Manitoba Conservation
Forest Practices
Guidebook

FOREST MANAGEMENT GUIDELINES for RIPARIAN MANAGEMENT AREAS

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Forest Management Guidelines For Riparian Management Areas

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TABLE OF CONTENTS

List of Tables

List of Figures

PREFACE

MANITOBA FOREST PRACTICES

This guidebook has been developed as part of Manitoba Conservation's Forest Practices Initiative. It is led by the Forestry Branch and is intended to provide consistent operational direction for resource managers, timber operators, natural resource officers and auditors to conduct or assess forestry activities.

One of the primary goals of the initiative is to advance best practices using guidelines and standards for sustainable forest management activities in Manitoba. Guidelines present alternative procedures or standards that can be applied to satisfy the principle upon which the guidelines are based. Guidelines are used to develop prescriptions in the Annual Operating Plan and are enforceable by a Work Permit. Forest practice guidebooks ensure all forest resource values are appropriately addressed during the full range of forest activities.

Forest practices guidebooks are references for resource managers, timber operators, natural resource officers, and auditors. References include provincial guidelines, forest management plans, annual operating plans and standard operating procedures developed by each forest company.

Representatives from several branches of Manitoba Conservation (Forestry, Wildlife and Ecosystems Protection, Parks and Natural Areas, Environmental Assessment and Licensing, etc.), Manitoba Water Stewardship (Fisheries, Water Quality), the three major Forest Management Licensees in Manitoba (Tembec Industries Inc., LP Canada Ltd., Tolko Industries Ltd.), and the Forest Industry Association of Manitoba (representing timber quota holders) co-operate in a consensus seeking manner to develop forest practice guidebooks. Regional specialists participate when meetings are held in their regions.

All guidelines for a specific forest practice are contained in a single guidebook. Each guidebook also contains pertinent references to science, legislation, policy, agreements and licences. Recommendations for the planning, implementation, monitoring and enforcement of the specific forest practice in question are included.

As much as possible the recommendations within each forest practice guidebook:

- are based on scientific evidence and traditional knowledge
- are measurable
- are practical
- are flexible and applicable in a variety of ecological conditions
- are clearly presented for consistent interpretation and application
- contain accepted terminology and definitions

Forestry practices within Manitoba will be continuously monitored and appropriately amended when necessary. Guidebooks will be reviewed after five years or a shorter period if required.

Guidebooks can be found on the Manitoba Conservation Forestry Branch website: http://www.manitoba.ca/conservation/forestry/forest-practices/practices/fpp-guideline-pdfs.html. The public is encouraged to submit comments and recommendations to Manitoba Conservation, Forestry Branch.

FOREST MANAGEMENT GUIDELINES
for
RIPARIAN MANAGEMENT AREAS

Introduction

This guidebook helps government and forest industry planners make informed management decisions about the forest adjacent to riparian areas (RAs). This process focuses on social, ecological, and economic criteria. The use of these keys will help create appropriate management prescriptions for riparian management areas (RMAs).

Purpose

This guidebook sets out specific management activities within RMAs (presently referred to as buffer zones) to help balance ecological, social and economic values at the landscape and stand levels.

Application and Implementation of Forest Management for Riparian Management Areas

Manitoba Conservation, regional Integrated Resource Management Teams (IRMTs) and forest industry planners are expected to incorporate these guidelines in harvesting and renewal planning operations. The intent is to identify opportunities where forest harvesting may be integrated with the protection of other resource values. The guidelines, based on a series of keys called the Riparian Management Decision Framework (RMDF), provide flexibility to accommodate the various resource values and site conditions identified through pre-harvest surveys (PHSs). PHSs are done on the total area considered for forest management activities including the reserve, machine free and management zones. In reviewing and approving the annual operating plans (AOPs), IRMTs may apply the guidelines based on site-specific conditions. A portion of riparian management areas will be monitored.

Ecological Functions of Riparian Areas

RAs are dynamic areas between terrestrial and aquatic ecosystems. Gradients in environmental conditions, ecological processes and species composition make RAs structurally and functionally diverse. They perform many important ecological functions -- from maintaining water quality and aquatic habitat, to providing high quality terrestrial habitat for animal and plant species. RAs recharge groundwater, recycle nutrients, trap sediment and pollutants and provide natural flood control. They are essential for the survival of a number of species and for preserving biodiversity because they support a greater variety and number of plant and animal species than other habitats. RAs act as travel corridors for many animals in a fragmented landscape and are necessary for food, shelter and reproduction.

Habitat fragmentation, travel corridors, biodiversity, water quality, RA functions and values, adjacent land or resource use, landform, site and habitat conditions and operational considerations all contribute to determining what forestry, if any, activities may be allowed within RMAs. Restrictions imposed on forestry activities may include retaining a percentage of cover,

controlling machinery traffic and other ground disturbances, protecting understorey and regeneration, preventing erosion and prohibiting the removal of trees that stabilize shorelines, specific harvesting prescriptions (single tree or group selection) and prohibiting high-grading. Scheduling for winter operations, irregular-shaped harvest units, patch and vertical structure retention and rapid effective natural regeneration can help alleviate potential problems from forestry activities.

A summary of ecological functions of RAs, the potential impact of forestry, and the suggested management strategy are described in Appendix 1, Table 1.1. and are provided as an overview.

Guiding Principles and Objectives

This document helps set the process for Manitoba Conservation and the forest industry to implement best management practices (BMPs) to sustain riparian forest values and function over time. The RMDF was developed under a set of sustainable development management objectives. The framework includes ecological, social and economic values associated with RAs. This document and subsequent riparian management activities will be guided by the following principles:

- to sustain or improve ecological function of riparian ecosystems
- to balance ecological, cultural, social and economic values/priorities
- to conserve biodiversity
- to provide a decision support mechanism to assist with informed decision making
- to provide a framework for operating plan requirements for proposed riparian management activities
- to facilitate the implementation of BMPs around water bodies and their associated RAs
- to facilitate the implementation of adaptive management strategies and effectiveness monitoring for RAs and RMAs

The following objectives provide the basis for implementing riparian management strategies within Manitoba:

- to ensure the sustainability of resource values through the management of timber resources
- to preserve the ecological integrity of the RMAs by rejuvenating RAs, mimicking natural disturbance, and maintaining successional pathways, which may require the harvesting of the RMA for its viability
- to preserve water quality, quantity, and aquatic habitat
- to preserve wildlife habitat and travel corridors
- to preserve visual barriers for cultural, recreational and aesthetics values
- to preserve stream banks and shoreline integrity
- to provide opportunities for management of commercial timber species
- to preserve forest health by monitoring and managing insect and disease infestations

Current Practices and Next Steps

Manitoba Conservation and forest industry planners have been using the 1996 *Consolidated Buffer Management Guidelines* (CBMG). They provide:

- riparian buffer management guidelines (Table 2 in the CBMG)
- buffer considerations for other significant resource values (Table 3 in the CBMG)
- all weather forestry road buffer management guidelines
- seasonal road/trail buffer management guidelines

The guidelines are based on the science available at the time. New research and monitoring supports the need for managing buffer zones associated with RAs to sustain the ecological functions and values of these areas. Manitoba Conservation recognizes the importance of a process to help regional IRMTs and forest planners manage RMAs to sustain their function and value and offer ecological, social and economic benefits to future generations. Palik, Brian J., Zasada, John C., and Hedman, Craig. (2000) explain:

> *an all-too-common silviculture prescription is to designate the riparian management area as a no-cut buffer. This is a legitimate management alternative in some situations. However, when pursued out of uncertainty about potential impacts, a no-cut buffer simply limits management options and opportunities. These opportunities include not only management for obvious features, such as desired commercial species and timber products, but also enhancement and restoration of riparian functions. Our point is that no-cut buffers do not accommodate the natural range of variability in riparian forests, including differences in potential composition and productivity. These buffers ignore the fact that disturbance is a natural part of riparian systems and they provide minimal flexibility for meeting diverse management objectives*

To meet some of these objectives, they must be addressed at a stand level or operational scale, for example wind throw and forest health concerns, while natural disturbance emulation and connectivity must be incorporated into landscape-level planning and filter down to the operational scale. Landscape-level planning guidelines are being developed and the Forest Management Guidelines for Riparian Management Areas will be incorporated into the landscape-level planning guidelines. Once objectives are determined, guidelines can be evaluated as part of an adaptive management loop that includes research and monitoring to determine whether objectives have been met. Manitoba Conservation and the forest industry planners will hold one meeting per year to evaluate implementation of the Forest Management Guidelines for Riparian Management Areas (using field inspections, Google Earth etc).

The Forest Management Guidelines for Riparian Management Areas will replace Table 2 in the CBMG and are designed to complement the remaining guidelines. Forest planners will be expected to use the Forest Management Guidelines for Riparian Management Areas and the remaining CBMG until new terrestrial guidelines are written.

Riparian Definitions

There are several working definitions for RAs which depend largely on whether the intent of the definition is ecological or management oriented (Appendix 5). The following definitions will be used to describe RAs and RMAs within Manitoba's forests:

Riparian Area (RA)
Riparian area means an area of land on the banks or in the vicinity of a waterbody, which due to the presence of water supports, or in the absence of human intervention would naturally support, an ecosystem that is distinctly different from that of adjacent upland areas (The Water Protection Act, 2005). For operational purposes, the RA will end at the edge of the merchantable forest. No forestry activity will be permitted within the RA.

Merchantable refers to marketable forests. A tree or stand of trees is considered to be merchantable once it has reached a size, quality, volume, or a combination that permits harvesting and processing. Merchantability is independent of economic factors, such as road accessibility or logging feasibility. (Dunster, Julian and Katherine. 1996)

Riparian Management Area (RMA)
The RMA is the forested area adjacent to the RA where forest management activities can be approved. A RMA can include the following zones: machine free zone (MFZ), MFZ and management zone (MZ), reserve zone (RZ), RZ and MZ, or in some cases only BMPs may be applied (Table 1).

Table 1 Best Management Practices for Operating Near Water Bodies

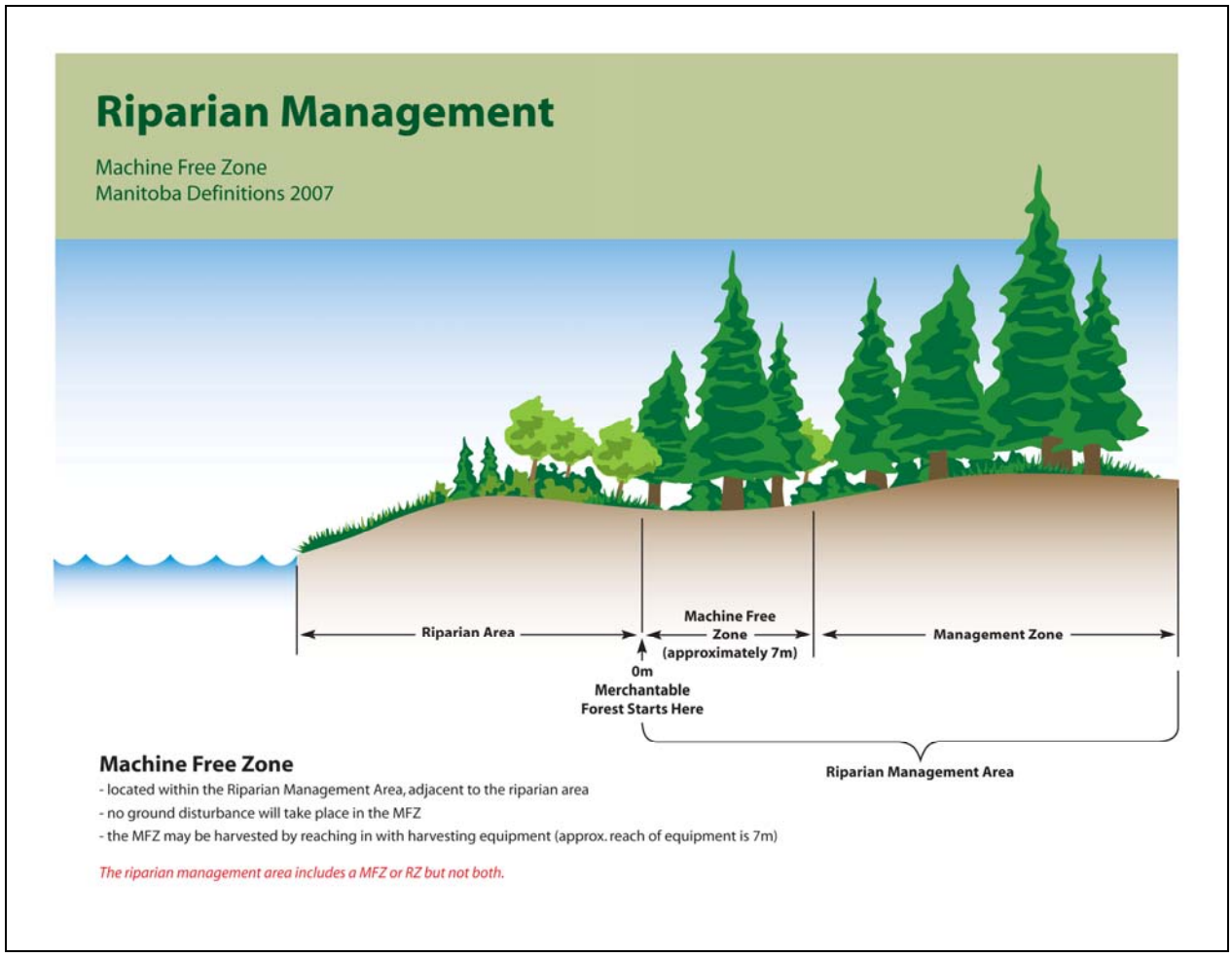
	Best Management Practices for Operating Near Water Bodies
1.	Remove only merchantable timber.
2.	Retain all shrub understorey, non-merchantable and immature timber.
3.	No operation of machinery within the approximately seven metre MFZ (harvesters, skidders, site preparation equipment, etc.).
4.	Slash must not be deposited in the stream or on the stream banks.
5.	Timber must be felled away from the stream, not across.
6.	For road development near RAs refer to the Forest Practices Guidelines Forestry Road Management (Manitoba Conservation 2005).
7.	Where it is necessary to cross a stream, a designated crossing established perpendicular to the stream must be used; refer to the Forest Practices Guidelines Forestry Road Management (Manitoba Conservation 2005) and the Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat (Fisheries and Oceans and Manitoba Natural Resources 1996.)
8.	Crossings will be removed, in accordance with Manitoba guidelines, once access to the other side of the stream is no longer required.
9.	Any soil disturbance in a RA (ex: the stream bank at a crossing) will require temporary and permanent erosion and sediment control measures.

Management may include protection or disturbance through forest management activities. Any proposed activities in the RMA must be approved by Manitoba Conservation's IRMTs.

Prior to any activities being permitted to occur within the RMA, surveys must be carried out that include information on understorey vegetation, species identified by the *Species at Risk Act* (SARA), the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and the Manitoba *Endangered Species Act* (MESA), (see Appendix 3) forest health, wildlife usage, heritage resources, and other resource values.

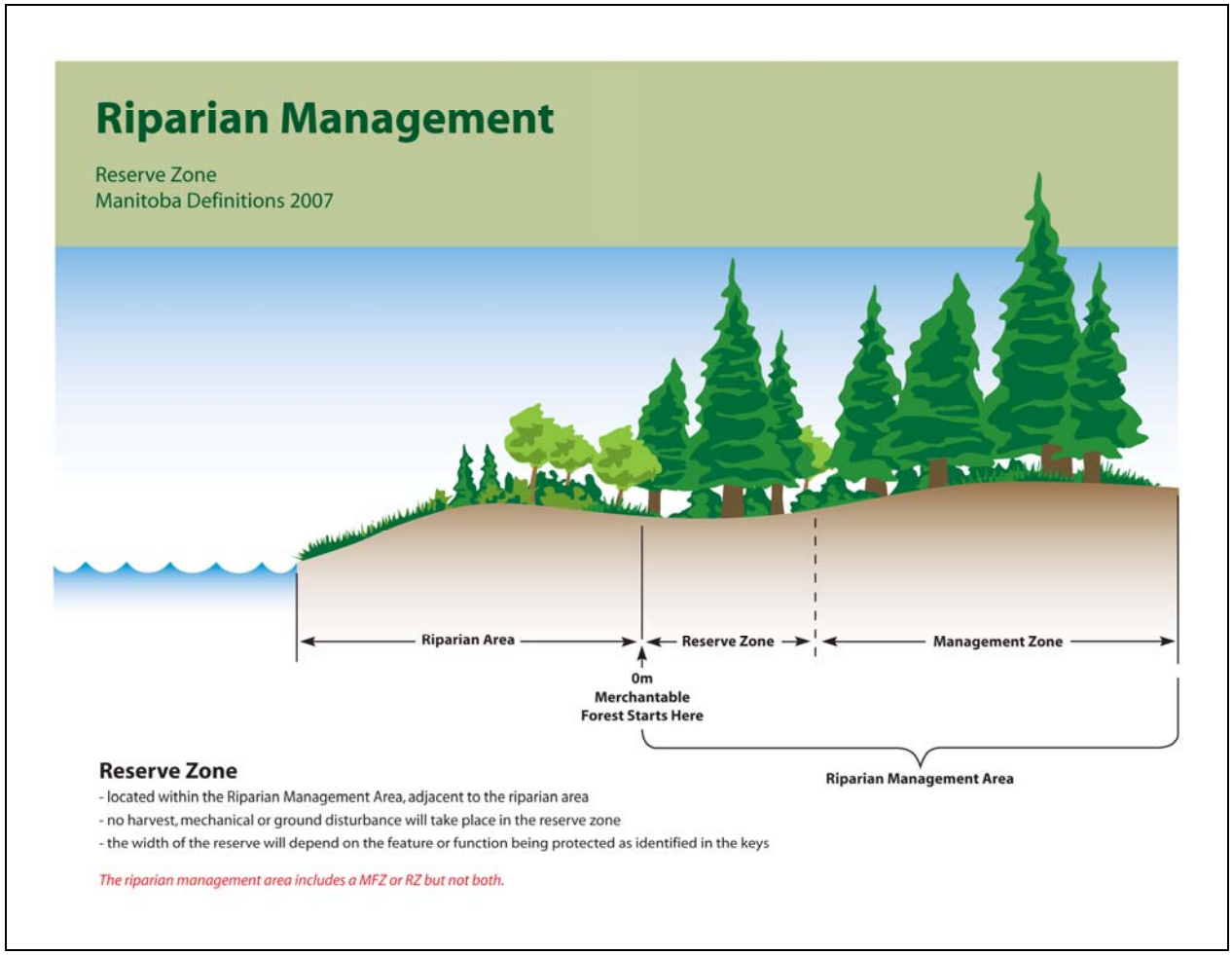
Machine Free Zone (MFZ) (Figure 1)
The MFZ is a zone located within the RMA, adjacent to the RA, in which no ground disturbance will take place but is permitted to be harvested by reaching in with harvesting equipment (approximate reach is seven metres). No harvesters, skidders, site preparation or scarification equipment are permitted in the MFZ. The MFZ will use BMPs for the protection of the water bodies.

Figure 1 Machine Free Zone



Reserve Zone (RZ) (Figure 2)
The RZ is located in the RMA adjacent to the RA. No harvest, mechanical or ground disturbance will take place in the RZ. The width of the RZ will depend on the feature or function being protected as identified in the keys.

Figure 2 Reserve Zone



Management Zone (MZ)
The zone within the RMA where prescribed harvesting activities may take place (Figures 1 and 2). Table 2 lists the harvest options for MZs.

Potential Forest Management Activities within the Management Zone

Where there is a MZ, the selected management strategy (Table 2) will be identified at the AOP level.

Table 2 Harvest Options for Management Zones

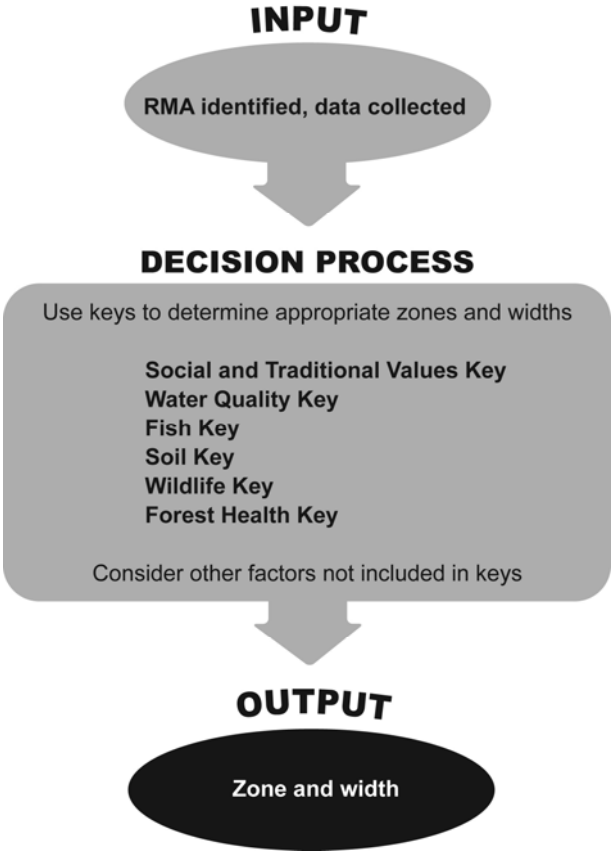
HARVEST OPTIONS FOR MANAGEMENT ZONES	DEFINITIONS
No Harvest	MZ remains untouched.
Patch Cuts	Removal of an entire stand of trees less than one hectare in size from a given area.
Strip Cuts	Long narrow clear-cuts with leave strips in between; leave strips may be harvested in the future, depending on regrowth of the strips harvested initially.
Selective Harvest	Harvesting of single, scattered merchantable trees or small groups of trees, while retaining shrubs, young or small trees or prescribed leave trees.
Shelterwood Harvest	Mature trees are removed in a series of cuts to achieve a new even-aged stand under the shelter of the remaining trees. Shelterwood cuts can include uniform, strip, group, or irregular.
Variable Retention Harvesting	Modified clear-cut with varying amounts of in-block residual vegetation remaining as single trees and/or forested patches.

Riparian Management Decision Framework (RMDF)

The following section presents a series of keys based on resource values used to determine the appropriate zones and their widths for a given RMA. For the MZ, prescriptions are developed and incorporated into AOPs by the forest planners. These prescriptions are mitigated and approved by the IRMTs and reflected in the Work Permits. The RMDF was developed based on the intuitive decision-making process applied by forest planners and IRMTs. Though one value is not necessarily more important than another, they are arranged in an order that provides an opportunity to balance a wide range of potentially competing values.

The six keys are displayed in the order they should be used (Figure 3). The key that results in the most protection (the widest reserve) being given is applied. See Appendix 2 for a case example.

Figure 3 Riparian Management Decision Framework



Social Values Assessment within Riparian Management Areas

The assessment of social and traditional values (Appendix 1, Table 1.2) within RMAs is a critical component of establishing the appropriate zones and widths. The following key will guide the user through the potential social and traditional values that must be considered. There may be other values not specifically identified within this key that can be incorporated when encountered.

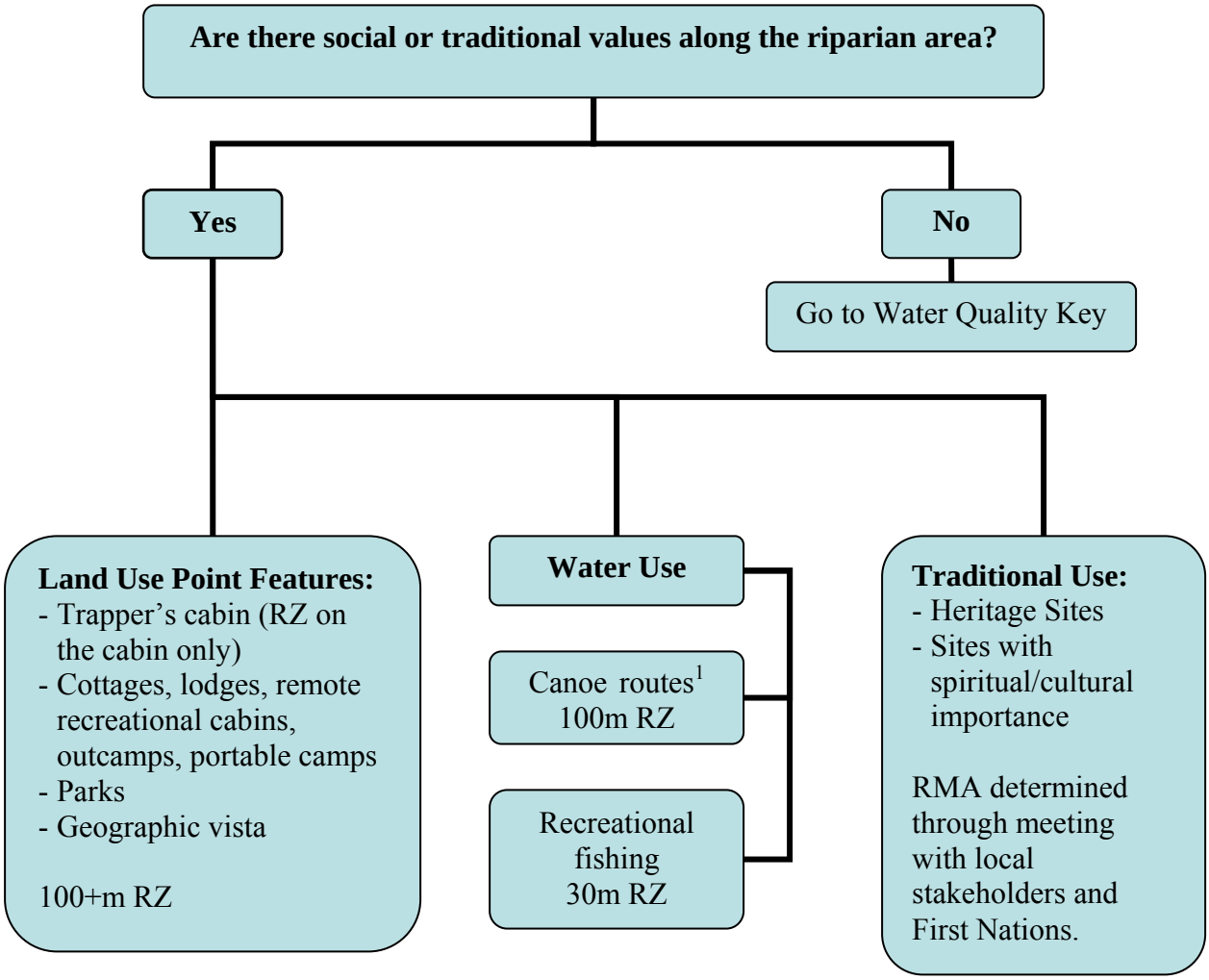
Social and Traditional Values Key

Objective: to protect social and traditional (cultural) values

Protection required for these values is determined by meeting with the stakeholders and First Nations and ultimately the RZ is determined by the IRMT.

Key Rules: harvest is by prescription within the MZ, see Table 2

– RZ is a **no harvest zone** adjacent to the RA



[1]Designated route or other routes well used and identified to the IRMT.

Water Quality Assessment within Riparian Management Areas

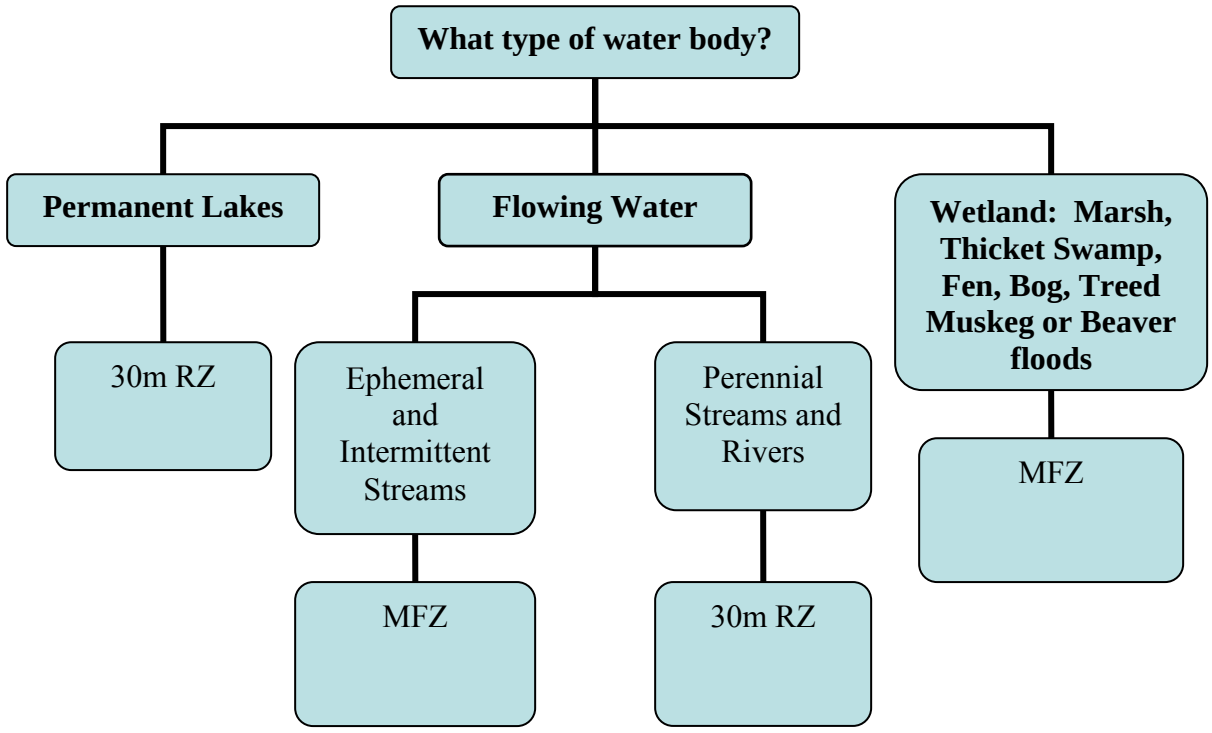
The second key assesses the water body in question and suggests the zone and width based on the feature's sensitivity to forest management activities adjacent to the RA. This key is supported by research that has found that smaller systems may need greater protection.

Water Quality Key

Objective: to protect water quality

Key Rules: harvest by prescription within the MZ, see Table 2

- RZ is a **no harvest zone** adjacent to the RA
- the outcome of any key may be overridden by the IRMT



Fish and Fish Habitat Assessment within Riparian Management Areas

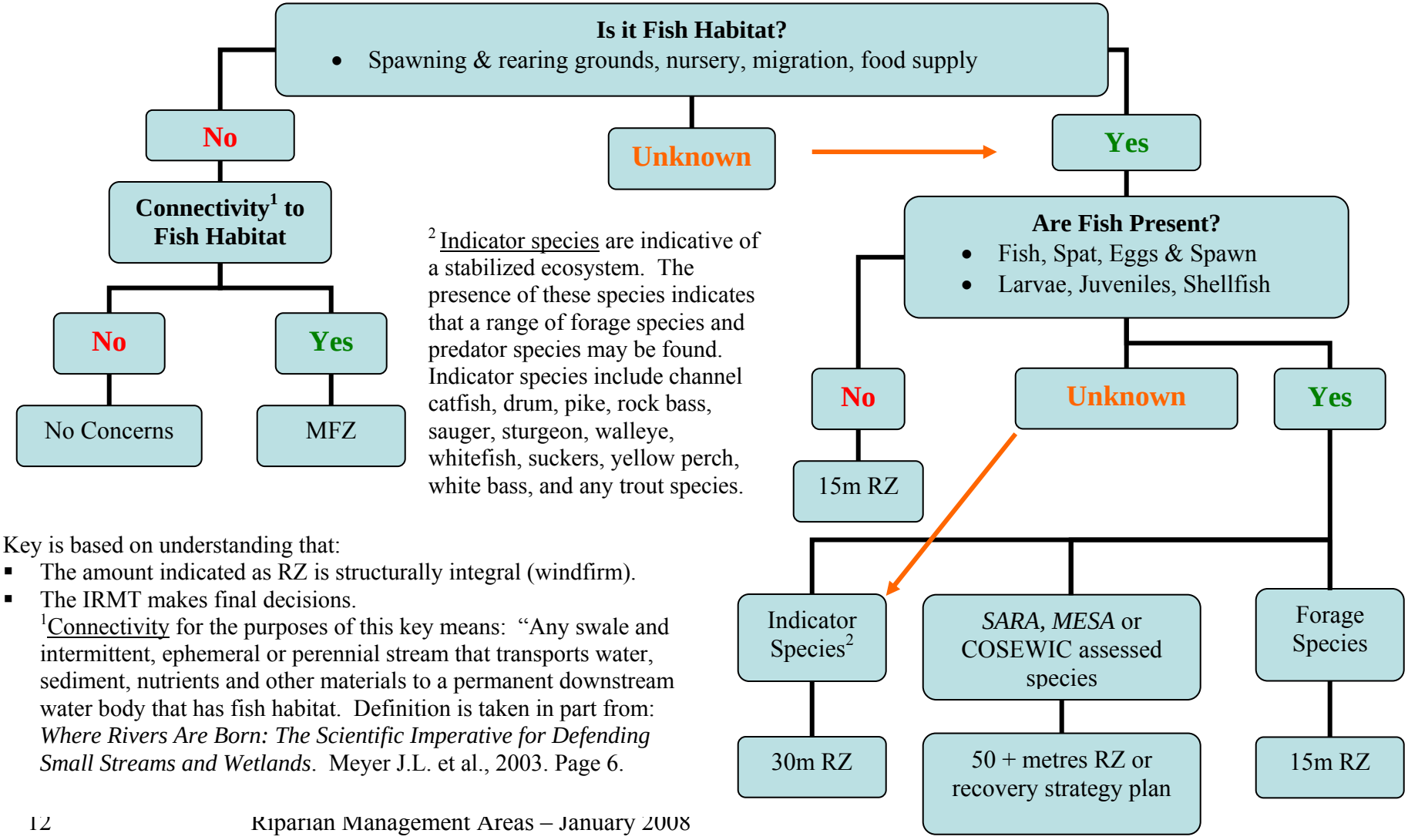
The third key assesses the fish and fish habitat features and suggests the appropriate zone and width based on the feature's sensitivity to forest management activities adjacent to the RA. This key is based on the *Fisheries Act* and the process that is currently used to determine the potential to cause a harmful alteration, disruption or destruction of fish habitat (HADD). This key is not meant to bypass consultation with Department of Fisheries and Oceans nor negate proponent responsibility/accountability for any activity that creates a HADD.

Fish Key

Objective: to protect fish and fish habitat

Key Rules: harvest by prescription within the MZ, see Table 2

- RZ is a **no harvest zone** adjacent to the RA
- the outcome of any key may be overridden by the IRMT



[2] Indicator species are indicative of a stabilized ecosystem. The presence of these species indicates that a range of forage species and predator species may be found. Indicator species include channel catfish, drum, pike, rock bass, sauger, sturgeon, walleye, whitefish, suckers, yellow perch, white bass, and any trout species.

Key is based on understanding that:

- The amount indicated as RZ is structurally integral (windfirm).
- The IRMT makes final decisions.

[1] Connectivity for the purposes of this key means: "Any swale and intermittent, ephemeral or perennial stream that transports water, sediment, nutrients and other materials to a permanent downstream water body that has fish habitat. Definition is taken in part from: *Where Rivers Are Born: The Scientific Imperative for Defending Small Streams and Wetlands*. Meyer J.L. et al., 2003. Page 6.

Erosion Potential Assessment within Riparian Management Areas

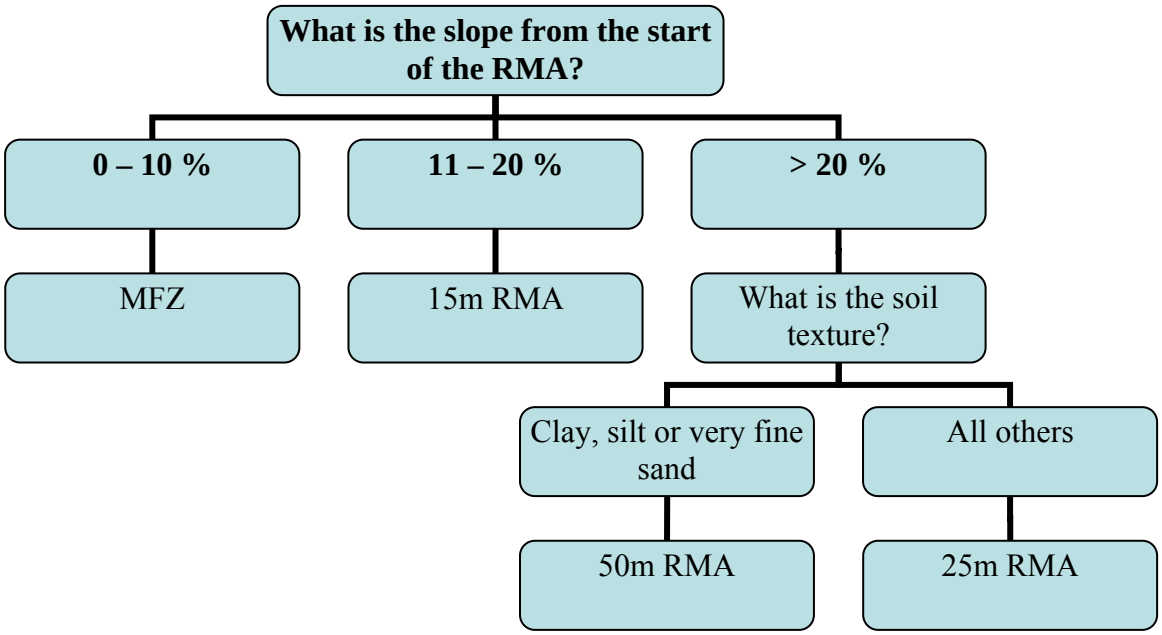
The fourth key considers erosion potential as a major factor in determining an appropriate zone and width. This key is founded on the potential for the occurrence of erosion and/or sedimentation resulting from forest management activities within a RMA. In areas where RMAs are highly sensitive to erosion, the no harvest strategy within a RMA will be an option to consider.

Soil Key

Objective: to prevent erosion and maintain water quality

Key Rules: harvest by prescription within the MZ, see Table 2

- RZ is a **no harvest zone** adjacent to the RA
- the outcome of any key may be overridden by the IRMT



Wildlife Habitat Assessment within Riparian Management Areas

The fifth key identifies major components used to evaluate wildlife habitat within a RMA.

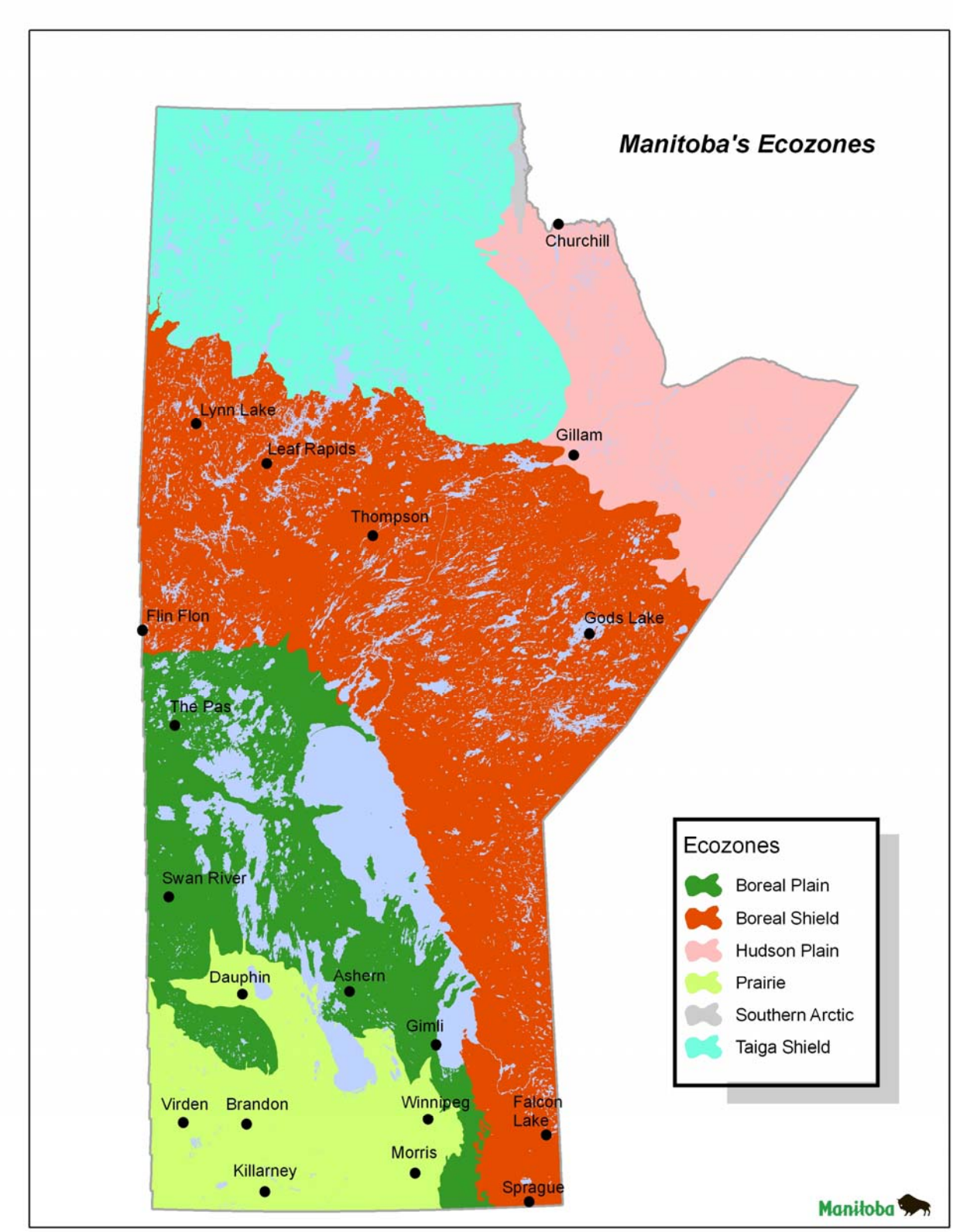
- Identification of species listed under *SARA* or *MESA,* COSEWIC assessed species, species of conservation concern as determined by the Manitoba Conservation Data Centre or species as directed by environmental licensing requirements.
- Identification of core habitats which are defined as areas used repetitively (seasonally/annually) rather than occasionally or infrequently.
- Identification of important site habitat such as stick nests, woodpecker cavities, snags, travel corridors, wintering areas, dens, licks, wallows, caves, etc. that are used repetitively or are currently managed under the CBMG.
- Other features or habitat considered important due to their rarity.
- The wildlife keys are based on habitat requirements for moose and elk, noting that if habitat is available for moose and elk, habitat for 80 per cent of insects, birds and small mammals will also be available.

Additional factors to consider when assessing wildlife values include:

- habitat value of V-types
- known key populations/issues
- forage areas
- thermal cover (winter and summer)
- size, abundance, and distribution of riparian area in operating area
- amount of harvest in operating area
- connectivity
- trapper and outfitters concerns
- First Nation and other Aboriginal hunters concerns
- First Nation gathers (plants for medicine/ceremony)
- line of sight
- aspect
- operability of slope
- access management

The wildlife key is made up of two keys based on Manitoba's ecozones (Figure 4). Wildlife habitat is classified using V-types (Zoladeski, C.A., Wickware, G.M., Delorme, R.J., Sims, R.A., and Corns, I.G.W. 1995) based on the abundance, and the wildlife habitat value of the V-type.

Figure 4 Manitoba's Ecozones

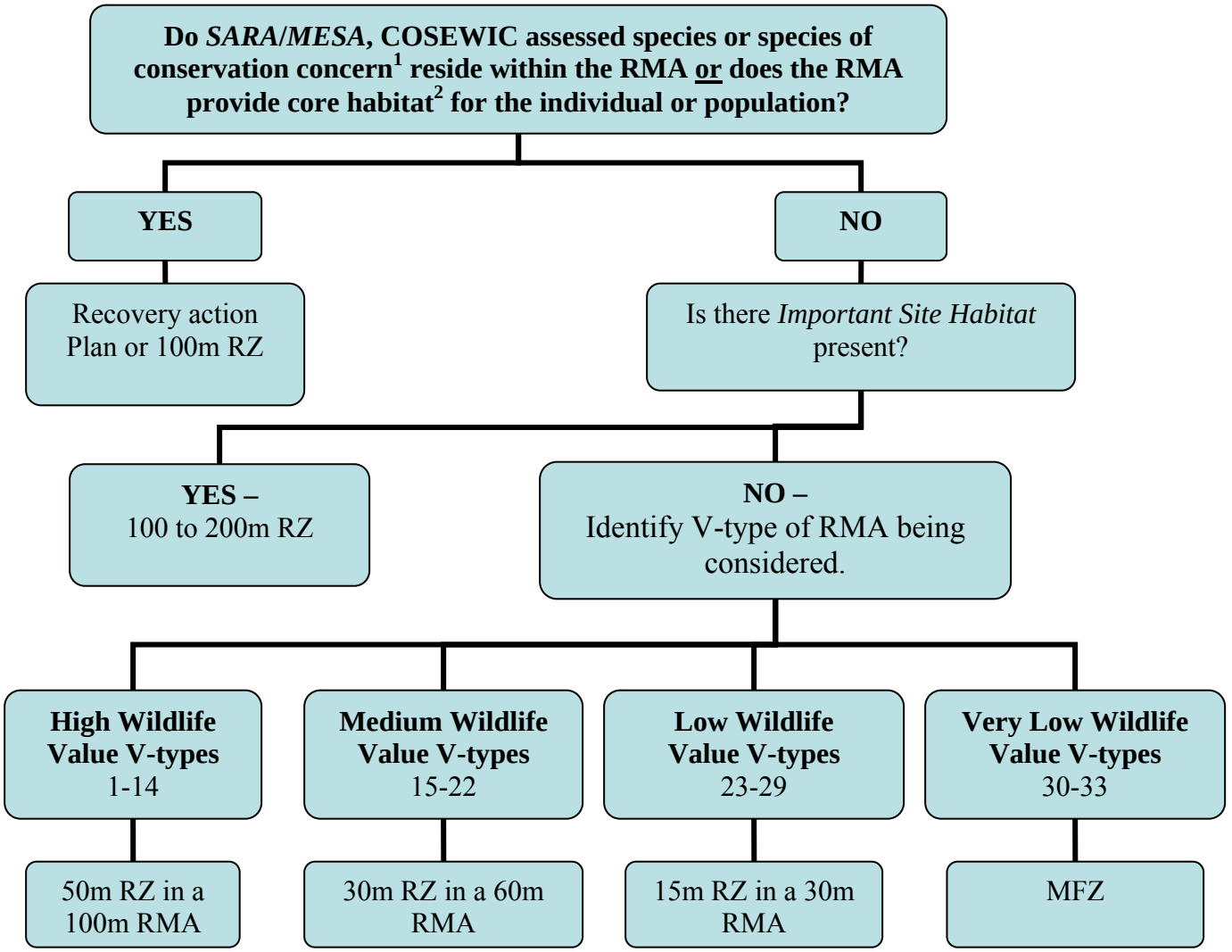


Wildlife Key – Boreal Shield Ecozone

Objective: to protect wildlife and wildlife habitat

Key Rules: harvest by prescription within the MZ, see Table 2

- RZ is the **no harvest zone** adjacent to the RA
- the outcome of any key may be overridden by the IRMT



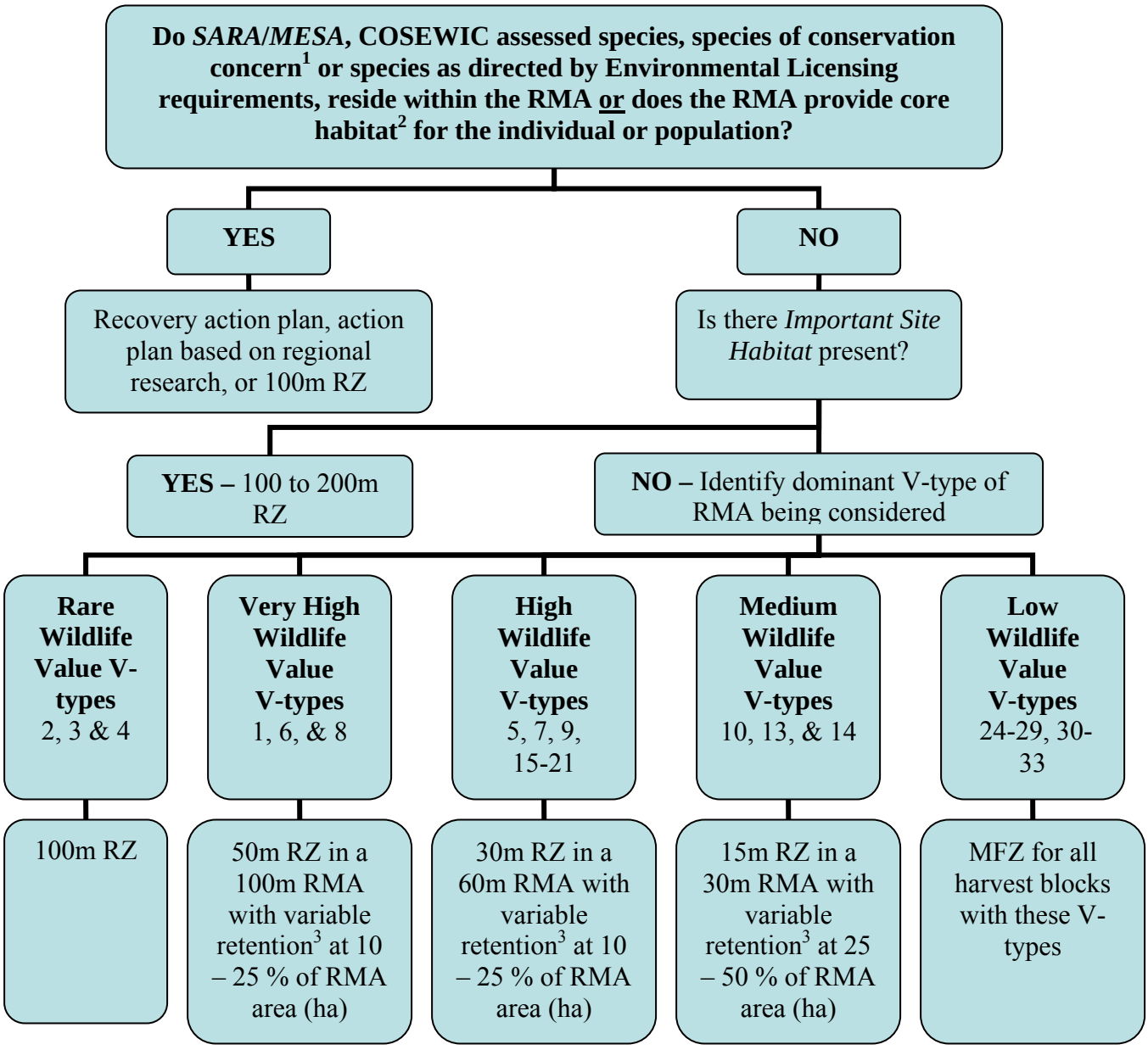
[1] "Species of conservation concern" as determined by the Manitoba Conservation Data Centre
[2] Core habitat - areas used repetitively (seasonally/annually) rather than occasionally or infrequently

Wildlife Key – Boreal Plain Ecozone

Objective: to protect wildlife and wildlife habitat

Key Rules: harvest by prescription within the MZ, see Table 2

- RZ is the **no harvest zone** adjacent to the RA
- specific V-types may increase the RMA width
- the outcome of any key may be overridden by the IRMT



[1] "Species of conservation concern" as determined by the Manitoba Conservation Data Centre

[2] Core habitat - areas used repetitively (seasonally/annually) rather than occasionally or infrequently

[3] Variable retention means a percentage of the forest cover is maintained through prescription in the MZ with a MFZ. This approach recognizes that about 75% of the shoreline is burnt to the edge in natural disturbance patterns caused by fire. In addition, certain areas of the Duck Mountains should be managed and harvested with specific key note species in mind, for example, elk wintering areas, moose wintering areas, marten areas, elk and moose calving sites, and forest interior song birds.

An Example of Applying Core Habitat

Core habitat - The term core habitat is meant to convey a consistent interpretation of use based on data from studies.

In applying this definition for caribou, the IRMT would ask "is the proposed RMA in core habitat for caribou?" If the RMA is a known calving site for an individual animal, then the answer is "yes". If the RMA is within a known wintering area, or a defined travel corridor, then the answer is "yes" and the default recovery action plan or 100 metres RZ applies. Conversely, if the RMA is not known to be core habitat, but still has occasional caribou use, then the answer is "no".

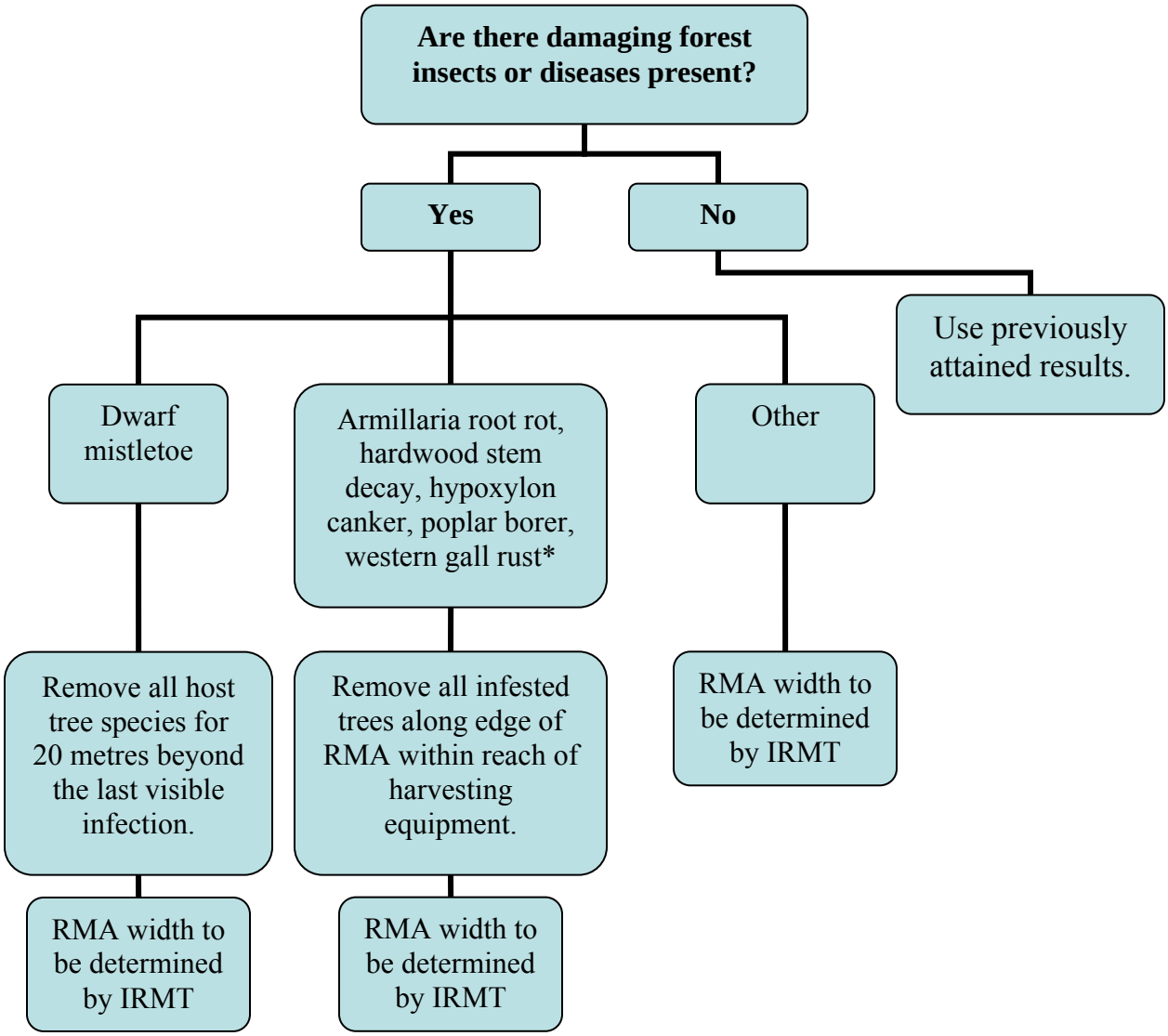
To help maintain variability in wildlife habitat, the reserve zone (RZ) can be reduced and designated a riparian management area (RMA) with 10 to 25 per cent variable retention (VR) in no greater than 50 per cent of the cut-blocks annually, depending on site specific conditions (ex.: regeneration, long-term habitat supply).

Forest Health Assessment within Riparian Management Areas

The sixth key identifies forest health concerns within the RMA. Consideration is given to the impact of insects and diseases on the structure and integrity of the RMA and their potential to affect regenerating stands.

Forest Health Key

Objective: to reduce the impact of forest insects and diseases on the regenerating stand



* If these pests are prevalent or severe throughout the RMA, expect its structure and integrity to be compromised because, extensive tree mortality or breakage will occur more rapidly than in an uninfested RMA.

Other Management Considerations

Once the RMDF keys have been completed, it is necessary to consider other values and/or concerns that may be factors in determining a RMA width. Other considerations may include season of harvest, forest cover types, natural disturbance patterns, wood supply, windthrow potential, fire risk, line of sight and economics (Table 3).

Table 3 Considerations for a Riparian Management Area Prescription

Consideration	Description
Management Objectives	Outlines rationale for conducting management activities within a RMA.
Forest Types/Wood Supply	Describes forest types within a RMA (V-Types, Forest Lands Inventory information, ecosite types, PHS data) .
Silviculture/Harvest System	Describes methods used to extract trees within RMA: no harvest, partial harvest, strip cuts, selective harvest, shelterwood harvest, variable retention harvest, seed tree retention, understorey protection.
Renewal Activities	Describes type of renewal activities that are proposed for the RMA after harvest. Examples: Leave for natural regeneration, site preparation, planting and stand tending activities.
Season of Harvest	Indicates ground conditions that will be required before harvesting takes place (dry, frozen or all season), all dependant on access conditions.

Riparian Management Monitoring

The forest companies will present AOPs with RMAs and their justifications clearly identified.

1. Manitoba Conservation will review the width of the RMA and proposed MZ activities.
2. It is the responsibility of the company to place the RMA in the correct place and to execute the AOP properly to conform to RMA prescriptions.
3. In keeping with adaptive management, Manitoba Conservation and the companies will monitor RMA prescriptions to ensure that ecological, traditional/cultural, social and economic values are maintained.
4. Research into the effects of timber harvesting in RMAs will continue.
5. The RMA guidebook will be amended based on the results of new research.

Appendices

Appendix 1 – Ecological Functions of Riparian Areas and Associated Social and Economic Values

Table 1.1 Ecological Functions (bracketed numbers refer to references listed at the end of the table)

This table contains the background references used in the development of this guidebook.

Function	Function Description	Potential Impact of Forestry	Management Strategy
Microclimate regulation (regulation of light and temperature)	Tree and shrub canopy provides shade and influences wind velocity and direction over the water surface which may produce substantial changes in water temperature if disturbed.	Decreased shade can lead to increased light and higher temperatures in streams and small lakes. Increased wind can cause more mixing in small lakes (< 4 hectares).	Retain riparian area of one tree length.(2) Retain a riparian area of 10 to 30 metres.(3) Retain ≥ 45 metres riparian area to maintain unaltered microclimatic gradient.(7)
Organic matter	Leaves, needles and wood supply energy – carbon - to headwater streams and near shore areas of waterbodies. NB of carbon inputs decreases as receiving water becomes larger however inflow of dissolved and particulate carbon from headwater areas remains an important supplement to *in situ* primary production by algae and other aquatic plants in creeks, rivers and lakes.	Can reduce the amount of litterfall. May alter original forest type (coniferous to deciduous).	Retain riparian area of one tree length from water's edge. Boreal forests may need to be wider.(2)
Woody debris	Persistent source of carbon and forms critical structural features for stream ecosystems.	Can reduce the amount of coarse woody debris. Changes from reduced input may not be observed for a long time.	Retain one tree length from the water's edge.(2)
Structural support	Vegetation roots anchor the streambank, floodplain and lakeshore soils, and increase their resistance to erosion and scour.	Removal destabilizes banks and can cause sedimentation.	Retain vegetation along the shore.(2)

Table 1.1 (continued)

Function	Function Description	Potential Impact of Forestry	Management Strategy
Evapotranspiration	Returns large amounts of water to the atmosphere via evapotranspiration and thereby increases the thickness of the unsaturated zone above the water table. Available storage for moisture is maximized as is the residence time of water passing from the uplands as subsurface flow to streams, rivers, wetlands and lakes.	Removal can increase water yield. Increased runoff and erosion following logging can increase sediment delivery to water.	Keep per cent of drainage basin logged to under 25 per cent.(2) Maintain riparian buffer to mitigate increased water and sediment yield from upland logging.(2)
Overland flow control and sediment deposition	Water holding capacity resulting from evapotranspiration, infiltration capabilities that typically exceed rainfall and snowmelt rates and a hydraulically rough surface combine to efficiently convert overland flow into subsurface flow. Sediments and other suspended materials are deposited on surface when overland flow seeps into the soil.		Keep percentage of drainage basin logged to under 25 per cent.(2) Maintain riparian buffer to mitigate increased water and sediment yield from upland logging.(2) For sediment removal maintain 30 metres riparian buffer (increase with increasing slope); extend along all streams.(3)
Nutrient uptake and assimilation	Nutrients (nitrogen, phosphorous and potassium) are taken up by organisms to fuel growth, development and biomass accumulation. Plant biomass through the decomposition processes slowly converts nutrients back into the soil. Can transform metals, hydrocarbons and pesticides into more benign forms.	Logging generally increases dissolved total phosphorous and total nitrogen. Increases in mercury, potassium and chlorine and decreases in calcium and magnesium have also been observed.	Ratio of percent of drainage basin logged to lake volume should be kept within a certain threshold. Lakes with: • a large catchment area relative to lake volume and/or • a high percentage of wetlands within drainage area should be considered to be high risk factors.(2) For nitrogen/phosphorous, retain 15 metres to 30 m buffer, increase buffer with increasing slope; 30+ metres provide more nitrogen removal. Pesticides and metals maintain minimum 15 metres buffer.(3)

Table 1.1 (continued)

Function	Function Description	Potential Impact of Forestry	Management Strategy
Habitat	Complex and varied characteristics provide diverse, sometimes unique, habitats for aquatic invertebrates, fish, amphibians and reptiles, birds and mammals. RAs are rich in both diversity and abundance of reptiles and amphibians, support many rare and endangered plant and animal species, host greater variety and number of birds than other habitats, and maintain populations of riparian-dependent interior species. Loss of upland forest results in riparian forest acting as refuge for birds and mammals. Riparian width must be wide enough to promote species and ecosystem biodiversity, to provide adequate breeding and foraging habitat, and to serve as travel or migration corridors.	Increased temperature and sedimentation, decreased CWD, and changes in structure of aquatic invertebrate community can negatively affect fish. Loss of habitat and changes in water quality can negatively affect amphibians. Loss of riparian habitat affects riparian obligate species. Loss of riparian habitat results in loss of biodiversity causing ecological concerns. Loss of adequate breeding and foraging habitat affects wildlife populations. Loss of wide enough buffers to provide sufficient habitat for riparian wildlife and plants and to function as corridors linking larger islands of riparian habitat, leading to increased fragmentation of habitat.	Minimize changes in factors affecting fish habitat.(2) Manage based on species present in the area. Identify and protect small/ephemeral streams and ponds.(2) Maintain RA wide enough to provide habitat for riparian obligates.(2) Retain some wider buffers (100 metres) or riparian reserves (60 to 100 metres) to provide habitat for some interior forest species.(2)(4) Vary riparian widths depending on species – birds, small mammals, large mammals, etc. – reptile/amphibian habitat > 30 to 1,000 metres, bird habitat > 40 to 1,600 metres, mammal habitat ≥ 50 metres, plant diversity ≥ 30 metres.(5)(7) Retain some wide riparian tracts (> 100 m) for sensitive interior-dwelling bird species, to increase species richness of breeding bird communities, to ensure values related to wildlife habitat (ex:. wildlife species requiring large home ranges such as black bears and raptors), for maintenance and dispersal of upland species (travel or migration corridors for moose, bear and other animals in fragmented landscape), and to maintain other ecological values such as old growth.(2)(3)(5)(6)(7)(8) To protect diverse terrestrial riparian wildlife communities may require some buffers of at least 100 metres and, in some instances, the protected river corridor may include the floodplain and an additional upland areas on at least one side.(3)

Table 1.2 - Social Values

Function	Function Description	Potential Impact of Forestry	Management Strategy
Aesthetics	Include the most striking and picturesque parts of the landscape.		
Cultural resources	Used by First Nation/Aboriginal people for thousands of years. Seasonal camps, canoe routes and portages are timeless features. Settlements, trading posts, rendezvous sites, traplines and cabins mark the transition from traditional to contemporary lifeways.	Non-renewable	Avoid
Spiritual values	Combination of ecological, aesthetic, cultural and historical values endows RAs with special significance.	Non-renewable	Avoid

Table 1.3 – Economic Values

Function	Function Description	Potential Impact of Forestry	Management Strategy
Wood fibre	Most productive components of the landscape. Certain prescriptions can favourably alter nutrient cycling by replacing a limited number of older trees with a larger number of rapidly growing young trees dispersed throughout the stand. Nutrient uptake and assimilation increases in proportion to rates of biomass accumulation. Harvesting some high-value mature trees before they succumb to windthrow, storm damage, insects, disease or fire; limits economic losses to mortality.		US state level forest cutting practices typically allow removal of up to 50 per cent of basal area once every ten years. Does not include trees within 5 to 10 metres of stream banks.(1)
Wildlife	Hunting (Treaty and Aboriginal rights), cultural, photography and eco-tourism opportunities.	Loss of pre-logging densities of some wildlife and plant species.	Retain some riparian reserve widths from 60 to over 100 metres to preserve wildlife species (both fauna and flora).(4)
Fisheries	Sport and commercial fishery and Treaty and Aboriginal rights.		If RA management plans and on-the-ground activities maintain key ecological functions, stream and lake fisheries should remain largely unaffected by forest harvesting practices.(2)
Recreation	Provides hunting, fishing, bird-watching and eco-tourism opportunities as well as sites for camping, hiking and relaxation.		Avoid conflict by 1) scheduling for winter operations, 2) harvest units with irregular boundaries, patch and vertical structure retention, and 3) rapid and effective natural regeneration to minimize problems.(1)
Non-timber forest products (NTFP)	NTFP are natural products harvested or originating from the forest. They may include but are not limited to mushrooms, berries, natural pharmaceuticals, craft products, seeds, floral greens, medicinal herbs, and landscaping products.		

Sources:

1. Barten, Paul K. 2001. Riparian area management principles and practices: workshop summary report. Prepared for Saskatchewan Environment and Resource Management, Forest Ecosystems Branch, Prince Albert, Saskatchewan. 48 pp.
2. McEachern, G. 2003. Where land and waters meet: understanding and protecting riparian areas in Canada's forests. (Gysbers, J.D., and P. Lee, editors; Carver, M., contributor). Edmonton, Alberta: Global Forest Watch Canada. 39 pp.
3. Wenger, Seth. 1999. A review of the scientific literature on riparian buffer width, extent and vegetation. For the Office of Public Service and Outreach, Institute of Ecology, University of Georgia, Athens, Georgia. 59 pp.
4. Richardson, John S. 2003. Riparian management along headwater streams in coastal British Columbia. Streamline Watershed Management Bulletin, Vol. 7, No. 3, Fall 2003. 3 pp.
5. Lee, Phillip, Smyth, Cheryl, and Boutin, Stan. 2003. Quantitative review of riparian buffer width guidelines from Canada and the United States. J. of Environmental Management 70 (2004), 165-180.
6. Taylor, Peter H. 2002. The space between, lying at the edge of land and water, riparian habitats play a crucial role in the ecosystem. Gulf of Maine Times Fall 2002 (Vol 6, No. 3). 2 pp.
7. Fischer, Richard A., Martin, Chester O., and Fishenich, J. Craig. 2000. Improving riparian buffer strips and corridors for water quality and wildlife. International Conference on Riparian Ecology and Management in Multi-Land Use Watersheds. American Water Resources Association. August. 7 pp.
8. Department of the Army New England Division, Corps of Engineers. 1991. Buffer strips for riparian zone management (a literature review). Section 22 Vermont. Waltham, Massachusetts, January 1991. Prepared for State of Vermont. 56 pp.

Appendix 2 - Using the Riparian Management Decision Framework

The following is an example of using the RMDF. The key that results in the most protection (the widest reserve) is applied.

Step 1 - Information from the PHS will identify the water bodies, soil types, slopes, vegetation types (trees and understorey species), rare and endangered plants and animals, wildlife habitat (snags, usage) and forest health concerns.

The block is located in the boreal shield ecozone. The PHS has indicated a permanent lake, with no social or traditional values within the RMA. The RMA is described as having a fine textured soil and a RMA slope (measured from the boundary between the RA and the RMA towards the direction of the slope/cutblock) of six per cent. The V-type has been classified as V18. (Black Spruce mixedwood/feather moss – Upland black spruce dominated mixedwoods. The herb and shrub understories are often poorly developed. Extensive feather moss characterizes the forest floor. Occurring on fresh, well-drained fine–textured soils. (Overstorey – BS, TA, JP, WB, BP)) (Zoladeski, C.A., Wickware, G.M., Delorme, R.J., Sims, R.A., and Corns, I.G.W. 1995) The survey does note two instances of moose scat. However, there is no note of any sensitive wildlife presence (ex: woodland caribou, mineral licks, rookeries). As well there is no known presence of any plant or animal species identified by *SARA, MESA*, a COSEWIC assessed species or species of conservation concern. The survey also identified a low level of armillaria root rot disease within the harvest block design.

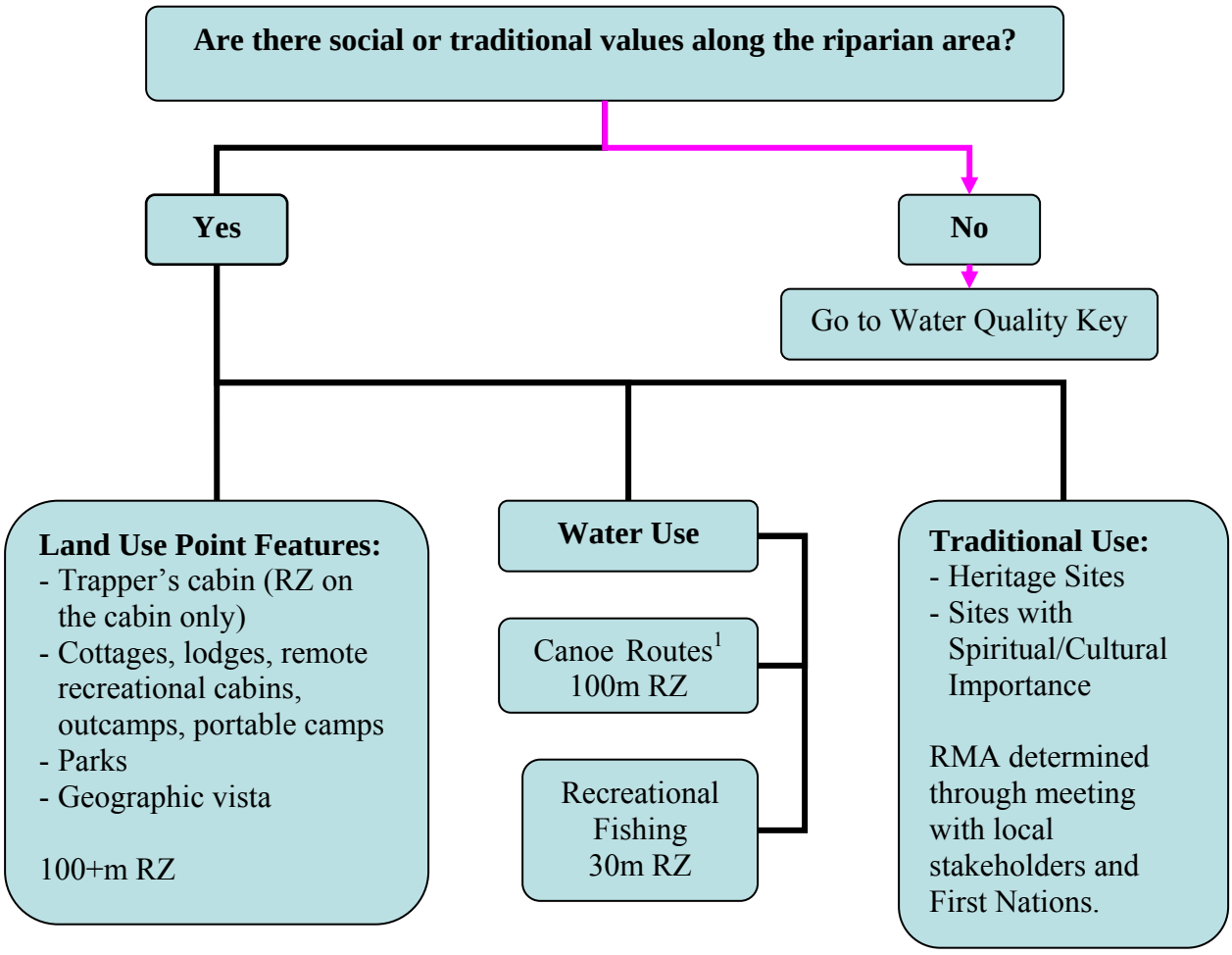
Step 2 - Social and Traditional Values Key
The user reviews the social and traditional values key knowing that this lake is not a designated canoe route. As well, there is no boat access and the operating area is not heavily used for recreation. There are no heritage sites or areas of cultural importance within the RMA. The outcome of working through the social and traditional values key is to move to the water quality key.

Social and Traditional Values Key

Objective: to protect social and traditional (cultural) values

Protection required for these values is determined by consultation with the stakeholders and First Nations. Ultimately the RZ is determined by the IRMT.
Key Rules: harvest is by prescription within the MZ, see Table 2

– RZ is a **no harvest zone** adjacent to the RA



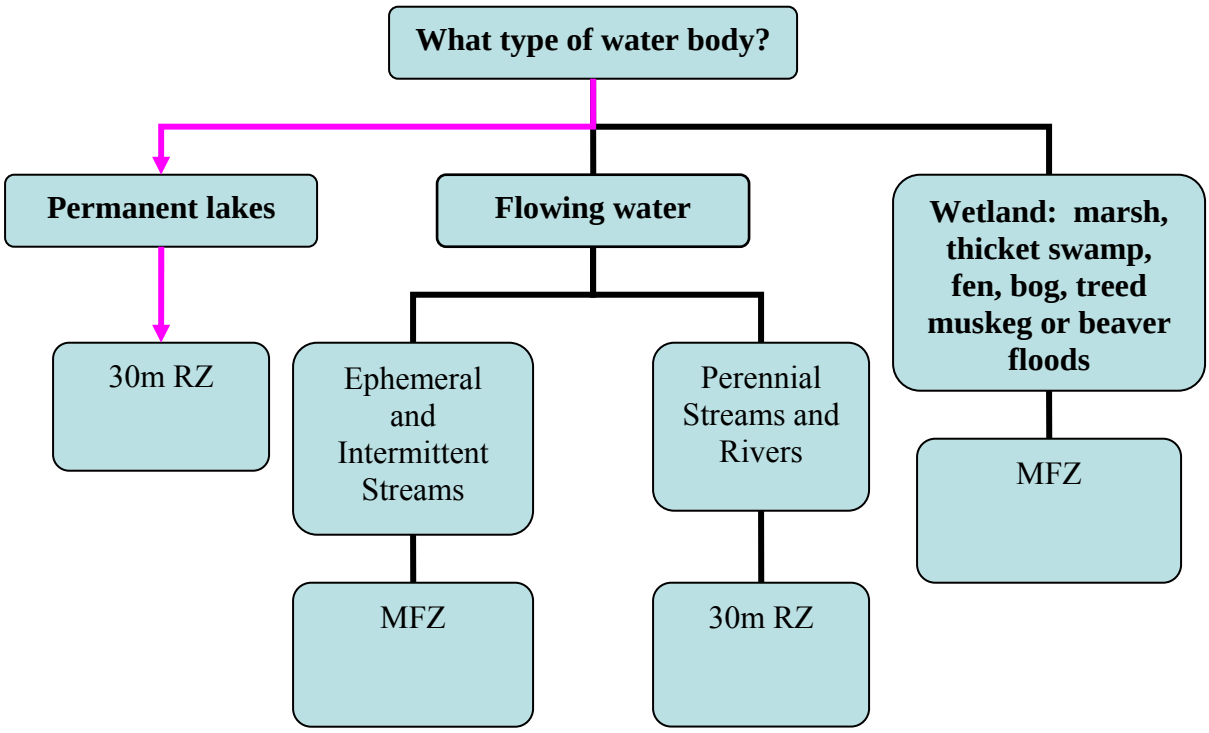
[1]Designated route or other routes well used and identified to the IRMT.

Step 3 - Water Quality Key
Working through the Water Quality key with the water feature *Permanent Lake* results in a RZ of 30 metres.

Water Quality Key

Objective: to protect water quality

Key Rules: harvest by prescription within the MZ, see Table 2
- RZ is a **no harvest zone** adjacent to the RA
- the outcome of any key may be overridden by the IRMT



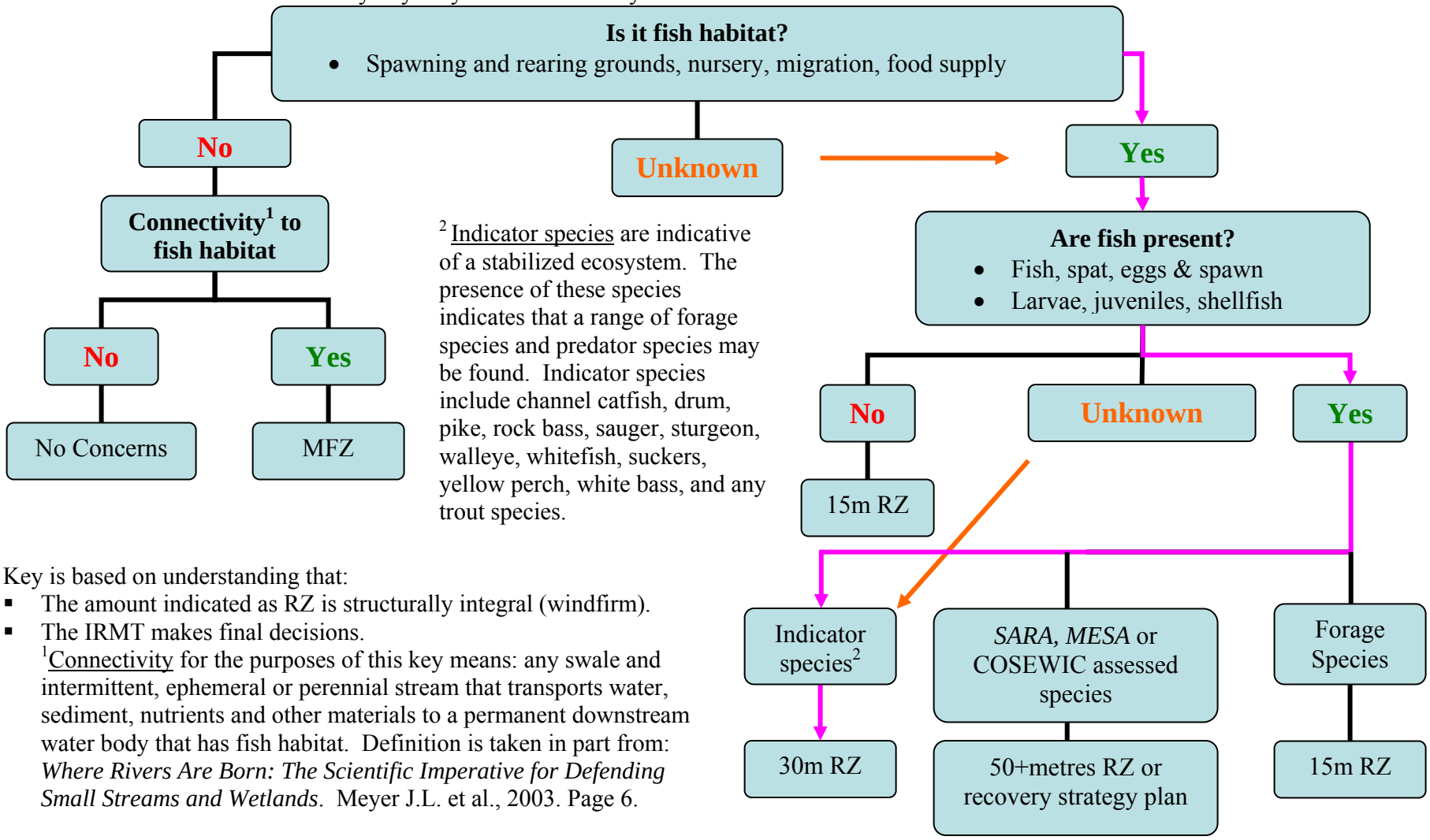
Step 4 - Fish Key (30 metre RZ carried forward)
Fish are present in this lake (walleye and pike are the primary species), they are *indicator species*. Therefore, the result of working through the key is a 30 metre RZ.

Fish Key

Objective: to protect fish and fish habitat

Key Rules: harvest by prescription within the MZ, see Table 2

- RZ is a **no harvest zone** adjacent to the RA
- the outcome of any key may be overridden by the IRMT



[2] Indicator species are indicative of a stabilized ecosystem. The presence of these species indicates that a range of forage species and predator species may be found. Indicator species include channel catfish, drum, pike, rock bass, sauger, sturgeon, walleye, whitefish, suckers, yellow perch, white bass, and any trout species.

Key is based on understanding that:

- The amount indicated as RZ is structurally integral (windfirm).
- The IRMT makes final decisions.

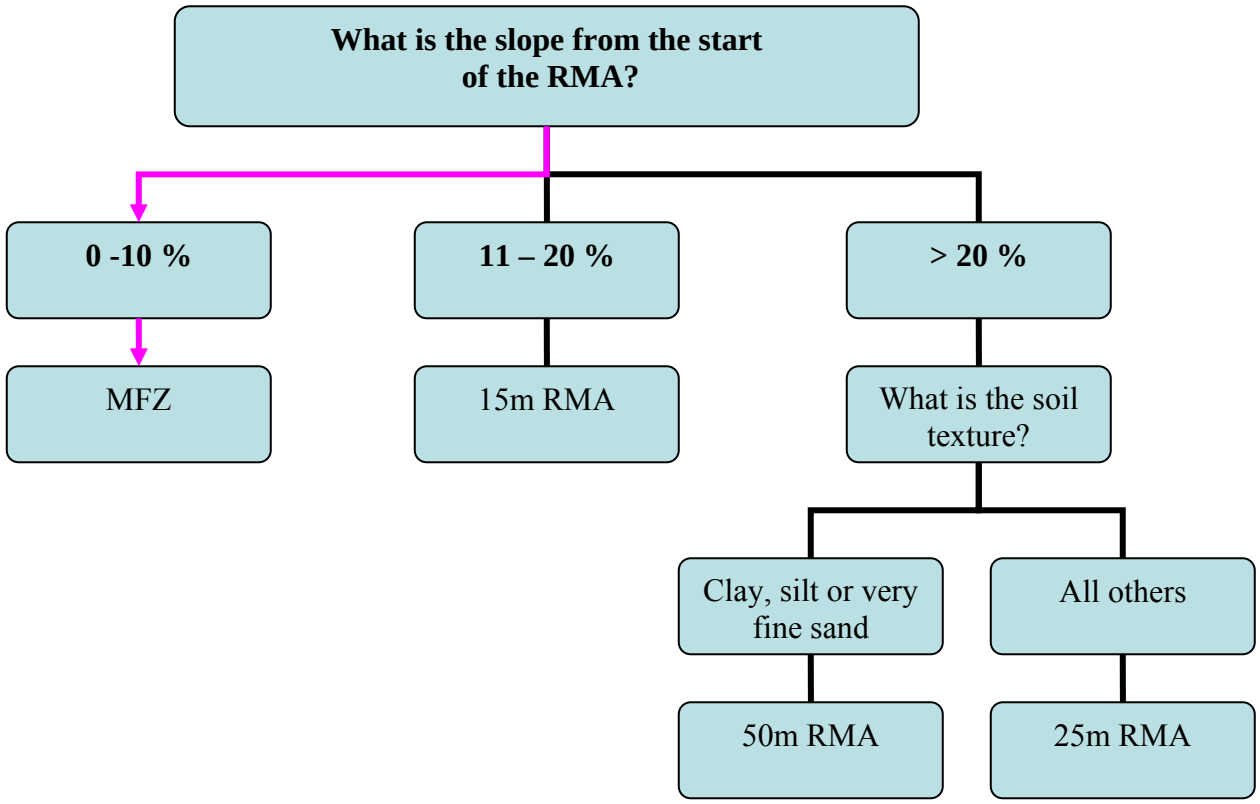
[1] Connectivity for the purposes of this key means: any swale and intermittent, ephemeral or perennial stream that transports water, sediment, nutrients and other materials to a permanent downstream water body that has fish habitat. Definition is taken in part from: *Where Rivers Are Born: The Scientific Imperative for Defending Small Streams and Wetlands*. Meyer J.L. et al., 2003. Page 6.

Step 5 - Soil Key (30 metre RZ carried forward)
The PHS indicated the soil type as fine textured, with a slope of 6 per cent (measured from the boundary between the RA and the RMA towards the direction of the slope/cutblock).
A RZ of 30 metre has been carried forward from the Fish Key. The Soil Key indicates a MFZ, but because the RZ of 30 metres offers more protection it will be carried forward.

Soil Key

Objective: to prevent erosion and maintain water quality

Key Rules: harvest by prescription within the MZ, see Table 2
- RZ is a **no harvest zone** adjacent to the RA
- the outcome of any key may be overridden by the IRMT

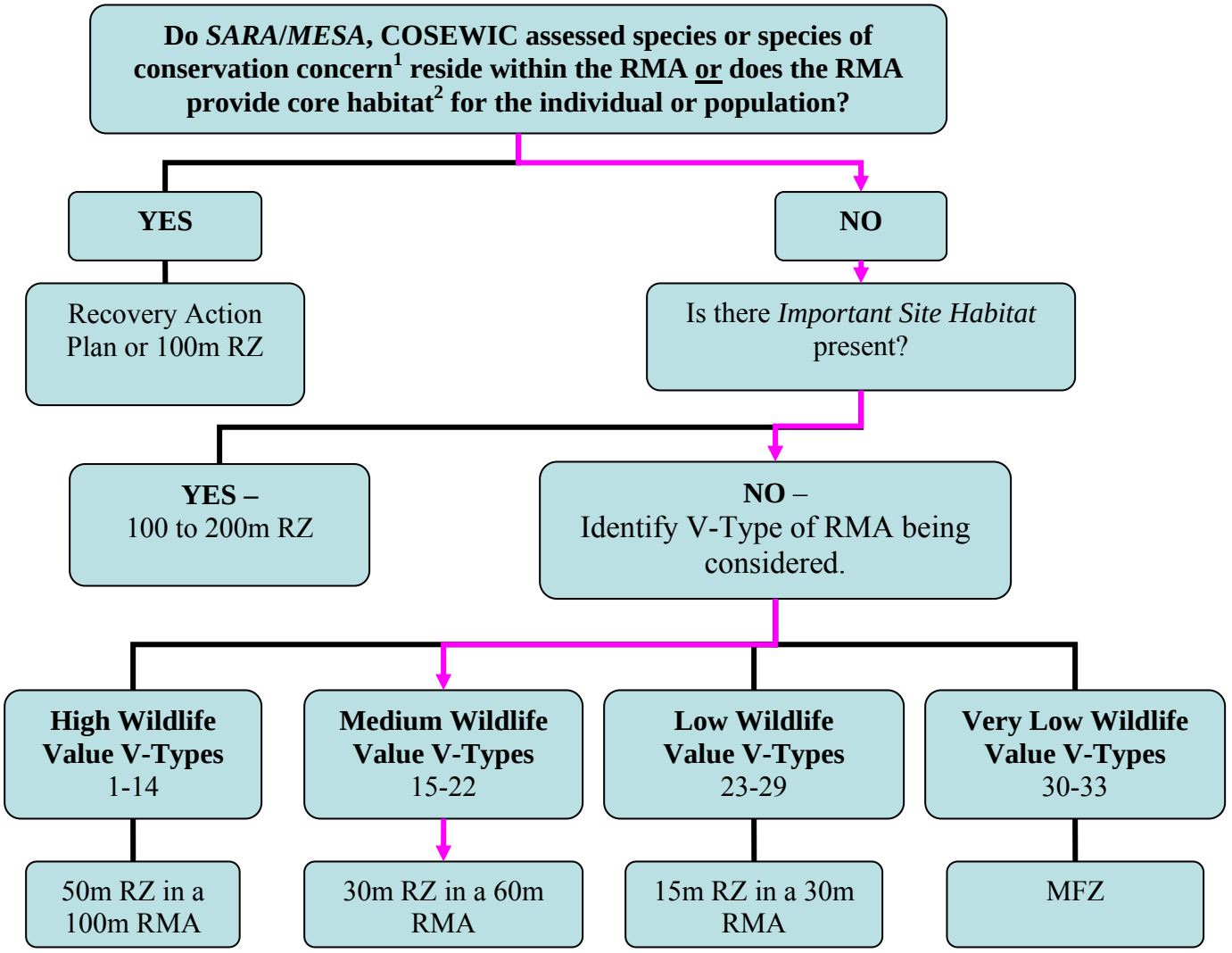


Step 6 - Wildlife Key Boreal Shield Ecozone (30 metre RZ carried forward)
There is no evidence of *SARA, MESA*, COSEWIC assessed species or species of conservation concern residing within the RMA or using the RMA as core habitat as identified by the PHS. As well there is no known *Important Site Habitat* present for the area. The V-Type has been classified as V18, which is considered medium in terms of wildlife values. The result of the wildlife key results in a RZ of 30 metres in a 60 metre RMA.

Wildlife Key – Boreal Shield Ecozone

Objective: to protect wildlife and wildlife habitat

Key Rules: harvest by prescription within the MZ, see Table 2
- RZ is the **no harvest zone** adjacent to the RA
- the outcome of any key may be overridden by the IRMT

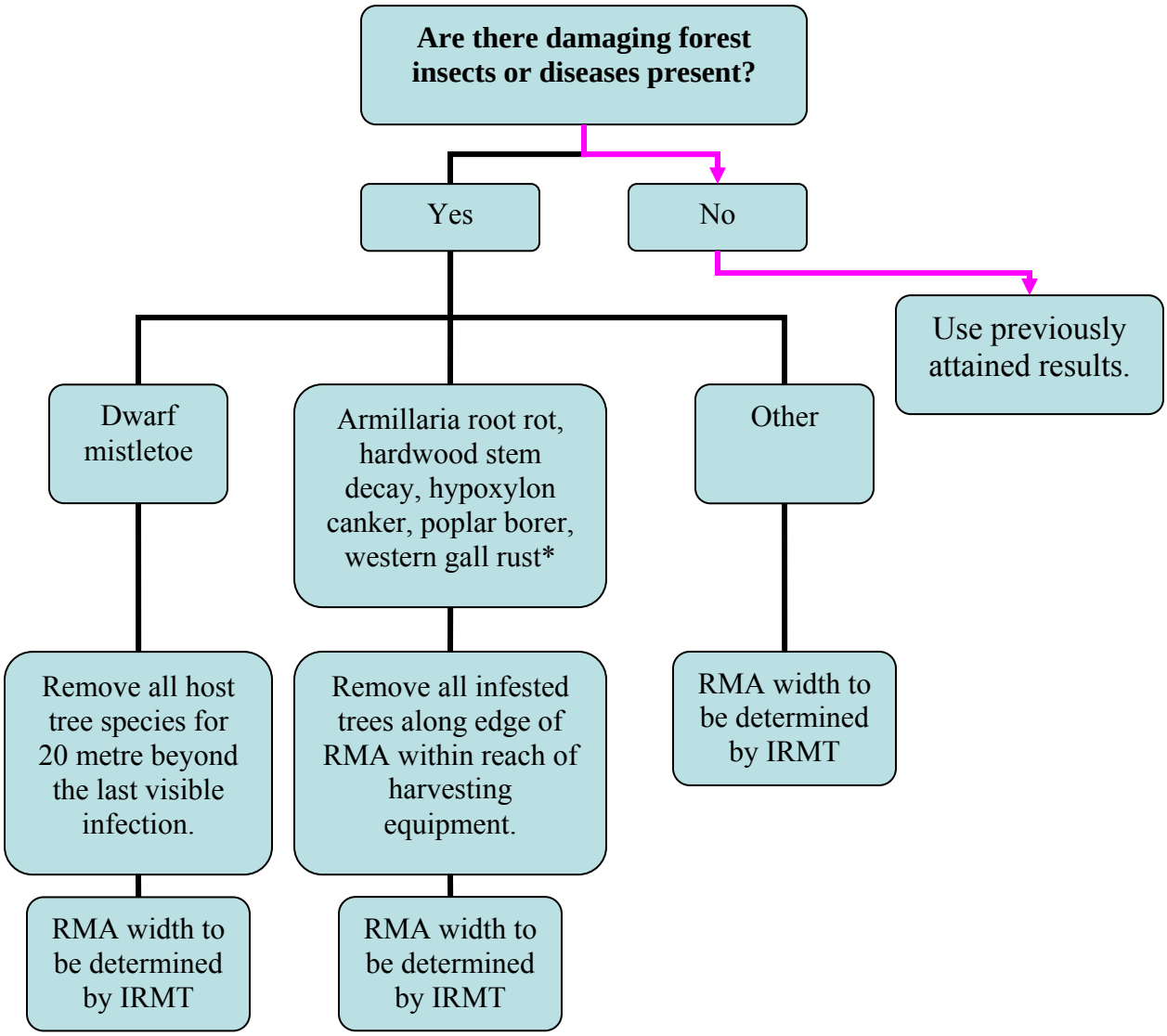


[1] Species of conservation concern as determined by the Manitoba Conservation Data Centre
[2] Core habitat - areas used repetitively (seasonally/annually) rather than occasionally or infrequently

Step 7 - Forest Health Key (30 metre RZ in a 60 metre RMA carried forward)
There is presence of armillaria root rot within the harvest block, but as none appeared in the RMA, there is no modification to the 30 metre RZ in a 60 metre RMA carried forward.

Forest Health Key

Objective: to reduce the impact of forest insects and diseases on the regenerating stand



* If these pests are prevalent or severe throughout the RMA expect its structure and integrity to be compromised because extensive tree mortality or breakage will occur more rapidly than in an uninfested RMA

Outcome of RMDF – 30 metre RZ in a 60 metre RMA

Other Management Considerations

Once the RMDF keys have been completed, it is necessary to consider other values and/or concerns that may be a factor in determining a RMA width. Other considerations may include season of harvest, forest cover types, natural disturbance patterns, wood supply, windthrow potential, fire risk, line of sight and economics (Table 3).
If there are no other management considerations, the appropriate zone and width as determined through the use of the keys will be incorporated into the AOP.

Appendix 3 – Legislation

The *Species at Risk Act*

In 2003, the *Species at Risk Act* (SARA) was proclaimed. The act protects wildlife species at risk in Canada. Within the act, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was established as an independent body of experts responsible for identifying and assessing species considered to be at risk. This is the first step towards protecting species at risk. Subsequent steps include COSEWIC reporting its results to the Canadian government and the public, and the minister of the environment's official response to the assessment results. Species that have been designated by COSEWIC may then qualify for legal protection and recovery under SARA.

www.sararegistry.gc.ca/default_e.cfm

The Committee on the Status of Endangered Wildlife in Canada

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was established in 1977 to provide Canadians with a single, scientifically sound classification of wildlife species at risk of extinction. COSEWIC began its assessments in 1978 and has met each year since then to assess species. COSEWIC uses a process based on science, Aboriginal traditional knowledge and community knowledge to assess the risk of extinction for species. Its process is thorough, independent and transparent.

www.cosewic.gc.ca/eng/sct6/sct6_6_e.cfm

The Manitoba *Endangered Species Act*

The Endangered Species Act ensures the protection and enhances the survival of threatened and endangered species in Manitoba. The act also enables reintroduction of extirpated species into the province, and designate species as threatened, endangered, extirpated or extinct. This legislation may be applied to any mammal, bird, reptile, amphibian, fish, or plant, living or dead. The act is binding on the Crown and Crown agencies and applies to all lands in Manitoba. A species is not protected until such time as it has been declared by regulation under the act to be threatened, endangered, extirpated or extinct.

www.gov.mb.ca/conservation/wildlife/legislation/endang_act.html

The Manitoba Conservation Data Centre

web2.gov.mb.ca/conservation/cdc/index.php

Appendix 4 - Riparian Management at a Landscape Scale

Manitoba is characterized by five different ecozones: Taiga Shield, Hudson Plains, Boreal Shield, Boreal Plains and Prairie. Within these ecozones, Manitoba is subdivided into 18 different ecoregions that have distinct regional ecological factors which include climate, physiography, vegetation, soil, water and fauna (Ecological Stratification Working Group 1995). Water, in particular, comprises approximately 1/6 of the total area in Manitoba in the form of lakes, rivers and streams (*The Manitoba Water Strategy* 2003), not including wetlands. RAs within forested landscapes are often zones of high biodiversity because of the interactions between ecological elements that create variable environmental conditions, suitable for a highly diverse community of plant and animal species.

The diverse landscape within Manitoba allows land use activities that comprise the majority of the province's economic base. Land use development such as agriculture, forestry, mining and hydroelectricity are all important to the growth and stability of the Manitoba economy. However, all of these activities can severely affect the environment, if sustainable BMPs are not implemented. More specifically, effects associated with water quality and quantity, changes in biodiversity and climate change are of primary concern within the province. In most cases, land use activities are making progress towards implementing new knowledge gained through research and monitoring initiatives, and developing BMPs to ensure environmental effects are minimized – this process has been termed *adaptive management*.

Over the past 10 years in Canada, progress towards understanding forest fire frequency and patterns, both historical and present day events, have led forest managers to develop practices intended to emulate natural disturbance patterns or elements of natural disturbances on the landscape. The natural disturbance model suggests the creation of a near natural landscape by providing variable age classes, stand types and residual structure within managed and unmanaged areas across the landscape. This landscape variability will assist in conserving biodiversity in the boreal forest. Natural disturbances such as forest fires, do not discriminate between upland forest and riparian forest. In most cases, wildfire characteristics, such as heat intensity, become the deterministic factors which lead to either ground fires, canopy fires or both. Essentially, forest fires and other natural disturbances in the boreal forest are the tools that implement forest rejuvenation. Currently, fire suppression practices and the implementation of no-cut buffer strips left along water bodies and watercourses are reducing the opportunity for forest rejuvenation processes. These processes are required to ensure long-term health of riparian forests and the water bodies with which they are associated.

Beavers also cause significant disturbances across the landscape. This influence is not well understood either spatially or temporally. However, their role in maintaining habitat heterogeneity could be as important as abiotic disturbances such as fire or wind (Wright *et al.* 2002). Beavers play a significant role in forming and maintaining RAs, particularly their effect on its vegetation structure and composition.

Harvesting options in RMAs could reduce the overall footprint on the landscape. Harvesting wood from some RMAs may help reduce road density and the amount of landscape in a harvested state, and increase the potential for larger core forest areas, while maintaining suitable patch size

distribution. Maintaining old growth forests on the landscape is imperative for those species dependent on old growth but for which riparian buffers may not represent suitable habitat because of configuration or proximity to a water body.

Appendix 5 - Definitions for Riparian Areas

There is much ambiguity surrounding the term "riparian." An overview of existing literature suggests that no single definition is used across studies or even across governments and other regulatory bodies. In some schools of thought the Latin roots of the term dictate that flowing water be involved in the definition. For example, the American Society of Fisheries (2005) defines RAs as "complex assemblages of organisms and their environments existing adjacent to and near *flowing* water." Other schools of thought include both lotic and lentic ecosystems by suggesting that RAs are simply, "…interfaces between aquatic and terrestrial systems" (Gregory *et al*. 1991). Indeed, there are several working definitions which depend largely on whether the intent of the definition is ecological or management oriented.

The idea that RAs are transition areas or ecotones provides one of the strongest ecological definitions. Ilhardt (2000), for example, suggests that RAs are, "…three-dimensional ecotones of interactions that include terrestrial and aquatic ecosystems, that extend down to the ground water, up above the canopy, outward across the floodplain, up the near slopes that drain to the water, laterally into the terrestrial ecosystem, and along the water course at variable width." This, thorough definition, addresses several important elements of riparian habitats such as their proximity to a water body, their probabilistic nature and their temporal and spatial variability. A probabilistic approach to understanding RAs is appropriate because the closer a habitat is to water the more likely it is to be considered riparian. However, there is no set distance at which ecosystems cease to be considered riparian. Attempts to draw such a boundary are inappropriate because the same boundary does not apply to all species. For example, at a stand scale Harper and Macdonald (2001) found that riparian mixedwood forest understorey vegetation communities showed edge effects up to 40 to 60 metres into the forest. While examining a similar question at a different scale Macdonald *et al.* (2004) found there was very little difference between the overall stand composition of riparian forests and that of the surrounding landscape.

The inherent landscape variability that is typical of boreal forest ecosystems is carried through to the presence of a wide range of aquatic habitat types (ex: rivers, lakes, marshes, bogs, fens and swamps). Each of these wetland types supports riparian habitats with a diverse vegetation community that also varies with respect to interactive factors such as topographic setting, soils, and hydrologic features (Gregory *et al*. 1991). Adding one final dimension to the definition of RAs, the undulations and meanderings of flowing systems throughout the landscape often result in what some authors term a riparian wetland or wetlands associated with a body of flowing water (Toner and Keddy 1997). Thus, RAs are not restricted to any particular vegetation class but can generally be identified by their proximity to a water body. Additionally, RAs are subject to drying events and flooding events that vary in space and in time, thus creating a complex series of habitat types across landscapes.

In a management context, the term riparian is often used in a slightly different way. A RMA (or riparian management zone) can be defined as the area near water in which management activities by forestry or other industry are permitted to take place. For example, regulations governing industrial forestry require that a strip of forest of specified width be left undisturbed (buffer strip) adjacent to a water body. In some jurisdictions the measurement of the buffer strip width is

calculated from the high water mark while in others it is calculated from the edge of merchantable timber. Thus, a buffer strip is not always entirely mature forest.

Glossary of Terms

Adaptive management – Active adaptive management is a systematic process of modeling, experimentation, and monitoring to compare the outcomes of alternative management actions (Farr 2000). Adaptive Management describes an iterative process designed to improve the rate of learning about the management of complex systems. The process incorporates an explicit acknowledgement of uncertainties and knowledge gaps about the response of the system to management actions" (Farr 2000).

Active adaptive management involves constructing a range of alternative response models (hypotheses) based on existing data, calculating the long-term value of knowing which is correct, and then weighing this long-term value against any short-term costs incurred in finding out which is correct. Active adaptive management involves deliberately perturbing the system to discriminate between alternative models (hypotheses). (Taylor *et al.* 1997).

Bog – Bogs are peat-covered wetlands (peatlands) in which the vegetation shows the effects of a high water table and a general lack of nutrients. The bog surface is often raised, but if it is flat or level with the surrounding wetlands, it is virtually isolated from mineralized soil waters. Hence, the surface waters of bogs are strongly acid and the upper peat layers are extremely deficient in nutrients. Peat is usually formed *in situ* under closed drainage and low oxygen. The thickness of peat exceeds 40 centimetres. Cushion-forming sphagnum mosses are common, along with heath shrubs. Trees may be absent; if present, they form open-canopied forests of low, stunted trees (National Wetland Working Group 1997).

Clearcut – An entire stand of trees is cleared at one time. This results in the establishment of a new even-aged stand of trees by either natural or assisted regeneration.

Core habitat – Areas used repetitively (seasonally/annually) rather than occasionally or infrequently. The term core habitat is meant to convey a consistent interpretation of use based on data from studies (K. Whaley 2006).

Disturbance – A significant change in the structure and/or composition of ecosystems, communities or populations through natural or human induced events (Canadian Council of Forest Ministers (CCFM) 2000).

Ecozone – a broad scale ecological unit that is based on patterns that include climate, geography and ecological diversity. A framework of 15 ecozones, subdivided into 53 ecoprovinces, 194 ecoregions and 1,020 ecodistricts is the national ecological classification of Canada (CCFM 2000).

Ephemeral stream – A stream that flows briefly only in direct response to precipitation in the immediate locality and whose channel is at all times above the water table (Dunster 1996).

Fen - Fens are peatlands characterized by a high water table, but with very slow internal drainage by seepage down very low gradient slopes. The oxygen saturation is relatively low but higher than in bogs. A slow moving water table is enriched by nutrients from upslope material and thus fens are more minerotrophic than bogs. The thickness of peat generally exceeds 40 centimetres.

The vegetation in fens usually reflects the water quality and quantity available, resulting in three basic types: graminoid fens without trees or shrubs, shrub fens, and treed fens. (National Wetland Working Group 1997).

Forest practices - Activities conducted during all stages of forest management. Examples are surveys, harvesting, road construction, and silviculture.

Geographic vista – a pleasing view relating to the arrangement of places and physical features.

Guidebook - A collection of policies, guidelines, procedures and standards related to a specific forest practice.

Guideline - Alternative procedures or standards that can be applied to satisfy the principle upon which the guidelines are based. Specific guidelines are enforceable when identified on Work Permits.

Important site habitat – Habitat required by a wildlife species and which affects the population attainable by that species. The absence of this habitat will not necessarily prohibit the species from occurring in the area (Manitoba Natural Resources 1989).

Integrated resource management team (IRMT) – A regional team organized to review natural resource issues and comprised of members of MC (Forestry, Wildlife and Ecosystems Protection, Regional Operations, Lands, Parks and Natural Areas) and Manitoba Water Stewardship (Fisheries and Water Quality).

Intermittent stream – Is a stream in contact with the groundwater table that flows only at certain times of the year, such as when the groundwater table is high and/or when it receives water from springs or from some surface source such as melting snow. It ceases to flow above the stream bed when losses from evaporation or seepage exceed the available streamflow (Dunster 1996).

Lake – A lake is a sizable water body surrounded by land and fed by rivers, springs, or local precipitation (Environment Canada 2004) and generally greater than 2 metres in depth. A lake has three zones: littoral zone, which is a sloped area that is close to land; open-water zone, where sunlight is abundant; and deep-water zone, where little sunlight can reach. A lake may be deposited with minerals and sediment, and gradually, the lake becomes a wetland, such as a swamp or marsh. Because of this process of succession it can be difficult to assign a water body to a particular class (Wetzel 2001).

Landscape design - driven by biodiversity concerns rather than just timber harvest scheduling, the strategic deployment of forest management effort in space and time is undertaken; coinciding with a greater emphasis on "coarse filter" management of habitats rather than single species and taking into account that most forests have to be managed over large spatial scales and long time frames to produce desired goods and services in perpetuity (Burton *et al.* 2003).

Machine free zone (MFZ) – The MFZ is a zone located within the RMA, adjacent to the RA, in which no ground disturbance will take place but will be harvested by reaching in with harvesting

equipment (approximate reach is 7 m). No harvesters, skidders, site preparation or scarification equipment is permitted in the MFZ. The MFZ will use BMPs for the protection of the water bodies.

Marsh – Marshes are wetlands that are periodically inundated by standing or slowly moving water and hence are rich in nutrients. Marshes are mainly wet, mineral-soil areas, but shallow, well-decomposed peat may be present. Marshes are subject to a gravitational water table, but water remains within the rooting zone of plants for most of the growing season. Waters are usually circumneutral to slightly alkaline, and there is a relatively high oxygen saturation. They are characterized by an emergent vegetation of reeds, rushes, or sedges (National Wetland Working Group 1997).

Merchantable – A tree or stand of trees is considered to be merchantable once it has reached a size, quality, volume, or a combination of these that permits harvesting and processing. Merchantability is independent of economic factors, such as road accessibility or logging feasibility (Dunster 1996).

Perennial or Permanent Stream – A stream that flows continuously throughout the year (Dunster 1996).

Policy - A deliberately chosen course of action. Policy in this document refers to governing principles and corresponding procedure and standards of the provincial government.

Procedures – A step or series of steps taken to put into practice a policy or guideline.

Recovery Action Plan – A plan that gives details about the actions or conditions necessary to promote a species recovery.

Riparian Area (RA) - Riparian area means an area of land on the banks or in the vicinity of a waterbody, which due to the presence of water supports, or in the absence of human intervention would naturally support, an ecosystem that is distinctly different from that of adjacent upland areas *(The Water Protection Act* 2005*).* For operational purposes, the RA will end at the edge of the merchantable forest. No forestry activity will be permitted within the RA.

Riparian Management Area (RMA) - The RMA is the forested area adjacent to the RA in which forest management activities can take place. A RMA can be comprised of the following zones: machine free zone (MFZ), MFZ and management zone (MZ), reserve zone (RZ), RZ and MZ, or in some cases only best management practices (BMPs) may be applied.

River – Rivers are natural drainage channels for surface waters. Surface waters are received from two major sources: *runoff* and *base flow*. Runoff is that part of precipitation that flows toward the rivers or streams on the ground surface or within the soil (subsurface runoff or interflow). Base flow is the part of stream flow that enters the stream channel from groundwater. A river's watershed or drainage basin – the area supplying it with water – is separated from the watersheds of neighbouring rivers by higher lands called *drainage divides* (Environment Canada. 2004).

Stakeholder – Anybody who feels that his/her interests will be affected by the outcome of a decision making process. These interests do not have to be of a financial nature, but may include a whole range of human values, such as the need for natural justice, religious value, ecological principles, and a longing for environmental protection (Dunster 1996).

Standards – Descriptions of targets or goals used to measure the success of procedures. They may be general or specific.

Succession - changes in species composition of an ecosystem over time, often in a predictable order (CCFM 2000).

Sustainable Forest Management – Management that maintains and enhances the long-term health of forest ecosystems for the benefit of all living things while providing environmental, economic, social and cultural opportunities for present and future generations (CCFM 2000).

Swamp – Swamps are wetlands where standing or gently moving waters occur seasonally or persist for long periods, leaving the subsurface continuously waterlogged. The water may also be present as a subsurface flow of mineralized water. The water table may drop seasonally below the rooting zone of the vegetation, creating aerated conditions at the surface. Swamp waters are circumneutral to moderately acid in reaction, and show little deficiency in oxygen or mineral nutrients. Their substrate consists of mixtures of mineral and organic materials, or woody, well-decomposed peat deposited in situ. The vegetation may consist of dense coniferous or deciduous forest, or tall shrub thickets (National Wetland Working Group 1997).

Water body - Means any body of flowing or standing water, whether naturally or artificially created, and whether the flow or presence of water is continuous, intermittent or occurs only during a flood, including but not limited to a lake, river, creek, stream, and wetland (slough, marsh, swamp, etc.), including ice on any of them (*The Water Protection Act* 2005).

Wetlands - Land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation, and various kinds of biological activity which are adapted to a wet environment. Generally less than approximately 2 metres in depth (National Wetland Working Group 1997).

Wildlife – A species, subspecies or biologically distinct population of animal, plant, or other organism, other than a bacterium or virus, that is wild by nature and native to Canada or has been present in Canada without human intervention for at least 50 years (*Species at Risk Act* 2002).

Literature Cited

American Society of Fisheries. 2005. www.fisheries.org/html/Public_Affairs/Policy_Statements/ps_14.shtml

Barten, Paul K. 2001. Riparian area management principles and practices: workshop summary report. Prepared for Saskatchewan Environment and Resource Management, Forest Ecosystems Branch, Prince Albert, Saskatchewan. 48 pp.

Burton, P.J., Messier, C., Weetman, G.F., Prepas, E.E., Adamowicz, W.L. and Tittler, R. 2003. The current state of boreal forestry and the drive for change. Chapter 1. In: Towards sustainable management of the boreal forest. Edited by P.J. Burton, C. Messier, D.W. Smith, and W. L. Adamowicz. NRC Research Press, Ottawa, Ontario, Canada. pp 1-40

Canadian Council of Forest Ministers (CCFM). 2000. Criteria and indicators of sustainable forest management in Canada. National status. www.ccfm.org/ci/national_status_full_report2000_e.pdf

Department of the Army New England Division, Corps of Engineers. 1991. Buffer strips for riparian zone management (a literature review). Section 22 Vermont. Waltham, Massachusetts, January 1991. Prepared for State of Vermont. 56 pp.

Dunster, Julian and Katherine. 1996. Dictionary of natural resource management. UBC Press. Vancouver B.C. 363 pp.

Ecological Stratification Working Group. 1995. A national ecological framework for Canada. Agriculture and Agri-Food Canada, Research Branch, Centre for Land and Biological Resources Research and Environment Canada, State of the Environment Directorate, Ecozone Analysis Branch, Ottawa/Hull. Report and national map at 1:7,500,000 scale. 125 pp.

Environment Canada. 2004.1 pp. www.ec.gc.ca/water/en/nature/rivers/e_riv.htm

Farr, D. 2000. Defining adaptive management. Adaptive Management Experiment – Report No. 3. 6 pp. www.ameteam.ca/About%20Flame/AAMdefinition.PDF

Fischer, Richard A., Martin, Chester O., and Fishenich, J. Craig. 2000. Improving riparian buffer strips and corridors for water quality and wildlife. International Conference on Riparian Ecology and Management in Multi-Land Use Watersheds. American Water Resources Association. 7 pp.

Fisheries and Oceans and Manitoba Natural Resources. 1996. Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat. www.gov.mb.ca/conservation/fish/images/stream.pdf 53 pp

Gregory, S.V., Swanson, F.J., McKee, W.A. and Cummins, K.W. 1991. An ecosystem perspective of riparian zones focus on links between land and water. BioScience 41(8):540-551.

Harper, K.A., and Macdonald, S.E. 2001. Structure and composition of riparian boreal forest: new methods for analyzing edge influence. Ecology 82:649-659.

Ilhardt, B.L., Verry, E.S., and Palik, B.J. 2000. Defining riparian areas. In: Riparian management in forests of the continental eastern United States. Edited by E.S.Verry, J.W. Hornbeck, and C.A.Dolloff. Lewis Publishers, Boca Raton, Florida. pp 23-42.

Lee, Phillip, Smyth, Cheryl, and Boutin, Stan. 2003. Quantitative review of riparian buffer width guidelines from Canada and the United States. J. of Environmental Management 70 (2004):165-180.

Macdonald, E., Burgess, C. J., Scrimgeour, G. J., Boutin, S., Reedyk, S., and Kotak, B. 2004. Should riparian buffers be part of forest management based on emulation of natural disturbance? Forest Ecology and Management 187:185-196.

Manitoba Conservation. 2005. Forestry Road Management. Forest Practices Guidebook. 28 pp.

Manitoba Natural Resources. 1996. Manitoba Natural Resources Consolidated Buffer Management Guidelines. 4 pp.

Manitoba Natural Resources. 1989. Forest Management Guidelines for Wildlife in Manitoba. 14 pp.

McEachern G. 2003. Where land and waters meet: understanding and protecting riparian areas in Canada's forests. Edited by J.D. Gysbers and P. Lee; M. Carver, contributor. Edmonton Alberta: Global Forest Watch Canada. 39 pp.

Meyer, J.L., Kaplan, L.A., Newbold, D., Strayer, D.L., Woltemade, C.J., Zedler, J.B., Beilfuss, R., Carpenter, Q., Semlitsch, R., Watzin, M.C., and Zedler, P.H. 2003. Where rivers are born: The scientific imperative for defending small streams and wetlands. 23 pp. Sponsored by American Rivers and Sierra Club. Website address: www.americanrivers.org/site/DocServer/WhereRiversAreBorn1.pdf?docID=182

National Wetland Working Group. 1997. The Canadian Wetland Classification System, 2nd edition. Edited by B.G. Warner and C.D.A. Rubec. Wetlands Resource Centre, University of Waterloo, Waterloo, ON. 68 pp.

Palik, Brian J., Zasada, John C., and Hedman, Craig. 2000. Ecological principles for riparian silviculture. In: Riparian management in forests of the continental eastern United States. Edited by Elon S.Verry, James W. Hornbeck and C. Andrew Dolloff. CRC Press LLC. 233-254 pp.

Richardson, John S. 2003. Riparian management along headwater streams in coastal British Columbia. Streamline Watershed Management Bulletin, Vol. 7, No. 3, Fall 2003. 3 pp.

Species at Risk Act (SARA). 2002. 97 pp www.sararegistry.gc.ca/the_act/SARA_e.pdl

Taylor, B., Kremsater, L., and Ellis, R. 1997. Adaptive management of forests in British Columbia. BC Ministry of Forests, Forest Practices Branch, Victoria, BC. 93 pp. Available at: www.for.gov.bc.ca/hfd/pubs/docs/sil/sil426.htm

Taylor, Peter H. 2002. The space between, lying at the edge of land and water, riparian habitats play a crucial role in the ecosystem. Gulf of Maine Times Fall 2002 (Vol 6, No. 3). 2 pp.

The Manitoba Water Strategy 2003. www.gov.mb.ca/waterstewardship/waterstrategy/pdf/water-strategy.pdf

The Water Protection Act. 2005. http://web2.gov.mb.ca/laws/statutes/ccsm/w065e.php

Toner, M. and Keddy, P. 1997. River hydrology and riparian wetlands: a predictive model for ecological assembly. Ecological Applications 7:236-246.

Whaley, K. 2006. Regional Wildlife Manager, Manitoba Conservation. Personal communication.

Wenger, Seth. 1999. A review of the scientific literature on riparian buffer width, extent and vegetation. For the Office of Public Service and Outreach, Institute of Ecology, University of Georgia, Athens, Georgia. Revised Version. 59 pp.

Wetzel, R.G. 2001. Limnology: lake and river ecosystems. 3rd Edition. Academic Press. 1006 pp.

Wright, J.P., Jones, C.G., and Flecker, A.S. 2002. An ecosystem engineer, the beaver, increases species richness at the landscape level. Oecologia 132:96-191.

Zoladeski, C.A., Wickware, G.M., Delorme, R.J., Sims, R.A., and Corns, I.G.W. 1995. Forest ecosystem classification for Manitoba: field guide. Nat. Resour. Can., Can. For. Serv., Northwest Reg., North For. Cent., Edmonton, Alberta. Spec. Rep. 2. 205 pp.