THE UNIVERSITY OF MANITOBA

A DISTRIBUTION SYSTEM OF IRRIGATION WATER FOR MANITOBA

by

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ABSTRACT

A DISTRIBUTION SYSTEM OF IRRIGATION WATER FOR MANITOBA

This study of irrigation in Manitoba concentrates on the preliminary design and costing of a proposed distribution system. It attempts to define the total water requirements for irrigation in terms of upset or limit values. Arbitrary assumptions on land suitability and availability of water have been made to limit the extent of this study and some of the related subjects are only briefly discussed.

The gross area considered suitable for irrigation in Manitoba equals 6.4 million acres with an average consumptive use requirement of 1.72 million acre feet, an average annual diversion requirement of 4.5 million acre feet and a maximum annual diversion requirement of 15.0 million acre feet. These requirements compare with an estimated available supply of water to this area in the order of 50 million acre feet. It appears that there is a surplus water in the order of 35 million acre feet per year.

Costs of water diverted for delivery to the farm vary from $10 to $58 per acre foot depending on relative location of source and farm. Average costs for the Province are $20 to $30. The economics of canal lining are dependent on the cost of water supplied to Southern Manitoba. The costs in this study are based on water available in the upper Assiniboine River. If all water had to be obtained in Lake Manitoba, all of the foregoing costs would be appreciably higher.

Further study is recommended in the general areas of smaller irrigation district design, methods of water application, use of return flows, drainage improvement requirements, ground water movements, and pumping costs. Also with particular reference to this study, the long term storage requirements, local runoff and return flow use, and the irrigation of clay soils warrant further attention.

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1.0 INTRODUCTION

This study of a water distribution system related to irrigation feasibility is part of an overall study on the Water Resources of Western Canada being carried out by the University of Manitoba as an inter-disiplinarian project. The overall project is concerned with assessment of Western Canada water resources and requirements, and the cost and effects of major water diversions to Southern Canada or the United States.

2.0 SCOPE AND LIMITATIONS

2.1 SCOPE

The purpose of this study is to define the extent of potential irrigation in South-Western and South-Central Manitoba as governed by soil types and topography, provide a ceiling type estimate of irrigation water requirements and to estimate the cost of transporting water from the point of supply to the farm fields. Emphasis has been placed on the preliminary design and costing of a major water distribution network for the South-Western and South-Central portions of the province. The detailed classification of land for irrigation and the precise irrigation water requirements are considered to be of secondary importance. The subjects of future land use and irrigation methods are only briefly touched on. Geomorphology and groundwater as related subjects are dealt with to the extent deemed necessary. Water requirements for municipal, industrial and other uses are considered where applicable as these would have significant impact on an analysis of benefits.

2.2 LIMITATIONS

Certain very obvious limitations are inherent in this study due to the large volume of work covered in relatively short period of time. Specifically the following arbitrary assumption is made to limit the extent of this study; the required water for irrigation and other purposes is available in either the Assiniboine River at the Saskatchewan border or in Lake Manitoba. The amount of water available in Lake Manitoba or the Assiniboine River has been estimated by others at 50 million acre feet annually. Local runoff and groundwater derived from both natural precipitation and irrigation return flows have not been used to offset the amounts of water required from outside sources. The values sought in this study for irrigation water requirements are outside or upper limit

figures and not necessarily design values. These upper limit values have been used in the preliminary design of the water distribution networks. Cost estimates have been prepared without consideration of construction staging and must be considered to have relative value only.

The areas east of the Red River have not been included in this study, the source of supply being from the Winnipeg River and Lake of the Woods, and as such not really related to the prairie water system.

3.0 GEOMORPHIC & HISTORICAL BACKGROUND

3.1 GLACIAL HISTORY OF MANITOBA

The physical features of Manitoba are essentially all of glacial origin. The Ice Age and its associated lacustrine developments have left many land forms as a reminder of the more ancient history of this area. The development of delta areas and lake flats is probably most significant to this study. However, spillway channels and beach areas also merit consideration.

The land area within Manitoba's boundaries has undergone extensive periods of intensive glacial activity. The northern portions of Manitoba have been essentially stripped of the softer sedimentary type rock and exist as exposed igneous rock surfaces. Southern portions of the province are generally covered with 50 - 200 feet of ground moraine or boulder till. Appendix Plan A-1, duplicated in part from the "Economic Atlas of Manitoba"[1] shows the origin of most of the larger overburden types and their relationship to glacial history. (Elson [4] and Davies [6]).

The glacial lake eras, which existed during and after various retreats of the glacier, can be described as 3 lake phases; Lake Souris, Lake Agassiz I and Lake Agassiz II.

The Lake Souris phase, which was partially coincident in time with the Lake Agassiz I phase, was responsible for the development of the Souris basin with its sandy and medium textured soils. It also resulted in the creation of the Pembina River Valley due to the overflow from the Lake paralleling the ice front. The end of the Lake Souris phase came as the ice front retreated northward and erosion cut the narrow Tiger Hills moraine. This resulted in a new outlet for the Souris basin and the abandonment of the Pembina Valley channel.

The Lake Agassiz I phase began at essentially the same time as the Souris Lake Phase, however, it did not end when the latter did.

3.1 GLACIAL HISTORY OF MANITOBA - Continued

The significant developments within Manitoba came later. Retreat of ice front to the north permitted the development of a new outlet for the Assiniboine River. The Assiniboine, which had previously dumped its sediment into the Lake Souris Basin, now flowed eastward and entered Lake Agassiz near Brandon. Large volumes of sediment entering the lake during the prolonged period resulted in the vast Assiniboine River Delta and supplied much of the Lake bottom clays and silts. Well defined beaches (known as Herman Beaches) were formed during this period.

The development of an eastern outlet for the lake is believed to have brought about the end of Lake Agassiz I.

The re-advance of the ice front forced the return of a southern outflow from the lake and brought about Lake Agassiz II.

Agassiz II phase is thought to have been of long duration as indicated by the prominent beach lines known as the Campbell Beaches which exist on both sides of the Red River Valley and extend north of the west side to the Dauphin area. During this period the Assiniboine River cut into the earlier formed delta and began the formation of a new delta at a lower level. This degradation persisted well into modern times, and at progressively reduced lake levels extended the delta eastward. The end result is the somewhat "perched" condition of the Assiniboine channel east of Portage La Prairie. This condition, and the presence of numerous beaches at varying levels, are responsible for some of the drainage problems in the former Agassiz basin.

The significance of the glacial history in this study relates largely to the classification of basic soil types and their suitability for agriculture and irrigation. Glacial origin of various soils is an excellent indicator of