Riparian Management
FIELD WORKBOOK
for Streams and Small Rivers

CANADA – BRITISH COLUMBIA ENVIRONMENTAL FARM PLAN PROGRAM

CANADIAN AGRICULTURAL PARTNERSHIP
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Canada

Riparian Management FIELD WORKBOOK

For Streams and Small Rivers

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Planning Workbook

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Acronyms

AGRI – BC Ministry of Agriculture

ARDCorp – BC Agriculture Research & Development Corporation

DFO – Fisheries and Oceans Canada

EFP – Environmental Farm Plan

ENV – BC Ministry of Environment and Climate Change Strategy

FLNRORD – BC Ministry of Forests, Lands, Natural Resource Operations, and Rural Development

RHA – Riparian Health Assessment

RHI – Riparian Health Inventory

SAR – Species at Risk

WFA – Whole Farm Assessment

PREFACE

The Riparian Management Field Workbook has been developed to support the protection and voluntary restoration of riparian and stream-based fish and wildlife habitat in agricultural areas. This field workbook and associated factsheets also represent a first commitment on the part of the agriculture community to develop an alternative assessment means to the Riparian Areas Regulation process. It focuses on streams and associated upland areas that together provide fish and wildlife habitat. It gives particular attention to ecosystem features and functions that provide essential support for healthy, diverse and self-sustaining fish and wildlife populations.

This document is an assessment and improvement tool that is part of the Environmental Farm Planning family of documents. **This Riparian Management Field Workbook is not a substitute for requirements under the federal *Fisheries Act, Waste Management Act, Migratory Bird Convention Act, Species at Risk Act, the Water Sustainablility Act,* or any other Act.** By focusing on voluntary corrective action, you will – over time – improve conditions for fish habitat and aspects of your own operation.

This workbook has been developed for use by agricultural producers in all regions of BC and relies primarily on the **Cows and Fish Riparian Health Assessment** developed in Alberta. It has been used in the Interior of British Columbia for many years. This assessment focuses on livestock operations and is more applicable to extensive farming activities but can be used with modifications on a variety of production areas in BC. The riparian assessment process under the EFP program is voluntary and the results are confidential.

The Riparian Management Field Workbook does not impose any legally binding requirements on any of the agencies involved in its development. This document is not to be used to assess the removal of riparian vegetation or riparian habitat. Contact with DFO, ENV and FLNRORD is *required* before any riparian vegetation can be removed.

LIMITATION OF LIABILITY AND USER'S RESPONSIBILITY

The primary purpose of the **Riparian Management Field Workbook** is to assist producers to assess riparian areas on their farms. It does require some training in plant identification. It is recommended that producers familiarize themselves with the Cows and Fish Riparian Health Assessment, either through the Environmental Farm Plan process or by attending a Cows and Fish training session.

While every effort has been made to ensure the accuracy and completeness of these materials, these materials should not be considered the final word on areas of practice that they cover. You should seek the advice of appropriate professionals and experts as the facts of your situation may differ from those set out in the materials.

All information in this workbook and related materials is provided entirely "as is" and no representations, warranties or conditions, either expressed or implied, are made in connection with your use of, or reliance upon, this information. This information is provided to you entirely at your risk.

The Government of Canada, the BC Ministry of Agriculture, BC Agriculture Research & Development Corporation, and the British Columbia Agriculture Council, its Directors, agents, employees, or contractors or the Cows and Fish Program will not be liable for any claims, damages or losses of any kind whatsoever arising out of the use of, reliance upon, this information.

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TABLE OF CONTENTS

1 ABOUT THIS GUIDE

Riparian Health Assessment

The main purpose of the Riparian Management Field Workbook is to assess the condition of riparian areas associated with watercourses on your property. It is meant for streams less than 15 m in width, that are easily crossed, or where your farm management practices will have an impact. The riparian health assessment (RHA) process is designed for producers and requires some training. It relies on visual guides and detailed knowledge of your farm/ranch operation. Some measurements are required. The assessment identifies potential problems, as well as a method for addressing these problems through actions for improvement. Repeated use of this RHA will help to monitor changes to watercourses and riparian areas over time.

This workbook describing the RHA process has been written for those people who can most effectively influence riparian areas with their management – landowners, livestock producers, farmers, agency staff, Environmental Farm Plan advisors and others who use and value these green zones.

A RHA blends many fields of science and undergoes periodic additions and modifications. In addition, the language describing the method of assessing riparian health undergoes continual revision, to clarify, expand and increase understanding.

A RHA forms part of a larger package of awareness about riparian areas, leading to choices on managing these vital landscapes and an alternative to the urban assessment process. It provides a starting point for future plans and management decisions.

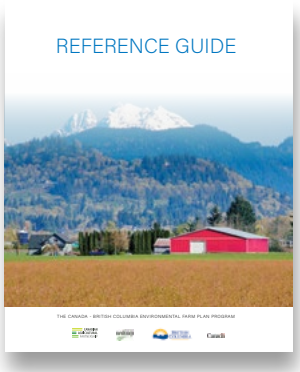
This workbook has been compiled from information contained in the British Columbia Environmental Farm Plan Riparian Self-Assessment Workbook, September 2004 edition (BC Agriculture Council) and the Manitoba and Alberta RHA Field Workbooks. The Alberta Cows and Fish programme, a recognized world leader in riparian care and management has been the foundation of all of these works.

How does it fit with my Environmental Farm Plan?

The **Environmental Farm Plan (EFP)** is a voluntary process to help producers identify areas where environmental improvements should occur on the farm. **The Canada-British Columbia Environmental Farm Plan: Reference Guide** provides information on various environmental regulations and makes suggestions for environmentally sound practices. It is the primary reference for completing the worksheets in the **Canada-British Columbia Environmental Farm Plan: Planning Workbook.**

The EFP Planning Workbook asks some basic questions regarding riparian health on your farm. If you have already completed an EFP, you may have identified action items or areas of improvement for your riparian management. Where appropriate, developing a riparian management plan can help in improving the health of riparian areas on your farm.

This **Riparian Management Field Workbook** is a companion document to the EFP Reference Guide and Planning Workbook shown below. This guidebook outlines the riparian assessment and offers separate factsheet information to guide producers in designing a riparian management plan based on concerns identified in the EFP. The information applies primarily to streams and small rivers in BC and is directed to livestock operations and extensive farming activities but can be used with modifications on a variety of production areas in BC. Overall, its purpose is to provide some incentive (and supportive information, advice and assistance) to farmers and ranchers to maintain their lands not only for fish and wildlife but also for their downstream neighbours.



What is in this workbook?

The **Riparian Management Field Workbook i**s divided into a number of sections that will help you to appreciate and assess the health of your riparian areas. Once you have familiarized yourself with the background and reference information, plant species lists and assessment procedure, the next steps will be to determine which riparian areas to assess, and when to do an assessment. This is followed by sections on how to rate each of the fifteen questions in the assessment. The questions are split into two sections: the **Whole Farm Assessment (WFA) and the Riparian Health Assessment (RHA).** The **RHA** is based entirely on the Alberta Cows and Fish **"Riparian Health Assessment for Streams and Small Rivers Field Workbook".** If you are interested in assessing wetlands, please refer to their **"Riparian Health Assessment for Lakes, Sloughs and Wetlands Field Workbook"** publication.

The RHA process is broken down into a number of steps as illustrated by this flowchart:

STEPS IN THE BC RIPARIAN HEALTH ASSESSMENT

1. **Choose a time to conduct assessment**
2. **Identify the type of watercourse**
3. **Select a site to assess**
4. **Conduct assessment**
   Forms: (1) Site Info (2) WFA (3) RHA
5. **Complete action sheet**
   Form 4

Why use this workbook?

When we look at a riparian area, the wet area next to streams, rivers, lakes, wetlands and springs, what we see and how we interpret our observations is often based on our backgrounds, experiences and perceptions. Even though we may be standing on the same streambank we don't often "see" all the same things. A RHA is a tool that allows us to do three things:

- "tune our eyes",
- begin to appreciate the key pieces of the riparian landscape
- evaluate what we see

It is an ecological "measuring stick" that provides some structure to our observations and allows us to evaluate the condition and health of riparian areas along streams or small rivers. We need to use the RHA to build a common language so we can communicate better with one another, maybe reduce the arguments, and begin to move toward fixing what's broken in riparian areas and maintaining what is healthy. This workbook gets us on that road together.

What will the workbook do for me?

This workbook is for use in the field. It will help you learn the basics of evaluating the riparian health of a stream or small river system. **A RHA requires instruction and practice;** both should be easier with the use of this workbook. With knowledge and experience gained from classroom and field training you will be able to apply this RHA procedure on your own place. The workbook gives you a place to record and store your measurements. It will start you down the road to recognising riparian health on your home turf, which is the first step to making better management decisions to maintain or restore your riparian areas. This workbook also sets a standard, so we all use a common measuring technique.

Who is it for?

This workbook is for farmers, ranchers, landowners, land/resource managers and others who want to learn to judge riparian health. Community groups, municipalities, regional districts and watershed groups will find this workbook helpful in understanding the procedures of this RHA and to interpret the results of watershed level inventories.

Where can I use it?

This workbook is designed for **streams and small river systems** in Alberta but has been adapted for British Columbia. It will be useful for other jurisdictions, with modifications to acknowledge vegetation differences. Different tools are available and should be used when measuring riparian health in large river systems, or in lakes, ponds and wetlands. In particular, the Alberta Cows and Fish **Riparian Health Assessment for Lakes, Sloughs and Wetlands Field Workbook** should be substituted for the streams and small rivers assessment if appropriate. Check with the Cows and Fish program for this and other RHA tools **(www.cowsandfish.org).**

RIPARIAN HINTS

Where does this workbook apply?

1. Streams or rivers that are easily crossed by humans or livestock
2. Systems that are generally less than 15 m (50 ft) in width
3. Tributaries of major rivers
4. Permanent streams, intermittent streams
5. Ravines and draws

NOTE: Other assessment tools are available for lakes, ponds, wetlands and large river systems (see above).

How to use the workbook

This Field Workbook was designed to be used with other riparian awareness materials, to train people to quickly assess riparian areas and to interpret the results of a riparian health evaluation.

- This workbook is designed for use with **Caring for the Green Zone: Riparian Areas – A User's Guide to Health**, an illustrated awareness guide which provides more detail on the concept of riparian health. Contact Cows and Fish for a copy.
- To be effective, a RHA requires some basic preparatory classroom time and field training. This workbook will help you to participate in an EFP riparian management training session, such as those put on by AGRI in partnership with the ARDCorp or by the Alberta Cows and Fish Program.
- Once you have some training and experience, the workbook will help you to carry out a RHA on streams and small rivers on your own land base.
- The workbook will also help you to interpret the results of a stream RHA or inventory that may be undertaken in your community.

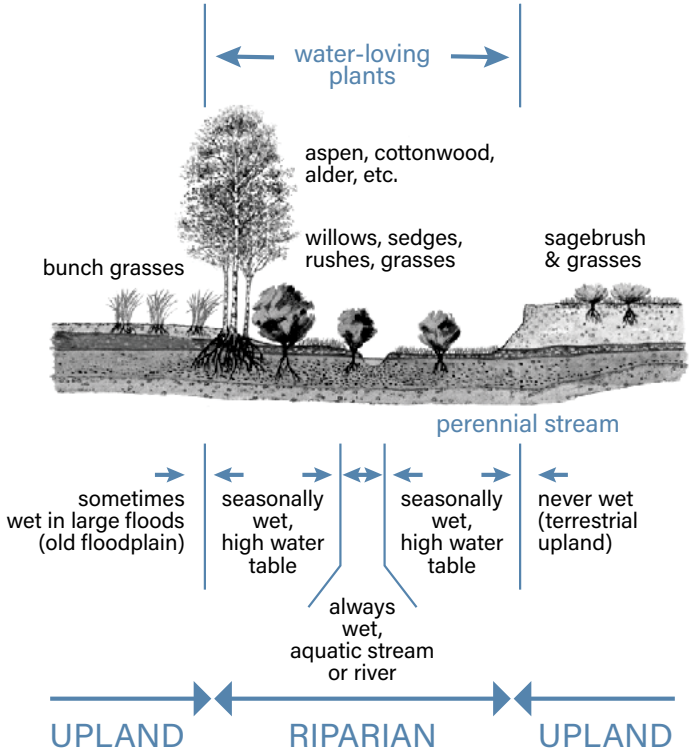
2 BACKGROUND

What is riparian?

To measure the health of a riparian area you first need to understand what "riparian" means. Riparian areas are transitional – they exist between the aquatic part and the surrounding terrestrial (or upland) area. Think of them as "wetter than dry" but "drier than wet". There is considerable variation in riparian areas, where water, soil and vegetation interact. Common to all riparian areas are the following features:

- a combined presence and abundance of water, either on the surface or close to the surface; even when the waterbody may appear dry;
- vegetation that responds to, requires and survives well in abundant water; and
- soils that are often modified by abundant water (as in high water tables), stream processes (like sediment deposition) and lush, productive and diverse vegetation.

Riparian areas are part of a larger, continuous landscape that grades from wet to dry. Sometimes it will not be easy to determine precisely where a riparian area begins and ends. However, rivers, streams, drainages and springs all have riparian areas adjacent to them. There will most often be a defined channel that continuously or seasonally carries flowing water and a floodplain where high flows will periodically escape the channel. Beaver ponds, seeps, wet meadows on the floodplain, coulees and draws are part of the riparian area. This workbook deals only with evaluating the riparian health of streams, flowing springs, coulees with at least periodic flow, and small rivers. Use the illustration on the next page to help you recognize what a riparian area looks like.



What is riparian health?

The word "health" conveys an impression of something that is in properly functioning condition: things working well. If health is applied to us, it relates to the ability of our bodies to perform certain functions within a measured set of standards. Our bodies undertake functions like respiration, circulation, digestion, filtration, cell repair, energy storage and movement. If these functions are occurring, within standards, we are healthy. In a similar way, landscapes, including riparian areas, perform certain functions. "Riparian health" means the ability of a reach of stream, or an entire stream or a watershed composed of many streams, to perform a number of key ecological functions.

RIPARIAN HINTS

What Do Healthy Riparian Areas Do?
Key Ecological Functions

1. Trap sediment
2. Build and maintain streambanks
3. Store floodwater and energy
4. Recharge groundwater
5. Filter and buffer water
6. Reduce and dissipate stream energy
7. Maintain biodiversity
8. Create primary productivity

See: Caring for the Green Zone: Riparian Areas – A User's Guide to Health

Why does riparian health matter?

We depend on not only our own health to sustain us but on the health of the environment in which we live. Riparian health matters for the same reason our own health matters!

Healthy, functioning riparian areas offer us:

- **resiliency:** the ability to bounce back from floods, droughts and human caused problems;
- **ecological services:** a long list of goods, benefits, functions and values; and
- **stability:** landscapes that maintain themselves, persist and are sustainable.

The following table indicates key riparian functions and reasons the functions are important:

What are the relationships between functions and why are these functions important?

Riparian Functions	Why Is This Function Important?
Trap Sediment	▪ Sediment adds to and builds soil in riparian areas ▪ Sediment aids in soil's ability to hold and store moisture ▪ Sediment can carry contaminants and nutrients – trapping it improves water quality ▪ Excess sediment can harm the aquatic environment
Build and Maintain Banks	▪ Balances erosion with bank restoration – reduces effects of erosion by adding bank elsewhere ▪ Increases stability and resilience ▪ Maintains or restores profile of channel – extends width of riparian area through higher water table
Store Water and Energy	▪ Stream safety valve- stores high water on the floodplain during floods ▪ Reduces flood damage ▪ Slows flood water allowing absorption and storage in aquifer
Recharge Aquifer	▪ Stores, holds and slowly releases water ▪ Maintains surface flows in rivers and streams ▪ Maintains high water table and extends width of productive riparian area
Filter and Buffer Water	▪ Reduces amount of contaminants, nutrients and pathogens reaching the water. ▪ Uptake and absorption of nutrients by riparian plants. ▪ Traps sediment, improves water quality and enhances amount of vegetation to perform filtering and buffering function.
Reduce and Dissipate Energy	▪ Reduces velocity which slows erosion and material transport ▪ Provides erosion protection and slows meander rate ▪ Aids in sediment capture
Maintain Biodiversity	▪ Creates and maintains habitats for fish, wildlife, invertebrates and plants ▪ Connects other habitats to allow corridors for movement and dispersal ▪ Maintains a high number of individuals and species
Create Primary Productivity	▪ Increases vegetation diversity and age-class structure – links to other riparian functions ▪ Ensures high shelter and forage values ▪ Enhances soil development ▪ Assists nutrient capture and recycling

Some basics of a riparian health assessment

No one characteristic can provide a complete picture of riparian site health or health trend. In order to assess the impact of intervening activities on riparian areas, the **Riparian Management Field Workbook** is divided into two distinct components that attempt to provide a snapshot of current riparian health. The **Whole Farm Assessment (WFA)** component reviews specific farming management activities on a broad scale in an attempt to categorise their impacts on riparian areas which may otherwise be missed on a site specific assessment.

The **Riparian Health Assessment (RHA)** component, however, knits together several key health characteristics, including vegetative (plants) and physical (soils and hydrology) features. The assessment procedure relies heavily on vegetative characteristics because they reflect and interact with the effects of soils and hydrology that form, and operate in, riparian areas. Plants and their characteristics are seen and interpreted more easily than those for soils and hydrology, providing you with an early indication of riparian health, and helping you to understand the successional trend on a site.

The types of plants present on a site provide some insight into:

- ► an indication of a trend toward or away from the potential of the site (what the site could be);
- ► utilization rates of certain types of vegetation that are key to riparian function (e.g. woody plants); and
- ► effectiveness of the vegetation in performing the key ecological functions of riparian areas.

In addition to vegetative features, **RHA** also considers physical factors for both ecological and management reasons. Changes in soils or hydrology can have major effects on riparian function and may be more difficult to remedy than changes in vegetation. Examples include:

- ► extensive down-cutting of the channel that will lower the water table, shrink the size of the riparian area, change the vegetation to drier or upland types, and reduce forage and shelter values;

- chronic overuse and removal of vegetation that will reduce the site's capability to trap sediment, build soil, and protect soil from erosion and removal from the reach; and
- trampling and compaction that will reduce moisture-holding and storage ability in the soil profile.

There is an interrelationship between physical and vegetative features. Reaches with significant hydrological and soil changes will likely show changes in plant community structure and potential. Changes in vegetation, the "glue" of riparian systems, may have a rebounding effect on hydrologic and soil features.

The health of a riparian reach can often be a result of what has happened or is happening upstream. Sometimes health can be affected by what occurs downstream, too. Health can often be linked directly to current management on the site or the effects of previous management. Sometimes there may already be clues to problems:

- many weeds or disturbance species;
- low forage production;
- shelter declining;
- down-cutting of the channel;
- many eroding, slumping banks;
- bare soil exposure; and
- few fish or wildlife present.

What RHA does is put those observations into a format that allows you to understand the significance of the site changes and to measure the condition of the reach against a standard. This is what your doctor does when you have a check-up.

A RHA gets you to focus your observations and measure fifteen factors on the reach you've selected and the adjacent areas. The four **Whole Farm Assessment (WFA)** questions focus on farm operations and their relationship to the health of the stream while the questions look specifically at the condition of the stream and riparian area associated with it. The observations and measurements you will make relate to the ability of the stream to perform key ecological functions that translate to health.

Limitations of a riparian health assessment

A RHA balances the need for a simple, quick and easily-taught index of health against the reality of a complex landscape with many variable situations (management and environment). This approach may not work perfectly every time, and it requires some practice to become proficient. In most cases, it provides a reasonably accurate and repeatable measure of riparian health. With training, you can use this tool to help you pursue sound management decisions.

The **Riparian Health** and **Whole Farm Assessment**s are not designed for an in-depth and comprehensive analysis and investigation of ecological processes and issues. **Riparian Health** and **Whole Farm Assessments** may provide the first step in clarifying whether an issue or problem exists and in identifying areas of concern. The next step, **Riparian Health Inventory (RHI)**, involves more measurements, taken in greater detail. It is often used at a drainage or watershed scale to provide a more comprehensive analysis of riparian function.

A RHA does not directly measure fish production, wildlife habitat, forage produced, water quality or other goods, products and benefits of healthy, functioning riparian areas. It does follow, though, that impairment of riparian area function results in decreased potential of the site to support these qualities. Assessment is an indirect method of determining the potential of the site. A **RHI**, as outlined by the Alberta Cows and Fish Program (www.cowsandfish.org), is a more detailed measuring stick, and does allow a relationship to be established between health and some aspects of riparian area benefits and values. Refer to the following table to see the differences between "Assessment" and "Inventory".

Avoid making comparisons using the assessment method with streams of different types, different sizes, or from outside the immediate locality or watershed. Appropriate comparisons using this method can be made between reaches of one stream, between adjacent streams of similar size and type, and between repeated assessments at the same site.

A single RHA provides a rating at only one point in time. Like a health check-up for us, once may not be enough. A single assessment cannot define the absolute status of site health or reliably indicate a trend (whether the site is improving, degrading or stable), but it may provide a warning signal. To monitor a trend and to account for the range of variation possible on a site, health assessments should be repeated, in subsequent years, at the same location, at the same time of year.

There is no simple way to measure some changes to riparian area health, even though these may be obvious and visible. These changes may result from problems that exist elsewhere in the drainage or in the watershed and are not part of the site being assessed. However, the effect of these distant impacts on the health rating of the site may be negative and result from:

- excessive amounts of sediment, either deposited on the substrate of the stream or dumped on the floodplain and banks;
- diversion or removal of water upstream;
- additional water added to the stream;
- changes in streamflow (timing of flow, duration of flooding, higher peak flows, lower flows) resulting from damming, major modification to vegetation cover, drainage or road networks; and
- extreme flooding from greater than normal precipitation or fast snowmelt.

Watershed scale evaluations, using the Riparian Health Inventory and instream flow assessment, may be required to analyse these effects.

Assessment vs. Inventory: what is the difference?

Assessment	Inventory
understanding the basic pieces of riparian areas	measuring, analysing and recording; detecting ecological problems, diagnosing them and decision making
most useful at the site level	useful at the site, drainage and watershed level
15 questions or parameters evaluated	79 questions or parameters evaluated
minimal training and experience required	significant training, background and experience required for proficiency
a first step; overview, initial or preliminary impression of condition	comprehensive measurement and evaluation
quick and relatively easy to grasp; useful for awareness and education	more time required for measurement and analysis; uses include problem diagnoses, management decisions, monitoring and watershed scale evaluations
identify and stratify reaches for inventory	detailed measurements to determine watershed condition, aid in preparation of management plans and monitoring
assess current condition	measures current condition and evaluates site potential; identifies the current plant community and the successional pathway with current management

Why develop riparian health assessment? Some history and uses

Riparian areas are the focus of attention because of their agricultural benefits, the biodiversity values they represent and for concerns about water quality. Some riparian areas have declined in their ability to perform the ecological functions that relate directly to these benefits and values. Often, the health of these valuable landscapes has changed over time, even though that decline isn't readily apparent. We need to understand the current status of riparian areas so that we can improve or maintain their health. The first step is to determine the condition or health of the site. Once we know the health of a site, we have a mechanism to link management actions to improving or maintaining ecological function.

In response to many concerns in the United States, the University of Montana, through its Riparian and Wetland Research Program, devised a system to survey and measure the overall health or condition of a riparian site. Many scientific disciplines participated to determine what the key ecological functions of riparian areas were and how these could be measured with a relatively quick and easy assessment technique. This method was initially used to evaluate riparian health on approximately 8,000 km of rivers and streams in Montana, Idaho, Wyoming, North Dakota and South Dakota. The testing and refinement of the method was expanded to include Alberta, British Columbia, and Saskatchewan. With this experience, the method has evolved into the present Alberta Cows and Fish Riparian Health Assessment. For BC, it has been adapted to include riparian and whole farm situations that will be encountered and may be useful for other jurisdictions.

There are four equally important purposes behind the development and use of a Riparian Health Assessment:

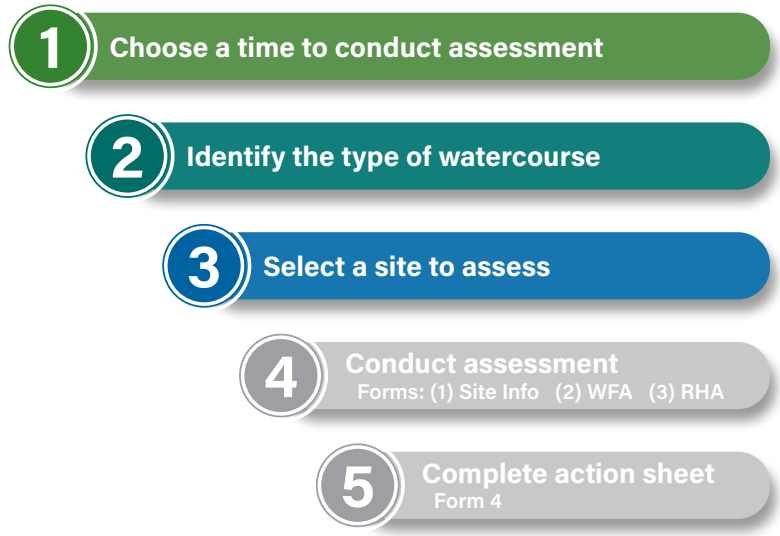
- **Riparian Health Assessment (RHA)** is a standard method to allow landowners, land/resource managers and others to quickly assess current health, and to identify the presence, scale and magnitude of issues and problems.
- It can be repeated, over time, to monitor changes that may result from natural variation or management actions and choices.
- Assessment can be a catalyst to begin thinking about management changes to correct declines in riparian health or to verify and continue management that maintains health.
- This is an educational tool, to allow those who use, manage and value riparian areas to better understand key functions, identify a way to measure those functions and to serve as a vehicle for better communications among riparian users.

Notes:

3 HOW TO ASSESS RIPARIAN HEALTH

Before performing an assessment on your riparian areas, first read through the **Riparian Management Field Workbook** to determine what information is needed and the steps involved. The following flowchart outlines the process:

STEPS IN THE BC RIPARIAN HEALTH ASSESSMENT



STEP 1: When to do your assessment

- When plants are in the growth phase and can be identified (June, July, August and September).
- When flow conditions are close to normal – assessments should not be done during peak spring run-off or immediately after a major storm.
- If repeating an assessment on a site or monitoring a site for changes, complete follow-up assessments at the same time of year
- If the management regime includes grazing, to be consistent, either do your assessment before or after grazing use.

STEP 2: Identify the type of watercourse

There are three different types of watercourses identified in this workbook:

- natural streams
- channelized streams, and
- constructed ditches.

Use the **Watercourse Flowchart** below to classify the types of watercourses on your property.

Often it is important to know the history of your property to properly identify a watercourse. For additional help in identifying the type of watercourse, use the watercourse descriptions given on pages 26-28 and the **Drainage Management Guide.**You can also contact local stewardship groups, municipal staff, ENV, FLNRORD or DFO who may already have this information on file.

What does a natural stream look like?

The appearance of a natural stream varies with the slope of the land. Streams on steep slopes have straight channels, large substrate and flow swiftly. Streams on gentle slopes have channels with bends or curves called meanders and finer substrate. In lower gradient areas, water flow varies between fast flowing, shallow sections called riffles and slow flowing, and deeper sections called pools. Small rocks and gravel are found in the riffles while sand and silt are found in the pools. Streams on nearly flat slopes have very large meanders, slow flowing water, and may not have any riffles. Most agricultural land has gentle or nearly flat slopes.

Meanders dissipate energy. This is because water flows more slowly through a stream with meanders than through a straight channel. The result is that the power of the water to erode streambanks is reduced.

Pools are areas of the stream where water velocity is low and sediment settles out and is stored. They usually occur where the stream bends and downstream of large boulders and fallen trees. Pools provide important feeding, resting and hiding areas for fish.

Riffles occur in shallow, straighter areas of the stream. Here the water moves more quickly and usually breaks over rocks and other bottom material. Riffles are important because this is where the water picks up oxygen. High oxygen levels are important to fish and other aquatic organisms. Riffles are also important for spawning, egg incubation, and aquatic insect production.

Trees that fall into the stream help to control the distribution of pools and riffles. They form natural dams and weirs, help add oxygen into the water, lower stream erosion power and provide habitat for aquatic life. In addition, fallen trees contribute to streambank stability. They also provide hiding places for young fish.

What does a channelized stream look like?

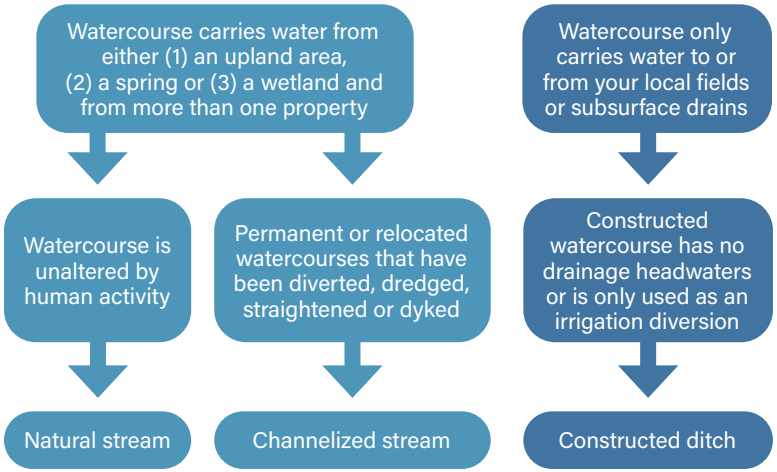
The appearance of a channelized stream varies with the degree to which it has been altered. Some channelized streams can look exactly like a natural stream except for a berm or dyke along their banks. They may have meanders, pools, and riffles, but may no longer often flood over their banks. In the Interior, channelized streams can be characterized as diversions that deliver water to an irrigation intake but take the overflow back to the stream.

Other channelized streams were used or altered to drain wetlands and may look exactly like a ditch. They are straight or mostly straight with only a few bends or curves. They have little variation in water depth and speed. Often the material at the bottom of the channel is sand or silt.

What does a constructed ditch look like?

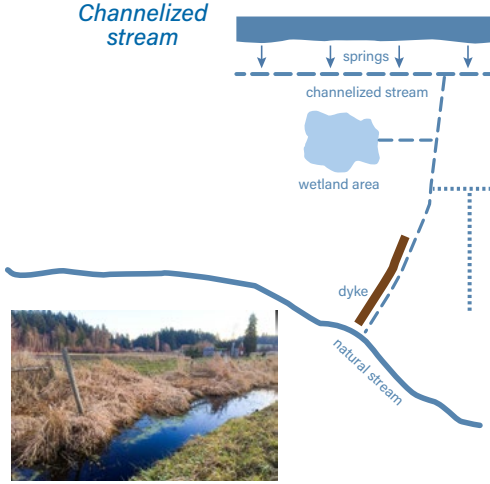
The appearance of a ditch is generally straight. Water depth and speed are almost constant. The material at the bottom of the channel is often the same as the surrounding land. Some channelized streams look exactly like a ditch. For this reason, it is important to know the history of your watercourse. In particular, constructed ditches only convey drainage and /or irrigation water from or to an individual farm property, may be permanently or intermittently wetted, are not fed by springs, include collector ditches that only drain other constructed ditches and are covered under the *Fisheries Act*.

WATERCOURSE FLOWCHART



Channelized stream

Channelized stream



Natural stream

Constructed ditch

STEP 3: Pick your site

Start by walking or riding the length of stream or river you want to assess. That will give you the opportunity to make observations and choose sites to assess health. If time is available, or the stream length is short, you might want to consider assessing all of the stream length. If time and distance are impediments, you have a couple of choices:

- pick a "critical" site, one that may be sensitive, or already has some specific problems, for assessment; or
- choose a "representative" site that is typical of a much longer reach of stream and that will provide an overall impression of health.

To select a site that is representative, become familiar with the entire length of stream and riparian area. What you are picking is a short reach that will represent the average condition of a long stretch of river or stream. Vegetation, use/utilization, channel characteristics and stream gradient in the representative reach should all reflect what is found in and is common to a longer reach. If there is too much variation, or a tributary joins, divide the stream into similar units and then select a representative piece from each unit.

The reasons for picking either or both critical and representative reaches may include:

Critical	Representative
problem spots indicating management concern	overall impression or average of riparian condition for a long stretch of stream
sensitive areas, including key habitats for plants, fish or wildlife	broader measurement of management actions or choices
places that may respond to management change quickly	broader measurement of vegetation characteristics, especially key indicators like woody vegetation, weeds or disturbance species
shorter reaches, easy to monitor	longer reaches for more comprehensive monitoring

It may be useful to assess both critical and representative reaches to understand both the strengths and weaknesses of a stretch of stream.

STEP 3: Identify a reach to assess

A site is a spot on the ground to begin from; **a reach has length and width. A reach is the place to start pacing over, to measure and to complete a health assessment.**

Reach length

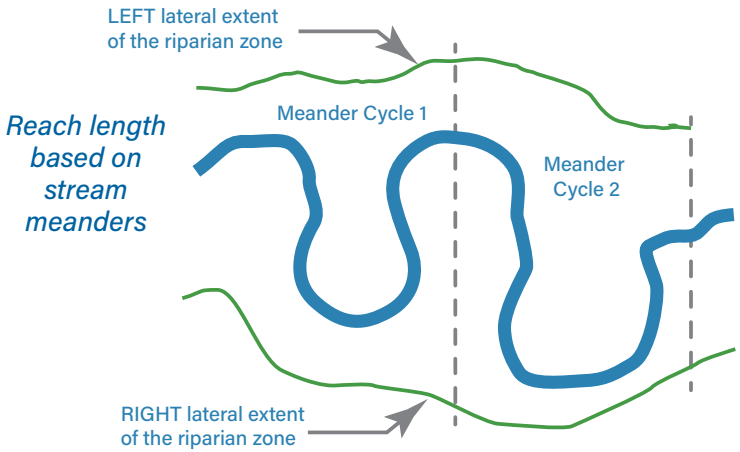
The first step is to determine the length of the reach. For measurements on smaller systems:

- The length of reach should be two channel meander cycles, especially on small streams. Review the illustration to see how to use stream meanders to pick a reach length.

Streambank problems will be overestimated if the reach is located mostly on an outside curve and underestimated if it is mostly on an inside curve. A complete meander cycle has equal inside and outside curvature. Scale will be a consideration in determining reach length. On smaller streams, a 200 m (650 ft) reach length will most often include two meander cycles. For rivers and streams 10 to 15 m (30 – 50 ft) wide, 200 m may be inadequate to do so.

- If it is impractical to assess a full meander cycle, you should assess a minimum of 200 m of river length.

If you have defined your reach as "critical", a length should be picked that is appropriate to what you want to assess.



Reach width

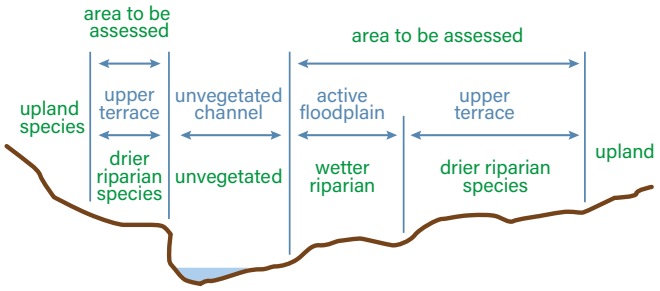
The next step is to determine riparian area width, within the upstream and downstream reach boundaries. The area to be assessed starts at the water and may include that portion of the aquatic area (the wetted channel) where persistent emergent vegetation (plants growing in the water such as cattails and sedges) exists. This forms the inner edge of the riparian area. For those situations where there is no emergent vegetation, the aquatic area is not included in the assessment. Streams that go dry during the growing season have riparian areas and the channel may remain un-vegetated after the water is gone. The non-vegetated channel is not included in the measurements; assume it has water in it, as a permanent stream would, and make all the same observations. The exception to this is a channel where the vegetation has been removed by human causes (e.g. grazing, logging, cultivation or construction). In these situations, the disturbed channel is considered as exposed soil surface (bare ground). Both sides of the stream channel should be assessed, unless the stream is a property boundary, each side has different management or the stream cannot be easily crossed by you or livestock.

That's the easy part. Now you have to find the outer edge of the riparian area. Review the definition of "riparian area" again. The outer boundary of the riparian area exists where:

- vegetation changes from plants responding to or requiring abundant water to drier, upland types;
- topographic changes like terraces, cutbanks or steep banks signal a clear line between the greener, lusher or denser vegetation and the upland;
- old channels or meander scars exist that show movement patterns of the stream and may still indicate a high ground water table; and
- flood water reaches seasonally, or on a regular basis, as high water breaks out of the stream channel.

A combination of vegetation changes, topographic breaks and flood evidence (or local knowledge of flooding extent) will help you find the edge. The area between the aquatic and terrestrial zones will have vegetation dominated by water loving plants or plants that respond well to abundant moisture, the active floodplain, the streambanks and, sometimes, areas within the stream channel with emergent vegetation. When in doubt, it is better to overestimate the width or extent of the riparian zone than to underestimate it.

Review the illustration to help you see "where do I measure?"



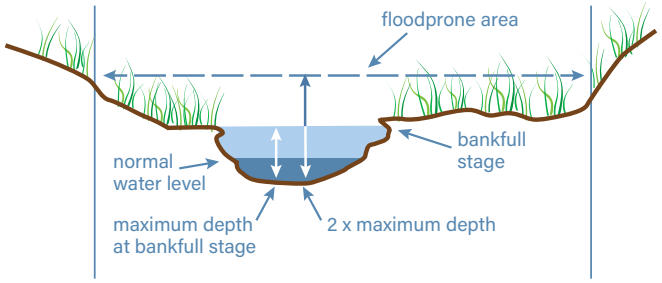
Where do I measure?

In those cases where it just isn't obvious where the transition exists between riparian and upland areas, a simple estimation of the "flood-prone" zone may be helpful. The floodprone zone is that area occupied by high water that escapes the stream channel on a regular basis (at least every 1 to 2 years on average). That zone often equates to the riparian area.

Try this

- Stand on the edge of the stream, at a riffle (shallow) area and establish a "bank-full" level - where high water will begin to escape the channel during floods. You can locate the bank-full level with the following observations:
  - the elevation at the top of depositional features like sand, silt or gravel bars;
  - the line of staining on boulders or rocks;
  - a major break in the slope of the banks;
  - a change in bank material from coarse substrate within an active channel to deposited material of a smaller size; and
  - exposed roots below an intact, vegetated soil layer indicating erosion.

- Estimate what the maximum depth of the stream would be at that bank-full level.
- Double your estimated depth and then project that line, with your eye, across the floodplain. Where that line touches is the outer edge of the flood-prone zone, and the area enclosed by that line is most of the riparian area. Use the illustration to guide you through this estimation of the outer edge of the riparian area.



A simple estimation to find the outer edge of the riparian area

Observations have confirmed that this is a useful guide for riparian area identification on most stream types. It is an indication of flood events and high water levels that have a consistent and recurring influence on riparian area structure and vegetation. Some streams, because of excessive down-cutting and continual instability, may not have a floodplain, or the stream valley is only accessed by high water during extreme flood events (greater than 1 in 50 year events). Here, the riparian area will be very narrow.

Reach tips

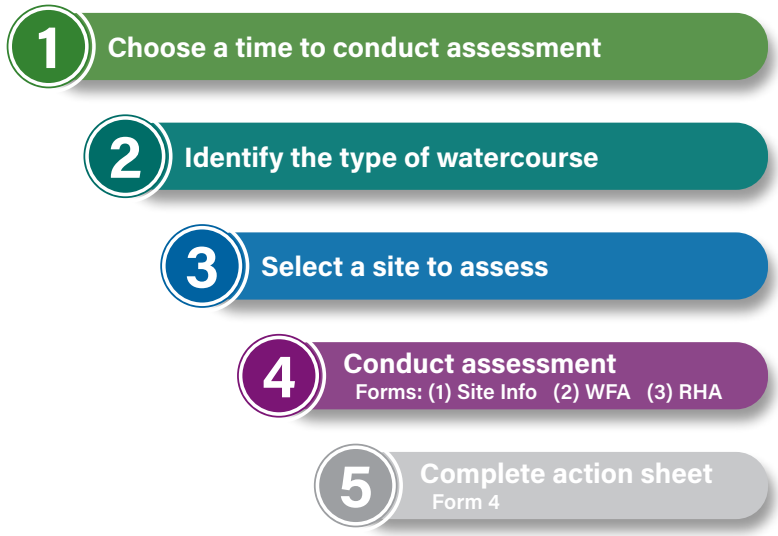
Assessments generally should not cross fences, roads or areas with different management. If the stream to be assessed crosses more than one management unit (e.g. pasture), at least one reach should be assessed in each unit. Fences, roads and sometimes trails exert a strong influence on livestock movement, grazing patterns and other traffic. To eliminate this bias, locate your reaches at least 75 m (250 ft) from the influence of a fence or a road. An exception to this might occur where holdings are small, and where there are many fences, because these factors could also exert a major influence on overall riparian health. In these situations, you may want to measure the effect or influence of fences and roads on riparian condition: your reach selection will be done with this in mind. Before you start to do an assessment, determine and record, where the upstream and downstream reach boundaries are located. Next year, or in a few years time, you may not be able to find them if you haven't penned a reminder to yourself. Link them with some visible landmark or measure the distance to them from that landmark. You might want to put in a couple of fence posts, rebar pounded flush with the ground or some other easily relocated item. Keep in mind that stream channels migrate and change. Your memory of the locations may be imperfect. Take a photograph to help jog your memory in the future.

4 GETTING STARTED

How to use the Site Information, Whole Farm and Riparian Health Assessment sheets.

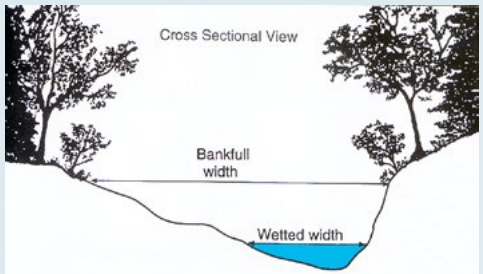
Collect the following information as a record of your riparian health assessment (RHA). This information is for your purposes only and should be completed for every assessment site on your property. Each **Whole Farm Assessment (WFA) Factor** is linked to questions in the **Environmental Farm Plan Planning Workbook** and should be checked prior to an assessment. For both the **WFA** and **RHA**, leave out any questions that are not relevant to your operation For example, if you do not move machinery across a watercourse do not rate **WFA Factor 2: "MACHINERY CROSSING TYPE"**.

STEPS IN THE BC RIPARIAN HEALTH ASSESSMENT



STEP 4: Collect Site Information

Complete Form #1, the site information and assessment site diagram, and later attach any photos that were taken on-site.

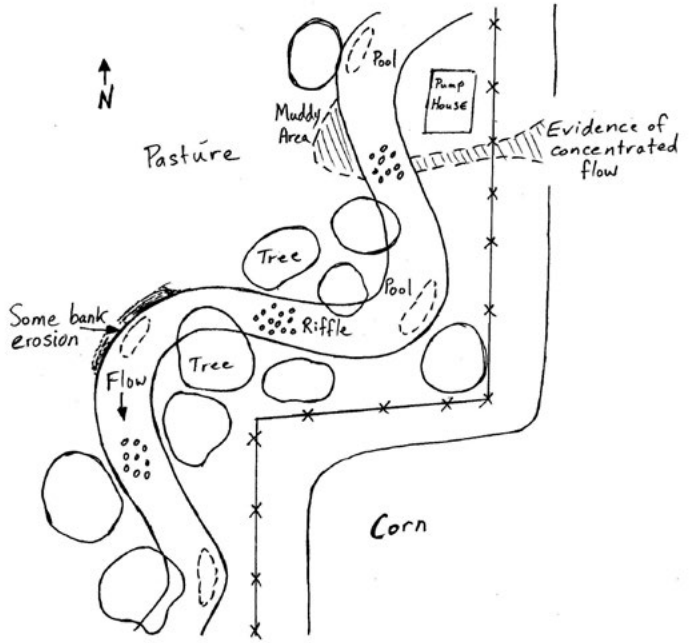
FORM #1	Site information and assessment site diagram	
Date:	Time:	Weather condition today:
Weather for previous 2-5 days:		
Landowner:		Lessee:
Assessor:		
Name of business:		
Address:		
Name of watershed where property is located:		
Name and type of watercourse:		
Principle land use next to the watercourse and riparian area (row crops, hay, grazing, pasture, forest, confined animal feeding operations, other):		
Land use(s) above your stretch of watercourse (agriculture, logging, industrial, residential, other):		
Land use(s) below your stretch of watercourse (agriculture, logging, industrial, residential, other):		
Location of assessment site:		
Bankfull channel width of stream/ constructed ditch: ( ) meters		
Bankfull channel width		
Length of watercourse audited: ( ) meters		
The main channel bottom material(s): boulder (more than 25 cm) cobble (6 cm – 25 cm) gravel (0.25 – 6 cm) sand (less than 0.25 cm) mud		

Create a Diagram/Digital Map of your Assessment Site

A diagram or digital map is a useful way to identify important features of the assessment area such as roads, buildings, stream crossing, the location of berms, dykes, fencing, and adjacent land uses on your diagram. Also, show ponds, springs, drainage pipes and tiled outlets that drain into the watercourse, the direction of water flow, riffles and pools, and the types of vegetation in the riparian area (trees, shrubs, grasses, sedges, etc.). The diagram/map provides a record of what was assessed. This makes it easy to find the same site if you decide to repeat the assessment. Diagrams/maps done at the same time each year can be compared to monitor changes to the area over time.

Sample diagram/digital map of an assessment area

When you draw the assessment area, include the watercourse, riparian area, main features and land uses. A diagram/map should be done for each assessment site.



Take photos of your assessment site

Photos are also a good way to record the condition of the stream, ditch, and riparian area. Use a GPS unit or a marker (steel post, marked fence post, or marked tree) so you can take photos from the same spot at about the same time every year. Record the date, stream, GPS location, and photo direction (down stream, upstream, or across to left/right bank). Compare photos from different years to monitor change over time.

Information to record on the back of the photo

***Place**: Beside upper summer pasture*

GPS coordinates: 45.034679, -122.246463 UTM

***Bank**: right-bank when facing upstream*

***Photo direction**: compass direction-S looking upstream*

***Date**: July 25th 2017*

STEP 4 : Whole Farm Assessment (WFA)

The **WFA** looks at four factors in and around riparian areas that may impact either the health of the riparian area or the ability of the water course to support fish.

Answering "C" or "D" to any of the four **WFA** questions may indicate that there are problems affecting riparian health that need to be dealt with prior to dealing with those issues raised during the **RHA.**

For the **WFA (Factors 1-4)**, use and refer to the appropriate sections which have information about each factor to be assessed. These sections include:

- Four ratings for each factor listed as "A", "B", "C" and "D"
- "**What to look for**" section to help you to determine which rating to give the factor

How to rate the Whole Farm Assessment Factors

Begin the assessment with the first factor: **Physical Barriers to Fish Movement.** Read through the four descriptions under: "A", "B", "C" or "D". Check or circle the description that most closely resembles your situation. Use your own judgement if the description does not exactly match your condition and compare your response with the questions linked to the **Environmental Farm Plan Planning Workbook**. Continue through the factors until you have completed all relevant ones for your particular watercourse and record them on **Form #2**.

Example:

WFA FACTOR 1 PHYSICAL BARRIERS TO FISH MOVEMENT

A	B	C	D
No barriers	Dams and culverts are properly installed and maintained to allow fish passage	Dams and culverts are properly installed, but not maintained to ensure fish passage	Dams and culverts do not allow fish passage*
WHOLE FARM ASSESSMENT			
This factor is evaluated in the Environmental Farm Planning Workbook with questions 275, 276 and 277			

* **May violate the federal Fisheries Act if the structure is undersized, improperly installed or blocked and prevents the safe passage of fish.**

If you are auditing more than one site, use the Assessment Worksheets located in Pull Out Sheet section. The Form #3 worksheet contains the descriptions under "A", "B", "C" and "D" for each factor but does not provide additional information.

What do the ratings indicate?

A rating of "A" or "B" indicates conditions that protect the watercourse, water quality and the riparian area, or have the lowest potential for damage to watercourses and riparian areas. A rating of "C" or "D" indicates conditions that have a higher risk of damaging the watercourse, water quality or the riparian area. Assessments over time will indicate a trend if the site is improving or degrading. Rating descriptions that have "bold" type with an asterisk (*) indicate conditions that may not comply with federal or provincial laws.

Are there physical barriers to fish movement?

This factor looks at physical barriers to fish movement.

Why is it important to consider barriers to fish movement?

Fish of all ages need to move up and down the length of a watercourse in order to search for food, flee from predators, respond to changes in the water condition and migrate to different habitats depending on their life history. When barriers prevent movement, fish are denied access to important rearing, spawning and feeding areas. Barriers may also isolate or strand fish and other aquatic life.

What kinds of barriers can prevent fish movement?

Barriers to fish movement may include:

- dams
- increased water speed over long stretches of the stream
- lack of pools at the base of small drops in the stream
- large drops in the stream
- shallow water
- log jams
- flow constrictions

Some barriers to fish are natural, such as waterfalls and boulder dams. However, humans create other barriers, such as improperly installed culverts and dams.

Culverts prevent fish movement when they are not installed or sized correctly or properly maintained. The force of the water through the culvert prevents fish from swimming upstream when the slope is too great or the culvert is too small.

Adult fish are also prevented from moving upstream when the culvert outlet is located more than 0.5 meters above the watercourse, and there is no **outlet pool** at the base of the drop. In the case of young fish, any drop from the culvert outlet to the watercourse stops them

from swimming upstream. Culverts that are not cleaned or repaired can restrict fish passage if water flows are blocked or impeded by debris and silt.

When is a dam not a barrier?

Generally, beaver dams do not restrict adult fish movement. If there is a beaver dam or fallen tree on the stream that is preventing fish passage, advise DFO. If beaver dams or fallen trees are causing drainage problems, refer to the Drainage Management Guide for the proper maintenance procedure.

Human built dams are not a barrier when a **fish ladder** or **bypass** are provided and maintained. However, the water in the *fish ladder* or *bypass* must be deep and slow enough so that fish can swim upstream.

When is a culvert not a barrier?

A culvert is not a barrier when:

- the culvert system is as wide as the stream,
- there is no drop between the culvert outlet and the watercourse,
- the outlet pool maintains water depth during low flow,
- the outlet pool slows water speed during high flow,
- it has **baffles** to slow the water (for culverts that have too great a slope), and
- it is properly maintained.

A box culvert that provides fish passage

Improperly installed culvert

A	B	C	D
No barriers	Dams and culverts are properly installed and maintained to allow fish passage	Dams and culverts are properly installed, but not maintained to ensure fish passag.	Dams and culverts do not allow fish passage*
WHOLE FARM ASSESSMENT			
This factor is evaluated in the Environmental Farm Planning Workbook with questions 275			

* **May violate the federal Fisheries Act if the structure is undersized, improperly installed or blocked and prevents the safe passage of fish.**

What to look for

Only do this factor if fish are present in the watercourse. To determine if fish are present, check with ENV, FLNRORD, DFO, your municipality or local stewardship groups. Otherwise, assume that fish may be present in the watercourse.

Look at dams and other physical barriers for the presence of fish ladders or bypasses. Look for structures that have a drop of more than 0.5 meters. Look for pools at the base of smaller drops. Single, large culverts with no slope that are set below grade and have sufficient flow are usually not a barrier to fish. However, culverts that have not been properly maintained (cleaned and repaired) may restrict fish passage. Small culverts or culverts with slopes may have high water speeds and flows that prevent fish passage. Check for baffles on culverts with steep slopes (< 10%). Also look for the presence of outlet pools below all culverts.

To obtain more information see:

Suggested Readings – CULVERTS AND BRIDGES.

Fish-stream Crossing Guidebook, revised *Forest Practices Code guidebook*, September 2012.

www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/resource-roads/fish-stream_crossing_web.pdf

WFA FACTOR 2 MACHINERY CROSSING TYPE

Are there machinery crossing(s) present? If so, what type?

This factor looks at the types of structure used by machinery to cross a stream or ditch and should be evaluated where applicable.

What happens when machinery is driven through a watercourse to cross it?

When machinery is driven through a watercourse, the weight and tires:

- Damage banks, which results in erosion and muddy areas where sediments can wash into the stream water.
- Stir up sediments from the channel bottom into the water. Higher sediment levels result in poor water quality for livestock, fish and other aquatic life.
- Damage the channel bottom which leads to a loss of aquatic habitat.
- Alteration or destruction of riparian vegetation

In addition, when machinery is driven through a watercourse, oil and fuel can directly enter the water. When they enter the water, oil and fuel become ***pollutants*** harmful to people, livestock, crops, wildlife, fish, and other aquatic life. Also, tire treads can drag soil into the stream bed.

What types of machinery crossings can be used to protect the watercourse?

A clear-span bridge is the best and preferred way for machinery to cross a watercourse. The banks and channel are then protected from damage.

When it is not possible to build a clear-span bridge, a culvert may be an option.

There are many types of culvert options available. To obtain information about machinery crossing options see **Suggested Readings – CULVERTS AND BRIDGES.**

What approvals are required to construct a machinery crossing?

Construction of machinery crossings over streams and ditches must only be done with approvals from Ministry of Environment (*Water Act* Notification or Approval required depending on crossing), (*Riparian Area Regulations or Streamside Protection Regulations* depending on location) and authorization from Fisheries and Oceans Canada (DFO) under the Fisheries Act.

DO NOT DO THIS FACTOR IF MACHINERY DOES NOT CROSS THE WATERCOURSE.

A	B	C	D
A clear-span bridge is used to move machinery	A culvert is used to move machinery across the watercourse	A bed-level structure is used to move machinery across the watercourse	There is no protection of bed and banks at the crossing point*
WHOLE FARM ASSESSMENT			
This factor is evaluated in the Environmental Farm Planning Workbook by questions 275, 276 and 277			

* **This may harmfully alter, destroy or disrupt fish habitat and/or destroy fish and therefore could be violation of the federal Fisheries Act.**

What to consider

Is machinery driven through the watercourse to cross it? Does this damage the banks and channel bed? Is soil, oil or fuel entering the water or dry channel bed?

WFA FACTOR 3 LIVESTOCK CROSSING TYPE

Is there a livestock crossing?

This factor looks at livestock crossings of streams and the type of structure(s) that are used.

What happens when livestock enter a watercourse to cross it?

When livestock enter a watercourse in order to cross it:

- They may trample and damage the banks which results in erosion and muddy areas where sediments wash into the watercourse.
- They may trample the channel-bottom which may directly damage fish and other aquatic habitat.
- They may stir up sediments that also end up in the water. Higher sediment levels result in poor water quality for drinking water, livestock, fish and other aquatic life.

In addition, manure (faeces and urine) could be directly or indirectly deposited into the water. Manure or runoff containing manure could be a deleterious substance. Manure can also introduce bacterial ***pathogens*** like *E. coli* and parasitic pathogens like *Crytosporidium* and *Giardia* (beaver fever), into the water, causing disease in humans and livestock. Manure also increases the nutrient level of the water. This can cause **algal blooms**, some of which are toxic to livestock. **Algae** during respiration and during die-off also use up the oxygen in the water, killing fish and other aquatic life.

What types of livestock crossings can be used to protect the watercourse?

A clear-span bridge is the best way for livestock to cross a watercourse. The banks and channel are then protected from hoof damage. Also, there is little chance of manure being directly deposited into the water.

When it is not possible to build a clear-span bridge, a culvert may be an option. There are many types of culverts. To obtain more information see **Suggested Readings – CULVERTS AND BRIDGES.**

For those situations where a bridge or culvert is not an option, it may be possible to install a **bed-level structure**.

This involves hardening off the banks and channel-bed with gravel. **Bed-level structures** protect the banks and channel, although now there is a chance that manure will be directly deposited into the water. The use of a fence (fixed or movable), to funnel livestock to the crossing-point will help minimize livestock loitering in the riparian area

What approvals are required to construct a livestock crossing?

Construction of livestock crossings for streams and ditches must only be done with approvals from ENV, FLNRORD and authorizations from DFO.

DO NOT DO THIS FACTOR IF LIVESTOCK DOES NOT CROSS THE WATERCOURSE.

A	B	C	D
A clear-span bridge is used by livestock to cross the watercourse. **	A culvert or bed-level structure is used by livestock to cross the watercourse.**	Controlled crossing points are used to move livestock across the watercourse. No protection of bed or banks.**	Livestock are herded across the watercourse at any point. No protection of bed or banks.*/**
WHOLE FARM ASSESSMENT			
This factor is also evaluated by Questions 105, 108, 109, 275, 311, 312, 313 in the Environmental Farm Plan Planning Workbook			

* **Unrestricted cattle access to a watercourse may degrade streambanks and riparian vegetation and accelerate erosion. Cattle may trample important aquatic vegetation and disrupt fish spawning and egg habitat.**

** **A Fisheries Act violation may exist wherever animals are able to deposit manure directly or indirectly into a watercourse.**

What to look for

Look for livestock paths leading to the watercourse. Trails indicate possible crossing points. Check both banks where the trail meets the watercourse. Is there a trail or muddy area on the opposite bank? If so, livestock may be moving in and out of the watercourse at this location.

On British Columbia's range lands, cattle are often required to cross many small watercourses. In many areas it is therefore difficult for ranchers to achieve a positive rating for this factor. Action to limit cattle movement across these small watercourses is only required if banks or beds are being consistently damaged.

WFA FACTOR **4** **DRAINAGE MANAGEMENT**

Is drainage management needed?

This factor looks at drainage management of streams and ditches.

Why do some watercourses require maintenance?

When a watercourse has been modified (i.e. vegetation removed or stream hydrology altered), maintenance activities may be required to prevent flooding, improve field drainage and provide irrigation water to fields.

Why is it important to consider how you do your drainage management?

When done properly, at the right time of year, drainage management activities will minimize the impact on fish, wildlife and their habitat.

What are the regulations for doing maintenance work?

In general, to do drainage management work, notification and/or approval is required from from ENV and FLNRORD and authorization is required from DFO.

The need for notification, approval or authorization will vary with the watercourse type, the date, the type of maintenance activity, and the presence or absence of protocol agreements.

The **Drainage Management Guide** provides guidance on maintenance procedures to farmers and ranchers in British Columbia.

The guide outlines works that can be done without contacting ENV, FLNRORD and DFO and which works require notification, approval and authorization.

Check with your local DFO office on how the **Drainage Management Guide** and protocol agreements are being used in your area. Farmers and ranchers doing works in natural and channelized streams must contact ENV, FLNRORD and DFO to obtain appropriate direction on how and when in-channel work should take place.

What is a Drainage Management Plan?

A drainage management plan can help to obtain the necessary approvals and authorizations to conduct maintenance. The plan should include:

- A ranch/farm map showing fields and watercourses.
- Identification of watercourse types (natural and channelized streams, and ditches) on your property.
- Assessment of the need to do maintenance, the type of work needed and how the work will be done.
- Determination of timing of the work.
- Obtaining appropriate approvals/ authorizations from ENV, FLNRORD and DFO.
- Following the conditions outlined in the approvals.

The following works are commonly included in a maintenance plan:

1. Aquatic weeds

Removing aquatic weeds by hand is preferable to using a machine as less sediment is released into the water with this method. Planting vegetation that blocks the sun and shades the water also helps reduce the number of aquatic weeds. Aquatic weeds growing along the sides of the channel do not impede water flow and should not be removed.

2. Small blockages

Small blockages, such as debris dams, can often be removed by hand.

3. Fallen trees that create a flood hazard

In most cases, when trees fall into the channel they contribute to channel form and provide habitat for fish. However, in some cases, a fallen tree can block the flow of water or threaten to flood and erode land next to the watercourse.

You can prepare for this situation ahead of time by developing a hazard tree plan. Your plan should include an inventory of trees that may present a flood hazard if they fall. You should also record the name and telephone number of the person or agency you need to call for help or information.

When you live outside of a municipal boundary contact the Environmental Emergency Program (ENV) at 1-800-663-3456. ENV will respond in situations where life or property is threatened by a fallen tree. ENV will also notify and/or obtain approval from the necessary government agencies to remove the tree.

When you live inside a municipal boundary, find out how your particular municipality deals with hazard trees. Often this will be the Emergency Coordinator or someone in the engineering department.

When you wish to remove a fallen tree from a channelized or natural stream yourself, you must notify ENV, FLNRORD and contact DFO for authorization.

Trees that have fallen into a constructed ditch and are causing drainage problems may be removed without contacting agencies.

ONLY CONSIDER THIS FACTOR IF YOU CARRY OUT DRAINAGE MANAGEMENT ACTIVITIES.

A	B	C	D
I have and follow a drainage management plan	Intentionally blank.	Intentionally blank	I have no drainage management plan.
WHOLE FARM ASSESSMENT			
This factor is evaluated by using the Environmental Farm Plan Drainage Management Guide and questions 324-328 in the Environmental Farm Plan Planning Workbook			

NOTE: Notification, approvals and/or authorization are required from ENV, FLNRORD and DFO for any work done in a stream to ensure the works do not harm fish habitat or degrade water quality.

WFA FACTOR 5 SPECIES AT RISK

ARE THERE SPECIES AT RISK PRESENT?

This factor looks at the occurrence and beneficial management practices of Species at Risk (SAR) that are associated with riparian areas, and that live on land and/or in the water.

What are Species At Risk?

In British Columbia, SAR include plants and animals that are extirpated, endangered, or threatened in the province, or those considered to be of special concern. Species of Special Concern are those that are particularly sensitive to human activities and natural events, and may become threatened or endangered. Some SAR associated with riparian areas can also be a benefit to landowners, as they can provide important ecosystem services, such as pest control and pollination.

How do I know if I have a Species at Risk?

Wildlife, including SAR, can be difficult to identify. If you are unsure of what to look for, an EFP Planning Advisor may also be able to assist in determining if SAR and/or SAR habitat exists on the farm. The BC Species and Ecosystems Explorer provides information about plants and animals in different areas of the province. The BC Conservation Data Centre maps occurrences of at-risk plants and animals and the BC Stewardship Centre assists with community-level mapping of SAR.

What are the regulations for Species at Risk?

The Federal Species at Risk Act (SARA) provides protection for species listed as endangered, threatened, or special concern at the federal level. There is no stand alone legislation for Species at Risk in British Columbia. Applicable provincial laws include the BC Wildlife Act, the Forest and Range Practices Act, the Riparian Areas Protection Act, Oil and Gas Activities Act, and the Land Act. A list of provincial Acts and Regulations pertaining to Species at Risk can be found at the BC Government Species at Risk Legislation website.

What types of farm activities can threaten Species at Risk in riparian areas?

Riparian areas are constantly changing. Some of this change is natural: flooding, landslides, wildlife grazing, insects, disease, and climatic influences (e.g. drought). However, some change is due to human activity. In agricultural areas, activities such as land clearing and tree removal, groundwater depletion, water diversion and damming, pesticide use, road development, unmanaged (i.e., unfenced) livestock grazing, and introduction of invasive species can alter riparian habitat and affect SAR directly or indirectly.

How can we best manage species at risk on agricultural land?

Even if the presence of SAR on the farm is uncertain, farm activities should aim to protect riparian habitat and minimize impacts to potentially associated SAR. The following considerations should be taken when managing SAR and their habitat:

1. **Habitat Protection**

   Riparian areas are very productive habitat used by most wildlife species at some time of their life. Numerous plant species are also associated with these habitats. On the farm, habitat protection can take the form of restricting livestock movement (e.g. fencing off watercourses and riparian habitat from livestock grazing, or using rotational grazing), minimizing land clearing, vegetation maintenance and development in riparian area, and ensuring best practices are followed when using fertilizers, pesticides, and other chemicals.

2. **Habitat Enhancement and Restoration**

   Enhancement is intended to provide additional features that will improve overall habitat, and is often intended to meet specific requirements of SAR.

   Restoration seeks to replace lost habitat. Planting can be done to re-vegetate previously cleared areas and restore connectivity in riparian ecosystems. Temporary or permanent fencing can be installed to protect newly restored areas from livestock damage until they have had enough time to become established. Another option is to create either permanent or portable watering sites for livestock, in the uplands, which can draw livestock pressure away from riparian areas and allow restoration a chance to occur.

3. Timing of Activities

Knowing when SAR are present in riparian areas, and what their specific needs are, can help land stewards effectively time their activities to avoid potential conflicts. The breeding season is a particularly sensitive time for many species, and disturbances can be disruptive and harmful. Refer to the BC Develop with Care Guidelines for Urban and Rural Development and Environment and Climate Change Canada Nest Calendars for information on bird breeding and nesting windows. An additional nesting tool is published by Birds Canada.

ONLY CONSIDER THIS FACTOR IF YOU HAVE, OR SUSPECT YOU MIGHT HAVE, SPECIES AT RISK OR HABITAT THAT COULD POTENTIALLY SUPPORT A SPECIES AT RISK.

A	B	C	D
Supports SAR; healthy condition; supported by BMPs.	Potentially supports SAR, healthy condition; not supported by BMPs	Potentially supports SAR; healthy condition with some problems, not supported by BMPs.	Does not support SAR; unhealthy condition; and is not supported by BMPs*.
WHOLE FARM ASSESSMENT			
This factor is evaluated in the Environmental Farm Plan Planning Workbook by questions 281 and 283			

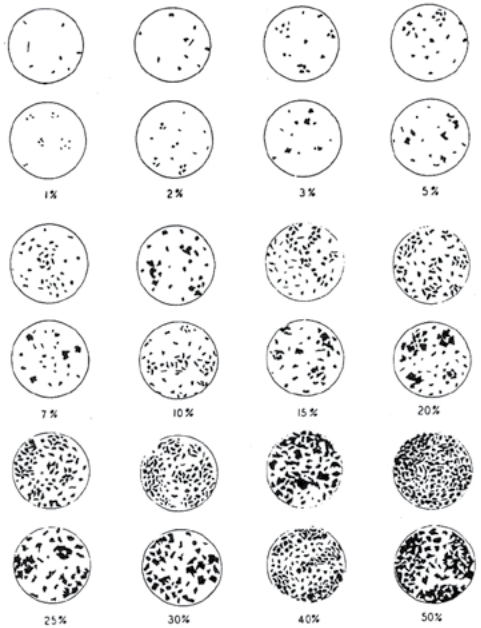
*May be in violation of the BC Wildlife Act, Federal Fisheries Act.

Note: Notification, approvals and/or authorization may be required from ENV, FLNRORD and DFO for work done in and about a stream to ensure the works do not directly harm fish habitat, harm downstream fish habitat, or degrade water quality.

Notes:

STEP 4 : Riparian Health Assessment (RHA)

There are 11 questions (Form #3) to answer that relate to components of the riparian reach you have selected. Many deal with the element of "coverage", that is, how much of the reach area is covered, influenced or affected by vegetation or structural impacts. The categories to choose from are expressed in percentages of the reach area. Start by measuring off the length and width of the reach, excluding the aquatic part. Calculate the area. Now you have the context to determine coverage for many of the questions (e.g. 10 m^2 of tree seedlings in a 1000 m^2 reach equals 1% coverage). As you become more practiced you can use the cover class standards shown here.



Cover class standards for judging vegetation canopy cover and bare soil

Most of the factors rated in this assessment are based on measurements using your eyes and your judgement. It may seem imprecise but with practice this method is repeatable and reasonably accurate. Extreme precision is not required for **RHA** since we are not attempting to determine an absolute value, only a broad impression of health.

RIPARIAN HINTS

Tuning Your Eye

- Riparian Health Assessment is about tuning your eye to see what pieces might be missing from a riparian system.
- It gets you beyond "if it's green, it's good".
- It helps you understand the pieces - how they fit together and how to rate the key pieces of the riparian area.

The maximum possible scores vary between the factors.

This weighting system between the factors measured reflects the:

- relative importance of the factor;
- influence on or relationship to other factors; and
- significance of the factor to an ecological function or functions.

Things you will face

Move around

Don't stand in one place to do the assessment. You will need to move around the reach, evaluating factors and mentally accumulating observations that you will then sum up. If you stand in one spot you will end up with an assessment of only what you observed in a narrow sphere around you. This may not give you an accurate, unbiased assessment for the reach.

Consider riparian functions

If a question on a particular reach perplexes you, go back and reconsider "Riparian Functions". Ask yourself if the factor measured is contributing to ecological function. An example might be a site covered with invasive weeds or disturbance species. Are these plants present on the reach during high water to reduce energy and trap sediment? Do these plants have the type of root systems that are deep and that bind streambank materials together? If the answer is no, then these plants do not contribute to ecological function and you should rate the site low for these categories.

Should it have wood or not?

Some questions on the assessment will not apply on all reaches. Reaches without potential for woody species (trees and shrubs) will not be rated on factors involving regeneration or utilization. On some prairie systems, on wet meadows with saturated soils, on severely disturbed riparian areas and on reaches with a history of chronic overuse, vegetation potential can be difficult to determine. To determine vegetation potential, where it is not immediately evident, you can:

- observe vegetation present upstream or downstream of the reach or search for stumps, snags or roots remaining on the site;
- consider vegetation present on similar reaches or nearby streams in the area;
- use archival photographs or pictures in family albums that indicate vegetation presence in previous times; and
- ask the elders of the community for their memories of woody species.

If, at the end of this evaluation, you conclude the reach has no potential for tree and shrub growth, eliminate questions 4, 5 and 6 and readjust the maximum possible total score accordingly. If the site does have potential, but no woody species are currently present, answer question 4 but eliminate questions 5 (keep 5b on woody use if woody plants have been removed) and 6.

Other considerations and observations

- No measurement system can capture all of the variation you are likely to encounter, nor will the categories in the questions exactly resemble what you see on the stream reach. You will have to select the answer you think is the closest, or the best fit, for the condition you observe.
- Because there is a spread between the scores you may be tempted to pick a number that reflects an average. The only choices for scores are those indicated. Make your best estimate and enter the value in the "actual" column of the Field Sheet.
- You must consider only the conditions that you observe at the time of the assessment. Don't guess on what conditions might have been previous to the assessment or speculate on future conditions.
- Don't stop when you've completed the scores. Make observations in the "Comments" section. Use the comments section to:
  - expand on the information and measurements especially if you are considering making management changes;
  - describe the reach in some detail and provide some characteristics of the vegetation types or plant distribution, especially weeds;
  - note your impressions of grazing, cultivation, recreation and other uses, wildlife use, wildlife and fish observations, water clarity and flow stage;
  - summarize the flood history of the reach, making note of time of high water and when the last major flood occurred;
  - note the vulnerability or sensitivity of some sites or reaches; and
  - make note of things happening outside the reach or beyond the riparian area, especially land uses that contribute to current condition or could affect future condition.

Take a photograph that captures the condition of the reach at the time of your evaluation. Include, in that photograph, the GPS location and a recognizable landmark that will allow you to retake the photograph in subsequent years. You may also want to take photographs at each end of the reach to help you identify these end locations later.

These observations can help you relate current condition to management, especially as you track reach health over time.

Notes:

Riparian Health Assessment: Questions 1-11

1. How much of the riparian area is covered by vegetation?

Vegetation cover of the floodplain and streambanks

Vegetation reduces the erosive forces of raindrop impacts and the velocity of water moving over the floodplain or along the streambanks. Vegetation cover also:

- ► traps sediment and stabilizes banks;
- ► absorbs and recycles nutrients;
- ► reduces the rate of evaporation; and
- ► provides shelter and forage values.

Vegetation cover is visually estimated using the canopy cover method. Use the illustrations below as well as the percent cover diagram above to help you estimate canopy cover on the reach.

- ► Sediment deposited on the reach is considered "bare ground" for this question.

Scoring

6 = More than 95% of the reach soil surface is covered by plant growth (less than 5% bare soil).

4 = 85% to 95% of the reach soil surface is covered by plant growth (5-15% bare soil).

2 = 75% to 85% of the reach soil surface is covered by plant growth (15-25% bare soil).

0 = Less than 75% of the reach soil surface is covered by plant growth (greater than 25% bare soil).

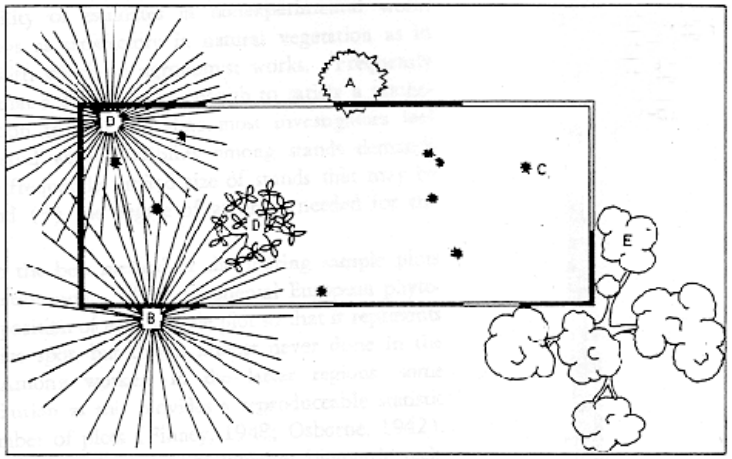
Scoring tip

Vegetation cover includes all standing, rooted plants (live or dead). Do not include litter or downed wood as vegetation cover.

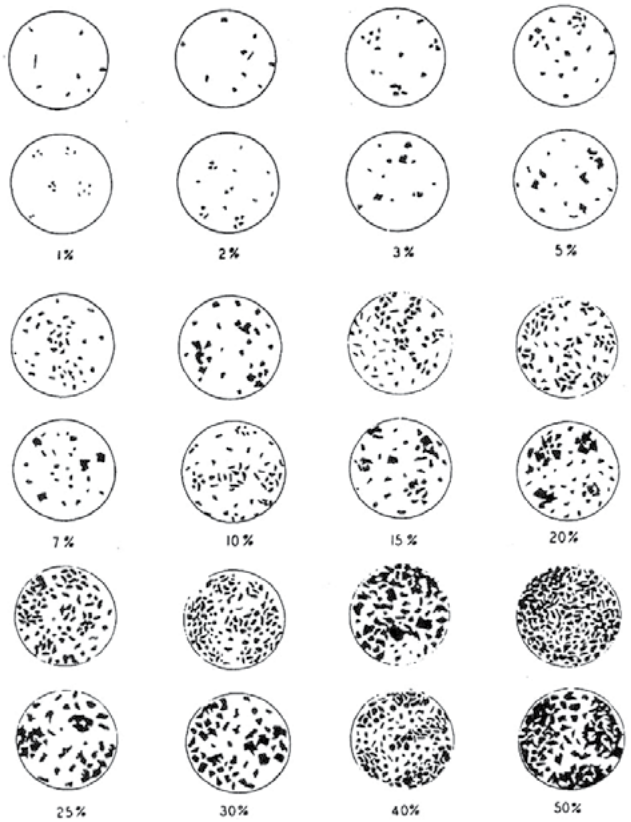
Foliar Cover

Canopy Cover

Imagine a line drawn about the leaf tips of the undisturbed canopies and project that coverage onto the ground. This projection is considered "canopy coverage".



Vegetation canopy cover is estimated for the riparian reach, in much the same way as for this plot frame. Imagine that you are observing the reach from above and estimate the vegetation canopy cover for all plant species combined. What percentage of the stream reach is covered by plant growth?



Cover class standards for judging vegetation canopy cover and bare soil

RIPARIAN HINTS

Vegetation Canopy Protects Soil

Like a tent or umbrella, vegetation canopy protects streambanks and soil from the erosive impact of raindrops.

It takes a lot of trees and shrubs to create this canopy over the ground.

2. How much of the riparian area is covered by invasive plant species?

Invasive plants are "alien species whose introduction does or is likely to cause economic or environmental harm". They may be referred to as "noxious weeds". Specific listed noxious weeds are those listed by the Provincial Weed Control Act

- ► The presence of invasive species indicates a threat to the reach or indicates a degraded ecosystem.
- ► While some of these species may contribute to some riparian functions, their negative impacts reduce overall reach health.
- ► This question considers both canopy cover and the degree of infestation of the reach.
- ► The term canopy cover is used here to describe the area of the reach that has become invaded by weeds and may be of concern to the manager.
- ► Infestation is a function of invasive plant density and patchiness or evenness over the reach. Infestation of a reach by invasive species is evaluated based on their density distribution in the reach.
- ► Record on the worksheet the species and the density distribution (see table on the next page) of all invasive plant species observed as you move across the reach being assessed.
- ► Measurement of canopy cover and density/distribution are done separately.

Canopy cover

Scoring

3 = No invasive species (noxious weeds) on the reach.

2 = Invasive plants present with total canopy cover less than 1 percent of the reach.

1 = Invasive plants present with total canopy cover between 1 and 15 percent of the reach.

0 = Invasive plants are present with total canopy cover more than 15 percent of the reach.

Density/distribution

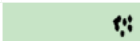
Scoring

3 = No invasive species (noxious weeds) on the reach.

2 = Invasive plants present with density/distribution in classes 1, 2, or 3.

1 = Invasive plants present with density/distribution in classes 4, 5, 6, or 7.

0 = Invasive plants are present with density/distribution in classes 8 or higher.

Class	Description of Abundance	Distribution Pattern	Score
0	no invasive plants on the reach		3
1	rare occurrence		2
2	a few sporadically occurring individual plants		
3	A single patch		
4	A single patch plus a few sporadically occurring plants		1
5	several sporadically occurring plants		
6	A single patch plus several sporadically occurring plants		
7	a few patches		
8	a few patches plus several sporadically occurring plants		0
9	several well-spaced patches		
10	continuous uniform occurrence of well-spaced plants		
11	continuous occurrence of plants with a few gaps in the distribution		
12	continuous dense occurrence of plants		
13	continuous occurrence of plants associated with a wetter or drier zone withing the reach		

Scoring tip 1

Invasive plant (noxious weeds) species are considered collectively, not individually.

Scoring tip 2

You should use a weed list that is standard for the locality and should indicate which species you found.

Examples of provincial noxious weeds for all regions

(see www2.gov.bc.ca/gov/content/industry/agriculture-seafood/animals-and-crops/plant-health/weeds) for a complete listing of noxious weeds for all and specific regions of the Province)

Common Name	Latin Name
Annual Sow Thistle	*Sonchus oleraceus*
Canada Thistle	*Cirsium arvense*
Common Crupina	*Crupina vulgaris*
Common Toadflax	*Linaria vulgaris*
Dalmatian Toadflax	*Linaria dalmatica*
Diffuse Knapweed	*Centaurea diffusa*
Dodder	*Cuscuta* spp.
Gorse	*Ulex europaeus*
Hound's-tongue	*Cynoglossum officinale*
Jointed Goatgrass	*Aegilops cylindrica*
Leafy Spurge	*Euphorbia esula*
Perennial Sow Thistle	*Sonchus arvensis*
Purple Nutsedge	*Cyperus rotundus*
Rush Skeletonweed	*Chondrilla juncea*
Scentless Chamomile	*Matricaria maritima*
Spotted Knapweed	*Centaurea maculosa*
Tansy Ragwort	*Senecio jacobaea*
Velvetleaf	*Abutilon theophrasti*
Wild Oats	*Avena fatua*
Yellow Nutsedge	*Cyperus esculentus*
Yellow Starthistle	*Centaurea solstitialis*

RIPARIAN HINTS

What do weeds tell us?

Weeds normally provide a strong message about riparian health. Weeds most often invade riparian areas where disturbance has resulted in available niche space such as bare soil or openings in the vegetation canopy. These micro-habitats are normally occupied by native plants, but are now available to weeds due to over-grazing or some other land use or natural disturbance.

- **NO WEEDS:** Unable to establish, reach is well vegetated, no bare soil and no seed source
- **ONE WEED:** Potential for invasion, seeds are available
- **SEVERAL WEEDS:** Present threat for quick invasion. Space is available for them to move in
- **MANY WEEDS:** System is degraded

3. How much of the riparian area is covered by disturbance-caused vegetation?

Disturbance-increaser undesirable herbaceous species

A large cover of disturbance-caused, undesirable herbaceous species, either native or introduced, indicates alteration of the normal plant community that would occur on the site.

- ► Like weeds, disturbance-caused species are well adapted to an environment of continual stress, where the competitive advantage of better riparian species has been diminished.
- ► Their presence or abundance may indicate a long history of heavier grazing use.

These species may have some grazing value but tend:

- ► to be shallow rooted and less productive; and
- ► have limited value for bank binding and erosion prevention, especially if they are annuals.

Scoring TIP 1

Provincial Noxious Weed species considered in the previous question **are not** reconsidered here.

Scoring TIP 2

The species list in Appendix 5 will help you identify those species that are disturbance-caused, undesirable herbaceous species.

Scoring

3 = Less than 5% of the reach covered by disturbance-caused undesirable herbaceous species.

2 = 5% to 25% of the reach covered by disturbance-caused undesirable herbaceous species.

1 = 25% to 50% of the reach covered by disturbance-caused undesirable herbaceous species.

0 = More than 50% of the reach covered by disturbance-caused undesirable herbaceous species.

Examples of disturbance-increaser undesirable species (refer to the Appendix 5 for a complete list)

Common Name	Latin Name
Blackberry	*Rubus discolor*
Clovers	*Trifolium* spp.
Common dandelion	*Taraxacum officinale*
Common rush	*Juncuts effusus*
Foxtail barley	*Hordeum jubatum*
Kentucky bluegrass	*Poa pratensis*
Plantains	*Plantago* spp.
Scotch broom	*Cytisus scoparius*
Smooth brome	*Bromus inermis*
Stinkweed	*Thlaspi arvense*

RIPARIAN HINTS

What are disturbance-caused species?

- ► Plants which are absent or present in low amounts, in undisturbed areas but that invade reaches with continuous use.

Why are they a concern?

- ► they do a poor job of binding the soil and preventing erosion.
- ► They show a history of overuse.

4. Is woody vegetation present and maintaining itself?

Preferred tree and shrub establishment and regeneration

Most, but not all, riparian areas can support woody vegetation (trees and shrubs). Where trees and shrubs exist, they play an important role in riparian condition. Their root systems generally are excellent bank stabilizers and play a key role in the uptake of nutrients that could otherwise degrade water quality. The canopies formed by trees and shrubs protect soil from erosion, provide shelter to wildlife and livestock, and modify the riparian environment. Even when dead, the trunks provide erosion protection and structural complexity which play a role in modifying stream valleys. A good indicator of ecological stability of a riparian reach is the presence of woody plants in all age classes, especially young age classes. Without signs of regeneration of preferred woody plants (those species that contribute most to riparian condition and stability) the long-term stability of the reach is compromised.

Not all trees and shrubs are equally important, useful or desirable for maintaining ecological function. Several species of woody vegetation are excluded from this evaluation of establishment and regeneration. See the table on page 68 for a list of these species.

Why are they excluded?

- These species often reflect long-term disturbance of the reach.
- They tend to increase and predominate under long term, heavier grazing pressure.
- There is rarely a problem in maintaining their presence on a reach.
- They are far more abundant on disturbance sites than are preferred woody species.
- Their abundance masks the ecological significance of the smaller amount of preferred species.
- They are generally small in height and have less shelter value.
- Their root systems may not be as capable of stabilizing banks and reducing erosion as those of preferred species.
- They are less palatable to browse users.
- In particular, Russian olive is an aggressive, invasive, undesirable exotic species.

For this question, first determine the total canopy cover of all preferred woody vegetation on the reach, then estimate what percentage of the total canopy cover is composed of seedlings and saplings (the youngest age classes) following these guidelines:

For trees

- consider seedlings to be up to 1.5 m (5 ft) tall with a stem diameter of up to 2.5 cm (1 in); and
- tree saplings could be greater than 1.5 m tall with a stem diameter up to 12.5 cm (5 in).

For shrubs

- seedlings and saplings can be quite variable so consider relative heights to obvious mature plants; look for recent growth that is below your knee in height; these age classes will generally have stems less than the diameter of your thumb; they will be pliable compared with mature growth.

For woody plants in general

- sometimes heavy browse use produces a plant with short stature; don't confuse these mature plants with seedling/sapling age classes; and
- growth and size of seedlings/saplings may be enhanced on some sites where growing conditions are ideal; look less at height and observe stem diameter and the pliable nature of the stems.

Scoring

6 = More than 15% of the total canopy cover of preferred trees/shrubs is seedlings and saplings.

4 = 5% to 15% of the total canopy cover of preferred trees/shrubs is seedlings and saplings.

2 = Less than 5% of the total canopy cover of preferred trees/shrubs is seedlings and saplings.

0 = Preferred tree/shrub seedlings or saplings absent.

Do not include these species when evaluating a reach for regeneration

Common Name	Latin Name	Category
Blackberry	*Rubus discolor*	Shrub
Hawthorn	*Crataegus* spp.	Shrub
Rose	*Rosa* spp.	Shrub
Snowberry	*Symphoricarpos* spp.	Shrub
Wolf willow	*Elaeagnus commutata*	Shrub
Russian Olive	*Elaeagnus angustifolia*	Tree/shrub

Scoring tip 1

If you have established that the reach has no potential for preferred woody vegetation (see page 54), replace the actual score and possible score with N/A and readjust the total score accordingly.

Scoring tip 2

It takes a lot of seedlings / saplings to equal the canopy of one mature tree or shrub.

RIPARIAN HINTS

How to know if trees and shrubs belong here

- Look upstream or downstream at the next field or neighbouring property.
- Look at other similar stream reaches or streams nearby.
- Check for historical photos or in family albums.
- Ask the elders in the community for their memories of woody species.

Examples of Preferred Trees and Shrubs

Trees: cottonwoods, trembling aspen, maples, birch, conifers

Shrubs: beaked hazel, pin cherry, chokecherry, highbush cranberry, black twinberry, willows, red-osier dogwood, buffalo berry, elderberry, ninebark, mock orange, oceanspray, gooseberry, raspberry, alders, Saskatoon, Douglas's spiraea.

5. Is woody vegetation being used?

Utilization of preferred trees and shrubs

Because woody species have such an important role to play in riparian health, measurements of the level of use helps us understand whether they will persist in the reach. Livestock will often browse woody plants, especially in late summer and fall. Wildlife, including beaver, elk, moose and deer make use of woody plants year-round, as do people. Woody plants can sustain low levels of use but heavier browsing can:

- deplete root energy reserves;
- inhibit establishment and regeneration;
- lead to replacement by less desirable woody species;
- cause the loss of preferred woody species;
- reduce or remove taller species from the plant community
- change wildlife habitat; and
- lead to invasion by disturbance or noxious weed species.

Browse of preferred trees and shrubs

Not all woody species are palatable or used by animals. Some species do not contribute significantly to riparian condition and stability although some utilization may occur. Other species may persist under high use but are not good indicators to evaluate the effect of browse. These species are excluded from this evaluation of browse. See the table of on the next page for a list of these species.

To establish the amount of utilization:

- first, randomly pick 2 to 3 plants of each of the preferred woody species found on the reach;
- for each plant, select a branch that would be available or accessible to browsing animals;
- count the total number of leaders (twigs) on the branch;
- now count only the older leaders (2nd year growth and older) that have been clipped off by browsing;
- determine the percentage of utilization by comparing the number of leaders browsed with the total number of leaders available on the branch; and

► do not count current year's use since an estimate in mid-season does not accurately reflect actual use, because browsing can continue year-round.

Scoring

3 = None (0% to 5% of available second year and older leaders of preferred species are browsed).

2 = Light (5% to 25% of available second year and older leaders of preferred species are browsed).

1 = Moderate (25% to 50% of available second year and older leaders of preferred species are browsed).

0 = Heavy (more than 50% of available second year and older leaders of preferred species are browsed).

Scoring tip 1

If you have established that the reach has no potential for preferred woody vegetation (see page 54), replace the actual score and possible score with N/A and readjust the total score accordingly.

Scoring tip 2

Beaver or people may cut or remove trees or shrubs. Measure these impacts in the next part of the question.

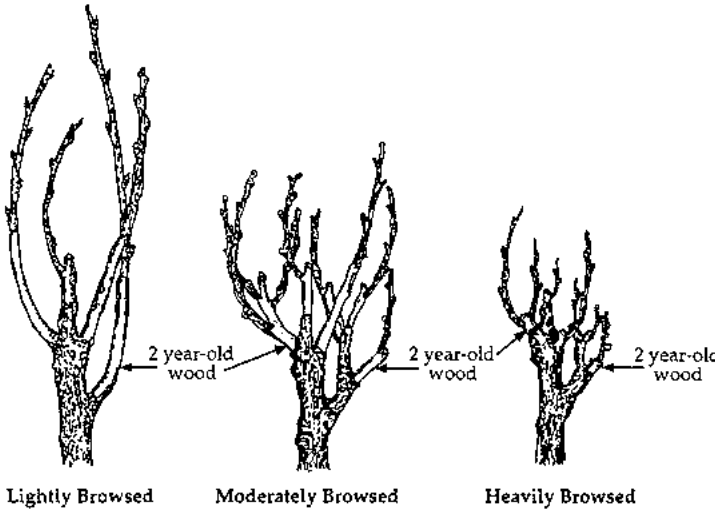
Scoring tip 3

Long-term heavy use by livestock mat result in umbrella-shaped shrubs. Count those as heavy use.

Do not include these species when evaluating a reach for brows:

Common Name	Latin Name	Category
Blackberry	*Rubus discolor*	Shrub
Hawthorn	*Crataegus* spp.	Shrub
Rose	*Rosa* spp.	Shrub
Snowberry	*Symphoricarpos* spp.	Shrub
Wolf willow	*Elaeagnus commutata*	Shrub
Russian Olive	*Elaeagnus angustifolia*	Tree/shrub

Browse utilization examples



RIPARIAN HINTS

Use Affects Woody Plant Vigour

Light to moderate use helps plants maintain vigour.

Heavy use reduces vigour.

Long-term, heavy use eliminates the best woody plants.

Like the old stockman's saying:
"If you keep down the shoot, you kill the root."

Other Use of Trees and Shrubs

Cutting or removing the parts of or the entire trees or shrubs by means other than browsing animals can result in many of the same negative effects to the plant community that are caused by heavy browsing. Causes of tree and shrub use other than browsing may include clearing, logging, mowing, cutting, and beaver. Do not include natural phenomena such as natural fire, insect infestation, prolonged flooding, or drought. Evaluate all the tree and shrub species except those in the table on page 69.

To establish the amount of live woody vegetation removal by means other than browse:

- determine the extent of tree and shrub removal (include partial and entire) in the recent past (stumps or slash piles are visible).
- then compare that to the amount remaining uncut/re-grown, and choose a "best fit estimate".
- give credit for re-growth. Consider how much the removal of a tree or shrub may have now been mitigated with young replacements or new growth.

Look at the volume (three dimensions) and not canopy cover (two dimensions) For example, if an old spruce tree is removed, a number of new seedlings/saplings may become established and could soon achieve the same canopy as the old tree had. However, the value of the old tree to wildlife and overall habitat values is far more than that of the seedlings/saplings. It will take a very long time before the seedling/saplings can grow to replace all the habitat values that were provided by the tall old tree. Some shrubs, such as willows, grow faster than trees and may replace the volume of removed plants in a much shorter time.

Scoring tip 1

If you have established that the reach has no potential for native woody vegetation (see page 58) AND there are no stumps or cut woody plants to indicate that it ever had any, replace the actual score and possible score with N/A and re-adjust the total score accordingly.

Scoring tip 2

In general, the more recent the removal, the more fully it is counted: and conversely, the older the removal, the more likely it has been mitigated by re-growth.

Scoring

3 = None (0% to 5% of live woody vegetation expected on the site is lacking due to removal by humans and/or beavers).

2 = Light (5% to 25% of live woody vegetation expected on the site is lacking due to removal by humans and/or beavers).

1 = Moderate (25% to 50% of live woody vegetation expected on the site is lacking due to removal by humans and/or beavers).

0 = Heavy (more than 50% of live woody vegetation expected on the site is lacking due to removal by humans and/or beavers).

6. How much dead wood is there?

Standing decadent and dead woody material

The amount of decadent and dead wood can be a signal of declining health of a reach. The term decadent is used in the broader sense to include not only mature trees slowly dying but also younger age classes of woody vegetation affected by a number of factors:

- large amounts of decadent and dead wood may indicate a change in water flow through the system due to either human or natural causes;
- de-watering of a reach, if severe enough, can dry the reach, changing vegetation potential from riparian to upland species;
- flooding of a reach, or a persistent high water table, from beaver dams, crossings that restrict flow or man-made dams, can kill and eliminate some riparian species;
- chronic overuse of browse can stress woody plants resulting in their eventual death;
- physical damage from rubbing and trampling, if chronic, can result in the death of woody vegetation; and
- climatic impacts (drought), weather (severe winters), disease and insect infestations can affect woody vegetation.

In all these cases, a high percentage of decadent and dead wood reflects declining vegetation health which can lead to reduced streambank integrity, increased channel incisement, excessive bank erosion and reduced shelter values.

Consider these categories:

- dead trees and shrubs that are still standing; and
- decadent trees and shrubs that show clear signs of stress with 30% or more dead branches in the upper canopy.

Healthy trees and shrubs will have some dead branches in their canopies, but are not considered in this question.

For this question, first assess the amount of woody canopy cover on the reach. Then estimate how much of that woody cover is decadent or dead. The illustrations below will help guide your estimation.

Scoring

3 = Less than 5% of the total canopy cover of woody species is decadent or dead.

2 = 5% to 25% of the total canopy cover of woody species is decadent or dead.

1 = 25% to 50% of the total canopy cover of woody species is decadent or dead.

0 = More than 50% of the total canopy cover of woody species is decadent or dead.

Scoring tip 1

If you have established that the reach has no potential for woody vegetation, replace the actual score and possible score with N/A and readjust the total score accordingly.

Scoring tip 2

Only standing decadent and dead material is included, not material lying flat on the ground.

Scoring tip 3

Consider individual trees and shrubs, not the entire woody canopy, to answer this question.

Dead – no live branches

Decadent – more than 30% dead branches

Alive – less than 30% dead branches

Alive – no dead branches

The amount of decadent and dead wood in a tree or shrub canopy can be an indicator of stress to woody plants.

7. Are the streambanks held together with deep-rooted vegetation?

Streambank root mass protection.

The role of streamside vegetation is to maintain the integrity and structure of the streambank by dissipating energy, resisting erosion and trapping sediment to build and restore banks. The root systems of plants bind substrate particles together and provide the "glue" that stabilizes the zone where stream flow and energy have the most consistent, regular effect. Vegetation with deep and binding roots best accomplishes this function, especially if there is a diversity of these species found on the reach. Review the illustration below to distinguish the below-ground attributes of various kinds of streamside vegetation.

Most tree and shrub species provide such deep roots. Herbaceous annuals and weeds lack this quality. Perennial herbs provide it in varying degrees. Some rhizomatous species, such as sedges, are excellent streambank stabilizers while others, such as Kentucky bluegrass and timothy, have shallow root systems and do not fulfill this key role. To consider the relative value of the vegetation present to perform this key function, you will need to consider the size of the stream, the gradient, soil/substrate makeup and flow/flood patterns. Use the table to help you measure streambank root mass protection for the system you are assessing.

- Walk or observe both sides of the stream reach.
- Evaluate vegetation species from the toe of the slope (at the water's edge during normal low flow) to a variable distance beyond the top of the bank, onto the floodplain.
- The zone to consider extends from the normal low flow stage to where the water level would be at during flooding. On very high cutbanks, the zone to be evaluated does not extend into the upland, but rather measure root mass protection in the riparian area (this may only be near the bottom of tall cliffs). Plants that have deep, binding root mass should be present over that range:
    - on small rivers, evaluate up to 10 m (30 ft) on the floodplain;
    - on large streams, evaluate up to 5 m (16 ft) on the floodplain;

- ▷ on small streams, evaluate up to 2 m (6 ft) on the floodplain; or
- ▷ on intermittent drainages, evaluate up to 1 m (3 ft) on the floodplain.

Scoring

6 = More than 85% of the streambank has a deep, binding root mass.

4 = 65% to 85% of the streambank has a deep, binding root mass.

2 = 35% to 65% of the streambank has a deep, binding root mass.

0 = Less than 35% of the streambank has a deep, binding root mass.

System Size	Trees	Preferred Shrubs	Other Shrubs	Native Grasses Forbs	Introduced Grass	Disturbance	Invasive Species
Small River	E	E / G	F / P	P	P	P	P
Large Stream	E	E	F / P	F	P	P	P
Small Stream	E	E	G	G	P	P	P
Intermittent Stream	E	E	E	E	G / F	P	P

Legend for Table

E - Excellent: these species have all the necessary properties of deep, binding and large root mass appropriate to stream size.

G - Good: species meet most of the requirements for holding streambank materials together.

F - Fair: marginal ability to perform stabilizing function based on high density of plants or presence of other preferred species.

P - Poor: vegetation unable to hold streambanks together under normal circumstances.

This table is based on hundreds of observations over a broad range of stream types.

Trees e.g.

cottonwoods, trembling aspen, maples, birch and conifers.

Preferred Shrubs e.g.

beaked hazel, pin cherry, chokecherry, highbush cranberry, black twinberry, willows, red-osier dogwood, buffalo berry, elderberry, ninebark, mock orange, oceanspray, gooseberry, raspberry, alders, Saskatoon, Douglas's spiraea.

Other Shrubs e.g.

rose, snowberry (buckbrush), shrubby cinquefoil

Perennial Grasses, Forbs e.g.

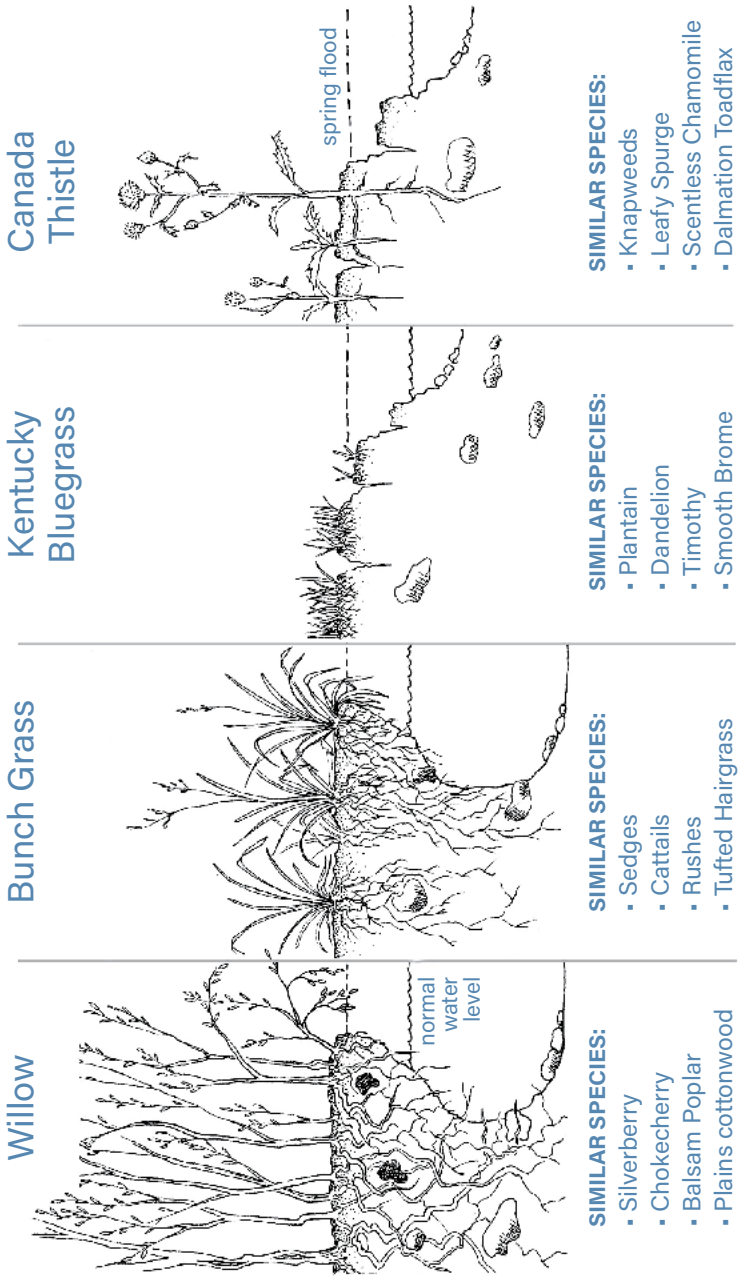
sedges, cattails, tufted hairgrass, other native bunch grasses and native sod-forming grasses

Introduced Grasses e.g.

Kentucky blue grass, timothy, smooth brome, quack grass, reed canary grass

Disturbance Species - see Appendix 5

Invasive Species - see Appendix 5



In this example willow and bunch grasses profide a deep binding root mass, while Kentucky Bluegrass and Canada Thistle do not.

8. How much of the riparian area has bare ground caused by human activity?

Human-caused bare ground.

Soil not covered by plants, litter, moss, downed wood or rocks larger than 6 cm (2.5 in) is considered bare ground. Bare ground is unprotected soil that is capable of being eroded by rain drops, overland flow or wind. Bare ground can exist under a tree or shrub canopy and still be subject to erosion from overland flow. It represents an opportunity for erosion and invasion by disturbance or weed species.

- ► Significant bare ground caused by human activity indicates a deterioration of riparian health.
- ► Bare ground resulting from natural events or processes, including erosion, deposition, landslides, wildlife, saline/alkaline areas and unvegetated channels in ephemeral streams, is excluded from this question.
- ► Human land uses causing bare ground include livestock grazing, cultivation, recreation, urban development (pavement, concrete), roads/trails, timber harvest and industrial activities.

Consider the entire riparian reach in this question. Estimate what percentage of the reach has human-caused bare ground using the cover standards illustration as a guide.

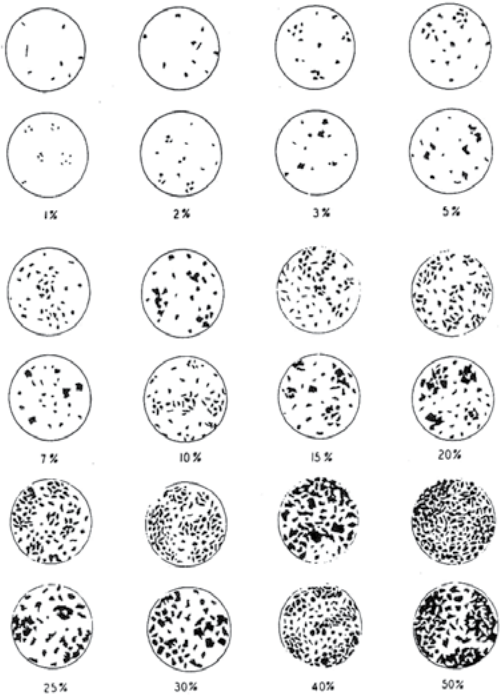
Scoring

6 = Less than 1% of the reach is human-caused bare ground.

4 = 1% to 5% of the reach is human-caused bare ground.

2 = 5% to 15% of the reach is human-caused bare ground.

0 = More than 15% of the reach is human-caused bare ground.



Cover class standards for judging vegetation canopy cover and bare soil

RIPARIAN HINTS

Estimating Human-Caused Bare Ground

- Vegetation canopy and bare ground measurements are interrelated. Before judging bare ground, go back and check your vegetation canopy estimate (see Question 1). Example: High vegetation canopy means low bare ground and low vegetation canopy may mean high bare ground.
- Does human-caused bare ground include recent sediment deposition? **NO**.

9. Have the streambanks been altered by human activity?

Streambanks structurally altered by human activity.

Stable streambanks maintain channel configuration, integrity and bank shape. When streambanks are physically altered, erosion can increase mobilizing channel and bank materials, water quality can deteriorate, and instability can increase within the reach and downstream.

- Bank alteration can result from livestock hoof shear, livestock trails/watering sites, recreational trails, flood/erosion control methods, irrigation diversions/return flows, timber harvest, crossings/fords, bridges/culverts, landscaping and channelization/drainage.
- Include pugging and hummocking on the banks.
- Consider those direct **human** activities that have resulted in cracking, slumping, shearing, removal or reconfiguration of streambank materials that leave the streambank altered in shape, unstable or vulnerable.
- **Natural** slides, slumps and eroding banks are not considered in this question.

In rating this question, consider the bank area from the water's edge up to 4 m (13 ft) small rivers; 2 m (6 ft) large streams or 1 m (3 ft) for small streams beyond the top of the bank. The bank top is that point where the upper bank levels off to the relatively flat surface of a floodplain or terrace. Include both sides of the stream reach.

Scoring

6 = Less than 5% of the bank is structurally altered by human activity.

4 = 5% to 15% of the bank is structurally altered by human activity.

2 = 15% to 35% of the bank is structurally altered by human activity.

0 = More than 35% of the bank is structurally altered by human activity.

10. Is the reach compacted, bumpy or rutted from use?

Human physical alterations to the reach (beyond the banks).

Changes in floodplain profile, shape, contour and soil structure due to human activities will alter infiltration of water, increase soil compaction and change the amount of sediment contributed to the waterbody. These changes reduce the water-holding abilities of the soil (the riparian "sponge"), thus impacting water storage and aquifer recharge. Filtration, nutrient uptake, floodplain maintenance and primary production may be altered as a result.

Soil compaction may be difficult to evaluate and is influenced by soil type. Include all physical alterations, such as pugging, hummocking, rutting, man-made surfaces (eg. compacted paths, pavement, buildings), constructed watercourse changes (e.g. ditches, diversions, berms), soil tillage, addition of material (e.g. fill, rip rap), landscaping, construction or other physical alterations.

Do not assess streambanks as they are assessed in Question 9.

Scoring:

3 = Less than 5% of the reach has been physically altered by human activity.

2 = 5% to 15% of the reach has been physically altered by human activity.

1 = 15% to 25% of the reach has been physically altered by human activity.

0 = More than 25% of the reach has been physically altered by human activity.

Hummocking and **pugging** results from livestock hoof action (occasionally people or rarely wild ungulates). Pugs are the depressions hooves or feet leave in soft soil; hummocks are the raised humps of soil 15 cm (6 in) or higher that result from the soil being pushed up from the pug.

Rutting is considered compacted trails or ruts (usually 5 cm [2"] or greater) from people, vehicles or livestock or highly managed ungulate populations (compacted and compressed soil is present).

11. Can the stream access its floodplain?

Stream channel incisement (vertical stability).

Floodplains, the riparian area that lies beyond the stream channel, provide a safety valve that allows water in excess of what the channel can hold to escape into a wider area. Floodplains provide temporary storage for high water and an opportunity to slow that water down, reducing energy. Incisement, or down-cutting, can limit the ability of the stream to access its floodplain during high water events. Streams are incised when down-cutting (erosion of the channel bottom) has significantly lowered the channel so that the average two-year flood cannot escape the existing channel. Incisement can result from:

- watershed-scale, cumulative effects of vegetation removal, drainage and road construction which affect runoff;
- local drainage-scale changes including vegetation removal, dams, water additions, road constructions and culvert installations occurring upstream of the reach (and sometimes downstream);
- reach scale changes including vegetation removal, beaver dam removal, channelization (straightening of stream, cutting out meander loops) and culverts; and
- natural events including landslides, beaver dam wash-outs and extreme flood events.

Incisement can result in:

- a reduced water table that affects current vegetation and the potential of the reach for some types of vegetation;
- increased stream energy with more erosion, sediment, and unstable banks which can persist downstream of the reach and potentially upstream as the stream readjusts;
- reduced water storage and retention leading to lower flows or flow ceasing during parts of the year;
- impairment in the ability of the reach to rebound from natural and human caused impacts; and
- decreased productivity, forage, shelter and bio-diversity values.

Incisement stages have been categorized by Rosgen (1996). His textbook or field guide may be useful materials to assist you in classifying your reach. These incisement stages range from unincised channels where high flow regularly spills onto the floodplain, to entrenched channels where water rarely escapes, possibly only during extreme flood events. Intermediate stages have slightly incised channels where the floodplain can be accessed but is relatively narrow. These intermediate stages represent streams in transition, either improving or degrading.

To rate the reach you are standing on you will need to:

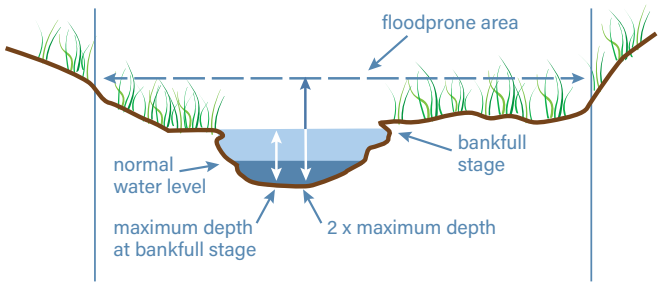
- carefully consider the descriptions of the various stages;
- review the illustrations for the "best fit", recognizing that rarely will your reach look exactly like the figures;
- reflect on past flood history, not the extreme events, but the normally occurring high water events and levels; and
- do some estimates of how much floodplain is available relative to the channel width of the stream.

The stages are often distinguished from one another based on the amount of floodplain width available relative to the stream channel width, at the bankfull stage. Bankfull is the point at which water begins to spill onto the floodplain. Review the following illustration and the instructions for **Reach Width.** Do the same visual estimates to establish the floodprone zone. What you will be comparing is the width of the stream channel, at the bank-full stage, with the width of the floodplain, from the bankfull edge to the outer edge of the floodprone zone on both sides of the stream. This estimation will help you understand if the floodplain is less than, equal to or greater than the bankfull channel width. The wider the floodplain is relative to the channel width, the greater the opportunity to store water and energy during high water events.

If you are evaluating an intermittent or ephemeral stream with no visible, defined channel consider the following:

- these are systems that only flow for a few days (rarely weeks) in the spring or after a rain storm;
- the volume of flow is insufficient to create a visible, unvegetated channel; and
- for these systems, if the width of the riparian area is vegetated with perennial forms, rate them as being vertically stable and unincised.

If you are evaluating a river with substantial flows and a wide channel, this question becomes difficult to answer. For systems of that size you should refer to the Cows and Fish website (http://cowsandfish.org/riparian/documents/AlbertaRiverSurveyManual.pdf) for more information on how to evaluate riparian health on large river systems.



How much floodplain can the stream access?

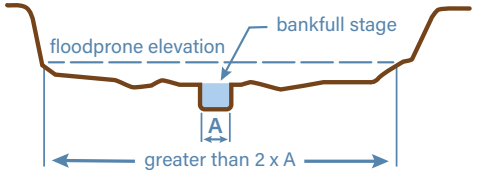
Scoring

9 = Stages 1a, 1b and 1c. Channel vertically stable and not incised; 1-2 year flows access a floodplain appropriate to stream size and flow volume.

Active down-cutting not evident. Any old incisement is now characterized by a broad floodplain inside which perennial riparian plant communities are well established.

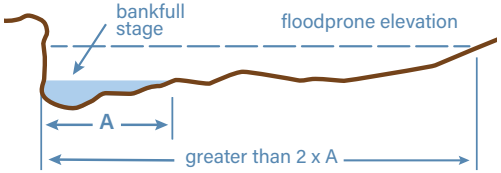
Stage 1a (9 points)

A stable, unincised, meandering meadow channel. Flows greater than bankfull (1-2 year event) spread over a floodplain more than twice the bankfull channel width.



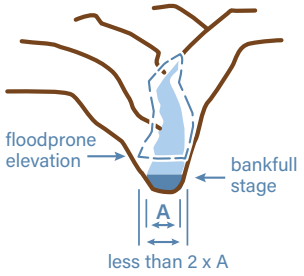
Stage 1b (9 points)

A fairly stable, unincised, wide valley bottom channel with broad curves and point bars. These systems typically cut laterally on the outside of curves and deposit sediment on inside point bars, but bank full flows (1-2 year events) still have access to a floodplain more than twice the bank full channel width.



Stage 1c (9 points)

A stable, unincised mountain or foothill channel with limited sinuosity and slopes greater than 2%. These channels are well armoured with bedrock, boulders and cobble and are not prone to down-cutting. Although bankfull flow stage is reached every 1-2 years, the floodplain is often narrower than twice the bankfull channel width. Overflow conditions will not be as obvious as in 1a or 1b but armouring maintains the channel.



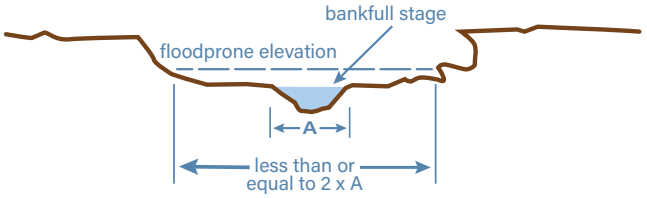
6 = Stage 2

Channel slightly incised. The 1-2 year high flow event can access only a narrow floodplain less than or equal to twice the bank full channel width. Perennial riparian vegetation is well established. This stage includes: (a) an improving phase that resembles 1a or 1b re-establishing in a narrower floodplain at a new, lower level; or (b) a degrading phase where a 1a is beginning to down-cut into the existing floodplain.

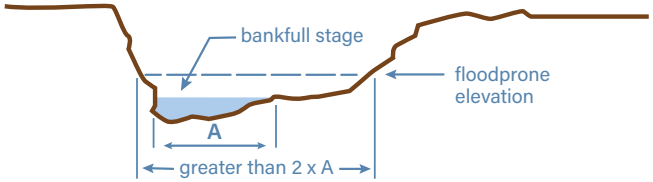
3 = Stage 3

Channel moderately incised. The 1-2 year flows may not access the floodplain but higher flows (less than a 5-10 year event) can access a narrow floodplain less than twice the bankfull channel width. This stage includes: (a) deep incisements that are starting to heal. Very limited new floodplain development is present and lateral erosion of high side walls is occurring as the system continues to widen at its new level... Channels are wide and shallow and unable to regularly (1-2 year event) access a floodplain. Some pioneer plants are beginning to establish on new sediment surfaces; or (b) an incisement that continues to down-cut and cannot regularly access a floodplain – it may look like a gully.

Stage 2 (6 points)



Stage 3 (3 points)



0 = Stages 4a and 4b.

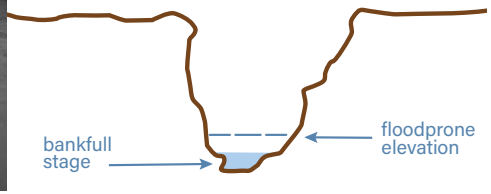
Channel vertically unstable and deeply incised. Resembles a ditch or gully. Active down-cutting is likely ongoing. Only extreme floods overtop the banks, and no floodplain development has begun.

Stage 4a

A deeply incised stream with a wide, shallow channel. Commonly found in fine substrates (sand, silt and clay). Banks are easily eroded. Only limited vegetation, primarily pioneer species, is present.

Stage 4b

A narrow, deep "gully" system, down-cut to the point where only the most extreme flood overtops the banks. Banks consist of fine materials which are constantly eroded. Vegetation is rarely present.



5 HOW TO USE THE RIPARIAN HEALTH ASSESSMENT FIELD SHEETS

In Appendix 1, a field sheet (Form #3) is provided for copying purposes so you can record the results of your training exercise or to apply the Riparian Health Assessment on your own land base. The field sheet will provide a permanent record for future reference and monitoring. In addition to health scores, space is also available to record specific details of what you have observed.

For example:

- if preferred woody species are being browsed, note the species that show the heaviest use levels;
- list the species of invasive species (weeds) or disturbance caused species that you have observed and where they are located;
- extra space is provided on the back of the sheet for more detailed comments on any of the 11 questions;
- there is also space to make a small sketch of where the stream reach occurs in a particular pasture and to note where photographs may have been taken; and lastly,
- another very important step is to consider the current management of the field you are in. This information should also be recorded and attached to the field sheet:
  - what is the current grazing intensity in the pasture (heavy, moderate, light)?
  - how long is the pasture grazed each year?
  - when are rest periods provided?
  - what livestock distribution tools are being used (salt, off-stream water, supplemental feed)?
  - if this is a cropped field, how is it managed?
  - what type and intensity of recreational traffic and other uses occurs here?

The field sheets are provided for copying. This will allow you to record scores for multiple sites as well as repeated measures over time. You can store the sheets in the workbook, or tear them out and file them away with photographs and other riparian management records.

How Do I Use the Results?

The field sheet knits together the 11 separate questions into one measure of riparian health. **Go to the section following the field sheets to consider what the health score tells you, so you can take the first steps to apply the results of the health rating to your management practices.**

RIPARIAN HINTS

What do healthy riparian areas do?
Key ecological functions

- Trap sediment
- Build and maintain streambanks
- Store flood water and energy
- Recharge groundwater
- Filter and buffer water
- Reduce and dissipate stream energy
- Maintain biodiversity
- Create primary productivity

Now what?

What to do when you finish the riparian health assessment

What does the health score mean?

The riparian health score is a cumulative measure of the 11 factors that you have considered on the reach you selected. If you picked a critical reach, the score is the condition for only that short stretch of stream you thought might have problems, be sensitive to use or had some other values. If you picked a representative reach, the score is the average condition for a long stretch of the stream, within one pasture or management unit. Note that the questions can have different possible scores. This gives questions a different weighting factor depending on what they are considered to contribute to a healthy functioning system.

When you have added up the scores for the individual questions to get a total score, calculate what the percentage is, based on the total possible score. The range on the bottom of the score sheet will help you to do this. The score you have derived for the reach falls into one of those categories. These categories (healthy, healthy but with problems, and unhealthy) describe the reach condition and the reach's ability to perform riparian functions.

What do the health categories tell me?

- A health score of 80% or greater means the reach has scored in the top category called "**healthy**". This tells you that all riparian functions are being performed and the reach exhibits a high level of riparian condition. Healthy, functioning riparian areas are resilient, provide a long list of benefits and values, and are stable.
- A health score between 60 and 79% puts the reach in the "**healthy but with problems**" category. Many riparian functions are still being performed, but some clear signs of stress are apparent. The reach may not be as capable of rebounding from floods and use, it may be vulnerable to erosion and some of the potential of the riparian area has been lost. This is like an amber warning light that there could be problems ahead and management changes should be actively

considered. At the same time, with effective management changes, it is likely that a return to a healthier condition is within your grasp.

- A health score of less than 60% means the reach is in an "**unhealthy**" category. Most riparian functions are severely impaired or have been lost. The reach has lost most of its resiliency, stability is compromised and much of the potential of the riparian area has been sacrificed. At this point, red lights are flashing and we need to stop and reflect on current management. Immediate changes are necessary to keep the reach from declining further and to begin the process of healing and restoration.

What should our goals be for riparian area health? Clearly, we all want these landscapes to be resilient and stable, and provide us with a long list of ecological services, whether we are livestock producers, farmers, anglers, bird watchers, hikers or downstream water drinkers. Riparian health can vary across the province, from stream to stream and within single drainages, ranging from healthy to unhealthy. Some of this variation relates to how riparian landscapes have evolved. Natural disturbances like floods, grazing from native ungulates, fire, drought, beavers and landslides have always affected riparian condition. The results of these disturbances meant health could vary over time and from reach to reach. Because of the natural resilience of these systems, however, it is likely that ecological function was restored relatively quickly. Our use of these landscapes represents an additive and cumulative effect which has often compromised resilience. That could be a consequence of what has happened on the reach or what has happened upstream or downstream of the reach. Additional variation in health conditions can be attributed to our use of riparian areas and, in some cases, that use has lead to a decline in condition.

Consider these general goals for riparian area health

- We need to quickly stabilize the number and length of reaches in an "unhealthy" category and actively restore them to a better condition.

There may always be a small percentage of sites in this category. The occasional crossing site, pressure point or naturally unstable bank may not contribute to an overall decline in reach health or make the reach more vulnerable to floods and other disturbance events. When these sites are the exception and not the general average for a stream, the resilient tendency of the reach compensates.

- We want to carefully watch and actively manage those reaches in a "healthy but with problems" category.

This category could include the majority of British Columbia's riparian areas within the less intensively developed parts of the Province. The economic, environmental and social values of these areas are high and we don't want to become complacent about their condition. Active management implies monitoring. We should ensure that the trend over time is positive, indicating improvement in reach condition.

- We must keep "healthy" reaches intact, learn from the management that maintains them and apply that knowledge to other areas that are not in as good a condition.
- We need to recognize the most powerful restoration tool we have at our disposal is the natural resilience of these riparian systems, especially the vegetation components.

If we can recognize the stresses, reduce the pressures, be patient and let the system rebound, condition will improve, assuming most of the key pieces are still intact. If some of those key pieces (like woody vegetation) have gone missing restoration will be difficult and time consuming.

- We not only need to consider the reaches we stand on, we also need to look upstream and downstream.

Often, we can improve or maintain health with reach management but sometimes, because of distant effects, we need to work with our neighbours, within our communities and at a watershed level to reach our goals.

Using the health scores to plan management objectives.

Take time to review the overall health score and the rating for each of the 11 questions.

- The total score will tell you if riparian health is good (healthy), if there is cause for concern (healthy but with problems) or if there exists a need for urgent action (unhealthy).
- The scores for individual questions will help you to recognize the riparian "pieces" that have gone missing from the riparian reach.

Riparian health assessment – field sheet

Date: D D M M Y Y

Landowner / lessee: Reach No:

Stream / River:

Site Description Scores or N/A

1. Vegetative cover of floodplain and streambanks 6 4 2 0		4	6
2. Invasive plant species 3 2 1 0 (cover)		1	3
3 2 1 0 (density)		1	3
3. Disturbance-increaser undesirable herbaceous species 3 2 1 0		1	3
4. Preferred tree and shrub establishment and regeneration 6 4 2 0		4	6
5. Use of trees and shrubs 3 2 1 0	*moderate use of willows by cattle and moose*	1	3
6. Standing decadent and dead woody material 3 2 1 0		2	3
7. Streambank root mass protection 6 4 2 0		4	6
8. Human-caused bare ground 6 4 2 0		4	6
9. Streambank structurally altered by human activity 6 4 2 0		6	6
10. Reach structurally altered by human activity (excl. banks) 3 2 1 0	*at crossing & watering site*	1	3
11. Stream channel incisement (vertical stability) 9 6 3 0	*initial signs of downcutting*	6	9
	TOTAL	35	57

PTS	17/57	23/57	29/57	32/57	34/57	37/57	40/57	46/57	52/57
%	30	40	51	56	60	65	70	80	91
	Unhealthy				Healthy with Problems			Healthy	

Riparian health scores and management sample field sheet

The sample reach (opposite page) on the Smith Ranch receives an overall rating of 61% based on an actual score of 35 points out of a possible score of 57 points (35/57 x 100 = 61%). This score puts the stream reach in the "healthy but with problems" category – most riparian functions are being performed, but signs of stress are evident.

- In this example, all questions apply and have been scored.
- Review the captions on the example worksheet to see what each score tells you about riparian health.

Vegetation canopy is reduced (question 1) and weeds and disturbance species (questions 2 & 3) have increased in abundance on the site.

Shrub species are regenerating quite well (question 4) but utilization of these species may be getting too high to sustain regeneration in the future (question 5).

Questions 7 and 8 show the early stages of decline in deep binding root mass and increase in human-caused bare ground and potential for erosion.

Livestock are exerting physical impact at crossings and watering points (question 10). The stream is still able to access is flood plain (question 11) but early signs of down-cutting are apparent.

If the stress on this reach continues, there is a risk of losing several riparian functions.

Riparian health scores and grazing management

The most important aspect of Riparian Health Assessment is to use the scores to help you formulate management changes. A few examples are provided here.

Example 1

A wintering site may score very low on question 4 (woody regeneration) and question 5 (woody utilization), yet have mid-range to high scores for all other questions. This result alerts the manager to the loss of woody species that are so critical for bank binding, yet so vulnerable to winter browsing. Can changes be made to grazing season or the use and placement of supplemental feeds to help woody species regenerate? (see **Environmental Farm Plan – Grazing Management Guide; Caring for the Green Zone – Riparian Areas and Grazing Management))**

Example 2

A pasture scores in the "healthy but with problems" category, with the score for question 9 (stream bank alteration) and question 10 (pugging and hummocking) receiving the lowest scores. With generally higher scores in other categories, this may alert the manager to the fact that livestock use of the riparian area is mostly for water. Stock impact is, therefore, mostly confined to physical pressure with little effect on vegetation from grazing. Perhaps off-stream water can be supplied to reduce the physical impacts.

RIPARIAN HINTS

THAT'S IT! Once you reach a health score and you also understand the riparian health category it represents, it's the **END OF THE BEGINNING!**

RIPARIAN HINTS

What Do the Health Scores Tell Me? Is My Crick Sick? Take a Reading . . .

If the score is 80 or higher ...

Congratulations! This score means that your riparian area is performing the functions you want it to. You should make a record of your present management practices for future reference and share that information with others.

If the score is between 60 and 80 ...

Don't jump off the bridge – many riparian functions are still being performed, but your riparian area is showing signs of stress. Time to start paying attention to management practices on this site.

If the score is less than 60 ...

This riparian area needs attention! Who can you contact for advice? **See Agency Contact Factsheet**

What are the main areas of concern? Woody species? Weeds? Bare soils? What can you do to change management? More rest? Off-stream water? Rotational grazing? Fencing?

Inspection schedule for watercourses

This Section contains a series of checklists that help monitor and evaluate your riparian health assessment.

- A "**YES**" response indicates conditions that protect the watercourse, water quality and the riparian area, or have the lowest potential for damage to watercourses and riparian areas.
- A "**NO**" response indicates conditions that have the highest risk of damaging the watercourse, water quality or the riparian area. Bolded numbers in the "**NO**" column indicate conditions that may violate federal or provincial laws. **These laws are listed at the end of the Checklists.**
- An "**DON'T KNOW**" response indicates a need to find out how a practice or condition is impacting the watercourse or riparian area.
- If the statement is not relevant to your operation, check the "**N/A**" column for "Not Applicable".

Inspection schedule for watercourses that are conducted in addition to the riparian health assessment

RESPOND TO THE FOLLOWING STATEMENTS.	YES	NO	DON'T KNOW	N/A
I inspect my streams and ditches every spring and fall.				
I inspect my streams and ditches after major storm events.				
I look for signs of damage to culverts and bridges.				
I look for signs of erosion:				
On the banks of streams and ditches				
Around culverts				
Around drainage pipes and tiled outlets				
At surface water entry points.				
I look for signs of sediments, nutrients and chemicals which can indicate reduced water quality:				
In channel waters of streams and ditches,				
In water coming out of drainage pipes and tiled outlets.				
I look to see if debris is causing blockages:				
In the channel of streams and ditches				
Inside, or at the mouth of culverts				
Under bridges.				
Fish Screens				

Maintenance of riparian vegetation

RESPOND TO THE FOLLOWING STATEMENTS.	YES	NO	DON'T KNOW	N/A
I protect vegetation by ensuring that garbage and cull piles are located outside of the riparian area.		1*		
I protect vegetation by ensuring that no burning takes place in the riparian area.		1,2,3		
These statements are for all ditches.				
I do not spray herbicides on vegetation where these herbicides can enter the ditch.		1,3		
I provide shade for the water and cover for nesting birds by not mowing vegetation beside ditches from mid-March to the end of July.		2,3		
I do not mow vegetation below the waterline.		1,3		

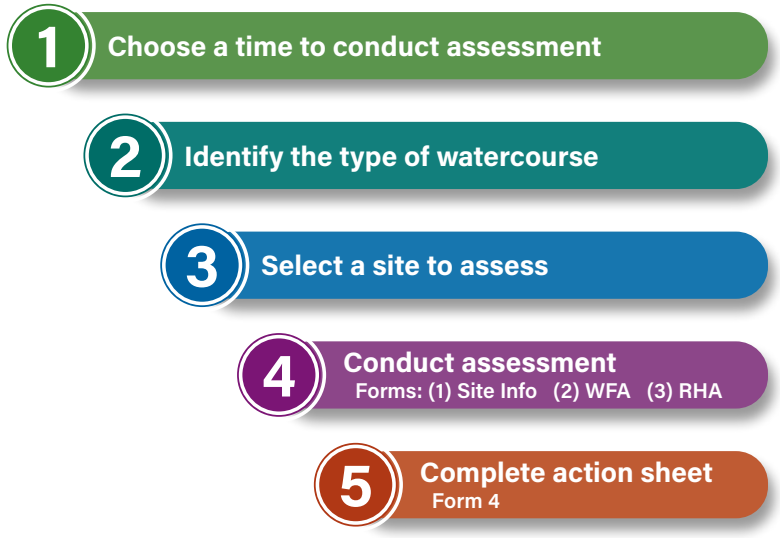
The bold numbers used in the checklists indicate conditions that may violate:

1. *Fisheries Act*
2. *Migratory Bird Act*
3. *Wildlife Act*

STEP 5: Develop an action plan

Once the **Whole Farm and Riparian Health Assessments** have been done, the next step is to develop an action plan to improve all your riparian areas represented by these assessments by using the **Action Sheet (Form #4).**

STEPS IN THE BC RIPARIAN HEALTH ASSESSMENT



As you fill in the Action Sheet**,** remember that this is your action plan. It must suit you and your operation while addressing those riparian conditions of concern. Once completed, and depending on the riparian health assessment outcomes, the Action Sheet will become the basis from which to trigger an application to the Environmental Farm Plan **Beneficial Management Practices** cost-share incentives program.

Conditions and practices that have the highest risk of damaging the watercourse, water quality or the riparian area include:

- Whole Farm Assessment Factors that you gave a C or D rating,
- Questions in the Riparian Health Assessment that have a low rating,
- **Checklist** statements that you gave a **"NO"** response.

How to use the action sheet

Complete a separate **Action Sheet** for each site that you assess.

How to fill in the action sheet with factor information

The **Action Sheet** has four columns. Complete each column with the following information:

COLUMN 1: Factor/Question Rating. Fill in the rating that you gave each of the applicable factors or questions.

COLUMN 2: Description of Problems. Describe the problems or concerns identified for factors and/or questions with low ratings.

COLUMN 3: Actions. Describe the actions you need to take to correct the problems. To identify appropriate actions see **Riparian Factsheet Series 1-10** and the suite of **EFP** guides and factsheets for appropriate beneficial management practices in riparian areas.

Contact DFO for technical advice on replanting and design is strongly advised and encouraged. Stewardship groups, watershed groups, roundtables have resources and expertise that can be coupled with EFP beneficial management practices funding to maximize riparian and farm benefits. These groups have experience with working with DFO, and can provide complimentary approaches.

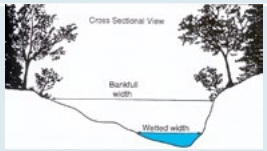
COLUMN 4: Timetable for Action. Fill in your time estimate for taking action. Give priority to conditions and practices that may violate federal or provincial laws. Also, give priority to problems affecting your family's health and safety, as well as those problems that pose a high risk to the environment.

APPENDICES

APPENDIX 1 PULL-OUT WORKSHEETS

FORM 1: Site information

Collect the following information as a record of your riparian assessment. This information is for your purposes only and should be completed for every assessment site on your property

Date:	Time:	Weather condition today:
Weather for previous 2-5 days:		
Landowner:		Lessee:
Assessor:		
Name of business:		
Address:		
Name of watershed where property is located:		
Name and type of watercourse:		
Principle land use next to the watercourse and riparian area (row crops, hay, grazing, pasture, forest, confined animal feeding operations, other):		
Land use(s) above your stretch of watercourse (agriculture, logging, industrial, residential, other):		
Land use(s) below your stretch of watercourse (agriculture, logging, industrial, residential, other):		
Location of assessment site:		
Bankfull channel width of stream/ constructed ditch: ( ) meters Bankfull channel width		
Length of watercourse audited: ( ) meters		
The main channel bottom material(s): gravel (0.25 – 6 cm) mud	boulder (more than 25 cm) cobble (6 cm – 25 cm) sand (less than 0.25 cm)	

FORM 1: Diagram/digital map of your assessment site

Draw your audit site or attach a digital map, include the watercourse, riparian area, RHA site(s), main features and land uses

FORM 2 : Whole farm assessment

WFA FACTOR 1 PHYSICAL BARRIERS TO FISH MOVEMENT

A	B	C	D
No barriers. No dams or culverts on stream	Dams and culverts are properly installed and maintained to allow fish passage	Dams and culverts are properly installed, but **not maintained** to ensure fish passage	**Dams and culverts do not allow fish passage**
WHOLE FARM ASSESSMENT			
This factor is evaluated in the EFP Workbook with questions 275, 276 and 277			

* This may harmfully alter, destroy or disrupt fish habitat and/or destroy fish and therefore could be violation of the federal Fisheries Act.

WFA FACTOR 2 MACHINERY CROSSING TYPE

DO NOT DO THIS FACTOR IF MACHINERY DOES NOT CROSS THE WATERCOURSE.

A	B	C	D
A clear-span bridge is used to move machinery	A culvert is used to move machinery across	A **bed-level structur**e is used to move machinery	There is no protection of bed and banks at the crossing point. *
WHOLE FARM ASSESSMENT			
This factor is evaluated in the EFP Workbook by questions 275, 276 and 277			

WFA FACTOR 3 LIVESTOCK CROSSING TYPE *

DO NOT DO THIS FACTOR IF LIVESTOCK DO NOT CROSS THE WATERCOURSE.

A	B	C	D
A clear-span bridge is used by livestock to cross the watercourse	A culvert or a bed-level structure is used by livestock to cross the watercourse	Controlled crossing points are used to move livestock across the watercourse. No protection of bed or banks	Livestock are herded across the water-course at any point. No protection of bed or banks. *
WHOLE FARM ASSESSMENT			
This factor is also evaluated in the EFP Workbook. by questions 105, 108, 109, 275, 311, 312 and 313			

WFA FACTOR 4 DRAINAGE MANAGEMENT

ONLY DO THIS FACTOR IF YOU CARRY OUT DRAINAGE MANAGEMENT ACTIVITIES.

A	B	C	D
I have and follow a drainage management plan	Intentionally blank	Intentionally blank	I have no drainage management plan
WHOLE FARM ASSESSMENT			
This factor is evaluated by using the Environmental Farm Plan Drainage Management Guide and by questions 324-328 in the Environmental Farm Plan Planning Workbook			

WFA FACTOR 5 SPECIES AT RISK

ONLY CONSIDER THIS FACTOR IF YOU HAVE, OR SUSPECT YOU MIGHT HAVE, SPECIES AT RISK OR HABITAT THAT COULD POTENTIALLY SUPPORT SPECIES AT RISK.

A	B	C	D
Supports SAR; healthy condition; supported by BMPs.	Potentially supports SAR, healthy condition; not supported by BMPs.	Potentially supports SAR; healthy condition with some problems, not supported by BMPs.	Does not support SAR; unhealthy condition; and is not supported by BMPs*.
WHOLE FARM ASSESSMENT			
This factor is evaluated in the EFP Workbook by questions 281 and 283			

***MAY BE IN VIOLATION OF THE BC WILDLIFE ACT, FEDERAL FISHERIES ACT.**

FORM 3: Riparian health assessment – field sheet

comments

1. Vegetative cover of floodplain and streambanks
2. Invasive plant species
3. Disturbance-increaser undesirable herbaceous species
4. Preferred tree and shrub establishment and regeneration
5. Utilization of preferred trees and shrubs
6. Standing decadent and dead woody material
7. Streambank root mass protection
8. Human-caused bare ground
9. Streambank structurally altered by human activity
10. Reach structurally altered by human activity (excl. Banks)
11. Stream Channel Incisement (vertical stability)

sketch stream reach here

show photo locations

FORM 3: Riparian health assessment – field sheet

Date: D D M M Y Y

Landowner / lessee: Reach No:

Stream / River:

Site Description

	Scores or N/A	
	Actual	Possible
1. Vegetative cover of floodplain and streambanks 6 4 2 0		
2. Invasive plant species 3 2 1 0 (cover) 3 2 1 0 (density)		
3. Disturbance-increaser undesirable herbaceous species 3 2 1 0		
4. Preferred tree and shrub establishment and regeneration 6 4 2 0		
5. Use of trees and shrubs 3 2 1 0 (preferred – browse) 3 2 1 0 (all – other uses)		
6. Standing decadent and dead woody material 3 2 1 0		
7. Streambank root mass protection 6 4 2 0		
8. Human-caused bare ground 6 4 2 0		
9. Streambank structurally altered by human activity 6 4 2 0		
10. Reach structurally altered by human activity (excl. banks) 3 2 1 0		
11. Stream channel incisement (vertical stability) 9 6 3 0		
TOTAL		

PTS	18/60	26/60	30/60	33/60	36/60	39/60	42/60	48/60	54/60
%	30	40	50	55	60	65	70	80	90
	Unhealthy				Healthy with Problems			Healthy	

Notes:

FORM #4 - ACTION SHEET

Watercourse: **Date:**

The Riparian Factsheet Series provides information to assist you to correct any riparian problems identified while doing your riparian health-assessment. **See the Factsheet "Beneficial Management Practice for Agricultural Riparian Areas**" for assistance in deciding which factsheet contains information about a specific problem.

WHOLE FARM ASSESSMENT				
Factor	Factor Rating	Description of Problem	Actions	Timetable for Action
1. Physical barriers to fish movement				
2. Machinery crossing type				
3. Livestock crossing type				
4. Drainage management				
5. Species at Risk				

RIPARIAN FARM ASSESSMENT				
Factor	Factor Rating	Description of Problem	Actions	Timetable for Action
1. Vegetative cover of floodplain & streambanks				
2. Invasive plant species				
3. Disturbance-increaser undesirable herbaceous species				
4. Preferred tree & shrub establishment & regeneration				
5. Use of trees & shrubs				
6. Standing decadent & dead woody material				

RIPARIANT FARM ASSESSMENT				
Factor	Factor Rating	Description of Problem	Actions	Timetable for Action
7. Streambank root mass protection				
8. Human-caused bare ground				
9. Streambank structurally altered by human activity				
10. Reach Structurally Altered by Human Activity (excl. banks)				
11. Stream channel incisement (vertical stability)				

APPENDIX 2 CREDITS

Cover and illustrations on pages 75 and 80 by Elizabeth Saunders, Sandpiper Environmental Consultants, Monarch, Alberta.

Figure on page 14 adapted from: Chaney, E., W. Elmore and W.S. Platts, 1990. **Livestock grazing on western riparian areas.** U.S. EPA 45p

Figures on pages 30, 32, 69, 87, 86 and 92 adapted from: Hansen et al. 2000.

Figure concept by Lorne Fitch, ASRD, Lethbridge: page 33.

Figure on page 56, reprinted from: Daubenmire, R. 1959. **A canopy-coverage method of vegetational analysis.** Northwest Science 33: 43-64.

Figure on page 62, by Darlene Moisey, Public Lands Division, ASRD, Lethbridge

Field sheet concepts by Barry Adams, ASRD, Lethbridge: pages 102, 107 and 108.

APPENDIX 3 REFERENCES

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Caring for the Green Zone – Riparian Areas and Grazing Management. 1995. 2nd Edition. Cows and Fish program, Lethbridge, 40 pages.

Cows and Fish Fact Sheets – available from the Cows and Fish website (www.cowsandfish.org) or contacts:

Cows and Fish Process

Cows and Fish: Facing the Issues

Riparian Health Assessment and Inventory

Getting Past the Talk: Working with Communities

Riparian Health Training

Riparian Demonstration Sites - a guide to selection and development

Biodiversity and Riparian Areas - Life in the Green Zone

Lakes and Wetlands

Water Quality and Riparian Areas

Riparian Profile and Reference Sites

Tools for Riparian Management

Invasive and Disturbance-caused Plants in Riparian Areas

Value of Wetlands

Community Stories

Producer Profiles

Can Cows and Fish Co-Exist? (scientific research paper)

Grasslands Conservation Council (GCC) of BC resources – available from the GCC: http://bcgrasslands.org/resources/

SUGGESTED READINGS AND OTHER REFERENCES

AgriService BC

Telephone: 888 221-7141 E-mail: AgriServiceBC@gov.bc.ca

CULVERTS AND BRIDGES

Land Development Guidelines for the Protection of Aquatic Habitat, BCMOE and DFO, 1992.
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RIPARIAN AREA MANAGEMENT

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Best Management Practices: Farm Forestry and Habitat Management
Hardcopies can be ordered online at ServiceOntario Publications:
http://www.omafra.gov.on.ca/english/environment/bmp/habitat.htm

Best Management Practices: Fish and Wildlife Habitat Management
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Develop with Care: Environmental Guidelines for Urban and Rural Land Development in British Columbia. 2014.
https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/best-management-practices/develop-with-care

Fringe Benefits: A Landowner's Guide to the Value and Stewardship of Riparian Habitat.
http://www.landstewardship.org/resources/resource/295/

Hansen, Paul L., William H. Thompson, Robert C. Ehrhart, Dan K. Hinckley, Bill Haglan, and Karen Price. 2000. ***Development of Methodologies to Evaluate the Health of Riparian and Wetland Areas***. In: Proceedings of the Fifth International Symposium of Fish Physiology, Toxicology and Water Quality, Hong Kong, China, November 10-13, 1998. Vance Thurston, Editor. United States Environmental Protection Agency, Office of Research and Development, Washington, DC, 20460. EPA/600/R-00/015. pp. 233-244

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WEED CONTROL

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APPENDIX 4 GLOSSARY

Accelerated erosion: where the natural rate of erosion has been increased due to changes to the increased water flows, inadequate riparian vegetation and other causes.

Action plan: An Action plan is prepared in the second stage of species recovery and outlines the specific measures to be taken on the ground to implement the recovery strategy.

Active channel: the width of the watercourse when its banks are full. Generally, that part of the watercourse where riparian vegetation does not become established.

Active floodplain: the area of land beyond the banks that is flooded every 2 to 3 years.

Algae: aquatic plants that lack true stems, roots or leaves and are often green, blue-green or brown in colour.

Algal blooms: rapid growth of algae in water due to high nutrient levels.

Aquatic weeds: undesirable plants that grow in the water like Eurasian Watermilfoil.

Authorized dyke: a structure constructed to prevent flooding and authorized by a municipality, Dyking Authority, , ENV or FLNRORD.

Baffles: concrete pieces or other material on the bottom of culverts used to interrupt water flow, control water speed and provide resting areas for fish.

Baseflow: the average stream flow during low flow conditions.

Bed-level structure: a structure designed to protect the stream banks and bed from livestock and machinery damage and is at the same level as the streambed. This may be a mix of large and small rocks buried in the substrate so that their highest point is the same level as the stream bed which prevents cattle and machinery from disturbing the substrate.

Biodiversity: refers to life in all its forms and the habitats and natural processes that support life. It encompasses: **Genetic diversity,** meaning the genetic variation among individuals of the same species; **Species diversity**, meaning the number of different plants, animals, fungi, and simple organisms such as bacteria and protozoa; and **Ecosystem diversity,** which includes the variety of ecosystems and the different ways they function.

Blue-listed: List of ecological communities, indigenous species and subspecies that are of special concern (formerly vulnerable) in BC. Blue-listed elements are at risk, but are not Extirpated, Endangered or Threatened. As determined by the Conservation Data Centre.

Buffer: A specially managed area that is used to separate farm activities from sensitive areas, such as a strip of crop vegetation, often grass or trees; some can act as a "treatment system" to remove contaminates before they reach the sensitive area such as a stream or wetland.

Bypass: a small watercourse built to allow fish to swim past a dam.

Canopy: a layer of trees and shrubs that closes over the stream from both banks to form an insulating cover that moderates wind, sunlight, humidity and temperature.

Canopy cover: the ground area covered by vegetative growth. Different plant species can provide varying degrees of cover depending on their overall size and abundance.

Critical site: one that may be sensitive, or already has some specific problems, for assessment.

Concentrated overland flow: where water flowing from upland areas changes from a sheet into narrower, faster channels.

Conservation status rank: A code that identifies the level of concern about risk to a species or ecological community in the Province. Based on their conservation status rank, each species and ecological community is assigned to the red, blue, or yellow list to define their status and help set conservation priorities

Continuity: where the riparian vegetation is uninterrupted by gaps, breaks, or areas of bare ground.

Corridor: A travel route that connects areas of plant and wildlife habitat, permits plant and wildlife movement across agricultural land, and provides food, shelter and protection from predators for organisms.

Critical habitat: The habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or action plan for the species. The prohibition on destruction of critical habitat applies to endangered and threatened species and species of special concern are not covered.

Disturbance-caused undesirable herbaceous species: native or introduced non-woody plant species that are well adapted to disturbance or an environment of continual stress.

Deep binding roots: the type of plant roots that hold together most of the shore or banks, in the face of regular waves, runoff and flooding.

Ecosystem function: is the role that any process, species, population, or physical attribute plays in the interrelation between living or non-living components of ecosystems. For example, some song birds play a role in pest control by significantly influencing budworm populations. The mycorrhizae fungi growing around tree roots increases their capacity to absorb water and nutrients. Large dead standing trees provide roosting or nesting sites for a variety of large birds. When old trees blow into streams and brooks they break up the water flow to create important aquatic habitat.. A healthy functioning riparian area depends on maintaining all it's component parts.

Endangered: A species facing imminent extirpation or extinction; as designated by the BC Wildlife Act and/or the Committee on the Status of Endangered Wildlife in Canada.

Extinct: A species that no longer exists; as designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

Extirpated: A species that no longer exists in the wild in British Columbia, but does occur elsewhere. Ecological communities that no longer exist in British Columbia, but do occur elsewhere.

Fish ladder: a structure built to allow fish to swim past a dam in the watercourse.

Fouling: to dirty the water with urine, manure or runoff from manure.

Freshet: a sudden rise or overflow as a result of heavy rains or rapidly melting snow.

Gullies: a furrow, channel, or miniature valley, usually with steep side through which water commonly flows during and immediately after rains or snow melt.

Habitat: The air, soil, water, food and cover components of the environment on which a plant or animal depend directly or indirectly in order to carry out their life processes such as eating, staying safe from predators, and reproducing.

Habitat restoration: Returning disturbed areas to native habitat through removal of non-native species and/or restoration of native species. Ideally, ecosystem functions will return when habitat is restored (see also Native habitat).

Human-caused bare ground: areas devoid of vegetation as a result of human activity. This can include vehicle roads, recreational and livestock trails.

Integrated Riparian Management: Riparian buffers are managed forest and shrubs in areas bordering lakes, streams, rivers, and wetlands. Integrated riparian management systems are used to enhance and protect aquatic and riparian resources as well as generating income from timber and non-timber forest products. Similar to shelter and timberbelts, integrated riparian management systems can employ a wide variety of tree and shrub species, with specific plantings tailored to suit the specific growing conditions and production opportunities.

Irrigation Management Plan: Assists producers with optimizing water use, hence improving water management during drought, long-term climate change and competing uses for water resources. See page 9-15 in the Canada-BC Environmental Farm Plan Reference Guide and the EFP Irrigation System Assessment Guide.

Invasive plants: undesirable plants, usually found on disturbed soils, that invade and replace native plants.

Keystone species: Species that support ecosystem function in a unique and significant manner through their activities; the effect is disproportionate to their numerical abundance. Their removal initiates changes in ecosystem structure and often loss of diversity. Examples of keystone species are salmon, badgers, grizzly bears, Pileated Woodpeckers, and whitebark pine.

Leaf litter: freshly fallen or decomposing vegetation, such as leaves.

Lentic: this term means standing or still water (i.e. lakes, wetlands and sloughs).

Listed: A species that is included on the federal Species at Risk List and is legally protected under the federal Species at Risk Act (in Schedule 1 to the Act).

Lotic: this term means flowing water (i.e. streams and rivers).

Meander: a sinuosity or loop-like bend in a stream related to flow & discharge rate.

Managed access: the duration, timing and intensity of livestock access to the watercourse and riparian area is controlled to minimize the impact on water quality and the health of the riparian area.

Native species: [from the BC Wildlife Amendment Act 2004] A species that is (a) indigenous to BC, or (b) has extended its range into BC from another part of North America, unless the species was introduced by human intervention or activities, or any part of the extension of its range within North America was aided by human intervention or activities. Native species refer to species that naturally occur in an area, such as antelope sage brush in the Okanagan. Native species includes plants and animals.

Not at Risk: A species that has been evaluated and found to be not at risk; as designated by the Committee on the Status of Endangered Wildlife in Canada.

Noxious weed: [from the Weed Control Act] A weed designated by regulation to be a noxious weed, and includes the seeds of the noxious weed; specified in Weed Control Regulation, Schedule A. Noxious weeds are typically non-native plants that have been introduced to BC without insect predators and plant pathogens to keep them under control.

Nutrients: Such as nitrogen and phosphorus found in manure and chemical fertilizers.

Outlet pool: a pool of water located at the culvert outlet designed to maintain water depth during low flow and slow water velocity during high flow.

Pathogens: any virus, microorganism or other substance that causes disease.

Pioneer species: plant species that are early or first to establish on recently made available habitat (eg. bare soil patch). Often these are annual weeds, but some native wildflower species, such as fireweed (not actually a weed) are also pioneer species.

Pollutants: contaminants that substantially alter or impair the environment and contravene federal, provincial, and/or municipal regulations.

Pugging and hummocking: the depressions (pugs) and raised mounds of soil (hummocks) resulting from large animals walking through soft or moist soil.

Reach: a stretch of shore assessed for riparian health, with width based on the extent of the riparian area (from open water to the upland) and with length based on selecting a representative or critical site within one management (and ownership) unit.

Recovery strategy: A recovery strategy is prepared in the first stage of species recovery and outlines the overall scientific framework for recovery. Recovery strategies may be mandated under the federal Species at Risk Act.

Red-listed: List of ecological communities, indigenous species and subspecies that are at risk of being lost (extirpated, endangered or threatened) in BC. Determined by the BC Conservation Data Centre.

Refugia: Areas that remain unchanged while surrounding areas change markedly; the unchanged areas thereby provide refuges for species that require specific habitats.

Representative site: a site that is typical of a much longer stretch of shore and that will provide an overall impression of health for that longer area.

Rills: a small channel created on steep slopes by water erosion, intermediate between sheet erosion and formation of gullies.

Riparian, area or zone: (a) transition area between watercourses and the surrounding, usually drier, upland areas, (b) the area of land that is adjacent to a stream, river, lake or wetland, and contains vegetation that, due to the presence of water, is distinctly different from the vegetation of adjacent upland; in dry locations, is easily identified by the green vegetation in contrast to the browns and yellows of the drier uplands.

Riparian Management Plan: Assist producers with the management and restoration of riparian habitat in agricultural areas. See page 7-10 in the Canada-BC Environmental Farm Plan Reference Guide and the EFP Riparian Management Field Workbook.

Riparian vegetation: Plant communities dependent upon the presence of free water near the ground surface (high water table).

Rutting: the compacted trails or ruts from people, vehicles or livestock, with trails compressed more than 5 cm (2 in) deep.

Scalloped: bank edge is curvy due to breaking or caving off of pieces of bank.

Scour: erosion that occurs along the banks and beds of streams through water action.

Sedges: plants with triangular jointless stems, a spiked flowering shoot, and long grass-like leaves.

Sediments: soil particles suspended in the water giving the water a cloudy appearance.

Sensitive Ecosystem Inventories (SEI): Systematically identifies and maps rare and fragile ecosystems in a given area. The purpose is to identify remnants of rare and fragile terrestrial ecosystems and to encourage land use decisions that will ensure the continued integrity of these ecosystems. Project by the BC Ministry of Environment.

Shelterbelt: Windbreak of living trees and shrubs established and maintained for protection of farm lands or buildings (see also Windbreak).

Sheet flow: where water flow from the upland is spread out like a sheet on the land.

Shrubs: woody plants that are usually multi-stemmed.

Slumping: collapse of an area of the bank.

Sloughing: breaking off of pieces of bank.

Snag: Any standing dead, dying, or defective tree that is at least three metres tall.

Species of special concern: A wildlife species that may become a threatened or endangered species because of a combination of biological characteristics and identified threats. Special concern was formerly referred to as "vulnerable" in BC. Species of special concern are designated by the Committee on the Status of Endangered Wildlife in Canada.

Species: [from the BC Wildlife Amendment Act 2004] A species, subspecies, variety or genetically or geographically distinct population of (a) animals, (b) fish, (c) plants, or (d) other organisms, except bacteria and viruses.

Species at risk: Plants and animals (insects, fish, amphibians, reptiles, birds, mammals) that are extirpated, endangered, or threatened in the province, or those considered to be of special concern (formerly called vulnerable in British Columbia). Species at risk can include mammals, fish, birds, reptiles, amphibians, insects, molluscs, vascular plants, mosses and lichens.

Species diversity: The variety of species.

Species richness: The number of species present in a given area.

Stewardship: The conducting, supervising or managing of something, especially the careful and responsible management of something entrusted to one's care. For example, stewardship of biodiversity on agricultural land.

Structural alteration: Physical changes to the shape or contour of the shore or banks caused by human influences. Some examples are livestock trampling, riprap and excavation.

Threatened: A wildlife species that is likely to become an endangered species if nothing is done to reverse the factors leading to its extirpation or extinction; as designated by the BC Wildlife Act and/or the Committee on the Status of Endangered Wildlife in Canada.

Tree and shrub regeneration: the presence of seedlings and saplings, or the new growth.

Tree and shrub utilisation: browse (eating by animals), rubbing off, or cutting/removal of woody growth on trees and shrubs (only utilisation of second year and older growth included in the riparian health assessment.

Unpalatable plants: plants not normally eaten by livestock. Examples include silver sagebrush, black greasewood, buttercup and conifers.

Vigour: active and healthy growth.

Water infiltration: the flow of water into the ground through small pores or openings in the soil.

Watershed: the area of land that drains into a single waterbody. While a small wetland will usually have a small watershed or drainage basin, a large river will have a very large watershed, composed of many smaller watersheds of other waterbodies.

Weed: Any plant that is growing where it is not wanted and/or crowds out cultivated plants. Weeds can also crowd out desirable native plants. For information on how to identify common BC weeds, see Guide to Weeds in BC and Field Guide to Noxious and other Selected Weeds of British Columbia

Wetland: (a) area of wet soil that is inundated or saturated long enough to promote wetland or aquatic processes as indicated by the presence of poorly drained soils, hydrophytic (water loving) plants, and various kinds of biological activity adapted to a wet environment; (b) [from the Forest Practices Code of BC Act] swamp, marsh, bog or other similar area that supports natural vegetation that is distinct from adjacent upland areas.

Wet meadow: a class of wetland having mineral soils which are periodically saturated. The dominant vegetation consists of water tolerant grasses, sedges, rushes

Wildlife: [from the Wildlife Act] Raptors, threatened species, endangered species, game or other species of vertebrates prescribed as wildlife and includes fish, but does not include species at risk.

Wildlife feature: Habitat components that support wildlife species (see also Habitat). For example, trees with nesting cavities, rock piles, downed logs, underground burrows. Can also include constructed features such as bird feeders, nesting boxes and bat houses.

Woody plant species: refers to trees and shrubs. These plants serve different riparian functions than grasses and broad-leaf plants, since they are typically more resilient and longer-lived, with deeper root systems.

Yellow-listed: List of indigenous species and ecological communities that are at the least risk of being lost in British Columbia.

APPENDIX 5

Invasive and Disturbance-Caused Undesirable Species for Riparian Health Assessments

Why have detailed species lists for invasive and disturbance-caused undesirable plants?

A comprehensive list of invasive and disturbance-induced species is necessary for riparian inventory and assessment. In order to accurately determine the health of a riparian area, those completing the assessments need to know which plant species in the native plant community would be present with natural disturbance and which would not. In other words, which ones are disturbance-induced species (native or introduced, they increase or become more prevalent due to higher than natural levels of disturbance or activities) and which are invasive (usually non-natives). Both of these can be classified as weeds. In addition to the potential economic losses to land managers from weeds, weeds may be vigorous competitors that prevent a healthy, native riparian community from providing important riparian functions like sediment trapping, bank stabilization and filtration.

Disturbance-Caused Undesirable Species

Disturbance-caused undesirable herbaceous species is a term used in Riparian Health Assessments to include most nuisance weeds as well as many other plant species that respond to site disturbance. Disturbance-caused undesirable species include native and non-native species that tend to increase with site disturbance, and are regarded as undesirable because they do not perform optimal riparian functions (e.g. provide deep-binding root mass for bank protection). Such site disturbance is often linked to a downward trend for plant communities from the potential natural community, and reduced riparian function or "health".

Invasive Species

Invasive weeds can usually be found on the noxious weed list due to their aggressive nature and it is important to control the spread of these weeds: left uncontrolled, these weeds may eventually create an unnatural monoculture. Because a monoculture consists of only one species, it provides minimal structural and habitat diversity, which may reduce or limit the ability of that area to provide wildlife habitat or perform ecological functions. Invasive non-native plants severely impact wildlife by replacing the vegetation they utilize for shelter or food. Invasives compete for nutrients, water and sunlight normally available to native plant species. Some have the ability to alter soil chemistry with subtle but harmful effects on native plant species, and consequently, the animals that rely upon them. Invasive weed invasions may result in more runoff and erosion because weeds generally do not provide adequate ground cover and lack deep, soil-binding root systems. Agricultural production, stream flow during dry periods, and wildlife habitat may be reduced or even eliminated. If you consider all of these negative effects, you can well imagine the millions of dollars lost to the British Columbia economy each year if these invasive weeds are left uncontrolled.

How to use this species list

This invasive (I) and disturbance (D) -caused undesirable species list was developed in conjunction with information from the *B.C. Weed Control Act* and Schedule and the Invasive Plant Council of B.C. There may be other invasive or disturbance-caused species or you may find that some species respond differently to disturbance, depending on the region you are working in. This list includes species that have been found to be invasive or disturbance-caused undesirable species in other adjacent jurisdictions as these may show up in British Columbia.

Latin Name	Common Name	Riparian Health Plant Category
Abutilion theophrasti	Velvetleaf	I
Acroptilon repens	Russian knapweed	I
Aegilops cylindrical	Jointed Goatgrass	I
Agropyron repens	Quackgrass	D
Amaranthus retroflexus	Redroot pigweed	D
Amaranthus albus	Tumble pigweed	D
Anchusa officinalis	Common bugloss	I
Antennaria spp	Pussy Toes and Everlasting	D
Anthriscus sylvestris	Wild Chervil	I
Apocynum androsaemifolium	Spreading dogbane	D
Arctium spp	Common burdock	I
Artemisia absinthium	Absinth	D
Asclepias speciosa	Showy Milkweed	D
Avena fatua	Wild oats	D
Avena sativa	Oats	D
Berteroa incana	Hoary Alyssum	I
Bidens cernua	Nodding Beggarticks	D
Bidens spp	Devil's beggarticks	D
Brassica napus	Canola (Argentine)	D
Brassica rapa	Canola (Polish)	D
Bromus inermis	Smooth Brome	D
Bromus japonicus	Japanese brome	I
Bromus tectorum	Downy brome grass	I
Campanula rapunculoides	Creeping bellflower/ garden bluebell	D
Capsella bursa-pastoris	Shepherd's purse	D
Cardaria spp	Hoary cress	I
Carduus acanthoides	Plumeless thistle	I
Carduus nutans	Nodding thistle	I
Cardaria pubescens	Globe-podded hoary cress	I

Latin Name	Common Name	Riparian Health Plant Category
Centaurea diffusa	Diffuse knapweed	I
Centaurea repens	Russian knapweed	I
Centaurea maculosa	Spotted knapweed	I
Centaurea pratensis	Meadow knapweed	I
Centaurea solstitialis	Yellow star thistle	I
Cerastium spp	Field chickweed	D
Chenopodium album	Lamb's-quarters	D
Chondrilla juncea	Rush Skeletonweed	I
Chrysanthemum leucanthemum	Ox-eye daisy	I
Cichorium intybus	Chicory	D
Cicuta douglasii	Water hemlock	D
Cirsium arvense	Canada thistle	I
Cirsium palustre	Marsh plume thistle	I
Cirsium vulgare	Bull thistle	I
Convolvulus arvensis	Field bindweed	I
Convolvulus sepium	Morning-glory	D
Crepis tectorum	Narrow-leaved hawk's beard	D
Crupina vulgaris	Crupina	I
Cuscuta species	Parasitic dodder	I
Cynoglossum officinale	Hound's tongue	I
Cyperus spp	Yellow & purple nutsedge	I
Cytisus scoparius	Scotch broom	D
Descurainia spp	Green & gray tansy mustard	D
Descurainia sophia	Flixweed	D
Echinochloa crusgalli	Barnyard grass	D
Echium vulgare	Blueweed	I
Elaeagnus angustifolia	Russian olive	I
Equisetum arvense	Field horsetail	D
Equisetum arvense	Field horsetail	D

Latin Name	Common Name	Riparian Health Plant Category
Erodium cicutarium	Stork's bill	D
Erucastrum gallicum	Dog mustard	D
Erysimum cheiranthoides	Wormseed mustard	D
Euphorbia cyparissias	Cypress spurge	I
Euphorbia esula	Leafy spurge	I
Fagopyrum tataricum	Tartary buckwheat	I
Fragaria spp	Strawberries	D
Galeopsis tetrahit	Hemp-nettle	D
Galium aparine	Cleavers	I
Galium spurium	False cleavers	I
Gnaphalium uliginosum	Cudweed	D
Grindelia squarrosa	Gumweed	D
Gypsophila paniculata	Baby's breath	I
Hypericum perforatum	St John's wort	
Heracleum mantegazzianum	Giant Hogweed	I
Hieracium aurantiacum	Orange hawkweed	I
Hieracium pilosella	Common hawkweed	D
Hordeum jubatum	Foxtail barley	D
Hordeum vulgare	Barley	D
Hypericum perforatum	St. John's Wort	I
Impatiens glandulifera	Himalayan balsam	D
Iva xanthifolia	False ragweed	D
Juncus effuses	Bog Rush	D
Knautia arvensis	Blue buttons, field scabious	I
Kochia scoparia	Kochia (summer cypress)	D
Lactuca pulchella	Blue lettuce	D
Lactuca serriola	Prickly lettuce	D
Lamium amplexicaule	Henbit	D
Lappula echinata	Bluebur	D

Latin Name	Common Name	Riparian Health Plant Category
Lepidium latifolium	Perennial pepperweed	I
Linaria dalmatica	Dalmation toadflax	I
Linaria vulgaris	Yellow toadflax	I
Lolium persicum	Persian darnel	I
Lychnis alba	White cockle	I
Lythrum spp	Loosestrife species	I
Lythrum salicaria	Purple loosestrife	I
Madia glomerata	Cluster tarweed	D
Malva neglecta	Common mallow	D
Malva rotundifolia	Round-leaved mallow	D
Matricaria maritimaa	Scentless chamomile	D
Matricaria matricariodes	Pineapple weed	D
Melilotus officinalis and alba	Sweet clovers	D
Myriophyllum spicatum	Eurasian water milfoil	I
Neslia paniculata	Ball mustard	D
Odontites serotina	Red bartsia	I
Onopordum acanthium	Scotch thistle	I
Panicum capillare	Witchgrass	D
Phleum pratense	Timothy	D
Pisum sativum	Peas (field)	D
Plantago spp	Plantains	D
Poa annua	Annual Bluegrass	D
Poa pratensis	Kentucky Bluegrass	D
Polygonum convolvulus	Wild buckwheat	D
Polygonum spp	Smartweed, Lady's-thumb	D
Polygonum cuspidatum	Japanese knotweed	I
Polygonum persicaria	Lady's Thumb	D
Potentilla anserine	Silverweed	D
Potentilla norvegica	Rough cinquefoil	D
Potentilla recta	Sulphur cinquefoil	D

Latin Name	Common Name	Riparian Health Plant Category
Ranunculus acris	Tall buttercup	I
Ranunculus repens	Creeping Buttercup	D
Raphanus raphanistrum	Wild radish	D
Rhamnus cathartica	Common buckthorn	I
Rhamnus frangula	Black-alder buckthorn	I
Rhus radicans	Poison-ivy	D
Rumex crispus	Curled dock	D
Salsola kali	Russian thistle	D
Secale cereale	Rye (cereal)	D
Senecio vulgaris	Common groundsel	D
Setaria spp	Green & yellow foxtail	D
Silene cserei	Biennial campion	I
Silene cucubalus	Bladder campion	I
Silene noctiflora	Night-flowering catchfly	D
Sinapis arvensis	Wild mustard	D
Sisymbrium altissimum	Tumble mustard	D
Solanum spp	Nightshade	D
Sonchus asper	Annual Sow-thistle, Spiny	D
Sonchus arvensis	Corn spurry	D
Stellaria media	Common chickweed	D
Tanacetum vulgare	Common Tansy	I
Taraxacum officinale	Dandelion	D
Thlaspi arvense	Stinkweed	D
Tragopogon dubius	Gorse	
Tribulus terrestris	Puncturevine	I
Trifolium spp	Clovers	D
Tritcum aestivum	Wheat	D
Ulex europaeus	Gorse	I
Urtica dioica	Stinging nettle	D

Latin Name	Common Name	Riparian Health Plant Category
Verbascum thapsus	Mullein	D
Vaccaria pyramidata	Cow cockle	D
X Triticosecale	Triticale	D
Xanthium strumarium	cocklebur	D
Medicado lupulina L.	Black medic	D

* Indicates suggested categorization of the species in Riparian Health Assessment/inventories: I-invasive species; D-disturbance-caused undesirable species

NOTE: Other non-native or agronomic species may be 'D' too, but are not listed here. If you find a species that is not listed here but should be considered in riparian health assessment or inventory, record it and note that it was included. Consistency is important.