

EROSION EXPOSURE ASSESSMENT—PORT HEIDEN

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



Port Heiden, Alaska, in 2017. Photo: Richard Buzard, Alaska Division of Geological & Geophysical Surveys.



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Report of Investigation 2021-3 Port Heiden

State of Alaska
Department of Natural Resources
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Richard M. Buzard¹, Mark M. Turner¹, Katie Y. Miller¹, Donald C. Antrobus², and Jacquelyn R. Overbeck¹

PORT HEIDEN EROSION EXPOSURE ASSESSMENT

This is a summary of erosion forecast results near infrastructure at Port Heiden, Alaska. We conduct a shoreline change analysis, forecast 40 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 (2002) Community Profile Map series.
- Added infrastructure such as roads and out-buildings, delineated if visible in the most up-to-date high resolution (≤ 0.66 ft [20 cm] ground sample distance) aerial orthoimagery (Quantum Spatial, 2020).
- Computed infrastructure cost of replacement based on square or linear footage from Buzard and others (2021).

Port Heiden is on the Bristol Bay shoreline of the Alaska Peninsula, where the Meshik River exits into Port Heiden (a bay of the same name). The great diurnal tidal range is 11.6 feet (NOAA, 2021). Exposure to a long fetch brings significant wave energy to the shoreline, resulting in major coastal reconfiguration (Kinsman and Gould,



2014). From 1957 to 2013, the average erosion rate was between stable and 23 feet per year. The complete disappearance and redistribution of sediments from the barrier Chistiakof Island exposed the Meshik shoreline to waves, increasing erosion rates after 1974 (Kinsman and Gould, 2014). Because of the marked increase in erosion rates, we only use the 1974 to 2019 shorelines (45 years) to forecast 40 years of erosion.

The former community of Meshik relocated to the city of Port Heiden due to rapid erosion. Meshik was built on the western side of Goldfish Lake, but every structure was removed or relocated by 2019 (Lujan and others, 2018). In November 2019, waves breached the bluffs fronting Goldfish Lake and it partially drained.

We forecast erosion 40 years from the most recent shoreline (2019) at 20-year intervals to identify the exposure of infrastructure to erosion. The erosion forecast shows nearly the entire footprint of Meshik is exposed to erosion through 2039. There is no visible infrastructure within most of the erosion forecast area by 2059. The greatest impact to current infrastructure in Port Heiden is the barge landing site. Most of the barge landing area is forecast to erode by 2039 (table 1), expanding out the

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

distance from the nearest barge landing pole and the 2039 shoreline to 500 ft. There is one abandoned structure exposed to erosion by 2059. It is possible that erosion will slow if sediment continues to fill in near the barge landing, which also complicates barge operations and navigability. For this reason, we list the barge landing as requiring replacement by 2039. The forecast shows continued undermining of the road to Meshik, which is used for subsistence activities, with up to 1,400 ft exposed in 40 years. The forecast shows erosion of small trail systems on the coast northwest of the community but does not reach the main road to Reindeer Creek by 2059. The total replacement cost of infrastructure exposed to erosion is \$3.06 million ($\pm$ \$0.92 million) by 2059

(table 2; fig. 1). We do not estimate erosion exposure for water lines because the data are not readily available and no visible water line infrastructure exists in the forecast area. There may be abandoned underground pipes and septic systems that do not have a replacement cost but will require cleanup when they are uncovered by erosion.

ACKNOWLEDGMENTS

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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)	Roads (LF)	Barge Landing (n)	Other Infrastructure
2019 to 2039	0	0	0	482	1	0
2039 to 2059	1	0	0	922	0	0
Combined Total	1	0	0	1,404	1	0

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	Roads	Barge Landing	Sum
2019 to 2039	\$0	\$0	\$0	\$200,000	\$2,500,000	\$2,700,000
2039 to 2059	\$0	\$0	\$0	\$361,600	\$0	\$361,600
Combined Total	\$0	\$0	\$0	\$561,600	\$2,500,000	\$3,061,600

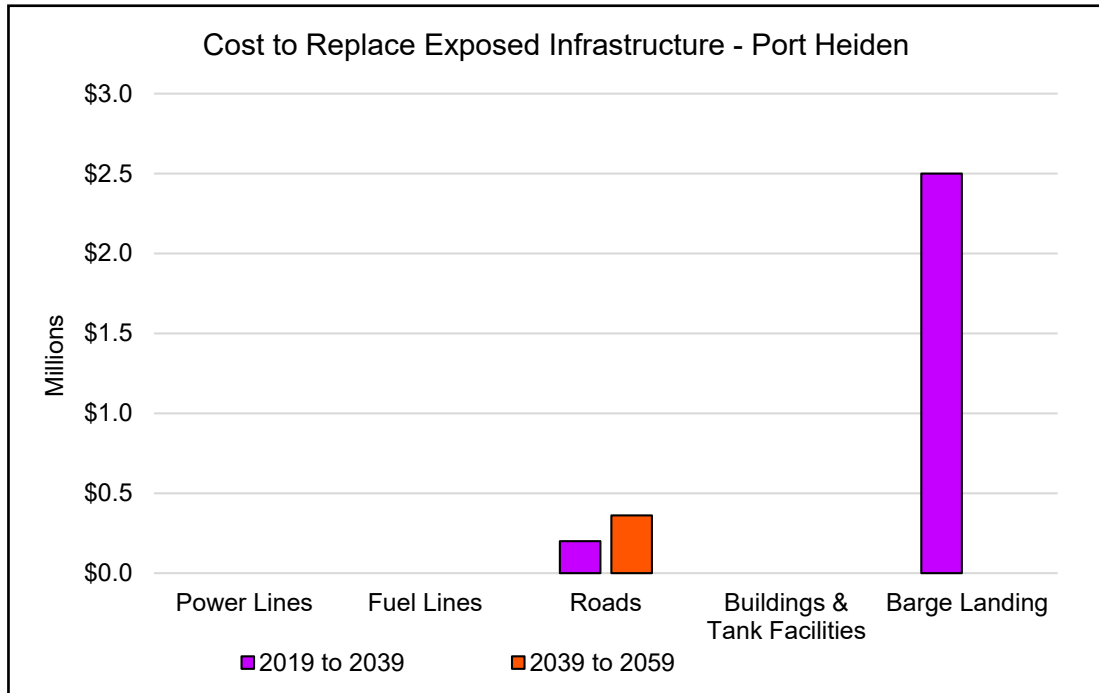


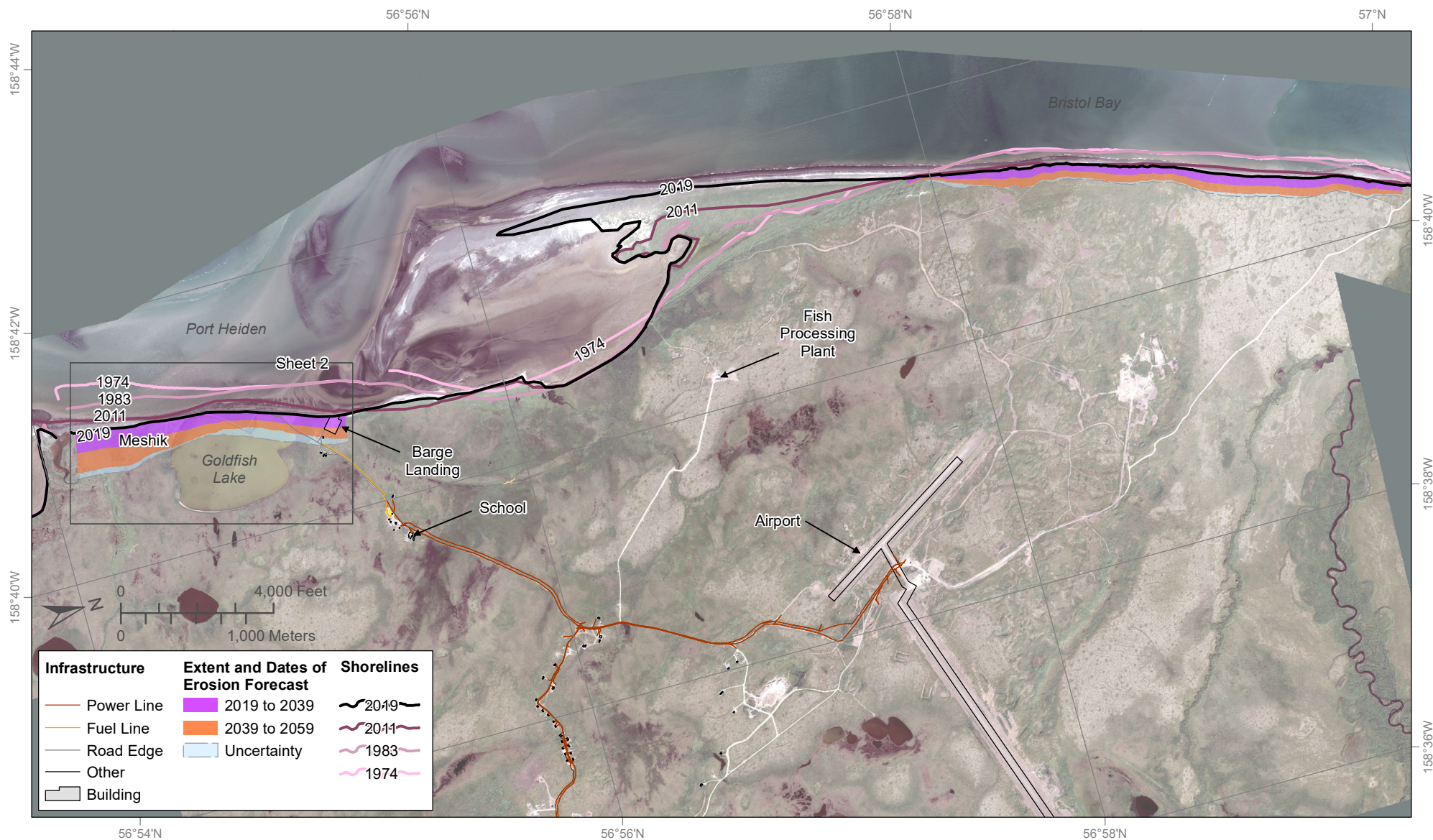
Figure 1. This figure shows the replacement cost of utilities, transportation infrastructure, and buildings and tank facilities that are forecast to erode per 20-year interval. Twenty-year intervals are symbolized by color: purple represents the time interval 2019 to 2039 and orange represents 2039 to 2059. The bulk of costs are the barge landing in the first 20 years (purple).

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Erosion Forecast Port Heiden, Alaska

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Buzard and others, 2021
Port Heiden, Sheet 1 of 2



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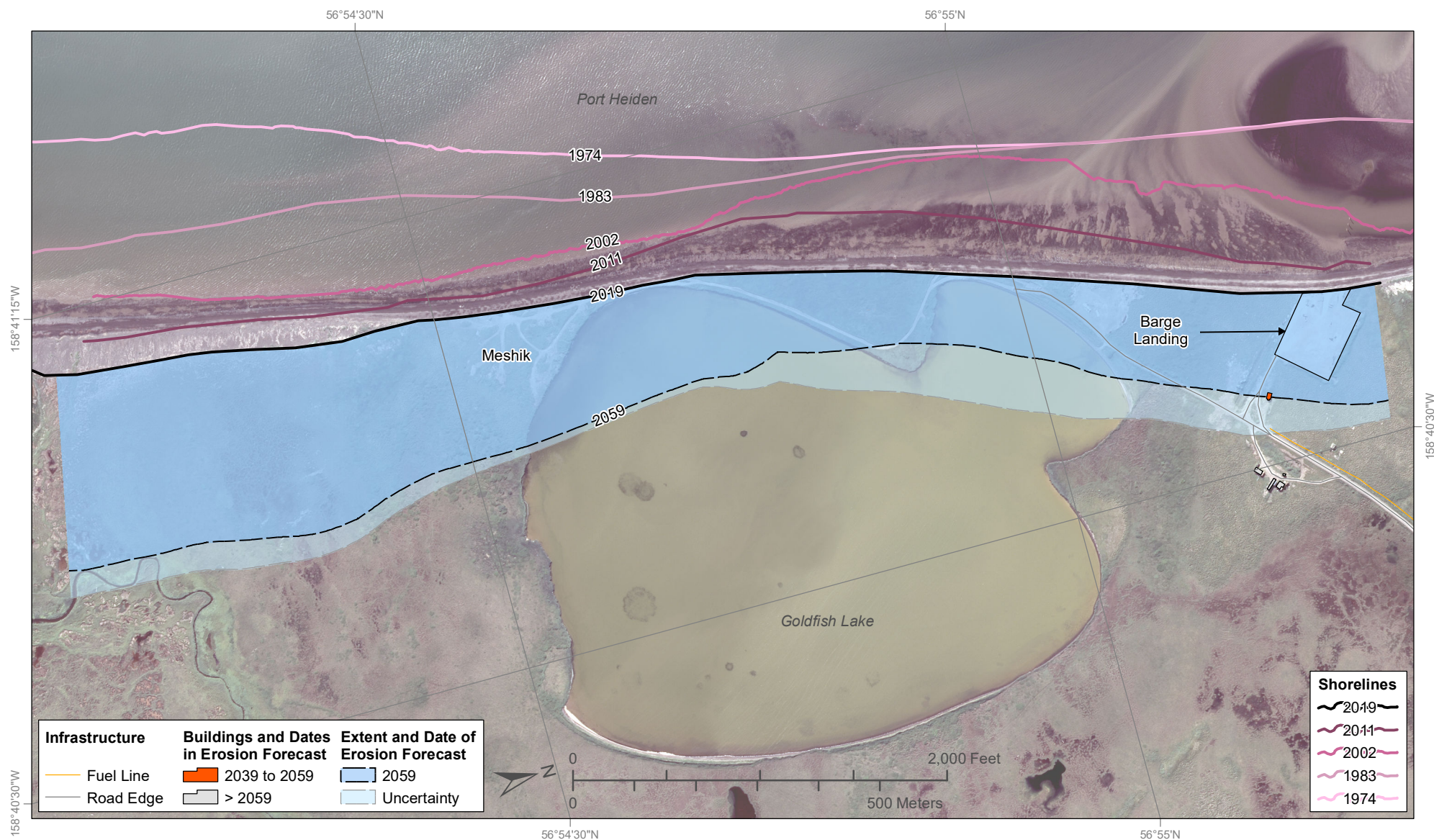
Erosion and accretion of coasts and rivers result in shoreline change. These rates of shoreline change at Alaska communities are calculated from historical and modern shorelines (shorelines shown as lines in pink scale and labeled by year). The long-term (1974 to 2019) shoreline change rate is used to forecast where erosion could impact community infrastructure. Erosion is forecast to reach the colored areas by specified time intervals: 2019 to 2039 (purple) and 2039 to 2059 (orange). The area of uncertainty of the 2059 shoreline at a 90 percent confidence interval is light blue. Areas that are not colored by time interval are not forecast to erode by 2059 based on the historical shoreline change rate. For more detailed information about the impacts to infrastructure from erosion at Port Heiden, refer to the Port Heiden 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 Port Heiden, Alaska

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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 pinkscale and labeled by year). The long-term (1974 to 2019) shoreline change rate is used to forecast where erosion could impact community infrastructure. Erosion is forecast to year 2059 (dark blue) with a 90 percent confidence interval area of uncertainty (light blue). Buildings in the erosion forecast area are colored by impact year range: 2019 to 2039 (purple), 2039 to 2059 (orange), and no impacts expected by 2059 (gray). For more detailed information about the impacts to infrastructure from erosion at Port Heiden, refer to the Port Heiden erosion exposure assessment report.

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