# How the Kwigillingok River has Changed Over Time

## Kuigilnguq, AK

**Bacus, J**
**Kwigillingok School Jr/HS Math and Science Teacher,**
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## Introduction

**Introduction**

The Village of Kuigilnguq, AK lies along the Kwigillingok River located at longitude 59º 52" 22', latitude 163º10"01'. Topography and aerial maps were collected along with many shape files of buildings and other community structures. The goal of this study is to collect data of the river's meanderings over the past two years. The focus is going to be on one particular structure, houses that might be in the path of river changing course, and trying to predict if the owners will need to move their house and if so, when.

**Fig. 1** Map of Alaska showing Kuigilnguq, AK, taken from the LKSD website @ lksd.org.

## Materials and methods

Topographical and aerial maps were collected from George Plumley at the Department of Commerce Community Advocacy in Anchorage, AK obtained by Kathy Smikrud. I contacted P. DeSmit from Lower Kuskokwim School District and obtained similar files. Using the internet I obtained other topographical maps and data. Aerial photographs taken in October 2005 where used for ground reference.

2002 and 2004 aerial and topographical maps were overlaid for comparison using ArcGIS. Shape files where created of the outline of the river from a 2002 USGS landsat map and transposed onto 2004 aerial photography. Using the measurement tool in ArcMap measurements where taken of changes in the course of the river and placed in an Excel spreadsheet. Boundary lines of contours of 30 feet and 60 feet were placed around the 2002 river outline.

Fig. 2 Map of Kuigilnguq, AK showing the difference in the river from 2002 to 2004.

## Data analysis

The data was collected over 20,130 feet of Kwigillingok River starting at the mouth of the river and the Bering Sea. The village of Kuigilnguq is located 4,286 feet from the mouth of the river and extends 15,594 feet along the river. The greatest width changes in the river occur along this stretch of the river.

**Kwigillingok River Widths 2002 vs. 2004**

Starting at the mouth of the river and following it Northwest from the Bering Sea

| 2002 Topography Map | 2004 Aerial Map | Difference | Features |
|---|---|---|---|
| 226 | 319 | 93 | Sewer Lagoon |
| 191 | 307 | 116 | Sewer Lagoon |
| 225 | 333 | 108 | Sewer Lagoon |
| 284 | 350 | 66 | Sewer Lagoon |
| 238 | 319 | 81 | Slough |
| 248 | 262 | 14 | Sewer Lagoon |
| 224 | 314 | 90 | Marina |
| 237 | 342 | 105 | Marina |
| 258 | 312 | 54 | Marina |
| 235 | 360 | 125 | Marina |
| 209 | 402 | 193 | Pond |
| 220 | 322 | 102 | Pond |
| 396 | 461 | 65 | Pond |
| 338 | 437 | 99 | N. Edge of new housing |
| 313 | 369 | 56 | New housing |
| 265 | 337 | 72 | New housing |
| 337 | 379 | 42 | New housing |
| 337 | 343 | 6 | New housing |
| 428 | 446 | 18 | S. Edge of new housing |
| 597 | 633 | 36 | Slough |
| 372 | 410 | 38 | Pond |
| 499 | 488 | -11 | Dock |
| 388 | 479 | 91 | Cluster of housing |
| 422 | 473 | 51 | Two houses |
| 422 | 422 | 0 | House |
| 608 | 681 | 73 | Mouth of the river |

Table 1. **Kwigillingok River Widths 2002 vs. 2004**

Fig. 3 Core sample May 2007

## Results

The Yup'ik translation of Kuigilnguq is "No River". According to elders the legend passed down is that the village was located at a spot where there was no river, but over time one was formed when a man dug a trench to retrieve a necklace lost by his daughter at the edge of a lake. The lake emptied out and formed the river that the village is located along. Villagers state if you travel to the end of the river that you will find the lakebed that formed the river.

The Kwigillingok River flows in a southeasterly direction towards the Bering Sea along with sloughs it drains the tundra on either side of the village and further northwest. The river is subject to daily tides that over time have caused the river bank to erode and change direction. The river flows through tundra vegetation and the soil Is silt for at least a depth of 70 feet calculated from a recent core samples taken in the village by the school located 1400 feet from the river in May 2007. The permafrost in this core sample was 18" below the surface and continued for 60 feet before the sample becomes slushy. The silt was permanently frozen with tiny ice crystals sparsely located throughout the sample at 60 feet. No core samples were taken closer to the river.

As you travel up the river from the Bering Sea no noticeable difference in the width of the river can be seen. However, as you approach the village the river undergoes shifting and width changes. I was thought that I would see the greatest changes along areas where structures where located within 60 feet of the river. However, there is currently no structures located that close. The closest feature is a pond that is parallel with the new housing on the west side of the river. Here the difference in the width is 193'. At this point the pond is located on 126' feet from the river and is at its widest point on the pond. The next greatest difference in width occurred where there was no structure or features. I did notice that the river was changing directions at these points however. The next width difference of note worthy was at the cluster of houses, where the closest house is less than 100 feet from the river.

Fig. 34 Widest widening of the river at 193 feet.

Pond parallel with new housing

## Conclusions

The Kwigillingok River lies within the Yukon Delta National Wildlife Refuge. The Soil is over 60 feet deep with silt and approximately 40 feet of that is discontinuous permafrost starting at about 18 inches below the surface. This permafrost is easily disturbed so housing in the village of Kuigilnguq is supported up off the ground by stilts to keep the house from warming the ground causing the permafrost to melt. This has little effect on the permafrost as houses are known to tilt with the summer thaws and are realigned in the winter months. It is no wonder that the river running along these structures are experiencing widening at levels greater than other parts of the river.

The greatest widening of the river occurred near the pond that was parallel to the new housing subdivision across the river. This area of housing has a lot of stress on it and the combination of the pond is adding even more stress as permafrost lies deeper under unfrozen bodies of water in the tundra and extend this trend beyond the boundaries of the water edge.

The next noticeable widening of the river that occurred within a close proximately of a structure was the cluster of older houses that lie within 100 feet of the river's bank. These houses are situated within close proximity of one another and are not lifted as far up off the ground as the newer housing. They are also located closer to the river's edge than any other structure or feature. They are a concern to the village planner and occupants as they are trying to find a time and place to move them. As this can only be done in the winter months, this makes for quite the production.

## Literature cited

Geography of Alaska, Dr. K. Leslie, UAF
Living with the Coast of Alaska, Mason, Neal and Pilkey

AVETA Report, US Army Corps of Engineers, http://www.alaskaerosion.com/files/AVETA%20Report%20-%20Compressed.pdf

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### For further information

For more information please contact *jennifer_bacus@lksd.org* *Kwigillingok School* website is at *www.lksd.org/kwigillingok*