Riparian Health Inventory Summary
2007

- Moose Mountain Environmental Enhancement Fund Area -

April 2008

Prepared for:

Elbow River Watershed Partnership

Project Area:

Moose Mountain Environmental Enhancement Fund Area

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1 BACKGROUND

In July 2007, the Alberta Riparian Habitat Management Society (Cows and Fish) conducted 13 riparian health inventories in the Moose Mountain Environmental Enhancement Fund (MMEEF) area. The inventories were conducted at the request of the Elbow River Watershed Partnership (ERWP). Funding for this project was provided the ERWP, the MMEEF established by Shell Canada Limited and Husky Energy and Cows and Fish members and supporters. These inventories in combination with others conducted by Cows and Fish in 2007 along the Elbow River and several of its tributaries will help provide the ERWP with an understanding of the current status of riparian health of the Moose Mountain project area. This information can then be used to assist with watershed management planning and ecological restoration or enhancement of riparian health where needed.

The project area lies within Kananaskis Country, owned and administered by the Province of Alberta (Figure 1). It lies primarily within the Sub-Alpine Natural Sub-region of the Rocky Mountains Natural Region but also includes the Montane Natural Sub-region along the Elbow River and lower reaches of some tributaries. The MMEEF area is in a region of Kananaskis Country that is managed through a unique and close partnership between Alberta Tourism, Parks, Recreation and Culture (ATPRC) and Alberta Sustainable Resource Development (ASRD). Many types of activities occur within the project area, including resource exploration and extraction and livestock grazing both requiring permits, as well as various recreational activity managed by ATPRC and ASRD.

Selection of riparian health inventory sites was done in consultation with Sarah Hamza (ERWP Coordinator), Steve Donelon (Heritage Protection Team Leader, ATPRC) and grazing allotment holders (responsible to ASRD Lands Division through management agreements overseen by local Rangeland Agrologist Melissa Schening). Riparian health inventory includes benchmark monitoring photographs taken at the upstream and downstream ends of all inventory sites to facilitate long-term monitoring. Photographs and observational notes were also taken, where appropriate, to record sites where industry funds (through the MMEEF) could be put toward restoring riparian health.

Riparian health inventory is a tool designed to help agencies and individual landowners or managers evaluate and understand the health of riparian areas in the watersheds within their landholdings. The health inventory establishes an important baseline to compare to in the future, to keep track of whether riparian health is being maintained, improving or declining. This summary report provides information on the current health and function of riparian areas as well as suggestions for how grazing allotment holders and government land managers can effectively manage riparian areas along the Elbow River and its tributaries with the MMEEF area. Health ratings and discussion are based on data collected within riparian areas during the 2007 inventory.

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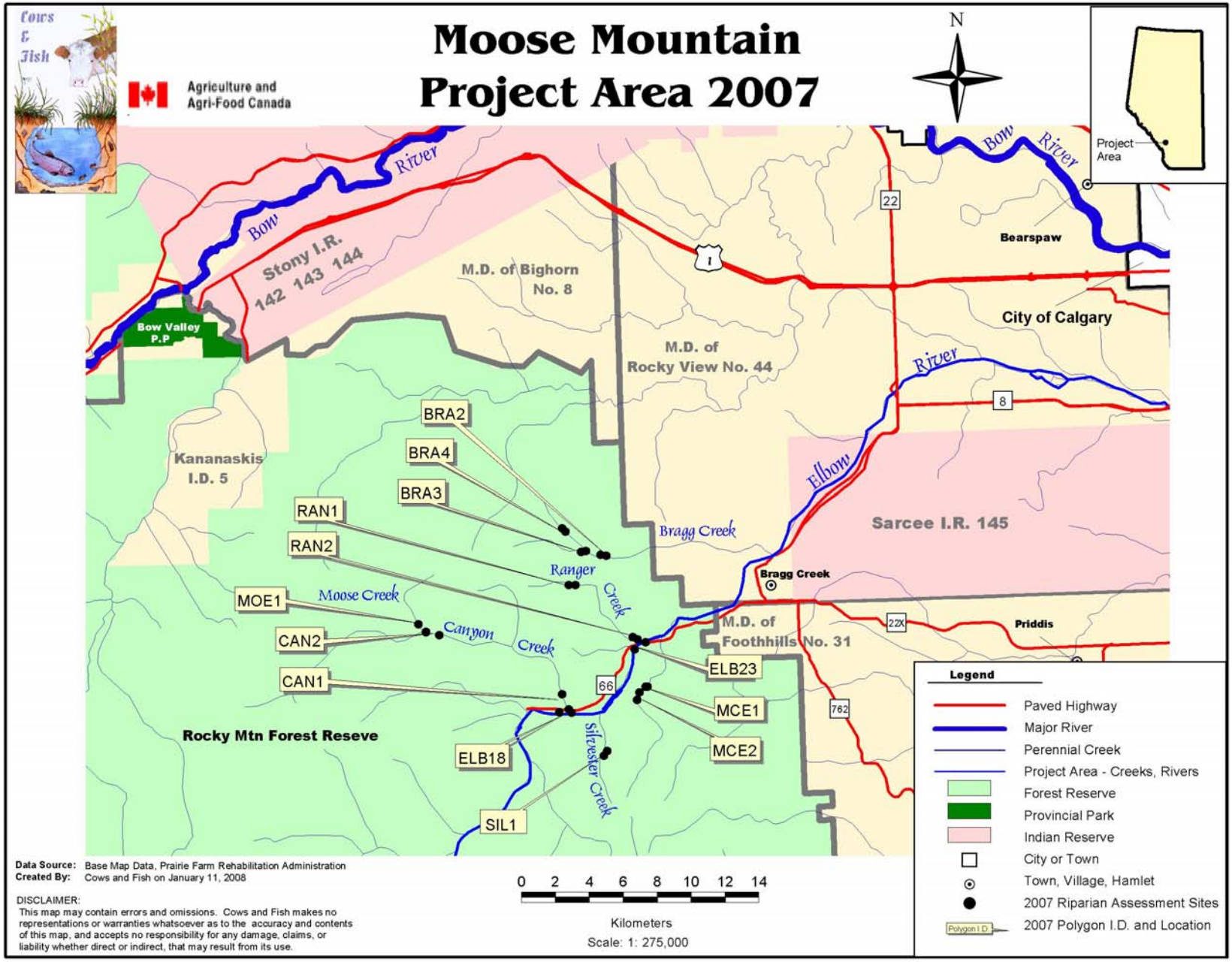

Figure 1 Moose Mountain Environmental Enhancement Fund Project Area (2007)

2 ASSESSING RIPARIAN HEALTH

Riparian areas are the portions of the landscape strongly influenced by water and are recognised by water-loving vegetation along rivers, streams, lakes, springs, ponds and seeps. Riparian areas can be described as the "green zones" around lakes and wetlands and bordering rivers and streams. Healthy riparian areas sustain fish and wildlife populations, provide good water quality and stable water supplies, and support people on the landscape. In doing so they play a role that is disproportionately important to the amount of area that they encompass (approximately 2-5% of the landscape).

Important ecological functions performed by healthy riparian areas include trapping and storing sediment to maintain and build banks, recharging groundwater supplies, providing stable flows and flood protection, and improving water quality by filtering runoff and reducing the amount of contaminants and nutrients reaching the water. Thus, despite occupying only a small percentage of the total land area within a watershed, riparian areas are critical to the long-term sustainability of a healthy landscape.

In general, this information assists managers and local communities to identify and effectively develop non-legislated or voluntary action plans to address specific riparian land use issues within local watersheds. Working together on riparian management issues, including riparian health inventories, displays a proactive message to the public that your community and the agricultural sector in general are taking steps to ensure the health of our landscapes and water supplies are being protected, maintained and improved.

It is emphasized that:

Due to the broad-scale nature of this representative sampling methodology, there may be unique areas of riparian zone within each reach not represented by the overall health rating for that reach.

Riparian health inventories conducted for this project do not address any in-stream, hydrological (i.e. issues associated with water flow regimes, water diversions, extractions, dam impacts) or water quality parameters.

2.1 General Inventory Protocol

Based on the objectives and resources of the Elbow River Watershed Partnership and the MMEEF, it was not possible for every kilometre of stream to be assessed. Using current aerial photography and in consultation with the ERWP, the local watershed was delineated into sections of stream with similar physical, vegetative and management influences. Each section is referred to as a reach. Grazing allotments and recreational areas were identified and inventory sites within those areas were selected after one-on-one discussion with the allotment holders and recreational area managers, who described the different management practices used along the stream.

Riparian health inventories were conducted in July 2007, by a team of one or two members of the Cows and Fish Field Crew. A hand-held Garmin GPS60^{TM} Global Positioning System receiver was used to record the locations of the upstream and downstream ends of the polygon. For monitoring purposes, benchmark photographs looking upstream and downstream were taken at each end of the polygon. Additional photographs were taken where warranted to document features of interest or concern (e.g., weed infestations, bank erosion etc.). The lateral extent of the riparian area was subjectively determined in the field and mapped on an airphoto (1: 5,500 to 1: 15,000 scale).

On creeks and small rivers both sides of the waterbody are inventoried as these generally have the same ownership and type of management. On large river systems only one side of the river is inventoried. Landmarks such as fence lines, tributaries or other identifiable features are used, where possible, to delineate the ends of the polygon in order to facilitate monitoring the same section of stream in the future. Inventory sites encompass a minimum of two meander cycles. A complete meander cycle has equal inside and outside curvature.

During a riparian health inventory, 79 health parameters are examined to provide comprehensive and detailed information on riparian function. A health score is derived from this data (Table 1) and breaks information down into 11 parameters that are used in this report to discuss the riparian health within the MMEEF project area. Six of the parameters relate to vegetation (invasive plants is considered one parameter, however is broken into two parts separating canopy cover and density distribution) and five relate to soil and hydrology. *A more detailed description of each of these 11 parameters and how they are evaluated is given in* ***Appendix D***. By objectively examining each of these health parameters we can determine which pieces are adequately performing the necessary functions of a healthy riparian area, and which are not. This examination provides us with a better understanding of where to concentrate efforts if improvements in riparian management are required, and what land use practices are currently maintaining riparian health.

Riparian areas are complex, dynamic systems that have a variety of attributes or health parameters that perform certain functions. To effectively understand the current status of riparian function we ask a number of questions regarding the functioning condition of the riparian area (Is it *healthy*?). Healthy riparian areas have the following *pieces* intact and functioning properly:

- successful reproduction and establishment of seedling, sapling and mature trees and shrubs (if site has potential to grow them),

- lightly browsed trees and shrubs (by livestock or wildlife),
- floodplains and banks with abundant plant growth,
- banks with deep-rooted plant species (trees and shrubs),
- very few, if any, invasive weeds (e.g. Canada thistle),
- not many disturbance-caused plant species (e.g. Kentucky bluegrass, dandelion),
- very little bare ground or altered banks, and
- ability to frequently (i.e. every few years) access a floodplain at least double the channel width.

These health parameters are like pieces of a puzzle. If all the pieces are intact, a riparian area functions properly or is *healthy* and, for example, provides shelter and forage for livestock and wildlife. When riparian health degrades, one or more of the pieces are impacted by natural or human-caused disturbances such as grazing, flooding or fire. Riparian areas are *healthy but with problems* when a few health parameters experience light to moderate impacts. As the rate and intensity of disturbance increases, the severity of health degradation can reach a point when the riparian area fails to perform its functions properly and becomes *unhealthy*. Generally, it is often difficult to see specific parameters decline in health, especially if the degradation occurs gradually over a long period of time. This health inventory establishes an important baseline to compare to in the future, to keep track of whether riparian health is being maintained, improved or is declining.

Health Category	***Score Ranges***	***Description***
Healthy	*80-100%*	little to no impairment to any riparian functions
Healthy, but with problems	*60-79%*	some impairment to riparian functions due to management or natural causes
Unhealthy	*<60%*	severe impairment to riparian functions due to management or natural causes

Please keep in mind, the objective of completing these riparian health inventories is to provide a coarse filter review of the status of riparian health or function within the project area. The riparian health scores provide a general status of riparian health, not an absolute one. Riparian areas are dynamic and are constantly changing. Because of this natural variability, the range of possible scores in each category is broad and one assessment is only an approximation of health. Inventories over a period of years at the same locations will provide a better picture of whether current management is maintaining, improving or negatively impacting riparian health.

3 Riparian Health Summary

Thirteen polygons were assessed in 4 grazing allotments and 2 recreational areas within the project area. Overall the health of riparian areas within MMEEF is considered in proper functioning condition or *healthy* (86%). The majority of the polygons (9 out of 13) assessed rated *healthy* in relation to the proper functioning condition guidelines within the inventory protocol. Three polygons assessed rated *healthy, but with problems* and one polygon rate *unhealthy*.

Refer to **Appendix A** for derived health scores for the entire project area and **Appendix C** for a glossary of terms used in this report.

Moose Mountain Environmental Enhancement
Project Area: Overall Health (13 polygons)

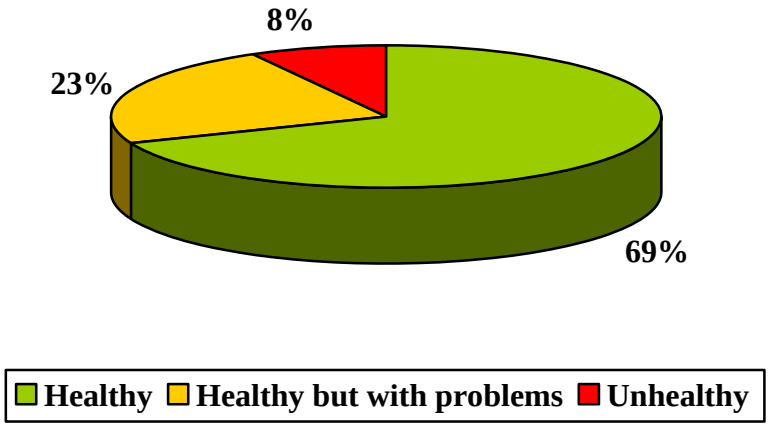

Figure 2 Riparian Health Within MMEEF Project Area.

Vegetative parameters score 85%, *healthy*, for the project area. Riparian areas are well vegetated with a diversity of plant species. Plant communities also display a high amount of structure as evidenced by overlap in life form (plant type) layers. Although there is evidence of human use in riparian areas such as ATV trails, old logging roads and livestock use, most of these impacts were localized so they did not affect the overall health of the parameters. The only exception was utilization due to moderate to heavy browse in 5 of the sites, but most of this was from wildlife use. This level of browse is not too much of a concern in this case because it does not seem to be affecting vegetation cover or regeneration since these parameters were all healthy. Overall, the shrub layer is vigorous and showing excellent regeneration.

Soil/hydrology parameters score 87%, *healthy*, for the project area. Bare ground is limited in most areas, creek banks have good structure with few human-caused alterations and water is not confined to the channel during high flows. Plants that have sufficient root mass to protect banks from erosion are lacking in some areas. Human-caused alterations to the riparian area (excluding streambanks), such as soil compaction, lowered the overall soil/hydrology score. These parameters are outlined in more detail in the following discussion.

Management suggestions for maintaining or improving the health of these sites and other riparian areas within the Moose Mountain project area are given on pages 14 and 15.

Table 1 Project Area Description

Polygon ID	*Location (all W5M)*	*Channel Length / Polygon Area*	*Vegetative Health Rating*	*Soil & Hydrology Health Rating*	*Overall Health Rating*	*Overall Health Description*
Elbow River						
ELB18	SE/SW 15-22-6	0.9 km / 0.9 ha	78%	67%	72%	*Healthy, but with problems*
ELB23	NW 30-22-5	0.9 km / 24.3 ha	63%	37%	49%	*Unhealthy*
Bragg Creek						
BRA2	NW 12-23-6	0.5 km / 3.8 ha	81%	97%	89%	*Healthy*
BRA3	SE/SW 14-23-6	0.3 km / 0.4 ha	89%	100%	95%	*Healthy*
BRA4	NE 15-23-6	0.3 km / 0.6 ha	93%	100%	96%	*Healthy*
Canyon Creek						
CAN1	NW/SW 15-22-6	1.1 km / 3.1 ha	100%	100%	100%	*Healthy*
CAN2	SE/SW 35-22-7	0.9 km / 4.7 ha	89%	93%	91%	*Healthy*
McLean Creek						
MCE1	SW 19-22-5	0.3 km / 3.0 ha	78%	80%	79%	*Healthy, but with problems*
MCE2	NE 13-22-6	0.7 km / 2.4 ha	81%	93%	88%	*Healthy*
Moose Creek						
MOE1	NE34/SW35-22-7	0.8 km / 2.3 ha	96%	100%	98%	*Healthy*
Ranger Creek						
RAN1	NE 3-23-6	0.5 km / 2.1 ha	93%	100%	96%	*Healthy*
RAN2	NE 25-22-6	0.4 km / 1.6 ha	78%	80%	79%	*Healthy, but with problems*
Silvester Creek						
SIL1	NE 2-22-6	0.4 km / 1.0 ha	85%	90%	88%	*Healthy*

3.1 Riparian Plant Communities

A well-known stockman, A.E. Cross, once stated, "Look after the grass, and the grass will look after you." If there is one thing a land manager, landowner or community can do to improve riparian health, it is to keep riparian plant communities healthy by using proper grazing management strategies and land use practices.

A) Background Information on Riparian Plant Communities

Typically, a particular species of willow or other shrub will form the understory of a poplar, cottonwood or spruce species, within a riparian area. On smaller systems willows might be the dominant plant in the upper canopy with sedges and smaller shrubs forming the understory. These different combinations of plants occupying the same ecological niche are referred to as the potential natural community. The potential natural community is comprised of **habitat types** and **community types**. Habitat types have the potential to support 'climax plant communities' or, final state plant communities that are self-perpetuating and in dynamic equilibrium with their environment. Community types have the potential to support 'seral plant communities', or interim plant communities that are replaced by another community or species as succession progresses. Using this classification system, all the plant communities within the project area whether habitat types or community types, were identified and stratified.

Understanding the type of riparian plant communities a stream, lake, or wetland system has the potential to grow is important for a number of reasons. Firstly it allows land managers to know if the desired plant communities are growing there already and if not, why not? How extensive should the plant communities be? Secondly it provides insight into the feasibility of improving existing site conditions and recovering desired and healthier plant communities, if the desired plant community does not exist or is limited. Knowing how far existing plant communities are from the potential natural community of the riparian area allows managers to:

i. set realistic goals to either improve or maintain existing riparian health,
ii. understand how long recovery may take if improvement is needed, and
iii. obtain insight into what management strategies need to be implemented for improvement to occur or to maintain existing riparian health.

B) MMEEF Project Area Riparian Plant Communities

Tree and shrub plant communities form the majority of riparian communities found in the MMEEF project area (Table 2). This indicates a healthy and vigorous riparian plant community. An indicator of a healthy shrub understory is the presence of willows (*Salix spp.*) and red-osier dogwood (*Cornus stolonifera*), highly palatable shrub species. These species are commonly found in Moose Mountain riparian areas. Trees and shrubs have deep, binding roots which are contributing to the streambank stability within the project area.

Most of the project area is occupied by naturally occurring habitat types while only a small portion (<1%) is occupied by disclimax-type[1] communities. Disturbance-caused undesirable

[1] A disclimax-type community occurs when recurring disturbances exert the predominant influence on structure and composition of the vegetation.

species[2] are present in most polygons inventoried but do not dominate the cover of any plant communities and therefore do not constitute enough prominence to be considered a distinct community type. Disturbance-caused plants cover approximately 16% of the project area. The most common disturbance-caused plants found were Kentucky bluegrass (*Poa pratensis*) and timothy (*Phleum pratense*).

Table 2 MMEEF Area Riparian Plant Communities

Plant Community[3]	***Classification***	***Area Occupied (hectares)***	***Area Occupied (%)***
Tree Communities			
white spruce/red-osier dogwood	Habitat Type	13.1	25.9
white spruce/horsetail	Habitat Type	5.0	10.0
white spruce/low-bush cranberry	Habitat Type	6.4	12.8
balsam poplar/herbaceous	Community Type	<0.1	0.1
	Tree Total	**24.5**	**48.8**
Shrub Communities			
beaked willow	Community Type	0.8	1.5
flat-leaved willow/water sedge	Habitat Type	1.2	2.2
	Shrub Total	**2.0**	**3.7**
Unclassified Communities			
unclassified wetland type	Disturbance Type	<0.1	<0.1
unclassified wetland type	Tree/shrub	8.2	16.3
unclassified wetland type	Open water	14.6	29.0
	Unclassified Total	**22.8**	**45.3**

[2] Disturbance-caused undesirable plants 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).

[3] The Riparian Classification for the Parkland and Dry Mixedwood Natural Region (Thompson and Hansen, July 2003) and Riparian Classification for the Grassland Natural Region (Thompson and Hansen, July 2000) were used to classify the riparian plant communities in the MMEEF project area. Riparian classification guides have not been developed for the Rocky Mountain Natural Region and therefore many plant communities were unclassified types.

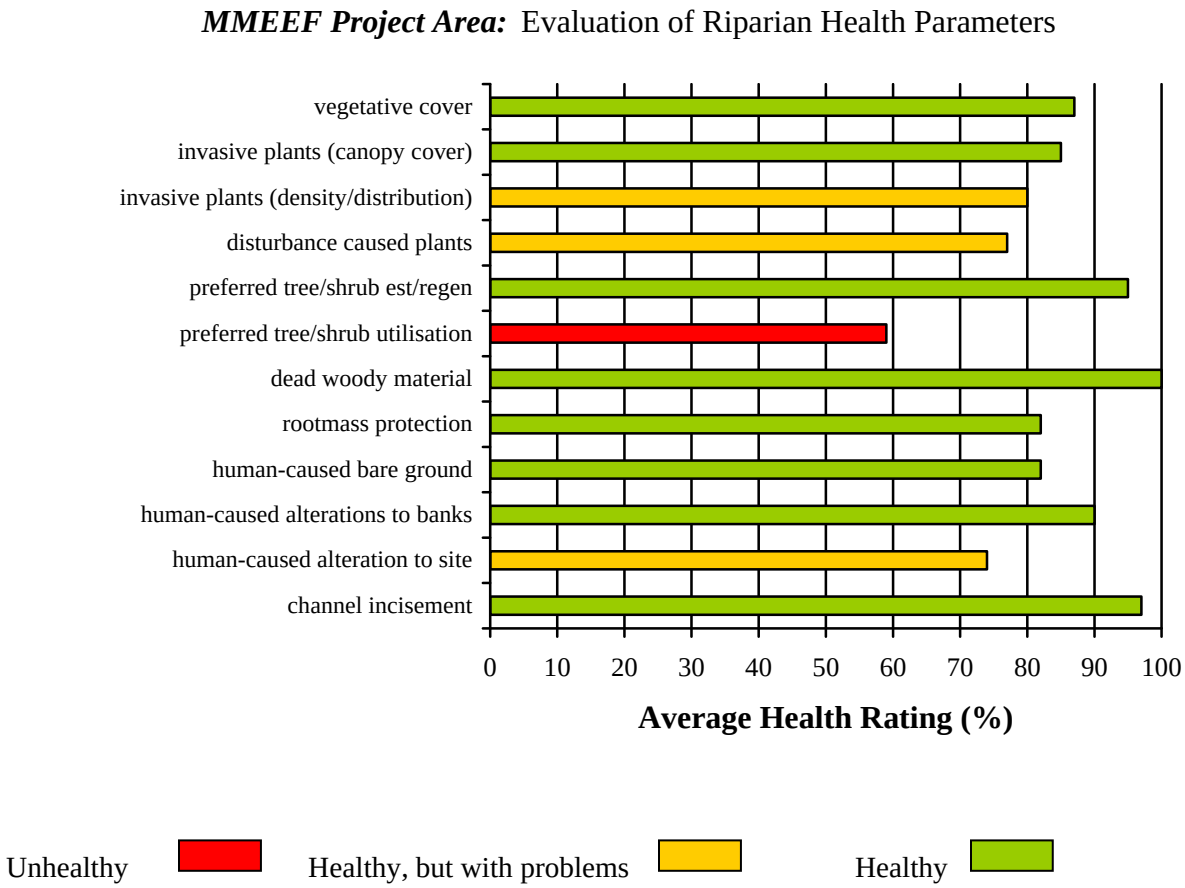

Figure 3 Breakdown of riparian health parameters for the Moose Mountain Project Area.

3.2 Woody Plants - Trees and Shrubs: Presence, Reproduction and Health

The presence of many different tree and shrub species is often a good indicator of structure and diversity. A diversity of plants provides "habitat layers" – low, medium, and high, benefiting wildlife and livestock. Preferred woody plants such as white spruce, poplars and willows were common in most sites. These species displayed good age class structure – young, middle-aged and mature plants were all present.

A good indicator of ecological stability of a riparian reach is the presence of woody plants in all age classes, especially young age classes. To maintain age class structure, at least 15% of the total cover of **preferred**[4] trees and shrubs should be comprised of seedlings and saplings. There are no concerns with the reproduction of preferred trees and shrubs in the project area. Successful preferred tree and shrub reproduction is occurring in every polygon inventoried.

Existing tree and shrub communities show normal amounts of dead and decadent branches in the upper canopy. This indicates there is sufficient moisture within the system, and that disease is not a problem in maintaining these communities. In 62% of polygons (8 of 13), preferred trees

[4] Not all trees and shrubs are equally important, useful or desirable for maintaining ecological function. Only those that contribute most beneficially to riparian condition and stability are considered in evaluating establishment and regeneration. See Appendix D, page 36 for further explanation and a list of excluded species.

and shrubs species are receiving light to no browse pressure. The remainder of polygons are receiving moderate to heavy browse pressure. Woody plants can sustain low levels of use but increased browsing can deplete root reserves and inhibit establishment and regeneration. Two polygons display signs of heavy browse pressure. The indicators of heavy browse pressure are umbrella-shaped mature shrubs and flat-topped or hedged seedling and saplings. Most of the browse use is from wildlife (mainly deer and moose) although some livestock use is evident. The level of browse does not appear to be affecting total vegetation cover, stand vigour or preferred tree and shrub regeneration. Nonetheless, browse use should be monitored to make sure that overall vegetation health is not affected over time.

Trees and shrubs that are considered preferred in terms of riparian health also tend to be those that are most palatable to wildlife and livestock (e.g. red-osier dogwood). Tree and shrub browse from livestock tends to occur most in the fall and winter after grasses have matured or in spring before grass begins growth.

3.3 Non-Woody Plants: Diversity and Health

Greater diversity lends to more robust and steady productivity over the long term and enhanced resilience to changes in the environment. An abundance of diversity in plant species occurs in the Moose Mountain project area. All polygons have adequate amounts of plant cover in the riparian area (greater than 85%) except the Allen Bill Pond site (ELB23). Although there are areas which would naturally be un-vegetated on this gravel and cobble dominated floodplain, it is evident that the development of the recreation area has removed a significant amount of the native vegetation. Tree and shrub plantings are evident throughout the site, however, these will not significantly contribute to the overall vegetative cover until they are better established. Monitoring should continue at this site as it recovers from flood damage and resultant development and remediation.

Disturbance-caused undesirable herbaceous species are found consistently, but are not abundant in the project area. Disturbance plants are typically non-native grasses and forbs (broad-leaved flowering plants) that aggressively displace native plants once the soil surface has been disturbed. Only 3 of the 13 polygons have more than 25% cover of disturbance-caused plants. The majority of sites (7/13) have less than 5% cover of disturbance-caused plants. The most prevalent of these plants are Kentucky bluegrass, smooth brome, and timothy[5]. Although disturbance plants do provide some forage value, they typically do not have a deep, binding root mass and therefore do not provide streambank protection as well as non-disturbance native species. Disturbance plants tend to compete well in areas that experience repeated grazing or other disturbance without sufficient rest between disturbances, but their presence is not always as a result of management at the site. Common, non-native forage species are prolific in livestock feed, reclamation sites (prior to the requirement to use native seed mixes) and road ditches, and therefore easily spread into riparian areas.

[5] Kentucky bluegrass, smooth brome and timothy are tame or introduced species that have invaded many rangelands over the past decades. Opinions vary on how these grasses should be viewed in terms of contributing to riparian or pasture health but generally are thought to reduce long-term productivity. For the purpose of this assessment, points were subtracted for the presence of these non-native species.

Canada thistle (*Cirsium arvense*) was found in about half (6/13) of the polygons. Its distribution and abundance in the riparian area was relatively limited, mostly consisting of few scattered individuals or a single patch. Canada thistle is the only invasive plant that currently occurs in polygons inventoried in the Moose Mountain project area. Invasive plants are those that are listed by the *Weed Control Act of Alberta* as **restricted** or **noxious** weeds. They are non-native species that spread rapidly and are difficult to control.

3.4 Streambanks and Floodplain / Soil and Water:

Stability

The role of streambank vegetation is to maintain the integrity and structure of the bank by dissipating energy, resisting erosion and trapping sediment to build and restore banks. Healthy, well vegetated riparian areas slow the rate of erosion and balance erosion in one spot with bank increases through deposition elsewhere. If unstable banks are occasional, limited to a few outside meander bends, and the banks revegetate within a year, erosion rates are normal. Most of the streambank inventoried in the Moose Mountain project area has adequate amounts of deep, binding root mass. Only 2 polygons (ELB23 and MCE1) have less than 65% of the streambank held together by sufficient plant material to act as deep, binding root mass.

The amount of bare ground in the project area is minimal. Two sites (ELB18 and ELB23) have more than 5% of the riparian area with bare ground. Bare ground is unprotected soil that is capable of being eroded by rain drops, overland flow or wind. Most bare ground in the project area can be attributed to natural processes (sediment deposition from recent flood events) and recreational activity.

Inventories found that high water events periodically access the highest terraces of the floodplain. The Elbow River and tributaries in the Moose Mountain project area are not considered incised (lowering of the channel within its floodplain). Flooding is an important factor in dispersing moisture throughout the riparian area and in the formation of point bars (necessary for riparian vegetation establishment).

Alterations

When a streambank is physically altered erosion can increase, mobilizing channel and bank materials, water quality can deteriorate and instability can increase within the reach and downstream. A key function of riparian areas is to have abundant plants that filter and trap sediments. This builds a soil layer of moist, fine-textured material. Associated with this, roots and underground fauna create soil structure and macropores that allow water infiltration and storage. These types of soils are very susceptible to vehicle traffic, hoof action and compaction.

Overall, streambanks in Moose Mountain project area are in excellent condition. About 10% of the streambank within the project area has structural alterations caused by human activities. These alterations are mostly found within the Elbow River sites (ELB18 and ELB23). The majority of these alterations are due recreational activities (trails and picnic sites) and

construction or remediation (rip rap, clearing vegetation). The remainder of polygons have less than 5% of streambank length altered by human activities.

Physical alterations in the polygon away from the streambanks are minor in the majority of polygons. Eight of 13 polygons have less than 5% of the polygon physically altered by human causes. Soil compaction, topographical changes and development of impervious surfaces as a result of recreational activity and construction accounts for most of the alterations. One polygon (SIL1) has experienced extensive soil compaction as a result of grazing and browsing activity by livestock and wildlife. This health parameter only considers alterations due to human activity (livestock included), but in the case of SIL1 the impacts observed were mostly pugging and hummocking (the depressions and raised mounds of soil resulting from large animals walking through soft or moist soil) and could not be differentiated between livestock and wildlife (particularly moose).

4 THE NEXT STEPS

4.1 Community and Individual Action

The most important aspect of riparian health discussion involves integrating management objectives with riparian management principles.

- ***Take stock of current and past conditions.*** The first step in addressing riparian management issues has been made; the collection of baseline information on riparian health and a review of historical land use practices have answered the question ***"Where are we now?"***
- ***Highlight and profile what's working on the landscape right now.*** The next step is to use this knowledge, along with the application of sound range and riparian management techniques, towards the restoration of riparian health. By working with recreational users, licence and allotment holders that want to improve riparian health, practical examples of proper riparian management can be demonstrated to others. Those that are already managing healthy riparian areas in the area can be profiled, meaning their "good news" stories can be shared with others to speed up our knowledge of what works. As these sites yield results, those with a vested interest in the MMEEF area will be closer to answering the question ***"Where do we want to go?"***
- ***Take control of the reins.*** Every participating resource manager and allotment holder has received a report on the riparian health for their Recreational Area or allotment, indicating what pieces of riparian health are there and what might be missing. Within these reports are some basic management principles specific to their riparian areas, providing insight into the question ***"How do we get there?"***
- ***Continue riparian inventory work over the long-term.*** Monitor progress of community and individual effort to address riparian land use issues. With the application of sound management principles on an individual and watershed basis, it is inevitable that the trend in riparian health will be positive over time. Long-term riparian monitoring and refinement in management will answer the question ***"Did we make it?"***

- A single evaluation cannot define the absolute status of site health. To measure trend (improving, declining or staying the same) monitoring should be pursued in subsequent years -every 3 to 5 years is generally recommended. Establishing demonstration and profile sites or another overall riparian inventory can achieve this.
- Management objectives should include maintaining the existing sedge, tree and shrub communities, especially important indicators like balsam poplar, yellow willow and red-osier dogwood.
- The majority of the Moose Mountain project area has healthy, deep-rooted woody communities. Where healthy tree and shrub communities are lacking due to historic or repeated disturbance, restoration may be slow. However, some improvement should be recognised within a few years, depending on the commitment of the individual, riparian site potential and the riparian management strategy implemented.

The field workbook Riparian Health Assessment for Streams & Small Rivers is available from Cows and Fish. This workbook explains how to conduct a riparian health assessment, or *rapid survey*, to quickly check the health status of your riparian area. This tool will allow individuals and managers to monitor and track their own progress regarding riparian health.

4.2 Management Suggestions to Maintain or Improve Riparian Health

The primary focus of riparian management is to maintain and improve existing plant communities, particularly trees and shrubs where possible. Maintaining physical characteristics of the streambank is also important. Management goals should continue to minimise human and livestock impacts along the banks and aim to maintain the riparian area in a healthy state.

Here is a list of ***general*** management strategies to help maintain or improve riparian health.

- **Monitor recreational/human activities.** Monitor existing recreational activity and infrastructure. Management plans for the area should address appropriate kinds of activities and access. Reclamation of non-designated trails and monitoring to prevent use or proliferation of non-designated trails should also be a component of management plans. Continuing to minimizing or isolating recreation areas while allowing the majority of the floodplain to remain in its natural state will ensure ongoing riparian function.
- **Maintain a riparian zone buffer.** Should logging or other industrial activity occur in this area, the riparian area should be left intact by leaving an appropriately sized buffer. For these sites, leaving a minimum buffer, depending on the site (please refer to the range of riparian widths provided for each site's riparian area description and summary) should protect the riparian area.
- **Monitor and control invasive weeds.** Weed control may be necessary for infestations of these weeds now that they are established. Although Canada thistle was the only invasive plant found in polygons inventoried, monitoring should still be continued as there is potential for them to be brought in from other areas and the presence/abundance of these plants can fluctuate yearly depending on growing conditions. If invasive species are found, contact the Public Lands Agrologist for the area, Melissa Schening (403-297-7364) for control methods that are safe to employ in riparian areas. In

addition, you can review invasive weed identification and control measures on the Alberta Invasive Plant Council website (www.invasiveplants.ab.ca). Watershed groups have also used weed-pulling days to target plants that can be effectively controlled by hand pulling.

- **Reduce cover of disturbance-caused plants.** Disturbance-caused plants such as Kentucky bluegrass and smooth brome can aggressively invade native habitats and impede natural shrub and tree regeneration and establishment. Complete elimination of disturbance-caused plants is not realistic, however, control methods such skim grazing, rest and grazing rotations that favour native plants have been effective in reducing or preventing the expansion of populations. Grazing strategies that avoid early spring and prolonged dormant season grazing tend to favour the growth of woody species. Smooth brome is not shade tolerant and therefore establishment of riparian forest would help to reduce its competitiveness.
- **Increase and maintain vegetation with deep binding root mass along the streambank.** This may be achieved by the continued successful regeneration of trees and shrubs. Tree and shrub establishment can sometimes be impeded by competition from aggressive introduced species. Grazing management can be helpful for improving and maintaining woody plants, e.g. rest and/or temporary fencing in degraded areas. Techniques such as soil bioengineering (Polster 2003[6]) to stabilize a streambank experiencing accelerated erosion may also be useful.
- **Carefully consider erosion control structures.** Regaining bank stability may require the temporary use of erosion control structures, especially where insufficient riparian vegetation exists. Vegetation that binds materials together, strengthens the banks and replaces itself over time should always be a part of the solution. Any stream restoration should be developed in concert with upstream watershed management and with a view to the watershed to see all of the things that contribute to instability.
- **Get to know your watershed.** Watershed activities may alter flow or water levels, impacting your riparian area.

An overview of riparian grazing management principles can be found in Caring for the Green Zone: Riparian areas and Grazing Management (included with this report). Additional copies are available from Cows and Fish. Some grazing management strategies to keep in mind to help maintain riparian health include:

- **Follow stocking rates prescribed by Alberta Sustainable Resource Development, Lands Division.** Ecologically sustainable stocking rates have been determined for these allotments. Stocking rates are set to balance livestock demands with available forage supply while at the same time ensuring healthy plant communities are maintained, soils are protected, and habitat and forage needs of wildlife are met. Stocking rates also need to take into consideration multiple activities that take place in the allotment, including recreation and resource exploration and extraction.

[6] Polster, D.F. 2003. Alternatives for bank stabilization: Literature review. Prepared for Streambank Erosion BMP Steering Committee. Polster Environmental Services Ltd. Lethbridge, Alberta.

- **Give pastures adequate rest during the growing season and minimize use of riparian areas early in the growing season.** Allowing for adequate rest of riparian areas during the growing season is important to allow plants to maintain their vigour and store sufficient energy reserves for survival and reproduction.
- **Manage or avoid grazing on riparian areas during vulnerable periods such as when soils are saturated, to prevent trampling damage.** Monitoring distribution of livestock is important to make sure that they do not linger in riparian areas for extended periods, especially during wet periods when they have the potential to do more damage. Herding or salting practices are ways to encourage livestock to move out of riparian areas.
- **Follow the Grazing Lease Stewardship Code of Practice.** This Code of Practice is available from the Public Lands website (www.srd.gov.ab.ca/lands/managingpublicland). This Code outlines some basic principles and practices of range management that consider good management of riparian areas. Basic responsibilities of leaseholders are also outlined in this report.

5 CLOSING

The Cows and Fish emphasis is to help individuals, municipalities and local communities address riparian management issues on a watershed basis by increasing awareness and obtaining baseline riparian health information. This riparian health assessment enables local communities and managers to identify and effectively develop plans to address specific land use issues. Working locally to develop common goals and objectives for entire watersheds is rewarding – it helps keep people invested in natural landscapes. Riparian management tools developed with the community allow people to improve landscape health, for their benefit and for others who use and enjoy these green zones.

To inquire about additional references for range or pasture management and plant identification and for further information on any aspect of this report, please contact:

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APPENDIX A

Riparian Health Score Sheet – MMEEF Project Area

ELB18

Question	Actual Score	Possible Score
Vegetation		
1. Vegetative Cover of Floodplain and Streambanks	4	6
2a. Invasive Plant Species Canopy Cover	2	3
2b. Invasive Plant Species Density Distribution	2	3
3. Disturbance-Caused Undesireable Herbaceous Species	1	3
4. Preferred Tree and Shrub Establishment and Regeneration	6	6
5. Utilisation of Preferred Trees and Shrubs	3	3
6. Decadent and Dead Woody Material	3	3
Vegetation Subtotal:	21	27
Soil/Hydrology		
7. Streambank Root Mass Protection	4	6
8. Human-Caused Bare Ground	2	6
9. Streambank Structurally Altered	4	6
10. Human Alteration to Polygon	1	3
11. Stream Channel Incisement	9	9
Soil/Hydrology Subtotal:	20	30
Total:	**42**	**57**

Riparian Health Score Sheet – MMEEF Project Area

ELB23

Question	Actual Score	Possible Score
Vegetation		
1. Vegetative Cover of Floodplain and Streambanks	0	6
2a. Invasive Plant Species Canopy Cover	2	3
2b. Invasive Plant Species Density Distribution	2	3
3. Disturbance-Caused Undesireable Herbaceous Species	2	3
4. Preferred Tree and Shrub Establishment and Regeneration	6	6
5. Utilisation of Preferred Trees and Shrubs	2	3
6. Decadent and Dead Woody Material	3	3
Vegetation Subtotal:	17	27
Soil/Hydrology		
7. Streambank Root Mass Protection	0	6
8. Human-Caused Bare Ground	2	6
9. Streambank Structurally Altered	0	6
10. Human Alteration to Polygon	0	3
11. Stream Channel Incisement	9	9
Soil/Hydrology Subtotal:	11	30
Total:	**28**	**57**

Riparian Health Score Sheet – MMEEF Project Area

BRA2

Question	Actual Score	Possible Score
Vegetation		
1. Vegetative Cover of Floodplain and Streambanks	6	6
2a. Invasive Plant Species Canopy Cover	2	3
2b. Invasive Plant Species Density Distribution	2	3
3. Disturbance-Caused Undesireable Herbaceous Species	1	3
4. Preferred Tree and Shrub Establishment and Regeneration	6	6
5. Utilisation of Preferred Trees and Shrubs	2	3
6. Decadent and Dead Woody Material	3	3
Vegetation Subtotal:	22	27
Soil/Hydrology		
7. Streambank Root Mass Protection	6	6
8. Human-Caused Bare Ground	6	6
9. Streambank Structurally Altered	6	6
10. Human Alteration to Polygon	2	3
11. Stream Channel Incisement	9	9
Soil/Hydrology Subtotal:	29	30
Total:	**51**	**57**

Riparian Health Score Sheet – MMEEF Project Area

BRA3

Question	Actual Score	Possible Score
Vegetation		
1. Vegetative Cover of Floodplain and Streambanks	6	6
2a. Invasive Plant Species Canopy Cover	3	3
2b. Invasive Plant Species Density Distribution	3	3
3. Disturbance-Caused Undesireable Herbaceous Species	3	3
4. Preferred Tree and Shrub Establishment and Regeneration	6	6
5. Utilisation of Preferred Trees and Shrubs	0	3
6. Decadent and Dead Woody Material	3	3
Vegetation Subtotal:	24	27
Soil/Hydrology		
7. Streambank Root Mass Protection	6	6
8. Human-Caused Bare Ground	6	6
9. Streambank Structurally Altered	6	6
10. Human Alteration to Polygon	3	3
11. Stream Channel Incisement	9	9
Soil/Hydrology Subtotal:	30	30
Total:	**54**	**57**

Riparian Health Score Sheet – MMEEF Project Area

BRA4

Question	Actual Score	Possible Score
Vegetation		
1. Vegetative Cover of Floodplain and Streambanks	6	6
2a. Invasive Plant Species Canopy Cover	3	3
2b. Invasive Plant Species Density Distribution	3	3
3. Disturbance-Caused Undesireable Herbaceous Species	3	3
4. Preferred Tree and Shrub Establishment and Regeneration	6	6
5. Utilisation of Preferred Trees and Shrubs	1	3
6. Decadent and Dead Woody Material	3	3
Vegetation Subtotal:	25	27
Soil/Hydrology		
7. Streambank Root Mass Protection	6	6
8. Human-Caused Bare Ground	6	6
9. Streambank Structurally Altered	6	6
10. Human Alteration to Polygon	3	3
11. Stream Channel Incisement	9	9
Soil/Hydrology Subtotal:	30	30
Total:	**55**	**57**

Riparian Health Score Sheet – MMEEF Project Area

CAN1

Question	Actual Score	Possible Score
Vegetation		
1. Vegetative Cover of Floodplain and Streambanks	6	6
2a. Invasive Plant Species Canopy Cover	3	3
2b. Invasive Plant Species Density Distribution	3	3
3. Disturbance-Caused Undesireable Herbaceous Species	3	3
4. Preferred Tree and Shrub Establishment and Regeneration	6	6
5. Utilisation of Preferred Trees and Shrubs	3	3
6. Decadent and Dead Woody Material	3	3
Vegetation Subtotal:	27	27
Soil/Hydrology		
7. Streambank Root Mass Protection	6	6
8. Human-Caused Bare Ground	6	6
9. Streambank Structurally Altered	6	6
10. Human Alteration to Polygon	3	3
11. Stream Channel Incisement	9	9
Soil/Hydrology Subtotal:	30	30
Total:	**57**	**57**

Riparian Health Score Sheet – MMEEF Project Area

CAN2

Question	Actual Score	Possible Score
Vegetation		
1. Vegetative Cover of Floodplain and Streambanks	4	6
2a. Invasive Plant Species Canopy Cover	3	3
2b. Invasive Plant Species Density Distribution	3	3
3. Disturbance-Caused Undesireable Herbaceous Species	3	3
4. Preferred Tree and Shrub Establishment and Regeneration	6	6
5. Utilisation of Preferred Trees and Shrubs	2	3
6. Decadent and Dead Woody Material	3	3
Vegetation Subtotal:	24	27
Soil/Hydrology		
7. Streambank Root Mass Protection	6	6
8. Human-Caused Bare Ground	4	6
9. Streambank Structurally Altered	6	6
10. Human Alteration to Polygon	3	3
11. Stream Channel Incisement	9	9
Soil/Hydrology Subtotal:	28	30
Total:	**52**	**57**

Riparian Health Score Sheet – MMEEF Project Area

MCE1

Question	Actual Score	Possible Score
Vegetation		
1. Vegetative Cover of Floodplain and Streambanks	6	6
2a. Invasive Plant Species Canopy Cover	2	3
2b. Invasive Plant Species Density Distribution	1	3
3. Disturbance-Caused Undesireable Herbaceous Species	2	3
4. Preferred Tree and Shrub Establishment and Regeneration	6	6
5. Utilisation of Preferred Trees and Shrubs	1	3
6. Decadent and Dead Woody Material	3	3
Vegetation Subtotal:	21	27
Soil/Hydrology		
7. Streambank Root Mass Protection	2	6
8. Human-Caused Bare Ground	4	6
9. Streambank Structurally Altered	6	6
10. Human Alteration to Polygon	3	3
11. Stream Channel Incisement	9	9
Soil/Hydrology Subtotal:	24	30
Project Area Total:	**45**	**57**

Riparian Health Score Sheet – MMEEF Project Area

MCE2

Question	Actual Score	Possible Score
Vegetation		
1. Vegetative Cover of Floodplain and Streambanks	6	6
2a. Invasive Plant Species Canopy Cover	2	3
2b. Invasive Plant Species Density Distribution	1	3
3. Disturbance-Caused Undesireable Herbaceous Species	3	3
4. Preferred Tree and Shrub Establishment and Regeneration	6	6
5. Utilisation of Preferred Trees and Shrubs	1	3
6. Decadent and Dead Woody Material	3	3
Vegetation Subtotal:	22	27
Soil/Hydrology		
7. Streambank Root Mass Protection	6	6
8. Human-Caused Bare Ground	4	6
9. Streambank Structurally Altered	6	6
10. Human Alteration to Polygon	3	3
11. Stream Channel Incisement	9	9
Soil/Hydrology Subtotal:	28	30
Total:	**50**	**57**

Riparian Health Score Sheet – MMEEF Project Area

MOE1

Question	Actual Score	Possible Score
Vegetation		
1. Vegetative Cover of Floodplain and Streambanks	6	6
2a. Invasive Plant Species Canopy Cover	3	3
2b. Invasive Plant Species Density Distribution	3	3
3. Disturbance-Caused Undesireable Herbaceous Species	3	3
4. Preferred Tree and Shrub Establishment and Regeneration	6	6
5. Utilisation of Preferred Trees and Shrubs	2	3
6. Decadent and Dead Woody Material	3	3
Vegetation Subtotal:	26	27
Soil/Hydrology		
7. Streambank Root Mass Protection	6	6
8. Human-Caused Bare Ground	6	6
9. Streambank Structurally Altered	6	6
10. Human Alteration to Polygon	3	3
11. Stream Channel Incisement	9	9
Soil/Hydrology Subtotal:	30	30
Total:	**56**	**57**

Riparian Health Score Sheet – MMEEF Project Area

RAN1

Question	Actual Score	Possible Score
Vegetation		
1. Vegetative Cover of Floodplain and Streambanks	6	6
2a. Invasive Plant Species Canopy Cover	3	3
2b. Invasive Plant Species Density Distribution	3	3
3. Disturbance-Caused Undesireable Herbaceous Species	3	3
4. Preferred Tree and Shrub Establishment and Regeneration	4	6
5. Utilisation of Preferred Trees and Shrubs	3	3
6. Decadent and Dead Woody Material	3	3
Vegetation Subtotal:	25	27
Soil/Hydrology		
7. Streambank Root Mass Protection	6	6
8. Human-Caused Bare Ground	6	6
9. Streambank Structurally Altered	6	6
10. Human Alteration to Polygon	3	3
11. Stream Channel Incisement	9	9
Soil/Hydrology Subtotal:	30	30
Total:	**55**	**57**

Riparian Health Score Sheet – MMEEF Project Area

RAN2

Question	Actual Score	Possible Score
Vegetation		
1. Vegetative Cover of Floodplain and Streambanks	6	6
2a. Invasive Plant Species Canopy Cover	2	3
2b. Invasive Plant Species Density Distribution	2	3
3. Disturbance-Caused Undesireable Herbaceous Species	1	3
4. Preferred Tree and Shrub Establishment and Regeneration	4	6
5. Utilisation of Preferred Trees and Shrubs	3	3
6. Decadent and Dead Woody Material	3	3
Vegetation Subtotal:	21	27
Soil/Hydrology		
7. Streambank Root Mass Protection	4	6
8. Human-Caused Bare Ground	6	6
9. Streambank Structurally Altered	6	6
10. Human Alteration to Polygon	2	3
11. Stream Channel Incisement	6	9
Soil/Hydrology Subtotal:	24	30
Total:	**45**	**57**

Riparian Health Score Sheet – MMEEF Project Area

SIL1

Question	Actual Score	Possible Score
Vegetation		
1. Vegetative Cover of Floodplain and Streambanks	6	6
2a. Invasive Plant Species Canopy Cover	3	3
2b. Invasive Plant Species Density Distribution	3	3
3. Disturbance-Caused Undesireable Herbaceous Species	2	3
4. Preferred Tree and Shrub Establishment and Regeneration	6	6
5. Utilisation of Preferred Trees and Shrubs	0	3
6. Decadent and Dead Woody Material	3	3
Vegetation Subtotal:	23	27
Soil/Hydrology		
7. Streambank Root Mass Protection	6	6
8. Human-Caused Bare Ground	6	6
9. Streambank Structurally Altered	6	6
10. Human Alteration to Polygon	0	3
11. Stream Channel Incisement	9	9
Soil/Hydrology Subtotal:	27	30
Total:	**50**	**57**

APPENDIX B

GPS Location Coordinates

*Location co-ordinates for the upper and lower ends of all polygons within the MMEEF project area (all Zone 11)**

	Upper End		*Lower End*	
Polygon	***Easting***	***Northing***	***Easting***	***Northing***
ELB18	657718	5637361	658454	5637336
ELB23	662166	5641075	662828	5641494
BRA2	660168	5646671	660483	5646592
BRA3	659003	5646818	659307	5646872
BRA4	657894	5648238	658086	5648028
CAN1	657888	5638411	658275	5637535
CAN2	649878	5642078	650668	5641919
MCE1	662803	5638858	662918	5638860
MCE2	662300	5638087	662457	5638535
MOE1	649440	5642553	649881	5642093
RAN1	658275	5644880	658681	5644868
RAN2	662058	5641794	662338	5641672
SIL1	660349	5634789	660541	5635065

*A hand-held Garmin GPS60™ Global Positioning System (GPS) receiver was used to record the locations of the upstream and downstream ends of each polygon. Projection used is UTM, NAD 83.

APPENDIX C

Glossary of Terms

Alluvial – deposited by running water. Recent alluvial bars are an accumulation of sediments deposited by floodwater in the current season.

Bankfull channel width – width of a stream channel at the point where high water will begin to escape the channel during floods. This point may be determined by: the elevation at the top of depositional features like sand, silt or gravel bars; changes in bank material from coarse substrate within an active channel to deposited material of a smaller size; or exposed roots below an intact, vegetated soil layer indicating erosion.

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. Total canopy cover can be greater than the area being studied due to overlap in plant structural layers.

Climax (plant) community – Refers to the final or steady state plant community which is self-perpetuating and in dynamic equilibrium with its environment. Also known as *Potential Natural Community.*

Community type – An aggregation of all plant communities distinguished by floristic and structural similarities in both overstory and undergrowth layers. ***For the purposes of this document, a community type represents seral vegetation, and is never considered to be climax.***

Disturbance-caused undesirable herbaceous species – native or introduced non-woody plant species that are well adapted to disturbance or an environment of continual stress. This term *does not* include invasive plant species.

Floodplain – the land base alongside a stream that has the potential to be flooded during high water events.

Habitat type – the land area that supports, or has the potential to support, the same primary climax vegetation. It is based on the potential of the site to produce a specific plant community (plant association).

Hoof shear – pieces of bank broken off as a result of hoofed animals walking along the stream edge.

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

Invasive plant species – these are typically weed species classified as *noxious* or *restricted* by your municipal district or county and have the potential to infest riparian areas.

Lotic – this term means *flowing water* (i.e., streams and rivers).

Lentic – this term means *standing* or *still water* (i.e., lakes, ponds and sloughs).

Pointbar – areas along the stream edge where sediment has been naturally deposited by moving water. These typically occur on the inside portion of a channel bend. Also known as a *sandbar or alluvial bar*.

Polygon – term used to describe a riparian inventory site. On lotic systems, a polygon has an upstream and downstream end along a reach of a stream and an associated riparian width. The lateral extent (width) of the riparian area is subjectively determined in the field based on vegetation and terrain clues indicating the flood prone area.

Pugging and Hummocking – the depressions (pugging) and raised mounds of soil (hummocking) resulting from large animals walking through soft or moist soil.

Reach – section of a stream or river with similar physical and vegetative features and similar management influences.

Stream channel incisement – the degree of downward erosion within the channel bed.

Structural alteration – physical changes to the shape or contour of the streambank caused by human influences. Some examples are livestock crossings, culverts and 'riprap'

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

Woody plant species – simply refers to trees and shrubs. These plants serve different riparian functions than grasses and broad-leaf plants.

APPENDIX D

Description of Riparian Health Parameters

The riparian health score is based on 11 basic parameters pertaining to riparian health. This appendix addresses the guidelines and stipulations followed when each parameter was answered during the assessment. Keep in mind that these parameters are meant to encompass the broad range of ecological diversity that stream, river, lake, and wetland systems have the potential to express. The interpretations are not completely specific to any one type of stream system, yet still capture the essential factors of riparian health and function.

Many different factors must be considered when answering any one of these parameters. It is quite possible that every scenario that could be encountered when conducting assessments is not covered here. Personal judgment based on sound riparian knowledge and good visual estimations are critical tools necessary for answering these questions consistently.

This description of riparian health parameters is based on the Alberta Lotic Wetland Health Assessment for Streams and Small Rivers (Survey) User Manual as created by Bitterroot Restoration, Inc. (2002).

RIPARIAN HEALTH PARAMETERS

The evaluator must keep in mind that this assessment form is designed to account for most sites and conditions in the applicable region. However, rarely will all the questions seem exactly to fit the circumstances on a given site. Therefore, try to answer each question with a literal reading. If necessary, explain anomalies in the comment section. Some factors on the evaluation will not apply on all sites. Sites without potential for woody species are not rated on factors concerning trees and shrubs. Vegetative site potential can be determined by using a key to site type (e.g., Hansen and others 1995, Kovalchik 1987, or another appropriate publication). On severely disturbed sites, vegetation potential can be difficult to determine. On such sites, clues to potential may be sought on nearby sites with similar landscape position.

Most of the factors rated in this evaluation are based on ocular estimations. Such estimation may be difficult on large, brushy sites where visibility is limited, but extreme precision is not necessary. While the rating categories are broad, evaluators do need to calibrate their eye with practice. It is important to remember that a health rating is not an absolute value. The factor breakout groupings and point weighting in the evaluation are somewhat subjective and are not grounded in quantitative science so much as in the collective experience of an array of riparian scientists, range professionals, and land managers.

Each factor below will be rated according to conditions observed on the site. The evaluator will estimate the scoring category and enter that value on the score sheet. Estimate the canopy cover on the polygon that is provided by all standing, rooted plants (live or dead). Do not include fallen wood or other plant litter. Do not consider the polygon area covered by water (such as between emergent plants).

1. Vegetative Cover of Floodplain and Streambanks. Vegetation cover helps to stabilize banks, control nutrient cycling, reduce water velocity, provide fish cover and food, trap sediments, reduce erosion, and reduce the rate of evaporation (Platts and others 1987). Stream channels that go dry during the growing season can create problems for polygon delineation. Some stream channels remain unvegetated after the water is gone. If the total vegetative cover of the channel is no more than 15%, it is considered a non-vegetated stream channel and is ***excluded*** from the polygon**.** Exceptions to this minimum of 15% canopy cover include channels with the vegetation removed by human-causes (such as grazing, logging, and

construction). These are considered exposed soil surface (bare ground). Those channels that do contain more than 15% vegetative cover are included as part of the riparian vegetation.

The evaluator is to estimate the fraction of the polygon covered by plant growth. Vegetation cover is ocularly estimated using the canopy cover method (Daubenmire 1959).

Scoring:
6 = More than 95% of the polygon area is covered by plant growth.
4 = 85% to 95% of the polygon area is covered by plant growth.
2 = 75% to 85% of the polygon area is covered by plant growth.
0 = Less than 75% of the polygon area is covered by plant growth.

2. Invasive Plant Species (weeds). Invasive plants are alien species whose introduction does or is likely to cause economic or environmental harm. Whether the disturbance that allowed their establishment is natural or human-caused, weed presence indicates a degrading ecosystem. While some of these species may contribute to some riparian functions, their negative impacts reduce overall site health. This item assesses the degree and extent to which the site is infested by invasive plants. The severity of the problem is a function of the density/distribution (pattern of occurrence), as well as canopy cover (abundance) of the weeds. In determining the health score, all invasive species are considered collectively, not individually.
A weed list should be used that is standard for the locality and that indicates which species are being considered (i.e., *Invasive Weed and Disturbance-caused Undesirable Plant List* [Cows and Fish 2002]). Some common invasive species are listed on the form, and space is allowed for recording others. Include both woody and herbaceous invasive species. ***Leave no listed species field blank, however;*** enter "0" to indicate absence of a value.

2a. Total Canopy Cover of Invasive Plant Species. The observer must evaluate the total percentage of the polygon area that is covered by the combined canopy of all plants of all species of invasive plants. Determine which rating applies in the scoring scale below.
Scoring:
3 = No invasive plant species (weeds) on the site.
2 = Invasive plants present with total canopy cover less than 1 percent of the polygon area.
1 = Invasive plants present with total canopy cover between 1 and 15 percent of the polygon area.
0 = Invasive plants present with total canopy cover more than 15 percent of the polygon area.

2b. Density/Distribution of Invasive Plant Species. The observer must pick a category of pattern and extent of invasive plant distribution from the chart below that best fits what is observed on the polygon, while realizing that the real situation may be only roughly approximated at best by any of these diagrams. Choose the category that most closely matches what you see.
Scoring:
3 = No invasive plant species (weeds) on the site.
2 = Invasive plants present with density/distribution in categories 1, 2, or 3.
1 = Invasive plants present with density/distribution in categories 4, 5, 6, or 7.
0 = Invasive plants present with density/distribution in categories 8, or higher.

CLASS	DESCRIPTION OF ABUNDANCE	DISTRIBUTION PATTERN
0	No invasive plants on the polygon	
1	Rare occurrence	
2	A few sporadically occurring individual plants	
3	A single patch	
4	A single patch plus a few sporadically occurring plants	
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	
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 within the polygon.	

Figure 1. Density and distribution of invasive plants.

NOTE: Prior to the 2001 season, the health score for weed infestation was assessed from a single numerical value that does not represent weed canopy cover, but instead represents the fraction of the polygon area on which weeds had a well established population of individuals (i.e., the area infested).

3. Disturbance-increaser Undesirable Herbaceous Species. A large cover of disturbance-increaser undesirable herbaceous species, native or exotic, indicates displacement from the potential natural community (PNC) and a reduction in riparian health. These species generally are less productive, have shallow roots, and poorly perform most riparian functions. They usually result from some disturbance which removes more desirable species. Invasive species considered in the previous item are not reconsidered here. As in the previous item, the evaluator should state the list of species considered. A partial list of undesirable herbaceous species appropriate for use in Alberta follows. A list should be used that is standard for the locality and that indicates which species are being considered (i.e., *Invasive Weed and Disturbance-caused Undesirable Plant List* [Cows and Fish 2002]). The evaluator should list additional species included.

Antennaria spp. (pussy-toes)	*Hordeum jubatum* (foxtail barley)	*Potentilla anserina* (silverweed)
Brassicaceae (mustards)	*Plantago* spp. (plantains)	*Taraxacum* spp. (dandelion)
Bromus inermis (smooth brome)	*Poa pratensis* (Kentucky bluegrass)	*Trifolium* spp. (clovers)
Fragaria spp. (strawberries)	_____	_____
_____	_____	_____

Scoring:
3 = Less than 5% of the site covered by disturbance-caused undesirable herbaceous species.
2 = 5% to 25% of the site covered by disturbance-caused undesirable herbaceous species.
1 = 25% to 50% of the site covered by disturbance-caused undesirable herbaceous species.
0 = More than 50% of the site covered by disturbance-caused undesirable herbaceous species.

4. Preferred Tree and Shrub Establishment and/or Regeneration. (Skip this item if the site lacks potential for trees or shrubs; for example, the site is a herbaceous wet meadow or marsh.) Not all riparian areas can support trees and/or shrubs. However, on those sites where such species do belong, they play important roles. The root systems of woody species are excellent bank stabilizers, while their spreading canopies provide protection to soil, water, wildlife, and livestock. Young age classes of woody species are important indicators of the continued presence of woody communities not only at a given point in time but into the future. Woody species potential can be determined by using a key to site type (Thompson and Hansen 2001, 2002, 2003 etc.). On severely disturbed sites, the evaluator should seek clues to potential by observing nearby sites with similar landscape position. (***Note:*** Vegetation potential is commonly underestimated on sites with a long history of disturbance.)

One tree species (*Elaeagnus angustifolia* [Russian olive]) and seven shrub genera or species (*Symphoricarpos* spp. [snowberry], *Rosa* spp. [rose], *Crataegus* spp. [hawthorn], *Elaeagnus commutata* [silverberry/wolf willow], *Caragana* spp [caragana], *Rhamnus cathartica* [European/common buckthorn], and *Tamarix* spp. [salt cedar] are excluded from the evaluation of establishment and regeneration. These are species that may reflect long-term disturbance on a site, that are generally less palatable to browsers, and that tend to increase under long-term moderate-to-heavy grazing pressure; ***AND*** for which there is rarely any problem in maintaining presence on site. *Elaeagnus angustifolia* (Russian olive), *Caragana* spp. [caragana], *Rhamnus cathartica* [European/common buckthorn], and *Tamarix* spp. [salt cedar] are considered especially aggressive, undesirable exotic plants.

The main reason for excluding these plants is they are far more abundant on many sites than are species of greater concern (i.e., *Salix* spp. [willows], *Cornus stolonifera* [red-osier dogwood], *Amelanchier alnifolia* [serviceberry], and many other taller native riparian species), and they may mask the ecological significance of a small amount of a species of greater concern. ***FOR EXAMPLE***: A polygon may have *Symphoricarpos occidentalis* (common snowberry) with 30% canopy cover showing young plants for replacement of older ones, while also having a trace of *Salix exigua* (sandbar willow) present, but represented only by older mature individuals.

We feel that the failure of the willow to regenerate (even though there is only a small amount) is very important in the health evaluation, but by including the snowberry and willow together on this polygon, the condition of the willow would be hidden (overwhelmed by the larger amount of snowberry).

For shrubs in general, seedlings and saplings can be distinguished from mature plants as follows. For those species having a mature height generally over 6.0 ft (1.8 m), seedlings and saplings are those individuals less than 6.0 ft (1.8 m) tall. For species normally not exceeding 6.0 ft (1.8 m), seedlings and saplings are those individuals less than 1.5 ft (0.45 m) tall or which lack reproductive structures and the relative stature to suggest maturity. (***Note:*** Evaluators should take care not to confuse short stature resulting from heavy browsing with that due to youth.)

Scoring: *(If the site has no potential for trees or shrubs [except for the species listed above to be excluded], replace both Actual Score and Possible Score with NA. If the evaluator is not fairly certain potential exists for preferred trees or shrubs, then enter NC and explain in the comment field below).*
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 tree/shrubs is seedlings and saplings.
0 = Preferred tree/shrub seedlings or saplings absent.

5. Utilization of Preferred Trees and Shrubs. (Skip this item if the site lacks trees or shrubs; for example, the site is a herbaceous wet meadow or cattail marsh.) Many riparian woody species are browsed by livestock and/or wildlife. Heavy browsing can prevent establishment or regeneration of these

important species. Excessive browsing can eliminate them from the community and result in their replacement by undesirable invaders.

One tree species (*Elaeagnus angustifolia* [Russian olive]) and seven shrub genera or species (*Symphoricarpos* spp. [snowberry], *Rosa* spp. [rose], *Crataegus* spp. [hawthorn], *Elaeagnus commutata* [silverberry/wolf willow], *Caragana* spp [caragana], *Rhamnus cathartica* [European/common buckthorn], and *Tamarix* spp. [salt cedar] are excluded from the evaluation of utilization of woody species. These are plants that may reflect long-term disturbance on a site, that are generally less palatable to browsers, and that tend to increase under long-term moderate-to-heavy grazing pressure; ***AND*** for which there is rarely any problem in maintaining presence on site. *Elaeagnus angustifolia* (Russian olive), *Caragana* spp. [caragana], *Rhamnus cathartica* [European/common buckthorn], and *Tamarix* spp. [salt cedar] are considered especially aggressive, undesirable exotic plants.

The main reason for excluding these plants is they are far more abundant on many sites than are species of greater concern (i.e., *Salix* spp. [willows], *Cornus stolonifera* [red-osier dogwood], *Amelanchier alnifolia* [serviceberry], and many other taller native riparian species), and they may mask the ecological significance of a small amount of a heavily utilized species of greater concern. ***FOR EXAMPLE***: A polygon may have *Symphoricarpos occidentalis* (common snowberry) with 30% canopy cover showing only light utilization, while also having a trace of *Salix exigua* (sandbar willow) present showing heavy utilization. We feel that, although there is only a small amount of willow present, the fact that it is being heavily utilized is very important to the health evaluation. By including the snowberry and willow together on this polygon, the condition of the willow would be hidden (overwhelmed by the larger amount of snowberry).

When estimating degree of utilization, count browsed second year and older leaders on representative plants of woody species normally browsed by ungulates. Do not count current year's use. This may not accurately reflect actual use because more browsing can occur late in the season. Determine percentage by comparing the number of leaders browsed with the total number of leaders available (those within animal reach) on a representative sample (at least three plants) of each tree and shrub species present.

Also include human removals by such activities as shearing and mowing. Do not count use of dead plants unless it is clear this condition was the result of over-grazing. ***Note:*** If a plant is entirely mushroom/umbrella shaped by long-term heavy browse or rubbing use, or is chewed off completely at the stem base, count as heavy utilization. Be sure to include physical and mechanical damage or cutting by humans, as well as consumptive use by animals.

Scoring: *(If the site has no potential for trees or shrubs [except for the species listed above to be excluded], replace both Actual Score and Possible Score with NA. If the evaluator is not fairly certain potential exists for preferred trees or shrubs, then enter NC and explain in the comment field below.)*
3 = None (0% to 5% of available second year and older leaders of preferred species are utilised).
2 = Light (5% to 25% of available second year and older leaders of preferred species are utilised).
1 = Moderate (25% to 50% of available second year and older leaders of preferred species are utilised).
0 = Heavy (More than 50% of available second year and older leaders of preferred species are utilised).

6. Standing Decadent and Dead Woody Material. (Skip this item if the site lacks trees or shrubs; for example, the site is a herbaceous wet meadow or cattail marsh.) The amount of decadent and dead woody material on a site can be an indicator of the overall health of a riparian area. Large amounts of decadent and dead woody material may indicate a reduced flow of water through the stream (dewatering) due to either human or natural causes. Dewatering of a site, if severe enough, may change the site vegetation potential from riparian species to upland species. In addition, decadent and dead woody material may indicate severe stress from over browsing. Finally, large amounts of decadent and dead woody material may indicate climatic impacts, disease and insect damage. For instance, severe winters may cause

extreme die back of trees and shrubs, and cyclic insect infestations may kill individuals in a stand. In all these cases, a high percentage of dead and decadent woody material reflects degraded vegetative health, which can lead to reduced streambank integrity, channel incisement, and excessive lateral cutting, besides reducing production and other wildlife values.

The most common usage of the term ***decadent*** may be for over mature trees past their prime and which may be dying, but we use the term in a broader sense. We count decadent plants, both trees and shrubs, as those with 30% or more dead wood in the upper canopy. In this item, scores are based on the percentage of total woody canopy cover which is decadent or dead, not on how much of the total polygon canopy cover consists of dead and decadent woody material. Only decadent and dead standing material is included, not that which is lying on the ground.

Scoring: (If site lacks potential for woody species, replace both Actual and Potential Scores with NA.)
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 45% of the total canopy cover of woody species is decadent or dead.
0 = More than 45% of the total canopy cover of woody species is decadent or dead.

7. Streambank Root Mass Protection. Streamside vegetation stabilizes the soil to the extent that it provides deep, binding roots. All tree and shrub species provide such roots. Herbaceous annuals lack this quality. Perennial herbs provide it in varying degree. Some rhizomatous species, such as sedges (*Carex* spp.), are excellent streambank stabilizers. Other rhizomatous species, such as Kentucky bluegrass (*Poa pratensis*), have shallow roots and are poor streambank stabilizers. The evaluator should seek to determine if the types of root systems present in the polygon are in fact contributing to the stability of the streambanks. For this item consider the streambank to extend from the toe of the bank to approximately 18 inches 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. Remember to include both banks (e.g., both sides of the stream). The amount of deep-binding roots needed is stream size dependent. Use the following table as a general guide to determine the width of band along the banks to assess for deep-binding roots.

Stream Size (Bankfull Channel Width)	Width of Band to Assess for Deep, Binding Roots
Small rivers approx. 10-15 m (33-55 ft)	10 m (35 ft)
Large streams approx. 5-10 m (16-33 ft)	5 m (17 ft)
Medium streams approx. 3-5 m (10-16 ft)	3 m (10 ft)
Small streams up to approx. 3 m (10 ft)	1 m (3 ft)

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.

8. Human-Caused Bare Ground. Bare ground is soil not covered by plants, litter or duff, downed wood, or rocks larger than 2.5 inches (6 cm). Bare ground caused by human activity indicates a deterioration of riparian health. Sediment deposits and other natural bare ground are excluded as normal or probably beyond immediate management control. Human land uses causing bare ground include livestock grazing, recreation, roads, and industrial activities. The evaluator should consider the causes of all bare ground observed and estimate the fraction that is human-caused.

Stream channels that go dry during the growing season can create problems for polygon delineation. Some stream channels remain unvegetated after the water is gone. If the total vegetative cover of the channel is no more than 15%, it is considered a non-vegetated stream channel and is ***excluded*** from the polygon**.** Exceptions to this minimum of 15% canopy cover include channels with the vegetation removed by human-causes (such as grazing, logging, and construction). These are considered exposed soil surface (bare ground). Those channels that do contain more than 15% vegetative cover are included as part of the riparian vegetation.

Scoring:
6 = Less than 1% of the site is human-caused bare ground.
4 = 1% to 5% of the site is human-caused bare ground.
2 = 5% to 15% of the site is human-caused bare ground.
0 = More than 15% of the site is human-caused bare ground.

9. Streambank Structurally Altered by Human Activity. Streambank structural integrity is vital to good channel configuration and bank shape. Impaired structure can mobilize channel and bank materials, cause loss of fishery and wildlife habitat, lower the water table, etc. Bank alteration can result from such causes as livestock trampling, pugging, hummocking, hoof shear, trails, human recreational use, and resource extraction activities, riprap, road crossings, etc. In rating this item, consider the bank area from the water's edge up to 0.5 meter (18 inches) 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. Remember to include both banks (e.g., both sides of the stream).

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. Human Physical Alteration to the Rest of the Polygon. Within the remainder of the polygon area, outside the streambank area that was addressed in the previous question, estimate the amount of area that has been physically altered by human causes.
The purpose of this question is to evaluate physical change to the soil, hydrology, etc. as it affects the ability of the natural sustem to function normally. Changes in soil structure will alter infiltration of water, increase soil compaction, and change the amount of sediment contributed to the water body. Every human activity in or around a natural site can alter that site. This question seeks to assess the accumulated effects of all human-caused change. Count such things as:

> Animal or human hummocking, pugging, rutting, and trampling;
> Changes to the soil surface that impede water infiltration (i.e., impervious covers, compacted paths, trails, etc.);
> Hydrologic changes (i.e., draining, ditching, berming, etc.);
> Disturbance to the natural soil surface caused by farming (plowing/tilling) or any other human activity.

Scoring:
3 = Less than 5% of the polygon is altered by human causes.
2 = 5% to 15% of the polygon is altered by human causes.
1 = 15% to 25% of the polygon is altered by human causes.
0 = More than 25% of the polygon is altered by human causes.

11. Stream Channel Incisement (vertical stability). Incisement can lower the water table enough to change current vegetation and site potential. It can also increase stream energy, reduce water retention/storage, and increase erosion. A stream is incised when downcutting has lowered the channel bed so that two-year flood events cannot overflow the banks. Four typical downcutting indicators are: a) headcuts; b) exposed cultural features (pipelines, bridge footings, culverts, etc.); c) lack of sediment and exposed bedrock; and d) a low, vertical scarp at the bank toe on the inside of a channel bend.

Channel incisement can occur in any of several stages (Figure 4). A severe disturbance can initiate downcutting, transforming the system from a steady state of high water table, appropriate floodplain, and high productivity to one of degraded water table, narrow [or no] active floodplain, and low productivity. (These stages of incisement can be categorized in terms of Rosgen Level I channel types [Rosgen 1996].)

A top rating goes to those unincised channels from which the 1-2 year high flow can access its floodplain. These can be meandering meadow streams (Rosgen E-type) and wide valley bottom streams (Rosgen C-type) which access floodplains much wider than the stream channel, or they may be mountain and foothill streams in V-shaped valleys which have limited floodplains because of topography. These latter types are usually armoured (well-rocked) systems with highly stable beds and streambanks that are not susceptible to downcutting. The lowest rating goes to entrenched channels (Rosgen F- or G-type) where even medium high flows which occur at 5-10 year intervals cannot overtop the high banks. Intermediate stages can be improving or degrading and may reflect slightly incised channels not yet so downcut that intermediate floods cannot access the floodplain, or they may be old incisements that are healing and rebuilding floodplain at a new, lower elevation.

Scoring:
9= Channel vertically stable and not incised; 1-2 year high flows access a floodplain appropriate to the stream type. Active downcutting is not evident. Any old incisement is characterized by a broad floodplain inside which perennial riparian plant communities are well established. This condition is illustrated in Figure 2 by the following three stages.
Stage A-1. A stable, unincised meandering meadow channel (Rosgen E-type). Flows greater than bankfull (1-2 year event) spread over a floodplain more than twice the bankfull channel width.
Stage A-2. A fairly stable, unincised wide valley bottom stream with broad curves and point bars (Rosgen C-type). Although these streams typically cut laterally on the outside of curves and deposit sediment on inside point bars, bankfull flows (1-2 year events) have access to a floodplain more than twice bankfull channel width.
Stage A-3. A stable, unincised mountain (Rosgen A-type) or foothill (Rosgen B-type) channel with limited sinuosity and slopes greater than 2%. Although bankfull flow stage is reached every 1-2 years, the adjacent floodplain is often narrower than twice the bankfull channel width. Consequently, overflow conditions are not so obvious as in Stages A-1 and A-2 systems.
6 = Either of two incisement phases: (a) an improving phase with a sinuous curve/point bar system (Rosgen C-type) or a narrow, meandering stream (E-type) establishing in an old incisement which now represents the new floodplain, although this may be much narrower than it will become;(b) an early degrading phase in which a narrow, meandering meadow stream (E-type) is degrading into a curve/point bar type (C-type) or a wide, shallow channel (Rosgen F-type). In either case, the 1-2 year high flow event can access only a narrow floodplain less than or only slightly wider than twice the bankfull channel width. Perennial riparian vegetation is well established along much of the reach. These conditions are represented in **Stage B** of Figure 2.
3 = Two phases of incisement fit this rating. (a) A deep incisement that is starting to heal. In this phase new floodplain development, though very limited, is key. This phase is characterized by a wide, shallow channel unable to access a floodplain (Rosgen F-type) evolving into a curve/point bar system (C-type) through sediment deposition and lateral cutting. Pioneer perennial plants are beginning to establish on the new depositional surfaces. (b) An intermediate phase with downcutting and headcuts probable. Flows less

than a 5-10 year event can access a narrow floodplain less than twice bankfull channel width. These conditions are represented in **Stage C** of Figure 2.

0 = The channel is deeply incised to resemble a ditch or a gully. Downcutting is likely ongoing. Only extreme floods overtop the banks, and no floodplain development has begun. Both **Stages D-1** and **D-2** of Figure 2 fall into this rating.

Stage D-1. An incised stream with a wide, shallow (F-type) channel. Commonly found in fine substrates (sands, silts, and clays), channel banks are very erodable. Only limited vegetation, primarily pioneer species, is present along the side of the stream.

Stage D-2. A narrow, deep "gully" system (Rosgen G-type) downcut to the point that only extreme floods can overtop the banks. Distinguished from narrow mountain streams (A-type) by the presence of a flat floodplain through which the stream has downcut and by banks consisting of fine materials rather than larger rocks, cobbles, or boulders.

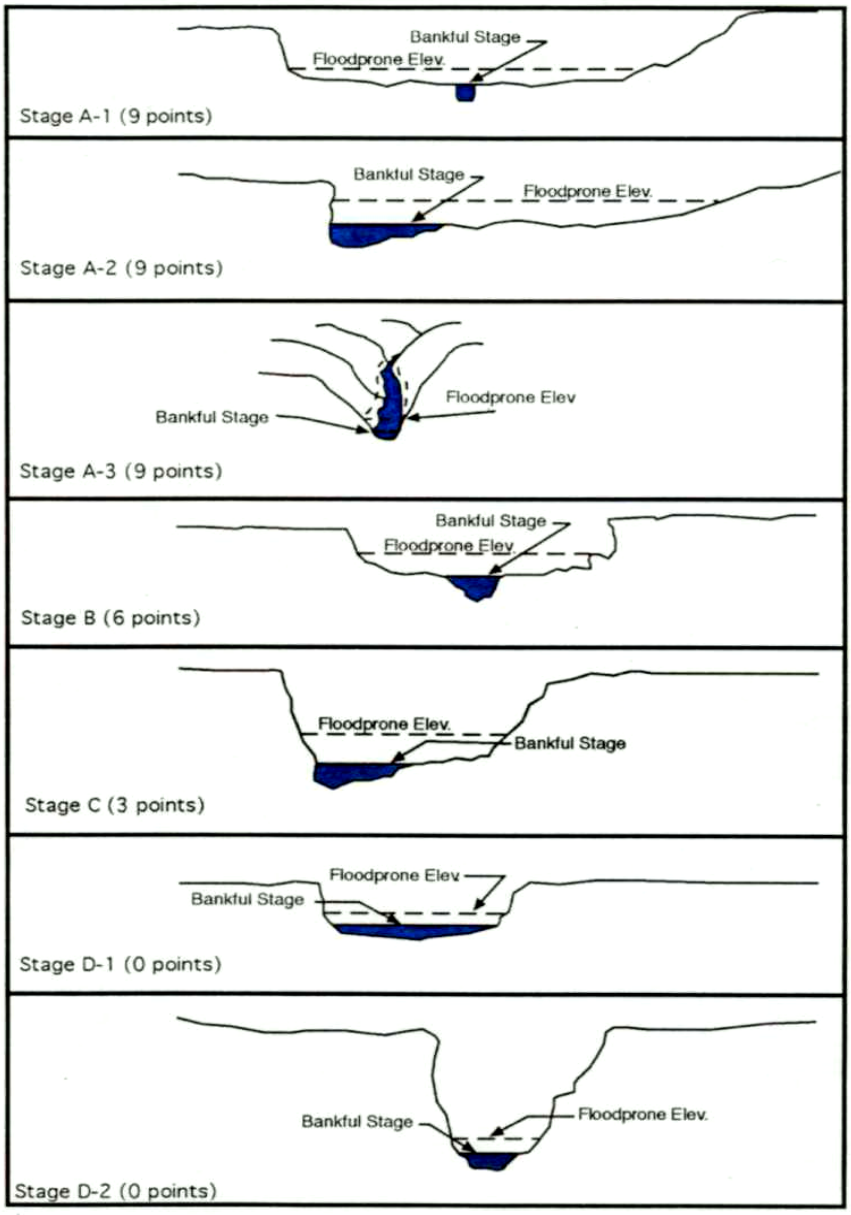

Figure 2. Guides for estimating stage of channel incisement.