Cows and Fish Report

2013 Riparian Health Inventory Project (Year 3): Westslope Cutthroat Trout Priority Streams

A Summary of the Riparian Health Status and Habitat Improvement Needs for Five Priority Westslope Cutthroat Trout Sites in the South Eastern Slopes of Alberta

Alberta Riparian Habitat Management Society (Cows and Fish)
Report No. 043

Cows and Fish

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About the Alberta Riparian Habitat Management Society

The Alberta Riparian Habitat Management Society (known as "Cows and Fish") is a non-profit society that strives to promote improved management and stewardship of riparian areas. As the buffer zone between our uplands and waterways, protecting riparian corridors and improving riparian health provides numerous benefits including stormwater filtration, reduced erosion, flood mitigation, groundwater recharge, and fish and wildlife habitat. Cows and Fish has worked with landowners, land managers, livestock producers and community groups across Alberta since 1992 on riparian awareness, stewardship and monitoring projects.

Cows and Fish Supporters and Members: Alberta Environment and Sustainable Resource Development, Alberta Agriculture and Rural Development, Alberta Beef Producers, Trout Unlimited Canada, Alberta Conservation Association, Department of Fisheries and Oceans, Agriculture and Agri-Food Canada Agri-Environment Services Branch, the Canadian Cattlemen's Association, producers and community groups.

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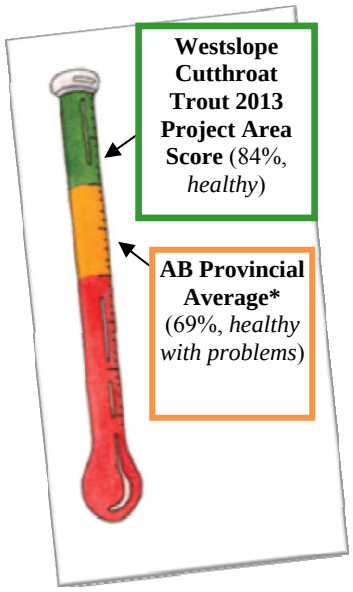
- *Riparian health inventories of small stream systems do not address in-stream, hydrological parameters (i.e. issues associated with water flow regimes, water diversions, extractions, dam impacts). Water quality testing/ monitoring is* ***not*** *conducted as part of riparian health inventories.*

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

EXECUTIVE SUMMARY

In 2013, the Alberta Riparian Habitat Management Society (Cows and Fish) conducted five riparian health inventories (RHIs) in priority native Westslope Cutthroat Trout stream reaches along Gold Creek, Lynx Creek, Rock Creek and the Livingstone River in the Oldman River basin. The 2013 project area encompassed approximately 5 km of bank length and 34 ha of riparian habitat. This project builds on riparian health inventories conducted by Cows and Fish in 2011 and 2012 on 32 priority Westslope Cutthroat Trout streams in the Eastern Slopes within the Bow and Oldman River basins. Project partners and/or primary sponsors include the Government of Canada (Environment Canada's Habitat Stewardship Program), Alberta Environment and Sustainable Resource Development (AESRD), Fisheries and Oceans Canada (DFO), the Alberta Conservation Association (ACA) and Trout Unlimited Canada (TUC). Riparian health data collected as part of this project will be used to help further Westslope Cutthroat Trout habitat stewardship and recovery efforts in Alberta. Westslope Cutthroat Trout, a *Threatened* native fish species under Canada's *Species At Risk Act* and Alberta's *Wildlife Act,* has been reduced to less than 10% of its historic range in the province.



The average riparian health rating for the five stream/river sites assessed in 2013 is 84% (*healthy*). Only one of the five sites rated slightly below the *healthy* threshold. The project area is mostly comprised of white spruce dominant riparian plant communities that display healthy levels of tree and shrub regeneration, multi-structural height layers and light to negligible browse utilization, beaver use or human clearing. Except for fire impacted reaches of Lynx Creek, the remainder of sites have minimal dead or decadent standing woody cover. Of concern, six invasive noxious weed species were recorded in the project area, primarily Canada thistle, ox-eye daisy and tall buttercup. Noxious weeds have greater than 1% cover in two of the five sites. Disturbance-caused plants exceed 25% cover in one site and have more than 5% cover in two sites. Invasive and disturbance-caused plants have encroached in areas with ground disturbance from various land uses as well as in areas subject to long-term grazing pressure. Fire impacts and recent floods contributed to accelerated bank erosion and high levels of sediment deposition in at least two sites. Major floods in June of 2013 also resulted in washout of bridges and road infrastructure along the Livingstone River and contributed to washing away standing dead trees along fire impacted reaches of Lynx Creek, causing major log jams. Although soil/hydrology parameters rated *healthy* on average, three sites received reduced health scores for human-caused bank alterations and/or floodplain alterations, mainly due to roads and trails and to a lesser extent, livestock trampling/trailing. Most sites have at least one or more forded vehicle crossings. More study is needed to determine crossing impacts on water quality parameters and sediment loading thresholds which are detrimental to Westslope Cutthroat Trout.

A brief review of next steps and management recommendations for riparian health improvements are provided in Section 5 of this report. Cows and Fish is continuing to engage with its project partners, landowners, grazing disposition holders, watershed groups, industry and recreational users and others to promote Westslope Cutthroat Trout habitat protection and improvement projects.

*Based on data collected by Cows and Fish in Alberta from 1997 to 2012 on 2,209 riparian sites on 491 waterbodies.

1 BACKGROUND

1.1 Project Overview

Reduced to less than 10% of its historic range, native pure strains of Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisii*) are now confined to a few, isolated headwater reaches in Alberta's eastern slopes (Costello 2006). As such, native pure stocks of Westslope Cutthroat Trout are designated as *Threatened* under Alberta's *Wildlife Act* and the federal *Species At Risk Act* (The Alberta Westslope Cutthroat Trout Recovery Team 2013). Given the importance of riparian areas to this species, maintaining riparian health in these remaining reaches is a priority for its continued survival.

In 2011, the Alberta Riparian Habitat Management Society (Cows and Fish) initiated a multi-year riparian health inventory (RHI) project focused on streams and rivers with native pure strains of Westslope Cutthroat Trout populations in the south eastern slopes of Alberta. The main intent of this project is to assess the current condition of priority native Westslope Cutthroat Trout riparian habitat and offer suggestions to land managers for ways to maintain or improve this habitat. This project was initiated by Cows and Fish in collaboration with Alberta Environment and Sustainable Resource Development (AESRD), Fisheries and Oceans Canada (DFO), the Alberta Conservation Association (ACA) and Trout Unlimited Canada (TUC). Primary funding for this project was provided through grants administered by ACA and through financial support provided by the Government of Canada (Environment Canada's Habitat Stewardship Program). This initiative has and will continue to involve close collaboration with fisheries biologists, Public Land managers, grazing disposition holders, private landowners, industry and recreational user groups. Since 2011, a key component of this project has been the coordination of annual multi-stakeholder workshops and educational field days aimed at building awareness about the threats facing Westslope Cutthroat Trout, identifying solutions and encouraging collaborative management actions to promote habitat improvement.

This report describes the riparian health results for five Westslope Cutthroat Trout priority sites assessed during the 2013 field season by Cows and Fish primarily in the Castle River and Crowsnest River watersheds. Individual site scores and details are provided in individual RHI summary reports submitted to AESRD, grazing allotment holders and private landowner project participants.

1.2 Summary of Westslope Cutthroat Trout RHI Sites Assessed Prior to 2013

To date (excluding 2013 sites), 37 RHIs have been conducted on 27 priority Westslope Cutthroat Trout stream reaches, encompassing a total of approximately 24 km of bank length and 63 ha of riparian habitat (Table 1, Figure 1). This includes 15 sites inventoried in 2011 and 17 sites inventoried in 2012 specifically as part of this project. Five additional sites were coincidentally inventoried on priority stream reaches prior to 2011 as part of other watershed health evaluation projects led by Cows and Fish. Riparian health results for these sites are described in previous summary reports compiled by Cows and Fish (Cows and Fish 2011; Cows and Fish 2012).

Table 1 Westslope Cutthroat RHI Sites 2005, 2010 to 2012

RHI Site ID	Watercourse	Date of RHI	Bank Length Inventoried (m)	Approximate Riparian Area Inventoried (ha)	ACA/AESRD Record No.	WSCT Purity
Waiparous Creek Watershed						
WAZ1	Unnamed tributary to Waiparous Creek	2010	560	0.3	J-G3	>=0.99
JON1	Johnson Creek	2010	1000	4.0	AFW-JC	>=0.99
WAI9	Waiparous Creek	2010	300	0.2	AFW-WC	>=0.99
Elbow River Watershed						
SIL1	Silvester Creek	2012	400	1.0	AFW-SiC	≥0.99
SIL2			410	1.5		
SIL3			410	1.0		
Sheep River Watershed						
GOR1	Gorge Creek	2012	740	0.5	J-S17a	>=0.95 but <0.99
Highwood River Watershed						
CTH1	Cutthroat Creek	2012	620	1.0	AFW-CuC	≥0.99
DEE1	Deep Creek	2011	1130	1.8	J-H11	>=0.99
FLA1	Flat Creek	2012	680	0.8	J-H7b	>=0.95 but <0.99
PEK15	Pekisko Creek	2012	710	0.7	AFW-PeC	>=0.95 but <0.99
PEK17			550	0.6	AFW-PeC	>=0.95 but <0.99
ZEP1	Zephyr Creek		550	1.0	J-H18	>=0.99
Willow Creek Watershed						
COL1	Corral Creek	2011	690	2.5	J-C1	≥.99
COL2		2011	450	1.1	D-W4	≥.99
JOH3	Johnson Creek	2011	890	3.6	D-W2	<0.95
JOY1	Unnamed Tributary to Johnson Creek	2011	660	0.9	D-W1	<0.95
WIL15	Willow Creek	2011	730	3.3	No data point	N/A*
Upper Oldman River Watershed						
HID1	Hidden Creek	2011	750	1.9	AFW-HC	>=0.99
HID2		2011	690	1.6	above D-04	>=0.99
OLD37	Oldman River (above falls)	2011	930	1.6	AFW-Ora	>=0.95 but <0.99
Callum Creek Watershed						
SHA1	Sharples Creek	2011	890	0.5	D-O3	>=0.99
Todd Creek Watershed						
TCT1	Unnamed Tributary to Todd Creek	2012	30	<0.1	ACA-Crow-8	>=0.95 but <0.99
TCT2		2012	510	0.8		
TCT3		2012	230	0.4		
Crowsnest River Watershed						
ALL1	Allison Creek	2012	1730	3.5	D-Cr2	>=0.95 but <0.99
ALL2			470	0.5	ACA-Crow-24	>=0.95 but <0.99
BLC1	Blairmore Creek	2005	90	0.1	BCA	0.95-0.99
Castle River Watershed						
CRT1	Carbondale River Tributary	2005	50	0.2	D-C4	>=0.99
CRB1	Carbondale River	2012	990	2.5	AFW-CaR	≥0.99
CRB2			690	2.1	ACA-59	>=0.95 but <0.99
LST1	Lost Creek	2011	870	5.5	AFW-LoC	>=0.95 but <0.99
LYX1	Lynx Creek	2011	880	1.1	ACA-83	>=0.99
LYX2		2011	1000	8.1	AFW-LyC	>=0.99
NLS1	North Lost Creek	2011	670	2.7	ACA-51	>=0.99
OHA1	O'Hagen Creek	2012	830	3.4	D-C4	≥0.99
SYN1	Syncline Brook	2012	520	0.4	ACA-44	≥0.99

Sites are listed alphabetically by sub-watershed based on geographic location from north to south.

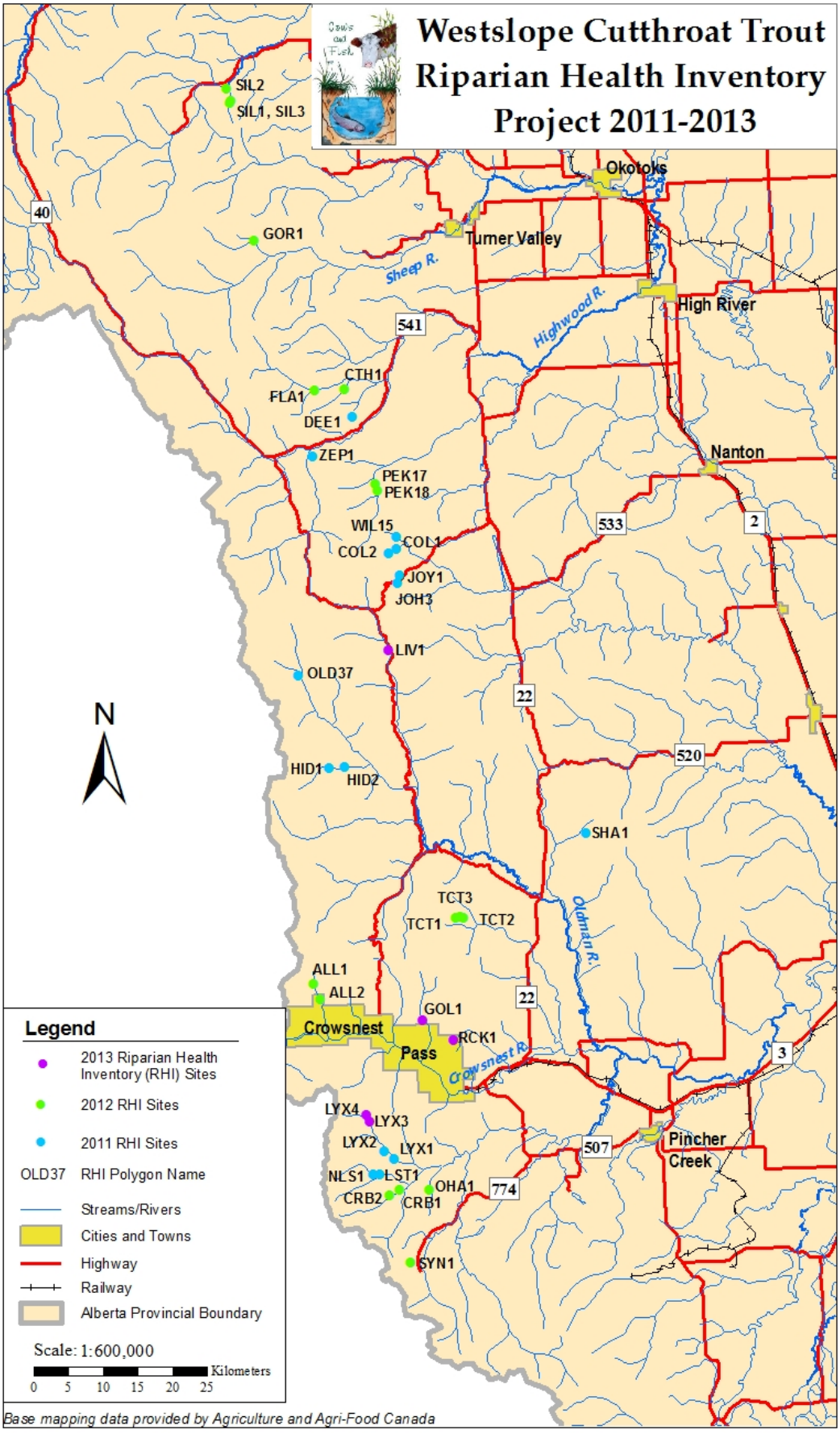


Figure 1 Westslope Cutthroat Trout 2011 to 2013 Riparian Health Inventory Locations

2 2013 RHI PROJECT AREA DESCRIPTION

Site Selection and 2013 Project Area Description

As was done in 2011 and 2012, RHI locations for this project were identified and selected in consultation with a collaboration of fisheries experts from AESRD, DFO, ACA and TUC. RHI sites were strategically selected on watercourses where recent fisheries assessments have confirmed the presence of genetically pure (95% purity or higher) Westslope Cutthroat Trout populations. To assist with site selection, AESRD provided Cows and Fish with a database of Westslope Cutthroat Trout population surveys and genetic purity for the Southern Rockies. Final site selection was determined based on access considerations, field scouts and/or consultation with the appropriate regional AESRD Fisheries Biologist and AESRD Public Lands, Rangeland Agrologist.

In total, five sites were assessed from July to August, 2013 along select reaches of the Livingstone River, Gold Creek, Rock Creek and Lynx Creek (Table 2, Figure 1). Approximately 5 km of bank length and 34 ha of riparian habitat were assessed as part of the 2013 project area (Table 2).

Table 2 Westslope Cutthroat Trout 2013 Project Area RHI Sites

RHI Site ID	Watercourse	2013 RHI Assessment Date	Streambank Length Inventoried (m)	Approximate Riparian Area Inventoried (ha)	ACA/AESRD Record No.	WSCT Purity
Livingstone River Watershed						
LIV1	Livingstone River	July 31	1430	15.9	(downstream from AFW-LR; but still above falls)	>=0.99
Crowsnest River Watershed						
GOL1	Gold Creek	July 30	560	0.8	(between GC13BP and GC18BP)	>=0.99
RCK1	Rock Creek	August 8	820	0.8	(upstream of AFW-RoC1)	>=0.99
Castle River Watershed						
LYX3	Lynx Creek	August 1	1390	11.2	(upstream of AFW Lyc and the Lynx Creek falls)	>=0.99
LYX4		August 1	820	4.9	(upstream of AFW Lyc and the Lynx Creek falls)	>=0.99
		TOTAL	5020	33.6		

Sites are listed based on geographic location from north to south.

Land Use and Land Management

With the exception of one private landholding on Rock Creek, the remainder of the 2013 RHI sites are located in headwater stream/river reaches in either Public Land grazing leases or multi-use Alberta Forest Reserve lands, managed by AESRD (Table 3). Forest Reserve lands encompass the Castle Special Management Area Public Land Use Zone (PLUZ)[1] and the Livingstone River grazing allotment. Public grazing leases are located in the M.D. of Ranchlands and the Municipality of Crowsnest Pass (Table 3). The entire project area occurs within the Montane Natural Subregion of Alberta's Rocky Mountain Natural Region (Natural Regions Committee 2006).

The project area is used for livestock grazing, recreation and industrial land uses (i.e. logging, oil and gas exploration) in the Forest Reserves. Many of the sub-basins within the project area are popular with both non-motorized (horseback riding, hiking, biking) and motorized recreational users (various types of off-highway vehicles [OHVs]). Several of these activities have increased in recent years (recreation) or are likely to increase (i.e. logging and oil and gas development). The need for comprehensive management planning in these headwater reaches is critical to ensure all land uses continue in a planned way, while ensuring the protection of riparian health, Westslope Cutthroat Trout habitat, water quality and other ecological goods and services that those within and downstream of the watershed rely on. Access management maps and guidelines for recreational use activities are available on-line for the Castle Special Management Area PLUZ.[2]

Table 3 Administrative Land Management Units within the 2013 Project Area

RHI Site ID	Watercourse	Land Management Unit	Municipality or PLUZ	Natural Region (NR) and Subregion (SR)
Livingstone River Watershed				
LIV1	Livingstone River	PNT970052	MD of Ranchlands	Rocky Mountain NR, Montane SR
Crowsnest River Watershed				
GOL1	Gold Creek	GRP 870052	MD of Ranchlands / Municipality of Crowsnest Pass	Rocky Mountain NR, Montane SR
RCK1	Rock Creek	Private Landholding	Municipality of Crowsnest Pass	Rocky Mountain NR, Montane SR
Castle River Watershed				
LYX3	Lynx Creek	Pincher Creek Stock Association (PNT 940206)	Castle Special Management Area PLUZ	Rocky Mountain NR, Montane SR
LYX4				

Sites are listed based on geographic location from north to south.

[1] Formerly referred to as "Forest Land Use Zones", "Public Land Use Zones are "*an area of public land to which legislative controls apply under authority of the Forests Act, Forest Recreation Regulation (343/1979) to assist in the management of industrial, commercial, and recreational land uses and resources*" (http://esrd.alberta.ca/recreation-public-use/recreation-on-public-land/public-land-use-zones/default.aspx)

[2] http://esrd.alberta.ca/recreation-public-use/recreation-on-public-land/public-land-use-zones/castle-area-pluz.aspx

3 METHODS

3.1 Riparian Health Inventory (RHI)

Riparian Health Inventories provide comprehensive information about the diversity, structure and health of plant communities and physical site integrity within the project area. This information will assist AESRD, ACA, TUC and DFO in recovery planning for Westslope Cutthroat Trout by:

- creating a baseline of riparian habitat status in priority reaches;
- identifying habitat degradation issues and concerns; and
- providing land managers and other stakeholders with an engagement tool to promote awareness and take action toward habitat improvement.

During a RHI, 79 health parameters are examined to provide comprehensive and detailed information on riparian function. For streams and small rivers, an overall riparian health rating is derived from six vegetation and five soil/hydrology parameters (i.e. key indicators of riparian function). A description of these parameters and how they are evaluated is provided in **Appendix C.** By objectively examining each of these health parameters, we can determine where best to concentrate management efforts aimed at improving riparian health. For a more detailed review of the RHI method, refer to Cows and Fish (2012). Riparian health ratings fall into one of three categories as described in Table 4.

Table 4 Description of Riparian Health Ratings

Health Category	Score Ranges	Description
Healthy	80-100%	Little to no impairment to any riparian functions
Healthy with problems	60-79%	Some impairment to riparian functions due to management or natural causes
Unhealthy	<60%	Severe impairment to riparian functions due to management or natural causes

Healthy riparian areas have the following pieces intact and functioning properly (Fitch *et al.* 2001):

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

3.2 General Inventory Protocol

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

A hand-held Garmin GPS60^{TM} Global Positioning System (GPS) receiver is used to record the locations of the upstream and downstream ends of the site. For monitoring purposes, benchmark photographs looking upstream and downstream are taken at each end of the site. Additional photographs are taken where warranted to document features of interest or concern (e.g. weed infestations, bank erosion, etc.). The lateral extent (outer boundary) of the riparian area is determined in the field and traced by hand on an airphoto. The inner RHI boundary includes the portion of the wetted channel with persistent emergent vegetation (e.g. cattails and sedges). In situations where there is no emergent vegetation, the wetted channel (aquatic zone) is not included in the assessment. A combination of indicators, including vegetation change to predominantly upland species, topographic breaks and flood evidence, are used to delineate the outer boundary of the riparian area.

On creeks and small rivers, both sides of the waterbody are inventoried, as these generally have the same ownership and type of management. Landmarks such as fence lines, tributaries or other identifiable features are used, where possible, to delineate the ends of the site in order to facilitate monitoring the same section of stream in the future. Inventory sites encompass a minimum of two meander cycles (Fitch *et al.* 2001). A complete meander cycle has equal inside and outside curvature.

3.3 Classification of Riparian Plant Communities

The Range Plant Community Type Guide for the Montane Subregion (Willoughby *et al.* 2008) was used to classify riparian plant communities in the project area. This Montane guide is based on field sampling of over 1,800 sites in the Montane Subregion in Alberta. Plant community types that did not fit with any of the types in this guide were described as "Unclassified" and assigned a conditional plant community name based on dominant plant species in one or more life form layers (as appropriate).

3.4 Additional Westslope Cutthroat Trout Habitat Data

To describe in-stream habitat characteristics, measurements were taken of channel width; channel bottom substrate composition; and "embeddedness" and "cementedness" as described in detail in Cows and Fish (2012). "Embeddedness" and "cementedness" refer to course estimates that were taken to assess the degree to which small cobble and gravel substrate were "embedded" or "cemented" by the long-term accumulation of fine sediment. Additional photographs and waypoints were also taken to document any potential barriers to fish movement (e.g. headcuts >50 cm vertical height, hanging culverts etc.) encountered along the entire RHI reach.

4 RESULTS AND DISCUSSION

4.1 Overview of Riparian Health Results

The average riparian health rating for the five stream sites assessed in 2013 is 84% (*healthy*). The majority of sites (four out of five) rated *healthy*; only one of the five sites rated *healthy with problems* (Figure 2). By area, of the approximately 34 ha of riparian habitat evaluated, 85% (29 ha) rated *healthy* and 15% (4 ha) rated *healthy with problems* (Figure 3). The assessed sites range from 0.8 ha along Gold Creek and Rock Creek to approximately 16 ha in size along the Livingston River (Table 2).

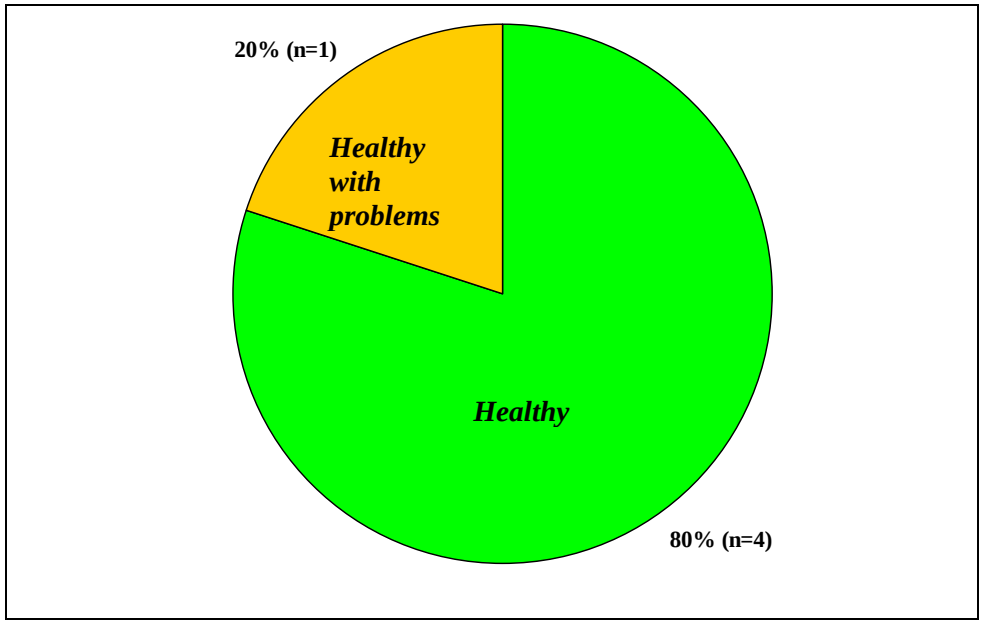


Figure 2 2013 Project Area Riparian Health Results

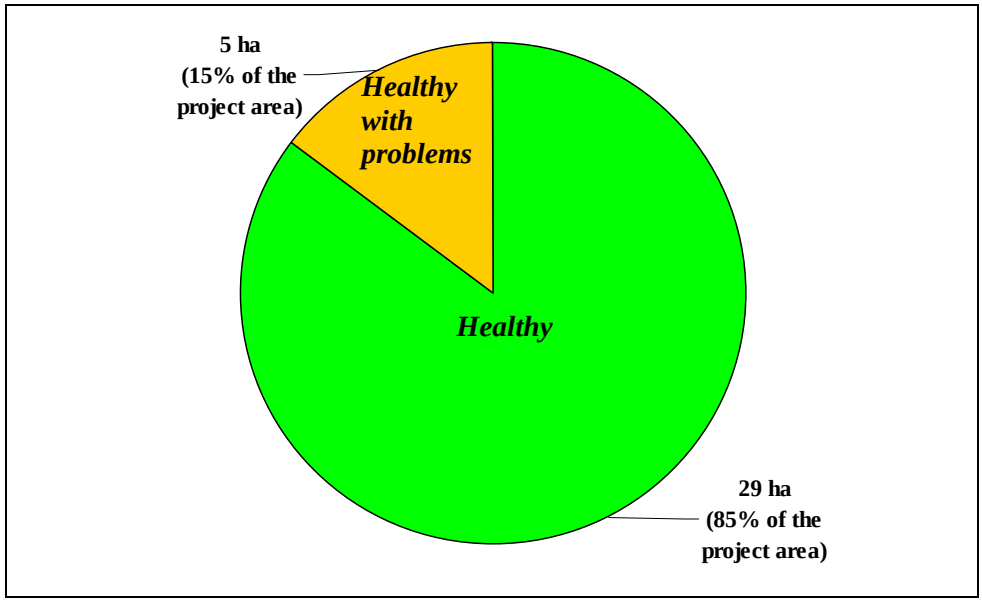


Figure 3 2013 Project Area Riparian Health Results By Area

4.2 Riparian Plant Communities in the Project Area

Five community types were described for the project area using the 2008 Montane Range Plant Community Guide (Willoughby *et al.* 2008) (Table 5). The majority (approximately 70%) of the project area is characterized by white spruce community types (Table 5).

Table 5 Plant Community Types in the Project Area

Plant Community*	AESRD Range Plant Community Guide Plant Community Code*	RHI Sites Where Found	Frequency of Occurrence in RHI Sites	Area Occupied (ha)	Area Occupied (%)
Tree Community Types					
white spruce / thimbleberry	E16	LYX3, LYX4	40%	14.6	43.2%
white spruce / pine grass	H15	LIV1	20%	6.4	18.8%
white spruce – trembling aspen / dwarf scouring rush	F12	GOL1, RCK1	40%	1.6	4.8%
Shrub Community Types					
Drummonds willow	D2A	LIV1, LYX3, LYX4	60%	6.4	18.9%
Herbaceous Community Types					
rough fescue – hairy wild rye	B15	LIV1	20%	4.8	14.1%

**Based on Willoughby et al. 2008. Listed in order of decreasing size by area.*

Tree Communities

By area, the dominant tree community in the project area is a late successional, fire impacted white spruce / thimbleberry (*Picea glauca / Rubus parviflorus*) community (Table 5). This community type usually occurs on north aspects with well drained, mesic (moderately moist) and mesotrophic (moderately nutrient rich) sites (Willoughby *et al.* 2008). This tree community occurs exclusively along Lynx Creek (**Photos a** and **b**, page 11). Up to 40% of the LYX4 white spruce canopy is dead or decadent due to fire, while up to 20% of the LYX3 white spruce canopy has been fire damaged. The white spruce / thimbleberry community type is rated as "non-use" for domestic livestock by ESRD; however, succession following a fire event may increase herbaceous forage productivity in the short-term (Willoughby *et al.* 2008).

A white spruce / pine grass (*Picea glauca / Calamagrostis rubescens*) community type occurs primarily in the west floodplain of the LIV1, Livingstone River site. This community tends to be found on shallower slopes and in low slope positions with more moisture. Due to occurrence of lodgepole pine and disturbance herbaceous species in the stand, it may represent a site that has been historically harvested or subject to fire disturbance (Willoughby *et al.* 2008).

Riparian habitat along the narrow, steep sided Rock Creek and Gold Creek valleys is best characterized as a white spruce – trembling aspen / dwarf scouring-rush (*Picea glauca – Populus tremuloides / Equisetum scirpoides*) community type (**Photo c**, page 11). This community occurs in moist, nutrient

rich, lower slope sites. Succession progresses from balsam poplar, as a pioneer species, to white spruce, as the climax species. Both the RCK1 and GOL1 sites have at least 20% cover from balsam poplar in the forest stand. The RCK1 site may be trending away from the climax community type as it has a high proportion of disturbance species in the understory, higher cover of increaser shrubs (e.g. raspberry [*Rubus idaeus*] and buckbrush [*Symphoricarpos occidentalis*]), and little cover from horsetail or scouring-rush. By comparison, the GOL1 site more closely resembles the described climax community with fewer disturbance species and much higher cover of both common horsetail (*Equisetum arvense*) and dwarf scouring-rush. River alder (*Alnus tenuifolia*) is common to both sites.

Shrub Communities

One shrub community, the Drummonds willow (*Salix drummondii*) type, was described for the Lynx Creek and Livingstone River sites (Table 5). This community type is typical of higher elevation riparian sites in the montane to subalpine (Willoughby *et al.* 2008). Drummonds willow occurs immediately along the streambank in the LYX3, LYX4 and LIV1 sites in moist, frequently flooded soils (**Photos a, b** and **d**, page 11). Succession is expected to shift to a white spruce dominated forest if the channel shifts, leading to drier soil conditions. This dense shrub community is rated by ESRD as non-use for domestic livestock (Willoughby *et al.* 2008).

Herbaceous Communities

Most of the project area has tree and shrub canopy cover. Small patches of herbaceous cover within tree and shrub complexes were not separately mapped or classified. Only one native herbaceous type was delineated as a unique community type in the LIV1 site (Table 5) (**Photo e**, page 11). The rough fescue – hairy wild rye (*Festuca scabrella – Elymus innovatus*) type occurs on the outer edge of the LIV1 riparian floodplain on the east side of the river. It appears to be trending away from the described type possibly due to livestock grazing disturbance as indicated by an absence of rough fescue, higher amounts of bluebunch (or Idaho) fescue (*Festuca idahoensis*) and high amounts of shrubby cinquefoil (*Potentilla fruticosa*), both of which are grazing 'increaser' species.

Plant Species Diversity in the Project Area:

There is a high diversity of native plant species in the project area. Greater plant species diversity creates more robust and steady primary productivity over the long term and enhances resilience to changes in the environment due to natural year-to-year fluctuations, climate change, pest outbreaks and disease.

- A total of 169 plant species were recorded in the project area (**Appendix B**), including 5 tree, 33 shrub, 37 grass/grass-likes and 94 forb species (**Appendix B**). Of these species, 146 (86%) are confirmed native species, 22 (13%) are introduced (non-native) forbs or grasses (including invasives) and one is a rye (*Elymus* genus) grass that could not be identified to species.
- Dominant trees and shrubs include white spruce, balsam poplar, Drummonds willow, shrubby cinquefoil and shining willow (*Salix lucida*) (**Appendix B**).

Photo a: Drummonds willow occurs along the banks of Lynx Creek (LYX3 shown here) buffered by a fire damaged white spruce/thimbleberry type in the floodplain. (*Photographer: J. Melsted, Catalogue No: RHIP03LYX012*)

Photo b: As in LYX3, the LYX4 site also has a distinct band of Drummonds willow along the bank and a white spruce dominated community in the floodplain, some of which escaped fire damage. (*Photographer: J. Melsted, Catalogue No: RHIP03LYX002*)

Photo c: White spruce cover is most dense at the upstream end of the RCK1 site; balsam poplar and willow cover increases in the spruce understory toward the downstream end. (*Photographer: K. Stebanuk, Catalogue No: RHIP01RCK002*)

Photo d: Dense stands of Drummonds willow occur along portions of the Livingstone River bank (LIV1 site). Riverbank reaches lacking willow were more prone to erosion in the 2013 flood. Note high amounts of flood deposited sediment in the foreground. (*Photographer: J. Melsted, Catalogue No: RHIP01LIV007*)

Photo e: A disturbed open herbaceous meadow in the east floodplain of the Livingstone River (LIV1 site) with high shrubby cinquefoil cover. (*Photographer: J. Melsted, Catalogue No: RHIP01LIV025*)

EXAMPLES OF RIPARIAN PLANT COMMUNITY TYPES IN THE PROJECT AREA

- Dominant grass and grass-like species (that comprise at least 3% of the total project area) include six native species [wire rush (*Juncus balticus*), fowl bluegrass (*Poa palustris*), bluebunch fescue, June grass (*Koeleria macrantha*), alpine bluegrass (*Poa alpina*) and marsh reed grass (*Calamagrostis canadensis*)] and two introduced species [Kentucky bluegrass (*Poa pratensis*) and redtop (*Agrostis stolonifera*)] (**Appendix B**).
- Dominant forbs (that comprise at least 1% of the total project area) include seven native species [graceful cinquefoil (*Potentilla gracilis*), ragwort (*Senecio cymbalarioides*), smooth aster (*Aster laevis*), veiny meadow rue (*Thalictrum venulosum*), white angelica (*Angelica arguta*), wild strawberry (*Fragaria virginiana*) and yellow avens (*Geum aleppicum*)] and an invasive noxious weed, Canada thistle (*Cirsium arvense*).

4.3 Vegetation Health Parameter Results

The average vegetation health rating for the 2013 RHI sites is 78% (*healthy with problems*). Similar to our findings in 2011 and 2012, most sites have more than 95% vegetation cover in the riparian area, healthy levels of establishment and regeneration of native trees and shrubs, low levels of woody vegetation removal by beavers or humans, and, with the exception of Lynx Creek sites, low levels of dead and decadent trees and shrubs (Figure 4). Vegetation health concerns include invasive and disturbance-caused non native species cover and/or density distribution (Figure 4). Browse utilization is not a concern for most of the 2013 sites.

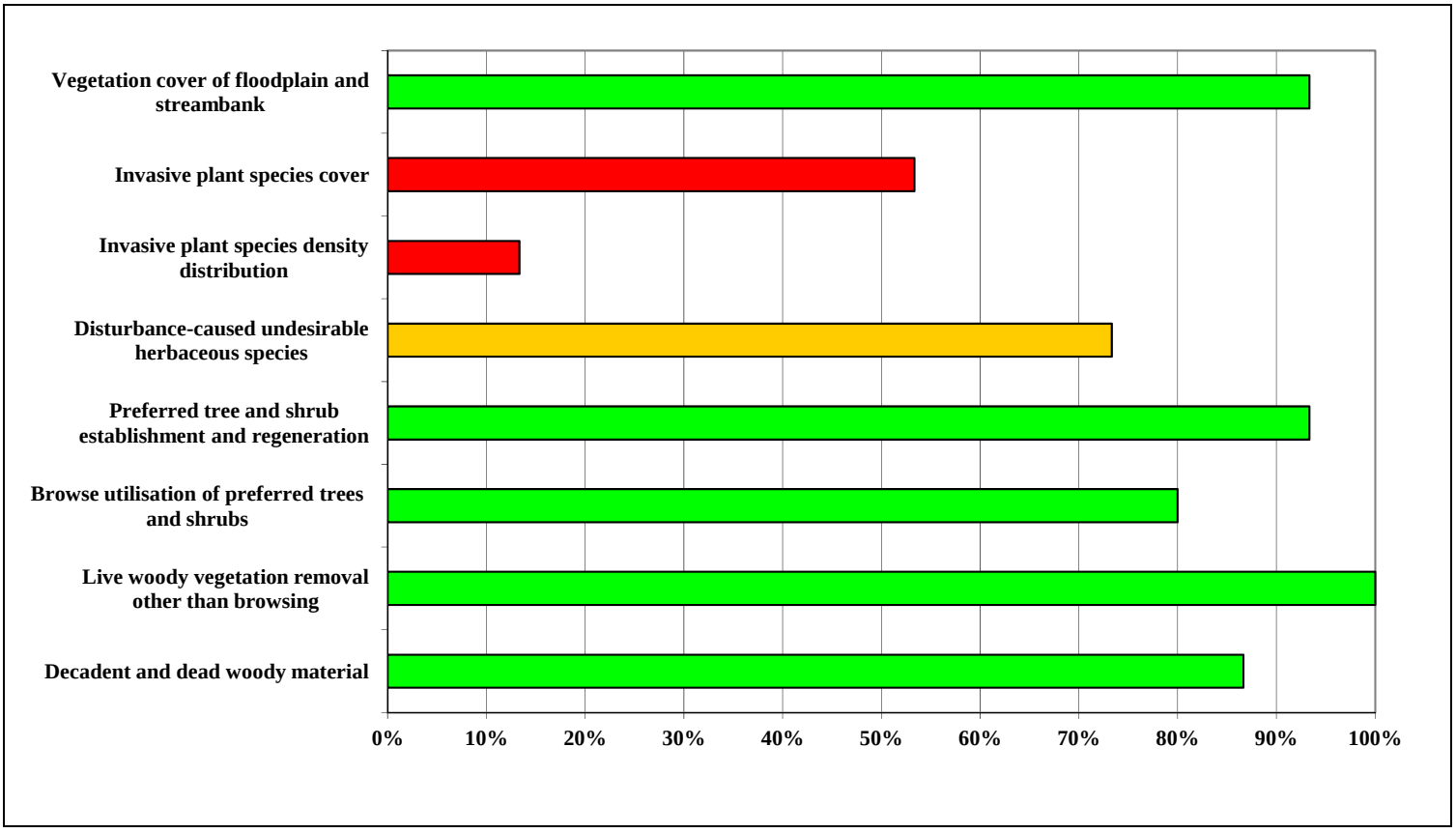


Figure 4 Vegetation Health Parameter Results

Herbaceous (Non-Woody) Riparian Health Parameters

Invasive species occur in all of the 2013 RHI sites (**Photo h**, page 15). Disturbance-caused species are also prevalent. Invasive plants are introduced species that are listed on Alberta's *Weed Control Act* as ***prohibited noxious*** and ***noxious*** weeds and others known to be problematic in riparian areas. They are non-native species that spread rapidly and are difficult to control. Disturbance-caused plants are typically non-native grasses and forbs that aggressively displace native plants once the soil surface has been disturbed.

An influx of shallow-rooted invasive and disturbance-caused plants can negatively impact Westslope Cutthroat Trout habitat by reducing overhanging woody cover and accelerating bank erosion, thereby contributing to increased sedimentation and degraded water quality. These undesirable plants also contribute to degraded rangeland health and productivity. Livestock avoid many invasive species (e.g. ox-eye daisy [*Chrysanthemum leucanthemum*] and tall buttercup [*Ranunculus acris*]) as they are highly unpalatable and have poor forage value. Tall buttercup is particularly problematic as it contains high concentrations of an irritant, protoanemonin, which causes inflammation of the throat and digestive tract in livestock and can be fatal if large quantities are ingested (Tannas 2004). Widespread incursion of invasive and non-native disturbance-caused plants may also alter the dynamics of natural food webs due to displacement of preferred native plant species that have evolved with the local fauna.

- **The prevalence of invasive plants is a concern.** Six invasive noxious weed species were recorded in the project area, including Canada thistle, common mullein (*Verbascum thapsus*), ox-eye daisy, perennial sow-thistle (*Sonchus arvensis*), tall buttercup and yellow toadflax (otherwise known as 'butter-and-eggs') (*Linaria vulgaris*).
- **The most widespread and abundant invasive species in the project area are Canada thistle, ox-eye daisy and tall buttercup.** Canada thistle occurs in all five sites, but is most abundant in the LYX4 site; it comprises approximately 2% by cover of the project area. Ox-eye daisy is prevalent along Lynx Creek and it also occurs along Gold Creek. Tall buttercup is present in all sites with the exception of the LIV1 site; it is most prevalent in the GOL1 site.
- **Collectively, invasive plants comprise approximately 2% of the 2013 project area.** Combined weed cover is highest (approximately 10%) for the LYX4 and GOL1 sites, but less than 1% cover in the remainder of sites.
- **Invasive plants are widespread (i.e. have a high density distribution) in all sites.** All of the 2013 RHI sites have unhealthy density distribution scores for invasive weeds (i.e. more than a few patches of weeds).
- **Non-native disturbance-caused plants have >25% cover in one site; 5-25% cover in two sites and <5% cover in two sites.** Disturbance-caused plants are associated with historic and recent human and natural-caused disturbance factors, mainly recreational use impacts, livestock grazing and recent fire disturbance.

- **Of the 15 disturbance-caused plants present, 5 are grasses and 10 are forbs.** Most of these are introduced species such as timothy and clover, but five are native species that naturally colonize areas of exposed soil (e.g. wild strawberry). The most abundant disturbance-caused plants are Kentucky bluegrass, timothy (*Phleum pratense*), white clover (*Trifolium repens*) and common dandelion.

Total Vegetation Cover and Woody Canopy Cover

A high level of vegetation cover in the riparian area, in particular cover from native trees and shrubs, provides soil stabilization and minimizes potential for erosion and sediment runoff into trout bearing streams. Riparian habitats in the moist foothills and montane regions of Alberta typically all have potential to support tree and shrub community types. A diversity of native woody plants provides short, medium, and tall wildlife habitat layers and a diversity of rooting depths across the site.

- With the exception of the LIV1 site, all other RHI sites in the 2013 project area have greater than 95% vegetation cover in the riparian zone (**Photo f**, page 15). Sediment deposition from the major June 2013 flood event contributed to high levels of exposed soil in the LIV1 site.
- A wide variety of native trees and shrubs, in combination, cover approximately 65% of the project area (**Photo g**, page 15). Refer to page 10 and **Appendix B** for a listing of dominant tree and shrub species in the project area.

Woody (Tree and Shrub) Riparian Health Parameters:

- ***Establishment and Regeneration***

A good indicator of ecological stability of a riparian reach is the presence of woody plants in all age classes, especially young age classes. To maintain age class structure, at least 15% of the total cover of preferred trees and shrubs should be comprised of seedlings and saplings. Preferred woody plants include deeply rooted native species and/or preferred browse species for livestock or wildlife such as red-osier dogwood and willows.

All of the 2013 RHI sites have healthy or near healthy levels of tree and shrub regeneration (**Photo i**, page 15).

- ***Browse Pressure and Woody Plant Removal***

All of the 2013 RHI sites have light to negligible levels of browse use from livestock and wildlife. Woody plants can sustain low levels of use, but greater browse pressure can deplete root reserves and inhibit establishment and regeneration. Live woody vegetation removal unrelated to browse (e.g. human cutting, clearing or beaver use) is minimal, with most sites showing limited or no signs of this type of removal. No recent beaver activity was observed in any of the sites.

Photo f: Most sites, like this reach of Gold Creek, have dense riparian tree and shrub canopy cover, beneficial for erosion resistance, streambank shading and thermal cover. (*Photographer: J. Melsted, Catalogue No: RHIP01GOL001*)

Photo g: A multi-structured tree and shrub canopy is one indicator of riparian health. (*Photographer: S. Yuckin, Catalogue No: RHIP04LYX007*)

Photo h: Disturbance-caused and invasive plants like ox-eye daisy are encroaching along trails and roads in the project area. (*Photographer: S. Yuckin, Catalogue No: RHIP04LYX006*)

Photo i: Most sites have healthy levels of tree and shrub seedlings and saplings, indicating successful stand regeneration. (*Photographer: J. Melsted, Catalogue No: RHIP01GOL009*)

Photo j: Lynx Creek sites have high levels of dead and decadent woody material due to fire damage; fire killed trees are susceptible to floods and winds, creating log jams and high in-stream woody debris. (*Photographer: J. Melsted, Catalogue No: RHIP03LYX019*)

Photo k: Fire damaged reaches along Lynx Creek show healthy levels of natural tree and shrub regeneration. (*Photographer: S. Yuckin, Catalogue No: RHIP04LYX011*)

VEGETATION HEALTH PARAMETER PHOTOGRAPHS

- ***Woody Canopy Dead and Decadence***

With the exception of the fire impacted Lynx Creek sites, existing tree and shrub communities show minimal 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.

The 2003 widespread Lost Creek fire impacted both the LYX3 and LYX4 sites, contributing to high levels of dead/dying white spruce cover (**Photo j**, page 15). Standing, rooted dead/dying fire-damaged trees still contribute to overall vegetation cover although they are easily susceptible to wind and flood damage. Recent flooding contributed to high levels of in-stream woody debris along Lynx Creek, which may restrict fish movement in low flow periods. Burned areas are expected to heal over time through natural processes of tree and shrub regeneration. Both the LYX3 and LYX4 sites show high amounts of natural regeneration (**Photo k**, page 15).

4.4 Soil and Hydrology Health Parameter Results

The average soil and hydrology health rating for the 2013 RHI sites is 90% (*healthy*) (Figure 5). Most sites have minimal amounts of human-caused bare ground; adequate levels of streambank rootmass protection and un-incised channel profiles. Several sites have minor structural alterations in the floodplain and one or multiple stream crossings. Although stream crossings do not affect a large portion of the bank reach in most sites, it is important to keep in mind that these crossings may cause perpetual sediment inputs. Crossings can therefore have notable negative impacts to water quality. Although bridge crossings are a preferable option, bridges require regular maintenance and repair and must be professionally designed to mitigate erosion risks (**Photo p and q**, page 19).

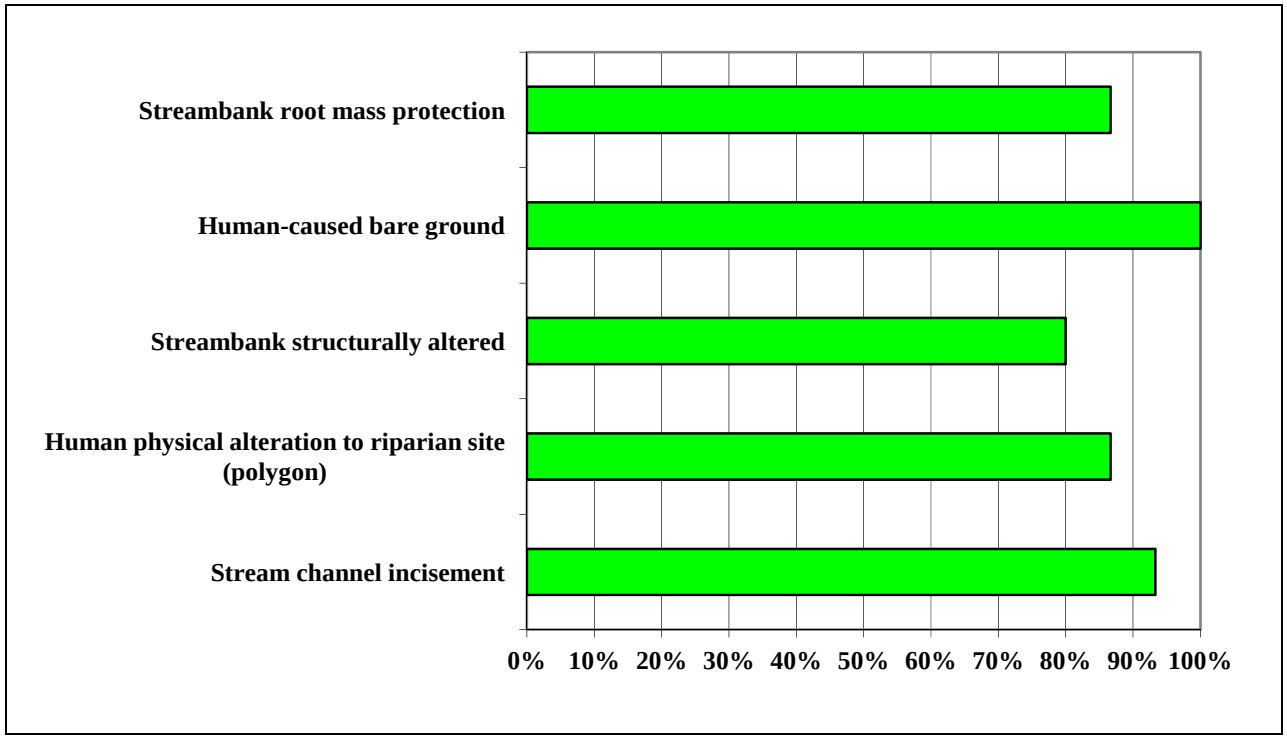


Figure 5 Soil and Hydrology Health Parameter Results

Streambank Stability and Root Mass Protection

The role of streambank vegetation is to maintain the integrity and structure of the bank by dissipating energy, resisting erosion and trapping sediment to build and restore banks. Healthy, well vegetated riparian areas slow the rate of erosion and balance erosion in one spot with bank increases through deposition elsewhere. If unstable banks are occasional, limited to a few outside meander bends and the banks revegetate within a year, erosion rates are likely minor. Accelerated bank erosion and removal of streambank vegetation can lead to rapid loss of riparian function, including degradation of habitat for Westslope Cutthroat Trout due to sediment inputs, loss of overhead cover, depleted water quality and degraded spawning and rearing habitat.

- With two exceptions, the majority of the 2013 RHI sites have healthy levels of streambank root mass protection (i.e. >85% of the reach has deep, binding root mass along the bank) (**Photo l,** page 19).
- Rootmass protection is slightly reduced (i.e. 65-85% of the reach has deep, binding root mass along the bank) for the LIV1 and the LYX4 sites. The Lynx Creek reach was heavily impacted by a 2003 wild fire. Both reaches were also impacted by the major June 2013 flood event, a significant erosive force.

Human-caused Bare Ground

Bare ground is unprotected soil that is capable of being eroded by rain drops, overland flow and wind. Bare ground in riparian areas is often present due to natural processes (e.g. sediment deposition from recent flood events). Bare ground can also result from activities such as vehicle traffic, livestock hoof shear and trailing, recreational trails, timber harvest and landscaping. Areas of natural or human-caused bare ground are susceptible to the encroachment of invasive and disturbance-caused species. Elevated levels of exposed soil due to human-causes can also contribute to abnormally high sediment inputs into trout bearing streams with negative consequences to the availability of suitable spawning habitat and degraded water quality concerns.

- Due to high amounts of exposed soil in the LYX3 and the LIV1 sites, approximately 12% (4 ha) of the 2013 project area has bare ground. The majority of bare ground (97%) is due to natural deposition of sediment as a result of the June 2013 flood.

- All sites have minimal amounts (<1%) of human-caused bare ground. Of the 0.1 ha of human-caused bare ground, 75% has resulted from recreational land use activities (e.g. trails, random camping, etc.); 24% is from livestock impacts (e.g. trails and hoof shear) (**Photo m**, page 19); and 2% is from logging impacts.

Human-caused Alterations to the Streambank and Floodplain

A key function of riparian areas is to filter and trap sediment. This builds a soil layer of moist, fine-textured material. Associated with this, roots and underground fauna create soil structure and macropores that allow water infiltration and storage. These types of soils are very susceptible to

vehicle traffic, hoof action and compaction. When a streambank is physically altered, erosion may increase, mobilizing channel and bank materials. As a consequence, water quality may deteriorate and instability can increase within the reach as well as downstream, with negative consequences to Westslope Cutthroat Trout habitat and downstream water users.

- Three sites have minimal human-caused bank alterations (i.e. <5% of their bank length is altered by human activities); one site has minor levels of human-caused bank alterations (i.e. 5 to 15% of the bank length is altered); and one site has moderate levels of bank alterations (i.e. 15 to 35% of the bank length is altered).

- In total, approximately 270 m of bank length in the 2013 project area (i.e. approximately 5% of the total streambank length examined) has human-caused bank alterations. The dominant cause of bank alteration is livestock hoof shear and trampling along 150 m of bank length. Roads and OHV trail crossings impact about 50 m and 70 m of total bank length, respectively. 'Vegetation removal' by humans and rip-rap erosion protection are minor contributors to bank alteration in at least one site. As mentioned, although minor in spatial extent, streambank alterations such as heavily used stream crossings can have a major impact on water quality. Steeply sloping braided trails present a particular concern to water quality.

- Three of the five sites have less than 5% of the entire riparian area (excluding streambanks) physically altered by human causes (these sites all rate as healthy for this parameter). The remaining two sites have minor levels of floodplain alterations (i.e. 5% to 15%).

- Overall, about 7% (2.2 ha) of the project area, away from the streambank, has human-caused alterations. Of this 2.2 ha of structurally altered floodplain, roads impact 1.6 ha and soil compaction from other land uses impacts 0.6 ha of riparian area. Alteration causes include recreational impacts (70%) (**Photos n and o**, page 19), livestock trampling and trailing (17%) and logging (12%).

Channel Incisement

Periodic flood events are important to disperse moisture throughout the riparian area for the maintenance of riparian vegetation. Flooding also spreads the energy of moving water over the riparian area, allowing sediment to be deposited and creating new areas for seedling tree and shrub establishment. Channel incisement, or downcutting, can limit the ability of a river to access its floodplain during high water events. Streams are incised when downcutting has significantly lowered the channel so that the average two-year flood event cannot escape the existing channel.

- Most sites in the project area rate healthy for this parameter. This means that high water events can periodically access the highest terraces of the floodplain, indicating that these stream reaches are not incised.

- The only stream reach with a slightly incised channel profile is the LYX4 site. The combined influence of fire damage and heavy flooding may be contributing factors to incisement along this portion of Lynx Creek.

Photo l: The majority of streambank reaches in the project area have minimal structural alterations and high amounts of deeply rooted plants. (*Photographer: J. Melsted, Catalogue No: RHIP01GOL002*)

Photo m: Livestock trampling and trailing is the main contributor to bank and floodplain soil compaction in at least two sites. (*Photographer: K. Stebanuk, Catalogue No: RHIP01RCK003*)

Photo n: Recreational trails and roads contribute to soil compaction and sedimentation concerns in the project area. (*Photographer: J. Melsted, Catalogue No: RHIP03LYX010*)

Photo o: Washed out bridge crossing due to major flooding in 2013 along the Livingstone River. (*Photographer: J. Melsted, Catalogue No: RHIP01LIV018*)

Photo p: A rutted, eroded OHV trail adjacent to the Livingstone River. (*Photographer: J. Melsted, Catalogue No: RHIP01LIV021*)

Photo q: Gold Creek bridge crossing. Bridges can help alleviate water quality impacts but must be properly installed, inspected and maintained. Bridge approaches, if not well designed, can continue to be a source of sediment. (*Photographer: J. Melsted, Catalogue No: RHIP01GOL016*)

SOIL AND HYDROLOGY HEALTH PARAMETER PHOTOS

4.5 Additional Westslope Cutthroat Trout Habitat Data

Channel Substrate Data

The 2013 RHI stream channel reaches are mainly comprised of a mix of small cobbles (24%), coarse gravels (22%), fine gravels (19%) and large cobbles (15%) (Table 6, Figure 6).

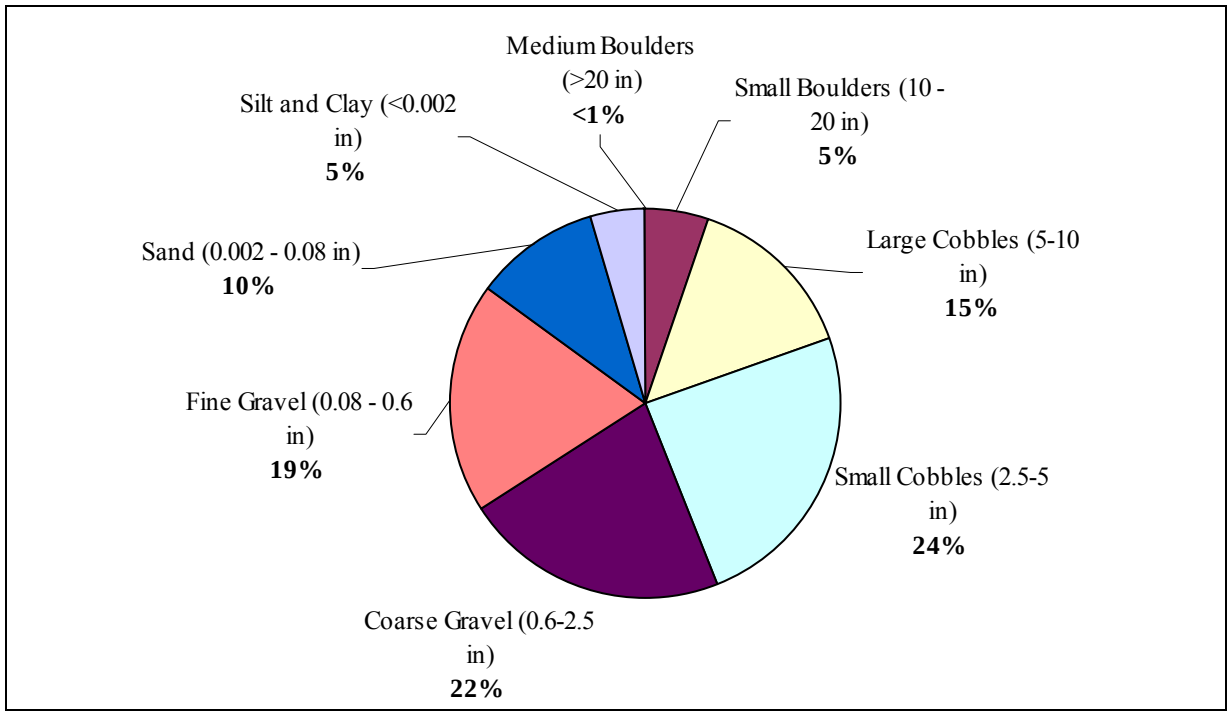


Figure 6 Average Channel Substrate Composition in the 2013 RHI Project Area

With two exceptions (RCK1 and LYX4), on average, the remainder of the 2013 RHI reaches have channel bottoms comprised of less than 5% silt and clay (Table 6).

Table 6 Average Channel Substrate Composition for the 2013 RHI Stream Reaches

RHI Site ID	>20 in. (med. Boulders +)	10-20 in (sm. boulders)	5-10 in (lg. cobbles)	2.5-5 in (sm. cobbles)	0.6-2.5 in (course gravel)	0.08 - 0.6 in (fine gravel)	0.062- 2mm (sand)	<0.062 mm (silt and clay)
GOL1	0.2%	6.7%	18.1%	41.1%	26.3%	6.7%	0.5%	0.5%
LIV1	0.2%	12.1%	20.9%	29.9%	14.3%	11.1%	8.1%	3.3%
LYX3	0.0%	1.1%	14.4%	23.6%	27.8%	26.1%	5.7%	1.2%
LYX4	0.3%	4.8%	15.7%	22.2%	27.7%	11.5%	11.1%	6.8%
RCK1	0.0%	0.5%	2.7%	5.3%	15.3%	36.6%	27.5%	12.0%

Embeddedness and Cementedness

Coarse estimates of 'embeddedness' and 'cementedness' were collected in all of the 2013 sites (Table 7). These measures are aimed at assessing the degree to which small cobble and gravel substrate have become embedded or cemented by the long-term accumulation of fine sediment. Most sites have relatively unembedded cobble/gravel substrate in riffle reaches where less than 25% of the rock surface is embedded in fine sediment (Table 7). In addition, none of the sites have evidence of highly cemented riffle reaches, with most reaches rated as 'loose' (uncemented) for this parameter (Table 7).

Of note, more robust techniques have recently been field tested by AESRD, Fish & Wildlife to more accurately monitor sedimentation of spawning gravels in Westslope Cutthroat Trout stream reaches. This includes the use of freeze-core sampling techniques to quantitatively collect and measure the percentage of fine sediment (silt and clay <0.063 mm) in the total mass of a streambed soil core. This technique is likely to provide a more repeatable monitoring metric for sedimentation than metrics used in this RHI study.

Table 7 Average "Embeddedness" and "Cementedness" Results

RHI Site ID	Average Embeddedness (%)	Average Loose (%)	Average Intermediate (%)	Average Cementedness (%)
LYX3	22	96	4	0
LYX4	38	73	27	0
LIV1	24	69	29	2
RCK1	14	94	3	3
GOL1	25	90	10	0

Potential Barriers to Fish Movement

Aside from three log jams along Lynx Creek (one on LYX3 and two on LYX4) (**Photos r to t**, page 22), no other obvious barriers to fish movement were observed. Log barriers along Lynx Creek resulted from heavy flooding washing away deadfall and destabilized fire-killed trees in the valley. These log jams likely do not completely obstruct fish passage, but may impede fish movement during low flows.

Photo r: A natural log barrier along LYX3 (at 11U 680595E 5487586N). (*Photographer: J. Melsted, Catalogue No: RHIP03LYX013*)

Photo s: Log jam at the upstream end of LYX4 (at 11U 680133E 5488989N). (*Photographer: S. Yuckin, Catalogue No: RHIP04LYX002*).

Photo t: Log jam along LYX4 (at 11U 680268E 5488629N). (*Photographer: S. Yuckin, Catalogue No: RHIP04LYX010*)

5 THE NEXT STEPS

This 2013 riparian health dataset represents the third year of data collection as part of this project. Cows and Fish hopes to continue this initiative over the next year (at a minimum) to fill in key riparian health data gaps within priority (i.e. ≥95% native pure) Westslope Cutthroat Trout stream reaches. Cows and Fish continues to actively engage with our project partners (AESRD, DFO, ACA and TUC) in communicating study results, planning and prioritizing future RHI sites and conducting annual multi-stakeholder consultation workshops and field days (including a streambank restoration bioengineering event held on Allison Creek on November 8, 2013). Another focus for Cows and Fish has been to work closely with RHI participants to date (including private landowners, Public Land Agrologists and their respective grazing disposition holders) to help plan and facilitate range improvements that will benefit Westslope Cutthroat Trout habitat. All project participants have received detailed site specific reports detailing the results of the RHI work to date. Each report contains a management summary that highlights steps to be taken to maintain and/or improve riparian health. To help promote and facilitate management improvements, Westslope Cutthroat Trout recovery strategies, success stories, and a general call to action were the focus of February 2014 multi-stakeholder workshop.

Below is a summary of management suggestions that will help promote conservation and enhancement of Westslope Cutthroat Trout riparian habitat. For a more detailed review of management suggestions refer to Cows and Fish (2011) and (2012).

Management Suggestions

- Maintain and carefully manage existing native riparian plant communities.
- Maintain the health and vigour of native trees and shrubs by carefully managing livestock use and avoiding new clearing of woody plants in the active riparian zone.
- Promote natural recovery of woody species in burned areas (e.g. the Lynx Creek valley). Riparian areas in recently burned watersheds should be carefully managed to promote natural recovery of woody species. Willow and poplar seedlings and saplings are especially vulnerable to livestock browse impacts.
- Control and monitor invasive weeds (with due care to native plants and water resources) in collaboration with local municipalities and watershed groups.
- Prevent further encroachment of disturbance-caused plants. It is unrealistic to completely remove these plants once they are well established in riparian areas; however, efforts to minimize new ground disturbance will help prevent further spread of undesirable disturbance-caused plants.
- Allow for rest and recovery of structurally altered portions of the streambank and floodplain where possible.

- Apply livestock distribution tools to avoid concentrated livestock use in sensitive riparian areas and carefully manage livestock stocking rates to sustain productive, healthy riparian plant communities.
- Avoid livestock use in permanently saturated wet meadow habitats that are especially vulnerable to trampling impacts. Willow/sedge communities with fine-textured, saturated soils are particularly susceptible to trampling impacts and should be excluded from use.
- Minimize new ground disturbance from human activities. This will reduce the potential for weed or disturbance-caused plant infestations. It will also help prevent soil compaction or erosion in the active floodplain and streambank. Seasonal timing restrictions may be required to avoid impacts during the early, wet spring season when trail braiding, run-off, soil compaction and damage to new growth is likely to be most severe.
- Monitor and limit further disturbance from recreational use in proximity to native pure Westslope Cutthroat Trout streams. Collaborative efforts are needed with local user groups and AESRD to reduce impacts from motorized vehicles in riparian areas and adjacent steep slopes. Forded stream crossings and highly erodible trails are of particular concern to Westslope Cutthroat Trout.
- Collaborate with forestry and industrial user groups to prevent new disturbance in priority Westslope Cutthroat Trout habitats. AESRD, Fish and Wildlife and DFO are encouraged to continue their work with forestry and industry groups to better inform them of cumulative effects management and land use planning in watersheds with remaining native pure Westslope Cutthroat Trout populations.
- Improve public education and awareness about Westslope Cutthroat Trout and potential impacts from recreational, agricultural and industrial activities.

6 CLOSING

The Cows and Fish emphasis is to help individuals, resource managers, municipalities and local communities address riparian management issues on a watershed basis by increasing awareness and obtaining baseline riparian health information. This riparian health assessment enables local communities and managers to identify and effectively develop plans to address specific land use issues. Working locally to develop common goals and objectives for entire watersheds is rewarding – it helps keep people invested in natural landscapes.

To inquire about additional references for riparian health monitoring and management and for further information on any aspect of this report, please contact:

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GLOSSARY

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

Canopy cover – the ground area covered by vegetative growth. Different plant species can provide varying degrees of cover depending on their overall size and abundance. Total canopy cover can be greater than the area being studied due to overlap in plant structural layers.

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

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

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

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

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

Invasive plant species – plant species that are designated by the *Weed Control Act* of Alberta as *restricted* or *noxious* weeds, as well as some additional species identified by Cows and Fish and/or Public Lands (Alberta Sustainable Resource Development) to be invasive within riparian areas.

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

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

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

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

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

Riffle –*A riffle is a short, relatively shallow and coarse-bedded reach where the stream flows at higher velocity and higher turbulence than it normally does in comparison to a pool* (source: http://en.wikipedia.org/wiki/Riffle)

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

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

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

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

APPENDIX A

RHI UPSTREAM AND DOWNSTREAM UTM LOCATIONS (FOR PUBLIC LAND RHI SITES ONLY)

RHI Site ID	UPSTREAM UTM COORDINATE (Zone: 11U)		DOWNSTREAM UTM COORDINATE (Zone: 11U)	
	Easting	**Northing**	**Easting**	**Northing**
GOL1	688184	5502545	688522	5502254
LIV1	683248	5555916	683378	5554711
LYX3	680504	5488045	680654	5487033
LYX4	680133	5488989	680333	5488433
RCK1	692582	5499767	692962	5500365

APPENDIX B

WESTSLOPE CUTTHROAT TROUT PROJECT AREA, 2013 RIPARIAN PLANT SPECIES INVENTORY

Life Form[1]	Plant Status[2]	Area by Species		Percent Canopy Cover[3]			Constancy[4]	Percent of 2013 Project Area
		acres	hectares	Avg	Min Range	Max Range		
TREES								
white spruce (*Picea glauca*)	native	34.4	14.1	41.8%	20.0%	70.0%	100.0%	41.8%
lodgepole pine (*Pinus contorta*)	native	2.0	0.8	2.9%	0.0%	3.0%	60.0%	2.4%
balsam poplar (*Populus balsamifera*)	native	1.8	0.8	2.6%	0.0%	20.0%	80.0%	2.2%
aspen (*Populus tremuloides*)	native	0.4	0.1	0.5%	0.0%	0.5%	80.0%	0.4%
subalpine fir (*Abies lasiocarpa*)	native	0.2	0.1	0.5%	0.0%	0.5%	40.0%	0.2%
SHRUBS								
Drummonds willow (*Salix drummondiana*)	native	9.7	4.0	12.1%	0.0%	20.0%	80.0%	11.8%
shrubby cinquefoil (*Potentilla fruticosa*)	native	7.8	3.2	19.0%	0.0%	20.0%	40.0%	9.4%
shining willow (*Salix lucida*)	native	5.2	2.1	6.7%	0.0%	10.0%	60.0%	6.3%
common bearberry (*Arctostaphylos uva-ursi*)	native	4.0	1.7	5.9%	0.0%	10.0%	60.0%	4.9%
river alder (*Alnus tenuifolia*)	native	3.7	1.5	8.5%	0.0%	20.0%	80.0%	4.5%
smooth willow (*Salix glauca*)	native	2.0	0.8	2.6%	0.0%	3.0%	60.0%	2.5%
beaked willow (*Salix bebbiana*)	native	1.4	0.6	8.8%	0.0%	10.0%	60.0%	1.7%
thimbleberry (*Rubus parviflorus*)	native	1.4	0.6	3.3%	0.0%	10.0%	60.0%	1.6%
Canada buffaloberry (*Shepherdia canadensis*)	native	1.1	0.5	1.4%	0.5%	3.0%	100.0%	1.4%
buckbrush/snowberry (*Symphoricarpos occidentalis*)	native	0.6	0.2	1.8%	0.0%	20.0%	60.0%	0.7%
ground juniper (*Juniperus communis*)	native	0.5	0.2	0.8%	0.0%	10.0%	80.0%	0.7%
northern gooseberry (*Ribes oxyacanthoides*)	native	0.4	0.2	0.5%	0.5%	0.5%	100.0%	0.5%
wild red raspberry (*Rubus idaeus*)	native	0.4	0.1	1.1%	0.0%	10.0%	60.0%	0.4%
prickly rose (*Rosa acicularis*)	native	0.3	0.1	0.5%	0.0%	0.5%	60.0%	0.4%
bracted honeysuckle (*Lonicera involucrata*)	native	0.2	0.1	0.5%	0.0%	0.5%	80.0%	0.3%
bunchberry (*Cornus canadensis*)	native	0.2	0.1	0.5%	0.0%	0.5%	40.0%	0.2%
dwarf birch (*Betula pumila*)	native	0.2	0.1	0.5%	0.0%	0.5%	20.0%	0.2%
creeping juniper (*Juniperus horizontalis*)	native	0.2	0.1	0.5%	0.0%	0.5%	20.0%	0.2%
basket willow (*Salix petiolaris*)	native	0.2	0.1	0.5%	0.0%	0.5%	20.0%	0.2%
purple clematis (*Clematis occidentalis*)	native	0.1	0.1	0.5%	0.0%	0.5%	40.0%	0.2%
narrow-leaved meadowsweet (*Spiraea alba*)	native	0.1	0.1	0.5%	0.0%	0.5%	20.0%	0.2%
common wild rose (*Rosa woodsii*)	native	0.1	0.05	0.9%	0.0%	3.0%	40.0%	0.1%
water birch (*Betula occidentalis*)	native	0.1	0.02	3.0%	0.0%	3.0%	20.0%	0.1%
velvet-fruited willow (*Salix maccalliana*)	native	0.1	0.02	3.0%	0.0%	3.0%	20.0%	0.1%

Life Form[1]	Plant Status[2]	Area by Species		Percent Canopy Cover[3]			Constancy[4]	Percent of 2013 Project Area
		acres	hectares	Avg	Min Range	Max Range		
SHRUBS Continued								
white meadowsweet (*Spiraea betulifolia*)	native	0.1	0.02	0.5%	0.0%	0.5%	20.0%	0.1%
flat-leaved willow (*Salix planifolia*)	native	0.02	0.01	0.5%	0.0%	0.5%	40.0%	0.02%
saskatoon (*Amelanchier alnifolia*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
silverberry (*Elaeagnus commutata*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
creeping snowberry (G*aultheria hispidula*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
red-osier dogwood (*Cornus stolonifera*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
wild black currant (*Ribes americanum*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
yellow willow (*Salix lutea*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
false mountain willow (*Salix pseudomonticola*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
GRASSES AND GRASS-LIKES								
wire rush (*Juncus balticus*)	native	8.0	3.3	19.5%	0.0%	20.0%	40.0%	9.7%
Kentucky bluegrass (*Poa pratensis*)	disturbance, introduced	4.9	2.0	5.9%	0.5%	10.0%	100.0%	5.9%
fowl bluegrass (*Poa palustris*)	native	4.3	1.8	5.4%	0.0%	10.0%	80.0%	5.3%
bluebunch fescue (*Festuca idahoensis*)	native	4.0	1.6	7.5%	0.0%	10.0%	60.0%	4.8%
June grass (*Koeleria macrantha*)	native	3.9	1.6	10.0%	0.0%	10.0%	20.0%	4.7%
alpine bluegrass (*Poa alpina*)	native	3.9	1.6	10.0%	0.0%	10.0%	20.0%	4.7%
redtop (*Agrostis stolonifera*)	introduced	3.5	1.4	8.1%	0.0%	10.0%	80.0%	4.3%
marsh reed grass (*Calamagrostis canadensis*)	native	3.3	1.3	7.8%	0.0%	20.0%	60.0%	4.0%
timothy (*Phleum pratense*)	disturbance, introduced	2.8	1.2	3.4%	3.0%	20.0%	100.0%	3.4%
smooth wild rye (*Elymus glaucus*)	native	2.8	1.2	6.8%	0.0%	10.0%	60.0%	3.4%
Rocky Mountain fescue (*Festuca saximontana*)	native	2.7	1.1	10.0%	0.0%	10.0%	20.0%	3.3%
California oat grass (*Danthonia californica*)	native	1.2	0.5	3.0%	0.0%	3.0%	20.0%	1.4%
hairy wild rye (*Elymus innovatus*)	native	1.2	0.5	3.0%	0.0%	3.0%	20.0%	1.4%
western porcupine grass (*Stipa curtiseta*)	native	1.2	0.5	3.0%	0.0%	3.0%	20.0%	1.4%
intermediate wheat grass (*Thinopyrum intermedium*)	introduced	1.2	0.5	3.0%	0.0%	3.0%	20.0%	1.4%
common tall manna grass (*Glyceria grandis*)	native	0.3	0.1	0.5%	0.0%	0.5%	60.0%	0.4%
small bottle sedge (*Carex utriculata*)	native	0.3	0.1	0.5%	0.0%	0.5%	80.0%	0.3%

Life Form[1]	Plant Status[2]	Area by Species		Percent Canopy Cover[3]			Constancy[4]	Percent of 2013 Project Area
		acres	hectares	Avg	Min Range	Max Range		
GRASSES AND GRASS-LIKES Continued								
small-winged sedge (*Carex microptera*)	native	0.2	0.1	0.5%	0.0%	0.5%	60.0%	0.3%
tufted hair grass (*Deschampsia cespitosa*)	native	0.2	0.1	0.5%	0.0%	0.5%	60.0%	0.3%
smooth brome (*Bromus inermis*)	disturbance, introduced	0.2	0.1	0.5%	0.0%	0.5%	60.0%	0.3%
quack grass (*Agropyron repens*)	disturbance, introduced	0.2	0.1	0.5%	0.0%	0.5%	40.0%	0.2%
northern awnless brome (*Bromus inermis* ssp *pumpellianus*)	native	0.2	0.1	0.5%	0.0%	0.5%	40.0%	0.2%
plains rough fescue (*Festuca hallii*)	native	0.2	0.1	0.5%	0.0%	0.5%	20.0%	0.2%
foxtail barley (*Hordeum jubatum*)	disturbance, native	0.2	0.1	0.5%	0.0%	0.5%	20.0%	0.2%
reed canary grass (*Phalaris arundinacea*)	native	0.1	0.1	0.5%	0.0%	0.5%	40.0%	0.2%
purple oat grass (*Schizachne purpurascens*)	native	0.1	0.1	0.5%	0.0%	0.5%	20.0%	0.2%
rough hair grass (*Agrostis scabra*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
Canada wild rye (*Elymus canadensis*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
wild rye (*Elymus* spp.)	unknown, not unique	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
foothills rough fescue (*Festuca campestris*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
timberline bluegrass (*Poa glauca*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
needle-and-thread (*Stipa comata*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
slender wheat grass (*Agropyron trachycaulum* var. *unilaterale*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
fringed brome (*Bromus ciliatus*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
awned sedge (*Carex atherodes*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
fowl manna grass (*Glyceria striata*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
small-fruited bulrush (*Scirpus microcarpus*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
FORBS								
graceful cinquefoil (*Potentilla gracilis*)	native	3.9	1.6	9.5%	0.0%	10.0%	40.0%	4.7%
wild strawberry (*Fragaria virginiana*)	disturbance, native	2.1	0.8	2.5%	0.5%	3.0%	100.0%	2.5%
smooth aster (*Aster laevis*)	native	2.1	0.8	2.6%	0.0%	3.0%	80.0%	2.5%
Canada thistle (*Cirsium arvense*)	invasive, introduced	1.6	0.6	1.9%	0.5%	10.0%	100.0%	1.9%

Life Form[1]	Plant Status[2]	Area by Species		Percent Canopy Cover[3]			Constancy[4]	Percent of 2013 Project Area
		acres	hectares	Avg	Min Range	Max Range		
FORBS Continued								
white angelica (*Angelica arguta*)	native	1.3	0.5	3.0%	0.0%	3.0%	80.0%	1.6%
yellow avens (*Geum aleppicum*)	native	1.2	0.5	3.0%	0.0%	3.0%	20.0%	1.4%
veiny meadow rue (*Thalictrum venulosum*)	native	1.1	0.4	1.4%	0.0%	3.0%	80.0%	1.3%
ragwort (*Senecio cymbalarioides*)	native	1.0	0.4	1.5%	0.0%	3.0%	40.0%	1.2%
common fireweed *(Epilobium angustifolium*)	native	0.7	0.3	0.9%	0.0%	3.0%	80.0%	0.9%
white clover (*Trifolium repens*)	disturbance, introduced	0.6	0.2	0.8%	0.0%	10.0%	80.0%	0.7%
ox-eye daisy (*Chrysanthemum leucanthemum* syn. *Leucanthemum vulgare*)	invasive, introduced	0.6	0.2	1.4%	0.0%	3.0%	60.0%	0.7%
common dandelion (*Taraxacum officinale*)	disturbance, introduced	0.5	0.2	0.6%	0.5%	3.0%	100.0%	0.6%
showy aster (*Aster conspicuus*)	native	0.5	0.2	1.3%	0.0%	3.0%	40.0%	0.6%
common yarrow (*Achillea millefolium*)	native	0.4	0.2	0.5%	0.5%	0.5%	100.0%	0.5%
harebell (*Campanula rotundifolia*)	native	0.4	0.2	0.5%	0.5%	0.5%	100.0%	0.5%
northern bedstraw (*Galium boreale*)	native	0.4	0.2	0.5%	0.5%	0.5%	100.0%	0.5%
common nettle (*Urtica dioica*)	native	0.4	0.2	0.5%	0.5%	0.5%	100.0%	0.5%
broad-leaved fireweed (*Epilobium latifolium*)	native	0.4	0.2	0.5%	0.0%	0.5%	80.0%	0.5%
dwarf scouring-rush (*Equisetum scirpoides*)	native	0.4	0.1	1.1%	0.0%	10.0%	60.0%	0.4%
bull thistle (*Cirsium vulgare*)	introduced	0.4	0.1	0.5%	0.0%	0.5%	80.0%	0.4%
northern willowherb (*Epilobium ciliatum*)	native	0.4	0.1	0.5%	0.0%	0.5%	80.0%	0.4%
cut-leaved anemone (*Anemone multifida*)	native	0.3	0.1	0.5%	0.0%	0.5%	60.0%	0.4%
Arctic aster (*Aster sibiricus*)	native	0.3	0.1	0.5%	0.0%	0.5%	60.0%	0.4%
common red paintbrush (*Castilleja miniata*)	native	0.3	0.1	0.5%	0.0%	0.5%	60.0%	0.4%
heart-leaved Alexanders (*Zizia aptera*)	native	0.3	0.1	0.5%	0.0%	0.5%	40.0%	0.4%
star-flowered Solomon's-seal (*Smilacina stellata*)	native	0.3	0.1	0.5%	0.0%	0.5%	80.0%	0.3%
wild vetch (*Vicia americana*)	native	0.3	0.1	0.5%	0.0%	0.5%	80.0%	0.3%
tall buttercup (*Ranunculus acris*)	invasive, introduced	0.3	0.1	0.6%	0.0%	3.0%	80.0%	0.3%
large-leaved yellow avens (*Geum macrophyllum*)	native	0.3	0.1	1.9%	0.0%	10.0%	40.0%	0.3%
common horsetail (*Equisetum arvense*)	native, poisonous	0.3	0.1	0.6%	0.0%	3.0%	40.0%	0.3%

Life Form[1]	Plant Status[2]	Area by Species		Percent Canopy Cover[3]			Constancy[4]	Percent of 2013 Project Area
		acres	hectares	Avg	Min Range	Max Range		
FORBS Continued								
mountain goldenrod (*Solidago spathulata*)	native	0.3	0.1	0.6%	0.0%	3.0%	40.0%	0.3%
red and white baneberry (*Actaea rubra*)	native, poisonous	0.2	0.1	0.5%	0.0%	0.5%	80.0%	0.3%
cow parsnip (*Heracleum lanatum*)	native	0.2	0.1	0.5%	0.0%	0.5%	80.0%	0.3%
black medick (*Medicago lupulina*)	disturbance, introduced	0.2	0.1	0.7%	0.0%	3.0%	60.0%	0.3%
spreading sweet cicely (*Osmorhiza depauperata*)	native	0.2	0.1	0.7%	0.0%	3.0%	60.0%	0.3%
meadow horsetail (*Equisetum pratense*)	native	0.2	0.1	0.5%	0.0%	0.5%	60.0%	0.3%
tall white bog orchid (*Habenaria dilatata*)	native	0.2	0.1	0.5%	0.0%	0.5%	60.0%	0.3%
brook ragwort (*Senecio triangularis*)	native	0.2	0.1	0.5%	0.0%	0.5%	60.0%	0.3%
alsike clover (*Trifolium hybridum*)	disturbance, introduced	0.2	0.1	0.5%	0.0%	0.5%	60.0%	0.3%
yellow false dandelion (*Agoseris glauca*)	native	0.2	0.1	0.5%	0.0%	0.5%	40.0%	0.2%
common scouring-rush (*Equisetum hyemale*)	native	0.2	0.1	0.5%	0.0%	0.5%	40.0%	0.2%
silky perennial lupine (*Lupinus sericeus*)	native	0.2	0.1	0.5%	0.0%	0.5%	40.0%	0.2%
common plantain (*Plantago major*)	disturbance, introduced	0.2	0.1	0.5%	0.0%	0.5%	40.0%	0.2%
pearly everlasting *(Anaphalis margaritacea*)	native	0.2	0.1	0.5%	0.0%	0.5%	40.0%	0.2%
butter-and-eggs/yellow toadflax (*Linaria vulgaris*)	invasive, introduced	0.2	0.1	0.5%	0.0%	0.5%	40.0%	0.2%
common mullein (*Verbascum thapsus*)	invasive, introduced	0.2	0.1	0.5%	0.0%	0.5%	40.0%	0.2%
alpine everlasting (*Antennaria alpina*)	disturbance, native	0.2	0.1	0.5%	0.0%	0.5%	20.0%	0.2%
cordilleran arnica (*Arnica mollis*)	native	0.2	0.1	0.5%	0.0%	0.5%	20.0%	0.2%
alpine milk vetch (*Astragalus alpinus*)	native	0.2	0.1	0.5%	0.0%	0.5%	20.0%	0.2%
tufted fleabane (*Erigeron caespitosus*)	native	0.2	0.1	0.5%	0.0%	0.5%	20.0%	0.2%
three-flowered avens (*Geum triflorum*)	native	0.2	0.1	0.5%	0.0%	0.5%	20.0%	0.2%
western bluebur (*Lappula occidentalis*)	introduced	0.2	0.1	0.5%	0.0%	0.5%	20.0%	0.2%
showy locoweed (*Oxytropis splendens*)	native, poisonous	0.2	0.1	0.5%	0.0%	0.5%	20.0%	0.2%
slender blue beardtongue (*Penstemon procerus*)	native	0.2	0.1	0.5%	0.0%	0.5%	20.0%	0.2%

Life Form[1]	Plant Status[2]	Area by Species		Percent Canopy Cover[3]			Constancy[4]	Percent of 2013 Project Area
		acres	hectares	Avg	Min Range	Max Range		
FORBS Continued								
common knotweed (*Polygonum arenastrum*)	introduced	0.2	0.1	0.5%	0.0%	0.5%	20.0%	0.2%
narrow-leaved dock (*Rumex triangulivalvis*)	native	0.2	0.1	0.5%	0.0%	0.5%	20.0%	0.2%
sweet-scented bedstraw (*Galium triflorum*)	native	0.2	0.1	0.5%	0.0%	0.5%	60.0%	0.2%
narrow-leaved hawkweed (*Hieracium umbellatum*)	native	0.1	0.1	0.5%	0.0%	0.5%	40.0%	0.2%
Canada goldenrod (*Solidago canadensis*)	native	0.1	0.1	0.5%	0.0%	0.5%	40.0%	0.2%
purple-stemmed aster (*Aster puniceus*)	native	0.1	0.1	0.5%	0.0%	0.5%	20.0%	0.2%
smooth scouring-rush (*Equisetum laevig*atum)	native	0.1	0.1	0.5%	0.0%	0.5%	20.0%	0.2%
wormseed mustard (*Erysimum cheiranthoides*)	disturbance, introduced	0.1	0.1	0.5%	0.0%	0.5%	20.0%	0.2%
yellow hedysarum (*Hedysarum sulphurescen*s)	native	0.1	0.1	0.5%	0.0%	0.5%	20.0%	0.2%
bishop's-cap (*Mitella nuda*)	native	0.1	0.1	0.5%	0.0%	0.5%	20.0%	0.2%
western lousewort (*Pedicularis bracteosa*)	native	0.1	0.1	0.5%	0.0%	0.5%	20.0%	0.2%
wild white geranium (*Geranium richardsonii*)	native	0.1	0.05	0.9%	0.0%	3.0%	40.0%	0.1%
curled dock (*Rumex crispus*)	introduced	0.1	0.03	0.5%	0.0%	0.5%	60.0%	0.1%
Canada anemone (*Anemone canadensis*)	native	0.1	0.03	0.5%	0.0%	0.5%	40.0%	0.1%
clasping-leaved twisted-stalk (*Streptopus amplexifolius*)	native	0.1	0.03	0.5%	0.0%	0.5%	40.0%	0.1%
tall lungwort (*Mertensia paniculata*)	native	0.1	0.03	3.0%	0.0%	3.0%	20.0%	0.1%
thin-leaved ragwort (*Senecio pseudaureus*)	native	0.1	0.03	3.0%	0.0%	3.0%	20.0%	0.1%
wild licorice (*Glycyrrhiza lepidota*)	native	0.1	0.02	0.5%	0.0%	0.5%	20.0%	0.1%
fringed grass-of-parnassus (*Parnassia fimbriata*)	native	0.1	0.02	0.5%	0.0%	0.5%	20.0%	0.1%
elephant's-head (*Pedicularis groenlandica*)	native	0.1	0.02	0.5%	0.0%	0.5%	20.0%	0.1%
early yellow locoweed (*Oxytropis sericea*)	native, poisonous	0.02	0.01	0.5%	0.0%	0.5%	40.0%	0.02%
common pink wintergreen (*Pyrola asarifolia*)	native	0.02	0.01	0.5%	0.0%	0.5%	40.0%	0.02%
western Canada violet (*Viola canadensis*)	native	0.02	0.01	0.5%	0.0%	0.5%	40.0%	0.02%
nodding onion (*Allium cernuum*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
small-leaved everlasting (*Antennaria parvifolia*)	disturbance, native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%

Life Form[1]	Plant Status[2]	Area by Species		Percent Canopy Cover[3]			Constancy[4]	Percent of 2013 Project Area
		acres	hectares	Avg	Min Range	Max Range		
FORBS Continued								
fairybells (*Disporum trachycarpum*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
variegated horsetail (*Equisetum variegatum*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
heal-all (*Prunella vulgaris*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
western meadow rue (*Thalictrum occidentale*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
long-fruited anemone (*Anemone cylindrica*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
brown-bracted mountain everlasting (*Antennaria umbrinella*)	disturbance, native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
sticky purple geranium (*Geranium viscosissimum*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
cream-colored vetchling (*Lathyrus ochroleucus*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
wild mint (*Mentha arvensis*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
wild bergamot (*Monarda fistulosa*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
one-sided wintergreen (*Orthilia secunda*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
northern grass-of-parnassus (*Parnassia palustris*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
cut-leaved ragwort (*Senecio eremophilus*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
perennial sow-thistle (*Sonchus arvensis*)	invasive, introduced	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%
green false hellebore (*Veratrum eschscholtzii*)	native	0.01	0.004	0.5%	0.0%	0.5%	20.0%	0.01%

ALL SPECIES LISTED IN ORDER OF DECREASING ABUNDANCE

[1] Our primary resource for plant species naming is Flora of Alberta by E.H. Moss (1994); for species not listed in Moss (1994), taxonomy follows the Integrated Taxonomic Information System (http://www.itis.gov/).

[2] Plant status is designated by Cows and Fish in association with Alberta Sustainable Resource Development (Public Lands), Alberta Agriculture, Food and Rural Development and the Alberta *Weed Control Act*. '*unknown*' = plant not identified to species; plant status unknown.

[3] Based on visual estimates of the amount of ground the canopy of the plant covers. The percent cover values presented are the mid-values for the following ranges: 0.5=less than 1%; 3.0=1%-5%; 10.0=5%-15%; 20.0=15%-25%; 30.0=25%-35%; 40.0=35%-45%; 50.0=45%-55%; 60.0=55%-65%; 70.0=65%-75%; 80.0=75%-85%; 90.0=85%-95%; 97.5=greater than 95%; — = not observed.

[4] Constancy is the number of times the species occurs divided by the total number of polygons.

APPENDIX C

DESCRIPTION OF RIPARIAN HEALTH PARAMETERS

1. **Vegetation Cover of Floodplain and Streambanks**

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

2a. Total Canopy Cover of Invasive Plant Species

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

2b. Density/Distribution of Invasive Plant Species (Table 1)

3 = No invasive plants (weeds) on site.
2 = Invasive plants present with density/distribution in categories 1, 2 or 3.
1 = Invasive plants present with density/distribution in categories 4, 5, 6 or 7.
0 = Invasive plants present with density distribution in categories 8 or higher.

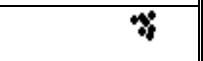
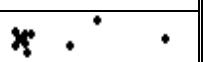
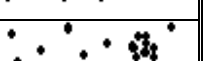
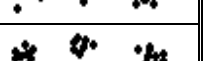
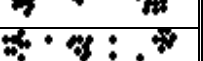
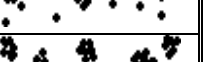
CLASS	DESCRIPTION OF ABUNDANCE	DISTRIBUTION PATTERN
0	No invasive plants on the polygon	
1	Rare occurrence	
2	A few sporadically occurring individual plants	
3	A single patch	
4	A single patch plus a few sporadically occurring plants	
5	Several sporadically occurring plants	
6	A single patch plus several sporadically occurring plants	
7	A few patches	
8	A few patches plus several sporadically occurring plants	
9	Several well spaced patches	
10	Continuous uniform occurrence of well spaced plants	
11	Continuous occurrence of plants with a few gaps in the distribution	
12	Continuous dense occurrence of plants	
13	Continuous occurrence of plants associated with a wetter or drier zone within the polygon	

Table 1. Density/distribution of invasive plant species.

3. Disturbance-Caused Undesirable Herbaceous Species

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

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

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

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

4. Preferred Tree and Shrub Establishment and Regeneration

(N/A will appear in the Riparian Health Score Table if the polygon lacks potential for preferred trees or shrubs)

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

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

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

0 = Preferred tree/shrub seedlings and saplings absent.

5a.Utilisation of Preferred Trees and Shrubs

(N/A will appear in the Riparian Health Score Table if the polygon lacks potential for preferred trees or shrubs)

3 = None (0% to 5% of available 2nd year and older leaders of preferred species are browsed).

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

1 = Moderate (25% to 50% of available 2nd year and older leaders of preferred species are browsed).

0 = Heavy (More than 50% of available 2nd year and older leaders of preferred species are browsed).

5b. Live Woody Vegetation Removal by Other than Browsing

(N/A will appear in the Riparian Health Score Table if the polygon lacks potential for trees or shrubs)

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

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

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

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

6. Standing Decadent and Dead Woody Material

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

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

1 = 25% to 45% of the total canopy cover of woody species is decadent or dead.

0 = More than 45% of the total canopy cover of woody species is decadent or dead.

7. Streambank Root Mass Protection

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

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

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

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

8. Human-Caused Bare Ground

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

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

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

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

9. Streambank Structurally Altered by Human Activity

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

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

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

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

10. Human Physical Alteration to the Rest of the Polygon

3 = Less than 5% of the polygon is affected by human causes.

2 = 5% to 15% of the polygon is affected by human causes.

1 = 15% to 25% of the polygon is affected by human causes.

0 = More than 25% of the polygon is affected by human causes.

11. Stream Channel Incisement (Vertical Stability) (Figure 1)

9 = Not incised

6 = Slightly incised

3 = Moderately incised

0 = Severely incised

Incisement Severity	Channel Development Stage	Rosgen Types Included	Description of Incisement Situation
Not Incised (9 points)	A	A, B, C, E	Channel is vertically stable and not incised; 1-2 year high flows can begin to access a floodplain appropriate to the stream type. Active downcutting is not evident. Any old incisement is characterized by a broad floodplain inside which perennial riparian plant communities are well established. This category includes a variety of stream types in all land forms and substrates. The floodplain may be narrow or wide, depending on the type of stream, but the key factor is vertical stability. The system may have once cut down, and later become healed and is now stable again, with a new floodplain appropriate to its stream type. In this case, the erosion of the old gully side walls will have ceased and stabilised. A mature, or nearly mature, vegetation community will occupy much of the new valley bottom.
Slightly (6 points)	B/D	C, F, G	This category contains both degrading and healing stages. In either case, the extent of incisement is minimal. In Stage B, the channel is just beginning to degrade, and a 2 year flood event may still access some floodplain, either partially or in spots. Downcutting is likely progressing. In Stage D, the system is healing. Downcutting should have ceased at this stage. A new floodplain should be well established with perennial vegetation, although it may not yet be as wide as the stream type needs. This is indicated by continuing lateral erosion of the high side walls of the original

			incisement, as the system continues to widen itself at its new grade level.
Moderately (3 points)	B/D	C, F, G	This category also contains both degrading and healing stages. In both cases, the extent of incisement is significant. In Stage B, the channel has downcut to a level that floods of the 1-5 year magnitude cannot reach a floodplain. Downcutting is likely still progressing, but the channel may already have the appearance of a gully. In Stage D, the system has only just begun to heal. A small floodplain along the new meanders within the gully is forming, and perennial vegetation is starting to colonize the new sediment features. The high side walls of the gully are being actively eroded as the system widens, and much of the fallen material is being incorporated along the bottom.
Severely (0 points)	C	F, G	This is the worst case category, where the system has no floodplain in the bottom of a deep entrenchment, and small-to-moderate floods cannot reach the original floodplain level. Downcutting may, or may not, still be in progress. High side wall banks may have begun to collapse and erode into the bottom, but high flows typically just wash this material directly through the system, with none of it being trapped to build a new floodplain. At this stage, the system has lost practically all of its riparian function and habitat value.

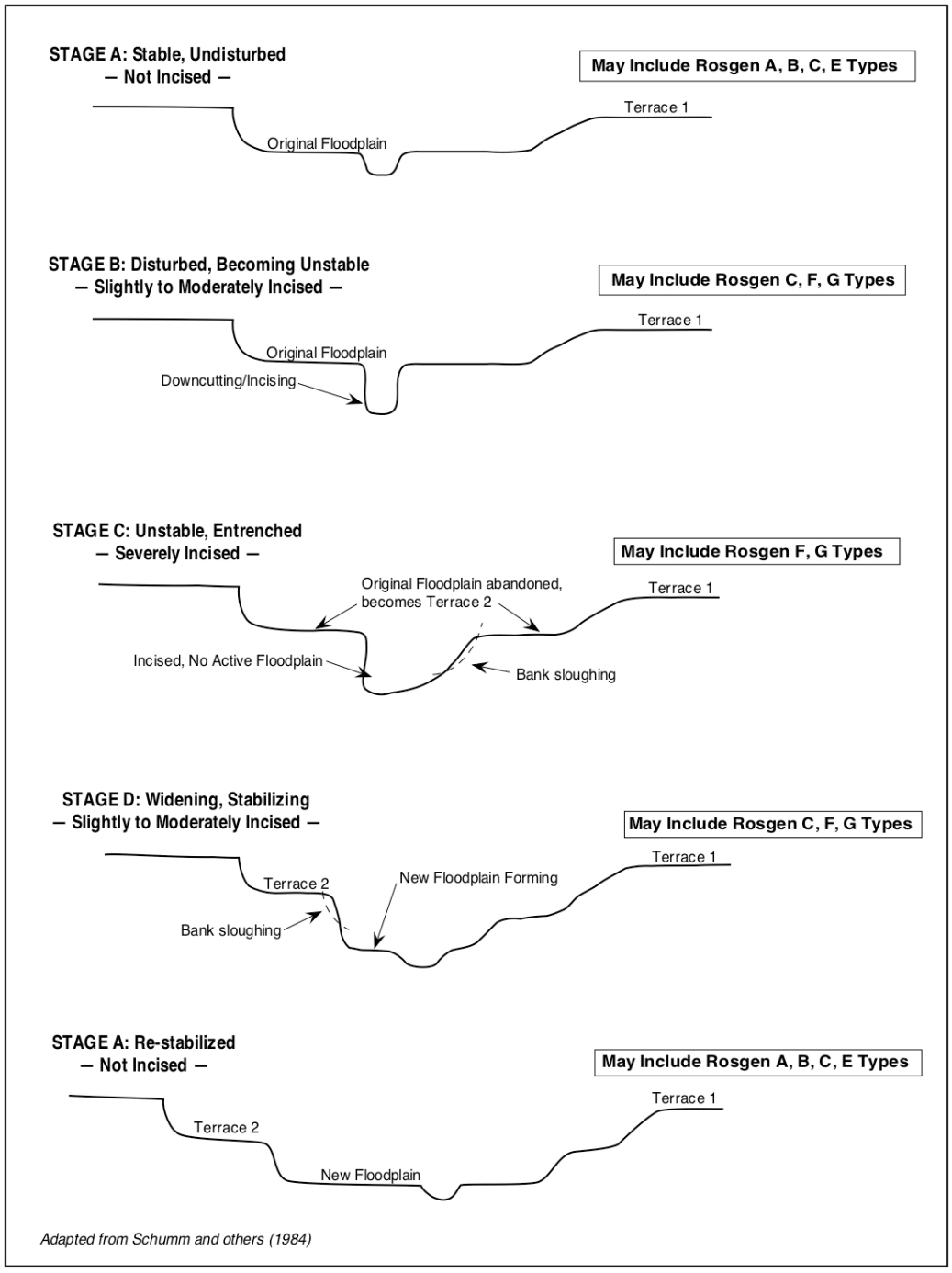


Figure 1. Guide for estimating channel incisement stage.