OREGON PARKS AND RECREATION DEPARTMENT
OCEAN SHORE PERMIT APPLICATION

SHORELINE PROTECTION STRUCTURES

FOR OFFICIAL USE ONLY

OPRD PERMIT #:	2988
APPLICATION DATE:	10/26/2021
DATE POSTED:	10/29/2021
COORDINATOR:	R Parker
60 DAY DUE DATE:	12/25/2021

Section 1. Proposed Project

Project type:

- [x] Riprap Revetment
- [ ] Vegetative Stabilization
- [ ] Seawall
- [ ] Other

Provide a brief description of the project:
Seawall back to original size and height with 5'-6' riprap: Riprap double layer at bottom half of wall

Estimated project start date	11/15/21	Estimated project completion date	12/10/21

Section 2. Applicant Information

Owner	Norm Holliday	Agent	Jon M. Thompson Excavation
Mailing Address	P.O. Box 1143	Mailing Address	P.O. Box 247
City / State / Zip	Sun Valley / ID / 83353	City / State / Zip	Lincoln City / Or / 97367
Phone / Fax	(760) 289-9207 /	Phone / Fax	(541) 992-5951 /
Email	normholliday@cox.net	Email	jevonmontre@gmail.com

Primary Contact: [ ] Owner [x] Agent

Section 3. Property Location and Information

Situs Address	22 South Lagoon Ln.
City/Town	Lincoln Beach
County	Lincoln

Township	Range	Section	Subsection	Tax Lot
08	03	CC		203

Current Use

- [x] Residential
- [ ] Commercial/Industrial
- [ ] Public
- [ ] Vacant (unbuilt)
- [ ] Other (explain)

City/County Zoning Designation	Residential	Year main structure was built	1966

Lot Dimensions

Lot Size	.39 acres	Oceanfront footage (in feet)	100
Street front footage (in feet)	100	East-West footage (in feet)	116

Setbacks

Distance from eastern (or landward) property line to nearest building (in feet)	25 feet
Distance from seaward dune crest or bluff edge to nearest building (in feet)	7 feet
Approximate height of oceanfront bluff, dune or escarpment (in feet)	28 feet

List the names, situs and mailing addresses of oceanfront landowners with property boundaries common to those of the property or properties described in the application.

Name	Property situs address	Mailing address
Alan Blumhagen & Richard Boyse: Trustees-South Property	24 South Lagoon Ln., Lincoln Beach, Oregon 97388	2200 Pacific Ave. #64, San Francisco, CA 94115
James and Diane Baker North Property	20 South Lagoon Ln., Lincoln Beach, Oregon 97388	1055 SW Englewood Dr., Lake Oswego, OR 97034

Section 4. Project Justification and Impacts

Provide a detailed explanation of the hazards and threat to property:
Original Sea Wall came down and started eroding in February of 2021 do to storm activity and King tides: During these events the ocean washed out the dune between the sea wall and the home. The dune was washed out within 10 feet from the home foundation.

(Include documented supporting evidence, i.e. photographs, and/or chronology of bank retreat)
Attach additional pages as necessary

Describe all potential impacts:
If a new sea wall is not rebuilt the home on this property will be undermined and fail into the ocean: The neighboring properties north and south will then be in danger of losing their frontage and homes.

Attach additional pages as necessary

Describe measures that will be taken to minimize the impacts identified above:
A new sea wall will be constructed and tied into the sea walls to the north and south.

Attach additional pages as necessary

Section 5. Project Details

Total Length along shoreline (in feet)	100	Height (in feet)	35
Total width of project (in feet)	40		
Slope (ratio-horizontal to vertical)	2:1	Total volume of all material(s) (cubic yards)	300

Riprap Specifications:

Armor stone type	Basalt	Armor stone source	Cedar Creek Quarry
Diameter of armor stone (in feet)	5-6	Amount of armor stone (cubic yards)	150
Type of filter fabric	Woven mesh road fabric	Type of backing fill material	6-18" chunky rock
The amount of backing fill material (cubic yards)	150	Will toe be keyed into bedrock?	☐ Yes ☒ No
Elevation of toe trench	-3' from high tide ocean elevation	Depth of toe trench	7 feet

Section 6. Analysis Of Hazard Avoidance

Please verify that the attached hazard avoidance analysis includes:

☒ A list of hazard avoidance alternatives

☒ A description of why hazard avoidance alternatives are not feasible

☐ If an alternative was tried, explain why it did not succeed

☐ Is the relocation cost estimate included? ***(If the cost of moving the building is listed as an unfeasible factor.)***

Section 7. Geologic Report

Please provide the following information:

Date of Report	2/20/20	Company	H.G. Shlicker & Associates Inc.		
Geologist Name	J. Douglas Gless	Geologist Certifications	MSc, RG, CEG, LHG		
Mailing Address	607 Main Street Suite #200				
City	Oregon City	State	OR	Zip	97045
Phone	(503) 655-8113	Fax	(503) 655-8173	Email address	HGSA@teleport.com

Please verify your geologic report contains all of the following information:

☒ The potential impacts from the proposed project on the sand source, supply, and movement on the affected beach as well as within the same littoral cell.

☒ The known or suspected geologic and seismic hazards in the project area and how the proposed project may affect or be impacted by those geologic and seismic hazards.

☒ A review of potential non-structural solutions, including, but not limited to: vegetative stabilization; non-structural dynamic revetments and foredune enhancement.

☒ The bank or bluff stability and erosion rates on the subject property and adjacent properties.

Section 8. Additional Permit Requirements

List the agency and type of permit required:

Lincoln County Planning Department Affidavit

☒ **No additional agency permit required**

Section 9. Signature Requirement

The application is hereby made for the ocean shore alteration described within this application. I certify that I am familiar with the information contained in this application, and, to the best of my knowledge and belief, this information is true, complete and accurate. I further certify that I possess the authority to undertake the proposed alteration.

I understand that the granting of an OPRD permit does not release me from obtaining any additional permits from any/all local, state, and/or federal agencies that may be required before commencing the project.

I understand that the payment of required OPRD processing fee does not guarantee the issuance of an approved permit.

Owner Signature Date 10/14/2021

☒ *I (Owner) authorize the Agent included in this application to act on my behalf during this application process.*

Agent Signature Date 10-14-21

Section 11. Application Fees and Calculation Worksheet (to be submitted with application)

Each application filed under ORS 390.640, for an alteration on the ocean shore shall be accompanied by a processing fee for the purpose of partial recovery to the Department of its administrative costs. The fee shall be determined according to the construction value of the project.

The application processing fee shall be:

(a) $400 for projects with a construction value less than $2,500; or

(b) $400 plus three percent of the construction value over $2,500 for projects with a construction value equal to or greater than $2,500.

Please use the formula below to determine total application fees.

Total construction value of project		$	54,000.00
Base construction value (Subtractable allowance)	-	$	2500.00
Subtotal (construction value minus base fee)	=	$	51,500.00 (x .03 =)
3% of subtotal		$	1,545.00
Add Base Fee	+	$	400.00
TOTAL APPLICATION FEE	=	$	1,945.00

EXAMPLE

Total construction value of project		*$*	*10,000.00*
Base construction value (Subtractable allowance)	*-*	*$*	*2,500.00*
Subtotal (construction value minus base fee)	*=*	*$*	*7,500.00 (x .03 = 225.00)*
3% of subtotal		*$*	*225.00*
Add Base Fee	*+*	*$*	*400.00*
TOTAL APPLICATION FEE	*=*	*$*	*625.00*

Submitted Ocean Shore Permit Application shall include this completed fee worksheet, as well as, evidence of construction value

CITY/COUNTY PLANNING DEPARTMENT AFFIDAVIT

Applicant

Last Halliday	First Norm	MI

Property Details

Township 08	Range 11	Section ~~12~~ 03	Subsection cc
Tax Lot00203-00			

County

- [ ] Clatsop
- [ ] Douglas
- [ ] Tillamook
- [ ] Coos
- [x] Lincoln
- [ ] Curry
- [ ] Lane

Project Type

- [x] Shorefront Protection
- [ ] Pipeline/Cable/Conduit
- [ ] Access/Other Misc.
- [ ] Natural Product Removal
- [ ] Sand Alteration

Planning Department Certification
(To be completed by local planning official)

Part I

In accordance with Statewide Planning Goal #18, Beaches and Dunes alteration permits for beachfront protective structures may be issued only where development existed on January 1, 1977, or where an exception to this Goal 18 implementation requirement has been approved by the appropriate local jurisdiction. For the purpose of this requirement, the definition of "development" means houses, commercial and industrial buildings, and vacant subdivision lots which are physically improved through the construction of streets and provisions of utilities to the lot.

Above property meets Goal 18 Eligibility? [x] Yes [ ] No [ ] Not Applicable

Part II

I have reviewed the proposed project application and have determined that:

- [ ] This project is not regulated by the local comprehensive plan and zoning ordinances.
- [x] This project has been reviewed and **is consistent** with the local comprehensive plan and zoning ordinance.
- [ ] This project has been reviewed and **is not consistent** with the local comprehensive plan and zoning ordinance.
- [ ] The consistency of this project with the local planning ordinance cannot be determined until the following local approvals are obtained:

- [ ] Conditional Use Approval
- [ ] Development Permit
- [ ] Zone Change
- [ ] Other (Specify)
- [ ] Plan Amendment

Comments:

John O'Leary
Local Planning Official Name (Please Print)

Senior Planner
Title

[signature]
Signature

10/21/2021
Date

The completed/signed form shall be submitted with the completed Ocean Shore Permit Application

Jon M Thompson Excavation, LLC
PO Box 247
Lincoln City, OR 97367 US
+1 5419210739
jonmthompsonexcavation@gmail.com
https://www.jonmthompsonexcavation.com/

Estimate

ADDRESS
Norm Halliday

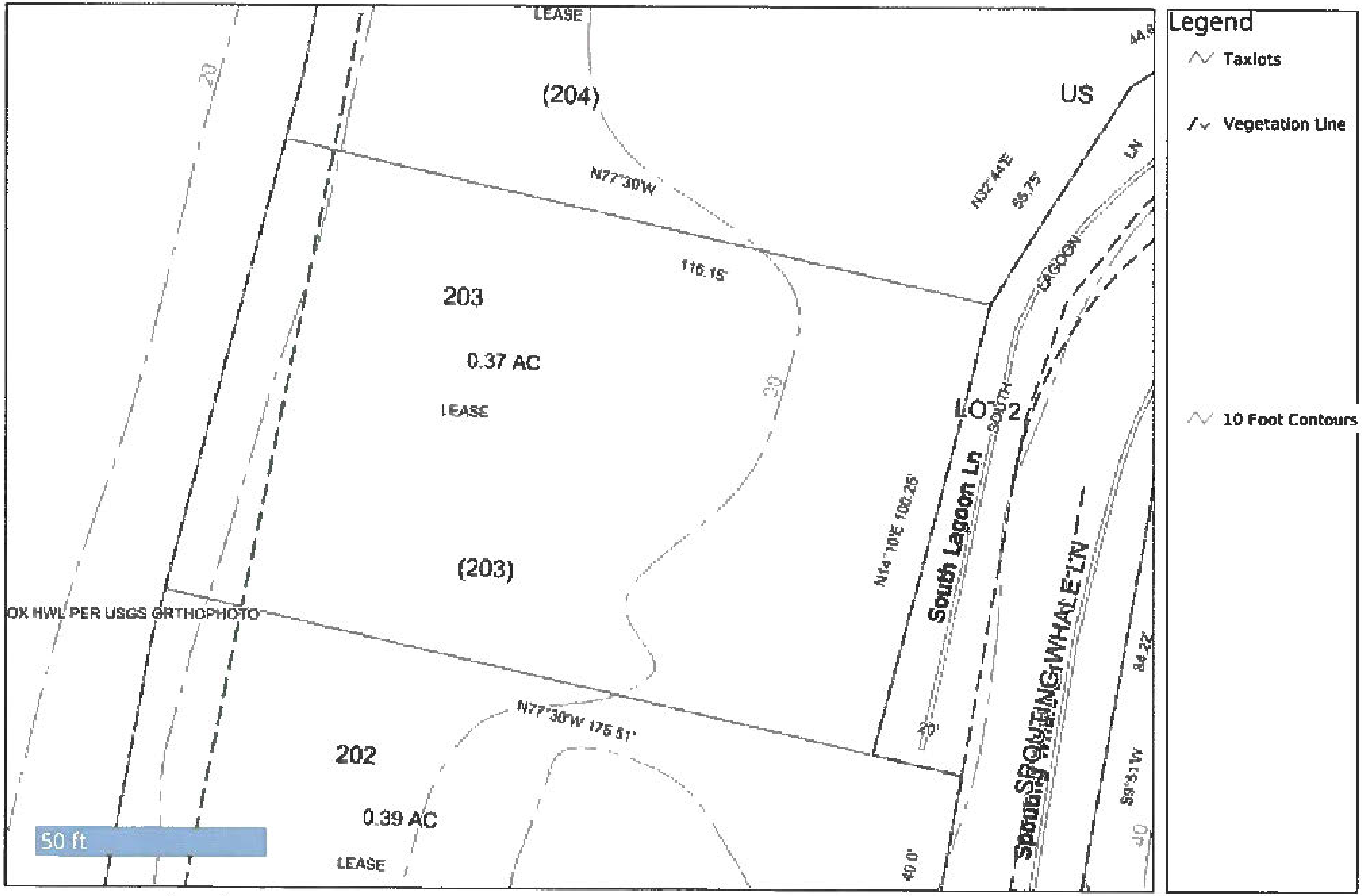
ESTIMATE #	DATE
1362	06/25/2021

ACTIVITY	DESCRIPTION	AMOUNT
	For the property of 22 S. Lagoon Lane in Salishan	
Seawall	For the reconstruction of 90LF of sea wall at 20' in height. This will consist of removing the existing Rip Rap from the face of the wall and setting it to the side. JMTE will utilize the existing chunky rock to build the slope to the seawall at a 2:1 slope. This rock mixture locks in the existing backing rock. The chunky rock section will run the full length and height of the wall. The existing large Rip Rap toe rock will be dug down into the sand as deep as possible. The toe of the wall will be built from existing Rip Rap. The existing rip rap will be stacked at 2:1 slope and be locked together so each rock supports another rock. This will be a single layer rip rap seawall. JMTE will utilize all the existing rip rap for the armor rock. If there is not enough existing rip rap or chunky rock and JMTE has to import this material this will be an additional per load cost. **NOTE** The cost of this wall does not reflect importing rock material to build the wall. If JMTE has to import chunky rock to create the desired height and slope of the wall this rock will be additional $450 per 12 YD load in place. If JMTE has to import rip rap to finish stacking the wall this will be an additional $800 per 12 YD load.	54,000.00

TOTAL **$54,000.00**

Accepted By

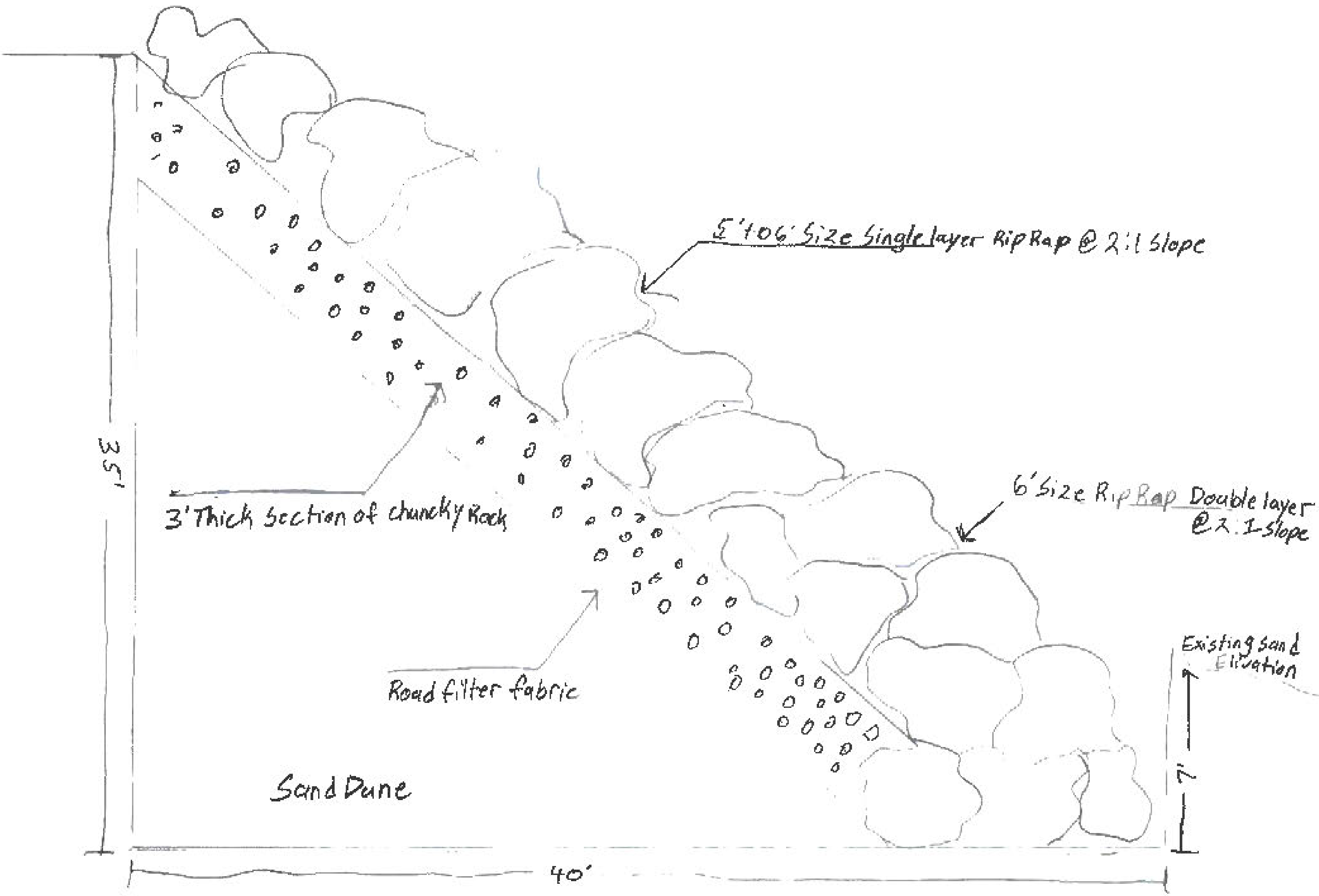
Accepted Date

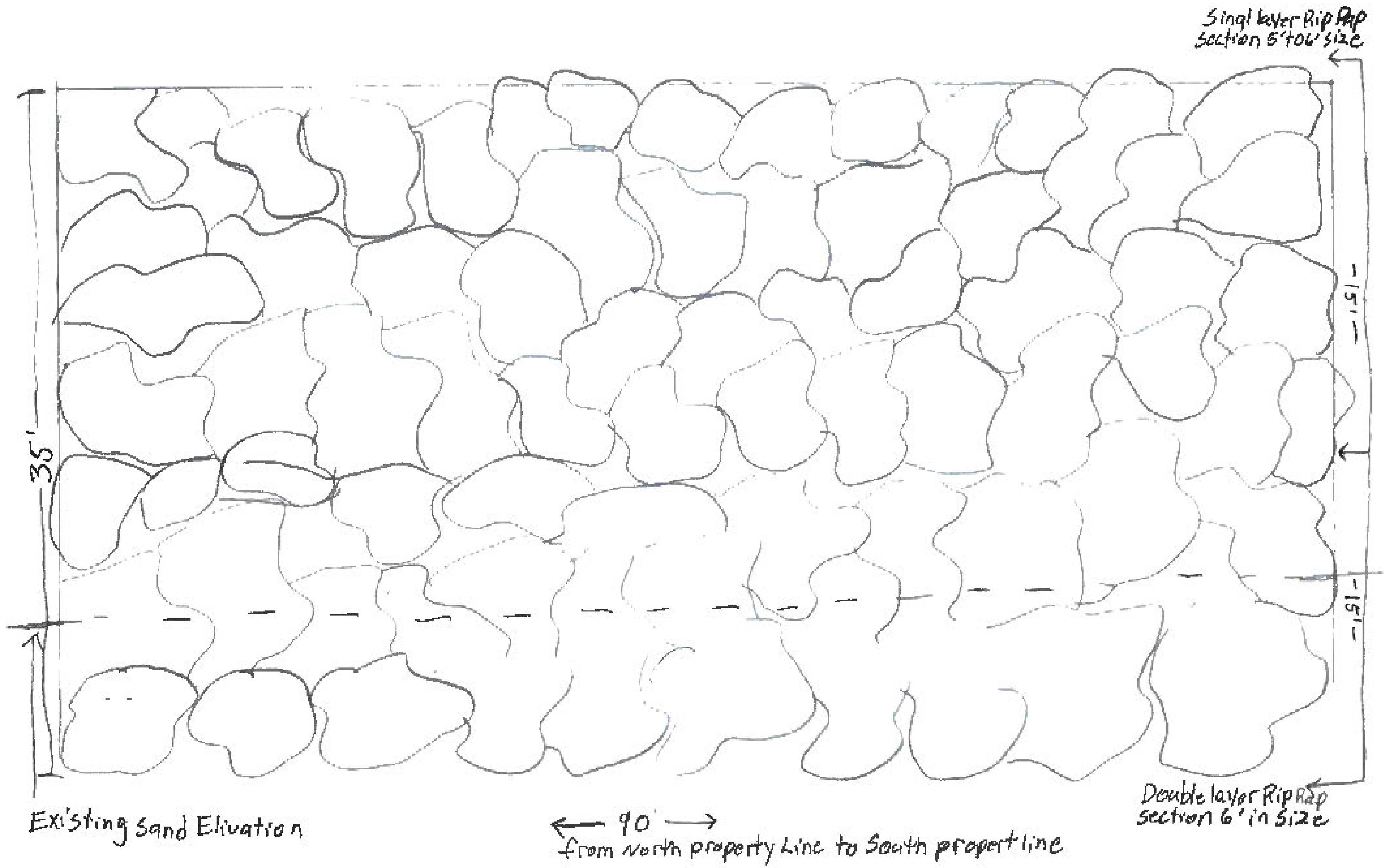


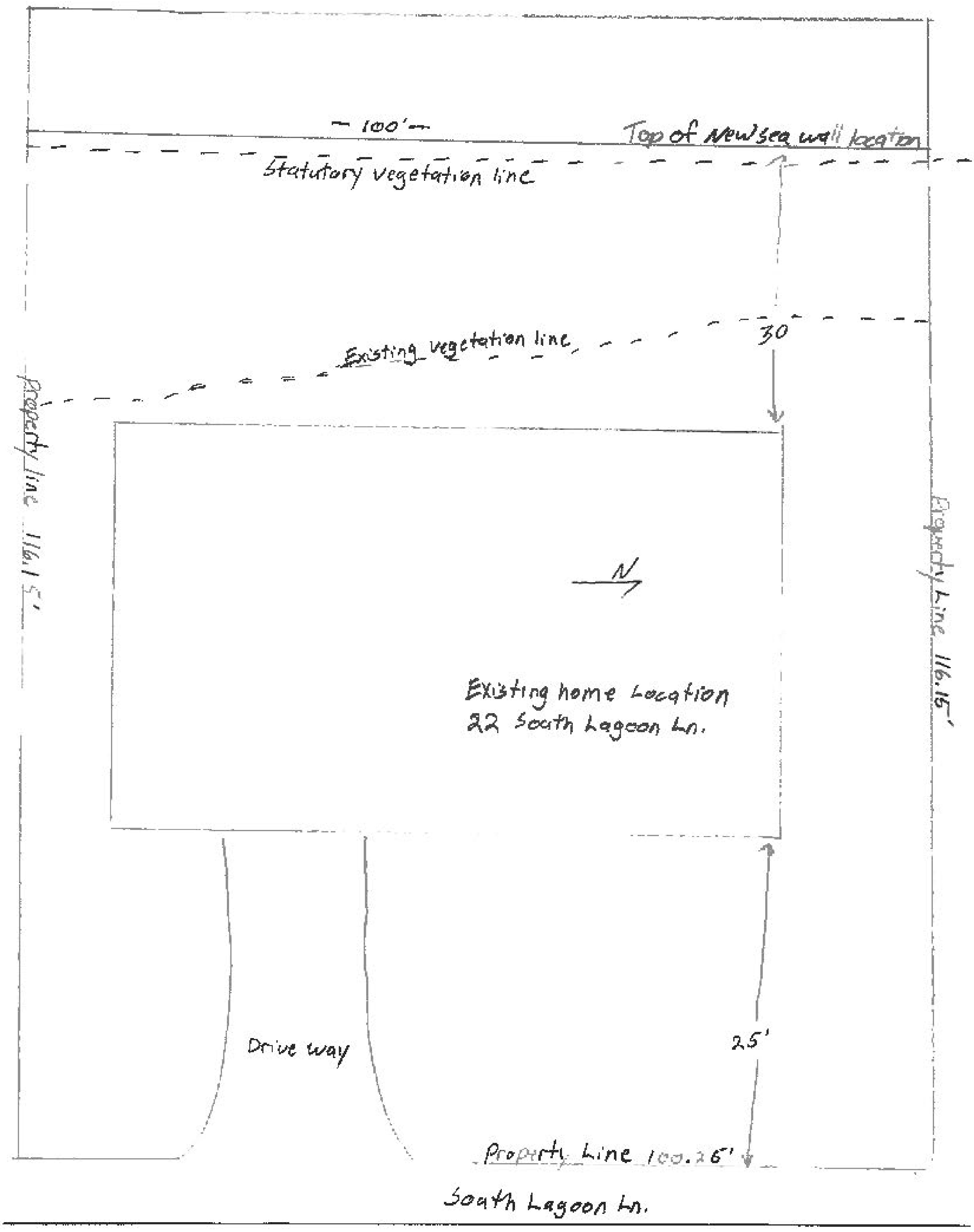
Printed on 10 / 14 / 2021

Lincoln County Government Use only. Use for any other purpose is entirely at the risk of the user. This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. Users should review the primary information sources to ascertain their usability.

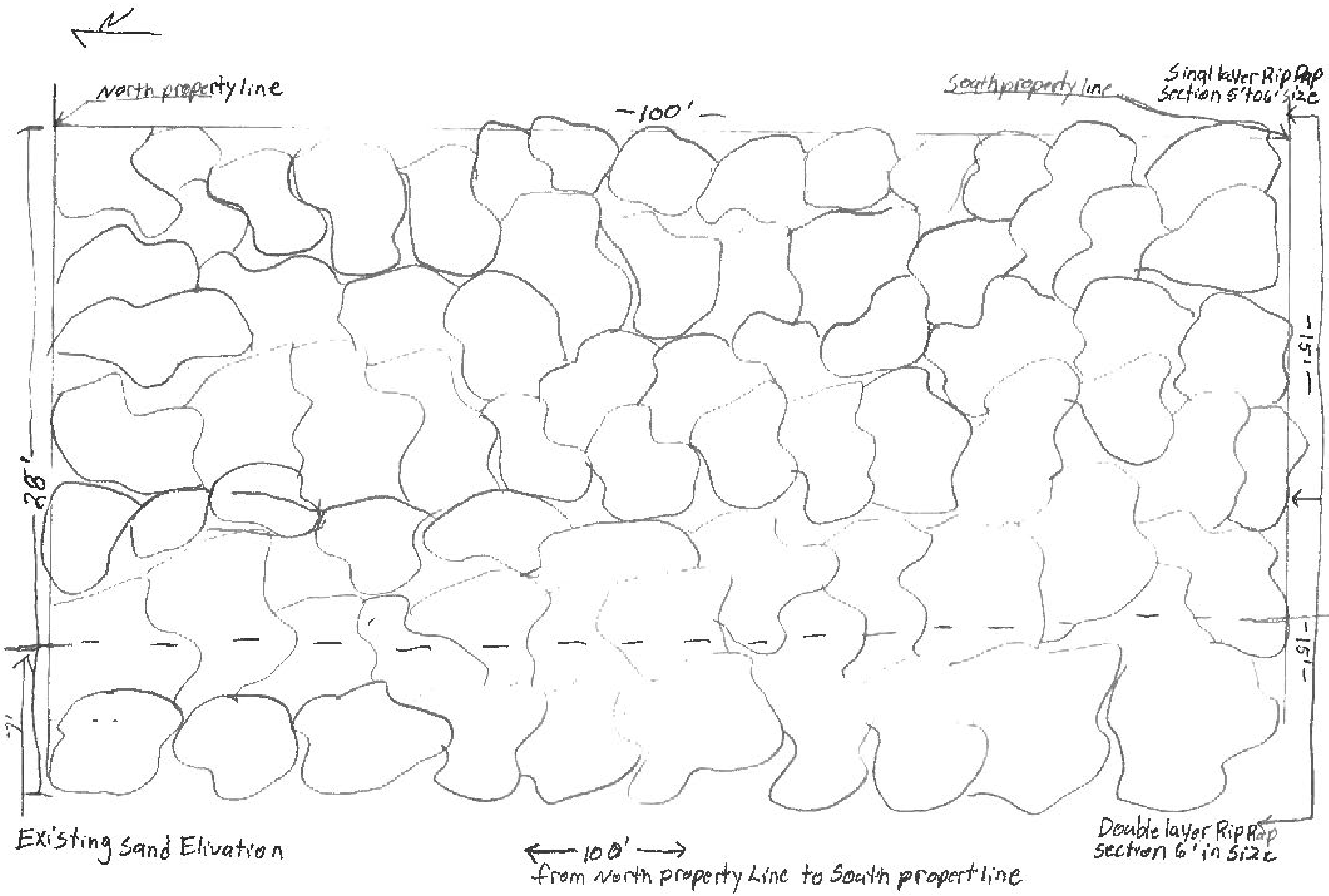
Norm Halliday Proposed Structure 9-30-21

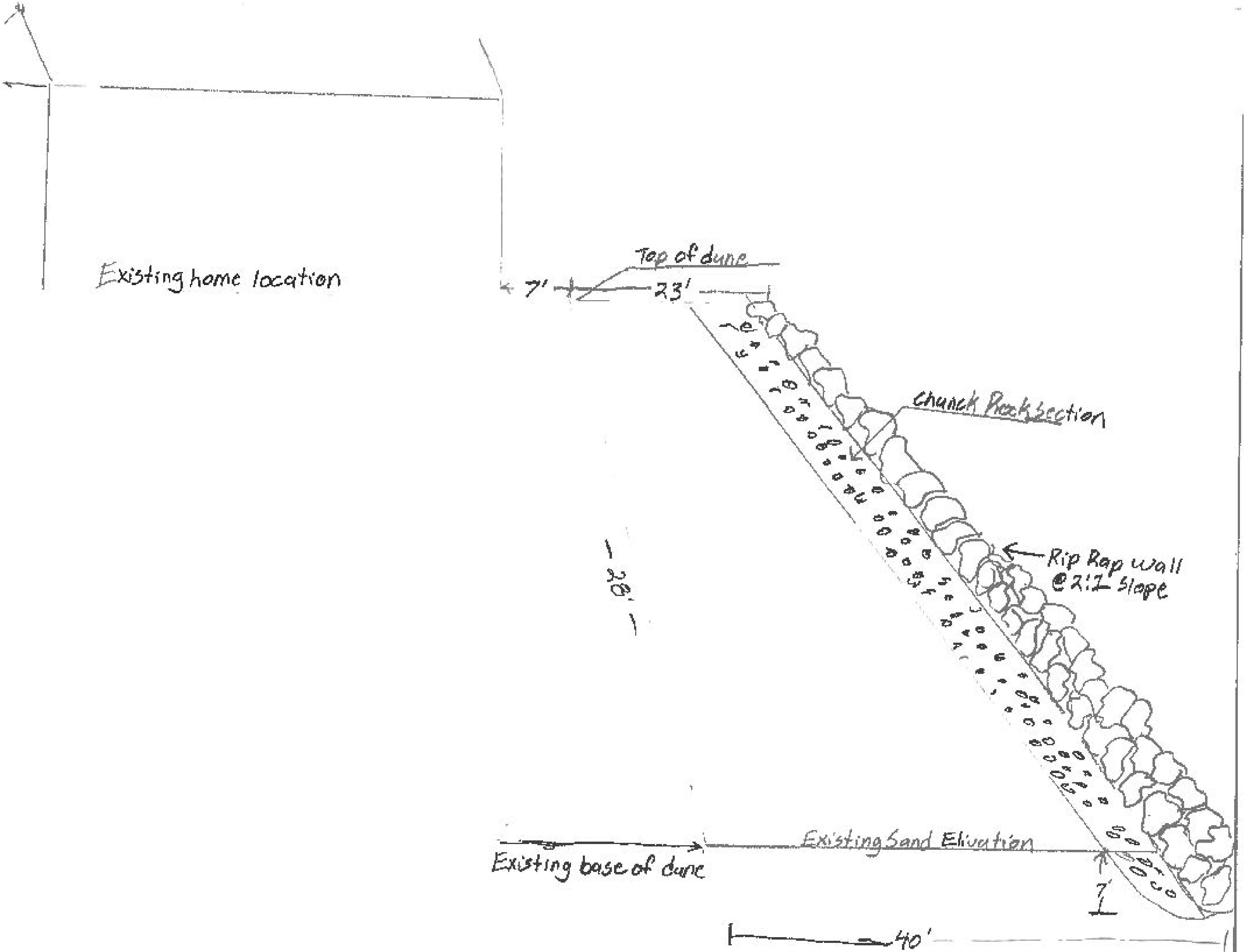


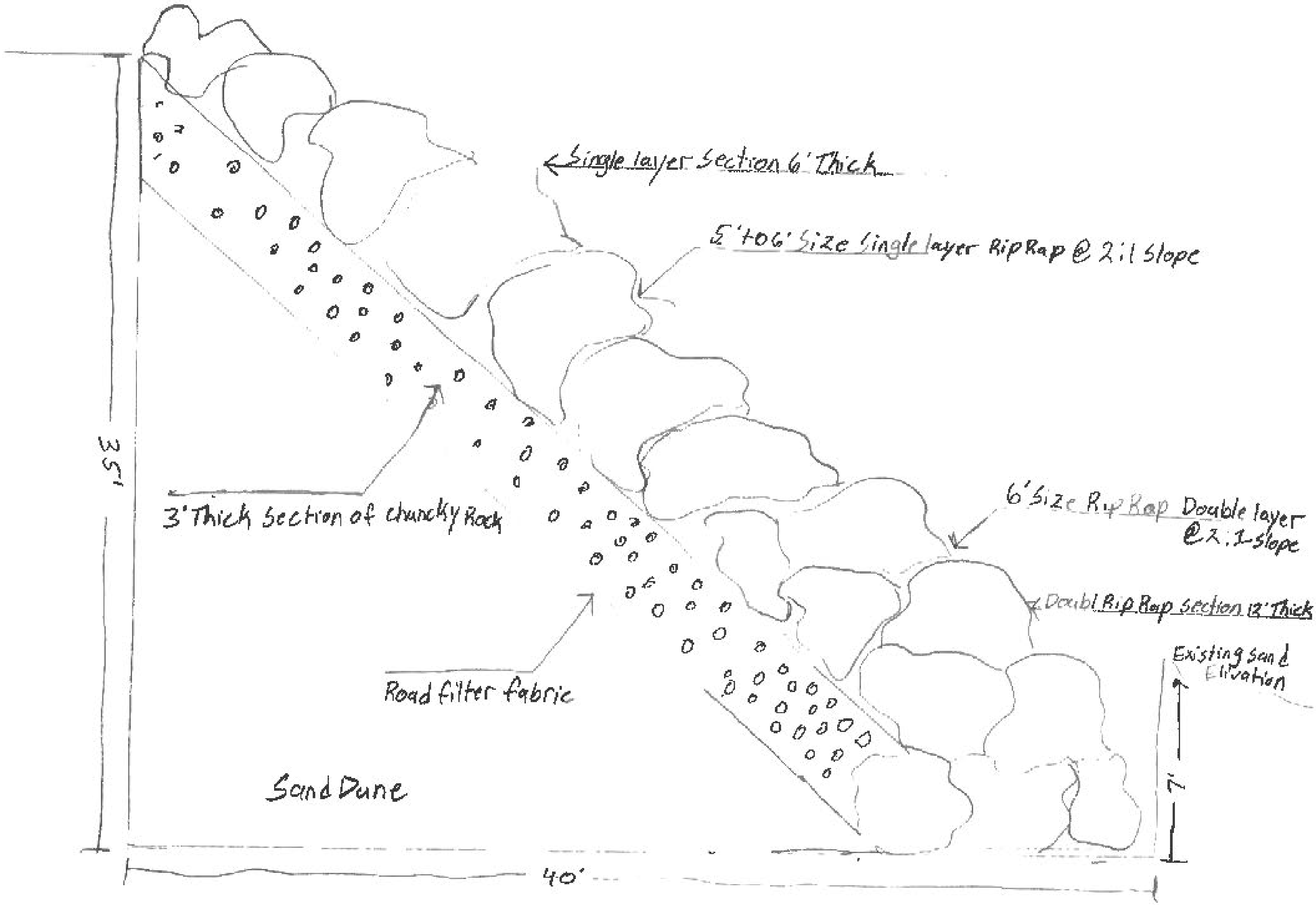

Singl layer Rip Rap
section 5'to6' size
35'
-15'-
-15'-
Double layer Rip Rap
section 6' in size
Existing Sand Elivation
90'
from North property Line to South propert line



~ 100' ~
Top of New sea wall location
Statutory vegetation line
Existing vegetation line
30
Property line 116.15'
Property Line 116.15'
N
Existing home Location
22 South Lagoon Ln.
Drive way
25'
Property Line 100.26'
South Lagoon Ln.


N
North property line
-100'-
South property line
Singl layer Rip Rap Section 5' to 6' size
28'
7'
-15'-
-15'-
Existing Sand Elivation
←100'→
from North property Line to South propert line
Double layer Rip Rap Section 6' in size


Existing home location
7'
Top of dune
23'
Chunck Rock section
28'
Rip Rap wall
@2:1 slope
Existing Sand Elivation
Existing base of dune
7'
40'


Single layer Section 6' Thick
5' to 6' Size Single layer Rip Rap @ 2:1 Slope
35'
3' Thick Section of chuncky Rock
6' Size Rip Rap Double layer @ 2:1 slope
Doubl Rip Rap section 12' Thick
Existing Sand Elivation
Road filter fabric
Sand Dune
7'
40'

Engineering Geologic Investigation
for Oceanfront Protection Along Siletz Spit
between Tax Lot 156, Map 08-11-09DD
and Tax Lot 200, Map 07-11-34CB
Lincoln County, Oregon

Prepared for:
Salishan Leaseholders
Attn: Christine McGowan
100 Salishan Drive,
Gleneden Beach, Oregon 97388

Project #Y174107

December 20, 2019

H.G. Schlicker & Associates, Inc.

Terms of Use

Use of this report is restricted to those Oceanfront Leaseholders who paid $1,200 to participate. Participants may access the report at a password-protected site.

A database of participants is maintained by SLI:

- When Oceanfront Leaseholders apply for an Ocean Shore Permit, an engineering geologic investigation and analysis is required. This study fulfills that requirement providing the Leaseholder is verified as a participant.
- If Oceanfront Leaseholders require additional engineering regarding their Ocean Shore Permit application, H.G. Schlicker & Associates, Inc. will also require that the Leaseholder be verified as a participant.
- At the time of sale, buyer will receive a copy of the seller's certification of participation and payment from SLI to use in future applications for riprap revetment.

Our intention is to expedite the application process for an Ocean Shore Permit for individuals or groups of leaseholders who will collaborate on construction of a revetment. If you are not a verified participant, please contact Christine McGowan, Manager, Salishan Leaseholders, Inc. to remit the $1,200 fee required to use the study in the application process (541-764-2208, christine@salishanleaseholders.com).

Salishan Leaseholders, Inc.
P.O. Box 219 Gleneden Beach, OR 97388 541-764-2208 salishan.leaseholders@gmail.com

January 20, 2020

Dear Oceanfront Leaseholders,

We are pleased to share with you the final results of the geologic study of the Salishan Spit by H.G. Schlicker & Associates, Inc. The enclosed report presents the results of their engineering geologic investigation and analysis, and recommendations for the design and construction of riprap revetments.

Salishan Leaseholder, Inc. (SLI) served as the facilitator of this study on behalf of the Oceanfront Leaseholders who contributed $1,200 per tax lot in order to save the time and money that would have been required for individual studies (estimated at $8,000 - $12,000). The members of the Shoreline Protection Committee who were appointed by the SLI Board reviewed this report and agreed that it met the specifications of the SLI contract with H.G. Schlicker & Associates. Jay Sennewald, the Ocean Shores Coordinator for the Oregon Parks and Recreation Department also reviewed the report and determined that it met the geological study prerequisite for an Ocean Shore Permit that is required for riprap replacement and revetment.

SLI calls your attention to the recommendation. *Due to the possibility of rapid erosion along the entire site, we encourage leaseholders to take a proactive approach to construction of riprap revetments fronting their properties rather than waiting until their homes are in imminent peril. Construction of revetments should also be considered prior to erosion of the dunes within 20 feet of the homes. We encourage the construction of revetments across several lots at the same time as it has the advantage of ensuring continuity, alignment, structural integrity, and can reduce costs. (Appendix A, Page 13)*

Pursuant to the SLI Lease, you are reminded that individual leaseholders have the sole obligation to repair, maintain and preserve the leased premises. Construction-related expenses, such as permits, riprap replacement and revetment reinforcement costs subsequent to this study will continue to be the responsibility of individual leaseholders.

Please make note of the password-protected site that you will receive in an email from me. Please read the study Parts A as well as B through H. Call Doug Gless or Jay Sennewald with any questions you may have. Their contact information follows.

Questions about study? Call:

J. Douglas Gless, MSc, RG, CEG, LHG
President/Principal Engineering Geologist
H.G. Schlicker & Associates, Inc.
607 Main Street, Suite 200
Oregon City, Oregon 97045
Office: 503-655-8113
Fax: 503-655-8173
HGSA@teleport.com
www.hgschlicker.com

Questions about Ocean Shore Permit? Call:

Jay Sennewald| Ocean Shores Coordinator
Oregon Parks and Recreation Department
12735 NW Pacific Coast Highway
Seal Rock, Oregon 97376
(541) 563-8504
Ocean Shore SRA

For additional background information, please see the following videos: Jay Sennewald, Ocean Shores Coordinator for the State of Oregon, and Doug Gless, Principal Engineering Geologist for H.G. Schlicker and Associates, give a clear overview of the status of our oceanfront on the Salishan Spit. Please watch their presentation *Oceanfront Protection* by copying this link https://vimeo.com/281145575 into your browser. If asked for password, use Salishan. At the same site is drone footage of the Salishan oceanfront prior to the most recent episodes of erosion. We are grateful to Leaseholder Barbara Fox for preparation of these materials.

We appreciate having the opportunity to facilitate the completion of this report.

Warm Regards,
Christine McGowan, Manager

Salishan Leaseholders, Inc.
541-764-2208
christine@salishanleaseholders.com

H.G. Schlicker & Associates, Inc.
607 Main Street, Suite 200 · Oregon City, Oregon 97045
(503) 655-8113 · FAX (503) 655-8173

Project #Y174107 December 20, 2019

To: **Salishan Leaseholders**
Attn: Christine McGowan
100 Salishan Drive,
Gleneden Beach, Oregon 97388

Subject: **Engineering Geologic Investigation**
for Oceanfront Protection Along Siletz Spit
between Tax Lot 156, Map 08-11-09DD
and Tax Lot 200, Map 07-11-34CB
Lincoln County, Oregon

Dear Ms. McGowan:

The accompanying report presents the results of our engineering geologic investigation and analysis, and recommendations for the construction of riprap revetments at the above subject sites. We have addressed the geologic conditions that lead to variability in erosion along the Siletz spit in order to provide the necessary background information and revetment design to streamline the application process for individual property leaseholders when submitting a Shoreline Protection Structure application for construction of a riprap revetment. If a major geologic event, such as a tsunami, subsidence induced erosion related to an earthquake, etc., were to occur, which invalidates the appropriateness of the provided designs, additional consulting work may be required.

Individual property leaseholders will need to complete and submit Ocean Shore Permit Applications as necessary prior to the construction or repair of riprap revetments. We can assist in this endeavor.

After you have reviewed our report, we would be pleased to discuss the report and to answer any questions you might have. This opportunity to be of service is sincerely appreciated. If we can be of any further assistance, please contact us.

H.G. SCHLICKER & ASSOCIATES, INC.

J. Douglas Gless, MSc, RG, CEG, LHG
President/Principal Engineering Geologist
JDG:aml

TABLE OF CONTENTS

Page

1.0 Introduction 1

2.0 Site Description 2

2.1 Published Literature and Publicly Available Data Review 4

2.2 Aerial Photo and Satellite Imagery Review 5

3.0 Geology 5

3.1 Geologic Structures 6

4.0 Slope Stability, Erosion, and Current Site Conditions 7

5.0 Regional Seismic Hazards 10

6.0 Flooding Hazards 11

7.0 Climate Change 12

8.0 Conclusions and Recommendations 12

8.1 Revetment Design Considerations 12

8.2 Revetment Design Specifications 13

9.0 Possible Adverse Impacts 16

9.1 Sand Source, Supply, and Movement 16

9.2 Post-Construction Bluff Stability and Erosion Rates 17

10.0 Evaluation of Other Protective Measures 17

10.1 Non-Structural Solutions 17

11.0 Potential Geologic and Seismic Hazards 18

TABLE OF CONTENTS (continued)

Page

12.0 Construction Observations 19

13.0 Limitations 19

14.0 Disclosure 19

15.0 References 20

FIGURES

Figure 1 – Location Map

Figure 2 – Revetment Detail

Figure 3 – Revetment Pathway Detail

APPENDICES

Appendix A – Site Photographs
Appendix A-1 – This Study
Appendix A-2 – Historical and Publicly Available Photographs

Appendix B – Lincoln County Assessor's Plat Maps

Appendix C – Site Maps

Appendix D – Beach Profiles

Appendix E – FEMA Flood Maps

Appendix F – Individual Tax Lot Information for Permit Applications

Appendix G – Beach Grass Establishment

Appendix H – Oregon Parks and Recreation Department, Ocean Shore Permit Application Form (Including Application Fee Form, page 8 of 9, Planning Department Affidavit, page 9 of 9)

H.G. Schlicker & Associates, Inc.
607 Main Street, Suite 200 · Oregon City, Oregon 97045
(503) 655-8113 · FAX (503) 655-8173

Project #Y174107 December 20, 2019

To: **Salishan Leaseholders**
Attn: Christine McGowan
100 Salishan Drive,
Gleneden Beach, Oregon 97388

Subject: **Engineering Geologic Investigation**
for Oceanfront Protection Along Siletz Spit
between Tax Lot 156, Map 08-11-09DD
and Tax Lot 200, Map 07-11-34CB
Lincoln County, Oregon

Dear Ms. McGowan:

1.0 Introduction

At your request and authorization, representatives of H.G. Schlicker and Associates, Inc. (HGSA) visited the subject site (Figure 1; Appendix A) multiple times between March and October 2019, to complete an engineering geologic investigation for shoreline protection. We have also observed conditions on the Siletz Spit over the last approximately 40 years during site visits for other projects. We completed this investigation to determine whether the tax lots located within the site need and would benefit from the construction of Shoreline Protection, in this specific case, the construction of new oceanfront riprap revetments at the site because of damage to existing revetments. Based upon our investigation, we have determined that the tax lots throughout the site would benefit from replacement of the existing protective structures, and we have provided designs and specifications for riprap revetments along Siletz Spit.

This report addresses the engineering geology at the subject site with respect to the replacement of existing revetments for shoreline protection. The existing riprap revetments were generally constructed under emergency conditions and are inadequately designed and constructed to protect the Salishan Leaseholder's properties during severe erosion events. Oregon Parks and Recreation Department (OPRD) have encouraged Salishan Leaseholders to have this comprehensive report completed so that it is readily available to rely on for construction of new revetments for the Salishan Leaseholders. This report documents historical erosion events and current conditions to provide an accurate evaluation of the geologic conditions and provide background information to streamline the process when submitting Shoreline Protection Structure applications for construction of riprap revetments.

This report addresses the engineering geology at the subject site with respect to the construction of new revetments for shoreline protection. The scope of our work consisted of site observations and measurements; a professional topographic survey with select cultural features identified; preparation of slope profiles, maps, and revetment design; a limited review of the geologic literature; interpretation of topographic maps, lidar, stereo-pair and mono aerial photographs and satellite imagery; and preparation of this report of our findings, conclusions, recommendations, and design of riprap revetments and pathways.

2.0 Site Description

The Salishan spit is approximately 2.7 miles long and is located between Lincoln City to the north and Gleneden Beach to the south (Figure 1). The spit is bounded to the east by Siletz Bay, to the north by the mouth of Siletz Bay, to the west by the Pacific Ocean and to the south by Gleneden Beach.

Development on the spit has been continuous since it began in the mid-1960s. There are 110 developed and developable tax lots and 15 undevelopable areas (e.g. "walkways," "beach access," "park," etc.) located along the western oceanfront side of the spit (Appendices B and C). Planned development of the Salishan spit began in the mid-1960s, and all of the tax lots subject to this report have been identified as Goal 18 eligible due to exception according to the Oregon Coastal Atlas Ocean Shores webpage (accessed September 20, 2019).

The subject tax lots consist of the westernmost oceanfront lots and interstitial areas owned by the Salishan Leaseholders between Tax Lot 200, Map 07-11-34CB at the northern extent, and Tax Lot 156, Map 08-11-09DD at the southern extent (Appendices B and C). The 14 southernmost tax lots are located along the northern extent of the bluff-backed Gleneden beach; the remaining tax lots are located along the sand dune-backed Siletz spit. Generally, the vegetated foredune crest and the top of erosion scarps along the spit, and the toe of the bluff slope in the southern portion of the site are at approximately 30 feet elevation (NAVD 88).

The beach fronting the site is dynamic and experiences substantial and unpredictable changes in the beach sand elevation. The occurrence of rip currents and their resultant embayments that allow larger waves to run further inshore are common in this area and typically are a significant contributor to the rapid and severe erosion of the dunes and bluff. It is this process that has led to severe erosion events that have damaged, destroyed, and overtopped revetments along the spit multiple times since development began.

Riprap revetment shoreline protective structures currently exist along most of the site (Appendices A, C, and D). During our site visits, we identified the location and condition of the exposed riprap revetments and attempted to locate existing revetments that were covered by dune sand. The condition of the riprap revetments along the spit varies from recently constructed with more modern techniques and materials to those that are older, poorly maintained, damaged, and constructed with poor quality material (Appendix A).

At the time of our site visits, we visually identified existing riprap revetments fronting 50 of the 58 developed lots south of and including Tax Lot 1000, Map 08-11-03CB (Appendices A and C). The condition of the exposed riprap revetments ranged from recently well-constructed to loosely stacked and scattered stones. During our site visits, we also probed the dune sand where riprap revetments were not exposed; in general, we were able to locate rock covered by approximately 6 to 8 feet of sand in the approximate area of the "edge of bank" surveyed by Harold Poling in 1970 (Survey #05426; available from Lincoln County webmaps: http://maps.co.lincoln.or.us/). The Oregon Coastal Atlas Ocean Shores webpage (accessed September 20, 2019) indicates that beachfront protective structures are present fronting all of the developed/developable properties owned by the Salishan Leaseholders; however, we were unable to confirm the presence of a riprap revetment at the southernmost Salishan Leaseholder owned tax lot, Tax Lot 156, Map 08-11-09DD.

The toe of the bluff slope fronting Tax lot 156, Map 08-11-09DD has experienced approximately 20 feet of additional erosion when compared to protected tax lots to the north. Active erosion at the toe of the bluff slope fronting Tax Lot 156, Map 08-11-09DD has led to recent shallow landslides and oversteepening the base of the slope (Appendix A-1: Photos 22 and 23). Review of stereopair aerial photos, maps, and satellite imagery indicates that this area of the bluff has become increasingly vegetated since at least 1955 when shallow failures had denuded much of the slope. More recently, a shallow failure occurred on the bluff slope west of the existing home on Tax Lot 156, Map 08-11-09DD sometime between 1983 and 1994.

Recent erosion, approximately between Tax Lot 1001, Map 08-11-03CB, and Tax Lot 600, Map 08-11-03CB (Appendix A), has exposed the poorly constructed revetment that had been previously covered with sand. We observed that a new revetment had been constructed fronting Tax Lot 1000, Map 08-11-03CB, and erosion had come within 5 to 15 feet of several of the nearby homes to the south (Appendix A).

In summary, the western part of the site needs improved oceanfront protection to protect the houses and infrastructure along this stretch of beach. The proposed project is to construct new permitted riprap revetments, on an as-needed basis, to meet current design standards and to provide mitigation for wave erosion and overtopping, which endangers the Salishan leaseholder's homes.

2.1 Published Literature and Publicly Available Data Review

Komar and Rea (1976) published a detailed study of the winter 1972-73 erosion that occurred on Siletz Spit. During the winter storms of 1972-73, several houses were threatened, and one house under construction was destroyed (Appendix A). Komar and Rea describe the presence of rip currents and rip current embayments as the primary cause of the severe erosion along the spit and note that erosion of sandy foredune areas of the coast can occur at any time and remove at least 50 meters (164 feet) of the foredune. The most severe erosion during the 1972-73 event eroded back approximately 30 meters over a 3-week period. The authors note that in response to the severe erosion, "riprap was installed hastily… and installation did not follow the established engineering procedures for riprap construction." Conclusions made by Komar and Rea include that "it is now necessary that the area be uniformly protected with riprap," and "if one neighbor does not protect his property, the defense will be breached and the erosion may come from the side rather than from the oceanfront."

McKinney (1976) and Komar and McKinney (1977) detail the conditions contributing to the Spring 1976 erosion of Siletz Spit and contrast it to earlier winter erosion periods. The authors discuss that, similar to previous storms, the presence of rip current embayments along the beach allowed waves to break closer to shore and run up the beach further. The primary difference between the erosion events in 1972-73 and the spring of 1976 was the tide levels, whereas neap tide conditions existed during the 1972-73 storm, spring tide conditions persisted during the February 1976 storm. The higher tide combined with storm waves during the February 1976 storm led to waves washing over the top of the spit and drift logs being thrown atop the dunes (Appendix A).

In the *Coastal Flood Hazard Study, Lincoln County, Oregon* (Allan et al., 2015) published by the Oregon Department of Geology and Mineral Industries (DOGAMI), historical shorelines, beach profiles, and lidar data, amongst other data, were used to help develop a digital flood insurance map and flood insurance study report for Lincoln County. Historical shorelines from the 1920s to 2010 illustrate the variability of the beach along Siletz Spit, where the shoreline width can vary over a distance of approximately 98 to 230 feet. Beach profile, wave, tide, and erosion characteristics along Siletz Spit were used in modeling storm conditions, and to determine the most likely winter profiles (MLWP), expected wave runup, and total water level (TWL) for 1% annual chance storm events. Model results indicate that TWL levels for 1% annual chance storm events range from approximately 29 to 37 feet (NAVD88) with the possibility of wave overtopping at many of the sites modeled. In addition to the possibility of waves overtopping the spit in several locations, the MLWPs indicate the possibility of revetments being fully exposed to their lowest elevation, thereby exposing the toe of the revetment to undercutting by waves.

Ongoing beach monitoring projects by Allan and O'Brien (2019) have included periodically collecting beach profile data and providing basic shoreline change analysis results. The data presented on the Northwest Association of Networked Ocean Observing Systems (NANOOS) webpage (http://nvs.nanoos.org/BeachMapping, accessed 10/3/2019) illustrate changes in the beach profiles from 1997 to 2018 and present general trends in erosion or accretion in the 6-meter (approximately 20 feet) beach contour.

Publicly available topographic and bathymetric lidar data from DOGAMI, NOAA, NASA, and USGS provide elevation data for the bluffs, dunes, beaches, and nearshore seafloor at the time of data collection. Analyzing and comparing multiple data sets from between 1997 and 2016 allowed us to determine recent topographic changes. Analysis of elevation differences between high-resolution lidar data sets from 2009 and 2016 reveal shallow slope failures along the bluff backed beach at the southern extent of the site, areas that have recently experienced erosion of the foredune, areas that have experienced growth of the foredune, and areas with little to no change.

Beach profiles derived from lidar data collected by DOGAMI in 2009 and NOAA/USGS in 2016, along with elevation data from Alan and Hart (2008), Allan et al. (2015), and Alan and O'Brien (2019) are presented in Appendix D.

Crowdsourced data and imagery are available online at the Oregon Shores Conservation Coalition webpage (oregonshores.org, accessed 10/2/2019) and Oregon King Tides Photo Initiative webpage (oregonkingtides.net; accessed 10/2/2019). Data submitted by citizen scientists to the above webpages provide additional information and photographic evidence of the wave and tidal conditions affecting the site and existing riprap revetments (Appendix A). Photographs available include images of erosion of the beach, bluffs, and dunes, revetment conditions and construction, and wave runup and overtopping of exposed revetments during king tide conditions without apparent storm influences.

2.2 Aerial Photo and Satellite Imagery Review

We reviewed stereopair aerial photography from 1955, 1970, 1972, 1976, 1982, 1983, and 1994 and satellite imagery, available from Google Earth Pro, from 1994, 2000, 2003, 2005, 2011, 2015, 2016, and 2019. Aerial and satellite imagery provides information regarding the variations in the beach-dune junction over time, changes in vegetative cover, the presence of rip-current embayments, the presence and condition of riprap revetments, and evidence of shallow bluff failures.

3.0 Geology

The Siletz spit was mapped by Schlicker et al. (1973) as unconsolidated fine- to medium-grained beach and dune sand, underlain by Quaternary Marine terrace. The marine terrace deposits consist of semi-consolidated, fine- to medium-grained, uplifted beach sand commonly overlain by unconsolidated, fine-grained stabilized dune deposits. The uplifted marine terrace sediments are typically high-energy nearshore marine deposits capped by beach sand (Kelsey et al., 1996). Priest and Allan (2004) mapped the Siletz spit as Quaternary beach sand and mapped Quaternary Marine terrace south of approximately Tax Lot 312, Map 08-11-09DA.

3.1 Geologic Structures

Structural deformation and faulting along the Oregon Coast are dominated by the Cascadia Subduction Zone (CSZ), which is a convergent plate boundary extending for approximately 680 miles from northern California to northern Vancouver Island. This convergent plate boundary is defined by the subduction of the Juan de Fuca plate beneath the North America Plate and forms an offshore north-south trench approximately 40 to 60 miles west of the Oregon coast shoreline. A resulting deformation front consisting of north-south oriented reverse faults is present along the western edge of an accretionary wedge east of the trench, and a zone of margin-oblique folding and faulting extends from the trench to the Oregon Coast (Geomatrix, 1995).

An inferred (concealed) fault which trends in a northwesterly direction has been mapped approximately 0.3 miles north of the Siletz spit (Schlicker et al., 1973; Priest and Allan, 2004). This fault is believed to be a normal fault with its upthrown side to the southwest. The fault cuts Tertiary units with no indications of recent movement.

A group of generally northwest-striking faults collectively referred to as the Siletz River faults (Personius et al., 2003), are located in the area from Government Point, approximately 4.5 miles south of Siletz Spit, northward to the mouth of the Siletz River. Their sense of movement and level of activity is poorly known at present. The two most distinct faults in the group are the Fishing Rock fault and the Fogarty Creek fault. The Fishing Rock fault is mapped approximately 3 miles south of the site near the headland of Fishing Rock (Personius et al., 2003; Priest and Allan, 2004). This fault offsets Quaternary Marine Terrace deposits by 15 feet and is downthrown to the northeast. The Fogarty Creek fault is a downthrown-north fault with 18-foot offset and is mapped approximately 3.5 miles south of the site (Personius et al., 2003; Priest and Allan, 2004).

The nearest mapped potentially active faults are the Yaquina Head Fault located approximately 15 miles south of the site, and the Yaquina Bay Fault located approximately 18 miles south of the site. The Yaquina Head Fault is an east-trending oblique fault with left-lateral strike-slip and either contractional or extensional dip-slip offset components (Personius et al., 2003). It offsets the 80,000-year-old Newport marine terrace in the area of the site by approximately 5 feet, indicating a relatively low rate of slip, if still active (Schlicker et al., 1973; Personius et al., 2003). The Yaquina Bay Fault is a generally east-northeast trending oblique fault that also has left-lateral strike-slip and either contractional or extensional dip-slip offset components (Personius et al., 2003). This fault is believed to extend offshore for approximately 7 to 8 miles and may be a structurally controlling feature for the mouth of Yaquina Bay (Goldfinger et al., 1996; Geomatrix, 1995). At Yaquina Bay, a 125,000-year-old platform has been displaced approximately 223 feet up-on-the-north by the Yaquina Bay Fault. This fault has the largest component of vertical slip (as much as 2 feet per 1,000 years) of any active fault in coastal Oregon or Washington (Geomatrix, 1995). Although the age for the last movement of the Yaquina Bay Fault is not known, the fault also offsets 80,000-year-old marine terrace sediments.

4.0 Slope Stability, Erosion, and Current Site Conditions

The site is mapped in an area designated as experiencing critical erosion of sand spits and dune areas in the northern part of the site and experiencing critical erosion of marine terraces and sediments in the southern part of the site (Schlicker et al., 1973).

In the winter of 1972/1973, severe ocean wave erosion occurred along Salishan Spit, which destroyed a house under construction and threatened several others along the spit (Appendix A). This severe erosion episode is believed to have partly been associated with rip currents, which are strong narrow currents that flow across the surf zone and out beyond the breakers (Komar and Rea, 1976). In the years following 1973, much of the Salishan Spit area had riprap revetments constructed to protect the spit from ocean wave erosion.

In the spring of 1976, a second episode of severe erosion occurred since the development of the spit began. Rip currents again caused rapid erosion of the dune; however, this erosion event differed from the 1972/73 event in that the dunes and previously built revetments were overtopped by waves, and large drift logs were thrown on top of the dunes (McKinney, 1976; Komar and McKinney, 1977) (Appendix A).

Riprap revetments along 11 contiguous properties on Siletz Spit were damaged and destroyed as a result of the combination of high tides, storm surge and waves associated with an episodic severe El Niño event in March 2016. The failure of the revetments appears to have been due to the undermining of the toe of the revetments, plucking of armor stones, shifting of revetment materials, and the resultant erosion of backing material and native dune sands that were being protected from erosion by the revetments. This resulted in a substantial threat to the homes from wave attack and the potential for undermining of foundations (Appendix A). Erosion came within 6 feet of one of the homes during this 2016 storm event (Sennewald, 2018). Repair permits were applied for and received from the Oregon Parks and Recreation Department (OPRD).

During the winter of 2018/2019 erosion exposed and damaged poorly constructed revetments, undermined and destroyed a patio fireplace, and threatened to damage several homes

(Appendix A). The 2018/2019 erosion occurred in the same general area along the spit as the 2016 erosion event; however, the revetments that were repaired in 2016 generally resisted the wave attack, and six lots to the north were severely eroded exposing and damaging the older revetments.

Erosion along the southern bluff-backed portion of the site (approximately between Tax Lot 156, Map 08-11-09DD to the south and Tax lot 315, Map 08-11-09DA to the north) is caused by wind, rain and wave attack. Waves have overtopped the revetments creating up to 6 feet high erosion scarps at the toe of the slope. Wind and rain have contributed to erosion of the upper portion of the bluff slopes, particularly in the upper 10 to 20 feet of the slope where marine terrace sands are exposed on near-vertical slopes with vegetation overhanging several feet. Existing revetments along this portion of the site have reduced erosion at the toe of the bluff and the occurrence of shallow slope failures.

Aerial and satellite imagery indicates that the bluff slope has become increasingly vegetated since 1955; however, the lack of a revetment fronting the southernmost property at the site (Tax Lot 156, Map 08-11-09DD) exposes the bluff to direct wave attack, and as a result, the toe of the bluff has eroded back approximately 20 feet more than the lots protected with revetments. Erosion of the toe of the bluff has recently led to several shallow slope failures on the western portion of Tax Lot 156, Map 08-11-09DD (Appendix A). As observed in the field, shallow failures have occurred south of the southern termination of the existing revetment. Vegetation differences observed in the field, and comparison of aerial and satellite images indicate that bluff failures have occurred since at least 1955 and as recently as sometime between 1983 and 1994 (Appendix A).

Properly designed and constructed riprap revetments greatly reduce the potential for erosion when maintained and repaired as necessary. At the time of our site visits, existing riprap revetments were exposed along much of the western face of the bluff and dunes (Appendices A and C). We observed that many of the riprap revetments were not adequately protecting the dune and bluff slopes above the revetment from direct wave attack and had been overtopped in the recent past. Overtopping of the revetments by waves has caused erosion of the sand behind the revetments (Appendix A). Generally, the height of the existing revetments is not adequate to provide sufficient protection from large waves.

Along this part of Oregon's coast, the average annual erosion rate was not determined by Priest (1994) and Priest et al. (1994) because this area had existing oceanfront protective structures at the time of the study. In those studies, areas with existing oceanfront protective structures, like Salishan Spit, were assumed to have an erosion rate near zero. However, to the south, at Gleneden Beach, an average erosion rate of 0.62 ± 0.76 feet per year has been determined for bluff-backed beaches. This erosion rate was calculated by measuring the distance from existing structures in the area to the bluff and compared to distances measured on a 1939 or 1967 aerial photograph (Priest et al., 1994).

Typically, the dune-backed beaches erode and rebuild seasonally, with wider, shallow sloping beaches during the summer and more narrow steeper beaches in the winter. Komar and Rea (1976) also describe a 10 to 15-year cycle of erosion and accretion along Siletz Spit based on analysis of aerial photographs dating back to 1939.

Based on mapping completed by Priest and Allan (2004), the western portion of all of the lots lie within the Active and High-Risk Coastal Erosion Hazard Zones, and the houses lie within the High and Moderate-Risk Coastal Erosion Hazard Zones as defined below.

4.1 Coastal Erosion Hazard Zone Definitions

The methodology provided by Priest and Allan (2004) defining the four coastal erosion hazard zones along dune-backed beaches in Lincoln County, Oregon, are as follows:

(Please note that the wave heights given below are deep-water significant wave heights which were determined from four wave buoys offshore from the Pacific Northwest Coast.)

"Hazard zones on dune-backed beaches were determined from a geometric model, whereby property erosion occurs when the total water level produced by the combined effect of extreme wave runup (R) plus the tidal elevation (ET), exceeds some critical elevation of the fronting beach, typically the elevation of the beach-dune junction (EJ). Three scenarios were used to model erosion hazard zones on dune-backed beaches:

Scenario 1 (HIGH risk). This scenario is based on a large storm wave event (wave heights ~47.6 ft high) occurring over the cycle of an above average high tide, coincident with a 3.3 ft storm surge. Under this scenario, the mapped width of the high-risk hazard zone was found to range from 138 to 510 ft.

The following two scenarios (MODERATE and LOW-risk events) are one of two "worst case" events identified. Both scenarios have low probabilities of occurrence.

Scenario 2 (MODERATE-risk). This scenario is based on an extremely severe storm event (waves ~52.5 ft high) coupled with a long-term rise in sea level of 1.31 ft. Maximum potential erosion distances (MPED) mapped under this particular scenario range from 279 to 772 ft.

Scenario 3 (LOW-risk). This scenario is similar to scenario 2 above but incorporates a 3.3 ft vertical lowering of the coast as a result of a Cascadia subduction zone earthquake. MPED mapped for scenario 3 ranged from 316 to 928 ft."

And,

"An active erosion hazard zone (AHZ) has also been identified. For dune-backed shorelines, the AHZ encompasses the active beach to the top of the first vegetated foredune, and includes those areas subject to large morphological changes adjacent to the mouths of bays due to inlet migration."

The methodology provided by Priest and Allan (2004) defining the four coastal erosion hazard zones along bluffed-backed beaches in Lincoln County, Oregon, are as follows:

"The basic techniques used here are modified from Gless and others (1998), Komar and others (1999), and Allan and Priest (2001). The zones are as follows:

1) Active hazard zone: The zone of currently active mass movement, slope wash, and wave erosion.

2) The other three zones define high-, moderate-, and low-risk scenarios for expansion of the active hazard zone by bluff top retreat. Similar to the dune-backed shorelines, the three hazard zones depict decreasing levels of risk that they will become active in the future. These hazard zone boundaries are mapped as follows:

a. High-risk hazard zone: The boundary of the high-risk hazard zone will represent a best case for erosion. It will be assumed that erosion proceeds gradually at a mean erosion rate for 60 years, maintaining a slope at the angle of repose for talus of the bluff materials.

b. Moderate-risk hazard zone: The boundary of the moderate-risk hazard zone will be drawn at the mean distance between the high- and low-risk hazard zone boundaries.

c. Low-risk hazard zone: The low-risk hazard zone boundary represents a "worst case" for bluff erosion. The worst case is for a bluff to erode gradually at a maximum erosion rate for 100 years, maintaining its slope at the angle of repose for talus of the bluff materials. The bluff will then be assumed to suffer a maximum slope failure (slough or landslide). For bluffs composed of poorly consolidated or unconsolidated sand, another worst-case scenario will be mapped that assumes that the bluff face will reach a 2:1 slope as rain washes over it and sand creeps downward under the forces of gravity. For these sand bluffs, whichever method produces the most retreat will be adopted."

It should be noted that mapping done for the 2004 study was intended for regional planning use, not for site-specific hazard identification.

5.0 Regional Seismic Hazards

Abundant evidence indicates that a series of geologically recent large earthquakes related to the Cascadia Subduction Zone have occurred along the coastline of the Pacific Northwest. Evidence suggests that more than 40 great earthquakes of magnitude 8 and larger have struck western Oregon during the last 10,000 years. The calculated odds that a Cascadia earthquake will occur in the next 50 years range from 7–15 percent for a great earthquake affecting the entire Pacific Northwest, to about a 37 percent chance that the southern end of the Cascadia Subduction Zone will produce a major earthquake in the next 50 years (OSSPAC, 2013; OSU News and Research Communications, 2010; Goldfinger et al., 2012). Evidence suggests the last major earthquake occurred on January 26, 1700, and may have been of magnitude 9.0 (Clague et al., 2000).

There is now increasing recognition that great earthquakes do not necessarily result in a complete rupture along the full 1,200 km fault length of the Cascadia subduction zone, such that partial ruptures of the plate boundary have occurred in the paleo-records due to smaller earthquakes with moment magnitudes (Mw) < 9 (Witter et al., 2003; Kelsey et al., 2005). These partial segment ruptures appear to occur more frequently in the southern Oregon coast, determined from paleotsunami studies. Furthermore, the records have documented local tsunamis from Cascadia earthquakes recur in clusters (~250–400 years) followed by gaps of 700–1,300 years, with the highest tsunamis associated with earthquakes occurring at the beginning and end of a cluster (Allan et al., 2015).

These major earthquake events were accompanied by widespread subsidence of a few centimeters to 1–2 meters (Leonard et al., 2004). Tsunamis appear to have been associated with many of these earthquakes. In addition, settlement, liquefaction, and landsliding of some earth materials are believed to have been commonly associated with these seismic events.

Other earthquakes related to shallow crustal movements or earthquakes related to the Juan de Fuca plate have the potential to generate magnitude 6.0 to 7.5 earthquakes. The recurrence interval for these types of earthquakes is difficult to determine from present data, but estimates of 100 to 200 years have been given in the literature (Rogers et al., 1996).

6.0 Flooding Hazards

The area of the subject site has had Flood Insurance Rate Maps prepared for it (FIRM Panels #41041C0117E and #41041C0120E, dated 10/18/2019). Based on these FIRM panels, the western portion of Siletz spit lies in areas rated as Zone VE with base flood elevations ranging from 29 to 37 feet (NAVD 88). Zone VE is defined as an area of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined (Appendix E).

Based on the Oregon Department of Geology and Mineral Industries mapping, all but the southernmost buildings on the site lie within the tsunami inundation zone resulting from an approximately 8.9 or larger magnitude Cascadia Subduction Zone (CSZ) earthquake (DOGAMI, 2013). The 2013 DOGAMI mapping is based upon five computer-modeled scenarios for shoreline tsunami inundation caused by potential CSZ earthquake events ranging in magnitude from approximately 8.7 to 9.1. The January 1700 earthquake (discussed in Section 5.0 above) has been rated as an approximate 8.9 magnitude event in DOGAMI's methodology. Other earthquakes can also generate tsunamis.

7.0 Climate Change

According to most of the recent scientific studies, the Earth's climate is believed to be changing as the result of human activities which are altering the chemical composition of the atmosphere through the buildup of greenhouse gases, primarily carbon dioxide, methane, nitrous oxide, and chlorofluorocarbons (EPA, 1998). Although there are uncertainties about exactly how the Earth's climate will respond to enhanced concentrations of greenhouse gases, scientific observations indicate that detectable changes are underway (EPA, 1998; Church and White, 2006). Global sea-level rise, caused by melting polar ice caps and ocean thermal expansion, could lead to flooding of low-lying coastal property, loss of coastal wetlands, increased wave heights, erosion of beaches and bluffs, and saltwater contamination of fresh groundwater. It can also lead to increased rainfall, which can result in an increase in landslide occurrence. Global climate change and the resultant sea-level rise may impact the subject site through accelerated coastal erosion.

8.0 Conclusions and Recommendations

To mitigate future ocean wave erosion and the resulting dune and bluff recession, and damage to homes, we recommend that new riprap revetments be constructed, maintained, and repaired with modern designs and materials, as shown in Figures 2 and 3. We have provided in this report design details applicable for typical replacement of the revetments in the subject area.

8.1 Revetment Design Considerations

Many factors have been considered for the design of the riprap revetments that will mitigate ocean wave impacts to the homes owned by the Salishan Leaseholders. Most of the existing revetments were constructed as emergency reactions to erosion events and were not constructed with adequate design considerations or materials. Subsequent storm events have exposed and damaged many of the revetments along the site and left the revetments and Leaseholder properties vulnerable to damage from future erosion events.

Ideally, revetments will be able to resist wave attack, dissipate the forces exerted by larger storm-driven breaking waves, withstand scour at the base of the revetments that can undermine the structure, and reduce the likelihood of overtopping.

Resistance to wave attack, dissipating large storm-driven breaking waves, and withstanding undermining of the revetment is largely dependent on armor stone quality, size and placement, and overall revetment design. We utilized shoal water and deep-water equations (Equations 2 and 3) presented in *California Bank and Shore Rock Slope Protection Design* (Racin et al., 2000) to determine the theoretical minimum rock mass which resists wave forces and remains in the revetment during typical tide and wave conditions. In addition to the rock size and weight required to resist destructive wave forces, we also considered the availability and cost of adequate armor stones used in the design of the revetment.

Base flood elevations range from approximately 29 to 37 feet (NAVD88) for 1% annual chance storm events, as mentioned in Section 6.0 above. In general, the foredune erosion scarps and base of the bluff slopes throughout the site lie at approximately 30 feet elevation (NAVD 88). During the 2018/2019 storm season, a recently constructed riprap revetment with a top elevation of approximately 28 feet was overtopped. As a result of the overtopping, we designed and recommended that the top of the revetment be raised approximately 5 feet to the 33 feet elevation (NAVD88). Although constructing the top of the riprap revetment at 33 feet elevation (minimum) may not prevent all occurrences of waves overtopping the revetments along the site, we believe that the increased elevation will reduce the likelihood of overtopping while preserving the views from each of the Leaseholder's houses. Constructing the top of the revetment to a higher elevation may better mitigate overtopping.

In addition to increased revetment heights, we recommend that the eastern edge of the top of the newly constructed revetments be located no closer than 20 feet from the westernmost foundation element of the house. The 20-foot buffer will provide some accommodation space for wave run-up and swash that overtops the revetment and drift logs that can be thrown beyond the revetment. Well-graded quarry-run rock should be used to back the revetment and fill the space between the revetment and erosion scarp as necessary to achieve the 20-foot buffer. Erosion can occur very rapidly along this stretch of beach, and if the shoreline has eroded within 20 feet of the existing structure, minor modification (minor fill) to the shoreline may be necessary, as provided for in Lincoln County Code LCC 1.1381(5)(f)(D), to ensure the continuity, alignment and structural integrity of new revetments.

Due to the possibility of rapid erosion along the entire site, we encourage Leaseholders to take a proactive approach to construction of riprap revetments fronting their properties rather than waiting until their homes are in imminent peril. Construction of revetments should be considered prior to erosion of the dunes within 20 feet of the homes. We encourage the construction of revetments across several lots at the same time as it has the advantage of ensuring continuity, alignment, structural integrity, and can reduce costs.

Several tax lots, particularly in the northern portion of the spit, have foredunes as much as 170 feet wide between the current location of the beach and the existing homes, and the older revetments, if present, are not yet exposed and the revetment location is generally unconfirmed. If Leaseholders would like to construct new revetments prior to erosion exposing the older revetments, the above considerations, and the design specifications below should be followed. Costs may be greater to construct revetments within the foredune due to the extensive excavation that would be required.

8.2 Revetment Design Specifications

As new revetments are constructed on an as-needed basis, consideration for continuity and alignment with neighboring revetments should be made. The footprint of new revetments should generally reside where existing revetments are located at the time of this study; however, exceptions should be made to keep the revetments well tied together and aligned. Maintaining the alignment of the revetments may require the use of additional backing rock to fill areas that experience extreme erosion, as indicated on Figures 2 and 3. The continuity of the revetments between Tax Lot 156, Map 08-11-09DD at the southern extent, and Tax Lot 200, Map 07-11-34CB at the northern extent should only be broken by the two tax lots identified as a "Park" (Tax Lot 235, Map 08-11-09AA and Tax Lot 139, Map 08-11-09AD). If desired, private and public beach access pathways (such as those areas identified as "walkway," "beach access," and Sea Dunes Lane on the Lincoln County plat maps) should be designed as part of the revetment as indicated on Figure 3 – Revetment Pathway Detail.

The terminal ends of the riprap revetments, north of Tax Lot 200, Map 07-11-34CB, south of Tax Lot 207, Map 08-11-09AA (north end of the "park"), and north of Tax Lot 108, Map 08-11-09AD (south end of "park") will likely need to extend beyond and wrap around existing structures to reduce erosion along the side of the lots during extreme erosion events (Appendix C). Tapering the southern end (Tax Lot 156, Map 08-11-09DD) of the riprap revetment into the bluff will reduce end effects at the southern extent of the revetment (Appendix C).

We recommend that the toe of the revetment be embedded into the beach sand to an elevation of approximately 6 feet above sea level (NAVD 88). The final revetment toe embedment depth should be as deep as "flowing/heaving" sand conditions allow at low tide. If rock is encountered in the excavation, the toe of the revetment should be embedded a minimum of 4 feet into hard rock. Toe trench embedment depths must be approved by a representative of HGSA at the time of construction.

As stated above, the eastern edge of the top of the newly constructed revetments should be located no closer than 20 feet from the westernmost foundation element of the house. If the dune sand fronting the house has eroded within 20 feet of the westernmost foundation element of the house, well-graded quarry-run rock should be used to back the revetment and fill the space between the revetment and erosion scarp as necessary to achieve the 20-foot buffer and maintain alignment with the neighboring revetments. The quarry-run backing rock should be equipment compacted in approximately 1-foot lifts to a dense unyielding state, and fill slopes should not exceed 2 horizontal to 1 vertical (2H:1V).

Non-woven filter fabric (Mirafi® 1100N or equivalent), quarry-run bedding rock, and filter rock (aka "chunky rock") should be placed between the riprap armor stones and the native soils or backing rock fill, as shown on Figures 2 and 3. The non-woven filter fabric should be installed from the top of the slope to the bottom of the toe trench and wrap the bottommost armor stone placed in the trench. An approximately 6-inch-thick layer of quarry-run bedding rock, consisting of 4-inch minus rock, should be placed on the filter fabric to prevent the more angular filter rock from puncturing the filter fabric. An approximately 18-inch-thick layer of filter rock (aka underlayer stone; locally referred to as Chunky Rock), consisting of ODOT Class 200 standard riprap, should be placed between the quarry-run bedding rock and the riprap armor to help dissipate wave energy and provide bedding material for armor stones. Any of the older, highly fractured rock from the existing protective structures within the footprint of the new revetment should be removed and could be broken into smaller, suitable sized pieces and used as underlayer stone (chunky rock) behind the armor stone layers.

Riprap (armor stone) should consist of hard, durable, angular, non-vesicular, basalt rock from an upland source, approximately 3 to 8 feet diameter, and weighing at least 165 pounds per cubic foot. Armor stones should be individually placed with "3-point bearing" (no wobbling) on adjacent rock (Racin et al., 2000). Two layers of riprap should be installed. The riprap revetment should slope at approximately 2H:1V. The top of the armor stone should be at 33 feet elevation (NAVD 88) minimum. Constructing the top of the revetment to a higher elevation may better mitigate overtopping. Additional design details are provided on Figures 2 and 3.

Construction of pedestrian access paths integrated into the new riprap revetments is acceptable, provided it is based on HGSA's design (Figure 3).

Following revetment construction, the revetment and any pit-run backing fill should be covered with a minimum 2-foot-thick layer of sand above the severe wave splash elevation, being sure to infill all interstitial space between riprap boulders. The sand should then be planted with beach grass, fertilized, and watered as necessary to establish vegetation growth for improved aesthetics. See Appendix G for beachgrass planting guidelines from *Stabilizing Coastal Sand Dunes in the Pacific Northwest* (Carlson et al., 1991).

Construction of riprap revetments along the entire length of the subject area will provide the greatest protection for the properties, increased longevity of the revetments, and reduced long-term costs. Many of the existing older riprap revetments located in the subject area have been undermined, overtopped, and severely damaged since the time of construction. If the riprap revetments are not repaired, replaced, or maintained as needed, we anticipate that ocean wave attack will render the structures ineffective in providing adequate protection for the houses.

9.0 Possible Adverse Impacts

The following discusses the possible adverse impacts as the result of the proposed new riprap revetments.

9.1 Sand Source, Supply, and Movement

Sand supplies along the Oregon coast are derived primarily from two sources, (1) from erosion of bluffs, headlands and dunes, and (2) to a lesser extent from sediments carried by streams and rivers that discharge to coastal areas.

Although the proposed revetments would prevent erosion along approximately 2.2 miles of beach length, as mentioned above in Section 4.0, mapping by Priest (1994) and Priest et al. (1994) estimated the net erosion rate at 0.0 feet per year due to the existing shoreline protective structures.

The southernmost tax lot (Tax Lot 156, Map 08-11-09DD) has approximately 200 feet of bluff back shoreline that is currently unprotected. Construction of a riprap revetment fronting this portion of the beach will prevent a small amount of sand supply to the beach; however, we believe that the loss of sand to the beach in this littoral cell as a result of this revetment will be too minor during the life of the riprap structure to significantly affect beach morphology.

Using an average annual erosion rate of 0.62 feet per year and a life of the revetment of 60 years, an approximate bluff height of 90 feet, and 200 feet of unprotected bluff, we estimate that the maximum total loss of sediment supply as a result of the revetment will be approximately 24,800 cubic yards in 60 years or an annual average loss of 413 cubic yards of material. Approximately 60% of this material is sand-sized, and approximately 40% is silt and clay. The estimated total loss of material was calculated by multiplying the average annual erosion rate (0.62 feet per year) by 60 years, multiplied by an average height of the bluff (90 feet) and length (200 feet) of the bluff segment. Sixty percent of these 24,800 cubic yards or 14,880 cubic yards of material have the potential to contribute to sand supply in 60 years.

The revetment has been designed to minimize obstructions to sand movement along the beach. We do not anticipate that sand movement along this very dynamic beach will be adversely impacted by the riprap revetment. The revetments will protect a section of the beach which was has been previously protected, except for the southernmost lot, which does not have a revetment.

9.2 Post-Construction Bluff Stability and Erosion Rates

The riprap revetments will increase the stability of the dunes and bluff slope and will mitigate continued ocean wave erosion. There will essentially be no erosion below the elevation of the top of the revetments if the revetment is well maintained, and repaired as necessary. However, any exposed dune or bluff above the revetments may continue to recede due to wind and rain erosion and severe wave splash.

10.0 Evaluation of Other Protective Measures

The following discusses other mitigation measures that were evaluated but not implemented.

10.1 Non-Structural Solutions

Non-structural solutions were not attempted for this site; however, non-structural solutions were considered as potential alternatives, and include (1) improving stormwater control, (2) vegetation stabilization, (3) slope stabilization by regrading, (4) beach filling or nourishment, (5) dynamic structures, and (6) relocation of the homes.

(1) Improving Stormwater Control – Erosion along the spit and bluff is primarily the result of ocean wave attack, with wind and rain activity being a relatively lesser concern. We observed no indications that stormwater runoff from the subject site had caused significant erosion along the slopes. Therefore, we believe that the improvement of stormwater control systems throughout the site would not significantly improve dune or bluff stability; however, stormwater that is directed toward the beach should be discharged at the revetment.

(2) Vegetation Stabilization – Due to the steep nature of the bluff slopes in the southern portion of the study area, the generally weak nature of the beach and dune sand, quaternary colluvium, and marine terrace materials, and the high wave energy at the site, we do not believe that vegetation stabilization of the dunes or bluff could be successfully implemented, nor would it be adequate to protect the site from future ocean wave erosion.

(3) Slope Stabilization by Regrading – Grading the dunes and/or bluffs to a more stable slope angle would not provide significant or lasting protection from erosion at this site because of the weak nature of the soil and the constant erosive force of repetitive storm wave action. Regrading to a flatter slope angle at this site may also increase wave run-up and flooding potential.

(4) Beach Filling or Nourishment – By placing large volumes of sand along the back-beach environment, beach nourishment can temporarily protect exposed bluffs and dunes from continued ocean wave attack. However, altering the beach profile

by placing or moving sand can significantly alter wave patterns along the beach. Because a natural beach profile is near the state of dynamic equilibrium with waves, currents, and winds that move sediments along the beach, altering the beach profile by adding or moving sand could cause increased erosion or deposition in other areas of the beach. Additionally, the added sand in front of the dunes and bluffs is likely to erode rapidly because the added sand is not in a state of equilibrium with the beach system. Therefore, beach nourishment may need to be repeated every year, or after every large or prolonged storm event.

(5) Dynamic Structures - Dynamic revetments are structures in which the movement of construction materials is a fundamental design concept (Lorang, 1994). Unlike riprap revetments, which are designed to be static, dynamic structures consist of sand, sandbags, gravel mounds, logs, or composite materials which are designed to mimic the natural dynamic beach environment.

There are few examples of dynamic revetments worldwide, and few studies of their long-term effectiveness (Allan et al., 2005). There remain a number of uncertainties concerning the physical design of dynamic revetments, especially on high-energy beaches such as that observed at the subject site (Allan et al., 2005). Because of the uncertainty and lack of design methodology for dynamic revetments, we cannot recommend them for this site at this time.

(6) Relocation of the Homes – Relocation of the existing homes throughout the site would provide little additional protection from dune and bluff erosion, as ocean wave erosion along this stretch of beach is so severe. For this reason, moving the homes eastward is not considered a feasible alternative method of mitigation.

11.0 Potential Geologic and Seismic Hazards

Ocean wave activity will eventually damage the riprap structures constructed along the dunes and bluffs at the site. Therefore, the riprap revetments should be maintained and repaired, as needed.

The site lies in an area that is subject to possible tsunami inundation hazards. In the event of a Great Subduction Zone Earthquake and possibly other large earthquakes, a tsunami may damage the riprap revetments which would require that the revetments are repaired or replaced following a tsunami event. Liquefaction of sands beneath the revetments during severe ground shaking caused by an earthquake would cause a loss of support for the revetments resulting in damage to them.

12.0 Construction Observations

A representative of HGSA should observe and approve all rock sources to be used in the proposed revetments at the quarry source prior to construction to ensure that appropriate materials are obtained and delivered to the project site. We should also periodically observe revetment construction operations, including toe trench excavation, fabric placement, placement of pit run materials, underlayer stone ("chunky rock"), and armor stone, sand covering placement, and the planting of vegetation to ensure that materials and work meet the project design and specifications. Please provide us with at least five (5) days' notice prior to any site observations. There will be additional costs for these services.

13.0 Limitations

The Oregon Coast is a dynamic environment with inherent, unavoidable risks to development. Landsliding, erosion, tsunamis, storms, earthquakes, and other natural events can cause severe impacts to structures built within this environment and can detrimentally impact the health and welfare of those who choose to place themselves within this environment. The client is warned that, although this report is intended to identify the geologic hazards causing these risks, the scientific and engineering communities' knowledge and understanding of geologic hazard processes is not complete. This report pertains to the subject site only and is not applicable to adjacent sites, nor is it valid for types of development other than that to which it refers. Geologic conditions, including materials, processes, and rates, can change with time and, therefore, a review of the site, and this report may be necessary as time passes to assure its accuracy and adequacy.

Our investigation was based on engineering geological reconnaissance and a limited review of published information. The information presented in this report is believed to be representative of the site. The conclusions herein are professional opinions derived in accordance with current standards of professional practice, and no warranty is expressed or implied. The performance of this site during a seismic event has not been evaluated. If you would like us to do so, please contact us. This report may only be copied in its entirety.

14.0 Disclosure

H.G. Schlicker & Associates, Inc. and the undersigned Certified Engineering Geologist have no financial interest in the subject site, the project, or the Client's organization.

15.0 References

Allan, J.C., and Hart, R., 2008, Oregon beach and shoreline mapping and analysis program: 2007-2008 beach monitoring report: Oregon Department of Geology and Mineral Industries Open file report O-08-15, 60 p.

Allan, J.C., Ruggiero, P., Cohn, N., Garcia, G., O'Brien, F., Serafin, K.A., Stimely, L., and Roberts, J.T., 2015, Coastal Flood Hazard Study, Lincoln County, Oregon: Oregon Department of Geology and Mineral Industries Open file report O-15-06, 361 p.

Allan, J.C., and O'Brien, F., 2019, Oregon beach and shoreline mapping and analysis program: Siletz Spit, Oregon Department of Geology and Mineral Industries: Portland, Oregon, Beach Monitoring Data, http://nvs.nanoos.org/BeachMapping, Oct 1997 to Nov 2018.

Allan, J. C., Geitgey, R., and Hart, R., 2005, Dynamic revetments for coastal erosion stabilization: A feasibility analysis for application on the Oregon Coast: Oregon Department of Geology and Mineral Industries, Special Paper SP-37.

Allan, J. C., Ruggiero, P., Cohn, N., Garcia, G., O'Brien, F. E., Serafin, K., Stimely, L. L. and Roberts, J. T., 2015, Coastal Flood Hazard Study, Lincoln County, Oregon: Oregon Department of Geology and Mineral Industries, Open-File Report O-15-06, 361 p.

Carlson, J., Reckendorf, F., Ternyik, W., 1991, Stabilizing Coastal Sand Dunes in the Pacific Northwest: United States Department of Agriculture Agriculture Handbook 687, 53 p.

Church, J. A., and White, N. J., 2006, A 20th-century acceleration in global sea-level rise: Geophysical Research Letters, v. 22, LO1601, 4 p.

Clague, J. J., Atwater, B. F., Wang, K., Wang, Y., and Wong, I., 2000, Penrose Conference 2000 - Great Cascadia Earthquake Tricentennial, Programs Summary and Abstracts: Oregon Department of Geology and Mineral Industries, Special Paper 33, 156 p.

DOGAMI, 2013, Tsunami inundation maps for Gleneden Beach – Siletz River, Lincoln County, Oregon: Oregon Department of Geology and Mineral Industries, TIM-Linc-03, maps.

EPA, 1998, Climate Change and Oregon; Environmental Protection Agency, EPA 236-98-007u,4 p.

Geomatrix Consultants, 1995, Seismic design mapping, State of Oregon, final report: Prepared for the Oregon Department of Transportation, Project No. 2442.

Goldfinger, C., Kulm, L. D., Yeats, R. S., Appelgate, B., MacKay, M. E., and Cochrane, G. R., 1996, Active strike-slip faulting and folding of the Cascadia Subduction-Zone plate boundary and forearc in central and northern Oregon: U.S. Geological Survey Professional paper 1560, p. 223-256.

Goldfinger, C., Nelson, C. H., Morey, A. E., Johnson, J. E., Patton, J. R., Karabanov, E., Gutiérrez-Pastor, J., Eriksson, A. T., Gràcia, E., Dunhill, G., Enkin, R. J., Dallimore, A., and Vallier, T., 2012, Turbidite event history—Methods and implications for Holocene paleoseismicity of the Cascadia subduction zone: U.S. Geological Survey Professional Paper 1661–F, 170 p.

Kelsey, H.M., Nelson, A.R., Hemphill-Haley, E., and Witter, R.C., 2005, Tsunami history of an Oregon coastal lake reveals a 4600 yr record of great earthquakes on the Cascadia subduction zone: Geological Society of America Bulletin, v. 117, no. 7/8, p. 1009-1032.

Kelsey, H. M., Ticknor, R. L., Bockheim, J. G., and Mitchell, C. E., 1996, Quaternary upper plate deformation in coastal Oregon: Geological Society of America Bulletin, v. 108, no. 7, p. 843-860.

Komar, P.D., and Rea, C.C., 1976. Beach Erosion on Siletz Spit, Oregon. The Ore Bin. v. 38, no 8, p. 119-134.

Komar, P. D., and McKinney, B. A., 1977. The Spring 1976 Erosion of Siletz Spit, Oregon, with an Analysis of the Causative Storm Conditions: Oregon State University, 23 p.

Leonard, L. J., Hyndman, R. D., and Mazzotti, S., 2004, Coseismic subsidence in the 1700 great Cascadia earthquake: Coastal estimates versus elastic dislocation models: Geological Society of America Bulletin, May/June 2004, v. 116, no. 5/6, pp. 655–670.

Lorang, M.S., 1994, Coastal erosion and shore protection: Conceptual alternatives to conventional rip-rap shore protection structures: Prepared for the Oregon Parks and Recreation Department, 19 p., appendices.

McKinney, B. A., 1976, The Spring 1976 Erosion of Siletz Spit, Oregon, with an Analysis of the Causative Wave and Tide Conditions. Oregon State University, Master's Thesis.

Oregon Seismic Safety Policy Advisory Commission (OSSPAC), February 2013, The Oregon Resilience Plan: Reducing Risk and Improving Recovery for the Next Cascadia Earthquake and Tsunami—Report to the 77th Legislative Assembly: State of Oregon Office of Emergency Management, 341 p.

OSU News and Research Communications, May 24, 2010, Odds are 1-in-3 that a huge quake will hit Northwest in next 50 years: Oregon State University, Corvallis http://oregonstate. http://edu/ua/ncs/archives/2010/may/odds-huge-quake-Northwest-next-50-years

Personius, S. F., Dart, R. L., Bradley, L-A, Haller, K. M., 2003, Map and data for Quaternary faults and folds in Oregon: U.S. Geological Survey, Open-File Report 03-095, 556 p., map.

Priest, G. R., and Allan, J. C., 2004, Evaluation of Coastal Erosion Hazard Zones Along Dune and Bluff Backed Shorelines in Lincoln County, Oregon: Cascade Head to Seal Rock, Technical Report to Lincoln County: Oregon Department of Geology and Mineral Industries, Open-File Report O-04-09, 202 pages.

Priest, G. R., Saul, I., and Diebenow, J., 1994, Explanation of chronic geologic hazard maps and erosion rate database, coastal Lincoln County, Oregon: Salmon River to Seal Rock: Oregon Department of Geology and Mineral Industries, Open-File Report 0-94-11, 45 p.

Priest, G. R., 1994, Chronic geologic hazard map of the Fogarty Creek-Lincoln Beach Area, Coastal Lincoln County, Oregon: Oregon Department of Geology and Mineral Industries, Open-File Report O-94-18, map.

Racin, J.A., Hoover, T.P., & Avila, C.C., 2000. California Bank and Shore Rock Slope Protection Design: Practitioner's Guide and Field Evaluations of Riprap Methods. 3rd edition.

Rogers, A. M., Walsh, T. J., Kockelman, J., and Priest, G. R., 1996, Earthquake hazards in the Pacific Northwest - an overview: U.S. Geological Survey, Professional Paper 1560, p. 1- 54.

Schlicker, H. G., Deacon, R. J., Olcott, G. W., and Beaulieu, J. D., 1973, Engineering geology of Lincoln County, Oregon: Oregon Department of Geology and Mineral Industries, Bulletin 81.

Sennewald, J., "Salishan: Living on the Edge." Presentation to Salishan Leaseholders, 17 July 2018, Salishan Conference Center, Lincoln County, Oregon

Witter, R.C., Kelsey, H.M., and Hemphill-Haley, E., 2003, Great Cascadia earthquakes and tsunamis of the past 6700 years, Coquille River estuary, southern coastal Oregon: Geological Society of America Bulletin, v. 115, p. 1289-1306.

It has been our pleasure to serve you. If you have any questions concerning this report or the site, please contact us.

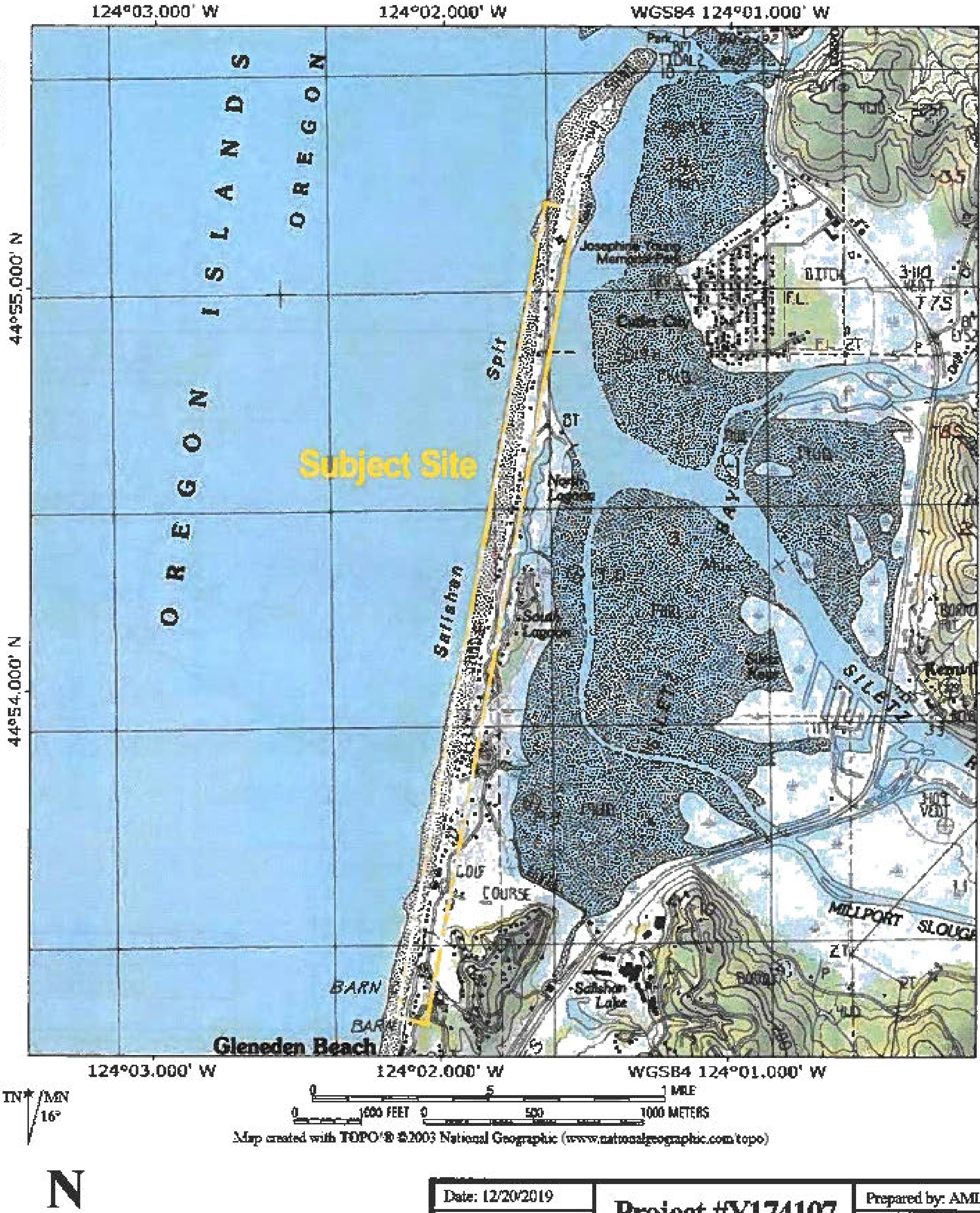
Respectfully submitted,

H.G. SCHLICKER AND ASSOCIATES, INC.

EXPIRES: 10/31/2020

J. Douglas Gless, MSc, RG, CEG, LHG
President/Principal Engineering Geologist

JDG:aml



Map created with TOPO!® ©2003 National Geographic (www.nationalgeographic.com/topo)

Date: 12/20/2019 Scale: 1" = 2,000'	**Project #Y174107**	Prepared by: AML Approved by: JDG

Location Map
Salishan Leaseholder Properties
Siletz Spit, Lincoln County, Oregon

Figure 1

1. Base of the riprap should be embedded at approximately 6 feet elevation (NAVD 88). The final revetment embedment depth should be as deep as "flowing/heaving" sand conditions at low tide allow. If bedrock is encountered in the excavation, the toe of the revetment should be embedded a minimum of 4 feet into bedrock.
2. If the minimum embedment cannot be achieved due to heaving or flowing sands at low tide, then the contractor should contact HGSA.
3. Top of the riprap armor stone should be at a minimum of 33 feet elevation (NAVD 88).
4. Riprap Armor should consist of hard, durable, fresh, angular basaltic rock, interlocked with a minimum of three points of contact. Larger stones should be placed at the base, and smaller stones toward the top. The largest stones should be placed at the toe of the revetment.
5. Non-woven filter fabric (Mirafi 1100N or equivalent) should be placed between the quarry run bedding and the native soils.
6. Riprap slopes should be 2 horizontal to 1 vertical (2H:1V).
7. Following construction, the revetment should be covered with a minimum of 2 feet of sand and planted with beach grass or other approved vegetation for stabilization. Refer to Appendix F for beachgrass planting guidelines.
8. Quarry-Run Fill (as necessary) should consist of well-graded ~4 inch minus, placed and equipment compacted in 12 inch lifts.
9. See Section 8.1 and Section 8.2 of this report for additional design considerations and specifications.

GRADATIONS

Armor Stone

Stone Size (ft)*	Stone Weight (tons)	% Smaller Than Or Equal To
6.7 to 8.0	27 to 45	100
5.9 to 6.5	18 to 25	80
4.7 to 5.3	9 to 14	50
2.1 to 2.7	1 to 2	10

* Long Dimension < 2.5* Short Dimension

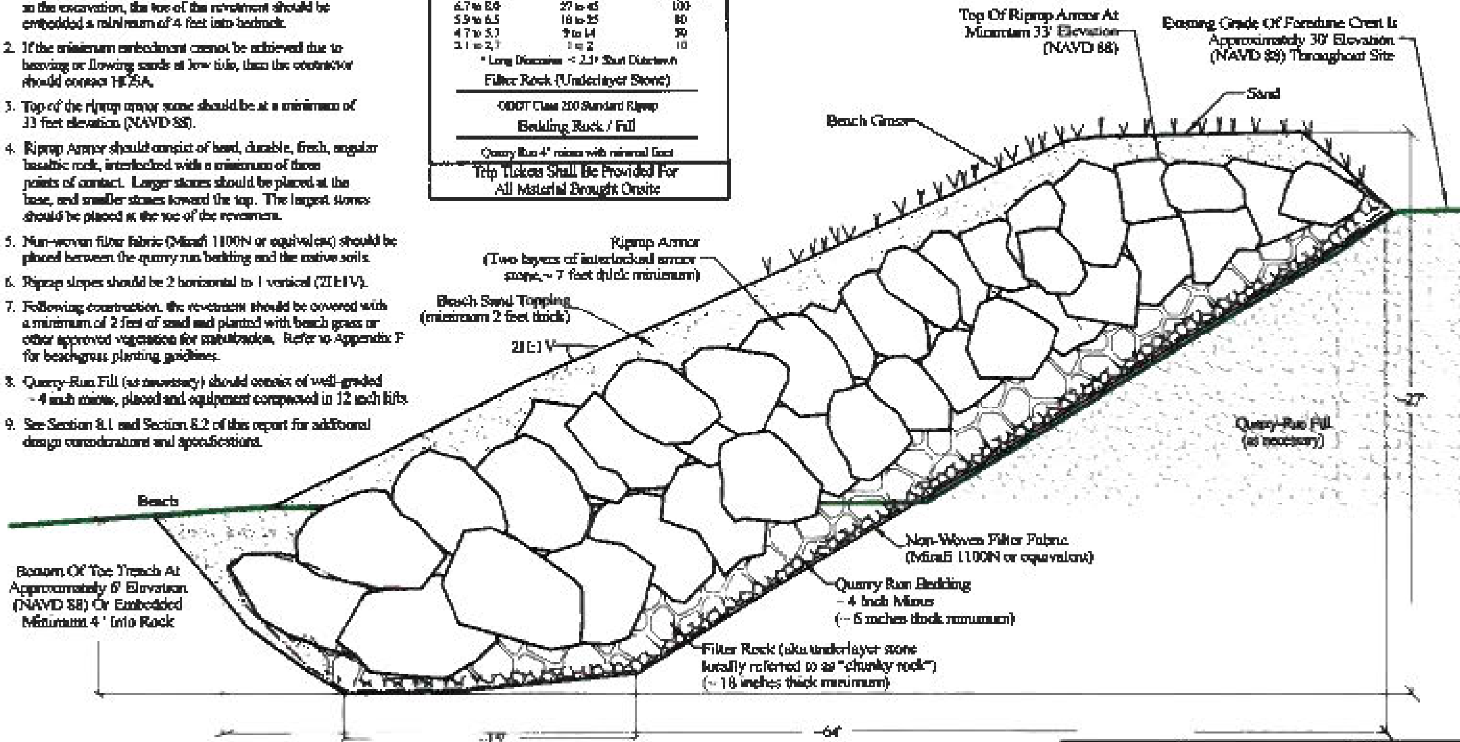
Filter Rock (Underlayer Stone)

ODOT Class 200 Standard Riprap

Bedding Rock / Fill

Quarry Run 4" minus with minimal fines

Trip Tickets Shall Be Provided For All Material Brought Onsite



As built dimensions may vary depending on site conditions actually encountered.

Date: 12/20/2019	Project #Y174107	Prepared by: AML
Scale: 1" = 8'		Approved by: RDO

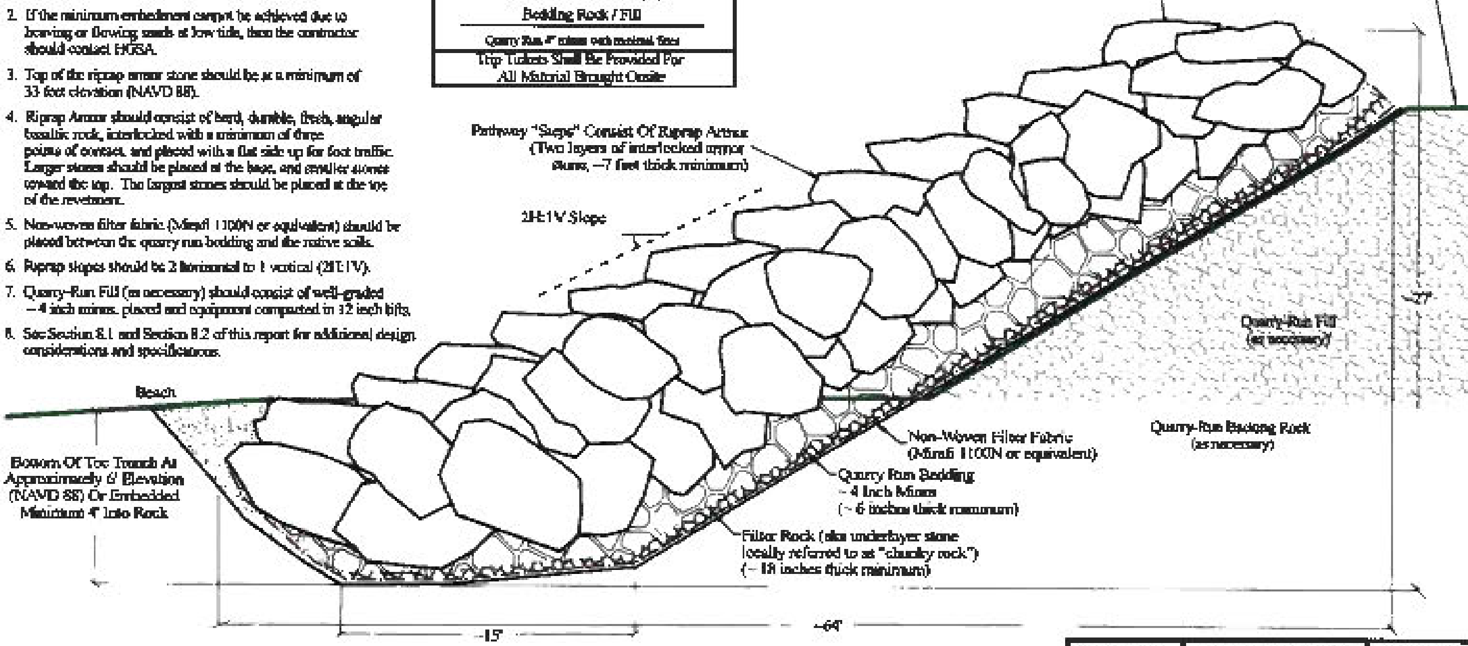
Revetment Detail
Salishan Leaseholder Properties
Siletz Spit, Lincoln County, Oregon

Figure 2

Pathway "steps" should be integrated into the riprap revetment following the same design considerations and requirements as for areas that do not have "steps" with the exception of covering with sand and vegetating.

1. Base of the riprap should be embedded at approximately 6 foot elevation (NAVD 88). The final revetment embedment depth should be as deep as "flowing/heaving" sand conditions at low tide allow. If bedrock is encountered in the excavation, the toe of the revetment should be embedded a minimum of 4 feet into bedrock.
2. If the minimum embedment cannot be achieved due to heaving or flowing sands at low tide, then the contractor should contact HGSA.
3. Top of the riprap armor stone should be at a minimum of 33 foot elevation (NAVD 88).
4. Riprap Armor should consist of hard, durable, fresh, angular basaltic rock, interlocked with a minimum of three points of contact, and placed with a flat side up for foot traffic. Larger stones should be placed at the base, and smaller stones toward the top. The largest stones should be placed at the toe of the revetment.
5. Non-woven filter fabric (Mirafi 1100N or equivalent) should be placed between the quarry run bedding and the native soils.
6. Riprap slopes should be 2 horizontal to 1 vertical (2H:1V).
7. Quarry-Run Fill (as necessary) should consist of well-graded ~4 inch minus, placed and equipment compacted in 12 inch lifts.
8. See Section 8.1 and Section 8.2 of this report for additional design considerations and specifications.

GRADATIONS Armor Stone		
Stone Size (ft)*	Stone Weight (tons)	% Smaller Than Or Equal To
4.7 to 8.0	27 to 45	100
5.9 to 6.5	18 to 25	80
4.7 to 5.3	9 to 14	50
2.1 to 2.7	1 to 2	10
* Long Dimension < 2.5 * Short Dimension		
Filter Rock (Underlayer Stone)		
ODOT Class 200 Standard Riprap		
Bedding Rock / Fill		
Quarry Run 4" minus with minimal fines		
Trip Tickets Shall Be Provided For All Material Brought Onsite		



= Existing grade of dune

= Non-Woven Filter Fabric (Mirafi 1100N or equivalent)

As built dimensions may vary depending on site conditions actually encountered.

Date: 12/20/2019	Project #Y174107	Prepared by: AML
Scale: 1" = 9'		Approved by: JDG

Revetment Pathway Detail
Salishan Leaseholder Properties
Siletz Spit, Lincoln County, Oregon

Figure 3

Appendix A
- Site Photographs -

Appendix A - I
- Site Photographs -

This Study

Photo 1 – Southerly view of Siletz Spit from Lincoln City.

Photo 2 – Southerly view of the vegetated foredune and beach fronting the houses at the northern end of the site.

Photo 3 – Northerly view of the gently sloping beach at the northern end of the site.

Photo 4 – Easterly view of the beach and vegetated foredune fronting the northernmost houses. Note the sand ramp and lack of well-defined erosion scarp along the beach-dune junction.

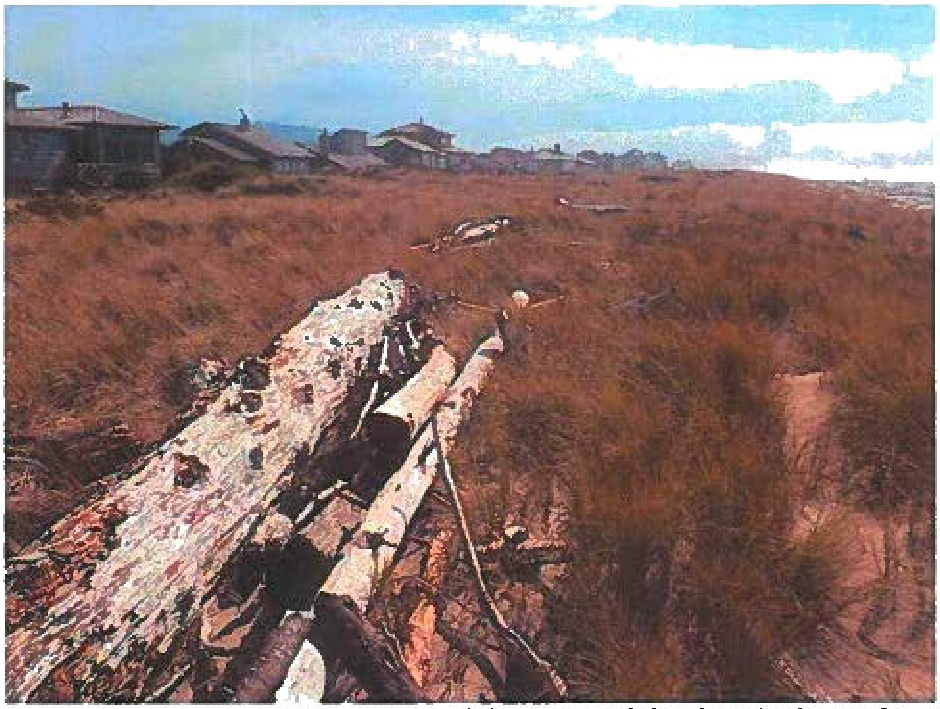


Photo 5 – View of drift logs on top of the vegetated foredune in the northern portion of the site.

Photo 6 – Southerly view of the beach-dune junction in the area of Tax Lot 103, Map 7-11-34CC. Well-defined erosion scarps were present along the beach-dune junction south of this area.

Photo 7 – Northerly view of the beach and beach-dune junction near Tax Lot 800, Map 08-11-03BB. Note the well-defined erosion scarp along the beach-dune junction.

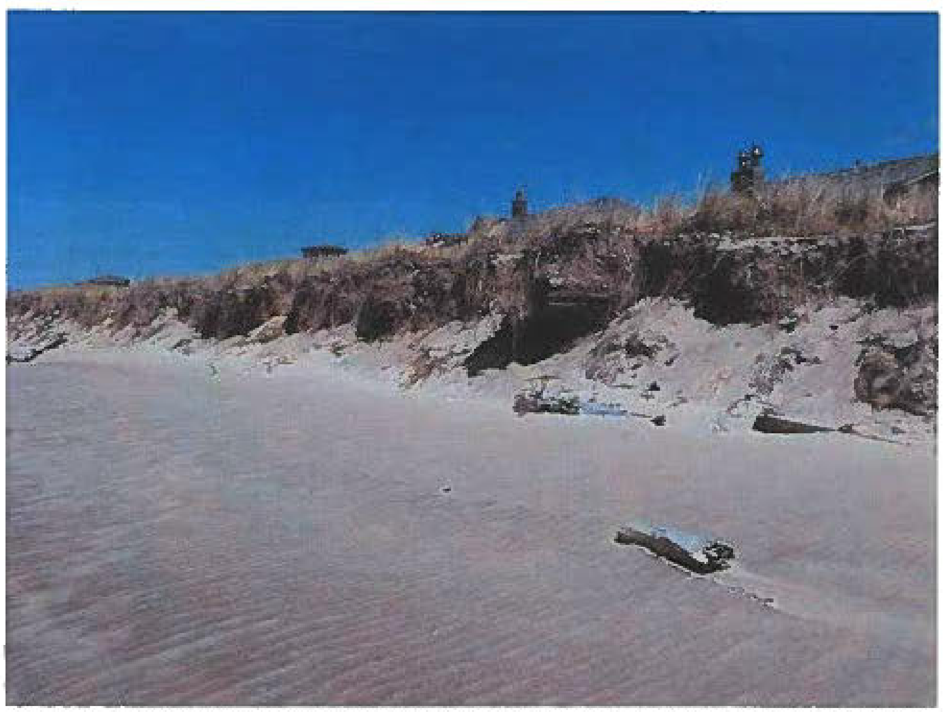


Photo 8 – View of the erosion scarp along the beach-dune junction near Tax Lot 900, Map 08-11-03BB. Note the buried drift logs having sawn ends exposed in the erosion scarp.

Photo 9 – Southerly view along the top of a recently built revetment fronting Tax Lot 1000, Map 08-11-03CB. Severe erosion during winter 2018/2019 necessitated emergency construction of this revetment to prevent further damage to the house. (Also see Appendix A-2)

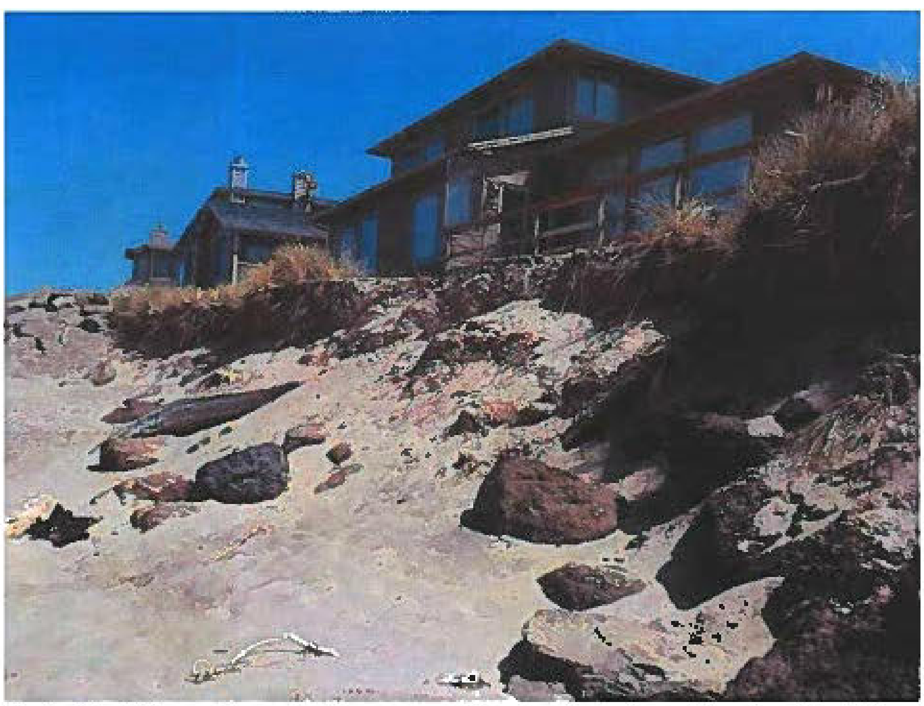


Photo 10 – View of the erosion scarp and damaged revetment fronting Tax Lot 900, Map 08-11-03CB. Note the inadequate size and poor quality of the armor stone of the damaged revetment. (Also see Appendix A-2)

Photo 11 – Close-up view of the inadequate armor stone exposed during the winter of 2018/2019.

Photo 12 – View of the revetments fronting the beach in the area of Tax Lot 700, Map 08-11-03CB where the rock quality improves. Reconstruction of revetments occurred between Tax Lot 700, Map 08-11-03CB and Tax lot 204, Map 08-11-03CC to the south after severe erosion along this stretch of beach in 2016. (Also see Appendix A-2)

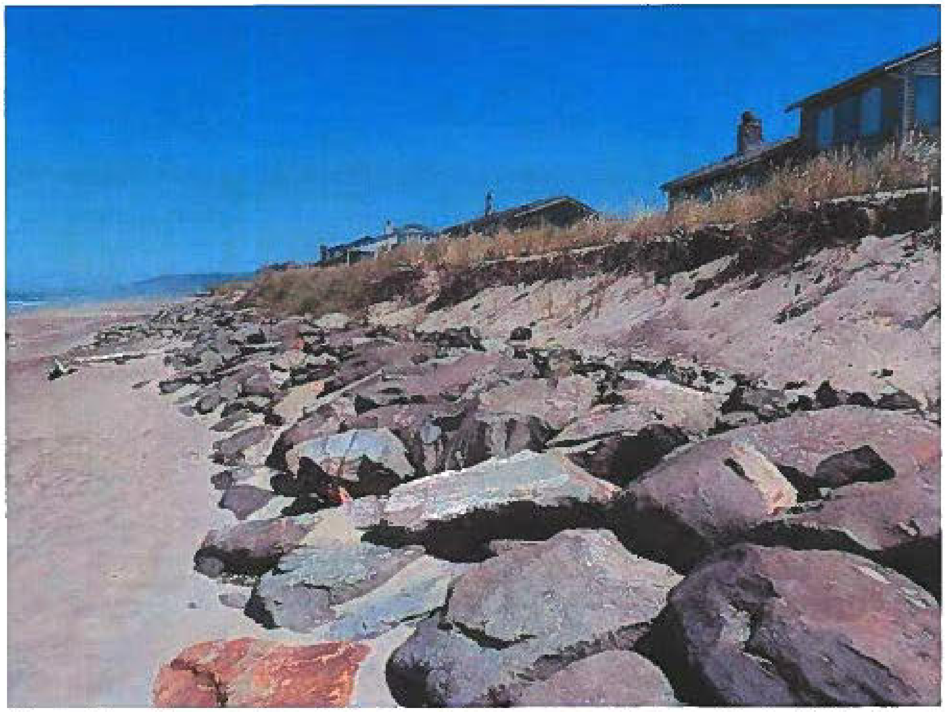


Photo 13 – Close-up view of the top of the revetment fronting Tax Lot 401, Map 08-11-03CB. Note the shallow revetment angle (~15°; ~3.5H:1V) and the erosion on the dune east of the revetment caused by overtopping of the revetment.

Photo 14 – View of drain pipe discharging to the riprap armor stone.

Photo 15 – View of damaged recently constructed revetment fronting Tax Lot 219, 08-11-03CC (Also see Appendix A-2).

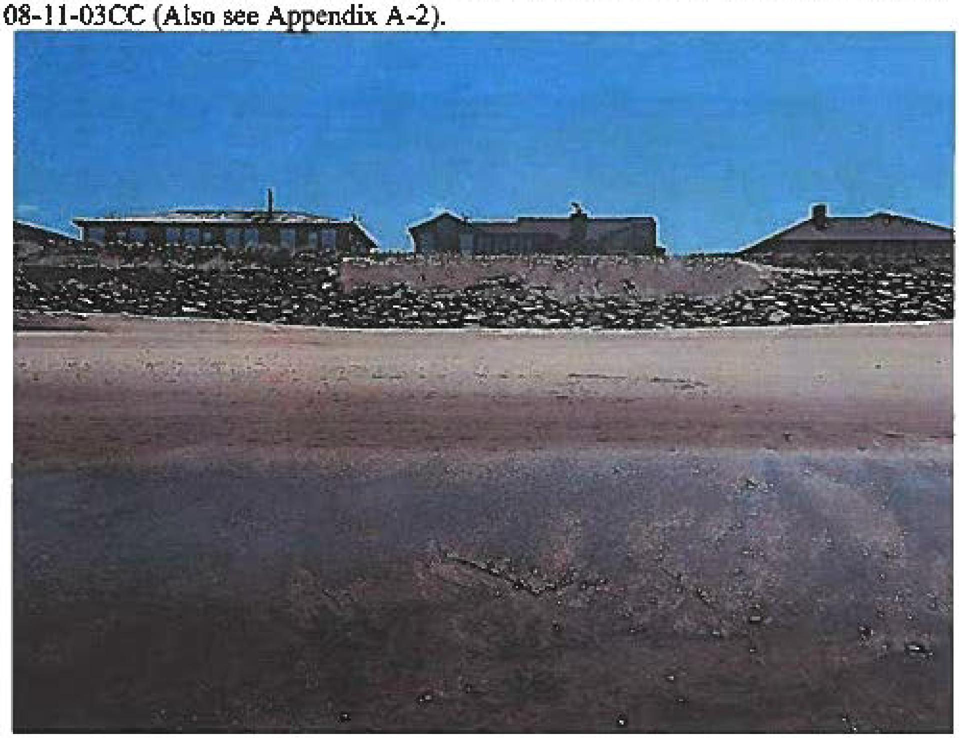


Photo 16 – View to the west of the revetments fronting Tax Lots 217 (right), 218 (center) and 219 (left), Map 08-11-03CC. The height of the revetment fronting Tax Lot 218 was recently raised to help mitigate overtopping (Also see Appendix A-2).

Photo 17 – Southeasterly view of the transition from competent high-quality rock at the southern extent of the recently constructed (2016) revetments to low-quality basalt breccia rock to the south.

Photo 18 – View of the loosely stacked basalt breccia armor stones used in construction of the original revetments.

Photo 19 – Northerly view of the foredune fronting the "park" (Tax Lot 235, Map 08-11-09AA, and Tax Lot 139, Map 08-11-09AD) which does not have a riprap revetment.

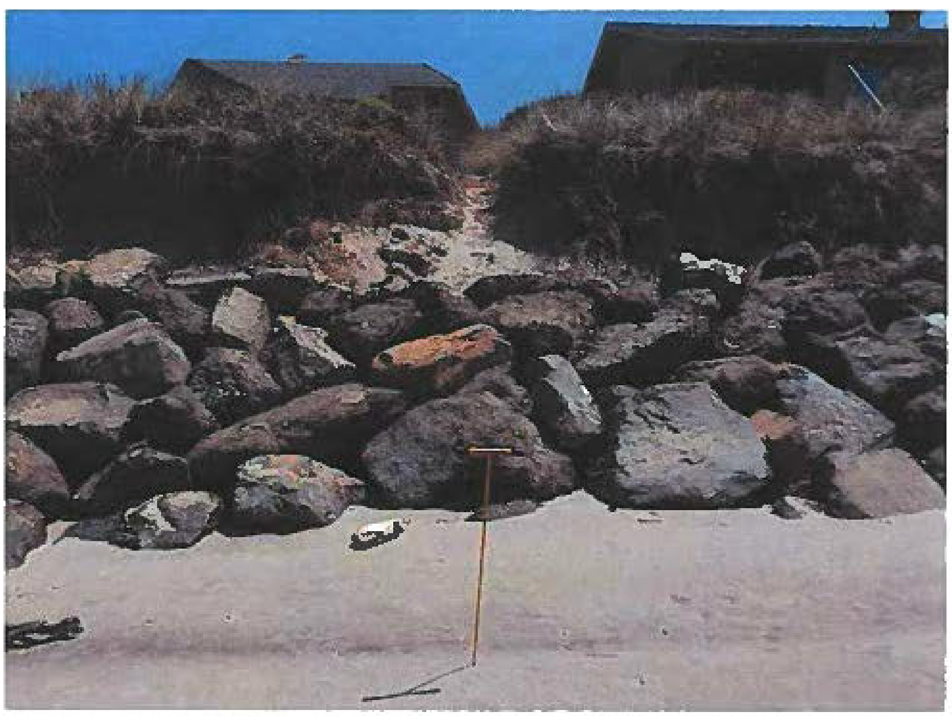


Photo 20 – View of a revetment where competent rock is mixed with poor-quality basaltic breccia.

Photo 21 – Close-up view of poor-quality basaltic breccia and pillow basalt armor stones. Note the fractures in the stones.

Photo 22 – View of the revetment near the southern extent of the site. Note the erosion above and behind the top of the revetment indicating previous overtopping of the revetment. (Photo taken 07/06/2018)

Photo 23 – Westerly view of the southern termination of the revetment (indicated with yellow arrow) along the northern property boundary of Tax Lot 156, Map 08-11-09DD. Note the erosion at the toe of the bluff immediately south of the termination of the revetment (indicated with red arrow). (Photo taken 05/31/2019)

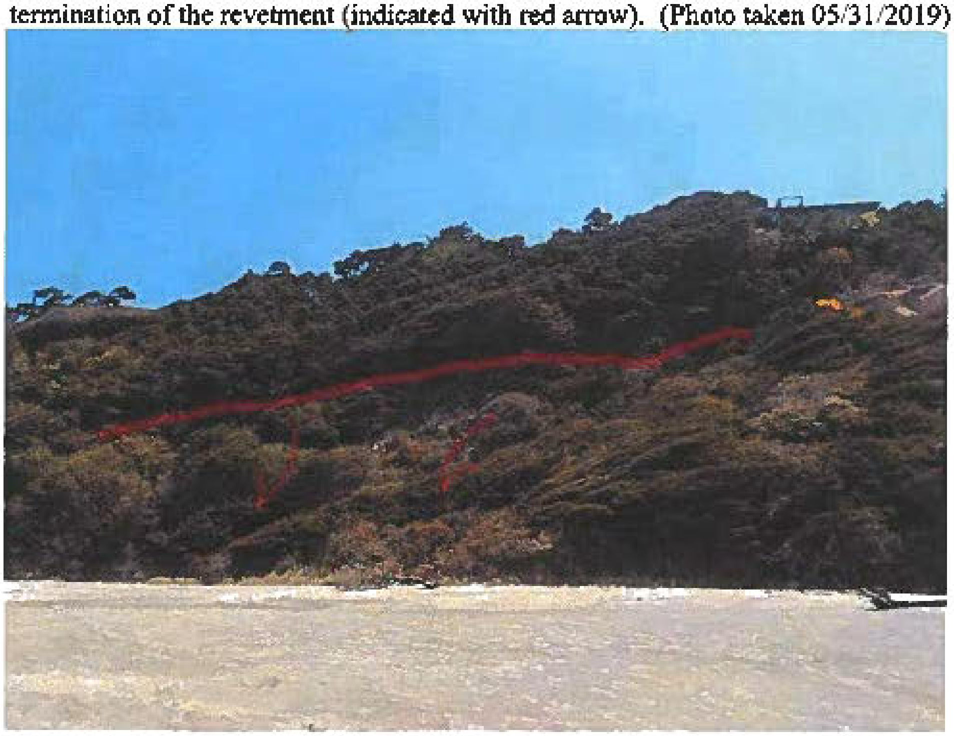


Photo 24 – View of the bluff slope on the western portion of Tax Lot 156, Map 08-11-09DD that has experienced shallow failures due to erosion of the toe of the bluff. Shallow landslide scarp indicated with red line; direction of movement indicated with red arrows.

Project #Y174107

Appendix A -2
- Site Photographs -

- Historical and Publicly Available Photographs -

28 December 1972

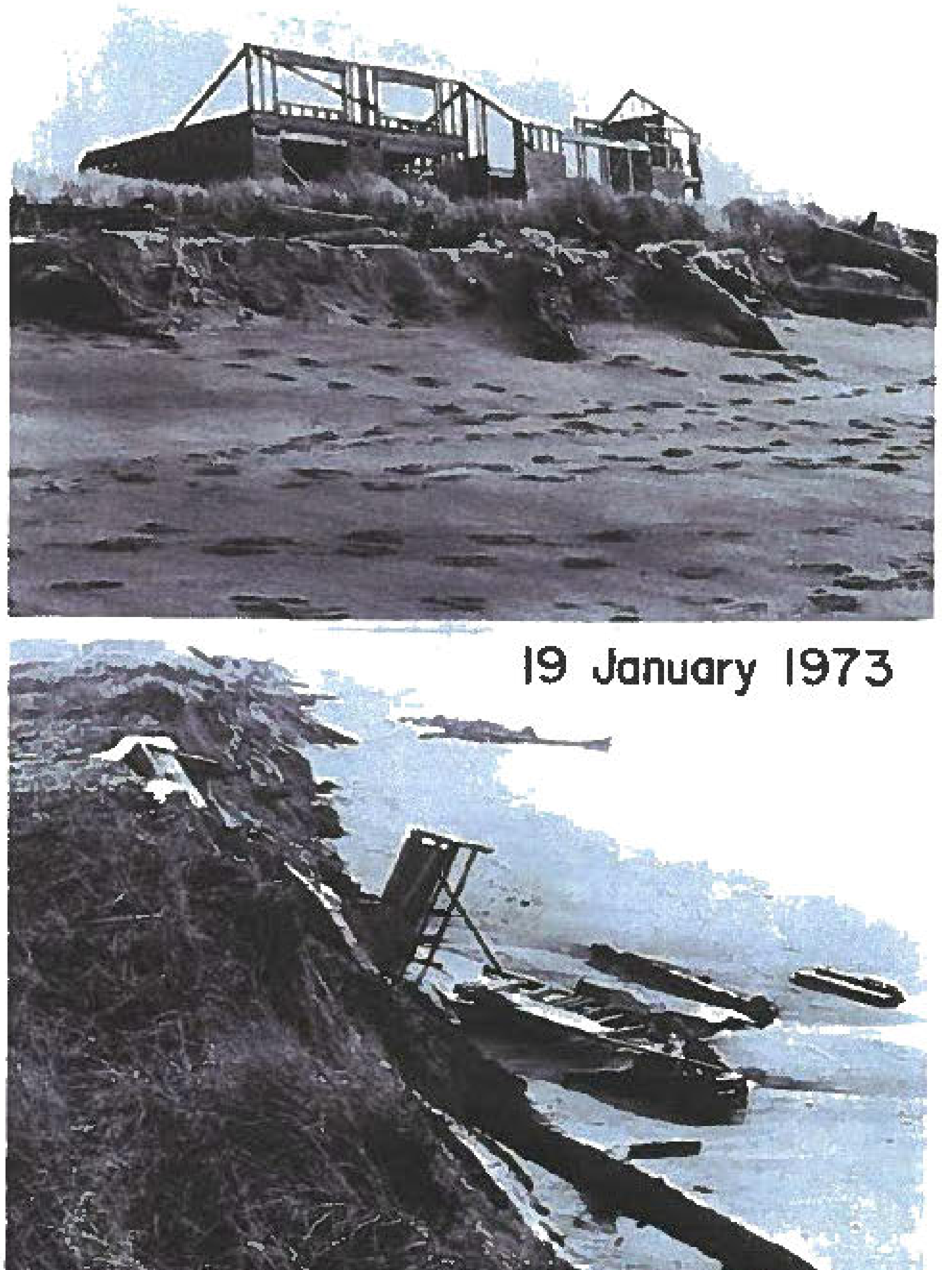


Figure 2. Erosion and destruction of the house under construction on lot 226 of Siletz Spit.

Photo 1 – From Komar and Rea (1976)

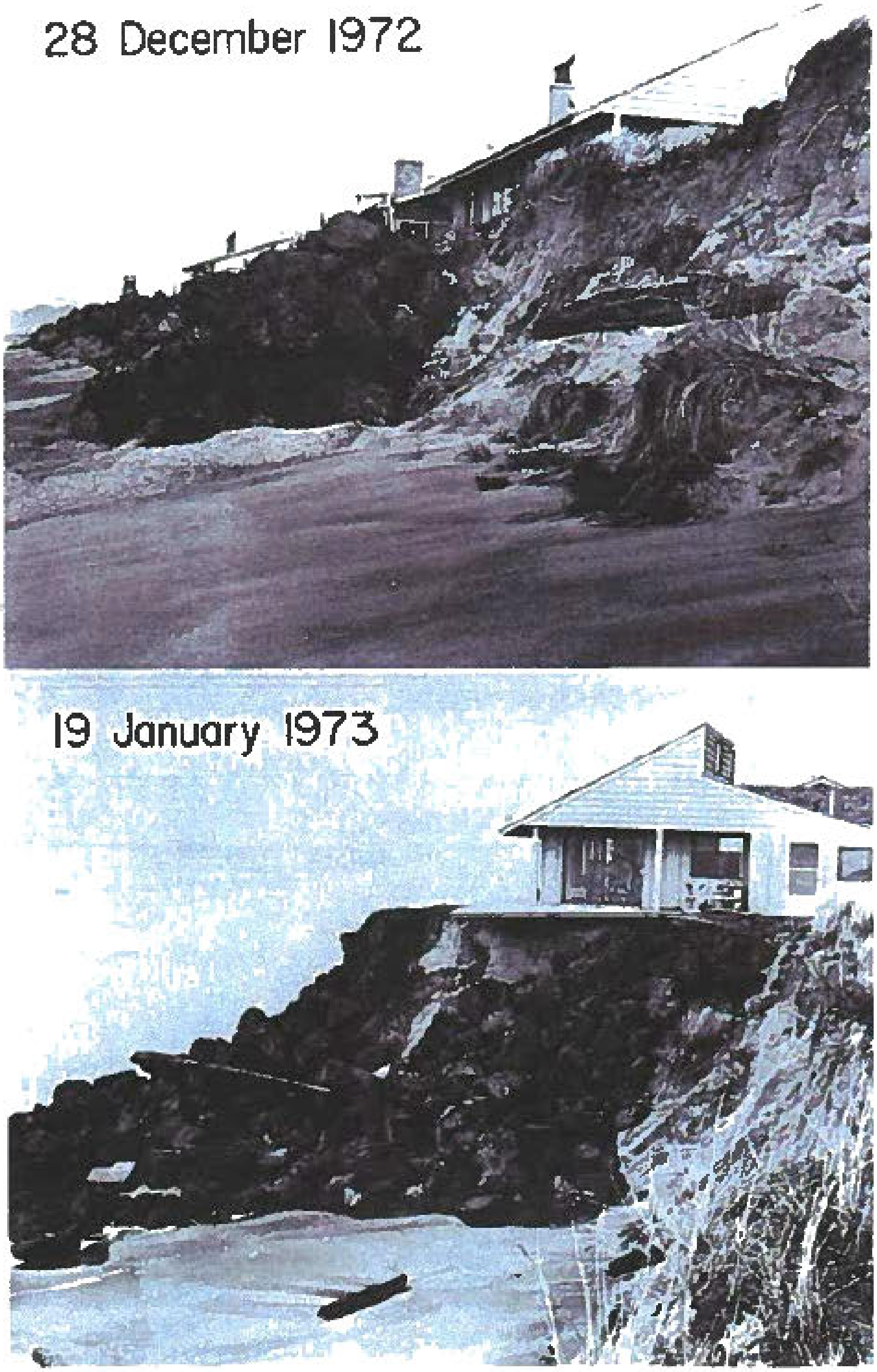


Figure 3. Erosion around the house on lot 229-A. Rapid erosion required placement of riprap fronting home in upper photo; but no riprap was installed in adjacent vacant lot, so erosion continued along the side as seen in lower photo.

Photo 2 - From Komar and Rea (1976)

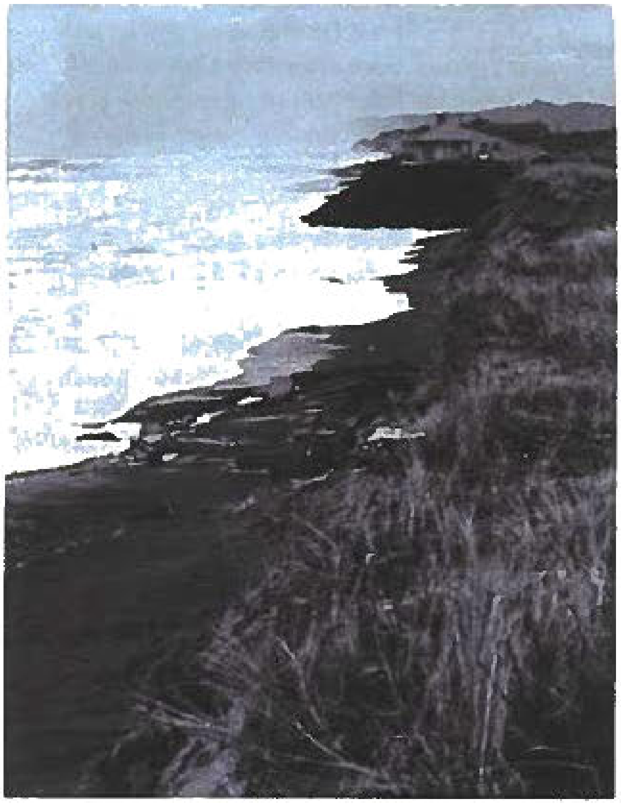


Figure 4. View of both houses of Figures 2 and 3.

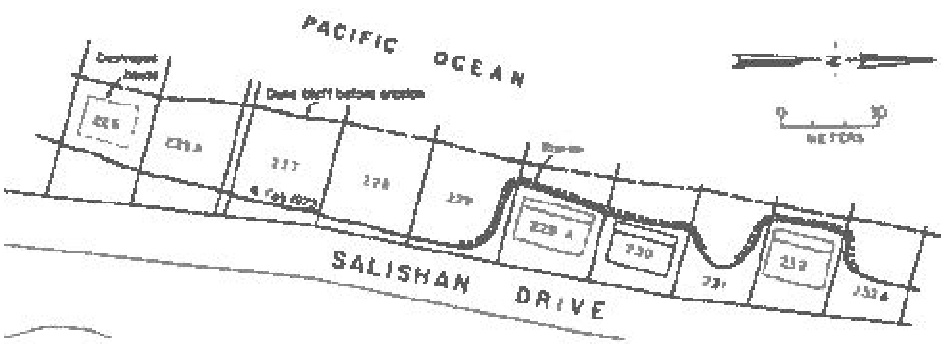


Photo 3 – From Komar and Rea (1976)

Photo 4 – From McKinney (1976)

Photo 5 – From McKinney (1976)

Photo 6 – March 2016 storm damage to riprap at Salishan affected 11 properties. Wave overtopping, inadequate design and poor construction contributed to the problem. From Sennewald (2018)

Photo 7 – Photo of emergency repairs underway to protect Tax Lot 219, Map 08-11-03CC. From Sennewald (2018)

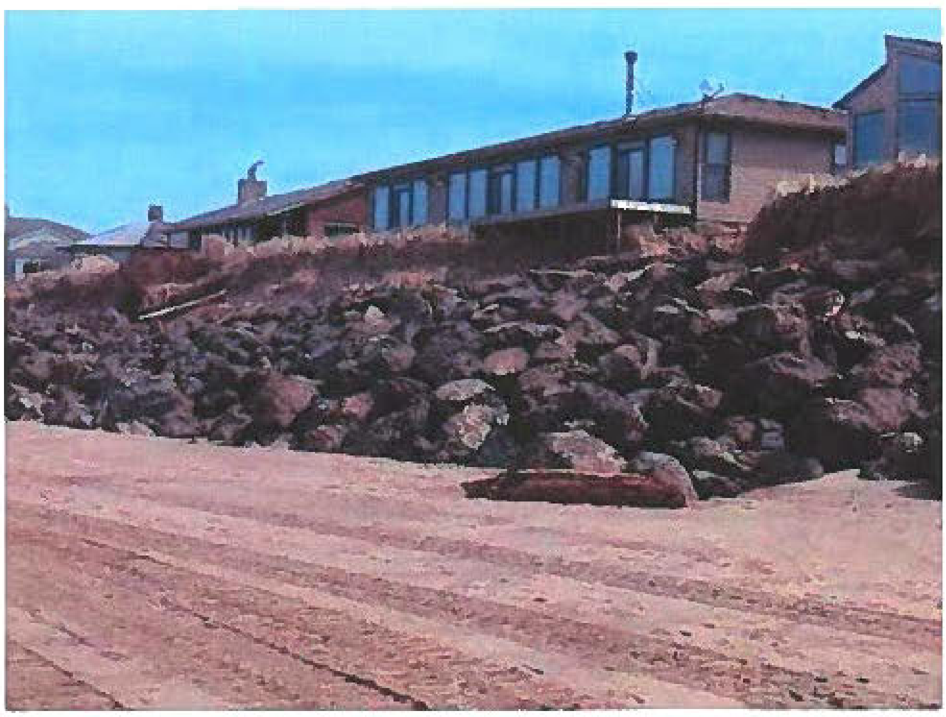


Photo 8 – Photograph taken 16 March, 2016, of emergency repairs completed at Tax Lot 219, Map 08-11-03CC. Provided to HGSA by a Salishan Leaseholder.

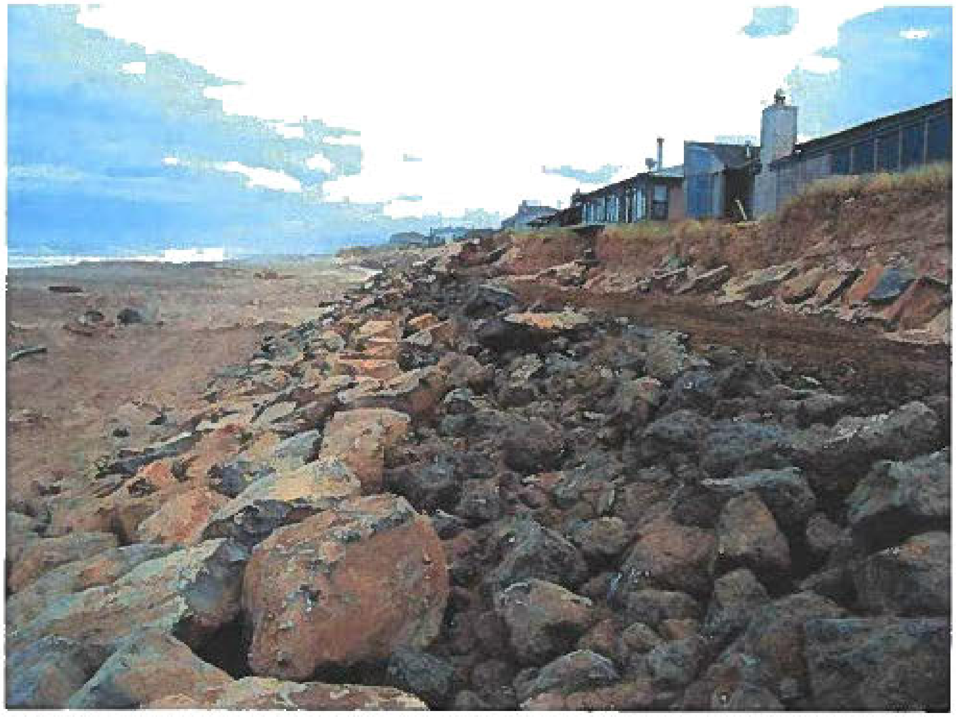


Photo 9 – Northerly view of the revetment fronting Tax Lot 218, Map 08-11-03CC during permitted repair work. Note the single layer of armor stone and lack of filter fabric backing the revetment. Photo taken by HGSA on 05/21/2016.

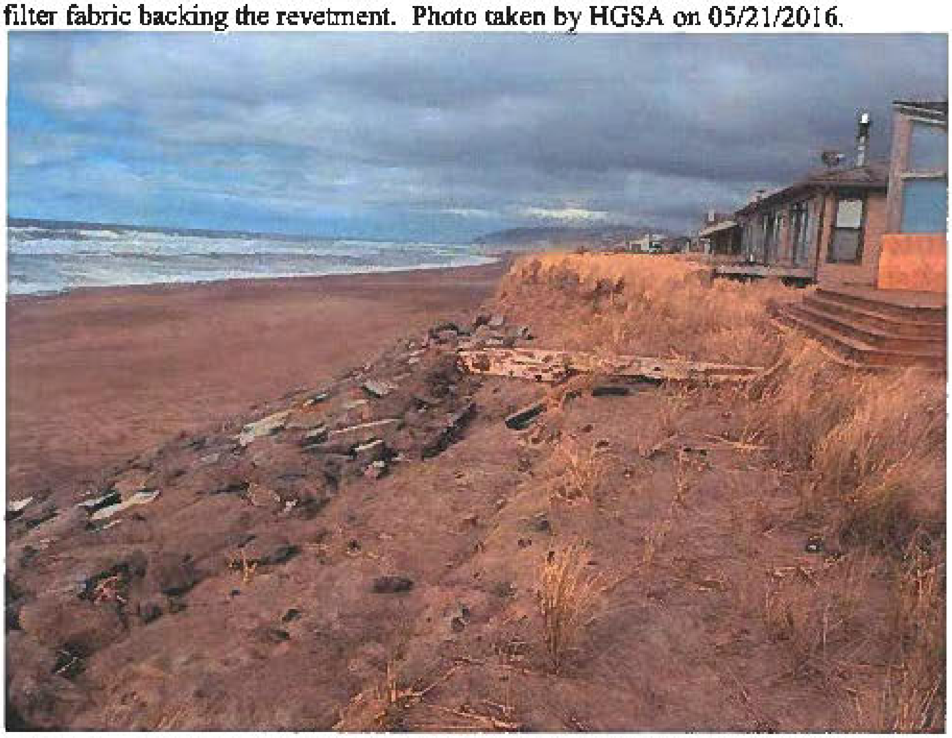


Photo 10 – Northerly view of the top of the revetment at Tax Lot 218, Map 08-11-03CC after the 2018/2019 winter when the revetment was overtopped. Note the erosion of the topping sand, the drift log on the top of the dune, and the plywood used to protect the windows. Photo taken by HGSA on 03/01/2019.

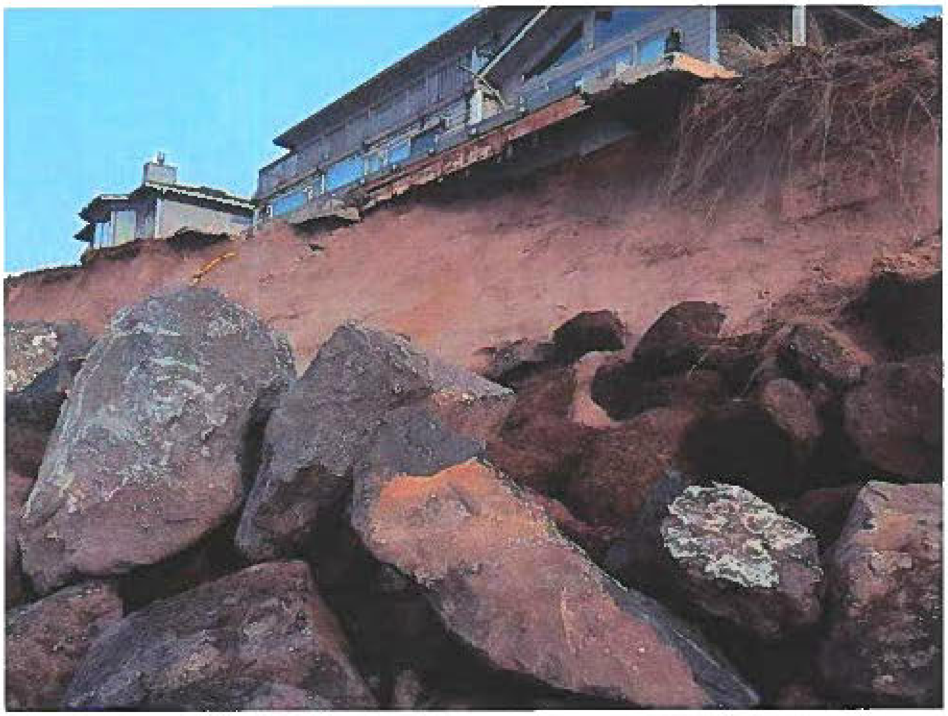


Photo 11 – View of the erosion that damaged the structure at Tax Lot 1000, Map 08-11-03CB, and riprap placed under an emergency permit. Photo taken on January 7, 2019 and submitted to oregonshores.org by user "ORbeach".

Photo 12 – View of wave splash overtopping the revetment fronting Tax Lot 701, Map 08-11-03CB, and landing on the roof of the house. Photo extracted from video provided by Jay Sennewald.

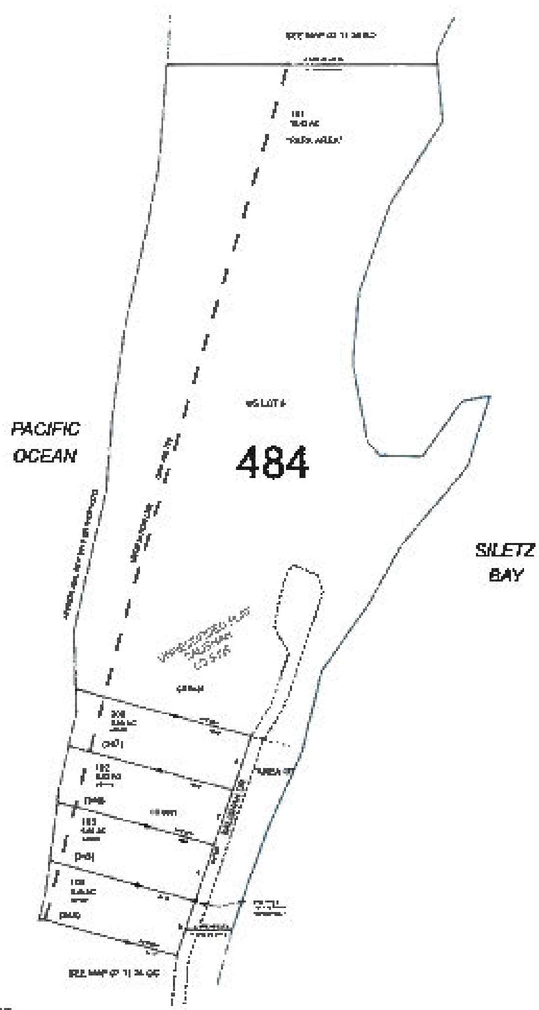
Project #Y174107

Appendix B
- Lincoln County Assessor's Plat Maps -

THIS MAP WAS PREPARED FOR ASSESSMENT PURPOSE ONLY

N.W.1/4 S.W.1/4 SEC.34 T.7S. R.11W. W.M.

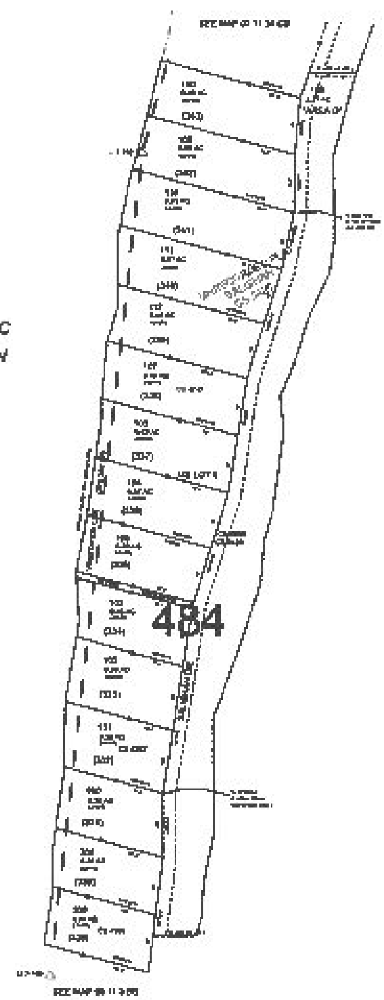
LINCOLN COUNTY



THIS MAP WAS PREPARED FOR ASSESSMENT PURPOSE ONLY

S.W.1/4 S.W.1/4 SEC.34 T.7S. R.11W. W.M.
LINCOLN COUNTY

07 11 34 CC

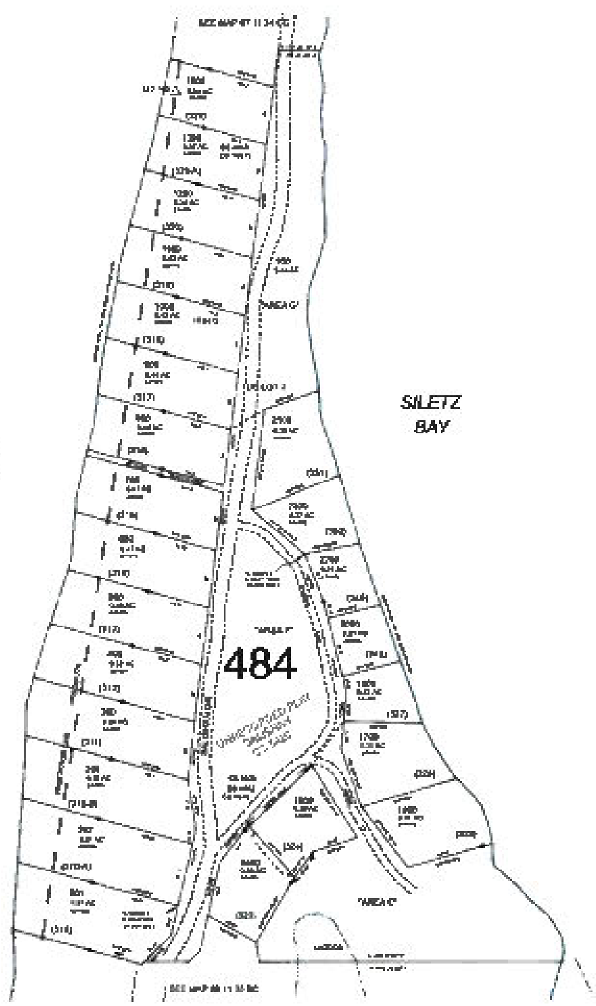


07 11 34 CC

THIS MAP WAS PREPARED FOR
ASSESSMENT PURPOSE ONLY

N.W.1/4 N.W.1/4 SEC.3 T.8S. R.11W. W.M.
LINCOLN COUNTY

08 11 03 BB

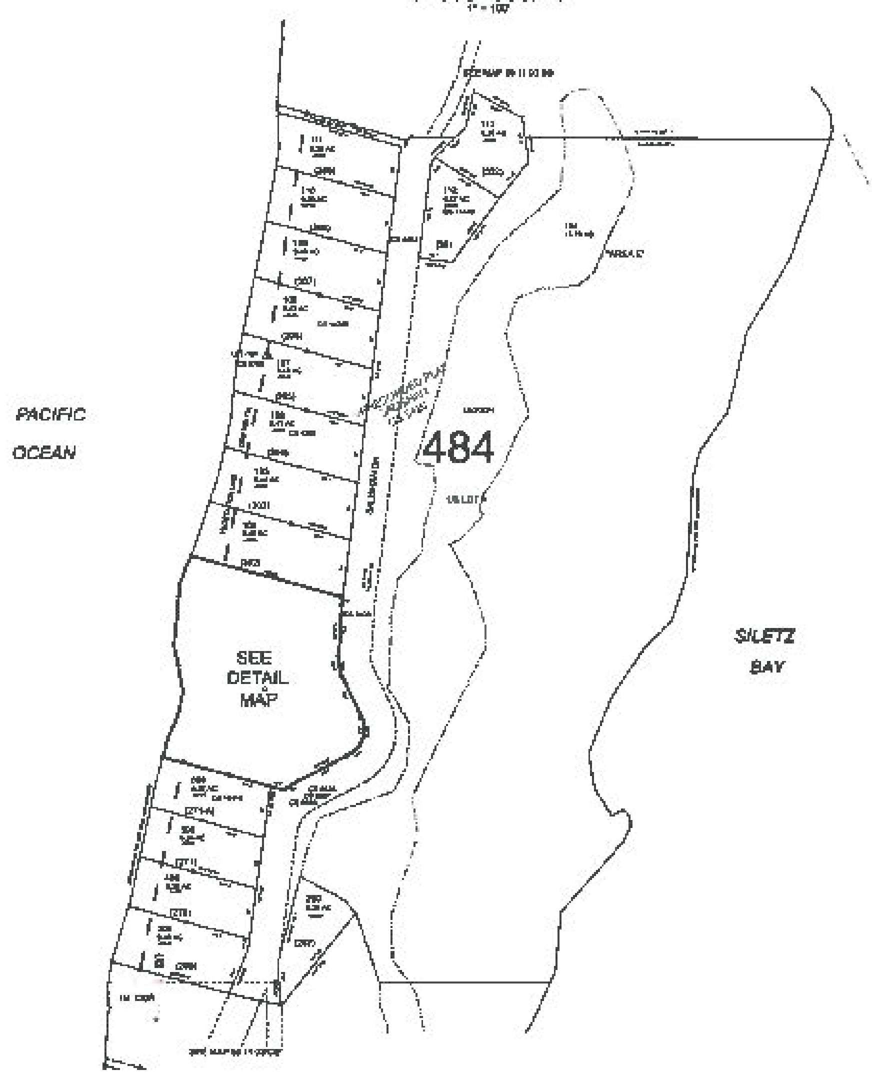


08 11 03 BB

THIS MAP WAS PREPARED FOR ASSESSMENT PURPOSE ONLY

S.W.1/4 N.W.1/4 SEC.3 T.8S. R.11W. W.M.
LINCOLN COUNTY

08 11 03 BC



08 11 03 BC

THIS MAP WAS PREPARED FOR ASSESSMENT PURPOSE ONLY

DETAIL MAP NO. 1
S.W.1/4 N.W.1/4 SEC.3 T.8S. R.11W. W.M.
LINCOLN COUNTY

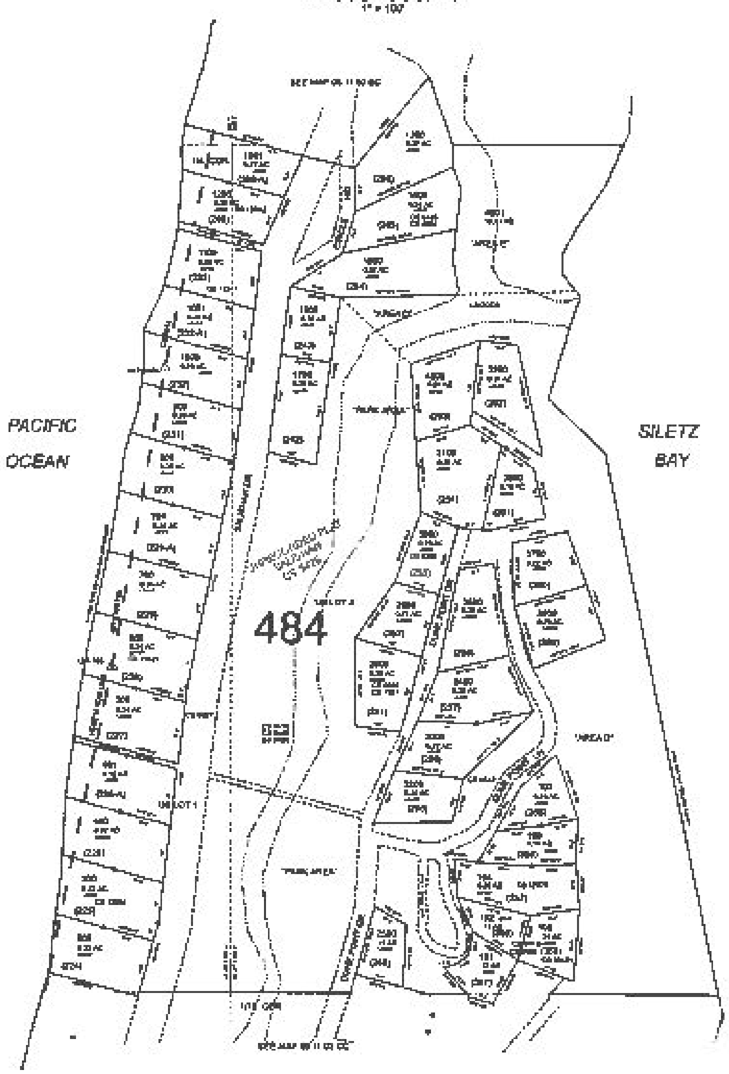
08 11 03 BC
DETAIL MAP NO 1

DETAIL MAP NO 1
08 11 03 BC

THIS MAP WAS PREPARED FOR ASSESSMENT PURPOSE ONLY

N.W.1/4 S.W.1/4 SEC.3 T.8S. R.11W. W.M.
LINCOLN COUNTY

08 11 03 CB

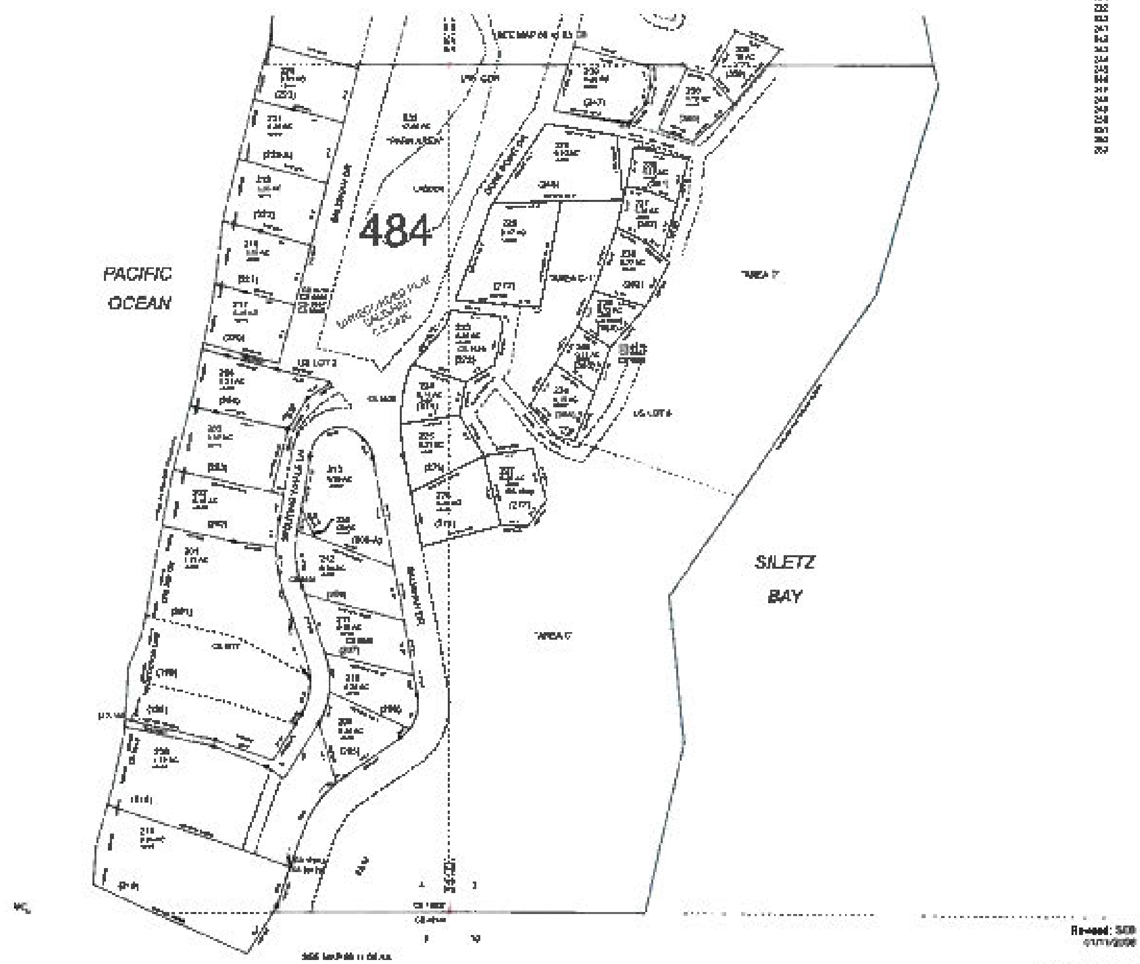


08 11 03 CB

THIS MAP WAS PREPARED FOR ASSESSMENT PURPOSE ONLY

S.W.1/4 S.W.1/4 SEC.3 T.8S. R.11W. W.M
LINCOLN COUNTY

08 11 03 CC



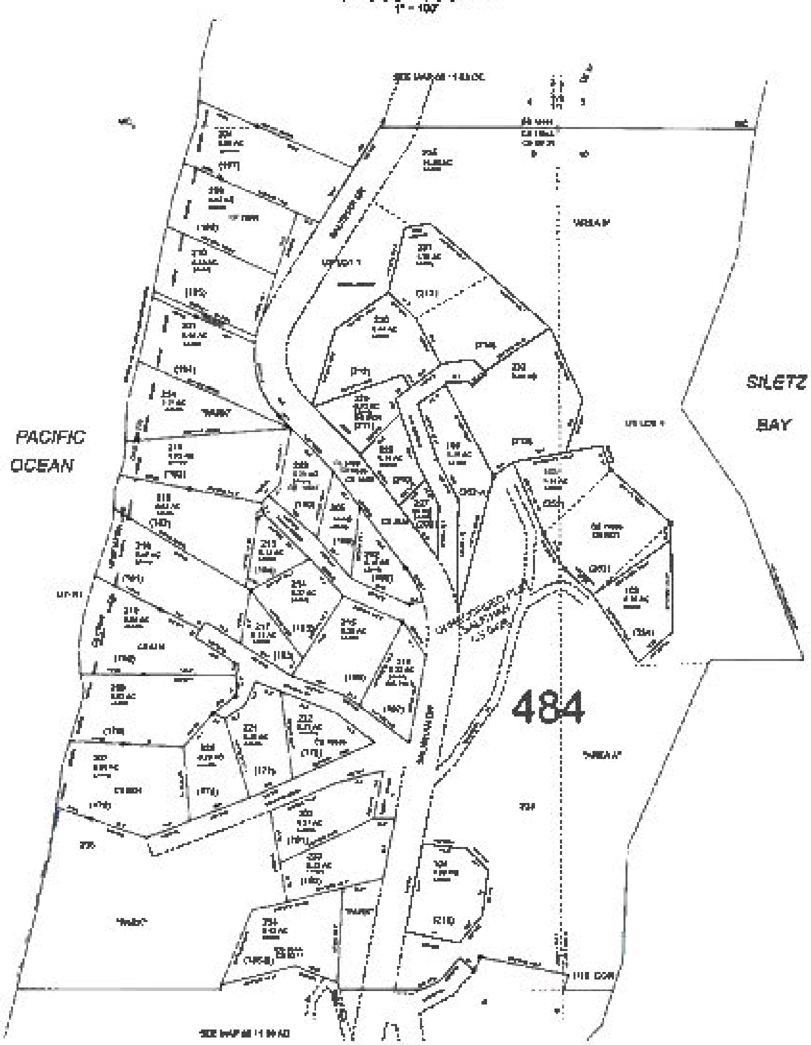
08 11 03 CC

THIS MAP WAS PREPARED FOR ASSESSMENT PURPOSE ONLY

N.E.1/4 N.E.1/4 SEC.9 T.8S. R.11W. W.M.
LINCOLN COUNTY
1" = 100'

08 11 09 AA

Cancelled
[illegible]



Revised: BEB
[illegible]

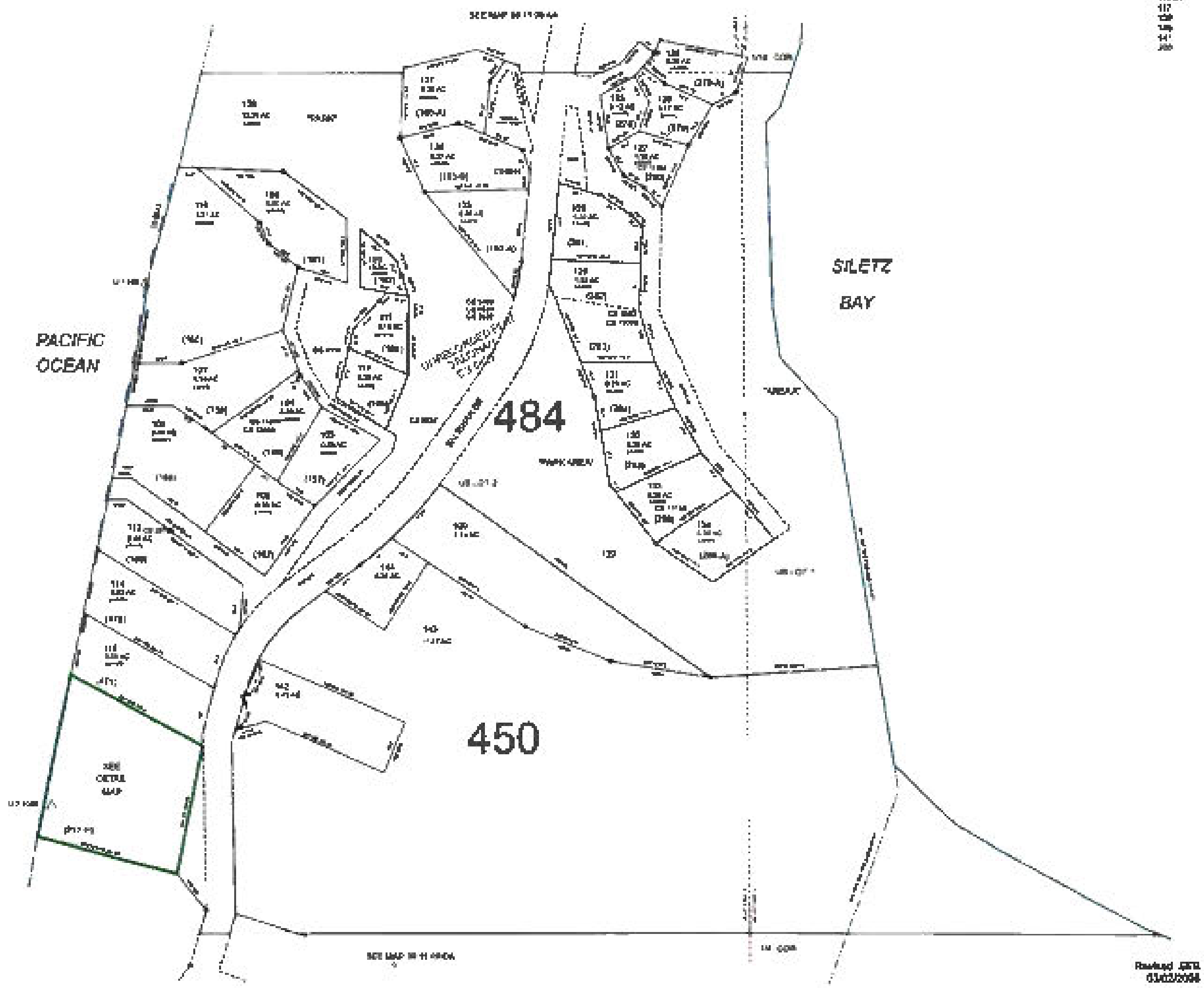
08 11 09 AA

THIS MAP WAS PREPARED FOR ASSESSMENT PURPOSE ONLY

S.E.1/4 N.E.1/4 SEC.9 T.6S. R.11W. W.M.
LINCOLN COUNTY

1" = 100'

08 11 09 AD

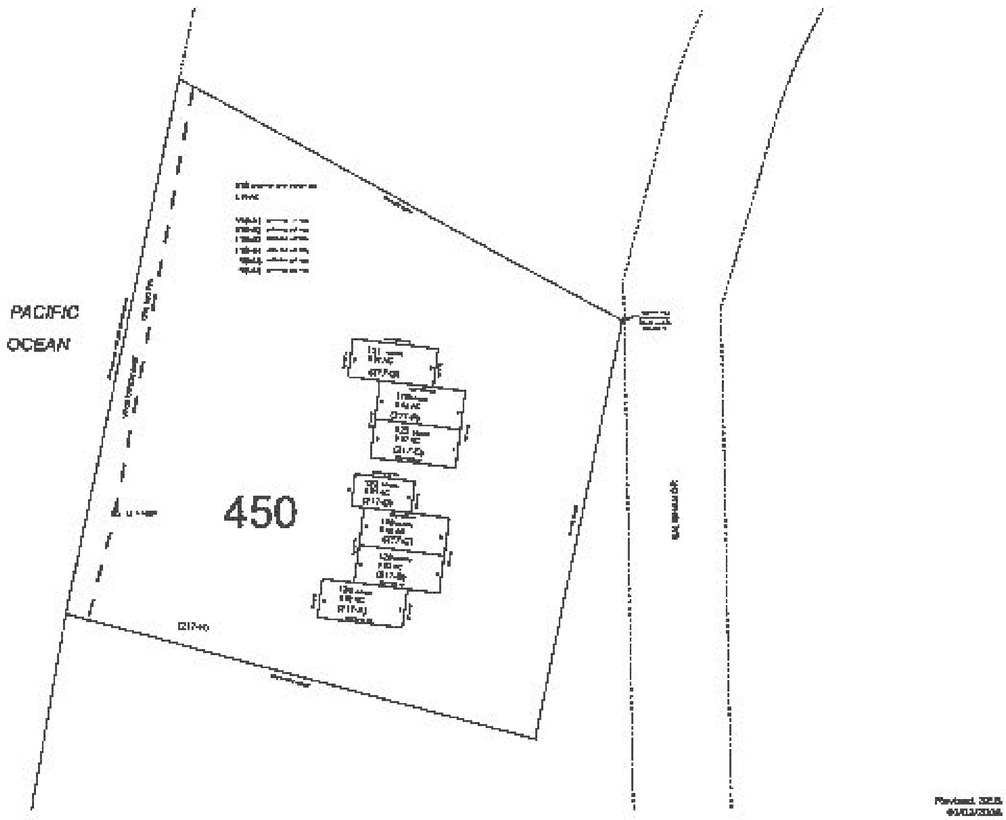


08 11 09 AD

THIS MAP WAS PREPARED FOR ASSESSMENT PURPOSE ONLY

DETAIL MAP NO. 1
S.E.1/4 N.E.1/4 SEC.9 T.6S. R.11W. W.M.
LINCOLN COUNTY
1" = 50'

08 11 09 AD
DETAIL MAP NO 1



DETAIL MAP NO 1
08 11 09 AD

THIS MAP WAS PREPARED FOR
ASSESSMENT PURPOSE ONLY

N.E.1/4 S.E.1/4 SEC.9 T.8S. R.11W. W.M.
LINCOLN COUNTY

08 11 09 DA

08 11 09 DA

THIS MAP WAS PREPARED FOR ASSESSMENT PURPOSE ONLY

S.E.1/4 S.E.1/4 SEC.9 T.8S. R.11W. W.M.
LINCOLN COUNTY
1" = 100'

Appendix C
- Site Maps -

Date: 12/20/2019	Project #Y174107	Prepared by: AML
Scale: 1" = 100'		Approved by: JDD

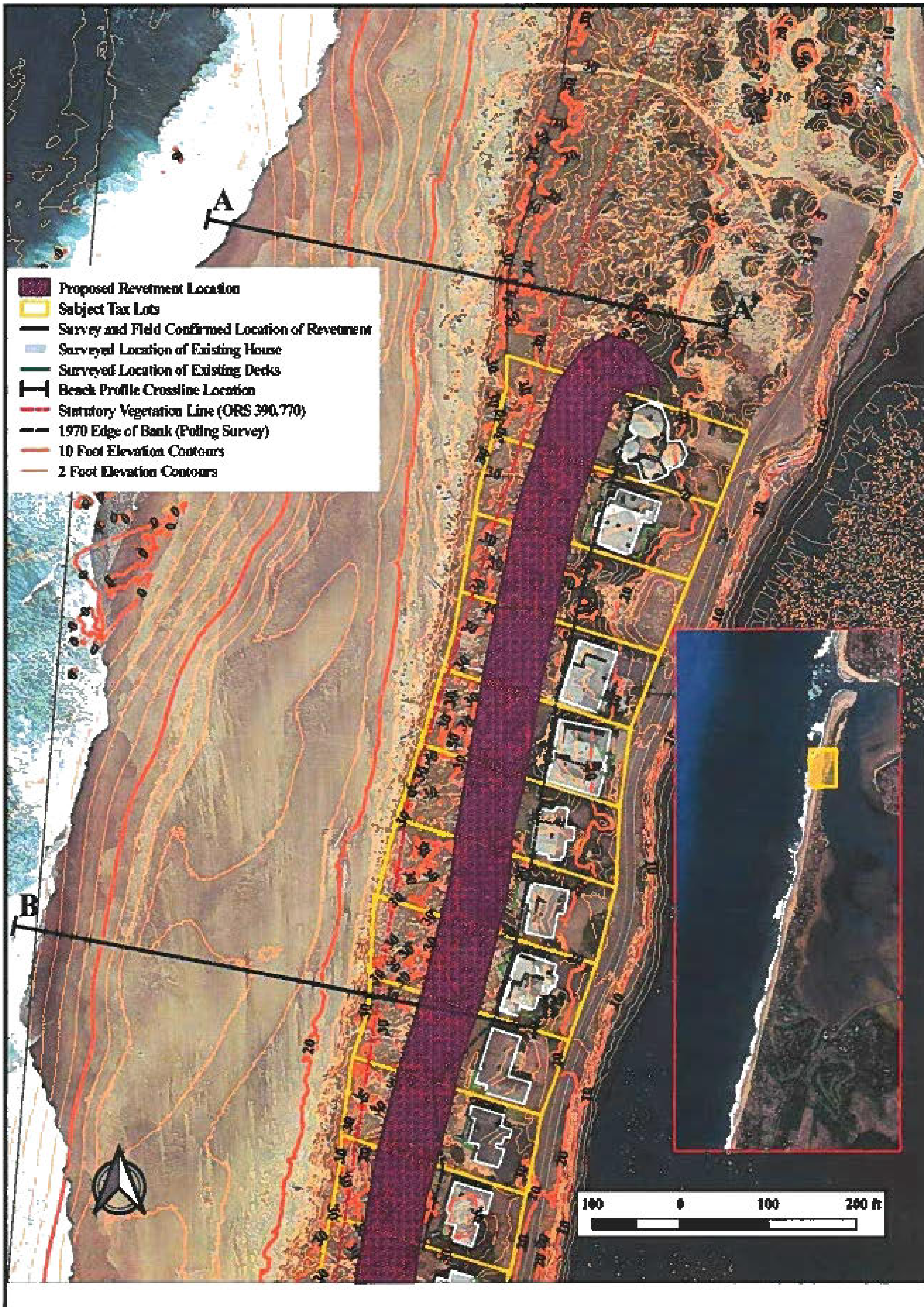
Site Map - Overview

Tax Lot 200, Map 07-11-34CB (north) to Tax Lot 105, Map 07-11-34CC (south)

H.G. Schlicker & Associates, Inc.

All locations and dimensions are approximate.

2016 satellite imagery from Google.



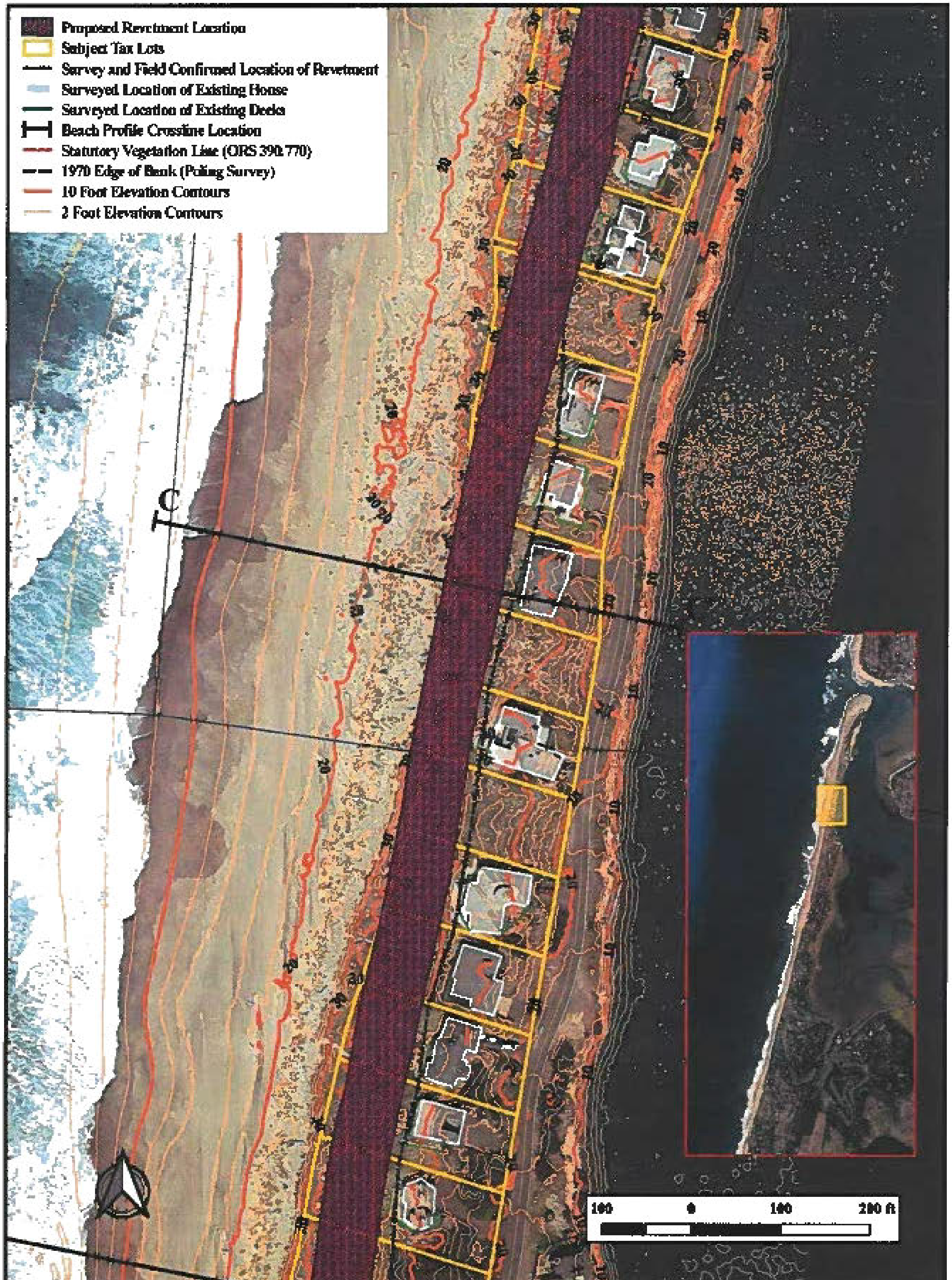
Date: 12/20/2019	**Project #Y174107**	Prepared by: AML
Scale: 1" = 100'		Approved by: JDG

Site Map - Area 1

Tax Lot 200, Map 07-11-34CB (north) to Tax Lot 105, Map 07-11-34CC (south)

H.G. Schlicker & Associates, Inc.

All locations and dimensions are approximate.
Topographic lines derived from 2016 USGS West Coast El-Nino Lidar (WA, OR, CA) provided by NOAA.
Elevation Datum is NAVD 88.
2016 satellite imagery from Google.



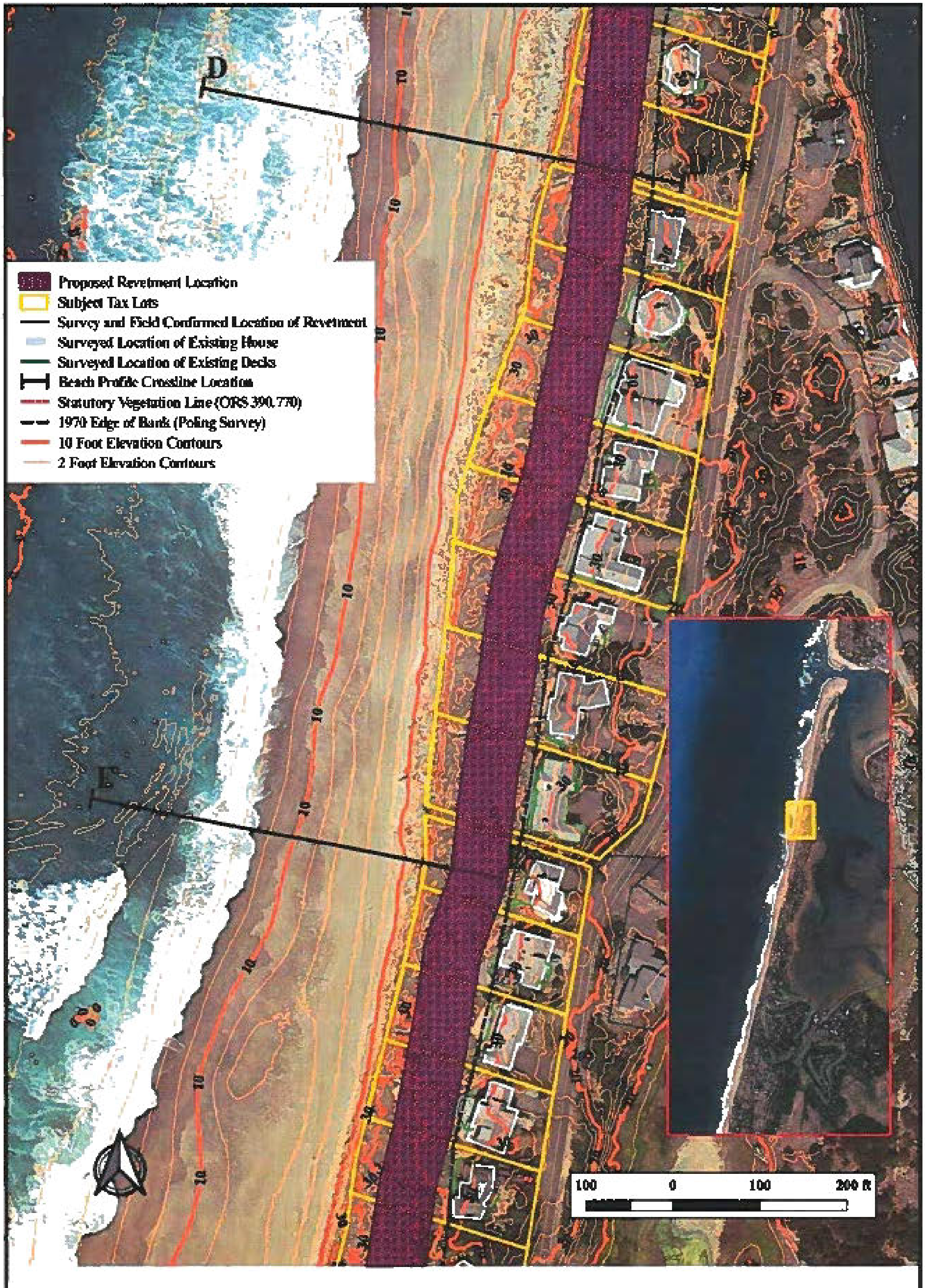
Date: 12/20/2019	Project #V174107	Prepared by: AML
Scale: 1" = 80'		Approved by: JDG

Site Map - Area 2

Tax Lot 804, Map 07-11-34CC (north) to Tax Lot 900, Map 08-11-03BB (south)

H.G. Schlicker & Associates, Inc.

All locations and dimensions are approximate.
Topographic lines derived from 2016 USGS West Coast El-Nino Lidar (WA, OR, CA) provided by NOAA.
Elevation Datum is NAVD 88.
2016 satellite imagery from Google.

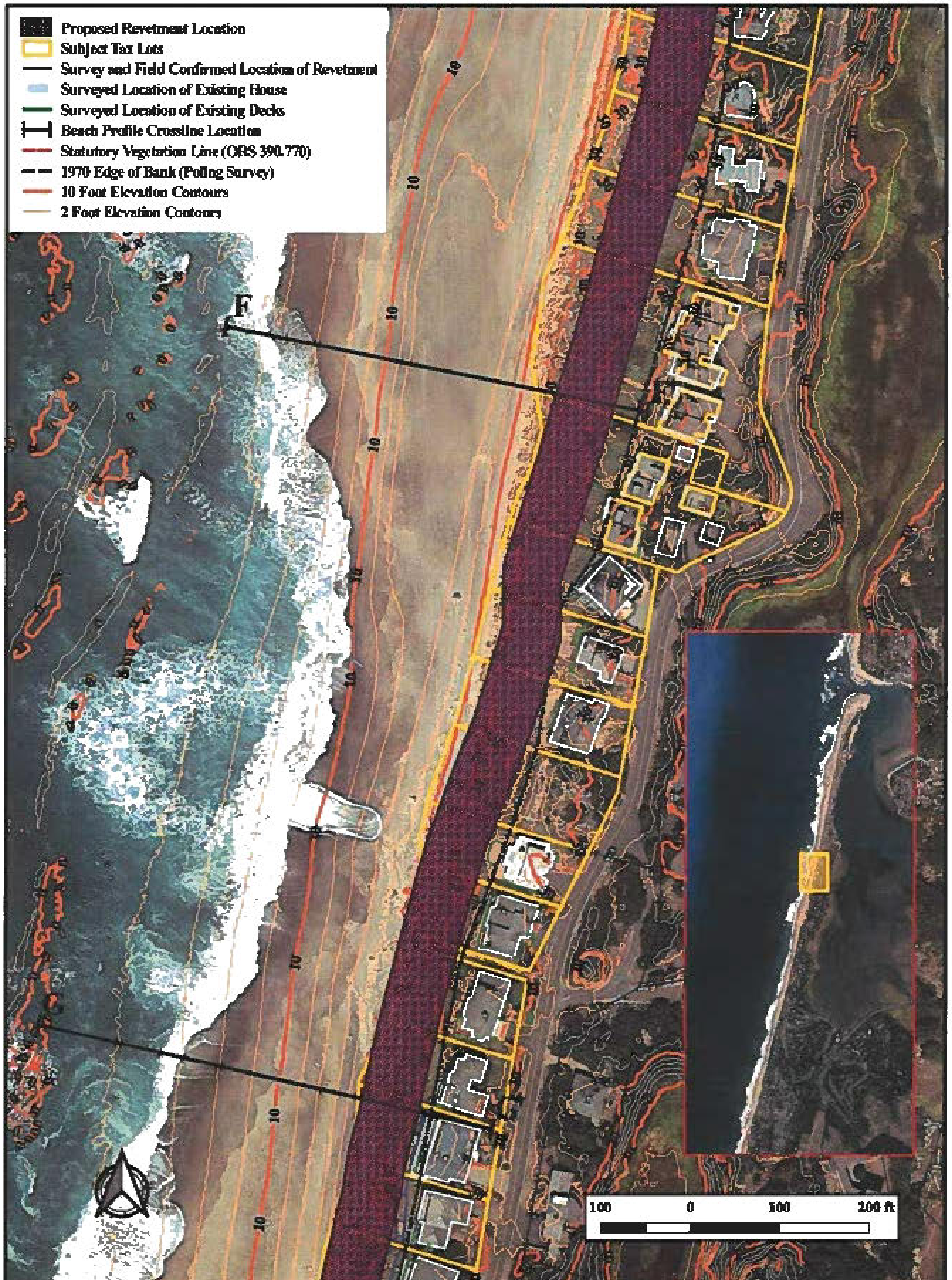


All locations and dimensions are approximate.
Topographic lines derived from 2016 USGS West Coast El-Nino Lidar (WA, OR, CA) provided by NOAA.
Elevation Datum is NAVD 88.
2016 satellite imagery from Google.

Date: 12/20/2019	**Project #Y174107**	Prepared by: AML
Scale: 1" = 100'		Approved by: JDG

Site Map - Area 3
Tax Lot 800, Map 08-11-03BD (north) to Tax Lot 107, Map 08-11-03BC (south)

H.G. Schlicker & Associates, Inc.



Date: 12/20/2019	Project #Y174107	Prepared by: AML
Scale: 1" = 100'		Approved by: JDG

Site Map - Area 4
Tax Lot 106, Map 08-11-03BC (north) to Tax Lot 900, Map 08-11-08CB (south)

H.G. Schlicker & Associates, Inc.

All locations and dimensions are approximate.
Topographic lines derived from 2016 USGS West Coast El-Nino Lidar (WA, OR, CA) provided by NOAA.
Elevation Datum is NAVD 88.
2016 satellite imagery from Google.

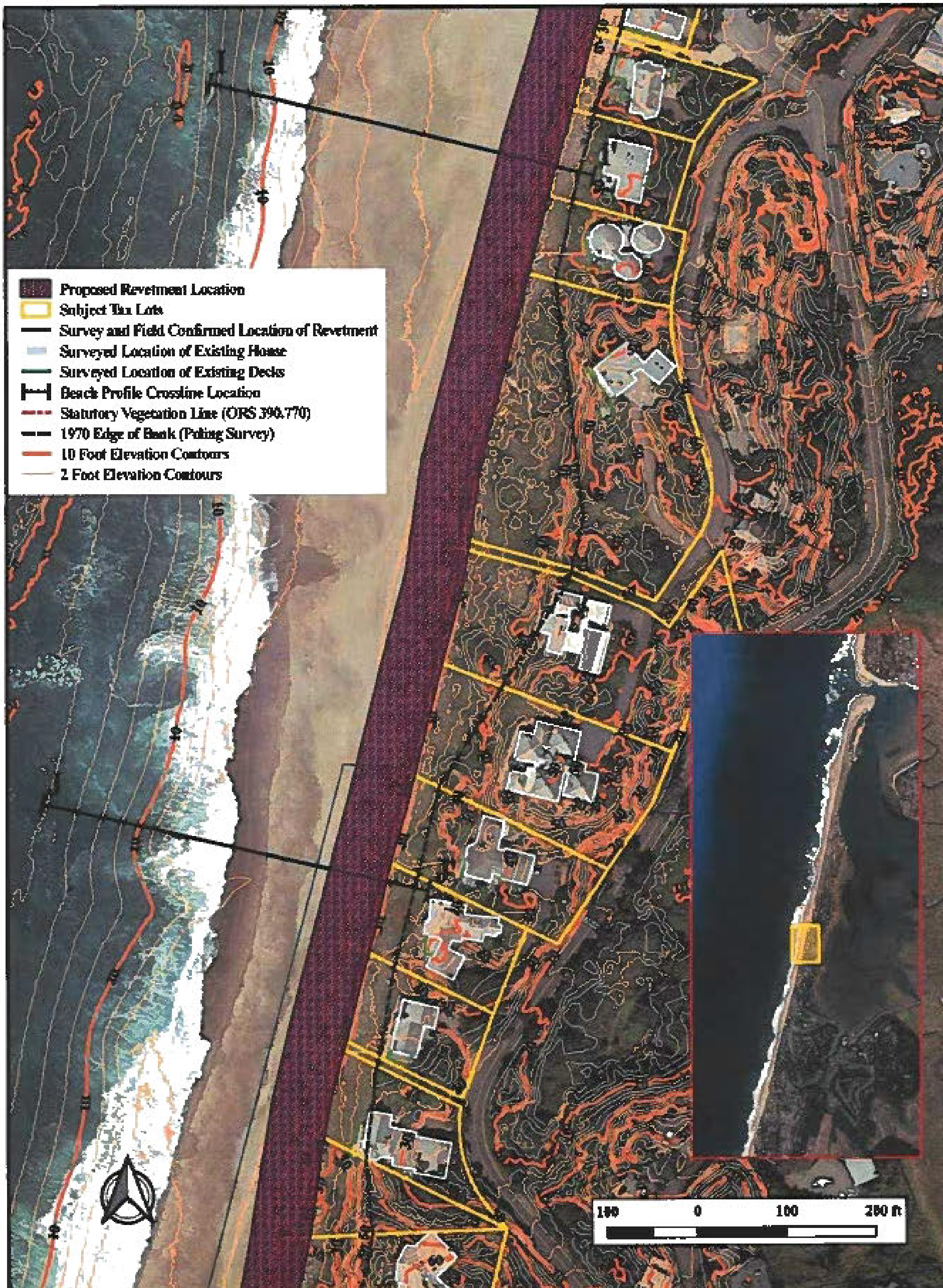
Date: 12/20/2019	Project #Y174107	Prepared by: AML
Scale: 1" = 100'		Approved by: JDG

Site Map - Area 5

Tax Lot 800, Map 08-11-03CH (north) to Tax Lot 217, Map 08-11-03CC (south)

H.G. Schlicker & Associates, Inc

All locations and dimensions are approximate.
Topographic lines derived from 2016 USGS West Coast El-Nino Lidar (WA, OR, CA) provided by NOAA.
Elevation Datum is NAVD 88.
2016 satellite imagery from Google.

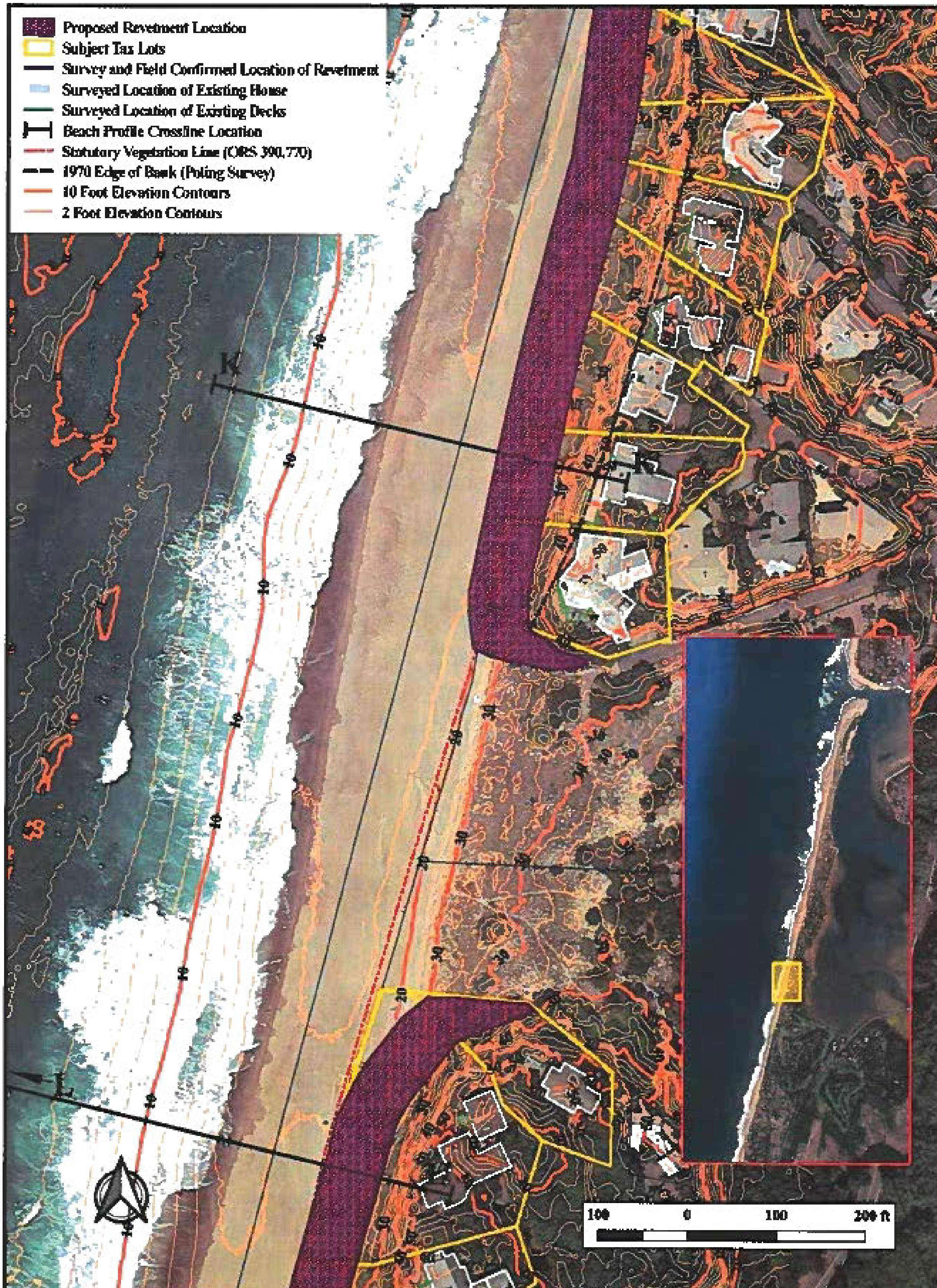


Date: 12/20/2019	**Project #Y174107**	Prepared by: AML
Scale: 1" = 100'		Approved by: JDG

Site Map - Area 6
Tax Lot 204, Map 08-11-03CC (north) to Tax Lot 224, Map 08-11-09AA (south)

H.G. Schlicker & Associates, Inc.

All locations and dimensions are approximate.
Topographic lines derived from 2016 USGS West Coast El-Nino Lidar (WA, OR, CA) provided by NOAA.
Elevation Datum is NAVD 88.
2016 satellite imagery from Google.



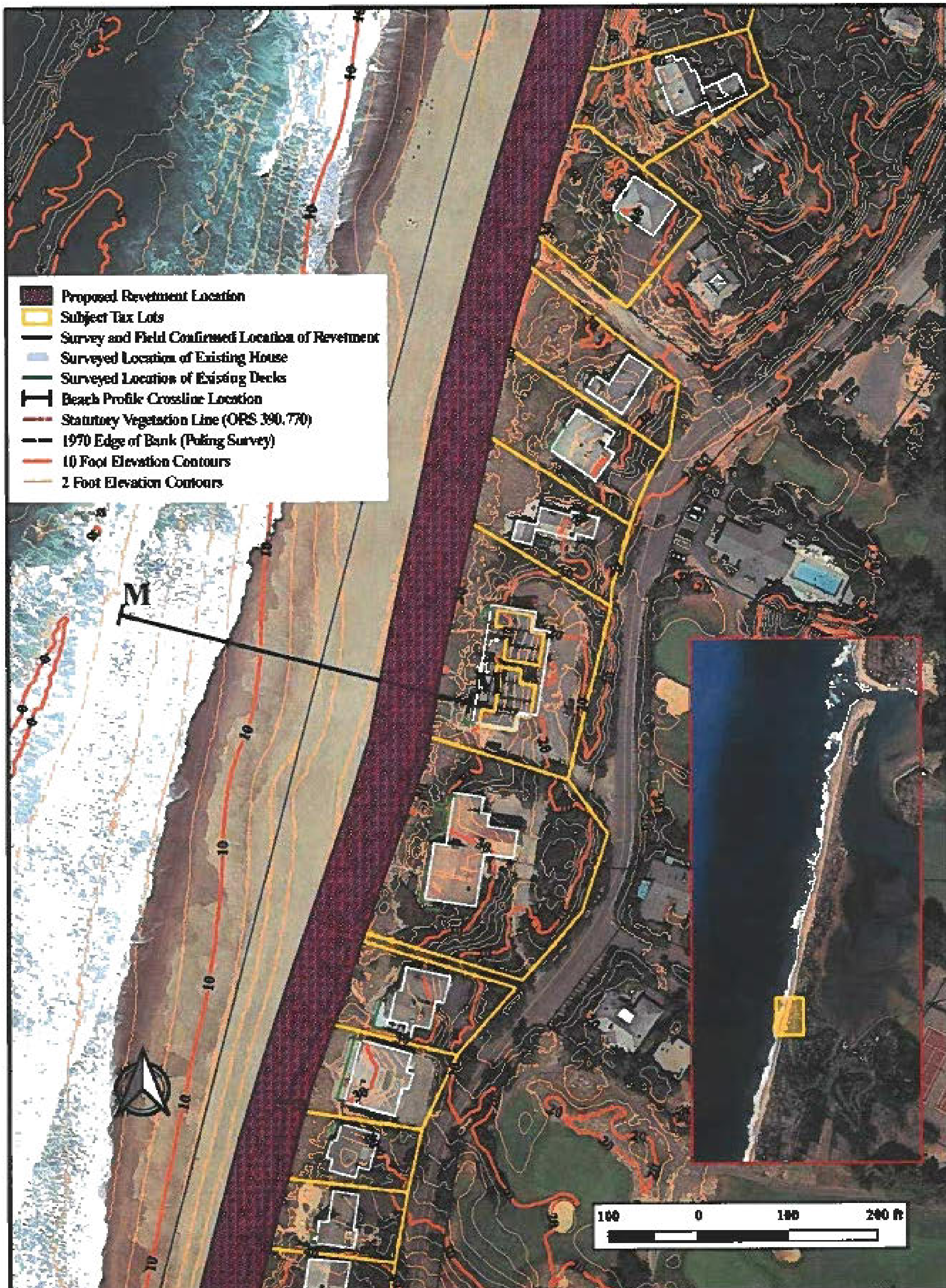
Date: 12/20/2019	Project #Y174107	Prepared by: AML
Scale: 1" = 80'		Approved by: JDG

Site Map - Area 7

Tax Lot 211, Map 08-11-09AA (north) to Tax Lot 110, Map 08-11-09AD (south)

H.G. Schlicker & Associates, Inc.

All locations and dimensions are approximate.
Topographic lines derived from 2016 USGS West Coast El-Nino Lidar (WA, OR, CA) provided by NOAA.
Elevation Datum is NAVD 88.
2016 satellite imagery from Google.



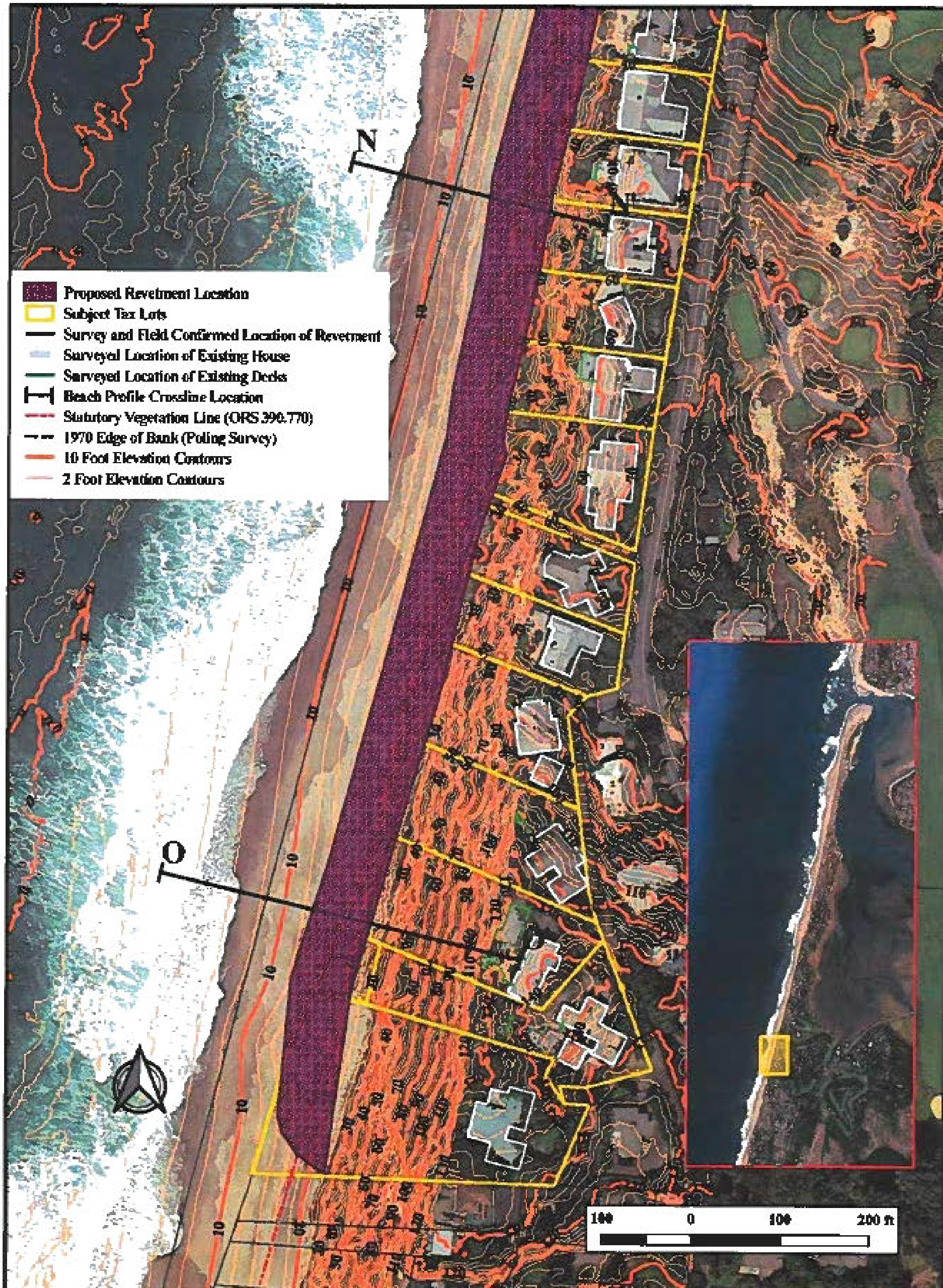
All locations and dimensions are approximate.
Topographic lines derived from 2016 USGS West Coast El-Nino Lidar (WA, OR, CA) provided by NOAA.
Elevation Datum is NAVD 88.
2016 satellite imagery from Google.

Date: 12/20/2019	Project #Y174107	Prepared by: AML
Scale: 1" = 100'		Approved by: JDG

Site Map - Area 8

Tax Lot 107, Map 08-11-09AD (north) to Tax Lot 312, Map 08-11-09DA (south)

H.G. Schlicker & Associates, Inc.



All locations and dimensions are approximate.
Topographic lines derived from 2016 USGS West Coast El-Nino Lidar (WA, OR, CA) provided by NOAA.
Elevation Datum is NAVD 88.
2016 satellite imagery from Google.

Date: 12/20/2019	Project #Y174107	Prepared by: AML
Scale: 1" = 100'		Approved by: JDG

Site Map – Area 9

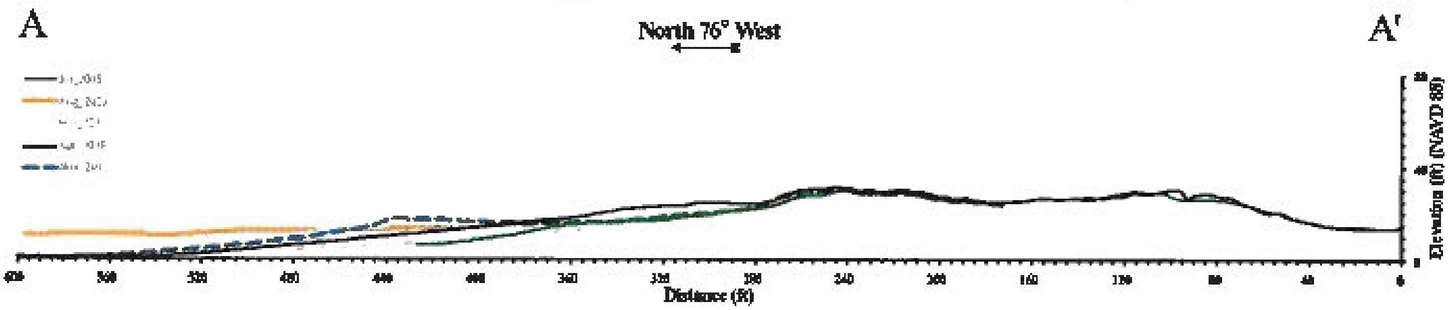
Tax Lot 311, Map 08-11-05CA (north) to Tax Lot 156, Map 08-11-09DD (south)

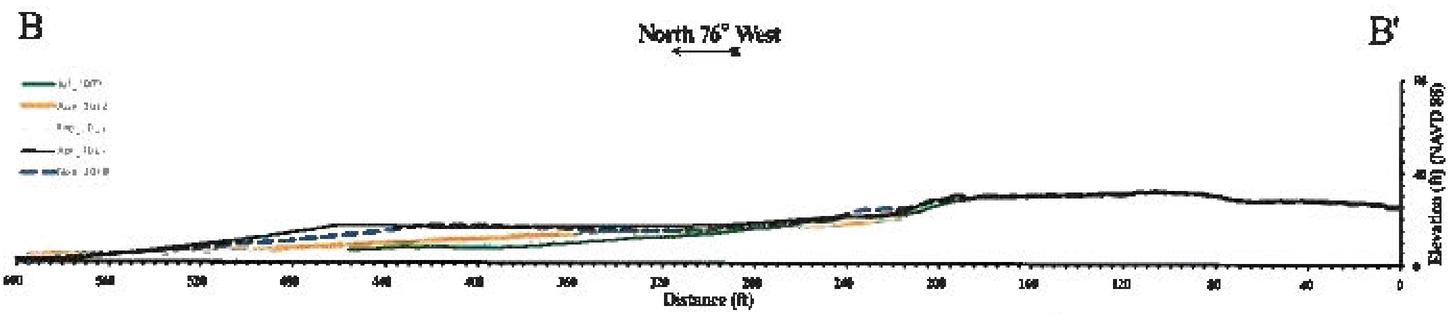
H.G. Schlicker & Associates, Inc.

Project #Y174107

Appendix D
- Beach Profiles -

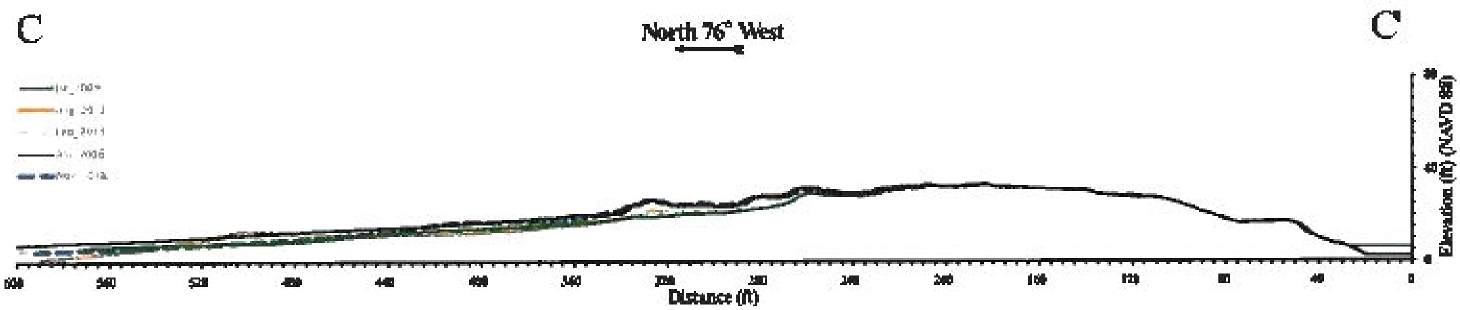
H.G. Schlicker & Associates, Inc.

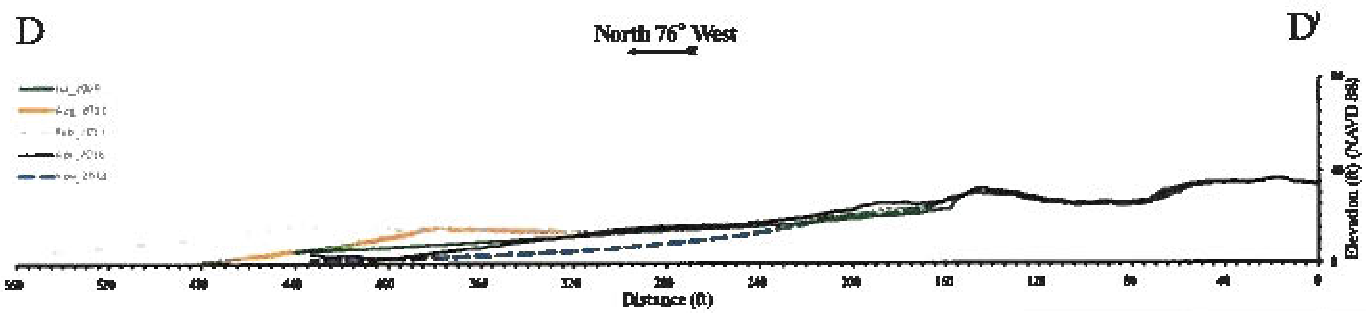




Slope profiles derived from:
2009 OLC North Coast Lidar provided by DOGAMI;
2012, 2013 and 2018 data from Allan and Hart (2008), Allan et al. (2015) and Allan and O'Brien (2019);
2016 USGS West Coast El-Nino Lidar (WA, OR, CA) provided by NOAA.
All locations and dimensions are approximate.

Date: [illegible]	Project #Y174107	Prepared by: AML
Scale: 1" = 40'		Approved by: JDG
Beach Profiles A-A' And B-B'		





Date: 12/20/2019	Project #Y174107	Prepared by: AML
Scale: 1" = 40'		Approved by: JDG
Beach Profiles C-C' And D-D'		

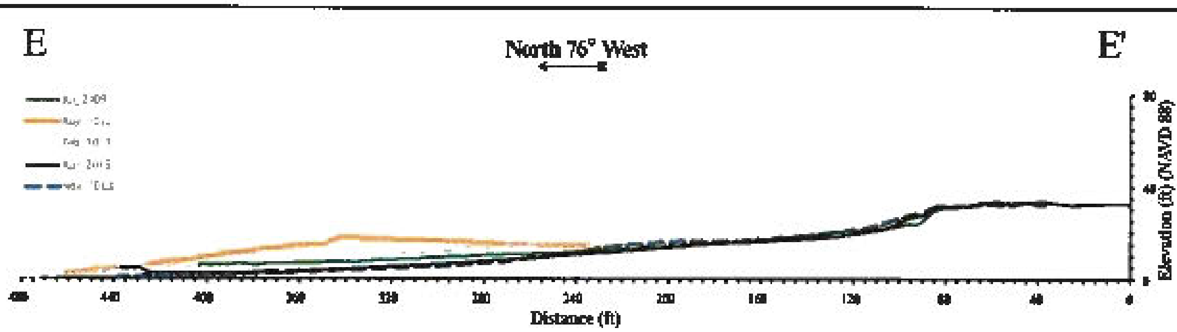
Slope profiles derived from:

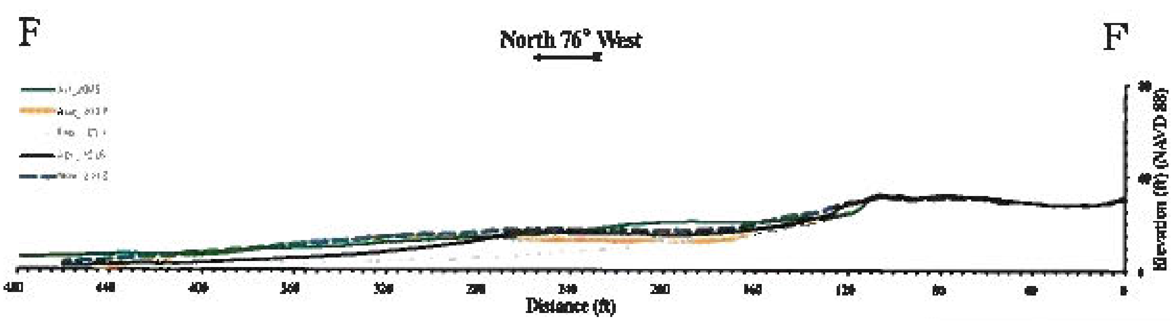
2009 OLC North Coast Lidar provided by DOGAMI;

2012, 2013 and 2018 data from Allan and Hart (2008), Allan et al. (2015) and Allan and O'Brien (2019);

2016 USGS West Coast El-Nino Lidar (WA, OR, CA) provided by NOAA.

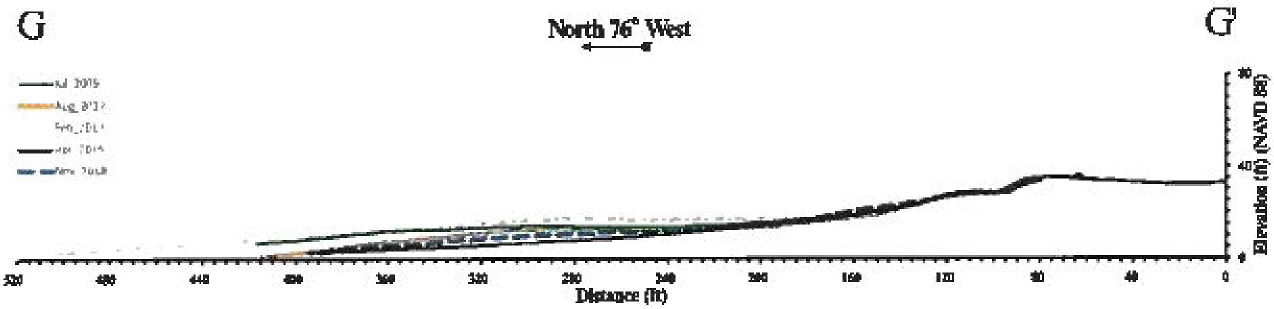
All locations and dimensions are approximate.

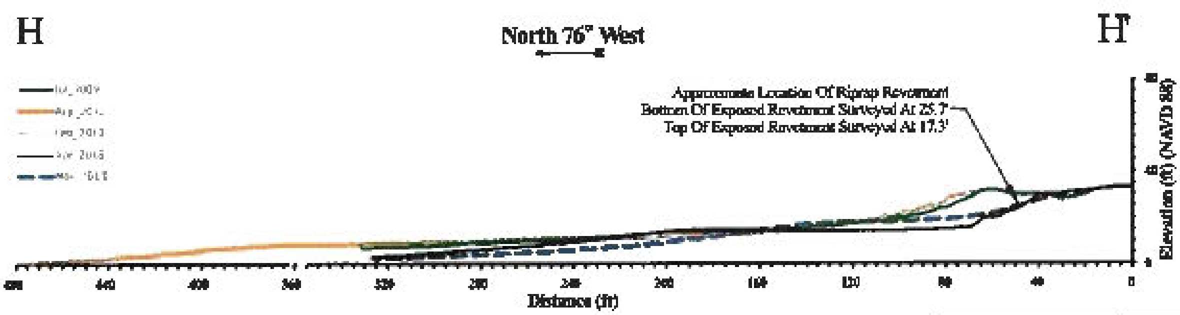




Slope profiles derived from:
2009 OLC North Coast Lidar provided by DOGAMI;
2012, 2013 and 2018 data from Allan and Hart (2008), Allan et al. (2015) and Allan and O'Brien (2019);
2016 USGS West Coast El-Nino Lidar (WA, OR, CA) provided by NOAA.
All locations and dimensions are approximate.

Date: 12/20/2019	Project #Y174107	Prepared by: AML
Scale: 1" = 40'		Approved by: JTG
Beach Profiles E-E' And F-F'		

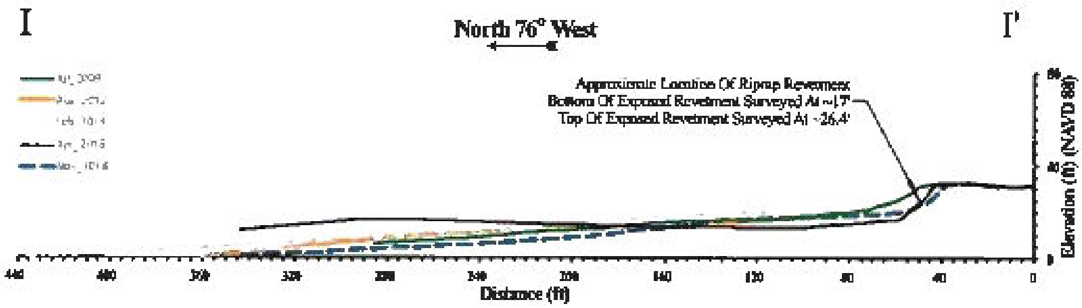


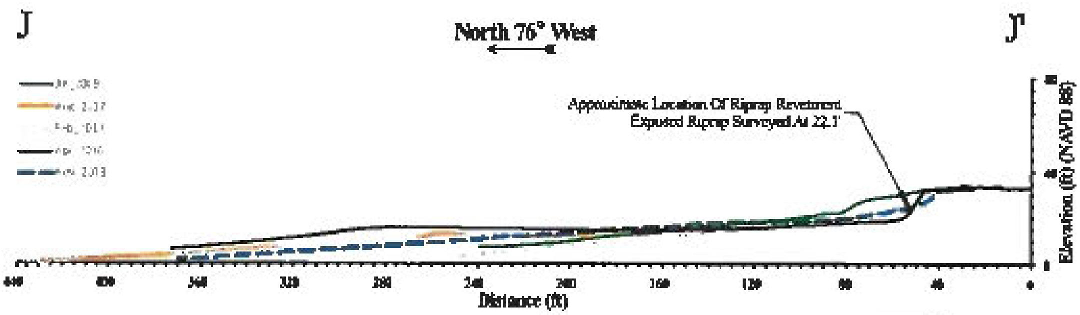


Date: 12/20/2019	Project #Y174107	Prepared by: ANL
Scale: 1" = 40'		Approved by: JDO

Beach Profiles G-G' And H-H'

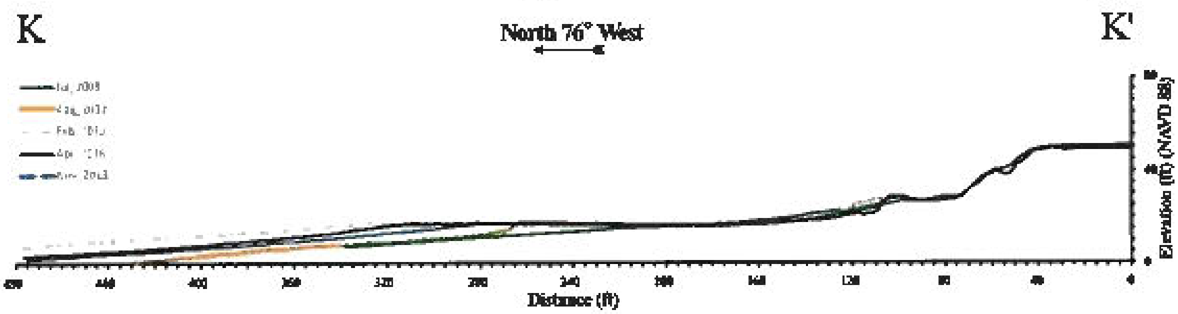
Slope profiles derived from:
2009 OLC North Coast Lidar provided by DOGAMI,
2012, 2013 and 2018 data from Allen and Hart (2008), Allen et al. (2015) and Allen and O'Brien (2019);
2016 USGS West Coast El-Nino Lidar (WA, OR, CA) provided by NOAA.
All locations and dimensions are approximate.

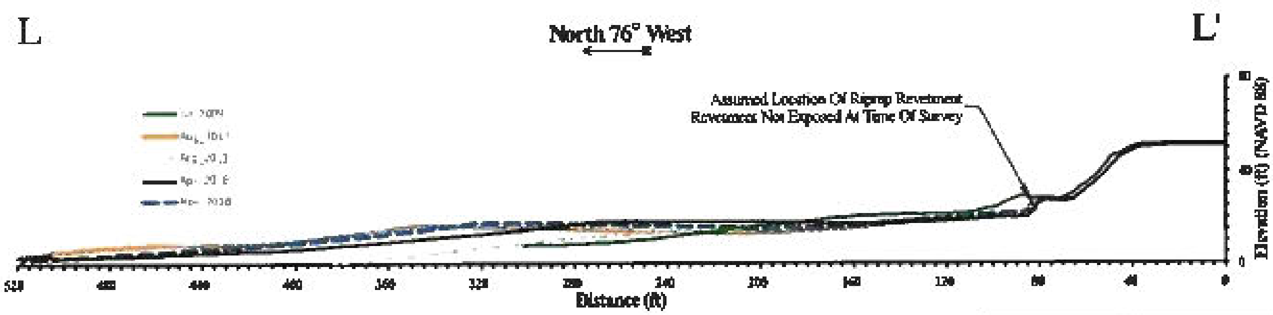




Date: 12/20/2019	Project #Y174107	Prepared by: AHL
Scale: 1" = 40'		Approved by:
Beach Profiles I-I' And J-J'		

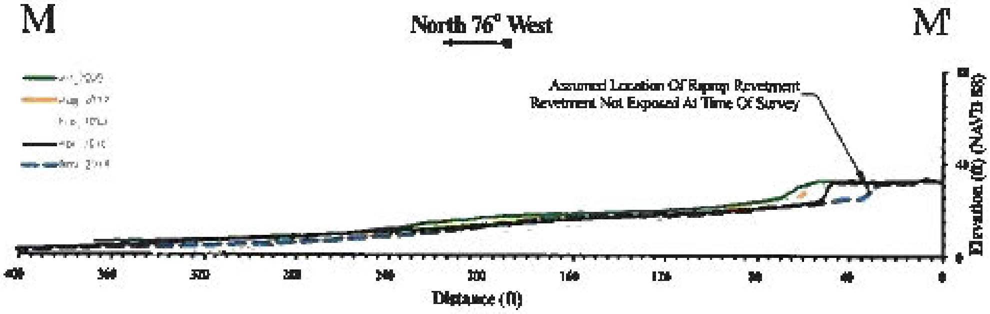
Slope profiles derived from:
2009 OLC North Coast Lidar provided by DOGAMI;
2012, 2013 and 2015 data from Allan and Hart (2008), Allan et al. (2015) and Allan and O'Brien (2019);
2016 USGS West Coast El-Nino Lidar (WA, OR, CA) provided by NOAA.
All locations and dimensions are approximate.

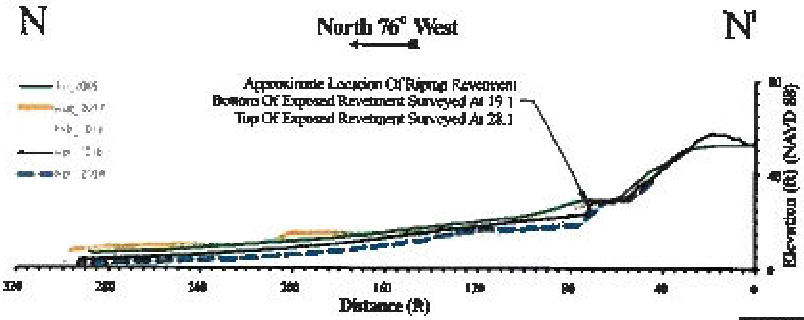




Slope profiles derived from:
2009 OLC North Coast Lidar provided by DOGAMI,
2012, 2013 and 2018 data from Allan and Hart (2008), Allan et al. (2015) and Allan and O'Brien (2019):
2016 USGS West Coast El-Nino Lidar (WA, OR, CA) provided by NOAA.
All locations and dimensions are approximate.

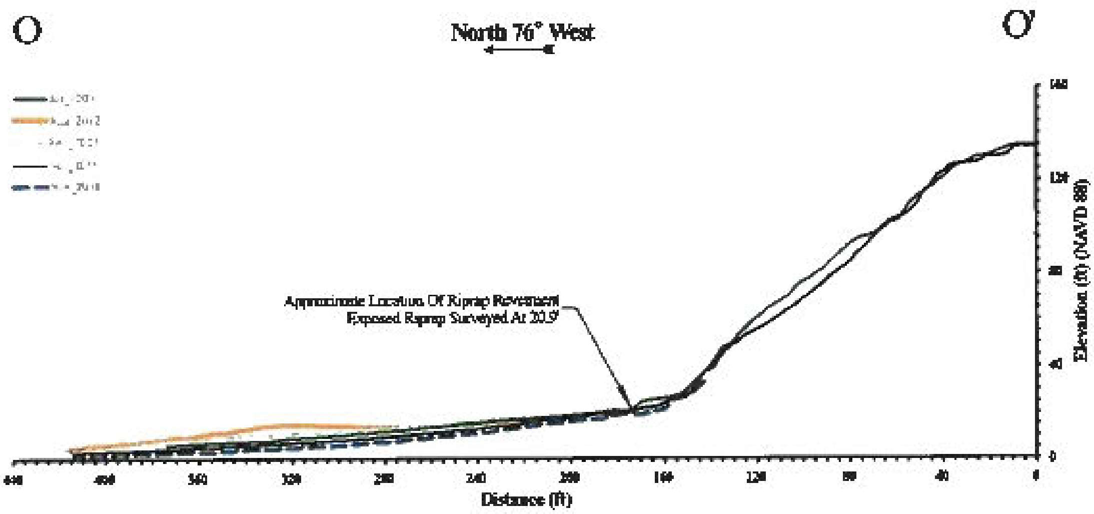
Date: 12/20/2019	Project #Y174107	Prepared by: AML
Scale: 1" = 40'		Approved by: JDG
Beach Profiles K-K' And L-L'		





Slope profiles derived from:
2009 OLC North Coast Lidar provided by DOGAMI;
2012, 2013 and 2018 data from Allan and Hart (2008), Allan et al. (2015) and Allan and O'Brien (2019);
2016 USGS West Coast El Niño Lidar (WA, OR, CA) provided by NOAA.
All locations and dimensions are approximate.

Date: 12/20/2019	Project #Y174107	Prepared by: AML
Scale: 1" = 40'		Approved by: JDO
Beach Profiles M-M' And N-N'		



Slope profiles derived from:

2009 OLC North Coast Lidar provided by DOGAMI;

2012, 2013 and 2018 data from Allan and Hart (2008), Allan et al. (2015) and Allan and O'Brien (2019);

2016 USGS West Coast El-Nino Lidar (WA, OR, CA) provided by NOAA.

All locations and dimensions are approximate.

Date: 12/20/2019	Project #Y174107	Prepared by: AML
Scale: 1" = 40'		Approved by: JDG
Beach Profile O-O'		

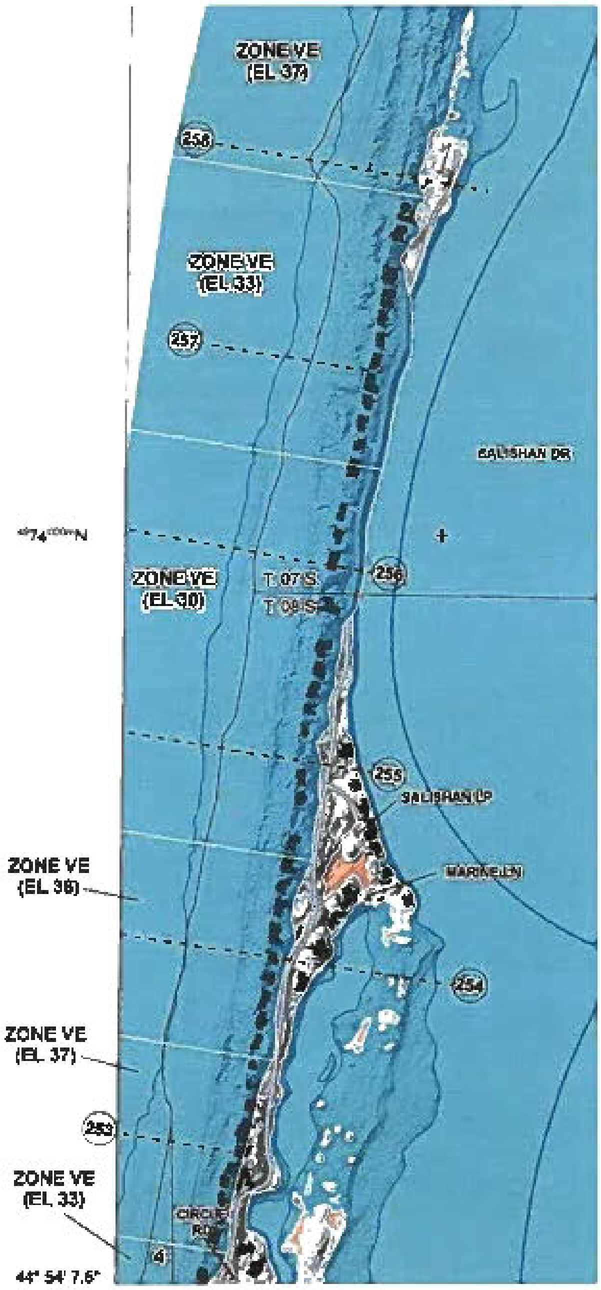
Appendix E
- FEMA Flood Maps -

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

HTTPS://MSC.FEMA.GOV

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS	NO SCREEN	Area of Minimal Flood Hazard Zone X
		Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES	E 18.2 17.5	Cross Sections with 1% Annual Chance Water Surface Elevation
	8	Coastal Transect
		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
	513	Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary



Map Projection:
NAD 1983 UTM Zone 10N;
Western Hemisphere; Vertical Datum: NAVD 88

N

1 inch = 500 feet 1:6,000

0 500 1,000 2,000 Feet

0 125 250 500 Meters

Date: 12/20/2019	Project #Y174107	Prepared by: AML
As Shown		Approved by: JDG

FEMA Flood Map

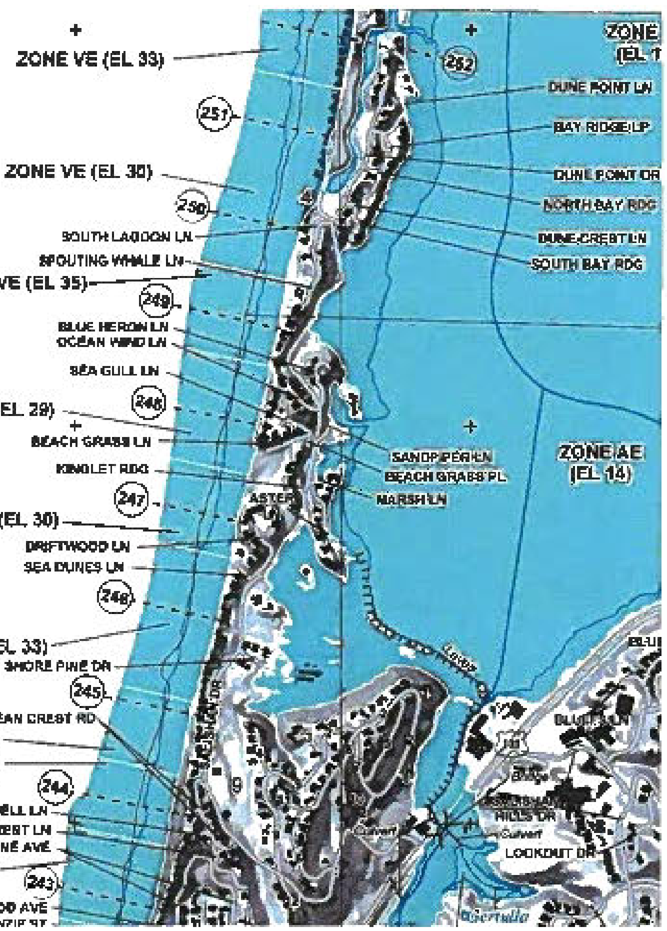
A Portion of FIRM Panel #41041C0117E, Effective 10/18/2019

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

HTTPS://MSC.FEMA.GOV

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS	NO SCREEN	Area of Minimal Flood Hazard Zone X
		Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES	18.2 / 17.5	Cross Sections with 1% Annual Chance Water Surface Elevation
	8	Coastal Transect
		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
	513	Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary



Map Projection:
NAD 1983 UTM Zone 10N,
Western Hemisphere; Vertical Datum: NAVD 88

N

1 inch = 1,000 feet 1:12,000

0 1,000 2,000 4,000 Feet

0 260 520 1,040 Meters

Date: 12/20/2019	Project #Y174107	Prepared by: AML
As Shown		Approved by: JDG
FEMA Flood Map A Portion of FIRM Panel #41041C0120E, Effective 10/18/2019		

Appendix F

- Individual Tax Lot Information for Permit Applications -

Appendix F: Tax Lot Information

ID #	Tax Lot	Tax Map	Situs	City/Town	Zoning Designation	Year Main Structure Built	Lot size	Oceanfront Footage	Streetfront Footage	East-West Footage	Distance From Eastern Property Line To Nearest Building	Distance From Seaward Dune Crest Or Bluff Edge To Nearest Building	Approximate Height Of Bluff, Dune, Or Escarpment
1	200	07-11-34DB	399 Salishan Drive	Salishan	R-1 PD	1971	0.55	90	90	285	54	TBD at time of application	TBD at time of application
2	102	07-11-34DB	397 Salishan Drive	Salishan	R-1 PD	1991	0.53	90	90	266	60	TBD at time of application	TBD at time of application
3	103	07-11-34CB	395 Salishan Drive	Salishan	R-1 PD	N/A	0.5	90	90	254	N/A	TBD at time of application	TBD at time of application
4	104	07-11-34CB	393 Salishan Drive	Salishan	R-1 PD	1988	0.45	90	90	234	42	TBD at time of application	TBD at time of application
5	100	07-11-34CC	391 Salishan Drive	Salishan	R-1 PD	2006	0.48	90	90	223	21	TBD at time of application	TBD at time of application
6	108	07-11-34CC	389 Salishan Drive	Salishan	R-1 PD	1973	0.5	90	90	234	50	TBD at time of application	TBD at time of application
7	110	07-11-34CC	387 Salishan Drive	Salishan	R-1 PD	1973	0.53	90	90	258	50	TBD at time of application	TBD at time of application
8	111	07-11-34CC	385 Salishan Drive	Salishan	R-1 PD	1982	0.51	90	90	259	35	TBD at time of application	TBD at time of application
9	112	07-11-34CC	383 Salishan Drive	Salishan	R-1 PD	1982	0.46	90	90	235	26	TBD at time of application	TBD at time of application
10	107	07-11-34CC	381 Salishan Drive	Salishan	R-1 PD	1970	0.43	90	90	223	30	TBD at time of application	TBD at time of application
11	105	07-11-34CC	379 Salishan Drive	Salishan	R-1 PD	1969	0.43	90	90	219	37	TBD at time of application	TBD at time of application
12	104	07-11-34CC	377 Salishan Drive	Salishan	R-1 PD	1970	0.42	90	90	213	35	TBD at time of application	TBD at time of application
13	106	07-11-34CC	375 Salishan Drive	Salishan	R-1 PD	1980	0.39	90	90	198	20	TBD at time of application	TBD at time of application
14	109	07-11-34CC	N/A - "Beach Access"	Salishan	R-1 PD	N/A	N/A	10	10	189	N/A	TBD at time of application	TBD at time of application
15	103	07-11-34CC	373 Salishan Drive	Salishan	R-1 PD	N/A	0.35	90	90	186	N/A	TBD at time of application	TBD at time of application
16	102	07-11-34CC	371 Salishan Drive	Salishan	R-1 PD	1980	0.38	100	100	172	37	TBD at time of application	TBD at time of application
17	101	07-11-34CC	369 Salishan Drive	Salishan	R-1 PD	1972	0.36	100	100	173	40	TBD at time of application	TBD at time of application
18	400	07-11-34CC	367 Salishan Drive	Salishan	R-1 PD	2001	0.35	100	100	159	33	TBD at time of application	TBD at time of application
19	300	07-11-34CC	365 Salishan Drive	Salishan	R-1 PD	N/A	0.35	90	90	172	N/A	TBD at time of application	TBD at time of application
20	200	07-11-34CC	363 Salishan Drive	Salishan	R-1 PD	1970	0.34	90	90	166	17	TBD at time of application	TBD at time of application
21	1400	08-11-03BB	361 Salishan Drive	Salishan	R-1 PD	N/A	0.35	90	90	168	N/A	TBD at time of application	TBD at time of application
22	1300	08-11-03BB	359 Salishan Drive	Salishan	R-1 PD	2006	0.37	90	90	175	38	TBD at time of application	TBD at time of application
23	1200	08-11-03BB	357 Salishan Drive	Salishan	R-1 PD	1983	0.39	90	90	186	40	TBD at time of application	TBD at time of application
24	1100	08-11-03BB	355 Salishan Drive	Salishan	R-1 PD	1991	0.42	90	90	198	54	TBD at time of application	TBD at time of application
25	1000	08-11-03BB	353 Salishan Drive	Salishan	R-1 PD	1970	0.43	90	90	208	57	TBD at time of application	TBD at time of application
26	900	08-11-03BB	351 Salishan Drive	Salishan	R-1 PD	1971	0.44	90	90	214	72	TBD at time of application	TBD at time of application
27	800	08-11-03BB	349 Salishan Drive	Salishan	R-1 PD	N/A	0.44	90	90	216	N/A	TBD at time of application	TBD at time of application
28	100	08-11-03BB	N/A - "Beach Access"	Salishan	R-1 PD	N/A	N/A	10	10	220	N/A	TBD at time of application	TBD at time of application
29	700	08-11-03BB	347 Salishan Drive	Salishan	R-1 PD	1983	0.47	90	90	220	40	TBD at time of application	TBD at time of application
30	600	08-11-03BB	345 Salishan Drive	Salishan	R-1 PD	1970	0.47	90	90	227	38	TBD at time of application	TBD at time of application
31	500	08-11-03BB	343 Salishan Drive	Salishan	R-1 PD	1984	0.48	90	90	228	37	TBD at time of application	TBD at time of application
32	400	08-11-03BB	341 Salishan Drive	Salishan	R-1 PD	2002	0.52	90	90	244	47	TBD at time of application	TBD at time of application
33	300	08-11-03BB	339 Salishan Drive	Salishan	R-1 PD	1980	0.54	90	90	260	40	TBD at time of application	TBD at time of application
34	200	08-11-03BB	337 Salishan Drive	Salishan	R-1 PD	1981	0.59	90	101	262	65	TBD at time of application	TBD at time of application
35	203	08-11-03BB	335 Salishan Drive	Salishan	R-1 PD	1989	0.61	99	99	275	70	TBD at time of application	TBD at time of application
36	201	08-11-03BB	333 Salishan Drive	Salishan	R-1 PD	1990	0.57	100	111	260	30	TBD at time of application	TBD at time of application
37	114	08-11-03BC	N/A - "Beach Access"	Salishan	R-1 PD	N/A	N/A	10	10	209	N/A	TBD at time of application	TBD at time of application
38	111	08-11-03BC	331 Salishan Drive	Salishan	R-1 PD	1977	0.35	80	80	199	26	TBD at time of application	TBD at time of application
39	110	08-11-03BC	329 Salishan Drive	Salishan	R-1 PD	1989	0.39	90	90	195	28	TBD at time of application	TBD at time of application
40	109	08-11-03BC	327 Salishan Drive	Salishan	R-1 PD	1979	0.4	90	90	201	40	TBD at time of application	TBD at time of application

Appendix F: Tax Lot Information (continued)

ID #	Tax Lot	Tax Map	Situs	City/Town	Zoning Designation	Year Main Structure Built	Lot size	Oceanfront Footage	Streetfront Footage	East-West Footage	Distance From Eastern Property Line To Nearest Building	Distance From Seaward Dune Crest Or Bluff Edge To Nearest Building	Approximate Height Of Bluff, Dune, Or Escarpment
41	108	08-11-03BC	325 Salishan Drive	Salishan	R-1 PD	2006	0.42	90	90	209	36	TBD at time of application	TBD at time of application
42	107	08-11-03BC	323 Salishan Drive	Salishan	R-1 PD	1966	0.45	90	90	233	50	TBD at time of application	TBD at time of application
43	106	08-11-03BC	321 Salishan Drive	Salishan	R-1 PD	1970	0.43	90	90	214	54	TBD at time of application	TBD at time of application
44	105	08-11-03BC	319 Salishan Drive	Salishan	R-1 PD	1970	0.44	90	90	224	33	TBD at time of application	TBD at time of application
45	104	08-11-03BC	317 Salishan Drive	Salishan	R-1 PD	2008	0.48	90	90	245	28	TBD at time of application	TBD at time of application
46	102	08-11-03BC	N/A - Salishan Dune House	Salishan	R-1 PD	N/A	0.93	170	235	245	30	TBD at time of application	TBD at time of application
47	1700	08-11-03BC	315 Salishan Drive, Unit 11	Salishan	R-1 PD	1969	0.03	N/A	N/A	N/A	N/A	TBD at time of application	TBD at time of application
48	1600	08-11-03BC	315 Salishan Drive, Unit 10	Salishan	R-1 PD	1969	0.03	N/A	N/A	N/A	N/A	TBD at time of application	TBD at time of application
49	1500	08-11-03BC	315 Salishan Drive, Unit 9	Salishan	R-1 PD	1969	0.03	N/A	N/A	N/A	N/A	TBD at time of application	TBD at time of application
50	1400	08-11-03BC	315 Salishan Drive, Unit 8	Salishan	R-1 PD	1969	0.03	N/A	N/A	N/A	N/A	TBD at time of application	TBD at time of application
51	1300	08-11-03BC	315 Salishan Drive, Unit 7	Salishan	R-1 PD	1969	0.03	N/A	N/A	N/A	N/A	TBD at time of application	TBD at time of application
52	1200	08-11-03BC	315 Salishan Drive, Unit 6	Salishan	R-1 PD	1969	0.03	N/A	N/A	N/A	N/A	TBD at time of application	TBD at time of application
53	101	08-11-03BC	N/A - Salishan Dune House	Salishan	R-1 PD	N/A	0.45	140	143	287	6	TBD at time of application	TBD at time of application
54	1000	08-11-03BC	313 Salishan Drive, Unit 4	Salishan	R-1 PD	1967	0.02	N/A	N/A	N/A	N/A	TBD at time of application	TBD at time of application
55	900	08-11-03BC	313 Salishan Drive, Unit 3	Salishan	R-1 PD	1967	0.02	N/A	N/A	N/A	N/A	TBD at time of application	TBD at time of application
56	800	08-11-03BC	313 Salishan Drive, Unit 2	Salishan	R-1 PD	1967	0.02	N/A	N/A	N/A	N/A	TBD at time of application	TBD at time of application
57	700	08-11-03BC	313 Salishan Drive, Unit 1	Salishan	R-1 PD	1967	0.02	N/A	N/A	N/A	N/A	TBD at time of application	TBD at time of application
58	600	08-11-03BC	311 Salishan Drive	Salishan	R-1 PD	1987	0.52	80	80	181	14	TBD at time of application	TBD at time of application
59	500	08-11-03BC	309 Salishan Drive	Salishan	R-1 PD	1973	0.34	80	80	188	22	TBD at time of application	TBD at time of application
60	400	08-11-03BC	307 Salishan Drive	Salishan	R-1 PD	1987	0.35	80	80	196	26	TBD at time of application	TBD at time of application
61	300	08-11-03BC	305 Salishan Drive	Salishan	R-1 PD	N/A	0.4	90	90	199	N/A	TBD at time of application	TBD at time of application
62	1201	08-11-03CB	303 Salishan Drive	Salishan	R-1 PD	1993	0.27	70	70	165	25	TBD at time of application	TBD at time of application
63	1200	08-11-03CB	301 Salishan Drive	Salishan	R-1 PD	1998	0.26	80	80	137	17	TBD at time of application	TBD at time of application
64	4001	08-11-03CB	No Situs - "Walkway"	Salishan	R-1 PD	N/A	N/A	10	10	137	N/A	TBD at time of application	TBD at time of application
65	1100	08-11-03CB	299 Salishan Drive	Salishan	R-1 PD	1989	0.29	90	90	145	17	TBD at time of application	TBD at time of application
66	1001	08-11-03CB	297 Salishan Drive	Salishan	R-1 PD	1990	0.28	80	80	166	18	TBD at time of application	TBD at time of application
67	1000	08-11-03CB	295 Salishan Drive	Salishan	R-1 PD	2002	0.28	80	80	160	22	TBD at time of application	TBD at time of application
68	900	08-11-03CB	293 Salishan Drive	Salishan	R-1 PD	1997	0.28	80	80	167	17	TBD at time of application	TBD at time of application
69	800	08-11-03CB	291 Salishan Drive	Salishan	R-1 PD	1967	0.35	80	80	167	19	TBD at time of application	TBD at time of application
70	701	08-11-03CB	289 Salishan Drive	Salishan	R-1 PD	1971	0.34	97.5	97.5	164	30	TBD at time of application	TBD at time of application
71	700	08-11-03CB	287 Salishan Drive	Salishan	R-1 PD	1979	0.34	97.5	97.5	164	7	TBD at time of application	TBD at time of application
72	600	08-11-03CB	285 Salishan Drive	Salishan	R-1 PD	1988	0.34	75	75	165	4	TBD at time of application	TBD at time of application
73	500	08-11-03CB	283 Salishan Drive	Salishan	R-1 PD	1981	0.34	97.5	97.5	167	11	TBD at time of application	TBD at time of application
74	4001	08-11-03CB	No Situs - "Walkway"	Salishan	R-1 PD	N/A	N/A	10	10	167	N/A	TBD at time of application	TBD at time of application
75	401	08-11-03CB	281 Salishan Drive	Salishan	R-1 PD	1980	0.32	90	90	169	20	TBD at time of application	TBD at time of application
76	400	08-11-03CB	279 Salishan Drive	Salishan	R-1 PD	1982	0.32	90	90	163	21	TBD at time of application	TBD at time of application
77	300	08-11-03CB	277 Salishan Drive	Salishan	R-1 PD	2002	0.32	90	90	157	34	TBD at time of application	TBD at time of application
78	200	08-11-03CB	275 Salishan Drive	Salishan	R-1 PD	1988	0.32	90	90	143	21	TBD at time of application	TBD at time of application
79	210	08-11-03CC	273 Salishan Drive	Salishan	R-1 PD	1977	0.31	90	90	145	17	TBD at time of application	TBD at time of application

Appendix F: Tax Lot Information (continued)

ID #	Tax Lot	Tax Map	Situs	City/Town	Zoning Designation	Year Main Structure Built	Lot size	Oceanfront Footage	Streetfront Footage	East-West Footage	Distance From Eastern Property Line To Nearest Building	Distance From Seaward Dune Crest Or Bluff Edge To Nearest Building	Approximate Height Of Bluff, Dune, Or Escarpment
80	231	08-11-03CC	273 Salishan Drive	Salishan	R-1 PD	1979	0.34	97.5	97.5	143	14	TBD at time of application	TBD at time of application
81	230	08-11-03CC	269 Salishan Drive	Salishan	R-1 PD	2015	0.34	97.5	97.5	142	25	TBD at time of application	TBD at time of application
82	228	08-11-03CC	267 Salishan Drive	Salishan	R-1 PD	1981	0.32	97.5	97.5	130	11	TBD at time of application	TBD at time of application
83	227	08-11-03CC	265 Salishan Drive	Salishan	R-1 PD	1983	0.3	97.5	97.5	121	10	TBD at time of application	TBD at time of application
84	233	08-11-03CC	No Situs - "Walkway"	Salishan	R-1 PD	N/A	N/A	10	10	121	N/A	TBD at time of application	TBD at time of application
85	204	08-11-03CC	20 South Lagoon Road	Salishan	R-1 PD	1969	0.37	90	90	208	58	TBD at time of application	TBD at time of application
86	203	08-11-03CC	22 South Lagoon Road	Salishan	R-1 PD	1966	0.37	100	100	157	38	TBD at time of application	TBD at time of application
87	202	08-11-03CC	24 South Lagoon Road	Salishan	R-1 PD	1973	0.39	90	85	177	22	TBD at time of application	TBD at time of application
88	201	08-11-03CC	20 Spouting Whale Lane	Salishan	R-1 PD	1964	1.71	105	105	270	3	TBD at time of application	TBD at time of application
89	233	08-11-03CC	No Situs - "Walkway"	Salishan	R-1 PD	N/A	N/A	10	10	240	N/A	TBD at time of application	TBD at time of application
90	208	08-11-03CC	26 Spouting Whale Lane	Salishan	R-1 PD	1966	1.12	127	153.8	214	110	TBD at time of application	TBD at time of application
91	215	08-11-03CC	28 Spouting Whale Lane	Salishan	R-1 PD	1969	0.96	126	150	262	55	TBD at time of application	TBD at time of application
92	204	08-11-09AA	247 Salishan Drive	Salishan	R-1 PD	1994	0.56	103	103	231	65	TBD at time of application	TBD at time of application
93	206	08-11-09AA	245 Salishan Drive	Salishan	R-1 PD	1969	0.47	102	102	185	25	TBD at time of application	TBD at time of application
94	210	08-11-09AA	243 Salishan Drive	Salishan	R-1 PD	1969	0.43	100	100	173	55	TBD at time of application	TBD at time of application
95	235	08-11-09AA	No Situs - "Walkway"	Salishan	R-1 PD	N/A	N/A	10	10	173	N/A	TBD at time of application	TBD at time of application
96	201	08-11-09AA	241 Salishan Drive	Salishan	R-1 PD	1964	0.46	101	100	174	10	TBD at time of application	TBD at time of application
97	224	08-11-09AA	No Situs - "Park"	Salishan	R-1 PD	N/A	0.37	128	0	258	N/A	TBD at time of application	TBD at time of application
98	211	08-11-09AA	26 Ocean Wind Lane	Salishan	R-1 PD	1969	0.53	54	125	224	17	TBD at time of application	TBD at time of application
99	212	08-11-09AA	29 Ocean Wind Lane	Salishan	R-1 PD	1971	0.52	52	25	225	43	TBD at time of application	TBD at time of application
100	218	08-11-09AA	22 Sea Gull Lane	Salishan	R-1 PD	1966	0.57	107	80	246	7	TBD at time of application	TBD at time of application
101	219	08-11-09AA	24 Sea Gull Lane	Salishan	R-1 PD	1965	0.54	157	70	243	23	TBD at time of application	TBD at time of application
102	208	08-11-09AA	26 Sea Gull Lane	Salishan	R-1 PD	1979	0.52	104	60	241	23	TBD at time of application	TBD at time of application
103	207	08-11-09AA	20 Beach Grass Lane	Salishan	R-1 PD	1972	0.6	104	73	175	17	TBD at time of application	TBD at time of application
104	235	08-11-09AA	No Situs - "Park"	Salishan	R-1 PD		85.8	300	N/A	N/A	N/A	TBD at time of application	TBD at time of application
105	139	08-11-09AD	No Situs - "Park"	Salishan	R-1 PD	N/A	2.32	135	N/A	N/A	N/A	TBD at time of application	TBD at time of application
106	109	08-11-09AD	16 Driftwood Lane	Salishan	R-1 PD	1964	0.3	16	82	247	12	TBD at time of application	TBD at time of application
107	110	08-11-09AD	17 Driftwood Lane	Salishan	R-1 PD	1963	1.27	335	100	326	5	TBD at time of application	TBD at time of application
108	107	08-11-09AD	15 Driftwood Lane	Salishan	R-1 PD	1985	0.38	46	67	262	24	TBD at time of application	TBD at time of application
109	106	08-11-09AD	12 Sea Dunes Lane	Salishan	R-1 PD	1968	0.63	138	50	231	76	TBD at time of application	TBD at time of application
110	130	08-11-09AD	No Situs - Sea Dunes Lane	Salishan	R-1 PD	N/A	N/A	33	33	142	N/A	TBD at time of application	TBD at time of application
111	113	08-11-09AD	11 Sea Dunes Lane	Salishan	R-1 PD	1966	0.49	90	80	255	33	TBD at time of application	TBD at time of application
112	114	08-11-09AD	173 Salishan Drive	Salishan	R-1 PD	1965	0.52	100	89	237	46	TBD at time of application	TBD at time of application
113	115	08-11-09AD	171 Salishan Drive	Salishan	R-1 PD	1973	0.5	100	92	235	35	TBD at time of application	TBD at time of application
114	116	08-11-09AD	No Situs - Salishan Longhouse	Salishan	R-1 PD	N/A	1.18	256	200	226	50	TBD at time of application	TBD at time of application
115	124	08-11-09AD	167 Salishan Drive, Unit A	Salishan	R-1 PD	1964	0.02	N/A	N/A	N/A	N/A	TBD at time of application	TBD at time of application
116	123	08-11-09AD	167 Salishan Drive, Unit D	Salishan	R-1 PD	1964	0.01	N/A	N/A	N/A	N/A	TBD at time of application	TBD at time of application
117	122	08-11-09AD	169 Salishan Drive, Unit E	Salishan	R-1 PD	1964	0.02	N/A	N/A	N/A	N/A	TBD at time of application	TBD at time of application
118	121	08-11-09AD	169 Salishan Drive, Unit G	Salishan	R-1 PD	1964	0.02	N/A	N/A	N/A	N/A	TBD at time of application	TBD at time of application

Appendix F: Tax Lot Information (continued)

ID #	Tax Lot	Tax Map	Situs	City/Town	Zoning Designation	Year Main Structure Built	Lot size	Oceanfront Footage	Streetfront Footage	East-West Footage	Distance From Eastern Property Line To Nearest Building	Distance From Seaward Dune Crest Or Bluff Edge To Nearest Building	Approximate Height Of Bluff, Dune, Or Escarpment
119	120	08-11-09AD	167 Salishan Drive, Unit B	Salishan	R-1 PD	1964	0.02	N/A	N/A	N/A	N/A	TBD at time of application	TBD at time of application
120	119	08-11-09AD	169 Salishan Drive, Unit F	Salishan	R-1 PD	1964	0.02	N/A	N/A	N/A	N/A	TBD at time of application	TBD at time of application
121	118	08-11-09AD	167 Salishan Drive, Unit C	Salishan	R-1 PD	1964	0.02	N/A	N/A	N/A	N/A	TBD at time of application	TBD at time of application
122	199	08-11-09DA	165 Salishan Drive	Salishan	R-1 PD	1969	1.31	230	230	272	80	TBD at time of application	TBD at time of application
123	194	08-11-09DA	No Situs - "Walkway"	Salishan	R-1 PD	N/A	0.05	10	10	224	N/A	TBD at time of application	TBD at time of application
124	198	08-11-09DA	163 Salishan Drive	Salishan	R-1 PD	1985	0.44	100	100.4	188	48	TBD at time of application	TBD at time of application
125	197	08-11-09DA	161 Salishan Drive	Salishan	R-1 PD	2006	0.35	100	91.5	173	33	TBD at time of application	TBD at time of application
126	196	08-11-09DA	159 Salishan Drive	Salishan	R-1 PD	1972	0.26	80	71.5	174	45	TBD at time of application	TBD at time of application
127	312	08-11-09DA	157 Salishan Drive	Salishan	R-1 PD	1970	0.31	80.4	80	179	48	TBD at time of application	TBD at time of application
128	311	08-11-09DA	155 Salishan Drive	Salishan	R-1 PD	1964	0.32	80.4	80	179	20	TBD at time of application	TBD at time of application
129	315	08-11-09DA	153 Salishan Drive	Salishan	R-1 PD	1986	0.53	80.4	80	182	15	TBD at time of application	TBD at time of application
130	310	08-11-09DA	151 Salishan Drive	Salishan	R-1 PD	1965	0.33	80	80.4	183	30	TBD at time of application	TBD at time of application
131	309	08-11-09DA	149 Salishan Drive	Salishan	R-1 PD	1964	0.33	80	80.4	183	31	TBD at time of application	TBD at time of application
132	314	08-11-09DA	147 Salishan Drive	Salishan	R-1 PD	1966	0.34	80	80.4	187	8	TBD at time of application	TBD at time of application
133	313	08-11-09DA	145 Salishan Drive	Salishan	R-1 PD	1967	0.48	91.8	136.9	200	12	TBD at time of application	TBD at time of application
134	399	08-11-09DA	No Situs - "Walkway"	Salishan	R-1 PD	N/A	0.06	10	10	200	N/A	TBD at time of application	TBD at time of application
135	307	08-11-09DA	143 Salishan Drive	Salishan	R-1 PD	1964	0.35	80	81	207	17	TBD at time of application	TBD at time of application
136	305	08-11-09DA	141 Salishan Drive	Salishan	R-1 PD	1982	0.37	80	80	207	25	TBD at time of application	TBD at time of application
137	304	08-11-09DA	19 Ocean Crest Road	Salishan	R-1 PD	1999	0.5	110	106	210	19	TBD at time of application	TBD at time of application
138	301	08-11-09DA	17 Ocean Crest Road	Salishan	R-1 PD	1963	0.59	110	125	260	0	TBD at time of application	TBD at time of application
139	304	08-11-09DD	15 Ocean Crest Road	Salishan	R-1 PD	1964	0.7	118	20	260	13	TBD at time of application	TBD at time of application
140	198	08-11-09DD	No Situs - Misc.	Salishan	R-1 PD	N/A	0.09	75	N/A	60	N/A	TBD at time of application	TBD at time of application
141	120	08-11-09DD	80 Colwell Lane	Salishan	R-1 PD	1963	0.59	75	150	385	14	TBD at time of application	TBD at time of application
142	156	08-11-09DD	88 Colwell Lane	Salishan	R-1 PD	1963	1.28	210	28	250	20	TBD at time of application	TBD at time of application

Appendix G
- Beachgrass Planting Guidelines (from Carlson et al., 1991) -

When To Plant Sand-Stilling Grasses

European and American beachgrass and American dunegrass should be planted when temperatures are between 32 and 60 °F. No planting should be done unless moisture is found within a depth of 3 inches of the dune surface. Most plantings are made during the cool, wet months from late fall through early spring (November 1 to April 15)

Proper temperature is critical. Work done by Brown (1942) at the Warrenton Project indicates erratic survival rates if temperature exceeds 60 °F within a 72-hour period after planting. The effect of warm temperatures late in the planting season can be somewhat minimized by planting at night. All transplanting stock is either stored at 35 °F or shade frames are placed 12 inches above the tops of heeled-in culm bundles. If plantings must be made during warm daytime temperatures, then each bundle of beachgrass is dipped in water to keep it from drying out during the planting process. To ensure success and minimize planting costs, select planting dates well before warm spring days or well after cool fall temperatures have set in.

Planting is not done during freeze periods. Therefore, November, February, and March usually are the best months to plant

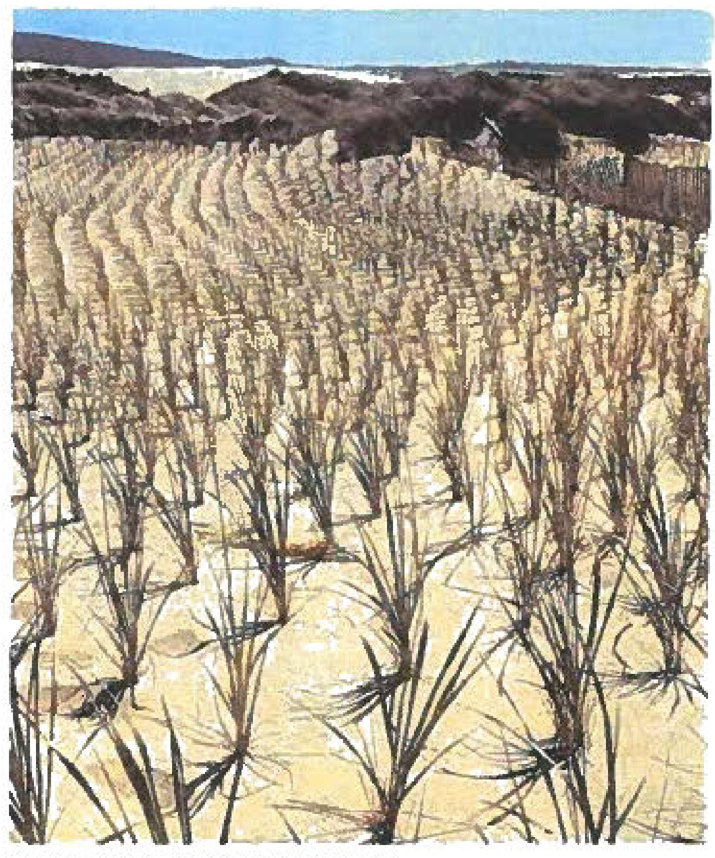
Plantings are usually successful during cool weather in these 3 months, even without precipitation for prolonged periods. Low-lying sites that are moist into early summer may be planted more safely later in middle to late spring than the higher, drier sites.

Plantings for the construction of foredunes should be made in the early spring after danger from severe storms is over. Plantings made earlier can be destroyed by very high tides. Plantings made early in spring establish themselves before the warm weather and grow rapidly as new sand accumulates on the dune throughout the season. A good planting may accumulate as much as 2 feet of sand annually.

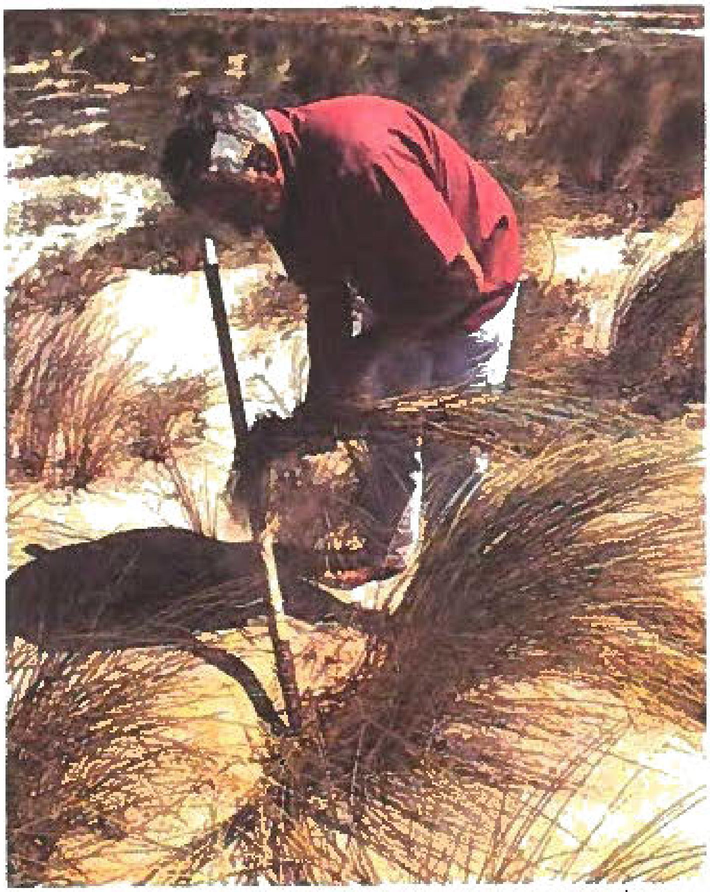
Areas that are subject to winter submergence should be planted in the spring as the water level recedes. Plantings that have not experienced one growing season fail to withstand extended submergence without damage.

Planting Stock

Commercial beachgrass stock may be obtained from nurseries or natural stands of proper age and quality. Nursery stock is dug at 2 years, and thus is designated "2-0" stock. Most natural stands will not produce quality stock, it is only



Shown here is a properly spaced planting of European beachgrass about 4 months after planting.



Beachgrass nursery stock usually originates from fertilized, relatively open, young stands where plants have room to grow and produce large, healthy culms.

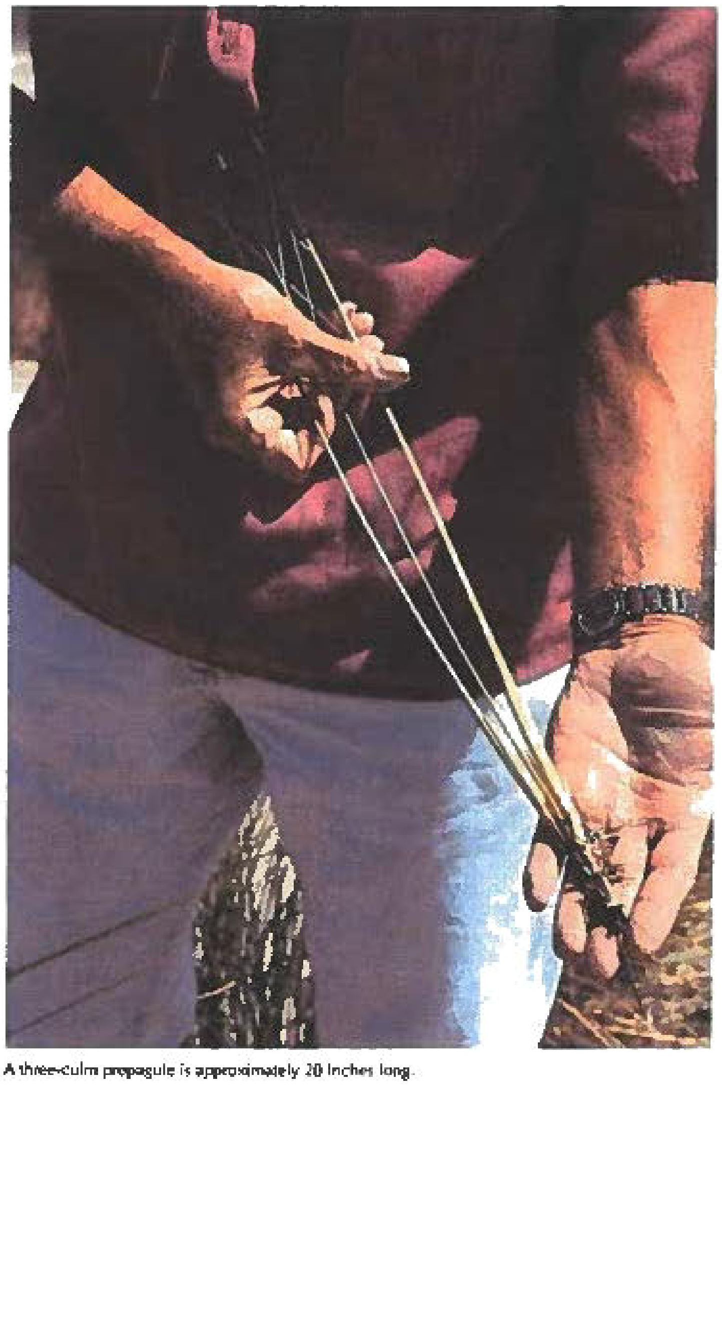
where new sand deposits on existing grass are fertilized that quality stock is produced. This results in 1-0 (1-year-old) stock from plants buried the previous season. Quality planting stock consists of young, vigorous, live culms with one to three root nodes and a minimum of old, dead material. It is not possible to dig old stands because of the excessive cost of removing old dead parts of individual plants. Because of varying growing depths caused by new windblown sand deposits, no specific digging depth is recommended. The grass should be dug at a depth that will ensure that all culms have one to three live root nodes remaining.

After being dug, grass is shaken free of sand, dead trash is cleaned from culms, and the hill or clump is broken into small bunches. Underground stems are broken back to one or two nodes. For convenience in stock accounting and handling, culms are tied into bundles of 10 pounds. After tying, the tops of the stock are cut back with an ax until the overall length is about 20 inches. This gets rid of long leaves that offer more surface for moisture loss and that are subject to wind agitation that could loosen the planted stem from the sand.

In nurseries, stock can be dug each year if given an annual application of fertilizer. When properly fertilized, a new crop will come up from underground stems or rootstalks. Nursery areas can be 95 percent dug without damage to the vegetative cover. New culms quickly regenerate from rhizomes.

Stock is harvested during the planting season. Stock should be collected during the cool, wet months from late fall through early spring (November 1 to April 15), when the plant is most nearly dormant. American dunegrass must be harvested when completely dormant. Dormant stock will have the greatest amount of stored energy and will, therefore, be more vigorous than culms from plants that are actively growing. The beachgrasses (European and American), however, will survive whether or not they are dormant, as long as the stock is harvested and planted in cool weather.

Storing of grass stock is confined to "heeling-in" on the nursery or planting site. It is important when heeling-in to keep the beds narrow, not over two bundles wide, in order to avoid heating of the grass. Bundles should be buried in the trench to a depth of approximately one-half their length, and sand firmed around them. The grass should not be heeled-in where water will stand on the bed as this will cause decomposition of the basal buds of the stem. The heeling-in bed should be a well-drained, damp trench with the roots (nodes) covered to a depth of at least 8 inches. Stock should not be held in heeling-in beds for more than 2 weeks. If



A three-culm propagule is approximately 20 inches long.

planting is late in the season, then either shade frames over the heel-in beds or artificial cold storage at 35 °F is recommended.

Tools for Planting

The most widely used tool for handplanting of beachgrass is the D-handle tile spade with an 18-inch blade. This can be thrust directly to a depth of 12 inches into the sand and provides the best hole that can be achieved for easy planting of the beachgrass culms. Planters normally make several hundred holes with this tool before planting.

Steep slopes must be planted by hand. However, on the less sloping areas, transplanting machines have been used with success since 1960 for larger plantings of 5 acres or more from Santa Maria, California, to Westport, Washington (Ternyik 1979b).

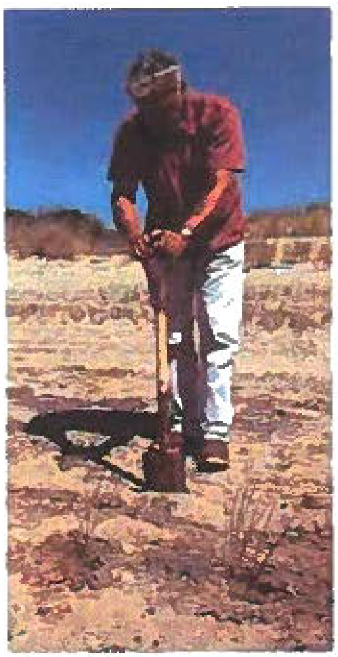
The planting machines now used for large plantings are modified, commercial row crop transplanting machines. The planting shoe was redesigned to get the 12-inch depths specified for beachgrass plantings. Pulling these machines are small, crawler type tractors equipped with a rear-mounted hydraulic hitch. Two machines are now used behind each tractor, with four people on the machines. This combination will allow five people (including driver) to plant from 1 to 3 acres per day, depending on the conditions at the site. The primary conditions determining planting speed are weather, degree of slope, and type of sand.

Methods of Planting

Beachgrasses should be planted to a depth of 12 inches and the sand compacted to remove air around the roots and stem nodes. The top of the plant should be upright and extend approximately 8 inches above the ground.

Handplanting requires wet sand, otherwise holes are not open and the planters break the stock trying to force it into a closed hole. This results in high plant mortality. Transplanting machines can plant through 6 inches of dry sand. As a last resort, irrigation also can prepare a dry dune for planting.

For most sites along the Pacific coast, a hill spacing of 18 inches, with three culms per hill is sufficient. On sites exposed to more severe weathering, in areas surrounded by particularly valuable property, or on steep slopes or sand sea cliffs, closer planting with hill spacing approximately 12 inches and up to five culms per hill is needed. Well-protected sites can be stabilized by wider-than-normal spacings. A summary of planting rates that were found to be successful on the



A

B

C

A beachgrass hand-planting operation includes (a) opening a 12-inch-deep hole in wet sand with a tile spade, (b) placing a beachgrass propagule in the hole and leaving an 8-inch top, and (c) tamping sand around the propagule with the heel of a boot.

Clatsop Plains area are given in table 2. True economy in planting is achieved when hill spacing and the number of culms per hill are adjusted to the onsite conditions.

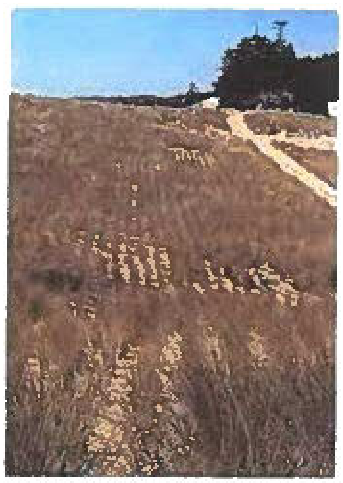
Fertilizing the Plantings

All planted areas should be fertilized with coarse-particle ammonium sulfate commercial fertilizer (N-P-K 21-0-0). This formulation should be applied at a rate of 42 pounds of available nitrogen per acre (200 pounds) during a period of light wind and steady rain. Rain is needed to thoroughly dissolve the fertilizer—a minimum of 4 hours of light rain or 2 hours of a downpour. If this is not done, fertilizer granules will be transported by winds, resulting in uneven distribution. Experience and weather forecasts are vital to ensure that the fertilizer is dissolved shortly after broadcasting. Irrigation may be substituted for rain, but usually is costly.

If the forward slope is steep or if sand sea cliffs have been planted, fertilizer must be applied immediately after planting so that it can be caught in the footprints left by the planting operation. If not, the fertilizer will filter to the bottom of the slope as the sand dries and no growth will occur on upper slopes. It is recommended that fertilizer application on these steep banks be doubled to 400 pounds of N-P-K 21-0-0 per acre. If necessary, irrigate lightly and long enough to dissolve the fertilizer.

In cases where planting stock is scarce, the use of fertilizer on plantings with wider-than-normal spacing may be cheaper than deferring planting until more stock becomes available.

Followup fertilization on established plantings is best done on the Pacific coast dunes when the most rapid spring growth begins. In Washington, this is April 1 to April 15; in Oregon, it is March 1 to April 1; and in California, it is February 15 to March 1. There is usually plenty of moisture at these times and this permits the fertilizer to penetrate to the grass root system.



This site needs fertilizer to maintain adequate cover.

Most fertilizer is applied by hand, out of buckets, or with hand-operated cyclone type spreaders. This is because newly planted beachgrass is severely damaged by tractor-mounted spreaders. Two-year-old, well-established beachgrass plantings can be fertilized with tractor-mounted spreaders with little damage. Fertilizer usually is not spread by airplane unless the almost ever-present winds, which tend to drift the fertilizer, are absent.

Maintaining Dunegrass Stands

In this initial stage of dune stabilization it is important to develop and maintain an even vegetal cover that is devoid of breaks until secondary or permanent cover is established. Some maintenance is usually necessary because of poor hill survival, excessively wide spacing, or failure to plant all exposed areas. This requires temporary brush mats in summer and prompt replanting in the winter. American beachgrass is the most satisfactory plant for such repair work because it competes better than European beachgrass with surrounding European beachgrass systems (McLaughlin and Brown 1942).

Table 2.—Hill spacing and culms per hill for European beachgrass

	High-intensity stabilization		Moderate-intensity stabilization	
Site conditions	Spacing	Culms	Spacing	Culms
	Inches	*Number*	*Inches*	*Number*
Steep slopes				
Windward				
Dry	12 by 12	3	18 by 18	5
Moist	18 by 18	5	18 by 18	3
Leeward				
Dry	18 by 18	5	18 by 18	3
Moist	18 by 18	3	24 by 24	5
Flat areas				
Exposed to high winds				
Dry	18 by 18	5	18 by 18	3
Moist	18 by 18	5	18 by 18	3
Exposed to moderate winds				
Dry	18 by 18	3	18 by 18	5
Moist	18 by 18	5	24 by 24	5
Irregular topography				
Exposed to high winds				
Dry	12 by 12	5	18 by 18	5
Moist	18 by 18	5	18 by 18	3
Exposed to moderate winds				
Dry	18 by 18	5	18 by 18	3
Moist	18 by 18	5	18 by 18	3

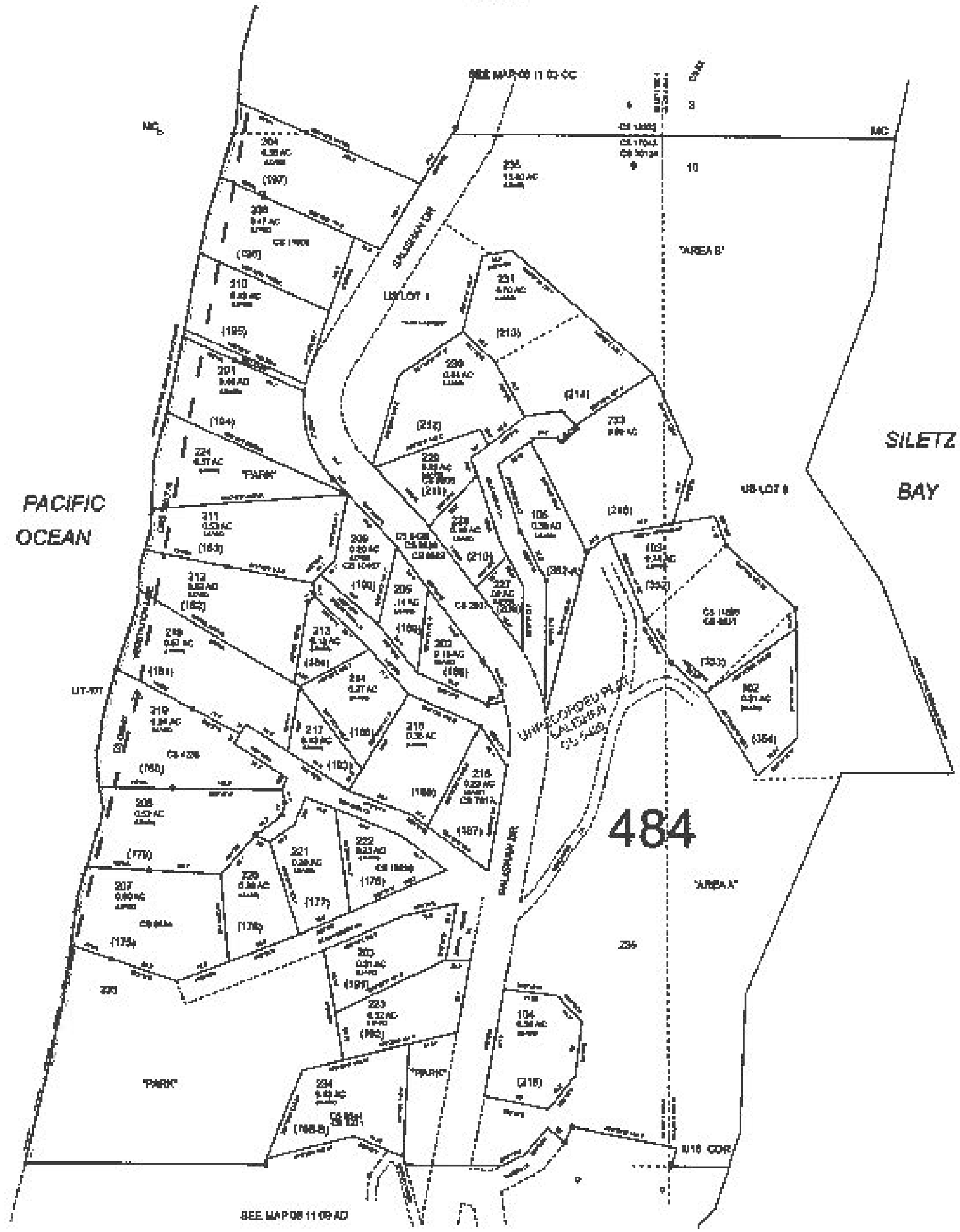
Appendix H
- Oregon Parks and Recreation Department, Ocean Shore Permit Application Form -
(Including Application Fee Form, page 8 of 9, Planning Department Affidavit, page 9 of 9)

THIS MAP WAS PREPARED FOR ASSESSMENT PURPOSE ONLY

N.E.1/4 N.E.1/4 SEC.9 T.8S. R.11W. W.M.
LINCOLN COUNTY
1" = 100'

08 11 09 AA

Cancelled
800
801
235
236
232
236
237
238
239
240
241
242
243
244
245
246
247
248
249
250
251
252
253



Revised: SEB
01/07/2006

08 11 09 AA