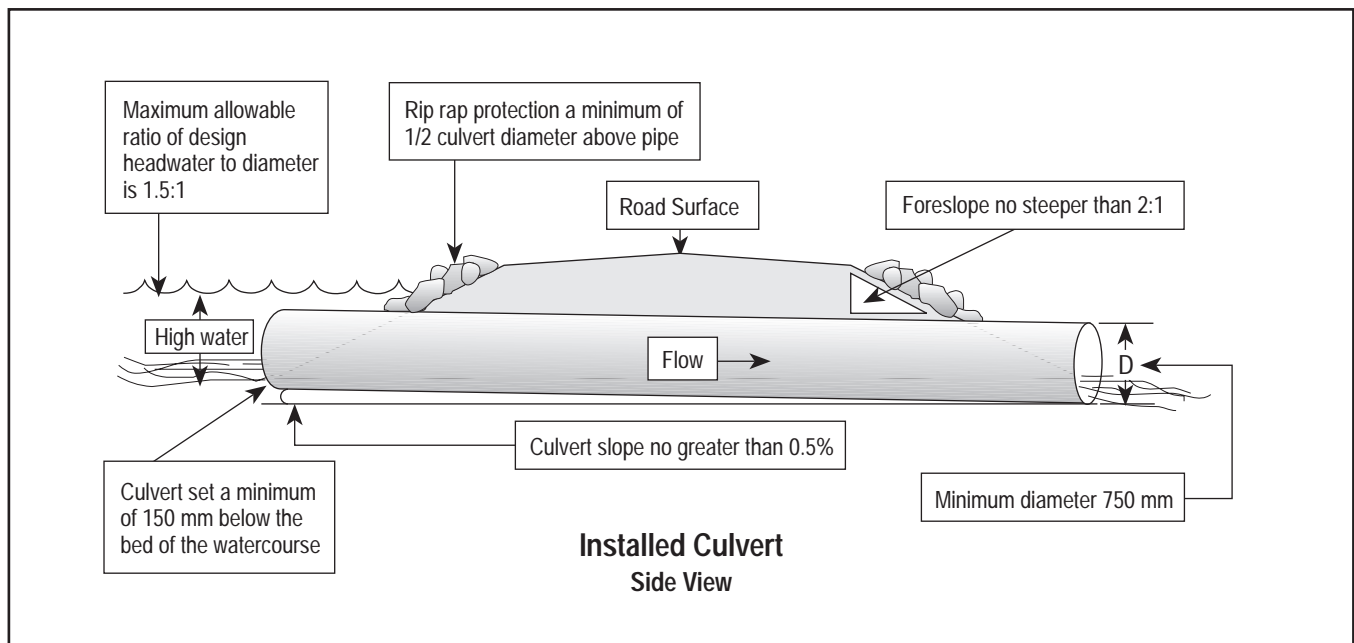
The hydraulic capacity of a culvert should not be less than that of the natural channel. Elliptical shapes are preferred over circular culverts which tend to reduce the cross sectional area and the hydraulic capacity. Reducing the area at the point of crossing may cause the following:

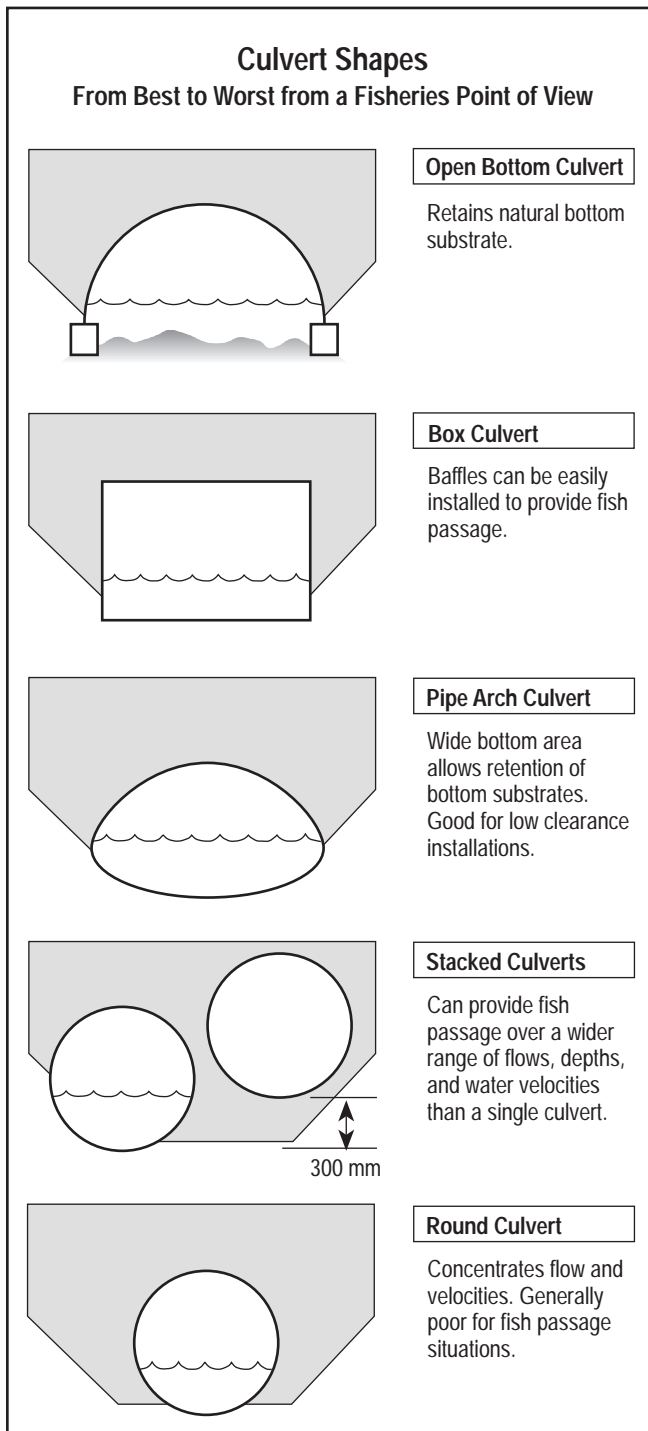
- 1) An increase in the velocity of the water within the culvert making it more difficult for the fish to swim and/or resulting in the undermining and erosion at the inlet or outlet.
- 2) A restriction of the free flow of debris.

If the pipe becomes blocked, the result is ponding or flooding upstream and increased sedimentation downstream.

The preferred shape of culvert crossing structures with regards to fisheries concerns are, from best to worst:

open bottom culvert, box culvert, pipe arch, stacked culverts (maximum of three), single round.





## Application Requirements

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

- a fully dimensioned sketch showing culvert shape, length, slope, diameter and alignment;
- a full description of construction methods and materials;
- a profile of the bed of the watercourse from 30 metres upstream to 30 metres downstream of the proposed location;
- the relationship of the elevation of the bed of the watercourse to the invert of the culvert.

Culvert *replacement or extension* is permitted under the **provisional permit** system if the activity is restricted to the time period between June 1st and September 30th and all other criteria as specified in the application package are met.

## Other Government Agencies Involved

The approval of the *Canadian Coast Guard*, Marine Navigation Services which administers the **Navigable Waters Protection Act**, must be obtained when any structure is to be placed in or across navigable waters.

## Application Review Process

Regulatory, and in some cases, Regulatory and Advisory.

**\*NOTE: Large culvert crossings must undergo a thorough hydraulic analysis involving factors such as channel gradient, velocity of flow, cross sectional area, flood frequency, and ice formation.**

## Construction

### Fish Passage

Fish passage must be taken into account at all times during the installation of the culvert. Special measures to provide for fish passage through the crossing once the pipe has been installed, such as fish baffles or resting pools, may be imposed. In the case of a sloping bedrock bottom, a pipe arch on concrete footings would require additional fish passage measures.

The invert of a culvert must be buried a minimum of 150 millimetres into the bed of the watercourse to facilitate the deposition of a layer of natural substrate and re-establish the natural habitat. The structure may require a layer of natural streambed material, stone and/or gravel installed in the invert.

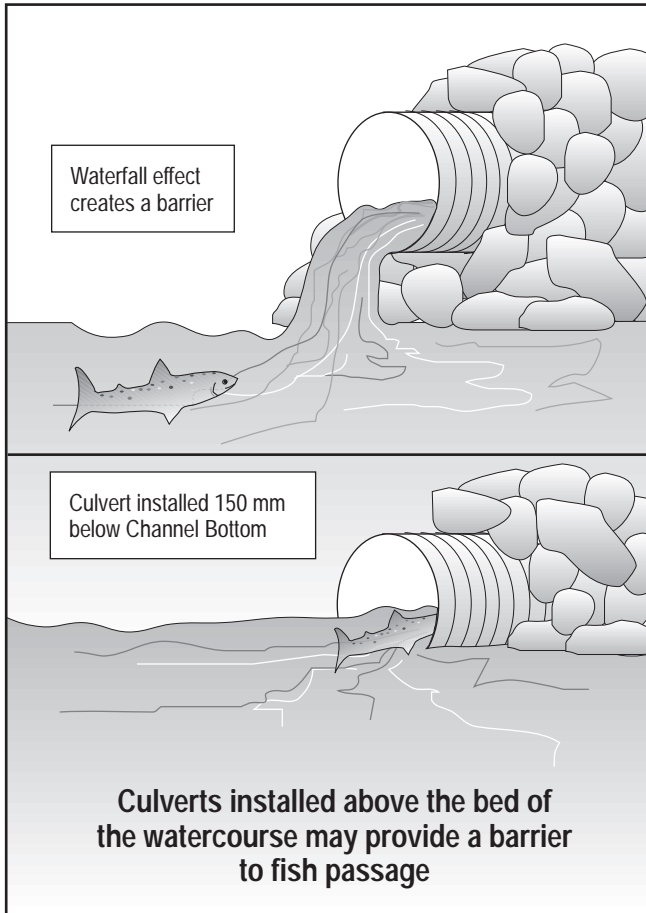
The ability of a fish to pass through a culvert is limited by the following factors:

- 1) Entrance conditions
- 2) Water depth and velocity of flow
- 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 culvert at the outlet.

In some cases, special arrangements must be made to provide light in the structure for fish to be able to pass through the culvert.

The minimum **water depth** required for a fish to swim is considered to be **fifteen to twenty three centimetres**. Fish swimming speed must exceed the water velocity for it to be able to pass through a culvert. Fish swimming ability will vary depending on **species, size, water quality, and hydraulic conditions**, but generally the following guidelines apply: for a culvert which is less than 25 metres in length, the average water velocity should not be higher than 1.2 metres per second in order for the fish to be able to swim through it. If the culverts are greater than 25 metres in length, the Department of Fisheries and Oceans will advise the applicant based on the conditions present at the site.



If the **slope of the invert of the culvert is greater than 0.5 %**, fish passage becomes difficult and a comprehensive, detailed plan for fish passage must be approved by the Department of Fisheries and Oceans prior to construction.

## Sediment Control

The length of time for the instream construction period necessary to install the culvert should be kept to a minimum to reduce environmental impact. Isolation of the worksite from the flowing water is necessary to prevent the release of large amounts of sediment into the watercourse and promote ease of installation. If the installation takes more than one day, the exposed soil should be stabilized at the end of each day.

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 introducing sediment directly into the watercourse.

## Guidelines

### Design

The culvert should be designed 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 alteration of the fish habitat.

The outlet should be designed to resist undermining and wash-out.

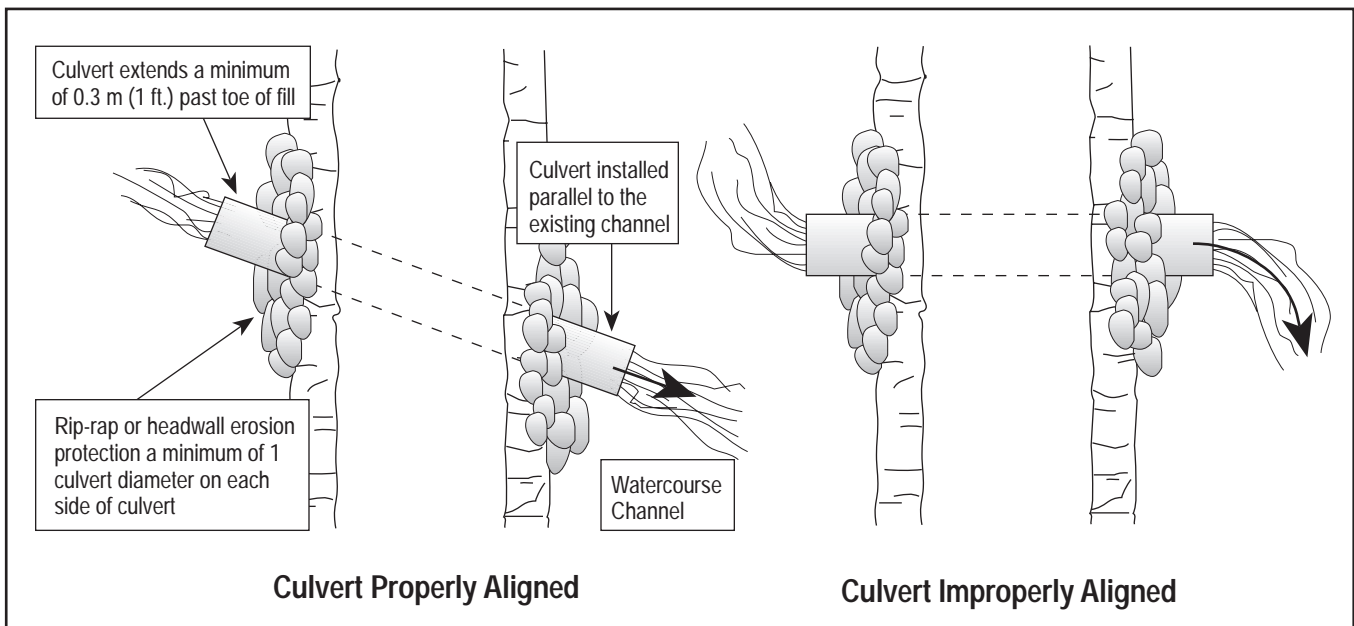
The culvert should be aligned parallel to or as close as possible to the watercourse.

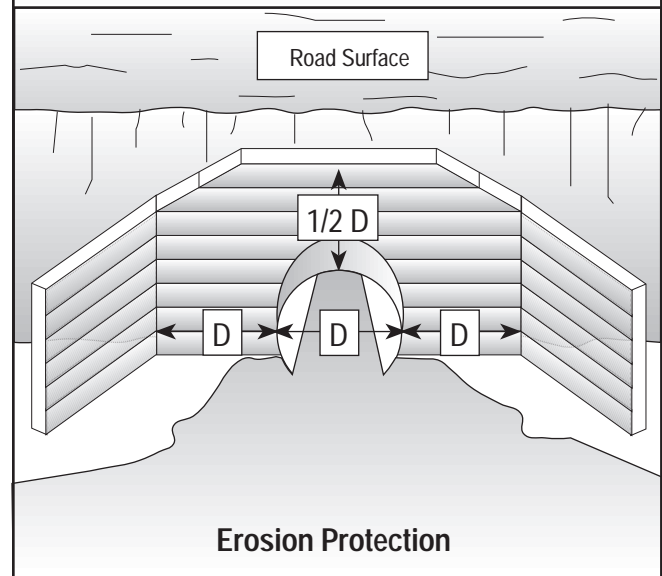
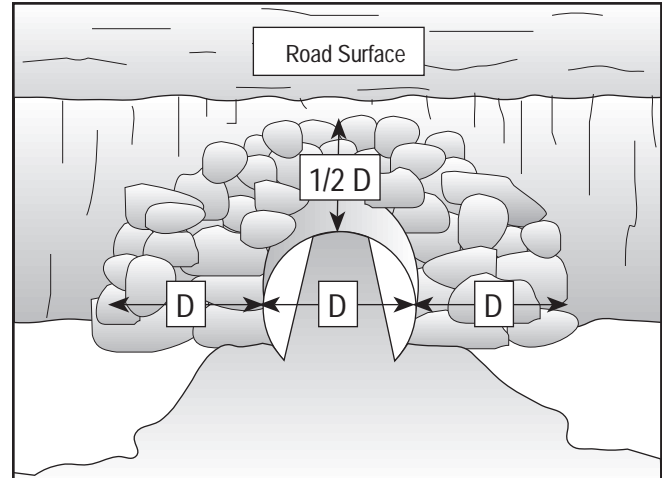
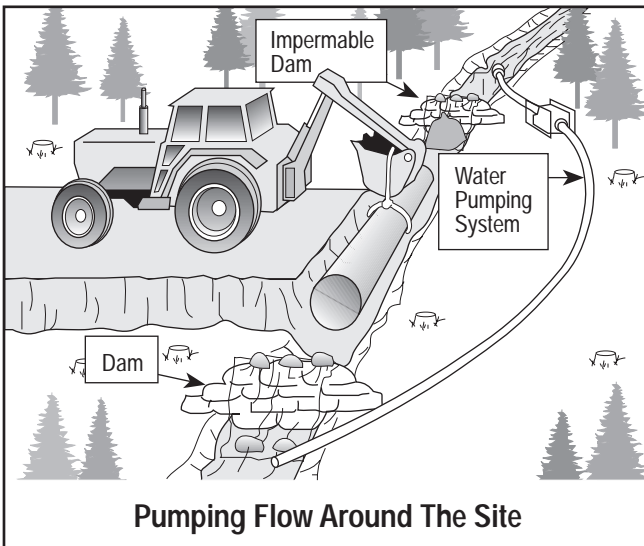
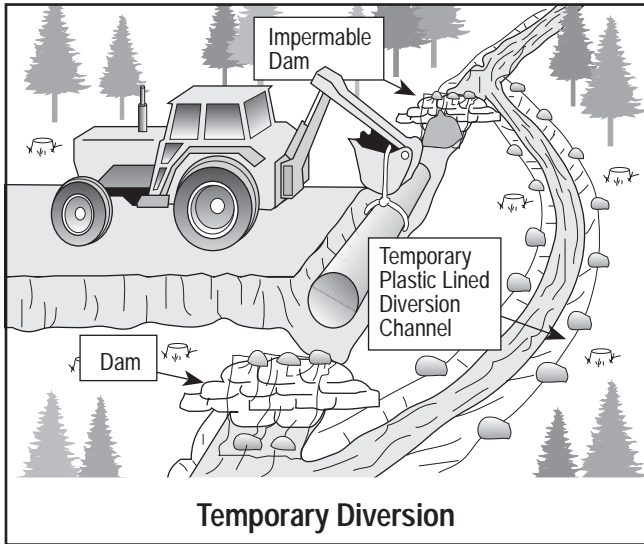
The site selected for the culvert crossing should have a uniform gradient.

### Construction

The instream work should be carried out in the dry using one of the following methods:

- (a) constructing a temporary plastic lined diversion; the diversion channel must be parallel to the existing channel and excavated from the downstream end.





- (b) stemming the flow upstream of the structure 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 of the construction site and a system must be established that ensures the *water is constantly pumped around the site until the installation is completed.*

Rip-rap and/or headwalls and wingwalls must be placed at both ends of the culvert to an elevation of at least one half of a pipe diameter above the top of the pipe and a minimum of one pipe diameter on each side of the culvert immediately upon completion of the culvert installation.

The invert of the culvert structure must be set a minimum of 150 millimetres below the channel bottom level at both the upstream and downstream ends to ensure that the water depth inside the culvert will be at least equal to that in the watercourse during low flow conditions. This also allows natural infilling of the invert of the pipe to help simulate a natural streambed for utilization by the fish.

Any excavation required for the culvert installation must be done with a backhoe or an excavator.

Prior to the onset of culvert installation, sediment control works should be installed to prevent sedimentation of the watercourse and be maintained, as required, until a vegetative cover is established. (see chapter on Sediment Control chapter)

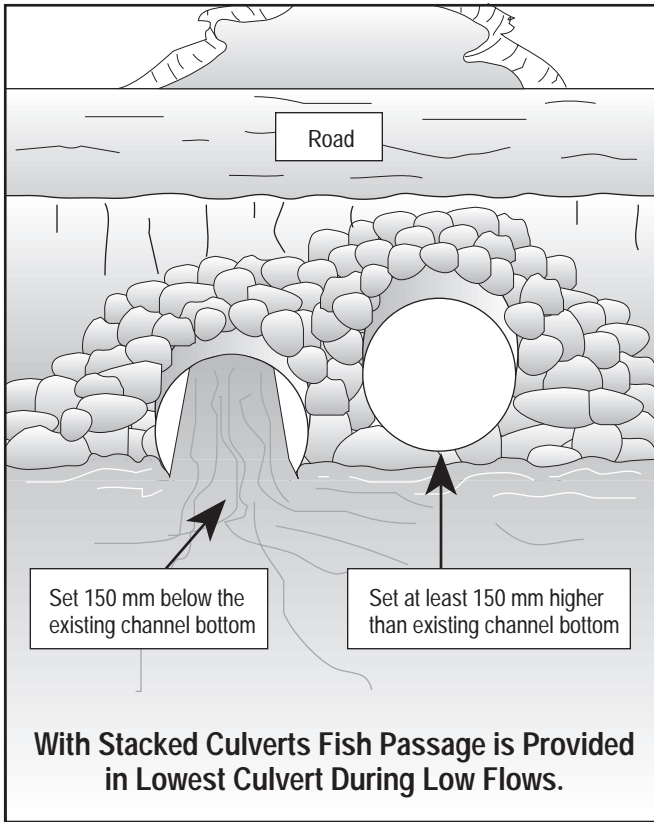
The culvert must be installed on firm ground. A soft foundation should be replaced with clean, granular material to prevent sagging.

The culvert must extend a minimum of 0.3 metres beyond the upstream and downstream toe of the fill placed around the structure.

All exposed erodible material resulting from cut and fill operations within 30 metres of the watercourse must be immediately stabilized to prevent siltation.

Any disturbance to the banks of the watercourse must be stabilized immediately to prevent sedimentation of the watercourse.

If two culverts or more are installed side by side, one culvert should be located in the deepest part of the channel with the invert set 150 millimetres (6 inches) below the existing channel bottom level and the invert of the other pipe(s) be set at least 150 millimetres higher so that during low flow conditions all the water will flow through the culvert which is situated in the natural channel.







# Alteration Type: Water Intake Structures

## 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 rate of water withdrawal (pumping rate) 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 may result in an increase in temperature, making the water intolerable for some species of fish. A decrease in water flow can also diminish suitable living space for fish, reduce the habitat 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 to 23 centimetres is 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 disrupt fish habitat. Any 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 outlet 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. A certain rate of flow must be maintained downstream of the water intake. This rate is known as maintenance flow and is unique to each site. Since channel flows fluctuate on a seasonal basis, acceptable rates of maintenance flows are based on the mean annual flow and may have specific conditions regarding water withdrawal during periods of low flow.

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.

## 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 cases such as these, plans should include a reservoir, to be filled during periods of higher flows.

If the withdrawn water is to be used on a continual basis, in a fish hatchery for example, 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.

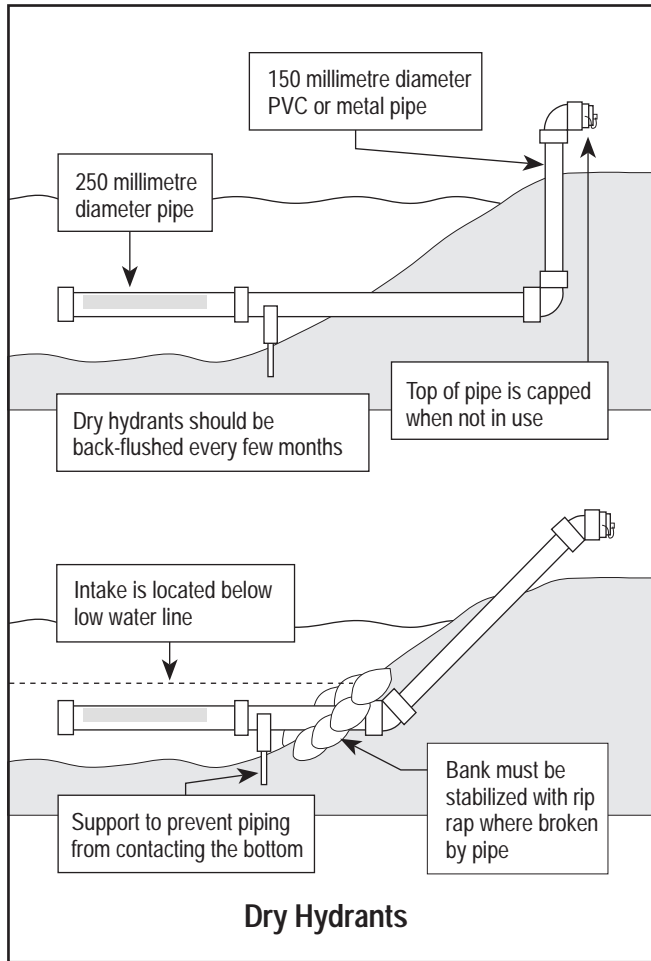
The low flow calculations performed by the Department of the Environment are based on a 20 year, 7 day return. The calculated value would represent the lowest flow expected for a seven day period once every 20 years. Hydrometric data is not available for every watercourse in the province, therefore, 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 alteration permit is not required. Compliance with the terms and conditions to which the permission is subject is mandatory.

## Dry Hydrants

Dry Hydrants are water intake structures consisting of a stand-pipe 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.



## Application Requirements

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

- pumping rates and schedule with specified dates and times;
- description of equipment including type and size of pipe;
- description of proposed construction methods;
- elevation of intake.

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 alteration permit is not required. The guidelines 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 and all specifications in the application package 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 the Department of Fisheries and Oceans or the *New Brunswick Department of Natural Resources and Energy* 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 approved by the *Department of Fisheries and Oceans*.

## Application Review Process

Regulatory, and in some cases, Regulatory and Advisory.

## Construction

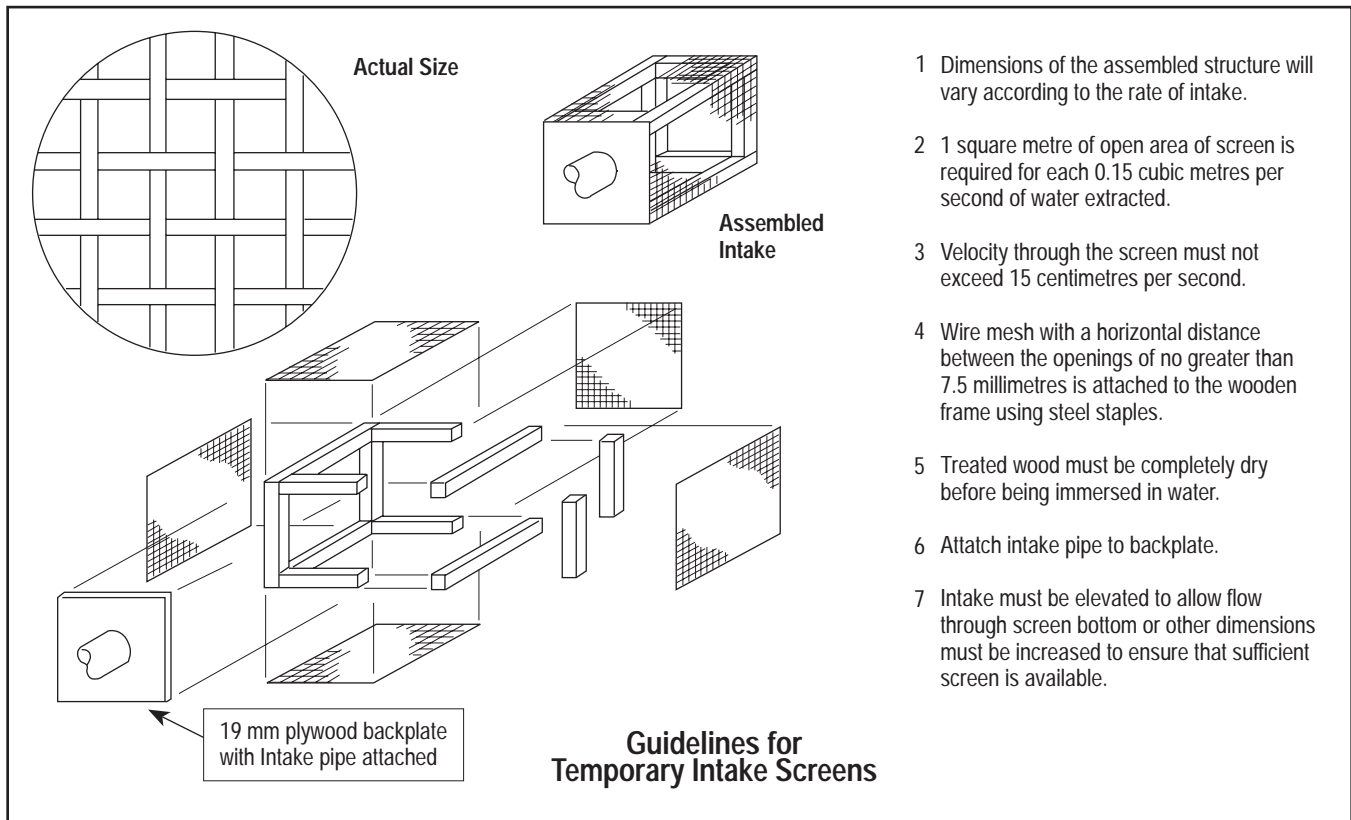
### Screens

Screens are generally constructed on a rectangular frame as shown on the following page.

### Installation of Water Intake

The watercourse 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 protection 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 1.0 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.

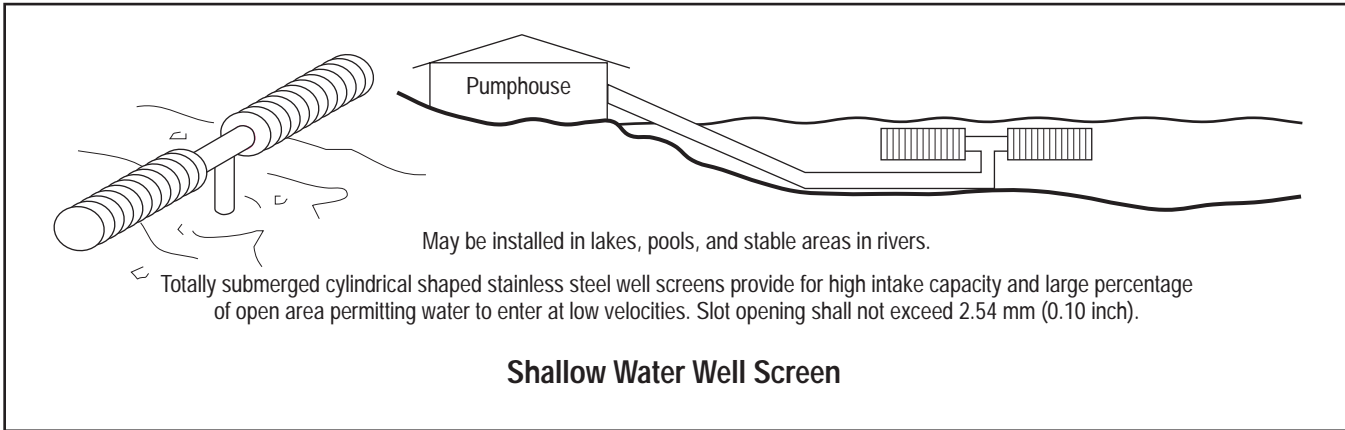
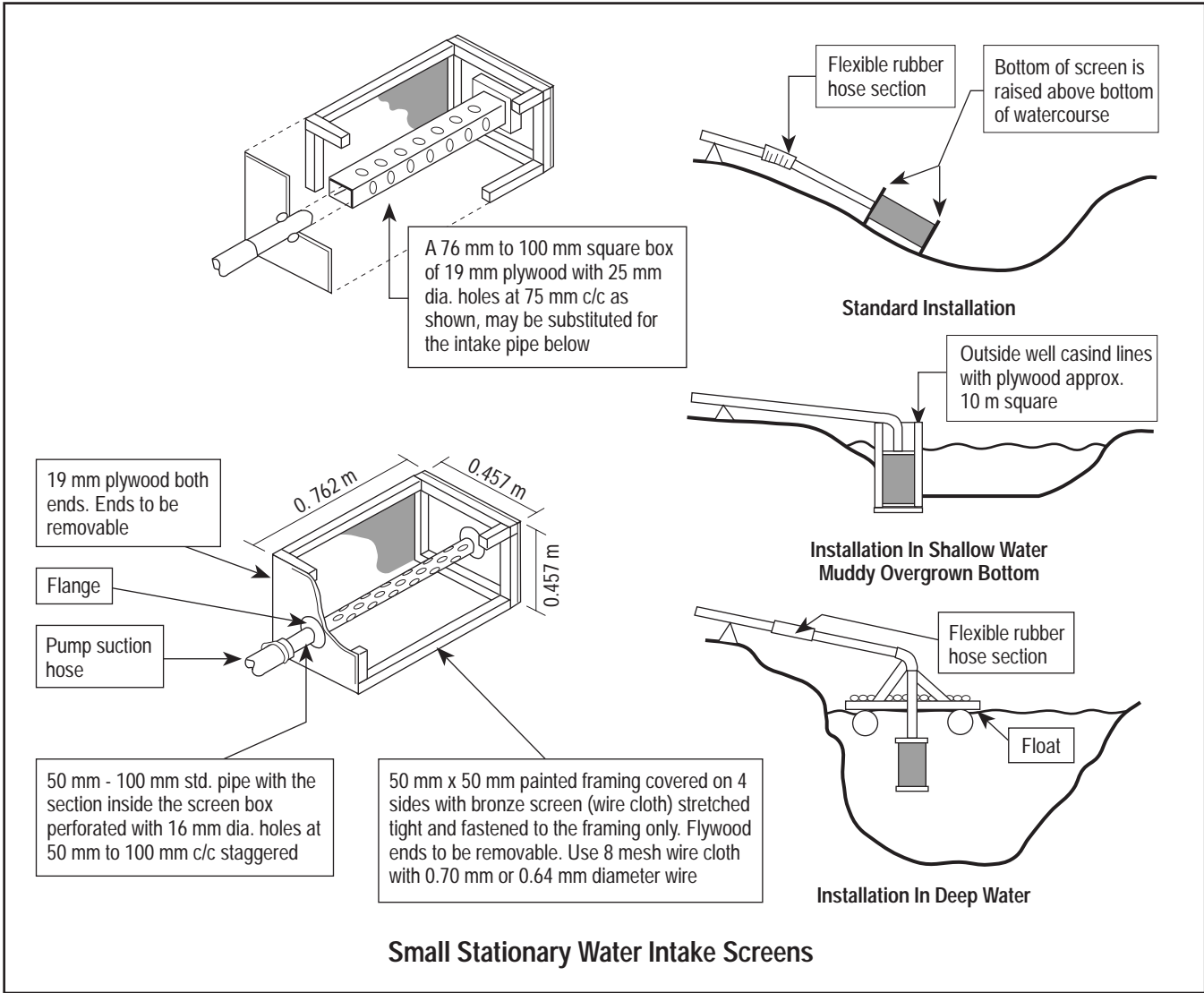
A spare screen must be available for maintenance purposes.

The screen must be cleared of debris at regular intervals.

All disturbance to the ground within 30 metres of the edge of the bank of the watercourse, caused by burying the water pipes must be immediately stabilized to prevent erosion.

The water intake structure must not pose a hazard to navigation.

The flow, specified in the Watercourse Alteration Permit, "Conditions of Approval", must be maintained in the watercourse downstream of the water intake structure at all times.



# 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.*

## 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 diminished water quality.

## Planning Considerations

### 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 wharves and piers may damage the sensitive littoral zone. This could occur by producing suspended sediment, introducing toxic chemicals during the construction process, and/or introducing toxic substances such as fuel or garbage while using the facility.

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 should be taken into consideration.
- Wharves or piers may increase the possibility of ice jamming.

### 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 nearshore areas, shoreline development should be limited or designed such that there is a minimal impact on habitat.

An assessment of the fish habitat and hydraulic conditions should be undertaken before plans for constructing the wharf or pier are made.

Recreational development of the shoreline for wharves or piers should be limited. Where possible, public facilities should be utilized and 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.

### 2) Wharves or Piers Supported by Posts

These structures generally have little impact on the littoral zone depending on the number and size of posts, 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 area that they cover. They may also interfere with water movement 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 supporting members 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.

## Application Requirements

In addition to the standard information required on the application form, plan, profile and cross sectional drawings to scale and a full description of the proposed construction method and materials must be included.

Installation of seasonal wharves or piers does not require a watercourse 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 construction activity 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) A "Letter of Authority to Occupy" from the Crown Lands Branch of the *New Brunswick Department of Natural Resources and Energy* is required for any structure that is to be placed below the normal high water mark. Unless riparian rights were granted, land below the normal high water mark are owned by the

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province. To verify ownership rights, the original grant documents should be checked or the Crown Lands Branch be contacted.

- 2) The approval of the *Canadian Coast Guard*, Marine Navigation Services, 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.

*Treated wood*, containing substances such as pentachlorophenol, chromated copper arsenate, or creosote, is not recommended for use below the high water mark. It can be used on materials intended for construction of parts of the wharves or piers with intermittent contact with water such as decking.

*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 cast on dry land and allowed to dry completely before placement in the water or cast in place in the dry behind a cofferdam.

*Plastics* are inert substances, durable in the 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 use 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.

Posts should be placed below the possible depth of scour.

### 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 wood that is to be used must be air dried for a period of at least 6 months prior to construction and must not visibly ooze treatment chemicals.

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.

# Glossary of Terms

**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

**aggradation** - progressive raising of a channel bed by accumulation of sediment

**alteration** - see "watercourse alteration"

**anadromous** - a behavioural characteristic of certain species in which they migrate from saltwater to freshwater to spawn

**approach velocity** - the speed at which water approaches a culvert, constriction, spillway, weir or water intake structure

**apron** - protective material laid on the bed of a watercourse to prevent scour

**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

**armor** - the artificial surfacing of bed, banks, shore or embankment to resist erosion or scour; armor 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

**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

**bank protection** - any means of stabilizing a bank against erosion, including devices deflecting the erosive forces away from the bank

**bar** - a site in a channel where sand and gravel deposits have accumulated, also, the deposits themselves

**basin area** - the total area within a drainage basin that contributes overland flow to a watercourse

**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

**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 connecting two points that carries pedestrian or vehicular traffic across a watercourse

**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.

**bulkhead** - a retaining structure of timber, steel or reinforced concrete used to shore upland areas adjacent to a watercourse

**by-pass pond** - a pond connected to a watercourse by inlet and outlet pipes so as to obtain water from that watercourse

**cable crossing** - the location where fibre optic or electrical cables cross a watercourse

**catadromous** - a behavioural characteristic of certain species of fish in which they migrate from freshwater to saltwater to spawn

**causeway** - rock or earth embankment carrying a roadway across water or wet ground

**cfs** - cubic feet per second

**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 debris and/or fluvial deposits to maintain hydraulic conditions for unobstructed flow

**channelization** - changes to an existing channel's width and/or depth, or straightening of meanders by cutoffs, or construction of a completely new channel

**channel maintenance** - see "channel cleaning" and "debris removal"

**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

**closed arch** - a type of culvert similar to an arch resting on abutments, but built over an artificial watercourse bed

**cms** - cubic metres per second

**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 the dry

**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 land underwater) held by the Province, both land which has never been sold and land which has been reacquired

**culvert** - a closed conduit for conveying water through an embankment

**cut-off** - a natural or artificial channel short-cutting a meander loop or winding length of channel

**dam** - a barrier to confine, raise or create a hydraulic head of water for storage

**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

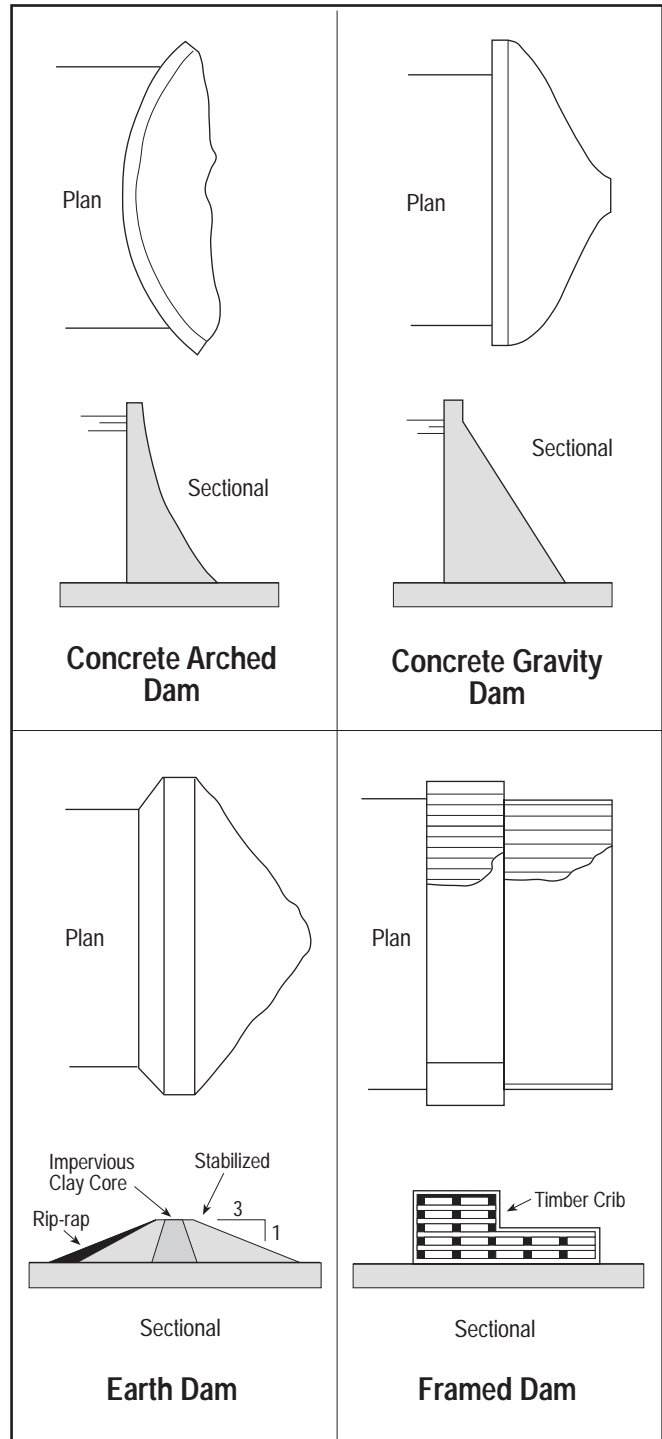
**hydraulic-fill dam** - a dam composed of earth, sand, gravel, etc. sluiced into place; generally the fines are washed towards the center of greater imperviousness

**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 from the bed or banks of the watercourse foreign to the normal composition



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**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

**design high water** - water level adopted for design, usually based on empirical frequency of recurrence

**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 permanent piping system, normally vacuum primed, which provides access to a water source other than a municipal-type water system year-round

**dug-out pond** - an excavation using groundwater or surface runoff as a water supply

**dyke** - an impervious embankment constructed along the bank of a watercourse to prevent the overflow of water onto lowlands and to retain floodwaters

**dyked land** - in New Brunswick, agricultural land protected by dykes

**ecology** - the study of the interrelationships which exist between living organisms and their environment

**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 debris within the watercourse

**estuary** - tidal reach at the mouth of a river

**farm pond** - and impoundment of water primarily for agricultural use

**filter** - a device or porous structure through which a liquid is passed in order to remove solids or impurities

**fisheries** - commercial or recreational harvesting or catching of fish in watercourses; the fish stocks

**fishery enhancement** - the creation of conditions more amenable to the rearing or taking of fish for commercial or recreational purposes

**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, computed maximum** - the largest instantaneous flood discharge believed possible using data pertaining to meteorologic conditions and snow cover within the watershed

**flood plain** - flat land bordering a watercourse which is subject to flooding

**flood protection** - measures taken to protect lives or property from the risk of flooding

**flood walls** - a retaining wall which protects land from inundation by floodwaters

**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 point along a watercourse where the bottom is firm, which is shallow enough to cross by walking or driving through the water

**freeboard** - the vertical distance between the elevation of the design headwater and the top of a dam, levee or diversion ridge

**gabions** - wire baskets filled with coarse gravel or rock used especially to support the bank of a watercourse or an abutment

**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

**gradation** - sieve analysis of aggregates

**gravel** - rounded pebbles larger than sand and smaller than cobble ranging in diameter from 0.5cm (1/5") and 7.6cm (3")

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**gravel removal** - the removal of material from the banks or bed of a watercourse

**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

**grouted** - bonded together with an inlay or overlay of cement mortar

**grubbing** - clearing stumps and roots

**gauging station** - a site on a watercourse where systematic records of stage or stage and discharge are obtained; also called a "hydrometric station"

**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

**hydraulic elements** - the depth, area, perimeter, hydraulic radius, velocity, energy and other quantities pertaining to a particular stage of flowing water

**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

**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

**in the dry** - separated from the wetted portion of the channel

**irrigation ditches** - an artificial ditch which delivers water for crop irrigation

**jam** - accumulation of debris, ice or other material which has become wedged in the channel of a watercourse forming a partial or complete obstruction

**jetty** - an elongated artificial obstruction projecting into a watercourse from the bank or shore to control shoaling and scouring by deflection of the strength of currents and waves

**lacustrine** - belonging to or produced by lakes

**lagoon** - an impoundment of water completely surrounded by a dyke or berm

**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 and/or 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 streamflow

**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** - removal of structures that create a hydraulic head

**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 12.7cm in diameter at breast height; any hardwood tree at least 7.6cm in diameter at breast height

**minor obstruction** - removal of 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 the Federal Ministry of Transport, 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

**normal 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

**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

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**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 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 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** - a person who is a member or licensee of the Association of Professional Engineers of the Province of New Brunswick, as described in the New Brunswick Engineering Profession Act

**rapids** - a portion of a watercourse in swift and turbulent motion without pronounced cascades or falls

**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

**rerouting watercourses** - the shifting of a watercourse to a new channel, with the new channel extending outside the original drainage basin, generally transferring the water to a different watercourse

**reservoir** - an artificial impoundment of water for the purpose of storage for latter use. Reservoirs are distinguished by monthly and/or annual regulation of flows while head ponds cater to daily and weekly fluctuations only.

**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

**revetment** - a protective facing placed on soil or rock to deter erosion by water or the elements

**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

**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

**river adjustments** - a form of channelization, the alteration of a watercourse's cross-sectional shapes

**riverine** - found in or near a river

**salmonoid** - of or related to the salmonidae family of fishes, including salmon, trout and char

**sand** - loose mineral and rock particles ranging in diameter from 0.06mm (0.0025") to 2mm (0.08")

**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

**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

**stream alteration** - see "watercourse alteration"

**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

**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

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**water control structures** - for the purpose of these guidelines include spillways, weirs, fishways and other structures which control flow by mechanical means

**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 alteration (legal)** - a temporary or permanent change made at, near or to a watercourse or to water flow in a watercourse and includes:

- (a) any change made to existing structures in the watercourse 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 a watercourse other than at a recognized fording place,
- (c) any deposit or removal of sand, gravel, rock, topsoil or other material into or from a watercourse or within thirty metres of the bank of a watercourse,
- (d) any disturbance of the ground within thirty metres of the bank of the 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 occur more than five metres from the bank of a watercourse.
- (e) any removal of vegetation from the bed or bank of a watercourse,
- (f) any removal of trees within thirty metres of the bank of a watercourse

**Watercourse Alteration Regulation** - a regulation under the New Brunswick Clean Water Act respecting watercourse alterations

**Watercourse Alteration Permit** - a permit signed by the Minister of the Environment and issued according to the Watercourse 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, etc.

**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** - lands transitional between terrestrial and aquatic systems where the water table is at or near the surface or the land is covered by shallow water at some time during the growing season. Wetlands are characterized by poorly drained soils and predominantly hydrophytic or water tolerant vegetation

**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)	<i>Acipenser brevirostrum</i> Shortnose Sturgeon	Saint John R (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
	<i>Acipenser oxyrinchus</i> Atlantic Sturgeon	coastal water systems	spawns in deep pools	anadromous	mid-March to May; early Sept. to late Oct.	early May to late June	mid-May to mid-July	13-17.8	22-28
Clupeidae (Herrings)	<i>Alosa aestivalis</i> 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
	<i>Alosa sapidissima</i> American Shad	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
	<i>Alosa pseudoharengus</i> Alewife; Gaspereau	most coastal rivers with unrestricted access	usually spawns in lakes, 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)	<i>Oncorhynchus mykiss</i> (Walbaum) Rainbow Trout	Big Presque Isle Stream, Shepody R System, Dicks Lake and scattered throughout 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

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
Salmonidae (Trout and Salmon) <i>Continued . . .</i>	<i>Salmo salar</i> 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
	<i>Salmo salar ouananiche</i> Land-locked Salmon	various, including Magaguadavic R 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
	<i>Salmo trutta</i> Brown Trout	various (esp. Meduxnekeag R, Digdeguash R, and Mispic and Little R systems and East Musquash Reservoir in St. 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
	<i>Salvelinus fontinalis</i> 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

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
Salmonidae (Trout and Salmon) <i>Continued . . .</i>	<i>Coregonus clupeaformis</i> (Mitchill) Lake Whitefish	Western NB	spawn in shallow water with a hard or stoney bottom; live in deeper water	freshwater	late Oct. to late Dec.	early Nov. to late Dec.	early Nov. to late May	< 7.8	3-4
	<i>Salvelinus alpinus</i> 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
	<i>Salvelinus namaycush</i> (Walbaum) Lake Trout; Lake Char; Togue	found 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
Ecodidae (Pikes)	<i>Esox niger</i> (Lesueur) Chain Pickerel	various (esp. St 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)	<i>Osmerus mordax</i> (Mitchill) Rainbow Smelt	various (esp. Miramichi R.)	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)	<i>Apeltes quadracus</i> (Mitchill) Fourspine Stickleback	usually a marine species, but lives in freshwater in the St John R	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
	<i>Culeae inconstans</i> (Kirtland) Brook Stickleback	various waters in Western NB	live in cool; clear water; spawn in marshy areas	freshwater	late March to late July	April to late July	early April to late July	8-19	< 1



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
Percichthyidae (Temperate Basses)	<i>Morone americana</i> (Gmelin) White Perch	various	shallow water in lakes and rivers; can tolerate low salinity and high temperatures, but prefers cool brackish water; any bottom type	anadromous/land-locked	late April to early July	May to early June	May to mid-June	11-15	2-3
	<i>Morone saxatilis</i> (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 June (spawning migration)	early June	June	15-19	4-6
Percidae (Perches)	<i>Perca flavescens</i> (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)	<i>Micropterus dolomieu</i> (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)	<i>Couesius plumbeus</i> (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
	<i>Pimephales promelas</i> (Rafinesque) Fathead Minnow	Upper St John R. 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
Gadidae (Cods)	<i>Microgadus tomcod</i> (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

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
Anguillidae (Freshwater Eels)	<i>Anguilla rostrata</i> (Lesueur) American Eel	various	N/A	catadromous	May & June; Sept. to mid-Oct.	February to end of July			8
Catostomidae (suckers)	<i>Catostomus commersoni</i> (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)	<i>Mytilus edulis</i> Blue Mussel	various	live in colonies attached to sand, gravel, pilings, wharves, etc. by strong byssal threads			June to end of August		15-20	< 1
Ostreidae (oysters)	<i>Crassostrea virginica</i> (Gmelin) Eastern Oyster	warm, shallow bays and estuaries of the Gulf of St. Lawrence	attached to a hard-rock or semi-hard mud bottom			late June to end of July		20	4-5
Xiphosura (Horseshoe Crabs)	<i>Limulus polyphemus</i> 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)	<i>Cambarus bartonii</i> (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-Shell Clams)	<i>Mya arenaria</i> Soft-Shell Clam	various estuarine areas	burrows in sand, mud or gravel			June to end of August		25-28	1-2
Veneridae (Hard Clams)	<i>Mercenaria mercenaria</i> 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 the Watercourse Alteration Program

Constraints placed on projects through legislation are those relating to the design or construction or the carrying out of a watercourse 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 Alteration Regulation

Watercourse alterations and the operation of the Watercourse Alteration Program are, in part, controlled by the **Watercourse 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 the Environment and Local Government.

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 or diverts all or part of a watercourse or of the water flowing in a watercourse 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.), 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 shall maintain the project or structure in good repair at all times.

#### The Watercourse Setback Designation Order

The **Order of Designation** under the subsection 14 (1) of the **Clean Water Act** designates lands within 75 metres of the banks of watercourses, located within the 31 watersheds designated as surface water supplies for municipalities, as protected areas. Activities, and land or water usage within the protected areas are restricted, controlled or prohibited in order to protect the quality and quantity of water.

Individuals must apply for a Ministerial Exemption in order to carry out watercourse alterations within these protected areas according to subsection 14.1.

"14.1(1) A person who owns, acquires or is proposing, developing, constructing, operating or maintaining an activity, thing, or use that is prohibited, controlled, limited or otherwise affected by any requirements imposed under subsection 14(3) may ask the Minister to grant an exemption by delivering a request for an exemption to the Minister, at any time after the Order is made, on a form provided by the Minister.

#### New Brunswick Crown Lands and Forest Act

Crown Lands refers to all or any part of the lands vested in the Crown and unless riparian rights were granted, includes any sub-merged land below the normal high water mark.

The Minister of Natural Resources and Energy and the Director of the Crown Lands Branch 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 any structure is to be constructed on 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 and Energy 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 and Energy 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. The Department is represented by the Minister of Natural Resources and Energy and all those persons he designates to act on his behalf.

The New Brunswick **Fish and Wildlife Act** authorizes the appointment of Game Wardens, Deputy Game Wardens and Assistant Game Wardens who are responsible for the enforcement of the **Fish and Wildlife Act**. Those persons holding either a Game

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Warden or Deputy Game Warden appointment are ex-officio fishery officers under the Canada **Fisheries Act**. Persons holding a Game Warden, Deputy Game Warden or Assistant Game Warden appointment are Game Officers for the purpose of the **Migratory Bird Convention Act**.

The Department of Natural Resources and Energy 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 Department of Natural Resources and Energy 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 Management Agreements with the Licensees. The Department of Natural Resources and Energy actively cooperates with the New Brunswick Department of the Environment and Local Government in the Watercourse Alteration Program to fulfil its legislative responsibilities and to assist in minimizing or eliminating damage to the aquatic environment.

Selected field staff have been designated as inspectors under the **Clean Water Act**, subsection 17(1) for the purpose of enforcing the **Watercourse Alteration Regulation**.

### Quarriable Substances Act

Irrespective of ownership, no quarriable substance can be removed within a "shore area"; 300 metres above and 300 metres below the ordinary high water mark of any marine shore without a permit from the Mineral Resources Division of the New Brunswick Department of Natural Resources and Energy.

### Engineering Profession Act

The **Engineering Profession Act**, administered by The Association of Professional Engineers 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 Profession 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."

"2(2).. Without restricting the generality of the foregoing, engineering works and systems shall include:

- (a) transportation systems and components related to air, water, land or outer space; movement of goods or people;
- (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 depend-

ent 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; and

(g) systems relating to surveying and mapping."

Drawings relating to engineering works shall be marked with the seal of a Professional Engineer 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 the Department of Fisheries and Oceans 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 Canada **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 place and of 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

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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."

The Department of Fisheries and Oceans 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 the Department of Fisheries and Oceans.

In planning a watercourse alteration, applicants should acquaint themselves with the requirements under the Fisheries Act.

### **Navigable Waters Protection Act**

The Marine Navigation Services, of the Canadian Coast Guard, 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 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 Alteration Advisory Committee:

The Watercourse Alteration Regulation is intended to protect the environment in particular, to control man-made changes to watercourses 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 Alteration Advisory Committee was formed.

The Watercourse Alteration Advisory Committee deals chiefly with *procedures* and *policy*. It reviews the operation and effectiveness of the Watercourse Alteration Program, 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, required documentation and regulation revisions. The Advisory Committee does not become involved with the review of applications for Watercourse 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:

- Regional Services Section, Assessment and Local Government and Regional Services Branch, New Brunswick Department of the Environment and Local Government.
- Engineering Branch, New Brunswick Department of Agriculture
- Fish and Wildlife Branch, New Brunswick Department of Natural Resources and Energy
- Department of Fisheries and Oceans Canada
- New Brunswick Department of Economic Development and Tourism
- Structures Branch, New Brunswick Department of Transportation

### The Watercourse Alteration Technical Committee:

The Watercourse Alteration Technical Committee should be referred to only by its full name to avoid confusion with other technical committees.

The Watercourse 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 construction of watercourse 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 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 Alteration Technical Committee consists of representatives of various government departments having an interest in watercourse alterations and the protection of the Province's rivers and lakes. These representatives may include those employees who work regularly on the Watercourse Alteration Program.

Agencies regularly represented on the Watercourse Alteration Technical Committee are:

1. **New Brunswick Department of the Environment**  
Water Resource Monitoring Section, Environmental Planning and Sciences Branch
2. **Department of Fisheries and Oceans**  
Research and Development Branch  
Habitat Management Division
3. **New Brunswick Department of Natural Resources and Energy**  
Fish and Wildlife Branch  
Mineral Resources Branch
4. **New Brunswick Department of Agriculture**  
Agricultural Engineering Branch
5. **New Brunswick Department of Transportation**  
Structures Branch
6. **New Brunswick Department of Economic Development and Tourism**  
Technical Services Branch
7. **New Brunswick Department of Fisheries and Aquaculture**  
Operations and Services Branch
8. **New Brunswick Department of Municipalities, Culture and Housing**  
Archaeology Branch
9. **Environment Canada**  
Inland Waters Directorate  
Water Resources Branch

## Appendix D: The Department of Fisheries and Oceans Habitat Policy

### Policy for the Management of Fish Habitat:

#### An Overview

This policy represents the guideline by which the Department of Fisheries and Oceans 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 the Department of Fisheries and Oceans is required to review watercourse alteration projects that may impact fish habitat.

In reviewing projects submitted for watercourse alteration permits, the Department of Fisheries and Oceans 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 alteration permit would be granted.

A copy of this policy may be obtained at any the Department of Fisheries and Oceans office.