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REPORT ON RECONNAISSANCE SURVEY OF EROSION ON BRULE RIVER

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At the request of Mr. A. D. Hasler, who is in charge of the Brule River Survey, E. F. Bean, State Geologist, M. F. Schweers, State Conservationist of the S.C.S., and O. R. Zeasman, Extension Soil Conservationist, made a hurried general survey of erosion along parts of the Brule, a few of its tributaries, and a few sample farms of the valley on April 28 and 29, 1944. Following are the more important observations, conclusions and recommendations:

As in the case with several other streams rising in northern Wisconsin, the Brule River does not have the characteristics of a "normal" stream with its gradient a curve which is flattest near the mouth and increases in steepness toward the headwaters, nor a broad valley with low banks near the mouth and a narrow valley with higher banks in the headwaters.

The Brule rises in the marshy bottom of a mile-wide trench 100 feet below the level of the sandy Barrens. The marsh is so flat that the divide between the Brule and the St. Croix is indistinguishable. In the upper half of its course, the streams flows in a broad, flat valley. The stream banks are low, stream velocities are moderate, and soil materials are course enough to resist movement. Because of the sandy drainage area, the runoff is light and the stream is fed in large measure by springs. For these reasons native vegetation has permanent possession of the banks and helps stabilize them. No particular erosion problem is present in this portion of the stream above the ranger station.

The lower Brule valley has the appearance of having been carved by a younger stream. The valley from near the ranger station to Lake Superior is narrow. The stream has cut a narrow, deep gorge in the Superior clay, leaving high, stee banks adjacent to or close to the stream. The only trap outcrops in the river are about a mile above Johnson's bridge. Sandstone exposures are numerous along the river from Johnson's bridge to Lake Superior. These outcrops act as dams which check stream velocity and reduce bank cutting. The gradient of the stream is much steeper than in the upper river. Sharp bends are common. This combination of swiftly flowing water in a meandering gorge of clay material produces stream bank erosion and murky water.

A number of points at which stream bank erosion is now very active were examined in some detail. The one on the west side of the river just below the Johnson bridge was particularly active. Here the stream has a velocity in excess of 8 feet per second. This swift stream makes a sharp bend at the foot of a high clay bank and undermines it because this soft material cannot offer sufficient resistance to prevent removal. Layers or extensive lenses of sand occur between beds of clay at considerable depths below the surface. These serve as under-drains for the lateral movement of the water that has percolated through the overlying clay, and produce landslides that add volume to the material dumped into the stream by stream bank erosion. The raw bank at this point is nearly 300 feet long and up to about 25 feet high. The bank on the inner side of this bend is aggrading and has advanced some 50 to 75 feet into the old stream bed. This bar, which is covered with alder brush, will continue to grow in extent as the river cuts away the clay bank on the outer side of the bend. The meander is not likely to mend itself

but will probably get worse and more extensive before the river shifts position and leaves this band as an oxbow pond. A local resident testifies that at this particular point stream bank erosion has been active for some 25 years.

Attached is a list of 29 banks where erosion is conspicuous at the present time. At other points, the actively eroding portions of the bank are of small extent now but conditions are such that greater activity is probable in the future. Some banks were noted where erosion had been active in the past but are now dormant or semidormant. These may become active at some future time.

Probably trees and brush were at one time growing on these banks that are now actively eroding, but erosion started because some accident disturbed the delicate balance. Bank erosion ceases when (1) the bank is cut back so far that stream velocity is lost, (2) the stream is deflected away from the bank or (3) boulders concentrated from the glacial drift form a riprap protection. When, for any reason, cutting is no longer active, the bank gradually assumes the angle of repose and vegetation forms a protective cover. But with active landslides, such as exist at the Johnson bridge bank, rather substantial structures are required.

Deflecting wing dams would be the cheapest solution for stabilizing the bank, but would cause filling of the deep hole by sedimentation and might cause active cutting on the opposite bank. Riprap, properly placed, could be used to stabilize the bank approximately as is. The cost of such protection would probably be about $1000 or more for such a bend as that at the Johnson bridge. Another remedy that might be applied at lower cost is a very low head dam (perhaps the creation of rapids with boulders) just below the active bends with the object of slowing down the velocity at the bend sufficiently to reduce the cutting of the banks. Careful examination and surveys would be necessary before this remedy could be recommended.

It is probable that stream bank erosion on the lower Brule has been active for centuries. In fact, the degree of activity is probably less now than it was some centuries ago when the gradient was even steeper than it is now and the gorge was narrower.

EROSION RESULTING FROM MAN'S ACTIVITIES

Roads built and maintained for access to the stream and to accommodate farmers and the traveling public are a fruitful source of sediment contributed to the lower Brule River and its tributaries. The topographic feature that amplifies this damage is the fact that the river lies in a narrow, deep valley and its tributaries have steep gradients and also flow in narrow valleys. This means that all roads and their adjacent ditches frequently have steep gradients directly to the streams. Spring thaws and every rainfall of more than very moderate intensity produce enough runoff down the roads and road ditches to cut gullies and carry much of the sediment directly into the streams.

The solution for this type of problem will have to be varied to accommodate the site. But the principle on which all of them are based is to provide some erosion resistant conduit to carry the water from the high level down to the level of the water in the stream. This may range from such a simple thing as a grassed waterway to the more complex and expensive structures, such as a series of low concrete or masonry notched dams, reinforced concrete or culvert pipe flumes, or even drop inlets. Such protection will add to the cost of construction but will greatly reduce maintenance. It is essential that the public using the highways and the river, as well as the officials responsible for highway construction and maintenance, be informed as to the damage being done by highways.

FARMING NOT MAJOR OFFENDER

Farm operations could create a problem from two sources: (1) Produce increased runoff, (2) carry on farm operations or pursue a type of agriculture that would produce excessive soil loss. In an effort to evaluate these factors, a half dozen farmers were interviewed with the following results. These 6 farms contained 457 acres. 177 acres were in hay, 25½, in grain, and 1 acre in intertilled crops. Pasture consisted of 63 acres open and 289 woods, part of which was rented. The livestock population was not dense. It consisted of 5 horses, 41 cows, 24 heifers, 7 calves, 4 bulls, and 62 sheep. Only limited amounts of lime and commercial fertilizers have been used. None of the cleared land appeared to be steeper than 3% and most of it was flatter. Approximately 7/8 of the field area was devoted to hay crops and almost all of the balance to grain. Such land use on the topography found here causes but little, if any more, soil and water loss than under the virgin forest cover. The only places at which some soil may be put into suspension are farmyards, cattle lanes, drives, and perhaps an occasional dead furrow. This would be an almost negligible percentage of the total sediments that are carried into the stream.

CONCLUSIONS

1. Stream bank erosion is the major source of the objectionable sediment in the lower river.

2. This phenomenon has been going on for centuries before settlement by man because of the steep gradients and fine-grained, easily erodable material that composes the banks.

3. Control of stream bank erosion would require riprap or low dams to check velocities at critical points. Either measure would be expensive.

4. Runoff from highways and the gullying in unprotected road ditches are the principal secondary sources of sediment. Cost of control measures would be justified by the saving in maintenance.

5. Farming is moderate in extent and of a character that does not contribute much excess runoff nor sediment to the stream.

RECOMMENDATIONS

1. Stream bank protection ought to be tried only on an experimental scale, testing both riprap and low dams.

2. An aggressive effort to control the highway erosion problem can be justified and might be accomplished by assigning a qualified individual to the area.

Conspicuously eroded banks along the river
(determined by photo examination)

(From Brule River Report of John W. Thomson)

T.49N.,R.10W. Sec. 15 - SE corner of NW¼ - back from river a little vegetation on top. West bank.
- center of SW corner of NE¼ - narrow slip-bank; vegetation on top near base. West bank.
- SW corner of NW¼ of SE¼ - very large, directly on river. Along west bank.
- South side of N½ of SE¼ - long slip bank on N side of river. (This is generally east shore.)

Sec. 22 - SE corner of NE¼ of NW¼ - small incipient slump begun.
- NW¼ and NE¼ of SE¼ - 2 small eroded faces along river.
- SW¼ of SE¼ - one long slump.

Sec. 27 - NW¼ of NE¼ - no slumping but bad wash near cultivation on top of both banks. There is very bad erosion observed from ground along the road cuts on both sides of the river. This is a non-through township road. Is it a privately maintained road?

Sec. 34 - West side of NE¼ of NE¼ - bad slump.
- East side of NW¼ of NE¼ - bad slump.
- NE corner of SW¼ of NE¼ - incipient slump.
- East side of NE¼ of SE¼ - 2 bad slumps just below Hwy. 13 bridge. The south one is very severe.

T.48N.,R.10W. Sec. 3 - NW corner of SE¼ - large slump. West side river.
Sec. 10 - NE¼ of SE¼ - incipient slump. East side river.
- NW¼ of SE¼ - very bad slump. West side river.
- SW¼ of SE¼ - severe slump.

Sec. 15 - NW¼ of NE¼ - west bank - slump.
- SW¼ of NE¼ - west bank - small slump.
- NW¼ of SE¼ - west bank - very large slump.
- SE corner of SW¼ of SE¼ - very severe slump just below N. P. Johnson's bridge. West bank.

Sec. 23 - NW¼ of SW¼ - incipient slump. Vegetation near river. West bank.
- SE¼ of SW¼ - slump bank, vegetation line along river. East bank.

Sec. 26 - NE corner of NE¼ of NW¼. Slump with line of vegetation along river. East bank.

Sec. 35 - South side of NW¼ of SE¼ - slump bank.

T.47N.,R.10W. Sec. 2 - SW¼ of NE¼ - 2 very large slumps.
- East side of NE¼ of NW¼ - large severe slump.

Sec. 14 - SE¼ of SW¼ - by Yale's cottage. (Does not show from air.)