

**TETRA TECH, INC.****MEMORANDUM**

TO: Brenda Kerr, Plan Formulation, Alaska District Corps of Engineers
FROM: Bill Fullerton, Senior Hydraulic Engineer; Ridge Robinson, Program Manger
SUBJECT: **October 21, 2003 Matanuska River Trip**
DATE: November 10, 2003

Trip Report, Matanuska River Bank Erosion Inspection near Palmer, Alaska
October 21, 2003

This letter documents the observations and conclusions concerning the current status of bank erosion processes along portions of the left bank of the Matanuska River from below the Old Glenn Highway to 2,000 feet downstream of Circle View Estates. The purpose of the site visit was to inspect the river and provide an opinion as to whether bank stability conditions had changed noticeably since the field inspections conducted one year ago as part of the "Expedited Reconnaissance Study of Matanuska River Erosion, Matanuska-Susitna Borough, Alaska - 905(B) Reconnaissance Report" (Prepared by Tetra Tech, Inc. for the Alaska District).

The site visit was conducted on October 21, 2003. Participants in the site inspection were Brenda Kerr (USACE, Alaska District), Robert Scott (Matanuska-Susitna Borough, Project Manager), Ridge Robinson (Tetra Tech, Senior Planner) and Bill Fullerton (Tetra Tech, Sr. Hydraulic Engineer). During the site visit, three primary areas along the left bank of the Matanuska River were visited. These were the dike along the left bank in the area of Ye Old River Road, the setback levee along the old Glenn Highway and the area around Circle View Estates. The latter area, was the primary focus of the trip. The Alaska District had indicated they had received concerns from local entities that the potential erosion conditions may be getting worse adjacent to the four installed spur dikes. Observations from each of the three areas are discussed below.

Dike near Ye Old River Road

This dike protects a low-lying area along the Matanuska River from flooding and erosion. The dike is riprapped and is elevated several feet above the floodplain on the backside of the levee. The dike parallels the river along the left bank. A gravel berm perpendicular to the dike and the Matanuska River has been constructed at the upstream end of the dike. This berm provides vehicle access and also prevents overbank flows from circumventing the dike.

Erosion at the upstream end of the dike has resulted in about 100 feet of bank recession. This erosion, if unchecked, could result in the dike being flanked. Although the gravel berm perpendicular to the levee may be able to hold back low velocity overbank flows, it would not withstand direct flow impingement in the event erosion results in the main channel impinging on the berm. The Borough is addressing this situation by extending the dike further upstream to protect the area that is currently eroding.

There are various locations along this dike in which the riprap is being scoured from the toe and portions of the dike have eroded. In the areas with the most severe damage, about half the roadway on top of the

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dike has been lost. The Borough is also addressing this situation and has also contracted to have the dike repaired at the same time the dike is extended further upstream.

At the downstream end of the dike, the bank is also receding from erosion. There is at least one house that is adjacent to this area of active erosion. The Borough indicated that the current dike repair contract would not address this area.

The Borough indicated the total repair and dike extension costs for the planned work are on the order of \$100,000.

Old Glenn Highway Setback Levee

Further downstream from the Ye Old River Road dike, but upstream of Bodenburg Butte, a levee several thousand feet long has been constructed adjacent to the Old Glenn Highway. The levee is parallel to the Matanuska River and is setback approximately 1,000 feet from the river. The dike prevents flood flows from the Matanuska from taking a path along the roadway and over to the Knik River. Records indicated the dike was first constructed in the 1940s, and improved after it was breached in the 1971 flood.

The levee ties into higher ground at its upstream end and into bedrock at the downstream end. The levee is not armored and is intended to hold bank low energy floodplain flows, but would not withstand direct impingement by the river. If the Matanuska River would migrate over to the dike, this could result in failure of the dike. However, this level of erosion is not expected in the near future. In the past 60 years erosion along this section of river at any point has not exceeded 400 feet and in most locations has been less than 200 feet. Additionally, the downstream end of the levee has a bedrock outcrop that extends nearly perpendicular out to the Matanuska River. This outcrop will tend to deflect the main flow of the Matanuska and decreases the likelihood of channel migration extending to the levee.

It is important that the levee along the Old Glenn Highway remain in place, so that a portion of the Matanuska River does not have the opportunity to cut a channel across the area adjacent to Bodenburg Butte and to the Knik River. The current measures appear to be sufficient for this purpose assuming the levee is constructed to withstand the force of ponded water behind it. Erosion rates of the Matanuska in this area have historically been slow and the 1,000 feet of separation between the river and the levee provides an adequate buffer. In the event that the distance between the river and the levee is reduced to on the order of 500 feet or less, then serious consideration to protect the levee or prevent the Matanuska River from migrating much further should be taken.

Circle View Estates Area

This area extends from the location where Bodenburg Butte Road takes a 90 degree turn and riprap is stockpiled, downstream past Circle View Estates and to the location where the Matanuska River takes a sharp bend to the left and flows to the Knik River. This area includes the four spur dikes constructed in 1992. Inspection of the area around the spur dikes was the primary purpose of the site visit. Photo 1 shows the spur dikes viewed from Bodenburg Loop Road. From this photo, it can be seen that the main flow at the time of the site visit missed spur dikes 1 and 2 (numbering the spur dikes from upstream to downstream, thus, spur dike 1 is the most upstream of the four), but impinged on spur dike 3 then continued to make an arc toward the bank and across the tip of spur dike 4.

The current flow and deposition patterns in the area of the spur dikes are depicted in Photos 2 through 8. The current area of concern is between spur dikes 3 and 4, where the flow arcs between the dikes and

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flows along the toe of the bank for a short distance (Photo 4). The flow was not impinging along the bank between any of the other spur dikes nor immediately upstream or downstream of the spur dikes. However, because of the braided, constantly shifting nature of the Matanuska River, the situation that currently exists between spur dikes 3 and 4 could exist between any of the other pair of dikes in the future and has likely existed in the past.

Inspection of the spur dikes indicated that all four had riprap eroded from the nose. This results in shortening of the dikes and also reduces the effectiveness of the dikes in deflecting the flow away from the banks. The Borough indicated that it is planning to repair the dikes and have funded on the order of \$50,000 for this purpose. In general, the Borough indicated that annual maintenance expenses for the spur dikes typically falls between \$50,000 and \$70,000 per year.

It appears that the spur dikes have been effective in protecting the banks between the dikes and for several 100 feet upstream and downstream of the dikes for over 10 years. However, the dikes have required considerable maintenance. Based on the historic performance, it appears that the dikes are spaced just close enough together to prevent significant flow from impinging on the banks between the spur dikes. When the dikes are damaged, their effectiveness is reduced and flows have the opportunity to impinge upon the banks, as is starting to happen between dikes 3 and 4. The alignment of the flow approaching spur dike 3 is adding to this problem, since the flow is cutting across the river corridor at an angle of about 45 degrees and impinging directly on spur dike 3.

If the spur dikes are to remain effective in this area, then they need to be maintained to their original design configuration. This includes restoring their length and the rounded nose or bulb at the end of each dike. Based on conversations with the Borough representative, the cost of doing such maintenance has been expensive. This illustrates the difficulty and expense associated with trying to control a glacial fed braided river in a broad valley through placement of riprap.

The areas of bedrock outcrops downstream of the spur dikes were inspected. Photo 9 shows the two primary outcrops.

Conclusions

Based on the site visit, it appears that there is a potential for bank erosion to be initiated between spur dikes 3 and 4. This is a result of the combination of the present main channel alignment with spur dike 3 and the damage to the noses of spur dikes 3 and 4 (Note: Spur dikes 1 and 2 have experienced similar damage, and would be susceptible to similar conditions if the main channel would shift to their locations.). Because of this situation, maintenance is required on all four spur dikes if they are to continue to be effective in controlling bank erosion.

However, no conditions were observed that would change the conclusions from the earlier study "Reconnaissance Study of Matanuska River Erosion" (USACE 2003), that placement of additional protection along the Matanuska River would be economically feasible. In fact, the current situation illustrates the considerable maintenance that is required in addition to the initial construction costs to maintain the effectiveness of any bank protection measures.

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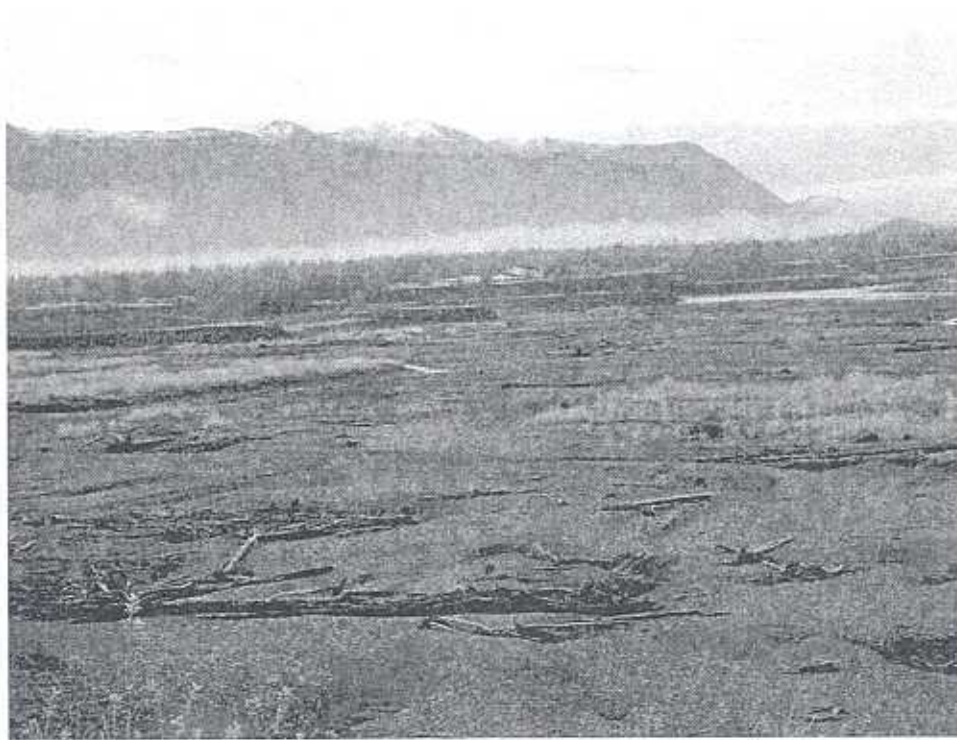


Photo 1 – Looking downstream toward the Circle View Estates Spur Dikes from Bodenburg Loop Road, all four spur dikes in the photo.

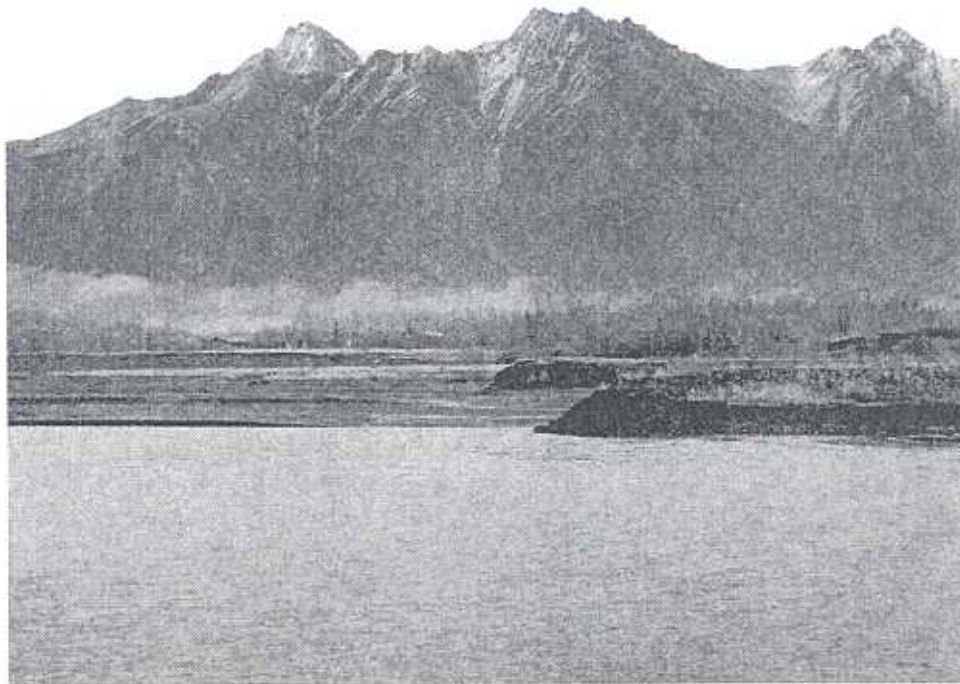


Photo 2 – View looking upstream at dike 3 from dike 4, flow impinges on nose and is partially deflected.

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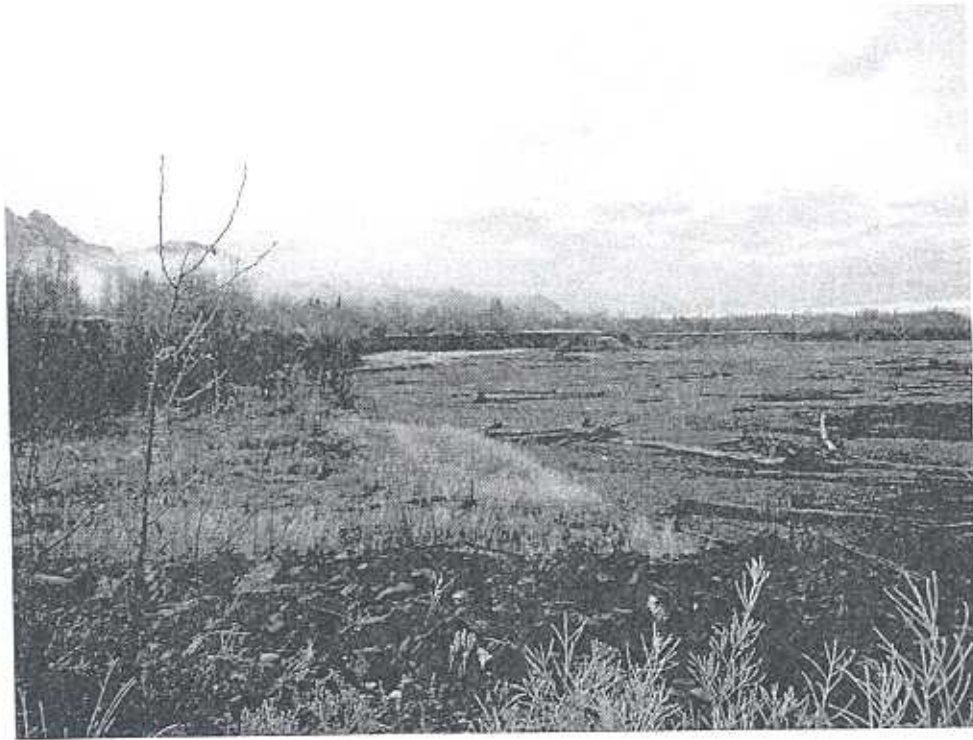


Photo 3 – Looking downstream from spur dike 4, flow is currently deflected away from bank, though dry river bed extends to bank approximately 400 feet downstream of the spur dike.



Photo 4 – View looking upstream from spur dike 4 at area where low flow impinges on bank between spur dikes 3 and 4

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Photo 5 – Looking downstream from spur dike 2 at spur dikes 3 and 4.



Photo 6 – Looking downstream at spur dike 2 from spur dike 1.

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Photo 7 – Looking downstream at area between spur dikes 1 and 2 from spur dike 1, higher vegetated deposits indicate main flow has not recently reached the bank in this area

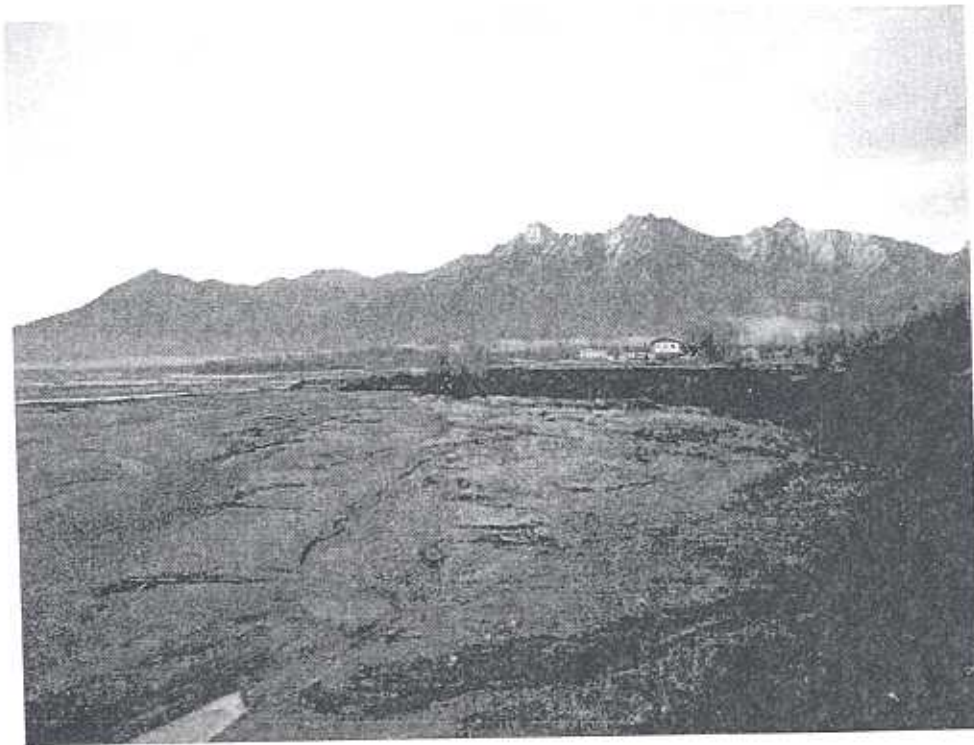


Photo 8 – View looking upstream from spur dike 1.

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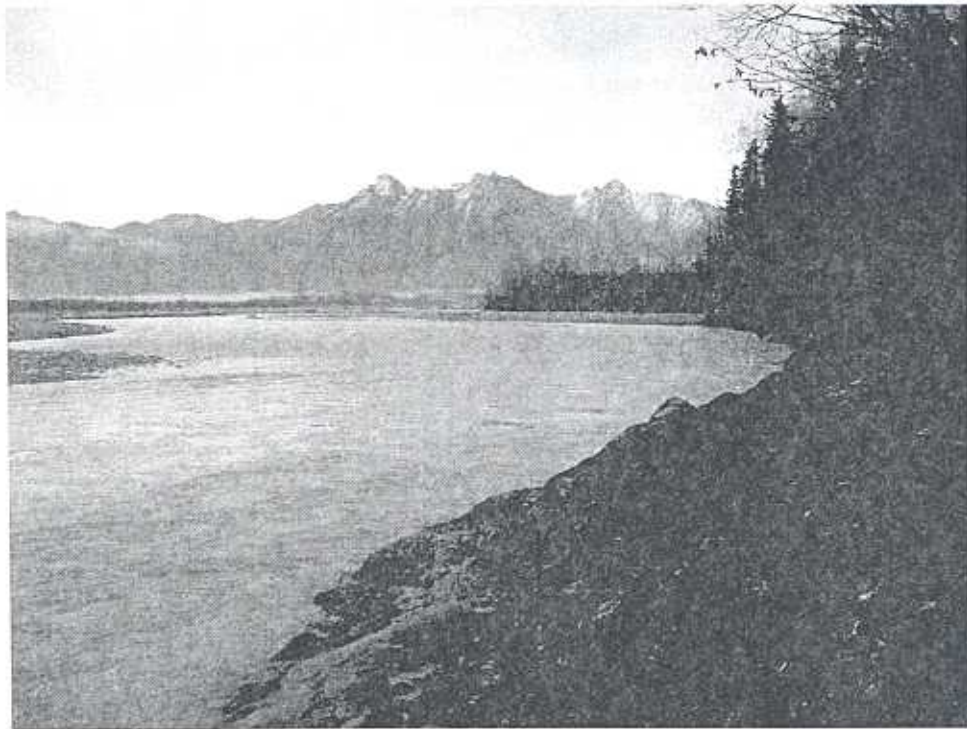


Photo 9 – Looking upstream from downstream bedrock outcrop toward upstream bedrock outcrop below Circle View Estates.