SHORELINES, SHORE-LANDS & WETLANDS

Manitoba Hydro

A GUIDE TO RIPARIAN ECOSYSTEM PROTECTION AT MANITOBA HYDRO FACILITIES

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For more information about this and other Manitoba Hydro publications dealing with the environment, contact:

Manitoba Hydro
Senior Environmental Specialist
Environmental Protection Department
4th Floor, 820 Taylor Avenue
Winnipeg, MB R3C 2P4
Phone: 204-474-4472
Fax: 204-474-4974
Email address: bgkouk@hydro.mb.ca

Prepared by:

Training Unlimited Inc.
Winnipeg, Manitoba

Adapted from a report written by:

Wildlife Resource Consulting Services MB Inc.
Winnipeg, Manitoba

TRAINING
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Third Edition – February 2000

Foreword

The waterways of Manitoba were originally used as travel routes by early inhabitants, fur traders, and the first wave of settlers arriving in the province. Cities and towns sprung up along their banks due to the availability of wood, water, and wildlife. Many landowners located their farmsteads to have easy access to rivers and streams, both for their own use and for watering livestock. Over the years, much of the natural vegetation along the banks of these waterways has been removed. This has had negative impacts. Sediment from soil erosion and pollutants from agricultural operations have damaged fish habitat. With the removal of river bottom forests, the wildlife that depended on this habitat has declined.

We are now learning about the importance of these riparian ecosystems and the vital role they play in overall environmental health. We have learned about the cumulative impacts of many small actions. We have experimented with ways of restoring these habitats and developed guidelines for their protection.

Manitoba Hydro facilities are located in, traverse, or run adjacent to many of Manitoba's lakes, rivers and wetlands. The Corporation has conducted research into the impact of its operations and activities, and has developed guidelines to reduce environmental impacts. This non-technical document outlines some of this research and has been produced to contribute to the collective understanding of riparian ecosystems. It provides a general overview of riparian ecosystems in Manitoba, their importance in the overall landscape, potential impacts of Manitoba Hydro operations and activities, and the actions taken to reduce these impacts. It also proposes a method for determining the optimum width of buffer zones which help to protect riparian ecosystems.

This document applies to all Manitoba Hydro activities other than generating stations, the impoundments behind them, and the tailrace discharging from them. Generating stations are large projects and typically require comprehensive, large scale environmental impact assessments which are outside the scope of this document. The construction and maintenance of transmission and distribution lines, access roads, borrow pits, and maintenance yards are examples of the types of activities with which this document is concerned.

This document is one in a series of publications that have been written to respond to issues and topics that are commonly raised about the environmental effects of Manitoba Hydro's facilities and operations. It will be of interest to the general public, people who have a basic understanding of ecosystems, and those who are involved in riparian ecosystem management.

There are a number of technical terms used throughout the document. A glossary is included for easy referral. The first time a term from the glossary is used in the text, it appears in a different **typeface**.

Pine Falls, MB c1923

Elimination of riparian ecosystems is not a recent occurrence.

Contents

Introduction

Manitoba Hydro is a provincial Crown Corporation responsible for providing continuous, reliable and economical electricity to Manitobans. It is committed to protecting and preserving the environment affected by its project facilities and operations. The commitment to environmental protection is the basis for the Corporation's sustainable development policy, adopted in 1993. This policy links Manitoba Hydro's responsibilities for supplying electricity, protecting environmental and human health, and contributing to the competitiveness of Manitoba's economy.

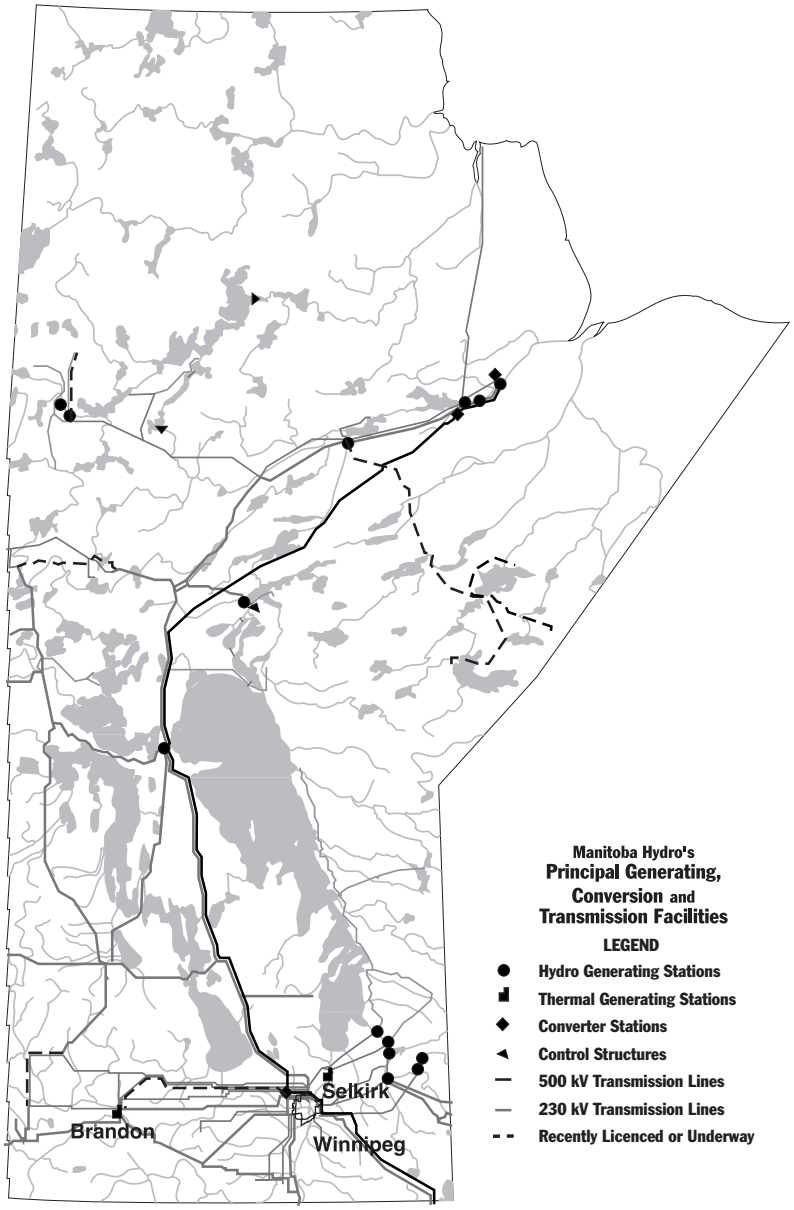
ROW route selection minimizes environmental impacts

To meet the short and long-term electrical needs of its customers, Manitoba Hydro builds new transmission and distribution lines, transformer stations, and access roads, and undertakes maintenance work on its facilities. New construction and changes to existing facilities are often needed to meet regional population growth, shifts in industrial demand, to improve the reliability of existing systems, and as part of operations and system maintenance activities.

Environmental protection occurs at all stages of a project, from planning and design through to construction, operation and maintenance, and decommiss–ioning. Before commencing a project, government and local approvals and licenses must be acquired. For many projects, this involves conducting environmental assessments and developing guidelines for reducing or eliminating environmental disturbances.

Approved projects may be located in a variety of ecosystems and among different features of the landscape. Some of these ecosystems and features are more sensitive than others and require greater care to reduce any potential impacts. One of the most sensitive of these is the riparian ecosystem: the shorelines of streams and rivers, the shorelands of lakes, and the various types of wetlands. During the environmental assessment and review process, potential impacts are identified and measures to reduce them are developed.

This report focuses on the potential impacts of Manitoba Hydro facilities and activities on riparian ecosystems in Manitoba and suggests ways to protect them. The impacts and mitigation measures in this report are not site-specific, but apply to riparian ecosystems in general.



The report discusses:

a) the definition of riparian ecosystems

b) the different types of riparian ecosystems in Manitoba

c) factors that must be considered when evaluating riparian ecosystems

d) potential impacts of Manitoba Hydro activities on riparian ecosystems

e) measures to reduce these impacts

f) recommended procedures to determine buffer zone size to protect the riparian area.

Riparian Ecosystems

What is a riparian ecosystem?

An ecosystem is a community of plants and animals together with its environment of soils, waters, and other elements on which the organisms depend for survival. A *riparian* ecosystem is the complex assembly of organisms and their environment existing *adjacent to, or near, water*. It is the transitional area between terrestrial (land) and aquatic (water) ecosystems and can be identified by the presence of vegetation that requires free, or unbound water, or conditions that are more moist than normal. Riparian ecosystems can vary

Riparian ecosystems are defined by their functions and depend on the type of water body, topography, soil type and climate.

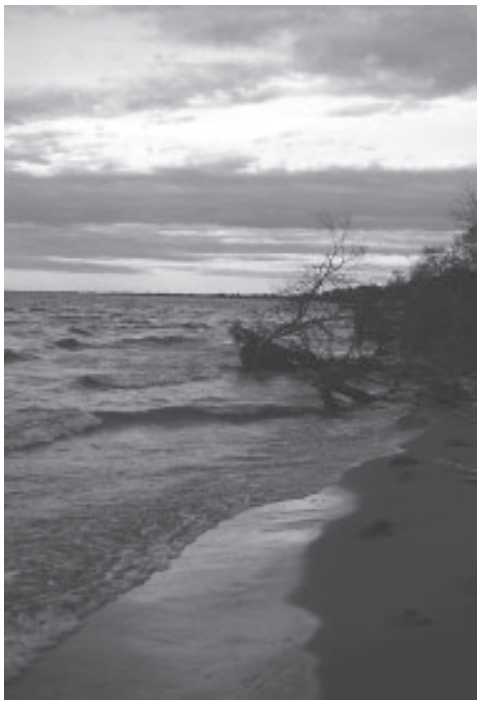
considerably in size and vegetation types because of the many combinations that can be created between water sources and the physical characteristics of a site. These characteristics include gradient, direction, topography, soil, type of stream bottom, water quality, elevation, and plant community.

Riparian ecosystems include lakes, streams and wetlands, and each is described here and summarized in Table 1.

Lakes

A lake is a distinct, permanent, inland body of water. In Manitoba, lakes range from a few square kilometres, like Oak Lake in southwestern Manitoba, to several thousand square kilometres, like Lake Winnipeg. This report focuses on the interface between the **terrestrial** ecosystem surrounding the lake and the aquatic ecosystem of the lake itself. Human activity in this area can impact either the terrestrial or the aquatic ecosystem.

The shoreline (including features such as vegetation, soil structure and wildlife) and the **edge** aquatic systems should be studied when planning, constructing, or operating projects and facilities around lakes.



Lake Manitoba shoreline.

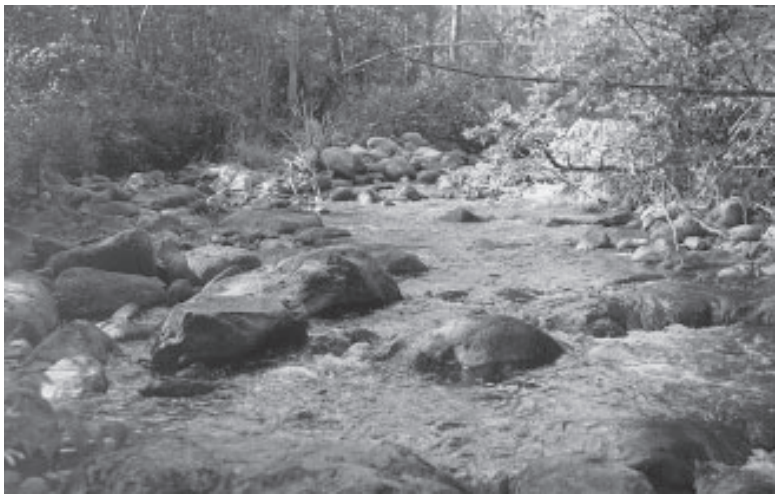
Streams

A stream or a river is a body of flowing water. Stream widths range from a few centimetres to several hundred metres and their lengths vary considerably. Streams can be subdivided into perennial (flowing year round) and **ephemeral** (flowing only for relatively short periods during the wetter months).

Important stream features that are susceptible to impacts include *riffles, bed materials and streambanks*.

Riffles.

Riffles occur when substantial portions of the stream channel bed either become exposed or have relatively shallow water flowing over them. They may be permanent or appear only during periods of low flow. In a meandering stream, riffles are usually located between successive pools of water. They are the most productive portion of the channel for generating food, especially **benthic** insects, and are generally utilized for fish spawning.



Boulder and course gravel bed materials.

Bed materials are the types of sediments that make up the surface layer of the stream channel bed. The spaces between the bed material particles are ideal habitat for many aquatic organisms, such as insects and over-wintering young-of-the-year fish, especially in streams having gravel bed material.

Streambank vegetation stabilizes channel banks.

Streambanks are the borders along streams. Vegetation helps stabilize the channel banks and contributes in various ways to fish productivity. Streambanks are especially important along small streams as they provide the habitat edge needed to maintain high fish densities. Fish adapt to this habitat edge because stable, well-vegetated streambanks provide cover, control water velocities and temperatures, and supply food. On streams over 10 metres wide, vegetative cover provided by grasses and sedges is more important in maintaining bank stability than in providing cover and shelter for fish.

As with lakes, this document is concerned with the interface between the terrestrial and aquatic ecosystems, and the three sensitive stream features just outlined. These are the areas that are most sensitive to human activity.

Wetlands

A wetland is land that is saturated by surface or groundwater long enough to support aquatic plants and wildlife for part of their life cycle. Wetlands generally have poorly drained soil, **hydrophilic** vegetation, and various kinds of biological activity that are adapted to a wet environment. Wetlands must have one or more of the following three attributes:

- at least periodically, the land supports predominantly **hydrophytes** (plants that grow in water or in substrate that has excessive water content);
- the substrate is predominantly undrained **hydric** soil; or
- the substrate is **organic** material and is saturated with water or covered by shallow water at some time during the growing season of each year.

Four common classes of wetlands are: ***marshes, bogs, fens*** **and** ***swamps***.

A *marsh* is a tract of soft, wet, land characterized by **herbaceous** vegetation such as cattails, sedges and rushes. Water levels in marshes rarely exceed 2 m in depth and they are often dry for part of each year. They have medium or high **loading rates** for nutrients, high productivity, and high soil **microbial** activity, all of which lead to rapid organic matter decomposition, recycling and fixation of nitrogen. Marshes may be sensitive areas, particularly during the waterfowl spring nesting season.

A *bog* consists of wet, spongy ground and frequently surrounds an open body of water. Sphagnum moss, sedges, and heath vegetation are characteristic of bogs. The soil in a bog is composed of a thick layer of **peat** which is highly acidic and usually extends well beneath the bog's surface.

A *fen* is a lowland covered wholly or partly with water; the water table is usually high and the area saturated. Vegetation includes sedges, grasses, or **emergent vegetation**. Fens are highly sensitive areas for wildlife and vegetation.

A *swamp* is an expanse of wet, spongy land that is saturated and partially or intermittently covered with water. Trees and tall shrubs, such as willow and alder, provide food and cover for wildlife, especially moose.

Table 1 Types of Riparian Ecosystems

Lakes		Vary in size from few square kilometres to several thousand square kilometres
Streams		Perennial flow - flow year round
		Ephemeral flow - flow for relatively short periods during wetter months
Wetlands	Marsh	Vegetation includes cattails, sedges & rushes Become dry for part of each year Water levels rarely exceed 2 m in depth
	Bog	Wet, spongy ground surrounding open body of water Sphagnum moss, sedges & heath vegetation including peat
	Fen	Lowland covered wholly or partly with water Sedges, grasses or emergent aquatic vegetation
	Swamp	Wet, spongy, water-saturated land that is partially or intermittently covered with water Vegetation includes trees and tall shrubs, such as willow

What types of riparian ecosystems are found in Manitoba?

Parent material and soil are the main factors that influence **geomorphology** and vegetation in Manitoba. In southern Manitoba, the deep soils covering the land have contributed to even-stream gradients. Flooding tends to be more serious on the prairies because of the very flat river gradients. Soft soils are easily eroded and the main streams are usually located in fairly deep basins well below the general prairie level.

The steep grades of the Manitoba escarpment, comprised of the Pembina and Tiger Hills and the Riding and Duck Mountains, cause rapid run-off toward the east. The lands lying east of the escarpment are underlain by deep, impervious clays which limit the extent of deep seepage.

In the northern and eastern watersheds of the province, the exposed, or nearly exposed, bedrock conditions have resulted in extremely uneven stream gradients where rivers are likely to form chains of lakes with interconnecting rapid water. There is a much narrower range between high and low flows than occurs in prairie rivers, and extreme droughts or extreme floods are unusual. Rapids and waterfalls occur over ledges of bedrock and stream erosion and siltation are reduced to a minimum. Where there is soil cover, the natural forest protects against sheet erosion.

Vegetation zones

All vegetation zones in Manitoba and elsewhere are influenced by geography and climate. The three largest geographic regions in Manitoba are the *subarctic, boreal* and *grassland* regions.

Subarctic wetland regions extend in a broad belt between the boreal forest and the treeless arctic. This area is characterized by open-**canopied** coniferous forest or by patches of open-canopied forest and **tundra**. **Permafrost** is widespread. Wetlands are common in the subarctic constituting about 30% of the land surface, and in some areas, they dominate the landscape. Distinctive wetland forms having limited plant growth and permafrost are produced by the interaction of excess water and severe climate.

Subarctic wetland regions can be broken into two primary sub-regions: *high subarctic* and *low subarctic*.

High subarctic consists of **uplands** characterized by open stands of black or white spruce with a conspicuous ground cover of lichen. In poorly drained areas, tamarack may also be present. Open tundra patches occupy increasingly larger areas toward the northern limit of the high subarctic. Common wetlands are **peat plateau** and **polygonal peat plateau** bogs separated by fens. In the Hudson Bay lowlands, there are unfrozen fens and permafrost-affected **palsa** and peat plateau bogs, some with **ice-wedge polygons** and the characteristic wetland forms.

Low subarctic vegetation consists of a spruce-lichen forest in which open-canopied black and white spruce dominate. On some hillsides, deciduous trees such as aspen or paper birch may occur, and on river floodplains, balsam poplar can be found mixed with white spruce. The common and characteristic wetlands are fen and peat plateau-palsa bog complexes. **Northern ribbed fens** occupy large areas, with developing permafrost in some of the ridges.

The second major vegetation zone is the ***boreal wetland region***. This region extends across Canada at mid-latitudes and is characterized by the widespread coniferous forest. This region covers about one-third of the area of Canada and greater than one-half of Manitoba. Wetlands make up approximately 20% of the land surface within this region and where **physiography** permits, they dominate the landscape.

Boreal wetland regions can be broken into three primary sub-regions:

- high-boreal,
- mid-boreal, and
- low-boreal.

Vegetation of drier uplands in the *high-boreal* wetland region is characterized by black and white spruce in pure stands or in mixtures with balsam fir, trembling aspen, and balsam poplar. On sandy soils, or after fires, jack pine grow, sometimes mixed with white birch. The most widespread wetlands are fens and bogs. Swamps are usually restricted to areas alongside streams or the edges of bogs. Marshes are relatively rare, occurring mainly on inland deltas or along lake shores. The common wetland forms found in the region are northern ribbed fens, which have narrow peat ridges extending across the direction of water movement, relatively featureless **horizontal fens** that occupy poorly defined depressions, and basin fens. Heavily treed peat plateau and palsa bogs occur as small islands in fens, accompanied by **collapse scar fens**. **Basin bogs** are common in areas of moderate relief .

In the *mid-boreal* wetland region, the vegetation of drier uplands is characterized by mixed wood forest of white spruce, balsam fir, and aspen, with black spruce restricted to areas of poor drainage. Jack pine are established after fires and on sandy soil. Black spruce often invade the gentle lower slopes which consequently accumulate shallow peat. The most common wetlands are bogs and fens. Coniferous swamps may be found locally on gently sloping areas that are covered by shallow peat. Marshes are generally restricted to **lacustrine** or **riverine** environments.

Also common to this area are peat plateau bogs characterized by an even bog surface that is elevated only slightly above associated fens, as well as flat bogs and basin bogs. Typical fens include northern ribbed fens, horizontal fens and basin fens. **Spring fens** may occur in areas of groundwater discharge. Delta and shore marshes develop in suitable locations throughout this wetland region.

The *low boreal* wetland region is found only in the extreme southeastern corner of the province. The vegetation of drier uplands is characterized by forest of hardwoods tolerant to the climate and soil conditions of the region. Jack pine and oak are common on dry sites after a fire. The most commonly occurring bog forms are **domed bogs** and basin bogs. Fens include basin fens and **shore fens**; **patterned fens** are rare. Swamps may be either the coniferous or the hardwood type.

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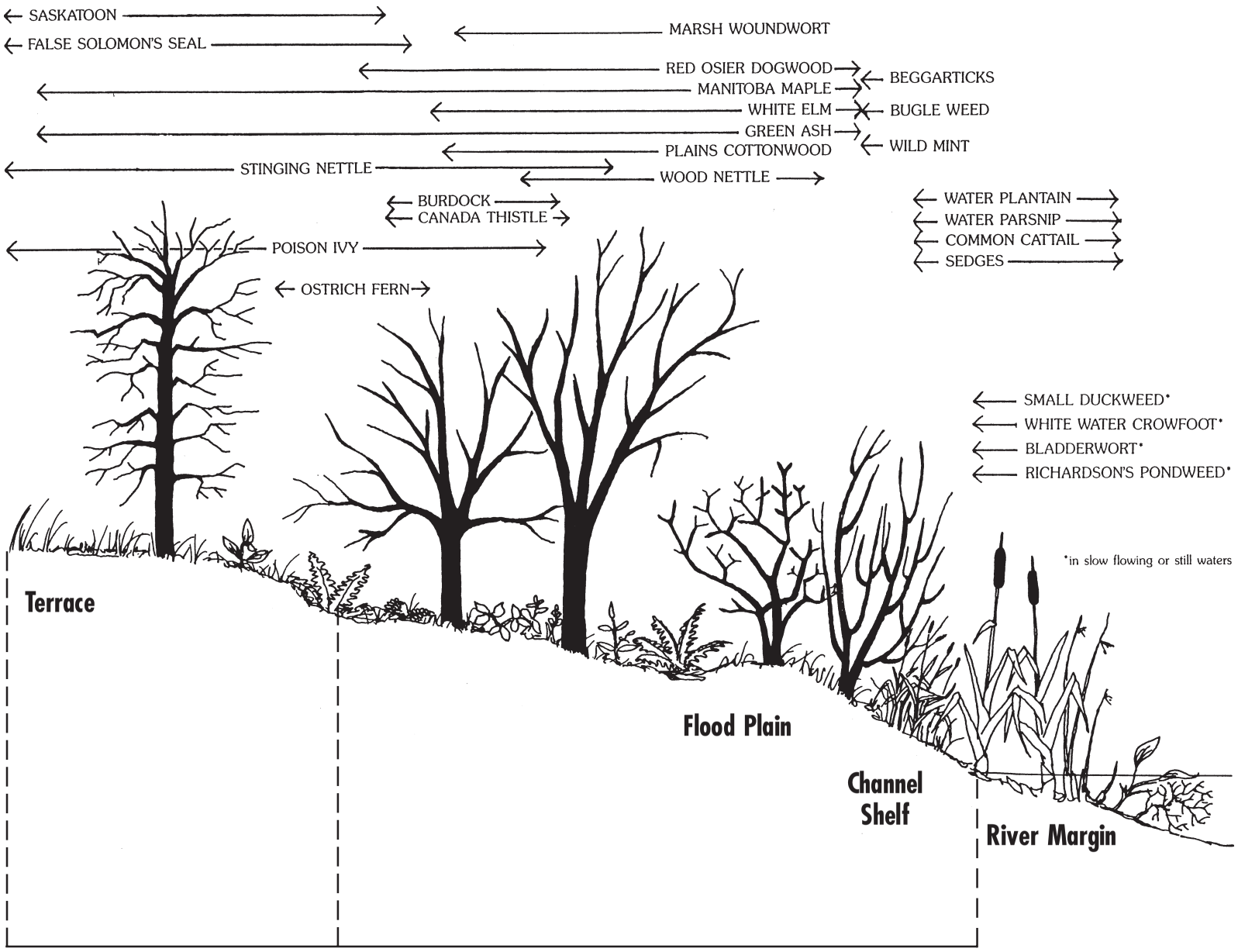
The ***grassland wetland region*** is the third vegetation zone and extends in a narrow belt south of the boreal forest. Wetlands are less common in the grassland region of Manitoba and they rarely dominate the landscape. Where they are present, they are produced by the interaction of excess water and the moderate climate. Distinct vegetation communities occur in association with different surface water features and are manifested by vigorous plant growth. The common and characteristic wetlands are marshes, either associated with riverine systems including floodplain, stream, channel marshes, and delta marshes, or those associated with surface drainage fed by local runoff or groundwater, including shallow basin marshes and **kettle marshes**. Other water features include lakes, streams, and shallow water. Deciduous species such as cottonwood, elm, green ash, and balsam poplar grow along river floodplains.



Terrestrial components of a riparian ecosystem.

Courtesy Manitoba Naturalists Society

The terrestrial landscape along rivers and streams found in the grassland region can be subdivided into three components: the *channel shelf, floodplain* and *terrace*.

The channel shelf, or gently sloping area adjacent to the edge of the water course, is dominated by **pioneer** species such as willow and cottonwood. Elevated above the channel shelf is the relatively flat floodplain which is dominated by elm, ash, basswood, and Manitoba maple. Farthest from the river lies the terrace, a higher area less prone to flooding, where the canopy includes bur oak along with elm, ash, and maple. Even though each of these landforms has its own characteristic elements, it is difficult to determine the boundaries between them.

Riverbottom forests are declining throughout the Western provinces.

Historically, the land next to flowing waters within southern Manitoba were covered with river bottom forest. Land use changes associated with agricultural and livestock operations, and the occurrence of Dutch elm disease have greatly affected the extent and general health of these riverbottom forest communities. A shift in the dominant canopy species on the floodplain from American elm to green ash has occurred across the entire area. Across North America, river bottom forests now make up only a small percentage of the total forest cover in the grassland region.

Riparian poplar forests of the western prairies are considered endangered as a result of the damming and diversion of rivers in this region. Dams that were constructed for flood control and water retention have contributed to forest failure by reducing downstream flows and/or altering flow patterns. Reduced flows induce drought stress which is lethal to seedlings and very old poplars.

Table 2 Vegetation Zones in Manitoba

Region	Sub-regions	Characteristics
Subarctic Wetland	High subarctic	• peat plateaus and polygonal peat plateau bogs separated by fens • some unfrozen fens & permafrost-affected palsa and peat plateau bogs, ice-wedge polygons
	Low subarctic	• fen & peat plateau-palsa bog complexes • northern ribbed fens with incipient permafrost in some ridges
Boreal Wetland	High-boreal	• fens & bogs; swamps restricted to stream borders or periphery of bogs • marshes are rare • northern ribbed fens with narrow peat ridges, fens that occupy poorly defined depressions & basin fens • heavily treed peat plateau & palsa bogs
	Mid-boreal	• bogs & fens; coniferous swamps on gently sloping areas covered by shallow peat • marshes restricted to riverine or lacustrine environments • peat plateau bogs, flat bogs & common fens
	Low-boreal	• domed & basin bogs; basin & shore fens, swamps
Grassland Wetland		• wetlands are less common • marshes associated with riverine systems, or with surface drainage • lakes, streams, shallow water

Why are riparian ecosystems important?

Riparian areas serve many important ecological functions. Healthy riparian ecosystems purify water, filtering out sediment as the water moves through vegetation. Riparian systems act like sponges, retaining water in stream–banks, shorelands, and the surrounding ground, and limit flooding by storing run-off. The major role of the riparian zone in **alluvial** land types is to function as a floodplain and dissipate stream energies associated with high flows before they reach high value fisheries or wildlife resources.

Recreation is an important value of riparian ecosystems.

Riparian ecosystems also act as reservoirs and recharge groundwater, maintain base stream flows, and return water to the atmosphere. They reduce ice buildups and trap and stop ice. Riparian ecosystems also offer habitat for wildlife and provide fish habitat, including spawning, rearing and feeding areas. They also provide habitat for rare plants, travel lanes, and escape and thermal cover for wildlife, and a quality gene pool for forest trees.

Riparian areas provide human-oriented or cultural values which may be separated into consumptive and non-consumptive uses. Consumptive uses include the harvest of timber, crops, fish, wildlife, energy, and water for drinking and other uses such as fire suppression. Nonconsumptive uses include scenic, recreational, educational, aesthetic, archeological, and heritage, both natural and human.

Importance of streamside forests

Streamside forests occur naturally in many riparian areas. Streamside forests function, often simultaneously, as filters, sources, transformers, and sinks.

Erosion and sedimentation result from removal of stream bank vegetation.

Streamside forests act as a *filter* by removing sediment and other suspended solids (such as phosphorus, which bonds to soil particles) from surface runoff. This is especially important in agricultural areas where cropland, pasture, and range erosion account for nearly 65% of the billion tons of sediment that go into waters each year.

Streamside forests function as a *transformer* through chemical and biological processes which change the chemical composition of compounds. For example, bacteria and fungi in the forest convert nitrogen in runoff and decaying organic debris into mineral forms which can be synthesized into proteins and used by plants or bacteria. Pesticides are converted to non-toxic forms by microbial decomposition, oxidation, reduction, hydrolysis, solar radiation, and other biodegrading forces at work in the soil and litter of the streamside forest.

Streamside forests function as a *sink* when nutrients are taken by plants and stored in plant tissue. Nitrogen removed by the forest is used in tree growth and may be stored for long periods of time in woody tissue until it is removed from the system by being passed up the food chain (e.g., grazing, logging) or reincorporated into the forest soil (decomposition).

Streamside forests function as a *source* when they provide energy to streams in the form of dissolved carbon compounds and particulate organic **detritus**. These materials are critical to processes within the stream itself, helping to restore and maintain nature's equilibrium. The organic compounds, or detritus, are consumed or used by the lowest order of the aquatic food chain including bacteria, fungi and invertebrates. They pass on this energy when they, in turn, are consumed by larger benthic fauna and eventually by fish.

Streamside forests function both as transformers and sinks.

Decomposing organic materials are a food source for aquatic organisms.

Importance for wildlife (flora and fauna)

Riparian ecosystems are one of the most important and fragile types of wildlife habitats. They are important for wildlife because they provide at least one of three critical habitat components (i.e., food, cover and water), and often all three. Plant **biomass** production is greater because of the increased availability of water in combination with deeper, richer soils. They also provide a suitable site for plants that don't grow elsewhere because of inadequate water. These factors in combination, increase the diversity of plant species. The dramatic contrast of the riparian plant complex with the general surrounding upland vegetation adds to the **structural diversity** of the area.

Contrasting ecozones increase diversity.

Aquatic Plants

Marsh Marigold

Fungi

Spider web

Riparian ecosystems provide water, food and cover for many species of wildlife including amphibians, waterfowl, and semi-aquatic mammals. They are also preferred by many larger wildlife species as travel corridors. Deer, elk, caribou, and particularly moose frequently utilize riparian zones. The fisher is an example of one of many predators (mink, weasel, and river otter) that use riparian areas as travel corridors or feeding routes. Many types of small mammals including red squirrel, American water shrew, and muskrat live in, or near, riparian zones. These species often form the prey base for carnivores and represent the first **trophic** level upon which this ecosystem is based.

Small mammal studies in Oregon suggest that both the number of individuals and species richness are greater in riparian than in upland areas. Adult insectivores and rodents tend to weigh more in riparian areas and are found in greater numbers in breeding condition. Because of this, riparian areas may act as a source of species that move into and occupy the adjacent upland areas.

Although shorelands represent only a small fraction of the prairie landscape, they are home to much of prairie wildlife. Songbirds, waterfowl, mink, and muskrat thrive in them and fish, frogs and turtles depend on them to protect and support their habitat.

Importance for fish

Four important factors affect the survival of fish and other aquatic organisms. These factors include water temperature, habitat structure, food availability, and sediment flux. These components are directly affected, to a large extent, by the terrestrial component of riparian areas.

Water temperature is affected by direct solar radiation and air temperature. Loss of shade from streamside forests can warm streams; the resulting in-stream plant growth reduces the amount of dissolved oxygen in the water, thereby affecting aquatic organisms.

Habitat structure, the second factor affecting fish survival, is often enhanced by the addition of naturally occurring large woody debris from the streamside forest. It creates pools and important rearing areas for fish and provides cover from predators. Pools are the major stream habitat of most fish during winter and summer. Pools of all shapes, sizes, and quality are needed to maintain a diversity of habitats for the diversity of fish species in streams.

Debris creates fish rearing habitat.

Food availability is often directly determined from the materials which enter the water from the streamside forest. Twigs, leaves, flowers, animals, and insects originating from the streamside forest enter the stream and provide food which supports the entire aquatic food chain.

The streamside forest helps control sediment flux by stabilizing streambanks. Stable streamside forests prevent too much sediment from entering the water and causing behavioral changes in fish and disrupting normal reproduction. Sediment may fill in the **interstitial** spaces or crevices between rock rubble, or gravel spawning areas, suffocating any eggs or fry that are present. Sediment also adversely affects **invertebrates** by filling up their crevice homes, muddying the surfaces to which they attach themselves, and eliminating the interstitial spaces which act as a storehouse for organic silt on which many invertebrates feed. Sediment deposited on the stream bottom can interfere with the feeding and reproduction of bottom dwelling fish and aquatic insects thereby weakening the food chain. Suspended sediment can reduce the abundance of insect larvae, a food source for fish, by filling up the larvae's guts with indigestible material.

Sedimentation removes bottom and riffle habitat, may bury organisms living on the stream bottom, can damage the gills of fish through abrasion, and can lower the productivity of water by increasing turbidity. Increased turbidity levels limit **photosynthesis** by algae and rooted plants by reducing sunlight penetration in the water. This limits production of food for aquatic life. As well, turbidity can cause changes in fish feeding behavior since prey is less visible.

Importance for birds

Other than insects, birds comprise the largest component of wildlife diversity and, occasionally, the largest numbers of individuals in riparian ecosystems. Groups of individuals play a unique role in this environment, often interacting in various degrees between the terrestrial and aquatic systems. For example, dead or dying trees suitable for cavity excavation are the most important factors in determining the numbers of cavity-nesting birds. These cavities provide nest sites for a great variety of birds and mammals. Small mammals often feed on the insects that live under the bark or below the decaying root system.

Mature forests close to water, especially those with a large deciduous component, are critical habitat for cavity nesting ducks. Vacated holes of northern flickers and pileated woodpeckers are the most important nest sites. They are usually located within 50 m of water in snags over 8 m high with a diameter at breast height (dbh) of at least 50 cm. Trees with dbh over 38 cm provide nest cavities for buffleheads and hooded mergansers, while trees with a minimum dbh of 50 cm are required for wood ducks, common goldeneye, and common merganser. See Appendix A for a list of bird species that use riparian ecosystems.

Riparian areas are not only very important to resident bird species, but also to short-distance and long-distance migrants such as neotropical migratory birds and migrating raptors. Many bird species utilize this habitat for nesting, feeding, and loafing. One study in Wyoming illustrates that the greatest number of bird species are found in riparian zones where tall, medium, and small trees are mixed together with a good **herbaceous** ground cover.

Photo Credit: Manitoba Habitat Heritage Corporation

Artificial nesting structure for cavity nesting waterfowl which protects from predators.

Eagles depend on healthy riparian ecosystems for both terrestrial and aquatic food supply.

Different types of riparian areas in different regions of Manitoba support a wide range of habitats. Different bird species prefer some habitats over others. For example, bird species diversity increases with the width of wooded riparian habitats. Ducks prefer shore marshes over peaty shore fens and spend more time loafing and resting than feeding on ponds with fens. One riparian habitat may be more valuable than another for maintaining the different life functions of wildlife.

Although figures are not readily available for Manitoba, one can draw comparisons to the western landscape of the United States where less than 1% is covered by riparian vegetation. The importance of these areas to wildlife in North America can not be overemphasized. Studies show that riparian areas provide habitat for more species of breeding birds than all other surrounding upland habitats combined.

What factors should be considered when locating a project in, or near, a riparian ecosystem?

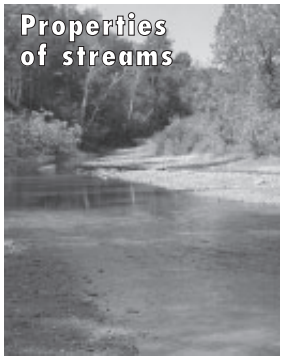
Table 3 summarizes the factors that should be considered when evaluating a riparian ecosystem to determine a management strategy for working in, or near the riparian area.

Table 3 Factors to consider when working in, or near, a riparian ecosystem

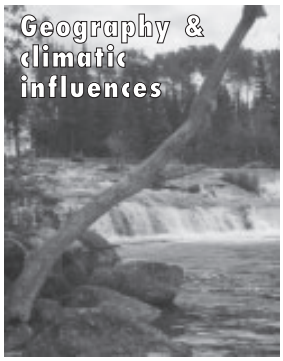
The watershed is not healthy if the condition of any of the following variables (based on established criteria) precludes a desired use:

- water quality - the chemical constituents & physical characteristics of water that are used to determine its suitability for consumptive or nonconsumptive uses
- water quantity - availability of water at any point on the watershed upon which a use is dependent
- erosion - the soil loss/gain through upland processes & its subsequent transport/ lack of transport to the channel
- geomorphology - channel shape, channel pattern, profile

Consideration of these factors points to problems or potential problems as well as the development of management strategies

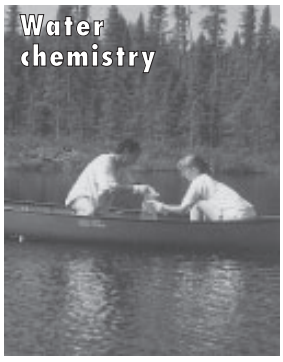


- nature of waterflow
- channel shape
- stream regime (degree of flow uniformity or variability)



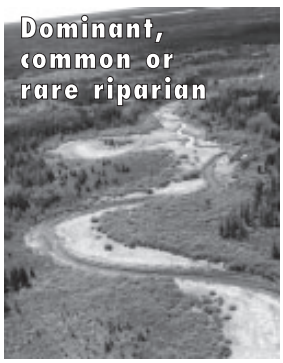
- riparian habitats continually adjust to hydrogeologic conditions that change over long periods of time
- changes that take place in hours or months may take years or centuries to erase

- chief factors governing the rate of water erosion are precipitation, topography & vegetation
- other factors include climate, soil characteristics, degree & length of slope, direction in which slope faces, vegetation & type and amount of machinery use
- serious erosion can lead to heavy sedimentation & bank failures especially where steeper slopes or sensitive soils are present
- dry, south-facing hillsides with sparse vegetation are more susceptible to erosion than moist, well-vegetated, north-facing slopes
- pay careful attention to site location, gradients & size of clearing

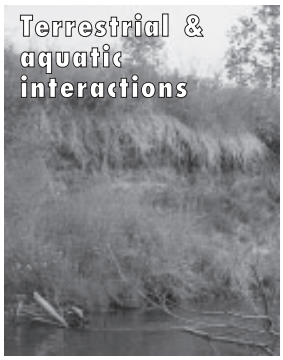


- erosion can increase the nutrients entering the water (carbon, nitrogen & phosphorus)
- removing riparian vegetation greatly increases the amount of nutrients that reach the water

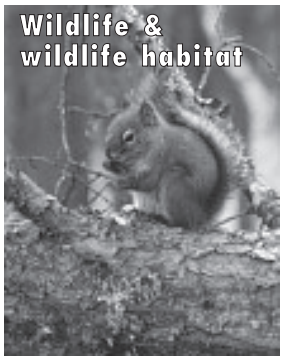
- defined as soil particles deposited into lakes & streams through the process of erosion
- once the water velocity is less than the soil particle's settling velocity, the particle becomes bedload sediment
- excessive sedementation may destroy breeding habitat of aquatic animals and insects



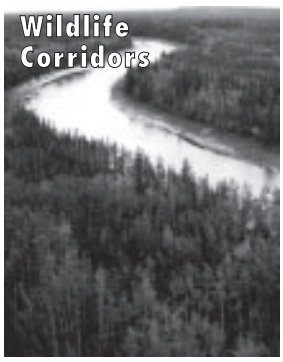
- the degree of care given to riparian areas may be influenced in positive or negative ways if a feature is considered common or rare
- high environmental standards and safeguards are required in every riparian zone and should not be downgraded even if the riparian type is considered common
- higher standards of practice may be necessary in rare riparian areas



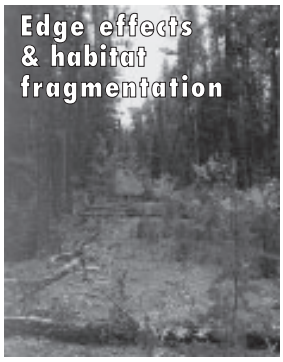
- vegetation buffers streambank against flowing water and may control channel geometry by reducing scour, increasing deposition & decreasing the rate of concave bank retreat
- when bank vegetation is removed & plant roots do not bind the soil, tension cracks can develop & lead to bank failure
- vegetation can regulate sunlight reaching the stream surface, thereby affecting water temperature
- vegetation contributes organic energy to stream waters



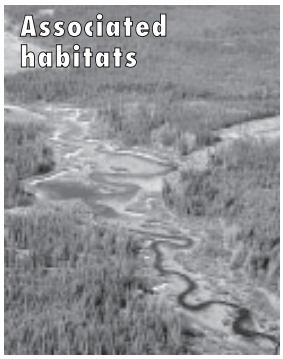
- 18% of Manitobans reported they participated in nonconsumptive wildlife related trips & 80% stated that wildlife was important to them
- the types of species, population levels, & communities that are present in or near riparian zones must be assessed; each assessment must be site specific
- habitat requirements of different species should be understood to develop appropriate management strategies



- these are narrow strips of habitat which permit the movement of plants, animals and invertebrates between two previously connected patches of habitat
- they can help to prevent extinctions by increasing immigration rates & decreasing the likelihood that demographic, ecological, or genetic factors will drive an isolated population to the brink of extinction
- riparian ecosystems are particularly important wildlife corridors



- edge habitat is the narrow transition zone between two types of vegetation communities or land uses; the number and density of species at the edges of plant communities is usually greater when compared with the interior habitat
- habitat fragmentation refers to the division or isolation of plant communities as a result of human or natural interventions. Small, isolated patches of habitat contain fewer species & fewer breeding pairs. The extinction of sensitive species in the community due to habitat fragmentation can disrupt important interactions and lead to further extinctions.



- riparian ecosystems have a greater perimeter-to-area ratio than upland ecosystems and, therefore, they interact extensively with adjacent ecosystems in terms of wildlife use and movements and the interchange of nutrients
- requires the integration of management procedures and mitigation techniques for both riparian ecosystems and upland areas

- tangential connections occur when projects such as a transmission line right-of-way, are aligned into a “squeeze area” or area where biophysical features do not allow room for altering the route. Location of a project depends on a compromise among economics, practicality & regional ecological need.
- when a project requires the crossing of a stream or riparian area, the terrestrial and aquatic ecosystems should be maintained in as close to their natural state as possible

- an access route is a temporary road or trail which allows access of equipment to remote project areas
- potential for increased access could increase the domestic, sport, or commercial harvest of wildlife and fish

What's special about wetlands?

Wetlands are "wet" "lands"; water is essential to maintain them. Without water, wetlands become uplands. Wetland management and protection strategies must consider the following factors:

- Wetlands are more sensitive than lakes and streams. For example, a one-foot change in water level may be insignificant to a lake or stream, but it may radically change the characteristics of a wetland.
- Wetlands each have their own unique characteristics because of the way water moves within them; i.e., the water regime. Different wetland types result from variations in water depth, its duration and velocity, and its nutrient and sediment loads. Water depth is the most significant factor.
- Wetlands are only one component of a watershed and are directly affected by water inflows, water movement within the watershed, and water outflows. Any changes in the watershed will change wetland characteristics.
- Wetlands provide a number of values ranging from human use, to wildlife habitat, to preservation of biodiversity, to removal of sediments.

Implications for management

1. The most effective management strategy is to maintain a wetland's hydropattern. A hydropattern is a measure of the water depth over a period of time. The hydropattern can fluctuate substantially over the period of a year and from one year to the next. Activities that disrupt the hydropattern should be avoided.
2. Wetland values must be considered when developing a protection plan. For example, if the wetland is important for wildlife, it should be managed to maintain critical wildlife habitat.
3. The health of wetlands and their watersheds are closely linked. Changes in status of one affects the other. Wetland values should be protected when developing watershed management plans.

Considered in isolation, the disturbance of one wetland or a change in one aspect of water flow may appear insignificant and may not even be immediately noticeable; but all of these isolated changes have a cumulative effect and can result in highly signficant impacts.

Chemical and physical changes in the upper reaches of a watershed work their way through to the final drainage point. There can be long lasting changes to aesthetics, water quality, fish and wildlife resources; ultimately, human populations can be affected. Repeated disturbances at a specific site or at several sites can magnify impacts and lengthen the recovery of natural systems.

We may not consider a minor wetland important, but if several minor wetlands are altered, they can have a major effect on the overall health of the watershed. Protection of these riparian areas depends on cooperative planning and careful timing of developments.

Potential Impacts

How do Manitoba Hydro activities and operations affect riparian ecosystems?

Potential impacts can be related to existing facilities, as well as construction of new facilities such as transmission line rights-of-way, towers, work camps, access routes, or borrow pits. This report examines potential impacts on the structure of a waterway, on the fish, wildlife and birds in a riparian ecosystem, and the possible effects of the removal of vegetation.

How might Manitoba Hydro activities affect the structure of the waterway?

Clearing operations near water bodies may cause erosion and sediment loading. Large deposits of sediment can overfill stream channels and floodplains, greatly increasing the potential for flooding. The range of potential impacts varies from minimal, when the work can be performed on frozen ground, to greater when it must be done under open water conditions.

Culverts installed at different elevation in Sundance Creek to enable fish passage at high and low flows.

The removal of vegetation and subsequent maintenance operations will result in a change in the vegetation pattern of the area and, when substantial amounts of vegetation are removed, the capabilities of the area to support wildlife may be positively or negatively affected. Building an access route across a stream usually involves prior installation of a stream crossing device (such as a culvert, ford, bridge or a combination), and temporary disturbance to the stream bed may be expected during construction. Subsequent impacts of major construction equipment using these devices is usually minimal; however, if a permanent road is constructed, it may affect the flow of water by acting as a dam and possibly affecting the migration of aquatic species.

How might Manitoba Hydro activities affect fish and wildlife in a riparian ecosystem?

The removal of vegetation, sediment, temperature change, herbicides, seeding, and noise associated with construction or maintenance activities may affect breeding and/or habitats of certain species. In aquatic systems, sediment loading due to soil erosion, improper watercourse crossing installation, and disposal of soil are most likely to affect habitat, breeding areas, and food supplies.

These impacts occur at stream crossings and in some wetland systems. The effects are usually minimal because a relatively small amount of vegetation is removed (compared to the total cover in most areas), and a small area of stream is influenced. Impacts are more significant where the affected area plays an integral role in the survival of a particular fish or wildlife species, or provides the sole breeding or habitat source in a particular area.

Where cutting removes cover, nesting habitat, or food sources for wildlife, the degree of impact depends entirely on the species present. Some species, such as forest canopy birds and fur bearers, are detrimentally affected while others, such as some sparrows, ruffed grouse, and white-tailed deer, react positively to open habitat. Although it is also possible to obtain a higher species diversity (i.e., number of species), there is always a likelihood that removing a specific habitat element (e.g., snags) may eliminate some species.

The migration of fish and wildlife species can be affected by several factors including the removal or alteration of a **staging** area, such as a small pond or wooded area, the presence of construction activities during migration, the placement of barriers such as temporary stream crossing devices, or by the presence of a linear corridor through forested areas.

If too much edge habitat is created, habitat **fragmentation** can occur along with a decrease in food supply. For instance, as the tall grass prairie areas became fragmented by agriculture, roadways, and towns, the animals which lived there gradually became restricted to small patches of land. Natural species dynamics quickly dictated the 'winners' and 'losers' resulting in some species (e.g., mule deer) disappearing from the local landscape.

Most Manitoba Hydro projects are not associated with large scale habitat fragmentation, but some projects, such as transmission line right-of-ways, create more edge habitat. This effect may or may not be desirable for species diversity, primarily in **vertically structured communities** such as forests. Here, sensitive species depend on large tracts of undisturbed **interior habitat** and edge may be detrimental to habitat specialists and rare species. Other species may invade these edges (e.g., brown-headed cowbirds) further reducing the remaining habitat available for edge-intolerant species.

A cleared corridor through a forested area could act as a barrier to movement of forest species and as a conduit for open-country species that otherwise would not usually penetrate the forest.

How might Manitoba Hydro activities affect birds in a riparian ecosystem?

One barrier to birds is the physical presence of power lines and towers. Collision mortality in various studies ranges from .01 to 1.16 % of the estimated total flights. Waterfowl, gulls, cranes, and other shorebirds accounted for the majority of collisions. Raptors are another group of birds that collide with power lines.

A threat to some avian species is the loss of forest adjacent to lakes and rivers. These areas offer water, greater vegetative production, greater vegetative diversity, and rapidly changing conditions in contrast to adjacent areas. They provide edges and openings essential to some species. In coniferous forests they provide a disproportionately high number of habitat zones because of deciduous vegetation that may exist there, but not elsewhere, and distinct height layers of vegetation not found in the forest.

Some species adapt better than others when their habitat is altered. Species specialized in their selection of nesting sites are considered intolerant species and would not adapt well to reduction in their preferred nesting substrate. Species that prefer a particular nesting substrate, but that also use alternative nesting sites, are considered to have low tolerance. Species of moderate tolerance can persist in a habitat after alteration of their preferred nesting substrate by shifting to an alternative nesting substrate; nesting densities, however, may decline. Tolerant species generalize in their selection of nesting substrates. These species would be relatively tolerant of habitat alterations.

Photo courtesy: Robert R. Taylor

Grouse respond favourably to more open habitat.

How might the removal of vegetation affect a riparian ecosystem?

When vegetation is removed from a riparian ecosystem, sediment and nutrient flow (phosphorus and nitrogen) into the water increases. When excess nutrients applied to the land in the form of manure or commercial fertilizer find their way into the water, blooms or overabundant growth of algae and other aquatic plants can result. By blocking sunlight, algae blooms at the surface can interfere with photosynthesis of submerged plants which causes them to die. As these plants decompose, dissolved oxygen levels near the bottom drop abruptly because of the increased oxygen demand by decomposing bacteria and the lack of oxygen produced by the dying plants. The problem is compounded when organisms which flourish in oxygen-starved environments release hydrogen sulfide and methane. Some species of fish, as well as other animals lower in the food chain, are very sensitive to low levels of oxygen or the presence of toxic substances like methane. These species generally die. The loss of species simplifies the food chain of an ecosystem and makes it more vulnerable to further destruction.

Poor land use practices rapidly degrade riparian ecosystems.

Mitigation

What is mitigation?

Perching poles and nesting platforms are erected to attract birds away from transmission lines and structures and station poles. They are taller than surrounding structures.

Mitigation is a process whereby a potential impact is avoided completely or minimized to the extent possible. For example, a transmission line can be routed so it avoids sensitive wildlife areas such as waterfowl breeding areas. Potential impacts from construction work can be reduced if construction takes place during the winter. Ice bridges can be used to protect the stream bed and banks; no debris is left behind.

A mitigation measure is a practice or procedure which reduces the potential impacts of a project. Using logs and rocks to hold soil in place on a steep slope that has been cleared is an example of a mitigation measure. Manitoba Hydro has developed guidelines, procedures and practices to mitigate the impacts of its activities on riparian ecosystems.

How can the potential impacts of Manitoba Hydro activities on riparian ecosystems be mitigated?

Manitoba Hydro has developed a system which classifies streams into three categories for the purposes of assessing potential impacts from its operations and activities. It has developed environmental protection plans which stipulate the types of activities that are allowed in the riparian areas alongside each stream classification.

Class 1 stream:

Class 1 streams and rivers usually have perennial flow. Year-round flow and the variability of seasonal flow depend on the regional or local terrain and climate conditions. Class 1 water courses are likely to contain important feeding, spawning and overwintering habitat for resident fish populations particularly in locations with groundwater upwellings. They may also provide spawning, nursery and migratory habitat for non-resident species.

Class 2 stream:

These water courses may or may not flow throughout the open water period. Class 2 streams are often narrow (less than 5 m wide), but may be substantially wider at some sites. These streams can support summer populations of small fish species, provide suitable nursery habitat for juvenile fish, and possibly serve as migratory corridors for fish moving between, or into, lake or downstream river habitats during spring or fall.

Class 3 stream:

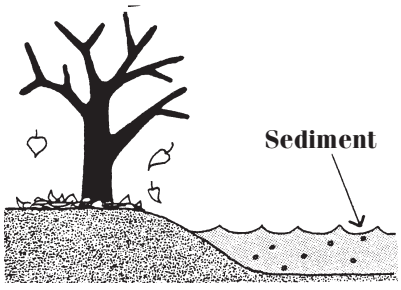
Class 3 streams are generally ephemeral in nature, but have a capacity to support fish on a seasonal basis, particularly in their lower reaches. Local terrain and precipitation conditions may cause them to cease flowing by mid-summer. Some of these stream sites may provide spring and early summer spawning habitat for fish, depending on the species present in the watershed and the nature of the substrate and hydrology.

Class 2 and 3 streams are particularly sensitive, as spring high water periods will scour disturbed, cleared shorelines and carry heavy silt loads into downstream spawning areas. One of the primary ways in which to mitigate impacts of activities on these types of streams, as well as other riparian ecosystems, is to identify a Riparian Management Area (RMA) and designate a buffer zone within the RMA.

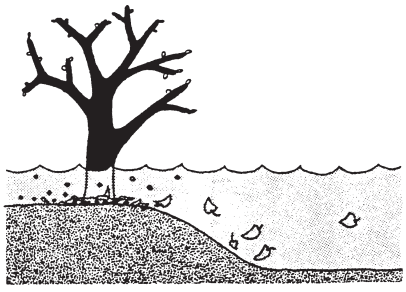
What is a riparian management area?

Riparian Management Areas are areas of land and habitat located adjacent to, and up-gradient from a waterbody or watercourse. They are naturally designed to provide high quality wildlife habitat and to remove or buffer the effects of nutrients, sediment, organic matter, and human pollutants prior to entry into surface waters and ground water recharge areas.

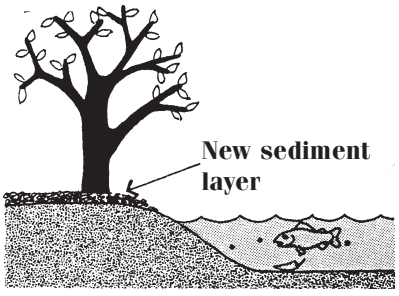
The RMA provides a stable ecosystem adjacent to the water's edge which maintains wildlife habitat; minimizes or eliminates **nonpoint sources of pollution**; provides soil/water contact area to facilitate nutrient buffering processes; provides shade to moderate and stabilize water temperature; provides the necessary contact time and carbon energy source for buffering processes to take place; provides long term storage of nutrients in the form of vegetation; filters sediment and nutrients; contributes necessary detritus and large woody debris to the stream ecosystem; and provides the space necessary to convert concentrated surface water flow to a uniform, shallow, sheet flow of water into the waterbody or watercourse.



Fall – leaf litter accumulates on land.



Spring flood – sediment carried by water is deposited on land. Leaf litter is removed by river.



Late spring – new sediment layer enriches soil on land. Leaf litter decomposes slowly and is carried downstream to feed other organisms.

Couresty of Manitoba Naturalists Society

What is a buffer zone?

A buffer zone is an area within the RMA that serves as a protective barrier. In riparian ecosystems, buffer zones are strips of trees, shrubs, and hardy perennial grasses that stabilize shorelands with their root systems, reduce erosion, act as filters around wetlands by trapping sediments and nutrients, and protect the ground during heavy rains. They ensure that wetlands receive cleaner ground and surface water. Vegetated banks can withstand up to three times the flows that a bare bank can handle without eroding. With careful management and an adequate buffer zone, natural wetland activity can continue virtually unaffected.

The main purposes of buffer zones are to maintain the ecological (e.g., source, sink, filter and transformer), physical (e.g., trap silt, slow water flow, create microclimate, trap nutrients) and biological (e.g., wildlife values, natural travel corridors) functions of the region. They can also create or maintain cultural or recreational attributes which sustain water-based, land-based, and inter-related activities (e.g., canoeing, angling, camping, hunting, nature interpretation, photography).

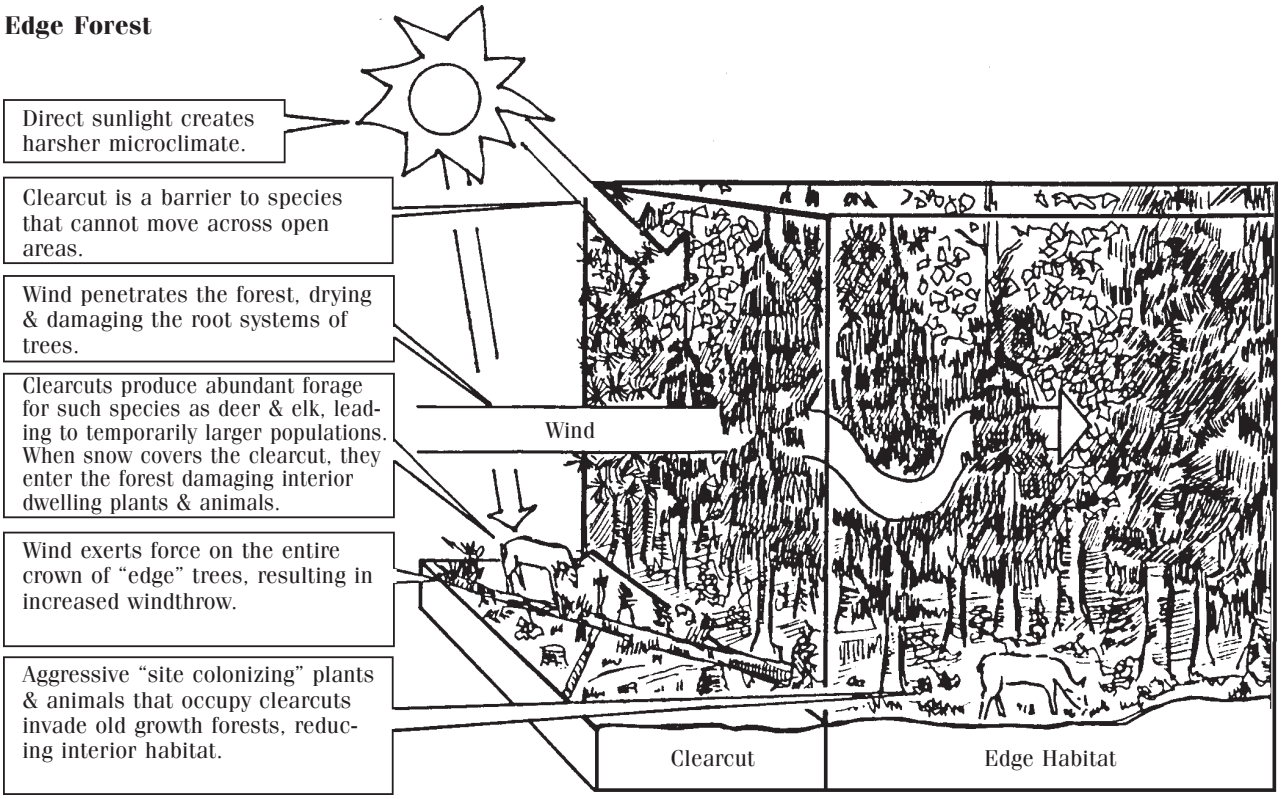
Buffer zones not only maintain the ecological function of the riparian area, but also provide protection to waterbodies by acting as a filter and barrier against overland flows of sediment before they enter a lake or stream (e.g., road construction, skidding activities); by restricting equipment activity in, and consequently, mechanical damage to, shoreline areas; by protecting the water body from an increase in solar radiation; and by providing protection against forestry activities (e.g., preventing slash and debris from entering streams).

How do RMAs and buffer zones protect riparian ecosystems?

Within RMAs and buffer zones, human disturbance activities are carefully controlled. Activity levels in an RMA can range from setting aside the area (i.e., no activity in the area) to maintaining the area, to actively crossing the waterbody. All activities are done in ways that have been proven to protect the ecosystems within the riparian area. For example, hand clearing of a transmission line right-of-way may be prescribed within the RMA and/or buffer zone as opposed to machine clearing. The width of the right-of-way may be narrower in the RMA or buffer zone to reduce the amount of vegetation that is removed. Tree clearing in the right-of-way may be limited to danger trees.

RMAs are not necessarily equivalent to buffer zones, although the buffer zone may include the entire RMA if deemed necessary to protect the riparian ecosystem.

The RMA approach is most effective when used as a component of a sound land management system. If not, there can be adverse impacts on buffer zone vegetation and stream hydraulics which can result in high maintenance costs, replanting, and the potential deterioration of the riparian area. The key is to integrate the management of the riparian ecosystem with the landscape adjacent to it.

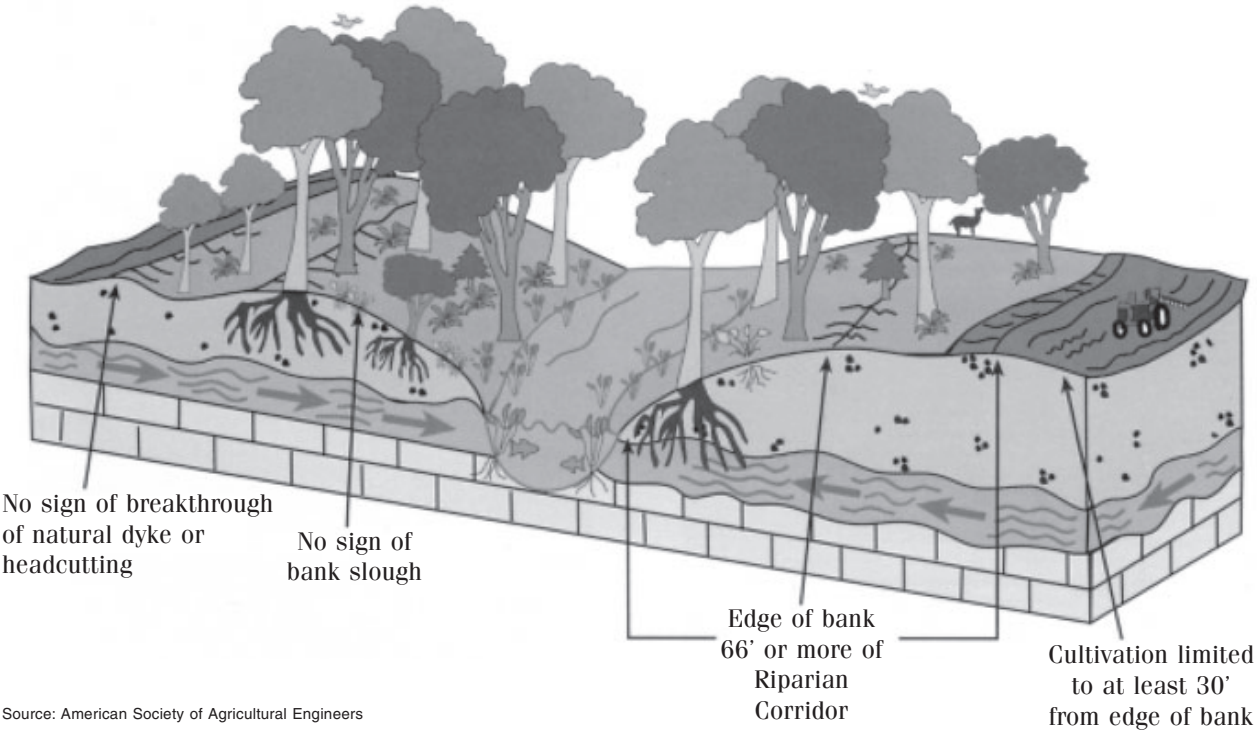


Reprinted with permission of the author from ***Seeing the Forest Among the Trees: The Case for Wholistic Forest Use*** *by Herb Hammond, Polestar Book Publishers, 1991 (adapted from Steve Cowden, The Oregonian, 1990)*

How is the width of a RMA determined?

Riparian ecosystems are defined by their functions and depend on the type of waterbody, topography, soil type, and climate. Therefore, the width of a riparian zone is often variable. Vegetation conditions, slope, soil, level of significance of the feature, other indicators of fragility or sensitivity of the feature, access to the feature, expected volume of use of the area, and management requirements are all factors to consider in determining the RMA width. Ideally, the width should approximate the ecologically defined riparian area. The Flood Prone Area (FPA) is considered the minimum extent of this boundary, but it may exceed beyond this limit if circumstances warrant the need for additional environmental protection.

A Healthy Riparian Corridor



Source: American Society of Agricultural Engineers

How is the size of the buffer zone within the RMA determined?

The desired width of a buffer zone will be determined by considering the slope of the land, the length of slope, soil type, vegetation, land use, ease of access, wildlife, and the overall sensitivity classification ratings of the waterbody or watercourse. The buffer zone for Class 2 and 3 streams should extend out from the waterbody at least as far as the zone of influence of the waterbody on vegetation and terrain; i.e., to include floodplains, bank slopes and associated vegetation growth.

Other important factors to consider which may increase the width of buffers in the RMA are the aesthetics of the area, input from landowners and from the surrounding community, unique and specialized habitat types, and heritage resource values. These factors may contribute to, and occasionally supersede, any standardized decision made for a RMA. In addition, many authors have suggested that any development activities near riparian areas need an absolute minimum buffer of 10 meters in grassland ecosystems, and 25 meters in forested ecosystems. All Manitoba Hydro projects can usually comply with these minimum standards and there will often be buffer zones well beyond these widths. However, there may be an occasional circumstance that may require some activities in this zone. Specified and approved environmental protection measures are included in site-specific plans if such a circumstance occurs.

Reduced ROW width at riparian crossing.

Rosgen's stream typing

An expert on riparian ecosystems, David L. Rosgen, has developed a classification system to categorize streams having similar characteristics. It uses an alphanumeric system where letters of the alphabet refer to gradient, and numbers refer to bed materials. Letters range from A to C types (steep gradient to flat gradient) to D types (those that are braided) through to F types (those that are deeply incised) and numbers describe predominate bed materials from bedrock to fine grained substrate, 1 to 6 respectively. For example, an A1 stream would have a steep, bedrock channel, B3 would be a moderate gradient course channel, and C5 would be a flat, fine grained stream.

This stream typing system also takes into consideration more complex measures including:

- entrenchment ratio
- width/depth ratio
- sinuosity
- slope of right and left banks

These measures help in the determination of RMA and buffer zone widths. It is important to note that stream typing should be done at the point of impact on the stream; i.e., the crossing point or area that will be disturbed. Although the stream may have a general classification, the actual crossing point could have the characteristics of a different stream type.

Appendix B contains the stream typing categories, cross-sectional and plan views of major stream types, and a table of management interpretations of various stream types.

Use of stream typing

During the environmental assessment process and when preparing management strategies and environmental protection plans, stream typing helps to focus the assessment team on specific potential impacts. Soil type determines susceptibility to erosion. For example, coarse textured (sandy) soils are not very susceptible to erosion because of their high infiltration capacity; fine textured (clay) soils are resistant to erosion because of their high cohesive strength; medium textured (loam) soils tend to erode. Slopes between 10% and 40% are highly erodible if their surface organic layers are removed. Slopes less than 10% pose less erosion potential, but operations on these slopes should be carefully conducted to maintain the vegetative cover and soil organic layers. Streams that are most sensitive to exposure from vegetation removal are generally shallow and wide. Clear, shallow, slow-moving streams with stable sand or silt bottoms are most likely to develop extensive plant beds if exposed to light.

Assessing the stream type, determining its sensitivity to disturbances, developing a management strategy and environmental protection plan, and calculating RMA and buffer zone widths is a highly sophisticated and technical process. This information is included here to illustrate the complexity of the process and to underscore the importance of involving a team of experts to assess riparian areas during the environmental impact assessment phase of a project and to develop management strategies to minimize or prevent potential impacts.

Mitigation Measures

What are general techniques for mitigating impacts in riparian areas?

When working in the vicinity of waterbodies:

- avoid stream crossings during routing
- keep access road lengths to a minimum
- remove vegetation by mechanical means except where hand clearing is stipulated
- maintain buffer zones between construction areas and natural waterbodies
- select and properly install appropriate water course crossing devices

Use of wide track vehicles reduces impact on soil and vegetation.

- time construction activities to seasons of the year best suited for construction and protection of critical habitats (e.g., during ice periods or low water flow periods to minimize potential erosion effects, or during major bird migration periods)
- avoid or minimize travel through sensitive landforms and habitats
- use sediment traps to filter sediment-laden water
- install erosion control devices
- retain bank vegetation wherever possible and encourage natural revegetation instead of seeding a cover crop
- regulate the use of herbicides near waterways as specified by the Herbicide Act
- use clean rip-rap and granular material in sensitive stream crossings
- use properly designed and installed culverts where access routes may interrupt waterflow patterns
- consult local trappers and recreationists during right-of-way route selection and clearing to avoid existing travel and trapping areas where possible
- monitor the success of site-specific RMA mitigation and protection measures and modify subsequent procedures or practices where shown to be desirable

What are specific techniques to mitigate impacts in riparian areas?

Specific mitigation techniques are used where appropriate when working in the vicinity of water bodies. They include:

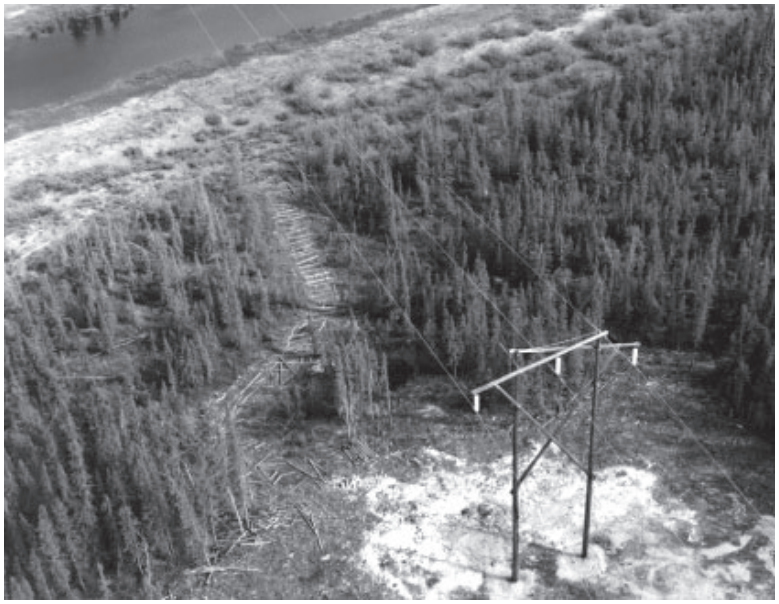
- All dewatering of excavations and depressions should be directed away from watercourses.
- Contaminated water should be filtered through rock containment or silt fences or removed in a dewatering truck. Bentonite and any other filtered materials should be removed to an approved disposal site.
- Where topsoil is stripped from a work site, it should be stockpiled in a location where natural drainage will not be impeded. If appropriate to the particular facility design, it should be replaced upon completion of construction activities. When it is not appropriate to replace topsoil, disposal arrangements should be made with the landowner as a first option.

Environmental Protection worker training course evaluating stream crossing site.

- Top-soil and sub-soil should be segregated for re-use in construction site reclamation. Fertilizers may be added to the soil to replace lost fertility.
- Where construction sites are located in floodplains, near wetlands or adjacent to streams, excess excavated soils should be removed to high ground. The disposal area will be graded and seeded. If there is no suitable disposal site, or if the soil is contaminated, it will be removed to an approved disposal site.
- Water used to clean concrete trucks, chutes and mixers should not be allowed to directly enter any surface waters. Such wash waters should be percolated through the soil after hardened concrete has been removed to reduce lime concentrations. Where there is potential for heavy run-off, berm construction and diversion channels may be necessary to retain such waters to allow time for percolation.
- Where tower sites are located on slopes and/or in proximity to water courses, some method of sedimentation control should be provided. Included in the options are: straw mulching and seeding, erosion control blanket and seeding, straw bale containment dam, and silt fence. Where such measures are employed, sites should be monitored and the effectiveness of the measures documented.

What are mitigation techniques for stream crossings?

- Access routes to construction sites should avoid stream crossings where possible.



Logs placed horizontally on steep slopes reduce erosion.

- Where crossing is necessary the crossing type and design should be specified in the development plan. The local Natural Resource Officer should be consulted and appropriate approvals regarding crossing sensitive streams obtained. The type of stream crossing design should be determined by site inspection.
- Necessary crossings of streams should be designed to protect the stream bed and banks, to minimize clearing of riparian vegetation, to prevent disruption to normal drainage patterns and to minimize interference to fish passage.
- Cover crops should be established (seeded/planted and then monitored to ensure success) on disturbed areas as soon as possible after a permanent stream crossing is installed.
- Bypass routes will be used in special cases to avoid or circumvent inaccessible steep slopes.

What are mitigation techniques for wetlands?

- Where possible, tower construction in wetlands should be avoided.
- Tower placement, conductor sag, and line marking should be considered as means by which to minimize bird strikes on conductors particularly in areas that experience unusual or prolonged inclement weather conditions.
- Alternatives to overhead conductors adjacent to wetlands should be considered (i.e., buried cable may be used where economically and technically feasible).
- Construction and access through wetlands should be planned for periods when critical life functions of waterfowl are not affected (i.e., late fall and winter).
- Equalizing culverts approved by water resource managers should be provided on a temporary/permanent basis where natural and constructed drainage is disrupted.
- Where a pole must be placed in a wetland only those treated with chromated copper arsenate (CCA) should be used. Poles treated with pentachlorophenol (Penta) should be used in upland areas.

What are mitigation techniques for special sites?

Some riparian areas require site-specific wildlife and habitat management decisions by resource specialists. When these areas are encountered, protection measures can be modified in the following ways:

- establish site-specific reserve areas,
- apply measures for the protection of birds against wire strikes,
- create snags or install artificial 'houses' to retain wildlife habitat, and
- pile brush cut to retain wildlife habitat.

Brush piles conceal wildlife and provide escape cover from predators.

What are mitigation techniques for birds and animals?

When trees containing large stick nests, active dens, or burrows are identified, mitigation measures are often adopted to preserve the bird and mammal species that occupy them. Mitigation techniques include adjusting the location of the project, or avoiding the area, especially during sensitive periods such as the nesting season. A 200 m reserve is established around nesting sites of eagles, ospreys and other birds of prey. Reserve areas can be recommended around special habitat features such as aquatic feeding areas, mineral licks, and calving sites. The shape and extent of the reserve is determined by the nature of each site, the need to maintain its integrity, and to maintain safe access to it from surrounding forest stands. In general, a 120 m reserve should be left around these areas.

Tower placement, conductor sag, and line marking are means by which to minimize bird strikes on conductors. Alternatives to placing overhead conductors adjacent to wetlands should be considered, such as using buried cable where economically and technically feasible.

Merlin

Other authors suggest that power lines routed through riparian vegetation should be designed to keep conductors well above the forest canopy because migrant **passerines** generally fly very low, usually beneath the height of the conductors. Where power lines cross natural flight lanes, the towers should be placed near the middle of the flight lane to increase the visibility of the power line. Markers should be placed on the ground wire(s). In Colorado, yellow spiral vibration dampers or yellow fiberglass swinging plates placed on power lines significantly reduced crane, waterfowl, and other bird mortality by 61% and 63% respectively by making the lines more visible to the birds. The use of yellow aviation balls and 'bird flight diverters' (i.e., spiral vibration damper with an enlarged coil at one end to increase its silhouette) significantly reduced bird strikes, averaging a 45% reduction.

Snags or standing dead trees can usually be found in any stand of mature trees. Snags at the edge of a transmission line right-of-way are usually identified as danger trees and are removed from the site. Snags, however, are rare in proportion to live trees especially in riparian areas. If tree cavity homes have to be removed, they can be replaced with artificial cavities such as bird boxes. These structures can be placed on live trees in the riparian area. Management techniques such as **tree girdling**, can also be used to initiate snags in adjacent riparian habitat. Selective tree girdling speeds up the natural process and quickly replaces those snags which had to be removed.

Timber cut on Crown Lands is often made available to local residents prior to transmission line construction. The slash is cut, piled, and burned, or it is disposed of as specified in work permits.

Environmental Protection Workers learning about mitigation techniques.

Another option is to leave these brush piles on site. If properly located and constructed, brush piles can potentially diversify wildlife habitat and can help wildlife survive during critical periods. Brush piles conceal wildlife and provide escape cover from predators. They offer shelter from wind, snow, and ice storms in winter, and shade in the summer. They are also suitable microclimates for seed germination, plant resprouting, and accelerated young plant growth.

Polar bears often den in the banks of streams.

What are mitigation techniques for existing Manitoba Hydro facilities?

This document has thus far focussed on construction of new projects, but there are many facilities already in existence. Although many of these were constructed prior to the development and implementation of the environmental protection measures contained in this document, they are maintained in accordance with these measures.

Helicopters expedite ROW inspection work over long distances.

Two approaches are used: active management and passive management. Active management is undertaken where there has been significant impact and remedial actions are required. These may include restoration of an eroded streambank, planting of vegetative cover, placement of erosion barriers. Passive management means allowing the existing vegetation to re-establish itself naturally in the buffer zone without any intervention by Manitoba Hydro.

Stream crossings are inspected and evaluated during routine maintenance activities and a decision made about the appropriate management approach. During regular maintenance activities, the environmental protection measures outlined in this document for riparian ecosystems are followed.

Summary

Manitoba Hydro projects are a small segment of the human activities that affect riparian ecosystems. Although each impact on a riparian ecosystem may be relatively small, the cumulative impacts can be much greater. When considered along with all of the other industries and human activities that have an impact on riparian ecosystems, the effect is again magnified.

This document examined both the positive and negative potential effects of Manitoba Hydro activities on riparian ecosystems. It gave examples of the effects on the fish, wildlife, birds, plants and amphibians. It reviewed how the potential impacts can be prevented during the site selection process by avoiding riparian ecosystems as much as possible, as well as the measures that are undertaken to mitigate potential negative effects.

Manitoba Hydro will continue to implement these measures and will monitor their effects so that future mitigation efforts can be improved and adapted to enhance management activities in riparian areas.

Appendix A

Appendix A

SPECIES COMMONLY FOUND IN RIPARIAN ECOSYSTEMS IN MANITOBA

Plants

B - Taiga Shield and C - Hudson Plains (Refer to map on page 85)

Tree	
White birch	Betula papyrifera
Tamarack	Larix laricina
White spruce	Picea glauca
Black spruce	Picea mariana
Balsam poplar	Populus balsamifera
Trembling aspen	Populus tremuloides
Shrub	
Alder	Alnus spp.
Bog rosemary	Andromeda polifolia
Scrub birch	Betula glandulosa
Swamp birch	Betula pumila
Black crowberry	Empetrum nigrum
Low juniper	Juniperus communis
Labrador-tea	Ledum palustre
Sweet gale	Myrica gale
Willow	Salix spp.
Canada buffaloberry	Shepherdia canadensis
White mountain-avens	Dryas integrifolia
Black crowberry	Empetrum nigrum
Dry-ground cranberry	Vaccinium vitis-idaea
Lichen/Herb/Grass	
Yarrow	Achillea borealis
	Alectoria nitidula
Alpine bearberry	Arctostaphylos rubra
	Argentina pacifica
Orache	Atriplex patula
Velvet bells	Bartsia alpina
Narrow reed grass	Calamagrostis neglecta
	Caloplaea spp.
	Campylium stellatum
Sedge	Carex spp.
Lichen	Cetraria spp.
Reindeer lichen	Cladina spp.
Club lichens	Cladonia spp.
	Cornicularia divergens
Broom moss	Dicranum spp.
Sickle moss	Drepanocladus spp.
Sea lime grass	Elymus arenarius
Horsetail	Equisetum spp.
Sheathed cotton-grass	Eriophorum vaginatum

Red fescue	Festuca rubra
Northern hedysarum	Hedysarum mackenzii
Wild barley	Hordeum jubatum
Stair-step mosses	Hylocomium spp.
	Hypnum spp.
Rush	Juncus spp.
Pale laurel	Kalmia polifolia
Twinflower	Linnaea borealis
	Parmelia spp.
Spotted dog lichen	Peltigera apthosa
Schreber's moss	Pleurozium schreberi
Cinquefoil	Potentilla spp.
	Rinodina oreina
Cloudberry	Rubus spp.
Western dock	Rumex occidentalis
Red samphire	Salicornia rubra
Three-toothed saxifrage	Saxifraga tricuspidata
Bulrush	Scirpus spp.
Moss	Scorpidium spp.
Three-leaved solomon's seal	Smilacina trifoliata
Moss	Sphagnum spp.
	Stereocaulon pascale
Western sea-blite	Suaeda depressa
	Umbillicaria spp.

D - Boreal Shield (Refer to map on page 85)

Tree

Balsam fir	Abies balsamea
White birch	Betula papyrifera
Black Ash	Fraxinus nigra
Tamarack	Larix laricina
Mountain maple	Acer spicatum
White spruce	Picea glauca
Black spruce	Picea mariana
Jack pine	Pinus banksiana
Balsam poplar	Populus balsamifera
Trembling aspen	Populus tremuloides
Cedar	Thuja occidentalis

Shrub

Alder	Alnus spp.
Saskatoon	Amelanchier alnifolia
Bog-rosemary	Andromeda polifolia
Scrub birch	Betula glandulosa
Swamp birch	Betula pumila
Leatherleaf	Chamaedaphne calyculata
Red-osier dogwood	Cornus stolonifera
Hazelnut	Corylus spp.
"Snowberry, wintergreen"	Gaultheria spp.

Juniper	Juniperus communis
Labrador-tea	Ledum palustre
Honeysuckle	Lonicera spp.
Sweet gale	Myrica gale
Swamp cranberry	Oxycoccus quadripetalus
Cherry	Prunus spp.
Currant	Ribes spp.
Wild rose	Rosa spp.
Willow	Salix spp.
Soapberry	Shepherdia canadensis
Blueberry	Vaccinium spp.
Cranberry	Viburnum spp.
Bearberry	Arctostaphylos uva-ursi
Dry-ground cranberry	Vaccinium vitis-idaea
Wild Sarsaparilla	Aralia nudicaulis

Lichen/Herb/Grass

Yarrow	Achillea millefolium
Wheatgrass	Agropyron spp.
Anemone	Anemone spp.
Aster	Aster spp.
Brome grass	Bromus spp.
Reed grass	Calamagrostis spp.
Sedge	Carex spp.
Reindeer lichen	Cladina spp.
Club lichen	Cladonia spp.
Blue bead lily	Clintonia boreal
Bunchberry	Cornus canadensis
Broom moss	Dicranum spp.
Sickle moss	Drepanocladus revolvens
Fireweed	Epilobium angustifolium
Horsetail	Equisetum spp.
Cotton-grass	Eriophorum spp.
Wild strawberry	Fragaria spp.
Bedstraw	Galium spp.
Hedysarum	Hedysarum spp.
Stair-step mosses	Hylocomium spp.
Impatiens	Impatiens capensis
Rush	Juncus spp.
Swamp laurel	Kalmia polifolia
“Wild peavine, vetchling”	Lathyrus spp.
Twinflower	Linnaea borealis
Twayblade	Listera spp.
Clubmoss	Lycopodium spp.
Lily-of-the-valley	Maianthemum canadense
Rice grass	Oryzopsis spp.
Spotted dog lichen	Peltigera apthosa
Coltsfoot	Petasites spp.
Schreber’s moss	Pleurozium schreberi

Bluegrass	Poa spp.
Hair cap moss	Polytrichum spp.
Cinquefoil	Potentilla spp.
Pyrola	Pyrola spp.
“Raspberry, cloudberry”	Rubus spp.
Bulrush	Scirpus spp.
Moss	Scorpidium spp.
Solomon’s seal	Smilacina spp.
Goldenrod	Solidago spp.
Moss	Sphagnum spp.
Cattail	Typha spp.
Violet	Viola spp.

E - Boreal Plains (Refer to map on page 85)

Tree

Balsam fir	Abies balsamea
Manitoba maple	Acer negundo
White birch	Betula papyrifera
Green ash	Fraxinus pennsylvanica
White spruce	Picea glauca
Black spruce	Picea mariana
Jack pine	Pinus banksiana
Balsam poplar	Populus balsamifera
Trembling aspen	Populus tremuloides
Bur oak	Quercus macrocarpa
American elm	Ulmus americana

Shrub

Mountain maple	Acer spicatum
Alder	Alnus spp.
Saskatoon	Amelanchier alnifolia
Dwarf birch	Betula glandulosa
Red-osier dogwood	Cornus alba
Hazelnut	Corylus spp.
Wintergreen	Gaultheria spp.
Juniper	Juniperus communis
Honeysuckle	Lonicera spp.
Cherry	Prunus spp.
Currant	Ribes spp.
Wild rose	Rosa spp.
Wild raspberry	Rubus idaeus
Willow	Salix spp.
Elder	Sabucus racemosa
Soapberry	Shepherdia canadensis
Narrow-leaved meadowsweet	Spiraea alba
Snowberry	Symphoricarpos occidentalis
Cranberry	Viburnum spp.
Bearberry	Arctostaphylos uva-ursi

Lichen/Herb/Grass

Wheatgrass	Agropyron spp.
Sarsaparilla	Aralia nudicaulis
Aster	Aster spp.
Vetch	Astragalus spp.
Brome grass	Bromus spp.
Marsh reed grass	Calamagrostis canadensis
Lichen	Caloplaca pyracea
Sedge	Carex spp.
Lichen	Catillaria glauconigricans
Club lichen	Cladonia spp.
Bower	Clematis spp.
Fairybells	Disporum trachycarpum
Wild rye	Elymus spp.
Horsetail	Equisetum spp.
Fescue	Festuca spp.
Northern bedstraw	Galium boreale
Geranium	Geranium spp.
	Hypogymnia spp.
Rush	Juncus spp.
Wild peavine, vetchling	Lathyrus spp.
Lichen	Lecanora coilocarpa
Wood lily	Lilium philadelphicum
Clubmoss	Lycopodium spp.
Solomon's seal	Smilacina spp.
Lily-of-the-valley	Mianthemum canadense
Rice grass	Oryzopsis spp.
Sweet cicely	Osmorhiza longistylis
Locoweed	Oxytropis spp.
Spotted dog lichen	Peltigera apthosa
Coltsfoot	Petasites spp.
Common reed grass	Phragmites communis
Lichen	Physcia adscendens
Schreber's moss	Pleurozium schreberi
Bluegrass	Poa spp.
Hair cap moss	Polytrichum spp.
Cinquefoil	Potentilla spp.
Pyrola	Pyrola spp.
"Raspberry, cloudberry"	Rubus spp.
Bulrush	Scirpus spp.
Carrion flower	Smilax herbacea
Goldenrod	Solidago spp.
Hedge-nettle	Stachys tenufolia
Meadow rue	Thalictrum spp.
Cattails	Typha spp.
Cranberry	Vaccinium spp.
Vetch	Vicia spp.
Violet	Viola spp.

F - Prairie (Refer to map on page 85)

Trees

Manitoba maple	Acer negundo
Green ash	Fraxinus pennsylvanica
Balsam poplar	Populus balsamifera
Cottonwood	Populus deltoides
Trembling aspen	Populus tremuloides
Bur oak	Quercus macrocarpa
Basswood	Tilia americana
American elm	Ulmus americana
Peach leaf Willow	Salix amygdaloides

Shrub

Saskatoon	Amelanchier alnifolia
Red-osier dogwood	Cornus alba
Hazelnut	Corylus spp.
Hawthorn	Crataegus chrysocarpa
Chokecherry	Prunus virginiana
Poison ivy	Rhus radicans
Wild black currant	Ribes americanum
Wild rose	Rosa spp.
Wild raspberry	Rubus idaeus
Willow	Salix spp.
Narrow-leaved meadowsweet	Spiraea alba
Snowberry	Symphoricarpos occidentalis
Downy arrowwood	Viburnum rafinesquianum

Lichen/Herb/Grass

Wheatgrass	Agropyron spp.
Water plantain	Alisma spp.
Hog peanut	Amphicarpa bracteata
Sarsaparilla	Aralia nudicaulis
Brome grass	Bromus spp.
Marsh reed grass	Calamagrostis canadensis
Sedges	Carex spp.
Northern bedstraw	Galium boreale
Sweet-scented bedstraw	Galium triflorum
Wild barley	Hordeum jubatum
Wood nettle	Laportea canadensis
Wild peavine	Lathyrus venosus
Fringed loosestrife	Lysimachia ciliata
Two-leaved solomon's seal	Maianthemum canadense
Moonseed	Menispermum canadense
Sweet cicely	Osmorhiza longistylis
Virginia creeper	Parthenocissus quinquefolia
Beardtongue	Penstemon spp.
Common reed grass	Phragmites communis
Bluegrass	Poa spp.
Smartweed	Polygonum spp.
Salt-meadow grass	Puccinellia nuttalliana

Black snakeroot	Sanicula marilandica
Spangletop	Scolochloa festucacea
Water-parsnip	Sium suave
Star-flowered solomon's seal	Smilacina stellata
Carrion flower	Smilax herbacea
Late goldenrod	Solidago gigantea
Sow thistle	Sonchus arvensis
Hedge-nettle	Stachys tenufolia
Needle grass	Stipa spp.
Meadow rue	Thalictrum spp.
Cattails	Typha spp.
Stinging nettle	Urtica dioica
Western Canada violet	Viola rugulosa
Wild grape	Vitis riparia

AMPHIBIANS

(Refer to legend at end of table)

CLASS: AMPHIBIA
ORDER: CAUDATA (Salamanders)

		Treatment					*Primary Habitat*		*General Habitat*			*Notes*		
		Riparian Specialist	Waterbody	Watercourse	Boreal Wilderness Area	Other	Terrestrial	Aquatic	Grass	Shrub	Tree	Range/ Ecozone	Residence & Abundance	Conservation Status
Blue-spotted Salamander	*Ambystoma laterale*	1	1	1	1		1	1			1	D	RE/U	S3S4
Gray Tiger Salamander	*Ambystoma tigrinum diaboli*	1	1	1			1	1	1	1	1	EF	RE/C	S4S5
Eastern Tiger Salamander	*Ambystoma tigrinum tigrinum*	1	1	1			1	1	1	1	1	EF	RE/R	S2
Mudpuppy	*Necturus maculosus maculosus*	1	1	1	1			1				DEF	RE/U	S4

ORDER: SALIENTIA (Frogs and Toads)

Boreal Chorus Frog	*Pseudacris triseriata maculata*	1	1	1	1		1	1	1	1	1	BCDEF	RE/C	S5
Canadian Toad	*Bufo americanus hemiophrys*	1	1	1	1		1	1	1	1	1	CDEF	RE/C	S4
Cope's Gray Treefrog	*Hyla chrysoscelis*	1	1	1			1	1	1	1	1	DEF	RE/C	S4
Eastern American Toad	*Bufo americanus americanus*	1	1	1	1		1	1	1	1	1	CDEF	RE/C	S5
Gray Treefrog	*Hyla versicolor*	1	1	1			1	1	1	1	1	DEF	RE/C	S4
Great Plains Toad	*Bufo cognatus*		1			1	1		1			F	RE/R	S2S3
Green Frog	*Rana clamitans melanota*	1	1	1	1			1				D	RE/R	S2
Mink Frog	*Rana septentrionalis*	1	1	1	1			1				D	RE/U	S3
Northern Leopard Frog	*Rana pipiens*	1	1	1	1		1	1	1	1		CDEF	RE/C	S4
Northern Spring Peeper	*Hyla crucifer crucifer*	1	1	1	1		1	1			1	DE	RE/C	S4
Plains Spadefoot Toad	*Scaphiopus bombifrons*		1			1	1		1			EF	RE/U	S3S4
Wood Frog	*Rana sylvatica*	1	1	1	1		1	1	1	1	1	BCDEF	RE/C	S5

REPTILES

CLASS: REPTILIA
ORDER: TESTUDINES (Turtles)

Common Snapping Turtle	*Chelydra serpentina serpentina*	1	1	1				1				DEF	RE/U	S3
Western Painted Turtle	*Chrysemys picta belli*	1	1	1			1	1				DEF	RE/C	S4

ORDER: SQUAMATA
SUBORDER: LACERTILIA (Lizards, Skinks)

Northern Prairie Skink	*Eumeces septentrionalis*					1	1		1			F	RE/U	S2

		Treatment					Primary Habitat		General Habitat				Notes		
		Riparian Specialist	Waterbody	Watercourse	Boreal Wilderness Area	Other	Terrestrial	Aquatic	Grass	Shrub	Tree	Range/ Ecozone	Residence & Abundance	Conservation Status
ORDER: SQUAMATA														
SUBORDER: SERPENTES (Snakes)														
Northern Red-bellied Snake	*Storeria occipitomaculata*		1			1	1	1	1	1	1	DEF	RE/C	S4
Plains Hognose Snake	*Heterodon nasicus nasicus*					1	1		1			F	RE/R	S2
Red-sided Garter Snake	*Thamnophis sirtalis parietalis*		1		1	1	1	1	1	1	1	DEF	RE/C	S3S4
Smooth Green Snake	*Opheodrys vernalis*		1			1	1	1	1	1	1	EF	RE/U	S3S4
Western Plains Garter Snake	*Thamnophis radix haydeni*		1			1	1	1	1			EF	RE/C	S4
TOTAL: 24 Species of Amphibians and Reptiles		16	22	16	11	8	20	20	17	12	13			
BIRDS														
ORDER: GAVIIFORMES (Loons)														
Common Loon	*Gavia immer*	1	1					1				BCDEF	M/U	S4B
Pacific Loon	*Gavia pacifica*	1	1			1		1				BC	M/U	S4S5B
Red-throated Loon	*Gavia stellata*	1	1					1				BC	M/U	S3S4B
Yellow-billed Loon	*Gavia adamsii*													SA
ORDER: PODICIPEDIFORMES (Grebes)														
Clark's Grebe	*Aechmophorus clarkii*	1	1					1				F	M/R	S2B
Eared Grebe	*Podiceps nigricollis*	1	1	1				1				F	M/U	S4S5B
Horned Grebe	*Podiceps auritus*	1	1	1				1				BCDEF	M/C	S4S5B
Pied-billed Grebe	*Podilymbus podiceps*	1	1	1				1				BCDEF	M/C	S4S5B
Red-necked Grebe	*Podiceps grisegena*	1	1	1				1				DEF	M/U	S4S5B
Western Grebe	*Aechmophorus occidentalis*	1	1					1				EF	M/C	S4B
ORDER: PELECANIFORMES (Pelecans)														
American White Pelican	*Pelicanus erythrorhyncos*	1	1	1			1	1				DEF	U	S3B
Double-crested Cormorant	*Phalacrocorax auritus*	1	1	1			1	1				DEF	C	S4B
ORDER: SULIDAE														
Northern Gannet	*Morus bassanus*													SA
ORDER: ANSERIFORMES (Waterfowl)														
American Black Duck	*Anas rubripes*	1	1	1	1		1	1	1			CD	M/U	S4B
American Wigeon	*Anas americana*	1	1	1	1		1	1	1			BCDEF	M/C	S5B

		Treatment					*Primary Habitat*		*General Habitat*			*Notes*		
		Riparian Specialist	Waterbody	Watercourse	Boreal Wilderness Area	Other	Terrestrial	Aquatic	Grass	Shrub	Tree	Range/ Ecozone	Residence & Abundance	Conservation Status
Barnacle Goose	*Branta leucopsis*													SR
Barrow's Goldeneye	*Bucephala islandica*													SA
Black Scoter	*Melanitta nigra*	1	1	1			1	1	1	1		BC	M/R	S3S4B
Blue-winged Teal	*Anas discors*	1	1	1	1		1	1	1			BCDEF	M/A	S5B
Brant	*Branta bernicla*													SAN
Bufflehead	*Bucephala albeola*	1	1	1	1		1	1	1		1	BCDEF	M/C	S5B
Canada Goose	*Branta canadensis*	1	1	1	1		1	1	1			BCDEF	M/A	S5B
Canvasback	*Aythya valisineria*	1	1					1				EF	M/C	S4B
Cinnamon Teal	*Anas cyanoptera*													SA
Common Eider	*Somateria mollissima*	1	1					1				BC	M/U	S4B
Common Goldeneye	*Bucephala clangula*	1	1	1	1		1	1	1		1	BCDEF	M/C	S5B
Common Merganser	*Mergus merganser*	1	1	1	1		1	1	1		1	BCDEF	M/C	S5B
Eurasian Wigeon	*Anas penelope*													SA
Gadwall	*Anas strepera*	1	1				1	1	1			DEF	M/C	S5B
Garganey	*Anas querquedula*													SA
Greater Scaup	*Aythya marila*	1	1	1	1		1	1	1			BC	M/U	S5B
Greater White-fronted Goose	*Anser albifrons*												M/T	SZN
Green-winged Teal	*Anas crecca*	1	1		1		1	1	1		1	BCDEF	M/C	S5B
Harlequin Duck	*Histrionicus histrionicus*													SA
Hooded Merganser	*Lophodytes cucullatus*	1	1	1	1		1	1	1		1	DEF	M/C	S5B
King Eider	*Somateria spectabilis*													SA
Lesser Scaup	*Aythya affinis*	1	1	1	1		1	1	1	1		BCDEF	M/C	S4B
Mallard	*Anas platyrhynchos*	1	1	1	1		1	1	1	1		BCDEF	M/A	S5B
Mute Swan	*Cygnus olor*													SE
Northern Pintail	*Anas acuta*	1	1		1		1	1	1			BCDEF	M/U	S4B
Northern Shoveller	*Anas clypeata*	1	1		1		1	1	1			BCDEF	M/C	S5B
Oldsquaw	*Clangula hyemalis*	1	1		1		1	1	1			BC	M/C	S5B
Red-breasted Merganser	*Mergus serrator*	1	1	1	1		1	1	1	1		BCDE	M/U	S5B
Redhead	*Aythya americana*	1	1		1		1	1	1		1	BCDEF	M/U	S4B
Ring-necked Duck	*Aythya collaris*	1	1	1	1		1	1	1			CDEF	M/C	S5B
Ross' Goose	*Chen rossii*	1	1	1	1		1	1	1			B	M/R	S2B

		Treatment					*Primary Habitat*			*General Habitat*		*Notes*		
		Riparian Specialist	Waterbody	Watercourse	Boreal Wilderness Area	Other	Terrestrial	Aquatic	Grass	Shrub	Tree	Range/ Ecozone	Residence & Abundance	Conservation Status
Ruddy Duck	*Oxyura jamaicensis*	1	1				1	1	1			EF	M/C	S5B
Smew	*Mergellus albellus*													SR
Snow Goose	*Chen caerulescens*	1	1	1	1		1	1	1	1		BC	M/A	S3S4B
Surf Scoter	*Melanitta perspicillata*	1	1	1			1	1	1	1		BC	M/R	S5B
Trumpeter Swan	*Cygnus buccinator*													SXSPB
Tundra Swan	*Cygnus columbianus*	1	1	1			1	1	1			BC	M/U	S4B
White-winged Scoter	*Melanitta fusca*	1	1	1			1	1	1	1		BCDEF	M/R	S4B
Wood Duck	*Aix sponsa*	1	1	1			1	1	1		1	DE	M/U	S5B
ORDER: FALCONIFORMES (Hawks and Falcons)														
American Kestrel	*Falco sparverius*				1		1		1	1	1	BCDEF	M/C	S5B
Bald Eagle	*Haliaeetus leucocephalus*	1	1	1			1	1			1	BCDEF	M/U	S4B
Broad-winged Hawk	*Buteo platypterus*				1		1				1	DEF	M/C	S5B
Cooper's Hawk	*Accipiter cooperii*				1		1				1	DEF	M/C	S4B
Ferruginous Hawk	*Buteo regalis*						1		1			F	M/R	S2B
Golden Eagle	*Aquila chrysaetos*				1		1				1	BCD	M/R	SHB
Gyrfalcon	*Falco rusticolus*												M/T	SZN
Merlin	*Falco columbarius*		1	1	1		1				1	BCDEF	M/U	S5B
Northern Goshawk	*Accipiter gentilis*				1		1				1	BCDEF	M/R	S5B
Northern Harrier	*Circus cyaneus*	1	1		1		1	1	1			BCDEF	M/C	S4S5B
Osprey	*Pandion haliaetus*	1	1	1			1	1			1	CDEF	M/U	S4S5B
Peregrine Falcon	*Falco peregrinus*		1	1	1	1		1	1	1	1	BCF	M/R	S1B
Prairie Falcon	*Falco mexicanus*												M/T	SZN
Red-shouldered Hawk	*Buteo lineatus*													SA
Red-tailed Hawk	*Buteo jamaicensis*				1		1		1	1	1	BCDEF	M/C	S5B
Rough-legged hawk	*Buteo lagopus*		1	1	1		1		1	1	1	BC	M/U	S4B
Sharp-shinned Hawk	*Accipiter striatus*		1	1	1		1			1	1	DEF	M/C	S5B
Swainson's Hawk	*Buteo swainsoni*					1		1	1			F	M/U	S3S4B
Swallow-tailed Kite	*Elanoides forficatus*													SR
Turkey Vulture	*Cathartes aura*				1	1	1		1	1	1	DEF	M/U	S4B

		Treatment					*Primary Habitat*			*General Habitat*			*Notes*		
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ORDER: GALLIFORMES (Gallinaceous Birds)														
Gray Partridge	*Perdix perdix*						1		1	1		EF	RE/C	SE
Greater Prairie Chicken	*Tympanuchus cupido*													SX
Ring-necked Pheasant	*Phasianus colchicus*						1		1			F	RE/R	SE
Rock Ptarmigan	*Lagopus mutus*												M/T	SZN
Ruffed Grouse	*Bonasa umbellus*				1		1				1	BCDEF	RE/C	S5B
Sage Grouse	*Centrocercus urophasianus*													SR
Sharp-tailed Grouse	*Tympanuchus phasianellus*				1		1		1	1	1	BCDEF	RE/C	S4B
Spruce Grouse	*Dendragapus canadensis*				1		1				1	BCDEF	RE/C	S5B
Wild Turkey	*Meleagris gallopavo*						1		1	1	1	F	RE/R	SE
Willow Ptarmigan	*Lagopus lagopus*				1		1		1	1	1	BC	RE/C	S5B
ORDER: CICONIIFORMES (Herons and Bitterns)														
American Bittern	*Botaurus lentiginosus*	1	1	1	1		1	1	1	1		BCDEF	M/U	S4B
Black-crowned Night-heron	*Nycticorax nycticorax*	1	1	1			1	1			1	DEF	M/U	S3S4B
Cattle Egret	*Bubulucus ibis*		1	1			1	1	1	1		DE	M/R	SPB
Glossy Ibis	*Plegadis falcinellus*													SA
Great Blue Heron	*Ardea herodias*	1	1	1	1		1	1	1		1	DEF	M/U	S4B
Great Egret	*Casmerodius albus*	1	1	1			1	1	1		1	F	M/R	S2B
Green Heron	*Butorides virescens*													SRB
Least Bittern	*Ixobrychus exilis*	1	1	1			1	1	1			F	M/R	S2B
Little Blue Heron	*Egretta caerulea*													SA
Snowy Egret	*Egretta thula*													SA
Tricolored Heron	*Egretta tricolor*													SA
White Ibis	*Eudocimus albus*													SA
White-faced Ibis	*Plegadis chihi*													SA
Yellow-crowned Night Heron	*Nyctanassa violacea*													SA
ORDER: GRUIFORMES (Cranes and Allies)														
American Coot	*Fulica americana*	1	1	1				1				DEF	M/A	S5B
Common Moorhen	*Gallinula chloropus*													SA
King Rail	*Rallus elegans*													SA
Sandhill Crane	*Grus canadensis*	1	1	1	1		1	1	1	1		BCDEF	M/C	S5B

		Treatment					*Primary Habitat*		*General Habitat*			*Notes*		
		Riparian Specialist	Waterbody	Watercourse	Boreal Wilderness Area	Other	Terrestrial	Aquatic	Grass	Shrub	Tree	Range/ Ecozone	Residence & Abundance	Conservation Status
Sora	*Porzana carolina*	1	1				1	1	1			BCDEF	M/C	S5B
Virginia Rail	*Rallus limicola*	1	1				1	1	1			DEF	M/U	S4B
Whooping Crane	*Grus americana*													SXB
Yellow Rail	*Coturnicops noveboracensis*	1	1		1		1	1	1			CDEF	M/U	S4B
ORDER: CHARADRIIFORMES (Shorebirds and Gulls)														
American Avocet	*Recurvirostra americana*	1	1				1	1	1			F	M/C	S5B
American Woodcock	*Scolopax minor*				1		1		1	1	1	DEF	M/U	S4B
Ancient Murrelet	*Synthliboramphus antiquus*													SA
Arctic Tern	*Sterna paradisaea*	1	1		1		1	1	1			BC	M/C	S5B
Baird's Sandpiper	*Calidris bairdii*												M/T	SZN
Black Guillemot	*Cepphus grylle*													SA
Black Tern	*Chlidonias niger*	1	1	1	1		1	1	1	1	1	CDEF	M/C	S3S4B
Black-bellied Plover	*Pluviaws squatarola*												M/T	SZN
Black-legged Kittiwake	*Rissa tridactyla*													SA
Black-necked Stilt	*Himantopus mexicanus*													SA
Bonaparte's Gull	*Larus philadelphia*	1	1	1	1		1	1	1		1	BCDEF	M/C	S5B
Buff-breasted Sandpiper	*Tryngites subruficollis*													SRB
California Gull	*Larus californicus*	1	1	1			1	1	1			EF	M/R	S4B
Caspian Tern	*Sterna caspia*	1	1	1			1	1	1			DEF	M/R	S3B
Common Black-headed Gull	*Larus ridibundus*													SA
Common Snipe	*Gallinago gallinago*	1	1	1	1		1	1	1	1		BCDEF	M/A	S5B
Common Tern	*Sterna hirundo*	1	1	1	1		1	1	1			BCDEF	M/U	S5B
Curlew Sandpiper	*Calidris ferruginea*													SA
Dovekie	*Alle alle*													SA
Dunlin	*Calidris alpina*	1	1		1		1	1	1			BC	M/U	S5B
Eskimo Curlew	*Numeniusborealis*													SXB
Forster's Tern	*Sterna forsteri*	1	1		1			1				EF	M/C	S3S4B
Franklin's Gull	*Larus pipixcan*		1		1		1	1	1			EF	M/C	S4S5B
Glaucous Gull	*Larus hyperboreus*												M/T	SZN
Glaucous-winged Gull	*Larus glaucescens*													SA
Great Black-backed Gull	*Larus marinus*													SA

		Treatment					*Primary Habitat*			*General Habitat*			*Notes*		
		Riparian Specialist	Waterbody	Watercourse	Boreal Wilderness Area	Other	Terrestrial	Aquatic	Grass	Shrub	Tree	Range/ Ecozone	Residence & Abundance	Conservation Status
Greater Yellowlegs	*Tringa melanoleuca*	1	1	1	1		1	1	1	1	1	BCDE	M/C	S5B
Herring Gull	*Larus argentatus*	1	1	1	1		1	1	1			BCDEF	M/U	S5B
Hudsonian Godwit	*Limosa Haemastica*	1	1		1		1	1	1			C	M/U	S4B
Iceland Gull	*Larus glaucoides*													SA
Ivory Gull	*Pagophila eburnea*													SA
Killdeer	*Charadrius vociferus*		1		1		1		1			BCDEF	M/A	S5B
Laughing Gull	*Larus atricilla*													SA
Least Sandpiper	*Calidris minutilla*	1	1		1		1	1	1			BC	M/C	S5B
Least Tern	*Sterna antillarum*													SA
Lesser Black-backed Gull	*Larus fuscus*													SA
Lesser Golden Plover	*Pluviaws dominica*		1		1		1	1	1			BC	M/C	S4S5B
Lesser Yellowlegs	*Tringa flavipes*	1	1	1	1		1	1	1	1	1	BCDE	M/C	S5B
Little Gull	*Larus minutus*	1	1		1		1	1	1			C	M/R	S1B
Long-billed Curlew	*Numenius americanus*													SXB
Long-billed Dowitcher	*Limnodromus scolopaceus*												M/T	SZN
Long-tailed Jaeger	*Stercorarius longicaudus*												M/T	SZN
Marbled Godwit	*Limosa fedoa*		1		1		1	1	1			EF	M/C	S4B
Mew Gull	*Larus canus*	1	1	1	1		1	1	1		1	BC	M/R	S3B
Parasitic Jaeger	*Stercorarius parasiticus*		1		1		1	1	1			BC	M/U	S5B
Pectoral Sandpiper	*Calidris melanotos*	1	1		1		1	1	1			B	M/R	S3B
Piping Plover	*Charadrius melodus*	1	1				1	1	1			DEF	M/R	S2B
Pomarine Jaeger	*Stercorarius pomarinus*												M/T	SZN
Purple Sandpiper	*Calidris maritima*													SA
Red Knot	*Calidris canutus*												M/T	SZN
Red Phalarope	*Phalaropus fulicaria*													SA
Red-necked Phalarope	*Phalaropus lobatus*	1	1		1		1	1	1			BC	M/U	S5B
Ring-billed Gull	*Larus delawarensis*	1	1	1	1	1	1	1	1			DEF	M/A	S5B
Ross's Gull	*Rhodostethia rosea*	1	1		1		1	1	1			C	M/R	S2B
Royal Tern	*Sterna maxima*													SR
Ruddy Turnstone	*Arenaria interpres*												M/T	SZN
Ruff	*Philomachus pugnax*													SA

		Treatment					*Primary Habitat*			*General Habitat*			*Notes*	
		Riparian Specialist	Waterbody	Watercourse	Boreal Wilderness Area	Other	Terrestrial	Aquatic	Grass	Shrub	Tree	Range/ Ecozone	Residence & Abundance	Conservation Status
Sabine's Gull	*Xema sabini*												M/T	SZN
Sanderling	*Calidris alba*												M/T	SZN
Semipalmated Plover	*Charadrius semipalmatus*	1	1	1	1		1	1	1			BC	M/C	S5B
Semipalmated Sandpiper	*Calidris pusilla*	1	1	1	1		1	1	1			BC	M/C	S5B
Short-billed Dowitcher	*Limnodromus griseus*	1	1		1		1	1	1			BCD	M/C	S5B
Solitary Sandpiper	*Tringa solitaria*	1	1	1	1		1	1	1	1	1	BCDE	M/U	S5B
Spotted Sandpiper	*Actitis macularia*	1	1	1	1		1	1	1			BCDEF	M/C	S5B
Stilt Sandpiper	*Calidris himantopus*	1	1		1		1	1	1			BC	M/C	S5B
Terek Sandpiper	*Xenus cinereus*													SR
Thayer's Gull	*Larus thayeri*													SA
Thick-billed Murre	*Uria lomvia*													SR
Upland Sandpiper	*Bartramia longicauda*		1		1		1	1	1			EF	S3S4B	
Wandering Tattler	*Heteroscelus incanus*													SA
Western Sandpiper	*Calidris mauri*													SA
Whimbrel	*Numenius phaeopus*		1		1		1	1	1	1		BC	M/U	S4B
White-rumped Sandpiper	*Calidris fuscicollis*												M/T	SZN
Willet	*Catoptrophorus semipalmatus*		1				1	1	1			F	M/U	S4B
Wilson's Phalarope	*Phalaropus tricolor*	1	1		1		1	1	1			DEF	M/C	S4S5B
ORDER: COLUMBIFORMES (Doves)														
Band-tailed Pigeon	*Columba fasciata*													SA
Mourning Dove	*Zenaida macroura*				1		1		1	1	1	DEF	M/A	S5B
Passenger Pigeon	*Ectopistes migratorius*													SXB
Rock Dove	*Columba livia*				1	1	1		1			CDEF	RE/A	SE
White-winged Dove	*Zenaida asiatica*													SA
ORDER: CUCULIFORMES (Cuckoos)														
Black-billed Cuckoo	*Coccyzus erythropthalmus*				1		1			1	1	DEF	M/U	S5B
Yellow-billed Cuckoo	*Coccyzus americanus*													SA
ORDER: STRIGIFORMES (Owls)														
Barn Owl	*Tyto alba*													SA

		Treatment					*Primary Habitat*		*General Habitat*			*Notes*		
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Barred Owl	*Strix varia*	1	1	1	1		1				1	DEF	RE/U	S3S4B
Boreal Owl	*Aegolius funereus*				1		1				1	BCDE	RE/U	S5B
Burrowing Owl	*Athene cunicularia*						1		1			F	M/R	S1B
Eastern Screech Owl	*Otus asio*				1	1	1		1	1	1	DEF	RE/R	S4B
Great Gray Owl	*Strix nebulosa*				1		1		1	1	1	BCDE	RE/U	S4B
Great-horned Owl	*Bubo virginianus*				1	1	1		1	1	1	BCDEF	RE/C	S5B
Long-eared Owl	*Asio otus*				1		1			1	1	DEF	RE/U	S4B
Northern Hawk Owl	*Surnia ulula*				1		1		1	1	1	BCDE	RE/U	S5B
Northern Saw-whet Owl	*Aegolius acadicus*				1		1			1	1	DEF	RE/U	S4B
Short-eared Owl	*Asio flammeus*		1		1		1		1	1		BCDEF	M/U	S3S4B
Snowy Owl	*Nyctea scandiaca*				1		1		1	1		BC	RE/U	S4B
ORDER: CAPRIMULGIFORMES (Goat Suckers)														
Common Nighthawk	*Chordeiles minor*				1	1	1		1			BCDEF	M/C	S5B
Common Poorwill	*Phalaenoptilus nuttallii*													SR
Whip-poor-will	*Caprimulgus vociferus*				1		1		1	1	1	DEF	M/U	S5B
ORDER: APODIFORMES (Swifts and Hummingbirds)														
Chimney Swift	*Chaetura pelagica*				1	1	1		1	1	1	DEF	M/U	S4S5B
Ruby-throated Hummingbird	*Archilochus colubris*				1	1	1		1	1	1	DEF	M/C	S5B
Rufous Hummingbird	*Selasphorus rufus*													SA
ORDER: CORACIIFORMES (Kingfishers)														
Belted Kingfisher	*Ceryle alcyon*	1	1	1	1		1	1	1	1	1	BCDEF	M/C	S5B
ORDER: PICIFORMES (Woodpeckers)														
Black-backed Woodpecker	*Picoides arctus*				1		1				1	BCDE	RE/U	S5B
Downy Woodpecker	*Picoides pubescens*				1		1			1	1	DEF	RE/C	S5B
Hairy Woodpecker	*Picoides villosus*				1		1			1	1	BCDEF	RE/C	S5B
Northern Flicker	*Colaptes auratus*				1		1		1	1	1	BCDEF	M/A	S5B
Pileated Woodpecker	*Dryocopus pileatus*				1		1				1	DEF	RE/U	S5B
Red-bellied Woodpecker	*Melanerpes carolinus*													SRB
Red-breasted Sapsucker	*Sphyrapicus ruber*													SR

		Treatment					*Primary Habitat*		*General Habitat*			*Notes*		
		Riparian Specialist	Waterbody	Watercourse	Boreal Wilderness Area	Other	Terrestrial	Aquatic	Grass	Shrub	Tree	Range/ Ecozone	Residence & Abundance	Conservation Status
Red-headed Woodpecker	*Melanerpes erythrocephalus*				1		1			1	1	DEF	M/U	S4B
Three-toed Woodpecker	*Picoides tridactylus*				1		1				1	BCDE	RE/U	S5B
Yellow-bellied Sapsucker	*Sphyrapicus varius*				1		1			1	1	DEF	M/C	S5B
ORDER: PASSERIFORMES (Perching Birds)														
Acadian Flycatcher	*Empidonax virescens*													SR
Alder Flycatcher	*Empidonax alnorum*	1	1	1	1		1	1	1	1	1	BCDEF	M/C	S5B
American Crow	*Corvus brachyrhynchos*		1	1	1	1	1		1	1	1	BCDEF	RE/A	S5B
American Goldfinch	*Carduelis tristis*			1	1		1		1	1	1	DEF	M/A	S5B
American Pipit	*Anthus rubescens*	1	1	1	1		1	1	1			BC	M/U	S5B
American Redstart	*Setophaga ruticilla*				1		1			1	1	DEF	M/C	S5B
American Robin	*Turdus migratorius*				1		1		1	1	1	BCDEF	M/A	S5B
American Tree Sparrow	*Spizella arborea*		1	1	1		1		1	1		BC	M/C	S5B
Baird's Sparrow	*Ammodramus bairdii*						1		1	1		F	M/R	S2S3B
Bank Swallow	*Riparia riparia*	1	1	1	1		1	1	1	1		BCDEF	M/C	S5B
Barn Swallow	*Hirundo rustica*	1	1	1	1	1	1	1	1	1		BCDEF	M/A	S5B
Bay-breasted Warbler	*Dendroica castanea*				1		1			1	1	DE	M/U	S4S5B
Bendire's Thrasher	*Toxostoma bendirei*													SR
Black-and-white Warbler	*Mniotilta varia*			1	1		1			1	1	DEF	M/C	S5B
Black-billed Magpie	*Pica pica*				1	1	1		1	1	1	DEF	RE/C	S5B
Black-capped Chickadee	*Parus atricapillus*		1	1	1	1	1		1	1	1	DEF	RE/C	S5B
Black-headed Grosbeak	*Pheucticus melanocephalus*													SA
Black-throated Blue Warbler	*Dendroica caerulescens*													SA
Black-throated Green Warbler	*Dendroica virens*				1		1			1	1	DE	M/U	S4S5B
Blackburnian Warbler	*Dendroica fusca*				1		1			1	1	DEF	M/C	S4S5B
Blackpoll Warbler	*Dendroica striata*			1	1		1		1	1		BCD	M/C	S5B
Blue Grosbeak	*Guiraca caerulea*													SR
Blue Jay	*Cyanocitta cristata*				1	1	1			1	1	DEF	RE/C	S5B
Blue-gray Gnatcatcher	*Polioptila caerulea*													SA
Blue-winged Warbler	*Vermivora pinus*													SA
Bobolink	*Dolichonyx oryzivorus*		1				1		1			EF	M/U	S4B

		Treatment					*Primary Habitat*		*General Habitat*			*Notes*		
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Bohemian Waxwing	*Bombycilla garrulus*				1		1			1	1	BCD	RE/C	S5B
Boreal Chickadee	*Parus hudsonicus*				1		1				1	BCDEF	RE/C	S5B
Brambling	*Fringilla montifringilla*													SA
Brewer's Blackbird	*Euphagus cyanocephalus*			1	1		1		1	1		DEF	M/C	S5B
Brewer's Sparrow	*Spizella breweri*													SA
Brown Creeper	*Certhia americana*				1		1			1	1	DEF	M/U	S5B
Brown Thrasher	*Toxostoma rufum*				1		1		1	1	1	DEF	M/U	S5B
Brown-headed Cowbird	*Molothrus ater*				1	1	1		1	1		DEF	M/C	S5B
Canada Warbler	*Wilsonia canadensis*		1	1	1		1			1	1	DEF	M/U	S4B
Cape May Warbler	*Dendroica tigrina*				1		1			1	1	DE	M/U	S5B
Carolina Wren	*Thryothorus ludovicianus*													SA
Cassin's Finch	*Carpodacus cassinii*													SR
Cedar Waxwing	*Bombycilla cedrorum*		1	1	1	1	1		1	1	1	DEF	RE/C	S5B
Cerulean Warbler	*Dendroica cerulea*													SA
Chestnut-collared Longspur	*Calcarius ornatus*						1		1			F	M/C	S3S4B
Chestnut-sided Warbler	*Dendroica pensylvanica*				1		1			1	1	DEF	M/C	S5B
Chipping Sparrow	*Spizella passerina*				1		1		1	1	1	BCDEF	M/A	S5B
Clark's Nutcracker	*Nucifraga columbiana*													SA
Clay-colored Sparrow	*Spizella pallida*		1	1	1		1		1	1		DEF	M/A	S5B
Cliff Swallow	*Hirundo pyrrhonota*	1	1	1	1	1	1	1	1	1		BCDEF	M/C	S5B
Common Grackle	*Quiscalus quiscula*		1	1	1		1		1	1	1	CDEF	M/A	S5B
Common Raven	*Corvus corax*		1	1	1	1	1		1	1	1	BCDE	RE/C	S5B
Common Redpoll	*Carduelis flammea*				1		1		1	1	1	BCD	RE/C	S5B
Common Yellowthroat	*Geothlypis trichas*	1	1	1	1		1	1	1	1		DEF	M/C	S5B
Connecticut Warbler	*Oporarnis agilis*				1		1			1	1	DE	M/U	S5B
Dark-eyed Junco	*Junco hyemalis*				1		1			1	1	BCDEF	M/A	S5B
Dickcissel	*Spiza americana*													SA
Eastern Bluebird	*Sialia sialis*				1	1	1		1	1		DEF	M/U	S5B
Eastern Kingbird	*Tyrannus tyrannus*				1		1		1	1	1	DEF	M/A	S5B
Eastern Meadowlark	*Sturnella magna*													SA
Eastern Phoebe	*Sayornis phoebe*	1	1	1	1	1	1			1	1	BDEF	M/C	S5B

		Treatment					*Primary Habitat*		*General Habitat*				*Notes*		
		Riparian Specialist	Waterbody	Watercourse	Boreal Wilderness Area	Other	Terrestrial	Aquatic	Grass	Shrub	Tree	Range/ Ecozone	Residence & Abundance	Conservation Status
Eastern Towhee	*Pipilo erythrophthalmus*						1		1	1	1	F	M/R	S2S3B
Eastern Wood-pewee	*Contopus virens*				1		1			1	1	DEF	M/U	S5B
Eurasian Tree Sparrow	*Passer montanus*					1	1		1	1	1	F	M/R	SE
European Starling	*Sturnus vulgaris*		1		1	1	1		1	1	1	BCDEF	RE/C	SE
Evening Grosbeak	*Coccothraustes vespertinus*				1		1			1	1	DE	RE/C	S5B
Field Sparrow	*Spizella pusilla*													SA
Fox Sparrow	*Passerella iliaca*			1	1		1		1	1	1	BCD	M/C	S5B
Golden-crowned Kinglet	*Regulus satrapa*				1		1			1	1	CDE	M/U	S5B
Golden-crowned Sparrow	*Zonotrichia atricapilla*													SA
Golden-winged Warbler	*Vermivora chrysoptera*			1	1		1		1	1	1	DF	M/R	S3B
Grasshopper Sparrow	*Ammodramus savannarum*						1		1			F	M/R	S2S3B
Gray Catbird	*Dumetella carolinensis*		1	1	1		1		1	1	1	DEF	M/C	S5B
Gray Jay	*Perisoreus canadensis*				1		1				1	BCDEF	RE/C	S5B
Gray-cheeked Thrush	*Catharus minimus*				1		1			1	1	BC	M/C	S5B
Gray-crowned Rosy-finch	*Leucosticte lephrocotis*													SA
Great Crested Flycatcher	*Myiarchus crinitus*				1		1			1	1	DEF	M/C	S5B
Green-tailed Towhee	*Pipilo chlorurus*													SA
Harris's Sparrow	*Zonotrichia querula*				1		1		1	1	1	BC	M/C	S5B
Henslow's Sparrow	*Ammodramus henslowii*													SR
Hermit Thrush	*Catharus guttatus*				1		1			1	1	BCDEF	M/C	S5B
Hoary Redpoll	*Carduelis hornemanni*				1		1		1	1	1	BC	RE/U	S5B
Hooded Warbler	*Wilsonia citrina*													SA
Horned Lark	*Eremophila alpestris*				1		1		1			BCDEF	M/A	S5B
House Finch	*Carpodacus mexicanus*					1	1		1	1	1	F	RE/U	S5B
House Sparrow	*Passer domesticus*					1	1		1	1	1	BCDEF	RE/A	SE
House Wren	*Troglodytes aedon*				1	1	1		1	1	1	DEF	M/C	S5B
Indigo Bunting	*Passerian cyanea*		1	1	1		1		1	1	1	DEF	M/U	S4B
Kentucy Warbler	*Oporornis formosus*													SA
Lapland Longspur	*Calcarius lapponicus*		1		1		1		1	1		BC	M/A	S5B
Lark Bunting	*Calamospiza melanocorys*						1		1			F	M/R	S2S3B
Lark Sparrow	*Chondestes grammacus*						1		1	1	1	F	M/U	S4B

		Treatment					*Primary Habitat*		*General Habitat*			*Notes*		
		Riparian Specialist	Waterbody	Watercourse	Boreal Wilderness Area	Other	Terrestrial	Aquatic	Grass	Shrub	Tree	Range/ Ecozone	Residence & Abundance	Conservation Status
Lazuli Bunting	*Passerian amoena*													SA
Least Flycatcher	*Empidonax minimus*				1		1			1	1	BCDEF	M/A	S5B
LeConte's Sparrow	*Ammodramus leconteii*	1	1	1	1		1	1	1	1		BDEF	M/C	S4B
Lincoln's Sparrow	*Melospiza lincolnii*	1	1	1	1		1	1	1	1		BCDE	M/C	S5B
Loggerhead Shrike	*Lanius ludocicianus*				1		1		1	1	1	DEF	M/R	S2S3B
MacGillivray's Warbler	*Oporornis tolmiei*													SR
Magnolia Warbler	*Dendroica magnolia*				1		1			1	1	DEF	M/C	S5B
Marsh Wren	*Cistothorus palustris*	1	1		1		1	1	1			DEF	M/C	S5B
McCown's Longspur	*Calcarius mccownii*													SA
Mountain Bluebird	*Sialia currucoides*				1	1	1		1	1	1	BEF	M/C	S5B
Mourning Warbler	*Oporornis philadelphia*		1		1		1		1	1	1	DEF	M/C	S5B
N. Rough-winged Swallow	*Stelgidopteryx serripennis*	1	1	1			1	1	1	1		EF	M/U	S5B
Nashville Warbler	*Vermivora ruficapilla*				1		1			1	1	DEF	M/C	S5B
Northern Cardinal	*Cardinalis cardinalis*													SA
Northern Mockingbird	*Mimus polyglottos*													SA
Northern Oriole	*Icterus galbula*			1	1		1		1	1	1	DEF	M/C	S5B
Northern Parula	*Parula americana*			1	1		1			1	1	D	M/U	S3B
Northern Shrike	*Lanius excubitor*				1		1			1	1	BC	M/U	S5B
Northern Waterthrush	*Seiurus noveboracensis*	1	1	1	1		1	1	1	1		BCDEF	M/C	S5B
Northern Wheatear	*Oenanthe oenanthe*													SA
Olive-sided Flycatcher	*Contopus borealis*		1	1	1		1			1	1	BCDE	M/U	S5B
Orange-crowned Warbler	*Vermivora celata*				1		1			1	1	BCDEF	M/C	S5B
Orchard Oriole	*Icterus spurius*						1		1	1	1	F	M/U	S5B
Ovenbird	*Seiurus aurocapillus*				1		1				1	DEF	M/C	S5B
Palm Warbler	*Dendroica palmarum*		1		1		1		1	1		BCDE	M/C	S5B
Phainopepla	*Phainopepla nitens*													SR
Philadelphia Vireo	*Vireo philadelphicus*			1	1		1			1	1	DEF	M/U	S4B
Pine Grosbeak	*Pinicola enucleator*				1		1			1	1	BCDE	RE/U	S5B
Pine Siskin	*Carduelis pinus*				1		1			1	1	DEF	M/C	S5B
Pine Warbler	*Dendroica pinus*				1		1				1	D	M/R	S2S3B
Prairie Warbler	*Dendroica discolor*													SA

		Treatment					*Primary Habitat*		*General Habitat*			*Notes*		
		Riparian Specialist	Waterbody	Watercourse	Boreal Wilderness Area	Other	Terrestrial	Aquatic	Grass	Shrub	Tree	Range/ Ecozone	Residence & Abundance	Conservation Status
Purple Finch	*Carpodacus purpureus*				1		1		1	1	1	DEF	M/C	S5B
Purple Martin	*Progne subis*				1	1	1		1	1	1	DEF	M/C	S5B
Pygmy Nuthatch	*Sitta pygmaea*													SR
Red Crossbill	*Loxia curvirostra*				1		1				1	DE	RE/U	S5B
Red-breasted Nuthatch	*Sitta canadensis*				1		1			1	1	DEF	RE/C	S5B
Red-eyed Vireo	*Vireo olivaceus*		1	1	1		1			1	1	DEF	M/A	S5B
Red-winged Blackbird	*Agelaius phoeniceus*	1	1	1	1		1	1	1	1	1	BCDEF	M/A	S5B
Rock Wren	*Salpinctes obsoletus*													SRB
Rose-breasted Grosbeak	*Pheucticus ludovicianus*		1	1	1		1			1	1	DEF	M/C	S4B
Ruby-crowned Kinglet	*Regulus calendula*			1	1		1			1	1	BCDE	M/C	S5B
Rusty Blackbird	*Euphagus carolinus*	1	1	1	1		1	1	1	1	1	BCDE	M/C	S5B
Sage Thrasher	*Oreoscoptes montanus*													SA
Savannah Sparrow	*Passerculus sandwichensis*		1	1	1		1		1	1		BCEDF	M/A	S5B
Say's Phoebe	*Sayornis saya*					1	1		1	1		F	M/R	S3B
Scarlet Tanager	*Piranga olivacea*				1		1				1	D	M/U	S4B
Scissor-tailed Flycatcher	*Tyrannus forficatus*													SA
Sedge Wren	*Cistothorus platensis*	1	1	1	1		1	1	1	1		DEF	M/C	S5B
Sharp-tailed Sparrow	*Ammodramus caudacutus*	1	1	1	1		1	1	1			DEF	M/U	S5B
Smith's Longspur	*Calcarius pictus*				1		1		1			BC	M/U	S4S5B
Snow Bunting	*Plectrophenax nivalis*												M/T	SRB
Solitary Vireo	*Vireo solitarius*				1		1			1	1	DEF	M/U	S5B
Song Sparrow	*Melospiza melodia*		1	1	1		1		1	1		BCDEF	M/A	S5B
Spotted Towhee	*Pipilo maculatus*						1		1	1	1	F	M/U	S3S4B
Sprague's Pipit	*Anthus spragueii*						1		1			EF	M/U	S3S4B
Steller's Jay	*Cyanocitta stelleri*													SR
Summer Tanager	*Piranga rubra*													SA
Swainson's Thrush	*Catharus ustulatus*				1		1			1	1	BCDEF	M/C	S5B
Swamp Sparrow	*Melospiza georgiana*	1	1	1	1		1	1	1	1		BCDEF	M/C	S5B
Tennessee Warbler	*Vermivora peregrina*		1	1	1		1			1	1	BCDEF	M/C	S5B
Townsend's Solitaire	*Myadestes townsendi*													SA
Tree Swallow	*Tachycineta bicolor*	1	1	1	1	1	1	1	1	1	1	BCDEF	M/A	S5B

		Treatment					*Primary Habitat*		*General Habitat*				*Notes*		
		Riparian Specialist	Waterbody	Watercourse	Boreal Wilderness Area	Other	Terrestrial	Aquatic	Grass	Shrub	Tree	Range/ Ecozone	Residence & Abundance	Conservation Status
Varied Thrush	*Ixoreus naevius*													SRB
Veery	*Catharus fuscescens*		1	1	1		1			1	1	DEF	M/C	S4B
Vesper Sparrow	*Pooecetes gramineus*				1		1		1	1		DEF	M/A	S5B
Violet-green Swallow	*Tachycineta thalassina*													SA
Warbling Vireo	*Vireo gilvus*			1	1		1			1	1	DEF	M/C	S5B
Western Kingbird	*Tyrannus verticalis*						1		1	1	1	EF	M/C	S5B
Western Meadowlark	*Sturnella neglecta*				1		1		1			DEF	M/C	S4S5B
Western Scrub Jay	*Aphelocoma californica*													SA
Western Tanager	*Piranga ludoviciana*													SA
Western Wood-pewee	*Contopus sordidulus*			1	1		1			1	1	EF	M/U	S4B
White-breasted Nuthatch	*Sitta carolinensis*				1		1			1	1	DEF	RE/C	S5B
White-crowned Sparrow	*Zonotrichia leucophrys*			1	1		1			1	1	BCD	M/C	S5B
White-eyed Vireo	*Vireo griseus*													SA
White-throated Sparrow	*Zonotrichia albicollis*				1		1			1	1	BCDEF	M/A	S5B
White-winged Crossbill	*Loxia leucoptera*			1	1		1			1	1	BDE	RE/U	S5B
Willow Flycatcher	*Empidonax traillii*	1	1	1			1	1	1	1		F	M/R	S3B
Wilson's Warbler	*Wilsonia pusilla*	1	1	1	1		1	1	1	1		BCDE	M/U	S5B
Winter Wren	*Troglodytes troglodytes*		1	1	1		1			1	1	CDE	M/U	S5B
Wood Thrush	*Hylocicla mustelina*													SA
Yellow Warbler	*Dendroica petechia*	1	1	1	1		1	1	1	1	1	BCDEF	M/A	S5B
Yellow-bellied Flycatcher	*Empidonax flaviventris*				1		1			1	1	BCD	M/U	S5B
Yellow-breasted Chat	*Icteria virens*													SRB
Yellow-headed Blackbird	*Xanthocephalus xanthocephalu*	1	1	1	1		1	1	1			DEF	M/C	S5B
Yellow-rumped Warbler	*Dendroica coronata*				1		1			1	1	BCDEF	M/A	S5B
Yellow-throated Vireo	*Vireo flavifrons*						1		1	1	1	EF	M/U	S3S4B
Yellow-throated Warbler	*Dendroica dominica*													SA
TOTAL: 283 Species of Birds		106	143	110	211	30	256	112	177	160	150			

(Total does not include Accidental, Reported or Extirpated species)

MAMMALS

		Treatment					*Primary Habitat*		*General Habitat*			*Notes*		
		Riparian Specialist	Waterbody	Watercourse	Boreal Wilderness Area	Other	Terrestrial	Aquatic	Grass	Shrub	Tree	Range/ Ecozone	Residence & Abundance	Conservation Status
ORDER: INSECTIVORA (Insectivores)														
American Water Shrew	*Sorex palustris*	1	1	1	1		1	1	1			BCDEF	RE/U	S5
Arctic Shrew	*Sorex arcticus*		1	1	1		1		1	1		BCDEF	RE/C	S5
Dusky Shrew	*Sorex obscurus*		1	1			1		1	1	1	F	RE/U	S3
Hayden's Shrew	*Sorex haydeni*						1		1	1	1	EF	RE/C	S4
Masked Shrew	*Sorex cinereus*				1		1		1	1	1	BCDEF	RE/C	S5
Pygmy Shrew	*Microsorex hoyi*				1		1		1	1	1	BCDEF	RE/C	S5
Short-tailed Shrew	*Blarina brevicauda*				1		1				1	DEF	RE/C	S5
Star-nosed Mole	*Condylura cristata*	1	1	1	1	1	1	1	1			DEF	RE/C	S3
ORDER: CHIROPTERA (Bats)														
Big Brown Bat	*Eptesicus fuscus*		1	1	1	1	1		1	1	1	DEF	RE/C	SRNS4S5B
Hoary Bat	*Lasiurus cinereus*		1	1	1		1				1	DEF	M/U	S3BSZN
Keen's Bat	*Myotis keenii*			1	1		1				1	DEF	M/U	S3S4NS4B
Little Brown Bat	*Myotis lucifugus*		1	1	1	1	1				1	DEF	RE/C	S2NS5B
Red Bat	*Lasiurus borealis*				1	1	1				1	DEF	M/U	S3BSZN
Silver-haired Bat	*Lasionycteris noctivagans*	1	1	1	1		1	1	1	1	1	DEF	M/C	S3S4BSZN
ORDER: LAGOMORPHA (Hares and Rabbits)														
Arctic Hare	*Lepus arcticus*				1		1		1	1		BC	RE/C	S5
Eastern Cottontail	*Sylvilagus floridanus*					1	1		1	1		EF	RE/C	S5
Snowshoe Hare	*Lepus americanus*				1		1			1	1	BCDEF	RE/C	S5
White-tailed Jack Rabbit	*Lepus townsendii*						1		1	1		EF	RE/U	S4
ORDER: RODENTIA (Rodents)														
Arctic Ground Squirrel	*Spermophilus parryii*		1	1	1		1		1	1		BC	RE/U	S3
American Beaver	*Castor canadensis*	1	1	1	1		1	1	1	1	1	BCDEF	RE/A	S5
American Porcupine	*Erethizon dorsatum*				1		1		1	1	1	BCDEF	RE/C	S5
American Red Squirrel	*Tamiasciurus hudsonicus*				1		1			1	1	BCDEF	RE/A	S5
Brown lemming	*Lemmus sibiricus*													SH
Chestnut-cheeked Vole	*M. xanthognathus*													SH
Collared Lemming	*Dicrostonyx torquatus*				1		1		1	1		B	RE/R	S3

MAMMALS
ORDER: INSECTIVORA (Insectivores)

		Treatment					*Primary Habitat*		*General Habitat*			*Notes*		
		Riparian Specialist	Waterbody	Watercourse	Boreal Wilderness Area	Other	Terrestrial	Aquatic	Grass	Shrub	Tree	Range/ Ecozone	Residence & Abundance	Conservation Status
Deer Mouse	*Peromyscus maniculatus*				1		1		1	1	1	CDEF	RE/A	S5
Eastern Chipmunk	*Tamias striatus*				1		1		1	1	1	DEF	RE/C	S5
Fox Squirrel	*Sciurus niger*					1	1		1	1	1	F	RE/R	S3
Franklin's Ground Squirrel	*Spermophilus franklinii*				1		1			1	1	DEF	RE/U	S5
Gapper's Red-backed Vole	*Clethrionomys gapperi*		1	1	1		1			1	1	BCDEF	RE/A	S5
Gray or Black Squirrel	*Sciurus carolinensis*					1	1		1	1	1	DEF	RE/C	S5
Heather Vole	*Phenacomys intermedius*		1		1		1		1	1	1	BCDEF	RE/C	S5
House Mouse	*Mus domesticus*					1	1		1	1		DEF	RE/C	SE5
Least Chipmunk	*Eutamias minimus*				1		1		1	1	1	BCDEF	RE/C	S5
Meadow Jumping Mouse	*Zapus hudsonius*		1	1	1		1		1	1		CDEF	RE/C	S5
Meadow Vole	*Microtus pennsylvanicus*		1		1		1		1	1		BCDEF	RE/A	S5
Muskrat	*Ondatra zibethicus*	1	1	1	1		1	1	1			BCDEF	RE/A	S5
Northern Bog Lemming	*Synaptomys borealis*		1	1	1		1		1	1	1	BCDE	RE/C	S5
Northern Flying Squirrel	*Glaucomys sabrinus*				1		1				1	BCDEF	RE/U	S5
Northern Grasshopper Mouse	*Onychomys leucogaster*						1		1			F	RE/U	S3
Northern Pocket Gopher	*Thomomys talpoides*		1	1			1		1			EF	RE/C	S5
Northern Red-backed Vole	*Clethrionomys rutilus*				1		1			1	1	B	RE/U	S3
Norway Rat	*Rattus norvegicus*				1	1	1		1	1		DEF	RE/U	SE5
Olive-backed Pocket Mouse	*Perognathus fasciatus*						1		1	1		F	RE/U	S3
Plains Pocket Gopher	*Geomys bursarius*						1		1			F	RE/R	S3
Prairie Vole	*Microtus ochrogaster*						1		1	1		F	RE/U	S3
Richardson's Ground Squirrel	*Spermophilus richardsonii*					1	1		1			EF	RE/U	S5
Southern Bog Lemming	*Synaptomys cooperi*		1	1	1		1		1	1	1	D	RE/U	S3
Thirteen-lined Ground Squirrel	*Spermophilus tridecemlineatus*						1		1	1	1	EF	RE/C	S5
Western Jumping Mouse	*Zapus princeps*		1	1			1		1	1		F	RE/U	S3
Woodchuck	*Marmota monax*				1		1		1	1	1	CDEF	RE/C	S5
Woodland Jumping Mouse	*Napaeozapus insignis*		1	1	1		1			1	1	D	RE/R	S2

ORDER: CARNIVORA (Carnivores)

American Badger	*Taxidea taxus*						1		1	1		F	RE/C	S4
American Black Bear	*Ursus americanus*		1	1	1		1			1	1	BCDEF	RE/C	S5

MAMMALS
ORDER: INSECTIVORA (Insectivores)

		Treatment					*Primary Habitat*		*General Habitat*			*Notes*		
		Riparian Specialist	Waterbody	Watercourse	Boreal Wilderness Area	Other	Terrestrial	Aquatic	Grass	Shrub	Tree	Range/ Ecozone	Residence & Abundance	Conservation Status
American Mink	*Mustela vison*	1	1	1	1		1	1	1	1		BCDEF	RE/A	S5
American Pine Marten	*Martes americana*				1		1				1	BCDE	RE/C	S5
Arctic Fox	*Alopex lagopus*		1		1		1		1	1		BC	RE/C	S5
Bobcat	*Lynx rufus*				1		1		1	1	1	DEF	RE/R	S3
Coyote	*Canis latrans*				1		1		1	1	1	BCD	RE/C	S5
Ermine	*Mustela erminea*		1	1	1		1		1	1	1	BCDEF	RE/C	S5
Fisher	*Martes pennanti*	1	1	1	1		1	1		1	1	BCDE	RE/U	S5
Grey Fox	*Urocyon cinereoargenteus*													SA
Grizzly Bear	*Ursus arctos*													SX
Least Weasel	*Mustela nivalis*		1	1	1		1		1	1	1	BCDEF	RE/C	S5
Long-tailed Weasel	*Mustela frenata*		1	1			1		1	1		F	RE/U	S5
Lynx	*Lynx lynx*				1		1				1	BCDE	RE/C	S5
Mountain Lion	*Felis concolor*				1		1				1	DEF	RE/R	S2
Polar Bear	*Ursus maritimus*	1	1		1		1	1	1	1	1	BC	M/C	S4
Raccoon	*Procyon lotor*		1	1	1		1			1	1	DEF	RE/C	S5
Red Fox	*Vulpes vulpes*		1	1	1		1		1	1	1	BCDEF	RE/A	S5
River Otter	*Lontra canadensis*	1	1	1	1		1	1	1			BCDEF	RE/U	S5
Striped Skunk	*Mephitis mephitis*		1	1	1		1		1	1	1	CDEF	RE/A	S5
Swift Fox	*Vulpes velox*													SX
Timber Wolf	*Canis lupus*				1		1		1	1	1	BCDEF	RE/U	S4
Wolverine	*Gulo gulo*				1		1		1	1	1	BCDE	RE/R	S4

ORDER: ARTIODACTYLA (Cloven-hoofed Mammals)

American Bison	*Bison bison*													SXS1
American Elk	*Cervus elaphus*				1		1		1	1	1	DEF	RE/U	S3S4
Moose	*Alces alces andersoni*	1	1	1	1		1	1	1	1	1	BCDE	RE/C	S5
Mule Deer	*Odocoileus hemionus*						1		1	1		EF	RE/R	S2S3
Muskox	*Ovibos moschatus*													SX
Pronghorn	*Antilocapra americana*													SX
White-tailed Deer	*Odocoileus virginianus*				1		1		1	1	1	DEF	RE/A	S5
Woodland Caribou	*Rangifer tarandus caribou*				1		1		1	1	1	BCDE	M/U	S4

ORDER: CETACEA (Whales, Dolphins and Porpoises)		*Treatment*					*Primary Habitat*		*General Habitat*			*Notes*		
		Riparian Specialist	Waterbody	Watercourse	Boreal Wilderness Area	Other	Terrestrial	Aquatic	Grass	Shrub	Tree	Range/ Ecozone	Residence & Abundance	Conservation Status
Bowhead Whale	*Balaena mysticetus*	1	1					1				BC	M/R	S1
White Whale (Beluga)	*Delphinapterus leucas*	1	1	1				1				BC	M/U	S2
ORDER: PINNIPEDIA (Seals, Sea Lions and Walrus)														
Bearded Seal	*Erignathus barbatus*	1	1				1	1				BC	M/U	S2S3
Harbour Seal	*Phoca vitulina*	1	1				1	1				BC	M/U	S2S3
Ringed Seal	*Phoca hispida*	1	1				1	1				BC	M/C	S5
Walrus	*Odobenus rosmarus*													SR
TOTAL: 80 Species of Mammals		15	38	31	57	10	78	15	57	58	49			

(Total does not include Accidental, Reported or Extirpated species)

TOTAL: 387 TERRESTRIAL VERTEBRATES WHICH MAY OCCUR WITHIN MANITOBA RIPARIAN HABITATS

LEGEND

RIPARIAN SPECIALIST - Large majority of life functions include water; water may be necessary for survival.

WATERBODY - Majority of life functions occur near waterbodies.

WATERCOURSE - Majority of life functions occr near watercourses.

BOREAL WILDERNESS AREA - Life functions may or may not include water. Primarily occurs in boreal forest.

OTHER - Habitat rarely includes water (e.g., desert, urban)

TERRESTRIAL - The majority, or at least many of the species life functions occur on land.

AQUATIC - The majority, or at least many of the species life functions occur over, or in water.

GRASS - The majority, or at least many of the species life functions occur in grasslands.

SHRUB - The majority, or at least many of the species life functions occur in shrublands.

TREE - The majority, or at least many of the species life functions occur in forests.

RANGE/ECOZONE - Refer to map. Primary reference to breeding range.

RESIDENCE & ABUNDANCE - where 'RE' is Resident or a species which remains year-round;

where 'M' is Migrant or a species which can be seen only during brief periods in spring, summer and/or fall. It may or may not breed here.

where 'T' is Transient or a species passing through or by a place with only a brief stay.

where 'A' is Abundant - can be observed on all visits in preferred habitat during the proper season, usually in large numbers

where 'C' is Common - can be observed on most visits in preferred habitat during the proper season; numbers vary considerably.

where 'U' is Uncommon - infrequently observed in preferred habitat, usually in low numbers.

where 'R' is Rare - seldom observed but can be expected to occur annually.

where 'O' is Occasional - seven or more confirmed sightings since 1945, but not seen every year; or, out-of-season occurrences of regular species.

CONSERVATION STATUS –-

S1 – Critically Imperiled: Typically five or fewer occurrences in Manitoba or very few remaining individuals; especially vulerable to extirpation.

S2 – Imperiled: Typicaly six to 20 occurrences in Manitoba or very few remaining individuals; susceptible to extirpation.

S3 – Vulnerable: Usually between 20 and 100 occurrences in Manitoba; may have fewer occurrences, but with a larger number of individuals in some populations; may be susceptible to large-scale disturbances.

S4 – Apparently Secure: Widespread, abundant, and apparently secure in Manitoba, but is of long-term concern; usually more than 100 occurrences; usually not susceptible to immediate threats.

S5 – Secure: Widespread, abundant, and demonstrably secure in Manitoba, and essentially ineradicable under present conditions.

S#S# Numeric range rank: Denotes range or uncertainty about the exact status of the species.

SH – Historical: Species occurred historically throughout its range in Manitoba, perhaps having not been verified in the past 20 years, and suspected to be still extant.

SX – Extinct/Extirpated: Element is believed to be globally extinct or extirpated within the country/subnation.

SA – Accidental: Accidental or casual in the country (i.e., infrequent and far outside usual range). A few of these species may even have bred on the one or two occasions they were recorded.

SE – Exotic: An exotic established in the country/subnation (e.g., house sparrow in MB); may be native in nearby regions.

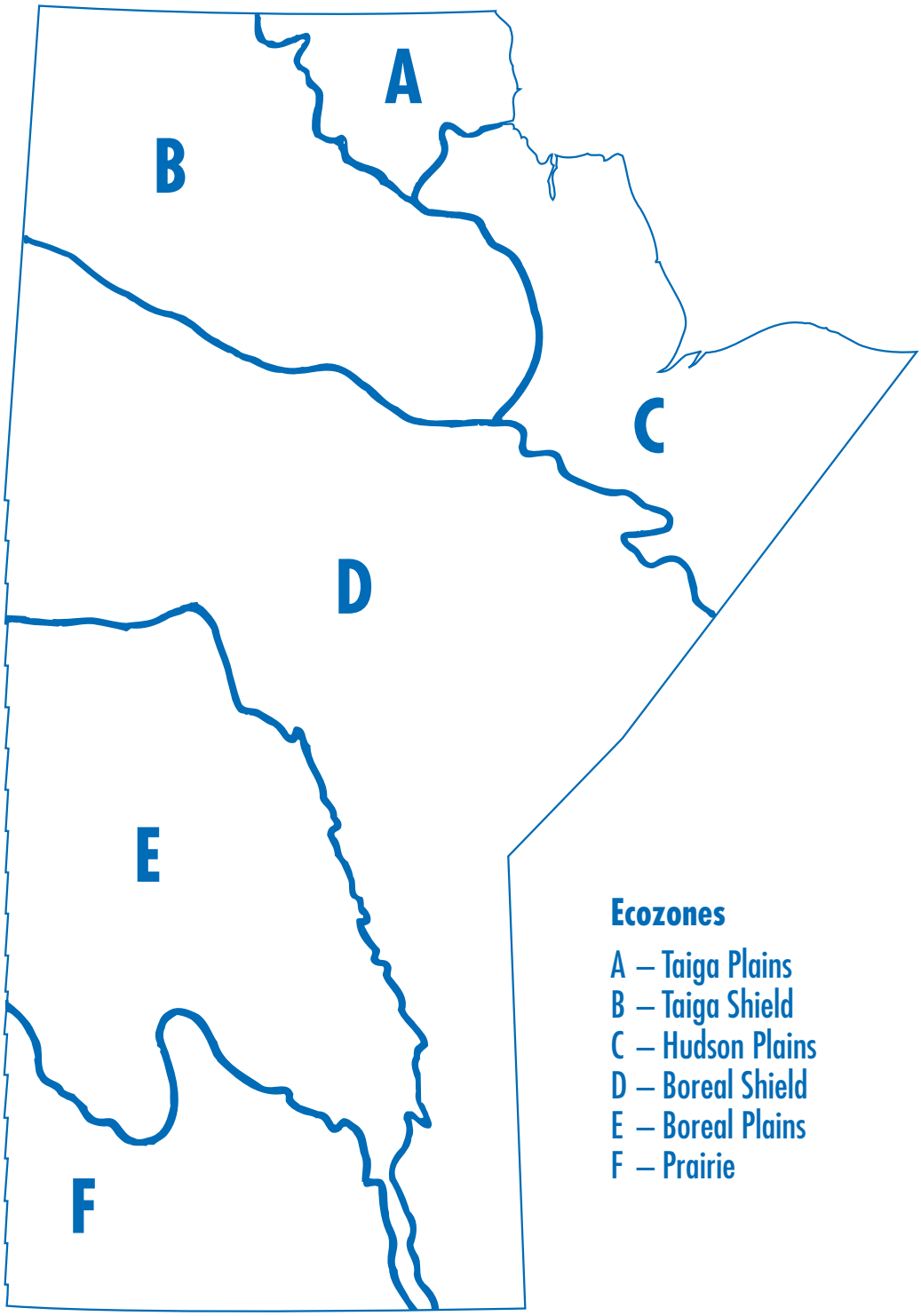
SP – Potential: Potential that element occurs in the country, but no occurrences reported.

SR – Reported: Element reported in the country/subnation but without persuasive documentation which would provide a basis for either accepting or rejecting the report.

SZ – Zero Occurrences: Not of practical conservation concern in the country/subnation, because there are no definable occurrences, although the taxon is native and appears regularly in the country. An SZ rank will generally be used for long distance migrants whose occurrences during their migrations are too irregular or transitory.

B – BREEDING: Basic rank refers to the breeding population of the element in the province.

N – NON-BREEDING: basic rank refers to the non-breeding population of the element in the province.



Ecozones

A – Taiga Plains
B – Taiga Shield
C – Hudson Plains
D – Boreal Shield
E – Boreal Plains
F – Prairie

Appendix B

Appendix B

ROSGEN'S STREAM TYPING

Table 1 Key to Rosgen's Stream Typing

	Bedrock	Boulders	Cobble	Gravel	Sand	Silt/Clay
A High Relief	1	2	3	4	5	6
B Moderate relief	1	2	3	4	5	6
C Broad valleys with terraces	1	2	3	4	5	6
D Broad valleys with alluvial fans	1	2	3	4	5	6
E Broad valley/meadows	1	2	3	4	5	6
F Gentle gradient	1	2	3	4	5	6
G Gulley, moderate slopes, deeply incised	1	2	3	4	5	6

Examples:

A3 = steep gradient slopes with cobble as the dominant bed material

F6 = gently sloping stream with silt/clay as dominant bed material

Note: When using any stream typing or classification system, it is important not to generalize the stream type for the entire length of the stream. For example, a stream may be classified as a C3 stream; i.e., a stream with a flat gradient and course bed material. However, at the point of crossing, the stream may actually be an A3 type, steep gradient with course bed material. A C3 stream type is moderately sensitive to disturbance, wheras an A3 stream type has a very high sensitivity to disturbance. What's important is the stream type at the point of crossing.

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Table 2 - Management interpretations of various stream types (Rosgen 1985).

STREAM TYPE	SENSITIVITY TO DISTURBANCES[1]	RECOVERY POTENTIAL[2]	SEDIMENT SUPPLY[3]	STREAMBANK EROSION POTENTIAL	VEGETATION CONTROLLING INFLUENCES[4]
A1	very low	excellent	very low	very low	negligible
A2	very low	excellent	very low	very low	negligible
A3	very high	very poor	very high	high	negligible
A4	extreme	very poor	very high	very high	negligible
A5	extreme	very poor	very high	very high	negligible
A6	high	poor	high	high	negligible
B1	very low	excellent	very low	very low	negligible
B2	very low	excellent	very low	very low	negligible
B3	low	excellent	low	low	moderate
B4	moderate	excellent	moderate	low	moderate
B5	moderate	excellent	moderate	moderate	moderate
B6	moderate	excellent	moderate	low	moderate
C1	low	very good	very low	low	moderate
C2	low	very good	low	low	moderate
C3	moderate	good	moderate	moderate	very high
C4	very high	good	high	very high	very high
C5	very high	fair	very high	very high	very high
C6	very high	good	high	high	very high
D3	very high	poor	very high	very high	moderate
D4	very high	poor	very high	very high	moderate
D5	very high	poor	very high	very high	moderate
D6	high	poor	high	high	moderate
DA4	moderate	good	very low	low	very high
DA5	moderate	good	low	low	very high
DA6	moderate	good	very low	very low	very high
E3	high	good	low	moderate	very high
E4	very high	good	moderate	high	very high
E5	very high	good	moderate	high	very high
E6	very high	good	low	moderate	very high
F1	low	fair	low	moderate	low
F2	low	fair	moderate	moderate	low
F3	moderate	poor	very high	very high	moderate
F4	extreme	poor	very high	very high	moderate
F5	very high	poor	very high	very high	moderate
F6	very high	fair	high	very high	moderate
G1	low	good	low	low	low
G2	moderate	fair	moderate	moderate	low
G3	very high	poor	very high	very high	high
G4	extreme	very poor	very high	very high	high
G5	extreme	very poor	very high	very high	high
G6	very high	poor	high	high	high

1 Includes increases in streamflow magnitude and timing and/or sediment increases.

2 Assumes natural recovery once cause of instability is corrected.

3 Includes suspended and bedload from channel derived sources and/or from stream adjacent slopes.

4 Vegetation that influences width/depth ratio-stability

Glossary

Alluvial soil (Hansen et al. 1995) - Sediments (clay, silt, gravel, cobbles and boulders) deposited by running water, ordinarily occurring on floodplains and at the base of ridges and slopes.

Basin bogs - these wetland forms develop in basins of essentially closed drainage, receiving their water from precipitation and runoff from the immediate surroundings. They have a flat surface often covering more than 3 m of peat that fills the topographic basin. They are usually treed with black spruce, but treeless shrub basin bogs are also encountered. They are often ringed with tall shrub or coniferous treed swamp margins.

Benthos/benthic (Ontario Ministry of Natural Resources 1994) - Organism living within a stream's substrate.

Biomass (Manitoba Hydro, Glossary, July, 1996) - weight of living material; usually expressed as dry weight per unit area.

Canopy (Ontario Ministry of Natural Resources 1989) - The more or less continuous cover of branches and foliage formed collectively by the crowns of trees.

Collapse scar (Manitoba Hydro, Glossary, July, 1996) - areas that have collapsed as a result of melting permafrost in organic landforms such as peat plateaus. The collapsing edge may form a steep bank. Characteristic are the leaning trees on the banks and submerged or partly submerged dead trees in the collapse area.

Detritus - loose materials (generally from organic particles) that results directly from disintegration.

Domed bogs - are characterized by thick, dome-shaped accumulations of peat in which the groundwater is at a higher elevation than in the surrounding areas. Both the surface and groundwater contours display a concentric pattern. As the center of the domed bog is higher than the edges, surface drainage can develop, radiating from the center. The vegetation of domed bogs is usually dominated by stunted black spruce, ericaceous shrubs, and Sphagnum mosses.

Edge effect (Thomas 1979) - The increased richness of flora and fauna resulting from the mixing of two communities where they join.

Edge (Thomas 1979) -The place where plant communities meet or where successional states or vegetative conditions within plant communities come together.

Edge (Bukowski, pers. comm.) - The interface of standing forest and a forest opening or early successional stage.

Emergent vegetation (Nebraskaland Magazine 1991) - Plants rooted in soil with their lower portions submersed, but with most of their photosynthetic tissues above water, such as cattail or bulrush.

Ephemeral stream (Hansen et al. 1995) - A stream or stretch of a stream that flows only in direct response to precipitation. It receives no water from springs and no long-continued supply from melting snow or other surface source. Its streamchannel is at all times above the water table. These streams do not normally flow for 30 consecutive days.

Fragmentation (Hammond, Herb, *Seeing the Forest Among the Trees, The Case for Wholistic Forest Use*, Polestar Press Ltd., 1991) - clearing parts of a habitat such that the habitat becomes fragmented; connections within the habitat or ecosystem are broken and the flow of water and energy and the movement of plants and animals are disrupted. The natural ecological processes required to maintain the habitat are damaged. Usually used in reference to forests. When a forest is turned into a checkerboard of clearcuts and forest fragments, large areas of interior forest habitat are transformed into a number of smaller interior forest habitats isolated form each other. The amount of interior forest habitat is reduced not only by the amount of land occupied by the human disturbance, but also by the amount of interior habitat converted to edge habitat.

Geomorphology (Ontario Ministry of Natural Resources 1989) - The study of the physical features of the earth, or the arrangement and form of the earth's crust.

Habitat structure (Schemnitz 1980) - is the sum total of the environmental factors, including food, cover, and water, that a given wildlife species needs to survive and reproduce in a given area. Wildlife selects habitat on the basis of the form or structure the vegetation takes (primarily grasses, shrubs or trees). The more complex and diverse the habitat structure of a given area, the greater the potential number of different habitats available to wildlife, and, usually, the greater number of species in a given area.

Herbaceous (Hansen et al. 1995) - Non-woody vegetation such as graminoids and forbs.

Horizontal fen (Manitoba Hydro, Glossary, July, 1996) - extensive flat, low lying areas that show very slight differences in the level peat surface. The water table is usually at or close to the surface.

Hydraulics (Ontario Ministry of Natural Resources 1994) - Water in motion

Hydric soil (Hansen et al. 1995) - A soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part of the soil profile.

Hydrology (Hansen et al. 1995) - The science dealing with the properties, distribution, and circulation of water.

Hydrophyte (Hansen et al. 1995) - Any macrophytic plant that grows in water or on a substrate that is at least potentially deficient in oxygen as a result of excessive water content; plants typically found in wetland and other aquatic habitats.

Ice-wedge polygons - these wetland forms are generally associated with permafrost in bogs and fens, but they also develop in mineral soils. Ice wedges form as thermal contraction cracks are filled with snow, hoarfrost, or water that later turns to ice. The ice of the wedges is clear, without inclusions, and it often contains bubble trains rising towards the surface in a slightly outward-curving arc. The cracking is caused by low temperatures and rapid cooling, and can extend 3 m or more into the ground. The peat near the surface is cut by the ice wedge, and contorted peat layers have been noted only near the surface where the ice wedge is the widest.

Interior habitat (Hammond, Herb, *Seeing the Forest Among the Trees, The Casefor Wholistic Forest Use*, Polestar Press Ltd., 1991) - forest interior is defined as the forest area two to three tree lengths from the edge of the forest, an area which is sheltered by the forest edge from the conditions and species of the ecosystems outside the forest. The interior habitat provides the seclusion and the stable ecosystem conditions which form the optimum habitat for some wildlife species.

Interstitial (Manitoba Hydro, Glossary, July, 1996) - pertains to the spaces between particles whether they be boulders or grains of sand.

Invertebrate (Manitoba Hydro, Glossary, July, 1996) - an animal with no backbone.

Kettle marsh - sometimes refereed to as a pothole; a marsh formed from the deposits or scouring by glacial drift. It is usually a steep-sided hollow without surface drainage.

Lacustrine system (Cowardin et al. 1979 in Hansen et al. 1995) - Any wetland or deepwater habitat with the following characteristics: 1) situated in a topographic depression or dammed river channel, 2) lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30 % aerial coverage, and 3) total area exceeds 8 ha.

Loading rate - a measure of the time that it takes for particulate matter (e.g., clay or sand particles) to enter a body of water (i.e., usually a watercourse), and the relationship of the water's capacity to sink, suspend, or move the materials either through the water column or along the watercourse.

Nonpoint source pollution (Platts 1990) - Sources of pollution that are diffuse in origin, their transportation into receiving water not well defined or constant, and their discharge occurring at many diffuselocations and depending heavily on weather conditions such as rainstorms or snowmelt. Pollution from forest management is of this type.

Organic soil (Hansen et al. 1995) - Soils composed of primarily organic rather than mineral material. Includes peats and mucks.

Palsa (Manitoba Hydro, Glossary, July, 1996) - a mound of peat with a frozen peat and/or mineral core occurring in waterlogged, treeless, or sparsely wooded fens. The height of a palsa is generally between 1 and 3 m, while the width is in the order of some tens of metres.

Palsa - are circular to elongated mounds of peat that have a permafrost core. They may reach 4 m in height, but their diameter is less than 100 m. They occur as islands or peninsulas in non-frozen wet fens, rising abruptly above the surface. The surface is highly uneven, often containing collapse scar bogs. Palsas are most commonly a bog form but also, can be considered a fen form.

Passerine - a large group of birds belonging to the order Passeriformes or perching birds. Common examples include warblers, thrushes and sparrows.

Patterned fen (Manitoba Hydro, Glossary, July, 1996) - this type of fen occupies very gently sloping areas. Its characteristic feature is a patten of ridges (also called strangs) and hollows (also called flarks). These sites are extremely wet throughout the summer.

Peat plateaus (Manitoba Hydro 1993) - Perennially frozen, raised bogs prevalent throughout most of the northern lowlands, characterized by elevated accumulations of frozen organic soils forming a hummocky plateau often several hundred metres in length andwidth. The permafrost table is usually about 0.5 metres below the surface and extends into the underlying mineral soil deposits. The surface relief varies from 1 to 3 metres and collapse scars may be evident around the perimeter of the plateau where the permafrost table has deteriorated owing to differential thaw.

Permafrost (Manitoba Hydro, Glossary, July, 1996) - a perennially (lasting throughout the year) frozen soil horizon.

Photosynthesis (Manitoba Hydro, Glossary, July, 1996) - a process which occurs in green plants where carbon dioxide and water are turned into useable energy in the presence of light.

Physiography (Ontario Ministry of Natural Resources 1989) - Description of the natural features of the surface of the earth.

Pioneer species - the first or early sequence of plant species that grow from a primary stage of soil development (i.e., growing from bare rock or bare soil). For example, after many plant species are killed after a fire, fireweed is generally the first plant species to recolonize the burned area. This flowering plant may then be replaced by other plants such as grasses.

Polygonal peat plateau - wetland forms with perennially frozen organic layers which commonly occur as treed islands raised about 1-2 m above the adjacent non-frozen fens. Their appearance varies from isolated, near-circular islands, to complex networks of coalescing plateaus, rectangular to eight-sided polygons, with only minor areas of fens. The surface is relatively flat, scored by a polygonal pattern of trenches that developed over ice wedges. Peat plateaus often extend over several square kilometres and occur as various stages of development rangingfrom youthful to mature to over-mature. They are also characterized by varying rates of growth as well as rates of degradation or decay of the permafrost, as evidenced by collapse scar fens within these wetlands or along their outer edges. The relative rate of growth and decay changes with latitude. The characteristic vegetation of peat plateau bogs is an open canopied to dense, closed-canopied woodland of black spruce with a prominent ground cover of feathermoss and lichens, and a sparse covering layer of ericaceous shrubs.

Riparian ecosystem (Platts 1990) - A transition between the aquatic ecosystem and the adjacent terrestrial ecosystem identified by soil characteristics or distinctive vegetation communities that require free or unbound water.

Riparian ecosystem (Hansen et al. 1995) - The ecosystem located between aquatic and terrestrial environments. Identified by hydric soil characteristics and riparian or wetland plant species that requires or tolerates free water conditions of varying during.

Riverine (Platts 1990) - Vegetation growing in the close proximity of watercourses, or on small islands in river beds.

Riverine system (Cowardin et al 1979 in Hansen et al. 1995) - Any wetland or deepwater habitat contained within a channel, with exception of wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens.

Riverine ecosystem (Platts 1990) - Land and water contained within the channel of a stream; includes streambars and the stream bottom; substrates are fluvial sediments with low degree of soil development.

Shore fen (National Wetlands Working Group 1987) - a fen with an anchored surface mat that forms the shore of a pond or lake. The rooting zone for plants is affected by the water of the pond or lake at both normal and flood levels.

Spring fen (National Wetlands Working Group 1987) - a fen nourished by a continuous discharge of groundwater. The surface is marked by pools, drainage tracks, and occasionally, somewhat elevated "islands". The nutrient level of water is highly variable between locations.

Staging area - a site that contains a group(s) of birds that flock together, usually during spring or fall migration. Staging areas most commonly refer to sites where ducks or geese gather to feed or rest prior to flying to, or from their breeding grounds. This term also applies to many other types of birds that gather together at common sites in large numbers, including shorebirds, raptors and passerines. The same groups of birds or their descendants usually return to the same areas year after year.

Structural diversity - a measure of any plant community that involves all basic plant forms (i.e., grass, forb, shrub, tree) and how these forms are distributed. Diversity implies a range of many plant forms. In general, structural diversity tends to increase as the number of plants and the number of plant forms are added to a community. Structural diversity tends to decrease if plants, such as trees, are even-aged, or where the number of plants species are low. Structural diversity has a direct affect on the quality of habitat, thereby affecting the number of individuals and wildlife species.

Substrate (Department of Fisheries and Oceans and Department of NaturalResources 1995) - The base on which organisms live.

Terrestrial ecosystem (Platts 1990) - Areas outside of floodplains occupied by vegetation communities that require well-drained soil conditions for at least part of the growing season.

Tree girdling (Manitoba Hydro, Glossary, July, 1996) - a method of killing woody vegetation by cutting more or less continuously around the stem or trunk, through the bark and cambium (growing layer).

Trophic state (Platts 1990) - The intensity of primary productivity in a stream, often estimated by the nutrient (nitrogen and phosphorus) enrichment to the water body.

Tundra (Manitoba Hydro, Glossary, July, 1996) - a treeless, generally level to undulating, region of lichens, mosses, sedges, grasses, and some low shrubs, including dwarf willows and birches, which is characteristic of both the Arctic and higher alpine regions outside the arctic.

Uplands (Hansen et al. 1995) - Any area that does not qualify as a wetland because the associated hydrologic regime is not sufficiently wet to elicit development of vegetation, soils, and/or hydrologic characteristics associated with wetlands. Such areas occurring in floodplains are more appropriately termed non-wetlands.

Vertically structured community - a group of associated plants and animals that grow or live on a common site because of soil uniformity, moisture content, habitat type etc. Plants in this community usually develop in many layers and grow relatively tall. Forestsare good examples of vertically structured communities, where wildlife species find food and cover from ground level up to the forest canopy. Shoals or reefs in lakes are other good examples of vertically structured communities within waterbodies. Grasslands, in general, are examples of plant and animal communities having little, if any, vertical structure.

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Copies of this report may be obtained from:

Manitoba Hydro
Environmental Protection Department
820 Taylor Avenue
Winnipeg, MB, R3C 2P4
Tel (204) 474-3137
FAX (204) 474-4974
Email address: bgkouk@hydro.mb.ca

Third Edition – February 2000

Printed in Canada

Manitoba Hydro