RIPARIAN PROTECTION

A riparian area is the transition zone between aquatic and terrestrial ecosystems, where the presence of water supports the growth of water-tolerant vegetation and soils are modified due to temporary or permanent inundation. Typically, riparian areas are identified as the zones adjacent to a creek, stream, river, lake or wetland. Ephemeral streams, those that only flow after a rain event or snowmelt and have no base flow (i.e. groundwater) component, may also be considered riparian if they consist of modified soils and water-tolerant vegetation.

As transition zones between the terrestrial and aquatic environment, riparian areas have a variety of functions that are important to maintaining the integrity of Nose Creek and West Nose Creek. Riparian areas are known to protect water quality by slowing the flow of water to facilitate the trapping of sediment (Cooper et al. 1987), nutrients (Gilliam 1994; Vought et al. 1994; Daniels and Gilliam 1996) and bacteria in soils and vegetation. Riparian vegetation is also a key component of streambank stability, as deep binding root mass holds soil together. The impact of stormwater runoff is also lessened by healthy riparian areas as flood water is absorbed in soils and released slowly throughout the remainder of the year. Overhanging riparian vegetation can moderate water temperature, making the creek more suitable for higher species of aquatic life. Finally, the riparian corridor maintains habitat diversity and allows for improved wildlife species distribution and diversity (Castelle et al. 1994). Generally, riparian areas are a small fraction of the landscape, comprising less than 2% of land area; their role, however, is essential to preserving the health of the Nose Creek Watershed.

Many key riparian components along Nose Creek and West Nose Creek are altered or missing which contributes to poor riparian health. The Alberta Riparian Habitat Management Society (Cows and Fish) conducted a riparian health assessment in 2000 along 17.3 km of Nose Creek and 10.7 km of West Nose Creek (Cows and Fish 2001). Figure 4.4 summarizes the results of the study which indicates that riparian areas in West Nose Creek are in better condition than in Nose Creek.

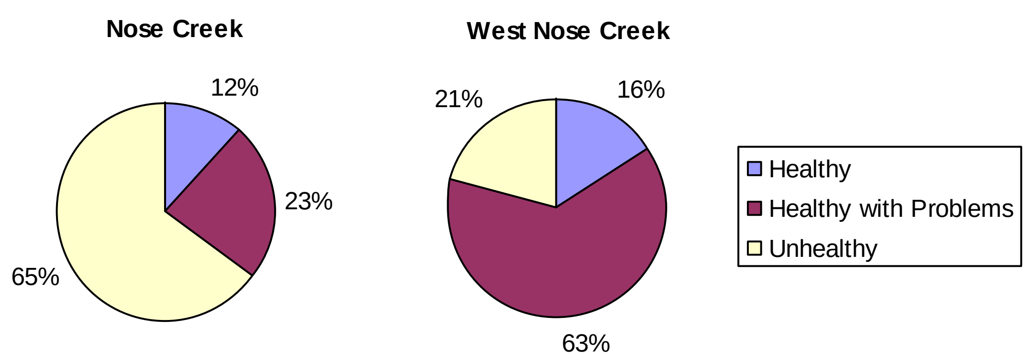

Figure 4.4. Results of the riparian health assessment (Cows and Fish 2001).

Nose Creek and West Nose Creek streambanks consist mostly of silt, clay and sand that are highly susceptible to erosion and deep binding root systems of sedge and shrub communities are important to maintain bank stability (Cows and Fish 2001). In low flow years, trenching caused by channelization, prevents water from accessing the floodplain. In high flow years, extreme bank erosion has resulted due to the lack of deep binding root mass in some areas. In the reaches studied along Nose Creek, the dominant shrub community sandbar willow (Salix exigua), occupied only 10% of the study area. Along West Nose Creek, there was a good diversity of willow communities, many of which were heavily utilized remnants occurring in isolated areas like oxbows. These communities could be healthier by adding longer periods of rest from grazing during the growing season.

The prevalence of invasive plants (noxious weeds) is a concern in Nose Creek and West Nose Creek. About 27% of the Nose Creek study area and 34% of West Nose Creek study area consisted of Canada thistle. Disturbed soil due to overgrazing and/or industrial, residential or recreation developments promotes the growth of noxious weeds. Disturbance-caused plants may also be introduced by reclamation re-seeding using seed mixes that are comprised of non-native grasses (Cows and Fish 2001).

Functionally, riparian areas are important for flood protection in the Nose Creek watershed. Channelization of Nose Creek and West Nose Creek has increased the velocity at which water drains from the headwaters to the Bow River. Increased velocity should be dissipated to floodplains to slow the flow of water and prevent streambank erosion. Without this area, flood damage to infrastructure increases, along with associated costs to repair damage.

Riparian areas in the Nose Creek watershed also hold important parts of our cultural heritage in the form of buffalo jumps, ancient campsites and traditional use areas. A comprehensive inventory of heritage sites within the mainstem of Nose Creek and West Nose Creek has not been completed. The main area that has been studied lie within the City of Calgary limits or areas just beyond (i.e. Balzac). Within this area, about 100-150 pre-contact and historic period sites have been recorded. Sites include single cairns possibly used as trail markers, small temporary encampments and stone circle sites, and larger bison kill and processing sites. Historic sites in the area include sandstone quarry locations found along West Nose Creek and various early homesteads. Portions of the watershed that lie further upstream away from the larger centres of population have never received the same level of inspection, but several important sites have been reported in these areas including the Bison Jump at Madden, and a Bison Jump on West Nose Creek. Some of these sites are seen as regionally important and have been designated as Provincially Significant Historical Resources. The age of these sites varies widely from 8000 years ago to less than 100 years ago. The loss of these sites occurs simultaneously with the loss of riparian areas (B. Vivian, Lifeways of Canada Limited, Pers. Comm.)

The Nose Creek watershed stakeholders identified the desire to improve on current practices to help protect riparian areas. They agreed on the need for riparian setbacks and consistent legislation, but also acknowledged that the goals for riparian protection must be well-defined and restrictions placed on land-use must be practical (Appendix B). The setbacks must be science-based and consider the functionality of the ecosystem in an urban environment. While legal tools are not always the most preferred method of protection, they can be the most effective.

Riparian Setback Overview

Riparian function can be protected by implementing setbacks or buffer strips. Buffer strips are vegetated zones located between natural resources and adjacent areas subject to human alteration (Castelle et al. 1994). The width of a buffer strip required to adequately protect riparian areas is determined by identifying the functional value of the riparian area in terms of the benefits it provides under site-specific conditions. Generally, smaller buffers are suitable where the existing buffer is in good condition (i.e. dense native vegetation with undisturbed soils) or the adjacent land use is low impact (i.e. park land having native vegetative cover). Larger buffers are required for high value wetlands and streams that are buffered from intense adjacent land uses (Castelle et al. 1994). Nose Creek and West Nose Creek are diverse and contain areas where large buffers or setbacks are required and also areas where smaller width setbacks would suffice. The intent of a buffer program is to modify location of development in relation to the creek but not the overall intensity.

Buffer setbacks can either be fixed-width or variable-width. Most land managers prefer fixed-width buffers since they are more easily enforced and are predictable (Table 4.2). However, fixed-width buffers do not consider site-specific conditions. A review of the literature demonstrates that buffer strip width varies by region and the desired environmental function. For water quality protection, buffer

widths ranged from 5 m (Madison et al. 1992) to greater than 30 m (Lynch et al. 1985). Table 4.3 summarizes some of the widths that have been adopted by other regions that would protect specific functional values identified by stakeholders during the Nose Creek Watershed Partnership Public Open Houses. Schueler (1995), reviewed 36 urban stream buffer programs, and found that buffers ranged from 6 m to 61 m (20 to 200 ft) in width from each side of the stream, with a median of 30 m (100 ft). In general, a minimum base width of at least 30 m (100 feet) has been recommended to provide adequate stream protection.

The Federal Interagency Stream Restoration Working Group (1998) recommended a three-zone buffer system that has three lateral zones: stream side, middle core, and outer zone. Each zone performs a different function, and has a different width, vegetative target and management scheme. The stream side zone protects the physical and ecological integrity of the creek ecosystem. The vegetative target is a riparian grass, shrub and tree community that reflects the natural, native vegetative community. 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-yr floodplain, adjacent steep slopes, protected wetland areas, and heritage value. Its key function is to provide further distance between upland development and the stream. The vegetative target is also native grass, shrub and tree community but some clearing may be allowed for access and recreational use (i.e., pathways). The outer zone is the buffer's buffer, an additional 7.6 m (25 ft) setback from the outward edge of the middle zone to the nearest permanent structure. In most instances it is a residential backyard and the vegetative target is usually turf or lawn. Very few uses, except permanent structures, are restricted in this zone.

Table 4.2. Comparison of fixed-width and variable width buffers as tools for land managers.

Type of Buffer	Advantages	Disadvantages
Fixed-Width	• More easily enforced • Do not require regulatory personnel with specialized knowledge of ecological principles • Allow for greater regulatory predictability • Require smaller expenditures of both time and money to administer	• Do not consider site-specific conditions, and therefore may not be adequately buffer aquatic resources
Variable-Width	• Based on a combination of buffer sizing criteria (i.e. functional value and adjacent land use intensity) • Adjusted accordingly to adequately protect valuable resources	• Require a greater expenditure of resources and a higher level of training for agency staff • Less predictable for land use planning

While fixed-width buffers are common, variable width setbacks are more appropriate for Nose Creek and West Nose Creek as adjacent land use ranges from relatively pristine areas to highly developed, urban centers. Furthermore, the erosion potential of the West Nose Creek streambanks is considerable, consisting of young soil deposits, compared to those of Nose Creek. The portions of West Nose Creek which lie above a point located between Centre St. and Harvest Hills Boulevard appear to have been extensively reworked and re-deposited over the last 4000 to 5000 years. Hence the terraces are all relatively low and the unconsolidated sediments, typical of this area, are more susceptible to on-going erosion events. Comparatively, testing along Nose Creek (portions between the City and Balzac) indicate the stream is deeply incised within the current bed and the sediments appear to have been reworked little over the last 7000 to 8000 years (B. Vivian, Lifeways of Canada Limited, Pers. Comm.). Water flows are actively carving new channels, particularly on West Nose Creek, and a larger buffer area that includes the delineation of the meander belt will be required to allow for natural channel migration.

A combination of site-specific variable widths and fixed-widths are required to adequately protect the Nose Creek watershed.

Table 4.3. Summary of buffer setback widths reported in the literature required to maintain riparian functional values. A priority rating for protection of the various functional values are provided for Nose Creek and West Nose Creek.

Functional Value	Priority Rating (High, Medium and Low)		Buffer Setback Width	References
	Nose Creek	West Nose Creek		
Sediment removal & erosion control	High	High	≥ 9 m	Ghaffarzadeh et al. 1992 in Alpine Environmental 2005
			≥ 30 m	Lynch et al.1985 in Alpine Environmental 2005
			≥ 61 m	Horner and Mar 1982 in Alpine Environmental 2005
			30 m	Lee and Smyth 2003
Water quality (protection from surface runoff)	High	High	30 m minimum	AAFRD 2001
			< 4% slope - > 30 m 4-6% - > 60 m 6-12% - > 90 m > 12% - no manure application	Agricultural Operations Practices Act (AOPA) 2004
			10 m minimum	County of Peterborough, Ontario
			30 m	U.S. Surface Mining Act
Meander Belt Protection	Medium	High	20 x the bank full width of the unconfined stream channel	Toronto and Region Conservation Authority 2004
			4.3 – 20.3 the bank full width of the stream channel	Parish Geomorphic 2004
Moderation of stormwater runoff (flood protection)	High	High	Site-specific widths according to Nose Creek and West Nose Creek floodplain mapping.	Alberta Environment 2004
Moderation of water temperature	Low	Low	≥ 30 m	Lynch et al. 1985 in Alpine Environmental 2005
			15 – 18 m	Lee and Smyth 2003
Maintenance of habitat diversity/wildlife species distribution and diversity	Medium	High	30 m minimum	AAFRD 2001
Headwater protection	High	High	75 m	New Brunswick Watershed Protection Program in Waxwing Synthesis and Resolution Inc. 2004
Aesthetics			45-75 m 36 m	Chagrin River Watershed Partners in Waxwing Synthesis and Resolution Inc.
Wetlands	High	High	15-36 m	
			30 m	Alpine Environmental 2005
Natural heritage features	High	High	30 m	Carolinian Canada in Waxwing Synthesis and Resolution Inc.
Public access	High	High		
General	-	-	15 m from the 1:100 year high water mark	NFLD and Labrador Department of Environment in Waxwing Synthesis and Resolution Inc.
			50 m adjacent to the Elbow River	Alpine Environmental 2005

Scientific Delineation of Riparian Areas in the Nose Creek Watershed

Riparian areas are defined by modified soils, water tolerant vegetation and partially, by the 1:100 year floodplain as determined by Alberta Environment. Riparian areas in the Nose Creek watershed were identified on the Riparian Area Setback Map (Figure 4.3; Appendix G) using soil layers obtained from the City of Calgary and the M.D. of Rocky View. Riparian areas were identified by Soils Group NSK1 to 3, 6 and 7; and the Rough Broken Soil Groups RB1 to RB5, and ZRB1 to 4 or ZAV1 to 4, as they appear on the Calgary Urban Perimeter Soils Survey, and the Soil Survey of the M.D. of Rocky View – Alberta Survey Report #53.

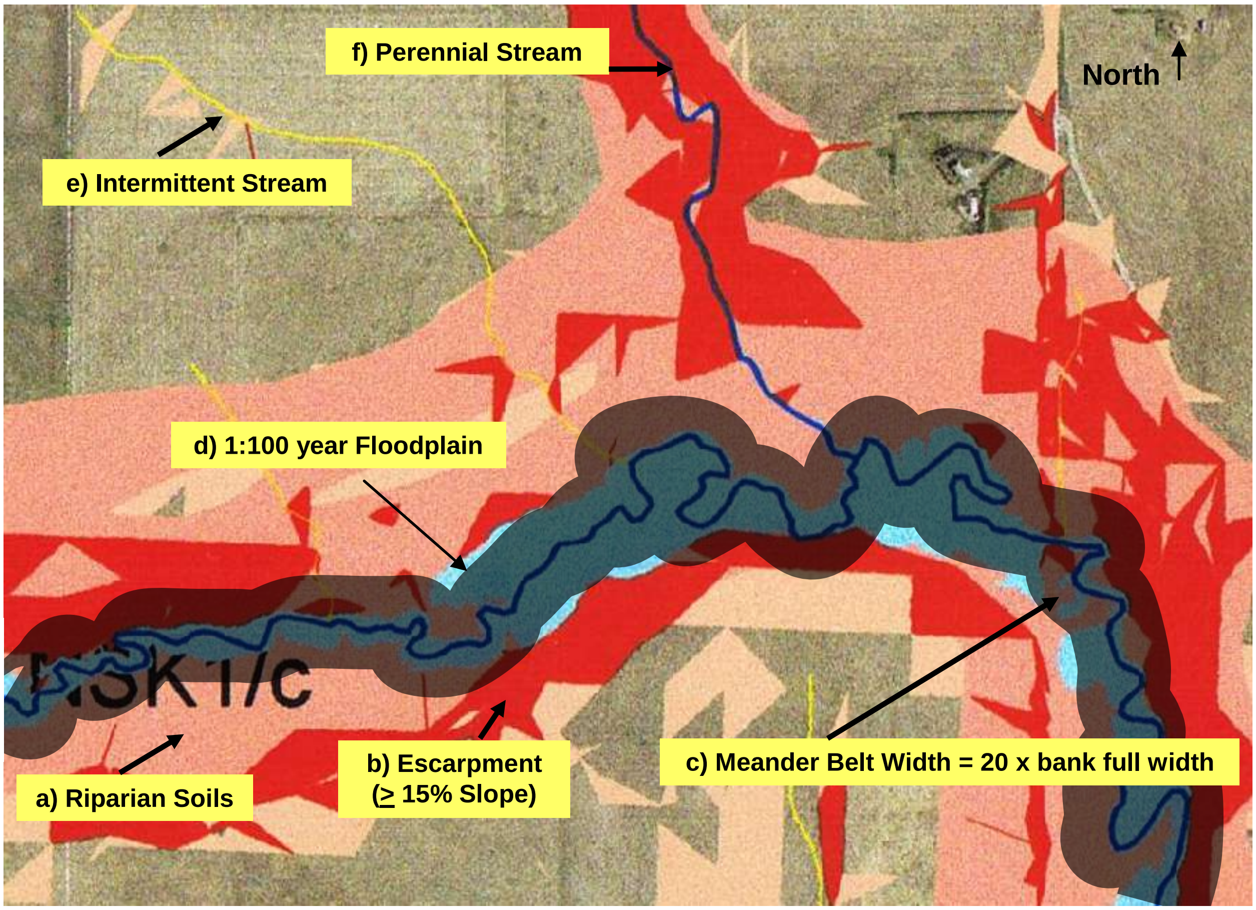

Figure 4.3. Example reach along West Nose Creek extracted from the Riparian Area Management Map. The meander belt is based on a bank full width of 5 m in this example which results in a 50 m wide belt on either side of the creek (e.g. 20 times the bank full width of 5 m equals 100 m). See Appendix G for actual maps.

In addition to soils and floodplain mapping, the meander belt width was identified. The meander belt width is important to allow for the natural migration of the stream channel as the creeks attempt to attain a state of balance in terms of hydrologic regime, land use changes and resisting forces (i.e. floodplain materials, vegetation) (Figure 4.5) (Parish Geomorphic Ltd. 2004). Studies identify meander belt width using empirical formulas related to bank full channel width or discharge (Parish Geomorphic Ltd. 2004). To estimate the belt width using these relationships, bank full channel width was multiplied by a value ranging between 4.4 and 20.3 (Parish Geomorphic Ltd. 2004). The range in values was partly related to site specific conditions that influence the meander belt width (i.e. floodplain materials), in addition to differences in the definition of meander belt among researchers (Parish Geomorphic Ltd. 2004).

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 (WER 2003) and multiplying by a factor of 20, the factor recommended for unconfined channels (Toronto and Region Conservation Authority (TRCA) 2004).

When considering meander belt width, it is also important to identify stable toe and stable slope allowances where the creek flows immediately adjacent to escarpments (slopes $\geq$ 15%). The stable slope setback ensures safety if slumping or slope failure occurs. The stability of slopes can be affected by increases in loading, such as placement of buildings, changes in drainage patterns, erosion of the toe slope and loss of stabilizing vegetation on the slope face (TRCA 2004). Currently the M.D. of Rocky View has protection measures in place for steep slopes that should be applied to the stable slope allowance. Stable toe allowance is provided in the meander belt width.

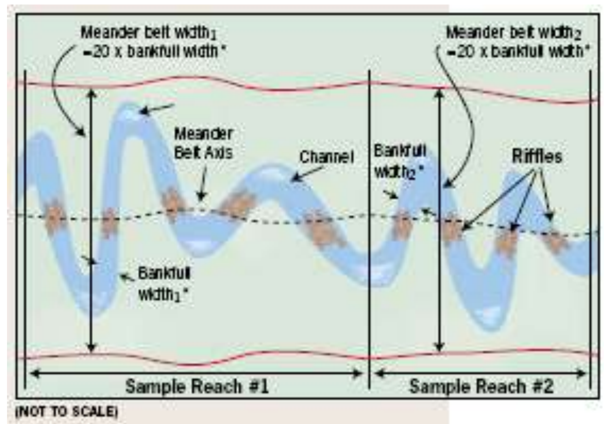

Figure 4.5. Schematic showing delineation of the meander belt width (TRCA 2004).

Table 4.4 summarizes the criteria that were used to determine the riparian setback reservation. The resulting area of overlap among the different criteria illustrated on the Riparian Area Management Map identifies the recommended riparian setback distances for use in the Nose Creek watershed. Additional recommendations are provided where the floodplain has not been mapped. The Riparian Area Management Map also provides an aerial overview of valued ecosystem components required to maintain the function of riparian areas in the Nose Creek watershed. The map should be used by planners and as part of the development permit process to identify riparian setbacks, valued ecosystem components and the need for further field investigations.

Table 4.4. Criteria used to define riparian setbacks adjacent to Nose Creek, West Nose Creek and their tributaries.

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 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 Line Network	Perennial streams require larger setbacks since they are higher in order than intermittent streams and generally convey more water