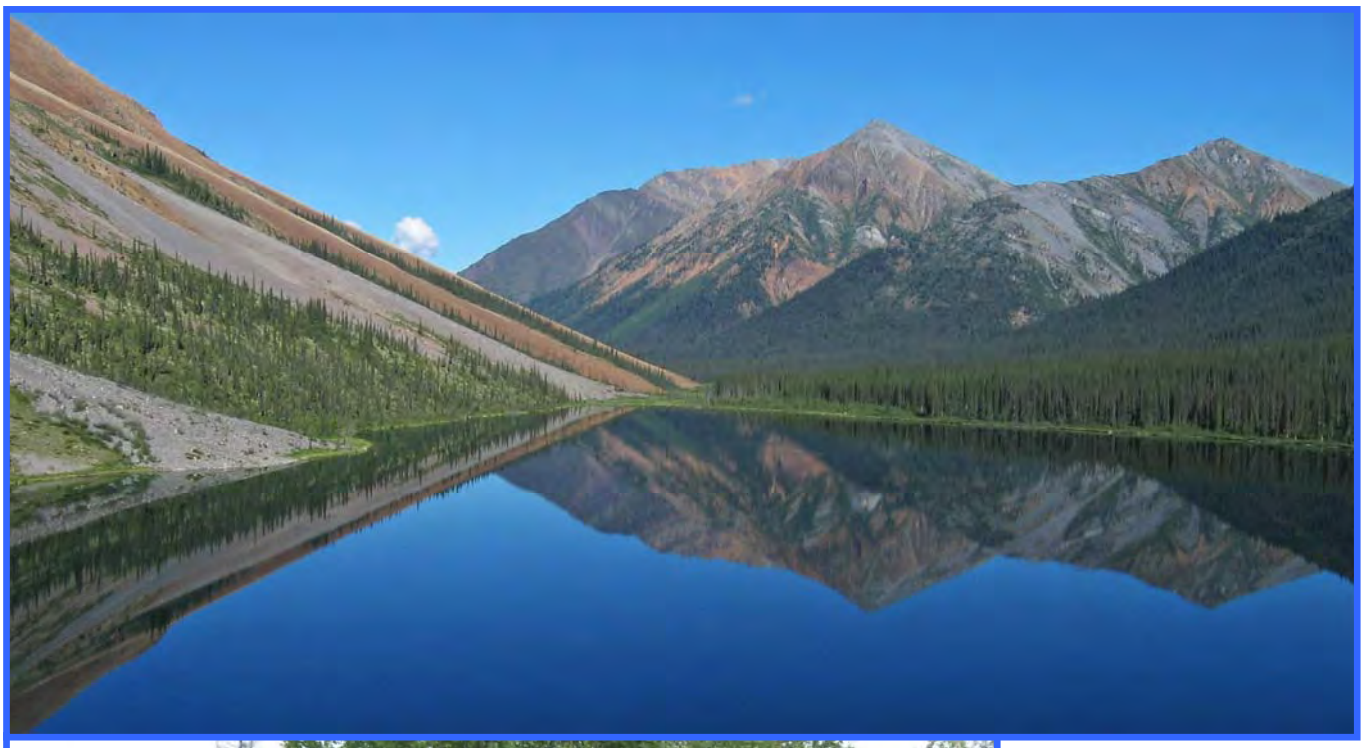
Best Management Practices for Works Affecting Water in Yukon



Yukon
Environment

Published May 2011
All photos Yukon government

ISBN 978-1-55362-525-4

Best Management Practices for Works Affecting Water in Yukon

Water Resources Branch
Environment Yukon

Acknowledgements

This document was developed through a contract between the Yukon government and Yucan Environmental Planning. Water Resources Branch would like to acknowledge Toos Omtzigt and Paul Matheus for their excellent work in creating this guide.

Reviewers and Contributors:

Yukon Government:

Energy, Mines & Resources: Josef Hanrath (Client Services & Inspections), Judy St. Amand (Mineral Resources), Greg Cowman (Forest Management)

Environment: Wendy Avison, Nancy Campbell (Corporate Services), Kevin McDonnell, John Minder (Water Resources)

Executive Council Office: Derek Fraser (Development Assessment)

Other Government Agencies:

Fisheries and Oceans Canada: Rob Smith

Yukon Environmental and Socio-economic Assessment Board: Michael Muller

Yukon Water Board: Kelly Boutilier, Neil Salvin, Carola Scheu

Table of Contents

Introduction

1.1 Approach and Layout of This Guide

The "Best Management Practices" Approach

The "Best Management Practices" (BMP) approach is a way to help developers comply with environmental regulations and avoid or mitigate the negative environmental impacts of development activities. Rather than focusing on a laundry list of prohibited activities, the premise of the BMP approach is that a project will be in compliance if the developer adheres to a number of key principles and prescribed work practices, and develops work plans in consultation with regulators. The focus of this guide is to provide Yukon-specific BMPs that prescribe practical work-site guidelines that will help planners and developers protect water resources and comply with water regulations.

While the types of projects that potentially impact water resources are diverse in nature, many of their component activities are similar across a broad range of industries. For example, refuelling equipment, fording streams, constructing access roads, installing culverts, and cutting brush are activities that may be undertaken by a large contractor building a multi-span bridge or a single farmer developing a new hay field. Consequently, the BMPs in this guide are organized by activity type, not industry type. The principles and practices can be applied to a variety of industries, ranging from mineral exploration and road construction to forestry and agriculture. This approach encourages developers to break their projects down into component activities, which will help them plan work more efficiently. It also avoids the redundancy that would be necessary if each imaginable industry were addressed individually.

Target Audience

This guide was written to be useful to all members of a development team. Government agencies and regulators should also find it useful for planning infrastructure projects and conducting environmental monitoring. It is detailed enough so that planners can refer to specific BMPs when preparing documents for YESAB (Yukon Environmental and Socio-economic Assessment Board) and licensing agencies, or when writing environmental management plans. For planners that need more detailed prescriptions or regulatory information, the guide provides references to other resources. Site managers and equipment operators should find the prescriptions in this guide to be concise and practical solutions to situations that will be encountered on the work site. Photos are used throughout the guide to provide examples of good work practices and site maintenance.

Layout and Use of This Guide

The introductory portion of this guide provides background on water protection principles, followed by a review of important regulatory acts. The best management practices themselves are divided into two sections. The first BMP section provides detailed information for basic practices that will be used across a broad range of work activities to control erosion, sedimentation, and contamination. For example, it explains how to erect structures like silt fences, check dams, and erosion control matting. The second section outlines best practices for specific activities that occur in or around water bodies, such as installing culverts or fording streams. The practices prescribed in the second section are more general in nature, often referring back to detailed practices in the first section. The reason for this is that every project will be unique and it is beyond the scope of this guide to cover every construction activity imaginable, or to be a technical how-to manual for any given activity. Instead, the intent is to arm planners and site workers with a good background in the principles and tools of water protection measures so that good work practices become second nature. The

appendices in this guide provide a variety of resources, including useful publications and web pages of regulators.

This is a Guide, Not a Regulatory Manual

It is important to understand that this guide is a not a regulatory manual. The practices described here are not, strictly speaking, all dictated by statute. Some are, and this is clearly indicated when it is the case. Instead, the practices represent industry standards for conducting work in a manner that minimizes the risk of negatively impacting water and violating regulations. If, for instance, mineral soil is stockpiled next to a stream without proper covering and it rains, causing sedimentation in the stream, this is a violation of the territorial *Waters Act* and the federal *Fisheries Act*, for which the responsible party will be liable. If standard erosion and sediment control measures were followed (e.g., stockpiled a minimum of 30 m from the watercourse and covered with geotextile cloth or plastic) then no sedimentation and no violation would have occurred.

Regulatory agencies will not dictate how to undertake a project to ensure that it does not violate water regulations, and they cannot be on site to guide the proponent through each step; the duty to comply with regulations and perform work without risk to the environment lies with the developer. If a project requires government authorization, the proponent will be required to submit a work plan that explains how practices will be implemented to avoid impacts to water. If inspections are conducted, regulators will expect the proponent to be implementing those practices. The value of this guide is that it will help proponents develop plans and conduct work in a responsible manner that minimizes the chances it will do harm and violate water regulations.

Project Planning

Keep in mind that some activities and mitigative measures will require planning and data collection at least a year prior to commencement of work. This is usually the case, for instance, with fish habitat compensation – fish inventories often need to be conducted the season prior to work. Also, some specialized materials, such as rolled erosion control products, may need to be ordered months prior to work.

As mentioned earlier, this guide cannot take into account every conceivable activity that will be encountered in a work plan. Each project will have its own unique challenges, and developers may still need to consult specialists and government agencies to devise specific solutions that augment the general guidelines outlined here. This underscores the fact that the sooner developers begin working with regulators to develop preventative and mitigative strategies for their projects, the better off they will be.

1.2 Protecting Water

The need to protect water sources from disturbance and contamination cannot be overstated. Although in some cases there still is societal debate as to what level of disturbance is considered acceptable, and what levels of certain contaminants are harmful, federal and territorial regulations are clear about the need to justify impacts before a disturbance can be permitted. For example, the federal *Fisheries Act* does not permit "the release of any deleterious substance into water" (including sediment). Likewise, under the *Waters Act*, any waste released into a watercourse needs to be justified and quantified before it can be considered for permitting under a water licence.

The easiest solution to safeguard water resources is to not work at all in or near water bodies, and this should always be considered the default way of performing work. However, not all development can be planned to occur away from water bodies. Indeed, some projects must by their nature occur in or adjacent to water bodies. Most of the BMPs in this guide emphasize ways to minimize and mitigate impacts to water resources when water bodies cannot be avoided, while other BMPs include prescriptions for preventing unanticipated impacts even when development occurs away from water bodies. For instance, the guide includes a BMP for controlling sediment runoff from roads because that sediment may eventually find its way to a watercourse.

From an environmental assessment standpoint, the potential for a development activity to cause harm to water and water bodies (including rivers, creeks, lakes, groundwater, swamps, fens, bogs and other wetlands) is determined by assessing the activity's potential to do three things: 1) contaminate water (including sedimentation), 2) restrict or alter flow, or 3) impact fish or fish habitat. The potential to cause water contamination is determined by assessing how much the activity will increase levels of sedimentation and runoff, increase influxes of pollutants and nutrients, or cause changes to water temperature. Flow restrictions or alterations occur when structures are built in streams, water is diverted, or banks and channels are disturbed. Impacts to fish and fish habitat include obvious actions, such as releasing contaminants or altering flow, but also include more subtle actions, such as disturbing spawning beds through the fording of streams or removing critical habitat components such as logs and channel substrate.

Here are the five main mechanisms by which contamination and alterations to flow conditions can be detrimental to water quality, fish, and other aquatic life:

1. *Increased runoff* – Land alterations and disturbances frequently increase the rate and amount of runoff from a watershed entering streams. Runoff can carry pollutants, erode stream channels and banks, destroy aquatic habitat and increase flood potential. It is important to remember that even projects that do not occur near water bodies can cause or increase runoff that eventually will end up in waterways.

2. *Sedimentation* – Eroded sediment from disturbed surfaces (e.g., construction sites), or even dirt and sand on roads, driveways and parking lots, often is transported to streams with storm water runoff. Cut and fill from temporary roadways are a large source of sediment contamination to streams, and it is important to remember that even sediment erosion that occurs far from water can quickly make its way to streams during storm events. Sedimentation causes turbidity, can smother aquatic habitat, reduces levels of dissolved oxygen, degrades aesthetic qualities and transports nutrients and toxic contaminants.

3. *Nutrient and Contaminant Influxes* – Excess fertilizers on revegetation plots (including hydroseeding) or agricultural fields end up being dissolved in surface and ground water and transported to water bodies. Failing septic systems and concentrated accumulations of animal or human waste can have similar effects. Influxes of nutrients can cause eutrophication of water bodies

and depleted levels of dissolved oxygen, damaging aquatic habitats and reducing aquatic diversity. Contaminants including hydrocarbons and metals can be introduced to water from sources such as spills or exposed mineralized rock material. These substances can also be transported to surface water bodies by runoff or ground water where they can cause detrimental changes to aquatic habitats due to their toxicity. While potentially negatively affecting aquatic life, influxes of nutrients and contaminants can also harm terrestrial animals and humans depending on the impacted water body.

4. *Temperature Alterations* – Warming of water bodies is a deleterious but often overlooked effect of altering land surfaces and development activities. Sheet wash and other surface runoff water tends to be relatively warm. Any activity that increases runoff usually causes an influx of warm water into water systems. Water bodies also can be unintentionally warmed by removing streamside vegetation, which reduces shading, or by reducing groundwater flow, since groundwater tends to be cool. Increasing water temperatures can be harmful to cold-water fish species such as salmon. It can also promote excessive plant growth, which chokes out still waters, reduces the level of dissolved oxygen, and has been linked to increased incidences of disease in fish.

5. *Flow Alteration* – It is inevitable that any change to stream channels or flow quantity will affect flow dynamics and the stream course. Flow velocities can be decreased in some portions of the channel and increased in others, ultimately changing the channel morphology and affecting parameters such as bank erosion and fish passage and habitat. It is important to consider that alterations to groundwater flow can also affect surface flow. Removing a portion of steam flow through pumping or diverting reduces the quantity of water flowing in the water course. This is particularly important for smaller streams and water courses supporting multiple users where the cumulative effects of water withdrawal may become significant, potentially impacting aquatic habitat and downstream users.

Regulations that protect water are based on the mechanisms and principles outlined above. Consequently, these are the types of actions to avoid because they typically cause harm and violate water regulations (unless a permit is issued):

1. Allowing or causing sediment-laden wastewater or runoff to enter a watercourse.
2. Discharging pump water directly into a watercourse.
3. Allowing or causing a toxic material to enter a watercourse.
4. Dumping any material into a watercourse, including sediment.
5. Infilling a portion of a watercourse.
6. Altering the bed and banks of a watercourse.
7. Altering the quantity and quality of flow.
8. Modifying channel or lakebed structures.

The basic principles of the BMPs in this guide are focused on helping developers avoid these violations and impacts to water. Essentially, those principles boil down to this:

Wherever and whenever possible,

1. Avoid working in or around water bodies.

2. Minimize the work-site footprint; only clear and excavate to the extent necessary.

3. Control for erosion and sedimentation by managing sediment-laden runoff:

    - Cover excavated and exposed surfaces, including stockpiled materials

    - Install silt fences when necessary

    - Avoid scraping (blading) down to mineral soil

    - Revegetate disturbed surfaces as soon as possible

4. When clearing vegetation, only cut down to ground level, leaving rootstock in place. This will greatly reduce erosion and sedimentation and will promote more rapid revegetation.

5. Stockpile mineral soil and organic soil separately; when spreading, spread mineral soil first and organics last. This will prevent erosion and encourage revegetation (surface stabilization).

6. Equipment should be refuelled and serviced >30m from a water body such that no deleterious substance enters any water body; all equipment must be clean and free of deleterious substances and invasive plant species before working in or near a water body.

7. The only fill material that should ever be placed in a water body, such as for riprap, is coarse gravel and non-acid generating rock. It must be clean and free of fines. Often, this means washing rock prior to placement.

8. Never pump construction water directly into a natural water body. Normally, it is pumped to a vegetated depression, sump or sediment trap to remove sediment and avoid erosion of the natural water body.

1.3 Acts and Regulations

This section provides an overview of the regulatory framework that has been developed to protect water resources. Its intent is to summarize salient points from relevant acts and regulations in order to help practitioners navigate the array of agencies and approval processes they may be confronted with.

It should be noted that the following discussion only touches on legislation and regulations that specifically address water protection. There are numerous acts and regulations dealing with mining, land development, forestry, pesticide-use, hazardous materials handling and other industrial activities that include measures to safeguard water. It is beyond the scope of this document to address those acts. An example of a document that thoroughly discusses regulatory requirements (and best management practices) within an industry-specific context is the *Yukon Mineral and Coal Exploration Best Management Practices and Regulatory Guide* (Yukon Chamber of Mines, 2010). It also must be considered that additional protocols, laws and permitting requirements may apply if working on Settlement Land, in which case the relevant First Nation government will be involved in the licensing process.

When considering the water-related permitting and licensing requirements for a project, a developer should always ask six questions:

1. Will this project require a Water Licence? (see 1.3.1 below "*Waters Act*")
2. Will this project require a Land Use Permit? (see 1.3.2 below "*Lands Act*")
3. Will this project require DFO authorizations or notifications? (see 1.3.3 below "*Fisheries Act*")
4. Will this project require a Navigable Waters Approval? (see 1.3.4 below "*Navigable Waters Protection Act*")
5. Will this project require a YESAA review? (see 1.3.5 below "*Yukon Environmental and Socio-economic Assessment Act*")
6. Will this project require a permit, or compensation under chapter 14 of the UFA, from an affected First Nation government?

1.3.1 Waters Act

The *Waters Act* (2003) regulates water use from water bodies in Yukon. It also regulates alterations to watercourses and deposition of waste and all other materials into water bodies (see definition section). The definition of water includes surface and ground water.

Many development activities that impact a water body will require a water licence. Schedules 5 through 10 of the *Waters Regulation* define the activities and uses that trigger the need to obtain a water licence. In summary, they are:

- Direct water use of 100 or 300 m^3/day or more, depending on the type of undertaking.
- Watercourse crossings, including pipelines, bridges and roads, if the watercourse is over 5 m in width at ordinary high water mark at the point of construction (unless it is placer mining, in which case all watercourse crossings require a licence).

- Altering the flow or direction ("watercourse training") of a non-intermittent watercourse over 5 m in width by making changes to the channel or bank, or by placement of infill, docks, culverts, or erosion control materials (unless it is placer mining, in which case all alterations require a licence).
- Alteration of flow or storage of a watercourse by constructing dams or dikes, when they exceed a certain size (unless it is placer mining, in which case all alterations require a licence).
- Depositing waste into water bodies.
- Constructing permanent flood control structures (some temporary structures also require a water licence).
- Diverting a watercourse that is 2 m in width or greater at ordinary high water mark (unless it is placer mining, in which case all watercourse crossings require a licence).
- Any other use that would have significant environmental effects.
- Any use that would interfere with the rights of other licensed water users.

Water licences are issued by the Yukon Water Board, which is an arms-length, government-appointed review board. Licences always have specific terms and conditions (e.g., maximum amount of water that may be pumped per day; season that activity is permitted/prohibited) and a list of monitoring requirements incumbent upon the licence holder (e.g., monitoring daily water use and submitting an annual report). The application also forms part of the licence, so it is very important that the application accurately reflects the planned activities. For every accepted or rejected licence application, the Yukon Water Board also will issue a document that explains the reasons for its decision and imposed conditions.

The thresholds and activities listed above require a Water Licence. However, this does not mean that activities below those thresholds are unregulated. *Any* water use or waste discharge (even those below the thresholds) conducted in the pursuit of an industrial, placer mining or quartz (hard rock) mining activity requires the developer to file a *Notification of Water Use/Waste Deposit Without a Licence* form with the Yukon Water Board 10 days prior to beginning the activity. According to the *Waters Act*, agricultural, municipal, power generation and miscellaneous activities do not require notification in this situation. The duty of enforcing conditions of a Water Licence is shared by Environment Yukon and the Department of Energy, Mines, and Resources (EMR). The Yukon Water Board's licences set out a requirement for annual monitoring reports submitted by the licence holder. The Yukon government is responsible for on-site inspection and enforcement, and also day-to-day interaction with licence holders to provide advice on how to comply with conditions of a licence.

The Yukon Water Board, the Water Resources Branch and EMR are all located in Whitehorse. Office locations and further contact information are included in Chapter 4.

1.3.2 Lands Act and Territorial Lands (Yukon) Act

The Lands Management Branch of the Department of Energy, Mines and Resources, manages the majority of public land in the territory under the *Lands Act* (2003) and the *Territorial Lands (Yukon) Act* (2003). Pursuant to this legislation, the branch regulates the disposition of land, including sales, leases and grants of rights-of-way or easements, as well as temporary use or work on public lands. A land use permit is required for activities such as: site clearing or earth work; constructing a new road, trail or access; clearing or installing a utility right-of-way; establishing quarries; and, conducting geo-technical or hydrological studies. The legislation also applies to land-based activities that occur directly adjacent to water.

The Yukon Government Lands Management Branch is located in Whitehorse (see Chapter 4).

1.3.3 Fisheries Act

The federal *Fisheries Act* (1985) is meant to prohibit the harmful alteration, disruption, or destruction of fish and fish habitat and to prevent pollution by prohibiting the deposit of harmful substances into Canadian waters. Developers should be aware that jurisdictional responsibilities for enforcement of the *Fisheries Act* are complicated. For instance, the Yukon government has been delegated responsibility for management of Yukon freshwater fish and fisheries, while the federal government retains responsibility for managing fish habitat, marine fisheries, and any deposition of harmful substances into waters. Consequently, the Yukon government establishes policy and sets out licence conditions for freshwater fisheries in the territory, and the Yukon's Director of Fish and Wildlife has the authority to change certain regulations such as fishery closure times, quotas, or catch limits without going through an application to change federal regulations (Yukon Environment 2010). In all other matters, the Department of Fisheries and Oceans (DFO) is responsible for administering and enforcing the *Fisheries Act*, which includes authorizing work that negatively impacts fish and fish habitat. However, Environment Canada (EC) is responsible for the pollution preventions in the *Act* while DFO retains responsibility for the deposition of sediment as a deleterious substance. Both DFO and EC have offices in Whitehorse. Contact information is included in Chapter 4 of this guide.

DFO's policy is that activities that may result in the Harmful Alteration, Disruption or Destruction (HADD) of fish habitat will require a *Fisheries Act* authorization (FAA). A HADD is defined as any change in fish habitat that reduces its capacity to support one or more life processes of fish. Prior to issuing an authorization, the proponent will need to conduct an aquatic effects assessment and develop a compensation plan for fish habitat that is lost due to the development. In addition, the proponent will need to provide construction drawings and monitoring plans along with a monitoring and adaptive management plan for the compensation works for DFO review prior to the issuance of a FAA.

1.3.4 Navigable Waters Protection Act (NWPA)

The federal *Navigable Waters Protection Act* (1985) regulates and protects the public's right to marine navigation on all navigable waterways in Canada. All construction of works built or placed in, over, through or across navigable waterways must be licensed by the federal Navigable Waters Protection Program. Licences are issued with conditional uses and construction requirements so that the water body remains navigable, even during construction. These requirements of the NWPA are easily overlooked by developers and are worth considering early in a project because the permitting process can be lengthy. Furthermore, the definition of "navigable" is easily met: a stream with a channel width >1.2 m or channel depth >0.3 m (with a few exceptions) is considered to be navigable. The original act of 1886, which is still in effect, essentially defines navigable water as all bodies of water that are capable of being navigated by any type of floating vessel for transportation, recreation or commerce. This includes a canal and any other body of water created or altered as a result of the construction of any work. Yukon is part of the Prairie & Northern Region of the Navigable Waters Protection Program (NWPP), whose office is in Edmonton. There is no Yukon office or local contact for the NWPP.

1.3.5 Yukon Environmental and Socio-economic Assessment Act (YESAA)

The *Yukon Environmental and Socio-economic Assessment Act* (2003) has Yukon's name on it, but it is actually a federal act. It provides a process to assess potential (negative) environmental and socio-economic effects of development projects in Yukon. When a project triggers the need for a YESAA review (see below), proponents of the project submit project plans to the Yukon Environmental and Socio-economic Assessment Board (YESAB) or its designated office (DO), along with supporting documents demonstrating how anticipated environmental and socio-economic issues will be addressed. YESAB reviews the submission, advertises the project, and then solicits comments from the public, relevant government departments, regulators, First Nations, and other affected parties. After this review and comment period,

YESAB may ask the proponent for additional information, after which it will release an assessment of the project. It will include its opinion on probable environmental and socio-economic impacts, suggestions for mitigative measures to be taken, and a recommendation to the relevant government decision body as to whether the project should be allowed to proceed, and under what conditions.

YESAB only assesses projects and makes recommendations; it is not a decision-making body. The authority that allows a project to proceed rests with the relevant government(s) (the decision body), which may also set conditions for the project. For example, the ultimate decision whether a new tract of land can be developed rests with the Yukon government (Lands Management Branch), but it may set conditions for the approval based on comments and recommendations received through the YESAA review process. For a project with overlapping jurisdictions, there may be more than one decision body. For projects that take place on First Nation Settlement Land, the local First Nation government, the territorial government or the federal government can be the decision body. A YESAA evaluation is typically required before a permit or licence is issued, because permitting agencies rely on the YESAA process for an assessment of the project impacts. The YESAA assessment and regulatory review can, to a degree, occur concurrently. Proponents are encouraged to discuss their application with the regulator(s) prior to applying to YESAB. This step can help ensure that the application is complete, which may reduce the time required for a proper YESAA assessment.

Developers should know that certain activities require a YESAA review and others do not. The *Assessable Activities, Exemptions and Executive Committee Projects Regulations* lists activities and thresholds that trigger an assessment and closely parallel the list of activities and thresholds that trigger a government authorization. In other words, if the project requires a government permit or licence, it almost certainly requires a review by YESAB. On the other hand, there are many project activities that trigger YESAA where no permit is required. While the types of activities undertaken in a project are important determinants for triggering a YESAA review, another major determinate is whether the activity occurs on public, private, or First Nation land. Many projects that would trigger a YESAA review when they occur on public land do not trigger a review when they occur on private or First Nation land. However, developers should be aware that while a project may occur on private land, it will require a YESAA review and water permits if it affects a public watercourse or fisheries.

The six YESAB DO offices are located in Dawson, Mayo, Haines Junction, Teslin, Watson Lake and Whitehorse. YESAB's main headquarters are located in Whitehorse. Detailed contact information is provided in Chapter 4.

2 Best Management Practices: Materials & Methods

The BMPs in this guide are organized in two chapters. This first chapter – *Materials & Methods*– explains in some detail procedures for controlling erosion, sedimentation and contamination, and protecting the aquatic environment. These are the basic tools of the trade, and include techniques such as revegetating a site, erecting a silt fence, or designing a check dam.

The next chapter – *Working in and around Water Bodies* – lays out best practices for some of the most common activities undertaken by developers in Yukon, such as installing culverts, diverting streams, fording streams or setting up barge landings. It provides notes for planners and designers, as well as a rundown of best practices to use during the construction process. For details on how to carry out those best practices, the reader will be referred back to sections in this *Materials and Methods* chapter.

2.1 Erosion and Sediment Control

2.1.1 General Principles

The process of soil erosion involves the detachment and transport of sediment particles. Weathering or soil disturbance causes detachment, while transportation mechanisms include water, ice, wind, gravity and machinery. If suspended or trapped in water or ice, sediment particles can travel long distances. Eventually particles will precipitate out of the water column, a process referred to as sedimentation.

An unprotected stream bank that is being eroded by high water.

Sediment particles suspended in water cause turbidity and affect numerous aspects of water quality. Natural turbidity levels fluctuate seasonally in most systems with the highest levels occurring during flood events and spring melt. Natural turbidity is markedly lower in winter. While aquatic life in Yukon is adapted to fluctuations in seasonal turbidity, increased turbidity can be very detrimental if it is sudden, excessive or occurs out of season. Turbidity blocks light from penetrating the water column proportionate to the density of suspended particles, with a reciprocal reduction in plant and algae growth due to reduced light for photosynthesis. This, in turn, affects the food supply for many aquatic animals. In addition, excessive amounts of sediment can cover fish eggs and clog gills, which can lead to death of eggs, fish and filter-feeding organisms. Besides affecting aquatic life, excessive erosion can damage the stability of the construction site or structures such as bridge foundations or culverts.

Strategies and Planning:

Preventing erosion should be the primary strategy of the erosion and sediment control plan. Moreover, it is often easier and less expensive to control erosion at the source than it is to deal with sediment after it has been mobilized. Activities which greatly increase the risk of erosion and which require planning include:

- handling and moving soil during construction
- erecting water diversions
- destabilizing slopes
- disturbing and melting permafrost
- conducting in-stream work
- building temporary roads
- clearing/grubbing vegetation

If it is not possible to eliminate erosion and sedimentation at the site, develop a control plan to minimize and manage them. Use the following principles:

The abutment and approach (not shown) of this bridge failed because surface drainage water flowed to the bridge rather than being directed away from it. This could easily have been prevented with proper grading and bridge design.

- Take into account that some erosion-control materials (e.g., geotextiles) will need to be ordered months before construction begins, so plan for them in project schedules and budgets.
- Think about whether construction can occur at a time of year that minimizes erosion.
- Time the mobilization and demobilization of equipment and camps to minimize erosion. Avoid mobilization efforts during spring melt-off. If possible, wait to demobilize until the ground has frozen.
- Visit the site before the work season and identify site-specific erosion issues and sediment release problems that may arise based on work-site factors such as:
    - Slope, aspect, and elevation
    - Soil texture and percolation characteristics
    - Areas with little vegetation cover that are likely to erode
    - Local climatic factors (e.g., rain shadows)
- Take into account the expected type, intensity, and duration of the disturbance, remembering that a small disturbance in a sensitive area or at the wrong time can be just as worrisome as a major disturbance in a resilient area.

General Preventative Measures:

- Minimize the size of the disturbed area (e.g., project footprint).
- Use existing trails and roads as much as possible.
- Maximize retention of natural vegetation cover—it is the best and cheapest defence against erosion.
- Maintain vegetation buffers, particularly near water.
- Minimize the amount of mass grading and soil compaction at the site.
- Avoid working on unstable areas and steep slopes.
- Minimize water crossings.
- Sequence and schedule construction to take advantage of drier weather.
- Avoid disturbing permafrost and the overlying vegetation, otherwise it will likely melt.

A rock flume is an erosion control measure commonly used for culvert outlets located on steep grades.

Active Erosion Control Measures:

- Cover and stabilize disturbed areas as soon as possible. Use appropriate erosion and sediment control products and methods (e.g., seeding, mulches, geotextiles, rolled erosion control products).
- Divert runoff around erosion-prone areas. Create durable ditches, roads and drainage structures (culverts).
- Identify vegetated natural depressions that can be used to contain runoff for natural treatment and filtration.
- Reduce the quantity and velocity of runoff water since fast flowing water mobilizes more sediment: keep channel slopes low and keep drainage areas small (e.g., higher density of smaller drainages).

Active Sediment Control Measures:

- Put sediment control measures in place before starting any work that may result in sediment mobilization. In most cases, these are: silt fences, sediment traps and dewatering basins.

- Mixing clean water with sediment-laden water simply produces a larger quantity of dirty water to manage, so keep clean water clean by:

    - Diverting sediment-laden runoff water in and around the construction site into sediment traps and dewatering basins; do not let dirty runoff water flow into a water body.

    - Diverting clean runoff water from undisturbed areas within the construction zone without mixing it with water from disturbed areas.

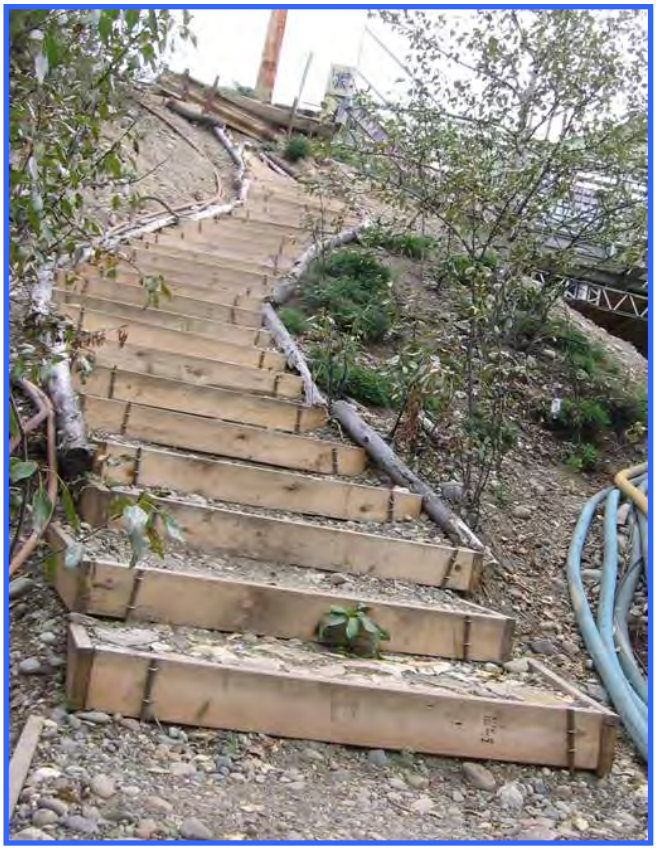
Response Planning:

- Ensure that all riprap and erosion control materials are on site and ready to be deployed before construction starts.

- Have extra materials readily available in case of unforeseen need and based on site erosion risk/potential. Left over material can always be used on the next project.

- Equipment may need to be left on the work site for longer than initially planned so that it is available for emergency response.

- Deploying erosion control measures or responding to unforeseen erosion and sedimentation problems may mean keeping additional or specialized equipment on site.



These steps were created for easy access down a steep bank to the river while also minimizing erosion of the bank. Smart planning can avoid problems later on.

2.1.2 Vegetation Management & Revegetation

Strategies and Planning:

Retaining as much natural vegetation as possible on-site is one of the best and cheapest tools that a developer can employ to prevent erosion and sedimentation. Vegetation holds sediment in place, detains and reduces the velocity of storm water, and filters runoff water. Just as important, retaining as much natural vegetation as possible can reduce the amount and cost of reclamation work after the project is completed.

When the nature of the work requires active revegetation efforts (e.g., planting/seeding), the common practice now is to use as many native species as possible in the seed/seedling mix, and preferably derived from local genetic stock. Seed and seedlings may be propagated outside of Yukon, but the original seed stock should originate from Yukon. Great care also must be taken not to introduce invasive species with seed mixes; purchased seed should be certified to be free of invasive species and certain weeds. In the planning process, be aware that planting seedlings requires significant pre-planning. Cuttings must be collected in the autumn prior to planting so they can be propagated in a greenhouse over the winter in time for planting the following year.

Techniques for Preserving Natural Vegetation:

Existing vegetation should be left undisturbed where possible unless it is determined to be invasive or otherwise harmful.

- Maintain “no-entry” vegetation buffers, particularly around water bodies, and clearly mark these before clearing starts to avoid excessive clearing. Riparian buffers are typically between 10 to 50 m wide, depending on the development activity. However, minimum buffers have been legally mandated for certain activities and industries, so check with regulators first before working directly adjacent to a water body.

Vegetated buffers were not maintained around streams for this forestry development project. The trees left uncut are on islands and were inaccessible.

- Only clear and blade to bare mineral soil when and where it is absolutely necessary. Consider instead if cutting trees and shrubs off at ground level and leaving the root mass in the ground is an option. Willows in particular are very versatile and will grow back after being cut off and driven on, as long as most of the roots are kept intact.

- When blading to bare mineral soil must be done, stockpile the scraped vegetation and organic soil and leave it in the immediate vicinity. It can be re-applied after work is complete, or applied elsewhere as needed to minimize revegetation time.

Techniques to Encourage Natural Revegetation:

- Most disturbed surfaces, natural or man-made, will eventually be re-colonized by native plants, but it is important to initiate the re-vegetation process as soon as possible to reduce erosion potential. In the north, this can be a very slow process. Conditions that determine the time it takes for natural vegetation to be re-established include:
    - Proximity of viable seed sources,
    - Surface and soil conditions (including active site preparation and stabilization measures), and
    - Local environmental conditions (e.g., elevation, location in Yukon, and the presence/absence of significant rains in early and mid summer).
- Natural revegetation can be greatly enhanced and accelerated by re-spreading topsoil and overburden that was previously scraped. The soil contains organics with a natural seed bank that should provide the necessary seed for revegetation. So where possible, stockpile stripped surface material for later use.
- Natural recovery of vegetation in Yukon can be slow (many years to decades). In situations where more rapid plant growth or cover is required, the area should be actively seeded. A mix of perennial grasses/forbs often suffices. But for steep slopes and other erosion-prone areas, it should include an annual grass for more rapid cover (see below).

Some sites are more challenging than others to revegetate.

Principles of Revegetation through Active Seeding and Planting:

If preserving vegetation or natural revegetation are not viable options, develop a revegetation plan for the site. Consider the following:

- Determine the revegetation objective in terms of the short and long-term goals:
    - Short-term: sediment and erosion control (e.g., stabilize the ground surface).
    - Long-term: rehabilitation to a “natural” state, creating fish/wildlife habitat, recreational use and aesthetics.

- Prior to construction, record the pre-existing vegetation and site conditions. This information will help when returning the site as close as possible to its pre-existing condition. Remember to take photographs of the area to document conditions before construction begins.

- When recording pre-existing vegetation types and site conditions, look beyond the immediate work site for a number of reasons. First, it may help you determine what early successional habitats look like in that area, which may suggest the best colonizing plants to re-introduce. Second, since it may not be realistic to immediately re-establish the type of habitat that existed prior to construction, knowing the range of habitat types that occur locally may offer different options for revegetation. Finally, such recording will provide information about possible sources of natural seeds for re-vegetation.

- When recording site data, describe and test basic soil conditions (e.g., pH, structure, organic content, nutrient levels) to determine the need for soil amendments that would stimulate plant growth, such as organics or fertilizer.

Willows are highly versatile shrubs that transplant easily if the roots are intact. This mature willow bush was cut off and then transplanted to a new location.

- Determine what type of seeding/planting materials and techniques are appropriate and practical for the site. These choices are largely determined by the site's slope and stability. Steep slopes and other unstable surfaces susceptible to erosion may require applications of stabilizing materials (see BMPs 2.1.3 *Mulching* and 2.1.4 *Rolled Erosion Control Products*). Selected seed mixes on these sites should contain rapid growing colonizing plants to quickly establish a ground cover, and may require hydroseeding (see below). Seeds usually can be applied mechanically, but seedlings and cuttings require hand planting.

- Timing: optimal seeding time is in spring (May/June) as soon after spring melt as possible. Fall seeding/planting is an option as well (from late September until the ground freezes), with germination occurring after snow melt in the following next year. The advantage of fall seeding is that plants will germinate and become established earlier in the following spring (because it is not necessary to wait for the land to dry out enough to operate seeding equipment). The drawback is that there will be more

Hydroseeding in progress. A slurry containing fibrous mulch, seed and fertilizer is sprayed onto the slope to reduce erosion potential and promote quick revegetation. A tackifier is often included to hold the mixture together.

seed loss when seeding in fall, due to runoff and winter kill if planting occurs too early (from mid-July until mid-September), seeds may germinate right away and many will die over winter (ungerminated seeds will survive winter, but recently germinated seeds and juvenile plants often will not).

- Seedbed preparation: Harrowing or other means of roughening up the surface, before and after seeding, helps improve seed germination rates by scarifying compacted soil, covering seed with dirt, and creating moisture pockets.

- Seeding methods: Either hand or mechanized seeding methods – or a combination – may be appropriate, depending on the total area being seeded and nature of the terrain. When possible, use a seed drill, as it maximizes the seed-soil contact and greatly improves germination success. Unfortunately, seed drills are only practical on relatively flat, debris-free terrain. Hand and mechanized broadcast spreaders are most often used. A practical and inexpensive set-up for seeding many acres over diverse terrain is an ATV equipped with a tine harrow and a broadcast seeder. Hydroseeding is typically used for slopes that are steeper than 3H:1V.

A harrow is used to loosen the surface soil prior to seeding. Seeding projects can often be completed by a two-person crew using an ATV equipped with a harrow and broadcast seeding, in conjunction with hand seeding.

To determine what seed mix is appropriate, consider the following:

- Seeds, seedlings, and the planting process can be expensive. So take considerable care selecting seed/seedling mixes to ensure that the plants germinate and take hold.

- An invaluable reference document is *Guidelines for Reclamation / Revegetation in the Yukon* published by Environment Yukon. Refer to it for seed-mixes and seeding rates that are matched to your project's site conditions. It also provides more details on reclamation and revegetation techniques than are listed here.

A small area next to a creek is raked in preparation for seed application.

- You will find that only a select variety of native seeds are available commercially, but availability is always changing, so consult seed suppliers or the Agriculture Branch (EMR) when planning seed mixes.

- Avoid introducing invasive species – choose only the highest quality seed as outlined in the federal *Seeds Act*. Ask for weed certificates from the supplier. This certificate lists results of testing for the type and percentage of weed seeds in the mix.

- Mixes of plants that are native to the site are preferred, but may be slow to establish. Consequently, it is acceptable to include an annual grass (rye, or barley) in the mix to create immediate ground cover. But do not include more than 5-10% because thick growth of an annual grass will impede growth of the preferred (native perennial) seed in the mix.

- For commercial production reasons, seeds and cuttings from native plants are often collected locally but propagated elsewhere, usually in Alberta and BC. When revegetating with "native plants," ask for verification that the seeds were propagated from original Yukon stock.

- When implementing special seed/planting requirements and planting native plants, try to plan at least one year ahead so a seed producer or nursery has time to collect and grow sufficient stock. Developing a large seed supply takes many years, but nursery stock (e.g., rooted plants) can often be produced in one year from seed or small cuttings.

Monitoring:

- Monitor the revegetation progress for several years after planting, particularly along streams/erosion areas. Reseed or replant problem areas if erosion occurs or plants do not emerge.

2.1.3 Mulching

Mulching is the application of fibrous plant material, such as straw, to the soil surface. It is an effective means of controlling runoff and erosion on flat, disturbed areas and is often applied as a component of revegetation (seeding) programs because it helps retain soil moisture, promotes germination, and protects seedlings. By design, mulching is a temporary measure that protects the ground surface while seedlings germinate or while other permanent grading or cover is applied.

General Principles:

- Protect mulches from wind by working them into the soil.
- When used in conjunction with seeding, apply the seed first and then the mulch.
- Water the mulched area to ensure the seeds below will germinate.
- Watch for and repair washout of mulch.
- Mulching can degrade slowly; therefore, some mulch products might need to be removed once vegetation is established.
- Avoid application where mulches may be washed from surfaces and end up clogging or polluting water bodies. If mulches are applied directly to stream banks, they must be well anchored with sticks or punching, or can be hand-worked into the soil.

Straw Mulch:

- Straw is a common mulch used as cover over a new seedbed. However, it is a short-lasting mulch so is usually used when the need for protecting seedlings lasts 3 months or less.
- When using straw in conjunction with seeding, apply the seeds first and then the straw.
- Straw should be properly cured and dried. Uncured straw will mould.
- Straw should come from stalks of wheat or oats. Other baled products, like hay and alfalfa, are an attractant to wildlife, are more prone to moulding, and will break down quicker than straw.

Straw mulch used to protect a seeded stream bank from erosion. This straw should have been worked into the ground surface better so it will not blow away or wash into the water body.

- It is important that the straw is free of seeds of weeds and invasive plants. To avoid introducing invasive plants, use locally-produced straw whenever possible.

- Straw can be broken up and spread by hand or machine, but to be effective it must be applied to a uniform thickness, no less than 10 cm and no greater than 20 cm.

- Straw mulch needs to be anchored to the surface. This can be done mechanically by crimping, disking, rolling or punching it into the soil. Care must be taken to not overly compact the site when using equipment to anchor straw mulch. Decomposable netting, such as jute or burlap, can be used to assist in anchoring. If the site allows for frequent (e.g., daily) watering, then the straw often can be anchored simply by keeping it moist on the surface.

Wood Chip Mulch:

- Chips should be relatively small to work well as a mulching medium. The largest pieces should be <5 cm in width and <10 cm in length. The average chip should be much smaller.

- Wood chips are only suitable for areas that will not be closely mowed.

- An advantage of wood chips is that they can be produced from trees that were cleared from the site, and thus provide inexpensive mulch material.

- Wood chips should only be applied to slopes that are <6 % (16H:1V) because chips on steep slopes are often washed away by runoff and commonly clog drainage inlets.

Wood Fibre Cellulose Mulch:

- This is a commercial product produced from recycled wood and paper fibres. It is dyed green and resembles cellulose insulation (which is very similar in composition).

- Wood fibre cellulose mulch can be spread dry on a surface, but it usually is applied wet, as a slurry using a hydromulcher. If applied dry, be sure to immediately wet the surface. Apply 11-14 kg per 92 m^2 (25 to 30 pounds per 1,000 ft^2).

- In Yukon, wood fibre cellulose generally is not cost-effective or readily available for use as a mulch, but it is used in the slurry applied during hydroseeding, where it also functions as a flocculent and binder.

- If used in hydroseeding or other applications, be sure to purchase a type that does not contain growth-inhibiting factors, such as that found in cellulose insulation. For this reason, do not use cellulose insulation for mulch.

- Long cellulose fibre mulches provide better erosion control than short fibre mulches, but they only work well in a water/seed/mulch slurry when a tacking (binding) agent is added. Short cellulose fibres do not require a tacking agent but do not prevent erosion as well.

2.1.4 Rolled Erosion Control Products

A manufactured erosion control product composed of straw and jute mats being installed along a creek. The surface was seeded before the matting was unrolled, and willow cuttings were later planted at the water's edge.

Rolled erosion control products (RECP) are flexible sheet materials that contain a central layer of permeable fibres sandwiched between two layers of coarse mesh. Often, both the fibres and the mesh are composed of organic materials so that the sheets decompose over time. Others are made from UV-stable synthetics (e.g., polypropylene) and are intended for longer-term use. RECPs are manufactured and purchased in rolls containing a sheet that is typically about 2 m wide and 16 m long.

RECPs are excellent products for covering unvegetated cut or fill slopes where erosion control or soil stabilization is needed. They are used where temporary seeding and mulching alone are inadequate or where mulch must be anchored and other methods such as crimping or tackifying are infeasible, like directly adjacent to streams.

RECPs function best in providing a protective cover on slopes and channels where the erosion hazard is high and plant growth is likely to be slow, generally on slopes steeper than 3H:1V and with greater than 3 m of vertical relief.

The same site as above one year later. Grass is emerging and the willow cuttings are growing along the water. The slope may look exposed and prone to erosion, but the buried matting is keeping the slope stable while vegetation becomes established.

Planning:

- There is an array of RECP products available, composed of many different materials, each designed for a specific application. Choose one with a life expectancy appropriate for the site and application. Some of the organic fibre RECPs, such as ones made from straw and coconut fibre only last about a year before breaking down. Synthetic RECPs with UV light-resistant materials will last many years. Each has its place and application. Most often, the goal is for the RECP to persist and stabilize erosive surfaces until vegetation has developed and can provide a permanent erosion-resistant cover. At other times, the RECP functions as a semi-permanent surface treatment. RECP products are very effective, but tend to be expensive. Consequently, the most cost-effective strategy may be to use them in small or high-risk areas, and in conjunction with other erosion-control measures.

Installation:

- Each type of RECP has its own specific installation procedure so consult directions provided by the manufacturer.

- It is critical that RECP sheets be anchored. Special spikes, staples, and pins are available from the manufacturer, but rocks and site-made stakes can be used. Anchor spacing will need to be adjusted based on the type of material and steepness of slope.

- For a RECP product to work effectively, it must be in direct, tight contact with the soil surface beneath it. Otherwise, runoff water can get between the sheet and soil and cause erosion.

- If used in conjunction with a seeding prescription, apply the seed and fertilize before installing the RECP.

Maintenance:

- Monitor the site for washouts and areas where RECP sheets may have slipped. After any damaged slope and rills have been repaired, reinstall the material and apply extra anchors.

- Periodically check that the anchors remain secure and are keeping the RECP sheets tight to the soil surface.

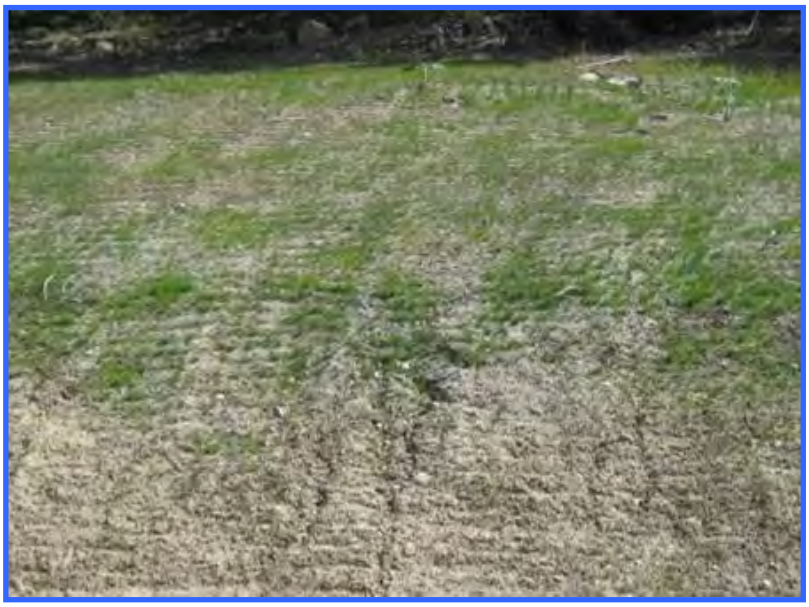
Coconut fibre matting reinforced with a UV resistant mesh was installed in this erosion-prone ditch that drained directly into an adjacent river. The site was seeded prior to installation of the matting. There are two installation errors to note: the edges of the matting should have been folded into the side slopes by means of an anchor trench, rather than lying flat on the ground. Also no dirt should have been put on top of the matting.

2.1.5 Surface Roughening

Surface roughening, or cat-tracking, is used on slopes to provide a surface structure with small pockets that trap runoff and where water infiltrates into the ground rather than flowing downhill. The texturing also helps the revegetation process as the roughened soil and trapped moisture promote seed germination and prevent seeds from being washed away. The surface should still be graded properly and the surface should only show a light roughened texture. The process should not leave an undulating or pock-marked surface. Visualize a smooth soil surface that is roughened by driving over it with a tracked vehicle moving in a straight direction.

Planning:

- Surface roughening works on flat and most moderately sloped areas, except when the soil is hard pan or saturated. Instruct crews not to blade surfaces smooth or drag a flat bucket over them when grading sites, but rather to leave a rough surface and shallow cat tracks. A toothed bucket or blade works best. This will save time and money by avoiding the need to texture the surface in a separate treatment.



This slope was properly tracked with a dozer and seeded the year before this picture was taken.

Methods:

- Run tracked machinery parallel to the fall line of the slope with the blade raised, not on the ground. Do not track parallel to the slope because it actually promotes erosion.
- Avoid compaction by driving up and down the slope on the same surface only once.
- Minimize the number of turns made on the treated slope, as this causes ruts and depressions.
- Keep about one foot between each new track and cover the entire slope.
- If needed, seed and mulch the slope immediately. Natural revegetation can be preferable

Extreme roughening of the soil surface using a ripper.

depending on site conditions, particularly if erosion is not an immediate concern.

Maintenance:

- Check for erosion after significant rainfall events and spring runoff. If rills appear, re-grade, roughen and seed again.

2.1.6 Check Dams

A check dam is a structure, usually temporary, erected in narrow, erosion-susceptible drainage channels that have been constructed on site to control storm water flow. They are installed to reduce flow velocity, and thus protect the channel from erosion, and also to reduce sediment loads in any channelled flows. They are placed directly in the channel and usually are positioned in series, constituting “steps”. It is not uncommon for check dams to be installed as semi-permanent sediment control measures.

Planning:

Check dams can be made from a variety of materials. They are most commonly constructed of rock, logs, sandbags, or straw bales. When using rock, the material diameter should be 2 to 38 cm (1 to 15 inches). Logs should have a diameter of 15 to 20 cm (6 to 8 inches). Regardless of the material used, design the check dam carefully to ensure its effectiveness. Check dam steps need to be properly spaced so that water ponded behind the downstream check step reaches just above the base of the upstream step, like a staircase. The materials and design should be chosen relative to the expected lifespan of the check dam and anticipated high water flow.

The following method explains the general design and application principles only. A site-specific design by an engineer may be required.

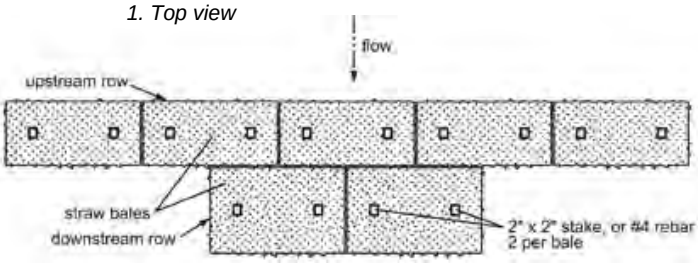
Constructing a Rock Check Dam:

- At the location of each rock check structure (step), excavate a trench key at least 15 cm deep, perpendicular to the channel.
- Place non-woven geotextile fabric over the footprint area of the rock check structure (including the trench key).
- Place the rock. The structure should extend all the way from one side of the ditch or channel to the other.
- The structure should be constructed so that centre of the crest is depressed to form a centre flow width that is a minimum of 30 cm lower than the outer edges.
- The height of the structures should be less than 20 cm (8 inches) to avoid impounding large volumes of runoff.
- Downstream slope of the check dam should be a minimum of 3H:1V.
- Upstream slope of the check dam should be a minimum of 2H:1V.
- The height and spacing between structures should be designed to reduce steep channel slopes to intervals of flatter gradient.
- Aggregate used should have a diameter between 2 and 38 cm (1 to 15 inches) and must be large enough to remain in place during high velocity flow situations.
- Maximum rock diameter should not exceed 15 cm if the structure is to be used as a sediment trap.

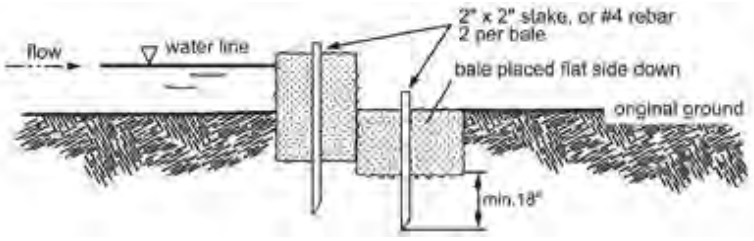
Constructing a Straw Bale Check Dam:

- At the location of each check structure (step), excavate a trench perpendicular to the channel that is approximately 15 cm deep and equal to the width of two straw bales.
- Place two rows of straw bales in each excavated trench perpendicular to flow direction, ensuring that the bales are staggered so that no joints are aligned on the upstream and downstream rows. Infill all joints with loose straw.
- The centre of the crest of the check structure should be at least 15 cm lower than the outer edges along the channel walls.
- Drive two 1.2 m long square section wooden stakes through each straw bale, ensuring each stake is embedded a minimum of 30 cm into the underlying soil.
- Backfill and compact the upstream and downstream edges of the check structure to seat the straw bales into the base of the ditch. Most local material will be suitable, but gravel is best.
- The lifespan and effectiveness of straw bale check dams is improved if each bale step is overlain with geotextile cloth prior to backfilling. The cloth should be pinned to the straw bales below grade before backfilling.
- The height and spacing between structures should be designed to reduce steep channel slopes to intervals of flatter gradient.
- To avoid impounding large volumes of runoff, check structures should be a maximum of one straw bale high.

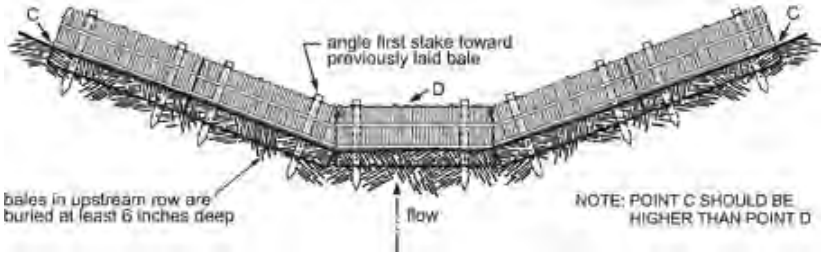
1. Top view



2. Side view



3. Upstream view



Source: U.S. Department of Agriculture Natural Resources Conservation Service. www.mt.nrcs.usda.gov/technical/fires/strawdam.html

2.1.7 Silt Fences

Silt fences are used to pond sheet flow runoff on mildly sloped areas, thus allowing heavy sediment particles to settle out while water and lighter particles slowly pass through the fence material. When properly designed and installed, silt fences are very effective at removing sediment from runoff.

In addition to creating sediment traps, another common application of silt fencing is for constructing perimeter barriers that prevent loose material from falling into creeks and water bodies.

The primary material used to construct silt fencing is geotextile cloth. There are two types of this handy, general-purpose synthetic cloth: woven and unwoven. Woven cloth is smooth, whereas unwoven cloth has a rougher, woolly finish. The two products function differently, and have different applications. The woven type is stronger and allows water to seep through, but is impervious to sediment. It is the type that should be used for silt fencing. The non-woven type is more porous, but tends to clog up quickly with sediment and is not stiff enough to stand upright on a fence and resist water pressure (e.g., they sag and rip).

This silt fence illustrates that even an imperfectly implemented sediment control measure is better than nothing. The fence did its job, but could have been built better and it is beginning to fail. It is collapsing because of inadequate staking; metal rebar or larger wood stakes should have been used. Woven geotextile should have been used instead of unwoven, as it is stronger and will sag less. The fence will need to be cleaned out before being repaired or removed.

The design life of a silt fence typically is only around six months or less. Silt fences must be removed and disposed of when no longer needed (e.g., when vegetation has been established and sedimentation is no longer a problem).

This silt fence should have been installed at the bottom of the disturbed slope rather than in the undisturbed vegetation. Currently it is non-functional.

Installation:

- Silt fences are frequently installed incorrectly. Successful performance is highly dependent on proper installation.
- Place the fence at the bottom of a slope or on a slope bench. Install it at right angles to the slope, following the slope contour.

- The filter cloth should be keyed into the surrounding earth to hold it in place. Otherwise, runoff and sediment will flow beneath the fence. To do this, dig a shallow trench and key the fabric in the ground. Cover the trench and compact the loose soil. Then pound the stakes into the ground.

- Posts should be spaced so that the geotextile cloth does not develop strong sags. The cloth should be securely attached to posts on the uphill side, so fasteners are not pulled out by the weight of sediment and water.

- Silt fences should not be used in locations with concentrated flow, including streams or other storm water conveyances, as they will not hold up to the flow.

Maintenance:

During installation or inspection, a silt fence may appear to be adequate, but the adequacy of a fence is only tested during storm events. Installers and inspectors must ask if the fence will hold up during storms. The filter cloth must be kept in good condition to maintain its function in a storm. If it is torn or frayed, replace it. If the cloth is not keyed into the surrounding earth, it must be reinstalled. The posts should be reinstalled if they loosen. The silt fence should be cleaned when sediment accumulates and cleaned or replaced when it is covered with sediment. Here is a checklist:

This silt fence was installed along a creek as a perimeter fence to keep loose material from rolling into the water.

- Straighten leaning fencing and secure loose posts. Fix rips in the cloth.

- Ensure that the filter cloth is securely attached to the fence posts.

- Check for evidence of runoff overtopping the filter cloth; correct as necessary. Clean out excess sediment.

- Check for underflow and re-key if necessary.

2.1.8 Sediment Traps, Sumps and Detention Ponds

Many development activities will generate significant amounts of sediment-laden water, either from runoff over newly exposed ground or from pumping and dewatering operations. It is standard practice to direct this wastewater into sediment traps of various sorts and sizes, depending on the types and scale of operation. Once in the trap, sediment settles out while the resulting clean water either percolates into the ground or is secondarily discharged. Silt fences perform a similar function. However, traps can handle larger volumes of water and sediment loads. They also function better than fences at removing fine-grained sediments such as clays or silts, as well as some chemicals.

This sediment trap contains water pumped from isolated in-stream work areas created to construct a new bridge pier. This sediment trap has a passive overflow so clear water can exit the overflow and pass through vegetation before re-entering the adjacent stream.

Detention ponds function similar to sediment traps, but they are large, permanent structures that require advanced engineering, whereas traps are more or less temporary in nature and often are built on-site with minimal materials. The photographs for this BMP illustrate the wide range of sediment traps, sumps, and ponds that can be constructed.

Sediment Traps and Natural Sumps:

Sediment traps usually are built on-site and often take advantage of natural sumps. However, manufactured tank systems are available and may be the best choice in some situations. Tanks come in many forms and most often are prescribed for space-limited situations, sensitive permafrost sites, or when contaminants other than sediments need to be separated from water. It is far more effective to contain and pump contaminated sediment from a hard-lined tank than from a hole in the ground.

Creative use of an old tank as a sediment settling system. The upper container receives the sediment-laden water and has a passive overflow to the lower container, which has an outlet controlled by a valve.

Site-built traps are either simple constructed containment structures or they utilize natural sumps. A simple trap can be made with straw bale walls and a lining of geotextile cloth. The main disadvantage of this system is that water does not percolate through the cloth, the trap quickly fills, and clean water must be discharged to yet another area. The simplest and most common approach to a sediment trap is to utilize a natural, vegetated depression (sump). Vegetation helps retain sediment and slow the flow of water, and clean water either

percolates into the ground or spreads further out in the depression. If only small volumes of dirty water are being treated, then even a flat surface or minor depression can be used, if it is well vegetated. If an area is already disturbed and stripped of vegetation, then a pit can be excavated and used as a trap, but it should be lined with rock and should have an elevated rock-lined outlet. Excavating a vegetated area for use as a trap usually is counterproductive and may lead to more erosion and sedimentation. In almost all terrain, some form of natural depression can be found.

The size of the sediment trap is designed to match the expected sedimentation rate, which is determined by sediment size (clay precipitates out slowest, gravel fastest), water input volume, and percolation (infiltration) rate. These factors make the type and size of the trap a very site-dependent decision. For instance, the amount of water being sent through a trap may be relatively small, but if the sediment load is very high and much of the sediment is fine clays, then the trap may need to be built as large as a trap that deals with large volume flood events carrying only a small load of sand.

The size of a sediment trap depends on the volume of water that will be generated and sediment settling rate. This trap, while small, was built to contain a small volume of concrete curing water, and was adequate for the job.

Dewatering Sediment Traps:

Water often accumulates in sediment traps faster than it can percolate, especially as the trap fills with sediment, and some traps are impermeable by design. In those cases, water must be properly dewatered either by pumping or via a controlled outlet. In either case, the sediment load of the discharge must be monitored and treated for sediment. If small volumes are involved, they usually are just pumped from the trap and directed onto a vegetated area for infiltration. A common mistake is to use a pump that is too large, causing the water to be pumped out too quickly or under too much pressure, which often leads to gullying and erosion. It is far better to use a small pump and run it for longer periods, or even continuously, so that the discharge occurs as a trickle. The outlet of the hose should be moved frequently to distribute water and sediment evenly. A second mistake is to pump water from too low in the trap, where there is more sediment. Floating pumps or floating suction inlets should be used so that only the cleanest water is discharged. Never pump overflow water directly into a water body. On traps with designed outlets, the outlet should be elevated and lined with rock. Outlet water either can be

A small excavated sump built to collect runoff from a drill site. This is a simple but effective method for reducing sedimentation.

directed to a vegetated area for natural infiltration, or into a rock flume if it is permitted to be channelled towards a water body.

Detention Ponds:

Detention ponds, also called retention ponds, are large, permanent water bodies that have the capacity to accept sudden and/or large amounts of runoff or discharge water. The ponds are dewatered through elevated outlet pipes, which allow for slow discharge of clean water. The clear water leaving these pipes will either be routed back to a natural water body or will receive further filtering and treatment. The volumes are generally too large to simply be discharged directly onto vegetated ground. Detention ponds can be effective for both reduction of downstream erosion (because they release slow-velocity water) and the trapping of sediment and contaminants. A number of variations on the basic design are available and such ponds can range from relatively small single basins to multiple basin systems comprised of interconnected manmade excavations and associated wetlands. They require regular maintenance (e.g., sediment removal) to ensure that proper capacity and adequate drainage are maintained. Depending on the source of water and sediment, disposal of sediments may require special arrangements to treat contaminants. That is especially a concern in the case of urban storm water management or large construction and mine sites.

Designing and constructing detention ponds is no small affair. They require the assistance of an engineer and working in collaboration with inspection and regulatory agencies, such as the Water Resources Branch or the Mining Inspection Office. They almost certainly will trigger the need for a water licence. The environmental concern about detention ponds stems just as much from the possible concentrating of contaminants in retained sediments (and safe disposal of those sediments) as from concern about water quality.

This is a well-designed and constructed sediment trap with a passive overflow.

2.2 Contaminant Control

2.2.1 Fuelling, Maintaining and Washing Equipment

A small amount of fuel spilt into water can have a relatively large environmental impact compared to a spill on land – and dealing with contaminated water is expensive and difficult. For these reasons, every effort should be made to avoid spills in water. And while fuel spills are the main concern, there are other sources of contamination related to equipment use: stored lubricants and cleaners, leaky and greasy equipment, and contaminated water from equipment wash stations. The owner of a well-maintained piece of equipment who follows well-practiced fuelling and washing procedures will be able to avoid accidental spills better and have fewer accidents. Yet, accidents can happen and it is important to have emergency contingency plans and know how to implement them. The following best practices will help:

A generator properly set on a spill tray with roof and fabric to protect it from the weather.

Fuel and Chemical Storage:

- Create a designated area to store fuel, lubricants, detergents and other chemicals. It should be located well away from any water body, minimally 30 m, and often will be the same area that equipment is fuelled, stored and maintained.

- Fuel tanks should be placed in some form of secondary containment. Standard practice is to place drums in spill pans and to place immobile storage tanks (anything larger than a drum) in secondary containment with a capacity that is 110% of the fuel being stored. The idea is that the entire volume of a tank would be contained if the tank was ruptured. The most common, and most hassle-free, approach being used today is to store fuel in a double walled tank. These do not require secondary containment, as that is already built-in. However, a spill tray should be placed under the fill nozzle to contain drips. Double walled tanks must be monitored regularly to detect leaks in the inner or outer tanks. Usually the space between the walls is a lower pressure or vacuum. Any increase in pressure or lack of vacuum indicates that the primary or secondary tank has developed a leak, and the tank must be immediately replaced or repaired.

- By law, tanks over 4,000 L (including single tanks or aggregates over 4,000 L) must be stored in an area that is impermeable to fuel and enclosed by a dyke having the following configuration:

    - The entire area enclosed by the dyke must be liquid-tight, impervious to fuel, and have no openings. The lining can be a synthetic liner, or compacted silt if it passes a compaction or permeability test.

    - The area must have the capacity to hold and contain 110% of the stored fuel volume.

- If constructed of earthen material (e.g., a berm), the dyke must have a flat top, not less than 61 cm wide and covered to protect against erosion (usually, this is the same material as the liner). It also must have sides that are sloped at a stable angle.

- Normal practice in Yukon is one of the following:

  - Construct a storage area with an earthen dyke that is lined with an impermeable membrane, or

  - Construct a containment area from compacted silts, or

  - Set up a commercial, manufactured rubber containment structure (pool), or

  - Use a double-walled tank, in which case a dyke is not required (except if the tank is larger than 50,000L).

While these drums of fuel and lubricants were placed in a spill tray and an attempt was made to cover them, the protection is not adequate. The plastic half drum and spill tray will collect rain water. Workers will be tempted to tip the containers to dump out the water and the lighter petroleum products will be the first to overflow. Note also that they are not stored 30 m away from the water body in the foreground.

- Keep a spill containment tray underneath fuelling nozzles. The most common form of fuel contamination occurs from drips and spills emanating from fuelling nozzles.

- Lubricants, detergents and other chemicals should be stored in weather tight containers, at least 30 m from a water body. If containers are kept under cover, ensure that they have adequate ventilation.

- Containment structures must be kept free of accumulated precipitation to maintain design capacities. Protecting the fuel storage area from rain and snow is the most effective method of achieving this requirement.

Fuelling and Storing Mobile Equipment:

Probably the most common form of fuel contamination on work sites occurs from drips and spills emanating from fuelling nozzles as they are moved back and forth from the fuel tank to equipment. Therefore, the best thing a contractor can do to avoid site contamination is to implement the following strict fuelling guidelines, paying particular attention to drips from nozzles:

- Create a designated area for equipment fuelling, repair and storage located well away from any water body, minimally 30 m. In most cases, it is the same location that fuel and other chemicals are stored.

- Often in small operations, a fuel truck with tidy tank is driven up to equipment for fuelling. Use care and elevate the nozzle when transferring it to and from the equipment. If the fuel truck cannot be

positioned immediately adjacent to the equipment, place a containment tray on the ground to catch any drips from the nozzle.

- In large operations, where equipment is driven to the refuelling area, make sure that a large enough drip tray is available to contain drips from the nozzle. For some Yukon government projects, contractors will be required to line and/or berm refuelling areas to provide secondary containment of spills.

- At the end of the workday, park equipment at least 30 m away from any water body, preferably in the designated equipment storage area.

- Plan for emergencies:

    - Prepare an emergency spill plan, post it in a conspicuous location in the fuel storage area and refuelling sites and ensure that all employees are familiar with the plan.

    - Keep spill kits handy, fully stocked, and stored in a weather-tight container.

    - Keep adequate fire-suppression equipment on hand, including extinguishers and a dedicated water pump and water supply when warranted.

    - Have emergency phone numbers posted in the event there is a need for immediate help (Yukon Spill Hot Line (867) 667-7244).

Fuelling Water Pumps:

By their nature, water pumps often must be placed directly adjacent to water bodies, and it usually is impractical to move them for refuelling. If the following procedures are employed, water pumps can be refuelled in-place:

- Place the pump on a fuel containment tray that is above the high water mark at all times.

- Fuel the pump by hand, using a hand-held fuel container (2-5gal fuel can). This is done so that the filling process can be monitored and there is little chance of over-filling. Do not fuel with electric pumps or gravity feed unless there is an emergency shut-off switch within reach while the operator fills the tank.

- Keep sorbent pads and other spill response materials handy and stored in a weather-tight container.

- Store the fuel container for the pump at least 30 m away from the watercourse.

- All fuel stored within 30 m of a watercourse should be placed within a secondary containment with 110% capacity.

- When the pump will not be used for a long period, do not leave it stationed at the water body. Move and store it at least 30 m away.

Fuelling Immobile Equipment:

Larger, mobile equipment (e.g., cranes) can be fuelled without moving them to the designated fuelling site using the following procedures:

- Move the equipment out of the watercourse, onto the shore above the ordinary high water mark.

- Fuel the equipment with two people: one person at the fuel tank; the other positioned at the target equipment. The purpose of this procedure is to facilitate a quick shut-off of the fuel. The two people should communicate clearly about the fuelling status (e.g., when the tank is almost full, when to slow down the flow). Practice this fuelling procedure so each person knows what to expect.

- Keep sorbent pads and other spill response materials handy and stored in a weather-tight container.

Condition of Equipment:

- Leaky equipment cannot be used for work that will occur in or adjacent to a watercourse. Equipment that leaks oil, fuel or hydraulic fluid must be removed from the site immediately.

- Grease, oil and surface grime on equipment can contaminate water and needs to be removed prior to use of the equipment in or near water.

- Always keep sorbent pads in the equipment.

Equipment Washing:

- Designate a site well away (minimum 30 m) from the watercourse as a washing area. A gravel pad is best, as it will promote the percolation and filtration of wash water.

- Pressure-wash the equipment until all dirt, grease and fuel have been removed from exposed surfaces. Minimize the use of detergents.

- If site conditions warrant, direct and contain runoff by means of berms, or natural sloping so that wash water collects in a sump that allows for percolation.

- Be aware that repeated washing of dirty, greasy equipment has the potential to create contaminated soil, for which the operator will be responsible to clean up. Soil remediation is expensive and time-consuming, so plan ahead to avoid this.

Emergencies:

- Prepare an emergency spill response plan. A number of documents are available to assist in preparing response plans, and a copy of the Yukon Water Board's Fuel Spill Contingency Plan is included in Appendix C.

- Train all staff in spill and emergency response practices. Post procedures to be followed in the event of an emergency. Include the phone numbers listed below, as well as contact information for site supervisors.

- You must call the Yukon Spill Hot Line (867) 667-7244 and/or Environment Canada (867) 667-3400 to report all spills and equipment that has fallen into a water body.

An emergency response situation. An oil spill occurred on this small lake during gravel extraction activities when a crack developed in the oil reservoir of an excavator. Booms are being deployed to contain the spill, and oil on the surface is skimmed off using absorbent pads. Ice on the lake helped contain the spill.

2.2.2 Using Concrete near Water

Concrete leachate and uncured cement are alkaline and highly toxic to fish and other aquatic life; it is a violation of Yukon and federal statutes to discharge alkaline materials into water bodies. The way to resolve this issue is to isolate and neutralize (bring to neutral pH) all concrete waste water and uncured cement materials before they are reintroduced to uncontaminated water. Fortunately, this is not a difficult procedure and cured concrete is very benign. Basically, concrete waste water and uncured materials are neutralized by allowing them to sit in a containment structure filled with neutral water. Over the course of a few days to weeks, the uncured cement in the solution will cure (by reacting with the water) and become neutral. The curing process is easy to monitor by regularly checking the pH. When a pH is achieved that matches that of the surrounding natural waters (usually 6.5 to 8.0), the water is considered safe for reintroduction to natural water systems. Note, however, that the discharge of this water back into a water body usually requires a water licence to ensure that proper discharge conditions are understood and met. This BMP lists the basic procedures for pouring concrete and safe handling of concrete-curing water.

Small Concrete Projects Adjacent to Watercourses (e.g., Platforms for Water Pumps):

- Small amounts of curing water will neutralize fairly quickly when mixed with neutral water in containment and left to cure. Avoid discharging this water directly into the adjacent water body. Instead, develop the practice of directing it into a sump area. After the water has percolated out or evaporated, remove the concrete crust/debris that is left and take it to an approved dump site.
- When larger amounts of waste water are generated, direct the curing water/runoff away from water bodies and into a designated settling area or sump. Alternatively, construct a perimeter berm or ditch around the pouring forms to prevent curing water from entering the water body directly. If it is diluted and allowed to sit (cure), it will neutralize in a few days to weeks. Monitor the water by testing the pH daily. Once the water has neutralized it can be discharged onto a rock flume or into vegetation. The concrete debris that is left needs to be removed and taken to an approved dump site.

Large Concrete Projects in and Adjacent to Watercourses (e.g., Piers and Dam Structures):

- Completely isolate all concrete work from the watercourse and any water that enters the watercourse or storm water system. Apply techniques prescribed in BMP 3.9 *Isolating In-Stream Work Areas*.
- Prevent any water that contacts uncured or partly cured concrete (during activities like washing exposed aggregate, wet curing, or rinsing equipment) from directly or indirectly entering any watercourse or storm water system.

A sturdy work platform constructed below this bridge allowed easy access to the superstructure, but it also helped catch debris and keep uncured concrete from falling in the water.

- Construct impermeable containment facilities to collect wash-down water used to clean concrete delivery trucks, concrete pumping equipment, and other tools and equipment. After the waste water has sat and neutralized, it can be discharged. Remember never discharge directly into a water body – discharge onto a rock flume or into a vegetation ground sump.

Emergency Planning:

- Keep on site one or more 75 L tanks (with regulator) containing CO_2, along with hose and a gas diffuser. Dissolved CO_2 in water reacts with alkaline solutions effectively reducing the pH. If a spill occurs, quickly contain it and then discharge the bottled CO_2 into the waste water.

- Because alkaline material is a contaminant, you are required to report all spills and accidental discharges of uncured materials into water bodies. Spills must be reported to the Yukon Spill Hot Line (867) 667-7244.

2.3 Fish Specific Guidelines

2.3.1 Fish Screens and Water Pumping Guidelines

Many work projects will require pumping water from a stream or lake. There are three principles to be aware of when pumping water:

1. A water licence will be required if pumping either 100 or 300 m^3/day or more, depending on the type of undertaking. Even if you do not exceed these thresholds, you must file a *Notice of Water Use/Waste Deposit Without a Licence* with the Yukon Water Board at least 10 days prior to commencing work. However, the requirement to file this notice only applies if the pumping is part of a mining or industrial project.

2. Water pumps need to be set up and fuelled as follows:

    - Place the pump on a fuel containment tray that is above the high water mark at all times.
    - Fuel the pump by hand, using a hand-held fuel container (2-5 gal. fuel can). This is done so that the filling process can be monitored and there is little chance of over-filling. Do not fuel with electric pumps or gravity feed unless there is an emergency shut-off switch within reach while the operator fills the tank.
    - Keep sorbent pads and other spill response materials handy and stored in a weather-tight container.
    - Store the fuel container for the pump at least 30 m away from the water.
    - When the pump will not be used for a long period, do not leave it stationed at the water body. Move and store it at least 30 m away.

A typical fish screen for a 4" to 5" pump, fitted with correct screen size.

3. Fish screens must be installed over the intakes of suction hoses placed in fish-bearing waters using the following DFO criteria (see DFO guidelines at www.dfo-mpo.gc.ca/Library/223669.pdf and its supplement at www.dfo-mpo.gc.ca/Library/341417.pdf :

    - Screens or nets must have a minimum of 3.5 openings per square centimetre and openings no greater than 3.2 mm along any given side.

- If a punch plate or similar material is used, openings must be no greater than 3.2 mm in length or width.
- The minimum surface area of open screen is 929 cm^2 for every 205 L/min being withdrawn.
- Monitor the screens to ensure they function effectively.
- Submerge the screen so the flow distribution is uniform around the total screen area.
- Stop pumping water if banks are slumping or other changes occur to the stream or channel.

An example of a fish screen with holes that are too large.

A very large fish screen for a high velocity 8"to 10" pump.

An unacceptable pump station. Water pumps need to be placed in spill trays and fuel must be stored >30 m away from any water body.

2.3.2 Fish Salvage

In-stream construction activities have the potential to kill fish. For instance, when a temporary isolation structure is erected in a river, fish may become trapped inside and will die when the structure is pumped dry. However, it is a violation of the *Fisheries Act* to destroy fish by any means other than sport, commercial, or subsistence fishing (except if authorized by the appropriate regulator). This requirement applies to all fish including, for example, slimy sculpins and suckers. Thus, developers are compelled to collect and transplant fish from the affected site. This is called a "Fish Salvage". Fish are collected using various means, including electroshocking and netting, and are immediately moved to an unaffected part of the stream or lake.

Be aware that a fish salvage operation can only be conducted by a qualified technician who possesses a fish collection licence issued by DFO. Make arrangements with such a technician well in advance of any work so the required fish collection permits can be obtained from DFO (this can take 1-2 weeks). As a project manager or site worker, you still may need to be aware of the fish salvage process and what it involves, so here is a brief summary:

- The DFO collection licence will be issued under the salvagers' names and their company. They will be responsible for supervising and conducting the fish salvage.

- Just upstream from the work site, the stream is blocked off with a net that is deployed in combination with fine-meshed chicken wire. In a lake setting, the netting is placed around the perimeter of the work site. The smaller the area that can be enclosed, the better.

- If there is a significant current, stakes or rods are pounded into the creek bottom to reinforce the netting.

- An initial physical sweep of the area may be made before the netting is completely closed, in order to drive fish out of the enclosure (especially larger fish).

Fish collected using a minnow trap.

- After the netting is closed, as many fish as possible are collected from the isolated area using a variety of techniques, including minnow trapping, netting, electroshocking, and even angling. Often nets and traps are used first, and then electroshocking is done to collect any remaining fish.

- Handling the fish as little as possible, they are put in a bucket containing fresh water and moved as soon as possible to an area outside of the enclosed area. The release should always occur downstream of the isolation area.

- As a condition of the collection licence, a report on the fish salvage is to be submitted to DFO.

- Fish salvages are licensed by DFO as short, one time events. In the event that flows in sections of streams are manipulated over long periods of time thus requiring multiple salvages, it is best to discuss these scenarios with DFO in advance as the nature of such a salvage scenario may be considered a HADD.

A fish salvage operation in progress. A section of the steam was netted off and fish were collected from the isolated area by means of electroshocking. The electroshocking unit is held on the back by the person on the left and the yellow pole is the shocking probe. The person on the right is helping retrieve the fish, which are only stunned for a fraction of a second so need to be caught quickly.

3 Best Management Practices: Working in and around Water Bodies

The BMPs in this chapter – "Working in and around Water Bodies" – lay out best practices for some of the most common activities undertaken by developers in Yukon. It provides notes for planners and designers, as well as a rundown of best practices to use during the construction process. For details on how to carry out those practices, refer back to specific sections in the previous chapter "Materials & Methods".

3.1 Working Adjacent to Water Bodies: General Principles

This BMP explains the basic operational procedures for work done within 50 m of any watercourse and along stream banks. Examples of these types of activities include general site preparation for road construction and forestry block development, as well as activities like shoreline construction and bank stabilization work.

Land-based activities adjacent to a stream require a Land Use permit or a Mining Land Use Approval from the Yukon government. In addition, if banks are altered, authorizations from both DFO and the Yukon Water Board may be required, or these agencies may need to be notified of the proposed activity. Contact both DFO and Water Resources to get further information on licensing requirements.

Planning for the Activity:

- Check equipment to ensure it is free of leaks and excess oil or grease. Clean it if necessary.
- Refuel equipment at least 30 m away from the water body.
- Keep spill kits handy.
- Plan for emergencies: have a spill plan in place and emergency phone numbers handy to call for help. Report spills to the Yukon Spill line (867) 667-7244.

The rock being placed in this stream is covered with sediment and is silting up the stream. It should have been washed prior to placement in the stream.

Erosion and Sediment Control Measures:

- Complete the work during favourable weather conditions to avoid erosion and sedimentation. In summer, avoid working near water bodies during wet periods. During other seasons, take advantage of frozen surfaces to do work that otherwise would cause disruption to soils.

- Take proactive measures to prevent any construction debris and deleterious substance from entering the water body, such as dirt, concrete, and other debris. Sometimes, this will mean building or installing containment structures such as berms and silt fencing. It may be as simple as laying down geo-textiles to catch debris or protect a stream bank.

- Often, projects conducted near water bodies call for the placement of rock, riprap or other materials on banks or in river channels. These materials must be clean (free from adhering debris) and non-acid generating, or washed if necessary, prior to their installation. Place the rocks carefully, one at a time, without splashing or stirring up the water body bottom. If sediment, rock, or other materials will be excavated prior to work, they should be stockpiled in a stable location above the high-water mark, as far as possible/practical from the water body. If the stockpile is close to the water, cover it with plastic sheeting or geotextile cloth as a temporary measure to avoid sediment runoff. Scrape and stockpile organic soil layers separately from sediment and rock so it can be re-applied to the top of the work site surface.

A simple diversion was created to guide runoff into the vegetation, rather than the stream. Sometimes it's the little things that make a big difference.

This stockpile of loose material should have been covered with plastic or geotextile to avoid sediment runoff into the river. Depending on how and when the material was to be used, it also should have been stockpiled away from the river.

- Minimize disturbance to existing vegetation. Cut brush off to ground height if needed, but without disturbing the roots. This practice will allow the vegetation to regrow from rootstocks.

- Construct temporary runoff ditches, water bars or diversions within the work area in a way that does not discharge sediment loaded water directly into the water body. Divert the ditch flow to a vegetated area where it can infiltrate into the ground.

- If operating stationary machinery next to a water body, position it on a stable location on the bank. Create an operating platform (with rock) if needed.

Site Restoration:

- Sediments, rock and other materials that were stockpiled should be redistributed on the site or hauled away.

- Grade disturbed areas and leave slopes in stable conditions after the work is completed. Use stockpiled materials strategically to achieve this goal. Try to spread stockpiled organic soils evenly over the top of the restored surface.

- If necessary, revegetate the site and use a seed mix with species native to the area. Use revegetation and other erosion control BMPs in this guide to augment the vegetation grown.

- When restoring water body banks, plant rooted shrubs or stakes (e.g., willows) along the bank and near the water. This is in addition to seeding the area.

- At the interface between water and a disturbed surface, it may be necessary to take additional erosion control measures, such as installing rolled erosion control products to augment seeding, shrub plantings, or riprap.

Maintenance:

- Check the site after the next heavy rain or when the snow has melted the following spring and fix slumps or erosion problems.

- Reseed or replant areas where vegetation failed to germinate or take hold.

3.2 In-Stream Work: General Principles

This BMP explains best practices for work done with equipment positioned in or crossing a stream.

In-stream work is only possible for low-flow streams (unless an isolation structure is erected – see BMP 3.9 *Isolating In-Stream Work Areas*). Typical work includes repairing or maintaining structures like weirs, culverts and bridge foundations, but may also include activities such as channel restoration. Authorizations from DFO, the Yukon Water Board, and Navigable Waters Protection Program are typically required for any in-stream work. Contact DFO, Water Resources, and Navigable Waters Protection Program to get further information on licensing requirements.

Planning for the Activity:

Pressure washing a dozer in a designated site that was lined and bermed.

- Check equipment to ensure it is free of deleterious substances such as oil, grease, etc.
- Wash equipment (away from the water) to remove all dirt, grease and oil. Pay special attention to grease and debris lodged behind bogie wheels, tracks and undercarriage structures.
- If riprap is to be placed, it must be clean, and free of debris of sediment. If riprap is not delivered clean, it must be washed. Washing should be done away from the creek with runoff control measures in place. It may be necessary to plan for and construct a staging area for receiving and washing riprap.
- New and altered water body features, including placement of rock, should be designed to match the existing bank and bed grade and height, unless otherwise prescribed.
- When necessary, install and maintain effective sediment and erosion control measures prior, during and post project. Consult Chapter 2.1 *Erosion and Sediment Control* in this manual for guidance on those measures.
- In-stream work must be scheduled to avoid disrupting fish during sensitive life stages (e.g., spawning). When scheduling in-stream work, consult the DFO webpage "Yukon Timing Windows" at www.pac.dfo-mpo.gc.ca/habitat/timing-periodes/tp-yukon-eng.htm. It lists the preferred in-stream work windows for fish species in each Yukon River drainage system.
- Regardless of preferred timing windows additional mitigation measures such as sediment curtains, will likely be required by regulatory agencies for in-stream work.

Working in the Water:

- Operate the machinery from a stable location on land and only enter the water if it is not feasible to work from land. It may be far better to build a temporary platform than to place equipment in the water.

- If working from land is not possible, enter the stream from a stable, gently sloped bank, and do not create multiple entry points for equipment.

- Install additional erosion control measures at the entry point. Riprap may be required.

- Minimize disturbance to existing vegetation at entry points. Cut brush off to ground height if needed, but without disturbing the roots. Avoid scraping down to bare mineral soil when unnecessary. This practice will allow the vegetation to regrow from rootstocks and keeps organic soil in place.

All that was available on short notice for use as a temporary erosion control measure on this road building project was unwoven geotextile cloth. While not the preferred material, this impromptu action on the part of the contractor was a resourceful solution, and was well-executed (note the ample staking). A week later, the permanent solution was installed and consisted of large rock (riprap) placed along the bank.

- Complete the in-stream activity as quickly as possible to minimize the time that equipment is in the water. Do not leave equipment in-stream during prolonged breaks in work activity.

- If sediment, rock, or other granular materials will be excavated prior to work, they should be stockpiled in a stable location above the high-water mark, as far as possible/practical from the water body. If the stockpile is close to the water, cover it with polyethylene plastic or geotextile as a temporary measure to avoid sediment runoff. Scrape and stockpile organic soil layers separately from sediment and rock so it can be re-applied to the top of the work site surface

Site Restoration:

- Sediments, rock and other materials that were stockpiled should be redistributed on the site or hauled away.

- Grade disturbed areas and leave slopes in stable conditions after the work is completed. Use stockpiled materials strategically to achieve this goal. Try to spread stockpiled organic soils evenly over the top of the restored surface.

- Revegetate the site and if possible use a seed mix with species native to the area. Use revegetation and other erosion control BMPs in Chapter 2.1 of this guide.

- When restoring water body banks, plant rooted shrubs or stakes (e.g., willows) along the bank and near the water. This is in addition to seeding the area.

- At the interface between water and a disturbed surface, it may be necessary to take additional erosion control measures, such as installing rolled erosion control products to augment seeding, shrub plantings, or riprap.

Maintenance:

- Check the site after the next heavy rain or when the snow has melted the following spring and fix slumps or erosion problems.

- Reseed or replant areas where vegetation failed to germinate or take hold.

3.3 Runoff Control on Roads

Properly designed and constructed roads have provisions to control runoff and avoid erosion. Avoiding erosion is important to keep sediment from entering nearby waters, but also to maintain the integrity of the road structure itself. This BMP describes four commonly used runoff control techniques for roads including water bars, cross ditches, slope grading and crowning. Bear in mind that the information provided here only constitutes an introduction to these techniques. Road design and construction often requires input from an engineer.

The lack of drainage control on this road has resulted in major washouts and has made the road barely useable.

Water Bars:

A water bar is a diagonal channel constructed across the road surface to channel excess water on a temporary basis, such as during spring melt or heavy storm events. Water bars allow water to cross a road in a focused channel, rather than flowing as sheet wash or riffles on top of road surfaces. They also reduce the length of the runoff path, which reduces the opportunity for water to cause erosion. Furthermore, by channelling the runoff, water can be kept out of erosion-prone portions of the road-bed and directed over more resistant sediments. Water bars are sometimes framed with boards on the sides and bottom or lined with gravel to increase their effectiveness. However, they must be left shallow enough for vehicles to drive over. Water bars find their application in situations where there is no defined ditch along the road.

Installation of a culvert to provide cross drainage.

Cross Ditches and Culverts:

A cross ditch or culvert differs from a water bar in that water is channelled beneath the road rather than being channelled across the road surface. Typically a cross ditch or culvert is located on the bottom of a slope, in a natural low area where water tends to accumulate. This type of water crossing is most commonly used for roads with defined side ditches. For details on installing culverts, see BMP 3.6 *Culverts*.

Sloped Grading:

Grading of a road toward (in-sloping) or away (out-sloping) from the slope of the road surface helps control runoff without ditches or cross drains. In-sloping directs runoff to remain in the road cut while out-sloping directs runoff across the road to the shoulder. This technique should only be used for roads with less than 6% grade. Furthermore, in-sloping will require a ditch in the road cut, or the construction of a much-elevated roadbed.

Crowning:

Creating a crown on a road means grading the road such that the centre is always slightly higher (10-20 cm) than the outer edges. Water that falls on the road surface is directed away from either side of the road surface into adjacent ditches or other drainage systems. Because the terrain varies along the course of a roadway, road design usually employs a combination of crowning and sloped grading. All roads should be crowned and have ditches to ensure proper runoff and maintain the integrity of the road structure.

Proper sloping, crowning, and ditch placement on this road is creating good drainage and a stable roadbed.

3.4 Stream Fordings

Fisheries and Oceans Canada permits one-time stream fordings when there are no other available means to cross a stream. They also allow construction, use, and maintenance of fords on a continuous basis in some circumstances, such as under the placer mining authorizations. However DFO requires that they be notified when a fording is to occur. This applies to dry stream beds as well as flowing waters. DFO also has issued a best practices Operational Statement (www.pac.dfo-mpo/gc.ca/habitat/os-eo/index-eng.htm) explaining how to complete a fording without damaging fish and fish habitat. The complete operational statement and the notification form are included in Appendix A. The best practices described here are consistent with the DFO operational statement.

Planning:

- Locate crossings at straight sections of the stream with low gradient banks; crossing should occur, perpendicular to the bank.
- The fording site must consist of stable material, such as gravel or bedrock and the stream banks must be low and stable.
- Minimize disturbance to riparian vegetation (e.g., vegetation that occurs adjacent to the watercourse). Minimize vegetation removal and prune/top it rather than grubbing, uprooting or scraping.
- Wash, refuel and service equipment and store fuel and other materials for the equipment at least 30 m away from the water.
- Keep an emergency spill kit on site in case of fluid leaks or spills from equipment.

This type of stream fording is a thing of the past in Yukon, and never should have reached this state. There has obviously been many fordings over the years, leaving permanent marks in a fish-bearing stream. A temporary bridge should have been installed.

- Schedule the fording to avoid disrupting fish during sensitive life stages (e.g., spawning). When scheduling a fording, consult the DFO webpage "Yukon Timing Windows" at www.pac.dfo-mpo.gc.ca/habitat/timing-periodes/tp-yukon-eng.htm. It lists the preferred in-stream work windows for fish species in each Yukon River drainage system.
- Install and maintain effective sediment and erosion control measures on erosion prone approaches.

- If possible, consider moving the equipment across the stream when the ground and/or stream are frozen. This could mean staging the equipment prior to the work season, or conducting a fording early in the morning in spring and fall.

Equipment Washing:

- Designate a site well away from the watercourse as a washing area. Preferably, this will be a gravel pad.

- If washing equipment causes runoff, contain it by means of berms or natural slopes.

- Pressure-wash the equipment until all dirt, grease and fuel have been removed from exposed surfaces.

Fording:

- If there is a risk of causing rutting, deploy stream bank and bed protection materials (e.g., geogrids, logs, swamp pads, rubber tire mats), provided they do not overly-constrict flow or block fish passage. Deploy only as much matting as necessary to minimize disturbance to the streambed.

- Ford only under low flow conditions and when water depth is sufficiently shallow. Often, this is only possible during the low flow season or early in the day. Streams in Yukon that are fed by glacial melt water experience lowest flow levels early in the morning, when rates of melting are lowest.

- Crossing should be conducted at slow speeds but with a steady pace to avoid bogging down. Keep the equipment moving and do not stop midstream.

- Operate equipment in a manner that minimizes disturbance to the watercourse bed and banks. Reduced speeds will minimize wakes and bank splash.

- When fording with an excavator, set the boom bucket on the opposite shore and slightly elevate the front of the tracks. Operate the boom to gently pull the excavator while driving across. This will reduce weight on the tracks and minimize the footprint left by the excavator.

- Stabilize any surfaces that are disturbed to prevent any sediment from entering the watercourse.

Restoration:

- Ensure banks are stabilized, restored to original shape, adequately protected from erosion and revegetated with native shrub or tree species.

- If spoil piles were created when a fording site was cleared, the material should be re-spread and seeded with native grasses and shrubs.

3.5 Clear-Span Bridges

Small, single span (e.g., clear span) bridges that are placed above the high water mark generally can be constructed without causing harm to fish and fish habitat, or depositing waste (e.g., sediment) into the water. The DFO web page (www.pac.dfo-mpo.gc.ca/habitat/os-eo-index-eng.htm) contains Operational Statements for the Yukon region that outline best practices for the construction of clear-span bridges. The best practices described here are a summary of the DFO Operational Statement, with some additional design information. The entire document complete with a notification form is included in Appendix A. If the project complies with conditions of the DFO Operational Statement and follows all of its prescribed measures for protecting fish and fish habitat, than the project can proceed without a formal DFO review. The conditions are as follows:

- The bridge is placed entirely above the high water mark (HWM).
- There is no alteration of the stream bed or banks or infilling of the channel.
- The bridge is no greater than two vehicle lanes in width, does not include sidewalks and biking lanes and does not encroach on the natural channel width by the placement of abutments, footings or rock armouring below the HWM.
- The work does not involve the clearing of riparian vegetation. However, removal of select plants within the road right-of-way can occur to meet operational and/or safety needs.
- The project does not require multiple bridge crossings over the same watercourse.
- The project incorporates the *Measures to Protect Fish and Fish Habitat when Constructing Clear-Span Bridges*.

Remember, authorizations from DFO, the Yukon Water Board, and the Navigable Waters Protection Program are typically required for any in-stream work, or at a minimum, these agencies may need to be notified of the proposed activity. Technically, clear-span bridges do not necessarily constitute “in-stream” work (since the bridge is spanning the stream), but it is often the case that some type of related in-stream work or bank modification will occur. This type of bridge-associated work may exclude it from complying with the DFO Operational Statement and hence DFO should be contacted. A Water Licence may still be required if the stream crossing is wider than 5 m. Similarly, if the stream is considered to be “navigable” (see Definitions Section) any bridge will require approval from Navigable Waters Protection Program. Check with the Water Resources Branch and Navigable Waters Protection Program to determine possible licensing requirements.

A properly-installed temporary clear-span bridge with perimeter silt fences.

Note: Construction of more complex, multi-span bridges and those requiring in-stream abutments, bank excavation, or pier structures will likely require a DFO authorization, as well as a Water Licence and

Navigable Waters Protection Program approval. A number of best practices are included in this manual to help with planning for those bridge projects (e.g., BMP 3.1 *Working Adjacent to Water Bodies*; 3.8 *Stream Diversions*; 3.9 *Isolating In-Stream Work Areas*).

Planning:

- To establish the best and most stable location to place a clear span bridge, avoid building on meander bends, braided streams, alluvial fans, or active flood plains.
- Design the bridge for expected flood levels. Depending on the design life of the bridge, typically this is for a one in 10-year flood for a temporary bridge and a one in 100-year flood for permanent structures.
- Design and construct approaches so that they are perpendicular to the watercourse and runoff is directed away from the deck, side slopes and approaches.
- Plan and install sediment and erosion control measures before starting work.
- Wash, refuel and service equipment and store fuel and other materials for the equipment at least 30m away from the water.
- Keep an emergency spill kit on site in case of fluid leaks or spills from equipment.

A properly-installed permanent clear-span bridge with riprap for bank protection.

The abutment of this clear-span bridge should have been protected with riprap. Embankment collapse and sediment release are imminent.

During Construction:

- If no detour options exist, a one-time fording is permitted, but DFO should be notified when an Operational Statement is used. See BMP 3.4 *Stream Fordings* in this manual.

- Minimize disturbance to riparian vegetation. Cut brush off to ground height if needed, but without disturbing the roots. Avoid scraping down to bare mineral soil when unnecessary. This practice will allow the vegetation to regrow from rootstocks and leaves organic soil in place

- Operate equipment in a manner that minimizes disturbance to the watercourse bed and banks.

- Prevent sediment, debris, concrete and other waste materials from entering the water.

- Stabilize any surfaces that are disturbed during work to prevent any sediment from entering the watercourse.

- If spoil piles are created, they should be covered with mats or tarps until the material can be re-spread and seeded.

Restoration:

- Restore banks to original condition and slope if any disturbance occurred.

- Ensure banks and disturbed surfaces are stabilized, restored to original shape, adequately protected from erosion and revegetated with native grasses, shrubs and trees (whichever is more appropriate for the site).

3.6 Culverts

Culverts are the most common form of water crossings on small to medium-size streams. Culverts come in many shapes and forms, but in terms of construction there is only one way to install them: they must be installed “In the Dry”. This means they are not installed directly in a channel while there is flow. Unless the flow is seasonal, and work can occur when the channel is naturally dry, flow must be diverted into a temporary channel, so the culvert can be constructed in dry conditions. The purpose of that procedure is to avoid releasing sediment into the watercourse.

Permits from DFO and the Yukon Water Board are typically required for culvert installations. If the stream is “navigable” (see Definitions Section) approval from Navigable Waters Protection Program is also required. Contact DFO, Water Resources and Navigable Waters Protection Program to get further information on licensing requirements.

Other BMPs in this guide should be consulted when installing culverts, specifically: 3.1 *Working Adjacent to Water*; 3.2 *In-Stream Work*; 3.4 *Stream Fordings*; 3.8 *Stream Diversions*; and 3.10 *Infilling Techniques*.

For clearing culverts of ice, debris and other maintenance issues, see the DFO Operational Statement best management practices for culvert maintenance at: www.pac.dfo-mpo.gc.ca/habitat/os-eo/culvert-ponceau-eng.htm and in Appendix A.

Planning and Design:

- Design the culvert size and placement to handle flow during the highest expected flood levels. For a temporary culvert, design it for a one in 10-year flood event. For a permanent culvert, design it for a one in 100-year flood event. Many culverts are undersized and fail.

- Ideally, the culvert diameter should be scaled so that it has the same grade, width and depth as the natural channel and does not speed up or slow down the velocity of the natural current.

- Design culvert placements so the culvert can be as short as possible. Size the length of the culvert for the width of the road/trail crossing, but with enough of the culvert protruding on each end in a manner that protects the channel from slumping sediments.

- The culvert and roadbed can be protected by installing a headwall around the culvert,

The site of a new culvert crossing is being prepared “in the dry”, while the stream is left undisturbed. The old culvert and channel will be reclaimed after the new one is activated.

or aprons, in situations where the roadbed grades steeply to the culvert inlet or outlet, and the potential of erosion is high.

- Design and construct approaches to the culvert site so that they are perpendicular to the watercourse.

- Schedule culvert installation to avoid disrupting fish during sensitive life stages (e.g., spawning). Consult the DFO webpage "Yukon Timing Windows" at www.pac.dfo-mpo.gc.ca/habitat/timing-periodes/tp-yukon-eng.htm. It lists the preferred in-stream work windows for fish species in each Yukon River drainage system.

- Many culverts are installed improperly. The usual problems are:

    - *Culverts buried too deep.* These can quickly fill with sediment and then do not have enough capacity for high flow volume. They may even become completely blocked.

    - *Culverts buried too shallow.* These are called perched culverts. Water will either become ponded on the inlet end or flow below and around the culvert, causing erosion and culvert failure. Even if water is able to enter the inlet, if the outlet is elevated then water may exist like a waterfall and scour the channel. Another major problem with perched culverts is that they block fish passage.

    - *Culverts are undersized.* Culverts must be sized to handle high water events, not just normal flow volumes. In undersized culverts, water velocities become too high for fish to pass through. High flows also can result in excessive scour at the culvert outlet, which can create a perched culvert.

    - *Culvert slope does not match channel slope.* When this occurs, the lowest portion of the culvert becomes filled with sediment and the highest portion can become perched.

    - *Culverts placed on a bed that had been over-excavated and then refilled, or placed on an uncompacted surface.* These culverts are prone to pitching and settling when fill is placed over them and flow is re-established.

Best Practices on-Site:

- If no detour options exist, a one-time fording is permitted. See BMP 3.4 *Stream Fordings.*

- Follow the BMP 3.8 *"Stream Diversions"* to divert the stream so the culvert can be installed "in the dry".

- When clearing to the culvert site, minimize disturbance to riparian vegetation. Cut brush off to ground height if needed, but without disturbing the roots. Avoid scraping down to bare mineral soil when unnecessary. This practice will allow the vegetation to regrow from rootstocks and leaves organic soil in place.

- Wash, refuel and service equipment and store fuel and other materials for the equipment at least 30 m away from the water.

- Keep an emergency spill kit on site in case of fluid leaks or spills from equipment.

- Operate equipment in a manner that minimizes disturbance to the watercourse bed and banks.

- Prevent debris, concrete and other waste materials from entering the water. Install and maintain sediment and erosion control measures before, during and after work.

- Stabilize any waste materials removed from the work site by covering spoil piles with mats or tarps or planting them with preferably native grass or shrubs.

Proper Culvert Installation:

- If there is flow in the channel, it must be diverted so the culvert can be placed in the dry. Divert the flow following BMP 3.8 *Stream Diversions*.

- Culverts should be placed in the middle of the channel. It is always preferred to maintain the same width, grade and depth in both the culvert and the natural channel. However, with some streams (e.g., braided streams) it may be necessary to narrow or focus the natural channel course to funnel it into the culvert. Installing aprons may be necessary, but it is best to avoid using them. Avoid restructuring the channel in a way that changes flow velocity.

- Excavate a shallow bed into the channel where the culvert will be placed. The depth of this bed generally should be 15-30 cm deep, and should be scaled to the diameter of the culvert within that range. The culvert should sit on compacted sediment, otherwise it could be undercut or settle when buried and flow is re-established. If the substrate it is placed on is solid and compacted, place the culvert directly in the excavated bed. If the substrate is compressible, excavate below the bed, add fine or crushed gravel and compact it. If filling and compacting, be sure to still leave a 15-30 cm deep depression. Proper embedment is important in ensuring that culverts do not become perched over time hence blocking fish passage.

- The slope (pitch) of the culvert should match the slope of the original streambed.

- Backfill the culvert with native materials if they do not have too much clay and will support the weight of traffic. Otherwise use crushed or fine gravel or road mix. Leave the prescribed length of culvert sticking out at each end (e.g., free of backfill). The fill at the ends (headwall) should have a slope of <30%.

- Install armouring and other protection of inlets and outlets as specified by the site plan. For example, clean non-acid generating riprap, aprons, reinforced headwalls and wingwalls.

The attempt to keep this culvert (on left) from filling with sediment was too little and too late (the culvert on the right is only intended to be a high water overflow pipe). The silt fence is inadequate for the size and amount of sediment, and for high water flow velocities. The problem with two pipe systems is that the lower one fills with sediment during high water events if there is a lot of sediment flowing through the creek, such as this one. A much larger culvert should have been installed to avoid this situation.

- Culverts installed on fish bearing watercourses must be shown to pass the known species of fish in the system that is the poorest swimmer (e.g., pike, burbot). DFO should be contacted about fish passage issues.

Restoration:

- Ensure banks are stabilized, restored to original shape, adequately protected from erosion, and revegetated with native grasses, shrubs and trees (whichever is more appropriate for the site).

- Remove from the site any excess riprap and other fill material.

Culvert Cleaning and Maintenance:

Even correctly sized and properly installed culverts may need occasional maintenance. The primary maintenance task is cleaning out wood debris or sediment build-up. Depending on what activities are involved, culvert cleaning or maintenance may trigger the requirement for a water licence or a DFO authorization, and perhaps even Navigable Waters Protection Program approval. At a minimum, the agencies may need to be notified of the activity. Contact DFO, Water Resources and the Navigable Waters Protection Program to get further information on permit requirements.

- There is a DFO Operational Statement for best management practices for cleaning and maintaining culverts at: www.pac.dfo-mpo.gc.ca/habitat/os-eo-culvert-ponceau-eng.htm. The most important points to remember are:
    - If it is necessary to pump water through culverts to clear them, use clean, sediment-free water. Capture and treat effluent water by pumping it into a sediment trap or sump (see BMP 2.1.8 *Sediment Traps, Sumps and Detention Ponds*).
    - Minimize disturbance to riparian vegetation when using equipment to clean/maintain culverts.
    - Install effective erosion control devises to prevent sediment and debris from entering the stream.
    - Minimize disturbance to the streambed by only working in the area of the culvert.
    - Operate equipment from stream banks wherever possible and minimize activities that will mobilize sediment.
- Schedule the work to adhere to preferred instream work windows for fish (www.pac.dfo-mpo.gc.ca/habitat/timing-periodes/tp-yukon-eng.htm.)
- Stabilize any sediment and waste materials generated during work, and revegetate disturbed areas with native grasses and shrubs.

3.7 Ice Bridges and Snow Fills

Ice bridges and snow fills are used as temporary winter crossing structures for creeks and rivers. Ice bridges are constructed on larger watercourses that have sufficient stream flow and water depth to allow for unrestricted flow underneath the ice. Snow fills, on the other hand are temporary stream crossings constructed by filling a stream channel with clean compacted snow.

DFO has issued an Operational Statement that outlines the best management practices for avoiding impacts to fish and fish habitat when constructing ice bridges and snow fills. The DFO Operational Statement for *Ice bridges and Snow Fills* and all other DFO Operational Statements can be found at www.pac.dfo-mpo.gc.ca/habitat/os-eo/index-eng.htm and in Appendix A. If all aspects of the Operational Statement can be followed for the protection of fish and fish habitat, then the project can proceed with a DFO notification only. The Yukon Water Board may need to be notified, but typically does not require a water licence for this type of activity. A summary of the DFO Operating Statement for this type of work is as follows:

Planning:

- Use existing trails, winter roads or cut lines wherever possible to avoid disturbance to the riparian vegetation and prevent soil compaction.
- Plan approaches and crossings perpendicular to the watercourse.
- Install erosion and sediment control measures along banks.
- Check equipment to ensure it is free of leaks and excess oil or grease.
- Refuel at least 30 m away from the water body.

Working from the ice is often the best way to access the underside of bridges, and makes it much easier to protect water bodies. In this case, an ice bridge across the Donjek River was built to facilitate construction of a new bridge.

Construction:

- Snow and ice fill used to construct icebridge and snow fill approaches should be clean and compacted.
- Place enough snow and ice to achieve a depth sufficient to avoid cuts to the banks of the lake, river or stream being crossed. In other words, the snow/ice bed should be built to a height that does not require vehicles to drive up or down an exposed bank to access the ice bridge. This may require the construction of snow/ice ramps at entry and exit points.
- Keep vegetation removal to a minimum.

- Operate machinery (both on land and ice) in a manner that minimizes disturbance to the banks of the lake, river or stream.

- Keep an emergency spill kit on site in case of fluid leaks or spills from machinery.

- Water intakes need to be sized and adequately screened to prevent debris blockage and fish entrainment (see BMP 2.3.1 *Fish Screens and Water Pumping Guidelines*).

- Make sure crossings do not impede water flow.

- When the crossing season is over and where it is safe to do so, create a v-notch in the centre of the snow/ice fill to allow it to melt from the centre. This will minimize channel erosion and flooding and help prevent the blockage of fish passage. Compacted snow should be removed from snow fills prior to the spring freshet.

- Stabilize any waste materials removed from the work site to prevent them from entering the lake, river, or stream. This could include covering spoil piles with biodegradable mats or tarps or planting them with grass or shrubs.

Restoration:

- Restore banks to original condition if any disturbance has occurred.

- Vegetate and stabilize any disturbed areas by planting and seeding. Cover such areas with mulch to prevent erosion and to help seeds germinate.

- Maintain effective sediment and erosion control measures until the site is revegetated.

3.8 Stream Diversions

Occasionally, small to medium size streams will need to be diverted around work sites, in order to conduct work "In the Dry". It is a practice commonly used when constructing culverts and performing other in-channel work. Stream diversions should not be taken lightly, as they have the potential to cause significant harm to aquatic life. However, there are best practices that can be employed to minimize the disturbance, and this BMP explains the basic operational procedures for the design, installation, maintenance and decommissioning of temporary stream diversions.

Most diversions are temporary – once the work is completed in the dry, the channel flow is re-initiated. However, sometimes a diversion is designed to be a permanent rerouting of the channel. For instance, for some bridge projects, the stream is left untouched while the new bridge and a new channel are constructed in the dry; when construction is completed, the stream is directed into the new channel followed by a decommissioning of the old bridge and old channel. Note that the prescriptions outlined here assume that the diversion is temporary, but they can be modified for permanent diversions as noted.

Permits from DFO and the Yukon Water Board are typically required for stream diversions. DFO may also require a fish salvage plan which also triggers the requirement for a fish collection licence (see BMP 2.3.2 *Fish Salvage*). If the stream is "navigable" (see Definitions Section) approval from the Navigable Waters Protection Program is also required. Contact DFO, Water Resources and Navigable Waters Protection Program to get further information on licensing requirements.

Planning:

- For streams that are wider than 6 m and with a flow rate greater than 2.8 m^3/sec, a stream diversion often is not practical or cannot be safely executed (Caltrans, 2003). Instead, work will have to be performed using in-stream isolation techniques (BMP 3.9 *Isolating In-Stream Work Areas*).

- For streams that are less than 6 m wide and with a flow rate less than 2.8m^3/sec, a diversion can be constructed by either pumping water around the work or by excavating a temporary channel diversion. For small and intermittent streams, pumped diversions are preferred. For larger creeks, an excavated channel diversion will be more appropriate.

- When scheduling any in-stream work, consult the DFO webpage "Yukon Timing Windows" at www.pac.dfo-mpo.gc.ca/habitat/timing-periodes/tp-yukon-eng.htm. It lists the preferred in-stream work windows for fish species in each Yukon River drainage system.

- When choosing material to block the original channel and direct flow into a temporary diversion, use a durable material that also is easy to retrieve when the main channel is reconnected. For example, aquadams and large sand bags (one-ton bags filled with gravel or sand) are better than rocks. However, for permanent diversions, rock is preferred. Place the largest and most angular rock on the upstream portion of the diversion; this will lock the rocks together and the structure will be more resistant to erosion.

- For all diversions on fish-bearing streams, DFO requires that a fish salvage plan be in place. A fish salvage operation must be completed under a scientific collection licence and by a qualified technician. See BMP 2.3.2 *Fish Salvage* for more information.

- Pumps that will be used on-site must be able to handle both the expected volume of the diversion and dewatering of seepage into the excavation (e.g., keeping the work site dry).

Pumped Stream Diversions

- Pumped diversions are not commonly used because they require very large pumps and hoses/pipes that are capable of transporting the entire stream flow. They also can be tricky and difficult to accomplish without doing harm.

- Fish salvage: Prior to blocking off the channel and activating the new one, a fish salvage operation needs to be completed in fish-bearing streams under a scientific collection licence and by a qualified technician (see *BMP* 2.3.2 *Fish Salvage*).

- Place the water intake of the pump into the stream, upstream of the work area and run pipes or hoses downstream around the work site. In some cases, it may be necessary to excavate a small depression for the intake and line it with rock; this will form a pool in front of the blockage that will be placed subsequently. Alternatively, a short section of culvert with holes punched in it can be planted upright at the intake point. The pump suction hose is then placed in the culvert.

- On the downstream end, the hose/pipe outlet should not be placed directly into the stream; doing so would inevitably cause scouring and erosion when the water is pumped. Instead, construct a structure beside the stream that will dissipate the energy from the pumped water. Usually, this is a small depression with a passive overflow that allows water to re-enter the creek. Both the depression and the overflow should be lined with rock or geotextile cloth.

- Even though the stream has not yet been blocked, start operating the pump once the properly

A pumped diversion showing the water intake. Even for this small stream, pumping its entire flow across the work site required large volume pumps.

The same site as above. The pumped water was released downstream of the work site in an excavated depression that was lined with rock. This slows the flow velocity and traps sediment. This picture shows the pumped water bubbling up and overflowing the rock lined area. The actual creek is in the background.

screened inlet is established, the hose/pipe is in place, and the dissipating structure is built.

- Once the pumping and dissipations systems are working properly, block off the stream using an aquadam or large sand bag covered with non-porous plastic (held in place by rock or small sand bags).

- Any water left in the isolated area needs to be pumped out and deposited into a vegetated depression, sump, or other type of settling area (see BMP 2.1.8 *Sediment Traps, Sumps and Detention Ponds*).

- To maintain this diversion, the pump will need to run continuously, so do not block off the channel until work is about to begin. Do not allow flow back into the channel until all work is finished. In other words, avoid a cycle of repeatedly pumping the channel dry and then letting water flow again.

Constructing Stream Diversion Channels

Design Criteria:

- If the stream diversion is temporary (e.g., less than one season) and will occur during low flow, the diversion simply needs to be designed to handle a volume equal to the mean annual flow.

- If the diversion will be in place for more than one season or it is a permanent diversion, then it needs to be designed to handle a volume equal to the potential flood volume – a 10-year flood for short-term diversions or a 100-year flood for permanent diversions, except in placer mining, where the DFO authorization for the specific watershed must be followed, or a site specific authorization obtained.

- When designing diversion channels, try to match the flow and velocity gradients to those in the original channel.

The project in this photo and the following photos involved lengthening two existing culverts at Watson Creek. To complete the work, the creek had to be diverted so the culvert extensions could be completed in the dry. This photograph shows the diversion channel on the right and Watson Creek on the left. The banks are lined with jute fabric to protect them from erosion. The new channel is being washed and the sediment-loaded water is being pumped out into the vegetation.

- Constructing and decommissioning the diversion, as well as dewatering activities, may require additional sediment control (see BMPs under 2.1 *Erosion and Sediment Control*).

- Develop plans to protect unvegetated banks with riprap, plastic or geotextile. This will be particularly important to protect the banks of a temporary diversion channel that was recently excavated.

- Consider if lining the entire diversion channel (banks and stream bottom) is a better way to manage sediment release upon connection to the natural channel.

Construction:

- Construct the diversion channel in the dry by leaving the upstream and downstream ends unexcavated – e.g., leave an upstream and downstream earthen plug in place and do not connect to the original channel (e.g., do not remove plugs) until the diversion channel is completed, including linings, riprap and sediment control.

- If a culvert, bridge or other structure is to be installed in the diversion channel, do so while the channel is dry, before initiating flow from the main channel. Often, this is the case when the diversion channel is meant to become the new permanent channel.

The same site as above. The downstream earth plug is being removed.

- In the case of temporary channels, the banks should be protected with erosion control materials, usually geotextile cloth or erosion control blankets. Permanent channel diversions require permanent armouring (such as clean riprap) of the banks and need to be seeded.

- Wash the new channel to remove loose sediment: pump wash water into the upstream end of the diversion and pump it out again when it has reached the downstream end. Do this until most of the loose sediment is washed out of the channel. Pump the waste water into a vegetated depression, sump, or other type of settling area (see BMP 2.1.8 *Sediment Traps, Sumps and Detention Ponds*).

The same site as above. The upstream earth plug is being removed.

- Fish salvage: Prior to blocking off the old channel and activating the new one, a fish salvage operation needs to be completed in fish-bearing streams (see BMP 2.3.2 *Fish Salvage*).

- Check the weather forecast and inspect the diversion daily for erosion and stream channel stability. Be prepared for heavy rain and erosion problems by having erosion control materials on-site.

Diverting the Stream:

- To open the diversion channel, start by removing the downstream plug, followed by the upstream plug.

- Once the diversion channel has been activated, the main channel can be blocked off. Use aquadams or large, non-porous sand bags (one-ton bags) covered with plastic and held in place by rock or small sand bags. Place the sandbags or other diversion material by working from both banks inward to close off the channel. Thus, the last sandbags will be placed mid-channel. This method avoids the problem of gradually focusing flow towards either bank and causing erosion and blowout as the gap is closed.

The same site as above. Watson Creek is being blocked off with large sand bags and the flow is captured by the diversion channel (foreground).

- Any water left in the old channel needs to be pumped out and deposited into a vegetated depression, sump, or other type of settling area (see BMP 2.1.8 *Sediment Traps, Sumps and Detention Ponds*).

Decommissioning Temporary Stream Diversions:

Once work activities are completed in the main channel and the temporary stream diversion is no longer needed, it must be deactivated using the following procedures:

- Open the main channel. Start by removing the downstream plug, followed by the upstream plug.

The same site as above. The sand bags are covered with plastic on the upstream side of the diversion. The plastic is anchored on the bottom with rocks to hold it in place and to seal the stream blockage.

- Once the main channel has been activated, the diversion channel can be blocked off using rock or solid native materials, or a combination.

- Any water left in the diversion channel needs to be pumped out and deposited into a vegetated depression, sump, or other type of settling area (see BMP 2.1.8 *Sediment Traps, Sumps and Detention Ponds*). Waste water should be pumped into a vegetated sump, not into the stream.

- Backfill the channel with native sediment, most likely the material that was originally excavated, and contour to the original grade. Be sure to place mineral soil first and place organic soil on top.

- Vegetate and stabilize the disturbed areas by planting and seeding. Cover such areas with mulch to prevent erosion and to help seeds germinate.

- Maintain effective sediment and erosion control measures until the site is revegetated.

The same site as above. The work area is dry and the culvert extensions are being attached.

3.9 Isolating In-Stream Work Areas

Diverting a large watercourse, defined as being greater than 6 m wide and having a flow rate greater than 2.8 m^3/sec, generally is not considered practical or safe (Caltrans, 2003). Consequently, erecting a structure or conducting construction activities directly in a large water body requires that a portion of the streambed (or lakebed) be completely isolated from the rest of the watercourse. A common example is the use of enclosed cofferdams to construct bridge piers. This BMP explains the basic operational procedures for the design, installation, maintenance and decommissioning of in-stream isolation structures.

Permits from DFO and the Yukon Water Board are typically required for in-stream isolation structures. If the stream is "navigable"(see Definitions Section), approval from Navigable Waters Protection Program is also required. Contact DFO, Water Resources and Navigable Waters Protection Program to get further information on licensing requirements.

Planning:

Cofferdams used in construction of bridge piers.

- Isolation of work areas is required in streams > 6m wide with flow rates of more than 2.8 m^3/sec, and in all lakes.
- Plan work sequences so that the isolation structure is in place for the shortest time possible and during low-water levels.
- When scheduling any in-stream work, consult the DFO webpage "Yukon Timing Windows" at www.pac.dfo-mpo.gc.ca/habitat/timing-periodes/tp-yukon-eng.htm. It lists the preferred in-stream work windows for fish species in each Yukon River drainage system.
- For all diversions of fish-bearing streams, DFO requires that a fish salvage plan be in place. A fish salvage operation must be completed with a scientific collection licence and a qualified technician. See the BMP 2.3.2 *Fish Salvage* for more information.
- Arrange to have enough pump capacity on-site to handle seepage into the work area. Be prepared to pump large volumes quickly.
- Develop an emergency plan in the event that an isolation structure is breeched.

Design criteria:

- If an isolation structure will be in place for an entire season, it should be sized to handle flow volumes and velocities of a 10-year flood event. If it will be in place for longer, then 50 and 100-year flood levels will need to be considered. If work is planned for a short period of time (days to weeks) and during low flow, the mean annual flow may be adequate as a design standard.

- Isolation structures should be made from a durable material that is easily retrieved from the water during decommissioning. For example, sand bags covered with heavy-duty non-porous poly sheathing or silt fences/curtains designed for in-stream application.

Construction Sequence:

- Proper sediment control measures will almost certainly need to be deployed during dewatering operations, and perhaps when isolation structures are being constructed and decommissioned (see BMP 2.1.8 *Sediment Traps, Sumps and Detention Ponds*).

- If the work will cause even temporary changes to flow volumes, velocities or turbulence, then protect nearby unvegetated banks with clean riprap or geotextile cloth.

Sand bags being used to protect an eroding lake shore. Note the clear water in the lake and the turbid water along the shore.

- If required, complete a fish salvage operation where the stream isolation structure will be installed.

- Install the isolation structure. The procedure and sequence of events should be clearly stated for the installers.

- Pump out the water from the isolated area. Pump the wash water into a vegetated depression, sump, or other type of settling area to filter/collect sediment. Monitor the sediment trap and ensure that any outflow water is clear. Water should never be pumped directly into the watercourse.

- Complete the construction activity inside the isolated area promptly so that the isolation structure is in place only as long as is necessary.

- Decommission the isolation structure by carefully starting with the downstream components. Work safely, as the structure will become unstable when it is partially disassembled and water flow resumes.

Maintenance:

- Check weather forecasts and inspect the isolated area at least daily. Be prepared to deal with high water events like heavy rain by having the necessary pump capacity on hand, as well as extra erosion control materials.

3.10 Infilling Techniques

Some projects require infilling portions of a stream or lake, though this type of work tends to be highly scrutinized by regulators. Infilling is done, for example, to create permanent barge landings, bridge abutments, lakefront development, and for some types of road construction. This BMP is meant to provide practical guidance on how to approach this type of activity and minimize the direct impact to water, fish and fish habitat.

Any project that will place 100 m^3 or more of infill will require a water licence. Even smaller infills may require a water licence, depending on their impact. Any infilling that occurs in a fish-bearing watercourse requires approval by DFO and if the stream is "navigable" (see Definitions Section) approval from Navigable Waters Protection Program needs to be obtained as well. Contact DFO, Water Resources and Navigable Waters Protection Program to get further information on licensing requirements.

General Principles and Planning:

- In some cases, it will be necessary to isolate a portion of the stream or lake prior to placing the fill. See BMP 3.9 *Isolating In-Stream Work Areas*.
- For all diversions of fish-bearing streams, DFO requires that a fish salvage plan be in place. A fish salvage operation must be completed with a scientific collection licence and a qualified technician. See the BMP 2.3.2 *Fish Salvage* for more information.
- When scheduling any in-stream work, consult the DFO webpage "Yukon Timing Windows" at www.pac.dfo-mpo.gc.ca/habitat/timing-periodes/tp-yukon-eng.htm. It lists the preferred in-stream work windows for fish species in each Yukon River drainage system.
- The infill material must be inert (no acid generating rock) and free of fines. This limits the infill material to clean gravel and rock.
- Because infilling usually involves large volumes of material that must be free of fines, it may be necessary to plan for a rock-washing facility. To avoid causing runoff and erosion if

Careful placement of clean rock along a stream bank. A water sample is being collected to measure the turbidity caused by sediment release.

A temporary ramp consisting of large, clean rock infill was constructed so the excavator could access the stream and work underneath the bridge. After the work was completed, the rock was removed.

the washing is done onsite, review applicable BMPs in the Erosion and Sediment Control sections of Chapter 2.

Construction Guidelines:

- Create a gradual ramp from the bank down to the water using clean material. Be sure to follow best practices for erosion and sediment control (e.g., silt fences, surface stabilization, runoff control, etc. See BMPs in Chapter 2).

- Infill material must be free of fines and non-acid generating. Set up a washing station if necessary and follow best practices for erosion and sediment control (see above).

- Stockpile the clean infill material next to the watercourse, and then carefully place it into the water with an excavator such that turbulence is minimized.

- As the infill area is being built up, select large angular rock for the perimeter of the infill area, and place smaller, smoother rock in the interior. Angular rock has better cohesive properties and resistance to erosion, so this method will help stabilize the infill body.

For this road-widening project, the lake edge had to be infilled. The procedure involved dumping rock on the ramp and then carefully push it into the lake with a dozer.

3.11 Docks and Barge Landings

Docks and barge landings on the shorelines of lakes and rivers are used in municipal, recreational and industrial applications. Docks come in a variety of shapes and forms. Some consist of floating platforms while others are supported by pipes, poles or cantilever arms. Barge landings are augmentations to bank structures and typically are built from wood or concrete. Some of the best practices discussed here are specific to docks and barge landings, but many are summaries of BMPs found elsewhere in this guide. Those are referenced and should be consulted for more specific prescriptions.

Constructing docks and landings can impact fish and fish habitat. DFO permits the construction of docks without review if fish habitat is not negatively affected and the developer follows DFO's Operational Statement for *Dock and Boathouse Construction in Freshwater Systems* (www.pac.dfo-mpo.gc.ca/habitat/os-eo/dock-quais-eng.htm.) Developers are still required to notify DFO when a dock is to be constructed in a fish-bearing watercourse, and DFO reserves the right to conduct inspections. The best practices described here comply with DFO's Operational Statement but are not a full restatement of DFO guidelines. Barge landings typically require more complex shoreline and near shore works that should be reviewed by DFO as a *Fisheries Act* authorization will most likely be required. Depending on the type or level of modification of the stream bank for either type of work, a water licence may be required and if the stream is "navigable" (see Definitions Section) approval from the Navigable Waters Protection Program needs to be obtained as well. Contact DFO, Water Resources and Navigable Waters Protection Program to get further information on licensing requirements.

Planning:

- When planning approaches to docks or landings, use existing roads, trails or cut lines where possible.
- Avoid areas of known fish spawning habitat.
- Where multiple docks are proposed, ensure a minimum of 50 m of undisturbed shoreline between docks or other in-water structures.
- Have materials on hand for the installation of erosion and sediment control measures along banks.

Construction:

- Check equipment to ensure it is free of leaks and excess oil or grease. Refuel equipment at least 30m from the watercourse.
- Keep an emergency spill kit on site in case of fluid leaks or spills from machinery.
- If sediment, rock, or other materials will be excavated from above the HWM during the work, they should be stockpiled in a stable location above the high-water mark, as far as practical from the water body. If runoff from the stockpile has the potential to enter the watercourse, cover the stockpile with plastic sheeting or geotextile cloth.
- Minimize disturbance to existing vegetation. Cut brush off to ground height if needed, but without disturbing the roots. This practice will allow the vegetation to regrow from rootstocks.

- Construct temporary runoff ditches, water bars or diversions within the work area in a way that does not discharge sediment loaded water directly into the water body. Divert the ditch flow to a vegetated depression (sediment trap) where it can infiltrate into the ground.

- Operate machinery on land in a manner that minimizes disturbance to the banks of the lake, river or stream. If operating stationary machinery next to the watercourse, position it on a stable location on the bank. Create an operating platform (with rock) if needed.

- Often, it is best to build a dock from a floating platform, rather than from shore.

- Do not take materials from the shoreline to build docks or landings. Bring in clean materials from land (see BMP 3.10 *Infilling Techniques*).

- If logs and other bottom structure must be disturbed, move them elsewhere in the water body so they remain functional as fish habitat.

- Prevent deleterious substances such as uncured concrete, grout, paint, sediment and preservatives from entering the water body.

- Use untreated materials (e.g., cedar, tamarack, hemlock, rocks, plastic, etc.) to construct submerged supports for dock structures.

- Treated materials can be used for above-water structures (e.g., decking), but only when treated with an approved material. Alkaline Copper Quaternary (ACQ) and Copper Azole (CA) are approved treatments as of this time. Creosote treated wood should not be used in or near water.

- If plastic barrel floats are used, ensure they are free of chemicals, and avoid the use of rubber tires, as they are known to leach toxins.

- Concrete leachate and uncured cement are alkaline and highly toxic to fish and other aquatic life. If using concrete for portions of the dock or landing:

    - Try to use precast material and ensure that it is fully cured before placing it in the watercourse.

Little Atlin Lake boat ramp is being expanded. Infill area in the lake has been isolated with a silt curtain to contain sediment. Note the turbid water inside of the silt curtain compared to the clear water beyond.

- If concrete will be poured on-site, the preferred method is to cast the concrete in component forms away from the watercourse and allow the concrete to cure for 30 days before placing components in the watercourse.

- If concrete must be poured directly in place, that portion of the watercourse will have to be isolated. See BMPs 3.9 *Isolating In-Stream Work Areas* and 2.2.2 *Using Concrete near Water*.

Restoration:

- Restore banks to original condition if any disturbance occurred during work.
- Reposition temporary stockpiles of soil and other materials and grade back into the site.
- Vegetate and stabilize any disturbed areas by planting and seeding. Cover such areas with mulch to prevent erosion and to help seeds germinate.
- Maintain effective sediment and erosion control measures until the site is revegetated.
- Review BMPs 2.1.1 to 2.1.5 in the chapter on Erosion and Sediment Control.

3.12 Exploration Activities: Trenching and Drilling

Trenching and drilling are two basic techniques used in mineral exploration. Sometimes these activities occur in the immediate vicinity of a water body and have potential to negatively impact water. Keep in mind that construction of roads and trails to the exploration sites may have as much direct and indirect impact on water as the actual trenching and drilling (see BMP 3.3 *Runoff Control on Roads*).

Trenching in particular can expose significant ground area to erosion and runoff. Because trenching often occurs on hillsides (sloped ground), runoff from trenches has potential to turn into gullies and transport significant amounts of sediment and contaminates to water bodies.

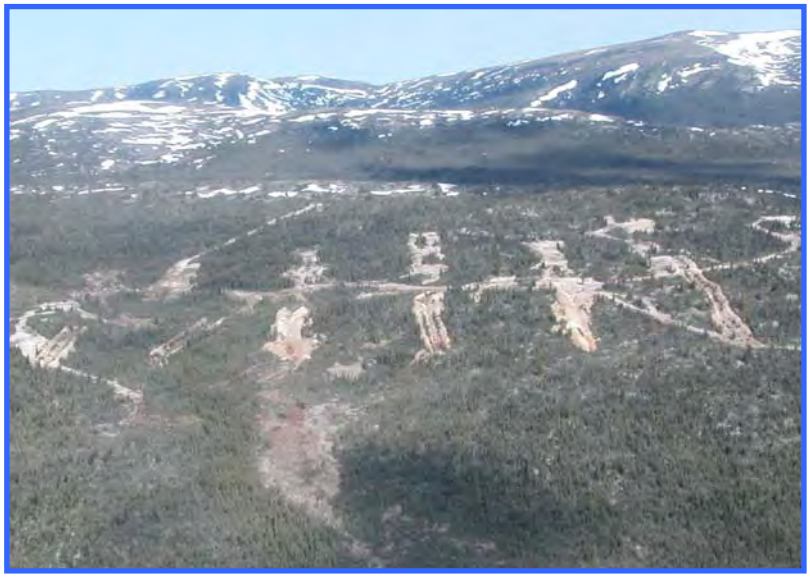
Some types of drilling require water for cooling and lubrication. If water is needed, the driller must file a *Notice of Water Use/Waste Deposit Without a Licence* with the Yukon Water Board at least 10 days prior to commencing work. The slurry ("mud") created from rock cuttings and cooling water during diamond drilling, as well as rock chips from reverse circulation drilling, may contain metal sulphides that could lead to acid rock drainage (ARD) if the cuttings are not properly disposed of. The combination of proximity to water bodies and potential for ARD means that it is critical to follow best practices when drilling. ARD can also be a concern when trenching if mineralized rock is exposed.

Complete best practices for exploration trenching and drilling (beyond just those protecting water resources) are covered in the Yukon Chamber of Mines' 2010 *Best Management Practices and Regulatory Guide*. The best practices presented here merely underscore those that specifically relate to protecting water.

Exploration Trenching

Planning and Construction:

- Maintain vegetated buffers of at least 30 m between trenches and water bodies.
- Orient trenches along slope contours as much as possible. That way trenches are less likely to become drainage channels for sediment-laden runoff.
- Contain runoff by means of berms and natural sloping. If runoff has the potential to reach a watercourse and cause sedimentation then exposed surfaces should also be covered and stabilized.



Large-scale trenching. In Yukon, many projects are multifaceted, include construction of access roads or trails, and are never very far from a watercourse. Planning and the application of best management practices are key to erosion and sediment control.

- When excavating, stockpile organic soil and vegetative debris separately from overburden material and rock. The latter should be kept away from water bodies and may need to be covered to avoid contaminated runoff. Other temporary erosion/sedimentation control measures, such as silt fences, may need to be deployed.

- Create a berm at the downhill end of the trench to contain water and thus prevent gullying beyond the trench.

Reclamation

- Fill in a trench with stockpiled material as soon as possible after the exploration program has been completed.

- Recontour the area to the original slope, or use 2:1 as the default slope.

- Backfill overburden material first and lightly compact it. Then apply the stockpiled organic soil.

- Stockpiled vegetation debris and other organic material should be scattered over the area to help reduce erosion.

- Backfilled trenches may require further erosion control measures, especially if on steep slopes or near water bodies. See sections in Chapter 2, *Erosion and Sediment Control*. They may even require seeding in areas where rates of natural revegetation is expected to be slow.

This exploration trench is cause for concern. The runoff is not being controlled and may be contaminated with heavy metals. The straight downhill run and slope grade mean that the trench should have been reclaimed, or at least stabilized (e.g., backfilled and vegetated).

Exploration Drilling

Planning and Construction:

- Locate drill pads on relatively flat terrain with stable slopes, and as far away from water bodies as possible.

- Do not store cores, core boxes or rock chip bags near a water body such that any leachate may enter any water body. Cover cores and bags with a tarp or store in a shed.

- Keep the drill pad area as small as possible.

- Maintain equipment and check for leaks daily. Use sorbent pads to capture small leaks.

- When clearing for drill pads and trails, clear only as much vegetation as is absolutely necessary and cut only to ground level, leaving root stock in place when possible.

- If the drill pad site or trails must be scraped, stockpile organic soil and vegetation debris separately from mineral soil and rock. The latter especially should be kept away from water bodies and may need to be covered to avoid contaminated runoff. When decommissioning the site and re-spreading material, spread the overburden material first and cover it with organic soil followed by organic debris from vegetation clearing.

- Use non-toxic additives and follow best practices below for handling of cooling water and "mud". Whenever possible, reuse and recirculate cooling water.

- Water pumps:

    - Place the water pump on a fuel containment tray (at all times) above the high water mark.

    - Fuel the pump by hand using a hand-held fuel container (2-5 gal. fuel can).

    - Keep sorbent pads and other spill response materials handy.

    - Store the fuel container at least 30 m away from the water and in secondary containment.

    - Fish screens must be installed over water intakes when placed in fish bearing water. See BMP 2.3.1 *Fish Screens and Water Pumping Guidelines*.

- Do not discharge any water directly into a water body. Runoff and other water that only contains surface sediment can be directed to ground sumps for filtering. Sumps can be natural, vegetated depressions, or man made excavations that are lined with geotextile cloth.

- Drill water (cooling water and "mud") containing non-toxic drilling additives should be discharged into ground sumps that will contain the slurry and allow water to dissipate in a controlled manner that will not cause erosion. If toxic drilling additives have been used, the slurry must be contained and disposed of properly.

Decommission of this drilling pad is nearly complete. The sump is left and the site still needs to be reclaimed. Note the pile of organic material piled along the edge of the vegetation. This will be spread over the mineral soil and the site will be seeded.

Reclamation:

- All drill holes should be plugged using commercial plugs, grout, or rocks. Drill holes with artesian groundwater conditions must be plugged

immediately such that flow to the surface is stopped.

- Remove and dispose of appropriately any contaminated soil, oily pads, fuel drums etc.

- Haul out and treat contaminated water that was collected in tanks. Settling ponds will need to be monitored and possibly covered until they can be reclaimed to ensure contaminated water does not enter the environment.

- Fill in sumps and ditches and remove any geotextile or plastic material used to control runoff from site. The sediment retained by lining materials will need to be properly disposed as it may contain contaminants.

- Scarify compacted soil and replace the salvaged organic topsoil layer. Spread vegetation debris from clearing over the site.

- Revegetate the site if there is a lack of organic material or high erosion potential.

3.13 Procedures for Emergency Works in and Around Water

If unforeseen or unpreventable circumstances call for immediate action, emergency works are permitted under the various water-protection acts if they are in the interest of public/personal safety or prevent larger environmental damage. This includes emergencies that develop as a result of flooding, unforeseen critical damage to vital structures in or near water due to human error or extreme weather events, equipment that has fallen in the water, or fuel and hazardous materials spills.

For instance, the *Waters Act* allows for the use of water without a water licence on an emergency basis for controlling or preventing a flood. In those cases, the person responsible for taking the action is required to discontinue any diversions constructed, and restore the original channel conditions when the need for the diversion ceases. Water licence holders may also apply to the Yukon Water Board for an emergency amendment and licensees should refer to the Board's Guidelines for Processing an Application for Emergency Amendment: www.yukonwaterboard.ca/policy/Emergency%20Amendment.pdf.

Immediate Action:

Before starting any emergency works you must contact these regulatory agencies:

- DFO 1-866-676-6722
- YG Water Resources (867) 667-3171
- Yukon Water Board (867) 456-3980
- The Yukon Spill Hot Line (867) 667-7244 and/or Environment Canada (867) 667-3400 for spills and equipment that has fallen in water
- If it concerns "navigable" water, also contact Navigable Waters Protection Program (780) 495-8215

Emergency Preparedness and Prevention:

The effectiveness of response to an emergency often is a reflection of the level of preparedness. Likewise, collateral environmental harm caused by an emergency response reflects the level of training and preparedness. To be ready for a proper and measured response:

- Keep equipment that is on the work site free of leaks and excess oil or grease so that if it must be deployed for an emergency response it will not contaminate water.
- Keep spill kits in handy, nearby locations. Quick and effective response to a spill will limit environmental damage and could minimize or prevent an emergency.
- It is always a good idea to keep extra erosion control material on-site. This includes rolls of poly and geotextile cloth and stakes for erecting sediment fencing.
- Ensure that all workers are well versed in emergency response procedures, especially spill response.
- Post procedures to be followed in the event of an emergency. Include the phone numbers listed above, as well as contact information for site supervisors.

- Consider keeping an inexpensive camera and extra batteries in a response kit or where emergency procedures are posted. Pictures will help document the emergency when a review is conducted. Inspectors may only visit the site after the emergency and the response is over thus only seeing the end results of the event. Having photos of the emergency situation will help justify the extent of the response and the results.

Actions During an Emergency Response:

- Even though it is an emergency, actions should be carried out in a calm and professional manner. Act promptly, but don't be hasty – take a minute to talk over your plan of action. Ensure that your response does not make the situation worse.

- The first course of action should be to ensure everyone's safety.

- The next step should be to safeguard and stabilize fuels so they do enter water bodies. This may mean quickly erecting berms or moving fuel storage containers.

- Even though it is an emergency, all equipment should still be refuelled >30 m from the water body.

- You still must make every effort to avoid and control erosion and sedimentation during your actions. Prevent any unnecessary material from entering the water course, such as dirt, dirty water, concrete, debris, etc. by building or installing structures like berms, containments, sediment fences, etc. Study the erosion and sediment control BMPs in this guide so you are familiar with these actions.

Accidents happen. Be prepared to deal with them!

- If a bank or structure is in risk of collapsing, place oversized rock, riprap or other non-erodible materials as necessary to provide stabilization.

- When possible operate equipment from the banks. Only enter the water with equipment as a last resort or to save life.

- In flooding situations, construct temporary runoff ditches, water bars or diversions to divert flow from the main channel so the main structure can be repaired or to avoid damage to it.

- If there is time and it is warranted, reposition excavated material and debris from the site in a stable location above the high-water mark such that they cannot enter any watercourse. If the stockpile is close to the water and cannot be moved, cover it with poly or geotextile cloth as a temporary measure to avoid sediment runoff.

Site Restoration and Follow-up:

- If the ground was excavated or disturbed, grade it back to the original slope then employ measures outlined earlier in this guide to stabilize and revegetate the surface. This likely means installing erosion control products and silt fences in combination with mulching and seeding.

- When the need for a diversion has ceased, discontinue the diversion and insofar as possible, restore the original channel conditions.

- If rock or riprap had to be placed, plan to remove it in a manner that minimizes erosion and sedimentation.

- Provide a report along with pictures to DFO, Water Resources Branch and the Yukon Water Board. If the work involved a spill or equipment in water, send the report to Environment Canada as well.

- Follow-up after the next heavy rain or winter snow melt to fix slumps or erosion problems.

- Design and install permanent fixes and obtain necessary approvals for these works.

4 Important Contact Information

For spills of any type or size in contact with water (this includes equipment that has fallen into a waterbody):

Yukon Spill Hot Line (867) 667-7244

The spill hot line is operated by the Emergency Measures Organization of the Yukon government. It will contact the responsible agency, such as Environment Canada or Environment Yukon, depending on the nature, size and location of the spill.

For spills on land, contact the spill hot line as well, or Environment Yukon:

Environment Yukon (867) 667-5683

Other useful contacts:

Environment Yukon – Water Resources Branch
Box 2703 (V-310)
Whitehorse, Yukon Y1A 2C6
Phone: (867) 667-3171
Toll free (in Yukon): 1-800-661-0408 local 3171
Fax: (867) 393-3195
Email: water.resources@gov.yk.ca
www.gov.yk.ca/monitoringenvironment/aboutwaterresources.php

Yukon Water Board
Suite 106, 419 Range Road
Whitehorse, Yukon Y1A 3V1
Phone: (867) 456-3980
Fax: (867) 456-3890
Email: ywb@yukonwaterboard.ca
www.yukonwaterboard.ca

Department of Energy Mines & Resources – Land Management Branch
Box 2703 (K-320)
Whitehorse, Yukon Y1A 2C6
Phone: (867) 667-5215
Toll-free : 1-800-661-0408 local 5215
Fax: (867) 393-6340
Email: land.use@gov.yk.ca
www.emr.gov.yk.ca/lands

Fisheries and Oceans Canada (DFO)
Yukon/Trans-boundary Rivers Office
100 – 419 Range Road
Whitehorse, Yukon Y1A 3V1
Phone: 867-393-6722 or 1-866-676-6722 (toll-free)
Fax: 867-393-6738
Email: WhitehorseA@pac.dfo-mpo.gc.ca
www.pac.dfo-mpo.gc.ca/yukon/default_e.htm

Environment Canada
Yukon Office
91782 Alaska Highway
Whitehorse, Yukon Y1A 5B7
Phone: 867-667-3400
Fax: 867-667-7962
Email: enviroinfo@ec.gc.ca
www.ec.gc.ca/pollution

Navigable Waters Protection Program – Prairie and Northern Region
Transport Canada
1100-9700 Jasper Avenue
Edmonton, AB T5J 4E6
Phone: 780-495-8215
Fax: 780-495-8607
E-mail: nwp-pen.pn@tc.gc.ca
www.tc.gc.ca/eng/marinesafety/oep-nwpp-menu-1978.htm

Yukon Environmental and Socio-economic Assessment Board (YESAB)
200-309 Strickland Street
Whitehorse, YT Y1A 2J9
Phone: 867-668-6420; toll free - 1-866-322-4040
Fax: 867-668-6425
Email: yesab@yesab.ca
www.yesab.ca

Dawson City Designated Office
Bag 6050, Dawson City, Y0B 1G0
Phone: 867-993-4040
Fax: 867-993-4049

Haines Junction Designated Office
PO Box 2126, Haines Junction, Y0B 1L0
Phone: 867-634-4040
Fax: 867-634-4049

Mayo Designated Office
PO Box 297, Mayo, Y0B 1M0
Phone: 867-996-4040
Fax: 867-996-4049

Teslin Designated Office
PO Box 137, Teslin, Y0A 1B0
Phone: 867-390-4040
Fax: 867-390-4049

Watson Lake Designated Office
PO Box 294, Watson Lake, Y0A 1C0
Phone: 867-536-4040
Fax: 867-536-4049

Whitehorse Designated Office
7209B-7th Avenue, Whitehorse, Y1A 1R8
Phone: 867-456-3200
Fax: 867-456-3209

5 Definitions

Developer or Development: A developer is a person or organization engaged in the creation or improvement of facilities, infrastructure, land or resources development. The actions of a developer are considered to be the development. For the purposes of this guide, a “development” activity can range from road construction and maintenance to farming and mining.

Eutrophication: The phenomenon caused by adding substances to water that function as nutrients to phytoplankton (algae). Usually these substances are high in nitrates and phosphates, and most often derive from fertilizers or sewage. The resulting "bloom" of algae negatively impacts water because there is rapid turnover of algae and as algae die they provide organic matter for microbes to feed on. These microbes consume oxygen in the water and severely deplete the level of oxygen available for fish and other aquatic life. The result of eutrophication is a sharp reduction in higher aquatic life and diversity.

High Water Mark or Ordinary High Water Mark: The highest non-flood water level reached by a body of water in the course of a year is the high water mark (HWM). In Yukon it is almost always is reached in spring. If high water has been measured for some period of time it is customary to refer to the “normal” high water level as the “Ordinary High Water Mark”. Evidence of ordinary high water can usually be seen as distinct character differences in both vegetation and soil along stream banks and lake shorelines. The ordinary HWM also is the point at which natural vegetation shifts from predominately water-dependent or flood-tolerant species (e.g., willows) to terrestrial species (e.g., spruce). These are distinguished from “flood” levels achieved in unusually high water years. The presence of scour marks on trees or debris deposits (e.g., leaves and twigs) usually indicates “flood events”

Riparian Zone or Riparian Area: These terms refer to the area of vegetation immediately adjacent to a river, stream or wetland. The zone can be anywhere from a few meters to a few hundred meters wide. The vegetation type and structure in a riparian zone is usually distinct as it tends to contain a mixture of flood tolerant species such as willows, alder, sedges and larger terrestrial species such as spruce and poplar. Riparian zones are important for many reasons. First, plant and animal diversity and productivity are very high in riparian zones. Secondly, some plant and animal species are highly dependent on riparian zones. Third, riparian habitat is very limited in extent relative to other habitat types. In other words, riparian habitat is very productive but relatively uncommon. Riparian vegetation provides natural erosion control, buffers storm water runoff, maintains bank stability, and offers stream cover, shade and food production for the aquatic environment.

Navigable Water: The Transport Canada Navigable Waters Protection Program defines these as any body of water capable of being navigated by any type of floating vessels for transportation, commerce or recreation. This includes both inland and coastal waters. The final authority to determine the navigability of a waterway rests with the Minister of Transport or his/her designated representative.

Sedimentation: Sedimentation is the tendency for particles in suspension to settle out of the fluid in which they are entrained and come to rest against a barrier. In geology, sedimentation is often used as the opposite of erosion, e.g., the terminal end of sediment transport. Settling is the falling of suspended particles through the liquid, whereas sedimentation is the termination of the settling process.

Turbidity: Turbidity is the cloudiness or haziness of a fluid caused by entrained or suspended particles that are generally invisible to the naked eye. Turbidity in water is analogous to smoke in air. The measurement of turbidity is a key test of water quality.

Waste: Waste is defined in the *Waters Act* as "any substance that, if added to water, would degrade or alter, or form part of a process of degradation or alteration of, the quality of the water to an extent that is detrimental to its use by people or by any animal, fish or plants…."

Water Use or Waste Deposit Without a Licence: Under Section 4.(1) of the *Waters Regulations*, notice must be given to the Yukon Water Board of any water use or deposition of a waste into a watercourse that occurs during placer mining, quartz mining, or any industrial undertaking.

Wetland: Land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, water dependent vegetation and other biological activities which are facilitated by a wet environment. The five wetland classes are bog, fen, swamp, marsh and shallow water. Note that areas do not need to be "wet" all year to be considered "wetlands".

Working "in the dry": This term refers to work that in conducted in water bodies whereby the water is first diverted or excluded from the work area for the duration of the construction period. For instance, to replace a culvert, the stream channel is diverted into a temporary channel so that work on the culvert can occur in dry conditions. The purpose of working in the dry is to avoid sedimentation and contamination of water that would be caused by equipment and work activities.

6 Resources

6.1 Publications

Alaska Department of Environmental Conservation. 2009. Alaska Storm Water Guide.

Alberta Transportation. 2003. Field Guide for Erosion and Sediment Control for Highways.

B.C. Government. 2000. Fact Sheet – Culverts and Fish Passage. British Columbia Ministry of Transportation and Highways.

B.C. Government. 2004. Standards and Best Practices for In-stream Works. British Columbia Ministry of Water, Land and Air Protection – Ecosystem Standards and Planning Biodiversity Branch.

Caltrans. 2003. Storm Water Quality Handbooks. Construction Site Best Management Practices Manual. California Department of Transportation.

Department of Fisheries and Oceans. 1995. Freshwater Intake End-of-Pipe Fish Screen Guidelines. By Communications Directorate Department of Fisheries and Oceans, Ottawa. ISBN 0-662-23168. Catalogue no. Fs 23-270/1995E.

Environment Yukon, Fish and Wildlife Branch. 2010. Status of Yukon Fisheries 2010. An overview of the state of Yukon fisheries and the health of fish stocks, with special reference to fisheries management programs. Publication No. MR-10-01.
www.gov.yk.ca/mapspublications/documents/status_yukon_fisheries2010.pdf

Fisheries and Oceans Canada – Pacific Region Operational Statements. Various publication dates. Available at www.pac.dfo-mpo.gc.ca/habitat/os-eo/index-eng.htm.

(1) Temporary Ford Stream Crossing
(2) Clear-Span Bridges
(3) Culvert Maintenance
(4) Ice Bridges and Snow Fills
(5) Dock and Boathouse Construction in Freshwater Systems

FP Innovations –Feric. 2007. Erosion and Sediment Control Practices for Forest Roads and Stream Crossings.

Kennedy, C.E. 1993. Guidelines for Reclamation/Revegetation in the Yukon. Yukon Renewable Resources. ISBN1-55018-519-5.

Nener, J. et al. Water Stewardship – a Guide for Agriculture. This publication is part of the Stewardship Series. Published by the Government of British Columbia. ISBN 0-7726-3174-3.

Transportation Association Canada. 2005. National Guide to Erosion and Sediment Control on Roadway Projects. Published: Transportation Association of Canada ISBN 978-1-55187-204-8.

Wright, S. 2008. A Revegetation Manual for Alaska. Alaska Plant Materials Center, Division of Agriculture, Alaska Department of Natural Resources, Palmer, Alaska.

Yukon Chamber of Mines. 2010. Yukon Mineral and Coal Exploration Best Management Practices and Regulatory Guide.

6.2 Useful Web Sites and Document Links

Alberta Transportation. Field Guide for Erosion and Sediment Control for Highways
www.transportation.alberta.ca/2620.htm

Environment Canada
www.ec.gc.ca/pollution

Environment Yukon – Water Resources Branch
www.environmentyukon.gov.yk.ca/monitoringenvironment/aboutwaterresources.php

Fisheries and Oceans Canada (DFO)
www.pac.dfo-mpo.gc.ca/yukon/default_e.htm

DFO Operational Statements: www.pac.dfo-mpo.gc.ca/habitat/os-eo/index-eng.htm.
Yukon Timing Windows: www.pac.dfo-mpo.gc.ca/habitat/timing-periodes/tp-yukon-eng.htm
Fish Collection Licence: www.pac.dfo-mpo.gc.ca/yukon/licensingscience.htm

Navigable Waters Protection Program – Prairie and Northern Region
www.tc.gc.ca/eng/marinesafety/oep-nwpp-menu-1978.htm

U.S. Department of Agriculture – Natural Resources Conservation Service
www.mt.nrcs.usda.gov/technical/fires/index.html

Yukon Environmental and Socio-economic Assessment Board
www.yesab.ca

Yukon Chamber of Mines
www.yukonminers.ca/Industry/MBPs.aspx

Yukon Department of Energy, Mines & Resources – Land Management Branch
www.emr.gov.yk.ca/lands

Yukon Department of Energy, Mines & Resources – Mineral Resources Branch
www.emr.gov.yk.ca/mining

Yukon Water Board
www.yukonwaterboard.ca

7 Appendices

7.1 Appendix A: DFO Operational Statements

(1) Temporary Ford Stream Crossing
(2) Clear-Span Bridges
(3) Culvert Maintenance
(4) Ice Bridges and Snow Fills
(5) Dock and Boathouse Construction in Freshwater Systems

1. Operational Statement - Temporary Ford Stream Crossing

A temporary ford stream crossing consists of i) a one-time ford in flowing waters, or ii) a seasonally dry streambed ford. Temporary ford stream crossings are employed for short term access across a watercourse by construction vehicles and equipment when an existing crossing is not available or practical to use. They are not intended for prolonged use (e.g., forest or mining haul roads). DFO prefers use of temporary bridges or dry fording over fording in flowing waters due to the reduced risk of damaging the bed of the watercourse and generation of downstream sedimentation caused by vehicles. Pacific Region Operational Statements are available for Ice Bridges and Snow Fills for temporary access during the winter. Consult your local DFO Area office for advice.

The risks to fish and fish habitat associated with temporary ford stream crossings include the potential for destabilization of stream banks, compaction of stream beds and spawning habitats, changes to channel morphology and hydrology, release of sediments and other deleterious substances (e.g., fuel, oil leaks), loss of riparian habitat, and direct harm or disruption to sensitive fish life stages.

Fisheries and Oceans Canada (DFO) is responsible for protecting fish and fish habitat across Canada. Under the *Fisheries Act* no one may carry out a work or undertaking that will cause the harmful alteration, disruption or destruction (HADD) of fish habitat unless it has been authorized by DFO. By following the conditions and measures set out below you will be in compliance with subsection 35(1) of the *Fisheries Act*.

The purpose of this Operational Statement is to describe the conditions under which it is applicable to your project and the measures to incorporate into your project in order to avoid negative impacts to fish habitat. You may proceed with your temporary ford stream crossing project without a DFO review when you meet the following conditions:

- the work does not include realigning, dredging, infilling, grading, or excavating the channel or stream bank, or diverting the watercourse,
- crossing sites avoid known fish spawning sites (e.g. tails of pools),
- fording of vehicles and equipment involves a one time event (over and back),
- the crossing will not result in erosion and sedimentation of the stream, alteration (e.g., compaction or rutting) of the bed and bank substrates, or blockage of fish passage,
- the crossing does not involve installation of a temporary culvert, and
- you incorporate the *Measures to Protect Fish and Fish Habitat when Carrying Out a Temporary Ford Stream Crossing* listed below.

If you cannot meet all of the conditions listed above and/or cannot incorporate all of the measures listed below then your project may result in a violation of subsection 35(1) of the *Fisheries Act* and you could be subject to enforcement action. In this case, you should contact the DFO office in your area if you wish to obtain DFO's opinion on the possible options you should consider to avoid contravention of the *Fisheries Act*.

You are required to comply with all municipal, provincial, territorial and federal legislation that applies to the work being carried out in relation to this Operational Statement. In British Columbia,

please contact the Water Stewardship Division, Ministry of Environment for information on the Provincial *Water Act Regulation* notification requirements when planning to conduct a temporary ford stream crossing in or around BC waters. In Yukon, please contact the Yukon Government (Department of Energy Mines and Resources: Land Use or Mining; Yukon Water Board; and/or Department of Highways and Public Works) to determine whether your project requires assessment under the Yukon Environmental and Socio-economic Assessment Act) and for information on regulatory requirements you may need when planning to conduct a temporary ford stream crossing in or around Yukon waters.

The activities undertaken in this Operational Statement must also comply with the *Species at Risk Act*. For general information on aquatic SARA species visit the following web site: http://www.dfo-mpo.gc.ca/species-especes/regions/Pac/pacific-index-eng.htm and/or contact DFO by email at: SARA@pac.dfo-mpo.gc.ca.

If you have questions regarding this Operational Statement, please refer to the list of Frequently Asked Questions) or contact DFO Regional Headquarters at 1-866-845-6776.

Please notify DFO, preferably 10 working days before starting your work, by filling out and sending the Pacific Region Operational Statement Notification Form directly to DFO Regional Headquarters. This information is requested in order to evaluate the effectiveness of the work carried out in relation to this Operational Statement. It is recommended that you keep a copy of the Operational Statement at the work site to demonstrate to Habitat and Fishery Officer staff that the conditions and measures, as outlined in the OS, are being followed.

Area of Application

This Operational Statement applies to the province of British Columbia and Yukon Territory freshwater systems only.

Measures to Protect Fish and Fish Habitat when Carrying Out a Temporary Ford Stream Crossing

1. Locate crossings at straight sections of the stream with low gradient banks, perpendicular to the bank. Avoid crossing on meander bends, braided streams, alluvial fans, or any other area that is inherently unstable and may result in the erosion and scouring of the stream bed. Avoid locations directly upstream of wetlands and sensitive fish rearing and spawning areas. Also plan activities and routes such to minimize the number of crossing sites required to reach your destination.

2. Minimize disturbance to riparian vegetation (i.e. vegetation that occurs adjacent to the watercourse) by using existing trails, winter roads or cut lines wherever possible and prevent soil compaction.

3. Select a site with early stage forest or shrub and grass riparian vegetation. Avoid thick riparian canopies and mature growth.

4. While this Operational Statement does not cover the clearing of riparian vegetation, the removal of select plants may be necessary to access the construction site. This removal should be kept to a minimum and within the road or utility right-of-way. Vegetation should be pruned or topped. Grubbing or uprooting vegetation within 15 m of a stream is not permitted.

5. Generally, there are no restrictions on timing for fording seasonally dry streambeds that do not support fish spawning, as this does not involve in-water work or driving over fish eggs and alevins. However, if

there is risk of any activities disrupting sensitive fish life stages (e.g., any uncertainty that the site does not support fish spawning) adhere to appropriate fisheries timing windows

6. Fording a flowing watercourse to bring vehicles and equipment required for construction to the opposite side is limited to a one-time event (over and back) and is to occur only if an existing crossing at another location or temporary bridge is not available or practical to use.

   6.1. To exercise this option, the stream bed at the fording site must be comprised of stable material such as gravel or bedrock and the stream banks must be low and stable.

   6.2. If minor rutting is likely to occur, use stream bank and bed protection methods (e.g., geogrids, logs, swamp pads, rubber tire mats – see Measure 8.1), provided they do not constrict flows or block fish passage. Maintain protection as required and maintain fish passage.

   6.3. Grading of the stream banks for the approaches is not permitted.

   6.4. If the stream bed and banks are steep and highly erodible (e.g., dominated by organic materials and silts) and erosion and degradation are likely to occur as a result of equipment fording, then use a temporary bridge in order to protect these areas.

   6.5. Time the one-time fording to prevent disruption to sensitive fish life stages by adhering to fisheries timing windows (see Measure 5).

   6.6. Ford only under low flow conditions, and not when flows are elevated due to local rain events or seasonal flooding.

   6.7. Ford only when water depth is sufficiently shallow to allow passage of vehicle/equipment, maintain crossing speed at a very slow and steady pace throughout the crossing and avoid rapid acceleration while on approaches or in the water.

7. Install effective sediment and erosion control measures before starting work to prevent the entry of sediment into the watercourse. Inspect them regularly during the course of construction and make all necessary repairs if any damage occurs.

8. Operate equipment in a manner that minimizes disturbance to the watercourse bed and banks.

   8.1. Protect entrances at equipment access points and establish single site entry and exit. e.g. place a large log tight to each bank to minimize pressure on the bank from the tracks. Excavators should use their boom bucket on the opposite shore and elevate the front tracks and gently pull to take pressure off the tracks. Operators should travel slowly so as not spin tracks and thereby avoid moving the logs, tearing the stream bank or cycling dirt into the watercourse. While large logs flat cut on the bottom are preferred, small swamp mats may also be used.

   8.2. Equipment is to arrive on site in a clean condition (mud and etc. removed) and is to be maintained free of fluid leaks, invasive species and noxious weeds.

   8.3. Wash, refuel and service equipment and store fuel and other materials for the equipment away from the water to prevent deleterious substances from entering the water.

   8.4. Keep an emergency spill kit on site in case of fluid leaks or spills from equipment.

9. No debris is to remain within the high water mark (HWM) or placed into a stream. On conclusion of the work activity, remove all protective materials introduced to the watercourse and rehabilitate the site to its original condition.

10. Stabilize any waste materials removed from the work site to above the HWM and prevent them from entering any watercourse. This could include covering spoil piles with biodegradable mats or planting them with preferably native grass or shrubs.

11. Revegetate any disturbed areas by planting and seeding with native trees or shrubs and grasses and cover such areas with mulch or other suitable organics to prevent soil erosion and to help seeds germinate. Follow the DFO guidance on Riparian Revegetation for all seeding and/or planting trees. If there is insufficient time remaining in the growing season, stabilize the site (e.g., cover exposed areas with erosion control blankets to keep the soil in place and prevent erosion) and revegetate the following spring.

    11.1. Maintain effective sediment and erosion control measures until revegetation of disturbed areas is achieved.

12. Ensure banks are stabilized, restored to original shape, adequately protected from erosion and revegetated with native shrub or tree species.

2. Operational Statement - Clear-Span Bridges

This Operational Statement applies to the construction of small-scale bridge structures that completely span a watercourse without altering the stream bed or bank, and that are a maximum of two lanes wide. The bridge structure (including bridge approaches, abutments, footings, and armouring) is built entirely above the high water mark (HWM). A clear-span bridge is preferred to a culvert as no structures are placed on the stream bed and therefore there is no alteration of natural channel processes.

Clear-span bridge construction has the potential to negatively affect riparian habitat. Riparian vegetation occurs adjacent to the watercourse and directly contributes to fish habitat by providing shade, cover and areas for spawning and food production. Only the vegetation required to accommodate operational and safety concerns for the crossing structure and approaches, within the right-of-way, should be removed. Stormwater run-off and the use of machinery can introduce deleterious substances to the water body and result in erosion and sedimentation.

Fisheries and Oceans Canada (DFO) is responsible for protecting fish and fish habitat across Canada. Under the *Fisheries Act* no one may carry out a work or undertaking that will cause the harmful alteration, disruption or destruction (HADD) of fish habitat unless it has been authorized by DFO. By following the conditions and measures set out below you will be in compliance with subsection 35(1) of the *Fisheries Act*.

The purpose of this Operational Statement is to describe the conditions under which it is applicable to your project and the measures to incorporate into your project in order to avoid negative impacts to fish habitat and maintain passage of fish. You may proceed with your clear-span bridge project without a DFO review when you meet the following conditions:

- the bridge is placed entirely above the high water mark (HWM),
- there is no alteration of the stream bed or banks or infilling of the channel,
- the bridge is no greater than two vehicle lanes in width, does not include sidewalks and biking lanes and does not encroach on the natural channel width by the placement of abutments, footings or rock armouring below the HWM,
- the work does not involve the clearing of riparian vegetation – removal of select plants with the road right-of-way can occur to meet operational and/or safety needs,
- your project does not require multiple bridge crossings over the same watercourse, and
- you incorporate the *Measures to Protect Fish and Fish Habitat when Constructing Clear-Span Bridges* listed below in this Operational Statement.

If you cannot meet all of the conditions listed above and cannot incorporate all of the measures listed below then your project may result in a violation of subsection 35(1) of the *Fisheries Act* and you could be subject to enforcement action. In this case, you should contact the DFO office in your area if you wish to obtain DFO's opinion on the possible options you should consider to avoid contravention of the *Fisheries Act*.

You are required to comply with all municipal, provincial, territorial and/or federal legislation that applies to the work being carried out in relation to this Operational Statement. In British Columbia, please contact the Water Stewardship Division, Ministry of Environment for information on the Provincial

Water Regulation notification requirements when planning to construct clear-span bridges in or around BC waters.

The activities undertaken in this Operational Statement must also comply with the *Species at Risk Act*. For general information on aquatic SARA species visit the following web site: http://www.dfo-mpo.gc.ca/species-especes/regions/Pac/pacific-index-eng.htm and/or contact DFO by email at: SARA@pac.dfo-mpo.gc.ca.

If you have questions regarding this Operational Statement, please refer to the list of Frequently Asked Questions or contact DFO Regional Headquarters at 1-866-845-6776.

Please notify DFO 10 working days before starting your work by filling out and sending the Pacific Region Operational Statement notification form directly to DFO Regional Headquarters. This information is requested in order to evaluate the effectiveness of the work carried out in relation to this Operational Statement. It is recommended that you keep a copy of the Operational Statement at the work site to demonstrate to Habitat and Fishery Officer staff that the conditions and measures, as outlined in the OS, are being followed.

Area of Application

This Operational Statement applies to the province of British Columbia and Yukon Territory freshwater systems only.

Measures to Protect Fish and Fish Habitat when Constructing Clear-Span Bridges

1. Minimize the riparian area temporarily disturbed by access activities along the adjacent upland property. Use existing trails, roads, or cut lines wherever possible to avoid disturbance to the riparian vegetation.

2. Avoid building on meander bends, braided streams, alluvial fans, active flood plains, or any other area that is inherently unstable and may result in the alteration of natural steam functions or erosion and scouring of the bridge structure.

3. While this Operational Statement does not apply to the clearing of riparian vegetation, the removal of select plants within the road right-of-way (ROW) may be required to meet operational and/or safety concerns for the crossing structure and the approaches. This removal should be kept to a minimum and within the road right-of-way. When practicable, prune or top the vegetation instead of uprooting.

4. Ensure that the clear span bridge is properly designed to address river and channel processes at flows above the ordinary high water mark.

5. Design and construct approaches so that they are perpendicular to the watercourse to minimize loss or disturbance to riparian vegetation.

6. Design the bridge so that stormwater runoff from the bridge deck, side slopes and approaches is directed into a retention pond or vegetated area to remove suspended solids, dissipate velocity and prevent sediment and other deleterious substances from entering the watercourse.

7. Generally there are no restrictions on timing for the construction of clear-span structures as they do not involve in-water work. However, if there are any activities with the potential to disrupt sensitive fish life stages (e.g., crossing of watercourse by machinery), these should adhere to appropriate fisheries timing

windows.

Machinery fording the watercourse to bring equipment required for construction to the opposite side is limited to a one-time event (over and back) and should occur only if an existing crossing at another location is not available or practical to use. *A Temporary Ford Stream Crossings Operational Statement* is also available.

7.1. To exercise this option, the stream bed at the fording site must be comprised of stable gravel or bedrock and the stream banks must be low and stable.

7.2. If minor rutting is likely to occur, stream bank and bed protection methods (e.g., swamp mats, pads) should be used provided they do not constrict flows or block fish passage.

7.3. Grading of the stream banks for the approaches is not permitted.

7.4. If the stream bed and banks are steep and highly erodible (e.g., dominated by organic materials and silts) and erosion and degradation are likely to occur as a result of equipment fording, then a temporary crossing structure or other practice should be used to protect these areas.

7.5. Time the one-time fording to prevent disruption to sensitive fish life stages by adhering to appropriate fisheries timing windows.

7.6. Fording should occur under low flow conditions and not when flows are elevated due to local rain events or seasonal flooding.

8. Install effective sediment and erosion control measures before starting work to prevent the entry of sediment into the watercourse. Inspect them regularly during the course of construction and make all necessary repairs if any damage occurs.

9. Operate machinery on land (above the HWM) and in a manner that minimizes disturbance to the banks of the watercourse.

   9.1. Machinery is to arrive on site in a clean condition and is to be maintained free of fluid leaks, invasive species and noxious weeds.

   9.2. Wash, refuel and service machinery and store fuel and other materials for the machinery away from the water to prevent any deleterious substance from entering the water.

   9.3. Keep an emergency spill kit on site in case of fluid leaks or spills from machinery.

   9.4. Restore banks to original condition if any disturbance occurs.

10. Use measures to prevent deleterious substances such as new concrete (i.e., it is pre-cast, cured and dried before use near the watercourse), grout, paint, ditch sediment and preservatives from entering the watercourse.

11. No debris to remain within the high-water mark or placed into a stream.

12. Stabilize any waste materials removed from the work site to prevent them from entering the watercourse. This could include covering spoil piles with biodegradable mats or tarps or planting them with preferably native grass or shrubs.

13. Vegetate any disturbed areas by planting and seeding with native trees, shrubs or grasses and cover such areas with mulch to prevent erosion and to help seeds germinate. All seeding and/or planting trees should follow the DFO guidance on Riparian Revegetation. If there is insufficient time remaining in the growing season, the site should be stabilized (e.g., cover exposed areas with erosion control blankets to keep the soil in place and prevent erosion) and vegetated the following spring.

    13.1. Maintain effective sediment and erosion control measures until re-vegetation of disturbed areas is achieved.

3. Operational Statement – Culvert Maintenance

Culvert maintenance is undertaken to extend the life of the structure and to ensure that it functions as designed, thus ensuring public safety and safe fish passage. Culvert maintenance includes the removal of accumulated debris (e.g., logs, boulders, garbage, ice build-up) that prevents the efficient passage of water and fish through the structure. Culvert maintenance may also include the reinforcement of eroding inlets and outlets, but does not include the replacement of damaged or destroyed bevel ends. Culverts requiring regular maintenance and significant structural repair should be considered for future remediation via redesign or reinstallation.

Culvert maintenance activities can affect fish and fish habitat by the removal of woody debris that is important for cover and food production, by causing flooding and excessive stream scouring if blockages are removed too quickly, excessive erosion and sedimentation from the use of equipment along the stream bank, and disruption of critical fish life stages. Replacement of eroded rock armouring can alter flows and fish movement patterns if done excessively.

Fisheries and Oceans Canada (DFO) is responsible for protecting fish and fish habitat across Canada. Under the *Fisheries Act* no one may carry out a work or undertaking that will cause the harmful alteration, disruption or destruction (HADD) of fish habitat unless it has been authorized by DFO. By following the conditions and measures set out below you will be in compliance with subsection 35(1) of the *Fisheries Act*.

The purpose of this Operational Statement is to describe the conditions under which it is applicable to your project and the measures to incorporate into your project in order to avoid negative impacts to fish habitat. You may proceed with your culvert maintenance project without a DFO review when you meet the following conditions:

- the work does not include realigning the watercourse, installing a culvert liner or support struts, replacing damaged or destroyed bevels ends, or extending/replacing the existing culvert,
- explosives are not used to remove debris,
- the work does not include any dredging, infilling (e.g., filling scour pools, rock reinforcement/armouring placement) or excavation of the channel upstream or downstream of the culvert, and
- you incorporate the *Measures to Protect Fish and Fish Habitat when Maintaining Culverts* listed below in this Operational Statement.

If you cannot meet all of the conditions listed above and cannot incorporate all of the measures listed below then your project may result in a violation of subsection 35(1) of the *Fisheries Act* and you could be subject to enforcement action. In this case, you should contact the DFO office in your area if you wish to obtain DFO's opinion on the possible options you should consider to avoid contravention of the *Fisheries Act*.

You are required to comply with all municipal, provincial, territorial and/or federal legislation that applies to the work being carried out in relation to this Operational Statement. In British Columbia, please contact the Water Stewardship Division, Ministry of Environment for information on the Provincial *Water Regulation* notification requirements when planning to conduct culvert maintenance in or around BC waters.

The activities undertaken in this Operational Statement must also comply with the *Species at Risk Act*. For general information on aquatic SARA species visit the following web site: http://www.dfo-mpo.gc.ca/species-especes/regions/Pac/pacific-index-eng.htm and/or contact DFO by email at: SARA@pac.dfo-mpo.gc.ca.

If you have questions regarding this Operational Statement, please refer to the list of Frequently Asked Questions or contact DFO Regional Headquarters at 1-866-845-6776.

Please notify DFO 10 working days before starting your work by filling out and sending the Pacific Region Operational Statement notification form directly to DFO Regional Headquarters. This information is requested in order to evaluate the effectiveness of the work carried out in relation to this Operational Statement. It is recommended that you keep a copy of the Operational Statement at the work site to demonstrate to Habitat and Fishery Officer staff that the conditions and measures, as outlined in the OS, are being followed.

Area of Application

This Operational Statement applies to the province of British Columbia and Yukon Territory freshwater systems only.

Measures to Protect Fish and Fish Habitat when Maintaining Culverts

1. Use existing trails, roads, or cut lines wherever possible to avoid disturbance to the riparian vegetation.

2. While this Operational Statement does not cover the clearing of riparian vegetation, the removal of select plants may be necessary to access the work site. This removal should be kept to a minimum and within the immediate work area. When practicable, prune or top the vegetation instead of uprooting.

3. Unless accumulated material (i.e., branches, stumps, other woody materials, garbage, etc) is preventing the passage of water and/or fish through the structure, time material and debris removal to prevent disruption to sensitive fish life stages by adhering to appropriate fisheries timing windows.

4. Install effective sediment and erosion control measures before starting work to prevent sediment from entering the watercourse. Inspect them regularly during the course of construction and make all necessary repairs if any damage occurs.

5. Limit the removal of accumulated material (i.e., branches, stumps, other woody materials, garbage, etc) to the area within the culvert, immediately upstream of the culvert and to that which is necessary to maintain culvert function and fish passage.

6. Remove accumulated material and debris slowly to allow clean water to pass, to prevent downstream flooding and to reduce the amount of sediment-laden water going downstream. Gradual dewatering will also reduce the potential for stranding fish in upstream areas.

7. Operate machinery on land (above the high water mark (HWM)) and in a manner that minimizes disturbance to the banks of the watercourse.

   7.1. Machinery is to arrive on site in a clean condition and is to be maintained free of fluid leaks,

invasive species and noxious weeds.

7.2. Wash, refuel and service machinery and store fuel and other materials for the machinery away from the water to prevent any deleterious substance from entering the water.

7.3. Keep an emergency spill kit on site in case of fluid leaks or spills from machinery.

7.4. Restore banks to original condition if any disturbance occurs.

8. If replacement rock reinforcement/armouring is required to stabilize eroding inlets and outlets, the following measures should be incorporated:

   8.1. Adhere to fisheries timing windows.

   8.2. Place appropriately-sized, clean rocks into the eroding areas associated directly with the inlet or outlet.

   8.3. Do not obtain rocks from below the HWM of any water body.

   8.4. Avoid the use of rock that is acid-generating. Also avoid the use of rock that fractures and breaks down quickly when exposed to the elements.

   8.5. Install rock at a similar slope to maintain a uniform stream bank and natural stream alignment.

   8.6. Ensure rock does not interfere with fish passage or constrict the channel width.

9. Stabilize any waste materials removed from the work site to prevent them from entering the watercourse. This could include covering spoil piles with biodegradable mats or tarps or planting them with grass or shrubs.

10. Vegetate any disturbed areas by planting and seeding with native trees, shrubs or grasses and cover such areas with mulch to prevent erosion and to help seeds germinate. All seeding and/or planting trees should follow the DFO guidance on Riparian Revegetation. If there is insufficient time remaining in the growing season, the site should be stabilized (e.g., cover exposed areas with erosion control blankets to keep the soil in place and prevent erosion) and vegetated the following spring.

    10.1. Maintain effective sediment and erosion control measures until re-vegetation of the disturbed areas is achieved.

4. Operational Statement – Ice Bridges and Snow Fills

Ice bridges and snow fills are two methods used for temporary winter access in remote areas. Ice bridges are constructed on larger watercourses that have sufficient stream flow and water depth to prevent the ice bridge from coming into contact with the stream bed or restricting water movement beneath the ice. Snow fills, however, are temporary stream crossings constructed by filling a stream channel with clean compacted snow.

Ice bridge and snow fill crossings provide cost-effective access to remote areas when lakes, rivers and streams are frozen. Since the ground is frozen, ice bridges and snow fills can be built with minimal disturbance to the bed and banks of the watercourse. However, these crossings can still have negative effects on fish and fish habitat. Clearing shoreline and bank vegetation increases the potential for erosion and instability of the banks and can lead to deposition of sediments into fish habitat. There is also potential for blockage of fish passage during spring break-up.

Fisheries and Oceans Canada (DFO) is responsible for protecting fish and fish habitat across Canada. Under the *Fisheries Act* no one may carry out a work or undertaking that will cause the harmful alteration, disruption or destruction (HADD) of fish habitat unless it has been authorized by DFO. By following the conditions and measures set out below you will be in compliance with subsection 35(1) of the *Fisheries Act*.

The purpose of this Operational Statement is to describe the conditions under which it is applicable to your project and the measures to incorporate into your project in order to avoid negative impacts to fish habitat. You may proceed with your ice bridge or snow fill project without a DFO review when you meet the following conditions:

- ice bridges are constructed of clean (ambient) water, ice and snow,
- snow fills are constructed of clean snow, which will not restrict water flow at any time,
- the work does not include realigning the watercourse, dredging, placing fill, or grading or excavating the bed or bank of the watercourse,
- the ice road/bridge does not run along the length of a water body,
- materials such as gravel, rock and woody material are NOT used,
- the withdrawal of any water will not exceed 10% of the instantaneous flow, in order to maintain existing fish habitat,
- water flow is maintained under the ice, where this naturally occurs, and
- you incorporate the *Measures to Protect Fish and Fish Habitat when Constructing an Ice Bridge or Snow Fill* listed below in this Operational Statement.

If you cannot meet all of the conditions listed above and cannot incorporate all of the measures listed below then your project may result in a violation of subsection 35(1) of the *Fisheries Act* and you could be subject to enforcement action. In this case, you should contact the DFO office in your area if you wish to obtain DFO's opinion on the possible options you should consider to avoid contravention of the *Fisheries Act*.

You are required to comply with all municipal, provincial, territorial and/or federal legislation that applies to the work being carried out in relation to this Operational Statement. In British Columbia,

please contact the Water Stewardship Division, Ministry of Environment for information on the Provincial *Water Regulation* notification requirements when planning to conduct ice bridge and snow fill construction in or around BC waters.

The activities undertaken in this Operational Statement must also comply with the *Species at Risk Act*. For general information on aquatic SARA species visit the following web site: http://www.dfo-mpo.gc.ca/species-especes/regions/Pac/pacific-index-eng.htm and/or contact DFO by email at: SARA@pac.dfo-mpo.gc.ca.

If you have questions regarding this Operational Statement, please refer to the list of Frequently Asked Questions or contact DFO Regional Headquarters at 1-866-845-6776.

Please notify DFO 10 working days before starting your work by filling out and sending the Pacific Region Operational Statement notification form directly to DFO Regional Headquarters. This information is requested in order to evaluate the effectiveness of the work carried out in relation to this Operational Statement. It is recommended that you keep a copy of the Operational Statement at the work site to demonstrate to Habitat and Fishery Officer staff that the conditions and measures, as outlined in the OS, are being followed.

Area of Application

This Operational Statement applies to the province of British Columbia and Yukon Territory freshwater systems only.

Measures to Protect Fish and Fish Habitat when Constructing an Ice Bridge or Snow Fill

1. Use existing trails, winter roads or cut lines wherever possible to avoid disturbance to the riparian vegetation (i.e., vegetation that occurs adjacent to the watercourse) and prevent soil compaction.

2. Construct approaches and crossings perpendicular to the watercourse.

3. Construct ice bridge and snow fill approaches using clean, compacted snow and ice to a sufficient depth to avoid cuts to the banks of the lake, river or stream.

4. While this Operational Statement does not cover the clearing of riparian vegetation, the removal of select plants may be necessary to accommodate the road. This removal should be kept to a minimum and within the road right-of-way.

5. Install sediment and erosion control measures before starting work to prevent the entry of sediment into the watercourse. Inspect them regularly during the course of construction and decommissioning activities and make all necessary repairs if any damage occurs.

6. Operate machinery on land or on competent ice and in a manner that minimizes disturbance to the banks of the lake, river or stream.

   6.1. Machinery is to arrive on site in a clean condition and is to be maintained free of fluid leaks, invasive species and noxious weeds.

6.2. Wash, refuel and service machinery and store fuel and other materials for the machinery away from the water to prevent any deleterious substance from entering the water or spreading onto the ice surface.

6.3. Keep an emergency spill kit on site in case of fluid leaks or spills from machinery.

6.4. Restore banks to original condition if any disturbance occurs.

7. If water is being pumped from a lake or river to build up the bridge, the intakes are sized and adequately screened to prevent debris blockage and fish mortality (refer to DFO's *Freshwater Intake End-of-Pipe Fish Screen Guidelines*, available at www.dfo-mpo.gc.ca/Library/223669.pdf). Avoid using small streams as a source for water.

8. Crossings do not impede water flow at any time of the year.

9. When the crossing season is over and where it is safe to do so, create a v-notch in the centre of the snow fill to allow it to melt from the centre and also to prevent blocking fish passage, channel erosion and flooding. Compacted snow should be removed from snow fills prior to the spring freshet.

10. Stabilize any waste materials removed from the work site to prevent them from entering the lake, river, or stream. This could include covering spoil piles with biodegradable mats or tarps or planting them with grass or shrubs.

11. Vegetate and stabilize (e.g., cover exposed areas with erosion control blankets or tarps to keep the soil in place and prevent erosion) any disturbed areas by planting and seeding with native trees, shrubs or grasses. All seeding and/or planting trees should follow the DFO guidance on Riparian Revegetation. Cover such areas with mulch to prevent erosion and to help seeds germinate.

    11.1. Maintain effective sediment and erosion control measures until re-vegetation of disturbed areas is achieved.

5. Operational Statement – Dock and Boathouse Construction In Freshwater Systems

Docks and boathouses are common features on the shorelines of lakes and rivers in Canada and are an important part of the recreational use of our waterways. This Operational Statement applies to docks which consist of floating platforms or those supported by pipes, poles or cantilever arms. The shoreline area in front of your cottage or waterfront property is also important habitat for a variety of aquatic organisms, including fish. Fish lay their eggs, feed and hide from predators in these shoreline areas.

Building a dock or boathouse along your waterfront can impact this important habitat by covering spawning habitat, removing rocks and logs that provide shelter, causing erosion and sedimentation from bank disturbance, introducing deleterious substances if improper building materials are used and disrupting sensitive fish life stages.

Fisheries and Oceans Canada (DFO) is responsible for protecting fish and fish habitat across Canada. Under the *Fisheries Act* no one may carry out a work or undertaking that will cause the harmful alteration, disruption or destruction (HADD) of fish habitat unless it has been authorized by DFO. By following the conditions and measures set out below you will be in compliance with subsection 35(1) of the *Fisheries Act*.

The purpose of this Operational Statement is to describe the conditions under which it is applicable to your project and the measures to incorporate into your project in order to avoid negative impacts to fish habitat. You may proceed with your dock or boathouse project without DFO review when you meet the following conditions:

- it is a new, repair or rebuild of a floating, cantilever or post dock or boathouse, with a total combined footprint no greater than 24 m^2 (258 ft^2),
- it does not occur over or adjacent to a location involving known fish spawning habitat,
- it does not require any dredging, blasting or infilling in the water body, and
- you incorporate the *Measures to Protect Fish and Fish Habitat when Building your Dock* listed below in this Operational Statement.

If you cannot meet all of the conditions listed above and cannot incorporate all of the measures listed below then your project may result in a violation of subsection 35(1) of the *Fisheries Act*and you could be subject to enforcement action. In this case, you should contact the DFO office in your area if you wish to obtain DFO's opinion on the possible options you should consider to avoid contravention of the *Fisheries Act*.

You are required to comply with all municipal, provincial, territorial and/or federal legislation that applies to the work being carried out in relation to this Operational Statement. In British Columbia, please contact the Water Stewardship Division, Ministry of Environment for information on the Provincial *Water Regulation* notification requirements when planning to conduct dock and boathouse construction in or around BC waters.

The activities undertaken in this Operational Statement must also comply with the *Species at Risk Act*. For general information on aquatic SARA species visit the following web site: http://www.dfo-mpo.gc.ca/species-especes/regions/Pac/pacific-index-eng.htm and/or contact DFO by email at: SARA@pac.dfo-mpo.gc.ca.

If you have questions regarding this Operational Statement, please refer to the list of Frequently Asked Questions or contact DFO Regional Headquarters at 1-866-845-6776.

Please notify DFO 10 working days before starting your work by filling out and sending the Pacific Region Operational Statement notification form directly to DFO Regional Headquarters. This information is requested in order to evaluate the effectiveness of the work carried out in relation to this Operational Statement. It is recommended that you keep a copy of the Operational Statement at the work site to demonstrate to Habitat and Fishery Officer staff that the conditions and measures, as outlined in the OS, are being followed.

Area of Application

This Operational Statement applies to the province of British Columbia and Yukon Territory freshwater systems only.

Measures to Protect Fish and Fish Habitat when Building your Dock and Boathouse

1. Use existing trails, roads, or cut lines wherever possible to avoid disturbance to the riparian vegetation (i.e., vegetation that occurs adjacent to the watercourse).

2. While this Operational Statement does not cover the clearing of riparian vegetation, the removal of select plants may be necessary to access the construction site. This removal should be kept to a minimum.

3. Avoid construction or placement of your dock or boathouse in areas of known fish spawning habitat.

4. Where multiple docks are proposed, ensure that there is a minimum of 50 meters (164 ft) of undisturbed shoreline between docks or other in-water structures.

5. The construction of boathouses above the high water mark (HWM) is strongly encouraged in order to minimize impacts to fish habitat.

6. Locate your dock to avoid aquatic vegetation. Minimize disturbance to the lakebed and surrounding aquatic vegetation by positioning the dock in water deep enough to avoid grounding of the dock and/or impacts by prop wash.

7. Do not take materials (e.g., rock, logs) to build the dock from the shoreline, from below the HWM or from any water body.

8. If rocks, stumps or logs need to be moved on the lake or river bottom or shoreline to build the dock, they should be relocated to an area of similar depth and not removed altogether from the bottom or shoreline.

9. Install effective sediment and erosion control measures before starting work to prevent the entry of sediment into the watercourse. Inspect them regularly during the course of construction and make all necessary repairs if any damage occurs.

   9.1. Avoid doing work during wet and rainy periods.

10. Use untreated materials (e.g. cedar, tamarack, hemlock, rocks, plastic, etc.) as supports for dock structures that will be submerged in water. Treated lumber may contain compounds that can be released

into the water and become toxic to the aquatic environment.

10.1. Use only treated lumber that is environmentally-friendly (see definition below) for dock structures that are above water.

10.2. Cut, seal and stain all lumber away from the water using only environmentally-friendly stains. All sealed and stained lumber should be completely dry before being used near water.

10.3. Ensure plastic barrel floats are free of chemicals inside and outside of the barrel before they are placed in water.

10.4. Avoid the use of rubber tires as they are known to release compounds that are toxic to fish.

11. Wherever possible, construct the dock either from a barge or float on the water or through the ice instead of using machinery from the bank of the water body.

12. Operate machinery on land (above the HWM) and in a manner that minimizes disturbance to the banks of the water body.

    12.1. Machinery is to arrive on site in a clean condition and is to be maintained free of fluid leaks, invasive species and noxious weeds.

    12.2. Wash, refuel and service machinery and store fuel and other materials for the machinery away from the water to prevent any deleterious substance from entering the water.

    12.3. Keep an emergency spill kit on site in case of fluid leaks or spills from machinery.

    12.4. Restore banks to original condition if any disturbance occurs.

13. If a concrete abutment is needed to secure your dock to land install it entirely on land, above the HWM. The concrete is to be pre-cast and cured away from the water before use to prevent seepage of potentially toxic substances into the water body.

14. Prevent deleterious substances such as uncured concrete, grout, paint, sediment and preservatives from entering the water body or storm drains.

15. Vegetate any disturbed areas by planting and seeding with native trees, shrubs or grasses and cover such areas with mulch to prevent erosion and to help seeds germinate. All seeding and/or planting trees should follow the DFO guidance on Riparian Revegetation. If there is insufficient time remaining in the growing season, the site should be stabilized (e.g., cover exposed areas with erosion control blankets to keep the soil in place and prevent erosion) and vegetated the following spring.

    15.1. Maintain effective sediment and erosion control measures until re-vegetation of disturbed areas is achieved.

Definition: Environmentally-friendly lumber and stains – Chemical wood preservatives used in Canada are regulated by the Pest Management Regulatory Agency, Health Canada. Approved preservatives used most commonly in lumber are Alkaline Copper Quaternary (ACQ) and Copper Azole (CA). Creosote treated wood should not be used in or near water. Ask your local building supply outlet for further information on available products or check the Wood Preservation Canada Website.

7.2 Appendix B: DFO Regulatory Overview and Habitat Management Website Overview

DFO Regulatory Overview

Fisheries Act - Fisheries and Oceans Canada

Fisheries and Oceans Canada (DFO) is responsible for the conservation and protection of fish and fish habitat across Canada. The *Fisheries Act* defines "fish" as fish, shellfish, crustaceans and marine animals and the eggs, sperm, larvae, spat and juvenile stages. Fish habitat is defined as the 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. Under the *Fisheries Act* no one may carry out a work or undertaking that will destroy fish or result in the harmful alteration, disruption or destruction (HADD) of fish habitat unless authorized by DFO. The most relevant sections of the Act are as follows:

> *Section 35* states that no person shall carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat unless authorized by the Minister;
>
> *Section 36* states that no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish;
>
> *Section 20 and 22* require the maintenance of fish passage and sufficient flows for fish;
>
> *Section 30* requires the use of appropriate fish screens when withdrawing water from fish bearing waters; and,
>
> *Section 32* prohibits the unauthorized killing of fish by means other than fishing.

It is important to note that in carrying out its responsibilities under the habitat protection provisions of the *Fisheries Act*, DFO must also ensure that the requirements of the *Species at Risk Act* and the *Canadian Environmental Assessment Act* (or other relevant environmental assessment legislation within the jurisdiction in question) are met and that potentially affected Aboriginal groups are consulted where appropriate.

Project Review

Works or undertakings that have the potential to impact fish or fish habitat are often those that are proposed to occur directly within water, within 30 meters of water (which includes the riparian area), or those that may affect water quality or quantity.

As a general rule, the greater the risk of harming fish or fish habitat, the more involved the DFO regulatory review process will be. This means that if a planned work or undertaking is likely to negatively affect fish or fish habitat, more information, time, and effort will be required to support the regulatory review and authorization process.

DFO has developed a process for the review of activities that are likely to pose a low risk to fish habitat. As part of this process, DFO provides upfront guidance on mitigation measures to help proponents plan and design their activities to avoid harmful effects to fish and fish habitat. To obtain copies of guidelines and

planning tools that may pertain to your activities, please visit the following Internet site:

www.pac.dfo-mpo.gc.ca/habitat/guide-eng.htm

When the advice in these documents can be followed, it is not necessary for a proposal to undergo formal DFO review and approval.

In cases where standard advice provided in DFO's operational statements cannot be adhered to or the planned activity is likely to result in harmful effects to fish or fish habitat, review by DFO Habitat Management Program staff prior to proceeding with proposed activities is recommended. DFO has developed a "Working Near Water" internet site which provides an overview of the regulatory review process in order to facilitate compliance with the *Fisheries Act*:

www.pac.dfo-mpo.gc.ca/habitat/index-eng.htm

DFO recommends that when a proposed work or undertaking is likely to result in harmful effects to fish and fish habitat, the proponent of the proposal should work closely with a Qualified Environmental Professional (QEP) before proceeding with the development of a proposal for submission to DFO for regulatory review.

A QEP with the appropriate experience and expertise should be selected to help with project design and where necessary to navigate through the DFO project review process.

DFO Habitat Management Website Overview – Pacific Region

Fisheries and Oceans ─ Habitat Management Program Pacific Region is pleased to announce a new "Working Near Water" website (www.pac.dfo-mpo.gc.ca/habitat/index-eng.htm) designed to help people undertaking projects in and around water understand what they need to know and do to comply with the *Fisheries Act.*

The new website is one component of a broader referral improvement initiative DFO has undertaken to: increase client access to regulatory process information; improve efficiencies and facilitate more effective interagency referral management processes; and, better support existing streamlined joint project review partnerships.

The website outlines the DFO regulatory review process for works in and around water, and provides step wise instructions for the public on navigating the DFO review, approval and authorization process. It also directs clients to project planning and design resources to assist them in developing their projects in a manner that will conserve or protect fish habitat.

Also included on the site is a new Project Review Application Form (PRAF) which will be required for any project DFO is being requested to review or authorize. While submissions in this format can still be mailed or delivered clients will also be able to submit applications electronically. Referrals should be directed to the appropriate DFO referral centre and electronic submissions should be sent to the appropriate e-mailboxes . The boundaries for the 6 DFO referral centres can be found on their website.

7.3 Appendix C: Yukon Water Board's Fuel Spill Contingency Plan

Fuel Spill Contingency Plan

You must complete a spill plan and submit it as part of your application.

A fuel spill emergency plan is required for all undertakings involving the handling or storage of petroleum products or hazardous materials. An emergency plan is required for small or large quantities of fuel that will be on the property, including fuel that will be hauled in daily. The emergency plan is also required in the event of a lubricant or fuel leak from any operational equipment (water pump, dozer, etc.).

A fuel spill emergency plan must be in place and a copy of it posted on site.

The following guidelines are provided to help you develop a Spill Contingency Plan suited to your project.

SPILL CONTINGENCY PLAN

GUIDELINES

TABLE OF CONTENTS

1.0 **Introduction**

Introduce the operation and operators and provide information on previous land use operations (history).

2.0 **Access**

Description of the route(s) you will be taking, ice bridge locations, etc.

3.0 **Haulage Contractor**

If using a contractor to haul your fuel, provide information on the company i.e. experience, describe equipment they will use.

4.0 **Spill Prevention Procedures**

Describe what you will do and how. The following ideas may be included. i.e. vehicle inspection to ensure the unit is roadworthy. Tanker inspection to ensure all hatch covers are locked down and hatch gaskets are sound and seating properly. Check all valving. Verify road conditions and monitor traffic. Progress will be monitored by call in at designated points. The truck will carry all materials and equipment to be used in an emergency. List all equipment. One tanker compartment will be empty in the event fuel is to be transferred from a damaged compartment. Transfer hoses, etc., will equip the transfer tanks.

5.0 **Spill Response Equipment**

List where the on site response equipment is and how it will be utilized.

6.0 **Response Procedures**

Outline training procedures for all on site employees in the use of the spill contingency plan. Details on how you or your representative will handle a possible spill.

7.0 **Containment Procedures**

Describe how you will contain a spill on land and from water bodies - both small and large should be described.

8.0 **Spill Site Clean-up**

Describe methods you are prepared to employ in the clean-up on land and from water bodies.
Examples: pump to another tank, sorbent material including type, remove contaminated liquids and/or materials from the site to a permitted/licensed disposal site, burning in an approved incinerator, etc.

9.0 **Reporting**
Provide details on who will report the spill and how.

Appendix A **Spill Reporting Flow Chart**

Provide a chart showing your spill notification procedures to report a spill to the Spill Hotline (867) 667-7244.

Appendix B **Material Safety Data Sheets**

Can be obtained from Distributors upon request.

Appendix C **Fuel Spill Notes**

Please provide more details regarding the following items as they pertain to your project:

A. Spill Prevention.
B. Snow, Permafrost, Ice.
C. On-Site Burning.
D. Method of Recording a Fuel Spill.

Appendix D **Telephone Contacts**

A list of your contacts.

NOTE: The above is a guideline for establishing your Plan.