Report of Investigation 2021-3 Napakiak

# EROSION EXPOSURE ASSESSMENT—NAPAKIAK

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Napakiak, Alaska, in 2021. Photo: Alaska Division of Geological & Geophysical Surveys.

Published by
STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS
2021

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State of Alaska
Department of Natural Resources
Division of Geological & Geophysical Surveys

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**Suggested citation:**
Buzard, R.M., Turner, M.M., Miller, K.Y., Antrobus, D.C., and Overbeck, J.R., 2021, Erosion Exposure Assessment of Infrastructure in Alaska Coastal Communities: Alaska Division of Geological & Geophysical Surveys Report of Investigation 2021-3.https://doi.org/10.14509/30672

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# EROSION EXPOSURE ASSESSMENT—NAPAKIAK

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## NAPAKIAK EROSION EXPOSURE ASSESSMENT

This is a summary of erosion forecast results near infrastructure at Napakiak, Alaska. We conduct a shoreline change analysis, forecast 60 years of erosion, and estimate the replacement cost of infrastructure in the forecast area. Buzard and others (2021) describe the method and guidance for interpreting tables and maps.

Source data for this summary include the following:

- Delineated vegetation lines and change assessment by Buzard and others (2021) following the methods of Overbeck and others (2020).
- Infrastructure AutoCAD outlines and metadata from Division of Community & Regional Affairs (2007) Community Profile Map series.
- Added infrastructure such as roads, power distribution lines, and buildings, delineated if visible in the most up-to-date high resolution (≤ 0.66 ft [20 cm] ground sample distance) aerial orthoimagery (Overbeck and others, 2016).
- Computed infrastructure cost of replacement based on square or linear footage from Buzard and others (2021).

Napakiak is located on the west bank of the lower Kuskokwim River. The slough that borders the community, Johnson Slough, is not included in the analysis because the shoreline change rates are near stable (Overbeck and others, 2020). Napakiak is located on a tidally influenced meander of the Kuskokwim River where the riverbank soil is undercut by the flow of water. In addition to channel


migration, coastal storm surge, spring breakup flooding, and wake from frequent barge traffic also contribute to erosion (U.S. Army Corps of Engineers [USACE], 2009). From 1952 to 2015, the highest erosion rates averaged 42 feet per year along the Kuskokwim Riverbank. The City of Napakiak (2018) reports that past erosion control and bank stabilization efforts have been largely unsuccessful. Documented relocation of infrastructure due to erosion began in 1986 (USACE, 2009), although the community has been relocating or losing structures prior, including the loss of the previous school by 1972. Efforts are ongoing to relocate remaining infrastructure (MacArthur, 2019).

We forecast erosion 60 years from the most recent shoreline (2019) at 20-year intervals to identify the exposure of infrastructure to erosion. All infrastructure fronting the airport are exposed to erosion through 2079 (tables 1–3; figs. 1 and 2). The bulk of erosion costs occur between 2019 and 2039 when the William N. Miller Memorial School and its facilities are in the erosion forecast area (table 2). Erosion is forecast to reach a significant amount of residential buildings and the community center that contains the washeteria and city offices by 2059 (table 3). More residential buildings, the airport, and the Napakiak Corporation tank farm are fore-

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**Table 1.** Quantity of infrastructure with estimated erosion exposure by linear footage (LF), square footage (SF), or count (n).

| Quantity of Exposed Infrastructure | | | | | |
|---|---|---|---|---|---|
| **Erosion Forecast Date Range** | **Buildings & Tank Facilities (n)** | **Power Lines (LF)** | **Water Lines (LF)** | **Roads (LF)** | **Airport (SF)** |
| 2019 to 2039 | 19 | 983 | 598 | 2,091 | 0 |
| 2039 to 2059 | 25 | 1,117 | 288 | 3,088 | 0 |
| 2059 to 2079 | 20 | 1,222 | 0 | 2,377 | 109,890 |
| Combined Total | 64 | 3,322 | 886 | 7,556 | 109,890 |

**Table 2.** Replacement cost of infrastructure exposed to erosion per 20-year interval.

| Cost to Replace Exposed Infrastructure | | | | | | |
|---|---|---|---|---|---|---|
| **Erosion Forecast Date Range** | **Buildings & Tank Facilities** | **Power Lines** | **Water Lines** | **Roads** | **Airport** | **Sum** |
| 2019 to 2039 | $41,525,900 | $196,500 | $239,100 | $836,400 | $0 | $42,797,900 |
| 2039 to 2059 | $13,050,000 | $223,400 | $115,000 | $1,235,000 | $0 | $14,623,400 |
| 2059 to 2079 | $8,450,000 | $244,400 | $0 | $951,000 | $9,123,300 | $18,768,700 |
| Combined Total | $63,025,900 | $664,300 | $354,100 | $3,022,400 | $9,123,300 | $76,190,000 |

**Table 3.** Cost estimate of exposed buildings and tank facilities by 20-year interval. The count of exposed residential or unspecified buildings is denoted in parentheses.

| Cost to Replace Exposed Buildings and Tank Facilities | | |
|---|---|---|
| **Erosion Forecast Date Range** | **Building Type** | **Cost of Replacement** |
| 2019 to 2039 | Residential (4) | $1,400,000 |
| | School Facilities (3) | $1,325,900 |
| | School | $35,000,000 |
| | Teacher Housing (7) | $2,100,000 |
| | General Store | $500,000 |
| | Unspecified (3) | $1,200,000 |
| 2039 to 2059 | Residential (14) | $4,900,000 |
| | Community Center | $4,000,000 |
| | Water Pump House | $500,000 |
| | CVRF Building | $700,000 |
| | Bingo Hall | $350,000 |
| | Unspecified (7) | $2,600,000 |
| 2059 to 2079 | Residential (15) | $5,250,000 |
| | Tank Farm | $1,500,000 |
| | Airport Maintenance (2) | $1,000,000 |
| | Unspecified (2) | $700,000 |

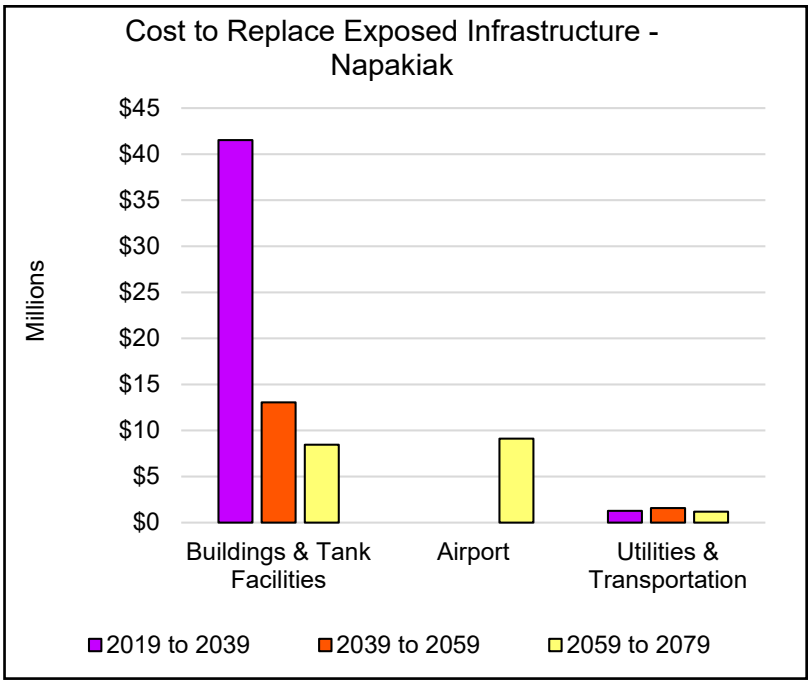


**Figure 1.** This figure summarizes the replacement cost of all infrastructure in the erosion forecast area. Twenty-year intervals are symbolized by color: purple represents the time interval 2019 to 2039, red represents 2039 to 2059, and yellow represents 2059 to 2079. The costliest erosion impacts to infrastructure are between 2019 and 2039 when the school is forecast to be impacted.

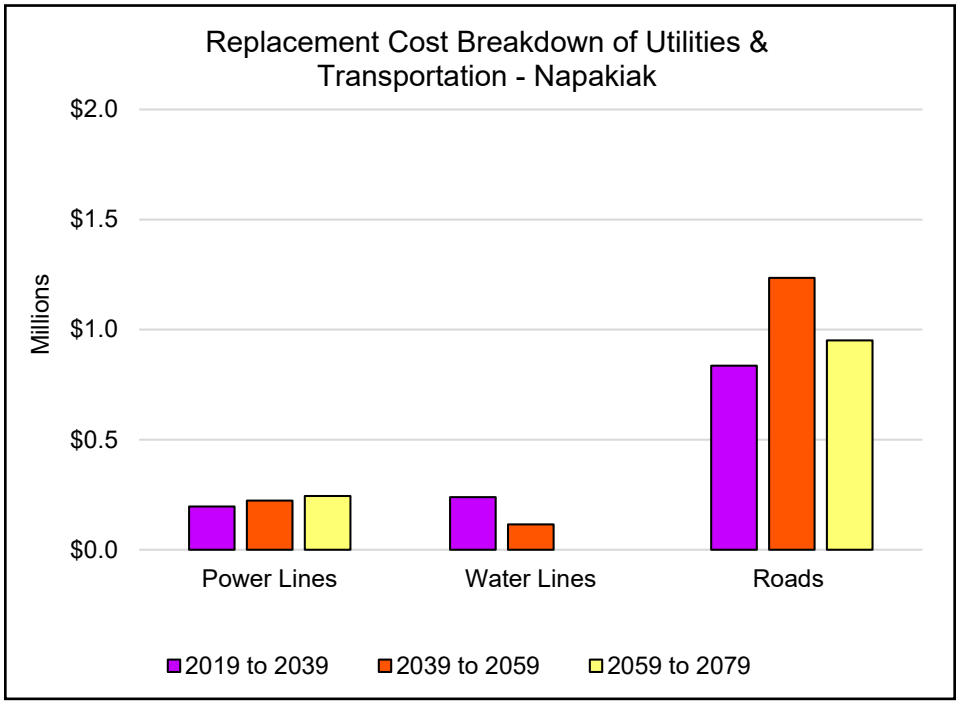


**Figure 2.** This figure breaks down the replacement cost of utilities and transportation infrastructure in the erosion forecast area. The greatest cost to utilities and transportation are the roads, costing $3.0 million over 60 years.

cast to be undermined by erosion between 2059 and 2079 (tables 1–3). The total estimated replacement cost of infrastructure exposed to erosion is $76.2 million (± $22.9 million) over the next 60 years (table 2; fig. 1). We did not estimate erosion exposure for fuel line infrastructure because the data were not available. Given the rapid rate of erosion in Napakiak and local efforts to relocate infrastructure, the infrastructure data near the shoreline in this report may be outdated.

## ACKNOWLEDGMENTS

This work was funded by the Denali Commission Village Infrastructure Protection Program through the project "Systematic Approach to Assessing the Vulnerability of Alaska's Coastal Infrastructure to Erosion." The community of Napakiak was not consulted for this report.

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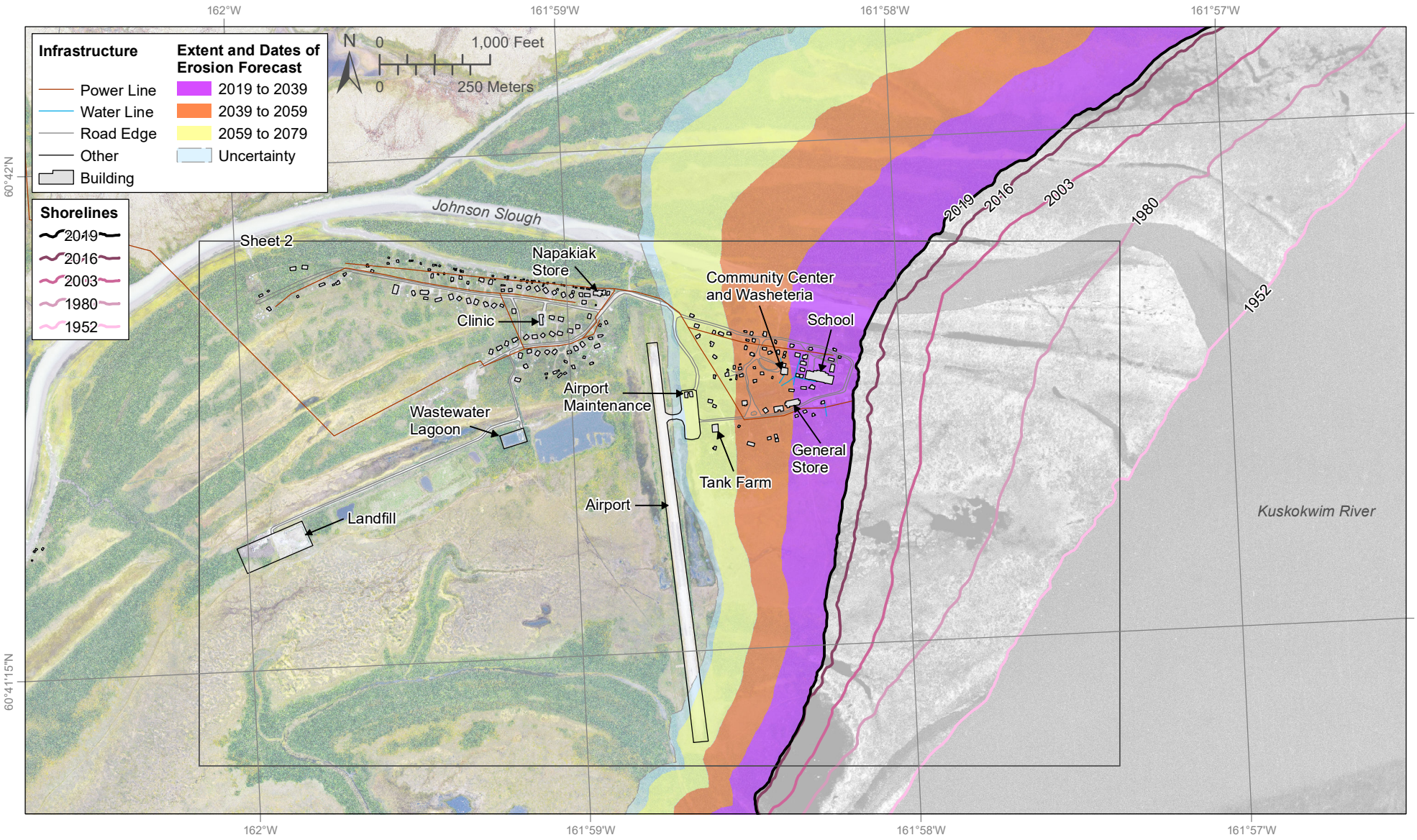
# Erosion Forecast
## Napakiak, Alaska

Report of Investigation 2021-3
Buzard and others, 2021
Napakiak, Sheet 1 of 2

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website: dggs.alaska.gov

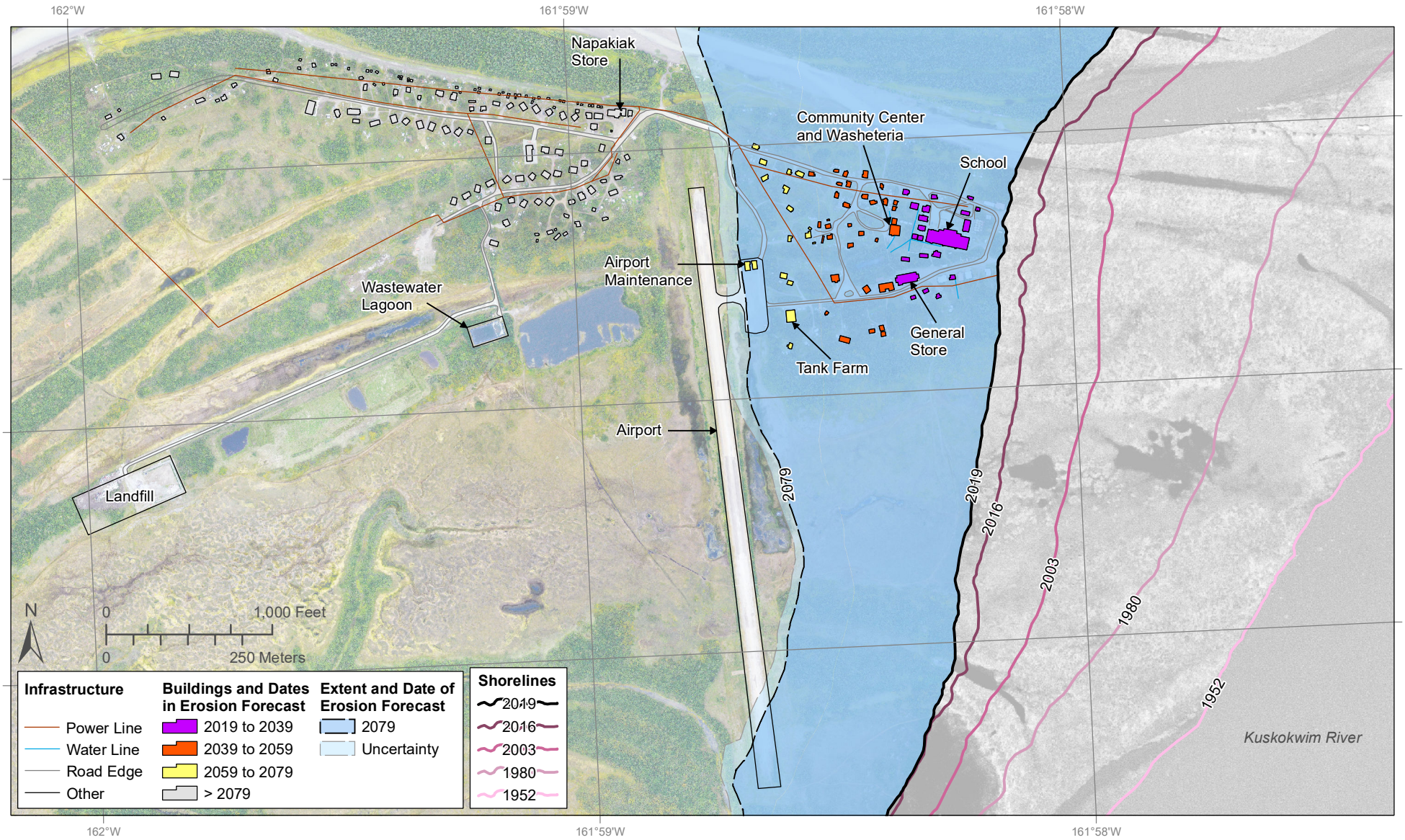
Projection: NAD83 UTM Zone 3N. Orthoimagery years: 2016 & 1952. Orthoimagery available from elevation.alaska.gov

Erosion and accretion of coasts and rivers result in shoreline change. These rates of shoreline change at Alaska communities are calculated from historical and modern shorelines (shorelines shown as lines in pinkscale and labeled by year). The long-term (1952 to 2019) shoreline change rate is used to forecast where erosion could impact community infrastructure. Erosion is forecast to reach the colored areas by specified time intervals: 2019 to 2039 (purple), 2039 to 2059 (orange), and 2059 to 2079 (yellow). The area of uncertainty of the 2079 shoreline at a 90 percent confidence interval is light blue. Areas that are not colored by time interval are not forecast to erode by 2079 based on the historical shoreline change rate. For more detailed information about the impacts to infrastructure from erosion at Napakiak, refer to the Napakiak erosion exposure assessment report.

*This work is part of the Coastal Infrastructure Erosion Vulnerability Assessment project funded by the Denali Commission Environmentally Threatened Communities Grant Program. Components of this map were prepared by the Alaska Department of Commerce, Community, and Economic Development (DCCED) using funding from multiple municipal, state, federal, and tribal partners. The original AutoCAD drawing of the infrastructure data layers was converted to ArcGIS.*

# Erosion Exposure
## Napakiak, Alaska

Report of Investigation 2021-3
Buzard and others, 2021
Napakiak, Sheet 2 of 2





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