

Mediating the Conflict Between Outdoor Recreation and Nature
Conservation: *A Study of the Assiniboine Park Riparian Forest*

A practicum submitted to the Faculty of Graduate Studies
in partial fulfillment for the degree of
Master of Landscape Architecture

By Helen Fabbri, B. Sc.

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**MEDIATING THE CONFLICT BETWEEN OUTDOOR RECREATION AND NATURE
CONSERVATION: A *STUDY OF THE ASSINIBOINE PARK RIPARIAN FOREST***

BY

Helen Fabbri

**A Thesis/Practicum submitted to the Faculty of Graduate Studies of The University
of Manitoba in partial fulfillment of the requirements of the degree
of
Master of Landscape Architecture**

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"Landscape is neither nature nor culture but rather 'suspended' between the two."

Peter Jacobs (1991)

Abstract

Riparian forests play a valuable role in our urban environments including water quality protection, flood control, bank stabilization, erosion control, nutrient and pollutant filtration and water temperature regulation. In addition, they provide valuable habitat for urban wildlife and provide a natural setting for educational and recreational activities for urban dwellers. In spite of their importance, riparian forests represent a threatened and endangered habitat type in the City of Winnipeg.

Heavy recreational use is one of the major impacts affecting the Assiniboine Park riparian forest. The impacts of outdoor recreation at the Assiniboine Park riparian forest include trampling and loss of vegetative cover, tree damage, soil erosion, introduction of exotic vegetation, soil compaction, trail-pitting, litter, and pollution of water resources. In addition, recreation can impact the quality of visitor experience including visitor crowding, conflicts between different user groups, reduction in visitor learning, and visitor displacement.

The Assiniboine Park riparian forest is an especially attractive location for various recreational activities. The presence of water, diverse vegetation, varied topography in a relatively 'flat' land, moderated climate and wildlife enhance the recreational experience of the trail user. However, as recreational use of the Assiniboine Park riparian forest continues, the environmental and recreational quality of the resource will further diminish. There is a need for protecting and conserving this sensitive riparian system in addition to providing recreational opportunities for the public.

The proposed strategy for the design and management of the Assiniboine Park riparian forest was to widen and reconnect the riparian corridor/buffer by reclaiming large areas of land within the Assiniboine Park adjacent to and within the Assiniboine Park riparian forest. Design recommendations and guidelines for riparian buffers and corridors were explored resulting in the application of a three-zone urban riparian buffer system approach to the Assiniboine Park riparian forest. Each zone serves a different biological purpose and different recreational uses are allowed in each zone. In addition, two multiple-use trails were designed taking into consideration the activity-type and location of trails within the riparian zones.

The design and management of the Assiniboine Park riparian forest mediates between resource protection and recreation provision focusing on understanding the needs of the recreational users and the sensitivity of the environment.

Acknowledgements

I would like to thank my committee chair Alan Tate for his support, guidance and encouragement throughout the Practicum process. Thanks to Dr. Dan Nuttall, my internal reader, for his support and his thoroughness in reading my document. And to my external advisor Cheryl Heming, City Naturalist, for her support, the opportunities she has provided me with, and for being flexible and understanding with my schedule over the years.

Thanks to the City of Winnipeg's Naturalist Services Branch for their support on the project, particularly on the "*Assiniboine Park Riparian Forest Trail-user Survey*".

Thanks to Cynthia Cohlmeier for her support, editing and overall interest in the subject. And to Richard Perron for sharing your ideas and critiquing my work.

A special thanks to my mother and father for their constant love and support throughout my academic career. I love you both very much. To my sister Loredana and my 'brother' Marco, I hope to see you in Italy soon.

To my good friend Ida, from the 'stairs' to studio, it has been great sharing the university experience with you.

To the 'girls,' Cheryl, Jocelyn and Chantal for our 'practicum meetings' over cheesecake and coffee.

And finally to Stephen, thank you for your love, understanding, and support over the years.

Table of Contents

Abstract	i
Acknowledgements	iii
Table of Contents	iv
List of Tables	vi
List of Figures	vii
Introduction	1

Part I: Literature Review

Chapter 1: Riparian Forests

1.1 Structure and composition of riparian forests	6
1.2 Benefits of riparian forests	7
1.3 Impacts on riparian forests	9

Chapter 2: Outdoor Recreation

2.1 Leisure vs. recreation	22
2.2 Benefits of outdoor recreation	23
2.3 Emergence of outdoor recreation in North America	26
2.4 Trends in outdoor recreation in Canada	28

Chapter 3: The Ecological and Social Impacts of Outdoor Recreation

3.1 Effects of outdoor recreation on soil	37
3.2 Effects of outdoor recreation on vegetation	40
3.3 Effects of outdoor recreation on wildlife	42
3.4 Effects of outdoor recreation on water	44
3.5 Social impacts of outdoor recreation	44

Chapter 4: Riparian Buffers

4.1 Functional objectives	48
4.2 Riparian buffer widths	48
4.3 Riparian buffer lengths	50
4.4 Riparian buffer zones	50
4.5 Urban riparian buffers	51
4.6 Planting riparian buffers	52
4.7 Recreation planning	54
4.8 Managing riparian buffers	54
4.9 Costs and benefits	55

Chapter 5: Design Precedents

Part II: Site Research, Analysis & User-Survey

Chapter 6: Site Research & Analysis

6.1 Site research	65
6.2 Site analysis	80

Chapter 7: The Assiniboine Park Riparian Forest Trail-User Survey

7.1 Methodology	108
7.2 Results	111
7.3 Discussion	123
7.4 Conclusion	128
 Part III: Site Design	
<hr/>	
Chapter 8: Concept	130
Chapter 9: Program Development	
9.1 Strategies	137
9.2 Buffer design approach	149
9.3 Site application	151
Chapter 10: Program and Proposals	
10.1 The three-zone Assiniboine Park riparian buffer system	169
10.2 The Assiniboine Park riparian forest trail system	172
10.3 Proposals	176
10.4 Implementation/phasing	193
10.5 Summary	195
References	197
Appendix 1: Vegetation and Wildlife	210
Appendix 2: Assiniboine Park Riparian Forest Trail-User Survey	227
Appendix 3: Recommended Planting List	239

List of Tables

Table 2.2.1	Types and categories of benefits associated with leisure activities	24
Table 2.4.1	Profile of Canadians participating in nature-related activities in 1996	32
Table 3.1.1	Relationships between soil characteristics and site vulnerability	37
Table 4.2.1	General riparian buffer strip width guidelines	49
Table 9.2.1	Summary of ideal urban riparian buffer strip design guidelines	150

List of Figures

Figure 1.1.1	Profile of a typical riparian forest	6
Figure 1.3.1	Urbanization along the Assiniboine River in Winnipeg	11
Figure 1.3.2	Parks along the Assiniboine River in Winnipeg	12
Figure 1.3.3	Purple loosestrife (<i>Lythrum salicaria</i>)	16
Figure 1.3.4	European buckthorn (<i>Rhamnus cathartica</i>)	18
Figure 2.4.1	Number and percentage of Canadians participating in nature-related activities in Canada in 1996	30
Figure 2.4.2	Percentage of Canadians participating in nature-related activities in 1996, by province or territory of residence	31
Figure 2.4.3	Percentage of Canadians participating in outdoor activities in natural areas in 1996	33
Figure 2.4.4	Percentage of Canadians participating in outdoor activities in natural areas in 1996, by province or territory of residence	33
Figure 2.4.5	Percentage of participants in outdoor activities in natural areas in 1996 who visited parks or other protected areas, by province or territory of residence	34
Figure 2.4.6	Percentage of Canadians expressing great or some interest in participating in outdoor activities in natural areas, by province or territory of residence	35
Figure 3.1.2	The three soil horizons in a typical soil	39
Figure 3.1.3	The effects of trampling on vegetation and soil	40
Figure 4.4.1	The three-zone riparian buffer system	51
Figure 4.5.1	The three-zone urban riparian buffer system approach	52
Figure 6.1.1	The Assiniboine Park riparian forest	65
Figure 6.1.2	Glacial Lake Agassiz	66
Figure 6.1.3	Wet trails in the floodplain region of the Assiniboine Park riparian forest eroded by bicycle-tire treads, east of the Assiniboine Park footbridge	69
Figure 6.1.4	Erosion and pitting along wet trails in the floodplain region of the Assiniboine Park riparian forest, east of the Assiniboine Park footbridge	69

Figure 6.1.5	Severe erosion and pitting along the Assiniboine Park riparian forest trails, immediately west of the Assiniboine Park footbridge	71
Figure 6.1.6	Wood nettle dominance in the floodplain region of the Assiniboine Park riparian forest, east of the Assiniboine Park footbridge	73
Figure 6.1.7	Wood nettle along the Assiniboine Park riparian forest trails in the floodplain region, east of the Assiniboine Park footbridge	73
Figure 6.1.8	A European buckthorn (<i>Rhamnus cathartica</i>) stand in the upland areas of the Assiniboine Park riparian forest, west of the Assiniboine Park footbridge	74
Figure 6.1.9	Assiniboine River flood map showing floodway and floodfringe	76
Figure 6.1.10	Early settlement along the Red and Assiniboine Rivers in the early 19 th Century	79
Figure 9.1.2	Meander formations of the Assiniboine River at Beaudry Provincial Park	138
Figure 9.1.3	Idealized conservation strategy for the Assiniboine Park riparian forest	143
Figure 9.1.4	Section through idealized conservation strategy	144
Figure 9.1.5	Idealized recreation strategy for the Assiniboine Park riparian forest	145
Figure 9.1.6	Section through idealized recreation strategy	146
Figure 9.1.7	Mediated recreation-conservation strategy for the Assiniboine Park riparian forest	147
Figure 9.1.8	Section through mediated recreation-conservation strategy	148
Figure 9.3.1	Recommended widths applied to the Assiniboine Park riparian forest	153
Figure 9.3.2	Riparian buffer zones as applied to the Assiniboine Park riparian Forest	155
Figure 9.3.3	Zone 1 of the Assiniboine Park riparian forest	157
Figure 9.3.4	Zone 2 of the Assiniboine Park riparian forest	159
Figure 9.3.5	Zone 3 of the Assiniboine Park riparian forest	161
Figure 9.3.6	Zone 1, 2, and 3 of the Assiniboine Park riparian forest showing areas of expansion and deletion	163
Figure 9.3.7	Relocation of areas within the Assiniboine Park riparian forest	165

Figure 9.3.8	Reclaimed zones of the Assiniboine Park riparian forest	167
Figure 10.3.1	The Assiniboine Park riparian forest showing proposed conservation areas	177
Figure 10.3.2	The Assiniboine Park riparian forest showing proposed recreation areas	178
Figure 10.3.3	The Assiniboine Park riparian forest master plan	179
Figure 10.3.4	Section A-A'	180
Figure 10.3.5	Section B-B'	181
Figure 10.3.6	Section C-C'	182
Figure 10.3.7	Section D-D'	183
Figure 10.3.8	Vignette showing proposed mountain bike park	184
Figure 10.3.9	Vignette showing proposed meadow area	185
Figure 10.3.10	Vignette showing proposed lookout point	186
Figure 10.3.11	Vignette showing Leo Mol Sculpture Garden	187
Figure 10.3.12	Vignette showing proposed Trail One	188
Figure 10.3.13	Vignette showing proposed Trail Two	189
Figure 10.3.14	Vignette showing proposed fishing spot	190
Figure 10.3.15	Vignette showing proposed access point boardwalk	191
Figure 10.3.16	Links and connecting routes to other trails and parks along the Assiniboine River	192

Introduction

Introduction

A riparian forest community is defined as the corridor of vegetation situated between aquatic and terrestrial environments that is periodically influenced by flooding (Bentrup & Hoag 1998; Wissmar & Beschta 1998). Riparian forests play a valuable role in water quality protection, flood control, bank stabilization, erosion control, nutrient and pollutant filtration and water temperature regulation. They also provide wildlife habitat, and recreational and educational benefits (Riley 1998).

In spite of their importance, riparian forests represent a threatened and endangered habitat type in North America (Knutson & Klass 1998). Historically, riparian forests were used extensively by humans because of their abundance of food plants and wild game, and as transportation routes. Over time, agricultural practices, timber harvesting, dam construction and urban development have adversely affected riparian habitat. As a result, the structure, composition and role of riparian forests have changed markedly leading to an increase in water pollution, flooding hazards, habitat fragmentation, a loss of wildlife habitat, and a reduction in urban nature for human use and enjoyment (Moffat 2002).

In Winnipeg, approximately 85% of riparian habitat has been negatively affected by urban development (C. Heming pers. comm. 2003). As such, there is a significant interest in protecting and conserving riparian forests along many of its creeks, streams and rivers from further disturbance or clearing. Private landowners, stewardship groups, non-profit organizations, civil, provincial and federal governments have begun to recognize the degradation of riparian ecosystems and the importance of protecting them.

In 1993, an inventory of natural heritage areas within the city of Winnipeg was carried out as a cooperative project between the Manitoba Naturalists Society, the Canadian Wildlife Service and the City of Winnipeg's Parks and Recreation Department. As a result, five native habitat types were identified and the information collected during the inventory provided an overview of the status of these native habitats. It became apparent from the inventory that, despite the amount of waterfront property within city limits, examples of good quality riparian habitat were rare (Cowan 1993).

In 1997, the Manitoba Naturalists Society, as part of the Urban Habitat Stewardship Project, and its natural areas inventory partners, began to examine the condition of riparian forests along Winnipeg's waterways. The study focused on identifying major impacts and establishing a baseline of information for various riparian forests across the City, including the Assiniboine Park riparian forest. Heavy recreational use was found to be one of the major impacts affecting the Assiniboine Park riparian forest (Fabbri & Jurkow 1997).

In 2004, the Assiniboine Park will be celebrating its hundredth year. Annually, the Assiniboine Park attracts hundreds of thousands of park-users (de Graaf 2000). Although the exact number of those that use the Assiniboine Park riparian forest each year has not been recorded, it can be said that it is well used, as there has been a marked decline in the quality of the forest environmentally and aesthetically, in part due to recreational activity.

Recreational use can cause adverse physical and biological impacts on riparian areas. The impacts of outdoor recreation at the Assiniboine Park riparian forest include trampling and loss of vegetative cover, tree damage, soil erosion, introduction of exotic vegetation, soil compaction, trail-pitting, litter, and pollution of water resources. In addition, recreation can impact the quality of visitor experience including visitor crowding, conflicts between different user groups, a reduction in visitor learning, and visitor displacement (Manning et al. 1996).

Riparian areas however, are especially attractive locations for various recreational activities (Welle & Baer 1997). The presence of water, diverse vegetation, varied topography in a relatively 'flat' land, moderated climate and abundant wildlife enhance the recreational experience of the trail user. The City of Winnipeg encourages the use of rivers and riparian areas stating in Plan Winnipeg's 2020 Vision on Managing Parks, Open Space, and Waterways in Section 5C-02 "*Promote the Use of Rivers and Riverbanks:*"

The City shall promote the use of its rivers and riverbanks by facilitating public access to rivers and riverbank lands and encouraging the use of Winnipeg's rivers for transportation and recreation through the provision of boat launches, docks, and other accessibility improvements (City of Winnipeg 2002).

Of the 240km of waterfront property within City limits, the City of Winnipeg owns about 45% (108km). Of that, only 35% (85km) are publicly accessible (Planning, Property & Development Department 2000). As recreational use of riparian areas increases, and the

abundance and quality of the resource decreases, the need for protecting and conserving remaining riparian forest in Winnipeg increases, for humans and wildlife alike.

The impacts of outdoor recreation on riparian forests in Winnipeg are to some extent recognized, however, nothing has been proposed thus far, to minimize this conflict.

This practicum intends to build on existing knowledge and research of the Assiniboine Park riparian forest gathered from the Fabbri & Jurkow (1997) study, focusing primarily on the issues of outdoor recreation and nature conservation. The objectives of this practicum are:

- 1) To review existing literature on the subject of riparian forests and outdoor recreation
- 2) To build on an existing baseline site analysis
- 3) To investigate the values and needs of trail-users
- 4) To develop a site program
- 5) To generate design proposals and recommendations for the Assiniboine Park riparian forest which aim to minimize the impacts of outdoor recreation on riparian areas, while considering the recreational experience of the trail user.

Chapter 1: *Riparian Forests*

Chapter 1

Riparian Forests

The term 'riparian' means 'affected by the river' (Malanson 1993) and as the name suggests, the composition and structure of riparian vegetation is determined by the frequency, magnitude, duration and seasonal timing of flooding as well as soil type (Bentrup & Hoag 1998).

1.1 Structure and Composition of Riparian Forests

Riparian forests are divided into three zones (Figure 1.1.1): the riverbank, floodplain and terrace as well as three layers: the upper canopy which is comprised of trees and large shrubs; the mid-canopy which is mainly comprised of shrubs; and the groundcover layer which is comprised of herbaceous annuals and perennials (Essenberg 1991; Bentrup & Hoag 1998).

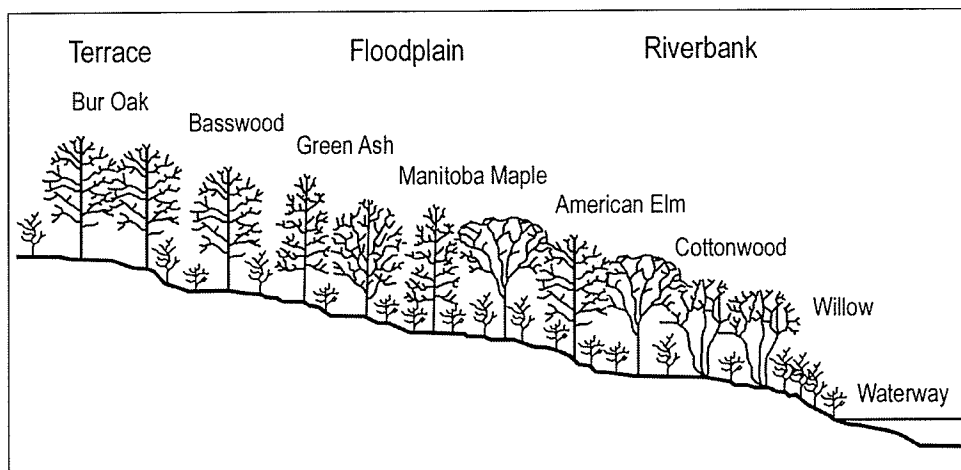


Figure 1.1.1: Profile of a typical riparian forest (Adapted from Canadian Forest Services, 1991).

Each riparian zone is associated with specific plant species that are adapted to the hydrology, soil type and microclimates characteristic of these areas (Daigle & Havinga 1996).

The riverbank is defined as the sloping area adjacent to the river (Essenberg 1991). In Manitoba, this riparian zone is dominated by tree species such as peach-leaved willow (*Salix amygdaloides*) and cottonwood (*Populus deltoides*) that can tolerate annual flooding and silt deposition. Shrub species such as beaked willow (*Salix bebbiana*) and sandbar willow (*Salix exigua*) also occupy this zone however few annual and perennial herbs are present.

The floodplain region is the relatively flat portion that lies above the riverbank and is subject to regular periods of inundation during flooding (Essenberg 1991). This zone usually contains the greatest variety of species and is inhabited by such tree species as Manitoba maple (*Acer negundo*), green ash (*Fraxinus pennsylvanica*), basswood (*Tilia americana*) and American elm (*Ulmus americana*). The mid-canopy includes species such as red-osier dogwood (*Cornus stolonifera*), chokecherry (*Prunus virginiana*) and wild currant (*Ribes americanum*). Herbaceous perennials include Virginia creeper (*Parthenocissus quinquefolia*), false Solomon's seal (*Smilacina stellata*), moonseed (*Menispermum canadense*), carrion-flower (*Smilax herbacea*) and tall meadow-rue (*Thalictrum dasycarpum*).

The terrace is the highest elevated area above the floodplain region (Essenberg 1991). This riparian zone is not subject to periods of flooding and is dominated by bur oak (*Quercus macrocarpa*), which prefers drier habitats.

Appendix 1A shows a species list of common plant species found in riparian forest communities in Winnipeg.

1.2 Benefits of Riparian Forests

Riparian forests are valuable natural ecosystems that provide many important benefits including flood control, bank stabilization, erosion control, filtration of nutrients and pollutants, water temperature regulation, wildlife habitat, and recreational and educational benefits. These benefits are described in more detail below.

Flood control

An important benefit of riparian forests is its ability to reduce flooding hazards. Native vegetation absorbs floodwaters and reduces the velocity of flowing water (Hey & Philippi 1995). However, the potential for damage is dependent on the width of the riparian zone and the density of native riparian vegetation. When human activity causes the degradation of riparian forests, the flood storage capacity is compromised, aggravating the impacts from flooding (Bentrup & Hoag 1998).

Bank stabilization

Riparian vegetation plays a significant role in bank stabilization by anchoring the riverbank into place. The structure of riparian vegetation particularly along the riverbank is such that their deep root systems trap the soil and protects it from the eroding forces of the river (Cowan 1995). More specifically, plant roots provide stability by increasing the cohesion of the soil, through the binding action of the soil with the root network and by contribution of the tensile strength of the roots themselves. Lateral roots contribute most to binding because they occur in greater densities, whereas vertical roots provide most of the tensile strength (Tabacchi et al. 1998).

Erosion control and filtration of nutrients and pollutants

Riparian forests can reduce the impacts of non-point source pollution by trapping eroded sediments and pollutants from urban runoff and preventing them from entering the river system. The ability of the river or stream bank to filter sediments, nutrients and pollutants from urban runoff is dependent on the density and width of the vegetation corridor, the height and slope of the riverbank, and the volume and velocity of runoff. As a consequence of filtering, the system's water quality is improved (Cowan 1995).

Water temperature regulation

Riparian vegetation plays an essential role in regulating water temperature thereby contributing to the overall health of riparian systems. Riparian vegetation protects streams and rivers from summer and winter extremes that may be stressful or detrimental to aquatic life. Shade cast by riparian vegetation helps in maintaining cooler water temperatures in the summer, affecting the rate of nutrient cycling and dissolved oxygen levels. Cooler water temperatures hinder algal growth resulting in an increase in dissolved oxygen levels, further improving water quality (Bentrup & Hoag 1998).

Wildlife habitat/corridors

Riparian forests are among the most productive wildlife habitats. The diversity and productivity of these systems provides a rich diversity of habitat niches. This translates into a high variety of wildlife species in the riparian habitat (Bentrup & Hoag 1998). Losses and

degradation of habitat quality pose serious problems for wildlife, especially birds, which depend on these resources for survival (Knutson & Klass 1998). Riparian forests also serve as conduits or corridors for the movement of wildlife along the river and between diverse habitats (Forman & Godron 1986).

Recreational and educational benefits

Riparian areas are attractive locations for a variety of recreational activities such as canoeing, hiking, cycling, jogging and cross-country skiing. They also provide great opportunities for nature viewing, outdoor education and interpretation.

1.3 Impacts on Riparian Forests

Riparian forests are environmentally sensitive areas that are subject to a variety of impacts. Simply defined, environmentally sensitive areas are those that contain native vegetation and natural features and/or natural resources. They contain natural communities of plants and animals whose existence is determined by such factors as soil composition, hydrology, climate, solar conditions and site history. Environmentally sensitive areas are vulnerable in that further fragmentation, disturbance and development will negatively affect natural processes, composition, structure and function of these systems. Environmentally sensitive areas usually have one or more of the following conditions: 1) contain abundant native biodiversity and few exotics; 2) are of adequate size and cohesiveness to be biologically sustainable; 3) are a remaining example of a pre-permanent settlement natural community; 4) are considered rare; 5) contain sensitive geological and hydrological features; 6) contain or are adjacent to a wetland, river or stream and are critical in maintaining water quality, rare species habitat or flood control; and 7) contribute significantly to biological or hydro-geological functions such as wildlife habitat, air purification and erosion control (City of St. Cloud 2001).

Riparian forests in Winnipeg are subject to a variety of impacts that can have adverse effects. Some common causes of degradation include: urbanization/riverbank development, mowing, Dutch elm disease, exotic plant species, beavers and recreation.

Urbanization/Riverbank Development

Riparian forests have been significantly modified over time as a result of continuous urban development of riparian habitat (Moffat 2002). As a result, riparian forests are fragmented and remnant habitat is becoming further degraded. Figure 1.3.1 shows the extent of urbanization (developed riparian lots) along the Assiniboine River in Winnipeg. This figure can be compared with Figure 1.3.2, which shows the occurrence of parks along the Assiniboine River in Winnipeg. It is apparent that despite the number of parks and natural areas along the Assiniboine River, riparian habitat is significantly fragmented. Fragmentation reduces habitat for urban wildlife and interrupts valuable riparian corridors for use by both wildlife and humans (Moffat 2002). The City of Winnipeg recognizes the importance of riparian habitat and has included its protection, preservation and maintenance in *Plan Winnipeg's 2020 Vision on Managing Parks, Open Space and Waterways* in Section 5C-04 "Protect Environmentally Sensitive Lands." The policy states that:

The City shall protect environmentally sensitive lands that contain pockets of natural flora and fauna or that are susceptible to damage from flooding or erosion by:

- 1) Evaluating proposed developments that affect high-quality natural areas and encouraging the protection and preservation of such lands to the greatest extent possible;*
- 2) Developing a lands plan which designates natural areas that are environmentally sensitive and/or significant lands;*
- 3) Protecting floodplains and unstable riverbank slopes by identifying susceptible areas and employing protective and preventive measures, including the possible acquisition of such lands, to reduce the risk of property damage where appropriate; and*
- 4) Encouraging private landowner participation in support of riverbank management.*

The City of Winnipeg's Naturalist Services Branch is committed to following through Plan Winnipeg's mandate when carrying out all projects.



Figure 1.3.1: Urbanization along the Assiniboine River in Winnipeg.



Figure 1.3.2: Parks along the Assiniboine River in Winnipeg (highlighted area is Assiniboine Park).

The Branch is involved in all aspects of natural areas within the City, co-managing various projects and forming partnerships with several non-profit organizations and stewardship groups. They are responsible for exchanging resources and providing technical advice to the public, environmental stewardship groups, other City of Winnipeg departments and all levels of government regarding issues of natural areas, sensitive lands and urban wildlife. Recently, an *Eco-gift* program was introduced to the City whereby property owners of ecologically sensitive lands can donate their land in order to protect ecological heritage from ongoing development. In return, the donor receives tax benefits for protecting this land (Naturalist Services Branch 2001).

Commercial developers wishing to develop facilities in natural areas must be sympathetic to the environment in terms of building styles, extent of development, management and operation (Norton & Roper-Lindsay 1992). They must also recognize that not all proposals will be compatible with the nature conservation values of a site.

Riverfront property owners must also be aware of the importance of riparian areas and through education, may be encouraged to conduct small-scale restoration efforts in their own yards.

Mowing

Replacing valuable riparian vegetation with turf grass and mowing to the river's edge commonly occurs along many riverfront properties and was also formerly practised by the City of Winnipeg. Mowing to the river's edge causes banks to become more susceptible to erosion, decreases wildlife habitat, and reduces water quality. In 1999, the City of Winnipeg's Parks Division in concert with the City Naturalist's Office established a no-mow policy in order to protect and preserve the natural landscape of the city. The policy prohibits mowing on City-owned property along all rivers and streams. It involves establishing a no-mow riparian buffer zone from the river's edge to the top of the bank that will allow for the naturalization of native trees and shrubs. In addition, there is to be no mowing where oak trees are stressed and where there is evidence of tip die back due to soil compaction from machinery (Naturalist Services Branch 1999).

The re-established vegetation has environmental, aesthetic and financial benefits. Environmentally, the policy would help stabilize the banks, provide additional wildlife habitat

and corridors, and improve water quality. Aesthetically, users of these spaces would enjoy increased richness and diversity of both plant life and wildlife that would be attracted to these areas. Financially, the policy would prove a more efficient expenditure of city tax dollars.

It will now become necessary to educate riverfront property owners about the importance of creating no-mow buffer strips in order to protect their property and riparian forests as a whole.

Dutch Elm Disease

Dutch elm disease is another major impact on riparian forests also affecting elm trees in numerous city parks, boulevards and residential yards within the city of Winnipeg.

The disease is caused by the ascomycete fungus *Ceratocytis ulmi*, which interferes with the conduction mechanism of xylem vessels, the principal water-conducting tissue in vascular plants. In Manitoba, the native elm bark beetle *Hylurgopinus rufipes* is the major vector of the fungus. However, the European elm bark beetle *Scolytus multistriatus* is another vector, although uncommon. The adult beetles breed underneath the bark of stressed, dying or dead elm trees. If the brood tree is infected with Dutch elm disease, the brood and larval galleries become infested with the fungus as well. The newly emerged beetles containing the fungus pass the disease to healthy elm trees upon feeding (Essenberg 1991). The resulting effect is leaf yellowing, wilting and drop, eventually leading to tree mortality.

The disease was first observed in Winnipeg in 1975 along the Red River and at present, continues to spread across the city. Since its appearance, the City of Winnipeg's Forestry Branch initiated the Dutch Elm Disease Control Program whose mandate is to ensure the well-being, longevity and enhancement of the urban elm forest within the City of Winnipeg through undertaking and maintaining excellent, effective and on-going disease control and tree maintenance procedures. Since 1975, the annual loss rate of elms within the city has remained at or below 2%. Of concern, recent losses have increased to approximately 3% per year, however steps are being taken to address the situation (Forestry Branch 2000). Dutch Elm Disease control efforts are limited to prevention of spread, and require numerous strategies. Unfortunately, there is no effective cure and partial implementation of the control

strategies has proven unsuccessful. Effective results can only occur with an integrated control program, involving community efforts. Control methods include surveillance (detection), sanitation (removal/disposal), basal treatment (insect control), tree care (pruning), root-graft control and injection with fungicide (Forestry Branch 2000).

Exotic Plant Species

Exotic plant species are defined as 1) “natural” invaders, or species which have expanded their ranges without the aid of humankind; 2) indigenous agricultural species which have evolved in the region or have long associations with local culture; 3) exotic agricultural or human-dependent species which are recent introductions and were not developed in their present form in the region; or 4) exotic wildland species which are indigenous to another region and were introduced by human activity, either intentionally or accidentally (Bratton 1982).

Exotics vary in the type and degree of ecosystem impact. A successful exotic invader of natural areas can, however, influence any process or biological characteristic of a functioning ecosystem. This includes all trophic relationships (herbivore, detritivore or predator-prey), interspecific competition, primary and secondary succession, nutrient cycling, system productivity, diversity and stability. In addition there can be changes in biogeophysical processes, substrate deposition, soil formation and erosion, solar insolation, hydrologic balance and disturbance frequency (Bratton 1982; Harty 1986).

The success of an exotic species depends on its genetics, physiology, behaviour and ecology (Berger 1993). These species germinate, grow and flower rapidly under a wide range of climatic and soil conditions, and lack insect pests and pathogens that kept them in check in their native environments. Exotics are primarily perennial and they produce abundant seeds that are easily dispersed and remain viable for numerous years in the soil. A large number of exotics have a disagreeable odour or taste, or possess thorns or spines to deter herbivores.

Riparian habitats are one of the most susceptible ecosystems for invasion by exotic species because of their naturally occurring breaks in plant cover (Berger 1993).

In Winnipeg, the invasive exotic species, purple loosestrife (*Lythrum salicaria*) and European buckthorn (*Rhamnus cathartica*) are affecting riparian forests.

Purple Loosestrife

Purple loosestrife (Figure 1.3.3) is a woody perennial native to Europe and introduced into Canada in the 19th Century (Thompson 1991). It primarily invades moist habitats such as marshes, bogs, riverbanks, retention ponds and roadside ditches (Heidorn & Anderson 1991). Purple loosestrife is an aggressive, highly prolific plant that crowds out and quickly replaces native vegetation resulting in a homogenous environment providing little food, shelter or breeding habitat for wildlife.



Figure 1.3.3: Purple loosestrife (*Lythrum salicaria*) (Manitoba Purple Loosestrife Project 1993).

Purple loosestrife has no natural enemies in North America and without an effective control strategy, the biodiversity of our riparian and wetland ecosystems will be threatened. Control methods include removing the plant in its entirety before the flower head begins to seed, then drying and burning. In July 2001, the City of Winnipeg began a purple loosestrife exchange program whereby homeowners could remove purple loosestrife plants present in their yards and gardens in exchange for a meadow blazingstar bulb (*Lyatrus ligulistylis*). Removing purple loosestrife can be a very laborious and costly method of control especially in high-density areas. Beginning in 1998, the leaf-eating beetle (*Gallerucella calmariensis*) was introduced from Europe and released in selected sites throughout the province,

including Winnipeg, which contained purple loosestrife infestations and has proven to be the most successful control strategy against this exotic species. In May 2002, mass rearing of the leaf-eating beetles was initiated at the Birds Hill Provincial Park, Manitoba Rearing Station for release throughout the province (The Manitoba Purple Loosestrife Project 2002).

European Buckthorn

European buckthorn (Figure 1.3.4) is a deciduous shrub native to Europe, Asia and North Africa. It was introduced into the city of Winnipeg in the late 19th Century commonly planted in residential areas as an ornamental shrub or hedge. It is an extremely hardy plant capable of inhabiting a large range of terrestrial ecosystems. European buckthorn leafs out in early spring and does not lose its leaves until late autumn giving it a much longer growing season (Gourley & Howell 1984; Archibold et al. 1997). When combined with a rapid growth rate and prolific seed production it quickly chokes out and replaces native vegetation in all three forest strata (herbaceous, shrub and tree layers), especially in the upper terrace areas of Winnipeg's riparian forests along both the Red and Assiniboine Rivers.

There are many methods of controlling European buckthorn including hand pulling, girdling, cutting, herbiciding and burning (Heidorn 1991). Unfortunately, these methods are very labour intensive especially in areas where European buckthorn densities are high. However, it is necessary to control existing stands and prevent further spread. The Manitoba Naturalists Society and the City of Winnipeg's Naturalist Services Branch, with the support from the Coalition to Save the Elms, have recognized the significance of European buckthorn as an aggressive species invading Winnipeg's natural heritage and are in the process of developing a five-year control program that will control, or at least limit, the spread of European buckthorn across the city.

At present there are no known biological control methods for European buckthorn. It seems to be an intermediate host for oat rust (*Puccinia coronata*) but does not appear to be greatly affected by it. Some research is being conducted in Europe and Canada on host-specific European insects and fungal pathogens, however results are not yet available (Northern Prairie Wildlife Research Center 2001).

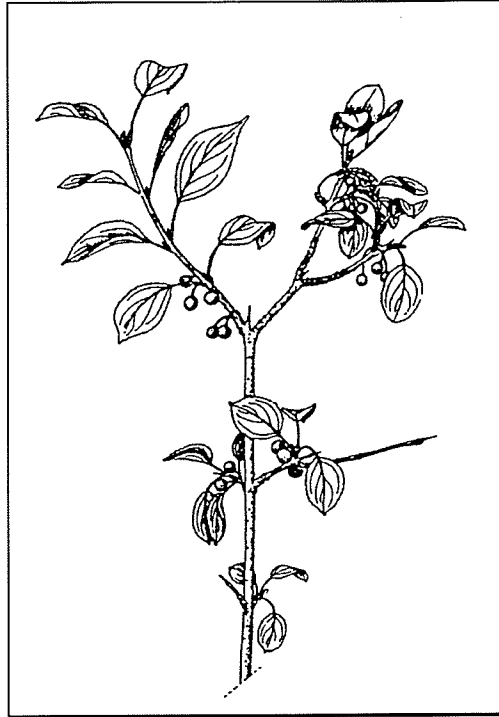


Figure 1.3.4: European buckthorn (*Rhamnus cathartica*) (Clare 1991).

Beavers

Beavers (*Castor canadensis*) that are present in an urban environment are responsible for significant impacts on waterways and riparian vegetation. Numerous hardwood trees from many of the city's riverbanks have been subject to beaver activity resulting in gaps where large trees once stood thus altering habitat for other wildlife, reducing the aesthetic and economic value for river-property owners, and the recreational value for recreationists. In addition, the sharply pointed stumps left over from beaver activity, pose a potential physical danger for site-users. The urban beaver population has increased significantly over the years, as there are no predators to keep them in check (Cowan 1995). Options for beaver management include tree-wrapping, live-trapping, trapping and flow devices. These methods are described below.

Tree-wrapping, consists of loosely wrapping stucco wire around the base of the tree creating a freestanding mesh cylinder to prevent beaver from accessing the tree. Another option includes live-trapping beaver for relocation outside city limits. Beaver relocation is a method used in areas where beaver populations are low however, it is less frequently used as the probability of individuals returning is high. Trapping or shooting beaver has caused great conflict over the years between wildlife management agencies, animal rights groups and

residents alike. In Manitoba, the number of beaver trapped by licensed trappers has recently declined due to low pelt prices resulting in a rise in beaver population. Manitoba Conservation in concert with the Association of Manitoba Municipalities and the Manitoba Trappers Association developed a winter subsidy program that provides monetary incentives to provincial trappers to encourage beaver-harvest in designated problem areas (Manitoba Conservation 2001). In this case, beavers are looked upon as problem wildlife where the best method of keeping population numbers down is trapping.

Conversely, the Fund for Animals Inc., an organization based in New Haven, Connecticut that specializes in solving beaver problems, believes that humans can work harmoniously with beavers to address issues of flooding. Instead of destroying beaver dams and trapping, which only has short-term effects, flow devices are designed to allow water to flow through a built dam preventing water from backing up and flooding (Fund for Animals Inc. 1999; Lisle 1999). This is essentially a win-win situation where the beaver can maintain its dam and the water level can be controlled. Similarly, the Zuni Fish and Wildlife Department in New Mexico has incorporated beavers as an important and innovative component in restoring riparian habitat (Albert & Trimble 2000). Beavers were reintroduced into degraded watersheds in order to benefit water quality, watershed health and riparian wildlife habitat. Dams built by beavers allowed sediment to drop out of suspension and raise the streambed. The spread of water over a wider area created larger pools of water allowing abundant riparian vegetation to develop thus encouraging more wildlife such as deer, elk, fish and amphibians.

Thus, good beaver management requires a complete understanding of the individual situation and the options available for reasonable, effective solutions.

Recreation

Recreational use of natural areas can cause adverse physical and biological impacts on the natural environment. Impacts include trampling and loss of vegetative cover, tree damage, compaction and erosion of organic litter and soil, introduction of exotic vegetation, harassment or displacement of wildlife, litter and pollution of water resources. In addition, recreation can impact the quality of visitor experience including visitor crowding, conflicts between incompatible visitor activities, reduction in visitor learning, and spatial, temporal, or total visitor displacement (Manning et al. 1996).

The City of Winnipeg encourages the use of rivers and riparian areas stating in *Plan Winnipeg's 2020 Vision on Managing Parks, Open Space, and Waterways* in Section 5C-02 "Promote the Use of Rivers and Riverbanks":

The City shall promote the use of its rivers and riverbanks by facilitating public access to rivers and riverbank lands and encouraging the use of Winnipeg's rivers for transportation and recreation through the provision of boat launches, docks, and other accessibility improvements (City of Winnipeg 2002).

Thus the conflict that exists between outdoor recreation and nature conservation will continue and will be amplified as the use of riparian forests is encouraged. The impacts of recreation on natural areas in Winnipeg are to some extent recognized and have been studied however, nothing has been proposed thus far to resolve this conflict. In 1997, the Manitoba Naturalists Society in concert with the City of Winnipeg's Naturalist Services Branch, the Canadian Wildlife Service, and the Critical Wildlife Habitat Program found that trampling associated with recreational activities played, and continues to play, a significant role in the degradation of the Assiniboine Park riparian forest (Fabbri & Jurkow 1997).

If the use of rivers and riparian forests is to be encouraged in Winnipeg, the effects of recreation on these sensitive ecosystems must be further studied and practical guidelines for its design and management should be discussed and implemented.

Chapter 2: *Outdoor Recreation*

Chapter 2

Outdoor Recreation

2.1 Leisure vs. Recreation

'Recreation' can have different meanings to many people. It is a term that is commonly used but seldom defined. Frequently, it is used interchangeably with the concept of 'leisure' or it has a more specific connotation which defines and distinguishes a distinctive behavioural area (Williams 1995). Zinser (1995) refers to leisure as a time concept and recreation as an activity concept. For the purposes of this study, the meanings of leisure and recreation are defined.

Conventionally, recreation is seen as a sub-area of leisure (Williams 1995). Leisure has been defined by many as the free or discretionary time available for people to use as they choose after meeting the biological requirements of existence and the subsistence requirements of work (Yukic 1970; Wall 1989; Zinser 1995). Zinser (1995) further defines four patterns in which leisure time occurs: 1) *daily leisure* – defined as the time after work or after school where only a few hours are available for recreation; 2) *weekly leisure* – refers to the weekend, where a larger block of time permits the use of recreational resources situated farther from the home; 3) *vacation leisure* – refers to a significant block of time in which one may travel to distant places for recreational pursuits; and 4) *retirement leisure* – allows an extended period of time for retirees to pursue recreational resources. Patmore (1983) uses the term 'leisure' in three distinct contexts: 1) it may be conceived in terms of time; leisure generally being that period of the day which remains after routine commitments to work, domestic chores and other obligations have been discharged; 2) it may be seen as an attitude of mind; for example, a reflection of an individual's perception of whether he or she is at 'leisure'; and 3) it may be associated with activity, and it is in this context that the concept of recreation emerges clearly.

The English word 'recreation' is derived from the Latin, '*recreate*', which means to create anew, to become refreshed (Jensen 1995). Recreation most often occurs during leisure time (Jensen 1995). Yukic (1970) defined recreation as an act or experience, selected by the individual during his [sic] leisure time, to meet a personal want or desire, primarily for his [sic] own satisfaction. Zinser (1995) defines it as any type of conscious enjoyment that occurs during leisure time. He distinguishes no sharp boundary between recreation and other activities and that the same activity may be work in some instances, and recreation in

others. The distinguishing characteristic is not the activity of recreation itself, but the attitude with which it is carried out. Patmore (1983) states that recreation is about an activity in which participants have chosen to engage. Recreational activities may serve a range of functions: they may be relaxing or energetic; they may foster social, cultural, intellectual or creative developments for individuals or groups; they may be recuperative; they may revitalize or re-create the participant, and usually they perform several of these functions at the same time.

2.2 Benefits of Outdoor Recreation

Outdoor recreation in North America is in great demand and appears to be rising in a society characterized by rapidly advancing technology, growing stress levels and time constraints. As a result, North Americans are placing a large emphasis on the leisure aspect of their everyday lives and on outdoor recreation as an essential leisure outlet (Pandolfi 1999).

Outdoor recreation can take place in many places and settings from one's own backyard, to small urban green spaces, to national parks. The main objectives and benefits of outdoor recreation, however, remain the same. Jensen (1995) lists five main objectives of outdoor recreation: 1) appreciation of nature; 2) personal satisfaction and enjoyment; 3) physiological fitness; 4) positive behavioural patterns; and 5) stewardship. He also describes the four distinct phases of the recreation experience: anticipation, planning, participation, and recollection. The *anticipation* phase occurs when an individual considers an activity and decides to pursue it. *Planning* involves aspects of education and preparation, for example, gathering equipment and supplies, preparing food and clothes, and making arrangements. The *participation* phase extends from the time of departure to the time of return. It includes the travel portion and the activity itself. Finally, the *recollection* phase involves thinking and telling about the experience through various media such as oral and/or written accounts, photographs, slides or videos.

Activities associated with recreation provide many benefits that include psychological, physiological, social/cultural, economic, environmental, educational and spiritual. Driver (1990) summarized the benefits attributed to leisure activities shown in Table 2.2.1.

Table 2.2.1: Types and categories of benefits associated with leisure activities

- I. Personal Benefits
 - A. Psychological
 - 1. Better mental health and health maintenance
 - Holistic sense of wellness
 - Stress management (prevention, meditation, and restoration)
 - Catharsis
 - 2. Personal development and growth
 - Self-confidence
 - Self-reliance
 - Self-competence
 - Self-assurance
 - Value clarification
 - Improved academic/cognitive performance
 - Independence/autonomy
 - Sense of control over one's life
 - Leadership
 - Aesthetic enhancement
 - Creativity enhancement
 - Spiritual growth
 - Adaptability
 - Cognitive efficiency
 - Problem solving
 - Nature learning
 - Cultural/historic awareness/learning/appreciation
 - Environmental awareness/understanding
 - Balanced competitiveness
 - Balanced living
 - Prevention of problems to at-risk youth
 - 3. Personal appreciation/satisfaction
 - Sense of freedom
 - Self-actualization
 - Exhilaration
 - Stimulation
 - Sense of adventure
 - Challenge
 - Nostalgia
 - Quality of life/life satisfaction
 - Creative expression
 - Aesthetic appreciation
 - Spirituality
 - Positive change in mood/emotion
 - B. Psycho-physiological
 - Cardiovascular benefits, prevention of strokes
 - Reduced or prevented hypertension
 - Reduced serum cholesterol and triglycerides
 - Improved control and prevention of diabetes

- Prevention of colon cancer
- Reduced spinal problems
- Decreased body fat/obesity/weight control
- Improved neuropsychological functioning
- Increased bone mass and strength
- Increased muscles strength and better connective tissue
- Respiratory benefits (increased lung capacity)
- Increased life expectancy
- Management of menstrual cycles
- Management of arthritis
- Improved immune system
- Reduced consumption of alcohol and tobacco

II. Social/Cultural Benefits

- Community satisfaction
- Pride in community/nation
- Cultural/historical awareness and appreciation
- Reduced social alienation
- Community/political involvement
- Ethnic identity
- Social bonding/cohesion/cooperation
- Conflict resolution/harmony
- Greater community involvement in environmental decision-making
- Social support
- Family bonding
- Reciprocity/sharing
- Social mobility
- Community integration
- Nurturance of others
- Understanding/tolerance of others
- Environmental awareness/sensitivity
- Enhance world view
- Socialization/acclimation
- Cultural identity
- Prevention of social problems by at-risk youth
- Developmental benefits of children

III. Economic Benefits

- Reduced health costs
- Increased productivity
- Less work absenteeism
- Reduced on-the-job accidents
- Decreased job turnover
- Local and regional economic growth
- Contributions to net national economic development

IV. Environmental Benefits

- Maintenance of physical facilities
- Stewardship
- Husbandry/improved relationship with natural world
- Understanding of human dependency on the natural world

Environmental protection

As the table shows, the benefits of recreation are broader and larger than one might have assumed. The benefits encompass almost all aspects of human behaviour and performance and can be realized in many different environments and settings from Central Park in New York to Mount Everest in Nepal and Tibet (Driver 1999).

2.3 Emergence of Outdoor Recreation in North America

In early North American settlement, open spaces were assigned for commons, pasture land, and training grounds for hunters (Ibbrahim & Cordes 1993). Commons were public grounds or village greens reproduced from the English (Jensen 1995). In New England, commons were characterized as plots owned by the community that had various functions including timber harvesting, livestock grazing, and political, social, commercial, and recreational activities (Ibbrahim & Cordes 1993; Jensen 1995). By the mid 18th Century, these open spaces were used for recreational activities and other amusements (Ibbrahim & Cordes 1993).

The need for local recreation was recognized and addressed in some North American urban environments. As North American cities were expanding rapidly and pollution levels were increasing, the need for open space was becoming increasingly important (Douglass 1999). In Canada, the establishment of municipal parks began with early settlements in New Brunswick, Nova Scotia, Quebec and Ontario. For example, in 1763, Halifax Commons was granted to the city and Montreal had its first public square in 1821 (Ibbrahim & Cordes 1993). In 1853, Frederick Law Olmsted and Calvert Vaux designed New York's Central Park where citizens could escape the poor conditions and tensions of city life through relaxation and exercise. Olmsted's vision was to create a public park,

'... large enough to contain a complete natural landscape, where boundaries are not obtrusive, where the city condition will not be unduly apparent, where one may stroll over hill and dale, across meadow and through woods, always amid natural surroundings, for hours without twice following the same routes; where one may come again and again without becoming familiar with all its interesting localities and natural features: where many thousands of visitors may be enjoying the scenery at the same time without crowding each other; where those who especially seek

seclusion may find parts so remote from the boundaries that even if city houses are not completely hidden they are reduced in the distant perspective of inconspicuous proportions as compared with the foliage of trees and other natural objects in the foreground; so remote that the roar of street traffic is less noticeable than the rustle of foliage stirred by the breeze or than the songs of birds.'

– Olmsted (de Graaf 2000)

This park set the precedent for major urban centres in North America to set aside open spaces for public recreation (Jensen 1995). In the late 19th Century in Canada, the importance of recreation in the citizens' everyday lifestyle, and the role that natural resources could play in the pursuits of outdoor activities gained importance. Provinces began enabling laws empowering their municipalities to build parks, set procedures for land acquisition, and establish standards for management of natural resources. Hamilton built its Gore Park in 1852 and Montreal established its Mount Royal Park in 1860 (Ibbrahim & Cordes 1993). In 1886, Stanley Park in Vancouver was designated as a public park (Tate 2001).

During the late 19th and early 20th centuries, fear of the destruction of natural resources due to population growth and expansion, resulted in the rise of a preservation movement which led, in turn, to the establishment, for the first time in human history, of natural areas allocated for the enjoyment of present and future generations (Ibbrahim & Cordes 1993). Many game preserves were established to protect and preserve popular game animals such as deer however, the concept of preservation reached its pinnacle in 1872 with the establishment of America's first national park. Yellowstone National Park in Wyoming, Idaho and Montana was established as a federal park because some farsighted individuals held out for its public ownership at a time when the land appeared to be valueless (Douglass 1999). The concept of federally designated national parks for the enjoyment of the public and the protection of natural resources is adopted by many nations today (Ibbrahim & Cordes 1993).

Expansion of outdoor recreational opportunities required the establishment of many agencies at the federal, state and local levels (Ibbrahim & Cordes 1993). This was in response to demands accelerated by:

- 1) The adoption of the Universal Declaration of Human Rights by the General Assembly of the United Nations in 1948 which states that *'every citizen has the right to rest and leisure, including reasonable limitation of working hours and periodic holidays with pay...and the right to freely participate in the cultural life of the community...'*
- 2) An increase in free time for almost every citizen in many countries regardless of social class and lifestyle;
- 3) An increase in disposable income allowing a greater percentage of money allocated for leisure activities (Jensen 1995);
- 4) The advent of industrialization and automation which allowed for greater free time;
- 5) An increase in urbanization with the resultant increase in the need for recreational outlets;
- 6) The provision of adequate means of transportation which takes the individual to the desired destination; and
- 7) Mobility with its social and psychological dimensions that drives one to seek recreational pursuits that correspond to a newly acquired status. For example, people seek higher pay, longer vacations, and the ability to afford an expensive recreational vehicle for both psychological and social reasons.

The relationship between outdoor recreational activities and open space is derived from a basic biological need to retain a connection with nature in sterile, urban environments, and a psychological need for contrast and change in one's surroundings and activities that most indoor environments do not provide. The desire to escape to natural open spaces is further enhanced when these needs are linked with routine indoor jobs and the artificial environments of most urban cities and suburbs (Gold 1997).

2.4 Trends in Outdoor Recreation in Canada

Canada is a country internationally renowned for its wildlife, forests, water, and protected areas. It contains 20 percent of the world's remaining natural areas and sustains a variety of nature-related activities that enhance the lives of millions of Canadians and foreign visitors. In 1996, Statistics Canada in concert with Environment Canada conducted the *Survey on the Importance of Nature to Canadians* that highlights the involvement of Canadians with nature through participation in various nature-related activities (Environment Canada 1997). The survey showed that 20 million Canadians (84.6 percent of the population) aged 15 years and over participated in one or more nature-related activities in Canada and participants dedicated 1.5 billion days of their leisure time and \$11.0 billion to these activities.

Nature-related activities include outdoor activities in natural areas, residential wildlife related activities, wildlife viewing, recreational fishing, hunting, and indirect nature-related activities. For the purposes of the study conducted by Statistics Canada and Environment Canada, a natural area was defined as forested areas, water bodies, wetlands, open fields and mountains. These nature-related activities mentioned above, are defined as:

Outdoor activities in natural areas – sightseeing in natural areas, photographing in natural areas, gathering nuts, berries, or firewood, picnicking, camping, swimming/beach activity, canoeing/kayaking/sailing, power boating, hiking/backpacking, climbing, horseback riding, cycling, off-road vehicle use, downhill skiing, cross-country skiing/snowshoeing, snowmobiling and relaxing in an outdoor setting.

Residential wildlife-related activities – activities that occur around the residence such as, watching, photographing, feeding or studying wildlife, and gardening.

Wildlife viewing – watching, photographing, feeding or studying wildlife for the purpose of enjoying wildlife and natural areas.

Recreational fishing – catching fish for non-commercial purposes.

Hunting – searching for, pursuing, stalking, trailing or lying in wait for game which may or may not be harvested.

Indirect nature-related activity – reading about nature, watching films or television programs about nature, purchasing art, crafts or posters of nature, visiting zoos, game farms, aquariums or natural history museums, joining or contributing to naturalist, conservation or sportsmen’s [sic] clubs and maintaining, restoring, or purchasing land for conservation purposes.

Figure 2.4.1 shows the number and percentage of Canadians participating in nature-related activities in Canada.

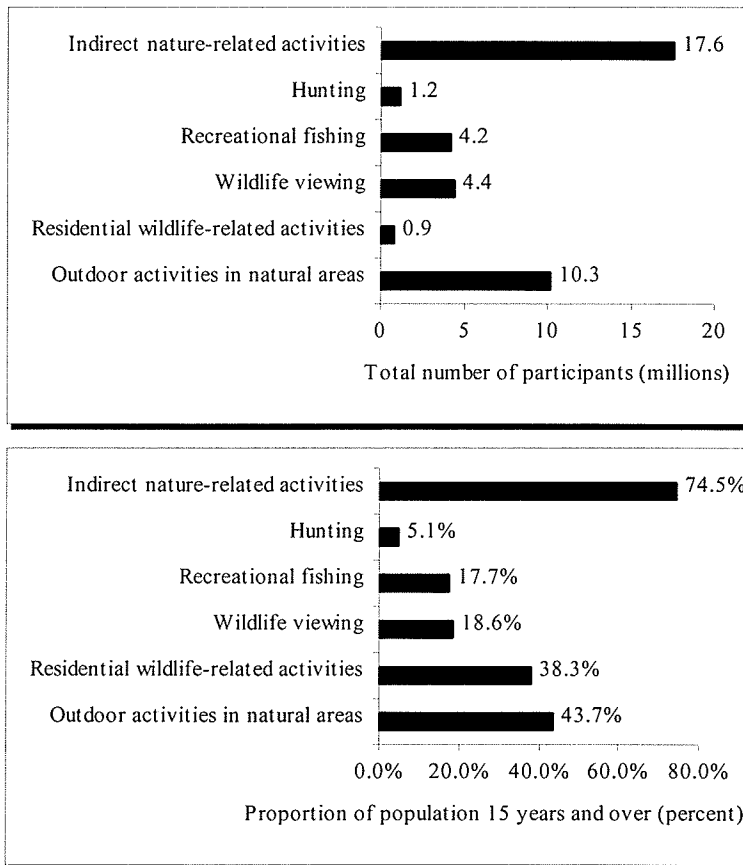


Figure 2.4.1: Number and percentage of Canadians participating in nature-related activities in Canada in 1996 (Environment Canada 1997).

The figure shows a high proportion of the population engaging in indirect nature-related activities (74.5%) followed by outdoor activities in natural areas (43.7 %) and residential wildlife-related activities (38.3%).

Figure 2.4.2 shows the percentage of Canadians participating in nature-related activities across Canada.

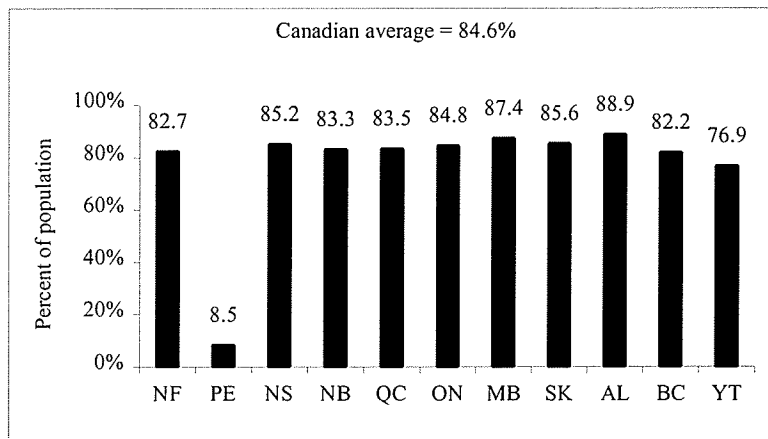


Figure 2.4.2: Percentage of Canadians participating in nature-related activities in 1996, by province or territory of residence (Environment Canada 1997).

Residents of Alberta, Manitoba, Saskatchewan, Nova Scotia, Prince Edward Island and Ontario had participation rates above the national average of 84.6 percent, with Alberta residents having the highest participation rate of 88.9 percent.

The proportion of residents participating in the various nature-related activities differs according to sex, age, urban-rural residence, education and personal income. Table 2.4.1 shows the profile of the Canadian population 15 years of age and over, in relation to the profiles of participants engaged in the various nature-related activities.

The table shows that the proportions of men and women that participated in outdoor activities in natural areas, in residential wildlife-related activities, and in wildlife viewing were similar while the proportion of men involved in recreational fishing and hunting practices was higher than that of women. In addition, the proportion of participants in nature-related activities between the ages of 15-19 and 65 years and over were considerably lower than those between the ages of 25-44. As well, the proportion of Canadians participating in nature-related activities was significantly higher with residents living in urban environments than those living in rural areas. Finally, there is a positive correlation between higher levels of both education and income, and participation in nature-related activities.

Table 2.4.1: Profile of Canadians participating in nature-related activities in 1996 (Environment Canada 1997).

	Outdoor activities in natural areas	Residential wildlife related activities	Wildlife viewing	Recreational fishing	Hunting	Population of Canada 15+
Total number of participants 15 years and over	10.3 million	9.0 million	4.4 million	4.2 million	1.2 million	23.6 million
Percent of participants						
Sex						
Male	50.5	47.5	49.3	66.3	8.5	49.1
Female	49.5	52.5	50.7	33.7	1.5	50.9
Age group						
15-19 years	9.8	6.6	7.8	9.4	6.7	8.4
20-24 years	10.1	6.3	8.8	9.3	8.4	8.4
25-34 years	25	18.5	23.8	23.5	21.9	19.9
35-44 years	25.6	23.3	25.9	26.8	27.3	21.4
45-54 years	15.4	18.7	17.2	16.2	19.2	16.4
55-64 years	7.6	12.2	8.9	0.8	10.2	10.8
65 years and over	6.5	14.4	7.6	6.8	6.3	14.6
Residence						
Urban	83	77.1	82.1	77.7	62.7	83
Rural	17	22.9	17.9	22.3	37.3	17
Education						
0-8 years	5.1	8.2	5.2	7.6	11	11.4
Some secondary	16.2	16.9	14.3	19.4	19.9	18.5
High school	17.3	18.1	17.2	18.5	17.7	18.5
Some post-secondary	11.2	9.9	11	10.5	8	9.9
Post-secondary certificate or diploma	27.4	26.7	27.8	29.1	32	24.6
University degree	22.8	20.2	24.5	14.9	11.3	17.1
Personal income						
No income	10.1	10.1	9.3	8.9	6.1	11.9
< \$5,000	10.4	9.3	9.5	9.4	6	9.9
\$5,000-\$9,999	9.6	11.1	10.2	8.7	7.8	12.2
\$10,000-\$19,999	16.6	19.6	17.3	16.2	15.5	20.4
\$20,000-\$29,999	16.5	15.9	16.4	17.1	20.3	16.5
\$30,000-\$39,999	13.4	12.1	13.4	14.5	16.4	11.3
\$40,000-\$49,999	9	8.3	9.1	9.5	11	7.1
>\$50,000	14.5	13.7	14.8	15.6	17	10.7

Focusing more specifically on outdoor activities in natural areas, Figure 2.4.3 shows the percentage of Canadians participating in outdoor activities in natural areas. Natural areas provided Canadians with opportunities for sightseeing (31.1%), picnicking (26.0%), swimming or beach activity (23.7%), camping (18.8%), photography (15.9%), and fruit and firewood gathering (11.0%). More active uses of natural areas included hiking or backpacking

(18.5%), canoeing or kayaking (9.9%), cycling in natural areas (8.6%), downhill skiing (4.7%), climbing (4.3%), cross-country skiing (3.5%) and horseback riding (1.6%).

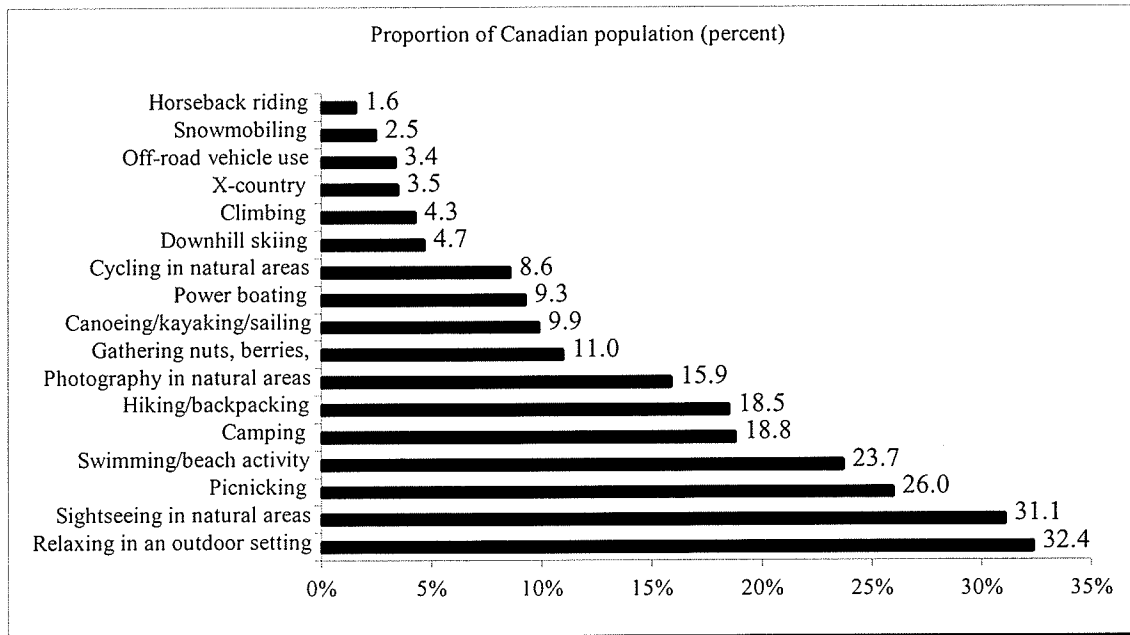


Figure 2.4.3: Percentage of Canadians participating in outdoor activities in natural areas in 1996 (Environment Canada 1997).

Participation rates of Canadians in outdoor activities in natural areas are shown in Figure 2.4.4. Residents of Alberta showed the highest rate (50.5%) above the national average (43.7%). Quebec and Prince Edward Island showed the lowest rates at 38.6% and 37.6%, respectively.

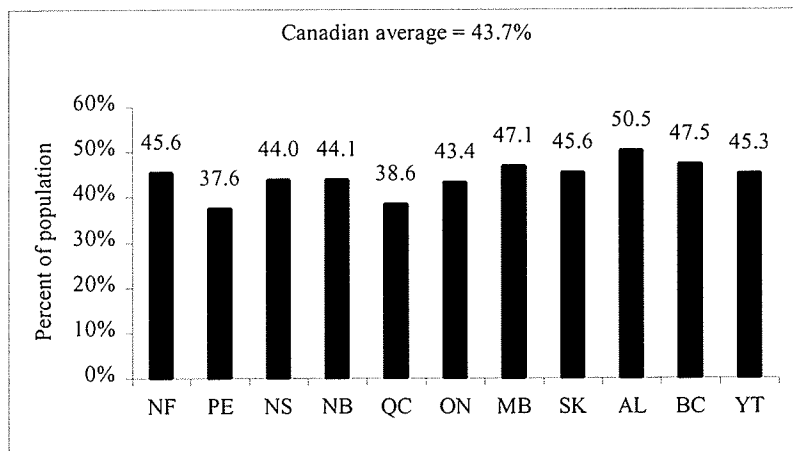


Figure 2.4.4: Percentage of Canadians participating in outdoor activities in natural areas in 1996, by province or territory of residence (Environment Canada 1997).

Of particular interest, other findings showed that Manitoba and Saskatchewan residents had the highest rates (73.6% each) of participation in outdoor activities in parks or other protected areas (Figure 2.4.5). Ontario, Quebec, Nova Scotia, Newfoundland, and the Yukon however, showed rates below the national average of 56.9 percent.

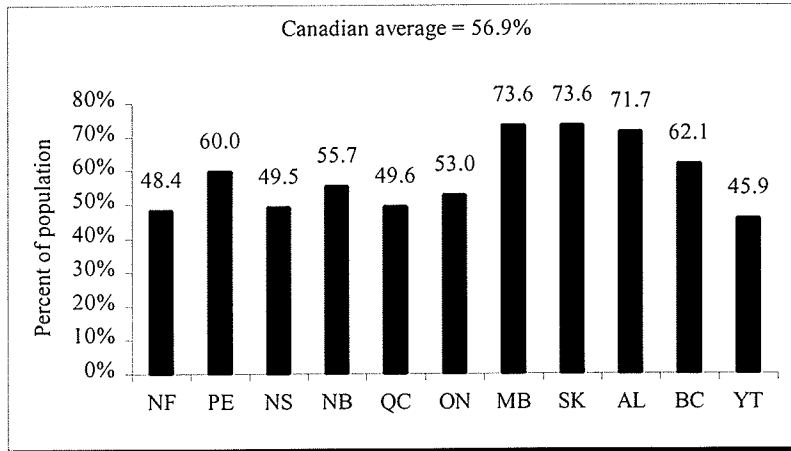


Figure 2.4.5: Percentage of participants in outdoor activities in natural areas in 1996 who visited parks or other protected areas, by province or territory of residence (Environment Canada 1997).

The *Survey on the Importance of Nature to Canadians* also addressed future changes to the current rates of participation in nature-related activities. The survey asked Canadians about their degree of interest in participating in nature-related activities, or whether they had interest in continuing to participate. Results showed that 74.0% of the Canadian population had either great or some interest in participating in outdoor activities such as hiking, riding, cycling, camping, skiing and snowshoeing in natural areas (Figure 2.4.6). If these results are compared to results from Figure 2.4.4, which shows the percentage of Canadians participating in outdoor activities in natural areas in 1996, we can see that the level of potential participation (74.0%) is over one and a half times higher than the rate of active participation in 1996 (43.7%). Thus, it is safe to assume that the rate of outdoor participation in recreational activities in Canada is likely to increase over time.

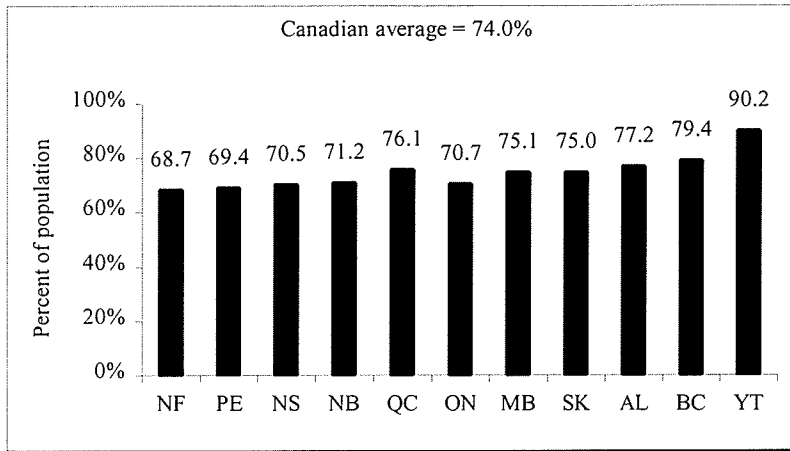


Figure 2.4.6: Percentage of Canadians expressing great or some interest in participating in outdoor activities in natural areas, by province or territory of residence (Environment Canada 1997).

Similar to what has occurred in the past and is occurring at present, future increase in outdoor recreation participation would be the result of demographic and socio-economic trends such as age, gender, culture, employment, leisure time, and technological advances (Wall 1989; Jensen 1995). This anticipated increase in outdoor recreational activities would have both positive and negative effects. The positive effects of recreation include personal benefits, social/cultural benefits, economic benefits and environmental benefits as set out in Table 2.2.1. The negative impacts of recreation are mainly of a social and environmental nature. Social impacts include conflicts between participants, conflicts between participants and non-recreationists/residents and impacts on local populations arising from infrastructure development. Social impacts are common in areas where tourism is high (Wall 1989). Environmentally, as the number of participants increase, overuse will exceed the ecological carrying capacity of a natural system and cause serious, often irreversible, damage (Burden & Randerson 1972). In addition, subsequent crowding and reduction in environmental quality will cause recreationists to venture more frequently and more extensively into more remote areas causing related impacts on soil, vegetation, wildlife and water. In addition, spatial expansion into remote regions is facilitated by technological innovations that will allow recreationists to readily venture into such areas (Wall 1989).

Chapter 3: *The Ecological and Social Impacts of Outdoor Recreation*

Chapter 3

The Ecological and Social Impacts of Outdoor Recreation

Activities associated with recreation result in the degradation of land, water and wildlife resources by simplifying plant communities, increasing animal mortality, displacing and disturbing wildlife, and distributing refuse (Boyle & Samson 1985).

Recreational impacts occur when there is an interaction between recreational use and environmentally sensitive areas. The degree of impact depends on 1) the characteristics of the environment, namely, the composition of the site and the vulnerability of its soils, vegetation, wildlife, water and topography; and 2) the characteristics of use of the environment, particularly, the amount of use, type of recreational activity, behaviour of recreationists, spatial distribution of use, and temporal distribution of use (Cole 1993).

The following section discusses and reviews existing literature on the effects of trampling associated with recreational activities on riparian soils, vegetation, wildlife and water, as well as the social impacts of outdoor recreation.

3.1 Effects of Outdoor Recreation on Soil

The vulnerability of soils to the impacts of recreational trampling varies depending on soil type, vegetation cover, topography and intensity of use (Weaver & Dale 1978). Impacted soils are typically found at picnic areas, campgrounds, low-standard roads, trails and off-roads (Douglass et al. 1999). Table 3.1.1 shows the relationship between soil characteristics and site vulnerability. Fine textured soils such as clay soils with high organic content and high soil moisture content, characteristic of riparian areas, are most vulnerable. On the other hand, loamy soils with moderate organic and soil moisture content are least vulnerable (Cole 1993).

Table 3.1.1: Relationships between soil characteristics and site vulnerability (Cole 1993).

Soil Property	Level of Vulnerability		
	Low	Medium	High
Texture	Medium (loam)	Coarse (sand)	Fine (clay)
Organic content	Moderate	Low	High
Soil moisture	Moderate	Low	High
Fertility	Moderate	High	Low
Soil depth	None	Deep	Shallow

The impacts of recreation on the air, water, dead organic matter and living organisms found in soil are unfavorable to all organisms that depend on this substrate for survival (Cole 1993). Figure 3.1.2 shows the three primary soil horizons. The uppermost layer of soil, the A-horizon, is the region of greatest physical, chemical and biological activity. It contains the greatest portion of the soil's organic matter, both living and dead, such as dead and decaying leaves and other plant parts, insects and decomposer organisms (Raven et al. 1992). The A-horizon plays an important role in the soil's biological activity and helps improve water quality by decreasing runoff and increasing water retention. It also contains the necessary nutrients required for plant growth and protects the more vulnerable mineral soil horizon below, from compaction and erosion (Cole 1993). This B-horizon is a region of deposition where iron oxide, clay particles, and small amounts of organic matter are carried from the top layer by percolating water. The B-horizon contains significantly less organic matter and is less weathered than the A-horizon (Raven et al. 1992). However, erosion of the mineral layer occurs once the vegetative cover and the organic layer is removed. Erosion processes are made worse by moderately steep to steeper slopes typical of riverbank zones. Once the soil-surface horizons are lost, long-term soil productivity decreases significantly (Douglass et al. 1999).

The principal effects of recreational trampling on soils are compaction, decreased macropore space, increased soil penetration resistance, increased soil density and a number of physical changes in the soil environment that inhibit seed germination (Kuss & Graefe 1985). When trampling affects the B-horizon, soil particles are compacted decreasing the amount of pore space resulting in reduced aeration and water content, making it difficult for plant roots to penetrate into the soil (Cole 1993). Crusts, which form on the surfaces of fine textured soils, inhibit seedling emergence and act as a seal against the entry of water, creating moisture stress in the soil surface (Jim 1987). Seedling mortality often results from desiccation and drought effects (Kuss & Graefe 1985).

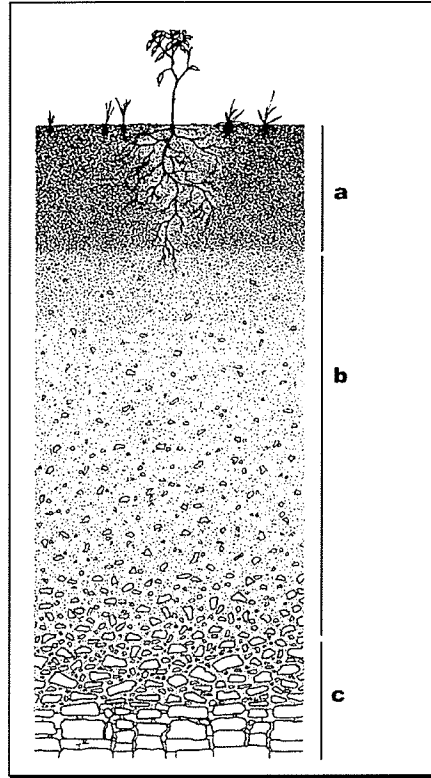


Figure 3.1.2: The three soil horizons in a typical soil (Raven et al. 1992)

Soil density changes influence root penetration, drainage properties, soil porosity and availability of soil nutrients (Liddle 1975). Changes in soil properties reflected by increased bulk density favour species with a greater tolerance to moisture and oxygen stresses as well as those morphologically adapted to gain establishment in highly compressed soils (de Gouvenain 1996). Thus, an increase in soil bulk density may cause the proliferation of one or more successful native and/or exotic species resulting in a change in community composition (Liddle 1975b).

Compacted soil will also affect the mobility of inorganic ions, and therefore their availability to plant roots (Burden & Randerson 1972). The resulting loss of vegetation cover and litter promotes higher soil surface temperatures and higher evaporation rates which lead to further restriction of soil air and moisture content (Kuss & Graefe 1985).

Figure 3.1.3 summarizes the effects of trampling on soil and vegetation.

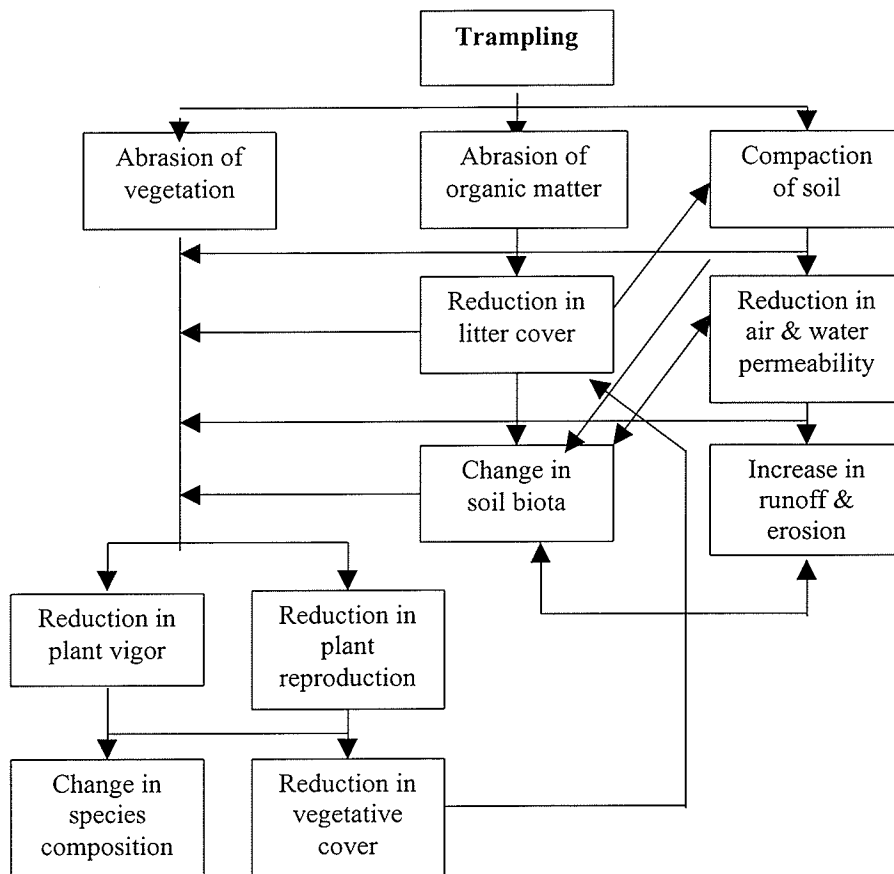


Figure 3.1.3: The effects of trampling on vegetation and soil (Cole 1993).

3.2 Effects of Outdoor Recreation on Vegetation

The impacts of recreation on vegetation are more evident than those on soils. Injury to plants caused by trampling may originate from below or aboveground damage (Dale & Weaver 1974). Belowground damage includes physical injury to root systems due to soil compaction and erosion effects exposing the roots (Douglass et al. 1999). Aboveground damage to fragile plant tissues includes bruising, crushing, tearing and uprooting. In areas of heavy recreation, trail networks fragment the forest leaving a large proportion of the surface stripped of vegetation (Cole 1993).

The ecological impacts of trampling on vegetation were best summarized by Liddle (1975). Two major effects can be observed: 1) the direct effects of mechanical forces which damage all or parts of the plant; and 2) the indirect effects of trampling on the physical and/or chemical characteristics of the soil, which in turn affect plant establishment, growth and reproduction. Bates (1935) suggested that the physical bruising of vegetation and puddling

caused by trampling has a greater effect on vegetation than the indirect effect of soil compaction. However, several researchers have discovered a causal relationship between marked changes in soil structure and vegetation degradation at trampled sites (Bhuju & Ohsawa 1998).

As diagnostic evidence of debilitation, symptoms of injured plants are similar to those expressed in response to disease and nutritional disorders (Kuss & Graefe 1985). Detrimental effects of trampling on vegetation include the disordered utilization of energy, injurious physiological processes and impaired vital functions of the injured plant (Kuss and Graefe 1985). Trampling damage to plants is often reflected by reduced vigour, significant reductions in height, loss of photosynthetic surfaces, flower and seed inhibition, defoliation, wilting, dieback and reduced biomass (Burden & Randerson 1972).

Some plant communities are more resistant to the direct effects of trampling than others, while some may be more resilient after direct impacts have ended (de Gouvenain 1996). This has been attributed to the fact that the resistance and resilience of different plant species to trampling varies depending on their morphology, anatomy, reproductive potential, and total biomass (Andraz & Ladislav 1998). Plants that are more vulnerable to the effects of trampling exhibit the following characteristics: 1) they grow to a moderate stature; 2) have an erect growth form; and 3) have woody, brittle, or delicate stems and leaves (Cole 1993; Cole & Landres 1995).

Characteristics that can make a plant more resistant to the effects of trampling include: 1) being either very small or very large; 2) growing either flat along the ground or in dense tufts; 3) having leaves and stems that are tough and/or flexible; 4) having growth points at or below the ground surface; 5) having a rapid growth rate; 6) producing numerous seeds; and 7) being an annual (Cole 1993; Cole & Landres 1995).

Recreational activities often play a role in introducing and encouraging weedy or exotic species, which often express these trampling-resistant characteristics (Douglass et al. 1999). Seeds or propagative tissue is easily dispersed along trails by humans through mud carried on footwear and bicycle tires, as well as the hooves, fur and feet of wildlife (Lanehart 1998). Once they are introduced into a disturbed area these weedy or exotic species thrive, favouring the environmental conditions present. They are resistant and/or resilient to the

impacts of trampling, and are likely to crowd out native vegetation, resulting in a decrease in the biodiversity of the site (Cole 1993).

3.3 Effects of Outdoor Recreation on Wildlife

With an ever-growing increase in outdoor recreation in natural areas, a lack of information about wildlife communities and their requirements and/or poor planning of recreational development could lead to considerable negative impacts on wildlife (Joslin & Youmans 1999). Boyle and Samson (1985) reviewed 166 articles that contained original data on the effects of non-consumptive outdoor recreation on wildlife and found that in 81% of the cases, effects were considered negative.

Human disturbance associated with recreational activities can impact wildlife in four main ways: exploitation, disturbance, habitat modification and pollution. *Exploitation* involves death of the animal via harvesting through hunting, trapping, fishing or collection. *Disturbance* involves activities such as photographing, bird watching, or hiking through an animal's territory. *Habitat modification* and *pollution* are indirect impacts. Vegetation, soil and water can be modified thus impacting the species that are dependent on these habitats. Animals may also be subject to pollutants, litter or food left behind by recreationists (Knight & Cole 1995).

Disturbance caused by recreational activities may trigger behavioural responses and/or physiological responses in wildlife (Douglass et al. 1999). The vulnerability of wildlife to these impacts depends on both the characteristics of the recreational disturbance and the characteristics of the affected wildlife. Characteristics of disturbance include type of activity, recreationist's behaviour, predictability, frequency and magnitude, timing and location. Characteristics of wildlife include type of animal, group size, and age and sex (Knight & Cole 1995b).

Wildlife may respond to these impacts in any of three ways: habituation, attraction or avoidance. These behavioural responses may be of short duration or longer term (Knight & Temple 1995).

Habituation: A waning of response to a repeated stimulus that is not associated with either a positive or negative reward. Conflicts with humans resulting from habituation may result in mortality such as vulnerability to hunters and poachers, vehicle collision, or management removal in response to constant property damage or nuisance.

Attraction: The strengthening of an animal's behaviour as a result of awards or reinforcement. Species are either in search for food they associate with humans such as garbage, pet food and bird feeders, or they approach humans for food in the case of squirrels, chipmunks, and some birds. This attraction of wildlife to humans can be dangerous to both wildlife and humans. In extreme cases, attraction can bring humans into contact with potentially dangerous animals resulting in the animal being killed or humans injured.

Avoidance: When human encounters are associated with pain or punishment shown in behavioural shifts in wildlife during recreational hunting season. Avoidance behaviour increases with an increasing number of negative encounters and can result in displacement and changes in distribution (Joslin & Youmans 1999).

Physiological responses to disturbance are difficult to observe and vary among species. These responses typically involve an elevated heart rate, increased blood flow to skeletal tissues, increased body temperature, elevated blood sugar levels, and reduced blood flow to the skin and digestive organs (Gabrielsen & Smith 1995). This active-defence response has a significantly large energy cost and can thus reduce vigour. However, an animal that is experiencing a deficient energy budget may express an opposite behavioural and physiological response to disturbance. This passive-defence response is characterized by the inhibition of activity, reduced blood flow to skeletal muscles, reduced blood flow to the digestive system, reduced heart and respiratory rate, and reduction in body temperature (Gabrielsen & Smith 1995).

Effects of disturbance can have detrimental effects to wildlife populations. If disturbance alters behaviours within a local population, it can result in distribution and habitat use changes, which may ultimately alter reproductive success and thus, the health and status of the population (Douglass et al. 1999). Several studies have shown that wildlife and humans can coexist together in most situations. However, there are two critical periods for many species of birds and mammals where human disturbance should be minimized or regulated

to prevent a reduction in the animal's reproductive success. These are the postnatal period in mammals and the breeding period in birds (Gabrielsen & Smith 1995).

3.4 Effects of Outdoor Recreation on Water

The majority of impacts of recreational activities on water occur indirectly through the disturbance of riparian soils and vegetation. Recreational use leads to a reduction in vegetative cover, loss of soil organic layers, and compaction of underlying mineral soils (Cole 1993). As a result, surface runoff increases and moves more rapidly because it has less resistance to flow compared to water percolating through soil (Douglass et al. 1999). This increase in surface runoff causes accelerated soil erosion and sediment deposition into the waterway, altering its physical structure and having adverse effects on aquatic life and habitat (Cole 1993; Douglass et al. 1999).

Compacted snow, as a result of winter recreational activities, melts rapidly and retains less water than non-compacted snow (Newmann & Merriam 1972). After heavy compaction, snow melting rates double, and the potential water-retaining capacity of compacted snow is significantly reduced. Consequently, during spring snowmelt, runoff increases significantly (Douglass et al. 1999).

3.5 Social Impacts of Outdoor Recreation

The social impacts of outdoor recreation include conflicts between participants, conflicts between participants and non-recreationists/residents and impacts on local populations arising from infrastructure development (Wall 1989). For the purposes of this study the impacts on the quality of visitor experience will be examined. Manning & Ballinger (1996) have found these impacts to include visitor crowding, conflicts between incompatible visitor activities, reduction in visitor learning, and spatial, temporal, or total visitor displacement.

Early outdoor recreation studies have shown that the quality of outdoor recreation experience diminishes as a result of increased use (Manning 1999). Crowding is often analyzed within social interference and stimulus overload theories (Baum & Paulis 1987). Social interference suggests that crowding occurs when the number of people present interferes with an individual's goals or desired activities. Stimulus overload is the result of an individual being overwhelmed by the presence of others. Studies have shown that perceived

crowding tends to be higher at more accessible locations and during peak use periods. On the other hand, perceived crowding is lower where management action is employed to reduce use (Shelby et al. 1989).

New behaviours, or coping mechanisms, evolve by individuals or groups of recreationists to deal with perceived crowding. Manning (1991) describes three main forms of coping behaviour: displacement, rationalization and product shift. Displacement is a behavioral coping mechanism that involves spatial displacement (intersite or intrasite) or temporal changes in use patterns. Rationalization is a cognitive coping mechanism involving rating one's recreation experience highly despite actual conditions in order to reduce internal conflict. Product shift is another cognitive coping mechanism whereby visitors experiencing higher use levels than expected or preferred, alter their definition of the recreational opportunity in correspondence with the conditions experienced.

It must be noted that use levels are not interpreted as crowding until it is perceived to interfere with an individual's values or objectives (Manning 1991). A number of factors have been found to influence crowding norms that include personal characteristics of visitors, characteristics of others encountered, and situational variables (i.e. location and environmental factors).

Other studies on outdoor recreation found conflicts between participants in alternative recreation activities. Conflict among recreationists is increasing as a consequence of technological innovations that contribute to the development of new recreational equipment and activities.

Conflict, for the most part, occurs among participants of differing recreational activities, especially between hikers and mountain bikers, and between canoeists and motor boaters (Manning 1999). Jacob and Schreyer (1980) defined conflict as goal interference attributed to another's behaviour resulting in dissatisfaction. They suggest that conflict is caused by four main factors that include activity style, resource specificity, mode of experience, and lifestyle tolerance. *Activity style* refers to the personal meanings assigned to an activity, which include intensity of participation, status as defined by equipment and expertise, and range of experience and definition of quality. *Resource specificity* refers to the significance attached to using a specific recreational resource for a given recreational experience

including, evaluation of resource quality, sense of possession, and status based on knowledge of a recreation area. *Mode of experience* refers to the extent to which the recreationist is focused or unfocused on the environment. Finally, *lifestyle tolerance* is the tendency to accept or reject lifestyles different from one's own.

Recreationists who are unable to cope with conflict stimuli experience diminished satisfaction and will ultimately be displaced. Conflict management is necessary in order to maintain the quality of recreation for those who are sensitive or intolerant of conflicting uses. Zoning of groups or recreational activities can be effective where goal interference is related to direct contact whereas, education is valuable where goal interference is indirect relating to differences in social values and attitudes (Manning 1999).

Chapter 4: *Riparian Buffers*

Chapter 4

Riparian Buffers

As discussed in Chapter 1, riparian buffers are valuable natural systems that provide many important benefits including flood control, bank stabilization, erosion control, filtration of nutrients and pollutants, water temperature regulation, wildlife habitat, and recreational and educational benefits. This chapter describes various guidelines and approaches to riparian buffer planning, design and implementation.

4.1 Functional Objectives

When designing riparian buffer strips or corridors, the primary objectives or functions of the buffer strip or corridor should be determined (Fisher & Fischenich 2000). Objectives may include: 1) water quality protection (pollutant removal, stream stabilization and temperature moderation); 2) riparian habitat (provision for aquatic and terrestrial wildlife); 3) flood control; and 4) recreational and educational opportunities (Berechtold et al. 1998). Land managers may choose to focus on one or all of the buffer strip functions.

4.2 Riparian Buffer Widths

Determining riparian buffer widths depends on the functional objectives one is interested in conserving (Berechtold et al. 1998). Criteria for determining proper buffer width dimensions for some functions are not well established and highly variable (Fisher & Fischenich 2000). Most existing criteria focuses on water quality protection however, it is only one of many functions performed by riparian buffers. There have been few approaches that mesh water quality width requirements with conservation values and recreational values (Fisher & Fischenich 2000). Generally speaking, the wider the buffer the better however, this is often not practical due to social, economic and political factors (Kipp & Callaway 2003).

Width recommendations for buffer strips can either be fixed or variable in nature (Fisher & Fischenich 2000). Fixed width buffer strips are usually based on a single function, for example, water quality protection. The advantage of fixed widths is that they are easier to enforce and administer by regulatory agencies. However, in certain situations, fixed widths may provide inadequate protection thus failing to address many of the riparian buffer functions (Castelle et al. 1994). Variable width buffer strips, on the other hand, are based on

multiple functions and may consider site-specific conditions by having widths adjusted according to adjacent land use, topography, hydrology, and wildlife considerations (Castelle et al. 1994). Table 4.2.1 shows a summary of recommended riparian buffer strip widths according to function.

Table 4.2.1: General Riparian Buffer Strip Width Guidelines (Fisher & Fischenich 2000)

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 non-point source pollution (NPSP) loads are particularly high.

RW ¹ = 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.

RW = 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.

RW = 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.

RW = 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.

RW = 3 to 10 m

¹Synopsis of recommended width (RW) values reported in the literature, a few wildlife species require much wider riparian corridors.

It is evident from the table that riparian buffer strip widths vary between functional objectives and vary within each function, depending on existing site conditions (topography, wildlife, and hydrology). However, in all cases, buffers wider than 10m should be promoted for optimizing a range of multiple objectives for water quality protection, stability, and habitat functions. Widths of 100m or more however, are usually needed to ensure values related to wildlife

habitat, and use as migration corridors (Fisher & Fischenich 2000). For recreational use within buffer strips, widths should be increased depending on the type of activity envisioned.

4.3 Riparian Buffer Lengths

According to Weller et al. (1998), long, continuous riparian buffer strips are encouraged rather than fragmented strips of greater width. In addition, unfragmented buffer strips are more effective at protecting water quality and for providing movement corridors for wildlife.

4.4 Riparian Buffer Zones

Several sources recommend a three-zone riparian buffer system approach in order to maximize the benefits of riparian buffers. (Bentrup & Hoag 1998; Berchtold et al. 1998; Connecticut River Joint Commission 2000; Fisher & Fischenich 2000). The most effective riparian buffers are comprised of three zones:

- *Streamside*: located from the high water line to the top of bank. This zone functions to protect the riverbank from erosion and provides habitat for both aquatic and terrestrial wildlife.
- *Middle Zone*: located inland from the top of bank. Width depends on the size of the existing site conditions (topography, wildlife, hydrology). This zone functions to protect water quality and provide wildlife habitat.
- *Outer Zone*: located upland from the middle zone, usually to the nearest permanent structure.

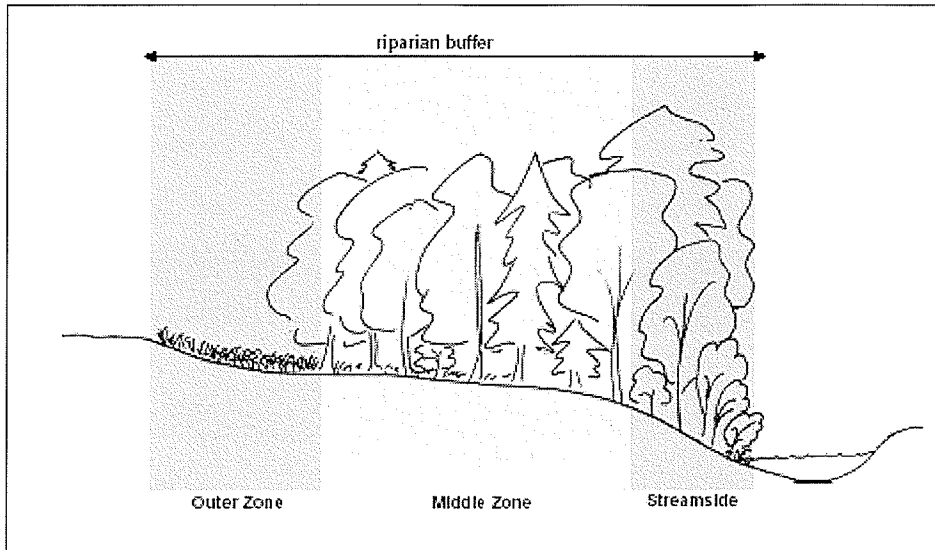


Figure 4.4.1: The three-zone riparian buffer system (Connecticut River Joint Commission 2000).

The description above can serve as a general guide to planning a riparian buffer, altered according to functional objectives and site conditions.

4.5 Urban Riparian Buffers

Riparian forests have been significantly modified over time as a result of continuous urban development of riparian habitat (Moffat 2002). Runoff from parking lots, roads, and lawns picks up heavy metals, toxins, litter, sediment, fertilizers, pesticides and other pollutants and carries them into streams. Removal of riverbank vegetation for land development and the use of riprap have reduced the ability of streams to cleanse themselves. Development has increased the amount of impervious surfaces such as roads, sidewalks, and parking lots increasing the risk of flooding (Connecticut River Joint Commission 2000).

Riparian buffers can counterbalance the negative effects of development, benefit public health, and bring beauty and enjoyment to a city. The three-zone riparian buffer system can be applied to urban areas as well. The most effective urban riparian buffers are those in which each zone serves a different purpose, and different uses are allowed in each zone (Bentrop & Hoag 1998; Berchtold et al. 1998; Connecticut River Joint Commission 2000; Fisher & Fischenich 2000). A general description of an urban riparian buffer is as follows:

- *Streamside*: located from the high water line to the top of bank and includes undisturbed forest along the riverbank. This zone functions to protect the riverbank from erosion, shade the stream, and provides habitat and food for terrestrial and aquatic organisms.
- *Middle Zone*: located inland from the top of bank. Width depends on the size of the existing site conditions (topography, wildlife, hydrology). This zone functions to protect water quality by removing pollutants from stormwater through filtering, denitrification, and plant uptake, and provides wildlife habitat. This zone is a strip of managed forest where some recreational uses such as pathways, may occur.
- *Outer Zone*: located upland from the middle zone, usually to the nearest permanent structure. The outer zone functions to help filter sediment from surface runoff. This zone is farthest from the stream and thus would allow for more uses.

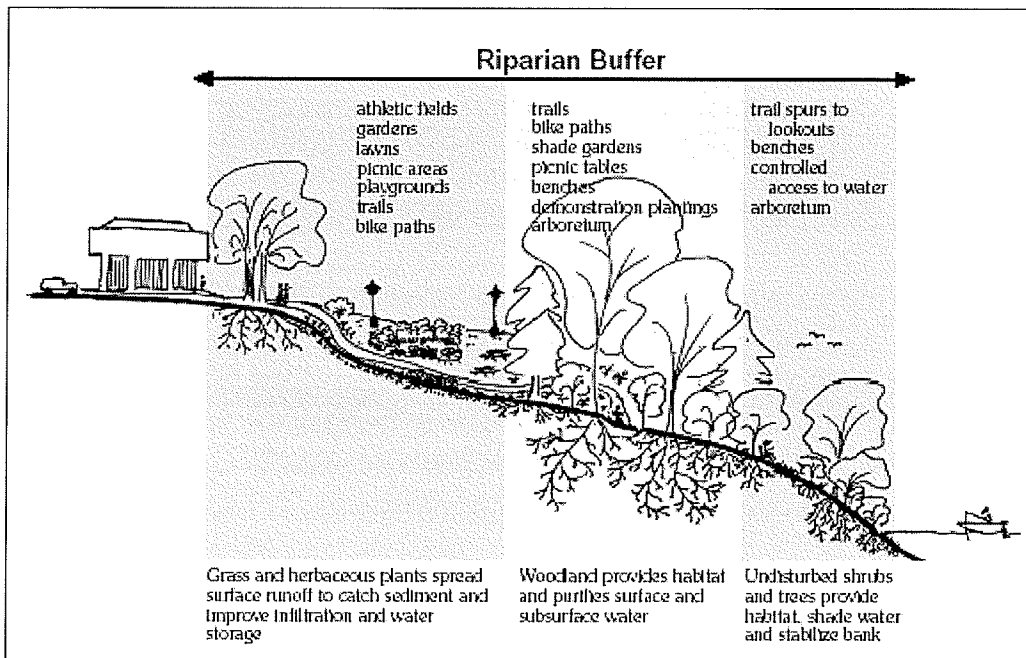


Figure 4.5.1: The three-zone urban riparian buffer system approach (Connecticut River Joint Commission 2000).

4.6 Planting Riparian Buffers

Revegetation

In order to reestablish or widen an existing riparian buffer, there are two main ways of establishing vegetation: natural revegetation or active revegetation. Natural revegetation involves creating a no-mow zone to allow pioneer species present in the area's seed bank to germinate and grow (Naturalist Services Branch 1999; Connecticut River Joint Commission 2000). Eventually, plants may be added and non-native plants can be removed. This method is less time-consuming and labour intensive and overall costs are reduced. Active revegetation involves establishing cuttings and/or nursery stock. This method allows for quicker results however, it is labour intensive and costly (Naturalist Services Branch 2003; Connecticut River Joint Commission 2000).

Plant Selection

In selecting appropriate vegetation for the riparian buffer, native plants that are well adapted to the environment will be the most successful (Fisher & Fischenich 2000). Native vegetation also requires less maintenance than non-native plants in addition, they are able to support native insects, birds, and wildlife (Connecticut River Joint Commission 2000). When selecting plants, it is recommended that a diversity of species be chosen to provide a more diverse habitat and visual appeal, as well as selecting age-diverse plants for a more 'natural' appearance (Naturalist Services Branch 2003; Connecticut River Joint Commission 2000).

Site Preparation & Planting

Prior to planting, invasive and aggressive species should be removed. Mechanical control is encouraged in riparian zones as chemicals can leach into the water system easily (Naturalist Services Branch 2003; Connecticut River Joint Commission 2000). When planting, avoid the use of heavy machinery near the riverbank. Arrange plants in a random fashion rather than in straight lines for a more natural appearance. When planting cuttings or live posts, drive them deeply into the soil, allowing a foot or so to remain. For rooted plants, prune any large damaged roots before planting. Set plant in a hole 2-3 times wide but only as deep as the root ball. Fill in the hole gently but firmly with the original soil, watering to settle the soil. Plant understory species later, once the tree and shrub strata have been established, as most do not tolerate full sun. Water plants regularly during the establishment period. Mulching can be used to limit surface erosion, suppress competitive weeds, and retain soil moisture. Weed blankets can also be used beneath the mulch for extra protection. Fencing can be used to control grazing, mechanical equipment, recreationists and vandals. Chicken wire or stucco

wire can be used to prevent small mammals from girdling saplings, and beaver activity (Naturalist Services Branch 2003; Connecticut River Joint Commission 2000).

Maintenance

Maintenance activities include monitoring for stressed or failed plants, invasive species, weed competition, browsing, erosion, and debris accumulation. Leave vegetation undisturbed along the riverbank unless it presents itself as a hazard. For larger rivers, remove a large leaning tree only if it threatens to destroy part of the riverbank, if it falls. For smaller streams, leave such trees undisturbed as it provides fish habitat and cover, unless it threatens to cause flooding. Leave leaf litter and undergrowth undisturbed in the streamside zone and as much as possible in the middle zone (Naturalist Services Branch 2003; Connecticut River Joint Commission 2000).

4.7 Recreation Planning

If recreational use is allowable in riparian buffer zones, keep recreationists on the trails and paths by establishing well-defined trails. Marker posts, boulders, signs, and fences should be used to direct traffic. Trails should run across a slope rather than down a slope to avoid creating runoff and erosion problems (Flink et al. 2001). A common mistake is to run a bike path adjacent to a river, which can result in an open 'swath', rather than a closed tree canopy. It is recommended instead to locate bike paths at a slight distance, with spurs to the river (Connecticut River Joint Commission 2000). Sensitive areas should be designated for low impact use rather than high impact use such as biking or horseback riding. Where vegetation is not fully established or rare, access should be restricted. In high traffic areas, trail surfaces should be firm however not impervious. Pet owners should be encouraged to avoid walking their pets in areas where droppings could wash into the river, and be reminded to pick up after their pets (Flink et al. 2001).

4.8 Managing Riparian Buffers

In order to manage riparian buffers, the Connecticut River Joint Commission (2001) suggests inspecting buffers regularly. Dumping, filling, and construction machinery should be excluded to protect damage to soils and vegetation. Cutting should occur only to trees that threaten to

pull the riverbank with them if they fall, but their root systems should be left to hold the bank in place. Tree snags should be removed from a stream channel only when it presents a flood hazard. Avoid raking leaves, clearing brush, and removing fallen logs to decrease runoff and to provide habitat for wildlife, particularly small mammals. If necessary, concentrate 'tidying up' efforts to highly visible areas. Exotic plant species should be identified and controlled as they can quickly spread and choke out native riparian plants. Public education focusing on the value and function of buffers should be adopted through signage, educational brochures, newsletters and field demonstrations to promote proper site-use and to prevent encroachment of development.

4.9 Costs and Benefits

The following describes the various costs and benefits involved in adding a riparian buffer in an urban setting (Connecticut River Joint Commission 2000):

Costs:

- Correction of compacted soil or other soil problems
- Plant material: Use cuttings or bare root plants from a native source; nursery stock are reliable but more expensive
- Mulch
- Labour in planting, pruning, sediment removal and maintenance
- Signage and fencing to guide public use, if appropriate
- Monitoring for signs of erosion and plant damage
- Cost of administering the buffer program
- Land acquisition, if applicable

Benefits:

- Reduced cost for mowing and maintaining
- Reduced cost for fertilizers, herbicides, fuel and equipment maintenance
- Avoided costs of engineering design, permits and bank stabilization
- Public land: recreation area and activities within buffer and waterfront access
- Flood protection
- Improved ambient air temperature and quality
- Visual screen and noise buffer
- Preserve important, valuable habitat
- Increased property value

The start-up costs of designing and implementing a riparian buffer may prove high initially however, the long-term benefits of riparian buffers greatly outweigh the initial costs.

Conclusion

This chapter revealed various guidelines and approaches to riparian buffer planning, design and implementation. Riparian buffers are among the best means for protecting rivers and streams and all that which lives within and adjacent to. In an urban environment, such a natural amenity is key to the quality of life of its citizens. Now, more than ever, riverfront lands are needed to protect the waterway from land-based pollution and to provide a place to recreate.

Chapter 5: *Design Precedents*

Chapter 5

Design Precedents

This chapter explores various projects where planning, design, or management strategies and recommendations have been proposed or implemented in order to minimize the ecological and/or social impacts of outdoor recreation in vulnerable landscapes.

The Wissahickon Riparian Restoration Trail Link – Philadelphia, Pennsylvania

The University of Pennsylvania's Morris Arboretum received a \$150,000 grant from the William Penn Foundation to coordinate and support a feasibility study, and to create a master plan for a multi-use path and riparian restoration along the Wissahickon Creek corridor between Fairmount Park in Philadelphia County and Fort Washington State Park in Montgomery County. Andropogon Associates Ltd., Cahill Associates, and Campbell Thomas & Co., were contracted by the Morris Arboretum for design, environmental consulting, and trail consulting services. In 1998, the feasibility study and master plan were completed.

The *Wissahickon Riparian Restoration and Trail Link Master Plan* is a set of conceptual and specific recommendations for the design and installation of a riparian restoration and trail link system.

“The vision of the Wissahickon Riparian Restoration and Trail Link project is to design a scheme for shared use in the project corridor that provides for recreation, education and enjoyment of the local community while preserving and enhancing the river corridor’s protective and nurturing role for plants and animals” (The *Wissahickon Riparian Restoration Trail Link Master Plan* 1998).

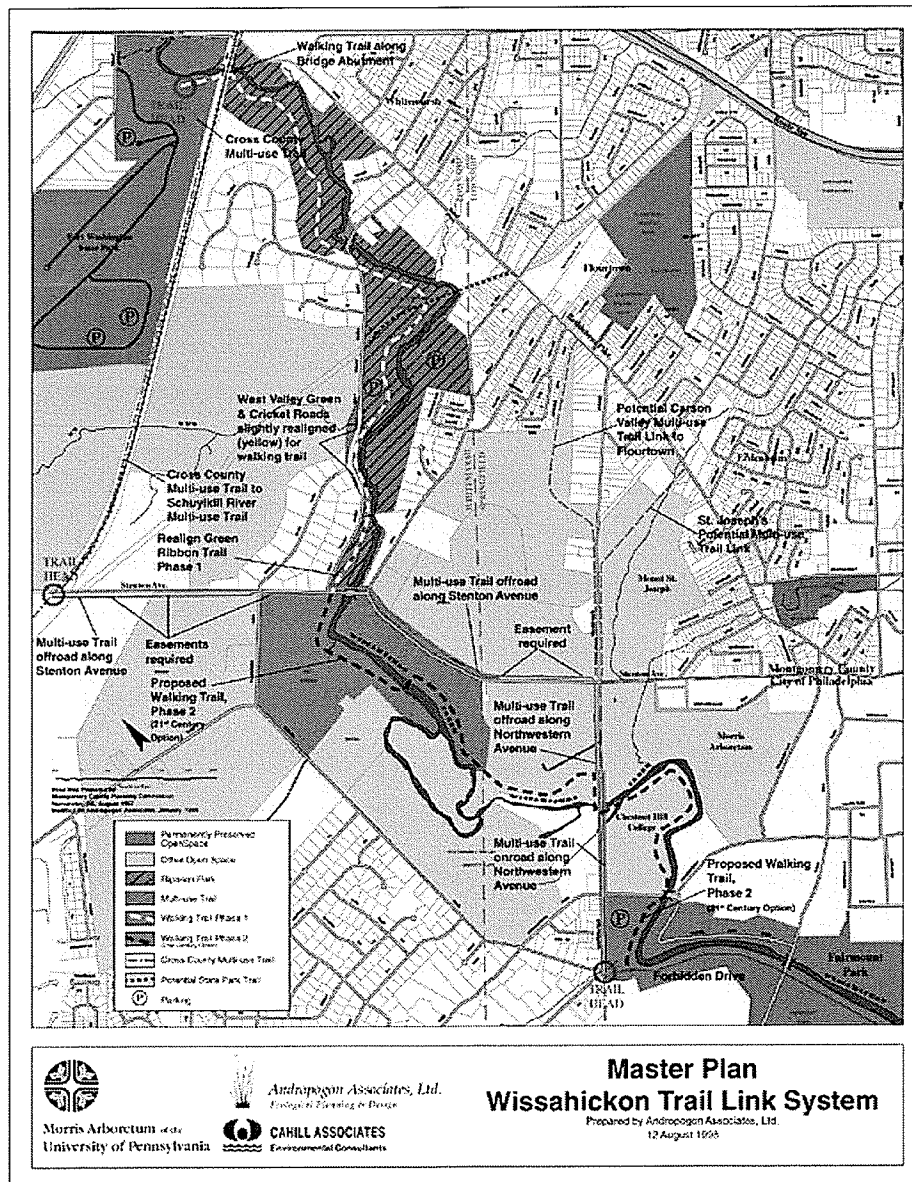
The Proposed Trail System

Three design guidelines for the trail system emerged from planning discussions:

- Provide for different types of user groups and prevent conflicts
- Provide a walking trail in natural areas that serves recreation needs that are consistent with the conservation of existing habitat
- Provide a wider hard-surfaced trail for recreational travelers and multiple uses outside of sensitive natural areas

These guidelines are based on the fact that different users have different needs and expectations, that no single trail or trail type can meet all recreational activities and their requirements successfully, and that the landscape is not suited to all potential users. The County and State lands adjacent to the Wissahickon Creek are viewed as irreplaceable and valuable habitat and of primary importance in sustaining water-related resources. Only recreational uses that are consistent with its value as a natural resource are deemed suitable.

The proposed trail system is composed of two trails: a *Multi-use Trail* along Northwestern and Stenton Avenues and a *Walking Trail* along the Wissahickon Creek. The conceptual design is customized to the unique conditions of the Wissahickon Creek riparian corridor.



The Walking Trail
The existing path along the Wissahickon Creek was too close to the water source in many locations and trail relocation was suggested in order to reduce negative impacts on stream bank stability. Bicycles were not permitted on the Walking Trail and were diverted to the Multi-use Trail. Where access to

Wissahickon Creek was desired, it was recommended that the soil surface be reinforced to handle excessive foot traffic without damage. Stepping stone trails, boardwalks over wet areas, fishing platforms, overlooks and rest areas were considered in order to allow opportunities for visitors to enjoy the water's edge. The following guidelines for the Walking Trail were developed:

- Limit use to pedestrians
- Relocate existing paths where damage has occurred
- Reinforce and manage streamside access
- Integrate environmental education, habitat restoration and recreation

The Multi-use Trail

The Multi-use Trail will provide connections with specific destinations and journeys incorporating a variety of experiences from share-the-road to off-road and will provide a scenic, cultural and pastoral journey. Trail surfaces for the Multi-use Trail include asphalt or porous asphalt paving designed to accommodate bicycles and meet the current guidelines for universal access for multi-purpose trails. The Multi-use Trail traverses the Wissahickon Creek twice allowing views of the Creek, however access is limited within the riparian corridor.

Blue Ridge Parkway – North Carolina

The Blue Ridge Parkway in North Carolina extends between Shenandoah National Park and the Great Smoky Mountains National Park, a distance of 469 miles. Construction began in 1935 and was completed 52 years later in 1987. The main intention of the Blue Ridge Parkway is to conserve, interpret, and exhibit the unique natural and cultural resources of the central and southern Appalachian Mountains, as well as provide for leisure motor travel through a variety of environments. The Parkway's varied topography and numerous vista points offer easy public access to spectacular views of the southern Appalachian rural landscapes and forested mountains. The Parkway's uninterrupted corridor facilitates the protection of a diverse range of flora and fauna including rare and endangered plant and animal species and areas designated as national natural landmarks (National Park Service 2003).

Craggy Pinnacle, a popular vista point along the Blue Ridge Parkway, offers spectacular views of the surrounding mountain range.

“Visitors hike a half-mile-long trail to the summit where they can enjoy panoramic vistas framed by numerous rock outcrops that encircle the peak. These outcrops enhance visitor experiences by offering extensive views, privacy, flat ledges for informal seating, and intriguing places to explore. They also harbour six rare or endangered species that account for nearly 90 percent of the vascular plant coverage on the rock outcrops” (Johnson 1989).

Visitor use of the area over the years, unchecked, has led to a network of informal trails converging, along with the official trail, toward the summit, where trampling of rare vegetation is problematic. The National Park Service conducted a preliminary inventory consisting of surveying visitor use and the distribution of rare plants. Results from the survey showed that frequency of visitor use was as high as 484 people per day during the height of the fall season and that as many as 50 % of those users arrived at the summit by unofficial trails. The vegetation survey showed that conditions ranged from areas relatively untouched to areas completely degraded where up to a foot of soil had been eroded, exposing bare rock (Johnson 1989b).

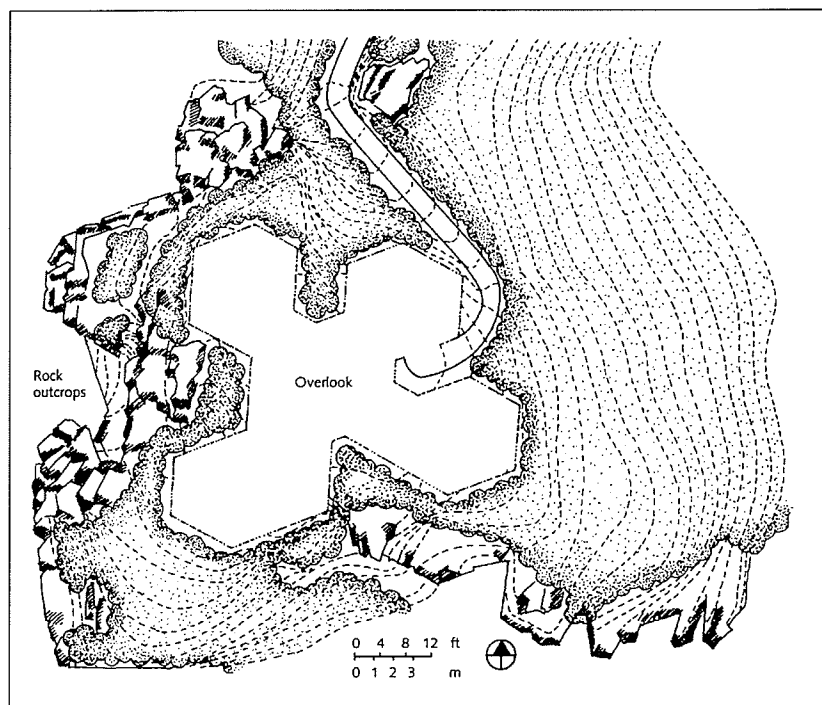
Preliminary efforts to close the informal trails with brush proved unsuccessful. Brush barriers were either destroyed or rendered ineffective. When signage, informing trail-users of the area’s fragile habitat were incorporated, barriers proved successful. Managers concluded that:

“The small interpretive signs were critical to keeping people on official trails, but that signs and brush barriers were still only a partial solution to the problem” (Johnson 1989c).

The design of an overlook platform for Craggy Pinnacle was determined to be necessary in order to concentrate use in a designated area, protect rare plants from trampling, and provide an attractive place for visitors to view the surroundings. Educational material, such as interpretive signage, was provided to inform visitors of the fragility of the site and to encourage visitors to stay within the designated areas (Johnson 1989). With visitor behaviour

under control, and the underlying cause of the problem solved, the final step involved reestablishing the damaged plant communities.

“Craggy Pinnacle offers a number of important lessons for greenway design and management. This example shows how site research and experimentation can be used effectively to identify and respond to the specific underlying problems facing the area. In this case, both visitor behaviour and environmental conditions were analyzed to help identify the root cause of the problems” (Cole 1993).



(Cole 1993)

Cole (1993) recommends using a combination of management strategies and actions when problem-solving. In the case of Craggy Pinnacle, a number of strategies were employed as part of the overall solution:

- Visitor use was concentrated in a smaller area
- Vulnerable sites were shielded from visitor use
- Sensitive areas were closed with barriers

- Education and interpretation were used to change or influence negative visitor behaviour
- Degraded areas were rehabilitated

Conclusion

In situations in which the ultimate goal is to provide recreational opportunities and to conserve natural resources, the key is to understand the recreational trail-users, their impacts, and the sensitivity of the resource at hand. The precedents outlined in this chapter provide useful recommendations and methods that can be drawn upon for the design and management of the Assiniboine Park riparian forest. These include:

- Providing for different types of user groups to prevent conflict
- Providing a walking, lower impact, trail in natural areas that allows for recreational activities that are consistent with the habitat conservation objectives of the site
- Providing another trail for higher impact recreational activities away from sensitive areas
- Using education and interpretation to encourage proper use and behaviour

Chapter 6: *Site Analysis*

Chapter 6

Site Inventory & Analysis

The Assiniboine River is a main tributary of the Red River (Baracos & Kingerski 1998). It flows southeast from its source in Saskatchewan towards Virden, Manitoba through to Portage la Prairie and into Winnipeg where it joins with the Red River. Winnipeg's Assiniboine Park is located west of the City centre on the south bank of the Assiniboine River. Park Boulevard borders Assiniboine Park on the east, and Corydon Avenue border it on the south. A pedestrian footbridge from Portage Avenue allows access from the north side.

6.1 Site Research

Site Location

The Assiniboine Park riparian forest is located within Assiniboine Park on the south bank of the Assiniboine River. It stretches along the Assiniboine River for approximately 2.3 km (Figure 6.1.1). The Assiniboine Park riparian forest is bordered by the Assiniboine River on one side and a paved bicycle path on the other. Beyond the bicycle path is the main thoroughfare, Assiniboine Park Drive, and the Assiniboine Park itself with its vast open recreational spaces and shade trees.

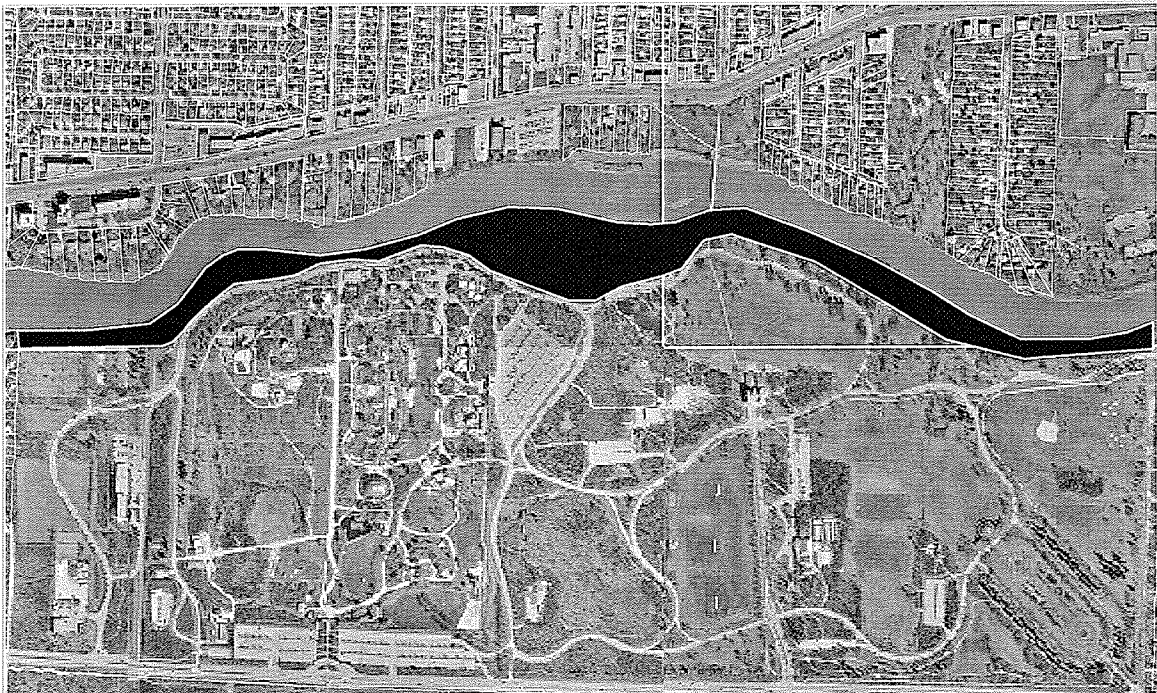


Figure 6.1.1: The Assiniboine Park riparian forest.

Geology

Bedrock formations underlying the Winnipeg region include rock types from the Mesozoic era to the Precambrian, with the dominant rock types of the Paleozoic era (Michalyna et al. 1975). Rocks of the Paleozoic era are mainly those of the Ordovician, Silurian and Devonian periods and are comprised of limestones and dolostones with small quantities of shales, sandstones and precipitates or evaporites. The rocks of the Mesozoic era include formations of the Jurassic and Cretaceous periods and are predominantly shales embedded with layers of sandstones, limestones and evaporites (Ehrlich et al. 1953).

The geology of the Assiniboine Park riparian forest area is attributed to the glacial history of the region. Approximately 12,000 years ago during the last retreat of the continental glacier, Lake Agassiz formed (Figure 6.1.2). It covered a significant portion of Manitoba and northwestern Ontario extending westward into Saskatchewan and southward into the northern United States (Krenz & Leitch 1993).

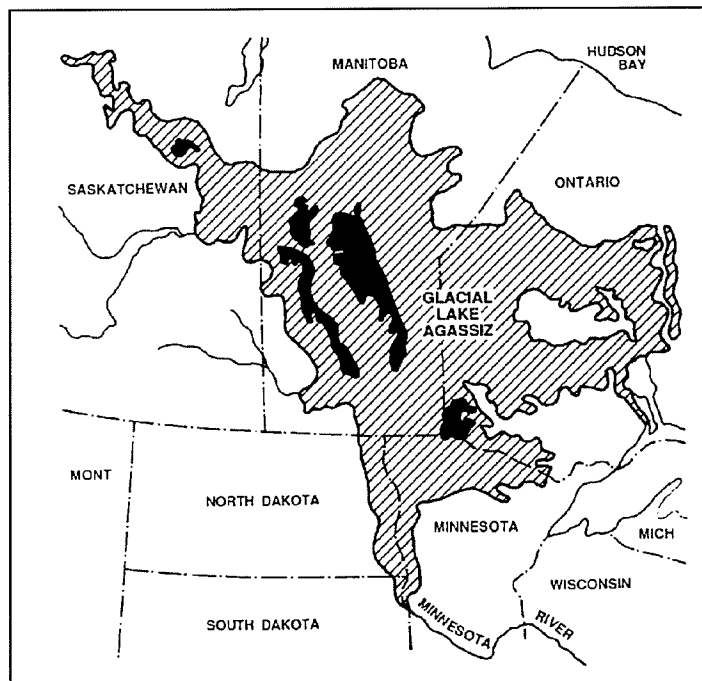


Figure 6.1.2: Glacial Lake Agassiz (Krenz & Leitch 1993).

From the time of glacial melting in the Pleistocene period, glacial drift or till, was modified by geological forces to produce diverse textural types of parent material (Ehrlich et al. 1953). Coarse fragments such as boulders, cobbles, gravel and stones were deposited along the

shoreline of the Lake Agassiz, whereas, finer sediments such as sand, silt and clay were transported and deposited on the lake bottom (Michalyna et al. 1975).

Winnipeg's glacial lake deposits vary in composition from predominantly clay to silty clay to predominantly silt (Baracos & Kingerski 1998). However, post-glacial river flooding, deposition and erosion, in conjunction with vegetation growth and human activity have consequently modified the surface of Lake Agassiz sediments within Winnipeg. Near-surface deposits are thus complex, and the highly plastic silty clay and clay in the upper zone of Lake Agassiz sediment have developed a "nuggety" structure from repeated shrinking and swelling activities associated with freezing and thawing. This upper zone has been defined as the Complex Zone Unit and typically extends 3m in depth. Below, homogenous glacial lake sediment extends to the till and has been called the Silty Clay Unit, which is approximately 9-12m in thickness. These two units, including another Complex Area along rivers and creeks, essentially underlie the entire city of Winnipeg (Baracos & Kingerski 1998).

Topography

The topography of the study area consists of the three zones typical of riparian forests: the riverbank, floodplain and terrace (Figure 1.1.1). During spring flooding, the rapid waters of the Assiniboine River erode and deposit sediment along its banks, constantly reshaping the land creating a system of river terraces (Briggs et al. 1993; Reilly 2000). The east side of the Assiniboine Park footbridge is characteristic of riverbank and floodplain zones. Elevation ranges from 217.5 m at the river's edge to 230.0 m at the forest's edge and paved bicycle path (Airquest Resource Surveys 1984). The average slope for the east side is 36.2% with a minimum slope of 18.9% closer to the footbridge and a maximum slope of 78.1% further east towards Park Boulevard. The west side of the Assiniboine Park footbridge is an area not prone to flooding and thus is characteristic of upland areas. Elevation ranges from 217.5 m at the river's edge to 232.0 m at the forest's edge and paved bicycle path (Airquest Resource Surveys 1984). The average slope is 47.3% with a maximum slope of 80.6% closer to the footbridge and a minimum slope of 19.6% approaching the western limits of the Assiniboine Park.

Soil

The soils of the Assiniboine Park riparian forest belong to the Riverdale Association. Riverdale soils are juvenile alluvial soils found on the terraces and floodplains along Winnipeg's rivers and their tributaries. These soils are recent alluvial deposits formed as a result of stream overflow. They are characterized by poor soil-horizon development composed of a thin leaf mat and layers of alluvial deposits varying in thickness and texture ranging from fine sandy loam to silty clay. Riverdale soils are a grayish brown colour in the upper portion of the profile, and slightly darker and sometimes iron-stained in the lower portion. These soils are highly fertile and can support dense deciduous forests comprised of elm, ash, aspen, cottonwood, basswood, Manitoba maple, and willow (Ehrlich et al. 1953).

St. Norbert Clays, which form part of the Red River Association of Blackearth Zone soils, are found primarily in the upland areas along the Assiniboine River. These soils are not regularly flooded and are moderately to highly fertile, supporting such species as oak, aspen, hazel, Saskatoon, and dogwood. St. Norbert Clays are well drained and better developed than Riverdale soils (Ehrlich et al. 1953).

The Riverdale soils of the Assiniboine Park riparian forest are subject to the impacts associated with heavy recreational use. Fabbri and Jurkow (1997) found a high percentage of bare ground in the floodplain region of the Assiniboine Park riparian forest, east side of the Assiniboine Park footbridge. Soils found along recreational trails in this area were 'cement-like' in character. Manning (1979) states that once trampling has removed leaf litter and organic matter, compaction of soils occurs. Compaction decreases soil porosity and thus decreases air and water permeability resulting in an increase in runoff and erosion (Lanehart 1998). During periods of spring flooding, the Assiniboine Park riparian trails become extremely wet and muddy (Fabbri & Jurkow 1997). Rutting and pitting occurs along these trails as a consequence of bicycle-tire treads eroding the wet surfaces of the clayey soils (Figures 6.1.3 and 6.1.4). When recreationists avoid these ruts and wet spots, further trampling of vegetation occurs and the trails become wider. In addition, users may create other temporary routes in order to avoid wet areas. As a result, an extensive network of braided trails or 'monkey trails' occurs throughout the riparian zone as observed at the Assiniboine Park riparian forest.



Figure 6.1.3: Wet trails in the floodplain region of the Assiniboine Park riparian forest eroded by bicycle-tire treads, east of the Assiniboine Park footbridge.



Figure 6.1.4: Erosion and pitting along wet trails in the floodplain region of the Assiniboine Park riparian forest, east of the Assiniboine Park footbridge.

The west side of the footbridge is characteristic of more upland areas and is not subject to regular periods of flooding. Fabbri and Jurkow (1997) found fewer instances of wet trails, rutting and trail braiding overall, however a few instances of heavy trail pitting was noted on the west side adjacent the footbridge where soil conditions are wetter (Figure 6.1.5). Observations suggest that recreationists prefer to keep to the main asphalt trail rather than using the few minor trails within the riparian zone. This may be due to the high density of European buckthorn occupying the shrub and tree layers of this forest. Leung and Marion (1996) state that forests with dense understories constrict trail users to the trail treads and reduce corridor width. Lanehart (1998) maintains that vegetation armed with thorns can also constrict trail traffic and reduce overall impacts to vegetation.

Vegetation

The vegetation of the study area is essentially characteristic of riparian forest communities. A list of plant species present along the Assiniboine Park riparian forest is found in Appendix 1B.

The composition of vegetation varies in relation to the topography of the site. The species composition on the east side of the Assiniboine Park footbridge is typical of the riverbank and floodplain zones of a riparian forest. This area is, however, characterized by a high canopy and relatively little understorey. As mentioned previously, trampling associated with heavy recreational use, plays a major role in the degradation of the Assiniboine Park riparian forest (Fabbri & Jurkow 1997). Trampling associated with recreational activities reduces or alters the vegetation within the trail corridor directly by bruising, crushing, or breaking vegetative tissue, or indirectly through soil compaction, alteration of surface water drainage, or introduction of exotic species (Manning 1979). Soil compaction reduces porosity, inhibiting seed germination, preventing root expansion or vegetative propagation (Hammit & Cole 1987). In many instances, water runoff erodes the upper soil horizons, decreasing trail depth and thus exposing tree roots, which has detrimental effects to the plant. In spring, during periods of flooding, wet trail conditions result in a high incidence of trail braiding, widening and erosion along the trails further trampling riparian vegetation. The floodplain area, east of the Assiniboine Park footbridge, is characterized by a high percentage of bare ground especially along pathways and low diversity and abundance values for the tree, shrub and herbaceous strata (Fabbri & Jurkow 1997).



Figure 6.1.5: Severe erosion and pitting along the Assiniboine Park riparian forest trails, immediately west of the Assiniboine Park footbridge (Fabbri & Jurkow 1997).

Vegetation present near these paths becomes bruised or crushed by recreational activity, stunting their growth or eliminating them completely (Burden & Randerson 1972).

Fabbri & Jurkow (1997) found that the herbaceous layer in the floodplain region of the Assiniboine Park riparian forest, east of the Assiniboine Park footbridge is dominated by the native riparian species, wood nettle (*Laportea canadensis*). This plant is covered with stinging hairs, or trichomes, that inject formic acid into the skin when rubbed against, causing an itching or burning sensation that lasts for a few minutes or in some cases, a few days (Tuberville et al. 1996). Its dominance may be the result of the combination of ideal floodplain growing conditions and its morphological characteristics. Trampling of wood nettle is reduced due to its stinging properties and is thus a contributing factor to its dominance. Figures 6.1.6 and 6.1.7 show the density of wood nettle in the floodplain region of the Assiniboine Park riparian forest. The presence of wood nettle may contribute to the low species diversity of the site because its large leaves limit the amount of light penetrating through to the understory thus inhibiting the growth of other species (Harrison & Kunec 1995). Fortunately, the occurrence of European buckthorn is limited in the floodplain region of the Assiniboine Park riparian forest, east of the Assiniboine Park footbridge. Archibold et al. (1997) found that prolonged high water levels during spring runoff regulate the spread of European buckthorn in low-lying riparian areas by suppressing seed germination.

Conversely, the species composition on west side of the Assiniboine Park footbridge is characteristic of the much drier, upper terraces. This area is not subject to spring flooding or heavy trampling associated with recreational trail use. As a consequence, there is a higher species abundance and diversity, particularly in the herbaceous layer. However, European buckthorn trees and shrubs heavily infest this area (Figure 6.1.8). This exotic plant has the ability to invade natural areas and replace native vegetation because it tolerates a wide range of soil moisture conditions and light levels, it produces vast amounts of fruit, and its seeds are highly viable and germinate rapidly (Gourley & Howell 1984). In fact, in the more upland regions of the Assiniboine Park riparian forest, west of the Assiniboine Park footbridge forest, rapid invasion of European buckthorn has claimed much of the shrub layer and is quickly invading the herbaceous layer (Fabbri & Jurkow 1997).



Figure 6.1.6: Wood nettle dominance in the floodplain region of the Assiniboine Park riparian forest, east of the Assiniboine Park footbridge.



Figure 6.1.7: Wood nettle along the Assiniboine Park riparian forest trails in the floodplain region, east of the Assiniboine Park footbridge.



Figure 6.1.8: A European buckthorn (*Rhamnus cathartica*) stand in the upland areas of the Assiniboine Park riparian forest, west of the Assiniboine Park footbridge.

Wildlife

Wildlife observed in the Assiniboine Park riparian forest was recorded by Fabbri and Jurkow (1997) and is shown in Appendix 1C. Six species of birds and five species of mammals were identified however, these numbers do not entirely reflect the wildlife diversity of the Assiniboine Park riparian forest. The birds and mammals observed are commonly found along many of Winnipeg's rivers, creeks and streams.

The impacts of recreational activities on wildlife at the Assiniboine Park riparian forest were not measured or observed as historical population counts are lacking. As a consequence, comparisons cannot be made. Wall (1989) states that population counts prior to the incidence of recreation are essential information where impact is due to habitat disturbance and modification.

In urban environments there are numerous native and migratory animals that have expanded their ranges and spend all or part of their lives within city limits. Many species adjust well to the presence of humans and often become tame and indifferent. Other, more sensitive, species are either displaced or decrease in number or variety (Wall 1989). As urbanization increases, and valuable native habitat decreases in number and quality, it becomes increasingly important to preserve existing native habitat in order to encourage and support urban wildlife diversity.

Water

Water levels and flow of the Assiniboine River within Winnipeg are highest in spring during the months of April, May and June with its mean peak in April (Water and Waste Department 2001). Figure 6.1.9 shows the extent of flooding for the Assiniboine River. Data for the map was obtained from the City of Winnipeg. Floods are flow events in which the water channel cannot contain the peak discharge. Following a period of heavy precipitation, excess water is stored initially in the channel area however, as storage capacity exceeds, water spills onto the floodplain resulting in a flooding event (www.euclid.dne.wvnet.edu). As shown in Figure 6.1.9, there are two areas along the floodplain that receive excess discharge from a flooding event, the floodway and the floodfringe. The floodway is defined as the portion of the floodplain that carries high velocity flows during a flooding event. The floodfringe is the portion of the

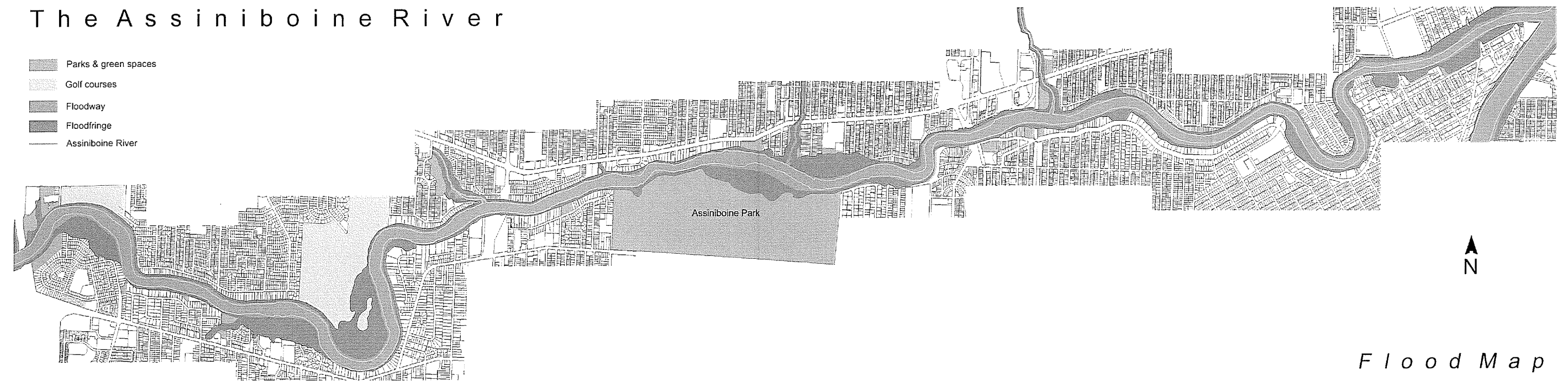


Figure 6.1.9: Assiniboine River flood map showing floodway and floodfringe.

floodplain that carries shallow, slow moving water during a flooding event. During the flood of 1997, river discharge along the Assiniboine River reached the extent of the floodway.

Climate

Winnipeg is located in the Mid-Boreal-Temperate Ecological Region, which is characterized by moderately cold to boreal temperatures and sub humid moisture (Baracos & Kingerski 1998). The mean annual temperature is 2.4° C with a mean maximum of 26.1° C in July and a mean minimum of -23.6° C in January. The mean annual precipitation is 504.4 mm with 404.4 mm as rainfall and 114.8 mm as snowfall. Peak rainfall occurs in June (83.8 mm) and peak snowfall occurs in January (19.3 mm). The mean annual sunshine is 2377.3 hours with its peak in July (321.7 hrs) and its dip in November (94.9 hrs) (Environment Canada 1998). Appendix D shows a detailed table of the Canadian climate normals recorded at Winnipeg International Airport between 1961-1990.

History

Riparian forest along Winnipeg's Assiniboine River remained significantly intact during the early settlement period. As Figure 6.1.10 shows, the majority of early settlement occurred along the Red River leaving most of the riparian forest along the Assiniboine River unaltered by humans (Arrowsmith 1819). During the late 19th Century, significant commercial, social, and civic growth was quickly replacing the pioneering conditions in Winnipeg (Parks and Recreation Department 1972). With the coming of the railroad in 1882 and the consequential growth in commercial activity, Winnipeg became the centre of Western economic activity. Commercial elite, whose interests lay in the promotion of economic activity, dominated the City's political, economic and social life (Graham 1983; de Graaf 2000). From a population of 6,178 in 1880, the city doubled in size to 13,856 in 1882, tripled to 19,574 in 1885, quadrupled to 24,068 in 1891, and steadily grew to 42,534 in 1900, and 122,390 in 1907 (Graham 1983). At this time, settlement along the Assiniboine River was expanding. Most of the desirable residential units were located west along the Assiniboine River, away from the industrial activity of the railway and the Red River (Graham 1983). The need for park space was expressed in the Public Parks Act of Manitoba passed by the Provincial Legislature on April 20, 1892 *promoting "the establishment and maintenance of public parks in cities and towns"* and that *"all parks...shall be open to the*

public free of charge" (Parks and Recreation Department 1972). In January 1893, the Public Parks Board was established and proposed the establishment "*of small urban parks, ornamental squares or breathing places, throughout the City, and also a large suburban, or outside park as a means of enjoyment and recreation.*" (Public Parks Board 1892).

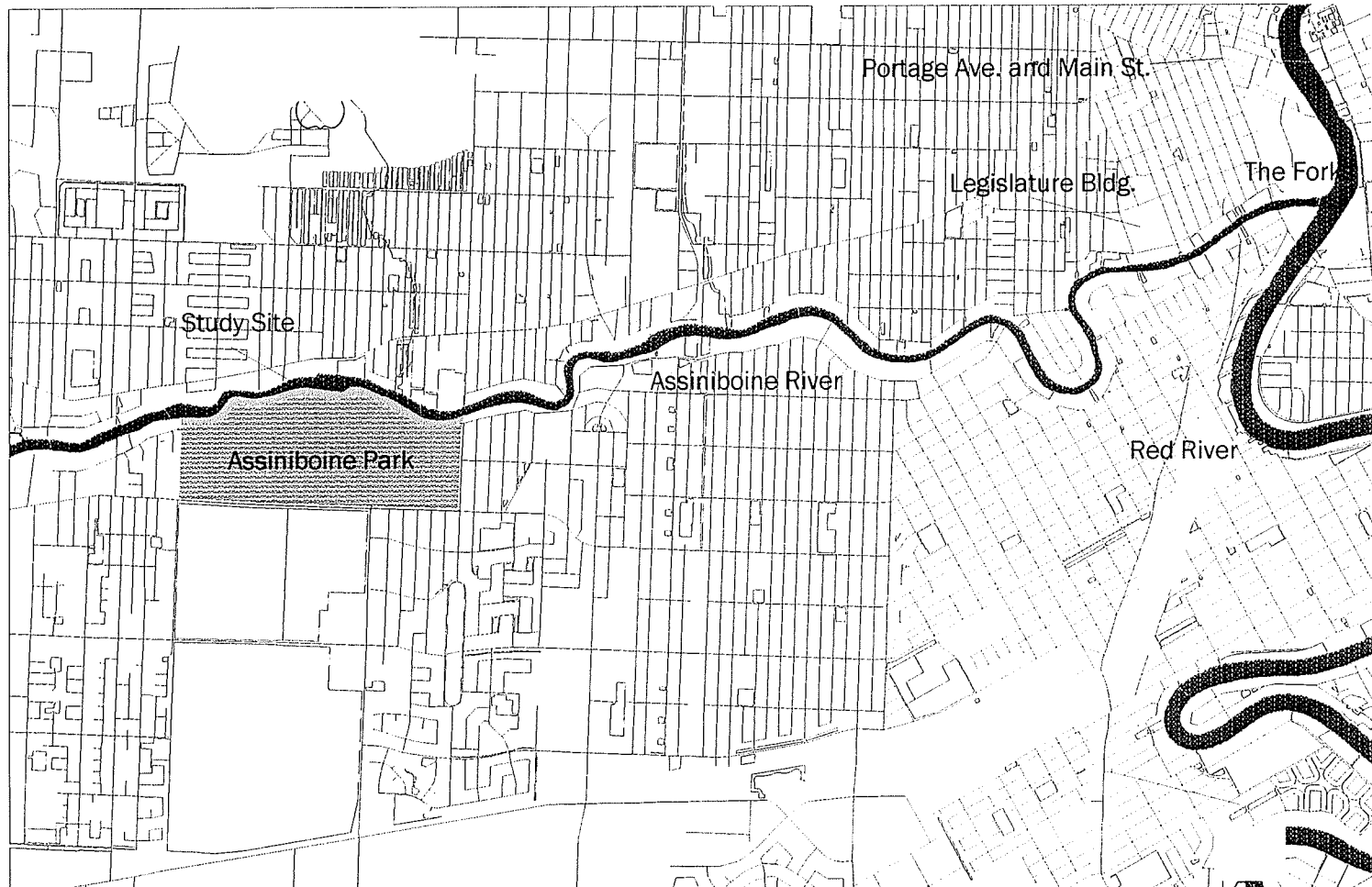
In May 1904, the Public Parks Board purchased 283 acres of woodland and prairie situated along the south side of the Assiniboine River to the west of Winnipeg. Frederick G. Todd, a landscape architect from Montreal, was commissioned to prepare plans and recommendations for the future Assiniboine Park. Despite Todd's "*disinterest*" in the "*flat*" nature of the site, the Parks Board felt that a "*very beautiful place can be made from the naturally very rich soil on a surface that undulates on the slope towards the river bed*" (Graham 1985). The style of the proposed park was the "*English Landscape Style*" which was developed in Britain and refined by Frederick Law Olmsted in such North American parks as Central Park in New York and Mount Royal Park in Montreal (Parks and Recreation Department 1972; de Graaf 2000).

By 1914, curvilinear roadways and path systems, buildings and landscape features, large-scale plantings and open lawn areas were completed. Recommendations for future development were made as a result of a growing and prospering Winnipeg and its suburbs. Assiniboine Park offered the only opportunity for citizens to participate in a wide variety of outdoor recreational activities in a single area. In addition to the recreational value of Assiniboine Park, the site was intended to serve as an outdoor classroom, educating the public about Manitoba's native vegetation (Parks and Recreation Department 1972).

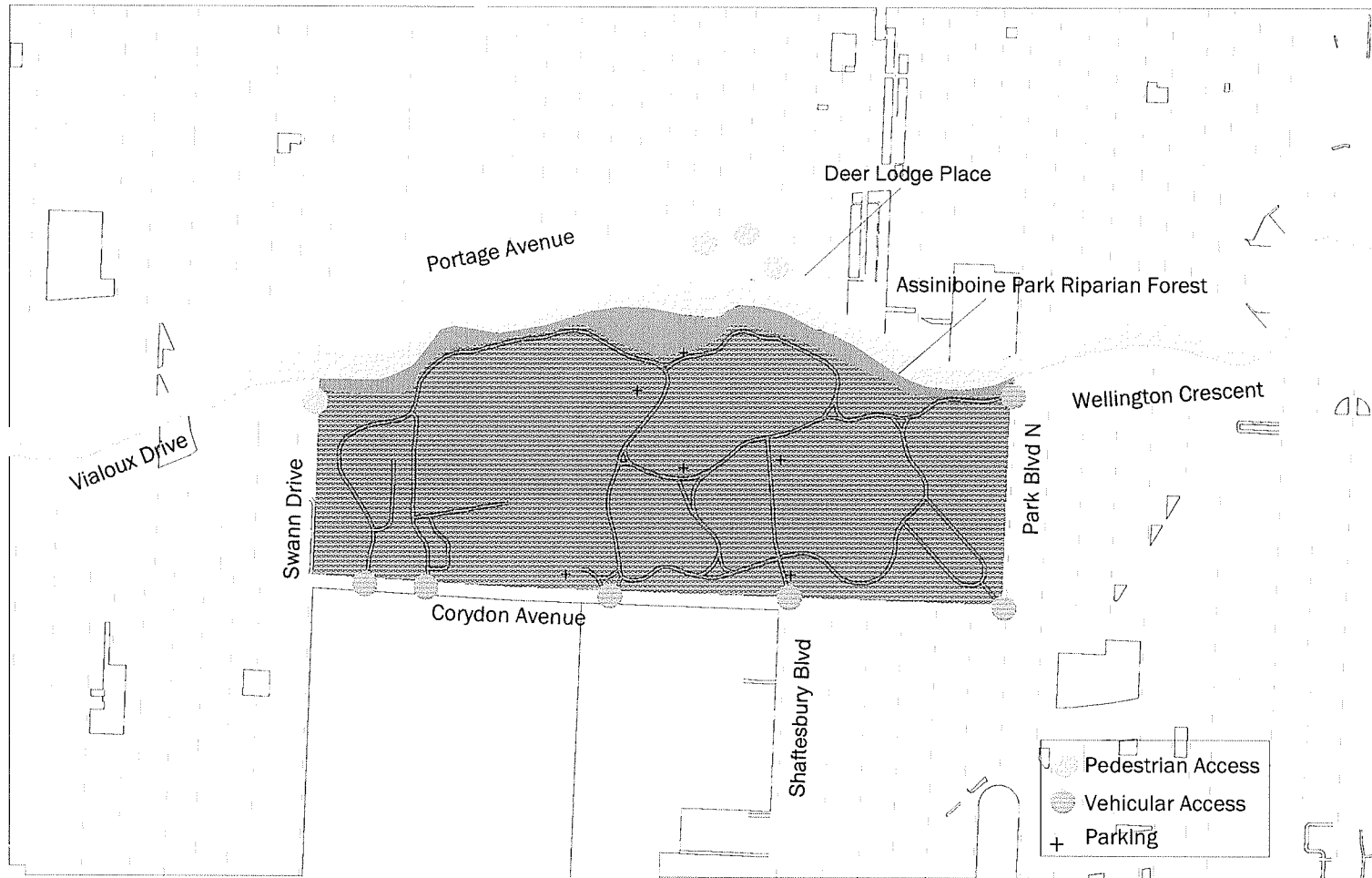
6.2 Site Analysis

This section identifies, in graphic format, the extent of the Assiniboine Park riparian forest, access and parking, context, topography, flooding, and significant features.

Site Location in Winnipeg



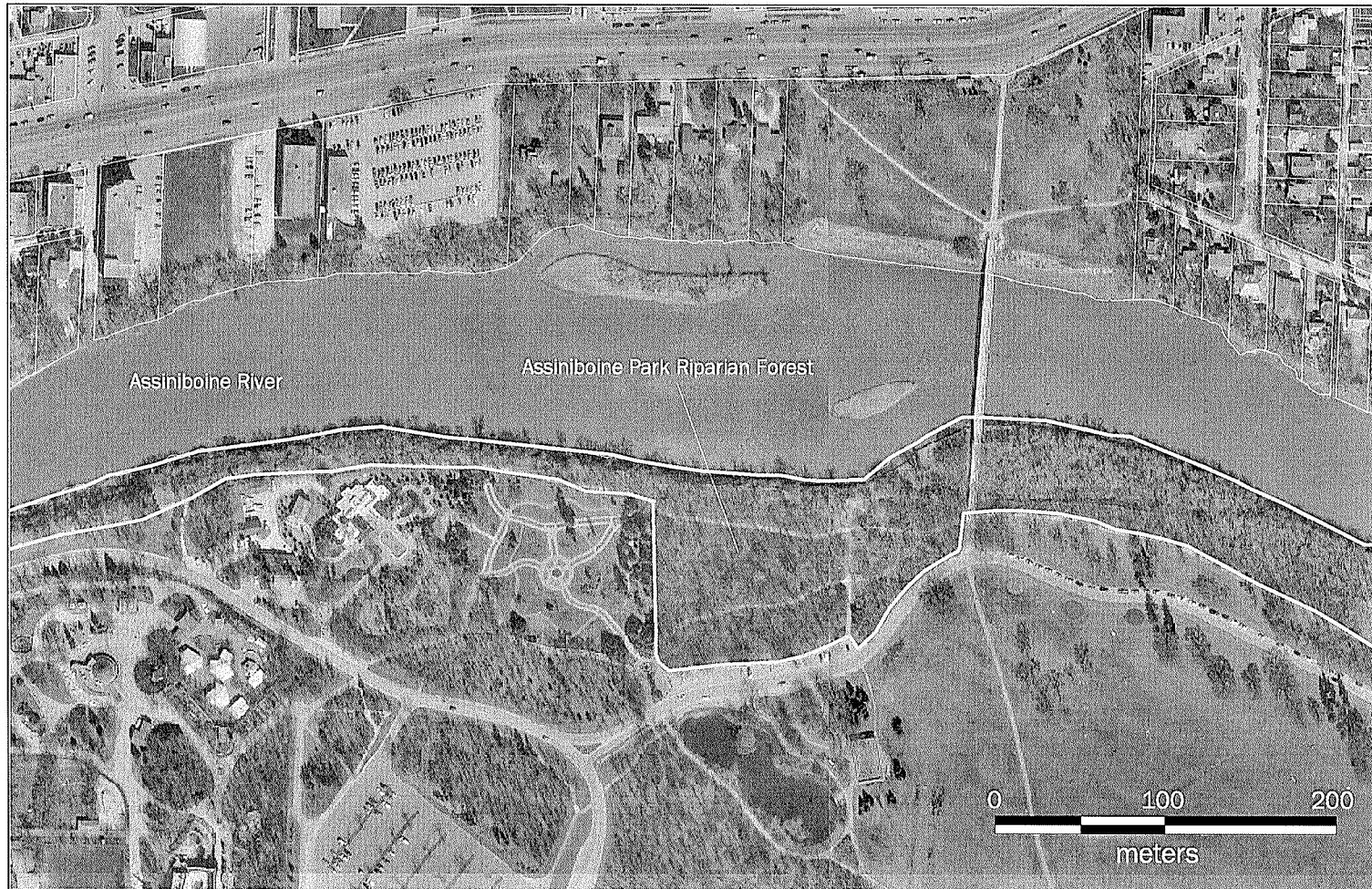
Access & Parking



Site Location - A



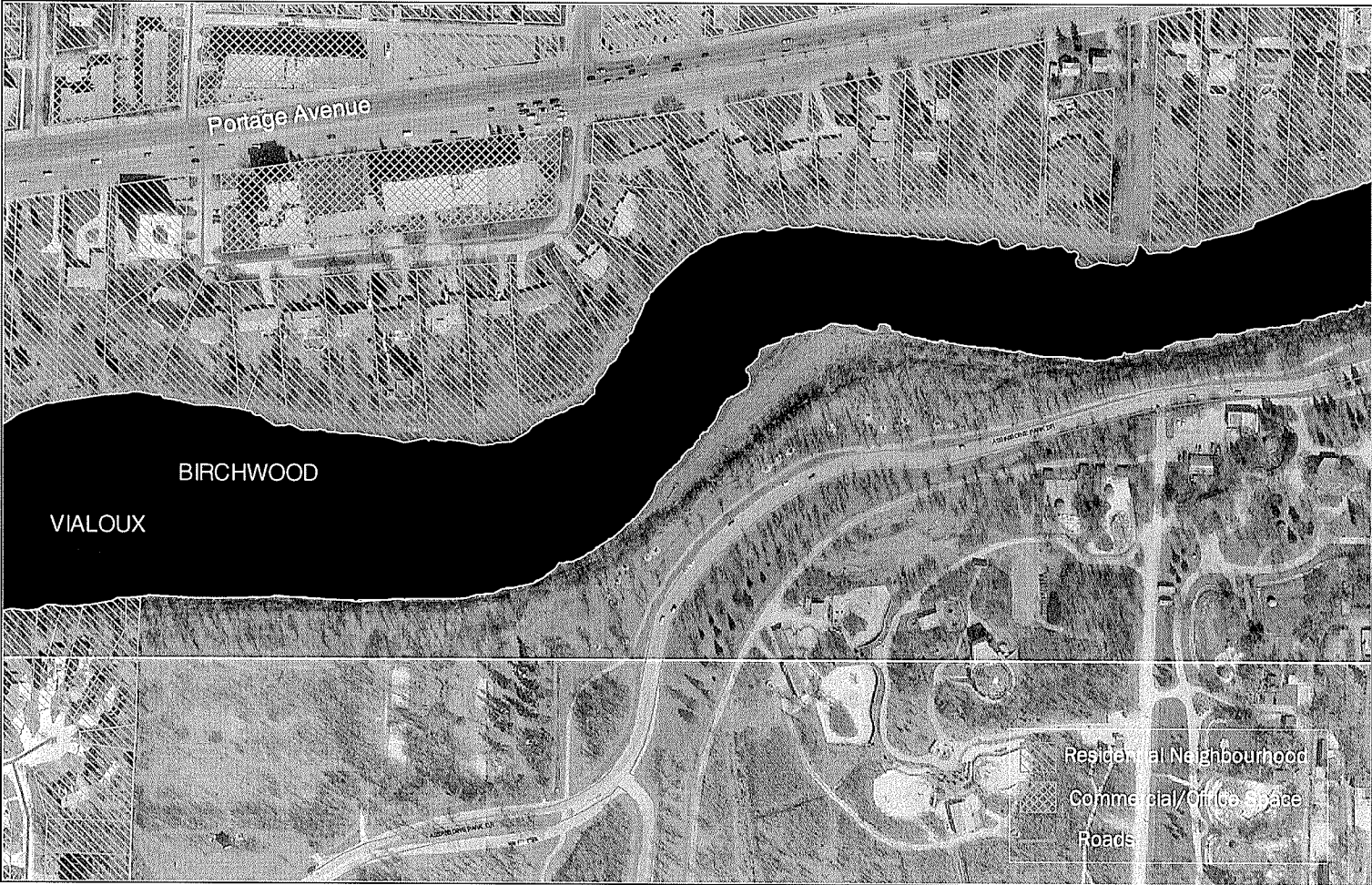
Site Location - B



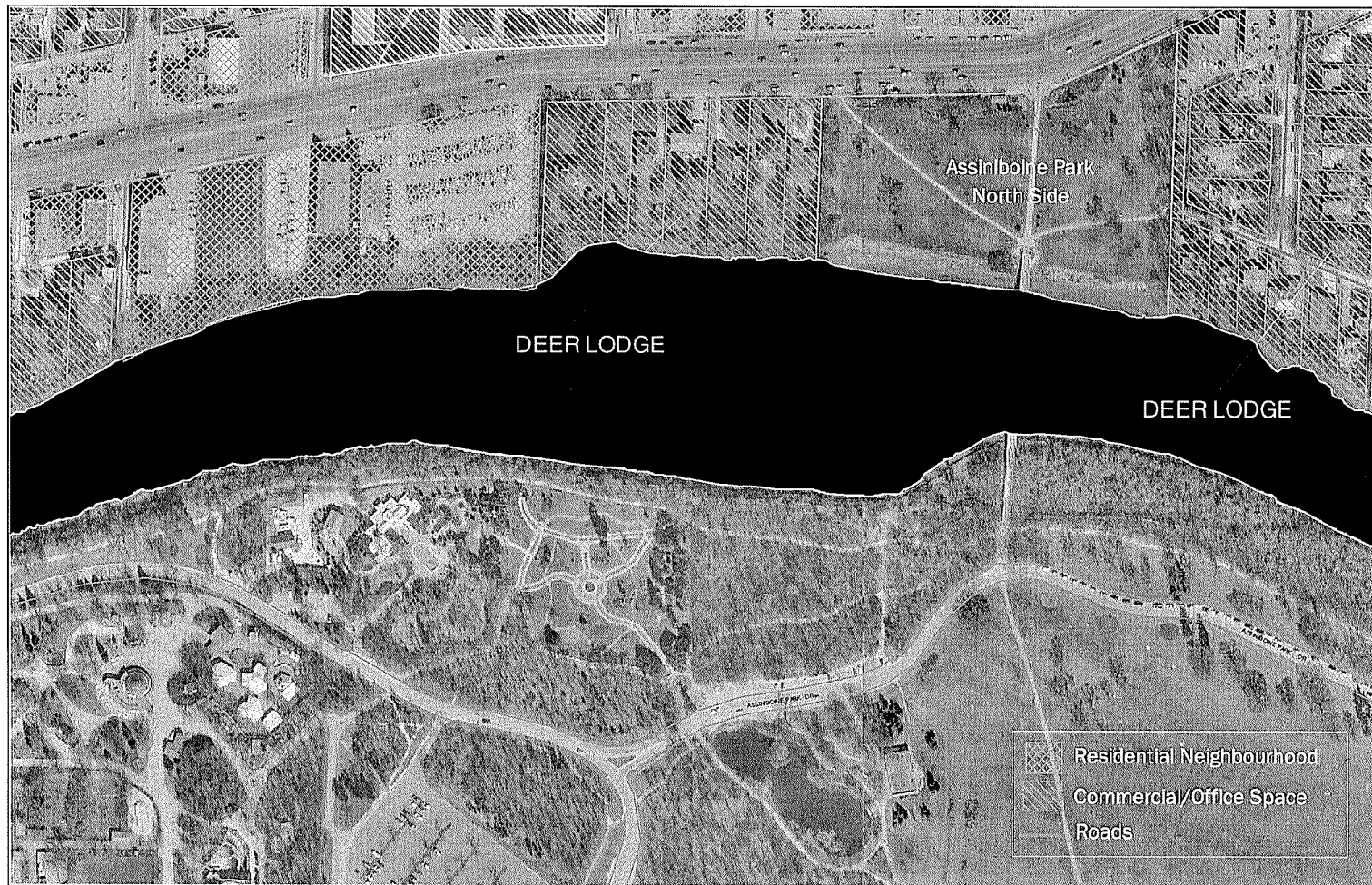
Site Location - C



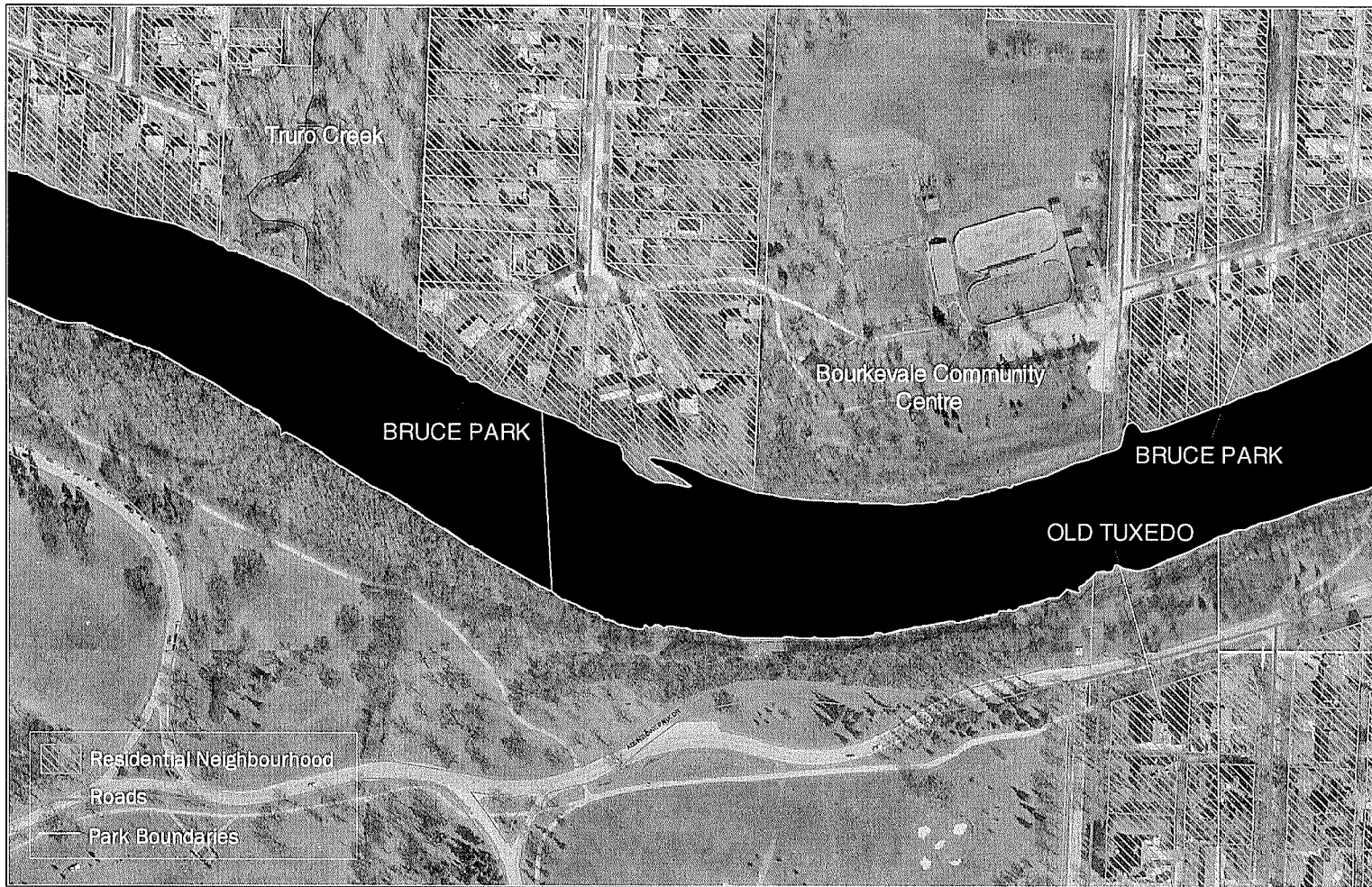
Site Context – A



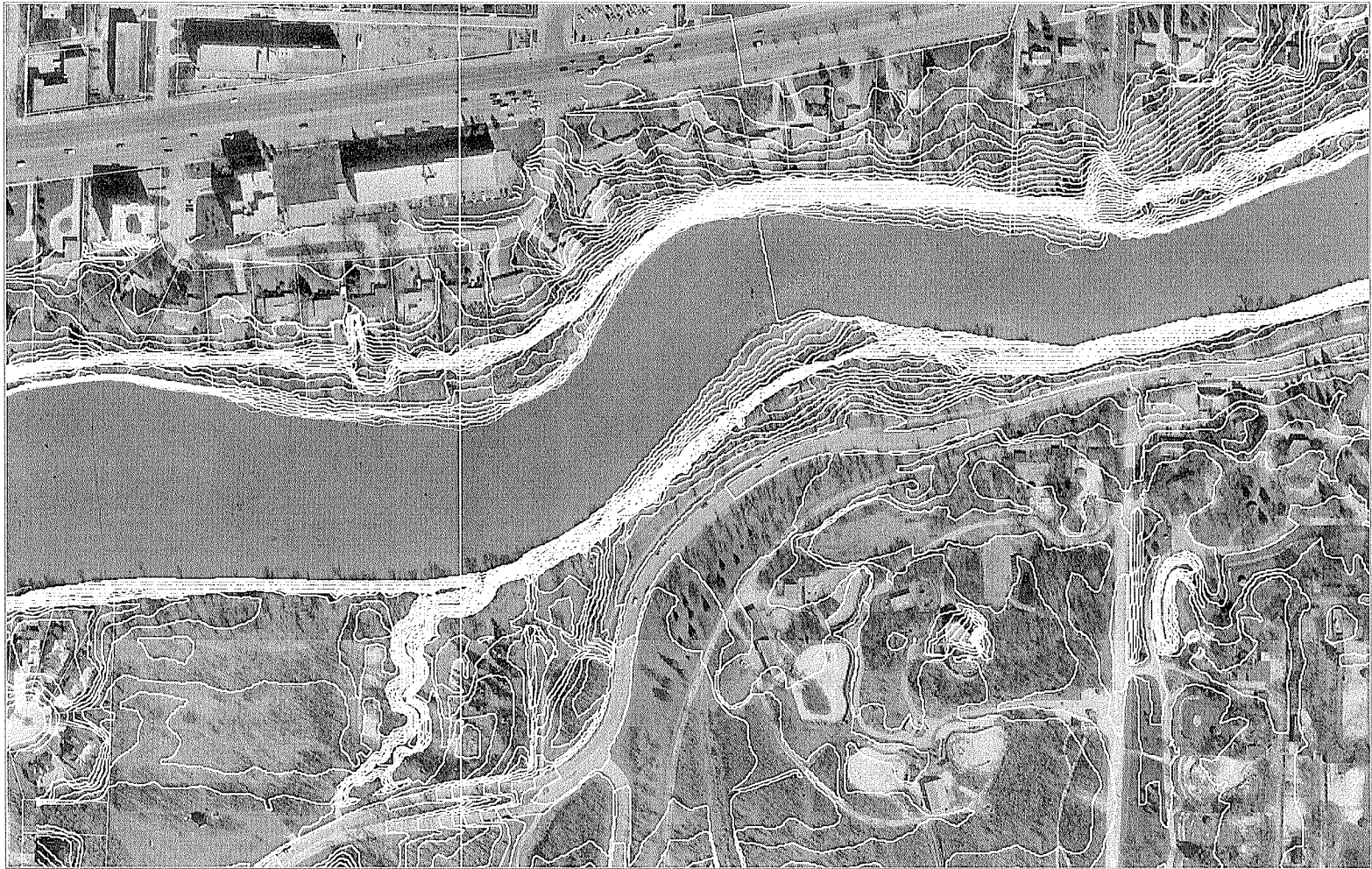
Site Context – B



Site Context – C



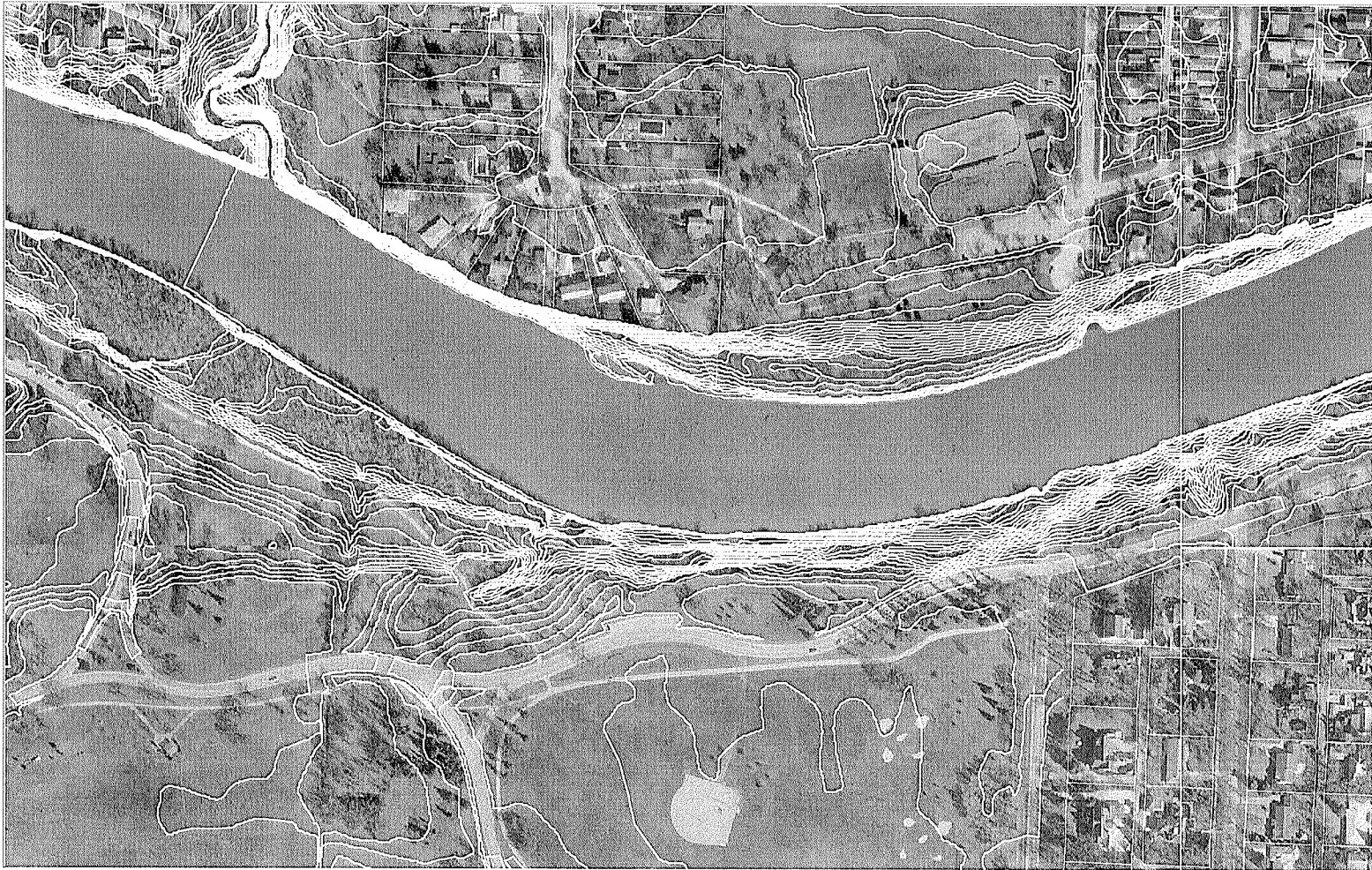
Topography - A



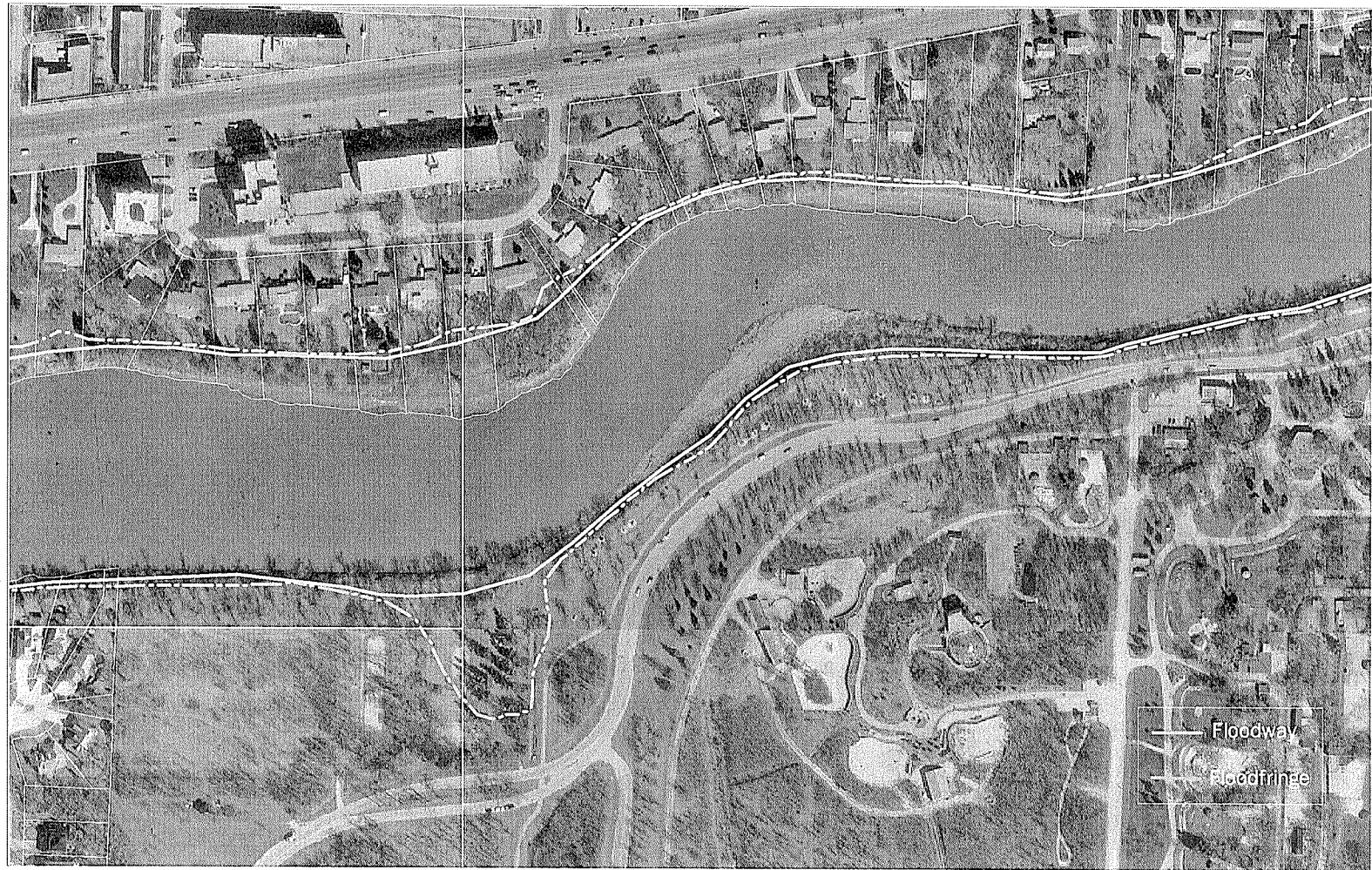
Topography - B



Topography - C



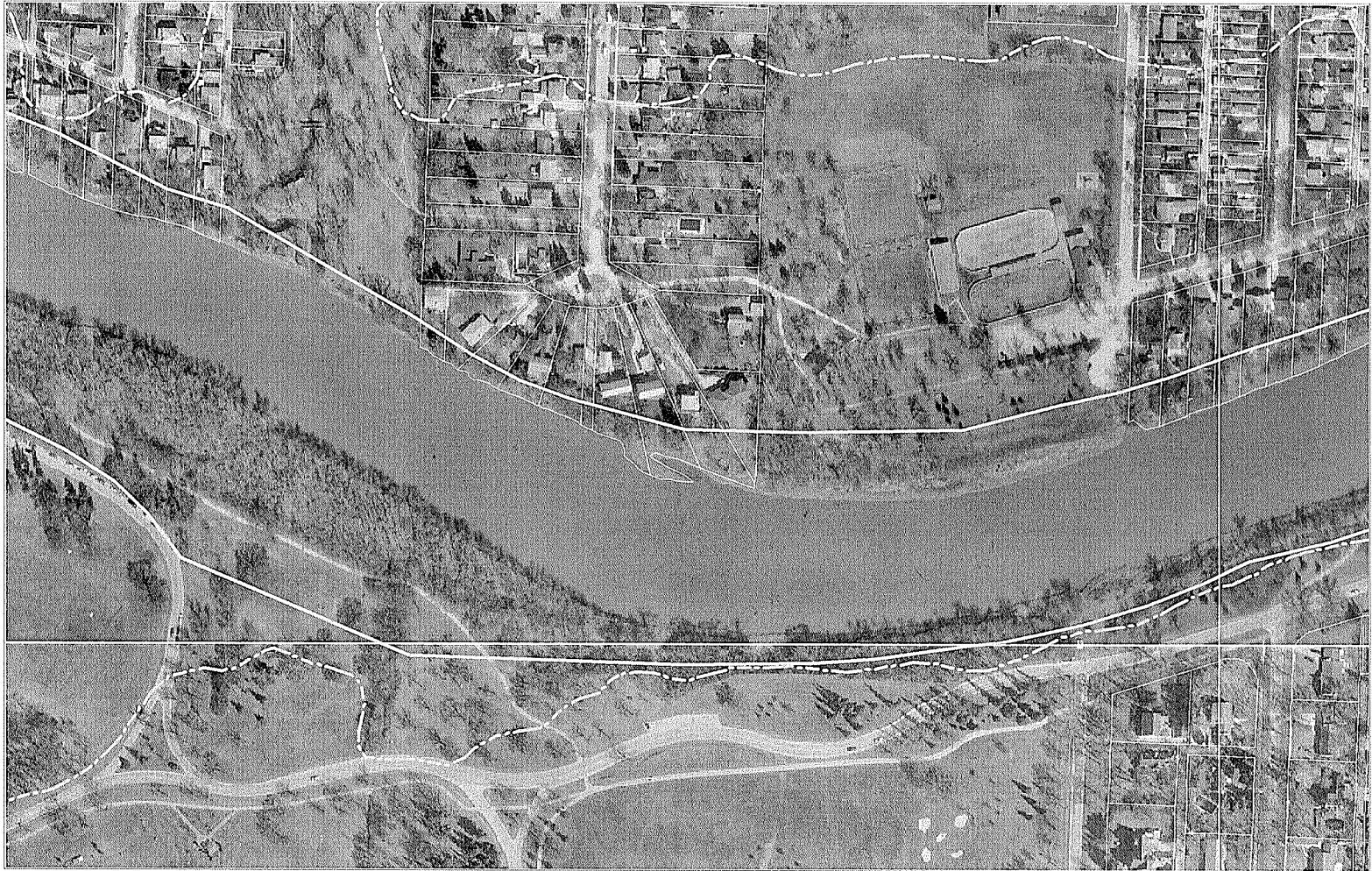
Flooding - A



Flooding - B



Flooding - C



Site Features – A



Map A – Photos of Site Features

1. West Entrance

- The Assiniboine Park can be accessed by pedestrians only from Swann Drive



2. Parkland Area

- Large open lawn area scattered with trees



3. 'Meadow' Area

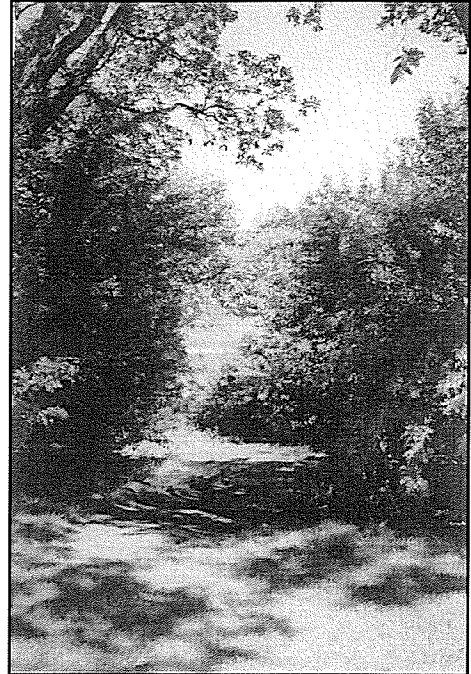
- Flat area of stream deposition on the inner bend of the Assiniboine River, situated beyond steep riverbank
- Comprised of willows, wildflowers, grasses and sedges
- Well screened by vegetation on opposite bank (residential properties)
- Significant view of the Assiniboine River
- Potential for viewing/sitting areas



(Fabbri & Jurkow 1997)

4. Entrance to 'Meadow' Area

- Entrance off informal riparian trail ('monkey trail')
- Entrance defined by eroded path and break in vegetation
- Entrance bordered by bur oak (*Quercus macrocarpa*), Saskatoon (*Amelanchier alnifolia*) and dogwood (*Cornus stolonifera*)
- Steep descent into 'meadow'



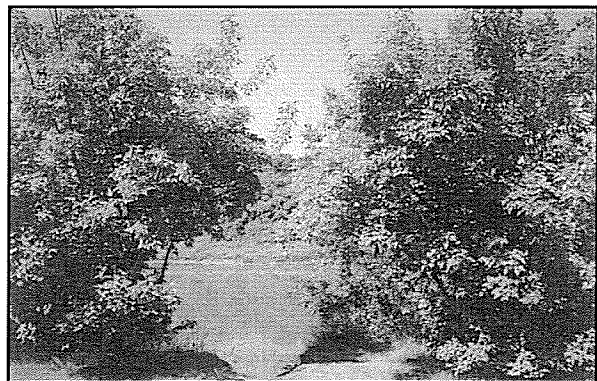
5. Limestone Outcrop Areas

- Located sporadically along shore of 'meadow' area
- Well screened by vegetation on opposite bank (residential properties)
- Provides natural sitting/viewing areas, and potential fishing and canoe launch areas



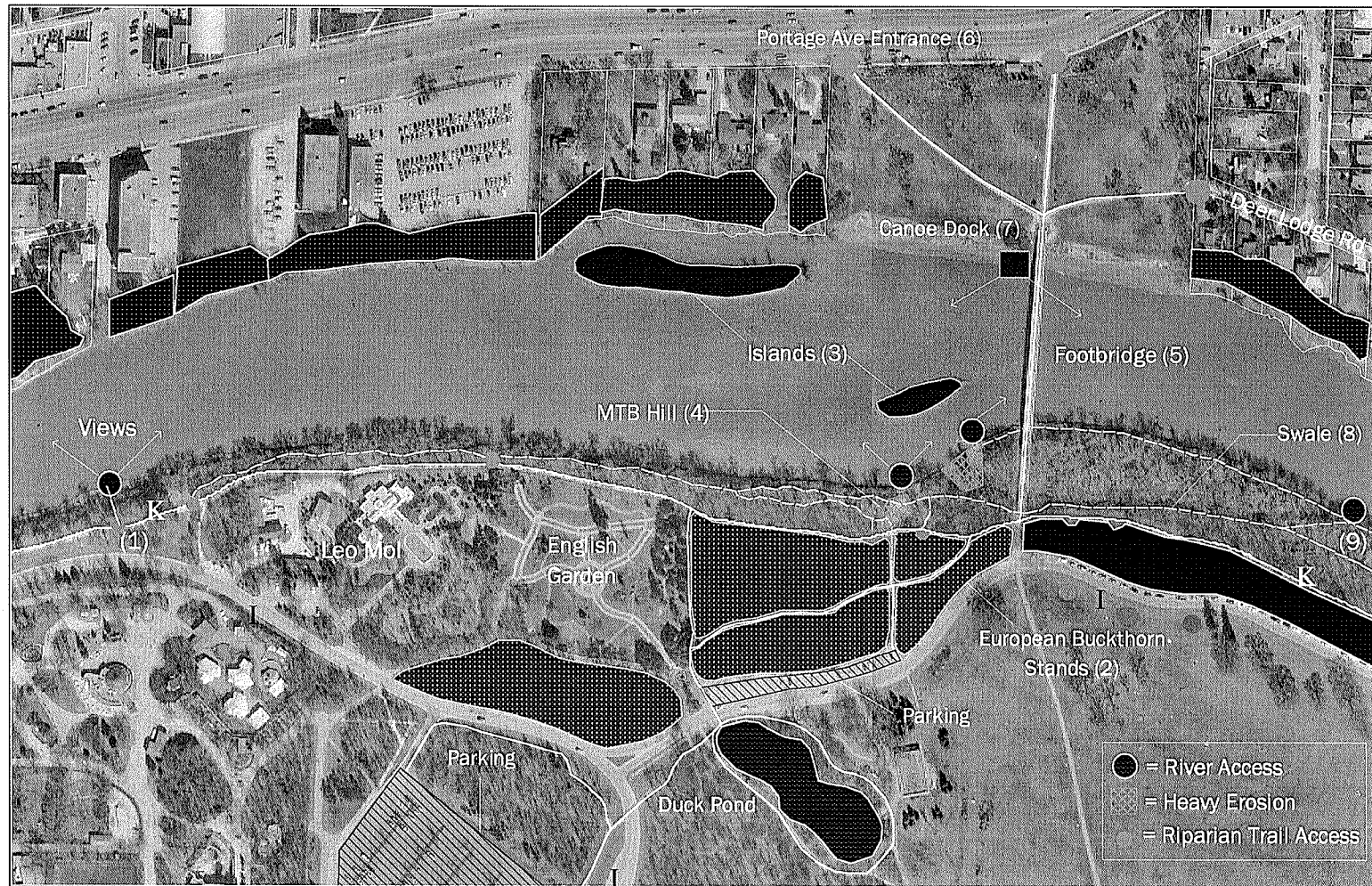
6. View of River

- Located west of the 'meadow' and limestone outcrop areas
- A break in vegetation provides a significant view of the Assiniboine River
- View is bordered by Saskatoon (*Amelanchier alnifolia*) shrubs
- Access to river limited by steepness of riverbank
- Should conserve view of river



(Fabbri & Jurkow 1997)

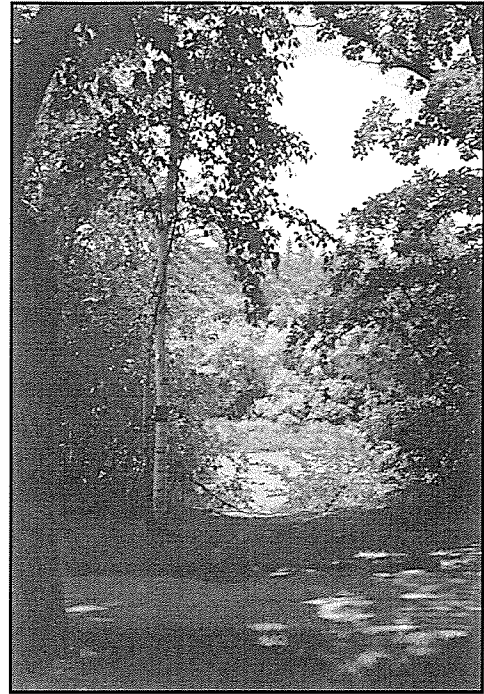
Site Features – B



Map B – Photos of Site Features

1. River Access

- Access and view of the Assiniboine River from the paved bicycle trail
- View is bordered by common caragana (*Caragana arborescence*)
- Steep descent to Assiniboine River
- Potential for well defined entrance and safe descent to river



(Fabbri & Jurkow 1997)

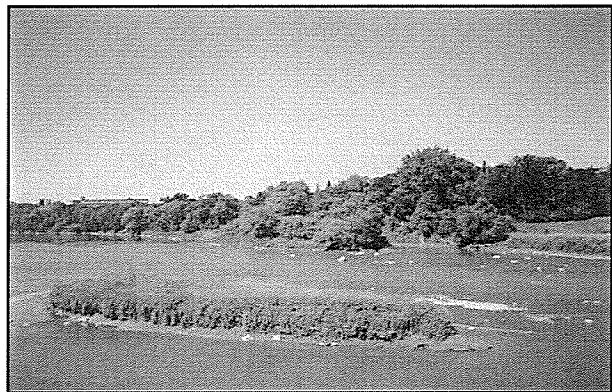
2. European Buckthorn Stands

- Located in the upland areas of the riparian forest and park
- Forms dense, impenetrable stands replacing native riparian vegetation
- Removal of European buckthorn or prevention of spread is key to preserving the natural integrity of the forest

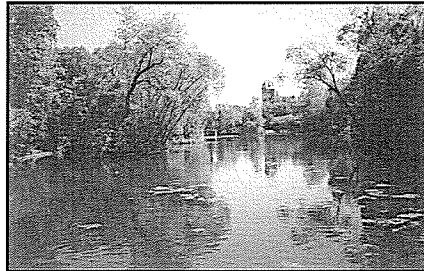
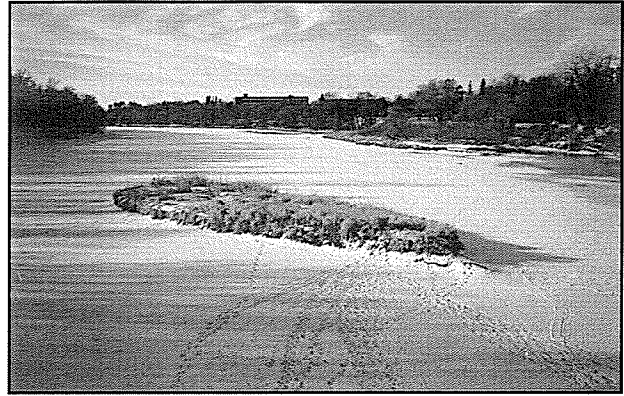


3. Ephemeral 'Islands'

- Two landforms emerge when water levels are low
- 'Island' off north bank is covered by grasses, shrubs and trees
- 'Island' off south bank is covered by various grasses and herbaceous species

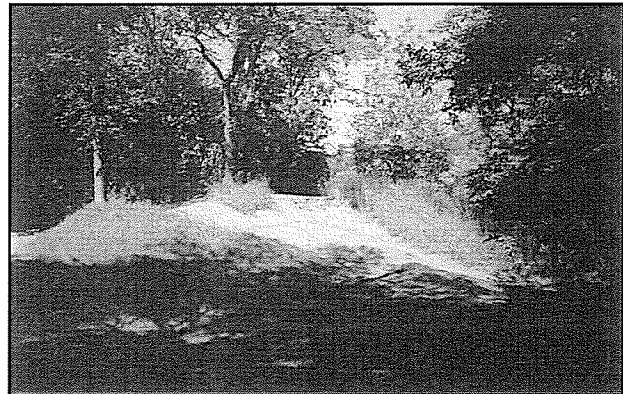


- 'Islands' are inaccessible in spring, summer and fall
- Islands are accessible in winter; footprints suggest desire to access them
- Can encourage ice-skating on the Assiniboine River in addition to the duck pond (below, left), as shown at The Forks (below, right). 'Islands' can serve as rest stations/kiosk areas.



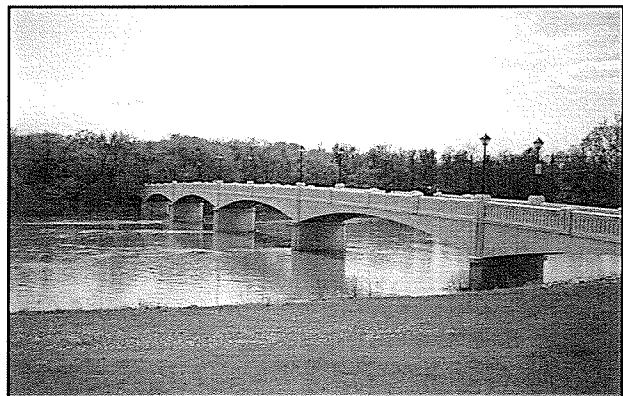
4. Mountain Bike Hill

- Located west of the pedestrian footbridge
- The hill is primarily stripped of vegetation aside from patches of sod
- Popular, well used site for mountain bikers



5. Footbridge

- Pedestrian footbridge links north bank with the south bank of the Assiniboine River
- The Assiniboine Park can be accessed, via the footbridge, from Portage Avenue and Deer Lodge Road



6. North Entrance (Portage Avenue)

- View of Portage Avenue entrance

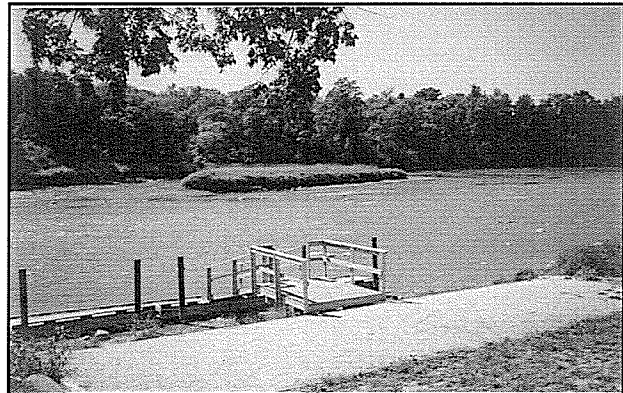


- View of Assiniboine Park and footbridge from Portage Avenue entrance



7. Canoe Dock

- The canoe dock is a recent addition to the Assiniboine Park, constructed in 2002
- Located on the north bank, it provides access to the river and spectacular views of the riparian forest and river



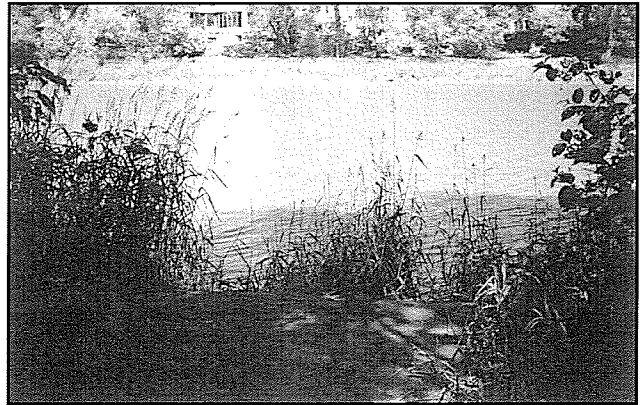
8. Swale

- Area of river backflow, creating a channel or pool of water adjacent to the main river
- Swales flood in spring and tend to dry up by early-mid summer
- Swales tend to have a high clay content and higher water content and as such, tree growth is limited (Hodges 1997)
- Image on the right, shows swale adjacent to the pedestrian footbridge



9. River Access

- Access and view of the Assiniboine River located after the first swale
- Accessed from riparian trail



Site Features – C



Map C – Photos of Site Features

1. Swale

- Image on right, shows the second swale located further east along the bank. Note the lack of vegetative growth and fallen logs traversing the swale



2. 'Monkey' Trails

- An extensive network of braided trails or 'monkey' trails occur throughout the Assiniboine Park riparian forest
- In spring, during periods of flooding, the trails become extremely wet and muddy
- Rutting and pitting along the trails result when bicycle-tire treads erode the wet, clayey soils
- When recreationists avoid these ruts and wet spots, further trampling of vegetation occurs and the trails become wider and more extensive
- Solutions should limit trail degradation and the formation of additional network trails



3. Riverbank Trails

- Floodplain trails, as shown above are accessible in all seasons
- Riverbank trails as shown on the right, may not be accessible in spring as water levels may be too high. In addition, the riverbank is separated in spring by the water-filled swales
- Fallen logs traversing the swales are presently utilized by recreationists to access the riverbank trails during periods of spring flooding



4. Access Points

- Riparian-trail access points occur at numerous places along the paved bicycle path
- The access points are informal in nature
- Entrances show high levels of erosion
- Main entrances should be identified and restored. Secondary entrances are deemed unnecessary and should be sealed to prevent entry



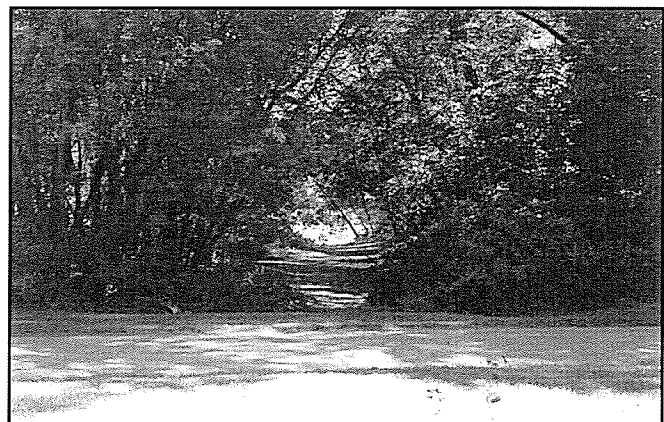
5. Obstacles

- Evidence of obstacles created for recreational purposes (mountain biking) were noted in the riparian forest
- The image on the right shows a ramp created by fallen tree limbs and the clayey riparian soils
- Mountain biking parks offering rugged terrain and obstacles may be provided in nearby areas, to discourage the immediate degradation of the riparian forest



6. River Access

- Access and view of Assiniboine River located after the second swale
- Accessed from the riparian trail and the paved bicycle trail
- Access-corridor substantially wide and well defined
- Existing access points should be preserved and enhanced rather than create new ones in order to preserve the existing riparian forest



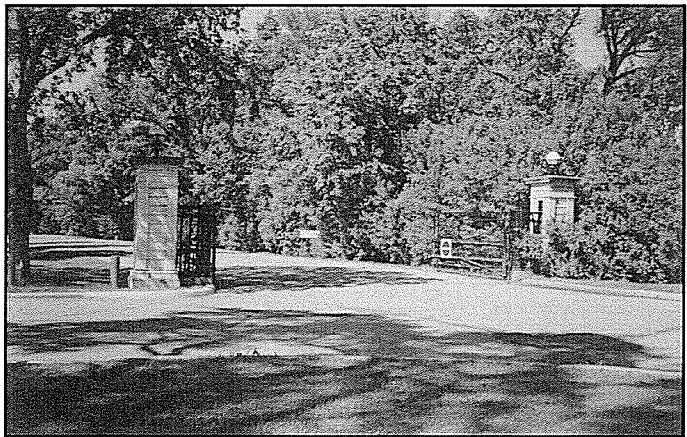
7. Limestone Outcrop Area

- Another limestone outcrop area occurs east along the Assiniboine River,
- It provides a natural sitting/viewing area, and a great view west comprising the river, riparian forest and footbridge.



8. East Entrance

- The Assiniboine Park can be accessed from Wellington Crescent and Park Boulevard



Conclusion

The site analysis for the Assiniboine Park riparian forest identified the extent of the site, context, topography, flooding, and significant features. It also revealed sensitive areas within the site where access and activities for recreation should be limited, such as along the riverbank and floodplain areas. The analysis also highlighted areas that would provide great opportunities for recreational activities such as the meadow, islands, mountain bike park, and viewing/sitting areas.

Chapter 7: Assiniboine Park Riparian Forest Trail-User Survey

Chapter 7

Assiniboine Riparian Forest Trail-User Survey

The *Assiniboine Park Riparian Forest Trail-User Survey* was undertaken in order to determine who uses the Assiniboine Park riparian forest, how people use the site, why people use the site, when they use the site, what their preferences and needs are, and if conflicts exist among user groups. The information gathered from the survey will be analyzed, discussed, and utilized to support and inform the program and design scheme for the Assiniboine Park riparian forest.

7.1 Methodology

The methodology for the survey involved setting objectives for the study, selecting an appropriate surveying method, designing a questionnaire, obtaining approval from the University of Manitoba's Joint-Faculty Research Ethics Board (JFREB), identifying a population, selecting a sample size and distributing the questionnaires. Data collected from completed questionnaires was analyzed and conclusions were made.

Survey Method

A mail survey was chosen as the mode of data collection because:

- Mail respondents are more likely to complete a mail survey at their convenience;
- Mail respondents are less likely to feel pressure in responding to questions and can instead re-read questions and think about appropriate responses;
- Mail respondents are more likely to divulge personal information in a mail survey;
- Mail surveys are not intrusive whereas, telephone surveys are unwelcome and often screened and ignored;
- Confidentiality and anonymity can be increased in mail surveys;
- Open-ended questions can be thoughtfully replied to (Savini 1989).

Some of the disadvantages of the mailing method include an extended return time and a lower response rate. Mail surveys take longer than most other survey types in that it may take several weeks to receive most of the responses. One way of improving survey response rates is to advise the sample population that they should expect a survey in a given time

period and/or, do a follow-up reminding the individual to complete and send-in the questionnaire. This however, can double or triple the mailing cost. Another method would be to provide an incentive for the sample population (DSS Research 2002). For the purpose of this study, a sample individual that completed and returned the questionnaire automatically entered a draw to win a book and free admission to a workshop on the subject of naturalizing riparian yards. In addition, a postage-paid, pre-addressed return envelope was included with each questionnaire in order to facilitate the return. The return envelopes were meter-marked so as to ensure envelope use for purposes intended by the researcher.

Questionnaire Design

The questionnaire was designed to be short, simple and user-friendly (Appendix 2A). An introductory remark was included at the beginning of the survey briefly describing the study and its objectives. Survey questions selected were both close-ended and open-ended. The close-ended questions supplied the respondent with a variety of straightforward answers, thereby reducing survey completion time and facilitating ease of completion. A number of close-ended questions included an option for 'other' where respondents could include answers not listed. Where the researcher could not specify response choices, open-ended questions were selected. Open-ended questions were necessary to give survey respondents an opportunity to express their views.

Survey Approval

Upon completion of the questionnaire design, the survey was submitted to the University of Manitoba's Joint Faculty Research Ethics Board (JFREB) for approval, along with an Ethics Protocol Submission Form, a detailed summary of the project and an Informed Consent Form (Appendix 2B). The information was submitted on August 30, 2001 and approved on October 15, 2001.

Target Population & Sample Size

The target population was determined to include the residents living along the Assiniboine River. It was felt that this segment of Winnipeg's population is aware of the Assiniboine Park riparian forest, has a particular interest in the subject, and is more likely to frequent the site due to its proximity. Population size was obtained by using the GIS software, MapInfo.

Detached single dwelling units along the Assiniboine River were selected whereas commercial buildings, offices, schools, churches, hospitals, and vacant residential units and parks were omitted. Population size was found to be approximately 700 residential units. From this, a list of addresses was generated. Limitations of the program were such that individual apartment and condominium units could not be sampled and postal codes could not be obtained.

With a known population size of 700 residential units along the Assiniboine River, a confidence level of 95% and a confidence interval of 4, the minimum sample size necessary was calculated to be 323. Survey response rates can vary from 3-60%, depending on population characteristics and survey content. Thus, depending on the anticipated response rate, between 538 and 10,766 surveys would have to be distributed in order to achieve the minimum sample size required, respectively. Budget constraints led to 500 surveys being randomly distributed to residents living along the Assiniboine River.

Response Rate & Analysis

After several weeks, the final survey response rate was determined. Of the 500 surveys distributed, 133 were returned. Thus, the survey response rate was calculated to be 27%.

Data from each survey was transferred onto a spreadsheet document in Microsoft Excel and processed. The analytical tools employed in order to analyze the data included frequency tables and cross-tabulations. Frequency tables indicate the number of responses and their percentages (de Graaf 2000). For example, in question 1, of the 133 respondents, 58 were female. Thus, 58 female respondents and its percentage (41.4%) are recorded in the frequency table. Frequency tables were generated for questions 1 through 14 and are presented in Appendix 2C.

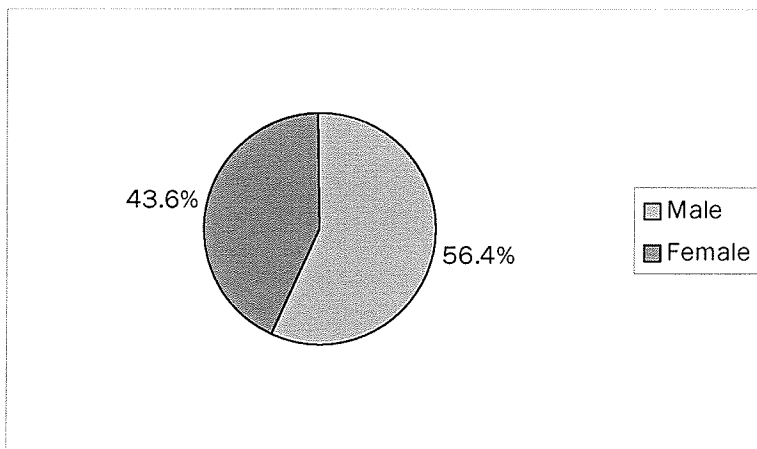
In order to study the relationships among and between variables, some of the data collected from the Assiniboine Park riparian forest trail-user survey was further analyzed by means of the cross-tabulation technique. This method classifies each question of interest as an independent variable (McCabe & Moore 1998). For example, in order to determine which age group is most concerned about personal safety, questions 2 (*“Which age group do you belong to?”*) and 11A (*“Do you have any concerns about personal safety?”*) are cross-tabulated. Relationships between age and safety concerns can then be identified and

discussed. Cross-tabulations are presented as absolute numbers and percentages. Tables are provided in Appendix 2D.

7.2 Results

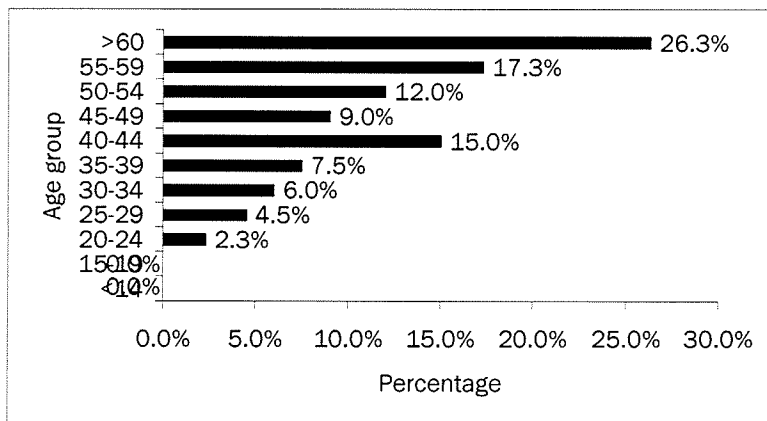
The following describes and discusses the findings gathered from the Assiniboine Park riparian forest trail-user survey in graphic and written format.

Survey Question 1: Are you male or female?



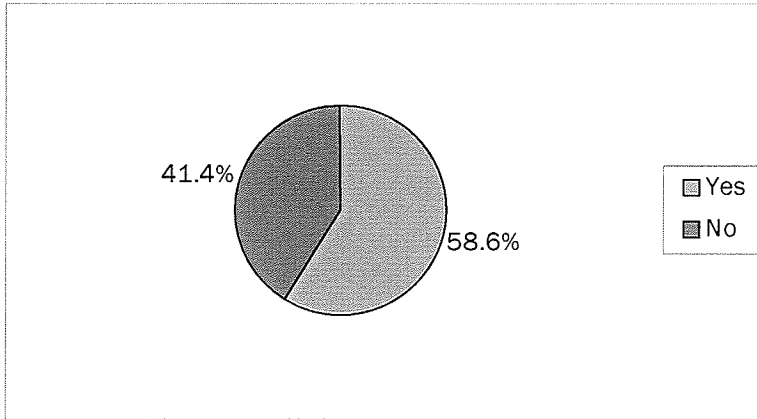
Of the 133 respondents, 78 were male and 58 were female, a ratio of 1.3:1.

Survey Question 2: What age group do you belong to?



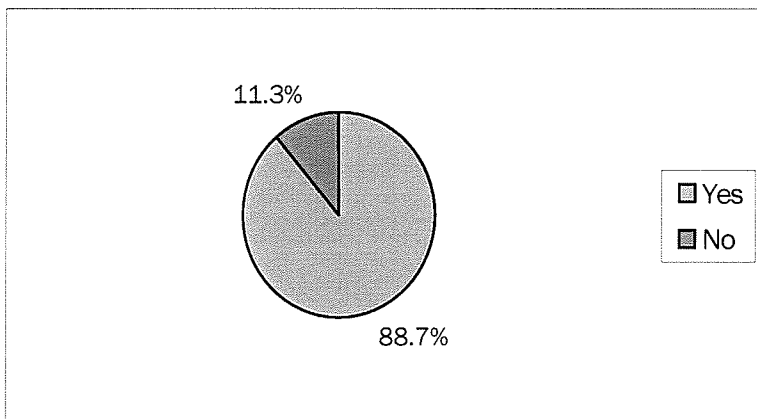
Results showed a high percentage of respondents over the age of 40 (79.6%). The greatest number were over 60 years of age (26.3%). A much lower response from those between the ages of 20-39 (20.3%) resulted, as well as, no response from those under the age of 19.

Survey Question 3: Are you aware that native riparian or 'riverside' forest represents a threatened or endangered habitat type in Winnipeg?



Of the 133 respondents, 78 were aware that native riparian forest represents a threatened habitat type in the City of Winnipeg, whereas 55 said that they were not aware.

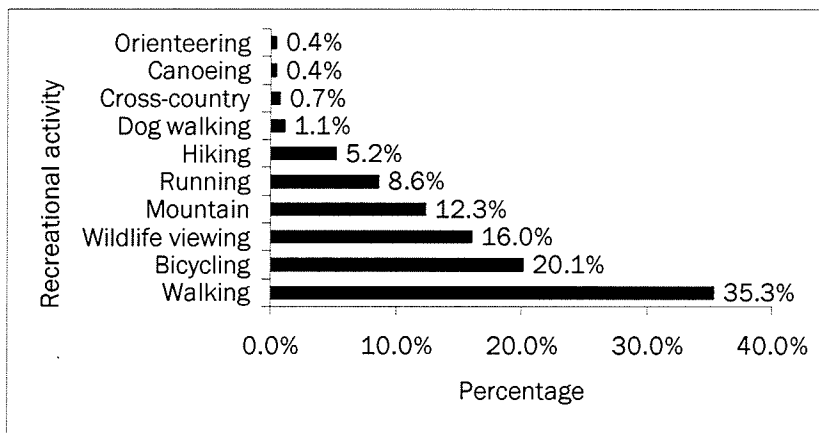
Survey Question 4: Have you ever used the Assiniboine Park riparian forest ('monkey trails')?



Of the 133 respondents, 118 said that they use, or have used, the Assiniboine Park riparian forest trail system whereas, 15 said they have never used it. Those that have never used it either have just moved into the area and intend on

using it, or spend most of their time enjoying their own riverfront properties however, encourage and support the project.

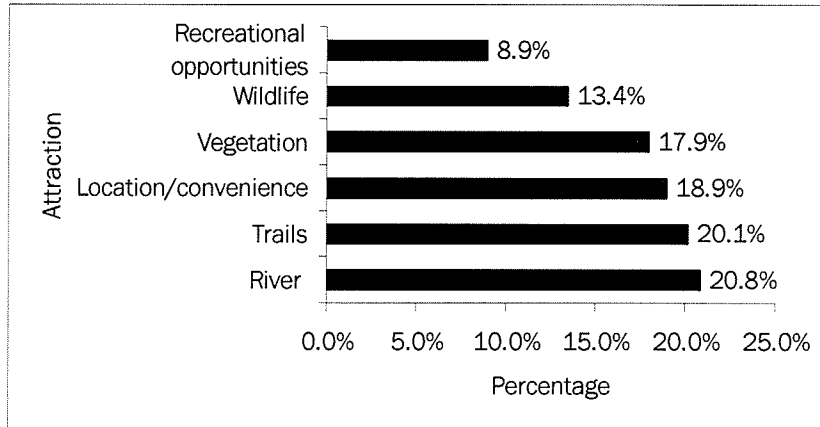
Survey Question 5: What outdoor recreational activities do you enjoy at the Assiniboine Park riparian forest trail system?



Results showed that the majority of users surveyed enjoy walking (35.3%) along the Assiniboine Park riparian forest trail system. A moderate

number of participants also enjoy bicycling (20.1%), wildlife viewing (16.0%) and mountain biking (12.3%). Fewer numbers participate in running (8.6%) and hiking (5.2%) activities. Dog walking (1.1%), cross-country skiing (0.7%), canoeing (0.4%) and orienteering (0.4%) fell into the 'Other' category and are represented by a small number of trail users.

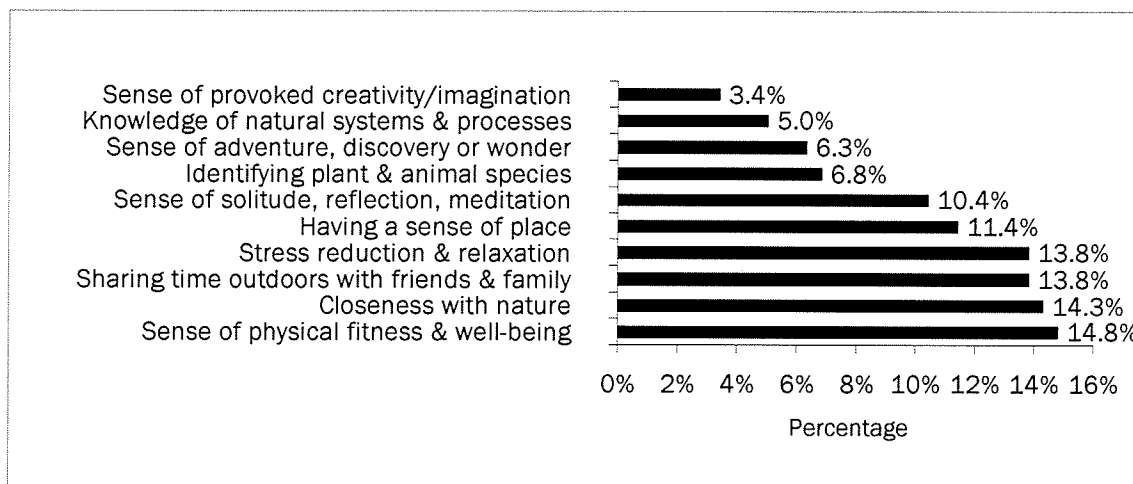
Survey Question 6: What attracts you to the Assiniboine Park riparian forest?



Results showed that the main attraction of the Assiniboine Park riparian forest is the Assiniboine River (20.8%). As attractive were the trails (20.1%), location and vicinity of the site (18.9%), vegetation

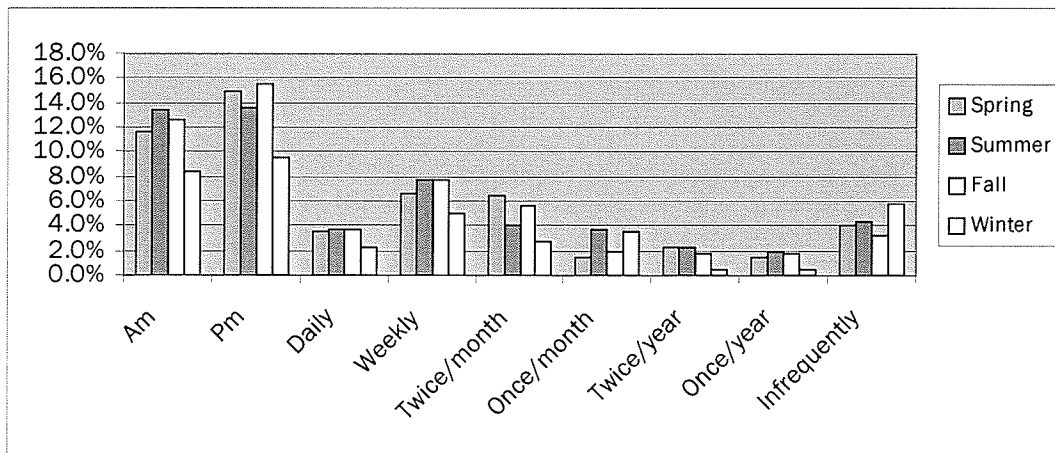
(17.9%) and wildlife (13.4%). The Assiniboine Park riparian forest was least attractive in terms of recreational opportunities that it provides (8.9%).

Survey Question 7: What outdoor recreational experiences do you gain from using the site?



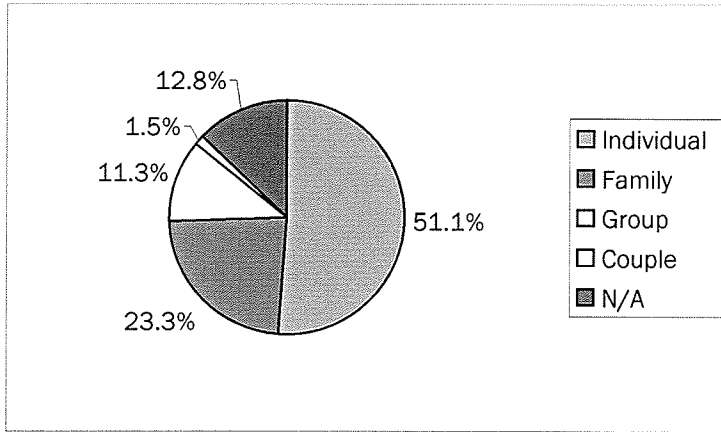
Results showed that the majority of trail-users gain physiological, psychological and social benefits from using the Assiniboine Park riparian forest trail system, rather than educational benefits. Most respondents gain a sense of physical fitness and well being while using the site (14.8%), feel closeness with nature (14.3%), enjoy spending the time outdoors with friends and family (13.8%), and gain a sense of stress reduction and relaxation (13.8%). Fewer respondents gain knowledge of plant and animal identification (6.8%), knowledge of natural systems and processes (5.0%) or gain a sense of provoked creativity/imagination (3.4%).

Survey Question 8: When and how often do you use the Assiniboine Park riparian forest trail system?



Results from the graph show that trail-use of the Assiniboine Park riparian forest is slightly higher in the afternoon and/or evening (53.7%) than before noon (46.2%). Regarding frequency of use, the majority of respondents use the site on a weekly basis (27.3%). Others use the site twice per month (19.0%), daily (13.4%), once per month (10.9%), twice per year (6.1%), or once per year (5.8%). 17.5% of respondents use the site infrequently. Seasonally, the majority of respondents use the site in summer (27.3%), followed by spring (26.1%) and fall (26.1%), and less in winter (20.5%).

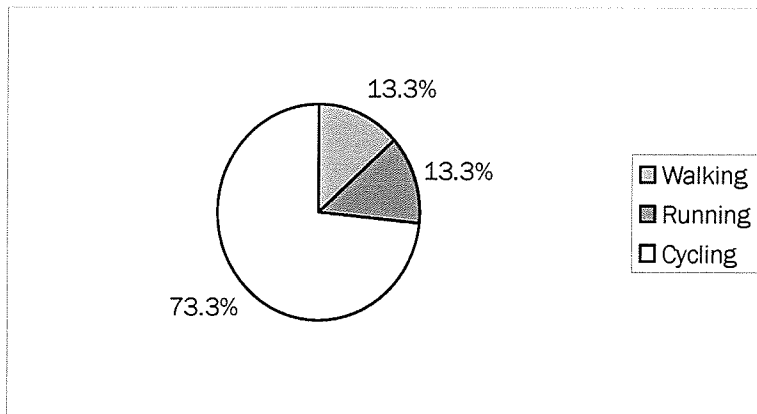
Survey Question 9: Do you use the trail as an: Individual, Family or Group?



Half of the participants surveyed use the Assiniboine Park riparian forest trails as an individual (51.1%). 23.3% use it as a family and 11.3% use it as part of a recreational group or organization. A few of the survey participants added that they use the trails as a 'Couple' even though it was

not included in the questionnaire's multiple-choice answers.

Survey Question 10: If as part of a group, what type of group or association?

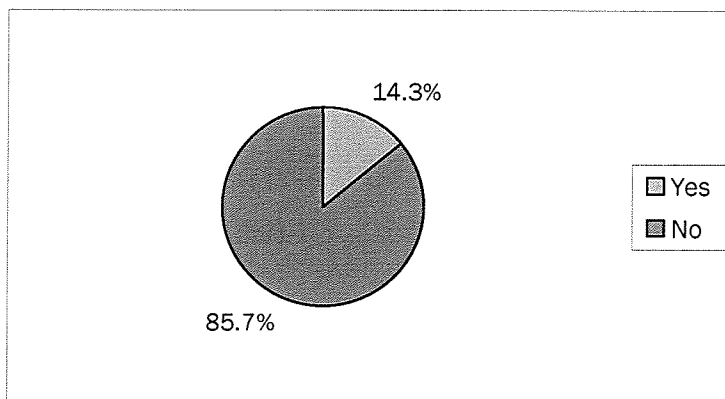


Of those participants surveyed that use the Assiniboine Park riparian forest trails as a group, the majority are members of cycling groups or associations (73.3%) however, there was no mention of which ones.

Fewer trail-users form part of walking (13.3%) or running (13.3%) groups or associations.

Survey Question 11: Do you experience any of the following problems on the trails?

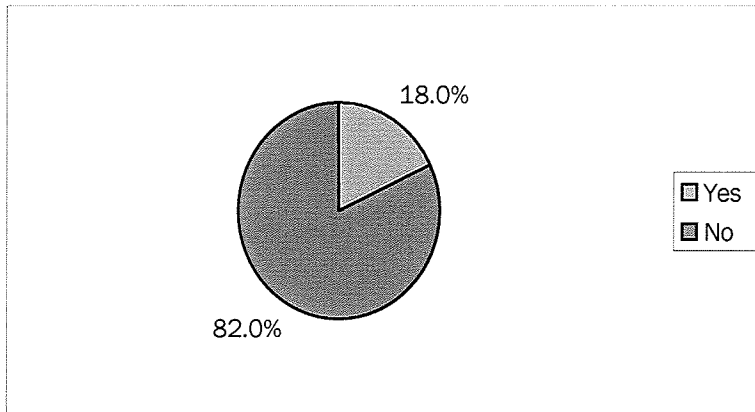
A) Concerns about personal safety



Of the 133 respondents, 19 had concerns about personal safety, whereas, 114 did not. Personal safety issues of those that answered 'Yes' to the above question include:

Not enough lighting (8%), low branches and deadfall (4%), low number of trail-users and thus scary (4%), and falling into the Assiniboine River (4%).

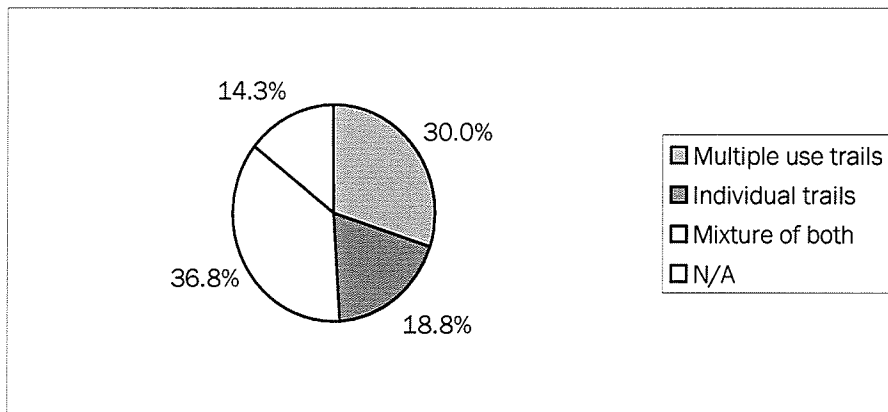
B) Conflicts with other trail users



Of the 133 respondents, 24 said that they encountered conflicts with other trail-users whereas, 109 did not. Conflicts of those that answered 'Yes' to the above question include: Bicyclists and walkers get in each other's ways (44%),

crowding (especially on weekends) (24%), speed conflict between different user types (20%), off-leash dogs (8%) and kids on bikes (8%).

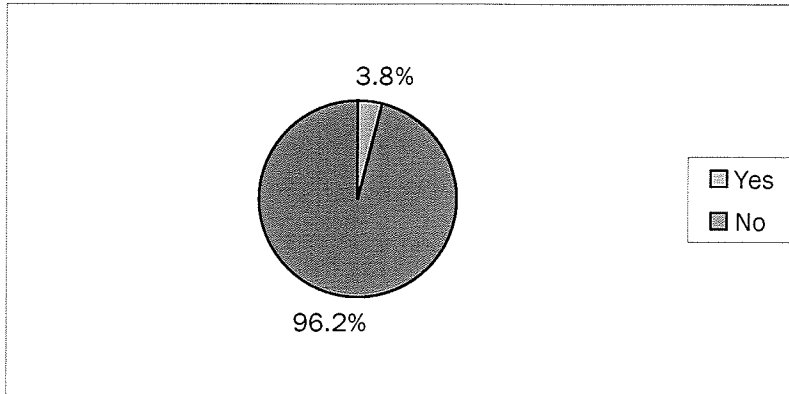
Survey Question 12: Do you prefer trails that are: Multiple-use, Individual, or Both?



Of the 133 respondents, 49 prefer trails that are a mixture of both individual trails and multiple-use trails, 40 prefer trails that are

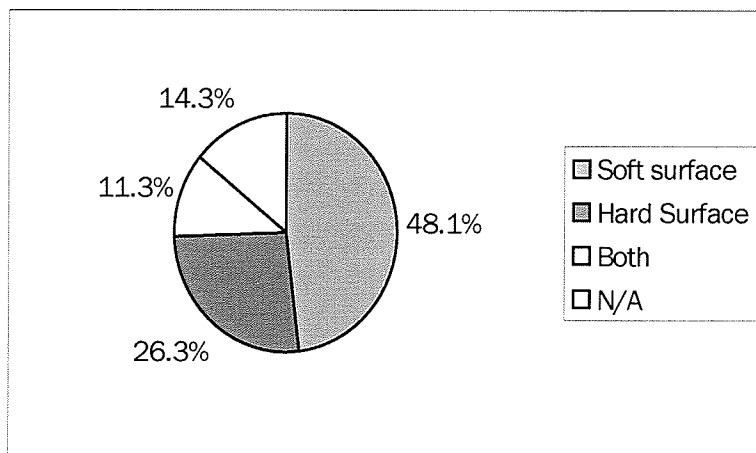
multiple-use only, and 25 prefer trails that are strictly user-specific.

Survey Question 13: Do you have a problem accessing the trails?



Of the 133 respondents, 5 had problems accessing the trails, whereas, 128 said they had no problems. Of the 5 that said 'Yes', no comments were made as to why problems were experienced.

Survey Question 14: Which type of trail surface do you prefer?



The majority of trail users of the Assiniboine Park riparian forest prefer soft trails (48.1%) such as the existing compacted soil, or woodchips or gravel. 26.3% prefer hard surface materials such as asphalt or concrete.

Survey Question 15: What improvements would you like to see made on the Assiniboine Park riparian forest trail system?

<u>Suggestions</u>	<u>Percentage*</u>
Connections to other trails	28.9%
Access to river	27.1%
Trail maintenance (removal of deadfall, prune low branches, fill ruts)	16.9%
Lighting	13.6%
Canoe dock, fishing point, viewing/sitting areas	11.9%
No change; leave trails alone	11.9%

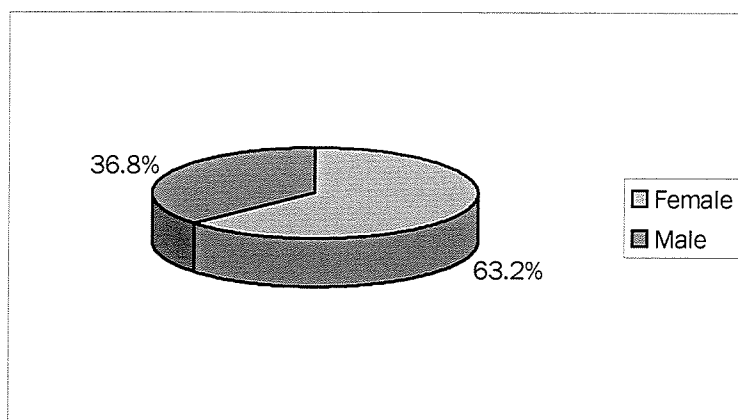
Maps of trails & interpretive signage	6.8%
Fewer trails; trail restriction	6.8%
Wider trails to avoid conflict with other users	5.1%
More trail types to disperse users & preserve natural integrity of site	5.1%
Habitat restoration	5.1%
Trails too muddy in spring	5.1%
Clearly marked and designated trails	3.4%
Groomed cross-country ski trails	1.7%
On-leash dogs; pooper scooper bags	1.7%
More trails that follow the riverbank	1.7%
Water fountains	1.7%

*Percentages of those trail users that answered the above question.

Cross-Tabulations

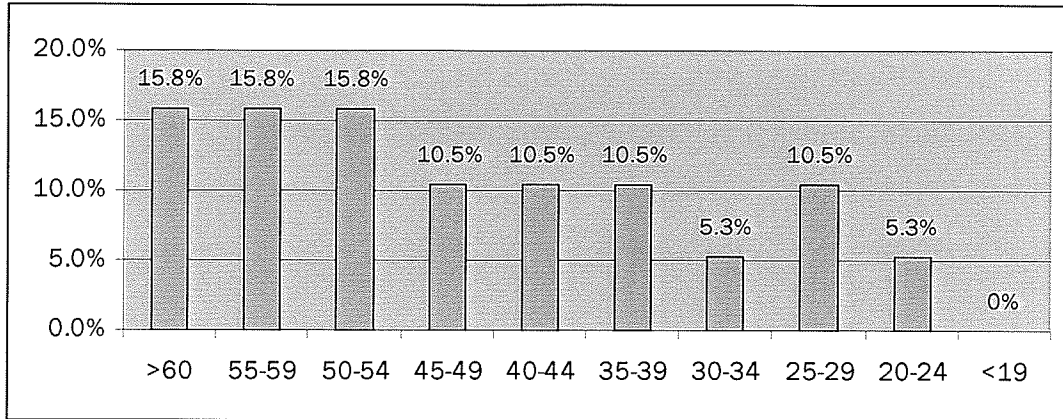
In order to study certain relationships among and between variables, some of the data collected from the Assiniboine Park riparian forest trail-user survey was further analyzed by using the cross-tabulation method. The following describes the findings gathered from the analysis through graphic and written format. Cross-tabulations are presented in tabular format in Appendix D.

1) Gender vs. Safety



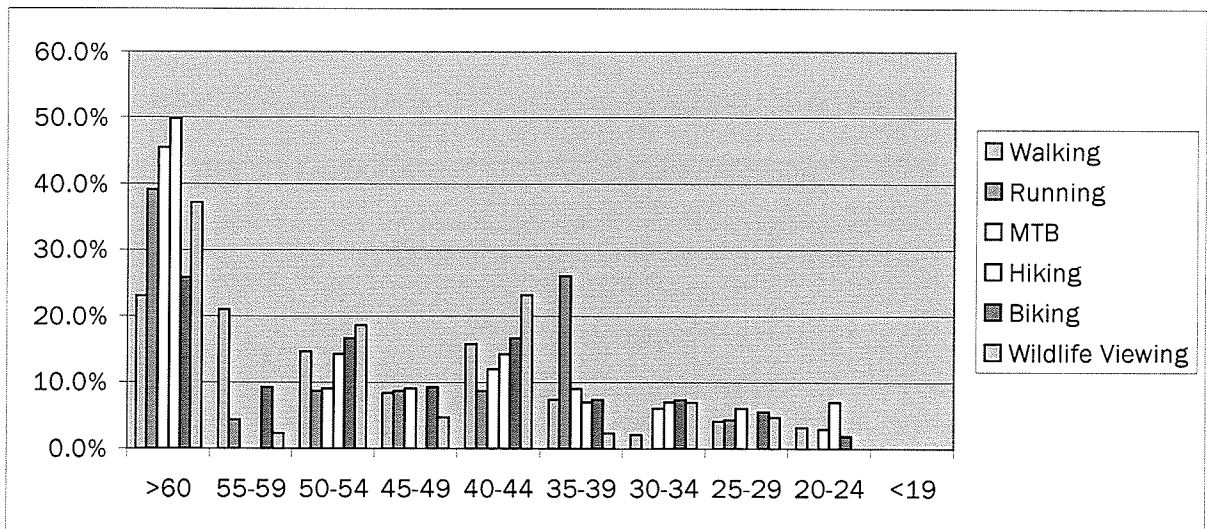
When survey questions 1 and 11A were cross-tabulated, results showed that of those Assiniboine Park riparian forest trail-users concerned about personal safety, the majority was female (63.2%).

2) Age vs. Safety



When survey questions 2 and 11A were cross-tabulated, results showed that of those Assiniboine Park riparian forest trail-users concerned about personal safety, the majority was over the age of 50 (47.4%).

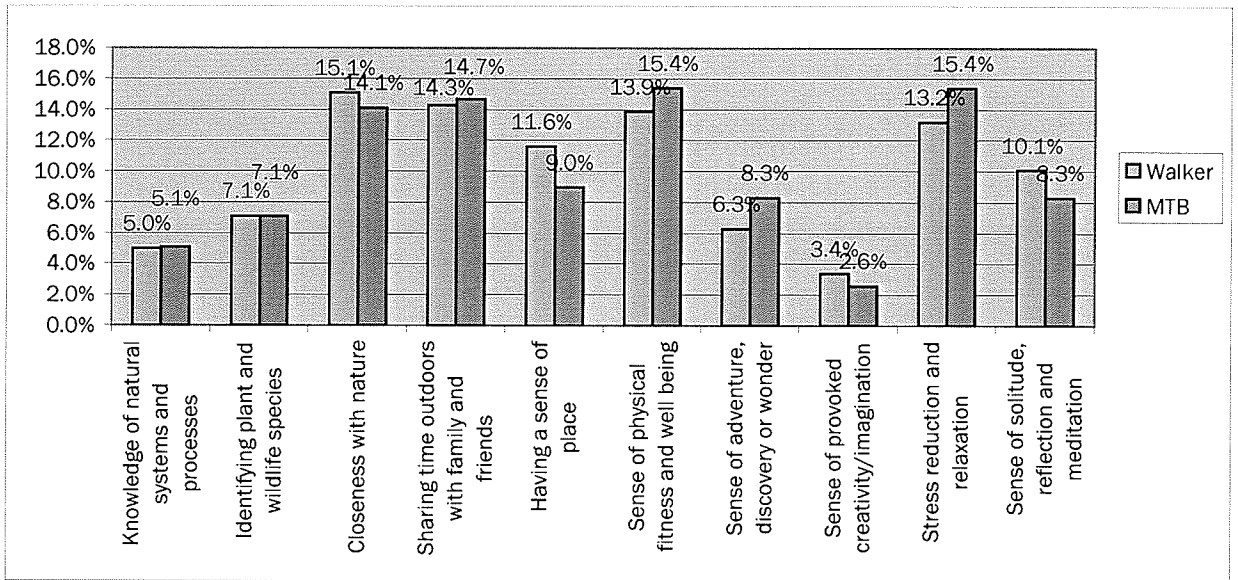
3) Age vs. Recreational Activity



When questions 2 and 5 were cross-tabulated, results showed that those over the age of 60, 50-54, 40-44, and 35-39 participated in all of the major recreational activities at the Assiniboine Park riparian forest. Those over the age of 60 had the highest overall rate of participation (31.7%), followed by those between the ages of 40-44 (16.0%), 50-54 (14.5%), 55-59 (10.3%) and 35-39 (8.4%). Those over 60 years of age had the highest rate of participation in hiking activities (50.0%) followed by mountain biking (45.5%), running

(39.1%), wildlife viewing (37.2%), biking (25.9%) and walking (23.1%). The top recreational activities for the remaining age groups include: walking (21.1%) for those between the ages of 55-59, wildlife viewing (18.6%) for those 50-54, biking (9.3%) for those 45-49, wildlife viewing (23.2%) for those 40-44, running (26.1%) for 35-39 year olds, biking (7.4%) for 30-34 year olds, mountain biking (6.1%) for those 25-29, and hiking (7.1%) for those between the ages of 20-24.

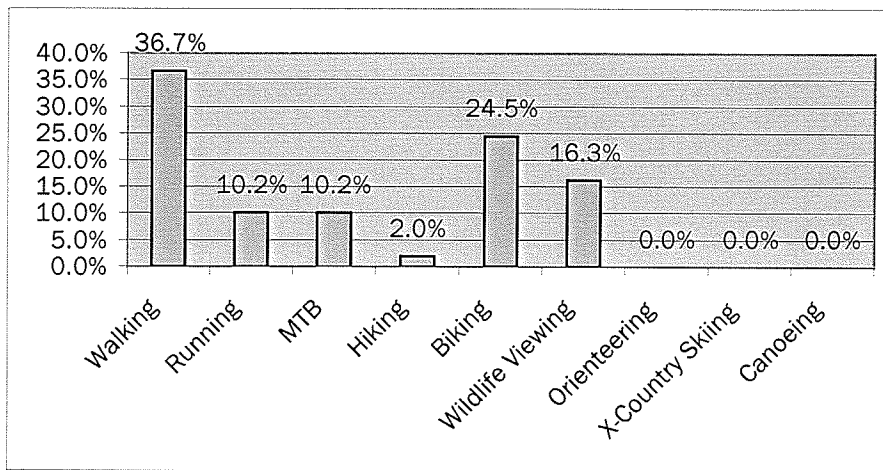
4) Walking vs. Mountain Biking and Outdoor Experiences



In order to determine a difference in the outdoor experiences of a less intense, low impact, low-speed activity such as walking and a more intense, more impact, high-speed activity such as mountain biking, questions 5 and 7 were cross-tabulated. The figure above shows that a connection with nature (15.1%), sharing time outdoors with family and friends (14.3%) and a sense of physical fitness and well-being (13.9%) were the top three outdoor experiences gained from walking. On the other hand, a sense of physical fitness and well being (15.4%), stress reduction and relaxation (15.4%) and connection with nature (14.1%) were the top three outdoor experiences gained from mountain biking. Most striking are the significant differences between walking and mountain biking among the various categories. Mountain bikers surpassed walkers in the following experiential categories: stress reduction and relaxation (2.2%), sense of adventure, discovery or wonder (2%), and a sense of physical fitness and well being (1.5%). Conversely, walkers surpassed mountain bikers in the

following experiential categories: having a sense of place (2.6%), sense of solitude, reflection and meditation (1.8%), closeness with nature (1.0%) and a sense of provoked creativity/imagination (0.8%). Equally, walkers and mountain bikers enjoy sharing time outdoors with family and friends, identifying plant and wildlife species and gain knowledge of natural systems and processes.

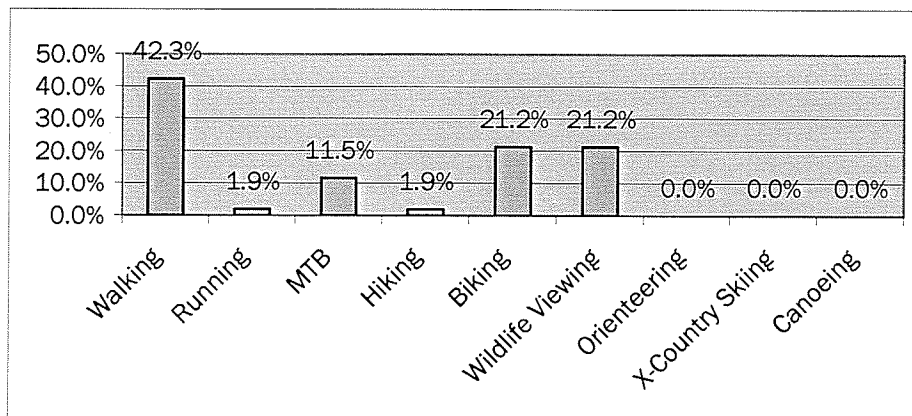
5) *Recreational Activity vs. Conflict*



In order to identify which user-types experience the most conflict at the Assiniboine Park riparian forest, questions 5 and 11B were cross-tabulated.

The figure above shows that walkers (36.7%) experienced the most conflict with other trail users, followed by bikers (24.5%) and wildlife viewers (16.3%). Runners (10.2%), mountain bikers (10.2%) and hikers (2.0%) encountered less conflict. No conflict was experienced among those participating in orienteering, cross-country skiing and canoeing.

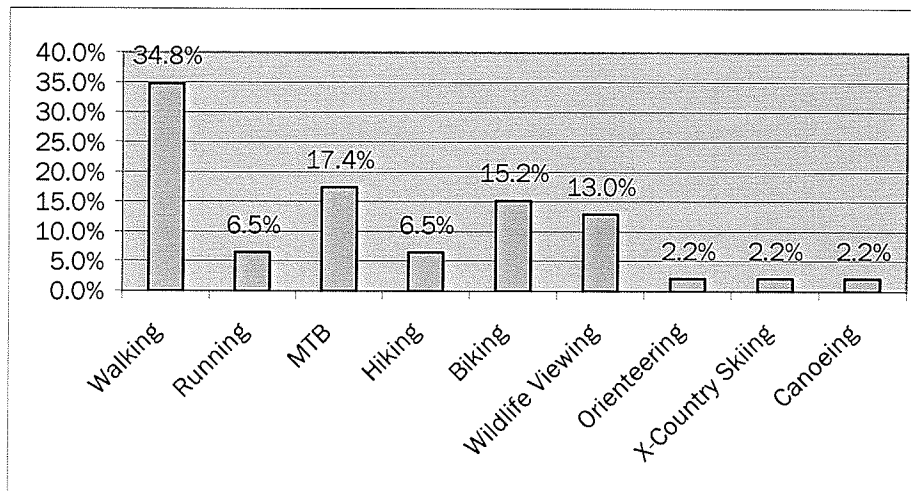
6) *Recreational Activity vs. Individual Trails*



In order to identify which recreational trail-users prefer individual trails, questions 5 and 12 were

cross-tabulated. The figure above shows that of those trail-users preferring individual trails, the majority were walkers (42.3%), followed by bikers (21.2%) and wildlife viewers (21.2%). Fewer mountain bikers (11.5%), runners (1.9%) and hikers (1.9%) prefer individual trails. Those participating in orienteering, cross-country skiing and canoeing activities did not express preference for individual trails. Results from question 12 however, show that the majority of trail-users (36.8%) prefer a mixture of both individual and multiple use trails.

7) Recreational Activity vs. Connectivity

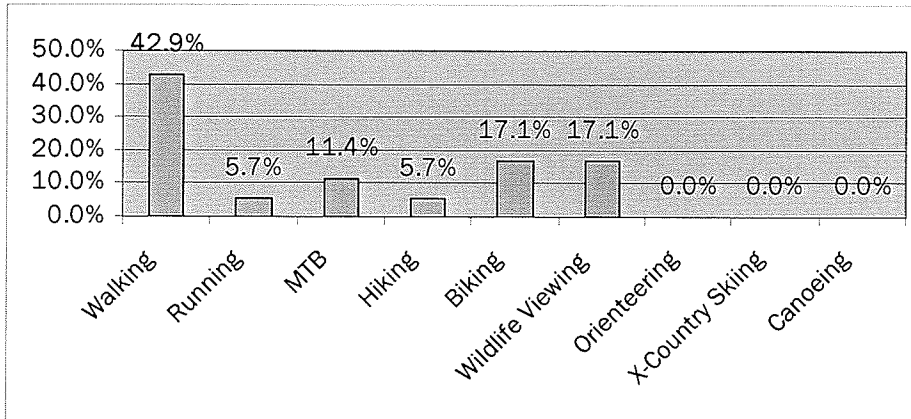


In order to identify which recreational trail-users would like connections to other trails, questions 5 and 15 were cross-tabulated. The

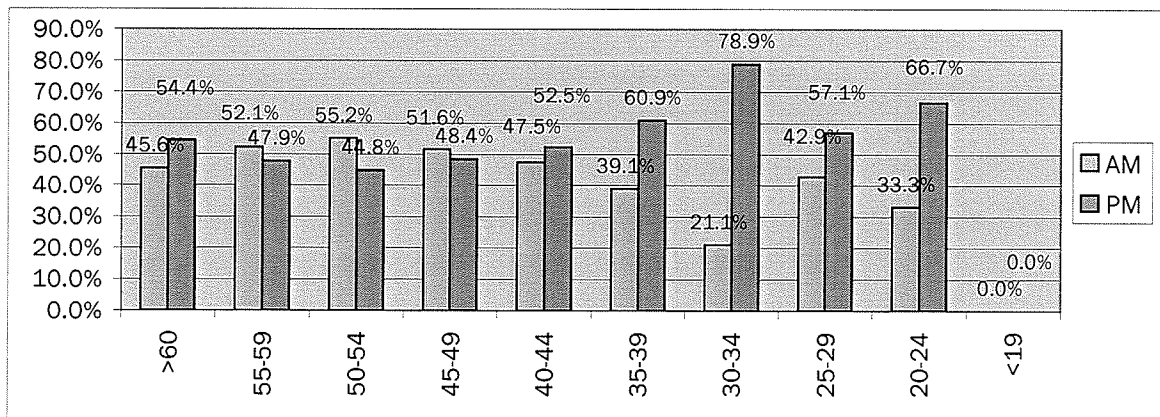
above figure shows that a high percentage of walkers (34.0%) want access to other riparian trails. In addition, a moderate number of mountain bikers (17.4%), bikers (15.2%), and wildlife viewers (13.0%) would like connections to other trails. Connections were less important to runners (6.5%), hikers (6.5%), orienteers (2.2%), cross-country skiers (2.2%) and canoers (2.2%).

8) Recreational Activity vs. River Access

In order to determine which recreational trail-users would like access to the Assiniboine River, questions 5 and 15 were cross-tabulated. The figure below shows that a high percentage of walkers (42.9%) would like access to the river, followed by bikers (17.1%) and wildlife viewers (17.1%). Access to the river was less important to mountain bikers (11.4%), runners (5.7%) and hikers (5.7%). No response resulted from those participating in orienteering, cross-country skiing and canoeing activities.



9) Frequency of Usage vs. Age Group



In order to identify which part of the day the various age groups prefer to use the Assiniboine Park riparian forest, questions 2 and 8 were cross-tabulated. Overall, the majority of Assiniboine Park riparian forest trail-users prefer afternoon/evening use. However, for the various age groups those between 45-59 preferred to use the site before noon, and those over 60 and between 20-44 preferred to use the site in the afternoon/evening.

7.3 Discussion

Age

A citywide automated telephone survey conducted in 1999 by the City of Winnipeg entitled, "A Needs Based Study of Assiniboine Park" indicated that Winnipeggers aged 34-54 years primarily visited Assiniboine Park (de Graaf 2000). Similarly, findings from the Assiniboine

Park riparian forest trail-user survey showed that the majority of trail-users are over the age of 40, particularly over 60 years of age. Fewer trail-users between the ages of 20-39, and no trail-users under the age of 19, resulted. The questionnaires were distributed to residents of riverfront properties along the Assiniboine River, an area containing some of Winnipeg's most expensive homes (Re/Max 2002). It is perhaps for this reason that those between the ages of 20-39 are poorly represented in this survey. Those under the age of 19 were not represented in the survey, even though this age group makes up a large number of the users observed at the Assiniboine Park riparian forest trails. This may be in part due to the fact that the homeowner or parent will typically fill out a household survey rather than the child or teen. It is believed that surveys conducted on-site at the Assiniboine Park riparian forest would have better captured this segment of the population. Due to time constraints, this method was not undertaken.

Awareness

Slightly more than half of the Assiniboine Park riparian forest trail-users are aware that native riparian forest represents an endangered habitat type in the City of Winnipeg. A relationship between demographic and socioeconomic variables of survey participants and level of awareness may exist but was not studied for the purposes of this practicum. Through on-site education or interpretation, knowledge of riparian forest systems would be gained, thus fostering an increased sense of appreciation and awareness from the surrounding community and riparian forest trail-users.

Recreational Activities

The Assiniboine Park riparian forest is host to a wide range of recreational activities including walking, running, mountain biking, hiking, biking, wildlife viewing, dog walking, orienteering, cross-country skiing and canoeing. The Assiniboine Park riparian forest provides a significant, popular, natural resource for nearby residents and city-dwellers as a whole. Among the Assiniboine Park riparian forest trail-users surveyed, the majority enjoys walking the trail system. According to Wall (1989), a relationship exists between age and participation in various recreational activities. Age does not determine recreation participation, but may create circumstances, such as declining physical ability, or perceptions, such as what is deemed appropriate for their age group, which may influence recreational choices. Manning (1999) also believes that age is strongly and inversely related to recreation activities

requiring physical strength and endurance. Conversely, the Assiniboine Park riparian forest trail-user survey showed that those over the age of 60 had the highest overall rate of participation in the various recreational activities among the other age groups. In addition, hiking, mountain biking, running, wildlife viewing, and biking were preferred over walking for this age group. This suggests that age is not necessarily a barrier in recreational choices and that Winnipeg's aging population is active, enjoys recreating outdoors, and are willing to explore diverse recreational activities regardless of people's perceptions of their physical abilities or what they consider appropriate for their age.

Impacts

Outdoor recreational use can cause adverse physical and biological impacts on riparian areas (Manning 1979). The trail-user survey identified which recreational activities are occurring at the Assiniboine Park riparian forest and which of these activities is most common. From the results, insight has been gained on which recreational activities may be responsible for the ecological impacts observed. According to Irving (1985), the impacts from walking, dog walking, running, and wildlife viewing are significant in large numbers, if on a weekly or more frequent basis. Findings from the Assiniboine Park riparian forest trail-user survey showed that walking was the most common activity overall. In addition, wildlife viewing ranked third in popularity, running ranked fifth and dog walking ranked seventh. Irving (1985) also states that the impacts from biking and mountain biking activities are significant in any number, if weekly or more frequent. Findings from the Assiniboine Park riparian forest trail-user survey showed that bicycling ranked second in popularity and mountain biking ranked fourth. Thus, the ecological impacts on the Assiniboine Park riparian forest may be a result of the high number of those participating in walking activities and the moderate numbers of those participating in bicycling, wildlife viewing and mountain biking activities.

Attractions

Findings from the survey indicate that Assiniboine Park riparian forest trail-users are attracted to the river, trails, location, vegetation, wildlife and recreational opportunities. These factors all function to enhance the recreational experience of the trail-user (Welle & Baer 1997). Assiniboine Park riparian forest trail-users are primarily attracted to the river.

Binford and Buchenau (1993) maintain that humans have a natural affinity for running water, and that riparian corridors are magnets for recreational use. In fact, results from the survey showed that 27.1% of trail-users would like more access to the Assiniboine River. Trails ranked the second most attractive feature of the Assiniboine Park riparian forest. Trapp et al. (1991) state that trails fill fundamental needs within oneself including: solitude, beauty, new experiences, meaning/connectedness, stress relief, self-renewal, peace, inspiration and challenge. Survey findings showed that 28.9% of Assiniboine Park riparian forest trail-users would like more connections to other trails in natural areas including those in riparian forests. Location of the Assiniboine Park riparian forest ranked third as an attractive feature for those residents living along the Assiniboine River. According to Irving (1985), woodland within walking distance of housing will greatly serve the surrounding community as a local park and used for short, regular visits. However, the Assiniboine Park and the riparian forest attract recreationists from a much wider area. " *A Needs Based Study of Assiniboine Park*" conducted by the City of Winnipeg concluded that 68% of Winnipeggers visited Assiniboine Park in 1999 (de Graaf 2000). The Assiniboine Park riparian forest is thus enjoyed by nearby residents and those living in distant communities alike. Vegetation and wildlife ranked fourth and fifth, respectively, in the Assiniboine Park riparian forest trail-user survey. Vegetation provides interest, diversity, and change (Trapp et al. 1991). This may take the form of the various colours and textures of bark, leaves, flowers and fruit as they change seasonally, the way light filters through the leaf canopy and plays on the shrubs and herbaceous plants, the way the tall tree canopy gives a sense of enclosure, or the way the forest moderates microclimate by sheltering out wind and cooling temperatures. In addition, wildlife occupying each layer of the forest adds a sense of intrigue, fascination and wonder to the riparian forest (Trapp et al. 1991). The Assiniboine Park riparian forest was least attractive in terms of recreational opportunities it provides. Perhaps this is due to poorly designated trails, the lack of connections, or degraded trail/site conditions.

Outdoor Experiences

In terms of outdoor experiences gained from using the Assiniboine Park riparian forest trail system, users primarily gained physiological, psychological and social benefits, rather than educational benefits. The Assiniboine Park riparian forest currently does not offer visitors information for trail interpretation. Results from the survey showed that 6.8% of trail-users desire maps and interpretive signage. Maps would serve to guide trail-users through the site

and identify key points of interest. Interpretive signage or brochures would allow visitors to learn more about the natural and historical significance of the site (Trapp et al. 1991).

Outdoor experiences gained by Assiniboine Park riparian forest trail-users differ according to the recreational activity performed. The survey showed significant differences between outdoor experiences gained from mountain biking, a more intense, high-speed recreational activity versus walking, a less intense, low-speed activity. Mountain bikers differed from walkers in feeling a sense of stress reduction and relaxation, a sense of adventure, discovery or wonder, and a sense of physical fitness and well being. On the other hand, walkers differed from mountain bikers in having a sense of place, feeling a sense of solitude, reflection and meditation, a closeness with nature, and a provoked sense of creativity and imagination. According to Carothers et al. (2001), mountain bikers and hikers seek very different experiences in their recreation. Mountain bikers seek a highly stimulating experience, one that is thrilling and exhilarating. Hikers, on the other hand, seek the opposite experience, one of solitude. It is evident that differences in outdoor experiences among various user-types should be considered when designing trails.

Seasonal and Temporal Use

The survey showed that Assiniboine Park riparian forest trail-use tended to be higher during the summer, fall and spring months of the year. Winter use was lower, probably a result of Winnipeg's low seasonal temperatures. Regarding temporal use, the majority of trail-users frequent the Assiniboine Park riparian forest on a weekly basis. According to Irving (1985), urban woodlands receive a more even spread of visitors throughout the week, and less dominant are Sunday attendance figures. Unfortunately, weekend figures were not obtained from the Assiniboine Park riparian forest trail-user survey, so it is uncertain whether trail-users prefer weekday to weekend use or vice versa. Other findings of the Assiniboine Park riparian forest trail-user survey showed that trail-use is slightly higher in the afternoon or evening than in the morning. According to Irving (1985), weekday mornings are the quietest periods, with more visitors in the afternoons. Perhaps the majority of Assiniboine Park riparian forest trail-users participate in recreational activities after a typical workday. The survey showed that the majority of those between the ages of 20-44 use the trails in the afternoon or evening. The majority of trail users between the ages of 45-59 participate in recreational activities before noon, perhaps preferring to avoid daytime temperatures or

afternoon crowds. Observations during the spring and summer months indicated a large proportion of seniors recreating in the early morning. Surprisingly, the Assiniboine Park riparian forest trail-user survey showed the majority of those over the age of 60 prefer to use the trails in the afternoon or evening. This discrepancy may be the result of varying lifestyles and preferences of the individual recreationist.

Safety

Results from the survey showed that the majority of Assiniboine Park riparian forest trail-users had no personal safety issues. Of those that did, the majority was female and was over the age of 50. Safety concerns included a lack of lighting, low branches and deadfall, and a low number of trail-users. Irving (1985) suggests trail maintenance to avoid injury and advises trail-users to keep alert, avoid walking alone, and to report any incidents.

Conflict

The survey showed that the majority of Assiniboine Park riparian forest trail-users experienced no conflict with other trail-users. Of those that did experience conflict, the majority were walkers. In addition, of those trail-users that preferred individual, activity-specific trails, the majority were also walkers. Survey respondents commented on the conflict between walkers and bikers, remarking that conflicting speed was an issue. According to Jacob and Schreyer (1980), the more intense the activity style, the greater the possibility that a social interaction with less intense participants will result in conflict.

7.4 Conclusion

The Assiniboine Park riparian forest trail-user survey provided valuable information on the characteristics, behaviours, values and preferences of trail-users. Pertinent information gathered from the trail-user survey will be utilized to support and inform the subsequent program and design scheme for the Assiniboine Park riparian forest. Five main points from the trail-user survey that will aid in driving the design of the Assiniboine Park riparian forest include: (1) the desire for connections to other trails and natural areas, (2) access to the river, (3) preference for a mixture of both individual and multiple-use trails, (4) the majority of trail-users are walkers, (5) walkers and bikers seek different experiences from using the trails.

Improvements to the Assiniboine Park riparian forest trail-user survey would include a much larger sample size, a broader target population size to include a wider spectrum of users, and a record of the actual number of Assiniboine Park riparian forest trail-users via an automated site-counter.

Chapter 8: Concept

Chapter 8

Concept

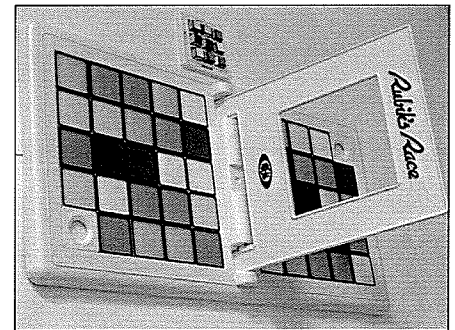
Nature can be viewed as a system of interconnected, interdependent and ever-changing parts. "Part" can refer to any number of elements within a landscape such as river, mountain, field, lake, island, and forest (Labaree 1992).

Riparian forests can thus be seen as systems that connect with their surroundings (river and upland forest), depend on their surroundings, and are subject to their surroundings such that a change in one "part" will affect another.

The riparian forest is thus a dynamic system, constantly in flux and ever-changing. Its boundaries are subject to constant pressures both natural (river processes) and cultural (development/recreation, introduction of invasive species). Riparian boundaries shift (push, pull, expand, contract) in response to these pressures or forces, creating new patterns in the landscape.

Inspiration – "Rubik's Race"

The idea of modifying and creating new patterns on the landscape by shifting, sliding, pushing and pulling of parts is much like the "Rubik's Race," a board game created in the 1980s modeled after the "Rubik's Cube" which involved: 1. Shaking the 'Scrambler,' 2. Sliding the tiles to match the 'Scrambler,' and 3. Dropping the frame to claim the game. The 'Scrambler' represents the 'catalyst' or 'force' (natural processes or cultural influence/impact) and the 'Game board' represents the 'landscape' on which the 'process/force/impact' is translated or expressed.

*Conceptual Demonstration*

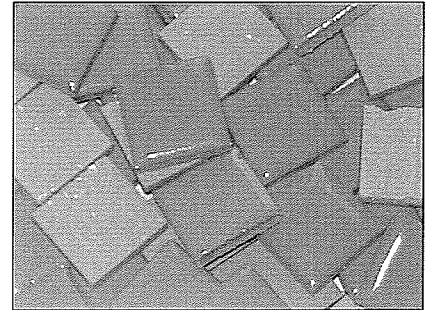
In order to express the effects of natural and cultural forces in modifying the landscape, a conceptual exercise was undertaken. The following describes the objectives, materials, methods, results and conclusions.

Objectives

The objectives of this demonstration were to comprehend visually and express the effects of these natural and cultural forces on modifying the Assiniboine Park riparian forest and to gain insight for the preliminary design phase of the site.

Materials

Clay mosaic tiles were used as the primary medium to demonstrate the concept. The clay tiles were chosen to represent the 'parts' or 'units' of which the 'sum of all parts,' or 'nature,' is comprised. In addition, the tiles provide ease with which to shift and slide the pieces in response to the applied 'forces.' They also reflect the historic use of river clays in the creation of handmade ceramic tile.



Methods

Each colour of tile was assigned to represent a particular element of the landscape within and immediately adjacent to the Assiniboine Park riparian forest. Green represents that portion of the riparian forest that is mostly comprised of native riparian vegetation, except for Tile Configuration 1, in which green represents the Assiniboine Park riparian forest area in its entirety. The 'forces' are represented by dark blue (river), orange (developed portions of the Park, south of the riparian forest), light blue (European buckthorn, the invasive exotic plant species), and red (developed areas within the riparian forest such as Leo Mol Sculpture Garden and the English Garden). Yellow represents areas of land reclamation.

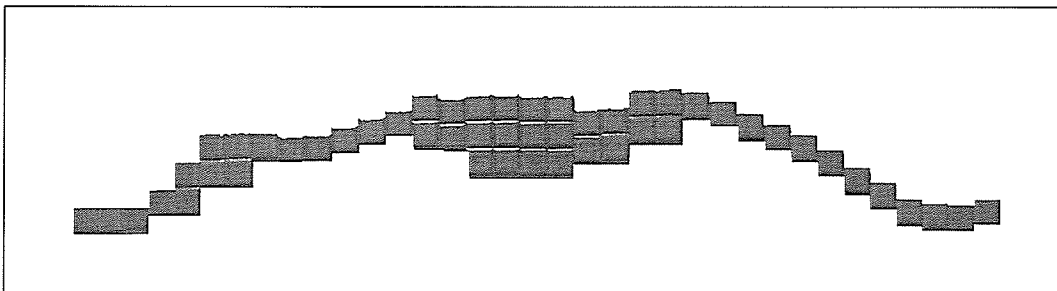
Once the various tile colours were assigned characteristics, the tiles were assembled. To begin with, the green tiles were laid out to represent the shape and extent of the Assiniboine Park riparian forest. Subsequently, the varying 'forces' were layered onto the original scheme. The tiles were then shifted to express the (hypothetical/potential) effects of these 'forces' on the site. In order to govern the shifting movement of the tiles, rules were formulated based on the effects of the various 'forces' gathered from existing literature. Depending on the nature of the force, as a rule, tiles would be deleted, added or replaced. Thus, in terms of the 'river force,' as part of a river's natural process, there is a tendency for rivers to erode the outermost edge of a river bend and to deposit sediment on the inner curve (Reilly 2000). Consequently, tiles would be removed from areas at risk of erosion, and

tiles would be added to areas prone to sediment deposition. In terms of the 'invasive species force,' European buckthorn has the effect of choking out and replacing native vegetation (Archibold et al. 1997). Accordingly, riparian forest tiles would be deleted and replaced by European buckthorn tiles where spread into more native zones is most likely to occur. In terms of the 'development force,' waterfront property remains an attractive location for recreational, residential and commercial development (Moffat 2002). Riparian forests are continuously being modified and consequently, the demand for waterfront property has exceeded the supply in most Canadian cities (Kipp & Callaway 2003). Development (roads and parkland) has replaced much of the upland portions of the Assiniboine Park riparian forest and has encroached towards the river in some areas (Leo Mol Sculpture Garden and English Garden). Expansion of developed areas within the riparian forest, in particular Leo Mol Sculpture Garden, is presently being considered by the City of Winnipeg. In view of that, riparian forest tiles would be deleted and replaced by development tiles in areas where future expansion may be proposed.

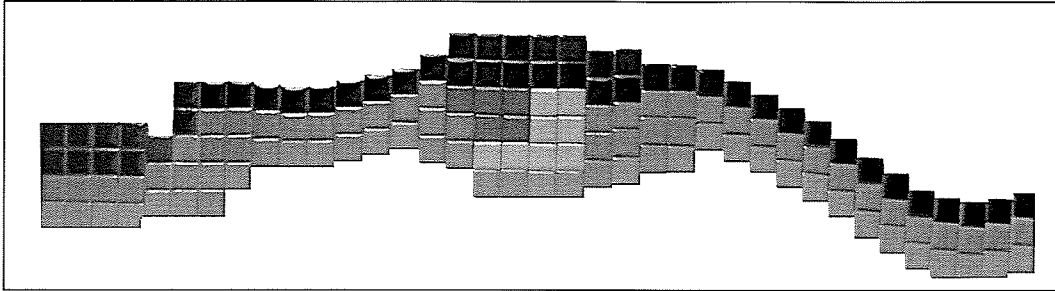
Digital photos were taken throughout the dynamic tile process and 5 significant tile configurations were mounted for presentation purposes.

Result

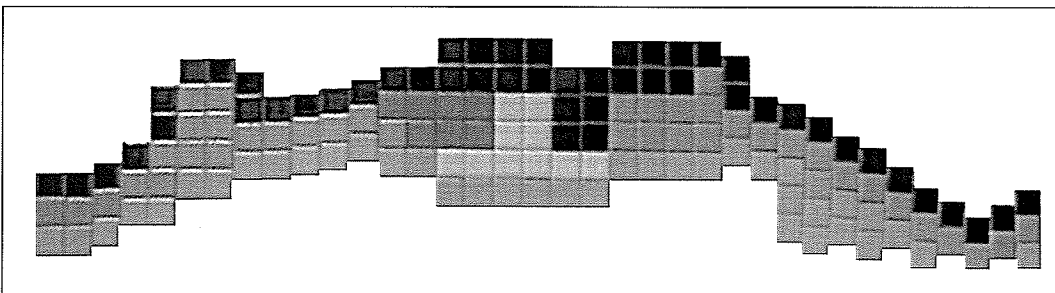
Tile Configuration 1: The extent of the Assiniboine Park riparian forest.



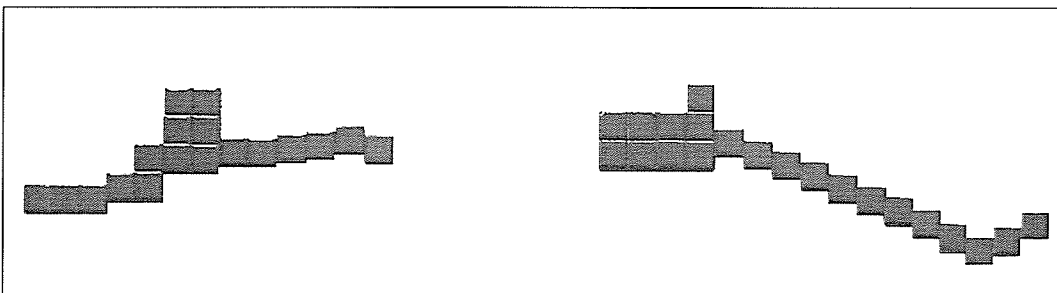
Tile Configuration 2: The natural and cultural 'forces.' The Assiniboine River to the north (dark blue) and developed areas to the south (orange) bind the site. Leo Mol Sculpture Garden (red), English Garden (red) and European buckthorn stands (light blue) occupy the central area.



Tile Configuration 3: The 'acting forces' shifting the riparian forest's boundaries according to the aforementioned rules.

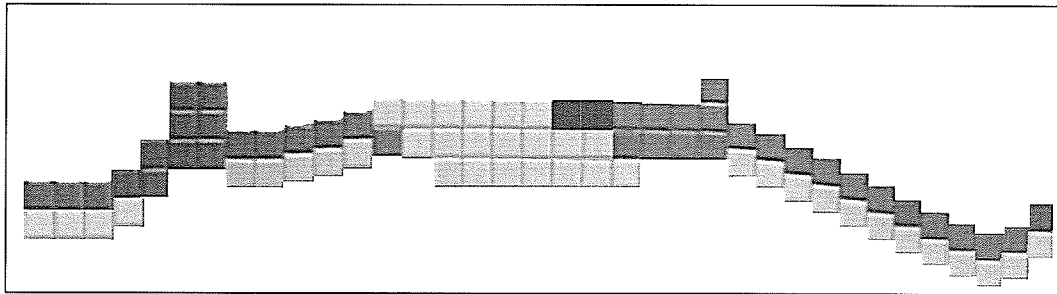


Tile Configuration 4: The 'result.' The forces have modified the riparian forest creating a new pattern of landscape. The result is a much narrower and more fragmented riparian forest, which consequently is both precipitated by the natural and cultural forces and continues to threaten both nature and culture.



Tile Configuration 5: 'Preliminary design intentions.' Tile Configuration 4 showed that the resulting riparian forest is much narrower and more fragmented. Any additional impact may cause the riparian forest corridor to 'thin' and 'break' further. It becomes evident that filling in 'gaps' and widening the existing riparian forest would aid in strengthening and reinforcing the site as a whole. The overall mosaic's integrity is dependent upon a) the presence of

particular tiles; b) the absence of others; and c) the connection between certain tiles. Tile configuration 5 shows areas of potential filling/reconnecting and widening of the riparian forest in order to prevent further narrowing and fragmentation of the corridor. Potential areas for reclamation are identified in yellow. Areas in dark blue identify zones at risk of erosion by the forces of the river. Widening of the forest will act to counterbalance the dynamic nature of the river and its impacts on the riparian forest.



Conclusion

The clay mosaic tile exercise provided a powerful representation of the effects of 'natural' and 'cultural' forces on influencing the structure, functioning and shape of the Assiniboine Park riparian forest. It demonstrates the overall vulnerability of these linear landscapes to various natural and cultural impacts. This exercise offered valuable insight as to what may result if these forces/impacts are further ignored. It also aided in the identification of areas of potential reclamation, which will be considered for the design phase of the practicum.

It becomes apparent that the overall concept, or strategy, for the Assiniboine Park riparian forest is to widen and reconnect the existing riparian forest by reclaiming large areas of land within and adjacent to the Park. This strategy would have both ecological and recreational benefits. Ecologically, natural habitat for wildlife would increase, the risk of forest fragmentation would be minimized, erosion and degradation of the water resource would decline, and the forest as a whole would be able to absorb any further impact and better respond to change. Recreationally, the quality of the trail experience would increase as a consequence of a more extensive recreation zone able to support a wider variety of activities, as well as a continuous corridor where movement or flow is unimpeded.

Chapter 9: Program Development

Chapter 9

Program Development

This chapter is divided into three sections: section one identifies three sets of strategies, which will be explored in the treatment of the Assiniboine Park riparian forest. Section two begins to further develop the overall strategy for the Assiniboine Park riparian forest by exploring design guidelines for riparian buffer strips and corridors. Section three examines the three-zone buffer design approach and applies it to the Assiniboine Park riparian forest.

9.1 Strategies

This section identifies and outlines conservation, recreation and mediation strategies for the Assiniboine Park riparian forest. For each set of strategies, an overall goal is identified followed by a series of specific action-oriented objectives. These strategies, goals and objectives will serve as a guideline, or list of rules, for achieving the proposed strategy /design solution.

Idealized Conservation Strategy

Conservation is defined as the preservation or restoration of a natural environment and its wildlife (Raven & Johnson 1992). An idealized conservation strategy would involve as its primary focus, the preservation or restoration of a particular natural system including all of its physical elements and its interactions or functions (Labaree 1992).

An idealized conservation strategy for the Assiniboine Park riparian forest establishes the ecological functioning of the forest as a priority. This approach would allow for the natural evolution of a river over time (Figure 9.1.2), preserve or restore habitat patches and corridors for wildlife, and allow for minimal or no human usage. The conservation goals and objectives for the Assiniboine Park riparian forest are as outlined below.

Conservation Strategy:

Goal: To conserve the ecological functioning of the Assiniboine Park riparian forest

Objectives:

- To minimize or prohibit human access, in the form of both passive and active recreational activities, to the Assiniboine Park riparian forest thereby eliminating trampling and loss of riparian vegetative cover; eliminating

compaction and erosion of organic litter and soil; eliminating disturbance to wildlife; eliminating trail braiding and widening; protecting existing mature riparian trees from damage

- To eliminate the presence of invasive exotic plant species (*Rhamnus cathartica*)
- To preserve existing natural features and native riparian vegetation
- To encourage natural regeneration of native riparian vegetation, where possible
- To restore degraded areas by planting native riparian vegetation

Public-Education Component:

- To foster an awareness, appreciation and understanding of the importance of conserving riparian habitat to the public through signage and educational brochures
- To provide nearby residents and park-users with opportunities to learn about the historical and natural assets of the Assiniboine River and the riparian forest through educational/interpretive programming

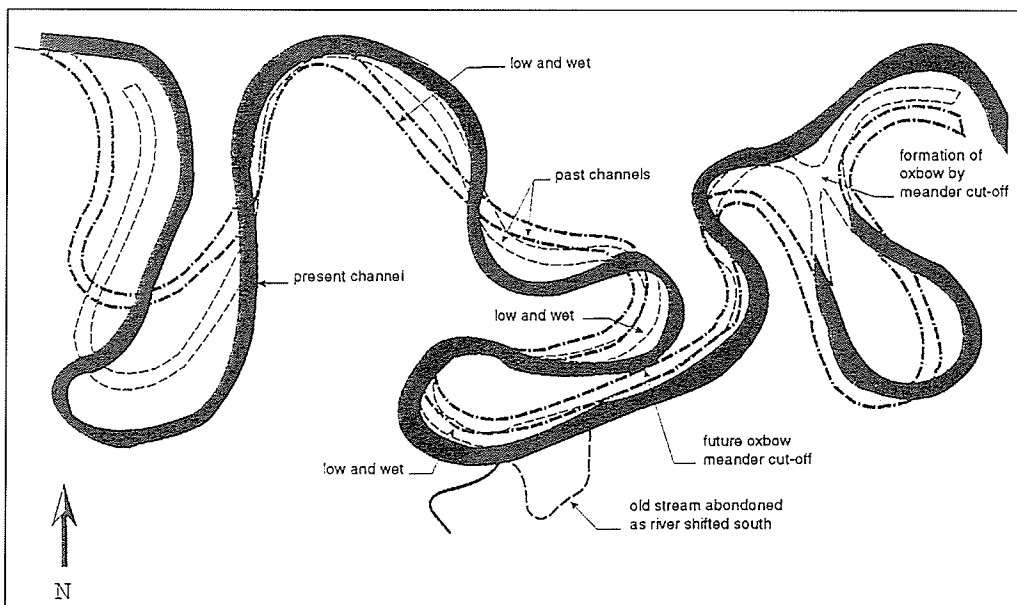


Figure 9.1.2: Meander formations of the Assiniboine River at Beaudry Provincial Park (Murdy 1977).

The advantage of this “save-all” conservation strategy is to allow the Assiniboine Park riparian forest to function ecologically for the benefit of native plant communities, wildlife, the water system, habitat for both plant and animal communities, a conduit for plants, animals, water, sediment, and chemicals. Figure 9.1.3 shows a representation of an idealized conservation strategy for the Assiniboine Park riparian forest. Figure 9.1.4 shows a section through the idealized conservation strategy.

Idealized Recreation Strategy

As discussed in Chapter 2, the demand for outdoor recreation has grown considerably over recent decades and appears to be rising steadily. Outdoor recreation offers many benefits for humans including psychological, physiological, social, educational and spiritual benefits. An idealized recreation strategy would establish outdoor recreational activities in natural areas as its main priority, for human use and enjoyment. The recreation goals and objectives for the Assiniboine Park riparian forest are as outlined below.

Idealized Recreation Strategy:

Goal: To enhance the recreational experience of trail-users

Objectives:

- To provide full access to the Assiniboine River and the Assiniboine Park riparian forest
- To support and encourage a wide range of recreational activities
- To design positive outdoor recreational experiences suited for the various forms of recreation
- To encourage use in all four seasons of the year
- To minimize potential conflict between the various recreational activities and trail-users
- To create connections or links to other riparian trails and natural areas

Public-Education Component:

- To foster an awareness, appreciation and understanding of riparian habitat to the public through signage, educational brochures and interpretive programming

- To provide way-finding information to guide trail-users throughout the trails
- To provide trail etiquette signage to encourage proper use of the trails and to avoid user conflict

Figure 9.1.5 shows a representation of an idealized recreation strategy for the Assiniboine Park riparian forest. Figure 9.1.5 shows a section through the idealized recreation strategy.

Mediated Recreation-Conservation Strategy

A mediation strategy has the dual goal of providing outdoor recreational opportunities and conserving nature. It involves maximizing the interaction and cooperation between the two strategies while minimizing the conflicts that exist. Mediation strategies should aim to channel the recreational users' needs and desires in a manner that will have less impact on the natural area (Cole 1993). A mediation strategy for the Assiniboine Park riparian forest incorporating conservation, recreation and education strategies is outlined below.

Mediated Recreation-Conservation Strategy:

Goals:

- ❖ To conserve valuable native riparian habitat for the benefit of both humans and wildlife
- ❖ To enhance the recreational experience of trail-users in a manner suited to the sensitivity of riparian systems

Objectives:

- To support and encourage various forms of recreational activities suitable to riparian habitats
- To encourage use in all four seasons of the year
- To minimize trampling and loss of riparian vegetative cover from recreational activities
- To protect existing mature riparian trees from damage due to recreational activities
- To minimize compaction and erosion of organic litter and soil from recreational activities
- To minimize disturbance to wildlife from recreational activities
- To reduce trail braiding and widening

- To minimize the spread of invasive exotic plant species such as *Rhamnus cathartica*
- To encourage natural regeneration of native riparian vegetation, where possible
- To restore degraded areas by planting native riparian vegetation
- To maintain the 'natural' appeal of the recreational resource at hand
- To conserve existing natural features and vegetation
- To minimize potential conflict between the various recreational activities and trail-users
- To design positive outdoor recreational experiences suited for the various forms of recreation
- To create connections or links to other riparian trails and natural areas
- To provide access to the Assiniboine River

Public-Education Component:

- To foster an awareness, appreciation and understanding of the importance of conserving riparian habitat to the public through signage and educational brochures
- To provide nearby residents and park-users with opportunities to learn about the historical and natural assets of the Assiniboine River and the riparian forest through educational/interpretive programming
- To provide way finding information to guide trail-users throughout the trails
- To provide trail etiquette signage to encourage proper use of the trails and to avoid user conflict

Figure 9.1.7 shows a representation of the mediated recreation-conservation strategy for the Assiniboine Park riparian forest. Figure 9.1.8 shows a section through the mediated recreation-conservation strategy. The 'Mediation Strategy' is the most suitable strategy for the Assiniboine Park riparian forest. A strict conservation strategy for the Assiniboine Park riparian forest would be inappropriate in a park as public as Assiniboine Park. The Park attracts hundreds of thousands of park-users on a yearly basis (de Graaf 2000). Although the exact number of those that use the Assiniboine Park riparian forest each year is not known, the recreational impacts indicate that the site is well used. Riparian areas are

attractive locations for various recreational activities due to the presence of water, diverse vegetation, moderated climate, abundant wildlife (Welle & Baer 1997) and varied topography in an otherwise 'flat' land. However, as recreational use of the Assiniboine Park riparian forest continues, the quality of the resource will further decline. Thus, a sole recreation strategy in an already sensitive environment would also seem inappropriate. The design and management of this urban natural resource should strike a balance between resource protection and providing for recreation focusing on understanding the needs of the recreational users and the constraints of the environment. The remainder of the practicum will focus on developing the mediation strategy and design for the Assiniboine Park riparian forest.

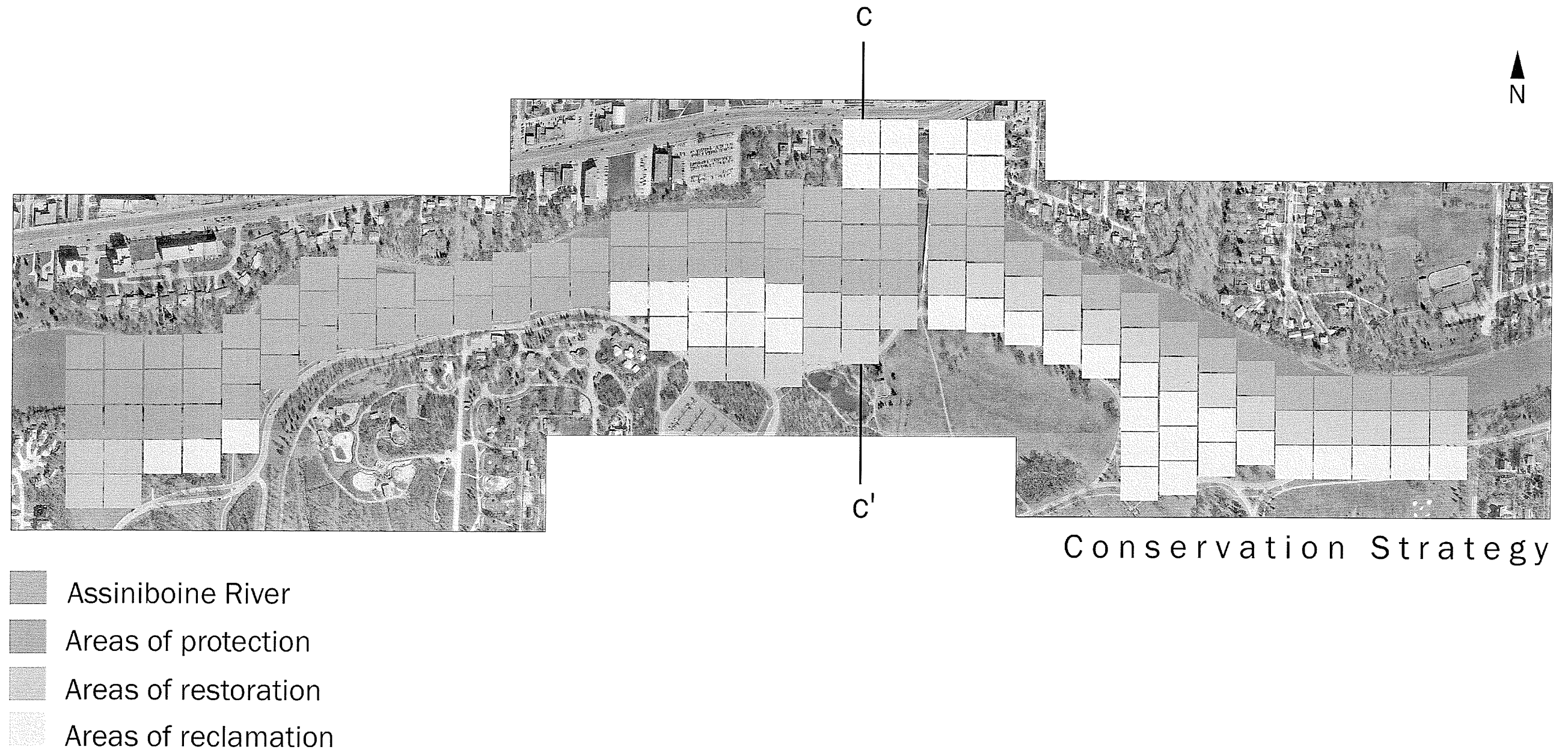


Figure 9.1.3: Idealized conservation strategy for the Assiniboine Park riparian forest.

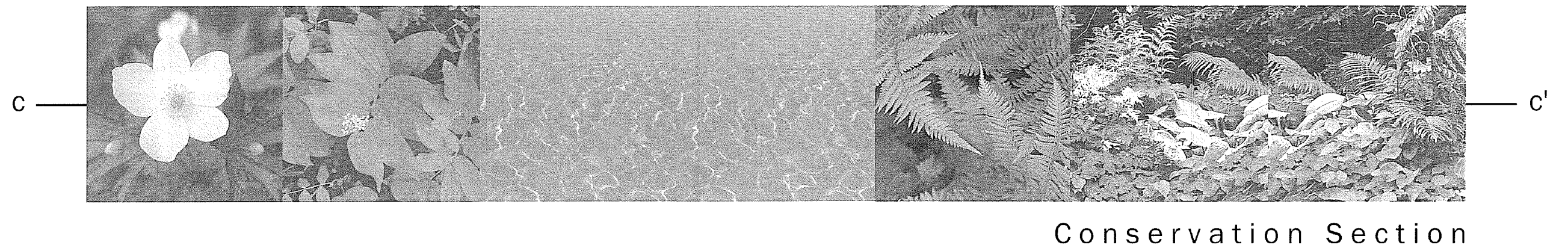


Figure 9.1.4: Section through idealized conservation strategy.

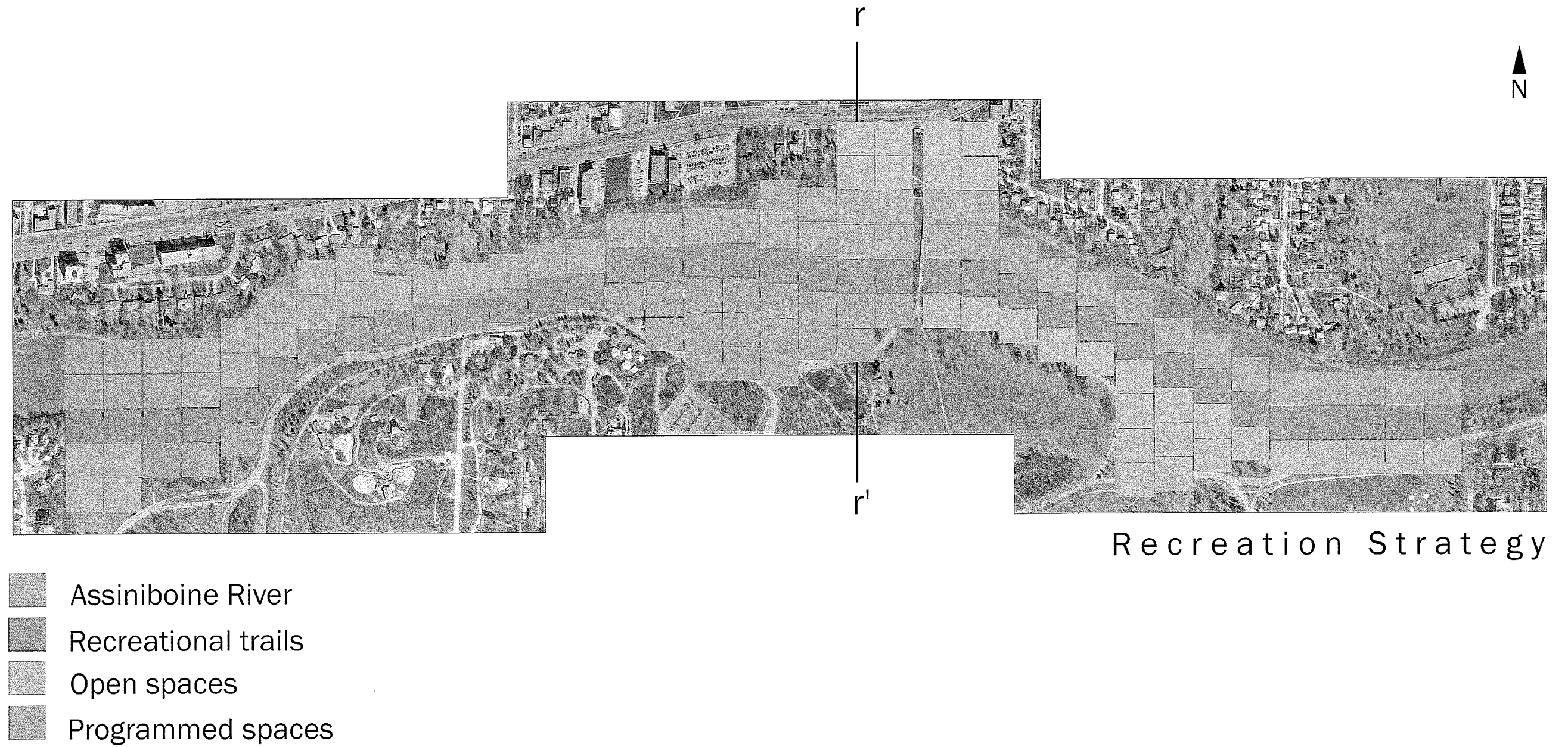


Figure 9.1.5: Idealized recreation strategy for the Assiniboine Park riparian forest.

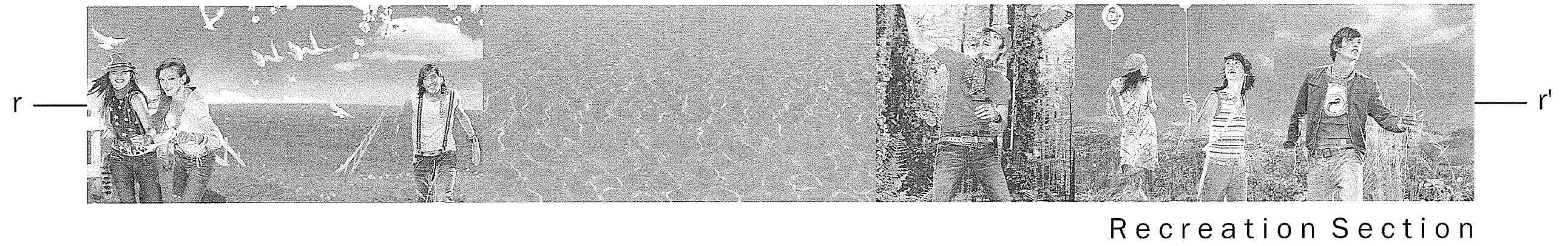


Figure 9.1.6: Section through idealized recreation strategy

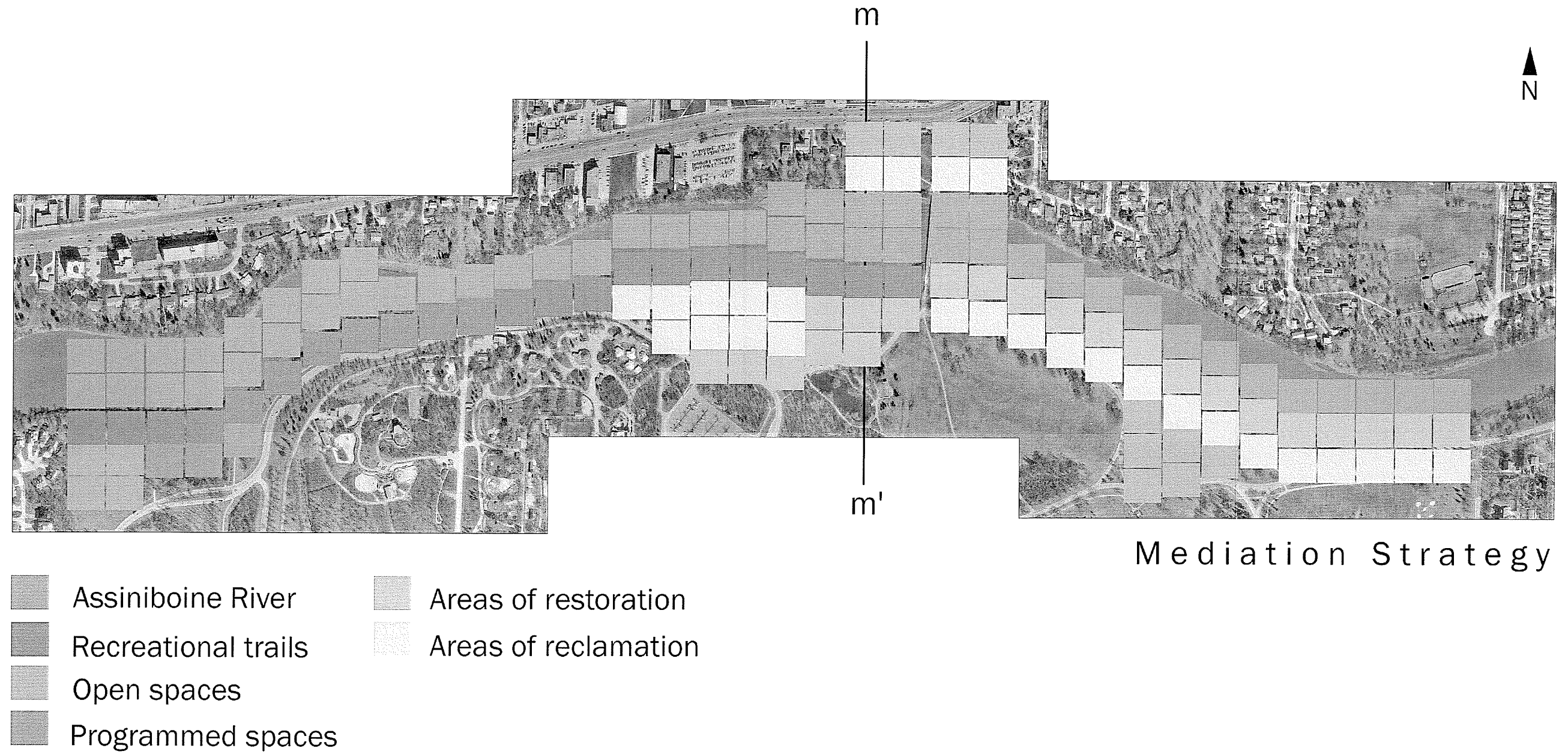


Figure 9.1.7: Mediated recreation-conservation strategy for the Assiniboine Park riparian forest.

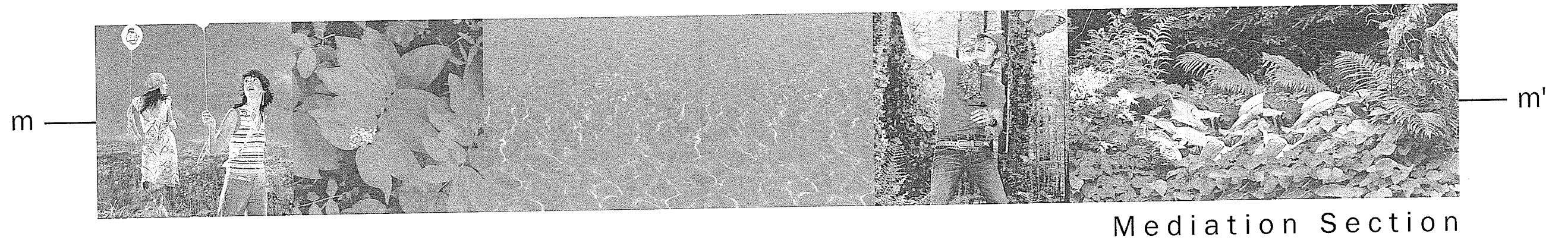


Figure 9.1.8: Section through mediated recreation-conservation strategy.

9.2 Buffer Design Approach

This section begins to develop, or expand on, the overall strategy for the Assiniboine Park riparian forest as revealed through the clay mosaic tile exercise in Chapter 8. The main strategy for the Assiniboine Park riparian forest is to widen and reconnect the riparian corridor/buffer by reclaiming large areas of land within the Assiniboine Park adjacent to, and within, the Assiniboine Park riparian forest. This strategy would have both ecological and recreational benefits. Ecologically, natural habitat for wildlife would increase, the risk of forest fragmentation would be minimized, erosion and degradation of the water resource would decline, and the forest as a whole would be able to absorb any further impact and better respond to change. Recreationally, the quality of the trail experience would increase as a consequence of a more extensive recreation zone able to support a wider variety of activities, as well as a continuous corridor where movement or flow is unimpeded. Design recommendations and guidelines for riparian buffers described in Chapter 4 will be explored in order to achieve the proposed strategy for the Assiniboine Park riparian forest.

Functional Objectives

When designing riparian buffer strips or corridors, the primary objectives or functions of the buffer strip or corridor should be determined (Fisher & Fischenich 2000). The functional objectives for the design of the Assiniboine Park riparian forest are: 1) water quality protection (pollutant removal, stream stabilization and temperature moderation); 2) riparian habitat (provision for aquatic and terrestrial wildlife); 3) flood control; and 4) recreational and educational opportunities.

Three-Zone Riparian Buffer System

As discussed in Chapter 4, several sources recommend a three-zone riparian buffer system approach in order to maximize the benefits of riparian buffers where each zone serves a different purpose, and different uses are allowed in each zone (Bentrup & Hoag 1998; Berchtold et al. 1998; Fisher & Fischenich 2000). The first buffer zone (streamside) includes undisturbed forest along the riverbank. This zone helps stabilize the streambank, shade the stream, and provides habitat and food for terrestrial and aquatic organisms. The second zone (middle zone) further upstream is a strip of managed forest where some recreational

uses such as pathways, may occur. This zone serves to remove pollutants from storm water through filtering, denitrification, and plant uptake. The third zone (outer zone), farthest from the stream, would allow for more uses. This zone helps to filter sediment from surface runoff. The urban riparian buffer strip approach described will be applied to the Assiniboine Park riparian forest.

Riparian Buffer Length

Chapter 4 revealed that long, continuous riparian buffer strips are encouraged rather than fragmented strips of greater width. In addition, unfragmented buffer strips are more effective at protecting water quality and for providing movement corridors for wildlife (Weller et al. 1998). For the Assiniboine Park riparian forest, the entire length of the riparian buffer will be conserved. Connecting buffer strips along the Assiniboine River, beyond the Park boundary should also be protected. In addition to conserving the entire length of the site, a continuous, unfragmented buffer strip will be achieved by reclaiming large areas of land within and adjacent to the Park.

Riparian Buffer Widths

As discussed in Chapter 4, determining riparian buffer widths depends on the functional objectives one is interested in conserving (Berechtold et al. 1998). Criteria for determining proper buffer width dimensions for some functions are not well established and highly variable (Fisher & Fischenich 2000). Most existing criteria focuses on water quality protection however, it is only one of many functions performed by riparian buffers. There have been few approaches that mesh water quality width requirements with conservation values and recreational values (Fisher & Fischenich 2000). Table 9.2.1 shows a synopsis of the recommended riparian buffer strip widths as per Bentrup & Hoag (1998), Berchtold et al. (1998) and Fisher & Fischenich (2000) that incorporates the four functional objectives intended for the Assiniboine Park riparian forest.

Table 9.2.1: Summary of ideal urban riparian buffer strip design guidelines (Bentrup & Hoag 1998; Berchtold et al. 1998; Fisher & Fischenich 2000).

Characteristics	Zone 1 (Streamside)	Zone 2 (Middle Zone)	Zone 3 (Outer Zone)
Function	Water quality protection (pollutant removal, stream stabilization, temperature regulation) and wildlife habitat provision	Surface and groundwater filtration (sediment, nutrient and pollutant removal) and major provision of wildlife habitat	Slowing runoff and filtering sediment and chemicals from surface runoff; allows for recreation benefits
Width	30m minimum from nearest continuous vegetated ground cover	70m minimum combined with Zone 1 will provide food & shelter for a wide range of aquatic & terrestrial wildlife	10m minimum setback to development, to be expanded wherever possible
Allowable Uses	Very restricted; no recreational uses	Restricted; some recreational uses allowed (footpaths)	Unrestricted; more recreational uses allowed (bike paths)

The widths presented are based on multiple functions (water quality, wildlife habitat, flood control and recreational/educational use) and may be expanded or contracted according to specific site conditions. For the Assiniboine Park riparian forest, the proposed 110m total buffer strip width will accommodate an extensive range of aquatic and terrestrial wildlife, in addition to, providing ample space for recreational activities to occur. Riparian buffer zoning will serve to protect sensitive areas along the river and floodplain region while allowing for recreation to occur in allotted areas in order to minimize the impacts to vegetation, soil, and wildlife.

These guideline widths represent an ideal approach to riparian buffer strip design and management. They are intended to serve as a starting point for regulatory agencies and land managers to make decisions regarding design and management of riparian buffer strips in the city of Winnipeg.

9.3 Site Application

In order to effectively manage the Assiniboine Park riparian forest for both nature conservation and outdoor recreation, the three-zone riparian buffer system approach, as described, will be applied to the site. The following images explore the buffer design approach as it applies to the Assiniboine Park riparian forest.

Recommended Buffer Widths
as applied to the Assiniboine Park
riparian forest (Figure 9.3.1). 30 m for
water quality protection; 70 m for
wildlife habitat provision; 10 m
minimum setback for recreational use.

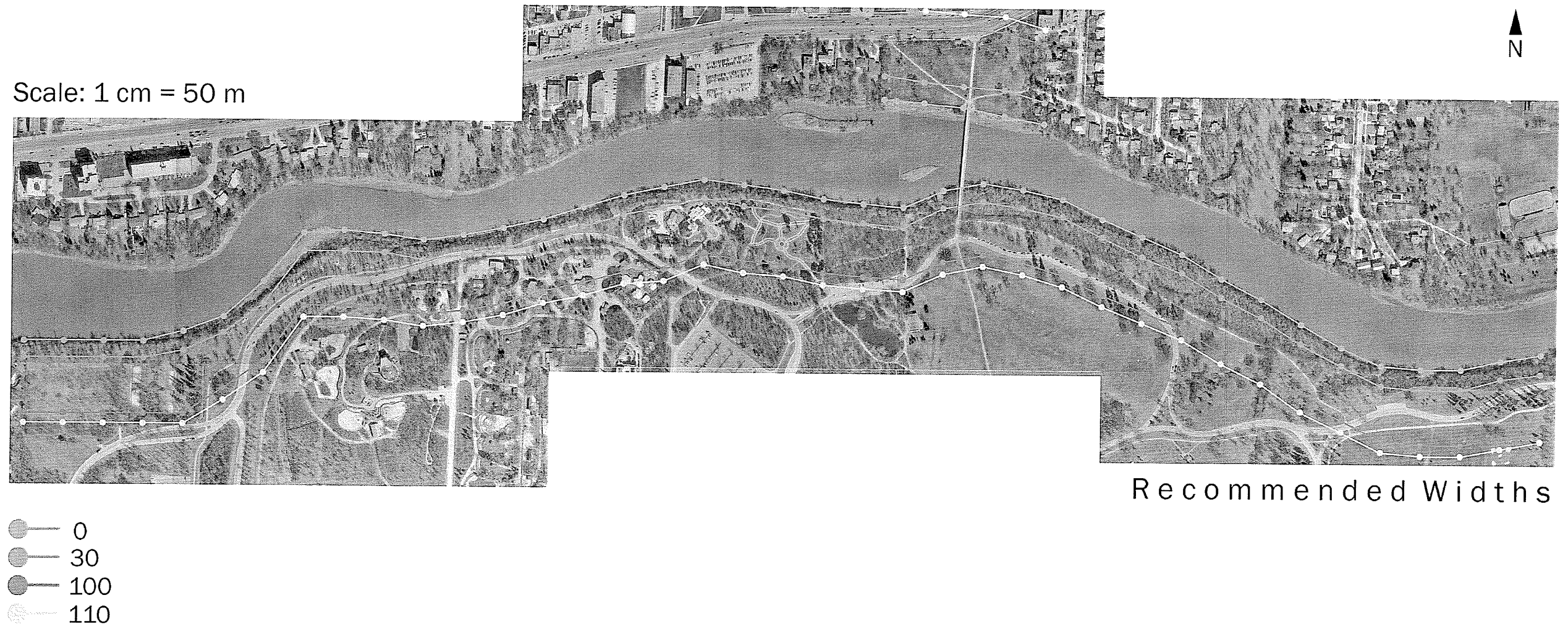


Figure 9.3.1: Recommended widths applied to the Assiniboine Park riparian forest.

Riparian Buffer Zones overlaid onto the Assiniboine Park riparian forest (Figure 9.3.2). Zones are identified as Zone 1 (Streamside), Zone 2 (Middle zone) and Zone 3 (Outer Zone).



Figure 9.3.2: Riparian buffer zones as applied to the Assiniboine Park riparian forest.

Zone Analysis: Zone One is located nearest the river. It is a continuous buffer strip subject to annual flooding and heavy trampling by recreationists (Figure 9.3.3).

Zone Analysis

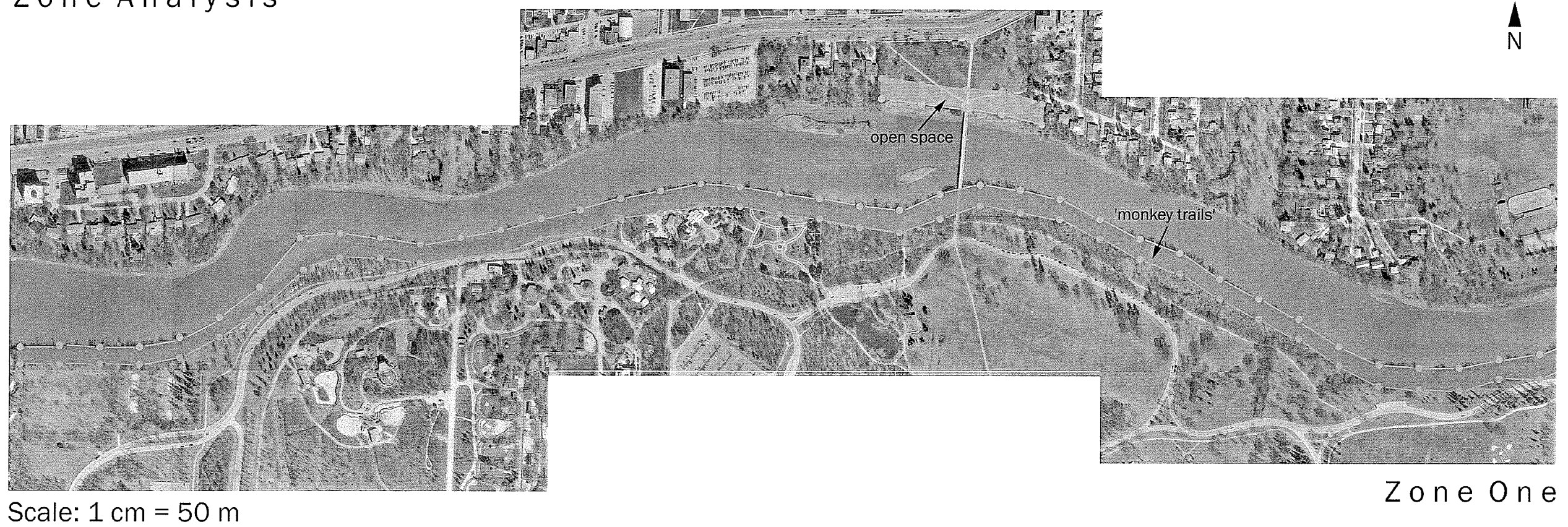


Figure 9.3.3: Zone 1 of the Assiniboine Park riparian forest.

Zone Analysis: Zone Two is located above Zone One. It is significantly fragmented by development including the Assiniboine Park Zoo, Leo Mol Sculpture Garden, English Garden, Park Police, parking lots and volleyball courts. The remaining areas of Zone Two are subject to invasive exotic species and heavy trampling by recreationists (Figure 9.3.4).

Zone Analysis

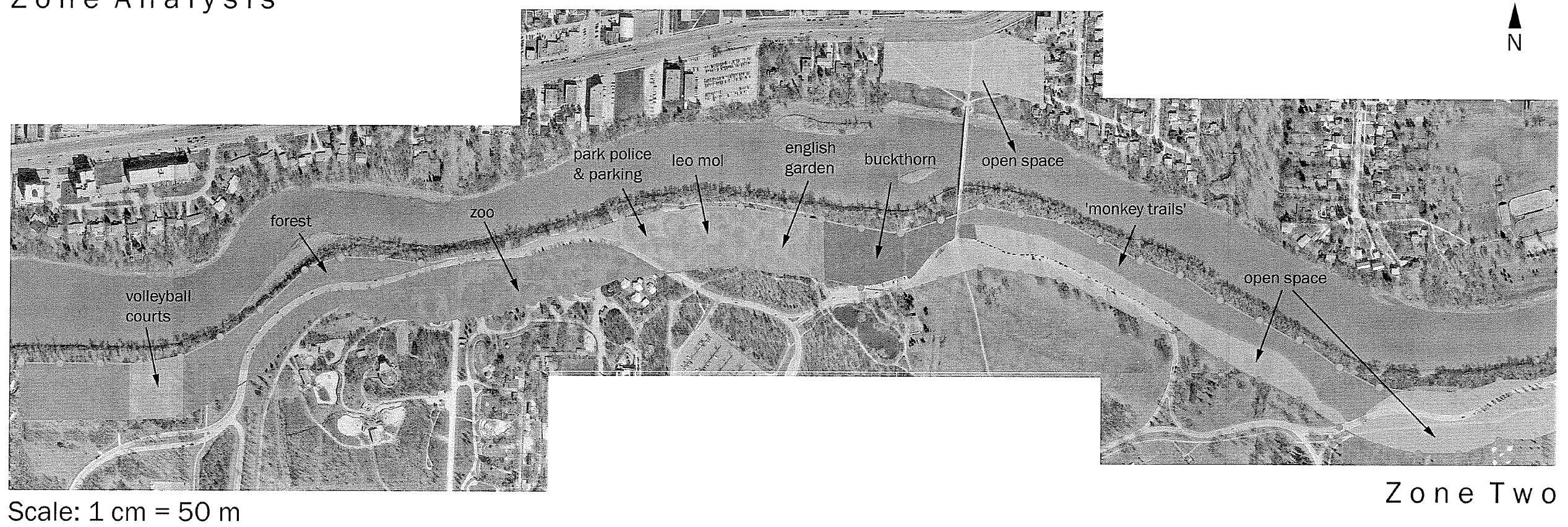


Figure 9.3.4: Zone 2 of the Assiniboine Park riparian forest.

Zone Analysis: Zone Three is a narrow strip located furthest from the river. It is fragmented by the Assiniboine Park Zoo and a parking lot, and is also subject to invasive exotic species. Zone Three is able to expand into parkland areas of the Assiniboine Park (Figure 9.3.5).

Zone Analysis

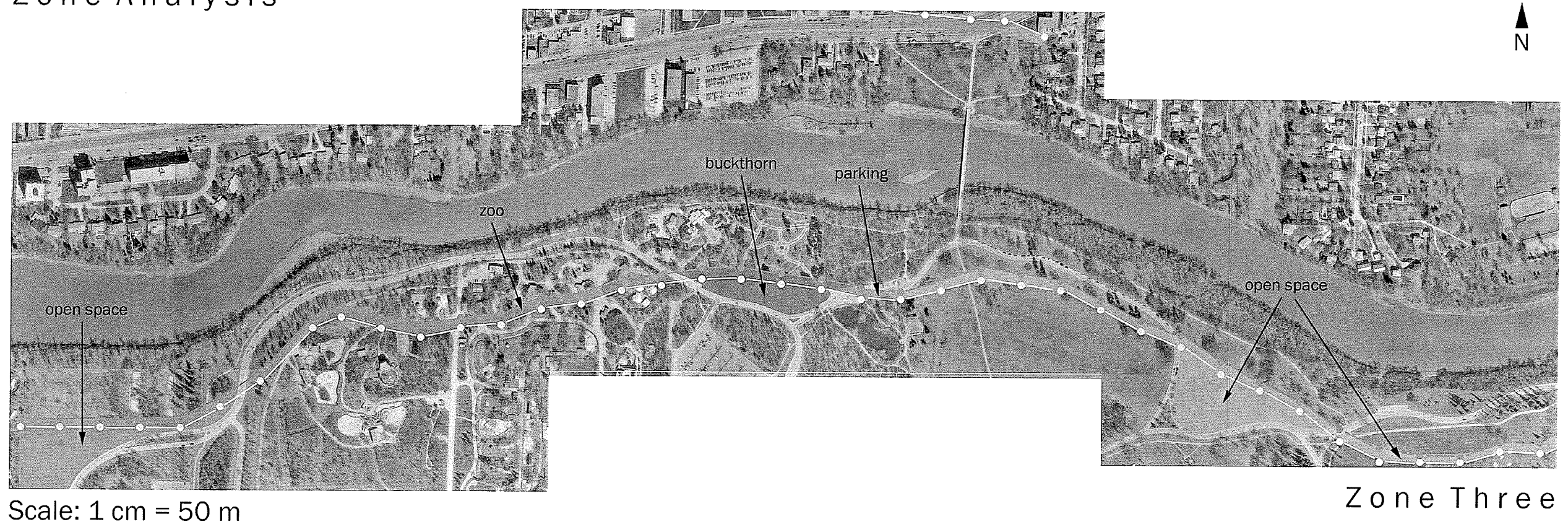


Figure 9.3.5: Zone 3 of the Assiniboine Park riparian forest.

Zone Analysis: Zones One, Two and Three are overlaid showing areas of addition (expansion) and subtraction (deletion) (Figure 9.3.6).

Zone Analysis

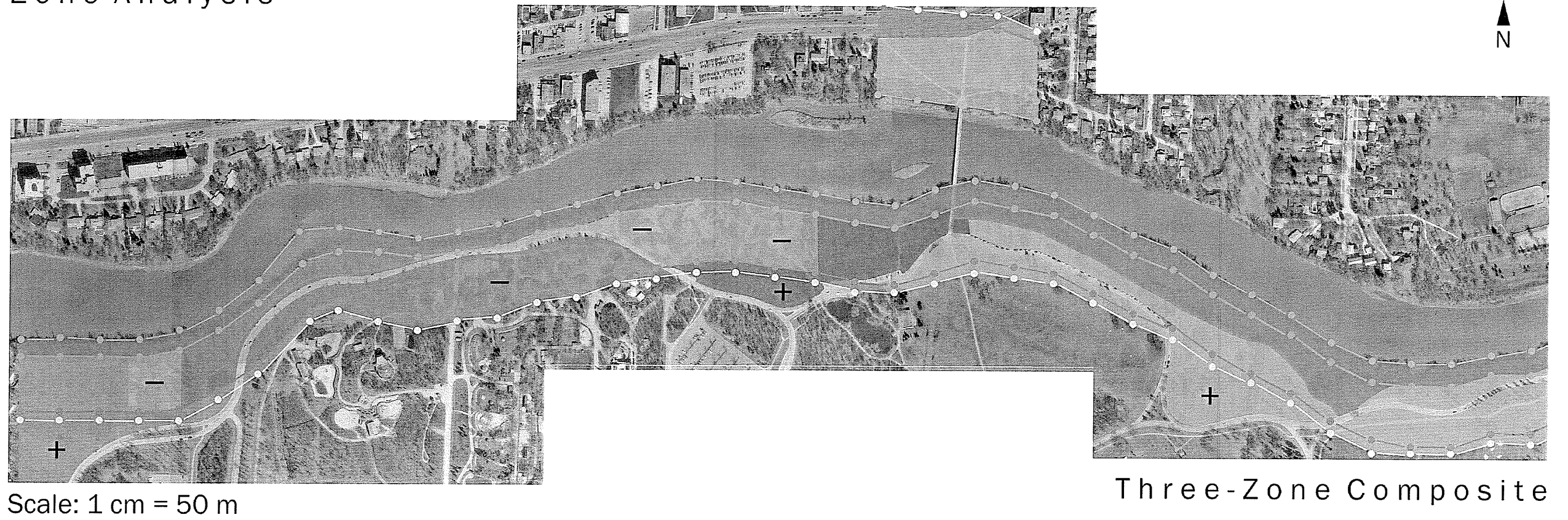


Figure 9.3.6: Zone 1, 2, and 3 of the Assiniboine Park riparian forest showing areas of expansion and deletion.

Shifting: Areas of subtraction (deletion) are re-located in other areas of Assiniboine Park. The volleyball courts are re-located South to the parkland area in Zone 3; the exhibits comprising the north portion of the Assiniboine Park Zoo (raccoon, magpie, lorikeets, tree kangaroo, finches, small primates, stone's sheep) are relocated to vacant areas south of the Siberian Tiger exhibit; the Zoo Office is relocated near the Zoo Society Office; the Park Police building is relocated to the parcel of land (containing high densities of European buckthorn) northwest of the Zoo parking lot; parking spaces have been reserved in the adjacent Zoo parking lot for employees; the English Garden is relocated in the vicinity of the Conservatory; the Leo Mol Sculpture Garden remains as an 'incident' in the park in which trails are aligned with sculptural elements in a natural setting; Assiniboine Park Drive is relocated below Zone 3 (Figure 9.3.7)



Scale: 1 cm = 50 m

Relocation

Figure 9.3.7: Relocation of areas within the Assiniboine Park riparian forest.

Result: The zones of the Assiniboine
Park riparian forest are reclaimed
(Figure 9.3.8).



Scale: 1 cm = 50 m

Result

Figure 9.3.8: Reclaimed zones of the Assiniboine Park riparian forest.

Chapter 10: Program & Proposal

This chapter describes in detail the three-zone riparian buffer system as it applies to the Assiniboine Park Riparian Forest and reveals the final design proposal for the site.

10.1 The Three-Zone Assiniboine Park Riparian Buffer System

As discussed in Chapter 9, the program and design of the Assiniboine Park riparian forest will include a three-zone riparian buffer system approach. The following provides a detailed description of this approach as it pertains to the Assiniboine Park riparian forest.

Zone 1: "Water Quality Protection Zone"

Location:

- This buffer zone is located adjacent to the river extending from the nearest continuous vegetated ground cover to approximately 30m.

Objective:

- Zone 1 is to remain predominantly 'natural,' functioning primarily for water quality protection (pollutant removal, stream stabilization, temperature regulation) and secondarily for wildlife habitat provision.

Guidelines:

- Existing riverbank vegetation will be preserved to protect water quality and to provide wildlife habitat
- Planting additional native riparian vegetation will enhance existing vegetation by further protecting water quality and providing diversity of habitat and food sources for aquatic and terrestrial wildlife
- Heavily eroded areas along the riverbank will be planted with native riparian vegetation
- Existing recreational trails in Zone 1 will be closed and restored to a natural state by the following procedures:
 - ❖ Provide a new trail in another area (Zone 2) that is appealing enough that users will abandon the old trail (IMBA 2001)

- ❖ Scarify or till old trails in order to loosen compacted soils allowing volunteer seedlings to germinate and grow (IMBA 2001)
 - ❖ Plant native riparian vegetation to enhance natural regeneration
 - ❖ Obstruct visual corridors of the old trail system to keep users off the old route by planting dense vegetation. If the trail is out of site, users will abandon an old trail (IMBA 2001)
 - ❖ Discourage access into old trails by planting thorny vegetation or stacking thorny brush
 - ❖ Educate the public. Signs explaining why the trail has been re-routed will help keep people off the old trail system
- Vegetation planted in Zone 1 will be adapted to the hydrology, soil and microclimate characteristics of this area, predominantly riverbank (Appendix 3 – Planting List 1)
 - Views of the river will be provided at key locations incorporating natural breaks in vegetation where possible or by selective thinning of vegetation
 - Lookout points, docks and access points will be placed at key locations along the riverbank in Zone 1 providing pedestrian access/views of the Assiniboine River

Zone 2: “Mediating Zone”

Location:

- This buffer zone is located further upland encompassing floodplain and upland riparian areas and is approximately 70m in width.

Objective:

- Zone 2 is intended for both conservation and recreation functions. Primarily, it functions for wildlife habitat provision. Secondly, it aids in water quality protection (removes pollutants from stormwater through filtering, denitrification, and plant uptake). In addition, it allows for some recreational pathways for low-impact recreational activities.

Guidelines:

- Fragmentation of Zone 2 will be minimized by relocating various facilities, which occur within this critical zone, to other areas of the Assiniboine Park as detailed in Chapter 9

- Existing floodplain vegetation will be preserved to promote wildlife habitat and to filter stormwater en route to the river
- Planting additional native riparian vegetation will enhance existing riparian vegetation by providing diversity of habitat and food sources for wildlife, protect water quality and enhance the recreational experience for trail-users in Zone 2
- Heavily compacted areas will be tilled and allowed to regenerate naturally. Planting native riparian vegetation will enhance and accelerate the regeneration process
- Vegetation planted in Zone 2 will be adapted to the hydrology, soil and microclimate characteristic of the zone (Appendix 3 – Planting List 2)
- Existing network of informal trails will be closed and vegetation along these trails restored through the following procedures:
 - ❖ Provide a new trail for higher-impact activities in another area (Zone 3) that is appealing enough that users will abandon the old trail (IMBA 2001)
 - ❖ Scarify or till old trails in order to loosen compacted soils allowing volunteer seedlings to germinate and grow (IMBA 2001)
 - ❖ Plant native riparian vegetation to enhance natural regeneration
 - ❖ Obstruct visual corridors of the old trail system to keep users off the old route by planting dense vegetation.
 - ❖ Discourage access into old trails by planting thorny vegetation such as hawthorn (*Crataegus rotundifolia*)
 - ❖ Educate the public. Signs explaining why the trail has been re-routed will help keep people off the old trail system
- One multiple-use trail will be designated in Zone 2; This trail will be designated as a low impact trail within the floodplain region suitable to the sensitivity of the site
- Pedestrian access to the various lookout points, docks and access points at the river's edge will be provided along the trails
- Connections to other trails and natural areas will be suggested

Zone 3: "Upland Activity Zone"

Location:

- This buffer zone is located farthest away from the stream in upland areas of the riparian forest. Zone 3 is at a minimum 10m and is expanded to varying widths where possible.

Objective:

- Zone 3 is primarily for recreational usage. It is an activity-oriented zone where higher impact recreational uses and amenities will occur. This zone also functions to filter sediment from surface runoff before entering the riparian zone below.

Guidelines:

- Existing upland vegetation will be preserved and enhanced to increase the quality of the recreational experience of the trail user. The vegetation will also help filter surface runoff from the adjacent roadway and provide wildlife habitat
- Vegetation planted in Zone 3 will be adapted to the hydrology, soil and microclimate characteristics of the zone (Appendix 3 – Planting List 3)
- One multiple-use trail will be designated in Zone 3. This trail will be designated as a moderate-high impact trail situated in upland areas away from the more sensitive riverbank and floodplain zones below
- Assiniboine Drive will be rerouted south of Zone 3
- Connections to other trails and natural areas will be suggested

10.2 The Assiniboine Park Riparian Forest Trail System

Based on the information gathered from reviewing literature, exploring precedents, surveying trail-users and analyzing the site, a general list of objectives for the Assiniboine Park Riparian Forest Trail System emerged. They include:

- Providing different trails and experiences for the various recreational user-types in order to enhance their recreational experience and to prevent conflicts
- Providing a low impact trail within the riparian forest suitable for the sensitivity of the site
- Providing a moderate to high impact trail in upland areas away from the more sensitive floodplain and riverbank zones

The following describes in detail the two trail types and their experiential intent.

Trail One: “Walking Trail”

Trail Type: Trail One will be suited to low to moderate impact recreational activities traveling at low to moderate speeds (~5-10km/hr) such as walking, wildlife viewing, educational/interpretive tours, and for canoe dock and fishing spot access.

Trail Location: Trail One will be located in Zone 2.

Trail Circuit: Trail One will continue along the length of the Assiniboine Park riparian forest. Connections to other trails along the Assiniboine River and to other natural areas are suggested.

Trail Surface: Wood and bark shreds will be used as the tread surface for Trail One. Wood and bark shreds are similar to woodchips, but they require less maintenance and compact better to provide a firmer footing (Flink et al. 2001). Woodchips do not compact well and will spread especially on sloping treads. In addition, they become slippery when wet. Wood and bark shreds on the other hand, bind together to form a mat-like surface that allows for water infiltration and holds soil particles in place. Wood and bark shreds blend well with natural surroundings and are quiet and comfortable to walk on. In addition wood and bark shred surfaces are not firm enough for cycling activities and will thus discourage use. The wood and bark shred surface will protect the trails from further erosion and define the trails for recreational purposes. In wet, muddy areas, a layer of logs or a boardwalk may be used. Pits and ruts will be filled in and maintained. As an extra precaution, the tread can be lined with rocks or logs to prevent any chance of spread and may help keep recreationists on the trail.

Trail Experience: Trail One is intended to be a low impact, low intensity trail for passive recreation. Users of Trail One can experience a sense of solitude, reflection and meditation as they travel along the trails and venture into nooks and sitting areas as they watch the tranquil Assiniboine River flow by. In addition, Trail One can be a social trail in which users can share the outdoors with friends and family as they take a stroll and converse along the tree-canopied trails. Finally, Trail One is an educational trail in which visitors will not only enjoy the natural resources of the site, but also learn about their importance and how to protect them.

Trail One Program: Trail One will incorporate the following elements:

- 1) *Defined trail entrances* – clearly defined entrance/exit points.

- 2) *Passive recreational trail* – located within Zone 2 intended for walking and wildlife viewing activities, canoe dock and fishing spot access, and educational/interpretive tours.

3) *Information kiosk* – providing educational brochures relevant to riparian forests and maps for trail-users.

4) *Woodcarving/ceramic studio* – in conjunction with the Leo Mol Studio, a woodcarving/ceramic studio will provide opportunities for artists to create, exhibit and sell their art in correspondence with the “Art (ist) in the Park” initiative. Main themes will include European buckthorn carving (from adjacent stands) and Assiniboine River clay ceramics. Workshops for children and adults will be organized to provide opportunities to learn the various techniques of woodcarving and ceramics.

5) *‘Leo Mol Sculpture Garden’* – an ‘incident’ in the Assiniboine Park riparian forest in which trail-users find themselves walking along sculpture-studded trails.

6) *Riparian Garden* – a plant-labeled demonstration botanical garden comprised of native tree, shrubs, and herbaceous species for public education and enjoyment. Garden plots can be themed for example, a garden of plants valuable to wildlife, or erosion control plants.

7) *Lookout points* – located along steep bank areas of Zone 1. These lookout points will provide viewing and sitting areas for trail-users.

8) *Meadow* – an area of natural sediment deposition on the southwest bank of the Assiniboine River. The area is comprised of willows, wildflowers, grasses and sedges, is well screened by vegetation on the opposite bank, and provides a spectacular view of the river. The area is secluded and not easily found. It will remain a ‘hidden treasure’ along the trails.

9) *Access points/docks* – located in lowland areas along the Assiniboine River in Zone 1. These access points/docks will provide views of the Assiniboine River, serve as rest stops for trail-users, and provide launching areas for canoes. Cantilever or floating docks would work well in river areas where water levels vary widely. They also do not disturb river bottoms or restrict the movement of water near the shore. In

addition these structures can improve fish habitat by providing fish extra shelter from predators (Ministry of Natural Resources 1996).

10) *Fishing spot* – an existing rocky area, comprised of boulders and gravel, on the southeast bank of the Assiniboine River from which to cast a line for fishing activities.

11) *Maps & signage* – provided along the trails to guide visitors.

12) *Connections* – to adjacent trail systems and parks

Trail Two: “Biking Trail”

Trail Type: Trail Two will be suited to moderate to high impact recreational activities traveling at moderate to high speeds (~10-16km/hr) such as biking, in-line skating, running, hiking and wheelchair use.

Trail Location: Trail Two will be located in Zone 3 in order to minimize impacts to the more sensitive riverbank and floodplain zones of Zone 1 and Zone 2, respectively.

Trail Circuit: Trail Two will parallel the Assiniboine River along the length of the Assiniboine Park riparian forest. Connections to other trails and parks will be provided.

Trail Surface: Crushed gravel will be used as the trail surface. Crushed gravel provides a smooth, firm and durable surface that is suitable for trails with high use requirements. In addition, they are easier to repair than asphalt trail surfaces and the patched areas blend in (Flink et al. 2001).

Trail Experience: Trail Two is intended to be a high impact, moderate to high intensity trail for active recreation.

Trail Two Program: Trail Two will incorporate the following elements:

- 1) *Defined entrances* – clearly defined entrance/exit points.

- 2) *Active recreational trail* – located in Zone 3 for biking, in-line skating, running, hiking and wheelchair use.

- 3) *Access points* – access from Trail Two will be provided to lookout points and docks.
- 4) *Facilities* – bicycle racks, drinking fountains and rest stops will be provided at key locations along the trail.
- 5) *Mountain Bike Park* – a park designed for mountain biking activities. The park will include various obstacles such as ramps, logs, balance beams, log steps, etc).
- 6) *Maps & signage* – provided to guide visitors through the trail system and to inform users of trail etiquette (entry points, route, trail distance, and simple 'rules of the road' should be indicated).
- 7) *Assiniboine Forest* – this trail will connect to the existing trail system in Assiniboine Forest, south of Assiniboine Park.
- 8) *Connections* – to other trail systems and parks.

10.3 Proposals

Conservation Aspect (Figure 10.3.1)

Recreation Aspect (Figure 10.3.2)

The Assiniboine Park Riparian Forest Master Plan (Figure 10.3.3)

Special Characters:

B – Bike rack

P – Parking

R – Restrooms

Sections (Figures 10.3.4 – 10.3.7)

Vignettes (Figures 10.3.8 – 10.3.15)

Links and Connecting Routes (Figure 10.3.16)

The Assiniboine Park Riparian Forest



Scale: 1 cm = 50 m

Conservation Areas

Figure 10.3.1: The Assiniboine Park riparian forest showing proposed conservation areas.

The Assiniboine Park Riparian Forest



Scale: 1 cm = 50 m

Recreation Areas

Figure 10.3.2: The Assiniboine Park riparian forest showing proposed recreation areas.

The Assiniboine Park Riparian Forest



Scale: 1 cm = 50 m

Master Plan

Figure 10.3.3: The Assiniboine Park riparian forest master plan.



Figure 10.3.4: Section A-A'

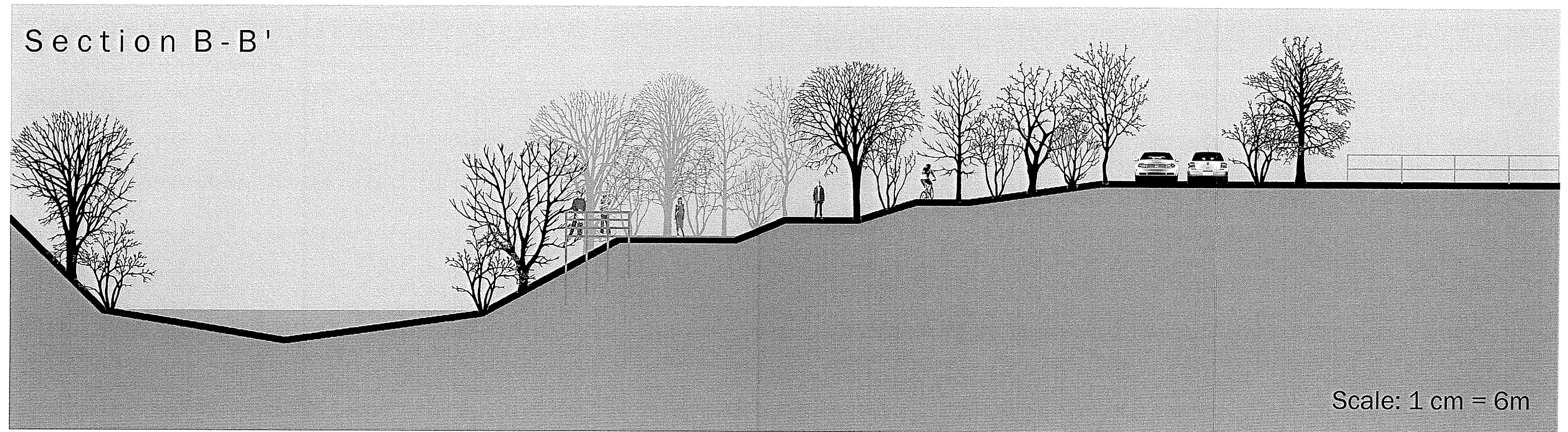


Figure 10.3.5: Section B-B.'



Figure 10.3.6: Section C-C.'

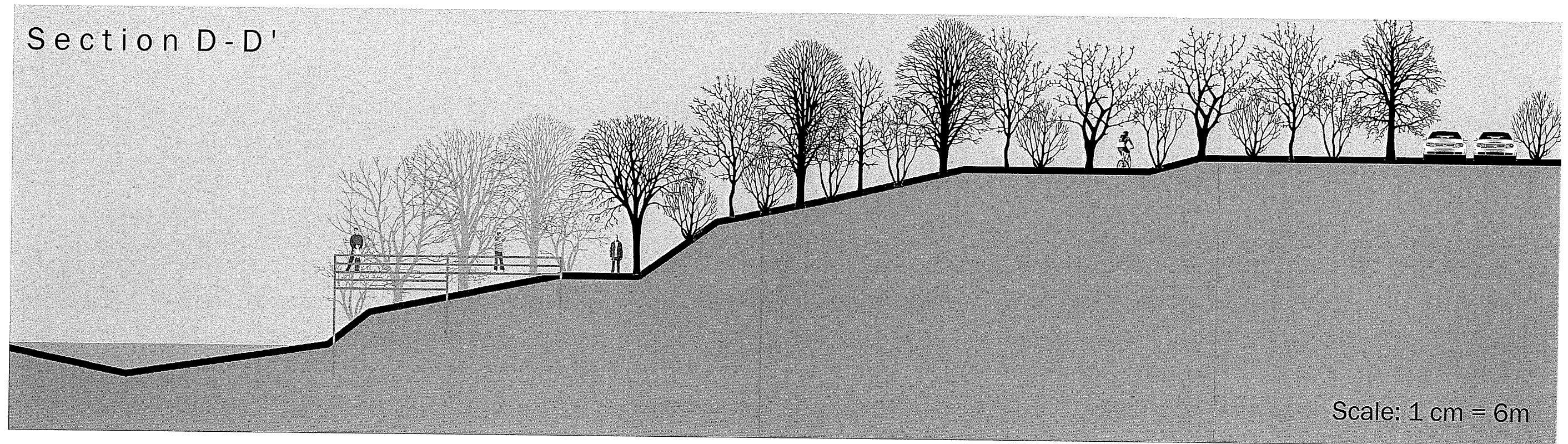


Figure 10.3.7: Section D-D.'

Mountain Bike Park



Figure 10.3.8: Vignette showing proposed mountain bike park.

Meadow



Figure 10.3.9: Vignette showing proposed meadow area.

Lookout Point



Figure 10.3.10: Vignette showing proposed lookout point.

Leo Mol Sculpture Garden



Figure 10.3.11: Vignette showing Leo Mol Sculpture Garden.

Trail One



Figure 10.3.12: Vignette showing proposed Trail One.

Trail Two



Figure 10.3.13: Vignette showing proposed Trail Two.

Fishing Spot

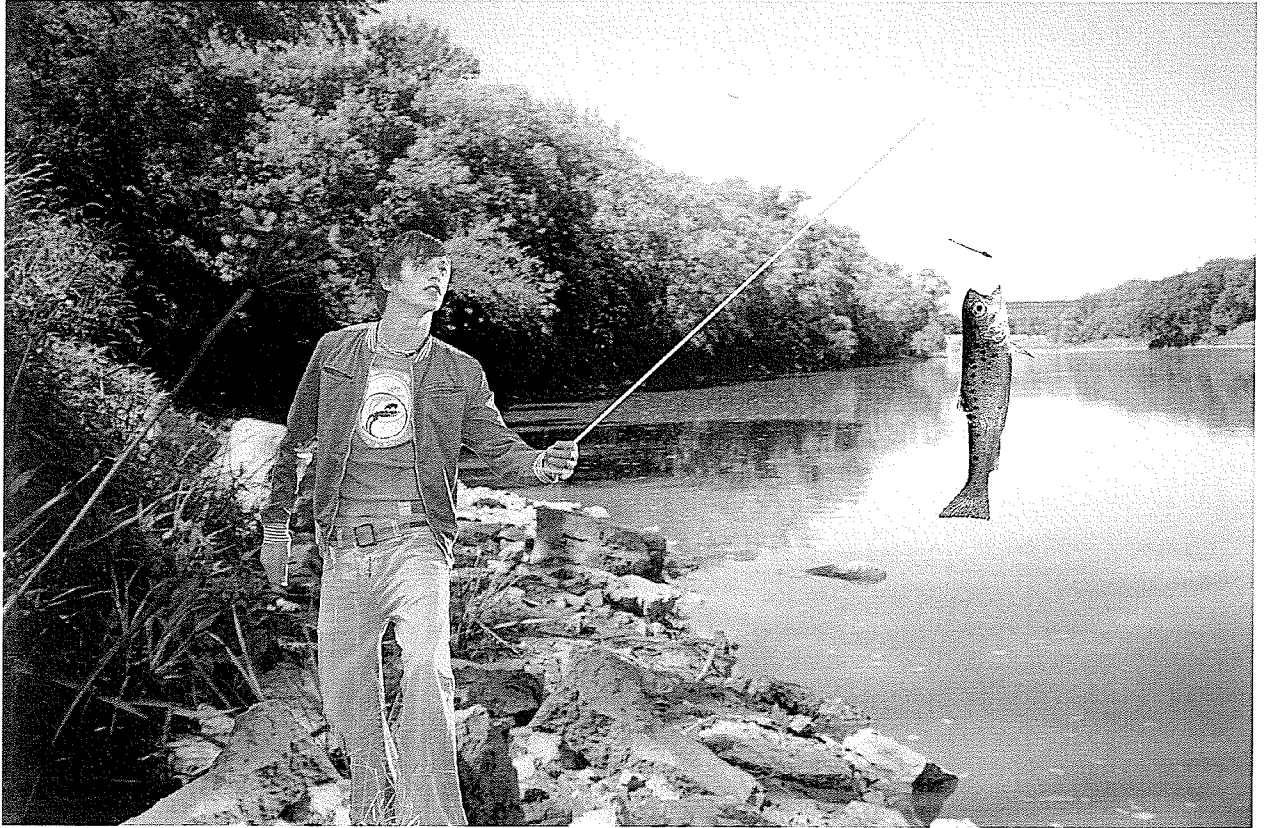


Figure 10.3.14: Vignette showing proposed fishing spot.

Access Point Boardwalk



Figure 10.3.15: Vignette showing proposed access point boardwalk.

The Assiniboine River

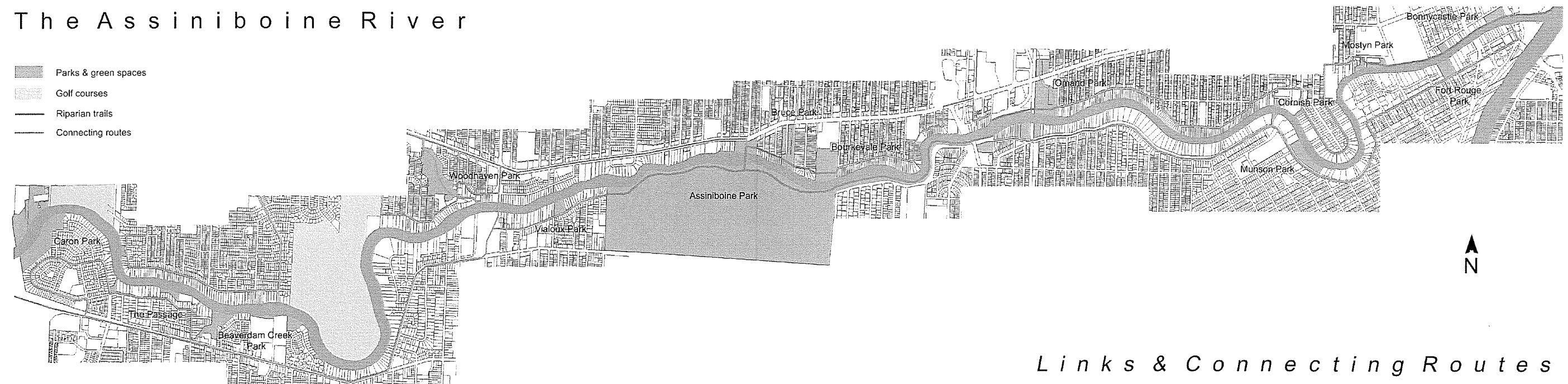


Figure 10.1.16: Links and connecting routes to other trails and parks along the Assiniboine River.

10.4 Implementation/Phasing

Years 1-5

- Establish no-mowing in Zones 2 & 3
- Stake the exact proposed location of Trail One and Trail Two
- Plant native riparian vegetation, suited to the conditions of Zones 2 & 3, to enhance natural regeneration
- Inform public (signage, media, etc.) of proposed changes to the Assiniboine Park and riparian forest
- Relocate English Garden adjacent to the Assiniboine Park Conservatory
- Convert English Garden site to Riparian Garden by replanting with native riparian vegetation and removing surrounding fencing
- Remove European buckthorn trees and shrubs present in the Leo Mol Sculpture Garden and replace with large native trees and shrubs
- Relocate volleyball courts south to the parkland area in Zone 3 and restore with native riparian vegetation

Years 5-10

- Relocate Park Police Office to parcel of land adjacent to the Assiniboine Park Zoo parking lot; remove parking lot and reserve parking spaces in Zoo parking
- Redistribute Assiniboine Park Zoo exhibits (raccoon, magpie, lorikeets, tree kangaroo, finches, small primates, and stone's sheep) to vacant areas south of the Siberian tiger exhibit
- Restore 'voids' in prior Zoo area with native riparian vegetation suited to Zones 2 & 3
- Relocate Zoo Office to Zoo Society Office
- Reroute Assiniboine Park Drive south of Zone 3

Years 10-15

- Prepare Trail One and Trail Two for trail-building
 - ❖ Clear proposed Trail One corridor of obstacles (branches, vegetation, fallen logs)
- Lay trail surface materials
- Construct 'Mountain Bike Park'

- Trim vegetation to frame views of river along Trail One
- Construct river platforms along river bank
- Retire old trails in Zones 1 & 2:
 - ❖ Scarify or till old trails in order to loosen compacted soils allowing volunteer seedlings to germinate and grow
 - ❖ Plant native riparian vegetation to enhance natural regeneration
 - ❖ Obstruct visual corridors of the old trail system to keep users off the old route by planting dense vegetation.
 - ❖ Discourage access into old trails by planting thorny vegetation such as hawthorn (*Crataegus rotundifolia*)
 - ❖ Educate the public. Signs explaining why the trail has been re-routed will help keep people off the old trail system

10.5 Summary

Riparian forests play a valuable role in our urban environments including water quality protection, flood control, bank stabilization, erosion control, nutrient and pollutant filtration and water temperature regulation. In addition, they provide valuable habitat for urban wildlife and provide a natural setting for educational and recreational activities for urban dwellers. In spite of their importance, riparian forests represent a threatened and endangered habitat type in the City of Winnipeg.

Heavy recreational use is one of the major impacts affecting the Assiniboine Park riparian forest. The impacts of outdoor recreation at the Assiniboine Park riparian forest include trampling and loss of vegetative cover, tree damage, soil erosion, introduction of exotic vegetation, soil compaction, trail-pitting, litter, and pollution of water resources. In addition, recreation can impact the quality of visitor experience including visitor crowding, conflicts between different user groups, reduction in visitor learning, and visitor displacement.

The Assiniboine Park riparian forest is an especially attractive location for various recreational activities. The presence of water, diverse vegetation, varied topography in a relatively 'flat' land, moderated climate and wildlife enhance the recreational experience of the trail user. However, as recreational use of the Assiniboine Park riparian forest continues, the environmental and recreational quality of the resource will further diminish. There is a need for protecting and conserving this sensitive riparian system in addition to providing recreational opportunities for the public.

The intent of this study was to review existing literature on the subject of riparian forests and outdoor recreation, build on existing baseline information, investigate the values and needs of trail-users and to generate a design proposal and recommendations for the Assiniboine Park riparian forest which aims to minimize the impacts of outdoor recreation on riparian areas, while considering the recreational experience of the trail user.

The proposed strategy for the design and management of the Assiniboine Park riparian forest was to widen and reconnect the riparian corridor/buffer by reclaiming large areas of land within the Assiniboine Park adjacent to and within the Assiniboine Park riparian forest. Design recommendations and guidelines for riparian buffers and corridors were explored

resulting in the application of a three-zone urban riparian buffer system approach to the Assiniboine Park riparian forest. Each zone serves a different biological purpose and different recreational uses are allowed in each zone. In addition, two multiple-use trails were designed taking into consideration the activity-type and location of trails within the riparian zones. The proposed design and management of the Assiniboine Park riparian forest mediates between resource protection and recreation provision focusing on understanding the needs of the recreational users and the sensitivity of the environment.

The findings of this study imply that policy should focus on the protection and preservation of riparian lands so that this valuable natural resource does not perish. The City of Winnipeg should encourage the protection and preservation of riparian land, designate riparian areas as environmentally sensitive and significant land, and establish guidelines for minimizing the impacts of recreation on riparian land, if recreation along rivers is to be encouraged.

The guidelines presented in this study are intended to serve as a starting point for regulatory agencies and land managers in Winnipeg to make decisions regarding the design and management of riparian land. The City of Winnipeg, trail groups, landscape architects and naturalists must work together to make this mutually beneficial change.

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Appendix 1: *Vegetation & Wildlife*

Appendix 1A

Species list of common plants found in riparian forest communities in Winnipeg. Nomenclature follows Looman & Best (1979).

A = annual e = early M = May * information not found
 B = biennial m = mid Jn = June
 P = perennial l = late Jl = July
 I = introduced Au = August
 N = native Se = September

Scientific Name	Common Name	Family	Origin	Longevity	Germination	Flowering	Fruiting
Trees							
<i>Acer negundo</i>	Manitoba maple	Aceraceae	N	P	IM	m-IM	IM
<i>Fraxinus pennsylvanica</i>	Green ash	Oleaceae	N	P	m-IM	IM-eJn	e-mAu
<i>Populus deltoides</i>	Cottonwood	Salicaceae	N	P	m-IM	IM-eJn	IJn-mJl
<i>P. tremuloides</i>	Trembling aspen	Salicaceae	N	P	mM	e-IM	IJn-mJl
<i>Quercus macrocarpa</i>	Bur oak	Fagaceae	N	P	IM	IM	m-IAu
<i>Salix amygdaloides</i>	Peach-leaved willow	Salicaceae	N	P	mM	IM	eJn
<i>Tilia americana</i>	Basswood	Tiliaceae	N	P	mM	eJl	e-mAu
<i>Ulmus americana</i>	American elm	Ulmaceae	N	P	mM	eM	IM-eJn
Shrubs							
<i>Amelanchier alnifolia</i>	Saskatoon	Rosaceae	N	P	IM	IM-eJn	IJn-mJl

Appendix 1A: Common riparian plant species in Winnipeg

Scientific Name	Common Name	Family	Origin	Longevity	Germination	Flowering	Fruiting
Shrubs continued							
<i>Alnus crispa</i>	Green alder	Betulaceae	N	P	mM	IM	e-mAu
<i>A. rugosa</i>	Speckled alder	Betulaceae	N	P	IM	m-IJl	Au-Se
<i>Amorpha fruticosa</i>	False indigo	Leguminosae	N	P	IM	Jn	IJl-Se
<i>Caragana arborescens</i>	Common caragana	Leguminosae	I	P	e-mM	M-Jn	Jn-IJl
<i>Cornus stolonifera</i>	Red-osier dogwood	Cornaceae	N	P	IM	eJn-eAu	IJn-mAu
<i>Corylus americana</i>	American hazelnut	Betulaceae	N	P	m-IM	eM	mJl
<i>C. Cornuta</i>	Beaked hazelnut	Betulaceae	N	P	m-IM	eM	IJn-mJl
<i>Cotoneaster acutifolia</i>	Cotoneaster	Rosaceae	I	P	mM	Jn	Jl-Au
<i>Crataegus rotundifolia</i>	Round-leaved hawthorn	Rosaceae	N	P	IM-eJn	eJn	IJn-eJl
<i>Lonicera dioica</i>	Twining honeysuckle	Caprifoliaceae	N	P	eM	IM-eJl	mJl-Au
<i>L. tatarica</i>	Tartarian honeysuckle	Caprifoliaceae	I	P	eM	eJn	mJl
<i>Prunus americana</i>	American plum	Rosaceae	N	P	mM	IM	IAu
<i>P. nigra</i>	Canada plum	Rosaceae	N	P	mM	IM	IAu
<i>P. pensylvanica</i>	Pin cherry	Rosaceae	N	P	mM	eJn-mJl	m-IJl
<i>P. virginiana</i>	Choke cherry	Rosaceae	N	P	mM	mJn-mJl	m-IJl
<i>Rhamnus alnifolia</i>	Alder-leaved buckthorn	Rhamnaceae	N	P	e-mM	IM-Jn	Au-Se
<i>R. cathartica</i>	European buckthorn	Rhamnaceae	I	P	eJn	IM-eJn	eAu
<i>Rhus radicans</i>	Poison ivy	Anacardiaceae	N	P	m-IM	mJn	e-mJl
<i>Ribes americanum</i>	Wild black currant	Saxifragaceae	N	P	mM	IM-eJn	mJl-Au

Appendix 1A: Common riparian plant species in Winnipeg

Scientific Name	Common Name	Family	Origin	Longevity	Germination	Flowering	Fruiting
Shrubs continued							
<i>R. glandulosum</i>	Skunkberry	Saxifragaceae	N	P	mM	IM-eJn	mJI-Au
<i>R. oxyacanthoides</i>	Northern gooseberry	Saxifragaceae	N	P	mM	IM-eJn	mJI-Au
<i>Rosa acicularis</i>	Prickly rose	Rosaceae	N	P	m-IM	eJn-eJI	eAu
<i>R. blanda</i>	Smooth rose	Rosaceae	N	P	IM	mJn	IJI
<i>Rubus idaeus</i>	Raspberry	Rosaceae	N	P	mM	e-mJn	m-IJI
<i>R. pubescens</i>	Dewberry	Rosaceae	N	P	mM	e-mJn	m-IJI
<i>Salix bebbiana</i>	Beaked willow	Salicaceae	N	P	eM	e-mM	eJn
<i>S. discolor</i>	Pussy willow	Salicaceae	N	P	eM	e-mM	e-mM
<i>S. exigua</i>	Sandbar willow	Salicaceae	N	P	mM	eJn	IM
<i>Solanum dulcamara</i>	Bittersweet	Solanaceae	I	P	m-IM	JI-Au	m-IAu
<i>Spiraea alba</i>	Narrow-leaved meadowsweet	Rosaceae	N	P	mM	IJn	IJI
<i>Symphoricarpos occidentalis</i>	Western snowberry	Caprifoliaceae	N	P	mM	mJn-mAu	IAu
<i>Virburnum lentago</i>	Nannyberry	Caprifoliaceae	N	P	mM	IM	IJI
<i>V. opulus var. americanum</i>	Highbush cranberry	Caprifoliaceae	N	P	mM	eJn	IJI
<i>V. rafinesquianum</i>	Downy arrowwood	Caprifoliaceae	N	P	mM	eJn	IJI
Vines							
<i>Celastrus scandens</i>	Climbing bittersweet	Celastraceae	N	P	IM	Jn-Se	IAu-mSe
<i>Echinocystis lobata</i>	Wild cucumber	Cucurbitaceae	N	P	eJn	eJI	mAu

Appendix 1A: Common riparian plant species in Winnipeg

Scientific Name	Common Name	Family	Origin	Longevity	Germination	Flowering	Fruiting
Vines continued							
<i>Menispermum canadense</i>	Moonseed	Menispermaceae	N	P	m-IM	Jn-eJl	Se
<i>Parthenocissus quinquefolia</i>	Virginia creeper	Vitaceae	N	P	eJn	eJl	IJI-mAu
<i>Smilax herbacea</i>	Carrion-flower	Liliaceae	N	P	mM-mJn	e-IJn	IJl
<i>Vitis riparia</i>	Wild grape	Vitaceae	N	P	IM	e-IJn	m-IsE
Herbs							
<i>Achillea millefolium</i>	Yarrow	Compositae	I	P	mM	Jn-Se	IJI-IAu
<i>Actaea rubra</i>	Baneberry	Ranunculaceae	N	P	mM	IM-eJn	m-IJl
<i>Amphicarpa bracteata</i>	Hog-peanut	Leguminosae	N	P	eJn	m-IJl	Se
<i>Anemone canadensis</i>	Canada anemone	Ranunculaceae	N	P	m-IM	eJn-mJl	eJl
<i>Apocynum androsaemifolium</i>	Spreading dogbane	Apocynaceae	N	P	IM	IJn	IJl
<i>A. cannabinum</i>	Indian hemp	Apocynaceae	N	P	IM	Jn-Au	mAu-eSe
<i>Aralia nudicaulis</i>	Wild sarsaparilla	Araliaceae	N	P	mM	eJn-mJl	mJl
<i>Arctium lappa</i>	Great burdock	Compositae	I	B	mJn	mJl	mAu
<i>A. minus</i>	Common burdock	Compositae	I	B	mJn	mJl	mAu
<i>Aster ciliolatus</i>	Lindley's aster	Compositae	N	P	mJn	mAu	eSe
<i>A. ericoides</i>	Many-flowered aster	Compositae	N	P	mJn	Au-Se	e-IsE
<i>A. laevis</i>	Smooth aster	Compositae	N	P	mJn	Au-Se	e-IsE
<i>A. simplex</i>	Small blue aster	Compositae	N	P	mJn	Au-Se	e-IsE
<i>Bidens frondosa</i>	Common beggarticks	Compositae	N	P	mJn	mJl	mAu

Appendix 1A: Common riparian plant species in Winnipeg

Scientific Name	Common Name	Family	Origin	Longevity	Germination	Flowering	Fruiting
Herbs continued							
<i>Cirsium arvense</i>	Canada thistle	Compositae	I	P	m-IJn	eJI-eAu	mAu
<i>C. flodmanii</i>	Flodman's thistle	Compositae	N	B	m-IM	mJn	e-IAu
<i>Convolvulus sepium</i>	Wild morning glory	Convolvulaceae	N	P	IM	IJn-IJI	mAu
<i>Epilobium glandulosum</i>	Northern willowherb	Onagraceae	N	P	eJn	mJI	mAu
<i>Fragaria virginiana</i>	Smooth wild strawberry	Rosaceae	N	P	eM	IM-mJn	mJn-eJI
<i>F. vesca</i>	Woodland strawberry	Rosaceae	N	P	eM	IM-IJn	e-IJI
<i>Galium boreale</i>	Northern bedstraw	Rubiaceae	N	P	mM	mJn	mJI
<i>G. triflorum</i>	Sweet-scented bedstraw	Rubiaceae	N	P	mM	mJn	mJI
<i>Geum allepicum</i>	Yellow avens	Rosaceae	N	P	IM-mJn	e-IJI	IJI-eAu
<i>Glechoma hederacea</i>	Ground ivy	Labiatae	N	P	eM	IM	JI
<i>Glycyrrhiza lepidota</i>	Wild licorice	Leguminosae	N	P	IM-eJn	JI-Au	mAu-ISE
<i>Helianthus tuberosus</i>	Jerusalem artichoke	Compositae	N	P	IM	IJI	Au
<i>Hesperis matronalis</i>	Dame's-rocket	Cruciferae	I	P	eM	IM	Jn-JI
<i>Humulus lupulus</i>	Common hop	Cannabinaceae	N	P	IM	Jn	IAu
<i>Laportea canadensis</i>	Wood-nettle	Urticaceae	N	P	IM-eJn	IJI	Au
<i>Lathyrus ochroleucus</i>	Cream-colored vetchling	Leguminosae	N	P	mM	eJn-mJI	eJI
<i>L. palustris</i>	Marsh vetchling	Leguminosae	N	P	m-IM	IJn	JI-Au
<i>L. venosus</i>	Wild peavine	Leguminosae	N	P	mM	Jn-Au	mAu-mSe
<i>Lycopus americanus</i>	Water horehound	Labiatae	N	P	IJI-eAu	m-IAu	Se

Appendix 1A: Common riparian plant species in Winnipeg

Scientific Name	Common Name	Family	Origin	Longevity	Germination	Flowering	Fruiting
Herbs continued							
<i>Lysimachia ciliata</i>	Fringed loosestrife	Primulaceae	N	P	IM-eJn	eJI-eAu	IJI-eAu
<i>Lythrum salicaria</i>	Purple loosestrife	Lythraceae	I	P	mM	IJn-IAu	mAu-Se
<i>Maianthemum canadense var. interius</i>	Two-leaved Solomon's seal	Liliaceae	N	P	mM-eJn	e-mJn	IJI
<i>Matricaria matricarioides</i>	Pineappleweed	Compositae	I	A	eM	IM	Jn-JI
<i>Medicago lupulina</i>	Black medick	Leguminosae	I	A	eM	IM	IJn-JI
<i>M. sativa</i>	Alfalfa	Leguminosae	I	P	IM	mJn-eJI	Au
<i>Melilotus alba</i>	White sweet clover	Leguminosae	I	B	IM-eJn	IJn-IJI	mAu
<i>M. officinalis</i>	Yellow sweet clover	Leguminosae	I	B	IM-eJn	m-IJn	mAu
<i>Mentha arvensis</i>	Field mint	Labiatae	N	P	m-IM	JI-Au	mAu-eSe
<i>Osmorhiza chilensis var. chilensis</i>	Blunt-fruited sweet cicely	Umbelliferae	N	P	mM	Jn	Au
<i>O. longistylis</i>	Anise root	Umbelliferae	N	P	mM	Jn	Au
<i>Oxalis stricta</i>	Yellow wood-sorrel	Oxalidaceae	N	A	m-IM	eJI-eAu	m-IAu
<i>Plantago major</i>	Common plantain	Plantaginaceae	I	P	m-IM	mJn	mJI
<i>Polygonatum canaliculatum</i>	Solomon's seal	Liliaceae	N	P	mM	Jn	IJI-ISe
<i>Potentilla anserina</i>	Silverweed	Rosaceae	N	P	mM	Jn-JI	mJI-IAu
<i>P. norvegica</i>	Rough cinquefoil	Rosaceae	N	P	mM	Jn-JI	mJI-IAu
<i>Ranunculus abortivus</i>	Smooth-leaved buttercup	Ranunculaceae	N	B	mM	eJn	e-mJI
<i>Rudbeckia hirta</i>	Black-eyed susan	Compositae	N	B	IM-eJn	JI-Au	mJI-eSe
<i>Rumex crispus</i>	Curled dock	Polygonaceae	N	P	eM-mJn	mJn	mJI

Appendix 1A: Common riparian plant species in Winnipeg

Scientific Name	Common Name	Family	Origin	Longevity	Germination	Flowering	Fruiting
Herbs continued							
<i>R. maritimus</i>	Golden dock	Polygonaceae	N	A	e-IM	m-IJn	mJI
<i>Sanicula marilandica</i>	Snakeroot	Umbelliferae	N	P	mM	m-IJn	mJI
<i>Sium suave</i>	Water parsnip	Umbelliferae	N	P	M	eJI	IJI-IAu
<i>Smilacina stellata</i>	False Solomon's-seal	Liliaceae	N	P	e-mM	IM-mJn	mJI
<i>Solidago canadensis</i>	Canada goldenrod	Compositae	N	P	mJI	IJI-IAu	e-ISE
<i>Sonchus arvensis</i>	Sow thistle	Compositae	I	P	eM	eAu	IAu
<i>Stachys palustris</i>	Woundwort	Labiatae	N	P	eJn	m-IJI	Au
<i>Taraxacum officinale</i>	Dandelion	Compositae	I	P	eM-mJn	IM-eJn	eJn-IJI
<i>Thalictrum dasycarpum</i>	Tall meadow-rue	Ranunculaceae	N	P	e-mM	mJn	IJn-eJI
<i>T. venulosum</i>	Veiny meadow-rue	Ranunculaceae	N	P	eM	eJn	m-IJn
<i>Thlapsi arvense</i>	Stinkweed	Cruciferae	I	A	eM	IM	Jn-JI
<i>Trifolium hybridum</i>	Alsike clover	Leguminosae	I	P	IM	mJn	IJI-mAu
<i>T. pratense</i>	Red clover	Leguminosae	I	P	IM	IJn	IJI-mAu
<i>T. repens</i>	White clover	Leguminosae	I	P	IM	IJn	IJI-mAu
<i>Trillium cernuum var. macranthum</i>	Nodding wakerobin	Liliaceae	N	P	eM	mM-eJn	eJI-eAu
<i>Typha latifolia</i>	Common cattail	Typhaceae	N	P	mM	Jn	IJI-Se
<i>Urtica dioica</i>	Stinging nettle	Urticaceae	N	P	mM	eJn	Au
<i>Vicia americana</i>	American vetch	Leguminosae	N	P	mM	eJn-JI	eJI-Au
<i>V. cracca</i>	Tufted vetch	Leguminosae	I	P	mM	IJn	e-mJI

Appendix 1A: Common riparian plant species in Winnipeg

Scientific Name	Common Name	Family	Origin	Longevity	Germination	Flowering	Fruiting
Herbs continued							
<i>Viola canadensis</i>	Canada violet	Violaceae	N	P	e-mM	Jn	Jl
<i>V. pubescens</i>	Downy yellow violet	Violaceae	N	P	e-mM	IM-eJn	IJn
<i>V. renifolia</i>	Kidney-shaped violet	Violaceae	N	P	e-mM	IM	Jl
<i>Zizia aurea</i>	Golden alexanders	Umbelliferae	N	P	mM	IM-mJn	mJl-mAu
Grasses							
<i>Agropyron repens</i>	Quack grass	Graminae	I	P	eJl	IJl	mAu
<i>A. trachycaulum</i>	Slender wheat-grass	Graminae	N	P	eJl	IJl	mAu
<i>Bromus ciliatus</i>	Fringed brome	Graminae	I	P	eJl	mJl-Au	IAu-eSe
<i>B. inermis</i>	Brome grass	Graminae	I	P	mM	mJn-eJl	eAu
<i>Calamagrostis canadensis</i>	Marsh reed-grass	Graminae	N	P	mM	eJn-eJl	IJl
<i>Elymus canadensis</i>	Wild rye	Graminae	N	P	mJn	eJl	e-IAu
<i>Hordeum jubatum</i>	Wild barley	Graminae	N	A	IM	eJl	mJl-eAu
<i>Phalaris arundinacea</i>	Reed canary grass	Graminae	N	P	*	Jn-Jl	*
<i>Phleum pratense</i>	Timothy grass	Graminae	I	P	*	eJl	IJl
<i>Phragmites australis</i>	Common reed grass	Graminae	N	P	*	Au-Se	*
<i>Poa palustris</i>	Fowl meadow-grass	Graminae	N	P	mM	Jn-Jl	Jl-eAu
<i>P. pratensis</i>	Kentucky bluegrass	Graminae	N	P	mM	e-IJn	Jl
<i>Puccinellia nuttalliana</i>	Alkali grass	Graminae	N	P	*	*	*

Appendix 1A: Common riparian plant species in Winnipeg

Scientific Name	Common Name	Family	Origin	Longevity	Germination	Flowering	Fruiting
Sedges & Rushes							
<i>C. alopecoidea</i>	Foxtail sedge	Cyperaceae	N	P	mM	mJn	mJl
<i>C. aquatilis</i>	Water sedge	Cyperaceae	N	P	e-mM	M-Jn	mJl
<i>C. assiniboinensis</i>	Assiniboia sedge	Cyperaceae	N	P	IM	mJn	mJl
<i>C. aurea</i>	Golden sedge	Cyperaceae	N	P	IM	mJn	mJl
<i>C. deweyana</i>	Dewey's sedge	Cyperaceae	N	P	mM	eJn	e-mJl
<i>C. sprengei</i>	Sprengel's sedge	Cyperaceae	N	P	mM	eJn	mJl
<i>C. stricta</i>	Erect sedge	Cyperaceae	N	P	mM	e-mJn	mJl
<i>C. tenera</i>	Quill sedge	Cyperaceae	N	P	e-mM	mJn	e-mJl
<i>Eleocharis erythropoda</i>	Bald spike-rush	Cyperaceae	N	P	mM	e-mJn	IJl
<i>Scirpus fluviatilis</i>	River bulrush	Cyperaceae	N	P	*	*	*
Ferns & Fern Allies							
<i>Botrychium virginianum</i>	Virginia grape fern	Ophioglossaceae	N	P	*	*	*
<i>Equisetum arvense</i>	Common horsetail	Equisetaceae	N	P	mM	IM	Jn-Jl
<i>E. pratense</i>	Meadow horsetail	Equisetaceae	N	P	mM	IM	Jn-Jl
<i>Matteuccia struthiopteris</i>	Ostrich fern	Polypodiaceae	N	P	eJn	IJn	IJl

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Appendix 1B

Species list of common plants found along the Assiniboine Park riparian forest. Nomenclature follows Looman & Best (1979).

I = Introduced

N = Native

Scientific Name	Common Name	Family	Origin
Trees			
<i>Acer ginnala</i>	Amur maple	Aceraceae	I
<i>A. negundo</i>	Manitoba maple	Aceraceae	N
<i>Fraxinus pennsylvanica</i>	Green ash	Oleaceae	N
<i>Picea glauca</i>	White spruce	Pinaceae	N
<i>Quercus macrocarpa</i>	Bur oak	Fagaceae	N
<i>Salix amygdaloides</i>	Peach-leaved willow	Salicaceae	N
<i>Tilia americana</i>	Basswood	Tiliaceae	N
<i>Ulmus americana</i>	American elm	Ulmaceae	N
Shrubs			
<i>Amelanchier alnifolia</i>	Saskatoon	Rosaceae	N
<i>Alnus crispa</i>	Green alder	Betulaceae	N
<i>A. rugosa</i>	Speckled alder	Betulaceae	N
<i>Caragana arborescens</i>	Common caragana	Leguminosae	I
<i>Cornus rugosa</i>	Spotted dogwood	Cornaceae	N
<i>C. stolonifera</i>	Red-osier dogwood	Cornaceae	N
<i>Corylus americana</i>	American hazelnut	Betulaceae	N
<i>C. Cornuta</i>	Beaked hazelnut	Betulaceae	N
<i>Elaeagnus angustifolia</i>	Russian olive	Elaeagnaceae	I
<i>Lonicera dioica</i>	Twining honeysuckle	Caprifoliaceae	N
<i>L. tatarica</i>	Tartarian honeysuckle	Caprifoliaceae	I
<i>Prunus pensylvanica</i>	Pin cherry	Rosaceae	N
<i>P. virginiana</i>	Choke cherry	Rosaceae	N
<i>Rhamnus cathartica</i>	European buckthorn	Rhamnaceae	I
<i>Rhus radicans</i>	Poison ivy	Anacardiaceae	N
<i>Ribes americanum</i>	Wild black currant	Saxifragaceae	N
<i>Rosa acicularis</i>	Prickly rose	Rosaceae	N
<i>R. blanda</i>	Smooth rose	Rosaceae	N
<i>Salix bebbiana</i>	Beaked willow	Salicaceae	N
<i>S. exigua</i>	Sandbar willow	Salicaceae	N
<i>Solanum dulcamara</i>	Bittersweet	Solanaceae	I

Scientific Name	Common Name	Family	Origin
<i>Symphoricarpos occidentalis</i>	Western snowberry	Caprifoliaceae	N
Shrubs continued			
<i>Virburnum lentago</i>	Nannyberry	Caprifoliaceae	N
Vines			
<i>Celastrus scandens</i>	Climbing bittersweet	Celastraceae	N
<i>Echinocystis lobata</i>	Wild cucumber	Cucurbitaceae	N
<i>Menispermum canadense</i>	Moonseed	Menispermaceae	N
<i>Parthenocissus quinquefolia</i>	Virginia creeper	Vitaceae	N
<i>Smilax herbacea</i>	Carrion-flower	Liliaceae	N
Herbs			
<i>Actaea rubra</i>	Baneberry	Ranunculaceae	N
<i>Amphicarpa bracteata</i>	Hog-peanut	Leguminosae	N
<i>Anemone canadensis</i>	Canada anemone	Ranunculaceae	N
<i>Apocynum androsaemifolium</i>	Spreading dogbane	Apocynaceae	N
<i>Aralia nudicaulis</i>	Wild sarsaparilla	Araliaceae	N
<i>Arctium lappa</i>	Great burdock	Compositae	I
<i>A. minus</i>	Common burdock	Compositae	I
<i>Capsella bursa-pastoris</i>	Shepherd's purse	Cruciferae	I
<i>Cirsium arvense</i>	Canada thistle	Compositae	I
<i>Convolvulus sepium</i>	Wild morning glory	Convolvulaceae	N
<i>Galium boreale</i>	Northern bedstraw	Rubiaceae	N
<i>Glechoma hederacea</i>	Ground ivy	Labiatae	N
<i>Glycyrrhiza lepidota</i>	Wild licorice	Leguminosae	N
<i>Humulus lupulus</i>	Common hop	Cannabinaceae	N
<i>Laportea canadensis</i>	Wood-nettle	Urticaceae	N
<i>Lappula echinata</i>	Stickseed	Boraginaceae	I
<i>Lythrum salicaria</i>	Purple loosestrife	Lythraceae	I
<i>Maianthemum canadense var. interius</i>	Two-leaved Solomon's seal	Liliaceae	N
<i>Matricaria matricarioides</i>	Pineappleweed	Compositae	I
<i>Medicago lupulina</i>	Black medick	Leguminosae	I
<i>Osmorhiza chilensis var. chilensis</i>	Blunt-fruited sweet cicely	Umbelliferae	N
<i>O. longistylis</i>	Anise root	Umbelliferae	N
<i>Plantago major</i>	Common plantain	Plantaginaceae	I
<i>Polygonatum canaliculatum</i>	Solomon's seal	Liliaceae	N
<i>Potentilla anserina</i>	Silverweed	Rosaceae	N
<i>P. norvegica</i>	Rough cinquefoil	Rosaceae	N
<i>Ranunculus abortivus</i>	Smooth-leaved buttercup	Ranunculaceae	N
<i>Smilacina stellata</i>	False Solomon's-seal	Liliaceae	N

Appendix 1B: Assiniboine Park riparian forest plant species list

Scientific Name	Common Name	Family	Origin
<i>Taraxacum officinale</i>	Dandelion	Compositae	I
<i>Thalictrum dasycarpum</i>	Tall meadow-rue	Ranunculaceae	N
Herbs continued			
<i>T. venulosum</i>	Veiny meadow-rue	Ranunculaceae	N
<i>Trillium cernuum var. macranthum</i>	Nodding wakerobin	Liliaceae	N
<i>Typha latifolia</i>	Common cattail	Typhaceae	N
<i>Urtica dioica</i>	Stinging nettle	Urticaceae	N
<i>Viola canadensis</i>	Canada violet	Violaceae	N
Grasses			
<i>Agropyron repens</i>	Quack grass	Graminae	I
<i>Bromus inermis</i>	Brome grass	Graminae	I
<i>Phalaris arundinacea</i>	Reed canary grass	Graminae	N
<i>Phragmites australis</i>	Common reed grass	Graminae	N
<i>Poa palustris</i>	Fowl meadow-grass	Graminae	N
<i>P. pratensis</i>	Kentucky bluegrass	Graminae	N
Ferns & Fern Allies			
<i>Equisetum arvense</i>	Common horsetail	Equisetaceae	N
<i>E. pratense</i>	Meadow horsetail	Equisetaceae	N
<i>Matteuccia struthiopteris</i>	Ostrich fern	Polypodiaceae	N

References:

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Appendix 1C

Bird Species List (Henteleff Nursery 2003)

Common Name	Scientific Name
Wood duck	<i>Aix sponsa</i>
Mallard	<i>Anas platyrhynchos</i>
Cooper's hawk	<i>Accipiter cooperii</i>
Merlin	<i>Falco columbarius</i>
Killdeer	<i>Charadrius vociferus</i>
Spotted sandpiper	<i>Actitis macularia</i>
Mourning dove	<i>Zenaida macroura</i>
Black-billed cuckoo	<i>Coccyzus erythrophthalmus</i>
Great-horned owl	<i>Bubo virginianus</i>
Ruby-throated hummingbird	<i>Archilochus colubris</i>
Downy woodpecker	<i>Picooides pubescens</i>
Hairy woodpecker	<i>Picooides villosus</i>
Easter wood peewee	<i>Contopus virens</i>
Least flycatcher	<i>Empidonax minimus</i>
Western kingbird	<i>Tyrannus verticalis</i>
Eastern kingbird	<i>Tyrannus tyrannus</i>
Barn swallow	<i>Hirundo rustica</i>
Blue jay	<i>Cyanocitta cristata</i>
Common crow	<i>Corvus brachyrhynchos</i>
Black-capped chickadee	<i>Parus atricapillus</i>
White-breasted nuthatch	<i>Sitta carolinensis</i>
House wren	<i>Troglodytes aedon</i>
American robin	<i>Turdus migratorius</i>
Gray catbird	<i>Dumatella carolinensis</i>
Brown thrasher	<i>Toxostoma rufum</i>
Bank swallow	<i>Riparia riparia</i>
Cedar waxwing	<i>Bombycilla cedrorum</i>
Yellow-throated vireo	<i>Vireo flavifrons</i>
Warbling vireo	<i>Vireo gilvus</i>
Red-eyed vireo	<i>Vireo olivaceus</i>
Yellow warbler	<i>Dendroica petechia</i>
American redstart	<i>Setophaga ruticilla</i>
Ovenbird	<i>Seiurus aurocapillus</i>
Common yellow throat	<i>Geothlypis trichas</i>
Rose-breasted grosbeak	<i>Pheucticus ludovicianus</i>
Chipping sparrow	<i>Spizella passerina</i>
Clay-coloured sparrow	<i>Spizella pallida</i>
Savannah sparrow	<i>Passerculus sandwichensis</i>
Song sparrow	<i>Melospiza melodia</i>
Red-wing blackbird	<i>Agelaius phoeniceus</i>
Common grackle	<i>Quiscalus quiscula</i>
Brown-headed cowbird	<i>Molothrus ater</i>
Orchard oriole	<i>Icterus spurius</i>
Baltimore oriole	<i>Icterus galbula</i>
Purple finch	<i>Carpodacus purpureus</i>
Pine siskin	<i>Carduelis pinus</i>
American goldfinch	<i>Carduelis tristis</i>
House finch	<i>Carpodacus mexicanus</i>
House sparrow	<i>Passer domesticus</i>

Appendix 1C: Common wildlife observed along the Assiniboine River

Mammal Species List

Scientific Name	Common Name	Family	Habitat	Postnatal Period
Mammals				
<i>Castor canadensis</i>	Beaver	Castoridae	Streams, rivers, lakes	April-July 1 litter/year
<i>Marmota monax</i>	Woodchuck	Sciuridae	Woodlands, grasslands	April-May 1 litter/year
<i>Ondatra zibethica</i>	Common muskrat	Cricetidae	Lakes, streams, rivers, ponds, marshes	April-August 2-3 litters/year
<i>Sciurus carolinensis</i>	Eastern grey squirrel	Sciuridae	Deciduous hardwood or mixed forests, riparian forests	May-June 2 litters/year
<i>Tamiasciurus hudsonicus</i>	Red squirrel	Sciuridae	Deciduous hardwood or mixed forests, coniferous forests, riparian forests	April-June 1 litter/year

References:

- Bull, J. and J. Farrand. 1977. The Audubon Society field guide to North American birds: Eastern region. Alfred A. Knopf, New York.
- Fabbri, H. and G. Jurkow. 1997. An enhancement plan for selected riverbottom forest habitat in Winnipeg. Prepared for the Manitoba Naturalists Society as part of the Urban Habitat Stewardship Project.
- Henteleff Nursery. 2003. Breeding birds on Henteleff Tree Nursery property.

Appendix 1D

Canadian climate normals recorded at Winnipeg International Airport between 1961-1990 (Environment Canada 1998).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature													
Daily Maximum (°C)	-13.2	-9.2	-1.8	9.8	18.6	23.4	26.1	24.9	18.6	11.3	-0.4	-9.9	8.1
Daily Minimum (°C)	-23.6	-20.6	-12.4	-2.3	4.5	10.4	13.4	11.7	6.1	0.1	-9.2	-19.4	-3.4
Daily Mean (°C)	-18.3	-15.1	-7	3.8	11.6	16.9	19.8	18.3	12.4	5.7	-4.7	-14.6	2.4
Precipitation													
Rainfall (mm)	0.3	0.4	5.9	26.4	57.8	83.8	72	75.3	50.9	24.6	5.3	1.6	404.4
Snowfall (cm)	22.6	17.1	19.2	9.4	2	0	0	0	0.4	4.9	19	20.1	114.8
Precipitation (mm)	19.3	14.8	23.1	35.9	59.8	83.8	72	75.3	51.3	29.5	21.2	18.6	504.4
Sunshine (hrs)	119.7	139.9	177.7	232.4	276.8	290.6	321.7	285.9	189.3	149.8	94.9	98.6	2377.3

Appendix 2: Assiniboine Park Riparian Forest Trail-User Survey

a particular natural environment)

8. When and how often do you use the Assiniboine Park riparian forest trail system? Check all that apply.

	Spring	Summer	Fall	Winter
Am	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Daily	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Weekly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Twice a month	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Once a month	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Twice a year	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Once a year	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Infrequently	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

9. Do you usually use the trails...

- As an individual As a family As part of a group

10. If as part of a group, what type of group or association?

- Walking Running Cycling Other _____

11. Do you experience any of the following problems on the trail:

- Concerns about personal safety Y N
 Conflicts with other trail users Y N
 Other _____

If you answered yes to any of the above please explain

12. Would you prefer trails which are:

- Multiple use trails Individual trails (i.e. biking only) Mixture of both

13. Do you have a problem with accessing the trails? Y N

If yes, please explain _____

14. Which type of trail surface do you prefer?

- Soft surface (wood chips, gravel, grass, unpaved, typically preferred by joggers)
 Hard surface (asphalt or concrete, typically preferred by cyclists)
 Other _____

15. What improvements would you like to see made on the Assiniboine Park riparian forest trail system? (i.e. more access points, connections to other trails, access to river, etc.)

The information gathered from this survey will be available to the public at the University of Manitoba's Architecture and Fine Arts Library upon completion of the Practicum, October 2003.
Thank you for your time and patience.

Fill out the slip below and send it with the completed survey, and enter to win a book and free admission to a workshop!

Name: _____

Address: _____

Postal Code: _____

Telephone: _____

&/or
Email Address: _____

Informed Consent Form

Research Project Title:

Mediating the conflict between outdoor recreation and nature conservation: A study of the Assiniboine Park riparian forest.

Researcher: Helen Fabbri
Contact Number: (204) 986-7235

Advisor: Alan Tate, Department Head
Contact Number: (204) 474-7173

University Unit: University of Manitoba
Faculty of Graduate Studies – Department of Landscape Architecture

This consent form, a copy of which will be left with you for your records and reference, is only part of the process of informed consent. It should give you the basic idea of what the research is all about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

Purpose of Research:

The main objective of this study is to investigate the behaviour and needs of Assiniboine Park riparian forest trail-users in Winnipeg.

Procedure:

The subject is asked to voluntarily complete a questionnaire. The duration of completion of the questionnaire is approximately 5-10 minutes. The completed questionnaire is to be returned by mail using the self-addressed and stamped envelope provided.

Risks:

There are no risks associated with this research.

Confidentiality:

Any information obtained during this study will be kept strictly confidential. The data will be stored in a locked cabinet in the investigator's office and will only be seen by the investigator for the duration of the study. Information obtained in this study will be presented and results published as aggregated data in the Practicum.

Feedback:

Feedback from the study will be provided at the subject's request. In addition, the information gathered will be available to the public at the University of Manitoba's Architecture and Fine Arts Library upon completion of the Practicum.

Your signature on this form indicated that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions for their legal and professional responsibilities. You are free to withdraw from the study at any time, and/or refrain from answering any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation.

Helen Fabbri, Principal Investigator
Alan Tate, Advisor

Office: (204) 986-7235
Office: (204) 474-7173

This research has been approved by the Joint-Faculty Research Ethics Board (JFREB). Any concerns or complaints regarding this project may be reported to the Human Ethics Secretariat (204) 474-7122 or the Head of the Landscape Architecture Department (204) 474-7173.

Signature of Subject:

Participant's Signature

Date

If you are giving consent for a subject incapable of doing so for him/herself, please indicate the relationship to the subject and the rationale for giving consent. Assent of the subject can be sought verbally once the information presented is understood.

Relationship to Subject

Rationale

Signature of Researcher:

Principal Investigator

Appendix 2C: Frequency Tables

Question 1

Gender	Frequency	Percent
Male	75	56.4%
Female	58	43.6%

Question 2

Age Group	Frequency	Percent
<14	0	0.0%
15-19	0	0.0%
20-24	3	2.3%
25-29	6	4.5%
30-34	8	6.0%
35-39	10	7.5%
40-44	20	15.0%
45-49	12	9.0%
50-54	16	12.0%
55-59	23	17.3%
>60	35	26.3%

Question 3

Awareness	Frequency	Percent
Yes	78	58.6%
No	55	41.4%

Question 4

Use	Frequency	Percent
Yes	118	88.7%
No	15	11.3%

Question 5

Recreational Activity	Frequency	Percent
Walking	95	35.3%
Bicycling	54	20.1%
Wildlife viewing	43	16.0%
Mountain biking	33	12.3%
Running	23	8.6%
Hiking	14	5.2%
Dog walking	3	1.1%
Cross-country skiing	2	0.7%
Canoeing	1	0.4%
Orienteering	1	0.4%

Question 6

Attraction	Frequency	Percent
River	87	20.8%
Trails	84	20.1%
Location/convenience	79	18.9%
Vegetation	75	17.9%
Wildlife	56	13.4%
Recreational opportunities	37	8.9%

Question 7

Outdoor Experience	Frequency	Percent
Sense of physical fitness & well-being	83	14.8%
Closeness with nature	80	14.3%
Sharing time outdoors with friends & family	77	13.8%
Stress reduction & relaxation	77	13.8%
Having a sense of place	64	11.4%
Sense of solitude, reflection, meditation	58	10.4%
Identifying plant & animal species	38	6.8%
Sense of adventure, discovery or wonder	35	6.3%
Knowledge of natural systems	28	5.0%
Sense of provoked creativity/imagination	19	3.4%

Question 8

	Spring		Summer		Fall		Winter	
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Am	31	11.8%	35	13.4%	33	12.6%	22	8.4%
Pm	39	14.9%	36	13.7%	41	15.6%	25	9.5%
Daily	14	3.5%	15	3.8%	15	3.8%	9	2.3%
Weekly	26	6.6%	31	7.8%	31	7.8%	20	5.1%
Twice a Month	26	6.6%	16	4.1%	22	5.6%	11	2.8%
Once a Month	6	1.5%	15	3.8%	8	2.0%	14	3.5%
Twice a Year	9	2.3%	6	2.3%	7	1.8%	2	50.0%
Once a Year	6	1.5%	8	2.0%	7	1.8%	2	50.0%
Infrequently	16	4.1%	17	4.3%	13	3.3%	23	5.8%

Question 9

	Frequency	Percent
Individual	68	51.1%
Family	31	23.3%
Group	15	11.3%
Couple	2	1.5%
N/A	17	12.8%

Question 10

Group	Frequency	Percent
Walking	2	13.3%
Running	2	13.3%
Cycling	11	73.3%

Question 11

	Frequency	Percent
Safety		
Yes	19	14.3%
No	114	85.7%
Conflict		
Yes	24	18.0%
No	109	82.0%

Question 12

Trail-type	Frequency	Percent
Multiple use	40	30.1%
Individual	25	18.8%
Mixture of both	49	36.8%
N/A	19	14.3%

Question 13

Access	Frequency	Percent
Yes	5	3.8%
No	128	96.2%

Question 14

Trail-surface	Frequency	Percent
Soft	64	48.1%
Hard	35	26.3%
Both	15	11.3%
N/A	19	14.3%

Appendix 2D: Cross-Tabulations

Gender vs. Safety

Gender	Safety	
	Frequency	Percent
Female	12	63.2%
Male	7	36.8%

Age vs. Safety

Age Group	Safety	
	Frequency	Percent
>60	3	15.8%
55-59	3	15.8%
50-54	3	15.8%
45-49	2	10.5%
40-44	2	10.5%
35-39	2	10.5%
30-34	1	5.3%
25-29	2	10.5%
20-24	1	5.3%
<19	-	-

Age vs. Recreational Activity

Age Group	Activity											
	Walking		Running		MTB		Hiking		Biking		Wildlife Viewing	
	N	%	N	%	N	%	N	%	N	%	N	%
>60	22	23.1%	9	39.1%	15	45.5%	7	50.0%	14	25.9%	16	37.2%
55-59	20	21.1%	1	4.3%	-	-	-	-	5	9.3%	1	2.3%
50-54	14	14.7%	2	8.7%	3	9.1%	2	14.3%	9	16.7%	8	18.6%
45-49	8	8.4%	2	8.7%	3	9.1%	-	-	5	9.3%	2	4.7%
40-44	15	15.8%	2	8.7%	4	12.1%	2	14.3%	9	16.7%	10	23.2%
35-39	7	7.4%	6	26.1%	3	9.1%	1	7.1%	4	7.4%	1	2.3%
30-34	2	2.1%	-	-	2	6.1%	1	7.1%	4	7.4%	3	7.0%
25-29	4	4.2%	1	4.3%	2	6.1%	-	-	3	5.6%	2	4.7%
20-24	3	3.2%	-	-	1	3.0%	1	7.1%	1	1.9%	-	-
<19	-	-	-	-	-	-	-	-	-	-	-	-

Recreational Activity vs. Conflict

Recreational Activity	Conflict	
	Frequency	Percent
Walking	18	36.7%
Running	5	10.2%
MTB	5	10.2%
Hiking	1	2.0%
Biking	12	24.5%
Wildlife Viewing	8	16.3%
Orienteering	0	0.0%
X-Country Skiing	0	0.0%
Canoeing	0	0.0%

Walker vs. Mountain Biking and Outdoor Experiences

Outdoor Experience	Walker		Mountain Biker	
	Frequency	Percent	Frequency	Percent
Knowledge of natural systems and processes	24	5.0%	8	5.1%
Identifying plant and wildlife species	34	7.1%	11	7.1%
Closeness with nature	72	15.1%	22	14.1%
Sharing time outdoors with family and friends	68	14.3%	23	14.7%
Having a sense of place	55	11.6%	14	9.0%
Sense of physical fitness and well being	66	13.9%	24	15.4%
Sense of adventure, discovery or wonder	30	6.3%	13	8.3%
Sense of provoked creativity/imagination	16	3.4%	4	2.6%
Stress reduction and relaxation	63	13.2%	24	15.4%
Sense of solitude, reflection and meditation	48	10.1%	13	8.3%

Recreational Activity vs. Individual Trails

Recreational Activity	Individual Trails	
	Frequency	Percent
Walking	22	42.3%
Running	1	1.9%
MTB	6	11.5%
Hiking	1	1.9%
Biking	11	21.2%
Wildlife Viewing	11	21.2%
Orienteering	0	0.0%
X-Country Skiing	0	0.0%
Canoeing	0	0.0%

Recreational Activity vs. Connectivity

Recreational Activity	Connectivity	
	Frequency	Percent
Walking	16	34.8%
Running	3	6.5%
MTB	8	17.4%
Hiking	3	6.5%
Biking	7	15.2%
Wildlife Viewing	6	13.0%
Orienteering	1	2.2%
X-Country Skiing	1	2.2%
Canoeing	1	2.2%

Recreational Activity vs. River Access

Recreational Activity	River Access	
	Frequency	Percent
Walking	22	42.9%
Running	1	5.7%
MTB	6	11.4%
Hiking	1	5.7%
Biking	11	17.1%
Wildlife Viewing	11	17.1%
Orienteering	0	0.0%
X-Country Skiing	0	0.0%
Canoeing	0	0.0%

Frequency of Usage vs. Age Group

Age Group	AM		PM	
	Frequency	Percent	Frequency	Percent
>60	26	45.6%	31	54.4%
55-59	25	52.1%	23	47.9%
50-54	16	55.2%	13	44.8%
45-49	16	51.6%	15	48.4%
40-44	19	47.5%	21	52.5%
35-39	9	39.1%	14	60.9%
30-34	4	21.1%	15	78.9%
25-29	3	42.9%	4	57.1%
20-24	3	33.3%	6	66.7%
<19	0	0.0%	0	0.0%

Appendix 3: *Recommended Planting Lists*

Recommended Planting List for the Assiniboine Park Riparian Forest

Planting List 1 – Zone 1: Riverbank Area

Trees

Cottonwood	<i>Populus deltoides</i>
Peach-leaved willow	<i>Salix amygdaloides</i>
Beaked willow	<i>Salix bebbiana</i>

Shrubs

Planting List 2 – Zone 2: Floodplain Area

Trees

Manitoba maple	<i>Acer negundo</i>
Black ash	<i>Fraxinus nigra</i>
Green ash	<i>Fraxinus pennsylvanica</i>
Balsam poplar	<i>Populus balsamifera</i>
Basswood	<i>Tilia americana</i>
American elm	<i>Ulmus americana</i>

Shrubs

Red-osier dogwood	<i>Cornus stolonifera</i>
Sandbar willow	<i>Salix exigua</i>
Wild currant	<i>Ribes americanum</i>
Highbush cranberry	<i>Viburnum trilobum</i>

Planting List 3 – Zone 3: Upland Area

Trees

Green ash	<i>Fraxinus pennsylvanica</i>
Trembling aspen	<i>Populus tremuloides</i>
Chokecherry	<i>Prunus virginiana</i>
Pin cherry	<i>Prunus pensylvanica</i>
Bur oak	<i>Quercus macrocarpa</i>

Shrubs

Saskatoon	<i>Amelanchier alnifolia</i>
Beaked hazelnut	<i>Corylus cornuta</i>
Hawthorn	<i>Crataegus melanocarpa</i>
Wolf willow	<i>Eleagnus commutata</i>
Prickly rose	<i>Rosa acicularis</i>
Northern gooseberry	<i>Ribes oxycanthoides</i>
Raspberry	<i>Rubus ideaus</i>
Western snowberry	<i>Symphoricarpos occidentalis</i>
Arrowwood	<i>Viburnum lentago</i>