

**Community Erosion Assessment
Napakiak, Alaska
15 January 2008**

1. Community: Napakiak, Alaska



Figure 1: Napakiak Location & Vicinity Map

2. Community Profile Summary:

Napakiak is a 2nd class city of 378 people in the Bethel Recording District of the Unorganized Borough. It is 15 miles southwest of Bethel on the north bank between the Kuskokwim River and Johnson's Slough. Napakiak is influenced by storms in the Bering Sea and also by inland continental weather. Average annual precipitation is 16 inches, with 50 inches of snowfall. The Kuskokwim River is typically ice-free from June through October. The city's population is predominantly Yup'ik Eskimos who live a fishing and subsistence lifestyle. Napakiak is a dry community which means the sale or importation of alcohol is banned.

3. Concise Description of Erosion Problem:

Erosion rates along the Kuskokwim River measured in the 1960's and 1970's show the river bank eroding at approximately 40 feet per year. Erosion rates for the next 50 years are estimated to continue at a rate of 25 to 50 feet per year. This will impact most of the community of Napakiak within the next 50 years. The soil is fine sand and silt allowing the river to easily undercut the riverbank. The loss of material causes a slope stability failure above the waterline in the riverbanks 3 foot vertical face. The sand and silt is also susceptible to pore pressure failure. The resulting saturation of the soil decreases its

strength below the waterline. With load above the waterline, the saturated soil is no longer able to support bank material causing bank failure similar to undercutting.

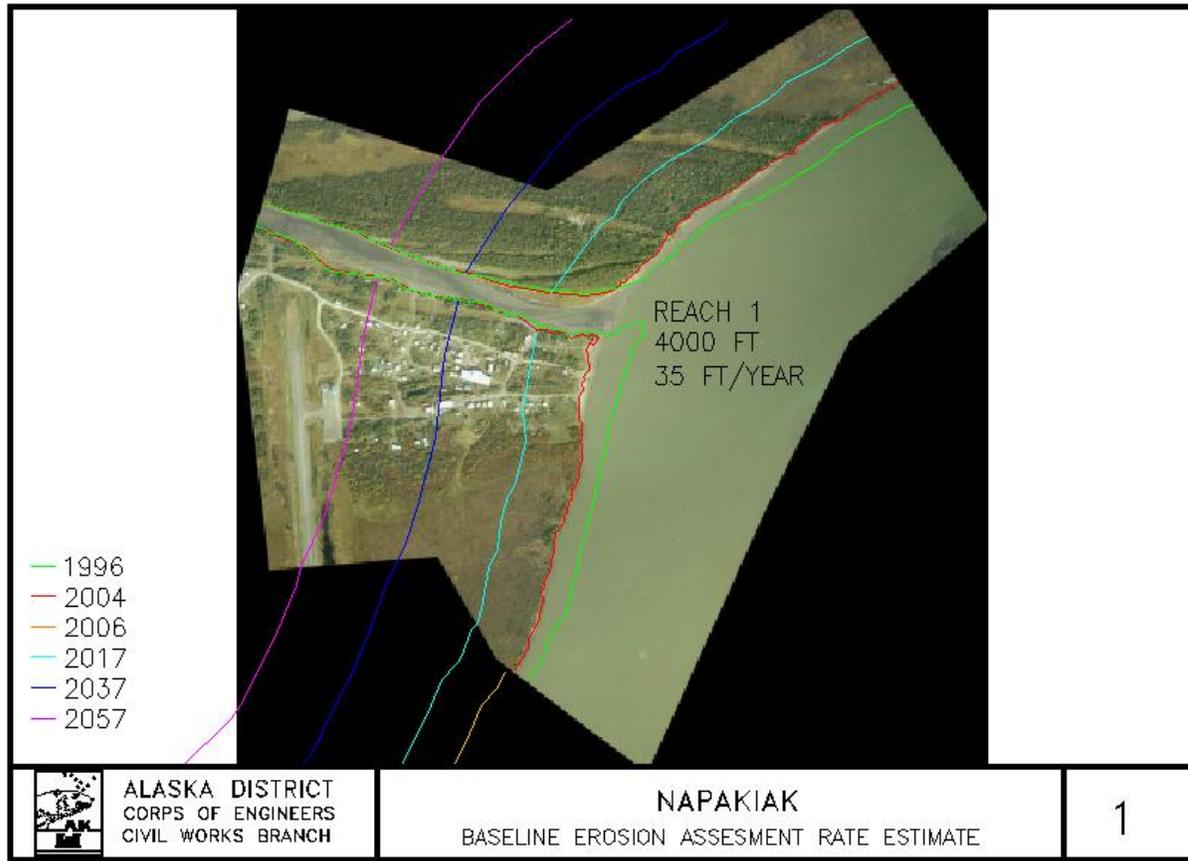


Figure 2. Napakiak Erosion Map

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 Napakiak fall into seven damage categories: land, residential structures, commercial structures, public structures, infrastructure, cemeteries, and environmental hazards. Approximately 8 percent of erosion damages in Napakiak are expected to occur in the first 10 years of the examined 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.

Napakiak is losing approximately 140,000 square feet of land per year (35 acres). It is expected that 164 acres will be lost over the 50-year period of analysis with a corresponding value of \$1.6 million and a net present value of \$655,000.

Expected residential damages in Napakiak are widely dispersed throughout the community. At-risk structures include 45 outbuildings (fish camps and related structures) and 41 residences. Each of the outbuildings is valued at \$1,000 and each residence is valued at \$205,000.

Eight commercial buildings are estimated to be subject to damages including: two retail stores and an associated outbuilding and warehouse; the village power plant, the marina, a Quonset hut, and one unidentified commercial structure. These buildings are expected to be lost in years 11 to 50. Our estimates likely understate the commercial damages. Were these structures to be lost, it would compromise the income earning opportunities for the businesses and the residents they employ and relocation efforts would impact these facilities as well. In addition, communications for the community would be lost.

Twenty-eight public buildings are at risk in Napakiak including various buildings associated with: the National Guard Armory, school, fire station, water treatment plant, city offices, city garage, teacher housing, washateria, IRA council building, and various outbuildings.

Expected structural damages in Napakiak are \$30 million with a net present value of \$10.5 million.

Infrastructure that lies within the 50-year erosion profile includes: 5,390 feet of roads, 7,500 feet of boardwalks, 2 wells, 4,110 feet of water lines, 750 feet of sewer lines, 2 fuel

headers, various bulk fuel tanks with approximately 310,000 gallons of capacity, 37 utility poles and related wiring, the sewage lagoon, and the airstrip.

Total infrastructure damages in Napakiak are \$44.8 million with a net present value of \$12 million.

Environmental concerns in Napakiak are: the old fuel farm, the sewage lagoon, and erosion of grave sites. Decommission and closure of the fuel farm will be essential to avoid harmful environmental effects. Based on our above assumptions, this will be necessary within the 0 to 10 year time frame. This process has a cost of \$2.8 million with a net present value of \$1.6 million. Decommission of the sewage lagoon has a cost of \$650,000 with a net present value of \$142,000. Estimates anticipate that 100 graves will need to be relocated over the 50-year period of analysis with a cost of \$750,000, and a net present value of \$91,000.

Environmental damages, environmental remediation, and grave relocation costs are estimated to be in excess of \$4.2 million with a net present value in excess of \$1.8 million and an average annual cost in excess of \$93,800.

Summary

Total erosion damages in Napakiak over the 50-year period of analysis are \$80.6 million with a net present value of \$24.9 million and an average annual value of \$1.3 million.

Table 1 summarizes the expected damages by category.

Table 1: 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 (acres) | 163.91 | \$354,000 | \$643,000 | \$643,000 | \$1,639,000 | \$655,000 | \$33,800 |
| Residential | 41 | 1,301,000 | 1,237,000 | 5,607,000 | 8,146,000 | 2,334,000 | 120,500 |
| Commercial | 8 | -- | 4,160,000 | 1,024,000 | 5,184,000 | 1,947,000 | 100,500 |
| Public buildings | 28 | -- | 15,165,000 | 1,495,000 | 16,660,000 | 6,186,000 | 319,400 |
| Infrastructure | -- | 3,842,000 | 10,377,000 | 30,543,000 | 44,762,000 | 12,000,000 | 619,600 |
| Cemetery relocation | 100 | -- | -- | 750,000 | 750,000 | 91,000 | 4,900 |
| Environmental hazards | -- | 903,000 | 1,936,000 | 650,000 | 3,490,000 | 1,722,000 | 88,900 |
| Total Damages | -- | \$6,400,000 | \$33,518,000 | \$40,712,000 | \$80,631,000 | \$24,935,000 | \$1,287,600 |

5. Potential Solutions:

Non-structural solutions include relocating structures away from the riverbank and constructing a road from Napakiak to Bethel. A road would provide ready access to the high ground on the north side of Johnson Slough and assist the community in relocating structures to areas not threatened by the Kuskokwim River. Constructing a road requires a planning process to determine a useable alignment with reasonable grades. A survey of potential alignments and subsurface investigation is needed to determine the required

amount of fill to protect the tundra from permafrost thaw. The road and bridge are estimated to cost \$63.6 million.

A revetment could be constructed to protect Napakiak from the Kuskokwim River. The revetment would be 10,000 feet long and 45 feet wide. Three feet of B rock would be placed over filter fabric to armor the river bank. The revetment cost is estimated at \$89.4 million which is roughly \$8,940 per linear foot of revetment.

6. Conclusion:

Napakiak has a definite erosion problem that is affecting the community over the next 50 years. The community has the potential to have approximately \$80.6 million in damages.

Napakiak 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:



Photo 1: Erosion along the bank of the Kuskokwim River.



N 60° 41.690' W 161° 57.979'

Napakiak

RIMG0036

Photo 2: Looking at the bank at what 50 feet of erosion looks like.



N 60° 41.654' W 161° 57.993'

Napakiak

RIMG0021

Photo 3: More bank erosion in Napakiak.



**Photo 4: The bank eroding and being carried away by the Kuskokwim River.
Erosion Rate Diagram**

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.



Kuskokwim River ←

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|--|--|---|--|---|--|
| | <p>Alaska District Corps of Engineers Civil Works Branch</p> | <p>Predicted and Historical Shorelines</p> <p>Legend</p> <p>— 1996 — 2017 — 2057 — 2004 — 2037</p> | | <p>0 215 430 860 Feet</p> <p>0 50 100 200 Meters</p> <p>1 inch equals 400 feet Image dated 2004</p> | <p>Alaska Baseline Erosion Napakiak, Alaska</p> |
|--|--|---|--|---|--|