GEI Consultants

Scarborough Flood Vulnerability Assessment
Pine Point Beach Neighborhood Meeting

Leila Pike, P.E.
Lisa Vickers

September 9th, 2025

Presentation Outline

1. Introduction
2. Flood Exposure and StoryMap
3. Adaptation Recommendations for Pine Point
4. Homeowner Adaptation Guide Tutorial
5. Next Steps

Introduction

PROJECT PURPOSE

Screening-level **coastal flood risk study** to identify areas and infrastructure at risk to flooding, propose **high-level adaptation** strategies, develop **pilot projects** to dive deeper into adaptation, and **review Town ordinances** to find opportunities to promote resilience.

Throughout the project, field work, **public engagement**, working group **meetings**, and draft technical **memos**.

Introduction

Spring 2024
Project Kickoff

Summer 2024
Community Presentations
Data Review
Vulnerability Assessment
Pump Station Survey

Fall 2024
Vulnerability Assessment

Winter 2024/5
Draft StoryMap
Pilot Projects

Spring 2025
Ordinance Review
Adaptation Report
Pilot Projects

Summer 2025
Pilot Projects
Council Meeting

Fall 2025
Neighborhood Meetings
Final StoryMap
Executive Summary

Introduction

We are here.

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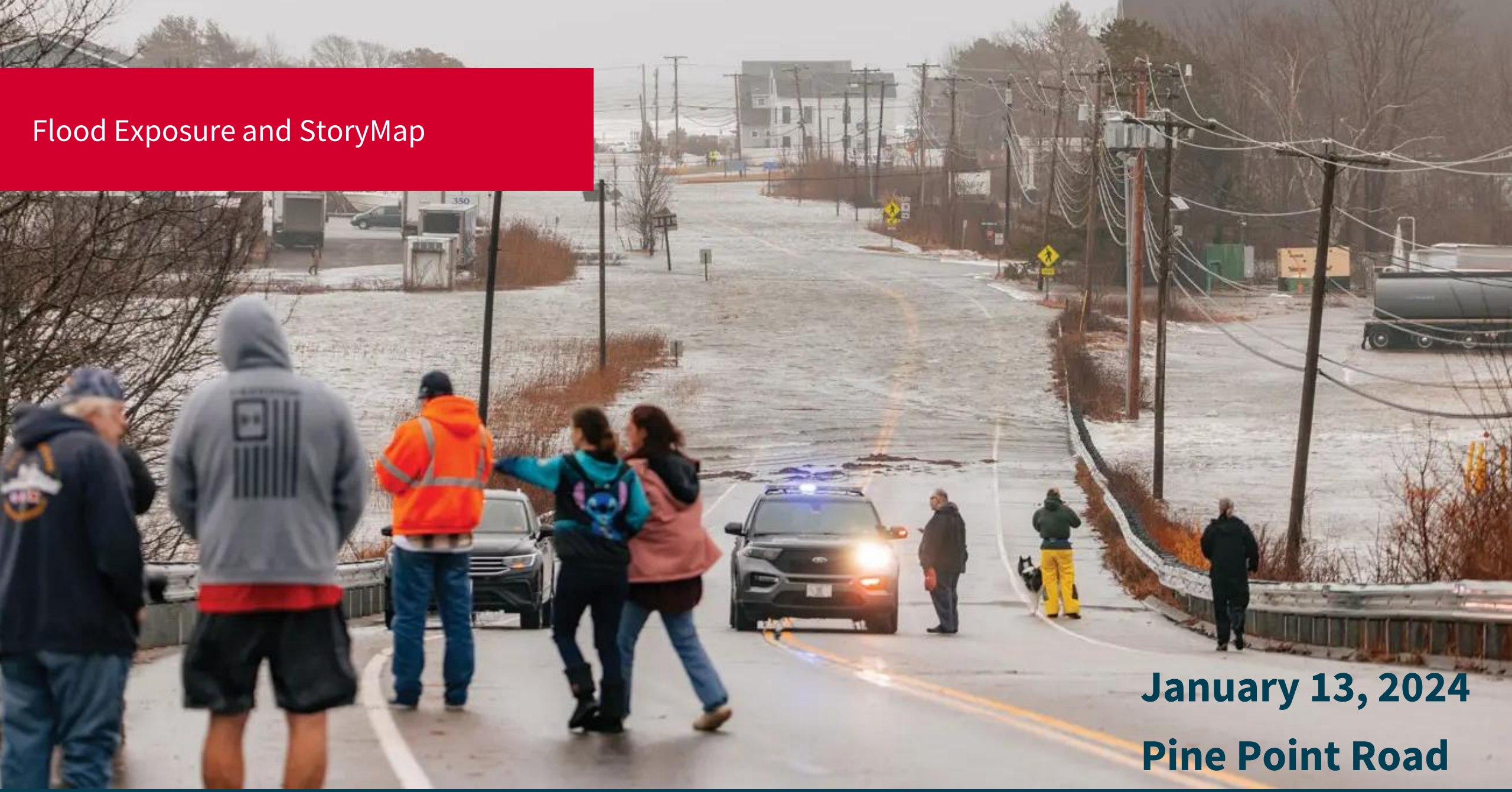
Flood Exposure and StoryMap



January 13, 2024

Pine Point Road

Which areas and what infrastructure are at risk of **coastal flooding** now and in the future?

*Coastal flooding is flooding due to **high tides** and/or **coastal storm surge**. Coastal flooding will likely worsen with **increasing sea levels**.*

Final Flood Scenarios

Flood Scenario	Water Surface Elevation (ft)	Flood Risk Time Horizon	
		Coastal Storm Event	"High Tide"
1	7.3	Now	2030
2	8.0	Now	2050
3	8.8	Now	2050
4	9.6	Now	2100
5	10.3	2030	2100
6	10.8	2050	2100
7	11.4	2050	2100
8	12.8	2100	2100
9	13.9	2100	2100
10	16.9	2100	2100

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"King Tide" in 2050 (1.9 ft SLR):

Similar to January 13, 2024 event:

100-yr storm in 2050 (1.5 ft SLR):

"King Tide" in 2100 (4.0 ft SLR):

100-yr storm in 2100 (4.0 ft SLR):

Final Flood Scenarios

“King Tide” in 2050 (1.9 ft SLR):
Similar to January 13, 2024 event:
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“King Tide” in 2100 (4.0 ft SLR):
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What isn't included?

- Wave action
- Rain events

Flood Results in StoryMap

Flood Exposure and StoryMap

Flood Scenario	Water Surface Elevation (ft)	Flood Risk Time Horizon	
		Coastal Storm Event	"High Tide"
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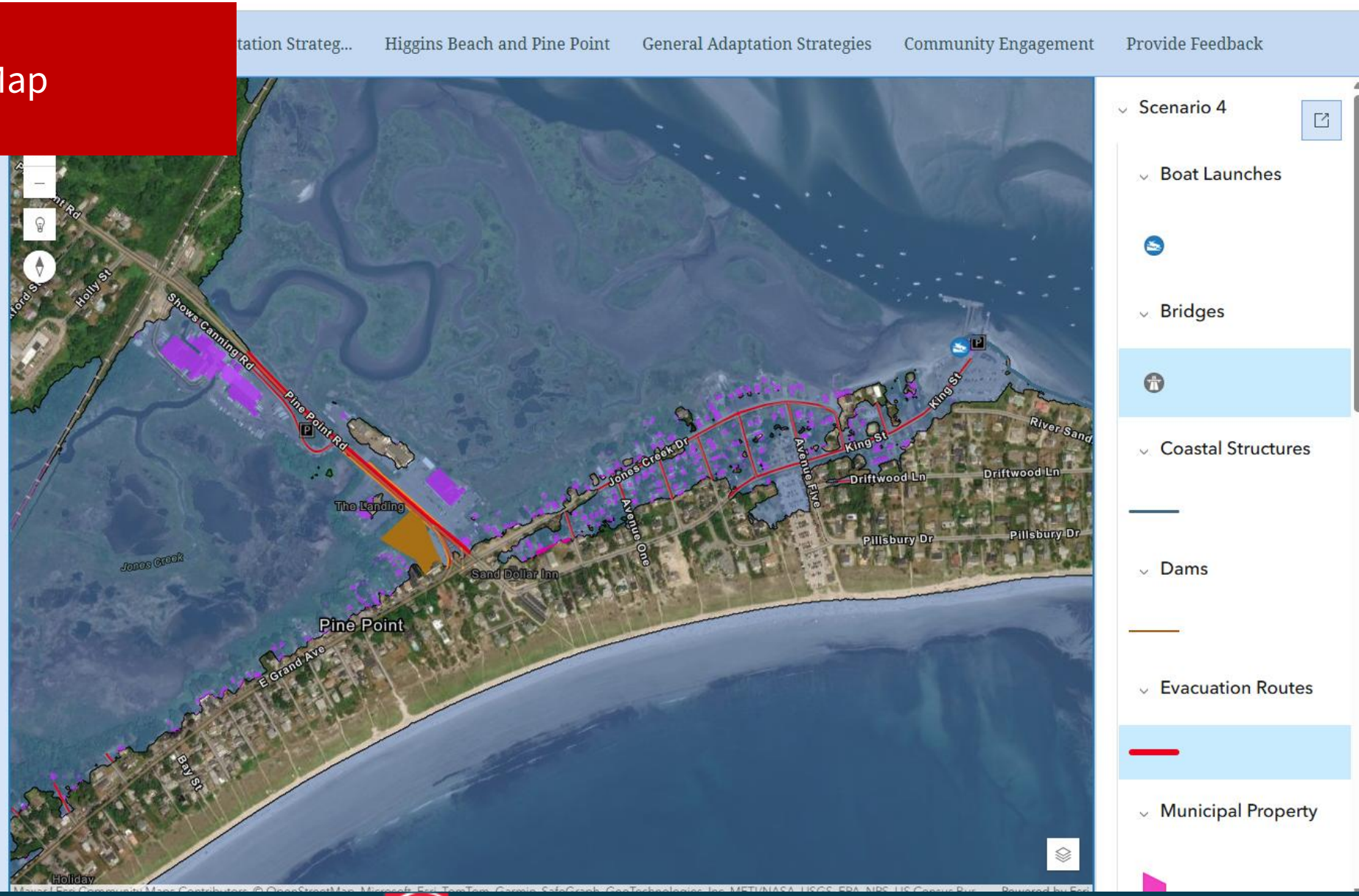
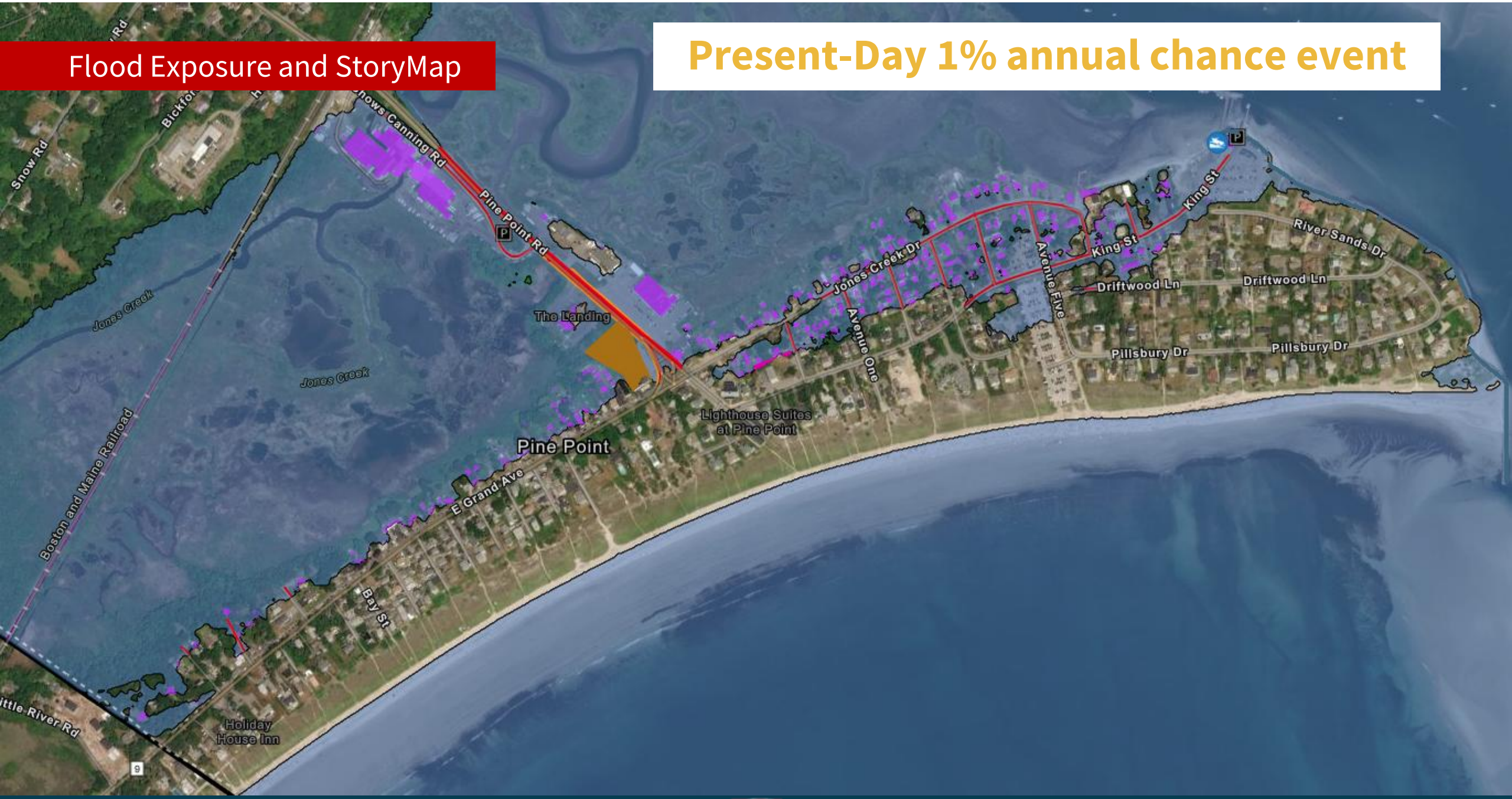
- To move around the map, click the map and hold and drag your cursor.
- To zoom in and out, use your mouse wheel or click the "+" and "-" buttons in the top left corner of the map.
- To view the the inundation extents from different flood scenarios, click the layer list icon in the bottom right corner of the map and click the eye icon to turn on and off the layer visibility.



Flood Exposure and StoryMap

Present-Day 1% annual chance event



Flood Exposure and StoryMap

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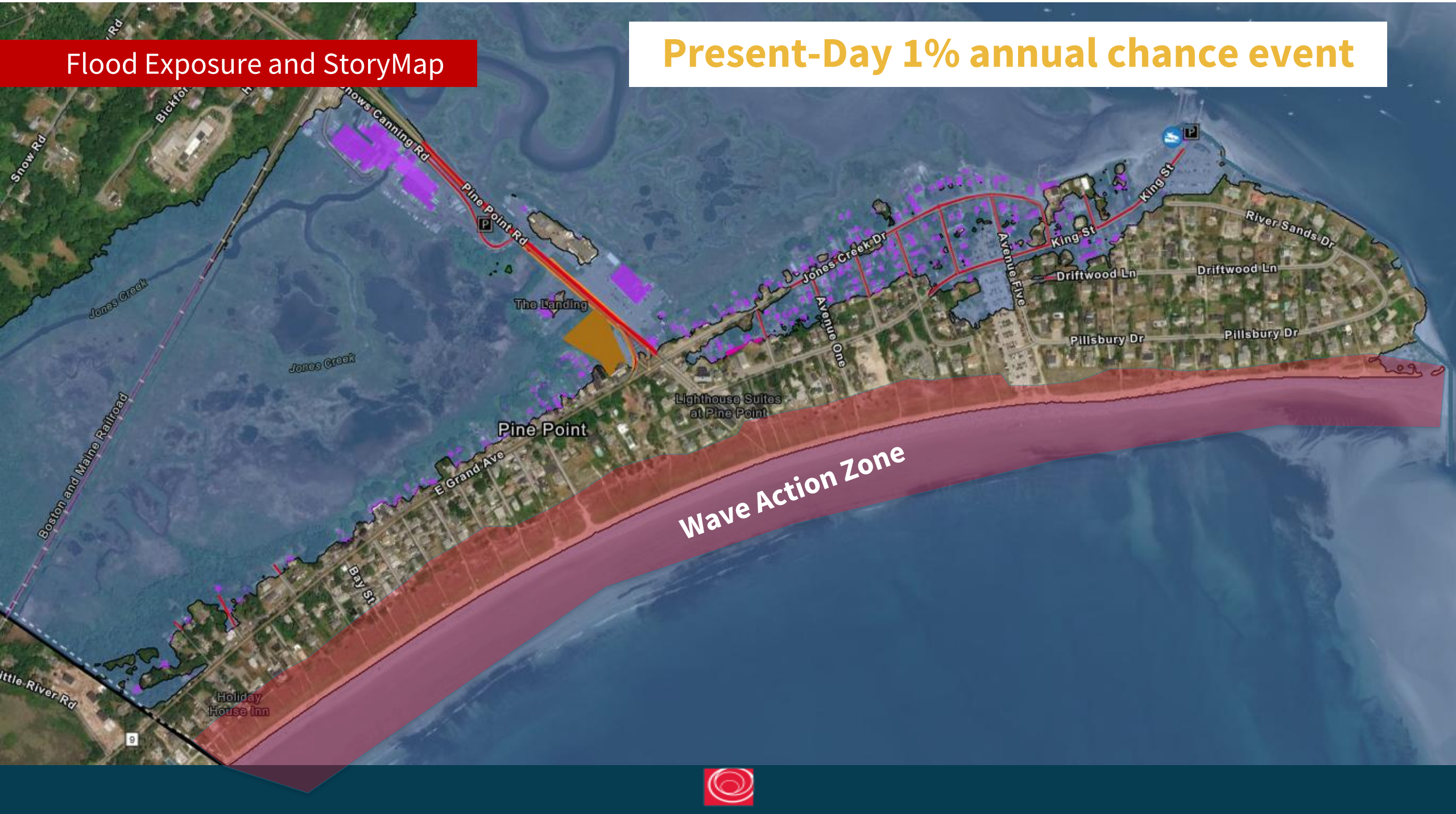
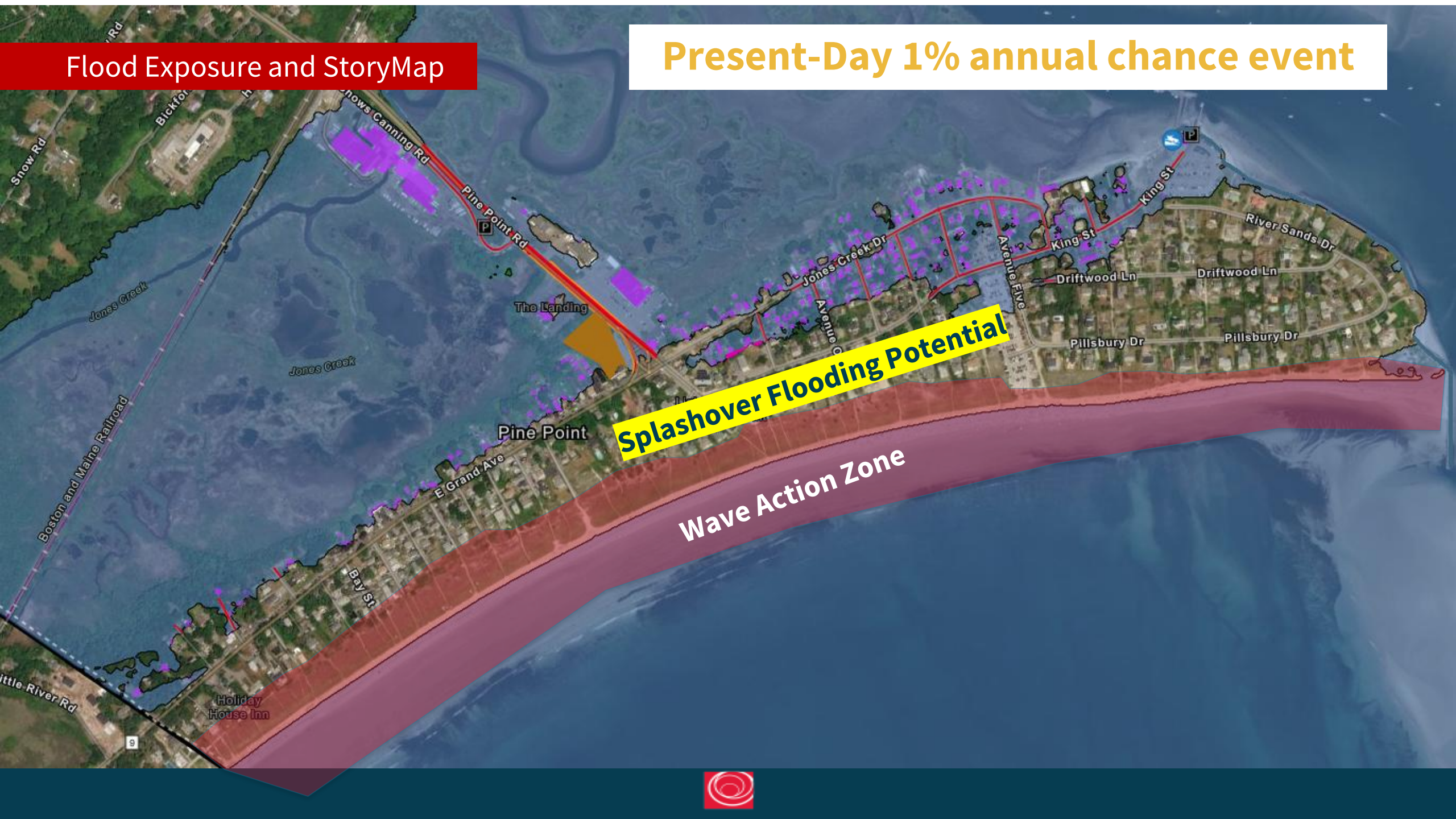
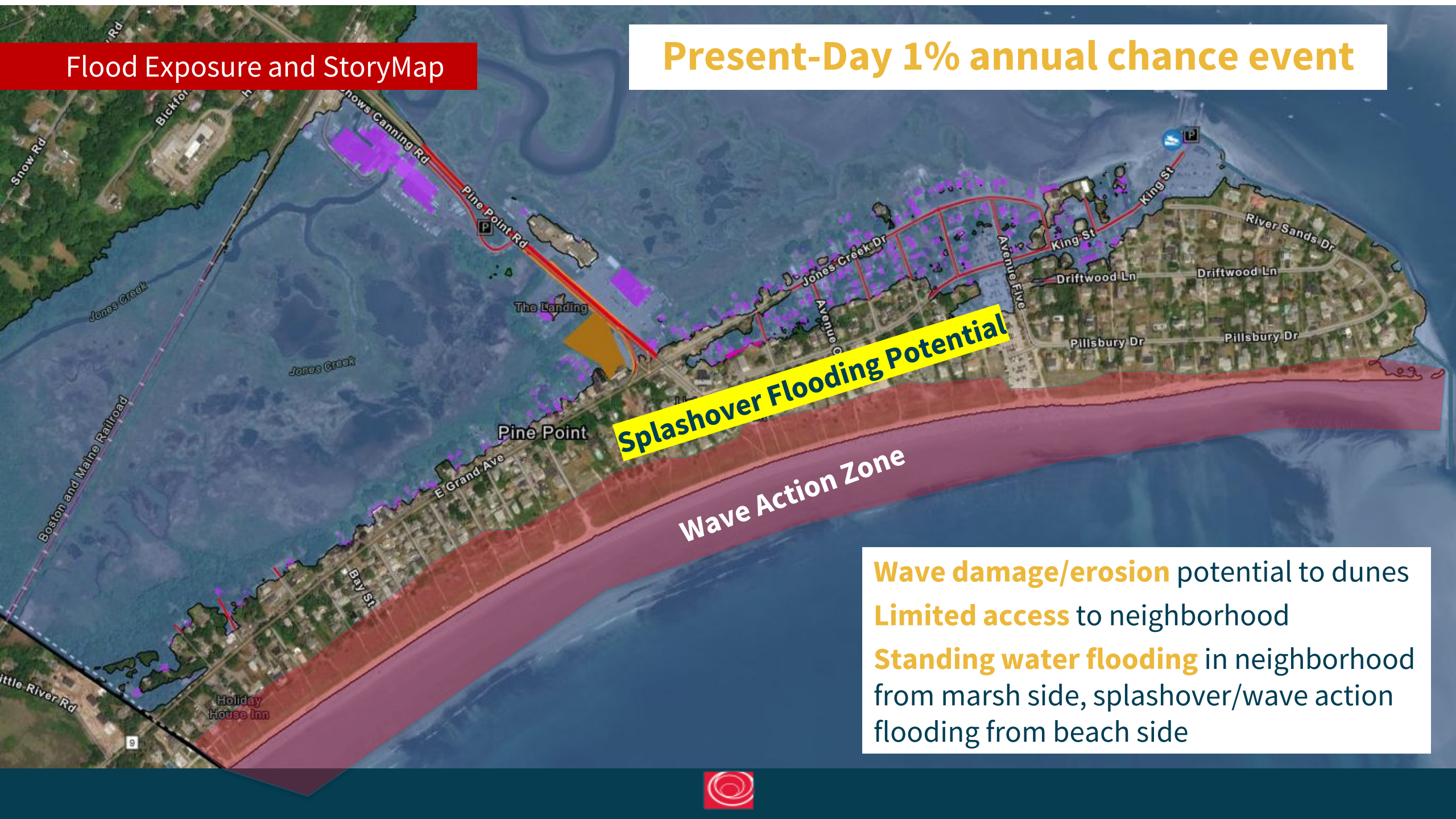



Flood Exposure and StoryMap
Present-Day 1% annual chance event
Splashover Flooding Potential
Wave Action Zone
Pine Point
The Landing
Pine Point Rd
Shows Canning Rd
Snow Rd
Jones Creek
Jones Creek Dr
Avenue Five
King St
Driftwood Ln
River Sands Dr
Pillsbury Dr
E Grand Ave
Bay St
Boston and Maine Railroad
Holiday House Inn

Flood Exposure and StoryMap

Present-Day 1% annual chance event



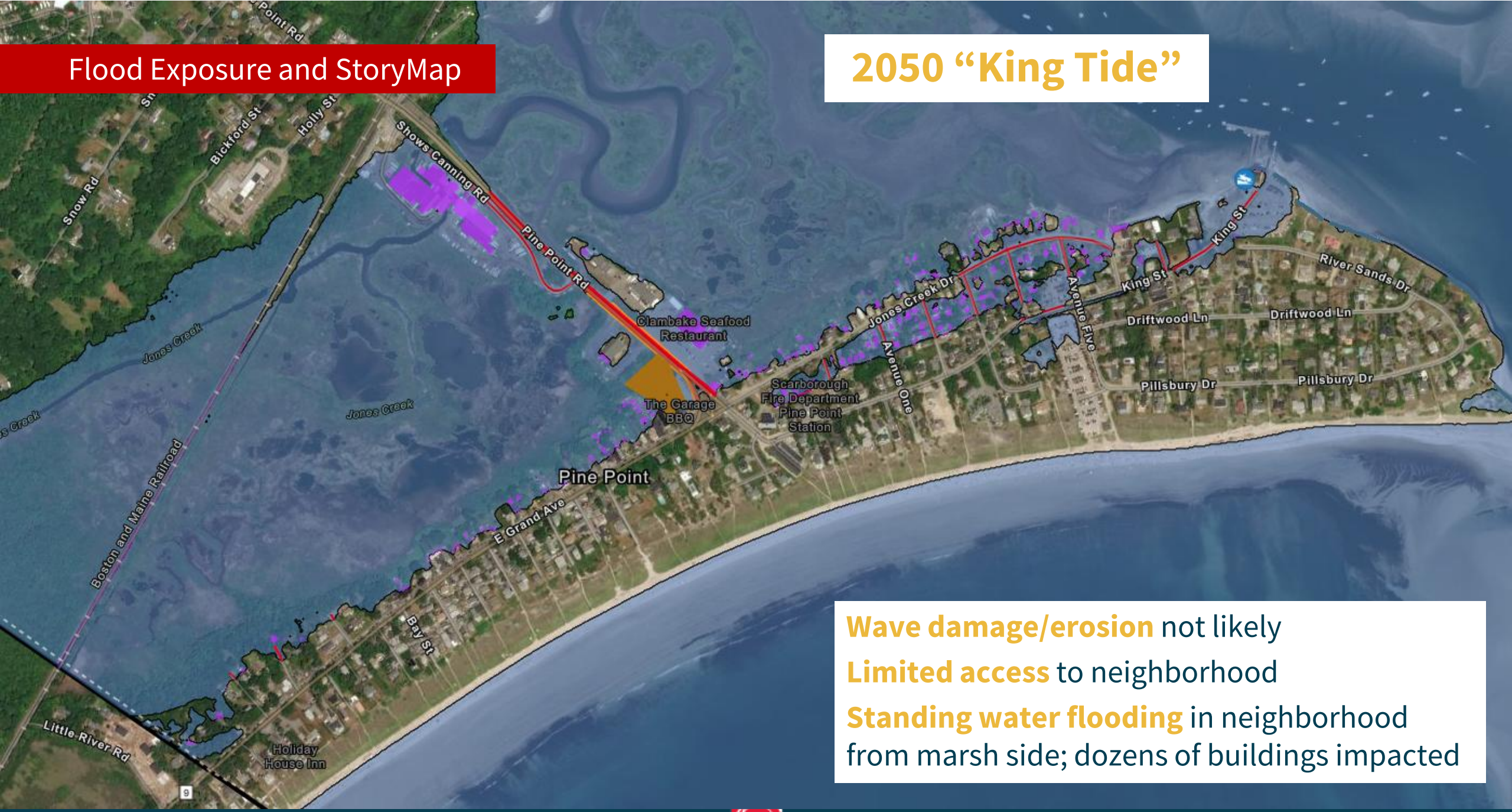
Wave damage/erosion potential to dunes

Limited access to neighborhood

Standing water flooding in neighborhood from marsh side, splashover/wave action flooding from beach side

Flood Exposure and StoryMap

2050 “King Tide”



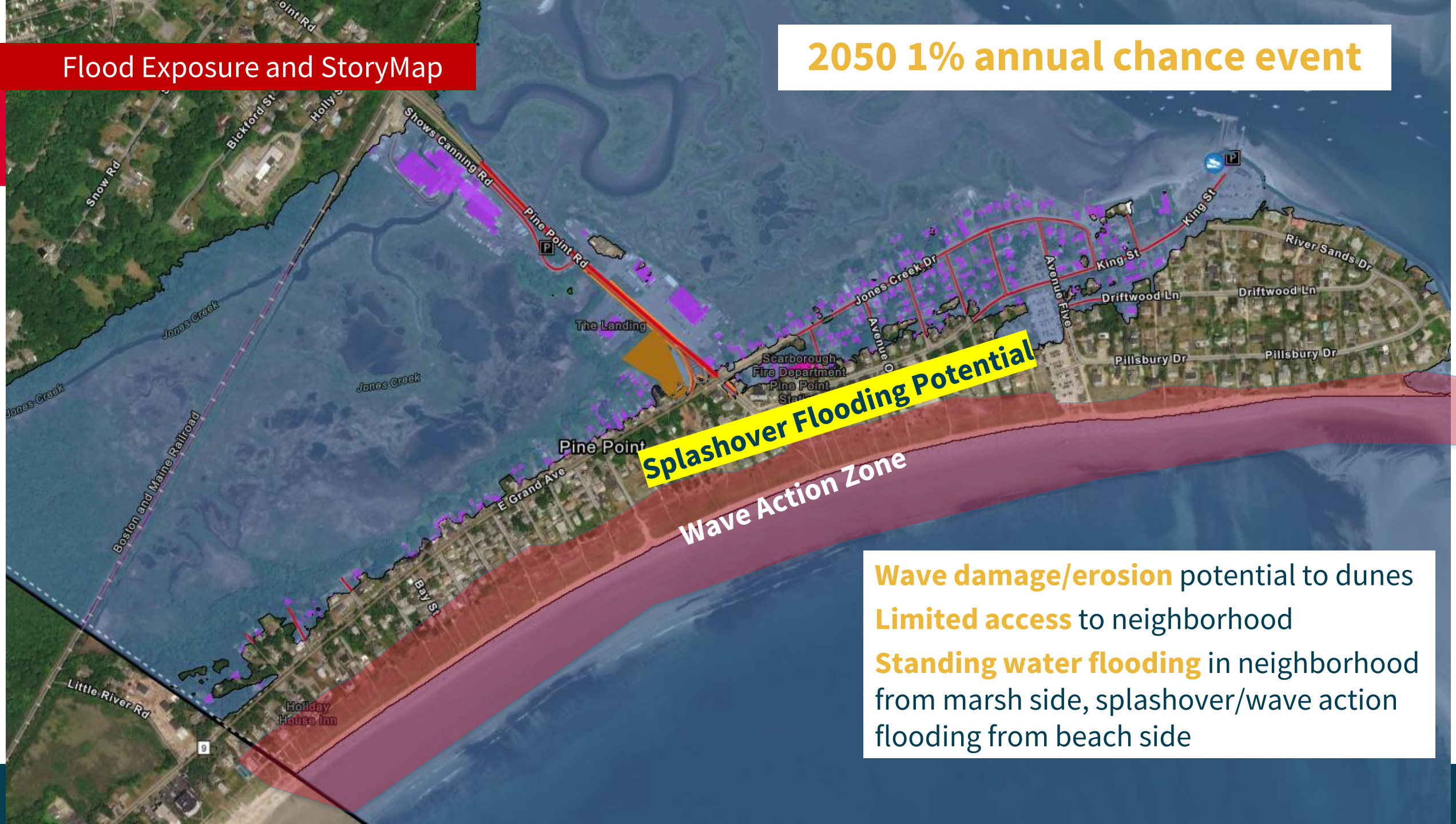
Wave damage/erosion not likely

Limited access to neighborhood

Standing water flooding in neighborhood from marsh side; dozens of buildings impacted

Flood Exposure and StoryMap

2050 1% annual chance event



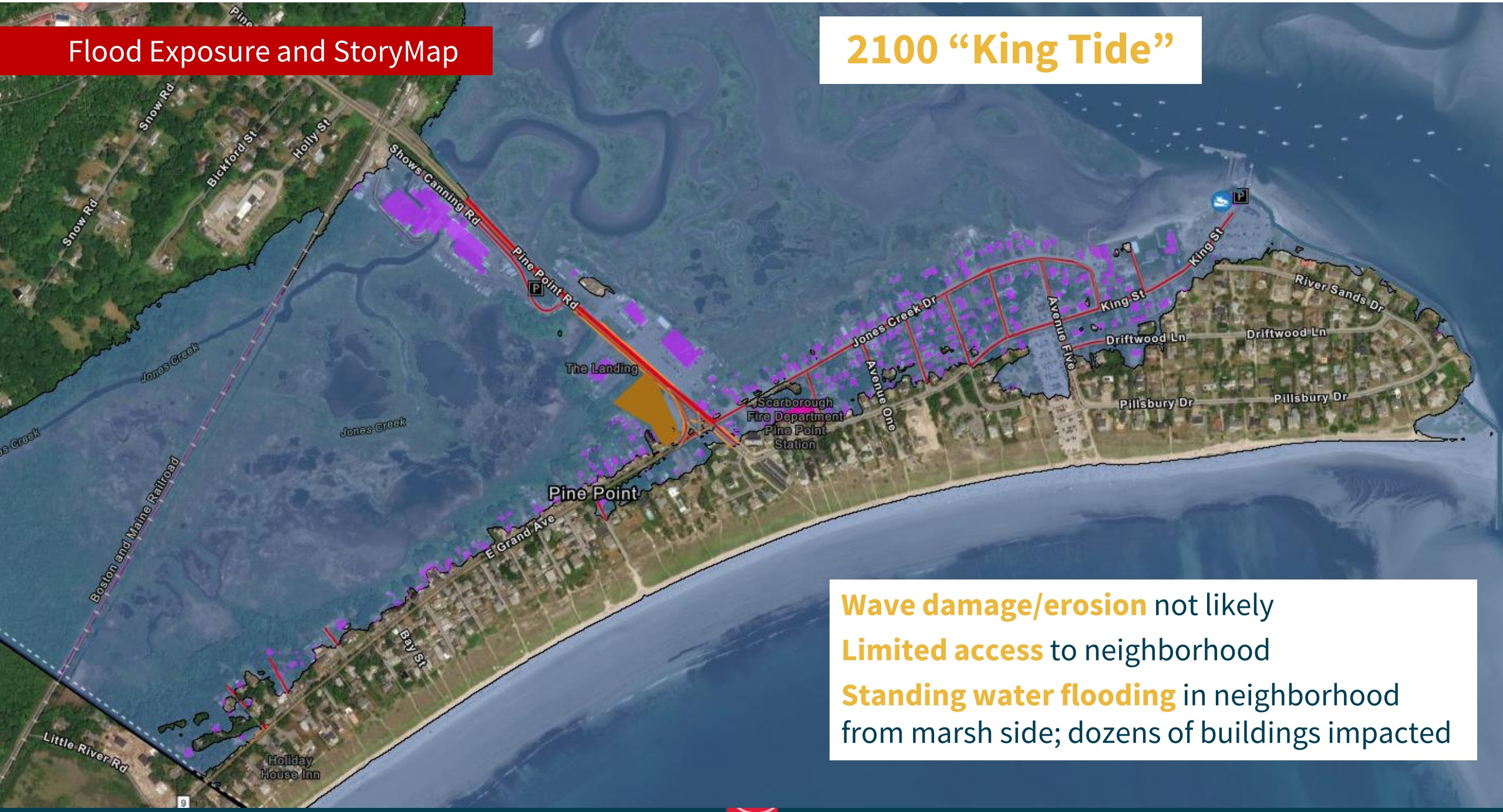
Wave damage/erosion potential to dunes

Limited access to neighborhood

Standing water flooding in neighborhood from marsh side, splashover/wave action flooding from beach side

Flood Exposure and StoryMap

2100 “King Tide”



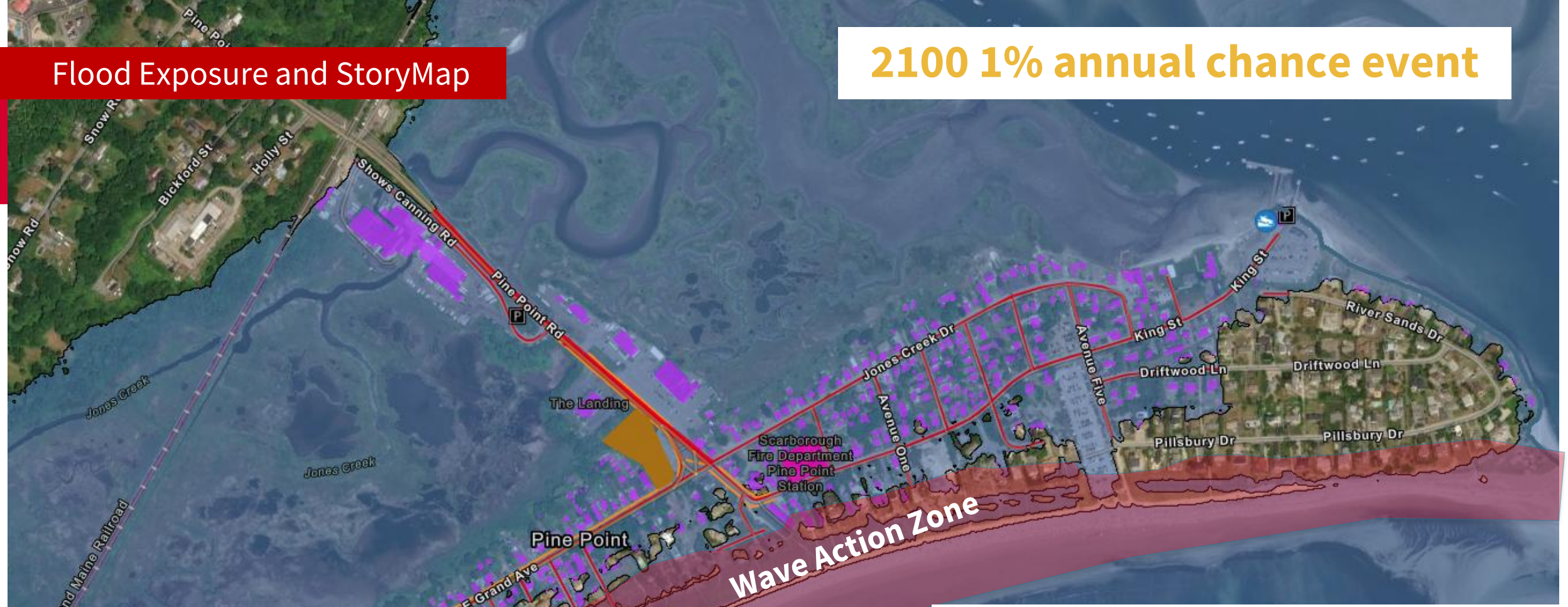
Wave damage/erosion not likely

Limited access to neighborhood

Standing water flooding in neighborhood from marsh side; dozens of buildings impacted

Flood Exposure and StoryMap

2100 1% annual chance event



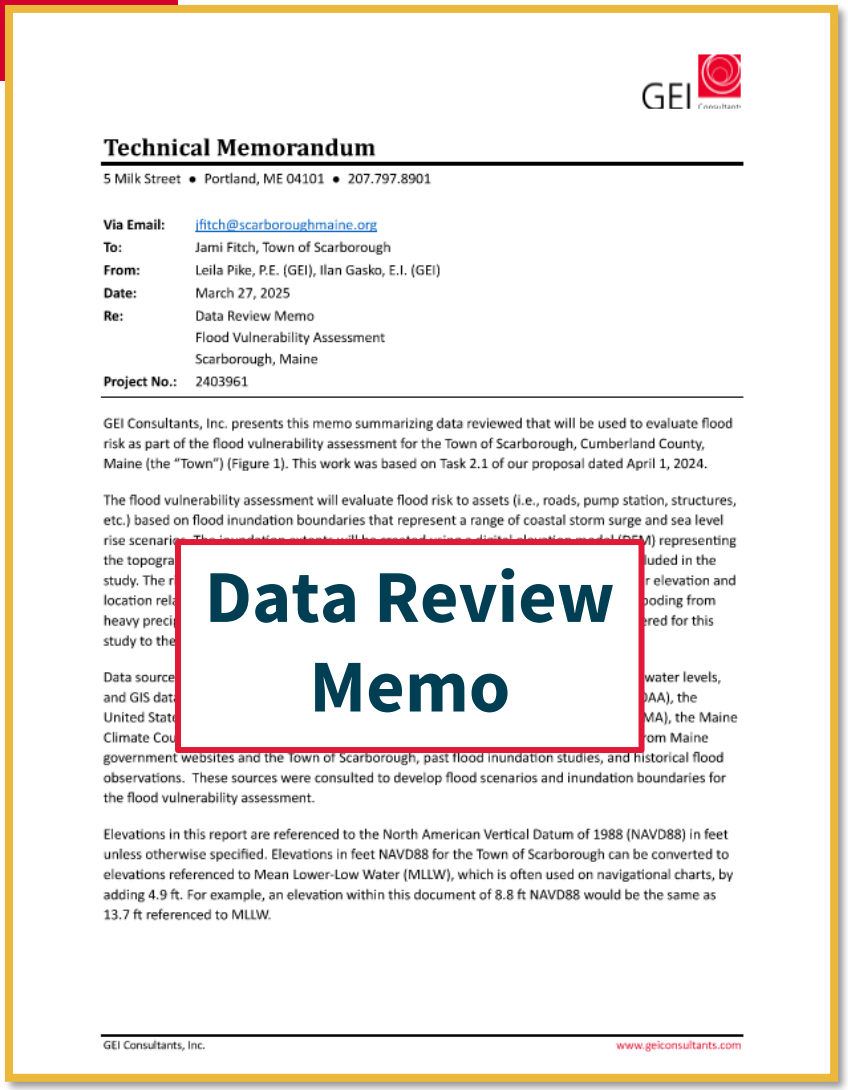
Wave damage/erosion potential to dunes

Limited access to neighborhood

Standing water flooding in neighborhood from marsh side, splashover/wave action flooding from beach side

Flood Exposure and StoryMap

The StoryMap is paired with technical **memos and reports** detailing methods and results. Links to these documents are (or will be) **provided in the StoryMap**.



GEI

Technical Memorandum

5 Milk Street • Portland, ME 04101 • 207.797.8901

Via Email: jfitch@scarboroughmaine.org
To: Jami Fitch, Town of Scarborough
From: Leila Pike, P.E. (GEI), Ilan Gasko, E.I. (GEI)
Date: March 27, 2025
Re: Data Review Memo
Flood Vulnerability Assessment
Scarborough, Maine
Project No.: 2403961

GEI Consultants, Inc. presents this memo summarizing data reviewed that will be used to evaluate flood risk as part of the flood vulnerability assessment for the Town of Scarborough, Cumberland County, Maine (the "Town") (Figure 1). This work was based on Task 2.1 of our proposal dated April 1, 2024.

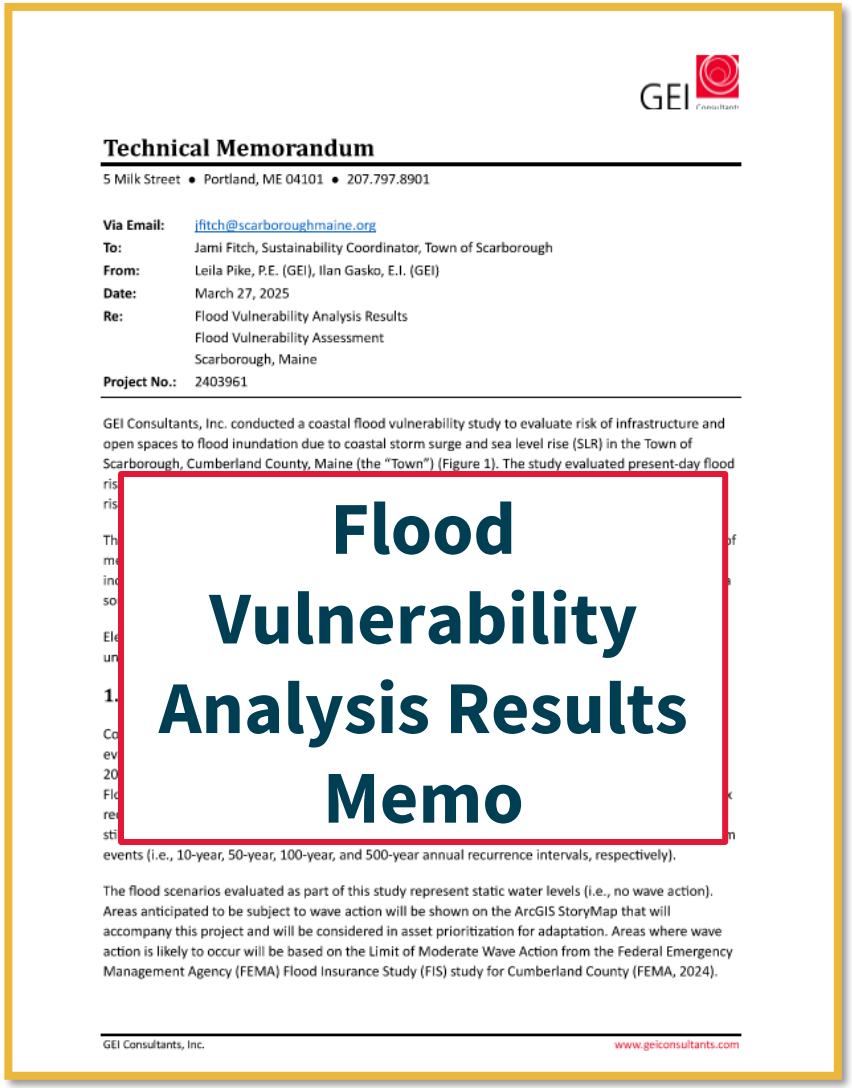
The flood vulnerability assessment will evaluate flood risk to assets (i.e., roads, pump station, structures, etc.) based on flood inundation boundaries that represent a range of coastal storm surge and sea level rise scenarios. The inundation extents will be created using a digital elevation model (DEM) representing the topogra luded in the study. The r r elevation and location rela ooding from heavy preci ered for this study to the

Data source water levels, and GIS data AA), the United State MA), the Maine Climate Cou om Maine government websites and the Town of Scarborough, past flood inundation studies, and historical flood observations. These sources were consulted to develop flood scenarios and inundation boundaries for the flood vulnerability assessment.

Elevations in this report are referenced to the North American Vertical Datum of 1988 (NAVD88) in feet unless otherwise specified. Elevations in feet NAVD88 for the Town of Scarborough can be converted to elevations referenced to Mean Lower-Low Water (MLLW), which is often used on navigational charts, by adding 4.9 ft. For example, an elevation within this document of 8.8 ft NAVD88 would be the same as 13.7 ft referenced to MLLW.

GEI Consultants, Inc. www.geiconsultants.com

Data Review Memo



GEI

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Via Email: jfitch@scarboroughmaine.org
To: Jami Fitch, Sustainability Coordinator, Town of Scarborough
From: Leila Pike, P.E. (GEI), Ilan Gasko, E.I. (GEI)
Date: March 27, 2025
Re: Flood Vulnerability Analysis Results
Flood Vulnerability Assessment
Scarborough, Maine
Project No.: 2403961

GEI Consultants, Inc. conducted a coastal flood vulnerability study to evaluate risk of infrastructure and open spaces to flood inundation due to coastal storm surge and sea level rise (SLR) in the Town of Scarborough, Cumberland County, Maine (the "Town") (Figure 1). The study evaluated present-day flood ris ris

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Co ev 20 Flo re sti n events (i.e., 10-year, 50-year, 100-year, and 500-year annual recurrence intervals, respectively).

The flood scenarios evaluated as part of this study represent static water levels (i.e., no wave action). Areas anticipated to be subject to wave action will be shown on the ArcGIS StoryMap that will accompany this project and will be considered in asset prioritization for adaptation. Areas where wave action is likely to occur will be based on the Limit of Moderate Wave Action from the Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) study for Cumberland County (FEMA, 2024).

GEI Consultants, Inc. www.geiconsultants.com

Flood Vulnerability Analysis Results Memo

Flood Exposure and StoryMap

Over **100 public roads** were identified as at-risk to coastal flooding, with **38** at-risk for present-day water levels and **62** at-risk by 2050.

A **risk-based prioritization** process was used to rank the roads in order of prioritization, based on **flood exposure** and **consequences**.

Consequences included: **area** impacted, impact to **public safety**, **damage** potential, **environmental** impact, and **economic** impact.

Flood Exposure and StoryMap

Consequences Matrix developed in consultation with the project working group

Table 2-1. Consequence Score Guidance Matrix

Consequence Score	Area Impact (# Buildings)[1]	Public Safety Impact[2]	Damage Potential[3]	Environmental Impact[4]	Economic Impact[5]
5 (Very High)	>150	Official evacuation route	- Has experienced damage in the past - In FEMA VE Zone - Utility infrastructure below roadway	>= 8 habitats impacted	In TCV1, Industrial Zone, Industrial Overlay; or AADT > 5,000
4 (High)	75-150	- Access to critical infrastructure or services - Unofficial evacuation route	In FEMA VE Zone	6-7 habitats impacted	AADT > 1,000
3 (Medium)	25-75	No alternate route	Revetment along roadway with scour potential	4-5 habitats impacted	In Beach Mixed Use or Town and Village Center Zone 4
2 (Low)	5-25	- Alternate route - No alternate access, but impacts property that would already be flooded	Stillwater inundation	1-3 habitats impacted	In Town and Village Transition and Fringe Zones or Coastal Mixed Use
1 (None)	<5	No impact (e.g., end of dead-end street)	High-tide inundation, no revetment, or other coastal structures	No habitats impacted	In Residential and Rural Farming Zones

Flood Exposure and StoryMap

Table 3-2. Top 30 Ranked Roads Based on Weighted Risk Score, Alphabetical Order

Road Name		
Avenue 1	E Grand Ave	Pine Point Rd*
Avenue 2	Ferry Rd	Route 1
Avenue 5	Jones Creek Dr	Route 9*
Avenue 6	Kent St	Sawyer St
Avenue 7	King St	Shipwreck Rd
Bayview Ave	Milliken Rd	Snow Canning Rd
Black Point Rd	Morning St	Spurwink Rd
Champion St	Ocean Ave	Vesper St
Clay Pits Rd	Old Neck Rd	Winnocks Neck Rd
Driftwood Ln	Payne Rd	Winnocks Neck to Plummer Island

Note: Route 9 refers to the section of Route 9 near the Scarborough Marsh Audubon Center currently planned for adaptation as part of the MaineDOT Route 1 and Route 9 Adaptation Project. Pine Point Road refers to the section of Route 9 near Jones Creek.

Flood Exposure and StoryMap

11 of Top 30 roads in Pine Point Beach Neighborhood

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Flood Exposure and StoryMap

Champion Street

Clay Pits Road

Driftwood Lane

East Grand Avenue

Ferry Road

Jones Creek Drive

Kent Street

King Street

Milliken Road

Morning Street

Ocean Avenue

Old Neck Road

Road Prioritization

Methods and results detailed in the **Adaptation Prioritization Methodology for Public Roadways** memo

GEI Consultants

Technical Memorandum

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Via Email: jfitch@scarboroughmaine.org
To: Jami Fitch, Sustainability Coordinator, Town of Scarborough
From: Leila Pike, P.E. (GEI), Ilan Gasko, E.I. (GEI)
Date: Revised August 6, 2025 (June 9, 2025)
Re: Adaptation Prioritization Methodology for Public Roadways
Flood Vulnerability Assessment
Scarborough, Maine
Project No.: 2403961

GEI Consultants, Inc. (GEI) conducted a risk-based prioritization assessment for roadways identified as at-risk of coastal flooding as part of the flood vulnerability assessment for the Town of Scarborough, Cumberland County, Maine (the "Town") (Figure 1). This work builds off the data review and flood vulnerability analysis efforts that were documented in previous memos provided to the Town (GEI, 2025a,b). The prior memos detail the data, methods, and results of the flood exposure analysis for the Town. The goal of this memo is to document the method used to prioritize roadways for adaptation based on their flood exposure and consequences.

The flood exposure study identified 111 publicly owned roads that would be at risk of coastal flooding under the flood scenarios included in this study. Through the risk-based prioritization process, the roads were ranked for adaptation prioritization based on their flood exposure and agreed upon consequence metrics. The top 30 "ranked" roads are presented within this memo and the full list of ranked roads is provided in Appendix A.

Estimating the risk for the roads was based upon the probability of flood exposure and the consequence of flood exposure, using the following standard risk-based formula:

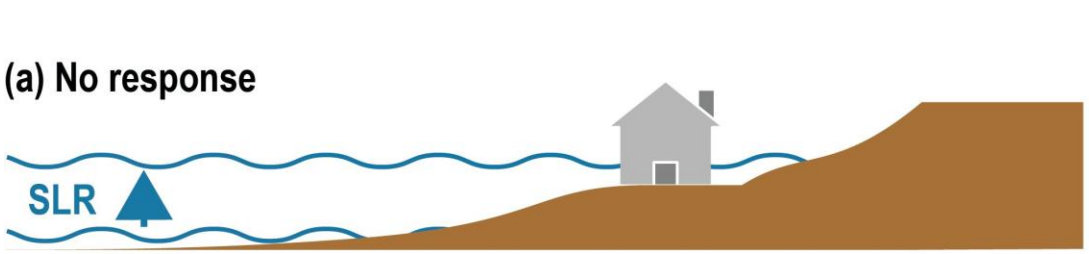
$$Risk = Probability\ of\ Flooding\ x\ Consequence$$

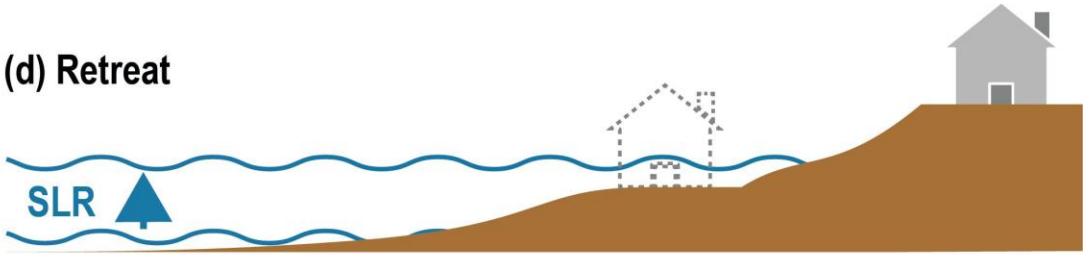
The prioritization process used the following four steps:

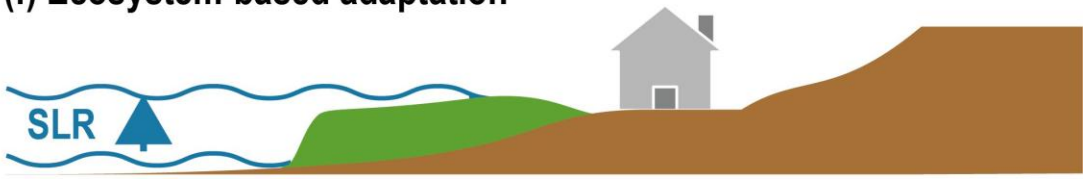
1. Identify roads subject to flooding.
2. Estimate probability of exceedance.
3. Calculate consequence of flooding score.
4. Calculate risk.

This memo focuses on Steps 2 through 4. Refer to the Flood Vulnerability Analysis Results Memo for more information on Step 1 (GEI, 2025b).

Flood Adaptation Recommendations







Flood Adaptation Recommendations

High-level, specific, adaptation recommendations for:

- Top Roads
- Pump Stations
- Select Town Facilities
- Higgins & Pine Point Neighborhoods

General adaptation recommendations for:

- Buildings
- Beaches/Dunes
- Non-Structural Measures

Flood Adaptation Recommendations

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General adaptation recommendations for:

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Relative Cost Estimates:

$	Low-cost measures likely feasible within a single fiscal year using existing Town funds.
$$	Moderate-cost measures requiring capital improvement planning, but potentially achievable within one budget cycle.
$$$	High-cost measures requiring substantial funding or a multi-year implementation approach.
$$$$	Very high-cost measures likely requiring multiple funding sources and long-term planning.

Flood Adaptation Recommendations

High-level, specific, adaptation recommendations for:

- Top Roads
- Pump Stations
- Select Town Facilities
- Higgins & Pine Point Neighborhoods

General adaptation recommendations for:

- Buildings
- Beaches/Dunes
- Non-Structural Measures

Flood Adaptation Recommendations

Coastal Sand Dune Map

- Roads within frontal dunes face **strictest regulations**
- Roads and parking lots within back dunes could be elevated
- New **sea walls would not be allowed** in these areas

Flood Adaptation Recommendations for Pine Point Beach Neighborhood

Establish Evacuation Routes

Prioritize adapting (elevating) Pine Point Road for evacuation and emergency access to the neighborhood. Alternatively, coordinate with Old Orchard Beach for adaptation of Eas

Flood Adaptation Recommendations for Pine Point Beach Neighborhood

Develop a Flood Alert System

Use multiple delivery methods, such as mobile and/or siren/airhorn

Consider seasonal renters and guests/visitors

Flood Adaptation Recommendations for Pine Point Beach Neighborhood

Deploy Temporary Flood Barriers

Consider installing seasonal/temporary flood barriers around vulnerable infrastructure (such as the Champion St Pump Station) for up to 7 months of the year

Source: https://usfloodcontrol.com/flood-barriers/

Flood Adaptation Recommendations for Pine Point Beach Neighborhood

Designate Emergency Shelters

Consider using the Pine Point Fire Station as a neighborhood shelter during flood events.

Flood Adaptation Recommendations for Pine Point Beach Neighborhood

2050 “King Tide”

Elevate roads where feasible to allow evacuation

Consider Road Elevation

Balance constraints of topography, right of way, and permitting regulations with benefits of select neighborhood road elevation

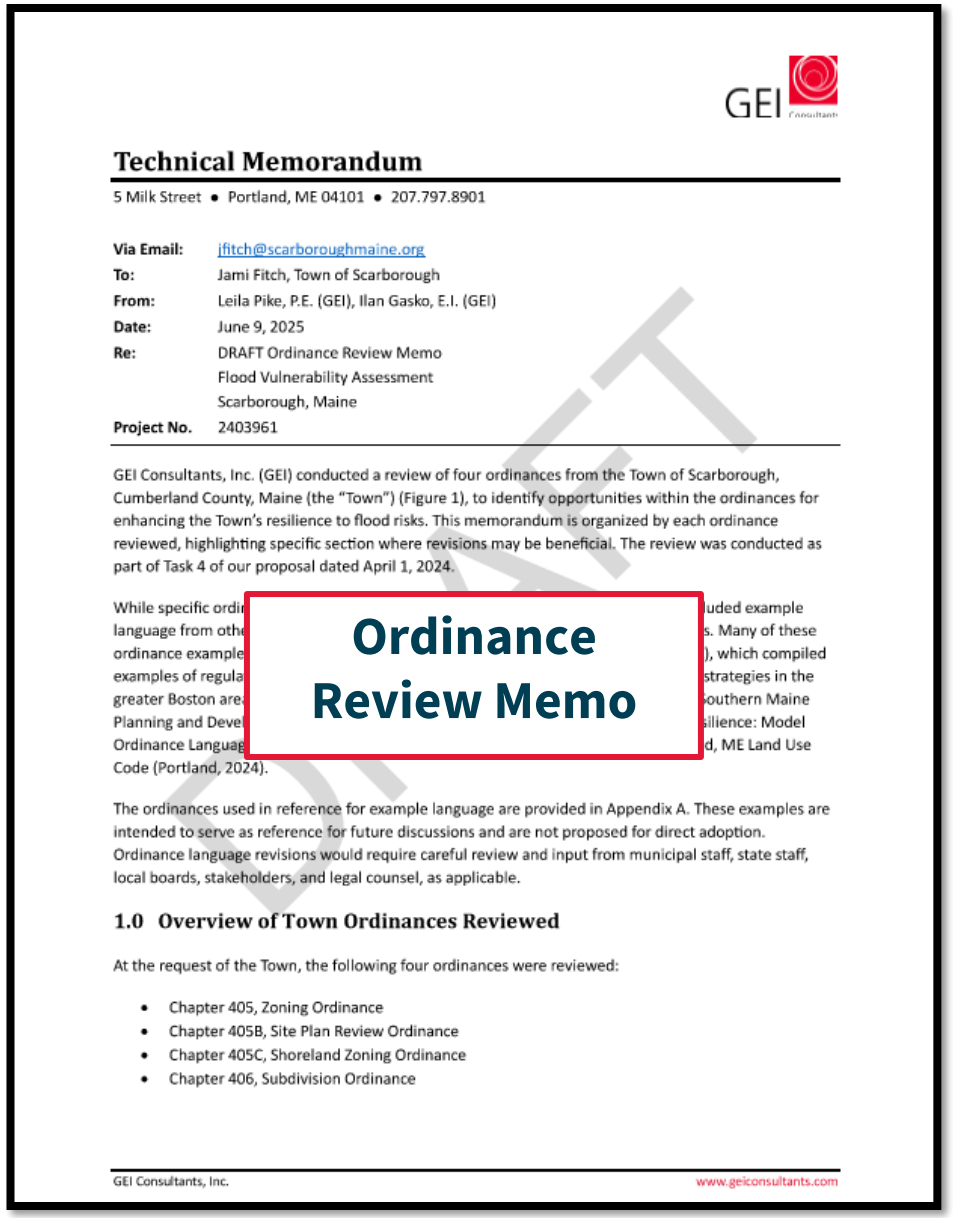
Flood Adaptation Recommendations

Policy Measures

As part of this project, four **Town Ordinances** were Reviewed:

- Chapter 405, Zoning Ordinance
- Chapter 405B, Site Plan Review Ordinance
- Chapter 405C, Shoreland Zoning Ordinance
- Chapter 406, Subdivision Ordinance

Identified **opportunities for increasing the Town's resilience** to flood risks. Examples of regulatory language, policies, and land use strategies from other New England municipalities was provided, but **specific ordinance language was not developed**.



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Technical Memorandum

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To: Jami Fitch, Town of Scarborough
From: Leila Pike, P.E. (GEI), Ilan Gasko, E.I. (GEI)
Date: June 9, 2025
Re: DRAFT Ordinance Review Memo
Flood Vulnerability Assessment
Scarborough, Maine
Project No. 2403961

GEI Consultants, Inc. (GEI) conducted a review of four ordinances from the Town of Scarborough, Cumberland County, Maine (the "Town") (Figure 1), to identify opportunities within the ordinances for enhancing the Town's resilience to flood risks. This memorandum is organized by each ordinance reviewed, highlighting specific section where revisions may be beneficial. The review was conducted as part of Task 4 of our proposal dated April 1, 2024.

While specific ordi luded example language from oth s. Many of these ordinance example), which compiled examples of regula strategies in the greater Boston are outhern Maine Planning and Deve ilience: Model Ordinance Languag d, ME Land Use Code (Portland, 2024).

Ordinance Review Memo

The ordinances used in reference for example language are provided in Appendix A. These examples are intended to serve as reference for future discussions and are not proposed for direct adoption. Ordinance language revisions would require careful review and input from municipal staff, state staff, local boards, stakeholders, and legal counsel, as applicable.

1.0 Overview of Town Ordinances Reviewed

At the request of the Town, the following four ordinances were reviewed:

- Chapter 405, Zoning Ordinance
- Chapter 405B, Site Plan Review Ordinance
- Chapter 405C, Shoreland Zoning Ordinance
- Chapter 406, Subdivision Ordinance

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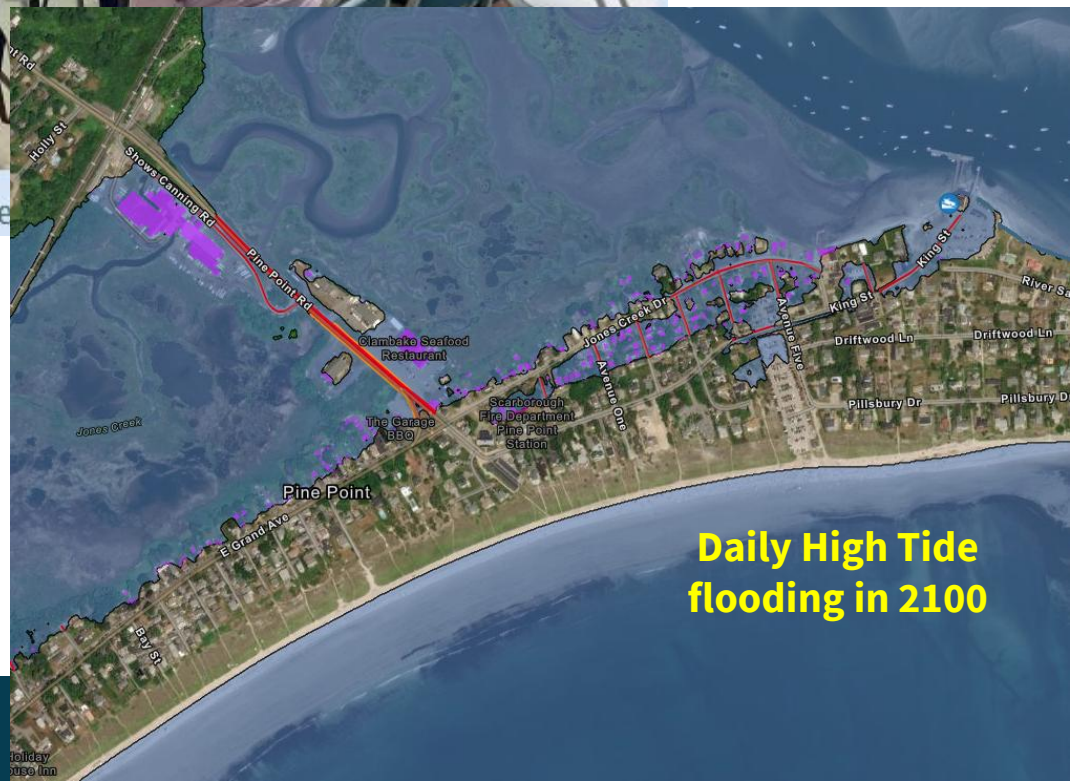
DRAFT

Flood Adaptation Recommendations

Consider Long-Term Managed Retreat

Continue neighborhood engagement and the discussion around long-term managed retreat.



Pine Point Beach Pilot Project

Three Pilot Projects Were Developed:

1. **Payne Road**: Flood Risk and Adaptation Recommendations
2. **Higgins Beach** Shoreline Stabilization Measures
3. **Pine Point** Homeowner Adaptation Guide

Homeowner Adaptation Guide Tutorial

PINE POINT HOMEOWNER ADAPTATION GUIDE

Roadmap to elevating a home

1- Review Flood Risk
2- Review FEMA Zones
3- Check Coastal Sand Dune Zones
4- Check Shoreland Zoning Overlay
5- Understand Implications
6- Contact Code Enforcement
7- Hire a Contractor

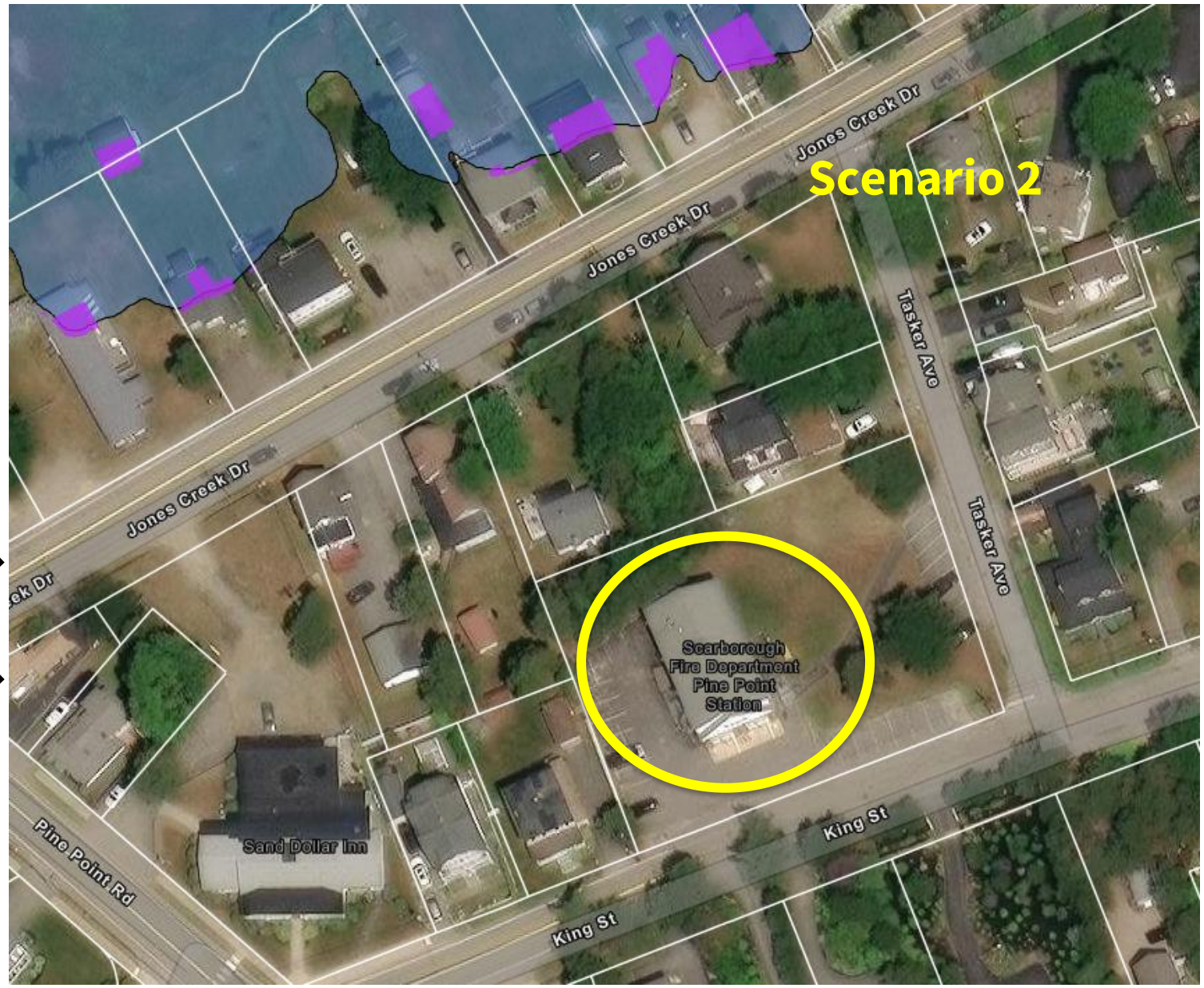
Walk through with Pine Point Fire Station as an example “House”

Homeowner Adaptation Guide Tutorial

Step 1: Review Flood Risk

In the StoryMap, review the following:

- **Scenario 2** for high tide flooding by 2050
- **Scenario 5** for “100-yr” coastal flooding by 2050
- **Scenario 6** for high tide flooding by 2100



Homeowner Adaptation Guide Tutorial

Step 1: Review Flood Risk

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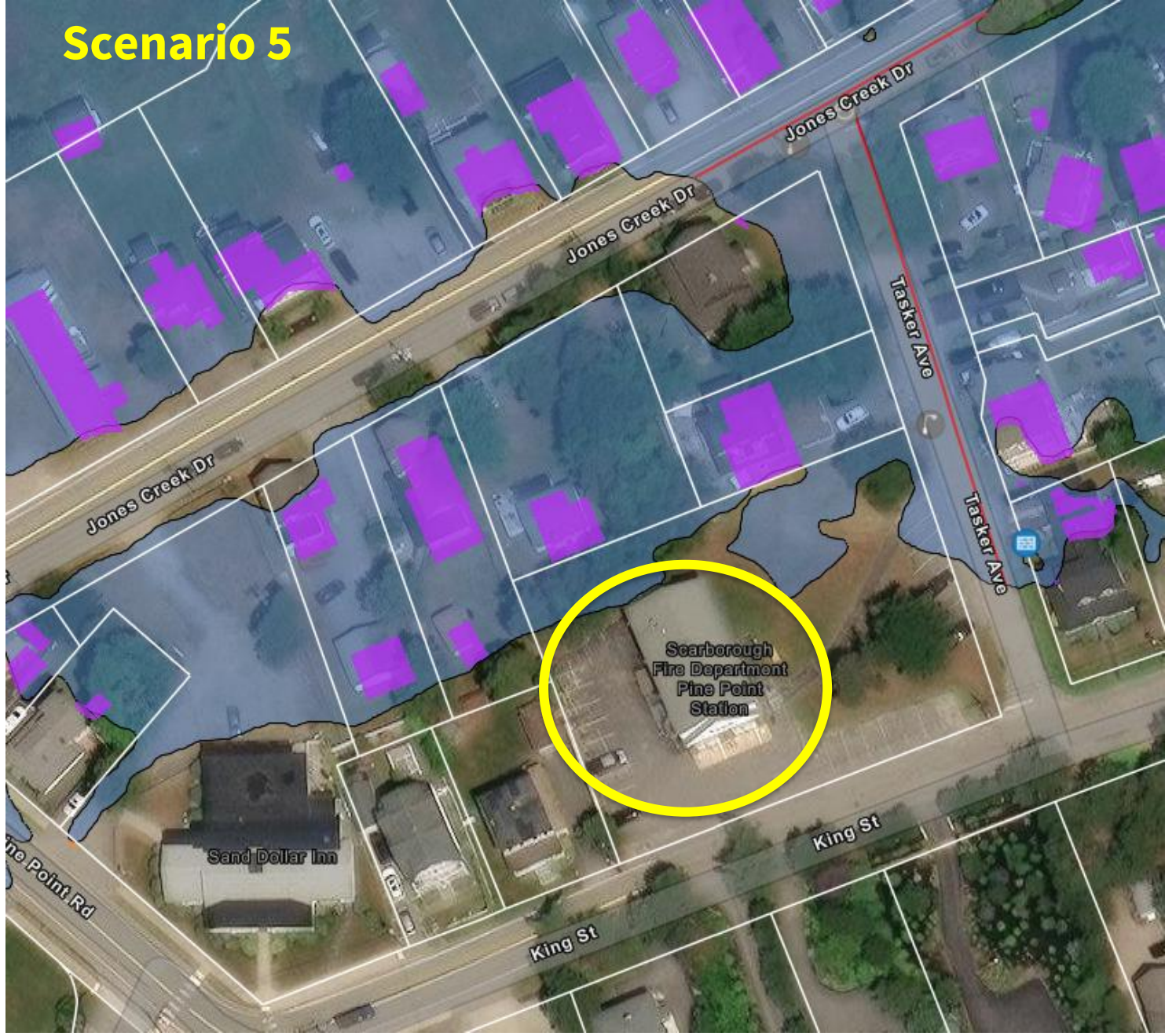

Homeowner Adaptation Guide Tutorial

Step 1: Review Flood Risk

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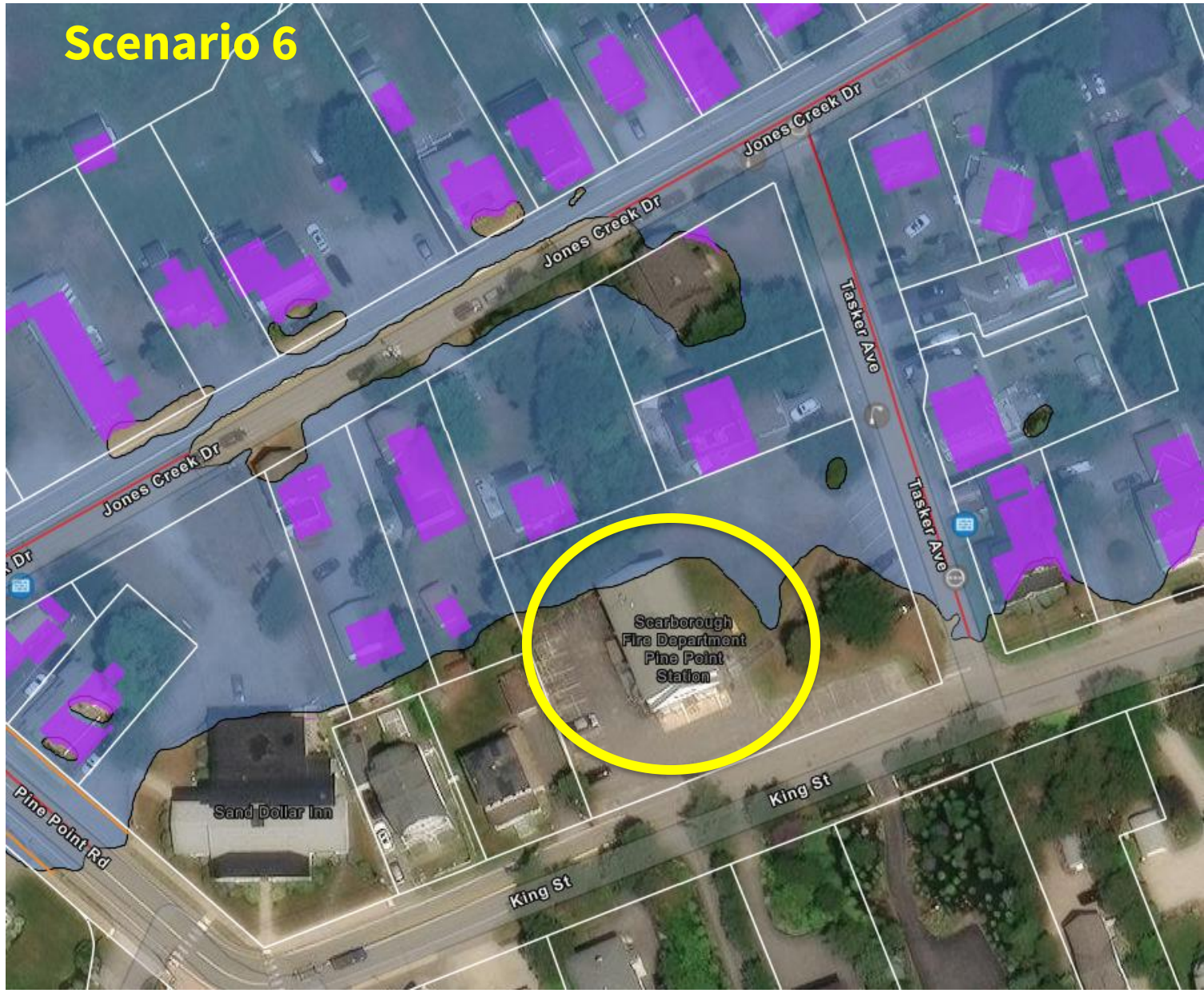
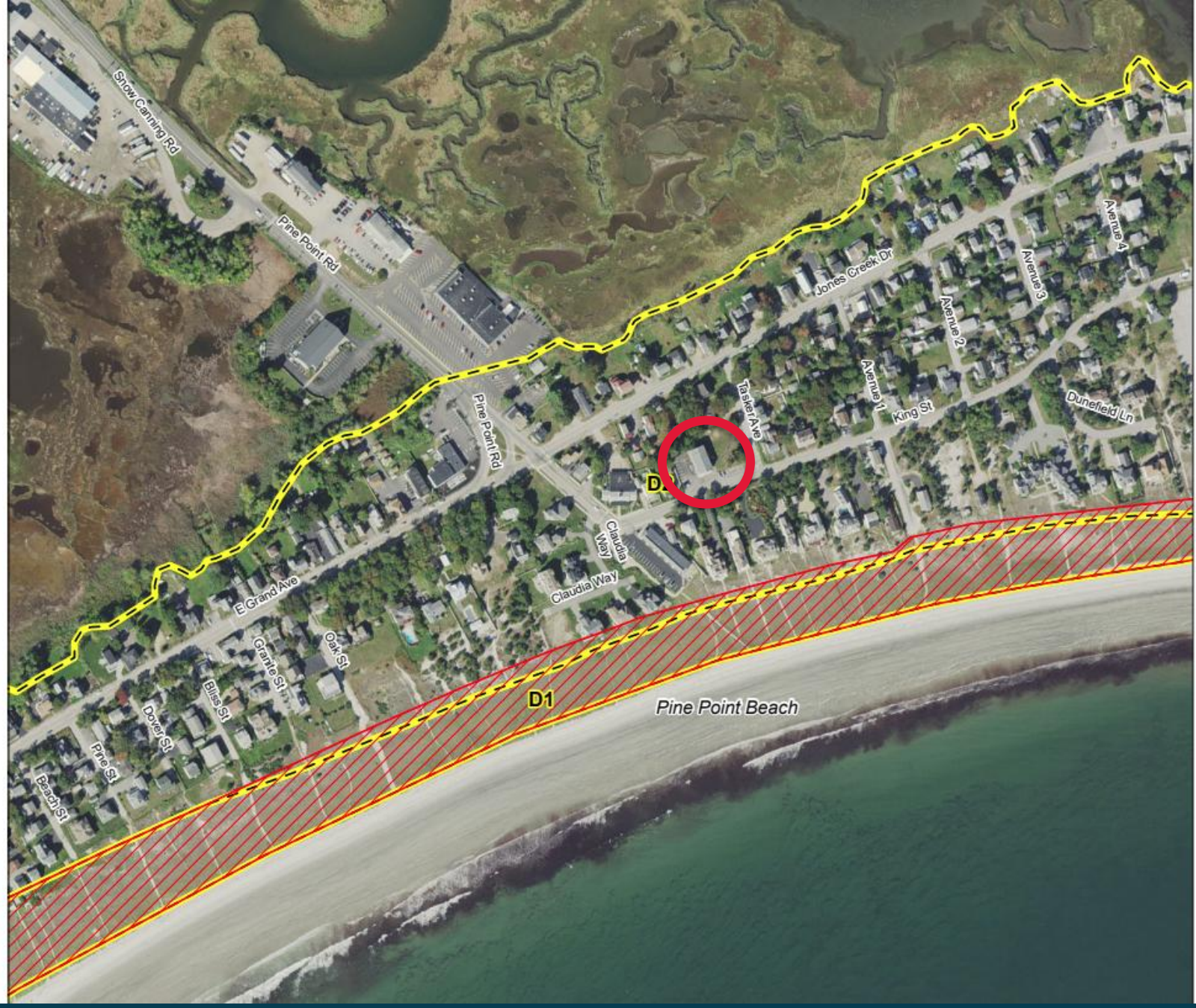


Step 2: Review FEMA Zones
Check if AE or VE zone and the elevation

Step 3: Check the Coastal Sand Dune Zones

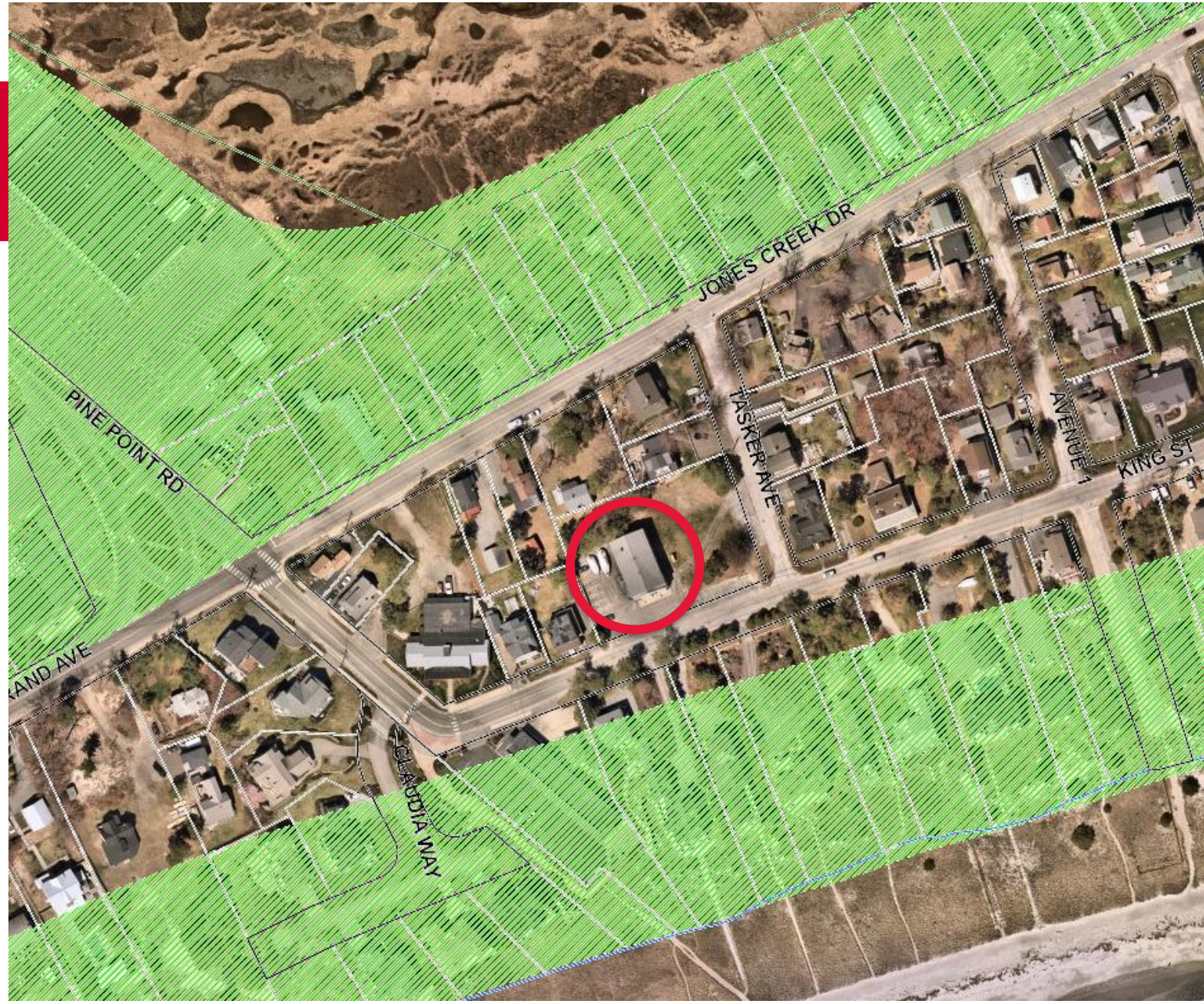
Check if in D2 (Back Dune), D1 (Frontal Dune), and/or EHA (Erosion Hazard Area)

Fire Station in D2: Back Dune



Step 3: Check Shoreland Zoning Overlay

Fire Station not in the Shoreland Zoning Overlay



Homeowner Adaptation Guide Tutorial

Step 4: Understand Implications

If the Fire Station were a residential structure and the owner wanted to elevate, it would need to be **elevated on open pilings** at least **2 ft above the BFE**. With a BFE of 13ft, the building would need to be **elevated to at least elevation 15 ft,** which is approximately 3.5 ft higher than the existing elevation

Table 3-1. Residential Structure Elevation Requirements

Zone Combination	Restrictions and Elevation Guidance
FEMA VE Zone + Frontal Sand Dune	1) Cannot develop on undeveloped lots under current Maine DEP Coastal Sand Dune rules. 2) For developed lots, elevate on open pilings to at least 2 ft above the BFE or the highest natural elevation measured 5 ft from the corners of existing building foundation (whichever is higher).
FEMA AE Zone + Frontal Sand Dune Or FEMA AE or VE Zone + Back Sand Dune + Erosion Hazard Area	Elevate on open pilings: 1) For undeveloped lots, elevate to at least 2 ft above the BFE or 3 ft above existing elevation within the building's footprint (whichever is higher). Additional limitations apply to lots that include VE zones[1]. 2) For developed lots, elevate to at least 2 ft above the BFE or the highest natural elevation measured 5 ft from the corners of existing building foundation (whichever is higher)
FEMA AE or VE Zone + Back Sand Dune (non-Erosion Hazard Area) Or FEMA AE or VE Zone (outside Coastal Sand Dune Zone)	Elevate on open pilings to at least 2 ft above the BFE. Additional limitations apply to lots that include VE zones[1].
Frontal Sand Dune (outside FEMA zone) Or Back Sand Dune + Erosion Hazard Area (outside FEMA Zone)	Elevate on open pilings: 1) For undeveloped lots, elevate at least 3 ft above existing elevation within the building's footprint 2) For developed lots, elevate to the highest natural elevation measured 5 ft from the corners of existing building foundation
Back Sand Dune (outside FEMA Zone)	No elevation requirements

Notes:

1. Refer to Section 6(C) of the Maine Department of Environmental Protection (DEP) Natural Resources Protection Act (NRPA) Chapter 355: Coastal Sand Dune Rules for more details about building restrictions in a coastal sand dune and VE zone (MDEP, . 2024).

Homeowner Adaptation Guide Tutorial

Step 6: Contact Code Enforcement

For help understanding regulations for a residential adaptation and/or building elevation project, contact the Town of Scarborough Planning and Code Enforcement Office

Scarborough Municipal Building
Lower Level, Room 125
259 U.S. Route 1
P.O. Box 360
Scarborough, ME 04070-0360
Phone: (207) 730-4040
Fax: (207) 730-4046

https://www.scarboroughmaine.org/departments/planning-codes

Step 7: Hire a Contractor

In a Shoreland Zone, the DEP requires the use of contractors certified in erosion and sediment control practices. A list of contractors is provided on the Maine DEP website.

Certified Companies

Contact: John Maclaine, (207) 615-3279, fax 207- 287-2814.

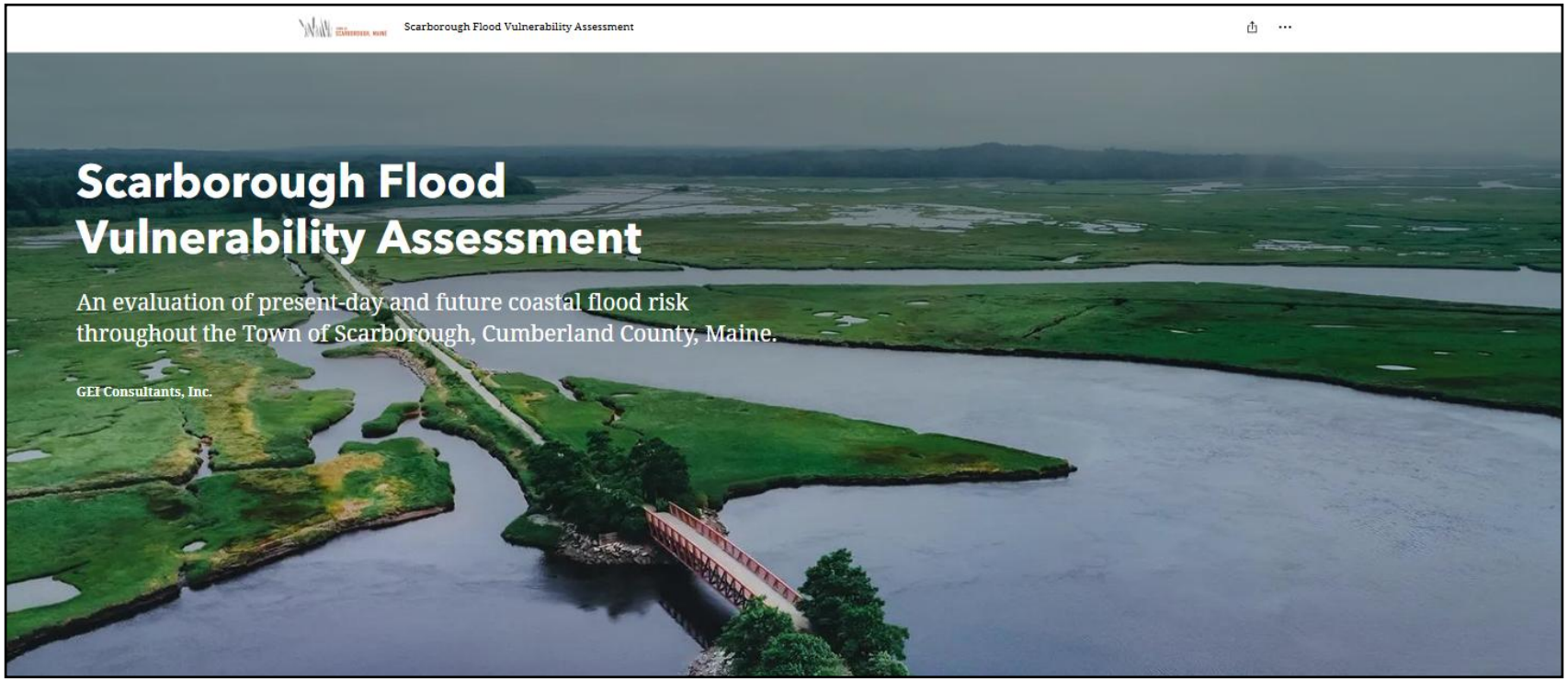
What it means to be a certified company. A company certified in erosion control practices by the Department is one that, at a minimum, has all of its construction site supervisors individually trained and certified in erosion control practices by the DEP. The basic premise in certifying a company in this manner is to ensure that all of the company's construction sites are supervised by an individual that is certified in erosion and sediment control practices.

A Higgins Beach Home Elevated on Open Pilings

Source: https://mainehomedesign.com/features/a-minimalist-cottage-style-home-for-a-downsizing-couple/#close

Timeline of Next Steps

October: Executive Summary and Final Work Products



Thank you!
Questions?

GEI Consultants

Consulting Engineers and Scientists

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