Report of Investigation 2021-3 Kwigillingok

EROSION EXPOSURE ASSESSMENT—KWIGILLINGOK

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Kwigillingok, Alaska, in 2014. Shorezone, shorezone.org.

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State of Alaska
Department of Natural Resources
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EROSION EXPOSURE ASSESSMENT—KWIGILLINGOK

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KWIGILLINGOK EROSION EXPOSURE ASSESSMENT

This is a summary of results from an erosion forecast near infrastructure at Kwigillingok, 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 (2004) Community Profile Map series.
- Added infrastructure such as roads, water and sanitation facilities, and outbuildings, 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 value based on square or linear footage from Buzard and others (2021).

Kwigillingok is located on the Yukon-Kuskokwim Delta along the Kwigillingok River. The river experiences relatively linear erosion at its cut banks and accretion at its point bars. Erosion is episodic, occurring during spring break-up and from coastal storm surge in the fall (U.S. Army Corps of Engineers, 2008). From 1953 to 2015, the Kwigillingok River nearly doubled in size from an average width of 240 ft to 460 ft. Erosion rates reached upwards of 14.4 feet per year, although some areas accreted as much as 4.6 feet per year (Overbeck and others, 2020). Erosion of a riverbend near the barge landing may lead to channel migration—joining two riverbends into one and forming a new channel across an existing point bar (meander cutoff). The point bar has narrowed to 700 feet across with eroding cutbanks on either side. Erosion forecasts assume past changes will continue at their observed rate, but the possible meander cutoff can result in erosion beyond the forecast area. We include the footprints of past rivers so decision-makers can visualize changes and make their own interpretations.

We forecast erosion 60 years from the most recent shoreline (2015) at 20-year intervals to identify the exposure of infrastructure to erosion. Buildings, roads, utilities, and the barge landing are exposed to erosion through 2075 (table 1). Buildings have the greatest cost ($5.2 million) followed by the barge landing ($2.5 million; table 2). There are at least two residences in the 2075 erosion forecast area, as well as the Kwik Inc. Store, IRA Council, and Kwik Inc. Storage (table 3). The greatest costs are in the 2015 to 2035 period (figs. 1 and 2). The total estimated replace-

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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 (n)**	**Power Lines (LF)**	**Water Lines (LF)**	**Roads & Boardwalks (LF)**	**Barge Landing (SF)**
2015 to 2035	5	47	0	1,109	18,388
2035 to 2055	9	492	62	1,187	0
2055 to 2075	21	1,593	385	1,910	0
Forecast Total	35	2,132	447	4,206	18,388
Migration Hazard	3	103	0	459	0
Combined Total	38	2,235	447	4,665	18,388

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

Cost to Replace Exposed Infrastructure						
Erosion Forecast Date Range	**Buildings**	**Power Lines**	**Water Lines**	**Roads & Boardwalks**	**Barge Landing**	**Sum**
2015 to 2035	$400,000	$50,000	$0	$83,200	$2,500,000	$3,033,200
2035 to 2055	$2,064,400	$57,800	$50,000	$284,900	$0	$2,457,100
2055 to 2075	$2,780,700	$318,700	$128,600	$136,600	$0	$3,364,600
Forecast Total	$5,245,100	$426,500	$178,600	$504,700	$2,500,000	$8,854,900
Migration Hazard	$400,000	$6,180	$0	$34,425	$0	$440,605
Combined Total	$5,645,100	$432,680	$178,600	$539,125	$2,500,000	$9,295,505

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

Cost to Replace Buildings and Tank Facilities		
Erosion Forecast Date Range	**Building Type**	**Cost of Replacement**
2015 to 2035	IRA Council Storage	NCA
	Unspecified (4)	$400,000
2035 to 2055	Residential (1)	$511,900
	Kwik Inc. Store	$300,000
	Unspecified (7)	$1,252,500
2055 to 2075	Residential (1)	$557,600
	Kwik Inc. Storage	$10,000
	Unspecified (19)	$2,213,100
Migration Hazard	Residential (1)	$400,000
	Unspecified (2)	NCA

ment cost of infrastructure exposed to erosion is $8.9 million (± $2.7 million). Additionally, there are power lines, roads, and three structures in the channel migration hazard area, totaling $0.4 million. We did not estimate erosion exposure for fuel lines because the data were not available.

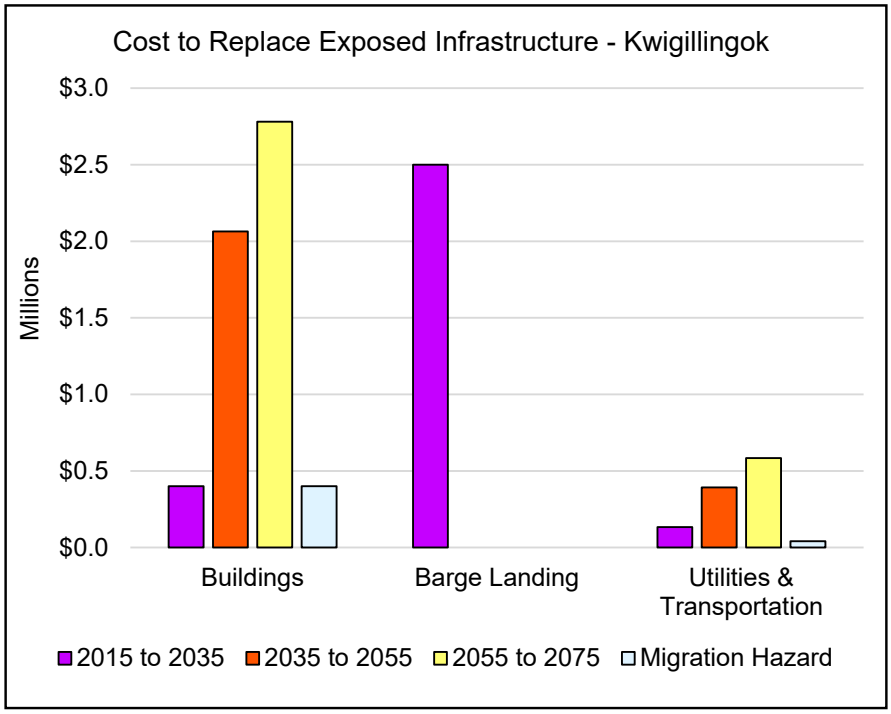

Figure 1. This figure summarizes the replacement cost of all infrastructure in the erosion forecast area. Twenty-year intervals are symbolized by color: purple represents the time interval 2015 to 2035, orange represents 2035 to 2055, yellow represents 2055 to 2075, and blue represents infrastructure in the river migration hazard zone.. The bulk of costs are buildings, especially from 2055 to 2075.

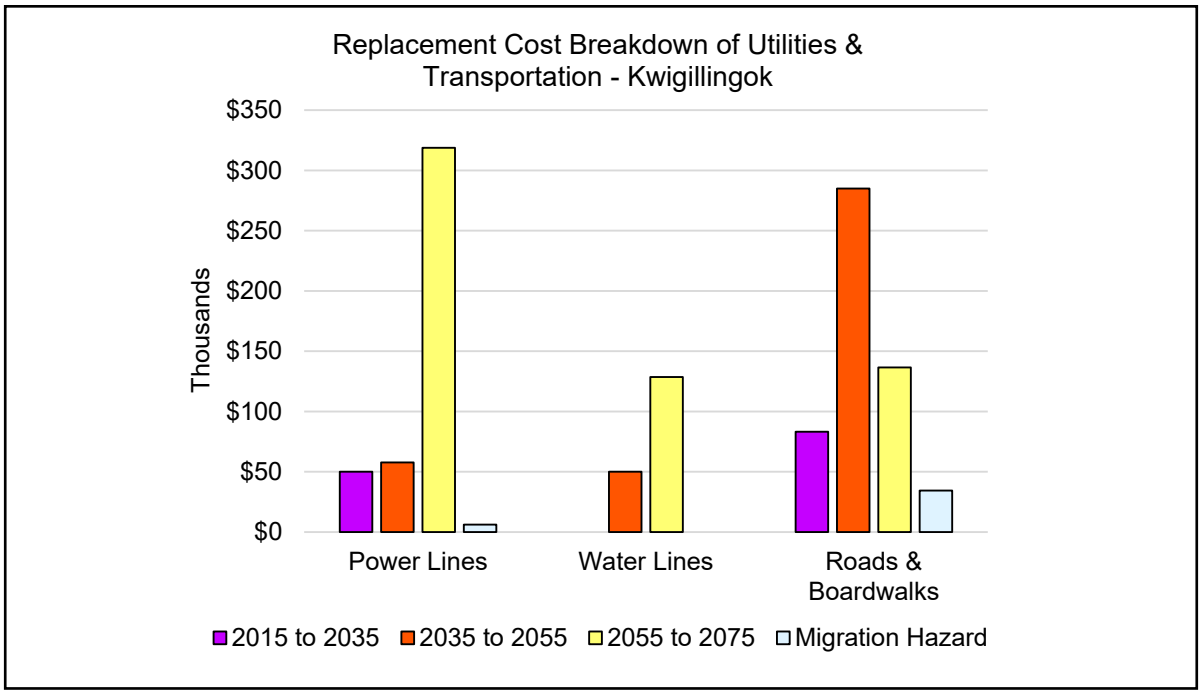

Figure 2. This figure breaks down the replacement cost of all utilities and transportation in the erosion forecast area. The greatest cost is erosion of the power lines from 2055 to 2075.

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 Kwigillingok 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
Kwigillingok, Alaska

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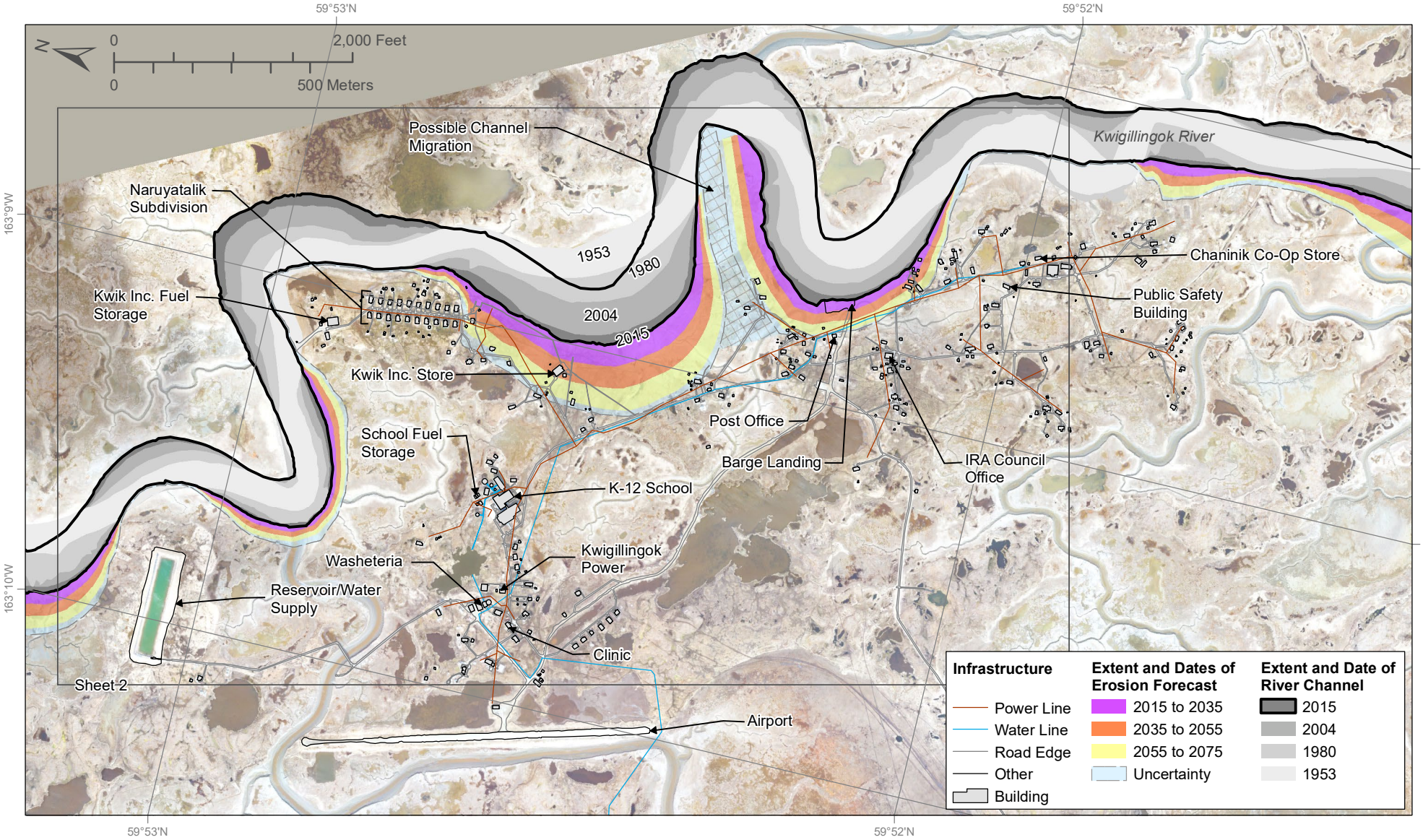
Buzard and others, 2021
Kwigillingok, Sheet 1 of 2



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Projection: NAD83 UTM Zone 3N. Orthoimagery year: 2015. 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 (river areas shown in grayscale and labeled by year). The long-term (1953 to 2015) 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: 2015 to 2035 (purple), 2035 to 2055 (orange), and 2055 to 2075 (yellow). The area of uncertainty of the 2075 shoreline at a 90 percent confidence interval is light blue. Areas that are not colored by time interval are not forecast to erode by 2075 based on the historical shoreline change rate. For more detailed information about the impacts to infrastructure from erosion at Kwigillingok, refer to the Kwigillingok 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
Kwigillingok, Alaska

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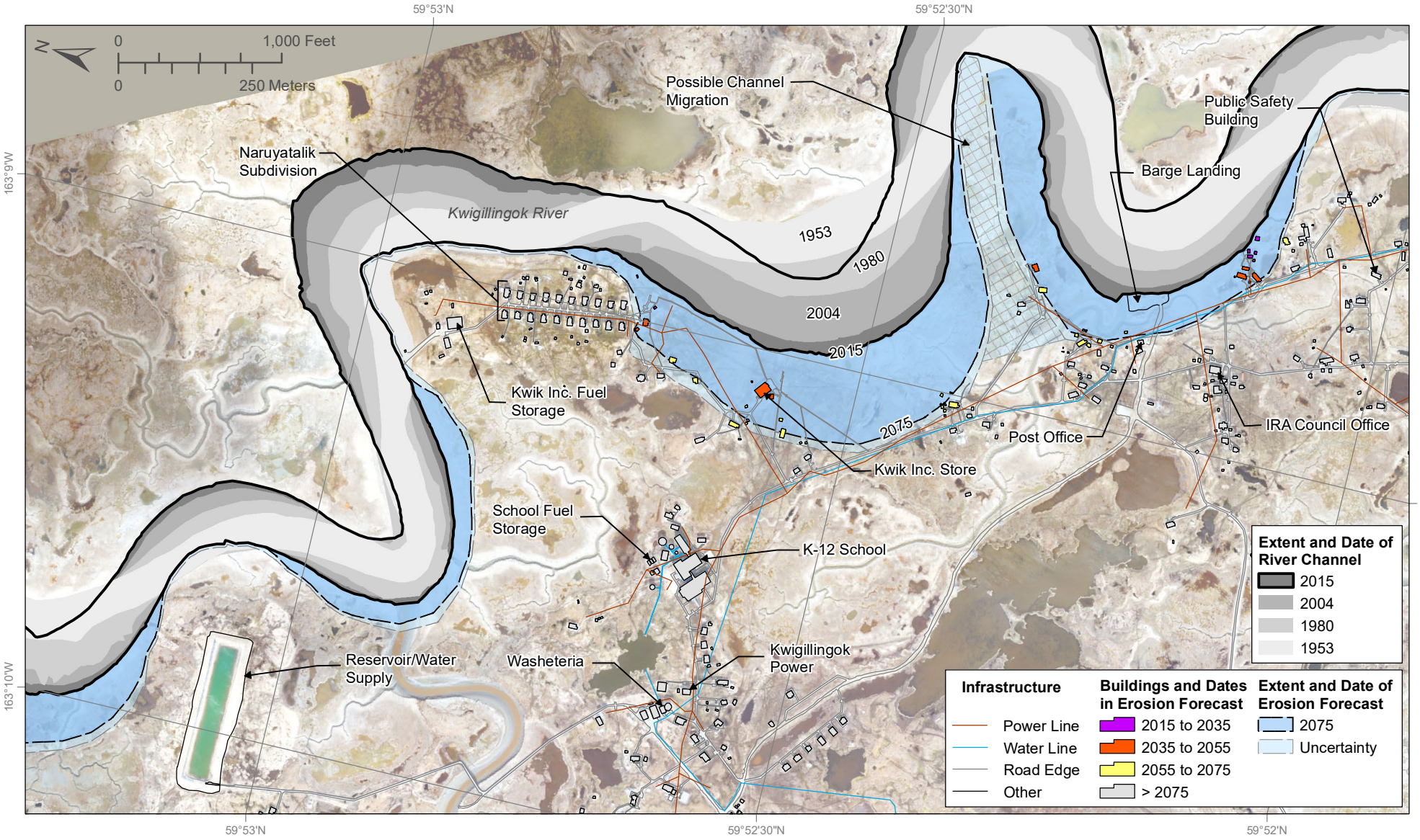
Buzard and others, 2021
Kwigillingok, Sheet 2 of 2



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