

**Community Erosion Assessment
Kwethluk, Alaska
26 January 2009**

1. Community: Kwethluk, Alaska



Figure 1: Kwethluk Location & Vicinity Map

2. Community Profile Summary:

Kwethluk, (KWEETH-luk), is a second class city of 696 people located at the junction of the Kwethluk and Kuskokwim Rivers. It is 12 air miles east of Bethel, and 384 miles west of Anchorage. Snowfall in Kwethluk averages 50 inches, with total precipitation of 16 inches per year. Temperatures range from -2 to 62 degrees Fahrenheit; extremes have been recorded from 86 to -46 degrees. The Kuskokwim is typically ice-free from mid-June through October.

3. Concise Description of Erosion Problem:

Kwethluk is experiencing erosion along the majority of its waterfront. For the purposes of this study, the bank was divided into four adjacent parts spanning from a point upstream of the community to approximately the city offices. The following paragraphs describe these reaches starting with the furthest upstream, and moving downstream.

Reach 1 is a 1,225 foot length of bank that borders the upstream edge of the community. It is eroding at an average rate of 2.3 feet per year. Reach 2 is defined as the 660 feet of bank immediately downstream from the first. It includes the primary residential area along the upstream end of the community and ends near the fuel farm. It is eroding at an average annual rate of 5.0 feet. Reach 3 is comprised of the next 1,640 feet of bank between the upstream fuel farm and the revetment is eroding at an average rate of 2.5 feet per year. Reach 4 stretches from the revetment to a point near the city offices. It is 1,580 feet long and has an average erosion rate of 2.3 feet per year.

There have been past erosion control efforts at Kwethluk. Most notably, a Fabriform revetment was constructed by FEMA around 1990. It is currently protecting several homes but is actively eroding. The community has also completed several home relocations.

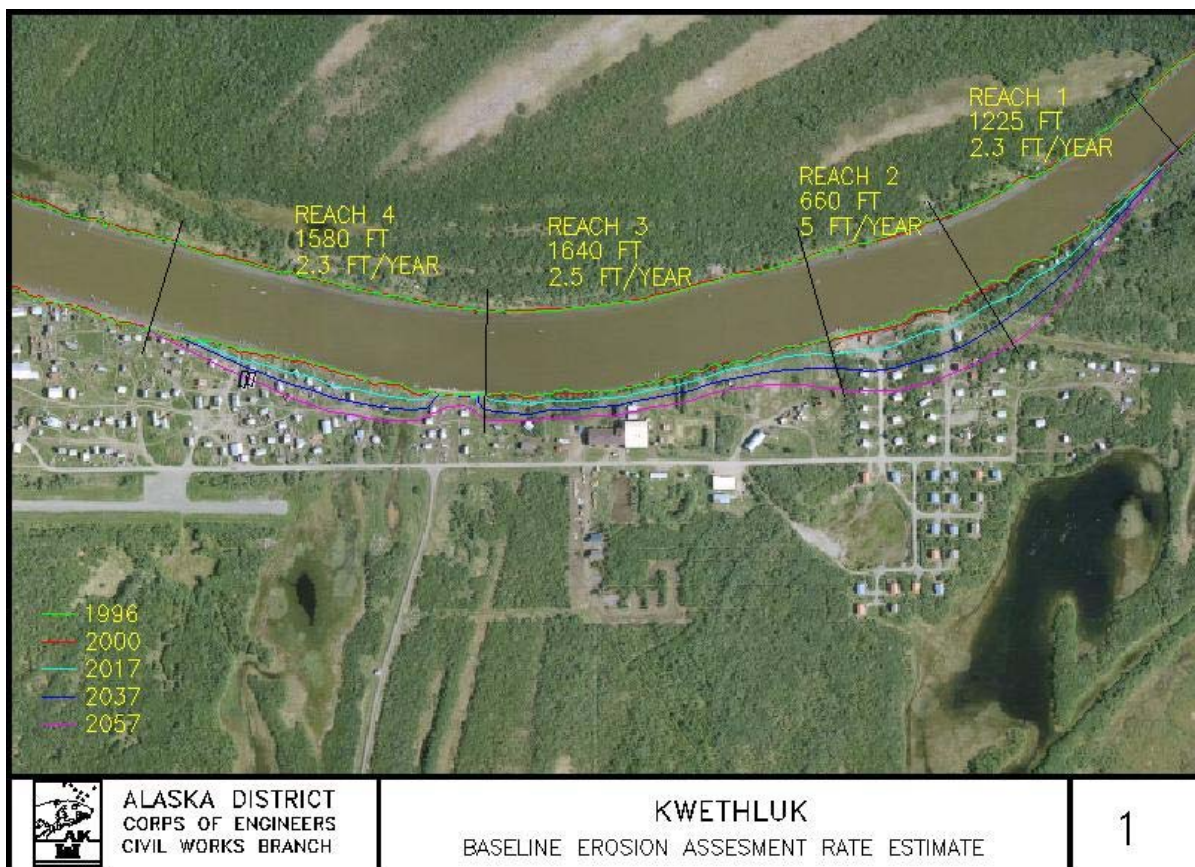


Figure 2. Kwethluk Erosion Map

4. Potential Erosion Damages

Using the projected erosion interval lines on the aerial photograph, the economic damages were developed for the 50-year period of analysis and broken down into the sub-intervals of 0-10 years, 11-30 years and 31-50 years. Breaking down the economic damages into these sub-intervals allows us to determine when the greatest economic impact is expected to occur. Determining when the greatest economic impact could

occur is important so that timely decisions can be made when an erosion retarding measure needs to be taken. For the purposes of this report, damages were assessed by time interval rather than attempting to estimate the exact year that the damage occurs. The analysis was completed in this manner to try and account for two types of uncertainty:

1. That which is associated with predicting erosion which is progressing at varying rates over time (including episodic events); and
2. That which exists when performing a surface analysis as opposed to doing an in depth investigation such as soils exploration and expensive modeling efforts.

Damage Categories

The approach used to determine potential erosion damages is based on several assumptions as they pertain to the damage categories of residential, commercial, public infrastructure, and land values. This evaluation relies on previous reports and information gathered during site visits to determine appropriate values where data was unavailable. Assumptions used for the various damage categories are described more fully in the following discussion of future damages.

Damages caused by erosion in Kwethluk fall into five damage categories: land, residential structures, commercial structures, public structures, and infrastructure. Structures were considered a loss once when the bank line encroached within ten feet of a structure's foundation. Approximately 28 percent of erosion damages in Kwethluk are expected to occur within the first 10 years of the examined time period.

Expected Damages

The period of analysis for this evaluation is 50 years and all damage categories have net present values calculated based on the federal fiscal year 2009 discount rate of 4 5/8 percent. The sections below detail expected losses with a summary provided in Table 1.

Kwethluk is losing approximately 13,900 square feet of land per year, or 0.32 acres. Estimated losses by river reach are: 3.30 acres from Reach 1, 3.86 acres from Reach 2, 4.80 acres from Reach 3, and 4.25 acres from Reach 4. It is expected that 16.22 acres will be lost over the 50-year period of analysis with a corresponding value of \$162,000 and a net present value of \$65,000.

Expected residential damages in Kwethluk are spread out along the entire community. There are 29 outbuildings, including fish camps and related structures, and 30 residences at risk within the 50-year period of analysis. Each of the outbuildings is valued at \$1,000 and each residence, including its contents, is valued at \$205,000.

There is one commercial building at risk of erosion in Kwethluk over the 50-year period of analysis. It is a communications hub with an associated microwave tower owned and operated by United Utilities. The communications station is estimated to have a value of approximately \$1,800,000 and a net present value of \$508,000. This represents an average annual loss of about \$26,200. These figures likely understate the commercial damages caused by erosion in Kwethluk. Were these structures to be lost, it could compromise the income earning opportunities for the businesses and relocation efforts could impact the earnings of the owners and employees.

Six public buildings are at risk in Kwethluk over the 50-year period of analysis. They are located in the Reaches 3 and 4. Four of these are associated with the school and the other two are thought to be meeting halls.

Total expected structural damage in Kwethluk for the 50-year period of analysis are expected to be \$9.6 million with a net present value of \$3.1 million and an average annual loss of about \$161,200.

Kwethluk has the following infrastructure at risk: 27,780 feet of roads (including the old and new barge landings), 11 utility poles with associated power and phone lines, 670 feet of boardwalks, 100 feet of water lines, a well, a water treatment facility, two fuel headers, a fuel storage tank and the existing Fabriform revetment.

In total, Kwethluk has \$17,837,000 of infrastructure at risk of erosion with a net present value of these items is \$8,747,000 and an average annual loss of \$451,600.

Fuel tank farms and solid waste sites are subject to erosion and pose additional problems when threatened. Allowing contaminants to flow into the river could cause harm to the community's fish stocks. The cost for this process is \$515,000 and a net present value of \$55,000 with an average annual loss of \$2,800.

Summary

Total erosion damages in Kwethluk over the 50-year period of analysis are \$28.1 million with a net present value of almost \$12 million and an average annual value of \$618,800. Table 1 summarizes the expected damages by category.

Table 1: Summary of Total Expected Damages.

Damage Category	Quantity	Time Span (Years)			Total value (50 years)	Net Present Value	Average Annual Value
		0-10	11-30	31-50			
Land	16.22	\$ 35,000	\$ 64,000	\$ 64,000	\$ 162,000	\$ 65,000	\$ 3,200
Residential	30	1,241,000	2,061,000	2,883,000	6,185,000	2,286,000	117,100
Commercial	1	--	1,800,000	--	1,800,000	508,000	26,200
Public buildings	6	--	749,000	866,000	1,615,000	347,000	17,900
Infrastructure	--	6,640,000	4,553,000	6,643,000	17,837,000	8,747,000	451,600
Environmental hazards	--	--	--	515,000	515,000	55,000	2,800
Total Damages		\$7,916,000	\$9,227,000	\$10,971,000	\$28,114,000	\$11,990,000	\$618,800

5. Potential Solutions:

An articulated concrete revetment could be constructed from the fish camp at the eastern end of the community and extend downstream approximately 3,350 feet to the existing fabriform revetment. The upper bank would be laid back and gravel fill would be used to create a uniform two to one slope along the bank. A separation geotextile fabric would then be placed over the gravel fill with a nine inch articulated concrete matt placed upon this fabric. The toe of the articulated matt would be placed six feet minimum below the existing channel bed to prevent undercutting of the matt. Gravel would be backfilled over the toe of the matt to provide scour protection. Approximate cost would be \$10.1 million or \$3,000 per linear foot.

6. Conclusion:

Kwethluk has a definite erosion problem that is affecting the community over the next 50 years. The community has the potential to have approximately \$28 million in damages.

Kwethluk will require some sort of assistance to stop the erosion from causing significant damages as they are unable to solve their own erosion problems due to limited financial resources.

7. Community Photos:



N 60° 48.766' W 161° 24.771'

Kwethluk

RIMG0012

Photo 1: Bank access near a fish smokehouse in Reach 1.



N 60° 48.727' W 161° 24.909'

Kwethluk

RIMG0021

Photo 2: Looking downstream in Reach 2.



Kwethluk

RIMG0059

Photo 3: Looking upstream at Reach 3.



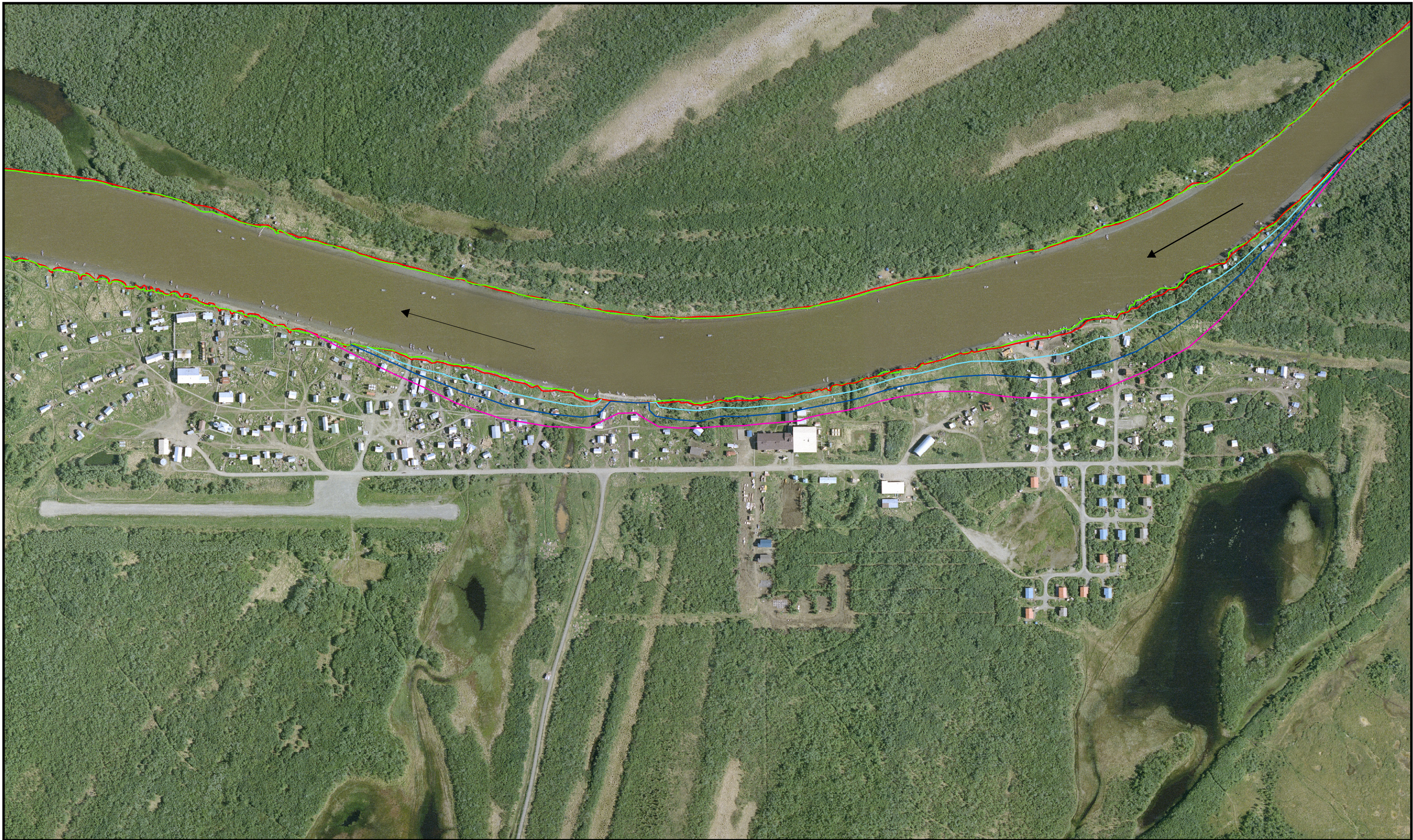
Kwethluk

RIMG0071

Photo 4: Looking upstream from bank in Reach 4. The bank here is highly vegetated.

8. Additional Information:

This assessment, as well as those for other communities, can be accessed on the internet at www.AlaskaErosion.com. The web site also contains additional information on addressing erosion issues, educational materials, and contact information.



Alaska District
Corps of Engineers
Civil Works Branch

Predicted and Historical Shorelines

Legend

1996	2017	2057
2000	2037	



0 220 440 880 Feet
0 70 140 280 Meters
1 inch equals 400 feet
Image dated 2000



Alaska Baseline Erosion
Kwethluk, Alaska