

Final Report

Interim Background Report

for

Riparian Land Conservation and Management Policy

Prepared for:



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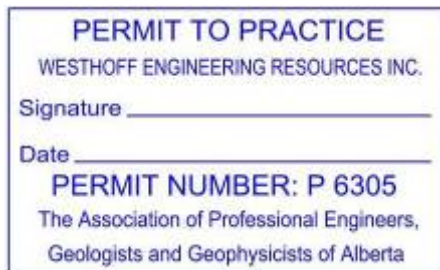


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1.0 INTRODUCTION

Renowned for its diverse landscapes, clean environment, and strong sense of community, Rocky View County (Rocky View) has become one of the fastest growing rural municipalities in Canada (Rocky View County, 2007a). This level of unprecedented growth has brought opportunity but also a number of challenges. To meet these challenges, Rocky View embarked on a Growth Management Strategy in order to facilitate sound land use and development decisions regarding community sustainability, resource management and the environment.

An important Rocky View goal is to promote the protection, conservation and sustainability of water as a key resource in the region. To this end, the municipality is engaged in inter-municipal water resource management initiatives, from participating in the Bow Basin and Elbow River and Nose Creek Watershed Management Plans to working with Alberta Environment and Ducks Unlimited to inventory wetlands. A priority strategy for protection of water resources is the development of riparian land regulations for the whole of the municipality. Several recent independent initiatives dealing with definition, appropriate use and protection of riparian areas highlighted the need for Rocky View-wide solutions to address riparian land sustainability, management and conservation.

1.1 Rocky View County Goals for Riparian Land

In 2005, Rocky View's Council undertook a Strategic Planning Process which led to the finalization of a Corporate Vision, Mission and Goals Statement. Goal 7 was the development of a Riparian Land Conservation and Management Policy, which included the creation of specific strategies to protect the water resources within the County. The primary focus and priority was to create policies for the development of riparian lands and wetland regulations. In 2008, Rocky View Council resolved to initiate a Rocky View-wide riparian land project. Rocky View's overarching goals for the project are as follows:

- | | |
|----------------------------|---|
| <i>Protect</i> | Conservation and protection of existing riparian areas and corridors, giving priority to those that are most intact, and those that pass through endangered ecological communities or threatened species populations. |
| <i>Rehabilitate</i> | Rehabilitation of degraded, fragmented and highly modified riparian areas and corridors that provide some of the functions of intact systems. |
| <i>Restore</i> | Restoration of the connectivity of riparian lands and the linkage between riparian lands and surrounding uplands. |
| <i>Enhance</i> | Conservation and enhancement of local biodiversity and habitat quality. |
| <i>Prevent</i> | Prevention of riparian land degradation through inappropriate land uses. |
| <i>Safeguard</i> | Safeguarding existing and new developments against the hazards associated with riparian lands. |

1.2 Purpose

In 2008, Westhoff Engineering Resources, Inc. (Westhoff), in association with Aquality Environmental Consulting Ltd. (Aquality), Judy Stewart, Barrister & Solicitor (Ms. Stewart), and O2 Planning + Design (O2) was retained by Rocky View County to complete the Riparian Policy Project.

Key Deliverables for the Riparian Policy Project are:

1. A **Riparian Land Background Report** that presents the specific background information used to generate and support the policy;
2. A **Riparian Land Conservation and Management Policy** to provide the regulatory framework for managing and conserving riparian lands (presented in Appendix A); and
3. **Riparian Land Policy Implementation Strategies** that provide practical implementation tools to direct administration in the day-to-day planning and management of land use relative to riparian lands.

The purpose of this Riparian Land Background Report (Background Report) is to provide an overview of the information used to develop the Riparian Land Conservation and Management Policy (Rocky View Riparian Policy), from a description of riparian lands and their functions to a review of strategies for riparian land management. The Background Report also presents the broad-scale regulatory framework for policy development. As it is in the overall greater public interest to conserve and manage riparian lands, municipalities have authority and jurisdiction, under the *Municipal Government Act* (1994), to enact *Land Use Bylaw* regulations that control land use and development within riparian lands. Municipalities have this authority whether riparian lands are privately or municipally owned. Provincial policies that support municipalities in framing such bylaws and regulations include *Water for Life: Alberta's Strategy for Sustainability* (Alberta Environment, 2003) and the *Alberta Land Use Policy* (Government of Alberta, 1996). Federal laws that affect municipal bylaws for protecting riparian lands include the *Fisheries Act* (Government of Canada, 1985a), the *Migratory Birds Convention Act* (Government of Canada, 1994), the *Navigable Waters Protection Act*, (Government of Canada, 1985b) and the *Species at Risk Act* (Government of Canada, 2002).

Details regarding the municipal, provincial and federal regulations that influence Rocky View County's efforts to protect riparian lands and implement the Rocky View Riparian Policy are presented in a separate stand-alone document Appendix B. Information on Land Ownership and *De Facto* Land Expropriation is also provided in Appendix C.

The Rocky View Riparian Policy itself reiterates this municipal authority, presents policy statements and outlines administrative responsibilities and suggested protocols for policy implementation. The Policy provides direction to Administration for the protection and management of riparian lands associated with drainage in Rocky View County, including the Bow River, the Elbow River; Nose Creek, Jumpingpound Creek; Big Hill Creek, Rosebud River, Little Red Deer River, and Horse Creek. In addition, these policy directives will apply to conservation and management of riparian lands associated with many smaller streams, creeks, gullies, draws and wetlands and lakes that contribute to the overall water system within the Bow River watershed and the Red Deer River watershed, both of which are partially located within Rocky View County's boundaries.

Strategies for implementing the Rocky View Riparian Policy are presented in the Background

Report. These strategies provide an initial framework for policy implementation. Tools are recommended to ensure successful integration of the Policy with respect to protecting the integrity of riparian lands as development occurs, both from a planning and an operational perspective.

1.3 Approach

The Background Report was developed through a review of the scientific literature on riparian lands and associated topics and issues. This review provided a broad base of information on riparian lands and their characteristics, functions, ecological, social and economic benefits and the challenges associated with managing them. A number of policy and planning documents were also reviewed that address the range of management strategies used to conserve water resources and specifically riparian lands. Key sources of information were relevant municipal, provincial and federal policies and regulations.

In addition to a thorough review of the literature, a public workshop was held on June 2, 2008 for the purpose of inviting discussion and feedback on riparian lands from a range of stakeholders. Representatives from the following stakeholder groups attended the workshop:

- Rocky View County
- City of Calgary
- Alberta Sustainable Resource Development (ASRD)
- Alberta Environment
- Calgary Airport Authority
- Realtors and Developers (including the Urban Development Institute)
- Rocky View County community residents
- Bow River Basin Council
- River Valleys Committee
- Western Irrigation District

Workshop participants provided feedback on a number of questions about riparian lands and strategies for their management and protection. From this broad range of feedback, a list of general topics was identified for consideration when preparing the Riparian Land Conservation and Management Policy and supporting Background Report. These key topics are presented in Table 1. A summary of workshop results and discussions is presented in Appendix D of this report.

Table 1 Key Topics Identified in the Workshop

Topic	Description
All Riparian Lands	The policy should be applicable to all riparian lands including those associated with intermittent water bodies and tributaries of major Rocky View County rivers and streams.
Riparian Land Functions	Riparian lands should be defined based on their functions, including water quality buffering and the maintenance of biodiversity and ecological connectivity.
Flooding	Riparian lands should be described in the context of the fluvial landform processes that shape them, as well as flood conveyance and flood risk. Best management practices and guidelines for land use sensitive to flood risk should be identified.
Regulatory Framework	The administrative and legal framework for conserving riparian lands should be described with consideration for land-owner concerns.
Best Management Practices	Recommendations should be made for best management practices that include education or incentive programs, development setbacks, stormwater management and municipal bylaws with clear and consistent regulations for land use and development.
Rural Issues	The policy should be sensitive to the rural nature of the municipality and related riparian land conservation issues.
Cumulative Effects	The potential cumulative effects of land use on riparian lands and the current regional initiatives to address them should be considered.

1.4 Other Related Initiatives

A number of other efforts have recently been initiated to generate guidelines for managing and conserving riparian lands. These efforts are presented in Table 2. A key effort is being initiated by the Calgary Regional Partnership (CRP). The CRP is working on a riparian policy to support their Regional Land Use Plan; a plan intended to guide its 18 members, including Rocky View County, in the integrated management of regional land use issues. In June 2007, after months of preparation and discussion, CRP members signed a historic charter called the “Terms of Agreement for Working Together: A Commitment to Develop a Regional Land Use Plan (RLUP) for the Calgary Region”. The policy for riparian areas, as a component of this plan, is still evolving. CRP members are reviewing concepts such as minimum or variable setbacks, but no specific approaches have been recommended or adopted. The roles different levels of government (local municipalities and the province) might have in implementing policies related to riparian areas is another topic of discussion. A draft of the RLUP and associated policies is expected in early 2009. Once adopted, it is anticipated that local municipalities will align their local plans to achieve the regional CRP goals and support this regional initiative.

Table 2 Other Riparian Land Management and Conservation Initiatives

Initiative	Description
Nose Creek Watershed Water Management Plan	Water management plan developed under provisions of the <i>Water Act</i> . Endorsed by Rocky View County and Adopted by Alberta Environment. Riparian land conservation and management recommendations form an important component (Palliser, 2008).
Draft Riparian Policy for Rocky View County	Developed as a part of the Greater Bragg Creek Area Structure Plan (Rocky View, 2007).
Central Springbank Area Structure Plan	Adopted plan that includes policies for addressing appropriate development within riparian lands (Rocky View, 2001).
Elbow River Basin Water Management Plan	A decision support tool that provides recommendations for the protection of water quality in the Elbow River (Elbow River Watershed Partnership, 2008). Endorsed by Rocky View County.
Bow Basin Watershed Management Plan	A plan to protect and enhance water quality in the Bow River watershed. Includes recommendations for riparian land conservation (Bow River Basin Council, 2008). Endorsed by Rocky View County.
Three Creeks Watershed Plan Initiative	Watershed management initiatives in progress involving the Town of Cochrane and Rocky View County for Horse Creek, Jumpingpound Creek and Big Hill Creek (Town of Cochrane, 2006). Horse Creek and Big Hill Creek representatives engaged in monitoring while Jumpingpound group initiating management plan.
Protecting Riparian Areas: Creative Approaches to Subdivision Development in the Bow River Basin	A set of guidelines for sustainable subdivision planning and conservation of riparian areas (Bow River Basin Council, 2002).
Rocky View Wetland Inventory	Prepared with assistance from Alberta Environment and other partners. Inventory to map Rocky View County wetlands and identify priority areas for immediate conservation and management intervention (Ducks Unlimited Canada, 2008).
Riparian Land Conservation & Management Project	An integrated riparian land management framework for water bodies in southern Alberta with a pilot project contemplated within Rocky View County (Alberta Environment, 2007).
Water Body Setback Guidelines	Guide for determining setbacks and assisting provincial and municipal planners, watershed groups, developers and land owners in protecting and maintaining riparian function (AMEC, 2008).
CRP Regional Land Use Plan	The Calgary Regional Partnership is developing a riparian policy to support their Regional Land Use Plan. Once adopted, it is anticipated that local municipalities will align their local plans to achieve the regional CRP goals and support this regional initiative (CRP, 2009).

2.0 RIPARIAN LANDS

2.1 What are Riparian Lands

Currently, there is no formal definition of riparian lands provided under municipal or provincial regulations relevant to managing the use of these lands in Rocky View County. The Alberta *Water Act* defines the aquatic environment in general as “the components of the earth related to, living in or located in or on water or the beds or shores of a water body, including but not limited to all organic and inorganic matter, and living organisms and their habitat, including fish habitat, and their interacting natural systems” (Government of Alberta, 2002). Elements of this definition are reflected by other environmental practitioners and policy makers when describing riparian lands for various municipal and provincial planning initiatives. Samples of these riparian land definitions are presented in Table 3. For the Riparian Land Conservation and Management Policy, the following definition of “Riparian Lands” is provided:

“The lands adjacent to lakes, rivers, streams, and other bodies of water, where the vegetation and soils show evidence of being influenced by the presence of water. Riparian lands are the green zones around lakes, rivers, streams and other bodies of water. They are the transitional zone between surface water and the drier uplands and play a vital role in the healthy functioning of both.”

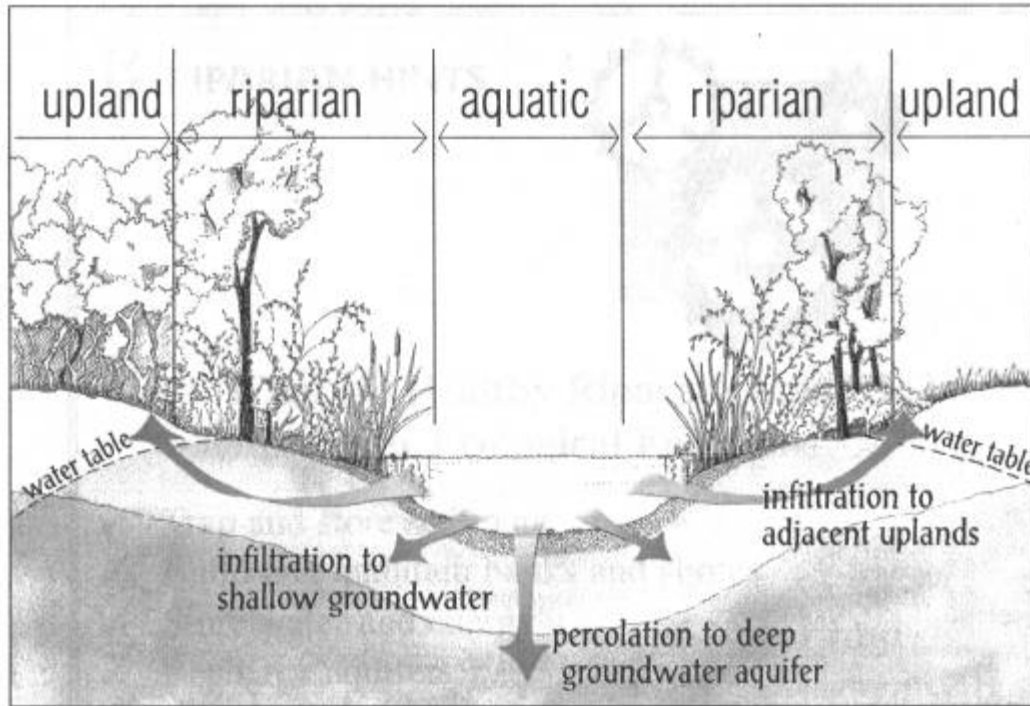
This definition reflects the diversity of water bodies these lands are associated with as well as the common factor of all riparian lands: the interaction of water, soil and vegetation. It also highlights the function of riparian lands as an ecotone between terrestrial and aquatic environments. This same definition is used by the Town of Cochrane in their Land Use Bylaw (Town of Cochrane, 2004). Figure 1 presents an example of a cross-section of a riparian land.

2.2 Riparian Land Characteristics

What all riparian lands have as a common factor is the interaction of water, soil and vegetation (Fitch et al., 2003). The water course or water channel associated with riparian lands is shaped by dynamic fluvial landform processes, also known as fluvial geomorphic processes. These processes create different types of channels, such as straight, braided (multi-channelled) or meandering (sinuous and migrating) streams. Factors that influence these processes include:

- the magnitude, frequency and duration of water flow;
- surface and bedrock floodplain materials;
- the width to depth ratio of the channel;
- sediment type and supply;
- the valley gradient; and
- the type of riparian vegetation (Parish Geomorphic Ltd., 2004).

Figure 1 Cross-section Depicting Riparian Area Lands



Source: Alberta Riparian Habitat Management Society, Cows and Fish Program (<http://www.cowsandfish.org/riparian/riparian.html>)

Over time, fluvial landform processes change the shape, character and location of water courses. A broader floodplain is created with the lateral migration of a water channel as well as with over-bank deposition from periodic flooding (Selby, 1985). The soils that develop on these fluvial deposits reflect wet environmental conditions and show signs of periodic inundation. The unique assemblage of plant species and communities that establish in the floodplain are well-adapted to these wet environmental conditions.

The outcome of interactions between water, soils and vegetation is an assortment of riparian lands that are rarely uniform, exhibiting substantial variation as a result of these dynamic landform processes that create them.

Table 3 Definitions of Riparian Lands

Source	Definition
Fitch and Ambrose, 2003	"Riparian areas are the green zones around lakes and wetlands, the emerald threads of vegetation that border rivers and streams and the lush fringe in valleys. Riparian areas are transitional; they exist between the surface water of a river, wetland or lake and the surrounding drier upland".
Town of Cochrane Land Use Bylaw, 2004	"Riparian lands are the lands adjacent to lakes, rivers, streams, and other bodies of water, where the vegetation and soils show evidence of being influenced by the presence of water. Riparian lands are the green zones around lakes, rivers, streams and other bodies of water. They are the transitional zone between surface water and the drier uplands and play a vital role in the healthy functioning of both."
Riparian Land Conservation & Management Project, 2007	"Riparian land is any land that adjoins or directly influences a water body and includes floodplains and land that directly influences alluvial aquifers."
Naiman & Decamps, 1997	"Riparian zones are an unusually diverse mosaic of landforms, communities, and environments within the larger landscape, and they serve as a framework for understanding the organization, diversity, and dynamics of communities associated with fluvial ecosystems".
NRC, 2002	"From a watershed perspective, riparian habitats in particular have come to be seen as diverse and essential habitats for many organisms and processes, and they provide a critical link between aquatic and upland ecosystems"
Gregory et al., 1991	"Riparian zones are the interfaces between terrestrial and aquatic ecosystems. As ecotones, they encompass sharp gradients of environmental factors, ecological processes, and plant communities".
Alberta Environment, 2003	"Riparian Area - The area along streams, lakes and wetlands where water and land interact. These areas support plants and animals, and protect aquatic ecosystems by filtering out sediments and nutrients originating from upland areas".
Government of Canada, 2008	"Riparian areas are the vegetated areas adjacent to a watercourse or water body that directly contribute to fish habitat by providing shade, cover and food production areas. Riparian areas are important because they stabilize stream banks and shorelines. To minimize disturbance to fish habitat and prevent bank erosion, it is important to retain as much riparian vegetation as possible, especially the vegetation directly adjacent to the watercourse or water body."
Illhardt et al., 2000 as reiterated in Hazlett, et al., 2008.	Riparian areas are three-dimensional ecotones of interaction between terrestrial and aquatic ecosystems that extend down into the groundwater, above into the canopy, outward across the floodplain, up near-slope areas that drain to the water, laterally into the terrestrial ecosystem, and along the water course at variable widths.
Palliser, 2008	Pertaining to, situated or dwelling on the margin of a river or other water body. Also applies to banks on water bodies where sufficient soil moisture supports the growth of mesic vegetation that requires a moderate amount of moisture.

2.3 Riparian Land Functions

Healthy riparian lands provide a variety of functions that benefit both society and the natural environment. A summary of these functions are listed in Table 4. A description of these riparian land functions is presented below.

Table 4 Riparian Land Functions*

Benefit	Function
Maintain water quality	<ul style="list-style-type: none"> • Trap and store sediments. • Filter and buffer water, reducing the amount of contaminants, nutrients and pathogens reaching a water course.
Conserve water supply	<ul style="list-style-type: none"> • Recharge ground water by slowing water flow and allowing for absorption and storage. • Act as a watershed safety valve by storing high water on the floodplain during floods. • Provide for draught management and amelioration.
Reduce incidence, risk, cost of floods and erosion	<ul style="list-style-type: none"> • Balance erosion with sediment capture and bank building. • Provide for increased stability, resilience and recovery. • Reduce flood damage by slowing water velocity and reducing erosion.
Maintain biodiversity	<ul style="list-style-type: none"> • Create habitat for fish, wildlife, invertebrates and vegetation. • Moderate stream temperature to the benefit of aquatic organisms. • Contribute to landscape and habitat connectivity through networks of drainages. • Create a bio-link between water bodies and adjacent uplands. • Contribute to species, community and landscape diversity. • Create primary productivity.
Provide social and economic benefits	<ul style="list-style-type: none"> • Supply water for domestic, agricultural and industrial needs. • Enhance water quality. • Support integrated stormwater management. • Encourage public awareness of natural areas and the functions of riparian lands. • Provide for tourism, hunting, fishing, recreation and overall enjoyment of natural landscapes. • Contribute to increased property value. • Contribute a natural aesthetic to developed areas.

*(Modified from Fitch and Ambrose, 2003)

2.3.1 Maintain or Improve Water Quality

Riparian areas have the potential to maintain or improve water quality through several different mechanisms. The lush vegetation that grows in riparian lands can trap sediments and buffer the effects of soil erosion caused by runoff and flooding. Reduced erosion means less sediment entering water courses and water bodies (Fitch et al., 2003).

Riparian areas can also store nutrients and contaminants. Plants and soil in riparian lands take up, use, store or transform nutrients and contaminants from runoff and floods. Numerous studies have looked at the effectiveness of riparian lands in restricting the influx of sediments, nutrients and contaminants. A summary of these study results is provided in Table 5. Variable results suggest this function of riparian lands is complex and may be influenced greatly by environmental factors such as the soil type, riparian vegetation type, landform gradients, width of riparian lands or adjacent land uses. The effectiveness appears to improve where slopes are gentle and where water flows through the plant root zone of the riparian lands (Fitch et al., 2003).

The more runoff or flooding that occurs in a relatively short time, the more saturated with moisture and sediments a riparian area becomes, making it less effective at filtering these non-point source pollutants. The effectiveness of riparian lands in water filtering is reduced as the ratio of healthy, well-vegetated riparian area to un-vegetated area decreases. Riparian lands with diverse vegetation community structure (e.g., a range of trees, tall and low shrubs and herbaceous plants) appear to be more effective in reducing pollutants under such high flow conditions (Klapproth and Johnson, 2000).

Table 5 Studies of Riparian Land Functions in Reducing Contaminants

Contaminant	Riparian Land Function	Source
Nitrogen	<ul style="list-style-type: none"> Nitrogen uptake into growing plants or by conversion of nitrate to nitrogen gases (NO, N² and NO²) by denitrifying micro-organisms. Sediment-bound nitrogen can be effectively removed when riparian vegetation physically slows the movement of water allowing increased sedimentation rates. Conversion to nitrate by nitrogen-fixing micro-organisms (primarily bacteria) associated with the roots of some plants (e.g., legumes), further complicating the situation for nitrogen exchange. 	Jacobs and Gilliam, 1985; Magette et al., 1989; Cooper, 1990; Groffman et al., 1991; Lowrance, 1992; Haycock and Pinay, 1993
Phosphorus	<ul style="list-style-type: none"> Phosphorus in agricultural runoff can be removed by absorption onto soil particles, sedimentation, or through uptake by plants. 	Cooper and Gillian, 1987
Total Suspended Solids	<ul style="list-style-type: none"> Retention of sediments, thereby reducing sediment loads to rivers and streams. 	Lowrance et al., 1986; Cooper et al., 1987; Heede, 1990
Fecal Coliforms	<ul style="list-style-type: none"> Trapping the particles with which fecal coliform bacteria, including <i>E. coli</i>, are commonly associated Filtration as surface water infiltrates the upper soil layers. 	Arora et al., 1996; Schmitt et al., 1999

Extensive clearing and intensive use in the watershed may contribute more sediment and contaminants to riparian lands (Fitch et al., 2003). Degradation of surface water quality in areas where native forest has been replaced with intensive agriculture has been well documented (Muscutt et al., 1993; Barling and Moore, 1994) but whether vegetated riparian lands along river and stream banks can mitigate these effects is less clear. The results of some studies clearly show nutrient removal in riparian lands (Lowrance et al., 1984; Cooper, 1990), and in some cases removal of phosphorus (P) and nitrogen (N) approaches 90 to 100%. Other studies show poor removal efficiencies of these nutrients (Magette et al., 1989; Groffman et al., 1991). Omernik et al. (1981) compared water quality in watersheds with similar degrees of conversion from forest to intensive agriculture. In some of the watersheds, the timber harvesting and land conversion to agriculture was predominantly in riparian lands. In other watersheds, the extent of timber harvesting was similar, but the agricultural activity was located away from riparian lands. Their results indicated that the proximity of agricultural activity to riparian lands did not influence water quality in the streams they studied (Omernik et al., 1981). Instead, they found that the total proportion of land converted to agriculture was a better predictor of water quality than proximity of agricultural activity to riparian lands.

When this function of riparian land is diminished, the quality of all associated water resources may be compromised. In addition to the water course, groundwater and, specifically, the alluvial aquifer, may also be subject to contamination by such pollutants (Cohen, 1997). Groundwater is the water found under the ground surface in the pore space of the sub-surface geology. It accumulates in underground water bodies called aquifers. The term "alluvial aquifer" describes the aquifer along a river or stream that is hydraulically connected to this surface water.

2.3.2 Conserve Water Supply

Healthy riparian lands have the capacity to store and replenish water supply. Direct contact between water courses and the ground water in alluvial aquifers allows for ground water recharge in periods of high rain fall and flooding (Elbow River Watershed Partnership, 2008). Equally, water from the alluvial aquifer may flow back into water courses or wetlands when drier conditions persist (Elbow River Watershed Partnership, 2008). Watersheds as a whole act as safety valves by storing water in periods of high flow (Fitch et al., 2003).

2.3.3 Reduce Flood and Erosion Risk

Riparian lands have the positive effect of balancing erosion from high stream flow with sediment capture and bank building. Specifically, the banks and shores of healthy riparian lands can create stability and resist high stream velocity and/or wave action. The lush vegetation that grows in riparian lands can trap sediments and buffer the effects of soil erosion caused by runoff and flooding. The banks of healthy riparian areas are, in essence, glued together by a diversity of plants with strong deep root systems, especially those of woody plants (Fitch et al., 2003). As the percentage of roots in stream banks and shorelines increases, erosion decreases (Fitch et al., 2003). Riparian vegetation also regulates soil moisture and provides tensile strength to the soil matrix, thereby increasing bank stability.

Healthy riparian lands can attenuate the force of flood waters by essentially slowing down water through friction. Flood conveyance occurs when concentrated flows spill over the bank and where water is slowed, spread-out and temporarily stored in the broader floodplain. The overall result of healthy riparian lands is increased stability, resiliency and recovery from seasonal flooding.

When considering riparian land functions for flood and erosion control, as well as contaminant and nutrient filtration, some degree of caution is advised. The effectiveness of riparian lands in providing these functions can be adversely affected by the magnitude of hydraulic and contaminant loadings. While riparian lands provide flood attenuation and filter out sediments, contaminants and nutrients, to a large extent these functions are tailored to pre-development conditions. Changes in flow regime from sheet flow to more concentrate flows associated with upstream urbanization will limit this riparian land function. As well, runoff from the adjacent uplands may be laden with contaminants, overwhelming the self-cleaning capacity of riparian lands.

2.3.4 Maintain Biodiversity

Biodiversity is, in essence, the variety of life, from genetic and species variability to ecosystem diversity (IUCN, 2009). Riparian lands support high levels of biodiversity; the combination of water, lush vegetation, and connections to other landscapes provides opportunities for many species (Cow and Fish Program, 2002). The relatively complex plant communities commonly associated with riparian lands offer layers of habitat, from ground cover and shrub layers to the overstory canopy. This complex habitat structure provides water, shelter, forage and breeding areas attractive to a wide range of species, including mammals, reptiles, amphibians, birds, fish and invertebrates. The stream banks and shorelines of riparian lands provide edge habitat for a range of aquatic species, from aquatic invertebrates to fish. The vegetation canopy on banks and over stream channels shades and moderates water temperatures in summer enhancing habitat conditions. In winter, the canopy can insulate streams, reducing ice build-up and providing for better winter survival of fish.

Approximately 80% of Alberta's wildlife use riparian lands for all or part of their life cycle requirements. Equally, an estimated two thirds of Canada's rare and endangered species rely on riparian areas for at least part of their life cycle (Fitch et al., 2002).

Habitat fragmentation, one of the greatest of all threats to biodiversity is a process where large blocks of natural habitat are broken up into smaller and isolated pieces (Noss, 1992). Natural landscape connections curb the adverse effects of habitat fragmentation. Intact riparian lands support this connectivity by providing natural linkages between lowland and upland habitats in a watershed network coursing through the broader landscape. The "bio-link" that riparian lands create supports ecological functions that include daily and seasonal wildlife movements within and between habitats and even long-range species migration and dispersal.

2.3.5 Provide Social and Economic Benefits

Riparian lands offer a number of social and economic benefits. They support the quality and supply of water required to meet domestic, agricultural and industrial needs. In the face of the growing infrastructure requirements of communities, healthy riparian lands also support more innovative and integrated approaches to stormwater management in more urban environments (see Appendix G Suggested Land Use Best Management Practices for more details)

Overall, people value riparian lands for their aesthetic qualities and for the recreation and leisure opportunities they provide. Riparian lands are enjoyed for a range of uses, from hunting and fishing to hiking and bird watching. Through public access to riparian lands, these areas provide opportunities to build public awareness of the functions and benefits provided by riparian lands.

3.0 THE ROCKY VIEW COUNTY LANDSCAPE

Rocky View County is a diverse landscape with terrain features ranging from the Rocky Mountain Foothills in the west to extensive plains in the east. Watersheds represented within the municipality include the:

- Bow River Watershed;
- Elbow River Watershed;
- Little Red Deer River Watershed;
- Nose Creek Watershed; and
- Rosebud River Watershed (Rocky View, 2004).

Water courses of interest to the development of the Rocky View Riparian Land Conservation and Management Policy include the Bow River, Elbow River, Nose Creek, Jumpingpound Creek, Big Hill Creek, Horse Creek, the Little Red Deer River, Rosebud River and many other smaller streams and creeks associated with these drainages.

Riparian lands in Rocky View County are influenced by the varying landform processes associated with these drainages. For example, the Elbow River is a short, steep braided river with multiple channels that tend to divide and reunite over time (Elbow River Watershed Partnership, 2008; Selby, 1985; Trenhaile, 1998). Subject to rapid and unpredictable abandonment or creation of channels, the Elbow River displays its braided nature with frequent changes in channel morphology, often following times of high water flow (Elbow River Watershed Partnership, 2008). Riparian lands associated with the Elbow River will vary in response to these changes.

Nose Creek has a very different form reflecting the sinuous nature of a meandering channel system. Erosion and deposition processes allow the channel to migrate downstream and across its floodplain (Trenhaile, 1998), creating a natural winding pattern with deposition features that include point bars, cutbanks and cut-off channels. This variation in channel morphology is reflected by other creeks and rivers in Rocky View County.

Rocky View County riparian lands are also influenced by the biophysical features of the broader landscape. Starting in the west, areas around Bragg Creek are typical of the Rocky Mountain Natural Region (Natural Regions Committee, 2006). This mountainous landscape supports extensive conifer and mixedwood forests. Riparian lands in this part of the municipality may be forested with dense White Spruce (*Picea glauca*) and/or Englemann Spruce (*Picea engelmannii*) stands and associated shrub and herbaceous understories. Further east, the Parkland Natural Region encompasses an area from Bottrel south to Cochrane and the Tsuu T'ina Nation Reserve. Aspen (*Populus tremuloides*) forests and grasslands are typical of this Foothills region where riparian lands may consist of balsam poplar stands (*Populus balsamifera*) and complex shrub and herb communities. In the eastern portions of Rocky View County, the Grassland Natural Region is represented by open grasslands and cultivated areas stretching across undulating plains (Natural Regions Committee, 2006). Forest cover may be sparse here, where riparian vegetation may consist more of shrub and herb communities.

With a land base of approximately 1,000,121 acres, a wide range of land uses take place within the Municipality (Rocky View, 2004). The area supports numerous farms, small acreages, commercial developments, natural resource extraction sites and some light industry relating to the oil and gas sector. Rocky View County envelops a number of small urban centres, such as the City of Airdrie, the Towns of Cochrane and Chestermere, and the Villages of Irricana and Beiseker (Rocky View, 2004).

Rocky View County is a vast agricultural production area with a variety of land-holding types, from large corporate farms and crown-owned leases to family farms and residential acreages. Crop production in the eastern two-thirds of Rocky View County centres on wheat, barley, canola and rye. The western third of the Municipality is generally devoted to livestock production where cereals for grain and green-feed and annual forage for pasture are prevalent.

Other emerging land uses include tree nurseries, wood lots and alternative meat industries such as bison and elk. Agri-tourism is an emerging industry responding to a growing demand for leisure access to farm and ranch lifestyles as well as products grown "on the farm" (Rocky View, 2004). Recreation is a significant land use within Rocky View County and includes activities such as hiking, camping, fishing, hunting, horseback riding and off-highway vehicle use. Golf course development within Rocky View County is considerable with eight golf courses operating in the Elbow River watershed alone (Elbow Watershed Partnership, 2008).

4.0 RIPARIAN LAND ISSUES AND CUMULATIVE EFFECTS

Riparian land issues are complex and reflect the cumulative effects of multiple land uses on both local and regional scales. Cumulative effects are the changes to the environment caused by all past, present and reasonably foreseeable future human activities (Alberta Environment, 2009). In general terms, the cumulative effects of land use on riparian lands include loss and/or degradation of riparian vegetation and soils from activities such as resource extraction, upstream urbanization, cattle grazing and/or intense recreational use.

Local alterations to riparian lands are expected to reduce their capacity to filter contaminants and buffer water quality, as well as provide habitat for a diversity of wildlife species. Negative effects may also result from channel modifications, culvert installation, or wetland drainage, which reduce the effectiveness of riparian lands in slowing water flow, attenuating floods or recharging ground water supplies.

On a regional scale, upstream modifications to the natural landscape from activities such as timber harvesting, cultivation, urban development and even natural disturbances such as forest fires can change the hydrologic regime of entire watersheds, potentially leading to increases in surface run-off, flooding, erosion, sedimentation, and contamination by pollutants.

Overall, a detailed evaluation of the cumulative effects of multiple land uses may be required to provide a comprehensive look at the nature and scope of riparian land issues. Regional land use planning initiatives on the part of the Calgary Regional Partnership (CRP) may contribute to our knowledge of cumulative effects on riparian lands.

5.0 STRATEGIES FOR RIPARIAN LAND CONSERVATION AND MANAGEMENT

Strategies for the conservation and management of riparian lands range from inventories that determine the distribution, extent and quality of these areas in Rocky View County to the implementation of regulatory tools for their protection. Presented below is a broad range of strategies that Rocky View County may consider to implement their Riparian Land Conservation and Management Policy. Best Management Practices are standards for land use that are sensitive to riparian land conservation and management. Some suggested land use Best Management Practices for both urban and rural environments are presented in Appendix G.

5.1 Riparian Land Inventory

Conservation and management of riparian lands is expected to require some level of evaluation to determine existing conditions with respect to the local and regional distribution of these lands. The Alberta Riparian Land Conservation Project (Alberta Environment, 2007a) recommends riparian land delineation be tied closely to ecological functions of riparian lands. Subsequently, the health, ecological integrity, level of function, and/or requirements for rehabilitation or enhancement of riparian lands may be assessed. A number of approaches may be applied to complete this characterization of riparian lands in Rocky View County.

5.1.1 Riparian Land Mapping

A key first step in the management and conservation of riparian lands is to inventory and map the location and distribution of these lands within Rocky View County. Spatial data from a variety of sources may be available for use in this process. The scale of mapping and subsequent level of detail may vary depending on the specific land use being considered. Mapping that supports planning initiatives applied on a sub-basin by sub-basin level will be of most use in terms of applying an integrated and effective approach to riparian land management.

5.1.1.1 Calgary Regional Partnership Mapping

As indicated previously, the Calgary Regional Partnership (CRP) is carrying out mapping initiatives to support their Regional Land Use Plan. The following baseline spatial information has been prepared for the CRP (Carroll, pers. comm. O2 Planning + Design Feb. 25, 2009):

- Species Richness;
- Natural Patch Size;
- Riparian Corridors;
- Wetlands and Wetland Complexes;
- Alluvial Soils;
- Slope Percent;
- Ridges;
- Environmentally Sensitive Areas;
- Land Cover Classification; and
- Canadian Land Inventory Agricultural Soil Classes.

Riparian corridors were mapped using Altalis' 1:20,000 single line network stream data. From that dataset, only the permanent streams were selected. For example, aqueducts, canals and ditches were not selected in this process. A 60-meter buffer was created to estimate the possible extent of riparian lands. No additional image analysis, fieldwork or ground-truthing was performed to refine riparian corridors. Rocky View County would need to conduct further detailed mapping to capture the smaller, more intermittent water courses and waterbodies or interest in the municipality.

CRP has made all data available to CRP member municipalities for additional planning and analysis, pending data-sharing agreements. (This data source may provide Rocky View County with the baseline information necessary for an initial riparian land inventory. Additional image analysis, fieldwork and/or ground-truthing for the refinement of this riparian corridor product may be required for inventory completion.

5.1.1.2 Scientific Delineation of Riparian Areas: Nose Creek Example

The Nose Creek Watershed Partnership used various approaches to map riparian lands associated with the Nose Creek watershed. The extent of soil types associated with riparian areas was mapped with reference to digital soil coverages provided by the City of Calgary and Rocky View County (Palliser, 2006). Digital information provided by Alberta Environment on the extent of the 1:100 year floodplain was also used to delineate riparian lands (Palliser, 2006).

The meander belt associated with Nose Creek and West Nose Creek was also identified. Studies identify meander belt width using empirical formulas related to bank full channel width or discharge (Parish Geomorphic Ltd., 2004, as quoted in Palliser, 2006). For the Nose Creek watershed, the meander belt width was calculated by determining the average bank full width of various reaches of Nose Creek and West Nose Creek (Westhoff, 2003) and multiplying by a factor of 20; the factor recommended for unconfined channels (TRCA, 2004, as quoted in Palliser, 2006).

As described for Nose Creek, it is also important to identify stable toe and stable slope allowances where the creek flows immediately adjacent to escarpments (slopes > 15%). Therefore, the Nose Creek initiative included the mapping of escarpments associated with Nose Creek and West Nose Creek that were greater or equal to 15% slope (Palliser, 2006).

5.1.2 Site-Specific Evaluations

Site-specific surveys may be prepared to determine the meander belt width or, for other channel patterns, the channel width and associated riparian land boundary. Biophysical features to be measured on a specific reach may include, but are not necessarily limited to:

- channel parameters such as flow characteristics and channel geometry;
- pattern of fluvial landform features, including the observed natural extent of the floodplain;
- distribution and/or extent of soils characterized by periodic water inundation
- slope stability or susceptibility of bed and bank materials and adjacent upland deposits to erosion; and
- distribution and extent of aquatic versus terrestrial plant species or wetland versus upland plant communities.

The term “floodplain” in this case refers to the broad plain created through the lateral migration of a water channel as well as with over-bank deposition from periodic flooding (Selby, 1985). Hydrologic modeling and associated ground-truthing would be required to determine the specific 1:100 year floodplain extent.

Some of the challenges associated with preparing this type of field evaluation relate to the natural and man-made influences shaping riparian lands over time. Change in the configuration of a watercourse is most often a response to a substantial alteration in the hydrologic regime (Parish Geomorphic Ltd., 2004). Alteration of the hydrologic regime can occur in response to long-term climate change or it may be induced by land use changes upstream. As a result, it is possible that the floodplain area of a watercourse today may not represent the full future extent of the floodplain when these external factors are considered. The type and extent of channel adjustments in response to such factors depend on the magnitude of effect on the hydrologic regime as well as the ability of the channel to respond and absorb new flow levels. For example, upstream urbanization can cause increased peak flows that result in significant impacts such as channel incision and enlargement of headwater tributaries. Increased discharge rates associated with such changes can cause channels and their associated floodplains to widen over the long-term. Such changes in hydrology and channel morphology can occur in all types of streams including the intermittent, first-order water courses in the upper reaches of the watershed. When the hydrologic regime of a water course is anticipated to change, this fact should be incorporated into such site-specific evaluations so that potential future floodplain occupation of the watercourse can be estimated.

5.1.3 Alluvial Aquifer Mapping

To fully evaluate the extent of a riparian land, the extent of the alluvial aquifer associated with a river or stream may be mapped. As discussed previously, the alluvial aquifer is the subsurface geological unit along a river or stream that is hydraulically connected to the surface water of the water course (Elbow River Watershed Partnership, 2008). The alluvial aquifer of the Elbow River was mapped using surficial geology data from the Alberta Geological Survey (Moran, 1986) and elevation information provided by ASRD. Such mapping provides for a basic understanding of the extent of the aquifer, which may be augmented as more geologic survey information becomes available. Well data from areas surrounding riparian lands may be available from Alberta Environment for use in supporting or improving the accuracy of alluvial aquifer mapping.

5.1.4 Riparian Land Health Assessment

A **Riparian Land Health Assessment** may be used to direct efforts to evaluate the status and integrity of Rocky View County riparian lands and determine the extent to which efforts may be required to rehabilitate and restore damaged riparian lands. The Alberta Cows and Fish Program has developed a procedure for conducting health assessments for riparian lands. This type of assessment looks at the vegetation, soils and hydrologic characteristics of a specific riparian reach and evaluates the condition of the site and the significance of any observed adverse changes. Vegetation characteristics are the most readily identifiable feature of riparian lands and make up the basis of this assessment procedure (Fitch et al., 2001).

The Cows and Fish Riparian Health Assessment is used to measure eleven (11) environmental parameters along a selected reach of a water course (Fitch et al., 2001). These parameters are:

- vegetation cover;
- invasive plant species cover and density;
- disturbance-increaser undesirable herbaceous species cover;
- woody vegetation present and regenerating cover;
- browsing evidence;
- standing decadent and downed woody material;
- presences of deep-rooting vegetation along banks;
- presence of human-caused bare ground;
- evidence of human activity along banks;
- compacted, bumpy or rutting soil; and
- accessibility of floodplain to the water body.

This assessment procedure provides a quick assessment of the current status of a riparian land as well as an evaluation of the presence, scale and magnitude of adverse effects associated with any current land use. It is recommended that this procedure be repeated over time to monitor any changes taking place in riparian lands (Fitch and Ambrose, 2003) and to aid in any efforts to restore or rehabilitate altered riparian lands.

5.1.5 Qualified Evaluation

The characterization of riparian lands requires certain professional qualifications to ensure the quality and accuracy of data collected. Qualifications applicable to the evaluation of riparian land boundaries of riparian land health may include sufficient knowledge and experience in:

- fluvial geomorphology and field evaluation of landform features;
- hydrology and field sampling of water flow characteristics and channel morphology;
- aquatic, riparian and upland plant species identification and vegetation community classification;
- wildlife habitat suitability field evaluation and inventories of wildlife habitat use; and
- soil sampling and classification.

Alberta Environment provides two definitions of professionals with expertise applicable to evaluating water contaminants. First, their *Code of Practice for Water Course Crossings* (Alberta Environment, 2000) requires that a **Qualified Aquatic Environment Specialist (QAES)** carry out assessments of water crossings that may result in the disruption or alteration of the bed and banks of a fish-bearing water body. The QAES is a person who:

- possesses:
 - a post-secondary degree in biological sciences,
 - a technical diploma in biological sciences, or
 - educational equivalencies.

- has a detailed knowledge of aquatic environment, including fish and fish habitat, management and assessment, and
- is currently experienced with:
 - fisheries and aquatic environment assessment methods, and
 - the determination of mitigation measures required to maintain the productive capacity of the aquatic environment, including fish habitats in Alberta that may be adversely affected by the carrying out of works in and adjacent to the water, bed and shore of water bodies.

Second, Alberta Environment's Provincial Wetland Compensation Guide (Alberta Environment, 2007b) provides a definition of a **Qualified Wetland Aquatic Environment Specialist (QWAES)** as an expert with detailed knowledge of the aquatic environment, wetland soils, wetland species, hydrology, and wetland margin habitat and their management and assessment.

The professional services of a QWAES or QAES should be expected, at a minimum, when evaluating the most effective approach to protecting riparian lands. These professionals should provide the necessary scientific background for the implementation of protective measures such as riparian setbacks.

5.1.6 The Concept of No-Net-Loss

Once a Rocky View County-wide inventory of riparian lands is prepared, a vision for riparian land management may be developed to suit the environmental directives of the municipality. The concept of "No Net Loss" is one that may be applied in Rocky View County to meet the broad riparian project goals of protection, rehabilitation, restoration, enhancement and prevention or further damage of riparian lands. The concept implies that the total inventory of riparian lands remains in a "stable" state through mitigation; a process that is expected to reduce land loss by avoiding and/or minimizing impacts, or requiring appropriate compensation for impacts to riparian lands that cannot be avoided or minimized.

5.1.7 Significant Riparian Lands

The Alberta *Land Use Policies*, adopted by Ministerial Order in 1996 (Minister of Municipal Affairs), provide overarching provincial policy direction and guidance to municipalities for land use planning and regulations where municipal interests might overlap or impact matters of provincial interest. Among other planning considerations, the *Land Use Policies* provide goals and strategies for mitigating impacts of subdivision and development on identified natural environment features and water resources.

Goals and strategies that a municipality, in consultation with Alberta Environment, are encouraged to pursue include:

- identify significant features in the natural environment and significant water resources within municipal boundaries;
- determine appropriate land use patterns in the vicinity of identified features and water resources; and
- incorporate measures to minimize or mitigate any negative impacts on those features or water resources during subdivision and development.

Features of the natural environment to be identified and protected from the impacts of development include:

- “significant ravines, valleys, stream corridors, lakeshores, wetlands and any other unique landscape area;
- areas which are prone to flooding, erosion, landslides, subsidence, or wildfire; and
- areas of significant fish, wildlife and plant habitat.”

These features represent what are defined here as riparian lands. In essence, the *Land Use Policy* encourages municipalities to identify, in consultation with Alberta Environment, significant riparian lands, determine appropriate land uses, and mitigate negative effects within and in the vicinity of these areas. The term “significant” as it pertains to riparian lands and other important natural features is not defined by the *Land Use Policy*. Alberta Environment may look to municipalities to issue criteria for determining what riparian lands within their jurisdiction may be considered significant and to map, manage, and mitigate for these significant lands, as per *Land Use Policy* specifications.

5.2 Existing Municipal Policy

Rocky View’s Riparian Land Conservation and Management Policy may be implemented using a range of existing municipal policy, planning and regulatory tools. A detailed account of the municipal authority and jurisdiction to conserve and manage riparian lands, as well as existing policies, plans and regulatory tools for policy implementation, are provided in Appendix B.

5.2.1 Statutory Planning Documents as Tools

In 1994, the *Municipal Government Act* (MGA) was amended to incorporate planning legislation from the *Planning Act* (Government of Alberta, 1980). As per the MGA, a municipal council can prohibit, or regulate and control the use and development of all private and municipal lands within its jurisdictional boundaries through provisions in its *Land Use Bylaw (Agricultural Operations Practices Act, Government of Alberta, 2000)*. The rights of individual property owners to use and enjoy their property are balanced with the need for municipal councils to plan patterns of human settlement that are “orderly, economical and beneficial” and maintain and improve the physical environment in the overall greater public interest (See Appendix B for further details on land ownership and municipal policy).

Part 17 of the MGA describes several statutory policy, planning and bylaw documents that a municipality must or may develop. These statutory plans and *Land Use Bylaws* can be used as tools to protect riparian lands from the potential negative impacts of land use and development.

A brief description of these documents, as identified in the MGA, and an explanation of how they may be used to conserve and manage riparian lands is provided below.

Inter-municipal Development Plans (IDP)

- Cooperative plans for two or more municipalities.
- Regional parks and trails on riparian lands can be developed through such a plan with cooperation from multiple municipalities and the Province.

Municipal Development Plan (MDP)

- Adopted by every municipality with a population of over 3500.
- Addresses future land use, coordination of land use and growth patterns, and environmental

matters in the municipality.

- Include maps of significant provincial and local natural landscape features such as riparian lands.

Area Structure Plans (ASP)

- Provide planning objectives for a specific area within the municipality.
- Provide a framework for subdivision and development within the municipality.
- Include information about proposed Municipal Reserves and Environmental Reserves and building development setbacks from identified natural landscape features and water resources, including wetlands and riparian lands.
- Provides the opportunity to assess the carrying capacity of the natural features and water resources for proposed building densities in certain areas.
- Important tools for developing improved stormwater facilities to protect receiving water bodies.

Area Redevelopment Plans (ARP)

- Created to address planning issues in established neighbourhoods, where redevelopment may occur.
- May be used to plan improved community water distribution, wastewater collection and stormwater services that reflect emerging technology and strategies such as low impact development techniques to control stormwater runoff onsite within specific areas.

Land Use Bylaw

- Legally enforceable bylaw regulating and controlling all land use development within the municipality.
- Prescribes appropriate land use districts (zoning) and associated permitted and discretionary uses in each district.
- Provides the substantive and procedural requirements for applications to subdivide or develop lands or construct any type of building in riparian lands adjacent to the beds and shores of waterbodies and water courses.
- May be amended to include building development setbacks based on scientific evaluation of riparian land functions and distance requirements to preserve those functions over time.

Outline Plans/Conceptual Schemes

- Provides the first opportunity for a municipality to ensure that a proposed development is consistent with provincial and municipal wetland and riparian land management policies, goals and objectives.
- Provides the opportunity for municipalities to work with subdivision applicants to ensure that the potential impacts of subdivision on wetlands and riparian lands are addressed.
- Can require submissions of scientific studies and environmental impact reports before the application is deemed complete.

Green Space/Open Space Plans

- Provide broad policy direction for decision-making regarding green space and/or open space for municipal development plans, area structure plans, and subdivision and development proposals.
- Provide a single, comprehensive and integrated source of policy and supporting information on open space use and development within a municipality.

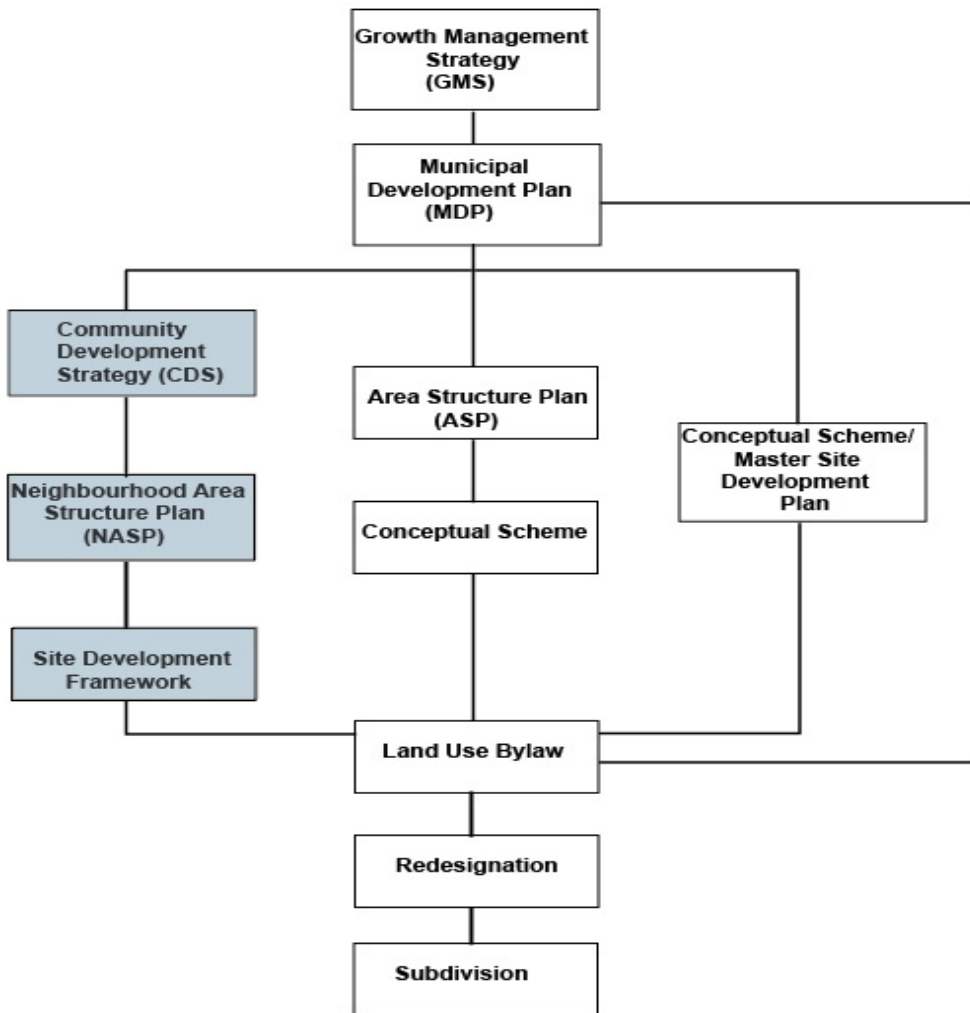
Master Drainage Plans

- Provide the principles and vision for water body management, which includes adjacent riparian lands within developing and industrialized environments.
- Provide opportunities for local rural initiatives where stormwater runoff may impact receiving water bodies and water courses.
- Provide an opportunity to consider the implementation of low impact development practices as well as integrated stormwater management initiatives in both rural and urban areas.

5.2.2 Rocky View County Planning Initiatives

Rocky View has developed a planning framework specific to their County that complies with the direction provided in the MGA. Figure 1 presents a general overview of Rocky View County's Planning Framework. The recently prepared Rocky View 2060 Draft Growth Management Strategy (2009) and Municipal Development Plan and in the reference list) provide a framework for planning on a County-wide scale. Policies such as Open Space Plans and the Wetland Conservation and Management Policy may also be applied to this regional scale. These regional planning efforts are compatible with other inter-municipal and provincial initiatives such as the Calgary Regional Partnership (see Section 7.1) and the *Alberta Land Use Framework*.

Figure 2 Rocky View County Framework for Municipal Land Use



On a more local, area-specific scale, Area Structure Plans, Conceptual Schemes and Master Drainage Plans are applied as well as these plans recently developed to facilitate the implementation of Rocky Views Growth Management Strategy:

- **Municipal Development Plan:** a statutory document to provide specific policy direction for managing future growth in the context of the Growth Management Strategy.
- **Community Development Strategy:** to define, at a general level, the settlement pattern and infrastructure system in a defined area.
- **Neighbourhood Area Structure Plan:** to describe the types of activities, the pattern in which they are arranged, the performance expected of them, and the major servicing system components necessary in support of development.
- **Site Development Framework:** to illustrate the boundaries of the land uses and alignments of the servicing system components.

In implementing the Rocky View Wetland Land Conservation and Management Policy, the municipality may want to review and amend their statutory planning documents in order to support the policy and facilitate its interpretation and implementation within areas proposed for development.

5.3 Existing Municipal Tools

The following municipal tools may be implemented through the County's Planning Framework, primarily on an area-specific basis

5.3.1 Land Use Districts

Municipal Land Use Bylaws divide municipalities into districts. Each district, unless designated as a direct control district, may prescribe certain land uses. Land use districts can be used as conservation and management tools. A Natural Area Land Use District is separate from the dedication of a Public Service Land Use District, which sometimes includes all municipally owned lands (public utility lots, Municipal Reserves and Environmental Reserves). Permitted and discretionary uses within the Natural Area Land Use District may be better regulated and controlled by Rocky View County, whether those lands are privately owned or owned by the municipality (e.g. Environmental Reserve after the parcel is subdivided).

5.3.2 Direct Control Land Use Districts

By designating a parcel as Direct Control, a municipal council may exercise particular control over the use and development of land or buildings within a parcel or land or a specific area of the municipality. Direct Control regulations are flexible and enable a council to waive or amend Land Use Bylaw regulations to achieve land use planning objectives for certain areas within the community, subject to any applicable statutory plan. For example, Strathcona County uses Direct Control Land Use Districts to address shared community values for protecting riparian lands adjacent to lakes within their boundaries (Strathcona County, 2001).

5.3.3 Building Development Setbacks

Building development setbacks, authorized by Section 640(4) (k) of the MGA, may be used to protect riparian lands and receiving water bodies and water courses from the potential negative impacts of adjacent land use and development. The desired outcome of using building development setback regulations is to ensure that riparian lands remain in their natural state whether on private or municipal lands. The municipality does not have to become the owner of

the lands in order to prohibit, or regulate and control use and development. The reason for using building development setbacks is not to stop private owners from owning or using their lands, but to prohibit certain uses and regulate and control others within a prescribed distance from waterbodies and watercourses in riparian lands. Building development setbacks are distinct regulatory tools unrelated to s (see Figure 3). Building development setback regulations affect all lands in all land use districts, whereas Environmental Reserves are prescribed and may only be required to be dedicated from certain parcels during the subdivision process.

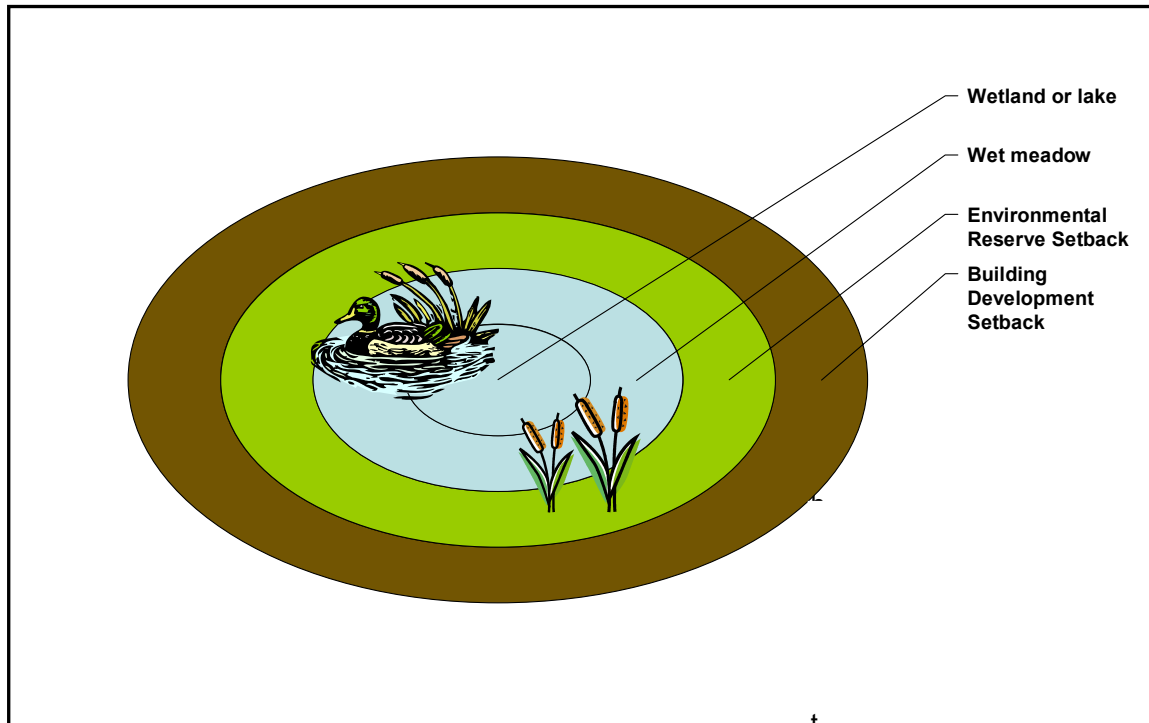
The terms in the phrase “building development setback” are defined either by the Province in the MGA (1994) or in municipal *Land Use Bylaws* as:

“**Building**” includes anything constructed or placed on, in, over or under land, but does not include a highway or road or a bridge that forms part of a highway or road.”

“**Development**” means

- i. an excavation or stockpile and the creation of either of them,
- ii. a building or an addition to or replacement or repair of a building and the construction or placing of any of them on, in over or under land,
- iii. a change of use or a building or an act done in relation to land or a building that results in or is likely to result in a change in the use of land or building, or
- iv. a change in the intensity of use of land or a building or an act done in relation to land or a building that results in or is likely to result in the intensity of use of the land or building.

Figure 3 Environmental Reserve Verses Building Development Setbacks



“**Setback**” is a term widely used in Alberta municipal *Land Use Bylaws* and is defined in different ways (See Appendix B). The MGA enables building development setback provisions to prohibit, or regulate and control:

the development of buildings:

- i. on land subject to flooding or subsidence or that is low lying, marshy or unstable; or
- ii. on land adjacent to or within a specified distance of the bed and shore of any lake, river, stream or other body of water.”

The provisions enable building development setback distances to be put in place to achieve municipal purposes generally, and specifically the purposes of Part 17 of the MGA. Unlike the Environmental Reserve provisions in the MGA, building development provisions do not limit the setback distance that a municipality can specify from the bed and shore of water bodies.

For the purpose of this Background Report, the term “**building development setback**” means the prescribed distance from buildings on privately owned or municipal lands and either:

- a. the edge or boundary of land subject to flooding or subsidence or that is low lying, marshy or unstable; or
- b. the bed and shore of any lake, river, stream or other body of water including wetlands, as shown on building development setback maps in the *Land Use Bylaw* (MGA section 640 (4)(k)(i) and (ii)).

Buildings might be prohibited or regulated and controlled by general provisions in a *Land Use Bylaw* for all lands within the mapped building development setback area. If building development setback regulations are written as general provisions, they would apply to all land use districts within the mapped area, for example, around the circumference of a wetland where there may be many landowners whose lands are zoned for many different purposes. They could also be written to apply only to a specific land use district.

Building development setbacks could be predetermined for all parcels in the community that contain water bodies, whether privately or municipally owned. The MGA grandparents “non-conforming uses” of lands prior to adoption of building development setback provisions but all new development after adoption of building development setback regulations would be either prohibited or regulated and controlled.

5.3.4 Overlay Zoning

Overlay zoning is an approach to controlling land use similar to but broader than building development setbacks. In Edmonton’s Zoning Bylaw, building development setbacks are set out in “overlays”. The “overlay” is defined in that bylaw as “additional development regulations superimposed on specific areas of the Zoning Map, which supersede or add to the development regulations of the underlying Zone” (City of Edmonton, 2001). An example of an Edmonton “overlay” is the North Saskatchewan River Valley and Ravine System Protection Overlay (hereinafter Edmonton’s NSR Overlay) (Ibid, 2001). No development is permitted within the mapped area, called the North Saskatchewan River Valley and Ravine System, or within a minimum 7.5 metres from the boundary of that mapped area. All lands in Edmonton’s North Saskatchewan River Overlay have been mapped, and the overlay regulations apply to all lands within the mapped area regardless of ownership or land use designation.

Development setback mapping is another approach that may be used to conserve riparian lands. Such mapping was prepared for Lethbridge’s River Valley Area Redevelopment Plan (RVARP) (City of Lethbridge, 1986). The lands in Lethbridge’s RVARP between the top of bank and bottom of slope setback lines, as defined therein, have restricted development regulations and controls. All land use districts may be accommodated within the mapped area, but the development setback regulations “overlay” all development. This is clarified by Lethbridge’s Land Use Bylaw (LUB) provisions concerning “statutory planning overlays” as defined below:

“41 Statutory Plan Overlays:

- (1) Where a statutory plan is in effect that affects the use or development of land or buildings in a particular district or districts, it shall be so indicated on the District Maps.
- (2) Where the policies, rules or procedures indicated in a statutory plan vary, supplement, reduce, replace or qualify the requirements of this By-law for a particular district or districts, the policies, rules or procedures indicated in the statutory plan shall take precedence”.

Lethbridge’s LUB prescribes a “Valley District”. The Valley District states that the specific land use rules and regulations in Lethbridge’s RVARP apply to all proposed development on lands in the Valley District. Lethbridge’s development setbacks do not apply to wetlands and riparian lands *per se* but include environmentally significant lands in the Old Man River valley, such as wetlands. Lethbridge maintains significant public parks in the Old Man River valley, including the Elizabeth Hall Wetland contained within the mapped area of Lethbridge’s RVARP. The Valley District restricts permitted uses and prescribes limited discretionary uses.

5.3.5 Development Permits

A person must obtain a development permit from the development authority before commencing any "development" as defined above, unless the *Land Use Bylaw* exempts the use from requiring such a permit. Rocky View County may include provisions in its *Land Use Bylaw* to enable the development authority to issue development permits with conditions which require landowners and developers to refrain from certain activities in certain land use districts. Development permits may be issued subject to other enactments, such as the *Safety Code Act* and regulations, *Water Act*, *Environmental Protection and Enhancement Act* and other provincial laws that require certain permits, approvals or licenses. The development permit stage offers opportunities for the development authority to ensure that council's planning policies for the protection of riparian lands are implemented within developing areas.

5.3.6 Subdivision Process

Part 17 of the MGA provides rules and regulations for the subdivision of lands. The subdivision process usually begins with a submission of a proposed outline plan or tentative plan of subdivision to the development authority. When a landowner applies to subdivide, a municipality may require that certain lands be dedicated as Reserve Lands, including Environmental Reserves or Environmental Reserve Easements, which are also discussed further below. The subdivision process provides opportunities to work with the development industry in creative ways to protect environmentally sensitive landscapes such as wetlands and riparian lands. The *Subdivision and Development Regulation* requires that certain subdivision applications for parcels of land that contain provincially owned or regulated lands, such as wetlands and water courses, be circulated to ASRD for review and consultation on potential impacts. Recently, ASRD provided draft guidelines for requiring dedications of appropriate widths of riparian lands adjacent to water resources.

5.3.7 Reserve Lands

At the time of subdivision, a municipality may require the dedication of "Reserve Lands" without compensation to the landowner. Reserve lands include "Environmental Reserves" which are essentially "un-developable" lands that must be left in their natural state or used as a public park. Reserves also include Municipal Reserves, School Reserves, or Municipal and School Reserves, which are dedications of up to 10% of the remaining "developable" lands in the parcel after the removal of Environmental Reserves and any lands required for roads and public utility lots.

Environmental Reserves and Environmental Reserve Easements provide opportunities for municipalities to maintain and protect riparian lands. The MGA specifies that Environmental Reserves must be left in a natural state or be used as public parks, unless certain legislated steps are taken to pass a bylaw to use Environmental Reserve land for other purposes.

Rocky View County Council may require that lands be dedicated as Environmental Reserves if they consist of:

- a swamp, gully, ravine, coulee or natural drainage course;
- land that is subject to flooding, or land that is unstable; or
- a strip of land, not less than six meters in width, abutting the bed and shore of any lake, river, stream or other body of water.

The strips of land abutting a water body are taken for two purposes: to prevent pollution or to provide public access to the bed and shore. Some municipalities have only required the dedication of the minimum 6 meter strip from the legal bank (City of Calgary, 2007). This width may be considered inadequate to maintain essential riparian functions and is not expected to achieve the essential function of buffering receiving water bodies from pollution caused from non-point sources such as stormwater runoff (McElfish et al., 2008). Environmental Reserves cannot be required to protect the water resource per se, other than to prevent "pollution." Pollution should therefore be defined within municipal *Land Use Bylaws*. The Municipal Government Board make it clear that a municipality requiring "excessive" dedication of Environmental Reserves from the bed and shore of a lake must be able to prove that the dedication is necessary to provide public access or prevent pollution.

The use of "Environmental Reserve Setback Policies" is one mechanism that municipalities are using to protect wetlands and riparian lands from point and non-point source pollutants. Such municipal policies that establish the extra wide Environmental Reserves will be required to be dedicated from private lands adjacent to certain water bodies during subdivision (City of Calgary, 2007). "Environmental Reserve Setbacks" are not building development setbacks. They are administrative guidelines that direct staff to require that wider strips of Environmental Reserves be dedicated to the municipality from private parcels to prevent pollution or provide public access. The City of Calgary "Environmental Reserve Setback Guidelines" are being used during the subdivision process to ensure that a sufficient strip of land adjacent to lakes, rivers, streams and wetlands is dedicated as Environmental Reserve.

Requiring dedication of extra wide Environmental Reserve strips from private landowners at the time of subdivision may not protect those lands from inappropriate use and development. Further explanation regarding this limitation of Environmental Reserve Setback Guidelines is provided in Appendix B.

Environmental Reserve Easements were introduced into the MGA in 1994 and are important tools that municipalities could use to protect riparian lands and wetlands from the impacts of development. As discussed above, private landowners may be required to transfer title of the beds and shores of temporary wetlands and riparian lands to the municipality as Environmental Reserves during the subdivision process. The MGA enables a landowner to apply for the creation of an "Environmental Reserve Easement" instead of transferring title of the identified lands to the municipality.

Environmental Reserve Easements are underutilized mechanisms to maintain wetlands and riparian lands in their natural state. A municipality may wish to establish a policy that directs administration to enter into Environmental Reserve Easements whenever the landowner is agreeable to preserve wetlands and riparian lands. Landowners then have the responsibility to preserve the easements in their natural state in accordance with the terms of the easement.

While the municipality must enforce the terms of the easement, a private landowner remains

responsible for the day-to-day use and care of the private property and continues to control public access.

5.3.8 Provincial Conservation Easements

Conservation Easements may be established through agreements between a land owner and the Province, with the objective being to restrict the types of activities on an area of land. Further details regarding the application of this approach to conserving and managing riparian lands are provided in Appendix B.

5.3.9 Green Space/Open Space Plans: A closer look

Green Space or Open Space Plans may be used to support the protection of riparian lands within municipalities. For example, the City of Calgary has an Open Space Plan (2002) that provides strategic direction for the long-term management of open space within their jurisdiction (City of Calgary, 2002). Objectives for Open Space include, but are not limited to:

- “Protect environmentally significant areas and provide a sustainable and bio-diverse open space system that represents the natural ecosystems of the Calgary region”
- “Provide a continuous integrated river valley park system that reflects the city’s unique prairie and foothills setting”.
- “Promote connected open space systems and the protection of natural areas and water quality in areas of future urban growth.”

Included in the City of Calgary Open Space Plan are policies that specify permitted and discretionary land uses within different categories of open space, strategies for plan implementation, requirements for conducting Environmental Impact Assessments (EIA) and Biophysical Impact Assessments (BIA), and maps of open space policy areas, including Natural Areas and Environmentally Significant Areas. These are mapped policy “overlays” that direct administration regarding how lands within these specific areas are to be developed in the future.

Rocky View County should consider developing an Open Space/Green Space Plan for the municipality as a whole to ensure that significant natural landscapes are identified, inventoried, conserved, and managed. By having such a plan in place, landowners and speculators are given advance warning that significant riparian land systems may have restricted development opportunities in the future.

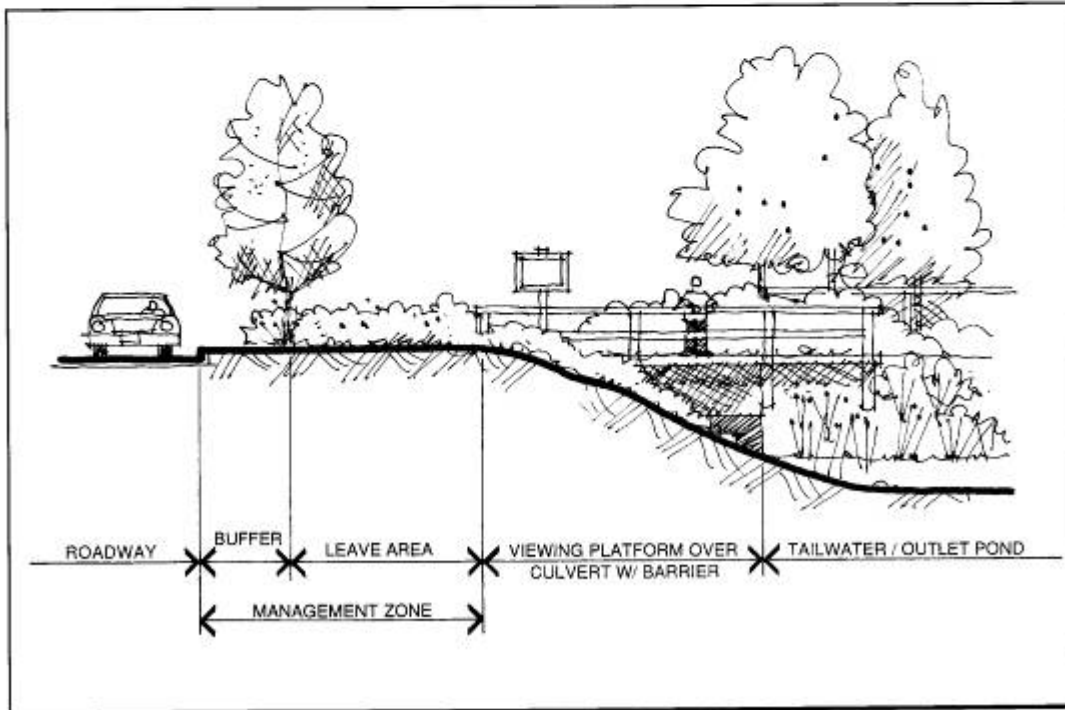
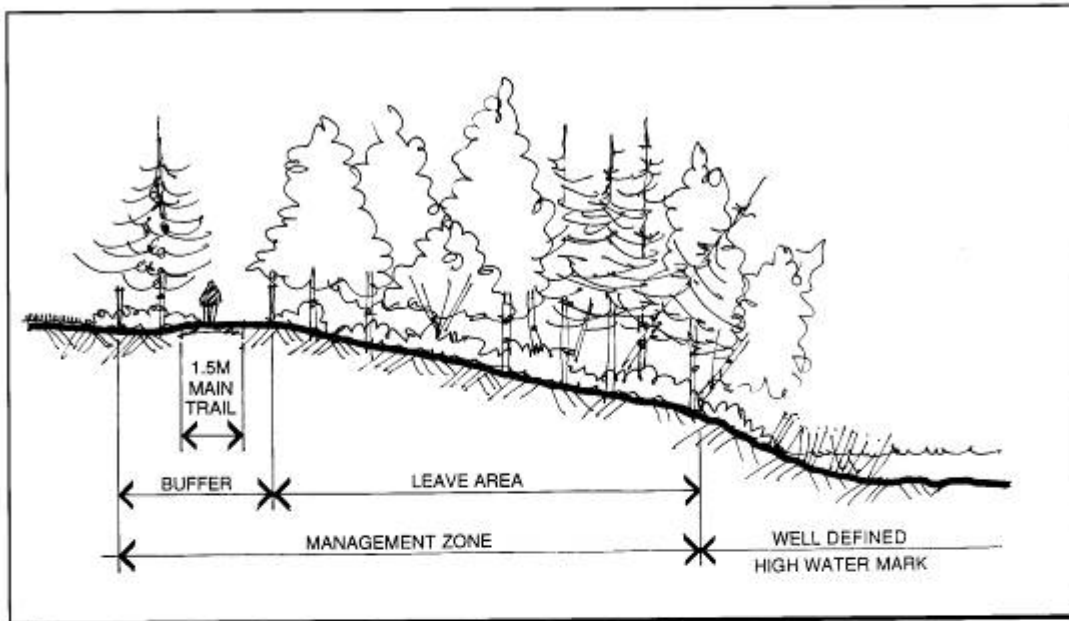
5.4 Options for Riparian Land Protection

Once riparian land inventories are prepared and the distribution of such lands is determined, the conservation of riparian lands requires certain management measures to mitigate the potential adverse effects of land use and development within or adjacent to these lands. Specifically, the objective in applying such mitigations is to preserve riparian lands and their functions. Certain protective designations, as described above, include the designation of Natural Area Land Use Districts or the implementation of Building Development Setbacks. These measures allow areas of riparian lands to, in essence, be identified as separate land types, or be “set aside” subject to certain specified land use restrictions. Various approaches may be used to determine the width of the added buffer of land needed to protect and accommodate riparian lands and their functions. Approaches range from fixed setback buffer widths to science-based approaches to delineating development setbacks. Rocky View County may consider these approaches when determining the strategies and methods used to protect riparian lands.

5.4.1 Vegetation Buffer Strips

Fisher and Fischenich, (2000), described vegetated riparian zones as linear bands of vegetation adjacent to aquatic ecosystems that are delineated to serve a certain conservation management objective. Such strips should not be confused with the riparian lands themselves, which are natural biophysical features, their physical extent dictated by environmental factors as described in Section 2.0 of this report. Vegetation buffer strips described by Fisher and Fischenich are artificial delineations prepared to support specific management considerations. The following Figures 4 provides examples of vegetation buffer strips zones used in riparian land management applications.

Figure 4 **Examples of Vegetative Buffer Strips**



Source: *Access Near Aquatic Areas*. A guide to Sensitive Planning, Design and Management. Fraser River Action Plan. Ministry of Environment, Lands and Parks (1996)

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The following Table (Table 6) from Fisher and Fischenich (2000) presents a review of buffer strip guidelines, based on approximately 30 sources in the literature. These buffer widths theoretically support water quality protection, riparian habitat, stream stabilization, flood attenuation and detrital input. McElfish et al. (2008) cite a large scientific literature examining effective buffer sizes for the conservation of water quality. Based on their review, 30 m is the average riparian buffer width required to prevent pollution of water bodies by contaminants. This distance increases depending on soils, vegetation, slope and whether the landscape is undergoing development (McElfish et al., 2008). Lee et al. (2003) prepared a quantitative review of riparian buffer width guidelines for timber harvest practices in 60 jurisdictions in Canada and the United States. Mean buffer width varied from 15.1 to 29.0 m for different waterbody types. Just less than half of the jurisdictions investigated had three or more modifying factors in their guidelines. Of these, waterbody type, shoreline slope, waterbody size, and presence of fish were the most common.

Fisher and Fischenich (2000) caution that there is no “one-size-fits-all” description of the ideal buffer strip. First and foremost, the primary objectives of a buffer strip should be determined, whether it be to protect water quality in a stream or protect, as a whole, the riparian lands associated with that stream. Fixed-width buffers can be easier to administer but often fail to provide for many ecological functions (Castelle et al., 1994). As well, fixed-width buffers do not fully consider site-specific conditions (Palliser, 2006). In Rocky View County, a fixed buffer width may not be as effective in conserving the range of ecological functions provided by the diversity of Rocky View’s riparian lands. Conversely, variable width buffers may be sensitive to site-specific conditions but require greater expense and higher levels of training to administer (Palliser, 2006).

5.4.1.1 Greater Bragg Creek Riparian Buffers

Two fixed-buffer widths were recommended in a riparian policy prepared for Rocky View County as part of a Resource Inventory and Sensitivity Analysis completed for the Greater Bragg Creek Area Structure Plan (Alpine Environmental, 2004). The argument for fixed width buffers in this case was made for ease of enforcement and to reduce the need for specialized evaluation. A minimum 30 m set back distance from the stream bank (top of bank) was defined, which may be amended and expanded to ensure adequate protection of riparian lands. The minimum setback might also be reduced in situations involving 1st order streams at the boundaries of wetland areas or where bedrock outcrops preclude the usefulness of a full riparian area. A review of the literature provided the basis for allocation of the 30 m buffer width. This buffer width applies to all streams and tributaries within Greater Bragg Creek except the banks of the Elbow River, where the minimum buffer width in all instances is 50 m (Alpine Environmental, 2004).

Table 6 General Riparian Buffer Strip Width Guidelines

Function	Description	Recommended Width ¹
Water Quality Protection	Buffers, especially dense grassy or herbaceous buffers on gradual slopes, intercept overland runoff, trap sediments, remove pollutants, and promote ground water recharge. For low to moderate slopes, most filtering occurs within the first 10 m, but greater widths are necessary for steeper slopes, buffers comprised of mainly shrubs and trees, where soils have low permeability or where NPSP loads are particularly high.	5 to 30 m
Riparian Habitat	Buffers, particularly diverse stands of shrubs and trees, provide food and shelter for a wide variety of riparian and aquatic wildlife.	30 to 500 m +
Stream Stabilization	Riparian vegetation moderates soil moisture conditions in stream banks, and roots provide tensile strength to the soil matrix, enhancing bank stability. Good erosion control may only require that the width of the bank be protected, unless there is active bank erosion, which will require a wider buffer. Excessive bank erosion may require additional bioengineering techniques.	10 to 20 m
Flood Attenuation	Riparian buffers promote floodplain storage due to backwater effects, they intercept overland flow and increase travel time, resulting in reduced flood peaks.	20 to 150 m
Detrital Input	Leaves, twigs and branches that fall from riparian forest canopies into the stream are an important source of nutrients and habitat.	3 to 10 m
¹ Synopsis of values reported in the literature, a few wildlife species require much wider riparian corridors.		

Fischer and Fischenich (2000)

5.4.1.2 Alberta Environment Waterbody Setbacks

Similar Environmental Reserve waterbody setbacks are being considered by Alberta Environment. AMEC Earth & Environmental is presently working with Cows and Fish (Alberta Riparian Habitat Management Society) to develop a How-to Guidebook for Alberta Environment for determining waterbody setbacks. This guidebook is being designed to aid provincial and municipal planners, watershed groups, developers and land owners to protect and maintain riparian lands within the settled region of Alberta. Through a public consultation process, Alberta Environment has sought feedback on recommended minimum Environmental Reserve/Easement widths. Environmental Reserve setback modifiers are also provided for lands unsuitable for development due to flooding potential, high erosion risk, or other topographical and geo-technical constraints (AMEC, 2009). Recommended Minimum Environmental Reserve/Easement Widths and Modifiers identified in the Guidebook Consultation Questionnaire are presented in Tables 7 and 8. It should be noted that this guidebook is still in progress.

Table 7 Alberta Environment Recommended Minimum ER/Easement Widths

Water Feature	Minimum ER Width	Notes
Reservoirs & Regulated Lakes	30 m from right-of-way or easement	A regulated lake is a lake where water levels are established to a predetermined elevation and actively managed through use of a licensing requirement (e.g. to pump water into the water body).
Lake (natural & controlled)	30 m from natural boundary	On controlled lakes, 30 m from sill elevation of licensed control structure.
Swamp/Wetland	Variable, include wet meadow zone	Wet meadow zone can be extensive in some situations, and in these instances the ER should be wide enough to preserve ecological function.
Large River ($\geq 15\text{m}$ width)	30 + m	See additional requirements for hazardous lands.
Small River/Large Stream (6-15m)	15 m	
Medium Stream (3-6m)	10 m	
Small Stream ($\leq 3\text{m}$)	6 m	
Ephemeral Watercourse (no defined channel)	0 m	Use bylaw to regulate tree cutting within a defined distance from feature to maintain riparian vegetation and drainage.
Braided Stream	10 m from outside boundary of active floodway.	

(ASRD, 2007)

Table 8 Additional Factors that may Increase the Width of an Environmental Reserve/Easement

Hazardous Lands	ER Modifier	Notes
Floodplain	The width of the 1:100 year flood line or 30 m from the natural boundary of a watercourse or lake, whichever is less. The width of meander belt for watercourses that tend to meander or entire floodplain if it is highly constrained within a confined valley.	Development within flood fringe area should only be considered if flood proofing is undertaken to reduce risk of flood damages. Flood risk mapping or delineation of the 1:100 year flood line generally define the extent of expected flood occurrence. The width of a meander belt is determined by multiplying bank full width by 20 for each reach, and is split equally on either side of creek along axis of meander belt.
Erosion Prone Areas	Provide for a toe erosion allowance.	Consider highly erodible soils and annual recession rates.
Gully, Ravine, Coulee, or Valley Escarpments	Provide for a stable slope allowance. Apply construction and building setbacks from this line.	Boundary of stable slope allowance measured from top of crest of plateau (terrace), valley slope or tableland.
Steep Slopes ($> 15\%$)	3X escarpment height or as recommended by a geotechnical report on slope stability, rate of erosion, etc.	

(ASRD, 2007)

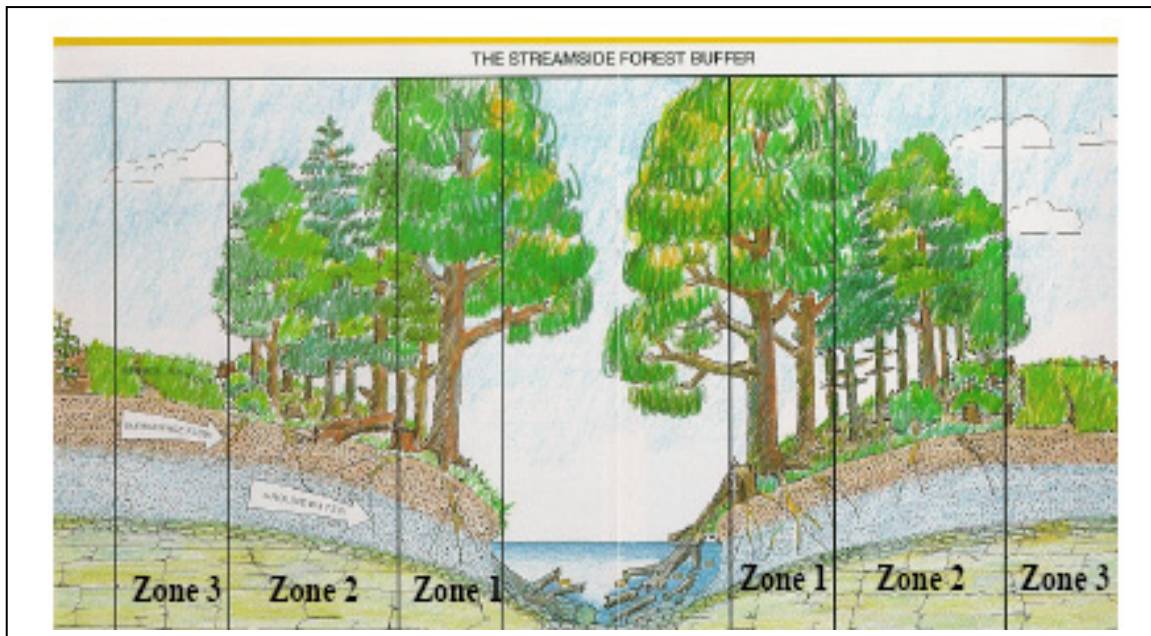
5.4.1.3 City of Calgary Environmental Reserve Setbacks

The City of Calgary has developed and implemented Environmental Reserve Setbacks for protection against pollution (City of Calgary, 2007). They apply a fixed-width base setback of 6m for 1st order streams and a fixed width base setback of 30 m for 2nd, 3rd, and 4th order streams as well as other permanent streams, such as irrigation canals. Class III to VI wetlands and isolated wetlands are also subject to a 30 m base setback. An adjustment factor is provided to accommodate greater setback widths based on factors such as slope, hydraulic connectivity to ground water and where there is an interest in providing for better buffering of waterbodies or the restoration of riparian lands and their functions.

5.4.2 Riparian Land Zones

Zones within riparian lands may be identified for the purpose of applying a hierarchy of management strategies specific to areas within riparian lands. The width of each zone is determined by site conditions and the riparian functions managers want to promote or enhance. Table 9 presents examples of three-zone systems used to classify riparian lands for management purposes. Figure 5 presents a three-zone system used by managers in the Chesapeake Bay Area of Virginia, U.S. (Welsch, 1991).

Figure 5 Depiction of a Three-Buffer Approach



(Fisher and Fischenich, 2000)

Each of these systems has an inner stream-side zone, a middle riparian area and an outer upland zone. Each zone performs a different function and has a different width, vegetative target and management scheme. For example, the Federal Interagency Stream Restoration Working Group (1998) recommends a three-zone system where the stream-side zone protects the physical and ecological integrity of the aquatic ecosystem. The middle zone extends from the outward boundary of the streamside zone, and varies in width, depending on stream order, the extent of the 100-year floodplain, adjacent steep slopes, protected wetland areas, and heritage value. Federal Interagency Stream Restoration Working Group (1998) identifies the outer zone as the buffer for the riparian area (as quoted in Palliser, 2006).

This three-buffer system allows managers to compartmentalize riparian lands based on different biophysical phases, from primarily aquatic to terrestrial environments. As a qualitative tool for classifying riparian lands, this system may be limited in places where it is difficult to distinguish between zones, for example, areas where differences in the structure and composition of vegetation are less distinct. In such areas, the three zones may be difficult to identify and delineate. It may also be the case that the riparian functions provided in each zone overlap significantly, therefore making the exercise of distinguishing between zones less constructive from a managerial perspective. This approach does, however, facilitate the application of a hierarchy of management objectives within riparian lands based on the different functions and sensitivities of each zone. It also provides a strong framework for the development of restoration and rehabilitation projects sensitive to the different biophysical phases of riparian lands.

Table 9 Examples of Riparian Land Management Zones

Source	Riparian Land Management Zone		
	Zone One	Zone Two	Zone Three
Welsh, 1991	<p>Zone One: at the stream edge where vegetation is tolerant to flooding.</p> <p>Designated for bank stabilization, sediment and nutrient removal, reducing flood effects, habitat for aquatic and terrestrial organisms, shade, woody debris and detritus. Area is 5-8 m or more in width.</p>	<p>Zone 2: from Zone 1 to upper boundary where vegetation is reasonably flood and drought tolerant.</p> <p>Designated for sediment and nutrient removal and protection of riparian vegetation.</p> <p>Area is 3 m or more in width depending on stream type, soil type or topography.</p>	<p>Zone 3: from Zone 2 to upper boundary where vegetation consists of grasses and herbaceous plants.</p> <p>Designated for slowing runoff, filtering sediments and contaminants, for protecting from overland flow, and providing upland habitat.</p> <p>Area is 4.5 m or more in width.</p>
City of Calgary, 2006	<p>Inner zone is at the bank and including the adjacent land. Areas is 6 m or less in width.</p> <p>Intended to maintain the integrity of the banks and adjacent aquatic habitat.</p>	<p>Middle zone separates the bank from any adjacent development. Area is 15-30 m in width.</p> <p>Provides the special separation between the inner zone and adjacent development.</p>	<p>Outer zone is meant to protect against encroachment from development, provides for filtering of runoff. No set width.</p> <p>Intended to minimize encroachment of adjacent development and provide initial filtering of runoff.</p>
The Federal Interagency Stream Restoration Working Group, 1998	<p>Stream side protects the physical and ecological integrity of the creek ecosystem.</p>	<p>Middle core varies in width depending on stream order, the extent of the 100-year floodplain, adjacent steep slopes, protected wetland areas, and heritage value.</p>	<p>Outer zone The outer zone is the buffer's buffer.</p>

5.4.3 Scientific Delineation of Riparian Land Setbacks: Nose Creek Example

The Nose Creek Watershed Partnership applied a unique approach to the delineation of riparian setbacks. They identified several biophysical features for determining the extent of the riparian area: distribution of riparian soils, 1:100 year floodplain, escarpments, and the meander belt width for Nose Creek, West Nose Creek and their tributaries (Palliser, 2006) (Table 10). The riparian setback widths are expected to be determined on a site-specific basis based on the greatest of these 3 criteria. When the slope of the bank adjacent to the water course is greater than 15%, an additional setback from the top of the bank is added to the riparian setback width to provide a stable slope allowance. Where the floodplain is not defined, the meander belt is calculated and the resulting width is used as the riparian setback, to a minimum width of 15 m. Riparian Area Management Maps prepared with digital data on these riparian land features were developed for planning purposes while actual riparian setbacks are meant to be calculated in the field by a QAES (see Section 5.1.5).

Table 10 Riparian Setback Criteria for the Nose Creek Watershed

Criteria	Description	Rationale
Riparian Soils	Saturated soils that are influenced by the presence of water.	Riparian soils are unique and reflect the presence of water or poorly drained soils.
1:100 year Floodplain	As defined by Alberta Environment.	Flood risk area that may be a public safety concern.
Adjacent Escarpments	Lands having equal to or greater than 15% slope.	Escarpments often define watercourses.
Meander Belt Width	20 times the bank full width for given reaches.	Allows for natural stream channel migration.
Perennial or Intermittent Stream	As defined by the Alberta Provincial Land Network.	Perennial streams require larger setbacks since they are higher in order than intermittent streams and generally convey more water.

(Palliser, 2006)

5.4.4 Riparian Matrix Setback Model

The Riparian Setback Matrix Model, created by Aquality Environmental Consulting Ltd., offers a unique approach to the development of setbacks based on measured environmental parameters that include height of bank, slope, groundwater table level and vegetation. The emphasis of the model is on determining appropriate setbacks for water quality maintenance. This model is used by Lac La Biche County, Alberta, to determine the appropriate area of Environmental Reserve. As discussed in Section 5.4.6, Environmental Reserve is dedicated to maintain healthy and functional riparian areas free from pollution while providing public access that will not impede natural functions. The model's site-specific approach is adaptable and may be modified to suit a broad range of setback applications. Equally, it may be modified to incorporate other significant environmental parameters influencing the riparian land function of water quality buffering, such as soil type and texture, organic content, pH, and conductivity.

A detailed description of the Riparian Setback Matrix Model, as it was applied Lakeland Country, is presented in Appendix E. For Rocky View County, the Model would be adjusted to incorporate soils information.

5.4.5 Wildlife Building Development Setbacks

An important function of riparian lands is providing habitat for a wide range of plant, animal and invertebrate species. As indicated previously, riparian lands support a wide variety of wildlife for all or part of their life cycles. Land uses within riparian land can cause loss or alteration of habitat, therefore reducing its suitability to support a diversity of species. Equally, land uses in and adjacent to riparian lands can cause sensory disturbance of wildlife that can lead to habitat avoidance. Building Development Setbacks may be applied to promote biodiversity, maintain the quality and effectiveness of habitat within riparian lands, and reduce or eliminate adverse land use effects. ASRD provides recommended setback distances and restriction dates for the protection of select wildlife species inhabiting the Grassland and Parkland Natural Regions of Alberta (ASRD, 2001). These ASRD guidelines focus on species identified, as per the Status of Alberta Wildlife (ASRD, 2001), as “at risk”, “may be at risk” or “sensitive”. These recommendations are based on expert opinion of expected human disturbance thresholds for key wildlife species and habitat areas (Table 11). These ASRD building development setbacks were also based on the degree to which local habitat elements (soils and vegetation) may be impacted by a proposed development or activity (Table 11). As a general rule, ASRD recommends that no industrial development or activity take place within 100 m of any water body or coulee crest (ASRD, 2001) that may be associated with riparian lands.

Similar information on habitat areas where wildlife may be sensitive to disturbance is provided in Bellrose (1980) for common waterfowl species (Table 12). Setbacks or, in this case, buffers of specified width are also presented for certain key management species in the Alberta Timber Harvest Planning and Operating Ground Rules Framework for Renewal (2008) (Table 13).

Table 11 Recommended Restricted Activity Dates and Setback Distances

Species	Wildlife Key Area	Restricted Activity Dates	Setback Distances by Land Use Category ¹		
			Low	Moderate	High
HERPTILES					
Northern Leopard Frog <i>Great Plains Toad</i> <i>Canadian Toad</i> <i>Plains Spadefoot Toad</i>	Ponds Used for Living, Breeding or Hibernating	Year Round	50 m	50 m	100 m
<i>Western Rattlesnake</i> <i>Western Hognose Snake</i>	Hibernaculae	Apr 1 – May 31 Jun 1 – Aug 14 Aug 15 – Oct 31 Nov 1 – Mar 31	200 m 50 m 200 m 100 m	200 m 200 m 200 m 200 m	200 m 200 m 200 m 200 m
<i>Short-horned Lizard</i>	Suitable Habitat	Year Round	100 m	100 m	100 m
BIRDS					
Peregrine Falcon	Nest Site	Apr 1 – Jul 31 Aug 1 – Mar 31	500 m 50 m	1000 m 100 m	1000 m 1000 m
Burrowing Owl	Nest Site	Apr 1 – Aug 15 Aug 16 – Oct 15 Oct 16 – Mar 31	200 m 200 m 50 m	500 m 200 m 100 m	500 m 500 m 500 m
Piping Plover	High Water Mark	May 1 – Jul 15 Jul 16 – Apr 30	200 m 50 m	200 m 50 m	200 m 200 m
Ferruginous Hawk <i>Prairie Falcon</i> <i>Bald Eagle</i> <i>Golden Eagle</i>	Nest Site	Mar 15 – Jul 15 Jul 16 – Mar 14	1000 m 50 m	1000 m 50 m	1000 m 1000 m
<i>Short-eared Owl</i>	Nest Site	Apr 1 – Jul 31	200 m	200 m	400 m
<i>Sprague's Pipit</i>	Nest Site	Apr 15 – Jul 15	100 m	100 m	100 m
<i>Long-billed Curlew</i>	Nest Site	Apr 15 – Jul 15	100 m	100 m	200 m
Greater Sage Grouse	Lek	Mar 1 – Jun 15 Jun 16 – Feb 29	500 m 100 m	500 m 100 m	1000 m 1000 m
Sharp-tailed Grouse	Lek	Mar 15 – Jun 15 Jun 16 – Sep 15 Sep 16 – Oct 31 Nov 1 – Mar 14	500 m 100 m 500 m 100 m	500 m 100 m 500 m 100 m	500 m 500 m 500 m 500 m
<i>American White Pelican</i> <i>Great Blue Heron</i>	Nesting Colony	Apr 1 – Jul 31 Aug 1 – Mar 31	500 m 100 m	1000 m 200 m	1000 m 1000 m
Sage Thrasher	Nest Site	May 15 – Jun 30 Jul 1 – May 14	100 m 50 m	200 m 50 m	200 m 200 m
MAMMALS					
Ord's Kangaroo Rat	Den	Year Round	50 m	100 m	100 m
Swift Fox	Den	Feb 15 – Jul 31 Aug 1 – Feb 14	500 m 50 m	500 m 100 m	500 m 500 m
Pronghorn	Winter Range	Jan 1 – Apr 30	Dependent Upon Winter Severity		

ASRD (2001) Bold = "At Risk"; *Italics* = "May be at Risk"; Regular = "Sensitive". Low = little of no land use (e.g. surveying, monitoring); Moderate = short-term vegetation disturbance (e.g., low footprint seismic activities); and High = structures, soils disturbed, or long-term vegetation disturbance (e.g. wellsite, powerline, pipeline, road).

Table 12 Setbacks for Common Waterfowl Species

Species Name	Setback From Water
Gadwall	100 yards (≈ 91 m) will accommodate most nests
Wigeon	An average of 36 yards (≈33 m) will accommodate most nests but ranges
Green-winged Teal	An average of 95 feet (≈29 m) will accommodate most nests but ranges
Mallard	100 yards (≈91 m) will accommodate most nests
Northern Pintail	100 yards (≈91 m) will accommodate most nests
Blue-winged Teal	An average 125 feet (≈38 m) will accommodate most nests but ranges
Northern Shoveler	Most nests are found within 75 to 200 feet (≈23 to 61 m) but ranges
Canvasback	Nests usually found in open water, for example on vegetation mats
Redhead	Most nests found within 4 to 7 feet (≈1 to 2 m) of water
Lesser Scaup	On average 39 feet (≈12 m) from water

(Bellrose, 1980)

Table 13 Width of Forested Buffer Dependent on Wildlife Species

Sensitive Site	Width of Forested Buffer
Breeding sites and hibernacula of Species at Risk salamanders, amphibians and reptiles	100 m
Bat hibernacula	
Colonial bird nesting area	
Sandhill Crane nesting area	
Wolverine den	
Mineral licks	
Raptor nest tree	
Grizzly bear den	
Natural springs and beaver ponds with no outflow channel	20 m – vegetated

(Alberta Timber Harvest Planning and Operating Ground Rules Framework for Renewal, 2008)

5.4.6 Riparian Wildlife Corridor Designation

Wildlife move across landscapes and between suitable habitats in order to accommodate their life requisites (Paquet et al., 1996). Natural movement routes can include game trails, ridges, open edges, river valleys, riparian zones, shorelines, open forest and/or mountain passes (Paquet et al., 1996). Habitat fragmentation can sever landscape connections that support wildlife movement. Wildlife corridors are distinct habitat linkages that can be designated to maintain these connections within the landscape.

Riparian lands may be managed for the purpose of conserving landscape connections and, specifically, to facilitate the movements of particular wildlife species of interest. With wildlife movement as a conservation goal, riparian lands may be evaluated for the habitat they provide but also the size and shape of designated riparian land zone needed to maintain these movements. A challenge in designing wildlife corridors is to ensure corridor function.

In the Town of Canmore, Alberta, for example, wildlife corridors were originally designed in 1990 to facilitate the movements of deer and elk. Today, area wildlife managers are working to make Canmore's wildlife corridors viable for the full range of species that use the Bow Valley, including more wary species (e.g., wolves) less adaptable to human development and activity (Herrero et. al., 2004). Monitoring of wildlife use of designated corridors may be required to confirm their effectiveness in facilitating wildlife movements. It should also be noted that riparian lands designated as wildlife corridors may only provide for some species movements and that a network of lowland and upland habitat linkages is required to fully accommodate movements between wildlife habitats in the broader landscape.

The Town of Canmore includes designated wildlife habitat and wildlife corridor areas in its Land Use Bylaw. These areas are designated as Wildlands Conservation District and include permitted and discretionary uses as well as regulations for development on adjacent lands.

38. WC WILDLANDS CONSERVATION DISTRICT

1. PURPOSE

To designate areas for the protection, conservation and enhancement of the environment including biological diversity, the protection, conservation and enhancement of natural scenic or aesthetic values and where consistent with either of the above, for low-impact recreational, open space or environmental educational use or use for research or scientific studies of natural ecosystems.

2. PERMITTED USES

Wildlife Corridors

Wildlife Habitat

3. DISCRETIONARY USES

Accessory uses to developments approved prior to 3rd reading of Bylaw 09-99

Emergency Municipal Road Access

Environmental Education

Habitat Enhancement

Linear Developments Associated with Public Utilities

Scientific Research

Trails for Non-Motorized Use

Uses existing on a specific site prior to 3rd reading of Bylaw 09-99

Vegetation Management

4. REGULATIONS

- a. The minimum setback for all yards shall be 15.0 m.
- b. The maximum height of buildings shall be 10.0 m.
- c. Development permit applications shall demonstrate to the satisfaction of the development authority that the proposed development or expansion to existing development will not detract from the quality of the natural values of the area

- surrounding the proposed development or expansion.
- d. Operating and progressive reclamation plans shall be required as part of the development permit application requirement for the surface expansion of any existing quarrying operation.

5.5 Safeguarding Against Riparian Land Hazards

5.5.1 Alberta Flood Damage Reduction Program

The most common use of building development setbacks in Alberta municipalities, as described in Section 5.3.3, is in relation to restrictions on development and buildings in flood risk areas mapped in accordance with the Alberta Flood Damage Reduction Program. In 1989, the Federal government and Alberta Environment initiated the Canada–Alberta Program to reduce the costs of flood damage by discouraging inappropriate building development in the floodplain (<http://environment.alberta.ca/1291.html>).

There are three main components to this program:

1. identify and map flood risk areas in urban areas across the province;
2. increase awareness of flood risk among the general public, industry and government agencies through a public information program; and
3. regulate new development in these flood risk areas using new Federal and Provincial policies.

Flood Risk Areas are mapped based on the categories described in Table 14. Examples of Flood Risk Area maps are provided in Figures 6 and 7. The Alberta Flood Damage Reduction Program was codified in Section 96 of the *Water Act* in 1999. Since 1989, flood risk maps have been prepared for larger communities with a history of flooding.

Table 14 Alberta Flood Damage Reduction Program: Flood Risk Areas

Area	Flood Management Considerations
Flood Risk Area	<ul style="list-style-type: none"> • Area inundated by the 1 in 100 year flood. • Area may be subject to damage from ice movement during the winter months.
Floodway	<ul style="list-style-type: none"> • Inner zone with the greatest risk of personal injury or damage to property. • Deep flood waters (i.e., typically more than 1 m deep) moving with the greatest velocity (typically more than 1 m/s). • New development is not recommended. (exceptions may include some parks and recreational facilities, agricultural land uses, flood control works and municipal infrastructure).
Flood Fringe	<ul style="list-style-type: none"> • Outer zone where lands could be inundated by the 1 in 100 year flood. • Shallower flood waters (i.e., less than 1 m deep) with lower relative velocity (i.e., typically less than 1 m/s). • Less significant potential for damage to human life or property. • New development provided adequate flood-proofing is undertaken.
Overland Flow	<ul style="list-style-type: none"> • Lands abutting the <i>floodway</i> or the <i>flood fringe</i> that would be inundated in the 1 in 100 year flood

(Alberta Environment, 2008)

Figure 6 Illustration of Flood Risk Area, Floodway and Flood Fringe

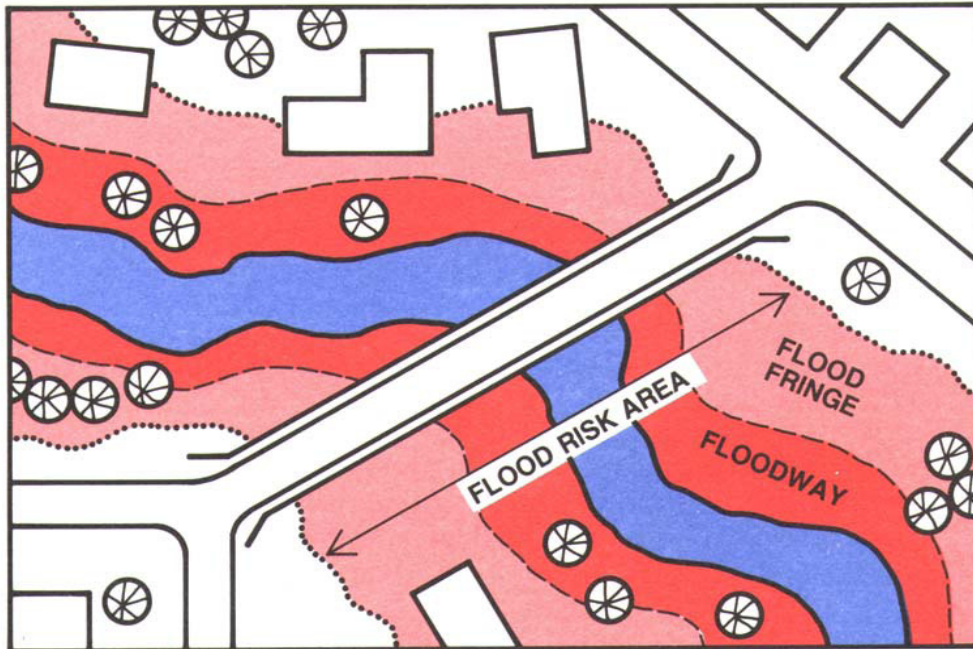
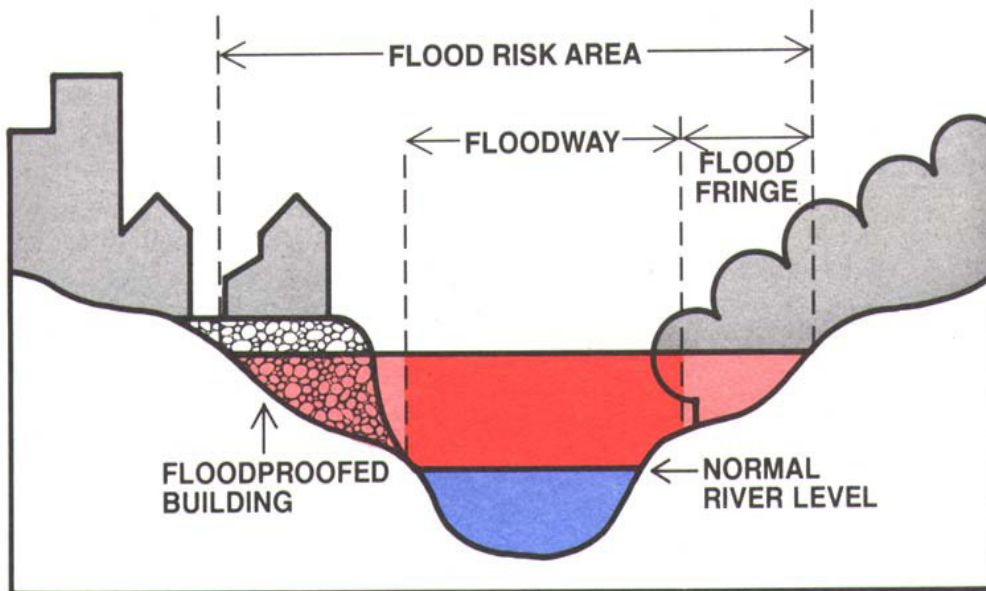


Figure 7 Flood-proofing in Flood Fringe Zone



(Alberta Environment, 2008)

As additional flood risk maps are completed, the provincial government will designate the flood risk area as a zone within which the following policies apply:

1. No new Federal or Provincial government buildings or structures that are vulnerable to flood damage will be placed in the flood risk area.
2. Financial assistance from Federal and Provincial government sources will no longer be available for new buildings or structures placed in the flood risk areas that are subject to flood damage.
3. Any buildings or structures vulnerable to flood damage placed in the flood risk area after designation may not be eligible for flood disaster assistance.
4. The Federal and Provincial governments will encourage the local authorities to adopt land use restrictions to prohibit further development that would be vulnerable to flood damage.

These policies become effective upon the date of designation of the flood risk maps for the study area in question. Any new buildings constructed after designation will be subject to these policies. They will not apply to buildings constructed within the flood fringe that have adequate flood proofing measures.

Flood-proofing measures can be taken to permanently protect individual buildings or other developments from flood damage. Effective flood-proofing measures may include:

- elevated pads or fill to raise buildings.
- elevated electrical panels and shut-off valves for gas and water lines.
- restricted use of developed space below the flood level.

Buildings that already exist in the flood risk area before designation are not affected by these policies.

5.5.2 Municipal Initiatives

Similar regulations and restrictions have been developed to reduce flood risk and associated damages within municipal jurisdictions. Rocky View County's Land Use Bylaw, in Sections 34, 40 and 41, presents development restrictions within and adjacent to water bodies. Similar restrictions are presented in the City of Calgary and Town of Canmore Land Use Bylaws (2004) as well as the Nose Creek Watershed Water Management Plan (Palliser, 2008). Building development setbacks are also recommended by the Bow River Basin Council Legislation and Policy Committee. These regulations and recommendations are presented in Appendix F.

5.5.3 Challenges to Managing Flood Risk

Substantial efforts have been made to reduce the costs of flood damage within federal, provincial and municipal jurisdictions. However, there remain considerable challenges associated with managing and mitigating for flood risk and associated damages.

1. There are inherent limitations to the statistical methods used to determine design (1 in 100 year) flood levels and delineate flood risk zones.

2. The magnitude of the design flood event may vary and be influenced by factors, such as climate change and other developments within the watershed, not necessarily accounted for in hydraulic models.
3. Flood way and flood fringe areas are subject to changes over time affecting the accuracy of Flood Risk Area Mapping (e.g., the Sheep River at Black Diamond has seen significant changes in the last decade).
4. Water courses in Alberta may be subject to flood events more severe than the 1 in 100 year flood.
5. Any development in the flood fringe, flood-proofed or not, may reduce the capacity of the area to attenuate floods, leading to potentially higher peak flows in downstream reaches.
6. In general, there may be limitations to the effectiveness of flood-proofing development methods that are worth consideration.

The uncertainty related to the challenges associated with managing flood risk should be considered when planning land use within and adjacent to riparian lands.

5.6 Appropriate Riparian Land Use

Once protective designations are in place, the management of riparian lands is expected to include certain restrictions to the type and intensity of land uses and activities. Examples of restricted and permitted land uses recommended for riparian lands are presented in Table 15. In these examples, new developments, including new stormwater management infrastructure and facilities are not recommended within riparian lands. As well, impermeable hard surfaces such as roads and pathways are discouraged. In general, motorized off-road vehicle access to riparian lands is restricted and replaced with more passive recreation activities such as walking or bird watching. In these examples, riparian lands are expected to provide opportunities for environmental education, such as interpretive signage installation.

Agricultural activities, such as cattle grazing, are permitted within riparian lands provided certain Best Management Practices are implemented, as described in Appendix G. Overall, human land use and activity that results in the least disturbance to riparian vegetation and landforms is considered appropriate for riparian lands.

Table 15 Examples of Restricted and Permitted Land Use and Activity within Riparian Lands

Land Use	Nose Creek Water Management Plan (2008)	Rocky View Bragg Creek ASP (2007)	Alberta Flood Damage Reduction Program (Unknown)	Town of Cochrane Land Use Bylaw (2004)
Existing Buildings and Structures	√	X (floodway) √ (flood fringe)	√	√
New Development or Buildings and Structures, (hard surfaces)	X	X (new structures) √ (redevelopment of existing)	X (floodway) √ (flood fringe with adequate flood proofing)	√ (with compensation)
Stormwater Management infrastructure	X	X (floodway) √ (flood fringe)	√ (existing, new discretionary)	No stipulated
Roads	√ (existing)	No stipulated	√ (existing, new roads discretionary)	√ (existing)
Agricultural Operations, Livestock Grazing	√ (if best management practices applied)	X (where practical and possible)	√ (existing)	√ (existing)
Recreation	√ (some access restrictions, passive recreation, existing parks and playgrounds, facilities)	X (for motorized off-road vehicles)	√ (existing recreation facilities, new parks discretionary)	√ (existing parks, playgrounds, parking areas, recreation facilities)
Pathways & Trails	√ (existing)	√ (on outer edge)	√ (existing)	√ (existing)
Public Utilities	√	Not stipulated	√ (existing, new discretionary)	Not stipulated
Maintenance and repair	√ (existing)	Not stipulated	Not stipulated	√ (existing)
Public Education (e.g. signage)	√	Not stipulated	Not stipulated	Not stipulated
Damage or Destruction of Vegetation	X	X	X (within 100 m of flood risk area)	X
Resource Extraction	Not stipulated	Not stipulated	Not stipulated	Not stipulated

X = not permitted; √ = permitted or restricted

6.0 STRATEGIES FOR RIPARIAN LAND POLICY IMPLEMENTATION

Rocky View County initiated the Riparian Land Project to protect and, where possible, restore and enhance riparian lands for their inherent value as well as the social and ecological functions they provide. An overview of riparian land considerations applicable to this goal is provided in this Background Report, from a description of riparian land functions and issues to approaches to riparian land conservation and management. The Riparian Land Conservation and Management Policy, presented in Appendix A, provides a planning and regulatory framework for achieving this conservation goal. This Policy supports provincial land use and water resource conservation objectives as identified in the *Alberta Land Use Policy*, the *Framework for Water Management Planning*, and *Water for Life*. Below are recommended strategies for Policy implementation.

6.1 Water Management Plans for Rocky View County Watersheds

The conservation of riparian lands is ultimately dependant on land use management efforts upstream and within the watershed as a whole. Watershed Water Management Plans provide direction for the management of water resources in entire watersheds. Rocky View County is authorized under Section 60 of the MGA to develop such plans in the Municipality. The *Alberta Water Act* provides for water management planning, taking an integrated approach to planning on a “watershed basis”. Watershed Water Management Plans include recommended strategies for source water protection and targets for water quality as well as appropriate stormwater runoff rates and volumes. This watershed approach to developing targets accommodates differences in, for example, stormwater runoff conditions between western and eastern parts of the municipality and would reflect the higher pre-development runoff conditions in the west.

Watershed Water Management Plans that have been, or are in the process of being prepared in Rocky View County include:

- Elbow River Basin Water Management Plan (2008);
- Bow River Watershed Management Plan (2008);
- Approved Water Management Plan for the South Saskatchewan River Basin (Alberta Environment, 2006);
- Nose Creek Water Management Plan (2008);
- Jumpingpound Creek Integrated Watershed Management Plan (Jumpingpound Creek Watershed Partnership, *in progress*); and
- Three Creeks Watershed Plan Initiative (for Horse Creek, Jumpingpound Creek and Big Hill Creek) (Town of Cochrane, *in progress*).

Rocky View County may wish to pursue the development of Watershed Water Management Plans in any remaining areas not covered by these projects.

Overall, these Watershed Water Management Plans provide a meaningful framework for the implementation of sustainable land use practices that are sensitive to water resources, including riparian lands. Such land use practices include integrated stormwater management and the use of Low Impact Development techniques, (see Appendix G) both of which would be required to meet specified water management targets.

Sensitive land use practices would include the treatment of runoff from all new developments

before release into watercourses and associated riparian zones. Recommendations for Best Management Practices specific to certain land uses may be included in Watershed Water Management Plans in Rocky View County.

Watershed Water Management Plans also provide a basis from which to evaluate and mitigate against the cumulative environmental effects of land use on Rocky View County watersheds. They also provide for community engagement and the development of a shared interest and involvement in water resource management. Building on this community stewardship will provide a strong base of support for Riparian Land Policy implementation in Rocky View County.

6.2 Rocky View County Open Space/Green Space Plan

It is recommended that Rocky View County develop a Green Space or Open Space Plan to support the protection of significant natural landscape features within the municipality, including riparian lands. Objectives for the Rocky View County Green Space/Open Space Plan would be to protect significant natural landscape features representing the natural ecosystems of Rocky View while also promoting a connected open space system of watercourses and waterbodies supporting water quality in areas of future growth. The Rocky View County Green Space/Open Space Plan may include:

- maps of open space policy areas, including environmentally significant landscape features;
- policies for permitted and discretionary land uses within different categories of open space,
- requirements for conducting Environmental Assessments (EA) to determine the potential impacts of developments on identified open spaces; and
- strategies for Open Space Plan implementation.

To achieve identified open space objectives, the location and distribution of significant natural landscape features will need to be inventoried and mapped. As indicated previously (see Section 5.1.7), these features are expected to include riparian lands and should be formally identified through consultation with Alberta Environment. Existing spatial data may be used to prepare such a baseline inventory and evaluate the current status of significant natural features and riparian lands within the municipality. Such mapping may be prepared at a scale that is meaningful and compatible with management recommendations outlined in Rocky View County Watershed Water Management Plans.

Map products prepared by the Calgary Regional Partnership (CRP) in support of their Regional Land Use Plan may be applicable to this inventory. Planning principles of the CRP emphasize the importance of facilitating open space linkages and linear corridors for water courses but also for wildlife movement. CRP map products may also provide a basis for the delineation of wildlife movement corridors within Rocky View County. Criteria would need to be developed to effectively determine the configuration of wildlife corridors required to facilitate the movements of specified wildlife species of management concern within the municipality. These criteria may also be developed in consultation with Alberta Environment.

Rocky View County may also prepare their own maps of significant natural landscape features, (including riparian lands and wildlife corridors). Riparian lands, in particular, may be mapped as described in Section 5.1.2 based on biophysical features that include fluvial landform features, (floodplain extent), the distribution of riparian soils, and the extent of riparian vegetation. As with the Nose Creek Watershed Water Management Plan, riparian lands may be mapped with

the use of available hydrologic modelling data from Alberta Environment of the 1:100 year floodplain extent. These data may need to be updated with additional modelling and field work to reflect any changes in channel configuration or morphology since this digital data was prepared. Alluvial aquifer mapping may also be prepared using existing surficial geology data from the Alberta Geological Survey and elevation information provided by ASRD.

6.3 No Net Loss Approach to Riparian Land Management

Once open space inventories are prepared, Rocky View County should develop a vision for riparian land management to suit the environmental directives of the Municipality. As indicated previous, the concept of “No Net Loss” is one that may be applied in Rocky View to meet the broad riparian project goals of protection, rehabilitation, restoration, enhancement and prevention or further damage of riparian lands. The concept implies that the total inventory of riparian lands remains in a “stable” state through mitigation: a process that is expected to reduce land loss by avoiding and/or minimizing impacts, or requiring appropriate compensation for impacts to riparian lands that cannot be avoided or minimized.

It is recommended that Rocky View County consider the development of a strategy of Riparian Land Protection that applies a No Net Loss approach. To initiate this approach, it is recommended that Rocky View work with the Province, neighbouring jurisdictions and relevant Watershed Stewardship Groups to ensure that all potential negative impacts of land use and development be managed through: A. avoiding impacts on riparian land, B. minimizing these impacts, and C. compensating for these impacts through riparian land restoration.

A. Avoid impacts

Efforts should be made to avoid any negative impacts of land use and development on riparian lands. The conservation and maintenance of riparian lands should, wherever possible, be integrated into existing and proposed land use activities, from agricultural practices to more urban-type development.

B. Minimizing impacts

Efforts to minimize the negative impacts of land use on riparian lands may include:

1. limiting disturbance to native riparian vegetation and restoring disturbed riparian lands;
2. preventing stormwater runoff, from construction and operation, from entering into riparian lands;
3. adhering to ecologically sound building development setbacks that prevent loss and minimize disturbance of riparian land functions; and
4. diverting roadways and utility corridors away from riparian lands wherever possible. If this is not possible, roadways and utilities may utilize the same access corridor and take the shortest route possible through riparian lands. The shoulders of corridors may include roadway protective berms to provide “dryland travel routes” and loafing sites away from roadways. Oversized culverts or bridges may also be installed in order to permit wildlife to travel from one reach to the other without having to cross over roadways.

To implement the No Net Loss approach, Rocky View County may require that development plans identify any negative effects associated with their projects, provide a rationale for carrying out these impacts if deemed unavoidable, and demonstrate how these impacts will be mitigated.

It is anticipated that Best Management Practices be prescribed and implemented for all land use practices taking place adjacent to riparian lands. These practices would apply in all phases of land development from construction to operation.

C. Restoration and Compensation

Compensation involves the replacement of damaged riparian lands with newly created riparian land and/or restored or enhanced lands. Compensation would only be considered when all other options (i.e., avoid and minimize) have been exhausted.

Depending on the severity of the disturbance, compensation may be achieved through:

- replacement of riparian land at or near the site;
- enhancement or improvement of existing riparian land near the site or away from the site; on the same watercourse; and
- maintenance or restoration of hydraulic connectivity between channel reaches.

Wherever feasible or required by provincial policy or legislation, restoration and compensation should be completed in accordance with provincial wetland policy and the Provincial Wetland Restoration/Compensation Guide (Alberta Environment, 2007b).

As adapted from the Nose Creek Watershed Water Management Plan (Palliser, 2008), the following considerations would apply with the implementation of a No Net Loss program.

- Effort should be made to partner with the province and Watershed Stewardship Groups to restore the ecological function of Rocky View County's riparian lands.
- Restoration projects should be properly designed to allow for the natural fluvial landform processes. Wherever possible, innovative bioengineering options should be employed to restore streambanks and reduce or prevent erosion.
- Priority sites that should be considered for restoration include:
 - areas that pose a safety hazard to the public due to accelerated erosion;
 - areas where the hydraulic connectivity, that allows interaction of water between the stream and abandoned channel reaches, have been disconnected; and
 - areas impacted by improper management of grazing lands.
- Where ever possible, reaches of Rocky View County's streams that have been channelized should be improved through the restoration of hydraulic connections.

6.4 Riparian Land Zone Management System

Once riparian land inventories are prepared and the distribution of such lands is determined, the conservation of riparian lands requires more local evaluation of riparian land configuration and extent. As well, management measures should be identified to mitigate the potential adverse effects of land use and development within or adjacent to these lands.

It is recommended that Rocky View County apply a three-zone system to riparian lands within the municipality, as proposed in Table 16. Each zone will accommodate a different ecological function of riparian land and have a different width, vegetation target, and management scheme.

As a starting point, it is recommended that the extent of all three-zones be a minimum of 30 m in width for all waterbodies. This 30 m minimum width is reflective of the riparian land extent

necessary for the provision of riparian habitat, as presented in Fischer and Fischenich (2000). This minimum 30 m is also supported by McElfish et al. (2008), who identify 30m as the average riparian buffer width required to prevent pollution of water bodies by contaminants. This distance increases depending on soils, vegetation, slope and whether the landscape is undergoing development (McElfish et. al., 2008). The 30 m width is at the higher end of the range of mean buffer widths identified for waterbodies in Canada and the Unites States, as described by Lee et al. (2003). A minimum 30 m set back distance from top of bank is identified by Alpine Environmental, (2004) to ensure adequate protection of riparian lands associated with all streams and tributaries in Greater Bragg Creek, excluding the Elbow River, which was allocated a minimum 50 m buffer. This minimum setback was determined based on extensive review of the literature. The City of Calgary (2006) also applies a fixed width base setback of 30 m to certain water bodies.

It is anticipated that Rocky View County apply this minimum 30 m riparian land management zone width to all waterbodies within the municipality including smaller more intermittent water courses. Scientific investigations are suggesting that smaller tributaries need equivalent setback widths to larger water course in order to protect water quality and quantity. In a report prepared by Brown and Caldwell (2009) protection of these smaller streams was identified as particularly important as soil disturbance and destruction of the vegetation around smaller streams can have a significant cumulative impact on the water quality of larger downstream waterbodies. Bradley (1997) maintains that smaller streams are a critically important part of a watershed, and that protection of small creeks is required in order to protect stream structure in upland areas, thereby protecting water resources, aquatic habitat and fisheries resources in downstream reaches.

Table 16 Proposed Rocky View County Riparian Land Management Zones

Parameter	Riparian Land Management Zone		
	One: Adjacent Zone	Two: Biodiversity Zone	Three: Maintenance Zone
	Minimum base width of 30 m		
Location	The inner edge of riparian land located directly adjacent to the water course or waterbody, including the bank and adjacent aquatic habitat.	The middle core of riparian land separating the bank from adjacent uplands.	The outer edge of uplands adjacent to the riparian lands.
Function	Intended to maintain the integrity of the banks and adjacent aquatic habitat of the aquatic ecosystem. Functions include water buffering, water temperature regulation, flood attenuation, bank stabilization, groundwater recharge and discharge, sustained water supply.	Represents the biophysical extent of riparian lands based on fluvial landforms, riparian soils and riparian vegetation. Provides vegetation and wildlife habitat to support riparian land biodiversity. Supports riparian land functions provided in Zone One.	A vegetated buffer strip meant to protect riparian lands against encroachment from development. Provides for filtering of surface runoff, setbacks in response to wildlife sensory disturbance and slope stability issues, and access for maintenance of riparian lands.

Once a minimum 30 m setback is implemented, the widths of Zones 1, 2 and 3 are subject to expansion based on the biophysical characteristics and functions of Zones 1 and 2. Zone 1 is the Adjacent Zone and functions primarily to maintain the integrity of the banks, to buffer water quality, attenuate floods, sustain water supply and provide aquatic habitat. The width of this zone may be fixed based on widths used in other jurisdictions or it may be determined, for example, using the Riparian Matrix Setback Model described in Section 5.4.4. Zone 2 is the Biodiversity Zone and is identified primarily for providing habitat for vegetation and wildlife associated with riparian lands. This Zone should be delineated to reflect the full biophysical extent of the riparian land. This extent may be measured using an approach similar to that applied for the Nose Creek Watershed Water Management Plan (2008) which considers the farthest reaching boundary of:

1. the 1 in 100 year floodplain (based on existing Alberta Environment data or revised information from modelling and field assessment);
2. the geographic extent of the floodplain (as determined through field evaluation of fluvial geomorphology);
3. the extent of riparian soils (with reference to available geologic mapping); and/or

4. the extent of riparian vegetation communities (determined through aerial photograph interpretation or field inventories).

Management of Zone 2 should focus on maintaining biodiversity and, specifically, the integrity of wildlife and vegetation habitat. It should accommodate the protection of wildlife and vegetation of special concern such as rare plants, rare plant communities, migratory birds, species with provincial conservation status, or federally listed Species-at-Risk.

Zone 3, the Maintenance Zone, is the upland vegetation buffer applied to protect the riparian lands represented in Zones 1 and 2. The extent of this buffer will be influenced by the following factors:

- the distance required to provide effective nesting habitat for sensitive wildlife species known to, or expected to, occur within Zone 1 and 2;
- recommended building setback distances for species of special management concern as described by ASRD (Section 5.4.5);
- setbacks to accommodate wildlife movement;
- setbacks to protect against slope instability; and/or
- additional requirements for water quality buffering.

The Maintenance Zone will need to be wide enough to accommodate any equipment required for carrying-out maintenance of riparian lands.

A hierarchy of management strategies specific to each riparian land zone may then be applied to reflect different conservation objectives. These management strategies would focus primarily on the types and intensity of permitted land uses within each riparian land zone. Table 17 provides some suggested permitted and restricted land uses for riparian lands in Rocky View County. They include restrictions to existing and new buildings. Building development in Zone 2, which generally represents the flood fringe as per the Provincial Flood Risk Reduction program, is discouraged. However, there may be some situations where additional flood-proofing measures may be implemented to allow for development in this zone. For example, if development is allowed in flood fringe areas, the first floor of all buildings could be constructed at a minimum of 1.0 m above the design flood level and 0.3 m above the highest grade existing on the street abutting the parcel that contains the building, whichever is higher. In addition, all electrical and mechanical equipment within a building could be located at or above the first floor of the building. No human occupation would be allowed in developed building space below grade. In the case of redevelopment, major alterations, and other changes to existing structures located within flood risk areas, the development shall be flood-proofed to the design flood level plus a 1.0 m freeboard.

Table 17 Proposed Restricted and Permitted Land Uses

Land Use	Riparian Land Zones		
	One: Adjacent Zone	Two: Biodiversity Zone	Three: Maintenance Zone
Existing Buildings and Structures	X (discretionary)	√ (discretionary)	√
New Developments or Buildings and Structures	X	X (not recommended even with flood-proofing)	√ (discretionary with flood-proofing)
Stormwater Management Infrastructure	X	X	√ (discretionary)
Roads	√ (existing, consider mitigation) X (new) discouraged	√ (existing, consider mitigation) X (new) discouraged	√ (consider mitigation)
Livestock Grazing and Cultivation	√ (discretionary livestock grazing using BMPs, emphasis on fencing and offsite watering)	√ (livestock grazing and using BMPs)	√ (livestock grazing, cultivation, using BMPs)
Recreation	√ (Passive, no ATVs, restrictions to hard surface trails, no buildings. Will depend on wildlife sensitivities)	√ (Passive, restrictions to hard surface trails, no buildings. Will depend on wildlife sensitivities)	√ (recreation including hard trails. Will depend on wildlife sensitivities) X (no ATVs)
Pathways and Trails	√ (existing with mitigation to reduce impacts)	√ (existing with mitigation to reduce impacts)	√ (with mitigation to reduce impacts)
Public Utilities	√(discretionary)	√	√
Maintenance /Repair	√ (discretionary with mitigations)	√ (discretionary with mitigations)	√ (discretionary with mitigations)
Public Education	√	√	√
Damage of Vegetation	X	X	√ (temporary with mitigations)
Resource Extraction	X	X	X

X = not permitted; √ = permitted or restricted

Restrictions are also recommended for the development of stormwater management infrastructure within riparian lands. Stormwater is expected to be better managed by reducing runoff volumes upstream and by retaining riparian lands in their natural state. Impermeable hard surfaces such as roads and pathways are discouraged within riparian lands. In general, motorized off-road vehicle access to riparian lands is restricted and replaced with more passive recreation activities such as walking or bird watching. Agricultural activities, such as cattle grazing, are permitted within riparian lands provided certain Best Management Practices are implemented, as described in Appendix G.

Overall, human land use and activity that results in the least disturbance to riparian vegetation and landforms is considered appropriate for riparian lands. Certain spatial or temporal restrictions to human access to Zone 1, 2 and 3 may apply if these areas are identified as important habitat for species of special management concern. In the case of resource extraction industries, it is recommended that any activity, such as gravel excavation, peat and soil extraction and/or timber harvest, which may cause significant damage to riparian vegetation, should be restricted.

6.5 Apply Existing Municipal Policies and Tools

The Rocky View Riparian Land Conservation and Management Policy may be implemented using a range of existing municipal policy, planning and regulatory tools. It is recommended that Rocky View County pursue the following initiatives:

- Amend all statutory planning documents to reflect Policy statements.
- In accordance with the Policy, amend the Land Use Bylaw to incorporate prohibitions, regulations and controls on land use within riparian lands.
- Amend the Land Use Bylaw to add Natural Land Use Districts and Direct Control Districts.
- Create incidental bylaws under Section 7 of the MGA to regulate and control activities that may negatively impact riparian lands owned privately.
- Amend the Land Use Bylaw and/or other relevant statutory documents to facilitate the use of various municipal tools, such as building development setbacks, Environmental Reserve Setbacks and Easements, overlay zoning, development permits, and the subdivision process to implement the three-zone riparian land management system and protect riparian lands.

The Riparian Land Conservation and Management Policy may be reflected in all of Rocky View County's statutory planning documents, including the Inter-municipal Development Plan, the Municipal Development Plan and Area Structure Plans and Area Redevelopment Plans. As these plans are reviewed and amended Rocky View County should include important Riparian Policy statements and recommended procedures, to provide guidance to Administration on how the Riparian Policy is to be interpreted and implemented within those developing areas. Planning and Operations Administration will need to create operations and procedural manuals to support Riparian Policy implementation.

These manuals and “codes” of practice will ensure that all employees in Rocky View County are aware of the policy and how it is to be implemented, and how approvals for new technology and innovations are to be applied for, deliberated and determined.

6.5.1 Amendments to the Land Use Bylaw

Rocky View County has some provisions in the current Land Use Bylaw to regulate development and buildings within the floodplain of a number of identified river valleys and stream corridors. However, the current provisions are intended to prevent hazards, and are not enacted to protect riparian lands for their ecological and social functions. The Land Use Bylaw may be amended to reflect prohibitions or regulations and controls on land use, both by private landowners who own and use large tracts of land for agricultural operations, and for private landowners who are bringing forward applications for subdivision and development approvals.

Historical existing land uses are always “grandfathered” but if a person wants to change land uses, then new provisions may apply. Some common uses of riparian lands are highly regulated by the Province, such as septic systems, water wells and waste disposal. The Land Use Bylaw must provide riparian land conservation and management regulations that are consistent with existing provincial laws and regulations. Rocky View County is able to enhance that regulatory regime to ensure that uses such as installation of water wells and septic systems are regulated within riparian lands in the municipality.

A good example of how to use riparian land conservation and management regulations appears in the Town of Cochrane’s Land Use Bylaw, Section 11 and reads as follows:

11.4 DEVELOPMENT OF RIPARIAN LANDS

a. Restrictions on Use:

Only the uses listed below may be allowed:

- i. existing uses, buildings, and structures;
- ii. existing extensive agriculture;
- iii. existing parks;
- iv. existing playgrounds;
- v. natural areas;
- vi. existing parking areas (limited to surface parking associated with recreational facilities, parks, or playgrounds);
- vii. existing recreational facilities (outdoor);
- viii. public and quasi-public installations and facilities;
- ix. roads and pathways;

b. Except for renovations and maintenance to buildings and structures listed in Section 11.12.4(a), no development shall be permitted in riparian lands;

c. If development occurs in riparian lands in accordance with

Section 11.12.4(a), the developer shall construct an equivalent riparian facility to replace the riparian land that was destroyed through development.

In Cochrane, as soon as the inventory of riparian lands and the delineation of riparian zones are completed, all new development in riparian lands will be regulated and controlled in accordance with these riparian lands land use regulations. Rocky View County could include such provisions in its Land Use Bylaw, once a riparian land inventory is completed. To facilitate Riparian Policy implementation, the Land Use Bylaw should also be amended to include intermittent and perennial streams under the definition of “water courses”.

6.5.2 Natural and Direct Control Land Use Districts

Rocky View County’s Land Use Bylaw may be amended to include a Natural Area Land Use District, within which permitted and discretionary uses may be better regulated and controlled by Rocky View, whether those lands are privately owned or owned by the municipality. Direct Control Land Use Districts may also be implemented by Rocky View to exercise particular control over the use and development of riparian land.

6.5.3 Incidental Bylaws

In Part 2 of the MGA, Section 7 the Province has delegated municipalities the authority and general jurisdiction to pass bylaws for municipal purposes. Rocky View County could use its general jurisdiction to pass a number of bylaws to prohibit or regulate and control a number of behaviours and activities on private lands that can negatively impact riparian lands and adjacent watercourses and water bodies. Bylaws under Section 7 are often enacted to address a specific community concern, and usually apply to all lands within the municipality; however, Rocky View could use Section 7 bylaws to address issues of particular concern raised locally within communities. Section 7 bylaws could include, for example:

- regulation of pesticide application on private lands for cosmetic purposes;
- restrictions on planting of invasive and ornamental species on private lands, and private lands that abut municipal lands;
- restrictions on unauthorized users; regulate and control access to Reserve Lands, especially Environmental Reserves;
- regulations and controls on the use of ATVs in riparian lands; and
- regulations of nuisances and littering to control obvious nuisance activities and littering behaviours on private and public lands that abut riparian lands.

6.6 Riparian Land Maintenance and Monitoring

Once efforts are made to protect riparian lands, their integrity should be maintained and, when needed, restored. Two factors influencing riparian land maintenance efforts are:

- the type and extent of maintenance activities; and
- the subsequent funding necessary to carry out these activities effectively and efficiently.

Examples of maintenance needs for riparian lands include:

- inspection and repair of any engineered structural works, for example, pathways and bridges;
- clean-up of garbage and debris;
- weed management; and

- fire-fighting activities.

Care should be taken to ensure the space needed to effectively carry-out these maintenance activities is provided within Zone 3; the Maintenance Zone for riparian lands. This zone may need to be sufficiently wide to facilitate the movement of maintenance equipment. It is crucial that Rocky View County establish a long-term maintenance funding mechanism.

Funding could come from the parks and open space budgets or stormwater budgets reflecting the stormwater conveyance function of riparian lands. Lack of maintenance due to funding constraints may endanger the long-term health and integrity of Rocky View riparian lands. An overarching goal of Rocky View's Riparian Project is to, where possible, rehabilitate, restore and enhance riparian lands and their functions. An approach to achieving this goal is as follows:

Build Partnerships

A key first step in the restoration of riparian lands would be the initiation of working partnerships with the Province, other municipal jurisdictions, and interest groups such as Watershed Stewardship Groups.

Riparian Land Inventory

Inventories described in 5.1 would provide an assessment of baseline conditions with respect to the distribution and extent of riparian lands within Rocky View County.

Riparian Land Status

Once riparian land inventories are completed, the status of riparian lands may be evaluated to determine the level of effort requirement for rehabilitation.

Phased Restoration

A phased approach may be implemented to address areas where there is a relatively more urgent need for riparian land restoration. Prioritization may be completed with reference to identified management objectives for restoring riparian land functions: maintaining water quality, conserving water supply, reducing flood risk, maintaining biodiversity, and/or providing social and economic benefits.

Priority sites may include: areas that pose a safety hazard or areas where hydraulic connections have been severed (Palliser, 2008).

Health Assessments

Detailed Health Assessments, as described in Section 5.1.4 may be prepared to assist in the prioritization of restoration projects.

Restoration Tools

A Riparian Land Restoration Plan may be developed that identifies specific tools for restoration including land use restrictions or on-site bioengineering techniques to restore stream banks. Measures that enhance the ecological functions of riparian lands may also be presented in the Plan, for example wildlife habitat enhancement projects.

Experts in the field of riparian land restoration, for example the Alberta Cows and Fish Program, should be consulted to determine the most appropriate tools for achieving restoration and enhancement of riparian lands.

To determine if the desired outcomes of the Riparian Land Conservation and Management Policy are being achieved, a monitoring and reporting program is recommended. Such a program may include:

- long-term flow monitoring in Rocky View County watersheds;
- Installation of reference sites to monitor erosion and stream bank stability using, for example, surveyed cross-sections or longitudinal profiles;
- benchmark photography to allow periodic visual assessments of changes to the watercourses;
- water quality monitoring of representative streams (including dissolved oxygen and temperature, pathogens, pesticides and herbicide, metals and sediments); and
- long-term fisheries, invertebrates and other biodiversity and habitat indicator monitoring (Westhoff, 2005)

Consultation with Alberta Environment and the Bow River Basin Council is recommended to establish appropriate performance indicators for monitoring.

6.7 Targeted Education and Outreach Initiatives

Promoting public education and building community awareness are key elements in the successful implementation of riparian land conservation initiatives. As outlined by the Alberta Cows and Fish Program (Fitch et al., 2003a), public education allows communities to develop an understanding of what riparian lands are and how riparian lands function as well as provide a different perspective on how riparian lands fit within the landscapes people live in. Education also provides an opportunity to introduce different ways of thinking about land use and how to manage human developments and activities to reduce or even eliminate impacts on riparian land health.

It is recommended that Rocky View County look to existing programs, such as Cows and Fish, for opportunities to collaborate and create a public awareness program for Rocky View that promotes and supports riparian land conservation. Various education tools may be applied to achieve the desired outcome of Riparian Policy implementation. Rocky View County may provide its residents with information on various incentive programs, such as the National Farm Planning Initiative, to encourage sustainable land use practices sensitive to riparian lands. Education programs may be targeted to specific land users within the community.

6.8 Riparian Land Conservation and Management Plan

Strategies presented in this Background Report provide an initial framework for Rocky View County Riparian Policy implementation. They reflect the broad range of approaches to riparian land conservation and management. A range of riparian land conservation and management tools are described that will assist in the successful application of the Policy as development occurs, both from a planning and an operational perspective. These strategies were provided as a basis from which to develop a formal plan for Policy implementation. A Riparian Land Conservation and Management Plan is recommended to aid Rocky View in Policy implementation through the identification of Rocky View-preferred tools, action items, and schedules for implementation. The Plan would also identify ways to develop working partnerships with the Province, other municipal jurisdictions, and interest groups, such as Watershed Stewardship Groups that may work together to support Rocky View's Riparian Land conservation initiative.

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