City of Homer
www.cityofhomer-ak.gov

Planning
491 East Pioneer Avenue
Homer, Alaska 99603
Planning@ci.homer.ak.us
(p) 907-235-3106
(f) 907-235-3118

Memorandum 22-101

MEMORANDUM PL 22-07

TO:	MAYOR CASTNER AND THE HOMER CITY COUNCIL
FROM:	RICK ABBOUD, AICP, CITY PLANNER
DATE:	May 26, 2022
SUBJECT:	COASTAL SETBACKS

After evaluating a an analysis of coastal bluff stability and policy completed by the Alaska Department of Natural Resources Division of Geological and Geophysical Surveys (DGGS), the Homer Planning Commission recommends an amendment to code that regulates setback from the coast of the City of Homer.

The recommendation of a 40' setback starting from the eastern boundary of Homer to below Soundview Avenue is widely accepted as a reasonable distance that gives most everyone an option to develop without an engineering study. One may develop with a smaller setback if it is recommended by an engineer, accepted by the City Engineer and approved with a CUP. The 60' setback designated for the coastal edge near Soundview Avenue continuing to the western boundary of the City recognizes the additional hazard predicted in the study. These lots are larger in size, have some of the tallest cliff faces, and some are unlikely to be developed such as those belonging of the Department of Natural Resources.

The use of the term 'coast bluff' has been modified to better describe features that represent appropriate points from which to measure the setback. The coastal edge is not solely dependent on bluff height, as the height of the bluff is not the only factor that contributes to the rate of erosion near the coast. This term 'coastal bluff' has been replaced with 'coastal edge', which necessitates that the term 'coastal bluff' be replaced where ever it is used in code.

The Commission finds that it is valuable to create a more practical setback now, but there are other actions and review to consider for the future. It is recognized that this ordinance should be revisited every five years or after any significant erosive event for consideration of modification. It is foreseeable that the City will need to work on additional measures to ensure responsible site development work near the coastal edge.

The subject of coastal setback was an agenda item at 6 Planning Commission meetings. The Commission held a public hearing on the proposed ordinance at their meeting of May 18, 2022 and voted with unanimous consent to recommend that the City Council adopt the draft ordinance.

Coastal Bluff Stability Mapping
Homer, Alaska

December 1, 2021

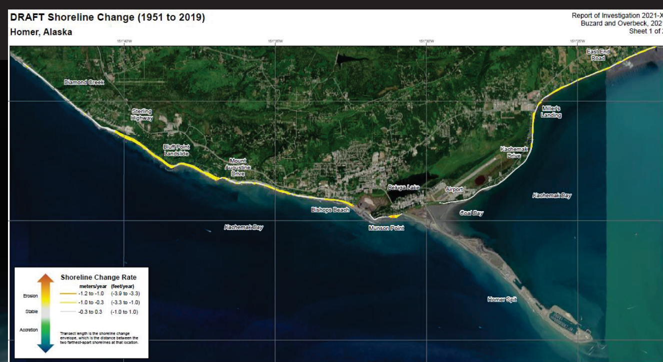
Jacquelyn Overbeck and Richard Buzard
Alaska Division of Geological & Geophysical Surveys

Coastal Bluff Stability Mapping: Project History

- 2018 DGGS Collects lidar to support landslide hazard project.
- 2019 initiate FEMA funded Coastal Bluff Stability Analysis.
- 2020-2021 present to Homer Planning Commission and for focus group for detailed feedback.
- 2021 provide final deliverables and outreach meetings.
- December 31, 2021 project completed.
- Future guidance through SOA.

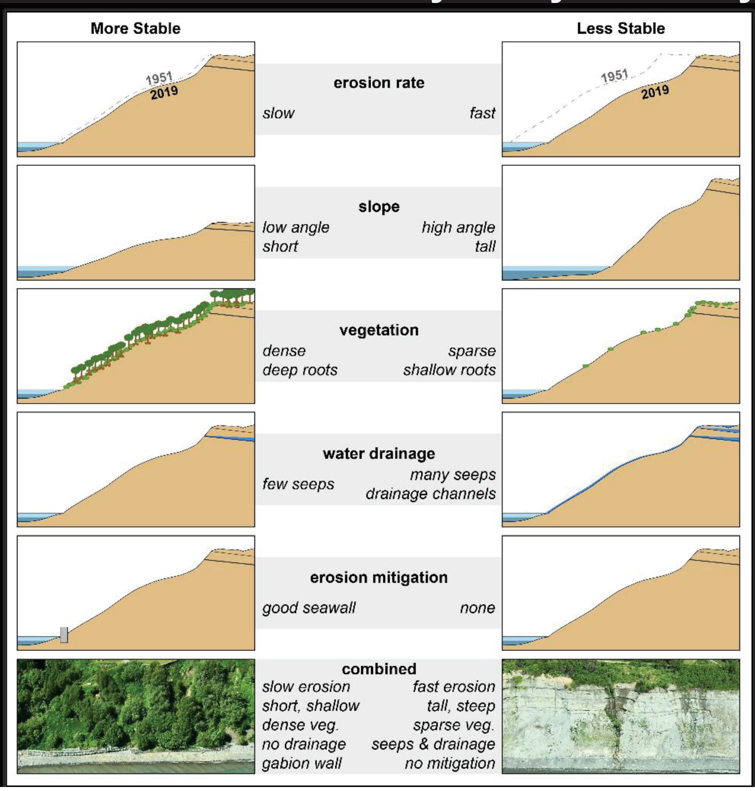
Coastal Bluff Stability Mapping: Project Overview & Deliverables

- Update shoreline change assessment (from Baird and Pegau).
- Use existing methods to define coastal bluff stability metrics and map bluffs in Homer.
- Provide data in relevant format for decision making on City Zoning policies.



Assessing the Hazard – Where?

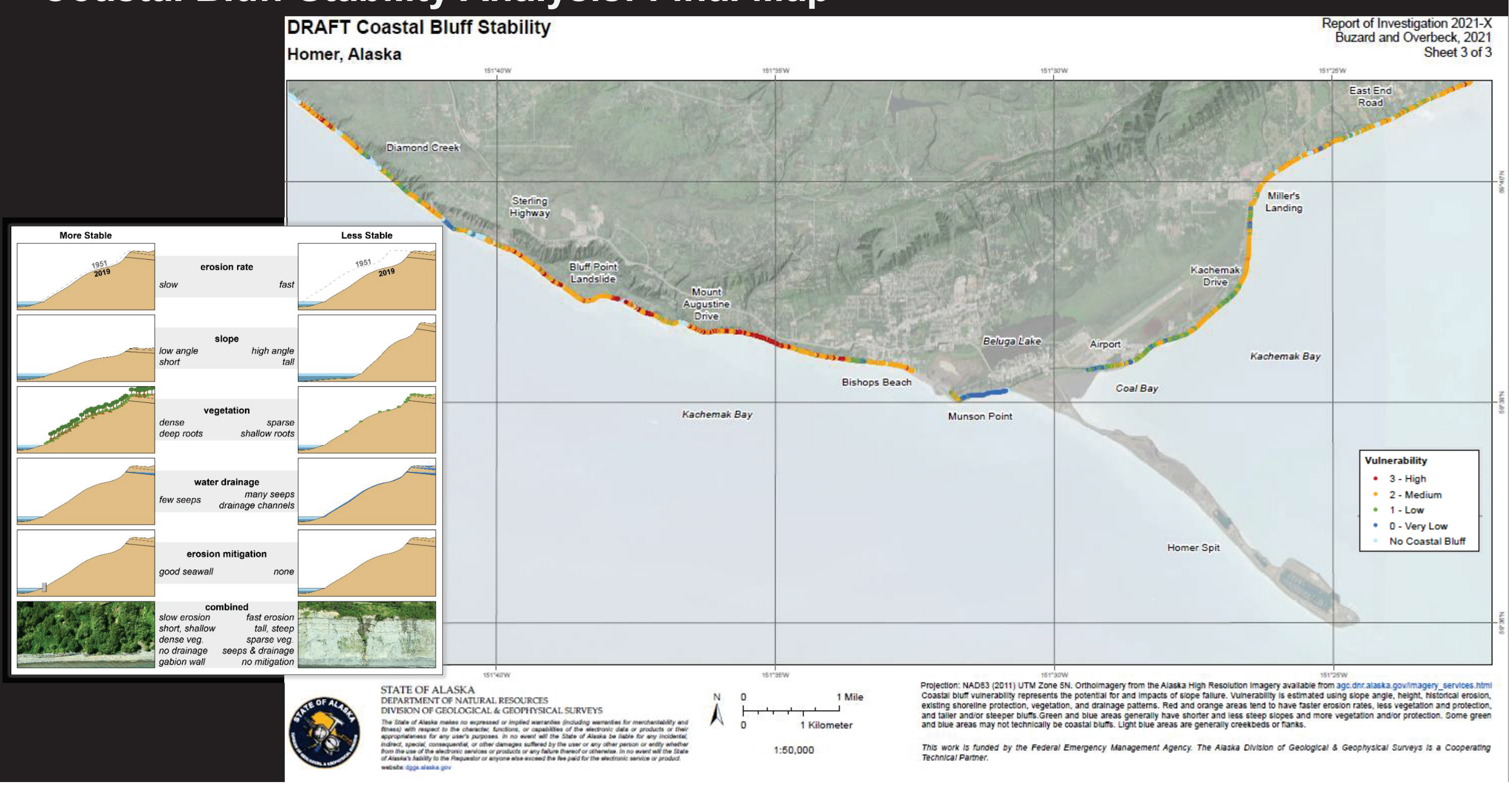
Coastal Bluff Stability Analysis: Analysis



Bluff Stability Analysis based on Maine Geological Survey, 2015, Coastal bluffs maps: Maine Geological Survey [website]: www.maine.gov/dacf/mgs/pubs/mapuse/series/descrip-bluff.htm

https://www.youtube.com/channel/UCs0-6PGoKbrO3jrnREdKKgQ/videos

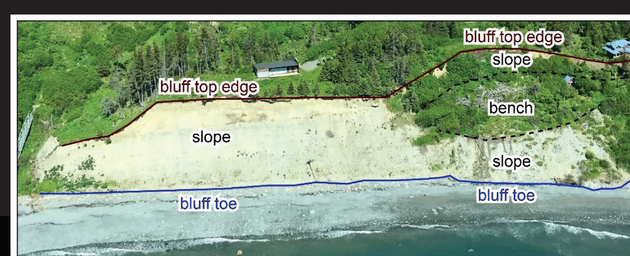
Coastal Bluff Stability Analysis: Final Map



Data for Decision Making – How Much?

Coastal Bluff Stability Mapping: Data for Decision Making

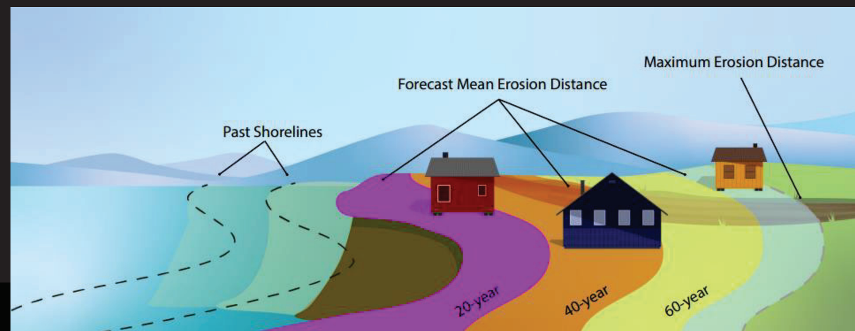
"Bluff" means an abrupt elevation change in topography of at least 15 feet, with an average slope of not less than 200 percent (two feet difference in elevation per one foot of horizontal distance). – City of Homer



In Homer, most coastal bluffs have slopes between 31 and 87 percent.

Coastal Bluff Stability Mapping: Data for Decision Making

No structure may be closer than **40 ft from the top of a coastal bluff**, and not closer than 15 feet from the toe.—City of Homer

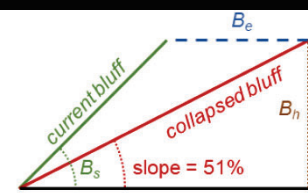


Two methods for evaluating potential erosion forecast **distance** within the bluff stability parameters:

- Historical Shoreline Change Rate
- Computed Bluff Failure Distance

$$B_e = B_h \times (B_s - 0.51)$$

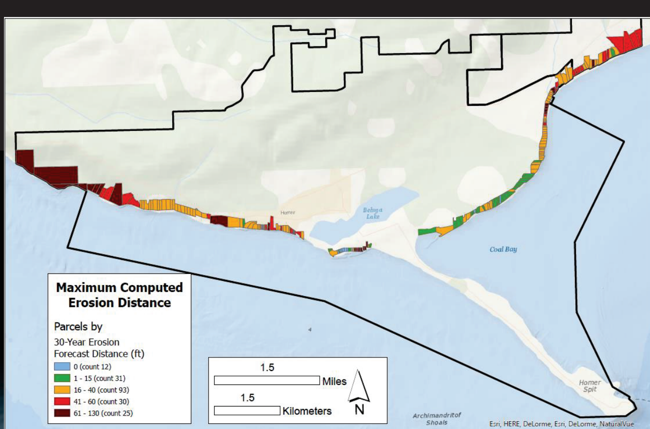
B_e = Horizontal bluff erosion due to slope failure
B_h = Bluff height
B_s = Average bluff slope percent (as a fraction)

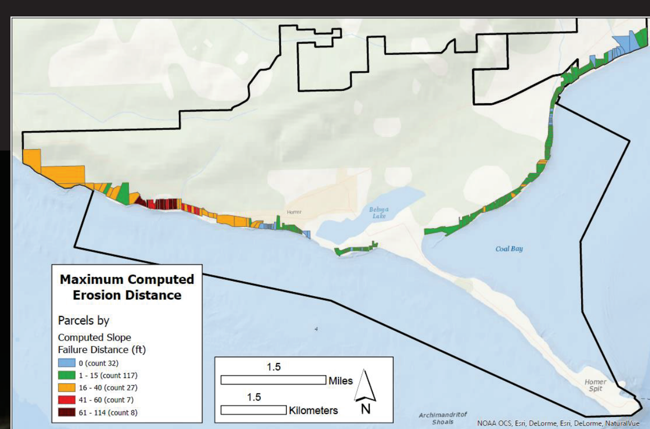


Coastal Bluff Stability Mapping: Data for Decision Making

Determining forecasted erosion distance and slope failure distance based on parcel.

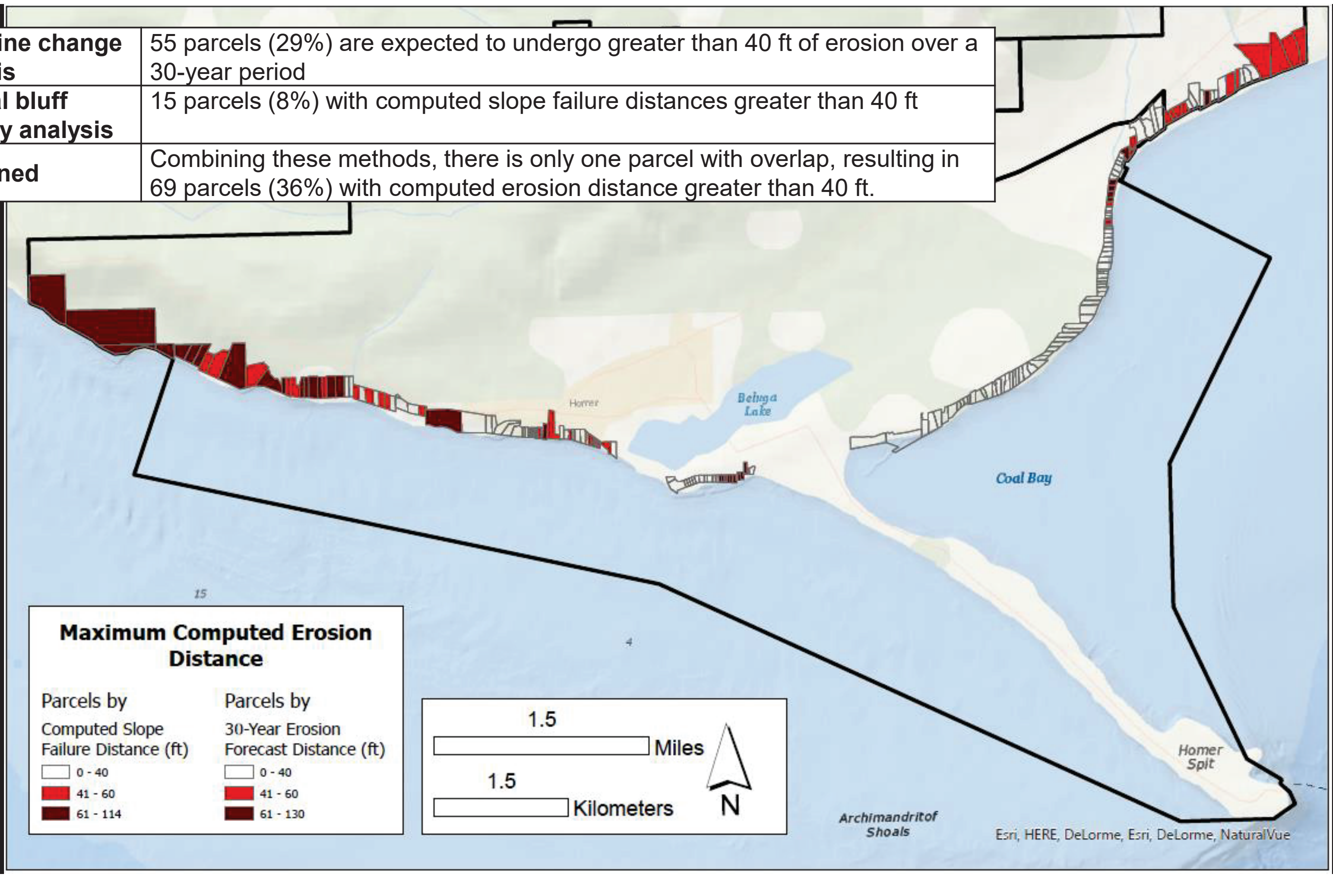
Parcels are not differentiated between developed and undeveloped.





Alaska Division of Geological & Geophysical Surveys | **Coastal Hazards Program**

Shoreline change analysis	55 parcels (29%) are expected to undergo greater than 40 ft of erosion over a 30-year period
Coastal bluff stability analysis	15 parcels (8%) with computed slope failure distances greater than 40 ft
Combined	Combining these methods, there is only one parcel with overlap, resulting in 69 parcels (36%) with computed erosion distance greater than 40 ft.



Coastal Bluff Stability Mapping: Summary

Key Findings

- Data to assist in changes to City Zoning Code:
  - Bluff Definition
  - Coastal Setback

Many of the parcels within the City boundary are already developed.

Next Steps

- Report and maps awaiting administrative review in DGGS. Report makes for outreach materials with the public.

- FEMA project coming to an end. DGGS available for future public meetings and technical guidance.

Contact Information
https://dggs.alaska.gov/hazards/coastal/

Jacquelyn Overbeck
Coastal Hazards Program Manager
Phone: 907-451-5026
Email: jacquelyn.overbeck@alaska.gov

City of Homer
www.cityofhomer-ak.gov

Planning
491 East Pioneer Avenue
Homer, Alaska 99603
Planning@ci.homer.ak.us
(p) 907-235-3106
(f) 907-235-3118

Staff Report PL 21-70

TO:	Homer Planning Commission
FROM:	Rick Abboud, AICP, City Planner
DATE:	December 1, 2021
SUBJECT:	Coastal Bluff Analysis

Introduction

Jaci from Alaska Department of Natural Resources Division of Geological and Geophysical Surveys (DGGS) will present on the latest draft of her report during the work session.

Analysis

My initial thought is that we have developed a good assessment of some hazards that affect coastal bluff stability. There are still a few things to consider and we may require some additional input.

First we must consider the measure of protection that we which to legislate. In general, I believe that most of the coastal areas would benefit from a 40' setback in all circumstances without the input of an engineer. There does seem to be some exception to this that may be a consideration. Will wait for feedback from the presentation before further addressing.

The other item is the concern is that our definitions that incorporate the bluff definition of a 2/1 slope and topography of at least 15 feet of elevation change. While this definition is a good rule of thumb for generally describing a slope that may be prone to failure, it really does not address an eroding shoreline. The erosion rate does not necessarily translate well to a slope and height calculation. One may be at 5 feet in elevation and be experiencing a high rate of erosion.

My goal is not to necessarily solve this issue at this meeting, but I would like to describe concerns and further develop solutions after receiving some input from the Commission after Jaci's presentation.

HCC 21.03.040

"Bluff" means an abrupt elevation change in topography of at least 15 feet, with an average slope of not less than 200 percent (two feet difference in elevation per one foot of horizontal distance).

"Coastal bluff" means a bluff whose toe is within 300 feet of the mean high water line of Kachemak Bay.

HCC 21.44.030 Slope development standards

c. Setbacks. Subject to the exceptions to setback requirements in HCC 21.44.040, all development activity is subject to the following setback requirements:

1. No structure may be closer to the top of a ravine, steep slope or noncoastal bluff than the lesser of:

a. Forty feet; or

b. One-third of the height of the bluff or steep slope, but not less than 15 feet.

2. No structure may be closer than 15 feet to the toe of a bluff other than a coastal bluff.

3. No structure may be closer than 40 feet to the top of a coastal bluff and closer than 15 feet to the toe of a coastal bluff.

Staff Recommendation
Discuss and make recommendations for further considerations of the Commission

  - it is not expected that nine additional residences will impact the natural drainage any more than what is actually going on currently
- what development is proposed for Lot A since the majority of the parcel is over 20% slope
  - Parcel A does not really lend itself for development and be feasible
  - Make that parcel a nature conservancy if possible
  - There is a spot in the NW corner that could be developed and possibly could be accessed from Alpine Way

HIGHLAND/MOVE TO ADOPT STAFF REPORT 21-69 AND RECOMMEND APPROVAL OF THE REVISED TERRA BELLA PRELIMINARY PLAT TO CREATE NINE RESIDENTIAL LOTS ALONG FAIRVIEW AVENUE AND ONE LARGE TRACT ACCESSED FROM ALPINE WAY WITH THE FOLLOWING COMMENTS:

1. DEDICATE A PUBLIC ACCESS EASEMENT OVER THE EXISTING CAMPGROUND ROAD WHERE IT ENCROACHES ON TRACT A
2. GRANT A PUBLIC ACCESS OR TRAIL EASEMENT FROM THE NORTHWEST CORNER OF KAREN HORNADAY PARK TO THE CITY PARCEL
3. CORRECT PLAT NOTE 6 TO SPECIFY WHICH LOTS HAVE ACCESS TO CITY WATER AND SEWER
4. DEDICATE A 60 FOOT DRAINAGE EASEMENT CENTERED ON THE EASTERN CREEK.
5. ACCEPT A 40 FOOT DRAINAGE EASEMENT ON THE WESTERN CREEK AS SHOWN ON THE PLAT (TO BE PROVIDED AS A LAYDOWN AT THE MEETING.)

A lengthy discussion ensued on approving the plat with development of the steeper parcels that will create drainage issues for the downslope properties. City Planner Abboud counseled the Commission on denial of the plat without the basis of standing regulations. Further discussion on postponement to have the applicant present or respond to their concerns ensued as well as points made on supporting their recommendation by the Borough and if the issue went to Court, and development versus subdivision is where these issues can be addressed.

VOTE. YES. BENTZ, CONLEY, BARNWELL, VENUTI, SMITH, CHIAPPONE
VOTE. NO. HIGHLAND.

Motion carried.

PENDING BUSINESS

A. Staff Report 21-70 Coastal Bluff Analysis

Chair Smith Introduced the item by reading of the title and invited City Planner Abboud to provide his report.

City Planner Abboud stated that this is a follow-up to the presentation and believed that Ms. Overbeck did a great job on what is in existing code. He facilitated discussions and responses to questions on the following:

- Recommended 40 foot setback requirement
    - Commented on the approval and construction of the cabin on the bluff side just at the entrance of the Homer
    - location of the 40 feet may not be adequate
        - increasing to 60 feet or more may not be advisable
- defining coastal bluff that would be relative to Homer
- when the coast line marches back those definitions should still be applicable
    - is 30 years the right term to plan for
- changing environmental conditions will policy and definitions still be effective
- review definitions to determine better ones that identify or describe coastal bluffs
- determine if a thirty year planning horizon the right term limit to consider
    - Environmental conditions
    - Infill on coastal bluffs
        - having policy and definitions that will address these conditions
- gradual erosion rate versus historic erosion rates
    - Hard data available to 60 years in the past
    - erosion versus evulsion regulations
    - description of the bluffs since they will move
- getting professional assistance
    - providing property at the end of West Hill is not described in the definitions
        - this may be a location where the bluff will let go all at once
        - the capacity to perform a buyout
        - application is 100 pages
        - rules and regulations pertaining to this
- satisfying the needs of the lender over the home owner and selecting a term that is in between
- the impact of the chemicals and toxins not to mention the human aspect when those house go into the ocean
- receding shoreline and the willingness of property owners in 20-30 years for implementing shoreline hardening and what that will look like for the community

NEW BUSINESS

A. Staff Report 21-71, Rezoning Portions of Rural Residential District to Urban Residential

Chair Smith introduced the item by reading of title and invited City Planner Abboud to provide his report.

City Planner Abboud provided a summary of Staff Report 21-71 for the Commission.
He facilitated discussion on the following:

- green infrastructure to mitigate drainage issues
- the inherent need of housing
- natural infrastructure is like fingers of green that are necessary for drainage connectivity trails or non-motorized access
- concerns on the wetlands
    - all area is wet, some of the larger lots they can have a discussion and some property owners may have to go to the Corps of Engineers

City of Homer
www.cityofhomer-ak.gov

Planning
491 East Pioneer Avenue
Homer, Alaska 99603
Planning@ci.homer.ak.us
(p) 907-235-3106
(f) 907-235-3118

Staff Report Pl 22-01

TO: Homer Planning Commission
FROM: Rick Abboud, City Planner
DATE: January 5, 2022
SUBJECT: City Planner's Report

City Council 12.13.21

Board of Adjustment (BOA)

a. Consideration of Motion for Leave to Supplement Points on Appeal to Address Planning Commission's Dismissal of Appeal by Frank Griswold, Appellant
Memorandum 21-201 from City Clerk as backup

b. Recommendation by the Planning Commission to Dismiss the Appeal of Conditional Use Permit (CUP) 20-15 for the Reconstruction of a Restaurant Building at 106 W. Bunnell Avenue, Homer, Alaska based on the Applicant's Withdrawal of their CUP Application.
Memorandum 21-202 from City Clerk as backup

REFERRED matters to a hearing officer with discussion.

Regular meeting

i. Ordinance 21-72, An Ordinance of the City Council of Homer, Alaska Appropriating $3,400 from the Land Fund to Acquire Tax Foreclosed Property from the Kenai Peninsula Borough and Retaining the Property for the Public Purpose of Determining the Special Assessment Liens and Creating a Clear Title to the Property, and Authorizing the City Manager to Negotiate and Execute the Appropriate Documents. City Manager. Recommended dates Introduction December 13, 2021 Public Hearing and Second Reading January 10, 2022.
Memorandum 21-209 from Deputy City Planner as backup

Kenai Homelessness Coalition

I did record a presentation that was presented at the MAPP Community Meeting on December 17th. If the Commission has interest, I can share the 3 minute video. We have come up with a new Draft Strategic Plan. You can sign up for updates on the coalition at https://www.kenaipeninsulahomeless.org/.

Permitting software

We continue to work on modifying and testing the software with hope that it will be ready for the next building season.

Hazard Mitigation Plan Update

Have not interacted much with the contractor during the holiday season, I look forward to picking things up in the New Year.

Rural Residential Rezone Update: a rough project outline

1. Make information available (January)

Over the next few weeks, staff will create content for a flier and the city website on the rezone. This content will include:

~ The rezone process
~Why now is the time to change the land use rules
~Analyze current land uses and non-conformities
~Explain what land use rights would change for property owners

2. Work with community partners (February)

After we have this information together, we'd like to work with community partners such as the realtor and developer community on increasing community awareness of the need for change. This could include public presentations if appropriate.

3. Schedule public outreach (conduct in mid-late February)

Prior to scheduling a public hearing, we'd like to have some method for people to meet with a planner and possibly a commissioner. Planning is working on another project, and we're trying a library fireplace area open house/brown bag type interaction. We'll see how that goes and modify for this rezone project.

4. Conduct public hearing and forward recommendations to Council (March?)

Economic Development Advisory Commission

At their December meeting, the EDC made some recommendations on the Land Allocation Plan, and reviewed the latest draft of the Wayfinding and Streetscape plan. Final review will be January 11th, with City Council review tentatively planned for January 42th.

Planning
491 East Pioneer Avenue
Homer, Alaska 99603

City of Homer
www.cityofhomer-ak.gov

Planning@ci.homer.ak.us
(p) 907-235-3106
(f) 907-235-3118

Staff Report PL 22-03

TO: Homer Planning Commission
FROM: Rick Abboud, AICP, City Planner
DATE: January 5, 2022
SUBJECT: Consideration of bluff setbacks

Introduction We heard from Jaci Overbeck at our last meeting concerning bluff stability.

Analysis Now that we have the study it is time to consider actions. One item that I plan to address is creating a definition of Coastal Bluff that works for Homer. I have talked to the Public Works Director to help find the appropriate professional among the engineering firms that the City has under contract.

Next is to consider the amount of regulation that is appropriate to apply. I propose to start the conversation with the consideration of having a set 40' setback from the bluff starting on the east side of town and then transition to a 60' setback from the bluff starting south of Saltwater Drive. Due to still having technical issues with our GIS system, I plan to screen share the Borough Parcel Viewer to provide the Commission with a view and sense of dimensions of the lots that are found along the coast from Saltwater Drive to the west. Using the maps attached to the study, you can see the increased erosion rates and decreased bluff stability from below Saltwater Drive and to the west.

Third is to consider the allowance for a land owner to develop closer than the setback with the guidance of an engineer. This item is intertwined with the consideration of the amount of regulation that is decided upon. Generally, our numbers from the study are based off of the consideration of a 30 year time frame. This is where we may make an allowance for an erosion mitigation device or methods.

Based on the discussion I will draft up some draft language for technical review and I will seek out answers to any technical question that we may have about the consideration of regulations. I do wish to make regulations that will work well with established building regulations and won't interfere with the possibility of Homer adopting a building code.

Staff Recommendation
Have a discussion and make recommendations regarding general regulations and standards that will be considered for adoption and/or further study

Attachments

Draft Coastal Bluff Stability Analysis
Draft Homer Map 1 Shoreline Change Analysis
Draft Homer Map 2 Coastal Bluff Stability
Final Latter Homer Bluff Considerations DGGS

Report of Investigation 202X-X

COASTAL BLUFF STABILITY ASSESSMENT FOR HOMER, ALASKA

Richard M. Buzard and Jacquelyn R. Overbeck

Published by
STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS
2022

Cover. Coastal bluff by the Sterling Highway, Homer, Alaska.

COASTAL BLUFF STABILITY ASSESSMENT FOR HOMER, ALASKA

Richard M. Buzard and Jacquelyn R. Overbeck

Report of Investigation 202X-X

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 for free 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., and Overbeck, J.R., 202X, Coastal bluff stability assessment for Homer, Alaska: Alaska Division of Geological & Geophysical Surveys Report of Investigation 202X-X, XX p. https://doi.org/10.14509/xxxxx

Contents

Figures

Tables

COASTAL BLUFF STABILITY ASSESSMENT FOR HOMER, ALASKA

Richard M. Buzard[1] and Jacquelyn R. Overbeck[1]

Abstract

We evaluate the stability of coastal bluffs in Homer, Alaska, using aerial imagery and modern elevation data. We produce maps of historical shoreline change and an alongshore bluff instability hazard score. Shoreline change is calculated by comparing the bluff top and toe positions in historical and modern orthorectified aerial imagery. Since 1951, Homer's coastal bluffs have eroded at an average rate of -1.0 ft/yr (-0.29 m/yr). Key indicators of bluff instability are historical shoreline change rates, bluff slope and height, vegetation, existing erosion protection structures, and water drainage. Most of the Homer coastline has a low to medium bluff instability hazard score. These coastal hazard products can guide decisions to reduce risk.

INTRODUCTION

Coastal bluff failure poses a hazard to the City of Homer (Baird and Pegau, 2011; Kenai Peninsula Borough, 2019; Salisbury, 2021). To assess this hazard, the Alaska Division of Geological & Geophysical Surveys (DGGS) created this report, associated maps, and GIS layers and data tables. This project is funded by the Federal Emergency Management Agency (FEMA) Cooperating Technical Partners (CTP) Program. This report is suitable to guide potential future updates to the FEMA Multi-Hazard Risk MAP analysis for Homer, should such an analysis be launched, and provide critical technical information for the next update of the Homer Local Hazard Mitigation Plan and future development plans or policies.

BACKGROUND

Geologic and Coastal Setting

The City of Homer, near the southwestern end of the Kenai Peninsula, is characterized by a prominent spit that extends into Kachemak Bay referred to locally as "Homer Spit" (Kenai Peninsula Borough, 2019; fig. 1). West of Homer Spit, bluffs near the coast rise to 800 ft (240 m) above mean sea level (MSL). The predominate rock type (the Kenai Group) comprises layers of poorly consolidated sands, silts, and clays, with intergraded beds of medium- to low-grade coal (Barnes and Cobb, 1959). Coal beds dip less than 10 degrees away from the shoreline and act as aquicludes, resulting in suspended water tables. The bluffs are partially vegetated with shrubs and trees. Exposed bluffs display visible groundwater seeps at coal beds. Properties at the top of the bluff overlook Kachemak Bay and Cook Inlet, with unimpeded views of the Kenai Mountains to the south and the volcanic Aleutian Range to the west. Coastal bluffs east of the spit are typically below 100 ft (30 m) above MSL and have numerous drainage channels. Residences and other infrastructure are built on the hilltops from Diamond Creek to past East End Road.

The majority of the Homer coastline consists of gently sloping (1 to 15 degrees) beaches of sand, pebbles, and cobbles (Kenai Peninsula Borough, 2021). Homer has semidiurnal tides with a great diurnal range of 18.4 ft (5.62 m; National Oceanic and Atmospheric Administration Center for Operational Oceanographic Products and Services [NOAA CO-OPS], 2020a; table 1). The local tidal datum was established in 2019, but the nearby Seldovia tide gage has been in operation since 1975 and has a similar datum (NOAA CO-OPS, 2020b; table 1). The highest water level recorded

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

in Seldovia reached 25.3 ft (7.72 m) above mean lower low water (MLLW) on November 5, 2002. Since 1964, relative sea level has fallen 1.8 ft (0.56 m; NOAA CO-OPS, 2020b).

Understanding Bluffs, Coastal Bluffs, and Erosion Rates

Bluffs are landforms that are steepened by erosion processes including wind, water, weathering,

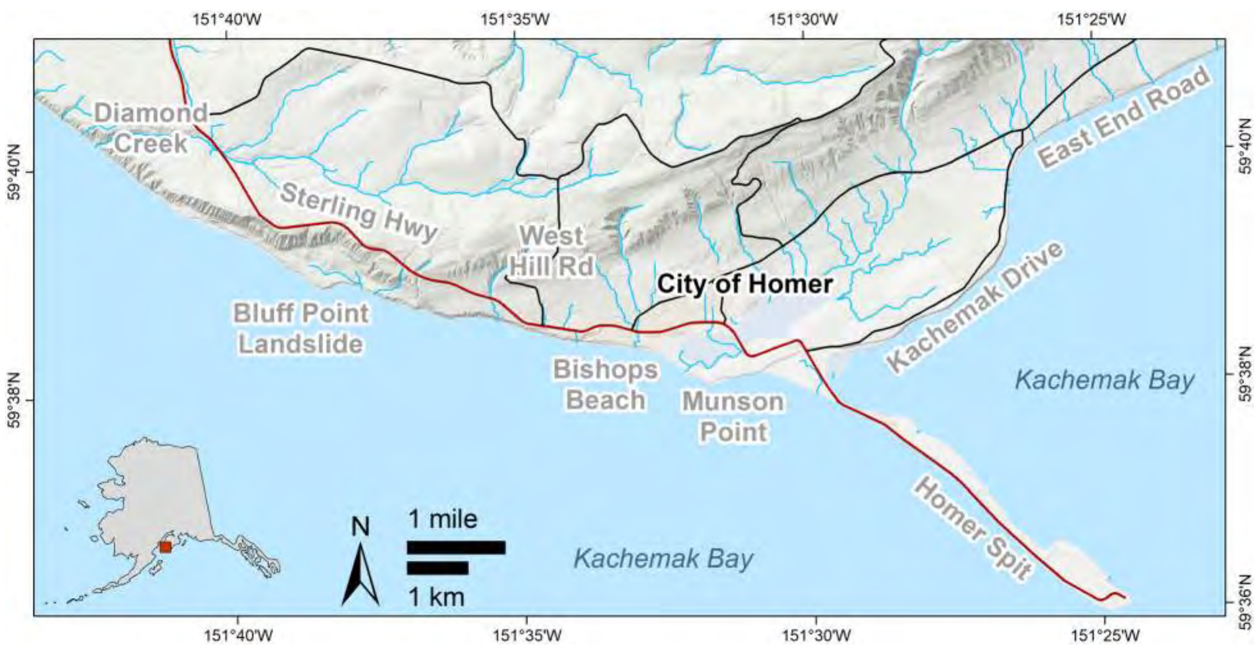


Figure 1. The area of interest for coastal bluff stability analysis includes the City of Homer and surrounding area. The hill-shade elevation model shown was collected by Salisbury and others (2021).

Table 1. Tidal datums for Homer, Alaska (Coal Point; station 9455558), and nearby Seldovia (station 9455500).

Datum	Datum abbreviation	Homer ft (m) above MLLW	Seldovia ft (m) above MLLW
Mean Higher-High Water	MHHW	18.432 (5.618)	18.041 (5.499)
Mean High Water	MHW	17.592 (5.362)	17.231 (5.252)
Mean Tide Level	MTL	9.626 (2.934)	9.462 (2.884)
Mean Sea Level	MSL	9.734 (2.967)	9.554 (2.912)
Mean Diurnal Tide Level	DTL	9.216 (2.809)	9.091 (2.771)
Mean Low Water	MLW	1.657 (0.505)	1.696 (0.517)
Mean Lower-Low Water	MLLW	0.000 (0.000)	0.000 (0.000)
North American Vertical Datum of 1988	NAVD88	5.095 (1.553)	5.161 (1.573)
Great Diurnal Range	GT	18.432 (5.618)	17.231 (7.072)
Mean Range of Tide	MN	15.935 (4.857)	7.766 (6.308)
Highest Astronomical Tide	HAT	N/A	23.110 (7.042)

and tectonic motion. Bluffs and steep slopes are often the focus for hazard assessments because they can gradually or rapidly erode and have the potential for massive failure (Highland and Bobrowsky, 2008). Several factors can contribute to destabilize a slope, including earthquakes, undercutting, increased load (such as from groundwater or surface water flooding), stratigraphy and aquicludes, or weak vegetation (Hampton and Griggs, 2004; Highland and Bobrowsky, 2008; Kokutse and others, 2016).

There is not a quantitative definition for a coastal bluff. "Coastal bluff" is a general term to describe a steep slope that is eroded by coastal processes like tides, waves, and currents (Hampton and Griggs, 2004). Coastal bluffs (and lake and riverine bluffs) can erode faster than inland bluffs due to frequent undercutting from water bodies. Coastal areas are also natural end points for watershed drainage, so ground and surface water accumulation may be higher than in inland areas (Heath, 1983).

Erosion of composite coastal bluffs (containing more than one type of material) commonly occurs in a two-step cycle of undercutting and steepening (toe erosion) via wave action, then mass movement (top erosion; Maine Geological Survey, 2015; fig. 2). The typical speed of this paired failure can dictate the proper method to assess a hazard: if there is annual to sub-decadal erosion, the hazard is described using long-term linear erosion rates (Himmelstoss and others, 2018). If erosion occurs rarely, such as on centennial or longer timescales, then it becomes more appropriate to describe hazards using probability or categorical hazard levels (such as Hapke and Plant, 2010). This is especially the case for extreme mass movements like deep-seated landslides (Varnes, 1978; Salisbury, 2021).

Coastal Bluff Erosion and Stability in Homer

The majority of Homer's coastal boundary comprises bluffs. Using sets of aerial images from 1951 to 2003, Baird and Pegau (2011) calculate average erosion rates of 2.6 ft/yr (0.8 m/yr) west of the spit and 2.0 ft/yr (0.6 m/yr) east. The period of greatest erosion occurred after March 27, 1964, when the magnitude 9.2 Good Friday earthquake caused an average 3.5 ft (1.1 m) of subsidence in the region (Stanley, 1968). High tide mostly submerged the spit, and waves reached the toes of many coastal bluffs (Gronewald and Duncan, 1965). Due to the unprecedented wave action, bluffs eroded as much as 8 ft (2.4 m) back in just 6 months (Stanley, 1968). Other than this major event, bluff erosion in Homer has been a slow process relative to many Alaska communities (Overbeck and others, 2020). Still, several structures are near eroding bluffs and have potential to be exposed to erosion in the coming decades.

METHODS

This analysis focuses on two goals: (1) calculate historical bluff erosion, and (2) estimate current bluff stability. Historical bluff erosion is computed using orthorectified aerial imagery and the Digital Shoreline Analysis System (DSAS; Himmelstoss and others, 2018). Bluff stability is estimated by combining variables that factor into instability: height, slope angle, vegetation, drainage, erosion history, and shoreline armoring.

Lidar-derived elevation models are critical for this analysis. In 2019, DGGS collected lidar over Homer and created a bare earth digital terrain model (DTM) and digital surface model (DSM) with a ground sampling distance (GSD) of 1.6 ft (0.5 m; Salisbury and others, 2021; fig. 1). DGGS also collected oblique alongshore imagery. In the same year, the U.S. Army Corps of Engineers (USACE) collected topobathymetric lidar from the Homer spit northwest to Diamond Creek, creating a DTM with 3.3-ft (1.0 m) GSD (OCM Partners, 2021). USACE also created two orthomosaics (at high tide and low tide) with 2-inch (0.05 m) GSD.

Identifying Coastal Bluffs and Study Extent

The extent of the DGGS lidar is used as the study area boundary (fig. 1). All slopes with toes reaching a coastal area are examined for this study. We extract the Mean High Water (MHW) line

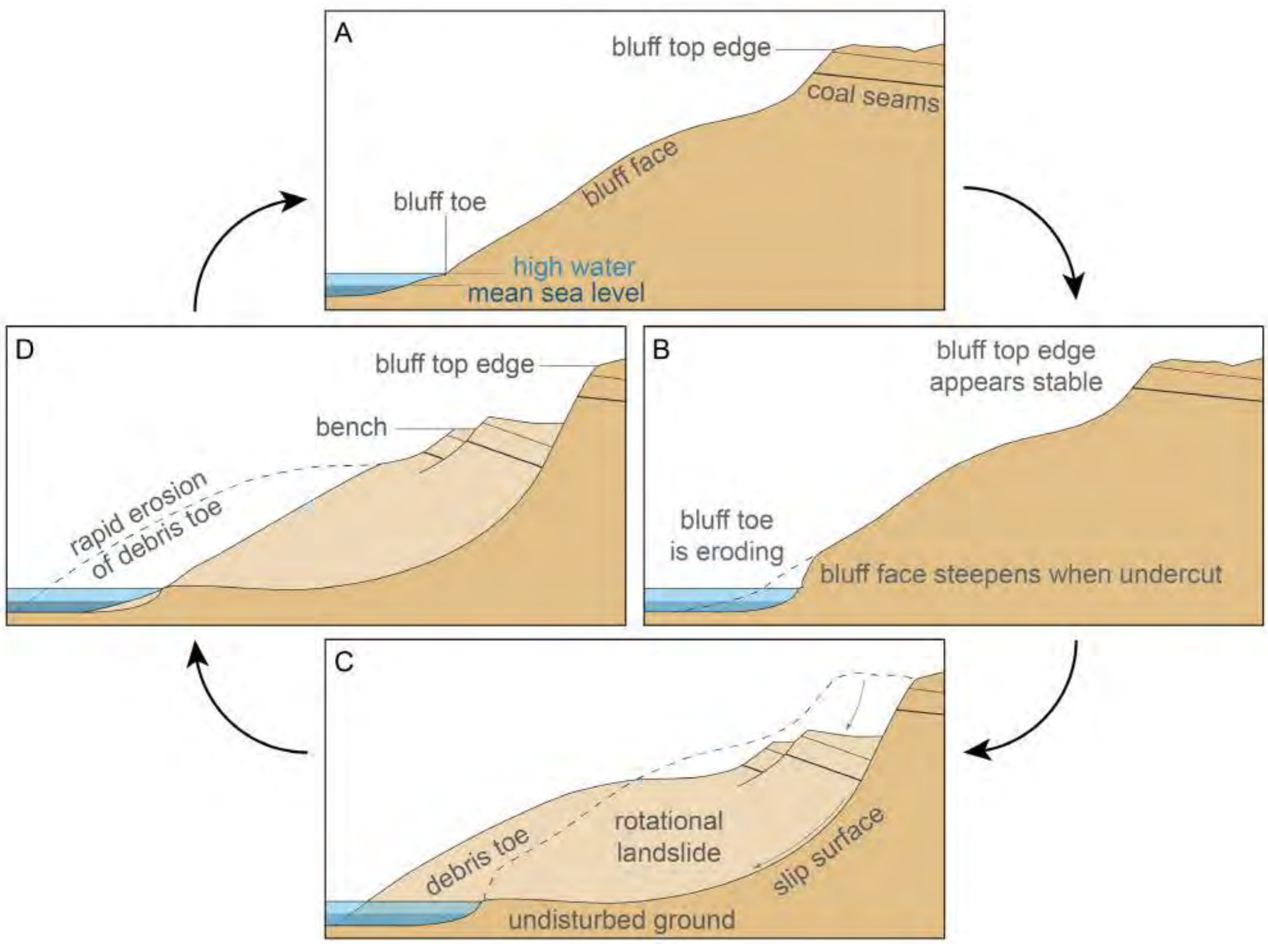


Figure 2. This schematic expands the two-step (top and toe) coastal bluff erosion cycle into four phases. **A.** The bluff is being eroded and undercut at the toe by storm-driven waves. **B.** Although the bluff top edge remains stable, the angle between the toe and top is steepening, leading to unstable conditions. **C.** A landslide (rotational slump) occurs and debris flows toward the ocean, lowering the blocks at the former bluff top edge along the slip surface. **D.** The debris in the intertidal and storm tide zone is eroded relatively quickly. Erosion slows because the remaining bluff is outside the intertidal zone. The new bluff face is at a shallower angle than before, and the cycle renews.

(12.50 ft [3.809 m] NAVD88) using the DGGS DTM and smooth it to contour the coastline. Along this line, we delineate the 2019 bluff toe and top using a combination of digital elevation models (DEM), orthomosaics, and oblique aerial imagery. The toe is generally defined as the seaward extent of a slope where a break to relatively flat land occurs (often a sediment transition), land continues down to the MHW line, and along that transect there exists no topography higher than the bluff toe (fig. 3). The bluff top edge is identified as the seaward extent of relatively flat land where a slope break or scarp occurs. For complex slopes with benches, the bluff top edge is landward of the benches (fig. 3). These manually delineated bluff features define the envelope where bluff face characteristics are measured.

Historical Shoreline Change Analysis

Traditionally, shoreline change is calculated by matching two aerial images taken at different times, delineating shorelines, and measuring the distance between them (Baird and Pegau, 2011; Overbeck and others, 2020). The coastal bluff erosion history in Homer has been calculated many times using this method, as recently as 2016 (City of Homer, 2021). We received the shorelines and imagery from 1951 to 2003 that were used and found two major

Figure 3. Oblique image of a coastal bluff with delineated toe (blue) and top edge (maroon). The right side shows how delineations are made for a complex section. The bluff has a bench (black dashed lines), so the delineated top edge is landward of this bench. In this example, there is a building on the bench that is seaward of the bluff top edge (far right side).

components that have caused significant errors: (1) some of the image sets are not orthorectified, and (2) delineations do not consistently follow the same features through time in all areas (switching between bluff top and toe). The affected images and shorelines are for the years 1951, 1961, 1968, 1975, and 1996. The orthorectified 2003 image is adequate. For these reasons, we source raw aerial imagery to orthorectify, delineate shorelines, and compute shoreline change using the DSAS tool (Himmelstoss and others, 2018). The orthoimagery dates are 1951/1952, 1964, 1985, 2003, 2011, and 2019 (table 2). The time steps between image collections are 12 or 13, 21, 18, 8, and 8 years, respectively.

Image Corrections

Orthometric corrections are vital for evaluating erosion of tall, steep bluffs. Buzard (2021) explains the historical aerial image orthorectification process. Historical aerial photos are initially collected with a low distortion frame lens pointed nadir. A simple method to display these images in a map is to shift and scale them to match features on the landscape. This method, called "georeferencing" or "georectification," may appear adequate from a distance, but the perspective from the image center causes offsets at finer scales (termed "relief displacement;" Crowell and others, 1991). Offsets increase near high-angle features, like bluffs, and

Table 2. Imagery used for shoreline delineations include color (RGB), color-infrared (CIR), and black and white (BW).

Date	Type	Orthomosaic pixel size (m)	Source
2019 JUL 17	RGB	0.05	OCM Partners (2021)
2011	RGB	0.75	GeoNorth BDL
2003	RGB	1.00	Baird and Pegau (2011)
1985 AUG 27	CIR	1.88	Alaska High Altitude Program
1964 APR 14	BW	0.55	Unknown
1951/1952	BW	1.14	U.S. Air Force

cause significant inaccuracy to bluff delineations. To allow for accurate measurements across the horizontal geographic plane on the image, the image must be orthorectified. Orthorectification is the process by which the perspective of an entire image is corrected to nadir: anywhere one looks in the orthorectified aerial image will appear as if looking straight down. Orthorectification can be accomplished using a DEM acquired near the same time or performing photogrammetric or structure-from-motion techniques on a collection of overlapping images. An orthorectified product is called an orthoimage or orthomosaic.

Shoreline Change Rate Calculations

The USGS created the DSAS tool to compute shoreline change by casting virtual transects perpendicular to an alongshore baseline and measuring the distance between shorelines on each transect (Himmelstoss and others, 2018). We space transects 16.4 ft (5 m) apart and calculate shoreline change rates separately for the bluff top edge and bluff toe. The average of these rates is used for the final change rate. This method summarizes total bluff erosion and is less susceptible to episodic events related to the bluff erosion cycle (Buzard and others, 2020). Where at least three shorelines are present, we calculate the weighted linear regression rate of change (WLR) and associated 90 percent confidence interval (WCI90). Otherwise, the end point rate of change (EPR) is calculated. These metrics describe the long-term erosion trend using an annualized linear rate of change in distance per year.

Shoreline Delineation

We delineate the bluff top and toe in each orthoimage. Slow and episodic bluff erosion complicates shoreline erosion calculations that rely on only one feature. For example, if the bluff toe eroded between two images and a study only calculates bluff top change, the study will incorrectly identify that bluff as stable when it is steepening and getting closer to a mass movement. Likewise, if a mass movement did occur over the study period, the bluff top edge may suggest far faster rates of erosion than will be seen in the future. Tracking the top and toe can determine what stage of the erosion cycle a bluff is in and improve understanding of current erosion hazards.

Bluff toes are generally clearly identifiable as the seaward extent of a bare or vegetated slope. Bluff tops are more subjective because some areas have partial slides or benches, leading to multiple edges. The chosen bluff top edge must represent the seaward extent of land that is neither part of a previous landslide nor a bench on a slope (fig. 3). We view the 2019 lidar to ensure the correct bluff top edge is chosen, but only use imagery for these delineations to maintain consistency. Interpretations of historical aerial imagery are aided by the DSMs produced by the orthorectification process. Where vegetation made visual interpretation challenging, the slope is visualized to identify steep slope breaks (fig. 4). This method helps to

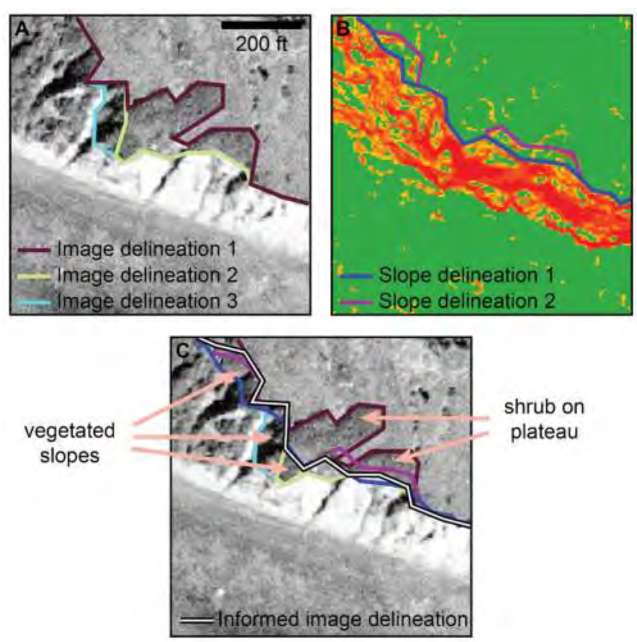


Figure 4. A. The orthoimage in 1951 has vegetation growing down the slope, making the bluff top edge challenging to identify. The three colored lines are separate interpretations of where the bluff top edge could be. **B.** The steep slope map is derived from the digital surface model created during the orthorectification process. The bluff top edge and toe are close to where steep slope angles (red) meet shallow slopes (green). **C.** A new delineation is made on the orthoimage, assisted by the interpretations from the slope map.

maintain consistent tracking of the bluff top edge and toe, especially around benches and complex bluffs. The shoreline delineations are still made using the orthoimage.

This study has one digitizer. Digitizing precision uncertainty represents the consistency with which the digitizer can interpret and trace a feature in an image. To compute digitizing precision, sections of the bluff toe totaling 3.3 miles (5.3 km) in length are delineated three times on the BDL. We cast transects at 16.4-ft (5 m) spacing perpendicular to these lines to measure the distance between them. Digitizing precision (U_d) is calculated by taking the mean of the maximum distance between the three lines (L_1, L_2, L_3) on each transect (equation 1).

Equation 1:

$$U_d = \sum_{i=1}^{n} \frac{max\left(|L_{1i} - L_{2i}|, |L_{1i} - L_{3i}|, |L_{2i} - L_{3i}|\right)}{n}$$

U_d = digitizer uncertainty

L_n = distance to baseline

The total uncertainty (U_t; equation 2) represents the positional accuracy of the delineated shorelines relative to real-world coordinates (table 3). Total uncertainty is high because all images are referenced to the BDL that has a total horizontal uncertainty of 6.3 ft (1.92 m). The total uncertainty relative to the BDL (U_r; equation 3) represents the positional accuracy of delineated shorelines relative to each other (table 4). This is a more appropriate metric for estimating uncertainty of delineations on imagery that are referenced relative to the same image.

Equation 2:

$$U_t = \sqrt{U_o^2 + U_p^2 + U_d^2}$$

Equation 3:

$$U_r = \sqrt{U_i^2 + U_p^2 + U_d^2}$$

U_t = total uncertainty of shoreline delineation

U_o = total uncertainty of image

U_r = relative uncertainty of shoreline delineation

U_t = relative uncertainty of image

U_p = pixel size

Coastal Bluff Stability Assessment

Long-term, annualized erosion rates may not adequately identify potential instability. We assess current coastal bluff stability by identifying combinations of variables that contribute to instability (similar to Maine Geological Survey, 2015). The chosen variables are erosion rate, slope angle, vegetation, water drainage, and erosion mitigation (fig. 5). (See "Study Limitations" for a discussion about these and other possible variables.) Each

Table 3. Total uncertainty of image orthorectification (U_o) and shoreline delineation (U_t). All values are in meters.

Year	Total uncertainty	Pixel size	Uncertainty to control	Uncertainty to BDL	Total image uncertainty	Digitizer uncertainty
	U_t	U_p	$U_{o,source}$	U_i	U_o	U_d
2019	**1.06**	0.05	0.07	1.92	0.07	1.06
2011	**2.32**	0.75	1.92	-	1.92	1.06
2003	**3.61**	1.00	1.92	2.69	3.30	1.06
1985	**4.20**	1.88	1.92	3.05	3.60	1.06
1964	**2.43**	0.55	1.92	0.89	2.12	1.06
1951/1952	**3.65**	1.14	1.92	2.68	3.30	1.06

Table 4. Relative total uncertainty of shoreline delineation (U_r). All values are in meters.

Year	Total uncertainty	Pixel size	Uncertainty to BDL	Digitizer uncertainty
	U_t	U_p	U_i	U_d
2019	**2.19**	0.05	1.92	1.06
2011	**1.30**	0.75	-	1.06
2003	**3.06**	1.00	2.69	1.06
1985	**3.74**	1.88	3.05	1.06
1964	**1.49**	0.55	0.89	1.06
1951/1952	**3.10**	1.14	2.68	1.06

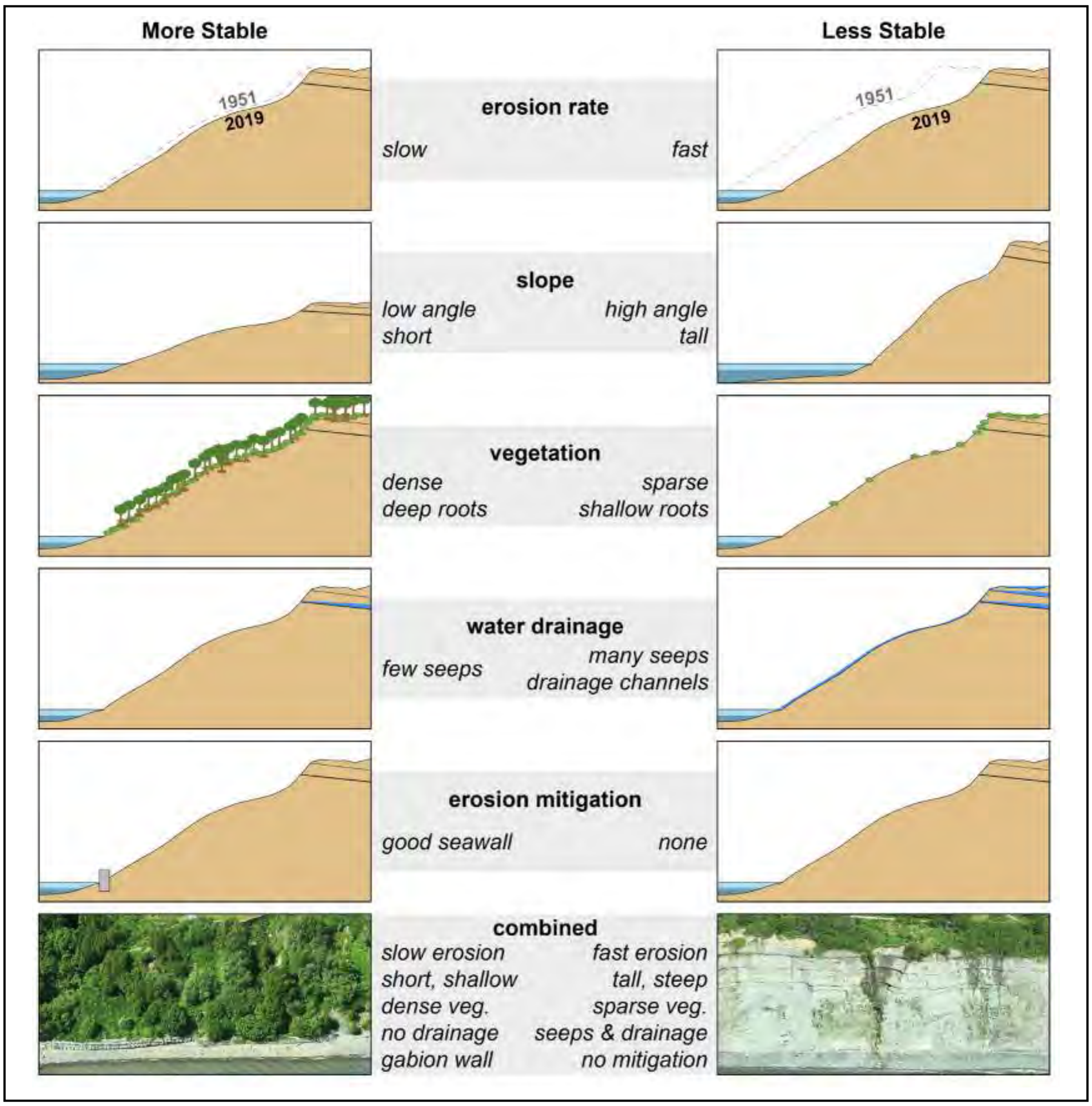


Figure 5. Conceptual diagram of bluff instability variables. The combination of variables determines the overall stability.

variable is evaluated using four instability categories: very low, low, medium, and high. The categories are combined for a total instability hazard score (fig. 5). Coastal slopes are manually identified using the delineations of the bluff top and toe from the DGGS DTM. Transects are cast perpendicular to the bluff toe at 16.4-ft (5-m) spacing along 14 miles (22 km) of shoreline. Variables are computed along each transect.

Instability Due to Erosion Rate

Coastal zone management often uses linear regression erosion rates to define coastal setback zones and erosion hazard areas (Crowell and others, 2018; Perello, 2019). We multiply the average erosion rate of the bluff top and toe by 50 years to symbolize possible future erosion distance based on observed change over the past 60 to 70 years. Fifty years is chosen because structures are commonly designed with 50-year design life (Val and others, 2019). Instability categories are based on coastal setback values of 15 and 40 ft (4.6 and 12 m; table 5). These setback distances are commonly used by homeowners or builders in Homer in compliance with existing city zoning. For example, if erosion rates suggest between 15 and 40 ft (4.6 and 12 m) of erosion will occur in the next 50 years, the location has a medium instability score in the erosion category.

Instability Due to Slope and Height

Greater slope angle increases the probability of a mass movement occurring (Highland and Bobrowsky, 2008; Kokutse and others, 2016). We use factor of safety (FOS) results to determine safe and unsafe slope angles. Salisbury (2021) calculates

Table 5. Instability category thresholds for 50 years of bluff erosion (E_{50}) based on historical erosion rates.

Instability category	Erosion distance (ft)
High	$E_{50} > 40$
Medium	$15 < E_{50} \leq 40$
Low	$0 < E_{50} \leq 15$
Very low	$E_{50} = 0$

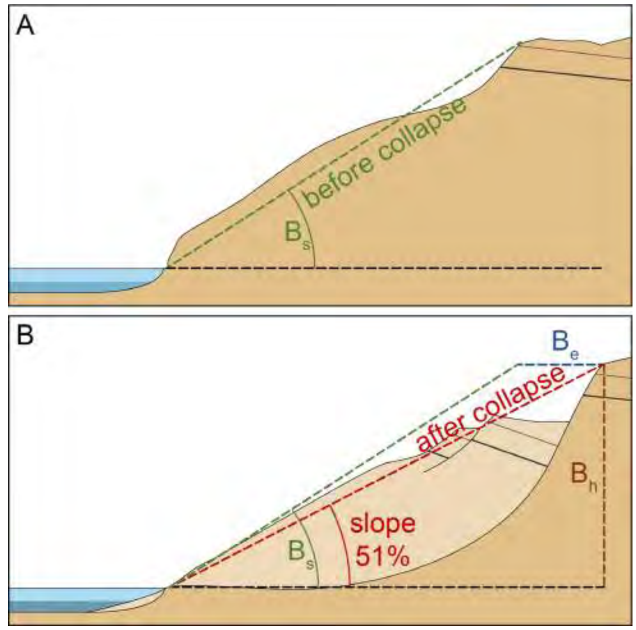


Figure 6. A. The current slope angle between the top and toe (B_s) is reduced after a mass movement **B.** Bluff erosion (B_e) is a function of height (B_h) and change from B_s to 51 slope percent. Taller and steeper bluffs experience greater horizontal erosion.

that, in Homer, silty sand slopes below 27 degrees tend to have an FOS greater than 1.5, meaning they have lower likelihood of failure. Kokutse and others (2016) find a similar slope angle threshold of 27 degrees for sand, silt, and clay slopes, like Homer's coastal bluffs. Rotational landslides are common modes of mass movement in Homer (Reger, 1979; Berg, 2009), so we use this as the failure type. We assume any slope greater than 27 degrees has some likelihood of failure, and if it fails in a rotational landslide the post-movement slope will be 27 degrees (51 percent slope) hinging roughly about the toe (Bishop, 1955; Chowdhury and Xu, 1994; Jiang and others, 2017; fig. 6). On each profile, we calculate the slope percent from toe to top (B_s) and subtract 51 percent slope to determine the angle change (equation 4).

In the context of hazards to infrastructure on the bluff, the greatest concern is the inland distance that the mass movement will reach. The erosion distance (B_e) is proportional to the height (B_h) and the change in slope (Bishop, 1955; fig. 6, equation 4). Instability categories are based on coastal setback values of 15 and 40 ft (4.6 and 12 m; table 6).

Equation 4:

$$B_e = B_b \times (B_s - 0.51)$$

B_e = horizontal bluff erosion due to slope failure

B_b = bluff height

B_s = average bluff slope percent (as a fraction)

Table 6. Instability category thresholds for bluff erosion (B_e) due to slope failure.

Instability category	Erosion distance (ft)
High	$B_e > 40$
Medium	$15 < B_e \leq 40$
Low	$0 < B_e \leq 15$
Very low	$B_e = 0$

Instability Due to Lack of Vegetation

Exposed slopes are often used as a proxy for instability because they can imply recent failure and/or frequent erosion (Salisbury, 2021). Deforestation is commonly a contributing factor to landslides (Highland and Bobrowsky, 2008). Vegetation improves slope stability primarily through soil cohesion via root tensile strength and reduced soil moisture via evapotranspiration and reduced infiltration (Wu, 1984). Vegetation also reduces erosion from wind and surface runoff. Kokutse and others (2016) show that the FOS of non-reinforced slopes is increased by up to 19 percent by trees, 14 percent by shrubs, and 7 percent by grasses. This increase is due to the root matrix increasing soil cohesion. However, heavy precipitation can increase sediment pore pressure, reduce the tensile strength of roots, and increase surface load, leading to shallow landslides (Hales and Miniat, 2017). The increased surcharge from trees can improve stability, except on very steep slopes (Nilaweera and Nutalaya, 1999; Kokutse and others, 2016). Despite these scenarios, increased vegetation is considered a net-positive for slope stability (Wu, 1984).

The root properties influencing soil cohesion are roughly proportional to vegetation height (Kokutse and others, 2016). We quantify the instability due to lack of vegetation using a function of vegetation height and coverage, similar to Maine Geological Survey (2015; table 7). On slope profiles, we calculate vegetation height as the difference between the DGGS DSM and DTM. We use mean vegetation height on each profile to generalize the type (grass, shrub, and tree). In Alaska, vegetation is classified as a small tree when it reaches 12 ft (4 m) in height (among other variables related to canopy and trunk width; Little, 1953). However, willow—a large shrub common to Homer (Ager, 1998)—is considered a tree due to its size and likeness to trees (Viereck and Little, 1972). Therefore, we consider vegetation height exceeding 5 ft (1.5 m) to be trees and large shrubs (Viereck and Little, 1972). Per Viereck and Little (1972), we classify heights below 2 ft (0.6 m) as grasses and small shrubs. While the average vegetation height calculation includes the entire profile, we had to limit percent coverage to vegetation at or above 3.3 ft (1.0 m; medium shrub) to reduce overestimations due to DEM noise.

Table 7. Instability category thresholds for vegetation type and coverage. Ties between categories average, rounding to the less stable category. For examples, a slope with trees (low) and 25 to 49 percent coverage (medium) is in the medium category. A slope with shrubs (medium) and greater than 75 percent coverage (very low) is in the low category.

Instability category	Vegetation type and coverage
High	Grass or less than 25 percent coverage
Medium	Shrubs or 25 to 49 percent coverage
Low	Trees or 50 to 75 percent coverage
Very low	Trees and greater than 75 percent coverage

Instability Due to Lack of Erosion Protection

Existing erosion protection structures can reduce erosion rates and prevent undercutting of coastal bluffs. Complex engineered structures such as seawalls and gabions tend to prevent erosion better than simple structures like riprap or piled debris (USACE, 2004; Rella and Miller, 2012). During the 2019 lidar survey, DGGS also collected alongshore oblique aerial imagery. We orthorectify and roughly georeference these data to create high-resolution 3D models in Agisoft Metashape. Using these models and other imagery, we delineate lengths of shoreline armoring and give a qualitative score of their current condition (good, fair, or poor). Instability is categorized as a function of armoring type and current condition (table 8). Erosion protection structures can have significant detrimental effects, especially to natural sediment dynamics and beach nourishment (Ruggiero, 2010). We include existing erosion protection because it is an important factor for assessing current instability. We do not express or imply whether existing or new structures are appropriate solutions for bluff instability hazards.

Table 8. Instability category thresholds for erosion protection.

Instability category	Erosion protection condition and type
High	None, or poor riprap
Medium	Poor seawall/gabion, fair riprap
Low	Fair seawall/gabion, good riprap
Very low	Good seawall/gabion

Instability Due to Drainage

Precipitation, groundwater, and streams lead to slope instability. Surface runoff causes erosion, confining layers cause suspended water tables, and increased pore fluid pressure reduces soil cohesion (Harp and others, 2006; Bukojemsky and Scheer, 2007). The water table generally contours surface topography, and lakes and streams are surface

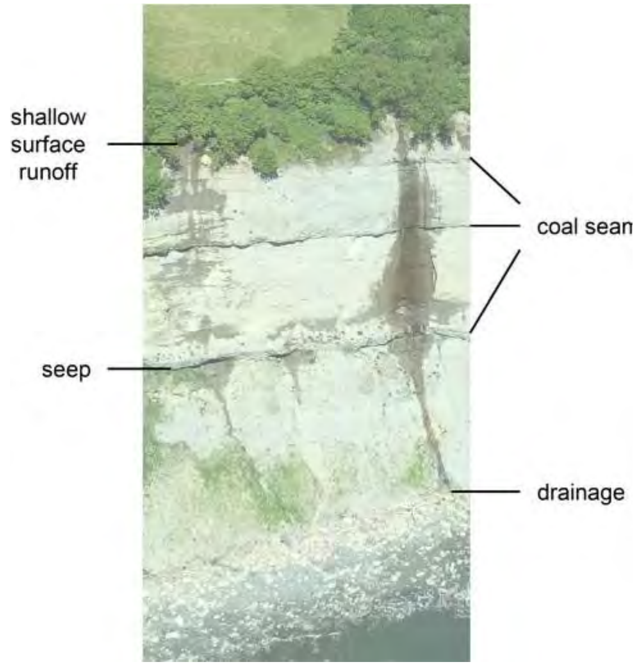


Figure 7. This 200-ft coastal bluff in Homer has surface runoff causing a continuous stream that drains to the beach. Groundwater also seeps from coal seams and other changes in the stratigraphy. Water causes channeling on the bluff face and undercuts coal seams, leading to instability.

expressions of the water table (Heath, 1983; Winter and others, 1998). We follow the assumption that areas where water collects have more groundwater flow and greater potential for related hazards.

We identify surface and groundwater expressions on the bluff slope using 3D models and imagery (fig. 7). However, many areas are obscured by vegetation, so water expressions may not be visible. In addition, the imagery only provides a snapshot in time, and conditions may have been unseasonably wet or dry. To consistently map drainage, we correlate observed hydrologic features with the flow accumulation through each transect based on the DTM. Flow accumulation represents the area of contributing streams toward a single point on the land surface within a user-defined catchment area. We identify flow channels on the DGGS DTM, correct the DTM to allow for flow through culverts under roads, then calculate the direction and accumulation of flow using ArcGIS hydrology tools. We correlate maximum flow accumulation and visible water expressions on each transect.

Shallow surface runoff and groundwater seeps tend to have lower flow accumulation than visible drainage streams and creeks. Half of all shallow surface runoff zones and seeps have flow accumulation below 27,000 ft^2 (2,500 m^2), so this is used as a lower cutoff to identify areas at very low drainage. As flow accumulation increases to 200,000 ft^2 (18,500 m^2), surface runoff and seeps transition to visible drainage channels. This is used as the lower threshold for medium drainage (where running water is actively causing minor erosion). Well-developed surface drainage channels primarily have flow accumulation upward of 540,000 ft^2 (50,000 m^2), and transition to creeks as flow increases. This flow accumulation value is used for the high drainage category (table 9). The value's magnitude is somewhat arbitrary because it is limited by the user-defined catchment; hence, we correlate the relative magnitude with observed hydrologic conditions.

Table 9. Instability category thresholds for drainage.

Instability category	Drainage indicators
High	Creeks, streams, continuous flow of water causing erosion
Medium	Flow of water from seeps and runoff causing minor erosion channels on bluff and beach
Low	Seeps and runoff exist but are not causing beach erosion
Very low	Seeps and runoff are rarely present

Combining Instability Variables

Instability variables are combined into one metric to determine the hazard posed by a combination of factors that destabilize slopes. No two categories are strongly correlated (table 10). Weights are not applied, but we give special consideration for areas with coastal armoring. Like vegetation, armoring can stabilize slopes and prevent erosion (Rella and Miller, 2012). For this reason, we use the most stable score between vegetation and armoring. For example, a seawall in good condition with no vegetation scores "very low" in the vegetation category. Similarly, we adjust the erosion score to the lesser of erosion and armor. This adjustment means an area with historically rapid erosion still scores "very low" if a seawall in good condition now exists. If an area has no armoring but very slow erosion, it still scores "very low." These modifications are only applied to the calculation of combined instability hazard scores; the original individual values are still available in the geodatabase. After these adjustments, combined instability is calculated using the average score rounded to the less stable score. The

Table 10. Correlation between instability variables. Values closer to 1 are strongly positively correlated (as variable 1 increases, variable 2 increases). Values of 0 are not correlated. Values closer to -1 are strongly negatively correlated (as variable 1 increases, variable 2 decreases).

	Armoring	Erosion	Slope	Vegetation	Drainage	Combined
Armoring	1					
Erosion	0.02	1				
Slope	0.19	0.08	1			
Vegetation	-0.17	0.42	0.26	1		
Drainage	0.12	-0.04	-0.18	-0.18	1	
Combined	0.41	0.56	0.52	0.54	0.21	1

average calculation involves four category values: drainage, slope and height, the most stable score between vegetation and armoring, and the most stable score between erosion and armoring.

RESULTS

Coastal bluff hazards are assessed using a historical shoreline change analysis and by combining bluff instability variables into a categorical hazard map. The shoreline change maps are more representative of the effects of long-term erosion trends. The bluff stability map communicates the potential for slope failure that may not be reflected in the historical erosion record.

Historical Shoreline Change Analysis (Map Sheet 1: Shoreline Change [1951 to 2019])

Shoreline change rates are between 1.0 and -3.9 ft/yr (0.3 and -1.2 m/yr; tables 11, 12). Erosion rates are greatest around the Bluff Point landslide

Table 11. Coastal bluff characteristics by region in feet and slope percent. Mean values are bolded. Bluff height is the difference between the top and toe elevation. Slope angle is between the bluff top and toe. Slope angle standard deviation (SD) is shown as a range about the mean because slope percent does not scale linearly with degrees. Negative shoreline change is erosion, positive is seaward movement of the shoreline (such as by accretion, aggradation, or mass movements).

	Bluff Height (ft)				Slope Angle (percent)				Shoreline Change Rate (ft/yr)			
	Mean	SD	Min.	Max.	Mean	Mean ± SD	Min.	Max.	Mean	SD	Min.	Max.
Diamond Crk	**310**	82	186	473	**31**	23 to 39	18	51	**-0.5**	0.3	-1.2	0.3
Bluff Pt	**79**	53	17	485	**74**	41 to 121	17	184	**-1.7**	1.0	-3.7	0.8
Downtown	**139**	75	12	276	**87**	39 to 179	22	205	**-1.0**	0.5	-2.7	0.7
Munson Pt	**16**	5	1	28	**64**	40 to 94	12	114	**-0.8**	1.3	-3.9	0.8
Kachemak Dr	**55**	23	10	89	**73**	44 to 113	24	317	**-0.5**	0.6	-2.7	0.7
East End Rd	**68**	16	26	113	**56**	31 to 87	17	128	**-1.1**	0.4	-3.2	0.7

Table 12. Coastal bluff characteristics in meters and degrees.

	Bluff Height (m)				Slope Angle (degrees)				Shoreline Change Rate (m/yr)			
	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.
Diamond Crk	**94**	25	57	144	**17**	4	10	27	**-0.15**	0.09	-0.37	0.09
Bluff Pt	**24**	16	5	148	**37**	14	10	61	**-0.52**	0.30	-1.13	0.24
Downtown	**42**	23	4	84	**41**	20	12	64	**-0.30**	0.15	-0.82	0.21
Munson Pt	**5**	2	0	9	**33**	11	7	49	**-0.24**	0.40	-1.19	0.24
Kachemak Dr	**17**	7	3	27	**36**	12	13	72	**-0.15**	0.18	-0.82	0.21
East End Rd	**21**	5	8	34	**29**	12	10	52	**-0.34**	0.12	-0.98	0.21

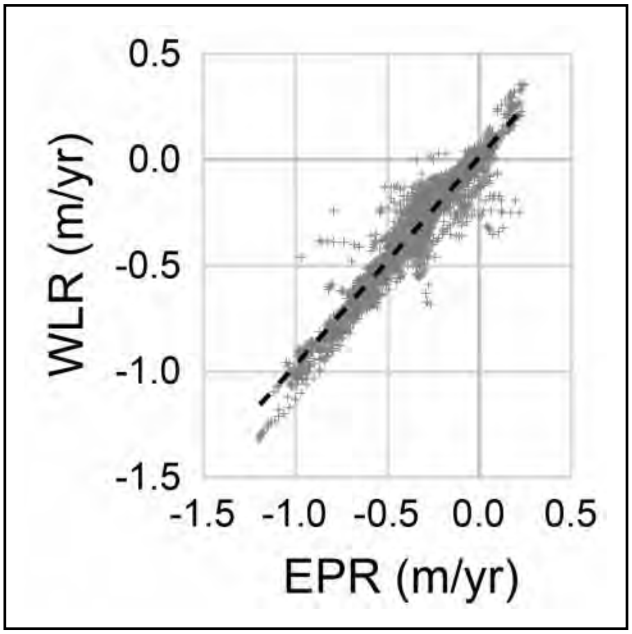


Figure 8. The end point rate (EPR) and weighted linear regression (WLR) shoreline change rate are highly correlated (slope = 0.99, R^2 = 0.92). EPR uses only the first and last shoreline. WLR uses all shorelines weighted by uncertainty.

area, Mount Augustine Drive, Bishops Beach, the seawall at Munson Point, and various sections near East End Road. Historical erosion is relatively slow or stable in the Diamond Creek area and along the section of Kachemak Drive near the airport runway. Bluff toe erosion often outpaces bluff top edge erosion from the Bluff Point landslide area to Bishops Beach, suggesting bluff steepening. The most significant toe erosion occurred after the 1964 earthquake (also observed by Stanley, 1968). Although this was a period of heightened erosion, it did not deviate significantly from the long-term change rate: the WLR rates of change are similar to EPR for both tops and toes (fig. 8). This finding suggests annualized erosion rates appropriately communicate erosion hazards in Homer, although erosion should not be expected on an annual basis. For example, if a shoreline eroded on average 3 ft/yr (1 m/yr), it may have remained stable for most of a 10-year period and eroded in one or a few episodes that total 30 ft (10 m).

Bluff Stability Assessment (Map Sheet 2: Coastal Bluff Stability)

Five variables are combined to visualize coastal bluff instability. Tall, steep bluffs with little vegetation, high drainage, rapid erosion, and no erosion protection have the highest hazard score. The area between the Bluff Point landslide and Bishops Beach is found to be the least stable. Munson Point, where the seawall now exists, is generally the most stable in all categories except historical erosion.

DISCUSSION

This coastal hazard assessment covers historical shoreline change and current bluff stability. In this section, we summarize findings and observations by location, then discuss study limitations.

Summary of Findings by Location

We break down results for six regions of Homer: Diamond Creek, Bluff Point Landslide Area, Downtown, Munson Point, Kachemak Drive, and East End Road (fig. 9; tables 11–13). Figures 10–12, 14, and 15 are screenshots from the oblique image-derived 3D model. This is a research tool to visualize the bluff complex for qualitative analysis, but many features and structures appear skewed due to insufficient overlap and camera angle.

Diamond Creek

The coastal bluffs of the Diamond Creek area reach from 250 to 500 ft (75 to 150 m) above MSL with an average slope of 17 ± 4 degrees (23 to 39

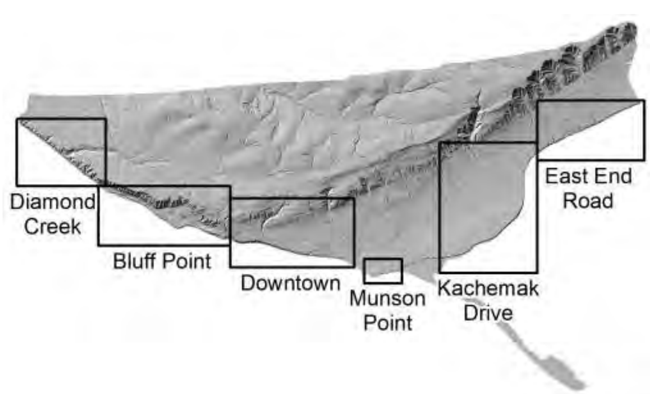


Figure 9. Discussion of results is divided into these six regions.

Table 13. Average coastal bluff instability by region. Scores range from 0 (very low instability) to 3 (high instability).

	Combined Instability	Combined Instability Score	Armor	Erosion	Slope	Veg.	Drainage
Diamond Crk	Medium	**1.8**	3.0	2.0	1.6	1.3	1.1
Bluff Pt	Medium	**2.0**	3.0	2.6	1.4	1.8	0.9
Downtown	Medium	**2.3**	3.0	2.7	2.0	2.4	0.7
Munson Pt	Very Low	**0.3**	1.2	1.4	0.8	1.8	0.3
Kachemak Dr	Low	**1.4**	2.8	1.7	1.3	1.5	0.4
East End Rd	Medium	**1.8**	3.0	2.8	0.8	1.9	0.7

Figure 10. Looking northeast at the coastal bluffs of Diamond Creek. The bluffs are tall, exposed, and undercut, leading to higher instability. This is a screenshot from our oblique image-derived 3D model.

Figure 11. Looking northwest at the Bluff Point landslide area. The coastal bluffs are the seaward-most bluffs in this screenshot from our oblique image-derived 3D model. Unlike the larger bluffs in the background, these coastal bluffs are mostly unvegetated and experience significant erosion.

percent). They are typically exposed, with grass near the coast and denser vegetation on the flanks leading to a plateau above (fig. 10). Water seeps and surface water runoff are common. Much of the area has a low to medium bluff instability score, mainly due to fast erosion rates and high drainage.

Bluff Point Landslide Area

The Bluff Point landslide area is most notable for the tallest coastal relief in Homer, reaching up to 800 ft (240 m) above MSL. The lower landscape is formed from a widespread landslide deposit (Reger, 1979). The entire bluff complex is influenced by coastal processes over geologic timescales. However, Reger (1979) explains that the inland bluffs are relatively stable because wave action only reaches the deposit. Therefore, we did not consider the larger landward bluffs to be coastal bluffs. The landslide deposit is so large that there are structures and small roads built upon it, and it has its own coastal bluffs about 30 to 100 ft (10 to 30 m) tall (fig. 11). These slopes are the second steepest in Homer, averaging 74 percent (36 degrees). This region has the fastest average erosion in Homer of -1.7 ft/yr (0.52 m/yr), reaching up to -3.7 ft/yr (-1.1 m/yr). The combined instability score of 2.0 (medium) is largely driven by these rapid erosion

Figure 12. Looking east at the steep, exposed bluffs near Mount Augustine Drive in the oblique image-derived 3D model. The bluffs gradually shorten and become less steep toward Bishops Beach.

rates and the lack of vegetation on slopes. Despite steep slopes, the hazard due to slope failure is lower because they are relatively short (there is less inland erosion due to slope failure).

Downtown

Coastal bluffs gradually transition from tall, steep, and exposed bluffs around Mount Augustine Drive to short and vegetated slopes at Bishops Beach (fig. 12). This region has a high coastal bluff instability score due to tall, steep slopes, considerable erosion, and little to no vegetation. Even though the Bishops Beach area has much shorter bluffs, there are still hazards due to rapid erosion. In general, the exposed bluffs have greater erosion at the toe than the top, indicating bluff steepening. The greatest toe erosion occurred between 1951 and 1964, likely in the aftermath of the earthquake (Stanley, 1968).

Munson Point

Munson Point has very low coastal bluff instability due to relatively short slopes and a seawall (fig. 13). Before the seawall, this area had the fastest erosion in Homer (-3.9 ft/yr, -1.2 m/yr). The area received the lowest combined bluff instability score of all regions. This is due to the short bluffs, little drainage, and significant armoring preventing further erosion.

Kachemak Drive

The coastal bluffs along Kachemak Drive have low combined instability. There is relatively slow erosion to stable shorelines, and the area with the greatest erosion is now protected by gabion seawalls. The bluffs average 55 ft (17 m) tall with slopes around 35 degrees (73 percent). Some sections of the bluffs are densely vegetated, others exposed (fig. 14). No major streams run through this area. There are still some areas with medium to high instability due mainly to steepness, height, and lack of vegetation. Overall, this region has the second lowest instability score (table 13). Although erosion rates are slow, some structures are very close to the bluff edge.

East End Road

The bluffs near East End Road have medium instability. They average 68 ft (21 m) tall with an angle of 56 percent (29 degrees), which is short and shallow relative to western Homer. However, erosion rates average -1.1 ft/yr (-0.34 m/yr), the second fastest in Homer. There is no armoring and most bluffs have light vegetation or are bare. Drainage channels and groundwater seeps are common (fig. 15). These factors compound to elevate the instability score.

Figure 13. A. This 2019 photo looking northwest at Munson Point (left) shows the seawall protecting grassy and exposed bluffs. **B.** This closeup photo shows how water comes right up to the seawall and would surely undercut the bluffs.

Figure 14. Looking west toward the partially vegetated bluffs near Kachemak Drive in the oblique image-derived 3D model.

Figure 15. Looking west toward the grassy-to-exposed bluffs and a densely vegetated creek near East End Road in the oblique image-derived 3D model. Exposed slopes show groundwater flow.

Study Limitations

This assessment is based on remotely sensed products and semi-automated techniques. This approach allows for a consistent metric to be applied across broad scales, but it is less accurate at small scales because it is unsupervised. The results are appropriate for regional-scale assessments of hazards, but localized interpretations should be made with critical judgement.

Coastal bluffs can become destabilized by several compounding environmental factors (Hampton and Griggs, 2004). When deciding which bluff stability variables to include, we consider available data, relative influence of the variable, and whether it may be correlated with other data. For example, high winds erode bluffs, but the magnitude can be relatively small compared to erosion from wave action. Including wind as a parameter may have little to no influence on the results. In addition, by measuring observed shoreline change over decades, we summarize all major eroding forces. If we include specific drivers (such as wind or wave activity) as a separate variable from historical erosion, the two may be correlated enough to bias the combined instability score. Similarly, lithology is an important factor in bluff stability. Lithology influences slope, height, drainage, vegetation cover, and how quickly a bluff erodes. Homer's coastal bluffs have similar lithology throughout (sands, silts, and clays; Barnes and Cobb, 1959; Salisbury, 2021). Due to the influence of lithology on so many variables and its homogeneity in the study area, we assume lithology is adequately represented. Ultimately, including the subtler influences of instability could improve this analysis, but they likely already factor into the existing variables.

Certain aspects of this study are automated; others are manually determined. We originally attempted an automated bluff top and toe detection using the method described by Palaseanu-Lovejoy and others (2016). The results were mostly accurate but required numerous minor fixes. Given the relatively small study area, it became faster and more accurate to delineate the bluff manually rather than correct the automated delineation. USGS recently published the Cliff Feature Delineation Tool that also follows an automated method (Seymour and others, 2020). We tested the USGS tool on our dataset and found the results unfavorable. The processing tool we built proved most useful for analyzing slope, vegetation, and drainage statistics in a small area while allowing easy manual corrections using visual interpretations.

Shoreline change analyses have well-documented limitations related to data collection, analysis methods, and non-linear change drivers (Crowell and others, 2018; Overbeck and others, 2020). When using erosion rates, some important factors to consider are changes in drivers of erosion over time. Relative sea level fall (as is documented in Seldovia; NOAA CO-OPS, 2020b) can result in fewer wave impact hours, slowing erosion of the bluff toe. Changes in prevailing wind direction and intensity could change the wave climate, although only minor changes in winds have been measured in Homer (explore climate data at uaf-snap.org). Hydrographic changes, such as river channel migration or

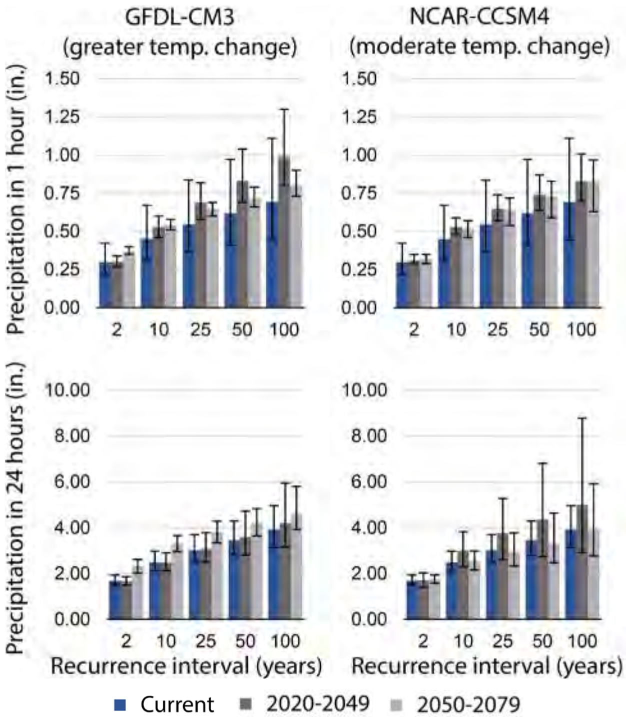


Figure 16. Current (blue) and future predicted (grayscale) precipitation trends in Homer, Alaska. The two columns show results from climate models predicting greater temperature change (left) and moderate temperature change (right). The rows show the current and predicted precipitation patterns in 1-hour (top) and 24-hour (bottom) periods. The Y axis is the total precipitation in inches. The X axis is the recurrence interval, from a 1- in 2-year event to a 1- in 100-year event. Modeled precipitation is similar to current conditions, especially considering the level of uncertainty. Data provided by uaf-snap.org.

drainage infrastructure, can bring unprecedented change to an area. Engineered structures may age or be damaged, repaired, or newly installed, changing coastal dynamics in the immediate area as well as nearby coastlines (Rella and Miller, 2012). These examples underscore the important considerations to make when using erosion rates.

Landslides can cause erosion outside the normal rate. Two major triggers for coastal bluff landslides are earthquakes and intense rainfall (Highland and Bobrowsky, 2008). Remarkably, the 1964 earthquake did not trigger major coastal landslides in Homer (Waller, 1966), but subsidence led to undercutting and swift erosion rates in the following years (Stanley, 1968). Climate model trends suggest a slight increase in extreme precipitation events in Homer, but there is no significant departure from current conditions (fig. 16). Regardless, current precipitation trends are enough to trigger landslides in Homer (Homer News, 2013). (See Salisbury [2021] for a full discussion on landslide susceptibility in Homer.)

Observations of 2009 Landslide in the Bluff Point Landslide Area

After completing this assessment, we found evidence that the 2009 landslide in the Bluff Point landslide area likely complicated erosion rates while providing insights into the connection between the coastal and inland bluffs. Between July 2 and July 3, 2009, two flanks collapsed in the Bluff Point landslide area and the beach uplifted as much as 15 ft (4.6 m), indicating a rotational slump occurred (Berg, 2009). Reger (1979) explains how these coastal bluffs are the eroded toes of rotated slump blocks from one or multiple ancient landslides. There are wide, underground shear planes connecting the inland bluffs to the coastal bluffs and beach (Berg, 2009). After a rotation, the uplifted area erodes. This process redistributes stress in the slump block back toward the bluff until another rotation occurs (fig. 2). The history of coastal erosion likely played a major role in destabilizing the bluff.

The 2009 landslide occurred across 800 ft (250 m) of shoreline, but comparisons of the 2008 and 2019 lidar reveal that the 2,500 ft (760 m) of coastal bluffs was translated seaward as far as 80 ft (25 m; fig. 17). The coastal bluffs remained mostly intact. Berg (2009) identified fissures in the slide mass that indicated active creeping. This suggests that the mass is debutressing from the inland bluff, leading to greater instability (B. Higman, written comm., 2021). Salisbury (2021) estimates that as far as 1,200 ft (366 m) inland from the bluff top edge is highly susceptible to a continued, retrogressive failure of the existing deep-seated rotational landslide block.

Where the Sterling Highway comes closest to the bluff edge (fig. 17, profile C), we did not find evidence of rotation from the 2009 landslide. The

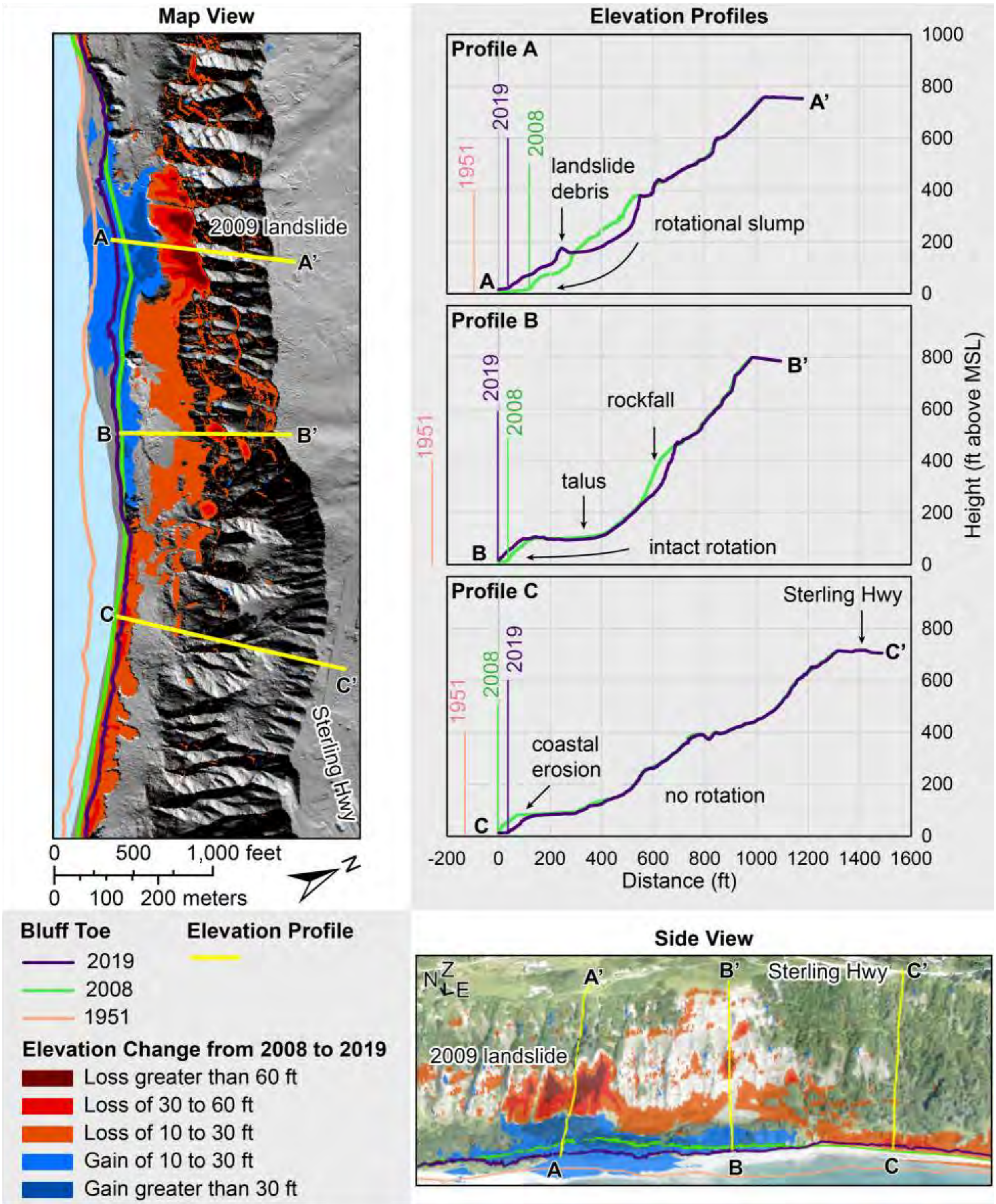


Figure 17. Map View and Side View of the region where the 2009 landslide occurred. The vertical change between the 2008 and 2019 lidar DTMs shows where the inland portion of the slump block lowered (warm colors) and rotated, uplifting the seaward section (cool colors). The bluff toe moved seaward between 2008 (green) and 2019 (purple). This is most apparent along profile A where the flank collapse occurred. On profile B, a smaller rockfall left a wide talus debris fan, and the coastal bluffs migrated seaward while remaining intact (carrying upright vegetation with them). Southeast of this area the rotation appears to end, and profile C has regular coastal erosion (also indicated by warm colors).

erosion history is similar to the nearby failure area, but the bluff is less steep. Continued erosion and bluff steepening decreases stability.

CONCLUSION

We assess coastal bluff stability for the Homer region using a shoreline change analysis and a combined coastal bluff instability score. Results indicate slow and ongoing erosion is steepening bluffs and encroaching on existing structures. Many bluffs have greater instability due to their height and slope, erosion at the toe, and lack of vegetation. The coastal bluff stability products highlight existing hazards and are tools to guide decisions to improve community safety.

ACKNOWLEDGMENTS

The Federal Emergency Management Agency (FEMA) provided funding through a Cooperative Agreement to the Alaska Division of Geological & Geophysical Surveys for the completion of this Coastal Bluff Stability Project under grant number EMS-2019-CA-00022-R05. We thank FEMA Cooperating Technical Partners Program, the City of Homer, and the Homer Planning Commission for supporting this work. Major improvements were made thanks to the thorough and insightful reviews by Hig Higman, Chris Maio, Barrett Salisbury, and FEMA. Much of this study was possible thanks to the foundational work by Steve Baird and the Kachemak Bay National Estuarian Research Reserve.

REFERENCES

Ager, T.A., 1998, Postglacial vegetation history of the Kachemak Bay area, Cook Inlet, south-central Alaska, *in* Kelley, K.D., and Gough, L.P., eds., Geologic studies in Alaska by the U.S. Geological Survey, 1998: U.S. Geological Survey Professional Paper 1615, p. 147–165.

Baird, Steve, and Pegau, Scott, 2011, Coastal Change Analysis: Kachemak Bay Research Reserve, 18 p.

Barnes, F.F., and Cobb, E.H., 1959, Geology and coal resources of the Homer district, Kenai coal field, Alaska: U.S. Geological Survey Bulletin 1058-F, p. 217–260, 11 sheets.

Berg, Ed, 2009, Sudden uplift of the beach recalls ancient landslides: Kenai National Wildlife Refuge Notebook, v. 11, no. 27, p. 54–55.

Bishop, A.W., 1955, The use of the slip circle in the stability analysis of slopes: Géotechnique, v. 5, no. 1, p. 7–17.

Bukojemsky, Allegra, and Scheer, David, 2007, Stormwater and meltwater management and mitigation—A handbook for Homer, Alaska: DnA Design, 67 p.

Buzard, R.M., 2021, Photogrammetry-derived historical orthoimagery for Homer, Alaska from 1951, 1952, 1964, and 1985: Alaska Division of Geological & Geophysical Surveys Raw Data File 2021-21, 10 p. doi.org/10.14509/30824

Buzard, R.M., Maio, C.V., Verbyla, David, Kinsman, N.E.M., and Overbeck, J.R., 2020, Measuring historical flooding and erosion in Goodnews Bay using datasets commonly available to Alaska communities: Shore & Beach, v. 88, no. 3, p. 3–13.

Chowdhury, R.N., and Xu, D.W., 1994, Geotechnical system reliability of slopes: Reliability Engineering and System Safety, v. 47, p. 141–151.

City of Homer, 2021, Coastal erosion: City of Homer [website]: www.cityofhomer-ak.gov/planning/coastal-erosion

Crowell, Mark, Leatherman, S.P., and Buckley, M.K., 1991, Historical shoreline change—Error analysis and mapping accuracy: Journal of Coastal Research, v. 7, no. 3, p. 839–852.

Crowell, Mark, Leatherman, S.P., and Douglas, Bruce, 2018, Erosion—Historical analysis and forecasting, *in*, Finkl, C.W., and Makowski, C., eds., Encyclopedia of Coastal Science: Springer International Publishing AG, p. 428–432.

Gronewald, G.J., and Duncan, W.W., 1965, Study of erosion along Homer spit and vicinity, Kachemak Bay, Alaska, *in* Proceedings, Coastal Engineering Conference, American Society of Civil Engineers: New York, NY, p. 673–682.

Hales, T.C., and Miniat, C.F., 2017, Soil moisture causes dynamic adjustments to root reinforcement that reduce slope stability: Earth Surface Processes and Landforms, v. 42, no. 5, p. 803–813.

Hampton, M.A., and Griggs, G.B., 2004, Formation, evolution, and stability of coastal cliffs—status and trends: USGS Professional Paper 1693, 123 p.

Hapke, C.J., and Plant, N.G., 2010, Predicting coastal cliff erosion using a Bayesian probabilistic model: Marine Geology 278, p. 140–149.

Harp, E.L., Michael, J.A., and Laprade, W.T., 2006, Shallow-landslide hazard map of Seattle, Washington: U.S. Geological Survey Open-File Report 2006–1139, 18 p., 2 plates, map scale 1:25,000. pubs.usgs.gov/of/2006/1139/pdf/of06-1139_508.pdf

Heath, R.C., 1983, Basic ground-water hydrology: U.S. Geological Survey Water-Supply Paper 2220, 86 p.

Highland, L.M., and Bobrowsky, Peter, 2008, The landslide handbook—A guide to understanding landslides: Reston, Virginia, U.S. Geological Survey Circular 1325, 129 p.

Himmelstoss, E.A., Farris, A.S., Henderson, R.E., Kratzmann, M.G., Ergul, Ayhan, Zhang, Ouya, Zichichi, J.L., and Thieler, E.R., 2018, Digital Shoreline Analysis System (version 5.0): U.S. Geological Survey software release. code.usgs.gov/cch/dsas

Homer News, 2013, Heavy rains cause Homer mudslides: Homer News [website]: www.homernews.com/news/heavy-rains-cause-homer-mudslides/

Jiang, Shui-Hua, Huang, Jinsong, Yao, Chi, and Jianhua, Yang, 2017, Quantitative risk assessment of slope failure in 2-D spatially variable soils by limit equilibrium method: Applied Mathematical Modelling, v. 47, p. 710–725. dx.doi.org/10.1016/j.apm.2017.03.048

Kenai Peninsula Borough, 2019, Section 2.0—Floods and coastal erosion, *in* Hazard mitigation plan 2019 update: Kenai Peninsula Borough, 41 p.

———2021, Geographic information systems: Kenai Peninsula Borough [website]: www.kpb.us/gis-dept

Kokutse, N.K., Temgoua, A.G.T., and Kavazović, Zanin, 2016, Slope stability and vegetation-conceptual and numerical investigation of mechanical effects: Ecological Engineering 86, p. 146–153.

Little, E.L., Jr., 1953, Check list of native and naturalized trees of the United States (including Alaska): U.S. Department of Agriculture, Agriculture Handbook 41, 472 p.

Maine Geological Survey, 2015, Coastal bluffs maps: Maine Geological Survey [website]: www.maine.gov/dacf/mgs/pubs/mapuse/series/descrip-bluff.htm

National Oceanic and Atmospheric Administration Center for Operational Oceanographic Products and Services (NOAA CO-OPS), 2020a, Coal Point AK, [website]: tidesandcurrents.noaa.gov/datums.html?id=9455558

———2020b, Seldovia AK, [website]: tidesandcurrents.noaa.gov/datums.html?id=9455500

Nilaweera, N.S., and Nutalaya, P., 1999, Role of tree roots in slope stabilisation: Bulletin of Engineering Geology and the Environment, v. 57, p. 337–342.

OCM Partners, 2021, 2019 USACE NCMP Topobathy Lidar—Alaska: NOAA [website]: www.fisheries.noaa.gov/inport/item/59331

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. doi.org/10.14509/30552

Palaseanu-Lovejoy, Monica, Danielson, Jeff, Thatcher, Cindy, Foxgrover, Amy, Barnard, Patrick, Brock, John, and Young, Adam, 2016, Automatic delineation of seacliff limits using lidar-derived high-resolution DEMs in Southern California, *in* Brock, J.C., Gesch, D.B., Parrish, C.E., Rogers, J.N., and Wright, C.W., eds., Advances in topobathymetric mapping, models, and applications: Journal of Coastal Research, Special Issue, no. 76, p. 162–173. doi.org/10.2112/SI76-014

Perello, Melanie, 2019, Draft Great Lakes coastal erosion—Review of erosion estimates, mapping, and public policies and outreach across the Great Lakes: Minnesota Department of Natural Resources, Lake Superior Coastal Program, 48 p. ardc.org/wp-content/uploads/2020/01/20191105_ReportOnGreatLakesErosionEfforts.pdf

Reger, R.D., 1979, Bluff Point landslide, a massive ancient rock failure near Homer, Alaska, *in* Short notes on Alaskan Geology, 1978: Alaska Division of Geological & Geophysical Surveys Geologic Report 61, p. 5–9.

Rella, A.J., and Miller, J.K., 2012, Engineered approaches for limiting erosion along sheltered shorelines—a review of existing methods: The

Hudson River Sustainable Shorelines Project, 104 p. www.hrnerr.org/wp-content/uploads/sites/9/2012/07/limiteros.pdf

Ruggiero, Peter, 2010, Impacts of shoreline armoring on sediment dynamics, *in* Shipman, H., Dethier, M.N., Gelfenbaum, G., Fresh, K.L., and Dinicola, R.S., eds., 2010, Puget Sound shorelines and the impacts of armoring—Proceedings of a state of the science workshop, May 2009: U.S. Geological Survey Scientific Investigations Report 2010-5254, p. 179–186.

Salisbury, J.B., Daanen, R.P., and Herbst, A.M., 2021, Lidar-derived elevation models for Homer, Alaska: Alaska Division of Geological & Geophysical Surveys Raw Data File 2021-2, 6 p. doi.org/10.14509/30591

Salisbury, J.B., 2021, Landslide Susceptibility in Homer, Alaska: Alaska Division of Geological & Geophysical Surveys Report of Investigations 2021-XX, XX p., 3 map sheets.

Seymour, A.C., Hapke, C.J., and Warrick, Jonathan, 2020, Cliff feature delineation tool and baseline builder version 1.0 user guide: U.S. Geological Survey Open File Report 2020-1070, 54 p. doi.org/10.3133/ofr20201070

Stanley, K.W., 1968, Effects of the Alaska earthquake of March 27, 1964 on shore processes and beach morphology: Washington, DC, US Government Printing Office, 21 p.

U.S. Army Corps of Engineers (USACE), 2004, Low cost shore protection—a property owner's guide: Monroeville, Pennsylvania, GAI Consultants, Inc., 155 p.

Val, D.V., Yurchenko, Daniil, Nogal, Maria, and O'Connor, Alan, 2019, Chapter seven—Climate change-related risks and adaptation of interdependent infrastructure systems, *in* Bastidas-Arteaga, E., and Stewart, M.G., eds., Climate Adaptation Engineering: Butterworth-Heinemann, p. 207–242. doi.org/10.1016/C2017-0-00942-4

Varnes, D.J., 1978, Slope movement types and processes, *in* Schuster, R.L., and Krizek, R.J., eds., Landslides analysis and control: Washington, D.C., National Research Council, Transportation Research Board Special Report 176, p. 11–33. onlinepubs.trb.org/Onlinepubs/sr/sr176/176.pdf

Viereck, L.A., and Little, E.L., Jr., 1972, Alaska trees and shrubs, U.S. Department of Agriculture, Agriculture Handbook 410, 265 p.

Waller, R.M., 1966, Effects of the earthquake of March 27, 1964 in the Homer area, Alaska: U.S. Geological Survey Professional Paper 542-D, 28 p.

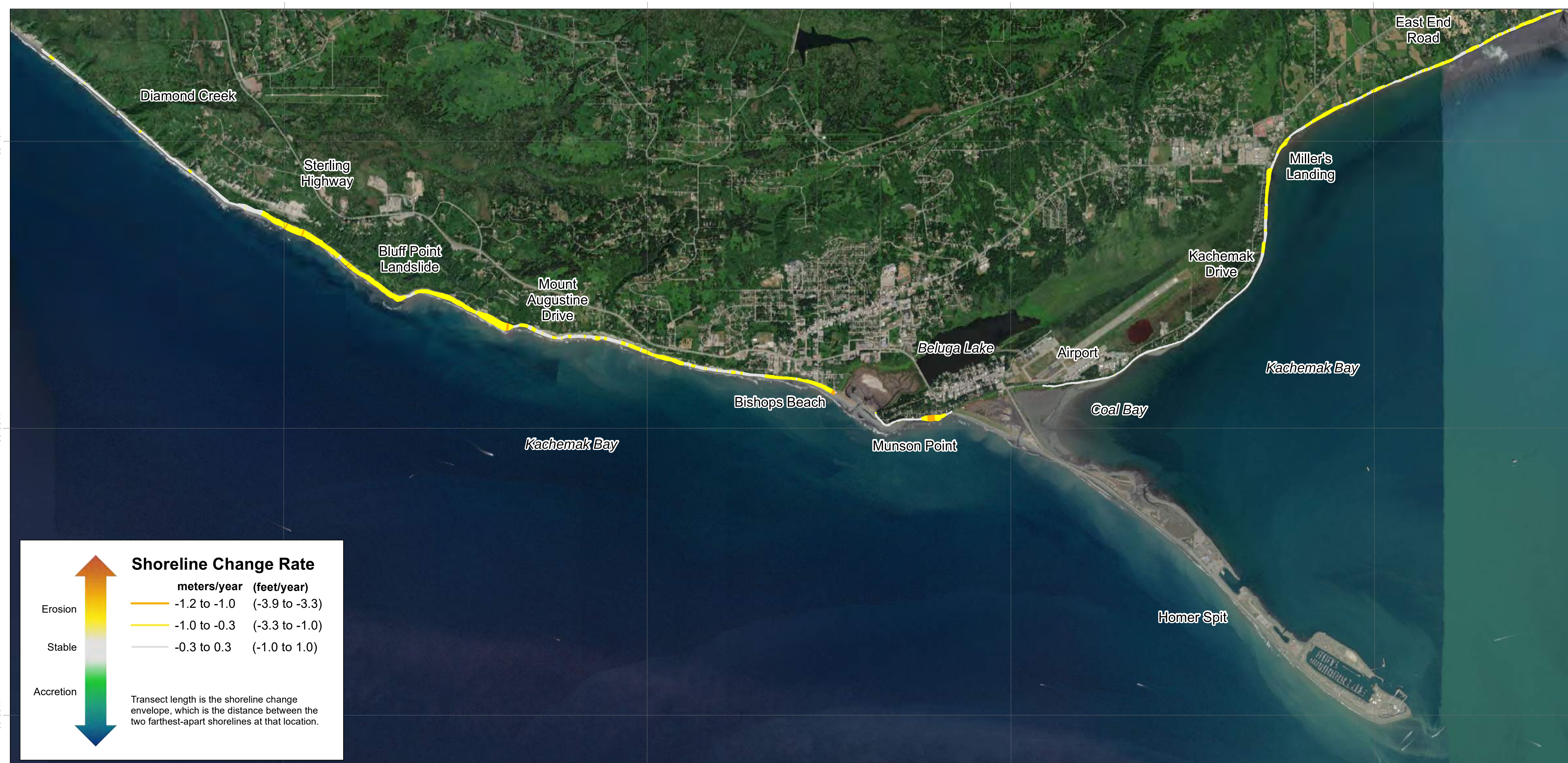
Winter, T.C., Harvey, J.W., Franke, L.O., and Alley, W.M., 1998, Ground water and surface water—A single resource: U.S. Geological Survey Circular 1139, 79 p.

Wu, T.H., 1984, Effect of vegetation on slope stability: Transportation Research Record, v. 965, p. 37–46.

DRAFT Shoreline Change (1951 to 2019)

Homer, Alaska

Report of Investigation 2021-X
Buzard and Overbeck, 2021
Sheet 1 of 2



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

website: dggs.alaska.gov

N

0 — 1 Mile

0 — 1 Kilometer

1:50,000

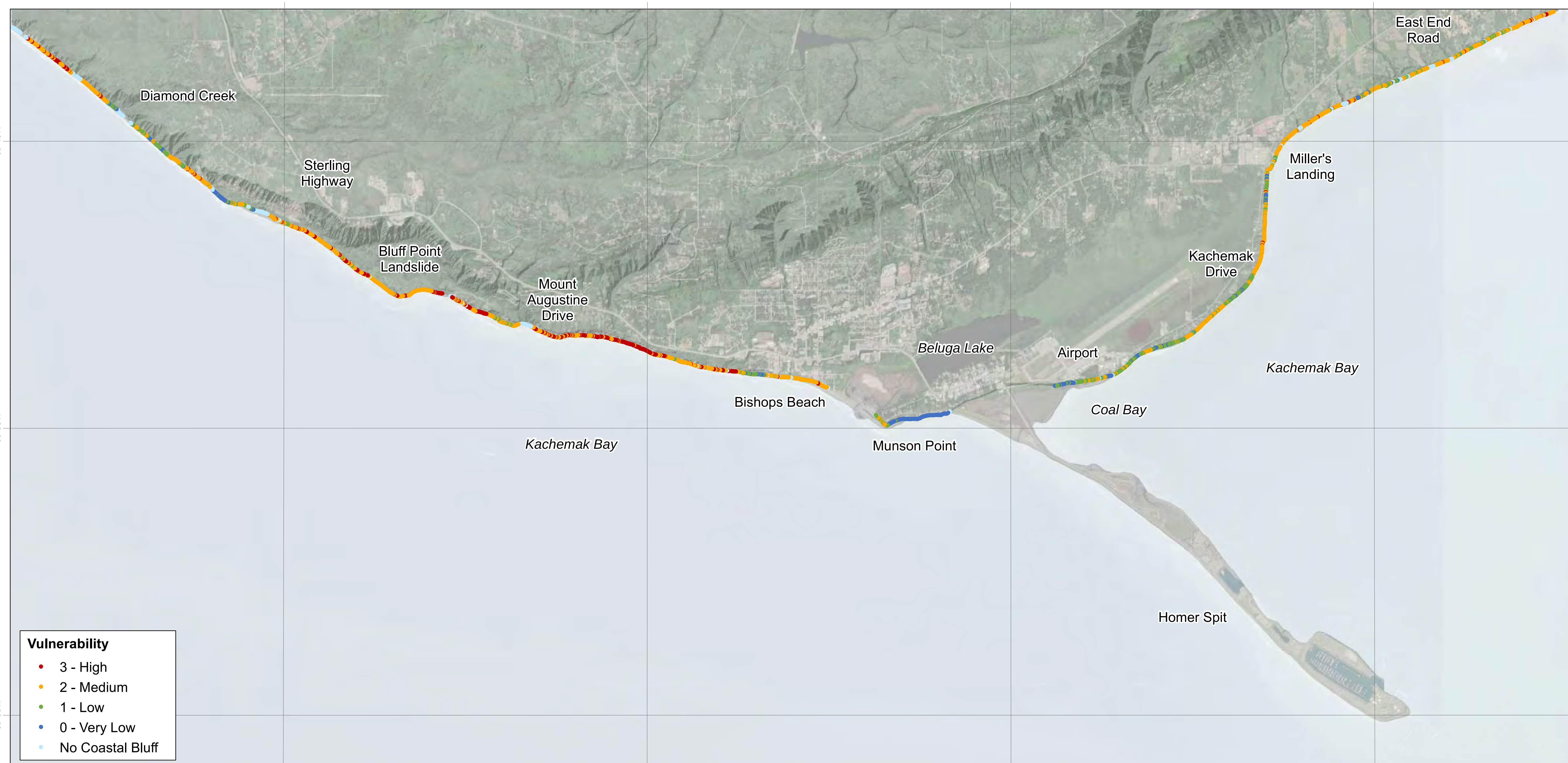
Projection: NAD83 (2011) UTM Zone 5N. Orthoimagery from the Alaska High Resolution Imagery available from agc.dnr.alaska.gov/imagery_services.html
The bluff top and toe are delineated from historical photographs collected between 1951 and 2019. Using the Digital Shoreline Analysis System developed by the U.S. Geological Survey, the measured distance between shorelines through time determines the linear rate of shoreline change at shore-perpendicular transects. The transect length indicates the distance between the nearest and farthest bluff toe between 1951 and 2019. The shoreline change envelope is colored by the shoreline change rate (meters/year and feet/year), with hot colors representing erosion and cool colors representing accretion. The average linear rate of the bluff top and toe is used for the visualized change rate. Linear rates of shoreline change are simplified and do not accurately reflect shoreline erosion and accretion at all locations.

This work is funded by the Federal Emergency Management Agency. The Alaska Division of Geological & Geophysical Surveys is a Cooperating Technical Partner.

DRAFT Coastal Bluff Stability

Homer, Alaska

Report of Investigation 2021-X
Buzard and Overbeck, 2021
Sheet 2 of 2



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

website: dggs.alaska.gov

N
0 1 Mile
0 1 Kilometer
1:50,000

Projection: NAD83 (2011) UTM Zone 5N. Orthoimagery from the Alaska High Resolution Imagery available from agc.dnr.alaska.gov/imagery_services.html

Coastal bluff vulnerability represents the potential for and impacts of slope failure. Vulnerability is estimated using slope angle, height, historical erosion, existing shoreline protection, vegetation, and drainage patterns. Red and orange areas tend to have faster erosion rates, less vegetation and protection, and taller and/or steeper bluffs.Green and blue areas generally have shorter and less steep slopes and more vegetation and/or protection. Some green and blue areas may not technically be coastal bluffs. Light blue areas are generally creekbeds or flanks.

This work is funded by the Federal Emergency Management Agency. The Alaska Division of Geological & Geophysical Surveys is a Cooperating Technical Partner.

THE STATE of ALASKA
GOVERNOR MICHAEL J. DUNLEAVY

Department of Natural Resources
DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

3651 Penland Parkway
Anchorage, Alaska 99508
Main: 907.696.0079
Fax: 907.696.0078

Homer Planning Commission &
City of Homer

November 24, 2021

RE: Considerations for coastal bluff definitions and coastal setbacks Homer, Alaska

The Alaska Division of Geological & Geophysical Surveys (DGGS) is charged by Alaska state statute to determine the potential geologic hazards that impact Alaska's people and infrastructure. DGGS, with a letter of support of the Homer Planning Commission received a competitive grant from the Federal Emergency Management Agency to conduct a coastal bluff stability analysis of the City of Homer. In addition, DGGS will provide considerations and data to the Homer Planning Commission that would inform the Commission should they seek changes to the Homer City Code. This letter outlines the current policy and how policy language relates not only to the current physical state of coastal bluffs but also descriptions of coastal setback policies from other states and how existing data may be used as tools in creating new policies. This letter is not meant to persuade policy change recommendations.

Many resources are available from the NOAA Coastal Zone Management program and various state management program counterparts outside of Alaska, as well as user guides for implementing land use regulations due to natural hazards. A great resource is the Oregon Landslide Hazard Land Use Guide (Sears and others, 2019), which encourages: making use of technical information and assistance, clearly linking the implementation of provisions (zoning code, building code, etc.) to technical information, and referring to documentation and maps in provisions, among other goals. These recommendations clearly state the importance of utilizing geologic and geographic information in the development and enforcement of land use regulations and provide guidance on implementing suggestions beyond what this document could accomplish.

DGGS conducted a remote sensing analysis of historical shoreline change and coastal bluff stability of Homer. The analysis has three primary components:

1. Computations of physical parameters that describe Homer bluff morphology (including bluff top edge, toe, and slope)
2. Historical shoreline change assessment with updated (from Baird and Pegau, 2011) methods for image processing to decrease uncertainty, re-identification of shorelines, and added imagery from historical and recent aerial imagery collections.
3. Coastal bluff stability map using a metric which considers historical erosion rate, horizontal distance of bluff failure from 2019 slope to a uniformly defined stable position, vegetation type and cover, presence of existing erosion protection, and drainage of surface and groundwater runoff.

The full analysis (Buzard and Overbeck, in prep) is in preparation and will be available in draft upon request of this commission and to the public upon final publication.

Regulations across the U.S. define coastal bluffs in many ways, usually mechanistically, geometrically, or some combination of both. The current definition of a coastal bluff in the Homer City Code is written such that the code does not identify any coastal bluffs in Homer (Table 1). Because of this issue, bluff parameters and applicable geometric and mechanistic definition examples from other states are described below (Tables 1 & 2).

Table 1. Homer City Code definitions for coastal bluffs and bluff parameters measured at Homer.

Jurisdiction	Source	Description
City of Homer	https://www.codepublishing.com/AK/Homer/#!/html/Homer21/Homer2144.html	**Steep Slope:** *starts at 45%* Buildings are not allowed to be built on these slopes unless approved by City Engineer.
	https://www.codepublishing.com/AK/Homer/cgi/defs.pl?def=25	**"Bluff"** means an abrupt elevation change in topography of at least 15 feet, with an average slope of not less than 200 percent (two feet difference in elevation per one foot of horizontal distance). *In Homer, most coastal bluffs have slopes between 31 and 87 percent.*
	https://www.codepublishing.com/AK/Homer/cgi/defs.pl?def=45	**"Coastal bluff"** means a bluff whose toe is within 300 feet of the mean high water line of Kachemak Bay. *The coastal bluff must first be defined as a bluff, which the current coastal bluffs in Homer do not satisfy. Then a measured distance must be made between the bluff toe and the mean high water line, however, a bluff toe is not defined.*
None	Measurements from Buzard and Overbeck (in prep)	In 2019, bluff parameters were measured from lidar and quality controlled with coincident aerial imagery to interpret bluff toe, bluff top edge and benches along the coast of Homer. **Bluff toe** - generally defined as the seaward extent of a slope where a slope break to relatively flat land occurs (often a sediment transition), land continues down to the MHW shoreline. **Bluff top edge** - the seaward extent of relatively flat land where a slope break or scarp occurs. For complex slopes with one or more benches, the bluff top edge is landward of the benches. **Bench** - a platform mid-slope of a larger slope complex that typically shows exposed earth upslope.

Table 2. Example definitions of coastal bluffs in other states.

California	Code of Regulations 10-5.2204 4 CCR § 13577 https://govt.westlaw.com/calregs/Document/I2EA4E8D32D044C78BF258B4F0DA30B08?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)	(h) Coastal Bluffs. Measure 300 feet both landward and seaward from the bluff line or edge. Coastal bluff shall mean: (1) those bluffs, the toe of which is now or was historically (generally within the last 200 years) subject to marine erosion; and (2) those bluffs, the toe of which is not now or was not historically subject to marine erosion, but the toe of which lies within an area otherwise identified in Public Resources Code Section 30603(a)(1) or (a)(2). Bluff line or edge shall be defined as the upper termination of a bluff, cliff, or seacliff. In cases where the top edge of the cliff is rounded away from the face of the cliff as a result of erosional processes related to the presence of the steep cliff face, the bluff line or edge shall be defined as that point nearest the cliff beyond which the downward gradient of the surface increases more or less continuously until it reaches the general gradient of the cliff. In a case where there is a steplike feature at the top of the cliff face, the landward edge of the topmost riser shall be taken to be the cliff edge. The termini of the bluff line, or edge along the seaward face of the bluff, shall be defined as a point reached by bisecting the angle formed by a line coinciding with the general trend of the bluff line along the seaward face of the bluff, and a line coinciding with the general trend of the bluff line along the inland facing portion of the bluff. Five hundred feet shall be the minimum length of bluff line or edge to be used in making these determinations.
New Jersey	7:7-9.29 https://www.nj.gov/dep/rules/rules/njac7_7.pdf	(a) A coastal bluff is a steep slope (greater than 15 percent) of consolidated (rock) or unconsolidated (sand, gravel) sediment which is adjacent to the shoreline or which is demonstrably associated with shoreline processes. 1. The waterward limit of a coastal bluff is a point 25 feet waterward of the toe of the bluff face, or the mean high water line, whichever is nearest the toe of the bluff. 2. The landward limit of a coastal bluff is the landward limit of the area likely to be eroded within 50 years, or a point 25 feet landward of the crest of the bluff, whichever is farthest inland. 3. Steep slopes, as defined at N.J.A.C. 7:7-9.32, are isolated inland areas with slopes greater than 15 percent. All steep slopes associated with shoreline processes or adjacent to the shoreline and associated wetlands, or contributing sediment to the system, will be considered coastal bluffs.
Michigan	https://www.govinfo.gov/content/pkg/CZIC-gb459-5-g8-g786-1979/html/CZIC-gb459-5-g8-g786-1979.htm	1. Bluffline means the line which is the edge or crest of the elevated segment of the shoreline above the beach which normally has a precipitous front inclining steeply on the lakeward side.
Connecticut	Gen. Stat. Ann. § 22a-93	Coastal bluffs and escarpments means naturally eroding shorelands marked by dynamic escarpments or sea cliffs which have slope angles that constitute an intricate adjustment between erosion, substrate, drainage and degree of plant cover.

Maine	Ch. 1000, 38 M.R.S.A § 435-449 https://www.law.cornell.edu/regulations/maine/06-096-Me-Code-R-Ch-1000	For principal structures, water and wetland setback measurements shall be taken from the top of a coastal bluff that has been identified on Coastal Bluff maps as being "highly unstable" or "unstable" by the Maine Geological Survey pursuant to its "Classification of Coastal Bluffs" and published on the most recent Coastal Bluff map. If the applicant and the permitting official(s) are in disagreement as to the specific location of a "highly unstable" or "unstable" bluff, or where the top of the bluff is located, the applicant may at his or her expense, employ a Maine Registered Professional Engineer, a Maine Certified Soil Scientist, a Maine State Geologist, or other qualified individual to make a determination. If agreement is still not reached, the applicant may appeal the matter to the board of appeals.

The purpose of coastal setbacks are to avoid coastal bluff erosion or mass wasting impacting infrastructure over a design life or home mortgage period. Currently in Homer, structures may not be built closer than 40 feet from the top of a coastal bluff, and not closer than 15 feet from the toe (less common). Through the analysis of Buzard and Overbeck (in prep), we find scenarios where erosion or bluff failure may encroach further than 40 feet over a 30-year timeframe. DGGS uses two different methods for computing forecast erosion distances, both of which have inherent uncertainties. The first method assumes the historical erosion rates continue over a 30-year timeframe (multiply the erosion rate by 30 years to determine distance). The second method assumes a bluff could erode due to slope failure from its current height and slope to a slope with a low risk of failure (similar to Kokutse and others [2016] for sand, silt, and clay slopes as described in Salisbury [in prep]; Figure 1). Such events may occur over decadal to centennial timescales (or longer), so the measured erosion rates may not reflect this phenomenon.

$$B_e = B_h \times (B_s - 0.51)$$

B_e = Horizontal bluff erosion due to slope failure
B_h = Bluff height
B_s = Average bluff slope percent (as a fraction)

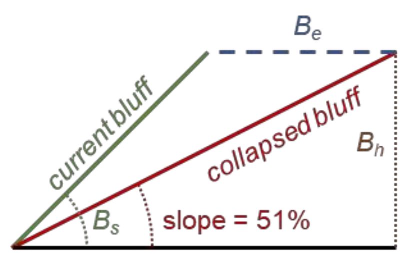


Figure 1. Equation and schematic of bluff relaxation computation from Buzard and Overbeck (in prep).

Erosion distances using both methods are mapped by parcels within the City of Homer (Figures 2 & 3). The mapped erosion distance for each parcel boundary is determined by taking the maximum erosion distance (for either the 30-year forecast-Figure 2 or the slope failure distance-Figure 3) and applying that distance to the entire parcel. To evaluate the overlap in either methods, we map them both, showing only the parcels with erosion greater than 40 ft (from either method; Figure 4). Using these methods, we find that a total of 69 parcels (36% of all parcels on coastal bluffs) have computed erosion distances greater than 40 ft somewhere along the parcel. These values can be utilized to determine whether changes to the coastal setback distance are needed in any future updates to the Homer City Zoning Code.

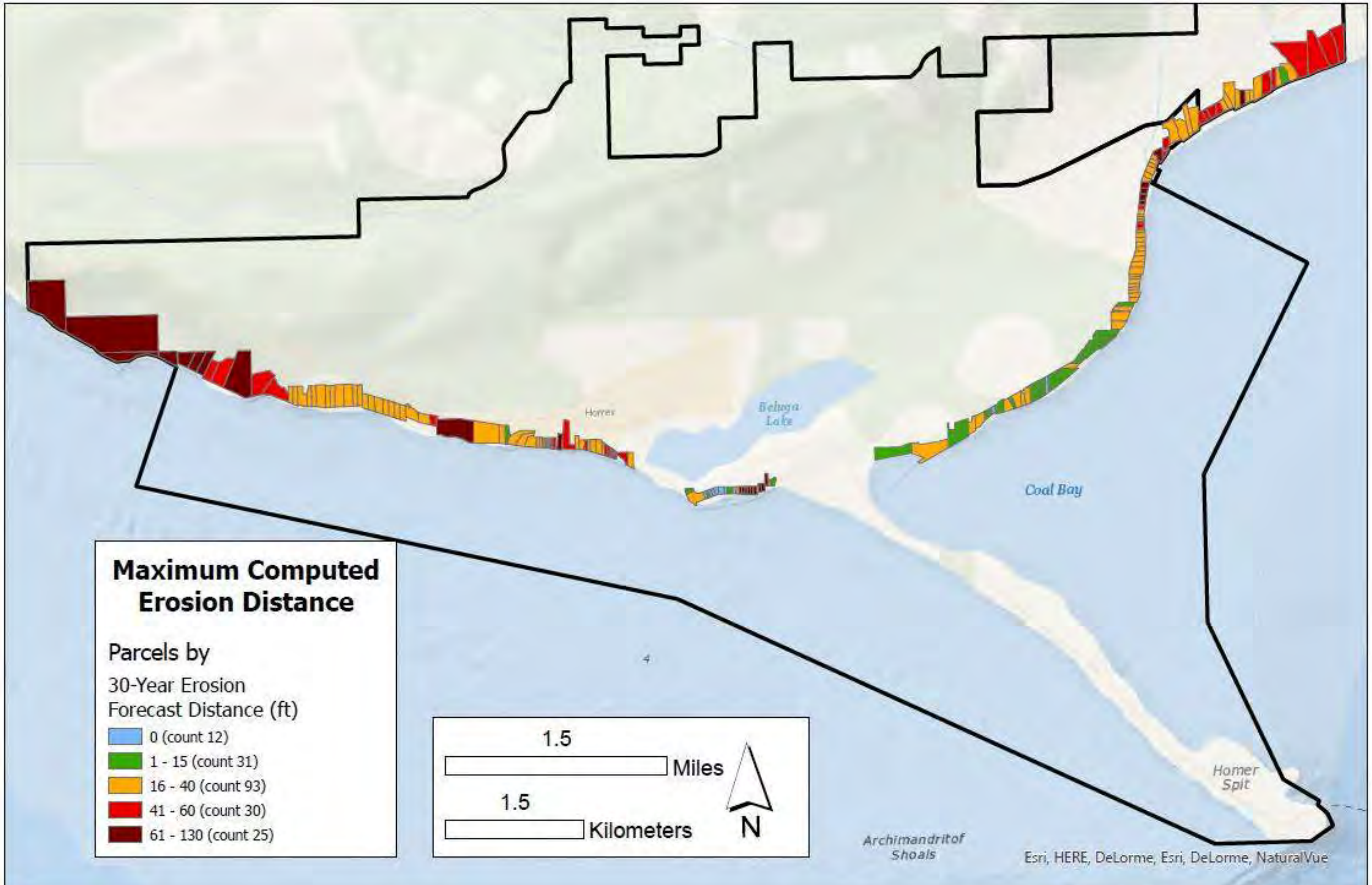


Figure 2. City of Homer parcels on coastal bluffs are symbolized by the maximum 30-year erosion forecast distance for coastal bluff erosion. This map shows 55 total parcels with a maximum erosion distance greater than 40 ft. The total number of parcels on coastal bluffs are 191, resulting in 29% of parcels having at least some section of their bluffs with an erosion distance greater than 40 ft. This City of Homer boundary is shown as a thick black boundary. Parcels are not differentiated between developed and undeveloped.

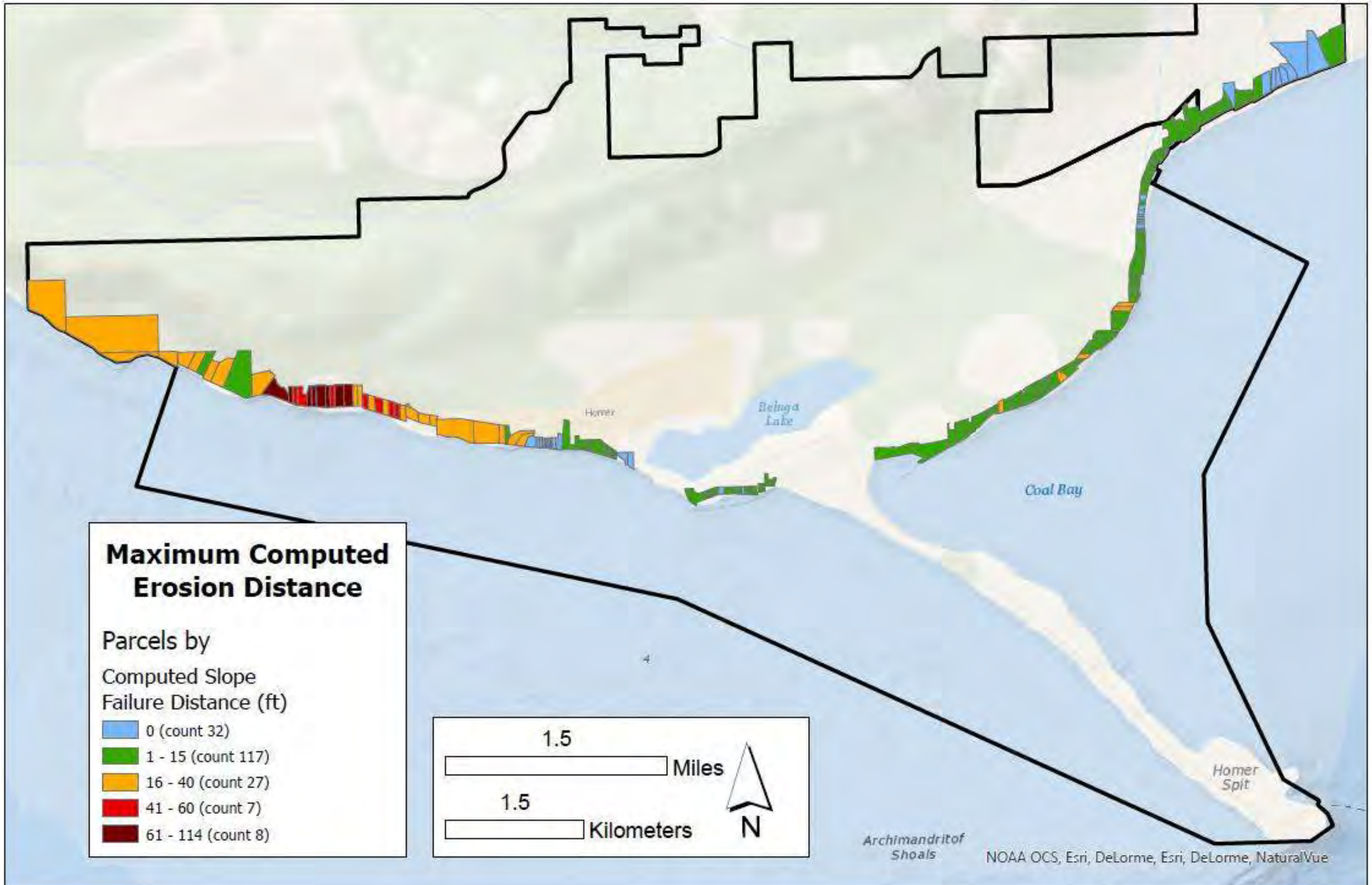


Figure 3. City of Homer parcels on coastal bluffs are symbolized by the maximum slope failure distance for coastal bluff erosion. This map shows 15 total parcels with a maximum erosion distance greater than 40 ft. The total number of parcels on coastal bluffs are 191, resulting in 8% of parcels having at least some section of their bluffs with an erosion distance greater than 40 ft. This City of Homer boundary is shown as a thick black boundary. Parcels are not differentiated between developed and undeveloped.

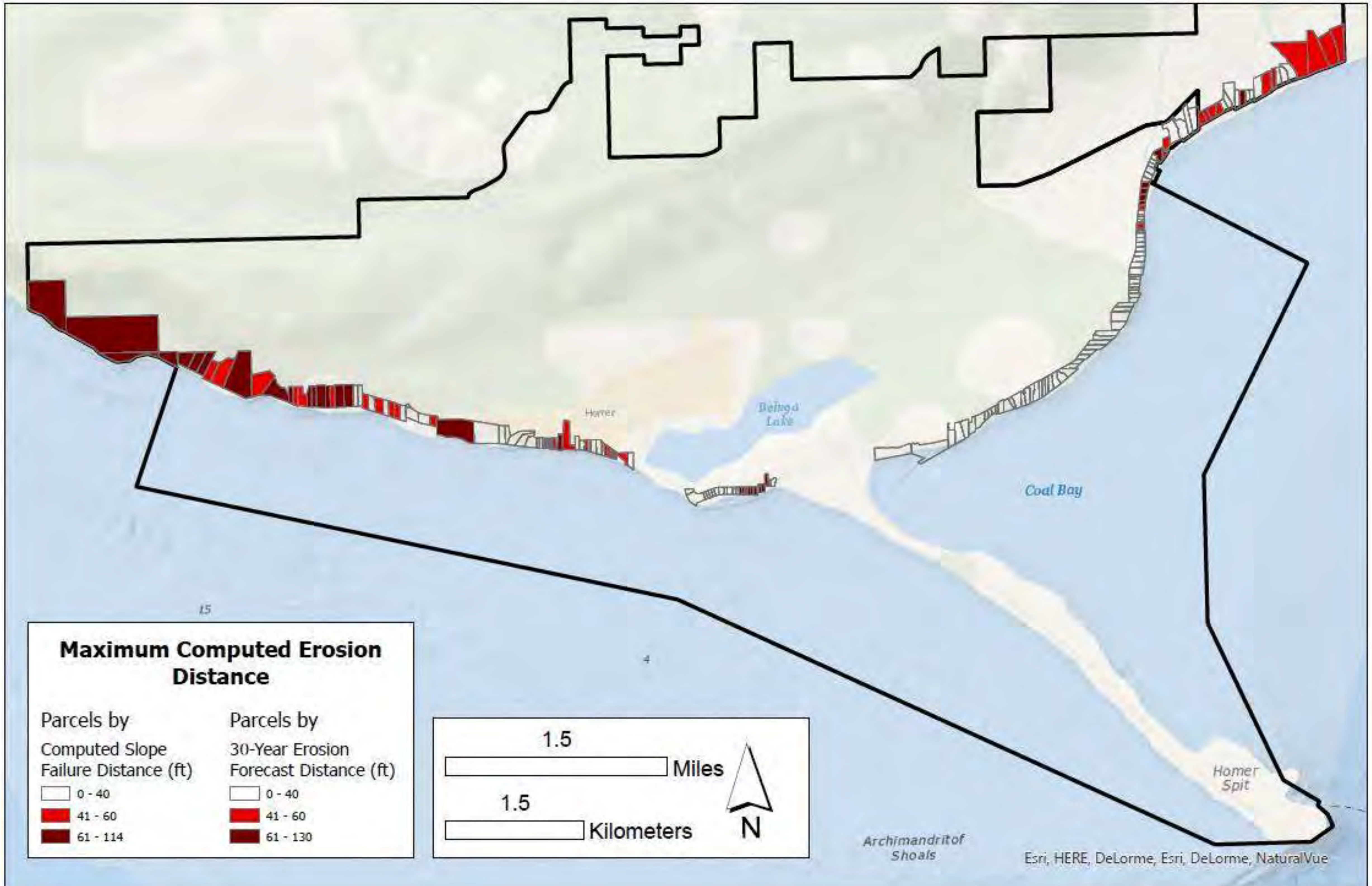


Figure 4. City of Homer parcels on coastal bluffs are symbolized by either the maximum 30-year erosion forecast distance or the computed slope failure distance for coastal bluff erosion. This map shows 69 total parcels with a maximum erosion distance greater than 40 ft. The total number of parcels on coastal bluffs are 191, resulting in 36% of parcels having at least some section of their bluffs with an erosion distance greater than 40 ft. This City of Homer boundary is shown as a thick black boundary. Parcels are not differentiated between developed and undeveloped.

Other states in the U.S. have well developed policies for coastal setback determinations or building restrictions due to erosion zonation. Examples from other states are compared to the current Homer City Zoning Code (Table 3).

In general, most states utilize a metric that is either defined at a set distance from a regulatory boundary (e.g., 150 feet from the ordinary high water mark) or by a timeline in which historical erosion rates are forecast to impact an area (e.g., a 30-year timeline with an erosion rate of 1 foot per year would make the setback 30 feet). Regulations become far more complex not only due to options for authorities to adjust policy among county or municipal boundaries (one county to the next may have a different policy) but also because greater limitations may be applied for areas considered at high erosion risk or ecologically important. These types of designations are expressed both linearly along the shoreline and as mapped zones (areas or polygons).

Table 3. Coastal setback examples from other states and parameters relevant to Homer coastal bluffs.

Homer City Zoning Code	
21.44.030 Slope development standards	No structure may be closer than 40 ft from the top of a coastal bluff, and not closer than 15 feet from the toe.
Homer Bluff Parameters from Buzard and Overbeck (in prep) City of Homer Boundaries	
Shoreline change analysis	Shoreline change rates range from 1 to 3.7 feet per year. Based on historical rates of shoreline change, 55 parcels (29%) are expected to undergo greater than 40 ft of erosion over a 30-year period.
Coastal bluff stability analysis	Horizontal bluff erosion due to slope failure ranges from zero to 114 feet, with 15 parcels (8%) with computed slope failure distances greater than 40 ft.
Combined	Combining these methods, there is only one parcel with overlap, resulting in 69 parcels (36%) with computed erosion distance greater than 40 ft.
Coastal Setback Examples from Other States	
Minnesota (outside high erosion areas)*	For non-erosion hazard areas: 75 feet from ordinary high water line elevation. 50 ft from shoreland in City of Duluth.
Minnesota (in North Shore Management Board Zone high risk erosion area)*	The annual erosion rate times 50 plus 25 feet from the top edge of the eroding bluff. 125 feet where annual erosion rate is unknown (based on 1989 map).
Michigan*	Determined by 30 (readily moveable structure) or 60 (non-readily moveable structure) year projected recession lines. Calculated as the recession rate ft/yr * 30 or 60 (depending on structure type) plus 15 ft. The state statute mandates that the erosion hazard line (EHL) be measured in reference to vegetation, which can be complicated due to various disturbances and fails to take the geomorphology of the site in account.
Ohio*	Required permitting in coastal erosion area. Defined using transects limitations on building in the defined area which represents the 30-year linear trend forecast of erosion. Mandatory updating of maps every 10 years.
Maine	All new principal and accessory structures shall be set back at least one hundred (100) feet, horizontal distance, from the normal high-water line of great ponds classified GPA and rivers that flow to great ponds classified GPA, and seventy-five (75) feet, horizontal distance, from the normal high-water line of other water bodies, tributary streams, or the upland edge of a wetland, except that in the General Development I District the setback from the normal high-water line shall be at least twenty five (25) feet, horizontal distance, and in the Commercial Fisheries/Maritime Activities District there shall be no minimum setback. In the Resource Protection District the setback requirement shall be 250 feet, horizontal distance, except for structures, roads, parking spaces or other regulated objects specifically allowed in that district in which case the setback requirements specified above shall apply.
Washington	Up to individual counties. Most examples are quite complex, including multiple buffer zone types (characterized zone—ecological function, human alteration, open space, public access, forecast rate, and single value). A minimum setback of 150 feet.

**see full text reference from Perello (2019)*

The geospatial datasets used to assess the coastal bluffs in Homer will be made available to the public so that physical features, metrics, and erosion rates (with uncertainties) described in this paper can be referenced.

For additional information or to gain access to the report of investigations on Homer Coastal Bluff Stability, please contact Jacquelyn Overbeck, information below.

Regards,

Jacquelyn Overbeck
Certified Floodplain Manager
Coastal Hazards Program Manager
Alaska Department of Natural Resources
Division of Geological & Geophysical Surveys
Office: 907-451-5026
jacquelyn.overbeck@alaska.gov

References

Baird, S., and Pegau, S., 2011, Coastal change analysis: Kachemak Bay Research Reserve, 18 p.

Buzard, R.M., and Overbeck, J.R. (in prep), Coastal bluff stability analysis for Homer, Alaska: Alaska Division of Geological & Geophysical Surveys Report of Investigation.

Kokutse, N.K., Temgoua, A.G.T., and Kavazović, Zanin, 2016, Slope stability and vegetation-conceptual and numerical investigation of mechanical effects: Ecological Engineering 86, p. 146-153.

Perello, Melanie, November 2019, Draft Great Lakes coastal erosion—Review of erosion estimates, mapping, and public policies and outreach across the Great Lakes: Minnesota Department of Natural Resources, Lake Superior Coastal Program, 48 p. http://ardc.org/wp-content/uploads/2020/01/20191105_ReportOnGreatLakesErosionEfforts.pdf

Salisbury, J.B., (in prep), Landslide susceptibility in Homer, Alaska: Alaska Division of Geological & Geophysical Surveys Report of Investigation.

Salisbury, J.B., Daanen, R.P., and Herbst, A.M., 2021, Lidar-derived elevation models for Homer, Alaska: Alaska Division of Geological & Geophysical Surveys Raw Data File 2021-2, 6 p. https://doi.org/10.14509/30591

Sears, Tricia R., Lahav, Marian, Burns, William J., and McClarey, Justin, October 2019, Landslide hazards land use guide for Oregon communities: Oregon Department of Conservation and Development and Oregon Department of Geology and Mineral Industries. https://www.oregon.gov/lcd/Publications/Landslide_Hazards_Land_Use_Guide_2019.pdf

A. Staff Report 22-01, City Planner's Report

City Planner Abboud reviewed his staff report that was included in the packet. He commented further on the following:

- Appeal to dismiss the withdrawn CUP application was moved to Hearing Officer
- Looking at Tax Foreclosures on Kachemak Drive
- He recorded a presentation which the link was provided in his report in the packet
- Still working on the permitting software
- Worked a bit on the Hazard Mitigation Plan update
- Reviewed the proposed Rural Residential Rezone update
- EDC December meeting update
- Multi-use Community Center update

City Planner Abboud responded to Commissioner Venuti regarding status of data on the asbuilts provided by builders. He noted that notices have been sent out and they are preparing to send out a stronger reminder. He will provide some statistics in his next report.

Commissioner Conley requested clarification on the presentation materials regarding the homelessness.

City Planner Abboud stated he will email commissioners the link.

Commissioner Bentz requested an update on the hazard mitigation planning process timeline.

City Planner Abboud facilitated questions and answers on the following:

- status update on the number of asbuilts submitted
  - City Planner will provide statistics in the next meeting packet
- Clarification on the Homeless Coalition Presentation materials
  - City Planner will provide a link to the Commissioners
- Hazard Mitigation Planning Process timeline
  - This is not his timeline but he is hoping to be completed in a couple of months but it depends on the other parties involved, City Planner will try to get that information nailed down

PUBLIC HEARINGS

PLAT CONSIDERATION

PENDING BUSINESS

A. Staff Report 22-03 Coastal Bluff Analysis

Chair Smith Introduced the item by reading of the title and invited City Planner Abboud to provide his report.

City Planner Abboud reviewed his staff report and what has been discussed by the Commission:

- establishing a 40 foot setback from a bluff and needing input from the Commission on this distance
- allowance to bring in an engineer, needing additional input from Commission
- bringing the proposed code language for review by building professionals and engineering professionals

City Planner Abboud then facilitated discussion on the following:

- definition of coastal buff would mean along the water's edge and bluff top edge would be the inland and away from the water
- needing to cross reference to make sure that they do not have a definition already
- review of the steep slope again to make sure that they are covered inland
- time frame to use should be based on the use of the 30 year planning since that is what was used for the data and science
- 40 foot setback is used as a building code guide and 60 foot get them where they want to be on the DNR land in the area of Baycrest Overlook
- Obtaining data on the average of how long a family stays in a home, thirty years works for the financing but not everyone stays in their home for thirty years and not guiding this based on mortgages and insurance
- Keeping the data relative to the dynamics of the structure and not the habit of the persons who occupy it
    - there are only a handful of structures that could be 50 years old, but structures that were built 20 years ago are substantially different than those built 35 years ago
    - Homer does not have a building code
    - review of other studies they would figure their measure and add 10 feet
    - How long should they give a structure pertaining to expected life of a structure
        - Dependent on how they were built, examples of structures that were constructed prior to the 1964 earthquake are still standing and structurally sound while there are many built in the 1970's that have multiple problems as they were built by individuals who did not have the necessary knowledge.
        - 30 years is the minimal time
- Different areas of Homer have experience various rates of erosion such as towards the west experienced 1.7 feet per year loss compared to the east along Kachemak Drive or East End have ½ a foot or less each year and using a overall instability as a metric using the data in the study. Referring to the Table 13 on page 42 of the packet.
    - Checking back with Ms. Overbeck on rates that were used in the table
    - Munson Point was provided as an example that the setback would not need to be increased from the standard due to the low instability score due to the preventative measures
- Clarification on the area of "downtown" that is being referred to was requested
- There are some areas along Kachemak Drive that lost 20 feet in one year, it was interesting that it has such a low score
- Review of communities in the United States shows that there are no set standards, each community has different regulations
- Establish an unattainable distance so that there will be no building in the future and then there will never be a failure

- Regulations that limit the use of private property to the effect that it deprives the property of any value amounts to a taking and is something to consider.
- Checking on the element of rising sea levels and increase in the strength of storms is something to consider
    - o There is probably some consideration but the sea levels and glacier retreat has been really small increments and calculated in millimeters, City Planner Abboud will double check that data with Ms. Overbeck
    - o Current land level is outpacing the sea level rise but the increasing frequency and intensity of coastal storms addresses that but considering that we have been looking at data that addresses the past does not lend itself for what they may experience in the future and that faster erosion rates could be experienced.
    - o That supports the increase by 10 feet because Mother Nature is not going to get better and difficult to predict.

B. Staff Report 22-05, Storage Container Dwellings

Chair Smith introduced the item and requested City Planner Abboud to provide his staff report.

City Planner Abboud provided a summary of the Staff Report 22-05 and noted the prior discussions conducted by the Commission. He noted that a recommendation was made for Commissioner's to work with staff to produce some proposed code but there was none received by the planning department.

City Planner Abboud noted that Commissioner Venuti requested this item to be on the agenda through the Chair and then requested Commissioner Venuti to speak to the topic.

Commissioner Venuti provided a history of his experience and certifications as well as licensures and how long he has worked in the construction industry. He acknowledged that not everyone can afford a $300,000-$500,000 home and that recycling a container into a dwelling may be appealing to some people. Commissioner Venuti proceeded to provide his reasons for not allowing the use of shipping containers as dwellings for the following reasons:

- safety and health hazards with materials used in shipping containers
- aesthetics
- there is no standards for construction
- there are no requirements for inspection
- Not appropriate structure to be used in the urban or residential zones of the city where residents are heavily invested using more conventional means
- Use of shipping containers he believes will devalue the neighboring properties
- Community Design Manual does not support the use shipping containers

VENUTI/HIGHLAND MOVED THAT THE CITY OF HOMER LIMITS THE USE OF SHIPPING CONTAINERS CONVERTED INTO HOMES TO THE CENTRAL BUSINESS DISTRICT, MARINE COMMERCIAL DISTRICT AND EAST END MIXED USE DISTRICT.

Discussion ensued by the Commission on the following points:

- Toxicity and safety requirements, are what would be found in Building Code which the City does not have;

Planning
491 East Pioneer Avenue
Homer, Alaska 99603
Planning@ci.homer.ak.us
(p) 907-235-3106
(f) 907-235-3118

City of Homer

www.cityofhomer-ak.gov

Staff Report PL 22-07

TO: Homer Planning Commission
FROM: Rick Abboud, AICP, City Planner
DATE: 2.2.22
SUBJECT: Coastal Bluff Analysis

Introduction

No decisions were made about regulations of coastal properties at the last meeting. I did contact Jaci with DGGS and inquired about the Coastal Bluff Stability map when it was suggested by the Commission to investigate if it would be proper to use the map as a modifier of setback policy. She did offer to go into further details if needed. I also could find no source of data regarding the length of occupancy of coastal structures. Please refer to your last packet for the study and maps or request another copy from the office.

Analysis

I do want to reinforce the use of our current code as a starting point. After study of the Coastal Bluff Stability map, I have found that the information supports the suggestion of making tighter code to perform as it was intended to when adopted. As the Stability map indicates, the areas suggested to be regulated with a 40' setback match the very low to medium risk. The particular lots that have greater computed future erosion rates (in the areas proposed to have a 40' setback) are already mostly fully developed and would not be expected to support near shoreline developments.

As one progresses from the Saltwater Drive areas to the west the vulnerability index is found to frequent the high vulnerability designation, where it was suggested to support a 60' setback due to the higher forecasted rates of erosion or possible slope failure.

Current Code

Current Code regulates on the basis of being "Located within 40 feet of the top or within 15 feet of the toe of a steep slope, bluff, coastal bluff or ravine", HCC 21.44.020(a)(2).

> HCC 21.44.030(c), Setbacks. Subject to the exceptions to setback requirements in HCC 21.44.040, all development activity is subject to the following setback requirements:

1. No structure may be closer to the top of a ravine, steep slope or noncoastal bluff than the lesser of:

    a. Forty feet; or

    b. One-third of the height of the bluff or steep slope, but not less than 15 feet.

2. No structure may be closer than 15 feet to the toe of a bluff other than a coastal bluff.

3. **No structure may be closer than 40 feet to the top of a coastal bluff and closer than 15 feet to the toe of a coastal bluff.**

"Coastal bluff" means a bluff whose toe is within 300 feet of the mean high water line of Kachemak Bay.

"Bluff" means an abrupt elevation change in topography of at least **15 feet**, with an average slope of not less than **200 percent** (two feet difference in elevation per one foot of horizontal distance).

The real issue with this that we have erosion issues regardless of the height of the bluff. We have a study that projects probable annual erosion rates. I would like to think of the coastline in term of a continuous coastal bluff, regardless of height.

We already require dwellings to be located at least 40' from the top of the 'bluff' that is within 300' of the bay, it is just that the definition of bluff is nearly non-applicable in Homer. Places that have been proposed to maintain a 40' setback from the 'bluff' is in keeping with the intent of locating dwellings from what is the current extent of the bay landward. I do not find this number controversial or inconsistent with the current intent of the code.

Additionally, a 40' setback from slopes is a rule of thumb distance required in the current International Building Codes (IBC). The rule is 40' or 1/3 the height of the bluff. While this may be a good rule of thumb for a noncoastal bluff, it further supports the contention that 40' should be the minimum distance from our eroding coastline, since the height of the bluff and relation to the annual erosion rate is somewhat nebulous and we have a study that refines our specific hazards.

It is not shocking, in the least, to current or prospective property owners to suggest that they keep developments 40' from the bluff transitions. I do believe that a 60' setback from the edge of the riskier lands to the west is reasonable where little developmental pressures are found.

Bluff Edge

The issue with the code not prescribing the 40’ setback consistently is that our definition of Coastal Bluff is basically non-existent in Homer, due to the poor match of physical description of our shoreline. This definition may work better in a place that only has a concern with tall bluffs, as mentioned above, our eroding shoreline is moving regardless of the height or steepness of the bluff.

After some professional input, we have drafted some language from our study and other descriptions that would better address the unique features of the Homer Shoreline. It may need some further revision as it is tested.

> *Bluff Edge – The bluff top edge is identified as the seaward extent of relatively flat land where a slope break or scarp occurs. The chosen bluff top edge must represent the seaward extent of land that is neither part of a previous landslide nor a bench on a slope”*

I would like to further consult and test the concept to consider some finer elements, but I believe it is a good basis of thought. I never thought that a description of this feature would be so challenging. But, it is apparently something that everyone struggles with, as you may see when looking at the examples from other coastal communities. Our coast is dynamic and somewhat unique. The one issue I wish to bring to a professional is considering the limit of the definition to describe the landward extent and just how applicable that is to Homer, as our current code describes a limit of 300’ from the shore.

Staff Recommendation

I would like a recommendation to draft up regulations for the Commission to review and for the public to provide input.

Attachments

Please refer to the study and maps found in the last packet or request them from the office if they are inaccessible.

Mr. Lakey responded to questions from the Commission on his location in relation to the applicants, if he had viewed the drainage plan contained in the packet, if he had reported the issues to Public Works Department and where the actual drainage ditch and how the flow of water is dispersed.

Mr. Gill responded to Commissioner Venuti that he would be willing to coordinate and work to address any drainage issues during his ground prep.

Commissioner Barnwell commented that they should require a drainage plan analysis incorporated into these types of situations especially in higher density situations and poor soils. He believed that with the data that is available he is wondering why they do not have that requirement currently.

City Planner Abboud responded that is code and they do not have off-site improvements; he then provided an explanation of what possible solutions and assured the Commission that Public Works did review this project and there is more than one property owner with these drainage issues.

City Planner Abboud responded to Commissioner concerns on the proposed siding selection in regards to the design manual and that those requirements do not apply to residential zone.

Vice Chair Highland requested a motion and second.

BENTZ/BARNWELL MOVED TO ADOPT STAFF REPORT 22-06 AND RECOMMEND APPROVAL OF CONDITIONAL USE PERMIT 22-01 FOR TWO BUILDINGS CONTAINING THREE DWELLING UNITS TOTAL AT 373 MOUNTAIN VIEW DRIVE WITH FINDINGS 1-10 AND CONDITION 1:

1. OUTDOOR LIGHTING SHALL BE DOWNLIT PER HCC 21.59.030 AND THE CDM

There was a brief comment on the information provided on the density in response to the public comments received.

VOTE. YES. VENUTI, CONLEY, BARNWELL, BENTZ, CHIAPPONE, HIGHLAND

Motion carried.

PLAT CONSIDERATION

PENDING BUSINESS

A. Staff Report 22-07 Coastal Bluff Analysis

Vice Chair Highland Introduced the item by reading of the title and invited City Planner Abboud to provide his report.

City Planner Abboud reviewed his staff report and facilitated discussion on the following:

- stability map and modifier for a setback map
- the stability map may not be the best resource to use
- City code review should happen frequently due to the dynamic coast land
- Comparison of other like communities show different coastal communities nothing is similar

- it is very complex, there are varying degrees of possible slope failure which should have a greater setback such as 60 feet
- Erosion rates do not depend on a coastal bluff
- City code was not based general slope stability
- Support for the 40 foot setback is a good point to start with
- description and definition for bluff edge
- different features and issues on Baycrest
    - different benches
    - rotational issues
    - historical landslides or slough

City Planner Abboud requested direction from the Commission to come up with code language.

Further discussion ensued on the definition clarification of coastal bluff, multiple benches, concerns on the scarp under West Hill location, setting threshold on the coastal erosion, requiring readily moveable structures, it would be dependent on the time of application since it changes all the time; using the LIDAR information that is currently available, establishing a setback at 40 feet catches most if not all the predicted erosion; using the LIDAR information to develop the definition as well as the mapping will provide the best definition and most appropriate definition.

Further discussion ensued on the definition of coastal bluff and that it is not a defined line. Additional comments were made on the 40 feet from the top of a slope and 15 feet from the bottom is from the building code and that they were not established for a coastal bluff in Homer, Alaska. City Planner Abboud noted that it is reasonable and you would not be condemning the land, basing it off of building code at minimum you are not going against it in theory if you adopt a building code there would be no conflict, the Commission can decide more but he would not recommend less.

BENTZ/ VENUTI MOVED TO REQUEST PLANNING STAFF DRAFT REGULATIONS AND BRING BACK TO THE MARCH 16TH MEETING FOR REVIEW BY THE COMMISSION.

Commissioner Bentz requested this to be on a worksession so it can be reviewed and discussed.

VOTE. NON-OBJECTION. UNANIMOUS CONSENT.

Motion carried.

B. Staff Report 22-08, Storage Container Dwellings

Vice Chair Highland introduced the item and requested City Planner Abboud to provide his staff report.

City Planner Abboud stated that the Commission wanted to view language to ban the use of storage containers for dwellings. He noted that the best way in his opinion since they do not have building code was to amend the term dwelling. He noted that without a building department there was not a better way in his opinion. He confirmed that this would be an amended definition of the word dwelling currently used.

City Planner Abboud facilitated an in-depth discussion on the following points:

- aesthetics of the use of shipping containers as dwellings
- limitations on regulating the use of shipping containers until the city has a building department
- applying personal opinions to regulate on the way things look and would this then apply to other non-standard dwelling materials such as yurts.
- cost comparison of converting a shipping container compared to traditional builds
- possible toxicity that can pass on to persons who reside in a shipping container
- how near future is a building department and code
- Use of shipping containers can be done in other applications such as commercial, example Oyster Bar that was approved.
- Structural concerns using converted shipping containers

Deputy City Clerk Krause reminded the Commission that this topic was postponed at the January 5, 2022 regular meeting reading the motions on the floor limiting the use of shipping containers as dwellings to the Central Business District, Marine industrial and East End Mixed Use District then the amendment was to remove the Central Business District. The current item before the Commission is to amending the definition which is another factor of the issue of using shipping containers as dwellings. So that issue will be on the February 16th agenda.

Commissioner Bentz restated her understanding of the discussion from the January meeting simplifying to to three points: the motion and amendment on the floor to limit the use of intermodal shipping containers, the amendment to city code regarding the definition of “dwelling” in relation to intermodal shipping containers and third for the Commission to explore adding building inspection services.

Vice Chair Highland did not recall that discussion but noted that they cannot move something that is not on the agenda.

Further discussion ensued on making motions to changing code and preference to address the issues through building inspections and adding building code and those types of city services and it would be very beneficial to the residents of Homer and use those instances as evidence to support the implementation of building code. Additional points made that typically residential structures are inspected but there is no way to know that at this time.

City Planner Abboud requested that the issue of building code be kept separate from these issues.

Vice Chair Highland restated the topics that would be coming before commission at the February 16th meeting and they can then bring back this item as well.

Commissioner Bentz would like to see proposed code language on limiting shipping containers since they have a motion on the floor.

City Planner Abboud expressed hesitancy in writing the language that Commissioner Bentz requested for the motions on the floor and that the Commission has not expressed solid support for the current recommendation he has presented to address the situation. He further expressed that he did not believe that it was a preferred choice on how to construct a dwelling.

Commissioner Conley requested a worksession on this topic to discuss and review all the options and to get a thorough understanding of the issues.

Commissioner Barnwell supported the idea of worksession instead of trying to make a decision in this limited time period.

Vice Chair Highland requested confirmation that City Planner Abboud had enough direction to proceed with the Building Code aspect of this by the commission.

City Planner Abboud confirmed.

Deputy City Clerk Krause requested a motion to postpone amending the definition from the Commission if they were not acting on it at this meeting.

BENTZ/VENUTI MOVED TO POSTPONE THIS ITEM TO THE FEBRUARY 16, 2022 REGULAR MEETING.

There was no further discussion.

VOTE. NON-OBJECTION. UNANIMOUS CONSENT.

Motion carried.

NEW BUSINESS

A. Staff Report 22-09 Maximum Parking Allowance for Large Retail

Vice Chair Highland introduced the item by reading of the title.

City Planner Abboud reviewed his staff report for the Commission.

Discussion was facilitated and focused more on the issues that were brought forward by the changes in the Safeway parking lot on the following:

- requirements for parking lots for commercial establishments
- design factor
- number of entrances
- looking at minimums
- making logical allowances for what is really necessary on site
- parking lots are really expensive
- reducing the percentage is the simplest method
- removal of landscape requirements
- accommodating snow removal and storage

BENTZ/CONLEY MOVED TO STRIKE LINE A PARKING LOTS FOR LARGE RETAIL AND WHOLESALE DEVELOPMENT SHALL NOT EXCEED THE MINIMUM NUMBER OF SPACES REQUIRED BY CHAPTER 21.55 BY MORE THAN 10 PERCENT.
There was no further discussion.

City of Homer
www.cityofhomer-ak.gov

Planning
491 East Pioneer Avenue
Homer, Alaska 99603
Planning@ci.homer.ak.us
(p) 907-235-3106
(f) 907-235-3118

Staff Report PL 22-12

TO:	HOMER PLANNING COMMISSION
FROM:	RICK ABBOUD, AICP, CITY PLANNER
DATE:	FEBRUARY 16, 2022
SUBJECT:	COASTAL BLUFF REGULATION

Introduction

The Commission requested that our discussion of coastal setback be brought to a work session. If you do not have access to the DGGS study from previous packets, please request copies from the office.

Analysis

My last staff report focused on analyzing our current code and what the expectations were, namely setbacks based on the bluff composition. Our study indicates that we have forecasted erosion rates and bluff failures that are not tied hard and fast to just the height and current slope of the bluff. Coastal Homer is a dynamic feature and reminds me of the investments disclaimer that state, "past performance may not be an indicator of future results". Some areas may move faster and some slower.

What we do have is better information than we have ever had. We have historical measures of erosion that date back to 1954. Slope failure distance averages have been computed and brought into the equation. Both these measures have been forecasted out 30 years. I would expect, as time goes on, we will again get even better information and will have to take that into consideration at the time. This is something that should be scheduled for review every 5 years or as new information comes available.

I have suggested to apply a 40' setback for new structures along the east coastal areas, heading west to somewhere adjacent to Saltwater Drive or the West Hill areas (with exclusion of the spit). From these areas west I suggest at least a 60' setback. These setbacks provide improved measures of safety compared to our current regulations, while allowing for a reasonable use of the lots near the bay. By my measurements, no one would be prohibited from developing on existing lots. It also conforms well to meeting the distances of most of the existing improvements, of course there are a few structures closer than this and they would be allowed to continued, but may not be eligible for replacement in their current location if damaged greater than 50% of the replacement cost.

After we get a commitment on setbacks, I will further test our definitions and look for any snags that we may not have been expecting. The working definition of the setback is proposed to be from a description of ‘bluff edge’

> *Bluff Edge – The bluff top edge is identified as the seaward extent of relatively flat land where a slope break or scarp occurs. The chosen bluff top edge must represent the seaward extent of land that is neither part of a previous landslide nor a bench on a slope.*

This is a dynamic definition that is similar in thought to those we use describing other slope or bluff and will change as conditions change. It is best to create a unique description, so it will not conflict with the use of terms found other places in code. In that vein, I will suggest something that eliminates the use of the term “bluff”, as it has a unique definition that will conflict with other uses of the definition. Also, I will have to come up with a measure of distance from the bay that applies to the definition to separate it from features further inland, such as the Baycrest pull out areas far away from the bay. A measure of 300’ is currently used in the definition of Coastal Bluff. I will further test this measure.

I believe that the suggested setbacks will serve Homer well and would not be a surprise or thought of as over-reach. Generally, the areas along the coast have been well developed and we would not expect much, if any, pressure to add to these sites. The lots that are left vacant have also not seen a great amount of development pressure.

Staff Recommendation
Provide a recommendation of coastal setbacks and locations. I will then test the ordinance with our coastal features and work up code language for review. This may need more time than the next meeting, so an open time of return would be appropriate.

Attachments
Refer to DGGS study previously provided or call for a copy.

Commissioner Highland noted that the Commission discussed this topic thoroughly and did not believe that there was anything additional to discuss.

VOTE. NON-OBJECTION. UNANIMOUS CONSENT.

Motion carried.

PLAT CONSIDERATION

PENDING BUSINESS

A. Staff Report 22-12 Coastal Bluff Analysis

Chair Smith Introduced the item by reading of the title and invited City Planner Abboud to provide his report.

City Planner Abboud reviewed his staff report at the worksession and provided a summary of what was discussed:

- work out issues insuring the setback is from the face or edge of the structure
- definition for “edge and maybe a measurement section to make sure this is not compromised by other measurements
- displaying 60 foot setbacks west of West Hill Road
- Shoring up definitions of bluff edge which include eliminating the word bluffs so it is not confused with regulations of other bluffs that they deal with
- adding a section or some definitions pertaining to the Marine Erosion and distance from the marine area that this will apply to
- possibly incorporating some measure of mean high water
- working with Commissioner Bentz to define the language for the above

Chair Smith noted that staff has requested motion for recommended setback and locations but was unsure if they were ready to do that at this time and requested further input from the Commission.

Commissioner Bentz stated that she agreed with the idea of a 40 foot setback for all areas of Homer east of West Hill and then a 60 foot setback for areas west of West Hill Road. She expressed that if they wanted to make the motion as a Commission about just that number of feet for the setback, and then opined that it would be useful to make a motion to request staff to provide an ordinance with proposed language for review at the next meeting. Ms. Benz further stated that just incorporating those key bullet points that City Planner Abboud just give us an overview of, in the language, will help and having it before us in a draft ordinance form will be really helpful as far as making decisions in the future.

City Planner Abboud stated that he was unsure if a draft ordinance could be ready by the March 2nd meeting as he will be taking some time off and Planning Staff will have other time commitments.

BENTZ/VENUTI MOVED TO RECOMMEND 40 FEET AS A SETBACK FOR LOCATIONS IN HOMER EAST OF WEST HILL AND THE STERLING HIGHWAY INTERSECTION AND 60 FEET SETBACK FOR LOCATIONS WEST OF THE INTERSECTION OF WEST HILL ROAD AND THE STERLING HIGHWAY.

Commissioner Bentz added that it is consistent with the data and the research that shows higher erosion rates in the western portion of City of Homer and lower erosion rates in the areas east of West Hill and that 40 foot setback is pretty consistent with the 30 year planning horizon and with other documentation that the Commission has been presented on this topic.

VOTE. NON-OBJECTION. UNANIMOUS CONSENT.

Motion carried.

BENTZ/BARNWELL MOVED TO REQUEST STAFF TO PROVIDE A DRAFT ORDINANCE OF PROPOSED LANGUAGE OF DEFINITION UPDATES FOR COASTAL BLUFFS FOR REVIEW AT THE STAFF'S CONVENIENCE OR WHEN READY.

There was a brief discussion on putting a time limit on the draft ordinance.

VOTE. NON-OBJECTION. UNANIMOUS CONSENT.

Motion carried.

B. Staff Report 22-13, Storage Container Dwellings

Chair Smith introduced the item and requested City Planner Abboud to provide his staff report.

City Planner Abboud stated that this was a subject thoroughly discussed by the Commission and there are motions on the floor pertaining to allowing container dwellings in the Central Business District, Marine Commercial and East End Mixed Use District and a draft ordinance on eliminating container dwelling city wide by definition and he looks forward to the Commission's guidance on what they wish to do.

Chair Smith requested clarification from the Clerk regarding the motions that were on the floor for consideration.

Deputy City Clerk Krause stated that there were two motions from the January 5, 2022 regular meeting, a main motion and amendment. The amendment will be dispensed with first then the main motion. She provided guidance on the procedure.

Chair Smith read the amendment into the record, VENUTI/HIGHLAND MOVED TO AMEND THE MOTION TO EXCLUDE THE CENTRAL BUSINESS DISTRICT FROM THE MOTION and opened the floor for discussion.

Chair Smith stated that since there was no discussion on the amendment, he requested objections to the motion before them amending the motion to exclude the CBD from the main motion.
Commissioner Venuti requested clarification on what they were voting on.

City of Homer
www.cityofhomer-ak.gov

Planning
491 East Pioneer Avenue
Homer, Alaska 99603
Planning@ci.homer.ak.us
(p) 907-235-3106
(f) 907-235-3118

Staff Report PL 22-31

TO:	HOMER PLANNING COMMISSION
FROM:	RICK ABBOUD, AICP, CITY PLANNER
DATE:	APRIL 20, 2022
SUBJECT:	COASTAL BLUFF REGULATION

Introduction

After previous discussion with the Commission, I have a draft code for review. It is complete in concept, but may need technical review/revision. It is not in ordinance format at this time, but includes line numbers for reference.

Analysis

I am proposing regulation based on the results of the DGGS study. The study has not been published yet and we may need to wait until it is, so that we may refer to it as a basis for our regulation. There are several more points of concern that we may address in the future. For now, we are sticking to coastal setback, as our current code does not address it as intend (since we really don't have much in the way of "coastal bluff", by definition). Previous staff reports have reviewed the study and the need for coastal setbacks due to predictions of erosion, regardless of bluff types.

Regulatory line to measure of setback

I have struck the term "coastal bluff", as it incorporates the use of "bluff" which is a term that is useful in regulation of non-coastal applications and should not have a conflicting definition. It has been replaced with "coastal edge" (lines 1-4), a word that may be revised for better semantics later, but it gets the point across for now. This will be the line which will be used to measure setbacks. The definition is dynamic and is based off the language used in the study.

Transition of standards (lines 42-48)

The Commission expressed support for a 40 foot setback that transitions to a 60 foot setback. These setbacks were based on a 30 year estimated erosion rate. I believe that this is a good place to start and it will require 5 and 10 year reviews or after any significant events. While 30 years is not a particularly long look to the future, our estimates are only based off of seventy some years that has included a significant event that caused a good deal of erosion. Forty feet is a good minimum, as it will not cause conflict with a proposed building code, as it is a distance used to setback from slopes common in building codes.

The 40 foot regulation would start at the east end of town and commence to the north-south section line located just west of Soundview Avenue. This corresponds with the transition where the study indicated a change in the erosion rates. The spit will be excluded with the reference to Mile Post 175 (which unfortunately is not displayed on the Highway – it looks to be just a post w/o a sign right now). It is found on the borough parcel maps and is just past where the Bay Avenue lots extend into the mud of high and extreme tides. Spit development is regulated by FEMA flood regulations. Just past Soundview Avenue, structures will be required to maintain a 60' setback.

Exceptions

Exception to the setback may be approved when the site plan is approved by the City Engineer and a CUP is approved (lines 86-88).

I am also proposing to take the City Planner out of the business of approving erosion control methods (line 63) and determining if development activity is reasonably intended to stabilize the slope (line 84). This is best left to the City Engineer.

This proposed regulation is a good place to start that better prescribes setbacks than current regulation. It allows for reasonable development opportunity while assuring a better measure of safety.

Staff Recommendation

Review and comment. The ordinance may receive further technical review prior to consideration for a public hearing and will be brought back at a later meeting.

Attachments

Draft Ordinance

"Coastal ~~bluff~~**<u>edge</u>**" means ~~a bluff whose toe is~~ **<u>the seaward extent of a relatively flat land where a slope break or scarp occurs that is adjacent and</u>** within 300 feet of the mean high water line of Kachemak Bay. **<u>The chosen coastal edge must represent the seaward extent of land that is neither part of a previous landslide nor a bench on a slope.</u>**

Chapter 21.44
SLOPES <u>& COASTAL DEVELOPMENT</u>

21.44.010 Purpose and intent.

This chapter regulates development activity and structures in areas affected by slopes, bluffs, ~~coastal bluffs~~, ~~and~~ ravines, **<u>and areas subject to coastal setback,</u>** and provides the means for additional review and protection to encourage safe and orderly growth to promote the health, welfare and safety of Homer residents.

21.44.020 Applicability.

a. This chapter applies to all development activity that disturbs the existing land surface, including without limitation clearing, grading, excavating and filling in areas that are subject to any of the following conditions:

1. Lots with average slopes 15 percent or greater, bluffs, coastal bluffs and ravines;

2. Located within 40 feet of the top or within 15 feet of the toe of a steep slope, bluff, coastal ~~bluff~~ **<u>edge</u>** or ravine; and

3. Any other location where the City Engineer determines that adverse conditions associated with slope stability, erosion or sedimentation are present.

b. This chapter imposes regulations and standards in addition to the requirements of the underlying zoning district(s). [Ord. 08-29, 2008].

21.44.030 Slope development standards.

The following standards apply to all development activity on a site described in HCC 21.44.020:

a. No development activity, including clearing and grading, may occur before the issuance of a zoning permit under Chapter 21.70 HCC.

b. Area of Development.

1. Except where the City Engineer approves a site plan under HCC 21.44.050 that provides for a larger area of development, the area of development on a lot with an average slope:

a. Of 15 to 30 percent shall not exceed 25 percent of the total lot area.

b. Greater than 30 percent but less than 45 percent shall not exceed 10 percent of the total lot area.

2. The area of development on a lot with an average slope of 45 percent or greater shall not exceed the area of development described in a site plan approved by the City Engineer under HCC 21.44.050.

c. Setbacks. Subject to the exceptions to setback requirements in HCC 21.44.040, all development activity is subject to the following setback requirements:

1. No structure may be closer to the top of a ravine, steep slope or noncoastal bluff than the lesser of:

a. Forty feet; or

b. One-third of the height of the bluff or steep slope, but not less than 15 feet.

2. No structure may be closer than 15 feet to the toe of a bluff other than a coastal bluff.

3. ~~No structure may be closer than 40 feet to the top of a coastal bluff and closer than 15 feet to the toe of a coastal bluff.~~ **Structures shall be setback 40 feet the coastal edge from points starting from the eastern most extent of Homer adjacent to Kachemak Bay extending to the north south Section Line dividing Sections 19 & 24 Township 6 South Range 14 West Seward Meridian, and excluding all property South of Mile Post 175 of the Sterling Highway. All structures west of the section line shall be setback 60 foot from the coastal edge. No structure may be placed closer than 15 feet from the toe of a coastal edge.**

d. Natural Drainage. The site design and development activity shall not restrict natural drainage patterns, except as provided in this subsection.

1. To the maximum extent feasible, the natural surface drainage patterns unique to the topography and vegetation of the site shall be preserved. Natural surface drainage patterns may be modified only pursuant to a site plan approved by the City Engineer under HCC 21.44.050, and upon a showing that there will be no significant adverse environmental impacts on the site or on adjacent properties. If natural drainage patterns are modified, appropriate soil stabilization techniques shall be employed.

2. The site shall be graded as necessary to ensure that drainage flows away from all structures for a distance of at least 10 feet, especially where building pads are cut into hillsides.

3. The development activity shall not cause an adverse effect on adjacent land and surrounding drainage patterns.

e. Erosion Control.

1. Erosion control methods approved by the ~~**City Planner and**~~ City Engineer, including without limitation sediment traps, small dams and barriers, shall be used during construction and site development to protect water quality, control soil erosion and control the velocity of runoff.

2. Winter Erosion Control Blankets. If development on a slope is not stabilized by October 15th, erosion control blankets (or a product with equivalent performance characteristics) must be installed upon completion of the seasonal work, but no later than October 15th. The erosion control blankets shall remain in place until at least the following May.

3. Vegetation shall remain undisturbed except as necessary to construct improvements and to eliminate hazardous conditions, in which case it must be replanted with approved materials including ground cover, shrubs and trees. Native vegetation is preferred for replanting operations, and will be used where practicable.

4. Grading shall not alter the natural contours of the terrain except as necessary for building sites or to correct unsafe conditions. The locations of buildings and roads shall be planned to follow and conform to existing contours as nearly as possible. [Ord. 08-29, 2008].

21.44.040 Exceptions to setback requirements.

a. Any of the following may be located within a setback required by HCC 21.44.030(c):

1. A deck extending no more than five feet into the required setback.

2. An unoccupied accessory structure having a building area not greater than 200 square feet that is no closer than 15 feet to the top of any bluff or ravine.

3. A boardwalk, sidewalk, foot path or stairway that provides access to a beach, bluff or accessory structure, and that is located at or within three feet above ground level.

4. Development activity that the ~~**City Planner**~~ **City Engineer** determines is reasonably intended to stabilize an eroding coastal bluff.

b. No structure other than a structure described in subsection (a) of this section may be located in a required setback without a conditional use permit issued in accordance with Chapter 21.71 HCC and a site plan approved by the City Engineer under HCC 21.44.050. [Ord. 08-29, 2008].

21.44.050 Site plan requirements for slope development.

a. No permit for development activity for which HCC 21.44.030 or 21.44.040(b) requires a site plan may be approved unless the City Engineer approves a site plan for the development activity that conforms to the requirements of this section. The City Engineer shall accept or reject the plan as submitted or may require that specific conditions be complied with in order for the plan to meet approval.

b. The site plan shall be prepared by a qualified geotechnical engineer licensed to practice in the State of Alaska and shall include the following information:

1. The location of all watercourses, water bodies, and wetlands within 100 feet of the location of the proposed development activity.

2. The location of all existing and proposed drainage structures and patterns.

3. Site topography shown by contours with a maximum vertical interval of five feet.

4. The location of all proposed and existing buildings, utilities (including on-site well and septic facilities), driveways and streets.

5. The location of all existing vegetation types including meadow, forest and scrub lands, identifying all areas of vegetation that will be removed as well as vegetation to be preserved or replaced. Specifications for revegetation shall also be included.

6. Specific methods that will be used to control soil erosion, sedimentation, and excessive stormwater runoff during and after construction.

7. A description of the stability of the existing soils on site and a narrative and other detail sufficient to demonstrate the appropriateness of the development and construction methods proposed.

8. A grading plan for all areas that will be disturbed by the development activity.

9. A slope stability analysis including the following:

a. Summary of all subsurface exploration data, including subsurface soil profile, exploration logs, laboratory or in situ test results, and groundwater information;

b. Interpretation and analysis of the subsurface data;

c. Summary of seismic concerns and recommended mitigation;

d. Specific engineering recommendations for design;

e. Discussion of conditions for solution of anticipated problems;

f. Recommended geotechnical special provisions;

g. An opinion on adequacy for the intended use of sites to be developed by the proposed grading as affected by soils engineering factors, including the stability of slopes.

HIGHLAND/VENUTI MOVE TO OPEN DISCUSSION ON STAFF REPORT 22-29, TINY HOMES.

There was no discussion.

VOTE. NON-OBJECTION UNANIMOUS CONSENT.

Motion carried.

City Planner Abboud facilitated discussion on the following:

- Tiny homes on wheels then removing the wheels
- Code acceptance, standards established for construction
- Appearance difference between RV's and Tiny Homes
- Developing building code would have a requirement
- Developing planning code to address appearance
- Comparing codes for dwellings they look at adequate egress, etc.
- Shared link with the commissioners and there is no charge to view the webinar which was believed to be in May
- Commissioner Venuti stated he would have to read the requirements before supporting it
- If building code is implemented a person will have to follow the requirements as outlined in the code for the structure to be approved
- Making a decision sooner rather than later as they will be coming to Homer in the near future.
- Building costs increasing
- Continuing ambiguity on what exactly defines a tiny home
- There is language now
- Not realistic to assume that someone will build a tiny home on a 60K lot
- There is no demand at this time for placing tiny homes
- According to existing code tiny homes that are moveable are classified as RVs
- Cannot divorce from RVs at this time
- Appearance is nicer than a Connex
- Someone may want this as a ADU
- Not permanent dwelling, may be a place for this at this time
- Specifics of verbiage for RV

C. Staff Report 22-31, Coastal Bluff Regulations

Chair Smith Introduced the item by reading of the title.

City Planner Abboud reviewed Staff Report 22-31.

HIGHLAND/ BARNWELL MOVE TO OPEN DISCUSSION AND REVIEW ON STAFF REPORT 22-31, COASTAL BLUFF REGULATION.

There was no discussion.

VOTE. NON-OBJECTION. UNANIMOUS CONSENT.

Motion carried.

City Planner Abboud deferred to the Public Works Director in her role as the City Engineer as she was more knowledgeable and could provide additional information.

Public Works Director Keiser reported the findings within the area of coastal bluffs using the DGGS Study, describing the discovery of old coal mines after a request for water and sewer in the area and determined that the city could not put services in that area requested, the city reserves the right not to extend utilities in risky areas and that will limit development in and by itself due to the inability to get a DEC approved septic system or well; this will protect the city infrastructure. She expounded on the city working on regulations that will strengthen the address the drainage issues such as requiring stormwater plans and development activity plans on all developments regardless of size or volume of dirt moved to allow better tracking, the definition of coastal edge is a great start, noting that there will be adjustments as the science is presented and there may be action to come before the Commission in the future on the coal mining areas. She noted that the city is in the process of staffing up with training and outside consultants.

Discussion was facilitated on these points:

- Definition for coastal edge
- Existing or current erosion due to the possible coal mine shafts
- Appreciation to bringing the expertise of the City Engineer to speak on these topics

NEW BUSINESS

A. Staff Report 22-30, Homer Non-motorized Trails & Transportation Plan Implementation

Chair Smith introduced the item by reading of the title.

City Planner Abboud provided a review of Staff Report 22-30.

HIGHLAND/VENUTI MOVE TO OPEN DISCUSSION AND REVIEW ON STAFF REPORT 22-30 HNMTTP IMPLEMENTATION.

There was no discussion.

VOTE. NON-OBJECTION. UNANIMOUS CONSENT.

Motion carried.

Public Works Director Keiser responded to questions regarding the purpose of the supplement or implementation plan, stating that this document is not a substitute for the HNMTTP but a detailed implementation plan.

City Planner Abboud reported that this does not limit the City but is a tool to use and assist in designating the funding to get recommendations done.

Commissioner Highland noted that she was on the advisory body that drafted the 2004 plan and then expressed her ongoing concerns with development in the Beluga Slough area.

VENUTI/HIGHLAND MOVED THAT THE PLANNING COMMISSION SUPPORTS THE HOMER NON-MOTORIZED TRAILS AND TRANSPORTATION PLAN IMPLEMENTATION PLAN AND APPROPRIATE FUNDING TO EXECUTE.

Public Works Director Keiser suggested that the Commission withhold their recommendation till the Ordinance requesting the funding comes before the City Council.

VOTE. NO. SMITH, VENUTI, HIGHLAND, CONLEY, BARNWELL

City of Homer
www.cityofhomer-ak.gov

Planning
491 East Pioneer Avenue
Homer, Alaska 99603
Planning@ci.homer.ak.us
(p) 907-235-3106
(f) 907-235-3118

Staff Report PL 22-37

TO:	HOMER PLANNING COMMISSION
FROM:	RICK ABBOUD, AICP, CITY PLANNER
DATE:	MAY 18, 2022
SUBJECT:	COASTAL SETBACKS

Introduction

The Planning Commission has reviewed a draft of the Coastal Bluff Stability Assessment for Homer developed by the State of Alaska Division of Geological & Geophysical Surveys (DGGS). After considering the study recommendations and draft code developed to address coastal erosion, we are holding a public hearing to receive comments on revised code language.

Analysis

Earlier staff reports and the DGGS study recognized that our current definition of 'coastal bluff' did not apply to the majority of the features found on the Homer coastline and our erosion hazard does not depend on the height of a coastal bluff alone. In order to provide a more useful measure of distance from the eroding hazard we are proposing a change in the term 'coastal bluff' and propose a definitive setback.

'Coastal bluff' is now referred to as 'coastal edge'. This change allows us to retain the definition of 'bluff' for use in non-coastal applications. The definition of coastal edge is dynamic in that it describes the manifestation of a feature associated active erosion near the coast. The draft ordinance replaces the term 'coastal bluff' found throughout code.

Setbacks from the 'coastal edge' are found on lines 92-98. This describes a 40' setback starting on the east extent of town, excludes the Spit, and continues until a transition to a 60' setback just west of Soundview Avenue (see attachment). This provides a recommended distance from the predicted 30 year erosion rate for the vast majority land likely to be developed. Since we rely on data that has "inherent uncertainties", we should reflect on our experiences every 5-10 years or after significant events to keep current.

A property owner may propose to build closer than the setback and would need to gain approval of a Conditional Use Permit with a site plan approved by the City Engineer under HCC 21.44.050. Other proposed changes include the exclusion of the City Planner in approving erosion control methods and determining development meant to stabilize an eroding bluff, this will be left to the City Engineer.

Staff Recommendation
Conduct a public hearing and make recommendation for adoption by the City Council.

Attachments
Draft Ordinance
Setback map

CITY OF HOMER
HOMER, ALASKA

Planning Commission

ORDINANCE 22-xx

AN ORDINANCE OF THE CITY COUNCIL OF HOMER, ALASKA AMENDING TITLE 21.03.040 DEFINTIONS USED IN ZONING CODE, TITLE 21.44 SLOPES, TITLE 21.50.020 SITE DEVELOPMENT STANDARDS – LEVEL ONE, AND TITLE 21.50.020 SITE DEVELOPMENT STANDARDS – LEVEL TWO

WHEREAS, The State of Alaska Division of Geological & Geophysical Surveys (DGGS) provided a study entitled Coastal Bluff Stability Assessment for Homer Alaska; and

WHEREAS, The study provided information and technical assistance to improve regulation of the coastline susceptible to erosion; and

WHEREAS, The 2018 Homer Comprehensive Plan concludes that new strategies will be needed to protect the environment as the community grows – particularly regarding drainage, erosion, open space, climate change; and

WHEREAS, The 2018 Homer Comprehensive Plan identifies that a need exists for the community to take seriously the issue of allowing ongoing shoreline development; and

WHEREAS, The Homer Planning Commission has considered the recommendations for coastal bluff definition and coastal setback policies developed by the DGGS study; and

WHEREAS, The Homer Planning Commission has found that the proposed amendments provide better measures of safety for those developing in proximity to the coastline than current code.

NOW, THEREFORE, THE CITY OF HOMER ORDAINS:

Section 1. Homer City Code Chapter 21.03.040 Definitions used in zoning code is hereby amended to read as follows:

“Coastal ~~bluff~~**edge**” means ~~a bluff whose toe is~~ **the seaward extent of a relatively flat land where a slope break or scarp occurs that is adjacent and** within 300 feet of the mean high water line of Kachemak Bay. **The chosen coastal edge must represent the seaward extent of land that is neither part of a previous landslide nor a bench on a slope.**

Section 2. Homer City Code Chapter 21.44 Slopes is hereby amended to read as follows:

Chapter 21.44 SLOPES **& COASTAL DEVELOPMENT**

21.44.010 Purpose and intent.

This chapter regulates development activity and structures in areas affected by slopes, bluffs, ~~coastal bluffs~~, ~~and~~ ravines, **and the coastal edge,** and provides the means for additional review and protection to encourage safe and orderly growth to promote the health, welfare and safety of Homer residents.

21.44.020 Applicability.

a. This chapter applies to all development activity that disturbs the existing land surface, including without limitation clearing, grading, excavating and filling in areas that are subject to any of the following conditions:

1. Lots with average slopes 15 percent or greater, bluffs, coastal ~~bluffs~~ **edge** and ravines;
2. Located within 40 feet of the top or within 15 feet of the toe of a steep slope, bluff, coastal ~~bluff~~ **edge** or ravine; and
3. Any other location where the City Engineer determines that adverse conditions associated with slope stability, erosion or sedimentation are present.

b. This chapter imposes regulations and standards in addition to the requirements of the underlying zoning district(s). [Ord. 08-29, 2008].

21.44.030 Slope development standards.

The following standards apply to all development activity on a site described in HCC 21.44.020:

a. No development activity, including clearing and grading, may occur before the issuance of a zoning permit under Chapter 21.70 HCC.

b. Area of Development.

1. Except where the City Engineer approves a site plan under HCC 21.44.050 that provides for a larger area of development, the area of development on a lot with an average slope:
    a. Of 15 to 30 percent shall not exceed 25 percent of the total lot area.
    b. Greater than 30 percent but less than 45 percent shall not exceed 10 percent of the total lot area.

2. The area of development on a lot with an average slope of 45 percent or greater shall not exceed the area of development described in a site plan approved by the City Engineer under HCC 21.44.050.

c. Setbacks. Subject to the exceptions to setback requirements in HCC 21.44.040, all development activity is subject to the following setback requirements:

1. No structure may be closer to the top of a ravine, steep slope or ~~**noncoastal**~~ bluff than the lesser of:

a. Forty feet; or

b. One-third of the height of the bluff or steep slope, but not less than 15 feet.

2. No structure may be closer than 15 feet to the toe of a bluff ~~**other than a coastal bluff**~~.

3. ~~No structure may be closer than 40 feet to the top of a coastal bluff and closer than 15 feet to the toe of a coastal bluff.~~ **Structures shall be setback 40 feet the coastal edge starting at the eastern extent of the City of Homer, adjacent to Kachemak Bay extending to the north-south Section Line dividing Sections 19 & 24 Township 6 South Range 14 West Seward Meridian, and excluding all property South of Mile Post 175 of the Sterling Highway. All structures west of the section line shall be setback 60 foot from the coastal edge. No structure may be placed closer than 15 feet from the toe of a coastal edge.**

d. Natural Drainage. The site design and development activity shall not restrict natural drainage patterns, except as provided in this subsection.

1. To the maximum extent feasible, the natural surface drainage patterns unique to the topography and vegetation of the site shall be preserved. Natural surface drainage patterns may be modified only pursuant to a site plan approved by the City Engineer under HCC 21.44.050, and upon a showing that there will be no significant adverse environmental impacts on the site or on adjacent properties. If natural drainage patterns are modified, appropriate soil stabilization techniques shall be employed.

2. The site shall be graded as necessary to ensure that drainage flows away from all structures for a distance of at least 10 feet, especially where building pads are cut into hillsides.

3. The development activity shall not cause an adverse effect on adjacent land and surrounding drainage patterns.

e. Erosion Control.

1. Erosion control methods approved by the ~~**City Planner and**~~ City Engineer, including without limitation sediment traps, small dams and barriers, shall be used during construction and site development to protect water quality, control soil erosion and control the velocity of runoff.

2. Winter Erosion Control Blankets. If development on a slope is not stabilized by October 15th, erosion control blankets (or a product with equivalent performance characteristics) must be installed upon completion of the seasonal work, but no later than October 15th. The erosion control blankets shall remain in place until at least the following May.

3. Vegetation shall remain undisturbed except as necessary to construct improvements and to eliminate hazardous conditions, in which case it must be replanted with approved materials including ground cover, shrubs and trees. Native vegetation is preferred for replanting operations, and will be used where practicable.

4. Grading shall not alter the natural contours of the terrain except as necessary for building sites or to correct unsafe conditions. The locations of buildings and roads shall be planned to follow and conform to existing contours as nearly as possible. [Ord. 08-29, 2008].

21.44.040 Exceptions to setback requirements.

a. Any of the following may be located within a setback required by HCC 21.44.030(c):
1. A deck extending no more than five feet into the required setback.
2. An unoccupied accessory structure having a building area not greater than 200 square feet that is no closer than 15 feet to the top of any bluff or ravine.
3. A boardwalk, sidewalk, foot path or stairway that provides access to a beach, bluff or accessory structure, and that is located at or within three feet above ground level.
4. Development activity that the ~~**City Planner**~~ **City Engineer** determines is reasonably intended to stabilize an eroding coastal ~~**bluff**~~ **edge**.

b. No structure other than a structure described in subsection (a) of this section may be located in a required setback without a conditional use permit issued in accordance with Chapter 21.71 HCC and a site plan approved by the City Engineer under HCC 21.44.050. [Ord. 08-29, 2008].

21.44.050 Site plan requirements for slope development.

a. No permit for development activity for which HCC 21.44.030 or 21.44.040(b) requires a site plan may be approved unless the City Engineer approves a site plan for the development activity that conforms to the requirements of this section. The City Engineer shall accept or reject the plan as submitted or may require that specific conditions be complied with in order for the plan to meet approval.

b. The site plan shall be prepared by a qualified geotechnical engineer licensed to practice in the State of Alaska and shall include the following information:
1. The location of all watercourses, water bodies, and wetlands within 100 feet of the location of the proposed development activity.

2. The location of all existing and proposed drainage structures and patterns.
3. Site topography shown by contours with a maximum vertical interval of five feet.
4. The location of all proposed and existing buildings, utilities (including on-site well and septic facilities), driveways and streets.
5. The location of all existing vegetation types including meadow, forest and scrub lands, identifying all areas of vegetation that will be removed as well as vegetation to be preserved or replaced. Specifications for revegetation shall also be included.
6. Specific methods that will be used to control soil erosion, sedimentation, and excessive stormwater runoff during and after construction.
7. A description of the stability of the existing soils on site and a narrative and other detail sufficient to demonstrate the appropriateness of the development and construction methods proposed.
8. A grading plan for all areas that will be disturbed by the development activity.
9. A slope stability analysis including the following:
   a. Summary of all subsurface exploration data, including subsurface soil profile, exploration logs, laboratory or in situ test results, and groundwater information;
   b. Interpretation and analysis of the subsurface data;
   c. Summary of seismic concerns and recommended mitigation;
   d. Specific engineering recommendations for design;
   e. Discussion of conditions for solution of anticipated problems;
   f. Recommended geotechnical special provisions;
   g. An opinion on adequacy for the intended use of sites to be developed by the proposed grading as affected by soils engineering factors, including the stability of slopes.

Section 3. Homer City Code Chapter 21.50.020 Site development standards – level one is hereby amended to read as follows:

21.50.020 Site development standards – Level one.

This section establishes level one site development standards.

a. Slopes. All development on a site affected by a slope of 15 percent or more, bluff, coastal **~~bluff~~** **edge** or ravine, as described in HCC 21.44.020, shall be subject to the requirements of Chapter 21.44 HCC in addition to the requirements of this section.

b. Drainage. All development activity on lands shall conform to the following:
1. Development shall provide a drainage system that is designed to deposit all runoff into either an engineered drainage system or into a natural drainage.
2. Where open-ditch construction is used to handle drainage within the development, a minimum of 15 feet shall be provided between any structures and the top of the bank of the defined channel of the drainage ditch.

3. When a closed system is used to handle drainage within the development, all structures shall be a minimum of 10 feet from the closed system.

c. Landscaping Requirements. All development activity on lands shall conform to the following:

1. Development activities shall not adversely impact other properties by causing damaging alteration of surface water drainage, surface water ponding, slope failure, erosion, siltation, intentional or inadvertent fill or root damage to neighboring trees, or other damaging physical impacts. The property owner and developer shall take such steps, including installation of culverts or buffers, or other methods, as necessary to comply with this requirement.

2. Upon completion of earthwork, all exposed slopes and all cleared, filled, and disturbed soils shall be protected against subsequent erosion by methods such as, but not limited to, landscaping, maintenance of native vegetative cover, or plantings to minimize invasive species.

3. All exposed, cleared, filled and disturbed soils shall be revegetated within nine months following the initiation of earthwork, or reseeded by the next August 31st. Native revegetation is acceptable if the site naturally revegetates within that nine-month period. If native revegetation is not successful within that nine-month period, the property owner and developer shall revegetate by other means no later than the end of that nine-month period.

4. Drainage can be stabilized by other means than vegetation, if approved in writing by the City Engineer.

d. A stormwater plan approved under Chapter 21.75 HCC is required for development that:

1. Creates more than 25,000 square feet of new impervious surface area on a lot;
2. Increases the total impervious surface area of a lot beyond one acre;
3. Includes grading, excavation or filling that cumulatively moves 1,000 cubic yards or more of material; or
4. Includes grading, excavation or filling that creates a permanent slope of 3:1 or more, and that has a total height, measured vertically from toe of slope to top of slope, exceeding 10 feet.

Section 4. Homer City Code Chapter 21.50.030 Site development standards – level two is hereby amended to read as follows:

21.50.030 Site development standards – Level two.

This section establishes level two site development standards.

a. Site Development.

1. Development shall not adversely impact other properties by causing damaging alteration of surface water drainage, surface water ponding, slope failure, erosion, siltation, or root damage to neighboring trees, or other adverse effects.
2. Upon completion of earthwork, all exposed slopes and all cleared, filled, and disturbed soils shall be protected against subsequent erosion by methods such as, but not limited to, landscaping, planting, and maintenance of vegetative cover.
3. All exposed, cleared, filled and disturbed soils shall be revegetated within nine months following the initiation of earthwork.

b. Slopes. All development on a site affected by a slope of 15 percent or more, bluff, coastal ~~**bluff**~~ **edge** or ravine, as described in HCC 21.44.020, shall be subject to the requirements of Chapter 21.44 HCC in addition to the requirements of this section.

c. Drainage.

1. Development shall provide a drainage system, as approved by the City, that is designed to deposit all runoff into either an engineered drainage system or into a natural drainage.
2. Where open-ditch construction is used to handle drainage within the development, a minimum of 15 feet shall be provided between any structures and the top of the bank of the defined channel of the drainage ditch.
3. When a closed system is used to handle drainage within the development, all structures shall be a minimum of 10 feet horizontally from the closed system.
4. Drainage can be stabilized by methods other than vegetation, if approved in writing by the City Engineer.

d. A development activity plan (DAP) approved by the City under Chapter 21.74 HCC is required if the project includes:

1. Land clearing or grading of 10,000 square feet or greater surface area;
2. The cumulative addition of 5,000 square feet or greater of impervious surface area from pre-development conditions;
3. Grading involving the movement of 1,000 cubic yards or more of material;
4. Grading that will result in a temporary or permanent slope having a steepness of 3:1 or greater and having a total slope height, measured vertically from toe of slope to top of slope, exceeding five feet;
5. Grading that will result in the diversion of an existing drainage course, either natural or human-made, from its existing point of entry to or exit from the grading site; or
6. Any land clearing or grading on a slope steeper than 20 percent, or within 20 feet of any wetland, watercourse, or water body.

e. A stormwater plan (SWP) approved under Chapter 21.75 HCC is required if the project includes:

1. An impervious surface coverage that is greater than 60 percent of the lot area (existing and proposed development combined);
2. The cumulative addition of 25,000 square feet or greater of impervious surface area from the pre-development conditions;
3. Land grading of one acre or greater surface area;
4. Grading involving the movement of 10,000 cubic yards or more of material;
5. Grading that will result in a temporary or permanent slope having a steepness of 3:1 or greater and having a total slope height, measured vertically from toe of slope to top of slope, exceeding 10 feet; or
6. Any land clearing or grading on a slope steeper than 25 percent, or within 10 feet of any wetland, watercourse, or water body.

f. Landscaping requirements. All development shall conform to the following landscaping requirements:

1. Landscaping shall include the retention of native vegetation to the maximum extent possible and shall include, but is not limited to, the following:

    a. Buffers.

    i. A buffer of three feet minimum width along all lot lines where setbacks permit; except where a single use is contiguous across common lot lines, such as, but not limited to, shared driveways and parking areas. Whenever such contiguous uses cease the required buffers shall be installed.

    ii. A buffer of 15 feet minimum width from the top of the bank of any defined drainage channel or stream.

    b. Parking Lots.

    i. A minimum of 10 percent of the area of parking lots with 24 spaces or more shall be landscaped in islands, dividers, or a combination of the two;

    ii. Parking lots with 24 spaces or more must have a minimum 10-foot landscaped buffer adjacent to road rights-of-way;

    iii. Parking lots with only one single-loaded or one double-loaded aisle that have a 15-foot minimum landscaped buffer adjacent to road rights-of-way are exempt from the requirement of subsection (f)(1)(b)(i) of this section.

2. Topsoil addition, final grading, seeding, and all plantings of flora must be completed within nine months of substantial completion of the project, or within the first full growing season after substantial completion of the project, whichever comes first. Required landscaping will be maintained thereafter, with all shrubs, trees, and ground cover being replaced as needed.

<u>Section 5.</u> This Ordinance is of a permanent and general character and shall be included in the City Code.

ENACTED BY THE CITY COUNCIL OF HOMER, ALASKA this _____day of __________, 2022.

CITY OF HOMER

____
KEN CASTNER, MAYOR

ATTEST:

____
MELISSA JACOBSEN, MMC, CITY CLERK

YES:
NO:
ABSTAIN:
ABSENT:

First Reading:
Public Hearing:
Second Reading:
Effective Date:

Proposed setback from coastal edge.
KBP Map Viewer, accessed 5.10.22

City of Homer
www.cityofhomer-ak.gov

Planning
491 East Pioneer Avenue
Homer, Alaska 99603
Planning@ci.homer.ak.us
(p) 907-235-3106
(f) 907-235-3118

Staff Report PL 22-37

TO: HOMER PLANNING COMMISSION
FROM: RICK ABBOUD, AICP, CITY PLANNER
DATE: MAY 18, 2022
SUBJECT: COASTAL SETBACKS

Introduction

The Planning Commission has reviewed a draft of the Coastal Bluff Stability Assessment for Homer developed by the State of Alaska Division of Geological & Geophysical Surveys (DGGS). After considering the study recommendations and draft code developed to address coastal erosion, we are holding a public hearing to receive comments on revised code language.

Analysis

Earlier staff reports and the DGGS study recognized that our current definition of 'coastal bluff' did not apply to the majority of the features found on the Homer coastline and our erosion hazard does not depend on the height of a coastal bluff alone. In order to provide a more useful measure of distance from the eroding hazard we are proposing a change in the term 'coastal bluff' and propose a definitive setback.

'Coastal bluff' is now referred to as 'coastal edge'. This change allows us to retain the definition of 'bluff' for use in non-coastal applications. The definition of coastal edge is dynamic in that it describes the manifestation of a feature associated active erosion near the coast. The draft ordinance replaces the term 'coastal bluff' found throughout code.

Setbacks from the 'coastal edge' are found on lines 92-98. This describes a 40' setback starting on the east extent of town, excludes the Spit, and continues until a transition to a 60' setback just west of Soundview Avenue (see attachment). This provides a recommended distance from the predicted 30 year erosion rate for the vast majority land likely to be developed. Since we rely on data that has "inherent uncertainties", we should reflect on our experiences every 5-10 years or after significant events to keep current.

A property owner may propose to build closer than the setback and would need to gain approval of a Conditional Use Permit with a site plan approved by the City Engineer under HCC 21.44.050. Other proposed changes include the exclusion of the City Planner in approving erosion control methods and determining development meant to stabilize an eroding bluff, this will be left to the City Engineer.

Staff Recommendation
Conduct a public hearing and make recommendation for adoption by the City Council.

Attachments
Draft Ordinance
Setback map

A. Staff Report 22-35, City Planner's Report

City Planner Abboud provided a summary of Staff Report 22-35. At his request for a volunteer, no Commissioners stepped forward to give the PC report to City Council at their May 23rd meeting. Chair Smith will provide a written report to the Clerk.

Commissioner Venuti commented on attending a webinar regarding Tiny Homes.

PUBLIC HEARINGS

A. Staff Report 22-36, An Ordinance of the City Council of Homer, Alaska, Amending Homer City Code 21.93 Administrative Appeals. City Clerk.

Chair Smith introduced the item by reading the title. He invited City Planner Abboud to speak to the memoranda provided.

City Planner Abboud spoke to Staff Report 22-36, highlighting the following:

- After the City Clerk has reviewed the revisions it was found that there were items that needed minor clarifications and procedures.
- Review of the draft ordinance which was provided in the Supplemental Packet

Chair Smith opened the public hearing, after verifying with the Clerk that there was no members of the public present on Zoom or present in the Chambers he closed the public hearing. He opened the floor to questions from the commission.

City Planner Abboud provided clarification on the date for the Public Hearing on the Rezone for Commissioner Barnwell in the previous item on the agenda.

Chair Smith commented on the action removing the responsibility from the Commission.

Chair Smith requested a motion and second.

HIGHLAND/VENUTI MOVED TO ADOPT STAFF REPORT 22-36 AND FORWARD A RECOMMENDATION THAT CITY COUNCIL APPROVE THE ORDINANCE AMENDING HOMER CITY CODE 21.93 ADMINISTRATIVE APPEALS TO CLARIFY GENERAL APPEAL PROCEDURES AND RELATED MATTERS.

There was no discussion.

VOTE: NON OBJECTION: UNANIMOUS CONSENT.

Motion carried.

B. Staff Report 22-37, An Ordinance of the City Council of Homer, Alaska, Amending Title 21.03.040 Definitions Used in Zoning Code, Title 21.44 Slopes, Title 21.50.020 Site Development Standards - Level One and Title 21.50.020 Site Development Standards - Level Two Redefining Coastal Bluff and Setback Therefrom. Planning Commission.

Chair Smith introduced the item by reading of the title and deferred to City Planner Abboud.

City Planner Abboud provided a summary of Staff Report 22-37. He highlighted the following points:

- Review of the draft ordinance which was provided in the Supplemental Packet which provided the documentation that recommended changes fit well within the Comprehensive Plan guidelines

- Language has been amended to make it concise and easily understood
- Removed reference to the City Planner changing it to the City Engineer which is more appropriate.
- Amended the definition of "bluff"
- Included an attachment that provides a description of the area that they would recommend for setbacks

Chair Smith opened the public hearing, after verifying with the Clerk that there was no members of the audience present wishing to provide testimony on Zoom he closed the public hearing. He opened the floor to questions from the commission.

Commissioner Chiappone noted a correction to line 99 of the draft ordinance.

Chair Smith requested a motion and second after confirming with the Clerk that a motion was needed to amend the draft ordinance.

CHIAPPONE/HIGHLAND MOVED TO AMEND LINE 99 TO ADD THE WORD "FROM" AFTER THE WORD "FEET".

There was no discussion.

VOTE. (Amendment) NON-OBJECTION. UNANIMOUS CONSENT.

Motion carried.

City Planner Abboud facilitated discussion on questions on the following

- provided explanation on clearing and grading and possibly bringing forth an ordinance
- site development and re-seeding or ground cover requirements shown on line 216 through 231 and Line 262.
- Line 306 the distance indicated of 10 feet from a water body being very short.

Deputy City Clerk Krause defined the phrase "in-situ" for the Commission at the request of Commissioner Highland, noting that it is usually hyphenated when used.

Chair Smith inquired if there were any additional questions or amendments from the Commission, hearing none he requested a motion and second.

HIGHLAND/VENUTI MOVED TO ADOPT STAFF REPORT 22-37 AND FORWARD A RECOMMENDATION THAT CITY COUNCIL APPROVE THE ORDINANCE AMENDING HOMER CITY CODE TITLE 21.03.040 DEFINITIONS USED IN ZONING CODE, TITLE 21.44 SLOPES, TITLE 21.50.020 SITE DEVELOPMENT STANDARDS – LEVEL ONE AND TITLE 21.50.020 SITE DEVELOPMENT STANDARDS – LEVEL TWO REFINING COASTAL BLUFF AND SETBACK THEREFROM.

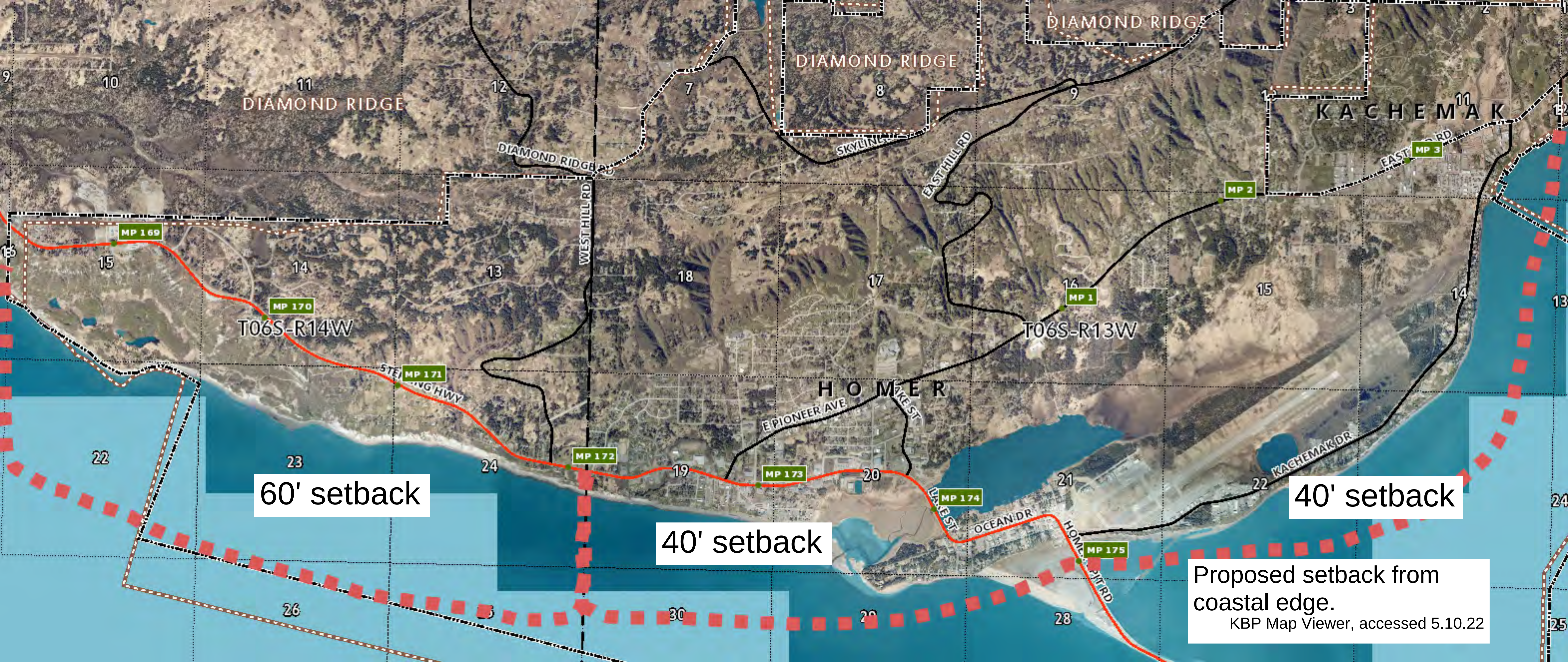
There was no further discussion.

VOTE. (Main) NON-OBJECTION. UNANIMOUS CONSENT.

Motion carried.

PLAT CONSIDERATION

PENDING BUSINESS


DIAMOND RIDGE
DIAMOND RIDGE
DIAMOND RIDGE
KACHEMAK
HOMER
DIAMOND RIDGE RD
SKYLINE
EAST HILL RD
WEST HILL RD
EAST END RD
E PIONEER AVE
LAKE ST
STERLING HWY
OCEAN DR
KACHEMAK DR
HOMER SPIT RD
MP 169
MP 170
MP 171
MP 172
MP 173
MP 174
MP 175
MP 1
MP 2
MP 3
T06S-R14W
T06S-R13W
60' setback
40' setback
40' setback
Proposed setback from coastal edge.
KBP Map Viewer, accessed 5.10.22