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# Riverbank erosion and ground-water conditions at Beaver, Alaska

By

Roger M. Waller

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# AT BEAVER, ALASKA

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## INTRODUCTION

An investigation of riverbank erosion and ground-water conditions at Beaver, Alaska, was made by the writer on June 12 and 13, 1957, at the request of the Alaska Rural Development Board. The purpose of the investigation was to determine whether further riverbank erosion might threaten the village, and to locate a ground-water supply at the new village site.

The small fur-trapping village of Beaver is on the Yukon River about 110 miles north of Fairbanks, Alaska, and 14 miles south of the Arctic Circle. It lies near the western end of a large, broad lowland known as the Yukon Flats.

The village is being threatened by bank erosion caused by the river. Riverbank erosion upstream from the village appears to have progressed at an alarming rate in recent years. ~~Location of proposed new~~ Relocation of the village is being considered.

At present the villagers use the Yukon River for their water supply. It is desired to obtain a ground-water supply at the new site in order to obtain water of better physical and sanitary quality than the present supply.

## PHYSICAL SETTING

The village is situated along the north bank of the complexly braided and meandering river. (See fig. 2). The river is broad and has several channels. The many abandoned meanders and numerous islands and gravel bars attest to the migratory character of the river. A low alluvial terrace, upon which the village is located, is the only other major topographic feature. The higher parts of the alluvial terrace are reported to be about 20 to 30 feet above the low river stage. These higher parts are usually the only areas that remain unflooded during the annual ice-breakup of the Yukon River.

At the time of the writer's visit the level of the river was about 15 feet below the top of the bank at the village. The recent flood and ice breakup of the Yukon River had crested about 5 feet below the top of the bank.

Exposures in the river bank at the village show about 4 to 6 feet of silt overlying gravel. A storage pit in the village, dug about 100 feet from the bank, reportedly was in gravel at a depth of 22 feet. Williams[1/] indicated that gravel was exposed to river level, $17\frac{1}{2}$ feet below the terrace, about half a mile downstream from Beaver. The river level at that time reportedly was the lowest in more than 40 years.

At the upstream end of the village the land surface is about 3 to 8 feet lower than the top of the riverbank in front of the village. This low land is an abandoned and partially filled meander channel of the river. Silt, sand and organic material are exposed in the bank above river level. Gravel underlies this layer near the village. Much of this low area, about half a mile long, was being actively eroded by the river at the time of the investigation.

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1/ Williams, John R., 1955, Observations of freeze-up and break-up of the Yukon River at Beaver, Alaska: Jour. Glaciology, v. 2, no. 17, p. 491, [illegible].

Beaver lies within the zone of discontinuous permafrost (perennially frozen ground).[2] Perennially frozen materials are found at depths of 1½ to 10 feet in most places in the Yukon Flats area. The thickness of the permafrost at Beaver is unknown; however, a test hole at Fort Yukon 60 miles to the east reportedly went out of the permafrost at 320 feet.

Near the river the ground is thawed by the relatively warm river water. The ground is thawed along the river in front of the village, and in one location at the site of the dug pit mentioned previously, the thawed zone extends at least 100 feet from the river. Water is reported to seep into the pit during spring floods. The gravel and the overlying silt are apparently thawed to varying depths and distances from the river's edge. Several shallow pits dug further away from the river bank are reported to have encountered frozen ground within 5 feet of the surface. In the fresh exposures along the actively eroding bank upstream from the village the silt is frozen.

## River bank Erosion

River-bank erosion progresses rapidly as the river thaws and removes the thawed material at and below river level. The frozen material above is undercut and huge blocks of material slump into the river. Williams[3] concludes that the process of undercutting is greatly accelerated by wind-generated waves on the river.

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2/ Hopkins, D. M., Karlstrom, Thor N. V., and others, 1955, Permafrost and ground water in Alaska: U. S. Geol. Survey Prof. Paper 264-F, p. 116.

3/ Williams, John R., 1952, Effect of wind-generated waves on migration of the Yukon River in the Yukon Flats, Alaska: Science, N. S., v. 115, no. 2993, p. 519-520, May.

It seems likely that the greater erosion of the bank upstream from the village is due to one or more of the following reasons: (1) the character of the material differs from that at the village, (2) the river current is directed against that portion of the bank, (3) the vegetation may be less effective in binding the soil and subsoil.

More rapid erosion because of an increase in river current appears to be a factor also. The villagers reported, and maps indicate, that a gravel bar is exposed at lower river level opposite the actively eroding bank (fig. 1). This bar is approximately a third of the way across the main channel and downstream from an island. The gravel bar undoubtedly divides and directs a portion of the current toward the north bank. Leopold and Wolman,[4/] in their summary of braided rivers, conclude that after deposition of a gravel bar in a river, the current is deflected against the banks of the channel causing them to be eroded. The villagers reported that the summer low flow of the river around the gravel bar and against the bank is more destructive than the flood flow when the bar is not exposed. Williams (1952, p. 520) concludes that wind-generated waves from the southwest are a very effective erosive agent on the north bank of the Yukon River during the summer. Hence, it appears that current and wave action are combined to form a more effective erosion agent.

Differences in types of vegetation also may have some effect on rates of erosion along the bank. It was noted that the vegetation in the village area consisted of birch, willow, and aspen, whereas in the areas of rapid

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4/ Leopold, Luna B., and Wolman, M. Gordon, 1957, River-channel patterns, braided, meandering, and straight: U. S. Geol. Survey Prof. Paper 282-B, p. 53.

erosion, which are also the poorly drained areas, black spruce and muskeg are generally predominant. However, evidence is too meager to indicate if the vegetation is a contributing factor in the rate of erosion.

In summarizing the causes of the increased erosion upstream from the village it appears to the writer that the predominant cause is probably the presence and enlargement of the gravel bar in the river which is directing a part of the current against the bank.

It would appear that, as the gravel bar grows downstream, bank erosion would progress downstream also. The presence of the higher, thawed, better drained land at the village would appear to the writer to deter the rate of erosion; however, it would not stop the downstream progress of the bank erosion entirely.

Another factor which could deter the erosion would be a change in the river channel. The abandoned meander at the upstream edge of the village (see fig. 1) extends for about 5 miles to the northeast. The upstream end of this partly filled meander is about 100 feet from the bank of the Yukon river and the bank at that point is being eroded. It is possible that if, and when, a flood cuts into this old meander the river will reoccupy the meander. The current produced from this side channel would undoubtedly remove, or retard the growth of, the present gravel bar in the main channel, thus halting the present riverbank erosion. However, the new channel would most likely create new erosion problems along its bank near the village.

The new village site (see fig. 1) picked by the villagers would appear to be the least likely area to undergo river erosion in the near future. Subsurface conditions would be similar to those in the present village area.

## Water Supply

A water supply probably can be obtained from a well or wells along the riverbank. Thawed gravel adjacent to the river and below low-river level should yield water to driven well points. Wells also could be driven below the bank, even though they would be subject to annual flooding. In such a case, the pump could be removed prior to the flood and reinstalled afterwards, if the well is still there. The relatively minor cost of a well point and some 30 feet of pipe would make loss of a well inconsequential. Dug wells in the Beaver area would most likely be flooded and ruined each year unless protected by a heavy, and possibly expensive, structure.

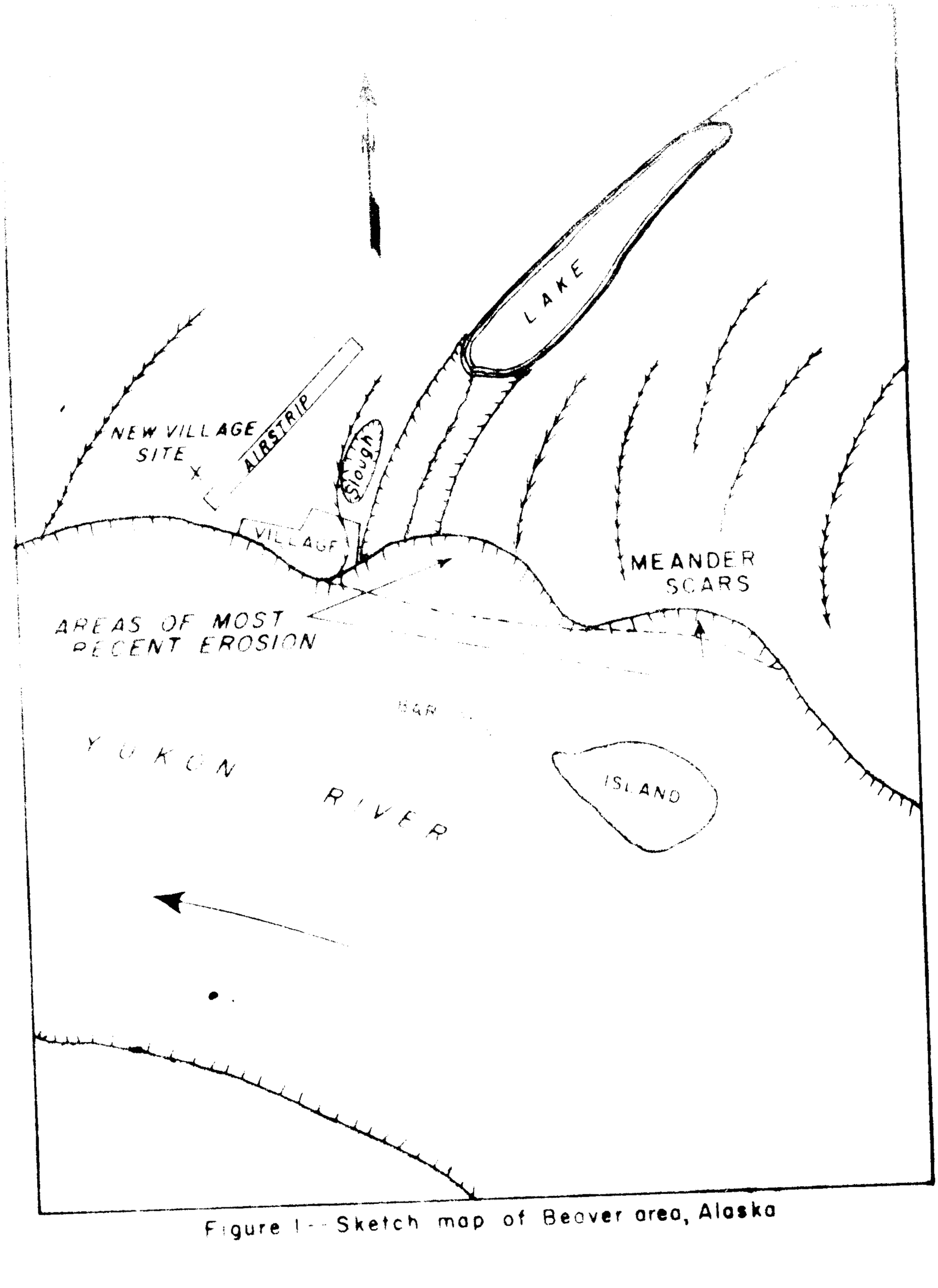


Figure 1-- Sketch map of Beaver area, Alaska