

Report of Investigation 2021-3 Ekuk

EROSION EXPOSURE ASSESSMENT—EKUK

Richard M. Buzard, Mark M. Turner, Katie Y. Miller, Donald C. Antrobus, and Jacquelyn R. Overbeck



Ekuk, Alaska, in 2006. Photo: ShoreZone, shorezone.org.



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EROSION EXPOSURE ASSESSMENT—EKUK

Richard M. Buzard¹, Mark M. Turner¹, Katie Y. Miller¹, Donald C. Antrobus², and Jacquelyn R. Overbeck¹

EKUK EROSION EXPOSURE ASSESSMENT

This is a summary of erosion forecast results near infrastructure at Ekuk, 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 (2003) Community Profile Map series.
- Added infrastructure such as roads and outbuildings, delineated if visible in the most up-to-date high resolution (≤ 0.66 ft [20 cm] ground sample distance) aerial orthoimagery (Quantum Spatial, 2019).
- Computed infrastructure cost of replacement based on square or linear footage from Buzard and others (2021).

Ekuk is on the eastern shore of Nushagak Bay at a sediment transport transition between steep bluffs that erode into a spit-like cusped depositional landform (Overbeck and others, 2020). Accretion occurs near the cannery as sediment from the eroding bluff is continually fed onto the north end of the spit. Erosion of the southern end



of the community has required the relocation of homes and continues to impact summer fishing set net sites (Bristol Bay Native Association, 2019).

We forecast erosion 60 years from the most recent shoreline (2018) at 20-year intervals to identify the exposure of infrastructure to erosion. Erosion forecasts show residential and seasonal-use (unspecified) buildings and the small gravel airstrip are exposed to erosion through 2078 (tables 1–3). Thirteen buildings are exposed to erosion by 2038 and 24 more buildings by 2078 (tables 1 and 3). The small gravel airstrip is valued the same as a gravel road for this study. The total replacement cost of infrastructure exposed to erosion is \$4.0 million (\pm \$1.2 million) by 2078 (table 2; fig. 1). We did not estimate erosion exposure for fuel lines because the data were not available.

ACKNOWLEDGMENTS

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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 (LF) |
| 2018 to 2038 | 13 | 254 | 0 | 0 | 0 |
| 2038 to 2058 | 11 | 336 | 0 | 0 | 86 |
| 2058 to 2078 | 14 | 180 | 0 | 0 | 145 |
| Combined Total | 38 | 770 | 0 | 0 | 231 |

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 |
| 2018 to 2038 | \$2,000,000 | \$50,700 | \$0 | \$0 | \$0 | \$2,050,700 |
| 2038 to 2058 | \$500,000 | \$67,300 | \$0 | \$0 | \$200,000 | \$767,300 |
| 2058 to 2078 | \$1,200,000 | \$35,900 | \$0 | \$0 | \$0 | \$1,235,900 |
| Combined Total | \$3,700,000 | \$153,900 | \$0 | \$0 | \$200,000 | \$4,053,900 |

Table 3. Cost estimate of exposed buildings and tank facilities by 20-year interval. The count of exposed buildings is denoted in parentheses. NCA designates facilities with no cost assigned.

| Cost to Replace Buildings and Tank Facilities | | |
|---|------------------|------------------|
| Erosion Forecast Date Range | Building Type | Replacement Cost |
| 2018 to 2038 | Residential (3) | \$1,200,000 |
| | Unspecified (10) | \$800,000 |
| 2038 to 2058 | Tank | NCA |
| | Unspecified (10) | \$500,000 |
| 2058 to 2078 | Commercial (1) | NCA |
| | Unspecified (13) | \$1,200,000 |

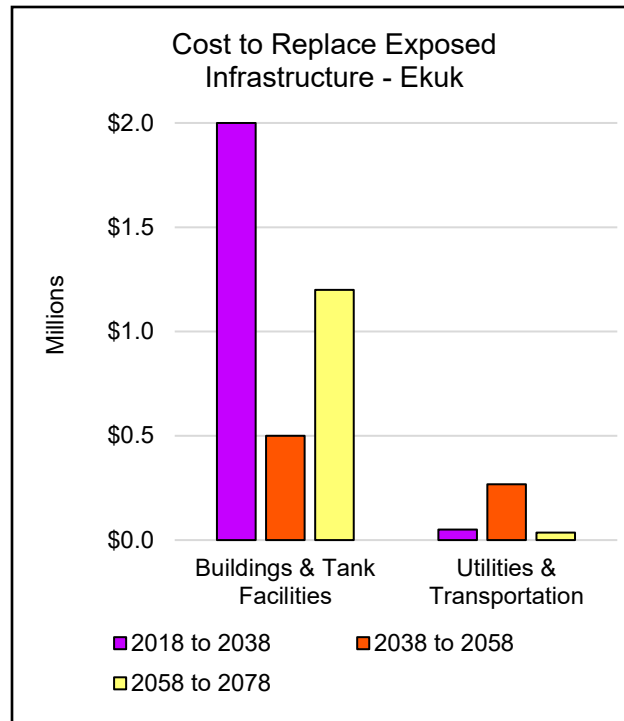


Figure 1. This figure summarizes the replacement cost of all infrastructure in the erosion forecast area. Twenty-year intervals are symbolized by color: purple represents the time interval 2018 to 2038, red represents 2038 to 2058, and yellow represents 2058 to 2078. Residential and seasonal-use buildings have the greatest cost of replacement forecast by 2078.

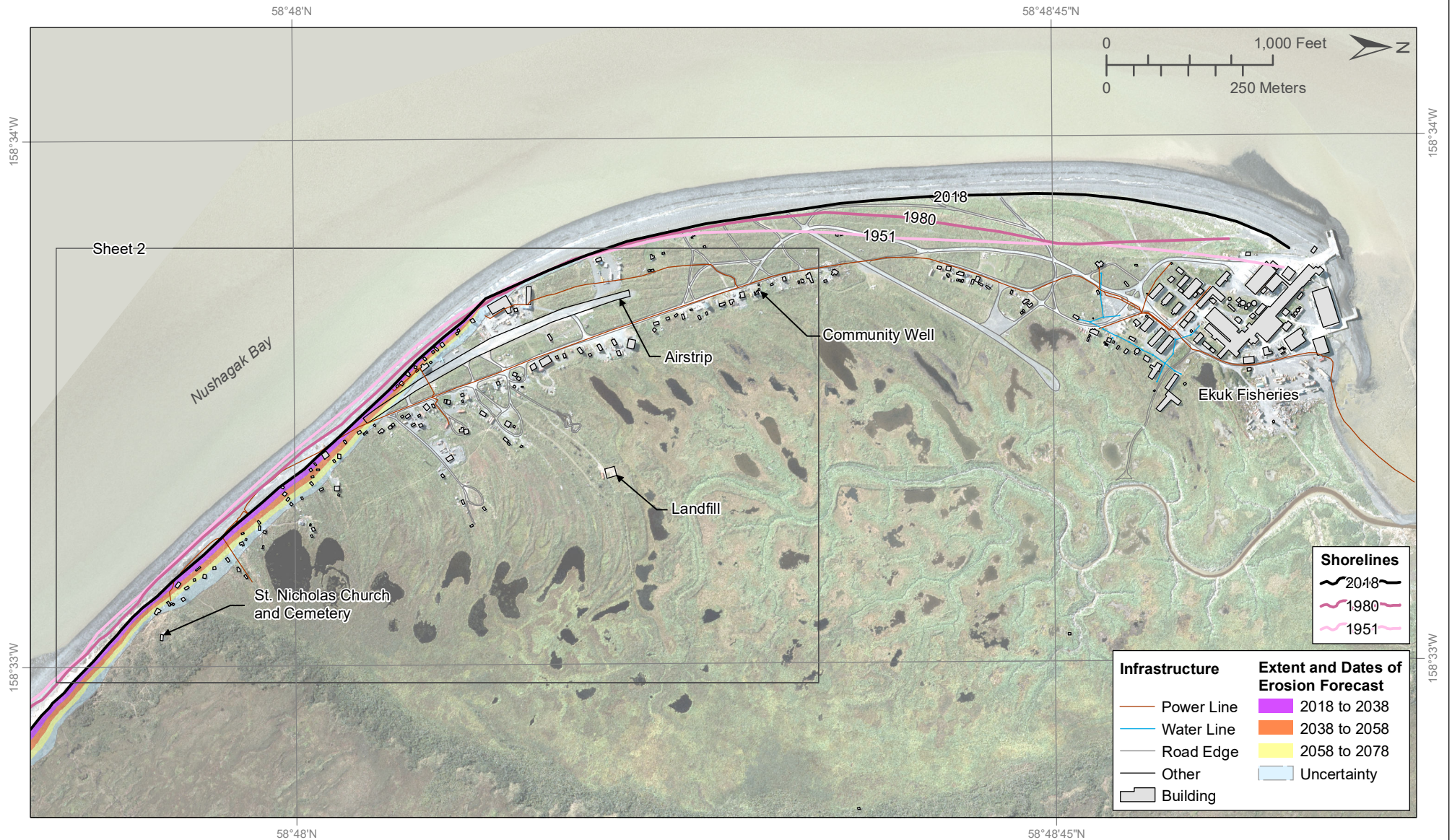
REFERENCES

- Bristol Bay Native Association (BBNA), 2019, Native Village of Ekuk—Tribal hazard mitigation plan: Bristol Engineering Services, LLC, 228 p.
- 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>
- Division of Community & Regional Affairs (DCRA), 2003, Community profile map, Ekuk: Department of Commerce, Community, and Economic Development. <https://www.commerce.alaska.gov/web/dcra/PlanningLandManagement/CommunityProfileMaps.aspx>
- Overbeck, J.R., Buzard, R.M., Turner, M.M., Miller, K.Y., and Glenn, R.J., 2020, Shoreline change at Alaska coastal communities: Alaska Division of Geological & Geophysical Surveys Report of Investigation 2020-10, 29 p., 45 sheets. <https://doi.org/10.14509/30552>
- Quantum Spatial, 2019, Bristol Bay shoreline 2018 imagery—Technical data report: Quantum Spatial, 10 p.
- U.S. Army Corps of Engineers (USACE), 2009, Alaska baseline erosion assessment report summary—Ekuk, Alaska: U.S. Army Corps of Engineers Alaska District, 4 p.

Erosion Forecast

Ekuk, Alaska

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Projection: NAD83 UTM Zone 4N. Orthoimagery year: 2018. 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 pink scale and labeled by year). The long-term (1951 to 2018) 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: 2018 to 2038 (purple), 2038 to 2058 (orange), and 2058 to 2078 (yellow). The area of uncertainty of the 2078 shoreline at a 90 percent confidence interval is light blue. Areas that are not colored by time interval are not forecast to erode by 2078 based on the historical shoreline change rate. For more detailed information about the impacts to infrastructure from erosion at Ekuk, refer to the Ekuk erosion exposure assessment report.

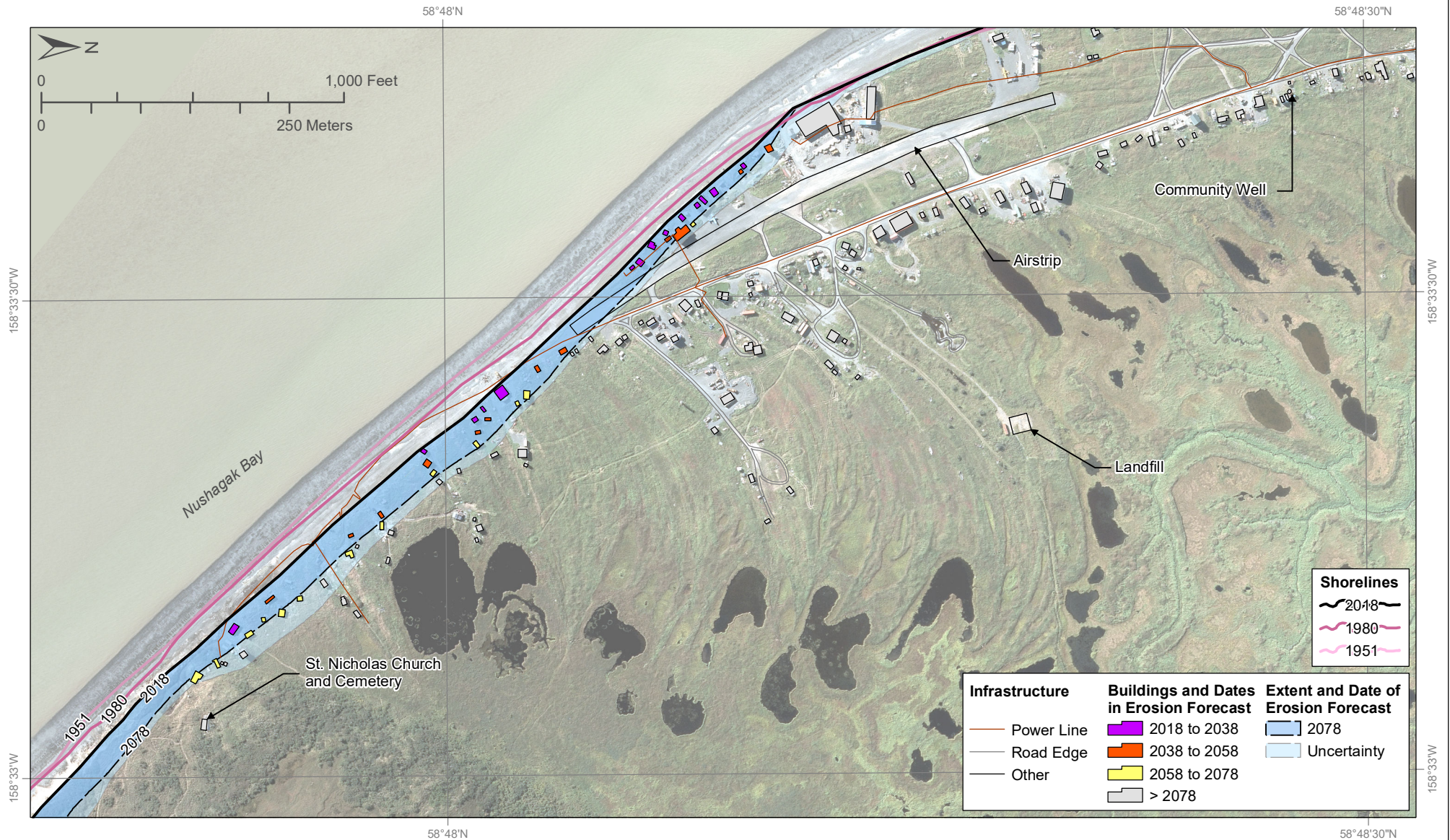
This work is part of the Coastal Infrastructure Erosion Vulnerability Assessment project funded by the Denali Commission Environmentally Threatened Communities Grant Program. Components of this map were prepared by the Alaska Department of Commerce, Community, and Economic Development (DCCED) using funding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



Erosion Exposure

Ekuk, Alaska

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 Buzard and others, 2021
 Ekuk, Sheet 2 of 2



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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 pink scale and labeled by year). The long-term (1951 to 2018) shoreline change rate is used to forecast where erosion could impact community infrastructure. Erosion is forecast to year 2078 (dark blue) with a 90 percent confidence interval area of uncertainty (light blue). Buildings forecast to be impacted by erosion are colored by the range of years when the impact is forecast to occur: 2018 to 2038 (purple), 2038 to 2058 (orange), 2058 to 2078 (yellow), and no impacts expected by 2078 (gray). For more detailed information about the impacts to infrastructure from erosion at Ekuk, refer to the Ekuk 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.