Cows and Fish Report

South Saskatchewan River Basin Riparian Health Overview, *including*:

Part 1-
Red Deer, Bow and South Saskatchewan Rivers

and

Part 2-
Oldman, Belly, St. Mary, Waterton, Crowsnest and Castle Rivers

Cows and Fish
Alberta Riparian Habitat Management Society Report No. 026
(includes Report No. 024)

South Saskatchewan River Basin Riparian Health Overview, *including*:

Part 1-
Project Area: Red Deer River, Bow River and South Saskatchewan River

[also found in Cows and Fish Report No. 024; work completed 2003-2004]

and

Part 2-
Project Area: Oldman River, Belly River, St. Mary River, Waterton River, Crowsnest River and Castle River [work completed 2004-2005]

Submitted:
March 2005

Prepared for:
Alberta Environment

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Citation:
Alberta Riparian Habitat Management Society – Cows and Fish. 2005. South Saskatchewan River Basin Riparian Health Overview: Part 1 - Red Deer, Bow, and South Saskatchewan Rivers and Part 2 - Oldman, Belly, St. Mary, Waterton, Crowsnest and Castle Rivers. Prepared for Alberta Environment. Lethbridge, Alberta. Cows and Fish Report No. 026.

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EXECUTIVE SUMMARY: YEAR 1 and YEAR 2

A general overview of the riparian health of the major rivers within the South Saskatchewan River Basin in Alberta is provided. Rivers examined are the Red Deer, Bow, South Saskatchewan, Oldman (including Castle and Crowsnest), Waterton, Belly and St. Mary Rivers. These rivers comprise approximately 2,657 km of river length in Alberta, draining 18% of Alberta's land. Just over 140 km of river was assessed in 94 sites, amounting to 5% of the total length (approximately 140 km). Because of the limited area sampled, it is important to recognize that this information is appropriate for planning or developing general recommendations, and some comparison of the relative pressures facing each river system. Year 1 (2003) of the project included the Red Deer, Bow and South Saskatchewan Rivers, while Year 2 (2004) included the Oldman (including Castle and Crowsnest), Waterton, Belly and St. Mary Rivers.

Riparian health of the rivers examined is varied. Red Deer River has the greatest proportion of healthy sites, while the St. Mary and South Saskatchewan Rivers have no healthy sites. Overall, 22% of 94 sites rate as healthy (functioning), 49% rate as healthy, but with problems (functioning, at risk), and 29% are unhealthy (non-functioning). The Red Deer River, with 19 sites, has the fewest reductions in riparian health due to hydrologic parameters (dewatering, damming, floodplain accessibility), and these are an important part of the reason that it rates healthier overall. Most of the rivers had sites that fell into all three health categories. Both the Belly and Bow Rivers had about half of their sites rated as healthy, but with problems, with the remainder split about equally between healthy and unhealthy. While the Oldman and Waterton Rivers also had about half of their sites in the middle health category, they had at least twice as many of the remaining sites in the unhealthy category, compared to healthy sites. With no healthy sites, the St. Mary and South Saskatchewan Rivers had nearly twice as many sites in the unhealthy category, compared to the healthy, but with problems category.

Historic and present land uses in the riparian areas along all these rivers are dominated by grazing, with lesser amounts of the length attributed to agricultural crops, development (industrial and urban), and undeveloped lands (parks, natural areas, etc.). Within the sites examined, water withdrawal, damming, grazing, recreation, transportation corridors (roads, railroads) and urban development all played a role in individual site health ratings. While grazing is the most widespread land use, it is not negatively affecting riparian health at all sites.

Cottonwood regeneration is good to excellent overall, but poorest on the St. Mary and South Saskatchewan Rivers. Our work supports previous researchers' findings that there has been a decline in cottonwood cover below the St. Mary Dam, with lower woody plant cover in downstream areas. Rivers examined in Year 2 had overall excellent cottonwood regeneration, but field observations suggest that there are many very small, young plants, established in relatively recent recruitment events, with low numbers of older saplings or pole trees. This may have resulted in an unusually high proportion of young to old trees, leading to high health ratings for this parameter. Based on the riparian inventory and assessment methodology, regeneration is assessed as proportion of cover comprised of the young age classes. Combined with an assessment of total woody cover, these parameters should identify problems with woody plant community health. The limitation may be that (except perhaps along the St. Mary River) recruitment is occurring without sufficient maintenance, in conjunction with woody cover that is still relatively high despite very high diversion and damming levels on many reaches.

Regeneration of non-cottonwood trees and preferred shrubs is good to excellent overall. Not all reaches on the Oldman River and its tributaries have the potential for supporting trees other than cottonwoods. However, on the Oldman and South Saskatchewan Rivers, areas with potential for other trees (excluding cottonwoods), are reproducing poorly or very poorly. Low levels of preferred tree and shrub regeneration on the Belly River are likely partially attributable to being heavily impacted by dewatering. Low levels of woody plant cover along the St. Mary River appear to be related to extensive dewatering and damming. Most of the other areas associated with the Oldman River and its tributaries did not show clear relationships between woody plant community health and hydrologic changes. Along the Bow, Red Deer, and South Saskatchewan Rivers, withdrawals of water appear to be resulting in or contributing to poor or absent regeneration of trees, including cottonwoods. Where dewatering or damming are extensive, but the woody plant community appears to be reproducing successfully, it may be that losses, or potential losses, in recent decades may not have yet reached the point where overall cover has declined enough to be rated negatively. Consequently, loss of total woody plant cover or change in woody species composition may not be captured in one sampling effort. Loss of woody cover or reduced tree and shrub regeneration may be additionally impacted by silt shadows due to reservoirs. Long-term monitoring is key to follow loss or changes in the woody plant community.

The herbaceous plant community, assessed by invasive and disturbance-caused plants and native graminoid cover, is generally not healthy. Historic disturbance, including floods, grazing, and broad landscape level changes (i.e. introduction of non-native species) have all likely played an important role in these riparian communities being invaded and replaced by less desirable species. Recreation, development and urban areas also contribute to loss of deep-rooted native species. Current grazing pressure, measured by browse pressure, does not always closely link to the status of the herbaceous community, since these plant communities are significantly altered at virtually all sites, even where browse is light or absent. Current levels of dewatering or diversions, as well as changes in peak and timing of flow due to damming may be influencing health of the herbaceous plant community. As with the woody plant community, improvements in grazing distribution, stocking rate and timing that provide rest and improve native plant vigour can help to reduce further spread of these species. Control of weeds is needed in many areas; the extensive distribution is problematic because these areas can quickly lead to new infestations and increased cover. Not only do these species lack deep binding roots required for bank stability and erosion protection, they may provide minimal habitat, and very limited forage potential. Because many of them are unpalatable to livestock, they may increase unless active control measures are put in place.

Alterations to the plant community resulting from livestock grazing and other disturbances on the landscape can occur over long periods. Much of the disturbance-caused plant cover is made up of tame forage species, which have been introduced across Alberta in forage plantings, roadsides, parks and lawns. Removing them from riparian areas is unrealistic, but management should aim to make the most of these areas by increasing vigour and health of the native plant community.

Structural alterations to the riverbanks and human-caused bare ground are present, but generally very minor; relatively few sites have physical impacts that significantly reduce the health of the site. In grazed areas, livestock use has generally resulted in minor impacts.

In urban, developed, or recreational areas, impacts from roads, construction, gravel extraction, and other activities have led to localized bank alterations and bare ground. Management to minimise use during wet periods is particularly valuable for bank integrity. Ensuring appropriate levels and intensity of all land uses will ensure sustained plant cover and prevent bare ground.

The proportion of natural flows removed from the river generally increases downstream for the Bow, Red Deer, Oldman, St. Mary, Belly, and Waterton River systems. In several of these rivers, up to or over 90% of the annual discharge is removed within one or more reaches. The Bow, Red Deer and South Saskatchewan Rivers have lower overall diversions than the highest diversion areas of the Oldman River and its tributaries. Current withdrawals of water from these rivers are impacting riparian health, and appear to be resulting in or contributing to poor and absent regeneration of trees, including cottonwoods, in some reaches.

Extensive damming occurs along the South Saskatchewan River Basin major rivers. Dams are present along the Bow, Red Deer, Oldman, Waterton, and St. Mary Rivers. Water flowing into the Belly and South Saskatchewan Rivers comes from areas where significant damming occurs. Recognising that damming is a potentially harmful impact to riverine ecosystems, limiting further damming and providing flow regimes that help maintain or improve riparian plant communities and channel processes would be beneficial.

Some improvements to the plant community should be attainable with local on-site management, but disturbance and seed or plant material from upstream or upslope make significant improvements in less desirable plant communities much more challenging. Impacts to the physical integrity of these riparian areas are minimal; keeping such impacts low is much easier than attempting to repair them later. Improvements in volume of flow and changes in flow peak and timing could be made that would be expected to assist in the long-term establishment and maintenance of riparian plant communities, particularly for trees and shrubs.

The South Saskatchewan River watershed and each of the rivers discussed includes hundreds of streams, rivers, lakes or wetlands, not examined as part of this project. To thoroughly understand the needs, issues, and importance these waterbodies play in contributing to or detracting from, riparian health, a better understand of these areas is also is needed.

BACKGROUND

Information contained in this report is provided to Alberta Environment, and requests for copies or information regarding this report should first go to Alberta Environment. Use of the information beyond the original intent of the work, as agreed to by Cows and Fish, will be the responsibility of Alberta Environment.

Information in this report provides a summary and overview by large reach and river system. Where appropriate, riparian health information on individual riparian sites (polygons) is included, with the understanding that specifics of landowner information will not be provided under the cover of this report, nor directly linked to the data, in order to protect their privacy and follow the intent of the Freedom of Information and Protection of Privacy Act.

This report outlines the findings from two years of work in the South Saskatchewan River Basin Riparian Health Overview Project. This report is a summary of riparian health inventories and assessments completed within the project area by Cows and Fish during the summer of 2003 and 2004 (in addition to a number from 2000 and 2001). Data is presented and summarised using primarily the Lotic Health Assessment for Large River Systems. Additional details resulting from the Lotic Wetland Inventory are provided in the appendices. The riparian health inventory differs from the riparian health assessment because it includes a more detailed inventory of vegetative, soil and hydrological parameters of the project area. The riparian health score provided here is calculated based on the results of the Lotic Health Assessment for Large River Systems and is used to discuss the overall riparian health of each river and reach. The collection of this baseline information is an important first step for riparian resource management professionals to make riparian management recommendations and monitor change in riparian health over time.

The inventory and assessment of the functioning condition (health) of riparian habitat does not address any detailed hydrological or water quality parameters associated with the project area. General overviews of some hydrologic parameters are included in the assessment of health.

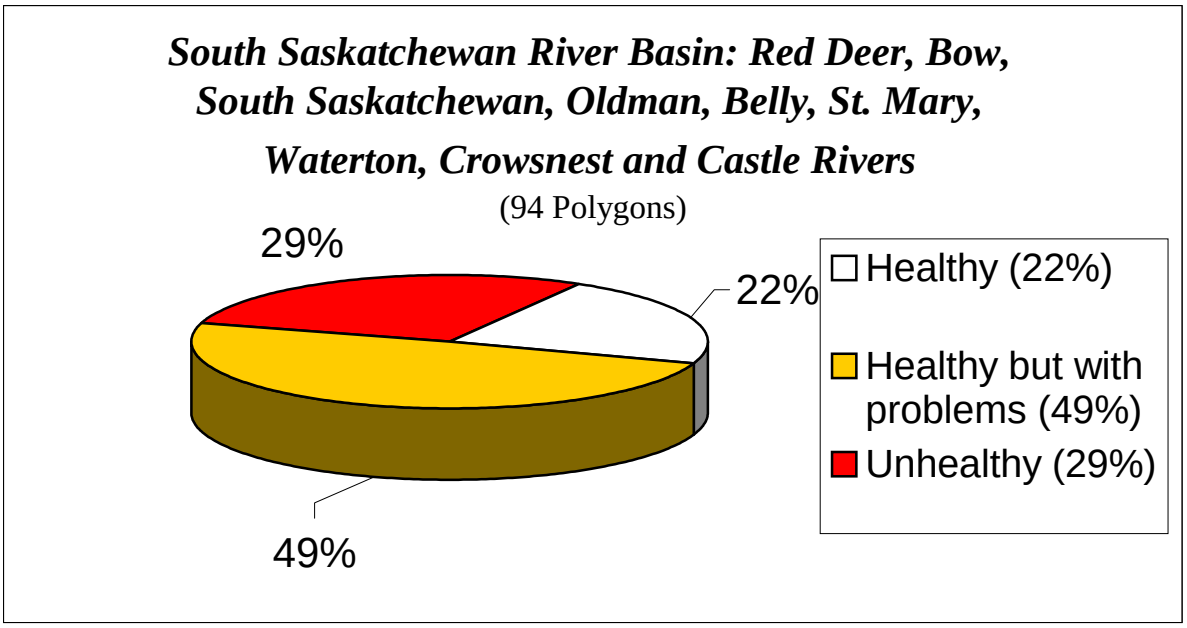
WHAT DID WE FIND?

- **Some concerns with riparian health.** The majority of the 94 polygons assessed rated *healthy, but with problems* in relation to the proper functioning condition guidelines within the assessment protocol. The overall assessment of riparian health for the project area is as follows;

  - Of the 94 polygons assessed: 22% (21/94) are *healthy*
    49% (46/94) are *healthy, but with problems*
    29% (27/94) are *unhealthy*

Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of the entire river.

Remember: We encourage users of the report to recognise the value of this report in broad-scale planning and identifying types of management and education approaches to take in the entire watershed--this is not a finger pointing exercise; it should be used as part of an awareness process that maintains or improves management.



Year 1-

Project Area: **Red River, Bow River, and South Saskatchewan Rivers** *[work completed 2004-2005]*

March 2004

Prepared for:

Alberta Environment

Project Area:

South Saskatchewan River Basin (partial): Red Deer River, Bow River, and South Saskatchewan River

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Citation:

Alberta Riparian Habitat Management Program – Cows and Fish. 2004. South Saskatchewan River Basin Riparian Health Overview: Part 1 - Red Deer, Bow, and South Saskatchewan Rivers. Prepared for Alberta Environment. Lethbridge, Alberta. Cows and Fish Report No. 024.

EXECUTIVE SUMMARY YEAR 1 PROJECT AREA

A general overview of the riparian health of the Red Deer, Bow and South Saskatchewan Rivers in Alberta is provided. The three rivers examined comprise approximately 1,618 km of river length in Alberta; just over 84 km of river was assessed in 48 sites, amounting to 5% of the total length examined. Because of the limited number of sites, it is important to recognize that this information is appropriate for planning or developing general recommendations across the major rivers in this watershed, and some comparison of the relative, but not absolute, pressures facing each river system examined.

Riparian health of the 3 rivers examined is varied; the Red Deer River has the greatest proportion of healthy sites, while the South Saskatchewan has the smallest proportion of healthy sites. Overall, 33% of the 48 sites rate as healthy (functioning), 46% rate as healthy, but with problems (functioning, at risk), and 21% are unhealthy (non-functioning). The Red Deer River, with 19 sites, has the fewest reductions in riparian health due to hydrologic parameters (dewatering, damming, floodplain accessibility), and these are an important part of the reason that it rates healthier overall (53% of sites healthy and no unhealthy sites). Based on the 21 sites examined for the Bow River, it has a mixture of health ratings, with 48% healthy, but with problems, and the remainder nearly evenly split between healthy and unhealthy. The South Saskatchewan River, with 8 sites assessed, has 5 of 8 sites rated as unhealthy. Local on-site management plays a role in how sites rate, although few, if any, sites were categorised as unhealthy due primarily to local management. More commonly, a significant loss in the health rating is attributed to the hydrologic parameters, either solely, or in combination with, some losses in health due to on-site management.

Historic and present land uses in the riparian areas along these three rivers are dominated by grazing, with lesser amounts of the length attributed to agricultural crops, development (industrial and urban), and undeveloped lands (parks, natural areas, etc.). Within the sites examined, water withdrawal, damming, grazing, recreation, transportation corridors (roads, railroads) and urban development all played a role in individual site health ratings. While grazing is the most widespread land use, it is not negatively affecting riparian health at all sites, and some sites with grazing are healthy.

Grazing management may be influencing establishment and regeneration of preferred trees and shrubs at some sites, particularly those with moderate or high utilisation and lower regeneration rates of trees. Impacts that relate to physical alterations from grazing (human-caused bare ground and structural alterations to the riverbank) are present, but minor. The overall impact on regeneration of trees and shrubs is not likely extensive.

With a few exceptions, primarily in the headwaters of the Bow and Red Deer Rivers, invasive species were widespread in most areas. The invasive species found are difficult to control and eradicate, but at most sites still do not contribute significant cover in the polygons examined, and efforts should be made to halt current levels of cover and prevent further expansion. Reduce the presence of invasive plants or aim to prevent further invasion with a combination of weed control measures and grazing strategies that consider rest, distribution, timing and stocking rates to prevent human-caused bare soil and to promote plant vigour. Disturbance resulting from recreation and development (urban areas, parks/natural areas) also requires weed control. Monitoring and control of invasive species is critical to preventing further spread.

The proportion of natural flows removed from the river generally increases downstream for the Bow River and Red Deer River systems. The Bow River, before its confluence with the Oldman River, has 46% of its average annual natural flow withdrawn (used or diverted), while the Red Deer River has nearly 15% of the flow removed before it leaves Alberta. The South Saskatchewan River reaches examined both have over 40% of the flow removed. In most reaches, removal of average river discharge is occurring to measurable levels, with the most limited removals nearest the headwaters of the Bow River and Red Deer River. Current withdrawals of water from these rivers are impacting riparian health, and appear to be resulting in or contributing to poor and absent regeneration of trees, including cottonwoods. As levels of withdrawal increase, recruitment and survival of seedlings and saplings is lower.

Extensive dams in the Bow River, and a single dam on the Red Deer River, control flood peak and timing considerably, including for the South Saskatchewan River. Recognising that damming is a potentially harmful impact on riverine ecosystems, consider limiting further damming and provide flow regimes that help maintain or improve riparian plant communities. Although not included in this riparian health examination, it is important to identify and quantify upstream minor or unlicensed dams to include them in overall modifications to peak timing and flow.

Where considerable dewatering and damming upstream occur in conjunction with heavier levels of woody plant utilisation, effects on preferred tree and shrub species may be magnified. Regeneration of both cottonwoods and other tree species is less in reaches with greater dewatering and damming upstream, suggesting impacts to tree seedling and sapling recruitment and survival. Opportunities to maintain and promote or increase regeneration and establishment will involve considering land use management (most often livestock grazing) in combination with hydrologic considerations.

The potential for improving riparian health is highly dependent on the specific reach and polygon. Some headwaters reaches are rated as very healthy and management impacts on site are minimal. Reaches in lower portions of the rivers are variably altered by on-site management, but frequently by hydrologic alterations. Where hydrologic alterations are limited, there are opportunities for improving management of the area, including grazing management, which is the dominant land use along the 3 rivers examined. Recreation and development in some areas also warrants improved management considerations. Overall, site potential depends on the ability to alter both on-site management and hydrologic modifications. Where on-site management is not the primary factor affecting riparian health, but hydrologic parameters are, unless these parameters are improved, additional impacts and loss of health may occur.

BACKGROUND

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Information in this report provides a summary and overview by large reach and river system. Where appropriate, riparian health information on individual riparian sites (polygons) is included, with the understanding that specifics of landowner information will not be provided under the cover of this report, nor directly linked to the data, in order to protect their privacy and follow the intent of the Freedom of Information and Protection of Privacy Act.

This report outlines the findings from the first year of the South Saskatchewan River Basin Riparian Health Overview Project, including the Red Deer River, Bow River, and South Saskatchewan River. Additional riparian inventories on the remaining major rivers in the South Saskatchewan River Basin are expected to occur in 2004.

This report is a summary of riparian health inventories and assessments completed within the project area by Cows and Fish during the summer of 2003. Data is presented and summarised using primarily the Lotic Health Assessment for Large River Systems. Additional details resulting from the Lotic Wetland Inventory are provided in the appendices. The riparian health inventory differs from the riparian health assessment because it includes a more detailed inventory of vegetative, soil and hydrological parameters of the project area. The riparian health score provided here is calculated based on the results of the Lotic Health Assessment for Large River Systems and is used to discuss the overall riparian health of each river and reach. The collection of this baseline information is an important first step for riparian resource management professionals to make riparian management recommendations and monitor change in riparian health over time.

The inventory and assessment of the functioning condition (health) of riparian habitat does not address any detailed hydrological or water quality parameters associated with the project area. General overviews of some hydrologic parameters are included in the assessment of health.

WHY ASSESS RIPARIAN HEALTH?

Riparian areas are simply the portions of the landscape strongly influenced by water and are recognised by water-loving vegetation along rivers, streams, lakes, springs, ponds and seeps. When in a properly functioning condition or *healthy* state, these green zones are one of the most ecologically diverse ecosystems in the world. Healthy riparian areas sustain fish and wildlife populations, provide good water quality and quantity, provide forage for livestock, and support people on the landscape.

Today, riparian areas are seen to be among the most valuable, productive, and vulnerable areas in settled portions of Alberta. In Alberta, growing public concern over water quality and land use issues are resulting in greater recognition of the importance of, and potential concerns regarding, riparian areas.

In general, the intent of riparian health inventory and assessment done at a watershed scale is to provide a state of the environment report; keep in mind however, that because of the very large area, this report gives only a general overview of health, not a detailed or absolute one. This report will provide information on riparian health or function that was previously lacking, to assist in making more informed management and planning decisions.

For the purposes of this report, riparian health simply means the ability of a river, including the channel and its riparian zone, to perform certain functions. These functions include sediment trapping, bank building, water storage, aquifer recharge, flow energy dissipation and maintenance of biological diversity.

Combining this information with existing practical knowledge of land management resources will provide the best alternatives for the sustainability of healthy riparian areas within the area. In general, this information could be used to assist agencies, rural landowners and local communities to 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 resource management professionals to:

- Create awareness among local landowners and their communities and build common understanding on riparian management issues in their watersheds.
- Take voluntary action by assisting local decision-makers to develop strategies to find local solutions that address riparian land use issues.
- Demonstrate that landowners are willing to face the issues by first acknowledging the need to take stock or determine the health of their riparian areas.
- Potentially identify the “good news” stories of agricultural producers or other landowners already managing healthy riparian areas.
- Temper the need for legislation and regulation as proactive efforts by landowners and their communities values cooperation over conflict, demonstrating a willingness to face any issues.
- Monitor progress in improving, maintaining and protecting riparian health for their operation or watershed.
- Identify environmental risk and integrate into urban, farm and ranch planning

WHY ARE HEALTHY RIPARIAN AREAS IMPORTANT?

Riparian areas can be viewed like a jigsaw puzzle, as they can be broken into pieces that are important to the whole image or function. How these individual pieces or components (e.g. vegetation, especially deep-rooted plant species) function together affects the health of the riparian ecosystem including the stream, its watershed, and overall landscape health and productivity.

To be healthy, riparian areas need to perform certain functions including trapping sediment to maintain and build stream and riverbanks, recharging groundwater supplies, storing flood water, reducing energy, filtering water, maintaining biodiversity, and creating primary productivity. Even though riparian areas comprise a small percentage of the landscape, they are critical to the long-term sustainability of a healthy landscape.

The Pieces Of Riparian Health

To effectively understand the current status of riparian function we ask a number of questions regarding the functioning condition of the riparian area (Is it healthy?). Healthy riparian areas have the following pieces intact and functioning properly:

- successful reproduction and establishment of seedling, sapling and mature trees and shrubs (if site has potential to grow them),
- nil or lightly browsed trees and shrubs (by livestock or wildlife),
- limited amounts of standing dead or decadent (dying) trees and shrubs,
- floodplains and banks with abundant plant growth,
- banks with deep-rooted plant species (trees and shrubs),
- very few, if any, invasive herbaceous plants (e.g. Canada thistle) or invasive trees,
- not many disturbance-caused plant species (e.g. Kentucky bluegrass, dandelion),
- native graminoid communities covering broad areas,
- well protected and stable banks based on extensive communities of deep-rooted species;
- very little human-caused bare ground or structurally altered banks
- ability to access a floodplain,
- minimal control of flood peak and timing by dams
- minimal withdrawals of water (diversions or consumptions) from the river

The riparian health inventory and assessment addresses a number of questions or parameters that help determine how the pieces of a riparian area are functioning. The assessment arrives at an overall health category for the riparian area, identified by a health score. Riparian health ratings are broken down into three categories and score ranges:

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

METHODS

Determining Riparian Health

While cursory methods of riparian evaluation (ground or aerial visual examination) may provide a very rough impression of health, they are unable to provide robust or methodologically substantiated data. Riparian health inventories provide the most robust and methodologically substantiated form of riparian health evaluation. Application of riparian health inventory on a watershed basis is based on stratification of physical and vegetative features and selection of sites that offer representative examples of riparian zones within the watershed area.

Due to the large geographic extent of the study area and available resources, it was decided to implement a two-year project: Accordingly, riparian health inventories and assessments were conducted on the Red Deer River, Bow River and South Saskatchewan River in 2003, leaving the Oldman River (and tributaries Castle River and Crowsnest River), Belly River, St. Mary River and Waterton River to be completed in 2004. Several sites on the South Saskatchewan River done for Canadian Forces Base Suffield in 2000 are included, with their permission.

Site Selection

Level One: Reach Delineation

Reach boundaries were provided by AENV, based on past work. To ensure that these AENV reaches were similar in terms of boundaries we would typically have delineated (see methods below under Level Two), and to delineate previously undelineated reaches (in headwaters areas), we examined the reaches with our criteria and compared AENV reaches to our own.

Based on aerial photo stratification of the Bow and Red Deer Rivers, we concluded that some of the AENV reaches could be broken down into shorter reaches, based primarily on topographic differences. The relevant reaches are as follows:

Red Deer River: 9 AENV reaches; we proposed 5 additional reaches for a total of 14 reaches. Only 9 final reaches were approved by AENV (see Table R4), but RD-07 and RD-06 were combined for presentation of some information.

Banff National Park East Boundary – Sundre: 2 reaches

- 2/3 of the reach from the Banff National Park eastern border is in the forest reserve and occurs within foothill/mountain terrain, the river channel is defined.

- the bottom 1/3 is quite open and flat and the river is more sinuous and has many channels.

Dickson Dam to confluence with the Medicine River:
- This is a very short reach and could be potentially lumped with the reach downstream

Proposed SAWSP site to Drumheller: 2 reaches
- Nevis to 20 km downstream of Nevis (valley is wide and open)
- 20 km downstream of Nevis to Drumheller (steep valley with many coulee draws)

Drumheller to Dinosaur Provincial Park: 3 reaches
- City of Drumheller to East Coulee bridge
- East Coulee Bridge to inlet
- Inlet to Dinosaur Provincial Park

Dinosaur Provincial Park to Bindloss: 2 reaches
- Dinosaur Provincial Park to NW33-22-8-W4M (narrow, steep valley)
- NW33-22-8-W4M to Bindloss (valley here is much wider and more shallow)

Bow River: 10 AENV reaches; we proposed 3 additional reaches for a total of 13 reaches. Only 10 final reaches were approved by AENV (see Table B4).

Carseland Weir to Bassano Dam: 2 reaches
- Carseland Weir to Rd 842 (wide riparian area, many cottonwoods, old meander bends)
- Rd 842 to Bassano Dam (riparian area narrow)

Bassano Dam to Grand Forks: 3 reaches
- Bassano Dam to NE20-17-18-W4M (moderately steep valley with many coulee draws, very wide meanders)
- NE20-17-18-W4M to approximately 33-14-15-W4M (narrow riparian area, not many coulee draws, some large meanders)
- 33-14-15-W4M to Grand Forks (similar to first section, coulee draws are more defined, cut banks)

Level Two: Delineation of Physical Features

The boundaries of the reaches, provided by AENV, were delineated onto 1:30,000 aerial photographs. Using remote sensing techniques, physical feature criteria were examined within each reach. Using these criteria (described below), the reach was delineated into homogeneous sub-reaches and one polygon was assigned to each of these sub-reaches, with the recognition that approximately 40 polygons was the limit of available resources for the project.

Physical Feature Criteria

1. Factors contributing to the broad level stream classification system as per Rosgen and Silvey (1998). Namely:

    a) Valley type
        - Canyon
        - U-shaped valley
        - Wide valley

    b) Slope (river gradient)

    c) Sinuosity
        - Low (<1.2)
        - Medium (1.2-1.5)
        - High (>1.5)

2. Presence of recent alluvial bar development / riparian tree and shrub recruitment

    In particular, narrow-leaf cottonwood (*Populus angustifolia*), balsam poplar (*Populus balsamifera)* and plains cottonwood *(Populus deltoides)* recent alluvial bar community types as described by Thompson and Hansen (2002). The presence of these physical features was determined by aerial photo interpretation.

3. General examination for presence and distribution of riparian poplars (cottonwoods).

Level Two: Land Use / Management

For each reach and sub-reach identified:

1) The riparian areas on both sides of the river were delineated into one of the following four categories, using ocular estimations of air photos:
    a) Agricultural rangelands (grazing)
    b) Agricultural agronomic lands (cropping)
    c) Developed: residential and / or industrial.
    - based on the amount of deviation from the natural state being greater than 50% of the total area; excludes agricultural use by grazing or cropping
    d) Undeveloped: recreational, parks, natural areas
    -based on the amount of deviation from the natural state being less than a 50% of the total area; excludes agricultural use by grazing or cropping

2) The proportion of each of these four categories was determined per reach.

3) Target areas that best fit the representative criteria outlined above are identified within each reach.

4) Landholdings within each of these target areas are identified and randomly selected (each polygon must be located wholly within one landholding).

5) Every attempt was made to select a proportional numbers of polygons based on the length in each land use category.

Landowner Consultation and Involvement

Cows and Fish is committed to the delivery of riparian health assessments and inventories as part of community based action wherever possible. To meet this commitment, we held community meetings (at a rural municipality scale) to inform local landowners of the potential activities and gather their support for the work.

All landowners selected as potential sites within the target areas were then contacted individually by telephone and, with their permission, an on-site visit with Cows and Fish was scheduled. Once an understanding of the scope of the project and subsequent voluntary participation was achieved, their input regarding the location of the polygon was sought. Polygon locations were determined based on management, plant community distribution and physical features of the river, most representative of their landholding.

Participating landowners will be provided with a summary report that details the current state of riparian health on their landholding (this information remains in confidence between the landowner and Cows and Fish).

Polygon selection

Based on the scope and objectives of the inventory project, every kilometre of stream could not be inventoried, but rather, a sample of polygons (inventory and assessment sites) was selected to provide a cursory overview of health for each reach. Accordingly, every attempt was made to select riparian sites that best represented each overall reach. In all, 42 polygons were examined in 2003. 6 sites, previously examined in 2000, are included in the analysis as well.

Ground Truthing Polygon Locations

Cows and Fish staff determined the exact boundaries of polygons based on ground truthing after stratification and landowner discussions were complete. Efforts were made to ensure that the polygon was representative of the overall landholding or at the least, the management unit the polygon was located in. The vegetative community was often the factor that determined the length of the polygon, as polygons were extended to include a representative vegetation sample. For example, in a stretch of river that was uniformly inhabited with cottonwoods, it was not necessary for that polygon to be extensively long. In a stretch of river with a greater spatial diversity of plants, it was necessary to ensure the length of the polygon included a representative vegetative sample. As well as confirming the physical features and vegetative community, staff would also confirm that the polygon was representative of the landholding or management unit based on other on-site factors, such as level of beaver activity and browse utilisation. For example, if the polygon had been utilised heavily by cattle and was not representative of the overall utilisation within the reach, the polygon would be not be situated in that location.

Lotic Riparian Health Inventory

Once the boundaries of the polygon were determined, a Lotic Wetland Inventory of the entire polygon was conducted. The inventory form provides a comprehensive inventory of a river segment and its associated riparian area, including vegetation data, physical site data and photographs. The vegetation data collected includes plant species identification and ocular canopy cover determinations, as well as age class breakdowns for tree and shrub species. Physical site data includes a description of the type of stream channel, substrate composition, stream bank condition, amount and cause of bare ground, and commentary. A health assessment rating is derived from the detailed inventory information.

Lotic Health Assessment for Large River Systems

The assessment of riparian health is based on 16 main parameters highlighting key characteristics of vegetation and soil/hydrology (refer to Appendix G1 for methodology), with 17 total parameters (invasive plants is separated into two sub-parameters). At the time of the riparian inventory, an assessment was completed of features identifiable on site. The remaining parameters were determined in the office, based on data provided by Alberta Environment/Alberta Sustainable Resource Development (SRD) (in some cases, raw data provided was further analysed by Cows and Fish).

Photographic Inventory

Photographs (digital) were taken facing upstream and downstream at the start and end of each polygon. Refer to photo plates in the report.

Determination of Hydrologic Parameters (for additional details, see appendices on riparian health methods)

Dewatering of the River System

The level of dewatering of each river is based on the average (1988-2001) of total uses and diversions as a percentage of natural flow, based on data provided by Alberta Environment (personal communication with Tom Tang).

Control of Flood Peak and Timing by Upstream Dams

GIS data provided by Sustainable Resource Development (personal communication Margaret Bradley), at the request of AENV was provided regarding the area of the watershed dammed. The area of watershed upstream from each polygon was broken into either dammed or undammed areas, always in reference to the location of the polygon. Dammed areas were calculated as any portions of the watershed that flowed into a dam. Undammed areas were identified as those areas of the watershed that flowed into the river which was unrestricted by dams. Specifically, if the polygon was located above any dam (and hence the watershed collected to that point), then that entire area was considered undammed. If the polygon was located at a dam, then the area of the watershed upstream from that point was considered dammed.

For polygons located below a dam, the area of watershed draining into that dam was calculated as the dammed portion and the area below the dam but above the polygon was undammed.

Floodplain Accessibility

The proportion of the floodplain accessible to flood flows in a polygon was determined by both ground truthing and examination of air photos. A determination was made in terms of what fraction of the historic 100 year floodplain remained unrestricted by embankments, such as berms, roads, railroads, or other barriers.

DATA LIMITATIONS

The three rivers examined comprise 1,618 km of river length in Alberta; only 84.13 km of river was assessed in 48 polygons, amounting to 5.2% of the total length examined. Because of the limited number of sites (polygons) spread across this extensive area, users of the information contained in this report and associated appendices must recognize that the information is appropriate for planning or developing general recommendations across the watershed, and some comparison of the relative, but not absolute, pressures facing each river system examined. In addition, due to broad-scale nature of this representative sampling methodology, it must be emphasised that there are likely sections of riparian area within each reach not represented by the overall health rating for that reach.

Every effort was made to representatively and proportionately sample within each river and within each reach, recognising that this sampling was very widely spread. Target areas and landowners were selected based on stratification procedures (outlined above), but due to the lack of interest or willingness to participate, often many attempts were required within a reach to find landowners willing to participate. This clearly reduced the representativeness of site included, and thus may reduce the representativeness of the reach and river findings.

Data on some of the hydrologic parameters used for riparian health assessment determination was at times less detailed and inclusive than it could have been. Determination of dewatering and control of flood peak/timing only includes major dams, diversions and licensed uses (and is based on data provided by AENV/ASRD). Unlicensed uses, which we expect to be occurring at an unknown level in unknown locations, cannot be included, for obvious reasons. In addition, small dams or impoundments (licensed or not) in the many streams and rivers that contribute to these larger rivers are not included, but may still be important in terms of potential impacts to riparian health and riparian health scores.

The inventory and assessment of the functioning condition (health) of riparian habitat does not address detailed in-stream or hydrological (i.e. issues associated with water flow regimes, water diversions, extractions, dam impacts) parameters associated with the project area. Parameters related to hydrology of the system (floodplain accessibility, proportion of watershed dammed upstream from a site, and amount of flow withdrawn) are broad scale examinations that relate to potential impacts on the site. Due to the diverse nature of dams and diversions, including differences in timing of storage and release, influences on riparian areas downstream may vary.

Dams and their associated reservoirs are also developed for diverse purposes, including for flow management, irrigation withdrawal, and hydro-electric power generation, each of which results in different types of flow management. This inventory and assessment of riparian health did not investigate the details of timing of changes to river flow, but such an examination could provide additional useful information related to riparian vegetation parameters.

In general, the intent of riparian health inventory and assessment done at a watershed scale is to provide a state of the environment report; keep in mind however, that because of the very large area, this report gives only a general overview of health, not a detailed or absolute one. This report will provide information on riparian health or function that was previously unavailable to assist in making more informed management and planning decisions. Caution should be applied when assuming that the reach and river summaries are entirely representative of what is located in each area.

Please Keep in Mind

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

Riparian Plant Communities-Why are they important?

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

Classification of Riparian Plant Communities

Understanding the type of riparian plant communities a river system has the potential to grow is important for a number of reasons:

- Allows landowners and land managers to know if the desired plant communities are growing there already and if not, why not? For example, will a particular river system grow cottonwoods or willows? How extensive should the plant communities be?
- 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 (PNC) of the riparian area allows us to:
    - set realistic goals to either improve or maintain existing riparian health,
    - understand how long recovery may take if improvement is needed, and
    - obtain insight into what management strategies need to be implemented for improvement to occur or to maintain existing riparian health.

Within the South Saskatchewan River Basin project area, tree and shrub communities are relatively extensive within all three rivers systems, but some areas have considerably greater cover than others. Trees other than cottonwoods are regenerating well in the upper reaches of the Red Deer River and Bow River, but seedlings and saplings are absent or low in very small quantities in the lower reaches of all three rivers. Potential exists for non-cottonwood trees even in these lower reaches, but many lack other trees of any age.

SOUTH SASKATCHEWAN RIVER BASIN PROJECT AREA 2003

The project area is defined as a selection of riparian areas involving a number of riparian sites along the Red Deer River, Bow River, and South Saskatchewan River from their headwaters downstream to the confluence of the river with another inventoried river (Bow River) or the Alberta-Saskatchewan border (Red Deer River and South Saskatchewan River) (refer to project area map – Figure 1).

Table 1. Summary of Riparian Health Work – South Saskatchewan River Basin

Year	River	# Landowners Contacted	# Landowners Participated	# Polygons Assessed	River Distance Assessed (km)
2003	Red Deer River	54	19	19	31.3
2003	Bow River	21	15	21	40
2000/ 2003	South Saskatchewan River	4	4	8	12.83

Figure 1. South Saskatchewan River Basin Project Area (2003)

WHAT DID WE FIND?

- **Some concerns with riparian health.** The majority of the 48 polygons assessed rated *healthy, but with problems* in relation to the proper functioning condition guidelines within the assessment protocol. The overall assessment of riparian health for the project area is as follows (Figure 2);

  - Of the 48 polygons assessed: 33% (16/48) are *healthy*
    46% (22/48) are *healthy, but with problems*
    21% (10/48) are *unhealthy*

Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of the entire river.

Remember: We encourage users of the report to recognise the value of this report in broad-scale planning and identifying types of management and education approaches to take in the entire watershed--this is not a finger pointing exercise; it should be used as part of an awareness process that maintains or improves management.

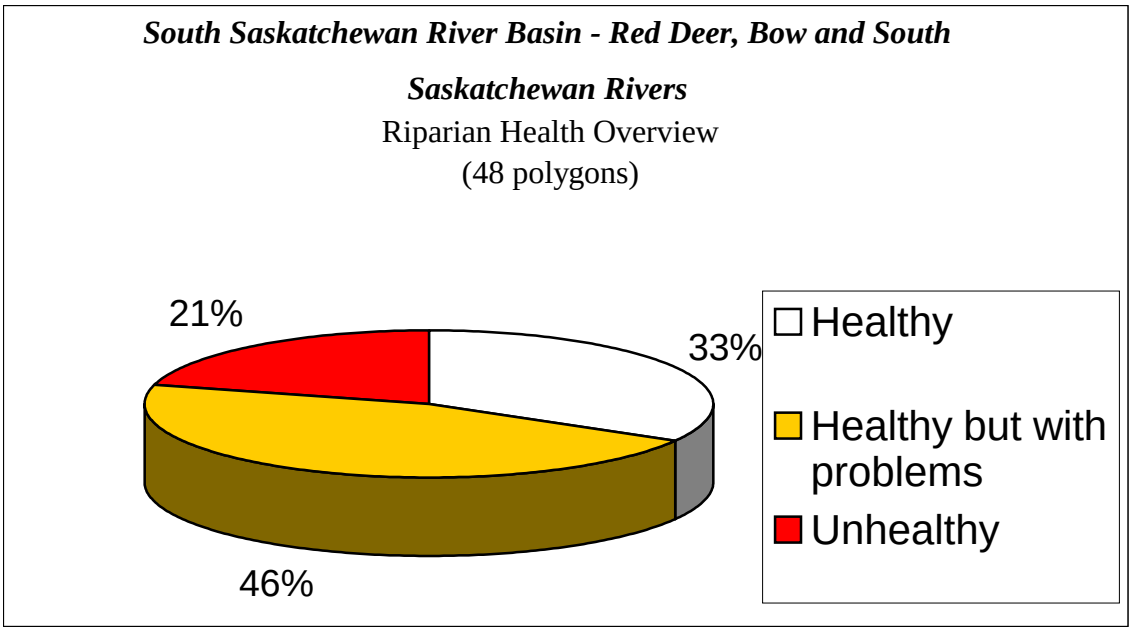


Figure 2. Breakdown of riparian health results for 48 polygons within the South Saskatchewan River Basin project area.

RIPARIAN HEALTH DISCUSSION

For details on riparian health, review individual river systems and refer to the summary provided below.

A Closer Look At The Riparian Health Pieces

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

During our assessment of riparian health we looked closely at 16 main health parameters (invasive plants is broken into 2 sub-parameters) and assessed their functioning condition. Eleven of the parameters relate to vegetation and six relate to soil and hydrology. Details of how each of these parameters are scored are in Appendix G1. By objectively examining each of these health parameters we can determine which pieces are adequately performing the necessary functions of a healthy riparian area, and which are not. This examination provides us with a better understanding of where to concentrate efforts if improvements in riparian management are required, and what land use practices are currently maintaining riparian health.

The following discussion provides some insights regarding the current status of the health of riparian areas within the entire project area.

South Saskatchewan River Basin Riparian Health Overview: Summary

The health of each river system varied, primarily with the level of use and development, as well as amounts of damming and water withdrawals. Riparian health of the polygons examined tended to decrease with increasing distance downstream; there is however, considerable variability between reaches and within a reach. Consequently, the observations below are provided as an overview that will assist in general management or monitoring planning. More detailed or specific use of the information should be done at the system, reach and polygon level, with a clear understanding of site or localised health status.

There are a number of riparian health parameters that tended to vary based on proximity to headwaters:

Vegetation:

- Greater abundance and distribution of invasive and disturbance-caused plants downstream
- Cottonwood regeneration from seed decreases (with some exceptions) downstream
- Regeneration and establishment of other tree species (with a few exceptions) is lower downstream
- Cover of woody species is greater upstream

There is a less clear trend for some riparian health parameters in terms of proximity to headwaters:

- Preferred shrub regeneration
- Presence of native graminoids
- Preferred tree and shrub utilisation
- Human alterations to the structure of riverbanks
- Human-caused bare ground
- Proportion of banks protected with deep-binding roots
- Proportions of natural flow removed, leading to greater dewatering of channel and floodplain (similar in South Saskatchewan, increasing with distance downstream in Red Deer River and Bow River)
- Control of flood peaks and timing by dams (this related directly to proximity to dams)

Some parameters of riparian health were similar, regardless of location along the river system:

- Decadent and dead woody material (healthy at most sites)
- Exotic, undesirable woody species (healthy at all sites)
- Floodplain accessibility (generally excellent, where altered, usually related to presence of an urban centre)

South Saskatchewan River Basin: Opportunities and Options for Improvement

From a basin-wide perspective, grazing is the dominant land use, and thus may be the most logical land use examined for management efforts. Settlement of many areas for ranching occurred between 1896 and 1910 (Marken 1993), so there has been a long history of use, of which most has left the riparian areas healthy or healthy, but with problems. At many sites there seems to be minimal impacts of grazing affecting riparian health. Grazing management may be influencing establishment and regeneration of preferred trees and shrubs at some sites, particularly those with moderate or high utilisation and lower regeneration rates of trees.

Impacts that relate to physical alterations from grazing (human-caused bare ground and bank structural alterations) are present, but generally minor, although a few sites do have physical impacts that reduce the health of the site. Management to improve physical impacts should relate to both timing and intensity of livestock use. Avoid using these areas during moist soil conditions, when compaction to soil will be greatest, and also minimise use during periods when graminoids are mature and less palatable, as livestock will focus more use on trees and shrubs during these periods. Where utilisation is moderate or high, this level of browse may not be sustainable in terms of allowing successfully regeneration and maintenance of tree and shrub communities, but the overall impact on regeneration is not likely extensive, since shrub regeneration is very good throughout most areas examined.

Alterations to the plant community resulting from livestock grazing can occur over long periods (Marken 2003; Cows and Fish pers. comm.), so appropriate long-term management strategies are key. Promote and support livestock grazing strategies that focus on keeping preferred tree and shrub utilisation to light, and occasionally moderate, levels, to benefit establishment of seedlings and saplings, by allowing increased plant growth and vigour. Avoiding use in sensitive periods (i.e. when graminoids and forbs have reduced palatability or are limited in quantity) will promote woody plant growth, while minimising livestock browse. Additional rest to sites will promote native trees, shrubs, and graminoids.

Where considerable dewatering and damming upstream occur in conjunction with heavier levels of woody plant utilisation, effects on preferred tree and shrub species may be magnified. Cottonwood regeneration is modest overall, with other tree species regenerating well in upper reaches of the Bow River and Red Deer River. All polygons examined had the potential for both cottonwood and other trees species. Other tree species are mostly not regenerating in the South Saskatchewan and in the lower reaches of the Bow and Red Deer Rivers. Regeneration of both cottonwoods and other tree species is less in reaches with greater dewatering and damming upstream, suggesting impacts to tree seedling and sapling recruitment and survival. Other researchers have indicated that reduced seedling establishment and success resulting from inappropriate or insufficient flows and floods are important in cottonwood establishment in Alberta (Bradley *et al.* 1991), although the reaches examined for that research indicated, with cautionary notes, that there had not been a significant change in poplar density over the previous 35 years for the Red Deer, Bow, and South Saskatchewan Rivers. Because modified hydrology exists throughout the reaches examined, regeneration and establishment of trees may be negatively affected throughout, even where no riparian health rating reduces health score. Opportunities to maintain and promote or increase regeneration and establishment will involve considering land use management (most often livestock grazing) and hydrologic considerations.

Other researchers in Alberta have clearly identified that large dams impact recruitment and survival of vegetation because they modify elements of the river, including timing, duration and magnitude of high flows (Rood and Mahoney 1990). Our work clearly agrees with their research, and with very diverse approaches to determining impacts.

In addition, maintenance of existing plant communities is key, since long periods of low moisture or lack of appropriate flood characteristics could result in extended periods without suitable opportunities for recruitment and colonisation. In the lower Red Deer River, some shrub communities showed almost no colonisation between 1950 and 1986 (Marken 1993). Marken (1993) also found that present conditions that may be maintaining plant communities might not equate to conditions required for establishment. This emphasises the need to maintain appropriate opportunities and characteristics for establishment and survival of tree and shrub communities over the long term. Cottonwood recruitment likely requires significant spring floods (Bradley *et al*. 1991; Marken 1993), which may not be present if damming significantly alters these events.

With a few exceptions, primarily in the headwaters of the Bow and Red Deer Rivers, invasive species were widespread in most areas. The invasive species found are difficult to control and eradicate, but at most sites still do not contribute significant cover in the polygons examined. Efforts should be made to halt current levels of cover and prevent further expansion.

Reduce the presence of invasive and disturbance plants or aim to prevent further invasion with a combination of weed control measures and grazing strategies that consider rest, distribution, timing and stocking rates that prevent human-caused bare soil and promote plant vigour. Disturbance resulting from recreation and development (urban areas, parks/natural areas) also requires weed control. Monitoring and control of invasive species is critical to preventing further spread. Minimise and reduce areas of human-caused bare ground as well as structural alterations, as this will reduce potential invasion sites, and assist in limiting infestations.

In most reaches, removal of average river discharge is occurring to measurable levels, with the most minimal typically being at the headwaters of the Bow River and Red Deer River. Water extractions are nearly half of the average annual discharge of the South Saskatchewan River and current withdrawals are impacting riparian health. As noted above, where dewatering is higher, regeneration of trees is worse.

Extensive dams in the Bow River, and a single dam on the Red Deer River control flood peak and timing significantly, including of the South Saskatchewan River. Recognising that damming is a potentially harmful impact on riverine ecosystems, consider limiting further damming and provide flow regimes that help maintain or improve riparian plant communities. Damming in Alberta has been seen to lower flow as well as flood timing (Marken 2003), which is mirrored in the riparian health ratings for this parameter and seen in vegetation parameters. Although not included in this riparian health examination, it is important to identify and quantify upstream minor or unlicensed dams to include them in overall modifications to peak timing and flow.

Floodplain accessibility and opportunity to deposit water and sediment on the floodplain is excellent in almost all reaches, but where it is not, it typically relates to an urban development with flood control protection measures. Maintain current floodplain accessibility by limiting further berms or embankments.

The potential for improving riparian health is highly dependent on the specific reach and polygon. Some headwaters reaches are rated as very healthy and management impacts on site are minimal. Reaches in lower portions of the rivers are variably altered by on-site management, and usually, hydrologic alterations. Where hydrologic alterations are limited, there are opportunities for improving management of the area, including grazing management, which is the dominant land use along the 3 rivers examined. Recreation and development in some areas also warrants improved management considerations. Overall, site potential depends on the ability to alter both on-site management and hydrologic modifications. Where on-site management is not the primary factor affecting riparian health, but hydrologic parameters are, unless these parameters are improved, additional impacts and loss of health may occur.

RIPARIAN HEALTH RESULTS IN RELATION TO SORAC DATA

Riparian health results from this project compare reasonably well to work done as part of a project to examine overall health of the rivers in the South Saskatchewan River Basin of Alberta, qualitatively examining riparian and aquatic conditions (Table 1). The project, titled SORAC (Strategic Overview of Riparian and Aquatic Condition), used a best judgement panel (BJP) to assign a relative rating based on water quality, quantity and flow modifications, aquatic health (including fish and other organisms), and riparian plant community health (based primarily on cottonwoods) (Golder Associates Ltd. 2003).

In most of the upper reaches, the BJP did not evaluate health. Most of the reaches rated as *moderate impact* by SORAC were categorised as *healthy, but with problems (functioning, at risk)* by our riparian health assessment. In the reaches where we assessed polygons as *healthy (functioning),* SORAC typically did not review those areas, so it is not clear if the two methods would have had a clear linkage. Of the two reaches we assessed as *unhealthy (non-functioning),* SORAC rated one as degraded and the other as moderate impact; too few comparisons are available to determine if these categories would correspond well in other situations. It is important to note that SORAC includes both aquatic and riparian areas in determining a rating or classification, while riparian health assessment does not include aquatic parameters such as water quality and aquatic life. Because a riparian health assessment and inventory is an examination of existing conditions, it is not possible to determine trend; trend determination requires examination of the site additional times. Consequently, the trend assigned based on SORAC cannot be compared with our work.

Table 2. Comparison of Riparian Health and SORAC Rating				
Red Deer River Alberta Environment Reach	**SORAC Rating**	**Riparian Health Rating**	**Polygon Code**	**Polygon Health**
RD-09	Not assessed	Healthy (92%)	RED1 RED2 RED3 RED4	Healthy (89%) Healthy (94%) Healthy (93%) Healthy (94%)
RD-08	Moderate impact – stable	Healthy (86%)	RED5 RED6	Healthy (85%) Healthy (88%)
RD-07/RD-06	Moderate impact – degrading Heavy impact – degrading	Healthy, but with problems (76%)	RED7 RED8	Healthy, but with problems (78%) Healthy, but with problems (74%)
RD-05	Heavy impact – degrading	Healthy, but with problems (79%)	RED9 RED10	Healthy (85%) Healthy, but with problems (73%)
RD-04	Moderate impact – degrading	Healthy, but with problems (70%)	RED11 RED12	Healthy, but with problems (65%) Healthy, but with problems (75%)
RD-03	Moderate impact – degrading	Healthy, but with problems (72%)	RED13 RED14 RED15	Healthy, but with problems (62%) Healthy, but with problems (72%) Healthy (81%)
RD-02	Moderate impact – degrading	Healthy, but with problems (72%)	RED16 RED17	Healthy, but with problems (72%) Healthy, but with problems (72%)
RD-01	Moderate impact - degrading	Healthy but with problems (74%)	RED18 RED19	Healthy, but with problems (77%) Healthy, but with problems (72%)

Bow River: Alberta Environment Reach	SORAC Rating	Riparian Health Rating	Polygon Code	Polygon Health
BW-10	Not assessed	Healthy (87.5%)	BOW1 BOW2	Healthy (94%) Healthy (81%)
BW-09	Not assessed	Healthy, but with problems (77.5%)	BOW3 BOW4	Healthy, but with problems (74%) Healthy (81%)
BW-08	Not assessed	Healthy (86%)	BOW5 BOW6	Healthy (83%) Healthy (89%)
BW-07	Not assessed	Healthy, but with problems (74.5%)	BOW7 BOW8	Healthy (85%) Healthy, but with problems (64%)
BW-06	Not assessed	Healthy, but with problems (70.5%)	BOW9 BOW10	Healthy, but with problems (64%) Healthy, but with problems (77%)
BW-05	Moderate impact – stable	Healthy, but with problems (61.5%)	BOW11 BOW12	Unhealthy (53%) Healthy, but with problems (70%)
BW-04	Moderate to heavy impact – stable	Healthy, but with problems (61%)	BOW13 BOW14	Unhealthy (59%) Healthy, but with problems (63%)
BW-03	Moderate impact – stable	Healthy, but with problems (73.5%)	BOW15 BOW16	Healthy, but with problems (73%) Healthy, but with problems (74%)
BW-02	Moderate impact – stable	Healthy, but with problems (72.0%)	BOW17 BOW18	Healthy, but with problems (69%) Healthy, but with problems (75%)
BW-01	Degraded - degrading	Unhealthy (51.3%)	BOW19 BOW20 BOW21	Unhealthy (54%) Unhealthy (52%) Unhealthy (48%)

South Saskatchewan River Alberta Environment Reach	SORAC Rating	Riparian Health Rating	Polygon Code	Polygon Health
SS-02	Moderate impact – stable	Healthy, but with problems (60.8%)	SOU1 SOU2 SOU3 SOU8 SOU9 SOU11	Unhealthy (58%) Unhealthy (53%) Healthy, but with problems (69%) Healthy, but with problems (64%) Unhealthy (52%) Healthy, but with problems (69%)
SS-01	Moderate impact - stable	Unhealthy (42%)	SOU10 SOU12	Unhealthy (28%) Unhealthy (56%)

NEXT STEPS

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 baseline information on riparian health and a review of historical land use practices have answered the question "Where are we now?"

- ***Highlight and profile what's working on the landscape right now.*** The next step is to use this knowledge, along with the application of sound range and riparian management techniques, towards the restoration of riparian health, at least to the level possible with current limitations to hydrologic characteristics (and consider where improvement on a watershed scale can be made to these). By working with landowners wanting to improve or maintain 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.

- ***Continue riparian inventory work over the long-term.*** Monitor progress of watershed, community and individual effort to address riparian issues. With the application of sound management principles on an individual and watershed basis, it is inevitable that the trend in riparian health will be positive over time. A single evaluation cannot define the absolute status of site health. To measure trend (improving, declining or staying the same) monitoring should be pursued in subsequent years. This can be achieved by another overall riparian inventory – every 3 to 7 years.

SELECTED REFERENCES AND LITERATURE CITED

Alberta Environment Conservation Authority (Alberta ECA). 1977. Flow regulations of the Red Deer River-Report and Recommendations. Edmonton, Alberta. 190 pp.

Alberta Environment Conservation Authority (Alberta ECA). 1974. Land use and resource development in the Eastern Slopes-Report and Recommendations. Edmonton, Alberta. 224 pp.

Bradley, Cheryl, Frances Reintjes and John Mahoney. 1991. The biology and status of riparian poplaras in southern Alberta. Prepared for World Wildlife Fund Canada and Forestry, Lands and Wildlife, Fish and Wildlife Division. 85 pp plus appendices.

Golder Associates Ltd. 2003. Strategic overview of riparian and aquatic condition of the South Saskatchewan River Basin. Submitted to Alberta Environment. Calgary, Alberta. 29 pp plus appendices.

Marken, Sandra. 1993. Plains cottonwoods and riparian plant communities on the lower Red Deer River. M.Sc. thesis. University of Calgary, Alberta.

Rood, Stewart and John M. Mahoney. 1990. Collapse of river valley forests downstream from dams in western Prairies: probable causes and prospects for mitigation. Environmental Management 14: 451-464.

Rosgen, Dave and Lee Silvey. 1998. Field guide for stream classification. Wildland Hydrology Books. Colorado, USA. 193 pp.

Thompson, W. H. and P. L. Hansen. 2002. Classification and management of riparian and wetland sites of the Alberta Grassland Natural Region and adjacent subregions. Bitterroot Restoration Inc. Prepared for the Alberta Riparian Habitat Management Program-Cows and Fish, Lethbridge, Alberta. 416 pp.

RED DEER RIVER PROJECT AREA

The project area is defined as a selection of riparian areas along the Red Deer River from the Eastern Boundary of Banff National Park downstream to the Alberta/Saskatchewan Provincial border (refer to project area map – Figure 1), a distance of approximately 708 km, of which just over 31 km was sampled as part of 19 polygons (Table R1, Appendix R11).

Riparian areas in the examined sites were up to 900 m wide, but more typically were 175-400 m maximum width, with an average width of 148 m (Appendix R13). Some reaches in lower portions of the river have incisement or down-cutting present (Appendix R12). Diverse vegetation is dominated by native species, although both invasive herbaceous and disturbance-caused plants are widespread. There were no invasive tree species found in the project area. White spruce/red-osier dogwood habitat type (HT) (*Picea glauca*/*Cornus stolonifera*) covered the greatest area of any other HT.

Thorny buffaloberry (*Shepherdia argentea*) community type (CT) covered the largest area of any CT. Yellow willow/red-osier dogwood HT (*Salix lutea*/*C. stolonifera*) and plains cottonwood/red-osier dogwood CT (*Populus deltoides*/*C. stolonifera*) were the next most common plant communities (Appendix R7).

WHAT DID WE FIND?

- **The level of awareness about the project was very low.** A lot of landowners were hesitant about participating in the project. Generally, those landowners who participated showed interest in determining the health of the riparian area. Thanks to everyone who allowed access to their land and supported this riparian inventory initiative. In all, 19 polygons were assessed on 19 landholdings along the Red Deer River in 2003 (Table R1, Appendix G3).

- **There are some concerns with the overall health of this riparian area, but no sites were rated as non-functioning.** Just over half of the 19 polygons assessed along the Red Deer River rated *healthy* in relation to the proper functioning condition guidelines within the inventory protocol. The remaining sites rated *healthy, but with problems*. The overall assessment of riparian health for the Red Deer River project area is as follows (Figure R1, Appendix R1);

  - Of the 19 polygons assessed: 53% (10/19) are *healthy*,
    47% (9/19) are *healthy but with problems*,
    0% (0/19) are *unhealthy*.

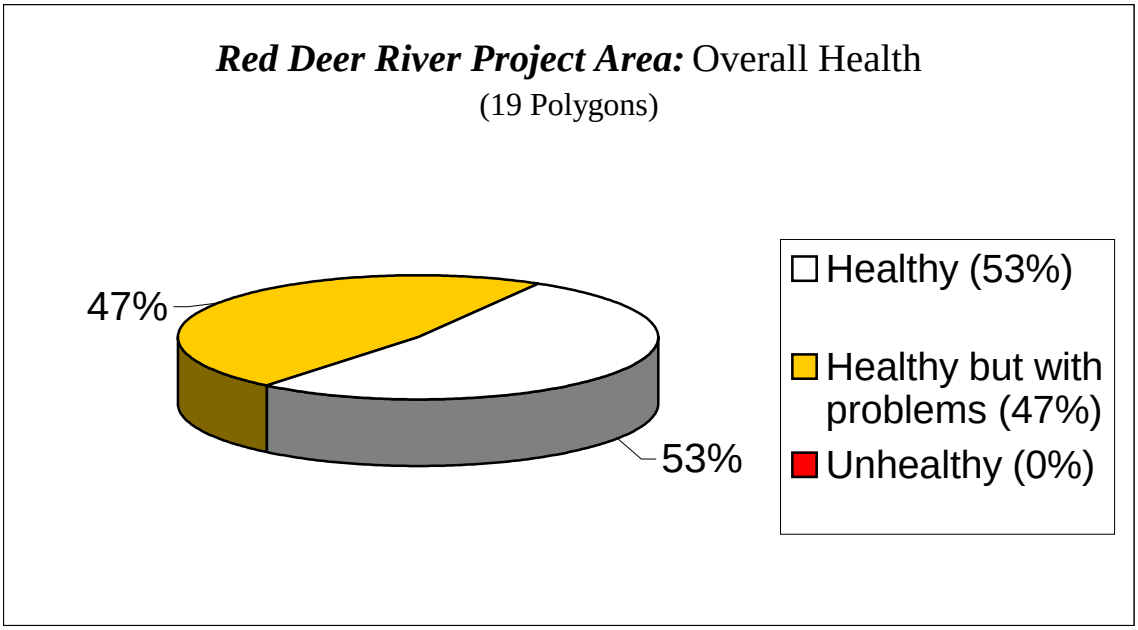


Figure R1. Overall health of the Red Deer River Project Area*.

*Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of the entire Red Deer River watershed, but they do give an overview of health of the riparian areas within this river.

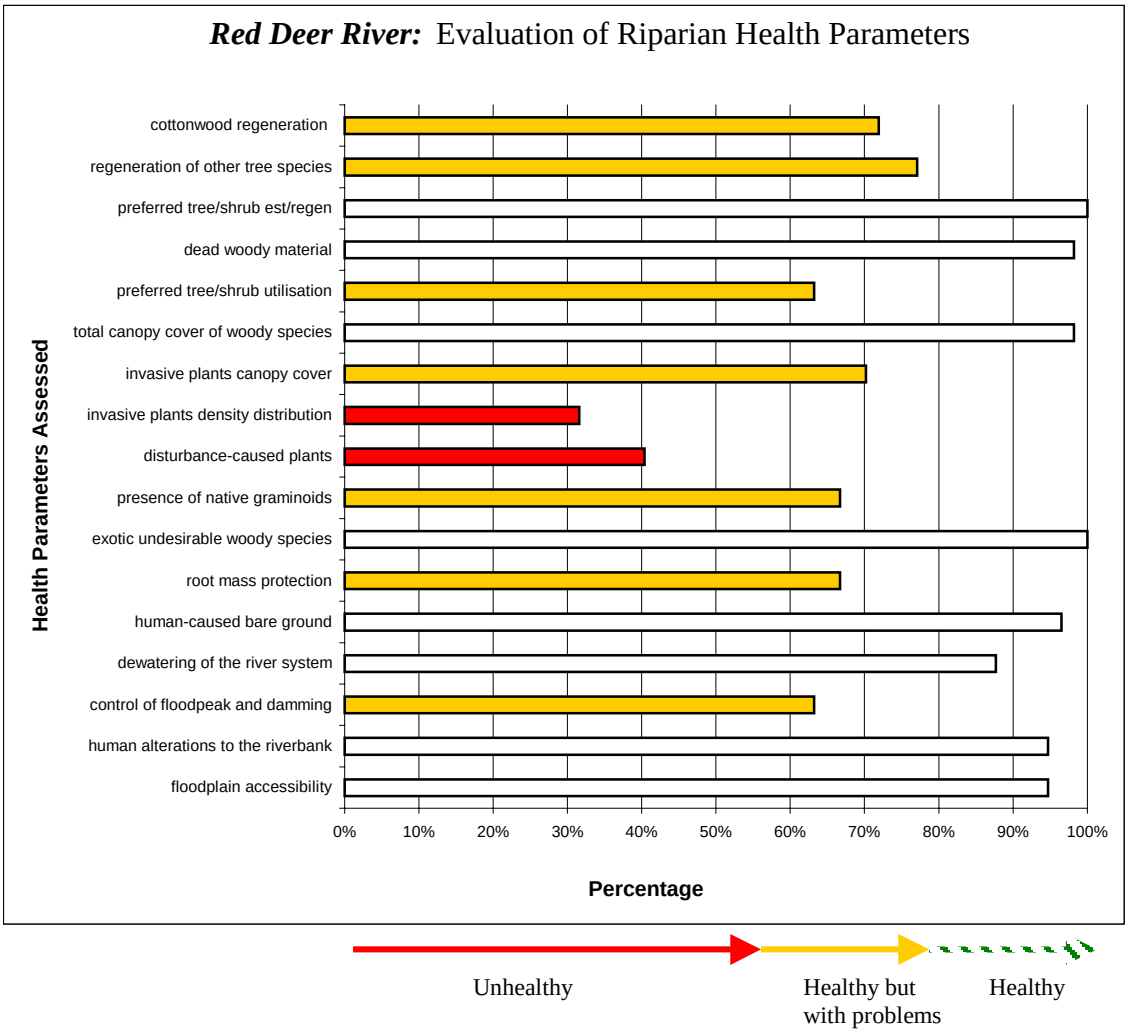
Remember: *We encourage users of the report to recognise the value of this report in broad-scale planning and identifying types of management and education approaches to take in the entire watershed--****this is not a finger pointing exercise; it should be used as part of an awareness process that maintains or improves management.***

Table R1. Summary of Riparian Health Work –Red Deer River

Year	River	# Landowners Contacted	# Landowners Participated	# Polygons Assessed	River Distance Assessed (km)
2003	**Red Deer River**	**54**	**19**	**19**	**31.3**

RIPARIAN HEALTH DISCUSSION

For a description of how the parameters of riparian health are impacted by human disturbances and the overall effect on riparian health refer to *A Closer Look At The Riparian Health Pieces* in the overall summary of the South Saskatchewan River Basin.



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure R2. Breakdown of riparian health results for 17 parameters assessed for the Red Deer River project area

For an overview of the limitations of riparian health assessments refer to the section titled *Data Limitations* in the overall South Saskatchewan River Basin Summary.

Historic and Present Influences on Riparian Health

The following discussion provides some insights regarding the current status of the health of riparian areas within the project area, based on existing and historic influences.

- **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 (Alberta ECA 1977). Currently, livestock grazing continues to be the dominant land use potentially influencing riparian health along the Red Deer River (Table R2, Appendix R10). While grazing is the dominant land use, riparian health in the sites assessed suggests that overall, riparian health has been maintained.

- **Cropland cultivation**, tame pasture and forages (including hay), have contributed to an increased presence of disturbance-caused undesirable plants within these riparian areas.

- **Availability of water.** Water diversion**,** for irrigation and other uses, as well as consumption, are affecting the overall health evaluation of the Red Deer River to a small degree at the present time. In downstream reaches, there may be long-term implications of reduced water volumes and/or changes to flood or high water events to maintaining riparian vegetation, including ensuring flood events provide sufficient recharge of local moisture and create opportunities to establish new trees. Demand for water at least as far back as the early 1970's was considered to be putting the river under stress (Alberta ECA 1974).

- **Damming of the watershed** is occurring in some reaches, with the proportion highest in reaches immediately downstream of the Dickson Dam. At the time of riparian health assessment, there were no signs of impacts on tree and shrub regeneration in upper reaches. Lower reaches have mostly poor or moderate regeneration of cottonwoods, which may be reflecting the changes in timing of flow and flood peaks. Although dewatering and control of peak flows/timing may not rate very low in all cases, there is a consistent trend for tree regeneration and establishment to rate poorly in these lower reaches. Additional examination of the thresholds for these parameters may indicate that hydrologic parameters in the riparian health assessment are currently insufficiently sensitive.

- **Timber harvest** occurs in some upper portions of the watershed (Alberta ECA 1977). There has been an accelerated delivery of water resulting from reduction in forest cover in upper areas of the watershed. Depending on the extent and intensity of timber harvest, there way be an impact on the quantity and quality of water reaching the river, as well as levels of sediment and increased potential for introduction and invasion of disturbance or invasive species, due to bare soil and increased risk of seed transmission.

- **Development and industrial activity** including ursban/domestic development, residential wastewater discharge, oil and gas exploration/development, roads and pipeline crossings are occurring along the Red Deer River.

All of these activities are occurring along the Red Deer River, but due to a limit in sample size and a focus on riparian health (as opposed to water quality, for example) only some of these activities were identified in the polygons assessed.
Activities and land uses identified as currently influencing riparian health include recreation, oil and gas exploration/development, roads, and other right-of-ways. These impacts were not extensive; impacts on riparian health was primarily through structural alterations to the riverbanks, increases in invasive or disturbance species and small amounts of human-caused bare ground. Incremental effects of this activity have coincided with cattle grazing for the past century, influencing current riparian health; there may also be effects on water quality and movement or delivery of water within the Red Deer River watershed.

- **Overall watershed changes** such as land cover types have increased the rate (and likely volume) at which water is delivered from the land, including a potential for more rapid rise in flood waters, with loss of wetlands, including muskeg (bogs or fens).

Table R2. Land uses along the Red Deer River Project Area

AENV Reaches for Red Deer River	**Land uses (% of reach based on length)**			
	Grazing	***Cropping***	***Developed***	***Undeveloped***
RD-01	98	2	0	0
RD-02	90	10	0	2
RD-03	68	8	15	9
RD-04	82	9	9	1
RD-05	79	19	1	0
RD-06/07	39	23	22	3
RD-08	78	0	15	7
RD-09	96	1	3	0
Total	78	9	8	3

Refer to methods in overall SSBR basin overview for a description of land use determination.

Refer to the section titled *Riparian Plant Communities-Why are they important?* for an overview of why understanding the riparian plant communities are important.

Riparian Plant Communities

Within the Red Deer River project area:

- All polygons examined supported both trees and shrubs, and all had preferred trees and shrubs.
- 18 different plant communities were identified.
- Shrub species cover 63% of the project area and trees occupy 34% of the project area (overlap may exist due to different heights of individual plants).
- 25% of the shrub canopy cover is comprised of three grazing-resistant shrubs (snowberry/buckbrush, *(Symphoricarpos occidentalis)*, common wild rose *(Rosa woodsii)* and prickly rose *(Rosa acicularis).*

- The other 75% of the shrub cover is comprised of *preferred*[1] shrub species (including 3 willow communities). 5 shrub community types were identified in the project area.
- A total of 8 tree community and habitat types were found, 6 of which were poplar or cottonwood (*Populus*) community types
- 4 different graminoid community and habitat types (all 4 native communities) were identified, occupying only 1.2% of the project area; however, graminoids cover 80.6% of the project area, providing extensive cover within the tree and shrub community and habitat types.
- A list of all plant species found in the project area is available in AppendixR3. Additional plant community and habitat type information can be found in Appendix R7. Refer to Appendix R4 for a complete listing of plant species observed within each polygon.

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

There is excellent vegetative cover provided by trees and shrubs. Preferred woody species such as willows (*Salix* spp.), red-osier dogwood (*Cornus stolonifera*) and saskatoon (*Amelanchier alnifolia*), are excellent for stabilizing and protecting the riverbank from erosion due to their deep binding roots.

The presence of many different tree and shrub species is often a good indicator of structure and diversity. A diversity of plants provides habitat layers benefiting wildlife and livestock.

Presence

- 7 tree species and 42 shrub species were identified and recorded within the Red Deer River project area. Included in the total number of shrub species is common caragana (*Caragana arborescens*), an introduced shrub species.
- Other shrubs that were common and abundant, in addition to those mentioned above, are thorny buffaloberry (*Shepherdia argentea*), yellow willow (*Salix lutea*) and sandbar willow (*Salix exigua*).
- Total area covered by all trees and shrubs was excellent overall, with all but 1 polygon receiving the maximum health rating for this parameter.

Reproduction

- Currently there are few concerns with the reproduction of *preferred* trees and shrubs.
- 8 of 19 polygons (42%) along the Red Deer River had at least 15% of cottonwood cover within the polygon provided by seedlings and saplings. The remaining sites (11 of 19) had cottonwood seedlings and saplings providing 5-15% of the cottonwood cover-this is positive.
- 16 of 19 polygons also had tree species other than cottonwoods found in the riparian area. White spruce *(Picea glauca)*, white birch (*Betula papyrifera*), Manitoba maple (*Acer negundo*) and lodgepole pine (*Pinus contorta*) are the non-cottonwood tree species that were found in the project area.

[1] refer to Users Manual for methodology

- On the sites where these species were present, the majority of polygons (11 of 16; 69%) had more than 5% of the canopy cover provided by seedlings and saplings.
- In all polygons (19 of 19) there was excellent regeneration and establishment of preferred shrub species. All polygons had more than 5% of the preferred shrub species cover provided by seedlings and saplings.

Health

- Existing tree and shrub communities show normal amounts of dead and decadent branches in the upper canopy. This suggests that: 1) at present, and in recent years, there is and has been sufficient moisture within the system, and 2) disease is not a significant problem in maintaining these communities.
- There are minor concerns with the overall health of shrubs.
    - Nearly 25% of the shrub canopy cover is comprised of three grazing-resistant, native shrubs (snowberry/buckbrush, common wild rose, and prickly rose).
    - In 26% of polygons (5/19), preferred trees and shrubs species are receiving moderate browse pressure from livestock (and to a lesser degree wildlife). In many locations this browse pressure is removing new growth and preventing seedlings and saplings from reaching a mature age class.

Non-Woody Riparian Plants: Diversity and Health

Diversity

- 61 species of grasses and grass-like plants (graminoids) and 154 species of broad-leaved plants (forbs) were recorded within the Red Deer River project area.
- The presence of native grasses is an important indicator of the level of disturbance occurring within the riparian area.
  The presence of native grasses diminishes with increased disturbances to the soil surface. Nearly half of the polygons (8 of 19) had only 25-50% of the total riparian area covered by native grasses.
- 64% (137 species) of the non-woody riparian plants recorded are native plants. Native plants provide riparian functions including deep, binding root masses and summer and winter forage production for livestock and wildlife.
- 11 poisonous plant species: early yellow locoweed (*Oxytropis sericea*), white camas (*Zigadenus elegans*), common horsetail (E*quisetum arvense*), late yellow locoweed (*Oxytropis monticola*), showy milkweed (*Asclepias speciosa*) tall larkspur (*Delphinium glaucum*), slender arrow-grass (*Triglochin palustris*), red and white baneberry (*Actaea rubra*), showy locoweed (*Oxytropis splendens*), death camas (*Zigadenus venenosus*) and Indian hemp (*Apocynum cannabinum)* were recorded within the project area but their overall presence is not of concern because they were not abundant.

Health

- 32% of the project area is occupied by disturbance-caused plants (grasses and forbs). Of the 36 disturbance-caused plants present, the most prevalent are smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*)[2].
- 63% (12 of 19) of polygons have between 25% and 50% of the riparian area covered in disturbance-caused undesirable herbaceous species. Disturbance-caused plants typically do not have a deep, binding root mass and therefore do not provide streambank protection as well as non-disturbance native species. Refer to Appendix R5 for more information regarding the area covered by disturbance plant species within each of the sites.
- Despite the abundance of disturbance-caused plants, native grasses and forbs continue to be maintained within the project area.
- Invasive plant species are found at all but two sites; those two polygons are located in the uppermost reach. In all other reaches, canopy cover of invasive plants is not extensive, but in virtually all cases, distribution of plants is sporadic or fairly continuous throughout, resulting in a low rating for this parameter.
- The prevalence of invasive plants (e.g. noxious weeds) is a concern. Invasive plants are abundant on 42% of the polygons (8 of 19) and range in occurrence from a few patches to continuous distribution throughout the entire riparian area. Canada thistle (*Cirsium arvense*), perennial sow thistle (*Sonchus arvense*) and common tansy (*Tanacetum vulgare*) are the three most prevalent invasive weeds. Butter and eggs/toadflax (*Linaria vulgaris*), scentless chamomile (*Matricaria perforate*), ox-eye daisy (*Chrysanthemum leucanthemum*) and white cockle (*Silene pratensis*) are present but in lesser amounts.

Physical Characteristics of Riverbank and Floodplain

Human-Caused Bare Ground and Alterations to the Riverbanks

- Overall, 6% of the riverbanks within the project area have structural alterations by human activities.
- Recreational and livestock impacts are the major causes of physical alterations along the Red Deer River. Roads, riprap, fences, power and gas lines are contributing to a lesser extent (Appendix R8).
- Exposed soil surface is not a problem in the majority of polygons. Of the bare ground overall, 60% is naturally occurring (depositional material from recent flood events) and 40% is human-caused. The minimal bare ground that is present is mostly due to recreation and livestock activity. Invasive plants can quickly become established in areas of bare ground.

[2] Kentucky bluegrass, smooth brome and timothy are tame or introduced species that have invaded many rangelands over the past decades. These grasses do not provide the same contributions to riparian health as native grasses because these non-natives have shallower, less dense root systems and minimal above-ground structure during spring melt.

Riverbank Root mass Protection

- The amount of deep binding root mass is variable along the Red Deer River, but generally good, with over two thirds of the sites moderately to very well protected. About one third of polygons (6 of 19) have more than 85% of the bank covered with deep binding root mass (this is excellent), and almost half of the polygons (8 of 19) have 65-85% of the riverbank with deep binding roots—this is positive. The remaining 5 polygons have between 35 and 65% of the bank protected by deep binding root mass.

Hydrologic Characteristics

Dewatering of the River System

- Along the Red Deer River, there are varied incidences of water removal. In more than half of cases (12 of 19), less than 10% of the average river discharge is artificially removed—this suggests that there is limited impact resulting from removal of water at these sites.
- In the remaining 7 polygons, 10-25% of the average river discharge is removed, with this parameter impacting the health assessment of those riparian areas.
- Removing water from a river system can reduce bank stability, wildlife habitat and primary production of the riparian area. .

Control of Flood Peak/Timing by Upstream Dams

- Along the Red Deer River, the Dickson Dam is the major dam impacting riparian health. These impacts will be most felt in polygons that were located immediately downstream of the dam. 4 of 19 polygons have 25-50% of their watershed upstream controlled by the Dickson Dam (Appendix R1). This is a considerable proportion of their watershed that has modifications to flood timing and intensity and is thus considered to be negatively impacting riparian health in those areas.
- Riparian health declines when influenced by man-made dams because the riparian areas depend on the natural flow of the river, especially flood events to recharge ground water reserves, and to rebuild and maintain riverbanks through sediment deposition.

Floodplain Accessibility

- Along the Red Deer River, almost all of the polygons (18 of 19) floodwaters have access to more than 85% percent of the floodplain, which is the minimum amount considered required to maintain riparian functions related to this parameter.
- This barrier prevents high water flows from accessing the floodplain, an important function of all river systems. Energy that is built up in flood events requires the floodplain as a place to disperse that energy, as well as deposit water and materials.
  If access is restricted then all of the energy is concentrated within the channel, leading to increased bank instability and erosion.

Red Deer River Riparian Health Overview: Summary

Riparian health of the polygons and reaches examined tends to decrease with increasing distance downstream; however, it is clear that there is considerable variability between reaches as well as within a reach. Consequently, the observations below are provided as an overview that will assist in general management or monitoring planning. More detailed or specific use of the information should be done at the reach and polygon level, with a clear understanding of site or localised health status.

A number of factors contributed to fewer healthier sites as distance from headwaters increased:

Vegetation:
- Greater abundance and distribution of invasive and disturbance-caused plants
- Cottonwood regeneration from seed decreases (with some exceptions)
- Regeneration of other tree species declines (with some exceptions)

Physical/Hydrological:
- Increasing proportions of natural flow removed, leading to greater dewatering of channel and floodplain
- Increasing control of flood peaks and timing by dams (this factor actually rates lowest in middle reaches, and improves somewhat as distance from the Dickson Dam increases)

There were less clear trends in these riparian health parameters as proximity to headwaters increased:
- Presence of native graminoids
- Preferred tree and shrub utilisation
- Proportion of banks protected with deep-binding roots

Some parameters of riparian health were similar, regardless of location along the river system:
- Cover of woody species (excellent at all but one site)
- Preferred shrub regeneration (excellent at all sites)
- Decadent and dead woody material (normal amounts at all but one site)
- Exotic, undesirable woody species (healthy at all sites)
- Human alterations to the structure of riverbanks (maximum rating at all but two sites)
- Human-caused bare ground (maximum rating at all but two sites)
- Floodplain accessibility (related to presence of an urban centre) (excellent on all but one site)

Limitations of the Data
Refer to Data Limitations in South Saskatchewan River Basin section.

Red Deer River: Opportunities and Options for Improvement

Grazing management has not significantly altered overall riparian health, but some signs of impacts are seen in the plant communities, including moderate levels of browse in about one quarter of sites. This level of browse may not be sustainable in terms of allowing successfully regeneration and maintenance of n tree and shrub communities, but is likely not having significant impact on these processes, since shrub regeneration is excellent throughout the areas examined.

There may be a confounding effect of utilisation on preferred species where dewatering and / or altered flow peak and timing occurs. There is a general trend to reduction in cottonwood regeneration with greater impacts on the hydrologic parameters. There is not a consistent pattern or trend of increasing utilisation linked to reduced tree regeneration, although it may be important at some sites, particularly where hydrologic limitations are also reducing establishment and regeneration. Continued successful reproduction and establishment of the present trees and shrubs will maintain these stands and promote riparian health; allowing this to occur will require appropriate livestock management.

Livestock grazing strategies that focus on keeping preferred tree and shrub utilisation to light, and occasionally moderate, levels, will also benefit establishment of seedlings and saplings, by allowing increased plant growth and vigour. Avoiding use in sensitive periods (i.e. when graminoids and forbs have reduced palatability or are limited in quantity) will promote woody plant growth, while minimising livestock browse.

All polygons examined had the potential for both cottonwood and other trees species, and most were reproducing well or moderately well at 13 of 19 sites. Seedlings and saplings of non-cottonwood trees were absent at 5 sites; cottonwood seedlings or saplings were present to some degree at all sites. Opportunities to maintain and promote or increase regeneration and establishment will involve considering land use management (most often livestock grazing) and hydrologic considerations.

Reduce the presence of invasive plants or aim to prevent further invasion. A combination of weed control measures and grazing strategies that consider distribution, timing and stocking rates will be required to prevent human-caused bare soil and promote plant vigour. Because the abundance of invasive plants can fluctuate greatly from year to year, monitor infestations closely. Continue to keep human-caused bare ground at a minimum. While human impacts to bare soil are minimal at present, the many land uses in the watershed have brought in seed and offer sources for future further invasion, particularly with the aid of water-borne seeds and deposition along the river. Additional information about invasive plants can be found in Appendix R6.

Continue to minimise livestock access to riverbanks and active floodplain during susceptible periods (i.e. moist soil conditions) to prevent additional structural alterations, which are currently minimal. There is good potential for the recovery of the few areas of altered riverbanks. Limiting livestock grazing to light-moderate levels will increase deep-rooted woody plants, which will help trap sediment to rebuild stream banks, and protect against lateral cutting and erosion. Once again, rest is needed during the sensitive portions of the growing season such as early spring to promote recovery. Additional information about the canopy cover provided by trees, shrubs, graminoids and forbs can be found in Appendix R2.

In the upper 5 reaches, less than 10% of the average river discharge is being removed. Water extractions are minimal from this portion of the Red Deer River and current extractions are having no significant impacts on the overall riparian health of this section of the river. In the lower 3 reaches, 10-15% of the flow is withdrawn, resulting in a reduction in riparian health. Regeneration of trees is lower in these reaches, and may be the result of reduced flow, or a combination of browse, reduced flow and alterations to peak flow and timing.

The upper two reaches are not dammed, but the Dickson Dam is controlling flood peak and timing significantly in RD-07 to RD-04. Due to increased distance from the dam, RD-03 to RD-01 are less impacted. Recognising that damming is a potentially harmful impact on riverine ecosystems, consider limiting further damming.

In addition, it is important to identify and quantify upstream minor or unlicensed dams to include these potential modifications.

Dams and berms are not impacting control of flow or floodplain accessibility in most of the river examined; only one polygon within RD-03 has floodplain accessibility considerably reduced by a berm (Town of Drumheller area).

Red Deer River Reach Overview

The reaches along the Red Deer River are summarized starting from the headwaters (RD-09) downstream to where the Red Deer River reaches the Saskatchewan provincial border (RD-01) (Table R3). In most reaches, 2 polygons, totally approximately 3 km of river length are evaluated for the Red Deer River (Table R4). The polygons rate roughly evenly between two riparian health categories—healthy (functioning) and healthy, but with problems (functioning but at risk) (Table R5).

Table R3. Alberta Environment (AENV) Reaches Boundary Descriptions - Red Deer River

Reach	Upstream and Downstream Description
RD-09	Banff National Park Boundary to Upstream of Sundre Gauging Station
RD-08	Sundre Gauging Station to Dickson Dam
RD-07/RD-06	Dickson Dam to Upstream of Blindman River Confluence
RD-05	Blindman River Confluence to Proposed Special Areas Water Supply Project Diversion Site
RD-04	Proposed Special Areas Water Supply Project Diversion Site to Upstream (Western Boundary) of Drumheller
RD-03	Western Boundary of Drumheller to Upstream of Dinosaur Provincial Park (includes Berry Creek)
RD-02	Western Boundary of Dinosaur Provincial Park to Upstream of Bindloss Gauging Station
RD-01	Bindloss Gauging Station to Saskatchewan/Alberta Border

Table R4. Summary of Red Deer River Reaches – Sites

AENV Reaches for Red Deer River	# Sites Assessed	River Distance Assessed (km)
RD-09	4	6.18
RD-08	2	2.43
RD-07/RD-06	2	3.17
RD-05	2	2.14
RD-04	2	3.20
RD-03	3	6.92
RD-02	2	3.70
RD-01	2	3.59
Total	19	31.33

Table R5. Number of Reach Sites by Riparian Health Category – Red Deer River

Reach	Healthy	Healthy but with problems	Unhealthy
RD-09	4	0	0
RD-08	2	0	0
RD-07/RD-06	2	0	0
RD-05	1	1	0
RD-04	0	2	0
RD-03	1	2	0
RD-02	0	2	0
RD-01	0	2	0
Total	10	9	0

Table R6. Reach Land Use - Red Deer River

AENV Reaches for Red Deer River	Land uses (% of reach based on length)			
	Grazing	***Cropping***	***Developed***	***Undeveloped***
RD-01	98	2	0	0
RD-02	90	10	0	2
RD-03	68	8	15	9
RD-04	82	9	9	1
RD-05	79	19	1	0
RD-06/07	39	23	22	3
RD-08	78	0	15	7
RD-09	96	1	3	0

Table R7. Summary of Plant Communities: Overall and Woody Communities – Red Deer River Reaches

Reach	# of Plant Communities	% of Area Examined with:	
		Tree Species	Shrub Species
RD-09	2	64	44
RD-08	4	67	66
RD-07/ RD-06	5	50	60
RD-05	4	21	68
RD-04	3	28	81
RD-03*	7	34	57
RD-02	4	10	80
RD-01	6	5	75

*In addition to graminoid and forb communities at most reaches, these reaches have some areas as unclassified wetland types.

Community and habitat types are determined using Thompson and Hansen (2002). Refer to Appendix R7 for a complete description of habitat and community types.

Table R8. Summary of Plant Communities: Herbaceous Communities – Red Deer River Reaches

Reach	% of Area Examined with:		
	Grass Species	Forb Species	Disturbance Species
RD-09	54	24	24
RD-08	63	26	53
RD-07/ RD-06	70	10	57
RD-05	71	29	48
RD-04	47	25	22
RD-03	77	31	11
RD-02	58	28	14
RD-01	87	25	30

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

Reaches typically have from 2-5 tree species, normally with shrubs ranging from 13-28 species. Reaches at the downstream end have less diverse woody plant communities (Table R8). White spruce is common in upper reaches, with balsam poplar in most reaches throughout river length. Regeneration of trees is moderately good in upper reaches fair or poor regeneration in many areas of lower reaches (Table R10). Dead branches and dead standing trees make up a normal amount of the woody plant canopy and utilisation/browse is generally light in upper reaches, with more sites with moderate or heavy use downstream (Table R11).

Table R9. Woody Plant Species Presence– Red Deer River Reaches

Reach	**# of Tree Species**	**# of Shrub Species**	**% of Polygon Area that is Woody Species**
RD-09	4	24	72
RD-08	3	27	72
RD-07/ RD-06	5	28	70
RD-05	5	20	78
RD-04	2	16	83
RD-03	5	22	71
RD-02	1	14	80
RD-01	1	13	76

Refer to Appendix R4 for a complete list of plant species.

Table R10. Wood y Plant Species Reproduction– Red Deer River Reaches

Reach	Cottonwood Regeneration (seedlings/ saplings)	Other Tree Species Regeneration (seedlings/ saplings)	# of Sites with seedlings /saplings >5% of total woody cover	Means for health…
RD-09	2 sites moderate to good, 2 sites excellent	White spruce excellent	4 (all)	Good regeneration
RD-08	All sites excellent	Conifers excellent	2 (all)	Excellent regeneration
RD-07/ RD-06	All sites excellent	Conifers excellent	2 (all)	Excellent regeneration
RD-05	1 site excellent, 1 site moderate to good	1 site conifers excellent, 1 site very poor	2 (all)	Generally very good for cottonwoods and shrubs, but non-cottonwood trees not reproducing on 1 site
RD-04	1 site moderate to good, 1 site poor	1 site poor, 1 site not applicable	2 (all)	Variable; 1 site poor for all trees, the other moderate for cottonwoods. Shrubs reproducing well
RD-03	2 sites poor, 1 site moderate to good	2 sites excellent, 1 site poor	3 (all)	Variable by site and woody type, with poor to moderate and excellent
RD-02	1 site moderate to good, 1 site poor	Not applicable; None observed	2 (all)	Variable for cottonwoods; excellent for shrubs
RD-01	1 site excellent, 1 site poor	1 site moderate to good, 1 site very poor	2 (all)	Variable, with 1 site moderate to excellent all types, 1 site poor to very poor for trees

Refer to Appendix R1 for a summary of river health survey scores.

Table R11. Woody Plant Health– Red Deer River Reaches

Reach	Dead and Decadence	Utilisation of Preferred Woody Plants	Means for health…
RD-09	Normal	Light	Excellent
RD-08	Normal	None - Light	Excellent
RD-07/ RD-06	Normal	None - Light	Excellent
RD-05	Normal	Light	Excellent
RD-04	Normal	Light - Moderate	Good
RD-03	Normal	Light, Moderate	Fair to Good
RD-02	Normal	Moderate	Fair
RD-01	Normal, Minor	Light - Moderate	Fair to Good

Non-Woody Riparian Plants: Diversity and Health

A wide diversity of herbaceous species were found, with over 20 graminoid species in most reaches and, at most sites, over 50 forb species. Native graminoids were generally prominent in the area. Disturbance species comprise a significant proportion of many reaches and are negatively impacting health (Table R13). Invasive plant species, while not covering significant areas, are sporadic and widespread throughout most reaches, and without appropriate management could infest much larger areas (TableR14). Canada thistle (*Cirsium arvense*) is the most common and widespread invasive plant, with numerous other species commonly found (TableR15#).

Table R12. Non-Woody Riparian Plant Diversity– Red Deer River Reaches

Reach	Total # of Grass/ Grass-like Species	Total # of Forb Species	Proportion of site covered by native graminoids	Means for health…
RD-09	31	67	2 sites >50%; 2 sites 25%-50%	Good to Excellent
RD-08	26	62	both sites <25%	Good
RD-07/ RD-06	24	51	1 site 25%-50%; 1 site <25%	Fair to good
RD-05	17	64	1 site >50%; 1 site 25%-50%	Fair to good
RD-04	22	58	both sites <50%	Good
RD-03	35	68	1 site >50%; 1 site <5%	Poor to Excellent
RD-02	28	43	1 site >50%; 1 site 25%-50%	Good to Excellent
RD-01	28	55	2 sites 25%-50%	Good

Table R13. Non-Woody Riparian Plant Health - Proportion Disturbance Caused Undesirable Herbaceous Species– Red Deer River Reaches

Reach	% of Reach with Disturbance Plants	Disturbance Plants Cover	Means for health…
RD-09	24	all sites 25-50%	widespread disturbance species; of concern
RD-08	53	1 site >50%; 1 site 5%-25%	variable from moderate to extensive; of concern
RD-07/ RD-06	57	1 site 25-50%; 1 site 5%-25%	variable from limited to widespread; some concern
RD-05	46%	1 site 25-50%; 1 site >50%	variable from widespread to extensive; of concern
RD-04	22	1 site 25-50%; 1 site 5%-25%	variable from moderate to widespread; some concern
RD-03	11	1 site each: <5%; 25-50%; >50%	variable from very limited to extensive; of concern on some sites
RD-02	24	1 site 25-50%; 1 site 5%-25%	variable from limited to widespread; some concern
RD-01	30	both sites 25-50%	widespread; of concern

Table R14. Non-Woody Riparian Plant Health - Proportion Invasive Plant Species– Red Deer River Reaches

Reach	# of Sites with Invasive Plants	Invasive Plants Cover	Density/ Distribution of Invasive Plants	Means for health…
RD-09	2 of 4	2 sites none; 2 very low cover	single occurrences to a single patch	Distribution is a concern
RD-08	2	both sites very low cover	throughout entire area	Distribution is a concern
RD-07/ RD-06	2	both sites very low cover	throughout entire area	Distribution is a concern
RD-05	2	both sites very low cover	sporadic	Cover is good, but potential for greater distribution with sporadic individuals
RD-04	2	both sites very low cover	throughout entire area	Distribution is a concern
RD-03	3	all sites very low cover	patches with sporadic individuals	Distribution is a concern
RD-02	2	both sites very low cover	single occurrences to a single patch	Distribution is a concern
RD-01	2	both sites very low cover	throughout entire area	Distribution is a concern

Table R15. Most Common Invasive Herbaceous Plant Species– Red Deer River Reaches

Reach	Species
RD-09	Canada thistle, perennial sow thistle
RD-08	Canada thistle, oxeye daisy
RD-07/ RD-06	Canada thistle, perennial sow thistle
RD-05	Canada thistle, common tansy, perennial sow thistle
RD-04	Canada thistle, perennial sow thistle
RD-03	Canada thistle, common tansy, perennial sow thistle, yellow toadflax
RD-02	Canada thistle, perennial sow thistle
RD-01	Canada thistle, perennial sow thistle

Physical Characteristics of Riverbank and Floodplain

Human-caused bare ground is minimal at most sites (Table R16). Where it does exist, it results from recreation, grazing, and roads/trails (Appendix R9). Human activities have altered riverbank structure overall to small degree, although a few individual sites have moderate alterations (Table R17). A combination of recreation, development (including roads, bridges, power lines, railroads and urban development), livestock activities, and riprap are the sources of these bank alterations. Riverbank root mass protection, as assessed by the length of bank with deep-binding roots, is generally moderate, with some areas poorly protected (Table R18). Appendix R14 also outlines the bank materials within each of the sites inventoried along the Red Deer River.

Human-Caused Bare Ground and Alterations to the Riverbanks

Table R16. Human-caused Bare Ground– Red Deer River Reaches

Reach	# of Sites with >5% Human Caused Bare Ground	Proportion of polygons covered by human-caused bare ground	Sites are…
RD-09	1 of 4	3 sites <5%; 1 site 5-25%	Mostly well vegetated
RD-08	0	both sites <5%	Well vegetated
RD-07/ RD-06	0	both sites <5%	Well vegetated
RD-05	0	both sites <5%	Well vegetated
RD-04	1 of 2	1 site <5%; 1 site 5-25%	Fairly well vegetated
RD-03	0	all sites <5%	Well vegetated
RD-02	0	both sites <5%	Well vegetated
RD-01	0	both sites <5%	Well vegetated

Table R17. Human-Caused Structural Alterations– Red Deer River Reaches

Reach	# of Sites with Human Caused Structural Alterations	# of Sites with Human-Caused Structural Alterations Along:				Banks are…
		< 10% of length	10-25% of length	25-50% of length	> 50% of length	
RD-09	3	3	0	0	0	Intact
RD-08	1	2	0	0	0	Intact
RD-07/ RD-06	2	1	1	0	0	Mostly Intact
RD-05	1	1	0	0	0	Intact
RD-04	1	2	0	0	0	Intact
RD-03	3	1	1	1	0	Variable: intact to significantly altered
RD-02	3	3	0	0	0	Intact
RD-01	2	2	0	0	0	Intact

Riverbank Root Mass Protection

Table R18. Proportion of Riverbank with Deep Binding Roots—Red Deer River Reaches

Reach	# of Sites with Riverbank Rootmass Protection along:				Banks are…
	> 85% of length	65-85% of length	35-65% of length	< 35% of length	
RD-09	2	2	0	0	Variable; half well protected; half moderately well protected
RD-08	0	2	0	0	Moderately protected
RD-07/ RD-06	1	1	0	0	Evenly split between well protected and moderately protected
RD-05	1	1	0	0	Evenly split between well protected and moderately protected
RD-04	0	1	0	1	Variable; from moderately protected to extremely unprotected
RD-03	2	1	0	0	Mostly protected
RD-02	0	0	2	0	Poorly protected
RD-01	0	0	2	0	Poorly protected

Hydrologic Characteristics

Dewatering is very minor in the upper reaches, with minor withdrawals in the remainder of the reaches (Table R19). Floodplain access of floodwaters is excellent and unrestricted at all but 1 (urban) site (Table R21). The proportion of damming and modifications to peak flows and timing is not impacting riparian health in the upper 2 reaches, but is extensive just below the Dickson Dam, and as distance from the dam increase, the proportion of the watershed dammed is lessened (Table R20).

Dewatering of the River System

Table R19. Dewatering of the River—Red Deer River Reaches

Reach	**Total use as a % of natural ***	**# of Sites with River Discharge Being Removed that is:**				**Impacts are…**
		< 10% of average	10-25% of average	25-50% of average	> 50% of average	
RD-09	0	4	0	0	0	Very Minor
RD-08	0.1	2	0	0	0	Very Minor
RD-07/06	0.3/3.2	2	0	0	0	Very Minor
RD-05	8.2	2	0	0	0	Minor
RD-04	8.2	2	0	0	0	Minor
RD-03	10.9	2	0	0	0	Minor
RD-02	14.3	0	3	0	0	Moderate
RD-01	14.9	0	2	0	0	Moderate

*Data provided by AENV. Note that only licensed and reported uses are included; unlicensed use is unknown.

Control of Flood Peak/Timing by Upstream Dams

Table R20. Flood Peak and Timing Control by Dams—Red Deer River Reaches

Reach	**# of Sites with Control By Dams Upstream Affecting:**				**Number of Dams**
	<10% of watershed	10-25% of watershed	25-50% of watershed	> 50% of watershed	
RD-09	4	0	0	0	0
RD-08	2	0	0	0	0
RD-07/ RD-06	0	0	0	2	1 (Dickson Dam)
RD-05	0	0	2	0	1 (Dickson Dam)
RD-04	0	0	2	0	1 (Dickson Dam)
RD-03	0	3	0	0	1 (Dickson Dam)
RD-02	0	2	0	0	1 (Dickson Dam)
RD-01	0	2	0	0	1 (Dickson Dam)

Floodplain Accessibility

Table R21. Floodplain Accessibility—Red Deer River Reaches

Reach	# of Sites with Flood Water Access to:				Major Obstructions to Flooding
	> 85% of floodplain	***65-85% of floodplain***	***35-65% of floodplain***	***< 35% of floodplain***	
RD-09	4	0	0	0	None
RD-08	2	0	0	0	None
RD-07/ RD-06	2	0	0	0	None
RD-05	2	0	0	0	None
RD-04	2	0	0	0	None
RD-03	2	0	0	1	Variable; from none to complete obstruction (within Town of Drumheller)
RD-02	2	0	0	0	None
RD-01	2	0	0	0	None

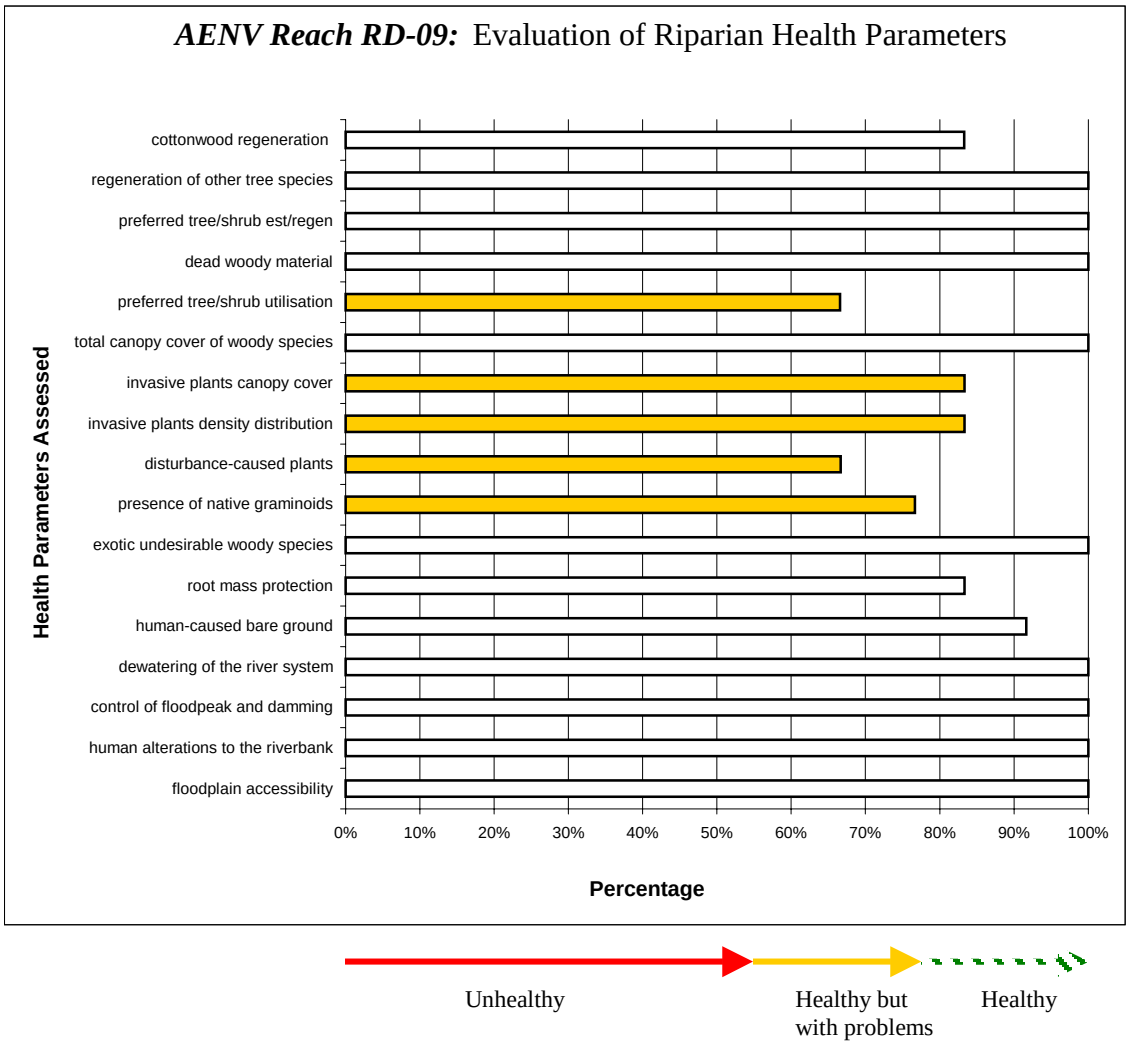
Alberta Environment Reach: Banff National Park Boundary to Upstream of Sundre Gauging Station (RD-09)

- **All of the polygons in this reach scored in the healthy category.** The overall assessment of riparian health for reach RD-09 of the Red Deer River project area is as follows:

  - Of the 4 polygons assessed: 100% (4/4) are *healthy*,
    0% (0/4) are *healthy but with problems*,
    0% (0/4) are *unhealthy*.

  - Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure R3. Breakdown of riparian health results for 17 parameters assessed for the Red Deer River reach RD-09.

Historic and Present Influences on Riparian Health: Reach Comments

Because this reach encompasses a more forested landscape nearer the headwaters, the extent of agricultural use, particularly cropping, is limited.
Grazing is the dominant land use along the Red Deer River reach RD-09 and adjacent lands[3]. There is also some a limited amount of development and recreational activities.

[3] Based on aerial photo interpretation and observations.

Within the watershed it is acknowledged that timber harvesting is also taking place, but this was not identified from aerial photographic interpretation of the river and immediately adjacent lands.

Riparian Plant Communities

- Currently, preferred tree and shrub communities are abundant and are providing significant vegetative cover. Woody plant communities are also diverse, offering multiple species and layers, with good establishment and regeneration of cottonwoods, other trees species and shrubs.
- A positive attribute of the Red Deer River reach RD-09 riparian areas is the moderately low presence of invasive plant communities. Graminoids and forbs are diverse, and primarily native species.
- Disturbance-caused species are present at low to moderate levels.

Physical Characteristics and Hydrologic Parameters

- Human-caused bare ground and structural alterations are generally minimal.
- There are currently no concerns with altered flow or timing and the river readily accesses its floodplain.

Opportunities and Options for Improvement: RD-09

Trees and Shrubs

- Existing tree and shrub communities show normal amounts of dead and decadent branches as well as mostly high levels of regeneration, indicating current land uses (primarily grazing) are not impacting tree and shrub health. In addition, these same factors suggest that there is sufficient moisture within the sites examined, and that disease is not a problem in maintaining these communities.
- Maintain the diversity of trees and shrubs through maintenance and / or improvement of current land uses and management. There is light browse (utilisation) of preferred trees and shrubs. Current health is high for tree and shrub parameters on most sites, so maintaining existing, successful management should be the starting point for management, recognising that whatever management is maintained or implemented, it must also consider the impacts of wildlife.
- Monitor the presence of preferred trees and shrubs versus less desirable shrubs and levels of utilisation to help follow the trend in the preferred woody communities over time.

Non-Woody Species

- Reduce the presence of disturbance-caused plants through sound grazing strategies that target non-native grasses, and prevent additional invasion of invasive weeds or disturbance-caused plants by both grazing management that ensures native plant vigour and avoids creating bare soil.

  Recreational and development management should minimise disturbance to avoid expansion of invasive and disturbance-caused species. These species are having a negative impact on the stability of banks due to their limited bank-holding capacity.
- Address existing invasive species concerns before additional invasion occurs.

Physical Characteristics and Hydrologic Parameters

- Maintain current management practices and monitor future activities to keep physical impacts to a minimum and prevent additional impacts. Livestock, recreational activities, fences and power lines are all contributing to structural alterations in this reach to some extent, so management and land use decisions should incorporate these broad areas. Reducing livestock access to streambanks using distribution tools and careful timing of grazing will allow areas altered by grazing to heal.
- There are currently no concerns with altered flow or timing and the river readily accesses its floodplain. Maintain current flows for future maintenance of riparian plant communities and channel process.

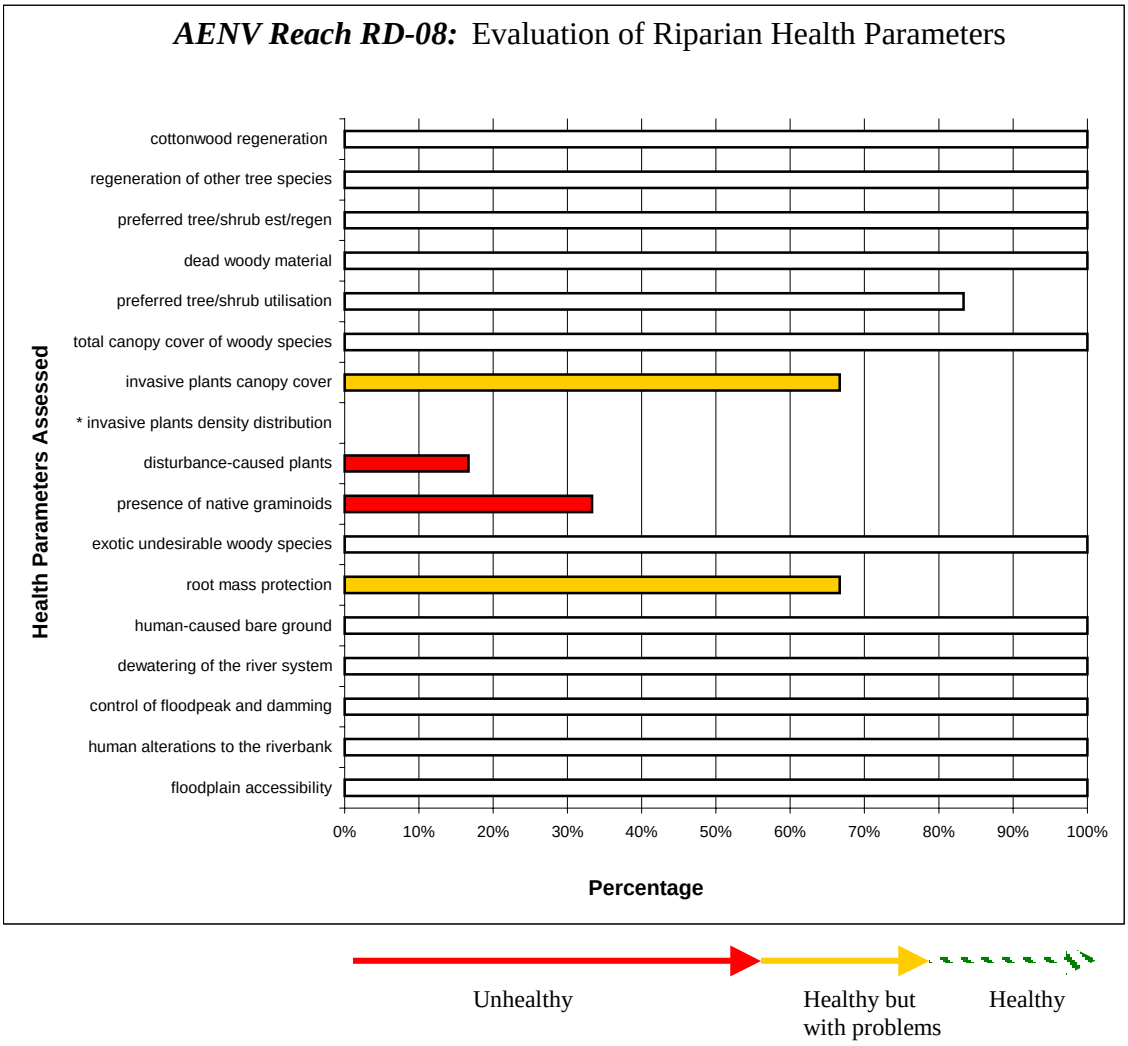
Alberta Environment Reach: Sundre Gauging Station to Dickson Dam (RD-08)

- **The two polygons in this reach scored in the healthy category.** The overall assessment of riparian health for reach RD-08 of Red Deer River project area is as follows:

  - Of the 2 polygons assessed: 100% (2/2) are *healthy*,
    0% (0/2) are *healthy but with problems*,
    0% (0/2) are *unhealthy*.

  - Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure R4. Breakdown of riparian health results for 17 parameters assessed for the Red Deer River reach RD-08.

*Invasive plant density distribution does not register on this graph because this parameter scored 0%.

Historic and Present Influences on Riparian Health: Reach Comments

Grazing is the dominant land use along the Red Deer River reach RD-08 and adjacent lands[4], with developed lands being the second most common. There are also some recreational activities in the area. Refer to Red Deer River Overview for more information on general historic and present potential influences on riparian health.

Riparian Plant Communities

- Tree and shrub communities are abundant, covering nearly three quarters of the assessed area, which, in combination with other vegetation life forms, are ensuring excellent vegetative cover. Silverberry (*Elaeagnus commutata*), river alder (*Alnus tenuifolia)* and several willow species (*Salix* spp.) provide considerable cover. Preferred trees and shrubs are successfully regenerating in this reach, with normal amounts of dead and decadent material.
- Invasive species do not provide extensive cover, but are widely distributed. Disturbance-caused species cover over half of the area examined. These species reduce stream bank stability.

Physical Characteristics and Hydrologic Parameters

- Human-caused bare ground and structural alterations are not significantly impacting riparian health. However, alterations are present in one of the polygons in Red Deer River reach RD-08. In this polygon the major alterations are caused by road construction and riprap.
- Bank stability is being impacted by disturbance-caused species. As well, there are portions of the riverbank where trees and shrubs with deep binding roots are not present and instability is noticeable.
- Road construction is also causing bare ground on one of the polygons. Although the level of bare ground is minor, it is important to understand that disturbance-caused and invasive plant species thrive in these areas of disturbed ground.
- Within this reach, less than 10% of the average river discharge is being removed. Water extractions are minimal from this portion of the Red Deer River and current extractions are having no significant impacts on the overall riparian health of this reach. Dams and berms are not impacting control of flow or floodplain accessibility in this reach.

Opportunities and Options for Improvement: RD-08

Trees and Shrubs

- Tree and shrub communities show normal amounts of dead and decadent branches as well as high levels of regeneration, indicating current land uses (primarily grazing) are not impacting tree and shrub health. Moisture is sufficiently available to maintain these communities.
- Current management is maintaining trees and shrubs diversity, and focus should be on maintaining these management strategies or increasing their effect.
  There is light or nil browse (utilisation) of preferred trees and shrubs, indicating current use by livestock and wildlife combined is well within appropriate levels.

[4] Based on aerial photo interpretation and observations.

Non-Woody Species

- Extensive disturbance-caused plants could be held in check, or reduced, through sound grazing strategies that target non-native grasses, such as early summer grazing and light utilisation. Prevent additional invasion and spread of invasive weeds by both ensuring grazing management maintains native plant vigour and avoids creating bare soil. Weed control methods should be considered.
- In both of the 2 polygons in RD-08, native grasses covered only 5-25% of the riparian area. The overall low presence of native grasses may be indicative of historical disturbances to the soil surface. A reduction or complete elimination of native grasses often occurs when there is a long-term disturbance within the riparian area. However, overall the health of these reaches is high, so ensuring no further loss of native graminoids using grazing strategies that promote these species would be appropriate.

Physical Characteristics and Hydrologic Parameters

- Maintain current management practices and monitor future activities to keep physical impacts to a minimum and prevent additional impacts. Livestock, riprap, and roads are all contributing to structural alterations in this reach to some extent, so management and land use decisions should include these land uses. Continuing to minimise livestock access to streambanks using distribution tools, appropriate timing and stocking rates will allow areas altered by grazing to heal.
- There are currently no concerns with altered flow or timing and the river readily accesses its floodplain. Maintain current flows for future maintenance of riparian plant communities and channel process.

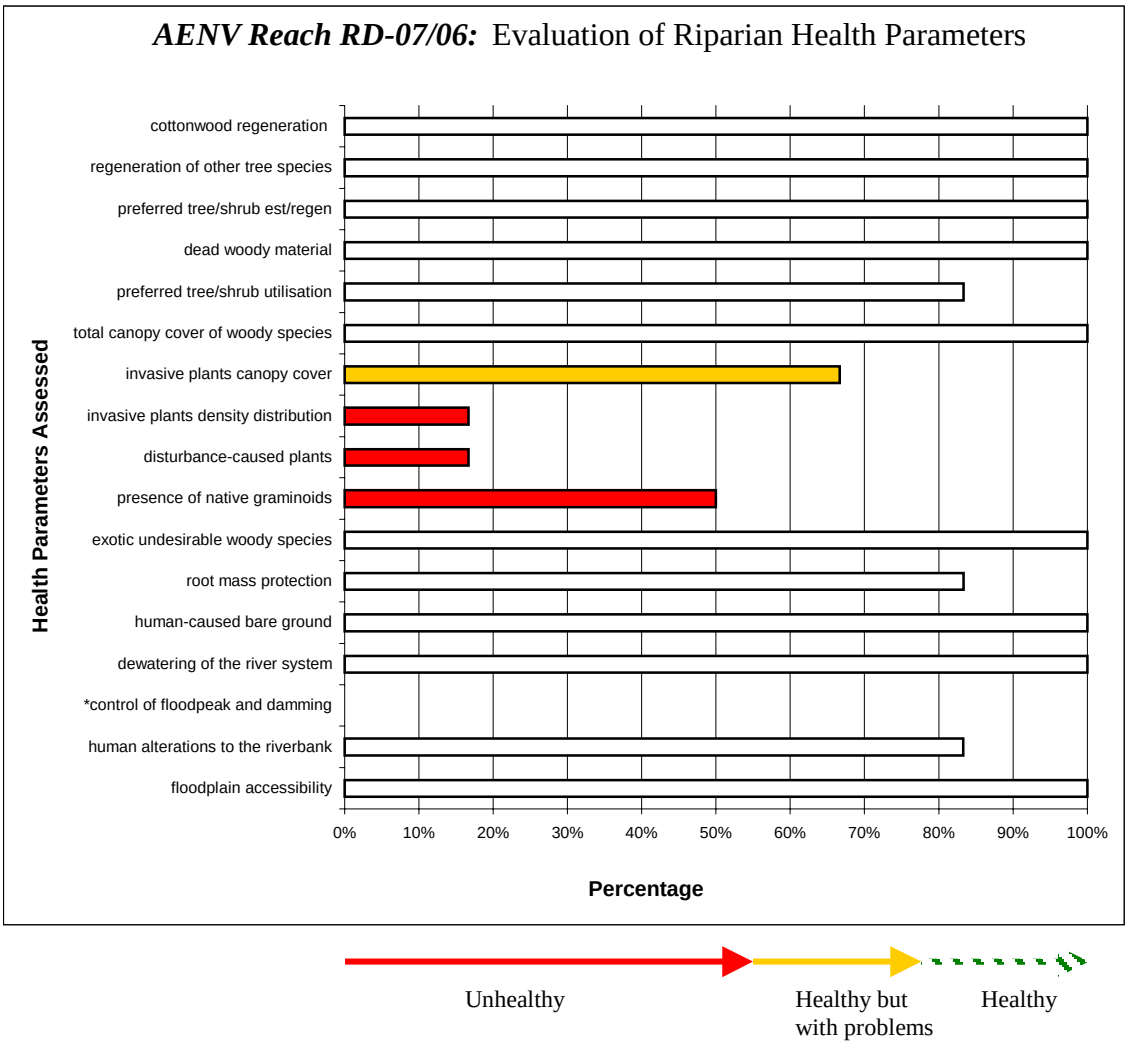
Alberta Environment Reach: Dickson Dam to Upstream of the Blindman River Confluence (RD-07/06)

- **Both of the polygons in this reach scored in the healthy category.** The overall assessment of riparian health for reach RD-07/06 of the Red Deer River project area is as follows:

  - Of the 2 polygons assessed: 100% (2/2) are *healthy*,
    0% (0/2) are *healthy but with problems*,
    0% (0/2) are *unhealthy*.

  - Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure R5. Breakdown of riparian health results for 17 parameters assessed for the Red Deer River reach RD-07/06.
* Control of flood peak and damming does not register on this graph because this parameter scored 0%

Historic and Present Influences on Riparian Health: Reach Comments

Land use in this reach is very mixed, with considerable livestock grazing, cropping, development, and a small amount of undeveloped areas. This reach includes areas that have been settled and farmed for most of a century and thus some additional impacts have occurred compared to the reaches upstream, which are less densely populated and have not been settled as extensively for as long a period.

One site falls within agricultural land, while the other is within the City of Red Deer.

In RD-06, cropping and development each comprise approximately one quarter of the area, with grazing identified as the land use in almost all of the remaining 50%.

Water diversion and consumption are not affecting overall the health evaluation of the Red Deer River within this reach. Damming upstream (Dickson Dam), while significant in terms of proportion of the watershed it affects, is affecting the overall health evaluation of this reach to a minor degree at the present.

Riparian Plant Communities

- 5 different plant communities were identified, with tree and shrub cover abundant, covering over half of the area assessed. 70% of the project area is occupied by tree and shrub communities. As in upstream reaches, regeneration and establishment of trees and shrubs is good to excellent, with light to no utilisation on preferred trees and shrubs. Some ornamental or domestic woody plants were found in this reach.
- Invasive species do not provide extensive cover, but are widely distributed, including within the urban area assessed. Disturbance-caused species cover a over half of the area examined and reduce bank stability to a moderate degree.

Physical Characteristics and Hydrologic Parameters

- Human-caused bare ground and structural alterations are impacting riparian health in a minor way. Bridges, riprap and a berm are the primary impacts to structural alterations in one polygon, with minor impact from livestock in the other polygon.
- Although generally quite good, bank stability is being impacted by disturbance-caused species.
- Within this reach, less than 5% of the average river discharge is being removed. Water extractions are minimal from this portion of the Red Deer River and are having no significant impacts on the overall riparian health rating of this reach. The level of water withdrawal within reach appears to be sustainable for a healthy riparian system.
- Although a berm is present in the City of Red Deer, there was no appreciable impact on floodplain accessibility.
- This reach is downstream of the Dickson Dam, resulting in over 50% of the watershed upstream of these this reach being influenced by the dam, but no signs of impacts on the riparian plant community were seen on the sites assessed.

Opportunities and Options for Improvement: RD-07/06

Trees and Shrubs

- Tree and shrub communities show normal amounts of dead and decadent branches as well as high levels of regeneration; indicating current land uses and hydrologic regime are not impacting tree and shrub health.
- Overall, strive to maintain trees and shrub diversity with current management. Maintain light or no browse (utilisation) of preferred trees and shrubs with current management.

Non-Woody Species

- Considerable invasive plants and extensive disturbance-caused plants could be stabilised, or reduced, through sound grazing strategies (rural settings) or through increased weed control and planting of native species (primarily urban settings).
- Recreational and development impacts (particularly in the lower polygon) contribute to increases in disturbance and invasive species, and a reduction in native graminoids. These land uses may require additional education, planning, or regulatory approaches.
- Displacement of native graminoids is considerable; increasing this cover will require the reduction, primarily, in disturbance-caused species. This will require long-term changes, and complete elimination of disturbance species is unrealistic.

Physical Characteristics and Hydrologic Parameters

- Maintain current management practices and monitor future activities to keep physical impacts to a minimum and prevent additional impacts. Livestock, riprap, bridges and berms are all contributing to structural alterations in this reach to some extent. Focus on minimising additional structural alterations with urban riparian planning, and continuing to keep livestock access to riverbanks low using distribution tools, appropriate timing and stocking rates.
- Maintain current minimal withdrawals for future maintenance of riparian plant communities. Avoid additional damming that may increase the impacts of timing and flood peak controls.

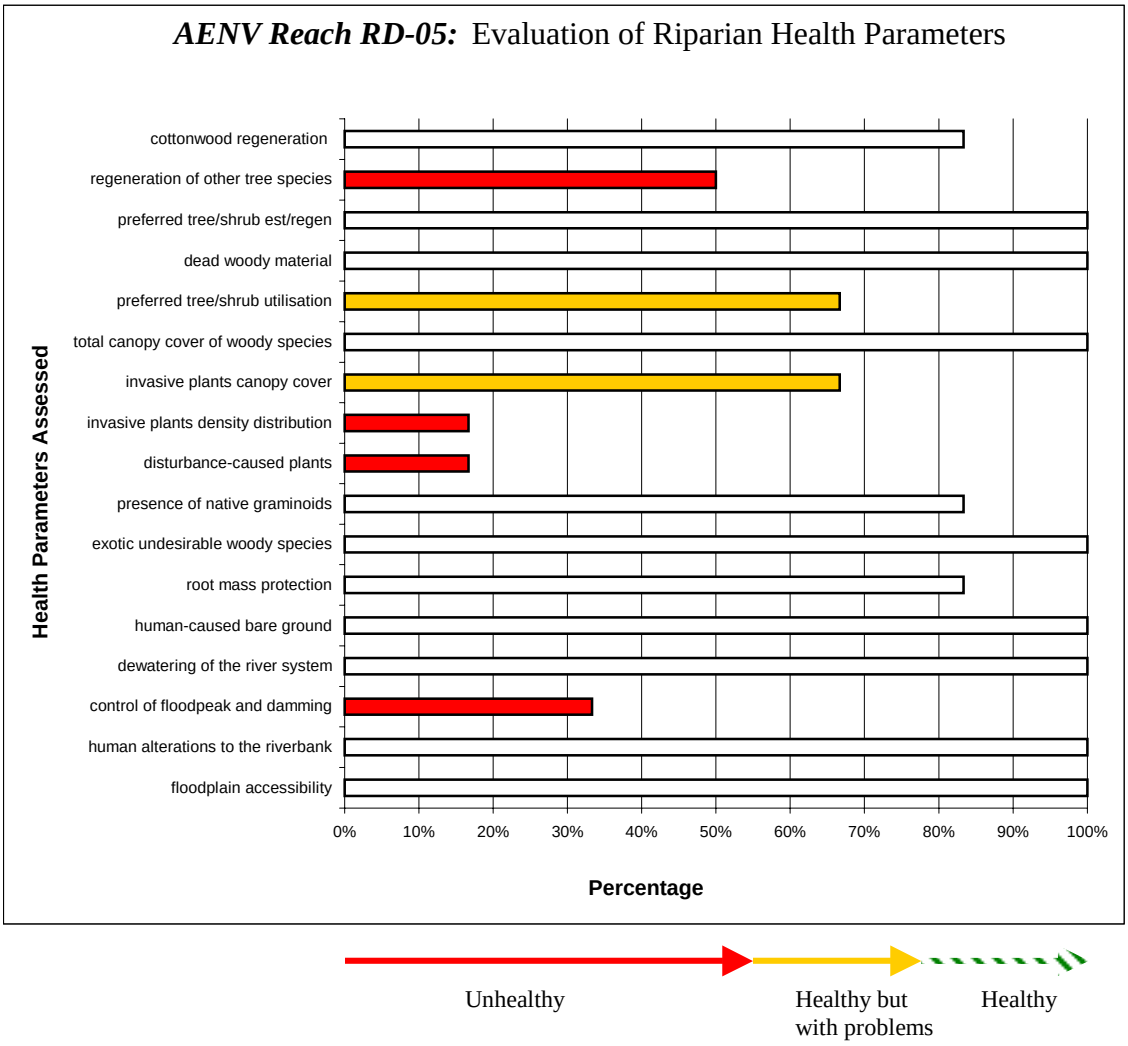
Alberta Environment Reach: Blindman Confluence to Proposed Special Areas Water Supply Project Diversion Site (RD-05)

- **One of the polygons in this reach scored in the healthy category and the other polygon scored in the healthy but with problems category.** The overall assessment of riparian health for reach RD-05 of the Red Deer River project area is as follows:

  - Of the 2 polygons assessed: 50% (1/2) are *healthy*,
    50% (1/2) are *healthy but with problems*,
    0% (0/2) are *unhealthy*.

  - Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure R6. Breakdown of riparian health results for 17 parameters assessed for the Red Deer River reach RD-05.

Historic and Present Influences on Riparian Health: Reach Comments

Livestock grazing is the dominant land use in this reach, with over 75% of the reach under this land use. Cropping is also a significant land use, at just over 20%. Agricultural use of these areas began over a century ago in this region.

Water diversion and use is not significant in this area, and although the distance from the Dickson Dam is greater than upstream reaches, control of flood peak and timing is assessed as impacting riparian health.

Riparian Plant Communities

- 4 different plant community types were identified, with significant cover provided by trees and shrubs. Trees cover 21% of the area inventoried, with 5 species present. 78% of the project area is occupied by tree and shrub communities. As in upstream reaches, regeneration and establishment of cottonwoods and shrubs is good to excellent, but seedlings and saplings of other tree species are absent on one site. Utilisation of preferred trees and shrubs is light. 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.
- As is common with most reaches on this system, invasive species do not provide extensive cover, but are sporadic throughout. Disturbance-caused species cover a large portion of each polygon and reduce bank stability to a moderate degree in one polygon. Native graminoids cover more than 50% of one polygons, but 25-50% of the area on the other polygon.

Physical Characteristics and Hydrologic Parameters

- Human-caused bare ground and structural alterations are impacting riparian health in a minor way. Structural alterations were only seen in one polygon, with clearing for natural gas pipeline causing the alteration.
- Deep binding roots stabilise at least 65% of the polygon length, but could be improved with the presence of fewer disturbance-caused species.
- Within this reach, less than 10% of the average river discharge is being removed. Water extractions are minimal from this portion of the Red Deer River and are having no significant impacts on the overall riparian health rating of this reach, although they may be impacting spruce regeneration (see above).
- This reach is rated as poor regarding proportion of the watershed dammed, with the Dickson Dam controlling 25-50% of the watershed upstream of these polygons. Spruce regeneration may be affected, but cottonwood and shrub regeneration is successful at the present.

Opportunities and Options for Improvement: RD-05

Trees and Shrubs

- Focus on maintaining existing management that has maintained a healthy tree and shrub community, including actively regeneration plants. Regeneration of white spruce (*Picea glauca*) is not occurring on one site; this species is found in the drier portions of the riparian area. The proportion of the watershed dammed, rated as moderately high, may be influencing flood peak and timing, but further research should be done to ensure site management or arid conditions in past years are not hampering regeneration. Although withdrawals are within the amount allowed as acceptable in the riparian health rating (without loss of rating), it is possible the 8% withdrawals could be related to limited regeneration of spruce.

Non-Woody Species

- Focus on reducing or stabilizing amounts of invasive and disturbance-caused plants through grazing strategies that target sensitive periods for these species, while increasing the vigour of native species, recognising that elimination of disturbance species is unrealistic.

- Monitor invasive species locations and abundance closely and consider weed control.

Physical Characteristics and Hydrologic Parameters

- Maintain current grazing management practices and monitor future activities to keep physical impacts to a minimum and prevent additional impacts. Focus on continuing to keep livestock access to riverbanks low using distribution tools, appropriate timing and stocking rates.
- Maintain current minimal withdrawals for future maintenance of riparian plant communities. Avoid additional damming that may increase the impacts of timing and flood peak controls. Examine flood peak flow and timing in this area to determine if current damming is impacting spruce regeneration.

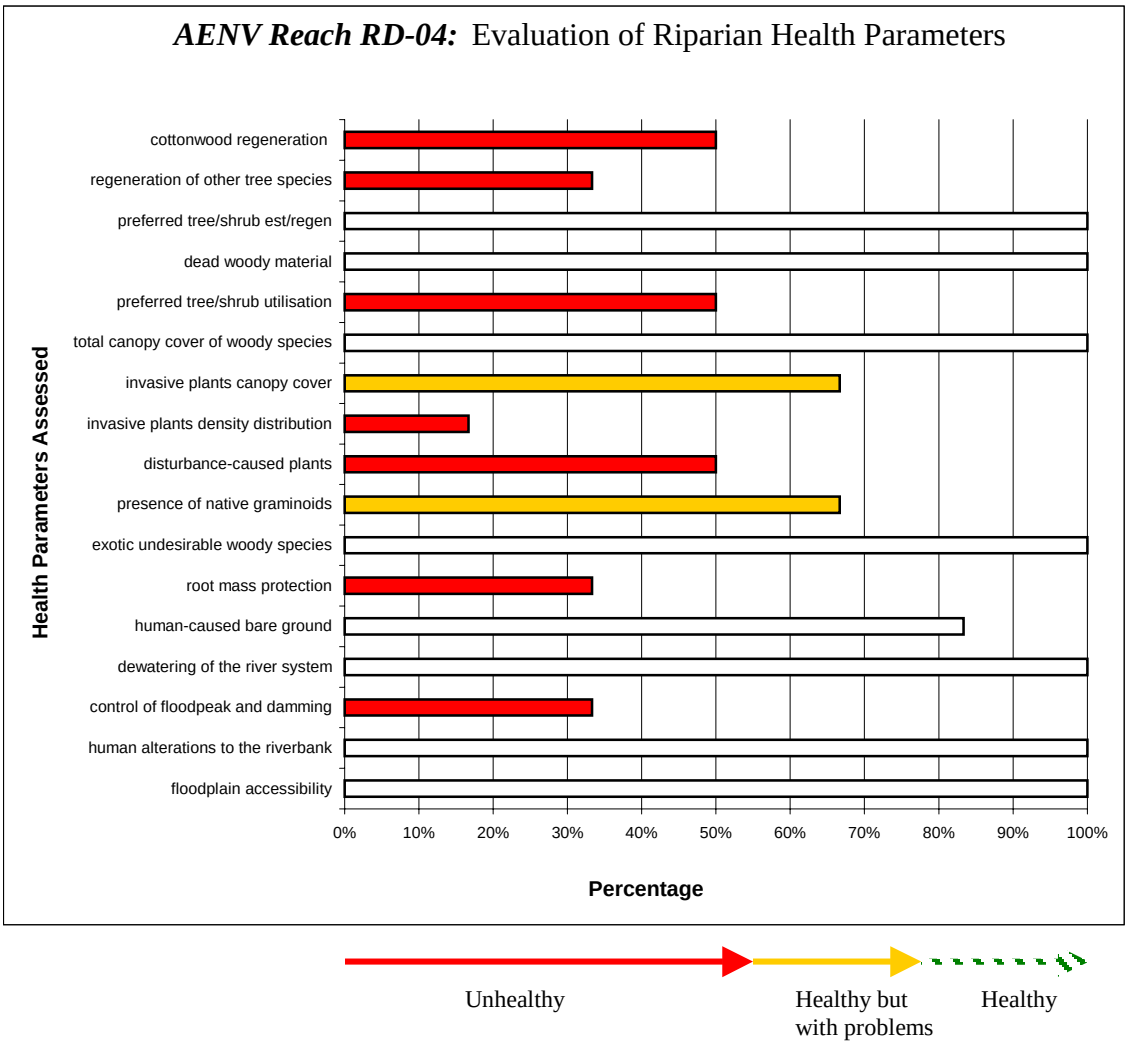
Alberta Environment Reach: Proposed Special Areas Water Supply Project Diversion Site to Upstream (Western Boundary) of Drumheller (RD-04)

- **Both of the polygons in this reach scored in the healthy but with problems category.** The overall assessment of riparian health for reach RD-04 of the Red Deer River project area is as follows:

  - Of the 2 polygons assessed: 0% (0/2) are *healthy*,
    100% (2/2) are *healthy but with problems*,
    0% (0/2) are *unhealthy*.

  - Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure R7. Breakdown of riparian health results for 17 parameters assessed for the Red Deer River reach RD-04.

Historic and Present Influences on Riparian Health: Reach Comments

Land use in this reach is dominated by grazing, with lesser, but similar amounts of cropping and development also present. Diversion of water from this reach is slightly higher than upstream reaches, but the proportion of the watershed dammed upstream is less, with increasing distance from the Dickson Dam.

Riparian Plant Communities

- 3 different plant community types were identified. Shrubs occupy 81% of the area inventoried in RD-04 and trees account for 28% of the inventoried area. In general, tree species, including cottonwoods, do not have as strong a presence in this reach. 2 tree species and 16 shrub species were recorded. Included in the total number of shrub species is common caragana (*Caragana arborescens*), an introduced shrub species.
- Regeneration of trees is fair to minimal and therefore there could be a decline in these species in the future. In contrast, preferred shrub species are present and are successfully regenerating. Light to moderate browse, in combination with limited regeneration of trees could be of concern in terms of maintaining a sustaining woody plant community.
- Invasive species cover a minimal area, but are widely spread throughout. Native grasses covered 25-50% of the area in the inventoried polygons in this reach, which is balanced against modest to considerable cover of disturbance-caused species (from 5-25% at one site, and 25-50% at the second).

Physical Characteristics and Hydrologic Parameters

- Livestock and recreational activities are the main causes of bank alterations and bare ground in this reach, although alterations affect a small portion of the sites. Deep binding roots stabilize less than 65% of the polygon length, linked to abundant disturbance plants.
- Within this reach, less than 10% of the average river discharge is being removed, and it is rated well for this parameter, however regeneration of trees suggest that this factor, perhaps in conjunction with proportion of watershed dammed (between 25 and 50%), which is rated as poor, may be impacting the establishment of seedlings and saplings. There are no obstructions for floodwaters to overcome when trying to spill onto the floodplain; floodwaters have access to over 85% of the floodplain.

Opportunities and Options for Improvement: RD-04

Trees and Shrubs

- Identify and maintain existing management which is allowing excellent shrub regeneration and light grazing, and attempt to reduce moderate browse with altered timing, distribution and additional rest.
- Examine hydrologic regime (flow peak/timing, and withdrawals) to further substantiate potential impacts on cottonwood regeneration, and maintain existing flows as a minimum to ensure current levels of regeneration are not potentially reduced.

Non-Woody Species

- Implement weed control and monitor invasive species locations and abundance.
- Target grazing strategies to reduce or stabilize disturbance-caused plants by including use during sensitive periods for these species, while increasing the vigour of native species, recognising that elimination of disturbance species is unrealistic.

Physical Characteristics and Hydrologic Parameters

- Focus on timing, distribution and stocking rate to minimise bank impacts due to livestock and provide education opportunities for reducing the limited recreational impacts.

- Encourage grazing and forage strategies that attempt to reduce expansion of disturbance species (primarily tame forage species).
- Maintain current withdrawals limits for future maintenance of riparian plant communities. Avoid additional damming that may increase the impacts of timing and flood peak controls. Examine flood peak flow and timing in this area to clarify if current damming is hindering cottonwood regeneration.

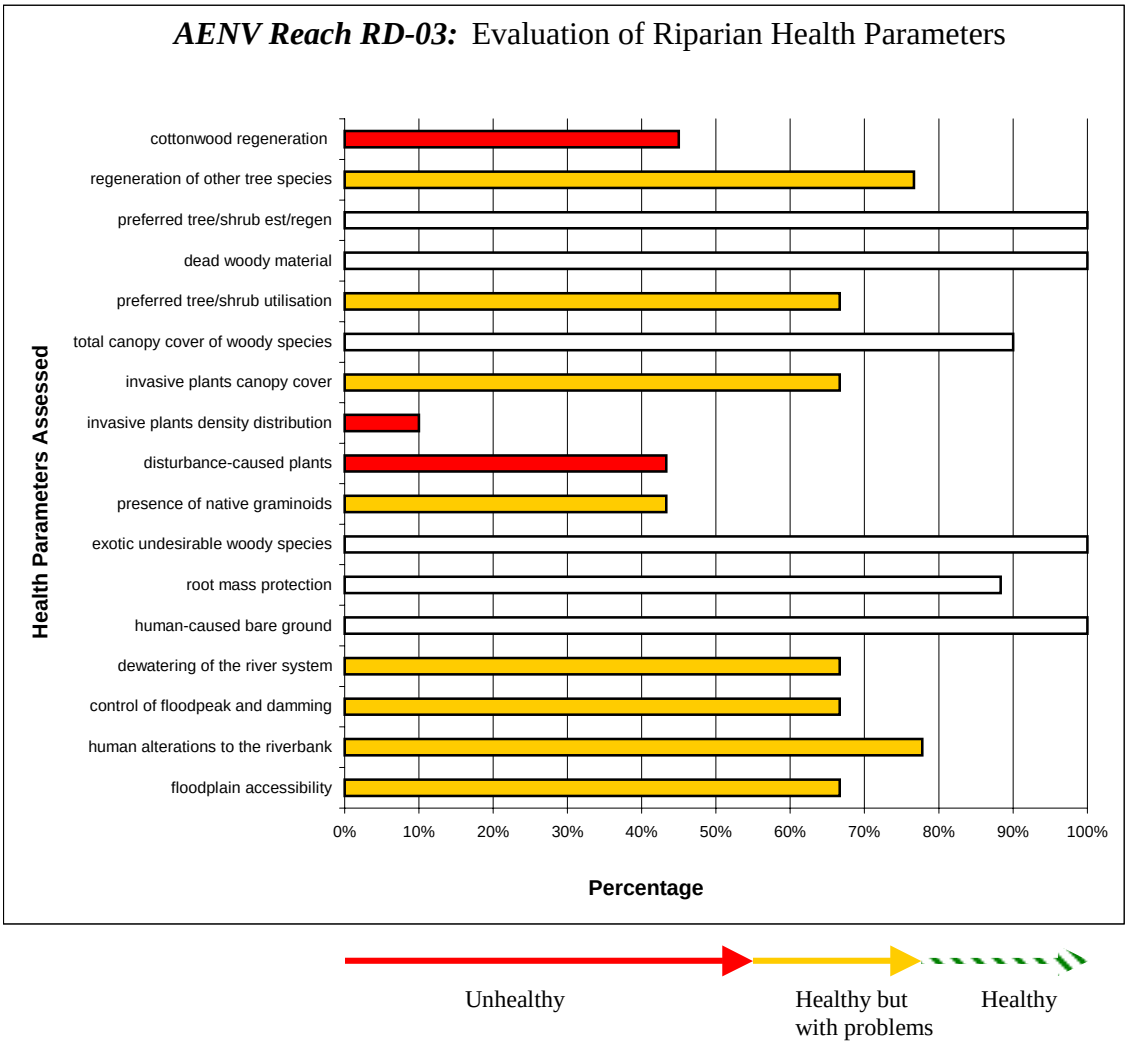
Alberta Environment Reach: Western Boundary of Drumheller to Upstream of Dinosaur Provincial Park (includes Berry Creek) (RD-03)

- **Two of the polygons in this reached scored in the healthy but with problems category and one of the polygons scored in the healthy category.** The overall assessment of riparian health for reach RD-03 of the Red Deer River project area is as follows:

  - Of the 3 polygons assessed: 33% (1/3) are *healthy*,
    67% (2/3) are *healthy but with problems*,
    0% (0/3) are *unhealthy*.

  - Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure R8. Breakdown of riparian health results for 17 parameters assessed for the Red Deer River reach RD-03.

Historic and Present Influences on Riparian Health: Reach Comments

Land use in this reach, while predominantly grazing, is also characterised by smaller areas of similar size of cropping, developed and undeveloped lands.

Diversion of water from this reach is slightly higher than upstream reaches, with just under 11% withdrawn. The proportion of watershed dammed upstream is impacting the riparian health rating to a small extent.

Riparian Plant Communities

- 7 different plant community types were identified. Shrubs occupy 57% of the area inventoried in RD-03 and trees account for 34% of the inventoried area. 5 tree species and 22 shrub species were recorded. Included in the total number of shrub species is common caragana (*Caragana arborescens*), an introduced shrub species.
- Cottonwood regeneration is poor, but other trees are regenerating poorly (1 site) to well (2 sites). Preferred shrub species are successfully regenerating. Browse ranges from nil to moderate browse. Browse pressure is not consistently correlated to successful tree regeneration, which suggests other reasons may be limiting seedlings and saplings.
- As at most sites, invasive species cover a minimal area, but are widely spread throughout. Native grasses cover is variable (5-50%). Overall, 11% of the inventoried area is covered by disturbance species—this is better than most reaches, but the range is from less than 5% to over 50% of an individual polygon.

Physical Characteristics and Hydrologic Parameters

- Overall human-caused structural alterations are minor, but there is one area where 25-50% of the riverbank has been altered from roads and recreation. Livestock are also responsible for some bank alterations and bare ground in this reach. Recreation is also resulting in bare ground. Deep binding roots are prominent, stabilising over 85% of 2 sites, and over 65% of the third site.
- In this reach, dewatering, water extraction for diversions and other licensed uses, is removing over 10.9% of the average river discharge, resulting in a reduction in this riparian health parameter. Poor to moderate regeneration of trees suggest that this factor (perhaps in conjunction with proportion of watershed dammed-over 10%), may be impacting the establishment of seedlings and saplings.
- As the Red Deer River flows through the polygons within this reach, 1 of 3 polygons have limited access, by the construction of man-made barriers, for floodwaters to access the floodplain. This, in conjunction with dewatering and damming may be resulting in poor cottonwood regeneration.

Opportunities and Options for Improvement: RD-03

Trees and Shrubs

- Identify and maintain existing management which is allowing excellent shrub regeneration and light browse, but improve timing and rest where moderate browse levels are occurring.
- Examine hydrologic regime (flow peak/timing, floodplain accessibility and withdrawals) to further substantiate potential impacts on cottonwood regeneration, and maintain existing flows as a minimum to ensure current levels of regeneration are not further reduced.

Non-Woody Species

- Reduce or minimise forage species in floodplain areas. Implement weed control and monitor invasive species locations and abundance.
- Target grazing and cropping strategies to reduce or stabilize disturbance-caused plants by including use during sensitive periods for these species, while increasing the vigour of native species. Elimination of disturbance species is unrealistic.

Physical Characteristics and Hydrologic Parameters

- Maintain current grazing management practices that are resulting in minimal physical disturbances, and ensure rest and appropriate timing maintain plant communities. Review recreational and road impacts to determine if restoration or management changes could reduce current structural changes. Encourage grazing and forage strategies that attempt to reduce expansion of disturbance species (primarily tame forage species). Bank stability, as measured by the proportion protected by deep-binding roots, is poor, and reduction in disturbance species could be a key area for improvement.
- Consider preventing further reduction in flow volume, flood peak and timing and access to ensure maintenance of riparian plant communities and channel processes.

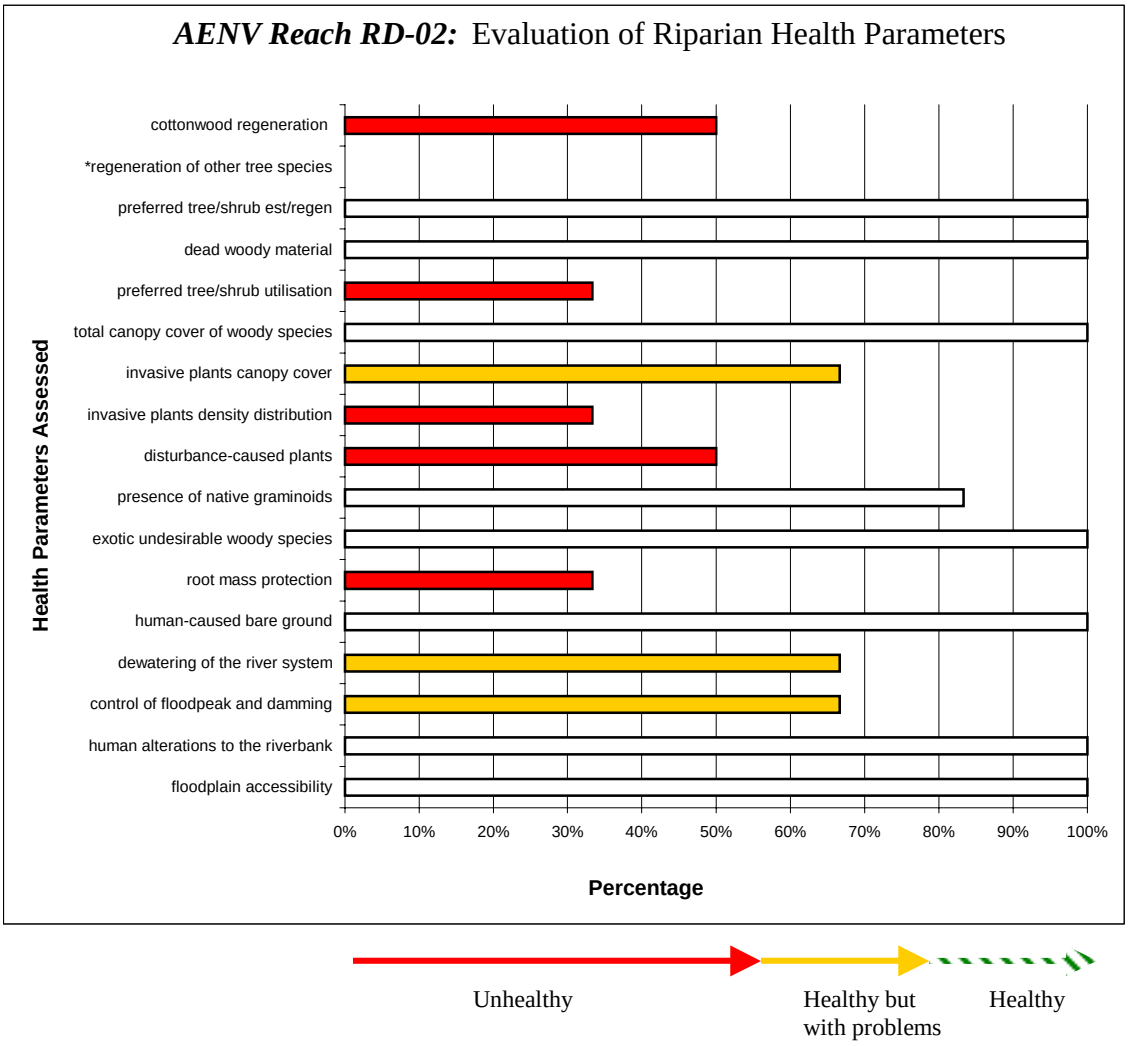
Alberta Environment Reach: Western Boundary of Dinosaur Provincial Park to Upstream of Bindloss Gauging Station (RD-02)

- **Both of the polygons in this reach scored in the healthy but with problems category.** The overall assessment of riparian health for reach RD-02 of the Red Deer River project area is as follows:

  - Of the 2 polygons assessed: 0% (0/2) are *healthy*,
    0% (2/2) are *healthy but with problems*,
    0% (0/2) are *unhealthy*.

  - Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure R9. Breakdown of riparian health results for 17 parameters assessed for the Red Deer River reach RD-02.
**There are no other tree species besides cottonwoods found in the inventoried area, however there is potential for Manitoba maple to exist in this reach, therefore this parameter scored 0%.*

Historic and Present Influences on Riparian Health: Reach Comments

Land use in this reach is heavily dominated grazing, with a small area of cropping.

Withdrawals from this reach are slightly higher than upstream reaches, with just over 14% withdrawn. As in neighbouring reaches, the proportion of watershed dammed upstream is impacting the riparian health rating to a small extent.

Riparian Plant Communities

- This reach contained 4 different plant community types. While 14 species of shrubs occupy a similar amount to adjacent the adjacent RD-03 (80%), a smaller area is covered by trees (10%). Plains cottonwood (*Populus deltoides*) was the only tree species present, although there was potential for non-cottonwood species in this reach.
- Cottonwood regeneration varies from fair to poor, with very good regeneration of shrubs. Browse is rated at moderate at both sites. Regeneration may be influenced by a combination of browse pressure as well as hydrologic limitations. As in all reaches, the proportion of dead and decadent standing trees/shrubs is normal, suggesting utilisation, disease, and hydrology are not leading to increased death of existing plants.
- Invasive plant distribution and disturbance-caused species cover are somewhat less in these polygons than elsewhere, but they are still generally widespread and should be of concern. Native grass cover rates moderate to excellent.

Physical Characteristics and Hydrologic Parameters

- Very minor structural bank alterations exist in this reach, but lack of bank stability, based on deep-binding roots, is poor.
- Over 14% of the average river discharge is being removed from this reach, rating this reach as somewhat impacted from this withdrawal. Regeneration of cottonwoods is fair to moderate and may be influenced by volume or peak timing modifications in this reach. No obstructions were found that would restrict floodwaters from accessing the floodplain.

Opportunities and Options for Improvement: RD-02

Trees and Shrubs

- Increase the rest period from grazing during the growing season. Rest from moderate browse pressure will assist in improving and maintaining regeneration of existing preferred trees and shrub communities and improving future reproduction and establishment. Attention to livestock management options such as distribution, timing, rotation, and stocking rate should enable preferred trees and shrubs to be maintained and increased.
- Acknowledge that existing hydrologic regime (flow peak/timing, and withdrawals) may be influencing establishment and regeneration of cottonwoods and aim to maintain or improve existing flow regime to ensure current levels of regeneration are not reduced.

Non-Woody Species

- Consider implementing weed control to hold invasive plant infestations at current levels (and hopefully reduce them), while monitoring locations and abundance.
- Ensure adequate rest and appropriate grazing strategies to reduce or stabilize disturbance-caused plants within both tame and native pastures. Recognise that elimination of disturbance species is unrealistic.

Physical Characteristics and Hydrologic Parameters

- Because structural alterations and bare ground are not impacting health, focus on improving plant vigour, including increasing the proportion of native species, which will increase deep-binding roots and improve bank stability.
- Rest, appropriate timing, distribution and stocking rate will be required to reduce expansion of disturbance species (primarily tame forage species)
- Prevent further increases in withdrawals and damming for future maintenance of riparian

plant communities. Monitor existing levels of cottonwood regeneration to ensure maintenance of tree communities. Consider investigating why non-cottonwood species are absent, but have the potential to exist in the reach.

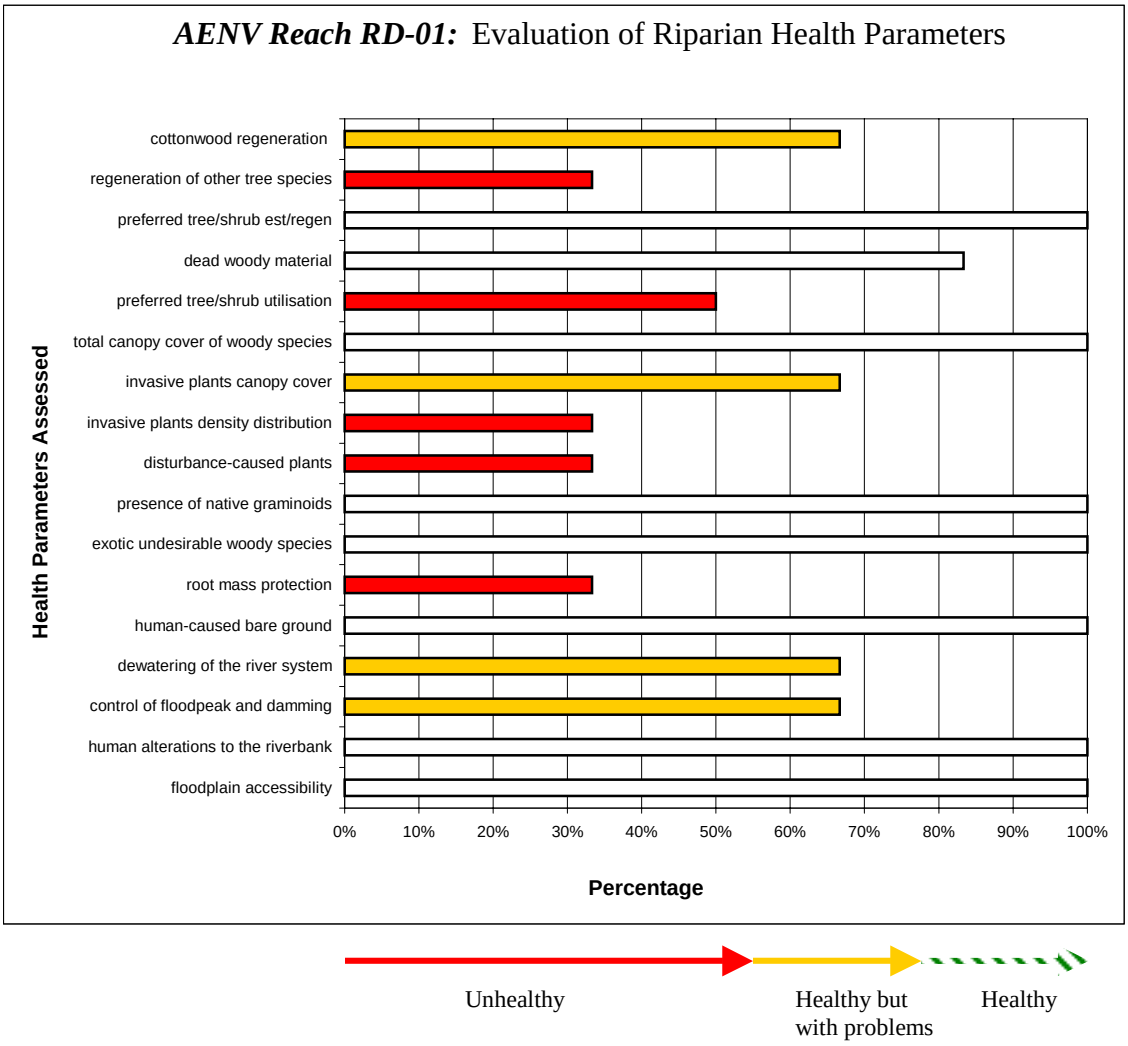
Alberta Environment Reach: Bindloss Gauging Station to Saskatchewan / Alberta Border (RD-01)

- **Both of the polygons in this reach scored in the healthy but with problems category.** The overall assessment of riparian health for reach RD-01 of the Red Deer River project area is as follows:

  - Of the 2 polygons assessed: 0% (0/2) are *healthy*,
    100% (2/2) are *healthy but with problems*,
    0% (0/2) are *unhealthy*.

  - Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure R10. Breakdown of riparian health results for 17 parameters assessed for the Red Deer River reach RD-01.

Historic and Present Influences on Riparian Health: Reach Comments

Land use in this reach is more heavily dominated by grazing than any other reach (98% by length), with only a very small amount of cropping along the reach.

Withdrawals from this reach are slightly higher than upstream reaches, with just under 15% withdrawn. The Dickson Dam is impacting the riparian health rating to a small extent.

Riparian Plant Communities

- 6 different plant community types were identified. 13 species of shrubs occupy 75% of the inventoried area, with only 5% covered by one tree species (plains cottonwood).
- Cottonwood regeneration varies from very good to poor, with very good regeneration of shrubs. Browse is rated at as light to moderate, and the heavier browse may be related to poorer tree regeneration at that site. Regeneration may be influenced by a combination of browse pressure as well as hydrologic limitations. One site within this reach had slightly higher than normal levels of dead and decadent standing trees/shrubs, which is likely not related to the light browse on that site. Hydrologic limitations (eg. insufficient or regularly available water) may be contributing to either reduced establishment or increased death of existing plants.
- As in most reaches, invasive plants are widely distributed. Disturbance-caused species cover from 25-50% of the areas inventoried. Both sites had excellent native grass cover, with over 50% cover.

Physical Characteristics and Hydrologic Parameters

- Structural bank alterations are very minor and are not impacting riparian health. Bank stability, based on deep-binding roots, is poor. Very small amounts of bare ground resulting from human activities are present (livestock and recreational trail).
- Annual withdrawals are nearly 15% of the average river discharge from this reach, resulting in rating this reach as somewhat impacted. Damming, as in the adjacent upstream reach, is affecting riparian health to some degree. Tree regeneration is variable and may be linked both to browse as well as hydrologic parameters in this reach. Although flow and timing/peaks are somewhat modified, floodwaters are not prevented from accessing the floodplain from man-made barriers.

Opportunities and Options for Improvement: RD-01

Trees and Shrubs

- Due to varied levels of cottonwood regeneration and utilisation, grazing management needs vary; maintain and promote existing levels of rest and use in some areas, while increasing rest, distribution, and appropriate stocking rates where utilisation and regeneration are poorer.
- Existing hydrologic regime (flow peak/timing, and withdrawals) may be influencing establishment and regeneration of cottonwoods; aim to maintain or improve existing flow regimes to ensure current levels of regeneration are not reduced.

Non-Woody Species

- Implement weed controls to prevent further spread and reduce infestation of invasive plants.
- Reduce vigour and area of disturbance-caused species using adequate rest and appropriate grazing strategies to reduce vigour in disturbance-caused plants, particularly tame species within native pastures. Recognise that elimination of disturbance species is unrealistic.

Physical Characteristics and Hydrologic Parameters

- As in the previous reach, structural alterations and bare ground are not impacting health, so focus on improving plant vigour, including increasing the proportion of native species, which will increase deep-binding roots and improve bank stability. Rest, appropriate timing, distribution and stocking rate will be required to reduce expansion of disturbance species (primarily tame forage species).
- Prevent further increases in withdrawals and damming for future maintenance of riparian plant communities. Because tree regeneration is variable within this reach, careful monitoring to link appropriate management choices is critical to ensure maintenance of these communities.

BOW RIVER PROJECT AREA

The project area is defined as a selection of riparian areas along the Bow River from the headwaters downstream to the confluence with the Oldman River, the Grand Forks (refer to project area map – Figure 1), a distance of approximately 624 km, of which just over 40 km was sampled at 21 polygons (Table B1, Appendix B11).

Riparian areas in the examined sites were up to 400 m wide, with a wide range in maximum widths (30 m to 300 m). Riparian area width was on average 99 m (Appendix B13). With one exception, the river was not incised (Appendix B12). Diverse vegetation is dominated by native species, although both invasive herbaceous and disturbance-caused plants are widespread, including tame grass species like Kentucky bluegrass (*Poa pratensis*) and introduced forbs, such as white sweet clover (*Melilotus alba*). There were no invasive tree species found in the project area. Balsam poplar/red-osier dogwood community type (CT) (*Populus balsamifera*/*Cornus stolonifera*) covered the largest area of any CT (Appendix B7). Balsam poplar was the most common tree species, found at 95% of sites.

WHAT DID WE FIND?

- **The level of awareness about the project was very low.** A lot of landowners were hesitant about participating in the project. Generally, those landowners who participated showed some interest in determining the health of the riparian area. Thanks to everyone who allowed access to their land and supported this riparian inventory initiative. In all, 21 polygons were assessed along the Bow River in 2003 (Table B1, Appendix G4).

- **There are concerns with the overall health of this riparian area.** The health scores for the polygons assessed along the Bow River varied from unhealthy, healthy but with problems, to healthy. However, the majority of the polygons were rated in the healthy but with problems category. The overall assessment of riparian health for the Bow River project area is as follows (Figure 2, Appendix B1);

  - Of the 21 polygons assessed: 29% (6/21) are *healthy*,
    48% (10/21) are *healthy but with problems*,
    24% (5/21) are *unhealthy*.

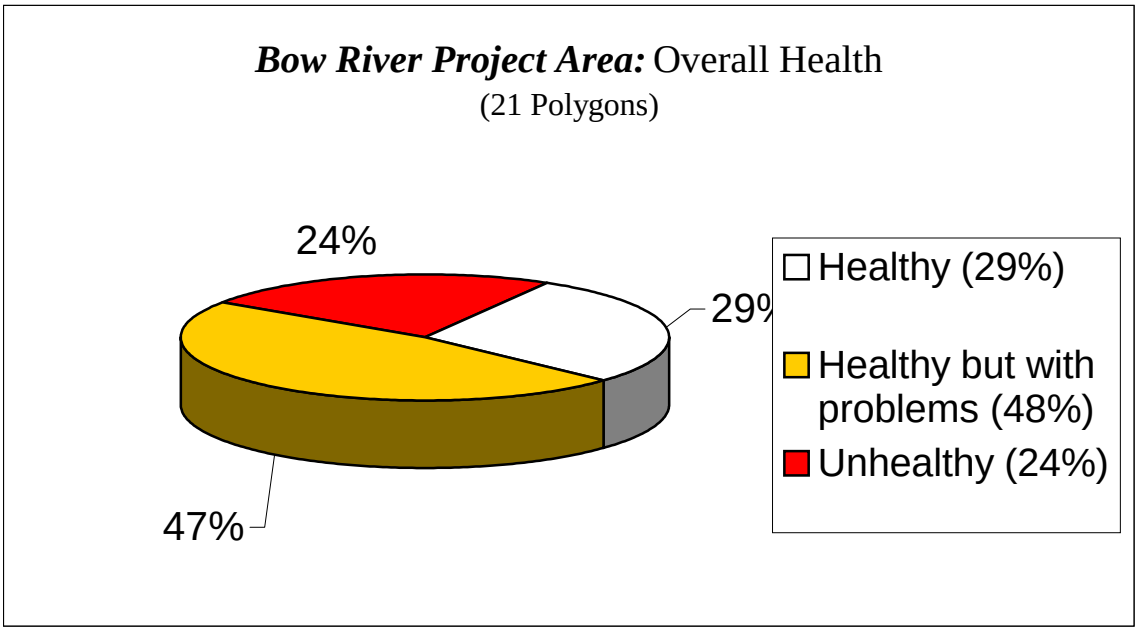


Figure B1. Overall health of the Bow River Project Area.

*Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of the entire Bow River watershed, but they do give an overview of health of the riparian areas within this river.

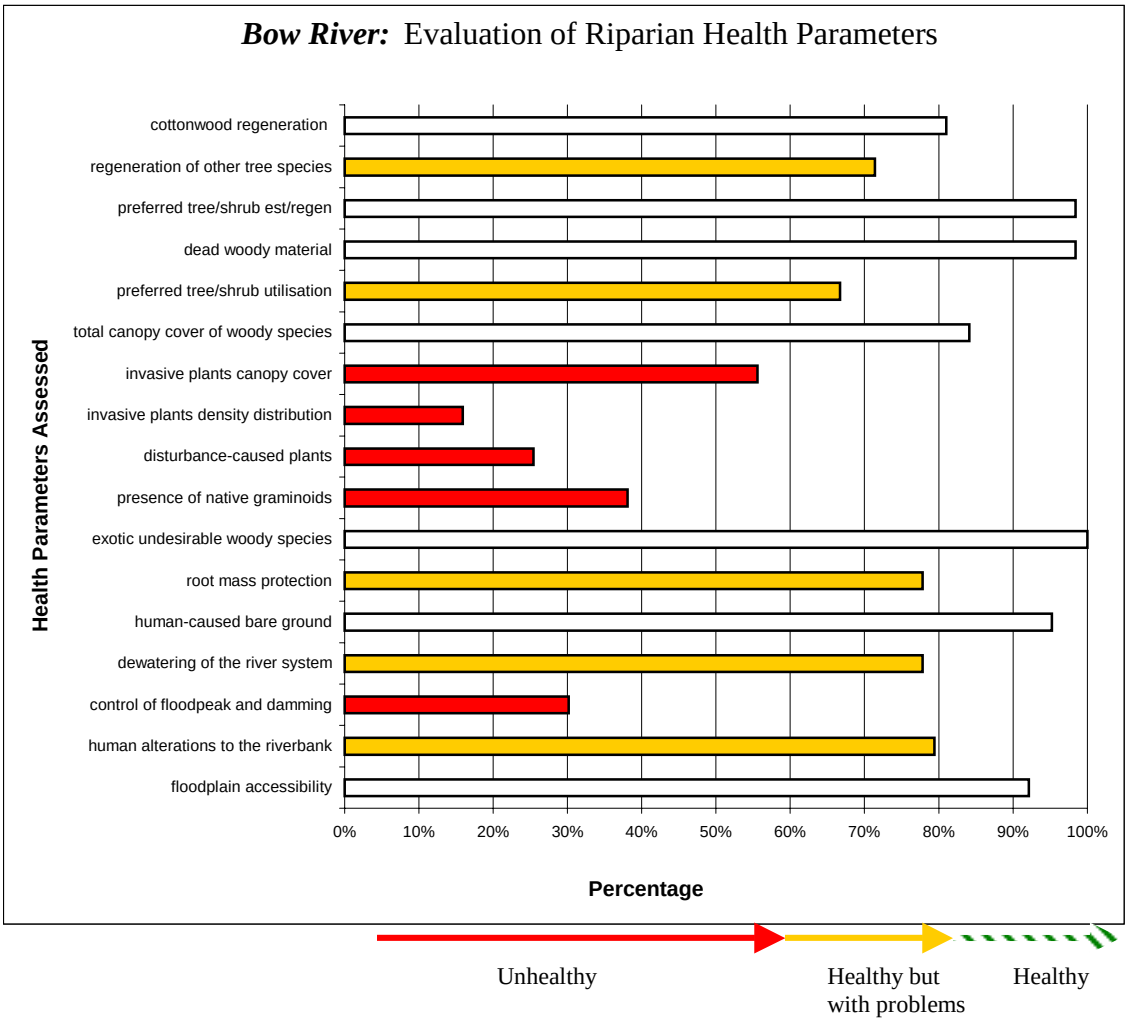
Remember: *We encourage users of the report to recognise the value of this report in broad-scale planning and identifying types of management and education approaches to take in the entire watershed--**this is not a finger pointing exercise; it should be used as part of an awareness process that maintains or improves management.***

Table B1. Summary of Riparian Health Work –Bow River

Year	**River**	**# Landowners Contacted**	**# Landowners Participated**	**# Polygons Assessed**	**River Distance Assessed (km)**
2003	Bow River	**21**	**15**	**21**	**40**

RIPARIAN HEALTH DISCUSSION

For a description of how the parameters of riparian health are impacted by human disturbances and the overall affect on riparian health refer to *A Closer Look At The Riparian Health Pieces* in the overall summary of the South Saskatchewan River Basin.



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure B2. Breakdown of riparian health results for 17 parameters assessed for the Bow River project area

For an overview of the limitations of riparian health assessments refer to the section titled *Data Limitations* in the overall South Saskatchewan River Basin Summary.

Historic and Present Influences on Riparian Health

The following discussion provides some insights regarding the current status of the health of riparian areas within the project area.

- **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 (Alberta ECA 1977). Currently, livestock grazing continues to be the dominant land use potentially influencing riparian health along the Bow River (Table B2, Appendix B10). While grazing is the dominant land use, riparian health in the sites assessed suggests that overall, riparian health has been maintained.

- **Cropland cultivation**, tame pasture and forages (including hay), have contributed to an increased presence of disturbance-caused undesirable plants within these riparian areas. Cropping along the reaches of the Bow River makes up a very small proportion of the total area.

- **Availability of water.** Water diversion and consumption, are affecting the overall health evaluation of the Bow River to a moderate degree at the present time. In downstream reaches, there may be additional long-term implications of reduced water volumes to maintaining riparian vegetation, including ensuring flood events provide sufficient recharge of local moisture and create opportunities to establish new trees. Demand for water at least may be putting the river under stress.

- **Damming of the upstream watershed** occurs in all 7 of 10 downstream-most reaches (BW-07 to BW-01), with over 50% of upstream areas dammed in all of these reaches. At the time of riparian health assessment, there were no signs of impacts on tree and shrub regeneration in the upper 3 reaches. The lower 7 reaches have poor or moderate regeneration of cottonwoods, which may be reflecting the changes in timing of flow and flood peaks. Other tree species are not regenerating well in lower reaches. Additional monitoring of long-term status of tree and shrub communities will determine if these concerns are sustained.

- **Timber harvest** occurs in some upper portions of the watershed (Alberta ECA 1977), although based on air photo examination of broad land use categories, it is not present in the riparian area. Forestry activities can accelerated delivery of water resulting due to reduced forest cover. Depending on the extent and intensity of timber harvest, there way be an impact on the quantity and quality of water reaching the river, as well as levels of sediment and increased potential for introduction and invasion of disturbance or invasive species, due to bare soil and increased risk of seed transmission.

- **Development and industrial activity** including urban/domestic development, residential wastewater discharge, oil and gas exploration/development, roads and pipeline crossings are occurring along the Bow River. All of these activities are occurring in the Bow River watershed, but due to a limit in sample size and a focus on riparian health (as opposed to water quality, for example) only some of these activities were identified as present and / or impacting riparian health of polygons assessed.
  Extensive areas of development (primarily urban centres), in addition to impacts from recreation, roads, and other right-of-ways, are influencing riparian health. Impacts to structural integrity of the riverbanks are noticeable, as are extensive amounts of invasive or disturbance-caused plants.

- **Overall watershed changes** such as land cover types have increased the rate (and likely volume) at which water is delivered from the land, including a potential for more rapid rise in flood waters, with loss of wetlands, including muskeg (bogs or fens).

Table B2. Land uses along the Bow River Project Area

AENV Reaches for Bow River	Land Uses (% of reach based on length)			
	Grazing	***Cropping***	***Developed***	***Undeveloped***
BW-01	86	14	0	0
BW-02	94	1	3	2
BW-03	90	10	0	0
BW-04	30	6	55	9
BW-05	0	0	89	11
BW-06	55	2	24	19
BW-07	72	0	17	11
BW-08	0	0	26	74
BW-09	0	0	20	80
BW-10	0	0	9	91
Total	61	6	14	19

Refer to the section titled *Riparian Plant Communities-Why are they important?* for an overview of why understanding the riparian plant communities is important.

Riparian Plant Communities

Within the Bow River project area:

- All polygons examined are identified as having the potential to grow trees and shrubs, including preferred tree and shrub species.
- 22 different plant communities were identified.
- Shrubs occupy 40% of the project area and trees cover 34% of the project area.
- However, 27% of the shrub canopy cover is comprised of three grazing-resistant, disturbance-increaser shrubs (snowberry/buckbrush, *(Symphoricarpos occidentalis)*, common wild rose *(Rosa woodsii)* and prickly rose *(Rosa acicularis)*.
- The other 73% of the shrub canopy cover is comprised of *preferred*[5] shrub communities (including 3 willow communities).
- A total of 8 tree community and habitat types were found, 5 of which were poplar or cottonwood (*Populus*) community and habitat types
- 4 different graminoid community and habitat types (2 native types) were identified, which occupy 13% of the project area; however, graminoids cover 65% of the project area, providing extensive cover within the tree and shrub community and habitat types.
- A list of all plant species found in the project area is available in Appendix B3. Additional plant community and habitat type information can be found in Appendix B7. Refer to Appendix B4 for a complete listing of plant species observed within each polygon.

[5] native, palatable shrubs (willows, red-osier dogwood etc.) that contribute to riparian function or health

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

Presence

- 14 tree species and 47 shrub species were identified within the Bow River project area. Included in the total number of shrub species is common caragana (*Caragana arborescens*), an introduced shrub species.
- Total area covered by all trees and shrubs combined is 55.2%(Appendix B2).

The presence of many different tree and shrub species is often a good indicator of structure and diversity. A diversity of plants provides habitat layers, benefiting wildlife and livestock.

Reproduction

- Currently there are few areas where the reproduction of *preferred* trees and shrubs is of concern.
- 14 of 21 polygons (67%) along the Bow River have at least 15% of cottonwood cover within the polygon provided by established seedlings and saplings, with 5 reaches having this level of regeneration. 14% of sites (3 of 21) have cottonwood seedlings and saplings providing 5-15% of the cottonwood cover. The remaining 19% (4 of 21) have either no cottonwood regeneration present (1 site) or less than 5% of the cottonwoods present are seedlings and saplings (3 sites).
- The upper 6 reaches have very good regeneration and establishment of other trees, but 3 of the remaining 4 reaches have very poor or no regeneration of other trees. 20 of 21 polygons have tree species other than cottonwoods. White spruce *(Picea glauca)*, white birch (*Betula papyrifera*), blue spruce (*Picea pungens*), Manitoba maple (*Acer negundo*), fir (*Abies* spp.), Douglas fir (*Pseudotsugs menziesii*), ash (*Fraxinus* spp.), larch (*Larix* spp.), oak (*Quercus* spp.) and lodgepole pine (*Pinus contorta*) are found in the project area. The non-native tree species are mostly located in developed urban areas. On the sites where these species are present, the majority of polygons (15 of 20), (75%) have more than 5% of the canopy cover provided by seedlings and saplings, which is good.
- All but one reach has excellent regeneration of preferred shrub species, and the remaining reach has good regeneration.
  95% (20 of 21) of the polygons has more than 5% of the preferred shrub species cover provided by seedlings and saplings. In the remaining site, regeneration provides only 1-5% of the cover of preferred shrub species.

Health

- Existing tree and shrub communities show normal amounts of dead and decadent branches in the upper canopy, with the exception of one site that has dead or decadent branches throughout 5-25% of the total canopy cover of woody species. Low levels of dead and decadence throughout woody communities indicate there is currently sufficient moisture within the system to sustain existing trees, and that disease is not a problem in maintaining these communities.

- There are minor concerns with the overall health of shrubs.
    - 27% of the shrub canopy cover is comprised of three grazing-resistant, disturbance-increaser shrubs (snowberry/buckbrush, *(Symphoricarpos occidentalis)*, common wild rose *(Rosa woodsii)* and prickly rose *(Rosa acicularis)*.
    - In 24%, (5 of 21) of polygons, preferred trees and shrubs species are receiving moderate (3 of 21) to heavy (2 of 21) browse pressure from livestock (and to a lesser degree wildlife). In some locations this browse pressure is removing new growth and contributes to preventing seedlings and saplings from reaching a mature age class.
    - The indicators of heavy browse pressure are umbrella-shaped mature shrubs and flat-topped or hedged seedling and saplings. Successful reproduction and establishment of the present trees and shrubs will maintain these stands and promote riparian health.

Non-Woody Riparian Plants: Diversity and Health

Diversity

- 52 species of grasses and grass-like plants (graminoids) and 166 species of broad-leaved plants (forbs) were recorded within the Bow River project area.
- The presence of native grasses is an important indicator of the level of disturbance occurring within the riparian area; this presence of native grasses diminishes with increased disturbances to the soil surface. The majority of reaches and polygons along the Bow River had poor or very poor coverage provided by native grasses. 29% (6 of 21) of polygons had less than 5% of the riparian area covered by native grasses. 33% (7 of 21) of polygons had 5-25% of the riparian area covered by native grasses. There was only one site that had adequate coverage of native grass species (more than 50% of the reach covered). Reach BW-05 had the consistently very poor (<5%) cover of native grasses.
- 63% (148 species) of the non-woody riparian plants recorded are native plants. Native plants provide riparian functions including deep, binding root masses and summer and winter forage production for livestock and wildlife.
- 10 poisonous plant species are noted within the project area but their overall presence is not of concern for management because they are not abundant: white camas (*Zigadenus elegans*), common horsetail (*equisetum arvense*), late yellow locoweed (*Oxytropis monticola*), showy milkweed (*Asclepias speciosa*), death camas (*Zigadenus venenosus*), tall larkspur (*Delphinium glaucum*), early yellow locoweed (*Oxytropis sericea*), Indian hemp (*Apocynum cannabinum*), showy locoweed (*Oxytropis splendens*) and red and white baneberry (*Actaea ru*bra).

Health

- 53% of the project area is occupied by disturbance-caused plants (grasses and forbs). All 4 of the downstream-most reaches were scored zero because disturbance-caused plants cover over 50% of each polygon within their boundaries.

Of the 28 disturbance-caused plants present, the most prevalent are smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*)[6].

- Disturbance-caused undesirable plants are abundant throughout the Bow River project area. 57% (12 of 21) polygons have more than 50% of the riparian area covered in disturbance-caused undesirable herbaceous species. Disturbance-caused plants typically do not have a deep, binding root mass and therefore do not provide riverbank protection as well as non-disturbance native species. Refer to Appendix B5 for more information regarding the area covered by disturbance plant species within each of the sites.
- The abundance of native grasses and forbs is reduced due to the abundance of disturbance-caused plants
- The prevalence of invasive plants (e.g. noxious weeds) is a concern. 12 of 21 polygons have invasive plants covering less than 1% of the riparian area. 8 of 21 polygons (38%) had invasive plants covering between 1-15% of the riparian area. Canada thistle (*Cirsium arvense*), perennial sow thistle (*Sonchus arvense*), yellow toadflax (*Linaria vulgaris*) and scentless chamomile (*Matricaria perforata*) are the most prevalent invasive weeds. Ccommon tansy (*Tanacetum vulgare*), dalmatian toadflax (*Linaria dalmatica*), leafy spurge (*Euphorbia esula*), tall buttercup (*Ranunculus acris*), ox-eye daisy (*Chrysanthemum leucanthemum*), downy brome (*Bromus tectorum*), bladder campion (*Silene cucubalus*), hoary cress (*Cardaria chalepensis*), white cockle (*Silene pratensis*) and perennial ryegrass (*Lolium perenne*) are also found throughout the project area in lesser amounts.

Physical Characteristics of Riverbank and Floodplain

Human-Caused Bare Ground and Alterations to the Riverbanks

- Overall, 33% (7 of 21) of the riverbanks within the project area having structural alterations by human activities.
- The level of structural alterations varies from less than 10% of the bank having alterations to more than 50%. The reaches with the highest average structural alterations are located approximately mid-way; however, there is high variability in structural impacts across the system, with polygons in the same reach commonly varying widely in the amount of alteration present.
- Several types of land use activities are contributing to structural changes to the riverbanks. Recreation (present in 6 reaches), livestock activity (hoof shear, trailing) (present in 3 reaches), railroads (present in 2 reaches) and rip-rap (present in 3 reaches) along the riverbank are the major causes of the alterations that are occurring along the Bow River. Power lines, pipelines and clearing for development are contributing to a lesser extent (Appendix B8).
- Exposed soil surface or bare ground was not a problem in the majority of polygons or reaches. Of the bare ground overall, 21% is naturally occurring (depositional material from recent flood events) and 79% is human-caused, but due to the small amounts of human-caused bare ground, this rates as very minimal or minor.

[6] Kentucky bluegrass, smooth brome and timothy are tame or introduced species that have invaded many native lands over the past decades. These species reduce long-term productivity and stability, because they do not have deep-binding roots.

The small amount of bare ground present from human causes is mostly due to recreation, with lesser amount from livestock activity, railroads, riprap and man made trails or roads. These areas offer invasive weeds and disturbance-caused plants and opportunity to establish or spread, and should be kept to a minimum.

Riverbank Root Mass Protection

- There is considerable variability within most reaches in terms of the proportion of the banks protected with deep-binding roots, although most areas had good to excellent root mass protection, and where this is not the case, there is no pattern related to distance downstream or level of development (eg. urban settings). All but one reach rate good to excellent, with the downstream most reach rating poor root mass protection. 52% (11 of 21) of polygons have more than 85% of the riverbank covered by deep binding roots, which is excellent. Of the remaining sites, 7 have 65-85% of the riverbank protected by deep binding roots and 3 sites have limited or poor bank protection with less than 65% of the banks with deep binding roots along the banks.

Hydrologic Characteristics

Dewatering of the River System

- Artificial removal of water from river systems can negatively affect bank stability, wildlife habitat, establishment and success of woody plants and overall riparian function.
- Along the Bow River there are some concerns with water removal. 4 of the upper 5 reaches rate as having no concerns, but all 4 of the lower reaches have either some or considerable concerns due to dewatering. The most downstream reach (BW-01), with 3 sites has the greatest level of withdrawal (25-50% of the average river discharge). 4 reaches (8 of 21 sites (38%)) have between 10-25% of the average discharge removed, with the balance of the reaches (and sites) having less than 10% of the average river discharge removed.

Control of Flood Peak/Timing by Upstream Dams

- Dams have negative impacts on the overall function of riparian areas because they remove water, adjust and control the annual peak flows that riparian areas depend on to recharge their reservoirs and rebuild the banks.
- Along the Bow River there are several dams that are impacting riparian health. These dams include: Kananaskis Dam, Horseshoe Dam, Ghost Dam, Bearspaw Dam, Carseland Weir, and Bassano Dam.
- These impacts will be most felt in polygons that were located immediately downstream of any of the dams; consequently, only the upper 3 reaches of the Bow River were rated as not being impacted by dams. The remaining reaches rate as having extensive control of flood peak and timing, with 14 of 21 polygons (67%) have more than 50% of the watershed upstream controlled by dams (one polygon with 25-50%, Appendix B1).

Because of the significant proportion of the watershed that has modifications to flood timing and intensity from damming, riparian health of the Bow River is negatively impacted.

Floodplain Accessibility

- Riparian areas depend on regular flood events to maintain groundwater reserves and rebuild banks through sediment deposition. Humans sometimes restrict floodwaters from accessing the floodplain through construction of embankments, levees and roadbeds.
- These barriers prevent high water flows from accessing the floodplain, an important function of all river systems. Energy that is built up in flood events requires the floodplain as a place to disperse that energy, as well as deposit water and materials. If access is restricted then all of the energy is concentrated within the channel, leading to increased bank instability and erosion.

- Along the Bow River, almost all of the polygons' (18 of 21) floodwaters have access to more than 85% percent of the floodplain, which is the amount required to maintain all riparian functions related to this parameter. One polgyon (within the City of Calgary) has almost removed floodplain access for high water events, and this reach is rated as having less than 50% floodplain access. All other reaches are rated as having nearly full floodplain access (over 85% access) or half full access plus half moderate access (65% to 85% floodplain accessible to flood flows)

Bow River Riparian Health Overview: Summary

Overall riparian health of the areas examined in the reaches is lower downstream compared to upstream; however, it is clear that there is considerable variability between reaches as well as within a reach, and some riparian parameters follow a pattern, while others do not. Consequently, the observations below are provided as an overview that will assist in general management or monitoring planning. More detailed or specific use of the information should be done at the reach and polygon level, with a clear understanding of site or localised health status.

A number of factors contributed to fewer healthier sites as distance from headwaters increased:

Vegetation:
- Regeneration of other tree species poorer in lower reaches (with BW-03 an exception)
- Cover of woody species generally higher in upper half of the river
- Invasive species density distribution generally lower in upper half of river
- Disturbance species canopy cover less in upper half of river

Physical/Hydrological:
- Lower reaches have increasing proportions of natural flow removed, leading to greater dewatering of channel and floodplain
- Upper 3 reaches with no major dams; all remaining downstream reaches with increasing/high levels of control of flood peaks and timing by dams

Some parameters of riparian health were similar, regardless of location along the river system:

- Decadent and dead woody material (normal amounts at all but one site)
- Exotic, undesirable woody species (healthy at all sites)
- Preferred shrub regeneration (excellent at all but 1 site)
- Human-caused bare ground (excellent at all but 2 reaches; good in those areas)

There were no clear trends in these riparian health parameters as distance from headwaters increased:

- Cottonwood regeneration
- Utilisation of preferred trees and shrubs
- Native graminoid cover
- Invasive species canopy cover
- Floodplain accessibility high in 7 of 10 reaches but reduced in 3 (in 1 of 3 limited reaches, access related to presence of an urban centre)
- Human alterations to the structure of riverbanks
- Proportion of banks protected with deep-binding roots

Limitations of the Data

Refer to Data Limitations in South Saskatchewan River Basin section.

Bow River: Opportunities and Options for Improvement

Grazing management may be influencing establishment and regeneration of preferred trees and shrubs at a few sites, based on moderate or high utilisation and lower regeneration rates. Most sites do not appear to be negatively affected by current/recent grazing management, with minimal amounts of human-caused bare ground, few structural alterations, and nil or light utilisation. At those sites where utilisation is moderate or high, this level of browse may not be sustainable in terms of allowing successfully regeneration and maintenance of tree and shrub communities, but it is likely not having significant impact on these processes, since shrub regeneration is excellent throughout the areas examined. Where appreciable dewatering and damming upstream occur in conjunction with heavier levels of woody plant utilisation, effects on preferred tree and shrub species may be greater. There is no clear trend to reduction in cottonwood regeneration with greater impacts on the hydrologic parameters, but there does seem to be poorer regeneration and establishment of other trees where hydrological parameters are more seriously altered.

Promote and support livestock grazing strategies that focus on keeping preferred tree and shrub utilisation to light, and occasionally moderate, levels, to benefit establishment of seedlings and saplings, by allowing increased plant growth and vigour. Avoiding use in sensitive periods (i.e. when graminoids and forbs have reduced palatability or are limited in quantity) will promote woody plant growth, while minimising livestock browse. Additional rest to sites will promote native trees, shrubs, and graminoids.

All polygons examined had the potential for both cottonwood and other trees species, and most were reproducing well or moderately well: cottonwoods (17 of 21 sites) and other trees species (15 of 21 sites). Similar to the Red Deer River, seedlings and saplings of non-cottonwood trees were absent at 5 sites; cottonwood seedlings or saplings were present to some degree at all sites. Opportunities to maintain and promote or increase regeneration and establishment will involve considering land use management (most often livestock grazing) and hydrologic considerations.

Invasive species were widespread in most areas. Reduce the presence of invasive plants or aim to prevent further invasion with a combination of weed control measures and grazing strategies that consider rest, distribution, timing and stocking rates will be required to prevent human-caused bare soil and promote plant vigour. In recreational and developed settings, weed control is equally important. Moisture and temperature can lead to highly variable abundance of invasive plants, so monitor infestations closely. In general, there was very little human-caused bare ground or structural alterations to the banks, which is positive--continue to keep these alterations to a minimum, since disturbance-caused and invasive plants are readily available to establish and spread. Additional information about invasive plants can be found in Appendix B6.

In 5 of the upper 6 reaches, less than 10% of the average river discharge is being removed. Water extractions are minimal from this portion of the Bow River and current extractions are having no significant impacts on the overall riparian health of this section of the river. In the lower 4 reaches, over 10% of the flow is withdrawn, resulting in a reduction in riparian health. Regeneration of non-cottonwood trees is lower in these reaches, and may be the result of reduced flow, or a combination of browse, reduced flow and alterations to peak flow and timing.

The upper 3 reaches are not dammed, but series of dams (Horseshoe, Kananaskis Falls, Ghost, and Bearspaw) are located within the middle reaches. Carseland Weir and Bassano Dam occur upstream of BW-02 and BW-01, respectively. These dams control flood peak and timing significantly. Recognising that damming is a potentially harmful impact on riverine ecosystems, consider limiting further damming and provide flow regimes that assist in maintaining riparian plant communities. In addition, it is important to identify and quantify upstream minor or unlicensed dams to include these potential modifications.

Dams and berms are not impacting control of flow or floodplain accessibility in most of the river examined; only three polygons within the Bow River areas examined have floodplain accessibility reduced, with one significantly impacting accessibility (in BW-05; Calgary).

Potential for increasing riparian health is limited in some areas, where on-site management does not appear to be having a significantly negative influence, and the greatest current impact to riparian health (and perhaps future health) is hydrologic modifications. There are sites where improved site management will improve health, but altering things like proportion of disturbance-caused species will take long-term management and monitoring to see an effect.

Bow River Reach Overview

The reaches along the Bow River are summarized starting from the headwaters (BW-10) downstream to where the Bow River joins the Oldman River at the confluence of the Grand Forks (BW-01) (Table B3). In most reaches, 2 polygons, totally approximately 3 km of river length are evaluated for the Bow River (Table B4). The polygons rate in all three riparian health categories, with the majority of sites functioning but at risk (healthy, but with problems) (Table B5).

Table B3. Alberta Environment (AENV) Reaches Boundary Descriptions - Bow River

Reach	Upstream and Downstream Description
BW-10	Lake Louise to Upstream of Banff
BW-09	Banff to Upstream of Canmore
BW-08	Canmore to Upstream of Kananaskis River Confluence
BW-07	Kananaskis River Confluence to Ghost Dam
BW-06	Ghost Dam to Bearspaw Dam
BW-05	Bearspaw Dam to Upstream of Western Irrigation District (WID) Weir
BW-04	WID Weir to Upstream of Highwood River Confluence
BW-03	Highwood River Confluence to Upstream of Carseland Weir
BW-02	Carseland Weir to Upstream of Bassano Dam
BW-01	Bassano Dam to Grand Forks (Confluence of South Saskatchewan River

Table B4. Summary of Bow River Reaches – Sites

AENV Reaches	# Sites Assessed	River Distance Assessed (km)
BW-10	2	3.71
BW-09	2	3.43
BW-08	2	3.78
BW-07	2	2.85
BW-06	2	2.35
BW-05	2	3.69
BW-04	2	3.05
BW-03	2	2.33
BW-02	2	4.82
BW-01	3	10.01
Total	21	40.02

Table B5. Number of Reach Sites by Riparian Health Category – Bow River Reaches

Reach	Healthy	Healthy but with problems	Unhealthy
BW-10	2	0	0
BW-09	1	1	0
BW-08	2	0	0
BW-07	1	1	0
BW-06	0	2	0
BW-05	0	1	1
BW-04	0	1	1
BW-03	0	2	0
BW-02	0	2	0
BW-01	0	0	3
Total	6	10	5

Table B6. Reach Land Use – Bow River Reaches

AENV Reaches for Bow River	**Land Uses (% of reach based on length)**			
	Grazing	***Cropping***	***Developed***	***Undeveloped***
BW-01	86	14	0	0
BW-02	94	1	3	2
BW-03	90	10	0	0
BW-04	30	6	55	9
BW-05	0	0	89	11
BW-06	55	2	24	19
BW-07	72	0	17	11
BW-08	0	0	26	74
BW-09	0	0	20	80
BW-10	0	0	9	91

Community and habitat types are determined using Thompson and Hansen (2002). Refer to Appendix B7 for a complete description of habitat and community types.

Table B7. Summary of Plant Communities: Overall and Woody Communities – Bow River Reaches

Reach	# of Plant Communities	% of Area Examined with:	
		Tree Species	Shrub Species
BW-10*	5	58	44
BW-09*	4	33	11
BW-08	3	75	68
BW-07	2	59	30
BW-06*	4	57	56
BW-05*	3	30	30
BW-04	4	26	34
BW-03	6	34	36
BW-02	5	34	80
BW-01	8	1	46
Total	22	34	40

*In addition to graminoid and forb communities, these reaches have some area as unclassified wetland types.

Community and habitat types are determined using Thompson and Hansen (2002).

Refer to Appendix B7 for a complete description of habitat and community types.

Table B8. Summary of Plant Communities: Herbaceous Communities Bow River Reaches

Reach	% of Area Examined with:	
	Grass/Grass-like Species	Forb Species
BW-10*	42	20
BW-09*	66	10
BW-08	31	20
BW-07	94	20
BW-06*	57	15
BW-05*	30	10
BW-04	90	24
BW-03	94	34
BW-02	80	20
BW-01	90	25
Total	65	18

*In addition to tree and shrub communities, these reaches had some area as unclassified wetland types.

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

Reaches typically have from 3-5 tree species, normally with over 20 shrub species. Reaches at the downstream end have less diverse woody plant communities (Table B9). White spruce is common in upper reaches, with balsam poplar in most reaches throughout river length. Regeneration of trees and shrubs is moderately good overall, with excellent establishment of seedlings and saplings in many reaches, but some sites with poor regeneration or the absence of non-cottonwood trees where potential exists (Table B10). Dead branches and dead standing trees make up a normal amount of the woody plant canopy and utilisation/browse is generally light to moderate, with a few sites rated as nil or heavy use (Table B11).

Table B9. Woody Plant Species Presence– Bow River Reaches

Reach	**# of Tree Species**	**# of Shrub Species**	**% of Polygon Area that is Woody Species**
BW-10	5	25	64
BW-09	4	21	38
BW-08	5	28	87
BW-07	3	25	78
BW-06	4	22	66
BW-05	9	24	40
BW-04	6	22	44
BW-03	4	19	56
BW-02	3	17	90
BW-01	2	12	46

Refer to Appendix B4 for a complete list of plant species.

Table B10. Woody Plant Species Reproduction– Bow River Reaches

Reach	Cottonwood Regeneration (seedlings/ saplings)	Other Tree Species Regeneration (seedlings/ saplings)	# of Sites with seedlings /saplings >5% of total woody cover	Means for health…
BW-10	Both sites excellent	Conifers and aspen excellent	2	Excellent regeneration
BW-09	Both sites moderate to good	Various species excellent	2	Good to excellent regeneration
BW-08	Both sites excellent	Various species excellent	2	Excellent regeneration
BW-07	1 site excellent, 1 site poor	Spruce and aspen: 1 site excellent, 1 moderate to good	2	1 site excellent for cottonwood and spruce; 1 site cottonwoods poor and moderate regeneration for other trees
BW-06	Both sites excellent	Spruce and aspen excellent	2	Excellent regeneration
BW-05	1 site excellent, 1 site moderate to good	Various species including ornamentals; excellent	2	Generally good regeneration of all trees, but ornamentals should be monitored
BW-04	1 site excellent, 1 site poor	Various species; 1 site poor, 1 site very poor	1	Good overall regeneration at 1 site, but minimal at the other
BW-03	Both sites excellent	Various species, including aspen and maple; excellent	2	Excellent regeneration
BW-02	Both sites excellent	1 site excellent, 1 site none found	2	Cottonwood regeneration excellent, but other trees absent from one site where potential exists
BW-01	1 site excellent, 1 site poor, 1 site very poor	All 3 sites very poor-none found	3	Cottonwood regeneration excellent to poor; other trees absent from all sites but potential exists

Refer to Appendix B1 for a summary of river health survey scores.

Table B11. Woody Plant Health– Bow River Reaches

Reach	Dead and Decadence	Utilisation of Preferred Woody Plants	Means for health…
BW-10	Normal	None-Moderate	Fair to Excellent
BW-09	Normal	Light-Moderate	Fair to Good
BW-08	Normal	Light	Good
BW-07	Normal	Light-Heavy	Poor to Good
BW-06	Normal	Light	Good
BW-05	Normal	Nil-Light	Good to Excellent
BW-04	Normal	Nil-Light	Good to Excellent
BW-03	Normal	Nil	Excellent
BW-02	Normal	Nil-Light	Good to Excellent
BW-01	Normal, Minor	Moderate-Heavy	Poor to Fair

Non-Woody Riparian Plants: Diversity and Health

A wide diversity of herbaceous species were found, with approximately 20 graminoid species in each reach and, at most sites, over 60 forb species.

Native graminoids were not prominent and only made up over 50% of one polygon, but were typically from 5 to 50% of the area. Disturbance species comprise a significant proportion of many reaches and are negatively impacting health (Table B13). Invasive plant species, while not covering significant areas, are sporadic and widespread throughout most reaches, and without appropriate management could infest much larger areas (Table B14). Canada thistle (*Cirsium arvense*) is the most common and widespread invasive plant, with numerous other species commonly found (Table B15).

Table B12. Non-Woody Riparian Plant Diversity– Bow River Reaches

Reach	Total # of Grass/ Grass-like Species	Total # of Forb Species	Proportion of site covered by native graminoids	Means for health…
BW-10	20	70	1 site 25-50%; 1 site <25%	Fair to good
BW-09	22	68	1 site 25-50%; 1 site <5%	Good to poor
BW-08	22	65	1 site 25-50%; 1 site <25%	Fair to good
BW-07	18	27	1 site 25-50%; 1 site <25%	Fair to good
BW-06	23	57	1 site >50%; 1 site <25%	Fair to excellent
BW-05	21	50	both sites <5%	Poor
BW-04	24	62	1 site <25%; 1 site <5%	Fair to poor
BW-03	23	62	both sites 25-50%	Good
BW-02	19	52	1 site <25%; 1 site <5%	Fair to poor
BW-01	22	46	1 site 25-50%; 2 sites <25%	Fair to Good

Table B13. Non-Woody Riparian Plant Health - Proportion Disturbance Caused Undesirable Herbaceous Species– Bow River Reaches

Reach	% of Reach with Disturbance Plants	Disturbance Plants Cover	Means for health…
BW-10	18	1 site 5%-25%; 1 site <5%	variable from very limited to widespread; some concern
BW-09	43	1 site >50%; 1 site 5%-25%	variable from moderate to extensive; of concern
BW-08	21	1 site 25-50%; 1 site 5%-25%	variable from moderate to widespread; of concern
BW-07	67	1 site >50%; 1 site <5%	variable from extensive to very limited; of concern on some sites
BW-06	24	1 site >50%; 1 site 5%-25%	variable from moderate to extensive; of concern
BW-05	30	both sites 25-50%	widespread; of concern
BW-04	90	both sites >50%	extensive; of concern
BW-03	60	both sites >50%	extensive; of concern
BW-02	64	both sites >50%	extensive; of concern
BW-01	72	all sites >50%	extensive; of concern

Table B14. Non-Woody Riparian Plant Health - Proportion Invasive Plant Species– Bow River Reaches

Reach	# of Sites with Invasive Plants	Invasive Plants Cover	Density/ Distribution of Invasive Plants	Means for health…
BW-10	2	1 site very low cover; 1 site low cover	single occurrences or patch to widespread throughout	Cover and distribution of some concern
BW-09	2	1 site very low cover; 1 site low cover	a few patches to widespread throughout	Cover and distribution of some concern
BW-08	2	1 site very low cover; 1 site low cover	many patches or widespread throughout	Cover and distribution of some concern
BW-07	1 of 2	1 site absent; 1 site very low cover	absent to widespread	Distribution is a concern
BW-06	2	both sites very low cover	a few patches to widespread throughout	Distribution is a concern
BW-05	2	both sites low cover	a few patches to widespread throughout	Distribution is a concern
BW-04	2	1 site very low cover; 1 site low cover	many patches or widespread throughout	Distribution is a concern
BW-03	2	both sites low cover	many patches or widespread throughout	Distribution is a concern
BW-02	2	both sites very low cover	a few patches with sporadic individuals	Distribution is a concern
BW-01	3	all sites very low cover	many patches or widespread throughout	Distribution is a concern

Table B15. Most Common Invasive Herbaceous Plant Species– Bow River Reaches

Reach	Species
BW-10	Canada thistle, oxeye daisy, perennial sow thistle, tall buttercup, butter-and-eggs/toadflax
BW-09	Canada thistle, perennial sow thistle, tall buttercup, butter-and-eggs/toadflax
BW-08	Canada thistle, perennial sow thistle, tall buttercup, butter-and-eggs/toadflax and others equally common
BW-07	Canada thistle, leafy spurge, perennial sow thistle, butter-and-eggs/toadflax
BW-06	Canada thistle, perennial sow thistle, butter-and-eggs/toadflax
BW-05	Canada thistle, tall buttercup, scentless chamomile, perennial sow thistle, downy brome, leafy spurge, and others equally common
BW-04	Canada thistle, common tansy, perennial sow thistle, leafy spurge, butter-and-eggs/toadflax and others equally common
BW-03	Canada thistle, common tansy, scentless chamomile, perennial sow thistle, leafy spurge
BW-02	Canada thistle, common tansy, scentless chamomile, perennial sow thistle, leafy spurge
BW-01	Canada thistle, scentless chamomile, perennial sow thistle

Physical Characteristics of Riverbank and Floodplain

Human-caused bare ground is minimal at most sites (Table B16). Where it does exist, it results from recreation, riprap, grazing, and roads/trails (Appendix B9). Human activities have altered riverbank structure overall to small degree, although a few individual sites have moderate alterations (Table B17). A combination of recreation, development (including roads, bridges, power lines, trails and urban development), livestock activities, and riprap are the sources of these bank alterations. Riverbank root mass protection, as assessed by the length of bank with deep-binding roots, is generally good to excellent, with a few areas poorly protected (Table B18). Appendix B14 also outlines the bank materials within each of the sites inventoried along the Bow River.

Human-Caused Bare Ground and Alterations to the Riverbanks

Table B16. Human-caused Bare Ground– Bow River Reaches

Reach	# of Sites with >5% Human Caused Bare Ground	Proportion of polygons covered by human-caused bare ground	Sites are…
BW-10	0	both sites <5%	Well vegetated
BW-09	0	both sites <5%	Well vegetated
BW-08	0	both sites <5%	Well vegetated
BW-07	0	both sites <5%	Well vegetated
BW-06	2 of 2	both sites 5-25%	Fairly well vegetated
BW-05	0	both sites <5%	Well vegetated
BW-04	1 of 2	1 site 5-25%; 1 site <5%	Well vegetated
BW-03	0	both sites <5%	Well vegetated
BW-02	0	both sites <5%	Well vegetated
BW-01	0	both sites <5%	Well vegetated

Table B17. Human-Caused Structural Alterations– Bow River Reaches

Reach	# of Sites with Human Caused Structural Alterations	# of Sites with Human-Caused Structural Alterations Along:				Banks are…
		< 10% of length	10-25% of length	25-50% of length	> 50% of length	
BW-10	2	1	0	1	0	Variable: intact to moderately altered
BW-09	2	1	1	0	0	Mostly Intact
BW-08	2	2	0	0	0	Intact
BW-07	0	2	0	0	0	Intact
BW-06	2	1	0	0	1	Variable: intact to significantly altered
BW-05	2	0	1	0	1	Variable: mostly intact to significantly altered
BW-04	2	1	1	0	0	Mostly intact
BW-03	1	2	0	0	0	Intact
BW-02	2	2	0	0	0	Intact
BW-01	3	2	0	1	0	Variable: intact to moderately altered

Riverbank Rootmass Protection

Table B18. Proportion of Riverbank with Deep Binding Roots— Bow River Reaches

Reach	**# of Sites with Riverbank Rootmass Protection along:**				**Banks are…**
	> 85% of length	65-85% of length	35-65% of length	< 35% of length	
BW-10	2	0	0	0	Well protected
BW-09	1	1	0	0	Well to moderately protected
BW-08	1	0	1	0	Variable; from well protected to poorly protected
BW-07	1	0	1	0	Variable; from well protected to poorly protected
BW-06	1	1	0	0	Well to moderately protected
BW-05	1	1	0	0	Well to moderately protected
BW-04	1	1	0	0	Well to moderately protected
BW-03	1	1	0	0	Well to moderately protected
BW-02	2	0	0	0	Well protected
BW-01	0	2	0	1	Variable; half well protected; half moderately well protected Poorly protected

Hydrologic Characteristics

Dewatering of the river is minor to very minor in all 6 upper reaches; minor withdrawals continue for BW-04 to BW-02, and are moderate for the downstream most reach (TableB19). 6 major dams are present on the Bow River. Only the upper 3 reaches have unmodified peak flows and timing, with the remainder of reaches having over 50% of their upstream watershed dammed (Table B20). Flood waters have access to their associated riparian areas in almost all sites, with a few sites having minor levels of obstruction. Only one site, located in the City of Calgary, has major obstructions to flood waters (Table B21).

Dewatering of the River System

Table B19. Dewatering of the River— Bow River Reaches

Reach	Total use as a % of natural *	# of Sites with River Discharge Being Removed that is:				Impacts are…
		< 10% of average	10-25% of average	25-50% of average	> 50% of average	
BW-10	0	2	0	0	0	Very Minor
BW-09	18.4	0	2	0	0	Minor
BW-08	0.1	2	0	0	0	Very Minor
BW-07	0.1	2	0	0	0	Very Minor
BW-06	2.3	2	0	0	0	Very Minor
BW-05	4.5	2	0	0	0	Very Minor
BW-04	13.2	0	2	0	0	Minor
BW-03	10.0	0	2	0	0	Minor
BW-02	23.1		2			Minor
BW-01	46.1			3		Moderate

*Data provided by AENV. Note that only licensed and reported uses are included; unlicensed use is unknown.

Control of Flood Peak/Timing by Upstream Dams

Table B20. Flood Peak and Timing Control by Dams – Bow River Reaches

Reach	# of Sites with Control By Dams Upstream Affecting:				Number of Dams Upstream
	<10% of watershed	10-25% of watershed	25-50% of watershed	> 50% of watershed	
BW-10	2	0	0	0	0
BW-09	2	0	0	0	0
BW-08	2	0	0	0	0
BW-07	0	0	0	2	2 (Horseshoe Dam and Kananaskis Falls Dam)
BW-06	0	0	0	2	3 (as above plus Ghost Dam)
BW-05	0	0	0	2	4 (as above plus Bearspaw Dam)
BW-04	0	0	0	2	4 (as above)
BW-03	0	0	1	1	4 (as above)
BW-02	0	0	0	2	5 (as above plus Carseland Weir)
BW-01	0	0	0	3	6 (as above plus Bassano Dam)

Floodplain Accessibility

Table B21. Floodplain Accessibility— Bow River Reaches

Reach	# of Sites with Flood Water Access to:				Major Obstructions to Flooding
	> 85% of floodplain	*65-85% of floodplain*	*35-65% of floodplain*	*< 35% of floodplain*	
BW-10	2	0	0	0	None
BW-09	1	1	0	0	None to minor
BW-08	1	1	0	0	None to minor
BW-07	2	0	0	0	None
BW-06	2	0	0	0	None
BW-05	1	0	0	1	Variable; from none to extensvie obstruction (within City of Calgary)
BW-04	2	0	0	0	None
BW-03	2	0	0	0	None
BW-02	2	0	0	0	None
BW-01	3	0	0	0	None

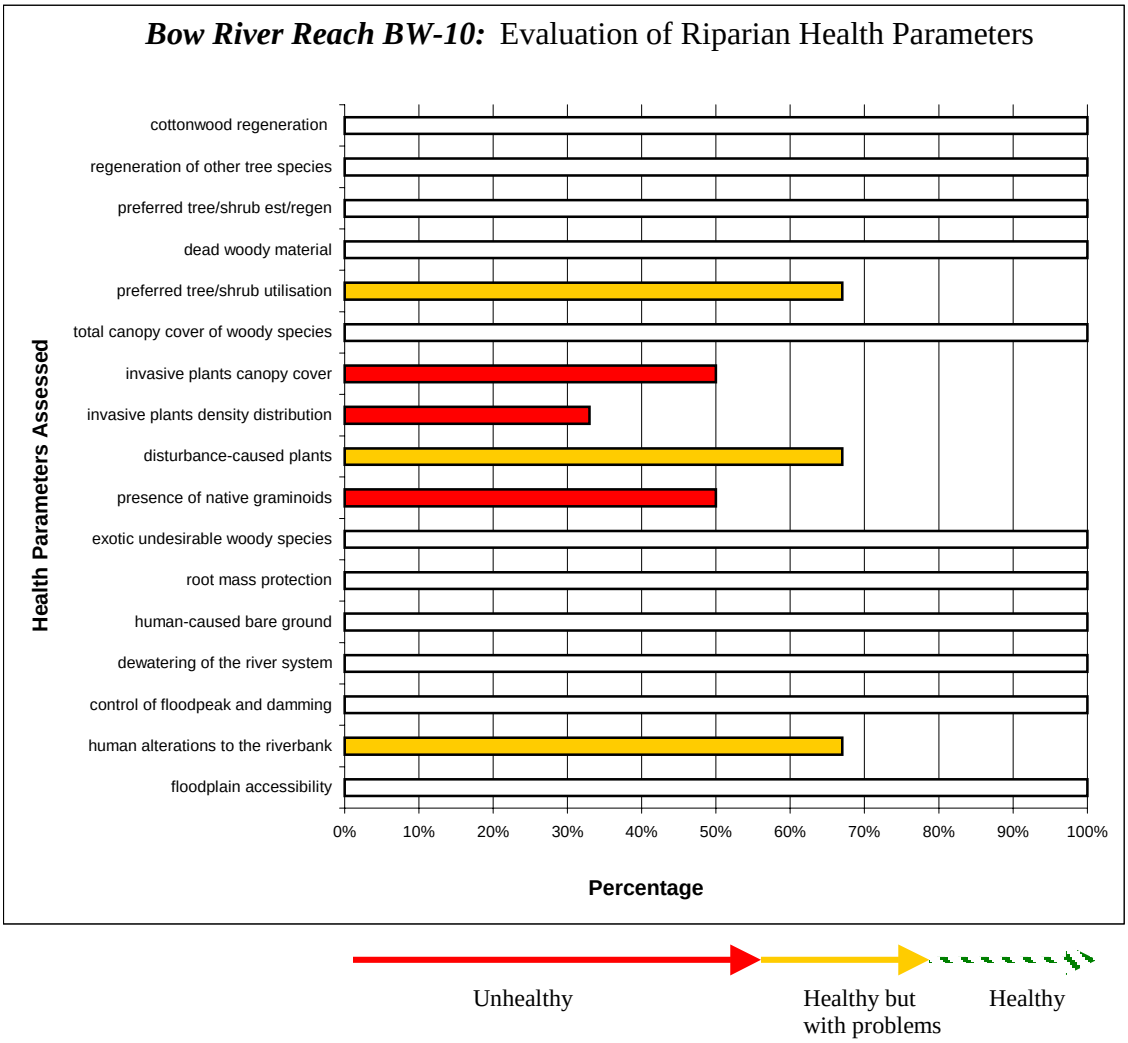
Alberta Environment Reach: Lake Louise to Upstream of Banff (BW-10)

- **Both of the polygons in this reach scored in the healthy category.** The overall assessment of riparian health for reach BW-10 of the Bow River project area is as follows:

  - Of the 2 polygons assessed: 100% (2/2) are *healthy*,
    0% (0/2) are *healthy but with problems*,
    0% (0/2) are *unhealthy*.

Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure B3. Breakdown of riparian health results for 17 parameters assessed for the Bow River reach BW-10.

Historic and Present Influences on Riparian Health: Reach Comments

Because this reach encompasses a moderately forested landscape nearer the headwaters, and with its location within Banff National Park, it has limited land use.

The dominant land use identified for this reach was 'undeveloped', with developed lands also notable in the area along the river and adjacent lands[7]. Historic and current grazing by wildlife may also influence riparian health parameters in this reach.

Riparian Plant Communities

- Currently, preferred tree and shrub communities are abundant and are providing significant vegetative cover. Woody plant communities are also diverse, offering multiple species and layers, with excellent establishment and regeneration of cottonwoods, other trees species and shrubs. Light browse levels from wildlife are assisting establishment of new trees and shrubs, as well as maintaining plant vigour.
- A positive attribute of this reach is that riparian areas here are covered less than most other reaches by disturbance-caused plant communities.

Physical Characteristics and Hydrologic Parameters

- Human-caused bare ground and structural alterations are minimal within this reach. Railroad and recreational activities are contributing to the limited structural alterations in this reach. There is excellent riverbank root mass protection in this reach-aim to manage to maintain this existing high quality.
- There are currently no concerns with altered flow or timing and the river readily accesses its floodplain.

Opportunities and Options for Improvement: BW-10

Trees and Shrubs

- Existing tree and shrub communities show normal amounts of dead and decadent branches as well as high levels of regeneration, indicating current land uses (recreation in undeveloped areas and development) are not impacting tree and shrub health. In addition, these same factors suggest that there is sufficient moisture within the sites examined, and that disease is not a problem in maintaining these communities.
- Maintain the diversity and age class structure of trees and shrubs by maintaining currently successful land uses and management. Maintain current light browse (utilisation) of preferred trees and shrubs. Incorporate the impacts of wildlife in grazing/browsing into management decisions.

Non-Woody Species

- Native grasses were present within this reach but the overall presence of these species could be improved with management of disturbance and invasive species.
- Reduce the presence of disturbance-caused plants through sound grazing strategies that target non-native grasses, and prevent additional invasion of invasive weeds or disturbance-caused plants by both grazing management that ensures native plant vigour and avoids creating bare soil.

  Recreational and development management should minimise disturbance to avoid expansion of invasive and disturbance-caused species.
  These species are not having any significant impact on the stability of banks; management should aim to maintain and improve current deep-binding roots.

[7] Based on aerial photo interpretation and observations.

Physical Characteristics and Hydrologic Parameters

- Maintain current management practices and monitor future activities to keep physical impacts to a minimum and prevent additional impacts. Livestock, recreational activities, and transportation corridors are all contributing to structural alterations in this reach to some extent, so management and land use decisions should incorporate these broad areas.
- Maintain current flows and floodplain access for future maintenance of riparian plant communities and channel processes.

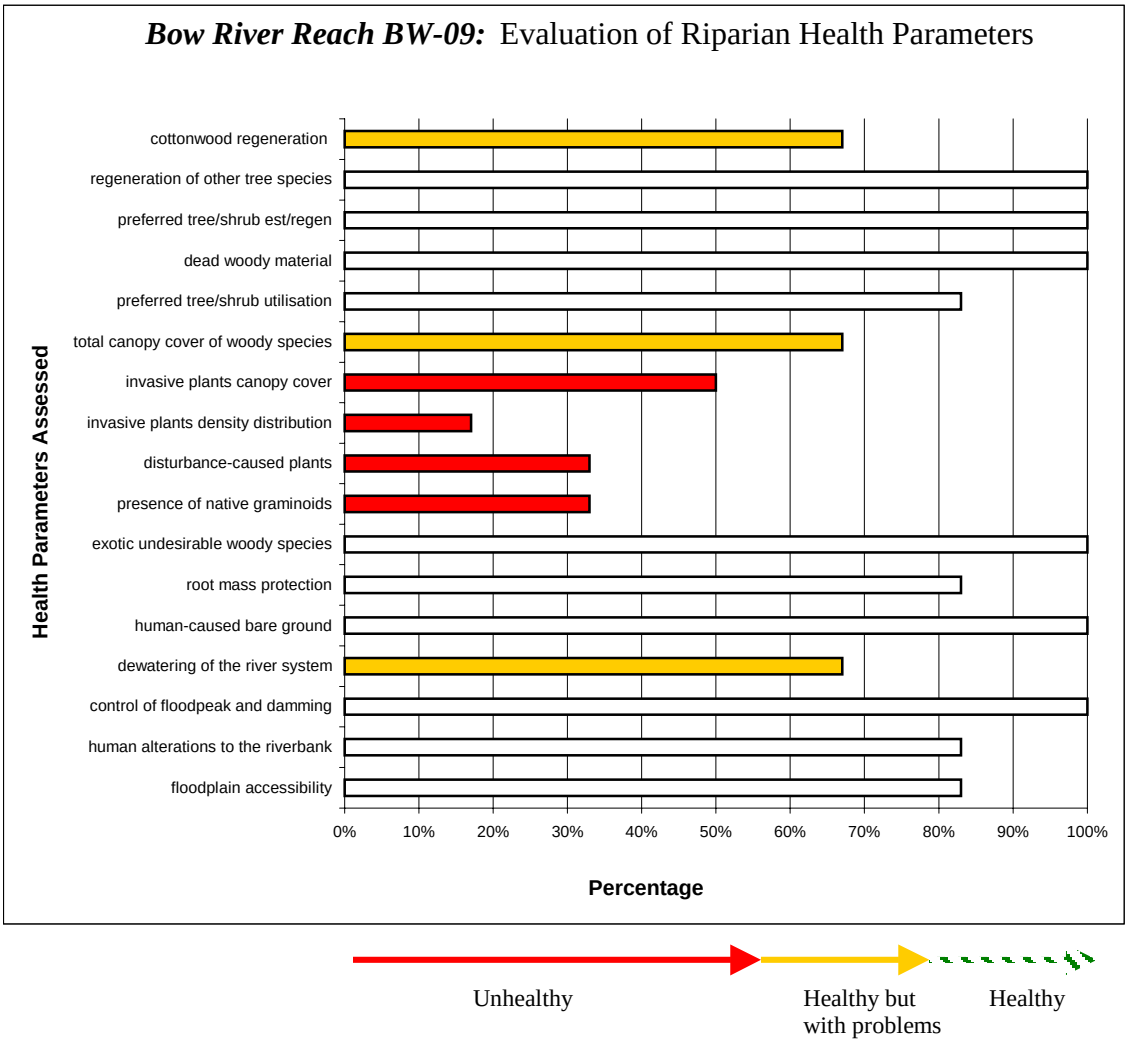
Alberta Environment Reach: Banff to Upstream of Canmore (BW-09)

- **One of the polygons in this reach scored in the healthy category and the other was rated as healthy but with problems.** The overall assessment of riparian health for reach BW-09 of the Bow River project area is as follows:

  - Of the 2 polygons assessed: 50% (1/2) are *healthy*,
    50% (1/2) are *healthy but with problems*,
    0% (0/2) are *unhealthy*.

Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure B4. Breakdown of riparian health results for 17 parameters assessed for the Bow River reach BW-09.

Historic and Present Influences on Riparian Health: Reach Comments

This reach encompasses a moderately forested landscape within Banff National Park and receives limited land use.

While the dominant land use identified for this reach is 'undeveloped', developed lands

(primarily urban or other dwellings/buildings) comprise 20% of the area along the river and adjacent lands[8]. Historic and current grazing by wildlife may also influence riparian health parameters in this reach.

Riparian Plant Communities

- Trees cover 33% of the area inventoried area, with moderately good regeneration of cottonwoods occurring. Other trees and shrubs are successfully establishing suitable amounts of seedlings and saplings. Utilisation is light to nil on preferred trees and shrubs.
- A diverse group of invasive species cover is of concern, with between 1 and 15% cover at one site, and extensively spread patches and individuals. Disturbance-caused plants are also a concern, with over 50% of one site covered in these species. This cover has replaced native graminoids, which amount to less than 5% of that site.

Physical Characteristics and Hydrologic Parameters

- Limited human-caused structural alterations are occurring along the riverbank in both of the polygons in this reach; railroads are the main cause of structural alterations in this reach. Human-caused bare ground from the railroad occurs in both polygons, however the amount occurring in this reach is not significantly hindering riparian function.
- Some areas within the reach have fairly well protected banks, with the remaining polygon having excellent deep-binding roots.
- Water withdrawals in this reach are minimal and are not impacting riparian health. Access to the full floodplain is somewhat limited in one polygon, but no barriers to floodwaters exist at the other site. No dams are present in this reach, so timing and peak flows are unimpacted.

Opportunities and Options for Improvement: BW-09

Trees and Shrubs

- Tree and shrub health is high; maintain and promote current management to maintain successful regeneration and light levels of browse.

Non-Woody Species

- Considering the extensive and diverse invasive and disturbance-caused species, management of development and recreational activities in the area should be examined to minimise further spread, and ideally, reduce the extent.

Physical Characteristics and Hydrologic Parameters

- Maintain limited human-caused structural alterations and human-caused bare ground due to recreation, development, and railroad.

  Promote bank stability by continuing to promote deep-rooted trees and shrubs, particularly in developed portions.
- Maintain current minimal water withdrawals and natural timing and peak flows. Limit additional barriers preventing floodplain access.

Alberta Environment Reach: Canmore to Upstream of

[8] Based on aerial photo interpretation and observations.

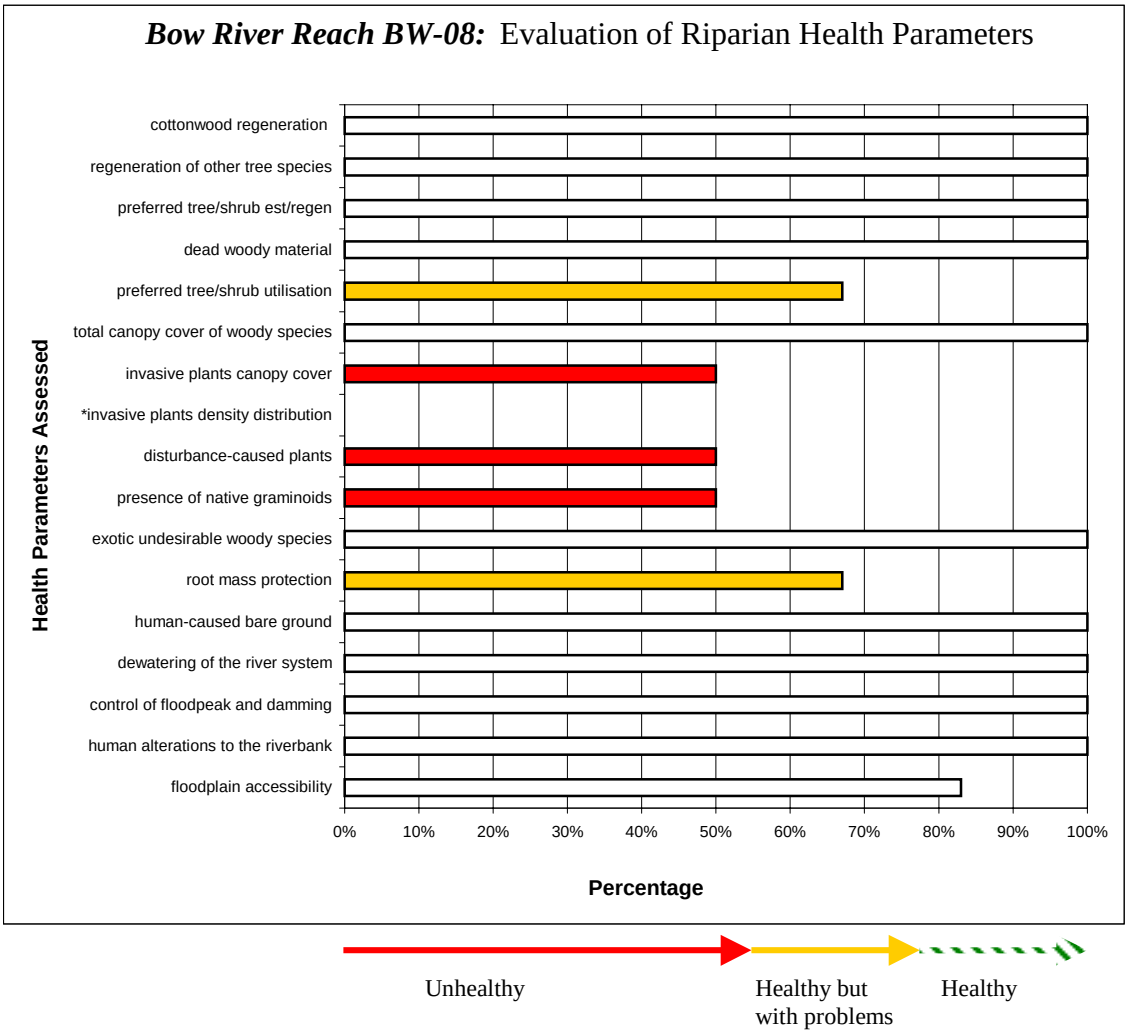
Kananaskis River Confluence (BW-08)

- **All of the polygons in this reach scored in the healthy category.** The overall assessment of riparian health for reach BW-08 of the Bow River project area is as follows:

  - Of the 2 polygons assessed: 100% (2/2) are *healthy*,
    0% (0/2) are *healthy but with problems*,
    0% (0/2) are *unhealthy*.

Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure B5. Breakdown of riparian health results for 17 parameters assessed for the Bow River Reach BW-08.
***** Invasive plant density distribution does not register on this graph because this parameter scored 0%.

Historic and Present Influences on Riparian Health: Reach Comments

This reach is in a partially forested landscape, in the Canmore and Kananaskis area.

While the dominant land use identified for this reach is 'undeveloped', developed lands (primarily urban or other dwellings/buildings) comprise just over 25% of the area along the river and adjacent lands[9]. Historic and current grazing by wildlife or livestock may also influence riparian health parameters in this reach.

Riparian Plant Communities

- Trees and shrubs are dominant in the inventoried area; these species occupy 87% of the area inventoried. There is excellent establishment and regeneration of *preferred* trees and shrubs in this reach. Utilisation is light on preferred trees and shrubs.
- Native grass cover is fair to good, with it being replaced by considerable areas of disturbance-caused species, and to a lesser extent, invasive plants. Invasive species are widespread throughout the area examined.

Physical Characteristics and Hydrologic Parameters

- Less than 10% of the riverbank length has human-caused structural alterations, but where they do exist, they are a result of housing developments and the presence of a pipeline. Human-caused bare ground is minimal and due to the presence of a pipeline and coal deposits within the riparian area. Riverbank root mass protection is variable, from excellent to poor.
- Water withdrawals in this reach are minimal and are not impacting riparian health. Access to the full floodplain is somewhat limited in one polygon due to a railroad, but no barriers to floodwaters exists at the other site. No dams are present in this reach, so timing and peak flows are unimpacted.

Opportunities and Options for Improvement: BW-08

Trees and Shrubs

- Tree and shrub health is high; maintain and promote current management to maintain successful regeneration and light levels of browse.

Non-Woody Species

- Considering the extensive and diverse invasive and disturbance-caused species, management of development and recreational activities in the area should be examined to minimise further spread, and ideally, reduce the extent. Consider promoting native herbaceous species use in developed landscapes.

Physical Characteristics and Hydrologic Parameters

- Maintain limited human-caused structural alterations and human-caused bare ground due to recreation, development, and railroad. Promote bank stability by continuing to promote deep-rooted trees and shrubs, particularly in developed portions.
- Maintain current minimal water withdrawals and natural timing and peak flows and prevent further impediments to floodplain accessibility.

[9] Based on aerial photo interpretation and observations.

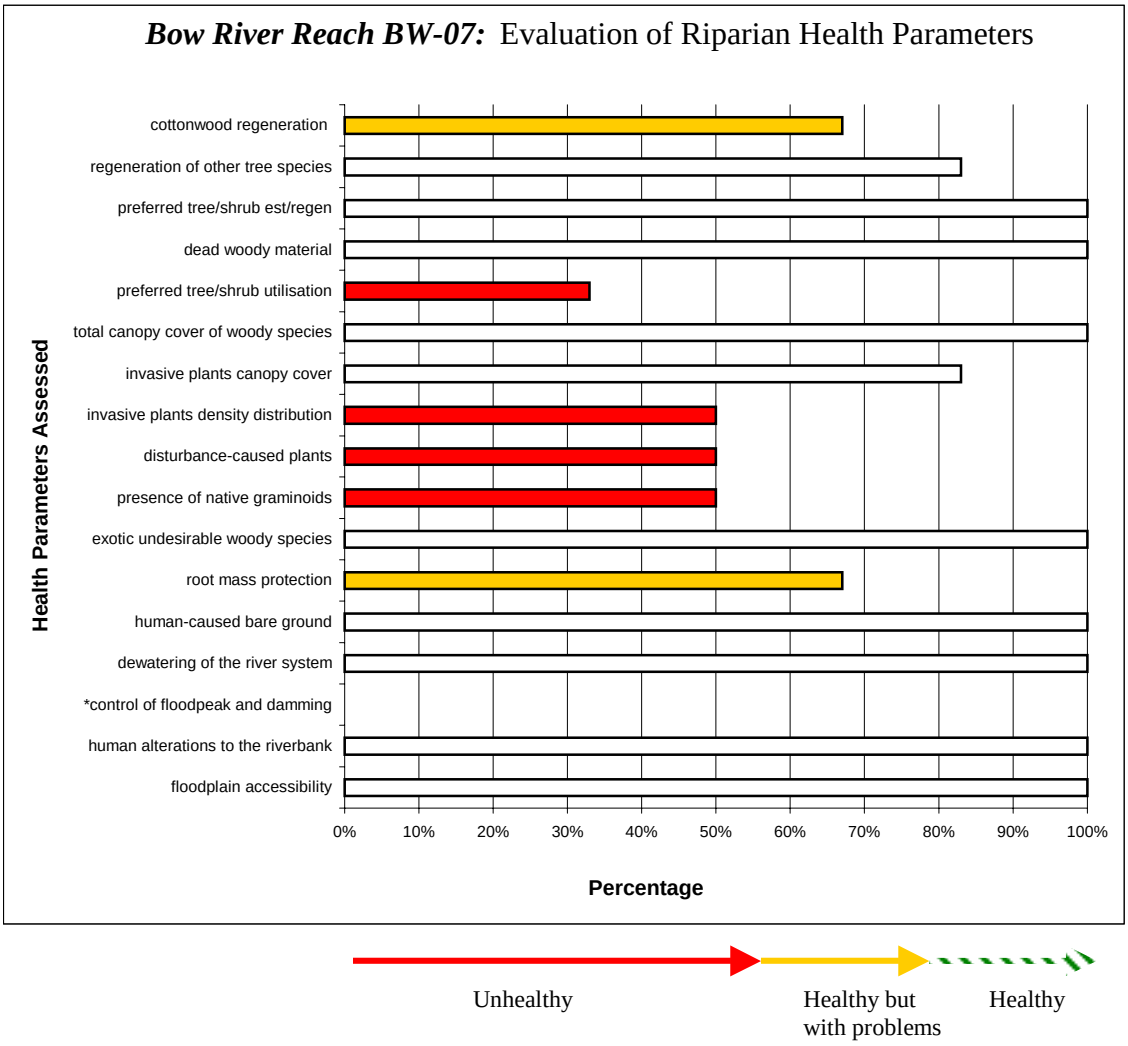
Alberta Environment Reach: Kananaskis River Confluence to Upstream of Ghost Dam (BW-07)

- **One of the polygons in this reach scored in the healthy category and the other was rated healthy but with problems.** The overall assessment of riparian health for reach BW-07 of the Bow River project area is as follows:

  - Of the 2 polygons assessed: 50% (1/2) are *healthy*,
    50% (1/2) are *healthy but with problems*,
    0% (0/2) are *unhealthy*.

Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure B6. Breakdown of riparian health results for 17 parameters assessed for Bow River reach BW-07.
***Control of flood peak and timing by upstream dams** does not register on this graph because this parameter scored 0%.*

Historic and Present Influences on Riparian Health: Reach Comments

Land use in this reach is dominated by grazing, with very small portions identified as developed and undeveloped. Historic and current grazing by wildlife and livestock may influence riparian health parameters in this reach. Damming upstream is rated as impacting control of flood peak and timing significantly.

Riparian Plant Communities

- Trees and shrubs communities are abundant in the area, with variable success at regeneration and establishment. In particular, one polygon has poor cottonwood regeneration, as well as moderate regeneration of other tree species. Utilisation at this site is heavy, and may be contributing to reduced seedlings and saplings. Light utilisation exists in the other polygon.
- Health of herbaceous communities is variable, with no invasive species and very low disturbance species in one polygon, but heavy invasive species infestations and extensive disturbance-caused species cover on the other site. Native grass cover is fair to good.

Physical Characteristics and Hydrologic Parameters

- Very limited human-caused structural alterations occur in one polygon, with no alterations present in the other polygon. Where present, livestock activity is the main cause of the alteration. Minimal human-caused bare ground exists; it is not of concern to riparian health. Riverbank root mass protection is variable, from excellent to poor.
- Water withdrawals in this reach are minimal and are not impacting riparian health. Access to the full floodplain is not restricted. Two upstream dams are impacting the riparian health rating. The Kananaskis Falls Dam and Horseshoe Dam are located upstream of this reach and therefore are impacting the water flow through this reach, controlling over 50% of the upstream watershed.

Opportunities and Options for Improvement: BW-07

Trees and Shrubs

- Tree and shrub health is generally high, but improvements to cottonwood regeneration could be made, and may link to the proportion of damming upstream. Additional rest from grazing is required at the site with heavy browse to ensure continued recruitment of seedlings and saplings.

Non-Woody Species

- Maintain current practices that have resulted in no invasive species and limited disturbance species, and considering adding additional rest, improved distribution, timing and stock densities that promote native plant vigour and utilise disturbance species when that use will promote native over non-native species.

Physical Characteristics and Hydrologic Parameters

- Continue to maintain limited human-caused structural alterations and human-caused bare ground due livestock. Promote bank stability by continuing to promote deep-rooted trees and shrubs, particularly in the lower polygon.
- Maintain current minimal water withdrawals and ensure continued floodplain accessibility. Due to extensive damming upstream, there could be future concerns with cottonwood (and other tree or shrub) regeneration. Monitor flow peaks to understand the long-term implications to a successfully regenerating riparian community.

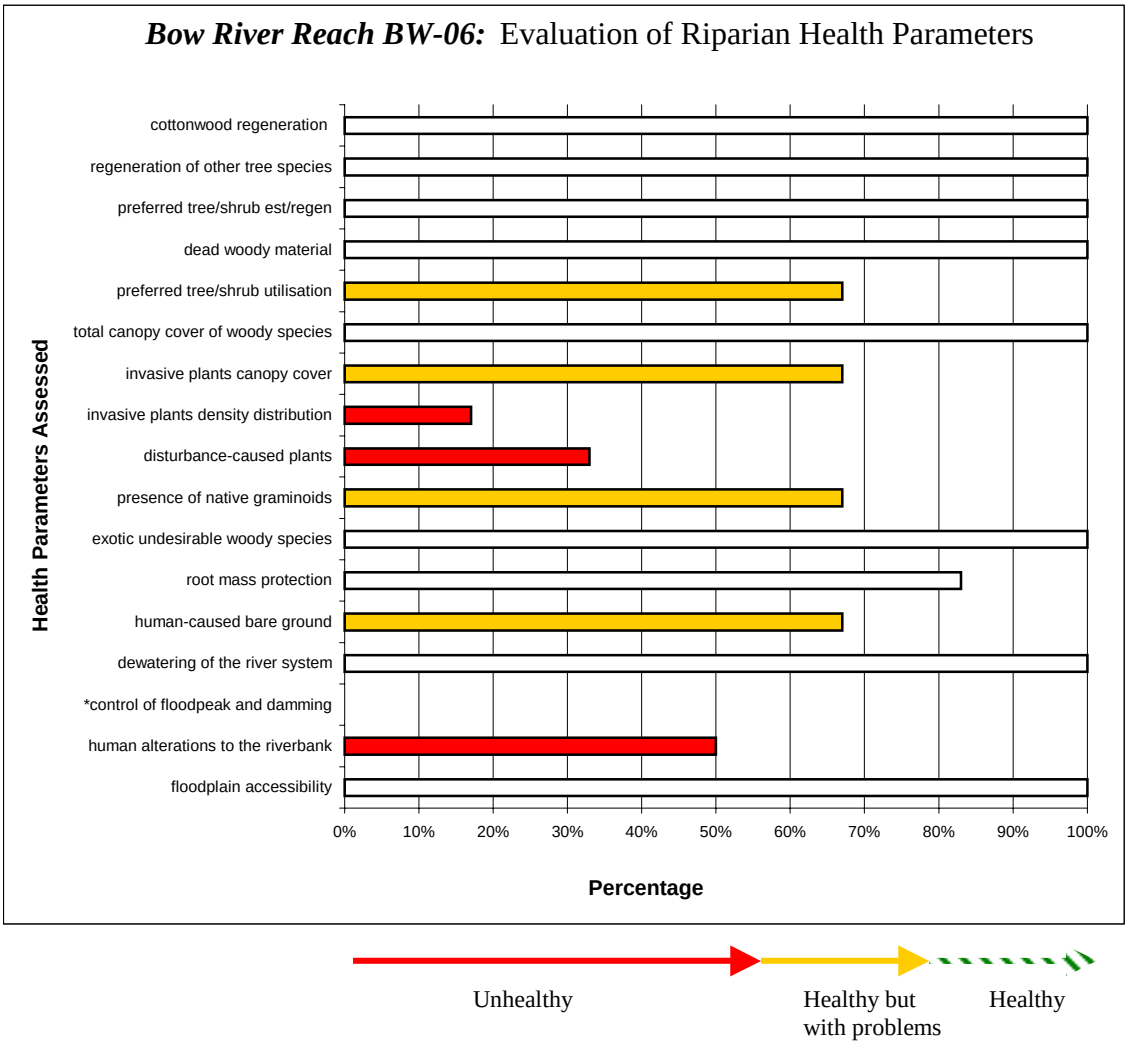
Alberta Environment Reach: Ghost Dam to Bearspaw Dam (BW-06)

- **All of the polygons in this reach scored in the healthy but with problems category.** The overall assessment of riparian health for reach BW-06 of the Bow River project area is as follows:

  - Of the 2 polygons assessed: 0% (0/2) are *healthy*,
    100% (0/2) are *healthy but with problems*,
    0% (0/2) are *unhealthy*.

Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure B7. Breakdown of riparian health results for 17 parameters assessed for Bow River reach BW-06.
**Control of flood peak and timing by upstream dams does not register on this graph because this parameter scored 0%.*

Historic and Present Influences on Riparian Health: Reach Comments

Land use in this reach is approximately half grazing, with one-quarter developed land (chiefly Cochrane area), and about one-fifth undeveloped.
A very small portion is identified as cropping. Historic and current grazing by wildlife and livestock may influence riparian health parameters in this reach. Damming upstream is rated as impacting control of flood peak and timing significantly.

Riparian Plant Communities

- 4 different plant communities were identified, with trees and shrub cover abundant. Regeneration and establishment of all groups of trees and shrubs is excellent, with light utilisation on preferred trees and shrubs.
- Health of herbaceous communities is variable, with few invasive species and low canopy cover of disturbance species in one polygon, but extensive invasive species infestations and widespread disturbance-caused species cover on the other site. Native grass cover is fair to good. Yellow toadflax, Canada thistle and perennial sow thistle are the invasive weeds that were found in this reach.

Physical Characteristics and Hydrologic Parameters

- Limited human-caused structural alterations occur in this reach, with livestock and riprap contributing to structural impacts. Small amounts of human-caused bare ground exist due to recreation, roads and riprap, but are not of concern to overall riparian health. Riverbank root mass protection is fairly good to excellent, and results from the extensive woody plants along the banks.
- Water withdrawals in this reach are minimal and are not impacting riparian health. Access to the full floodplain is not restricted. Three upstream dams are impacting the riparian health rating because over 50% of the upstream watershed is dammed (Kananaskis Falls Dam, Horseshoe Dam and Ghost Dam).

Opportunities and Options for Improvement: BW-06

Trees and Shrubs

- As in upstream reaches, tree and shrub communities show normal amounts of dead and decadent branches, as well as high levels of regeneration, indicating current land use and hydrologic regime are not presenting impacting tree and shrub health. Maintain existing management of livestock that is resulting in light utilisation.

Non-Woody Species

- Attempt to limit further spread of invasive plants and extensive disturbance-caused plants through appropriate grazing strategies or increased weed control and planting of native species (primarily developed areas).

Physical Characteristics and Hydrologic Parameters

- Human-caused structural impacts and bare ground from livestock, recreation and riprap are small, and should be maintained as such with continued appropriate grazing management, and attention to development activities.
- Maintain current minimal water withdrawals and ensure continued floodplain accessibility, particularly in urban settings where the greatest likelihood for impediments to flow exists. Due to extensive damming upstream, there could be future concerns with cottonwood (and other tree or shrub) regeneration.
  Monitor tree and shrub community, in addition to flow peaks to understand the long-term implications to a successfully regenerating riparian community.

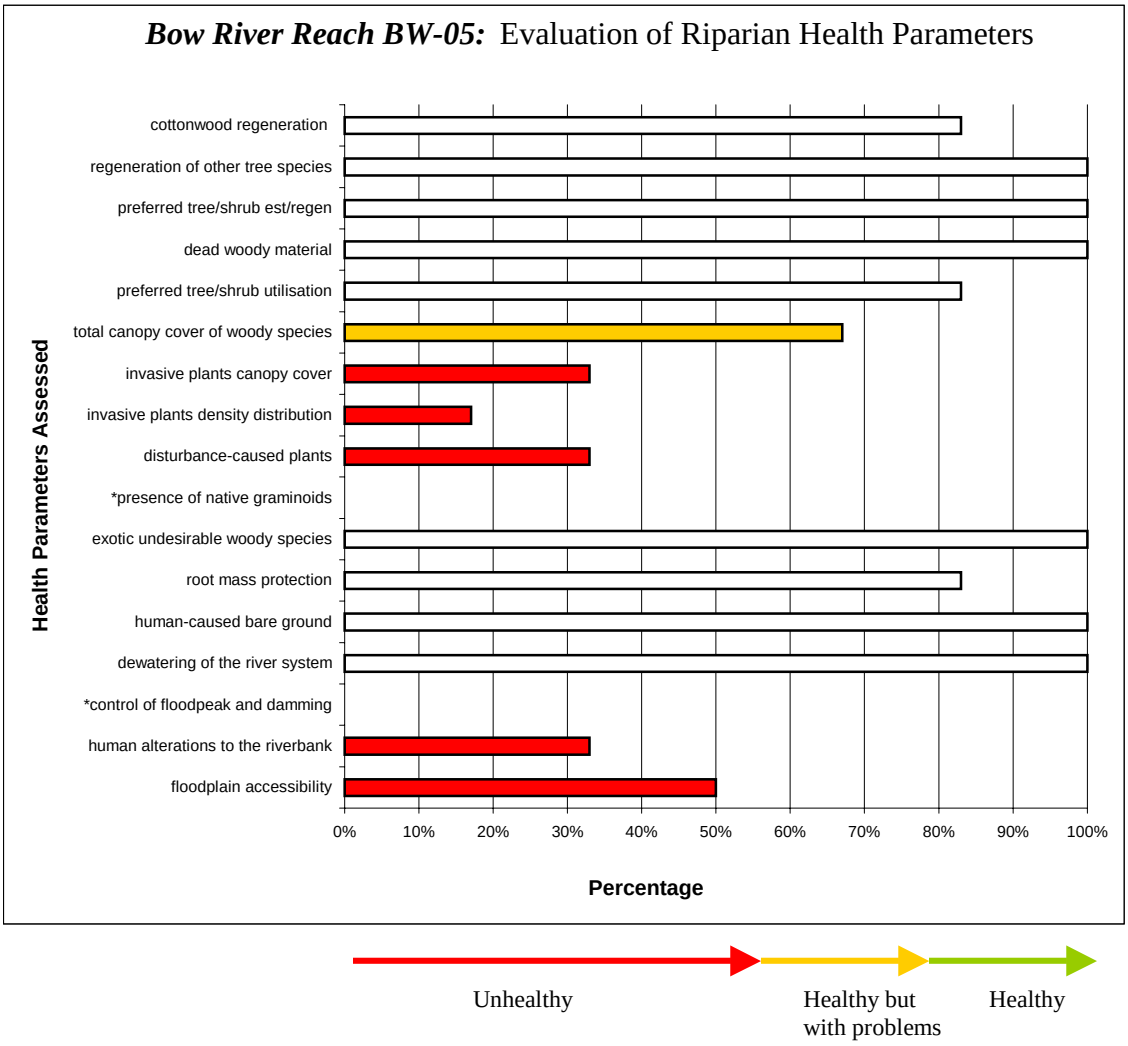
Alberta Environment Reach: Bearspaw Dam to Upstream of WID Weir (BW-05)

- **One of the polygons in this reach scored in the healthy but with problems category and the other polygon rated unhealthy.** The overall assessment of riparian health for reach BW-05 of the Bow River project area is as follows:

  - Of the 2 polygons assessed: 0% (0/2) are *healthy*,
    50% (1/2) are *healthy but with problems*,
    50% (1/2) are *unhealthy*.

Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure B8. Breakdown of riparian health results for 17 parameters assessed for Bow River reach BW-05.
**Presence of native graminoids and control of flood peak and timing by upstream dams do not register on this graph because these parameters scored 0%.*

Historic and Present Influences on Riparian Health: Reach Comments

Land use in this reach is heavily dominated by developed lands (City of Calgary), with just over 10% in undeveloped lands (parks and green spaces).
Development in this area has a long history and has had many decades to impact riparian health. Floodplain accessibility and damming upstream are rated as these areas.

Riparian Plant Communities

- 3 different plant community types were identified, with trees and shrub cover much less abundant in this reach compared to upstream reaches. Regeneration and establishment of trees and shrubs is excellent, with nil to light utilisation on preferred trees and shrubs. A number of ornamental tree species were found in this area—these species are not substantially regenerating.
- Considerably diverse invasive species and cover of disturbance species is impacting the herbaceous community, with very small amounts of cover provided by native graminoids.

Physical Characteristics and Hydrologic Parameters

- Riprap is significantly impacting bank integrity in one polygon, with recreation and roads influencing a moderate amount of the other site. Recreational Riverbank root mass protection is good to excellent, and results from the extensive woody plants along the banks.
- Water withdrawals are not impacting riparian health in this reach. Access to the full floodplain is variable, from severely restricted to unrestricted. Four upstream dams are impacting the riparian health rating, with over 50% of the upstream watershed is dammed (Kananaskis Falls Dam, Horseshoe Dam , Ghost Dam and Bearspaw Dam).

Opportunities and Options for Improvement: BW-05

Trees and Shrubs and *Non-Woody Species*

- Although regeneration and establishment is relatively high, the proportion of area with trees and shrubs is lower than upstream areas, while disturbance species are widespread and native graminoids diminished. Manage development and recreational activities in the area to minimise further spread on non-natives and reduce their extent by encouraging native herbaceous and woody species use in developed landscapes. Monitor the area to ensure non-native trees are not displacing native trees. Implement invasive weed control.

Physical Characteristics and Hydrologic Parameters

- Minimise further structural impacts, including riprap and floodplain protection. Maintain current minimal water withdrawals.
- Due to extensive damming upstream, there could be future concerns with cottonwood (and other tree or shrub) regeneration—slightly reduced cottonwood regeneration at one site may be an indicator of current and past impacts to successful seedling establishment. Carefully monitor tree and shrub community, in addition to flow peaks to understand the long-term implications to a successfully regenerating riparian community.

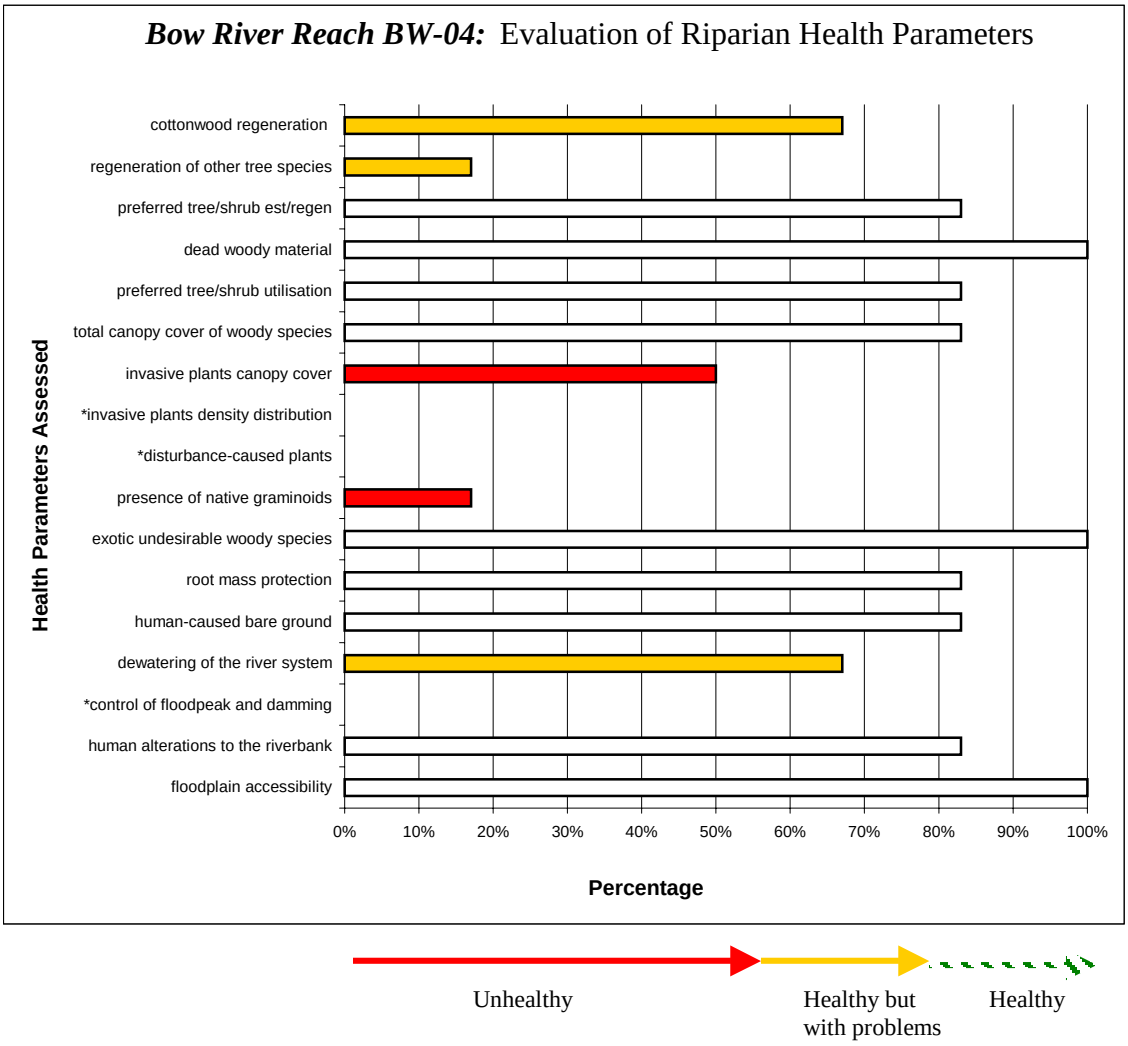
Alberta Environment Reach: WID Weir to Upstream of Highwood River Confluence (BW-04)

- **One of the polygons in this reach scored in the healthy but with problems category and the other polygon rated unhealthy.** The overall assessment of riparian health for reach BW-04 of the Bow River project area is as follows:

  - Of the 2 polygons assessed: 0% (0/2) are *healthy*,
    50% (1/2) are *healthy but with problems*,
    50% (1/2) are *unhealthy*.

Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure B9. Breakdown of riparian health results for 17 parameters assessed for Bow River reach BW-04.
**Invasive plants density distribution, disturbance-increaser undesirable herbaceous species and control of flood peak and timing by upstream dams do not register on this graph because these parameters scored 0%.*

Historic and Present Influences on Riparian Health: Reach Comments

Land use in this reach is heavily dominated by developed lands (City of Calgary), with a mixture of other land uses: grazing (30%), cropping (6%) and undeveloped lands (9%). Development and agriculture both have a long history in the area. Impacts to the hydrology include water withdrawals, some limits to floodplain accessibility and damming upstream.

Riparian Plant Communities

- 4 different plant community types were identified, with trees and shrub cover similar to the upstream reach, with approximately 25-30% cover by each. Regeneration is present within this reach, however in one of the sites regeneration of cottonwoods and other tree species is minimal, with moderate regeneration of preferred shrub species. The other site has excellent cottonwood and preferred shrub regeneration, but very poor aspen regeneration. Light to no utilisation is occurring on preferred trees and shrubs.
- Extensive distribution of invasive species and over 50% cover of disturbance species is impacting the herbaceous community, with very small amounts of cover provided by native graminoids.

Physical Characteristics and Hydrologic Parameters

- Human-caused structural modifications and bare ground are present in very small or moderate amounts in both polygons. Riprap and recreational activity is impacting bank integrity and health rating, primarily at one site. Recreational trails are the main source of human-caused bare ground. Riverbank root mass protection is good to excellent.
- Dewatering from water withdrawals is moderately impacting riparian health, but floodplain accessibility is good. Four upstream dams are impacting the riparian health rating due to changes in peak flow and timing, with over 50% of the upstream watershed dammed (Kananaskis Falls Dam, Horseshoe Dam , Ghost Dam and Bearspaw Dam).

Opportunities and Options for Improvement: BW-04

Trees and Shrubs

- Limited regeneration of cottonwoods (1 site) and other trees (both sites) may be reflecting impacts due to changes in flood peak and timing or dewatering, since browse pressure (from wildlife within Calgary), which is light to nil, is not reducing plant vigour.

Non-Woody Species

- Disturbance species are widespread and native graminoids diminished; manage development and recreational activities in the area to minimise further spread on non-natives and reduce their extent by encouraging native herbaceous and woody species use in developed landscapes. Implement invasive weed control.

Physical Characteristics and Hydrologic Parameters

- Minimise further structural impacts, including riprap and floodplain protection. Maintain current minimal water withdrawals.
- Due to extensive damming upstream, there could be future concerns with cottonwood (and other tree or shrub) regeneration—see above comment under *Trees and Shrubs.*

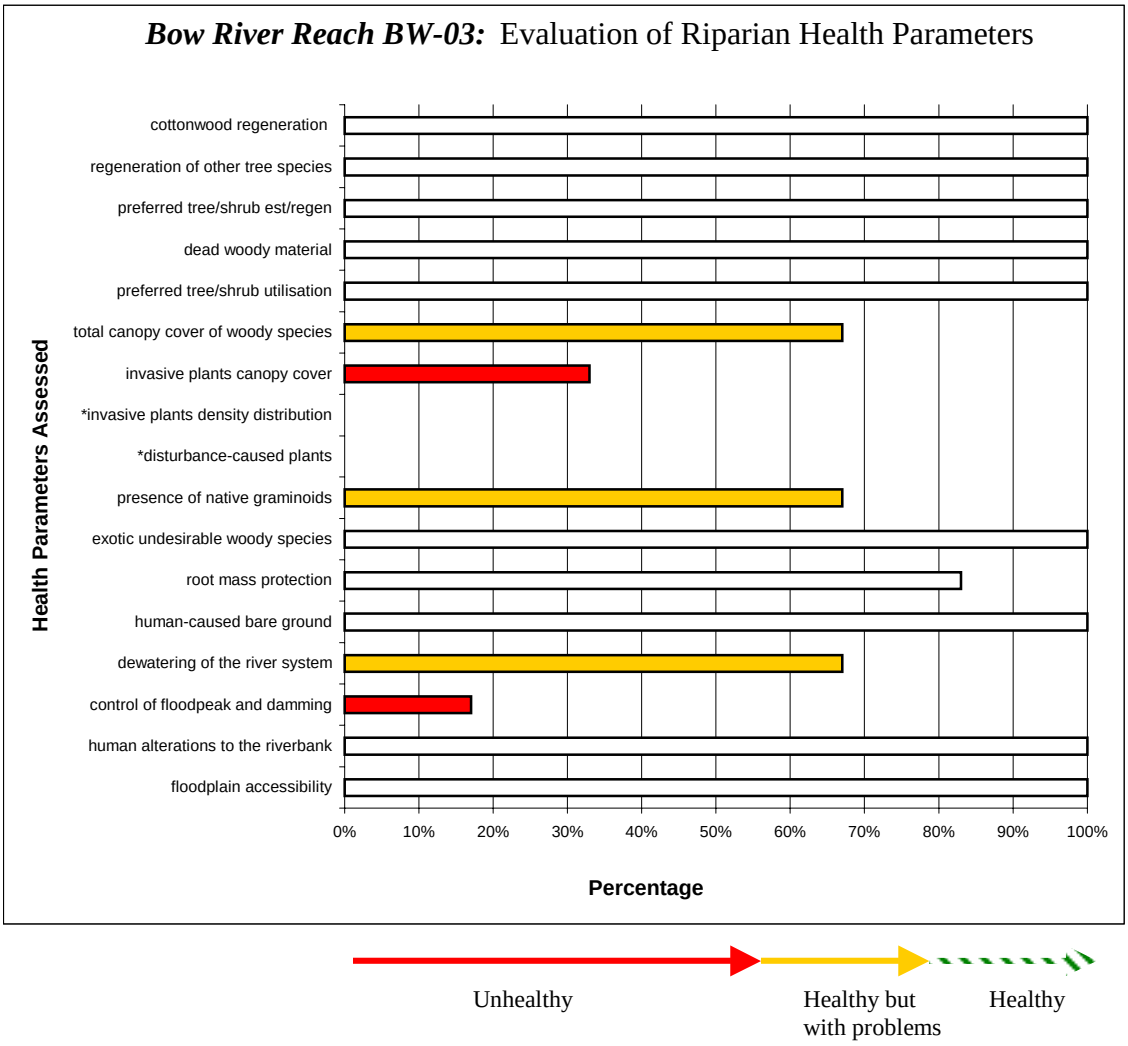
Alberta Environment Reach: Highwood River Confluence to Upstream of Carseland Weir (BW-03)

- **All of the polygons in this reach scored in the healthy but with problems category.** The overall assessment of riparian health for reach BW-03 of the Bow River is as follows:

  - Of the 2 polygons assessed: 0% (0/2) are *healthy*,
    100% (2/2) are *healthy but with problems*,
    0% (0/2) are *unhealthy*.

Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure B10. Breakdown of riparian health results for 17 parameters assessed for Bow River reach BW-03.
****** Invasive plant density distribution and disturbance-increaser undesirable herbaceous species do not register on this graph because these parameters scored 0%.*

Historic and Present Influences on Riparian Health: Reach Comments

Land use in this reach is heavily dominated by grazing, with a very small amount of the reach length in cropping. Agriculture has been in this area for over a century.
Riparian health is also related to withdrawals and damming upstream.

Riparian Plant Communities

- While 6 different plant community types were identified, trees cover only 12% of the inventoried area. There is excellent establishment and regeneration of *preferred* trees and shrubs in this reach. Utilisation on preferred trees and shrubs within this reach is rated as nil.
- Invasive and disturbance species are of concern, with extensive distribution of invasive species and 60% cover by disturbance species. Native graminoid cover is moderate, but could be at risk of replacement by non-native grasses.

Physical Characteristics and Hydrologic Parameters

- Human-caused structural modifications and bare ground are present in very small amounts in both polygons, and are not impacting riparian health. Recreational trails are the source of minor structural impacts, while livestock and recreation are causing very small amounts of bare ground. Riverbank root mass protection is good to excellent.
- Water withdrawals are removing 10-25% of the average river discharge, impacting riparian health. Upstream dams are impacting the riparian health rating due to changes in peak flow and timing, with 25-50% or over 50% of the upstream watershed dammed (Kananaskis Falls Dam, Horseshoe Dam , Ghost Dam and Bearspaw Dam).

Opportunities and Options for Improvement: BW-03

Trees and Shrubs

- Although tree and shrub communities show normal amounts of dead and decadent branches and excellent regeneration, there may be some need for monitoring of long-term success of plants with modified hydrologic parameters. Current grazing management does not appear to be reducing woody plant health, with light grazing levels.

Non-Woody Species

- Extensive disturbance-caused plants could be held in check or reduced through sufficient rest and appropriate timing that promotes native graminoid vigour. Historic introduction (accidental or intentional) of tame forage species will be difficult to change, but certainly current management appears to be maintaining moderate to good native graminoid cover. Weed control to prevent further invasive species spread is important.

Physical Characteristics and Hydrologic Parameters

- Minimal structural and bare ground impacts suggest that current grazing management is providing effective rest and timing to avoid soil compaction and eliminate any substantial bare soil.

- Water withdrawals and damming upstream do not appear to be impacting seedling establishment, but there could be future concerns with cottonwood (and other tree or shrub) regeneration, which warrants monitoring to ensure establishment of seedlings/saplings results in maintenance and survival to mature plants.

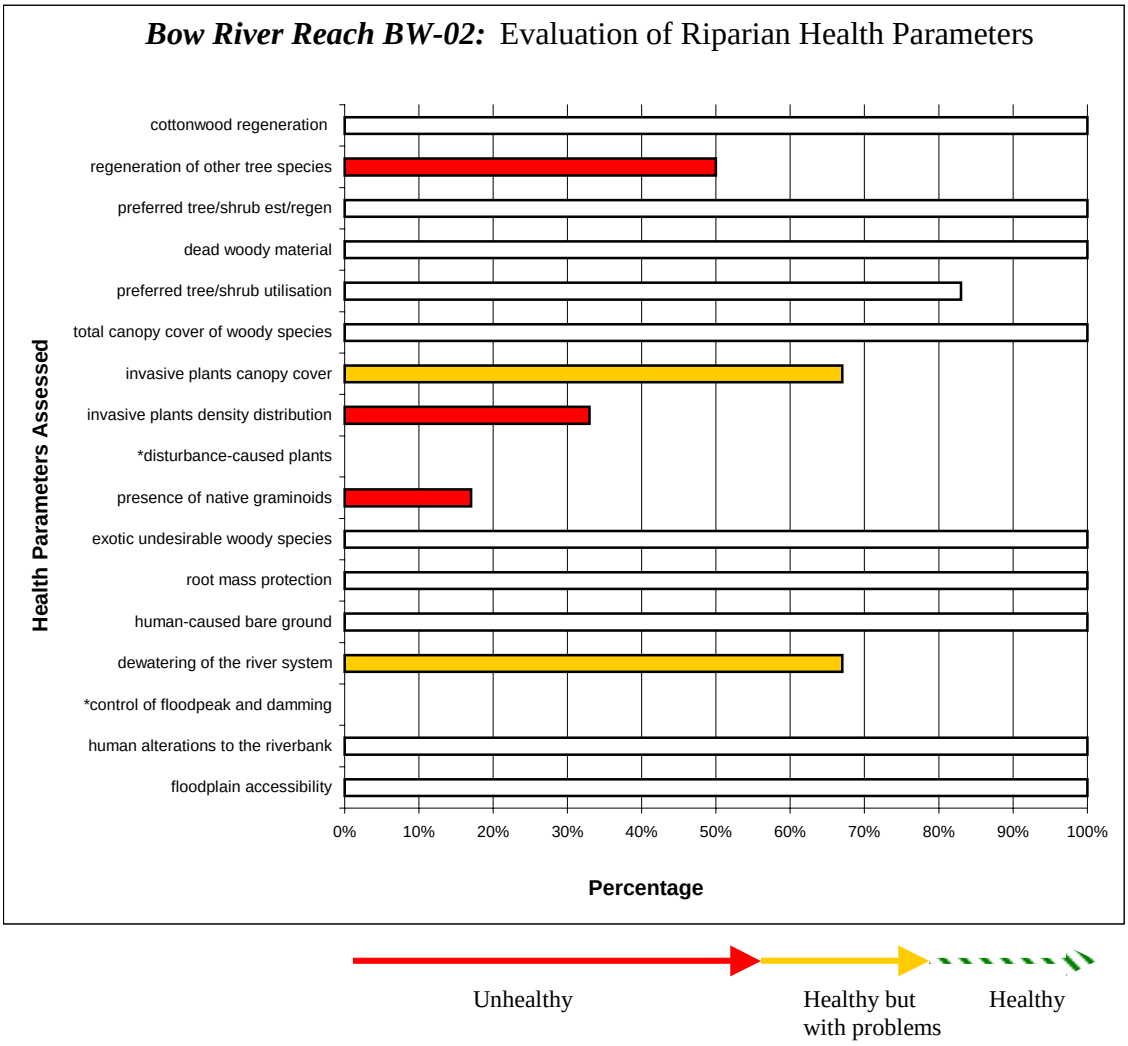
Alberta Environment Reach: Carseland Weir to Upstream of Bassano Dam (BW-02)

- **All of the polygons in this reach scored in the healthy but with problems category.** The overall assessment of riparian health for reach BW-02 of the Bow River project area is as follows:

  - Of the 2 polygons assessed: 0% (0/2) are *healthy*,
    100% (2/2) are *healthy but with problems*,
    0% (0/2) are *unhealthy*.

Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure B11. Breakdown of riparian health results for 17 parameters assessed for Bow River reach BW-02.
****** Disturbance-increaser undesirable herbaceous species and control of flood peak and timing by upstream dams do not register on this graph because these parameters scored 0%.*

Historic and Present Influences on Riparian Health: Reach Comments

Land use in this reach is heavily dominated by grazing, with a very small amount in each of cropping, development and undeveloped lands.
Agriculture has been in this area for over a century. Riparian health ratings are also related to withdrawals and damming upstream.

Riparian Plant Communities

- Although shrubs cover 80% of the inventoried area, a considerable portion of these are grazing-resistant species (buckbrush and rose). Only 17% of the area is covered by trees. Regeneration of cottonwoods and preferred trees and shrubs is excellent; other tree species are reproducing well on one site, but are absent from the other site, which was identified as having potential to support them. Utilisation on preferred trees and shrubs is light to nil.
- Invasive and disturbance species are of concern, with extensive distribution of invasive species and 64% cover by disturbance species. Native graminoid cover is poor to moderate.

Physical Characteristics and Hydrologic Parameters

- Human-caused structural modifications and bare ground are present in very small amounts in both polygons, and are not impacting riparian health. Livestock activities are the source of these small amounts of physical modification the polygons. Riverbank root mass protection is excellent.
- Water withdrawals are removing 10-25% of the average river discharge, impacting riparian health. Upstream dams are impacting the riparian health rating due to changes in peak flow and timing, with over 50% of the upstream watershed dammed (Kananaskis Falls Dam, Horseshoe Dam , Ghost Dam , Bearspaw Dam and Carseland Weir).

Opportunities and Options for Improvement: BW-02

Trees and Shrubs

- Current successful regeneration and very light browse suggests that current and recent management of livestock grazing is not hindering woody plant communities, but there may have been past impacts that lead to the prominence of grazing-resistant shrub species. Appropriate stocking rates and rest in the growing season will assist preferred tree and shrub to increase. Monitoring of maintenance of woody plants under the current hydrologic modifications would follow long-term success of seedling and sapling establishment.

Non-Woody Species

- Extensive disturbance-caused species and invasive plants suggest either localised past impacts from livestock, intentional introduction of tame species, or perhaps some relationship to hydrologic parameters and past flood events (eg. creation of exposed soil and seed sources). Grazing strategies that promote increased native plant vigour should reduce expansion of these invasive and disturbance-caused species; weed control to reduce further spread of invasive species is important.

Physical Characteristics and Hydrologic Parameters

- Continue to minimise livestock impacts to banks and soil using distribution tools, appropriate timing and stocking rates. Maintain and support current grazing management that results in light rates of utilisation.
- Moderate water withdrawals and extensive damming upstream do not appear to be impacting seedling establishment, but there could be future concerns with cottonwood (and other tree or shrub) regeneration, which warrants monitoring to ensure establishment of seedlings/saplings results in maintenance and survival to mature plants.

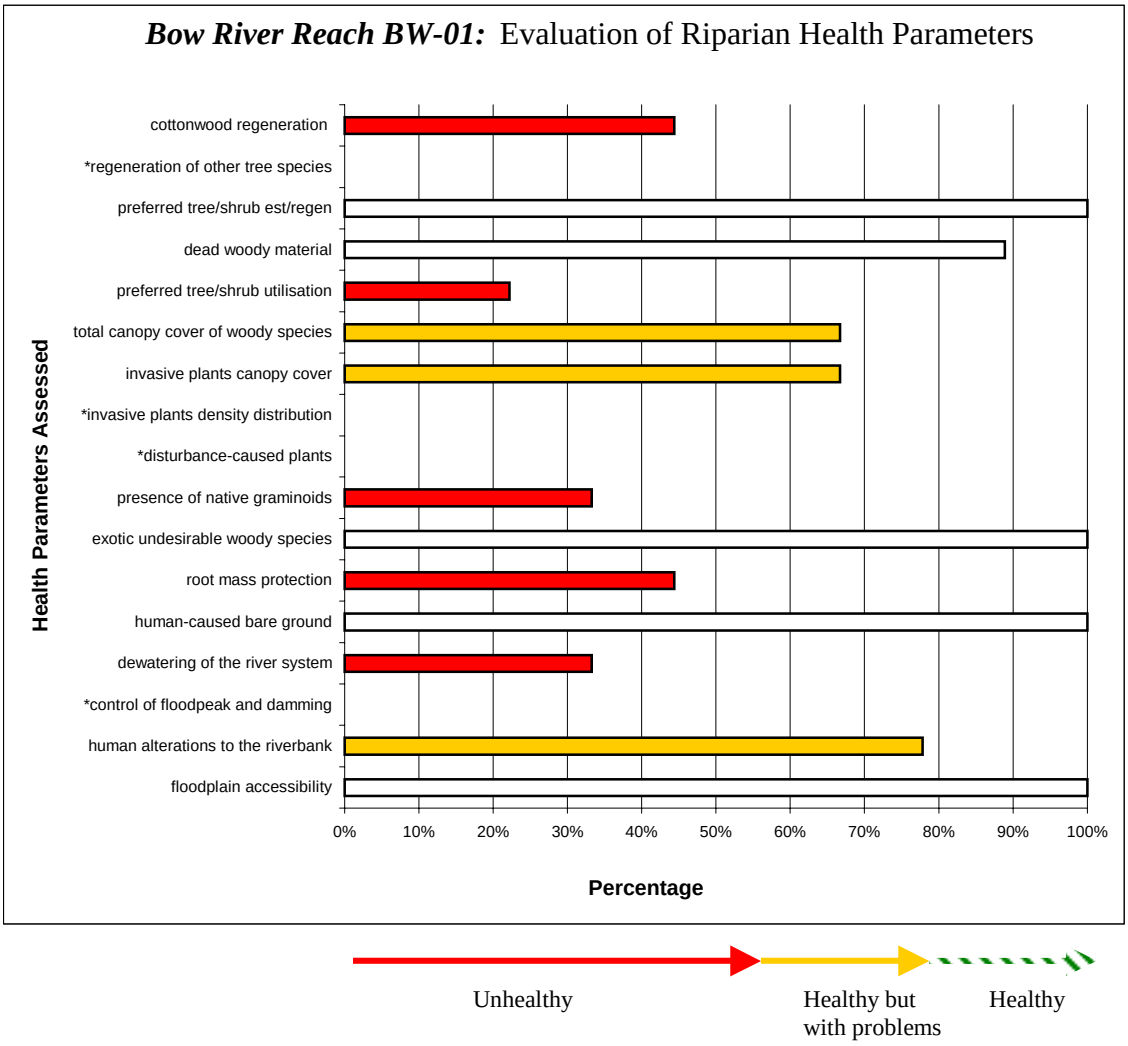
Alberta Environment Reach: Bassano Dam to Grand Forks (Confluence of South Saskatchewan River) (BW-01)

- **All of the polygons in this reach scored in the unhealthy category.** The overall assessment of riparian health for reach BW-01 of the Bow River project area is as follows:

  - Of the 3 polygons assessed: 0% (0/3) are *healthy*,
    0% (0/3) are *healthy but with problems*,
    100% (3/3) are *unhealthy*.

Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure B12. Breakdown of riparian health results for 17 parameters assessed for Bow River reach BW-01.
*******Regeneration of other tree species, invasive species density distribution, disturbance-increaser undesirable herbaceous species and control of flood peak and timing by upstream dams do not register on this graph because these parameters scored 0%..*

Historic and Present Influences on Riparian Health: Reach Comments

Land use in this reach is dominated by grazing, with a small amount in cropping (13%) and a very small amount developed (<1%). Agriculture has been in this area for more than a century. Riparian health ratings are also relate to withdrawals and damming upstream.

Riparian Plant Communities

- Preferred tree and shrub communities are present, however the presence of tree communities is very insignificant within BW-01; shrubs cover 46% of the area, while trees only cover 1%. 8 different plant communities were identified.
- Regeneration of preferred shrubs is excellent, but cottonwood regeneration ranges from absent to excellent, with an overall rating of fair. Other tree species (eg. Manitoba maple) are not found in the reach, but potential exists for them to use the area. Utilisation is moderate to heavy.
- Invasive species do not provide extensive cover, but are widely distributed. Disturbance-caused species cover over half of the area. Native graminoid cover is variable, from good to very poor.

Physical Characteristics and Hydrologic Parameters

- Very minimal human-caused structural bare ground exists, and is not impacting riparian health. Structural alterations to the riverbanks are minimal at two sites, but extensive at the one site. Livestock, roads, pipelines and power lines are the main causes of alterations within this reach. Deep-binding roots are moderately extensive on two sites, but very limited on the third.
- Water withdrawals are removing over 25% of the average river discharge, impacting riparian health and 6 upstream dams are impacting the riparian health rating due to changes in peak flow and timing, with over 50% of the upstream watershed dammed (Kananaskis Falls Dam, Horseshoe Dam , Ghost Dam , Bearspaw Dam, Carseland Weir and Bassano Dam).

Opportunities and Options for Improvement: BW-01

Trees and Shrubs

- Variable, including poor, regeneration of preferred tree species may be linked to the very small proportion of area covered by trees in this reach. Utilisation is currently moderate to heavy and, in conjunction with reduced flows and altered peak and timing, may be limiting establishment and maintenance of preferred trees and shrubs. Focus on adding additional rest and avoiding browsing-susceptible periods in grazing management to reduce browse pressure.
- Monitoring of maintenance of woody plants under the current hydrologic modifications would follow long-term success of seedling and sapling establishment.

Non-Woody Species

- Reduce the extent of disturbance-caused species with appropriate grazing strategies that promote increased native plant vigour. Control weeds to reduce further spread of invasive species.

Physical Characteristics and Hydrologic Parameters

- Continue to minimise livestock impacts to banks and soil using distribution tools, appropriate timing and stocking rates.
- There is good riverbank root mass protection in two of the polygons in this reach, with 65-85% of the bank with deeply rooted vegetation, but there is room for improvement.

The other site has poor root mass protection with less than 35% of the bank protected by deeply rooted vegetation and this could be improved.

- Moderate water withdrawals and extensive damming upstream do not appear to be impacting seedling establishment, but there could be future concerns with cottonwood (and other tree or shrub) regeneration, which warrants monitoring to ensure establishment of seedlings/saplings results in maintenance and survival to mature plants. Maintain current flows as a minimum.

SOUTH SASKATCHEWAN RIVER PROJECT AREA

The project area is defined as a selection of riparian areas along the South Saskatchewan River from the confluence of the Bow and Oldman Rivers (the Grand Forks) to the Alberta/Saskatchewan provincial border (refer to project area map – Figure 1). This amounts to a distance of approximately 286 km, of which just under 13 km was sampled at 8 polygons (Table S1, Appendix S11).

Riparian areas in the examined sites were up to 700 m wide, with a wide range in maximum widths (40 m to 700m). Riparian area width was on average 112 m (Appendix S13). The upper 3 polygons were rated as slightly incised (Appendix S12). Diverse vegetation is dominated by native species, although both invasive herbaceous and disturbance-caused plants are widespread, limiting native graminoid communities. There were no invasive tree species found in the project area. Choke cherry (*Prunus virginiana*) community type (CT) covered the largest area of any CT (Appendix S7). Plains cottonwood (*Populus deltoides*) was the most abundant tree species.

WHAT DID WE FIND?

- **The level of awareness about the project was very low.** Landowners were hesitant about participating in the project. Generally, those landowners who participated showed some interest in determining the health of the riparian area. Thanks to everyone who allowed access to their land and supported this riparian inventory initiative. In all, 3 polygons were assessed along the South Saskatchewan River in 2003 and the remaining 5 were assessed in 2000 (Canadian Forces Base, Suffield graciously agreed to share this data for the current project; Appendix G3).

- **There are concerns with the overall health of this riparian area.** No sites were rated as healthy, with over half rated as unhealthy in relation to the non-functioning condition guidelines within the inventory protocol (Appendix G1). The overall assessment of riparian health for the South Saskatchewan River project area is as follows (Figure S1, Appendix S1);

  - Of the 8 polygons assessed: 0% (0/8) are *healthy*,
    37.5% (3/8) are *healthy but with problems*,
    62.5% (5/8) are *unhealthy*.

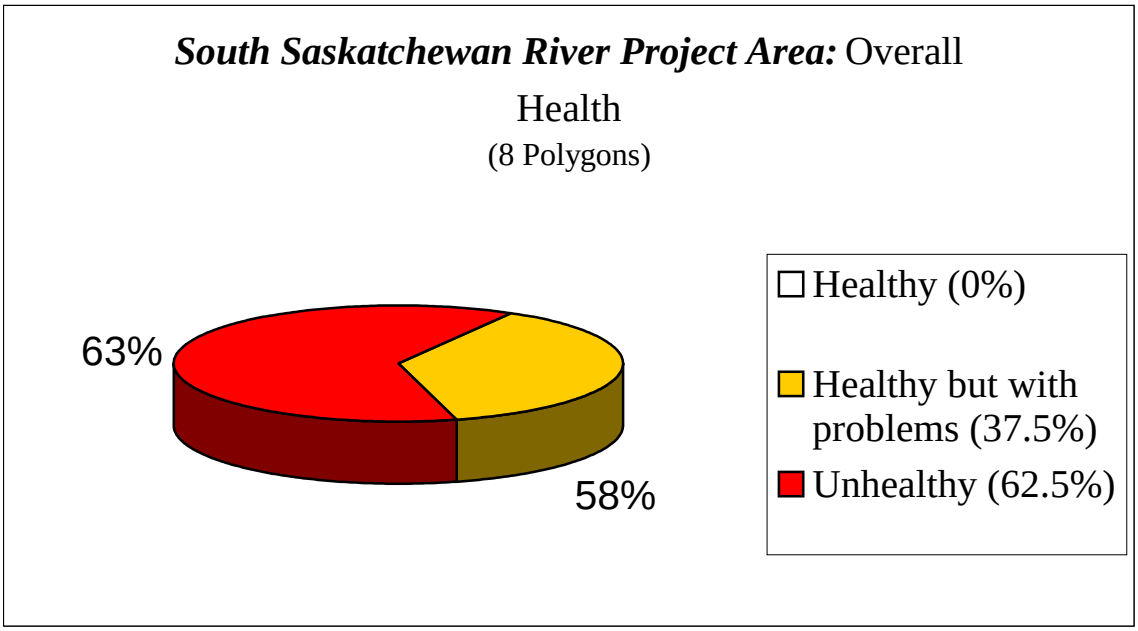


Figure S1. Overall health of the South Saskatchewan River Project Area.

- Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of the entire South Saskatchewan River watershed, but give an overview of health of the riparian areas within watershed.

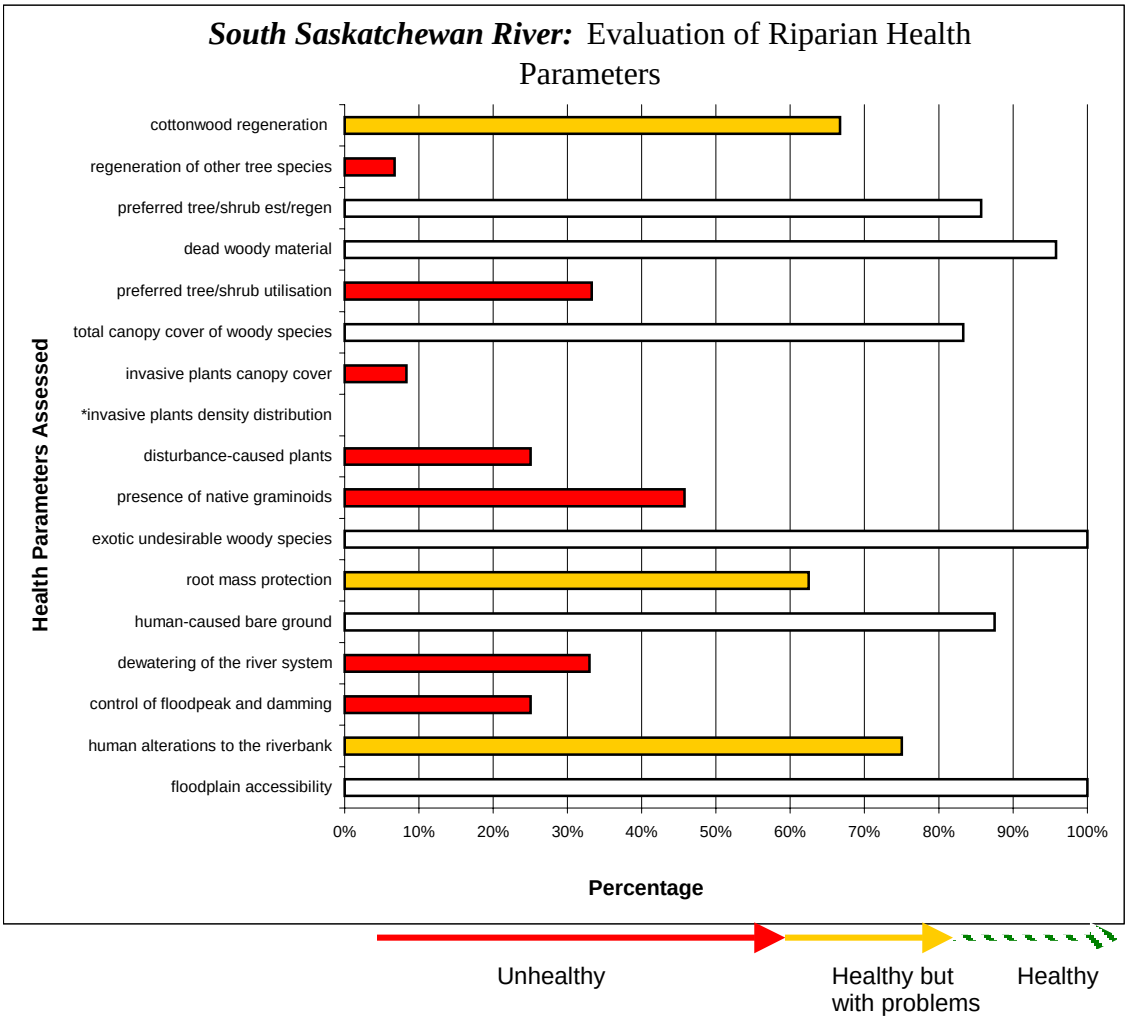
Remember: *We encourage users of the report to recognise the value of this report in broad-scale planning and identifying types of management and education approaches to take in the entire watershed--**this is not a finger pointing exercise; it should be used as part of an awareness process that maintains or improves management.***

Table S1. Summary of Riparian Health Work –South Saskatchewan River

Year	River	# Landowners Contacted	# Landowners Participated	# Polygons Assessed	River Distance Assessed (km)
2003	South Saskatchewan River	**3**	**3**	**3**	**5.79**
2000	South Saskatchewan River	**1**	**1**	**5**	**7.04**
Total		**4**	**4**	**8**	**12.83**

RIPARIAN HEALTH DISCUSSION

For a description of how the parameters of riparian health are impacted by human disturbances and the overall affect on riparian health refer to *A Closer Look At The Riparian Health Pieces* in the overall summary of the South Saskatchewan River Basin.



Unhealthy	*(<60%)* Impairment to riparian health parameter due to human or natural causes.
Healthy but with problems	*(60-79%)* Some impairment to riparian health parameter due to human or natural causes.
Healthy	***(80-100%)*** Little or no impairment to riparian health parameter.

Figure S2. Breakdown of riparian health results for 17 parameters assessed for the South Saskatchewan River project area
***Invasive plants density distribution** does not register on this graph because this parameter scored 0%.*

For an overview of the limitations of riparian health assessments refer to the section titled *Data Limitations* in the overall South Saskatchewan River Basin Summary.

Historic and Present Influences on Riparian Health

The following discussion provides some insights regarding the current status of the health of riparian areas within the project area.

- **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 and horses (particularly in early settlement), bison provided the greatest seasonal grazing pressures on riparian areas within the project area (Alberta ECA 1977). Currently, livestock grazing continues to be the dominant land use potentially influencing riparian health along the South Saskatchewan River (Table S2, Appendix S10). Some parameters of the riparian health evaluation on grazed sites suggest that some aspects of riparian health may be influenced by grazing, while other parameters, seem not to be noticeably influenced by grazing.

- **Cropland cultivation** is a very small proportion of the reaches examined, but recent past and historic cultivation has likely increased presence of disturbance-caused undesirable plants within these riparian areas.

- **Availability of water.** Water diversion and consumption are affecting the overall health evaluation of the South Saskatchewan River to a considerable degree at the present time. In upstream reaches, the impact of damming is greatest, but is considerable throughout both reaches. Regeneration of trees, including cottonwoods is moderate to fair overall, and this may be a sign of hydrologic impacts on the woody plant community. Long-term implications of reduced water volumes exist, including: maintaining riparian vegetation, ensuring flood events provide sufficient recharge of local moisture and creating opportunities to establish new trees. Demand for water at least over the past few decades may be putting the river under stress.

- **Overall watershed activity,** including activities in upstream rivers, including agriculture, industrial development, timber harvest, urbanisation and damming or water extraction may influence delivery rate of water into the South Saskatchewan River. Depending on the extent and intensity of these activities, there way be an impact on the quantity and quality of water reaching the river, as well as levels of sediment and increased potential for introduction and invasion of disturbance or invasive species, due to bare soil and increased risk of seed transmission.

Table S2. Land uses along the South Saskatchewan River Project Area

AENV Reaches for South Saskatchewan River	**Land Uses (% of reach based on length)**			
	Grazing	***Cropping***	***Developed***	***Undeveloped***
SS-01	68	0	7	25
SS-02	94	1	0	5
Total	78	0	5	17

Refer to the section titled *Riparian Plant Communities-Why are they important?* for an overview of why understanding the riparian plant communities is important.

Riparian Plant Communities

Within the South Saskatchewan project area:

- All polygons examined are identified as having the potential to grow trees and shrubs, including preferred tree and shrub species, although regeneration of trees other than cottonwoods is absent or minimal.
- 19 different plant communities were identified.
- Shrub communities occupy 55% of the project area and tree communities occupy 28% of the project area.
- However, 37% of the shrub canopy cover is comprised of two grazing-resistant, disturbance-increaser shrubs snowberry/buckbrush, *(Symphoricarpos occidentalis)* and common wild rose *(Rosa woodsii)*.
- The other 63%of the shrub communities are comprised of *preferred*[10] shrub communities (including 3 willow communities).
- A total of 7 tree community and habitat types were found, 6 of which were poplar or cottonwood (*Populus*) community types.
- 3 different graminoid habitat types (all are native graminoid communities) were observed. Graminoids occupy 75% of the project area.
- A list of all plant species found in the project area is available in Appendix S3. Additional plant community and habitat type information can be found in Appendix S7. Refer to Appendix S4 for a complete listing of plant species observed within each polygon.

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

Presence

- 3 tree species and 14 shrub species were recorded within the South Saskatchewan River project area.
- Total area covered by all trees and shrubs, combined is 82%.

The presence of many different tree and shrub species is often a good indicator of structure and diversity. A diversity of plants provides habitat layers, benefiting wildlife and livestock.

Reproduction

- Currently there are some areas where the reproduction of *preferred* trees and shrubs is of concern.
- Only 3 of 8 polygons (38%) along the South Saskatchewan River had at least 15% of cottonwood cover within the polygon provided by established seedlings and saplings. Three of the sites had 5-15% cottonwood cover provided by seedlings and saplings. The remaining two sites had less than 5% or no cottonwood cover provided by seedlings and saplings.
- Regeneration of other tree species was very poor along the South Saskatchewan River.

[10] native, palatable shrubs (willows, red-osier dogwood etc.) that contribute to riparian function or health

In most cases there were no tree species other than cottonwoods found along the river. However, in one of the polygons Manitoba maple is occurring and the regeneration that is present for this species accounts for less than 1% of the total canopy cover of Manitoba maple.

- Overall there was good regeneration of shrub species along the river, with a few areas of concern. Most polygons had over 5% of the shrub cover provided by seedlings and saplings, which is positive. One of the polygons had poor regeneration with less than 1% of the shrub cover provided by seedlings and saplings.

Health

- Overall, existing tree and shrub communities show normal amounts of dead and decadent branches in the upper canopy, with the exception of one site that has dead or decadent branches throughout 5-25% of the total canopy cover of woody species. Low levels of dead and decadence throughout woody communities indicate there is sufficient moisture currently within the system to maintain existing plants, and that disease is not a problem in maintaining these communities.
- There are concerns with the overall health of shrubs.
  - 37% of the shrub canopy cover is comprised of two grazing-resistant, disturbance-increaser shrubs (snowberry/buckbrush, *(Symphoricarpos occidentalis)* and common wild rose *(Rosa woodsii)*.
  - In 63%, (5 of 8) of polygons, preferred trees and shrubs species are receiving moderate (2 of 8) to heavy (3 of 8) browse pressure from livestock (to a lesser degree wildlife).
  - Regeneration and establishment is very good at all but 2 sites, which have low to moderate levels of regeneration.
  - The indicators of heavy browse pressure are umbrella-shaped mature shrubs and flat-topped or hedged seedling and saplings. Successful reproduction and establishment of the present trees and shrubs will maintain these stands and promote riparian health.
  -

Non-Woody Riparian Plants: Diversity and Health

Diversity

- 41 species of grasses and grass-like plants (graminoids) and 70 species of broad-leaved plants (forbs) were recorded within the South Saskatchewan River project area.
- The presence of native grasses is an important indicator of the level of disturbance occurring within the riparian area. The presence of native grasses diminishes with increased disturbances to the soil surface. The majority of polygons along the South Saskatchewan River had native grasses present in the riparian area, however in all of the polygons there is room for improvement. The optimum amount of native grasses for riparian health is for more than 50% of the riparian area to be covered by native grass species. In most polygons (5 of 8) native grasses cover between 25-50% of the riparian area. The remaining polygons had a much poorer representation of native grasses and in some polygons (2 of 8) there is less than 5% of the riparian area covered by native grasses.
- 59% (66 species) of the non-woody riparian plants recorded are native plants.

Native plants provide riparian functions including deep, binding root masses and summer and winter forage production for livestock and wildlife.

- 3 poisonous plant species: common horsetail (*equisetum arvense*), showy milkweed (*Asclepias speciosa*) and Indian hemp (*Apocynum cannabinum*) were recorded within the project area but their overall presence is not of concern because they were not abundant.

Health

- 62% of the project area is occupied by disturbance-caused plants (grasses and forbs). Of the 20 disturbance-caused plants present, the most prevalent are smooth brome (*Bromus inermis*) [11] and quack grass (*Agropyron repens*).
- Disturbance-caused undesirable plants are abundant throughout the South Saskatchewan River project area. 50% (4 of 8) polygons have between 25-50% of the riparian area covered by disturbance species, and more significantly 38% of polygons have over 50% of the riparian area covered by disturbance-caused species. Disturbance-caused plants typically do not have a deep, binding root mass and therefore do not provide streambank protection as well as non-disturbance native species. Refer to Appendix S5 for more information regarding the area covered by disturbance plant species within each of the sites.
- With the abundance of disturbance-caused plants, native grasses and forbs are reduced within the project area.
- Invasive species are abundant throughout the South Saskatchewan River project area and their prevalence is a concern.
  75% of the polygons have more than 15% of the project area covered by invasive species. Bladder campion (*Silene cucubalus*), leafy spurge (*Euphorbia esula*), scentless chamomile (*Matricaria perforata*), Canada thistle (*Cirsium arvense*) and perennial sow thistle (*Sonchus arvensis*) are the invasive weeds found throughout the project area.

Physical Characteristics of Riverbank and Floodplain

Human-Caused Bare Ground and Alterations to the Riverbanks

- Overall, 23% of the inventoried bank length of the South Saskatchewan River has alterations from human causes. 75% (6 of 8) of the polygons had alterations occurring along the riverbank.
- Half of the polygons had less than 10% of the bank length altered-this is positive. 38% of polygons had a minor amount of alterations, with structural impacts occurring along 10-25% of the bank length. Only one polygon had more than 50% of the riverbank altered by human causes, severely impacting riparian health.
- Livestock activity (hoof shear, trailing), recreation and pipeline crossings are the main causes of alterations along the South Saskatchewan River banks (Appendix S8).
- Exposed soil surface or bare ground create minor impacts in the polygons along the South Saskatchewan River. Human-caused bare ground occurs in all polygons, but the majority of the sites (5 of 8) had less than 5% of the riparian are impacted. In the remaining three sites, bare ground impacts a limited area (5-25% of the riparian area).

[11] Smooth brome and quack grass are tame or introduced species that have invaded many native lands over the past decades. These species reduce long-term productivity and stability, because they do not have deep-binding roots.

The majority of the human-caused bare ground present is due to livestock activity and recreation (Appendix S9).

Riverbank Root Mass Protection

Riverbank root mass protection is variable along the South Saskatchewan River. 3 of 8 sites have excellent root mass protection with more than 85%of the bank length covered by deeply rooted vegetation. The rest of the sites are less well protected: 2 polygons have 65-85% of the bank protected, 2 have 35-65% of the bank with deeply rooted vegetation and 1 site has less than 35% of the bank protected by deeply rooted vegetation. Appendix S14 also outlines the bank materials within each of the sites inventoried on the South Saskatchewan River.

Hydrologic Characteristics

Dewatering of the River System

- Artificial removal of water from river systems can negatively affect bank stability, wildlife habitat, establishment and success of woody plants and overall riparian function.
- Along the South Saskatchewan River there are concerns with the amount of water that is removed.
  On all of the polygons significant volumes of water are removed from the average river flow, with these reaches experiencing 25-50% removal of the average river discharge.

Control of Flood Peak/Timing by Upstream Dams

- Dams have negative impacts on the overall function of riparian areas because they remove water, adjust and control the annual peak flows that riparian areas depend on to recharge their reservoirs and rebuild the banks.
- Within the South Saskatchewan River watershed there are numerous dams impacting riparian health, none of which are located on the main stem of the South Saskatchewan River. 6 dams are on the Bow River and 3 on the Oldman River (and tributaries); the 1 dam on the Red Deer River does not impact this reach of the South Saskatchewan River, as the Red Deer River enters the South Saskatchewan River further downstream. The dams impacting peak flows and timing include: Kananaskis Falls Dam, Horseshoe Dam, Ghost Dam, Bearspaw Dam, Carseland Weir, and Bassano Dam on the Bow River and the Oldman Dam on the Oldman River, the Waterton Dam on the Waterton River and the St. Mary Dam on the St. Mary River.
- All polygons are significantly impacted by upstream damming, with SS-01 (the lower reach) having all 6 polygons (75% of all sites) with between 25-50% of the watershed upstream controlled by dams. SS-02 (the upper reach with 2 polygons) is more heavily impacted by damming over 50% of the watershed upstream controlled by dams (Appendix S1).

Floodplain Accessibility

- Riparian areas depend on regular flood events to maintain groundwater reserves and, rebuild banks through sediment deposition. Humans sometimes restrict floodwaters from accessing the floodplain through construction of embankments, levees and roadbeds.
- Along the South Saskatchewan River, in all of the polygons (8 of 8) floodwaters have access to more than 85% percent of the floodplain, which is the minimum amount considered required to maintain riparian functions related to this parameter.

South Saskatchewan River Riparian Health Overview: Summary

Overall riparian health of the areas examined is low throughout both reaches. SS-02 rates lower than SS-01, but there is a very limited sample in SS-02 compared to SS-01, making it difficult to compare overall health. Because of the limited number of polygons in a reach, and the limited number of reaches, trends along the length of the South Saskatchewan are less obvious than the other rivers examined in this project.
The observations below are provided as an overview that will assist in general management or monitoring planning. More detailed or specific use of the information should be done at the reach and polygon level, with a clear understanding of site or localised health status.

A number of parameters showed a trend in increased health as distance from headwaters increased:

Vegetation:
- Preferred shrub regeneration (somewhat higher downstream)
- Cover of woody species higher in downstream reach
- Disturbance species canopy cover
- Native graminoid cover

Physical/Hydrological:
- Upper reach has greater proportions levels of control of flood peaks and timing by dams

Some parameters of riparian health were similar, regardless of location along the river system:

- Exotic, undesirable woody species (healthy at all sites)
- Human-caused bare ground (good to excellent at all sites)
- Decadent and dead woody material (excellent at all but 1 site, which rates good)
- Regeneration of other tree species-poor throughout
- Invasive species canopy cover and density distribution extensive throughout
- Dewatering (withdrawal of natural flow) is considerable throughout
- Floodplain accessibility good throughout

There were no clear trends in these riparian health parameters as distance from headwaters increased:

- Cottonwood regeneration
- Utilisation of preferred trees and shrubs

- Human alterations to the structure of riverbanks
- Proportion of banks protected with deep-binding roots

Limitations of the Data

Refer to Data Limitations in South Saskatchewan River Basin section.

South Saskatchewan River: Opportunities and Options for Improvement

Grazing management may be influencing establishment and regeneration of preferred trees and shrubs at some sites, particularly those with moderate or high utilisation and lower regeneration rates of trees.

Physical impacts from grazing (human-caused bare ground and bank structural alterations) are present, but generally minor, although at some sites, physical impacts are reducing the health of that parameter. Avoid using these areas during moist soil conditions. Where utilisation is moderate or high, this level of browse may not be sustainable in terms of allowing successfully regeneration and maintenance of tree and shrub communities, but the overall impact on regeneration is not likely extensive, since shrub regeneration is excellent throughout the areas examined.

Where appreciable dewatering and damming upstream occur in conjunction with heavier levels of woody plant utilisation, effects on preferred tree and shrub species may be greater. Cottonwood regeneration is modest, with other trees mostly not regenerating, throughout. Because modified hydrology exists throughout the reaches examined, regeneration and establishment of trees is likely negatively affected throughout.

Promote and support livestock grazing strategies that focus on keeping preferred tree and shrub utilisation to light, and occasionally moderate, levels, to benefit establishment of seedlings and saplings, by allowing increased plant growth and vigour. Avoiding use in sensitive periods (i.e. when graminoids and forbs have reduced palatability or are limited in quantity) will promote woody plant growth, while minimising livestock browse. Additional rest to sites will promote native trees, shrubs, and graminoids. Refer to Appendix S2 for more information regarding the canopy cover provided by each of these lifeforms.

All polygons examined had the potential for both cottonwood and other trees species, and most were reproducing cottonwoods well or moderately (6 of 8 sites) but reproduction and maintenance of other trees species is virtually absent, even though sites have potential for non-cottonwood tree species. Opportunities to maintain and promote or increase regeneration and establishment will involve considering land use management (most often livestock grazing) and hydrologic considerations.

Invasive species were widespread in most areas (Appendix S6). Reduce the presence of invasive plants or aim to prevent further invasion with a combination of weed control measures and grazing strategies that consider rest, distribution, timing and stocking rates will be required to prevent human-caused bare soil and promote plant vigour. Disturbance resulting from recreation and development (urban areas, parks/natural areas) also requires weed control.

Moisture and temperature can lead to highly variable abundance of invasive plants, so monitor infestations closely. In general, there was some human-caused bare ground or structural alterations to the banks--continue to keep these alterations to a minimum, since disturbance-caused and invasive plants are readily available to establish and spread.

In both reaches, 25 – 50% of the average river discharge is being removed. Water extractions are considerable from this portion of the South Saskatchewan River and current withdrawals are impacting riparian health. Regeneration of non-cottonwood trees is absent in these reaches, and may be the result of reduced flow, or a combination of browse, reduced flow and alterations to peak flow and timing.

Extensive dams upstream control flood peak and timing significantly. Recognising that damming is a potentially harmful impact on riverine ecosystems, consider limiting further damming and provide flow regimes that assist in maintaining riparian plant communities. In addition, it is important to identify and quantify upstream minor or unlicensed dams to include these potential modifications. Maintain current floodplain accessibility by limiting berms or embankments.

Potential for increasing riparian health depends on the ability to alter both on-site management and hydrologic modifications. Some areas appear to be showing some signs of grazing, but all sites are impacted by changes to water (volume, timing); the ability to improve health will rely on attempting improve local management (where applicable), but recognising, that unless hydrologic parameters are changed, additional impacts and loss of health may occur.

South Saskatchewan River Reach Overview

The reaches along the South Saskatchewan River are summarized starting from the confluence of the Oldman and Bow Rivers (the Grand Forks) downstream (SS-02) to where the South Saskatchewan reaches the Alberta/Saskatchewan provincial border (SS-01) (Table S3). In most polygons, over 1 km of river was assessed, with 12.83 km assessed for the project (Table S4). More than half of the polygons examined (5 of 8) rated as unhealthy, with the remainder rating healthy, but with problems (Table S5).

Table S3. Alberta Environment (AENV) Reaches Boundary Descriptions – South Saskatchewan River

AENV Reach	**Upstream and Downstream Description**
SS-02	Grand Forks to upstream of the Medicine Hat gauging station
SS-01	Medicine Hat gauging station to Saskatchewan/Alberta border

Table S4. Summary of South Saskatchewan River Reaches – Sites

AENV Reaches for South Saskatchewan River	# Sites Assessed	River Distance Assessed (km)
SS-02	2	10.11
SS-01	6	2.72

Table S5. Number of Reach Sites by Riparian Health Category

Reach	Healthy	Healthy but with problems	Unhealthy
SS-02	0	0	2
SS-01	0	3	3
Total	0	3	5

Table S6. Land Uses along the South Saskatchewan River Project Area

AENV Reaches for South Saskatchewan River	Land Uses (% of reach based on length)			
	Grazing	***Cropping***	***Developed***	***Undeveloped***
SS-02	94	1	0	5
SS-01	68	0	7	25

Table S7. Summary of Plant Communities: Overall and Woody Communities – South Saskatchewan River Reaches

Reach	# of Plant Communities	% of Area Examined with:	
		Tree Species	Shrub Species
SS-02	5	16	28
SS-01*	17	29	57

*In addition to graminoid and forb communities at most reaches, these reaches have some area as unclassified wetland types.

Community and habitat types are determined using Thompson and Hansen (2002). Refer to Appendix S7 for a complete description of habitat and community types.

Table S8. Summary of Plant Communities: Herbaceous Communities –South Saskatchewan River Reaches

Reach	% of Area Examined with:		
	Grass Communities	Forb Species	Disturbance Species
SS-02	82	32	66
SS-01	75	36	62

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

Reaches typically have from 2-3 tree species, normally with fewer shrubs than either the Bow or Red Deer Rivers, with 8-14 species. The upstream has less woody plant community diversity compared to the downstream reach (Table S9). Poplars (balsam poplar *Populus balsamifera* and plains cottonwood *P. deltoides*) were present in both reaches. Regeneration of cottonwoods ranges from poor to excellent, but other trees are absent or not reproducing (Table S10). Dead branches and dead standing trees make up a normal amount of the woody plant canopy and utilisation/browse is variable, from heavy to light (Table S11).

Table S9. Woody Plant Species Presence South Saskatchewan River Reaches

Reach	**# of Tree Species**	**# of Shrub Species**	**% of Reach Area that is Woody Species**
SS-02	2	8	36
SS-01	3	14	65

Refer to Appendix S4 for a complete list of plant species.

Table S10. Woody Plant Species Reproduction–South Saskatchewan River Reaches

Reach	**Cottonwood Regeneration (seedlings/ saplings)**	**Other Tree Species Regeneration (seedlings/ saplings)**	**# of Sites with seedlings /saplings >5% of total woody cover**	**Means for health…**
SS-02	1 site poor, 1 site moderate	No other tree species present, poor, potential is there for Manitoba maple (*Acer negundo*)	1 (half of the sites)	Poor to moderate regeneration
SS-01	3 sites excellent 2 sites moderate 1 site poor	1 site Manitoba Maple, poor. 5 sites no other tree species present, poor, potential is there for Manitoba maple	5 (5 of 6 sites)	Moderate regeneration overall, but variable and poor at some sites

Refer to Appendix S1 for a summary of river health survey scores.

Table S11. Woody Plant Health – South Saskatchewan River Reaches

Reach	**Dead and Decadence**	**Utilisation of Preferred Woody Plants**	**Means for health…**
SS-02	Normal - Moderate	Light- Moderate	Fair to Good
SS-01	Normal	Light- Heavy	Poor to Good

Non-Woody Riparian Plants: Diversity and Health

A wide diversity of herbaceous species were found, with 41 different graminoid species and 70 forb species. Native graminoids were variable, with some sites having generally prominent native graminoid cover, but other with limited cover. Disturbance species comprise a significant proportion of both reaches and are negatively impacting health (Table S13). Invasive plant species, while not covering significant areas, are sporadic and widespread throughout most reaches, and without appropriate management could infest much larger areas (Table S14). Canada thistle (*Cirsium arvense*) is the most common and widespread invasive plant, with numerous other species commonly found (Table S15).

Table S12. Non-Woody Riparian Plant Diversity–South Saskatchewan River Reaches

Reach	**Total # of Grass/ Grass-like Species**	**Total # of Forb Species**	**Proportion of site covered by native graminoids**	**Means for health…**
SS-02	16	30	Both sites less than 5%	Poor
SS-01	44	64	5 sites 25-50%; 1 site <25%	Fair, to mostly good

Table S13. Non-Woody Riparian Plant Health - Proportion Disturbance Caused Undesirable Herbaceous Species–South Saskatchewan River Reaches

Reach	**% of Reach with Disturbance Plants**	**Disturbance Plants Cover**	**Means for health…**
SS-02	66	Both sites > 50%	extensive; of concern
SS-01	62	1 site >50%; 4 sites 25-50%; 1 site 5-25%	variable from moderate to extensive; of concern

Table S14. Non-Woody Riparian Plant Health - Proportion Invasive Plant Species–South Saskatchewan River Reaches

Reach	# of Sites with Invasive Plants	Invasive Plants Cover	Density/ Distribution of Invasive Plants	Means for health…
SS-02	2 of 2	1 site high cover; 1 site moderate cover	patches to continuous occurrence	Canopy cover and distribution is a concern
SS-01	6 of 6	5 of 6 sites high cover; 1 site moderate cover	1 site patches to continuous occurrence [5 sites-density distribution not assessed in 2000]	Canopy cover and distribution/ infestation a concern

Table S15. Most Common Invasive Herbaceous Plant Species–South Saskatchewan River Reaches

Reach	Species
SS-02	Canada thistle and leafy spurge
SS-01	Leafy spurge and Canada thistle

Physical Characteristics of Riverbank and Floodplain

Human-caused bare ground is limited at most sites (Table S16). Where it does exist, it results from both recreation and grazing.

Human activities (grazing, recreation, and pipeline) have altered riverbank structure at only 4 of 8 sites, with alterations impacting a limited portion of each reach (Table S17). Riverbank root mass protection, as assessed by the length of bank with deep-binding roots, is highly variable within a reach from poor to excellent (Table S18).

Human-Caused Bare Ground and Alterations to the Riverbanks

Table S16. Human-caused Bare Ground–South Saskatchewan River Reaches

Reach	# of Sites with >5% Human Caused Bare Ground	Proportion of polygons covered by human-caused bare ground	Sites are…
SS-02	1 of 2	1 site <5% 1 site 5-25%	Well to fairly well vegetated
SS-01	2 of 6	4 sites <5% 2 sites 5-25%	Mostly well vegetated, some sites fairly well vegetated

Table S17. Human-Caused Structural Alterations–South Saskatchewan River Reaches

Reach	# of Sites with Human Caused Structural Alterations	# of Sites with Human-Caused Structural Alterations Along:				Banks are…
		< 10% of length	10-25% of length	25-50% of length	> 50% of length	
SS-02	2 of 2	1	0	0	1	Variable: intact to significantly altered
SS-01	4 of 6	3	3	0	0	Intact to moderately altered

Riverbank Root Mass Protection

Table S18. Proportion of Riverbank with Deep Binding Roots—South Saskatchewan River Reaches

Reach	# of Sites with Riverbank Rootmass Protection along:				Banks are…
	> 85% of length	65-85% of length	35-65% of length	< 35% of length	
SS-02	0	1	1	0	Variable; moderately to, poorly protected
SS-01	3	1	1	1	Variable, several sites well protected, with the remainder moderately to very poorly protected

Hydrologic Characteristics

Dewatering is considerable throughout both reaches (Table S19). Floodplain access of floodwaters is excellent and unrestricted at all sites (Table S21). The proportion of damming and modifications to peak flows and timing is impacting riparian health ratings in both reaches, due to extensive damming upstream (Table S20).

Dewatering of the River System

Table S19. Dewatering of the River—South Saskatchewan River Reaches

Reach	**Total use as a % of natural ***	**# of Sites with River Discharge Being Removed that is:**				**Impacts are…**
		< 10% of average	10-25% of average	25-50% of average	> 50% of average	
SS-02	43.7	0	0	2	0	Moderate
SS-01	43.3	0	0	6	0	Moderate

*Data provided by AENV. Note that only licensed and reported uses are included; unlicensed use is unknown.

Control of Flood Peak/Timing by Upstream Dams

Table S20. Flood Peak and Timing Control by Dams—South Saskatchewan River Reaches

Reach	**# of Sites with Control By Dams Upstream Affecting:**				**Number of Dams**
	<10% of watershed	10-25% of watershed	25-50% of watershed	> 50% of watershed	
SS-02	0	0	0	2	9
SS-01	0	0	6	0	9

*Data provided by AENV. Includes dams on main stem rivers only.

Floodplain Accessibility

Table S21. Floodplain Accessibility—South Saskatchewan River Reaches

Reach	**# of Sites with Flood Water Access to:**				**Major Obstructions to Flooding**
	> 85% of floodplain	***65-85% of floodplain***	***35-65% of floodplain***	***< 35% of floodplain***	
SS-02	2	0	0	0	None
SS-01	6	0	0	0	None

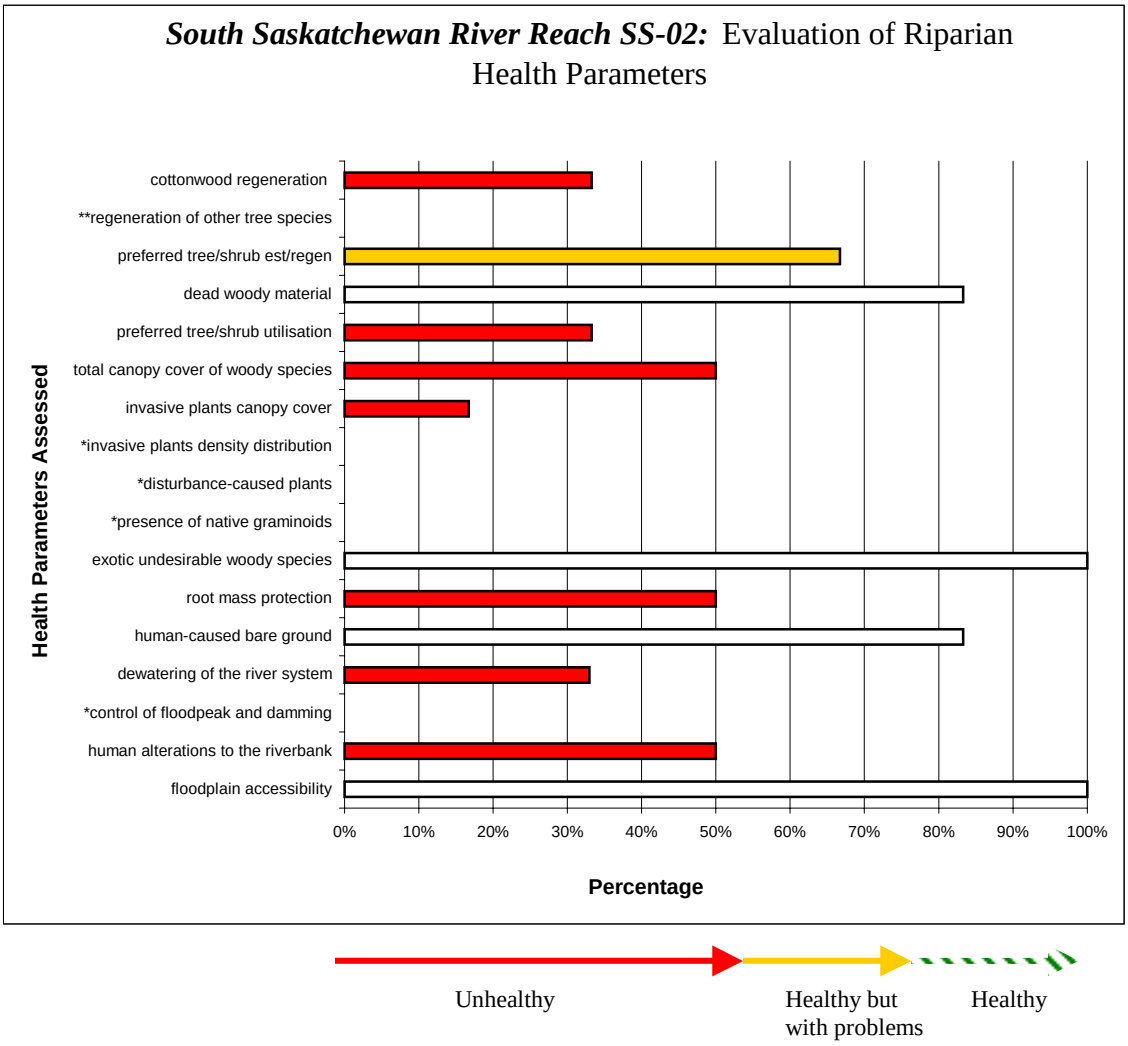
Alberta Environment Reach: Grand Forks to Upstream of the Medicine Hat Gauging Station (SS-02)

- **Both of the polygons in this reach scored in the unhealthy category.** The overall assessment of riparian health for reach SS-02 of the South Saskatchewan River project area is as follows:

  - Of the 2 polygons assessed: 0% (0/2) are *healthy*,
    0% (0/2) are *healthy but with problems*,
    0% (2/2) are *unhealthy*.

Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure S3. Breakdown of riparian health results for 17 parameters assessed for South Saskatchewan reach SS-02.
** Regeneration of other tree species, invasive plants density distribution, disturbance-caused plants, presence of native graminoids and control of flood peak and damming do not register on this graph because these parameters scored 0%*

Historic and Present Influences on Riparian Health

Currently, grazing is by far the dominant land use in this reach. A very small proportion of the length was identified as cropping or undeveloped. Riparian health ratings are also related to withdrawals and damming upstream.

Riparian Plant Communities

- This reach has considerably less tree and shrub cover than many of the other reaches examined in the South Saskatchewan River Basin, with 28% covered by shrubs, and 16% by trees. Regeneration of cottonwoods, preferred trees and shrubs is poor to absent, and is a concern. There is no regeneration of preferred trees (other than cottonwoods), although the site has potential to support such trees (eg Manitoba maple). Utilisation on preferred trees and shrubs is light to heavy, and may be influencing regeneration. There are slightly elevated levels of dead and decadent standing woody plants at one site, which may link to both on site management and water availability.
- Invasive and disturbance species are of concern, with extensive distribution of invasive species and 66% cover by disturbance species. Native graminoid cover is poor, with less than 5% cover in each polygon examined.

Physical Characteristics and Hydrologic Parameters

- Human-caused structural alterations impacting riparian health are very variable between the two polygons examined, with more than 50% impacted at one site, but less than 10% altered at the other. Livestock activities are the main causes of the alterations in this reach. Human-caused bare ground is limited to minimal, but still may be a concern. There are some concerns with riverbank root mass protection in this reach, with moderate to poorly protected banks.
- Within this reach, dewatering is having negative impacts on overall riparian health ratings, with 25-50% of the average river discharge removed from this reach. Dams on major tributaries upstream result in more than 50% of the watershed controlled by dams, introducing modifications to flood timing and intensity. Floodplain accessibility is not an issue in this reach.

Opportunities and Options for Improvement: SS-02

Trees and Shrubs

- Current browse levels may be impacting successful recruitment and maintenance of the tree and shrub community, in conjunction with limitations to seedling establishment and success that may result from impacts to water volume, flow or timing. Appropriate stocking rates, distribution, timing and rest in the growing season will assist preferred tree and shrub to increase. Monitoring of maintenance of woody plants under the current hydrologic modifications would determine long-term impacts on regeneration and maintenance.

Non-Woody Species

- Extensive disturbance-caused species and invasive plants suggest cumulative, longer term impacts from livestock, intentional introduction of tame species, or perhaps some relationship to hydrologic parameters and past flood events (eg. creation of exposed soil and seed sources). Grazing strategies that promote increased native plant vigour should help slow or reduce expansion of these invasive and disturbance-caused species; weed control to reduce further spread of invasive species is important.

Physical Characteristics and Hydrologic Parameters

- Reduce or minimise livestock impacts to banks and soil using distribution tools, appropriate timing and stocking rates, allowing time for healing of structural impacts.

- Extensive water withdrawals and extensive damming upstream may be impacting seedling recruitment and success, which warrants further investigation, including determining if the absence of non-cottonwood trees is influenced by alterations to hydrologic parameters.

Alberta Environment Reach: Medicine Hat Gauging Station to Saskatchewan/Alberta Border (SS-01)

WHAT DID WE FIND?

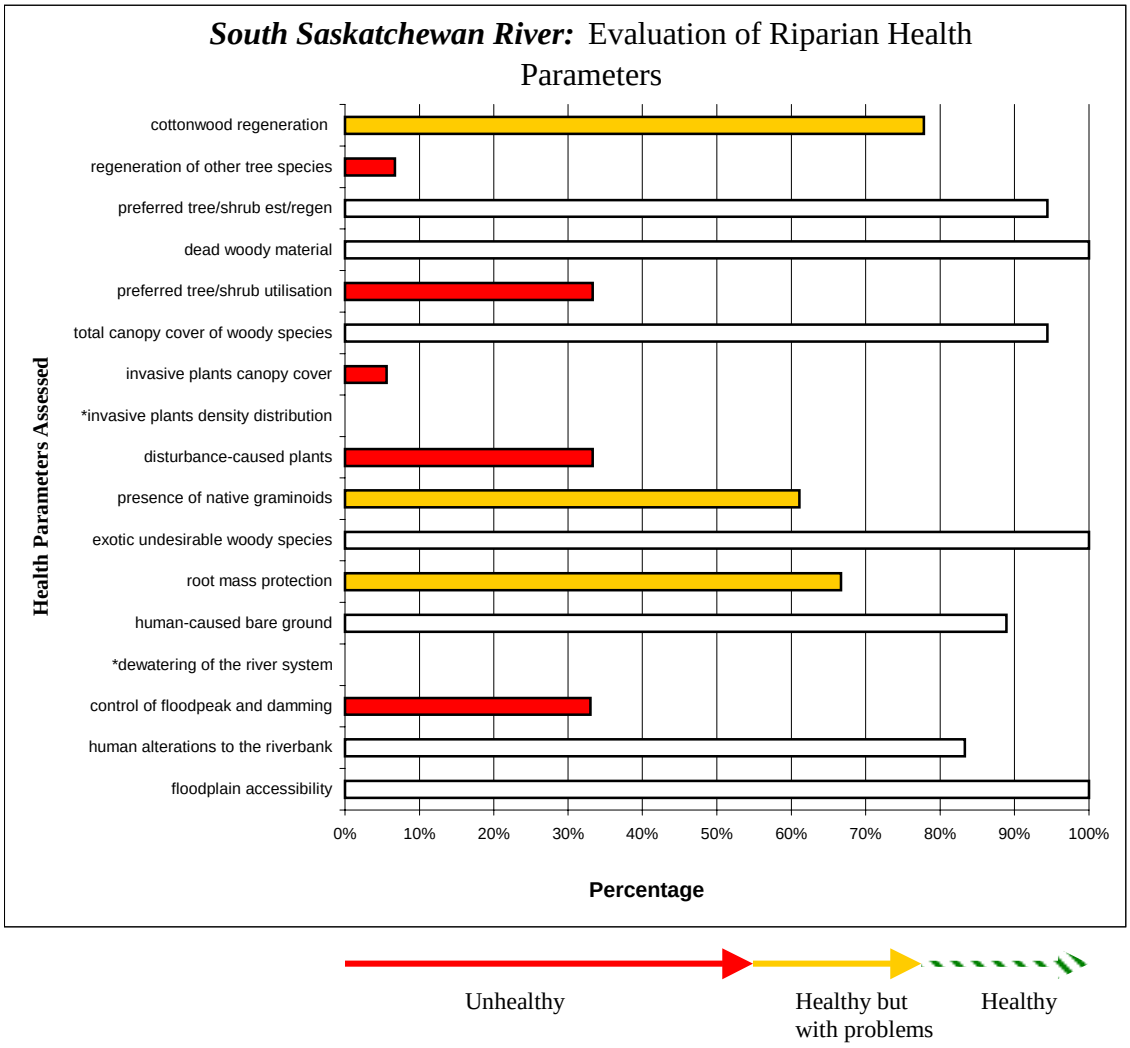
- Thanks to everyone who allowed access to their land and supported this riparian inventory initiative. In this reach 1 polygon was assessed during August of 2003 and 5 polygons were assessed during July and August of 2000.

- **Three polygons in this reach score in the healthy but with problems category and the other three polygons were rated in the unhealthy category.** The overall assessment of riparian health for reach SS-01 of the South Saskatchewan River project area is as follows:

  - Of the 6 polygons assessed: 0% (0/6) are *healthy*,
    50% (3/6) are *healthy but with problems*,
    50% (3/6) are *unhealthy*.

Please note: due to the small number of polygons assessed these health ratings do not represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure S4. Breakdown of riparian health results for 17 parameters assessed for South Saskatchewan reach SS-01.
** Invasive plants density distribution and dewatering of the river system do not register on this graph because these parameters scored 0%**

Historic and Present Influences on Riparian Health

Currently, grazing is the dominant land use in this reach. One quarter of the length was identified as undeveloped and less than 10% as developed lands. Riparian health ratings are also related to withdrawals and damming upstream.

Riparian Plant Communities

- This reach has nearly twice the tree and shrub cover compared to SS-02, with 57% covered by shrubs, and 29% by trees. Regeneration of cottonwoods and preferred shrubs is good in most polygons, but poor or moderate in a few. There is almost no regeneration of preferred trees (other than cottonwoods), although the area has potential to support such trees (eg Manitoba maple). Utilisation on preferred trees and shrubs is quite variable, from light to heavy, and may be influencing regeneration.
- Invasive and disturbance species are of concern, with extensive infestations of invasive species and 62% cover by disturbance species. Native graminoid cover is good, with 25-50% cover in each polygon examined.

Opportunities and Options for Improvement: SS-01

Trees and Shrubs

- Although variable, and somewhat site specific, current browse levels may be impacting successful recruitment and maintenance of the tree and shrub community, in conjunction with limitations to seedling establishment and success that may result from impacts to water volume, flow or timing. Appropriate stocking rates, distribution, timing and rest in the growing season will assist preferred tree and shrub to increase. Monitoring of maintenance of woody plants under the current hydrologic conditions would determine long-term impacts on regeneration and maintenance.
- Consider investigating why non-cottonwood species are mostly absent, but have the potential to exist in the reach.

Non-Woody Species

- Consider implementing weed control to hold invasive plant infestations at current levels (and hopefully reduce them), while monitoring locations and abundance.
- Ensure adequate rest and appropriate grazing strategies to reduce or stabilize the coverage of disturbance-caused plants and increase native plant vigour. Recognise that elimination of disturbance species is unrealistic.

Physical Characteristics and Hydrologic Parameters

- Human-caused structural alterations are present in half of the polygons examined, with 10 –25% of the banks altered, with livestock activities being the main cause of the alterations. Human-caused bare ground is limited to minimal, but still may be a small concern. Riverbank root mass protection in this reach is highly variable; with excellent to poorly protected banks.
- Within this reach, dewatering is having negative impacts on overall riparian health ratings, with 25-50% of the average river discharge removed from this reach. Dams on major tributaries upstream result in 25-50% of the watershed controlled by dams, introducing modifications to flood timing and intensity. This is a considerable proportion of their watershed that has modifications to flood timing and intensity and is thus considered to be negatively impacting riparian health in those areas. Floodplain accessibility is not an issue in this reach.

Physical Characteristics and Hydrologic Parameters

- Reduce or minimise livestock impacts to banks and soil using distribution tools, appropriate timing and stocking rates, allowing time for healing of structural impacts, where they are occurring.
- Moderate water withdrawals and damming upstream may be altering seedling recruitment and maintenance, suggesting further examination might be useful, including determining if the near absence of non-cottonwood trees is influenced by alterations to hydrologic parameters. Consider preventing further reduction in flow volume, flood peak and timing to prevent further impacts to the maintenance of riparian plant communities and channel processes.

Year 2 2004

Project Area: **Oldman River, Belly River, St. Mary River, Waterton River, Crowsnest River and Castle River**

WHY ASSESS RIPARIAN HEALTH?

Refer to page 10 for details.

WHY ARE HEALTHY RIPARIAN AREAS IMPORTANT?

Riparian areas can be viewed like a jigsaw puzzle, as they can be broken into pieces that are important to the whole image or function. How these individual pieces or components (e.g. vegetation, especially deep-rooted plant species) function together affects the health of the riparian ecosystem including the stream, its watershed, and overall landscape health and productivity.

To be healthy, riparian areas need to perform certain functions including trapping sediment to maintain and build stream and riverbanks, recharging groundwater supplies, storing flood water, reducing energy, filtering water, maintaining biodiversity, and creating primary productivity. Even though riparian areas comprise a small percentage of the landscape, they are critical to the long-term sustainability of a healthy landscape.

Refer to page 11for discussion of riparian health parameters.

The riparian health inventory and assessment addresses a number of questions or parameters that help determine how the pieces of a riparian area are functioning. The assessment arrives at an overall health category for the riparian area, identified by a health score. Riparian health ratings are broken down into three categories and score ranges:

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

METHODS

For full details, see pg 12.

Determining Riparian Health

For full details, see pg 12.

Due to the large geographic extent of the study area and available resources, it was decided to implement a two-year project: Accordingly, riparian health inventories and assessments were conducted on the Red Deer River, Bow River and South Saskatchewan River in 2003, while the Oldman River (and tributaries Castle River and Crowsnest River), Belly River, St. Mary River and Waterton River were completed in 2004.

Several sites on the South Saskatchewan River done for Canadian Forces Base Suffield in 2000 were included, with their permission, in the 2003 project area. Several sites along the Oldman River from previous (unrelated) riparian inventory work in 2001 are included in 2004 work, with permission, from the landowners involved.

Site Selection

Level One: Reach Delineation

Reach boundaries were provided by AENV, based on past work. For additional methodology details, see pg 12. We examined the reaches and compared AENV reaches to our stratification results.

Based on aerial photo stratification of the Oldman River and St. Mary River, we concluded that some of the AENV reaches could be broken down into shorter reaches, based primarily on topographic differences. AENV decided to go with their original reaches, but the additional relevant reaches we proposed are as follows:

Oldman River: 10 AENV reaches; we proposed 7 additional reaches for a total of 17 reaches. Only 10 final reaches were approved by AENV (see Table OM4).

Waldron's Corner gauging station to Oldman Dam: 3 reaches

- Waldron's corner gauging station to NE17-9-21-W5M (Topographic change: v-shaped valley, minimal floodplain)
- SE17-9-21-W5M to NE21-8-1-W5M (Topographic change: valley becomes wider, channel is braided)
- SE21-8-1-W5M to NE9-8-1-W5M (Topographic change: broad, u-shaped valley)

Crowsnest River: BC/AB border to the Oldman Dam (Todd Creek Confluence): 2 reaches

- BC/AB border to the Municipality of Crowsnest/MD of Pincher Creek Border (Topographic change: mountain pass, narrow floodplain)
- Municipality of Crowsnest/MD of Pincher Creek Border to the Oldman Reservoir (Todd Creek confluence) (Topographic change: foothills and grassland, wider riparian area)

Castle River: Castle River gauge station to the Oldman Reservoir: 2 reaches

- Castle River gauge station to the confluence of the West Castle River (Topographic change: mountainous terrain, narrow riparian area, forest reserve)
- Confluence of the West Castle River to the Oldman Reservoir (Topographic change: foothills, floodplain widens, vegetation shifts from conifers to more deciduous)

Willow Creek confluence to u/s of Belly River: 2 reaches

- Willow Creek confluence to County of Lethbridge (Topographic change: wide u-shaped valley, dense riparian poplar communities)
- County of Lethbridge to Belly River confluence (Topographic change: narrow, v-shaped valley, no riparian poplar communities.)

St. Mary River confluence to u/s of Little Bow River confluence: 2 reaches

- St. Mary River confluence to north end of 31-9-21-W4M (Topographic change: u-shaped valley, dense riparian poplar communities)
- South end of 6-10-21-W4M to u/s of the Little Bow River confluence (Topographic change: broad, u-shaped valley, sparse riparian poplar communities)

Little Bow River confluence to Grand Forks: 2 reaches

- Little Bow River confluence to SE 36-10-17-W4M (Topographic change: defined u-shaped valley, broad valley bottom, change in riparian poplar density, poplars are sparce)
- NE36-10-17-W4M to Grand Forks (Topographic change: narrow, almost v-shaped valley/ u-shaped valley, riparian poplars are negligable in this reach)

St. Mary River: 3 AENV reaches; we proposed 1 additional reach for a total of 4 reaches. Only 3 final reaches were approved by AENV (see Table OM4).

Canada/USA border to the St. Mary Dam (SE 35-3-25-W4M): 2 reaches

- Canada/U.S.A. border to HWY 501 (opographic change: valley and riparian area are much narrower)
- HWY 501 to the St. Mary Dam (SE 35-3-25-W4M) (Topographic change: valley widens, woodies are more abundant)

Level Two: Delineation of Physical Features

The boundaries of the reaches, provided by AENV, were delineated onto 1:30,000 aerial photographs. Using remote sensing techniques, physical feature criteria were examined within each reach. Using these criteria (described under Physical Feature Criteria), the reach was delineated into homogeneous sub-reaches and one polygon was assigned to each of these sub-reaches, with the recognition that approximately 39 polygons was the limit of available resources for the project.

Physical Feature Criteria

1. Factors contributing to the broad level stream classification system as per Rosgen and Silvey (1998).

2. Presence of recent alluvial bar development / riparian tree and shrub recruitment

3. General examination for presence and distribution of riparian poplars (cottonwoods).

Full methodology details are on page 14.

Level Two: Land Use / Management

For each reach and sub-reach identified:

1. The riparian areas on both sides of the river were delineated into one of the following four land use categories, using ocular estimations of air photos. Full methodology details are on pg 14.

2. The proportion of each of these four categories was determined per reach.

3. Target areas that best fit the representative criteria outlined above are identified within each reach.

4. Landholdings within each of these target areas are identified and randomly selected (each polygon must be located wholly within one landholding).

5. Every attempt was made to select a proportional numbers of polygons based on the length in each land use category.

Landowner Consultation and Involvement

Cows and Fish is committed to the delivery of riparian health assessments and inventories as part of community based action wherever possible. To meet this commitment, we held community meetings (at a rural municipality scale) to inform local landowners of the potential activities and gather their support for the work.

All landowners selected as potential sites within the target areas were then contacted individually by telephone and, with their permission, an on-site visit with Cows and Fish was scheduled. Once an understanding of the scope of the project and subsequent voluntary participation was achieved, their input regarding the location of the polygon was sought. Polygon locations were determined based on management, plant community distribution and physical features of the river, most representative of their landholding.

Participating landowners will be provided with a summary report that details the current state of riparian health on their landholding (this information remains in confidence between the landowner and Cows and Fish).

Polygon selection

Based on the scope and objectives of the inventory project, every kilometre of stream could not be inventoried, but rather, a sample of polygons (inventory and assessment sites) was selected to provide a cursory overview of health for each reach. Accordingly, every attempt was made to select riparian sites that best represented each overall reach. In all, 38 polygons were examined in 2004. 8 sites, previously examined in 2001, are included in the analysis as well. We anticipate doing an additional 2 sites in 2005 along the Oldman River (reach OM-06).

Ground Truthing Polygon Locations

See details are on pg 14.

Lotic Riparian Health Inventory

See details are on pg 16.

Lotic Health Assessment for Large River Systems

See details are on pg 16.

Photographic Inventory

See details are on pg 16.

Determination of Hydrologic Parameters (for additional details, see appendices on riparian health methods)

Dewatering of the River System

The level of dewatering of each river is based on the average (1988-2001) of total uses and diversions as a percentage of natural flow, based on data provided by Alberta Environment (personal communication with Tom Tang).

Control of Flood Peak and Timing by Upstream Dams

GIS data provided by Sustainable Resource Development (personal communication Margaret Bradley), at the request of AENV was provided regarding the area of the watershed dammed. The area of watershed upstream from each polygon was broken into either dammed or undammed areas, always in reference to the location of the polygon. Dammed areas were calculated as any portions of the watershed that flowed into a dam. Undammed areas were identified as those areas of the watershed that flowed into the river which was unrestricted by dams. Specifically, if the polygon was located above any dam (and hence the watershed collected to that point), then that entire area was considered undammed. If the polygon was located at a dam, then the area of the watershed upstream from that point was considered dammed.

For polygons located below a dam, the area of watershed draining into that dam was calculated as the dammed portion and the area below the dam but above the polygon was undammed.

Floodplain Accessibility

The proportion of the floodplain accessible to flood flows in a polygon was determined by both ground truthing and examination of air photos. A determination was made in terms of what fraction of the historic 100 year floodplain remained unrestricted by embankments, such as berms, roads, railroads, or other barriers.

DATA LIMITATIONS

The six rivers examined as part of the 2004 project comprise 1,039 km of river length in Alberta; only 56.8 km of river was assessed in 46 polygons, amounting to 5.5% of the total length examined. Because of the limited number of sites (polygons) spread across this extensive area, users of the information contained in this report and associated appendices must recognize that the information is appropriate for planning or developing general recommendations across the

watershed, and some comparison of the relative, but not absolute, pressures facing each river system examined. In addition, due to broad-scale nature of this representative sampling methodology, it must be emphasised that there are likely sections of riparian area within each reach not represented by the overall health rating for that reach.

Every effort was made to representatively and proportionately sample within each river and within each reach, recognising that this sampling was very widely spread. Target areas and landowners were selected based on stratification procedures (outlined above), but due to the lack of interest or willingness to participate; often many attempts were required within a reach to find landowners willing to participate. This clearly reduced the representativeness of site included, and thus may reduce the representativeness of the reach and river findings.

Data on some of the hydrologic parameters used for riparian health assessment determination was at times less detailed and inclusive than it could have been. Determination of dewatering and control of flood peak/timing only includes major dams, diversions and licensed uses (and is based on data provided by AENV/ASRD). Unlicensed uses, which we expect to be occurring at an unknown level in unknown locations, cannot be included, for obvious reasons. In addition, small dams or impoundments (licensed or not) in the many streams and rivers that contribute to these larger rivers are not included, but may still be important in terms of potential impacts to riparian health and riparian health scores.

The inventory and assessment of the functioning condition (health) of riparian habitat does not address detailed in-stream or hydrological (i.e. issues associated with water flow regimes, water diversions, extractions, dam impacts) parameters associated with the project area. Parameters related to hydrology of the system (floodplain accessibility, proportion of watershed dammed upstream from a site, and amount of flow withdrawn) are broad scale examinations that relate to potential impacts on the site. Due to the diverse nature of dams and diversions, including differences in timing of storage and release, influences on riparian areas downstream may vary. Dams and their associated reservoirs are also developed for diverse purposes, including for flow management, irrigation withdrawal, and hydro-electric power generation, each of which results in different types of flow management. This inventory and assessment of riparian health did not investigate the details of timing of changes to river flow, but such an examination could provide additional useful information related to riparian vegetation parameters.

In general, the intent of riparian health inventory and assessment done at a watershed scale is to provide a state of the environment report; keep in mind however, that because of the very large area, this report gives only a general overview of health, not a detailed or absolute one. This report will provide information on riparian health or function that was previously unavailable to assist in making more informed management and planning decisions. Caution should be applied when assuming that the reach and river summaries are entirely representative of what is located in each area.

Please Keep in Mind

The objective of completing these riparian health assessments and inventories is to provide a coarse filter review of the status of riparian health or function within the project area. The riparian health scores provide a general status of riparian health, not an absolute one. Riparian areas are dynamic and are constantly changing. Because of this natural variability, the range of

possible scores in each category is broad and one assessment is only an approximation of health. Inventories over a period of years at the same locations will provide a better picture of whether current management (local and watershed level) is maintaining, improving or negatively impacting riparian health.

Riparian Plant Communities-Why are they important?

Refer to general values of riparian plant communities on page 18.

Within the South Saskatchewan River Basin project area in 2004, tree and shrub communities are relatively less extensive within all six rivers systems, in generaly, compared to those rivers examined in 2003. Trees other than cottonwoods are regenerating well in the upper reaches of the Red Deer River and Bow River, but seedlings and saplings are absent or low in very small quantities in the lower reaches of all three rivers examined in 2003. Cottonwood regeneration is mostly good to excellent in the six rivers examined in 2004, but there are very few areas with any other tree species present.

SOUTH SASKATCHEWAN RIVER BASIN PROJECT AREA 2004

The project area is defined as a selection of riparian areas involving a number of riparian sites along the Oldman River (including the Crowsnest and Castle Rivers), Belly River, St. Mary River and Waterton River from their headwaters downstream to the confluence of the river with another inventoried river (Oldman River) or the confluence with the Bow River at the Grand Forks (refer to project area map – Figure 3).

Table 3. Summary of Riparian Health Work – South Saskatchewan River Basin

Year	River	# Landowners Contacted	# Landowners Participated	# Polygons Assessed	River Distance Assessed (km)
2001 & 2004	Oldman River	34	13	20	28.24
2004	Castle River	3	2	2	2.69
2004	Crowsnest River	5	2	2	2.11
2004	Belly River	8	6	10	12.55
2004	St. Mary River	8	5	6	9.59
2004	Waterton River	15	6	6	6.42


South Saskatchewan River Basin
Project Area 2004
Cows & Fish
N
2001 Polygon Locations
2004 Polygon Locations
Alberta Hydrology
Settlements
Paved Road
Forest Reserve
Oldman River Watershed
Scale 1:1 200 000
30 0 30 60 Kilometers

Figure 3.0

WHAT DID WE FIND?

- **Some concerns with riparian health.** The majority of the 46 polygons assessed rated *healthy, but with problems* in relation to the proper functioning condition guidelines within the assessment protocol. The overall assessment of riparian health for the project area is as follows (Figure 4);

  - Of the 46 polygons assessed: 11% (5/46) are *healthy*
    52% (24/46) are *healthy, but with problems*
    37% (17/46) are *unhealthy*

Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of the entire river.

Remember: We encourage users of the report to recognise the value of this report in broad-scale planning and identifying types of management and education approaches to take in the entire watershed--this is not a finger pointing exercise; it should be used as part of an awareness process that maintains or improves management.

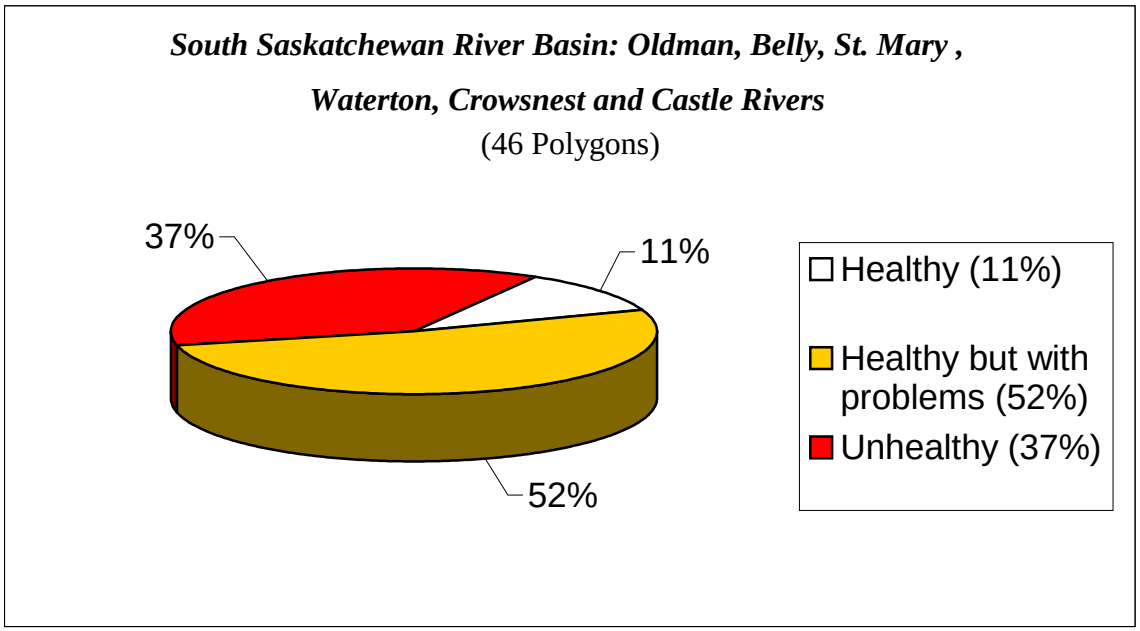


Figure 4. Breakdown of riparian health results for 46 polygons within the South Saskatchewan River Basin project area.

RIPARIAN HEALTH DISCUSSION

For details on riparian health, review individual river systems and refer to the summary provided below.

A Closer Look At The Riparian Health Pieces

(For more details see page 22)

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

Of the parameters examined, eleven relate to vegetation and six relate to soil and hydrology. Details of how each of these parameters are scored are in Appendix G9. By objectively examining each of these health parameters we can determine which pieces are adequately performing the necessary functions of a healthy riparian area, and which are not. This examination provides us with a better understanding of where to concentrate efforts if improvements in riparian management are required, and what land use practices are currently maintaining riparian health.

The following discussion provides some insights regarding the current status of the health of riparian areas within the project area from 2004: Oldman River (including Castle River and Crowsnest River), Belly River, St. Mary River, and Waterton River.

South Saskatchewan River Basin Riparian Health Overview 2004: Summary

A general overview of the riparian health of the southern major rivers within the South Saskatchewan River Basin (Oldman (including Castle and Crowsnest), Waterton, Belly and St. Mary Rivers) in Alberta is provided. These rivers comprise approximately 1,039 km of river length in Alberta; just over 56 km of river was assessed in 46 sites, amounting to 5% of the total length examined.

The health of each river system varied, related to intensity of use, as well as amounts of damming and water withdrawals.

Unlike the project area examined in 2003, which had a fairly clear trend of decreasing health the further downstream the reach, there was not a similar clear trend in 2004 project work, although the uppermost reach was always rated the most healthy of that system, except in the Belly River, in which case the healthiest reach was the second most upper reach. The lowest rated reaches in each river system were typically near the middle; again, the exception to this was the Belly River, where the least healthy reach was the furthest downstream. The Oldman River tended to show the greatest variability, in part due to greater sampling intensity within reaches, greater number of total reaches, and greater geographic extent of the river. There was considerable variability within many of the reaches, for at least some parameters, on all rivers. Because of this variability, and the relatively small sample size (typically about two polygons per reach), the observations below are provided as an overview that will assist in general management or monitoring planning. More detailed or specific use of the information should be done at the system, reach and polygon level, with a clear understanding of site or localised health status, and a recognition of the limited sampling intensity that these generalizations are based on.

There are a couple of riparian health parameters that tended to vary based on proximity to headwaters:

Physical:

- Proportions of natural flow removed, leading to greater dewatering of channel and floodplain (healthier in all uppermost reaches, and very extensive diversions in lower reaches). St. Mary River, though rated healthier, still has significant removals even in the headwater reach)
- Control of flood peaks and timing by dams (directly related to proximity to dams; all headwater and upper reaches rate highly, with all lower reaches rating poorly. Due to overall greater length, some of the lowest Oldman River reaches do not rate as comparatively unhealthy for this parameter as those immediately downstream of the dam)

There is a no distinct trend for many riparian health parameters relative to headwater proximity:

- Regeneration and establishment of other tree species was highly variable. This parameter was only applicable in portions of five Oldman River reaches, and one Belly River reach; the remaining reaches were not applicable as no other trees were seen, and these areas were rated as not having potential to support non-cottonwood species.
- Decadent and dead woody material (healthy at most sites, but limited in some areas) was not consistently linked to either current heavy browse nor dewatering of the river. However, there were sites where low levels of browse and high diversion and/or damming corresponded with above normal amounts of dead and decadence, in the wood plant canopy.

- Preferred tree and shrub utilisation (highly variable, with over half of sites with light browse and just under half of the sites with moderate or heavy use (utilisation attributed primarily to livestock).
- Cover of woody species (excellent at all Waterton River and Belly River sites, but variable along the St. Mary and Oldman Rivers)
- Disturbance-caused plants (generally moderate cover to very extensive at all sites, but with variability)
- Presence of native graminoids (generally limited at all sites, but with variability)
- Proportion of banks protected with deep-binding roots (highly variable on all rivers)

Some parameters of riparian health were similar, regardless of location along the river system:

- Cottonwood regeneration from seed (generally excellent; a few sites with concerns)
- Preferred shrub regeneration (excellent at all but a few sites)
- Invasive plant species cover (generally extensive, but with variability on all rivers)
- Invasive plant species distribution (widespread on all but very few sites)
- Exotic, undesirable woody species (healthy at all sites)
- Human-caused bare ground (generally very minimal on all rivers, but with some site variability)
- Human alterations to the structure of riverbanks (at most sites, very minor alterations; a few sites with concerns)
- Floodplain accessibility (excellent, without impediments at all three smaller rivers (St. Mary, Waterton, and Belly Rivers) but with numerous sites impacted on the lower half of the Oldman River, usually related to presence of an urban centre; one site on the Crowsnest due to channelisation)

South Saskatchewan River Basin (Oldman River and major tributaries): Opportunities and Options for Improvement

Across the Oldman River and its major tributaries, grazing is the dominant land use, and this should be one of the key areas to focus on-site management, either maintaining existing good management, or improving management where it is negatively impacting riparian health. Settlement of many areas for ranching occurred between 1896 and 1910 (Marken 1993), so there has been a long history of use. Across Alberta, grazing, combined with over 100 years of development and settlement, has left most riparian areas with at risk or unhealthy. Despite this long history of grazing, many of the parameters that we would expect to be negatively affected by grazing are rated well in the 2004 project area. Because livestock often browse (eat tree and shrub species), we would expect this parameter, and those related to it, to be helpful in identifying problems. Overall browse on preferred trees and shrubs is light or absent at 27 of 46 sites, which is very positive. There are 19 sites with moderate to heavy use, but even at these sites, where we would expect to see effects on the woody plant community, there is not a significant effect on some woody plant parameters, since most sites have excellent regeneration of trees and shrubs, regardless of utilisation level.

In addition, there are only limited situations where low woody plant cover may be related to higher browse levels; at the majority of sites, it does not seem to be limited by browse pressure. Grazing management may be somewhat influencing establishment and regeneration of preferred trees and shrubs at sites with moderate or high utilisation; in those areas, appropriately setting stocking rate, modifying timing, and carefully distributing livestock can all reduce use of trees and shrubs.

The herbaceous plant community, assessed by invasive and disturbance-caused plants and native graminoid cover, is generally not healthy. Historic disturbance, including floods, grazing, and broad landscape level changes (i.e. introduction of non-native species) have all likely played an important role in leading to these riparian communities being invaded and replaced by less desirable species. Current grazing pressure, measured by browse pressure, is moderately linked to the status of the herbaceous community, since these plant communities are significantly altered at virtually all sites, even where browse is light or absent. It is likely that long-term accumulated impacts, including at grazed sites, has led to changes in the plant communities. Current levels of dewatering or diversions, as well as changes in peak and timing of flow due to damming may also be influencing health of the herbaceous plant community. As with the woody plant community, improvements in grazing distribution, stocking rate and timing that provide rest and improve native plant vigour can help to reduce further invasion of invasive or disturbance species. Control of weeds is needed in many areas; the extensive distribution is problematic because these areas can quickly lead to near infestations, and increase cover. Equally of concern are the high levels of cover of invasive plants at some sites—not only do these species not provide deep binding roots for bank stability and erosion protection, they may provide minimal habitat, and very limited forage potential. Because many of them are unpalatable to livestock, particularly cattle (the main domestic grazer in Alberta), they may increase unless active control measures are put in place.

Alterations to the plant community resulting from livestock grazing and other disturbances on the landscape can occur over long periods (Marken 2003; Cows and Fish pers. comm.), so appropriate long-term management strategies are key. Much of the disturbance-caused plant cover is made up of tame forage species, which have been introduced across Alberta in forage plantings, roadsides, parks and lawns. Removing them from riparian areas is unrealistic, but management should aim to make the most of these areas by increasing vigour and health of the native plant community, while limiting further coverage of disturbance-caused species.

Alterations to riverbanks, as well as human-caused bare ground, are minimal overall, although a few sites have moderate to high impacts. Current management of the sites examined, generally, is successful at not creating structural changes or bare soil, and should be promoted. Where present, even when minor, it is typically due to livestock grazing (being the dominant land use), but considering the extent of this land use, there is very low impact at most sites. Avoid using these areas during moist soil conditions, when compaction to soil will be greatest. Although low in total area, roads and trails are also quite common causes of alterations, and typically result in some bare soil for whatever portion of the area the traverse.

Similarly, wherever they cross the riverbank, structural alterations occur. Gravel extraction is not extensive, but where it occurs, it creates significant areas of bare ground and considerable structural alterations. Minimising these areas, reclaiming them, and carefully management equipment movement will reduce alterations and help limit further weed invasion. A few sites have recreational impacts or riprap; these areas can be minimised through development planning, and encouraging revegetation of these sites.

For long expanses of these rivers, there are significant concerns with dewatering / diversion and modified peaks and timing due to damming. There is some limited evidence from this project that these hydrologic alterations are impacting the woody plant community, but the evidence varies somewhat by river. Within the Oldman River, where four of five sites with cottonwood regeneration concerns coincide with both significant loss of flow and large areas of damming, there may be some evidence to indicate that loss of cottonwood regeneration is related. Within the Belly River, there may be some linkages between increased levels dead and decadence in the tree and shrub community (and loss of cottonwood regeneration) and extensive site dewatering. Along the St. Mary River, hydrologic modifications may be impacting trees and shrubs as seen in lower total cover provided by woody plants. There, with increasingly high levels of dewatering (combined with damming), cover provided by woody plants drops. In addition to impacts directly related to loss of water, silt shadows below the Oldman, Waterton, and St. Mary Reservoirs have been linked to reduced seedling establishment on these rivers, as well as the Belly River (Mahoney 1996).

There is considerable evidence in the literature, including extensive work on southern Alberta rivers, that damming and diversions impact establishment and maintenance of tree communities in riparian ecosystems. Reduced seedling establishment and success resulting from inappropriate or insufficient flows and floods are important in cottonwood establishment in Alberta (Rood and Mahoney 1990; Rood *et al*. 1990; Bradley *et al.* 1991). Long-term, riparian cottonwood (eg. *Populus balsamifera, P. deltoides, and P. angustifolia*) community success requires both maintenance flows as well as periodic flood (over bank) flows to allow for regeneration (Hughes and Rood 2003). Researchers have acknowledged that current hydrologic regimes that may be maintaining existing riparian plant communities (primarily cottonwoods), may not equate to flow and timing needed for establishment of new communities (Marken 1993).

Recent flood events in southern Alberta may be contributing to the apparent high levels of cottonwood and shrub regeneration in the project area. In 1995, flooding led to the establishment of new cottonwood stands; again in 2002, floodwaters were sufficient, combined with deposition, that seedling recruitment occurred. Our management of dams following these and smaller high water events may be insufficient for these seedlings (and their successors) to reach more mature age classes, or even older young classes (eg. sapling) (pers. communication J. Mahoney). Our observations in the field suggest that there are many very small, young plants, established in relatively recent recruitment events, but the age class structure is skewed to very young plants, with low numbers of older saplings or pole trees. Based on the riparian inventory and assessment

methodology, regeneration is assessed as proportion of cover comprised of the young age classes; combined with an assessment of total woody cover, these parameters should identify problems with woody plant community health.
The limitation may be that (except perhaps along the St. Mary river) recruitment without sufficient maintenance is occurring, in conjunction with woody cover that is still relatively high. In some of the areas examined, woody plant cover (not just cottonwoods) may have been very high, both in the early to mid 1900's and later. Losses, or potential losses, in recent decades may not have yet reached the point where overall cover has declined enough to be rated negatively. Consequently, loss of total cover, or change in species that make up that cover, may not be captured in one sampling effort. Long-term monitoring is key to follow loss of the woody plant community, including changes leading to increases in less riparian obligate species.

The St. Mary Dam has led to a progressive decline in cottonwood cover with 68% of the river length losing cottonwood communities, between 1951 to 1985; this was attributed to insufficient flows and rapid decline of high flows (Rood *et al*. 1995). Our work supported this trend, with lower woody plant cover in downstream areas. Floods and high water event in the past two decades have resulted in cottonwood recruitment; the successful maintenance of these seedlings is probably low (see above). However, with some success (and repeat new events), leading to a relatively high proportion of young to old trees, that may be why we do not see significant problems with tree and shrub communities along the Oldman, Waterton, and Belly Rivers, despite very high diversion and damming levels.

Considerable work has been done on modelling and stream flow data regarding appropriate water management to sustain cottonwood communities in southern Alberta (eg. SSRB Planning Program Scenario Report; Clipperton *et al.* 2003). Using modelling and ecological knowledge of cottonwoods, poplar rule curves have been established to identify instream flow needs that will maintain riparian cottonwood communities over the long-term (Clipperton *et al.* 2003). Significant, clear evidence, specific to Alberta, has indicated the likely loss or change of riparian plant communities that will result from the extensive damming and diversion in the southern tributaries. Because monitoring is both expensive and requires long periods of time (decades) to pass before problems can be identified, use this past data, in combination with the present data and modelling scenarios, to institute water management that will sustain riparian plant communities into the future.

One component within the riparian plant community that may require additional scrutiny is the shrub community. Because mature cottonwoods are phreatophytes, they are able to keep some of their roots below the water table, so they are more able to withstand drought, once established than perhaps many riparian shrubs (Tyree et al. 1994). Consequently, mature cottonwood stands may persist, while cottonwood recruitment into the young age classes is relatively unsuccessful, and loss or change in the shrub community occurs.

Floodplain accessibility and opportunity to deposit water and sediment on the floodplain

is excellent in almost all reaches, but where it is not, it typically relates to an urban development. Maintain current floodplain accessibility by limiting further berms or embankments. Prevent further channelisation or redirection of rivers.
The potential for improving riparian health is dependent on the specific reach and polygon. At some sites, local management impacts are minimal, or result from historic impacts, and not necessarily present day management. Regardless of whether plant community parameters rate as altered due to major hydrologic alterations, these flow and timing alterations are, or will be, areas to focus management long-term. Grazing management, which is the dominant land use along all rivers examined should focus on sustainable stocking, timing and distribution. Recreation and development in some areas also warrants improved management considerations. In general, site potential depends on the ability to alter both on-site management and hydrologic modifications. The ability to manage or modify those factors will determine the success at maintaining or improving riparian health.

RIPARIAN HEALTH RESULTS IN RELATION TO SORAC DATA

Our riparian health results from year two of this project compare from very well to moderately well to work done as part of a project to examine overall health of the rivers in the South Saskatchewan River Basin of Alberta, qualitatively examining riparian and aquatic conditions (Table 4). The project, titled SORAC (Strategic Overview of Riparian and Aquatic Condition), used a best judgement panel (BJP) to assign a relative rating based on water quality, quantity and flow modifications, aquatic health (including fish and other organisms), and riparian plant community health (based primarily on cottonwoods) (Golder Associates Ltd. 2003).

On the Oldman River, the riparian health assessment generally indicated a lower health than the SORAC rating. All five lower Oldman River reaches were rated as moderate for ecological condition (SORAC), but using riparian health assessment four of the five were rated as unhealthy, and the fifth was near the bottom of the healthy but with problems category. A major impact reducing the health rating was the modification to the hydrology (both loss of volume of flow and large area of the upstream watershed dammed). While these two evaluation systems do not examine entirely the same parameters (see below), they sufficient similarities to warrant further discussion. Based on these similarities, it is possible that either the BJP did not assign sufficient impact resulting from the hydrologic modifications, or herbaceous plant community changes, or it may be that the riparian health rating weights these hydrologic changes somewhat too heavily.

The remaining river reaches examined in 2004 were generally rated similarly between the riparian health methodology and SORAC, with unhealthy riparian areas equating to degraded or heavily impacted rivers, and healthy areas relating to unchanged/recovered sites. Those areas with moderate impact ratings were typically linked to the riparian health category of healthy, but with problems. In the 3 reaches ranked moderate impact that were not healthy but with problems, the reaches scores were on the border with an adjacent category.

When comparing these two methods, keep in mind that SORAC includes both aquatic and riparian areas when determining a rating or classification, while riparian health assessment does not include aquatic parameters such as water quality and aquatic life.

In addition, because a riparian health assessment and inventory is an examination of existing conditions, it is not possible to determine trend; trend determination requires examination of the site more than once. Consequently, the trend assigned based on SORAC cannot be compared with our work.

Table 4. Comparison of Riparian Health and SORAC Rating (Oldman River and major tributaries)

Oldman River Environment Reach	SORAC Rating	Riparian Health Rating	Polygon Code	Polygon Health
OM-10 (OM-08 in SORAC report)	Unchanged/Recovered to Moderate Impact - stable	Healthy, but with problems (76%)	OLD10 OLD11 OLD12	Healthy (84%) Healthy, but with problems (78%) Healthy, but with problems (74%)
OM-09 (Crowsnest River)	Not assessed	Healthy, but with problems (66%)	CRW1 CRW2	Healthy, but with problems (67%) Healthy but with problems (64%)
OM-08 (Castle River)	Not assessed	Healthy (84%)	CAT1 CAT2	Healthy (86%) Healthy, but with Problems (78%)
OM-07	Moderate impact – stable	Healthy, but with problems (72%)	OLD17 OLD18	Healthy, but with problems (72%) Healthy, but with problems (71%)
OM-06	Moderate impact – stable	Not available	N/A	N/A
OM-05	Moderate impact – stable	Unhealthy (54%)	OLD1 OLD15 OLD21	Unhealthy (38%) Healthy, but with problems (63%) Healthy, but with problems (60%)
OM-04	Moderate impact – stable	Unhealthy (59%)	OLD2 OLD13 OLD14	Unhealthy (55%) Unhealthy (59%) Healthy, but with problems (62%)
OM-03	Moderate impact – stable	Unhealthy (53%)	OLD5	Unhealthy (53%)
OM-02	Moderate impact – stable	Unhealthy (57%)	OLD4 OLD7	Healthy, but with problems (60%)

			OLD8 OLD9 OLD16 OLD20	Healthy, but with problems (63%) Unhealthy (50% Unhealthy (51%) Unhealthy (51%) Healthy, but with problems (68%)
OM-01	Moderate impact – stable	Unhealthy (56%)	OLD19 OLD22	Unhealthy (58%) Unhealthy (53%)

St. Mary River: Alberta Environment Reach	**SORAC Rating**	**Riparian Health Rating**	**Polygon Code**	**Polygon Health**
SM-03	Moderate impact – stable	Healthy, but with problems (64.5%)	STM3 STM4	Unhealthy (52%) Healthy, but with problems (76%)
SM-02	Degraded impact-declining	Unhealthy (43.5%)	STM1 STM5	Unhealthy (47%) Unhealthy (40%)
SM-01	Degraded impact-declining	Unhealthy (55.5%)	STM2 STM6	Unhealthy (51%) Healthy, but with problems (60%)

Belly River: Alberta Environment Reach	**SORAC Rating**	**Riparian Health Rating**	**Polygon Code**	**Polygon Health**
BL-05	Not assessed	Healthy but with problems (72.5%)	BEL9 BEL10	Healthy (89%) Unhealthy (56%)
BL-04	Moderate impact – stable	Healthy (80%)	BEL1 BEL6	Healthy, but with problems (79%) Healthy (81%)
BL-03	Moderate impact – stable	Healthy, but with problems (71.5%)	BEL7 BEL8	Healthy, but with problems (74%) Healthy, but with problems (69%)
BL-02	Moderate impact – declining	Healthy, but with problems (77%)	BEL2 BEL5	Healthy, but with problems (77%) Healthy, but with problems (77%)
BL-01	Heavily impacted-declining	Healthy, but with problems (61.5%)	BEL3 BEL4	Unhealthy (55%) Healthy, but with problems (68%)

Waterton River: Alberta Environment Reach	SORAC Rating	Riparian Health Rating	Polygon Code	Polygon Health
WT-03	Unchanged/Recovered- stable	Healthy (81%)	WAT4 WAT5	Healthy, but with problems (79%) Healthy (83%)
WT-02	Heavily impacted-declining	Unhealthy (57.5%)	WAT3 WAT7	Unhealthy (56%) Unhealthy (59%)
WT-01	Heavily impacted-stable	Healthy, but with problems (61%)	WAT2 WAT6	Healthy, but with problems (62%) Healthy, but with problems (60%)

NEXT STEPS

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 baseline information on riparian health and a review of historical land use practices have answered the question "Where are we now?"

- ***Highlight and profile what's working on the landscape right now.*** The next step is to use this knowledge, along with the application of sound range and riparian management techniques, towards the restoration of riparian health, at least to the level possible with current limitations to hydrologic characteristics (and consider where improvement on a watershed scale can be made to these). By working with landowners wanting to improve or maintain 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.

- ***Continue riparian inventory work over the long-term.*** Monitor progress of watershed, community and individual effort to address riparian issues. With the application of sound management principles on an individual and watershed basis, it is inevitable that the trend in riparian health will be positive over time. A single evaluation cannot define the absolute status of site health. To measure trend (improving, declining or staying the same) monitoring should be pursued in subsequent years. This can be achieved by another overall riparian inventory – every 3 to 7 years.

SELECTED REFERENCES AND LITERATURE CITED

Alberta Environment Conservation Authority (Alberta ECA). 1977. Flow regulations of the Red Deer River-Report and Recommendations. Edmonton, Alberta. 190 pp.

Alberta Environment Conservation Authority (Alberta ECA). 1974. Land use and resource development in the Eastern Slopes-Report and Recommendations. Edmonton, Alberta. 224 pp.

Bradley, Cheryl, Frances Reintjes and John Mahoney. 1991. The biology and status of riparian poplaras in southern Alberta. Prepared for World Wildlife Fund Canada and Forestry, Lands and Wildlife, Fish and Wildlife Division. 85 pp plus appendices.

Bradley, Cheryl, Frances Reintjes and John Mahoney. 1991. The Biology and Status of Riparian Poplars in Southern Alberta. Prepared for World Wildlife Fund Canada and Forestry, Lands &Wildlife, Fish and Wildlife Division. 85 pp+ App.

Clipperton, Kasey, C. Wendell Koning, Allan G.H. Locke, John Mahoney, Bob Quazi. 2003. Instream Flow Needs Determinations for the South Saskatchewan River Basin, Alberta, Canada. Alberta Environment and Alberta Sustainable Resource Development, Pub No. T/719, Calgary, Alberta. 271pp + App.

Corbett, Bill and Kim Lalonde. 2004. The State of Southern Alberta's Water Resources. Retrieved March 18, 2005. From the World Wide Web (http://www.confronting-water-scarcity.ca/files/waterresources.pdf).

Golder Associates Ltd. 2003. Strategic overview of riparian and aquatic condition of the South Saskatchewan River Basin. Submitted to Alberta Environment. Calgary, Alberta. 29 pp plus appendices.

Hughes, Francine and Stewart Rood. 2003. Allocation of River Flows for Restoration of Floodplain Forest Ecosystems: A review of Approaches and Their Applicability in Europe. Environmental Management 32 (1): 12-33.

Mahoney, John and Stewart Rood. 1993. The Potential Effects of an Operating Plan for the Oldman River Dam on Riparian Cottonwood Forests. Oldman River Dam Mitigation Program Downstream Vegetation Project Report Volume II. Prepared for Alberta Public Works, Supply and Services. 108pp + App.

Mahoney, John. 1996. How River Hydrology Affects the Establishment and Growth of Riparian Poplars. PhD dissertation. University of Calgary, Alberta.

Marken, Sandra. 1993. Plains cottonwoods and riparian plant communities on the lower Red Deer River. M.Sc. thesis. University of Calgary, Alberta.

Rood, Stewart, Craig Hillman, Trevor Sanche and John Mahoney. 1994. Clonal reproduction of riparian cottonwoods in southern Alberta. Can. J. Bot 72 : 1766-1774.

Rood, Stewart and John M. Mahoney. 1990. Collapse of river valley forests downstream from dams in western Prairies: probable causes and prospects for mitigation. Environmental Management 14: 451-464.

Rood, Stewart and John Mahoney. 1991. Pulsed Flows for River Valley Recharge During Extended Minimum Flow Periods. Department of Biological Sciences, University of Lethbridge, Alberta. 15pp.

Rood, Stewart and John Mahoney. 1991. The Biology of Riparian Cottonwood Forests in the Oldman River Basin. Oldman River Dam Mitigation Program Downstream Vegetation Project Report Volume II. Prepared for Alberta Public Works, Supply and Services. 115pp+ App.

Rood, Stewart and John Mahoney. 1991. Impacts of the Oldman River Dam on Riparian Cottonwood Forests Downstream. Prepared for Oldman River Dam Environmental Assesment Panel. 34pp.

Rood, Stewart, John M. Mahoney, David Reid and Leslei Zilm. 1995. Instream flows and the decline of riparian cottonwoods along the St. Mary River, Alberta. Can. J. Bot. 73: 1250-1260.

Rood, Stewart and Sig Heinze-Milne. 1989. Abrupt downstream forest decline following river damming in southern Alberta. Can. J. Bot. 67: 1744-1749.

Tyree, Melvin, Kimberley Kolb, Stewart Rood and Sandra Patino. et al. 1994. Vulnerability to drought-induced cavitation of riparian cottonwoods in Alberta: a possible factor in the decline of the ecosystem? Tree Physiology 14: 455-466.

OLDMAN RIVER PROJECT AREA

The project area is defined as a selection of riparian areas along the Oldman River (from Waldron's Corner gauging station upstream of the Oldman Dam to the confluence with the Bow River) including the Crowsnest River (from the Alberta/British Columbia border to the Oldman Dam) and the Castle River (from the Castle River gauging station to the Oldman Dam) (refer to project area map – Figure 3). The Oldman River project area covers a distance of approximately 637 km, including about 64 km for the Crowsnest River, and 172 km along the Castle River. A total of just over 28 km was sampled as part of 24 polygons (Table OM1, Appendix OM13).

NOTE: Castle River and Crowsnest River:
Oldman River reaches identified by Alberta Environment included the Castle River (OM-08) and the Crowsnest River (OM-09).

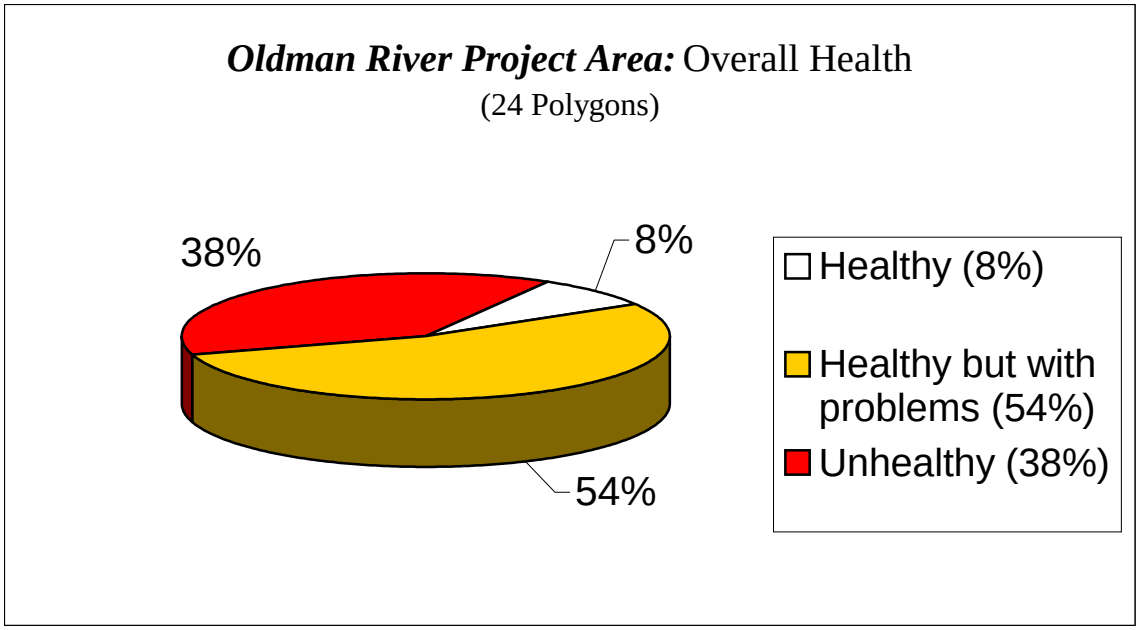
Throughout the Oldman River project area summaries, these two rivers are included. For details on these rivers specifically, refer to the reach overview (OM-08 and OM-09) and data provided in the attached appendices.

Riparian areas in the examined sites were up to 750 m wide, but more typically were 75-400 m maximum width, with an average width of 150 m (Appendix OM13) (Note: as per riparian health inventory methodology, sites examined only include one side of the river). There is a wide diversity of native vegetation along the river, with disturbance-caused and invasive plants interspersed throughout the native plant communities. Beaked willow/awned sedge habitat type (HT) (*Salix bebbiana/Carex atherodes*) covered the greatest area of any other HT. Balsam poplar/ snowberry/buckbrush (*Populus balsamifera/Symphoricarpos occidentalis*) community type (CT) covered the largest area of any CT. Narrow –leaf cottonwood/snowberry/buckbrush (*P. angustifolia /Sypmhoricarpos occidentalis*) and narrow-leaf cottonwood/red-osier dogwood (*P. angustifolia/Cornus stolonifera*) were the next most common plant communities (Appendix OM7).

WHAT DID WE FIND?

- **The level of interest in the project was very low.** Many of the landowners were cautious when considering participation in the project. Generally, those landowners who participated showed interest in determining the health of the riparian area. Thanks to everyone who allowed access to their land and supported this riparian inventory initiative. In all, 24 polygons were assessed on 17 landholdings along the Oldman River in 2001 and 2004 (Table OM1, Appendix OM1).

- **There are some concerns with the overall health of this riparian area, with 9 sites rated as non-functioning.** Only two polygons assessed along the Oldman River rated healthy in relation to guidelines within the inventory protocol. The remaining sites rated in the *healthy, but with problems* and *unhealthy category* (Appendix G9). The overall assessment of riparian health for the Oldman River project area is as follows (Figure OM1, Appendix OM13);



- Of the 24 polygons assessed: 8% (2/24) are *healthy*,
  54% (13/24) are *healthy but with problems*,
  38% (9/24) are *unhealthy*.

Figure OM1. Overall health of the Oldman River Project Area*.

*Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of the entire Oldman River watershed, but they do give an overview of health of the riparian areas within this river.

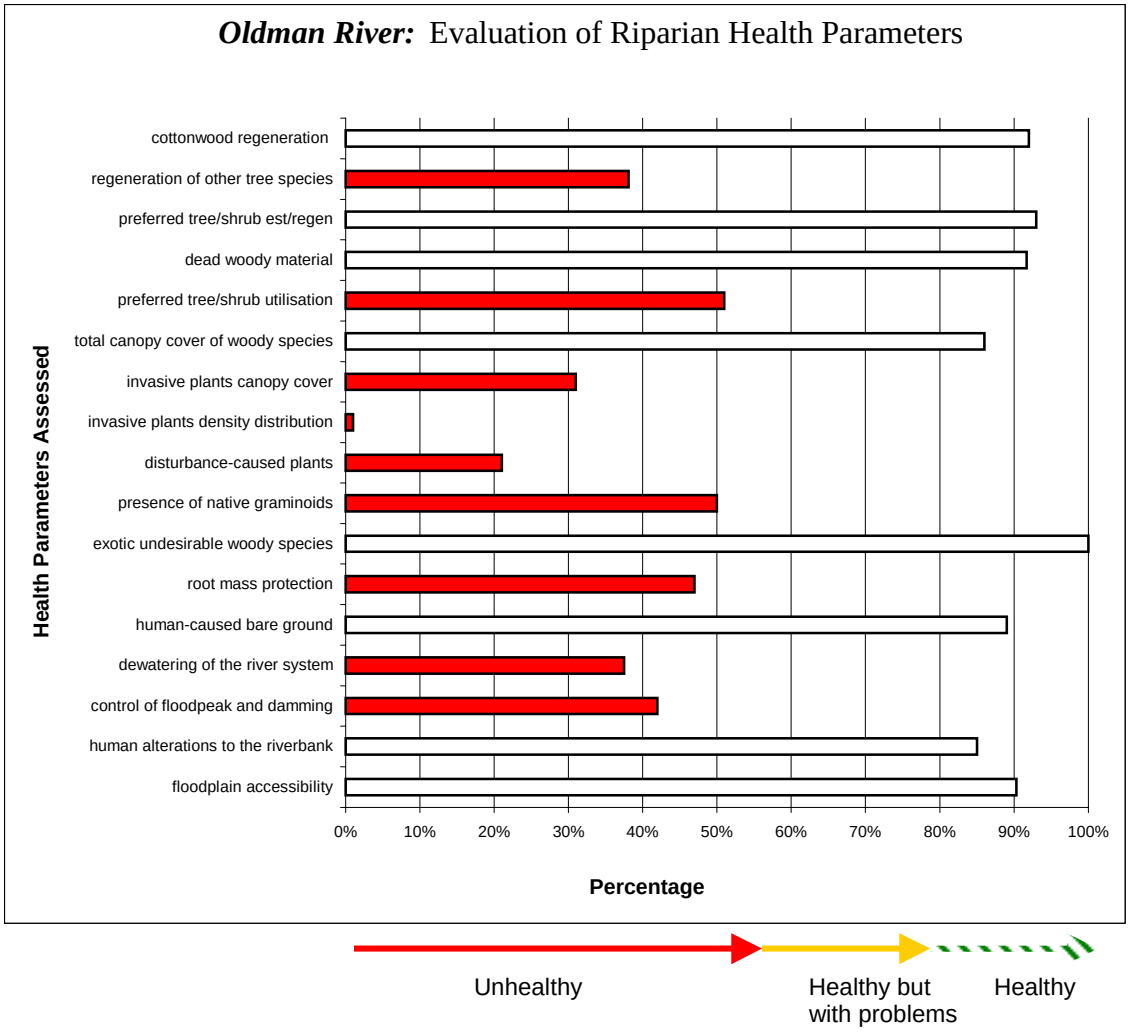
Remember: *We encourage users of the report to recognise the value of this report in broad-scale planning and identifying types of management and education approaches to take in the entire watershed--**this is not a finger pointing exercise; it should be used as part of an awareness process that maintains or improves management.***

Table OM1. Summary of Riparian Health Work –Oldman River

Year	River	# Landowners Contacted	# Landowners Participated	# Polygons Assessed	River Distance Assessed (km)
2001	**Oldman River**	**7**	**7**	**8**	**9.48**
2004	**Oldman River (including Castle and Crowsnest Rivers)**	**35**	**10**	**16**	**18.76**

RIPARIAN HEALTH DISCUSSION

For a description of how the parameters of riparian health are impacted by human disturbances and the overall effect on riparian health refer to *A Closer Look At The Riparian Health Pieces* in the overall summary of the South Saskatchewan River Basin.



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure OM2. Breakdown of riparian health results for 17 parameters assessed for the Oldman River project area

For an overview of the limitations of riparian health assessments refer to the section titled *Data Limitations* in the overall South Saskatchewan River Basin Summary.

Historic and Present Influences on Riparian Health

The following discussion provides some insights regarding the current status of the health of riparian areas within the project area, based on existing and historic influences.

- **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 (Alberta ECA 1977). At present, livestock grazing continues to be the primary land use along the Oldman River, and is thus the dominant land use potentially influencing riparian health (Table OM2, Appendix OM10). Current and past grazing use may be influencing riparian health at some of the sites assessed, primarily related to change in herbaceous plant communities.
- **Cropland cultivation**, tame pasture and forages (including hay), while comprising a small portion of riparian areas along the Oldman, Castle and Crowsnest Rivers, may have contributed to an increased presence of disturbance-caused undesirable plants and loss of native species within these riparian areas. In addition, irrigation requirements for water may negatively impact health (see availability of water and damming discussion).
- **Availability of water.** Water diversion**,** for irrigation, consumption and other uses, is affecting the overall health evaluation of the Oldman River to a substantial degree at the present time. In middle and downstream polygons, tree and shrub communities examined are not showing obvious signs of this water extraction (see overview for addition discussion), but long-term, these reduced water volumes and/or changes to flood or high water events can be expected to impact the maintenance of riparian vegetation. This will likely result from insufficient moisture being available to maintain tree and shrub communities or limiting moisture may prevent successful establishment of new plants.
- **Damming of the watershed** is occurring, primarily as a result of the Oldman Dam. Reaches below this dam have the greatest proportion of their watershed modified by peak flow and timing changes. In the polygons examined, there were no signs of impacts on tree and shrub regeneration in reaches where damming of the watershed upstream was significant. Because other researchers have found that damming and flow peak or flood modification can significantly alter long-term maintenance of tree and shrub communities, it is important to carefully monitor these areas and consider a more in depth examination of these parameters (see overview for further discussion).
- **Timber harvest** occurs in upper portions of the watershed. There has been an accelerated delivery of water resulting from reduction in forest cover in upper areas of the watershed. Depending on the extent and intensity of timber harvest, there way be an impact on the quantity and quality of water reaching the river, as well as levels of sediment and increased potential for introduction and invasion of disturbance or invasive species, due to bare soil and increased risk of seed transmission.

- **Development and industrial activity** including urban/domestic development, residential wastewater discharge, oil and gas exploration/development, roads and pipeline crossings are occurring along the Oldman, Castle and Crowsnest Rivers. In the stratification process, all of these activities were identified as occurring along the Oldman River reaches, but due to a limit in sample size and a focus on riparian health only some of these activities were identified in the polygons assessed. Activities and land uses identified as currently influencing riparian health on sites assessed include recreation, roads, other right-of-ways, paved and dirt foot trails, bridges, irrigation pumps and stations, gravel pits, and fish weirs. While these impacts are not extensive, they are sporadic and wide-spread. Impacts on riparian health was primarily through structural alterations to the riverbanks, increases in invasive or disturbance species and small amounts of human-caused bare ground. Incremental effects of this activity have coincided with cattle grazing for the past century, influencing current riparian health; there may also be effects on water quality and movement or delivery of water within the watershed.
- **Overall watershed changes** such as land cover types have increased the rate (and likely volume) at which water is delivered from the land, including a potential for more rapid rise in flood waters. These changes are more noticeable in areas that contribute to the middle and lower reaches.

Table OM2. Land uses along the Oldman River Project Area

AENV Reaches for Oldman River	**Land uses (% of reach based on length)**			
	Grazing	***Cropping***	***Developed***	***Undeveloped***
OM-01	67	18	6	8
OM-02	45	10	12	33
OM-03	43	12	4	41
OM-04	84	2	1	13
OM-05	92	2	6	0
OM-06	100	0	0	0
OM-07	64	0	0	36
OM-08	98	0	0	2
OM-09	67	0	19	14
OM-10	77	0	0	23
Total	72	7	6	15

Refer to methods in overall SSBR basin overview for a description of land use determination.

Refer to the section titled *Riparian Plant Communities-Why are they important?* for an overview of why understanding the riparian plant communities is important.

Riparian Plant Communities

Within the Oldman project area:

- All polygons examined supported both trees and shrubs, and all had preferred trees and shrubs.
- 25 different plant communities were identified.
- Shrub species cover 59% of the project area and trees occupy 56% of the project area (overlap may exist due to different heights of individual plants).
- 9 shrub community types were identified in the project area, including 4 willow types.
- A total of 10 tree community and habitat types were found, 9 of which were poplar (*Populus*) types.
- 4 different graminoid community and habitat types (2 native communities) were identified, occupying only 4.1% of the project area; however, graminoids cover 70.2% of the project area, providing extensive cover within the tree and shrub community and habitat types.
- A list of all plant species found in the project area is available in Appendix OM3. Additional plant community and habitat type information can be found in Appendix OM7. Refer to Appendix OM4 for a complete listing of plant species observed within each polygon.

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

There is good vegetative cover provided by trees and shrubs, with an average of 71% cover by woody species. Preferred woody species such as willows (*Salix* spp.), choke cherry (*Prunus virginiana*) and saskatoon (*Amelanchier alnifolia*) are common; these species are excellent for stabilizing and protecting the riverbank from erosion due to their deep binding roots.

The presence of many different tree and shrub species is often a good indicator of structure and diversity. A diversity of plants provides habitat layers benefiting wildlife and livestock.

Presence

- 10 tree species and 43 shrub species were identified and recorded within the Oldman River project area. Included in the total number of shrub species is common caragana (*Caragana arborescens*), an invasive shrub species.
- Other shrubs that were common and abundant, in addition to those mentioned above, are snowberry/buckbrush (*Symphoricarpos occidentalis*), thorny buffaloberry (*Shepherdia argentea*), yellow willow (*Salix lutea*) and sandbar willow (*Salix exigua*).
- Total area covered by all trees and shrubs was good to excellent overall, with 17 of 24 polygons receiving the maximum health rating for this parameter. A few sites rated poorly.

Reproduction

- 19 of 24 polygons (79%) along the Oldman River had at least 15% of cottonwood cover within the polygon provided by seedlings and saplings. The majority of the remaining sites (4 of 24) had cottonwood seedlings and saplings providing 5-15% of the cottonwood cover and 1 site had only up to 5% cover provided by cottonwood seedlings and saplings-this is positive.
- 29% of the polygons also had tree species other than cottonwoods found in the riparian area. White spruce *(Picea glauca)*, lodgepole pine (*Pinus contorta)*, trembling aspen (*Populus tremuloides*), Manitoba maple (*Acer negundo*), Douglas fir (*Pseudotsuga menziesii*), white birch *(Betula papyrifera)* and limber pine (*Pinus flexilis*) are the non-cottonwood tree species that were found in the project area. On the sites where these species were present, two polygons (33%) had more than 5% of the canopy cover provided by seedlings and saplings.
- In the majority of polygons (21 of 24) there was excellent regeneration and establishment of preferred shrub species. These polygons had more than 5% of the preferred shrub species cover provided by seedlings and saplings.

Health

- Existing tree and shrub communities show normal amounts of dead and decadent branches in the upper canopy. This suggests that: 1) at present, and in recent years, there is and has been sufficient moisture within the system and 2) disease is not a significant problem in maintaining these communities.
- There are some potential, minor concerns with the overall health of shrubs.
    - A fairly high proportion (28%) of the shrub canopy cover is comprised of four grazing-resistant shrubs (snowberry/buckbrush, *(Symphoricarpos occidentalis)*, common wild rose *(Rosa woodsii)*, prickly rose *(Rosa acicularis)* and silverberry *(Elaeagnus commutata)*.
    - The other 72% of the shrub cover is comprised of *preferred*[12] shrub species (including 4 willow communities) (this is positive).
    - In 42% of polygons (10 of 24), preferred trees and shrubs species are receiving moderate to heavy browse pressure from livestock (and to a lesser degree wildlife). In many locations this browse pressure is removing new growth and preventing seedlings and saplings from reaching a mature age class. This browse may be increasing the proportion of grazing-resistant shrubs.
    - The lowest two reaches have less extensive cover of preferred trees and shrubs compared to those areas upstream; whether this is due to changes in moisture availability, site characteristics or land use impacts long-term is uncertain.

[12] refer to Users Manual for methodology

Non-Woody Riparian Plants: Diversity and Health

Diversity

- 53 species of grasses and grass-like plants (graminoids) and 147 species of broad-leaved plants (forbs) were recorded within the Oldman River project area.
- Long-term or short-term use of a riparian area can be reflected in the presence or abundance of native grasses. These grasses will diminish with increased disturbances to the soil surface, often being replaced by disturbance-caused species. The majority of polygons (13 of 24) had less than 25% of the total riparian area covered by native grasses, and an additional 9 of 24 sites had 25-50% of the riparian area covered by native grasses.
- 68% (135 species) of the non-woody riparian plants recorded are native plants. Native plants provide riparian functions including deep, binding root masses and summer and winter forage production for livestock and wildlife.
- 5 poisonous plant species: early yellow locoweed (*Oxytropis sericea*), water hemlock *(Cicuta maculata)*, common horsetail (E*quisetum arvense*), showy milkweed (*Asclepias speciosa*) and showy locoweed (*Oxytropis splendens*), were recorded within the project area but their overall presence is not of concern because they were not abundant.

Health

- 46% of the project area is occupied by disturbance-caused plants (grasses and forbs). Of the 35 disturbance-caused plants present, the most prevalent are smooth brome (*Bromus inermis*), quack grass *(Agropyron repens)* and Kentucky bluegrass (*Poa pratensis*)[13].
- Over half (54%) of the polygons have over 50% of the riparian area covered in disturbance-caused undesirable herbaceous species. Disturbance-caused plants typically do not have a deep, binding root mass and therefore do not provide riverbank protection as well as non-disturbance native species. Refer to Appendix OM5 for more information regarding the area covered by disturbance plant species within each of the sites.
- Although there is an abundance of disturbance-caused plants, native grasses and forbs are found throughout the project area.
- Invasive plant species are found on all sites. Canopy cover of invasive plants is high enough to be a serious concern. In addition, distribution of plants is sporadic or fairly continuous throughout, resulting in a low rating for this parameter.
- The distribution of invasive plants (e.g. noxious weeds) is a concern. On 23 of 24 sites (96%) invasive plants have high distribution and are occurring continuously throughout the polygon or found in several patches.

[13] Kentucky bluegrass, smooth brome and timothy are tame or introduced species that have invaded or been introduced into many rangelands over the past decades. These grasses do not provide the same contributions to riparian health as native grasses because these non-natives have shallower, less dense root systems and minimal above-ground structure during spring melt.

Leafy spurge *(Euphorbia esula),* Canada thistle (*Cirsium arvense*) and common hound's-tongue *(Cynoglossum officinale),* are the three most prevalent invasive weeds. Blueweed *(Echium vulgare),* ox-eye daisy *(Chrysanthemum leucanthemum),* perennial sow-thistle (*Sonchus arvense*), diffuse knapweed *(Centaurea diffusa),* tall buttercup *(Ranunculus acris),* dalmation toadflax *(Linaria dalmatica),* bladder campion *(Silene cucubalus),* butter and eggs/yellow toadflax (*Linaria vulgaris*), Russian knapweed *(Centaurea repens),* spotted knapweed *(Centaurea maculosa),* common tansy (*Tanacetum vulgare*), white cockle (*Silene pratensis),* scentless chamomile (*Matricaria perforata*) and hoary cress *(Cardaria chalepensis)* are all present but in lesser amounts. There was also one invasive grass species, downy chess *(Bromus tectorum)* and an invasive shrub, common caragana *(Caragana arborescens)* found within the Oldman River project area.

Physical Characteristics of Riverbank and Floodplain

Human-Caused Bare Ground and Alterations to the Riverbanks

- Overall, 10% of the riverbanks within the project area have structural alterations by human activities.
- Riverbank modifications (including riprap and weirs) as well as livestock activity are the major causes of physical alterations along the Oldman River. Recreational activity is contributing to a lesser extent (Appendix OM8).
- Exposed soil surface is not a problem in the majority of polygons. Of the bare ground overall, 76% is naturally occurring (depositional material from recent flood events) and 24% is human-caused. The human caused bare ground that is present is mostly due to livestock activity and modifications to the riverbanks mainly for vehicle access. It is important to remember that invasive and disturbance-caused plants are aggressive and will invade areas of disturbed soil.

Riverbank Root mass Protection

- The presence of deeply rooted trees and shrubs is necessary along river systems for binding and holding the riverbanks together. These species act like armour and protect the banks from erosion and also aid in dissipating energy built up during flood events.
- The amount of deep binding root mass is variable along the Oldman River. Overall root mass protection was fair, but over half of the sites (13 of 24) had poor protection along the riverbanks, with >65% of the bank protected. The remaining sites are moderately to very well protected, with 21% of the polygons having over 85% of the bank with deep binding root mass, and the remaining 25% of polygons have 65-85% of the riverbank with deep binding roots—this is positive.

Hydrologic Characteristics

Dewatering of the River System

- Along the Oldman River, there is a variable amount of water removal. In more than half of cases (15 of 24), over 50% of the average river discharge is removed for human purposes---suggesting that there may be significant impacts resulting from the removal of water from these sites. This equates to five of the 9 reaches examined having over 50% of flow removed.
- In the remaining 9 polygons (and four reaches), less than 10% of the average river discharge is removed; in these reaches, there are likely very limited impacts to riparian health.
- Removing water from a river system can reduce bank stability, wildlife habitat and primary production of the riparian area.

Control of Flood Peak/Timing by Upstream Dams

- Along the Oldman River, the Oldman Dam is the major dam impacting riparian health. These impacts may be most felt in polygons located immediately downstream of the dam. 8 of 24 polygons have more than 50% of their watershed upstream controlled by the Oldman Dam; these are in the three reaches immediately downstream of the dam. 9 of 24 polygons have 25-50% of their watershed upstream controlled by the Oldman Dam, these being the three reaches furthest downstream (Appendix OM1). This is a considerable proportion of their watershed that has modifications to flood timing and intensity and is thus considered to be negatively impacting riparian health in those areas.
- Man-made dams negatively influence riparian health because they alter the natural flow of the river, removing water and adjusting flood patterns. Riparian areas depend on the natural flow of the river, especially flood events to recharge ground water reserves, and to rebuild and maintain riverbanks through sediment deposition.

Floodplain Accessibility

- Along the Oldman River, almost all of the polygons (17 of 24) floodwaters have access to more than 85% percent of the floodplain, which is the minimum amount considered required to maintain riparian functions related to this parameter.
- In the sites where there where barriers are present, this barrier prevents high water flows from accessing the floodplain, an important function of all river systems. Energy that is built up in flood events requires the floodplain as a place to disperse that energy, as well as deposit water and materials. If access is restricted then all of the energy is concentrated within the channel, leading to increased bank instability and erosion.

Oldman River Riparian Health Overview: Summary

Along the Oldman River, riparian health is higher in the upper reaches of the Oldman River, with all 5 lower reaches falling in the unhealthy category. Most reaches have minimal intra-reach variation (recognising the few polygons per reach examined), and generally have 5-10% variation between polygons in a given reach. Because a couple of reaches did show somewhat more variability between polygons, and due to the small sample size in each reach, keep in mind that the observations below are provided as an overview that will assist in general management or monitoring planning. More detailed or specific use of the information should be done at the reach and polygon level, with a clear understanding of site or localised health status.

A number of factors contributed to lack of healthy sites in the lower reaches:
Physical/Hydrological:

- Extensive proportion of natural flow removed, leading to greater dewatering of channel and floodplain (all four upper most reaches rated excellent; all of the lower five reaches rated poorly)
- Control of flood peaks and timing by dams (this factor actually rates lowest in middle reaches, and improves somewhat as distance from the Oldman Dam increases)
- Human-caused bare ground (maximum rating in all upper four reaches, with moderate scores in all remaining lower reaches)

There were no clear trends in these riparian health parameters as proximity to headwaters increased:

- Regeneration of other tree species
- Preferred tree and shrub utilisation
- Cover of woody species (upper three reaches and lower most reaches had some reduced scores)
- Invasive species cover
- Disturbance-caused plant cover was generally poor, but sporadically very poor or moderate.
- Presence of native graminoid species
- Proportion of banks protected with deep-binding roots
- Human alterations to the structure of riverbanks (concerns with five sites, scattered among three reaches; two reaches impacted by fish weirs)
- Floodplain accessibility (four reaches have limitations, but no pattern)

Some parameters of riparian health were similar, regardless of location along the river system:

- Cottonwood regeneration from seed (excellent at all but 4 sites)
- Preferred shrub regeneration (excellent at all except 3 sites)
- Decadent and dead woody material (normal amounts at most sites, with the occasional site with small extra amounts throughout the river length)
- Invasive species density distribution (extensive distribution, leading to very poor score at all but one site)
- Exotic, undesirable woody species (healthy at all sites)

Limitations of the Data

Refer to Data Limitations on page 164.

Oldman River: Opportunities and Options for Improvement

Although quite common and extensive as a land use along the Oldman River, grazing management is only the partial cause of loss of overall riparian health. There are certainly some signs of grazing impacts on the plant communities, including moderate or heavy levels of browse at about 40% of sites. While this level of browse is generally not considered sustainable because it reduces plant vigour and typically limits regeneration of new plants, it is not currently expressing that impact, since preferred shrub regeneration is excellent throughout the areas examined. Where dewatering and / or altered flow peak and timing are extensive (rated poorly), shrub regeneration does not appear to be limited by browse. Long-term or past grazing management may be important, particularly with regard to changes to the herbaceous community.

While there is not a clear trend to reduction in cottonwood regeneration, four of the five sites with cottonwood regeneration concerns are impacted by both removal of flow and presence of a dam. The one site where no dewatering or dam issues were identified was on the Crowsnest River. It is possible small local dams exist on this reach, either known or unknown to Alberta Environment. If present, these dams are not included in data provided by Alberta Environment, because only the major dams are included in the data prepared for this project.

Regeneration of preferred shrubs is moderate to good throughout the riparian areas examined. This suggests generally grazing pressure is not currently limiting growth and maintenance of these communities, and despite extensive removal of the flow within the river, these sites are also not showing impacts that result from drying out of the site.

Livestock grazing management in these areas should focus on keeping preferred tree and shrub utilisation to light, and occasionally moderate, levels (down from heavy to moderate in some areas). This will benefit seedlings and saplings establishment and growth, through increased growth and vigour. Focussing on ways to minimise use in sensitive periods (i.e. when graminoids and forbs have reduced palatability or are limited in quantity) will promote woody plant growth, while minimising livestock browse.

Regeneration of cottonwoods was occurring to some degree at all sites, although it was minimal at one site. Less than one third of sites supported other tree species, and five of those seven sites had some regeneration of non-cottonwood trees occurring. The amount of regeneration (seedlings and saplings) of non-cottonwood trees was highly variable to absent, but because some sites had single or very few trees (eg. single coniferous tree on a bank escarpement), making a general observation is not valid. At the present, it does not appear that cottonwood regeneration is a concern at the sites examined, due to on-site management or hydrologic modifications. No generalization regarding regeneration of other tree species can be made due to limited data.

Invasive weeds are a significant concern along the Oldman River; reducing the presence

and distribution of invasive plants and limiting further invasion should be an integral part of preventing further riparian health decline. Invasive weeds not only reduce native plant abundance and cover, but they can remove habitat for wildlife and contribute to bank instability and erosion. A combination of weed control measures and grazing strategies that consider distribution, timing and stocking rates will be required to prevent human-caused bare soil, limit weeds and promote plant vigour. Because the abundance of invasive plants can fluctuate greatly from year to year, monitor infestations closely. Continue to keep human-caused bare ground at a minimum. While human impacts to bare soil are minimal at present, the many land uses in the watershed have brought in seed and offer sources for future further invasion, particularly with the aid of water-borne seeds and deposition along the river. Additional information about invasive plants can be found in Appendix OM6.

There were very few impacts to bank structure, but where present, they were due to livestock, recreation, and development (including weirs). To maintain the bank integrity, continue to minimise livestock access to riverbanks and active floodplains during susceptible periods (i.e. moist soil conditions) to prevent additional structural alterations. Because there are currently minimal structural alterations, there is good opportunity to maintain bank integrity. Those areas with development or weirs are assumed to be less likely to change, and therefore they will persist without significant effort.

In grazed areas, limiting livestock grazing to light-moderate levels will increase deep-rooted herbaceous and woody plants. This will help trap sediment to build stream banks, protecting against lateral cutting and erosion. Rest is needed during the sensitive portions of the growing season to promote recovery. Rest and sustainable stocking rates will also help reduce invasive weeds and give a competitive advantage to native grasses, reducing disturbance species abundance. Long-term changes resulting from heavy or poorly timed grazing have undoubtedly contributed to existing high levels of disturbance plants and concurrent loss of native graminoids. Watershed changes that increase seeds and plant material of less desirable species make removing them unrealistic, but grazing management can aim to increase native plant vigour and reduce further spread of invasive and disturbance-caused plants.

The uppermost reach on the Oldman, Castle and Crowsnest Rivers each have less than 10% of the average river discharge removed. In these headwater areas, water extractions are minimal and are not posing any significant. The reach immediately below the Oldman Dam similarly has minimal water removed. All remaining downstream reaches have over 50% of the flow removed, potentially providing considerable constraints to long-term maintenance of tree and shrub communities and aquatic life, as well as hydrologic processes. We do not see an obvious relationship between those reaches with extensive withdrawal and regeneration of trees or shrubs. This may result from limited sample size (i.e. there is an impact, but we did not examine enough sites), it may accurately reflect the riparian situation (i.e. there is no impact), or there may be confounding factors that have mitigated the impact of the withdrawals. High spring flows (resulting in floods) as well as above normal rainfall in some relatively recent years may be mitigating the potential impact of extensive withdrawals.

The upper three reaches are not dammed (the uppermost Oldman River reach and the Castle and Crowsnest Rivers), but the Oldman Dam is controlling flood peak and timing significantly in OM-07 to OM-01. With increased distance from the dam, OM-03, OM-02 and OM-01 are somewhat less influenced, with 25-50% of the watershed upstream dammed. As with the extensive water withdrawals, damming is currently not seen to be affecting woody plant regeneration, but the potential effects could be masked by sample size limitations or very significant flood events in recent years. Because damming is generally acknowledged to have potentially harmful impacts on riverine ecosystems, consider limiting further damming and aim to maintain peak flow and timing that allows for maintenance of riparian plant communities as well as channel process. The number and volume of minor or unlicensed dams within the entire watershed (including off the main river) should be identified and quantified to more fully understand potential modifications to stream flow parameters.

In some areas, small dams, berms or development activities have resulted in some loss of floodplain accessibility; however, most of the river can easily access its entire floodplain. To ensure future floodplain access, limit construction and development that is designed to constrain the river in a narrow area.

Oldman River Reach Overview

The reaches along the Oldman River are summarized starting from Waldron's Corner gauging station, including the two main tributaries: Crowsnest River from the Alberta/British Columbia border and Castle River from the Castle River gauging station, downstream to where the Oldman River joins the Bow River at the Grand Forks. (Table OM3). In most reaches, at least 2 polygons, totalling approximately 2 km of river length are evaluated for the Oldman River (Table OM4). The polygons rate roughly evenly between two riparian health categories—healthy, but with problems (functioning but at risk) and unhealthy (non-functional) (Table OM5).

Table OM3. Alberta Environment (AENV) Reaches Boundary Descriptions - Oldman River

Reach	Upstream and Downstream Description
OM-10	Waldron's Corner gauging station on Oldman River to Oldman Dam
OM-09	Crowsnest River at BC/AB border to Oldman Dam
OM-08	Castle River gauging station to Oldman Dam
OM-07	Oldman Dam to upstream of Pincher Creek confluence
OM-06	Pincher Creek confluence to upstream of Lethbridge Northern Irrigation District (LNID) Weir
OM-05	LNID Weir to upstream of Willow Creek confluence
OM-04	Willow Creek confluence to upstream of Belly River confluence
OM-03	Belly River confluence to upstream of St. Mary River confluence
OM-02	St. Mary River confluence to upstream of Little Bow River confluence
OM-01	Little Bow River confluence to Grand Forks (confluence with Bow River

Table OM4. Summary of Oldman River Reaches – Sites

AENV Reaches for Oldman River	# Sites Assessed	River Distance Assessed (km)
OM-10	3	2.55
OM-09	2	2.11
OM-08	2	2.69
OM-07	2	2.30
OM-06	*	*
OM-05	3	4.07
OM-04	3	4.67
OM-03	1	3.20
OM-02	6	5.21
OM-01	2	1.44
Total	24	28.24

*OM-06 will be assessed in the summer of 2005 and data made available the following winter.

Table OM5. Number of Reach Sites by Riparian Health Category – Oldman River

Reach	Healthy	Healthy but with problems	Unhealthy
OM-10	1	2	0
OM-09	0	2	0
OM-08	1	1	0
OM-07	0	2	0
OM-06	NA	NA	NA
OM-05	0	2	1
OM-04	0	1	2
OM-03	0	0	1
OM-02	0	3	3
OM-01	0	0	2
Total	2	13	9

Table OM6. Reach Land Use - Oldman River

AENV Reaches for Red Deer River	Land uses (% of reach based on length)			
	Grazing	***Cropping***	***Developed***	***Undeveloped***
OM-10	77	0	0	23
OM-09	67	0	19	14
OM-08	98	0	0	2
OM-07	64	0	0	36
OM-06	100	0	0	0
OM-05	92	2	6	0
OM-04	84	2	1	13
OM-03	43	12	4	41
OM-02	45	10	12	33
OM-01	67	18	6	8

Table OM7. Summary of Plant Communities: Overall and Woody Communities – Oldman River Reaches

Reach	# of Plant Communities	% of Area Examined with:	
		Tree Species	Shrub Species
OM-10	6	28	12
OM-09	3	8	45
OM-08	5	38	30
OM-07	3	77	47
OM-06	NA	NA	NA
OM-05	8	68	62
OM-04	7	57	77
OM-03	4	50	80
OM-02	9	58	52
OM-01	3	1	20

In addition to graminoid and forb communities at most reaches, these reaches have some areas as unclassified wetland types.

Community and habitat types are determined using Thompson and Hansen (2002). Refer to Appendix OM7 for a complete description of habitat and community types.

Table OM8. Summary of Plant Communities: Herbaceous Communities – Oldman River Reaches

Reach	% of Area Examined with:		
	Grass Species	Forb Species	Disturbance Species
OM-10	36	31	22
OM-09	96	22	34
OM-08	26	18	14
OM-07	60	20	57
OM-06	NA	NA	NA
OM-05	80	30	51
OM-04	70	31	50
OM-03	80	40	40
OM-02	72	49	51
OM-01	31	20	30

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

Reaches typically have from 2-6 tree species, with shrubs typically ranging from 10-27 species. Balsam poplar is common throughout most of the reaches and narrow-leaved cottonwood becomes prominent in OM-05 and continues throughout the reaches downstream. Plains cottonwood is present in the lower reaches (Appendix OM6). Regeneration of trees is excellent to moderate for most of the reaches with some variability between sites within some of the reaches (Table OM10). Dead branches and dead standing trees make up normal to slightly above normal amounts of the woody plant canopy and utilisation/browse is variable, generally light to moderate, with some heavy use in some of the reaches (Table OM11).

Table OM9. Woody Plant Species Presence– Oldman River Reaches

Reach	# of Tree Species	# of Shrub Species	% of Polygon Area that is Woody Species
OM-10	4	22	38
OM-09	2	19	53
OM-08	6	27	56
OM-07	2	15	77
OM-06	NA	NA	NA
OM-05	2	19	71
OM-04	2	15	77
OM-03	2	12	80
OM-02	5	26	73
OM-01	4	10	20

Refer to Appendix OM4 for a complete list of plant species.

Table OM10. Woody Plant Species Reproduction– Oldman River Reaches

Reach	Cottonwood Regeneration (seedlings/ saplings)	Other Tree Species Regeneration (seedlings/ saplings)	# of Sites with seedlings /saplings >5% of total woody cover	Means for health…
OM-10	All sites excellent	1 site conifers excellent, 2 sites not applicable (no other trees observed)	2	Excellent regeneration, although regeneration of preferred shrubs poor at one site.
OM-09	1 site excellent, 1 site moderate to good	1 site conifers poor, 1 site conifers very poor	2	Variable regeneration, generally very good for cottonwoods and shrubs, but poorer for conifers
OM-08	All sites excellent	1 site conifers excellent and 1 site conifers very poor	2	Excellent regeneration of cottonwoods and preferred shrubs, but variable for confers
OM-07	All sites excellent	Not applicable, (no other trees observed)	2	Excellent regeneration for cottonwoods and

				preferred shrubs, no other tree species to evaluate
OM-06	NA	NA	NA	NA
OM-05	2 sites excellent, 1 site moderate to good	2 sites not applicable, none observed	3	Excellent to moderate cottonwood regeneration; no other tree species to evaluate. Excellent preferred shrub regeneration.
OM-04	All sites excellent	Not applicable (no other trees observed)	3	All sites excellent regeneration of cottonwood and preferred shrub species. Other tree species absent.
OM-03	1 site moderate to good	Not applicable (no other trees observed)	1	Moderate cottonwood regeneration, excellent preferred shrub regeneration and other tree species are absent.
OM-02	4 sites excellent, 1 site moderate to good, 1 site poor	1 site excellent, 1 site very poor and 4 sites not applicable (no other tree observed)	4	Variable; poor to excellent cottonwood and other tree species regeneration. Other tree species are absent on 4 sites. Excellent preferred shrub regeneration on 4 sites, 1 site moderate and 1 site poor.
OM-01	All sites excellent	Not applicable (no other trees observed)	2	Excellent regeneration of cottonwoods and preferred shrub species. Other tree species are absent.

Refer to Appendix OM1 for a summary of river health survey scores.

Table OM11. Woody Plant Health– Oldman River Reaches

Reach	Dead and Decadence	Utilisation of Preferred Woody Plants	Means for health…
OM-10	Normal	Light - heavy	Fair
OM-09	Normal, minor	Moderate	Fair
OM-08	Normal	Light - moderate	Fair
OM-07	Normal, minor	Light	Excellent
OM-06	NA	NA	NA
OM-05	Normal, minor	Light	Excellent
OM-04	Normal, minor	Light - moderate	Fair
OM-03	Minor	Moderate	Fair
OM-02	Normal, minor	None - moderate	Fair
OM-01	Normal	Light - heavy	Fair

Non-Woody Riparian Plants: Diversity and Health

A wide diversity of herbaceous species were found, with over 20 graminoid species and over 55 forb species found in all reaches combined. Native graminoids were present but not highly abundant throughout most of the reaches. Disturbance species have significant ground cover of most reaches and are negatively impacting health (Table OM13). Invasive plant species are present throughout all reaches, although coverage of these species is minimal. They are widely and sporadically distributed throughout all of the reaches, leading to potential further infestations of disturbed areas (Table OM14). Canada thistle (*Cirsium arvense*) and common hound's tongue *(Cynoglossum officinale)* are the most common and widespread invasive plants, with numerous other species commonly found (Table OM15).

Table OM12. Non-Woody Riparian Plant Diversity–Oldman River Reaches

Reach	Total # of Grass/ Grass-like Species	Total # of Forb Species	Proportion of site covered by native graminoids	Means for health…
OM-10	29	66	1 site 25%-50%, 2 sites 5%-25%	Fair to good
OM-09	24	63	1 site >50%, 1 site 5%-25%	Fair to excellent
OM-08	23	69	2 sites 5%-25%	Fair
OM-07	28	59	2 sites 5%-25%	Fair
OM-06	NA	NA	NA	NA
OM-05	31	63	3 sites 25%-50%	good
OM-04	23	59	1 site >50%, 1 site 25%-50%, 1 site 5%-25%	Fair to excellent
OM-03	13	22	1 site 25%-50%	Good
OM-02	37	73	3 sites 25%-50%, 2 sites 5%-25%, 1 site <5%	Poor to good
OM-01	23	50	2 sites 5%-25%	Fair

Table OM13. Non-Woody Riparian Plant Health - Proportion Disturbance Caused Undesirable Herbaceous Species– Oldman River Reaches

Reach	% of Reach with Disturbance Plants	Disturbance Plants Cover	Means for health…
OM-10	22	2 sites 5%-25%; 1 site 25%-45%	Variable, from moderate to widespread, of concern
OM-09	34	1 site 5%-25%; 1 site >45%	Variable, from moderate to extensive; of concern
OM-08	14	1 site 5%-25%; 1 site 25%-45%	Variable, from moderate to widespread; of concern
OM-07	57	2 sites >45%	Extensive; of concern
OM-06	NA	NA	NA
OM-05	51	3 sites >45%	Extensive; of concern
OM-04	50	3 sites >45%	Extensive; of concern
OM-03	40	1 site 25%-45%	Widespread; of concern
OM-02	51	2 sites 25%-45%; 4 sites >45%	Variable, from widespread to extensive; of concern
OM-01	30	2 sites 25%-45%	Widespread; of concern

Table OM14. Non-Woody Riparian Plant Health - Proportion Invasive Plant Species– Oldman River Reaches

Reach	# of Sites with Invasive Plants	Invasive Plants Cover	Density/ Distribution of Invasive Plants	Means for health…
OM-10	3	1 low cover, 1 site moderate cover, 1 site high cover	Rare occurrence to patches to continuous occurrence of plants with a few gaps in the distribution	Canopy cover and distribution are of concern
OM-09	2	2 sites moderate	Rare occurrence to patches to continuous occurrence with a few gaps in the distribution	Canopy cover and distribution are of concern
OM-08	2	1 site low cover; 1 site moderate cover	A few sporadically occurring plants to patches to continuous occurrence of well spaced plants	Canopy cover and distribution are of concern
OM-07	2	2 sites moderate cover	Rare occurrence to patches to continuous occurrence of well spaced plants	Canopy cover and distribution are of concern
OM-06	NA	NA	NA	NA
OM-05	3	1 site low cover, 2 sites moderate cover	Rare occurrence to patches to continuous occurrence of well spaced plants	Canopy cover and distribution are of concern
OM-04	3	2 sites low cover, 1 site high cover	Rare occurrence to several sporadically occurring plants to several well spaced patches	Canopy cover and distribution are of concern
OM-03	1	1 site high cover	Single patch to a few patches to continuous uniform occurrence of well	Canopy cover and distribution are of concern

			spaced plants	
OM-02	6	2 sites moderate cover, 4 sites high cover	Rare occurrence to several sporadically occurring plants to continuous occurrence of plants associated with wetter or drier zones	Canopy cover and distribution are of concern
OM-01	2	2 sites moderate cover	Few sporadically occurring to several sporadically occurring to continuous occurrence of plants with a few gaps in the distribution	Canopy cover and distribution are of concern

Table OM15. Most Common Invasive Herbaceous Plant Species– Oldman River Reaches

Reach	Species
OM-10	Canada thistle, common hound's tongue, leafy spurge
OM-09	Canada thistle, common caraganna, tall buttercup
OM-08	Canada thistle, common hound's tongue, ox-eye daisy, perennial sow-thistle, tall buttercup, downy chess
OM-07	Canada thistle, ox-eye daisy, downy chess
OM-06	NA
OM-05	Canada thistle, common hound's tongue, ox-eye daisy, perennial sow-thistle
OM-04	Canada thistle, common hound's tongue, perennial sow thistle
OM-03	Canada thistle, common hound's tongue, leafy spurge
OM-02	Canada thistle, diffuse knapweed, leafy spurge
OM-01	Canada thistle, leafy spurge, perennial sow-thistle

Physical Characteristics of Riverbank and Floodplain

Human-caused bare ground is minimal throughout the upper reaches and becomes more noticeable (but still mostly low) from reach OM-05 downstream to the confluence with the Bow River (Table OM16). The main sources of human-caused bare ground are livestock grazing and roads/trails (Appendix OM9). Human activities are altering the structure of the riverbank in most of the reaches to a very limited extent; however, some activities have resulted in moderate to significant alterations at a few polygons (Table OM17).

A combination of development (including roads and construction of weirs (along the Crowsnest River)), livestock activities and recreation are the sources of these bank alterations. Riverbank root mass protection, as assessed by the length of bank with deep-binding roots, is variable, with very poor to well protected areas (Table OM18). Appendix OM14 also outlines the bank materials within each of the sites inventoried along the Oldman River.

Human-Caused Bare Ground and Alterations to the Riverbanks

Table OM16. Human-caused Bare Ground–Oldman River Reaches

Reach	**# of Sites with >5% Human Caused Bare Ground**	**Proportion of polygons covered by human-caused bare ground**	**Sites are…**
OM-10	0 of 3	all sites <5%	Well vegetated
OM-09	0 of 2	all sites <5%	Well vegetated
OM-08	0 of 2	all sites <5%	Well vegetated
OM-07	0 of 2	all sites <5%	Well vegetated
OM-06	NA	NA	NA
OM-05	1 of 3	1 site 5%-25%, 2 sites <5%	Mostly well vegetated
OM-04	1 of 3	1 site 5%-25%, 2 sites <5%	Mostly well vegetated
OM-03	1 of 1	1 site 5%-25%	Fairly well vegetated
OM-02	4 of 6	4 sites 5%-25%, 2 sites <5%	Fairly well vegetated
OM-01	1 of 2	1 site 5%-25%, 1 site <5%	Fairly well vegetated

Table OM17. Human-Caused Structural Alterations– Oldman River Reaches

Reach	# of Sites with Human Caused Structural Alterations	# of Sites with Human-Caused Structural Alterations Along:				Banks are…
		< 10% of length	10-25% of length	25-50% of length	> 50% of length	
OM-10	3	3	0	0	0	Intact
OM-09	2	0	0	1	1	Moderate to significantly altered
OM-08	2	2	0	0	0	Intact
OM-07	0	2	0	0	0	Intact
OM-06	NA	NA	NA	NA	NA	NA
OM-05	2	1	1	0	1	Intact to significantly altered
OM-04	3	3	0	0	0	Intact
OM-03	1	1	0	0	0	Intact
OM-02	6	5	0	1	0	Mostly intact to moderate altered
OM-01	2	2	0	0	0	Intact

Riverbank Root Mass Protection

Table OM18. Proportion of Riverbank with Deep Binding Roots—Oldman River Reaches

Reach	# of Sites with Riverbank Rootmass Protection along:				Banks are…
	> 85% of length	65-85% of length	35-65% of length	< 35% of length	
OM-10	1	0	0	2	Variable; 1 well protected, two very poorly protected
OM-09	0	0	1	1	Variable, half poorly protected, half very poorly protected
OM-08	0	1	1	0	Variable: half moderately protected, half poorly protected
OM-07	0	2	0	0	Moderately protected
OM-06	NA	NA	NA	NA	NA
OM-05	1	1	0	1	Variable; 1 well protected, 1 moderate, 1 very poorly protected
OM-04	1	0	2	0	Variable; 1 well protected, 2 poorly protected
OM-03	0	0	1	0	Poorly protected
OM-02	2	2	2	0	Variable, 2 well protected, 2 moderate, 2 poorly protected
OM-01	0	0	0	2	Very poorly protected

Hydrologic Characteristics

Dewatering is very minor in the upper reaches and increases dramatically with major withdrawals from OM-05 and all of the reaches downstream, with the exception of OM-03 where there very minor withdrawals occurring (Table OM19). Floodplain access of by floodwaters is mostly good with only minor restrictions occurring throughout OM-09, OM-04, OM-03 and OM-01 (Table OM21). The proportion of damming and modifications to peak flows and timing is absent or minimal in the upper three reaches, but it is extensive just below the Oldman Dam, and as distance from the dam increase, the proportion of the watershed dammed is lessened (Table OM20).

Dewatering of the River System

Table OM19. Dewatering of the River—Oldman River Reaches

Reach	Total use as a % of natural *	# of Sites with River Discharge Being Removed that is:				Impacts are…
		< 10% of average	10-25% of average	25-50% of average	> 50% of average	
OM-10	6.0	3	0	0	0	Very minor
OM-09	5.8	2	0	0	0	Very minor
OM-08	2.6	2	0	0	0	Very minor
OM-07	6.6	2	0	0	0	Very minor
OM-06	8.0	NA	NA	NA	NA	NA
OM-05	73.7	0	0	0	3	Significant
OM-04	67.6	0	0	0	3	Significant
OM-03	77.0	0	0	0	1	Significant
OM-02	77.6	0	0	0	6	Significant
OM-01	76.4	0	0	0	2	Significant

*Data provided by AENV. Note that only licensed and reported uses are included; unlicensed use is unknown.

Control of Flood Peak/Timing by Upstream Dams

Table OM20. Flood Peak and Timing Control by Dams—Oldman River Reaches

Reach	# of Sites with Control By Dams Upstream Affecting:				Number of Dams
	<10% of watershed	10-25% of watershed	25-50% of watershed	> 50% of watershed	
OM-10	3	0	0	0	0
OM-09	2	0	0	0	0
OM-08	2	0	0	0	0
OM-07	0	0	0	2	1 (Oldman Dam)
OM-06	NA	NA	NA	NA	NA
OM-05	0	0	0	3	1 (Oldman Dam)
OM-04	0	0	0	3	1 (Oldman Dam)
OM-03	0	0	1	0	1 (Oldman Dam)
OM-02	0	0	6	0	1 (Oldman Dam)
OM-01	0	0	2	0	1(Oldman Dam)

Floodplain Accessibility

Table OM21. Floodplain Accessibility—Oldman River Reaches

Reach	# of Sites with Flood Water Access to:				Major Obstructions to Flooding
	> 85% of floodplain	***65-85% of floodplain***	***35-65% of floodplain***	***< 35% of floodplain***	
OM-10	3	0	0	0	None
OM-09	1	1	0	0	None to minorr
OM-08	2	0	0	0	None
OM-07	2	0	0	0	None
OM-06	NA	NA	NA	NA	NA
OM-05	3	0	0	0	None
OM-04	2	1	0	0	None to minor
OM-03	0	1	0	0	Minor
OM-02	2	4	0	0	None to minor
OM-01	2	0	0	0	None

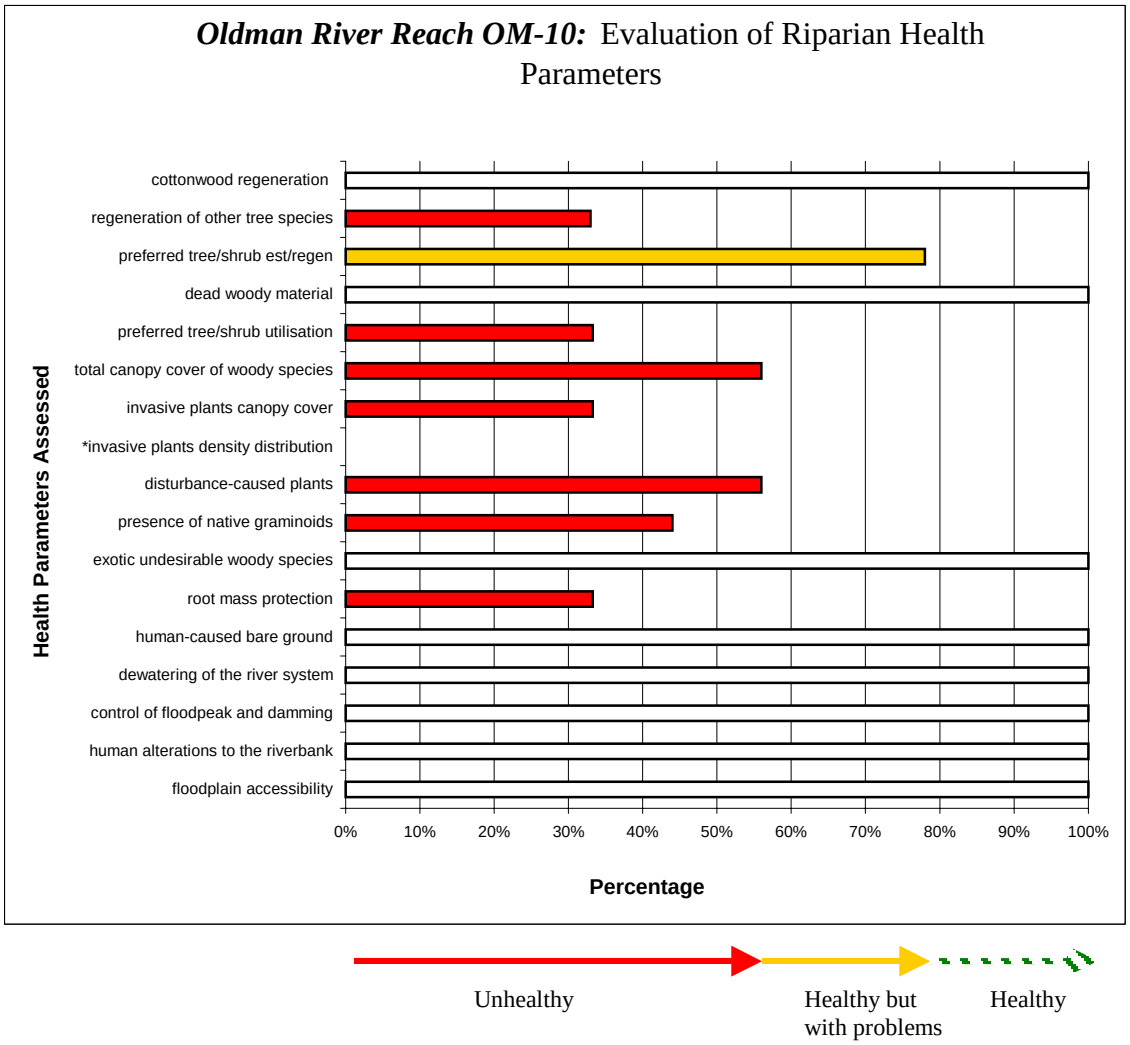
Alberta Environment Reach: Waldron's Corner Gauging Station on Oldman River to Oldman Dam (OM-10)

- **One polygon scored in the healthy category and remaining 2 polygons in this reach scored in the healthy but with problems category.** The overall assessment of riparian health for reach OM-10 of the Oldman River project area is as follows:

  - Of the 3 polygons assessed: 33% (1/3) are *healthy*,
    77% (2/3) are *healthy but with problems*,
    0% (0/3) are *unhealthy*.

  - Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure OM3. Breakdown of riparian health results for 17 parameters assessed for the Oldman River reach OM-10.

** Invasive plant density distribution does not register on this graph because this parameter scored 0%.*

Historic and Present Influences on Riparian Health: Reach Comments

This reach (OM-10) encompasses the furthest upstream portion of the Oldman River that was assessed. Downstream of the Livingston Range, this reach flows primarily through agricultural land and is dominated by grazing[14]. A small portion of the reach is undeveloped with no identified land-use occurring in this area.

Riparian Plant Communities

- Channel movement and depositional processes have restricted vegetative cover of portions of the riparian areas along this reach. The vegetation is growing on large areas of gravel and cobble. Mature balsam poplar communities along with recently established communities of seedlings along the gravel-based alluvial bars are common. Tree species other than cottonwoods are present but scarce, however regeneration of cottonwoods and preferred shrub species is excellent for the most part.
- A positive attribute of the Oldman River reach OM-10 riparian areas is the presence of cottonwood and preferred shrub species regeneration. Native grasses and forbs are also present, however their overall coverage is limited.
- Disturbance-caused species have moderate to widespread coverage in this reach.

Physical Characteristics and Hydrologic Parameters

- Alterations and bare ground as a result of human activity are minimal
- There is some concern with the amount of protection by deeply rooted species along the riverbank.
- There are currently no concerns with altered flow or timing and the river readily accesses its floodplain.

Opportunities and Options for Improvement: OM-10

Trees and Shrubs

- The existing tree and shrub communities show normal amounts of dead and decadent branches as well as mostly high levels of regeneration, indicating current land uses (primarily grazing) are not generally impacting woody plant health. The only site with moderate browse, was also the only site with low shrub regeneration.
- For cottonwoods at all sites, and shrubs at two sites, maintaining the existing woody plant communities may require maintenance and / or slight improvement of current land uses and management (grazing). At the site with heavy browse, reducing utilisation levels would be beneficial for long-term maintenance of shrub communities.
- Very few other tree species are found in these areas, but in this reach, in areas where there is potential, promote non-cottonwood tree species by using grazing levels that limit woody plant browse levels to light or light-moderate.

  Tracking the proportion of preferred trees and shrubs compared with less desirable

[14] Based on aerial photo interpretation and observations.

woody plants will assist in monitoring the trend in the preferred woody communities over time.

Non-Woody Species

- Because there are extensive areas of non-native grasses and other herbaceous disturbance-caused species, long-term change will require long-term management modifications. While eliminating these species may not be realistic, reducing their abundance should be. Reduce the presence of disturbance-caused plants through sound grazing strategies that target non-native grasses, and prevent additional invasion of invasive weeds or disturbance-caused plants by both grazing management that ensures both native plant vigour and avoids creating bare soil.

  There is very limited recreation and development (i.e. roads) in this area, but where present, minimising disturbance will help prevent or limit expansion of invasive and disturbance-caused species.
- Invasive species must be managed to reduce further invasion; this will minimise further loss of native species and other riparian functions (eg. insufficient bank stability due to inadequate roots).

Physical Characteristics and Hydrologic Parameters

- Maintain current management practices and monitor future activities to keep physical impacts to a minimum and prevent additional impacts. Livestock, recreational activities, and roads are all contributing to structural alterations in this reach to some extent. Management and land use decisions should incorporate these broad areas. With grazing being the primary land use and identified as causing some alterations, focus on reducing livestock use of streambanks by implementing distribution tools and careful timing. This will allow areas altered by grazing to heal.
- There are currently no concerns with altered flow or timing and the river readily accesses its floodplain. Maintain current flows for future maintenance of riparian plant communities and channel process.

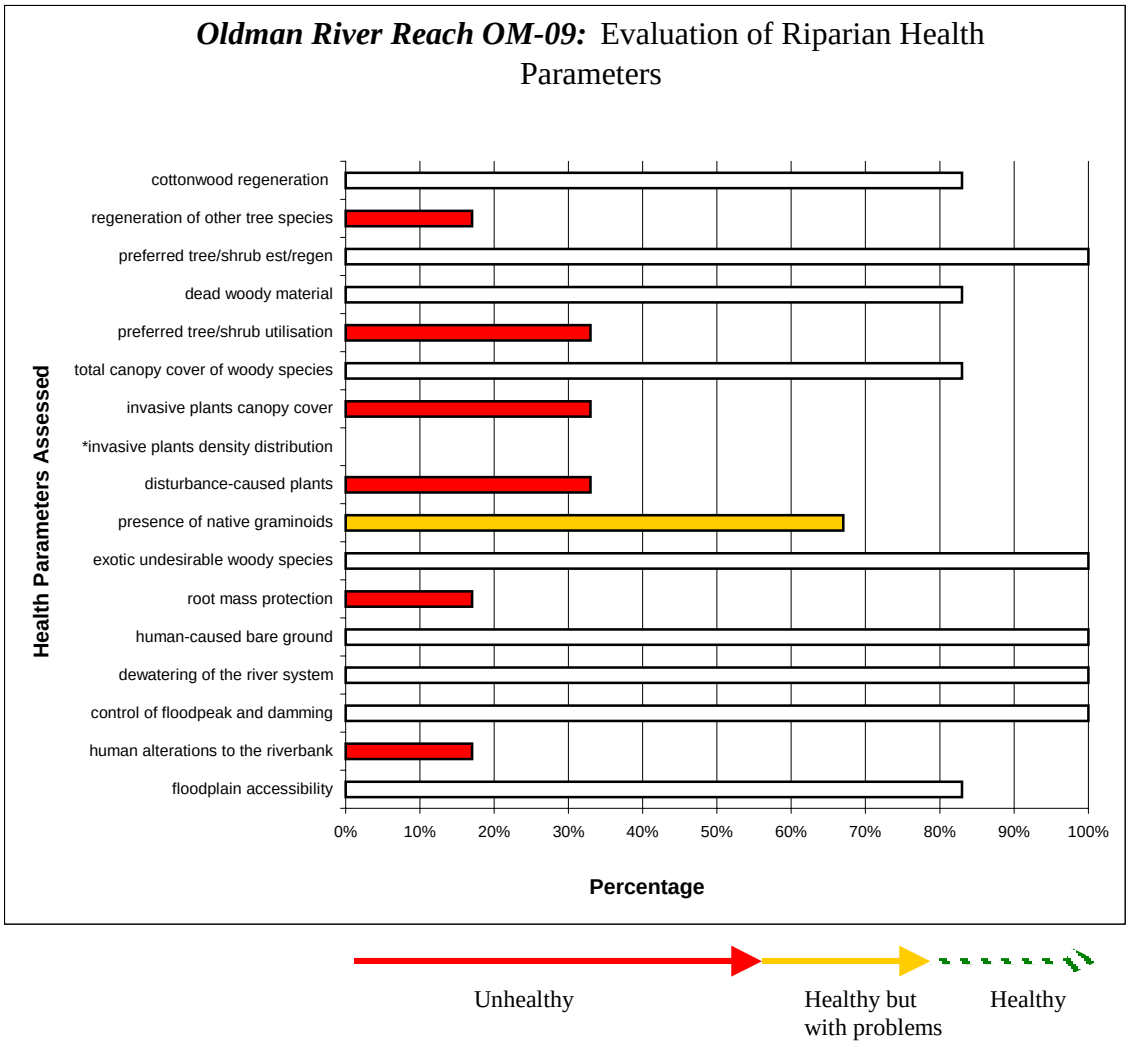
Alberta Environment Reach: Crowsnest River at B.C./ Alberta Border to Oldman Dam (OM-09)

- **The two polygons in this reach scored in the healthy but with problems category.** The overall assessment of riparian health for reach OM-09 of the Oldman River project area is as follows:

  - Of the 2 polygons assessed: 0% (0/2) are *healthy*,
    100% (2/2) are *healthy but with problems*,
    0% (0/2) are *unhealthy*.

  - Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure OM4. Breakdown of riparian health results for 17 parameters assessed for the Oldman River reach OM-09.

** Invasive plant density distribution does not register on this graph because this parameter scored 0%.*

Historic and Present Influences on Riparian Health: Reach Comments

Grazing is the dominant land use along the Oldman River reach OM-09 (Crowsnest River) and adjacent lands[15], with developed lands being the second most common. There are also some undeveloped areas along this river where no determined land use, or recreational activities are occurring. Refer to the Oldman River Overview for more information on general historic and present potential influences on riparian health.

Riparian Plant Communities

- Shrub community and habitat types are abundant, covering 98% of the assessed area. Tree communities cover only 2% of the area, with no areas classified as grass community or habitat (although grass is a significant understory, covering 96% of the total area). The diversity within these vegetative communities provides excellent wildlife habitat, while maintaining riparian function. The presence of beaked willow (*Salix bebbiana*) and water birch (*Betula occidentalis*) is significant in this reach. There is good to excellent regeneration of preferred trees and shrubs with minor to normal amounts of dead and decadent material.
- Ground cover and the distribution of invasive species are of concern. Invasive species are occurring continuously or in patches throughout this reach. Disturbance-caused species cover approximately a third of the area examined. These species are of concern because they have shallow, inadequate root systems to stabilize riverbanks; these species often displace native vegetation.

Physical Characteristics and Hydrologic Parameters

- Human-caused bare ground is not impacting riparian health. However, human activities have caused extensive alterations to the banks of the river in this reach. In the upper polygon, the Crowsnest River has been re-routed and channelised, while in the lower polygon, construction of weirs to improve fish habitat has altered the natural structure of the riverbank.
- Bank stability is poor to very poor, which can be associated with the abundance of disturbance-caused species. Areas of the banks that have been modified have lost vegetation, reducing the coverage by deeply rooted species, in turn increasing instability along these sections.
- There are no dams altering the flow of the river upstream of this reach and water extractions are minimal (<10%). Flood water has full access to the floodplain in one of the sites with minor restrictions to floodplain access in the upstream site due to re-routing of this portion of the river.

[15] Based on aerial photo interpretation and observations.

Opportunities and Options for Improvement: OM-09

Trees and Shrubs

- Tree and shrub communities show normal amounts of dead and decadent branches as well as high levels of regeneration (except in non-cottonwood trees), indicating current land uses (primarily grazing) are not generally impacting tree and shrub health. Moisture is sufficiently available to maintain these communities. Further monitoring or evaluation is needed to determine if non-cottonwoods would be expected in greater abundance, or if there small coverage is appropriate for these sites's potential.
- Current management is maintaining trees and shrubs diversity, but moderate browse levels may lead to reduced preferred tree and shrub vigour, establishment and abundance over time. Focus on reducing utilisation levels through grazing timing or intensity changes.

Non-Woody Species

- The upper polygon had fairly minimal disturbance-caused plants, while the lower polygon had extensive and widespread cover of disturbance-caused plants. Extensive disturbance-caused plants could be held in check, or reduced, through sound grazing strategies that target non-native grasses, such as early summer grazing and light utilisation. Prevent additional invasion and spread of invasive weeds by ensuring grazing management maintains native plant vigour and avoids creating bare soil. Weed control methods should be considered.
- Coincident with the abundance of disturbance species is native graminoid cover—high in the upper polygon, but low in the downstream polygon. Management to prevent further expansion and to give native grasses a competitive advantage (eg. avoiding early spring use on native species) should both reduce disturbance species cover, as well as increase native graminoid cover.

Physical Characteristics and Hydrologic Parameters

- With limited native grasses and some heavy utilisation on preferred tree and shrub species, riverbank root mass protection is impaired. The banks, in part altered by grazing, are more heavily impacted by the channelisation and re-routing of the channel, as well as weir and riprap placement. Continuing to minimise livestock access to streambanks using distribution tools, appropriate timing and stocking rates will prevent significant livestock alterations. Allowing the river to establish its own course and revegetation (natural or artificial) along the channelised stretch and weir, respectively, will lead to improvements in bank structure.
- Damming and water withdrawal are not a concern in this reach, but some limitations to floodplain accessibility exist due to the channelisation of the river. Increasing the channel's access the floodplain may require long periods of time to heal.

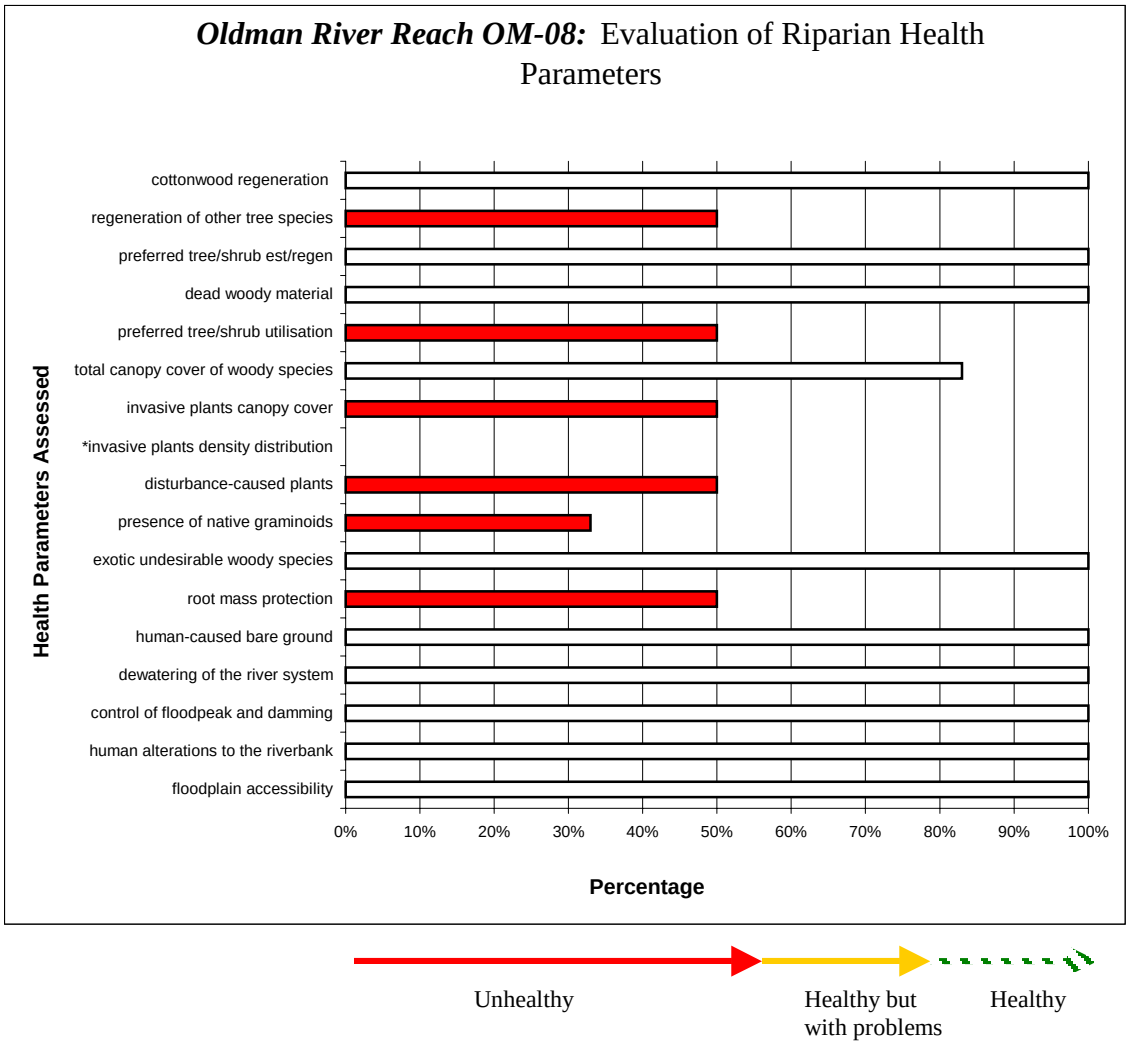
Alberta Environment Reach: Castle River gauging station to Oldman Dam (OM-08)

- **One of the polygons in this reach scored in the healthy category and the other polygon rated healthy but with problems.** The overall assessment of riparian health for reach OM-08 of the Oldman River project area is as follows:

  - Of the 2 polygons assessed: 50% (1/2) are *healthy*,
    50% (1/2) are *healthy but with problems*,
    0% (0/2) are *unhealthy*.

  - Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure OM5. Breakdown of riparian health results for 17 parameters assessed for the Oldman River reach OM-08 (Castle River).

** Invasive plant density distribution does not register on this graph because this parameter scored 0%*

Historic and Present Influences on Riparian Health: Reach Comments

Livestock grazing is the dominant land use in this reach OM-08, the Castle River. This

reach includes area within the Forest Reserve which has grazing allotments throughout, downstream to primarily rural residential land and then to the Oldman Dam.

Riparian Plant Communities

- 5 different tree communities were identified, with balsam poplar (*Populus balsamifera*) the dominant tree species found in this reach. White spruce is common in the upper portion of this reach within the forest reserve. Tree and shrub cover of these sites is extensive with 56% of the area assessed covered by trees and shrubs. There is excellent regeneration of trees and shrubs and other trees have excellent regeneration in one site and poor in the site downstream of the forest reserve Utilisation is light to moderate and levels of dead and decadence within the woody communities are normal.
- Invasive species have minimal but are widely distributed, increasing the risk of further infestations. Disturbance-caused species cover 14% of the area examined, resulting in decrease bank stability, however native species are abundant.

Physical Characteristics and Hydrologic Parameters

- Human-caused bare ground and structural alterations are occurring within the assessed sites but are not significantly impacting riparian health. Mainly livestock grazing and to a lesser degree recreational activities have caused minor alterations to the natural structure of the riverbank. Livestock activity, mostly in the form of hoof shear and trailing, although very minor, is the cause of bare ground in the assessed areas
- Riverbank root mass protection is moderate to poor within this reach. The presence of disturbance-caused species along the riverbank may be reducing bank stability along sections of this reach.
- Currently within this reach there are no significant water extractions or dams present, therefore the natural flow of the river has not been disturbed. Floodwaters have full access to the floodplain, within the sites assessed there are no restrictions to movement of floodwaters.

Opportunities and Options for Improvement: OM-08

Trees and Shrubs

- With excellent regeneration of preferred tree and shrub communities, and normal amounts of dead and decadent branches, there is good opportunity to maintain woody plant communities. Current land use and hydrologic regime do not appear to be negatively impacting tree and shrub maintenance and establishment. There is potential to somewhat reduce browse pressure at the upper polygon; this would continue to help ensure long-term sustainability of tree and shrub communities.
- Overall, strive to maintain trees and shrub diversity with current management. Maintain or encourage light browse (utilisation) of preferred trees and shrubs.

Non-Woody Species

- Of all the reaches of the Oldman River project, the Castle River has one of the lowest total areas covered by disturbance-caused species. Promoting strong

native plant communities will hopefully continue this positive feature of these riparian areas. Current grazing management has allowed limited establishment of disturbance plants and invasive weeds; continue existing management. With invasive weed area comparatively low, but widely distributed, work on weed control methods to limit or prevent any further spread.

- Some additional coverage of native graminoids would be beneficial; managing grazing to promote strong native graminoid vigour should be encouraged, if not already in place.

Physical Characteristics and Hydrologic Parameters

- With some reduced native graminoid cover and establishment of disturbance-caused plants and weeds, these areas need additional deep binding roots. Physical alterations and human-caused bare ground are not impacting riparian health in these areas—continue to use management that has adequately protected the physical features of the sites to date.
- No impacts were recorded from dewatering, control of flood peak and timing, or floodplain accessibility; maintain current hydrologic regimes and management.

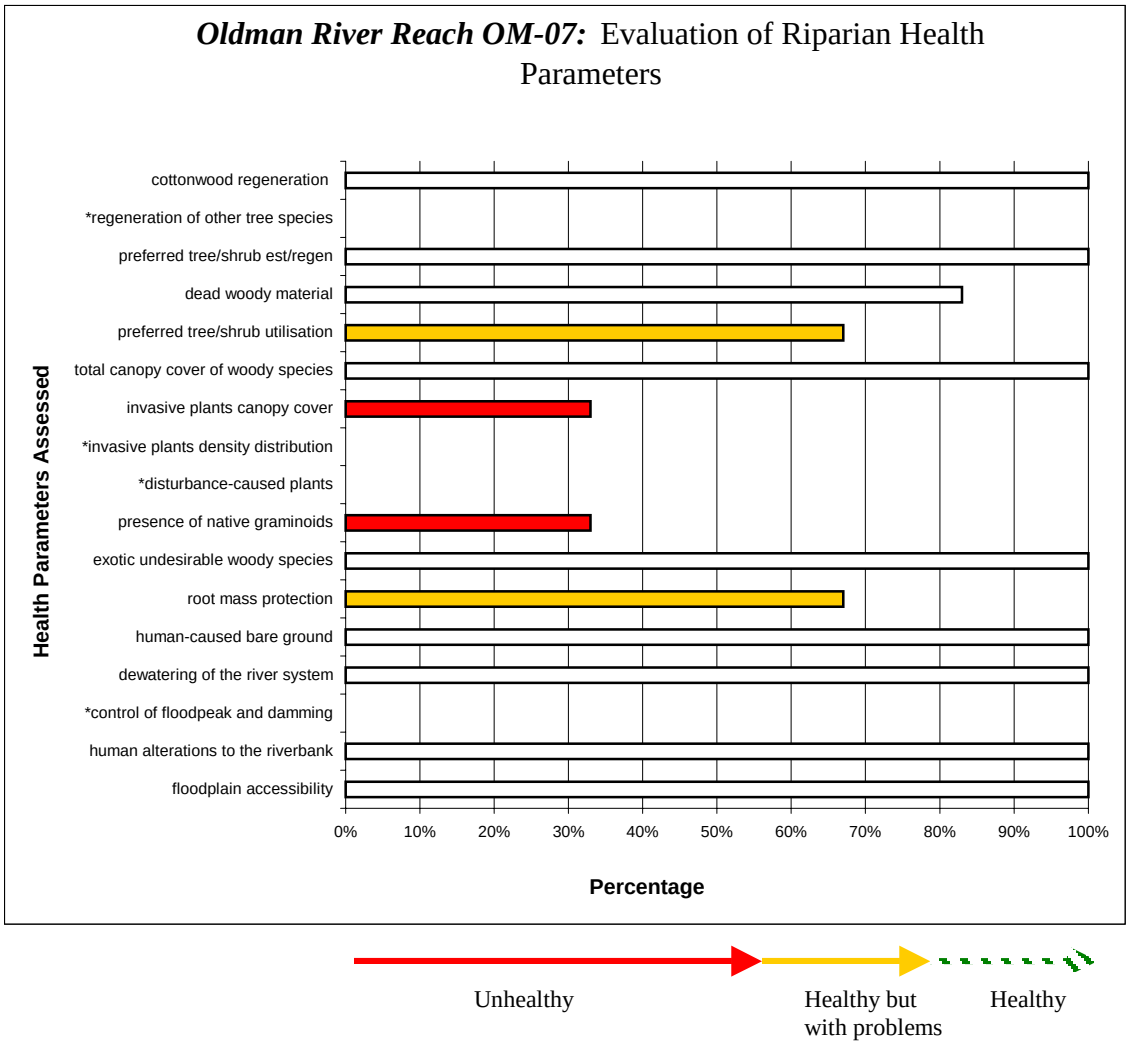
Alberta Environment Reach: Oldman Dam to upstream of Pincher Creek Confluence (OM-07)

- **Both of the polygons in this reach scored in the healthy but with problems category.** The overall assessment of riparian health for reach OM-07 of the Oldman River project area is as follows:

  - Of the 2 polygons assessed: 0% (0/2) are *healthy*,
    100% (2/2) are *healthy but with problems*,
    0% (0/2) are *unhealthy*.

  - Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure OM6. Breakdown of riparian health results for 17 parameters assessed for the Oldman River reach OM-07.

** Invasive plant density distribution, disturbance-caused plants and control of flood peak due to damming do not register on this graph because these parameters scored 0%. Regeneration of other tree species does not register on this graph because there were no other trees than cottonwoods observed; therefore this parameter was not assessed.*

Historic and Present Influences on Riparian Health: Reach Comments

Livestock grazing is the dominant land use in this reach, with a large portion of the reach undeveloped (no detected land use). This reach is located on the Oldman River and encompasses the area from the Oldman Dam downstream to the confluence with Pincher Creek. The dam development has resulted in significant physical changes to the river at and near the structure.

Riparian Plant Communities

- Balsam poplar (*Populus balsamifera*) and narrow-leaved cottonwood (*Populus angustifolia*) communities are significant within this reach. Trees and shrubs combined are covering 77% of the area assessed, with 100% of the area classified as poplar community types. Grass and grass-like plants make up a considerable understory component (covering 60% of the area). Only cottonwood tree species were found on this reach. Regeneration of cottonwood and preferred shrubs is excellent. Overall utilisation of preferred trees and shrubs is light and there are normal to minor additional levels of dead and decadence occurring within the woody communities.
- Invasive species have limited coverage; however the distribution of these species is of concern. Invasive plants are found continuously or in many patches throughout the area assessed along this reach, increasing the opportunity of further infestations. The coverage of disturbance-caused species is also of concern. Currently these species are present throughout 57% of the area assessed. Disturbance-caused species are poor for bank stability and tend to out-compete native plant communities. In addition, native graminoids are reduced, and only cover 5%-25% of the assessed area.

Physical Characteristics and Hydrologic Parameters

- Currently there are no signs of human activities altering the natural structure of the riverbanks. A vehicle trail and soil pit are the cause of bare ground in one of the sites, however the overall impact is minor. Natural processes including erosion and sedimentation are the only sources of bare ground in the other assessed area.
- The amount of deep binding roots along the riverbank has been noticeably reduced due to the large area of ground covered by disturbance-caused plants. Bank stability can improve with the establishment of more deeply rooted species (willows, balsam poplar) along these areas. Currently deep binding roots are stabilising 65%-85% of the polygon length in both of the areas assessed.
- Water extractions are very minimal from this reach with less than 10% of the average river discharge removed. Currently water extractions are having no significant impacts on the overall riparian health rating of this reach.
- This reach extends from the Oldman Dam downstream to the Pincher Creek confluence and therefore is significantly impacted by the Oldman Dam. More than 50% of the watershed upstream of this reach is dammed, altering the natural flow of the river.

Opportunities and Options for Improvement: OM-07

Trees and Shrubs

- Current land use and management are maintaining healthy tree and shrub communities, so maintaining them with similar management in the future should be appropriate. Long-term, monitoring the impacts of the dam on tree and shrub communities should also incorporated into management.

Non-Woody Species

- The presence of extensive disturbance-caused and invasive species may be due to some long-term changes from past grazing, but with a healthy tree and shrub community present, some other factors are likely also important in the presence of the herbaceous community. Past flood events, causing natural erosion and deposition, combined with seed or root fragments from nearby and upstream sources may also have contributed to the abundance and distribution of disturbance and invasive species. Management of the area to minimise human-caused disturbance, combined with weed control, should help reduce, or at least prevent, further spread.

Physical Characteristics and Hydrologic Parameters

- Maintain current grazing management practices and monitor future activities to keep physical impacts to a minimum and prevent additional impacts. Focus on continuing to keep livestock access to riverbanks low by using distribution tools, appropriate timing and stocking rates.
- Maintain current minimal withdrawals for future maintenance of riparian plant communities. Avoid additional damming that may increase the impacts of timing and flood peak controls, and consider flow regimes that will ensure long-term maintenance of plant communities and channel processes.

Alberta Environment Reach: Pincher Creek confluence to Upstream of the LNID Weir (OM-06)

- Additional polygons will be completed in 2005. Information pertaining to this reach will be added in 2006 and located in Appendix OM15

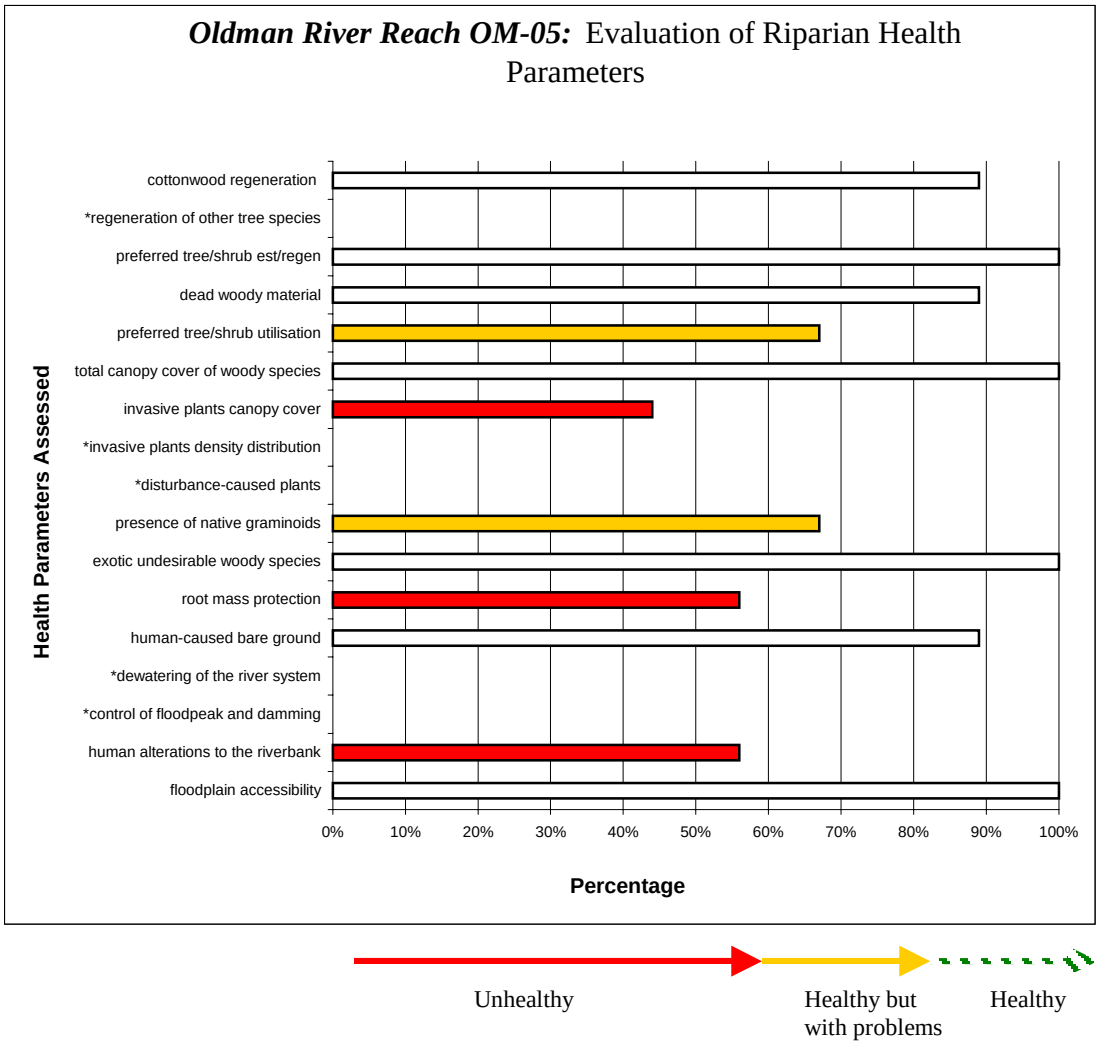
Alberta Environment Reach: LNID Weir to upstream of Willow Creek confluence (OM-05)

- **Two of the polygons in this reached scored in the healthy but with problems category and one of the polygons rated unhealthy.** The overall assessment of riparian health for reach OM-05 of the Oldman River project area is as follows:

  - Of the 3 polygons assessed: 0% (0/3) are *healthy*,
    67% (2/3) are *healthy but with problems*,
    33% (1/3) are *unhealthy*.

  - Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure OM7. Breakdown of riparian health results for 17 parameters assessed for the Oldman River reach OM-05.

** Regeneration of other tree species does not register on this graph because there were no trees other than cottonwoods observed, therefore this parameter was not assessed. Invasive plant density distribution, disturbance-caused plants, dewatering of the river system and control of flood peak through damming do not register on this graph because these parameters scored 0%*

Historic and Present Influences on Riparian Health: Reach Comments

Land use in this reach is dominated by grazing, but there are also smaller areas that are influenced by cropping and development (the town of Town of Fort Macleod).

Diversion of water from the river dramatically increases from this reach with over 74% of the river flow withdrawn. Large water diversion (LNID weir) occurs as part of this reach. The Oldman Dam, located upstream of this reach, is also altering the natural flow of the river and rated as significantly impacting riparian health in this reach.

Riparian Plant Communities

- 8 different plant communities were identified in this reach. Trees and shrubs are abundant with trees occupying 68% and shrubs covering 62% of the inventoried area (with overlap, 71% of the area is covered by woody plants). Narrow-leaved cottonwood is the dominant tree in this reach, although balsam poplar is also present throughout the reach. There were 2 tree species and 19 shrub species recorded in this reach.
- There is good to excellent regeneration of cottonwoods; no other tree species were identified in this reach. Preferred shrub regeneration is also excellent. Utilisation of preferred trees and shrubs is light overall and there are normal to minor additional amounts of dead and decadent branches occurring within the woody communities.
- Invasive species are prevalent in this reach and although they have minimal ground cover, their distribution is of concern. Invasive plants are widespread throughout the areas inventoried easing future infestations of disturbed areas. Spotted knapweed, a restricted species, was also identified in this reach. Disturbance-caused species are abundant throughout the reach and cover more than 50% of the inventoried areas. The persistence of the disturbance species may be driving out some of the native species, especially native grasses, as native grasses are covering only 25%-50% of the areas assessed.

Physical Characteristics and Hydrologic Parameters

- Human-caused structural alterations are variable in this reach and are found in two of the assessed areas. One is severely impacted by riprap along the majority (>50%) of the bank length and the other site has minor alterations due to livestock activity. Human-caused bare ground, while quite limited, occurs throughout the reach and is mainly due to the construction of roads, paths and bridges and, to a lesser degree livestock activity. Root mass protection is variable throughout this reach with excellent stability (>85% of the bank) in one area, 65%-85% stability in another, and less than 35% of the riverbank stabilised in the remaining polygon. In this last area, riprap is impeding the growth of deeply rooted vegetation and therefore riverbank deep binding roots are very low.
- Water extraction for diversions, dewatering, and other licensed uses, is removing more than 74% of the average river discharge, negatively impacting the riparian health assessment.

  The Oldman Dam is also negatively influencing riparian health by controlling the

flow of more than 50% of the watershed upstream of this reach.

- Floodwaters flowing through this portion of the Oldman River have no impediments to access the entire floodplain.

Opportunities and Options for Improvement: OM-05

Trees and Shrubs

- Identify and maintain existing management that is allowing excellent shrub regeneration and light browse.
- At one site, there is not full regeneration of cottonwoods; determine if physical alteration or hydrologic regime (flow peak/timing and withdrawals) are impairing regeneration, and make appropriate management change.

Non-Woody Species

- Reduce non-native species in floodplain areas through grazing management that reduces their vigour or through urban management that allows or promotes additional native species to thrive. Elimination of disturbance-species is unrealistic, but managing their abundance should be the goal of improving these areas. Implement weed control and monitor invasive species locations and abundance.

Physical Characteristics and Hydrologic Parameters

- In riprap areas, promote growth of tree and shrub species to establish natural amour for these areas (even through existing rock). Ensure additional roads and paths are not developed in the floodplain. Consider, when maintenance or improvements are needed, moving existing paths or roads outside the riparian area. Review recreational and road impacts to determine if restoration or management changes could reduce current structural changes. In grazed areas, continue or increase management that reduces livestock use of bank areas. Maintain current grazing management practices that are resulting in minimal physical disturbances, and ensure rest and appropriate timing maintain plant communities and reduce disturbance species.
- Prevent further reduction in flow volume and changes to flood peak and timing to ensure maintenance of riparian plant communities and channel processes. Monitor existing volume and timing in conjunction with plant communities; aim to modify volume and timing if plant communities are limited by the hydrologic regime.

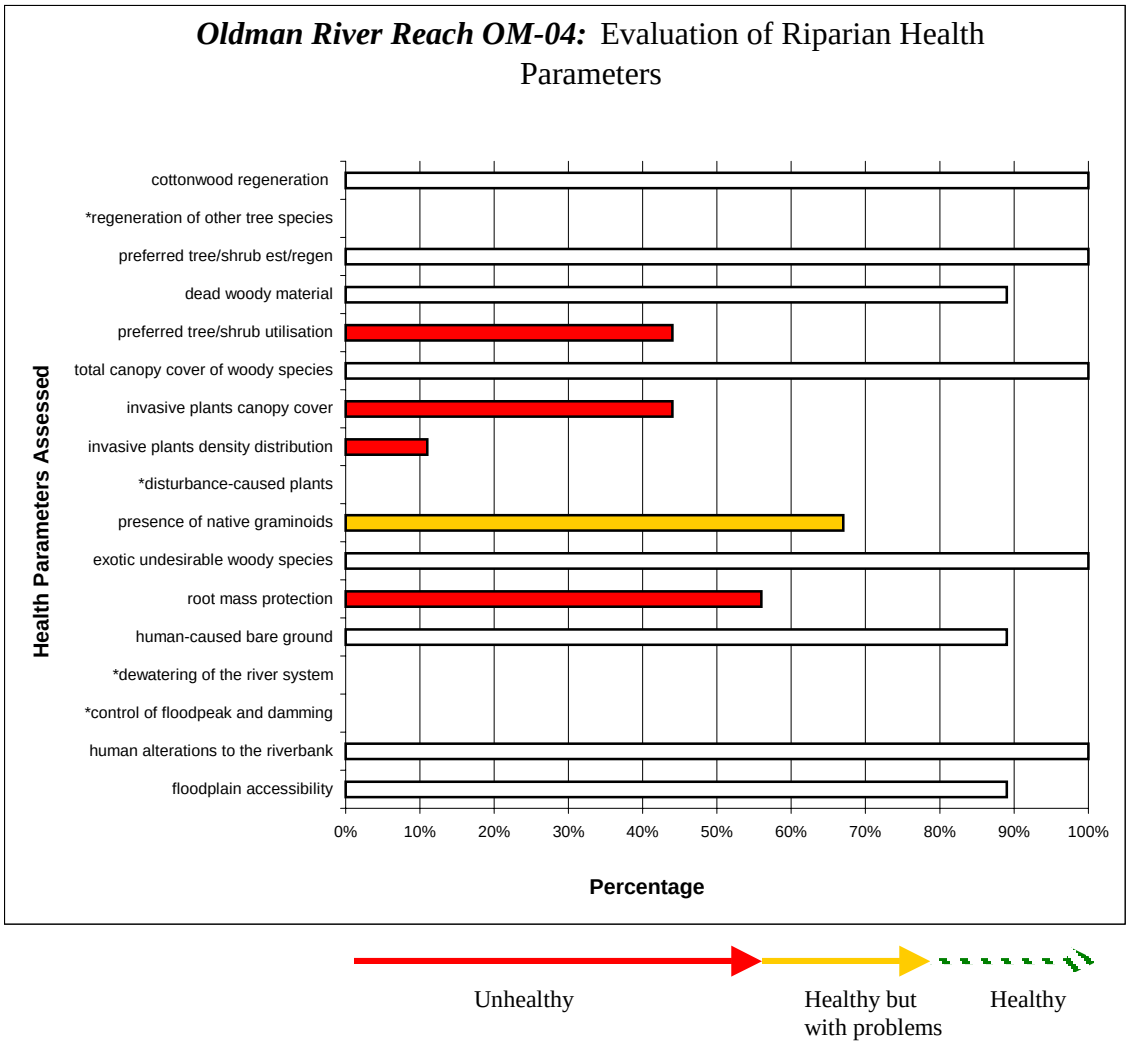
Alberta Environment Reach: Willow Creek confluence to Upstream of the Belly River Confluence (OM-04)

- **Two polygons in this reached scored in the unhealthy category and one polygon rated healthy but with problems.** The overall assessment of riparian health for reach OM-04 of the Oldman River project area is as follows:

  - Of the 3 polygons assessed: 0% (0/3) are *healthy*,
    33% (1/3) are *healthy but with problems*,
    67% (2/3) are *unhealthy*.

  - Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure OM8. Breakdown of riparian health results for 17 parameters assessed for the Oldman River reach OM-04.

** Regeneration of other tree species does not register on this graph because there were no trees observed; therefore this parameter was not assessed. Disturbance-caused plants, dewatering of the river system and control of floodpeak damming do not register on this graph because these parameters scored 0%.*

Historic and Present Influences on Riparian Health: Reach Comments

Grazing is the dominant land use in this reach, however there are also small areas

influenced by cropping and development, as well as some undeveloped areas. Withdrawals and the alterations to the natural flow of the river by the Oldman Dam are modifying the overall riparian health rating of this reach.

Riparian Plant Communities

- 6 different plant communities were observed in this reach. Trees and shrubs are abundant with shrubs covering a larger area (77%) than the area occupied by trees (57%). Narrow-leaved cottonwood is the dominant tree species, however balsam poplar is found throughout this reach. Cottonwoods are the only tree species observed in this reach.
- There is excellent regeneration of cottonwoods and preferred shrubs within this reach. Browse utilisation of preferred woody species ranged from light to moderate, which may influence the levels of woody regeneration if moderate browse levels continue. Similar to reaches upstream, the level of dead and decadence is normal to minor, suggesting utilisation, disease, and hydrology are not having significant impacts on the woody plant communities.
- Invasive plants have little ground cover, however the distribution of these plants is of concern. Disturbance-caused species cover more than 50% of the area assessed in this reach, significantly limiting the amount of ground covered by native plant species in two polygons. Native grasses have variable coverage, ranging from 5% to more than 50% cover.

Physical Characteristics and Hydrologic Parameters

- There are very minor structural alterations within this reach, and they are not affecting the health rating. Those structural alterations present are mostly due to livestock grazing with small areas influenced by riprap. These impacts have also resulted in small areas of bare ground, but the overall impacts to riparian health are limited.
- Riverbank root mass protection is variable, ranging from excellent to poor stability along the banks.
- Over 67% of the average river discharge is being removed from this reach, having significant impacts on the riparian health of this reach. The close proximity of the Oldman Dam is also influencing riparian health by altering the natural flow of the river. More than 50% of the watershed upstream of this reach is controlled by the Oldman Dam. The majority of the floodplain within the areas assessed is not obstructed to flood water; one site has some reduced access, with 65%-85% of the floodplain available.

Opportunities and Options for Improvement: OM-04

Trees and Shrubs

- Regeneration of preferred trees and shrubs is excellent, suggesting that overall recent and current management are not of concern; however, there is moderate utilisation, which over longer periods could lead to reduced vigour and loss of tree and shrub communities. Focus attention on livestock management options such as distribution, timing, rotation, and stocking rate should enable preferred trees and shrubs to be maintained and increased.
- Although current polygon assessment did not find concerns with tree and shrub communities, monitor them to ensure regeneration and maintenance are not affected by extensive withdrawals and damming.

Non-Woody Species

- Implement weed control to hold invasive plant infestations at current levels (and hopefully reduce them), while monitoring locations and abundance. Where development and other land use (including irrigation pumps, roads and gravel pits) is creating bare soil, weed control is important to avoid further establishment and spread of invasive plants.
- Ensure adequate rest and appropriate grazing strategies to reduce disturbance-caused plants within native pastures. Recognise that elimination of disturbance species may be unrealistic, but aim to increase native graminoid cover.

Physical Characteristics and Hydrologic Parameters

- Grazing and roads are creating minor alterations to the banks, with some human-caused bare ground resulting from these as well as pumping station and gravel pits. Manage grazing similar to currently, with additional focus on management such as distribution and timing that pull livestock away from the banks. Reduce further development and consider reclaiming areas impacted by roads or gravel pits.
- Prevent further additional withdrawals of flows and consider reducing existing withdrawal for future maintenance of riparian plant communities. Avoid additional damming that may increase the impacts of timing and flood peak controls, and consider flow regimes that will ensure long-term maintenance of plant communities and channel processes.

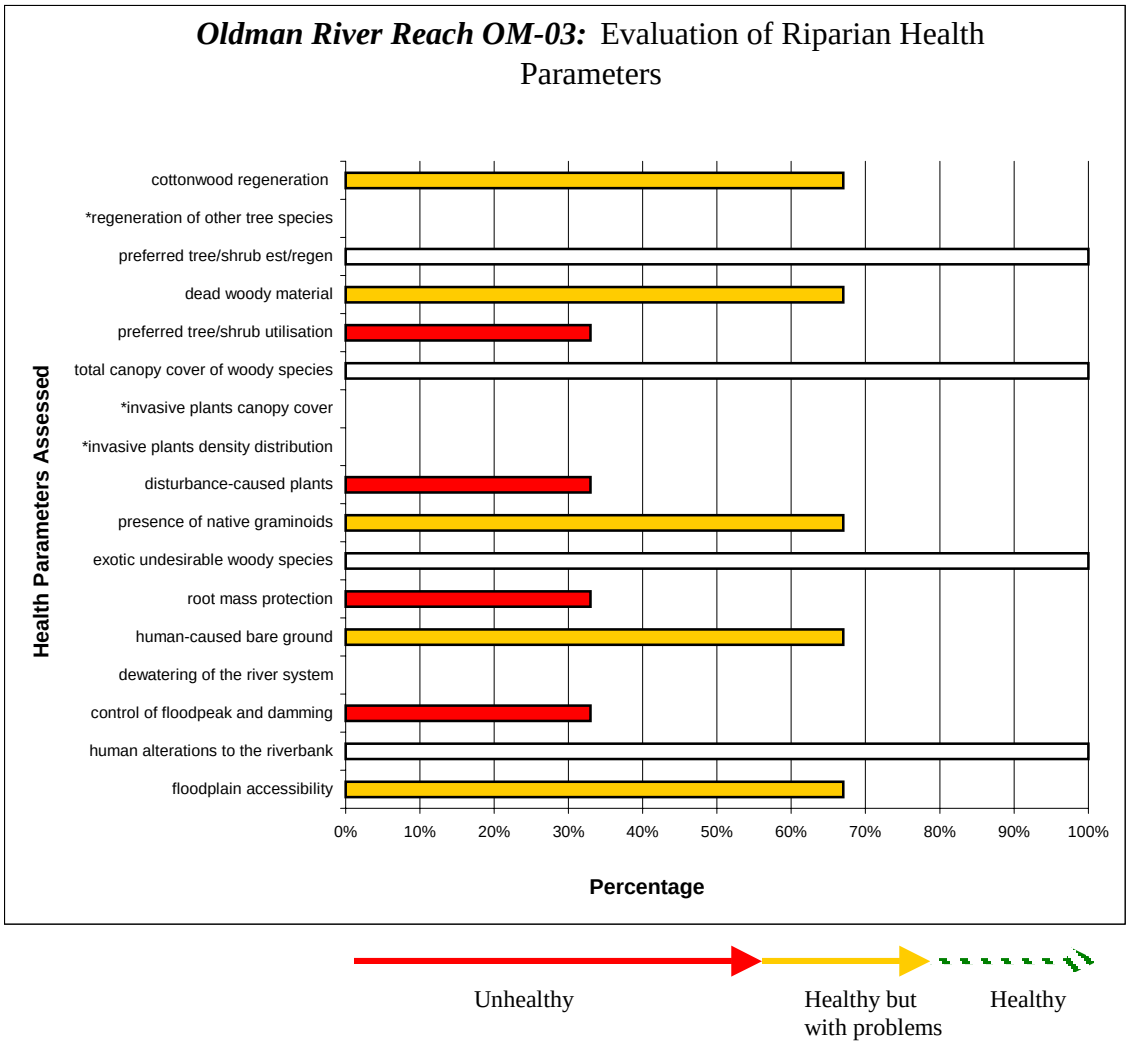
Alberta Environment Reach: Belly River confluence to Upstream of St. Mary River Confluence (OM-03)

- **The polygon in this reach scored in the unhealthy category.** The overall assessment of riparian health for reach OM-03 of the Oldman River project area is as follows:

  - The 1 polygon assessed: 0% (0/1) are *healthy*, 0% (0/1) are *healthy but with problems*, 100% (1/1) are *unhealthy*.

  - Please note: due to the single polygon assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general impression of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure OM9. Breakdown of riparian health results for 17 parameters assessed for the Oldman River reach OM-03.

** Invasive plants canopy cover, invasive plants density distribution and dewatering do not register on this graph because these parameters scored 0%. Regeneration of other tree species does not register on this graph because there were no other trees species present; therefore this parameter was not assessed.*

Historic and Present Influences on Riparian Health: Reach Comments

Land use in this reach is split mainly between grazing and undeveloped areas, such as recreation. There are also small areas influenced by cropping and development within this reach.

Withdrawals from this reach are similar to the two reaches upstream, with more than 70% of the average river discharge removed. The impacts of the Oldman Dam are somewhat reduced with less of the watershed upstream of this reach controlled by the Oldman Dam.

Riparian Plant Communities

- 4 different plant community types were identified. 12 species of shrubs occupy 80% of the inventoried area, with 50% covered by two tree species.
- Similar to reaches upstream, cottonwoods are the only tree species observed in this reach. Browse is moderate and may be influencing the reduced level of cottonwood regeneration in this reach. There are minor levels of dead and decadent branches in the woody communities.
- Invasive plants are covering more than 15% of the assessed area and they are widely distributed. Disturbance-caused species are also of concern, covering 25%-50% of the area assessed. The presence of disturbance-caused and invasive plants is limiting the ground occupied by native species, especially native grasses. The presence of native grasses is similar to the two nearest upstream reaches, with 25%-50% coverage by native grasses.

Physical Characteristics and Hydrologic Parameters

- Currently, the riverbank in this reach has not been affected by human alterations. However, vehicle trails have resulted in limited patches of bare soil. Bank stability, based on deep-binding roots, is poor.
- Dewatering is significantly impacting the riparian health rating within this reach. The Oldman Dam is also still impacting the riparian health rating, but due to increased distance, the level of impact is less for this reach, with 25%-50% of the watershed upstream controlled by dam. Floodwaters are somewhat restricted from accessing the entire floodplain in the single polygon assessed for this reach.

Opportunities and Options for Improvement: OM-03

Trees and Shrubs

- Utilisation on preferred trees and shrubs may be limiting cottonwood regeneration to some extent, and if moderate browse continues, there is a risk of depleting existing tree and shrub communities, as well as reducing successful establishment of new communities. Grazing management may need to promote additional rest during the growing season as well as minimise use of the area when graminoid forage has matured or been depleted, in order to reduce browse levels. Management should aim to provide appropriate distribution and stocking rates.
- There is moderate regeneration of cottonwoods and may be linked both to browse as well as hydrologic parameters in this reach. There are not other tree species present in this reach.
  The existing hydrologic regime (diversion and damming) may be influencing

establishment and regeneration of cottonwoods; aim to maintain or improve existing flow regimes to ensure current levels of regeneration are not reduced, and hopefully increase regeneration so that at least 15% of cottonwood cover is seedlings or saplings.

Non-Woody Species

- Implement weed controls to prevent further spread and reduce infestation of invasive plants.
- Reduce vigour and area of disturbance-caused species using adequate rest and appropriate grazing strategies, particularly tame species within native pastures. Recognise that elimination of disturbance species is likely unrealistic, but increasing native plant species cover should be attainable.

Physical Characteristics and Hydrologic Parameters

- There are no human activities creating structural alterations to the banks, but vehicle traffic is creating a small amount of bare ground, impacting health. Minimise further bare soil by limiting vehicles to existing trails and avoiding periods when soil is more susceptible. Continue to promote and support the format of land use that has resulted in no structural alterations to the banks.
- Improve current flow levels by minimising or eliminating any further withdrawals to ensure future maintenance of riparian plant communities. Prevent further damming in this or nearby reaches, monitor tree and shrub communities to ensure they are maintained long-term, and aim to provide flow patterns that promote establishment and maintenance of riparian plant communities.

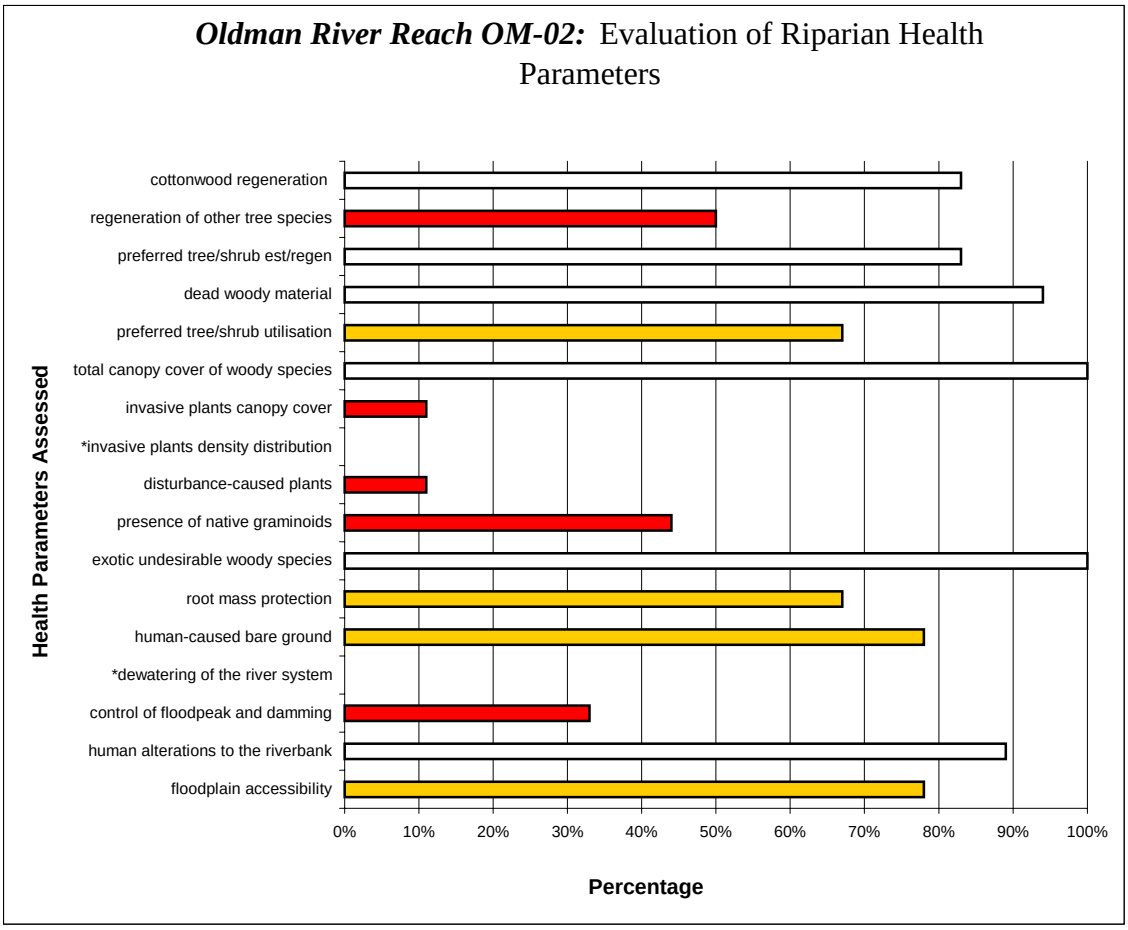
Alberta Environment Reach: St. Mary River Confluence to Upstream of Little Bow River Confluence (OM-02)

- **Three of the polygons in this reach scored in the healthy but with problems category and the other three polygons rated in the unhealthy category.** The overall assessment of riparian health for reach OM-02 of the Oldman River project area is as follows:

  - Of the 6 polygons assessed: 0% (0/6) are *healthy*,
    50% (3/6) are *healthy but with problems*,
    50% (3/6) are *unhealthy*.

  - Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure OM10. Breakdown of riparian health results for 17 parameters assessed for the Oldman River reach OM-02.

**Invasive density distribution and dewatering of the river system do not register on this graph because these parameters scored 0%*

Historic and Present Influences on Riparian Health: Reach Comments

There are a variety of land uses in this reach; however, the primary activity along this reach is livestock grazing. Undeveloped areas, areas that may be used for recreational activities, occupy a significant portion of the area within this reach and small areas of cropping and development are also found along this section of the Oldman River.

Withdrawals from this reach drastically rise from the previous reach with more than 50% of the average river discharge removed for irrigation and consumption. Again, the Oldman Dam is still influencing riparian health rating in this reach, however the impacts of the dam decrease as the distance between the dam and inventory sites increase.

Riparian Plant Communities

- There are 9 different plant community types identified in this reach. 26 species of shrubs occupy 52% of the inventoried area and tree species have slightly more coverage than shrubs accounting for 58% of the area assessed.
- Cottonwood regeneration is variable but mainly excellent, with two sites ranging from poor to good. Trees other than cottonwoods were observed in this reach (mainly Manitoba maple *Acer negundo*); their coverage was minimal and regeneration was poor to excellent. Overall, there was excellent regeneration of preferred shrubs, with 2 areas that had poor to good regeneration. Browse utilisation was generally light, with one area not subjected to any browse pressure and another that was experiencing moderate levels of utilisation. Regeneration may be influenced by a combination of browse pressure as well as hydrologic limitations.
- For the majority of sites assessed, there were normal levels of dead and decadent branches within the woody communities. One site that had minor levels of above-normal dead and decadent trees and shrubs.
- There are a wide variety of invasive species observed within this reach including one restricted species, spotted knapweed (*Centaurea maculosa*). The distribution of invasive species is of concern. Disturbance-caused species are abundant and cover over 50% of the inventoried area—a concern for bank stability and erosion protection. The presence of native grasses is variable in this reach, with half of the six sites having moderate coverage, but the remaining three sites with very poor to poor coverage of native grasses.

Physical Characteristics and Hydrologic Parameters

- Grazing and recreation are the primary causes of the structural bank alterations and human-caused bare ground within this reach. There are also small areas of bare ground caused by a vehicle trail and weir construction. The overall impacts of these alterations and areas of bare ground are minor.
- Annual withdrawals are nearly 78% of the average river discharge from this reach, resulting in rating this reach as severely impacted. Damming is affecting riparian health with 25%-50% of the watershed upstream of the reach controlled by the Oldman Dam. Floodwaters have minor restrictions from accessing the entire floodplain in 4 of the 6 areas assessed in this reach.

Opportunities and Options for Improvement: OM-02

Trees and Shrubs

- In those areas with grazing, management needs vary, where utilisation and regeneration are poorer, add rest, improve distribution, and ensure appropriate stocking rates. In most of the polygons, there was no land use other than nature trails and limited recreation, yet weeds and disturbance-caused species are prevalent.
- There are minor reductions in woody plant regeneration at some sites, which may be related to the existing hydrologic regime (damming, and extensive withdrawals), grazing, or recreational use. Because there are some polygons with reduced regeneration (of cottonwoods, other trees, or preferred shrubs) that have no on-site land use (or minimal), there may be a link to hydrologic parameters or site potential.

Non-Woody Species

- Due to widespread and relatively common invasive plants, implement weed controls to prevent further spread and reduce infestation.
- Reduce vigour and area of disturbance-caused species using adequate rest and appropriate grazing strategies at grazed sites. At nature reserve and park areas, restoration and maintenance techniques that replace disturbance species or promote native species should be considered. Elimination of disturbance species is likely unrealistic.

Physical Characteristics and Hydrologic Parameters

- There are some areas with impaired root mass protection on the banks, primarily due to increases in disturbance species; focus on management that will reduce introduction and further spread of these species, as well as rest, appropriate timing and stocking rates of use in grazed areas. Human-caused bare ground is affecting health to a small degree. Reducing or eliminating those areas of bare soil will complement management designed to improve deep-binding roots and reduced disturbance species.
- Prevent further increases in withdrawals and damming for future maintenance of riparian plant communities, and consider returning flow or peak timing that is likely to maintain existing and establish new tree and shrub communities. Because tree regeneration is variable within this reach, careful monitoring to link appropriate management choices is critical to ensure maintenance of these communities. Floodplain accessibility is modestly reduced at numerous sites; evaluate if human developments have the ability to be modified to eliminate floodplain restriction.

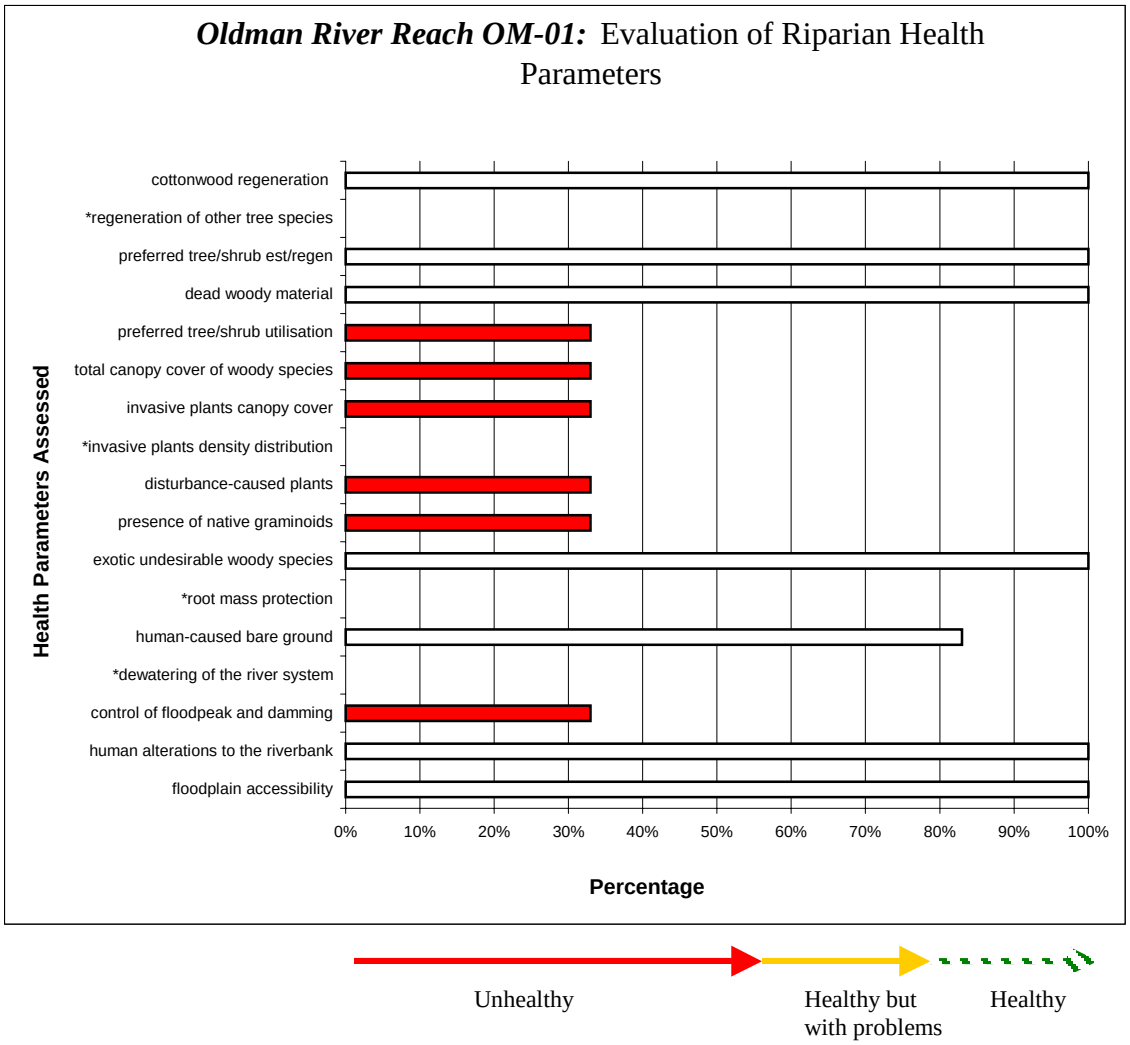
Alberta Environment Reach: Little Bow River Confluence to the Confluence with the Bow River (Grand Forks) (OM-01)

- **Both of the polygons in this reach scored in the unhealthy category.** The overall assessment of riparian health for reach OM-01 of the Oldman River project area is as follows:

  - Of the 2 polygons assessed: 0% (0/2) are *healthy*,
    0% (0/2) are *healthy but with problems*,
    100% (2/2) are *unhealthy*.

  - Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure OM11. Breakdown of riparian health results for 17 parameters assessed for the Oldman River reach OM-01.

** Regeneration of other tree species does not register on this graph because there were no other observed; therefore this parameter was not assessed. Invasive density distribution, root mass protection and dewatering of the river system do not register on this graph because these parameters scored 0%*

Historic and Present Influences on Riparian Health: Reach Comments

Land use in this reach is dominated by livestock grazing and secondly by cropping, which is more prevalent in this furthest downstream reach. Development and undeveloped lands (mainly recreational areas) are also occupying a small portion of this reach.

Withdrawals continue to severely impact riparian health ratings in this reach with 76% of the average river discharge removed. Similar to the previous reach, the Oldman Dam is controlling 25%-50% of the watershed upstream of this reach.

Riparian Plant Communities

- 3 different plant community types were identified. Overall coverage of woody species has declined considerably compared to upstream reaches, with only 20% cover of shrubs and 13% cover of trees.
- Trees and preferred shrubs that are present within this reach have excellent regeneration. No trees other than cottonwood species were observed. Plains cottonwood (*Populus deltoides*) is the dominant tree observed in this reach. Browse is rated at light to heavy; heavy browse maybe impacting the coverage of woody communities in affected area, although regeneration at that site is still excellent. There are normal levels of dead and decadent branches found within the woody communities in this reach.
- Invasive plants are covering 1%-15% of this reach. Despite the overall low coverage of these species, their distribution is of concern. Disturbance-caused species provide somewhat less coverage than some upstream reaches with 25%-50% of the reach occupied by these species. Native grasses are presently covering 5%-25% of the assessed area.

Physical Characteristics and Hydrologic Parameters

- Neither structural alterations nor human-caused bare ground are having a significant impact on riparian health within this reach. Where present, these minor amounts of structural changes and human-caused bare ground are due to livestock grazing. Bank stability, based on deep-binding roots, is very poor, directly relating to the lack of tree and shrub cover within this reach.
- Annual withdrawals are well over 50% of the average river discharge from this reach, significantly impacting overall riparian health. The Oldman Dam continues to impact riparian health rating in this reach, controlling 25%-50% of the watershed upstream of the areas assessed. The overall coverage of woody species may be linked to one or both of browse or hydrologic parameters in this reach. Floodwaters are not prevented from accessing the floodplain from man-made barriers.

Opportunities and Options for Improvement: OM-01

Trees and Shrubs

- With excellent regeneration of preferred trees and shrubs but heavy to light browse, grazing management needs vary; maintain and promote existing levels of rest and use in some areas, while increasing rest, distribution, and appropriate stocking rates where utilisation is poorer.
- Existing hydrologic regime (flow peak/timing, and withdrawals) may be influencing reduced overall cover of woody plants; aim to maintain or improve existing flow regimes to ensure current levels of regeneration are not reduced, and to promote further establishment.

Non-Woody Species

- Implement weed control to prevent further spread and reduce infestation of invasive plants.
- Reduce vigour and area of disturbance-caused species using adequate rest and appropriate grazing strategies, particularly tame species within native pastures. Recognise that elimination of disturbance species is unrealistic.

Physical Characteristics and Hydrologic Parameters

- Structural alterations are not impacting health, and bare ground is only impacted to a small degree by human activity. Focus on improving plant vigour, including increasing the proportion of native species, which will increase deep-binding roots and improve bank stability. Rest, appropriate timing, distribution and stocking rate will be required to reduce expansion of disturbance species.
- Prevent further increases in withdrawals and damming for future maintenance of riparian plant communities. Monitor tree and shrub communities and ensure flow and flood timing that will sustain communities and allow for establishment of new communities along this reach.

BELLY RIVER PROJECT AREA

The project area is a selection of riparian areas along the Belly River from the international Boundary (U.S.A/Alberta) downstream to the confluence with the Oldman River, (refer to project area map – Figure 3), a distance of approximately 156 km, of which approximately 12.6 km was sampled at 10 polygons (Table BL1, Appendix BL13).

Riparian areas in the examined sites were up to 840 m wide; with a wide range in maximum widths (130 m to 840 m) Riparian area width was on average 257 m (Appendix B13). (Note: as per riparian health inventory methodology, sites examined only include one side of the river, and thus these widths are based on the site examined). The river was not incised (Appendix B12). Diverse vegetation is dominated by native species, although both invasive herbaceous and disturbance-caused plants are widespread, including tame grass species like smooth brome (*Bromus inermis*) and introduced forbs, such as white clover (*Trifolium repens*). There were no invasive tree species found in the project area. Narrow-leaf cottonwood/red-osier dogwood community type (CT) (*Populus angustifolia*/*Cornus stolonifera*) covered the largest area of any CT (Appendix BL7). Narrow-leaf cottonwood was the most common tree species, found at 90% of sites.

WHAT DID WE FIND?

- **The level of interest in the project was very low.** Many of the landowners were cautious when considering participation in the project. Generally, those landowners who participated showed interest in determining the health of the riparian area. Thanks to everyone who allowed access to their land and supported this riparian inventory initiative. In all, 10 polygons were assessed along the Belly River in 2004 (Table BL1, Appendix BL1).

- **There are concerns with the overall health of this riparian area.** The health scores for the polygons assessed along the Belly River varied from unhealthy, healthy but with problems, to healthy. However, the majority of the polygons were rated in the healthy but with problems category. The overall assessment of riparian health for the Belly River project area is as follows (Figure BL1, Appendix BL1);

  - Of the 10 polygons assessed: 20% (2/10) are *healthy*,
    60% (6/10) are *healthy but with problems*,
    20% (2/10) are *unhealthy*.

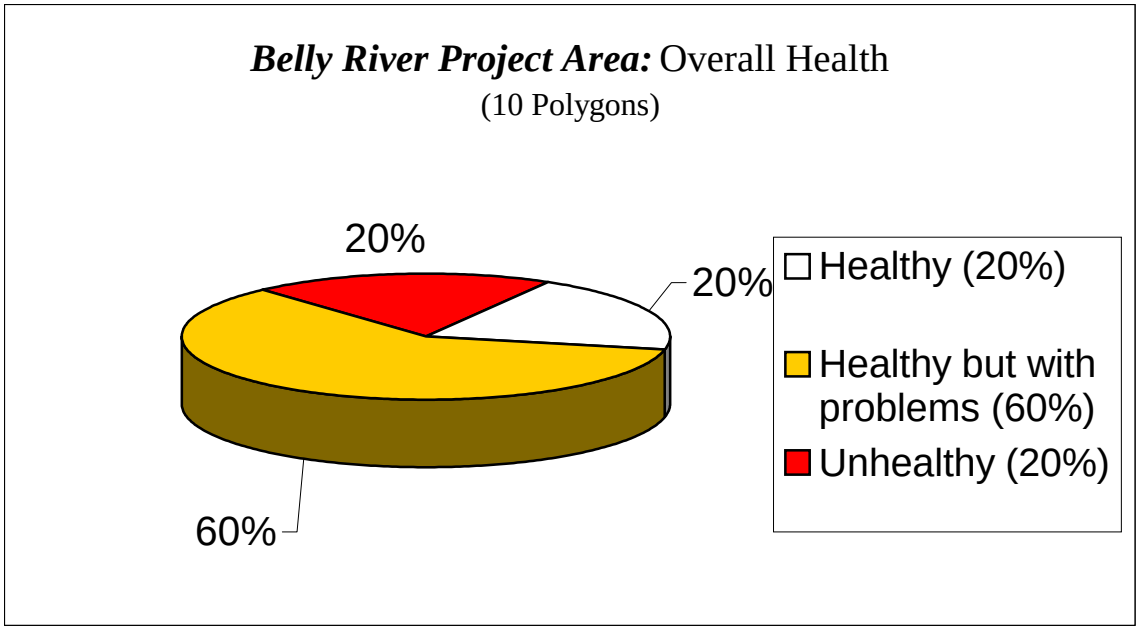


Figure BL1. Overall health of the Belly River Project Area.

*Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of the entire Belly River watershed, but they do give an overview of health of the riparian areas within this river.

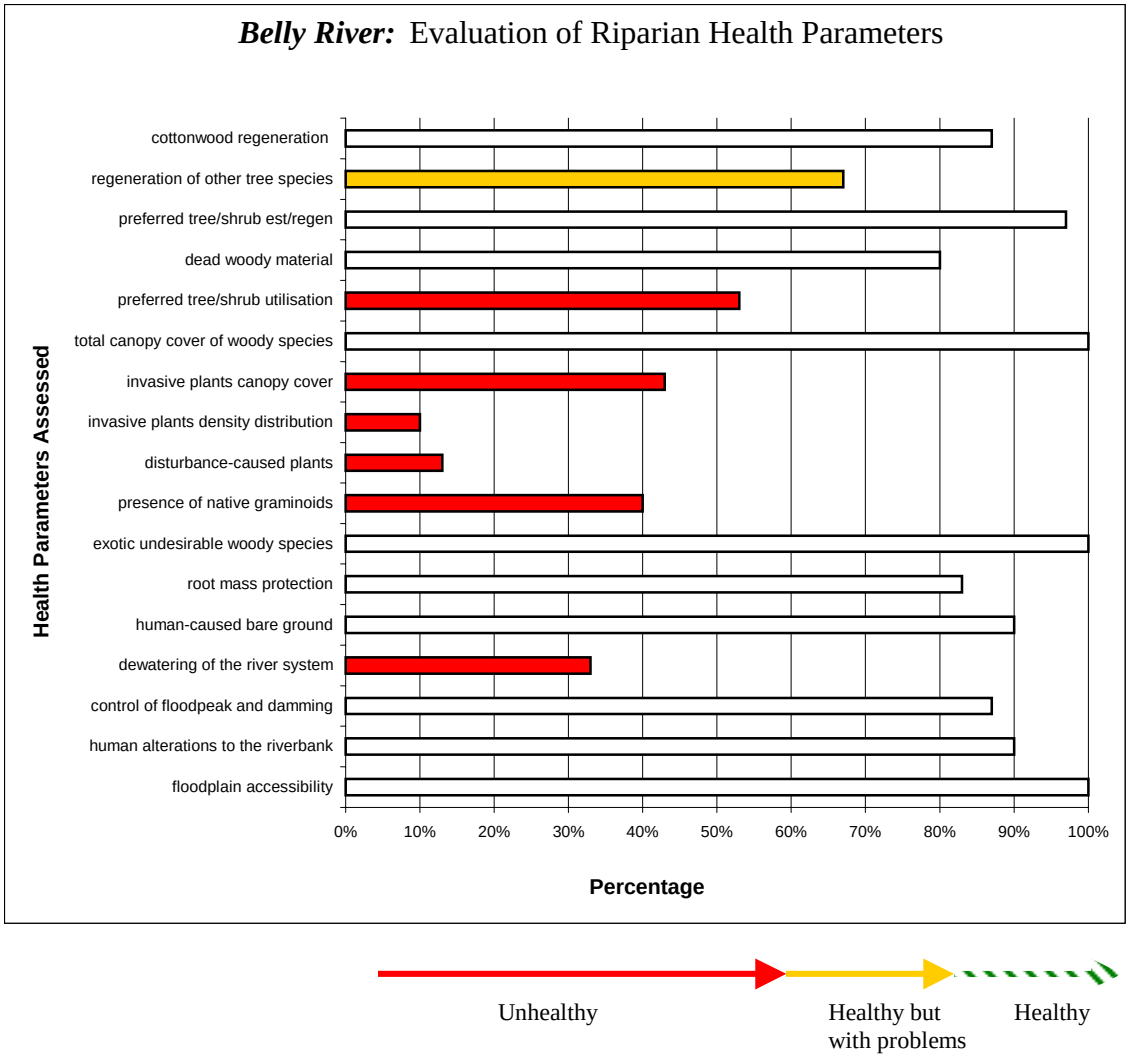
Remember: *We encourage users of the report to recognise the value of this report in broad-scale planning and identifying types of management and education approaches to take in the entire watershed--**this is not a finger pointing exercise; it should be used as part of an awareness process that maintains or improves management.***

Table BL1. Summary of Riparian Health Work –Belly River

Year	**River**	**# Landowners Contacted**	**# Landowners Participated**	**# Polygons Assessed**	**River Distance Assessed (km)**
2004	Belly River	**8**	**6**	**10**	**12.55**

RIPARIAN HEALTH DISCUSSION

For a description of how the parameters of riparian health are impacted by human disturbances and the overall affect on riparian health refer to *A Closer Look At The Riparian Health Pieces* in the overall summary of the South Saskatchewan River Basin.



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure BL2. Breakdown of riparian health results for 17 parameters assessed for the Belly River project area.

For an overview of the limitations of riparian health assessments refer to the section titled *Data Limitations* in the overall South Saskatchewan River Basin Summary.

Historic and Present Influences on Riparian Health

The following discussion provides some insights regarding the current status of the health of riparian areas within the project area.

- **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 (Alberta ECA 1977). At present, livestock grazing is the dominant land use potentially influencing riparian health along the Belly River (Table BL2; Appendix BL10).

- **Cropland cultivation** only makes up a very small component of the land use along the Belly River, and was not present in the polygons assessed. General changes to land cover by cultivation typically contribute to an increase in disturbance-caused undesirable plants within riparian areas.

- **Availability of water.** Water diversion and consumption are affecting the overall health evaluation of the Belly River, ranging from unaffected to heavily affected. In all but the uppermost reach, there may be long-term implications of reduced water volumes to maintaining riparian vegetation. Demand for water may be putting the river under stress. At the time of riparian health assessment, there were some minor concerns with regeneration and amounts of dead and decadent material in the tree and shrub community, which may be linked to one or both of grazing or water availability.

- **Damming of the upstream watershed** occurs in only the downstream-most reach (BL-01). Minor concerns with regeneration and dead/decadent trees and shrubs may be related to local site management or land use (mostly grazing) or changes to the flow peak and timing.

- **Timber harvest,** at minor levels occurs in some portions of the watershed, although based on air photo examination of broad land use categories, it is not present in the riparian area. Forestry activities can accelerated delivery of water resulting due to reduced forest cover. Depending on the extent and intensity of timber harvest, there way be an impact on the quantity and quality of water reaching the river, as well as levels of sediment and increased potential for introduction and invasion of disturbance or invasive species, due to bare soil and increased risk of seed transmission.

- **Development and industrial activity** including urban/domestic development, residential wastewater discharge, oil and gas exploration/development, recreation and roads are occurring along the Belly River. All of these activities are occurring in the Belly River watershed, but with the small sample size, only some of these activities were identified as present and / or impacting riparian health of polygons assessed. Roads for recreational use and livestock management, as well as some gravel extraction are influencing riparian health.

- **Overall watershed changes** such as land cover types are expected to increase the rate (and likely volume) at which water is delivered from the land (Alberta ECA 1977).

Table BL2. Land uses along the Belly River Project Area

AENV Reaches for Bow River	Land Uses (% of reach based on length)			
	Grazing	***Cropping***	***Developed***	***Undeveloped***
BL-01	55	8	1	36
BL-02	60	0	3	37
BL-03	58	0	0	42
BL-04	79	0	0	21
BL-05	34	0	0	66
Total	60	4	1	35

Refer to the section titled *Riparian Plant Communities-Why are they important?* for an overview of why understanding the riparian plant communities is important.

Riparian Plant Communities

Within the Belly River project area:

- All polygons examined are identified as having the potential to grow trees and shrubs, including preferred tree and shrub species.
- 8 different plant communities were identified.
- Shrubs occupy 78% of the project area and trees cover 61% of the project area.
- A total of 6 tree community and habitat types were found, 5 of which were poplar or cottonwood (*Populus*) community and habitat types
- Graminoids cover 67% of the project area, providing extensive cover within the tree and shrub community and habitat types.
- A list of all plant species found in the project area is available in Appendix BL3. Additional plant community and habitat type information can be found in Appendix BL7. Refer to Appendix BL4 for a complete listing of plant species observed within each polygon.

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

There is excellent vegetative cover provided by trees and shrubs, with an average of 72% cover by woody species. Preferred woody species such as water birch (*Betula occidentalis*), choke cherry (*Prunus virginiana*), saskatoon (*Amelanchier alnifolia*) and willows (*Salix* species) are common; these species are excellent for stabilizing and protecting the riverbank from erosion due to their deep binding roots.

Presence

- 6 tree species and 35 shrub species were identified within the Belly River project area.
- Total area covered by all trees and shrubs combined is 87% (Appendix BL2).

Tree and shrub communities provide critical habitat and shelter for many bird species, wildlife and livestock

Reproduction

- Currently there are two polygons where the reproduction of *preferred* trees and shrubs is of concern.
- 8 of 10 polygons (80%) along the Belly River have at least 15% of cottonwood cover within the polygon provided by established seedlings and saplings. The remaining 20% (2 of 10) have less than 5% of the cottonwoods present as seedlings and saplings.
- The upper reach has variable regeneration of other trees, ranging from poor to very good, but the remaining four lower reaches have only cottonwoods for trees. White spruce *(Picea glauca)*, Douglas fir (*Pseudotsuga menziesii*), and limber pine (*Pinus* flexilis) are found in the upper reach of the project area. On the 2 sites where these species are present, 1 polygon has more than 5% of the canopy cover provided by seedlings and saplings, and the other polygon has <5% of the canopy cover provided by seedlings and saplings.
- All but one polygon has excellent regeneration of preferred shrub species, and the remaining polygon has good regeneration. This means 90% (9 of 10) of the polygons have more than 5% of the preferred shrub species cover provided by seedlings and saplings, and the remaining site has only 1-5%.

Health

- Half of the sites are showing increased levels of dead and decadent branches in the tree and shrub communities. Four polygons have 5-25% of woody branches dead or decadent and one polygon has 25%-50% of the woody branches dead or decadent.

The remaining five polygons have normal levels of dead and decadence. Increased levels of dead and decadence throughout woody communities indicate that there may be a deficiency in moisture availability throughout sections of the system, disease may be impacting these communities, or long-term heavy utilisation may be increasing dead and dying trees and shrubs. Areas where utilisation is moderate are sometimes coincident with higher levels of dead/decadence. In addition, some areas with light utilisation have higher levels of dead/decadence, which may be linked to high levels of dewatering.

- There are minor concerns with the overall health of shrubs.
  - 22% of the shrub canopy cover is comprised of four grazing-resistant shrubs (snowberry/buckbrush, *(Symphoricarpos occidentalis)*, common wild rose *(Rosa woodsi)*, silverberry (*Elaeagnus commutata*) and prickly rose *(Rosa acicularis))*. The other 78% of the shrub canopy cover is comprised of *preferred*[16] shrub communities (including 2 willow communities).
  - In 30%, (3 of 10) of polygons, preferred trees and shrubs species are receiving moderate (2 of 10) to heavy (1 of 10) browse pressure from livestock (and to a lesser degree wildlife). In some locations this browse pressure is removing new growth and contributes to preventing seedlings and saplings from reaching a mature age class. Increased proportions of native, but grazing-resistant shrubs may result if moderate and heavy grazing persists over the long-term.
  - The indicators of heavy browse pressure are umbrella-shaped mature shrubs and flat-topped or hedged seedling and saplings. Successful reproduction and establishment of the present trees and shrubs will maintain these stands and promote riparian health.

Non-Woody Riparian Plants: Diversity and Health

Diversity

- 42 species of grasses and grass-like plants (graminoids) and 107 species of broad-leaved plants (forbs) were recorded within the Belly River project area.
- The presence of native grasses is an important indicator of the historic and recent levels of disturbance occurring within the riparian area; native grasses diminish with increased disturbances to the soil surface. The majority of reaches and polygons along the Belly River had poor or very poor coverage provided by native grasses. 10% (1 of 10) of polygons had less than 5% of the riparian area covered by native grasses. 60% (6 of 10) of polygons had 5-25% of the riparian area covered by native grasses. The remaining sites (3 of 10) had 25%-50% of the riparian area covered by native grasses. No sites had adequate coverage of native grass species (more than 50% of the reach covered).

[16] native, palatable shrubs (willows, red-osier dogwood etc.) that are good indicators of riparian health

- 63% (97 species) of the non-woody riparian plants recorded are native plants. Native plants provide riparian functions including deep, binding root mass and summer and winter forage production for livestock and wildlife.
- 4 poisonous plant species are noted within the project area but their overall presence is not of concern for management because they are not abundant: common horsetail (*Equisetum arvense*), Indian hemp (*Apocynum cannabinum*), showy locoweed (*Oxytropis splendens*) and water hemlock (*Cicuta* maculata).

Health

- 57% of the project area is occupied by disturbance-caused plants (grasses and forbs). Of the 28 disturbance-caused plant species present, the most prevalent are smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*)[17].
- Disturbance-caused undesirable plants are abundant throughout the Belly River project area. 60% (6 of 10) polygons have more than 50% of the riparian area covered in disturbance-caused undesirable herbaceous species. Disturbance-caused plants typically do not have a deep, binding root mass and therefore do not provide riverbank protection as well as non-disturbance native species. Refer to Appendix BL5 for more information regarding the area covered by disturbance plant species within each of the sites.
- Disturbance-caused species compete with native plants for water, nutrients and space to grow. Often disturbance-caused plants will displace entire native communities; along the Belly River, the abundance of disturbance-caused plants has reduced the overall coverage of native grasses and forbs.
- The prevalence of invasive plants (e.g. noxious weeds) is a concern. 4 of 10 polygons have invasive plants covering less than 1% of the riparian area. 5 of 10 polygons (50%) had invasive plants covering between 1-15% of the riparian area and 1 polygon had more than 15% of the riparian area covered by invasive plants. Leafy spurge (*Euphorbia esula*), Canada thistle (*Cirsium arvense*) and ox-eye daisy (*Chrysanthemum leucanthemum*) are the most prevalent invasive weeds. Spotted knapweed (*Centaurea maculosa*), nodding thistle (*Carduus nutans*), blueweed (*Echium vulgare*), common hound's tongue (*Cynoglossum officinale*), perennial sow thistle (*Sonchus arvense*), tall buttercup (*Ranunculus acris*), downy chess (*Bromus tectorum*), bladder campion (*Silene cucubalus*) and white cockle (*Silene pratensis*) are also found in the project area in lesser amounts. Spotted knapweed and nodding thistle are restricted plant species.

Physical Characteristics of Riverbank and Floodplain

Human-Caused Bare Ground and Alterations to the Riverbanks

- Overall, 4.3% of the riverbanks within the project area having structural alterations by human activities.

[17] Kentucky bluegrass, smooth brome and timothy are tame or introduced species that have invaded or been introduced into many native lands over the past decades. These species reduce long-term productivity and stability, because they do not have deep-binding roots.

- The majority of alterations are affecting less than 10% of the riverbank at any site. In the two polygons where alterations impacted health ratings, riverbank alterations make up 10%-25% of the bank at one site, and along the other site, alterations occur along 25%-50% of the bank.
- The main land use that is contributing to structural changes to the riverbanks is livestock activity. Roads and gravel excavation are contributing to a much lesser extent.
- Exposed soil surface or bare ground resulting from human activity was not a problem in the majority of polygons or reaches. Of the bare ground overall, 60% is naturally occurring (depositional material from recent flood events) and 40% is human-caused, but due to the small amounts of human-caused bare ground, this rates as very minimal or minor. The small amount of bare ground present from human causes is mostly due to livestock activity, with lesser amount from recreation and vehicle trails. These areas offer invasive weeds and disturbance-caused plants an opportunity to establish or spread, and should be kept to a minimum.

Riverbank Root Mass Protection

- For the majority of reaches and polygons, riverbanks have adequate protection by deep-binding roots. Of 10 sites, 7 polygons that had excellent protection, 2 polygons that had moderate protection and one site had very poor root mass protection. Of the sites without adequate root mass protection, two sites have 65-85% of the riverbank protected by deep binding roots and one has less than 35% of the banks with deep binding roots.

Hydrologic Characteristics

Dewatering of the River System

- Artificial removal of water from river systems can negatively affect bank stability, wildlife habitat, establishment and success of woody plants and overall riparian function.
- Along the Belly River there are major concerns with water removal. 3 of the 5 reaches, the downstream-most reaches, have considerable concerns due to dewatering. These reaches are experiencing withdrawals of more than 50% of the average river discharge.

Control of Flood Peak/Timing by Upstream Dams

- Dams negatively impact riparian health by altering the natural flow and flood patterns of river systems. By altering floodpeak timing and removing water, riparian areas are not able to recharge the ground water reserves necessary for maintaining riparian plant communities, nor create over-bank flows that deposit materials that allow for new plant community establishment.

- There are no dams along the Belly River; however, the Waterton River, which is dammed, joins the Belly River in the lowest reach and therefore a portion of the watershed upstream of this reach is controlled by the Waterton Dam. The Waterton Dam controls 25%-50% of the watershed upstream of the polygons in the most downstream reach.

Floodplain Accessibility

- The ability of floodwaters to disperse over the floodplain without restriction is an important function of riparian ecosystems. Flooding enables sediment deposition, a process that is necessary for repairing and rebuilding banks as well as for providing critical areas for cottonwood seedling establishment.
- Along the Belly River, all ten of the polygons' floodwaters have access to more than 85% percent of the floodplain, which is the amount required to maintain all riparian functions related to this parameter and to receive a healthy rating.

Belly River Riparian Health Overview: Summary

There is no consistent trend in health between reaches as you move downstream. Within three of the five reaches, variation between polygons is minimal (within 5%), but greater variation exists in the upper (BL-05) and lower (BL-01) most reaches (33% and 13% variability, respectively). The observations below provide a general overview that will assist in general management or monitoring planning. More detailed or specific use of the information should be done at the reach and polygon level, with a clear understanding of site or localised health status.

Only a couple of parameters showed differences based on distance from headwaters:

Physical/Hydrological:

- Human-caused bare ground was better in the lower reaches
- Lower reaches have increasing proportions of natural flow removed, leading to greater dewatering of channel and floodplain

Some parameters of riparian health were similar, regardless of location along the river system:

- Cottonwood regeneration (all excellent, except 2 sites, one near headwaters, one near confluence with Oldman River)
- Preferred shrub regeneration (excellent at all but 1 site)
- Cover of woody species (excellent at all sites)
- Invasive species density distribution (widespread or very widespread throughout)
- Disturbance species canopy cover (poor rating in all sites; not quite as extensive at upper most reach)
- Exotic, undesirable woody species (none found-healthy at all sites)
- Human alterations to the structure of riverbanks (excellent at all but 2 sites)
- Floodplain accessibility (no concerns)

There were no clear trends in these riparian health parameters as distance from headwaters increased:

- Regeneration of other tree species (only BL-05 had other tree species)
- Decadent and dead woody material (range from normal to considerably above normal amounts, sporadically)
- Utilisation of preferred trees and shrubs
- Invasive species canopy cover
- Native graminoid cover
- Proportion of banks protected with deep-binding roots
- Upper 4 reaches with no major dams; but downstream reach has control of flood peaks and timing by Waterton Dam

Limitations of the Data

Refer to Data Limitations in Year 1 of the South Saskatchewan River Basin Riparian Health Overview.

Belly River: Opportunities and Options for Improvement

Existing grazing management may be influencing riparian health to a variable extent at some sites, but it is most apparent where there is moderate or high utilisation. However, the majority of sites do not have extensive utilisation and regeneration of trees and shrubs are generally excellent. Most sites do not appear to be negatively affected by current/recent grazing management, with minimal amounts of human-caused bare ground and few structural alterations. Historic grazing management, in addition to disturbance and development from other land uses likely has contributed to high levels of disturbance caused plants, invasive weeds (providing seed sources and transport mechanisms) and loss of native graminoids. Where dewatering is occurring, there is some evidence that increased dead and decadence in tree and shrub may be resulting. At some of these sites browse is light (suggesting browse is not contribution to lack of woody plant health); at other sites browse is moderate (so cause of dead/decadence is more difficult to identify). There is excellent regeneration of preferred trees and shrubs overall. At one site where cottonwood regeneration is low (where the highest dead/decadence level is also found), the highest reach levels of dewatering and damming occur. Due to the very low sample size, further monitoring in this reach would be valuable to determine if this is common pattern, or an atypical situation, perhaps due to site type or successional stage.

Although utilisation is mostly light (70% of sites), there is room to improve grazing management to benefit both the woody and herbaceous plant communities. Promote and support livestock grazing strategies that focus on keeping preferred tree and shrub utilisation to light, and occasionally moderate, levels, increasing plant growth and vigour. Avoiding use in sensitive periods (i.e. when graminoids and forbs have reduced palatability or are limited in quantity) will promote woody plant growth, while minimising livestock browse. Additional rest to sites will promote native trees, shrubs, and graminoids.

As with many riparian areas in Alberta, invasive species were widespread in most areas, but there is less total cover than on the Oldman and St. Mary Rivers. Reduce the presence of invasive plants or aim to prevent further invasion. A combination of weed control measures and grazing strategies that consider rest, distribution, timing and stocking rates will be required to prevent human-caused bare soil and promote plant vigour. Where recreational activities are also present, weed control is equally important, through minimising trails, bare soil, and transport of weed seed on vehicles. Monitor regularly to keep these infestations from covering wider areas, particularly because annual weather conditions, combined with some types of land use/management, can lead to rapid increases.

Existing and past management has had very minimal impacts to riparian soil and bank structure, with only one site with considerable human-caused bare ground and bank structural alterations. Continuing management and land use that keeps these modification to a minimum will also benefit the herbaceous plant communities, reducing disturbance-caused and invasive plants.

In the upper reach, less than 10% of the average river discharge is being removed, with between 10% and 25% removed in the next downstream reach (BL-04). The remaining and most downstream reaches (BL-03, BL-02, BL-01) have extensive withdrawals, with over 50% of the average discharge removed. At the present there is only minor possible linkages/impacts to tree and shrub health, but long-term, high levels of water removal may impact riparian plant communities, channel morphology and aquatic life.

Although no dams occur directly on the Belly River, the bottom reach is influenced by damming with the Waterton Dam, which provides water to the Belly. Recognising that damming has a potentially harmful impact on riverine ecosystems, consider limiting further damming and provide flow regimes that assist in maintaining riparian plant communities. In addition, it is important to identify and quantify upstream minor or unlicensed dams to include these potential modifications and their impacts on the river ecosystem.

Floodplain accessibility is not impacted by human-built structures or physical modifications. Maintain current floodplain access to flood flows with development and river management that recognises the importance of over bank flows.

For much of the river, the main visible limitations to riparian health on-site are modifications to the herbaceous plant community (loss of native graminoids, increase in disturbance plants and infestations by invasive plants). Grazing management that focuses on managing native and tame grass species to improve native plant vigour will help reduce disturbance plant communities and weeds. Combined with long term maintenance and monitoring of flows that support riparian plant communities, these areas can may increase or maintain their riparian health.

Belly River Reach Overview

The reaches along the Belly River are summarized starting from the headwaters (BL-05) downstream to where the Belly River joins the Oldman River (BL-01) (Table BL3). In each reach, 2 polygons, totalling approximately 2 km of river length, are evaluated for the Belly River (Table BL4). The polygons rate in all three riparian health categories, with the majority of sites functioning but at risk (healthy, but with problems) (Table BL5).

Table BL3. Alberta Environment (AENV) Reaches Boundary Descriptions - Belly River

Reach	Upstream and Downstream Description
BL-05	International boundary (U.S.A./Alberta) to upstream of the Mountainview gauging station
BL-04	Mountainview gauging station to upstream of the St. Mary Canal
BL-03	St. Mary Canal to 5 km downstream of the St. Mary Canal (near gauging station by Standoff)
BL-02	5 km downstream of St. Mary Canal (near gauging station by Standoff) to upstream of the Waterton River confluence **Note: AENV reach descriptions indicated the upper boundary was near Standoff; hence reach boundary was delineated as at the town of Standoff. However, post-field work revealed that the station was approximately 2 km downstream of Standoff, resulting in 1 polygon being located between Standoff and the gauging station. Because of its very close proximity and stratification efforts to balance each reach's sampling, this polygon was included in BL-02.
BL-01	Waterton River confluence to the confluence with the Oldman River

Table BL4. Summary of Belly River Reaches – Sites

AENV Reaches	# Sites Assessed	River Distance Assessed (km)
BL-05	2	2.4
BL-04	2	2.5
BL-03	2	1.6
BL-02	2	2.4
BL-01	2	3.7
Total	10	12.6

Table BL5. Number of Reach Sites by Riparian Health Category – Belly River Reaches

Reach	Healthy	Healthy but with problems	Unhealthy
BL-05	1	0	1
BL-04	1	1	0
BL-03	0	2	0
BL-02	0	2	0
BL-01	0	1	1
Total	2	6	2

Table BL6. Reach Land Use – Belly River Reaches

AENV Reaches for Bow River	**Land Uses (% of reach based on length)**			
	Grazing	***Cropping***	***Developed***	***Undeveloped***
BL-05	34	0	0	66
BL-04	79	0	0	21
BL-03	58	0	0	42
BL-02	60	0	3	37
BL-01	55	8	1	36

Table BL7. Summary of Plant Communities: Overall and Woody Communities – Belly River Reaches

Reach	# of Plant Communities	% of Area Examined with:	
		Tree Species	Shrub Species
BL-05	2	62	84
BL-04	2	70	24
BL-03	4	38	67
BL-02	3	65	91
BL-01	2	62	88

Community and habitat types are determined using Thompson and Hansen (2002).

Refer to Appendix BL7 for a complete description of habitat and community types.

Table BL8. Summary of Plant Communities: Herbaceous Communities Belly River Reaches

Reach	% of Area Examined with:	
	Grass/Grass-like Species	Forb Species
BL-05	22	28
BL-04	54	17
BL-03	70	30
BL-02	63	18
BL-01	90	28

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

Most of the reaches typically have 2 tree species, except for the most upstream reach where 6 tree species were observed. Again, in the most upstream reach (BL-05), there was a wide variety of shrub species with 28 species observed, but for the remainder of the reaches there were generally between 12 and 18 shrub species (Table BL9). White spruce is observed in the upper most reach, with balsam poplar and narrow-leaved cottonwood occurring throughout the majority of the river length. Regeneration of trees and shrubs is generally excellent, with the exception of a few sites that have poor regeneration. Non-cottonwood species are only present in BL-05 and have poor to excellent regeneration in this area (Table BL10). Dead and decadent material within the woody plant communities was of concern in one of the sites, but for the majority of sites there were minor additional to normal levels. Utilisation/browse is generally light, with two sites having moderate browse, and one site with heavy use (Table BL11).

Table BL9. Woody Plant Species Presence– Belly River Reaches

Reach	**# of Tree Species**	**# of Shrub Species**	**% of Polygon Area that is Woody Species**
BL-05	6	28	90
BL-04	2	12	80
BL-03	2	18	81
BL-02	2	14	91
BL-01	2	17	88

Refer to Appendix BL4 for a complete list of plant species.

Table BL10. Woody Plant Species Reproduction– Belly River Reaches

Reach	Cottonwood Regeneration (seedlings/ saplings)	Other Tree Species Regeneration (seedlings/ saplings)	# of Sites with seedlings /saplings >5% of total woody cover	Means for health…
BL-05	1 site poor, 1 site excellent	1 site poor, 1 site, 1 site excellent	1 of 2	Variable, 1 site excellent regeneration of all woody species, 1 site poor tree regeneration and moderate shrub regeneration
BL-04	All sites excellent	Not applicable, none observed	2 (all)	Excellent tree and shrub regeneration
BL-03	All sites excellent	Not applicable, none observed	2 (all)	Excellent tree and shrub regeneration
BL-02	All sites excellent	Not applicable, none observed	2 (all)	Excellent tree and shrub regeneration
BL-01	1 site poor, 1 site excellent	Not applicable, none observed	2 (all)	Variable, 1 site poor tree regeneration and excellent shrub regeneration; 1 site excellent tree and shrub regeneration

Refer to Appendix BL1 for a summary of river health survey scores.

Table BL11. Woody Plant Health– Belly River Reaches

Reach	Dead and Decadence	Utilisation of Preferred Woody Plants	Means for health…
BL-05	Minor	Light, heavy	Fair
BL-04	Normal	Light	Excellent
BL-03	Normal, minor	Moderate	Fair to good
BL-02	Normal, minor	Light	Good to excellent
BL-01	Normal, moderate	Light	Fair to excellent

Non-Woody Riparian Plants: Diversity and Health

There is a variety of herbaceous species occurring along the Belly River, with 16 to 30 graminoid species found in each reach and 48 to 65 forb species.

Native graminoids covered 5%-50% of the assessed area and in one case less than 5%. Disturbance-caused species are abundant throughout all of the Belly River reaches and are normally covering 25%- >50% of the riparian areas assessed (Table BL13). Invasive plant species are sporadic and widespread throughout the reaches occurring in patches and continuously throughout the riparian areas (Table BL14). Leafy spurge (*Euphorbia esula*) is covering the largest area; however, Canada thistle (*Cirsium arvense*) is the most common and widespread invasive plant, with numerous other species commonly found (Table BL15).

Table BL12. Non-Woody Riparian Plant Diversity– Belly River Reaches

Reach	Total # of Grass/ Grass-like Species	Total # of Forb Species	Proportion of site covered by native graminoids	Means for health…
BL-05	21	65	1 site 5%-25%; 1 site <5%	Very poor to poor
BL-04	30	56	Both sites 5%-25%	Poor
BL-03	21	56	Both sites 25-50%	Fair
BL-02	30	55	Both sites 5%-25%	Poor
BL-01	16	48	1 site 5%-25%; 1 site 25%-50%	Poor to fair

Table BL13. Non-Woody Riparian Plant Health - Proportion Disturbance Caused Undesirable Herbaceous Species– Belly River Reaches

Reach	% of Reach with Disturbance Plants	Disturbance Plants Cover	Means for health…
BL-05	38	All sites 25%-50%	Widespread disturbance species, of concern
BL-04	51	1 site 25%-50%; 1 site >50%	Widespread to extensive coverage of disturbance species, of concern
BL-03	60	All sites >50%	Extensive coverage of disturbance species, of concern
BL-02	45	1 site 25%-50%; 1 site >50%	Widespread to extensive coverage of disturbance species, of concern
BL-01	74	All sites >50%	Extensive coverage of disturbance species, of concern

Table B1L4. Non-Woody Riparian Plant Health - Proportion Invasive Plant Species– Belly River Reaches

Reach	# of Sites with Invasive Plants	Invasive Plants Cover	Density/ Distribution of Invasive Plants	Means for health…
BL-05	2	All sites low cover	A few to several sporadically occurring plants to a few patches	Canopy cover is good, distribution is a concern
BL-04	2	All sites moderate cover	A few to several sporadically occurring plants, a few patches to continuous uniform occurrences of well spaced plants	Canopy cover and distribution are of concern
BL-03	2	All sites moderate cover	Rare occurrence, few to several sporadically occurring plants to several patches	Canopy cover and distribution are of concern
BL-02	2	All sites low cover	A few sporadically occurring plants to single patches with several individual plants	Canopy cover is good, distribution is of concern
BL-01	2	1 site moderate cover; 1 site high cover	Rare occurrence to continuous dense occurrence of plants	Canopy cover and distribution are of concern

Table BL15. Most Common Invasive Herbaceous Plant Species– Belly River Reaches

Reach	Species
BL-05	Canada thistle, ox-eye daisy, perennial sow-thistle
BL-04	Canada thistle, common hound’s tongue, spotted knapweed
BL-03	Canada thistle, common hound’s tongue, ox-eye daisy
BL-02	Canada thistle, ox-eye daisy, perennial sow thistle
BL-01	Canada thistle, common hound’s tongue, leafy spurge

Physical Characteristics of Riverbank and Floodplain

Human-caused bare ground is minimal for most sites, with only 2 sites having considerable to minor amounts of bare ground (Table BL16). The main causes of bare ground include grazing, recreation and vehicle trails (Appendix BL9). Human activities have altered the riverbank structure at most sites, but except for two sites, it is less than 10% of the bank length, so no loss to riparian health score occurs. The exceptions are two sites that have either 10%-25% or 25%-50% of the bank altered (Table BL17). The majority of the alterations are due to livestock activity, with roads and gravel excavation altering the banks to a lesser degree. For the majority of reaches there is adequate protection along the riverbank provided by deeply rooted species, however there are a few sites that have very poor to moderate protection (Table BL18). Appendix B14 also outlines the bank materials within each of the sites inventoried along the Belly River.

Human-Caused Bare Ground and Alterations to the Riverbanks

Table BL16. Human-caused Bare Ground– Belly River Reaches

Reach	# of Sites with >5% Human Caused Bare Ground	Proportion of polygons covered by human-caused bare ground	Sites are…
BL-05	1 of 2	1 site <5%; 1 site 25%-50%	Poor to very well vegetated
BL-04	1 of 2	1 site <5%; 1 site 5%-25%	Fair to very well vegetated
BL-03	0	Both sites <5%	Very well vegetated
BL-02	0	Both sites <5%	Very well vegetated
BL-01	0	Both sites <5%	Very well vegetated

Table BL17. Human-Caused Structural Alterations– Belly River Reaches

Reach	# of Sites with Human Caused Structural Alterations	# of Sites with Human-Caused Structural Alterations Along:				Banks are…
		< 10% of length	10-25% of length	25-50% of length	> 50% of length	
BL-05	1	1	0	1	0	Variable, intact to moderately altered
BL-04	2	2	0	0	0	Intact
BL-03	2	1	1	0	0	Mostly intact
BL-02	0	2	0	0	0	Intact
BL-01	2	2	0	0	0	Intact

Riverbank Root Mass Protection

Table BL18. Proportion of Riverbank with Deep Binding Roots— Belly River Reaches

Reach	# of Sites with Riverbank Rootmass Protection along:				Banks are…
	> 85% of length	65-85% of length	35-65% of length	< 35% of length	
BL-05	1	0	0	1	Well to very poorly protected
BL-04	1	1	0	0	Well to moderately protected
BL-03	2	0	0	0	Well protected
BL-02	2	0	0	0	Well protected
BL-01	1	1	0	0	Well to moderately protected

Hydrologic Characteristics

Dewatering of the river is significant within the lower reaches (BL-03, BL-02 and BL-01), with very minor withdrawals from the most upstream reach (BL-05) (Table BL19). There are no dams located directly on the Belly River, however the dam on the Waterton River, which drains into the Belly River is modifying the flow of reach BL-01, the reach below the confluence with the Waterton River. Here the Waterton Dam is controlling 25%-50% of the watershed upstream of this reach (Table BL20). Flood waters have unrestricted access to their associated riparian areas in all sites (Table BL21).

Dewatering of the River System

Table BL19. Dewatering of the River— Belly River Reaches

Reach	**Total use as a % of natural ***	**# of Sites with River Discharge Being Removed that is:**				**Impacts are…**
		< 10% of average	10-25% of average	25-50% of average	> 50% of average	
BL-05	0	2	0	0	0	Very minor
BL-04	12.1	0	2	0	0	Minor
BL-03	91.3	0	0	0	2	Significant
BL-02	87.4	0	0	0	2	Significant
BL-01	87.6	0	0	0	2	Significant

*Data provided by AENV. Note that only licensed and reported uses are included; unlicensed use is unknown.

Control of Flood Peak/Timing by Upstream Dams

Table BL20. Flood Peak and Timing Control by Dams – Belly River Reaches

Reach	**# of Sites with Control By Dams Upstream Affecting:**				**Number of Dams Upstream**
	<10% of watershed	10-25% of watershed	25-50% of watershed	> 50% of watershed	
BL-05	2	0	0	0	0
BL-04	2	0	0	0	0
BL-03	2	0	0	0	0
BL-02	2	0	0	0	0
BL-01	0	0	2	0	1 Waterton Dam

Floodplain Accessibility

Table BL21. Floodplain Accessibility— Belly River Reaches

Reach	# of Sites with Flood Water Access to:				Major Obstructions to Flooding
	> 85% of floodplain	*65-85% of floodplain*	*35-65% of floodplain*	*< 35% of floodplain*	
BL-05	2	0	0	0	None
BL-04	2	0	0	0	None
BL-03	2	0	0	0	None
BL-02	2	0	0	0	None
BL-01	2	0	0	0	None

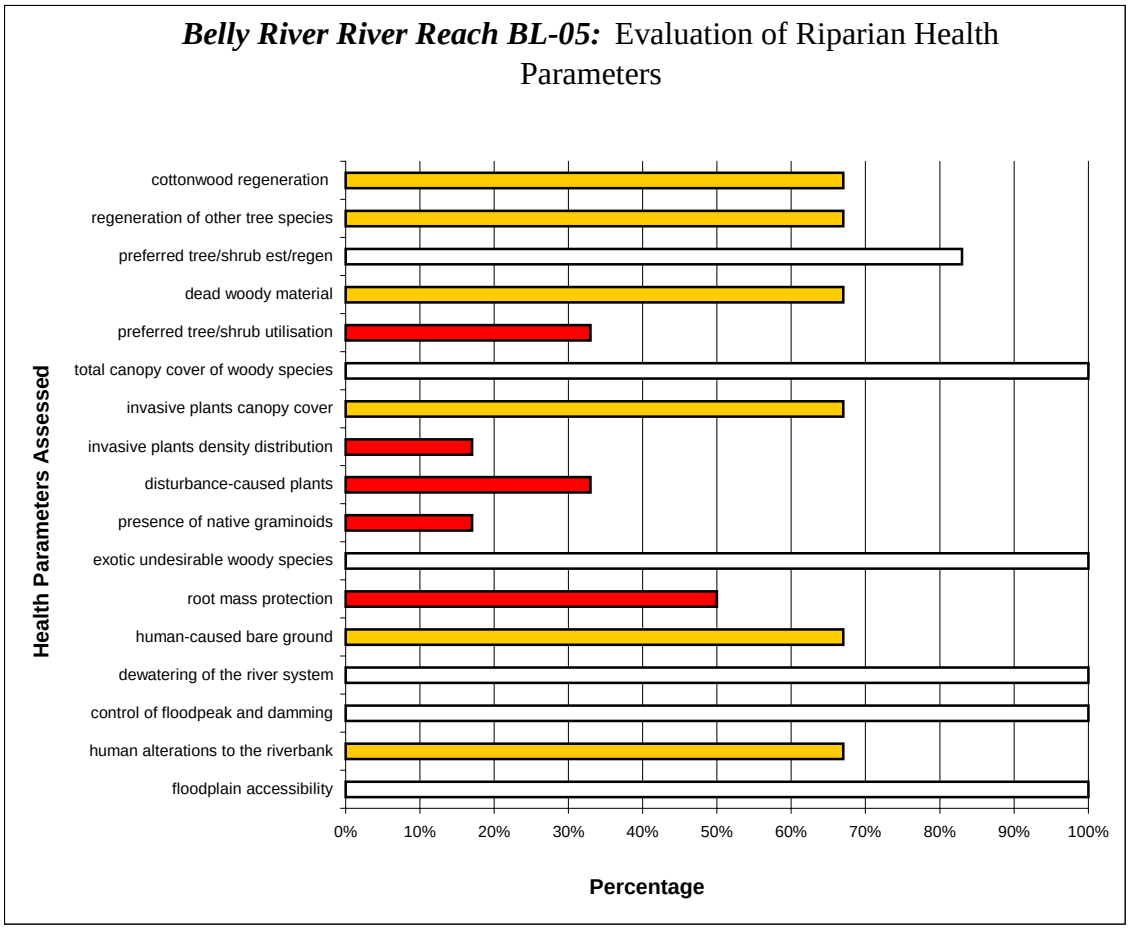
Alberta Environment Reach: International Boundary U.S.A/AB to Upstream of the Mountainview Gauging Station (BL-05)

- **One of the polygons scored in the healthy category and the other polygon rated unhealthy.** The overall assessment of riparian health for reach BL-05 of the Belly River project area is as follows:

  - Of the 2 polygons assessed: 50% (1/2) are *healthy*,
    0% (0/2) are *healthy but with problems*,
    50% (1/2) are *unhealthy*.

Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure BL3. Breakdown of riparian health results for 17 parameters assessed for the Belly River reach BL-05.

Historic and Present Influences on Riparian Health: Reach Comments

The upper end of this reach is the border between the United States and Alberta. The river flows through forests dominated by coniferous trees gradually shifting to tree communities dominated by balsam poplar (*Populus balsamifera*).

The majority of the land within this reach was identified as undeveloped. Grazing accounted for the land use occurring on the remainder of the land along the river in this reach.

Riparian Plant Communities

- Currently, preferred tree and shrub communities are present and have excellent regeneration in one of the sites in this reach, but while they are present in the other site, regeneration of preferred trees is minimal. Two woody plant community types are observed in this reach, white spruce (*Picea glauca*)/ red-osier dogwood (*Cornus stolonifera*) and balsam poplar (*Populus balsamifera)/* snowberry/buckbrush (*Symphoricarpos occidentalis*). This site has the largest diversity of trees with 6 different species observed. Browse utilisation of preferred woody plants is variable ranging from light to heavy and may be restricting the regeneration of preferred trees and shrubs where seedlings and saplings are lacking. There are minor levels of dead and decadent branches within the woody communities in this reach.

Physical Characteristics and Hydrologic Parameters

- There is minimal human-caused bare ground and the riverbanks are not subjected to structural alterations in one of the sites in this reach. The other site is significantly impacted by human activities, mainly grazing, resulting in large areas of bare soil and alterations occurring along sections of the riverbank. There is excellent riverbank root mass protection along one of the areas assessed with very poor protection of the riverbanks at the other site, which directly corresponds to the large area affected by structural alterations.
- Currently there are no dams altering the flow of the river or significant withdrawals from this reach. There are no restrictions to floodwater access to the floodplain in the areas assessed.

Opportunities and Options for Improvement: BL-05

Trees and Shrubs

- Existing tree and shrub communities show minor increases in amounts of dead and decadent branches, with variable levels of regeneration, indicating current land uses (primarily grazing) may be impacting tree and shrub health at one site.
- Maintain the diversity and age class structure of trees and shrubs by maintaining currently successful land uses and management.

Encourage reduced browse (utilisation) of preferred trees and shrubs to improve regeneration and ensure maintenance of woody plant communities.

Non-Woody Species

- Native grasses were present within this reach but the overall presence of these species could be improved with management of disturbance and invasive species.
- Reduce the presence of disturbance-caused plants through sound grazing strategies that target non-native grasses, and prevent additional invasion of invasive weeds or disturbance-caused plants by both grazing management that ensures native plant vigour and avoids creating bare soil.

Physical Characteristics and Hydrologic Parameters

- Maintain current management practices where physical impacts are minimal; but improve grazing management where bare ground and bank alterations are significant. Use improved timing, distribution and stocking rates to reduce physical impacts resulting from livestock.
- Maintain current flows and floodplain access for future maintenance of riparian plant communities and channel processes.

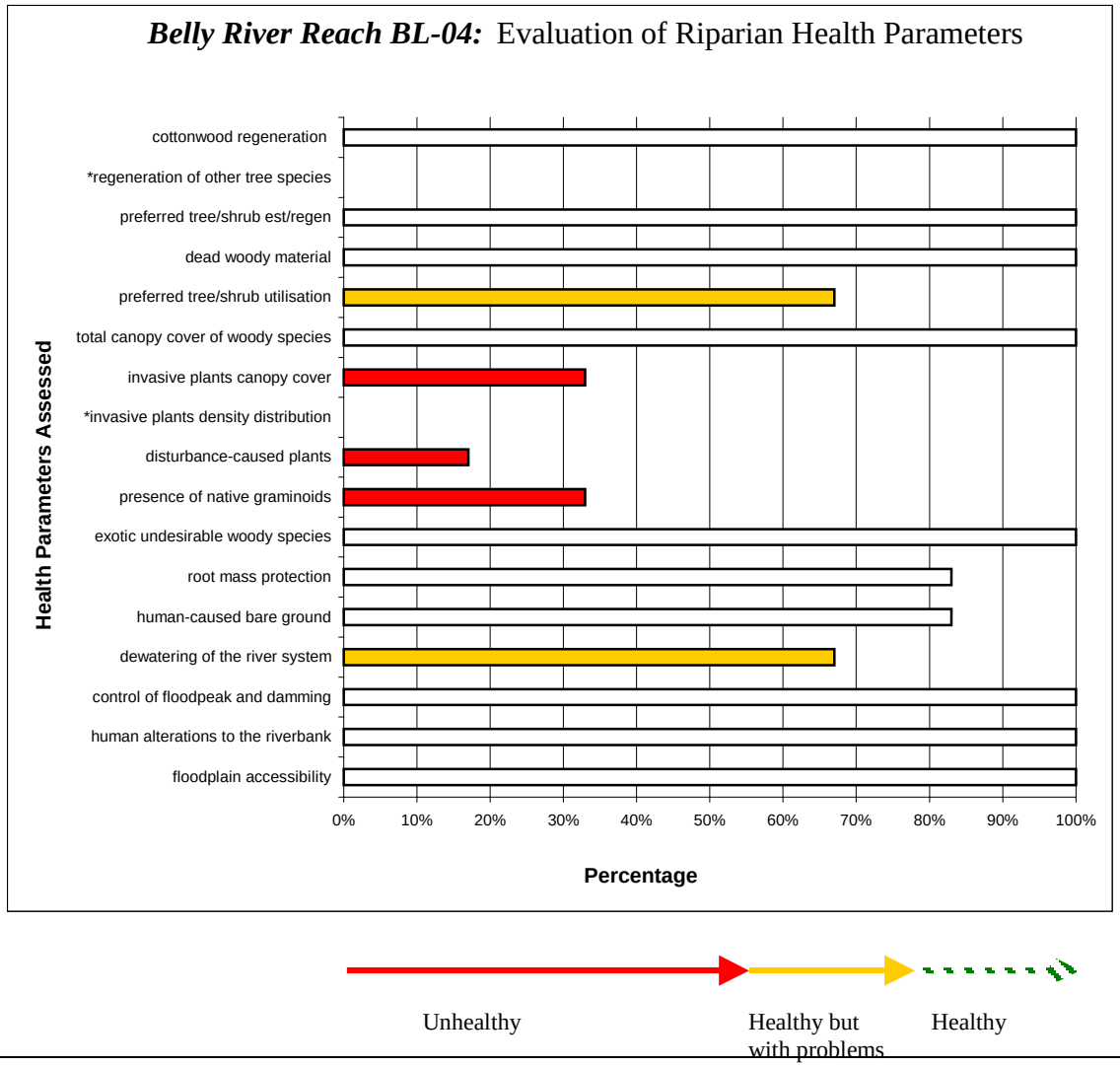
Alberta Environment Reach: Mountainview Gauging Station to upstream of the St. Mary Canal (BL-04)

- **One of the polygons in this reach scored in the healthy category and the other was rated as healthy but with problems.** The overall assessment of riparian health for reach BL-04 of the Belly River project area is as follows:

  - Of the 2 polygons assessed: 50% (1/2) are *healthy*,
    50% (1/2) are *healthy but with problems*,
    0% (0/2) are *unhealthy*.

Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure BL4. Breakdown of riparian health results for 17 parameters assessed for the Belly River BL-04.

** Regeneration of other tree species does not register on this graph because there were no other trees present therefore, this parameter was not assessed. Invasive plant density distribution does not register on this graph because this parameter scored 0%*

Historic and Present Influences on Riparian Health: Reach Comments

Grazing is the principal land use, although there are portions of this reach influenced by cropping and some sections are undeveloped.

Riparian Plant Communities

- Trees have significant cover (70%) of the inventoried area, with a smaller area covered by shrubs (24%). Non-cottonwood species were not observed in the assessed area; however there is excellent regeneration of preferred shrubs and cottonwood species. The diversity of trees and shrubs is considerably lower than reach BL-05, with 2 tree and 12 shrub species recorded in this reach.
- Invasive plant species are covering 1%-15% of the area assessed in this reach. The distribution of these species is of concern with a variety of invasive plants found continuously with patches in their occurrence throughout the riparian area. Of particular concern is the presence of spotted knapweed (*Centaurea maculosa*) a restricted plant species observed within this reach. Disturbance-caused plants are also a concern, with over 50% of one site and 25%-50% of the other site covered in these species. This cover has replaced native graminoids, which occupy only 5%-25% of the areas assessed.

Physical Characteristics and Hydrologic Parameters

- Limited human-caused structural alterations are occurring along the riverbank in both of the polygons in this reach; grazing and gravel excavation are the main causes of structural alterations in this reach. Human-caused bare ground, mainly from grazing and recreation to a lesser degree, occurs in both polygons, however the amount is significantly greater in one of the sites (5%-25%).
- The riverbanks are well protected with deep rooted species throughout one site, with moderate protection in the other.
- Water withdrawals increase in this reach, with 10%-25% of the average river discharge withdrawn. There are no dams present and there are no restrictions to floodwaters accessing the floodplain.

Opportunities and Options for Improvement: BL-04

Trees and Shrubs

- Regeneration of preferred trees and shrubs is excellent, with no above normal dead or decadent material. This, along with light browse levels suggests that grazing levels are generally appropriate, and management should continue to maintain these parameters of riparian health.

Non-Woody Species

- With very low cover of invasive species, target existing patches to prevent further spread. With the extensive coverage of disturbance-caused species, management of grazing in the area should be focussed on improving native plant vigour through appropriate stocking, timing and intensity of grazing.

Physical Characteristics and Hydrologic Parameters

- Maintain limited human-caused structural alterations and human-caused bare

ground due to livestock, encouraging distribution that limits the amount of time spent on or near the riverbank. Continue to maintain and promote extensive deep-rooted species through appropriate timing and intensity of livestock use.

- Prevent further water withdrawals and maintain existing natural timing and peak flows, but monitor riparian plant community maintenance and consider adjusting flow volume to meet plant needs. Maintain existing floodplain accessibility.

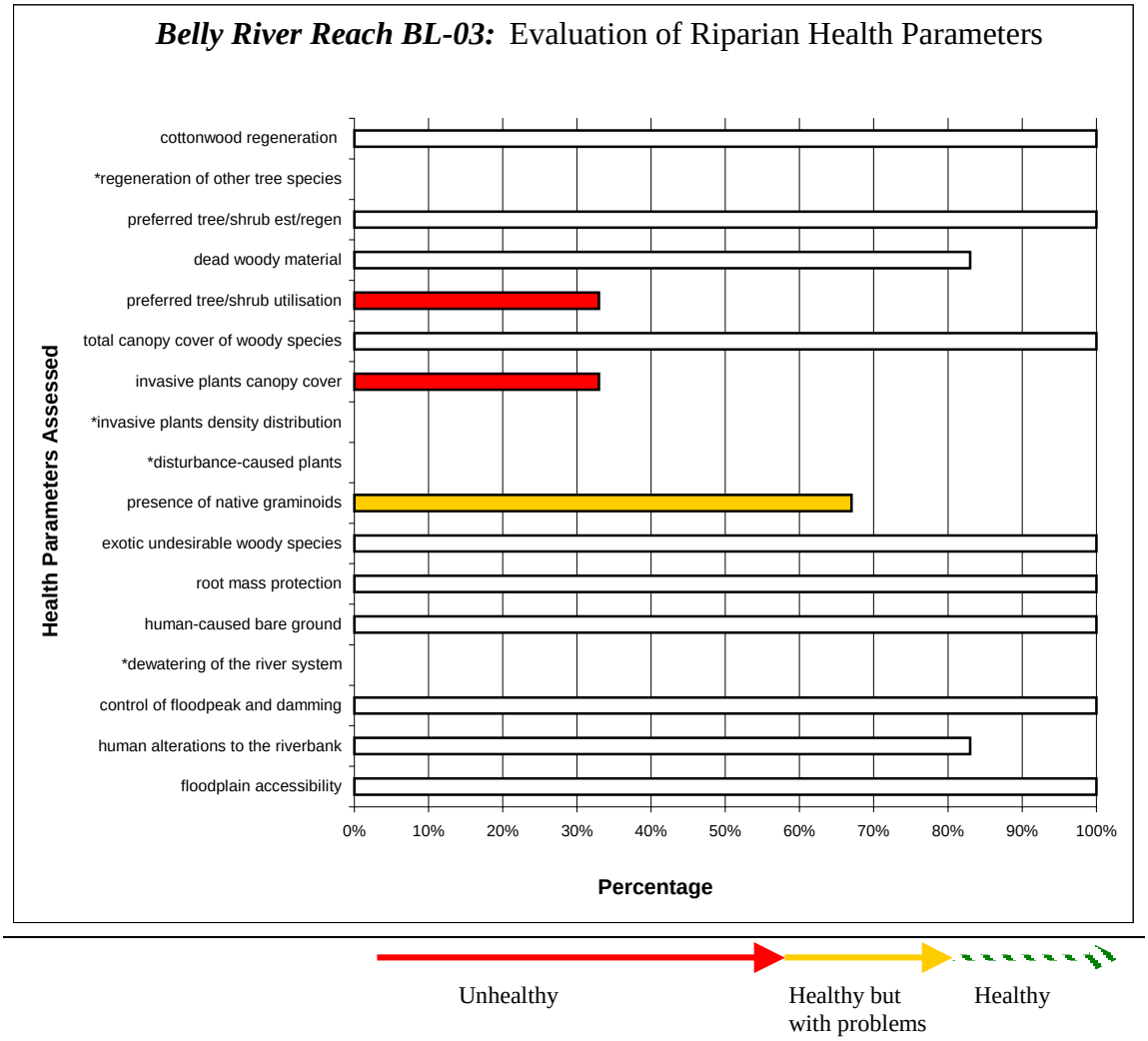
Alberta Environment Reach: St. Mary Canal to 5 kilometres downstream of the St. Mary Canal (BL-03)

- **Both of the polygons in this reach scored in the healthy but with problems category.** The overall assessment of riparian health for reach BW-03 of the Belly River project area is as follows:

  - Of the 2 polygons assessed: 0% (0/2) are *healthy*,
    100% (2/2) are *healthy but with problems*,
    0% (0/2) are *unhealthy*.

Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure BL5. Breakdown of riparian health results for 17 parameters assessed for the Belly River Reach BL-03.

** Regeneration of other tree species does not register on this graph because there were no other trees species present, therefore this parameter was not assessed. Invasive plant density distribution, disturbance-caused plants and dewatering of the river system do not register on this graph because these parameters scored 0%.*

Historic and Present Influences on Riparian Health: Reach Comments

Over 50% of the land-use within this reach is occupied by livestock grazing and remaining portion was designated as undeveloped.

Riparian Plant Communities

- Shrub species are covering a greater area (67%) than trees (38%) of the area assessed in this reach. There is excellent regeneration of both cottonwoods and preferred shrub species. No other trees besides cottonwoods were observed in this reach. Preferred trees and shrubs are receiving moderate utilisation; however browse levels do not seem to be restricting the preferred woody regeneration.
- There is good coverage of native grasses with 25%-50% of the assessed area covered by these species. Despite the presence of native plants, disturbance-caused grasses are abundant throughout the reach covering more than 50% of the assessed area. Invasive plants also have significant ground cover (1%-15%), however attention should be focussed on the distribution of these species. Invasive plants are widespread and found continuously with a few patches.

Physical Characteristics and Hydrologic Parameters

- There is human-caused bare ground occurring within this reach, however the impacts are not significant and are only affecting less than 5% of the area assessed. Structural alterations are occurring in both of the sites in this reach, but are only of concern in one of the sites as 10%-25% of the bank length has been altered. The majority of the structural alterations and bare ground within this reach are due to livestock activity. Deeply rooted species are providing excellent protection along the riverbank within this reach.
- Water withdrawals increase dramatically within this reach with more than 50% of the average river discharge removed. There are no dams present and therefore the natural flow of the river has not been altered. There are currently no barriers along the river and floodwaters have full access to the floodplain.

Opportunities and Options for Improvement: BL-03

Trees and Shrubs

- Tree and shrub health is high; maintain and promote current management to maintain successful regeneration, but modify management where needed to reduce browse levels by changing intensity, timing or distribution of livestock.

Non-Woody Species

- With low cover of invasive species, target existing patches to prevent further spread. With the extensive coverage of disturbance-caused species, management of grazing in the area should be focussed on improving native plant vigour through appropriate stocking, timing and intensity of grazing.

Physical Characteristics and Hydrologic Parameters

- Maintain limited human-caused structural alterations and human-caused bare ground due to livestock use, maintaining existing riverbank root mass protection.
- Monitor current extensive water withdrawals to determine if riparian plant communities are being sustained; consider providing additional flows to increase likelihood of long-term maintenance and establishment of riparian plant communities. Maintain existing natural timing and peak flows and prevent any impediments to floodplain accessibility.

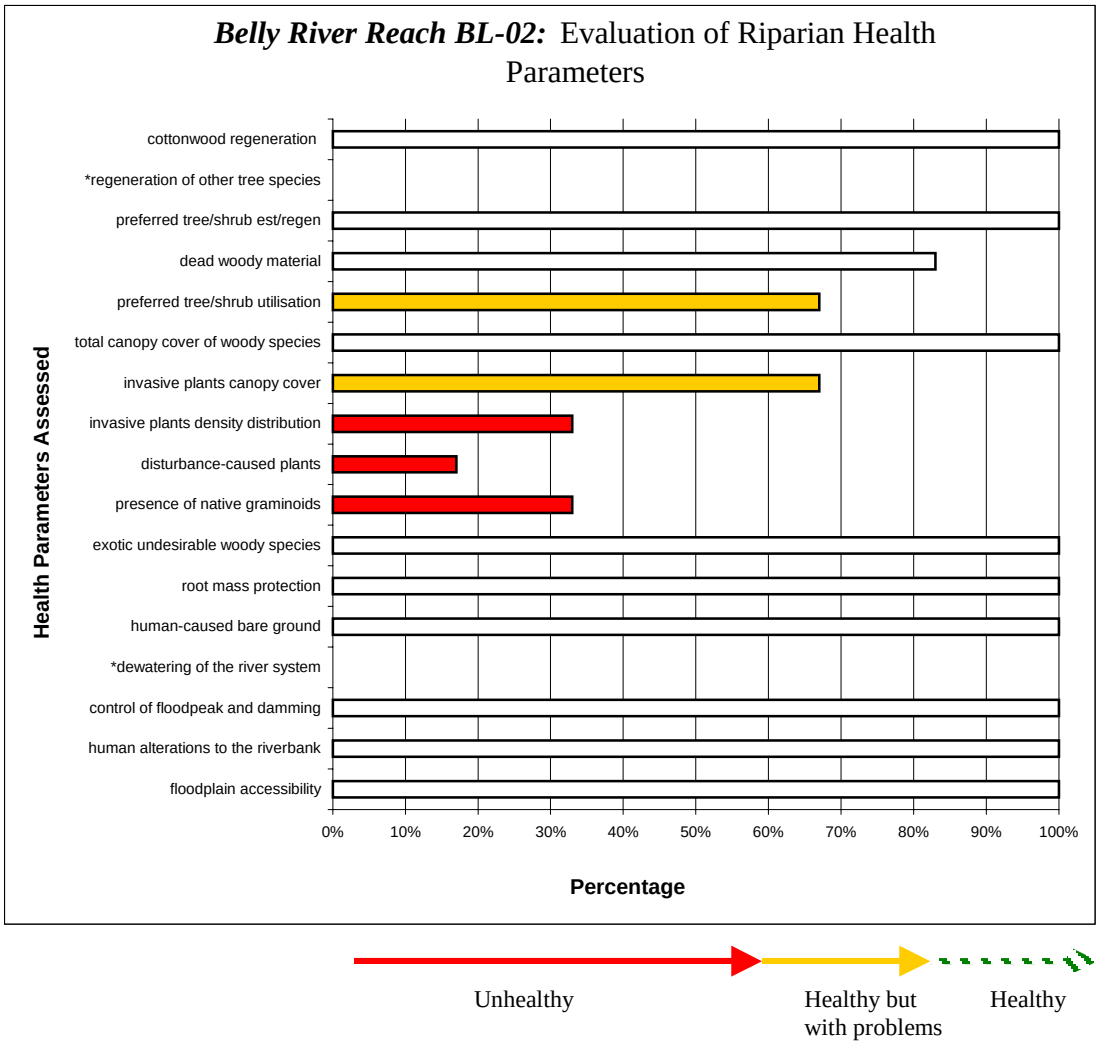
Alberta Environment Reach: 5 kilometres downstream of the St. Mary Canal to Upstream of the Waterton River Confluence (BL-02)

- **Both of the polygons rated in the healthy but with problems.** The overall assessment of riparian health for reach BL-02 of the Belly River project area is as follows:

  - Of the 2 polygons assessed: 0% (0/2) are *healthy*,
    100% (2/2) are *healthy but with problems*,
    0% (0/2) are *unhealthy*.

Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure BL6. Breakdown of riparian health results for 17 parameters assessed for Belly River reach BL-02.

** Regeneration of other tree species does not register on this graph because there were no other trees species than cottonwoods present, therefore this parameter was not assessed. Dewatering of the river system does not register on this graph because this parameter scored 0%.*

Historic and Present Influences on Riparian Health: Reach Comments

Grazing continues to be the dominant land use in this reach, with portions of the reach undeveloped, as well as a small developed area.

Riparian Plant Communities

- Shrubs are covering a significant portion of the assessed area (91%) and trees are also present covering 65% of the area. Regeneration of cottonwoods and preferred shrubs is excellent throughout this reach, providing sustainability within these communities. Overall utilisation is light, with current browse levels having no significant impact on the regeneration of preferred woody communities.
- The presence of invasive species is lower in this reach than the previous reaches with invasive plants covering less than 1% of the assessed area. Invasive plants are found mainly in patches; however the distribution of these species facilitates further infestation, potentially increasing future ground cover. Disturbance-caused species are abundant and reducing the overall coverage provided by native grasses with only 5%-25% of the area assessed occupied by native grasses.

Physical Characteristics and Hydrologic Parameters

- There is very limited human-caused bare ground and currently there are no alterations occurring along the riverbanks of this reach. Livestock activity is the main cause of the bare ground within this reach; however, the impacts are minimal. Riverbank root mass protection is excellent and supported by the abundance of deeply rooted tree and shrub species growing along the banks.
- Similar to the previous reach, there are major water withdrawals, with greater than 50% of the average river discharge removed from this reach. Dams are not present along the river and the natural flow of the river is not altered. There are no obstructions along the riverbank and floodwaters have full access to the floodplain.

Opportunities and Options for Improvement: BL-02

Trees and Shrubs

- With excellent regeneration, tree and shrub health is high; maintain and promote current management to maintain successful regeneration, continue to promote light browse levels.

Non-Woody Species

- With very low cover of invasive species, work to limit spread by targeting existing patches. With the extensive coverage of disturbance-caused species, management of grazing in the area should be focussed on improving native plant vigour through appropriate stocking, timing and intensity of grazing.

Physical Characteristics and Hydrologic Parameters

- Continue to maintain limited human-caused structural alterations and human-caused bare ground due livestock with appropriate distribution, timing and stocking rates.
- Monitor current extensive water withdrawals to determine if riparian plant communities are being sustained; consider providing additional flows to increase likelihood of long-term maintenance and establishment of riparian plant communities. Maintain existing natural timing and peak flows and prevent any impediments to floodplain accessibility.

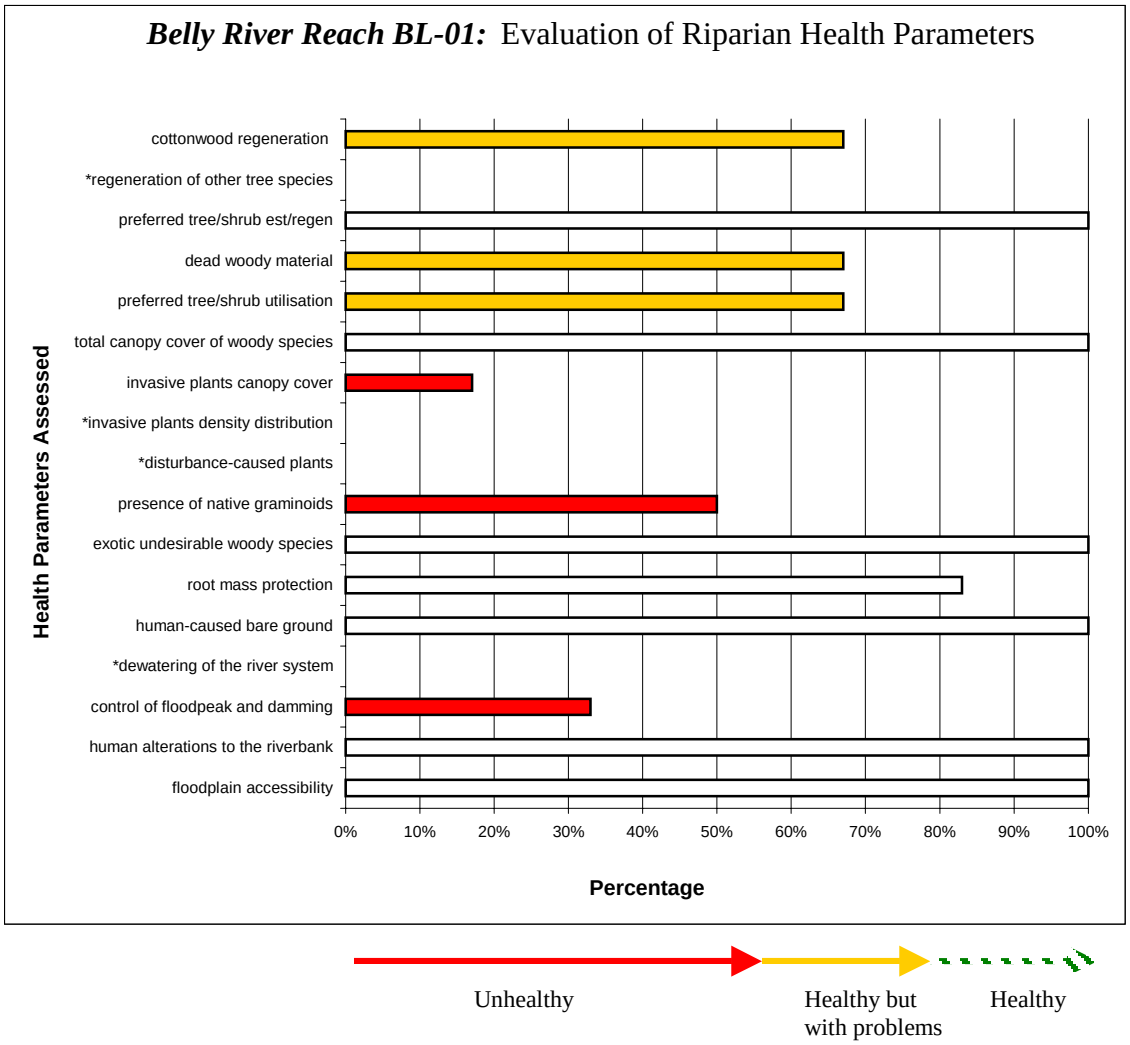
Alberta Environment Reach: Waterton River confluence to the confluence with the Oldman River (BL-01)

- **One of the polygons in this reach scored in the healthy but with problems category and the other polygon rated unhealthy.** The overall assessment of riparian health for reach BL-01 of the Belly River project area is as follows:

  - Of the 2 polygons assessed: 0% (0/2) are *healthy*,
    50% (1/2) are *healthy but with problems*,
    50% (1/2) are *unhealthy*.

Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure BL7. Breakdown of riparian health results for 17 parameters assessed for Belly River reach BL-01.

** Regeneration of other tree species does not register on this graph because there were no other trees species present, therefore this parameter was not assessed. Invasive plants density distribution, disturbance-caused plants and dewatering of the river system do not register on this graph because these parameters scored 0%.*

Historic and Present Influences on Riparian Health: Reach Comments

The majority of the land use in this reach is grazing, followed by undeveloped lands, and then areas of cropping and development.

This reach is located downstream of the confluence with the Waterton River and therefore the Waterton Dam is altering the flow of the water entering the Belly River.

Riparian Plant Communities

- 2 plant communities were identified, with total woody plants covering 88% of the reach. Cottonwood regeneration is excellent in one of the sites and poor in the other, with excellent regeneration and establishment of preferred shrub species in both sites. Browse utilisation of preferred trees and shrubs is light overall. There are normal amounts of dead and decadent branches at one of the sites, however at the other site there is moderate additions to dead and decadence in the woody plant community
- There is considerable coverage of invasive species, with invasive plants occupying 1%-15% of one site and greater than 15% of the other. There is also concern with the distribution of invasive plants, as they are widely spread throughout the reach in continuous occurrences with a few gaps in their distribution. Disturbance-caused plants are covering more than 50% of the assessed area and are reducing the amount of area occupied by native grasses, particularly at one of the sites. Native grasses are still reasonably prominent at the other site covering 25%-50% of the area.

Physical Characteristics and Hydrologic Parameters

- Human-caused bare ground and structural alterations are occurring within this reach, however their impacts are minimal and do not impact riparian health. Grazing, and to a lesser degree vehicle trails, are contributing to these limited bare ground and bank alterations. Riverbank root mass protection is good to excellent, and results from the extensive woody plants along the banks.
- Similar to the upstream reaches, water withdrawals are significant and are negatively influencing riparian health ratings. The Waterton Dam is altering the natural flow of Waterton River, which is emptying into this reach. Therefore 25%-50% of the watershed upstream is controlled by dams. Currently, there are no structures along the area assessed in this reach restricting floodwaters from accessing the floodplain.

Opportunities and Options for Improvement: BL-01

Trees and Shrubs

- Because of the differences in the two polygons assessed, it is difficult to generalise about the tree and shrub community. One site has excellent regeneration, normal dead/decadence and light utilisation, so maintaining riparian health with existing management may be very realistic.
- The other site has poor regeneration of cottonwoods, high levels of dead/decadence, and yet light browse, high levels of woody plant cover and excellent shrub

regeneration. This site may be showing signs of limited tree and shrub health due to water withdrawal or peak timing modifications, but with the limited sample size, it is not possible to determine for certain. Monitor these sites, promoting grazing management continues to result in light levels of browse, and evaluate if regeneration and dead/decadence continue to be a concern.

Non-Woody Species

- Invasive and disturbance-caused plants collectively have a greater negative impact on riparian health than in the other Belly River reaches. Focus on weed control and grazing management using appropriate grazing strategies that promote rest, appropriate timing, and stocking rates, leading to improved native plant vigour. As with many of these reaches, human-caused bare ground is minimal, so some of the weed concerns may be related to naturally occurring bare soil opportunities for weed establishment, availability of seed sources upstream, up slope, and perhaps historic/past human alterations to the sites.

Physical Characteristics and Hydrologic Parameters

- Maintain minimal human-caused structural alterations and human-caused bare ground due livestock with appropriate distribution, timing and stocking rates.
- Monitor current extensive water withdrawals to determine if riparian plant communities are being sustained, since one site is potentially showing some signs of concern, which may be linked to volume of discharge and/or damming. With extensive withdrawals and impacts due to damming, tree and shrub community maintenance may be at risk. Consider providing additional flows or modified peak and timing to increase likelihood of long-term maintenance and establishment of riparian plant communities.

ST. MARY RIVER PROJECT AREA

The project area is a selection of riparian areas along the St. Mary River from the international boundary (U.S.A./Alberta) to the confluence with the Oldman River (refer to project area map – Figure 3). This amounts to a distance of approximately 147 km, of which 9.6 km was sampled at 6 polygons (Table SM1, Appendix SM13).

Riparian areas in the examined sites were up to 400 m wide, with a wide range in maximum widths (20 m to 400m). Riparian area width was on average 71 m (Appendix SM13). (Note: as per riparian health inventory methodology, sites examined only include one side of the river). The river was not incised (Appendix SM12). Diverse vegetation is dominated by native species, although both invasive herbaceous and disturbance-caused plants are widespread, limiting native graminoid communities. There were no invasive tree species found in the project area. Balsam poplar/herbaceous (*Populus balsamifera/herbaceous)* CT covers the largest portion of the project area (Appendix SM7). Narrow-leaf cottonwood was the most abundant tree species.

WHAT DID WE FIND?

- **The level of interest in the project was low.** Many of the landowners were cautious when considering participation in the project. Generally, those landowners who participated showed interest in determining the health of the riparian area. Thanks to everyone who allowed access to their land and supported this riparian inventory initiative. In all, 6 polygons were assessed along the St. Mary River in 2004 (Appendix SM1).

- **There are concerns with the overall health of this riparian area.** No sites were rated as healthy, with two thirds of the polygons rating non-functioning in relation to the guidelines within the inventory protocol (Appendix G9). The overall assessment of riparian health for the St. Mary River project area is as follows (Figure SM1, Appendix SM1);

  - Of the 6 polygons assessed: 0% (0/6) are *healthy*,
    33% (2/6) are *healthy but with problems*,
    67% (4/6) are *unhealthy*.

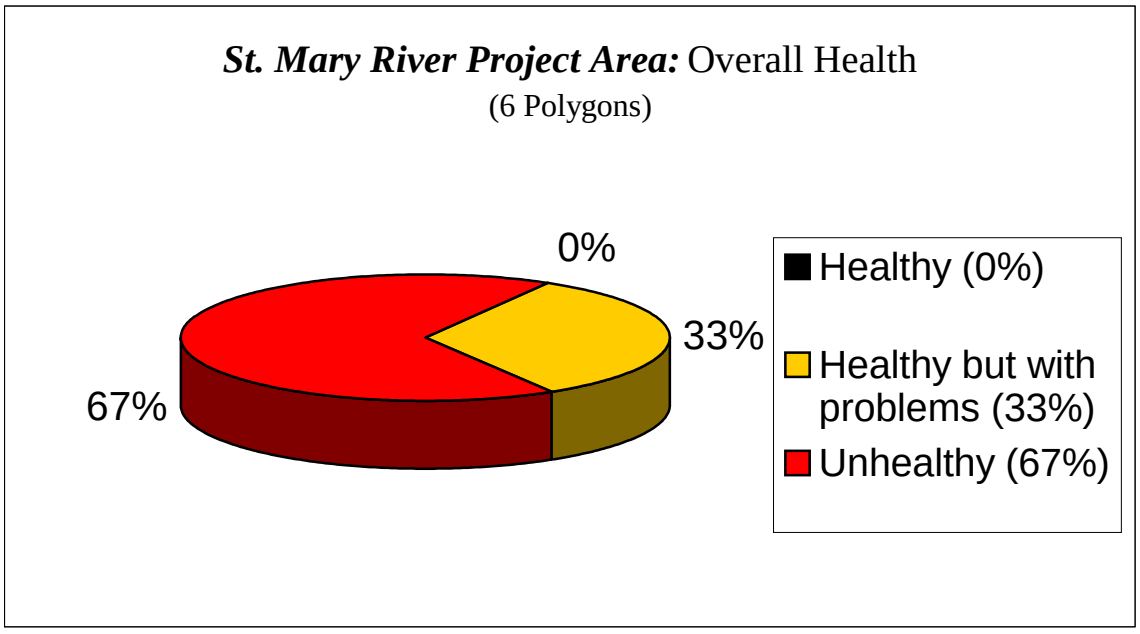


Figure SM1. Overall health of the St. Mary River Project Area.

  - Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of the entire St. Mary River watershed, but give an overview of health of the riparian areas within the watershed.

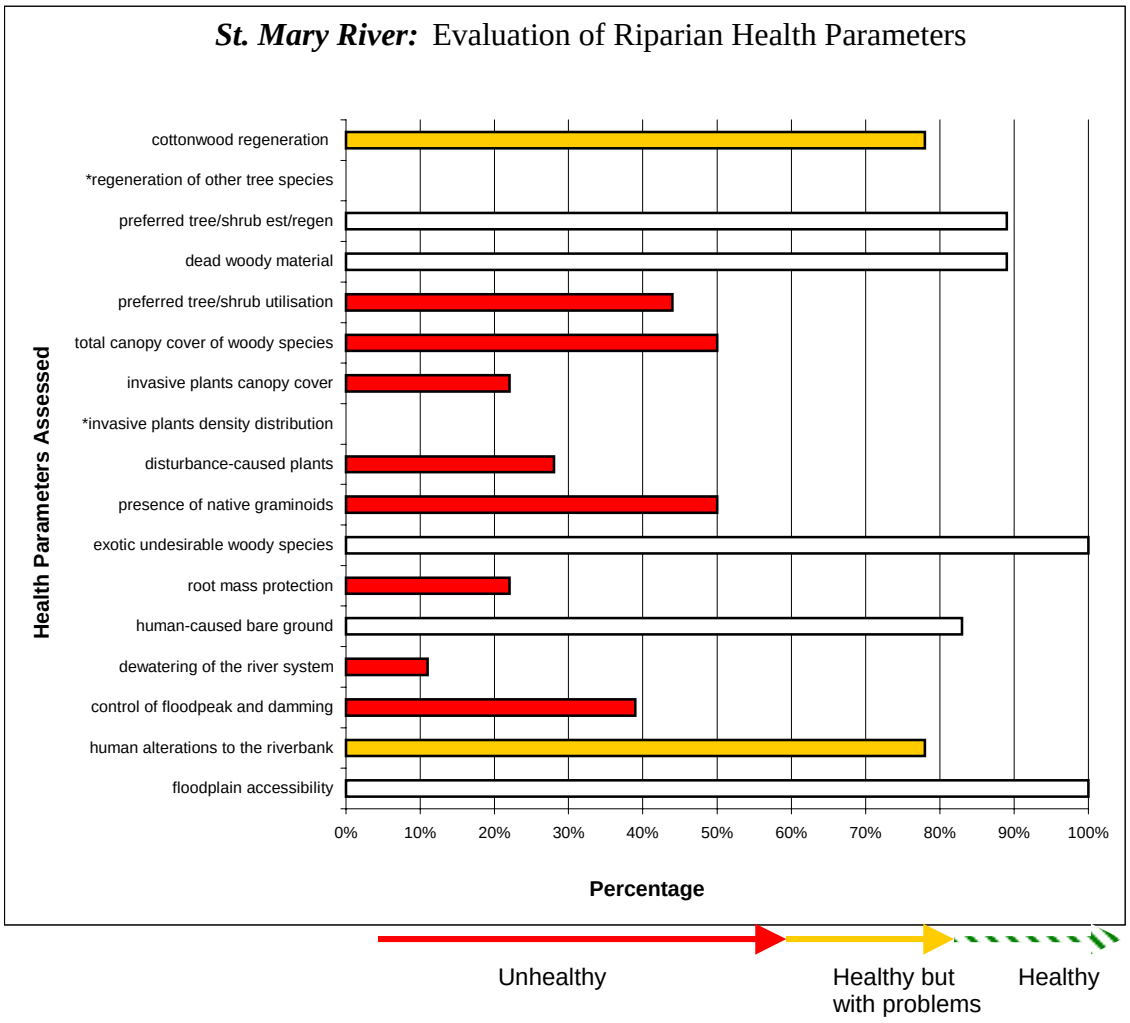
Remember: *We encourage users of the report to recognise the value of this report in broad-scale planning and identifying types of management and education approaches to take in the entire watershed--**this is not a finger pointing exercise; it should be used as part of an awareness process that maintains or improves management.***

Table SM1. Summary of Riparian Health Work –St. Mary River

Year	River	# Landowners Contacted	# Landowners Participated	# Polygons Assessed	River Distance Assessed (km)
2004	St. Mary River	**8**	**5**	**6**	**9.6**

RIPARIAN HEALTH DISCUSSION

For a description of how the parameters of riparian health are impacted by human disturbances and the overall affect on riparian health refer to *A Closer Look At The Riparian Health Pieces* in the overall summary of the South Saskatchewan River Basin.



Unhealthy	*(<60%)* Impairment to riparian health parameter due to human or natural causes.
Healthy but with problems	*(60-79%)* Some impairment to riparian health parameter due to human or natural causes.
Healthy	***(80-100%)*** Little or no impairment to riparian health parameter.

Figure SM2. Breakdown of riparian health results for 17 parameters assessed for the St. Mary River project area

***Invasive plants density distribution** does not register on this graph because this parameter scored 0%.*

Regeneration of other tree species does not register on this graph because there were no other tree species other than cottonwoods found in the project area; therefore this parameter was not assessed.

For an overview of the limitations of riparian health assessments refer to the section titled *Data Limitations*.

Historic and Present Influences on Riparian Health

The following discussion provides some insights regarding the current status of the health of riparian areas within the project area.

- **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 and horses (particularly in early settlement), bison provided the greatest seasonal grazing pressures on riparian areas within the project area (Alberta ECA 1977). Currently, livestock grazing continues to a dominant land use potentially influencing riparian health along the St. Mary River (Table SM2, Appendix SM10). Some parameters of the riparian health evaluation on grazed sites may be influenced by grazing, such as preferred tree and shrub utilisation and increases in non-native, disturbance-caused herbaceous species.

- **Cropland cultivation** is a very small proportion of the reaches, but recent past and historic cultivation, both near the river, as well as in the uplands, have likely increased presence of disturbance-caused undesirable plants within these riparian areas. Cultivation may also have reduced cover of trees and shrubs in riparian areas due to clearing and tilling of soil.

- **Availability of water.** Water diversion and consumption are affecting the overall health evaluation of the St. Mary River to a significant degree, with over 80% of annual discharge removed from both of the lower reaches. In addition, the St. Mary Dam is a large modifier of peak and timing of flow at two thirds of sites. Cover of woody species is lower where dewatering and damming are high; there may be a loss of woody plant communities due to hydrologic regime changes, or resulting in combination with grazing impacts. Potential long-term implications of reduced water volumes and changes in peak or timing on the riparian area include: reduced opportunities to establish new cottonwoods, insufficient recharge of floodplain moisture and loss of riparian vegetation. Demand for water at least over the past few decades may be putting the river under stress.

- **Overall watershed activity,** including activities in upstream rivers and streams, such as agriculture, industrial development, timber harvest, urbanisation and damming or water extraction may influence delivery rate of water into the St. Mary River.

Depending on the extent and intensity of these activities, there may be an impact on the quantity and quality of water reaching the river, as well as levels of sediment and increased potential for introduction and invasion of disturbance or invasive species, due to bare soil and increased risk of seed transmission.

Table SM2. Land uses along the St. Mary River Project Area

AENV Reaches for South Saskatchewan River	**Land Uses (% of reach based on length)**			
	Grazing	***Cropping***	***Developed***	***Undeveloped***
SM-01	92	3	0	5
SM-02	72	5	1	22
SM-03	85	11	0	4
Total	81	6	1	12

Refer to the section titled *Riparian Plant Communities-Why are they important?* for an overview of why understanding the riparian plant communities is important.

Riparian Plant Communities

Within the St. Mary River project area:

- All polygons examined are identified as having the potential to grow trees and shrubs, including preferred tree and shrub species, although trees other than cottonwoods are absent.
- 5 different plant communities were identified.
- Shrubs occupy under 7% of the project area and trees occupy 39% of the project area.
- A total of 3 tree community types were found, all of which were poplar or cottonwood (*Populus*) community types.
- Graminoids occupy 77% of the project area.
- A list of all plant species found in the project area is available in Appendix SM3. Additional plant community and habitat type information can be found in Appendix SM7. Refer to Appendix SM4 for a complete listing of plant species observed within each polygon.

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

Overall cover by trees and shrubs is moserate along this river with only 43% of the areas assessed covered by woody species. Balsam poplar (*Populus balsamifera*) and narrow-leaf cottonwood (*Populus angustifolia*) are common; these species are excellent for stabilizing and protecting the riverbank from erosion due to their deep binding roots.

Presence

- 3 tree species and 22 shrub species were recorded within the St. Mary River project area.
- The total area covered by shrub species (7%) is significantly lower than the area occupied by trees (39%).

The presence of trees along the riverbanks provides strength in these areas and aids in protecting the banks from erosion. The presence of shrubs in the understory of the tree communities builds up habitat layers, adding to the protection along the banks as well as providing habitat sought after by wildlife and livestock. With lower coverage of woody plants, riverbank root mass protection is also limited.

Reproduction

- Currently there are a few areas where the reproduction of *preferred* trees and shrubs is of concern.
- 4 of 6 polygons (67%) along the St. Mary River had at least 15% of cottonwood cover within the polygon provided by established seedlings and saplings. One of the sites had 5-15% cottonwood cover provided by seedlings and saplings. The remaining site had less than 5% cottonwood cover provided by seedlings and saplings.
- There were no tree species other than cottonwoods found along the St. Mary River at the sites examined.
- Overall, there was good regeneration of shrub species along the river, with only one site of concern; here there was less than 1% of the shrub cover provided by seedlings and saplings. The remaining polygons had over 5% of the shrub cover provided by seedlings and saplings, which is positive.

Health

- Most of the existing tree and shrub communities show normal amounts of dead and decadent branches in the upper canopy, except two sites, in the most upstream reach, that have minor additional components of dead or decadent branches (5-25% of the total canopy cover of woody species). Low levels of dead and decadence throughout woody communities indicate there is generally sufficient moisture within the system to maintain existing plants, and that disease is not a problem in maintaining these communities.
- There are concerns with the overall health of shrubs.
    - 16% of the shrub canopy cover is comprised of four grazing-resistant shrubs snowberry/buckbrush, *(Symphoricarpos occidentalis),* silverberry (*Elaeagnus commutata*), prickly rose (*Rosa acicularis*) and common wild rose *(Rosa woodsii)*.

The remaining 84% of the shrub communities are comprised of *preferred*[18] shrub communities (including 1 willow community). The grazing-resistant shrubs are native, but increase with long-term heavy levels of grazing, masking the concomitant loss of preferred trees and shrubs.

- At half of the polygons, preferred trees and shrubs species are receiving moderate (1 of 6) to heavy (2 of 6) browse pressure from livestock (to a lesser degree wildlife).
- Regeneration and establishment is excellent at all but 1 site, which has poor regeneration.
- The indicators of heavy browse pressure are umbrella-shaped mature shrubs and flat-topped or hedged seedling and saplings. Successful reproduction and establishment of the present trees and shrubs will maintain these stands and promote riparian health.

Non-Woody Riparian Plants: Diversity and Health

Diversity

- 35 species of grasses and grass-like plants (graminoids) and 87 species of broad-leaved plants (forbs) were recorded within the St. Mary River project area.
- All polygons along the St. Mary River had native grasses present in the riparian area; however, in all of the polygons, there is room for improvement. We expect at least 50% of the riparian area to be covered by native grass species to have a full riparian health rating. In half of the polygons (3 of 6) native grasses cover between 25-50% of the riparian area. The other half of polygons had a much poorer representation of native grasses with only 5%-25% of the riparian covered by native grasses.
- 46% (60 species) of the non-woody riparian plants recorded are native plants. Native plants have deep root systems necessary for binding the soil and these plants are also an important source of forage for both livestock and wildlife.
- 6 poisonous plant species: common horsetail (E*quisetum arvense*), early yellow locoweed (*Oxytropis serica*), showy locoweed (*Oxytropis splendens*), seaside arrow-grass (*Triglochin maritima,)* showy milkweed (*Asclepias speciosa*) and Indian hemp (*Apocynum cannabinum*) were recorded within the project area but their overall presence is not of concern because they were not abundant.

Health

- 33% of the project area is occupied by disturbance-caused plants (grasses and forbs). Of the 26 disturbance-caused plants present, the most prevalent are Kentucky bluegrass (*Poa pratensis*) and smooth brome (*Bromus inermis*) [19].

[18] native, palatable shrubs (willows, red-osier dogwood etc.) that are good indicators of riparian health

[19] Smooth brome and quack grass are tame or introduced species that have invaded or been introduced into many native lands over the past decades. These species reduce long-term productivity and stability, because they do not have deep-binding roots.

- Disturbance-caused undesirable plants are abundant throughout the St. Mary River project area. 33% (2 of 6) polygons have between 5-25% of the riparian area covered by disturbance species, one site has 25%-50% of the riparian area occupied by disturbance species, and more significantly, the remaining half of polygons have over 50% of the riparian area covered by disturbance-caused species. Disturbance-caused plants typically do not have a deep, binding root mass and therefore do not provide streambank protection as well as non-disturbance native species. Refer to Appendix SM5 for more information regarding the area covered by disturbance plant species within each of the sites.
- The abundance of disturbance-caused plants has put pressure on native plant communities and has resulted in decreases in the amount of coverage provided by native plants.
- Invasive species are abundant throughout the St. Mary River project area and their prevalence is a concern.
- 50% of the polygons have more than 15% of the project area covered by invasive species. Leafy spurge (*Euphorbia esula*), Canada thistle (*Cirsium arvense*), common hound's tongue (*Cynoglossum officinale*), ox-eye daisy (*Chrysanthemum leucanthemum*), tall buttercup (*Ranunculus acris*), downy chess (*Bromus tectorum*), cleavers (*Galium aparine*) and perennial sow thistle (*Sonchus arvensis*) are the invasive weeds found in the project area.

Physical Characteristics of Riverbank and Floodplain

Human-Caused Bare Ground and Alterations to the Riverbanks

- Overall, 8% of the inventoried bank length of the St. Mary River has alterations from human causes. 83% (5 of 6) of the polygons had some level of alterations occurring along the riverbank.
- Most of the polygons (4 of 6) had less than 10% of the bank length altered-this is positive. However, within reach SM-02, one polygon had moderate levels of alterations, with structural impacts occurring along 10-25% of the bank length. The other polygon had more than 50% of the riverbank altered by human causes, impacting riparian health.
- Livestock activity (hoof shear, trailing) and roads are the causes of alterations along the St. Mary River banks (Appendix SM8).
- Exposed soil surface or bare ground due to human causes has created minor impacts in the polygons along the St. Mary River. Human-caused bare ground occurs in all polygons, but the majority of sites (4 of 6) had less than 5% of the riparian are impacted. In one of the remaining two sites, bare ground impacts a moderate area (5-25% of the riparian area). In the other site, human-caused bare ground is more severe and is impacting 25%-50% of the riparian area. The majority of the human-caused bare ground present is due to roads and livestock activity (Appendix SM9).

Riverbank Root Mass Protection

There are concerns with riverbank root mass protection along the St. Mary River. Half of the sites have less than 35% of the bank protected by deep, binding roots. 2 of 6 sites have 35-65% of the bank protected by deeply rooted vegetation and 1 site 65%-85% of the bank protected by deeply rooted vegetation. No sites have over 85% of length well protected. Appendix SM14 outlines the bank materials within each of the sites inventoried on the St. Mary River.

Hydrologic Characteristics

Dewatering of the River System

- Artificial removal of water from river systems can negatively affect bank stability, wildlife habitat, establishment and success of woody plants and overall riparian function.
- Along the St. Mary River there are concerns with the amount of water that is removed or diverted.
- On all of the polygons, significant volumes of water are removed from the average annual river flow. One third of the polygons are experiencing 25-50% removal of the average river discharge and the remaining two thirds are experiencing significantly more than 50% removal of the average river discharge.

Control of Flood Peak/Timing by Upstream Dams

- Dams upset the natural flow patterns of river systems, removing water and adjusting the timing of flood events. These changes to natural flow patterns impact riparian vegetation as well as bank rebuilding and ground water recharge.
- Within the St. Mary River watershed there is one dam located on the St. Mary River impacting riparian health (St. Mary Dam).
- 4 of 6 polygons are impacted by upstream damming, with 1 site having between 25-50% of the watershed upstream controlled by dams and 3 sites more heavily impacted by damming, with over 50% of the watershed upstream controlled by the dam (Appendix SM1).

Floodplain Accessibility

- The construction of berms, levees and roadbeds along rivers sometimes prevent flood events from accessing the entire floodplain. Flood events are necessary for rebuilding banks, recharging ground water reserves and dissipating flood energy.
- Along the St. Mary River, floodwaters have access to more than 85% percent of the floodplain in all of the polygons (6 of 6). This is the minimum amount considered required to maintain riparian functions related to this parameter.

St. Mary River Riparian Health Overview: Summary

Riparian health of the areas examined along the St. Mary River is low. Only the upper reach (SM-03) rates, based on the average of two polygons, as healthy, but with problems. Both lower reaches rate as unhealthy (likewise based on averaging two polygons). There are significant losses to riparian health in vegetative parameters as well as physical and hydrologic parameters.

The observations below are provided as an overview that will assist in general management or monitoring planning. More detailed or specific use of the information should be done at the reach and polygon level, with a clear understanding of site or localised health status.

A number of parameters showed a trend in health as distance from headwaters increased:

Vegetation:

- Decadent and dead woody material (scored lower in the upper most reach)
- Cover of woody species higher in headwaters reach
- Invasive species canopy cover (less cover in upper most reach)
- Native graminoid cover higher in headwaters reach

Physical/Hydrological:

- Dewatering (diversion of natural flow) is considerable throughout, but better (lower) in the upper most reach
- Damming - control of peak and timing is least in the upper most reach

Some parameters of riparian health were similar, regardless of location along the river system:

- Preferred shrub regeneration (excellent at all but one site)
- Invasive species density distribution (extensive at all sites)
- Exotic, undesirable woody species (healthy at all sites)
- Floodplain accessibility (good throughout)

There were no clear trends in these riparian health parameters as distance from headwaters increased:

- Cottonwood regeneration
- Utilisation of preferred trees and shrubs
- Disturbance species canopy cover (generally rated poorly)
- Human-caused bare ground
- Proportion of banks protected with deep-binding roots
- Human alterations to the structure of riverbanks

Limitations of the Data

Refer to Data Limitations.

St. Mary River: Opportunities and Options for Improvement

Grazing management may be influencing establishment and regeneration of preferred trees and shrubs or woody canopy cover at some sites, particularly those with moderate or high utilisation, but this link is not consistent. For instance, at one site where heavy utilisation exists, there is excellent regeneration of all trees and shrubs, but lower cover of woody species. Conversely, at two sites with only light browse, there is lower cover of woody species but excellent preferred shrub regeneration, and one site has slightly reduced cottonwood regeneration while the other is still excellent. Because these relationships between potential grazing use and woody plant communities are not very clear, it suggests that historic and recent past use as well as water management may be playing a role in the present riparian health. As with all the river systems examined, the small sample size makes generalizations and clear relationships difficult to establish.

Because grazing is the dominant land use of the polygons examined, and of the reach as a whole, sustainable grazing management should be a key focus of local level management efforts. Grazing management that uses non-native grasses when most palatable, while resting native grasses should promote improvements in the herbaceous plant community.

Invasive species were widespread and relatively abundant, with more than 10% of the assessed area covered by invasive weeds. Reduce the presence of invasive plants and aim to prevent further invasion with a combination of weed control measures and grazing strategies that consider rest, distribution, timing and stocking rates; both will be required to prevent human-caused bare soil and promote native plant vigour. Disturbance resulting from traffic, recreation or development (eg. gravel extraction) also requires weed control and monitoring. Keep human-caused bare ground and structural alterations to the banks to a minimum, and reduce any future land use impacts with careful management. These actions, combined with grazing management, will help reduce disturbance-caused and invasive establishment and spread.

Promote and support livestock grazing strategies that keep or lead to preferred tree and shrub utilisation at light, and occasionally moderate, levels, to benefit establishment of seedlings and saplings, by allowing increased plant growth and vigour. Avoiding use in sensitive periods (i.e. when graminoids and forbs have reduced palatability or are limited in quantity) will promote woody plant growth, while minimising livestock browse. Additional rest to sites will promote native trees, shrubs, and native graminoids.

Physical impacts from grazing and roads (human-caused bare ground and bank structural alterations) are present, but generally minor overall. The site with the greatest area of human-caused bare ground was impacted primarily by gravel removal from within the channel and road building.

Impacts on riverbank integrity were only negatively affecting the health at two sites, both due to livestock grazing. Preventing industrial activities within the channel and floodplain will minimise not only physical alterations, but also reduce spread and opportunity for establishment of invasive species (see above). In grazing situations, avoid using these areas during moist soil conditions to minimise compaction of soil.

Cottonwood and preferred shrub regeneration is lowest in the upper reach (SM-03), where dewatering is high, but where no damming occurs. Where loss of river flow is between 2 and 2.5 times greater than SM-03 and extensive damming of the watershed is occurring (i.e. SM-02 and SM-01), regeneration is good to excellent. This, examined alone, would suggest that preferred tree and shrub regeneration is not negatively impacting woody plant communities. When we look at total canopy cover provided by woody plants (trees and shrubs combined), there are some potential concerns. The highest, but still reduced, ratings for woody plant cover occur in the headwater reach (SM-03). In the lower two reaches, there is considerably less total woody plant cover within the riparian area. This may suggest that although at present there are still seedlings and saplings establishing, over time there has been a loss in the total cover of woody plants compared to what we would expect at these sites. This low cover may be linked to one or both of dewatering and damming; woody plant cover rated its lowest where these two hydrologic parameters are also rated the lowest.

Results from this work suggest there are potential concerns with riparian health due to extensive loss of flow and damming of these watersheds. There appears to be a linkage between low cover of woody plants and increased hydrologic alterations, which are not necessarily mirrored in regeneration of preferred tree and shrub species. Changes in the woody plant community are more readily examined compared to the herbaceous plant community. Although there is no way to separate grazing impacts (long or short-term) from results of changes in hydrologic regime with the limited sampling in this project, there are more disturbance caused plants present where loss of water flow and increased damming has occurred. Further work needs to be done to determine if or how these hydrologic parameters impact the herbaceous plant community.

Some improvements to the plant community should be attainable with grazing management, but disturbance and seed or plant material from upstream or upslope make significant improvements in disturbance and invasive plant communities much more challenging. Improvements in volume of flow and changes in flow peak and timing could be made that would certainly be expected to assist in the establishment and maintenance of riparian plant communities, particularly for trees and shrubs.

St. Mary River Reach Overview

The reaches along the St. Mary River are summarized starting from the international boundary (U.S.A/Alberta) to the confluence with the Oldman River (SM-01) (Table SM3). In most polygons, over 1 km of river was assessed, with 9.6 km assessed for the project (Table SM4). Two thirds of the polygons examined (4 of 6) rated as unhealthy, with the remainder rating healthy, but with problems (Table SM5).

Table SM3. Alberta Environment (AENV) Reaches Boundary Descriptions – St. Mary River

AENV Reach	Upstream and Downstream Description
SM-03	International Boundary (U.S.A./Alberta) to the St. Mary Dam
SM-02	St. Mary Dam to 37 km upstream of the confluence with the Oldman River
SM-01	37 km upstream of the confluence with the Oldman River to the confluence with the Oldman River

Table SM4. Summary of St. Mary River Reaches – Sites

AENV Reaches for South Saskatchewan River	# Sites Assessed	River Distance Assessed (km)
SM-03	2	3.3
SM-02	2	2.4
SM-01	2	3.9
Total	6	9.6

Table SM5. Number of Reach Sites by Riparian Health Category – St. Mary River

Reach	Healthy	Healthy but with problems	Unhealthy
SM-03	0	1	1
SM-02	0	0	2
SM-01	0	1	1
Total	0	2	4

Table SM6. Land Uses along the St. Mary River Project Area

AENV Reaches for St. Mary River	Land Uses (% of reach based on length)			
	Grazing	***Cropping***	***Developed***	***Undeveloped***
SM-03	85	11	0	4
SM-02	72	5	1	22
SM-01	92	3	0	5

Table SM7. Summary of Plant Communities: Overall and Woody Communities – St. Mary River Reaches

Reach	# of Plant Communities	% of Area Examined with:	
		Tree Species	Shrub Species
SM-03	3	48	5
SM-02	3	0.5	14
SM-01	2	0.5	13

Community and habitat types are determined using Thompson and Hansen (2002). Refer to Appendix SM7 for a complete description of habitat and community types.

Table SM8. Summary of Plant Communities: Herbaceous Communities – St. Mary River Reaches

Reach	% of Area Examined with:		
	Grass Communities	Forb Species	Disturbance Species
SM-03	80	10	29
SM-02	50	63	46
SM-01	69	66	50

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

Reaches typically have from 2-3 tree species and lower diversity in the number of shrubs observed in the previous rivers with 10-16 different species found in each reach (Table SM9). The coverage provided by woody species diminishes significantly in the lower reaches below the St. Mary Dam. Regeneration of cottonwoods ranges from poor to excellent, and other trees are absent (Table SM10). There are minor additional to normal amounts of dead branches and dead standing trees in the woody plant canopy and utilisation/browse is variable, from heavy to nil (Table SM11).

Table SM9. Woody Plant Species Presence St. Mary River Reaches

Reach	# of Tree Species	# of Shrub Species	% of Reach Area that is Woody Species
SM-03	2	10	50
SM-02	2	16	17
SM-01	3	12	13

Refer to Appendix SM4 for a complete list of plant species.

Table SM10. Woody Plant Species Reproduction– St. Mary River Reaches

Reach	Cottonwood Regeneration (seedlings/ saplings)	Other Tree Species Regeneration (seedlings/ saplings)	# of Sites with seedlings /saplings >5% of total woody cover	Means for health…
SM-03	1 site excellent, 1 site poor	Not applicable, no other trees present	1 of 2	1 site excellent tree and shrub regeneration; 1 site poor tree and shrub regeneration
SM-02	1 site excellent, 1 site moderate	Not applicable, no other trees present	2 of 2	Moderate to excellent tree and shrub regeneration
SM-01	2 sites excellent	Not applicable, no other trees present	2 of 2	Both sites excellent tree and shrub regeneration

Refer to Appendix SM1 for a summary of river health survey scores.

Table SM11. Woody Plant Health – St. Mary River Reaches

Reach	Dead and Decadence	Utilisation of Preferred Woody Plants	Means for health…
SM-03	Minor	Moderate – Heavy	Fair
SM-02	Normal	Light	Good
SM-01	Normal	Nil- Heavy	Poor to Excellent

Non-Woody Riparian Plants: Diversity and Health

A wide diversity of herbaceous species was found, with 48 to 61 different graminoid species and 21-28 different forb species found throughout the reaches. The coverage of native graminoids was variable, with poor to good coverage in the areas assessed. Disturbance species are significant in a few of the sites and are negatively impacting health (Table SM13). Invasive plant species, while not covering significant areas, are sporadic and widespread throughout most reaches, and without appropriate management could infest much larger areas (Table SM14). Leafy spurge (*Euphorbia esula*) is the most common and widespread invasive plant, with numerous other species commonly found (Table SM15).

Table SM12. Non-Woody Riparian Plant Diversity– St. Mary River Reaches

Reach	Total # of Grass/ Grass-like Species	Total # of Forb Species	Proportion of site covered by native graminoids	Means for health…
SM-03	21	48	Both sites 25%-50%	Good
SM-02	27	61	Both sites 5%-25%	Fair
SM-01	28	56	1 sites 25-50%; 1 site 5%-25%	Fair to good

Table SM13. Non-Woody Riparian Plant Health - Proportion Disturbance Caused Undesirable Herbaceous Species– St. Mary River Reaches

Reach	% of Reach with Disturbance Plants	Disturbance Plants Cover	Means for health…
SM-03	29	1 site 5%-25%, 1 site 25%-50%	Variable, from moderate to widespread; of concern
SM-02	46	1 site 5%-25%, 1 site > 50%	Variable, from moderate to extensive; of concern
SM-01	50	Both sites >50%	Extensive; of concern

Table SM14. Non-Woody Riparian Plant Health - Proportion Invasive Plant Species– St. Mary River Reaches

Reach	# of Sites with Invasive Plants	Invasive Plants Cover	Density/ Distribution of Invasive Plants	Means for health…
SM-03	2 of 2	1 site moderate cover, 1 site low cover	Rare occurrence to several well spaced patches	Canopy cover and distribution of some concern
SM-02	2 of 2	2 sites high cover	Single patch plus few sporadically occurring plants to continuous dense occurrence of plants	Canopy cover and distribution/ infestation a concern
SM-01	2 of 2	1 site moderate cover, 1 site high cover	Rare occurrence to several sporadically occurring plants to continuous dense occurrence of plants	Canopy cover and distribution/ infestation a concern

Table SM15. Most Common Invasive Herbaceous Plant Species– St. Mary River Reaches

Reach	Species
SM-03	Canada thistle, common hound's tongue, leafy spurge, ox-eye daisy
SM-02	leafy spurge, Canada thistle, perennial sow-thistle
SM-01	Canada thistle, common hound's tongue, leafy spurge

Physical Characteristics of Riverbank and Floodplain

There is limited human-caused bare ground at most sites, with only one site having 25%-50% bare ground (Table SM16). Where it does exist, it is the result of grazing, road development and gravel extraction. Grazing and road development have altered the riverbank structure in 5 of 8 sites, with mainly minor impacts in most sites and one site where >50% of the bank length has been altered (Table SM17). Riverbank root mass protection, as assessed by the length of bank with deep-binding roots, is variable but mainly poor to very poorly (Table SM18).

Human-Caused Bare Ground and Alterations to the Riverbanks

Table SM16. Human-caused Bare Ground– St. Mary River Reaches

Reach	# of Sites with >5% Human Caused Bare Ground	Proportion of polygons covered by human-caused bare ground	Sites are…
SM-03	1of 2	1 site <5%, 1 site 25%-50%	Well to poorly vegetated
SM-02	1 of 2	1 site <5% 1 site 5-25%	Well to fairly well vegetated
SM-01	0 of 2	2 sites <5%	Well vegetated

Table SM17. Human-Caused Structural Alterations– St. Mary River Reaches

Reach	# of Sites with Human Caused Structural Alterations	# of Sites with Human-Caused Structural Alterations Along:				Banks are…
		< 10% of length	10-25% of length	25-50% of length	> 50% of length	
SM-03	2 of 2	2	0	0	0	Intact
SM-02	2 of 2	0	1	0	1	Variable: moderately altered to significantly altered
SM-01	1 of 2	2	0	0	0	Intact

Riverbank Root Mass Protection

Table SM18. Proportion of Riverbank with Deep Binding Roots— St. Mary River Reaches

Reach	# of Sites with Riverbank Rootmass Protection along:				Banks are…
	> 85% of length	65-85% of length	35-65% of length	< 35% of length	
SM-03	0	1	0	1	Variable, moderately to very poorly protected
SM-02	0	0	1	1	Variable; poorly to very poorly protected
SM-01	0	0	1	1	Variable, poorly to very poorly protected

Hydrologic Characteristics

Dewatering is considerable throughout all reaches (Table SM19). Floodplain access of floodwaters is excellent and unrestricted at all sites (Table SM21). The proportion of damming and modifications to peak flows and timing is impacting riparian health ratings in both of the lower reaches, due to the St. Mary Dam (Table SM20).

Dewatering of the River System

Table SM19. Dewatering of the River—St. Mary River Reaches

Reach	**Total use as a % of natural ***	**# of Sites with River Discharge Being Removed that is:**				**Impacts are…**
		< 10% of average	10-25% of average	25-50% of average	> 50% of average	
SM-03	36.9	0	0	2	0	Moderate
SM-02	84.9	0	0	0	2	Significant
SM-01	91.2	0	0	0	2	Significant

*Data provided by AENV. Note that only licensed and reported uses are included; unlicensed use is unknown.

Control of Flood Peak/Timing by Upstream Dams

Table SM20. Flood Peak and Timing Control by Dams— St. Mary River Reaches

Reach	**# of Sites with Control By Dams Upstream Affecting:**				**Number of Dams**
	<10% of watershed	10-25% of watershed	25-50% of watershed	> 50% of watershed	
SM-03	2	0	0	0	0
SM-02	0	0	0	2	1
SM-01	0	0	1	1	1

*Data provided by AENV. Includes dams on main stem rivers only.

Floodplain Accessibility

Table SM21. Floodplain Accessibility— St. Mary River Reaches

Reach	**# of Sites with Flood Water Access to:**				**Major Obstructions to Flooding**
	> 85% of floodplain	***65-85% of floodplain***	***35-65% of floodplain***	***< 35% of floodplain***	
SM-03	2	0	0	0	None
SM-02	2	0	0	0	None
SM-01	2	0	0	0	None

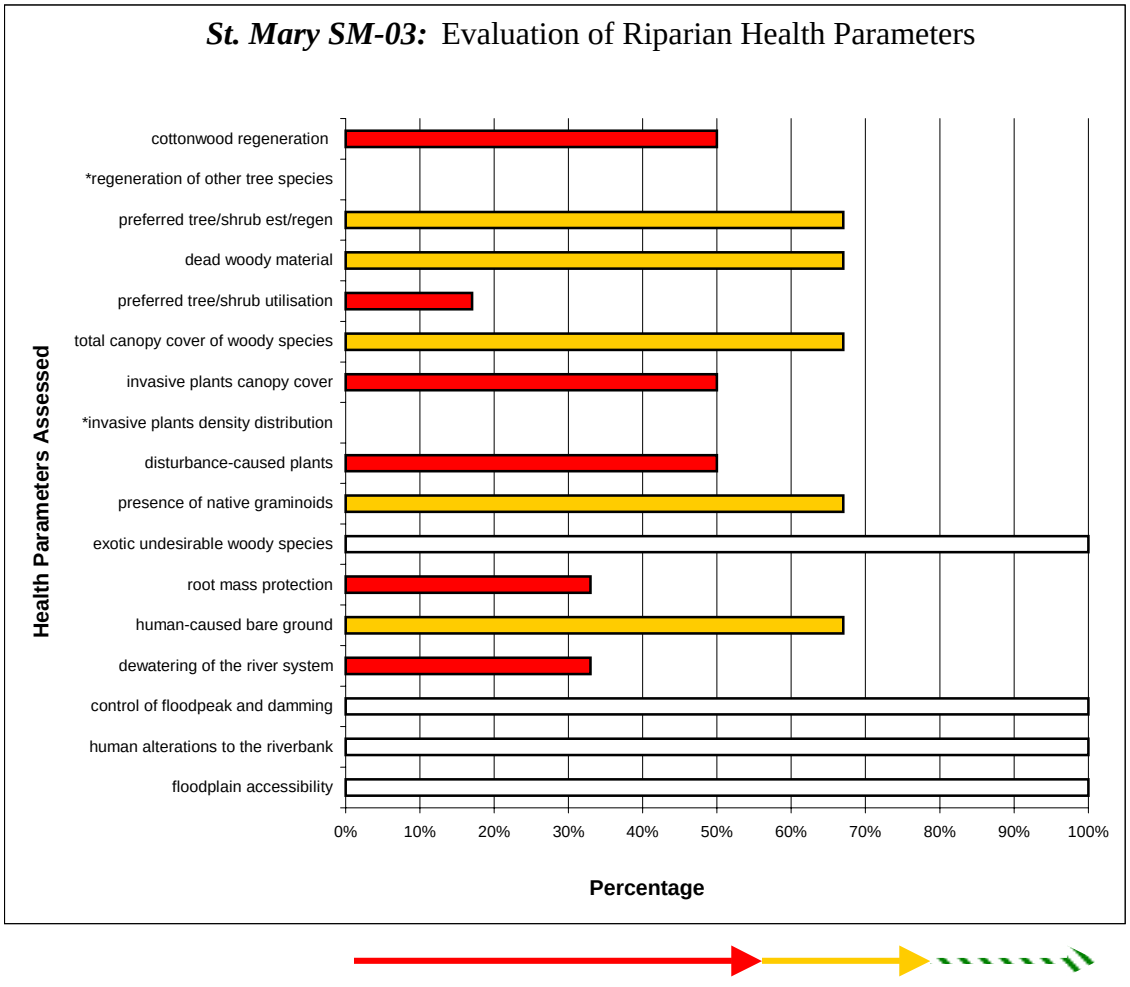
Alberta Environment Reach: International Boundary (USA/AB) to the St. Mary Dam (SM-03)

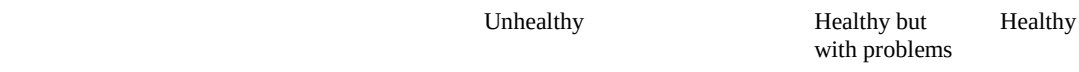
- **One of the polygons in this reach scored in the healthy but with problems category, the other is unhealthy.** The overall assessment of riparian health for reach SM-03 of the St. Mary River project area is as follows:

  - Of the 2 polygons assessed: 0% (0/2) are *healthy*,
    50% (1/2) are *healthy but with problems*,
    50% (1/2) are *unhealthy*.

Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION





Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure SM3. Breakdown of riparian health results for 17 parameters assessed for St. Mary River reach SM-03.
** Regeneration of other tree species does not register on this graph because there were no other tree species observed and therefore this parameter was not assessed. Invasive plants density distribution does not register on this graph because this parameter scored 0%*

Historic and Present Influences on Riparian Health

Currently, grazing is the dominant land use in this reach. A small proportion of the length was identified as cropping and as undeveloped. Water withdrawal is occurring from this section of the St. Mary River (25%-50% of the average river discharge) however it is not as severe as the reaches further downstream.

Riparian Plant Communities

- This reach has the best woody coverage (50%) of all the sections on the river. Shrubs have very minimal coverage (5%) with trees covering 48% of the area assessed. There is excellent cottonwood regeneration in one of the sites while cottonwood seedlings and saplings are absent from the other site. Preferred shrub regeneration is poor to excellent; there were only cottonwood trees observed. Utilisation on preferred trees and shrubs is moderate to heavy, and may be influencing regeneration. There are minor additional levels of dead and decadent standing woody plants in both sites.
- Canopy cover of invasive plants is not significant however the widespread distribution of these plants is of concern. Because of the distribution of invasive plants the risk of these species spreading and covering a large area is greatly increased. Disturbance-caused species are present; however they occupy a relatively small area (5%-25%) in one of the sites and have greater coverage (25%-50%) in the other. There is fairly good cover provided by native graminoids (25%-50%), which is important to prevent further spread of disturbance-caused and invasive species.

Physical Characteristics and Hydrologic Parameters

- Human-caused structural alterations are present and mainly due to livestock activity, however there is only a small area affected and they are not negatively

impacting riparian health. Human-caused bare ground occurs on both of the sites in this reach, but is significantly more prevalent at one of the sites. In this site, gravel removal and road construction has caused a large area of bare ground. Riverbank root mass protection is very poor to good and directly linked to the amount of deeply rooted trees and shrubs located along the banks.

- This reach is located upstream of the St. Mary Dam and therefore the natural flow has not been altered from damming. However, there is significant withdrawal of water from this reach with 25%-50% of the average river discharge removed for irrigation and consumption. The floodplain is fully accessible to floodwater within this reach.

Opportunities and Options for Improvement: SM-03

Trees and Shrubs

- Current browse levels may be impacting successful recruitment and maintenance of the tree and shrub community, in conjunction with limitations to seedling establishment and woody plant success that may result from impacts to water volume.

  Appropriate stocking rates, distribution, timing and rest in the growing season will assist preferred tree and shrub to increase. Monitor maintenance of woody plants under the current flow to determine long-term impacts on regeneration and maintenance.

Non-Woody Species

- Extensive disturbance-caused species and invasive plants suggest cumulative, longer term changes resulting from livestock, introduction of tame species, or perhaps some relationship to hydrologic parameters and past flood events (eg. creation of exposed soil and seed sources). Grazing strategies that promote increased native plant vigour should help slow or reduce expansion of these invasive and disturbance-caused species; weed control to reduce further spread of invasive species is important.

Physical Characteristics and Hydrologic Parameters

- Alterations to the bank are minimal, but result from livestock; continue to maintain these minimal livestock impacts to banks and soil using distribution tools, appropriate timing and stocking rates. Manage human-caused bare ground through livestock grazing (currently minor impacts) and gravel extraction or roads. Re-vegetation excavated area, or locating these areas further away from the river would be beneficial to riparian health. Improving the vigour and abundance of native plants is needed to improve the bank protection from deep binding roots.
- Significant water withdrawals in these areas may be impacting seedling recruitment and success, and altering long-term cover of woody plants. Monitor and modify based on reducing or minimising impacts to the tree and shrub community. Determine if the absence of non-cottonwood trees is influenced by alterations to hydrologic parameters. Prevent any damming from altering peak timing and flows

Alberta Environment Reach: St. Mary Dam to 37 kilometres Upstream of the confluence With the Oldman River (SM-02)

WHAT DID WE FIND?

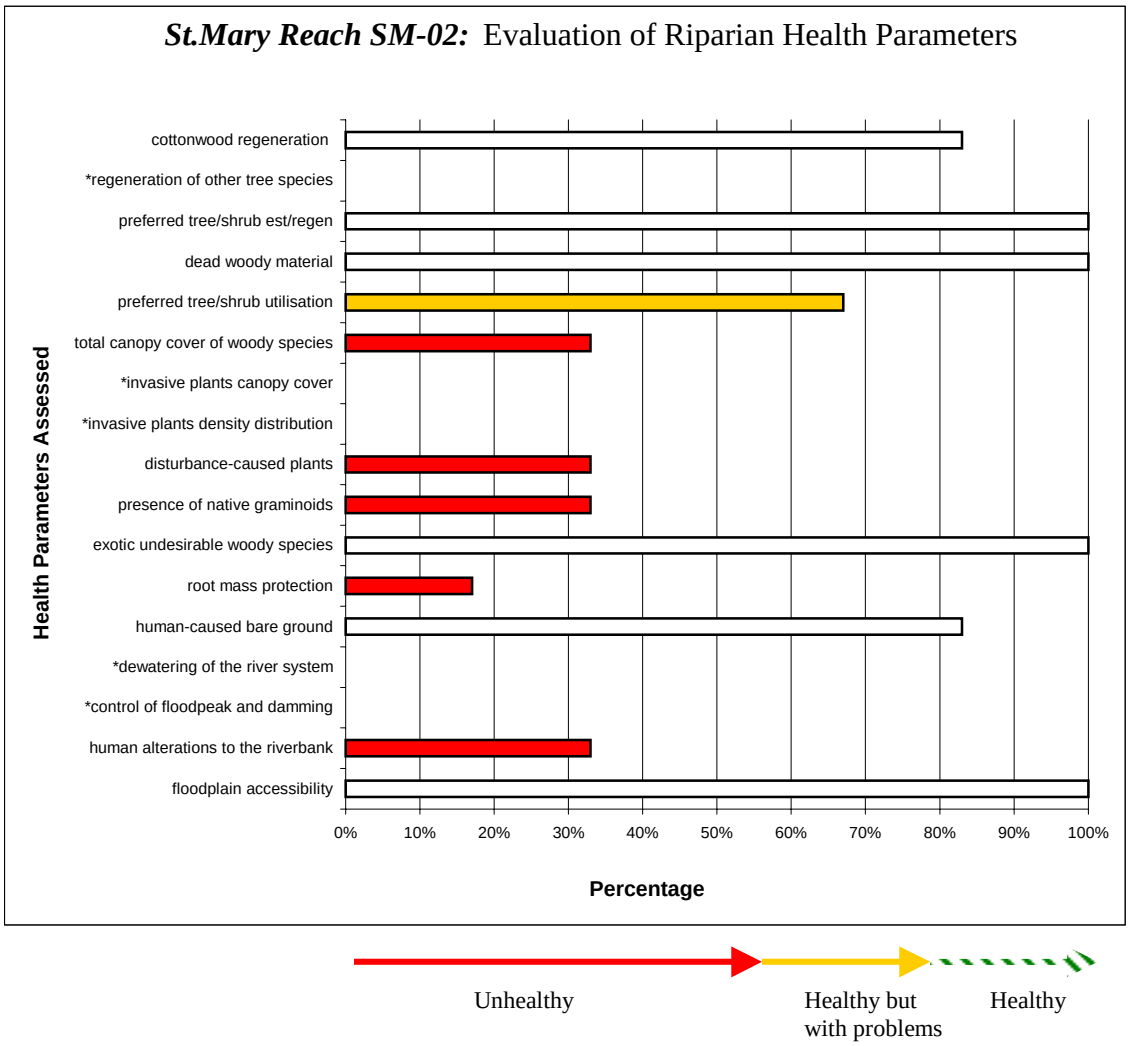
- Thanks to everyone who allowed access to their land and supported this riparian inventory initiative.

- **Both of the polygons in this reach scored in the unhealthy category.** The overall assessment of riparian health for reach SM-02 of the St. Mary River project area is as follows:

  - Of the 2 polygons assessed: 0% (0/2) are *healthy*,
    0% (0/2) are *healthy but with problems*,
    100% (2/2) are *unhealthy*.

Please note: due to the small number of polygons assessed these health ratings do not represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure SM4. Breakdown of riparian health results for 17 parameters assessed for St. Mary River reach SM-02.

** Regeneration of other tree species does not register on this graph because there were no other tree species observed. Invasive plant canopy cover and invasive plant density distribution, dewatering of the river system and control of floodpeak and damming do not register on this graph because these parameters scored 0%******

Historic and Present Influences on Riparian Health

Grazing is the dominant land use in this reach, however there is a significant portion of the reach that is undeveloped. Cropping and development influence minor portions of the reach. This reach is downstream of the St. Mary Dam, altering the natural flow pattern of the river and significant impacting riparian health.

Riparian Plant Communities

- The presence of woody species dramatically decreases in this reach, with only 17% of the area assessed covered by woody plants. Shrubs are more abundant than trees covering 14% of the area; trees barely occupy 1% of the area assessed. Cottonwood regeneration is fair to excellent and there is also excellent regeneration of preferred shrub species. Cottonwoods are the only trees present. The levels of decadent and dead standing woody plants are normal and overall utilisation of preferred woody plants is light.
- The canopy cover and distribution of invasive plant species is of concern with invasive species occupying more than 15% of the area of both sites. Disturbance-caused species are of concern in one of the sites with more than 50% of the area infested, but they are of minor concern in the other site. Native grasses are present; however the overall coverage of these species is poor.

Physical Characteristics and Hydrologic Parameters

- Human-caused structural alterations and bare ground are present throughout this reach but are more significant at one of the sites, where over 50% of the bank length has been altered by livestock activity. Riverbank root mass protection is poor to very poor, due to the combined low presence woody species and extensive invasive and disturbance-caused plants within this reach.
- Dewatering is negatively impacting riparian health ratings in this reach with more than 50% of the average river discharge removed from the system. The St. Mary Dam is also negatively influencing riparian health with more than 50% of the watershed upstream controlled by the St. Mary Dam. Removing water and adjusting the timing of flood events upsets the natural cycles of sediment deposition, ground water recharge and water availability for vegetative communities. There are no restrictions to floodwaters to access the entire floodplain in the areas assessed in this reach.

Opportunities and Options for Improvement: SM-02

Trees and Shrubs

- Regeneration of preferred trees and shrubs is good to excellent, but cover of woody species is low. Currently, with light levels of browse, grazing is likely only minorly contributing to loss of woody plants, since it is not reducing seedling and sapling cover. Past levels of use, if higher, may have contributed to reduced woody plant communities, but present levels should be sustainable.

Continue to ensure appropriate stocking rates, distribution, timing and rest in the growing season to assist preferred tree and shrub to increase. Monitor maintenance of woody plants under the current flow to determine long-term impacts on regeneration and maintenance.

Non-Woody Species

- Extensive disturbance-caused species and invasive plants suggest cumulative, longer-term changes resulting from livestock, introduction of tame species, or perhaps a relationship to hydrologic parameters and past flood events (eg. creation of exposed soil and seed sources). Grazing strategies that promote increased native plant vigour should help slow or reduce expansion of these invasive and disturbance-caused species. Such weed control to reduce further spread of invasive species is important. Recognise that elimination of disturbance species is unrealistic.

Physical Characteristics and Hydrologic Parameters

- Reduce or minimise livestock impacts to banks and soil using distribution tools, appropriate timing and stocking rates, allowing time for healing of structural impacts and bare soil, where they are occurring.
- Very extensive diversions of water (85% of annual flow) and significant levels of damming (over 50% of the watershed upstream) are likely a key reason that woody plant communities are not very extensive. Current livestock management does not seem to be preventing seedling or sapling establishment or impacting health by too heavy browse, so maintenance of these plants is likely limited by the current hydrologic regime. Prevent further loss to flow and changes to timing or peaks and consider providing a flow regime that will support both establishment and maintenance of woody plant communities. Low bank protection from deep rooted species puts the reach at risk for more extensive erosion and lateral cutting; promoting more appropriate levels of woody cover and deep rooted species along the banks is key to limit bank erosion.

Alberta Environment Reach: 37 kilometres upstream of the confluence with the Oldman River to the confluence with the Oldman River (SM-01)

WHAT DID WE FIND?

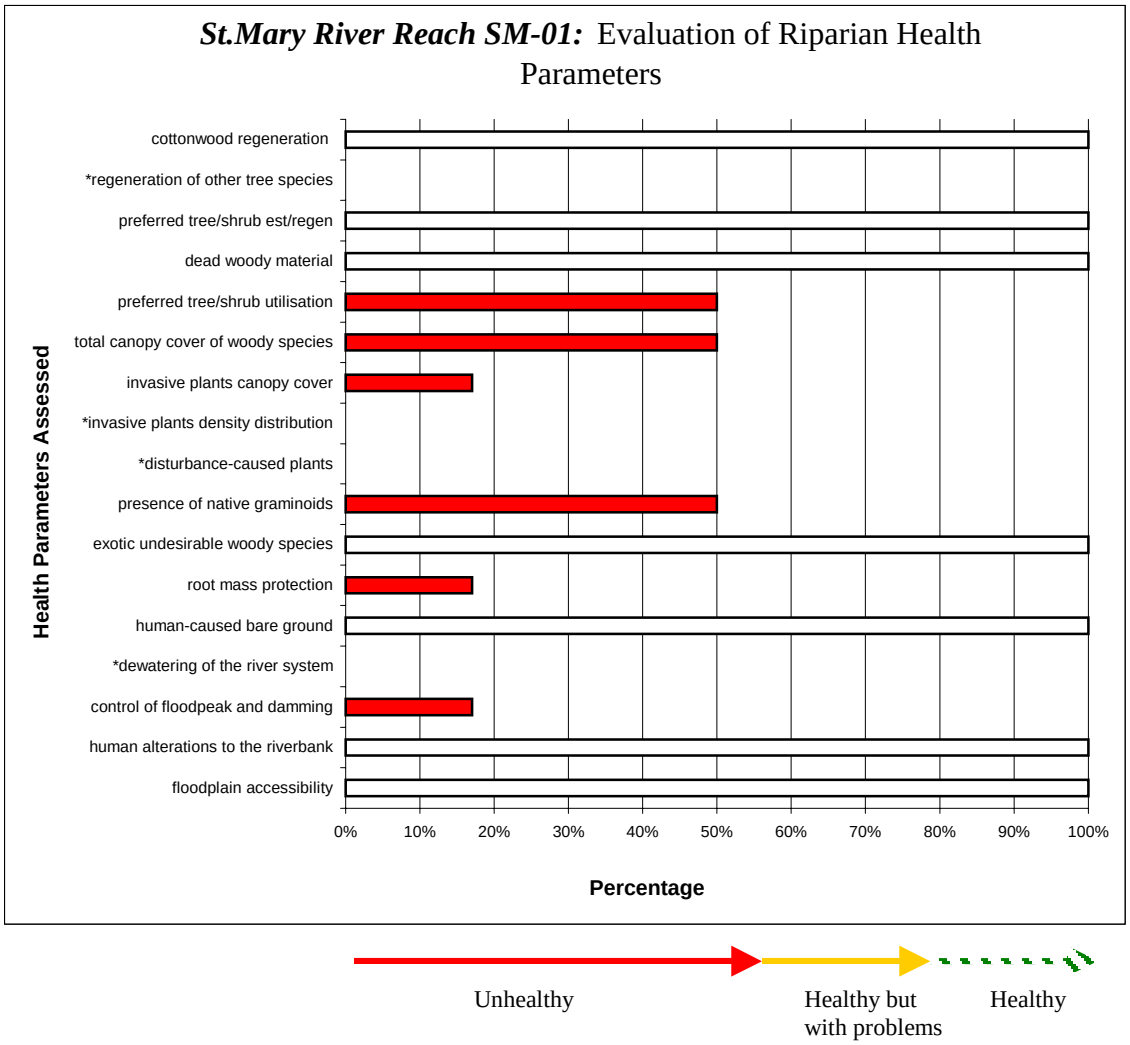
- Thanks to everyone who allowed access to their land and supported this riparian inventory initiative.

- **One of the polygons in this reach scored in the healthy but with problems category and the other polygon rated unhealthy.** The overall assessment of riparian health for reach SM-01 of the St. Mary River project area is as follows:

  - Of the 2 polygons assessed: 0% (0/2) are *healthy*,
    50% (1/2) are *healthy but with problems*,
    50% (1/2) are *unhealthy*.

Please note: due to the small number of polygons assessed these health ratings do not represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure SM5. Breakdown of riparian health results for 17 parameters assessed for St. Mary River reach SM-01.

Regeneration of other tree species does not register on this graph because there were no other tree species observed; therefore this parameter was not assessed. Invasive plants density distribution, disturbance-caused plants and dewatering of the river system do not register on this graph because these parameters scored 0%

Historic and Present Influences on Riparian Health

Currently, grazing is the dominant land use in this reach. Very small portions of the reach were identified as cropping and undeveloped. Water withdrawals and the St. Mary Dam are both influencing the health of riparian areas within this reach.

Riparian Plant Communities

- Woody plants continue to have little coverage, similar to the adjacent upstream reach, with total woody plants only occupying 13% of the area assessed. Trees have very little coverage (0.5%) and therefore shrubs make up the majority of the woody plant cover. Seedlings and saplings made up a significant portion of the cottonwood cover and therefore cottonwood regeneration was considered excellent. Cottonwoods were the only tree species observed in this reach. Preferred shrubs also have excellent regeneration within their communities, with normal levels of dead and decadence found throughout the woody plant communities. Utilisation/browse of preferred trees and shrubs is variable and ranges from nil to heavy.
- Invasive plants have significant cover of the riparian areas in this reach, 1%->15% and are occurring in large continuous patches with breaks in their infestations. Disturbance-caused species are covering 50% of the area assessed and are competing with the native species in the reach. Native grasses have moderate coverage of one of the sites and poor coverage of the other.

Physical Characteristics and Hydrologic Parameters

- Human-caused bare ground and alterations to the bank are minimal and at only one site; these minor changes to the polygon result from livestock activity. The amount of deeply rooted trees and shrubs along the riverbanks is inadequate and therefore the protection along these areas is poor to very poor, directly correlated to the lack of woody cover in this reach.
- Significant water withdrawals, removing more than 50% of the average river discharge are negatively impacting riparian health. The St. Mary Dam is also negatively influencing riparian health controlling more than 50% of the watershed upstream in one of the sites and 25%-50% of the other site. Withdrawing and withholding water reduces water availability for riparian plant communities. There are no obstructions along the river and flood water has full access to the entire floodplain.

Opportunities and Options for Improvement: SM-01

Trees and Shrubs

- Regeneration of preferred trees and shrubs is excellent, but cover of woody species is moderately low. Browse pressure is highly variable, from heavy to nil. Since seedling and sapling cover is appropriate, currently utilisation is likely not impacting regeneration. At the site with heavy utilisation, there is lower woody plant cover, compared to the site with virtually no browse.

Past levels of use, if higher, may have contributed to present day reduced woody plant communities, but present levels do not seem to be the primary cause of loss (due to healthy regeneration). Continue to ensure appropriate stocking rates, distribution, timing and rest in the growing season to assist preferred tree and shrub to increase. Current diversion and damming are likely limiting successful mature tree and shrub establishment and long term maintenance, since woody plant cover is low. Monitor maintenance of woody plants under the current flow to determine long-term impacts on regeneration and maintenance.

Non-Woody Species

- Extensive disturbance-caused species and invasive plants suggest cumulative, longer-term changes resulting from livestock, introduction of tame species, or perhaps a relationship to hydrologic parameters and past flood events (eg. creation of exposed soil and seed sources). This reach does have moderate to poor cover of native graminoids, so increasing native plant cover, while reducing disturbance plant cover, should be attainable with light to moderate grazing intensity. Grazing strategies that promote increased native plant vigour should help slow or reduce expansion of these invasive and disturbance-caused species. Such weed control to reduce further spread of invasive species is important. Elimination of disturbance-caused species is unrealistic.

Physical Characteristics and Hydrologic Parameters

- Maintain minimal livestock impacts to banks and soil using distribution tools, appropriate timing and stocking rates.
- Very extensive diversions of water (91% of annual flow) and significant levels of damming (over 50% of the watershed upstream) are likely a key reason that woody plant communities are not very extensive. Similar to the upstream reach, current livestock management is not preventing seedling or sapling establishment, so maintenance of these plants is likely limited by the current hydrologic regime. Prevent further loss to flow and changes to timing or peaks and consider providing a flow regime that will support both establishment and maintenance of woody plant communities. Poor bank protection from deep rooted species puts the reach at risk for more extensive erosion and lateral cutting; increased woody cover and deep rooted species along the banks will help limit bank erosion.

WATERTON RIVER PROJECT AREA

The project area is defined as a selection of riparian areas along the Waterton River from the Waterton Park gauging station to the confluence with the Belly River (refer to project area map – Figure 3. This amounts to a distance of approximately 99 km, of which just over 6 km was sampled at 6 polygons (Table WT1, Appendix WT13).

The assessed riparian areas were up to 360 m wide, with a broad range in maximum widths (70 m to 360m). Riparian area width was on average 150 m (Appendix WT13). (Note: as per riparian health inventory methodology, sites examined only include one side of the river). There was no channel incisement observed in the areas assessed (Appendix WT12). There is a wide diversity of native vegetation observed along the river, however disturbance-caused and invasive plant species persist. There were no invasive tree or shrub species observed and there are only cottonwood species growing along the river. Narrow-leaf cottonwood (*Populus angustifolia*)/snowberry/buckbrush (*Symphoricarpos occidentalis*) community type (CT) covered the largest area of any CT (Appendix WT7).

WHAT DID WE FIND?

- **The level of interest in the project was low.** Many of the landowners were cautious when considering participation in the project. Generally, those landowners who participated showed interest in determining the health of the riparian area. Thanks to everyone who allowed access to their land and supported this riparian inventory initiative. In all, 6 polygons were assessed along the Waterton River in 2004 (Appendix WT1).

- **There are some concerns with the overall health of this riparian area.** One site was rated as healthy, three sites fell into the healthy but with problems category and twos sites rated unhealthy, in relation to the functioning guidelines within the inventory protocol (Appendix G9). The overall assessment of riparian health for the Waterton River project area is as follows (Figure WT1, Appendix WT1);

  - Of the 6 polygons assessed: 17% (1/6) are *healthy*,
    50% (3/6) are *healthy but with problems*,
    33% (2/6) are *unhealthy*

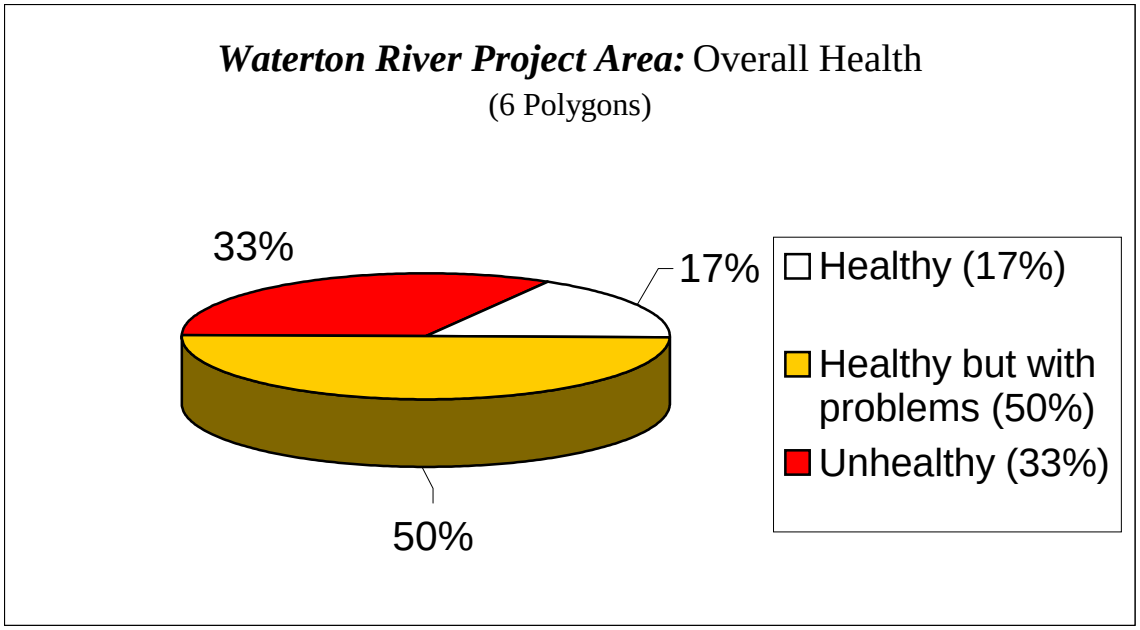


Figure WT1. Overall health of the Waterton River Project Area.

- Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of the entire Waterton River watershed, but give an overview of health of the riparian areas within watershed.

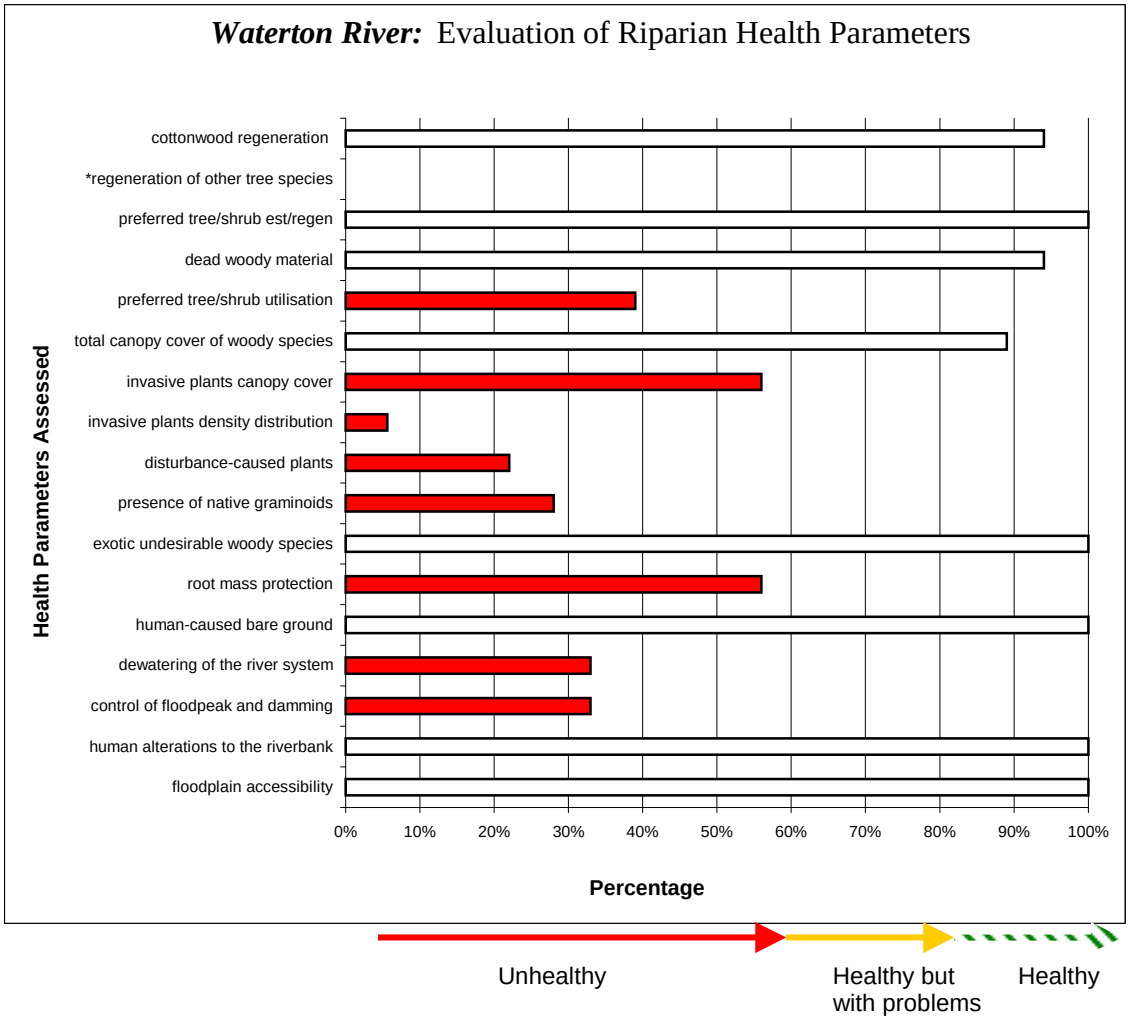
Remember: *We encourage users of the report to recognise the value of this report in broad-scale planning and identifying types of management and education approaches to take in the entire watershed--**this is not a finger pointing exercise; it should be used as part of an awareness process that maintains or improves management.***

Table WT1. Summary of Riparian Health Work –Waterton River

Year	River	# Landowners Contacted	# Landowners Participated	# Polygons Assessed	River Distance Assessed (km)
2004	Waterton River	15	6	6	6.42

RIPARIAN HEALTH DISCUSSION

For a description of how the parameters of riparian health are impacted by human disturbances and the overall affect on riparian health refer to *A Closer Look At The Riparian Health Pieces* in the overall summary of the South Saskatchewan River Basin.



Unhealthy	*(<60%)* Impairment to riparian health parameter due to human or natural causes.
Healthy but with problems	*(60-79%)* Some impairment to riparian health parameter due to human or natural causes.
Healthy	***(80-100%)*** Little or no impairment to riparian health parameter.

Figure WT2. Breakdown of riparian health results for 17 parameters assessed for the Waterton River project area

***Regeneration of other tree species does not register on this graph because no other tree species than cottonwoods were observed, therefore this parameter was not assessed.*

For an overview of the limitations of riparian health assessments refer to the section titled

Data Limitations in the overall South Saskatchewan River Basin Summary.

Historic and Present Influences on Riparian Health

The following discussion provides some insights regarding the current status of the health of riparian areas within the project area.

- **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 and horses (particularly in early settlement), bison provided the greatest seasonal grazing pressures on riparian areas within the project area (Alberta ECA 1977). Currently, livestock grazing is by far the dominant land use along the river, and thus potentially influencing riparian health along the Waterton River (Table WT2, Appendix WT10). Some parameters of the riparian health evaluation on grazed sites suggest that several aspects of riparian health may be influenced by grazing, while other parameters, seem not to be noticeably influenced by grazing.

- **Cropland cultivation** is a very small proportion of the reaches examined, but recent past and historic cultivation, including in adjacent upland areas, has likely increased presence of disturbance-caused undesirable plants within these riparian areas.

- **Availability of water.** Water diversion and consumption are affecting the overall health evaluation of the Waterton River to a considerable degree at the present time. The Waterton Dam controls flow timing and peaks and may influence riparian plant communities. Currently, of the sites examined, there is good to excellent regeneration, so these sites do not appear to have major moisture limitations preventing maintenance and establishment. Long-term implications of appropriate water volumes and timing of flow include: maintaining riparian vegetation, ensuring flood events provide sufficient recharge of local moisture and creating opportunities to establish new trees.

- **Overall watershed activity,** including activities in tributaries, such as agriculture, development, farm and home site development, and small scale damming or water extraction may influence delivery rate of water into the Waterton River. Depending on the extent and intensity of these activities, there way be an impact on the quantity and quality of water reaching the river. Other impacts include decreased levels of sediment and increased potential for introduction and invasion of disturbance or invasive species, due to bare soil and increased risk of seed transmission.

Table WT2. Land uses along the Waterton River Project Area

AENV Reaches for Waterton River	Land Uses (% of reach based on length)			
	Grazing	***Cropping***	***Developed***	***Undeveloped***
WT-01	100	0	0	0
WT-02	98	0	0	2
WT-03	87	5	1	7
Total	92	3	1	4

Refer to the section titled *Riparian Plant Communities-Why are they important?* for an overview of why understanding the riparian plant communities is important.

Riparian Plant Communities

Within the Waterton River project area:

- All polygons have the potential to grow preferred trees and shrubs and these species were observed within all reaches. Trees other than cottonwoods were not observed within any of the sites assessed.
- 3 different plant communities were identified.
- Shrubs occupy 42% of the project area and trees occupy 55% of the project area.
- There may be some areas to monitor, as 22% of the shrub canopy cover is comprised of four grazing-resistant shrubs: silverberry (*Elaeagnus commutata*), snowberry/buckbrush, *(Symphoricarpos occidentalis),* prickly rose (*Rosa acicularis*) and common wild rose *(Rosa woodsii)*.
- The other 78% of the shrub canopy cover is comprised of *preferred*[20] shrub species.
- The three community types found, were all cottonwood community types.
- Graminoids occupy 68% of the project area.
- A list of all plant species found in the project area is available in Appendix WT3. Additional plant community and habitat type information can be found in Appendix WT7. Refer to Appendix WT4 for a complete listing of plant species observed within each polygon.

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

There is good vegetative cover provided by trees and shrubs, with an total of 67% cover by woody species. Preferred woody species such as water birch (*Betula occidentalis),* chokecherry (*Prunus virginiana*) and saskatoon (*Amelanchier alnifolia*) are common; these species are excellent for stabilizing and protecting the riverbank from erosion due to their deep binding roots.

[20] native, palatable shrubs (willows, red-osier dogwood etc.) that are good indicators of riparian health

Presence

- 2 tree species and 20 shrub species were recorded within the Waterton River project area.

The presence of many different tree and shrub species along the riverbanks is important for providing protection and stability in this area. Plant diversity also provides habitat for a wide array of bird and wildlife species.

Reproduction

- Overall reproduction of *preferred* trees and shrubs is generally excellent.
- 5 of 6 polygons along the Waterton River have more than 15% of the cottonwood cover provided by established seedlings and saplings. The remaining site had good cover of cottonwood seedlings and saplings (1-15% of the cottonwood cover).
- There was excellent regeneration of preferred shrub species along the river. All polygons had over 5% of the shrub cover provided by seedlings and saplings, which is positive.

Health

- There are normal levels of dead and decadent branches in the canopy cover of woody species in all sites except one, which has minor additional dead and decadent branches. Low levels of dead and decadence throughout woody communities indicate there is sufficient moisture currently within the system to maintain existing plants, and that disease is not a problem in maintaining these communities.
- There are some concerns with the overall health of shrubs.
    - 22% of the shrub canopy cover is comprised of four grazing-resistant, shrubs: silverberry (*Elaeagnus commutata*), snowberry/buckbrush, *(Symphoricarpos occidentalis),* prickly rose (*Rosa acicularis*) and common wild rose *(Rosa woodsii)*. While native, these species will increase due to long-term heavy utilisation or browse.
    - In 50%, (3 of 6) of polygons, preferred trees and shrubs species are receiving moderate (1 of 6) to heavy (2 of 6) browse pressure from livestock (to a lesser degree wildlife).
    - The indicators of heavy browse pressure are umbrella-shaped mature shrubs and flat-topped or hedged seedling and saplings. Successful reproduction and establishment of the present trees and shrubs will maintain these stands and promote riparian health, but long-term heavy browse will likely lead to loss of some or all preferred woody plant communities.

Non-Woody Riparian Plants: Diversity and Health

Diversity

- 38 species of grasses and grass-like plants (graminoids) and 80 species of broad-leaved plants (forbs) were recorded within the Waterton River project area.
- Native grasses are present in all of the reaches along the Waterton River; however there is room for improvement on all of the sites assessed. As disturbance-caused species increase, native species, particularly native grasses, decrease in cover. The preferred and expected amount of native grass cover for riparian health is for more than 50% of the riparian area to be covered by native grass plants. Half of the polygons had from 5% to 25% native grass cover, 1 site had 25%-50% and the remaining 2 sites had <5% cover provided by native grasses.
- 59% (72 species) of the non-woody riparian plant species recorded are native plants. Native plants typically provide riparian functions including deep, binding root masses and summer and winter forage for livestock and wildlife.
- 6 poisonous plant species: common horsetail (*Equisetum arvense*), showy locoweed (*Oxytropis splendens*), water hemlock (*Cicuta maculata*), early yellow locoweed (*Oxytropis sericea*), white camas (*Zigadenus elegans*) and Indian hemp (*Apocynum cannabinum*) were recorded within the project area but their overall presence is not a management concern because they were not abundant.

Health

- 56% of the project area is occupied by disturbance-caused plants (grasses and forbs). Of the 20 disturbance-caused species present, the most prevalent are smooth brome (*Bromus inermis*) [21] and quack grass (*Agropyron repens*).
- Disturbance-caused undesirable plants cover a significant portion of the Waterton River project area. A third of the polygons have 25%-50% of the riparian area covered by disturbance species, and more significantly, half of polygons have over 50% of the riparian area covered by disturbance-caused species. The remaining site has less coverage, with 5%-25% of the area covered. The shallow root systems of disturbance-caused plants are not as efficient as native species for stabilising soil and providing protection along riverbanks. Refer to Appendix WT5 for more information regarding the area covered by disturbance plant species within each of the sites.
- Invasive species are present throughout the Waterton River project area. The overall coverage of these species is minimal; however their widespread distribution is of concern.

[21] Smooth brome and quack grass are tame or introduced species that have invaded or been introduced into many native lands over the past decades. These species reduce long-term productivity and stability, because they do not have deep-binding roots.

- Canada thistle (*Cirsium arvense*), perennial sow-thistle (*Sonchus arvensis*), common hound's tongue (*Cynoglossum officinale*), ox-eye daisy (*Chrysanthemum leucanthemum*), tall buttercup (*Ranunculus acris*), white cockle (*Silene pratensis*), and downy chess (*Bromus tectorum*), an invasive grass, are the invasive plants found in the project area.

Physical Characteristics of Riverbank and Floodplain

Human-Caused Bare Ground and Alterations to the Riverbanks

- There are very few alterations occurring along the riverbanks of the Waterton River, with only 1.7% of the inventoried bank length impacted by alterations. No polygons decreased in health rating with this minimally impacted area, which existed along the riverbank in 4 of 6 polygons (rated as less than 10% of bank length altered). 2 polygons had no alterations-this is positive.
- Of these minor impacts, livestock activity (hoof shear, trailing) is the main cause of alterations along the Waterton River banks (Appendix WT8).
- There are small amounts of exposed soil surface or bare ground created by human activities in each of the Waterton River reaches. However the overall impacts are minor, with less than 5% of the assessed area affected. Livestock activity, recreation and roads are the causes of bare ground within the sites along the Waterton River. The majority of the overall bare soil within the areas assessed is present due to natural causes such as sediment deposition and erosion (Appendix WT9).

Riverbank Root mass Protection

Riverbank root mass protection is variable along the Waterton River. Only one site has excellent root mass with more than 85% of the bank length covered by deeply rooted vegetation. 2 sites have 65%-85% of the bank protected and the remaining 3 sites have 35%-65% of the bank length covered by deeply rooted species. Appendix WT14 also outlines the bank materials within each of the sites inventoried on the Waterton River.

Hydrologic Characteristics

Dewatering of the River System

- Artificial removal of water from river systems can negatively affect bank stability, wildlife habitat, establishment and success of woody plants and overall riparian function.
- Along the Waterton River there are concerns with the amount of water that is removed in the 2 downstream reaches (WT-02 and WT-03). Within these lower reaches, 94.5% and 89%, respectively, of the average river discharge is removed.

This is very significant and should be of concern if long-term maintenance of the riverine ecosystem is desired.

Control of Flood Peak/Timing by Upstream Dams

- Dams have negative impacts on the overall function of riparian areas because they remove water, adjust and control the annual peak flows that riparian areas depend on to recharge their groundwater reservoirs and rebuild the banks.
- The Waterton Dam is located between reaches WT-03 and WT-02. The riparian health rating of all polygons downstream of the dam is significantly impacted, with over 50% of the watershed upstream controlled by the Waterton dam (Appendix WT1).

Floodplain Accessibility

- Riparian areas depend on regular flood events to maintain groundwater reserves and, rebuild banks through sediment deposition. Humans sometimes restrict floodwaters from accessing the floodplain through construction of embankments, levees and roadbeds.
- Along the Waterton River, in all of the polygons (6 of 6) floodwaters have access to more than 85% percent of the floodplain, which is the minimum amount considered required to maintain riparian functions related to this parameter.

Waterton River Riparian Health Overview: Summary

Overall riparian health of the areas examined is fairly high in the upper reach, but unhealthy, or just in the healthy, but with problems category in the lower two reaches. As with most of the rivers assessed, the limited number of polygons in each reach makes generalisations about the entire river challenging, but the Waterton has minimal intra-reach variability. All parameters rated within one health rating between polygons in the same reach. The observations below are provided as an overview that will assist in general management or monitoring planning. More detailed or specific use of the information should be done at the reach and polygon level, with a clear understanding of site or localised health status.

A number of parameters showed a change in health as distance from headwaters increased:

Physical/Hydrological:
- Dewatering is higher in the lower two reaches
- Upper reach with no major dams; but downstream reaches controlled by Waterton Dam

Some parameters of riparian health were similar, regardless of location along the river system:

- Cottonwood regeneration (excellent at all but 1 site)
- Preferred shrub regeneration (excellent at all sites)
- Decadent and dead woody material (excellent at all but 1 site, which rated good)
- Cover of woody species (excellent at 4 and good at 2 sites)
- Invasive species density distribution (extensive throughout)
- Exotic undesirable woody species (none found)
- Human alterations to the structure of riverbanks (excellent at all sites)
- Human-caused bare ground (excellent at all sites)
- Floodplain accessibility (no limitations)

There were no clear trends in these riparian health parameters as distance from headwaters increased:

- Utilisation of preferred trees and shrubs (the average rating for each reach declined, but utilisation was variable between polygons in the lower two reaches)
- Invasive species canopy cover (poor to moderate)
- Disturbance species canopy cover
- Native graminoid cover
- Proportion of banks protected with deep-binding roots

Limitations of the Data

Refer to Data Limitations in South Saskatchewan River Basin section.

Waterton River: Opportunities and Options for Improvement

Except at one site where cottonwood regeneration is rated as good, all other tree/shrub regeneration was excellent. Utilisation is variable, but moderate to high at some sites. Areas with less than preferred amounts of woody canopy cover do not readily coincide with utilisation or increased dead and decadent material. While there does not seem to be significant impact on tree and shrub community health, there are very high levels of disturbance-caused species as well as invasive weed species, which may reflect past and, to varying degrees, current grazing management. Because grazing is the dominant land use of the polygons examined, and of the reach as a whole, grazing management should be a key focus of local level management efforts. Grazing management that uses non-native grasses when most palatable, while maximizing rest to native grasses, should promote improvements in the herbaceous plant community.

Physical impacts from grazing (human-caused bare ground and bank structural alterations) are very minor and are not affecting health, suggesting that grazing management is and has been effective at not negatively impacting these parameters. Maintain existing management that has successfully achieved the minimal physical impacts, combined with an aim to promote the herbaceous native community.

Of all the rivers in the 2004 project, the Waterton River has the smallest proportion of the area inventoried covered by invasive species. Reduce the presence of invasive plants or aim to prevent further invasion with a combination of weed control measures and grazing strategies that consider rest, distribution, timing and stocking rates will be required to prevent human-caused bare soil and promote plant vigour. Where recreational activities are also present, weed control is equally important, through minimising trails, bare soil, and transport of weed seed on vehicles. To keep these infestations from covering wider areas, monitor regularly, particularly because annual weather conditions, combined with some types of land use/management, can lead to rapid increases.

In the upper reach, less than 10% of the average river discharge is being removed but extensive withdrawal occurs downstream, with over 50% removed in the two lower reaches (in fact over or nearly 90%, depending on the reach). At the present, there is no clear impact to tree and shrub health, but long-term, such extremely high levels of water removal would be expected to impact riparian plant communities, channel morphology and aquatic life. Monitoring and adjustment of water availability based on that monitoring should be considered.

The bottom reach is influenced by the Waterton Dam. Research has acknowledged that damming is a potentially harmful impact on riverine ecosystems, so for long-term health or to prevent further loss of riparian health, consider limiting further damming and provide flow regimes that assist in maintaining riparian plant communities. In addition, it is important to identify and quantify upstream minor or unlicensed dams to include these potential modifications and their impacts on the river ecosystem.

Floodplain accessibility is not impacted by human-built structures or physical modifications. Maintain current floodplain access to flood flows with development and river management that recognises the importance of over bank flows.

As with the Belly River, the main visible changes impacting riparian health on-site are modifications to the herbaceous plant community (loss of native graminoids, increase in disturbance plants and infestations of invasive plants). Grazing management that focuses on managing native and tame grass species to improve native plant vigour will help reduce disturbance plant communities and weeds. Combined with long term maintenance and monitoring of flows that support riparian plant communities, these areas can may increase or maintain their riparian health.

Waterton River Reach Overview

The reaches along the Waterton River are summarized starting from the Waterton Park gauging station to the confluence with the Belly River (Table WT3). In most polygons, approximately 1 km of river was assessed, with 6.42 km assessed for the project (Table WT4). One of the polygons examined rated as healthy, with 3 rating healthy but with problems and 2 rated unhealthy (Table WT5).

Table WT3. Alberta Environment (AENV) Reaches Boundary Descriptions –Waterton River

AENV Reach	Upstream and Downstream Description
WT-03	Waterton Park gauging station to Waterton Reservoir
WT-02	Waterton Reservoir to 45 kilometres upstream of the Belly River confluence
WT-01	45 kilometres upstream of the Belly River confluence to the confluence with the Belly River

Table WT4. Summary of Waterton River Reaches – Sites

AENV Reaches for South Saskatchewan River	# Sites Assessed	River Distance Assessed (km)
WT-03	2	1.77
WT-02	2	2.06
WT-01	2	2.59

Table WT5. Number of Reach Sites by Riparian Health Category Waterton River

Reach	Healthy	Healthy but with problems	Unhealthy
WT-03	1	1	0
WT-02	0	0	2
WT-01	0	2	0
Total	1	3	2

Table WT6. Land Uses along the Waterton River Project Area

AENV Reaches for Waterton River	Land Uses (% of reach based on length)			
	Grazing	*Cropping*	*Developed*	*Undeveloped*
WT-03	87	5	1	7
WT-02	98	0	0	2
WT-01	100	0	0	0

Table WT7. Summary of Plant Communities: Overall and Woody Communities – Waterton River Reaches

Reach	# of Plant	% of Area Examined with:

	Communities	Tree Species	Shrub Species
WT-03	2	43	42
WT-02	2	49	38
WT-01	1	63	45

Community and habitat types are determined using Thompson and Hansen (2002). Refer to Appendix WT7 for a complete description of habitat and community types.

Table WT8. Summary of Plant Communities: Herbaceous Communities Waterton River Reaches

Reach	% of Area Examined with:		
	Grass Species	Forb Species	Disturbance Species
WT-03	87	10	71
WT-02	58	19	38
WT-01	70	18	68

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

All reaches have 2 tree species and 13-18 shrub species. The furthest upstream reach (WT-03) has less woody plant diversity compared to the downstream reaches (Table WT9). Poplars (balsam poplar *Populus balsamifera* and narrow-leaf cottonwood (*P. angustifolia*) are present in all reaches. Regeneration of cottonwoods ranges from moderate to excellent, but other trees are absent (Table WT10). There are normal to minor amounts of dead branches and dead standing trees and utilisation/browse is variable, from heavy to light (Table WT11).

Table WT9. Woody Plant Species Presence - Waterton River Reaches

Reach	# of Tree Species	# of Shrub Species	% of Reach Area that is Woody Species
WT-03	2	13	64
WT-02	2	18	58
WT-01	2	15	75

Refer to Appendix WT4 for a complete list of plant species.

Table WT10. Woody Plant Species Reproduction– Waterton River Reaches

Reach	Cottonwood Regeneration (seedlings/ saplings)	Other Tree Species Regeneration (seedlings/ saplings)	# of Sites with seedlings /saplings >5% of total woody cover	Means for health…
WT-03	1 site moderate, 1 site excellent	None observed, not applicable	2	Moderate to excellent regeneration

WT-02	All sites excellent	None observed, not applicable	2	Excellent regeneration
WT-01	All sites excellent	None observed, not applicable	2	Excellent regeneration

Refer to Appendix WT1 for a summary of river health survey scores.

Table WT11. Woody Plant Health – Waterton River Reaches

Reach	**Dead and Decadence**	**Utilisation of Preferred Woody Plants**	**Means for health…**
WT-03	Normal	Light	Good
WT-02	Normal - Minor	Light- Heavy	Poor to Fair
WT-01	Normal	Moderate- Heavy	Poor to Fair

Non-Woody Riparian Plants: Diversity and Health

There were many different herbaceous species observed, with 38 different graminoid species and 80 forb species. Coverage of native grasses was variable; however they were present on all of the sites, with poor to moderate coverage. Disturbance-caused species comprise a significant proportion of the reaches and are negatively impacting riparian health (Table WT13). Invasive plant species, while not covering significant areas, are sporadic and widespread throughout all of the reaches, and without appropriate management could infest much larger areas (Table WT14). Canada thistle (*Cirsium arvense*) is the most common and widespread invasive plant, with numerous other species commonly found (Table WT15).

Table WT12. Non-Woody Riparian Plant Diversity– Waterton River Reaches

Reach	**Total # of Grass/ Grass-like Species**	**Total # of Forb Species**	**Proportion of site covered by native graminoids**	**Means for health…**
WT-03	23	51	1 site 25%-50%, 1 site <5%	Very poor to fair
WT-02	29	57	1 site 5%-25%, 1 site <5%	Very poor to poor
WT-01	28	52	Both sites 5%-25%	Poor

Table WT13. Non-Woody Riparian Plant Health - Proportion Disturbance Caused Undesirable Herbaceous Species– Waterton River Reaches

Reach	**% of Reach with Disturbance Plants**	**Disturbance Plants Cover**	**Means for health…**
WT-03	71	1 site 25%-50%, 1 site >50%	Variable, moderate to extensive, of concern
WT-02	38	1 site 25%-50%, 1 site 5%-25%	Variable, minor to moderate, of concern
WT-01	68	2 sites >50%	Extensive, of concern

Table WT14. Non-Woody Riparian Plant Health - Proportion Invasive Plant Species– Waterton River Reaches

Reach	# of Sites with Invasive Plants	Invasive Plants Cover	Density/ Distribution of Invasive Plants	Means for health…
WT-03	2 of 2	1 site low cover, 1 site moderate cover	Patches to continuous occurrence	Canopy cover and distribution are of concern
WT-02	2 of 2	2 sites moderate cover	Patches plus several sporadically occurring plants	Canopy cover and distribution are of concern
WT-01	2 of 2	1 site low cover, 1 site moderate cover	Patches to continuously occurrence	Canopy cover and distribution are of concern

Table WT15. Most Common Invasive Herbaceous Plant Species– Waterton River Reaches

Reach	Species
WT-03	Canada thistle, common hound's tongue, ox-eye daisy
WT-02	Canada thistle, common hound's tongue, perennial sow-thistle
WT-01	Canada thistle, common hound's tongue, perennial sow-thistle

Physical Characteristics of Riverbank and Floodplain

Human-caused bare ground is minimal throughout the assessed areas (Table WT16). Livestock activity, recreation and roads are the main causes of bare ground. Livestock activities have also altered the riverbank structure in 4 of 6 sites, with minor alterations impacting a limited portion of each reach, and not impacting riparian health (Table WT17). Riverbank root mass protection, as assessed by the length of bank with deep-binding roots, is variable along the river ranging from poor to excellent (Table WT18).

Human-Caused Bare Ground and Alterations to the Riverbanks

Table WT16. Human-caused Bare Ground– Waterton River Reaches

Reach	# of Sites with >5% Human Caused Bare Ground	Proportion of polygons covered by human-caused bare ground	Sites are…
WT-03	0	2 sites <5%	Well vegetated
WT-02	0	2 sites <5%	Well vegetated
WT-01	0	2 sites <5%	Well vegetated

Table WT17. Human-Caused Structural Alterations– Waterton River Reaches

Reach	# of Sites with Human Caused Structural Alterations	# of Sites with Human-Caused Structural Alterations Along:				Banks are…
		< 10% of length	10-25% of length	25-50% of length	> 50% of length	
WT-03	2 of 2	2	0	0	0	Mostly intact
WT-02	2 of 2	2	0	0	0	Mostly intact
WT-01	0 of 2	2	0	0	0	Intact

Riverbank Root Mass Protection

Table WT18. Proportion of Riverbank with Deep Binding Roots— Waterton River Reaches

Reach	# of Sites with Riverbank Rootmass Protection along:				Banks are…
	> 85% of length	65-85% of length	35-65% of length	< 35% of length	
WT-03	0	1	1	0	Variable, moderately to poorly protected
WT-02	0	0	2	0	Poorly protected
WT-01	1	1	0	0	Variable, well to moderately protected

Hydrologic Characteristics

Dewatering is considerable throughout the lower reaches, WT-02 and WT-01 (Table WT19). Floodwaters have unrestricted access to the floodplain in all reaches (Table WT21). The proportion of damming and modifications to peak flows and timing is impacting riparian health ratings in the two lower reaches (Table WT20).

Dewatering of the River System

Table WT19. Dewatering of the River— Waterton River Reaches

Reach	Total use as a % of natural *	# of Sites with River Discharge Being Removed that is:				Impacts are…
		< 10% of average	10-25% of average	25-50% of average	> 50% of average	
WT-03	0	2	0	0	0	Nil
WT-02	94.5	0	0	0	2	Significant
WT-01	89.0	0	0	0	2	Significant

*Data provided by AENV. Note that only licensed and reported uses are included; unlicensed use is unknown.

Control of Flood Peak/Timing by Upstream Dams

Table WT20. Flood Peak and Timing Control by Dams— Waterton River Reaches

Reach	# of Sites with Control By Dams Upstream Affecting:				Number of Dams
	<10% of watershed	10-25% of watershed	25-50% of watershed	> 50% of watershed	
WT-03	2	0	0	0	0
WT-02	0	0	0	2	1
WT-01	0	0	0	2	1

*Data provided by AENV. Includes dams on main stem rivers only.

Floodplain Accessibility

Table WT21. Floodplain Accessibility— Waterton River Reaches

Reach	# of Sites with Flood Water Access to:				Major Obstructions to Flooding
	> 85% of floodplain	*65-85% of floodplain*	*35-65% of floodplain*	*< 35% of floodplain*	
WT-03	2	0	0	0	None
WT-02	2	0	0	0	None
WT-01	2	0	0	0	None

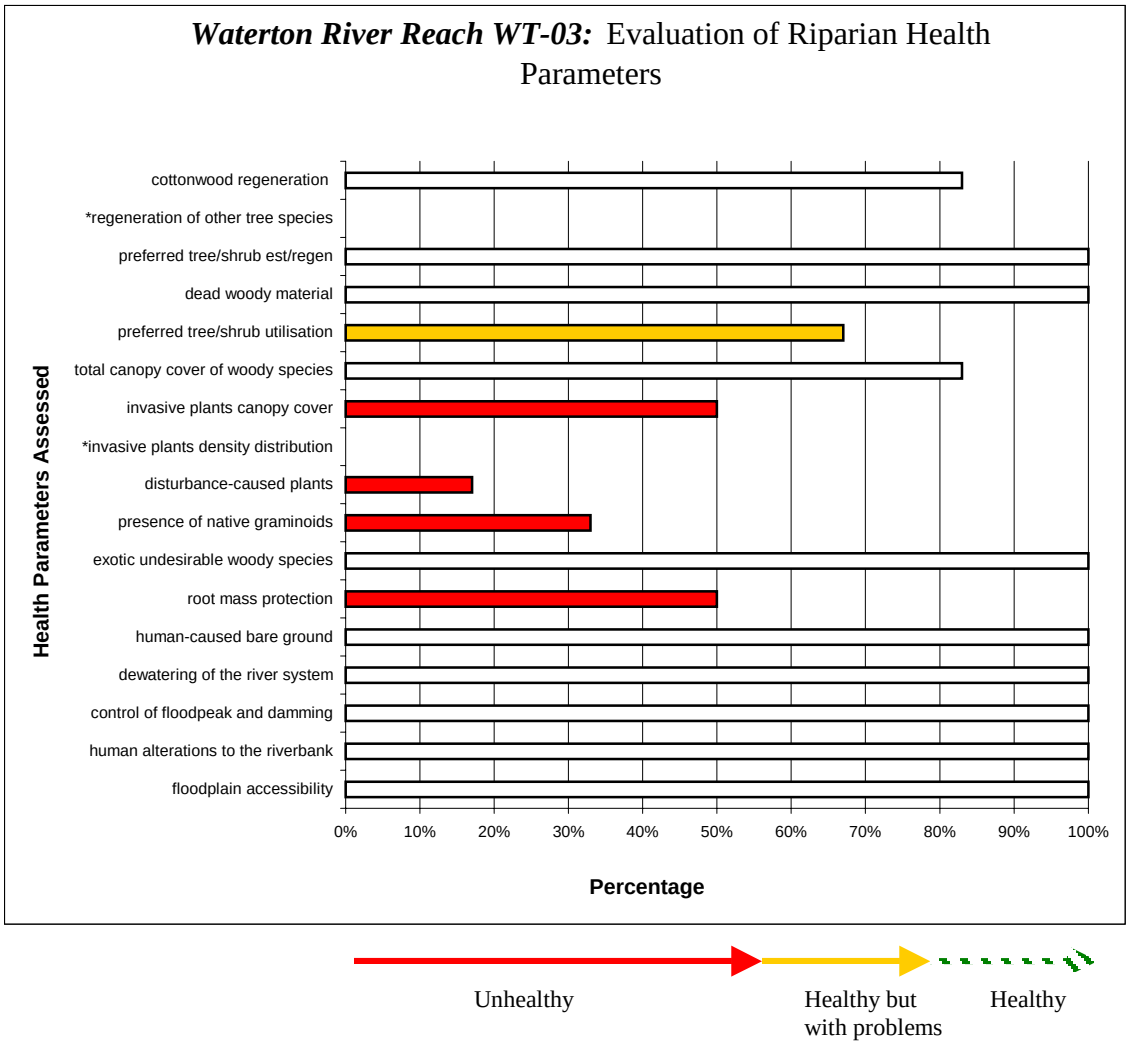
Alberta Environment Reach: Waterton Park Gauging Station to the Waterton Reservoir (WT-03)

- **One of the polygons in this reach scored in the healthy category and the other polygon rated healthy but with problems.** The overall assessment of riparian health for reach WT-03 of the Waterton River project area is as follows:

  - Of the 2 polygons assessed: 50% (1/2) are *healthy*,
    50% (1/2) are *healthy but with problems*,
    0% (0/2) are *unhealthy*

Please note: due to the small number of polygons assessed these health ratings do not necessarily represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure WT3. Breakdown of riparian health results for 17 parameters assessed for Waterton River reach WT-03.

** Regeneration of other tree specie does not register on this graph because there were no other trees present; therefore this parameter was not assessed. Invasive plants density distribution does not register on this graph because this parameter scored 0%*

Historic and Present Influences on Riparian Health

Currently, grazing is by far the dominant land use in this reach. The remainder of the reach was divided into small areas of cropping, developed and undeveloped areas.

Riparian Plant Communities

- Trees and shrubs combined cover 64% of the area assessed in this reach. Trees and shrubs have almost equal cover with trees covering 43% and shrubs occupying 42% of the area assessed. There is moderate to excellent regeneration of cottonwoods and there are no other trees than cottonwood species present. Preferred shrubs also have excellent regeneration with normal amounts of dead and decadent branched in both the shrub and tree communities. Overall utilisation of preferred trees and shrubs is light and at this level of browse, woody communities should be maintained.
- The overall cover of invasive species is not significant (one site each with <1% and 1%-15% cover), however the widespread distribution of these species is of concern. Disturbance-caused species are covering over 50% of the area assessed at one site, with 25%-50% at the other site. These species are of concern because they are limiting the overall coverage of native species. Native grasses are significantly reduced due to abundance of disturbance-caused species and are occupying 25%-50% of the area in one site and less than 5% in the other.

Physical Characteristics and Hydrologic Parameters

- Livestock activity is causing alterations along the riverbank in this reach; however the overall area of impact is minimal and is not reducing riparian health. Human-caused bare ground, caused by livestock activity, is also very limited and the overall impacts to riparian health are minimal. There are some concerns with riverbank root mass protection in this reach, with moderate to poorly protected banks.
- Within this reach, there are no significant withdrawals and therefore riparian health is not influenced by this parameter. There are no dams located upstream of the areas assessed, as this reach is located upstream of the Waterton Dam, and peak flows and timing are not modified by the dam. Floodwaters have unrestricted access to the floodplain, an important factor for moisture on the floodplain and energy dispersal during flood events.

Opportunities and Options for Improvement: WT-03

Trees and Shrubs

- With light utilisation, regeneration is good to excellent in the tree and shrub community. The cottonwood community (at one site) has slightly less than required regeneration (to rate healthy) and that same site also has somewhat less then expected cover provided by woody plant species. Appropriate stocking rates, distribution, timing and rest in the growing season will assist preferred trees and shrubs to be maintained or increase.

Non-Woody Species

- Extensive disturbance-caused species and invasive plants suggest cumulative, longer term impacts from livestock, introduction of tame species, or perhaps some relationship to hydrologic parameters and past flood events (eg. creation of exposed soil and seed sources). Grazing strategies that promote increased native plant vigour should help slow or reduce expansion of these invasive and disturbance-caused species; weed control to reduce further spread of invasive species is important.

Physical Characteristics and Hydrologic Parameters

- With no impacts to health from human-caused bare ground or alterations to the riverbanks, continue to maintain and promote grazing management that prevents any increase in pressure along river reaches.
- Water flow, timing and access to the floodplain are all unimpaired in this reach. Continue to provide average discharge at these levels and prevent any physical modifications that modify timing or access of flood waters.

Alberta Environment Reach: Waterton Reservoir to 45 Kilometres upstream of the Belly River confluence (WT-02)

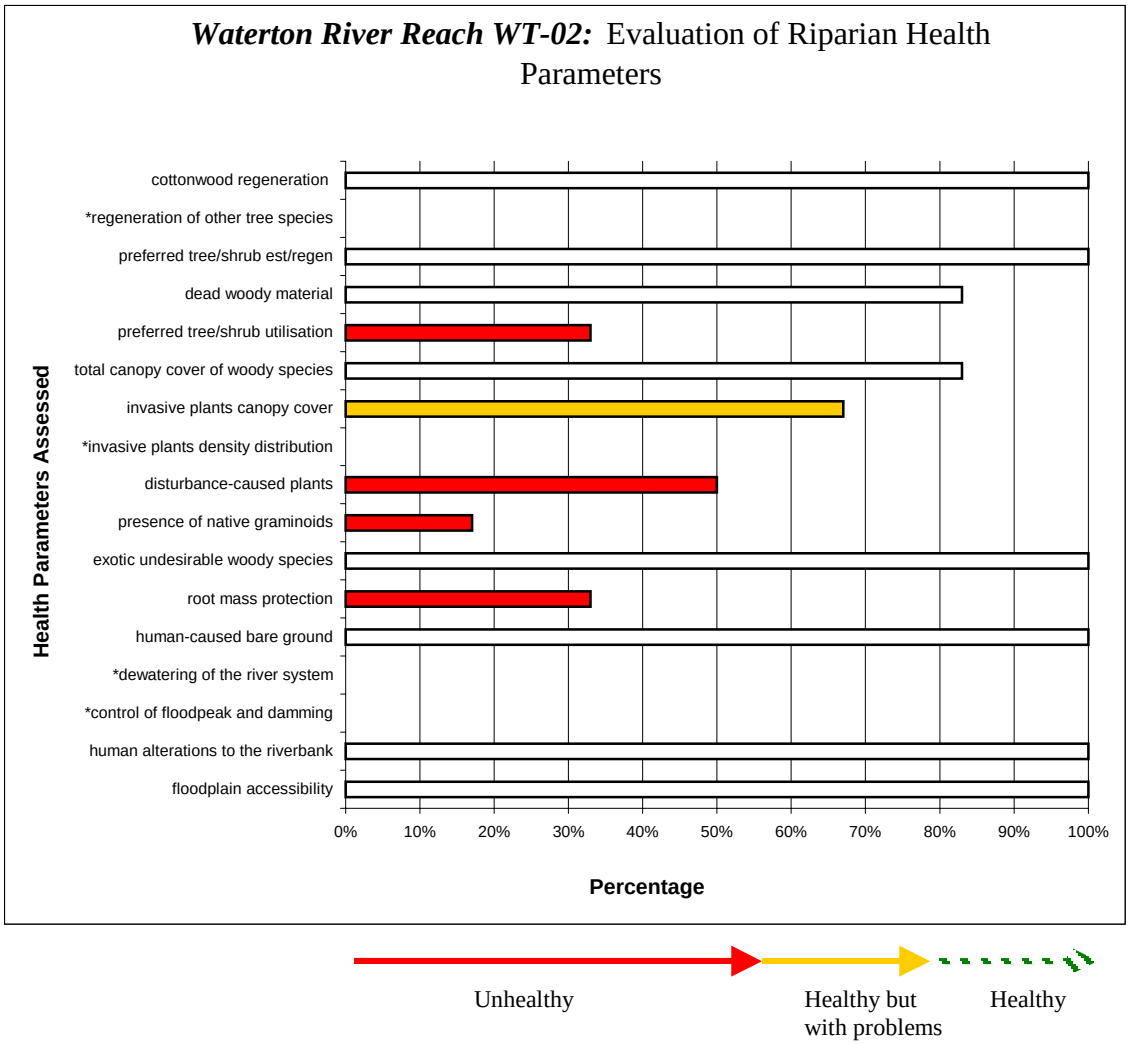
WHAT DID WE FIND?

- **Both of the polygons in this reach rated unhealthy.** The overall assessment of riparian health for reach WT-02 of the Waterton River project area is as follows:

  - Of the 2 polygons assessed: 0% (0/2) are *healthy*,
    0% (0/2) are *healthy but with problems*,
    100% (2/2) are *unhealthy*.

Please note: due to the small number of polygons assessed these health ratings do not represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure WT4. Breakdown of riparian health results for 17 parameters assessed for Waterton River reach WT-02.

** Regeneration of other tree specie does not register on this graph because there were no other trees present; therefore this parameter was not assessed. Invasive plants density distribution, dewatering of the river system and control of floodpeak and damming do not register on this graph because these parameters scored 0%******

Historic and Present Influences on Riparian Health

Currently, grazing is the dominant land use in this reach, with a small portion identified as undeveloped. Riparian health ratings are significantly impacted by withdrawals and damming upstream.

Riparian Plant Communities

- Trees are covering slightly more area than shrubs in this reach with 49% of the area occupied by trees and 38% by shrubs. There is excellent cottonwood regeneration in all of the sites assessed with seedlings and sapling providing more than 15% of the cottonwood cover. Cottonwoods are the only trees present in this reach. Preferred shrubs also have excellent regeneration, with minor additional to normal levels of dead and decadent branches in the tree and shrub communities. Utilisation on preferred trees and shrubs is variable, from light to heavy, and may influence future success of the woody communities if heavy use persists.
- There is minimal cover of invasive plants, however their widespread distribution facilitates further infestation of these species and therefore is of concern. Disturbance-caused plants have very poor root systems and perform poorly most riparian functions (eg. stabilising riverbanks). The presence of disturbance-caused plants is somewhat better in this reach, compared to adjacent reaches, but is still a concern, as they are covering 38% of the assessed area. Disturbance-caused species also compete with native plants and have significantly reduced the native grass cover in this reach.

Physical Characteristics and Hydrologic Parameters

- Similar to the previous reach, livestock activity is the cause of alterations along the riverbank, however these alterations are minimal and having very little impact on overall riparian health. Human-caused bare ground is also occurring in this reach, although the area impacted is relatively small. Livestock activity and roads are the causes of the bare soil in this reach. Riverbank root mass protection is poor along the areas assessed in this reach, resulting in some areas of instability along the bank.
- There are significant withdrawals, with more than 50% of the average river discharge removed from this reach. The Waterton Dam is also located at the upper end of this reach, resulting in more than 50% of the watershed upstream controlled by the dam. Water withdrawal and damming both alter the natural flow and water available for riparian vegetation as well as altering the processes of sediment deposition and ground water recharge. There are no obstructions along the river that prevent floodwaters from accessing the floodplain in this reach.

Opportunities and Options for Improvement: WT-02

Trees and Shrubs

- Excellent regeneration of preferred trees and shrubs is occurring under variable browse levels, ranging from light to heavy.

There is a slight increase in dead/decadent material, coincident with the site with heavy utilisation, but this site still has excellent regeneration as well as woody cover. Slightly reduced woody cover is present at the site with light utilisation, excellent regeneration and normal amounts of dead/decadent material. Grazing pressure does not appear to be limiting the tree and shrub community to any significant extent, although monitoring woody cover over time is important to ensure maintenance of the plant communities. Slightly lower woody cover at one site may be related to past livestock use, long term changes in floodplain water table levels, or some combination of the two factors. Appropriate stocking rates, distribution, timing and rest in the growing season will continue to allow preferred tree and shrub to establish and be maintained. Monitor woody plant cover and long term success of these plant communities, as loss and change of flows due to diversion and damming can be expected to impair tree and shrub communities.

Non-Woody Species

- Consider implementing weed control to hold invasive plant infestations at current levels (and hopefully reduce them), while monitoring locations and abundance.
- Ensure adequate rest and appropriate grazing strategies to reduce or stabilize the coverage of disturbance-caused plants and increase native plant vigour. While elimination of disturbance species may be unrealistic, this reach has less cover by either disturbance-caused or invasive plants than its adjacent reaches, as so it has the greatest opportunity to reduce cover before it becomes so extensive.

Physical Characteristics and Hydrologic Parameters

- With minimal human-caused bare ground and bank structural alterations, promoting existing livestock grazing that has avoided creating any significant alterations is important. Preventing further roads in the riparian area, and reducing existing impacts would limit further human-caused bare ground. Riverbank root mass protection in this reach is poor, increasing possible bank erosion and lateral cutting, primarily as a result of extensive disturbance plant communities replacing deep-rooted species.
- Very high levels of diversion/withdrawal (95% loss of flow volume), are very likely to have (or be having) significant long-term impacts; consequently, it is surprising that more impacts are not noted in the woody plant community. Lowering of the ground water table on the floodplain is expected to change establishment and maintenance of the riparian plant community. Disturbance and invasive plants may also be impacted by dewatering, but their generally abundant nature even in sites with minimal dewatering makes it difficult to ascertain. Monitoring of riparian plant communities, particularly to identify reduced regeneration and maintenance of woody plant communities, is recommended. Provide flows required to prevent loss or reduction in riparian tree and shrub communities.

Alberta Environment Reach: 45 kilometres upstream of the Belly River confluence to the confluence with the Belly River (WT-01)

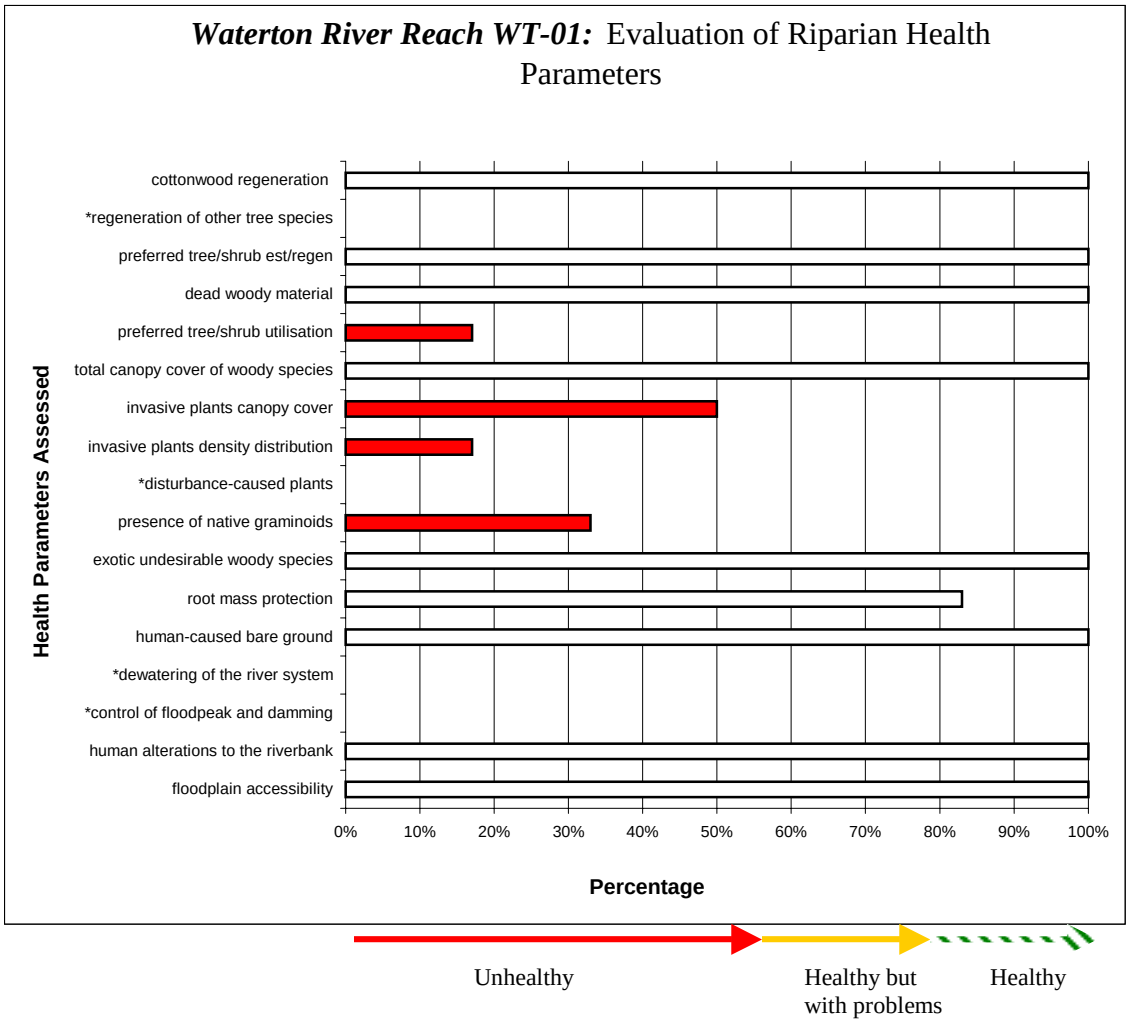
WHAT DID WE FIND?

- **Both of the polygons in this reach rated in the healthy but with problems category.** The overall assessment of riparian health for reach WT-01 of the Waterton River project area is as follows:

  - Of the 2 polygons assessed: 0% (0/2) are *healthy*,
    100% (2/2) are *healthy but with problems*,
    0% (0/2) are *unhealthy*.

Please note: due to the small number of polygons assessed these health ratings do not represent the health of this entire reach but rather give a general overview of health.

RIPARIAN HEALTH DISCUSSION



Unhealthy (<60%) Impairment to riparian health parameter due to human or natural causes.

Healthy but with problems (60-79%) Some impairment to riparian health parameter due to human or natural causes.

Healthy (80-100%) Little or no impairment to riparian health parameter.

Figure WT5. Breakdown of riparian health results for 17 parameters assessed for Waterton River reach WT-01.

** Regeneration of other tree specie does not register on this graph because there were no other trees present, therefore this parameter was not assessed. Disturbance-caused plants, dewatering of the river system and control of floodpeak and damming do not register on this graph because these parameters scored 0%*

Historic and Present Influences on Riparian Health

Grazing is the dominant land use in this reach with smaller areas cropped, developed and undeveloped also found in this reach. Water withdrawals and damming are significant in this reach and are negatively impacting riparian health.

Riparian Plant Communities

- Trees and shrubs combined are covering 75% of the area assessed in this reach, with trees more abundant than shrubs. There is excellent regeneration of cottonwoods and preferred shrub species in this reach. There were only cottonwoods observed and no other trees present. There are normal levels of dead and decadence in the woody communities and overall preferred tree and shrub utilisation is moderate to heavy.
- Invasive plants are present throughout the reach, with the continuous and wide spread distribution of these species of concern. Disturbance species are covering more than 50% of the areas assessed, competing with the vegetative cover of native plants. The abundance of disturbance-caused plants has significantly reduced the presence of native grasses, with 5%-25% of the area assessed occupied by native grasses.

Physical Characteristics and Hydrologic Parameters

- There are no alterations occurring along the riverbank in the areas assessed in this reach. However there are small areas of human-caused bare ground found throughout the reach and these areas are the result of livestock grazing and recreational activities; human-caused bare ground is not impacting riparian health ratings. Riverbank root mass protection has is somewhat higher in this reach, compared to upstream, with 65%-85% of the reach protected in one of the sites and more than 85% of the bank covered by deeply rooted species in the other site- this is positive.
- Water withdrawals are significantly impacting riparian health, removing more than 50% of the average river discharge. The Waterton Dam is also negatively impacting riparian health, damming and altering the flow of more than 50% of the river upstream of the sites in the reach. These alterations to the water available and natural flow of the river disrupt the natural processes of the river (sediment deposition, ground water recharge, cottonwood establishment). There are no obstructions along the river that prevent floodwaters from accessing the floodplain in this reach.

Opportunities and Options for Improvement: WT-01

Trees and Shrubs

- With excellent regeneration of trees and shrubs, but moderate to heavy utilisation, combined with very high loss of average discharge, tree and shrub community maintenance are at risk in the future. Grazing management that ensures appropriate stocking rates, distribution, timing and rest in the growing season will assist in sustaining woody plant communities.

Non-Woody Species

- Consider implementing weed control to hold invasive plant infestations at current levels (and hopefully reduce them), while monitoring locations and abundance.
- Ensure adequate rest and appropriate grazing strategies to reduce or stabilize the coverage of disturbance-caused plants and increase native plant vigour. Improving native plant vigour should also improve riverbank root mass protection. Recognise that elimination of disturbance species is unrealistic.

Physical Characteristics and Hydrologic Parameters

- Very minimal human-caused structural alterations and bare ground are present; maintain these levels with stocking rates and distribution mechanisms that prevent intensive use of bank areas.
- Within 89% of average annual flow removed from this reach, dewatering is a major concern, having negative impacts on overall riparian health ratings. In addition, damming upstream by the Waterton Dam has resulted in over 50% of the watershed controlled by dams, introducing modifications to flood timing and intensity. At present, there are not obvious impacts to the woody plant community maintenance, but they would be expected over the long term. Monitoring to follow changes in the riparian plant community should help identify if this occurs, and allow for improvement to be made in volume and timing of flows. Prevent any further loss in flows to prevent any other potential impacts to plant communities, channel processes and aquatic communities. Continue to maintain floodplain accessibility throughout the reach.