Report of Investigation 2021-3 Nunam Iqua

EROSION EXPOSURE ASSESSMENT—NUNAM IQUA

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

Nunam Iqua, Alaska, in 2014. Shorezone, shorezone.org.

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State of Alaska
Department of Natural Resources
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EROSION EXPOSURE ASSESSMENT—NUNAM IQUA

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NUNAM IQUA EROSION EXPOSURE ASSESSMENT

This is a summary of erosion forecast results near infrastructure at Nunam Iqua, 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).

Nunam Iqua is located on the south fork of the Yukon River in the Yukon-Kuskokwim Delta. The community is situated on the riverbank of Kwemeluk Pass which is tidally influenced by the Bering Sea. Erosion ranges from 1 to 3 feet per year on the east coast of the community and increases to 3 to 7 feet per year on the northern shoreline where the barge landing is located (Overbeck and others, 2020). Wave action, tidal fluctuations, and storm surge events contribute to erosion, with the fall coastal storm season having the most impact (Nunam Iqua Advisory Planning Board, 2017) along with ice push, thawing permafrost, and boat wake (U.S. Army Corps of Engineers, 2009). With no shoreline protection structures, the community has been relocating or demolishing infrastructure in response to erosion (Overbeck and others, 2020).

We forecast erosion 60 years from the most recent shoreline at 20-year intervals to identify the exposure of infrastructure to erosion. The erosion forecast of the northern riverbank of Nunam Iqua shows infrastructure exposed to erosion within 20 years (table 1). The barge landing site is within the erosion forecast area by 2039 and fully encompassed by 2079 (table 1). We consider the barge landing site effectively disabled by 2059 because most of the staging area is within the erosion forecast area. Residences, boardwalks, and utilities are forecast to be undermined by 2039 and will continue to undergo erosion in the following 40 years (table 1). The airport utility apron is forecast to undergo minor erosion from 2019 to 2079 (table 1). The total replacement cost of infrastructure exposed to erosion is $5.6 million (± $1.7 million) by 2079 (tables 2 and 3; figs. 1 and 2).

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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)**	**Fuel Lines (LF)**	**Water Lines (LF)**	**Boardwalks (LF)**	**Airport (SF)**	**Barge Landing (SF)**
2019 to 2039	6	294	63	201	270	853	13,750
2039 to 2059	5	471	63	321	610	1,163	9,530
2059 to 2079	3	98	96	537	849	1,564	4,760
Combined Total	14	863	222	1,059	1,729	3,581	28,040

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**	**Fuel Lines**	**Water Lines**	**Boardwalks**	**Airport**	**Barge Landing**	**Sum**
2019 to 2039	$450,000	$58,700	$20,000	$80,500	$75,000	$85,300	$0	$684,200
2039 to 2059	$800,000	$94,200	$0	$128,500	$0	$116,300	$2,500,000	$3,522,700
2059 to 2079	$800,000	$19,700	$0	$214,700	$54,700	$156,400	$0	$1,089,100
Combined Total	$2,050,000	$172,600	$20,000	$423,700	$129,700	$358,000	$2,500,000	$5,654,000

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. NCA designates buildings with no cost assigned.

Cost to Replace Exposed Buildings and Tank Facilities		
Erosion Forecast Date Range	**Building Type**	**Cost of Replacement**
2019 to 2039	Residential (1)	$400,000
	Unspecified (4)	NCA
	Water Intake	$50,000
2039 to 2059	Residential (1)	$400,000
	Unspecified (4)	$400,000
2059 to 2079	Residential (2)	$800,000
	Unspecified (1)	NCA

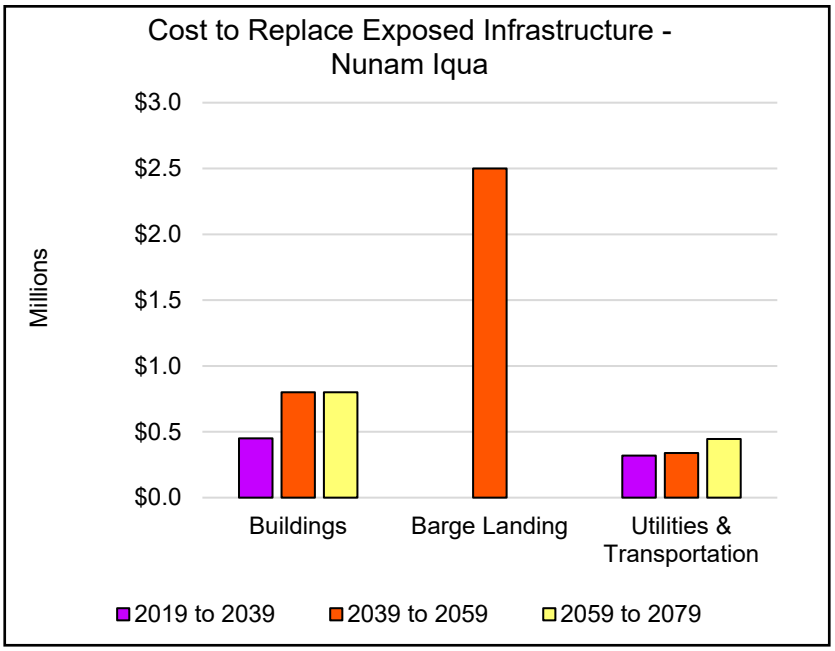

Figure 1. This figure summarizes the replacement cost of infrastructure in the erosion forecast area. 20-year intervals are symbolized by color: purple represents the time interval 2019 to 2039, red represents 2039 to 2059, and yellow represents 2059 to 2079. The single greatest cost is the barge landing that is forecast to experience erosion from 2019 to 2079. The replacement cost for the barge landing is applied between 2039 to 2059 because most of the staging area is in the erosion forecast area by then.

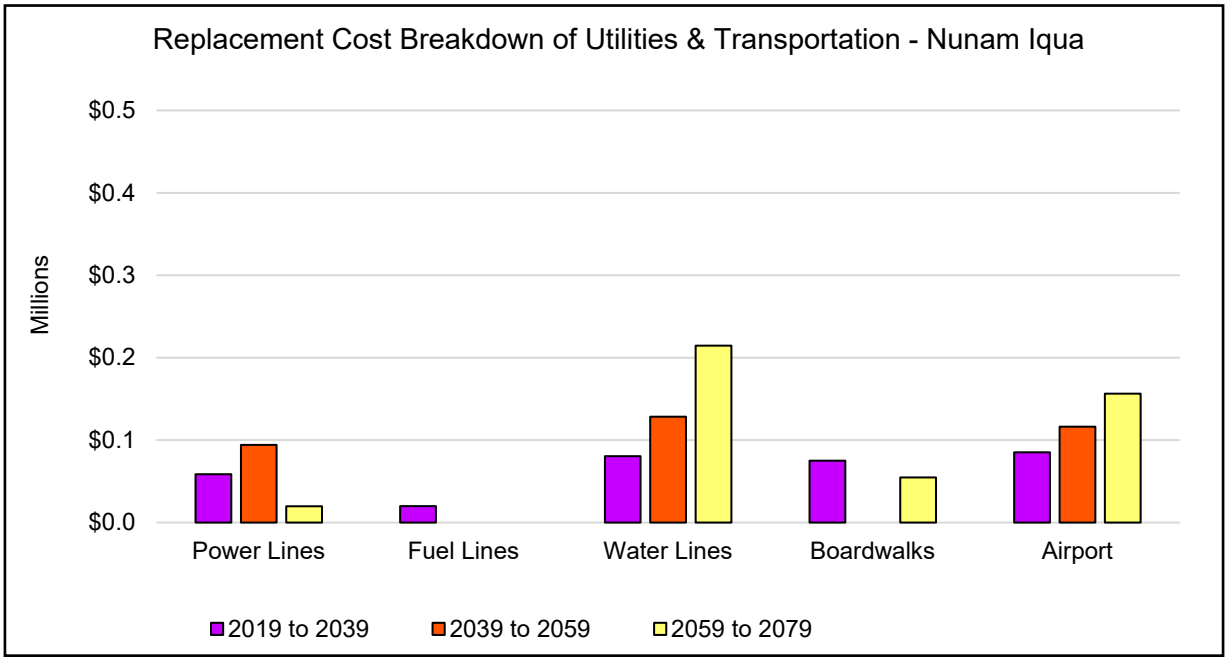

Figure 2. This figure breaks down the replacement cost of utilities and transportation infrastructure that are in the erosion forecast area. The greatest cost to utilities and transportation is the water and sewer infrastructure.

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 Nunam Iqua was not consulted for this report.

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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 Forecast
Nunam Iqua, Alaska

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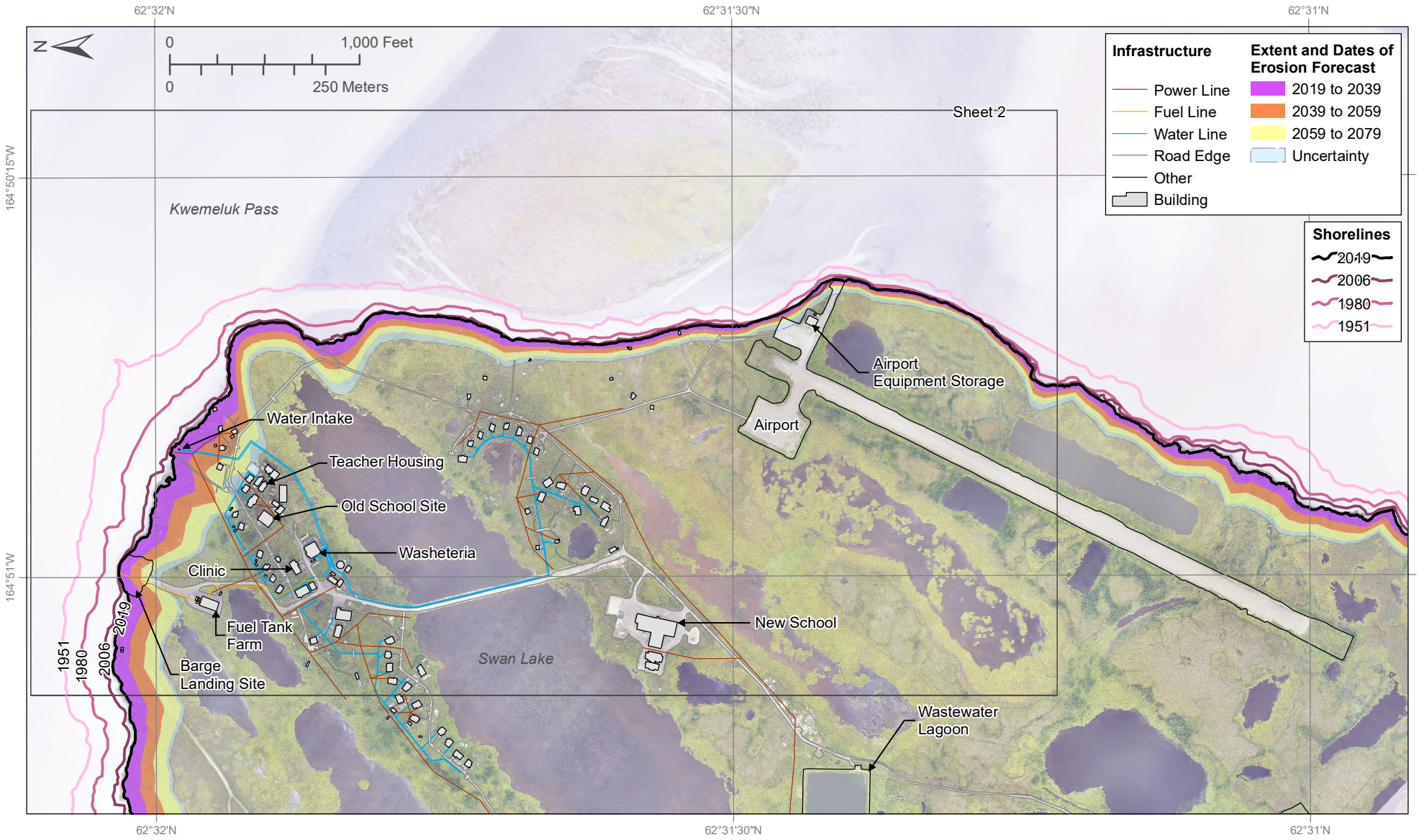
Buzard and others, 2021
Nunam Iqua, Sheet 1 of 2



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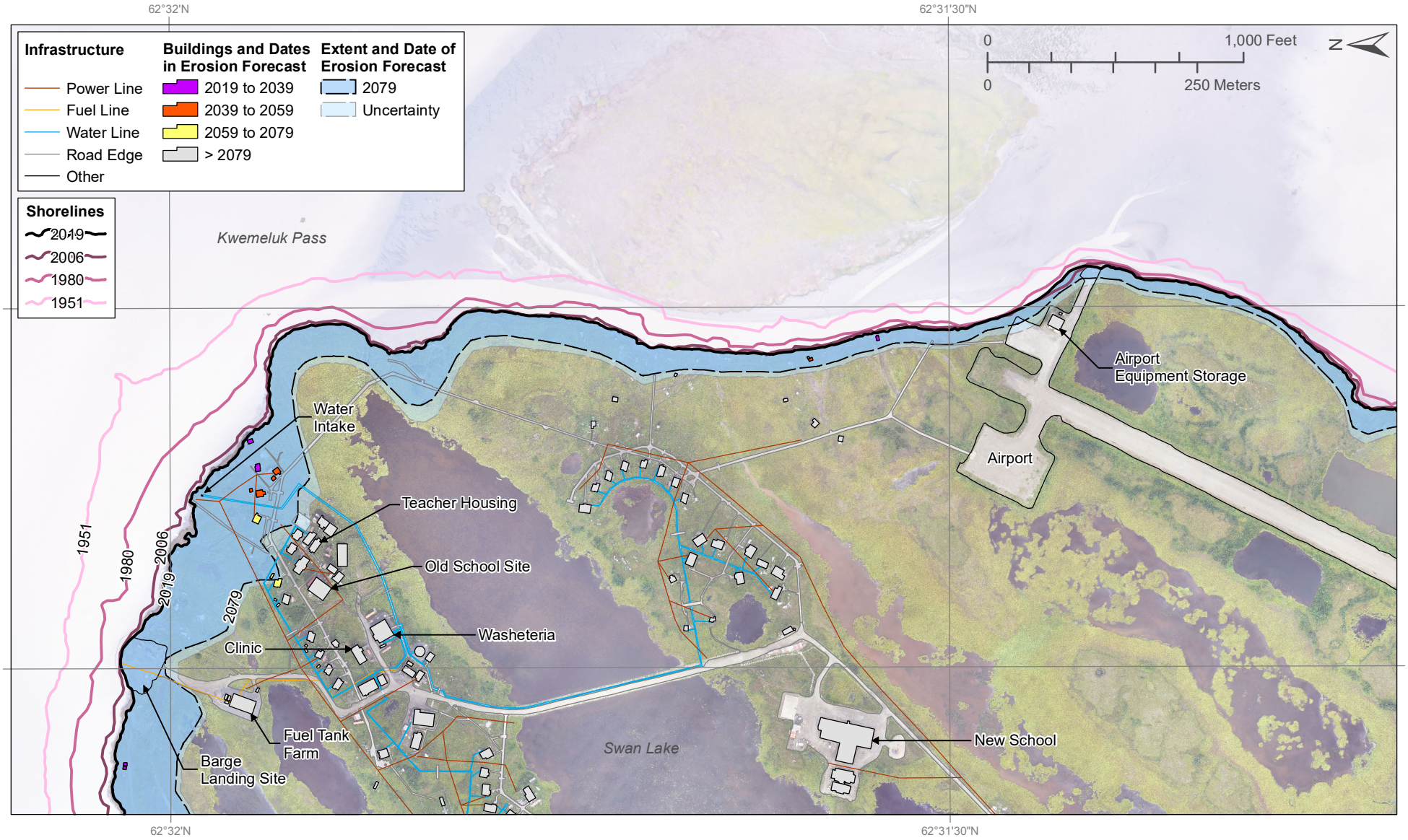
Projection: NAD83 UTM Zone 3N. Orthoimagery year: 2019. Orthoimagery available from elevation.alaska.gov

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 (1951 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 Nunam Iqua, refer to the Nunam Iqua 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
Nunam Iqua, Alaska

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



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