



# Advancing Infrastructure Resilience in Washington's State Parks

APWA Washington Spring Conference 2024





# Outline

- 1 Project Background
- 2 Approach
- 3 Key Findings
- 4 Adaptation Strategies
- 5 Screening Tool
- 6 Lessons Learned



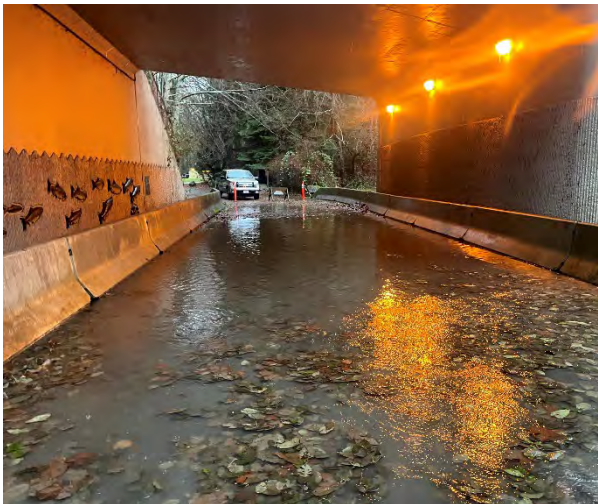


# Project Background





# Flooding currently impacts infrastructure



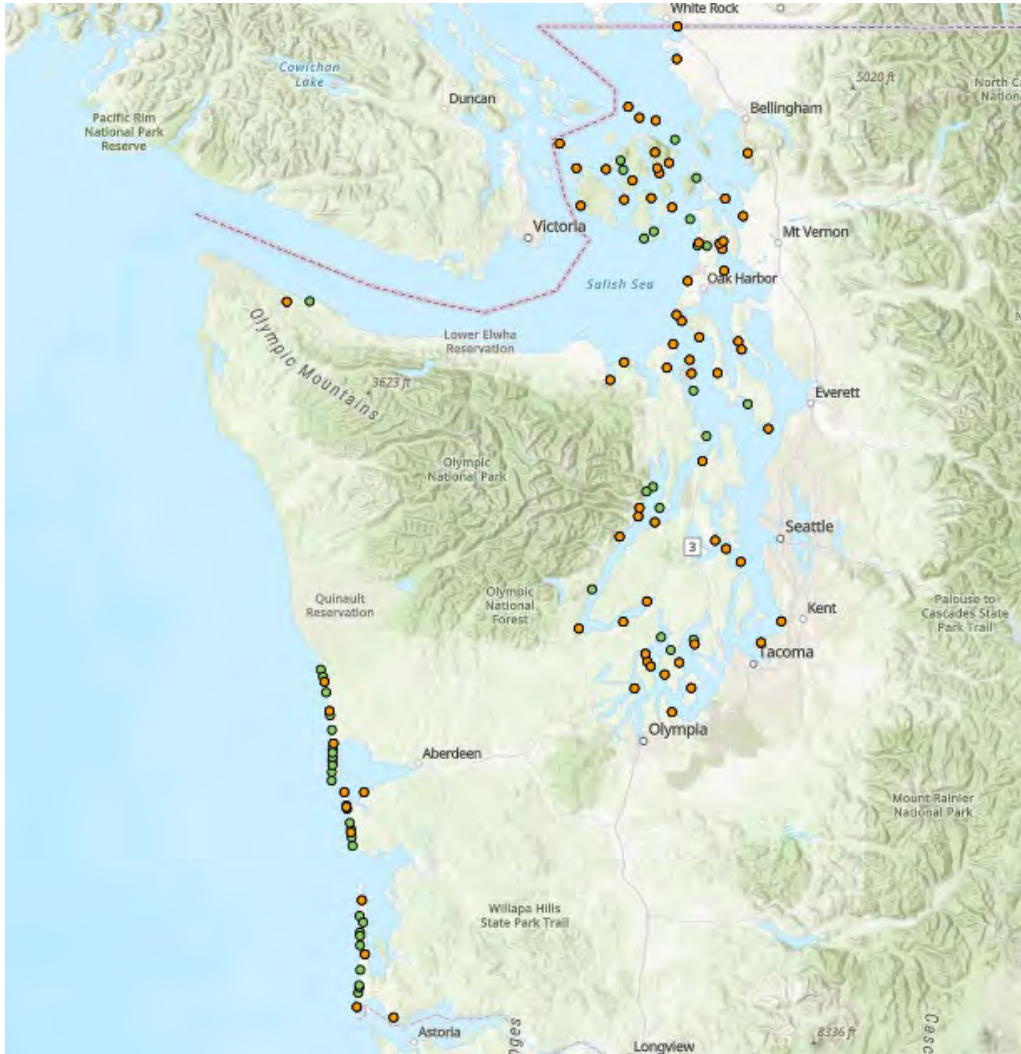


# Erosion currently impacts infrastructure





# State parks have a lot of infrastructure



93 coastal properties

74 with infrastructure

52 with on-site visit

# This project builds on previous work

## Preparing Washington State Parks for Climate Change

*A Climate Change Vulnerability Assessment for Washington State Parks*

June 2017



**Prepared by**  
The University of Washington Climate Impacts Group  
**In partnership with**  
The Washington State Parks and Recreation Commission



## WASHINGTON STATE PARKS ADAPATION PLAN

June 2019



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The University of Washington, Climate Impacts Group  
  
In Partnership with  
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# Washington State Parks Climate Resiliency Framework

1

## Authorization

Mainstream climate resiliency  
into existing policies &  
practices

2

## Adaptation

Prepare parks for current and  
future climate change  
conditions

3

## Mitigation

Reduce greenhouse gas  
emissions and energy  
consumption

4

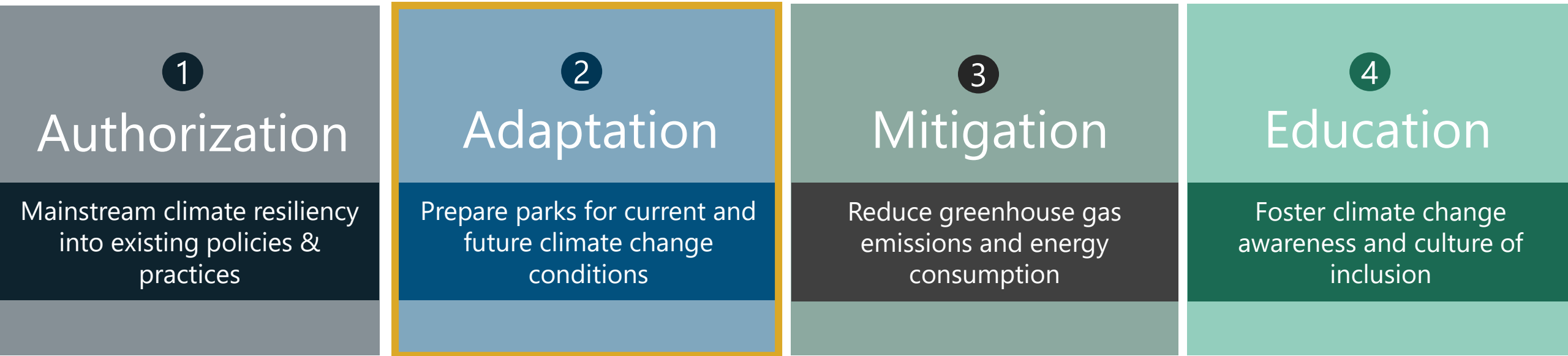
## Education

Foster climate change  
awareness and culture of  
inclusion

Building capacity to prepare for, adapt to,  
and recover from current and future climate-related impacts



# Washington State Parks Climate Resiliency Framework



Building capacity to prepare for, adapt to,  
and recover from current and future climate-related impacts



# Sea level rise vulnerability assessment for coastal infrastructure

## Preparing Washington State Parks for Climate Change

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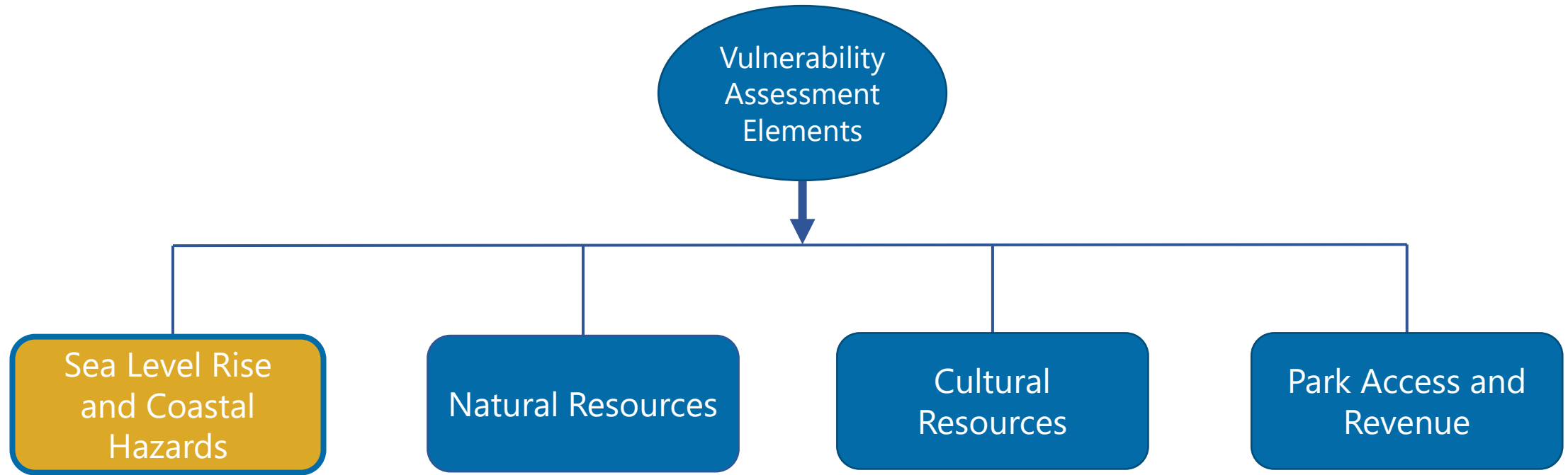


## Washington State Parks and Recreation Commission Coastal Facilities Vulnerability Assessment: Implications for Sea Level Rise and Coastal Hazard Planning



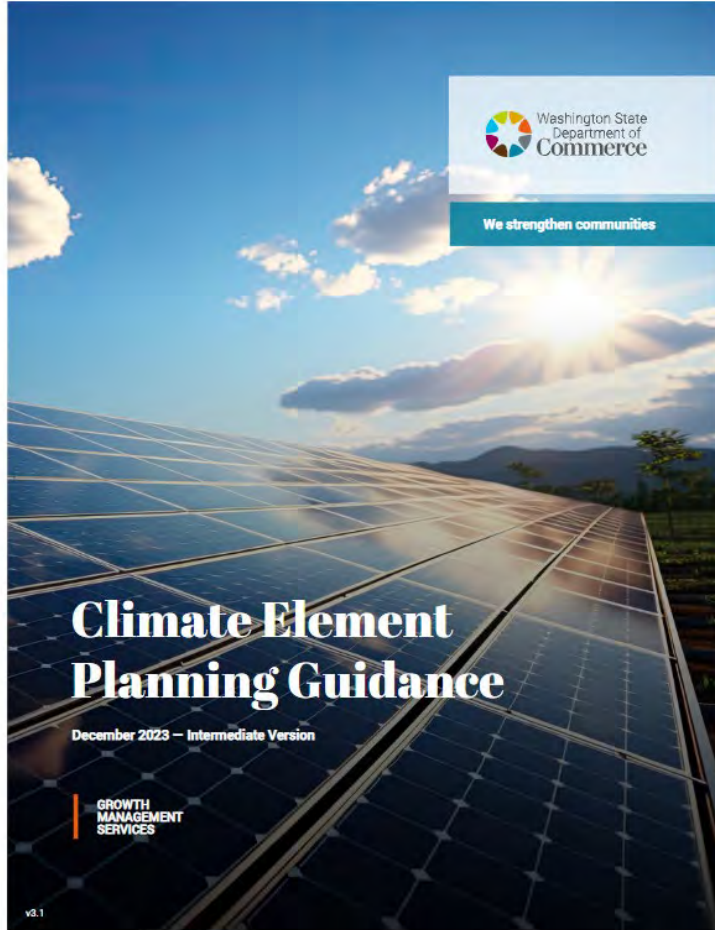


# Washington State Parks Climate Adaptation Framework





# Policy context for vulnerability assessments



## Steps and Pathways to Integrate Resilience into Comprehensive Plan



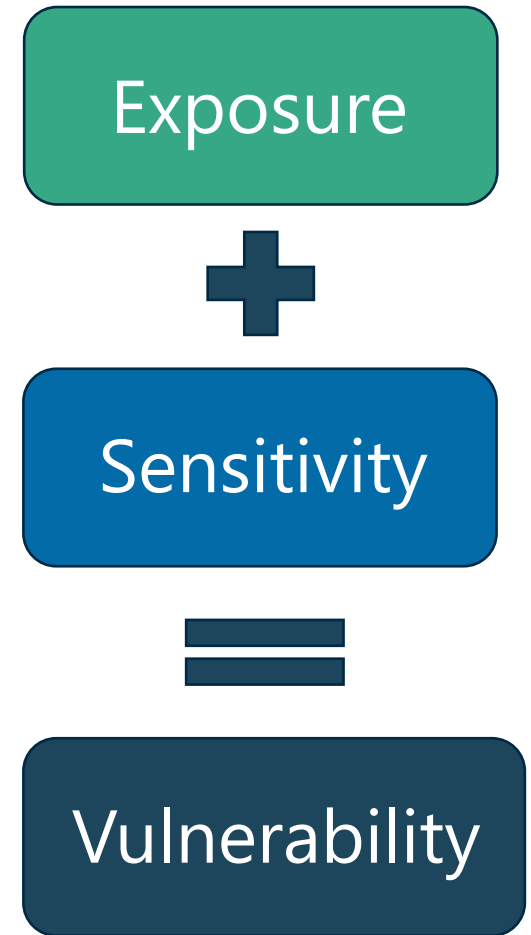
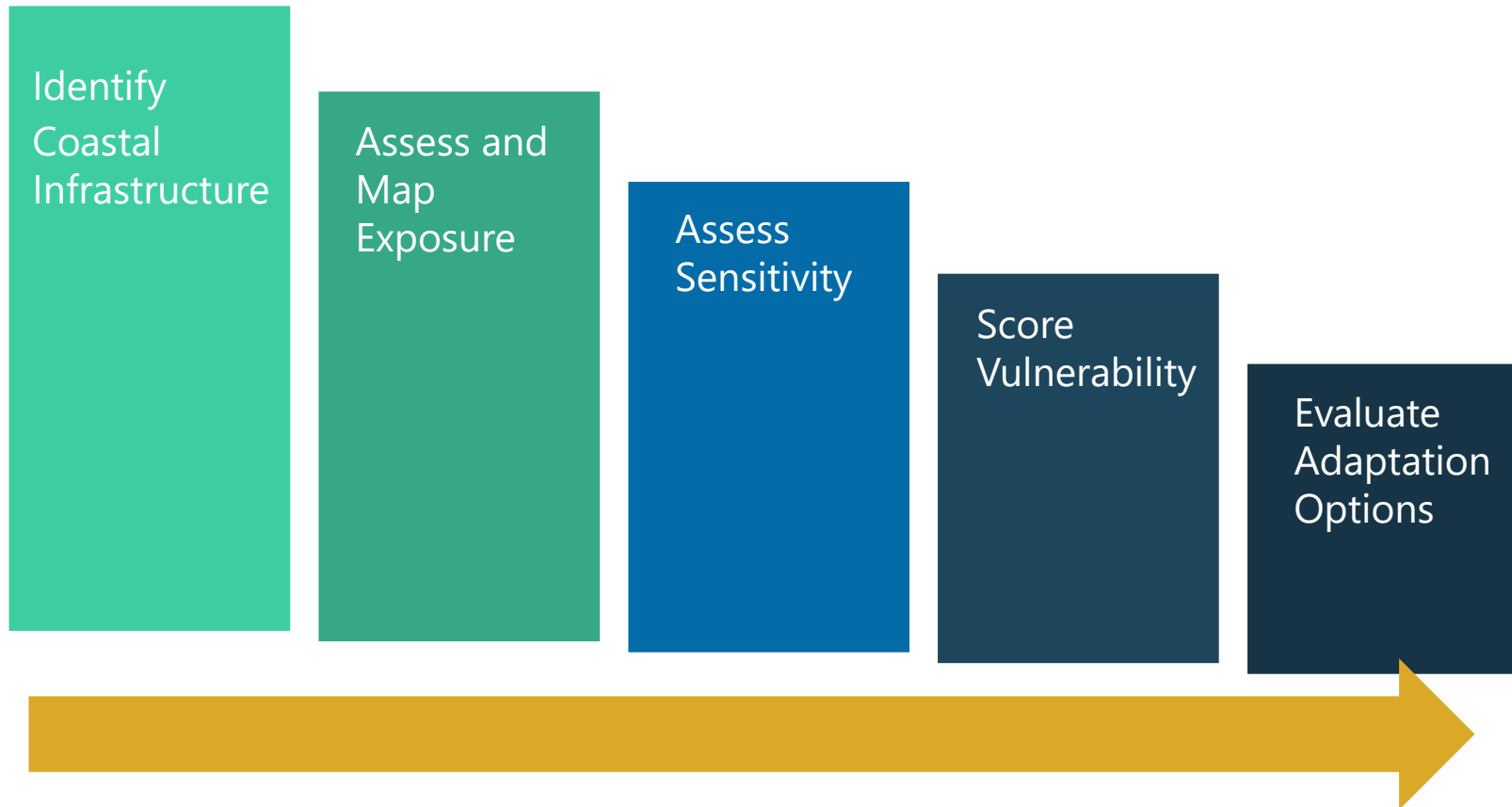


# Coastal Infrastructure Vulnerability Assessment Approach

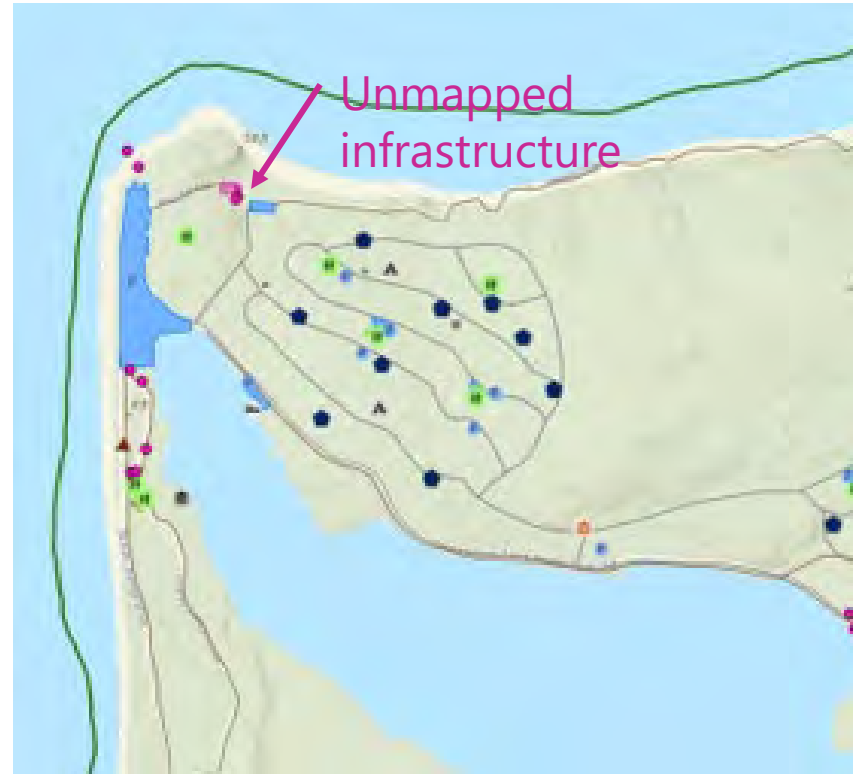




# Vulnerability assessment approach



# 1. Identify Coastal Infrastructure

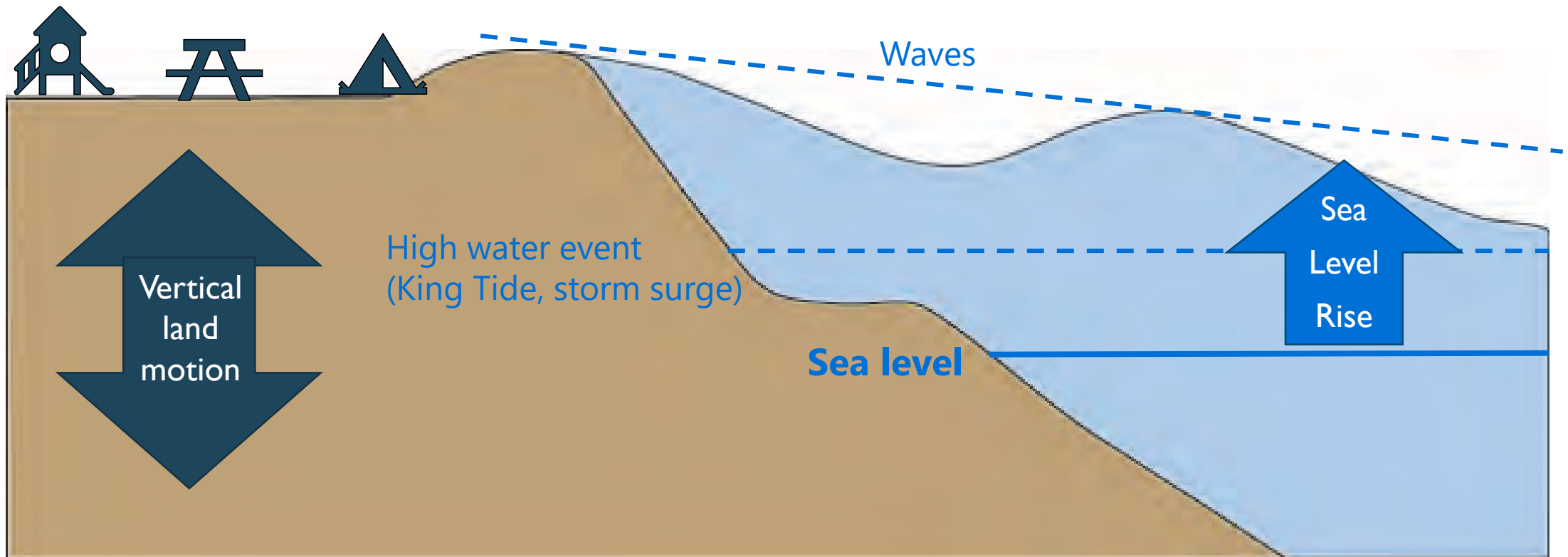




## 2. Assess and Map Exposure

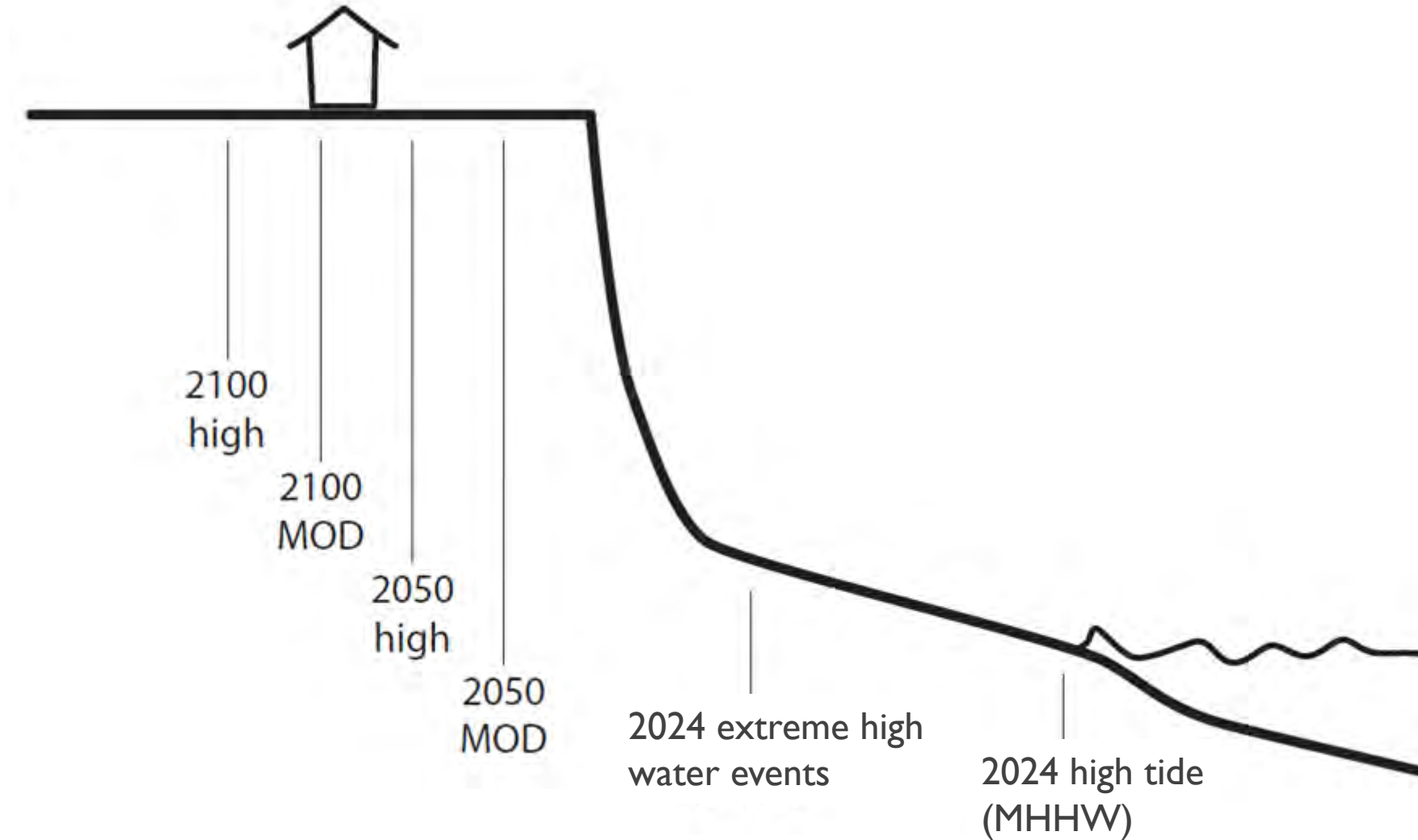


# Sea level rise does not act alone





# Erosion rates are linked with sea level rise rates



# Consider different likelihoods and timeframes

## Inundation

<b>50% likelihood by 2050</b>	Sea level rise about MHHW (RCP 8.5) + 20-year high water event
<b>50% likelihood by 2050, with waves.</b>	Sea level rise about MHHW (RCP 8.5) + 20-year high water event + waves
<b>1% likelihood by 2050</b>	Sea level rise about MHHW (RCP 8.5) + 20-year high water event
<b>1% likelihood by 2050, with waves</b>	Sea level rise about MHHW (RCP 8.5) + 20-year high water event + waves
<b>Compound flooding</b>	FEMA 100-year base flood elevation (coastal, riverine, and surface)

## Erosion

<b>High confidence bluff erosion</b>	Puget Sound minimum long-term bluff recession rate
<b>Intermediate confidence bluff erosion</b>	Puget Sound median long-term bluff recession rate Pacific Coast shoreline change rate
<b>Low confidence bluff erosion</b>	Puget Sound maximum long-term bluff recession rate



# Map and score exposure

## Facilities

### Exposure Score



### 3. Assess Sensitivity





# Consider the impact of damaged infrastructure

*If this infrastructure was exposed, how big of an impact would it have on:*

- Human health and safety?
- The environment?
- Park operations?

Less sensitive

More sensitive



- Temporary structures
- Nonhazardous storage
- Trails

- Administrative buildings
- Docks and piers
- Roofed accommodations

- Evacuation routes
- Sewage/ wastewater utilities
- Shore protection

# Map and score sensitivity

## Facilities

### Sensitivity Score





## 4. Score Vulnerability

### Facilities

#### Exposure Score

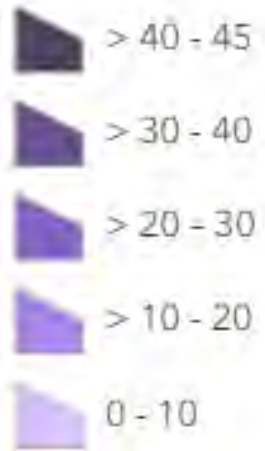


Exposure

# Overlay exposure and sensitivity

## Facilities

### Sensitivity Score



Exposure



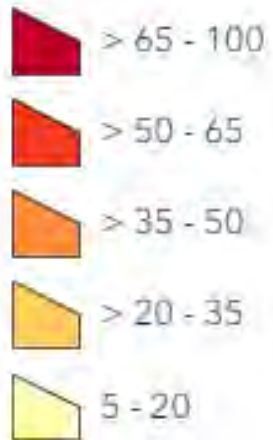
Sensitivity



# Exposure + sensitivity = vulnerability

## Facilities

### Vulnerability Score



Exposure

+

Sensitivity

=

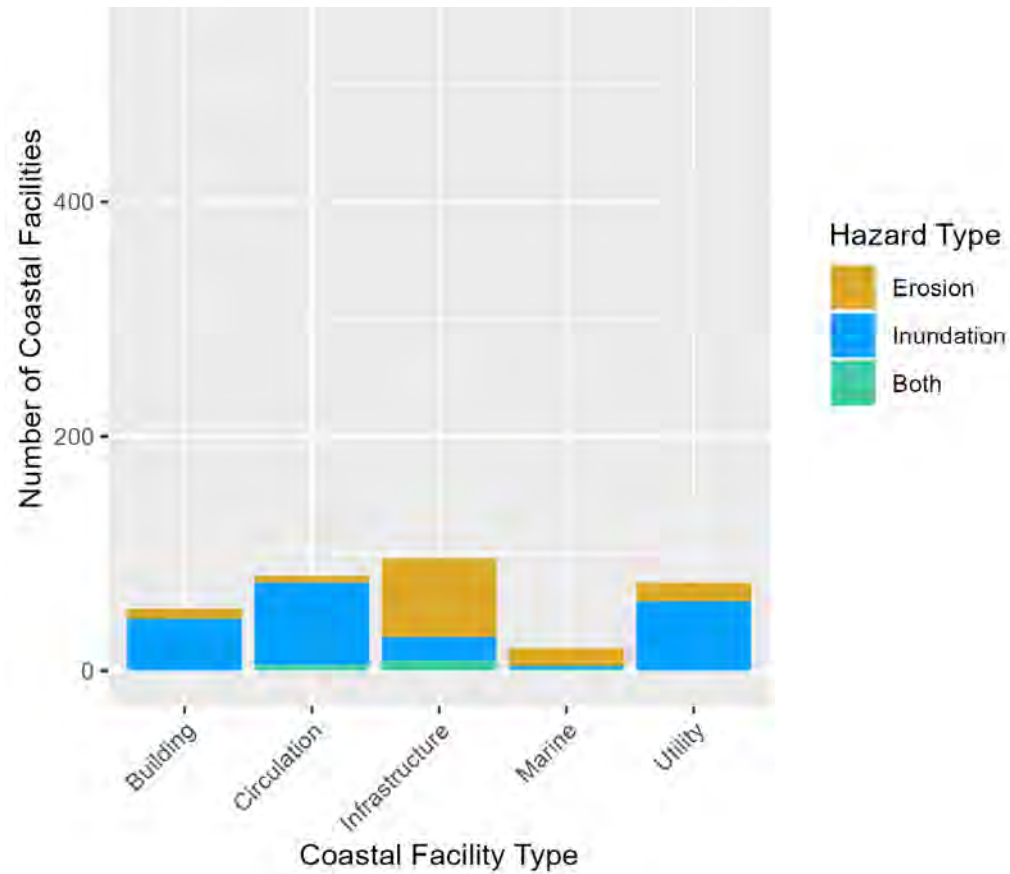
Vulnerability

# Key Findings



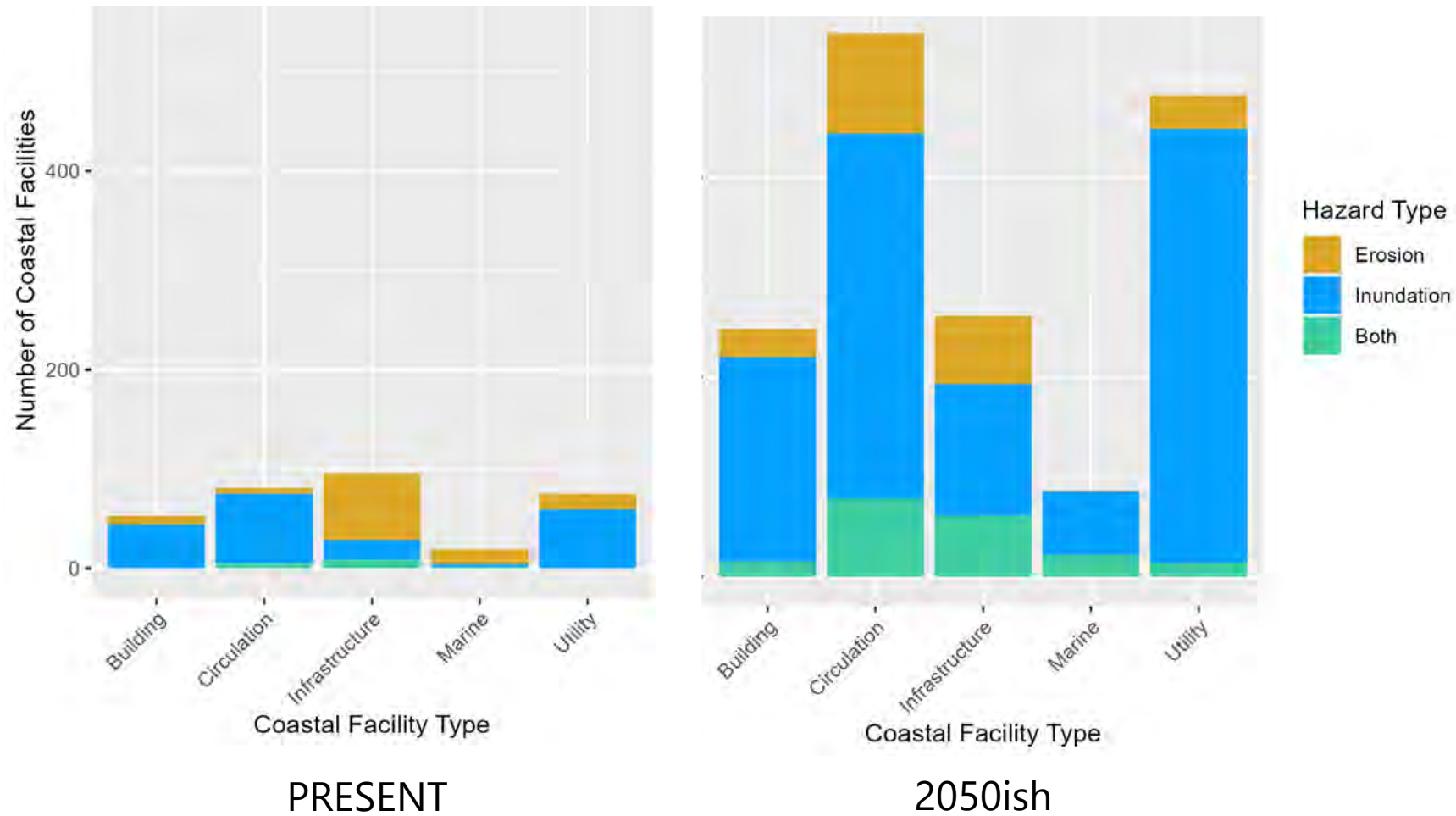


# Many facilities are currently exposed



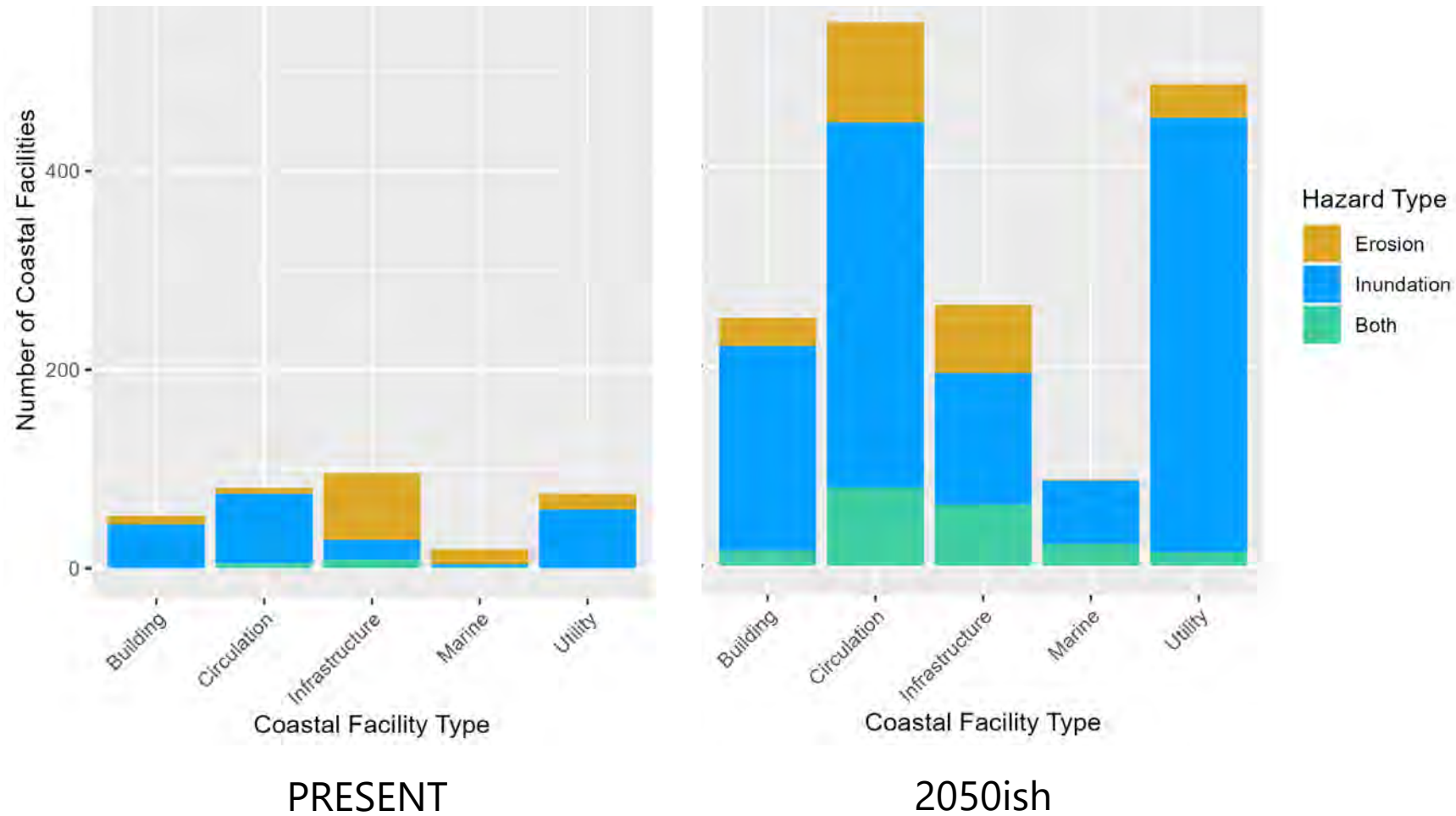
PRESENT

# More facilities will be exposed in the future

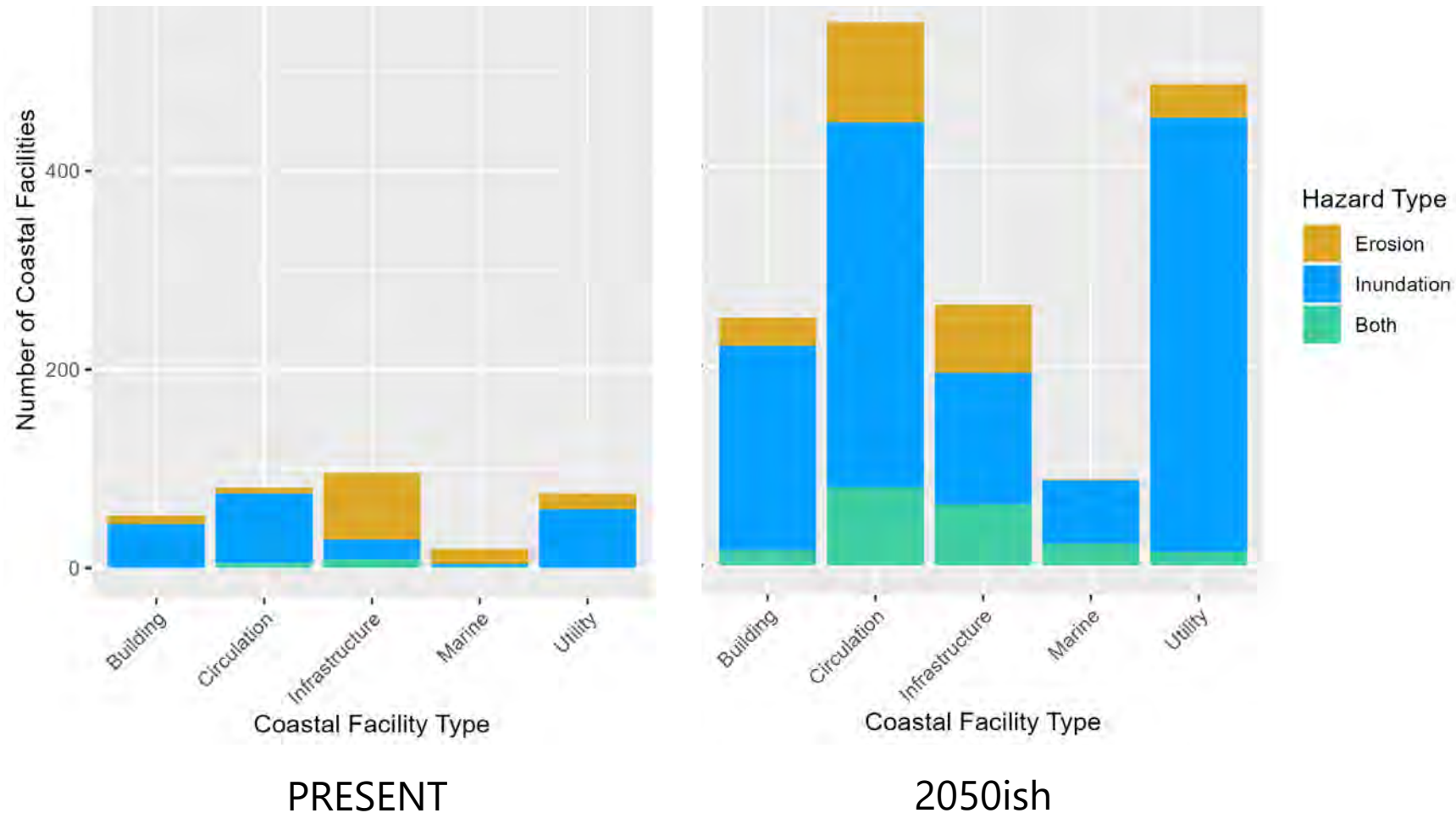




# Inundation AND erosion will both be hazards



# Roads and utilities will be especially vulnerable











# Adaptation Strategies



# Evaluate Adaptation Options

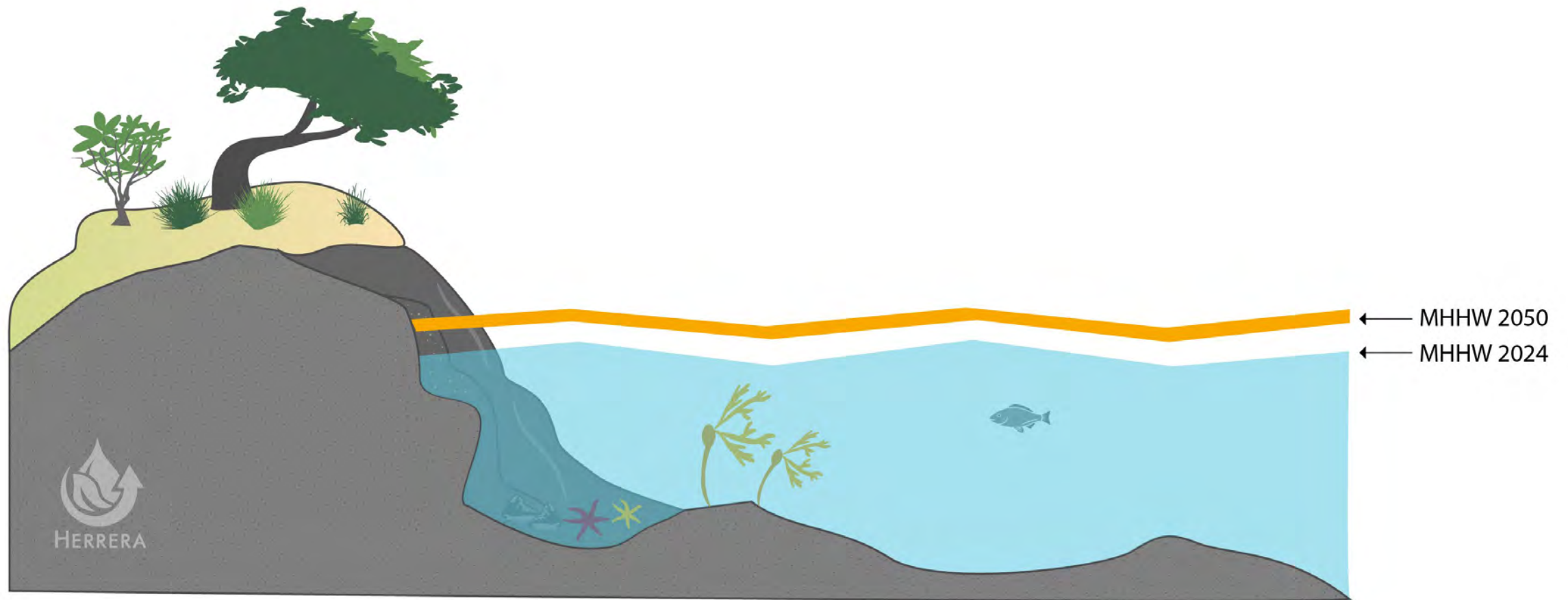
No Action		Make Space (Retreat)		Adapt in Place (Accommodate)			Delay (Resist)	
								
No Action		Remove	Relocate	Restore	Redesign	Replace	Protect	Mitigate



# Evaluate Adaptation Options

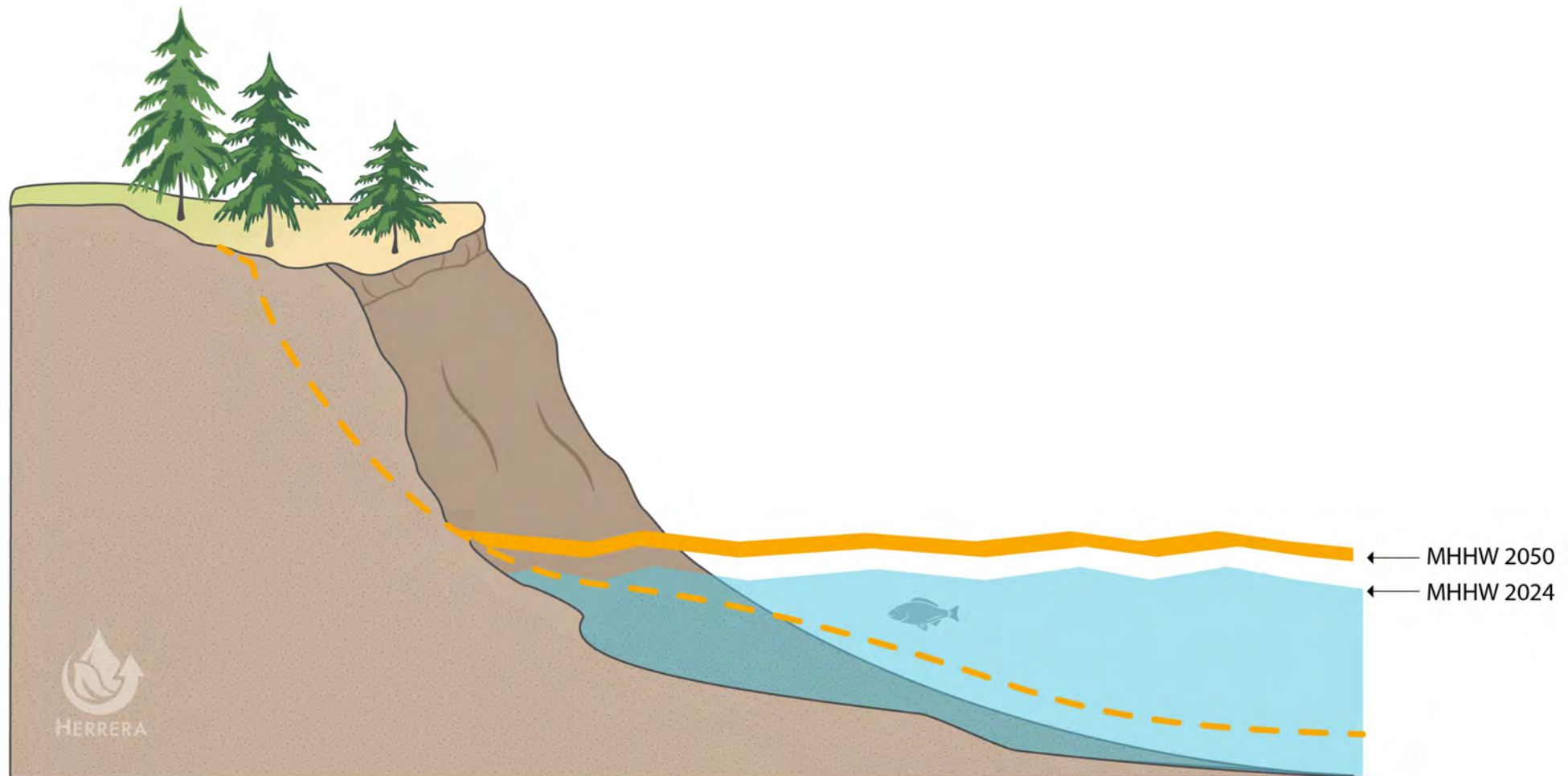
No Action		Make Space (Retreat)		Adapt in Place (Accommodate)			Delay (Resist)	
 No Action		 Remove	 Relocate	 Restore	 Redesign	 Replace	 Protect	 Mitigate

# No Action - rocky shore

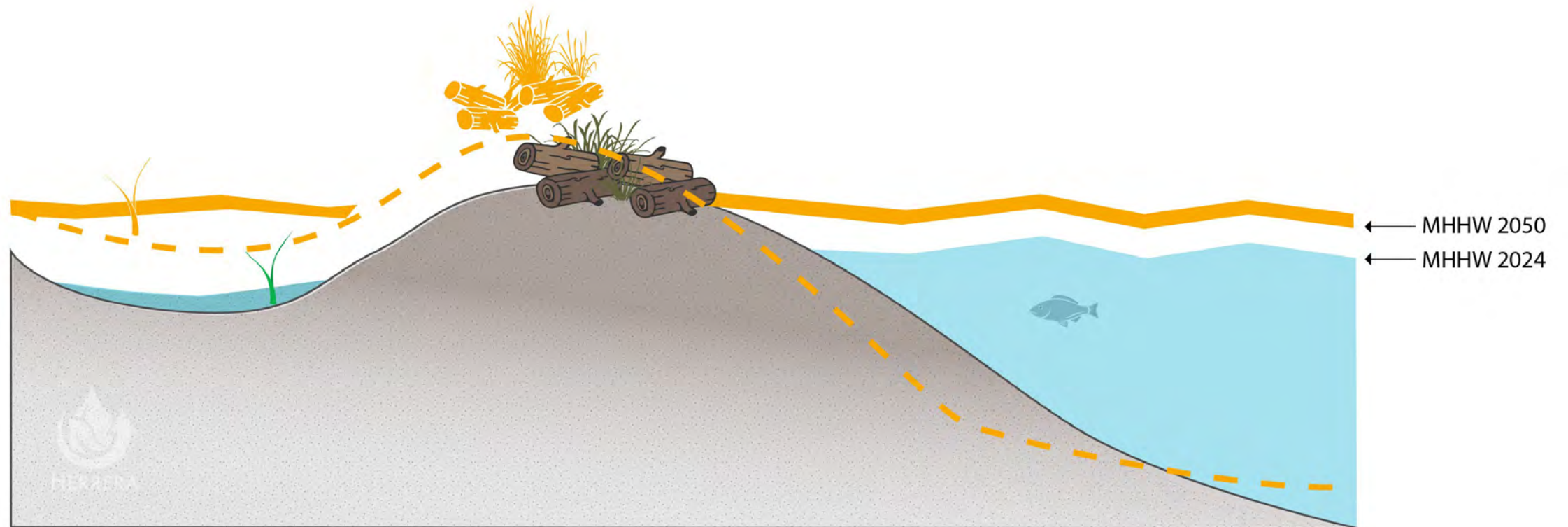




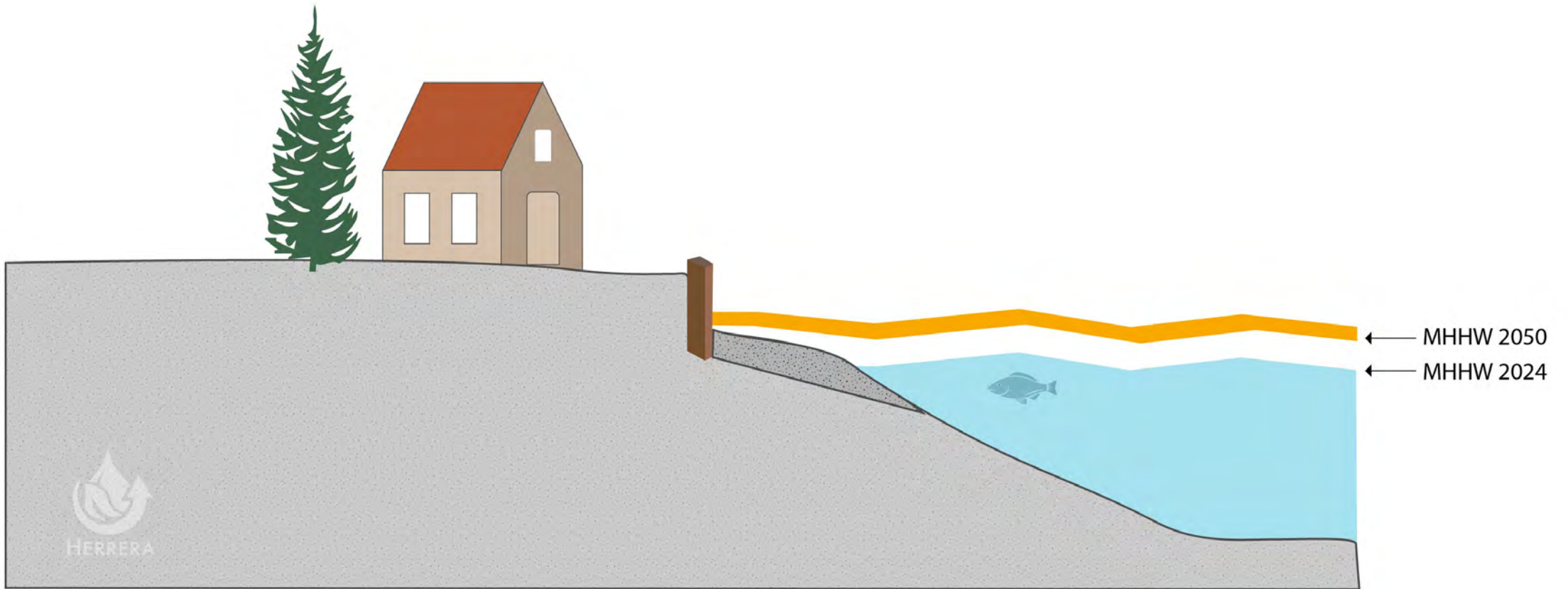
# No Action – coastal bluff



# No Action – barrier beach

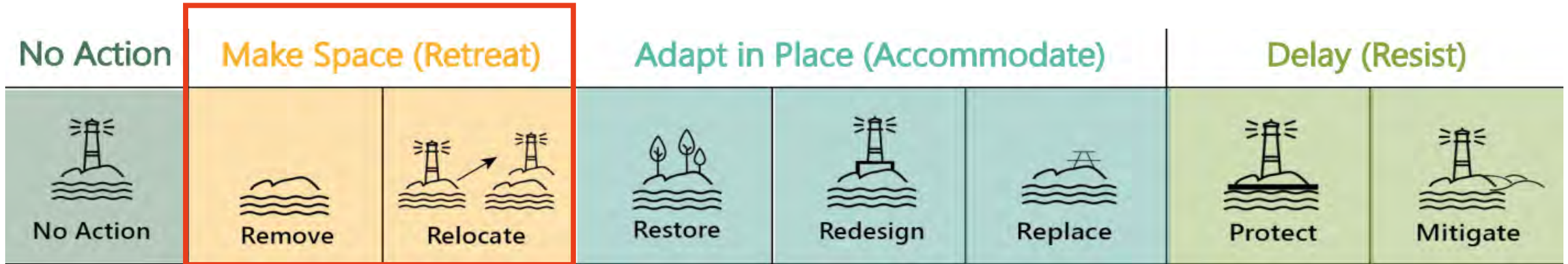


# No Action – armored beach

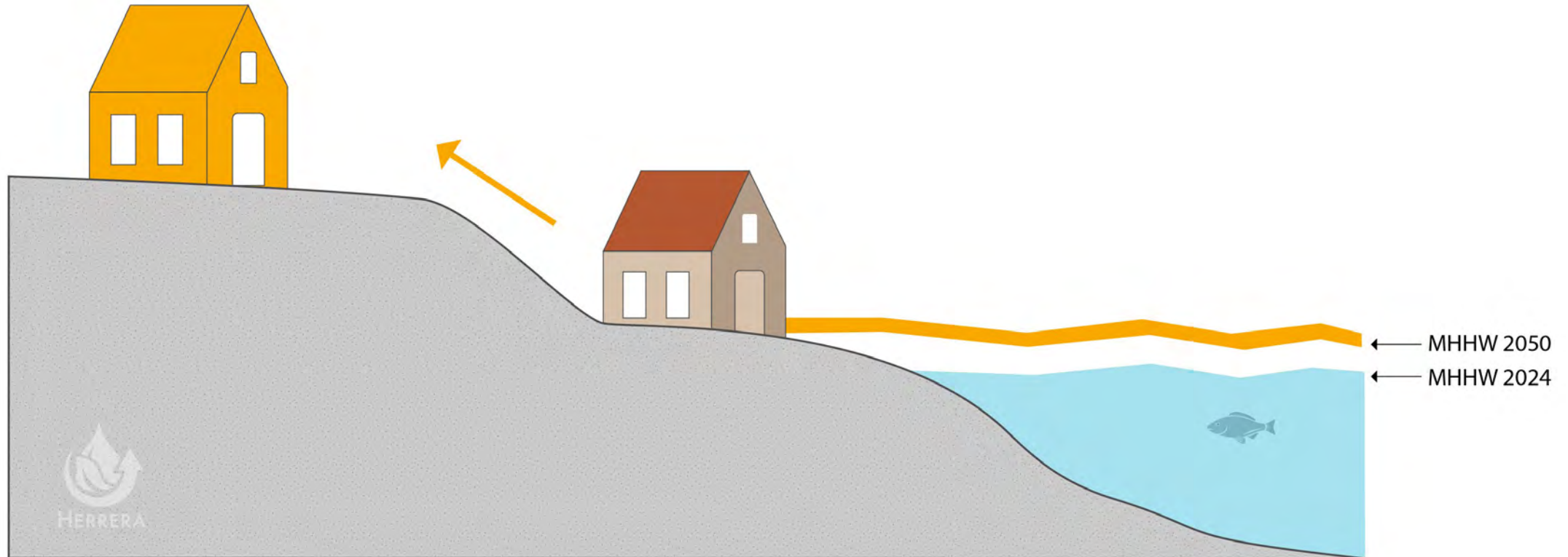




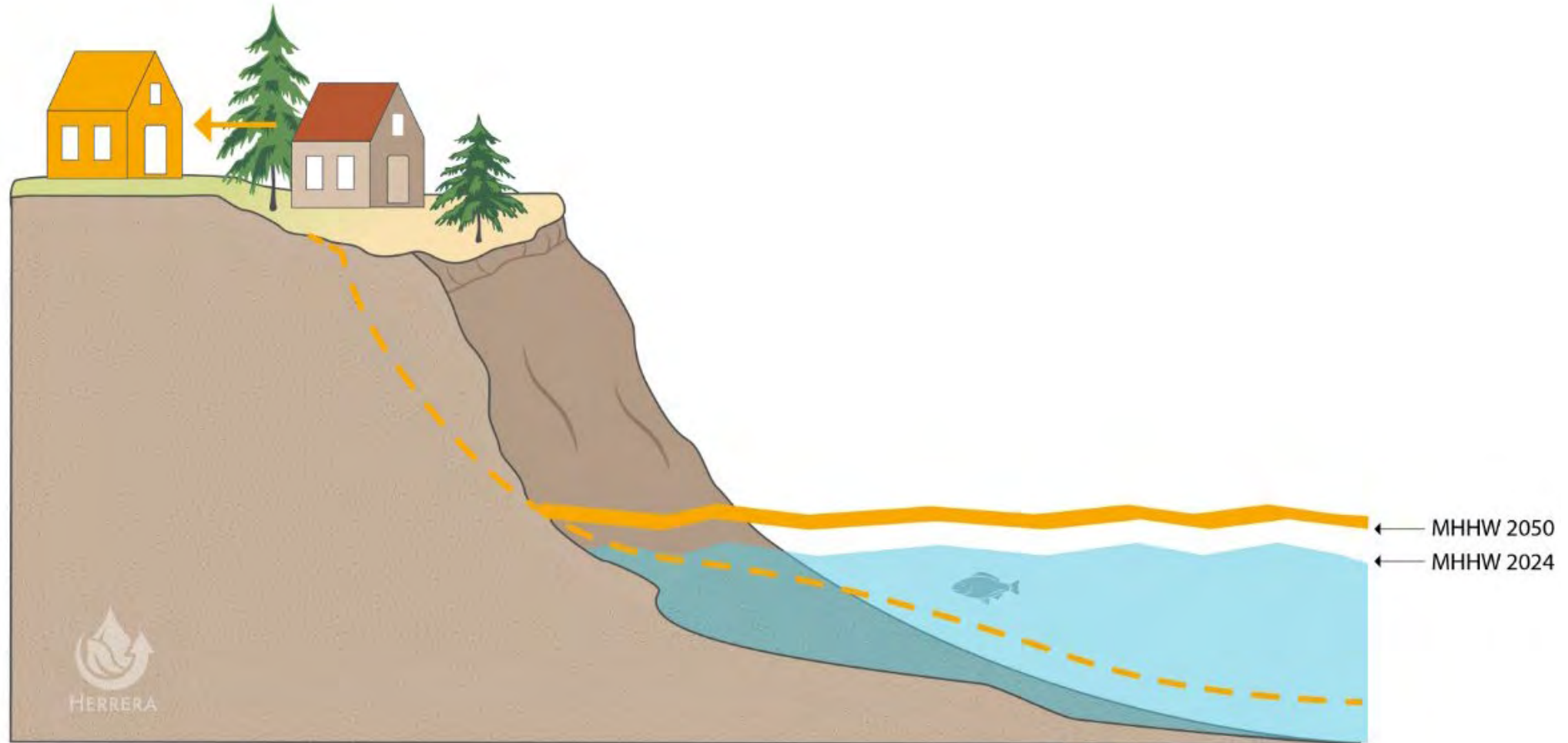
# Evaluate Adaptation Options



# Make Space – move away from the water




# Make Space – move away from the bluff crest





# Evaluate Adaptation Options

No Action	Make Space (Retreat)		Adapt in Place (Accommodate)			Delay (Resist)	
							
No Action	Remove	Relocate	Restore	Redesign	Replace	Protect	Mitigate

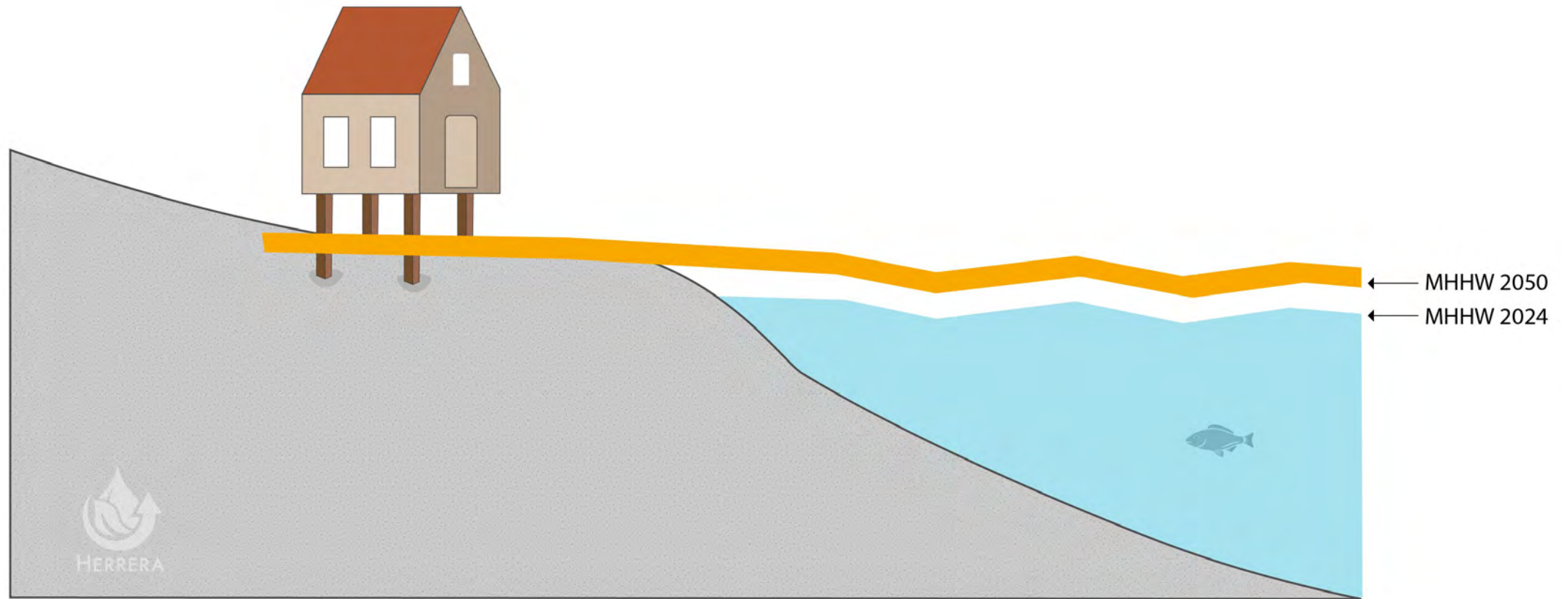


# Adapt in Place – restore areas





# Adapt in Place – elevate structures













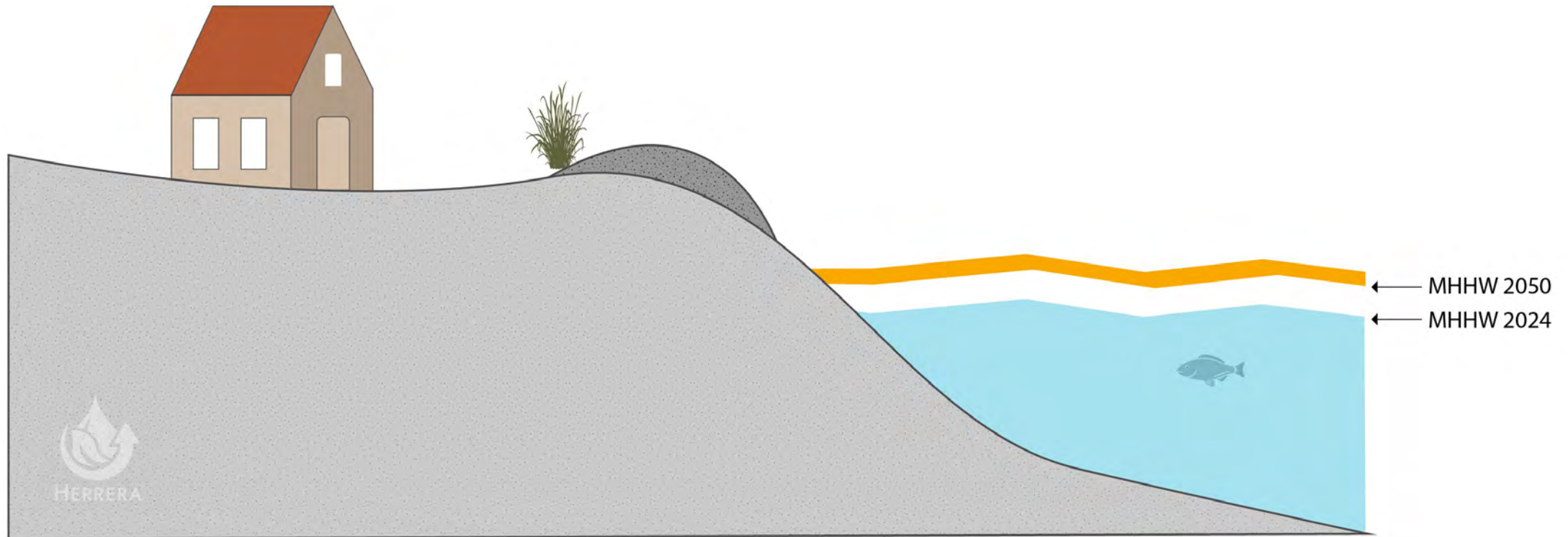
# Adapt in Place – replace function



# Evaluate Adaptation Options

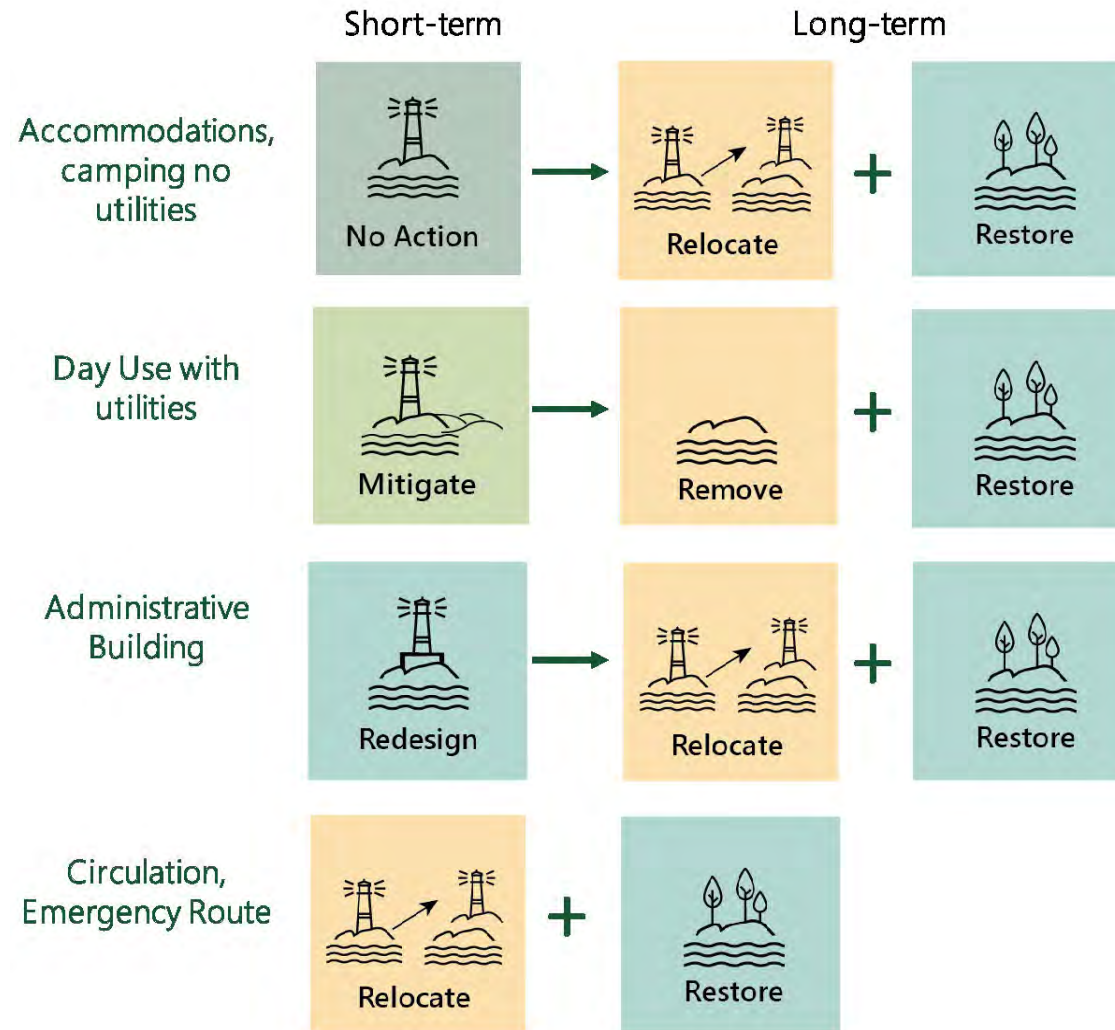
No Action	Make Space (Retreat)		Adapt in Place (Accommodate)			Delay (Resist)	
							
No Action	Remove	Relocate	Restore	Redesign	Replace	Protect	Mitigate

# Delay – beach nourishment





# Adaptation strategies can be paired



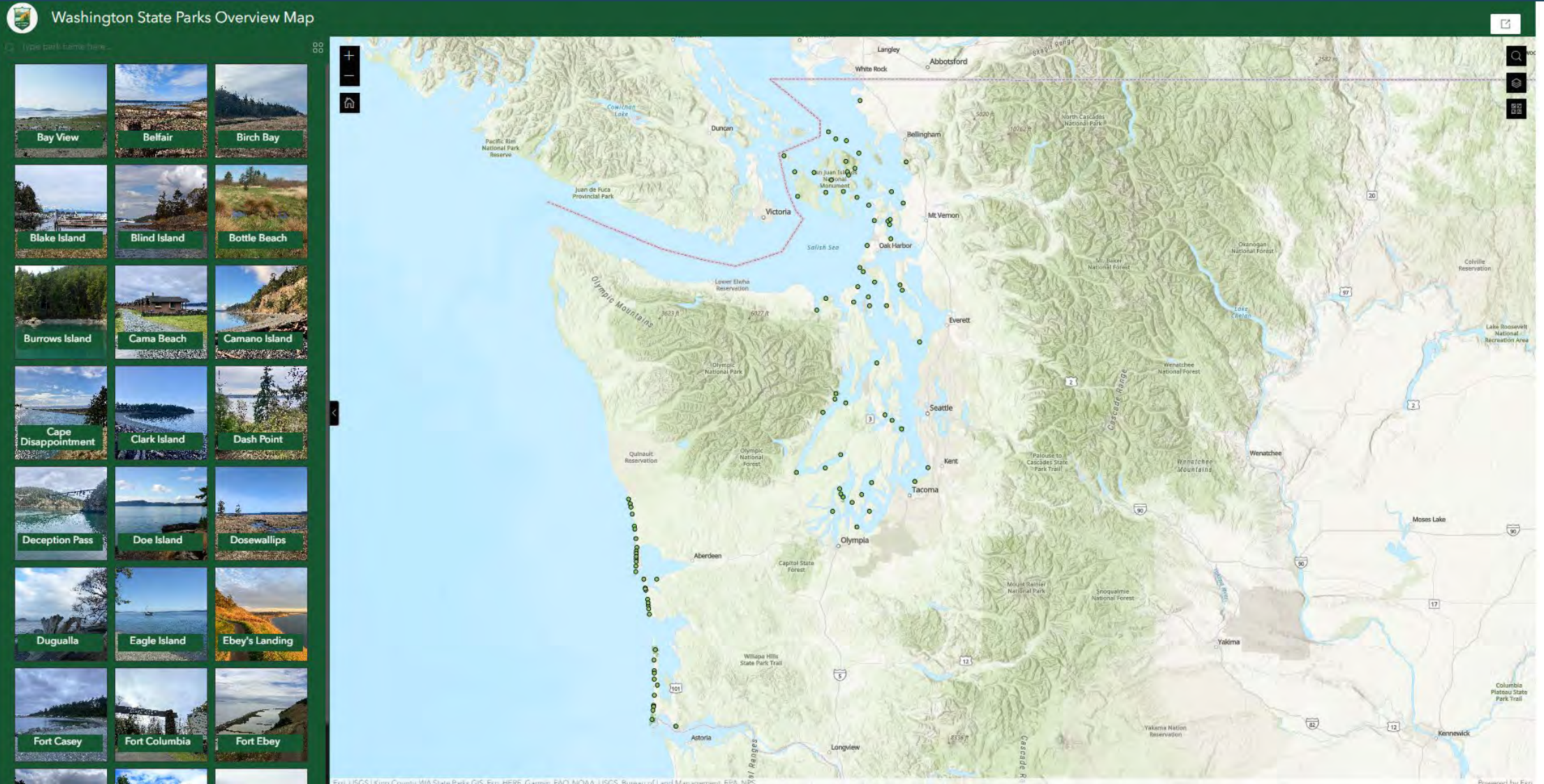


# Screening Tool



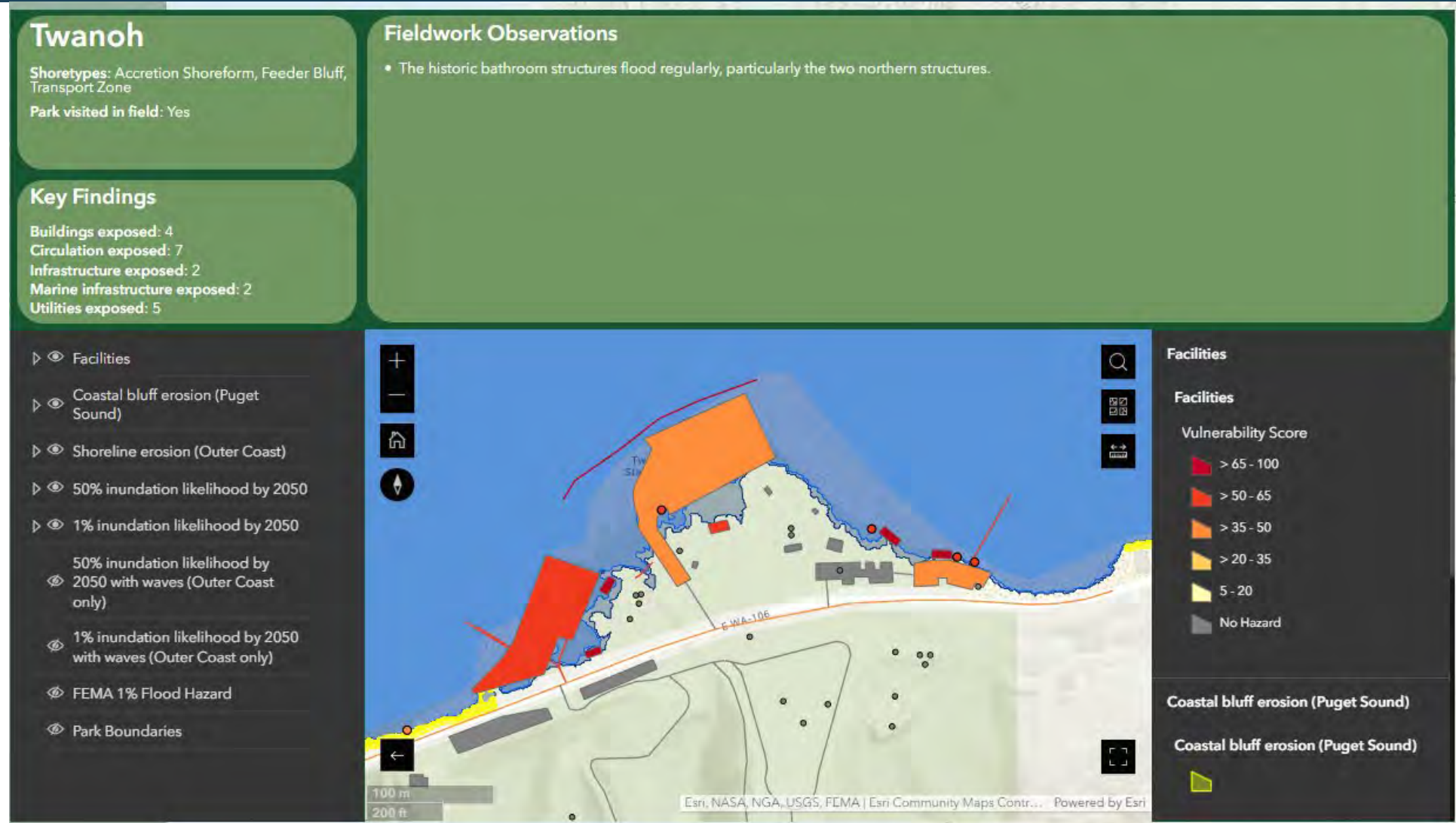


# Dashboard GIS tool

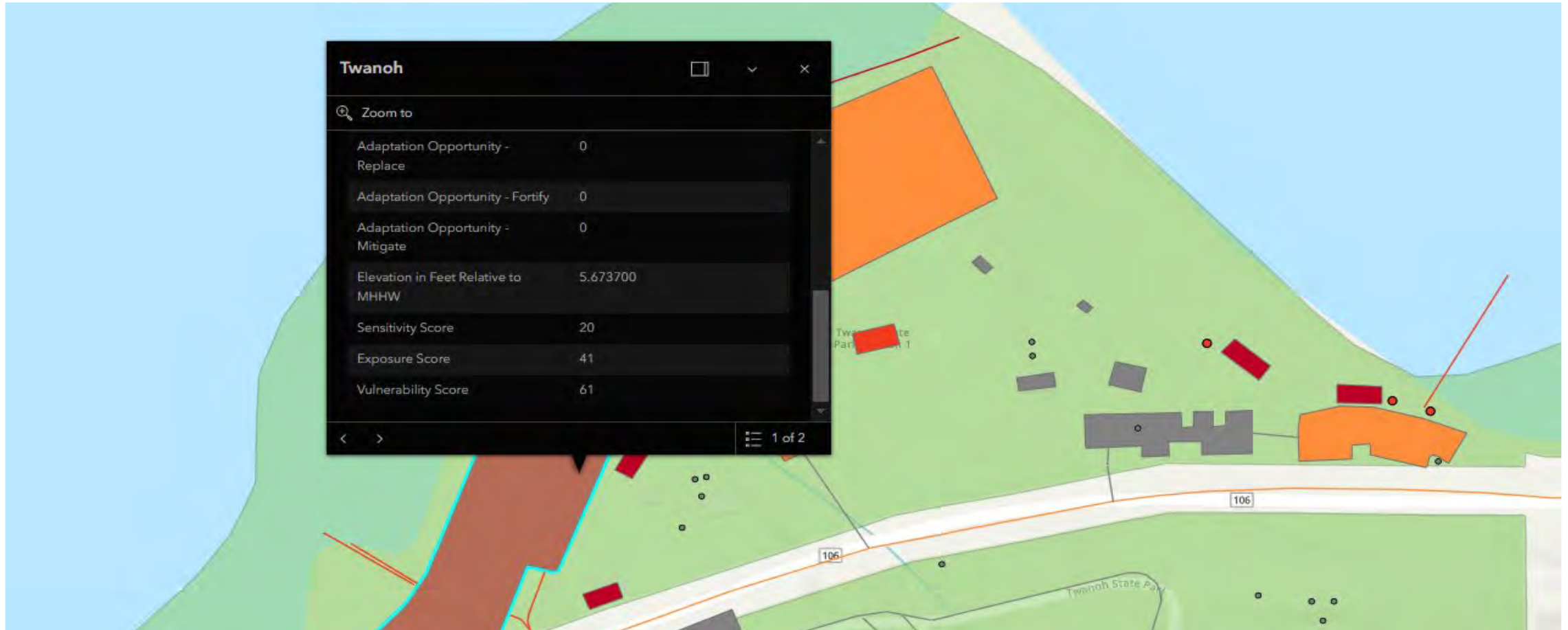




# Explore park-specific data and maps



# Explore infrastructure-specific details





# Lessons Learned



- **This is not an emerging issue.** Coastal facilities are already being impacted by sea level rise annually.
- **Proactive action is needed in the near-term.** If not, infrastructure is likely to become more vulnerable.
- **Future assessments will need to consider other assets,** such as cultural and natural resources.





Thank You.



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