AN INVESTIGATION INTO RIVER BANK IMPROVEMENT IN THE WINNIPEG AREA

A Thesis

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Edwin H. Klassen

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SUMMARY

In this study of "Investigation Into River Bank Improvement In Metropolitan Winnipeg" an effort has been made to gain insight into the problems, solutions and economics of providing complete overall protection for the river banks of Metropolitan Winnipeg. The basic principle has been that if protection is carried out in a "piecemeal" manner there may be a disturbance of the natural regimen of the rivers, resulting in movement of the destructive forces downstream from the isolated areas of protection. This action would render the original protection useless and further protection would be required downstream from the original location.

Investigations were made into three aspects of river bank stability, namely, geomorphology, hydraulics, and soils. Solutions were classified into the three categories of bank drainage, resedimentation, and structures. The economics of various combinations of these solutions were studied by a comparison of total benefits and total costs. Costs were computed in the usual manner. For a derivation of benefits a survey was made regarding the amount of bank recession occurring at various locations, together with the proximity of buildings to the tops of banks. These figures were then developed into a recession-damage curve. Of the seven projects studied, two were considered to be economical but were not further pursued because they lacked the adequacy of protection required. Two projects, according to the assumptions and calculations made, yielded substantial protection for the most adverse conditions. These projects, a retaining wall and a heavy toe berm, whose total costs were estimated at 147 million dollars and 20 million dollars respectively, were both in excess of the total estimated benefits of approximately 17.5 million dollars. It is suggested, however, that further study be made of the project of toe fill since the difference in cost and benefit is not unduly large for a preliminary study.

In the survey made, inquiries were also made regarding allocation of costs of bank improvement projects. These were analyzed and the figures arrived at allotted the Federal Government 48.8 per cent, the Provincial Government 35.2 per cent, Metropolitan Government 10.4 per cent and the owner 5.6 per cent. These figures were considered, by the author, to be unrealistic, and the division of costs was placed at 30 - 50 per cent for the owner and the remainder for Metropolitan Government, with substantial contributions by the municipalities concerned.

CHAPTER I

INTRODUCTION

Hargrave, in his study of the Red River states:

> "A study of the historic development of settlements along the Red and Assiniboine Rivers reveals the significance of the river as related to the sites of settlements. From earliest times the waterways were essential to transportation. It is, therefore, not surprising that practically every settlement was located along the two rivers or their smaller tributaries. The present site of Winnipeg, for example, was originally the chief point of departure and distribution during the period of early exploration and settlement, due to its strategic position at the confluence of the Red and Assiniboine Rivers". (1)

Further, Hargrave's account states that:

> "The houses in no place extend back from the rivers, proximity to which has hitherto formed the sole reliance of the inhabitants for their water supply".

Even today one of the most obvious proofs of this statement is the division of large portions of property into long narrow strips, extending perpendicularly away from the rivers.

After the Manitoba Act in 1870, government land surveys were begun, and once the potentialities of the land in the Red River Valley were realized, settlers began arriving in increasing numbers, initiating a period of intense agricultural development. Unlike agriculture, industry began at Winnipeg on a small scale some fifty to sixty years ago. Growth in this field has accelerated considerably since then and

unfortunately, too much of the development has taken place near the river banks. Whereas in pioneer days stores and trading posts were relatively small and temporary and could be easily relocated because of river encroachment, today factories are of such a size that large amounts, indeed sometimes excessive amounts of money are required to remove an industry to safer ground. To this date, few if any moves have been necessary, but within the next few decades river encroachment will be a menace and a hazard to industry located near the banks of rivers. At present, 15,000 feet of bank are occupied by industry.

The problems and the accompanying hazards of erecting structures near river banks have been realized for many years. In the settlers' days, living near the river's edge during the flood meant, frequently, the sweeping away of all property, food and often domestic animals. In more recent years, while the largest floods have been of somewhat smaller magnitude than in settlers' years, structures have been built more soundly and lavishly, with the result that they have not been washed away but that the damage due to ice and water has been almost as critical, financially. Despite the fact that the river's potential danger has long been known, and is becoming more and more obvious through bank erosion, property adjacent to the river is becoming increasingly more desirable and more costly to purchase. Thirty to fifty years ago, it may have been possible to purchase all

river bank property and convert it to stable banks, used as playgrounds and parks. This is now an almost insurmountable task.

The river banks throughout the Winnipeg area are generally fairly well defined and quite steep. Through many of the residential areas, particularly from the north end of the city to Middlechurch, the banks are well treed. The tree line in most cases extends but a short distance below the top of the bank. At many locations, where the banks have slipped extensively the trees have been carried down with the banks, but still flourish.

Erosion of the banks is now quite general and particularly prevalent on almost all concave or outside bends. Erosion is light on convex or inside bends where extensive willow growth exists, this growth, being prevalent in the northern and southern portions of the city.

Throughout the built-up areas, both residential and commercial, many buildings, as mentioned above, are located close to the river banks. Subsequent erosion and slides, much of which appears to have occurred since 1950, have resulted in loss of property but only limited damage to buildings. In some instances buildings have had to be moved. Individual efforts have been made to prevent erosion and to rectify the condition of the banks resulting from the slides. These frequently consist of improperly located stone riprap, construction of cribs or

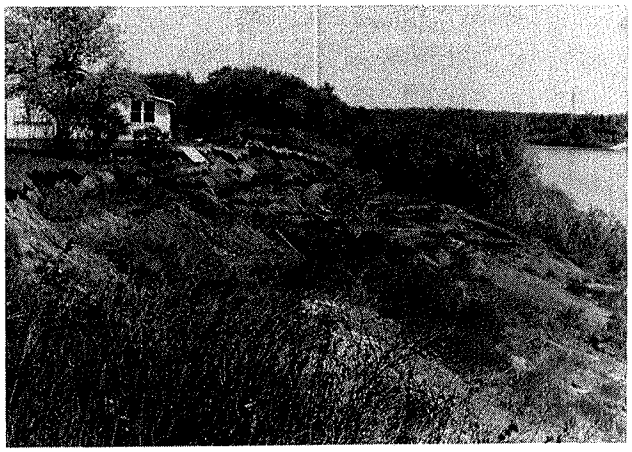
driving of piles, and the placement of backfill, with the result that the problem is often only aggravated.

The main causes of bank failure by sliding are the overloading of banks by man, and secondly the reducing of the factor of safety against sliding by bank saturation and erosion. Indiscriminate dumping of waste or spoil material and the stockpiling of equipment and building supplies along the river banks, which has been common practice in certain areas, tend to overload the banks and may often contribute to subsequent slides. In April 1951 Bill 70, "An Act to amend the Rivers and Streams Act" was passed in the Manitoba Legislature. This act provides that no person or persons, without a permit, shall deposit any material or erect any structures within one hundred and fifty feet from the normal summer water level. Even this, later studies have indicated, may be inadequate. Dumping on the river banks has not, at the present time, been sufficiently widespread to make any appreciable change in the carrying capacity of the channel, although it does result in increased velocities where dumping has taken place, producing localized erosion. The driving of piles and placing of riprap has proven to be quite adequate for minor toe erosion but a survey of these installations has shown that when a slide occurs, these installations have moved along with the sliding banks. Photographs number 1 to number 6, page 5, show

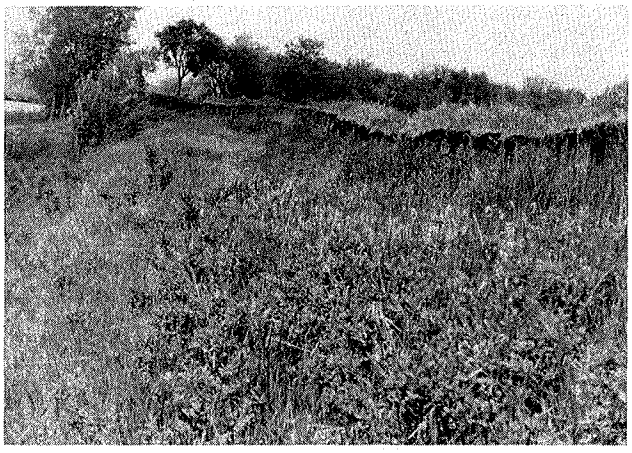
PHOTOGRAPH 1 - Recent Slide
Concave Edge, East Bank
Height 33 ft. Average Slope 6.8 : 1

PHOTOGRAPH 2 - Older Slide
Concave Edge, East Bank
Height 33 ft. Average Slope 6.7 : 1

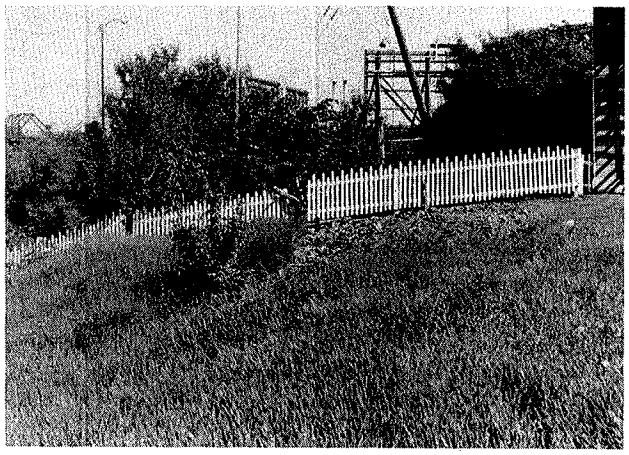
PHOTOGRAPH 3 - Recent Slide
Concave Edge, West Bank Looking South
Height 40 ft. Average Slope 5.1 : 1



PHOTOGRAPH 4
Same as Photograph 3
West Bank Looking North



PHOTOGRAPH 5 - Old Slide
Convex Edge, East Bank
Height 30 ft. Average Slope 5.4 :1



PHOTOGRAPH 6 - Old Slide with Fill
Concave Edge, East Bank
Height 34 ft. Average Slope 4.9 : 1
Note Fence Separation indicating
continued movement

Courtesy Professor A. Baracos