Riparian Health Summary
Final Report

- Moose Lake Tributaries Project Area – Revisit

2014 Results
&
Trend vs. 2005

Alberta Riparian Habitat Management Society
(Cows and Fish)

December 2015

Prepared for:

Moose Lake Watershed Society

Project Area:

Moose Lake Tributaries
within M.D. of Bonnyville

Thin Lake River – Yelling Creek confluence to Moose Lake including Thin Lake
Yelling Creek – west M.D. of Bonnyville boundary to confluence Thin Lake River
Valer's Creek (also known as Vincent Creek) – Highway 41 to confluence Moose Lake
Kehiwin Creek – between Bangs Lake and Kehiwin Lake

*Prepared by***:**

Cows and Fish
Alberta Riparian Habitat Management Society
c/o 306 J.G. O'Donoghue Building
7000-113 Street
Edmonton, AB
T6H 5T6

Writer:
Kerri O'Shaughnessy

Contributors:
Christy Sikina, Kristi Stebanuk, Jessica Melsted, Kirby England, Anthony Sarrazin, and Mick Plemel, Carolyn Ross

Suggested report citation: *O'Shaughnessy, K. 2015. Riparian Health Summary, Final Report, Moose Lake Tributaries Revisit 2014 Results and Trend vs. 2005. Alberta Riparian Habitat Management Society (Cows and Fish).*

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

Acknowledgements

A key to the success of this project was the interest and co-operation demonstrated by landowners in the Moose Lake Tributaries Revisit project area. Thank you to everyone who allowed access to their land and supported this riparian inventory! A special thanks to the Moose Lake Watershed Society (MLWS) and their partners for their assistance in contacting landowners. We also thank the Municipal District of Bonnyville for providing air photos for our field crews as well as a portion of imagery needed for reporting. This riparian health inventory summary report is part of the Water Quality and Riparian Health Initiative project initiated by the Moose Lake Watershed Society.

Funding for the Moose Lake Tributaries Revisit riparian health inventory was provided by the Community Initiatives Program grant received by the Moose Lake Watershed Society and the Municipal District of Bonnyville. Other support for the riparian health inventory was also provided by the Moose Lake Watershed Society and Municipal District of Bonnyville, Cows and Fish members and supporters, and individual landowners.

Disclaimer

- Any release of the information contained in this report, in whole or in part, to parties other than the MLWS and participating landowners will not be the responsibility of Cows and Fish. Liabilities with the release of this report or use of the information beyond the original intent of the work will be the responsibility of the MLWS.

- All information in this report is a summary reflecting the overall state of current riparian health for those sites involved in the Moose Lake Tributaries project area in 2014. It does not share any specific information on individual landholdings assessed, based on Cows and Fish's commitment of confidentiality with the landowners who participated. Only general findings, reflecting the overall state of riparian health of the Moose Lake Tributaries project area are presented in this report. Part 2 will look at changes since 2005 where it is possible to make comparisons.

- The objective of completing these riparian health inventories is to provide a coarse filter review of the status of riparian 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 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. Repeat 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.

- This report outlines the findings from the MLWS Moose Lake Tributaries Revisit riparian health inventory initiative. Additional riparian health inventories and/or assessments are required in subsequent year(s) to better reflect riparian health conditions within a more representative proportion of the Moose Lake Tributaries watershed.

- The inventory and assessment of the functioning condition (health) of riparian habitat does not address any in-stream or water quality parameters associated with the Moose Lake Watershed. Water quality sampling was done by MLWS members and other partners as part of the water quality component of the broader initiative. That information is summarised elsewhere.

EXECUTIVE SUMMARY

In 2014, the Alberta Riparian Habitat Management Society (Cows and Fish) partnered with the Moose Lake Watershed Society (MLWS) to re-inventory riparian health along properties adjacent to the major tributaries to Moose Lake (Thin Lake River, Thin Lake, Valer's Creek [a.k.a Vincent Creek], Yelling Creek, Kehiwin Creek). This re-inventory is a component of the Water Quality and Riparian Health Initiative undertaken by the Moose Lake Watershed Society as part of their conservation programming. In 2005, the first riparian health inventories were completed in the project area which provided the benchmark of riparian health for the participating properties along the Moose Lake Tributaries. In 2014, second riparian health inventories were completed on most of the same sites as in 2005. The results from the 2014 re-inventory are presented in this report, as well as, comparisons between 2005 and 2014 where possible. A secondary goal of the project was to assess landowner interest in making management changes and the potential for participation in the Growing Forward 2 Agricultural Watershed Enhancement Program.

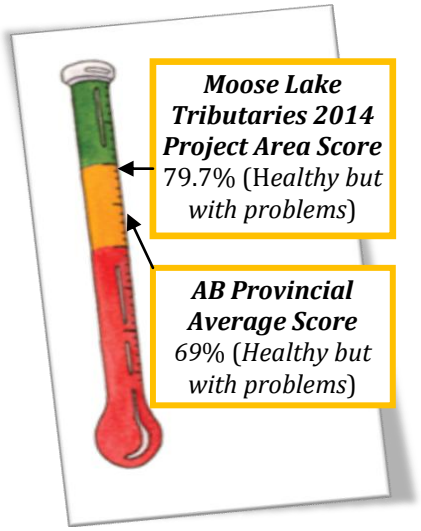


Figure 1. Riparian Health Score Comparison: Moose Lake Tributaries Project Area and AB Provincial Average (1996 to 2013)

Information obtained from the inventory of riparian health in the Moose Lake Tributaries project area will inform and facilitate land management planning within the watershed, encouraging private landowners to understand and effectively manage riparian areas under their care. Riparian areas along the tributaries in the Moose Lake watershed provide important fish and wildlife habitat, improve water quality and maintain water quantity on the landscape.

In August 2014, riparian health inventories were completed on 18 sites within the Moose Lake Tributaries project area, plus one riparian health assessment (survey) for a total of 19 sites. These sites represent approximately 12 km of stream, river and shore length and 47 hectares of riparian area. 18 of the 19 sites were previously inventoried or assessed by Cows and Fish in 2005.

Site selection in 2014 is based on landowners who participated in the original inventory project in 2005. Agriculture, for the purposes of livestock grazing and cropping, is the primary land use within uplands of the project area with mostly non-use for human activities within the riparian area.

Of the 19 riparian sites inventoried/assessed in 2014, 11 (58%) rate *healthy*, six (32%) rate *healthy but with problems* and two (10%) are in *unhealthy* condition. The average riparian health score for the project area is 79.7% (*healthy but with problems*), as shown in Figure 1, well above the Alberta provincial average[1].

Overall vegetation cover is excellent though there are some concerns with the abundance of invasive and disturbance caused plants in the project area. Preferred tree and shrub regeneration

[1] Cows and Fish Riparian Health Inventory Data (1996 – 2013), based on 2,276 sites on 525 waterbodies in Alberta

and utilisation is moderate but there is very little dead and decadent woody material which is indicative that current pressures on the woody plant community is not too high, moisture levels are sufficient and disease is not an issue. The structural integrity of the riparian area overall on lentic sites and the riparian area beyond the banks on stream and river sites is good but there are concerns with the degree of alterations to the banks of the stream and river sites. Historical channelization of Valer's Creek is a primary cause of alterations to the banks by human activities. Grazing, where it is present, is also having an impact.

When more than one inventory has been conducted in a project area, we can start to assess trend and the impacts of any changes that have occurred. The overall health score for this project area has improved slightly from 2005 (73%) to 2014 (79%) but still remains in the *healthy but with problems* category. This is based on 18 sites revisited with comparable data (17 evaluated with riparian health inventory methods and one with riparian health assessment (survey) methods). Of the 18 riparian sites revisited in 2014, 10 (56%) rate *healthy*, six (33%) rate *healthy but with problems* and two (11%) are in *unhealthy* condition. The 2005 baseline for these same 18 sites was 10 (56%) rate *healthy*, four (22%) rate *healthy but with problems* and four (22%) are in *unhealthy* condition.

Since 2005, vegetation parameter scores remain the same on average overall but there has been a noticeable improvement in soil and hydrology parameters. There is some improvement in scores of certain vegetation parameters such as utilization of preferred trees and shrubs which also improved in health category. Parameter scores for the cover, and density and distribution of invasive plants have declined and remain *unhealthy*. Within the soil and hydrology parameters, all the scores showed some improvement within their health categories and human physical alterations to the rest of site (beyond the banks) for lotic sites improved in health category as well.

Recommendations for riparian health are provided in this report and include maintaining and increasing the regeneration of tree/shrub communities and the cover of riparian vegetation overall; monitoring browse utilization; monitoring and controlling disturbance-caused and invasive species; reducing livestock and other human access where altered banks continue to be present; maintaining the natural meandering pattern of tributaries that have not previously been channelized; and continuing to allow water levels in the lakes to fluctuate naturally without artificially adding or withdrawing water.

There is some interest among those we visited in the programs like the Growing Forward 2 On Farm Stewardship and Agricultural Watershed Enhancement programs, but there is also some uncertainty expressed from the landowners about the relevance of programs like this to them right now. Part of that uncertainty for some is their age at this time and the transition to children taking over the operation that is happening but not yet complete. This can be challenging for stewardship but also poses opportunities as the new owners/managers get more involved. When current landowners were asked what has motivated them to make management changes so far, age and desire to retire, and decrease work were among the answers. Incidentally this is also one of the reasons preventing some from doing more or others from making a change to begin with.

This riparian health inventory and landowner follow-up was made possible by the support of the Moose Lake Watershed Society and the Community Initiative Program grant, Cows and Fish members and supporters, the Municipal District of Bonnyville, and the participating landowners.

1 BACKGROUND

1.1 *Alberta Riparian Habitat Management Society - Cows and Fish*

Cows and Fish was formed in 1992 to foster a better understanding of how improvements in grazing management and other uses of riparian areas can enhance landscape health and productivity for the benefit of producers and others who use and value riparian areas. A key feature empowering Cows and Fish is the declaration of ownership of riparian issues in agricultural areas by cattle producers, other landowners and community groups.

1.2 *What Is A Riparian Area?*

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 (Figure 2). Riparian areas can be described as the "green zones" around lakes and wetlands and bordering rivers and streams.

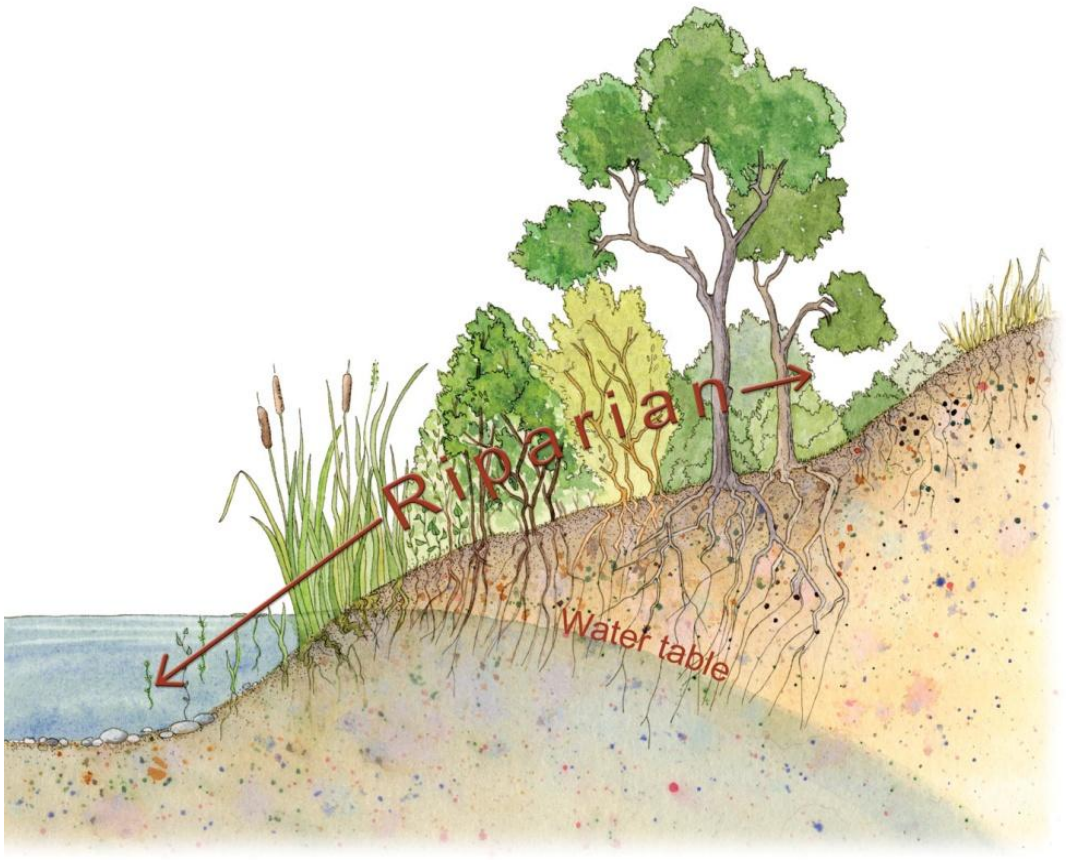


Figure 2. Diagrammatic Representation of a Riparian Area[2]

[2] Source: Fitch, L. and N. Ambrose 2003. Riparian Areas: A User's Guide to Health. Lethbridge, Alberta: Cows and Fish Program. ISBN No. 0-7785-2305-5.

1.3 *Why Are Healthy Riparian Areas Important?*

When in a properly functioning condition or *healthy* state, riparian areas sustain fish and wildlife populations, provide good water quality and stable water supplies, and support people on 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, improving water quality by filtering runoff and reducing the amount of contaminants and nutrients reaching the water, and providing habitat for fish and wildlife, and shelter and forage for livestock. Maintaining healthy riparian areas is therefore important to the long-term sustainability of a healthy landscape.

1.4 *Why Assess Riparian Health?*

The intent of riparian health inventories is to provide a *state of the environment report* to the local community. Hopefully, this report will assist your community in making the best decisions on how to manage riparian range resources most effectively.

Combining this information with existing practical knowledge of rangeland resources will provide the best alternatives for sustaining healthy riparian areas within the Moose Lake Tributaries project area. In general, this information helps producers and local communities identify and effectively develop non-legislated or voluntary action plans to address specific riparian land use issues within local watersheds.

Assessing riparian health allows communities, landowners and professionals to:

- **Create awareness** amongst local producers and their communities and build common understanding on riparian management issues in their watersheds.
- **Take action** by assisting local decision-makers develop strategies to find local solutions to address riparian land use issues.
- **Monitor progress** in improving, maintaining and protecting riparian health for their operation or watershed.
- **Identify environmental risk** and integrate into farm and ranch planning.
- **Develop and maintain** range and riparian management plans for long-term productivity and ecological health.
- **Establish** benchmarks of riparian health from which change over time can be measured.

Working together on riparian management issues, including riparian health inventories, conveys a proactive message to the public. It shows that your community and the agricultural sector in general are taking steps to protect, maintain and improve the health of our landscapes and water supplies.

2 PROJECT DESCRIPTION

2.1 *Project Background*

History

Cows and Fish was invited in 2004 by the Moose Lake Water for Life Committee (now the Moose Lake Watershed Society) to complete riparian health inventories on the major tributaries to Moose Lake (Thin Lake River, Thin Lake, Valer's Creek [a.k.a Vincent Creek], Yelling Creek, Kehiwin Creek). A community meeting was held at Flat Lake Community Hall in April 2005, organized with the help of Lakeland Agriculture Research Association (LARA), to inform the local people of this initiative and to gauge their support. All landowners along the selected tributaries were invited to attend. The turnout was average (approx 20 people) and though only a few landowners signed up for the initiative the overall sense was that the project could go ahead.

The project area at that time was stratified into similar reaches based on valley types, sinuosity, vegetation and management by Cows and Fish staff using air photo interpretation. Landowners were contacted by Cows and Fish staff, with some help from LARA, to assess their interest in participating in the project and those who volunteered were included. Those who signed up at the meeting were contacted first. Others were then called at random. Through one-on-one visits with these participating landowners, riparian health inventory sites were selected on their property. Where possible these sites were chosen to represent the stratified reaches. Many of the possible landowners in the project area could not be reached or chose not to participate, which made finding representative sites challenging and in some cases impossible. To meet the proposed number of sites required for a representative length of sampled riparian area, some reaches were sampled more heavily. In total 19 riparian health inventory sites were evaluated, 18 using riparian health inventory methods and one using riparian health assessment (survey) methods.

Current

In 2014, the Moose Lake Watershed Society (MLWS) invited Cows and Fish back to the watershed to gather more riparian health information, as part of a water quality and riparian health initiative. The intent of the riparian health component was to revisit the 2005 riparian health inventory sites to get a sense of how things have changed. Almost all of the original landowners involved in 2005 agreed to participate again in 2014. We were unable to get permission to revisit one site due to a personal situation for them; they were interested but unforeseen circumstances prevented that final conversation to happen. One site was added on Valer's Creek for a new landowner who expressed interest upon a phone call with regard to another site.

Funding and support for the 2014 program was provided by the MLWS and the Community Initiatives Program grant, the Municipal District of Bonnyville, individual landowners within the Moose Lake Tributaries project area and Cows and Fish members and supporters.

The following activities occurred in preparation for and during delivery of the 2014 project:

- Participating members from the 2005 Moose Lake Tributaries project area riparian health inventory were invited by letter mail to attend a 2014 riparian health revisit project launch meeting at the Bonnyville Centennial Center on January 22, 2014 prior to the Moose Lake Watershed Society Annual General Meeting (AGM). This landowner meeting was poorly attended by past participants so the content of the meeting was moved to the AGM instead which had good lake and general community representation, but very few farmers from the Moose Lake watershed.
- Following this meeting, landowners who had taken part in the 2005 riparian health inventory were invited to meet one-on-one with Cows and Fish and MLWS in February 2014 to discuss the revisit project, gather management information, assess interest in riparian health inventory, and interest in Growing Forward 2 funding programs. We were able to meet with some landowners in February and others we met with over the following months leading up to August.
- Riparian Health Inventories for those who agreed to a re-inventory were completed in August 2014.
- Data entry, analysis and reporting of 2014 results occurred between September 2014 and April 2015.
- Analysis and reporting to compare riparian health results from 2005 and 2014 occurred between May 2015 and December 2015.
- Presentation of the results to the community at a meeting has yet to be determined.

Landowners who participated in this project have each received detailed riparian health summary reports based on data that was collected on their lands in 2014. Where applicable, comparisons to 2005 results were also provided to each landowner.

This Riparian Health Summary - Final Report does not contain site specific details in keeping with confidentiality agreements with the participating landowners. Instead, this report summarizes average riparian health conditions within the Moose Lake Tributaries project area as a whole. In order to provide a 'present day' evaluation of riparian health (for ongoing management objective purposes), all 2014 riparian health results are presented in Sections 4 and 5. Following the 2014 results, a comparison of the 2005 versus 2014 riparian health data for the 18 revisit sites is discussed in the 'riparian trend' section (Section 6)..

2.2 *Project Area Description*

The 2014 Moose Lake Tributaries project area includes riparian areas along Kehiwin Creek, Thin Lake River, Thin Lake, Valer's Creek and Yelling Creek (Figure 3).

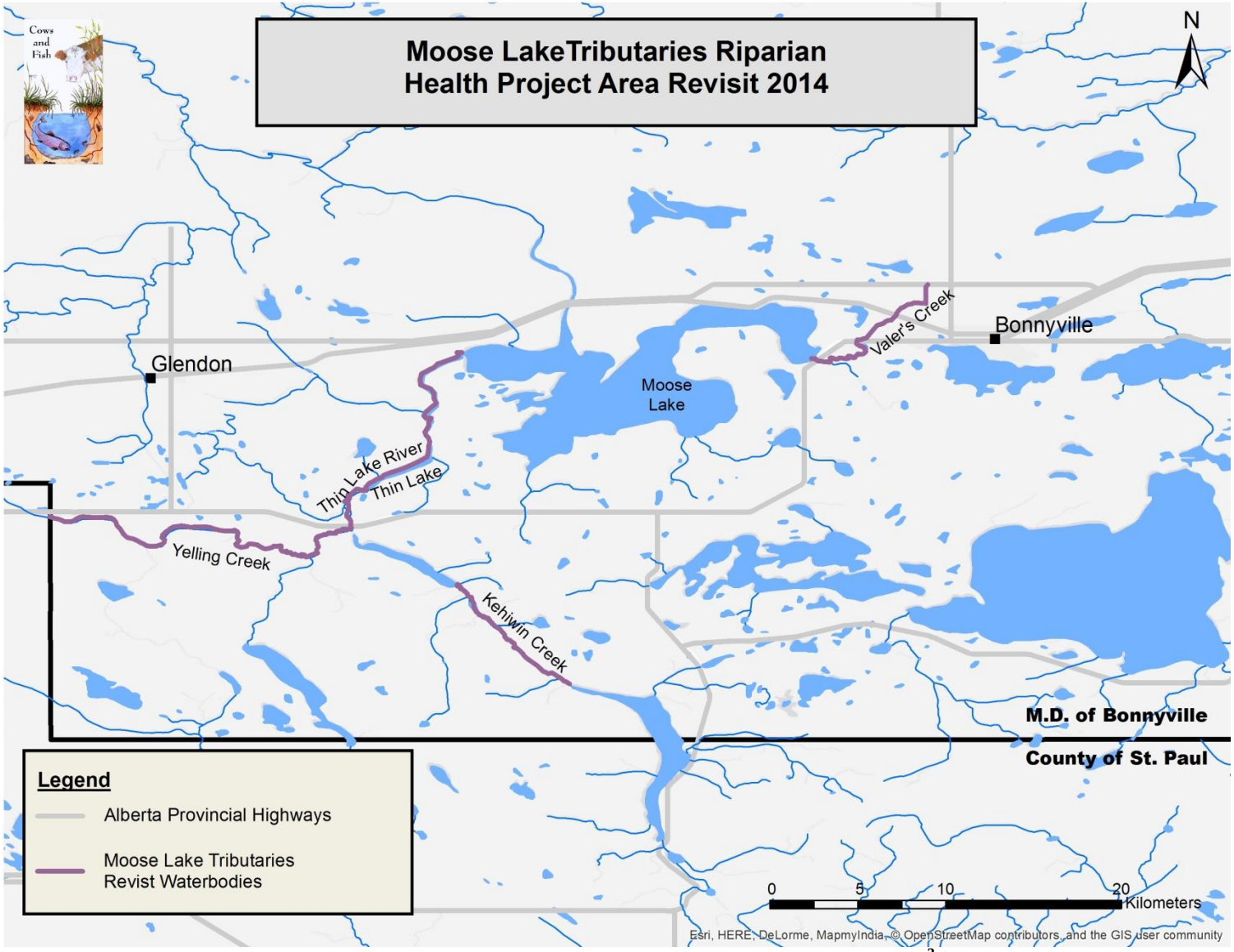


Figure 3. Moose Lake Tributaries Revisit Project Area (2014)[3]

[3] For confidentiality purposes, exact locations of the 2014 RHIs are not shown on the above map. Purple highlighting is used to show the approximate extent of the project area, but it depicts a greater stream length than was actually assessed.

Moose Lake is located in Northeastern Alberta in the Lakeland Region, 240km Northeast of Edmonton and 3.5km west of the Town of Bonnyville (Aquality, 2005). Excerpts from the Moose Lake State of the Watershed Report (Aquality, 2005) characterises the Moose Lake watershed as follows:

> The Moose Lake Watershed is within the Boreal Transition Ecoregion and is part of the Boreal Plain Ecozone of western Canada (Environment Canada, 1996). This is a broad ecological land classification that considers soil, geology, vegetation and climate. The natural forest of this area is mixedwood dominated by species of trembling aspen, balsam poplar, white birch, white spruce and balsam fir (Mitchell & Prepas, 1990). There is agricultural development throughout the watershed but primarily in the Western portion near Yelling Creek and to the South and East of the lake. Agriculture is typically mixed farming (Runge, 1977).
>
> Moose Lake covers about 8,530 ha and drains a gross area of 84,581 ha (excluding the lake). The surface area of the lake is less than 5% of the entire drainage basin. Most of the watershed has a gently undulating terrain (Mitchell & Prepas, 1990). The main surface water inflow to Moose Lake is the Thin Lake River. This enters directly into Franchere Bay in the southwest corner of Moose Lake. The Thin Lake River is formed by the confluence of two lotic sources: Yelling Creek and Kehiwin Creek. Yelling Creek flows through the western most portion of the watershed through predominantly agricultural land. Kehiwin Creek forms a surface drainage path in a gradual southeast to northwest direction. Small surface tributaries drain into Kehiwin Lake; this lake drains into Kehiwin Creek and then into Bangs Lake. Bangs Lake drains via a short tributary that merges with Yelling Creek to form the Thin Lake River. Bently Lake and Chickenhill Lake form another surface drainage pattern in a southeast to northwest direction. However, in recent years the outflow of Chickenhill Lake has been dry and has not drained into Yelling Creek (pers. obs. T. Charette, AENV). In total, the Thin Lake River drains approximately 75% of the entire catchment (Runge, 1977). In addition, five intermittent streams drain the remaining 25% of the catchment and flow directly into Moose Lake on the south, southeast, northeast and northwest shores.

2.3 *Site Selection*

In the original inventory project of 2005, every effort was made to select sites that could represent larger reaches through a stratification process but at that time, many of the possible landowners in the project area could not be reached or chose not to participate, which made finding representative sites challenging and in some cases impossible. To meet the proposed number of sites required for a representative length of sampled riparian area, some reaches were sampled more heavily. Riparian inventory sites, or polygons, were identified within each private landholding after one-on-one discussions with landowners. Management practices, fence lines and topography constraints were taken into consideration when determining the upstream and downstream boundaries of the riparian health inventory sites.

In 2014, site selection was done based on the willingness of the landowners involved in the original 2005 inventory to participate again, rather than another scientific, randomized selection of reaches. The approximate same area and length of stream, river or shore for each site was sampled again in 2014.

The 2014 Moose Lake Tributaries project area encompasses 19 riparian sites with 12 km of bank length and a total area of approximately 47 ha along Kehiwin Creek, Thin Lake River, Thin Lake, Valer's Creek and Yelling Creek (Table 1).

Table 1. Moose Lake Tributaries 2014 Project Area Description

Waterbody	# Landowners Contacted	# Landowners Participated	# Riparian Inventories	Stream/Shore Distance Inventoried (km)	Riparian Area Inventoried (ha)
Thin Lake River	3	3	2	1.6	11.3
Thin Lake (lentic)			3	1.0	2.4
Yelling Creek	7	6	6	5.7	21.8
Kehiwin Creek			1	0.6	2.2
Valer's Creek (a.k.a. Vincent Creek)	3	3^	7*^	3.5	9.3
Total	**13**	**12**	**19**	**12.4**	**47.0**

* A riparian health assessment (survey) was completed on one of these sites, so total number of site evaluated with riparian health inventory is 18
^ One of the inventory sites on Valer's Creek is a new site with a new landowner in 2014 that was not assessed in 2005.

In Table 1, the number of landowners contacted is slightly different than the number of landowners who participated because one landowner chose not to participate; they were interested but circumstances beyond our (and their) control did not allow conversations to get to the point of granting permission to revisit their site. Of the landowners who did participate in 2014, one is new with a new site compared to 2005; one of the original landowners involved is no longer in the area but their land was purchased by another participating landowner; and one landowner is longer part of the management of the land they were involved with in 2005.

Photo a: Riparian area along Yelling Creek in the Moose Lake watershed.

M. Plemel, RHIP07YEC024

3 RIPARIAN HEALTH INVENTORY METHODS

3.1 *Riparian Health Inventory*

Riparian health inventories provide comprehensive information about the diversity, structure and health of plant communities within the project area. The health inventory establishes an important baseline to compare to in the future, to keep track of whether riparian health is stable, improving or declining.

During a riparian health inventory, approximately 79 health parameters are examined to provide comprehensive and detailed information on riparian function and the overall health rating is derived from these details. There are inherent differences between flowing and non-flowing waterbodies even if they are connected. Therefore, there are different methods for evaluating riparian health on lotic and lentic waterbodies, but both assessments result in a health rating of one of the three categories displayed in Table 2.

Table 2. Description of Riparian Health Ratings

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

There are common parameters between the lotic and lentic assessments, but there are also differences to capture the unique form and function of the two waterbody types (Table 3). For lotic systems such as the streams in the Moose Lake watershed, the overall riparian health rating is derived from six vegetation[4] and five soil/hydrology parameters (i.e. key indicators of riparian function). For lentic systems such as Thin Lake, the overall riparian health rating is derived from six vegetation and four soil/hydrology[5] parameters. A description of the lotic and lentic parameters and how they are evaluated is given in Appendix E and F respectively. By objectively examining each of these health parameters we can determine where best to concentrate management efforts aimed at improving riparian health.

[4] Invasive plants in both lotic and lentic methods is considered one parameter, however is broken into two parts, separating canopy cover and density distribution. Utilisation of woody plants is also broken into two parts to take into account browse use by animals and cutting / mowing of woody plants by humans and beavers.

[5] Human-caused alterations to the physical site is considered one parameter, however is broken into two parts, separating percentage of site area altered by human activities and severity of the alterations.

Table 3. Riparian Health Parameters Relative to Waterbody Type

Riparian Health Parameter Assessed		Waterbody Type	
		Lakes and Wetlands (lentic)	**Streams and Small Rivers (lotic)**
Vegetative	vegetative cover	✓	✓
	preferred tree/shrub regeneration	✓	✓
	preferred tree/shrub utilisation	✓	✓
	dead/decadent woody material		✓
	invasive plants (canopy cover and distribution)	✓	✓
	disturbance plants	✓	✓
	human-caused alterations to vegetation	✓	
Soil (Physical)	root mass protection		✓
	human-caused alterations to banks		✓
	human-caused bare ground	✓	✓
	human-caused alterations to rest of site		✓
	human-caused alterations to the physical site & severity of human alterations to the physical site	✓	
Hydrologic	artificial water level change	✓	
	channel incisement		✓

3.2 *General Inventory Protocol*

Riparian health parameters are visually assessed by trained observers in the field. A health rating is derived from this field data using a computer software program (FileMaker Pro), in conjunction with field observations.

A hand-held Garmin GPS60™ Global Positioning System (GPS) receiver is used to record the locations of the upstream and downstream ends of each site. For monitoring purposes, benchmark photographs looking upstream and downstream are taken at each end of all sites. Additional photographs are taken where warranted to document features of interest or concern (e.g. weed infestations, bank erosion, etc.). The lateral extent of the riparian area is subjectively determined in the field and mapped on an air photo[6] (1: 5,500 to 1: 9,000 scale).

On creeks and small rivers, both sides of the water body are inventoried as these generally have the same ownership and type of management. For larger waterbodies such as Thin Lake and the Thin Lake River as it gets closer to Moose Lake, only one side is inventoried at a time because land ownership and management is typically different on either side of the waterbody. Landmarks, such as fence lines, tributaries or other identifiable features, are used, where possible, to delineate the ends of the site in order to facilitate monitoring the same section of stream in the future. Inventory sites encompass a minimum of two meander cycles on streams and rivers. A complete meander cycle has equal inside and outside curvature. For lakes and wetlands, inventory sites encompass a minimum of 200 m of shore (Cows and Fish 2014).

[6] Aerial photography was provided for the project by the M.D. of Bonnyville (field and portion of reporting) and Cows and Fish (reporting).

3.3 *What Makes a Riparian Area "Healthy"*

Riparian areas are like a jigsaw puzzle; each individual piece or component of a riparian ecosystem is important to the successful function of the entire system. How the individual pieces function together affects the health of the riparian ecosystem including the stream, its watershed, and overall landscape health and productivity.

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),
- shores, floodplains and banks with abundant plant growth,
- shores and banks with deep-rooted plant species (trees and shrubs),
- very few, if any, invasive weeds (e.g. Canada thistle),
- few disturbance-caused plant species (e.g. Kentucky bluegrass, dandelion),
- very little bare ground or altered banks or shores,
- the ability to frequently (i.e. every few years) access a floodplain at least double the channel width, and
- ability to store water, sustain and establish new plant communities even during natural climatic cycles (e.g. drought).

When riparian health degrades it usually means that one or more of the pieces has been impacted by natural or human-caused disturbances such as development, recreation, grazing, flooding or fire. 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*. Riparian areas with moderate levels of impacts will typically fall within the *healthy but with problems* category, while those with very few or no impacts will normally be rated as *healthy*. Generally, it is difficult to see specific parameters decline in health, especially if the degradation occurs gradually over a long period of time. Therefore, having a metric, such as riparian health assessment, enables observers to evaluate all of these pieces of riparian health at one point in time using a structured methodology, allowing for comparison and monitoring in the future.

Note: Refer to Appendix A for a glossary of terms used in this report

4 WHAT DID WE FIND IN 2014?

4.1 *Riparian Health Summary*

Of the 19 riparian sites inventoried/assessed in 2014, 11 (58%) rate *healthy*, six (32%) rate *healthy but with problems* and two (10%) are in *unhealthy* condition (Figure 4). The average riparian health score for the project area is 79.7% (*healthy but with problems*). Refer to Appendix B for the project area riparian health score sheet.

The Moose Lake watershed is a large area and this project only included a select number of waterbodies within the Municipal District of Bonnyville. Therefore, the summary presented here does not represent the entire watershed. However, it does well represent the health of the sites included in the project area. It also provides information on riparian health and function that was previously unavailable to assist in making more informed management and planning decisions.

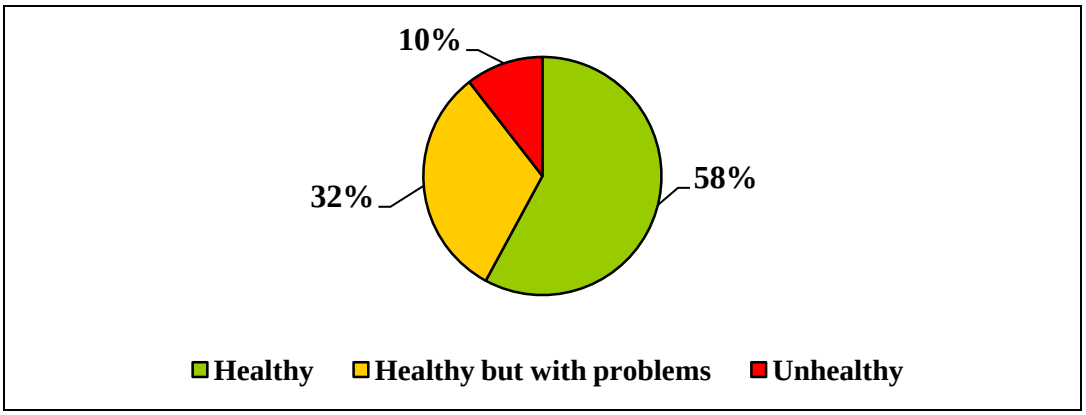


Figure 4. Moose Lake Tributaries Project Area Riparian Health Score Results (2014) (based on 19 sites)

Since riparian health inventory sites vary in size, the relative health of the project area based on the area assessed, compared to the number of sites assessed, may differ. For the 19 sites evaluated in the Moose Lake Tributaries project area, the average area-weighted riparian health rating is 81% (*healthy*), slightly higher than by number of sites. By area, approximately 60 ha (69%) of riparian habitat rates *healthy*, 17 ha (22%) rates *healthy but with problems*, and approximately 5 ha (9%) of riparian habitat that rates *unhealthy*.

Photos b – g (Page 11-12) provide examples of riparian sites along the Moose Lake Tributaries in each of the three health categories.

Examples of riparian areas along Moose Lake Tributaries rated as "Healthy"

M. Plemel, RHIP01THI015

Photo b: Cattail and sedge communities reflect a high water table and healthy riparian areas.

M. Plemel, RHIP07YEC018

Photo c: Willows provide deep binding root mass and add structure to healthy riparian plant communities.

Examples of riparian areas along Moose Lake Tributaries rated as "Healthy but with problems"

M. Plemel, RHIP02VAL021

Photo d: A straightened channel is well vegetated with riparian grasses and sedges but woody regeneration is minimal. The banks are altered due to the historic channelization.

M. Plemel, RHIP03VAL019

Photo e: Invasive species such as Canada thistle and perennial sow thistle are a problem in some riparian areas.

Examples of riparian areas along Moose Lake Tributaries rated as "Unhealthy"

A. Sarrazin, RHIP01KEH027

Photo f: Bare ground creates opportunities for invasive and disturbance plants to become established. Woody plants (in background) display an umbrella shape indicative of grazing periods that are longer than growing season rest periods.

K. Stebanuk, RHIP02YEC025

Photo g: Altered streambanks by hoof shear and little to no willow and other riparian shrubs with deep binding roots result in unstable streambanks.

5 RIPARIAN HEALTH DISCUSSION

5.1 *Historic and Present Influences on Riparian Health*

The following discussion provides some insights on present and historical land use influences on riparian health conditions in the local watershed.

- Beaver have been building and modifying riparian areas for thousands of years. Beavers "create and maintain aquatic habitats" (Hood, 2011) and "manage" riparian areas with their extensive dams and through their harvest of trees and shrubs. Beaver dams can benefit landowners by storing water during periods of drought and by mitigating flood damage further downstream. Over long periods of time, productive and fertile stream valleys evolve under beaver management, and beaver-modified valleys need deep-rooted plants to resist down-cutting through accumulated sediment. In the short term, beaver activity can conflict with human uses of riparian systems by flooding roads and pastures and plugging culverts. There are a variety of techniques available that deal with the management of beaver problems such as population control, culvert protectors and water level control (e.g. pond levellers) but it is important to consider the costs and benefits of our actions towards beavers, before selecting a management approach (D'Eon et al, 1995; Fortin et al, 2002; Hood, 2011; Cows and Fish 2009, 2013). The ability of beaver to modify stream valleys was most apparent along Yelling Creek during the 2014 inventory with many sites "flooded" by downstream dams.

- **Grazing animals (including livestock and wildlife)** have primarily dominated land use in Alberta's riparian zones for hundreds of years. Prior to the introduction of cattle, bison provided the greatest seasonal grazing pressures on riparian areas within the project area. Currently, livestock grazing continues to be a dominant land use influencing riparian health in many riparian areas and the adjacent lands[7]. According to many landowners, there are some areas within the Moose Lake Tributaries project area that still have localised, prolonged season-long grazing by livestock, but the riparian areas are often not used for livestock grazing on a regular basis due to steep banks and beaver activity. However, wildlife is a common sight as they use the valleys for forage, shelter, and as travel corridors and they can have an influence on soils and plants as well.

- **Cropland cultivation** and tame pasture 'improvements' for grazing and hay in the uplands have an influence on riparian health. In the entire Moose Lake drainage basin, about 46% of the natural forest cover has been cleared for agriculture (i.e. cropland, grazing)[8]. These modified areas are contributing to an increased presence of disturbance-caused undesirable plants within the riparian zones. Opinions vary on how these plant species, in particular Kentucky bluegrass (*Poa pratensis*) and smooth brome *(Bromus inermis*) should be viewed in terms of contributing to riparian health, but generally are thought to reduce long-term productivity and function of riparian systems.

[7] Based on aerial photo interpretation and observations from Cows and Fish field crews.
[8] Moose Lake Watershed Management Plan Terms of Reference. November 2004. 17 pages.

- **Urban, recreational, agricultural and industrial activity within the Moose Lake watershed** including urban development, road construction, recreational development, farming, ranching, industrial activities, channelization and drainage has influenced stream dynamics and riparian health over time. Each of these activities may be more prevalent along one waterbody more than another, but cumulatively they can all have an effect on land and water. Historic land management changes within the watershed can impact riparian health and stream dynamics today. Further studies may indicate the influence of historic land management changes on riparian health and stream dynamics.

5.2 *Riparian Plant Communities*

The vegetation health rating for a riparian area is influenced by the types of riparian plant communities present, and the health of both the woody and non-woody (herbaceous) plant components (refer to Sections 5.4 and 5.5).

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 community, 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, were identified and classified.

Understanding the type of riparian plant communities a stream, river, 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.

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 sustainable grazing management strategies and land use practices.

Moose Lake Tributaries Project Area Riparian Plant Communities

Tree and shrub communities form a large portion of riparian communities found in the Moose Lake Tributaries project area (Table 3). Approximately 70% of the project area is occupied by naturally occurring habitat types, while the remainder of the project area is occupied by seral or interim plant communities (community types) and one unclassified type.

A diverse woody plant community, including trees and shrubs, provides stability to the banks and shelter and forage for livestock and wildlife. Overall, native tree communities make up approximately 26.5% of the project area (of which 12% is the trembling aspen/low bush cranberry community type (*Populus tremuloides/Viburnum edule* CT). An indicator of a healthy shrub understory is the presence of willows (*Salix* species) and red-osier dogwood (*Cornus stolonifera*), two highly palatable shrub species, of which both are found in this project area. Native shrub communities (primarily willow types) make up about 33% of the project area.

Native herbaceous species (e.g. sedges, reed canary grass, common cattail) also exhibit deep binding root characteristic to help stabilize the streambank, although not to the same extent of shrubs and trees. Native herbaceous communities comprise about 35% of the project area. Long-term livestock grazing and adjacent hayfields can lead to encroachment of non-native disturbance-caused plants such as Kentucky bluegrass. Although Kentucky bluegrass is present in the project area, as a community type it occupies less than 1% of the area, which is positive.

Although considered a native plant, reed canary grass (*Phalaris arundinacea*) can be an introduced plant community, with a highly invasive nature where it was originally seeded as part of a hay or tame pasture seed mix in the Parkland Natural Subregion[9]. The reed canary grass habitat type comprises almost 11% of the project area (Photo h) and is likely present as a result of encroachment from surrounding landscapes in most instances as opposed to be being seeded directly into the riparian area. The conversion of native riparian habitat to hayfields, and tame pastures negatively impacts riparian health because often trees and shrubs are removed which results in loss of native biodiversity and reduced habitat structure and food sources for fish and wildlife, as well as compromised bank stability, increased erosion,.

Photo h: Reed canary grass covers 11% of the project area and as seen here can form dense plant communities.

[9] Thompson, W. and P. Hansen. 2003. Classification and Management of Riparian and Wetland Sites of Alberta's Parkland Natural Region and Dry Mixedwood Natural Subregion. Bitterroot Restoration, Inc. Prepared for the Alberta Riparian Habitat Management Society (Cows and Fish), Lethbridge, Alberta. 340 pp.

Table 4. Moose Lake Tributaries Project Area Riparian Plant Communities

Plant Community[10]	*Classification**	*Area Occupied (ha)*	*Area Occupied (%)*
Tree Communities			
Trembling aspen/low bush cranberry	Community Type	5.7	12.2
balsam poplar/red- osier dogwood	Community Type	3.6	7.7
White spruce/low bush cranberry	Habitat Type	1.6	3.5
White birch	Community Type	1.2	2.4
White spruce/common horsetail	Habitat Type	0.2	0.4
Trembling aspen/beaked hazel nut[11]	Habitat Type	0.2	0.3
	Tree Total	**12.5**	**26.5**
Shrub Communities			
Beaked willow/awned sedge	Habitat Type	7.5	16.0
Basket willow/awned sedge	Habitat Type	4.2	8.9
Basket willow/red-osier dogwood	Habitat Type	1.1	2.4
Yellow willow/red-osier dogwood	Habitat Type	0.9	1.9
Sandbar willow	Community Type	0.9	1.8
Beaked willow/red-osier dogwood	Habitat Type	0.5	1.1
Red-osier dogwood	Community Type	0.2	0.3
Beaked willow	Community Type	0.2	0.4
	Shrub Total	**15.5**	**32.8**
Herbaceous Communities			
Reed canary grass	Habitat Type	5.1	10.8
Marsh reed grass	Habitat Type	2.7	5.8
Beaked sedge	Habitat Type	2.5	5.3
Water sedge	Habitat Type	1.4	0.7
Awned sedge	Habitat Type	1.4	3.0
Kentucky bluegrass	Community Type	0.2	0.5
	Grass and Grass-like Total	**13.3**	**26.1**
Common cattail	Habitat Type	4.6	9.8
	Forb Total	**4.6**	**9.8**
Unclassified Communities*			
Unclassified		1.9	4.1
	Unclassified Total	**1.9**	**4.1**

* "Unclassified" plant communities refer to those types that are not described in the 2012 ESRD guide or by Thompson and Hansen 2003.

[10] The *Riparian Classification for the Parkland and Dry Mixedwood Natural Region* (Thompson and Hansen, July 2003) was used to classify the riparian plant communities in the Moose Lake Tributaries project area unless otherwise noted.
[11] Moisey et al. 2012.

5.3 *A Closer Look at the "Pieces"*

To better understand the overall health rating for the project area, it is helpful to take a closer look at which pieces of the riparian area are intact and functioning and which area not.

Figure 5 provides an overview of the health ratings for each of the riparian health parameters that were assessed. The overall project area rates as *healthy but with problems* on average so there are impacts to riparian vegetation and soil/hydrology health, some of which have resulted from long-term livestock grazing, other agricultural land uses (e.g. haying) and channel modification.

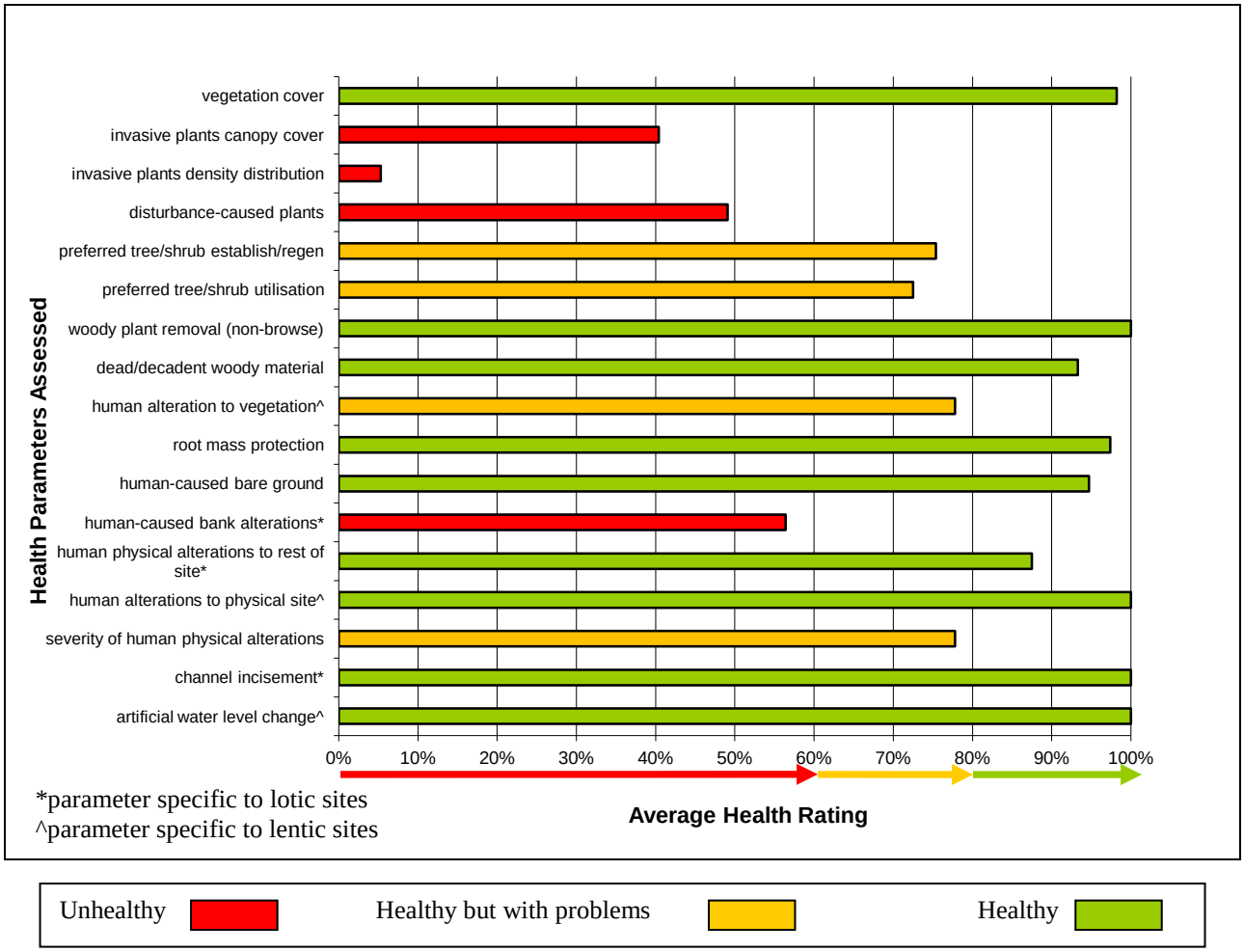


Figure 5. Breakdown of Riparian Health Parameter Ratings for the Moose Lake Tributaries Project Area (2014) (based on 19 sites)

Collectively, the vegetation parameters in the project area rate as *healthy but with problems* (71%). Riparian areas are well vegetated with a diversity of plant species. Refer to Appendix C for a list of all plants found in the Moose Lake Tributaries project area. Detracting from the vegetative health of riparian areas is high proportion of invasive plants and disturbance-caused grasses and forbs.

Soil/hydrology parameters in the project area rate as *healthy* (90%). Human-caused bare ground is limited in most areas and water is able to escape the channel during high flows on all of the waterbodies in the project area. Plants with sufficient root mass to protect streambanks from erosion are abundant in the majority of sites where it could be evaluated. Detracting from the soil and hydrology score of the project area overall is, a high amount of human-caused alterations to the streambank of lotic sites and the severity of human-caused alterations to the riparian area on lentic sites, though the overall area altered is minimal.

Three of the lotic sites do not have a defined stream or bank and channel which means that parameters relevant to bank (i.e. bank rootmass protection, human-caused alteration banks) and channel (i.e. channel incisement) could not be evaluated on those sites. Therefore discussions of those parameters are based on the number of sites that have a defined bank and channel.

The following sections describe in more detail the riparian health results of the Moose Lake Tributaries project area in 2014. For the more detailed analysis and interpretation, the discussion is based on the 18 sites with inventory data.

5.4 *Woody Plants - Trees and Shrubs: Presence, Reproduction and Health*

The parameters for woody plants are assessed on both lotic and lentic site unless otherwise noted.

Figure 6. Moose Lake Tributaries Project Area Woody Plant Parameters Health Ratings (2014) (based on 19 sites)

Presence

The presence of many different native tree and shrub species is often a good indicator of habitat structure and biodiversity. A diversity of plants provides low, medium, and tall habitat layers, benefiting wildlife and livestock (Photo j, page 23).

- Balsam poplar and trembling aspen cover 6.5% and 6.2% (3.0 ha, 2.8 ha) of the riparian area respectively; and are the dominant trees in the riparian area.
- In addition to balsam poplar and trembling aspen, three other tree species and 44 unique shrub species were recorded within the Moose Lake Tributaries project area. With the

exception of common caragana (invasive), all of the tree and shrub species recorded are native (Appendix C).

- The combined canopy of trees and shrubs covers approximately 49% (22.6 ha) of the project area.
- Dominant shrubs (with ≥5% cover of the project area) are beaked willow (*Salix bebbiana*), basket willow (*Salix petiolaris*), and red-osier dogwood, listed in order of decreasing abundance.
- Ten of the shrubs recorded are willow species and many others such as saskatoon (*Amelanchier alnifolia),* are indicative of moist, nutrient rich habitats.

Reproduction

A good indicator of the ecological stability of a riparian reach is the presence of woody plants in all age classes, especially young as shown in Photo i (page 23). All sites in the project area have the potential to grow preferred trees and shrubs. Two sites currently did not have any preferred woody plants in the seedling and sapling age classes on site, but still have potential. The majority of sites (11 of 19, 59%) have greater than 15% of the preferred woody plant cover provided by seedlings and saplings.

Health

The health of the woody plant community can be described by a variety of factors (Figure 6).

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 14 of the 17 sites with preferred trees and shrubs on site, the majority of plants are receiving *none* to *light* browse pressure (0% to 25%) from livestock and wildlife. Woody plants can sustain low levels of use, but increased browsing can deplete root reserves and inhibit establishment and regeneration. Three of the remaining sites display signs of *moderate* browse pressure, which is characterised by umbrella-shaped mature shrubs (Photo k, page 23) flat-topped seedling and saplings. Two sites did not have any preferred trees and shrubs recorded so utilisation could not be evaluated on those sites.

Other removal of woody vegetation by activities such as human cutting, clearing or beaver use, is minimal, with all sites showing no (i.e. 0% to 5%) recent signs of this type of removal. All but two sites have beaver activity on them (i.e. dams, lodges, cut stems) (Photo l, page 23), either historical or active, but the amount of woody removal by beavers remains low. The highly forested landscape in the project area can support beavers on the landscape, considering that willows in particular, readily sucker and re-grow following beaver use. As discussed in the Historical and Present Influences on Riparian Health section, beavers are a natural component of the Moose Lake watershed and can have beneficial ecological effects such as buffering flood impacts and raising the water table locally. By altering soil moisture conditions, beavers can also be an asset for restoration of degraded or altered riparian habitat.

How the Health of Trees and Shrubs Could Be Improved

- **Monitor and reduce** browse pressure on trees and shrubs where possible. Trees and shrubs considered preferred in terms of riparian health also tend to be those that are most palatable to livestock (e.g. red-osier dogwood). Woody plants are typically most susceptible to being browsed by livestock in the fall and winter after grasses have matured, or in spring before grass growth begins.
- **Provide rest** from grazing and other disturbances to ensure seedling and sapling tree and shrub communities have time to establish and mature. Planting balsam poplar, willow and other native tree and shrub species in areas where they are lacking also has the potential to enhance and promote further regeneration of the woody plant community.
- **Avoid** any new clearing of trees and shrubs in the riparian area.

5.5 *Non-Woody Plants: Diversity and Health*

The parameters for invasive and disturbance-caused plants are assessed on both lotic and lentic sites unless otherwise noted.

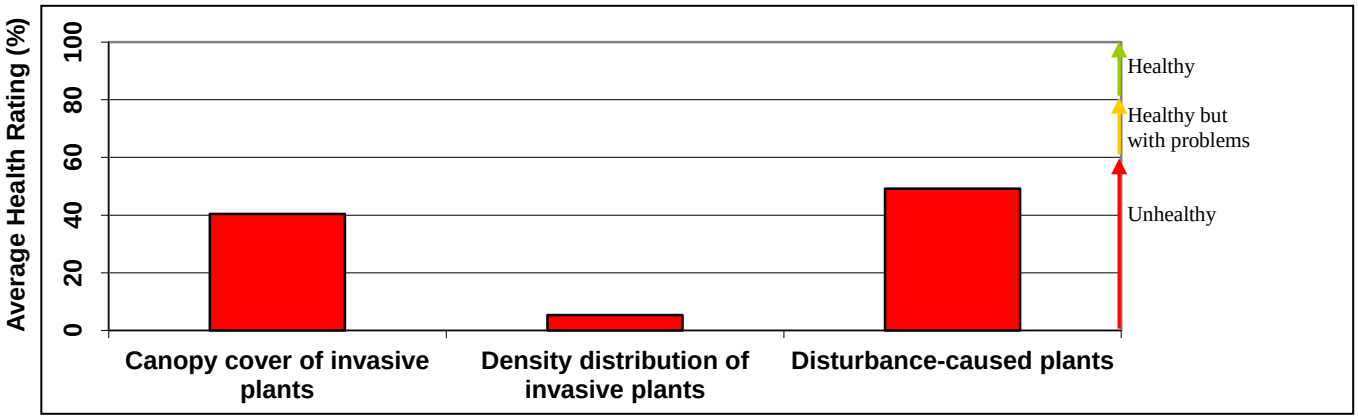


Figure 7. Moose Lake Tributaries Project Area Invasive and Disturbance-Caused Plant Parameters Health Ratings (2014) (based on 19 sites)

Diversity

Greater native plant species 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 Lake Tributaries project area:

- 39 unique species of grasses and grass-like plants and 116 unique species of broad leafed plants (forbs) were recorded. Of these, 76% (118 species) are native plants. Having evolved in the area for thousands of years, native plant species are well adapted to local climatic fluctuations, soil conditions, pollinators, and predator or disease stresses.
- Six plants with poisonous properties were recorded in the project area: common horsetail (*Equisetum arvense*), seaside arrow-grass (*Triglochin maritima*), common tansy (*Tanacetum vulgare*), red and white baneberry (*Actaea rubra*), spreading dogbane (*Apocynum androsaemifolium*) and water hemlock (*Cicuta maculata*). These plants were only found in

trace amounts and do **not** pose a management concern. However, avoiding early summer grazing of riparian areas with water hemlock should be considered as the risk to livestock can increase because other palatable forage has yet to emerge. With the exception of common tansy, which is invasive, these plants with poisonous properties are native, naturally occurring components of the riparian habitat.

Health

Disturbance-caused undesirable herbaceous species and invasive species are prevalent throughout the Moose Lake Tributaries project area. Disturbance-caused plants are typically non-native grasses and forbs that aggressively displace native plants once the soil surface has been disturbed. Invasive plants are those that are listed on Alberta's *Weed Control Act* as **prohibited noxious** or **noxious** weeds, as well as some additional species identified by Cows and Fish to be invasive within riparian areas. Invasive plants are non-native species that spread rapidly and are difficult to control (Photo e, page 12).

- Nine of 19 sites have more than 25% of the riparian area covered in disturbance-caused undesirable herbaceous species, while three sites have less than 5% cover of these species. The remaining seven sites have 5% to 25% cover of disturbance-caused plants. Combined, disturbance-caused species cover approximately 18% of the project area and can be indicative of long-term livestock grazing impacts, conversion to tame forage or encroachment from adjacent agricultural land uses and other watershed influences (e.g. seeded road ditches).
- Of the 26 disturbance-caused plant species present, the most prevalent are smooth brome and Kentucky bluegrass[12]. Although these plants do provide forage for livestock, compared to native sedges and shrubs, they do not provide adequate amounts of deeply binding rootmass and generally do not perform many riparian functions as well as native species. Banks and shores with only disturbance-caused plant cover are highly susceptible to erosion where a deep binding root mass is lacking.
- **The prevalence of invasive plants is a concern.** Eight noxious weed species were found: smooth perennial sow-thistle (*Sonchus arvensis ssp. uliginosus*), Canada thistle (*Cirsium arvense*), perennial sow-thistle (*Sonchus arvensis)*, white cockle (*Silene pratensis syn. Silene latifolia)*, common tansy, cleavers (*Galium aparine*), scentless chamomile (*Matricaria perforata syn. Tripleurospermum inodorum*), and common caragana (*Caragana arborescens*). Canada thistle occurs in all 19 sites and has the second highest overall canopy cover in the project area at 2.3%. Perennial sow-thistle and/or smooth perennial sow-thistle are present on all but one site and cover 1.0% to 2.5% of the project area.

  The distribution of Canada thistle throughout the project area ranges from a single patch plus a few sporadically occurring plants (three sites) to a continuous uniform occurrence of well spaced plants (one site), but on average it is present in a few patches plus several sporadically occurring plants. The range of distribution for smooth perennial and perennial sow-thistle is

[12] 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.

similar to Canada thistle on average and at the maximum end of the range, but the minimum end of the range is a few sporadically occurring individual plants (one site).

White cockle is present on 13 sites, but the total cover of this species is less than 1% and the distribution is relatively low on average. Common caragana and cleavers were found in trace amounts as a rare occurrence on one site each, and a few sporadically occurring individual plants of scentless chamomile were found on one site.

How the Health of Non-Woody Plants Could Be Improved

- **Prevent an increase in disturbance-caused plants.** Complete elimination of disturbance-caused plants is not realistic. Instead, the best approach is to maintain the health of native plant communities and minimize new ground disturbance from vehicles, livestock or people. Avoid further conversion of native plant communities to hayland or cropland in, or adjacent to the riparian area.
- **Monitor and control invasive plants.** Landowners are encouraged to work closely on this in collaboration with M.D. of Bonnyville Agricultural Services and the Alberta Invasive Species Council (https://www.abinvasives.ca/). Minimizing ground disturbance will help reduce potential for weeds to spread. Each participating landowner has been provided with details on weed species abundance and distribution specific to their riparian site.
- **In grazing situations, determine stocking rates for riparian pastures based on plant communities.** Landowners are encouraged to refer to ESRD's Central and Dry Mixedwood Range Plant Community Guide to determine appropriate ecologically sustainable stocking rates for the riparian plant communities in their landholdings (http://esrd.alberta.ca/lands-forests/grazing-range-management/range-plant-community-guides-stocking-rates.aspx). Riparian plant communities in the project area vary greatly in their forage productivity potential and/or suitability for cattle grazing.

5.6 *Human-Caused Alterations to Riparian Vegetation on Lentic Sites*

Alteration of the vegetation is meant to include all changes to the plant community composition or structure within the site caused by human actions (e.g., logging, mining, roads, construction, or development) or by agents of human management (e.g. pets and livestock). The intention here is to assess long term, or permanent, vegetation changes, not transitory or short-term removal of plant material that does not impact plant community composition. Of concern are changes that diminish or disrupt the natural wetland function of the vegetation.

Two of the three lentic sites in the project area have no alterations to the vegetation composition by human activities. The other lentic site has 15% to 35% of the vegetation composition altered by grazing and the result is a shift from native to non-native (introduced) plant species.

How the Health of Altered Vegetation on Lentic Sites Could Be Improved

Prevent an increase in disturbance-caused plants. Complete elimination of disturbance-caused plants is not realistic. Instead, the best approach is to maintain the health of native plant communities and minimize new ground disturbance from vehicles, livestock or people. Avoid further conversion of native plant communities to hayland or cropland in or adjacent to the riparian area.

Where Efforts Could Be Focused

Achieving the above goals requires ensuring plant communities have enough rest from grazing during the growing season to reduce the amount of bare ground and to allow native plants to out-compete disturbance-caused and invasive plants for nutrients and water. A combination of weed control measures and grazing strategies (where appropriate) that consider distribution, timing and stocking rates will be required.

Vegetation health parameter photos

M. Plemel, RHIP01VAL026

Photo i: A diversity of age classes of trees and shrubs provides good ecological stability of the riparian area.

M. Plemel, RHIP01THI022

Photo j: A variety of native and preferred riparian plant species (woody and herbaceous) are present throughout the project area.

A. Sarrazin, RHIP01KEH023

Photo k: The umbrella shape of these willows is due to heavy browse utilization.

M. Plemel, RHIP04YEC030

Photo l: Beaver activity is present throughout the project area but tree and shrub removal is minimal overall.

5.8 *Soil / Hydrology Health of Lotic Sites*

This section discusses the soil and hydrology parameters relative to the riparian area including stream/river banks and floodplains of lotic sites. There are 16 lotic sites in the Moose Lake Tributaries project area (15 inventories and one assessment (survey)).

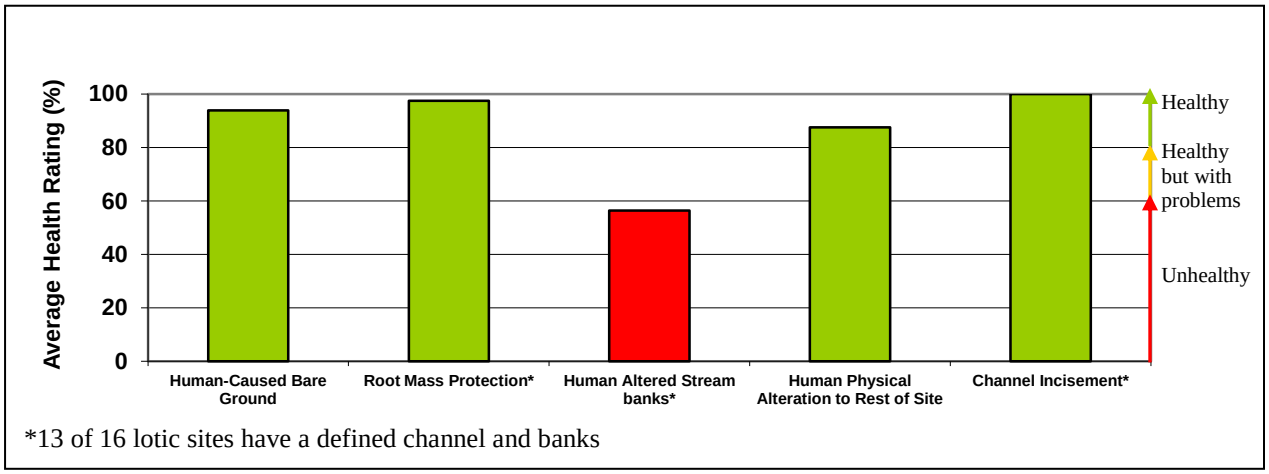


Figure 8. Moose Lake Tributaries Project Area Soil and Hydrology Parameters Health Ratings (2014) (based on 16 lotic sites)

Streambank Stability and Root Mass Protection

Deeply rooted streambank vegetation such as sedges, willows and balsam poplar helps maintain the integrity and structure of the bank by dissipating energy, resisting erosion and trapping sediments to build and restore banks. Healthy, well vegetated riparian areas slow the rate of erosion and balances 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 re-vegetate within a year, erosion rates are considered normal.

- Most of the bank length were visible along the Moose Lake Tributaries has adequate amounts of deep, binding root mass (greater than 85%); however there are concerns with increased risk of erosion where the deep binding rootmass is lacking in some places (Photo m, page 29).
- Stream and riverbank rootmass protection could not be assessed at three sites because those sites did not have a defined bank either due to the high amount of cattail (two sites) or from beaver activity (one site).

Bare Ground

Bare ground is unprotected soil that is capable of being eroded by rain drops, overland flow or wind. Bare ground in riparian areas is often attributed to natural processes, such as sediment deposition from recent flood events. Bare ground can also result from activities like vehicle traffic, livestock hoof shear and trailing, recreational trails, timber harvest, and landscaping

(Photo n, page 29). Areas of natural or human-caused bare ground are susceptible to weedy species encroachment.

- 12 sites are completely vegetated with no exposed soil! Of the remaining four sites, two have less than 1%, one has less than 5% and the other has 5% to 15% bare soil.
- The total amount of bare ground on lotic sites in the project area is minimal, approximately 0.8%. Of this, approximately 88% is due to human causes, such as livestock grazing, recreation and industrial development.
- There is also a small proportion of natural bare ground on lotic sites in the project area. Approximately 9% of the bare ground present is from erosion, deposition and wildlife use.

Alterations to the Stream/River Bank and Floodplain

When a stream or river bank is physically altered erosion can increase, mobilizing the channel and bank materials. This can degrade water quality and increase bank instability 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.

Stream/River bank alterations:

- Bank alterations could not be assessed at three lotic sites, due to the lack of a defined channel and bank.
- Of the 13 sites where the bank could be assessed, six have no alterations, one has less than 5% of the stream or river bank altered, one site has 15% to 35% of the bank altered, and the remaining five sites have greater than 35% of the bank structurally altered by human activities. Historic channelization is the primary cause of bank alterations on Valer's Creek and grazing is causing some bank alterations along Yelling Creek.
- Of the sites with defined banks, alterations from human activities impact approximately 28% (2.4 km) of the length of stream and river bank which could be assessed (8.5 km). On the sites where alterations are present, 62% (4.0 km) of bank is altered by human causes.

Floodplain alterations:

- Eight sites have no alterations from human causes to the riparian area beyond the banks and eight sites have some alterations. Of those sites with alterations to the floodplain, six have less than 5% of the area altered, and two have greater than 25% of the site (excluding the banks) physically altered by human causes.
- Overall, about 8.5% of the project area (3.7 ha) has human caused alterations to the riparian area beyond the banks. Grazing, along with recreation, roads and industrial development are the causes of the alterations. Soil compaction is the primary kind of alteration to the floodplain though berms (landscaping), hydrologic change, and impervious surfaces are also present.

Channel Incisement

Flooding is an important factor in dispersing moisture throughout the riparian area and in the formation of new sediment (necessary for riparian vegetation establishment) and dissipating water energy that might otherwise cause accelerated erosion within the channel. Incisement is the down-cutting or lowering of the channel bed so that flood waters can no longer access a floodplain suitable to the size of the stream or river on a regular basis (i.e. every 1-2 years)

- High water events can periodically access the highest terraces of the floodplain on all of the lotic sites within the Moose Lake Tributaries project area.

How Health of Stream/River Banks and Floodplains Could Be Improved

- ***Reduce livestock access to stream/river banks and active floodplain*** to allow structurally altered and damaged areas time to heal. Trampled portions of the bank will recover naturally if given rest from disturbance. Limiting livestock access will increase deep-rooted woody plants, which will help trap sediment to rebuild the banks, and protect against lateral cutting and erosion. Providing rest, especially during the sensitive portions of the growing season such as early spring, will help promote natural recovery.
- ***Maintain, protect and restore riparian buffers and minimize ground disturbance from human activities (e.g. industrial sites) along the stream/river banks and in the floodplain.*** To maintain bank integrity, water quality and riparian health, it is important to limit further ground disturbance to the banks and floodplain (including avoiding clearing of riparian plants). Where possible, riparian buffers should be established or restored in formerly cultivated (hayed) portions of the riparian area.
- ***Maintain natural meanders and variability within the Moose Lake tributaries.*** According to some landowners, sections of Valer's Creek were channelised and ditched by the M.D. of Bonnyville in the 1970s. Though there is not a lot of water that regularly flows through this system, removing the natural bends of rivers and streams can alter the ability of that stream to absorb and retain water when it does fall. Water generally moves more quickly through a straight channel and can thus increase potential for erosion in both the straightened reaches and downstream during times of high flow. Though returning the natural channel structure of these sections is probably not feasible, avoiding these practices in the future will help maintain riparian health within the project area.
- ***Restrict any further drainage or channelization work in the Moose Lake watershed.*** Mechanical damage to natural stream and river bank structure and sinuosity, due to historic channelization, is significant on some sites. Any drainage or channelization work within a watershed impacts overall flow and stream energy, generally resulting in significant downstream impacts and alterations to natural flood frequency and flows.

5.9 *Soil / Hydrology Health of Lentic Sites*

This section discusses the soil and hydrology parameters relative to the riparian area of the three lentic sites in the Moose Lake Tributaries project area.

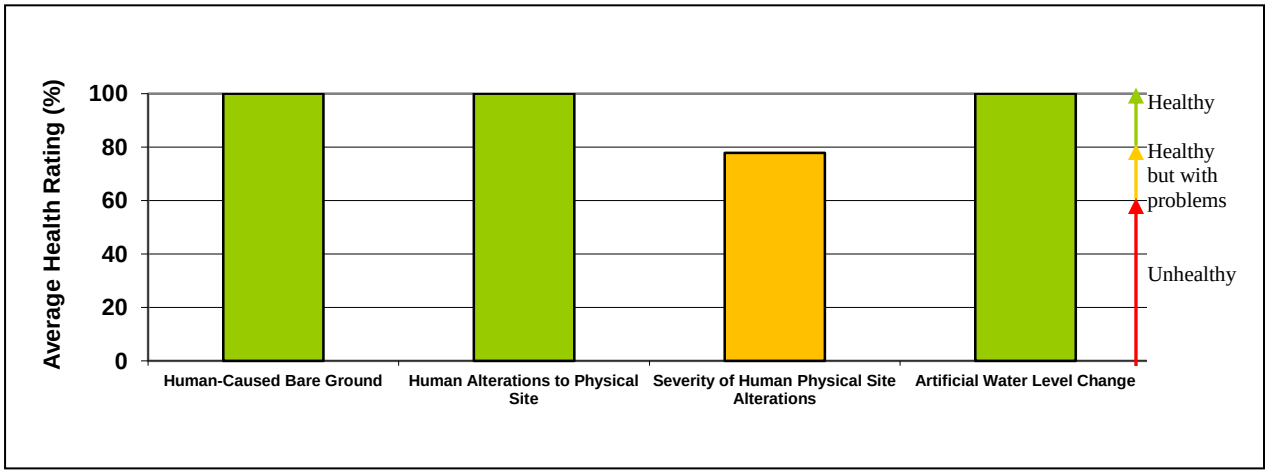


Figure 9. Moose Lake Tributaries Project Area Soil and Hydrology Parameters Health Ratings (2014) (based on 3 lentic sites)

Human-Caused Alterations to Riparian Area Physical Structure

Physical changes to the soil, shoreline integrity, and hydrology affect the ability of a natural lentic system to function normally. Changes in shore and bank contour and any change in soil structure will increase soil compaction, alter infiltration of water, and can cause increased sediment contribution to the water body. Every human activity in or around a riparian area has the potential to alter that site. This riparian health parameter seeks to assess the accumulated effects of all human-caused change to the physical characteristics of a site.

- Two of the three lentic sites in the project area have some alterations to the riparian area physical structure from human causes and the amount is less than 5% of the area. The other site has no alterations. The primary causes of alterations are soil compaction and damaged banks from grazing. The area altered is relatively small overall, and the severity of these physical alterations is s*light* meaning there is minimal impact to plant communities and hydrologic function in the altered areas; the physical site integrity remains near natural.

Bare Ground

Bare ground is unprotected soil that is capable of being eroded by rain drops, overland flow or wind. Bare ground in riparian areas is often attributed to natural processes, such as sediment deposition from recent flood events. Bare ground can also result from activities like vehicle traffic, livestock hoof shear and trailing, recreational trails, timber harvest, and landscaping (Photo m, page 29). Areas of natural or human-caused bare ground are susceptible invasive and disturbance plant species encroachment.

- The total amount of bare ground on lentic sites in the project area is minimal, approximately 0.5%. Of this, approximately 76% is due to natural causes (wildlife use).
- There is a small proportion of human-caused bare ground on the lentic sites in the project area (approximately 23%) and it is caused by grazing.
- All lentic sites have less than 1% bare ground.

Artificial Water Level Change (Additions or Withdrawals)

Although water levels naturally fluctuate on a seasonal basis in most systems, some wetland systems are affected by human-caused (artificial) additions or withdrawals. These artificial changes of water level rarely follow a temporal regime that maintains healthy native wetland plant communities. The result is often a barren band of shore exposed or inundated for much of each growing season. This causes shore material to destabilize, and often provides sites for weeds to invade. Such conditions are extremely detrimental to healthy riparian function.

- The severity of water level manipulation for Thin Lake is assessed as *not subjected*. There may be very small amounts of withdrawals for agricultural purposes, but there is no detectible fluctuation in water level.

How Health of Soil/Hydrology of Lentic Sites Could Be Improved

- ***Continue to minimise livestock and other human access to shores and riparian areas*** to maintain the healthy condition that currently exists. Well vegetated and physically intact riparian areas will continue to help trap sediment to rebuild riparian soils, protect water quality, and reduce erosion.
- ***Maintain, protect and restore riparian buffers and minimize ground disturbance in the riparian area from human activities (e.g. vehicle trails).*** To maintain shore integrity, water quality and riparian health, it is important to continue to limit ground disturbance to the riparian area (including avoiding clearing of riparian plants).

Soil / Hydrology health parameter photos	
 *K. Stebanuk, RHIP02YEC023*	 *A. Sarrazin, RHIP01KEH026*
Photo m: A lack of deep rooted plant material has caused this portion of bank to be unstable and slumping. This is not common on most sites in the project area but is a concern on certain sites.	**Photo n:** In areas of bare soil, even small ones, the potential for spread of invasive and disturbance plant species is increased. Soil compaction reduces infiltration and ground water storage.

6 RIPARIAN HEALTH TREND

When more than one inventory has been conducted on a site, we can begin to assess trends and the impacts of any management changes. The following discussion illustrates the main points of riparian function, as well as any changes that have occurred from 2005 to the present (2014). Eighteen sites (17 riparian health inventory and one riparian assessment (survey)) are included in this riparian health trend summary 2005 versus 2014 (Table 5).

Table 5. Moose Lake Tributaries Number of Revisit Participants and Sites 2005 vs. 2014

Waterbody	**# Landowners Contacted**		**# Landowners Participated**		**# of Sites (Riparian Inventories)**		**# of Sites (Riparian Health Assessment (Surveys))**		**Total # of Sites**	
	2005	2014	2005	2014	2005	2014	2005	2014	2005	2014
Thin Lake River	5	3	3	3	2	2			2	2
Thin Lake (lentic)					3	3			3	3
Yelling Creek	10	7	7	6	7	6			7	6
Kehiwin Creek					1	1			1	1
Valer's Creek (a.k.a. Vincent Creek)	4	3	3	3^	5	6	1	1	6	7
Total	19	13	13	12	18	18	1	1	19	19
Comparable					**17^**		**1**		**18**	
Land Owner Changes			1-2							

^ One of the inventory sites on Valer's Creek is a new site with a new landowner in 2014 that was not assessed in 2005 and therefore not included in this comparison. In 2014, two sites on Valer's Creek have been purchased by one of the other landowners involved already.

In 2005, 56% of sites (10 sites) rated *healthy*, 22% of sites (4 sites) rated *healthy but with problems*, and 22% of sites (4 sites) rated *unhealthy*. In 2014, 56% of site (10 sites) rated *healthy*, 33% of sites (6 sites) rate *healthy but with problems*, and 11% of sites (2 sites) rate *unhealthy* (Figure 10).

Since riparian health inventory sites vary in size, the relative health of the project area based on the area assessed, compared to the number of sites assessed, may differ. For the 18 sites evaluated in the Moose Lake Tributaries project area, the average area-weighted riparian health rating is the same in both 2005 and 2014 at 81% (*healthy*), slightly higher than by number of sites in both years. In both 2005 and 2014, by area, approximately 59 ha (69%) of riparian habitat rated *healthy*, approximately 16.8 ha (22%) rated *healthy but with problems*, and approximately 5 ha (9%) of riparian habitat that rated *unhealthy*.

The 2014 reassessments were completed August 12 -21 which is within approximately two weeks of the initial assessment in 2005 (August 9-11, 30-September 2) to minimize seasonal influences on site conditions.

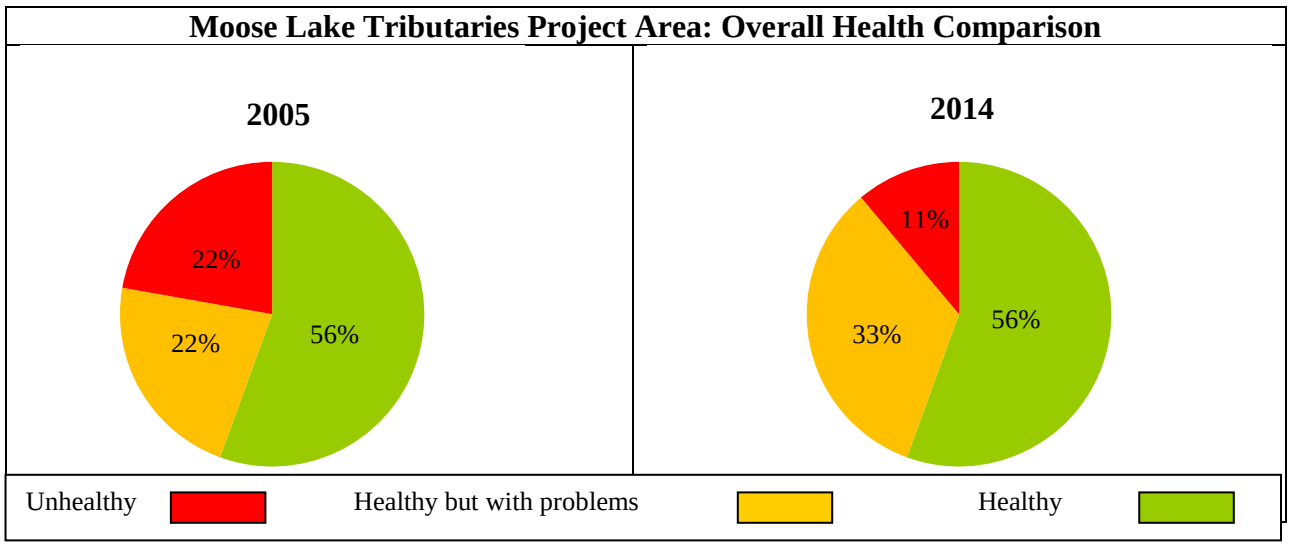


Figure 10. Comparison of Riparian Health Score Results: 2005 vs. 2014 for 18 Revisit Sites in the Moose Lake Tributaries Project Area

The following sections describe the riparian health trends of the Moose Lake Tributaries project area from 2005 to 2014 based pm 18 revisit sites where possible. For the more detailed analysis and interpretation, the discussion is based on the 17 sites with inventory data.

6.1 *Overall Health Trend*

Using the Lentic and Lotic Inventory methods, the overall riparian health score for the 18 Moose Lake Tributaries project area revisit sites has improved from 73% (*healthy but with problems*) to 79% (*healthy but with problems*) since 2005 (Table 6).

Table 6. Moose Lake Tributaries Revisit Project Area Description and Comparison of Average Vegetative, Soil and Hydrology and Overall Health Scores for 18 Revisit Sites (2005 to 2014)

	2005	2014
Stream Distance Inventoried (km)	12.4	12.2
Riparian Area Inventoried (ha)	52.0	46.4
Vegetative Health Rating	69%	70%
Soil & Hydrology Health Rating	79%	90%
Overall Health Rating	73%	79%
Overall Health Description	*Healthy but with problems*	*Healthy but with problems*

Note: a change of >5% indicates a rating that is improving or declining. Otherwise there is no change.

Overall, vegetation parameter scores remained the same on average but there has been a noticeable improvement in soil and hydrology parameters since 2005. There is some improvement in scores of certain vegetation parameters such as utilization of preferred trees and shrubs which actually improved in health category as well. Parameter scores for the cover, and density and distribution of invasive plants have declined. Within the soil/hydrology parameters, all the scores showed some improvement within their health categories and human physical alterations to the rest of site (beyond the banks) for lotic sites actually improved in health category as well.

Figure 11 shows a comparison of the various health parameters that were evaluated in 2005 and again in 2014. Refer to Appendix D for the comparison riparian health score sheet along with additional comparison and summary tables by waterbody in the project area.

To reflect our improved knowledge of riparian systems and better indicators of riparian function, our riparian health methodology has evolved since 2005. Riparian health indicators (parameters) that cannot be directly compared due to method changes are shown in the table below as "NA". For more details on how we evaluate and score each parameter, refer to the *Riparian Health Score Sheet Categories for Streams and Small Rivers* (Appendix E) and the *Riparian Health Score Sheet Categories for Lakes and Wetlands* (Appendix F).

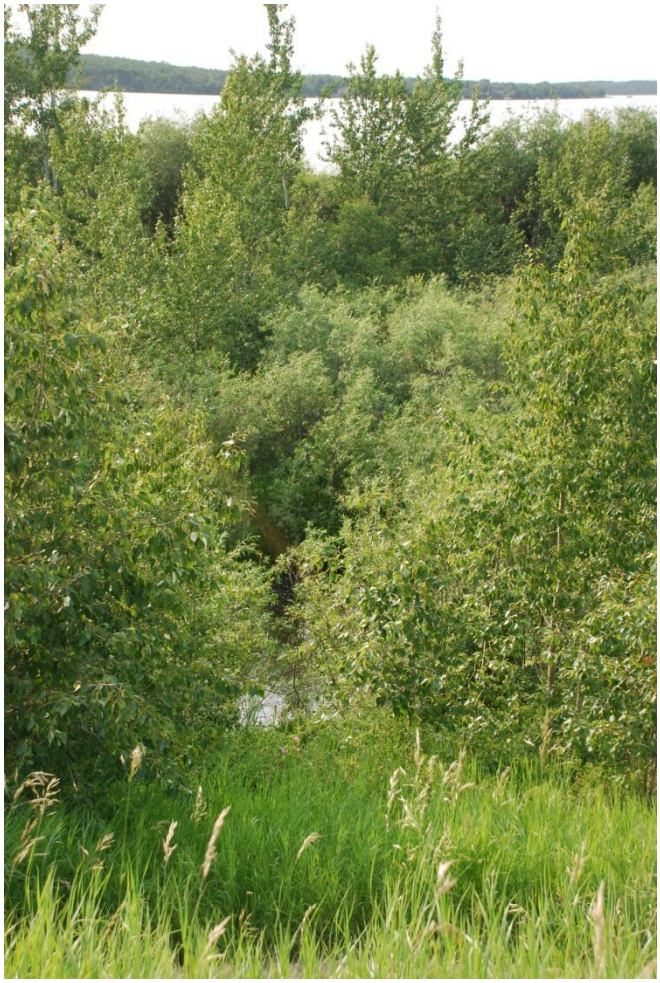
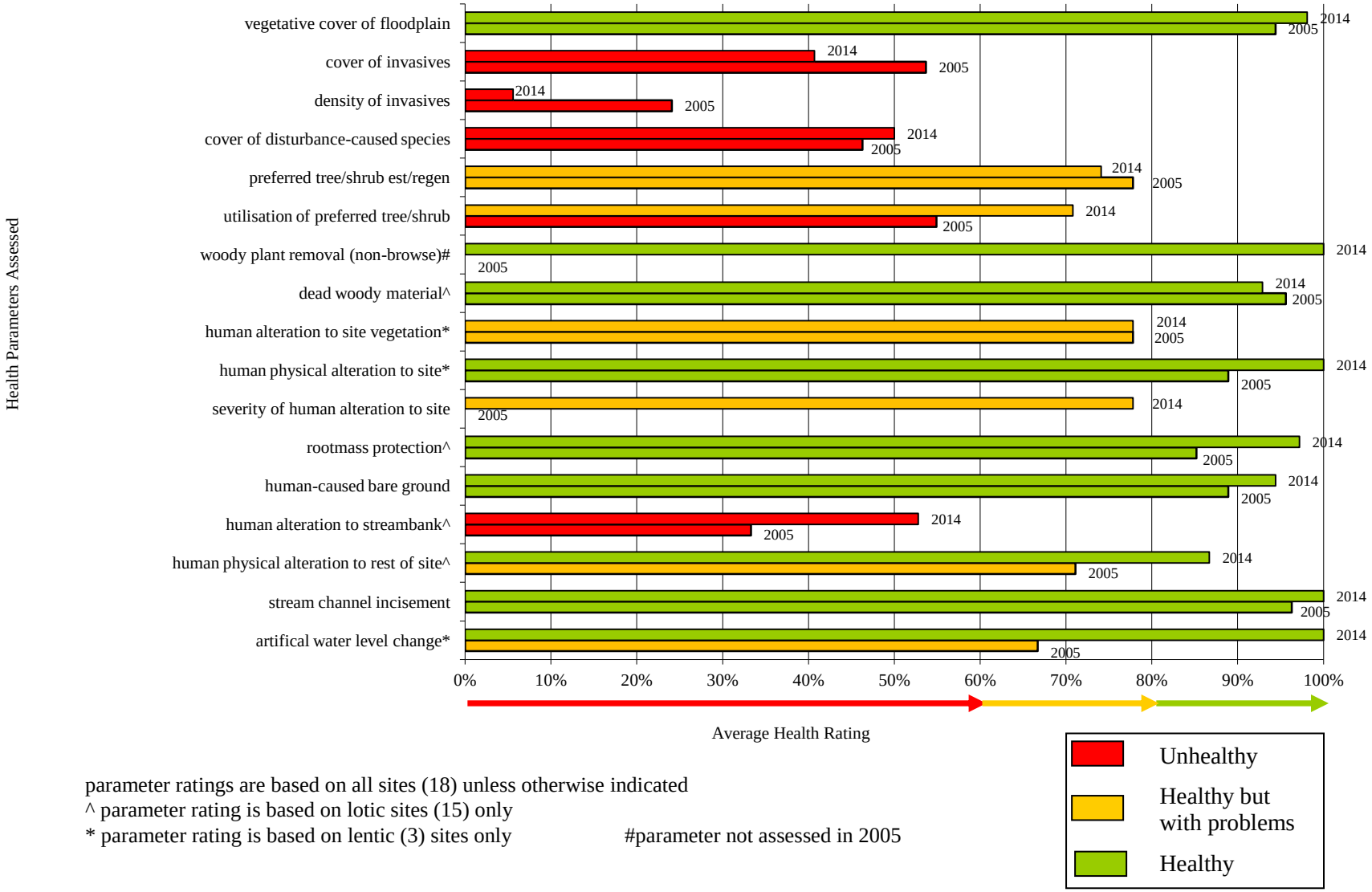


Photo o. View towards Moose Lake near Valer's Creek confluence
K. O'Shaughnessy, MONTVAL0001



parameter ratings are based on all sites (18) unless otherwise indicated
^ parameter rating is based on lotic sites (15) only
* parameter rating is based on lentic (3) sites only #parameter not assessed in 2005

Figure 11. Comparison of Riparian Health Parameters: 2005 vs. 2014 for 18 Revisit Sites within the Moose Lake Tributaries Project Area

6.2 *Overall Vegetation: Health Trends*

- **Overall Trend: Vegetative cover remains in the same *healthy* category overall.**

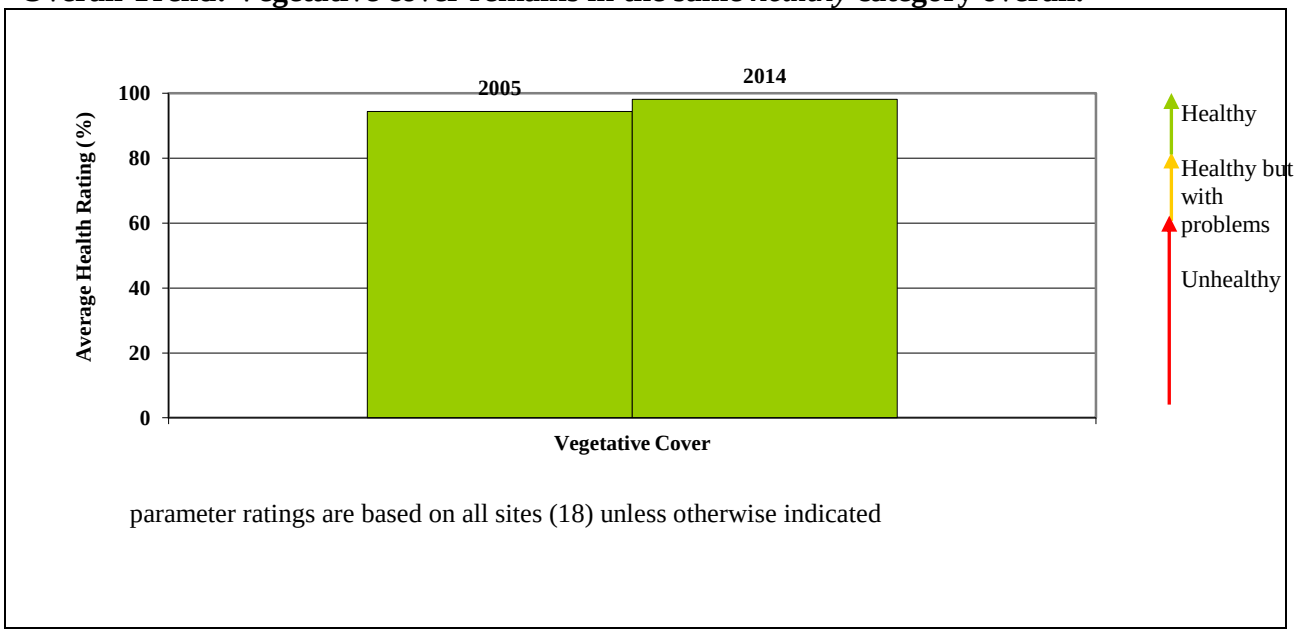


Figure 12. Comparison of Vegetative Cover Parameter Health Rating: 2005 vs. 2014 for 18 Revisit Sites within the Moose Lake Tributaries Project Area

Vegetative cover remains *healthy* in the project area with, on average, greater than 95% coverage by plants of any life form. There is a high diversity of plant species and the majority of them are native (Table 7). The difference in the number of species observed between 2005 and 2015 in the various categories can be attributed to a combination of staff knowledge and skills, changes in the Alberta Weed Control Act Regulations in 2010, and site characteristics.

Table 7. Moose Lake Tributaries Project Area Riparian Plant Composition Summary Comparison (2005 vs. 2014)

	2005		2014	
Life Form	Unique	% Native Species	Unique	% Native Species
Total # of species =	163	84%	204	81%
Total # of TREE species =	5	100%	5	100%
Total # of SHRUB species =	31	100%	44	97%
Total # of GRASS / GRASS LIKE species =	30	83%	39	87%
Total # of FORB species =	97	78%	116	72%
Plant Status				
Total # of ***native plants*** =	137	-	166	-
Total # of ***prohibited noxious*** plants =	0	-	0	-
Total # of ***invasive*** plants =	5	-	8	-
Total # of *disturbance* plants =	25	28%	26	23%
Total # of plants with *poisonous* properties =	7	86%	6	67%

Forbs (broad leaf plants) and shrubs have the highest number of species in each year.

6.3 *Woody Plants: Health Trends*

- **Overall Trend: Woody plants (trees and shrubs) parameters remain in similar health categories overall except for utilisation which has improved from the *unhealthy* to *healthy but with problems* category (Figure 13).**

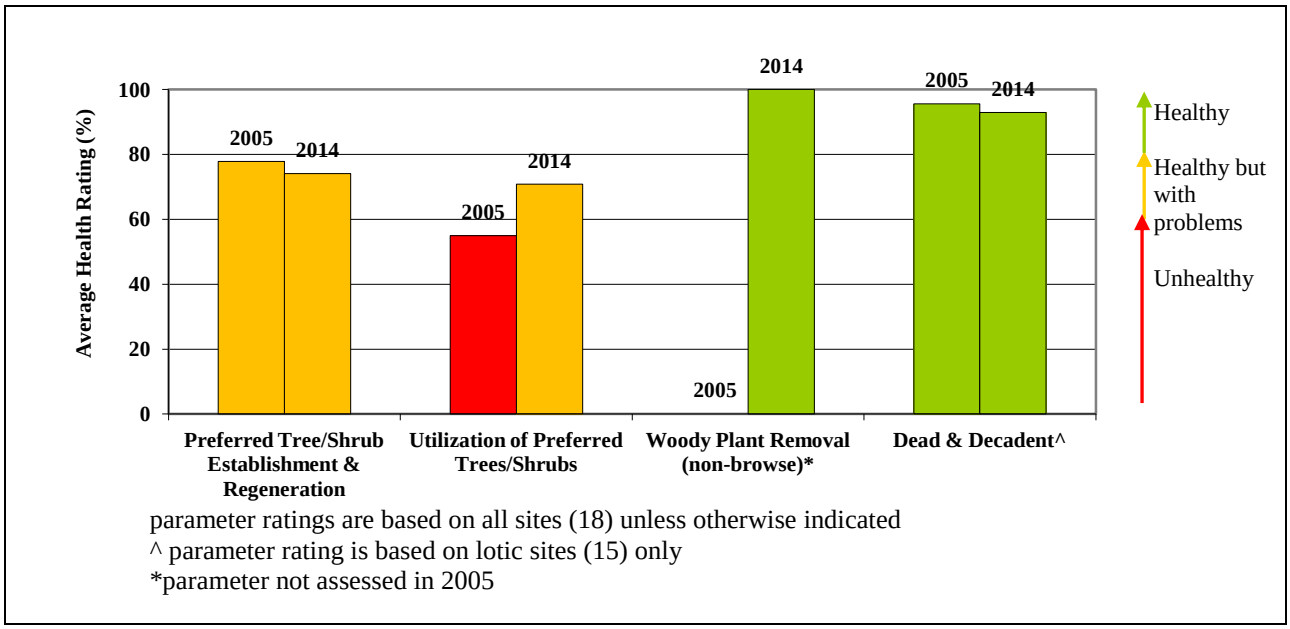


Figure 13. Comparison of Woody Plant Parameters Health Ratings: 2005 vs. 2014 for 18 Revisit Sites within the Moose Lake Tributaries Project Area

Tree cover represents approximately the same amount of the project area between the two visits (13% in 2005 versus 15% in 2014. There are no new tree species observed. Shrub cover has increased (39% in 2005 and 44% in 2014) and so has the number of species. Total woody cover has increased slightly from 45% in 2005 to 48% in the most recent inventory. Photos p and q show woody growth and regeneration in the project area.

Regeneration and establishment of preferred trees and shrubs (both lotic and lentic)

- **Preferred tree and shrub establishment and regeneration is mostly the same since 2005 and remains in the *healthy but with problems* category.**
- The percent cover of preferred trees and shrubs seedlings and saplings decreased on four sites, increased on four sites and the other ten sites had no change.
- In each year, the majority of sites had greater than 15% of the woody cover as seedlings and saplings.

Utilisation (Browse) of Preferred Trees and Shrubs (both lotic and lentic)

- **Browse improved from the *unhealthy* to *healthy but with problems* category overall.**
- Overall, seven sites show improvement, one site declined, and nine sites had no change. One site had a few young willows observed in 2005 but they were not found in 2014 so utilisation cannot be compared on this site.
- In each year the majority of sites with preferred trees and/ or shrubs had *none* or *light* browse.

Woody Removal by Other Means (Non-Browse) (both lotic and lentic)

- Other means of removing trees and shrubs refers to the removal of parts of, or whole, shrubs and trees by beaver and/or human-causes (such as logging or clearing).
- **In 2014, although many sites had beaver activity, the volume of woody cover being removed was no more than 5% which rates this parameter *healthy*.**
- Clearing or other vegetation removal by human activities was generally not observed in the project area.
- This type of use was not a separate parameter in 2005.

Standing Decadent and Dead Woody Material (lotic only)

- **Remains in the *healthy* category since 2005 with no change in average percent of dead and decadent woody canopy.**
- Existing tree and shrub communities within the Moose Lake Tributary project area continue to show normal amounts of dead and decadent branches in the upper canopy. The dead and decadence parameter is not part of the assessment for lentic sites.
- Two sites did have an increase in the amount of dead and decadence (from less than 5% in 2005 to 5-25% in 2014) but not enough to affect the overall health category for this parameter.

M. Uchikura, RHP031HL009

Photo p: September 1, 2005. Old wooden boat frame at the base of the slope is surrounded primarily by grasses.

K. Stebanuk RHIP03THL023

Photo q: August 12, 2014. The old wooden boat is a good reference point to monitor. Over time willows have become well established around it. An example of excellent preferred woody regeneration and establishment.

6.4 *Non-Woody Plants: Diversity and Cover Health Trends*

- **Overall Trend: Disturbance-caused and invasive plants remain prevalent and in the *unhealthy* category (Figure 14).**

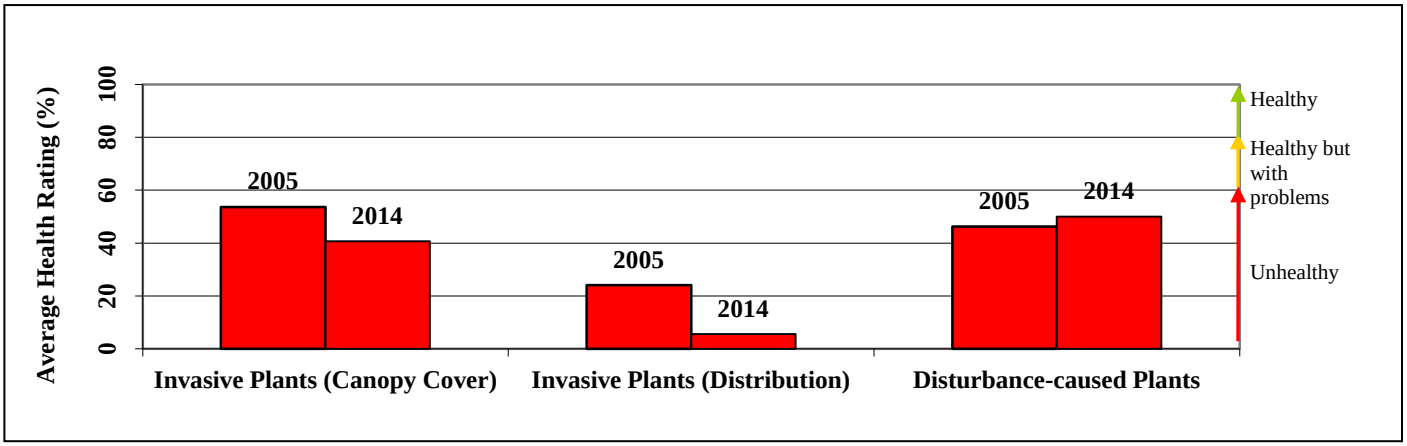


Figure 14. Comparison of Invasive and Disturbance-Caused Plants Parameters Health Ratings: 2005 vs. 2014 for 18 Revisit Sites within the Moose Lake Tributaries Project Area

Grasses and grass-likes cover represents approximately the same amount of the project area between the two visits (72% in 2005 versus 76% in 2014). Broad leaf plants (forbs) cover is also approximately the same amount of the project area between the two years (30% in 2005 and 33% in 2014). There were both more grass and grass-like, and forb species observed in the more recent inventory.

Invasive plant species (both lotic and lentic)

- **The overall average ratings for invasive plant species canopy cover and density and distribution remain in the *unhealthy* category but these species are more prevalent in 2014, than they were in 2005. Therefore, the health score actually decreased.**
- In 2005, the majority of sites had less than 1% canopy cover of invasive plants and in 2014 the majority of sites have 1-15% canopy cover of invasive plants.
- Seven sites show an increase in cover of invasive plants (i.e. a decline in health score) and 10 sites did not change. One site shows an opposite trend with a decrease in invasive plant species canopy cover (i.e. an improved health score).
- Overall cover of invasive plants combined has increased from 1.7% in 2005 to 4.7% in 2014.
- In total, eight invasive plant species were identified in 2014 with only five in 2005 (
- Table **8**). All sites have at least one invasive plant species in both years.
- The most common invasive plant continues to be Canada thistle, which was found on all sites (Photo s). Smooth perennial sow thistle or perennial sow thistle also continue to be very common, being found on all but one site in both years but the site without them is not the same between the years.

- The cover of Canada thistle has increased from 0.7% in 2005 to 2.2% in 2014. The density and distribution has also expanded with more sites having a few patches plus several sporadically occurring individuals than in 2005.
- In 2014 both perennial sow thistle and smooth perennial sow thistle were identified in the project area. Smooth perennial sow thistle has the highest overall cover at 2.5% of the project area with perennial sow thistle covering 1.1% in 2014. In 2005, perennial sow thistle had 1.3% cover and smooth perennial sow thistle was not identified. The density and distribution of smooth and perennial sow thistle has also expanded with more sites having a few patches plus several sporadically occurring individuals compared to 2005.
- White cockle is fairly common being found on 12 sites in 2014 and eight sites in 2005. Though the cover remains low, this species increased in density and distribution on the sites it was found in 2014.
- Common tansy cover remains low and not very common. It was found on the same site in both years as well as one more site in 2014.
- Cleavers remains a rare occurrence with low cover. It was found once in both 2005 and 2014 but at different sites.
- Scentless chamomile (a few sporadically occurring individual plants) and common caragana (rare occurrence) are additional species found on one site each and with very low cover.

Table 8. Invasive Plant Species Comparison (2005 vs. 2014) based on 17 Riparian Health Inventory Revisit Sites

Species	Constancy (expressed as number of sites observed)		Canopy Cover (Percent of Project Area)		Density / Distribution Class Range	
	2005	2014	2005	2014	2005	2014
smooth perennial sow thistle	0	9	-	2.5%	-	4 to 10
Canada thistle	17	17	0.7%	2.2%	2 to 10	4 to 10
perennial sow thistle	16	14	1.3%	1.1%	2 to 9	4 to 10
white cockle	8	12	0.2%	0.4%	1 to 4	2 to 8
common tansy	1	2	0.1%	0.2%	4	6,8
cleavers	1	1	0.04%	0.09%	1	1
common caragana	0	1	-	0.07%	-	1
scentless chamomile	0	1	-	0.05%	-	2

M. Plemel, RHIP01VAL024

Photo r: Disturbance caused plants like clovers offer ground cover but don't have deep binding roots.

M. Plemel, RHIP03VAL019

Photo s: Canada thistle is the most common invasive plant in the project area with the second highest cover.

Disturbance-Caused Undesirable Plant Species (both lotic and lentic)

- **Disturbance-caused plants remain similar since 2005, although this parameter continues to rate in the *unhealthy* category (Figure 14).**
- Five sites improved (i.e. had a decrease in overall cover of disturbance-caused plants), 10 sites had no change, and three sites declined (i.e. had an increase in overall cover of disturbance-caused plants).
- Disturbance caused plant species now cover 18% of the project area, as compared to 20% in 2005.
- The same five grasses are present in both years. The most prevalent disturbance-caused grasses continue to include Kentucky bluegrass and smooth brome. However, the percent cover of Kentucky bluegrass has decreased by 2% while smooth brome has increased by 2% since 2005. Other disturbance-caused grass species present in both years include timothy, quack grass and foxtail barley and their covers have not changed much since 2005.
- Clovers (*Trifolium* species) (Photo o) continue to be among the disturbance forb species and their covers are about 2% overall in 2014 which is about the same as in 2005.
- Of the disturbance-caused species found 22 are present in both years, three forbs were present in 2005 but not in 2014, and four forbs are present in 2014 but not in 2005.

6.5 *Human-Caused Alterations to Riparian Vegetation on Lentic Sites*

➢ **Overall Trend: Human-caused alterations to riparian vegetation remains in the same health category overall (Figure 15).**

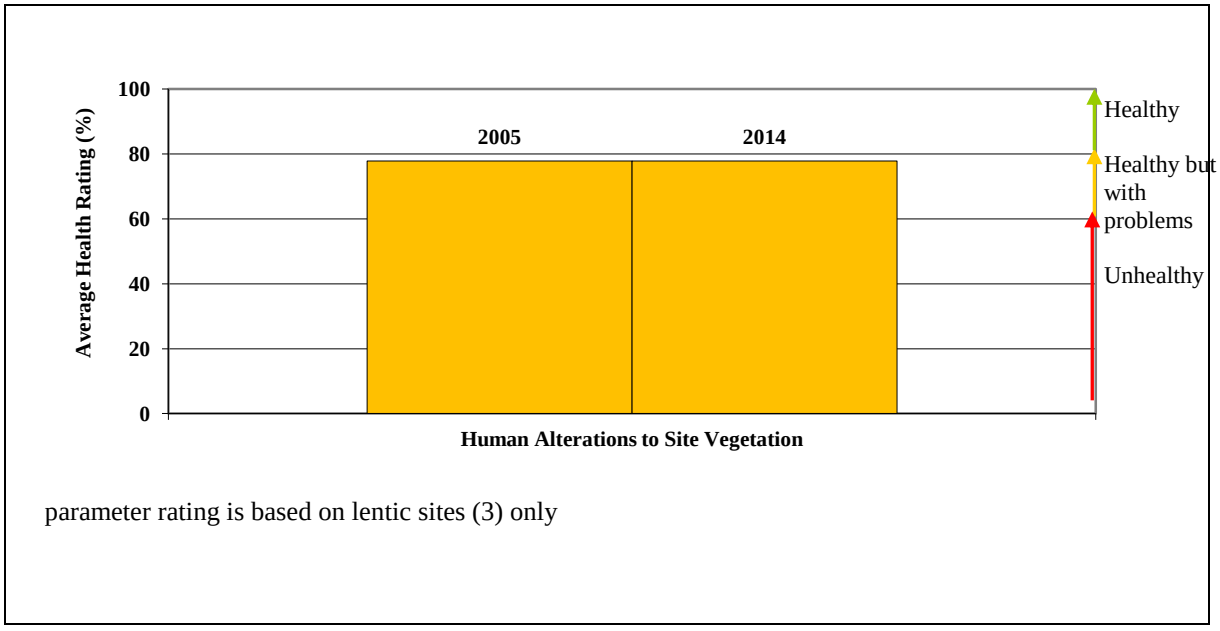


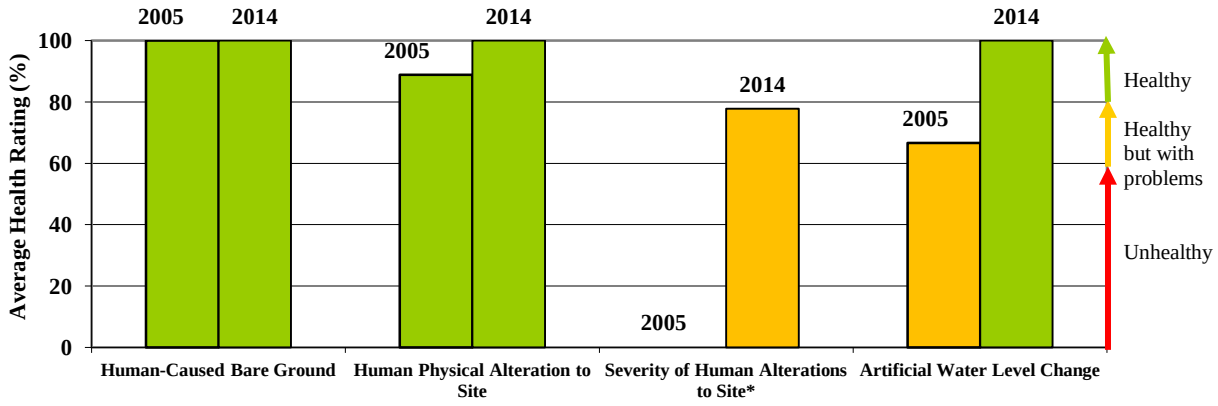
Figure 15. Comparison of Human Alterations to Site Vegetation Parameter Health Ratings: 2005 vs. 2014 for Three Lentic Revisit Sites within the Moose Lake Tributaries Project Area

Alteration of the vegetation is meant to include all changes to the plant community composition or structure within the site caused by human actions (e.g., logging, mining, roads, construction, or development) or by agents of human management (e.g. pets and livestock). The intention here is to assess long term, or permanent, vegetation changes, not transitory or short-term removal of plant material that does not impact plant community composition. Of concern are changes that diminish or disrupt the natural wetland function of the vegetation.

- Two of the three lentic sites in the project area continue to have no or minimal (0% to 5%) alterations to the vegetation composition by human activities. The other lentic site continues to have 15% to 35% of the vegetation composition altered by grazing and the result is a shift from native to non-native (introduced) plant species.

6.6 *Soil and Hydrology Health Trends: Lentic Sites*

➢ **Overall Trend: Bare ground and human physical alterations to the riparian area remain minimal overall and in the *healthy* category. Where there are alterations the average rating is *healthy but with problems.* There is an improvement in the rating for artificial water level change from *healthy but with problems* to *healthy* (Figure 16).**



parameter ratings are based on all lentic sites (3) unless otherwise indicated
*severity of human-caused alterations to site was not asked in 2005 therefore there is no data for that parameter in that year

Figure 16. Comparison of Soil and Hydrology Health Parameter Ratings: 2005 vs. 2014 for Three Lentic Revisit Sites in the Moose Lake Tributaries Project Area

Human-Caused Bare Ground

- **All lentic sites have less than 1% bare ground in both years which is a *healthy* rating.**
- The total amount of bare ground on lentic sites in the project area is minimal, approximately 0.5%. Of this, approximately 76% is due to natural causes (primarily wildlife use) in 2014 which is a decrease from 83% in 2005, also primarily wildlife use).
- Of the less than 1% total bare ground on the lentic sites in the project area, there is a small proportion that is human-caused (approximately 23% in 2014 which is an increase from 15% in 2005) and it is attributed to grazing in both years.

Human-Caused Alterations to Site and their Severity

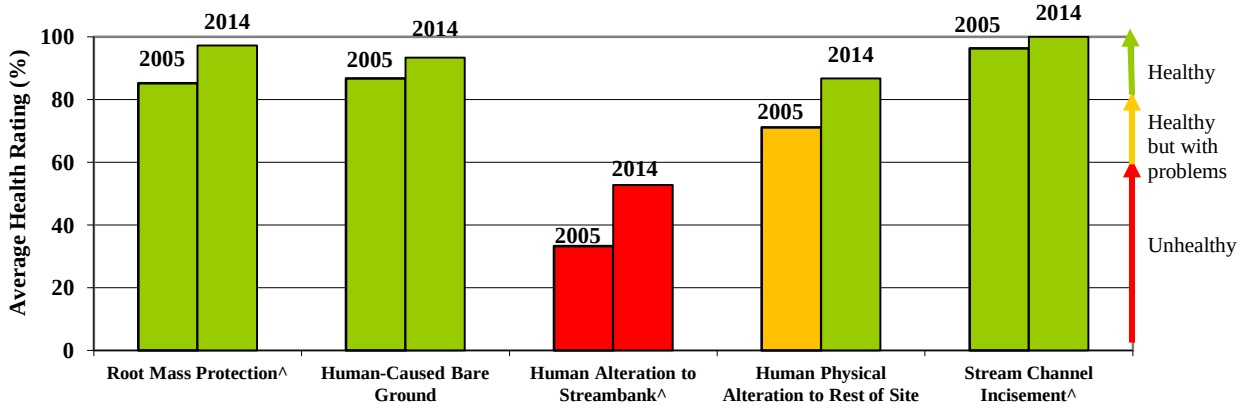
- **Human-caused alterations to the riparian area remain minimal and rate *healthy*.**
- Overall, in both years there is less than 2% of the project area on lentic sites with alterations to the riparian area physical structure by human activities.
- In 2005, one site had 5-15% of the riparian area physically altered from grazing activity but that improved to less than 5% in 2014.
- In 2014, one site has less than 5% physical alterations to the riparian area, again from grazing activity, compared to none observed in 2005.
- One site has no observed physical alterations to the riparian in either year.
- Where they were observed exist, the primary kinds of alterations in both years are soil compaction and damaged banks from grazing.
- **The area altered is relatively small overall, and the severity of the physical alterations in 2014 is s*light*.** This means there is minimal impact to plant communities and hydrologic function in the altered areas; the physical site integrity remains near natural. Severity of physical alterations was not evaluated in 2005 so cannot be compared to 2014.

Artificial Water Level Change (Additions or Withdrawals)

- **Thin Lake is not subjected to artificial additions or withdrawals and rates *healthy* for this parameter.**
- In 2005 we assessed minor artificial removal of water for agricultural purposes but the rate and amount at that time was slow enough relative to the size of the lake that the shore remained vegetated.
- In 2014, there is less use of the lake for agricultural purposes as discussed with landowners involved in the inventory. There may still be very small amounts of withdrawals for agricultural purposes, but there is no detectible fluctuation in water level.

6.7 *Soil and Hydrology Health Trends: Lotic Sites*

- **Overall Trend: All physical parameters for the creek and river sites show improvement within their health categories and one has improved a health category (Figure 17).**



parameter ratings are based on all lotic sites (15) unless otherwise indicated
^ parameter rating is based on number of lotic sites with defined channel and bank (12 in 2014, 9 in 2005)

Figure 17. Comparison of Soil and Hydrology Parameters Health Ratings: 2005 vs. 2014 for 15 Lotic Revisit Sites within the Moose Lake Tributaries Project Area

Human-Caused Bare Ground

- **The average score for bare ground on stream and river sites due to human or livestock use, has improved from 87% in 2005 to 93% in 2014, remaining in the *healthy* category.**
- In 2005 all sites had bare ground of some kind observed but the majority still within a *healthy* range (less than 1% human caused). In 2014, only four sites have bare ground observed, the others have none.
- Total bare ground in the project area, including both human-caused (e.g. livestock trails/trampling) and natural (e.g. sediment deposition) is 0.8% in 2014 compared to 2.7% in 2005 which is minimal overall.
- Of the small amount of bare soil present, the majority continues to be from human causes such as grazing, recreation, and industrial yard activities.

Human-Caused Physical Alteration to the Rest of Site

- **The average score for human alterations to the rest of site (beyond the banks) on stream and river sites has improved from *healthy but with problems* (71%) in 2005 to *healthy 87*%) in 2014.**
- In 2005 the majority of sites had alterations from human causes away from the bank of some kind but still mostly within a *healthy* range (less than 5% of the area altered). In 2014, half of sites have alterations away from the bank, the others had none.

- The total area altered by human activities beyond the banks was 17% in 2005 and is 9% in 2014 which is an improvement.
- The majority of the alterations continue to be caused by grazing, construction and recreation trails. The primary impact from these activities is soil compaction. There are also some hydrologic change, landscaping, impervious surface, berming and industrial yard impacts but to a lesser degree.

Streambank Root Mass Protection

- **Overall, the length of bank with deep, binding roots has increased within the *healthy* category from 85% in 2005 to 93% in 2014.**
- There are three stream and river sites that did not have a defined bank and channel in 2005 or 2014 therefore this parameter could not be assessed on those sites in either year.
- There are another three sites that we determined did not have a defined bank and channel in 2005 because ponded water from beaver activity was obscuring the channel at that time. However in 2014, there was a change in water levels and now the channel is visible on these sites with defined banks and the deep binding root mass is excellent, but the years cannot be compared.
- Of the nine sites that have a defined channel and banks in both years, two sites improved in rootmass protection and seven had no change.
- Plants, such as willows, native riparian grasses and sedges adjacent to the stream channel continue to maintain the integrity and structure of stream and river banks by dissipating energy, resisting erosion and trapping sediment to build and restore banks. These plants also protect against the erosive force of and damage due to ice.

Human-Caused Structural Alteration to Streambanks

- **Structural alterations to the streambanks by human causes had improved from 33% to 53% but remains in the *unhealthy* category.**
- There are three stream and river sites that did not have a defined bank and channel in 2005 or 2014 therefore this parameter could not be assessed on those sites in either year.
- There are another three sites that we determined did not have a defined bank and channel in 2005 because ponded water from beaver activity was obscuring the channel at that time. However in 2014, there was a change in water levels and now the channel is visible on these sites with defined banks so alterations could be evaluated and there were no human-caused alterations, but the years cannot be compared.
- Of the nine sites that have a defined channel and banks in both years, one site improved for the amount of alterations and eight had no change.
- In 2005, 89% of sites (8 of 9) with a defined channel and streambanks had alterations by human causes and the majority were in the *unhealthy* range. In 2014, 50% of sites (6 of 12) had alterations observed, the others had none. Still of those with alterations, the majority are in the *unhealthy* range which is greater than 35% of the bank length altered.

- One site did have an improved score going from greater than 35% of the bank length altered in 2005 to 15-35% altered in 2014.
- Where there were none or less than 5% alterations in 2005, those sites remained unaltered.
- Total bank length altered by human activities in the project area is 49% in 2005 compared to 28% in 2014 which is an improvement.
- The majority of alterations continue to be a result of construction and channelization of Valer's Creek and grazing. These activities are creating, or have created, berms, roads, trails. hoof shear and trampling that are impacting the streambanks.

Channel Incisement

- **Channel incisement remains in the *healthy* category and there is no present or past downcutting of the channel bed to restrict flooding.**
- There are three stream and river sites that did not have a defined channel in 2005 or 2014 therefore this parameter could not be assessed on those sites in either year.
- There are another three sites that we determined did not have a defined channel in 2005 because ponded water from beaver activity was obscuring the channel at that time. However in 2014, there was a change in water levels and now the channel is visible on these sites with defined banks and the channel is not incised, but the years cannot be compared.
- Of the nine sites that have a defined channel in both years, one site improved from *slightly* incised to *not incised* and the others did not change; they remain *not incised.* This means that regular high water events can access an adequate floodplain to disperse water energy, and slow water down so it can absorb into the soil and reduce erosion.

The following photos (t – w) are examples of baseline (2005) and revisit (2014) photos taken in the Moose Lake Tributaries project area.

Examples of Riparian Health Inventory Monitoring Photos (2005 compared to 2014)

T. Debroux, RHIP02VAL002

Photo t-a: August 10, 2005. Straightened channel has completely altered banks by human activities. Vegetation is present but abundance is limited. Active grazing on site.

M. Plemel, RHIP02VAL013

Photo t-b: August 13, 2014. Channel is still straight so altered banks remain. However, riparian vegetation is more abundant with sedges in the channel. This site has not had grazing for a few years now.

M. Uchikura, RHIP01KEH002

Photo u-a: September 2, 2005. Some livestock activity in the project area created pugs and hummocks and bare ground.

A. Sarrazin , RHIP01KEH016

Photo u-b: August 20, 2014. The vegetation has filled in this portion of bare ground. Livestock are still grazing here but changes in intensity, timing and/or distribution has allowed this area to become re-vegetated with riparian species.

Examples of Riparian Health Inventory Monitoring Photos (2005 compared to 2014) *continued*

T. Debroux, RHIP03YEC003

Photo v-a: August 30, 2005. This area had been recently drained including beaver dam removal for culvert replacement in 2005. Sediment that would have been exposed is now vegetated over but is vulnerable to undesirable and invasive plant species.

A. Sarrazin , RHIP03YEC030

Photo v-b: August 18, 2014. The valley bottom here is now entirely covered in water due to continued beaver activity in the valley. Vegetation includes a cattail community in the distance.

M. Uchikura, RHIP02THI003

Photo w-a: September 1, 2005. Due to the extensive cattail communities this site does not have a defined streambank or channel though there may be one more towards the middle of the valley. Parameters about streambank and channel cannot be assessed in this situation.

M. Plemel, RHIP02THI016

Photo w-b: August 12, 2014. A defined streambank still is not present within the site and the cattail community remains extensive. The cattail and high water table is also limiting for access so there aren't any alterations from livestock or humans here. Streambank and channel parameters still cannot be assessed.

6.8 *Riparian Management Trends – Landowner Discussion Summary*

In 2014, 12 landowners participated in the riparian health inventory revisits. Of those, 11 are the same landowners from 2005. With 10 of those, we discussed management changes as part of the on-site visit: four (40%) have not made a management change and six (60%) have.

For those that have made a management change since 2005, those changes include:

- alternate or improved watering systems/sources (2);
- excluding livestock from grazing in riparian area, permanently (2);
- land use shift to recreation (crown);
- converting adjacent pasture to cropland for silage.

One landowner had sold their cattle prior to the first visit in 2005 and left the riparian area alone ever, since so good management was already in place prior to contact with Cows and Fish.

The primary driver for making the change was retiring or aging and consequently a desire to decrease work. Other reasons include wanting to provide a secure water source for livestock (even though the naturally steep topography is a natural deterrent, the alternate water system help to keep the animals away from the surface water); personal health issues so don't have cattle any more; and end of a grazing lease.

One landowner commented on the benefits of their alternative or improved watering systems/sources: "there is decreased access to surface water by livestock and improved water quality".

For those that have not made a management change since 2005, when asked why, some of the reasons include:

- [Riparian] *Land is Environmental Reserve (ER) so can't do anything with it.*
- *The* [riparian] *area is not easily accessible* [for livestock] *and there is no need to use it.*
- *It has been fenced along the top of the hill* [for a while now].
- *Haven't used it* [the riparian area] *much in the past and still aren't.*
- *Beavers have flooded a lot of the grass that might have been available.*
- *Steep valley and bushy.*
- [Riparian] *Land is doing just fine the way it is* [so why change it?].

All landowners were asked if they planned to make a change in the next 2 to 3 years [that might affect the riparian area]. Some of the responses include:

- passing things on to sons, they will take over (2);
- adding a new winter watering system;
- planting fields adjacent to riparian area into hayland;
- keep the weeds down with grazing;
- not unless pasture becomes in really short supply.

If management changes have not been made, reasons preventing those changes include:

- age and desire to retire;
- dynamic nature of riparian areas creates management difficulty (i.e flood events);
- lack of time, labour and/or costs associated with management change.

Landowners were also asked about what they value about their riparian area, creek, river or lake; what is special about their farm/ranch/property; or to share any additional comments:

- Long time family farm. Been in area since early 1900s. *There is lots of history here.*
- Family settled in area in 1927 from Ukraine. *I liked the recreation opportunities [of the creek] when I was younger. Creek provides livestock water source.*
- *Bought the family farm and the creek came with it.*
- Land purchased by father in 1970s. Recently built a home [near the valley]. *It might not be that productive but it's pretty to look at.*
- Creek valley slopes grow blueberries and choke cherries. *Used to be fish in the creek right below the house but not any more.*
- There is interest in other waterbodies on the property.

Appendix G has additional comments from some of these same landowners about stewardship programs like the Growing Forward 2 On Farm Stewardship and Agricultural Watershed Enhancement programs as well as what resources they use for stewardship and environmental information.

7 THE NEXT STEPS

7.1 *Community and Individual Action*

- ***Take stock of current and past conditions.*** The first step in addressing riparian management issues has been made; the collection of two sets of baseline information on riparian health in 2005 and 2014 and a review of historical land use practices have answered the question ***"Where are we now?"***

- ***Highlight and profile what is 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 landowners wanting to improve riparian health, practical examples of proper riparian management can be demonstrated to other landowners and communities. Landowners 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, the landowners of the Moose Lake Tributaries project area will be closer to answering the question ***"Where do we want to go?"***

- ***Take control of the reins.*** Each landowner that participated in this riparian health inventory project will receive a riparian health report for their landholding indicating what pieces of riparian health are intact, what pieces might be missing, and how things have changed since the first visit. Within these reports are some basic management principles specific to their riparian pastures, 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 range 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 continue to be pursued in subsequent years. Establishing demonstration and profile sites, or another overall riparian inventory can achieve this – every 3 to 5 years. This revisit in 2014, nine years after the first visit is a great start for assessing trend for two points in time.

  - The field workbooks *Riparian Health Assessment for Streams and Small Rivers* and *Riparian Health Assessment for Lakes, Wetlands, Ponds and Sloughs* are available from Cows and Fish (www.cowsandfish.org). These workbooks explain how to conduct a riparian health assessment (rapid survey) to quickly check the health status of your riparian area. These tools allow landowners and managers to monitor and track their own progress regarding riparian health. For more information on this, contact Cows and Fish.

7.2 *Management Objectives*

Management objectives should include:

- Establishing new and maintaining the existing healthy tree and shrub communities.
- Maintain the health and vigour of native trees and shrubs by keeping livestock browse utilization to a minimum (particularly during the spring and fall).
- Maintain and monitor regeneration rates for native trees and shrubs and avoid new clearing of woody plants in the active riparian zone.
- Prevent a further increase in the abundance or distribution of disturbance-caused plants. It is unrealistic to completely remove these plants once they are well established in riparian areas; however, sound grazing and other riparian management practices can be effective in reducing the prevalence of disturbance-caused plants.
- Control and monitor invasive plants in collaboration with the Agriculture Fieldman at the M.D. of Bonnyville and/or Lakeland Agricultural Research Association (LARA).
- Minimize new ground disturbance from human activities. This will reduce potential for weed or disturbance-caused plant infestations. It will also help prevent soil compaction or erosion in the active floodplain, banks and shores.
- Restore actively slumping and eroding banks by planting or allowing for recovery of native riparian plants. Allow for rest and recovery of trampled portions of the riparian area.

- Maintain an adequate riparian buffer along the banks and shores and avoid new hayfield or tame pasture developments in the active floodplain.
- Maintain and increase the cover of native deeply rooted plants within the riparian area, particularly along the banks.
- Carefully manage livestock stocking rates to sustain productive, healthy riparian plant communities.
- Maintain natural meanders and variability within the Moose Lake Tributaries and avoid further channelization and straightening of streams and rivers.
- Allow lakes to naturally fluctuate in water level without artificially adding or removing water.

---

*For more information on riparian grazing management strategies refer to the Cows and Fish "**Caring for the Green Zone: Riparian areas and Grazing Management**" publication (included with this report). Additional copies are available from Cows and Fish.*

7.3 *How to Contact Us*

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 riparian health monitoring and management and for further information on any aspect of this report, please contact:

Kerri O'Shaughnessy
Riparian Specialist – Edmonton
Tel: (780) 427-7940
Fax: (780) 422-9745
Email: koshaugh@cowsandfish.org
Website www.cowsandfish.org

LITERATURE CITED

Aquality Environmental Consulting Ltd and Alberta Environment. 2005. State of the Watershed Environmental Inventory Report for Moose Lake: Summary of Current Information. 40 pp.

Alberta Riparian Habitat Management Society – Cows and Fish. 2014. Alberta Lentic Wetland Inventory Form and User Manual. Available from Cows and Fish.

Alberta Riparian Habitat Management Society – Cows and Fish. 2014. Alberta Lotic Wetland Inventory Form and User Manual. Available from Cows and Fish.

Alberta Riparian Habitat Management Society – Cows and Fish. 2014. Alberta Lotic Wetland Assessment (Survey) Form and User Manual. Available from Cows and Fish at http://www.cowsandfish.org/riparian/health.html

Alberta Riparian Habitat Management Society – Cows and Fish. 2013. An Overview of Beaver Management for Agricultural Producers – Decision Matrix Tool. 4 pages. www.cowsandfish.org.

D'Eon, R.G., Lapointe, R., Bosnick, N., Davies, J.C., MacLean, B., Watt, W.R., Wilson, R.G. 1995. The beaver handbook: a guide to understanding and coping with beaver activity. OMNR, Northeast Science & Technology. FG-006. 76p.

Fortin, Christian, Moanon Laliberte and Jacques Ouzilleau. 2002. Management Guide for Land Used by Beavers in Quebec, Sainte-Foy, Fondation de la faune du Quebec, 108p.

Hood, G.A. 2011. The Beaver Manifesto. Rocky Mountain Books. Calgary, Alberta. 144p.

Moisey, D., J. Young, D. Lawrence, D., C. Stone and M. Willoughby. 2012. Range Plant Community Types and Carrying Capacity for the Central and Dry Mixedwood Subregions in Alberta (7th Approximation). Alberta Environment and Sustainable Resource Development, Lands Division. ISBN No. 978-1-4601-0313-5. Pub No. T/276. http://esrd.alberta.ca/lands-forests/grazing-range-management/documents/DryCentralMixedwoodRangePlantTypes-2012.pdf (accessed October 2014).

Thompson, W. and P. Hansen. 2003. Classification and Management of Riparian and Wetland Sites of Alberta's Parkland Natural Region and Dry Mixedwood Natural Subregion. Bitterroot Restoration, Inc. Prepared for the Alberta Riparian Habitat Management Society (Cows and Fish), Lethbridge, Alberta. 340 pp.

APPENDIX A: 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).

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 riverbank 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 B: MOOSE LAKE TRIBUTARIES RIPARIAN HEALTH SCORE SHEET (2014)

n=19	Average		
Riparian Parameter	**Actual Score**	**Possible Score**	
Vegetation			
1. Vegetative Cover of Riparian Area	5.9	6	
2a. Invasive Plant Species Canopy Cover	1.2	3	
2b. Invasive Plant Species Density Distribution	0.2	3	
3. Disturbance-Caused Undesirable Herbaceous Species	1.5	3	
4. Preferred Tree and Shrub Establishment and Regeneration	4.5	6	
5a. Utilisation of Preferred Trees and Shrubs[1]	2.2	3	
5b. Woody Vegetation Removal by Other than Browsing	3.0	3	
6. Decadent and Dead Woody Material^[2]	2.8	3	
6. Human Alteration to Vegetation*	4.7	6	
Vegetation Subtotal/Rating:	***21.2***	***30.0***	***70.5%***
Soil/Hydrology			
7a. Human Alteration to Physical Site*	12.0	12	
7b. Severity of Physical Alterations*	2.3	3	
7. Streambank Root Mass Protection^[3]	5.8	6	
8. Human-Caused Bare Ground	5.7	6	
9. Degree of Artificial Water Level Change*	9	9	
9. Human Altered Streambanks^[3]	3.4	6	
10. Human Physical Alteration to Rest of Site^	2.6	3	
11. Stream Channel Incisement^[3]	9	9	
Soil/Hydrology Subtotal/Rating:	***24.1***	***26.7***	***90.1 %***
Overall Total/Rating:	***45.3***	***56.7***	***79.7%***

*indicates parameter is assessed for lentic sites only (n=3)

^indicates parameter is assessed for lotic sites only (n=16)

[1] Parameter was evaluated at 17 of 19 sites; 2 sites did not have any preferred woody vegetation present therefore this parameter is not applicable on those sites at this time.

[2] Parameter was evaluated at 18 of 19 sites; 1 site did not have any woody vegetation present therefore this parameter is not applicable on that site at this time.

[3] Parameters were evaluated at 13 of 16 lotic sites; high water levels obscured bank conditions at 3 sites in 2014, thus bank and channel related data could not be collected at this time.

	Healthy (80-100%) – Little or no impairment to riparian functions.
	Healthy but with Problems (60-79%) – Some impairment to riparian functions due to human or natural causes.
	Unhealthy (<60%) – Impairment to many riparian functions due to human or natural causes.

APPENDIX C: RIPARIAN PLANT INVENTORY (2014)

This plant inventory list is based on the 18 riparian health inventory sites completed in 2014.

Life Form	Plant Status[1]	Area by Species		Percent Canopy Cover[2]				Percent of Project Area
		acres	hectares	Avg	Min Range	Max Range	Constancy[3]	
TREES								
balsam poplar (Populus balsamifera)	native	8.0	3.3	7.1%	0.0%	50.0%	94.4%	7.0%
aspen (Populus tremuloides)	native	7.1	2.9	6.7%	0.0%	30.0%	88.9%	6.3%
white spruce (Picea glauca)	native	1.7	0.7	3.7%	0.0%	20.0%	38.9%	1.5%
white birch (Betula papyrifera)	native	1.5	0.6	2.3%	0.0%	10.0%	44.4%	1.3%
tamarack (Larix laricina)	native	0.8	0.3	2.8%	0.0%	10.0%	16.7%	0.7%
SHRUBS								
beaked willow (Salix bebbiana)	native	12.2	5.0	11.5%	0.0%	30.0%	83.3%	10.7%
basket willow (Salix petiolaris)	native	9.3	3.8	8.4%	0.0%	30.0%	88.9%	8.2%
red-osier dogwood (Cornus stolonifera)	native	7.7	3.1	7.3%	0.0%	30.0%	83.3%	6.8%
wild red raspberry (Rubus idaeus)	native	4.0	1.6	3.8%	0.0%	20.0%	83.3%	3.5%
yellow willow (Salix lutea)	native	3.0	1.2	4.5%	0.0%	20.0%	66.7%	2.6%
river alder (Alnus tenuifolia)	native	3.0	1.2	7.0%	0.0%	20.0%	27.8%	2.6%
buckbrush/snowberry (Symphoricarpos occidentalis)	native	2.7	1.1	2.4%	0.5%	20.0%	100.0%	2.4%
sandbar willow (Salix exigua)	native	2.4	1.0	5.3%	0.0%	20.0%	44.4%	2.1%
beaked hazelnut (Corylus cornuta)	native	2.0	0.8	3.3%	0.0%	20.0%	55.6%	1.7%
Saskatoon (Amelanchier alnifolia)	native	1.8	0.7	1.8%	0.0%	20.0%	88.9%	1.6%
false mountain willow (Salix pseudomonticola)	native	1.6	0.7	2.9%	0.0%	10.0%	38.9%	1.4%
common wild rose (Rosa woodsii)	native	1.3	0.6	1.3%	0.0%	20.0%	83.3%	1.2%
low-bush cranberry (Viburnum edule)	native	1.3	0.5	2.8%	0.0%	10.0%	33.3%	1.2%
bog birch (Betula glandulosa)	native	1.3	0.5	20.0%	0.0%	20.0%	5.6%	1.1%
flat-leaved willow (Salix planifolia)	native	1.0	0.4	1.9%	0.0%	3.0%	38.9%	0.9%
dwarf birch (Betula pumila)	native	0.8	0.3	3.0%	0.0%	3.0%	11.1%	0.7%
bracted honeysuckle (Lonicera involucrata)	native	0.6	0.2	0.8%	0.0%	3.0%	61.1%	0.5%
choke cherry (Prunus virginiana)	native	0.5	0.2	0.6%	0.0%	3.0%	61.1%	0.4%
twining honeysuckle (Lonicera dioica)	native	0.4	0.2	0.7%	0.0%	3.0%	38.9%	0.4%
dewberry (Rubus pubescens)	native	0.4	0.2	0.8%	0.0%	3.0%	38.9%	0.4%
bunchberry (Cornus canadensis)	native	0.4	0.2	0.8%	0.0%	3.0%	38.9%	0.4%

Life Form	Plant Status[1]	Area by Species		Percent Canopy Cover[2]				Percent of Project Area
		acres	hectares	Avg	Min Range	Max Range	Constancy[3]	
SHRUBS (continued)								
northern gooseberry (Ribes oxyacanthoides)	native	0.3	0.1	0.5%	0.0%	0.5%	72.2%	0.3%
Canada buffaloberry (Shepherdia canadensis)	native	0.3	0.1	0.6%	0.0%	3.0%	38.9%	0.3%
northern black currant (Ribes hudsonianum)	native	0.3	0.1	0.6%	0.0%	3.0%	38.9%	0.3%
prickly rose (Rosa acicularis)	native	0.3	0.1	0.6%	0.0%	3.0%	33.3%	0.2%
alder-leaved buckthorn (Rhamnus alnifolia)	native	0.2	0.1	2.6%	0.0%	3.0%	16.7%	0.2%
thimbleberry (Rubus parviflorus)	native	0.1	0.1	3.0%	0.0%	3.0%	5.6%	0.1%
hoary willow (Salix candida)	native	0.1	0.04	0.5%	0.0%	0.5%	5.6%	0.1%
velvet-fruited willow (Salix maccalliana)	native	0.1	0.04	0.5%	0.0%	0.5%	5.6%	0.1%
shining willow (Salix lucida)	native	0.1	0.04	0.5%	0.0%	0.5%	16.7%	0.1%
water birch (Betula occidentalis)	native	0.1	0.04	0.5%	0.0%	0.5%	11.1%	0.1%
wild red currant (Ribes triste)	native	0.1	0.03	0.9%	0.0%	3.0%	16.7%	0.1%
common caragana (Caragana arborescens)	invasive, introduced	0.1	0.03	0.5%	0.0%	0.5%	5.6%	0.1%
willow (Salix spp.)	unknown, not unique	0.1	0.03	0.5%	0.0%	0.5%	5.6%	0.1%
wild black currant (Ribes americanum)	native	0.1	0.02	0.5%	0.0%	0.5%	11.1%	0.1%
green alder (Alnus crispa)	native	0.1	0.02	0.5%	0.0%	0.5%	11.1%	0.1%
common bearberry (Arctostaphylos uva-ursi)	native	0.1	0.02	0.5%	0.0%	0.5%	11.1%	0.05%
snowberry (Symphoricarpos albus)	native	0.05	0.02	0.5%	0.0%	0.5%	16.7%	0.04%
pin cherry (Prunus pensylvanica)	native	0.04	0.02	1.4%	0.0%	3.0%	11.1%	0.03%
common Labrador tea (Ledum groenlandicum)	native	0.03	0.01	0.5%	0.0%	0.5%	5.6%	0.03%
twinflower (Linnaea borealis)	native	0.03	0.01	0.5%	0.0%	0.5%	5.6%	0.03%
common blueberry (Vaccinium myrtilloides)	native	0.03	0.01	0.5%	0.0%	0.5%	5.6%	0.03%
bog cranberry (Vaccinium vitis-idaea)	native	0.03	0.01	0.5%	0.0%	0.5%	5.6%	0.03%
silverberry (Elaeagnus commutata)	native	0.02	0.01	0.5%	0.0%	0.5%	5.6%	0.02%
Scouler's willow (Salix scouleriana)	native	0.01	0.01	0.5%	0.0%	0.5%	5.6%	0.01%
cherry species (Prunus spp.)	unknown, not unique	0.01	0.00	0.5%	0.0%	0.5%	5.6%	0.01%
GRASSES AND GRASS-LIKES								
reed canary grass (Phalaris arundinacea)	native	21.5	8.8	20.8%	0.0%	50.0%	88.9%	19.0%
awned sedge (Carex atherodes)	native	17.4	7.1	16.0%	0.0%	40.0%	94.4%	15.3%
marsh reed grass (Calamagrostis canadensis)	native	11.3	4.6	11.4%	0.0%	30.0%	77.8%	10.0%

Life Form	Plant Status[1]	Area by Species		Percent Canopy Cover[2]				Percent of Project Area
		acres	hectares	Avg	Min Range	Max Range	Constancy[3]	
GRASSES AND GRASS-LIKES (continued)								
water sedge (Carex aquatilis)	native	7.6	3.1	8.5%	0.0%	20.0%	72.2%	6.7%
common tall manna grass (Glyceria grandis)	native	6.9	2.8	9.6%	0.0%	30.0%	55.6%	6.1%
smooth brome (Bromus inermis)	disturbance, introduced	6.7	2.8	7.5%	0.0%	40.0%	88.9%	5.9%
small bottle sedge (Carex utriculata)	native	6.4	2.6	8.7%	0.0%	10.0%	61.1%	5.7%
Kentucky bluegrass (Poa pratensis)	disturbance, introduced	5.9	2.4	9.3%	0.0%	30.0%	66.7%	5.2%
slough grass (Beckmannia syzigachne)	native	3.5	1.4	4.1%	0.0%	10.0%	72.2%	3.1%
fowl bluegrass (Poa palustris)	native	3.3	1.4	3.1%	0.0%	10.0%	83.3%	2.9%
quack grass (Agropyron repens)	disturbance, introduced	2.6	1.1	6.1%	0.0%	30.0%	50.0%	2.3%
timothy (Phleum pratense)	disturbance, introduced	2.0	0.8	3.5%	0.0%	20.0%	55.6%	1.8%
fowl manna grass (Glyceria striata)	native	1.7	0.7	2.8%	0.0%	10.0%	33.3%	1.5%
Bebb's sedge (Carex bebbii)	native	1.1	0.5	2.3%	0.0%	3.0%	27.8%	1.0%
woolly sedge (Carex lanuginosa)	native	1.0	0.4	8.8%	0.0%	10.0%	11.1%	0.9%
wire rush (Juncus balticus)	native	0.9	0.4	3.6%	0.0%	10.0%	33.3%	0.8%
foxtail barley (Hordeum jubatum)	disturbance, native	0.7	0.3	0.8%	0.0%	3.0%	72.2%	0.6%
reed (Phragmites australis)	native	0.7	0.3	2.5%	0.0%	3.0%	16.7%	0.6%
spangletop (Scolochloa festucacea)	native	0.6	0.3	0.9%	0.0%	3.0%	55.6%	0.6%
sedge (Carex spp.)	unknown, not unique	0.6	0.3	3.0%	0.0%	3.0%	5.6%	0.6%
small-fruited bulrush (Scirpus microcarpus)	native	0.5	0.2	0.9%	0.0%	3.0%	50.0%	0.5%
common great bulrush (Scirpus validus)	native	0.4	0.2	0.6%	0.0%	3.0%	50.0%	0.3%
northern reed grass (Calamagrostis inexpansa)	native	0.3	0.1	1.7%	0.0%	3.0%	16.7%	0.3%
slender wheat grass (Agropyron trachycaulum)	native	0.3	0.1	2.8%	0.0%	3.0%	16.7%	0.3%
western wheat grass (Agropyron smithii)	native	0.2	0.1	3.0%	0.0%	3.0%	5.6%	0.1%
water foxtail (Alopecurus geniculatus)	introduced	0.2	0.1	3.0%	0.0%	3.0%	5.6%	0.1%
creeping spike-rush (Eleocharis palustris)	native	0.1	0.1	1.0%	0.0%	3.0%	22.2%	0.1%
slender wheat grass (Agropyron trachycaulum var. unilaterale)	native	0.1	0.1	3.0%	0.0%	3.0%	16.7%	0.1%

Life Form	Plant Status[1]	Area by Species		Percent Canopy Cover[2]				Percent of Project Area
		acres	hectares	Avg	Min Range	Max Range	Constancy[3]	
GRASSES AND GRASS-LIKES (continued)								
fringed brome (Bromus ciliatus)	native	0.1	0.1	0.6%	0.0%	3.0%	22.2%	0.1%
hairy wild rye (Elymus innovatus)	native	0.1	0.05	0.5%	0.0%	0.5%	16.7%	0.1%
Sartwell's sedge (Carex sartwellii)	native	0.1	0.05	0.5%	0.0%	0.5%	11.1%	0.1%
alpine foxtail (Alopecurus occidentalis)	native	0.1	0.04	0.8%	0.0%	3.0%	11.1%	0.1%
small-winged sedge (Carex microptera)	native	0.1	0.03	0.5%	0.0%	0.5%	11.1%	0.1%
short-awn meadow-foxtail (Alopecurus aequalis)	native	0.1	0.03	0.5%	0.0%	0.5%	5.6%	0.1%
Nuttall's salt-meadow grass (Puccinellia nuttalliana)	native	0.1	0.02	0.5%	0.0%	0.5%	5.6%	0.05%
green needle grass (Stipa viridula)	native	0.05	0.02	0.5%	0.0%	0.5%	11.1%	0.04%
western porcupine grass (Stipa curtiseta)	native	0.03	0.01	0.5%	0.0%	0.5%	5.6%	0.02%
mud rush (Juncus tracyi)	native	0.02	0.01	0.5%	0.0%	0.5%	5.6%	0.02%
toad rush (Juncus bufonius)	native	0.02	0.01	0.5%	0.0%	0.5%	5.6%	0.02%
wheat grass (Agropyron spp.)	unknown, not unique	0.01	0.00	0.5%	0.0%	0.5%	5.6%	0.01%
long-styled rush (Juncus longistylis)	native	0.01	0.00	0.5%	0.0%	0.5%	5.6%	0.01%
FORBS								
common cattail (Typha latifolia)	native	12.2	5.0	11.4%	0.0%	30.0%	88.9%	10.8%
common nettle (Urtica dioica)	native	3.7	1.5	3.4%	0.0%	20.0%	88.9%	3.3%
smooth perennial sow-thistle (Sonchus arvensis ssp. uliginosus)	invasive, introduced	2.9	1.2	5.5%	0.0%	10.0%	50.0%	2.6%
Canada thistle (Cirsium arvense)	invasive, introduced	2.6	1.0	2.3%	0.5%	10.0%	100.0%	2.3%
wild mint (Mentha arvensis)	native	1.9	0.8	1.8%	0.0%	3.0%	83.3%	1.7%
hemp-nettle (Galeopsis tetrahit)	disturbance, introduced	1.7	0.7	2.0%	0.0%	10.0%	77.8%	1.5%
common horsetail (Equisetum arvense)	native, poisonous	1.3	0.5	1.6%	0.0%	20.0%	66.7%	1.2%
perennial sow-thistle (Sonchus arvensis)	invasive, introduced	1.2	0.5	1.2%	0.0%	3.0%	83.3%	1.1%
white clover (Trifolium repens)	disturbance, introduced	1.2	0.5	3.2%	0.0%	10.0%	38.9%	1.0%
marsh hedge-nettle (Stachys palustris)	native	1.1	0.5	1.0%	0.0%	3.0%	88.9%	1.0%
red clover (Trifolium pratense)	disturbance, introduced	1.1	0.5	1.3%	0.0%	10.0%	72.2%	1.0%

Life Form	Plant Status[1]	Area by Species		Percent Canopy Cover[2]				Percent of Project Area
		acres	hectares	Avg	Min Range	Max Range	Constancy[3]	
FORBS (continued)								
agrimony (Agrimonia striata)	native	1.0	0.4	1.4%	0.0%	3.0%	55.6%	0.9%
common dandelion (Taraxacum officinale)	disturbance, introduced	0.9	0.4	1.0%	0.0%	3.0%	77.8%	0.8%
purple-stemmed aster (Aster puniceus)	native	0.9	0.4	1.1%	0.0%	3.0%	66.7%	0.8%
wild strawberry (Fragaria virginiana)	disturbance, native	0.9	0.4	0.9%	0.0%	10.0%	77.8%	0.8%
common yarrow (Achillea millefolium)	native	0.8	0.3	0.7%	0.5%	3.0%	100.0%	0.7%
northern willowherb (Epilobium ciliatum)	native	0.8	0.3	1.0%	0.0%	3.0%	66.7%	0.7%
Canada goldenrod (Solidago canadensis)	native	0.8	0.3	0.7%	0.0%	3.0%	88.9%	0.7%
nodding beggarticks (Bidens cernua)	native	0.7	0.3	1.0%	0.0%	3.0%	50.0%	0.6%
seaside arrow-grass (Triglochin maritima)	native, poisonous	0.7	0.3	2.0%	0.0%	3.0%	22.2%	0.6%
water smartweed (Polygonum amphibium)	native	0.7	0.3	0.7%	0.0%	3.0%	77.8%	0.6%
smooth aster (Aster laevis)	native	0.6	0.3	1.2%	0.0%	3.0%	27.8%	0.6%
water smartweed (Polygonum coccineum)	native	0.6	0.2	1.4%	0.0%	3.0%	27.8%	0.5%
white sweet-clover (Melilotus alba)	disturbance, introduced	0.6	0.2	0.8%	0.0%	3.0%	50.0%	0.5%
water-hemlock (Cicuta maculata)	native, poisonous	0.6	0.2	0.6%	0.0%	3.0%	72.2%	0.5%
veiny meadow rue (Thalictrum venulosum)	native	0.5	0.2	0.5%	0.0%	0.5%	83.3%	0.4%
wild vetch (Vicia americana)	native	0.5	0.2	0.5%	0.0%	3.0%	77.8%	0.4%
wild sarsaparilla (Aralia nudicaulis)	native	0.5	0.2	0.8%	0.0%	3.0%	55.6%	0.4%
white cockle (Silene pratensis syn. Silene latifolia)	invasive, introduced	0.4	0.2	0.5%	0.0%	3.0%	72.2%	0.4%
showy aster (Aster conspicuus)	native	0.4	0.2	0.8%	0.0%	3.0%	44.4%	0.4%
water parsnip (Sium suave)	native	0.4	0.2	0.5%	0.0%	0.5%	66.7%	0.4%
common plantain (Plantago major)	disturbance, introduced	0.4	0.2	0.7%	0.0%	3.0%	50.0%	0.4%
northern bedstraw (Galium boreale)	native	0.4	0.2	0.7%	0.0%	3.0%	61.1%	0.3%
spotted touch-me-not (Impatiens capensis)	native	0.4	0.2	0.6%	0.0%	3.0%	50.0%	0.3%
large-leaved yellow avens (Geum macrophyllum)	native	0.4	0.1	0.5%	0.0%	3.0%	38.9%	0.3%
Canada anemone (Anemone canadensis)	native	0.3	0.1	0.5%	0.0%	0.5%	72.2%	0.3%
star-flowered Solomon's-seal (Smilacina stellata)	native	0.3	0.1	0.5%	0.0%	0.5%	61.1%	0.3%
marsh-marigold (Caltha palustris)	native	0.3	0.1	0.9%	0.0%	3.0%	33.3%	0.3%
many-flowered yarrow (Achillea sibirica)	native	0.3	0.1	0.5%	0.0%	0.5%	55.6%	0.3%

Life Form	Plant Status[1]	Area by Species		Percent Canopy Cover[2]				Percent of Project Area
		acres	hectares	Avg	Min Range	Max Range	Constancy[3]	
FORBS (continued)								
yellow sweet-clover (Melilotus officinalis)	disturbance, introduced	0.3	0.1	0.8%	0.0%	3.0%	27.8%	0.3%
marsh skullcap (Scutellaria galericulata)	native	0.3	0.1	0.5%	0.0%	0.5%	44.4%	0.3%
cow parsnip (Heracleum lanatum)	native	0.3	0.1	0.5%	0.0%	0.5%	38.9%	0.3%
western Canada violet (Viola canadensis)	native	0.3	0.1	0.5%	0.0%	0.5%	38.9%	0.3%
common fireweed (Epilobium angustifolium)	native	0.3	0.1	0.5%	0.0%	0.5%	44.4%	0.3%
tall lungwort (Mertensia paniculata)	native	0.3	0.1	0.5%	0.0%	0.5%	38.9%	0.2%
narrow-leaved dock (Rumex triangulivalvis)	native	0.3	0.1	0.5%	0.0%	0.5%	38.9%	0.2%
western willow aster (Aster hesperius)	native	0.2	0.1	0.9%	0.0%	3.0%	38.9%	0.2%
alsike clover (Trifolium hybridum)	disturbance, introduced	0.2	0.1	0.7%	0.0%	3.0%	44.4%	0.2%
sweet-scented bedstraw (Galium triflorum)	native	0.2	0.1	1.6%	0.0%	3.0%	22.2%	0.2%
meadow horsetail (Equisetum pratense)	native	0.2	0.1	1.3%	0.0%	3.0%	22.2%	0.2%
caraway (Carum carvi)	introduced	0.2	0.1	1.1%	0.0%	3.0%	11.1%	0.2%
common tansy (Tanacetum vulgare)	invasive, introduced, poisonous	0.2	0.1	1.1%	0.0%	3.0%	11.1%	0.2%
Lindley's aster (Aster ciliolatus)	native	0.2	0.1	3.0%	0.0%	3.0%	5.6%	0.2%
common pink wintergreen (Pyrola asarifolia)	native	0.2	0.1	0.5%	0.0%	0.5%	22.2%	0.2%
northern water-horehound (Lycopus uniflorus)	native	0.2	0.1	0.5%	0.0%	0.5%	27.8%	0.2%
western dock (Rumex occidentalis)	native	0.2	0.1	0.5%	0.0%	0.5%	22.2%	0.2%
cream-colored vetchling (Lathyrus ochroleucus)	native	0.2	0.1	0.5%	0.0%	0.5%	33.3%	0.2%
arrow-leaved coltsfoot (Petasites sagittatus)	native	0.2	0.1	0.5%	0.0%	0.5%	22.2%	0.2%
golden dock (Rumex maritimus)	native	0.2	0.1	0.5%	0.0%	0.5%	22.2%	0.1%
lamb's-quarters (Chenopodium album)	disturbance, introduced	0.2	0.1	0.5%	0.0%	0.5%	22.2%	0.1%
silverweed (Potentilla anserina)	disturbance, native	0.2	0.1	0.6%	0.0%	3.0%	33.3%	0.1%
red and white baneberry (Actaea rubra)	native, poisonous	0.2	0.1	0.5%	0.0%	0.5%	22.2%	0.1%
alfalfa (Medicago sativa)	introduced	0.1	0.1	0.5%	0.0%	0.5%	27.8%	0.1%
prairie sagewort (Artemisia ludoviciana)	native	0.1	0.1	0.5%	0.0%	0.5%	22.2%	0.1%
forb (Forb)	unknown, not unique	0.1	0.1	0.5%	0.0%	0.5%	16.7%	0.1%

Life Form	Plant Status[1]	Area by Species		Percent Canopy Cover[2]				Percent of Project Area
		acres	hectares	Avg	Min Range	Max Range	Constancy[3]	
FORBS (continued)								
common mare's-tail (Hippuris vulgaris)	native	0.1	0.1	0.5%	0.0%	0.5%	16.7%	0.1%
curled dock (Rumex crispus)	introduced	0.1	0.1	0.5%	0.0%	0.5%	16.7%	0.1%
snakeroot (Sanicula marilandica)	native	0.1	0.1	0.5%	0.0%	0.5%	16.7%	0.1%
biennial sagewort (Artemisia biennis)	native	0.1	0.1	0.5%	0.0%	0.5%	16.7%	0.1%
palmate-leaved coltsfoot (Petasites palmatus)	native	0.1	0.05	1.3%	0.0%	3.0%	16.7%	0.1%
cut-leaved anemone (Anemone multifida)	native	0.1	0.05	0.5%	0.0%	0.5%	27.8%	0.1%
wild lily-of-the-valley (Maianthemum canadense)	native	0.1	0.05	0.5%	0.0%	0.5%	11.1%	0.1%
clasping-leaved twisted-stalk (Streptopus amplexifolius)	native	0.1	0.05	0.5%	0.0%	0.5%	11.1%	0.1%
cleavers (Galium aparine)	invasive, introduced	0.1	0.04	0.5%	0.0%	0.5%	5.6%	0.1%
gentian (Gentiana spp.)	unknown, not unique	0.1	0.04	0.5%	0.0%	0.5%	5.6%	0.1%
fringed loosestrife (Lysimachia ciliata)	native	0.1	0.04	0.5%	0.0%	0.5%	5.6%	0.1%
wormseed mustard (Erysimum cheiranthoides)	disturbance, introduced	0.1	0.04	0.5%	0.0%	0.5%	11.1%	0.1%
yellow avens (Geum aleppicum)	native	0.1	0.04	0.7%	0.0%	3.0%	16.7%	0.1%
small-leaved everlasting (Antennaria parvifolia)	disturbance, native	0.1	0.03	0.5%	0.0%	0.5%	16.7%	0.1%
seaside buttercup (Ranunculus cymbalaria)	native	0.1	0.03	0.5%	0.0%	0.5%	16.7%	0.1%
marsh horsetail (Equisetum palustre)	native	0.1	0.03	0.5%	0.0%	0.5%	5.6%	0.1%
woodland strawberry (Fragaria vesca)	disturbance, native	0.1	0.03	0.5%	0.0%	0.5%	5.6%	0.1%
red-root pigweed (Amaranthus retroflexus)	disturbance, introduced	0.1	0.03	0.5%	0.0%	0.5%	5.6%	0.1%
plains wormwood (Artemisia campestris)	native	0.1	0.03	0.5%	0.0%	0.5%	5.6%	0.1%
tall meadow rue (Thalictrum dasycarpum)	native	0.1	0.03	0.5%	0.0%	0.5%	5.6%	0.1%
spreading dogbane (Apocynum androsaemifolium)	disturbance, native, poisonous	0.1	0.03	0.5%	0.0%	0.5%	27.8%	0.1%
narrow-leaved bur-reed (Sparganium angustifolium)	native	0.1	0.03	0.5%	0.0%	0.5%	11.1%	0.1%
long-fruited anemone (Anemone cylindrica)	native	0.1	0.03	0.5%	0.0%	0.5%	11.1%	0.1%
yellow lucerne (Medicago falcata)	introduced	0.1	0.02	0.8%	0.0%	3.0%	16.7%	0.1%

Life Form	Plant Status[1]	Area by Species		Percent Canopy Cover[2]				Percent of Project Area
		acres	hectares	Avg	Min Range	Max Range	Constancy[3]	
FORBS (continued)								
maple-leaved goosefoot (Chenopodium gigantospermum)	native	0.1	0.02	0.5%	0.0%	0.5%	11.1%	0.1%
narrow-leaved field dock (Rumex stenophyllus)	introduced	0.1	0.02	0.5%	0.0%	0.5%	11.1%	0.05%
common tall sunflower (Helianthus nuttallii)	native	0.1	0.02	0.5%	0.0%	0.5%	5.6%	0.05%
scentless chamomile (Matricaria perforata syn. Tripleurospermum inodorum)	invasive, introduced	0.1	0.02	0.5%	0.0%	0.5%	5.6%	0.05%
Philadelphia fleabane (Erigeron philadelphicus)	native	0.05	0.02	0.5%	0.0%	0.5%	11.1%	0.04%
harebell (Campanula rotundifolia)	native	0.04	0.02	0.5%	0.0%	0.5%	11.1%	0.04%
celery-leaved buttercup (Ranunculus sceleratus)	native	0.04	0.01	0.5%	0.0%	0.5%	11.1%	0.03%
stinkweed (Thlaspi arvense)	disturbance, introduced	0.03	0.01	0.5%	0.0%	0.5%	11.1%	0.03%
fern (Fern spp. PTERIDOPHYTA)	unknown, not unique	0.03	0.01	0.5%	0.0%	0.5%	5.6%	0.03%
yellow evening-primrose (Oenothera biennis)	native	0.03	0.01	0.5%	0.0%	0.5%	5.6%	0.03%
northern grass-of-parnassus (Parnassia palustris)	native	0.03	0.01	0.5%	0.0%	0.5%	5.6%	0.03%
saxifrage (Saxifraga spp.)	unknown, not unique	0.03	0.01	0.5%	0.0%	0.5%	5.6%	0.03%
giant bur-reed (Sparganium eurycarpum)	native	0.03	0.01	0.5%	0.0%	0.5%	5.6%	0.02%
Argentine canola/rape (Brassica napus var. napus)	disturbance, introduced	0.03	0.01	0.5%	0.0%	0.5%	5.6%	0.02%
common buckwheat (Fagopyrum esculentum)	introduced	0.03	0.01	0.5%	0.0%	0.5%	5.6%	0.02%
common blue lettuce (Lactuca pulchella)	native	0.03	0.01	0.5%	0.0%	0.5%	5.6%	0.02%
graceful cinquefoil (Potentilla gracilis)	native	0.02	0.01	0.5%	0.0%	0.5%	5.6%	0.02%
marsh aster (Aster borealis)	native	0.02	0.01	0.5%	0.0%	0.5%	5.6%	0.02%
shepherd's-purse (Capsella bursa-pastoris)	disturbance, introduced	0.02	0.01	0.5%	0.0%	0.5%	5.6%	0.02%
northern hedysarum (Hedysarum boreale)	native	0.02	0.01	0.5%	0.0%	0.5%	5.6%	0.02%
absinthe wormwood (Artemisia absinthium)	introduced	0.01	0.01	0.5%	0.0%	0.5%	5.6%	0.01%
giant hyssop (Agastache foeniculum)	native	0.01	0.00	0.5%	0.0%	0.5%	5.6%	0.01%
creeping white prairie aster (Aster falcatus)	native	0.01	0.00	0.5%	0.0%	0.5%	5.6%	0.01%
mustard (Brassica spp.)	introduced	0.01	0.00	0.5%	0.0%	0.5%	5.6%	0.01%
oak-leaved goosefoot (Chenopodium salinum)	native	0.01	0.00	0.5%	0.0%	0.5%	5.6%	0.01%
common knotweed (Polygonum arenastrum)	introduced	0.01	0.00	0.5%	0.0%	0.5%	5.6%	0.01%

Life Form	Plant Status[1]	Area by Species		Percent Canopy Cover[2]				Percent of Project Area
		acres	hectares	Avg	Min Range	Max Range	Constancy[3]	
FORBS (continued)								
flat-topped goldenrod (Solidago graminifolia)	native	0.01	0.00	0.5%	0.0%	0.5%	5.6%	0.01%
aster (Aster spp.)	unknown, not unique	0.01	0.00	0.5%	0.0%	0.5%	5.6%	0.01%
narrow-leaved collomia (Collomia linearis)	native	0.01	0.00	0.5%	0.0%	0.5%	5.6%	0.01%
black medick (Medicago lupulina)	disturbance, introduced	0.01	0.00	0.5%	0.0%	0.5%	5.6%	0.01%
wild buckwheat (Polygonum convolvulus)	disturbance, introduced	0.01	0.00	0.5%	0.0%	0.5%	5.6%	0.01%
polygonum (Polygonum spp.)	unknown, not unique	0.01	0.00	0.5%	0.0%	0.5%	5.6%	0.01%
marsh yellow cress (Rorippa palustris)	native	0.0	0.00	0.5%	0.0%	0.5%	5.6%	0.01%

Moose Lake Tributaries Project Area 2014 Riparian Plant Composition Summary

Unique Species Tally Summary		% Native Species
Total # of species =	204	81%
Total # of TREE species =	5	100%
Total # of SHRUB species =	44	97%
Total # of GRASS / GRASS LIKE species =	39	87%
Total # of FORB species =	116	72%

Total # of ***native plants*** =	166
Total # of ***prohibited noxious*** plants =	0
Total # of ***invasive*** plants =	8
Total # of *disturbance* plants =	26
Total # of plants with *poisonous* properties =	6

APPENDIX D: MOOSE LAKE TRIBUTARIES PROJECT AREA REVISIT SITES COMPARISON RIPARIAN HEALTH SCORE SHEET (2005 VS. 2014)

Note: parameter ratings are based on all sites (n=18) unless otherwise indicated

^ parameter rating is based on lotic sites only (n=15) * parameter rating is based on lentic sites only (n=3)	Average 2005			Average 2014			Healthy (80-100%) Healthy but with problems (60-79%) Unhealthy (<60%)
Riparian Health Parameter	**Actual Score**	**Possible Score**	**%**	**Actual Score**	**Possible Score**	**%**	**Health trend** <5% Difference = No Change
Vegetation							
1. Vegetative Cover of Floodplain and Streambanks	5.7	6	94%	5.9	6	98%	No Change
2a. Invasive Plant Species Canopy Cover	1.6	3	54%	1.2	3	41%	Declined
2b. Invasive Plant Species Density Distribution	0.7	3	24%	0.2	3	6%	Declined
3. Disturbance-Caused Undesirable Herbaceous Species	1.4	3	46%	1.5	3	50%	No Change
4. Preferred Tree and Shrub Establishment and Regeneration	4.7	6	78%	4.4	6	74%	No Change
5a. Utilisation of Preferred Trees and Shrubs	1.6	3	55%	2.1	3	71%	Improved
5b. Woody Vegetation Removal by Other than Browsing	NA	NA	NA	3.0	3	100%	NA
6. Decadent and Dead Woody Material^	2.9	3	96%	2.8	3	93%	No Change
6. Human Alteration to Site Vegetation*	4.7	6	78%	4.7	6	78%	No Change
Vegetation Rating	18.8	27.3	69%	21.1	30	70%	No Change
Soil/Hydrology							
7a. Human Alteration to Physical Site*	10.7	12	89%	12.0	12	100%	Improved
7b. Severity of Human Alteration to Physical Site*	NA	NA	NA	2.3	3	78%	NA
7. Streambank Root Mass Protection^	5.1	6	85%	5.8	6	97%	Improved
8. Human-Caused Bare Ground	5.3	6	89%	5.7	6	94%	Improved
9. Artificial Water Level Change*	6.0	9	67%	9	9	100%	Improved
9. Streambank Human Structurally Altered^	2.0	6	33%	3.2	6	53%	Improved
10. Human Alteration to Rest of Site^	2.1	3	71%	2.6	3	87%	Improved
11. Stream Channel Incisement^	8.7	9	96%	9	9	100%	No Change
Soil/Hydrology Rating	17.8	22.5	79%	23.7	26.5	90%	Improved
Overall Rating	36.6	49.8	73%	44.8	56.5	79%	Improved

Table D-1. Comparison by Waterbody and Number of Sites 2005 vs. 2014

Health Category	Waterbody									
	Yelling Creek & Kehiwin Creek		Valer's Creek		Thin Lake		Thin Lake River		Total	
	2005	2014	2005	2014	2005	2014	2005	2014	2005	2014
Healthy	4	4	2	2	2	2	2	2	10	10
Healthy but with Problems	0	1	3	4	1	1	0	0	4	6
Unhealthy	3	2	1	0	0	0	0	0	4	2
Total	7	7	6	6	3	3	2	2	18	18

Table D-2. Comparison by Waterbody and Percent of Sites 2005 vs. 2014

Health Category	Waterbody									
	Yelling Creek & Kehiwin Creek		Valer's Creek		Thin Lake		Thin Lake River		Total	
	2005	2014	2005	2014	2005	2014	2005	2014	2005	2014
Healthy	57%	57%	33%	33%	67%	67%	100%	100%	56%	56%
Healthy but with Problems	0%	14%	50%	67%	33%	33%	0%	0%	22%	33%
Unhealthy	43%	29%	17%	0%	0%	0%	0%	0%	22%	11%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table D-3. Overall Health Trend Summary By Waterbody 2005 vs. 2014

Percent Change	Waterbody				
	Yelling Creek & Kehiwin Creek	Valer's Creek	Thin Lake	Thin Lake River	All
Average	6.3%	4.9%	5.0%	3.9%	5.3%
Minimum	0.2%	6.8%	1.0%	1.4%	0.2%
Maximum	40.8%	13.7%	8.0%	6.4%	40.8%
# of Sites (% of Sites)					
No Change*	5 (71%)	1 (17%)	1 (33%)	1 (50%)	8 (44%)
Improving	1 (14%)	4 (67%)	2 (67%)	1 (50%)	8 (44%)
Declining	1 (14%)	1 (17%)	0	0	2 (11%)

*<5% Difference = No Change

APPENDIX E: DESCRIPTION OF RIPARIAN HEALTH PARAMETERS FOR STREAMS AND SMALL RIVERS

The riparian health score for streams and small rivers 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 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 for lotic sites is based on the Alberta Lotic Wetland Health Assessment for Streams and Small Rivers User Manual (Cows and Fish, current as of April 18, 2014). The complete user manual can be found at www.cowsandfish.org.

FACTORS FOR ASSESSING STREAMS AND SMALL RIVER (LOTIC WETLAND) HEALTH

Some factors on the evaluation will not apply on all sites. For example, 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., Thompson and Hansen 2001, 2002, 2003, 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.

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. 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.

SCORING

1. Vegetative Cover of Floodplain and Streambanks.

6 = More than 95% of the reach soil surface is covered by live plant growth.
4 = 85% to 95% of the reach soil surface is covered by live plant growth.
2 = 75% to 85% of the reach soil surface is covered by live plant growth.
0 = Less than 75% of the reach soil surface is covered by live plant growth.

2a. Total Canopy Cover of Invasive Plant Species (Weeds).

3 = No invasive plant species (weeds) on the site.
2 = Invasive plants present with total canopy cover less than 1% of the site area.
1 = Invasive plants present with total canopy cover between 1 and 15% of the site area.
0 = Invasive plants present with total canopy cover more than 15% of the site area.

2b. Density/Distribution Pattern of Invasive Plant Species (Weeds) (Figure 1).

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.

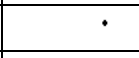
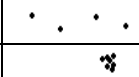
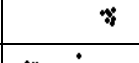
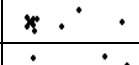
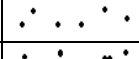
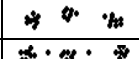
CLASS	DESCRIPTION OF ABUNDANCE	DISTRIBUTION PATTERN
0	No invasive plants on the site	
1	Rare occurrence	
2	A few sporadically occurring individual plants	
3	A single patch	
4	A single patch plus a few sporadically occurring plants	
5	Several sporadically occurring plants	
6	A single patch plus several 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 site	

Figure 1. Invasive plant species class guidelines (figure adapted from Adams and others [2003])

3. Disturbance-Increaser Undesirable Herbaceous Species.

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

4. Preferred Tree and Shrub Establishment and/or Regeneration.

(*If the site has no woody vegetation [except for the species listed to be excluded], replace both Actual Score and Possible Score with NA.*)

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.

5a. Browse Utilization of Preferred Trees and Shrubs.

(*If the site has no woody vegetation [except for the species listed to be excluded], replace both Actual Score and Possible Score with NA.*)

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).

5b. Live Woody Vegetation Removal by Other Than Browsing

(*If the site has no trees or shrubs **AND** no cut plants or stumps of any trees or shrubs [except for the species listed to be excluded], replace both Actual Score and Possible Score with NA.*)

3 = None (0% to 5% of live woody vegetation expected on the site is lacking due to cutting).
2 = Light (5% to 25% of live woody vegetation expected on the site is lacking due to cutting).
1 = Moderate (25% to 50% of live woody vegetation expected on the site is lacking due to cutting).
0 = Heavy (More than 50% of live woody vegetation expected on the site is lacking due to cutting).

6. Standing Decadent and Dead Woody Material.

(*If the site has no woody vegetation [except for the species listed to be excluded], replace both Actual Score and Possible Score with NA.*)

3 = Less than 5% of the total canopy cover of woody species is decadent and/or dead.
2 = 5% to 25% of the total canopy cover of woody species is decadent and/or dead.
1 = 25% to 50% of the total canopy cover of woody species is decadent and/or dead.
0 = More than 50% of the total canopy cover of woody species is decadent and/or dead.

7. Streambank Root Mass Protection.

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.

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.

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 Site.

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

11. Stream Channel Incisement (Vertical Stability) (Figure 2)

9 = Not incised
6 = Slightly incised
3 = Moderately incised
0 = Severely incised

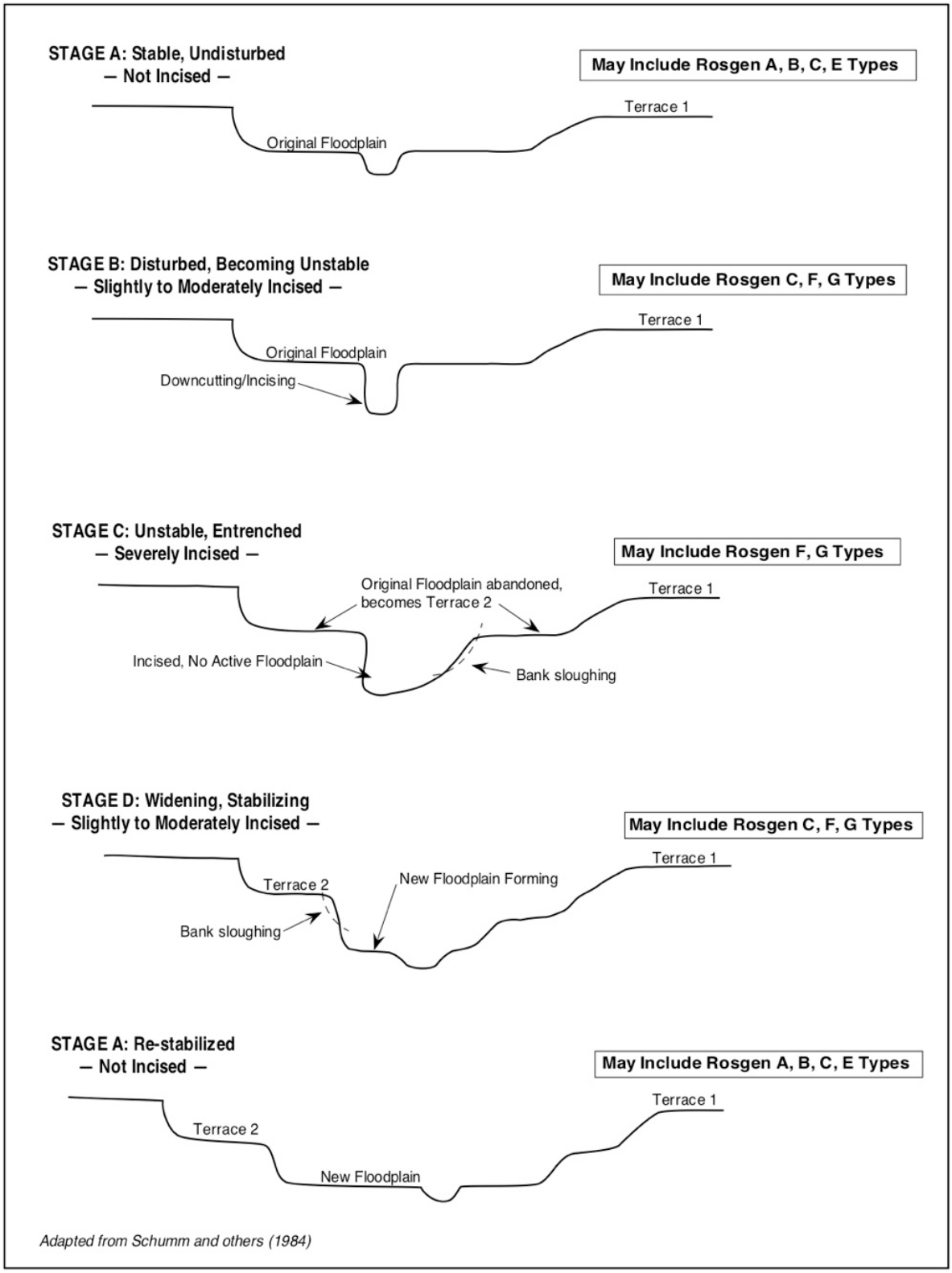


Figure 2. Schumm's stages of stream channel evolution (Rosgen 2006), going from initial destabilization and incisement, through ultimate healing and re-stabilization with a new floodplain

APPENDIX F: DESCRIPTION OF RIPARIAN HEALTH PARAMETERS FOR LAKES AND WETLANDS

The riparian health score for lakes and wetlands is based on 9 basic parameters pertaining to riparian health. This appendix addresses the guidelines and stipulations followed when each parameter is answered during the assessment. Keep in mind that these parameters are meant to encompass the broad range of ecological diversity that lake and wetland systems have the potential to express. The interpretations are not completely specific to any one type of lake or wetland 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 for lentic sites is based on the Alberta Lentic Wetland Health Assessment for Lakes and Wetlands User Manual (Cows and Fish, current as of April 18, 2014). The complete user manual can be found at www.cowsandfish.org.

FACTORS FOR ASSESSING LAKE AND WETLAND (LENTIC WETLAND) HEALTH

Some factors on the evaluation will not apply on all sites. For example, 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., Thompson and Hansen 2001, 2002, 2003, 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.

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. 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.

SCORING

1. Vegetative Cover of the Site.

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

2a. Total Canopy Cover of Invasive Plant Species (Weeds).

3 = No invasive plant species (weeds) on the site.
2 = Invasive plants present with total canopy cover less than 1% of the site area.
1 = Invasive plants present with total canopy cover between 1% and 15% of the site area.
0 = Invasive plants present with total canopy cover more than 15% of the site area.

2b. Density/Distribution Pattern of Invasive Plant Species (Weeds) (Figure 1).

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 site	
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 site	

Figure 1. Invasive plant species class guidelines (figure adapted from Adams and others [2003])

3. Disturbance-Increaser Undesirable Herbaceous Species.

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

4. Preferred Tree and Shrub Establishment and/or Regeneration.

(*If site lacks potential for woody species, replace both Actual and Possible Scores with NA.*)

6 = More than 15% of the total canopy cover of preferred trees/shrubs are seedlings and/or saplings.
4 = 5% to 15% of the total canopy cover of preferred trees/shrubs is seedlings and/or saplings.
2 = Less than 5% of the total canopy cover of preferred tree/shrubs are seedlings and/or saplings.
0 = Preferred tree/shrub seedlings and saplings absent

5a. Browse Utilization of Available Preferred Trees and Shrubs. 3

(*If the site has no woody vegetation [except for the species listed to be excluded], replace both Actual Score and Possible Score with NA.*)

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).

5b. Live Woody Vegetation Removal by Other Than Browsing

(*If the site has no trees or shrubs **AND** no cut plants or stumps of any trees or shrubs [except for the species listed to be excluded], replace both Actual Score and Possible Score with NA.*)

3 = None (0% to 5% of live woody vegetation expected on the site is lacking due to cutting).
2 = Light (5% to 25% of live woody vegetation expected on the site is lacking due to cutting).
1 = Moderate (25% to 50% of live woody vegetation expected on the site is lacking due to cutting).
0 = Heavy (More than 50% of live woody vegetation expected on the site is lacking due to cutting).

6. Human Alteration of Site Vegetation Community Composition.

6 = Less than 5% of site vegetation community composition is altered by human activity.
4 = 5% to 15% of site vegetation community composition is altered by human activity.
2 = 15% to 35% of site vegetation community composition is altered by human activity.
0 = 35% or more of site vegetation community composition is altered by human activity.

7a. Percent of Site Physical Site Altered by Human Activity.

12 = Less than 5% of the site is physically altered by human activity.
8 = 5% to 15% of the site is physically altered by human activity.
4 = 15% to 35% of the site is physically altered by human activity.
0 = More than 35% of the site is physically altered by human activity.

7b. Severity of Human-Caused Alteration of Site Physical Site (Regardless of Percent Area).

3 = ***No physical alterations*** to the site by human activity.
2 = Human alterations to the physical site are ***slight*** in effect.
1 = Human alterations to the physical site are ***moderate*** in effect.
0 = Human alterations to the physical site are ***severe*** in effect

8. Human-Caused Bare Ground.

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 = 15% or more of the site is human-caused bare ground.

9. Degree of Artificial Withdrawal or Raising of Water Level (Table below).

9 = The water body, or wetland, is ***not subjected*** to artificial water level change.
6 = The degree of artificial water level change is ***minor.***
3 = The degree of artificial water level change is ***moderate.***
0 = The degree of artificial water level change is ***extreme.***

Severity Categories of Lentic Water Level Manipulation

Not Subjected	The water body, or wetland, is not subjected to artificial water level change (e.g., drawdown, addition, stabilization, etc.). This category may include very small amounts of change that cause no detectible fluctuation in water level.
Minor	The water body or wetland is subject to no more than minor artificial water level change. The shore area remains vegetated, and withdrawal of water is limited or slow enough that vegetation is able to maintain growth and prevent soil exposure. A relatively narrow band affected by the water level fluctuation may support only annual plants.
Moderate	The water body or wetland is subject to moderate quantities, speed and/or frequency of artificial water level change. Where water is removed, it is done in a way that allows pioneer plants to vegetate at least half of the exposed area resulting from drawdown. Where water is added, some flooding may occur at levels or times not typical to the area/season.
Extreme	The water body or wetland is subjected to extreme changes in water level due to volume (extent), speed and/or frequency of artificial water addition or removal. Frequent or unnatural levels of flooding occur where water is added, including extensive flooding into riparian and/or upland areas; or no natural annual drawdown is allowed to occur. In extreme artificial drawdown situations, a wide band of exposed bottom remains unvegetated.

APPENDIX G: SUMMARY OF ADDITIONAL INFORMATION GATHERED FROM PARTICIPATING LANDOWNERS

In addition to the standard questions we ask participating landowners at the time of our in-person visit, for this project area we asked a few different ones to help gauge interest in future management changes as well as where people get their information and ask questions about stewardship and environmental topics.

Some of the conversations with landowners did not lend themselves to asking these additional questions for the following reasons:

- They have already done something and didn't have any other plans at the time.
- They didn't have time to chat so only captured the basics.
- They no longer have livestock or actively farming in the project area.

1. Are you interested in information about the Growing Forward 2 – On Farm Stewardship Program?

Response	Number of Responses	Comments
Yes	3	"Already done it but could use a winter waterer" (1)
No	2	"Not really applicable to them now" (1) "Not at this time" (1)
Not Applicable	1	Don't have land in the project area anymore
Didn't Ask	2	Already fenced and animals kept out of riparian area.(1) Surveyor felt landowner not ready for the conversation.(1)
Forgot to Ask / No Time to Ask	2	Could do future follow-up

2. Are you interested in learning more about the Growing Forward 2 – Agricultural Watershed Enhancement Program? Being Involved?

Response	Number of Responses		Comments
	Learn More	Being Involved	
Yes	1	0	"Already done it but could use a winter waterer" (1)
No	2	2	Not him but maybe son(s) (2)
Depends	2	1	"If we are still here" (1) "If it affects his cows, then maybe" (1) On being involved: "our area doesn't have much for cattle any more in the valley, so may not be eligible" (1)
Not Applicable	1	1	Same reasons as above
Didn't Ask	2	2	Same reasons as above
Forgot to Ask / No Time to Ask	2	2	Could do future follow-up

3. Who do you loo to for stewardship/environmental information, questions, answers?

Response	Number of Responses	Comments
Grain News	1	
Public Lands	1	"otherwise no where in particular"
Internet	1	
LARA		"know of LARA but never done much with them, off farm job too busy" (1) "helped with EFP" (1)
NSWA	1*	
BRWA	1*	
Conservation Tillage	1*	
Alberta Environment	1*	
District Agriculturalist	1*	"in the past"
Lakeland College	1*	Alumni
Alberta Environment & Sustainable Resource Development	1	
Didn't Ask	2	
Forgot to Ask / No Time to Ask	3	Could do future follow-up

*Same person listed all of these

4. Any other questions or comments?
    - Why is it called Yelling Creek?
    - What about Bangs Lake – doing anything there?
    - Know anything about how to designate a small area for a historical site (e.g. original homestead/house location)