Integrated Riparian Assessment for Tembec's Operating Areas in the East Kootenay, British Columbia

Volume 4: Detailed Riparian Assessment for the South Purcell Region

Final Report - March 2009

Moyie Lake looking west

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Acknowledgements

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Introduction

This volume is the forth of seven comprising the Integrated Riparian Assessment for Tembec's operating areas in the East Kootenay region of south-eastern British Columbia. The Integrated Riparian Assessment was developed in order for Tembec to maintain or restore riparian ecosystems and all their functions, and so meet the requirements of the Forest Stewardship Council standards (Criteria 6.5bis) for forest management in British Columbia[1].

This volume contains detailed riparian assessments and management strategies for each of the seven riparian assessment units in the South Purcell Riparian Assessment Region. For each riparian assessment unit, the assessments include background information, key values, the results of the current condition riparian budget analysis, and riparian management strategies for the streams, lakes, and wetlands in the unit, by stream or lake class. Maps of most key values and of the budget analysis are available in digital and hard copy form for each unit; see appendix C and D of Volume 1 for locations. The strategies were developed by a team of Professional Hydrologists and Biologists with considerable field experience in the East Kootenay, using a combination of field work, aerial photo analysis, analysis of existing digital data on key values, and the results of previous hydrological, riparian, and ecological studies in the area. For details on the team and the methodology please see Volume 1.

Detailed riparian assessments for the other five riparian regions in Tembec's operating area in the East Kootenay are found in volumes 3 through 7. These regions are:
Volume 2: North Purcell (TFL 14)
Volume 3: Central Purcell
Volume 5: Central Rocky Mountain
Volume 6: North Elk
Volume 7: South Elk

Volume 1 of the Integrated Riparian Assessment contains the strategic overview, literature review, scientific rationale, and methodology for the detailed riparian assessments and management strategies presented in Volumes 2 through 7. Volume 1 also outlines the rationale behind the division of Tembec's operating area into six riparian regions and 34 riparian assessment units, and the methodology used to calculate the current amount of riparian buffer areas relative to the budgets in the FSC-BC standard.

Readers are strongly encouraged to read Volume 1 in association with the other volumes, and use the information within it in addition to the detailed guidance specific to each riparian management unit. Key sections of Volume 1 are repeated here because they contain the fundamental recommendations for management within all RAUs.

Key Concepts for Field Implementation of these Management Guidelines

The strategies presented in this volume are premised on the concept that riparian ecosystems are best managed through the delineation of Riparian Management Areas (RMAs) consisting of either Riparian Reserve Zones (RRZs) or Riparian Management Zones (RMZs) or both. In general, RRZs are intended to exclude all forestry operations except road crossings, while RMZs limit the extent of forestry operations.

[1] http://www.fsccanada.org/docs/48B4F585905BF469.pdf

A primary objective of the RMA is to preserve channel – riparian interactions. The most important physical consideration for determining the width of the RRZ is the rate and potential extent of lateral migration of the channel over time. RRZs are primarily required over the active floodplain or valley flat along the margins of larger alluvial stream channels (S1 and S2) where channel migration over time is likely to result in the channel shifting, so an RRZ is needed to ensure that key riparian functions are maintained despite natural encroachment by the stream. Larger RRZs may be required to manage for the key values described for each RAU, such as riparian ecosystems, significant spawning areas for Bull Trout, important foraging habitat for grizzly bears, important wildlife features (i.e. trails, dens, licks, raptor nests, perches) or high value biodiversity components (large trees, standing dead trees, large logs, etc).

RMZs are required along the outer edges of RRZs along S1 and S2 streams and along most S3 to S6 streams. Tree retention levels in RMZs vary from less than 30% to at least 80% of the forest stand for the different Riparian Assessment Units, depending on level of riparian function observed during the reconnaissance field investigation, and on the key values present in the unit. Guidance on specific retention levels for each RAU is provided in the detailed riparian strategies for each RAU.

The exact widths of RRZ and RMZ in specific locations are not specified in these strategies; flexibility is given to the prescribing forester to place retention based on the objectives specified in the management strategies and the key values occurring there. However, the total amount of riparian retention (in units of ha/km of stream or lakeside) must also meet or exceed the riparian budgets provided in the FSC-BC Standards, in addition to maintaining riparian function and key values. An analysis of the current amount of riparian retention relative to FSC requirements has been completed for each unit, and is presented in the detailed strategies for each unit. Prescribing foresters should first place retention according to the detailed strategies, then prioritize any additional retention required remaining for areas related to the key values, and in stream classes where the budget is close to being in deficit (i.e. <110%; no RAUs were identified that were currently in deficit with respect to the FSC budget). For limitations of the budget analysis and considerations for its use see Volume 1.

Field Data Collection

Full implementation of the riparian management strategies requires detailed field work along each watercourse within a cutblock, together with the information in this Volume. Tembec currently (2009) completes at least 2 or 3 detailed field assessments of each riparian area. These assessments identify or field-confirm the key values occurring along specific reaches:

1. Riparian assessment. The entire length of a creek within cutblocks is walked by Professional Foresters or Forestry Technicians and information collected on stream morphology, stream characteristics, fish-bearing status and wetland status. This information is used to classify the stream/wetland according to both provincial and FSC standards. Channel width, bottom channel width, depth, and slope data are collected within 100 m of any proposed stream crossings in order to determine correct culvert size, or if a bridge is necessary.
2. Fish assessments. If there is any uncertainty about whether fish are present in a stream or not, a fish assessment (electo-shocking) is conducted by a Professional Biologist. This information feeds into the classification of the stream.
3. Riparian Area tracking. Data on the percent riparian habitat, structural stage, tree and snag species composition and diameter distribution, shrub coverage, CWD amounts, and any significant habitat features (i.e. bird nests, dens, licks, wallows) or biodiversity features (veteran trees, high value snags, spruce brooms, etc.) are collected. The estimated maximum, minimum, and average width of the pre-harvest RRZ and RMZ is also recorded, and a diagram of the stream and RMA drawn.

Additional assessments by a Professional Hydrologist are conducted if significant concerns about harvesting impacts on water quality or quantity or terrain stability are present or suspected. ECA

(Equivalent Clearcut Area) assessments are also completed for all drainages in which ECAs are approaching or over 25 %, and harvesting is proposed. Information from these assessments feeds into specific riparian designs as necessary and as advised by a Professional Hydrologist. Assessments by a Professional Biologist are also conducted if habitat for rare or endangered species is suspected to occur in the riparian area, or if important wildlife or biodiversity features are found and detailed guidance on RMA development is required.

All the above field information is considered in the development of RMA, along with the guidance provided by the detailed strategies and the current condition of the riparian budget relative to FSC requirements.

Riparian Reserve Zones should be considered in the following locations:

- Aquatic-terrestrial interface[2] of alluvial streams (i.e. active floodplains along intermediate (5 m to 20 m wide) to large (>20 m wide) streams and rivers), and lakes and wetlands;
- Riparian habitats of species-at-risk or species of interest, including important foraging areas for grizzly bear (i.e. those vegetated with horsetails, skunk cabbage, and/or sedges);
- Streams or streams segments with high value fisheries habitat and/or licensed consumptive-use water intakes;
- Where hygric, subhygric, and rare riparian ecosystem types exist, as identified in Table 21 in Volume 1;
- Mature and old cottonwood stands along streams, and hardwood stands along lakes and wetlands;
- Mature and old growth coniferous and mixed wood stands along lakes, rivers, streams, and wetlands, especially in watersheds where these type of riparian stands are rare due to previous wildfire¸ timber harvesting, or development;
- Areas with important wildlife features, such as high-use trails along the watercourse, significant wallows and licks, dens, and raptor nests
- Areas supporting high biodiversity, such as those with a large number of high value snags, large diameter coarse woody debris, and veteran trees
- Other key values as specified in the key values section for each riparian unit

Entry into any Riparian Reserve Zone (RRZ) should only be considered in extenuating circumstances such as severe forest health problems or excessive fuel loadings that may lead to unnaturally catastrophic burns. Tree-parasitic insects and diseases operating at endemic levels are beneficial for the ecology or riparian areas and do not require management intervention.

Riparian Management Zones should be considered in the following locations:

- Adjacent to RRZs to protect the integrity of the reserve by reducing windthrow and the sediment delivery hazard.
- Adjacent to RRZs where topography/terrain features extend riparian function beyond the obvious valley flat/floodplain slope break. For example, in confined draws/valleys where LWD (large woody debris) is being recruited from upper slopes or where wildlife trees or wildlife corridors are situated along the outer margins and/or glaciofluvial terrace tops adjacent to riparian areas.

[2] Technical terms are defined in the next section – Glossary.

- Adjacent to water features where the conditions for delineation of RRZs do not occur but where riparian vegetation is providing a source of LWD that is functioning to maintain channel stability (e.g. small (<5m) streams that do not contain high value fish habitat)
- Adjacent to headwater features to protect wildlife habitat especially for amphibians, and to maintain invertebrate, nutrient and food web input to the downstream fish habitat; depending on the size of the headwater stream complex.
- To increase the ecological value of RRZs by increasing the size of habitat patches beyond RRZs and provide habitat connectivity to upland or other riparian areas.

Because forest harvesting is not excluded in Riparian Management Zones, **a minimum seven (7) meter no-machine zone must be defined** along all classified water features where there is no RRZ or RMZ, except as required for designated crossings. The primary objective of the no-machine zone is to reduce the potential for direct disturbance to the forest floor, understory vegetation, and channel banks from logging equipment.

The delineation of RRZs and RMZs should:

- Follow logical topographic breaks, and/or reflect terrain features. Where streams are confined by steep slopes (>50%), RMZs should extend far enough upslope or to a logical topographic break to manage for windthrow hazards (next bullet) and to minimize sediment delivery.
- Manage for windthrow hazard. Since windthrow may compromise the integrity of riparian buffers, consider special treatments (e.g., feathering of reserve edges, selective removal of susceptible trees, etc.) in areas of high windthrow hazard. Establishment of RMZs with variable retention can prevent windthrow in RRZs. Some windthrow is beneficial for riparian ecosystems, especially if it leads to LWD input into water bodies. However, excessive LWD input can be detrimental by slowing water velocity to the extend of increasing deposition of fine sediment or creating LWD jams that cause the stream to abandon a well-developed channel. This is especially important in small streams where flows can easily be impacted.
- Where present, follow natural stand or ecosystem boundaries, e.g. the transition between Sx dominated and Pl dominated stands, or the boundary between riparian and upland ecosystems.

Where riparian vegetation consists of lodgepole pine leading stands that are currently or are likely to be infested with mountain pine beetle (MPB), the infested and dead standing stems count towards the required percentage of retained stems in RMZs.

Retained stems in RMZs should reflect the pre-harvest species composition of the stand, with the exception that lodgepole pine should be prioritized for removal over other species because of Mountain Pine Beetle hazard. Retained stems should be a mix of ages and be windfirm.

Retained stems in RMZs are to be distributed as uniformly as possible along the length and width of the riparian buffer. Where a uniform distribution of stems is not possible along at least 70% of the steam length in the area proposed for development, then a site assessment should be undertaken to determine an appropriate management strategy.

Monitoring

A monitoring plan to monitor the implementation and effectiveness of these strategies is currently under development. This plan will include long-term strategic monitoring (updating of the GIS riparian buffer budget analysis), as well as a field component. As part of the monitoring program, objectives will be set, appropriate variables selected and data collected, and the data analyzed and reported on. Existing information and complementary data (i.e. from the Forest and Range Evaluation Program) will be used where possible and practicable. Riparian strategies will then be revised, if necessary, using an adaptive management framework.

Glossary of Terms

The following terms are used throughout the Management Strategies tables:

Terrestrial-aquatic interface: The transition zone between the aquatic ecosystem and the terrestrial ecosystem marginal to water bodies (lakes, wetlands, streams) where water table fluctuations associated with changes in water level influence vegetation and soil properties.

Channel morphology: The form or structure of the channel.

Colluvial deposit: Coarse, unsorted deposits from avalanches, rockfall and other gravity induced failures.

Floodplain: Flat part of a valley bottom adjacent to a river that is made of unconsolidated, river-borne sediment and is periodically flooded during large flood events. A river, gradually or abruptly shifts location over the floodplain and in doing so, re-mobilizes previously deposited sediment.

Glacial depression: A depression in the ground formed during glaciation. A kettle is a depression formed when a large block of glacial ice melts out of thick glacial sediment deposit leaving a depression. Some of these depressions are now occupied by water creating lakes or wetlands.

Glaciofluvial scarp: Thick accumulations of sediment deposited by rivers flowing from melting glaciers filled many of the large river and tributary valleys throughout the Kootenay region. Present-day rivers and streams have eroded down into these sediments creating high raveling scarps of unconsolidated sediments along many of the larger streams and rivers. These are referred to as glaciofluvial scarps.

Lateral bar: The deposits of sand, gravel and cobbles along the margins of a stream or river.

LWD: Large woody debris (LWD) in the east Kootenay region generally refers to woody material (eg. branches or stems) greater than 10cm in diameter.

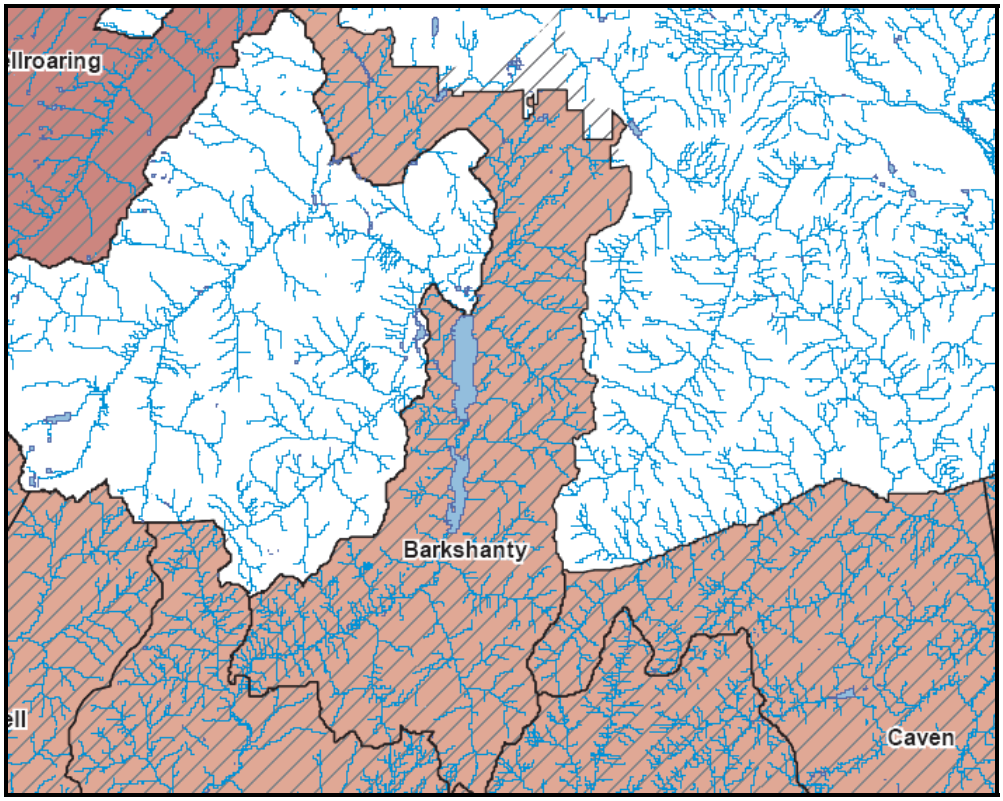
Meander:	The bend in a stream or river.
Reach:	Length of stream channel that displays consistent channel form.
Redd:	A depression dug in the stream substrate where a female fish deposits eggs.
Riparian function:	The physical, biological and chemical interaction of the riparian vegetation with the aquatic environment.
Swale:	A shallow troughlike depression often formed by glacial meltwater during deglaciation that now is dry or only carries minimal amounts of water mainly during rainstorms or snow melt.
Unconfined:	A channel that is unconfined is able to shift to either side of its present course without being constrained by valley sides.
Valley flat:	The relatively flat area of ground in the bottom of a stream valley that is underlain by a combination of alluvium (water borne) and colluvium (gravity deposits). Although the stream can shift over the valley bottom much of the material was not deposited by the stream and is not readily transported by the stream during average flows.

1.0 South Purcell Region

The South Purcell Riparian Management Region has been subdivided into 7 Riparian Management Units. The criteria used to divide the region include similarities in physiography, relief, climate and geologic and hydrologic processes. The Riparian Management Units (RAU's) for the Southern Purcell region are:

1. Barkshanty
2. Caven
3. Gilnockie
4. Goat
5. Gold
6. Little Moyie
7. Russell

1.1 Barkshanty RAU



1.1.1 Characteristics

Physical Characteristics

The Barkshanty riparian management unit is underlain by moderately north dipping Middle Proterozoic Purcell Supergroup argillites and wackes of the Aldridge and Creston formations. Carbonate rocks of the Kitchener Formation are exposed in the northern portion of the unit stratigraphically above Creston formation meta-sediments. Elevation ranges from 2100 at the headwaters of Sunrise Cr to 900 metres

in the Moyie River valley bottom. Most of the mountains and ridges in this management unit were overridden by glaciers at the height of the Frazier Glaciation between 12,000 and 10,000 years ago resulting in rounded, subdued topography at the upper elevations and moderately to steeply incised tributary valleys along the mid and lower slopes. Remnant glaciofluvial terraces are present along the lower reaches of Lamb Creek and along the length of Moyie River.

BEC Classification

Most valley bottoms and lower slopes of the Barkshanty management unit are in the ICHdw1 and ICHdm biogeoclimatic zones. Mid and upper elevation slopes (above 1500m) on the north and south sides of Moyie River in the western portion of this MU are classified as ESSFdm1. Mid and upper elevation slopes east of Moyie River and Moyie Lake from Sundown Creek north to Prudhomme Creek are classified as ESSFdk. A thin sliver of ground around the northern edge of Moyie Lake is situated within the IDFdm2 biogeoclimatic zone.

Natural Variability in Riparian Function

Most of the landscape is in NDT3 where fires are expected frequently and are often of stand-replacing or mixed severity. The generally subdued topography at the upper elevations suggests similar fire regimes between riparian and upslope stands. The highest fire frequency with lower severity can be expected in the northern part of the management unit around the north end of Moyie Lake and Lumberton Creek. Riparian stands with higher fire resiliency occur at the highest elevations of the Moyie and Yahk Ranges and in the steep, incised valley sides of the larger tributaries to Moyie River (Prudhomme to Ferrel Creeks).

Flooding is an important agent of riparian disturbance and LWD recruitment along the main stem of the Moyie River. South and east flowing tributaries to the north of Moyie River and west of Moyie Lake that drain from slopes below 1800 meters elevation are subject to relatively frequent debris floods (~1:10 – 1:20) caused by rain-on-snow events that occur early in the spring snowmelt period.

1.1.2 Riparian Budget

The overall budget for this assessment unit is 2,358.8 ha of retention, with 48% of this required in specific riparian classes (1,131.0). S4 streams make up the single biggest component of the retention requirement.

Table 15. Barkshanty Riparian FSC Retention Budgets

Riparian Feature	Riparian Class	RRZ ha*	RMZ ha*	Retention Percent	Effective RMZ ha	Total Effective Retention ha	Class Specific Budget ha
Lake	L1	17.7	16.3	30.0	4.9	22.6	14.2
	L2	0.3	0.3	30.0	0.1	0.4	0.2
	L3	2.1	1.5	30.0	0.4	2.5	1.7
	L4	0.0	0.0	30.0	0.0	0.0	0.0
	NC	0.0	0.0	30.0	0.0	0.0	0.0
Wetland	W1	23.7	15.0	30.0	4.5	28.3	19.0
	W2	0.0	0.0	30.0	0.0	0.0	0.0
	W3	13.7	9.1	30.0	2.7	16.4	11.0
	W4	0.0	0.0	30.0	0.0	0.0	0.0
	W5	0.0	0.0	30.0	0.0	0.0	0.0
Stream River	S1	0.0	6.6	65.0	4.3	4.3	0.0
	S2	174.5	242.1	65.0	157.4	331.8	139.6
	S3	286.3	208.4	65.0	135.5	421.8	229.0
	S4	741.3	582.7	65.0	378.7	1120.1	593.1
	S5a	69.7	65.7	65.0	42.7	112.4	55.8
	S5b	0.0	22.0	30.0	6.6	6.6	0.0
	S6a	84.4	81.8	65.0	53.2	137.5	67.5
	S6b	0.0	513.5	30.0	154.0	154.0	0.0
Assessment Unit Retention Budget						2,358.8	1,131.0

* Calculated using GIS buffering techniques to avoid double counting of overlap areas between streams, lakes and wetlands. Calculations based off feature lengths would give inflated estimates.

1.1.3 Current Condition Assessment

The results of the current condition assessment for the Barkshanty assessment unit are provided in the table below and mapped in Appendix C. Budget minimums were compared with current (July 2006) retention levels to assess consistency with FSC requirements. Both riparian class specific requirements and overall assessment unit requirements were examined.

Table2. Barkshanty Current Conditions Relative to Targets

Riparian Feature	Riparian Class	Class Specific Budget (ha)	Retention Area (ha)	Surplus / Deficit		Assess Unit Budget (ha)	Assess Unit Retention (ha)	Surplus / Deficit
Lake	L1	14.2	69.3	55.2		2,358.8	4,052.4	1693.6 Surplus 172% of budget
	L2	0.2	0.5	0.3				
	L3	1.7	5.8	4.1				
	L4	0.0	0.0	0.0				
	NC	0.0	0.0	0.0				
Wetland	W1	19.0	48.9	29.9				
	W2	0.0	0.0	0.0				
	W3	11.0	28.0	17.0				
	W4	0.0	0.0	0.0				
	W5	0.0	0.0	0.0				
Stream River	S1	0.0	9.4	9.4				
	S2	139.6	744.5	604.9				
	S3	229.0	823.0	593.9				
	S4	593.1	919.9	326.8				
	S5a	55.8	252.6	196.9				
	S5b	0.0	34.0	34.0				
	S6a	67.5	265.5	198.0				
	S6b	0.0	850.9	850.9				

Area requirements are currently met with significant surpluses occurring in all riparian classes.

1.1.4 Riparian Management Strategy

General strategies for riparian management and a rationale for these strategies can be found in Section 6.0 of Volume 1 – Strategic Overview and Budget Calculations. This section should be read together with the detailed guidance specific to retention strategies and priorities for this RAU.

Unit-specific rational for management strategies

Most of the streams in this RAU are S3 to S6. Only the lowest reaches of Sunrise, Sundown and several other tributaries streams are classified as S2. The Moyie River is classified as S1. Streams flowing from the north and west of Moyie River and Moyie Lake drain broad headwater basins (eg. Etna and Braunagle Creeks). These streams have high stream power and frequently host debris floods resulting in very limited riparian function. Streams draining from east and south of Moyie Lake and Moyie River are generally larger and have a more complex topography that results in lower stream power during the spring melt so riparian vegetation plays a greater role in maintaining channel structure in channels less than 8 metres wide. Riparian strategies presented here are developed for these higher function streams. Maintaining channel structure and shade are the primary focus of strategies in this RAU.

Key Values

The important non-timber values to be considered when implementing riparian retention strategies and deploying riparian budgets in the Barkshanty management unit consist of:

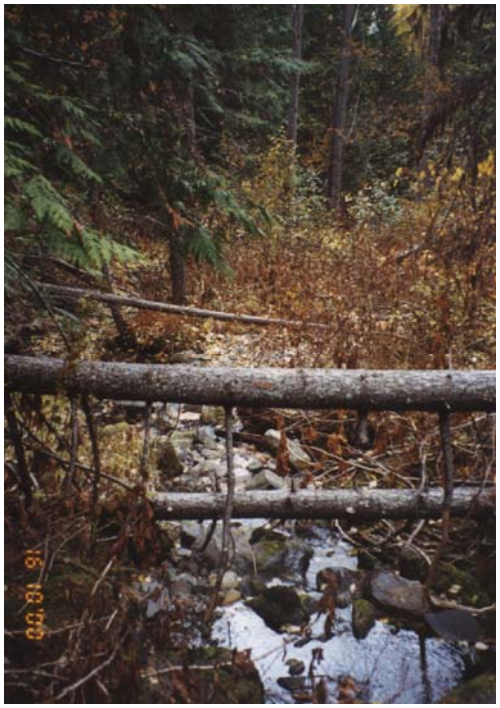
1. HCVF areas: Gilnockie Creek is a back-up community water supply for the community of Moyie. Most of the drainages on the north and west side of Highway 3 have been identified as having terrain stability and flooding hazards. Flooding hazards are also identified for catchments on the east side of Highway 3

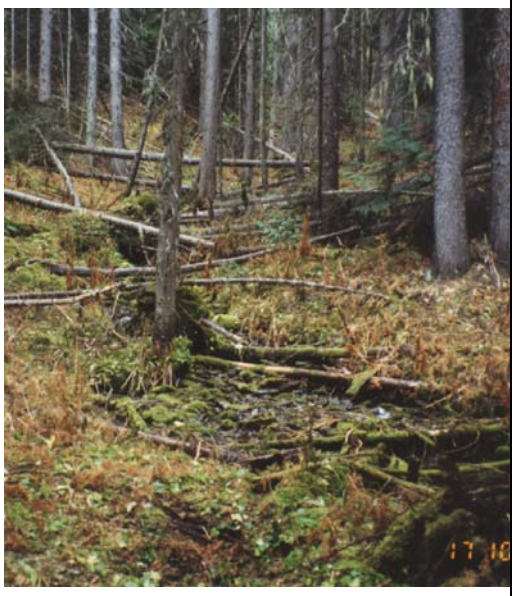
along the length of Moyie Lake. This unit also contains HCVFs for grizzly movement, old growth, old growth riparian habitat (Glencairn Creek), Williamson's Sapsucker, and Kokanee spawning.

2. Stream Temperature: Canopy cover is critical to maintaining stream temperature along many of the streams in this MU. Lower elevation, south-flowing streams are most likely to experience temperature increases following removal of riparian shade. Streams draining lower gradient terrain, including most of the tributaries to the Moyie River will require RMZ's that are sufficiently wide and have adequate retention to provide shade to the channels.
3. Kokanee (Moyie Lake; Lamb, Cotton, Barkshanty, Sunrise and Sundown Creeks): maintain canopy cover to avoid stream temperature increases. Spawning is known to occur in Lamb Creek.
4. Moose (lower valley slopes and floodplain along Moyie River): retain security cover adjacent to key feeding patches (dogwood, willows) and manage for a mixture of forage and cover in riparian areas. Retain patches of mature and old spruce in riparian reserves. Cedar in riparian areas in the Kiakho area provides an important winter food source for deer and elk that winter in this relatively deeper snow area.
5. Hardwoods: Major existing riparian hardwood values that should be retained are along Moyie River and Moyie Lake.

Maps illustrating the spatial location of most riparian values are included for each RAU in Appendix C and D of Volume 1.

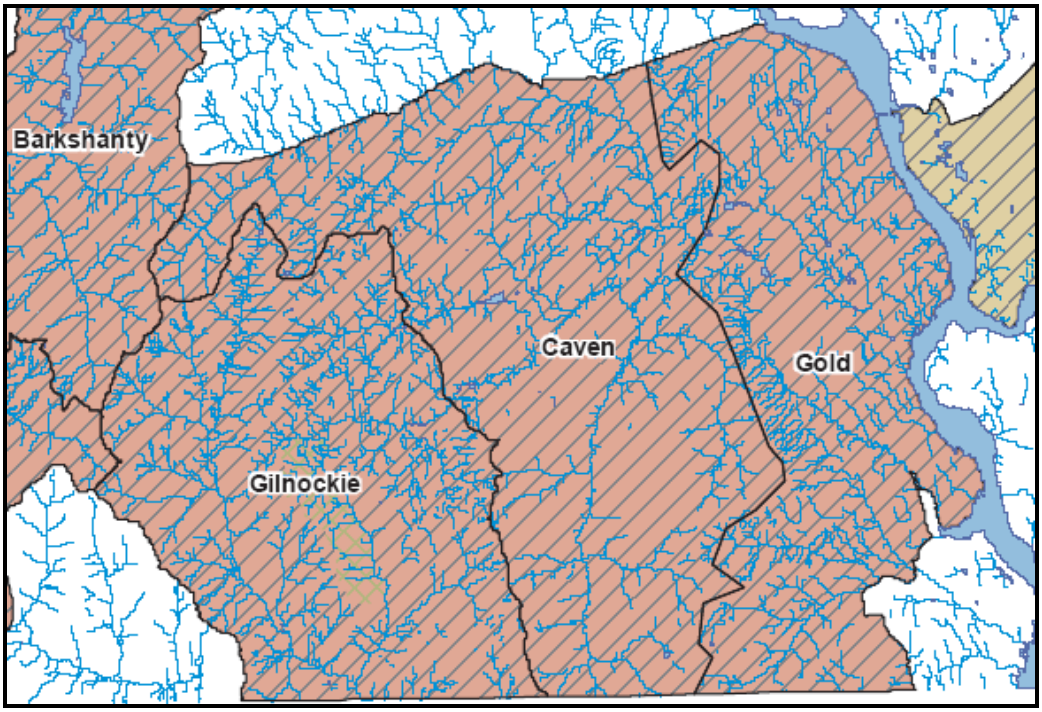
Stream type	Example	Riparian Management Guidance
S1a,b (> 20m) Large Streams and Rivers (with fish or community watershed)		**Riparian Function** The Moyie River is the only S1 stream in this MU. Spruce, Douglas fir, larch and cedar and hardwoods including cottonwood and aspen provide protection to banks and adjacent forest floor. It also facilitates flood water storage, moderates discharge, and facilitates ground water recharge. The Moyie R. flows over a wide floodplain. There is limited LWD in the channel. Most of the LWD occurs as accumulations on lateral and mid-channel sediment bars. LWD functions locally to provide aquatic habitat and complexity to the channel bed. **Management Strategy** Riparian reserve zone over the valley flat and a riparian management zone of sufficient width or to the top of a topographic break to manage for wind throw and sediment delivery hazards. Ensure the RMZ is large enough to protect key values, and provides large diameter snags, where present, for cavity nesting birds and ducks, perches for aerial insectivores, and security cover for large mammals, particularly moose. Riparian ecosystems should be included in the RRZ.

Stream type	Example	Riparian Management Guidance
S2 (5-20 m) Intermediate Streams and Rivers (with fish or in community watershed)		**Riparian Function** S2 streams in this MU are generally the lower reaches of larger tributaries (eg. Sunrise Cr, Sundown Cr.). Mature spruce, cedar, Douglas fir, larch and hardwoods provide protection to banks and adjacent forest floor. Deciduous shrubs of alder and dogwood are present along channel banks and adjacent valley flat. LWD (> 30cm) provides aquatic habitat and complexity to channel bed important to these streams as they provide rearing habitat for adult age classes of fish. LWD and shrubs along channel margins provides aquatic and terrestrial habitat and input to the food web. **Management Strategy** Riparian reserve zone over the valley flat and a riparian management zone of sufficient width or to the top of a topographic break to manage for wind throw and sed. delivery hazards, as well as for key values.
S3 (1.5 – 5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams		**Riparian Function** Glencairn Creek and the lower reaches of smaller tributaries to Moyie River and Moyie Lake are S3. Also the upper tributaries of Sundown and Sunrise Creeks (fish bearing) are classified as S3. Riparian vegetation and function varies with elevation. Riparian function is most important on the tributary fans along the Moyie valley bottom. Riparian vegetation in this area reduces the rate of lateral migration of the stream channel, provides stability to the primary stream channels and over flow channels. LWD (> 10cm) provides sediment storage sites and aquatic habitat. Deciduous shrubs along channel margins provide shade and terrestrial habitat. These moderately sized streams provide rearing habitat for multiple life stages of fish. Furthermore, they can act as spawning and over-wintering locations. **Management Strategy** S3 reaches along the Moyie valley bottom require riparian reserve zones over the width and length of the fan deposit or valley flat and an RMZ where necessary to protect the RRZ from wind throw hazards. For smaller streams (1.5m) at higher elevations or on open slopes stream temperature is likely to be a management concern. For these smaller streams Where present, establish a RRZ over the width of the valley flat. Where there is no valley flat or obvious riparian ecosystem, the riparian strategy is to retain at least 50% of the mature coniferous trees, avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous under story as possible on either side of the stream channel or for the width of the alluvial/colluvial deposit.

Stream type	Example	Riparian Management Guidance
S4 (<1.5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams		**Riparian Function** In most cases the S4 streams are low gradient (< 5%) lower to intermediate reaches of 1st or 2nd order tributaries that flow into the Moyie River. S4 streams also occur in the upper reaches of many of the tributaries along the east side of Moyie Lake and south side of Moyie River. The bed load in these channels consists of gravel and finer texture sediment. Riparian vegetation includes deciduous shrubs, grasses and a mixed stand of spruce and pine. Many S4 streams support resident fish populations. Therefore, habitat requirements of all life stages must be maintained. Roots, branches and woody debris from the adjacent stands provide shade, bank resiliency, organic litter and, in some streams, channel structure. **Management Strategy** Avoid mechanical disturbance to stream banks. Maintain a RMZ on the valley flat or, where no valley flat exists, on both sides of the stream in which at least 30% of the forested stand is retained and minimal disturbance to understory shrubs within 7 m of stream banks. Retained stems should include a mix of species and ages and should be as wind firm as possible. The RMZ should be wide enough to maintain the function of shade and rate of LWD supply. Channels oriented generally east-west should have higher retention on south side (~50%).
5a (>3m) a) Domestic watershed, &/or b) <500 m upstream of fish-bearing stream, &/or c) not fish bearing or domestic watershed but >10m S5b (3-10m) Fish absent, Not domestic and, >500 m upstream of fish bearing stream		**Riparian Function** Riparian vegetation plays an important role in maintaining channel stability and creating aquatic habitat in 3 to 10 metre wide channels with gradients less than 15% in the Barkshanty RAU. Mature cedar, spruce and balsam fir provide a source of LWD that create storage sites for bed load sediment, creates aquatic habitat and controls channel morphology. Root systems of mature trees provide resiliency to channel banks Deciduous shrubs including red-osier dogwood, alder and willow colonize channel banks and sediment bars following disturbance. Root systems from deciduous shrubs provide stability to banks and bars, preventing sedimentation of downstream spawning habitat as well as providing leaf litter that creates soil on scoured surfaces and adds nutrients to the aquatic habitat. **Management Strategy** Reserve stands on the valley flat. Establish RMZ with levels of retention high enough to protect reserve zone from wind throw and terrain stability hazards. Avoid mechanical disturbance to banks and understory vegetation 7 m from waters edge.

Stream type	Example	Riparian Management Guidance
S6a (0.5<3m) Small streams not in a community watershed or fish bearing but, a) in domestic watershed &/or b) <250m upstream from fish bearing stream. S6b Not community watershed or fish bearing but a) 0.5-3 m and not domestic watershed and >250 m from fish bearing stream b)<0.5m wide		**Riparian Function** S6 streams in the Barkshanty RU are upper elevation headwater channels. The moderate to gentle gradient slopes in this management unit result in relatively low gradient headwater channels that often have step-pool morphologies. LWD and root systems from spruce and balsam fir provide stability to channel bed and banks, preventing sedimentation to downstream, fish bearing reaches during heavy surface rain events. **Management Strategy** For streams 0.5 to 3m designate a RMZ over the valley flat or along channel margins and retain at least 60% of the riparian stand that is as wind firm as possible. Retained stems should include a mix of species and ages. The RMZ should be wide enough to ensure LWD supply is maintained. For smaller streams (<0.5m) on open slopes where there is no valley flat or obvious riparian ecosystem, the management strategy is to avoid disturbance to stream banks and under story brush within 7 m of banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous understory as possible on either side of the stream channel or for the width of the alluvial/colluvial deposit.
Lakes (L1 – L4) L1 > 5 ha L2 (1-5ha in PP or IDF) L3 (1-5ha not in PP or IDF) L4 (0.25-1ha)		**Riparian Function** Very few lakes occur in this management unit. The lakeshore of Moyie Lake is vegetated with grasses, Douglas fir, lodgepole and yellow pine and hardwoods. Riparian vegetation buffers the lake from increases in nitrogen and phosphorus levels. The riparian vegetation here plays a limited role with respect to shade. Beaver-influenced riparian areas are present at the northern end of Moyie Lake. **Management Strategy** Establish a RMZ along the riparian – upland interface that is of sufficient width to protect lakeshores from mechanical disturbance, wind throw and terrain stability hazards, and manage for key values. Retain all hardwood stands.
Wetlands (W1 – W4) W1 > 5 ha. W2 1-5 ha. (PP or IDF) W3 1-5 ha. (not in PP or IDF) W4 0.25-1 ha. (in PP or IDF) W5 complex of 2 or more wetlands of 5ha or more combined area		**Riparian Function** Wetlands occur along the margins of Moyie River. Riparian vegetation in these areas includes hardwoods, mixed conifers, grasses and deciduous shrubs. Riparian vegetation buffers the wetlands from potential increased nitrogen and phosphorus levels from cattle and harvesting. **Management Strategy** Establish reserves on the floodplain and a RMZ along the riparian – upland interface that is of sufficient width to protect wetlands from mechanical disturbance, windthrow and terrain stability hazards. Manage towards a mixture of deciduous and coniferous species. Where beavers are present retain all hardwoods in the RMZ. Ensure the RMZ is large enough to protect key values, and provides large diameter snags, where present, for cavity nesting birds and ducks, perches for aerial insectivores, and security cover for large mammals, especially in areas with lots of willow and dogwood (foraging for moose).

1.2 Caven RAU



1.2.1. Characteristics

Physical Characteristics

The Caven riparian management unit includes Caven Creek, Teepee Creek and Bloom Creek. All three catchments flow eastward into Gold Creek from the McGillivary Range in the Purcell Mountains. Gold Creek, in turn, flows southeast toward Lake Koocanusa in the Rocky Mountain Trench. The northern flank of Mount Fitzpatrick forms the highest point in the watershed at just over 2000 metres.

The area is underlain by steeply to moderately east-dipping, north-south trending Proterozoic sediments consisting of carbonates and fine textured siltstone of the Kitchener, Van Creek, Nicol Creek and Gateway Formations.

BEC Classification

The Caven management unit is situated in the Dry climate region of the Engelmann Spruce – Subalpine Fir biogeoclimatic zone (ESSFdk) above approximately 1600 metres and the Montane Spruce biogeoclimatic zone (MSdk) below 1600 metres (Braumandl and Curran, 1992).

Biogeoclimatic sub-zone-variants included in this management unit include ESSFdk/dm/dm1/wm, MS dk, ICH dm/dw/dw1/mk1, IDF dm2, PP dh2 (NDT 3 and 4). Most valley bottoms and lower slopes are in the MSdk or ICHdw1 except for those that drain into the trench (e.g., Gold Creek), which are IDFdm2. Mid and upper elevation slopes (above 1500m) are ESSFdk in the eastern portion of the MR

This management unit is located in one of the driest hydrological zones in B.C. with average annual run off estimated at just over 400 mm (Obedkoff, 2002).

Natural Variability in Riparian Function

Most of the landscape is in NDT3 where fires occur with a frequency between 14-130 years depending on elevation. Fires are often of stand-replacing or mixed severity. The generally subdued topography suggests similar fire regimes between riparian and upslope stands (Forsite, 2005).

Forest fires approximately 100 years ago burned off a large portion of the management unit in Caven and Teepee Creeks.

Fire in riparian stands is an important LWD recruitment mechanism in this management unit.

1.2.2 Riparian Budget

The overall budget for this assessment unit is 3,526.9 ha of retention, with 49% of this required in specific riparian classes (1,723.2). S4 streams make up the single biggest component of the retention requirement.

Table 16. Caven Riparian FSC Retention Budgets

Riparian Feature	Riparian Class	RRZ ha*	RMZ ha*	Retention Percent	Effective RMZ ha	Total Effective Retention ha	Class Specific Budget ha
Lake	L1	4.9	2.3	30.0	0.7	5.6	3.9
	L2	0.0	0.0	30.0	0.0	0.0	0.0
	L3	4.9	3.9	30.0	1.2	6.0	3.9
	L4	0.0	0.0	30.0	0.0	0.0	0.0
	NC	0.0	0.0	30.0	0.0	0.0	0.0
Wetland	W1	20.1	16.6	30.0	5.0	25.0	16.1
	W2	0.0	0.0	30.0	0.0	0.0	0.0
	W3	23.1	14.5	30.0	4.3	27.4	18.5
	W4	0.0	0.0	30.0	0.0	0.0	0.0
	W5	0.0	0.0	30.0	0.0	0.0	0.0
Stream River	S1	0.0	0.0	65.0	0.0	0.0	0.0
	S2	159.4	260.7	65.0	169.5	328.9	127.5
	S3	487.0	360.4	65.0	234.3	721.2	389.6
	S4	1436.8	1035.6	65.0	673.1	2110.0	1149.5
	S5a	1.7	1.4	65.0	0.9	2.6	1.3
	S5b	0.0	0.0	30.0	0.0	0.0	0.0
	S6a	16.3	18.6	65.0	12.1	28.4	13.0
	S6b	0.0	906.1	30.0	271.8	271.8	0.0
Assessment Unit Retention Budget						3,526.9	1,723.2

* Calculated using GIS buffering techniques to avoid double counting of overlap areas between streams, lakes and wetlands. Calculations based off feature lengths would give inflated estimates.

1.2.3. Current Condition Assessment

The results of the current condition assessment for the Caven assessment unit are provided in the table below and mapped in Appendix C. Budget minimums were compared with current (July 2006) retention levels to assess consistency with FSC requirements. Both riparian class specific requirements and overall assessment unit requirements were examined.

Table 17. Caven Current Conditions Relative to Targets

Riparian Feature	Riparian Class	Class Specific Budget (ha)	Retention Area (ha)	Surplus / Deficit		Assess Unit Budget (ha)	Assess Unit Retention (ha)	Surplus / Deficit
Lake	L1	3.9	6.9	3.0		3,526.9	4,340.7	813.8 Surplus 123% of budget
	L2	0.0	0.0	0.0				
	L3	3.9	10.5	6.6				
	L4	0.0	0.0	0.0				
	NC	0.0	0.0	0.0				
Wetland	W1	16.1	34.2	18.1				
	W2	0.0	0.0	0.0				
	W3	18.5	34.3	15.8				
	W4	0.0	0.0	0.0				
	W5	0.0	0.0	0.0				
Stream River	S1	0.0	0.0	0.0				
	S2	127.5	614.8	487.3				
	S3	389.6	993.2	603.7				
	S4	1149.5	1437.8	288.3				
	S5a	1.3	1.3	0.0				
	S5b	0.0	0.0	0.0				
	S6a	13.0	43.7	30.6				
	S6b	0.0	1164.1	1164.1				

Area requirements are current met with surpluses occurring in all riparian classes.

1.2.4. Riparian Management Strategy

General strategies for riparian management and a rationale for these strategies can be found in Section 6.0 of Volume 1 – Strategic Overview and Budget Calculations. This section should be read together with the detailed guidance specific to retention strategies and priorities for this RAU.

Unit-specific rational for management strategies

Riparian function varies substantially with slope gradient and disturbance history through the Caven RAU. In general riparian vegetation plays a very important role with respect to channel structure and aquatic habitat in lower gradient, lower elevation streams in this RAU. Stream power is generally low so riparian vegetation continues to play a role in channel structure in streams with gradients up to 35%. Fire is an important disturbance agent in riparian stands and is the main recruitment mechanism for LWD. Snow avalanches and debris flows occur in streams draining from high elevation ridges.

Key Values

The important non-timber values to be considered when implementing riparian retention strategies and deploying riparian budgets in this RAU consist of:

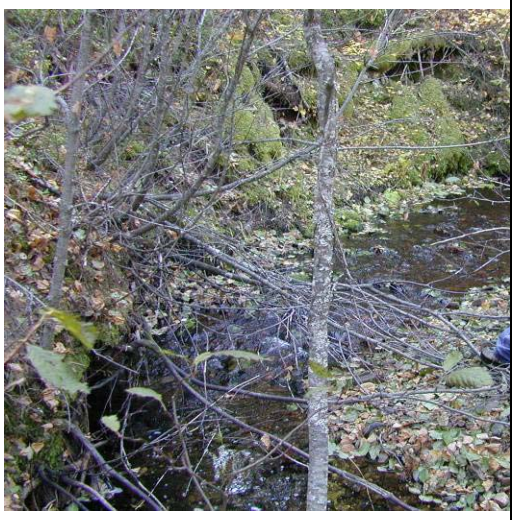
1. HCVFs: HCVFs have been established in this RAU for old growth and high elevation grasslands; there are none for riparian or water quality/quantity values.
2. Stream temperature: Canopy cover is critical to maintaining stream temperature along many of the streams in this management unit. Lower discharge and wider valleys make streams more likely to experience temperature increases following removal of riparian shade. Streams draining lower gradient terrain, including most of the tributaries of Caven and Teepee Creeks

will require RRZ and/or RMZ's that are sufficiently wide and have adequate retention to provide shade to the channels, reduce overland flows and groundwater discharge into streams, and lengthen the floodwater and snowmelt water storage time intervals.

3. Aquatic values: Bull trout spawning and westslope cutthroat, all life stages (Gold Creek): avoid sedimentation, increased water temperatures and maintain LWD inputs and overhanging vegetation.
4. Terrestrial values: **Moose**: will winter in riparian areas; retain security cover adjacent to key feeding patches (dogwood, willows) and manage for a mixture of forage and cover. Retain patches of mature and old spruce in riparian reserves. **Otter and Mink** – have been observed in this unit. These species prefer cover in riparian areas, which should be provided for by reserves along larger streams. OGMAs – Small OGMAs have been located along many of the creeks in this RAU. Due to the extensive history of logging and wildfire, remaining old growth riparian patches should be placed in reserves.

Maps illustrating the spatial location of most riparian values are included for each RAU in Appendix C and D of Volume 1.

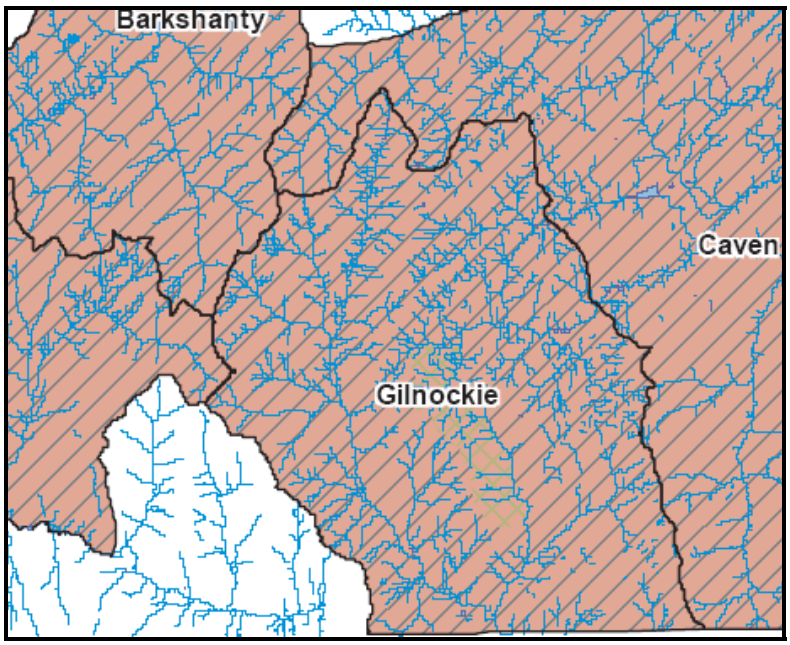
Stream type	Example	Riparian Management Guidance
S1a,b (> 20m) Large Streams and Rivers (with fish or community watershed)	No S1 streams in this Management Unit	
S2 (5-20 m) Intermediate Streams and Rivers (with fish or in community watershed)		**Riparian Function** Mature spruce, and balsam fir or pine provides protection to banks and LWD to instream habitat utilized by rearing adult fish. Deciduous shrubs of alder and dogwood are present along channel banks and adjacent valley flat. Shrubs function to provide shade to the stream and protection to channel banks. LWD (> 30cm) provides aquatic habitat and complexity to the channel bed. LWD and shrubs along channel margins provide aquatic habitat and contribute to the food web input. **Management Strategy** Riparian reserve zone over the valley flat and a riparian management zone of sufficient width or to the top of a topographic break to manage for wind throw and sed. delivery hazards, and maintain key values. Reserves should include riparian ecosystems and areas with large trees, high value snags, large CWD, and extensive shrubs. Provide security cover for moose and ungulate trails. Watch for areas with horsetail and sedges, important bear feeding areas in spring, and provide security cover for these areas, especially near roads.

Stream type	Example	Riparian Management Guidance
S3 (1.5 – 5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams		**Riparian Function** Many of the small streams in this MU are S3, providing important spawning and rearing habitat for resident and migratory fish populations. Mature spruce, pine and deciduous shrubs are present as riparian vegetation, LWD (> 10cm) provides sediment storage sites and aquatic habitat. Deciduous shrubs along channel margins provide shade and aquatic habitat (nutrient input and cover). **Management Strategy** S3 reaches require riparian reserve zone over the valley flat and an RMZ where necessary to protect the RRZ from wind throw hazards. For smaller streams (1.5m) on open slopes where there is no valley flat or obvious riparian ecosystem, the riparian strategy is to retain at least 50% of the mature coniferous trees, avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous under story as possible on either side of the stream channel or for the width of the alluvial/colluvial deposit.
S4 (<1.5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams		**Riparian Function** In most cases the S4 streams are low gradient (< 15%) lower to intermediate reaches of headwater tributaries. The bed load in these channels consists of gravel and finer texture sediment. Riparian vegetation includes deciduous shrubs, grasses and a mixed stand of spruce and pine. Roots, branches and woody debris from the adjacent stands and understory brush provides shade, bank resiliency, nutrients, organic litter, food web input, and, in some streams, channel structure. **Management Strategy** Avoid mechanical disturbance to stream banks. Maintain a RMZ on both sides of the stream in which at least 50% of the forested stand is retained. Stems retained should include a mix of species and ages and should be as wind firm as possible. Avoid riparian vegetation disturbance 7 m from waters edge.

Stream type	Example	Riparian Management Guidance
5a (>3m) a) Domestic watershed, &/or b) <500 m upstream of fish-bearing stream, &/or c) not fish bearing or domestic watershed but >10m S5b (3-10m) Fish absent, Not domestic and, >500 m upstream of fish bearing stream		**Riparian Function** Riparian vegetation plays a vital roll in maintaining channel stability and creating aquatic habitat in 3 to 10 metre wide channels in the Caven RMU. Mature spruce, balsam fir and pine provide a source of LWD that create storage sites for bed load sediment, creates aquatic habitat and controls channel morphology. Root systems of mature trees provide resiliency to channel banks. Deciduous shrubs typically colonize channel banks and sediment bars following disturbance. Root systems from deciduous shrubs provide stability to banks and bars as well as leaf litter that creates soil on scoured surfaces and adds to the aquatic food web in the immediate area as well as downstream. **Management Strategy** Riparian reserve zones over the width of the valley flat and/or floodplain and a RMZ where necessary to protect reserve zone from wind throw and terrain stability hazards and to ensure continued supply of LWD to the channel.
S6a (0.5<3m) Small streams not in a community watershed or fish bearing but, a) in domestic watershed &/or b) <250m upstream from fish bearing stream. S6b Not community watershed or fish bearing but a) 0.5-3 m and not domestic watershed and >250 m from fish bearing stream b)<0.5m wide		**Riparian Function** S6 streams in the Caven RU are upper elevation headwater channels. Many have carried snow avalanches or debris flows in the past several decades following large-scale forest fires. Riparian vegetation is generally limited to deciduous shrubs. Deciduous species provide organic input (leaf litter) and nutrients, an import energy source for the food web in the immediate area and downstream food web. Root systems of deciduous shrubs provide stability to channel bed and banks. **Management Strategy** Riparian management will depend on channel gradient and disturbance history. For 0.5 to 3 metre channels with gradients less than 35%, designate a RMZ over the valley flat or on both channel sides and retain at least 60% of the forest stand. Retained stems should include a mix of species and ages. The RMZ should be wide enough to ensure LWD supply is maintained. For steeper gradient or smaller streams (<0.5m) on open slopes where there is no valley flat or obvious riparian ecosystem, avoid disturbance to stream banks and immediate surrounding bank shrub vegetation, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous under story as possible on either side of the stream channel or for the width of the alluvial/colluvial deposit.

Stream type	Example	Riparian Management Guidance
Lakes (L1 – L4) L1 > 5 ha L2 (1-5ha in PP or IDF) L3 (1-5ha not in PP or IDF) L4 (0.25-1ha)		**Riparian Function** The lake level in Cherry Lake is controlled by groundwater outflow. Lakeshores are vegetated with grasses and deciduous shrubs. Lake level fluctuates annually but has been low in recent years. Coniferous vegetation plays limited roll with respect to shade. Riparian vegetation buffers the lake from increase nitrogen and phosphorus levels. The level of Fish Lake is (was) controlled by beaver dams. Dam-burst floods are common on the outflow stream from Fish Lake. **Management Strategy** Establish a RMZ along the riparian – upland interface that is of sufficient width to protect lakeshores from mechanical disturbance, wind throw and terrain stability hazards. Manage towards a mixture of deciduous and coniferous species. Protect riparian deciduous stands, riparian ecosystems, and wildlife values.
Wetlands (W1 – W4) W1 > 5 ha. W2 1-5 ha. (PP or IDF) W3 1-5 ha. (not in PP or IDF) W4 0.25-1 ha. (in PP or IDF) W5 complex of 2 or more wetlands of 5ha or more combined area		**Riparian Function** Wetlands are formed by beaver dam complex on lower Caven Cr. Riparian vegetation includes grasses and deciduous shrubs. Coniferous vegetation plays limited roll with respect to shade. Riparian vegetation buffers the wetlands from increase nitrogen and phosphorus levels. Beaver's primary food source is the bark of aspen, cottonwood and willow. Declining supplies of these species will result in decreased beaver populations and abandoned dams. **Management Strategy** Establish a RMZ along the riparian – upland interface that is of sufficient width to protect wetlands from mechanical disturbance, windthrow and terrain stability hazards. Manage towards a mixture of deciduous and coniferous species, and maintain existing old growth and mature riparian stands. Ensure the RMZ is large enough to protect key values, and provides large diameter snags, where present, for cavity nesting birds and ducks, perches for aerial insectivores, and security cover for large mammals, particularly moose.

1.3. Gilnockie RAU



1.3.1. Characteristics

Physical Characteristics

The Gilnockie Riparian Management Unit includes the Yahk River and Gilnockie Creek watersheds that flow southward towards the Montana border from the McGillivary Range in the southern Purcell Mountains. Gilnockie Creek flows into the Yahk River just north of the B.C. Montana border.

Elevation ranges from 2180 metres at Yahk Mountain to 1000 metres at the southern edge of the MU.

Folded and faulted siltstone, quartzite, argillite and dolostone of the Middle Proterozoic Purcell Supergroup underlie the MU and control the trend of the main valleys. Yahk River and Gilnockie Creeks occupy large glacial melt water valleys. Large boulders deposited during down-wasting of the glaciers (glacial erratics) occur along the length of Gilnockie Creek.

Average annual total precipitation for Gilnockie MU is estimated between 600 and 1000 mm. Most of the precipitation is snowfall between the months of October and April. Peak flows typically occur from late May to mid June in response to spring snowmelt.

BEC Classification

The Gilnockie Management Unit is situated in the Interior Cedar Hemlock Biogeoclimatic zone (ICHmk1 below 1100 metres and ICHdm below approximately 1500 metres) and the Englemann Spruce – Subalpine Fir Biogeoclimatic zone (ESSFdk) above 1500 metres The Montane Spruce Biogeoclimate zone (MSdk) is present on moderate to gentle gradient south and west aspect slopes on the east side of the Yahk River (Braumandl and Curran, 1992).

Natural Variability in Riparian Function

Fire is a significant agent of disturbance in the Gilnockie MU. Mixed severity fires have affected large portions of both the Yahk and Gilnockie Creek drainages in the past century resulting in a mosaic of different age classes of vegetation. Riparian areas along the main stems and many of the larger tributary streams have not experienced the same frequency of fires as valley sides and smaller

tributaries. Mature coniferous species including cedar, hemlock, Doulas Fir and spruce are present in riparian areas throughout this management unit and LWD is present in many streams channels.
Flooding plays a less significant role in riparian disturbance in this Management Unit. Wide, low gradient valleys formed during deglaciation effectively reduce stream velocity and minimize the impacts of flooding on the adjacent riparian areas.

1.3.2. Riparian Budget

The overall budget for this assessment unit is 2,915.3 ha of retention, with 47% of this required in specific riparian classes (1,369.2). S4 streams make up the single biggest component of the retention requirement.

Table 18. Gilnockie Riparian FSC Retention Budgets

Riparian Feature	Riparian Class	RRZ ha*	RMZ ha*	Retention Percent	Effective RMZ ha	Total Effective Retention ha	Class Specific Budget ha
Lake	L1	1.1	0.6	30.0	0.2	1.3	0.9
	L2	0.0	0.0	30.0	0.0	0.0	0.0
	L3	1.2	1.1	30.0	0.3	1.5	0.9
	L4	0.0	0.0	30.0	0.0	0.0	0.0
	NC	0.0	0.0	30.0	0.0	0.0	0.0
Wetland	W1	24.7	14.0	30.0	4.2	28.8	19.7
	W2	0.0	0.0	30.0	0.0	0.0	0.0
	W3	18.0	10.3	30.0	3.1	21.1	14.4
	W4	0.0	0.0	30.0	0.0	0.0	0.0
	W5	0.0	0.0	30.0	0.0	0.0	0.0
Stream River	S1	2.5	3.8	65.0	2.5	5.0	2.0
	S2	124.9	166.8	65.0	108.4	233.4	99.9
	S3	294.3	185.8	65.0	120.8	415.1	235.5
	S4	1104.8	990.9	65.0	644.1	1748.9	883.8
	S5a	43.9	46.3	65.0	30.1	74.1	35.2
	S5b	0.0	22.0	30.0	6.6	6.6	0.0
	S6a	96.0	96.5	65.0	62.7	158.7	76.8
	S6b	0.0	736.3	30.0	220.9	220.9	0.0
Assessment Unit Retention Budget						2,915.3	1,369.2

* Calculated using GIS buffering techniques to avoid double counting of overlap areas between streams, lakes and wetlands. Calculations based off feature lengths would give inflated estimates.

1.3.3. Current Condition Assessment

The results of the current condition assessment for the Gilnockie assessment unit are provided in the table below and mapped in Appendix C. Budget minimums were compared with current (July 2006) retention levels to assess consistency with FSC requirements. Both riparian class specific requirements and overall assessment unit requirements were examined.

Table 19. Gilnockie Current Conditions Relative to Targets

Riparian Feature	Riparian Class	Class Specific Budget (ha)	Retention Area (ha)	Surplus / Deficit		Assess Unit Budget (ha)	Assess Unit Retention (ha)	Surplus / Deficit
Lake	L1	0.9	3.8	2.9		2,915.3	4,564.5	1,649.2 Surplus 157% of Budget
	L2	0.0	0.0	0.0				
	L3	0.9	4.0	3.1				
	L4	0.0	0.0	0.0				
	NC	0.0	0.0	0.0				
Wetland	W1	19.7	53.1	33.4				
	W2	0.0	0.0	0.0				
	W3	14.4	40.1	25.7				
	W4	0.0	0.0	0.0				
	W5	0.0	0.0	0.0				
Stream River	S1	2.0	8.9	6.8				
	S2	99.9	485.3	385.3				
	S3	235.5	720.8	485.4				
	S4	883.8	1601.2	717.4				
	S5a	35.2	170.6	135.5				
	S5b	0.0	40.5	40.5				
	S6a	76.8	316.5	239.8				
	S6b	0.0	1119.7	1119.7				

Area requirements are current met with significant surpluses occurring in all riparian classes.

1.3.4. Riparian Management Strategy

General strategies for riparian management and a rationale for these strategies can be found in Section 6.0 of Volume 1 – Strategic Overview and Budget Calculations. This section should be read together with the detailed guidance specific to retention strategies and priorities for this RAU.

Unit-specific rational for management strategies

Riparian function varies substantially with slope gradient and disturbance history through the Gilnockie RAU. In general riparian vegetation plays a very important role with respect to channel structure and aquatic habitat in lower gradient, lower elevation streams in this RAU. Stream power is generally low so riparian vegetation continues to play a role in channel structure in streams with gradients up to 35%. Fire is an important disturbance agent in riparian stands and is the main recruitment mechanism for LWD. Snow avalanches and debris flows occur in streams draining from high elevation ridges.

Key Values

The important non-timber values to be considered when implementing riparian retention strategies in this RAU consist of:

1. Stream temperature: Many of the small streams draining the Gilnockie RAU do not have alpine or steep colluvial headwaters. These small, slow flowing streams are susceptible to increased temperatures following removal of riparian vegetation. Riparian vegetation on the southern side of the channels are most important for providing shade to the streams. Riparian vegetation also

contributes towards maintaining water temperatures in hygric areas (wetlands) that occur in the meltwater channels throughout this RAU.

2. Aquatic values: Gilnockie and Yahk watersheds are contain fish habitat. In S2 and smaller channels (< 12 metres width) LWD that enters the channels creates shelter, contributes to overhanging banks and pool habitat.
3. Terrestrial values: Tailed Frog (Yahk River): observe WHA provisions and Tembec's SFMP guidelines. Grizzly Bear: Retain security cover (2x sight distance) around riparian feeding areas (sedges, horsetails, skunk cabbage). Although this RAU is not high quality grizzly habitat it is important for the threatened population in the Yahk. Moose: **Moose** will winter in the lower elevations of much of this RAU. Retain security cover adjacent to key feeding patches (dogwood, willows) and manage for a mixture of forage and cover. Retain patches of mature and old spruce in riparian reserves. The wetlands on the lower Yahk are particularly important for moose; retain security and shade cover adjacent to these on all sides.
4. HCVF areas: There are no HCVFs for riparian values in this unit. HCVFs have been established here for old growth and high elevation grasslands.

Maps illustrating the spatial location of most riparian values are included for each RAU in Appendix C and D of Volume 1.

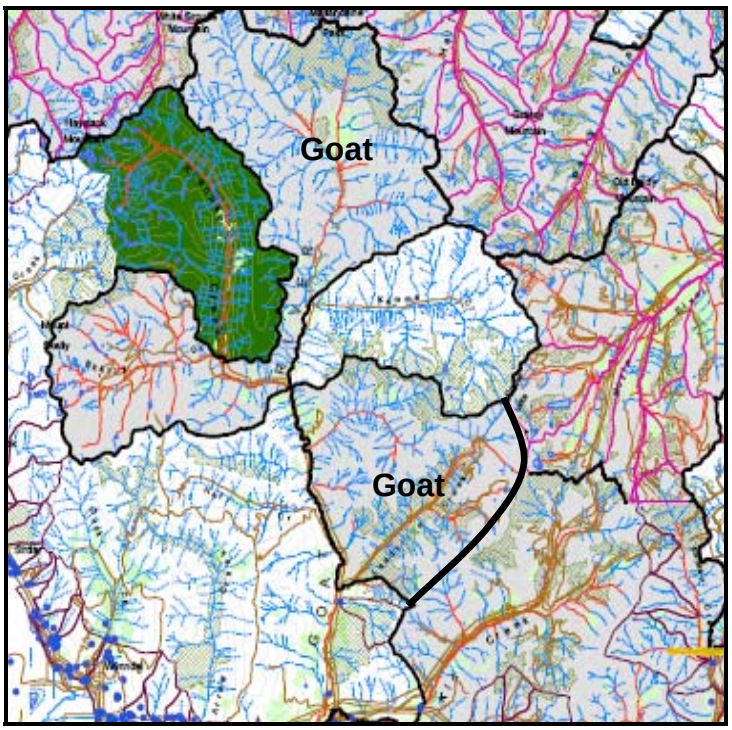
Stream type	Example	Riparian Management Guidance
S1a,b (> 20m) Large Streams and Rivers (with fish or community watershed)	No S1 streams in this Management Unit	
S2 (5-20 m) Intermediate Streams and Rivers (with fish or in community watershed)		**Riparian Function** Mature spruce, balsam fir and/or cedar, hemlock provides protection to banks and adjacent forest floor. LWD (> 30cm) provides complexity to channel bed, improving rearing habitat for adult age classes of fish. In channels less than 8 metres LWD moderates sediment transport thereby protecting potential spawning habitat. LWD and shrubs along channel margins provides aquatic habitat **Management Strategy** Riparian reserve zone over the valley flat and a riparian management zone of sufficient width or to the top of a topographic break to manage for wind throw and sed. delivery hazards Ensure the RRZ is large enough to protect key values, and provides security cover for large mammals, particularly moose. Reserve existing old and mature riparian stands, and recruit large diameter snags and trees in previously logged areas.

Stream type	Example	Riparian Management Guidance
S3 (1.5 – 5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams		**Riparian Function** Mature spruce, balsam fir and cottonwood provide protection to banks and adjacent forest floor, provide flood water storage, and ground water recharge. LWD (> 30cm) provides long term sediment storage sites and moderates sediment transport. This is important here as S3 streams typically contain a substantial amount of spawning habitat. LWD along channel margins increases the diversity of aquatic habitat. **Management Strategy** S3 reaches of Gilnockie riparian unit require riparian reserve zone over the valley flat and an RMZ where necessary to protect the RRZ from wind throw hazards. For smaller streams (1.5m) on open slopes where there is no valley flat or obvious riparian ecosystem, the riparian strategy is to retain at least 50% of the stand, avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous understory as possible on either side of the stream channel or for the width of the alluvial/colluvial deposit.
S4 (<1.5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams		**Riparian Function** In most cases the S4 streams are low gradient (< 5%) lower to intermediate reaches of headwater tributaries. The bed load in these channels consists of gravel and finer texture sediment. Some spawning habitat may exist if fines are limited. Riparian vegetation includes deciduous shrubs, grasses and a mixed stand of spruce and pine. Roots, branches and woody debris from the adjacent stands provide shade, bank resiliency and, in some streams, channel structure. **Management Strategy** Avoid mechanical disturbance to stream banks. Maintain a wind firm RMZ on both sides of the stream in which at least 30 % of the forest stand is retained. Species retained should include a mix of species and ages. Retention levels should be higher (60%) on south and west sides of stream channels to provide shade.

Stream type	Example	Riparian Management Guidance
5a (>3m) a) Domestic watershed, &/or b) <500 m upstream of fish-bearing stream, &/or c) not fish bearing or domestic watershed but >10m S5b (3-10m) Fish absent, Not domestic and, >500 m upstream of fish bearing stream		**Riparian Function** Riparian vegetation plays a vital roll in maintaining channel stability in 3 to 10 metre wide channels in the Gilnockie RMU. Mature spruce, balsam fir and pine provide a source of LWD that create storage sites for bed load sediment, creates aquatic habitat and controls channel morphology Root systems of mature trees provide resiliency to channel banks Deciduous shrubs typically colonize channel banks and sediment bars following disturbance. Root systems from deciduous shrubs provide stability to banks and bars as well as leaf litter that creates soil on scoured surfaces and provides organic litter and nutrients to the aquatic habitat in immediate area and downstream aquatic habitat. **Management Strategy** Riparian reserve zones over the width of the valley flat and/or floodplain and a RMZ where necessary to protect reserve zone from wind throw and terrain stability hazards.
S6a (0.5<3m) Small streams not in a community watershed or fish bearing but, a) in domestic watershed &/or b) <250m upstream from fish bearing stream. S6b Not community watershed or fish bearing but a) 0.5-3 m and not domestic watershed and >250 m from fish bearing stream b)<0.5m wide		**Riparian Function** S6 streams in the Gilnockie RAU are upper elevation headwater channels. Many have carried debris flow in the past several decades following large-scale forest fires. Riparian vegetation is generally limited to deciduous shrubs. Root systems from deciduous shrubs provide stability to channel bed and banks, and moderate temperature and relative humidity. **Management Strategy** Riparian management will depend on channel gradient and disturbance history. For 0.5 to 3 metre channels with gradients less than 35%, designate a RMZ over the valley flat or on both channels sides and retain at least 60% of the forest stand. Retained stems should include a mix of species and ages. The RMZ should be wide enough to ensure LWD supply is maintained. For steeper gradient or smaller streams (<0.5m) on open slopes where there is no valley flat or obvious riparian ecosystem, avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous under story as possible on either side of the stream channel or for the width of the alluvial/colluvial deposit.

Stream type	Example	Riparian Management Guidance
Lakes (L1 – L4) L1 > 5 ha L2 (1-5ha in PP or IDF) L3 (1-5ha not in PP or IDF) L4 (0.25-1ha)		**Riparian Function** Lakes are associated with beaver dam complexes on lower Yahk River and Gilnockie Cr. Lakeshores are vegetated with grasses and deciduous shrubs. Coniferous vegetation plays limited roll with respect to shade. Riparian vegetation buffers the lake from increase nitrogen and phosphorus levels. Beaver's primary food source is the bark of aspen, cottonwood and willow. Declining supplies of these species will result in decreased populations and abandoned dams. **Management Strategy** Establish a RMZ along the riparian - upland interface that is of sufficient width to protect lakeshores from mechanical disturbance, wind throw and terrain stability hazards. Manage towards a mixture of deciduous and coniferous species, and ensure key values are maintained. Security cover must be maintained for moose feeding in the wetlands. Maintain snags and perches for aerial insectivores and cavity nesting ducks and birds; retain riparian ecosystems with large trees and snags.
Wetlands (W1 – W4) W1 > 5 ha. W2 1-5 ha. (PP or IDF) W3 1-5 ha. (not in PP or IDF) W4 0.25-1 ha. (in PP or IDF) W5 complex of 2 or more wetlands of 5ha or more combined area		**Riparian Function** Wetlands are formed by beaver dam complex on lower Yahk River and Gilnockie Cr. Riparian vegetation includes grasses and deciduous shrubs. Coniferous vegetation plays limited roll with respect to shade. Beaver's primary food source is the bark of aspen, cottonwood and willow. Declining supplies of these species will result in decreased beaver populations and abandoned dams. **Management Strategy** Establish a RMZ along the riparian - upland interface that is of sufficient width to protect wetlands from mechanical disturbance, windthrow and terrain stability hazards. Manage towards a mixture of deciduous and coniferous species. Ensure the RMZ is large enough to protect key values, and provides large diameter snags, where present, for cavity nesting birds and ducks, perches for aerial insectivores, and security cover for large mammals.

1.4. Goat RAU



1.4.1. Characteristics

Physical Characteristics

The Goat riparian management unit includes the upper Goat River, Skelly, Cameron and Leadville Creeks as well as the lower Goat River between Skelly and Leadville Creeks. The Goat River flows south towards Kitchener and then west to the Kootenay River at Creston. Elevation ranges from 2700 on Mount Evans at the headwaters of the Goat River to 760 metres at the confluence of Leadville Creek and the Goat River.

The Goat RMU is underlain by a thrust-faulted sequence of middle Proterozoic to lower Cambrian fine textured argillites, wackes, siltstones and limestones. Skelly Creek is underlain by Cretaceous granodiorite, which results in the texture of the channel beds being much coarser in Skelly Creek channels than in the rest of the management unit.

Thick glaciofluvial terraces mantle the lower valley sides of Goat River and the lower reaches of the main tributaries. Ravelling and undercutting of the glaciofluvial terraces provides a continual source of fine textured sediment along the length of Goat River.

Precipitation ranges from 1800 mm annually at the highest elevations to approximately 800 mm annually in the valley bottoms. Most precipitation falls as snow between the months of October and April. Peak flows occur between mid May and mid June. The largest floods on record in the Goat RMU occurred following several days of sustained high temperatures in late May or early June.

BEC Classification

Biogeoclimatic zones in the Goat RMU include the Dry Mild subzone of the Engelmann Spruce – Subalpine Fir (ESSFdm1) zone above about 1600 metres elevation. The main valley sides between

approximately 1100 and 1600 metres lie within the Dry-Mild subzone of the Interior Cedar Hemlock zone (ICHdm) (Braumandle and Curran, 1992) and the valley bottoms below 1100 metres lie within the Interior Cedar Hemlock Moist-Cool subzone (ICHmk1).

Natural Variability in Riparian Function

Most of the Goat RMU is in NDT3 where fires are expected frequently. The physiographic setting of the Goat River with respect to the Kootenay River valley appears to have some influence of the recurrence interval of lightning-initiated fires on the upper elevation slopes in this drainage. A review of air photographs of the Skelly Creek drainage indicates that two large-scale fires have occurred in this portion of the management unit in the past century. Lower elevation riparian in this management unit have a much lower recurrence of stand-replacing fires and are characterized by older age class mixed conifer and hardwood stands.

Flooding associated with rapid melting of the high elevation snowpack is a frequent disturbance mechanism along all stream classes in this management unit. As well, snow avalanches occur very frequently in the steep tributary channels that drain from the high elevation ridges throughout the Goat MU.

1.4.2. Riparian Budget

The overall budget for this assessment unit is 2,381.0 ha of retention, with 46% of this required in specific riparian classes (1,096.4). S4 streams make up the single biggest component of the retention requirement.

Table 7. Goat Riparian FSC Retention Budgets

Riparian Feature	Riparian Class	RRZ ha*	RMZ ha*	Retention Percent	Effective RMZ ha	Total Effective Retention ha	Class Specific Budget ha
Lake	L1	4.9	4.8	30.0	1.4	6.4	3.9
	L2	0.0	0.0	30.0	0.0	0.0	0.0
	L3	6.3	6.1	30.0	1.8	8.2	5.1
	L4	0.0	0.0	30.0	0.0	0.0	0.0
	NC	0.0	0.0	30.0	0.0	0.0	0.0
Wetland	W1	6.4	4.3	30.0	1.3	7.7	5.2
	W2	0.0	0.0	30.0	0.0	0.0	0.0
	W3	20.4	12.3	30.0	3.7	24.1	16.3
	W4	0.0	0.0	30.0	0.0	0.0	0.0
	W5	0.0	0.0	30.0	0.0	0.0	0.0
Stream River	S1	41.1	47.5	65.0	30.9	71.9	32.8
	S2	155.2	193.3	65.0	125.7	280.9	124.2
	S3	300.1	188.9	65.0	122.8	422.9	240.1
	S4	745.6	552.4	65.0	359.1	1104.6	596.4
	S5a	37.3	39.7	65.0	25.8	63.1	29.9
	S5b	0.0	53.7	30.0	16.1	16.1	0.0
	S6a	53.1	55.2	65.0	35.8	89.0	42.5
	S6b	0.0	953.7	30.0	286.1	286.1	0.0
Assessment Unit Retention Budget						2,381.0	1,096.4

* Calculated using GIS buffering techniques to avoid double counting of overlap areas between streams, lakes and wetlands. Calculations based off feature lengths would give inflated estimates.

1.4.3. Current Condition Assessment

The results of the current condition assessment for the Goat assessment unit are provided in the table below and mapped in Appendix C. Budget minimums were compared with current (July 2006) retention levels to assess consistency with FSC requirements. Both riparian class specific requirements and overall assessment unit requirements were examined.

Table 20. Goat Current Conditions Relative to Targets

Riparian Feature	Riparian Class	Class Specific Budget (ha)	Retention Area (ha)	Surplus / Deficit		Assess Unit Budget (ha)	Assess Unit Retention (ha)	Surplus / Deficit
Lake	L1	3.9	18.6	14.7		2,381.0	5,451.3	3,070.3 Surplus 229% of Budget
	L2	0.0	0.0	0.0				
	L3	5.1	23.1	18.0				
	L4	0.0	0.0	0.0				
	NC	0.0	0.0	0.0				
Wetland	W1	5.2	19.5	14.4				
	W2	0.0	0.0	0.0				
	W3	16.3	54.8	38.5				
	W4	0.0	0.0	0.0				
	W5	0.0	0.0	0.0				
Stream River	S1	32.8	163.7	130.9				
	S2	124.2	653.0	528.8				
	S3	240.1	896.7	656.6				
	S4	596.4	1270.4	673.9				
	S5a	29.9	156.4	126.6				
	S5b	0.0	108.4	108.4				
	S6a	42.5	240.7	198.2				
	S6b	0.0	1846.0	1846.0				

Area requirements are currently met with significant surpluses occurring in all riparian classes.

1.4.4. Riparian Management Strategies

General strategies for riparian management and a rationale for these strategies can be found in Section 6.0 of Volume 1 – Strategic Overview and Budget Calculations. This section should be read together with the detailed guidance specific to retention strategies and priorities for this RAU.

Unit-specific rational for management strategies

Management strategies in the Goat RAU reflect the relatively minor role that riparian vegetation plays with respect to channel stability or aquatic habitat. In general, high discharges driven by snowmelt from extensive alpine areas results in very limited riparian function in channels greater than about 10% gradient. Most S5 and S6 streams in this RAU are steep, high elevation streams that carry frequent snow avalanches and debris flows.

Key Values

Mining and logging activities in the early 1900's have had a major impact on riparian ecosystems in portions of the Goat RMU. The important non-timber values to be considered when implementing riparian retention strategies and deploying budget surpluses in this RAU consist of:

1. HCVFs: HCVFs have been established in this unit for caribou, grizzly, and riparian old growth cedar stands (Kidd Creek).
2. Aquatic values: Westslope Cutthroat, all life stages (Upper Goat River above dam): avoid stream sedimentation, retain overhanging vegetation, and ensure LWD input.

3. Terrestrial habitat: Grizzly Bear: This unit provides significant grizzly habitat, particularly in the upper Kidd, Leadville, and Mallandine. Retain security cover (2x sight distance) around riparian feeding areas (sedges, horsetails, skunk cabbage).
4. Terrestrial values: The amount of late successional forests is likely outside the range of variability due to past mining and logging activities and fires. Place remaining LSF patches in RRZs and RMZs, particularly those with cedar/hemlock. Consider partial cutting treatments with large-tree retention in RMZs to accelerate growth of trees and progression to late-successional structural conditions. Major existing riparian hardwood values that should be retained are along the Lower Goat River

Maps illustrating the spatial location of most riparian values are included for each RAU in Appendix C and D of Volume 1.

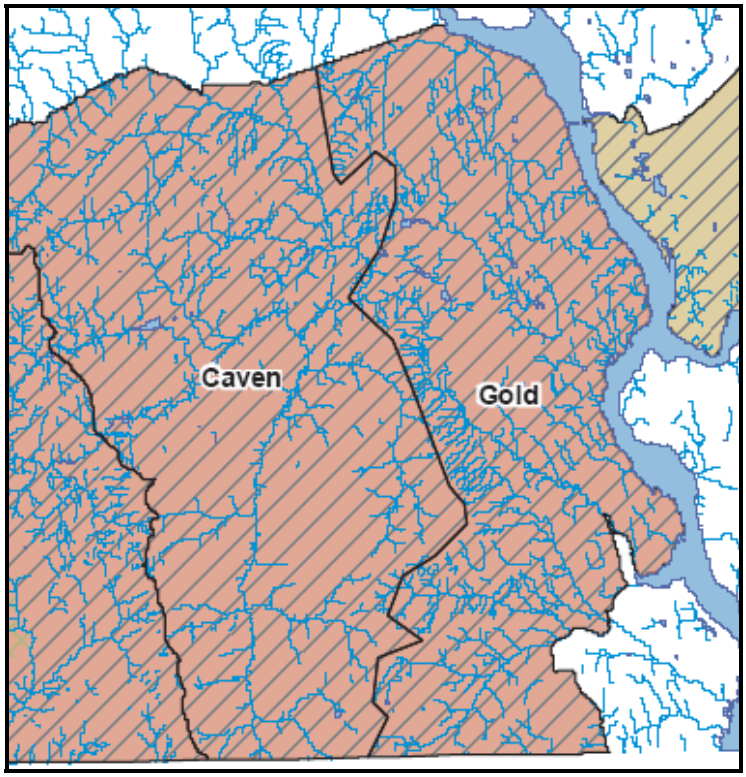
Stream type	Example	Riparian Management Guidance
S1a,b (> 20m) Large Streams and Rivers (with fish or community watershed)		**Riparian Function** The Goat River below Skelly Creek is the only S1 stream in this MU. Spruce, Douglas fir, larch and cedar and hardwoods including cottonwood and aspen provide protection to banks and adjacent forest floor as well as increasing flood water storage capacity and ground water recharge. Most of the LWD occurs as accumulations on lateral and mid-channel sediment bars. LWD functions locally to provide aquatic habitat and complexity to the channel bed. **Management Strategy** Riparian reserve zone over the valley flat and a riparian management zone of sufficient width or to the top of a topographic break to manage for wind throw and sed. delivery hazards, as well as maintain key values.
S2 (5-20 m) Intermediate Streams and Rivers (with fish or in community watershed)		**Riparian Function** Streams in the Goat RMU are subject to relatively frequent large flood events due to the high elevation source areas. Steep gradients and high discharges result in stream powers that are too high for functioning LWD in many of the S2 streams In channels with gradients < 10% and widths < 7 metres LWD (>40cm) contributes to channel stability and/or channel structure, increasing overall rearing potential for adult fish inhabiting these streams. Root networks of larger coniferous trees provide armor to channel banks. **Management Strategy** RRZ over valley flat and RMZ on adjacent valley side slopes to manage for wind throw and terrain stability hazards and maintain key values.

Stream type	Example	Riparian Management Guidance
S3 (1.5 – 5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams		**Riparian Function** Riparian vegetation plays a limited role in maintaining channel condition and aquatic habitat in smaller, steeper streams of the Goat MU. Lower gradient S3 streams typically provide important rearing and spawning habitat. Deciduous species provide organic input (leaf litter) and nutrients, an import energy source for the food web in the immediate area and downstream food web. Frequent floods have resulted in very little functioning LWD in the stream channels. Steep alpine sourced channels in this management unit are not temperature sensitive. **Management Strategy** RMZ on valley flat and adjacent valley side slopes to manage for wind throw and terrain stability hazards. Avoid direct disturbance to channel banks and shrub vegetation 7 m width from stream edge. Retain at least 60 % of the standing trees with a mixture of age classes and species types.
S4 (<1.5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams		**Riparian Function** S4 streams in the Goat MU are, for the most part, the lower reaches of snow avalanche/debris flow gullies that drain the steep side-slopes of the main valleys These reaches likely contain adequate spawning substrate delivered from upslope erosion. Riparian vegetation consists primarily of alder, cottonwood, willow and immature coniferous species (balsam fir and spruce) which increases surface water infiltration and water storage capacity. Root networks of riparian vegetation provide some stability to channel banks while the vegetation provides overhead cover required for suitable rearing habitat. **Management Strategy** Avoid mechanical disturbance to stream banks and all brush. Maintain a wind firm RMZ on both sides of the stream with retention of 30 to 60% of the mature stand. Percent retention the forested stand is dependant on the function of LWD in the stream. Retained trees should include a mix of species and ages. Provide security cover around shrubby and grassy areas that may be used for foraging by bears.

Stream type	Example	Riparian Management Guidance
5a (>3m) a) Domestic watershed, &/or b) <500 m upstream of fish-bearing stream, &/or c) not fish bearing or domestic watershed but >10m S5b (3-10m) Fish absent, Not domestic and, >500 m upstream of fish bearing stream		**Riparian Function** S5 streams in the Goat RMU are steep gradient headwater streams. Many of these streams are snow avalanche and/or debris flow channels Very little LWD is present in these channels due to the high stream powers. Roots of mature coniferous trees provide armour to banks and adjacent valley flat. Stream bank understory and shrubs provide organic litter and nutrients to the aquatic system in the immediate area as well as downstream. **Management Strategy** Where coniferous trees are present designate a RRZ over valley flat and RMZ on adjacent valley side slopes to manage for wind throw and terrain stability hazards. Where riparian vegetation consists of deciduous shrubs and LWD is not functioning or present in the channel a RMZ is not required but avoid direct disturbance to channel banks and bank vegetation.
S6a (0.5<3m) Small streams not in a community watershed or fish bearing but, a) in domestic watershed &/or b) <250m upstream from fish bearing stream. S6b Not community watershed or fish bearing but a) 0.5-3 m and not domestic watershed and >250 m from fish bearing stream b)<0.5m wide		**Riparian Function** S6 streams in the Goat RAU are upper elevation headwater channels. Most of these are snow avalanche and/or debris flow tributaries. Riparian vegetation is limited to deciduous shrubs that establish rapidly following disturbance events. These supply organic litter and nutrients to the food web in the surrounding area and downstream aquatic ecosystem. Root systems from deciduous shrubs provide some stability to channel bed and banks during average annual peak flows. **Management Strategy** Where coniferous trees are present designate a RRZ over valley flat and RMZ on adjacent valley side slopes to manage for wind throw and terrain stability hazards. Where riparian vegetation consists of deciduous shrubs and LWD is not functioning or present in the channel a RMZ is not required. Avoid disturbance to the extent practicable to shrubs within 7 m of the stream banks.
Lakes (L1 – L4) L1 > 5 ha L2 (1-5ha in PP or IDF) L3 (1-5ha not in PP or IDF) L4 (0.25-1ha)	There are no lakes in this Management Unit	

Stream type	Example	Riparian Management Guidance
Wetlands (W1 – W4) W1 > 5 ha. W2 1-5 ha. (PP or IDF) W3 1-5 ha. (not in PP or IDF) W4 0.25-1 ha. (in PP or IDF) W5 complex of 2 or more wetlands of 5ha or more combined area		Beaver maintained wetlands occur on the floodplain of Kamma Creek – which is not in Tembec's operating area. It is likely that similar wetlands occur along the margins of the upper Goat River but were not identified during the field review. **Management Strategies** Establish reserves on the floodplain and a RMZ along the riparian – upland interface that is of sufficient width to protect wetlands from mechanical disturbance, windthrow and terrain stability hazards. Where beavers are present retain all hardwoods in the RMZ. Ensure the RMZ is large enough to protect key values, and provides large diameter snags, where present, for cavity nesting birds and ducks, perches for aerial insectivores, and security cover for large mammals, particularly moose and bears, so they cannot be seen from the road when in the riparian areas or shrub lands.

1.5 Gold RAU



1.5.1. Characteristics

Physical Characteristics

The Gold riparian management unit is situated along the west side of Lake Koocanusa and includes the catchment of Gold Creek below Teepee Creek. Most of this management unit is situated on gentle gradient terrain of the Rocky Mountain trench. Slopes become steeper to the west in the Gold Mountain area. The area is underlain by steeply to moderately east-dipping, north -plunging folded and thrust faulted Middle Proterozoic sediments of the Purcell Supergroup including consisting of carbonates and fine textured siltstone of the Kitchener, Van Creek, Nicol Creek and Gateway Formations.

Linklater and Purcell Creek are two of the largest tributary catchments in this management unit. Both drain east to Lake Koocanusa from the higher elevation slopes south of Gold Mountain.

Plumbob Creek, Linklater Creek and Purcell Creek are identified as licensed water supplies within this management unit, however, only Plumbob Creek provides consumptive-use water.

Mount Fitzpatrick at the headwaters of Linklater Creek forms the highest point in the Management unit at just over 2200 metres. The confluence of Gold Creek and Lake Koocanusa is at 750 m elevation.

This management unit is located in one of the driest hydrological zones in B.C. with average annual run off estimated at just over 400 mm (Obedkoff, 2002).

BEC Classification

The Gold management unit is situated in the Dry climate region of the Engelmann Spruce – Subalpine Fir biogeoclimatic zone (ESSFdk) above approximately 1500 metres and the Montane Spruce biogeoclimatic zone (MSdk) below 1500 metres (Braumandl and Curran, 1992). Most valley bottoms and lower slopes are in the MSdk or ICHdm2 biogeoclimatic zone. Biogeoclimatic sub-zone-variants included in this management unit include ESSFdk/dm/dm1/wm, MS dk, ICH dm/dw/dw1/mk1, IDF dm2, PP dh2 (NDT 3 and 4).

Natural Variability in Riparian Function

The Gold Creek management unit landscape is in NDT3 and NDT4 where fires are expected frequently, often of mixed severity. The generally subdued topography suggests similar fire regimes between riparian and upslope stands, however, the incised valleys of Linklater and Purcell Creeks at the mid and upper elevations in the western portion of this management unit are exceptions to this and have later seral forests suggesting a more variable fire regime. The highest fire frequency with lower severity can be expected in the NDT4 part of the Gold Creek area. Fire in riparian stands is an important LWD recruitment mechanism in this management unit.

Large channel forming floods occur relatively infrequently in this management unit due to the generally low gradients and low discharges of the main stream channels that reduces the potential for impacts to channels and riparian areas.

1.5.2. Riparian Budget

The overall budget for this assessment unit is 2,103.8 ha of retention, with 50% of this required in specific riparian classes (1,057.6). S4 streams make up the single biggest component of the retention requirement.

Table 21. Gold Riparian FSC Retention Budgets

Riparian Feature	Riparian Class	RRZ ha*	RMZ ha*	Retention Percent	Effective RMZ ha	Total Effective Retention ha	Class Specific Budget ha
Lake	L1	22.1	23.6	30.0	7.1	29.2	17.7
	L2	1.5	1.4	30.0	0.4	1.9	1.2
	L3	5.0	3.7	30.0	1.1	6.1	4.0
	L4	0.0	0.0	30.0	0.0	0.0	0.0
	NC	0.0	0.0	30.0	0.0	0.0	0.0
Wetland	W1	31.0	21.4	30.0	6.4	37.4	24.8
	W2	1.5	1.3	30.0	0.4	1.9	1.2
	W3	24.7	18.1	30.0	5.4	30.1	19.7
	W4	0.0	0.0	30.0	0.0	0.0	0.0
	W5	0.0	0.0	30.0	0.0	0.0	0.0
Stream River	S1	28.8	33.2	65.0	21.6	50.4	23.0
	S2	34.4	38.5	65.0	25.0	59.4	27.5
	S3	194.1	116.3	65.0	75.6	269.7	155.3
	S4	871.1	603.4	65.0	392.2	1263.3	696.9
	S5a	10.5	10.7	65.0	7.0	17.5	8.4
	S5b	0.0	2.8	30.0	0.8	0.8	0.0
	S6a	97.4	102.4	65.0	66.6	164.0	77.9
	S6b	0.0	573.7	30.0	172.1	172.1	0.0
Assessment Unit Retention Budget						2,103.8	1,057.6

* Calculated using GIS buffering techniques to avoid double counting of overlap areas between streams, lakes and wetlands. Calculations based off feature lengths would give inflated estimates.

1.5.3. Current Condition Assessment

The results of the current condition assessment for the Gold assessment unit are provided in the table below and mapped in Appendix C. Budget minimums were compared with current (July 2006) retention levels to assess consistency with FSC requirements. Both riparian class specific requirements and overall assessment unit requirements were examined.

Table 22. Gold Current Conditions Relative to Targets

Riparian Feature	Riparian Class	Class Specific Budget (ha)	Retention Area (ha)	Surplus / Deficit		Assess Unit Budget (ha)	Assess Unit Retention (ha)	Surplus / Deficit
Lake	L1	17.7	94.9	77.2		2,103.8	3,427.0	1,323.1 Surplus 163% of Budget
	L2	1.2	6.5	5.3				
	L3	4.0	16.6	12.6				
	L4	0.0	0.0	0.0				
	NC	0.0	0.0	0.0				
Wetland	W1	24.8	74.3	49.5				
	W2	1.2	6.2	5.0				
	W3	19.7	70.4	50.6				
	W4	0.0	0.0	0.0				
	W5	0.0	0.0	0.0				
Stream River	S1	23.0	83.2	60.2				
	S2	27.5	121.7	94.1				
	S3	155.3	479.6	324.3				
	S4	696.9	1163.6	466.8				
	S5a	8.4	38.7	30.3				
	S5b	0.0	4.3	4.3				
	S6a	77.9	374.1	296.2				
	S6b	0.0	892.8	892.8				

Area requirements are current met with significant surpluses occurring in all riparian classes.

1.5.4. Riparian Management Strategy

Unit-specific rational for management strategies

General strategies for riparian management and a rationale for these strategies can be found in Section 6.0 of Volume 1 – Strategic Overview and Budget Calculations. This section should be read together with the detailed guidance specific to retention strategies and priorities for this RAU.

Stream temperature and disturbance by cattle are two important considerations to riparian management strategies in the Gold RAU. The strategies presented here recognize that riparian vegetation is important to maintaining channel structure and aquatic values along all stream classes.

Key Values

The important non-timber values to be considered when implementing riparian retention strategies and deploying budget surpluses in this RAU consist of:

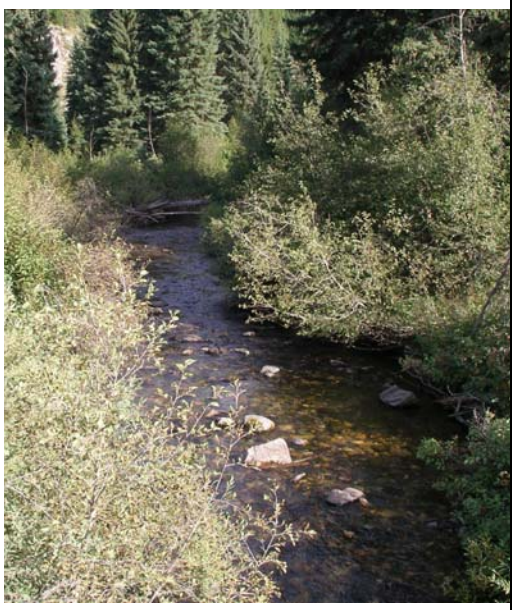
1. HCVF areas : have been established in this unit for dry forest restoration and high elevation grasslands.
2. Stream Temperature: Canopy cover is critical to maintaining stream temperature along many of the streams in this management unit. Lower discharge and wider valleys make streams more likely to experience temperature increases following removal of riparian shade. Streams draining lower gradient terrain, including most of the tributaries to the Gold Creek will require RRZ and/or RMZ's that are sufficiently wide and have adequate retention to provide shade to the channels.
3. Aquatic Values: Bull Trout and Westslope Cutthroat are present in Gold Creek.
4. Terrestrial Values: **Old Growth:** The Gold River management unit is a fire maintained ecosystem (NDT4). Retain or restore late-successional stand structure (i.e., large, widely-spaced trees). Cattle impacts may be high in some locations; design RRZ and RMZ to decrease access for cattle. **Hardwoods:** Major existing riparian hardwood values should be retained along Gold Creek. **Lewis's Woodpecker** – Observe WHA provisions and Tembec's SFMP guidelines. Retain any existing cottonwoods in riparian reserves. **Badger** burrows may be present in the fine textured glaciofluvial

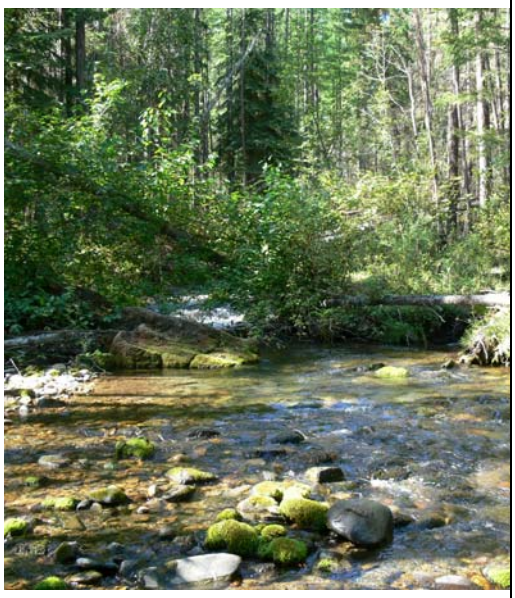
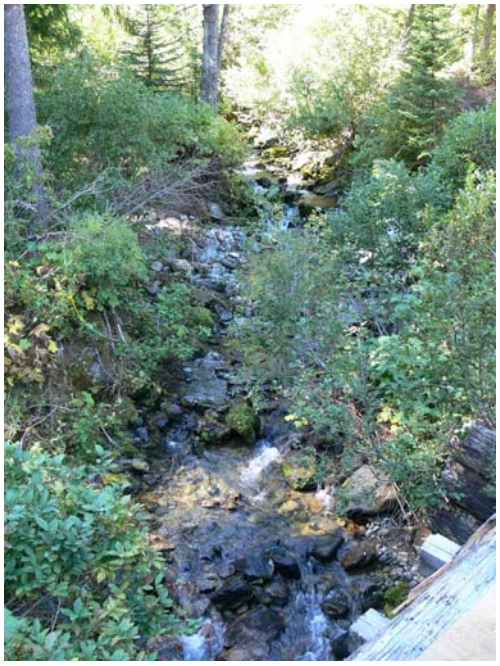
sediments on lower valley sides throughout this management unit. **Great Blue Heron:** establish a WHA or protect the old breeding site near Struass Rd and protect nearby lakes and wetlands foraging habitat through RRZs and RMZs.

5. Lakes and Wetlands: wetlands in this unit provide important habitat for wetland birds such as the Bittern. Avoid sedimentation of wetlands and provide vegetative cover adjacent to the wetlands.
6. Beaver habitat: Beavers are present along Gold, Linklater and possibly lower Purcell Creeks. Wetlands in this management unit are directly associated with the presence of beaver dams.

Maps illustrating the spatial location of most riparian values are included for each RAU in Appendix C and D of Volume 1.

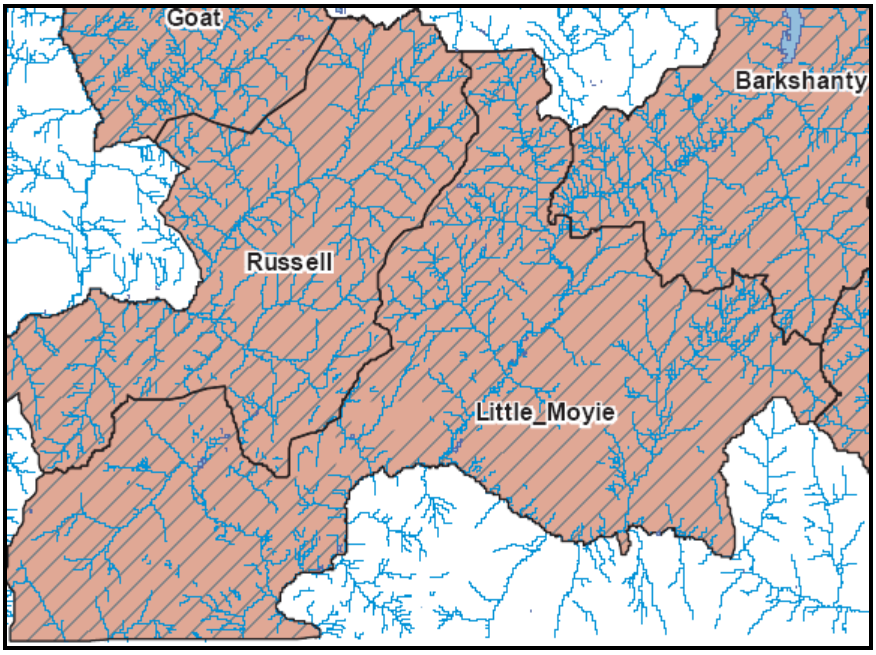
Stream type	Example	Riparian Management Guidance
S1a,b (> 20m) Large Streams and Rivers (with fish or community watershed)	No S1 streams in this Management Unit	
S2 (5-20 m) Intermediate Streams and Rivers (with fish or in community watershed)		**Riparian Function** Mature spruce, balsam fir and locally cedar, pine and Douglas fir provide protection to banks and adjacent forest floor as well as flood water storage and ground water recharge. Deciduous shrubs of alder and dogwood are present along channel banks and adjacent valley flat. Shrubs provide shade, organic litter, and to the stream, as well as moderate relative humidity and protect channel banks. LWD (> 30cm) and shrubs along channel margins provides aquatic habitat and complexity to the channel bed. **Management Strategy** Riparian reserve zone over the valley flat and a riparian management zone of sufficient width or to the top of a topographic break to manage for wind throw and sed. delivery hazards and preserve the function of shade to the channel. Ensure the RRZ/RMZ is large enough to maintain key values; attempt to discourage cattle use of the riparian areas. Ensure high value snags are protected, and large trees maintained. Areas with sedges provide bear foraging areas in spring and require security cover, especially when roads are near.

Stream type	Example	Riparian Management Guidance
S3 (1.5 – 5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams		**Riparian Function** Many of the small streams in this MU are S3. Mature spruce, pine, balsam fir and cedar and deciduous shrubs are present as riparian vegetation. The riparian serves to prevent sedimentation of spawning habitat located in these streams. LWD functions locally to provide channel structure and increase diversity of rearing habitat. Deciduous shrubs along channel margins provide shade and aquatic habitat as well as energy input into the food web, terrestrial and aquatic. **Management Strategy** S3 reaches require riparian reserve zone over the valley flat and an RMZ where necessary to protect the RRZ from wind throw hazards. For smaller streams (1.5m) on open slopes where there is no valley flat or obvious riparian ecosystem, the riparian strategy is to retain at least 60% of the forest stand, avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous understory as possible on either side of the stream channel.
S4 (<1.5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams		**Riparian Function** Many tributaries to Gold Creek will be classified as S4 due to fisheries values. The bed load in these channels consists of gravel and finer texture sediment, therefore providing potential spawning habitat. Riparian vegetation includes deciduous shrubs, grasses and a mixed stand of spruce and pine. Roots, branches and woody debris from the adjacent stands provide shade, bank resiliency, relative humidity, organic litter, nutrients, and, in some streams, channel structure. Where streams are contained on a defined valley flat conifers including spruce and pine provide shade to the channels. **Management Strategy** Avoid mechanical disturbance to stream banks and adjacent shrubs and understory vegetation. Maintain a wind firm RMZ on both sides of the stream in which at least 60 % of the forested stand is retained. Stems retained should include a mix of species and ages and should be as wind firm as possible.

Stream type	Example	Riparian Management Guidance
5a (>3m) a) Domestic watershed, &/or b) <500 m upstream of fish-bearing stream, &/or c) not fish bearing or domestic watershed but >10m S5b (3-10m) Fish absent, Not domestic and, >500 m upstream of fish bearing stream		**Riparian Function** Riparian vegetation plays an important roll in maintaining channel stability and creating aquatic habitat in 3 to 10 metre wide channels in the Gold RMU. Mature spruce, balsam fir, pine and in some locations cedar provide a source of LWD that create storage sites for bed load sediment, creates aquatic habitat and controls channel morphology. Root systems of mature trees provide resiliency to channel banks. Upper reaches of Linklater and Purcell Creeks are S5. Deciduous shrubs typically colonize channel banks and sediment bars following disturbance. Root systems from deciduous shrubs provide stability to banks and bars as well as leaf litter that creates soil on scoured surfaces as well as organic litter to the aquatic habitat. **Management Strategy** Riparian reserve zones over the width of the valley flat and/or floodplain and a RMZ where necessary to protect reserve zone from wind throw and terrain stability hazards. Beavers are present along the lower reaches of Linklater Creek. Cattle grazing has been identified as a problem to riparian function in this management unit. Higher retention levels and CWD in heavily grazed areas somewhat reduces the ability of cattle to access channels.
S6a (0.5<3m) Small streams not in a community watershed or fish bearing but, a) in domestic watershed &/or b) <250m upstream from fish bearing stream. S6b Not community watershed or fish bearing but a) 0.5-3 m and not domestic watershed and >250 m from fish bearing stream b)<0.5m wide		**Riparian Function** S6 streams in the Gold RU are upper elevation headwater channels. Many of these occur on open slopes with no defined riparian area. Root systems and woody debris from conifers and deciduous shrubs provides shade to the channels and are important for regulating temperature, relative humidity, higher moisture levels of the terrestrial habitat gradient on adjacent banks and stability to channel bed and banks **Management Strategy** These are forested lower elevation tributaries that will be temperature sensitive. Designate a wind firm RMZ over the valley flat if present and retain at least 60% of the forested stand. For smaller streams (<1.5m) on open slopes where there is no valley flat or obvious riparian ecosystem, the riparian strategy is to avoid disturbance to stream banks, retain a minimum of 30% of the standing timber all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous under story as possible on either side of the stream channel or for the width of the alluvial/colluvial deposit.

Stream type	Example	Riparian Management Guidance
Lakes (L1 – L4) L1 > 5 ha L2 (1-5ha in PP or IDF) L3 (1-5ha not in PP or IDF) L4 (0.25-1ha)		**Riparian Function** Lakes in the Gold MU are controlled by groundwater levels. Lakeshores are vegetated with grasses and deciduous shrubs. Riparian vegetation buffers the lake from increase nitrogen and phosphorus levels. Lake level fluctuates annually but has been low in recent years. Coniferous vegetation plays limited roll with respect to shade. **Management Strategy** Establish a RMZ along the riparian - upland interface that is of sufficient width to protect lakeshores from mechanical disturbance, wind throw and terrain stability hazards (See comments in Section 5). Manage towards a mixture of deciduous and coniferous species. Ensure the RMZ is large enough to protect key values, and provides large diameter snags, where present, for cavity nesting birds and ducks, perches for aerial insectivores, and security cover for large mammals. Reserve existing old and mature riparian stands, and recruit large diameter snags and trees in previously logged areas.
Wetlands (W1 – W4) W1 > 5 ha. W2 1-5 ha. (PP or IDF) W3 1-5 ha. (not in PP or IDF) W4 0.25-1 ha. (in PP or IDF) W5 complex of 2 or more wetlands of 5ha or more combined area		**Riparian Function** Wetlands in The Gold MU are associated with beaver dam complexes along Gold Creek and the lower reaches of Purcell and Linklater Creeks. Riparian vegetation includes grasses and deciduous shrubs. Coniferous vegetation plays limited role with respect to shade. Riparian vegetation also buffers the wetlands from increase nitrogen and phosphorus levels. Beaver's primary food source is the bark of aspen, cottonwood and willow. Declining supplies of these species will result in decreased beaver populations and abandoned dams. **Management Strategy** Establish a RMZ along the riparian - upland interface that is of sufficient width to protect wetlands from mechanical disturbance, wind throw and terrain stability hazards. Manage towards a mixture of deciduous and coniferous species. Ensure the RMZ is large enough to protect key values, and provides large diameter snags, where present, for cavity nesting birds and ducks, perches for aerial insectivores, and security cover for large mammals. Reserve existing old and mature riparian stands, and recruit large diameter snags and trees in previously logged areas.

1.6 Little Moyie RAU



1.6.1. Characteristics

Physical Characteristics

The Little Moyie RMU includes the west flowing Little Moyie River and east flowing Hawkins Creek drainages and the Moyie River valley. Hawkins Creek is characterized by broad valleys with moderate gradient slopes and rounded ridges that are generally below 1900 metres elevation. Little Moyie River is characterized by moderate to steep slopes through the lower to mid elevations and broad, steep-sided cirques basins forming the headwaters above 1900 metres.

The bedrock geology underlying the management unit consists of fine textured argillites and siltstones of the Proterozoic Purcell Supergroup and coarse textured mafic intrusive rocks of the Moyie Sills. Remnant terraces of glaciofluvial sediments occur locally on the lower valley slopes along the lowermost reaches of both Hawkins Creek and Little Moyie River.

Valleys are forested to approximately 1900 meters and above this bedrock and talus slopes occur at the upper-most headwaters.

Little Moyie River is an irregular to meandering channel that ranges from a boulder – LWD step pool to a boulder plane-bed to cobble riffle-pool morphology along its length. A wide beaver dam controlled wetland complex occurs along the lower main stem of Little Moyie River.

The morphology of Hawkins Creek ranges from LWD step pool to cobble to boulder plane bed channel along its length with a section of bedrock falls in the central portion of the drainage.

The highest elevations at the headwaters of the Little Moyie receive up to 1800 mm of precipitation annually (primarily as snow) and the lower elevations near the confluence with the Moyie River receive less than 600 metres of precipitation. Precipitation in Hawkins Creek is ranges from 1400 mm on upper ridges to 600 mm near the confluence with the Moyie River.

Peak flows typically occur in both Hawkins Creek and Little Moyie River as a result of snowmelt in late May or early June. Flooding often occurs as a result of several days of sustained high temperatures during the late spring.

BEC Classification

Biogeoclimatic zones in the Little Moyie RMU include the Dry Mild subzone of the Engelmann Spruce – Subalpine Fir (ESSFdw) zone above about 1600 metres elevation. The main valley sides between

approximately 1100 and 1600 metres lie within the Dry-Mild subzone of the Interior Cedar Hemlock zone (ICHdm) (Braumandle and Curran, 1992) and the valley bottoms below 1100 metres lie within the Interior Cedar Hemlock Moist-Cool subzone (ICHmk1).

Natural Variability in Riparian Function

Fire is the primary mechanism of riparian disturbance throughout this MU. Early 1900's stand replacing fires affected large portions of both drainages. Riparian areas along the main stems and many of the tributary streams were severely burnt during the fires. Burnt stumps observed in many of the riparian areas indicate that the pre-fire riparian stands consisted of large diameter trees. The intensity of the early 1900's fires and extensive logging activities preceding and following the fires has resulted in very few of the burnt stems being available for recruitment in the decades following the fires. As a result functioning LWD is absent from most of the channels in this MU and most riparian stands consist of immature coniferous trees.

The lack of mature trees and functioning LWD has resulted in substantial flooding related disturbance to stream channels and riparian areas throughout the MU. Alder has established along the banks of most stream channels in this MU following a very large flood in the early 1970's (1974). Large mobile bed loads and a lack of root networks are resulting in channels that are actively shifting across valley flats.

1.6.2 Riparian Budget

The overall budget for this assessment unit is 2571.0 ha of retention, with 46% of this required in specific riparian classes (1181.5). S4 streams make up the single biggest component of the retention requirement.

Table 23. Little Moyie Riparian FSC Retention Budgets

Riparian Feature	Riparian Class	RRZ ha*	RMZ ha*	Retention Percent	Effective RMZ ha	Total Effective Retention ha	Class Specific Budget ha
Lake	L1	0.4	0.3	30.0	0.1	0.5	0.3
	L2	0.0	0.0	30.0	0.0	0.0	0.0
	L3	4.3	2.6	30.0	0.8	5.1	3.4
	L4	0.0	0.0	30.0	0.0	0.0	0.0
	NC	0.0	0.0	30.0	0.0	0.0	0.0
Wetland	W1	5.8	2.8	30.0	0.8	6.6	4.6
	W2	0.0	0.0	30.0	0.0	0.0	0.0
	W3	8.9	6.1	30.0	1.8	10.8	7.1
	W4	0.0	0.0	30.0	0.0	0.0	0.0
	W5	0.0	0.0	30.0	0.0	0.0	0.0
Stream River	S1	9.3	12.8	65.0	8.3	17.6	7.5
	S2	134.4	265.7	65.0	172.7	307.1	107.5
	S3	311.2	200.0	65.0	130.0	441.2	248.9
	S4	909.1	705.4	65.0	458.5	1367.6	727.3
	S5a	27.8	28.1	65.0	18.3	46.1	22.3
	S5b	0.0	50.0	30.0	15.0	15.0	0.0
	S6a	65.7	67.1	65.0	43.6	109.3	52.6
	S6b	0.0	813.7	30.0	244.1	244.1	0.0
Assessment Unit Retention Budget						2,571.0	1,181.5

* Calculated using GIS buffering techniques to avoid double counting of overlap areas between streams, lakes and wetlands. Calculations based off feature lengths would give inflated estimates.

1.6.3 Current Condition Assessment

The results of the current condition assessment for the Little Moyie assessment unit are provided in the table below and mapped in Appendix C. Budget minimums were compared with current (July 2006) retention levels to assess consistency with FSC requirements. Both riparian class specific requirements and overall assessment unit requirements were examined.

Table 24. Little Moyie Current Conditions Relative to Targets

Riparian Feature	Riparian Class	Class Specific Budget (ha)	Retention Area (ha)	Surplus / Deficit		Assess Unit Budget (ha)	Assess Unit Retention (ha)	Surplus / Deficit
Lake	L1	0.3	1.0	0.7		2,571.0	5,518.0	2,947.0 Surplus 215% of Budget
	L2	0.0	0.0	0.0				
	L3	3.4	11.4	8.0				
	L4	0.0	0.0	0.0				
	NC	0.0	0.0	0.0				
Wetland	W1	4.6	11.3	6.7				
	W2	0.0	0.0	0.0				
	W3	7.1	23.7	16.5				
	W4	0.0	0.0	0.0				
	W5	0.0	0.0	0.0				
Stream River	S1	7.5	48.3	40.9				
	S2	107.5	840.3	732.7				
	S3	248.9	978.2	729.3				
	S4	727.3	1575.5	848.2				
	S5a	22.3	114.2	91.9				
	S5b	0.0	95.9	95.9				
	S6a	52.6	267.2	214.7				
	S6b	0.0	1551.0	1551.0				

Area requirements are current met with significant surpluses occurring in all riparian classes.

1.6.4 Riparian Management Strategy

General strategies for riparian management and a rationale for these strategies can be found in Section 6.0 of Volume 1 – Strategic Overview and Budget Calculations. This section should be read together with the detailed guidance specific to retention strategies and priorities for this RAU.

The Little Moyie RAU includes both Hawkins Creek and the Little Moyie River. Fire disturbance and historic logging activities over the past century has influenced riparian function throughout this RAU. Riparian function has shifted from maintaining channel structure and moderating sediment yield to providing bank stability. This shift has resulted in degraded channel condition in many of the S2 to S6 channels in this RAU. Restoration of riparian function should be the primary focus of riparian management strategies along heavily impacted channels in this RAU. Relatively high levels of retention are recommended for management zones along all stream classes.

Key Values

The important non-timber values to be considered when implementing riparian retention strategies and deploying surplus budgets in this RAU consist of:

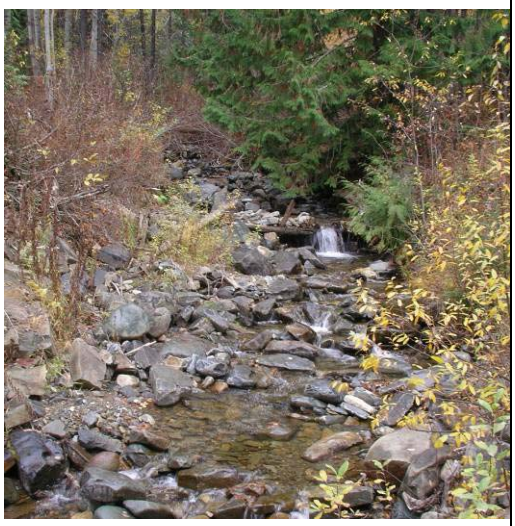
1. Stream temperature: Many of the small streams draining the north side of Hawkins Cr. do not have alpine or steep colluvial headwaters. These small, slow flowing streams are susceptible to increased temperatures following removal of riparian vegetation.
2. Terrestrial values: The amount of Late Seral Forests is likely outside the range of variability due to past mining and logging activities and fires. Place remaining LSF patches in RRZs and RMZs. Consider partial cutting treatments with large-tree retention in RMZs to accelerate

growth of trees and progression to late-successional structural conditions. Major existing riparian hardwood values that should be retained are along the Hawkins Creek, Little Moyie River and in the Glenlily and Curzon areas. Grizzly Bear: Retain security cover (2x sight distance) around riparian feeding areas (sedges, horsetails, skunk cabbage). Moose: Moose winter throughout the lower elevations in this unit. Retain security cover around key feeding areas (willow, dogwood) and manage for a mix of cover and forage in riparian areas. Badgers are present in the glaciofluvial terrace banks along Hawkins and Cold Creeks. Short-eared Owl: Little Moyie wetlands. Follow HCVF guidelines and WHA provisions. Cattle damage is affecting this wetland significantly.

3. HCVF areas: Little Moyie has been identified for flooding hazards. Terrains stability hazards occur on the face area draining directly down to Moyie River. Other HCVFs have been identified for old growth (including riparian old growth) and grizzly movement.
4. Beaver habitat: Wetlands along the lower reaches of Little Moyie are associated with the presence of beaver dams. Beavers are beginning to re-establish along the lower tributaries and main stem channel in Hawkins Creek.

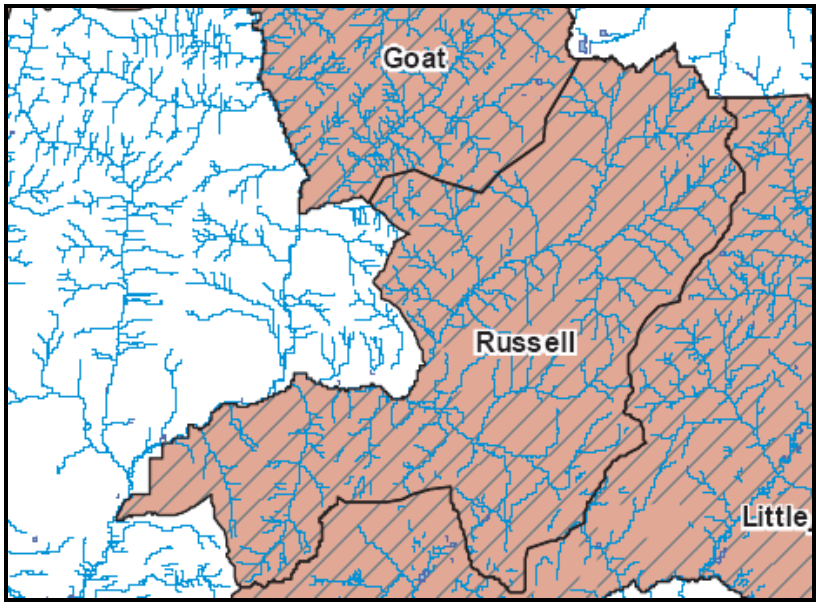
Stream type	Example	Riparian Management Guidance
S1a,b (> 20m) Large Streams and Rivers (with fish or community watershed)	No S1 streams in this Management Unit	
S2 (5-20 m) Intermediate Streams and Rivers (with fish or in community watershed)		**Riparian Function** At the present time riparian vegetation plays a limited role in maintaining channel stability in 5 to 20 metre wide channels in the Little Moyie RMU. Where present, mature spruce, balsam fir and/or cedar, hemlock provides protection to banks and adjacent forest floor, Only the largest LWD (>40cm) in channels less than ~10 m wide provides long-term channel structure and moderates sediment transport rates. LWD and shrubs along channel margins and lateral bars contributes to aquatic habitat. Deciduous species provide organic input (leaf litter) and nutrients, an import energy source for the food web in the immediate area and downstream food web. **Management Strategy** Riparian reserve zone over the valley flat and a riparian management zone of sufficient width or to the top of a topographic break to manage for wind throw and sed. delivery hazards and key values as described above. Retain or restore old growth stands in riparian areas.

Stream type	Example	Riparian Management Guidance
S3 (1.5 – 5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams		**Riparian Function** Fire and flooding has resulted in a lack of functioning LWD in all streams of this MU. LWD is important in providing diverse rearing habitat and maintaining suitable spawning substrate. Mature spruce, balsam fir and cottonwood provide protection to banks and adjacent forest floor. LWD (> 30cm) provides long-term sediment storage sites and moderates sediment transport rates. LWD along channel margins provides aquatic habitat. The shrub under story provides organic litter, nutrients, and energy into the food web for the terrestrial and aquatic habit as well as the downstream aquatic food web. **Management Strategy** S3 require a RRZ over the valley flat and riparian management zones on both sides or to the top of a topographic break to manage for wind throw and sed. delivery hazards. Where there is no valley flat, avoid mechanical disturbance to stream banks. Maintain a wind firm RMZ on both sides of the stream in which at least 60 % of the forested stand is retained. Retained trees should include a mix of species and ages. Retain all LWD leaning over or spanning the channel as well as the understory shrub community along banks. Retain existing old and mature stands and trees, and recruit these features in previously logged areas.
S4 (<1.5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams		**Riparian Function** In most cases the S4 streams are high gradient (> 5%) upper reaches of headwater tributaries. The bed load in these channels consists of boulders to gravel, providing potential spawning habitat. Riparian vegetation includes alder along channel banks and a mixed stand of spruce, balsam, and hemlock. Roots, branches and woody debris from the adjacent stands provide bank resiliency and, in some streams, channel structure. **Management Strategy** Avoid mechanical disturbance to stream banks and shrub vegetation next to the stream up to 7 m from the waters edge. Maintain a wind firm RMZ on both sides of the stream in which at least 60 % of the forested stand is retained (see comments in Section 5). Retained trees should be wind firm and include a mix of species and ages. Retain all LWD that is leaning over or spanning the channel.

Stream type	Example	Riparian Management Guidance
5a (>3m) a) Domestic watershed, &/or b) <500 m upstream of fish-bearing stream, &/or c) not fish bearing or domestic watershed but >10m S5b (3-10m) Fish absent, Not domestic and, >500 m upstream of fish bearing stream		**Riparian Function** At the present time riparian vegetation plays a limited role in maintaining channel stability in 3 to 10 metre wide channels in the Little Moyie RMU. Early 1900's fires have reduced the amount of mature spruce, balsam fir, hemlock and cedar available for recruitment as LWD. Root systems of mature trees provide resiliency to channel banks Deciduous shrubs typically colonize channel banks and sediment bars following disturbance. Root systems from deciduous shrubs provide stability to banks and bars as well as leaf litter that creates soil on scoured surfaces and organic input to aquatic ecosystem in the immediate area and downstream. Shrubs help to buffer temperature, moisture levels, slow down and store over-land flows to release them slowly through the summer months. **Management Strategy** Riparian reserve zones over the width of the valley flat and/or floodplain and a RMZ where necessary to protect reserve zone from wind throw and terrain stability hazards.
S6a (0.5<3m) Small streams not in a community watershed or fish bearing but, a) in domestic watershed &/or b) <250m upstream from fish bearing stream. S6b Not community watershed or fish bearing but a) 0.5-3 m and not domestic watershed and >250 m from fish bearing stream b)<0.5m wide		**Riparian Function** S6 streams in the Little Moyie RAU include upper elevation headwater channels and small, steep first order gullies that flow directly into the Little Moyie. Most of these channels are debris flows gullies and riparian vegetation is generally limited to deciduous shrubs. Root systems from deciduous shrubs provide some stability to channel bed and banks during average annual peak flows. Deciduous species provide organic input (leaf litter) and nutrients, an import energy source for the food web in the immediate area and downstream food web. **Management Strategy** Designate a RMZ over the valley flat if present and retaining at least 60% of the mature coniferous riparian vegetation. For smaller streams (<1.5m) on open slopes where there is no valley flat or obvious riparian ecosystem, the riparian strategy is to avoid disturbance to stream banks, retain all LWD that is spanning or suspended above the channels and retain as much of the deciduous and coniferous under story as possible in wind firm buffers on either side of the stream channel.

Stream type	Example	Riparian Management Guidance
Lakes (L1 – L4) L1 > 5 ha L2 (1-5ha in PP or IDF) L3 (1-5ha not in PP or IDF) L4 (0.25-1ha)		**Riparian Function** Only one lake exists in this RMU. Lake level has dropped in recent years resulting in a small (L4) lake surrounded by meadow. **Management Strategy** Establish a RMZ along the riparian - upland interface that is of sufficient width to protect lakeshores and marshy areas from mechanical disturbance, wind throw and terrain stability hazards. Ensure the RMZ is large enough to protect key values, and provides large diameter snags, where present, for cavity nesting birds and ducks, perches for aerial insectivores, and security cover for large mammals. Reserve existing old and mature riparian stands, and recruit large diameter snags and trees in previously logged areas. Attempt to reduce cattle access to the lake through retention of CWD.
Wetlands (W1 – W4) W1 > 5 ha. W2 1-5 ha. (PP or IDF) W3 1-5 ha. (not in PP or IDF) W4 0.25-1 ha. (in PP or IDF) W5 complex of 2 or more wetlands of 5ha or more combined area		**Riparian Function** Wetlands are formed by beaver dam complexes on lower reaches of the Little Moyie River. Riparian vegetation includes grasses and deciduous shrubs. Coniferous vegetation plays limited role with respect to shade. Riparian vegetation buffers the wetlands from increase nitrogen and phosphorus levels. Beaver's primary food source is the bark of aspen, cottonwood and willow. Declining supplies of these species will result in decreased beaver populations and abandoned dams. **Management Strategy** RRZ over valley flat and flood plain. RMZ along the riparian - upland interface that is of sufficient width to protect wetlands from mechanical disturbance, wind throw and terrain stability hazards (see comments for in Section 5 for Beaver influenced environments). Manage towards a mixture of deciduous and coniferous species. Ensure the RMZ is large enough to protect key values, and provides large diameter snags, where present, for cavity nesting birds and ducks, perches for aerial insectivores, and security cover for large mammals, especially moose. Reserve existing old and mature riparian stands, and recruit large diameter snags and trees in previously logged areas.

1.7 Russell RAU



1.7.1 Characteristics

Physical Characteristics

Meadow Creek and tributaries Russell Creek and Kidd Creek are included in the Russell Riparian Management Unit. Kidd Creek, which flows south from the Moyie Range in the southern Purcell Mountains is the largest headwater tributary to Meadow Creek. Russell Creek flows north into Meadow Creek just upstream from the confluence with the Goat River. Elevation ranges from 2300 metres at the headwaters of Kidd Creek to 700 metres at the confluence with the Goat River.

The Russell RMU is underlain by mid Proterozoic fine textured argillites, wackes and siltstones of the Alderidge Formation. Thick glaciofluvial terraces mantle the lower valley slopes and provide a continual source of fine textured sediment along the length of Kidd Creek.

Precipitation ranges from 1800 mm annually at the highest elevations to approximately 800 mm annually in the valley bottoms. Most precipitation falls as snow between the months of October and April. Peak flows occur between mid May and mid June. The largest floods on record in the Russell RMU occurred following several days of sustained high temperatures in late May or early June.

BEC Classification

Biogeoclimatic zones in the Russell RMU include the Dry Mild subzone of the Engelmann Spruce – Subalpine Fir (ESSFdm1) zone above about 1600 metres elevation. The main valley sides between approximately 1100 and 1600 metres lie within the Dry-Mild subzone of the Interior Cedar Hemlock zone (ICHdm) (Braumandle and Curran, 1992) and the valley bottoms below 1100 metres lie within the Interior Cedar Hemlock Moist-Cool subzone (ICHmk1).

Natural Variability in Riparian Function

Flooding and fire are both frequent mechanisms of riparian disturbance in the Russell RMU. Most of the streams in the Russell RMU have steep gradients and appear to carry debris flows and floods on a regular basis. Large woody debris in even the smallest channels is often broken apart and distributed along channel margins and banks. Multiple ages of debris levees are present along Russell Creek and many of the smaller tributaries in Kidd Creek. Hillslopes and riparian areas throughout the MU have experienced numerous variable intensity fires over the past century. Riparian vegetation consists primarily of immature cedar and hemlock, cottonwood, aspen and deciduous shrubs of alder and willow. Due to past logging and fires there is very little functioning LWD in the channels and very little available

for recruitment. As a result channels in this RMU are very active and appear to transport large volumes of bed load sediment annually.

1.7.2 Riparian Budget

The overall budget for this assessment unit is 1200.1 ha of retention, with 50% of this required in specific riparian classes (603.7). S4 streams make up the single biggest component of the retention requirement.

Table 25. Russell Riparian FSC Retention Budgets

Riparian Feature	Riparian Class	RRZ ha*	RMZ ha*	Retention Percent	Effective RMZ ha	Total Effective Retention ha	Class Specific Budget ha
Lake	L1	0.0	0.0	30.0	0.0	0.0	0.0
	L2	0.0	0.0	30.0	0.0	0.0	0.0
	L3	0.8	1.0	30.0	0.3	1.1	0.7
	L4	0.0	0.0	30.0	0.0	0.0	0.0
	NC	0.0	0.0	30.0	0.0	0.0	0.0
Wetland	W1	0.0	0.0	30.0	0.0	0.0	0.0
	W2	0.0	0.0	30.0	0.0	0.0	0.0
	W3	0.0	0.0	30.0	0.0	0.0	0.0
	W4	0.0	0.0	30.0	0.0	0.0	0.0
	W5	0.0	0.0	30.0	0.0	0.0	0.0
Stream River	S1	0.0	0.0	65.0	0.0	0.0	0.0
	S2	48.2	58.5	65.0	38.0	86.2	38.6
	S3	158.5	99.1	65.0	64.4	222.9	126.8
	S4	498.8	297.9	65.0	193.6	692.4	399.0
	S5a	15.7	16.6	65.0	10.8	26.4	12.5
	S5b	0.0	24.5	30.0	7.4	7.4	0.0
	S6a	32.6	33.7	65.0	21.9	54.5	26.1
	S6b	0.0	363.4	30.0	109.0	109.0	0.0
Assessment Unit Retention Budget						1,200.1	603.7

* Calculated using GIS buffering techniques to avoid double counting of overlap areas between streams, lakes and wetlands. Calculations based off feature lengths would give inflated estimates.

1.7.3 Current Condition Assessment

The results of the current condition assessment for the Russell assessment unit are provided in the table below and mapped in Appendix C. Budget minimums were compared with current (July 2006) retention levels to assess consistency with FSC requirements. Both riparian class specific requirements and overall assessment unit requirements were examined.

Table 26. Russell Current Conditions Relative to Targets

Riparian Feature	Riparian Class	Class Specific Budget (ha)	Retention Area (ha)	Surplus / Deficit		Assess Unit Budget (ha)	Assess Unit Retention (ha)	Surplus / Deficit
Lake	L1	0.0	0.0	0.0		1,200.1	2,437.1	1,237.0 Surplus 203% of Budget
	L2	0.0	0.0	0.0				
	L3	0.7	3.1	2.4				
	L4	0.0	0.0	0.0				
	NC	0.0	0.0	0.0				
Wetland	W1	0.0	0.0	0.0				
	W2	0.0	0.0	0.0				
	W3	0.0	0.0	0.0				
	W4	0.0	0.0	0.0				
	W5	0.0	0.0	0.0				
Stream River	S1	0.0	1.0	1.0				
	S2	38.6	201.0	162.4				
	S3	126.8	495.0	368.1				
	S4	399.0	783.3	384.2				
	S5a	12.5	68.1	55.6				
	S5b	0.0	48.3	48.3				
	S6a	26.1	140.9	114.8				
	S6b	0.0	696.5	696.5				

Area requirements are current met with significant surpluses occurring in all riparian classes.

1.7.4 Riparian Management Strategy

General strategies for riparian management and a rationale for these strategies can be found in Section 6.0 of Volume 1 – Strategic Overview and Budget Calculations. This section should be read together with the detailed guidance specific to retention strategies and priorities for this RAU.

Unit-specific rational for management strategies

Kidd Creek is the largest stream in the Russell RAU. Riparian function is naturally limited in steep gradient S5 and S6 streams in this RAU as a result of frequent snow avalanches and debris flows. Historical logging and fire disturbance has reduce riparian function along many of the lower gradient (<15%) S2 to S4 streams. Management strategies in this unit are generally a function of stream gradient and elevation. Retention in RMZ will be higher along lower elevation channels and along lower gradient reaches.

Key Values

The important non-timber values to be considered when implementing riparian retention strategies and deploying budget surpluses in this RAU consist of:

1. Terrestrial values: The amount of **Late Seral Forests** is likely outside the range of variability due to past mining and logging activities and fires. This is especially true in the cedar/hemlock stands. Place remaining LSF patches in RRZs and RMZs. Consider partial cutting treatments with large-tree retention in RMZs to accelerate growth of trees and progression to late-successional structural conditions. Major existing riparian hardwood values that should be retained are along the Lower Goat River, Kitchener Creek, and Kidd Creek areas. **Moose :**

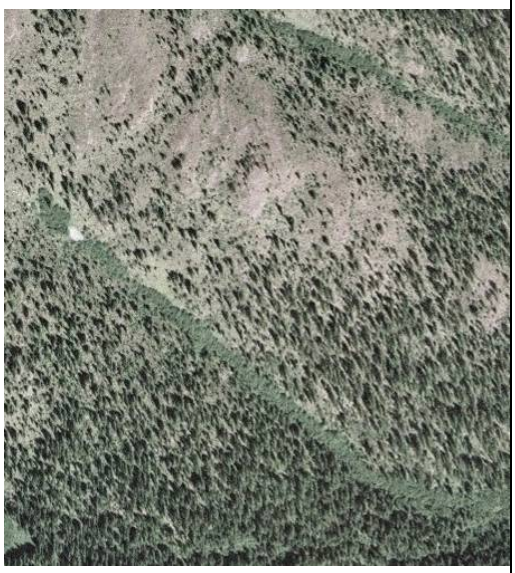
Retain security cover around key feeding areas (willow, dogwood) and manage for a mix of cover and forage in riparian areas. **Grizzly**: Upper Kidd creek provides some important grizzly habitat. Retain security cover (2x sight distance) around riparian feeding areas (sedges, horsetails, skunk cabbage). Lower elevations are also important as movement corridors across Highway 93.

2. HCVF areas: Flooding is identified as a hazard in Russell Creek. Slopes along the north side of Highway 3 are classified as HCVF for terrain stability. Russell Creek is the designated Community watershed for Kitchener. The Kitchener Improvement District maintains 2 domestic water licenses on Russell Creek (C109262, C111626) that supply consumptive-use water to approximately 60 to 70 households in the community of Kitchener. The community water intake is situated on the upper portion of the fan of Russell Creek. HCVFs have also been established for grizzly habitat and movement, and old growth cedar hemlock stands, including some in riparian areas (Kidd Creek).

Maps illustrating the spatial location of most riparian values are included for each RAU in Appendix C and D of Volume 1.

Stream type	Example	Riparian Management Guidance
S1a,b (> 20m) Large Streams and Rivers (with fish or community watershed)	No S1 channels occur in this Management Unit	
S2 (5-20 m) Intermediate Streams and Rivers (with fish or in community watershed)		**Riparian Function** Streams in the Russell RMU are subject to relatively frequent large flood events. In channels with gradients <10% and widths < 7 metres LWD (>40cm) contributes to channel stability and increases the value of rearing habitat. Most of the riparian vegetation in this MU is immature due to fire and/or logging in the late 1800 and early 1900's so there is very little functioning LWD. Riparian values must be maintained to allow for functional LWD to become re-established Root networks of larger coniferous trees provide armor to channel banks. **Management Strategy** RRZ over valley flat and RMZ on adjacent valley side slopes to manage for wind throw and terrain stability hazards and maintain key values. Maintain remaining old growth and mature stands in riparian ecosystems, and any deciduous species. Provide security cover for large mammals and maintain high value snags and veteran trees.
S3 (1.5 – 5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams		**Riparian Function** At the present time riparian vegetation plays a limited role in maintaining channel condition and aquatic habitat in smaller streams of this MU. Fire, riparian logging and frequent floods have resulted in very little functioning LWD in the stream channels. LWD typically maintains suitable spawning substrate in these streams by enhancing hydrologic diversity. **Management Strategy** RRZ over valley flat and RMZ with at least 60% retention of forest stand on adjacent valley side slopes to manage for wind throw and terrain stability hazards.

Stream type	Example	Riparian Management Guidance
S4 (<1.5m) Small Streams in community watershed or containing fish) or direct tributary to fish streams		**Riparian Function** S4 streams in the Russell MU are, for the most part, debris flow or erosion gullies that drain the steep side-slopes of the main valleys. Riparian vegetation consists primarily of alder, cottonwood, willow and immature coniferous species. Root networks of riparian vegetation provide some stability to channel banks. **Management Strategy** Avoid mechanical disturbance to stream banks. Maintain a wind firm RMZ on both sides of the stream. Percent retention the forested stand is dependant on the function of LWD in the stream should range between 30 and 60% (See comments in Section 5). Retained trees should include a mix of species and ages. Avoid mechanic disturbance of understory especially deciduous shrubs about 7 m from stream edge.
5a (>3m) a) Domestic watershed, &/or b) <500 m upstream of fish-bearing stream, &/or c) not fish bearing or domestic watershed but >10m S5b (3-10m) Fish absent, Not domestic and, >500 m upstream of fish bearing stream		**Riparian Function** S5 streams in the Russell RMU are steep gradient headwater streams. Many of these streams are snow avalanche and/or debris flow channels Where present, LWD provides stability to channel beds and banks. Roots of mature coniferous trees provide armour to banks and adjacent valley flat. Stream side vegetation especially deciduous species provide organic litter, nutrients, buffer temperature, retain snowmelt waters, and important input to the food web in the immediate area as well as aquatic ecosystem downstream. **Management Strategy** Designate a RMZ over the valley flat or on both sides of the channel to manage for wind throw and terrain stability hazards. Retention levels and width will vary with elevation and stream gradient. For streams less than 25% or where riparian vegetation is contributing to channel structure or bank stability retain at least 60% of the stand. Where riparian vegetation consists of deciduous shrubs and LWD is not functioning or present in the channel a RMZ is not required. Avoid mechanic disturbance of under story especially deciduous shrubs about 7 m from stream edge.

Stream type	Example	Riparian Management Guidance
S6a (0.5<3m) Small streams not in a community watershed or fish bearing but, a) in domestic watershed &/or b) <250m upstream from fish bearing stream. S6b Not community watershed or fish bearing but a) 0.5-3 m and not domestic watershed and >250 m from fish bearing stream b)<0.5m wide		**Riparian Function** S6 streams in the Russell RAU are upper elevation headwater channels. Most of these are snow avalanche and/or debris flow tributaries. Riparian vegetation is limited to deciduous shrubs that establish rapidly following disturbance events. Deciduous species provide organic input (leaf litter) and nutrients, an import energy source for the food web in the immediate area and downstream food web. Root systems from deciduous shrubs provide some stability to channel bed and banks during average annual peak flows. **Management Strategy** Designate a RMZ over the valley flat or on both sides of the channel to manage for wind throw and terrain stability hazards. Retention levels and width will vary with elevation and stream gradient. For streams less than 25% or where riparian vegetation is contributing to channel structure or bank stability retain at least 30% of the stand. Where riparian vegetation consists of deciduous shrubs and LWD is not functioning or present in the channel a RMZ is not required. Avoid mechanic disturbance of understory especially deciduous shrubs about 7 m from stream edge.
Lakes (L1 – L4) L1 > 5 ha L2 (1-5ha in PP or IDF) L3 (1-5ha not in PP or IDF) L4 (0.25-1ha)	There are no lakes in this Management Unit	
Wetlands (W1 – W4) W1 > 5 ha. W2 1-5 ha. (PP or IDF) W3 1-5 ha. (not in PP or IDF) W4 0.25-1 ha. (in PP or IDF) W5 complex of 2 or more wetlands of 5ha or more combined area	Wetlands occur on the floodplain of Meadow Creek but this is not in Tembec's operating area	