THE RIDING MOUNTAIN BIOSPHERE RESERVE: A SYNTHESIS OF THE NATURAL RESOURCE DATA BASE

by

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Submitted in Partial Fulfillment of the
Requirements for the Degree,
Master of Natural Resources Management

Natural Resources Institute
University of Manitoba
Winnipeg

April 6, 1990

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ISBN 0-315-63391-3

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A practicum submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of Master of Natural Resources Management.

ABSTRACT

In 1986, Riding Mountain National Park (RMNP) and 18 surrounding municipalities were designated as a Biosphere Reserve, under the Man and the Biosphere (MAB) Program. This designation was the first step in establishing a framework for more effective integration of local resource and economic concerns. This study provides a step towards implementing the Biosphere Reserve concept through an concise collation, description and assessment of the natural resource data base for the Riding Mountain Biosphere Reserve (RMBR).

Available information on eight resource categories (climate, hydrology, geology, geomorphology, soils, vegetation, wildlife/fauna, cultural resources) was examined. A description of current problems, issues and concerns was compiled. An assessment of the data base was completed based on six factors applicable to the information base. These were type, scale, period, presence, coverage and utility. Generally, more information on resources exists for the area outside the Park.

Recommendations are proposed to assist in achieving the objectives of the RMBR and enhancing the natural resource data base. Opportunities for further research to address data gaps and to provide for an concise natural resource data base for ecological management and public education are indicated.

ACKNOWLEDGEMENTS

I would like to thank my practicum advisory committee for their guidance and helpful commentary: Dr. Rick Baydack, Faculty Advisor, Natural Resources Institute; Mr. Mel Falk, Natural Resource Management Co-ordinator, Canadian Parks Service: Dr. John Lehr, Professor of Geography, University of Winnipeg; Dr. Paul Paquet, Wildlife Biologist, University of Alberta; and Dr. W.R. Henson, Oral Examination Chairman, Natural Resources Institute.

Financial assistance for this practicum was graciously provided by the Canadian Parks Service, with additional assistance from the Natural Resources Institute and the Riding Mountain Biosphere Reserve Management Committee. I am very grateful to the Canadian Parks Service for the opportunity and especially to Mr. Mel Falk, my client and my committee advisor. Mr. John Whitaker's assistance was also appreciated during the course of this study.

Special thanks to Susan Plenart at the Canadian Parks Service for her tireless efforts in the production of the final map copies. Her skill and patience were a valuable contribution. I am grateful for the support received from my family and friends during the course of this study.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Note: All large 11 x 17" fold-out figures after Krawchuk, (1990).

CHAPTER ONE

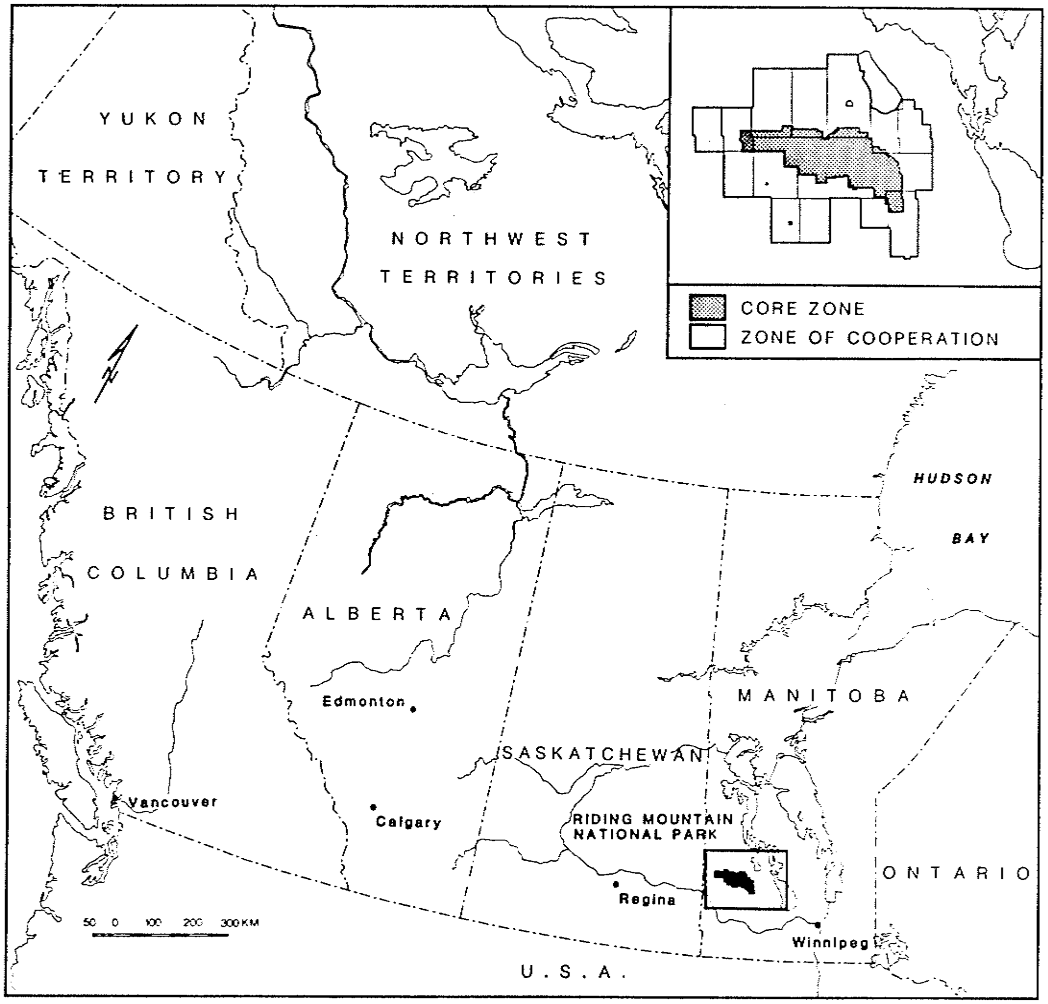
INTRODUCTION

1.1 BACKGROUND

The Riding Mountain Biosphere Reserve (RMBR) is located in the geographic heartland of North America (Fig. 1). It was designated in 1986 and consists of Riding Mountain National Park (RMNP) as the core area and surrounding rural municipalities as the zone of co-operation. The RMBR is accessible by Provincial Trunk Highways 10 and 16, 307 kilometres northwest of Winnipeg. RMNP, comprising 2,976 square kilometres, serves as a recreational resource for Manitoba and Saskatchewan visitors, although Manitoba residents account for 85 percent of total visitation (Parks Canada, 1987a). The purpose of RMNP in the National Park's system is:

> "To protect for all time an area of Canadian significance that represents the southern Boreal Plains and Plateaux natural region plus a portion of the Manitoba Lowlands natural region." (Parks Canada, 1987a).

The National Park contains the headwaters for three major drainage systems that flow down to the surrounding lowlands. The zone of co-operation consists of the flat to gently undulating Manitoba Lowlands that have been mainly cleared for agricultural purposes. Intensive grain and dairy farms are predominant in this zone (Roots, 1988).



Source: Environment Canada, Parks,(1985)

Figure 1. Regional setting of Riding Mountain Biosphere Reserve.

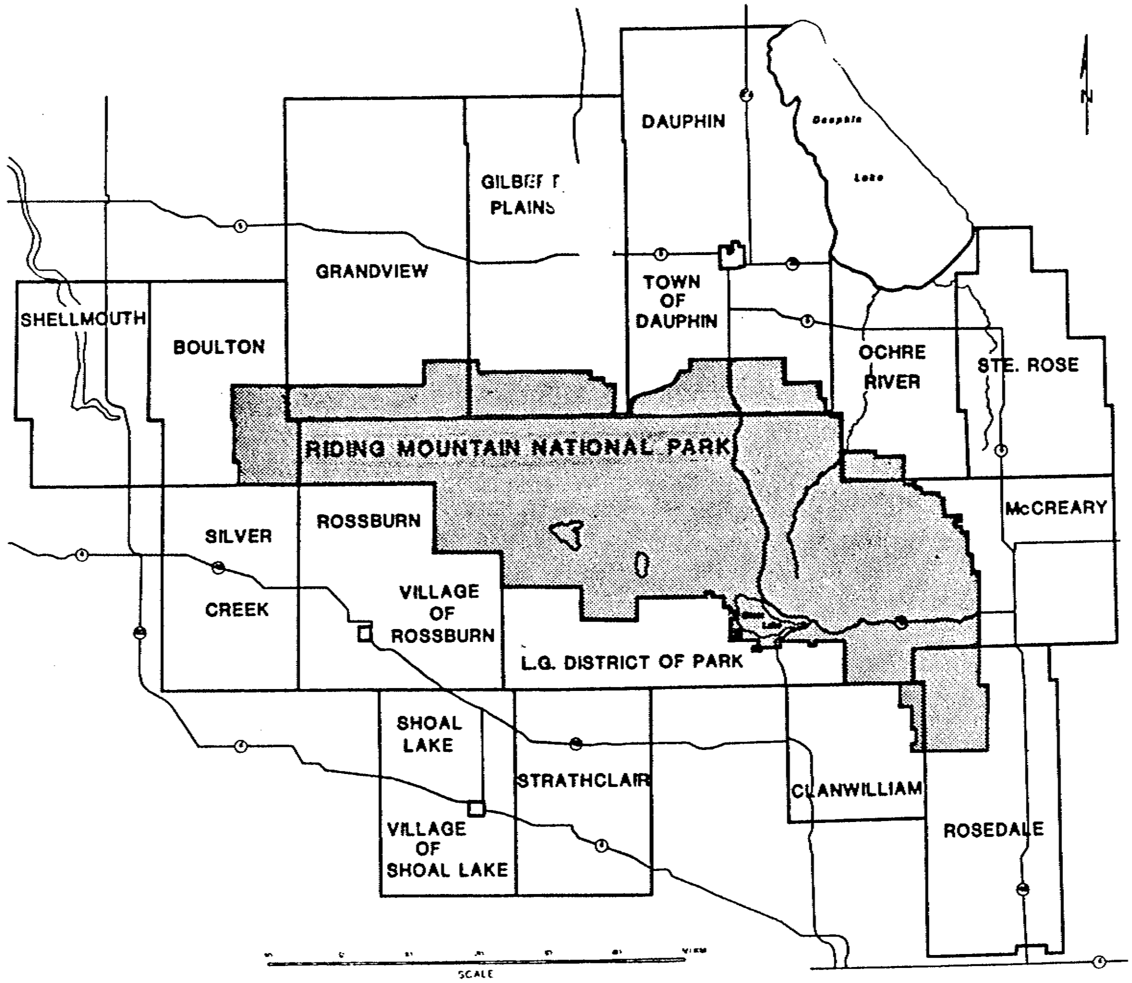
The RMBR occupies the transition zone between the Canadian prairie ecosystem and the Boreal Plains (Roots, 1988). Several natural themes are associated with these regions; the most significant of which is the Manitoba Escarpment, which rises 475 metres above the surrounding plain. Erosional forces, both wind and water, continue to reshape the Escarpment and surrounding topography. The Escarpment is part of a much larger ridge extending from North Dakota into Manitoba and Saskatchewan. Riding Mountain's portion of the Escarpment is unique because the lower slopes are covered with eastern deciduous forest; the northernmost limit of its range (Parks Canada, 1983). From the eastern ridge, the parklands roll westward for approximately 100 kilometres. Other themes of national significance include rough fescue prairies in central and western areas of the Park, prairie pothole terrain, and the boreal island phenomenon created by the Park's elevation and different climate regimes (Parks Canada, 1987a).

RMNP is a crossroads where habitats characteristic of eastern, western and northern Canada meet in a unique assemblage of forest, grassland, hills and valleys. (Parks Canada, 1987a). The Park area is home to black bear, moose, elk, wolf, and beaver, and the rarer species such as the elk, and beaver, and the rarer species such as the wolf, bald eagle, osprey and cougar (see Appendices for scientific names). This prairie "mountain" with its rich biological and terrestrial mosaic is an island nature reserve surrounded by man-altered environment. Wheat fields and pastures adjacent to the boundaries of the Park dramatically illustrate this feature.

Landscape features in the park area are representative of prairie pothole country. Evidence of Quaternary glaciers and fluvial processes such as relict beach ridges, meltwater channels, rolling moraines and outwash plains point to the influence of glacial Lake Agassiz. By far the greatest influence on lands surrounding the Park relates to the agricultural activities of European settlers. The Park's natural environment remains its most outstanding attribute even though the impact of man is evident in many locations (Parks Canada, 1987a).

Resource management seeks to maintain the natural and cultural resources of a park in order to achieve stated objectives of preservation and/or use. Resource conservation issues in RMNP are listed in the Park Conservation Plan (Parks Canada, 1987b). These can be categorized into Park ecosystem description (ecosystem dynamics and historical analysis) and data integration. Factors that have influenced the 1987 Park Management Plan for Riding Mountain include the nature of resource inventory programs since 1977, the regional setting of the Park and the Natural Resource Management Process (NRMP) (Parks Canada, 1987a). The basic resource inventory is complete, although it is largely out of date and data gaps exist. CPS policy requires that an integrated natural resource data base be developed and maintained for each National Park (Parks Canada, 1980). Updating the park data base is identified in the 1987 Park Management Plan.

Co-operative planning and management is an important part of the resource conservation program. An innovative measure of co-operative planning is regional integration through the MAB Program (Parks Canada, 1987a). The United Nations Educational, Scientific and Cultural Organization (UNESCO) established the MAB Program in 1971 to address people's relationship to the environment through the establishment of biosphere reserves. Biosphere reserves form a global system closely affiliated with, and is usually based on, established conservation areas. A biosphere reserve consists of a protected core of natural environment together with adjacent areas, which form the zone of co-operation, showing how once similar lands are managed presently to meet human needs (Fig. 2). Practical strategies



Source: Environment Canada, Parks,(1985)

Core Zone (Riding Mountain National Park)

Zone of Cooperation (Rural Municipalities)

BOULTON	STRATHCLAIR
McCREARY	SHOAL LAKE
ROSEDALE	STE. ROSE
SHELLMOUTH	DAUPHIN
SILVER CREEK	GRANDVIEW
CLANWILLIAM	L.G.DISTRICT OF PARK
GILBERT PLAINS	VILLAGE OF ROSSBURN
OCHRE RIVER	VILLAGE OF SHOAL LAKE
ROSSBURN	TOWN OF DAUPHIN

Figure 2. Riding Mountain Biosphere Reserve.

for resource management can be learned from carefully planned studies that compare conditions in both protected and exploited areas. Research and pilot projects are carried out through scientific co-operation and local management. As of 1987, there were 266 biosphere reserves in 70 countries (Canada/MAB, 1987).

There is an increasing awareness that National Parks are becoming insularized unto themselves and that the MAB concept is an attractive way to remove existing barriers (Parks Canada, 1987b). In response to the UNESCO Program, Canada has developed a National Action Plan for Biosphere Reserves (1987). Canada/MAB, the Canadian Committee for the MAB Program, has three objectives: to establish a biosphere reserve in each biogeographic region in Canada; to promote biosphere reserve objectives and activities in Canada; and to contribute to global biosphere reserve activities (Canada/MAB, 1987).

One of the MAB Program's major objectives is the development of a global network of biosphere reserves. Each biosphere reserve is selected on the basis of an international classification of biogeographic provinces. The network will eventually include representation of all the world's ecological systems and the associated patterns of human land use (Parks Canada, 1987a). Much can be learned from this network by incorporating applied research into resource management practices and in monitoring changes caused by human use in natural ecosystems (Canada/MAB, 1987).

In Canada, management and technical committees are established for each biosphere reserve. These committees consist of representatives from federal and/or provincial agencies, local municipal officials, private landowners, and university research staff. Committees advise on and develop suitable co-operative research, monitoring, and education programs to ensure that significant benefits are derived from the biosphere reserve. At the same time, effort is made not to interfere with the management responsibilities of the agencies and landowners concerned (Canada/MAB, 1982).

Riding Mountain has an impact on the region and the region has an influence on the Park (Parks Canada, 1987a). The socio-economic benefits derived from the Park in relation to the adjacent area, in terms of employment and the demand for goods and services, are generally positive. However, few if any land uses, either inside or outside National Parks, can occur without there being both beneficial and detrimental effects on the surrounding lands (Parks Canada, 1980). CPS is aware of the potential impact of its actions through its regional integration policy, using a wide variety of measures, to ensure park management is responsive to local concerns.

National Parks can no longer be assured of protecting entire and representative ecosystems. The present approach to resource management in National Parks has tended to focus on ad hoc decision-making based on incomplete knowledge of ecosystems (Forster, 1973 ; Nelson et al., 1978). A comprehensive approach is needed, based on ecological concepts, to establish a better equilibrium between man and the environment. Such approaches can be very fruitful for National Parks and related reserves for improved environmental management and understanding human adaptation efforts (Nelson et al., 1978). The Riding Mountain area is subject to more than one set of goals and objectives for rural land management. Thus, regional management strategies involving co-operative approaches are critical for identifying local and regional concerns in planning while recognizing the Canadian Parks Service desire to preserve ecosystems (Fay, 1982; Roots, 1988).

The RMBR designation, as an example of a regional integration strategy, lends itself to solving incompatible or conflicting issues arising from the Park's location in an agricultural setting. By actively researching solutions to problems and in experimenting with new management techniques, the National Park and local residents will benefit through co-operative management of local resources. In order to conserve the land base, a comprehensive resource inventory is essential to understand and appreciate the various human and natural factors affecting the landscape and the resource qualities, which make a National Park significant.

1.2 ISSUE STATEMENT

Participation in the MAB Program is beneficial for regional resource management (Parks Canada 1987b). In Riding Mountain, management and technical committees have been formed to identify and implement a research and monitoring plan for the RMBR. Before effective integration of the MAB Program in and around Riding Mountain can take place, an integrated natural resource data base must be in place (Parks Policy, 1980; Biosphere Reserve Action Plan, 1987; Park Management Plan, 1987a; and the Park Conservation Plan, 1987b). This involves collating, synthesizing and analyzing information on the Park and the surrounding zone of co-operation to identify important data deficiencies. Data presentation should be oriented to a format applicable to MAB needs. More informed management decisions for the Park and/or the RMBR will result by knowing strengths and weaknesses of the resource data base.

1.3 OBJECTIVES

The purpose of this study was to collate available information on the natural resources (ie. water, geology, soils, vegetation, wildlife, culture etc) in the RMBR and to synthesize available data into a consistent style of presentation.

To achieve this end, four specific objectives were identified:

1. To review available information on RMNP and the immediate vicinity to provide a current understanding of the RMBR.
2. To inventory and describe natural and cultural resources within the RMBR.
3. To select a format for resource data presentation applicable to the RMBR.
4. To assess resource data for the RMBR in relation to the stated purpose and objectives of the RMBR.

Benefits associated with providing a concise resource information base will be achieved through public education, and environmental research and resource monitoring programs. This common information base will provide the means to: identify data gaps that are in need of attention; identify problems requiring attention/revaluation; identify further co-operative joint venture/information sharing projects; and identify future decision requirements in the Park versus the surrounding zone of co-operation.

1.4 JUSTIFICATION

The Riding Mountain National Park Management Plan (1987) states:

> "Awareness of the need for improved regional integration of the Park has developed since the 1977 Master plan was approved. Plan decisions responsive to regional concerns and aspirations are required."

It is important that CPS commit itself to regional integration measures, such as the MAB Program, which will be used to enhance the role of ecosystem management. Effective management and administration of the RMBR on a local, co-operative basis is essential to meet resource management concerns.

1.5 METHODS

According to RMNP's revised and updated Park Conservation Plan (Parks Canada, 1987b), the format of the Park's present data system was varied and maps are of different scales making comparative study difficult. Information on the surrounding region was scattered in many different locations where comparable records of information may or may not exist. This was addressed in the 1988 Park Data Management Plan (John/Paul and Associates, 1988) for RMNP. There remained, however, a demand for a comprehensive understanding of the resources in the RMBR.

This study incorporated three sequential phases in towards providing an integrated natural resource base for the RMBR.

Phase 1 - Data Collection

The quantity of information available on Riding Mountain and the adjacent region was extensive. Unpublished reports were on file at the Park Office in Riding Mountain, Prairie and Northern Regional Office (PNRO) in Winnipeg, various Provincial government/municipal agencies, and local interest groups. A complete list of agencies checked for unpublished and published information as well as relevant unpublished theses relevant to the study area are appended. A preliminary review of the literature formed the historical background section regarding the development of the study area (Chapter Two). An overview of the MAB Program and its applicability to the Riding Mountain area is provided in Chapter Three.

Phase 2 - Integration

The second task involved compilation of descriptive data on the natural and cultural resources in the Biosphere Reserve. Emphasis was placed on acquiring mapped information. An overview of the natural resource base and initial inventory of the resource information constitutes Chapter Four. Chapter Five involves further resource description based on these data contrasting and comparing resource information within the RMBR. The study concludes with general statements on the resource data base and resources within the RMBR as well as recommendations for future management considerations and research requirements.

Phase 3 - Presentation

The format of data presentation chosen to clarify the nature of land resources in the RMBR involved the use of standard, registered map/overlays of important natural and cultural resources that were compatible with the objectives of this study. Because the area of interest is large, both geographically and thematically, a map scale of approximately 1:800,000 was used. The specific themes represented in this stage include:

1 - surface water ie. watersheds
2 - groundwater ie. aquifers and pollution hazard areas
3 - bedrock geologic formations/surficial geology

4 - dominant soil orders
5 - agricultural capabilities
6 - water and wind erosion risks
7 - vegetation land regions
8 - wildlife: ungulate and waterfowl capability
9 - cultural resource features (archaeological sites)
10 - crown lands (and refuges for wildlife)
11 - planning districts and conservation areas

The data collated were analyzed (Chapter 4) using a matrix chart format according to specific factors. These are: type; scale; period; presence; coverage; and utility. These factors were first operationally developed. Criteria were then established (high, medium, low, n/a) and defined. Numerical values were then assigned ranking the criteria from 0 to 3. These values were further defined to give a representative magnitude for each criteria. Tables and/or graphs were also employed where overlay presentation of the resource information was not suitable. Scientific names for wildlife and vegetation species were appended unless mentioned in the text. The following chart shows the research phases and the sequencing of events through the course of this study.

1989-90	May-August	Sept-Oct	Nov-Dec	Jan-Mar
Phase 1	XXXXX Ch. 1 Ch. 3 Ch. 2			
Phase 2	XXXXXXX Ch.4	XXXXXXX Ch. 2 Ch. 4	XXXXXX Ch. 5 Ch. 6	
Phase 3	XXXXXXX Ch. 4			XXXXX Ch. 4 Ch. 5

1.6 LIMITATIONS

The proposed study considered the entire area encompassing the RMBR, consisting of Riding Mountain National Park and 18 surrounding municipalities. As a result, representation of the natural and cultural resource base was limited at times to rather superficial levels. Time constraints were a factor in determining the extent of data integration and presentation. Associated with a limited time period for the study were the availability and/or lack of data for inventory purposes. This was especially apparent in attempting to contrast and compare resource information for the Park versus the surrounding area. Problems were encountered regarding scale, date of information, level of detail and period of record discrepancies.

1.7 CLIENTS

The following clients will, directly or indirectly, benefit from this research project:

1. Canadian Parks Service, Prairie and Northern Region, Natural Resource Conservation Section and Riding Mountain National Park.
2. Man and the Biosphere (MAB) Management and Technical Committees.
3. Provincial/municipal government agencies, private sector groups and local residents of the RMBR.
4. Conservation associations, naturalist societies, non-governmental organizations, researchers and students interested in further study in the RMBR.
5. Interested members of the public.

CHAPTER TWO

THE STUDY AREA

Regional Setting

Historical Perspective

A diverse mix of plants and animals is one of the many features that made the Park and its adjacent environs worthy of consideration of Biosphere Reserve status. The size of the Park has been questioned relative to the existence of a complete ecosystem, however, a complete natural food chain is believed to exist in the Park area (Parks Canada, 1987a). The diversity of wildlife habitats and vegetation complexes occur primarily as a result of variations in physiography and climate over the Riding Mountain upland. The effects of glaciation and the geologic history of the region has been recorded on the landscape as a further example of the area's heritage resource base.

In prehistoric times, the Park and surrounding area was utilized by various hunting and gathering nomadic peoples (Parks Canada, 1984). The modern historic period witnessed the occupation of the region by the Assiniboine, Cree and Saulteaux-Ojibwa. Cree and Assiniboine nations, originating in the northern woodlands of Eastern Canada, extended their territories into the future prairie provinces by 1690. The Cree tended to inhabit Manitoba's eastern and northern woodlands, while the Assiniboine occupied the belt of mixed prairie and aspen parkland.

By 1763, the Cree had expanded into the mixed aspen prairie of Manitoba, including the Riding Mountain area due to an increasing involvement in the fur trade. They maintained their influence in the area until 1821. The Saulteaux-Ojibwa then became the most predominant group in the Park area moving in from southeastern Manitoba (Parks Canada, 1987a). They replaced the Cree who had migrated westward over time to provision the expansionist fur trade (Parks Canada, 1984).

Today, an example of this cultural heritage survives as a tangible reminder of the phases of native occupation in the RMBR as the Okanesse Cemetery near Clear Lake. Native land use is only minimally noticeable on the landscape. Native land claims in the central and western portions of Manitoba, including the area that would later become a National Park, were extinguished under Treaty No. 2 signed in 1871 with the Dominion Government. As a result three Indian Reserves were established: Lizard Point, west of Rossburn; Keeseekowenin, north of Elphinstone; and Rolling River, west of Erickson (Parks Canada, 1984).

Thus, after the transfer of Rupert's Land to Canada in 1870, Riding Mountain's resources came under federal jurisdiction which generally followed the principle of pragmatic resource use (Parks Canada, 1984). For example, Riding Mountain's initial potential was conceived in terms of the Government's National Policy objectives of settlement and nation building. Wood, water, meadows and game were viewed principally as assets for agricultural settlement. The creation of the Riding Mountain Forest Reserve in 1895, to protect and manage valuable stands of timber for agricultural communities on its periphery, and the subsequent opening of parts of its lands for grazing purposes in 1909, initiated the phase of extractive resource use that continued well into the 20th Century (Parks Canada, 1984).

The Riding Mountain area was initially surveyed and opened for settlement in the 1870's. This was influenced by existing access routes into southwestern Manitoba. These links consisted of several Hudson Bay Company trails, such as the Saskatchewan trail (the northern branch of which became the present Yellowhead Highway); steamboat service via the upper Assiniboine as far as Fort Ellice; and the Canadian Pacific Railroad as far as Brandon by 1881 (Parks Canada, 1984). By this time, the areas south, east and west of Riding Mountain began to receive significant numbers of English speaking settlers and a handful of Metis settlers.

With the extension of the Manitoba-Northwest Railway through Minnedosa and Birtle in 1886, renewed settlement was promoted as the area just south of the Park and west of the Little Saskatchewan River received several groups of Ukrainian settlers. In addition a Swedish colony near Otter Lake in Erickson was established. Originally confined to the Shoal Lake area, the Ukrainians spread southeast along the present Park boundary into the forest reserve and also opened homesteads west of Lake Audy (Parks Canada, 1984).

Settlement of marginal lands north of Riding Mountain occurred after southern lands were taken. The opening of townships around Dauphin in 1886 brought the first wave of permanent settlement, quickly branching westward to Gilbert Plains and Grandview. Settlers arrived by three trail routes: Arden Ridge along the edge of the Riding Mountain Escarpment; Audy Trail across the forest reserve north from Strathclair; and a trail that began at Birtle following the Birdtail Creek north over the Park and branching down into the Gilbert Plains area (Parks Canada, 1984).

In comparison, settlement of the eastern portions of Riding Mountain occurred late, due to the limited agricultural resource base and poor drainage. As other lands became scarce, settlement moved northward limited to a narrow strip along the upper lowland plain. With the extension of the railroad in the mid-1880's, the lower lowland region attracted some settlement of Ukrainian and British homesteaders. The implementation of extensive drainage programs in northern sections of the plain attracted a substantial group of French Canadian and Ukrainian grain farmers to this area by the 1920's (Parks Canada, 1984).

The period of settlement also recognized the value of Riding Mountain for timber. Settlers were able to cut timber, and lumbering enterprises were given timber berths as a means for the Department of Interior to generate some revenue. However, by the 1870's indiscriminate logging practices by settlers and lumber owners in Riding Mountain drastically reduced the water table as a source of running water for agricultural areas on the periphery. In 1895, the Dominion Government withdrew Riding Mountain from settlement and made it a forest reserve. Logging operators continued to cut trees, but conservation stipulations were being strictly enforced by The Forestry Branch (Parks Canada, 1984).

By 1909, of a total of 379,577 ha in the Riding Mountain area, only 89,568 ha of timber remained, mostly poplar with some white spruce. To facilitate settlers' needs, portable sawmills were permitted under licence to cut timber renewable for only one five year period. Table 1 shows the importance of timber permits/berths and the revenue generated from the Riding Mountain Forest Reserve. Similarly, the

Table 1 - Revenue received from timber permits and berths, Riding Mountain Forest Reserve (Department of Interior Annual Reports, 1911-1929).

Year	No. of Permits	Receipts	No. of Berths	Receipts
1911	281	3,774.36	5	718.12
1912	780	2,176.90	6	49.64
1914	524	3,632.00	5	1,246.28
1915	748	5,056.34	5	927.54
1918	1,216	10,756.34	4	307.15
1919	1,203	12,521.00	4	588.13
1920	1,259	16,672.67	4	222.15
1921	1,203	10,557.63	4	644.96
1922	761	5,451.43	4	446.13
1923	744	6,790.57	2	227.50
1924	1,080	10,097.77	2	227.50
1929	1,314	12,618.46	n/a	n/a

Source : (after Tabulenas, 1983)

Forestry Branch began reforestation practices to replace cut timber and lands were opened up in the forest reserve for grazing to benefit surrounding farmers and to assist in fire prevention within the reserve. Sites in the central portion of Riding Mountain were heavily grazed up until the 1960's (Parks Canada, 1984).

Recreation and tourism began to replace the traditional resource uses of Riding Mountain after the 1920's. Timber extraction and grazing, as economic activities began to wane in importance, as western coal replaced timber as a fuel source. The concept of establishing a National Park in Manitoba originated in 1919. It centred on creating a Park in either the Whiteshell or the Riding Mountain Forest Reserve. A Commission was established by the National Parks Branch, led by R.W. Cautley, who concluded that neither was worthy of National Park status. He recommended that the proposed Whiteshell reserve be cancelled and a recreation centre be built at Clear Lake. Cautley believed that the Riding Mountain area would serve the public better as a Forest Reserve. Renewed pressure succeeded in changing this position towards the National Park concept, and the Riding Mountain Forest Reserve was set aside in 1929 (Parks Canada, 1984).

RMNP was formerly established by an Order-in-Council in in 1930. With an area of 2,976 square kilometres it was the last National Park created before the Natural Resource Transfer Agreements (1930) gave the western provinces control of resources and lands within their boundaries. The Park was created by an internal transfer of lands from the Federal Forest Reserve to the National Parks Branch (Fay, 1982). The Riding Mountain area offered a large population of Wapiti (elk) and other large mammals, a scenic Escarpment, an existing resort at Clear Lake, and relatively good access. RMNP was to be developed as a national treasure and recreational playground according to the Park planners of the day.

In accordance with the mandate of National Parks, several wildlife conservation programs were initiated in Riding Mountain, including a display herd of bison at Lake Audy. In 1931, due to a decline of the Parks resident beaver population a conservation project was led by the naturalist, Grey Owl, to re-establish beaver within the Park boundaries. The beaver program suited the Parks dual goals of preservation and stimulating public interest and tourism. Grey Owl was somewhat of a novelty and tourist attraction that aroused the visitor's curiosity (Tabulenas, 1983). However, Grey Owl only remained in Riding Mountain for six months before moving on to Prince Albert National Park.

The modern period of resource protection, dating from the Park's creation in 1930, continued. This period was initially characterized by the development era of public works projects which led to the construction of most of the existing Park facilities (Fay, 1982). At the same time, resource extraction activities continued. During the depression cattle were grazed, and fuel shortages during the Second World War led to some logging (Parks Canada, 1984). German prisoners-of-war (P.O.W.'s) were also put to work at Whitewater Lake cutting cordwood. Kippen's Mill, originally located at Edwards Creek, shipped out large quantities of cut wood.

Of particular significance from the 1940's to the late 1960's was the operation of a Forestry Experimental Station under Canadian Forestry Service (CFS) authority north of Clear Lake. The primary purpose of the Station was to conduct research on silviculture practices, tree growth rates and effects of cultural treatments (prescribed cutting). This was followed by demonstration cutting on a large scale to put into effect the research findings for forest production, specifically white spruce. The station also acted as a nursery for reforestation, which generated from 1945, an average of 20-30,000 spruce seedlings. The experimental area only affected 200 acres. By 1968, following a 10 year period of culling, an over-mature white spruce stand that no longer met requirements for forestry research resulted. The area was re-oriented towards ecological study associated with forestry management (Tabulenas, 1983).

Historically, RMNP has had strong ties with the surrounding area and the area has, in turn, influenced the Park. Initially, the Park was managed on a multi-use basis that encouraged strong economic ties (Fay, 1982), before the gradual phasing out of consumptive activities. The settlement of Europeans after the 1870's with their related agricultural practices is evident across the surrounding region and is of particular relevance to Biosphere Reserve designation and subsequent management. Before the 1960's and a shift in Parks Canada Policy towards representative preservation, examples of exploitive activities were widely evident within the Park. These included a work camp of the depression era, a P.O.W. camp, commercial timber and haying operations, and a forestry experimental station (Parks Canada, 1987a).

Establishment of the RMBR

The RMBR represents a transition between Canadian Prairie and the Boreal Plain. The RMBR designation was based on Parks Canada's proposal to have RMNP nominated as a possible core for a Biosphere Reserve in response to the formation of the Riding Mountain Regional Liaison Committee (RMRLC) in 1980. The RMRLC was formed in order to develop dialogue with the Park on common problems and to establish mutually acceptable solutions to those problems (Roots, 1988). The signing of a Federal-Provincial agreement on beaver population control in Park and abutting agricultural land is an example.

The Biosphere Reserve designation was viewed as a continuation of the benefits of co-operation and was further appealing because the concept was an international program that emphasized local control in finding solutions to resource problems. Initially, only 17 out of the 18 surrounding municipalities favoured the concept. This resulted in the move to pursue the nomination for Biosphere Reserve status. In 1986, an area consisting of 1,273,857 ha (the Park and all 18 surrounding municipalities), was designated as the RMBR (Roots, 1988).

The RMBR should provide opportunities for initiating conservation projects in the zone of co-operation similar to that being undertaken in Shoal Lake as part of the North American Waterfowl Management Plan (NAWAMP). In this particular case, farmers are given financial incentives not to drain land in order to retain valuable waterfowl habitat (Roots, 1988). Similar programs could help further the aims of the RMBR.

At the same time, the role of the surrounding area in providing enhanced recreational opportunities may become more prominent. Traditionally, the Park provided natural recreational facilities necessary to support demand with very little spillover occurring in the region. Limited kinds of development within the Park, combined with a general increase in demand for recreation and support services, results in growing pressure to develop on lands adjacent to the Park (Fay, 1982). The prairie pothole country south of RMNP, constituting the South Riding Mountain Planning District (SRMPD), is the best example in terms of providing a particularly attractive setting for intensive recreational development. Thus, all this human activity may yet provide another facet in Park-region relationships that the Biosphere Reserve concept will have to face.

CHAPTER THREE

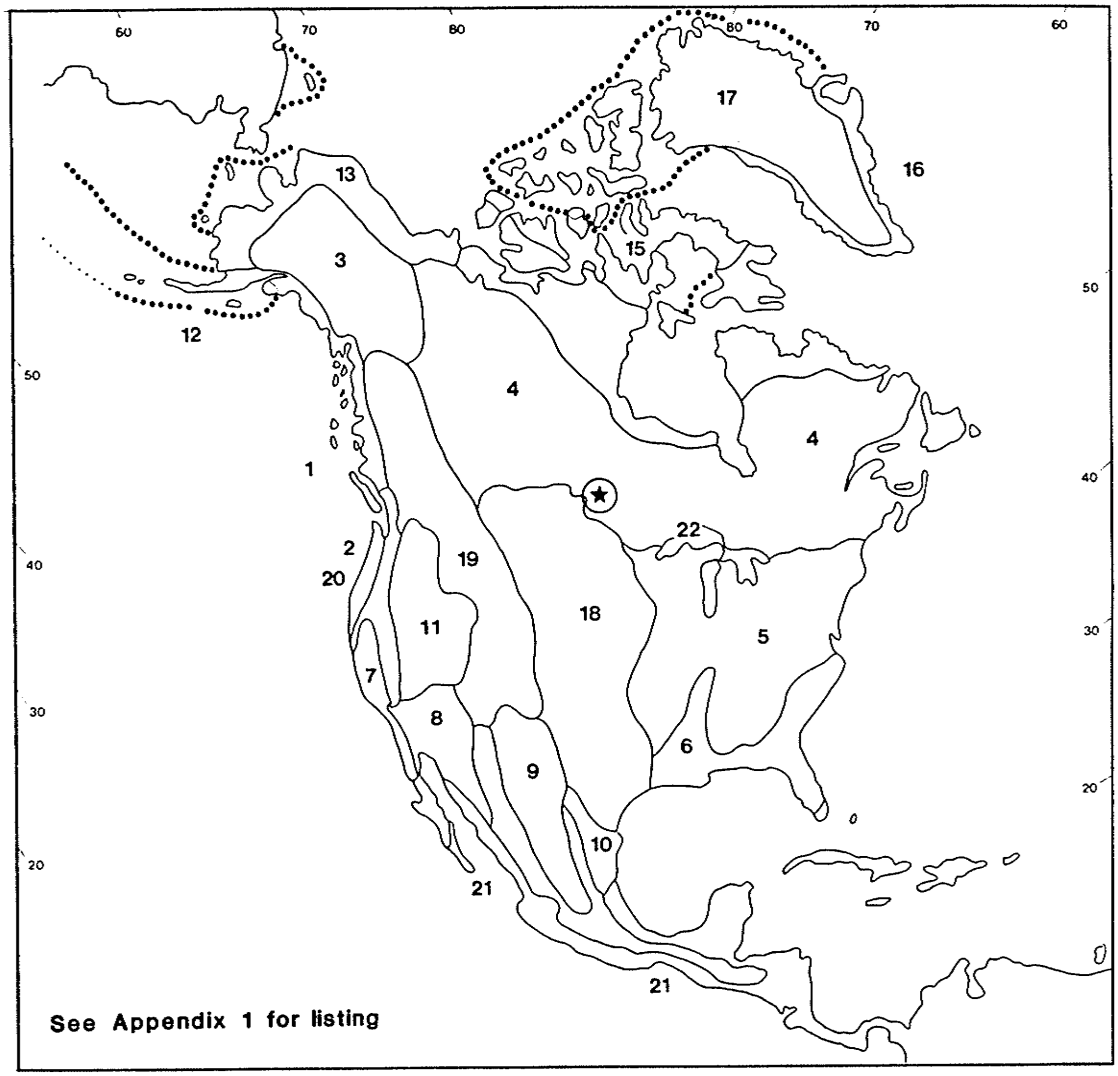
MAN AND THE BIOSPHERE PROGRAM

Introduction

The fundamental paradox surrounding society's relationship to the environment, that of enjoying today and having tomorrow, has existed for millenia. As a result, society has developed ways of exploiting and conserving the natural environment to suit particular needs at the time. One such idea that has served both ends is the concept of national parks (Nelson et al, 1978). The classical North American National Park focuses on areas where there are few signs of man, extractive activities are controlled, and native populations have been relocated (Nelson et al, 1978). This latter notion is being challenged today since natives have always had a functional place in ecosystems ie. hunting and burning (Nelson et al, 1978). This cultural conservation is viewed as being a part of a larger environmental question. Can the long term health of the natural environment be maintained as demand and production pressures increase? There is substantial information about changes in ecosystems. However, there is a lack of detailed study (Nelson et al, 1978).

Among international agencies, UNESCO has taken the lead in promoting research into man's relationship with the environment. The MAB Program, set up in 1971, was an attempt by nations working globally to improve the ability to solve environmental and natural resource problems in an integrated fashion (Page, 1984). MAB projects are currently being carried out in a worldwide network in terms of research, education, and training components.

MAB is viewed as a progressive program as it is aimed not just at the accumulation of knowledge, but at the contribution to present and future problem solutions (Canadian Committee for MAB, 1973). Similarly, it is designed to combine the efforts of the natural sciences, social sciences, and humanities disciplines essential to national decision-making on resource management over the short and medium term (Page, 1984). One of MAB's objectives is to develop a global network of biosphere reserves. Much can be learned by establishing Biosphere Reserves in each biogeographic province of the world, including the Nearctic Realm (Fig. 3), and by monitoring changes in natural ecosystems caused by human use (Canada/MAB, 1987; Ward, 1987). Page (1984) views that applied research should also look at the relationships between social factors and natural resource management.



Source: Canada/MAB,(1975)

Figure 3. IUCN Biogeographical Provinces in North America (Neararctic Realm).

Canada's Response to MAB

Canada had been a participant in UNESCO/MAB since 1971. By 1980, administrative functions within the federal government were finalized for promoting MAB activities in Canada. Initially, the broad scope and diffusion of responsibility for resources and environmental matters in Canada made overall response difficult, since it was hard to identify appropriate mechanism(s) to support the program (Canadian Committee for MAB, 1973). Canada's committee was designed to co-ordinate activities by involving government, university and private sectors oriented towards problem solving, and emphasizing training, education, and information exchange on resource management practices. Canada/MAB was to add a further dimension in filling information gaps in the present body of natural resource data in a comprehensive and integrated fashion. An additional attractive feature was that MAB projects need not be costly.

According to Page (1984), Canada/MAB has sought to focus research efforts on a particular problem area - rational use and conservation of Biosphere Reserves. Ward (1987) views the conservation of representative features as one of the major objectives; just as important are long term environmental research and monitoring. Comparative studies on protected and utilized zones of Biosphere

Reserves will contribute towards improving resource management, rehabilitating degraded areas, and documenting changes originating from human activities. This has been lacking in the past (Unesco/MAB, 1984). Canada/MAB did not become a continuing program until April 1984, when the Canadian Commission for UNESCO renewed its activities in strengthening its commitment to MAB's concepts and goals. Wherever possible, MAB projects were to be interdisciplinary in nature and required some sort of stable funding source in order to achieve international recognition. As a further response to the UNESCO program, Canada established a National Action Plan for Biosphere Reserves (1987) as a strategy to meet objectives called for in the International Action Plan.

The MAB program seeks to represent typical, but not necessarily unique ecosystems. On a worldwide basis, Biosphere Reserves contribute to knowledge that can be applied to management of local resources (Canada/MAB, 1987). This is a valuable attribute of the program in that much can be gained from providing assistance to meet local resource management responsibilities. The ideal Biosphere Reserve consists of multiple use areas (zone of co-operation); rehabilitation areas; core zone (ie. National Park); traditional use areas; and experimental research areas

areas (Canada/MAB, 1987). The various components may vary in size and the border itself is indefinite as it is designed to secure local co-operation. This means local landowners in the co-operative zone are free to decide whether they wish to be involved in the reserve program. The only guideline is that the area has to be big enough to comprise self-sustaining ecological systems (Canada/MAB, 1982). Size of the reserve refers to the area needed to maintain representative local population species.

Ward & Killham (1987) identify three criteria used in selecting suitable sites for designation as Biosphere Reserves:

1) Representative natural characteristics are judged according to global classification of biogeographic provinces.
2) Managed and transformed ecosystems must be included along with undisturbed and protected ecosystems.
3) Inter-organizational arrangements must be considered to establish and maintain Biosphere Reserves.

A problem with the above criteria, however, revolves around the goals, practices and impacts of such a global program. Many countries do not have the ability to set aside new natural areas specifically for Biosphere Reserves. Thus, considerable overlap with existing conservation units (ie.

National Parks) is inevitable and expected. Consideration must be given to the multiple functions of the area as a Biosphere Reserve and its role in an international network in regard to overall management practices. In addition, Forster (1973) notes that Biosphere Reserves should attempt to link conservation to man's activities and rural development. The ultimate conservation solution must be viewed in terms of planning on a regional basis closely approximating a complete ecological system. Of all the known biosphere functions, the social dimension together with scientific research appear to be the weakest of all (Unesco/MAB, 1984). This generally reflects the importance of information dissemination about Biosphere Reserves and their objectives.

As of 1990, five Biosphere Reserves have been established in Canada. Mont-Saint-Hilaire in PQ (1978) was Canada's first Biosphere Reserve. Waterton Lakes, AB (1979), Long Point, ON (1986) Riding Mountain, MB (1986) and Charlevoix, PQ (1988) make up the remaining Canadian network. Each of the five Biosphere Reserves are distinctly different. Together they form a basis for conservation and exchange of information on widely separated areas. Waterton Lakes Biosphere Reserve is considered a model of local involvement in decision-making for other potential Biosphere Reserves in Canada (Canada/MAB, 1987). The 1987 National

Action Plan for Canada further proposes the establishment of at least nine more biosphere reserves. The present Biosphere Reserves all have core areas based on existing protected areas. Proposals for new Biosphere Reserves will be closely associated with existing or proposed protected areas (Canada/MAB, 1987). Additional designations can only be achieved if there is an improved understanding of the potential contribution of Biosphere Reserves to national and local resource management (Canada/MAB, 1987). Otherwise, redundancy with existing conservation units and their functions may result.

Riding Mountain Biosphere Reserve

Riding Mountain Biosphere Reserve was designated in 1986 as an area representative of Canadian Taiga and Grasslands ecosystems. This designation: reinforced a sense of regional identity; acted as a catalyst for research and conservation; contributed to regional development; reduced barriers to collaboration; and provided a formal working system for overcoming practical local problems (Canada/MAB 1987). Canada/MAB provides the forum to co-ordinate various government and local agencies responsible for Park management and of peripheral areas to ensure Park objectives are met and contentious issues are resolved (Park Conservation

Plan, 1987b). The RMRLC, which represents 18 municipalities, the Park and Provincial resource management and education agencies is a good example of co-ordination and co-operation. Other Provincially-sponsored groups should have an interest in the National Park's regional impact in order to satisfactorily reach consensus on shared resource concerns.

The Turtle River Watershed Conservation District (TRWCD) in its 1987 Draft Management Plan, recognized RMNP as a valuable contribution to the District. The Park contributes over one-quarter of the District but the TRWCD has no direct jurisdiction over Park lands. The District is committed to wise use and integrated management and development of resources through co-operation with Federal, Provincial and municipal governments, and local residents.

CHAPTER FOUR

INVENTORY OF THE RESOURCE BASE

Introduction

This chapter will present an overview of the existing resource base as it applies to the RMBR. An initial inventory of the resource base is presented along with a brief assessment of its adequacy. This assessment was based on the following factors: presence of data; type of data; scale; level of detail; period of record; and utility. Thus, the compatibility of various resource categories can be determined.

Resources of the RMBR were classified and identified under the following natural resource headings:

macro-climate	water	geology
geomorphology	soils	vegetation
wildlife/fauna	cultural resources	

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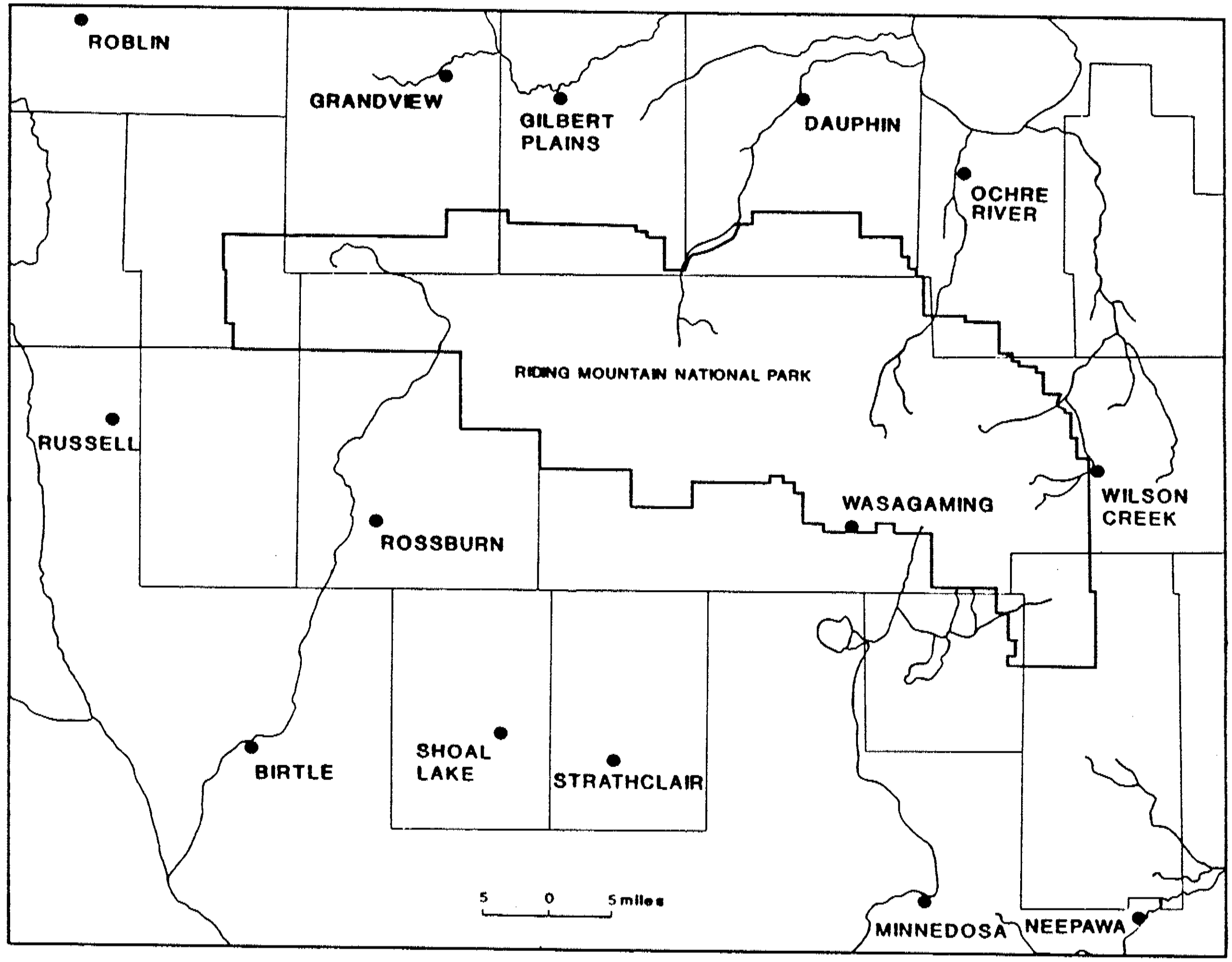
* (see glossary for definition of terms)

CLIMATE

Macro-Climate

The climatic record of any area varies in the length of time representative stations have been recording weather data. In the past, climatological studies for the Park have collected data on temperature, precipitation, wind and comfort (Keck, 1975; Lombard North Group Ltd., 1976; and Parks Canada, 1984). There is, however, a general deficiency in comparative climatic data for the RMBR of a more recent nature. Figure 4 shows representative stations in the study area. Based on the most current 30 year period for climate normals, 1951-1980, (Atmospheric Environment Service, 1982) temperature and precipitation are presented in Tables 1 & 2. Longer periods of climatic record exist for stations outside the Park compared to within the Park.

The study area typifies the continental climate found across the Canadian prairies. Summers characteristically range from warm to hot and humid under the influence of prevailing Gulf and Pacific Coast air masses moving from the south and southwest. In winter, cold and frigid air masses from Polar and Arctic regions move in from the north and northwest (Lombard North Group Ltd., 1976). However, a wide range of climatic conditions can be experienced within the RMBR. Factors such as prevailing winds and elevation changes



Source: Keck,(1975)
(after Atmospheric Environment Service,(1982)

Figure 4. Climatological stations in the Riding Mountain Biosphere Reserve study area.

Table 2 - Mean Annual Daily Temperature (*C) at Selected Stations in the RMBR area.

Station	Temperature	Code
Birtle	0.8	1
Dauphin	1.4	1
Gilbert Plains	0.8	8
Minnedosa	0.8	8
Neepawa	1.7	8
Ochre River	2.0	8
Rossburn	1.6	3
Russell	0.8	2
Strathclair	0.6	8
Wasagaming	-0.3	8
Wilson Creek Weir	2.1	8

Codes:

Based on the most recent 30 year period for climate normals for the Province of Manitoba collected by the Atmospheric Environment Service.

1 - indicates complete 30 year record
2 - 25 to 29 years
3 - 20 to 24 years
6 - less than 10 but more than 4 years
8 - adjusted normals based on 5 to 19 years inclusive

Source: (Atmospheric Environment Service, 1982)

Table 3 - Total Annual Precipitation and Annual Snowfall at Selected Stations in the RMBR area.

Station	Precipitation (mm)	Snowfall (cm)	Code
Birtle	451.2	145.0	1
Dauphin	495.8	149.1	1
Gilbert Plains	476.6	141.2	3
Grandview	460.4	136.0	8
Minnedosa	490.4	102.0	8
Neepawa	466.5	134.3	8
Ochre River	527.3	125.7	8
Rossburn	539.4	149.4	3
Russel	451.2	136.0	8
Shoal Lake	430.8	99.9	8
Strathclair	463.9	124.8	8
Wasagaming	546.0	160.0	8
Wilson Creek Weir	536.0	133.8	8

Codes:

Based on the most recent 30 year period for climate normals for the Province of Manitoba collected by the Atmospheric Environment Service.

1 - indicates complete 30 years of record
3 - 20 to 29 years
8 - adjusted normals based on 5 to 19 years inclusive

Source: (Atmospheric Environment Service, 1982) can have an effect in localized areas (Parks Canada, 1984).

The Riding Mountain uplands are subject to lower temperatures and less precipitation than the Manitoba Lowland areas (Lombard North Group, Ltd., 1976). The Manitoba Escarpment generates additional turbulence due to orographic and strong frontal lifting combined with an abundance of lakes and/or wetlands within the Park interior. This contributes to warmer/wetter conditions, especially in July and August (Seecharan, 1980; Parks Canada, 1984). Summer thunderstorms are usually of short duration with high precipitation levels and the potential for intense lightning storms. Snowfalls in the winter months are frequent and occur over a longer duration, but total accumulation levels can be much lower. Hot humid conditions vary throughout the region but are less frequent in RMNP (Keck, 1975).

The prevailing winds for the RMBR are from the north-west and southeast (Keck, 1975). Winds in the Park are generally lighter than over the surrounding rural areas. This is primarily due to the forest cover and the rolling topography in the Park, although peak wind gusts of over 128 km/h can occur.

In summary, the available climate data for the Park is incomplete in terms of period of record compared with climatic records for stations in the surrounding area. Greater climatic variation occurs within the Park as opposed to the surrounding lowland area due to changing elevations experienced along the uplands and Escarpment area. Topographic anomalies in climate are mostly associated with the Riding Mountain Escarpment where radical changes in precipitation patterns are quite common. Also, storms are more intense and vigorous.

WATER RESOURCES

Limitations of the Data Base

The following overview of surface and groundwater resources is based on mapped information and water resource availability studies carried out by the Provincial Water Resources Branch (1972, 1976, 1978, 1987). Mapped data bases at 1:250,000 were used for compatibility although there were some differences in scale and level of detail. Specific information is available on streams flowing off the Manitoba Escarpment (Newbury, 1980; Seecharan, 1980; Wilson Creek Committee, 1983; Newbury and Gaboury, 1987; and Mackling, 1988). Coverage over some portions of the Biosphere Reserve, particularly in the northwest, is lacking, especially in regards to groundwater. Information on water resources and related problems in the study area is somewhat dated, as the last known report comparing surface and groundwater resources was compiled in 1970. Substantial information exists concerning the decline of the Lake Dauphin Basin (Water Resources, 1982; Manitoba Water Commission, 1984; McGarry, 1987; MB. Natural Resources, 1989b).

Surface Water-Drainage Systems

The RMBR is composed of six major drainage systems, four of which originate in RMNP. These are the Valley River

Turtle River, Birdtail Creek/Oak River, and the Little Saskatchewan River. The Big Grass River and Central Whitemud River watersheds both originate outside the Park boundaries (Water Resources, 1988). The total area drained in the RMBR is approximately 21,600 square kilometres. For the purpose of this report, the area has been divided into 16 watershed units (Fig. 5). Table 4 shows watershed unit summaries.

The Turtle River drainage system comprises the Ochre River and Turtle River watersheds. The Valley River drainage system includes the Vermilion River, Wilson River, Valley River, and Fishing River/Mink Creek. Together, these rivers drain most of the northern and eastern portions of the RMBR into Lake Dauphin. These two particular units are also susceptible to flooding, erosion and sediment deposition to various degrees. Streams draining the Manitoba Escarpment area are more subject to flooding than other areas. Damage is common to crops, farmland and public works where peak flows from spring snowmelt/runoff often exceed natural and artificial channel capacities (Parks Canada, 1984; PFRA, 1988). Wilson Creek, within the Turtle River Watershed, has been studied by a Federal-Provincial Committee in an attempt to analyze and rectify downstream causes and effects of flooding. To a lesser extent, flooding occurs in the Ochre River, Vermilion River/Edwards Creek and Wilson River

Table 4 - Watershed Unit Summary for Riding Mountain Biosphere Reserve.

Watershed Division	Watershed Unit	Area (sq.km.)
Mossy River Division	Dauphin River Region	1178
	Turtle River	1168
	Ochre River	510
	Vermilion River	1026
	Wilson River	1004
	Valley River Lower	663
	Valley River Upper	1974
	Mink River	282
	Fishing River	293
Lake Manitoba Southwest	Big Grass River	2209
	Arden Creek	319
	Neepawa Creek	329
Kamsack Division	Shell River Lower	811
Foxwarren Division	Birdtail Creek	1344
	Silver Creek	308
	Little Saskatchewan Lower	1624
	Little Saskatchewan Upper	1717
	Rolling River	805
Hamiota Division	Oak River	1979
	Arrow River	653

Source: (Gaboury, 1989)

watershed units (PFRA, 1988).

Draining the southcentral and southwest portions of the RMBR, the Little Saskatchewan River drainage system includes the Upper and Lower Little Saskatchewan River (formerly the Minnedosa River) and is joined by flows from Clear Lake, Whirlpool River and Rolling River from the Park. Together, these rivers drain in a southwesterly direction, eventually entering the Assiniboine River.

Birdtail Creek, Oak River and Silver Creek form the Birdtail Creek/Oak River drainage system. Together, they form part of headwaters of the Assiniboine River Basin and are responsible for draining the western portion of RMNP. The Shell River and Assiniboine West are watersheds unto themselves. These two units share the headwaters of the Shell River that drains the upper portion of the Assiniboine River Valley area, occupied by the Shellmouth Reservoir.

The Big Grass River and Central Whitemud River Watershed comprise the Whitemud River Drainage system. Both contain their respective headwaters, the Big Grass River and the Whitemud River outside of the National Park. The area drains in a southeasterly direction into Lake Manitoba.

Within the study area there are numerous waterbodies, major lakes as well smaller ponds, creeks, drains, reservoirs, marshes and sloughs. These have been identified by watershed unit (Table 4) in a waterbody report drafted by Provincial Fisheries Branch personnel (Gaboury, 1989) for fish habitat inventory purposes. Kooyman and Hutchison (1979) have surveyed rivers, lakes, ponds, and wetlands in RMNP by watershed.

Waterbodies in RMNP can be classified into five broad categories: large, deep, clear lakes; moderately large, shallow, turbid lakes; small, shallow, saline lakes; other small lakes/ponds; and wetlands. Clear, South and Empress lakes are examples of the first three classes whereas Katherine, Whirlpool and Audy lakes fall within the fourth class (Kooyman & Hutchison, 1979). Moderately large to shallow, small lakes/ponds are present in the surrounding area, particularly south of the Park. These include Rossman, Bottle, Sandy, Otter, Gertrude and Kerr lakes. The exception to the above is Dauphin Lake, an example of a large, shallow lake.

Kettle lakes and/or ponds are common in the interior of the Park as well as the area immediately to the south. These have formed in depressions of stagnant glacial till and are characteristic of knob and kettle topography (Kooyman & Hutchison, 1979). Wetlands are present throughout the RMBR, particularly in the Park. Turtle Marsh is a prominent example outside the Park. Major reservoirs in the study area include the Shellmouth and Vermilion River reservoirs.

Streams and lakes in the Park have been surveyed for water quality. Total water hardness of streams surveyed ranged from 100 mg/L to a high of 340 mg/L. Total hardness for lakes measured ranged from a low of 38 mg/L to an extreme of 1,450 mg/L (Parks Canada, 1984).

Groundwater Resources

The representative aquifers, or water bearing formations of earth, gravel or porous stone, (Figure 6) represent those most commonly tapped for either domestic, industrial or farm requirements (Rutulis pers. comm., 1989). Some bedrock formations, discussed in more detail in the next section, do not fall neatly into the definition of an aquifer. In fact, sources of aquifers vary throughout the RMBR.

Overall, the supply of groundwater is not evenly distributed in the RMBR. In some parts of the RMBR, groundwater is abundant while in other areas supplies are minimal. In other areas, groundwater supply is barely potable. Typically, these groundwater problem areas would give very low yields and/or very poor quality supplies (Rutulis pers. comm, 1989). Groundwater pollution hazard areas occur where aquifers are subject to pollution by infiltration from the surface (Rutulis, 1986a).

Groundwater resources for this area of southwestern Manitoba have been identified (Fig. 6). The base of the Manitoba Escarpment region including the R.M.'s of Dauphin, Ochre River, Ste. Rose du Lac and McCreary have mostly thin sand or sand and gravel aquifers. Exceptions are an extensive aquifer formed of limestone/dolostone in the northeastern part of the Turtle River Watershed (Fig. 5) and smaller sandstone aquifers west of Ochre River and south of Ste. Rose du Lac (Water Resources, 1977).

Groundwater problem areas, indicating saline water conditions, are fairly extensive and are found east and north of Highway No. 5 in the R.M. of Rosedale, east of the town of McCreary, south of Ste Rose du lac, and west of the Ochre River (Water Resources, 1977). In the R.M. of Dauphin, there are few known groundwater sources in and around the town of and in the western part of the municipality (Water Resources, 1970 & 1973b). Several groundwater pollution hazard areas exist throughout this region (Fig. 6).

The Valley River plain area includes the R.M.'s of Grandview and Gilbert Plains. This particular region is practically void of any water bearing formations, principally due to impermeable bedrock conditions in the area

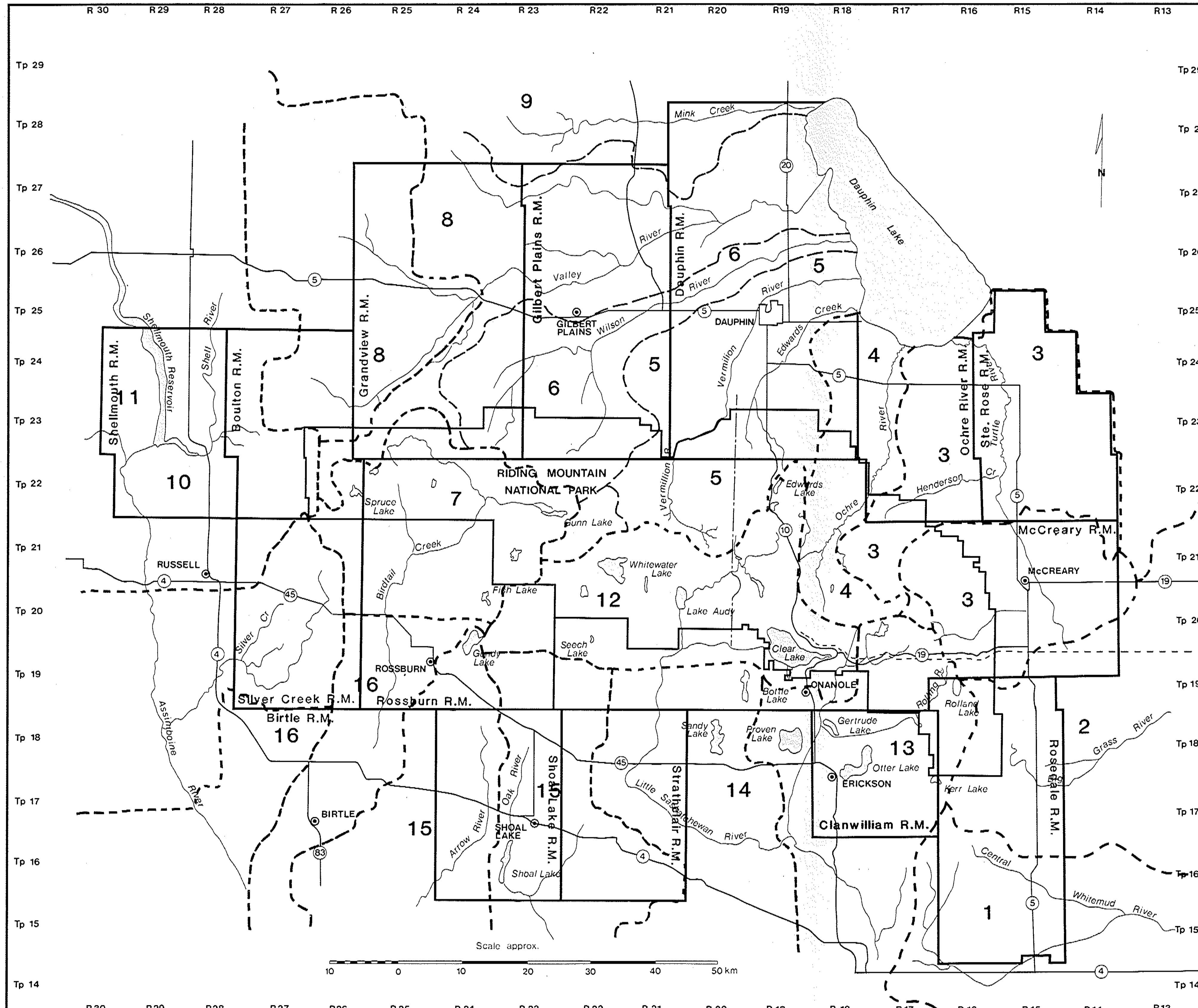
(Water Resources, 1970). There are pockets of unsatisfactory groundwater supplies in and around the towns of Grandview and Gilbert Plains. As a result, significant water supply problems are prevalent (Rutulis pers. comm., 1989).

The western slopes of the study region, including the upper Assiniboine River Valley area, (ie. the R.M.'s of Boulton, Shellmouth, Silver Creek, Rossburn and Shoal Lake) indicate extensive aquifer formation in the underlying shale bedrock. The only exceptions to this are along the Birdtail Creek Valley and the eastern portion of Rossburn municipality where sand and gravel aquifers are the most common (Water Resources, 1989). Groundwater pollution hazard areas are scattered throughout the region (Fig. 6). The most extensive areas occur in the Birdtail Creek Valley and around the Village of Rossburn (Water Resources, 1989).

The municipalities of the South Riding Mountain Planning District (ie. Strathclair, L.G. District of Park, and Clanwilliam) are underlain by two kinds of aquifers. Shale aquifers are the most common and extensive in the western portion, while sand and gravel aquifers occur in the eastern half (Water Resources, 1980). Poorer quality water occurs in the southwestern part of the District. A substantial groundwater pollution hazard area exists in the northern portion of the District (Water Resources, 1980). Most aquifers developed for water supply are overlain by thick permeable surficial deposits which prevent pollution of aquifers. In extensive areas of the RMBR, surficial deposits consist of sand and gravel that may form shallow aquifers. These areas are subject to pollution and are considered groundwater pollution hazard areas (MB. Natural Resources, 1989).

RMNP is underlain by shale bedrock and, for the most part, water bearing formations are not known to be present. However, where the upper part of the shales are fractured or weathered a permeable aquifer may form (Rutulis, 1986b). Pockets of sand and gravel aquifers can occur on top of the shale west of the Escarpment and can yield water on a small individual scale (Betcher pers. comm., 1990). Aquifer water quality for shale bedrock is indicated to be potable with a total dissolved solids concentration of less than 2500 mg/l. In some areas, along the base of the Manitoba Escarpment, bedrock aquifers indicate salty water with a total solids dissolved concentration of 5000 mg/L to 100,000 mg/L. Where sand and gravel aquifers predominate, very poor to slightly saline water can occur with a total dissolved solids concentration from 2500 mg/L to 5000 mg/L (Rutulis, 1986b).

In summary, a general data base exists for water resources within the RMBR. For comparative purposes, deficiencies in scale, level of detail, type of data and presence were noticed. Overall, more information is available on water resources and related problems for the area surrounding the Park. An exception is the extensive research carried out in the Wilson Creek watershed which originates in the Park. In the Riding Mountain section of the Escarpment, four major watersheds originate within the Park. Two watersheds originate outside the Park, draining the Manitoba Lowlands. The majority of lakes, ponds and smaller wetlands in the RMBR are consistent with the rolling topography of the Riding Mountain Upland. Groundwater aquifers, as a source of water supply are adequate, except in the Valley River area, and in the Park where aquifer potential is limited. Extensive groundwater pollution hazard areas exist outside the Park.



LEGEND

Figure 5 Watersheds

1 Central Whitemud River
2 Big Grass River
3 Turtle River
4 Ochre River
5 Vermilion River and Edwards Creek
6 Wilson River
7 Birdtail Creek (Upper)
8 Valley River
9 Fishing River and Mink Creek
10 Shell River
11 Assiniboine West River
12 Upper Little Saskatchewan includes Clear Lake
13 Central Little Saskatchewan includes Whirlpool River and Rolling River
14 Lower Little Saskatchewan River
15 Oak River Includes Arrow River
16 Lower Birdtail Creek Includes Silver Creek
Watershed Boundaries

Source: Water Resources Watershed Plans 1976, 1977, 1978

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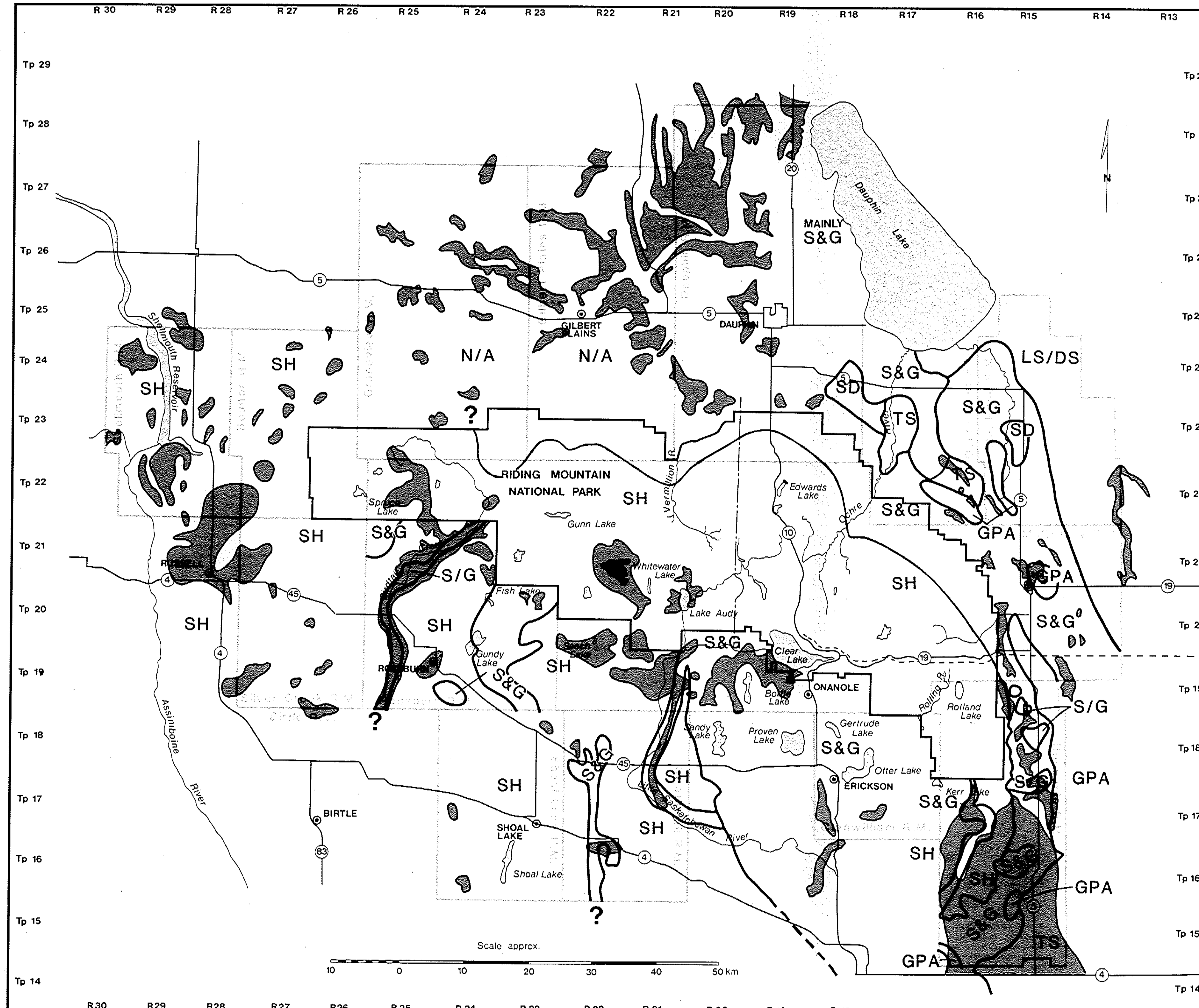

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Figure 6 Groundwater Resources

Aquifers

- SH Shale
- S&G Sand and Gravel
- S/G Shale/Gravel
- TS Thin Sand
- GPA Groundwater Problem Area
- SD Sandstone
- LS/DS Limestone/Dolostone
- N/A No major aquifers Based on lack of water bearing formations
- Groundwater Pollution Hazard Areas
- ? Limits of Data

Source: Water Resources Branch Planning Division 1970,1973,1977,1979
Rutulis 1986, 1989
Water Resources Division 1978

Environment Canada Parks Service / Environnement Canada Service des parcs

GEOLOGY/GEOMORPHOLOGY

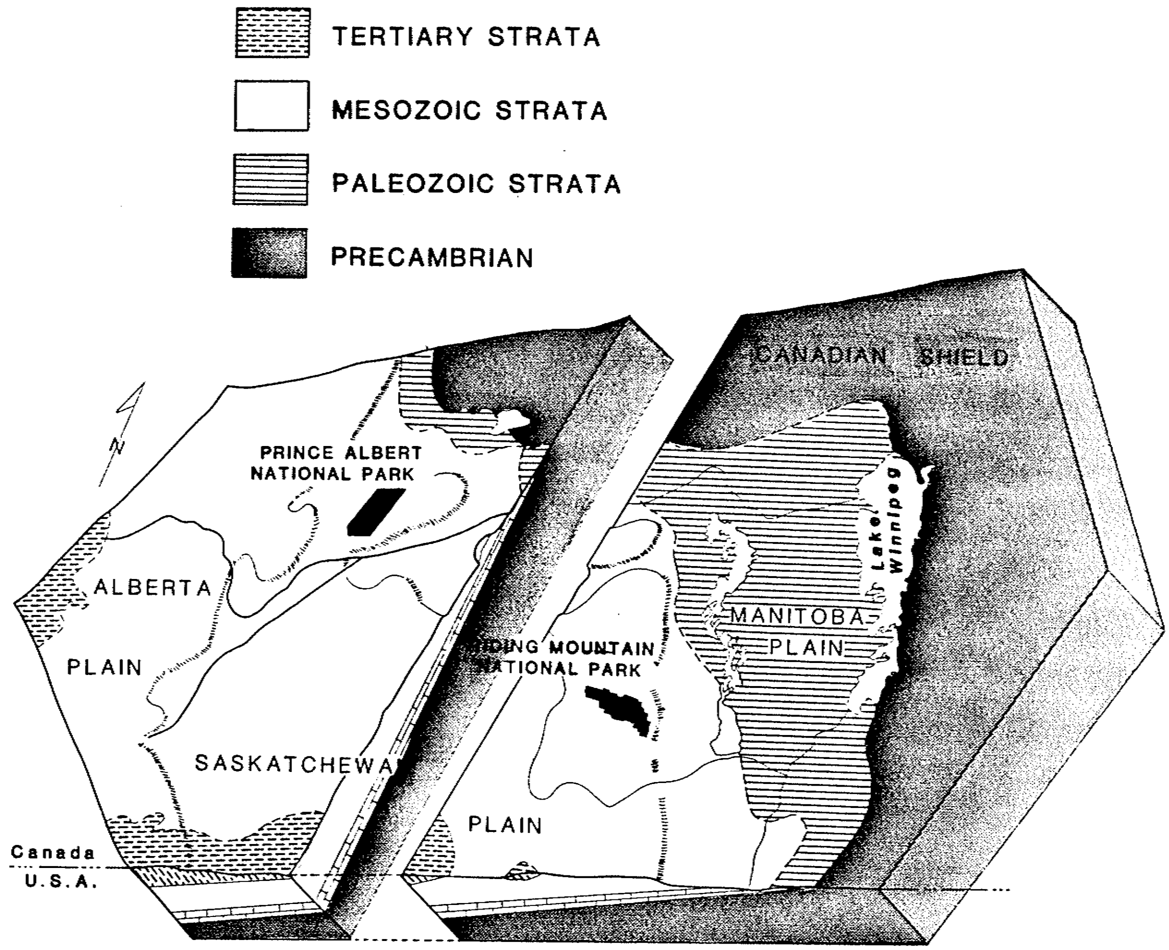
Limitations of the Data Base

For the most part, bedrock and surficial geology information for the RMBR was gathered from mapped data bases at 1:250,000 from (Groundwater Availability Studies, Water Resources, 1972, 1976, 1978, 1987). For surficial geology, the groundwater map series was compared with Surficial Geological Map of Manitoba at 1:1,000,000 (Manitoba Mineral Resources Division, 1981). This resulted in greater accuracy of representation in the final thematic overlay. The main geomorphic features present in the study region are well-documented for comparison purposes (Lombard North Group Ltd, 1976; Klassen, 1979; Parks Canada, 1984; and PFRA, 1988).

Bedrock Geology

The bedrock geology of the RMBR can best be introduced in the context of topographic levels that compose the Canadian Prairies (Fig. 7). The study area is primarily underlain by the Saskatchewan Plain, constituting a portion of the Western Uplands and, to the east by a part of the Manitoba Lowlands. These two physiographic regions are generally separated by the Manitoba Escarpment.

The underlain sedimentary bedrock is composed of various formations which have contributed to the area's



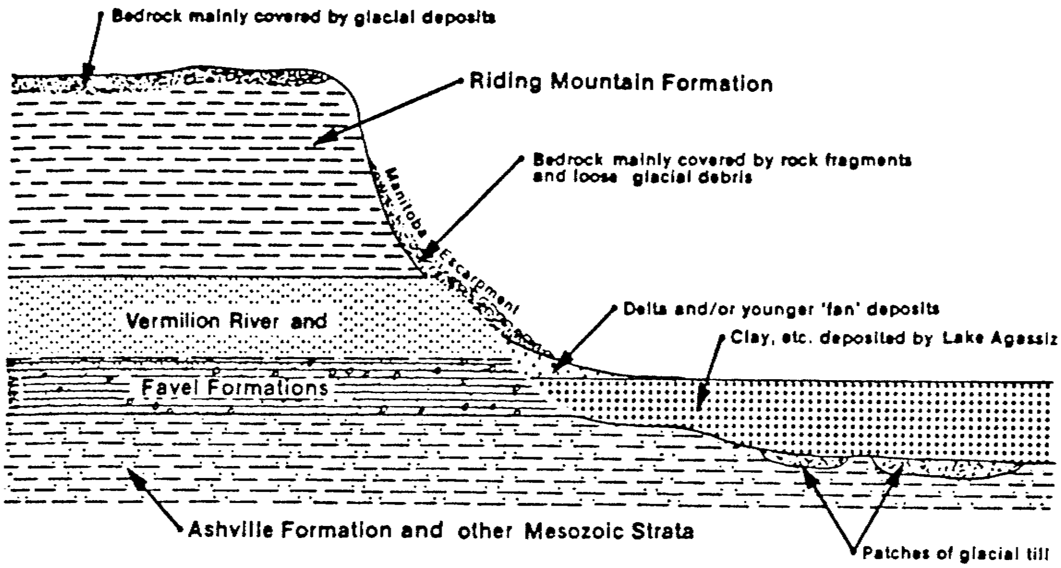
Source: Parks Canada,(1984)

Figure 7. Bedrock structure underlying the Southern Interior Plains.

physiography or land base. A geological cross-section of the Manitoba Escarpment illustrates this point (Fig. 8) showing the significance of the Riding Mountain, Vermilion River, Favel and Ashville formations. These formations outcrop along the Escarpment (Lombard North Group Ltd, 1976; Parks Canada, 1984).

Bedrock of the Riding Mountain formation, the most predominant over the study area (Fig. 9), is composed of two sections: 1) the harder overlying Odanah section consisting of the darker gray shales, and 2) the underlying Millwood section comprising the softer greenish gray shale that tends to weather more rapidly (Groundwater Availability Study, 1978).

Underlying bedrock north of the Park and along the east side of the Escarpment is made up of other Cretaceous shales, constituting the Vermilion River, Favel, and Ashville formations and the unconsolidated quartz sand and sandstone of the Swan River formation. Outcrops of these formations are subject to mass movement, characterized by the downslope movement of rock debris under the force of gravity, and extensive erosion (Parks Canada, 1984). The Melita formation, representing only a small portion of the study area along the northeast, is made up of quartz sand, sandstone and some limestone which underlie most of the



Source: Parks Canada,(1984)

Figure 8. Geological cross section of the Manitoba Escarpment, Riding Mountain National Park.

Manitoba Lowlands.

Surficial Geology

The RMBR, as noted under bedrock geology, has been described in terms of the land districts: uplands; escarpment; and lowlands. These districts constitute the first order topographic features for the area, which describe major geological boundaries. Landforms and surficial deposits comprise the second order topographic level (Fig. 10).

The main geomorphic features of the Park and surrounding area include: Duck Mountain upland; Valley River plain; Riding Mountain upland; Assiniboine River plain; Manitoba Escarpment; and the Manitoba plains (Klassen, 1979). The advance and retreat of the Pleistocene ice sheets bulldozed the landscape. The last glacial period, known as the Wisconsin, and the period of deglaciation ending approximately 12,500 years ago played vital roles in present landscape formation.

The study area contains surficial deposits formed by glacial and post-glacial processes (Fig. 10). Glacial features occur as glacial till, glacio-fluvial, or outwash deposits, and glacio-lacustrine deposits. Post-glacial features include more recent fluvial and lacustrine deposits, such as alluvial fans (PFRA, 1987), as well as erosional features from active processes along the Escarpment (Parks Canada, 1984).

Thick moraines, deposited on upland areas, provided for a variety of glacial features. Predominantly, glacial till stagnation moraines, or knob and kettle topography, occur within the Park, along the southern reaches of the Park area, and to a lesser extent along eastern portions. The hummocky moraine of the Riding Mountain upland gives way to gently irregular landscape of the Assiniboine River plain, where recessional moraines (glacial till plains) and end moraines are more prevalent (Klassen, 1979; Parks Canada, 1984). To the north, the Riding Mountain upland is separated from the Duck Mountain upland by a broad meltwater channel and is occupied by the Valley River plain. This area east to Dauphin Lake is indicative of gently rolling, nearly flat till and lake plain (Klassen, 1979).

Fluvial, or post-glacial erosional processes are dominant in the Escarpment area and to the northeast. Here, glacial till is being eroded exposing the underlying bedrock and forming floodplains and alluvial fans on lowland areas. The Manitoba plains, gently sloping eastward from the boundary of the Valley River plain, were inundated by Glacial Lake Agassiz. Much of the till has been reworked through the deposition of silt and clay (Klassen, 1979). Abandoned beach deposits and deep basin deposits noticeably trend in a southeasterly direction (Fig. 10).

Aggregate Resources

The following section is presents a brief qualitative discussion of some of the economic aspects of geology as they relate to surficial materials identified for the RMBR. Specifically, the regional importance of aggregate material for building and construction purposes is considered.

The distribution of aggregate material (sand and gravel) and the associated potential of certain types of deposits can be indicated. Of the kinds of deposits that can exist, kames, found over hummocky moraines, and eskers tend to have a greater variety of aggregate materials and grain sizes than do outwash plains, alluvial flats or terraces, or abandoned beaches (Klassen, 1979).

Known granular prospects, aggregate deposits, gravel pits, and bedrock quarries have been compiled for the RMBR (Fig. 11). Except in specific instances, based on available information, little distinction has been made about the quality of the deposits (Manitoba Energy and Mines, 1988). For example, in the Neepawa Area (ie. the R.M.'s of Rosedale and Langford), high quality material, particularly in

Rosedale, (UMA Engineering Group Ltd.,1980) occurs locally as an abandoned beach ridge of lesser aggregate variety known as the "Arden Ridge".

An outwash deposit west of Neepawa contains moderate quality aggregate (Manitoba Minerals Resource Division, 1979). The South Riding Mountain Planning District (ie. the R.M.'s of Strathclair, L.G. District of Park, and Clanwilliam) has been estimated to contain significant quantities of moderate quality aggregate. The largest reserves are located within the L.G. District of Park (Municipal Planning Branch, 1981).

Mapping of aggregate material within Riding Mountain National Park has received some attention. Certain developments can or have been cited on an initial basis based on suitable landform information or careful geological reconnaissance (J.D. Mollard and Associates, 1971; Parks Canada, 1984). The only known systematic search for granular materials in the Park was confined to an area north along Highway No. 10 from Clear Lake to the Town of Dauphin (Fig. 11). Nearly all of the mapped granular prospects were rated from poor to doubtful with some potential for fair quality. There were no classic indicators of good quality deposits (J.D. Mollard and Associates, 1971). Most of the Park is covered by a thick mantle of glacial hummocky moraine containing occasional pockets of sand and gravel. Based on this particular study, any sizeable aggregate deposits in the remainder of the Park would seem to be doubtful.

In summary, data on geological/geomorphological features for the study area are available and are generally well suited for comparison purposes in terms of scale and level of detail. Information on aggregate resources, however, is inadequate or lacking for the Park. The most distinctive geologic/geomorphic feature for the RMBR is the Manitoba Escarpment. The Park is characterized by the Escarpment and the hummocky nature of the Riding Mountain Upland. The remainder of the study area is representative of a broad meltwater channel, a nearly flat till and lake plain and a gently irregular river plain. Finally, moderate to high quality deposits of sand and gravel exist in the surrounding area while the Park is generally indicative of poor to fair qualities.

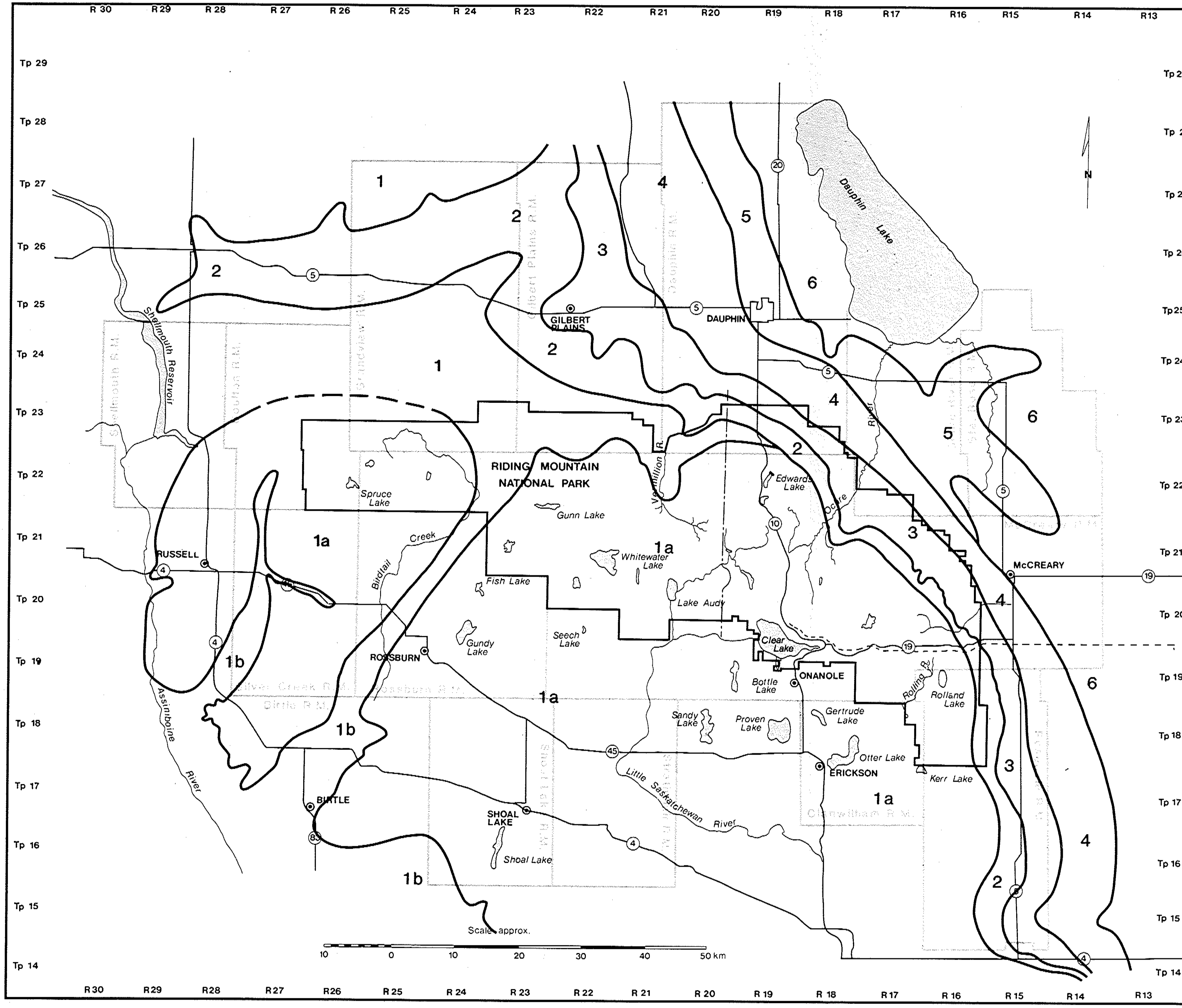


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Figure 9 Bedrock Geology

1 Riding Mountain Formation
1a Odanah Member
1b Millwood Member
2 Vermilion River
3 Favel
4 Ashville
5 Swan River
6 Melita

Source: Manitoba Natural Resources 1972, 1976, 1978, 1987

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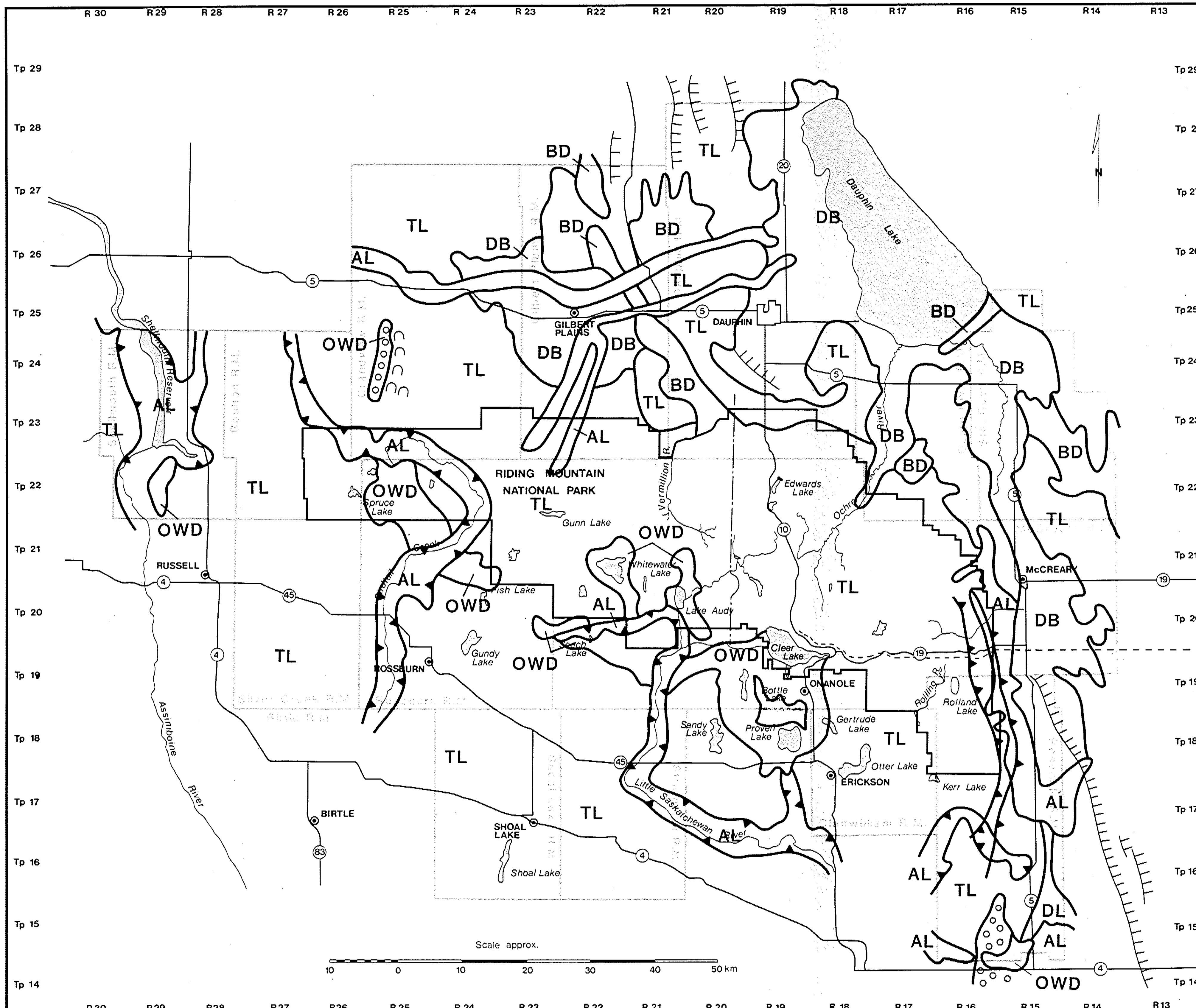

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Figure 10 Surface Geology

Non Glacial

AL Alluvial Deposit

PRO Glacial and Glacial

Glacio Lacustrine Deposits

BD Beach Deposits

DB Deep Basin Deposit

DL Deltaic Deposits

OWD Outwash or Glacio-Fluvial Deposits

Glacial Deposits

TL Till

Escarpment

Glacial Spillway

Hummocky Stagnation Moraine

Moraines

Beach Ridges

Source: Manitoba Mineral Resources Division, 1981

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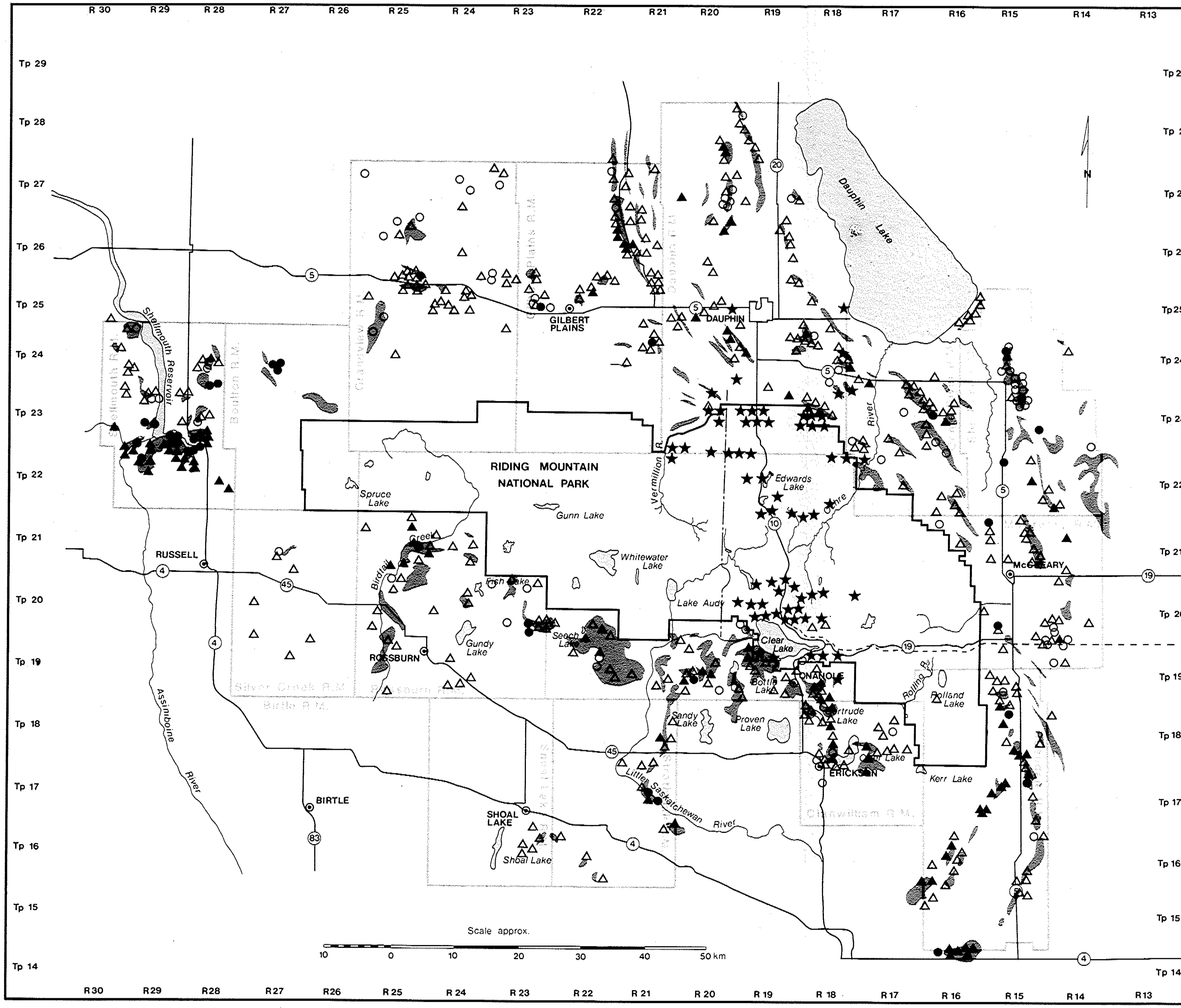

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Figure 11 Aggregate Resources

Aggregate Deposit

▲ Gravel Pit: active, private sand and gravel

△ Gravel Pit: inactive, private sand and gravel

● Gravel Pit: active, crown sand and gravel

○ Gravel Pit: inactive or depleted private sand and gravel

Source: Manitoba Energy and Mines, 1988
Maps scale 1:250,000
62J 62K, 62N, 62O

★ 1971 Granular Prospects

(BASED ON INITIAL GEOLOGICAL RECONNAISSANCE THROUGH AIRPHOTO INTERPRETATION)

LOCATIONS ARE APPROXIMATE

Source: J.D. Mollard and Associates, 1971

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SOIL RESOURCES

Limitations of the Data Base

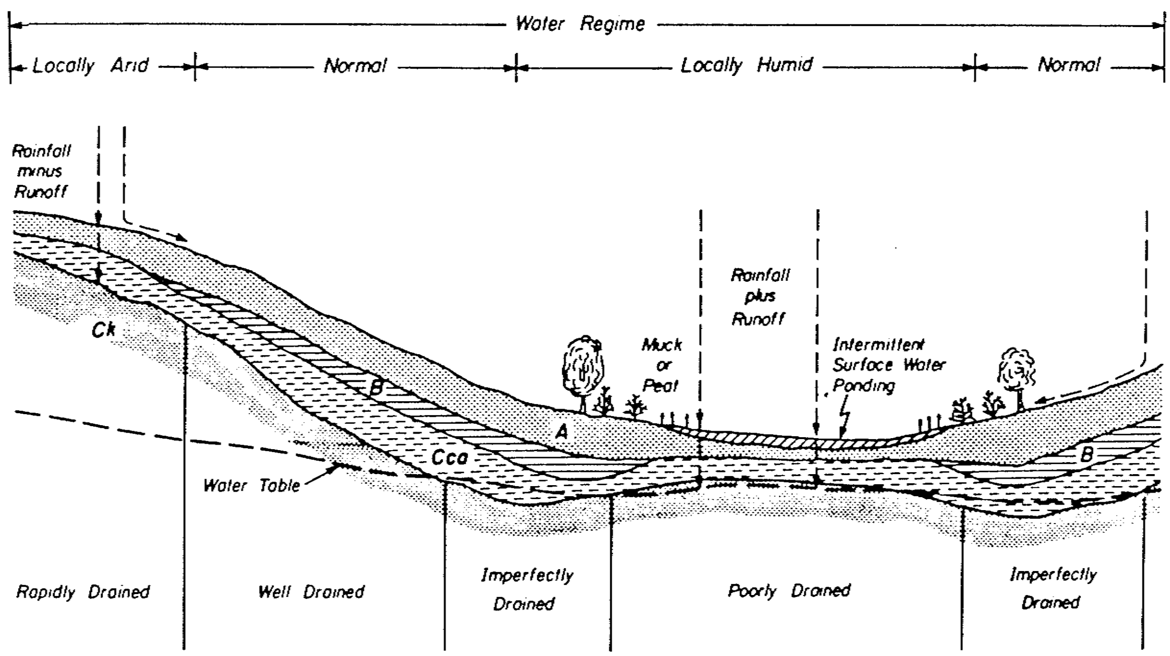
The following soils overview is based on mapped information provided by the Canada-Manitoba Soil Survey, Soil Landscapes of Manitoba (1986) project, Canada Land Inventory data on soil capabilities (1966, 1967, 1968, 1971), and PFRA water and wind erosion risk maps (1989). More detailed soil survey reports (1956, 1958, 1959, 1981) at 1:126,720 are available for the study area but, along with Canada Land Inventory information at 1:250,000, do not classify Park soils. Detailed representation of soils and soil subgroups within the Park is available at 1:250,000 (Parks Canada, 1984). At 1:1,000,000, the Soil Landscapes of Manitoba Map shows the main characteristics of the most common soil landscapes for the study region, compiled from existing soil surveys. This, however, does not make for easy comparison with soil capability mapping for agriculture but will suffice for the purposes of this overview.

Soil Orders (Great Groups)

The formation of soils is a result of the parent material, biota, climate and topography present in an area over time (Parks Canada, 1984). The influence of topography has acted as a fundamental factor in the determination of local conditions affecting soil formation (Mills, 1984). Two-thirds of the land surface in the study area is classifed as primarily rolling, rapidly to well-drained upland, while the remainder consists of imperfectly to poorly drained lowland areas. Soil textures range from coarser sands to finer clays. Soil drainage, itself, is also an important factor which is to a great degree determined by the slope of the land, climate of the area, soil texture and location of the soils relative to the water table (Mills, 1984). Figure 12 illustrates the effect topography has on soil development and drainage. Here, the full impact of climate and vegetation on Black Chernozems can be seen in terms of the succession from drier to wetter landscapes over undulating surfaces (Mills, 1984).

After the melting of the last ice sheets 12,500 years ago, soils began to develop on both glacial and post-glacial surficial deposits (Fig. 10). Based on the System of Soil Classification for Canada (1974) five dominant soil great groups have been identified for the study area:

1) Gray Luvisols are the most predominant great group within the Park area. These soils develop under forest vegetation where loam textured material exists as well in the grassland-forest transition zone (Parks Canada, 1984). They are imperfect to well-drained soils with parent



Source: Mills,(1984)

Figure 12. Effect of topography on soil development and drainage in the black chernozems of south western Manitoba.

material of morainal deposits over knob and kettle topography (Canada-Manitoba Soil Survey, 1986).

2) Black Chernozems and the Dark Gray Chernozems/Gray Luvisols cover most of the remaining study area (Fig. 13). Black Chernozems are characteristic of grassland and grassland-forest transition zones, and consist of well-drained to imperfectly-drained soils under sub-humid conditions. They form primarily on medium textured lacustrine deposits or till and are among the most fertile and productive soils for agriculture purposes in Manitoba (Mills, 1984).

3) Dark Gray Chernozems/Luvisols, running primarily as a belt south of the Park from the northwest to the southwest, acts as an interface between the Black Chernozems of warmer south and the Gray Luvisols of the cooler forested upland areas to the north. These soils usually develop on various outwash, lacustrine and till deposits (Canada Land Inventory, 1971).

4) Unlike the zonal Chernozems and Luvisols mentioned above, the intrazonal Regosols and Gleysols, need not be restricted by a particular climate of vegetative region and can occur in any part of southern Manitoba (Mills, 1984). The Regosols in the study area are isolated in former/remnant meltwater channel areas. These soils are usually formed

on fresh material and are immature, having been exposed to soil forming activity only recently (Mills, 1984; Parks Canada, 1984). They are commonly found on rapidly drained and well-drained sites, such as river floodplains and deltas, but can occur on imperfectly-drained sites. Another type of Regosol, not shown in Figure 13, occurs where erosion has recently removed the surface soil downstream forming fluvial fans and terraces (Mills, 1984). The base of the Manitoba Escarpment would be such an area.

5) The only large area of Gleysols occurs immediately southeast of Lake Dauphin (Fig. 13). This great group is commonly characteristic of poorly drained depressions or flat regions where there are periods of excess surface water conditions. These Gleysols may be altered through the institution of drainage works (Canada Land Inventory, 1971). In the Park, Gleysols will be found in patches anywhere the water table is near the surface (Scott, 1990).

6) Organic soils will occur in all vegetative areas in the RMBR. They form from the accumulation of organic materials derived from vegetation common in low areas - marshes, swamps, fens and bogs. Organic soils are only a local occurrence in the relatively warm grassland region of Manitoba but become more common in cool, humid northern areas of Manitoba (Mills, 1984).

Agricultural Capability

Soil capability for agriculture (Fig. 14) shows the ability of soils to sustain crop growth based on limitations to the management of the soils. For the purpose of this overview, soils were classified into four groupings according to their respective potentials (Rees, 1977). The first group, essentially the first class (H), has no limitations to the production of cereal crops. Class two and three (M) comprise the second grouping indicating moderate to severe limitations to sustained crop production. Those soils with severe to very severe limitations, classes four to seven (L) or the third grouping, consist of marginal lands, permanent or wild pasture areas and agriculturally unsuitable land areas. The last grouping (Ø) consists of organic soils derived from decomposed vegetation and is not placed in any class.

Along the base of the Manitoba Escarpment region in the R.M.'s of Dauphin, Ochre River, Ste Rose du Lac, McCreary and Rosedale land capability classification rankings vary from medium to low, or classes three to six (Fig. 14) for the Black Chernozems and Dark Gray Luvisols. The Gleysols that occupy an area near Lake Dauphin have a low capability, especially if they are undrained, of four to seven. Organic soils are common where the surface water ponds (Canada Land

Inventory, 1971).

The Valley River plain region (R.M.'s of Gilbert Plains and Grandview) has a capability rating ranging from two to six, on the Black Chernozems, with changing limitations from moderate to severe where the slope of the land becomes sharper (Canada Land Inventory, 1968). The Dark Gray Chernozems/Gray Luvisols occurring in the Duck Mountains and the surrounding hills have a fairly moderate to low capability as well (Fig. 14). Organic soils are present in scattered locations.

The western slopes of the RMBR, from the upper Assiniboine River Valley area to the south side Riding Mountain region have capabilities for agriculture ranging from class three to six, or moderate to low. Organic soils occur in locations in close proximity to the National Park boundary (Fig. 14). Although not shown on the overlay, Organic soils are quite prominent throughout the Park where wetland vegetation is the dominant cover, and occur within the Park much as Gleysols do (Parks Canada, 1984).

Areas with varying degrees of wind and water erosion potential identified (Fig. 15 & 16) refers to bare, unprotected soils. The information has been adapted from Canada-Manitoba Soil Survey maps (PFRA, 1989) and is based on data from surrounding agricultural reporting stations. The extent of soil susceptibility to wind erosion within the RMBR varies with soil surface texture and the suitability for agricultural use. Water erosion problems, on the other hand, are characteristic of extreme to moderately severe sloping topography. The Manitoba Escarpment region, for example, indicates high risk for water erosion. Wind erosion is confined mainly to the lowlands.

In summary, a diverse information base exists for soils in the RMBR. This is primarily due to the differences in scale and level of detail making a comparison between the most common soil landscapes and soil capabilities for agriculture difficult. The Park is dominated by the great group - Gray Luvisols, while Black Chernozems predominate in the surrounding area. General capabilities for agriculture in the Park have not been surveyed, since this does not conform to Park Policy (1979). Capabilities for agriculture in the surrounding area range from moderate to low (classes 3-6). Water erosion risks are much higher in areas associated with the Manitoba Escarpment and Upland plateau districts, whereas wind erosion is more prevalent along the Lowlands.

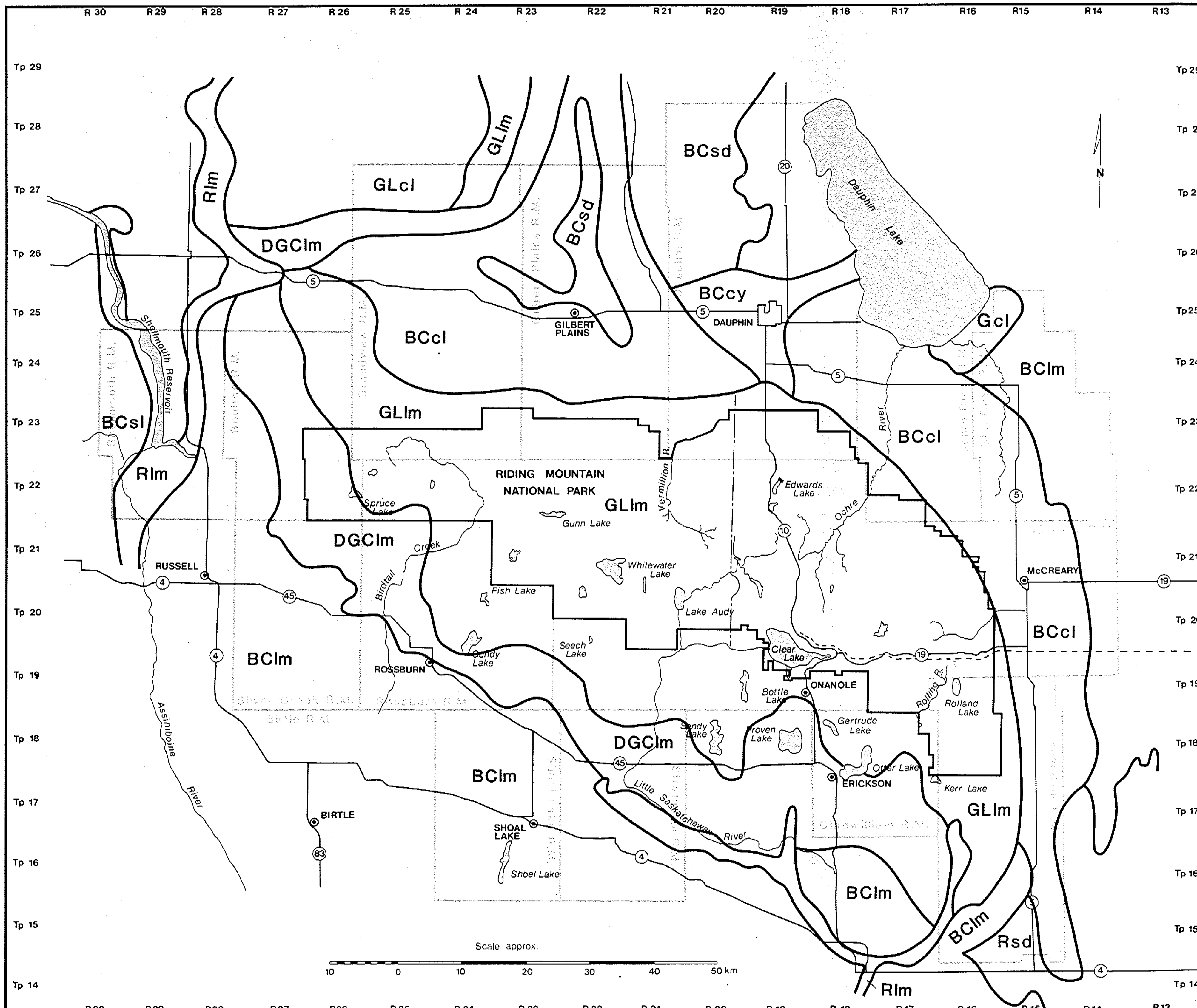


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Figure 13 Dominant Soil Orders

GL	Grey Luvisols
DGC	Dark Grey Chernozemic
DGL	Dark Grey Luvisols
R	Regosols
G	Gleysols
BC	Black Chernozems

Textural Group of Parent Material

sd	Sand
lm	Loam
cl	Clay Loam
cy	Clay
sl	Sandy Loam

Source: Soil Landscapes of Manitoba, 1986
Scale 1:1,000,000

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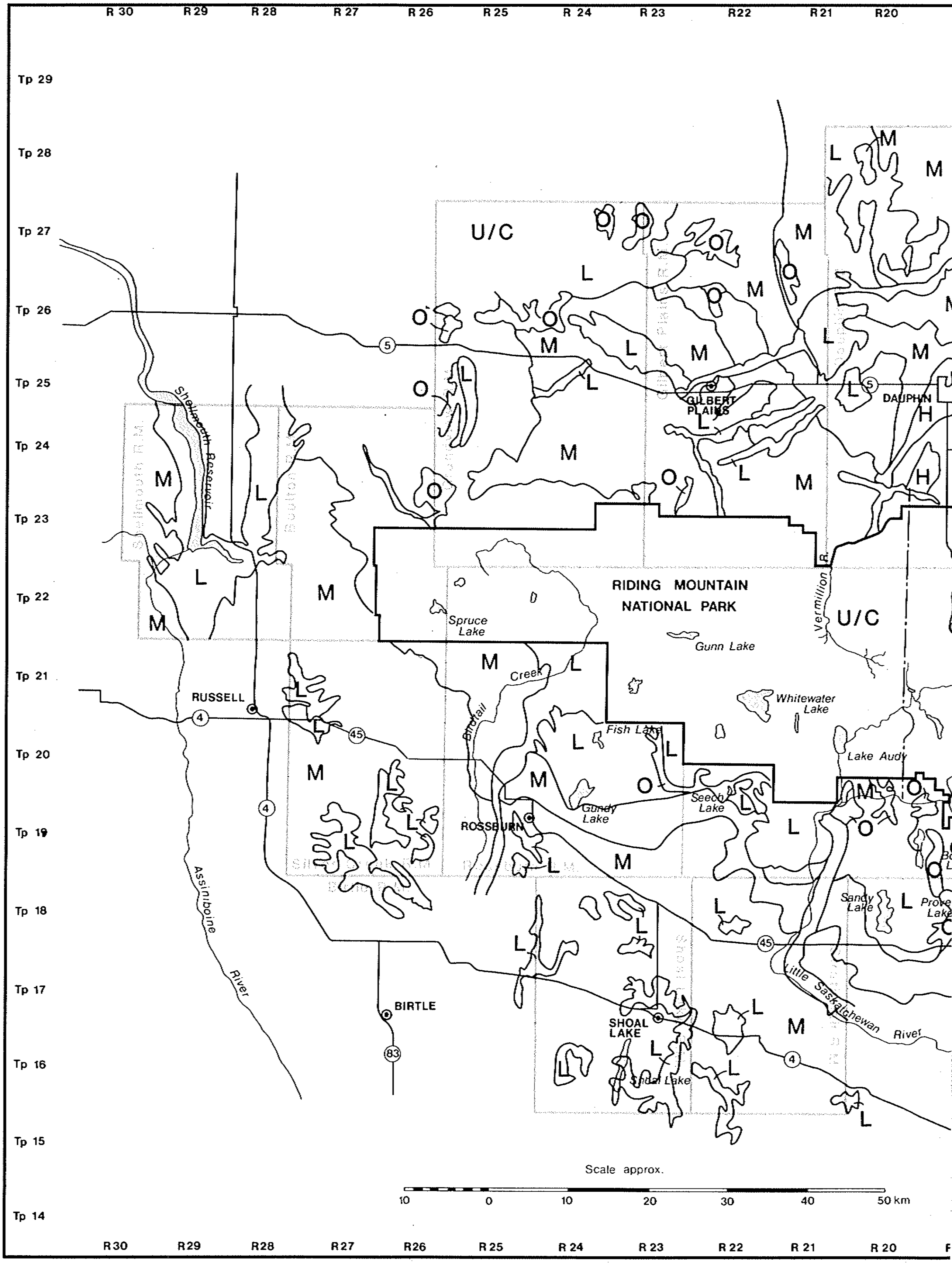
R 30
R 29
R 28
R 27
R 26
R 25
R 24
R 23
R22
R 21
R20
Tp 29
Tp 28
Tp 27
Tp 26
Tp 25
Tp 24
Tp 23
Tp 22
Tp 21
Tp 20
Tp 19
Tp 18
Tp 17
Tp 16
Tp 15
Tp 14
U/C
GILBERT PLAINS
DAUPHIN
Shellmouth Reservoir
RIDING MOUNTAIN NATIONAL PARK
Spruce Lake
Gunn Lake
Whitewater Lake
Vermillion R.
Lake Audy
Fish Lake
Birdtail Creek
RUSSELL
ROSSBURN
Gundy Lake
Seech Lake
Sandy Lake
Assiniboine River
Little Saskatchewan River
BIRTLE
SHOAL LAKE
Shoal Lake
Scale approx.
10
0
10
20
30
40
50 km

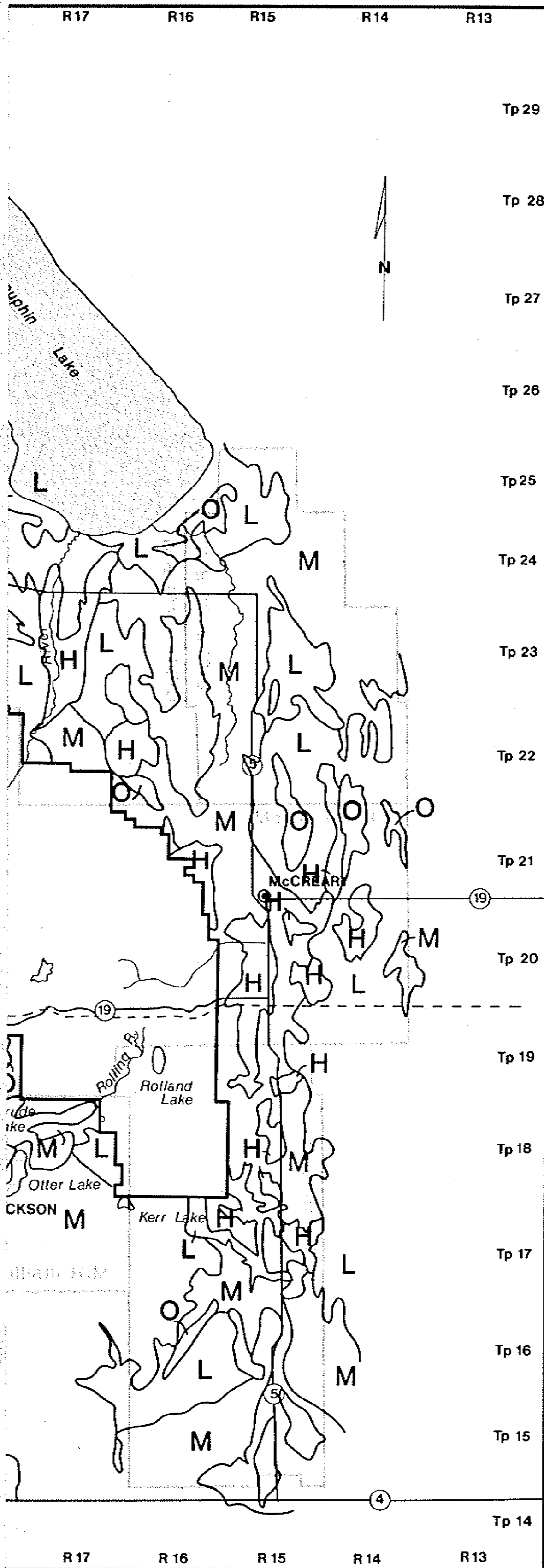

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Figure 14 Soils: Agricultural Capability

H	Class 1 High Capability/No Limitations
M	Class 2 & 3 Moderate Capability/ Moderate to Severe Limitations
L	Class 4–7 Low to No Capability Severe to Very Severe Limitations
O	Organic Soil
U/C	Unclassified

Source: Canada Land Inventory
1966, 1967, 1968, 1971

Maps scale 1:250,000
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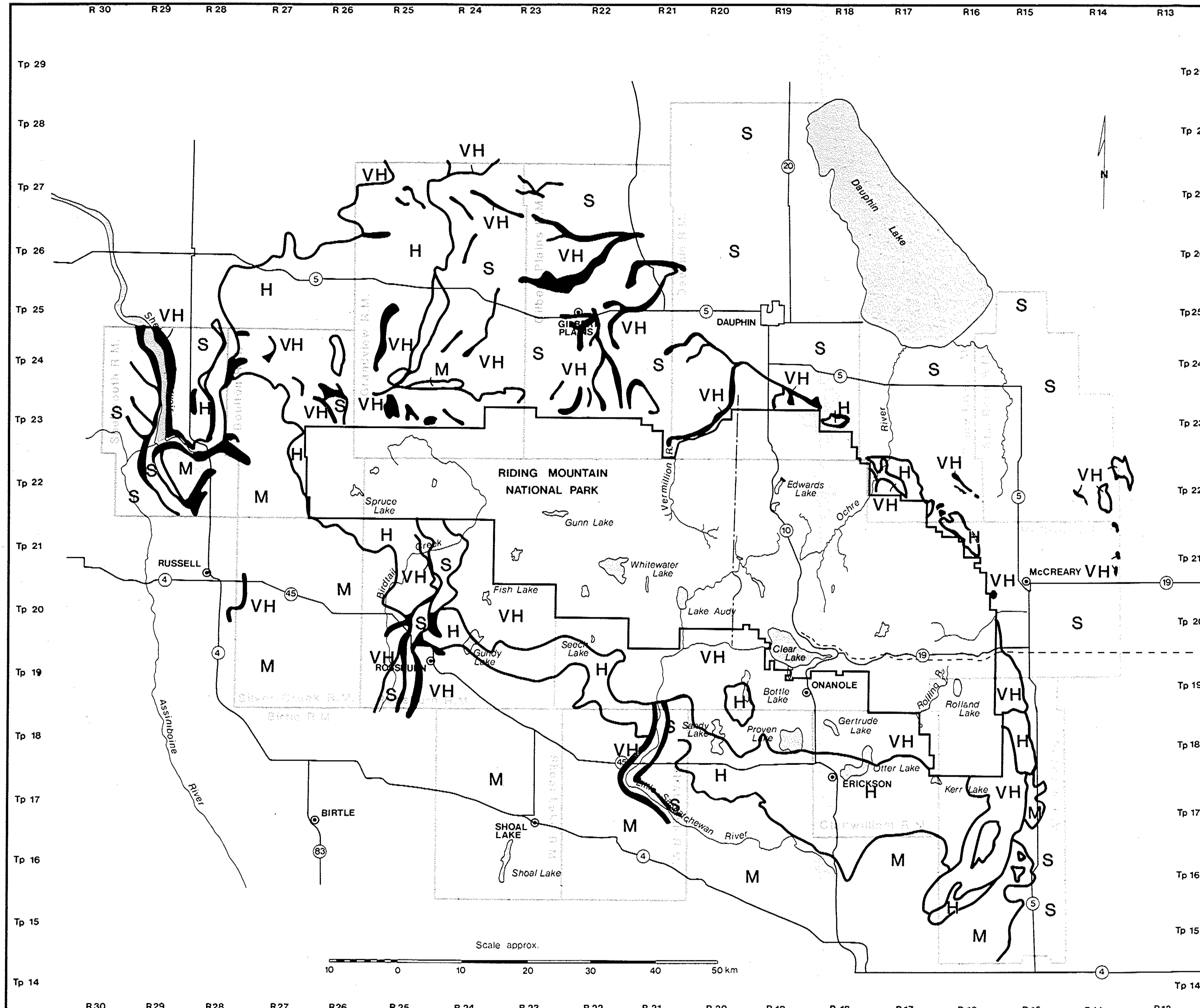

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Figure 15 Soils: Water Erosion Risk

S Slight
M Moderate
H High
VH Very High

Source: Agriculture Canada Maps
PFRA, 1989

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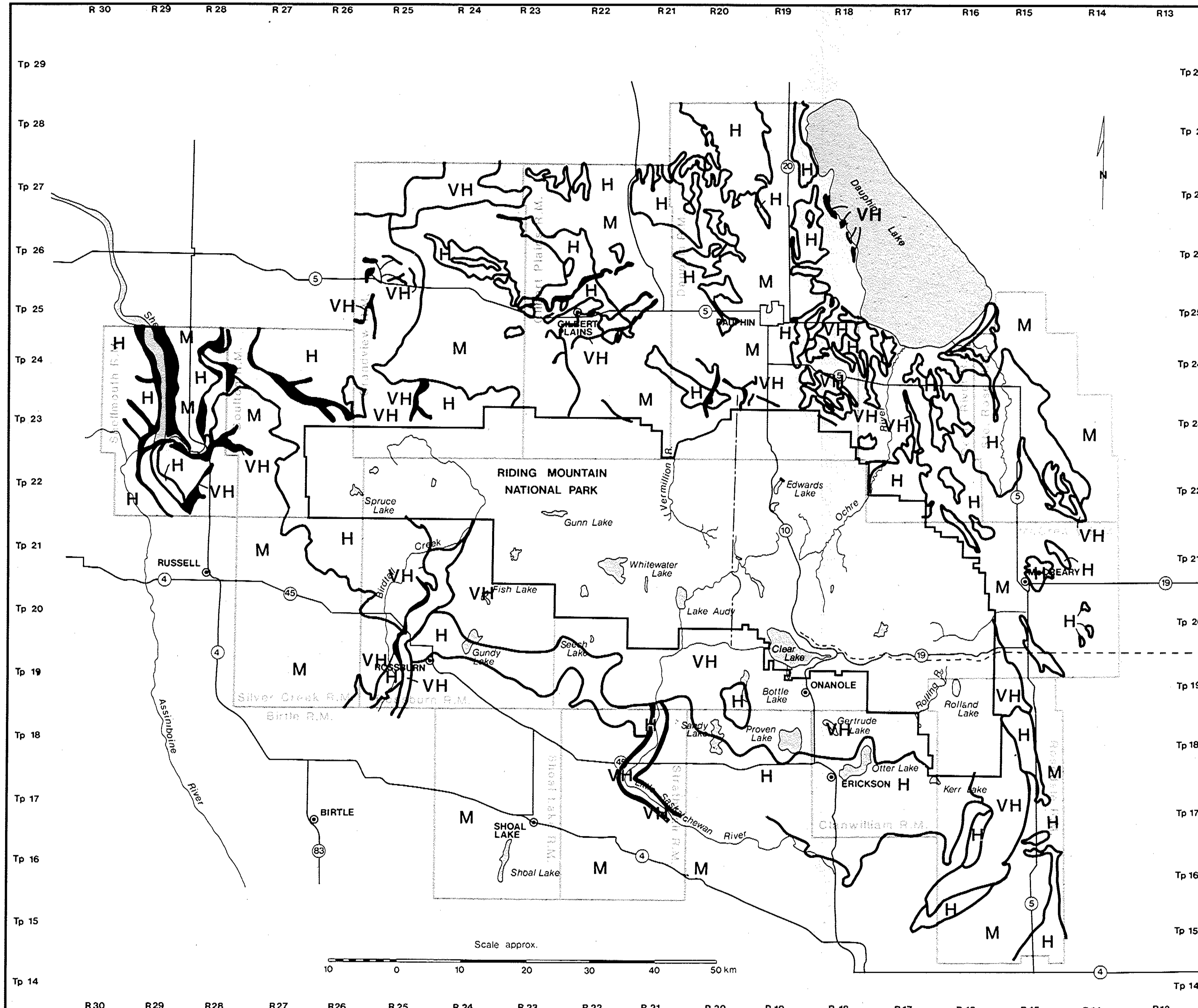

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Figure 16 Soils: Wind Erosion

M Moderate

H High

VH Very High

Source: Agricultre Canada Maps
PFRA, 1989

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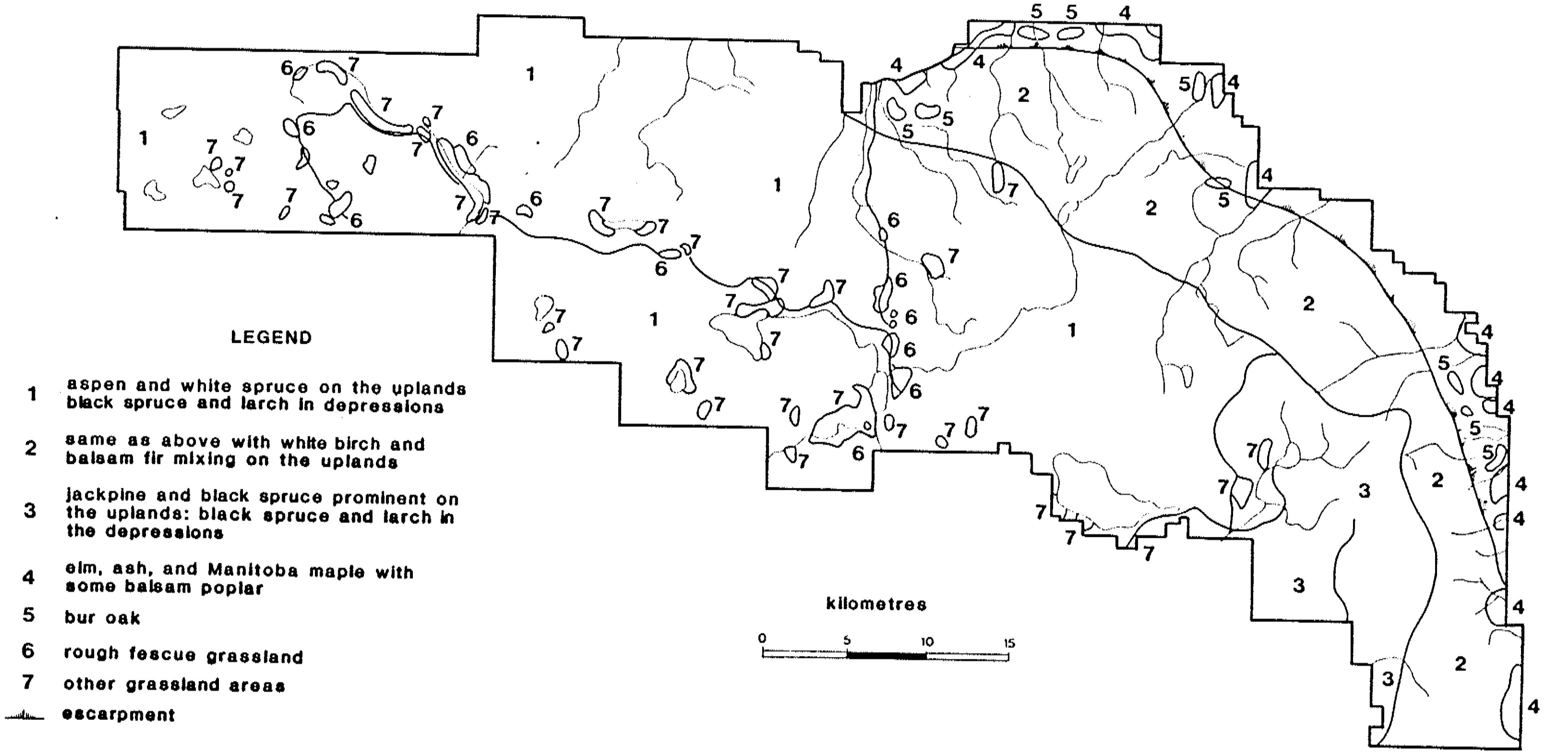
<u>Vegetation</u>

The RMBR is situated within the Boreal Forest Region of Canada. Black and white spruce along with a general mixture of deciduous trees such as white birch, trembling aspen, and balsam poplar are characteristic (Rowe, 1972). Most of the RMBR lies in the Mixedwooded Section of this Region, in a modified or relatively natural state as in the Park (Fig. 17). The remainder of the study area is covered by a distinctive Deciduous Forest zone, or the Aspen-Oak section of the Boreal Forest Region (Lombard North Group, 1976). More detailed descriptions of major forest vegetation communities and significant grassland communities within the Park can be found in Bailey (1968), Trottier (1974), Parks Canada (1984) and Cody (1988). Figure 18 shows a generalized pattern of this distribution.

Outside the Park, the vegetative type is characteristic of the Aspen-Oak/Woodland Section. Small areas west of the Shellmouth Reservoir and in the vicinity of the Duck Mountains are intruded by the Aspen-Grove Section. Part of the northeast, identified as Aspen-Oak and Mixedwooded lies in the Manitoba Lowlands Section of the Boreal Forest Region (Fig. 17).

The following, adapted from Rowe (1972), Canada Land Inventory information (Lands Directorate, 1974) and Adams



Source: Cody,(1988)

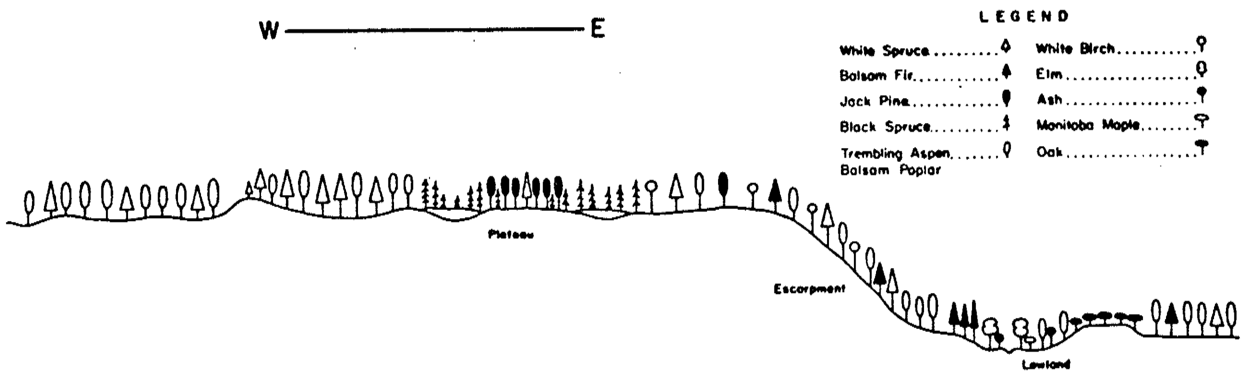
Figure 18. A generalized pattern of major plant communities, in Riding Mountain National Park.

(1985) describes the ecoregions recognized in the Boreal Forest Region for the RMBR. Areas where coniferous and deciduous species mix refers to the Mixedwooded Section. The Riding Mountain Upland is covered extensively by coniferous species such as white spruce, black spruce, tamarack, and jack pine due to higher precipitation and a more humid climate. The east slope of Riding Mountain and the area just east and south of the Park support extensive stands of deciduous species, dominated by trembling aspen due to its ability to regenerate quickly after being disturbed (Rowe, 1972). To the northeast, mixtures of Manitoba maple, green ash, and white elm are also found (Lands Directorate, 1974). The Valley River plain area also supports mixedwooded species, which to a great degree have been modified by extensive cultivation for crops/hay and for pasture and graze (Pokrant and Gaboury, 1983).

The Aspen-Oak/Woodland Section represents the second ecologically significant area in the RMBR, and is characteristic of open deciduous stands, hardwood clumps and fringes of trees along streams and grasslands. Associated tree species include trembling aspen, balsam poplar, and other species such as bur oak, Manitoba maple, green ash and white elm (Lands Directorate, 1974). Oak are found predominantly on drier sites, while Manitoba maple, green ash and white elm are restricted mainly to the vicinity of streams and river valleys (Water Resources, 1979).

This represents a transition zone from grasslands to a more woody forested area of groves and bluffs. Most of the land, however, is now under cultivation either for forage or cereal crops so as a result the remnant forest cover is not very extensive. In the northeastern part of study area and including most of the southern and western portions, tills and finer lacustrine deposits identified previously (Fig. 10) support tree clumps of various sizes on imperfectly and poorly drained sites to well-drained and moist locations (Lands Directorate, 1974). The limited presence of the Aspen-Grove Section (Fig. 17) supports natural stands of trembling aspen and balsam poplar on the more moist lowland areas (Rowe, 1972). The relationship of the various vegetative species to edaphic and physiographic factors is accurately represented in Figure 19.

Remnants of natural grassland occur in the central area of the Park (Trottier, 1974). Four types were identified for the Park: climax rough fescue; disturbed rough fescue; blue-bunch-wheatgrass; and junegrass-wheatgrass. Dominant species associated with the blue-bunch-wheatgrass include Kentucky bluegrass and slender wheatgrass. Junegrass and wheatgrass comprise the junegrass-wheatgrass community (Parks Canada,



Parent Material	Glacial Till	Coarse Outwash	Glacial Till	Peat	Glacial Till	Peat	Glacial Till	Recent Alluvium	Gravel Beach	Glacial Till
Soil	Grey Wooded	Dark Grey Wooded	Grey Wooded	Organic	Grey Wooded	Organic	Grey Wooded	Regosol	Black	Grey Wooded
Soil Texture	Loam to Clay Loam	Coarse Sand to Sandy Loam	Loam to Clay Loam	Fibrous	Very Fine Sandy Loam to Clay Loam	Fibrous	Very Fine Sandy Loam to Clay	Silty Clay Loam	Loamy Sand	Fine Sandy Loam to Clay Loam
Soil Moisture	Fresh to Very Moist	Dry	Fresh to Very Moist	Wet	Dry to Fresh	Wet	Fresh to Very Moist	Very Moist	Dry	Fresh to Very Moist

Source: Parks Canada,(1984)
(after Bailey)

Figure 19. Relationship of tree species to edaphic and physiographic factors in Riding Mountain National Park

1984).

Upland shrubs are limited to areas where forest cover is sparse and is dominated by beaked hazel, Saskatoon berry and some cranberry (Parks Canada, 1984). The northeast slope of RMNP and the lowlands just east and south of the Park support shrub communities consisting mainly of alder, beaked hazel, hazelnut, prickly rose, willow, and some dogwood (Lands Directorate, 1974; Water Resources, 1979; Parks Canada, 1984).

Areas of the RMBR that are poorly drained consist of bogs, swamps, wet meadows, and marshes, either occurring up on the Escarpment and Upland areas or in the lowlands. Alders, willows, dwarf birch, and sedges dominate these wetland areas. Common emergent marsh species include reed grass, cattail, sprangle-top and bulrush while sedges dominate wet meadow communities (Lands Directorate, 1974; Water Resources, 1979; Parks Canada, 1984). Floating and submergent plants in these open water areas include common bladderwort, the common pond weed and the water milfoil as examples (Shay, 1984).

Timber removal within the various vegetative communities may have aided the introduction and of exogenous species that now form an integral part of the Park flora (Bailey, 1968). The CFS Experimental Forestry Research Area, north of Clear Lake, is a relevant example. A partial list of the more common species include: Canada thistle (<u>Cirsium arvense</u>), hemp nettle (<u>Galeopsis tetrahit</u>), narrow-leaved hawk's-beard (<u>Crepis tectorum</u>), lady's-thumb (<u>Polygonum persicaria</u>) and clover (<u>Trifolium</u> spp.). However, establishment of these 'weeds' has been largely dependent upon the surrounding farmlands which provide the required habitat for seed production (Bailey, 1968).

Forest insect populations can cause epidemic problems and are monitored yearly. These include the spruce budworm (<u>Choristoneura frimiferana</u>) and the birch skeletonizer (<u>Bucculatrix canadensisella</u>). Defoliation has been limited to the area south of Clear Lake and between Edwards Lake and Northgate in the Park (Tidsbury, 1984). In 1985, Dutch Elm Disease (D.E.D.) (<u>Ceratocystis ulmi</u>) was first identified along the Escarpment Area (Dobson, 1985).

In summary, a general data base is available on vegetation types in the RMBR, with more detailed levels of descriptive information present for the Park. The surrounding vegetation has greatly been modified by cultivation. The Park is characteristic of the Mixedwooded Section of the Boreal Forest, surrounded by the Aspen-Oak/Woodland. Patches of native grassland are interspersed in both areas.

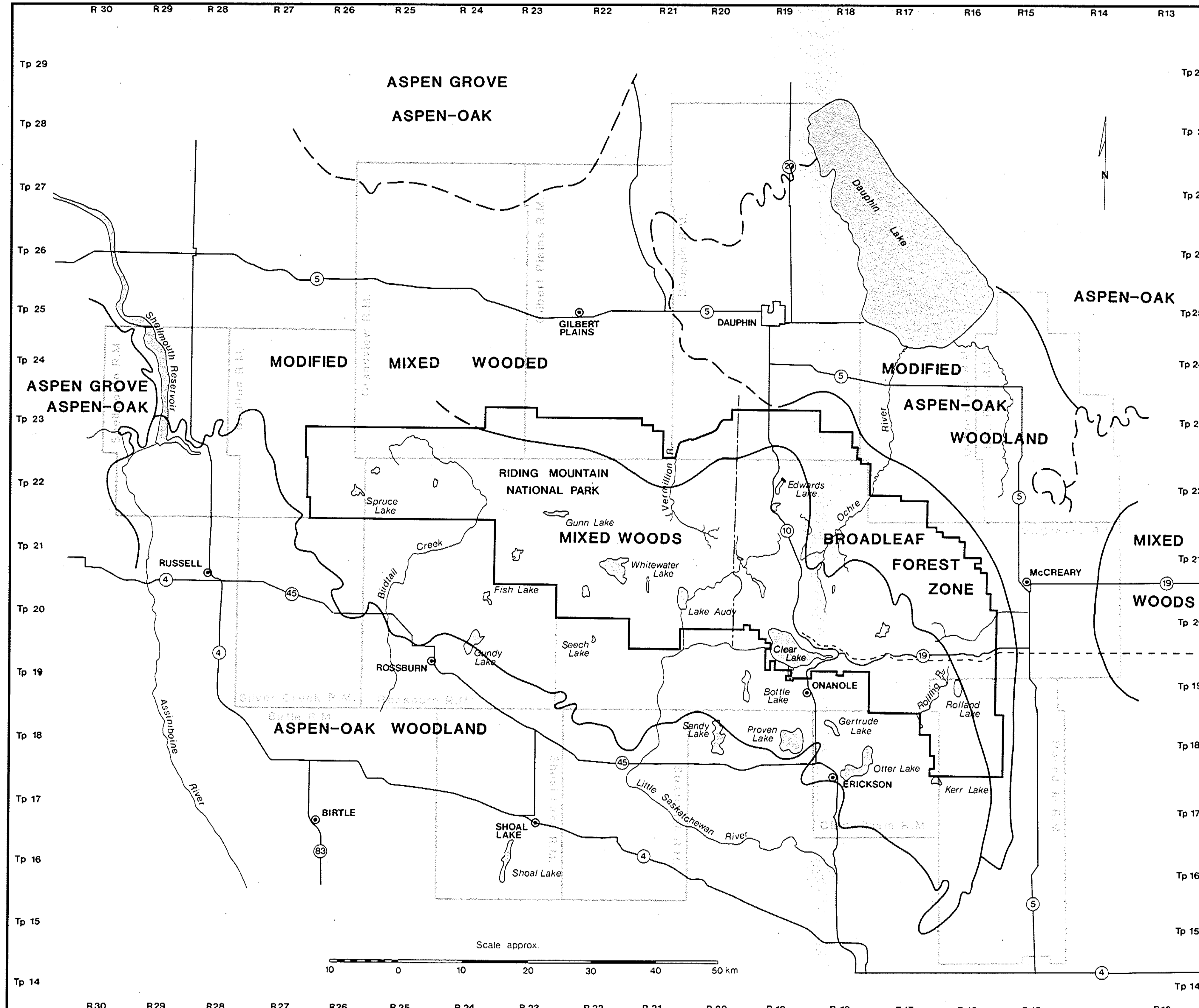
WILDLIFE RESOURCES

Limitations to the Data Base

A variety of wildlife is found throughout the RMBR. Whereas wildlife species for the Park have or are in the process of being studied, the degree and level of information that exists for the area outside the Park is very general. Detailed lists of representative species are available in a number of sources (Banfield, 1974, 1977; Godfrey, 1986). Those species relative to Manitoba are generally summarized in Reports to the Legislature on Wildlife (MB. Natural Resources, 1987). However, these reports are limited in that species of particular interest over the past 5 years tend to be the only ones highlighted.

Mammals

Mammals present in RMNP are listed in Appendix 3. Of the mammals present in the study area, black bear have one of the highest habitat carrying capacities as they are common throughout forested regions of the Park. Based on field reports and the frequency of crop damage claims (Parks Canada, 1984; MB. Natural Resources, 1987; Rousseau, 1988) it is estimated that population levels have remained quite high, at approximately 1500. Individual sightings of cougar are rare as their density is quite low in most southwestern



LEGEND

Figure 17 Vegetative Land Regions

NOTE: DASHED LINE INDICATES SIGNIFICANT CHANGE IN VEGETATIVE COVER

After: Canada Land Inventory – Forestry Map Scale 1:250,000 1974, 1975
Lombard North Group, 1976
Water Resources, 1979
Pokrant, Gaboury, 1983

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areas of the Province. A small population may yet exist in the Park as adequate habitat and food sources are available.

Four ungulate species are identified for the RMBR; white-tailed deer; North American elk; moose; and the rare mule deer. White-tailed deer are the most numerous species for the area surrounding the Park. They prefer the aspen-parkland cover. They were first identified in the early 1900's (Canada Land Inventory-Ungulates, 1971) after moving in from eastern and southern areas. The rich, rolling landscape of the western portions of the Valley River Plain and Assiniboine River Valley area support larger populations of white-tailed deer than eastern portions of the study area. Historically, elk have been abundant in the area encompassing RMNP. During pre-settlement times, large herds of elk were common on the surrounding plains. Subsequent agricultural expansion and hunting pressures pushed smaller remnant herds into the heavily forested uplands of the Riding and Duck Mountain areas (Canada Land Inventory-Ungulates, 1971; Parks Canada, 1984). Today, elk are the most numerous ungulate in the Park. Severe winters often force the elk to lower elevations of Riding Mountain outside the Park boundary.

Moose were once prevalent throughout the region, but they too have now been restricted to lands in or near the

Park and important isolated habitat areas in the Duck Mountains (Canada Land Inventory-Ungulates, 1973). The once high capability of adjacent lowlands has been rendered unsuitable due to extensive agricultural activities. Throughout the entire region, mule deer were once quite plentiful but now have been drastically reduced to few scattered remnants or may now be totally absent. Loss of favourable open habitat and increased competition from white-tailed deer are the probable causes (Canada Land Inventory-Ungulates, 1972). Wildlife capabilities for ungulates are represented for the RMBR (Fig. 20) ranging from areas with no significant limitations (including important wintering habitat) to areas with very high limitations.

Wolves are present in fluctuating densities, having ranged between 52 and 78 animals over the past 10 years (Carbyn et al, 1986). They are limited to portions of the Riding Mountain upland area of the Park and some border areas along with the Duck Mountain upland region (Carbyn et al, 1986; MB. Natural Resources, 1987). Coyotes are common and widely distributed in and around the periphery of the Park with fluctuating populations due to hunting pressure and food availability (Parks Canada, 1984). Wolf and coyote population dynamics have been the subject of investigations as part of Parks Large Mammal Systems Studies (Carbyn, 1980; Trottier, 1987) and a recent ecological report series (Carbyn et al., 1984, 1986).

Smaller furbearing mammals present in the study region with stable or increasing population numbers (depending on the availability of habitat) include red fox, weasel, red squirrel, badger, skunk, porcupine, mink, muskrat, racoon, and beaver. Beaver are important in the RMBR for the fact that each year the Park receives complaints from adjacent municipalities about beaver flooding farmland bordering on the Park. A subsequent Beaver Management Agreement has been signed between the Province and the CPS to deal with the problem. Studies such as Rounds (1980) and yearly aerial surveys support the notion that the flooding is due to beaver damming streams outside the Park as beaver density exceeds available habitat in the Park (Parks Canada, 1984). Rarer furbearer species of interest in the region include otter, fisher and lynx (MB. Natural Resources, 1987).

Avifauna

A diverse population of avifauna exists in the RMBR. The region is significant being located at the geographic centre of Canada at the crossroads of three different ecosystems. Consequently, ranges of particular bird species overlap. Similarly, migration pathways of several other species cover the area. The most up to date information on birds is found in Weedon (1987). Including the surrounding farmlands has increased the total number of species on the Riding Mountain list (Weedon, 1987) but even this study was limited by physical boundaries. A list of rare and significant recorded bird species which are or could be present has been compiled on separate occasions (Banash et al., 1977; Pylypuik, 1987).

Seasonal dynamics play an important role in the ecological character of the Park area. Over 175 species of birds are known to nest in this region during the summer whereas less than 40 species of birds are year round residents (Weedon, 1987). A partial table reflecting those species that are more seasonally abundant illustrates the ecological importance of birds in the RMBR (Appendix 4).

Some particular species are of interest due to their low populations and warrant protected designation status. Rare species whose breeding ranges can occur in the study area include: Bald Eagle; Double-Crested Cormorant; Great Gray Owl; Osprey and Swainson's Hawk (MB. Natural Resources, 1987; Pylypuik, 1987).

Twenty-two species of ducks and four species of geese are found in Manitoba at various times. Only two species of geese, Snow Geese and Canada Geese, nest in Manitoba. The greatest diversity and highest breeding densities occurs in the agricultural regions (MB. Natural Resources, 1987). Upland birds in southern areas include Ruffed Grouse, Sharp-tailed Grouse, Spruce Grouse and the introduced Gray Partridge. Due to the widespread distribution of preferred habitat accurate population estimates have not been available on a Provincial basis (MB. Natural Resources, 1987).

Migratory and nesting waterfowl are present where permanent or semi-permanent wetland habitat still exists. The knob and kettle topography of the Riding Mountain Plateau area, an extension of the Minnedosa pothole region and the Assiniboine River Valley area, is favourable to the production of waterfowl. Waterfowl capabilities for the study region are shown in Figure 21.

Western and central portions of the study area have very slight to moderately severe limitations for waterfowl. More severe limitations exist in the northeast. Mallard, American Widgeon, Bufflehead, Scaup and Common Goldeneye are abundant across the Riding Mountain Upland region. Northern and northeastern regions include those species mentioned along with Blue and Green-winged Teal, American Coot, Pintail, Canvasback, Redhead, Shoveler, Ruddy Duck, Ring-

Necked Duck, Lesser Scaup, and Gadwall (Canada Land Inventory-Waterfowl, 1970).

Amphibians and Reptiles

The RMBR contains 11 species of herpetiles; six amphibians and five reptiles (Table 5). Although all are either afforded protection under the Provincial Wildlife Act or the National Parks Act, habitat areas and population levels are largely unknown. The Leopard frog is the most widely distributed herpetile in the Province, followed by the red-sided garter snake, western painted turtle, snapping turtle, and the tiger salamander (Parks Canada, 1984; MB. Natural Resources, 1987). The actual numbers in any particular area will depend on the extent of preferred habitat. A recent study of herpetiles (Munro, 1987a) has provided up-to-date information on resident species for the Park.

Fish Species

Of the 16 watershed units identified for the RMBR (Fig. 5), 12 have been inventoried on a representative basis for fish (Kooyman et al., 1979; Gaboury, 1989). The occurrence of indigenous fish species by waterbody or stream is represented in Table 6. Appendix 5 lists fish species by common and scientific names.

Table 5 - Herpeties of Riding Mountain Biosphere Reserve.

Class	Family	Common Name	Scientific Name
Amphibia	Ranidaie	Leopard frog	*Rana pipiens*
		Wood frog	*Rana sylvatica*
	Hylidae	Boreal chorus frog	*Pseudacris triseriata masculata*
		Western gray tree frog	*Hyla chryroscelis*
	Bufonidae	Canadian Toad	*Bufo hemiophrys hemiophrys*
	Ambystomidae	Tiger Salamander	*Ambystoma tigrinum diaboli*
Reptilia	Colubridae	Plains garter snake	*Thamnophis radix*
		Red-sided garter snake	*Thamnophis sirtalis parietalis*
		Red-bellied Snake	*Storeria occipitoma-culata*
	Emydidae	Western painted Turtle	*Chrysemys picta*
	Chelydridae	Common snapping Turtle	*Chelydra serpentina linnaeus*

Source: (Parks Canada, 1984; Preston, 1982)

Table 6 - Occurence of Fish Species by Watershed, RMBR

Fish Species	Lake Region	Turtle River	Ochre River	Vermilion River	Wilson River	Valley River	Fishing River	Birdtail Creek	Shell River	U Little Sask	C Little Sask	L Little Sask	Big Grass River
Bigmouth Buffalo	X												
Blacknose Dace	X	X	X	X	X	X	X			X			X
Blacknose Shiner						X				X			
Brassy Minnow	X					X	X						
Brook Stickleback	X	X	X	X	X		X	X	X		X	X	X
Brook Trout		X	X	X			X	X			X		
Brown Trout*			X	X				X				X	
Burbot	X												
Carp*	X					X							
Cisco	X												
Common Shiner	X	X	X	X		X	X						
Creek Chub	X	X	X	X	X		X						X
Emerald Shiner	X					X							
Fathead Minnow	X	X	X	X	X	X		X	X	X	X	X	X
Finescale Dace			X			X							X
Golden Shiner						X							
Goldeye	X					X							
Iowa Darter	X					X		X					
Johnny Darter	X	X	X	X		X	X	X		X			X
Kokanee*								X				X	
Lake Trout								X		X			

Table 6 - Occurence of Fish Species by Watershed, RMBR

Fish Species	Lake Region	Turtle River	Ochre River	Vermilion River	Wilson River	Valley River	Fishing River	Birdtail Creek	Shell River	U Little Sask	C Little Sask	L Little Sask	Big Grass River
Lake Whitefish	X		X							X			
Largemouth Bass*								X				X	
Logperch						X							
Longnose Dace	X	X	X			X	X						
Northern Pike	X	X	X		X	X	X	X		X	X	X	
Pearl Dace	X	X				X	X						X
Quillback	X					X							
Rainbow Trout*			X					X			X	X	
River Darter	X					X							
Sauger						X							
Shorthead Redhorse	X					X							
Silver Chub				X									
Silver Redhorse						X							
Slimy Sculpin	X									X			
Smallmouth Bass*				X		X		X		X			
Spottail Shiner						X				X			
Trout Perch	X									X			
Walleye	X	X			X	X	X	X		X	X	X	
White Sucker	X	X	X	X	X	X	X	X		X	X		X
Yellow Perch	X					X		X		X	X	X	

Source: (MB Natural Resources, 1989; Parks Canada, 1984)

X Indicates Presence
* Introduced Species

Briscoe (1979) reviewed sport fish management for the Park. There have been attempts to stock certain waterbodies in the RMBR with varying degrees of success. Attempts to introduce fish species fell into two time periods, the 1920's to the 1960's when lake trout, walleye and some northern pike were the stocked fish, and the 1960's to the early 1970's, when the emphasis was on Rainbow trout and brook trout (Parks Canada, 1984). Fish stocking still occurs in RMNP, particularly in Katherine and Deep lakes (Parks Canada, 1987b). Park waters that are too shallow or nutrient enriched will not allow for viable fish populations.

On a larger scale, studies are in progress relating to rehabilitation of the Dauphin Lake fishery. Headwaters on the northeast side of the Park, particularly Edwards Creek, have been examined by the Province of Manitoba for cultured walleye spawning in order to increase populations in Lake Dauphin (Parks Canada, 1987b). Similarly, natural spawning habitat improvements for walleye have been undertaken on Mink Creek and Wilson River by the Manitoba Habitat Heritage Corporation. This was in response the establishment in 1989 of a Committee Advisory Board to address opportunities for Lake Dauphin restoration (MB. Natural Resources, 1989b). The Advisory Board summarized more than 30 years of studies and investigations into ways of stopping and reversing the decline of Lake Dauphin. Key issues identified include: headwater retention; lake regulation/Crown Land Management; fisheries enhancement; and sediment and water quality monitoring.

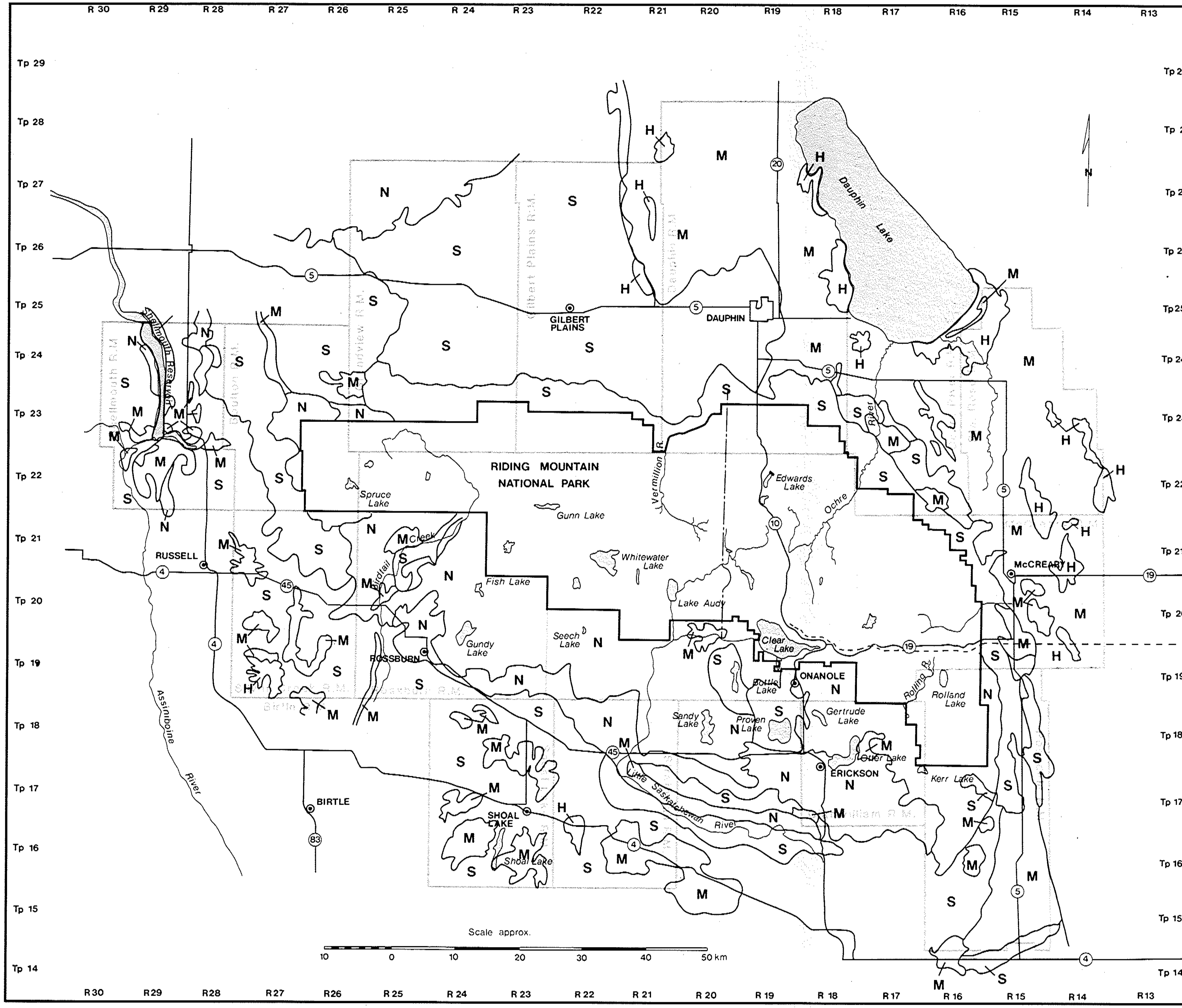
The SRMPD has witnessed an attempt to overcome the lack of fisheries resources through the flourishment of trout farming. Certain ponds and lakes in this area are capable of supporting summer and early winter populations (UMA Engineering, 1981). The importance of this resource to the local and Provincial sport fishery has been noted in the Background Study for the SRMPD (Municipal Planning Branch, 1981) in terms of quality sport fish lakes containing norther pike, perch or walleye and marginal or winter-kill lakes.

Butterflies and Skippers

RMNP is well known for the diversity of butterfly and skipper species (Parks Canada, 1984). Heron & Robinson, (1976) listed species that were indigenous to the Park and/or the immediate agricultural vicinity. Based on authenticated records, 13 species of skippers and 69 species of butterflies have been collected in the Park (Parks Canada, 1984). Species recorded in the Park outside their normal range include: Mexican sulphur (*Eurema mexicana*);

buckeye (Precis coenia coenia); and Edward's Fritillary (Speyeria edwardsi). Three additional species are migratory from the south including: the Monarch (Danas plexippus); Painted Lady (Vanessa cardui); and Variegated Fritillary (Euptoieta claudia) (Parks Canada, 1984).

In summary, available data on wildlife resources in the Park is superior in terms of type of data and level of detail whereas information for the area outside the Park is more superficial. Wildlife species characteristic of the RMBR are generally common to both the Park and the surrounding zone of co-operation depending on the time of year, the extent of available habitat, food sources, and hunting pressure. Important mammals in the RMBR include: black bear; cougar; elk; white-tailed deer; moose; wolf; coyote; and beaver. Mule deer are now believed to be absent from the study area. A variety of avifauna are known to inhabit the RMBR including rarer bird species, migratory waterfowl, and Upland game birds. More important fish species include: walleye; northern pike; lake trout; brook trout; and rainbow trout.



LEGEND

Figure 20 Ungulate Capability

N No Significant Limitation
Class 1,
1W - (IMPORTANT WINTER RANGE)

S Very Slight to Slight Limitation
Class 2, 3,
2W, 3W - (IMPORTANT WINTER RANGE)

M Moderate to Moderately Severe
Class 4,5

H High or Very High Limitation
Class 6, 7

Source: Canada Land Inventory- Ungulates
Maps 62 J, K N, O
Scale 1:250,000
1971, 1972, 1973

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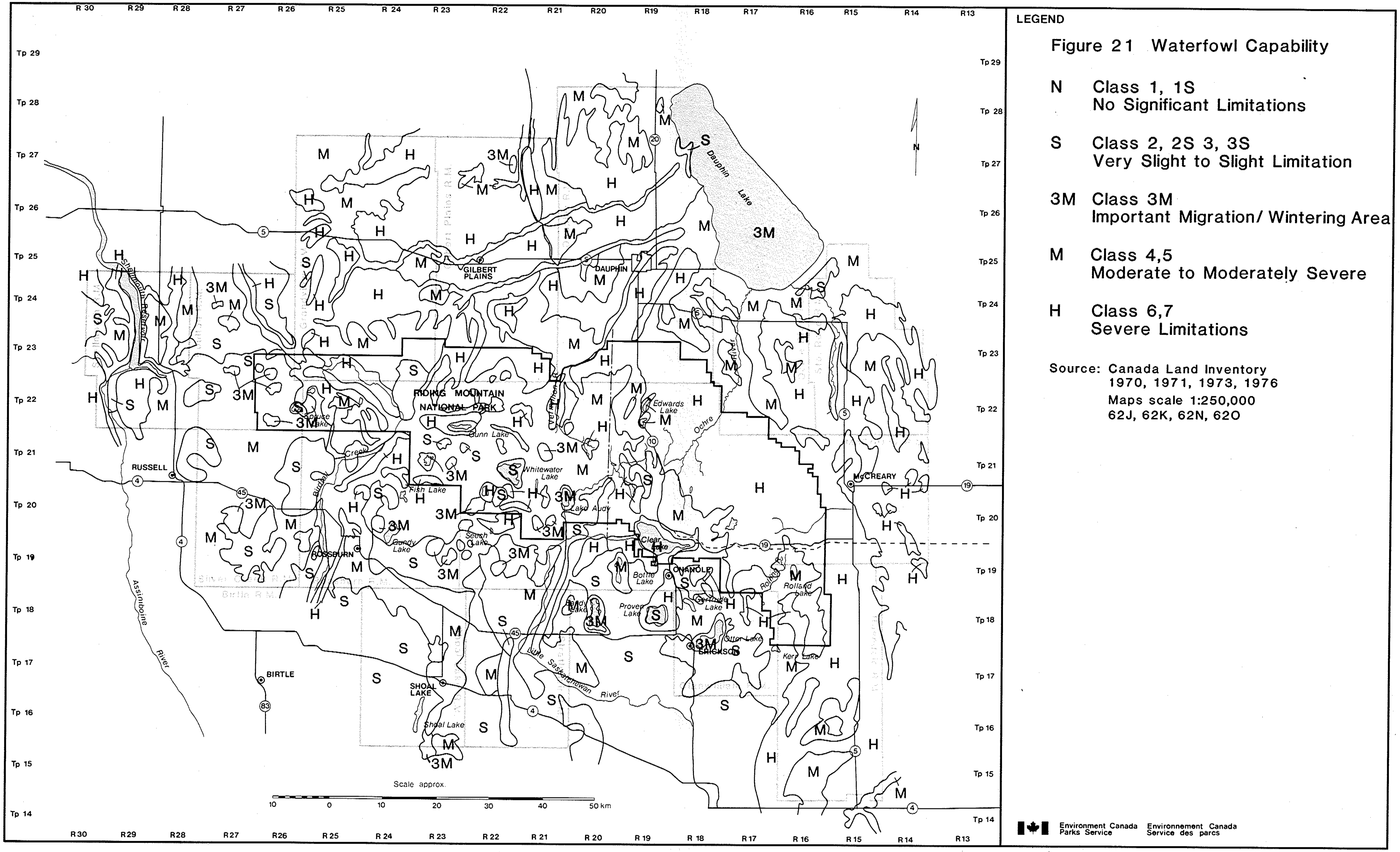

LEGEND
Figure 21 Waterfowl Capability
N Class 1, 1S
No Significant Limitations
S Class 2, 2S 3, 3S
Very Slight to Slight Limitation
3M Class 3M
Important Migration/ Wintering Area
M Class 4,5
Moderate to Moderately Severe
H Class 6,7
Severe Limitations
Source: Canada Land Inventory
1970, 1971, 1973, 1976
Maps scale 1:250,000
62J, 62K, 62N, 62O
Environment Canada Parks Service
Environnement Canada Service des parcs
RIDING MOUNTAIN NATIONAL PARK
Dauphin Lake
DAUPHIN
GILBERT PLAINS
RUSSELL
McCREARY
ROSSBURN
ONANOLE
ERICKSON
BIRTLE
SHOAL LAKE
Clear Lake
Whitewater Lake
Edwards Lake
Gunn Lake
Fish Lake
Lake Audy
Gundy Lake
Seech Lake
Bottle Lake
Proven Lake
Otter Lake
Rolland Lake
Kerr Lake
Shoal Lake
Assiniboine River
Little Saskatchewan River
Shellmouth Reservoir
Ochre
Scale approx.
10 0 10 20 30 40 50 km
R 30 R 29 R 28 R 27 R 26 R 25 R 24 R 23 R 22 R 21 R 20 R 19 R 18 R 17 R 16 R 15 R 14 R 13
Tp 29 Tp 28 Tp 27 Tp 26 Tp 25 Tp 24 Tp 23 Tp 22 Tp 21 Tp 20 Tp 19 Tp 18 Tp 17 Tp 16 Tp 15 Tp 14

CULTURAL RESOURCES

Archaeology

Archaeological resources in the RMBR have been investigated over the years. Most of the archaeological work for the Park occurred in the early 1970's but was limited to accessible grassland areas, roadway allowances, and lakeshores (Jamieson & Thompson, 1973; Jamieson, 1974). Based on the artifacts retrieved and the state of the various sites it seems probable that the Park was inhabited in early prehistoric times, from about the 3000 to 2000 B.C. period. Later prehistoric sites have been much more difficult to locate (Parks Canada, 1984).

The surrounding area has been investigated through the MB. Historic Resources Branch. In the past, surveys were conducted on a systematic basis coinciding with the establishment of municipal planning districts. Sites are recorded on Branch Inventory Files (MB. Historic Resources, 1986). In other areas, where such districts do not exist, only a scant number of sites have been identified, partly as a result of local initiatives. A useful document is Manitoba's Quarry Landscape (Macdonald, 1985). Archaeological Inventory sites presently on file are listed (Appendix 6) and illustrated (Fig. 22) for study region. Most of the sites are classed as unidentified or undated prehistoric.

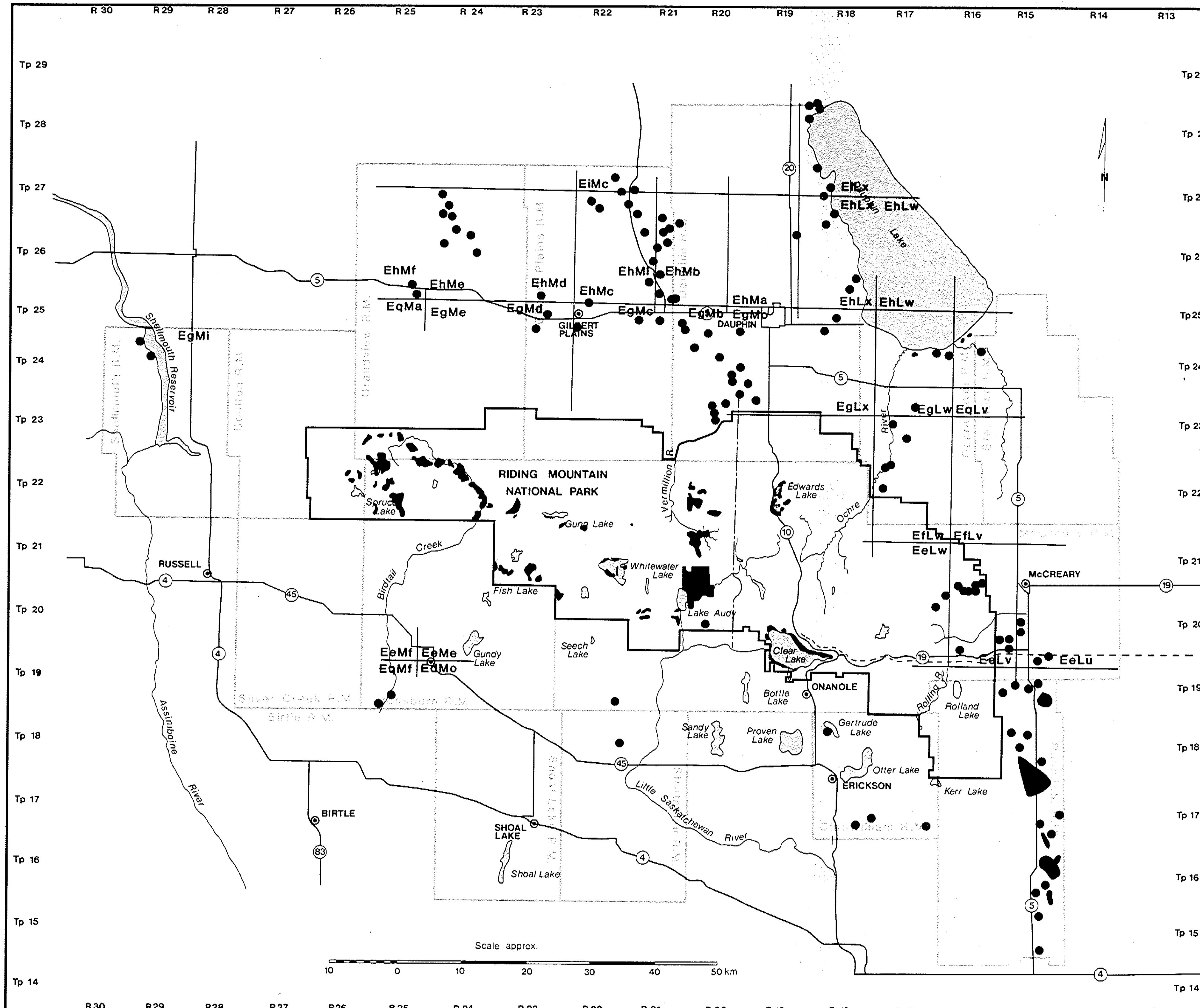
Human History

From prehistoric times to the present, human history in the Riding Mountain area has adapted to the changing development patterns on the region's resource base. Different cultural groups defined and used resources in different ways. This changing activity has been traced chronologically from the early hunting and gathering societies to the modern period of resource protection and/or maximization.

Recent preparations of narrative human histories for RMNP (Tabulenas, 1983; Chabot, 1988) have resulted in a comprehensive understanding of human occupation and activity in the Park area from prehistoric times to the present. The majority of the work has emphasized the period after contact between natives and Europeans and is reflected in the works of the 19th and 20th Centuries. Most recently, the volume of documentation has increased during the 1980's, reflecting the numerous centenaries celebrated by surrounding municipalities through the publication of area histories. A gap in the historical record of the Park concerns the study of the log and frame structures that comprised the RMNP Building Program of the 1930's (Parks Canada, 1984).

Native prehistory has been treated in a series of pamphlets and monographs available through the Provincial Historic Resources Branch. In the past, Historic Resources has been able to prepare detailed overviews of heritage resources surveying the natural and cultural histories in planning districts. Such was the case for the Neepawa and Area and South Riding Mountain region Districts (Ledohowski, 1980, 1981). In these areas the heritage and architectural history has been fully analyzed. Other than these systematic surveys, the Branch maintains Inventory files on Historic and Architectural sites but are not comprehensive. Again, local sources of information regarding locations are relied upon.

In summary, data on cultural resource information is limited for the Park in terms of period of recorded activity in archaeological and historic resources research. Cultural resource data are generally better documented for areas outside the Park. Significant heritage resource features exist both in the Park and in the surrounding municipalities that reflects the area's early history.



LEGEND

Figure 22 Archaeologic Sites

- ● Archaeological Sites
- Areas of Interest
- EgMb Borden Block

Source: Manitoba Historical Resources, 1986
National Topographic Maps
scale 1:50,000
See appendices for listing of sites

LOCATIONS ARE APPROXIMATE

Environment Canada Parks Service
Environnement Canada Service des parcs

Summary of the Resource Data Base

A chart (Matrix 1) was developed to assess the adequacy of the natural resource data base. Six factors were used to classify the eight resource categories according to the core zone (Park) and the zone of co-operation. Factor and category totals as well as means are also provided. A higher number represents better information. According to the six criteria, the matrix shows that there is better information in the surrounding zone than in the Park. This trend is similar for the resource category totals with a few exceptions. Geology/geomorphology information is higher for the zone of co-operation, whereas geomorphology information is lower for the Park. Climate information is low for both the Park and the surrounding zone. Better information exists on soils outside the Park. Higher category totals exist for wildlife and cultural resources in the Park.

The matrix assessment allowed for a subjective analysis of the resource data base using six factors as defined by specific objective criteria. The results of this analysis have contributed to dispelling a commonly held myth relating to the adequacy of the data base information. This assessment indicates that the Park does not have better information over the surrounding area but, in fact, that the opposite is true in most cases.

Matrix 1 - Summary of the Resource Data Base for the RMBR.

Resource Category	Factor															
	Type		Scale		Period		Presence		Coverage		Utility		Totals		Mean	
	cz	zc	cz	zc	cz	zc	cz	zc	cz	zc	cz	zc	cz	zc	cz	zc
Climate	2	2	0	0	1	2	1	2	1	3	1	2	7	11	1.2	1.5
Hydrology	2	3	2	2	1	2	1	3	1	2	2	3	9	15	1.5	2.5
Geology	2	2	3	3	3	3	3	3	3	3	3	3	17	17	2.8	2.8
Geomorphology	2	2	1	3	1	3	1	3	2	3	1	3	8	17	1.3	2.8
Soils	2	3	1	2	2	3	2	3	2	3	2	3	11	17	1.8	2.8
Vegetation	2	2	1	2	2	1	2	2	2	2	2	1	11	10	1.8	1.7
Wildlife	2	2	2	1	3	1	3	1	2	1	3	1	15	7	2.5	1.2
Cultural	2	2	1	0	2	2	3	2	3	2	2	1	13	9	2.2	1.5
Total	16	18	11	13	14	17	15	19	16	19	16	17	/		/	
Mean	2	2.3	1.4	1.6	1.8	2.1	1.9	2.4	2	2.4	2	2.1	/		/	

Legend: Matrix 1

cz core zone - Park
zc zone of co-operation

type: defined as data appropriate for the study

criteria:	high - analyzed map form	3	GT 75%
	medium - written report form	2	50-75%
	low - raw data	1	LT 50%
	n/a - not applicable	0	

scale: defined for comparability purposes from a working map scale 1:250,000 (1:250k)

criteria:	high - good	3	most at 1:250k
	medium - acceptable	2	some at 1:250k
	low - poor	1	few at 1:250k
	n/a - none of the above	0	

period: defined as record of information over a continuous/periodic/random time frame since 1960

criteria:	high - good	3	complete
	medium - acceptable	2	discon/up to date
	low - poor	1	sporadic
	n/a - no record	0	

presence: defined as degree of availability/deficiency in information base

criteria:	high	3
	medium - (availability)	2
	low	1
	n/a - none available	0

coverage: defined as level of detail (area)

criteria:	high - good	3	GT 75%
	medium - acceptable	2	25-75%
	low - poor	1	LT 25%
	n/a	0	spotty

utility: defined for management/decision-making purposes (quality)

criteria:	high - good	3	above average
	medium - acceptable	2	adequate
	low - poor	1	marginal
	n/a - not appropriate	0	

CHAPTER FIVE

DESCRIPTION OF BIOSPHERE RESERVE RESOURCES

Introduction

This Chapter will further describe the resource information in relation to problems, issues and concerns recognized in the study area. An assessment of the information is undertaken to compare and contrast the resource elements within the RMBR. In particular, this Chapter notes opportunities for development and/or use, additional protection, or further study for each of the resource components overviewed for the RMBR.

Description and Assessment

1. **Water - Surface/Groundwater**

RMNP serves as an important upland plateau area for the eastern and northern portions of the Dauphin Lake Watershed. Headwaters of several important streams and/or creeks are located within the Park boundary including: Wilson River; Vermilion River; Edwards Creek; Ochre River; Turtle River; Henderson Creek; and Wilson Creek (Fig. 1). The significance of flooding and siltation problems from these streams along the Manitoba Escarpment cannot be understated in relation to the role of the Park in protecting and regulating water supply for use in the RMBR. Initially, the Escarpment was believed to be the sole source of shale build-up in drainage systems along the subescarpment. Studies have since shown the Escarpment's contribution to be only 25 percent. In fact, 75 percent of the shale deposited downstream is being re-eroded in subescarpmental alluvial fan area drains (Wilson Creek Committee, 1983). With the clearing of alluvial fan areas for agricultural purposes and the straightening of drainage channels, such as Edwards Creek Drain, the sediment load into Lake Dauphin has increased in sheer volume (Manitoba Water Commission, 1984).

Studies to rectify or mitigate the problems have been undertaken (Newbury & Gaboury, 1987). Consider the Wilson Creek watershed, where on average its drain must be dredged out every 2-3 years (Mackling, 1988). Recently, potential headwater storage sites on the Escarpment were identified and assessed as to their suitability for development as storage reservoirs in flood damage reduction (PFRA, 1988). Detailed investigations occurred on the Wilson River and the Fishing River among others. The study concluded that headwater storage for flood control was of limited applicability and uneconomical along the Manitoba Escarpment in general.

Further investigation aimed at improving water management on streams flowing from the Park into Lake Dauphin is of concern to the TRWCD and the WRCD (Mackling, 1988). The installation of energy dissipating rock weirs on key streams in the Park, such as those for Wilson Creek, is believed to be a feasible solution to streams eroding and downcutting their gradients to match that of the lower reach drainage ditches (Mackling, 1988). The installation of these weirs could be expanded to include the Turtle, Ochre and Wilson Rivers. Consideration would have to be given to Park heritage values and the economic feasibility of such an approach.

The R.M. of Rosedale, as part of the Neepawa and Area Planning District and the WRCD, is drained by the Eden, Spring and Neepawa Creeks as well as a number of man-made systems which contributes to sporadic or flash flooding (Seecharan, 1980; and UMA Engineering Group Ltd., 1980). Compared to Wilson Creek, the movement of shale downstream and its subsequent deposition in drainage channels in the lower reaches, contributes to flash flooding along Eden Creek. The lack of native vegetation is an additional factor here (Seecharan, 1980).

The streams along the Manitoba Escarpment could be of use for purposes other than flood control as a result of headwater storage and reservoir development including water supply, fisheries and recreation (PFRA, 1988). Such an evaluation, should the need arise, is feasible considering the substantial amount of topographic, hydrologic, and geologic data available on streams in the RMBR.

The Park is also of importance in that the Vermilion River and Edwards Creek, both emanating in the Park, serve as a source of water supply for the Town of Dauphin. Concerns over this situation reflect the flooding of Park lands as a result of the Vermilion Reservoir; maintenance of the earthen dyke at Edwards Creek by the Town of Dauphin work crews, and the lack of an agreement allowing for the use of either site as a source of water (Parks Canada, 1987b).

The RMBR contains waterbodies of various sizes and depths. Thus, there is potential for a diversity of water based recreational activities, particularly in the rolling topography south of the Park as opposed to the development or use of relatively pristine lakes and ponds within the Park. Development, however, would be unsuitable in low areas adjacent to streams or lakes where they may be subject to flooding from spring runoff and summer storms (MB. Natural Resources, 1982). Substantial bodies of open water that could be considered south of the Park include Kerr, Otter, Bottle, Gertrude and Sandy lakes.

In the R.M. of Shellmouth, the Shellmouth Reservoir was created for flood control and water impoundment storage purposes. The reservoir is contained within the natural confines of the Assiniboine River Valley northward into Saskatchewan and eastward along a portion of the Shell River Valley. Surrounding lands are recognized, in part, for their prime recreational opportunities (C.L.C.C., 1988).

Groundwater aquifers within the RMBR serve as a source of municipal water supply. Towns such as Erickson, Rossburn and Strathclair as well as smaller communities like Birnie, Eden and Riding Mountain in the R.M. of Rosedale have a vested interest in their use. In most instances the groundwater resources are adequate for present and immediate requirements, except in the Valley River Plain region. This is based upon the fact that many of the groundwater aquifers are recharged from the Riding Mountain Escarpment and plateau areas. Groundwater pollution is identified as a serious problem. Hence, the overall concern is groundwater management and protection to assure adequate supply and quality for existing users and for potential development.

2. Geology/Geomorphology

From a geological perspective, the significance of bedrock geology formations underlying the RMBR is best represented in the geologic cross section of the Manitoba Escarpment (Fig. 6). Of the representative formations, which include Riding Mountain, Vermilion River, Favel, Ashville, Swan River and Melita, the shales of Riding Mountain stand out in terms of erosion and sedimentation processes. These cause problems along Escarpmental streams. The erosion of the Odanah and underlying Millwood shales has created many large alluvial fans at the base of the Escarpment. These shale fragments are highly mobile and are often eroded from fan areas and deposited in channels downstream, and hence flood cultivated farmland (PRFA, 1988). Of the many streams draining the Escarpment, Wilson Creek offers an excellent interpretive opportunity in terms of stream behaviour.

Similarly, the Vermilion and Favel formations occur in areas where there is great potential for mass movement and erosion. This is due to the presence of bentonite, an unstable element that is highly susceptible to slumping when disturbed. Thus, any development involving slope failure could be the result of the removal of vegetation cover or excavation activity (Parks Canada, 1984).

The effects of glaciation and subsequent deglaciation on the landscape is widely evident throughout the RMBR. Particular features, such as relict beach ridges and remnant glacial spillways, have interpretive potential that could be further recognized. Within Asessippi Provincial Park, lands classified as special areas encompass a series of exceptionally well-defined esker formations which have a unique significance to the local natural history (MB. Parks Branch, 1973). Other natural features within the RMBR include the Arden Ridge, in the northern corner of the R.M. of Rosedale, and glacial spillways associated with the Birdtail Creek and the Little Saskatchewan River (Fig. 10).

3. Non-renewable Aggregate Resources

For most of the RMBR aggregate resources are generally widespread, with a number of areas identified as having potentially valuable sand and gravel deposits. Concerns reflect possible land use conflicts, particularly on lands surrounding the Park, where valuable agricultural lands may overlay known or potential deposits of aggregate. Tradeoff revolves around whether to develop immediately or to wait until demand warrants mineral extraction (UMA Engineering Group Ltd, 1982). Further concern reflects rehabilitation of depleted sand and gravel pits to ensure that they are environmentally and aesthetically acceptable. Of all the active and inactive sand and gravel pits in the RMBR the SRMPD area has received the most study in terms of rehabilitation potential and development status. A total of

68 sites were analyzed as to the conditions of stop, caution and go (Radwanski, 1981).

In contrast, very little is known about the aggregate potential within RMNP. A granular survey was conducted along a corridor following Highway No. 10 to Dauphin by J.D. Mollard and Associates (1971). Local concern reflects Parks policy that would not allow for use of this aggregate material. Concern also exists if municipal sources of aggregate become scarce. Park projects, such as highway resurfacing, would require use of Park sources (Riding Mountain Task Force, 1984).

4. Soils and Agricultural Land Use

Agricultural land uses recommended for the major soil types within the RMBR are related to the Canada Land Inventory capability classification system discussed in Chapter Four. The RMBR, excluding the Park, is predominantly a grain growing region based on present land use followed by livestock production and specialty crops (Barto & Vogel, 1978; PFRA, 1988). Along the base of the Manitoba Escarpment, the Black soils are generally suited for grain crops, oilseed crops, and mixed farming (including beef and dairy cattle, poultry, and pigs) with grasses, forages, and legumes in rotation. Of the seeded area for crop production, 82 percent is used for cereal production and 18 percent for specialty crops such as vegetables, fruits, and nursery products with 12 percent of the area as summerfallow. The TRWCD encourages planting of forages on marginal lands to reduce wind and water erosion risks (PFRA, 1988) which range from slight to very high along the Escarpment (Fig. 15 and 16).

The dominant soils in the Valley River Plain region are the Black soils with a land use suitability for grain crops and specialty crops. Again, 81 percent of the seeded area is in cereal crops and 19 percent for special crops with 6 to 39 percent of the cultivated areas in summerfallow. As a result, risks for wind and water erosion range from slight to very high.

The region to the south and west of the Park provides some of the best agricultural land developed on Black soils, particularly in the SRMPD. Agricultural production lies primarily in cereal and oilseed crops with potential in forage crops in association with increased livestock production (UMA Engineering Group Ltd., 1983). The loss of highly productive soils to wind and water erosion is a prime concern given associated risk factors ranging from high to very high (Fig. 15 and 16).

The same concerns exist within the R.M. of Rosedale as part of the WRCD. The land next to Riding Mountain is very prone to wind and water erosion. Of particular interest in the RMBR is the existence of the Rosedale Farm Conservation Project. 480 acres of land exists as a demonstration site of what can be accomplished through proper management of soil and water on Escarpmental lands by planting of forage crops and field shelterbelts. The WRCD has the largest organized field shelterbelt program in North America (Hildebrand pers. comm., 1989). The Rosedale Farm example offers an opportunity in promoting a new approach to land management along the Escarpment.

5. Vegetation Communities

Three major ecosystems characteristic of the Boreal Forest Region of Canada, Mixedwooded, Aspen-Oak/Woodland, and Grassland, are present in the RMBR. They are part of the long-term process of successional change which is defined as trends over a 100 to 200 year period, depending on whether there are major shifts in climate and/or natural and human disturbances (Parks Canada, 1984). Aspen is the dominant tree species within the RMBR mixing in with associated spruce forests in the Park. Aspen is also present in many former grassland areas, in the Park and in areas below the Manitoba Escarpment. Their presence is usually preceded by shrub encroachment (hazel, willow and aspen suckers) (Parks Canada, 1984). An area of aspen forest in the western portion of the Park was given special international status worthy of preservation because it was an example of forest-grassland transition (MB. Natural Resources, 1986).

The floral and ecological diversity of vegetation communities, such as hardwood forests and rough fescue grassland, in the Park are important features. The rough fescue prairie is of national significance as there are few undisturbed examples remaining in Canada. The Birdtail Valley supports one of the best examples of fescue grassland in Manitoba. For this reason the site was included among 10 other sites as having formal conservation status recognized under the United Nations as International Biological Program (IBP) sites (MB. Natural Resources, 1986). Other special vegetation features designated as IBP sites are included on Table 7.

A valuable feature of natural history in the Park which is also of important scientific significance is the existence of a triploid clone of trembling aspen. Exceptional growth characteristics enhance its scientific and aesthetic value, genetic research potential, and reforestation importance (Reimer, 1986). Action on its conservation is necessary due to possible decay from old age.

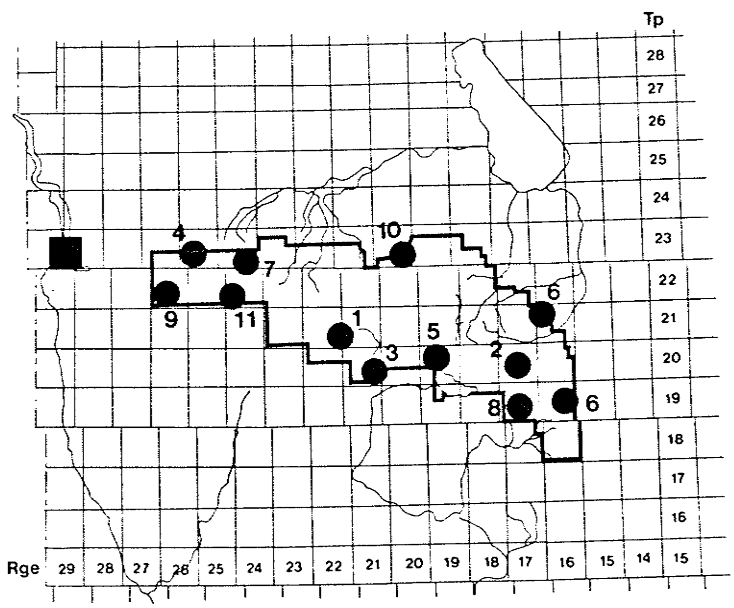
Table 7. Special areas within Riding Mountain Biosphere Reserve.

IBP SITES

● UNITED NATIONS RECOGNITION

1- Whitewater Lake
2- Whirlpool Lake
3- Meadows and Potholes
4- Heron Rookery
5- Shoal Lake
6- Manitoba Escarpment
7- Bird Tail Valley
8- Spruce Bog and Jack Pine
9- Aspen Forest
10- Vermillion River
11- Major Moraine

Other Protected
■ - Asessippi Provincial Park



Source: Barto and Vogel, (1978)

The hardwood forest community below the Manitoba Escarpment is also of special significance. The area represents an atypical forest community in Manitoba as it is similar to the hardwood forests present in eastern Canada (Parks Canada, 1984). Two sites along the Manitoba Escarpment exhibiting great hardwood diversity and a site at Vermilion River where a Bur-oak forest is located are IBP sites (Table 7). The persistence of the hardwood community in the Park is due to the unique combination of micro-climatic and edaphic factors along the Escarpment (Parks Canada, 1984).

Within Asessippi Provincial Park, the Shell River winds its way through a relatively undisturbed valley of considerable ecological importance. Here, the only remnants of a relatively intact Aspen-Oak/Aspen-Grove forest exists (MB. Parks Branch, 1973). Resource management and conservation efforts have revolved around maintaining a proper ecological balance as a result of variable flooding and draining due to the Shellmouth Reservoir.

With respect to Dutch Elm Disease (Ceratocystis ulmi), the pattern of incidence is growing and spreading since first being detected in Winnipeg, Selkirk and Brandon in the mid-1970's. The fungus, spread by the native elm bark beetle (Hylurgopinus rufipes), infects both native and planted elm trees. Since 1985, naturally occurring white elm in the Park, mostly along the Escarpment, have shown signs of D.E.D. Dobson (1985) estimated that a minimum of 50 trees were infected. RMNP participates in a co-operative program with the Province of Manitoba to detect and control dispersal of D.E.D. However, the Provincial control program is generally concentrated in cities and towns with only localized attempts at monitoring the disease in widely scattered rural areas.

6. Wildlife Resources

The diversity of wildlife in the RMBR provides opportunities for interpretation of a nearly complete functioning parkland-boreal forest ecosystem. It also poses constraints to management of the Park's natural resources in relation to the surrounding landscape. There are a number of facets worth mentioning which are of particular relevance to the RMBR and which will require a co-operative approach to be resolved.

Briefly, the extension of wildlife habitat beyond the Park boundaries has led to some problems involving beaver, elk, moose, wolves and bears. These concerns can be linked to the relatively protected confines afforded the various species in the Park as opposed to the hunting pressures present around the Park. Depredation of livestock by wolves originating in the Park has been cited over the years although studies have not conclusively proven a direct link (Fay, 1982). It is believed that wolf populations have been reduced due to increased trapping and the lack of food on the periphery (Parks Canada, 1987b). The impact of the reduced wolf population on predator-prey imbalances, that could contribute to elk and beaver resource problems outside the Park, is identified as a concern in the 1987 Park Conservation Plan.

The greatest concern has centred on beaver management problems regarding flooding of lands on the Park periphery (Fay, 1982) and flooding of Park facilities, roads and trails (Parks Canada, 1987b). A Beaver Management Plan is being prepared according to the 1987 Park Conservation Plan. In the meantime, a co-operative beaver damage reduction agreement has been in operation since 1981. The agreement is cost shared between the Federal and Provincial governments to minimize adverse effects on adjacent lands.

Other concerns include Elk depredation on surrounding farmland and to a lesser extent moose. Particular damage is done to crops, as a result of the large elk and moose populations in the Park (Fay, 1982). Elk populations were believed to be decreasing within the Park (Parks Canada,

1984) due to habitat succession; however, the importance and magnitude of population fluctuations is not clearly understood. For black bears, these natural omnivores have only recently been the subject of a joint Federal/Provincial co-operative study (1987) to determine bear populations, ranges and denning activities (Parks Canada, 1987b). A large black bear population in a near natural ecosystem provides an ideal situation for their study (Parks Canada, 1984).

Of the remaining wildlife species, mammals that have special management requirements or of significant scientific importance in the RMBR include the: striped skunk; fisher; otter; porcupine; snowshoe hare; lynx; cougar; and mule deer. Further study would be beneficial due to the poorly understood nature of these species. The captive herd of bison in the Park at Lake Audy could be included in this category in that the display herd has no natural predation, requiring periodic culling of animals (Parks Canada, 1984).

The diversity of bird species within the Park is due to a wide variety of habitats. Major portions of the Park are remote and undisturbed providing suitable environs for nesting raptors (eg. bald eagle, osprey) and colonial nestors (eg. turkey vulture, great blue heron, forster's tern) which are not found in the extensive agricultural areas surrounding the Park. All these species are very sensitive to disturbance and are scientifically important; requiring monitoring programs. Other rare bird species observed within the RMBR may reflect accidental migration beyond normal ranges or pockets of critical habitat amidst widespread agricultural activity. Examples could include the pine warbler, scarlet tanager, and cardinal. This observation requires further investigation.

Herpetile species present in the Park are generally common throughout the surrounding region. A large hibernaculum of the red-sided garter snake is present near Ochre River in the Park. It is of scientific interest as the den is located in an exposed shale outcrop along the Escarpment (Parks Canada, 1984). Another hibernaculum may exist at the old Kippan's Mill site (Munro, 1987a). Large concentrations of other species or locations of specific dens in the surrounding area are largely unknown. For butterflies and skippers, six potential habitat preservation areas within the Park have been identified (Heron & Robinson, 1976); three of which have been recorded as significant natural areas (Parks Canada, 1984). Most of the species listed for the Park are also present in the adjacent agricultural region.

The majority of indigenous fish species in the RMBR are common to most watersheds in the area (Fig. 5) due to the presence of shallow, eutrophic lakes and small headwater streams (Parks Canada, 1984). Deeper bodies of water, such as Clear, Grayling, Long and Deep lakes within the Park, support greater fish species diversity and/or larger aquatic ecosystems. The Clear Lake-South Lake area is of special interest. South Lake is used for spawning by walleye and pike when water levels are favourable. However, their survival can only be assured by keeping the channel open. Sport fishing opportunities exist in the larger, deeper lakes within the Park, such as Clear Lake, where walleye, perch, pike, and whitefish are available. Other lakes, such as Kathleen and Deep lakes, offer rainbow and brook trout resulting from periodic stocking (Parks Canada, 1987b).

River and streams offer low potential for sport fishing because of their shallow nature and intermittent flows. Perch and pike are possible but are subject to winter-kill due to low oxygen or summer-kill due to algal blooms (Parks Canada, 1984). Significant species range extension is possible. Two fish species previously recorded in south-eastern Manitoba, the finescale dace and the silver chub, have been collected in Park streams.

The fish potential varies much the same for the marshes, ponds, lakes, and intermittent streams over the surrounding landscape. Although occasional fish kills may occur summer or winter in some of these lakes and rivers, these waterbodies are still of prime recreational significance. The fishery potential for most of the area south of the Park, encompassing the Provincial Planning Districts, has not been studied extensively nor has the actual angler harvest and the historical fish-kill record been assessed (MB. Natural Resources, 1982, 1989). Rossman Lake is one example of a significant sport fishery in the Rossburn Planning District which includes walleye, pike, perch, and common white sucker.

Other important water bodies of substantial significance in the RMBR are Dauphin Lake, which supports a troubled fisheries resource at the present because of increased sediment deposition from streams draining the Escarpment area. Of particular importance to the commercial and sport fisheries has been the reduction in the walleye population (Manitoba Water Commission, 1984). The Shellmouth Reservoir, located in the R.M. of Shellmouth, has evolved over the years into one of the most important sport fisheries in Manitoba. All the major tributaries and streams that flow into this waterbody are also significant from a fisheries perspective as critical spawning habitat (McKay et al., 1969; C.L.C.C., 1988).

7. Cultural Resources

Cultural resource protection within the RMBR is a concern due to the general incomplete identification and/or analysis of the resources. Based on earlier reconnaissance (Jamieson, 1974) productive, unproductive, and potential archaeological sites were identified for the Park (Fig. 22). However, additional sites may yet be hidden or are inaccessible due to a heavy forest cover or other environmental factors. Parks Policy calls for minimal terrain disturbance of Park so as not to impair significant artifacts that may exist (Parks Canada, 1987b).

The state of significant archaeological resources in the adjacent region varies, with the most thorough coverage existing in municipal planning districts including: Neepawa & Area; Rossburn; and South Riding Mountain. Archaeological research in the TRWCD has yielded 20 important sites (MB. Historic Resources, 1986). These are known to cluster in three areas: the Norgate District; the south shore area of Dauphin Lake in the vicinity of Ochre River; and west of McCreary along the Agassiz Ski Road in the Park (Fig. 22).

Native cultural exhibits within the Park are very limited. The Okanese Indian cemetery is the only tangible reminder of the former Okanese Indian Reserve at Clear Lake (Parks Canada, 1984) and an important cultural connection for native peoples still living in the area. Residents of the Keeseekowenin Indian Reserve, north of Elphinstone, have historical ties to the Clear Lake Indian Reserve (John/Paul & Associates, 1988).

Other remnant heritage resources within the Park include: Kippan's mill at Edwards Creek; a herder's cabin in the Birdtail Valley; German P.O.W. camp at Whitewater Lake; and the naturalist Grey Owl's cabin (Parks Canada, 1984). A significant part of the Park's cultural landscape relates to the historic structures of the RMNP Building Program of the 1930's which are provided protection under the new Federal Heritage Building Review guidelines (Parks Canada, 1984).

Of the heritage resources surveyed on lands adjacent to the Park, numerous church, school, post office, and other heritage sites have been documented in the South Riding Mountain, Neepawa and Area and Rossburn districts. Important historic trails recorded in this region include: Audy; Rolling River; Burrows; Hun's Valley; and the North Branch Saskatchewan Trail (Ledohowski, 1980, 1981). Architectural and historic sites of importance and/or significance in the TRWCD are fairly limited (MB. Historic Resources, 1986). For the remainder of the study area no specific inventories have been conducted on the archaeological, architectural, and heritage resources.

8. Present Land Use

The RMBR exhibits a wide range of capabilities/limitations for the various resources identified from a land use, development and planning perspective. This section will focus on the disposition of Provincial Crown Lands in the periphery for a variety of land use purposes in light of the institutional framework existing in the RMBR. Three planning districts have been created on the periphery of RMNP (Fig. 23) as well as two conservation districts governed under two separate Provincial Acts.

Federal Crown Land in the RMBR includes RMNP, portions of community pastures in the R.M. of McCreary and the R.M. of Dauphin, and the three Federal Indian Reserves south of the Park. A fourth, Valley River, exists south of Duck Mountain Provincial Forest Reserve (Fig. 24). Scattered parcels of Provincial Crown Land occur in the R.M.'s of Boulton, Gilbert Plains, Grandview, and Dauphin. No attempt has been made to delineate between the different commitments save for wildlife management areas (WMA).

The designation and maintenance of WMA's in key areas along the periphery of RMNP serves two important functions. The first function concerns the problems associated with high wildlife populations in the Park and quality farmland just outside the boundary. WMA usually focus on existing blocks of Crown Land providing cover for wildlife moving out of the Park and lure crops to help alleviate crop depredation. Secondly, a WMA also serves as buffer and transition zones to lessen the abruptness between the Park and farmland. However, adoption of the WMA concept in the adjacent region has been a slow process (Fay, 1982).

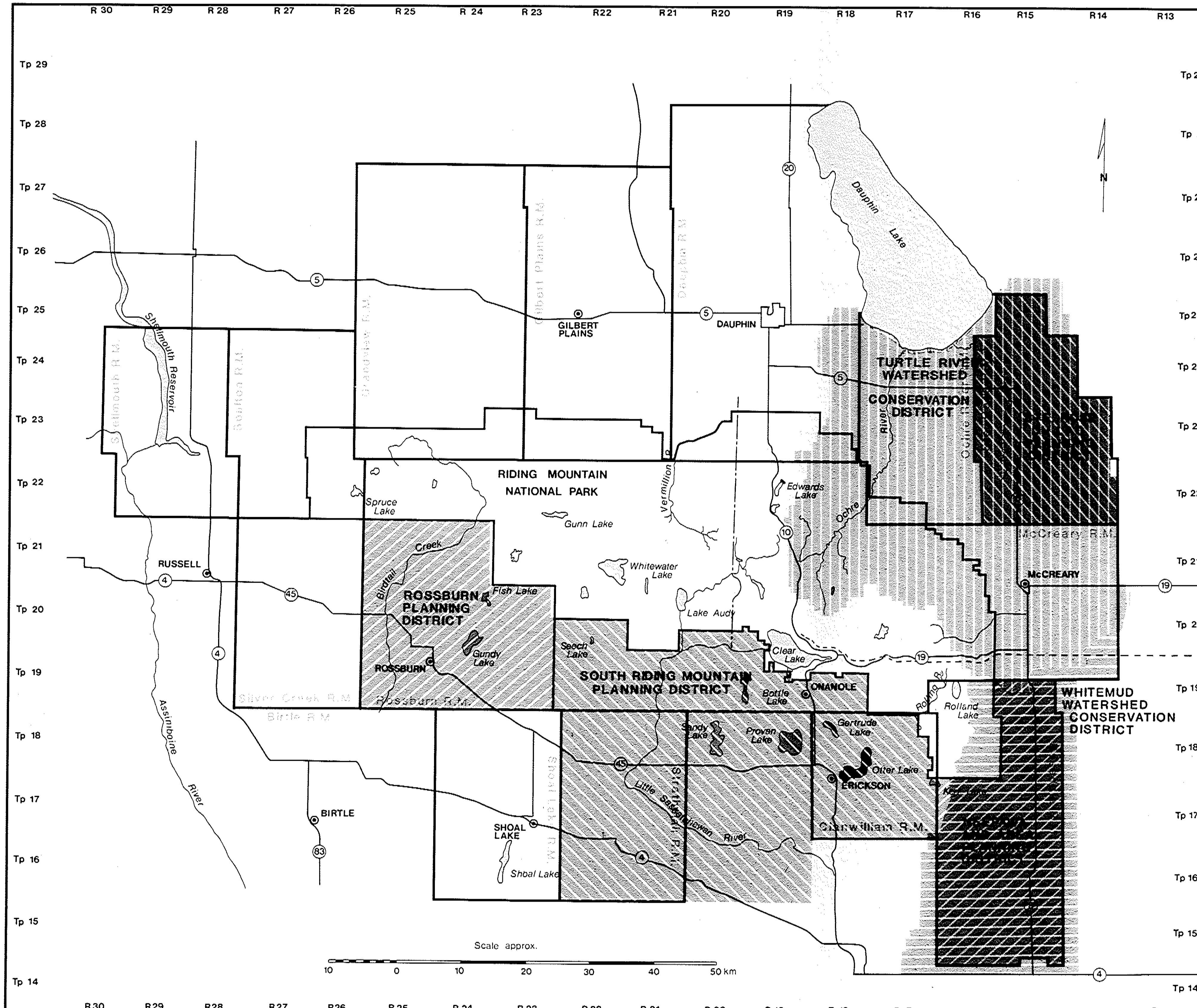
Present Crown Land commitments for the periphery of RMNP have been inventoried (Fig. 24). It is acknowledged that the state of Crown Lands is a very dynamic process that changes from year to year. Of the Crown Land present in the area south of the Park, agricultural leases and permits make up the most significant commitment of Crown Lands (MB. Natural Resources, 1982, 1989a). These are lands designated primarily for agricultural purposes or for multiple-use purposes with agriculture as an interim or secondary use (C.L.C.C., 1989).

Significant wildlife management areas and Ducks Unlimited Projects exist in the SRMPD. These include the Onanole WMA, Parkland WMA, Proven Lake, Gunville Lake, and Lake 15 (MB. Natural Resources, 1982). A portion of Proven Lake has subsequently been declared a WMA as well (Crown Land Map 620, 1988). Other important Crown Lands for wildlife occur in the R.M. of Silver Creek in the vicinity of Diamond and Tibbats Lakes and Lidcliff Marsh. These have been identified as significant waterfowl production areas (C.L.C.C., 1987). The R.M. of Rossburn contains the Parkland WMA and a Wildlife Refuge (MB. Natural Resources, 1989).

The Neepawa and Area Planning District includes lands classed, for the most part, as agriculture/native environment lands or natural resource use (C.L.C.C., 1982). Other lands are classified as natural hazard areas due to their proximity to the Escarpment. Also included is one small Provincial Special Use Park along the shore of Kerr Lake in the R.M. of Rosedale. Of the wildlife lands present, none as of yet have been designated as a WMA.

The TRWCD maintains an extensive area of Crown Land commitments (Fig. 24) primarily for agricultural purposes. Over the years, three WMA's have been proposed including Riding Mountain, along the Park boundary; Beaver Dam Lake; and Turtle Marsh (Water Resources, 1979). The absence of suitably owned public lands and limited funding has restricted further progress. However, Turtle Marsh has recently received renewed attention (Manitoba Water Commission, 1984).

Extensive Crown Land commitments exist for the R.M. of Shellmouth in the immediate vicinity of the Shellmouth Reservoir. Outside the reservoir area Crown Lands are minimal and are classified for agriculture/native environment lands. A few parcels of wildlife lands located on the slopes of the Shell River are still relatively wooded (C.L.C.C., 1988). Agriculture/native environment lands are first allocated under agricultural lease but at the same time a high wildlife value is recognized for these lands. Most of the Shellmouth Reservoir shoreline has a high ungulate wildlife capability and portions of the reservoir have been set aside for wildlife purposes. The remainder of Crown Lands along the reservoir are committed to intensive recreation and/or agricultural use, primarily on the upland above the valley slopes (C.L.C.C., 1988).



LEGEND

Figure 23 Planning Districts and Conservation areas in Riding Mountain Biosphere Reserve.

Source: Fay, 1982

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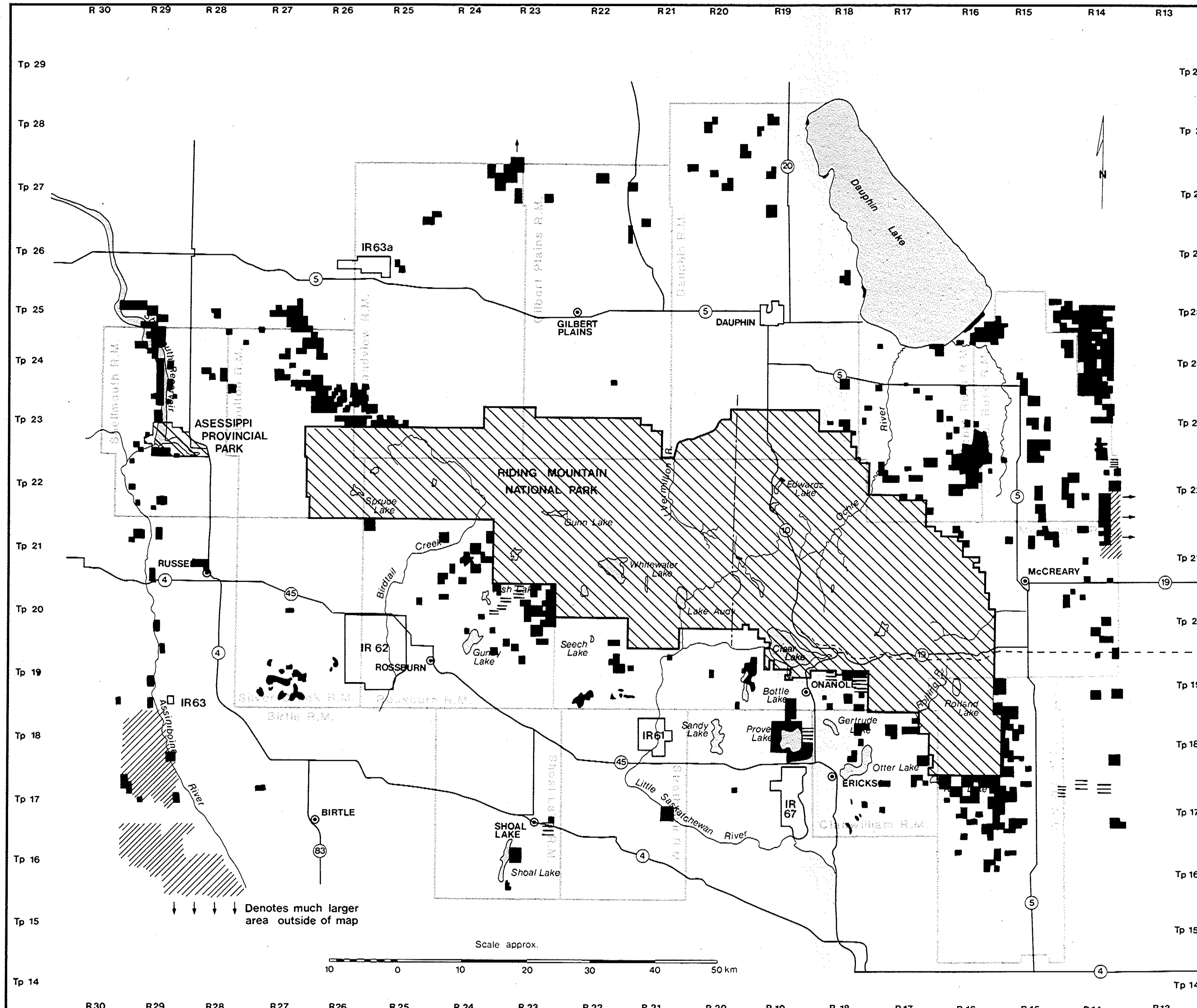

LEGEND

Figure 24 Crown Lands and Wildlife Refuges

- National or Provincial Park
- Crown Lands
- Wildlife Management Areas
- Community Pastures
- IR61 Federal Indian Reserves

Source: Crown Lands(and Refuges for Wildlife)
1:250,000 NTS
62J Neepawa, 1988
62K Riding Mountain, 1988
62N Duck Mountain, 1983
62O Dauphin Lake, 1980

M.P. Fay, 1982

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CHAPTER SIX

SUMMARY/CONCLUSIONS

Summary

Biosphere Reserves are organized generally to consist of three interrelated parts: a core area; a buffer zone; and a zone of co-operation (transition zone). In the case of the RMBR, the core area is legally represented by RMNP. The transition zone consists of 18 rural municipalities comprising the RMRLC. The role of this Committee is to develop and implement strategies to integrate the Park with the surrounding area.

The transition zone was superimposed upon these participating municipalities of the RMRLC as a matter of administrative convenience. Typically, this transition zone is a flexible and dynamic area that may include settlements, croplands, managed forests, areas for intensive recreation and/or protection, small industry, and other economic uses characteristic of the area. The zone of co-operation within the RMBR provides opportunities where research, rehabilitation and traditional use activities can be practised.

RMNP is an important asset in southwestern Manitoba. The designation of the RMBR is indicative of a regional integration effort so important to the protection and management of RMNP. Managing resource issues in Riding

Mountain and the surrounding lands in a manner acceptable to the Park's heritage resource values and to the resident's aspirations is essential. Activities related to the RMBR should serve as a catalyst for co-operative activities based on communication between residents and RMNP. Through dialogue and the institution of research projects, a mutually acceptable solution to problems can be achieved (Roots, 1988).

To facilitate long-term study of the relationships between socio-economic and natural resource factors for better decision-making, communication and education in the Biosphere Reserve, a comprehensive synthesis and collation of the existing resource information base was required. An initial inventory and a more detailed description of the resource base information was conducted to assess the Biosphere Reserve data base and to compare the data base inside and outside the Park.

Hence, the following conclusions apply to the RMBR data base:

* The climatic record for the Park is presently inadequate for comparative purposes in terms of year-round coverage and of variability within the Park. Only three stations are located in the Park while eleven stations are outside the Park area.

* Information on hydrologic resources (surface water and groundwater) exists in various useable forms although the general resource data base needs to be updated. A comprehensive water management plan does not exist for the Park and surrounding area.
* Significant erosion and siltation problems occur along the upper and lower reaches of Escarpment streams originating within the Park. Clogging of artificial drainage works occurs downstream and contributes to flash flooding on agricultural lands. Flooding is also known to occur south of the Park but is more intermittent in nature due to the gently rolling plateau.
* Groundwater aquifers are deemed adequate for present and future requirements as a source of water supply except in the Valley River Plain region. Extensive groundwater pollution hazard areas exist in thin surficial deposits of sand and gravel outside the Park. Aquifers of limited potential can exist in the Park.
* Geological/geomorphological information for the study region is well documented within the RMBR for comparison purposes. The only exception is for non-renewable aggregate resources. Known deposits of

sand and gravel, both active and inactive pits on private or Crown hands outside the Park, have been inventoried. However, information on the quality and extent of rehabilitated pits in the surrounding area is lacking. Even less is known about the presence of aggregate material within the Park, save for one study conducted in the 1970's.

* A generalized soil data base has been compiled for the RMBR identifying the characteristics of the most common soil landscapes in the study area. Comparison of dominant soil groups with soil capability data for agriculture was difficult due to differences in scale.

* Most of the relatively undisturbed soils, mostly Gray Luvisols, occur in the Park. Black Chernozems constitute the cultivated soils in the surrounding area. The exception to this distribution includes natural hazard areas such as the Escarpment and grassland-forest transition zones in the Park the presence of organic soils. General capabilities for agriculture outside the Park range from moderate to low (classes 3-6) which indicates soils with moderate to severe limitations for sustained crop production. Wind and water erosion risks range from

slight to very high for the RMBR with high to very high risks associated with the Escarpment and the Riding Mountain plateau areas. Soil capability information is not applicable to Park lands.

* Based on existing inventory information, a generalized representation of vegetation types was derived for the RMBR. Ecologically significant vegetation types indicative of the Boreal Forest Region of Canada includes: Mixedwooded in the Park; Aspen-Oak/Woodland predominately over the surrounding landscape; and patches of native grassland both inside and outside the Park. Vegetation patterns and successional trends are not well understood in the Park. Native cover in the adjacent area has been greatly modified by cultivation.
* Available data on wildlife resources differs between the Park and the surrounding area. Specific information exists for most species in the Park. A more generalized picture exists for wildlife outside the Park.
* Wildlife species representative of the RMBR are generally common to both the Park and its adjacent environment with some exceptions. White-tailed deer inhabit the prairie-pothole country south of the

Park. Remnant herds of mule deer are now believed to be non-existent in the RMBR. Rare species of avi-fauna are more likely to be found in the Park where suitable habitat still exists. Only one large garter snake hibernaculum has been confirmed. It is in the Park.

* There is incomplete cultural resource identification and/or analysis within the Park; except for limited archaeological research in the 1960's. Significant heritage resource potential exists dating to early settlement in the Park region. Archaeological, architectural, and heritage resources have been more extensively identified in relation to municipal planning districts outside the Park.

Based on the available resource information and the issues identified, the following recommendations have been developed for the RMBR.

<u>Management Considerations</u>

The purpose of designating a Biosphere Reserve in the RMNP area reflected the need to reinforce a sense of regional identity, to act as a catalyst for research and conservation within the Park, to contribute to regional development, to reduce barriers for collaboration, and to provide a formal working system for overcoming practical local resource problems. Specific objectives of the RMBR are: 1) to protect and study the genetic diversity of the area; 2) to promote conservation and sustained development with respect to resources (wildlife, agriculture, tourism); and 3) to develop the economy of the area (Roots, 1988).

Once an integrated data base is in place for the RMBR, certain opportunities and constraints can be identified for informed management decision-making and public education purposes. As a basis for evaluating the success of the Biosphere Reserve in achieving its objectives, it is recommended that:

* in conjunction with management and technical expertise, the RMBR should develop a monitoring program to evaluate the effectiveness of public promotion activities.
* once the framework has been established, it can be used to increase basic knowledge for conserving ecosystems and maintaining ecological diversity.
* a more appropriate ecological boundary should be identified for the RMBR, if possible, once interrelationships within ecosystems represented by the RMBR are better understood.

* a long-term strategic plan should be developed for the RMBR to assist the local Management Committee in achieving its stated objectives of conservation and sustainable development.
* in light of the above, the RMBR should adopt the concept of ecosystem management in support of these stated objectives and activities.

Through the development of this Practicum certain perceived data deficiencies were overcome, but other resource data needs became evident during inventory. In light of the fact that additional resource information would be beneficial in enhancing the general resource overview, it is recommended that:

* background data in this report should be used as a basis for further refinements of inventory and management programs within the RMBR.
* once appropriate additions have been made, consideration should be given to the development of an interpretive plan which incorporates the initial overview to assist the RMBR in meeting objectives of environmental education and training.
* a common data management framework should be established as a means to link available data bases in differing formats; the GIS (Geographic Informa-

tion System) technology has potential to perform this role.

Research Opportunities

Given that identified data gaps need to be filled, opportunities for further research are listed below:

* Comparative climatic studies to determine variations for different geographical areas of the RMBR are required.
* Detailed investigation of potential groundwater aquifers within the Park is required due to the lack of available data for comparative purposes with adjacent areas. The importance of the Escarpment as a recharge area for subescarpment users needs to be studied.
* Further identification and assessment of geomorphological resources within the Park are required due to the lack of available data.
* A thorough assessment of the quality of known aggregate materials in the surrounding area is required considering its economic importance for construction purposes.
* Present vegetation patterns and successional trends occurring within the RMBR should be identified.

* Information is required on the introduction of exotic weed species through silviculture practices in the Park and crop disturbance in the surrounding agricultural area.
* The extent of herbicide and pesticide use in the transition zone should be assessed due to possible negative environmental and health effects.
* Accurate population estimates and distribution patterns for most wildlife species discussed, particularly in the surrounding region, are required. This is necessary for co-operative wildlife management and for determining the extent of transboundary movements.
* Opportunities for expansion of wildlife management areas, to provide wildlife protection in the face of growing hunting pressures, and to lessen crop depredation on the Park periphery, should be identified.
* Potential heritage resources, special areas, and significant features within the RMBR should receive further study and/or protection.
* Socio-economic factors related to tourist pressures on the Park, the pursuit of recreational development outside the Park, and diversification of the area's economy should be assessed.

GLOSSARY

CFS	Canadian Forestry Service
CPS	Canadian Parks Service
CLCC	Crown Land Classification Committee
DED	Dutch Elm Disease
ha	hectares
MAB	Man and the Biosphere
MB.	Province of Manitoba
mg/L	milligrams per Litre
PFRA	Prairie Farm Rehabilitation Adminimnstration
PNRO	Prairie and Northern Region
NRMP	Natural Resource Management Process
RD&A	Resource Description and Analysis
RM	Rural Municipality
RMBR	Riding Mountain Biosphere Reserve
RMNP	Riding Mountain National Park
RMRLC	Riding Mountain Regional Liasion Committee
SRMPD	South Riding Mountain Planning District
TRWCD	Turtle River Watershed Conservation District
UNESCO	the United Nations Educational, Scientific and Cultural Organization
WMA	Wildlife Management Area
WRCD	Whitemud River Conservation District

Crown Lands - lands included under Order-in-Council designations (ie. Community Pastures, Provincial Parks, Provincial Forests, Wildlife Managment Areas, Ecological Reserves, Special Forest Areas)

Cultural resources - includes archaeological sites (artifacts), historic and architectural heritage resources (ie. post offices, churches, school houses, cemeteries, barns, trading posts, historic trails)

Geology - refers to underlying sedimentary bedrock formations, or geologic boundaries, that constitute the study area's physiography or land base

Geomorphology - refers to the origin and distribution of landforms (uplands, plains, escarpment, lowlands) and the nature of surficial deposits (glacial till, outwash deposits, fluvial deposits, alluvial fans, hummocky moraines) as well as active erosional processes and sand & gravel aggregate

Hydrology - refers to surface water (rivers, creeks, lakes, ponds, sloughs, reservoirs, wetlands) groundwater aquifers (shale and sand & gravel) and includes groundwater pollution hazard areas and water quality

Macro-Climate - refers to the general or representative conditions of the atmosphere at a location, (precipitation, temperature, wind, humidity and other comfort factors), including any extreme and infrequent conditions

Soils - refers to the uppermost layer of the earth's surface formed under the influence of climate and biota on rock and sediments forming dominant soil orders and great groups (Gray Luvisols, Black Chernozems, Dark Gray Chernozems/Luvisols, Regosols, Gleysols, and Organic); and includes soil capability for agriculture and soil wind and water erosion risk

Study area (RMBR) - includes Riding Mountain National Park and 18 surrounding municipalities (Boulton, Clanwilliam, Dauphin, Gilbert Plains, Grandview, L.G. District of Park, McCreary, Ochre River, Rosedale, Rossburn, Ste. Rose, Shellmouth, Shoal Lake, Silver Creek, Strathclair, Town of Dauphin, Village of Rossburn, & Village of Shoal Lake)

Vegetation - refers to major plant communities within a forested or cultivated landscape (mosses, grasses, herbs, shrubs, trees); and includes forest insect disease

Wildlife/fauna - refers to any mammals (carnivores, omnivores, smaller furbearers), avifauna, aquatic biota, amphibians & reptiles, and butterflies & skippers

BIBLIOGRAPHY

Adams, G.D. (1985). A Regional Map Base for a Migratory Bird Habitat Inventory, Prairie Provinces. Canadian Wildlife Service, Saskatoon.

Agriculture Canada. (1988). Soil Water and Wind Erosion Risk Maps. Scale 1:1,000,000. PFRA, Winnipeg. (m)

Atmospheric Environment Service. (1982). Canadian Climate Normals, The Prairie Provinces 1951-1980. Temperature and Precipitation, Volume 2. Downsview, Ontario.

Babuluk, J.A., B.M. Belcher and J.S. Campbell. (1984). "An Investigation of the Sport Fishery on Dauphin Lake, Manitoba, 1982". Canadian Manuscript Report Series, Fish Aquatic Sciences, No. 1777. Winnipeg.

Bailey, R.H. (1968). Notes on the Vegetation in Riding Mountain National Park. National Park Forest Survey Report No. 2. Department of Forestry and Rural Development, Ottawa.

Banash, U., A. Gill and J. Bauer. (1977). A Study of Sensitive Avifauna in Riding Mountain National Park, 1775-1976. Unpublished Report, Canadian Wildlife Service, Edmonton.

Banfield, A.W.F. (1974). The Mammals of Canada. University of Toronto Press, Toronto.

Banfield, A.W.F. (1977). The Mammals of Canada. Second Edition, Revised. University of Toronto for the National Museums of Canada, Toronto.

Barto, W.P. & C.G. Vogel. (1978). Agro-Manitoba Information Package. Department of Mines, Natural Resources and Environment. Technical Report No. 78-9, Winnipeg.

Betcher, R.N. Hydrology Section, Water Resources Branch. Pers. Comm. (1990).

Briscoe, B.W. (1979). A Review of Sport Fish Management in Riding Mountain National Park. Unpublished Report. Parks Canada, Winnipeg.

Canada Land Inventory. (1967). Soil Capability for Agriculture. Neepawa 62J, 1:250,000. ARDA, Ottawa. (m)

Canada Land Inventory. (1966). Soil Capability for Agriculture. Riding Mountain 62K, 1:250,000. ARDA, Ottawa. (m)

Canada Land Inventory. (1968). Soil Capability for Agriculture. Duck Mountain 62N, 1:250,000. ARDA, Ottawa. (m)

Canada Land Inventory. (1971). Soil Capability for Agriculture. Dauphin Lake 62O, 1:250,000. ARDA, Ottawa. (m)

Canada Land Inventory. (1971). Land Capability for Wildlife-Ungulates. Neepawa 62J, 1:250,000. Department of Environment, Ottawa. (m)

Canada Land Inventory. (1971). Land Capability for Wildlife-Ungulates. Riding Mountain 62K, 1:250,000. Department of Regional Economic Expansion, Ottawa. (m)

Canada Land Inventory. (1973). Land Capability for Wildlife-Ungulates. Duck Mountain 62N, 1:250,000. Department of Environment, Ottawa. (m)

Canada Land Inventory. (1972). Land Capability for Wildlife-Ungulates. Dauphin Lake 62O, 1:250,000. Department of Environment, Ottawa. (m)

Canada Land Inventory. (1973). Land Capability for Wildlife-Waterfowl. Neepawa 62J, 1:250,000. Department of Regional Economic Expansion, Ottawa. (m)

Canada Land Inventory. (1976). Land Capability for Wildlife-Waterfowl. Riding Mountain 62K, 1:250,000. Department of Economic Expansion, Ottawa. (m)

Canada Land Inventory. (1970). Land Capability for Wildlife-Waterfowl. Duck Mountain 62N, 1:250,000. Department of Regional Economic Expansion, Ottawa. (m)

Canada Land Inventory. (1971). Land Capability for Wildlife-Waterfowl. Dauphin Lake 62O, 1:250,000. Department of Regional Economic Expansion, Ottawa. (m)

Canada/MAB. (1976). Guidelines for the Selection of Biosphere Reserves in Canada. The Canadian Committee for MAB, Report No. 6, Ottawa.

Canada/MAB. (1982). Biosphere Reserves. Canadian Man and the Biosphere Committee, (pamphlet), Ottawa.

Canada/MAB. (1987). National Action Plan for Biosphere Reserves in Canada. Canadian Commission for UNESCO, Report No. 19, Ottawa.

Canada-Manitoba Soil Survey. (1986). Soil Landscapes of Manitoba Project, 1:1,000,000. Department of Energy, Mines and Resources, Winnipeg. (m)

Canadian Committee for MAB. (1973). Prospectus for Canada/MAB. The Unesco Programme on Man and the Biosphere Program in Canada, Ottawa.

Canadian Soil Survey Committee. (1974). The System of Soil Classification for Canada. Publication No. 1455. Department of Agriculture, Ottawa.

Carbyn, L.N. (1980). Ecology and Management of Wolves in Riding Mountain National Park, Manitoba. Final Report, Large Mammal Systems Studies, No. 10. Canadian Wildlife Service, Edmonton.

Carbyn, L.N., P. Paquet and D. Meleshko. (1984). Ecological Studies of Wolves and Coyotes in Riding Mountain National Park, Manitoba. Progress Report No. 2. Canadian Wildlife Service, Edmonton.

Carbyn, L.N., P. Paquet, D. Meleshko, and S. McKinlay (1986). Ecological Studies of Wolves and Coyotes in Riding Mountain National Park, Manitoba. Progress Report No. 3 (New Series). Canadian Wildlife Service, Edmonton.

Chabot, H. (1988). The Native Human History of Riding Mountain National Park: An Overview. RMNP, Wasagaming.

Cody, W.J. (1988). Plants of Riding Mountain National Park. Publication No. 1818. Agriculture Canada, Ottawa.

Conservation Districts Authority. (1987a). Turtle River Watershed Conservation District Draft Management Plan, 1988-2008. Manitoba Natural Resources, Winnipeg.

Conservation Districts Authority. (1987b). Turtle River Watershed Conservation District - Managing Our Resources, Issues and Options. Manitoba Natural Resources, Winnipeg.

Conservation Districts Authority. (1989a). Whitemud Watershed Conservation District - Conservation Issues and Options. Manitoba Natural Resources, Winnipeg.

Conservation Districts Authority. (1989b). Whitemud Watershed Conservation District Draft Management Plan. Manitoba Rural Development, Winnipeg.

C.L.C.C. (1982). Crown Land Use Plan Classification Plan for Neepawa and Area Planning District. Department of Natural Resources, Winnipeg.

C.L.C.C. (1984). Crown Land Use Plan Classification Plan for South Riding Mountain Planning District. Department of Natural Resources, Winnipeg.

C.L.C.C. (1987). Provincial Crown Land Plan for the R.M. of Silver Creek. Department of Natural Resources, Winnipeg.

C.L.C.C. (1988). Provincial Crown Land Plan for Lake of the Prairies, R.M. of Shellmouth and Roblin Planning District. Department of Natural Resources, Winnipeg.

C.L.C.C. (1989). Interdepartmental Operational Crown Land Plans. Manitoba Natural Resources, Winnipeg.

Crown Lands Map. (1980). Dauphin Lake 62O, 1:250,000. Surveys and Mapping Branch. Edition 3, Winnipeg. (m)

Crown Lands Map. (1983). Duck Mountain 62N, 1:250,000. Surveys and Mapping Branch. Edition 2, Winnipeg. (m)

Crown Lands Map. (1988a). Riding Mountain 62K, 1:250,000. Surveys and Mapping Branch. Edition 2, Winnipeg. (m)

Crown Lands Map. (1988b). Neepawa 62J, 1:250,000. Surveys and Mapping Branch. Edition 2, Winnipeg. (m)

Davies, D. (1986). Wildlife Resources of the Turtle River Watershed Conservation District. Unpublished submission for the Turtle River Conservation District Management Plan. Regional Wildlife Branch, Dauphin.

Department of Mines and Natural Resources. (1969). Watershed Divisions. Canada Land Inventory Project, Winnipeg. (m)

Development of the International Biosphere Reserve Network, Annex 10, 1982-1984. (Unesco/MAB).

de Vos, A. (1965). A Study of the Resources and Related Problems of Riding Mountain National Park. Winnipeg.

Dobson, R. (1985). Parks Canada's Response to the Occurrence of Dutch Elm Disease affecting Elm trees in Riding Mountain National Park. Unpublished Report. Parks Canada, Prairie and Northern Region, Winnipeg.

Ehlrich, W.A., L.E. Pratt and E.A. Poyser. (1956). Report of Reconnaissance soil survey of Rossburn and Virden Map Sheet Areas. Soils Report No. 6. Manitoba Soil Survey, Winnipeg.

Ehlrich, W.A., L.E. Pratt, E.A. Poyser and F.P. Leclaire. (1958). Report of Reconnaissance soil survey of Westlake Map Sheet Area. Soils Report No. 8. Manitoba Soil Survey, Winnipeg.

Ehlrich, W.A., L.E. Pratt and F.P. Leclaire. (1959). Report of Reconnaissance soil survey of Grandview Map Sheet Area. Soils Report No. 9. Manitoba Soil Survey, Winnipeg.

Environment Canada. (1986). Terrestrial Ecozones of Canada. Ecological Land Classification Series, No. 19, Ottawa.

Fay, Michael P. (1982). A National Park Regional Integration Strategy with Special Reference to Riding Mountain National Park. Occasional Paper No. 3, University of Manitoba.

Forster, Richard R. (1973). Planning for Man and Nature in National Parks. IUCN Publication New Series, No. 26, Morges, Switzerland.

Gaboury, M. (1989). Waterbody Report. Unpublished List. Fisheries Branch, Manitoba Natural Resources, Winnipeg.

Godfrey, W.E. (1986). The Birds of Canada. Second Edition. National Museums of Canada, Ottawa.

Heron, R.J. and A.G. Robinson. (1976). A Field Survey of the Butterflies and Skippers of Riding Mountain National Park, Manitoba. Department of Entomology, University of Manitoba, Winnipeg.

J.D. Mollard and Associates Ltd. (1971). Airphoto Search for Granular Materials in Northern Riding Mountain National Park and Dauphin Area, Manitoba. Unpublished Contract Report, Department of Public Works, Calgary.

Jamieson, S.M. and N. Thompson. (1973). A Preliminary Synthesis of Archaelogical Research in Riding Mountain National Park to 1973. Unpublished Contract Report. Parks Canada, Winnipeg.

Jamieson, S.M. (1974). A Synthesis of Archaeological Research in Riding Mountain National Park to 1973. Unpublished Contract Report. Parks Canada, Winnipeg.

Jenkins, G.C. (1970). South Side Riding Mountain Area - Canada Land Inventory Project, ARDA No. 7038. Manitoba Department of Natural Resources, Winnipeg.

John/Paul and Associates. (1988). Riding Mountain National Park Data Management Plan. Unpublished Report. Prepared for Environment Canada, Parks, Riding Mountain National Park, Wasagaming.

Keck, A.J. (1975). The Climate of Riding Mountain National Park Manitoba. Atmospheric Environment Service. Unpublished Manuscript, Report No. 19, Toronto.

Klassen, R.W. (1979). Pleistocene Geology and Geomorphology of the Riding Mountain and Duck Mountain Areas, Manitoba-Saskatchewan. Geological Survey Memoir 396, Ottawa.

Kooyman, A.H. and R.C. Hutchison. (1979). The Aquatic Resources of Riding Mountain National Park. Vol I: General Summary. Unpublished Report. Canadian Wildlife Service, Edmonton.

Lands Directorate. (1974a). Land Capability for Forestry, Neepawa 62-J. Canada Land Inventory, Department of Environment, Ottawa. (m)

Lands Directorate. (1975). Land Capability for Forestry, Riding Mountain 62-K. Canada Land Inventory, Department of Environment, Ottawa. (m)

Lands Directorate. (1974b). Land Capability for Forestry, Duck Mountain 62-N. Canada Land Inventory, Department of Environment, Ottawa. (m)

Lands Directorate. (1974c). Land Capability for Forestry, Dauphin Lake 62-O. Canada Land Inventory, Department of Environment, Ottawa. (m)

Ledohowski, E.M. (198Ø). Over the River: A Review of Heritage Resources of the South Riding Mountain Planning District. Department of Cultural Affairs and Historic Resources, Winnipeg.

Ledohowski, E.M. (1981). The Beautiful PLains Country: An Overview of the Heritage Resources of the Neepawa & Area Planning District. Department of Cultural Affairs and Historic Resources, Winnipeg.

Lombard North Group, Ltd. (1976). Riding Mountain National Park biophysical land inventory. Unpublished contract report. Parks Canada, Prairie Region, Winnipeg.

McGillis, J.R. and J.G. Stelfox. (1976). Aerial Survey of bald eagle and osprey in Riding Mountain National Park. Unpublished Report. Canadian Wildlife Service, Edmonton.

Macdonald, G. (1985). Manitoba's Quarry Landscape: A Contribution to Historical Resources Planning. Manuscript on file. Manitoba Historic Resources Branch, Winnipeg.

Manitoba Department of Mines and Natural Resources. (1966). Guide to Land Use: Periphery of Duck Mountain Provincial Forest. Winnipeg.

Manitoba Department of Mines, Resources and Environmental Management. (1972a). Whitemud River Watershed Resource Study Phase I - Agriculture Sector. Prepared by G.C. Jenkins, Winnipeg.

Manitoba Department of Mines, Resources and Environmental Management. (1972b). Whitemud River Watershed Resource Study Phase I - Fishery Resource of the Whitemud Watershed Area. Prepared by N. Ward Falkner, Winnipeg.

Manitoba Department of Mines, Resources and Environmental Management. (1972c). Whitemud River Watershed Resource Study Phase I - Wildlife Section. Prepared by Herbert D. Goulden et al., Winnipeg.

Manitoba Department of Mines, Resources and Environmental Management. (1972d). Whitemud River Watershed Resource Study Phase I - Land Use. Prepared by J.A. Hodgson, Winnipeg.

Manitoba Department of Mines, Resources and Environmental Management. (1972e). Whitemud River Watershed Resource Study Phase I - Outdoor Recreation of the Whitemud Watershed Area. Prepared by T. Searth, Winnipeg.

Manitoba Department of Mines, Resources and Environmental Management. (1972f). Whitemud River Watershed Resource Study Phase I - Water Resource Inventory and Problem Identification and Appendix. Prepared by Water Resources Branch, Winnipeg.

Manitoba Department of Mines, Resources and Environmental Management. (1972g). Whitemud River Watershed Resource Study Phase I - Forest Resources of the Whitemud Watershed Area. Prepared by H. Veldhuis et al., Winnipeg.

Manitoba Department of Mines, Resources and Environmental Management. (1974). Whitemud River Watershed Resource Study. Prepared for the Whitemud River Watershed Board, Winnipeg.

Manitoba Department of Mines, Natural Resources and Environment. (1979a). Rosedale Farm Conservation Project, (pamphlet), Winnipeg.

Manitoba Department of Mines, Natural Resources and Environment, Mineral Resources Division. (1979b). Report of Field Activities. Winnipeg.

Manitoba Department of Tourism, Recreation and Cultural Affairs. (1972). Lake Dauphin Regulation Study. Parks Branch, Planning Section, Winnipeg.

Manitoba Energy and Mines. (1988a). Aggregate Resources Compilation Map Series. Map AR88-1-7 Neepawa, NTS 62J, 1:250,000. (m)

Manitoba Energy and Mines. (1988b). Aggregate Resources Compilation Map Series. Map AR88-1-8 Riding Mountain, NTS 62K, 1:250,000. (m)

Manitoba Energy and Mines. (1988c). Aggregate Resources Compilation Map Series. Map AR88-1-10 Dauphin Lake, NTS 62O, 1:250,000. (m)

Manitoba Energy and Mines. (1988d). Aggregate Resources Compilation Map Series. Map AR88-1-11 Duck Mountain, NTS 62N, 1:250,000. (m)

Manitoba Fisheries Branch. (1989). Habitat Inventory and Classification. Unpublished Report. Manitoba Natural Resources, Winnipeg.

Manitoba Historic Resources Branch. (1985a). Architectural Sites Inventory. NTS Map Sheets, 1:50,000. Department of Culture, Heritage and Recreation, Winnipeg. (m)

Manitoba Historic Resources Branch. (1985b). Historic Sites Inventory. On card file. Department of Culture, Heritage and Recreation, Winnipeg.

Manitoba Historic Resources Branch. (1986). Archaelogical Sites Inventory. NTS Map Sheets, 1:50,000. Department of Culture, Heritage and Recreation, Winnipeg. (m)

Manitoba Minerals Resources Division. (1981). Surficial Geological Map of Manitoba. Scale 1:1,000,000 Map 81-1. (m)

Manitoba Natural Resources. (1972). Groundwater Availability Map Series, Neepawa Area (62J). Water Resources. Prepared by J. Little. Winnipeg. (m)

Manitoba Natural Resources. (1978). Groundwater Availability Map Series, Riding Mountain (62K). Water Resources. Prepared by D. Sie. Winnipeg. (m)

Manitoba Natural Resources. (1976). Groundwater Availability Map Series, Duck Mountain (62N). Water Resources. Prepared by D. Sie. Winnipeg. (m)

Manitoba Natural Resources. (1982). Planning Report on Natural Resources, South Riding Mountain Planning District. Resource Allocation Working Group. Technical Report 82-16, Winnipeg.

Manitoba Natural Resources. (1986). IBP Summary Sheets. Resource Allocation and Planning Branch. Winnipeg.

Manitoba Natural Resources. (1987a). Five-Year Report to the Legislature on Wildlife. Year ending March 31, 1987, Winnipeg.

Manitoba Natural Resources. (1987b). Groundwater Availability Map Series, Dauphin Lake (62O). Water Resources. Prepared by R.N. Betcher. Winnipeg. (m)

Manitoba Natural Resources. (1988a). Basin and Watershed Boundaries. Water Resources Branch, Winnipeg. (m)

Manitoba Natural Resources. (1988b). Ecologically Significant Areas Directory - Ecological Reserves Program. Technical Report 88-05, Winnipeg.

Manitoba Natural Resources. (1989a). Planning Report on Natural Resources, Rossburn Planning District. Resource Allocation Working Group. Technical Report 89-6, Winnipeg.

Manitoba Natural Resources. (1989b). Dauphin Lake-Opportunities for Restoration. Prepared for Dauphin Lake Advisory Board. Winnipeg.

Manitoba Parks Branch. (1973). Outdoor Recreation Master Plan (Provisional) - Asessippi Provincial Park. Department of Natural Resources, Winnipeg.

Manitoba Water Commission. (1984). Dauphin Lake Regulation and Siltation Study. Winnipeg.

McKay, M.C. et al. (1969). Shellmouth Designated Reservoir Area Proposed Land Use Plan. Canada Land Inventory Project. Manitoba Department of Mines and Natural Resources, Winnipeg.

Mills, G.F. and R.E. Smith. (1981). Soils of the Ste. Rose du lac Area. Soils Report No. 21. Manitoba Soil Survey, Winnipeg.

Mills, G.F. (1984). "Soils of Manitoba". Natural Heritage of Manitoba: Legacy of the Ice Age. Manitoba Museum of Man and Nature, Winnipeg. J.T. Teller, editor, p. 67-91.

M.M. Dillon Ltd. (1972). Engineering Study of the Lake Dauphin Basin Marshland. Prepared for Ducks Unlimited, Winnipeg.

Municipal Planning Branch. (1981). Background Studies for the South Riding Mountain Planning District Development Plan. Municipal Affairs, Winnipeg.

Munro, S. (1987a). Herpetile resource description and analysis, Riding Mountain National Park. Natural Resource Conservation, Prairie and Northern Region, Environment Canada - Parks, Winnipeg.

Munro, S. (1987b). Herpetile Management Plan, Riding Mountain National Park. Prairie and Northern Region, Environment Canada - Parks, Winnipeg.

Munro, S. (1987c). Herpetile Field Survey Data Report, Riding Mountain National Park. Prairie and Northern Region, Environment Canada - Parks, Winnipeg.

National and Historic Parks Branch. (1972). Proposed Boundary Adjustments and Buffer Considerations, Riding Mountain National Park. Prepared by Western Regional Office, Planning Division-Park Planning Section.

Nelson, J.G., R.D. Needham and D.L. Mann. (1978). International Experience with National Parks and Related Reserves. Dept. of Geography Publication Series, No. 12, University of Waterloo.

Nelson, J.G. (1984). An External Perspective on Parks Canada Strategies, 1986-2001. Occasional Paper, No. 2, University of Waterloo.

Newbury, R. (1980). Restabilization and Sediment Control in the Wilson Creek Channel and Drain. Preliminary Report, Winnipeg.

Newbury, R. and M. Gaboury. (1987). The Use of Natural Stream Characteristics for stream rehabilitation works below the Manitoba Escarpment. Manitoba Natural Resources, Fisheries Branch, Winnipeg.

Page, Garnet T. (1984). International Conference on Environmental Education. Canada/MAB-Unesco Man and the Biosphere Programme Alberta, Canada.

Pedocan Land Evaluation Ltd. (1988). Forest Ecosystem Classification and Land System Mapping Pilot Project Duck Mountain, Manitoba. Published Contract Report, Edmonton.

Pokrant, H. and M. Gaboury. (1983). Remote Sensing to Assess Land Use/Land Cover Changes Affecting The Dauphin Lake Fishery. Department of Natural Resources, Winnipeg.

Parks Canada. (1979). Resource Description and Analysis, Riding Mountain National Park. Prairie and Northern Region, Winnipeg.

Parks Canada. (1980). Parks Canada Policy. Department of Environment, Ottawa.

Parks Canada. (1984a). Resource Description and Analysis, Riding Mountain National Park. Prairie and Northern Region, Winnipeg.

Parks Canada. (1984b). Natural Resource Studies Conducted in the National Parks of the Prairie Region: 1973-74 to 1982-83. Natural Resource Conservation, Prairie Region, Winnipeg.

Parks Canada. (1987a). Riding Mountain National Park Management Plan. Environment Canada - Parks, Ottawa.

Parks Canada. (1987b). Riding Mountain National Park Conservation Plan, Revision and Update. Prairie and Northern Region, Winnipeg.

Parks 2000 - Vision for the 21st Century. (1987). Nature Concervancy of Canada. Heritage Resources Centre, University of Waterloo.

PFRA. (1988). Manitoba Escarpment Headwater Storage Study. Main Report and Appendices. The Steering Committee, Winnipeg.

Preston, William B. (1982). The Amphibians and Reptiles of Manitoba. Manitoba Museum of Man and Nature, Winnipeg.

Pylypuik, G. (1987). Rare and Significant Bird Species List. Unpublished Report, Riding Mountain National Park. June 25, No. 9850-5.

Rounds, R.C. (1980). Beaver Depredation on Private Lands Surrounding Riding Mountain National Park. Rural Community Resources Centre, Brandon.

Rees, William E. (1977). The Canada Land Inventory in Perspective. Lands Directorate, Environment Canada. Report No. 12. University of British Columbia.

Riding Mountain Task Force Report. (1984). Working Committee of the Interdepartmental Planning Board (IPB), Winnipeg.

Rowe, J.S. (1972). Forest Regions of Canada. Canadian Forestry Service, Publication No. 1300, Ottawa.

Rousseau, P.R. (1988). Annual Report on the Bear Management Program Riding Mountain National Park. Prairie and Northern Region, Winnipeg.

Rutulis, M. (1986a). Aquifer Pollution Hazard Areas in Southern Manitoba. No. (M-459). Water Resources Branch, Winnipeg. (m)

Rutulis, M. (1986b). Aquifer Maps of Southern Manitoba. Parts 1 & 2. Water Resources Branch, Winnipeg. (m)

Rutulis, M. (P. Eng.) Aquifer Data Geologist, Manitoba Natural Resources, Water Resources Branch. Pers. Comm. (1989).

Scoggan, H.J. (1957). Flora of Manitoba. National Museum of Canada Bulletin, No. 140, Ottawa.

Scott, G. Professor, Department of Geography, University of Winnipeg. Pers. Comm. (1990).

Scott, W.B. and E.J. Crossman. (1973). Freshwater Fishes of Canada. Fisheries Research Board of Canada, Bulletin 184, Ottawa.

Shay, C.T. (1984). "The History of Manitoba's Vegetation". Natural Heritage of Manitoba: Legacy of the Ice Age. Manitoba Museum of Man and Nature, Winnipeg. J.T. Teller, editor, p. 93-125.

Tabulenas, T. (1983). A Narrative Human History of Riding Mountain National Park and Area Prehistory to 1980. Manuscript of file. Parks Canada, Prairie Region, Winnipeg.

Task Force on Park Establishment. (1987). Our Parks - Vision for the 21st Century. Environment Canada, Parks and Heritage Resource Centre, University of Waterloo.

Tidsbury, C. (1984). Insect and Disease Conditions in Riding Mountain National Park, 1983. Unpublished Report. Canadian Wildlife Service, Edmonton.

Trottier, G.C. (1974). Range Studies, Riding Mountain National Park. Unpublished Contract Report. Canadian Wildlife Service, Edmonton.

Trottier, G.C., L.N. Carbyn and E.S. Telfer. (1987). Large Mammal System Study in Riding Mountain National Park. Canadian Wildlife Service, Edmonton.

UMA Engineering Group Ltd. (1980). Background Study to the Development Plan for the Neepawa & Area Planning District. Municipal Affairs, Winnipeg.

UMA Engineering Group Ltd. (1983). The South Riding Mountain Planning District Development Plan. Prepared for the South Riding Mountain Planning Board, Winnipeg.

Unesco. (1980). Man and the Biosphere Program - Directory of Biosphere Reserves. Paris.

Unesco. (1984). "Action Plan for Biosphere Reserves". Nature and Resources. Vol. XX, No. 4.

Valiant, H. (1986). Fisheries Input for the Turtle River Watershed Conservation District Plan. Unpublished Submission for the Turtle River Conservation District. Regional Fisheries Branch, Dauphin.

Ward, Neville E. and Beth Killham. (1987). Heritage Conservation - The Natural Environment. Heritage Resources Centre, University of Waterloo.

Water Resources Branch. (1970). Water Resources and Water Related Problems in the Parkland Region. Planning Division, Winnipeg.

Water Resources Branch. (1973a). Groundwater Availability in the Ochre River-Ste. Rose Area. Groundwater Availability Studies, Report No. 7. Planning Division, Winnipeg.

Water Resources Branch. (1973b). Groundwater Availability in the Dauphin Area. Groundwater Availability Studies, Report No. 10. Planning Division, Winnipeg.

Water Resources Branch. (1979). Turtle River Watershed Conservation District Scheme. Department of Mines, Natural Resources and Environment, Winnipeg.

Water Resources Division. (1978). Groundwater Hazard Maps, 62 J,K,N 1:250,000. Manitoba Natural Resources, Winnipeg. (m)

Water Resources. (1977). Groundwater Resources in the Turtle River Watershed. Planning Branch, Manitoba Natural Resources, Winnipeg.

Water Resources. (1979). Groundwater Resources in the Neepawa & Area Planning District. Planning Branch, Manitoba Natural Resources, Winnipeg.

Water Resources. (1980). Groundwater Resources in the South Riding Mountain Planning District. (A Synopsis). Water Investigations, Prepared by M. Rutulis. Winnipeg.

Water Resources. (1982). Dauphin Lake Sedimentation Study. Prepared by R. Oshoway, Water Control Works Section, Winnipeg.

Water Resources. (1989). Groundwater Resources in the Rossburn Planning District. (A Synopsis). Hydrogeology Section, Prepared by M. Rutulis. Winnipeg.

Weedon, D. (1987). Updated Bird Checklist for Riding Mountain National Park. Unpublished Contract Report. Prairie and Northern Region, Winnipeg.

Wilson Creek Committee on Headwater Flood and Erosion Control. (1983). Summary Report of the Wilson Creek Watershed Study 1957-1982. Prepared by R.W. Newbury, Winnipeg.

(m) denotes mapped reference

Appendix 1 - Principal Biome Types for the Nearctic Realm.

Note - A classification number 1.1.2 would be recognizable as lying in the Nearctic region of the Sitkan Province (biogeographic province) consisting of sub-tropical and temperate rain forest or woodlands (biome type). The numbering system and names of the Realms, and Biome Types of the world is as follows:

<u>Biogeographic Realm</u>

1. Nearctic Realm
2. Palearctic Realm
3. Africotropical Realm
4. Indomalayan Realm
5. Oceania Realm
6. Australian Realm
7. Antarctic Realm
8. Neotropical Realm

<u>Principal Biome Types</u>

1. Tropical Humid Forests
2. Subtropical & Temperate Rain Forests or Woodlands
3. Temperate Needle-leaf Forests or Woodlands
4. Tropical Dry or Deciduous Forests or Woodlands
5. Temperate Broad-leaf Forests or Woodlands, & Subpolar Deciduous Thickets
6. Evergreen Sclerophyllous Forests, Scrubs and Woodlands
7. Warm Deserts and Semi-Deserts
8. Cold-winter (continental) Deserts and Semideserts
9. Tundra Communities and Barren Arctic Desert
10. Tropical Grasslands and Savannas
11. Temperate Grasslands
12. Mixed Mountain & Highland Systems
13. Mixed Island Systems
14. Lake Systems

Appendix 1 - Principle Biome Types for the Nearctic Realm.

1. The Nearctic Realm

Number	Biogeographic Province
1.1.2	Sitkan
1.2.2	Oregonian
1.3.3	Yukon taiga
1.4.3	Canadian taiga
1.5.5	Eastern Forest
1.6.5	Austroriparian
1.7.6	Californian
1.8.7	Sonoran
1.9.7	Chihuahuan
1.10.7	Tamaulipan
1.11.8	Great Basin
1.12.9	Aleutian Islands
1.13.9	Alaskan tundra
1.14.9	Canadian tundra
1.15.9	Arctic Archipelago
1.16.9	Greenland tundra
1.17.9	Arctic desert and ice cap
1.18.11	Grasslands
1.19.12	Rocky Mountains
1.20.12	Sierra-Cascade
1.21.12	Madrean-Cordilleran
1.22.14	Great Lakes

Source: Canada/MAB, 1975 (after Udvardy, 1975)

Appendix 2 - Some Important Vegetation Components of the Riding Mountain Biosphere Reserve.

Common Name	Scientific Name
Tree Stratum	
Trembling aspen	*Populus tremuloides*
White spruce	*Picea glauca*
Black spruce	*Picea mariana*
Balsam popular	*Populus balsamifera*
Jack Pine	*Pinus banksiana*
Balsam fir	*Abies balsamea*
Bur oak	*Quercus macrocarpa*
White (American) Elm	*Ulmus americana*
Green Ash	*Fraxinus pennsylvanica*
Manitoba Maple	*Acer negundo*
Tamarack	*Larix laricina*
Shrub/Herb Stratum	
Beaked hazelnut	*Corylus cornuta*
Willow	*Salix* spp.
Prickly rose	*Rosa acicularis*
Saskatoon berry	*Amelanchier alnifolia*
Wild Red Raspberry	*Rubus idaeus*
Red-osier dogwood	*Cornus stolonifera*
Cranberry	*Vaccinium vitus-idaea*
Alder	*Alnus* spp.
Dwarf birch	*Beluta glandulosa*
Sprangle-top	*Leptochloa fascicularis*
Sedge	*Carex* spp.
Bulrush	*Scirpus* spp.
Reed grass	*Calamagrostis* spp.
Cat-tail	*Typha latifolia*
Grasslands	
Rough fescue	*Festuca scabrella*
Wheatgrass	*Agropyron* spp.
Kentucky bluegrass	*Poa pratensis*
Junegrass	*Koeleria cristata*

Source: (Bailey, 1968; Shay, 1984; Vance et al., 1984)

Appendix 3 - Mammals of Riding Mountain National Park.

Family/Common Name	Scientific Name
Family-Soricidae	
Masked Shrew	*Sorex cinereus*
Vagrant Shrew	*Sorex vagrans*
American Water Shrew	*Sorex palustris*
Arctic Shrew	*Sorex arcticus*
Pygmy Shrew	*Sorex hoyi*
Short-tailed Shrew	*Blarina brevicuada*
Family-Talpidae	
Star-nosed Mole	*Condylura cristata*
Family-Verspertilionidae	
Little Brown Bat	*Myotis lucifugus*
Big Brown Bat	*Eptesicus fucus*
Red Bat	*Lasiurus borealis*
Silver-haired Bat	*Lasionycteris noctivagans*
Family-Leporidae	
White-tailed Jack Rabbit	*Lepus townsendii*
Snowshoe Hare	*Lepus americanus*
Family-Sciuridae	
Eastern Chipmunk	*Tamais striatus*
Least Chipmunk	*Tamais minimus*
Woodchuk	*Marmota monax*
Richardson's Ground Squirrel	*Spermophilus richardsonii*
Franklin's Ground Squirrel	*Spermophilus franklinii*
Thirteen-lined Ground Squirrel	*Spermophilus tridecemlineatus*
American Red Squirrel	*Tamiasciurus hudsonicus*
Northern Flying Squirrel	*Glaucomys sabrinus*
Eastern Gray Squirrel	*Sciurus carolinensis*
Family-Geomyidae	
Northern Pocket Gopher	*Thomomys talpoides*

Appendix 3 - Mammals of Riding Mountain National Park.

Family/Common Name	Scientific Name
Family-Castoridae	
Beaver	Castor canadensis
Family-Cricetidae	
Deer Mouse	Peromyscus maniclatus
Northern Grasshoper Mouse	Onychomys leucogaster
Red-backed Vole	Clethrionomys gapperi
Heather Vole	Phenacomys intermedius
Meadow Vole	Microtus pennsylvanicus
Prairie Vole	Microtus ochrogaster
Northern Bog Lemming	Synaptomys borealis
Muskrat	Ondatra zibethicus
Family-Muridae	
Norway Rat	Rattus norvegicus
House Mouse	Mus musculus
Family-Zapodidae	
Meadow Jumping Mouse	Zapus hudsonius
Family-Erethizontidae	
American Porcupine	Erethizon dorsatum
Family-Canidae	
Coyote	Canis latrans
Gray Wolf	Canis lupus
Red Fox	Vulpus vulpus
Family-Ursidae	
Black Bear	Ursus americanus
Family-Procyonidae	
Raccoon	Procyon lotor

Appendix 3 - Mammals of Riding Mountain National Park.

Family/Common Name	Scientific Name
Family-Mustelidae	
Fisher	Martes pennanti
Least Weasel	Mustela nivalis
Ermine	Mustela erminea
Long-tailed Weasel	Mustela frenata
Mink	Mustela vison
American Badger	Taxidea taxus
Striped Skunk	Mephitis mephitis
Otter	Lutra canadensis
Family-Felidae	
Canada Lynx	Lynx canadensis
Cougar	Felis concolor
Family-Cervidae	
Wapiti (Elk)	Cervus canadensis
Moose	Alces alces
White-tailed Deer	Odocoileus virginianus
Mule Deer	Odocoileus hemionus
Family-Bovidae	
Bison	Bison bison

Source: (Parks Canada, 1984)

Appendix 4 - A Partial Bird Checklist of Riding Mountain Biosphere Reserve.

	Common Name	Scientific Name
Early Spring	Canada Goose	Branta canadensis
	Northern Pintail	Anas acuta
	Rough-legged Hawk	Bueto lagopus
	Northern Harrier	Circus cyaneus
	American Kestrel	Falco sparverius
	Lesser Yellowlegs	Tringa flavipes
	Pectoral Sandpiper	Calidris melanotos
	Mountain Bluebird	Sialia currucoides
	Yellow-rumped Warbler	Dendroica coronata
	Fox Sparrow	Passerella iliaca
Late Spring	Ruddy Duck	Oxyura jamaicensis
	Common Goldeneye	Bucephala clangula
	Broad-winged Hawk	Buteo platypterus
	Olive-sided Flycatcher	Contopus borealis
	Western Wood Pewee	Contopus sordidulus
	Red-eyed Vireo	Vireo olivaceus
	Chestnut-sided Warbler	Dendroica pensylvanica
	Mourning Warbler	Oporornis philadelphia
Summer	Common Loon	Gavia immer
	American White Pelican	Pelecanus erythrorhynchos
	Common Merganser	Mergus merganser
	Red-tailed Hawk	Buteo jamaicensis
	Killdeer	Charadrius vociferus
	Spotted Sandpiper	Actitis macularia
	Forster's Tern	Sterna forsteri
	Black Tern	Chlidonias niger
	Eastern Kingbird	Tyrannus tyrannus
	Cedar Waxwing	Bombycilla cedrorum
	American Redstart	Setophaga ruticilla
	White-throated Sparrow	Zonotrichia albicollis
Fall	Snow Goose	Chen caerulescens
	Mallard	Anas platyrhynchos
	Green-winged Teal	Anas crecca
	Blue-winged Teal	Anas discors
	Northern Shoveler	Anas clypeata
	Gadwall	Anas strepera

Appendix 4 - A Partial Bird Checklist of Riding Mountain Biosphere Reserve.

	Common Name	Scientific Name
	American Widgeon	Anas americana
	Canvasback	Anthya valisineria
	Redhead	Anthya americana
	Ring-necked Duck	Anthya collaris
	Lesser Scaup	Anthya affinis
	Bufflehead	Bucephala albeola
	American Coot	Fulica americana
	Northern Flicker	Colaptes auratus
	American Robin	Turdus migratorius
	Dark-eyed Junco	Junco hyemalis
	Pine Siskin	Carduelis pinus
Winter	Northern Goshawk	Accipiter gentilis
	Ruffed Grouse	Bonasa umbellus
	Spruce Grouse	Dendragapus canadensis
	Sharp-tailed Grouse	Tympanuchus phasianellus
	Gray Partridge	Perdix perdix
	Great Horned Owl	Bubo virginianus
	Pileated Woodpecker	Dryocopus pileatus
	Gray Jay	Perisoreus canadensis
	Blue Jay	Cyanocitta cristata
	Black-capped Chickadee	Parus atricapillus
	Boreal Chickadee	Parus hudsonicus
	Pine Grosbeak	Pinicola enucleator
	Evening Grosbeak	Cocothraustes vespertinus
Other Species of Interest:		
	Double-crested Cormorant	Phalacrocorax auritus
	Osprey	Pandion haliaetus
	Bald Eagle	Haliaeetus leucocephalus
	Swainson's Hawk	Buteo swainsoni
	Great Gray Owl	Strix nebulosa

Source: (after Weedon, 1987)

Appendix 5 - Fish Species list for the Riding Mountain Biosphere Reserve.

Common Name	Scientific Name
Bigmouth Buffalo	Ictiobus cyprinellus
Blacknose Dace	Thinichthys atratulus
Blacknose Shiner	Notropis heterolepis
Blackside Darter	Percina maculata
Brassy Minnow	Hybognathus hankinsoni
Brook Sticleback	Culaea inconstans
Brook Trout	Salvelinus fontinalis
Brown Trout	Salmo trutta
Burbot	Lota lota
Carp	Cyprinus carpio
Cisco	Coregonus artedii
Common Shiner	Notropis cornutus
Creek Chub	Semotilus atromaculatus
Emerald Shiner	Notropis atherinoides
Fathead Minnow	Pimephales promelas
Finescale Dace	Chrosomus neogaeus
Golden Shiner	Notemigonus crysoleucas
Goldeye	Hiodon alosoides
Iowa Darter	Ehteostoma exile
Johnny Darter	Etheostoma nigrum
Kohanee	Onocorhyncus nerka
Lake Trout	Salvelinus namaycush
Lake Whitefish	Coregonus clupeaformis
Largemouth Bass	Micropterus salmoides
Logperch	Percina caprodes
Longnose Dace	Rhinichthys cataractae
Northern Pike	Esox lucius
Pearl Dace	Semotilus margarita
Quillback	Carpiodes cyprinus
Rainbow Trout	Oncorhynchus mykis
River Darter	Percina shumardi
Sauger	Stizostedion canadense
Shorthead Redhorse	Moxostoma macrolepidotum
Silver Chub	Hybopsis storeriana
Silver Redhorse	Moxostoma anisurum
Slimy Sculpin	Cottus cognatus
Smallmouth Bass	Micropterus dolomieui
Spottail Shiner	Notropis hudsonius
Trout Perch	Percopsis omiscomaycus
Walleye	Stizostedion vitreum
White Sucker	Catostomus commersoni
Yellow Perch	Perca flavescens

Source: (Manitoba Fisheries Branch, 1989)

Appendix 6 - Archaeological Sites Within the Riding Mountain Biosphere Reserve.

Site	Location	Comments
EdLw-1	NE/SW 16-18-17W	Paleo-Indian 12-11,000 B.P.
EdLw-2	NW/SW 16-18-17W	late prehistoric
EdLw-3	N/NW 16-18-17W	Oxbow 3,000 B.C.
EdMa-1	NE/NW 27-19-19W	unknown
EdMc-1	SE 15-18-22W	late prehistoric
EdMc-2	NW 2-19-22W	Elphinstone
EeLu-1	SE/SE 34-19-15W	undated prehistoric
EeLu-2	NE/NE 9-20-15W	undated prehistoric
EeLu-3	NE/NE 35-19-15W	undated prehistoric
EeLu-4	NE/NE 9-20-15W	McCreary Half-Way House
EeLv-1	SE/SW 5-20-15W	undated prehistoric
EeLv-2	NE/NW 2-21-16W	undated prehistoric
EeLv-3	NW/NW 2-21-16W	undated prehistoric
EeLv-4	NE/NW 3-21-16W	undated prehistoric
EeLv-5	SE/NW 3-21-16W	undated prehistoric
EeLv-6	SW/NW 3-21-16W	undated prehistoric
EeLv-7	SE/NE 4-21-16W	undated prehistoric
EeLv-8	NE/NW 4-21-16W	undated prehistoric
EeLv-9	NW/NW 5-20-15W	undated prehistoric
EeLv-10	NW/NW 6-20-15W	"Prehistoric"
EeLw-1	NE/SE 32-19-16W	undated prehistoric
EeLw-2	SW/SW 32-20-16W	undated prehistoric
EeLw-3	NE/SE 31-20-16W	undated prehistoric
EfLw-1	NE 19-22-17W	Prehistoric-Archaic-Woodland (800 B.P. to A.D. 0)
EfLw-2	SE/SE 4-23-17W	undated prehistoric
EfLw-3	SE/SE 31-22-17W	undated prehistoric
EfLw-4	SE/SE 31-22-17W	undated prehistoric
EfLw-5	NE/NE 4-23-17W	undated prehistoric
EgLv-1	NW/SE 29-24-16W	undated prehistoric
EgLw-1	SE/SW 26-24-17W	Archaic (5000-4000 B.P.)
EgLw-2	SE/SE 27-24-17W	undated prehistoric
EgLw-3	NE/NE 30-24-16W	undated prehistoric
EgLw-4	SE 34-23-17W	undated prehistoric

Appendix 6 - Archaeological Sites Within the Riding Mountain Biosphere Reserve.

Site	Location	Comment
EgLx-2	NW/NW 4-25-18W	undated prehistoric
EgLx-3	SW/SE 10-25-18W	undated prehistoric
EgMa-1	SW/SE 7-24-19W	undated prehistoric
EgMa-2	NE/SW 4-24-19W	undated prehistoric
EgMa-4	SE/SE 11-24-20W	undated prehistoric
EgMa-5	NW/NE 24-24-20W	Paleo-Indian-Archaic (7000-2000 B.P.)
EgMa-6	NE/SW 24-24-20W	"Woodland"
EgMa-7	SW/SW 30-24-19W	"Woodland" (0-1700 A.D.)
EgMa-8	Dauphin	undated prehistoric
EgMb-1	SW/W 14-24-20W	undated prehistoric
EgMb-3	SW/SW 7-25-20W	"Archaic" (1000 B.P. to A.D. 0) Pelican Lake
EgMb-4	NE/NW 32-24-20W	undated prehistoric
EgMb-5	Dauphin	undated prehistoric
EgMb-6	NE/NW 35-23-20W	undated prehistoric
EgMb-7	SW/SE 2-23-20W	undated prehistoric
EgMb-8	Dauphin	undated prehistoric
EgMb-9	SW/NW 7-25-20W	undated prehistoric
EgMb-10	NW/NW 13-24-21W	undated prehistoric
EgMb-11	SW/SE 15-25-21W	undated prehistoric
EgMc-1	NE/SE 9-25-22W	Late "Archaic" (2000 B.P. to A.D. 0)
EgMc-2	NE/SW 10-24-21W	undated prehistoric
EgMd-1	Gilbert Plains	Paleo-Indian-Archaic (9-2000 B.P. to 1000 B.P. - A.D. 0)
EgMd-2	SE/NE 11-25-23W	Woodland (9-8000 B.P. to A.D. 1700)
EgMd-3	SW/SW 2-25-23W	Woodland (8-7000 B.P. to A.D. 1700)
EgMf-1	NE/NE 24-23-26W	undated prehistoric
EgMi-3	SW/SW 26-24-29W	undated prehistoric
EgMi-4	NW/SE 34-24-29W	undated prehistoric
EhMa-1	NW/NE 25-26-19W	undated prehistoric
EhMb-1	NE/NE 34-25-21W	undated prehistoric

Appendix 6 - Archaeological Sites Within the Riding Mountain Biosphere Reserve.

Site	Location	Comment
EhMb-2	SW/SE 19-25-20W	Paleo Indian-Archaic-Woodland (9-8000 B.P. to A.D. 1700)
EhMb-3	NW/SW 24-25-21W	undated prehistoric
EhMb-4	NE/NE 34-25-21W	undated prehistoric
EhMb-5	Gilbert Plains	Paleo Indian-Archaic-Woodland (7-6000 B.P. to A.D. 1700)
EhMb-6	NW/SW 24-25-21W	Archaic-Woodland (3-4000 B.P. to A.D. 1700)
EhMb-7	SE/NW 26-25-21W	undated prehistoric
EhMb-8	NW/NW 26-25-21W	undated prehistoric
EhMb-9	NW/NW 13-25-21W	undated prehistoric
EhMb-10	NW/NW 13-25-21W	undated prehistoric
EhMb-11	NE/SE 23-25-21W	undated prehistoric
EhMb-12	NE/SE 10-26-21W	undated prehistoric
EhMb-13	SW/NW 11-26-21W	undated prehistoric
EhMb-14	NW/NW 12-26-21W	undated prehistoric
EhMb-15	NW/NE 3-26-21W	undated prehistoric
EhMb-16	SW/NE 3-26-21W	undated prehistoric
EhMb-17	SE/SE 26-25-21W	undated prehistoric
EhMc-1	SE/SW 22-25-22W	undated prehistoric
EhMc-2	SE/SW 3-26-21W	Archaic-Woodland (1000-500 B.P. to A.D. 1700)
EhMc-3	Dauphin	undated prehistoric
EhMc-4	NW/SE 32-26-21W	undated prehistoric
EhMc-5	SW/SE 20-27-21W	undated prehistoric
EhMc-6	SW/SE 9-26-21W	undated prehistoric
EhMc-7	SE/SE 9-26-21W	undated prehistoric
EhMc-8	NW/NW 21-26-21W	undated prehistoric
EhMc-9	SW/SE 10-27-22W	undated prehistoric
EhMc-10	NE/SE 22-27-22W	undated prehistoric
EhMc-11	SW/SW 22-26-21W	undated prehistoric
EhMc-12	NW/NW 15-26-21W	undated prehistoric
EhMc-13	SE/SW 21-27-21W	undated prehistoric
EhMe-2	NW/NW 11-26-24W	Archaic-Woodland (5000-0 B.P. to A.D. 9-1300)
EhMe-3	SW/SW 12-26-24W	"Archaic"
EhMe-4	NE/NE 1-26-24W	undated prehistoric
EhMe-5	SE/SE 15-26-24W	"Woodland"
EhMe-6	NW/NW 10-26-24W	Archaic (6000 B.P. to A.D. 0)

Appendix 6 - Archaeological Sites Within the Riding Mountain Biosphere Reserve.

Site	Location	Comment
EhMe-7	SE/SE 35-26-24W	undated prehistoric
EhMe-8	NE/NE 4-26-4W	"Woodland"
EhMe-9	SW/SW 36-25-23W	undated prehistoric
EiMc-9	SE/SW 32-27-21W	undated prehistoric
EiMc-10	SE/SW 28-27-21W	undated prehistoric
EiLx-1	SE/SE 7-28-18W	undated prehistoric
EiLx-2	NW 32-28-18W	undated prehistoric
EiLx-3	NE/NW 31-28-18W	undated prehistoric
EiLx-4	NE/SW 32-28-18W	undated prehistoric
EiLx-5	SW/NW 30-28-18W	undated prehistoric
EhLx-1	SW/SE 23-26-18W	undated prehistoric
EhLx-2	SW/NW 24-26-18W	undated prehistoric
EhLx-3	NW/NW 32-26-18W	undated prehistoric
EhLx-4	SE/SW 15-27-18W	Lake Dauphin House (1775) H.B.C.-Post
EhLx-5	SW/SE 28-27-18W	undated prehistoric
EhLx-6	NW/NE 21-27-18W	undated prehistoric

Source: (MB. Historic Resources Branch - Archaeological Site Inventory, 1986)

Appendix 7 - A Partial List of Relevant Unpublished Theses, Riding Mountain Biosphere Reserve.

Bessy, K.M. (1983). "Analysis of the Illegal Harvest of White-tailed Deer in AgroManitoba: Implications for Program Planning and Management". M.N.R.M. Natural Resources Institute, University of Manitoba.

Blais E.L. (1980). "An Investigation Into the Movement of Alluvial Shale Gravels in the Riding Mountain Area of Manitoba". M.A. Thesis, Department of Geography, University of Manitoba.

Bruce, G.N. (1984). "The Development of a Soil-Water Management Plan for the Subescarpment of the Turtle River Watershed Conservation District". M.N.R.M. Natural Resources Institue, University of Manitoba.

Carlyle, W.J. (1965). "The Relationship Between Settlement and the Physical Environment in Part of the West Lake Area of Manitoba from 1878 to 1963". M.A. Thesis, Department of Geography, University of Manitoba.

Dunlop, S.L. (1981). "An Agroclimatology of Southern Manitoba". M.A. Thesis, Department of Geography, University of Manitoba.

Harvey, K. (1988). "Long-Tailed Weasels (Mustela frenata) in Manitoba". M.N.R.M. Natural Resources Institute, University of Manitoba.

Hopkinson, M.F. (1969). "An Investigation Into the Reasons for, and Characteristics of, Population Change in the Area South of Riding Mountain between 1941-1961". M.A. Thesis, Department of Geography, University of Manitoba.

Klenner, W.E. (1982). "Seasonal movements, home range utilization and denning habits of black bears (Ursus americanicus) in western Manitoba". M.Sc. Department of Zoology, University of Manitoba.

Koruluk, K.B. (1981). "A Self-Guided Interpretation System for the Riding Mountain Parkway Corridor, Riding Mountain National Park". M.L.A. Thesis, Department of Landscape Architecture, University of Manitoba.

Kunec, D.L. (1986). "Investigating Trail Deterioration in Riding Mountain National Park". M.N.R.M. Natural Resources Institute, University of Manitoba.

Livingston, R.D. (1979). "Regional Economic Development in the Parkland Region of Manitoba". M.N.R.M. Natural Resources Institute, University of Winnipeg.

Mackling, H.N. (1988). "The Identification and Assessment of Soil and Water Conservation Demonstration Sites in the Turtle River and Whitemud Watershed Conservation Districts". M.N.R.M. Natural Resources Institute, University of Manitoba.

McGarry, P.T. (1987). "An Assessment of the Physical Impacts of Agricultural Development on the Valley River Watershed". M.N.R.M. Natural Resources Institute, University of Manitoba.

McGinn, R.A. (1979). "Alluvial Fan Geomorphic Systems: The Riding Mountain Escarpment Model". Ph.D. Thesis, Department of Geography, University of Manitoba.

Millican, C. (1975). "Natural Processes and Landscape Form: Wilson Creek Alluvial Fan". M.L.A. Thesis, Department of Landscape Architecture, University of Manitoba.

Morgan, J.P. (1985). "An Analysis of Landowner Attitudes Towards Techniques of Wetland Preservation in the Prairie Pothole District in Manitoba". M.N.R.M. Natural Resources Institute, University of Manitoba.

Munro, H.L. (1981). "An Analysis of the Use of Nest Boxes by Mountain Bluebirds in Southwestern Manitoba". M.A. Thesis, Department of Geography, University of Manitoba.

Radwanski, M.J. (1981). "An Appraisal of the Management of Sand and Gravel Pits in the South Riding Mountain District". M.N.R.M. Natural Resources Institute, University of Manitoba.

Reimer, P.D. (1986). "The Recognition and Significance of Triploid Aspen: A Case Study in Riding Mountain National Park". B.Sc. Thesis, Department of Geography, University of Winnipeg.

Roots, J.M. (1988). "Biosphere Reserves in Canada: Current Status and Future Prospects". MES, Enviromental Studies, Dalhousie University.

Rounds, R.C. (1980). "Beaver Depredation on Private Lands Surrounding Riding Mountain National Park". Rural Community Resource Centre, Brandon University & the Natural Resources Institute, University of Manitoba.

Schroeder, R.E. (1981). "Factors Contributing to Resource Conflict: A Study of Riding Mountain National Park in its Regional Setting". M.N.R.M. Natural Resources Institute, University of Manitoba.

Seecharan, R. (1980). "Environmental and Socio-Economic Implications of Land and Water Resources Planning in Eden Creek Watershed". M.N.R.M. Natural Resources Institute, University of Manitoba.

Singhroy, V.H. (1977). "Sedimentation and Erosion Studies in Wilson Creek Watershed, Manitoba, with Particular Reference to Shale Bank Retreat". M.A. Thesis, Department of Geography, University of Manitoba.

Trotter, R.W. (1987). "A Review of Provincial Park System Evolution in Alberta and in Manitoba". B.A. Thesis, Department of Geography, University of Winnipeg.

Young, R.C. (1975). "Some Morphometric Properties and Erosion Rates of Gullies Along a Portion of the Manitoba Escarpment". M.A. Thesis, Department of Geography, University of Manitoba.

Appendix 8 - List of Agencies Contacted for Information Regarding RMBR.

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