KITSAP COUNTY

Sea Level Rise Vulnerability and Risk Assessment

This project was funded under a Shoreline Planning Competitive Grant received by the State of Washington Department of Ecology.

Agenda

- Project Overview
- Assessment Results
- Draft Maps
- Mitigation Strategies
- Next Steps
- Q&A

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Project Purpose

Identify

Identify assets with potential for loss or damage from sea level rise.

Complete

Complete risk analysis and vulnerability assessment, based on mapping predictions to decided on by the Technical Advisory Committee (TAC).

Propose

Propose practical region-specific actions or projects, to address increased sea water interactions.

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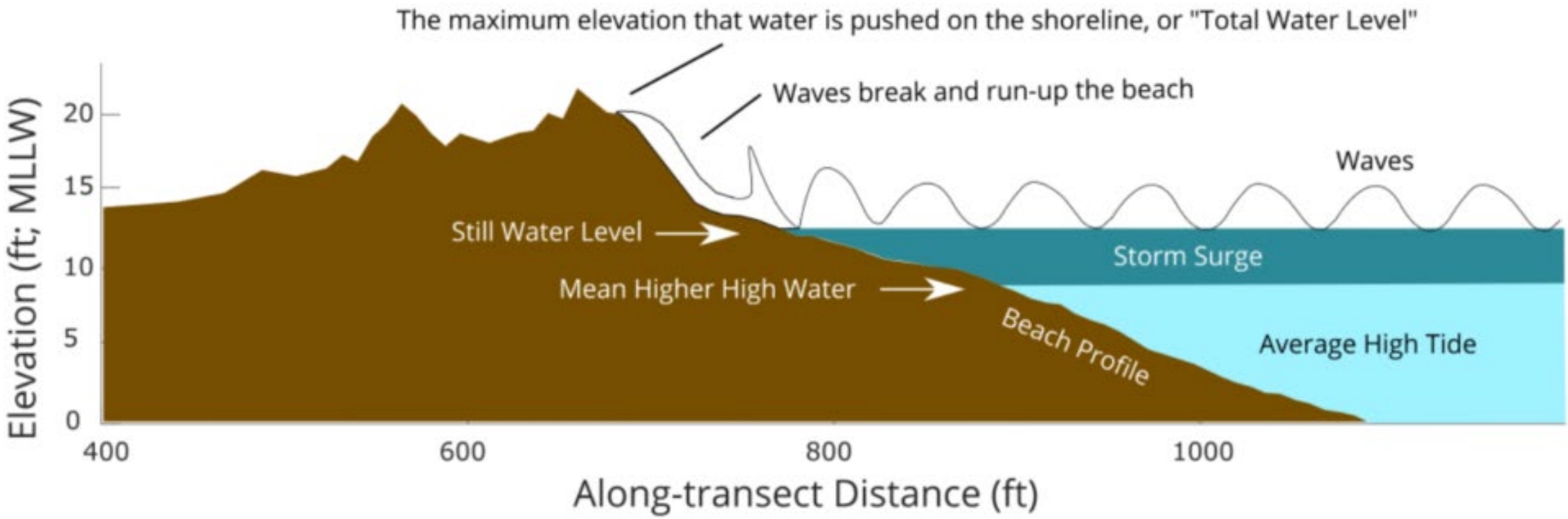

Source: Miller et al. 2019. Extreme Coastal Water Level in Washington State: Guidelines to Support Sea Level Rise Planning. https://cig.uw.edu/publications/extreme-coastal-water-level-in-washington-state-guidelines-to-support-sea-level-rise-planning/

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Projections – What are they?

- How are Sea Level Rise (SLR) & flood levels estimated?
  - Probability Confidence
  - International predictions based on emissions
  - Tide gauge trends – Mean Higher High Water (MHHW) and extreme flood
- Relative Sea Level Rise
  - Absolute SLR + Land Movement
- Confidence Intervals by year

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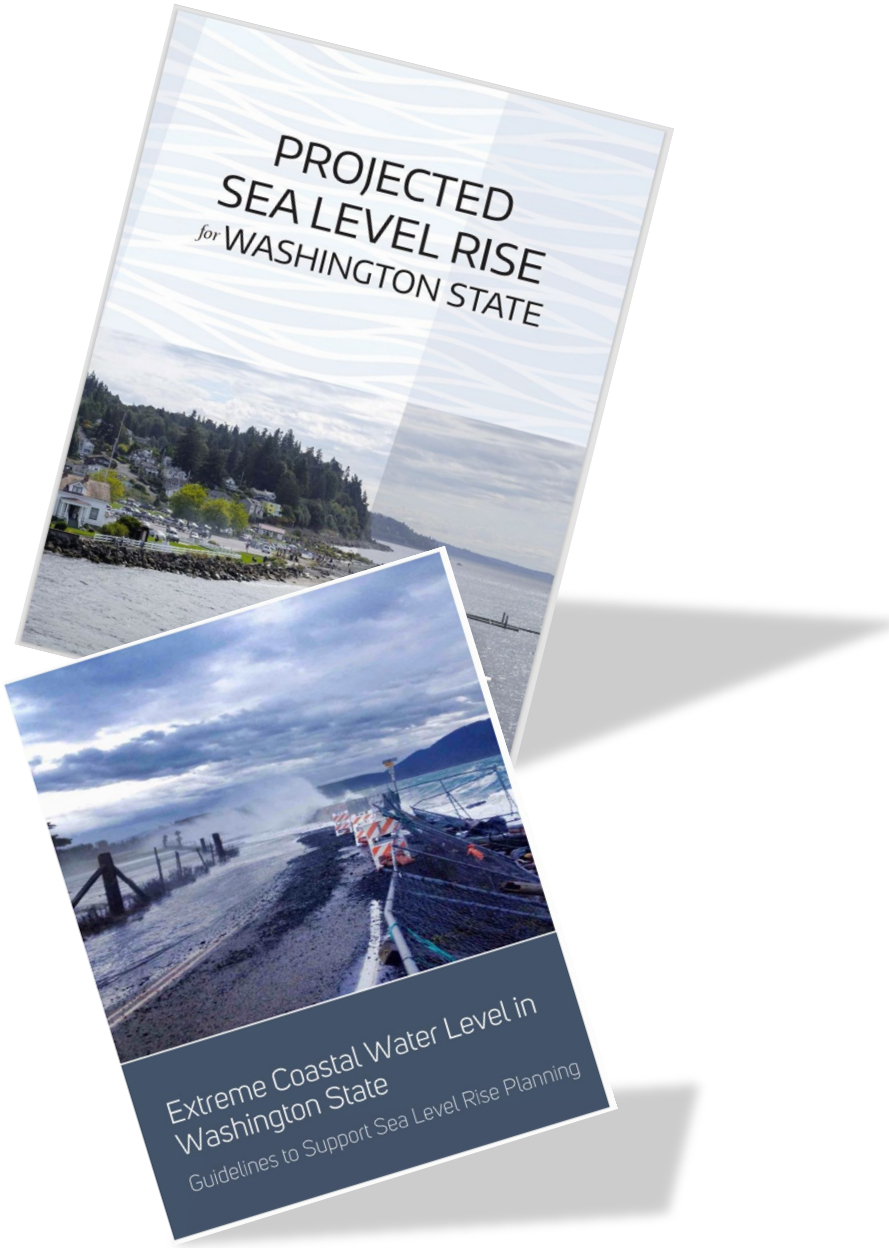
Projections - Where do the levels come from?

- **2018 Report**
  - "Stillwater", no wave run-up
- **2019 Report**
  - Extreme water levels seen by tide gauges

Resilience Resource Library | Washington Coastal Hazards Resilience Network (wacoastalnetwork.com)

Washington Sea Grant - YouTube



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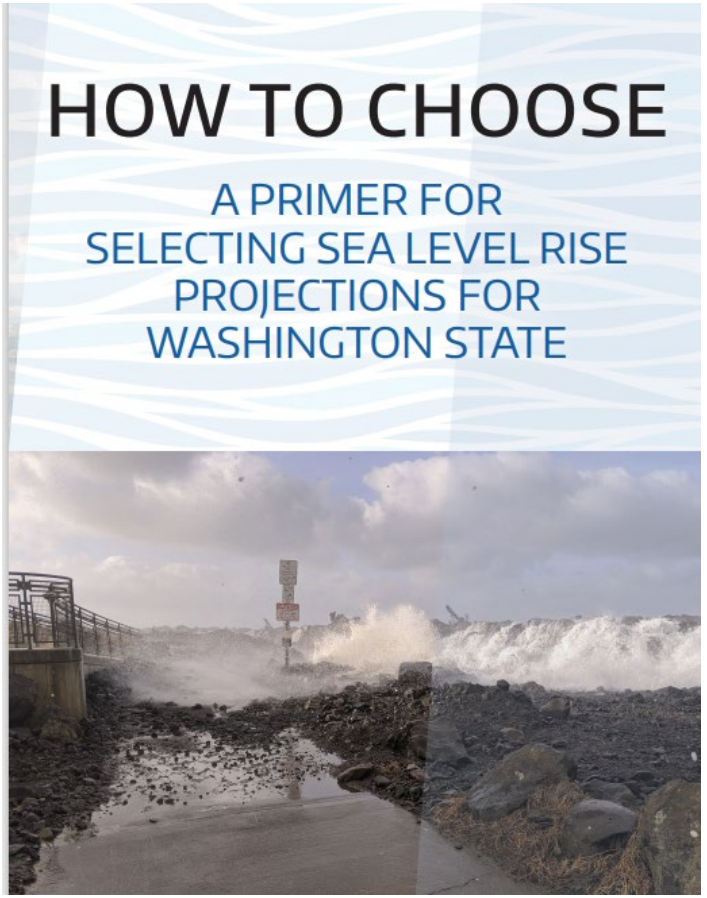
Projections – Selected by Technical Advisory Committee

1. RCP: 4.5 or **8.5**

2. Timeframe: **2050**? 2060? **2100**? 2150*?

3. Certainty/Level of Risk: **1%** (less likely),

50%, 90% (very likely)



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SLR Projections	90% Certainty	50% Certainty	1% Certainty
2050	0.5 ft	1 ft	1.5 ft
2100	1.5 ft	2.5 ft	5.0 ft

Location	50-yr Return Flood (90% Certainty		50-yr Return Flood (50% Certainty		50-yr Return Flood (1% Certainty)	
	2050	2100	2050	2100	2050	2100
Shorelines not in an inlet	3.5 ft	4.5 ft	4.0 ft	5.5 ft	4.5 ft	8.0 ft
Dyes Inlet	3.5 ft	4.5 ft	4.0 ft	5.5 ft	5.0 ft	8.5 ft
Sinclair Inlet	4.0ft	5.0 ft	4.5 ft	6.0 ft	5.0 ft	8.5 ft
Agate Pass	4.0 ft	5.0 ft	4.5 ft	6.0 ft	5.0 ft	8.5 ft
Port Gamble	4.0 ft	5.0 ft	4.5 ft	6.0 ft	5.0 ft	8.5 ft
Liberty	4.0 ft	5.0 ft	4.5 ft	6.0 ft	5.5 ft	9.0 ft

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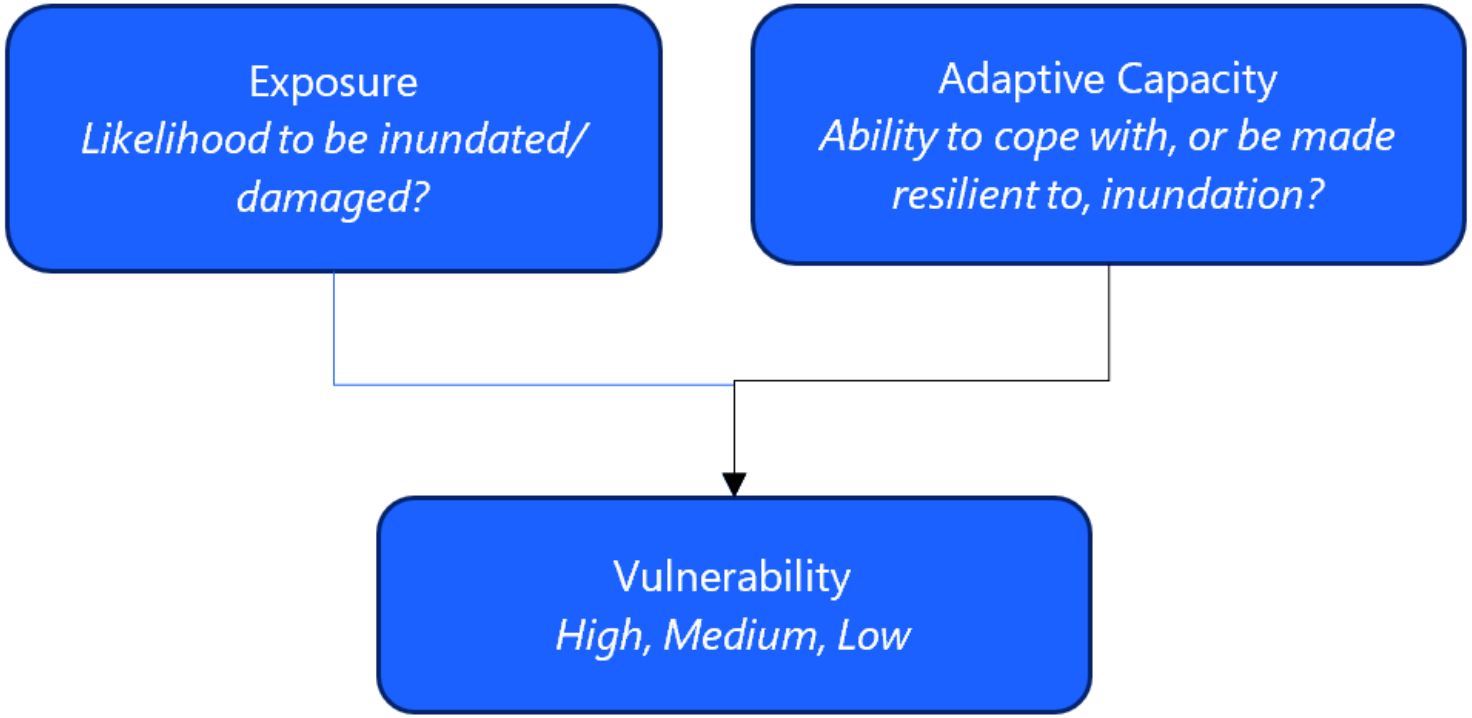
Assessment



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Exposure Criteria

Exposure Ranking	Description	
High *– likely to be exposed sooner*	Asset may be inundated by coastal flooding (SLR or 50-year return extreme flood) by 2050 with a 90% or 50% probability.	**+4.0-4.5 ft above MHHW**
Medium	Asset may be inundated by coastal flooding (SLR or 50-year return extreme flood) by 2050 with a 1% probability, or by 2100 with a 90% probability.	**+4.5-5.5 ft above MHHW**
Low *-less likely to be exposed*	Asset may be inundated by coastal flooding (SLR or 50-year return extreme flood) by 2100 with a 50% or 1% probability	**+8.0-9.0 ft above MHHW**

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Adaptive Capacity Criteria

Adaptive Capacity Ranking	Description
Low - Does *not easily* adapt, or is difficult to adapt, *to new conditions*	Impacts on assets may lead to significant operational disruptions or loss of functionality. Adaptative solutions may need to be innovative and require collaboration with agencies and representatives. High costs are likely associated and may require significant capital improvements to mitigate impacts
Medium	Impacts on assets may lead to temporary operational disruptions or loss of functionality. Impacts can be reduced or mitigated to some extent, but adaptive solutions may only be feasible for certain components of the assets. Some assets may face challenges regarding cost and implementation. .
High *-More easily adapted*	Assets can adapt to impacts with minimal difficulty. Adaptive solutions are highly feasible for most assets with affordable costs

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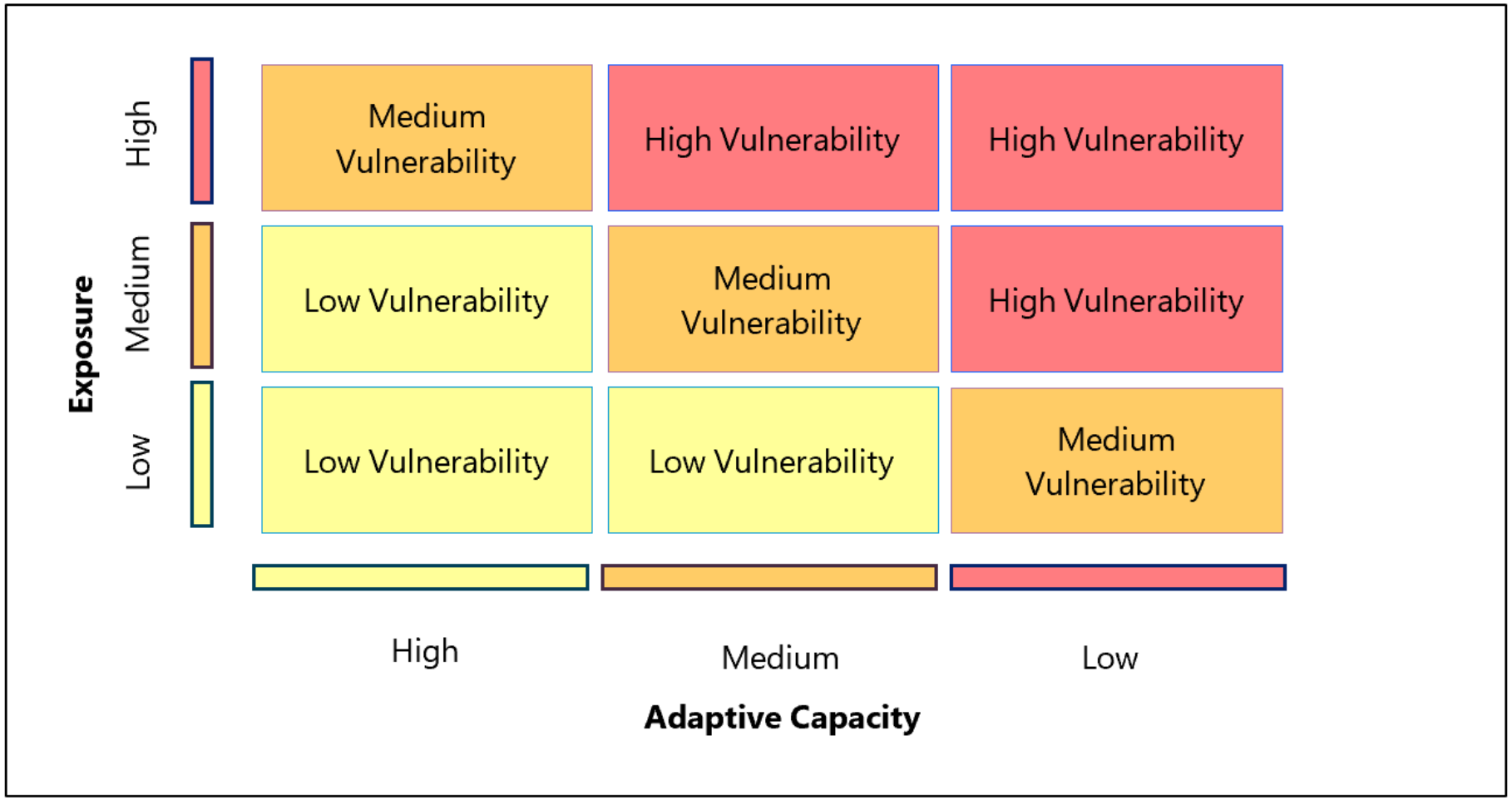
Vulnerability Matrix



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List of Assets

Type of Asset				
Transportation	**Structures**	**Utilities Infrastructure**	**Environmental**	**Land Use**
Roads and Transportation	Coastal Buildings	Coastal On-Site Septic Systems[7]	Beaches	Agricultural Land/Farmland
Airports	Police Stations	Group A and B Water Systems	Marinas and Boat Ramps	Brownfield Sites/Landfills/Toxic Cleanup Sites
	Fire Stations	PSE Substations	Wetlands	Parks
	Historic and Cultural Sites	Sewer Districts/Water Treatment Plants		Shellfish/Seafood Industrial Facilities
	Hospitals	Stormwater Facilities		
	Libraries			
	Schools			

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Roads

Type of Asset	Exposure	Adaptive Capacity	Vulnerability
Roads	Approximately 7.0 miles of roadways within unincorporated Kitsap County likely to be inundated by a coastal flooding (SLR or 50-year return extreme flood) by 2050 with a 90% or 50% probability. **(Exposure = High)**	Temporary or permanent impacts due to flooding of transportation routes Impacts can be reduced or mitigated to a certain extent. However, the cost and implementation to retrofit, relocate or expand capacity of stormwater systems is a significant investment. Relocation opportunities are severely limited or non-existent. Certain roadways may need to be elevated or relocated to improve resilience to flood events. **(Adaptive Capacity = Low)**	**High**
	Approximately 1.5 miles of roadways are expected to be inundated by a coastal flooding (SLR or 50-year return extreme flood) by 2050 with a 1% probability, or by 2100 with a 90% probability. **(Exposure = Medium)**	*See above* **(Adaptive Capacity = Low)**	**High**
	Approximately 14.5 miles of roadway are expected to be inundated by a coastal flooding (SLR or 50-year return extreme flood) by 2100 with a 50% or 1% probability. **(Exposure = Low)**	Many roads are in areas where alternate routes exist. Temporary impacts due to flooding may impact the accessibility of residents. Impacts can be reduced or mitigated to a certain extent. Cost and implementation to retrofit, relocate or expand capacity of stormwater systems is a significant investment. However, roadways that are at a medium risk of exposure will likely not be impacted except temporarily during extreme weather events **(Adaptive Capacity = Medium)**	**Medium**

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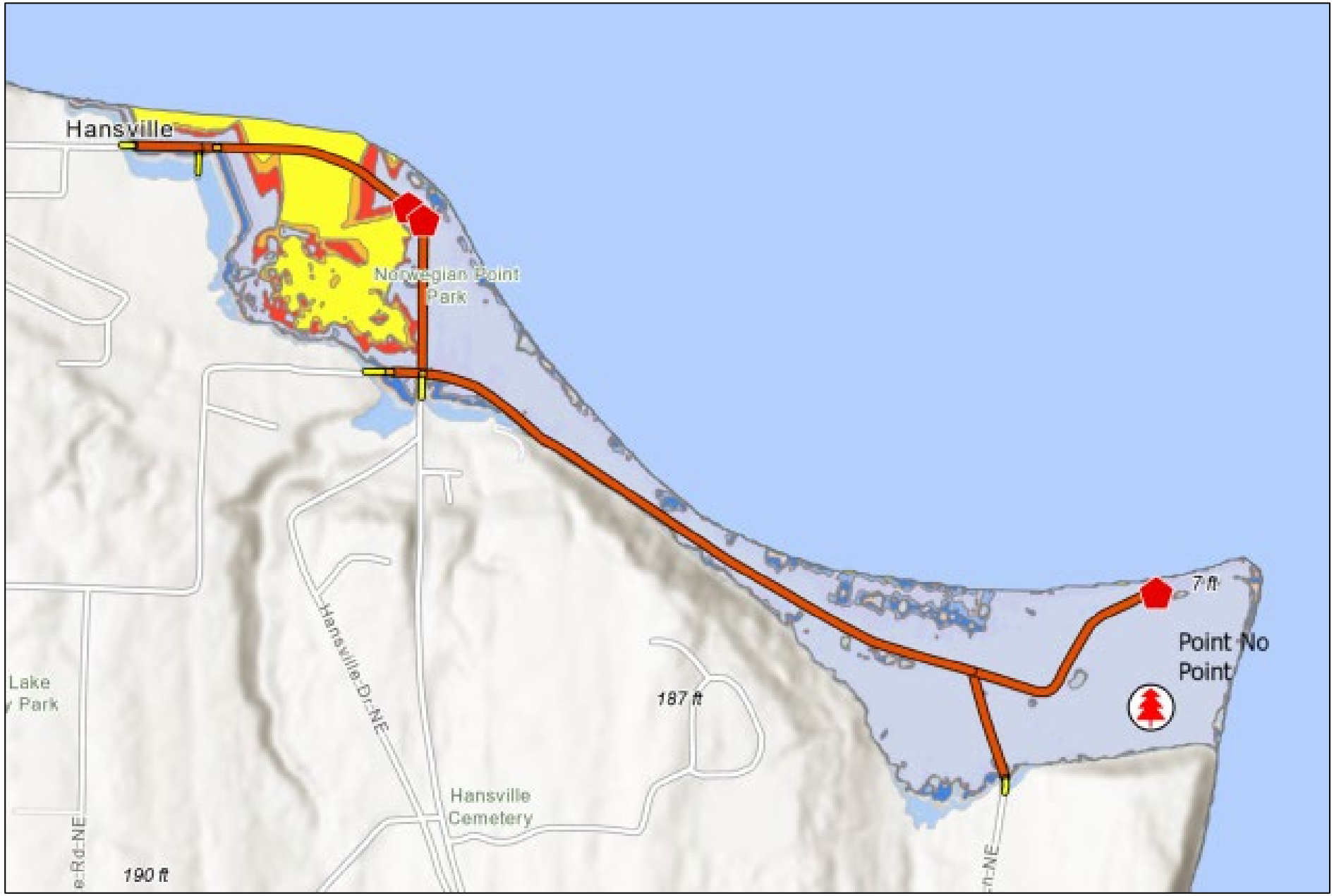
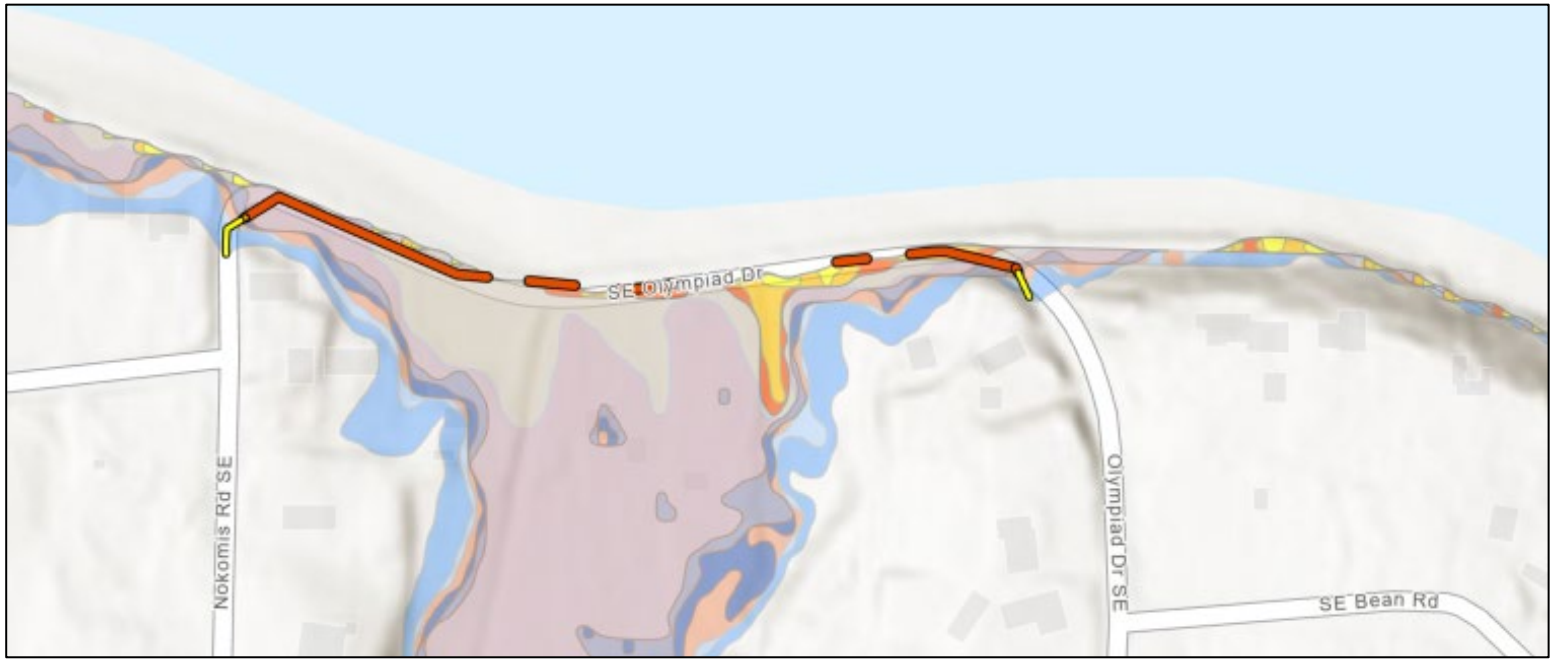


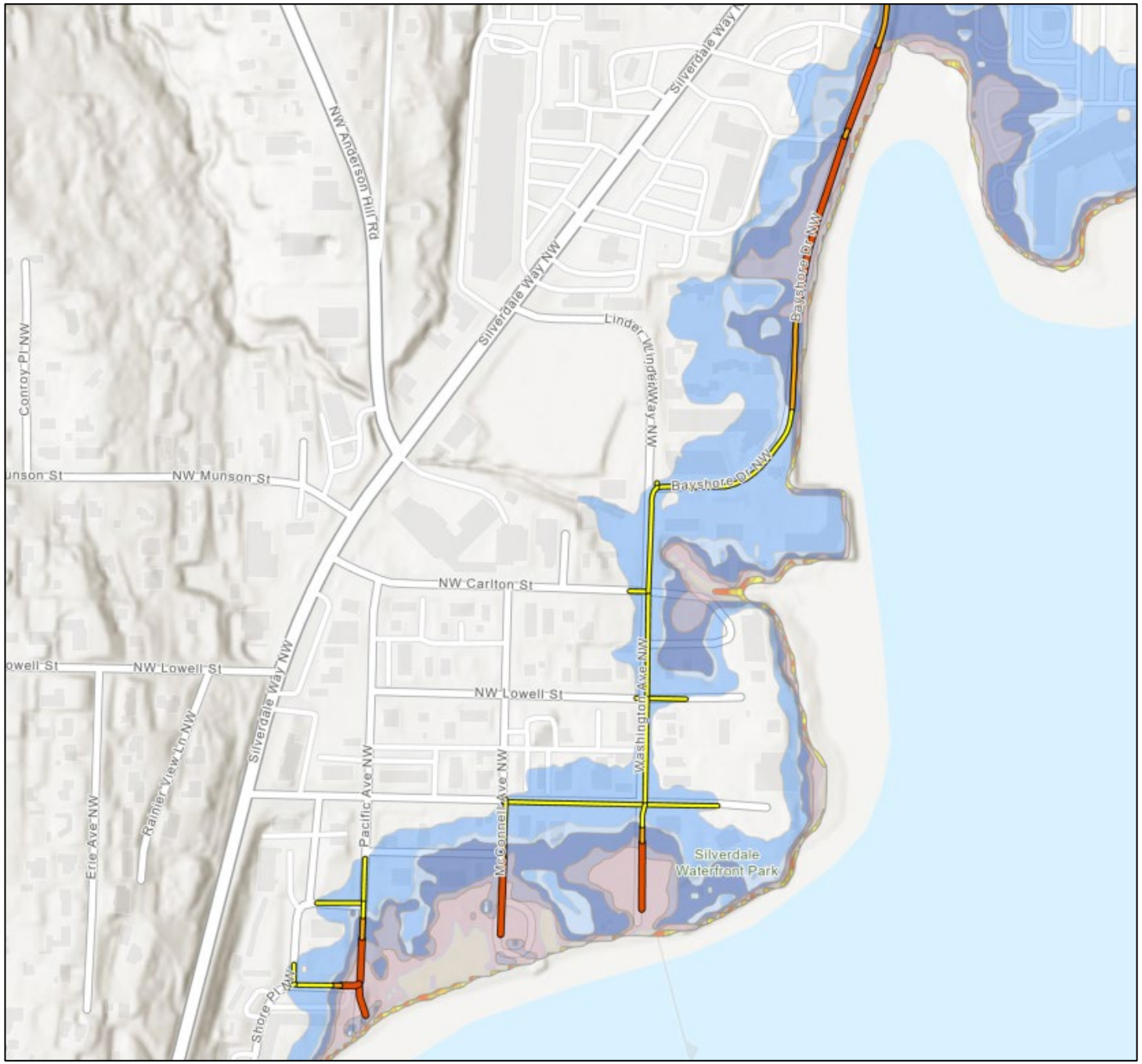
Hansville area exposure likelihood for:

- Roads
- Parks
- Contaminant sites (Ecology)

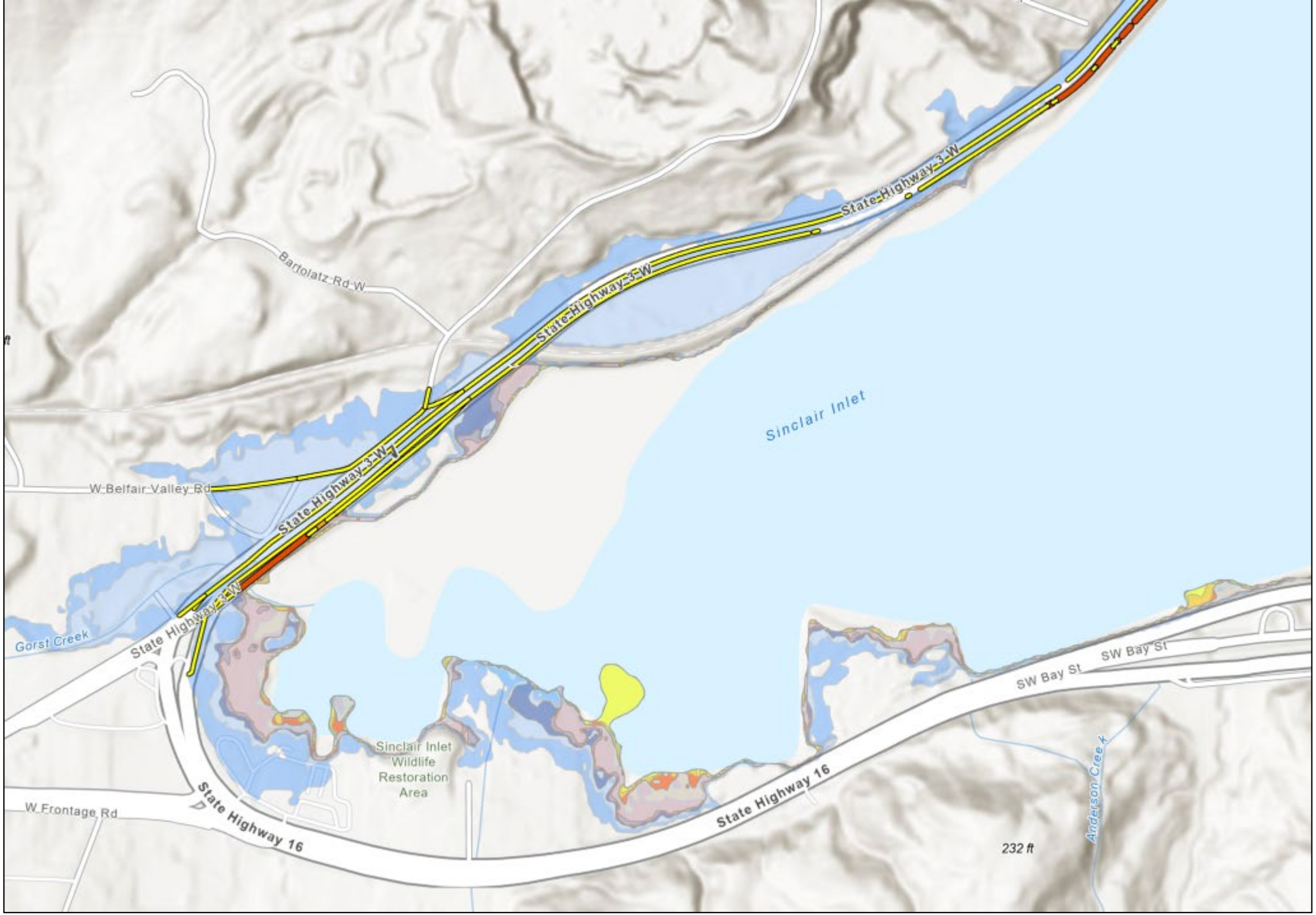


Exposure likelihood of roads in the Southworth area

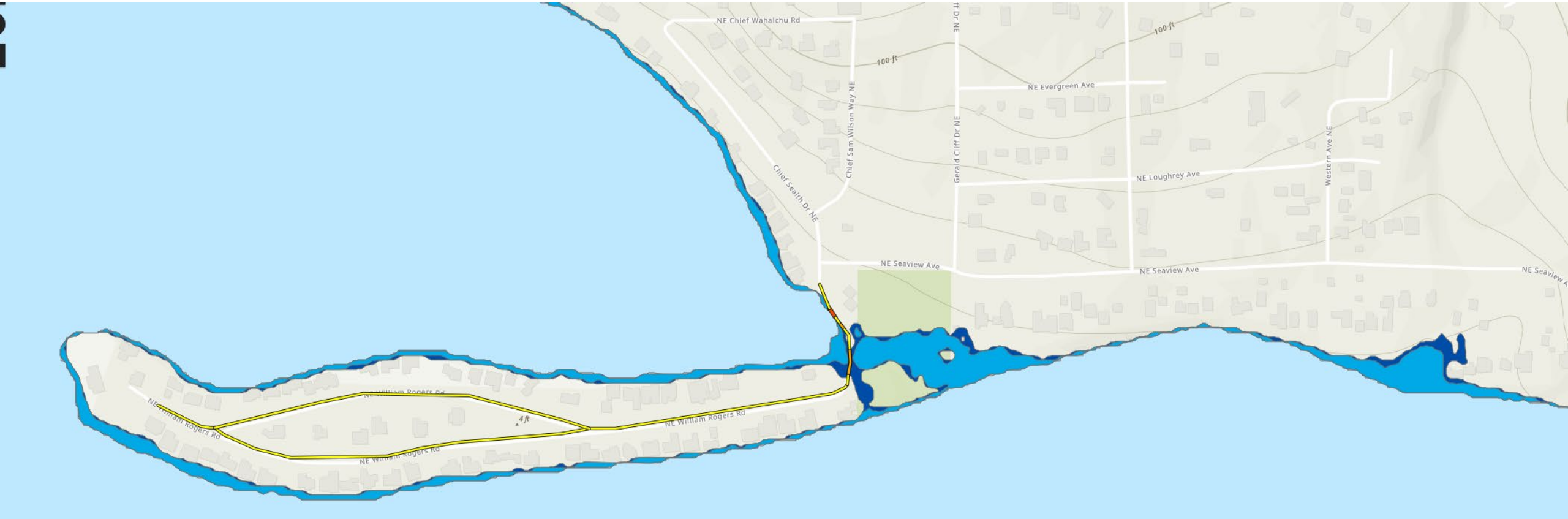
Exposure likelihood of roads in the Silverdale area



Exposure likelihood of roads in the Gorst area



Roads with an exposure likelihood by 50-Yr return frequency flood by 2050 with 50% certainty.



Coastal Buildings

Type of Asset	Exposure	Adaptive Capacity	Vulnerability
Buildings	1,190 buildings are likely to be inundated by a coastal flooding (SLR or 50-year return extreme flood) by 2050 with a 90% or 50% probability. **(Exposure = High)**	Mitigation measures for buildings may require significant improvements to increase resilience from SLR and flooding impacts. Adaptations are possible, but cost is a challenge. **(Adaptive Capacity = Low)**	**High**
	260 buildings are expected to be inundated by a coastal flooding (SLR or 50-year return extreme flood) by 2050 with a 1% probability, or by 2100 with a 90% probability. **(Exposure = Medium)**	Mitigation measures for buildings may require improvements to increase resilience from temporary flooding impacts in the near term. Adaptations are possible, but cost is a challenge. Long-term planning efforts may be required as structures are redeveloped or replaced. **(Adaptive Capacity = Medium)**	**Medium**
	1,090 buildings are expected to be inundated by a coastal flooding (SLR or 50-year return extreme flood) by 2100 with a 50% or 1% probability. **(Exposure = Low)**	*See above* **(Adaptive Capacity = Medium)**	**Low**

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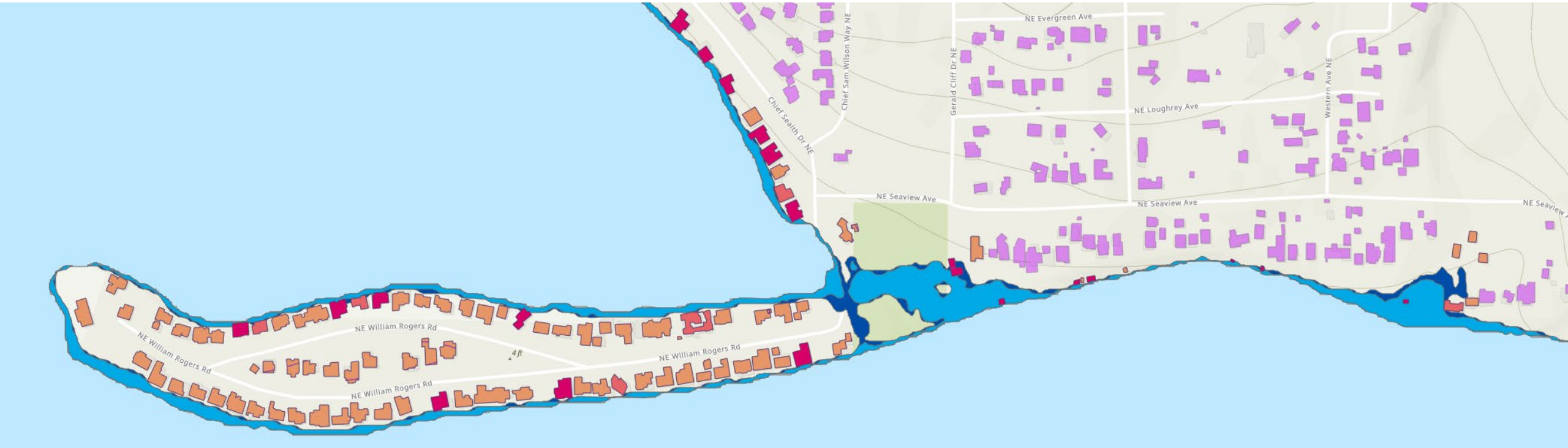
Structures with an exposure likelihood by 50-Yr return frequency flood by 2050 with 50% certainty.



Historic and Cultural Sites

Type of Asset	Exposure	Adaptive Capacity	Vulnerability
Historic and Cultural Sites	Three (3) historic structures and/or cultural sites are likely to be inundated by a coastal flooding (SLR or 50-year return extreme flood) by 2050 with a 90% or 50% probability, including • Doe-Kag-Wats, Indianola *(Estuary – Suquamish Tribal Reservation)* • Point No Point Light Station (*Historic Structure)* • Old Man House Site (*Cultural Site/Structure – Suquamish Tribe)* **(Exposure = High)**	Historic structures and cultural sites are expected to have limited options for adaptation. Preserving these sites in place can be costly, and their cultural and historical significance is not easily replicated. Relocation is generally not feasible without compromising their historic integrity. **(Adaptive Capacity = Low)**	**High**
	The Norwegian Point Park Boathouse (*historic structure)* in Hansville is expected to be inundated by a coastal flooding (SLR or 50-year return extreme flood) by 2100 with a 50% or 1% probability. **(Exposure = Low)**	*See above* **(Adaptive Capacity = Low)**	**Medium**

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Historic and Cultural Sites

Doe-Kag-Wats Estuary,
Indianola

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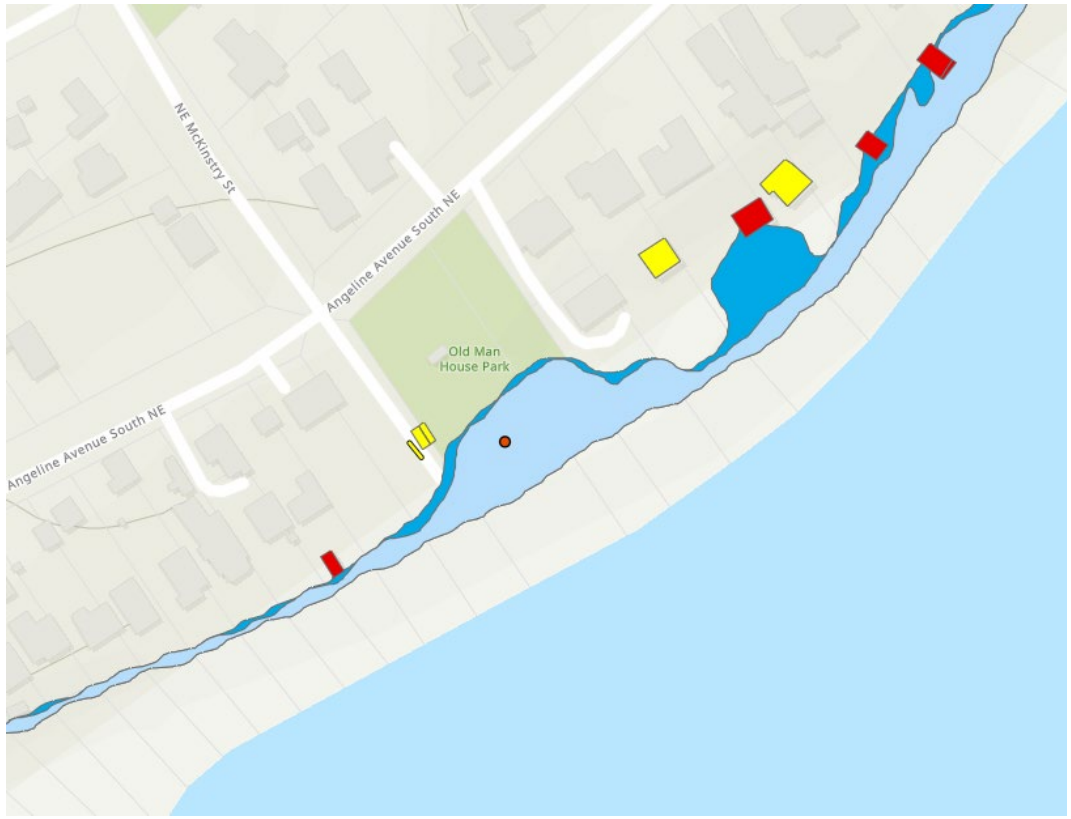
Historic and Cultural Sites

Old Man House Site, Suquamish



Water Systems

Type of Asset	Exposure	Adaptive Capacity	Vulnerability
Group B Water Systems	Six (6) Group B water systems are likely to be inundated by a coastal flooding (SLR or 50-year return extreme flood) by 2050 with a 90% or 50% probability, including the following: • Evanger (3 connections) • Misery Point HOA (7 connections) • President Point (4 connections) • Redman (4 connections) • Richardson Water (3 connections) • Scandia Court (5 connections) **(Exposure = High)**	The adaptive capacity of wells is considered low because of the significant cost for replacement and due to the fact, that once contaminated, repair can be costly and difficult. Interruption of operations has a significant impact on end users. **(Adaptive Capacity= Low)**	**High**
	Three (3) Group B water systems are expected to be inundated by a coastal flooding (SLR or 50-year return extreme flood) by 2100 with a 50% or 1% probability including: • Conifer Crest Water (4 connections) • Kristensen (2 connections) • Olalla Bay Market (2 connections) **(Exposure = Low)**	*See above* **(Adaptive Capacity= Low)**	**Medium**

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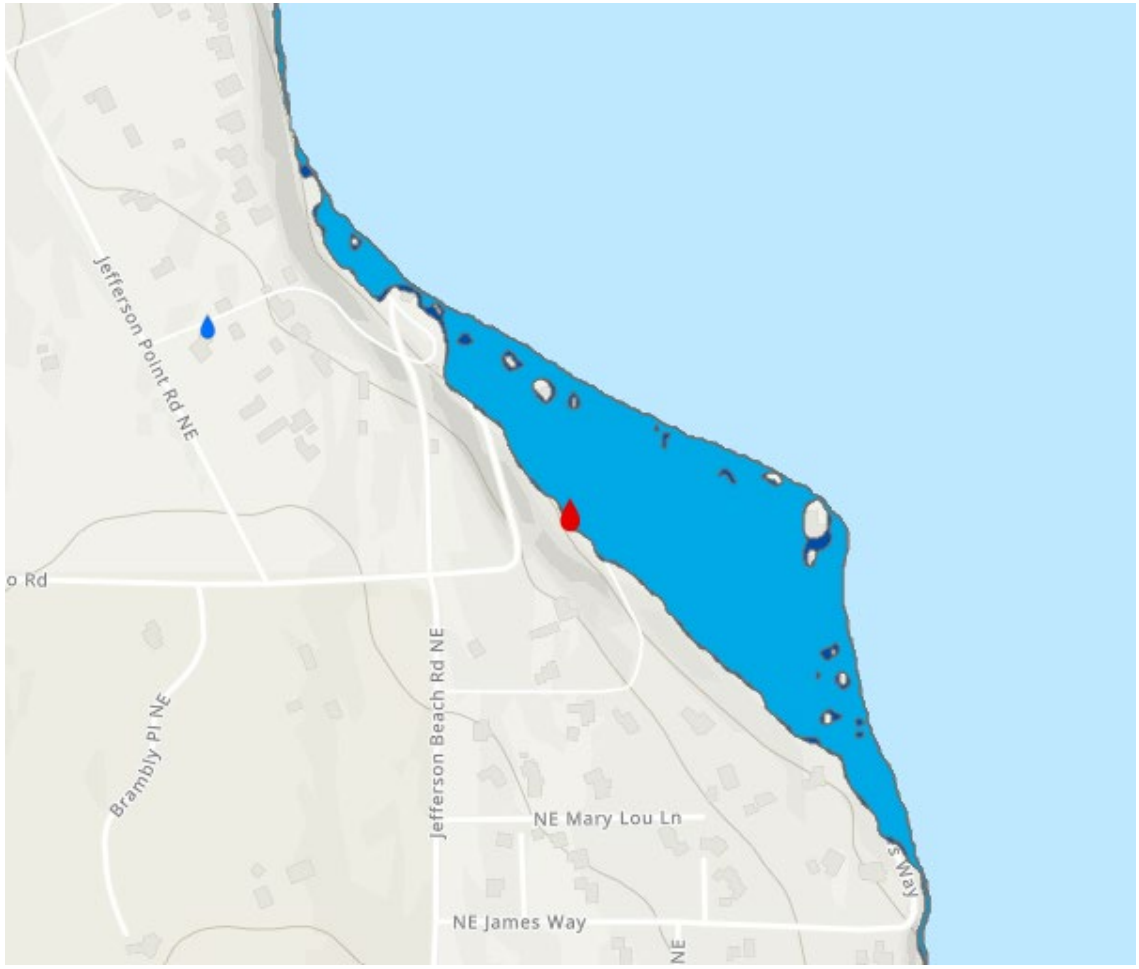
Water Systems

President Point Group B Well



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Water Systems

Some wells are currently showing high levels or Chloride, indicating they may be experiencing saltwater intrusion in the President Point Road area.

Map Source: KPUD

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Stormwater Facilities

Type of Asset	Exposure	Adaptive Capacity	Vulnerability
Stormwater Facilities	11 catch basins , 86 raingardens, and 130 outfalls are likely to be inundated by a coastal flooding (SLR or 50-year return extreme flood) by 2050 with a 90% or 50% probability. **(Exposure = High)**	*See above* **(Adaptive Capacity = Low)**	**High**
	One (1) stormwater basin, two (2) raingardens and 25 outfalls are expected to be inundated by a coastal flooding (SLR or 50-year return extreme flood) by 2050 with a 1% probability, or by 2100 with a 90% probability. **(Exposure = Medium)**	Impacts on these facilities are unlikely to occur within the short-term planning horizon but are likely to occur by 2100. Infrastructure improvements could be prioritized under Capital Improvement planning as infrastructure is repaired or replaced over time. **(Adaptive Capacity = Medium)**	**Medium**
	Five (5) stormwater basins and nine (9) raingardens are expected to be inundated by a coastal flooding (SLR or 50-year return extreme flood) by 2100 with a 50% or 1% probability. **# of outfalls above 1.4 ft over MHHW were not quantified in HDR 2019* **(Exposure = Low)**	*See above* **(Adaptive Capacity = Medium)**	**Low**

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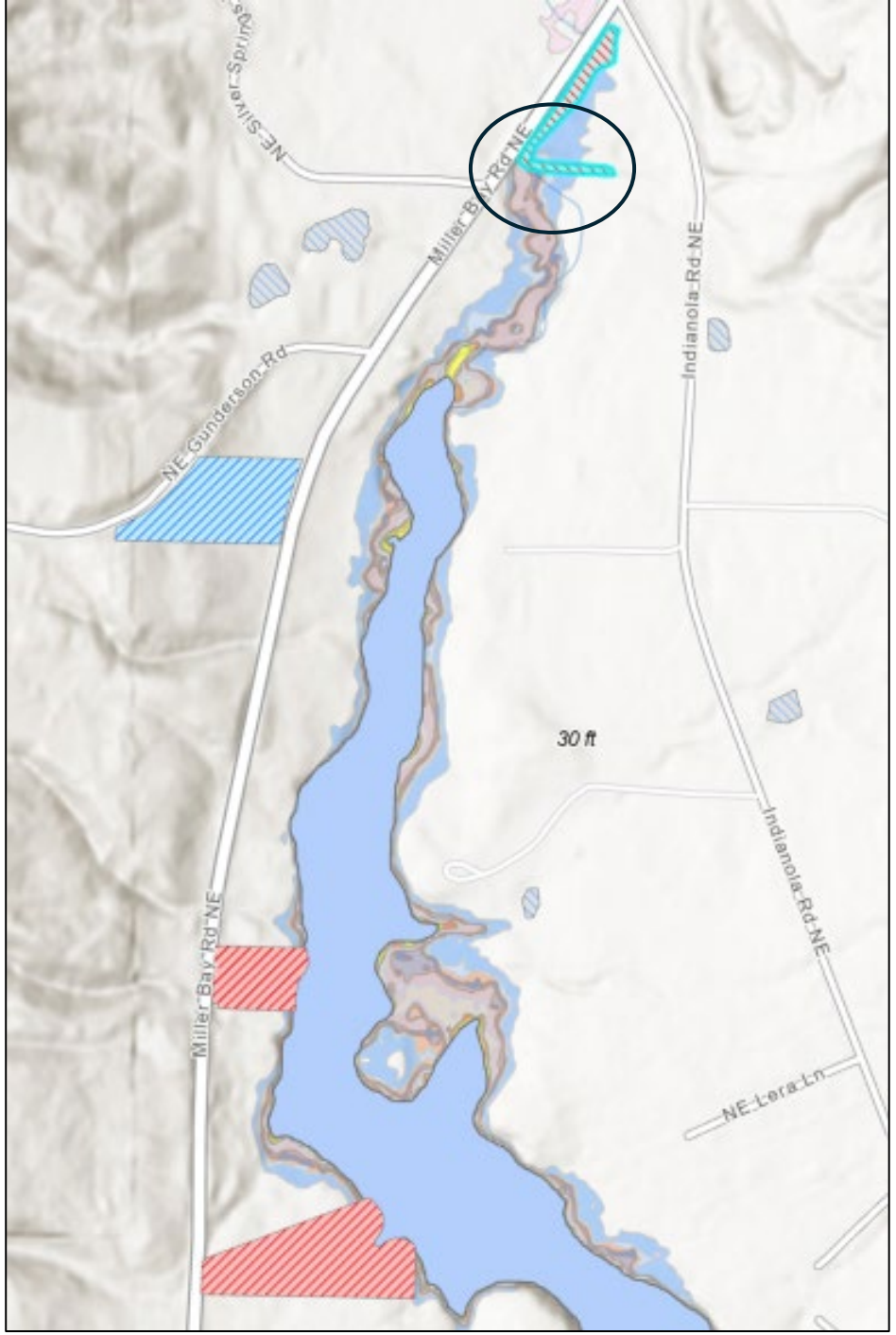

Raingardens and stormwater basins in Grover's Creek area, north end of Miller Bay

Seafood and Shellfish Facilities

Type of Asset	Exposure	Adaptive Capacity	Vulnerability
Seafood and Shellfish Industrial Facilities	Grovers Creek Hatchery is expected to be inundated by a coastal flooding (SLR or 50-year return extreme flood) by 2100 with a 50% or 1% probability **(Exposure = Low)**	Adaptive Capacity of hatcheries is dependent on whether critical facilities, buildings and electrical infrastructure can be raised. It also depends on capacity to handle excess water. Relocation is not possible due to natal stream requirements of salmon populations. **(Adaptive Capacity = Low)**	**Medium**

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Sewer Facilities

Type of Asset	Exposure	Adaptive Capacity	Vulnerability
Sewer Facilities	Six (6) sewer facilities are likely to be inundated by a coastal flooding (SLR or 50-year return extreme flood) by 2050 with a 90% or 50% probability. **(Exposure = High)**	Buried infrastructure related to the municipal sewer service are likely to be resilient to periodic inundation. Material improvements may be required if infrastructure is permanently inundated in the future and should be monitored during temporary inundation events. Above-ground infrastructure improvements may be required for periodic or permanent inundation but could be planned for through Capital Improvement Funds. **(Adaptive Capacity = Medium)**	**High**
	One (1) sewer facility is expected to be inundated by a coastal flooding (SLR or 50-year return extreme flood) by 2050 with a 1% probability, or by 2100 with a 90% probability. **(Exposure = Medium)**	*See above* **(Adaptive Capacity = Medium)**	**Medium**
	One (1) sewer clean out is expected to be inundated by a coastal flooding (SLR or 50-year return extreme flood) by 2100 with a 50% or 1% probability. **(Exposure = Low)**	Sewer clean-outs are located above ground and may be at greater risk from impacts during temporary or permanent inundation. Adaptation strategies such as raising cleanouts above projected flood levels, or upgrading surrounding infrastructure may be required to increase resiliency. Mitigation measures are possible, but may be costly depending on the extent of infrastructure improvements required. **(Adaptive Capacity = Medium)**	**Low**

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Sewer Components with an exposure likelihood in Suquamish.

- Treatment Plant
- Wet well,High
- Wet well, Medium
- Wet well, Not in
- Meter

Summary of Risk Exposure

Asset	High	Medium	Low
Roads	7 miles	1.5 miles	14.5 miles
Total # of buildings	1,190	260	1,090
Drinking Water – Group A/B	11	0	8
Stormwater – basins	97	3	14
Stormwater - outfalls	194	18	75
Sewer Clean out	0	0	1
Sewer Facilities	6	1	0
Contaminated Sites	4	1	2
Wetlands	4627 acres	4 acres	67 acres
Marinas	3	1	1
Parks	6	1	3

Adaptation Strategies

- Consider requiring assessments or reports to include sea-level rise projections for potentially impacted properties.
- Limit redevelopment or expansion of existing legal non-conforming structures in vulnerable locations.
- Prioritize transportation connectivity and resiliency.
- Encourage alternatives to hard shoreline stabilization measures.
- Require special considerations when permitting critical infrastructure and facilities.
- Provide support for education opportunities about raising vulnerable structures and identify incentives or funding opportunities, when available.
- Incentivize community flood control and adaptation strategies.

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Recommended Next Steps

- Expand on the findings of these reports and begin implementing resiliency strategies to protect assets and infrastructure in the future.
- Consider seeking grant opportunities for financial support to replace the aging infrastructure, particularly in areas most vulnerable.
- Quantify exposure of forage fish beaches to see where beaches could experience possible coastal squeeze.
- Consider revisions development regulations to improve the resilience of new or redeveloped properties.
- Develop Community Plans for residential areas most at risk (e.g. Hansville).
- Develop an informational tool that allows residents to conduct a high-level self-assessment of their vulnerability through a series of guided questions and prompts. (Done)
- Work with Washington State Department of Ecology to identify ways to streamline permitting for certain resiliency strategies and update codes respectively to allow for improved implementation.

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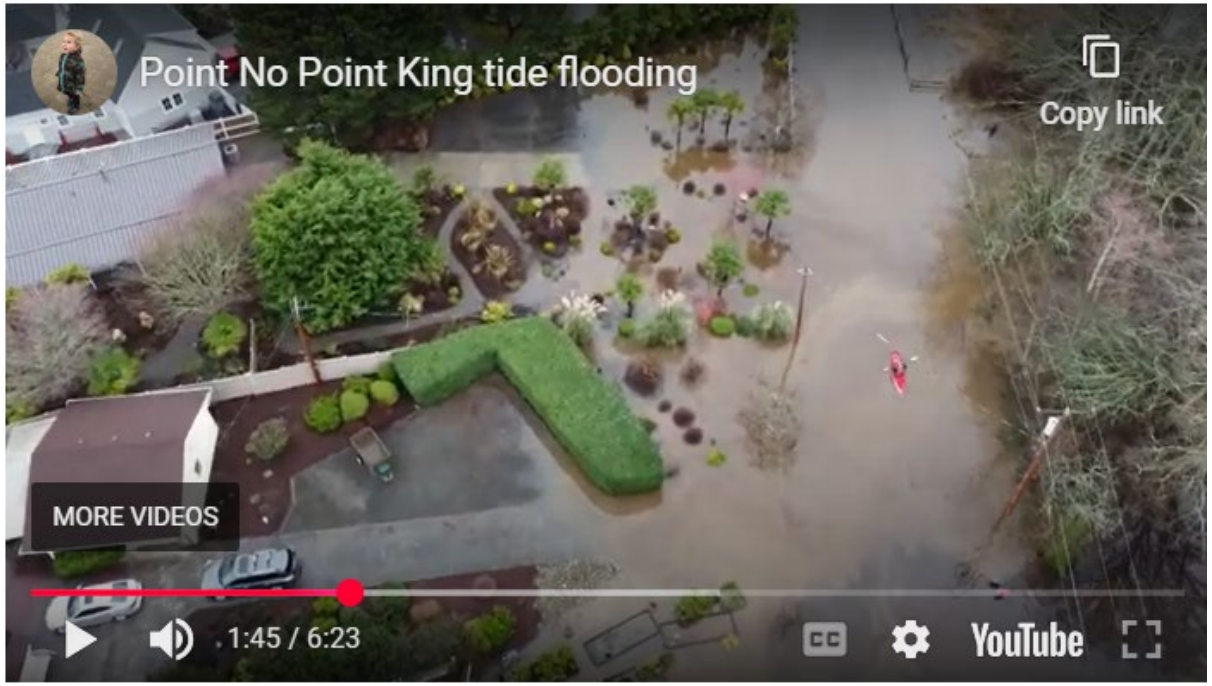
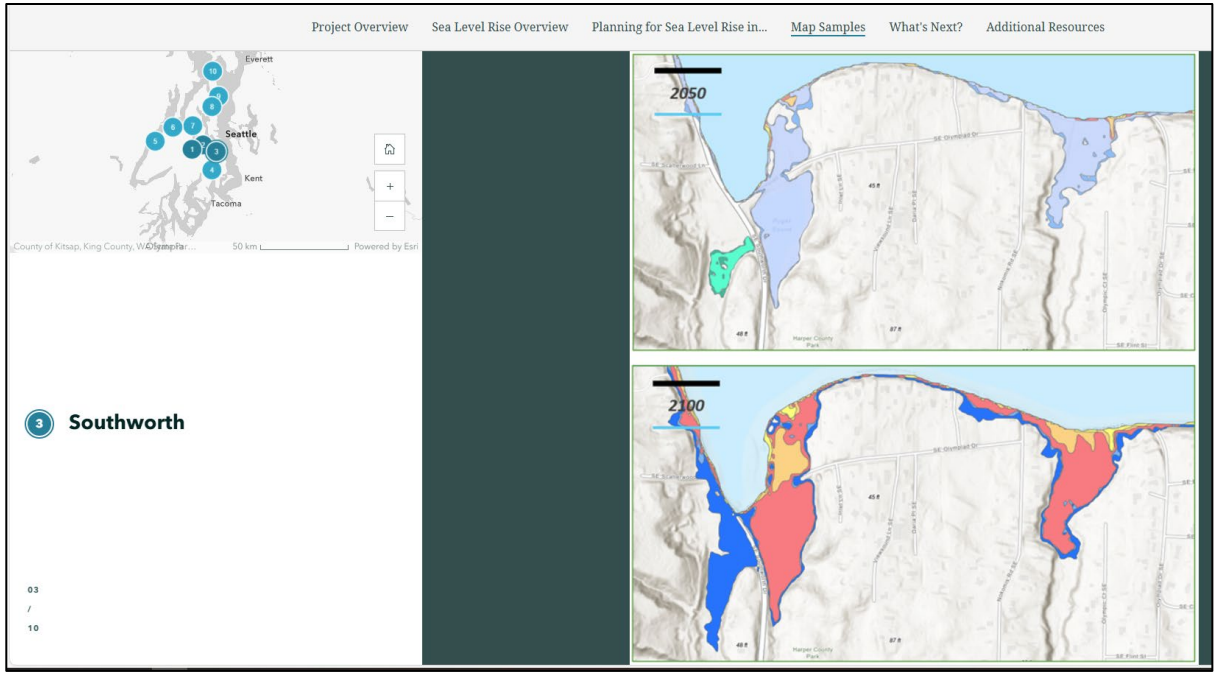
StoryMap

[County's Sea Level Rise Vulnerability and Risk Assessment](#) Website Hub





Discussion