

EROSION EXPOSURE ASSESSMENT—TOKSOOK BAY

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



Toksook Bay, Alaska, in 2014. Shorezone, shorezone.org.



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



EROSION EXPOSURE ASSESSMENT—TOKSOOK BAY

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

Report of Investigation 2021-3 Toksook Bay

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

STATE OF ALASKA

Mike Dunleavy, Governor

DEPARTMENT OF NATURAL RESOURCES

Corri A. Feige, Commissioner

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

Steve Masterman, State Geologist and Director

Publications produced by the Division of Geological & Geophysical Surveys (DGGS) are available to download from the DGGS website (dggs.alaska.gov). Publications on hard-copy or digital media can be examined or purchased in the Fairbanks office:

Alaska Division of Geological & Geophysical Surveys
3354 College Rd., Fairbanks, Alaska 99709-3707
Phone: (907) 451-5010 Fax (907) 451-5050
dggspubs@alaska.gov | dggs.alaska.gov

DGGS publications are also available at:

Alaska State Library,
Historical Collections & Talking Book Center
395 Whittier Street
Juneau, Alaska 99811

Alaska Resource Library and Information Services (ARLIS)
3150 C Street, Suite 100
Anchorage, Alaska 99503

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>



Contents

Toksook Bay Erosion Exposure Assessment.....	1
Acknowledgments	1
References	3

Figures

Figure 1. Replacement cost of infrastructure in the erosion forecast area.....	3
--	---

Tables

Table 1. Quantity of infrastructure with estimated erosion exposure.....	2
Table 2. Replacement cost of infrastructure exposed to erosion.....	2
Table 3. Cost estimate of exposed buildings and tank facilities.....	2

EROSION EXPOSURE ASSESSMENT—TOKSOOK BAY

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

TOKSOOK BAY EROSION EXPOSURE ASSESSMENT

This is a summary of results from an erosion forecast near infrastructure at Toksook Bay, 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 meta-data from the 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 cost of replacement based on square or linear footage from Buzard and others (2021).

Toksook Bay is on the southern shore of Nelson Island in the Yukon-Kuskokwim Delta where Kangirlluar Bay mixes with the Bering Sea. The western side of Toksook Bay has relatively slow to stable erosion rates (Overbeck and others,



2020). Erosion was slowed by a gabion seawall constructed in the 1980s and 2000s (U.S. Army Corps of Engineers, 2008). Erosion rates are higher across the Qumqeng River, reaching between 1 and 2.6 feet per year (Overbeck and others, 2020).

We forecast erosion 60 years from the most recent shoreline (2015) at 20-year intervals to identify the exposure of infrastructure to erosion. The erosion forecast shows most infrastructure in Toksook Bay is not exposed to erosion by 2075. Five structures and 50 feet of roadway are within the erosion forecast area through 2075 (tables 1–3). Of these structures, one is a residence and the remaining are unspecified small buildings (such as sheds; table 3). The total replacement cost of infrastructure exposed to erosion is \$600 thousand (\pm \$180 thousand) by 2075 (table 2; fig. 1).

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 Toksook Bay was not consulted for this report.

¹ Alaska Division of Geological & Geophysical Surveys, 3354 College Rd., Fairbanks, Alaska 99709-3707

² Alaska Native Tribal Health Consortium, 4000 Ambassador Drive, Anchorage, Alaska 99508

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

Quantity of Exposed Infrastructure					
Erosion Forecast Date Range	Buildings & Tank Facilities (n)	Power Lines (LF)	Fuel Lines (LF)	Water Lines (LF)	Roads (LF)
2015 to 2035	0	0	0	0	18
2035 to 2055	1	0	0	0	13
2055 to 2075	4	0	0	0	19
Combined Total	5	0	0	0	50

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	Roads	Other	Sum
2015 to 2035	\$0	\$0	\$0	\$0	\$200,000	\$0	\$200,000
2035 to 2055	\$400,000	\$0	\$0	\$0	\$0	\$0	\$400,000
2055 to 2075	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Combined Total	\$400,000	\$0	\$0	\$0	\$200,000	\$0	\$600,000

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

Cost to Replace Exposed Buildings and Tank Facilities		
Erosion Forecast Date Range	Building Type	Cost of Replacement
2015 to 2035	None	\$0
2035 to 2055	Residential (1)	\$400,000
2055 to 2075	Unspecified (4)	NCA

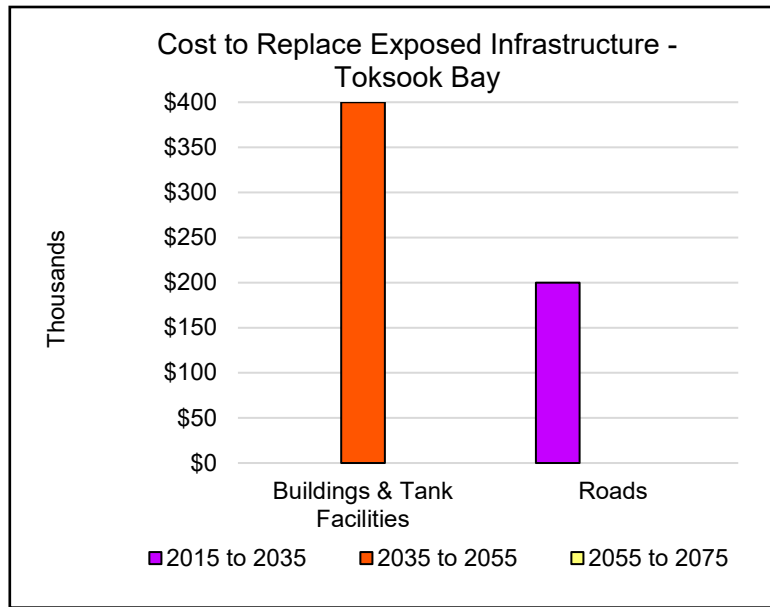


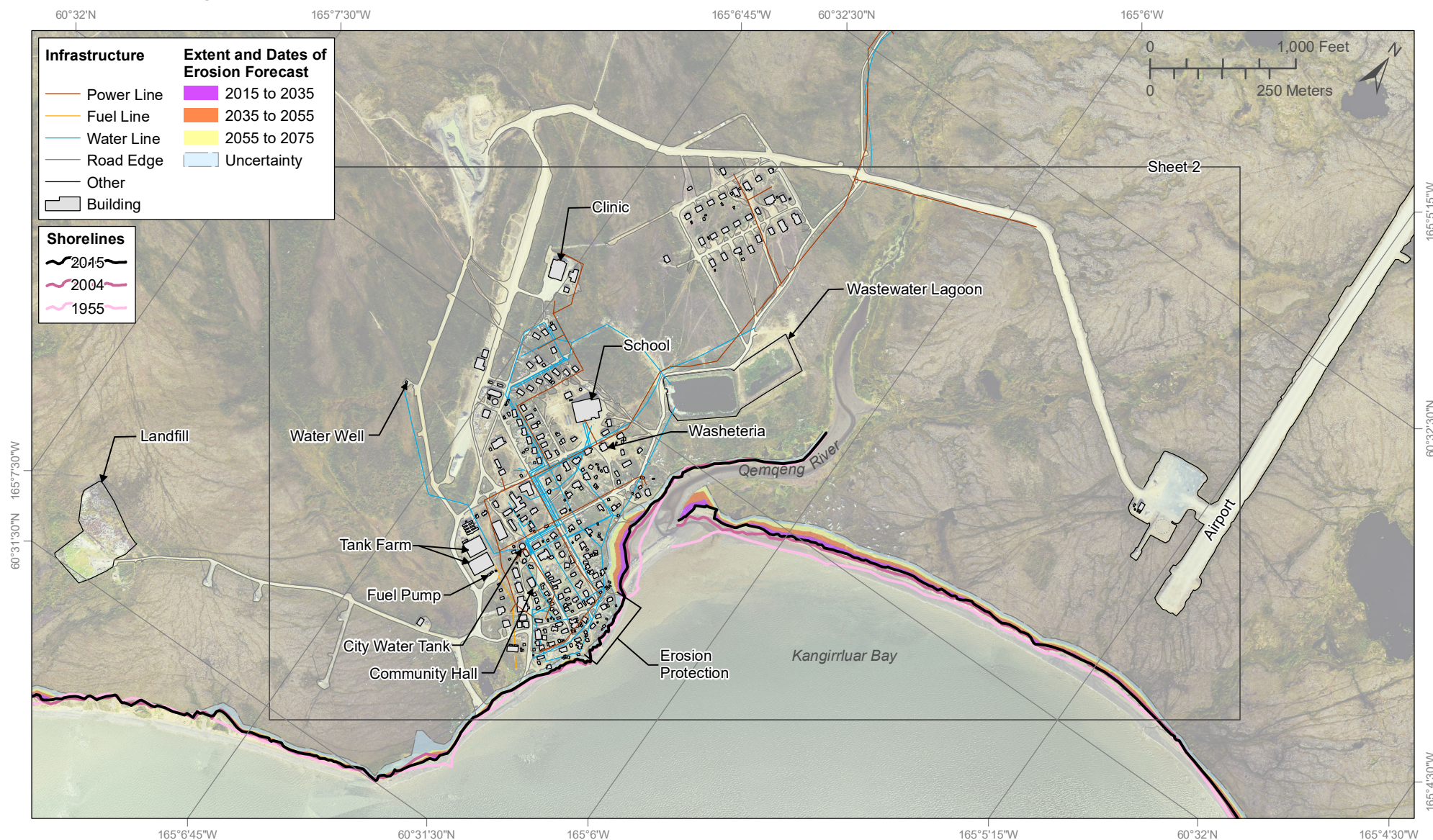
Figure 1. This figure summarizes the replacement cost of all infrastructure in the erosion forecast area. Twenty-year intervals are symbolized by color: purple represents the time interval 2015 to 2035, orange represents 2035 to 2055, and yellow represents 2055 to 2075.

REFERENCES

- 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, 2004, Community profile map, Toksook Bay: 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>
- Overbeck, J.R., Hendricks, M.D., and Kinsman, N.E.M., 2016, Photogrammetric digital surface models and orthoimagery for 26 coastal communities of western Alaska: Alaska Division of Geological & Geophysical Surveys Raw Data File 2016-1, 3 p. <https://doi.org/10.14509/29548>
- U.S. Army Corps of Engineers, 2008, Alaska baseline erosion assessment report summary—Toksook Bay: U.S. Army Corps of Engineers Alaska District, 3 p.

Erosion Forecast Toksook Bay, Alaska

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



STATE OF ALASKA DEPARTMENT OF NATURAL RESOURCES DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

The State of Alaska makes no expressed or implied warranties (including warranties for merchantability and fitness) with respect to the character, functions, or capabilities of the electronic data or products or their appropriateness for any user's purposes. In no event will the State of Alaska be liable for any incidental, indirect, special, consequential, or other damages suffered by the user or any other person or entity whether from the use of the electronic services or products or any failure thereof or otherwise. In no event will the State of Alaska's liability to the Requestor or anyone else exceed the fee paid for the electronic service or product.
website: dggs.alaska.gov

Projection: NAD83 UTM Zone 3N. Orthomimagery year: 2015. Orthomimagery available from elevation.alaska.gov

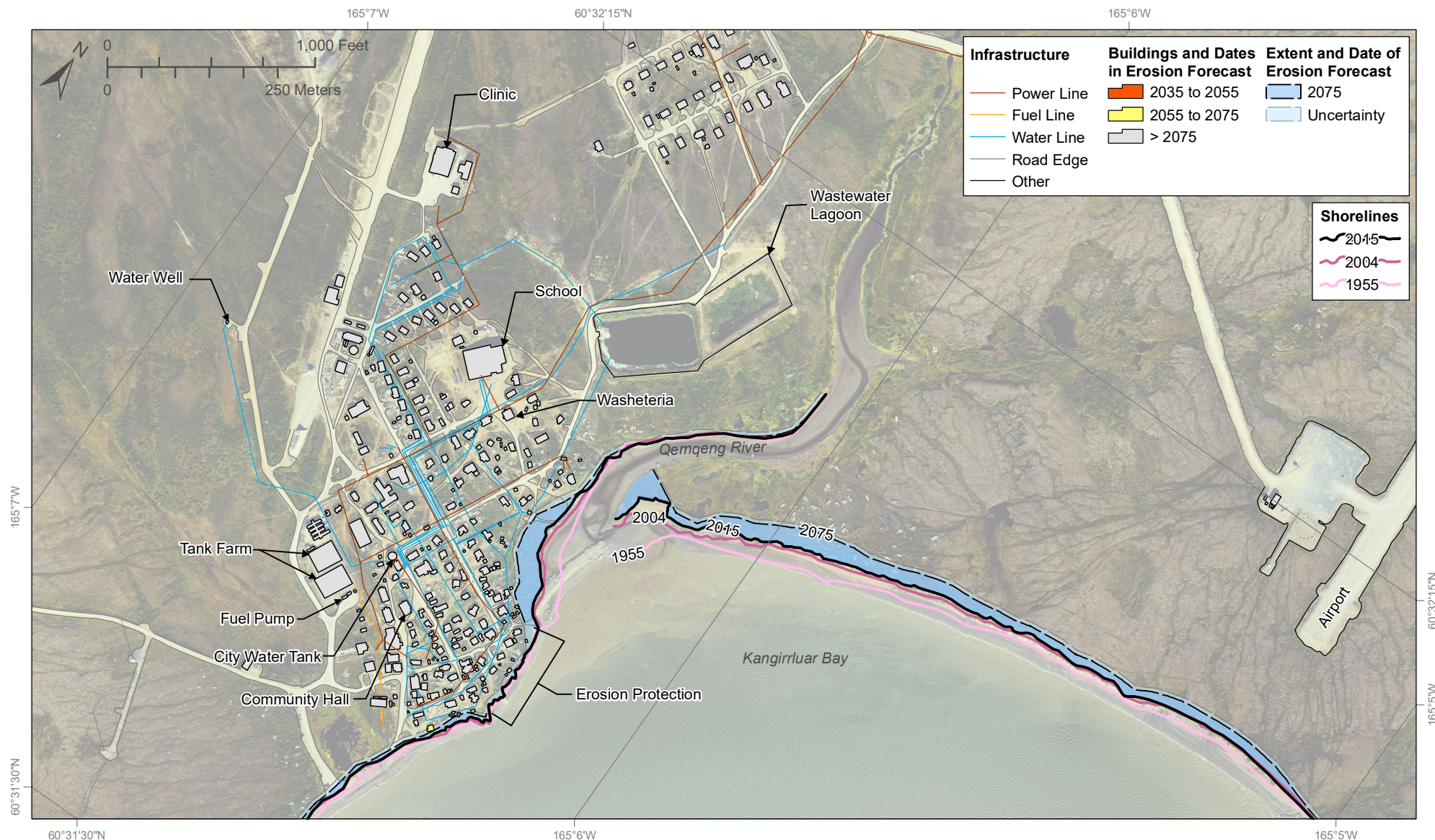
Erosion and accretion of coasts and rivers result in shoreline change. These rates of shoreline change at Alaska communities are calculated from historical and modern shorelines (shorelines shown as lines in pink scale and labeled by year). The long-term (1955 to 2015) shoreline change rate is used to 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 Toksook Bay, refer to the Toksook Bay 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 Toksook Bay, Alaska

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



STATE OF ALASKA DEPARTMENT OF NATURAL RESOURCES DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

The State of Alaska makes no expressed or implied warranties (including warranties for merchantability and fitness) with respect to the character, functions, or capabilities of the electronic data or products or their appropriateness for any user's purposes. In no event will the State of Alaska be liable for any incidental, indirect, special, consequential, or other damages suffered by the user or any other person or entity whether from the use of the electronic services or products or any failure thereof or otherwise. In no event will the State of Alaska's liability to the Requestor or anyone else exceed the fee paid for the electronic service or product.
website: dggs.alaska.gov

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 (shorelines shown as lines in pinkscale and labeled by year). The long-term (1955 to 2015) shoreline change rate is used to forecast where erosion could impact community infrastructure. Erosion is forecast to year 2075 (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: 2015 to 2035 (purple), 2035 to 2055 (orange), 2055 to 2075 (yellow), and no impacts expected by 2075 (gray). For more detailed information about the impacts to infrastructure from erosion at Toksook Bay, refer to the Toksook Bay 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.

