THE UNIVERSITY OF MANITOBA

SEDIMENTATION AND EROSION STUDIES IN WILSON CREEK WATERSHED, MANITOBA, WITH PARTICULAR REFERENCE TO SHALE BANK RETREAT

By

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ABSTRACT

Wilson Creek Watershed is located on the eastern slopes of Riding Mountain National Park in Manitoba and covers an area of 8.18 square miles. It contains two main streams--Packhorse and Baldhill--which join to form Wilson Creek at the foot of the Manitoba Escarpment.

Field data collected from 1964 to 1974 show that the 47 shale banks are the main source of sediment. The shale banks are eroded in horizontally bedded calcareous shale that weathers to produce screes at their bases. Mean slope angles of 35 scree slopes, measured over a ten-year period, range between 32.55 and 29.97 degrees. Moreover, it has been shown statistically that the instability of shale screes is a function of their location 'at' or 'away' from the creek. The annual rate of retreat of the shale banks is 0.5 feet for Packhorse and 0.2 feet for Baldhill. Over the period 1964-1972, there was a substantial net loss of debris on Packhorse Creek. The cumulative size of screes along Packhorse Creek has, therefore, markedly diminished, whereas there has been an overall growth of screes on Baldhill Creek.

Longitudinal profile determinations revealed a general rise in stream bed. Degradation and aggradation studies show that lateral erosion was more extensive than vertical erosion

and aggregate deposition was three times greater than aggregate erosion.

Weathering is the most extensive process producing shale plates which are subsequently removed by mass wasting, wind transportation and surface water erosion. Soil creep, slumping and gullying are confined to till slopes in the upper reaches of the Watershed; talus shift, wind erosion, debris fall and basal undercutting predominate on the shale screes and free face banks.

Within the Watershed, log cribs and rip raps are the most effective bank protection methods. Revegetation by willows is valuable in promoting shale stabilization. The sediment trap at the foot of the escarpment is not only a flood control device, but an efficient system for monitoring bedload.

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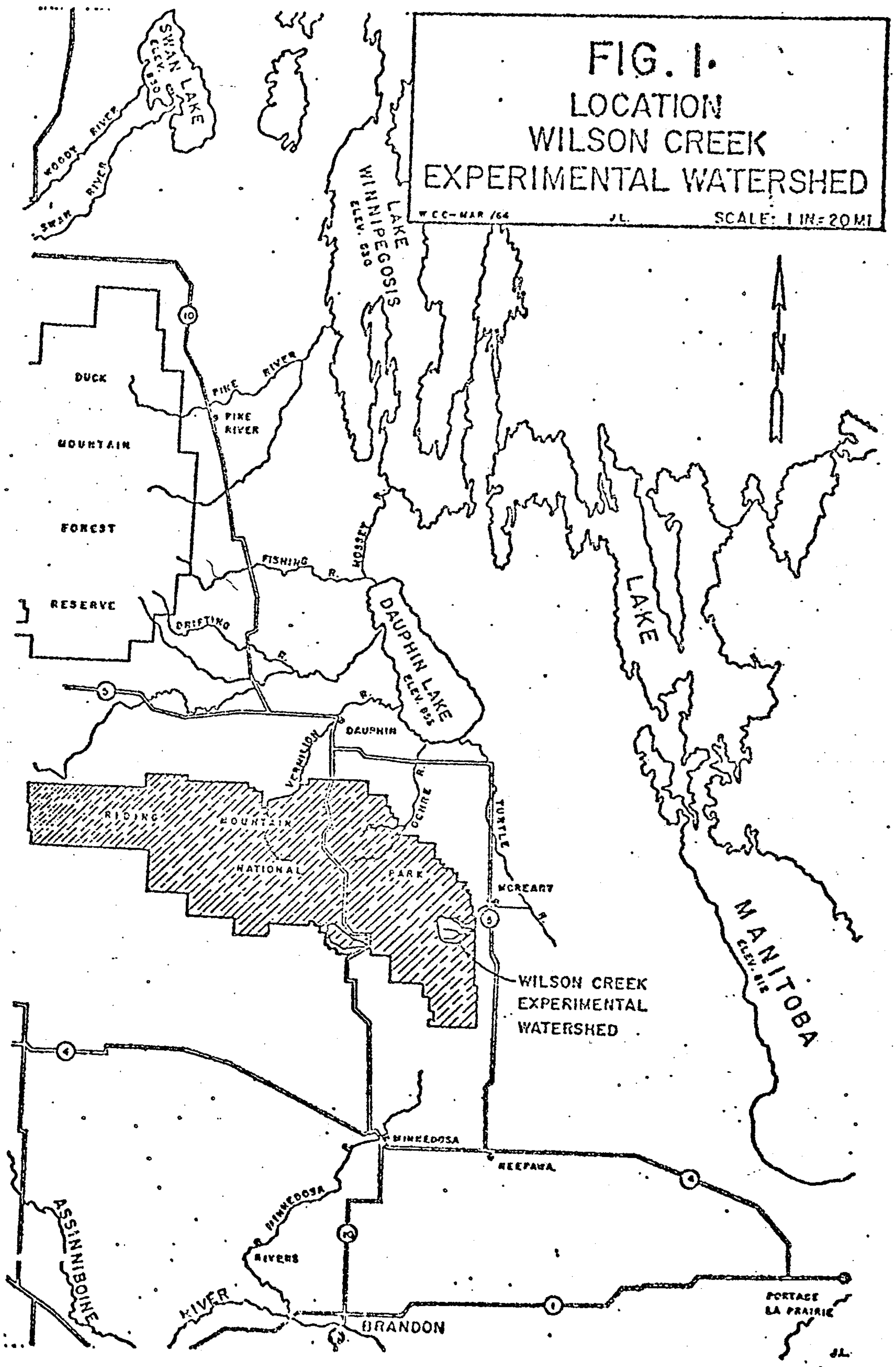
CHAPTER I

INTRODUCTION

Brief Description of Wilson Creek Watershed

Wilson Creek Watershed is located on the eastern slopes of Riding Mountain National Park, approximately five miles southwest of the town of McCreary, Manitoba (Fig. 1). The highest part of the Watershed is 2,400 feet above sea level, and covers an area of 8.1501 square miles (Fig. 2). It contains two main streams - Packhorse and Baldhill - which join to form Wilson Creek at the foot of the Manitoba Escarpment. For experimental purposes, the Watershed is arbitrarily defined from the foot of the Manitoba Escarpment, enclosing the area drained by Packhorse and Baldhill Creeks. As a geomorphic unit, Wilson Creek Watershed forms part of the headwaters of Turtle River which flows into Lake Dauphin, 853 feet above sea level. The Watershed is characterised by steep V-shaped valleys that cut 300-500 feet through shale bedrock (Fig. 3) leaving huge shale banks exposed to the agents of weathering, mass wasting and erosion (Fig. 4). Within the Watershed, in a distance of four miles, the main streams fall approximately 1,300 feet from the Manitoba Escarpment to the alluvial fan at the basin outlet. From there the land slopes to Lake Manitoba.



after McKay 1970

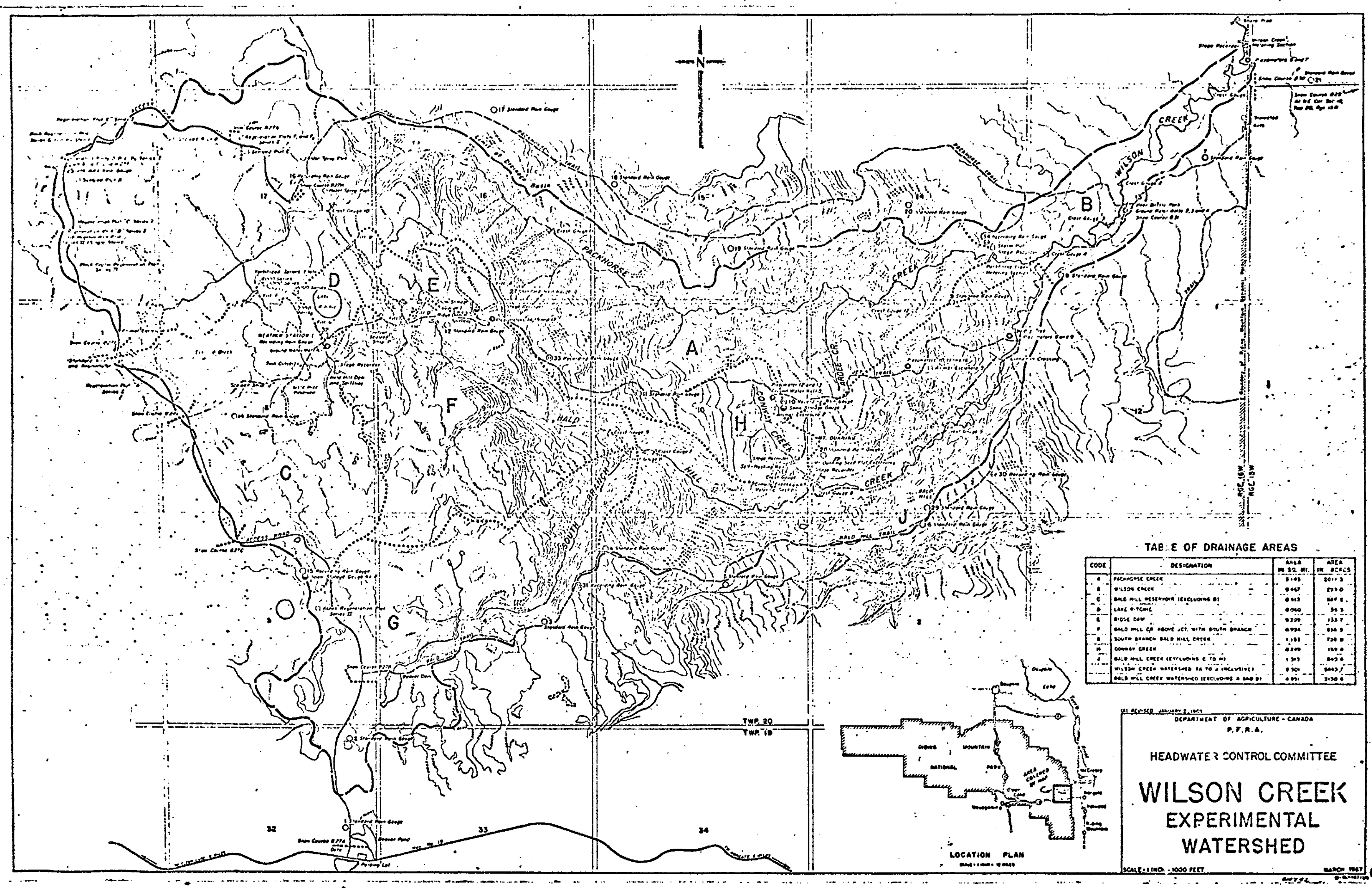

N
WILSON CREEK
PACKHORSE
BALD HILL
CREEK
SOUTH BRANCH
A
B
C
D
E
F
G
H
J
TWP. 20
TWP. 19
RGE. 16W
RGE. 15W
TABLE OF DRAINAGE AREAS
CODE
DESIGNATION
LOCATION PLAN
DEPARTMENT OF AGRICULTURE - CANADA
P.F.R.A.
HEADWATER CONTROL COMMITTEE
WILSON CREEK
EXPERIMENTAL
WATERSHED
SCALE: 1 INCH - 1000 FEET
MARCH 1967

Figure 2.

Figure 3. V-Shaped Valley Cutting Through Shale Bedrock.

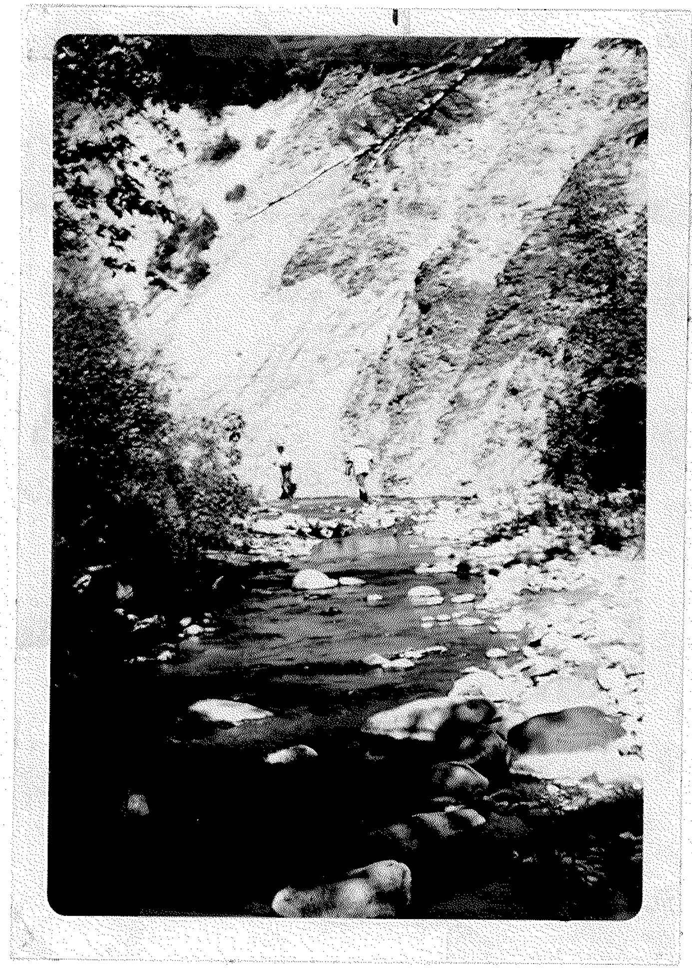


Figure 4. Shale Banks Exposed to the Agents of Weathering, Mass Wasting and Erosion.

Glacial till covers Upper Cretaceous shale bedrock of the Riding Mountain and Vermillion River Formations. The shales of the Riding Mountain Formation are hard and siliceous, characteristically medium to light grey (Wickenden, 1945).

Previous Research

To date, seven theses have been written on various aspects of Wilson Creek Watershed. Rosemary Cox (1968) investigated stream flow and ground water in the Watershed and found through chemical analyses that the ground water contributing to discharge is local and surficial in origin.

F. W. Schwartz (1970) investigated the geohydrology and hydrogeochemistry of the ground water of the Watershed. It was found that there is a downward hydraulic gradient characterized by transverse local and intermediate ground water flow patterns above Packhorse-Baldhill confluence and that ground water enters the surface water system east of the Watershed outside its boundaries.

H. G. MacKay's (1970) study is of more interest to the author, especially in his quantitative estimate of erosion and sedimentation within the Watershed as a geomorphic unit during the period since deglaciation. It was estimated that about 430 million cubic yards of material have been eroded from the Watershed during the period. This estimation was based on the assumption that northern and southern boundaries of the Watershed have not been eroded. Using sediment data for the period 1962-1970, MacKay calculated the average sediment load - suspended and bed - at the basin outlet, as 8.51 tons per day. From various estimates, MacKay concluded that over the past decade erosion rates were considerably less than previously.

M. Sydor (1970) constructed a mathematical model of Wilson Creek Watershed. "The model consisted of a computer program which uses rainfall and evaporation data as input and which produces hourly stream-flow hydrographs as output."[1] This model closely coincides with the actual recorded streamflow.

D. Cass (1970) investigated evaporative heat transfer over snow surfaces for the Watershed. The results of this research were compared with similar studies done by other researchers for different areas and it was found that the energy budget approach to snow melt cannot be used with confidence.

N. G. Banera (1972) used hydrometeorological data available for Wilson Creek Watershed as representative in estimating evapotranspiration along the Manitoba Escarpment.

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1. M. Sydor, "Computer Simulation Model of Wilson Creek Watershed" (Unpublished M.Sc. Thesis, University of Manitoba, 1970) p. 1.