BUILDING NEARSHORE RESILIENCE + AVOIDING ARMOR

SALISH SEA | JUNE 20, 2024

HERRERA
Science + Planning + Design

INTRODUCTION

- 20+ years of Salish Sea experience
- Sea Level Rise Hazard Mapping and Analysis
- Marine Shorelines Design Guidelines
- Developed several regional datasets
  - Littoral drift mapping, geomorphic shoretype mapping
  - Erosion rates
  - Coastal management & outreach
  - Shore Friendly Program
  - Process-based restoration/naturalizing shorelines

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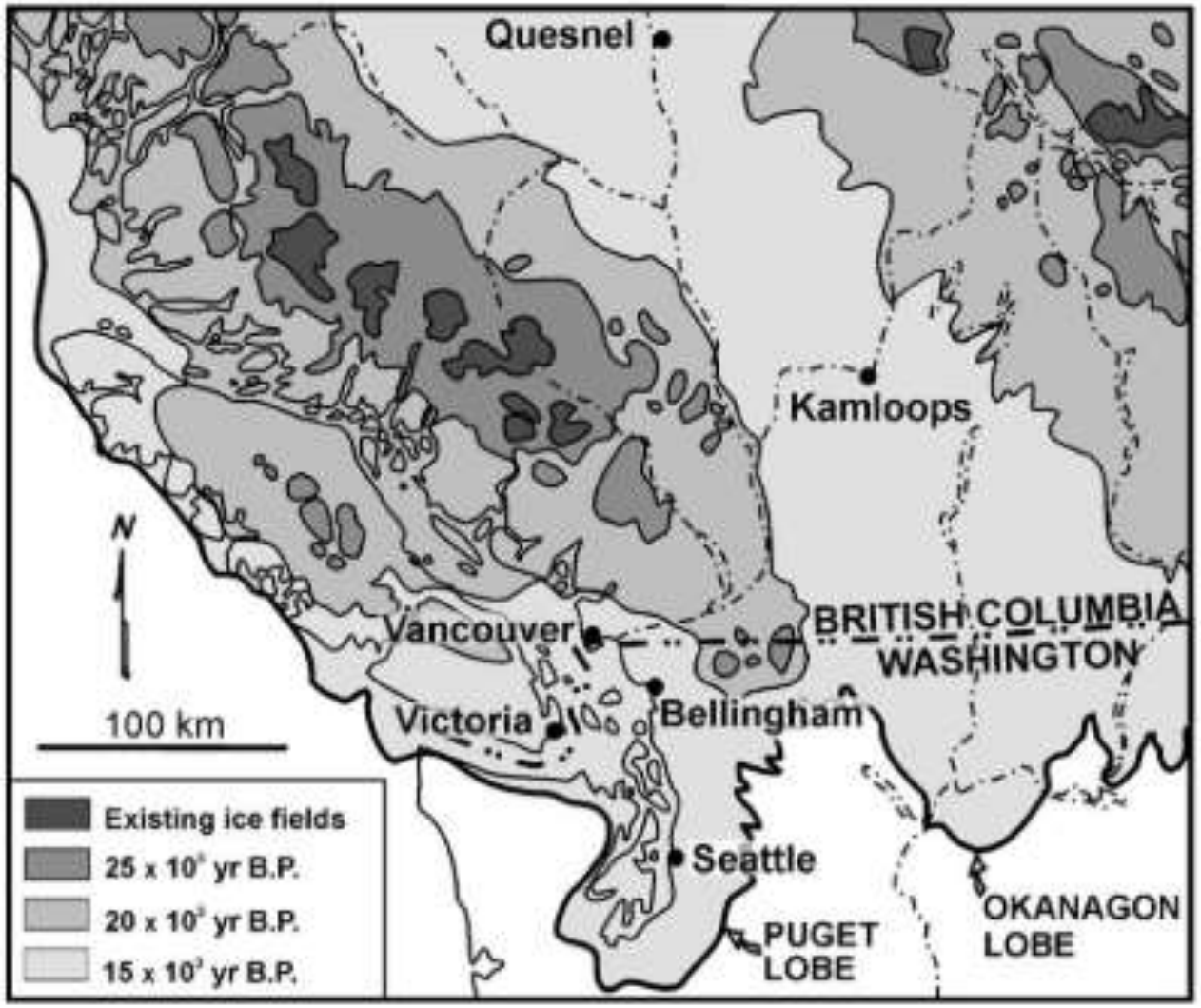
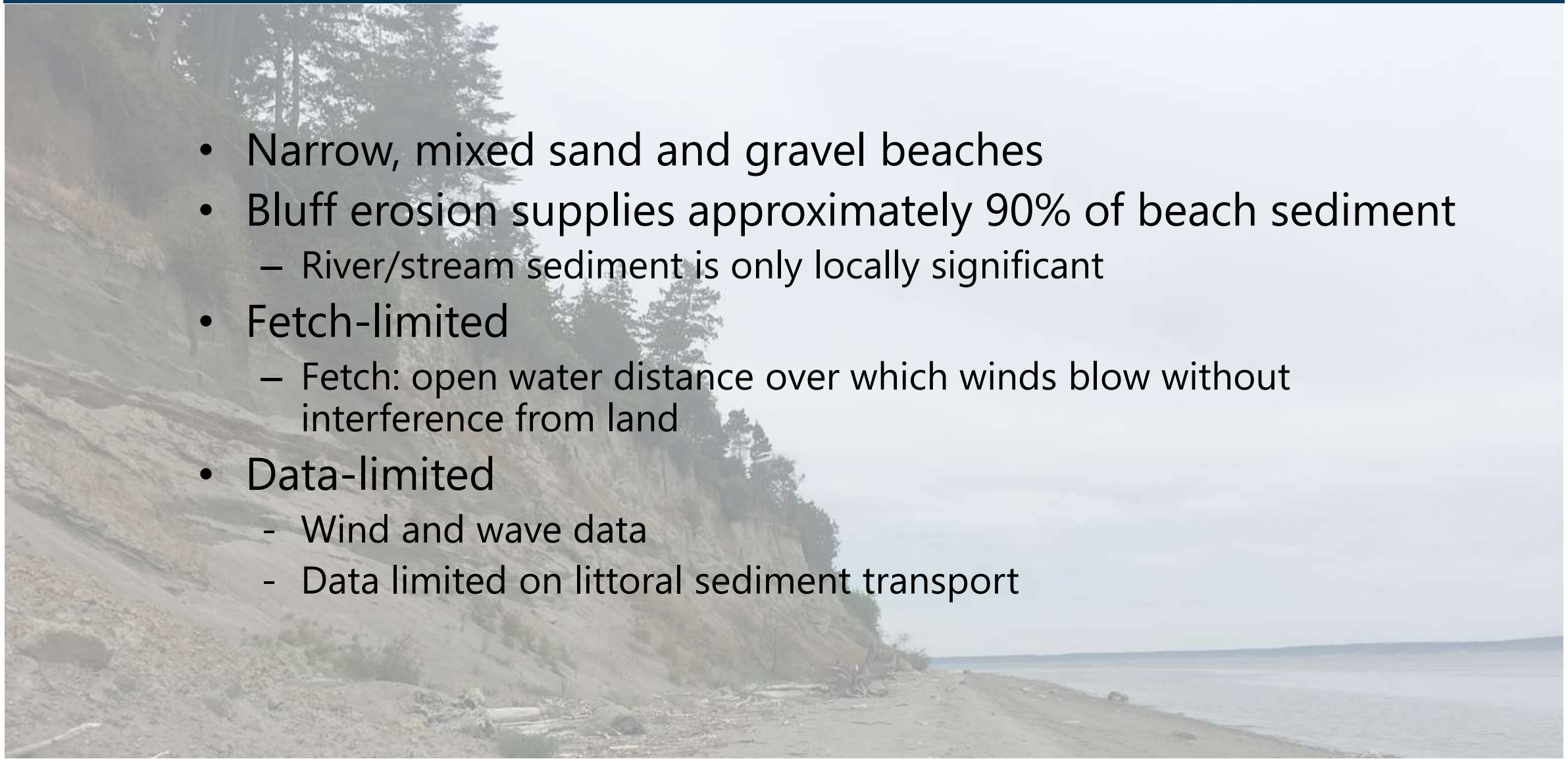
Coastal geomorphologist.

COASTAL PROCESSES IN SALISH SEA

- Glacial legacy
- Topography formed 13-16k years ago
- Repeated advance and retreat
- Sub-glacial meltwater scoured N-S trending basins
- Ice melted, sea levels rose, land uplifted (5000 ya), and our current shorelines began to evolve



COASTAL PROCESSES IN SALISH SEA



- Narrow, mixed sand and gravel beaches
- Bluff erosion supplies approximately 90% of beach sediment
  - River/stream sediment is only locally significant
- Fetch-limited
  - Fetch: open water distance over which winds blow without interference from land
- Data-limited
  - Wind and wave data
  - Data limited on littoral sediment transport

RESILIENT ALTERNATIVES TO SHORELINE ARMOR

What ARE appropriate alternatives for my property?

Tools used depend on **shoretype**, **hazard exposure**, and **local conditions** and will change over time

Reslope and revegetate

Relocate and elevate

Nourish the beach

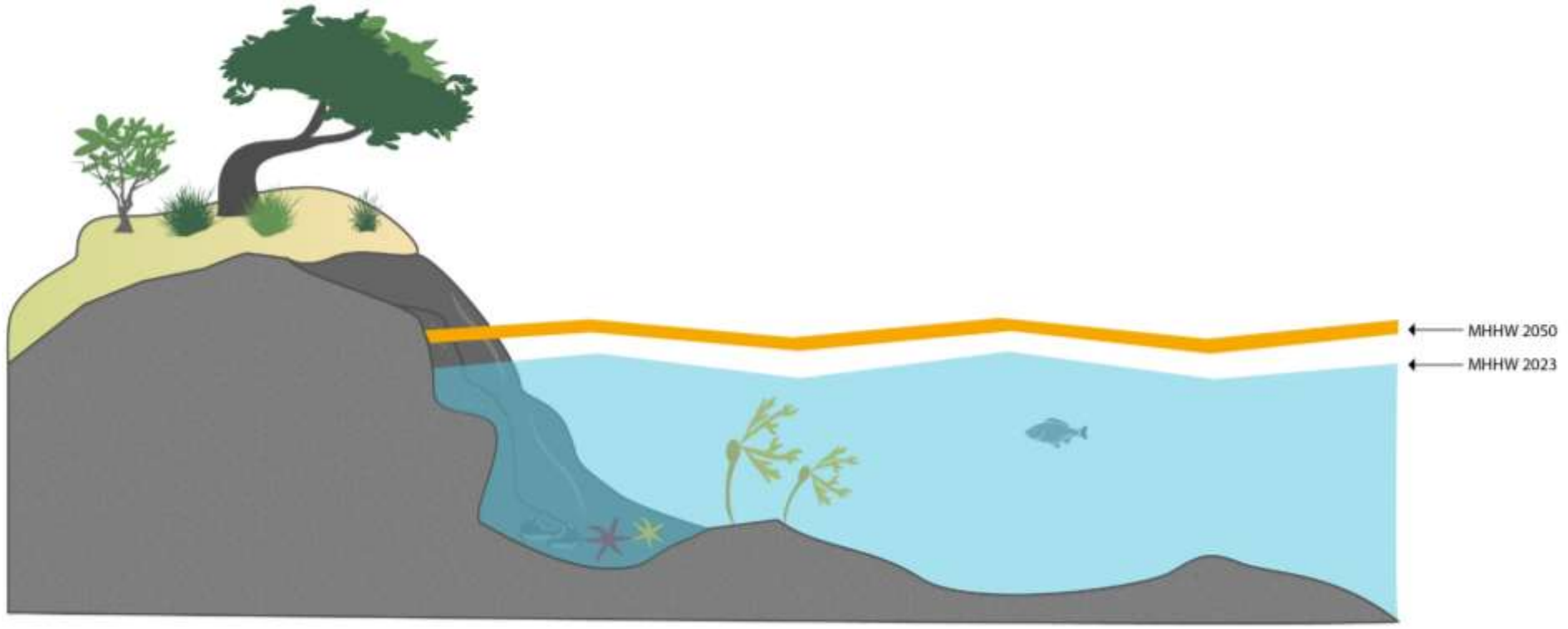
Manage drainage

Enhance native vegetation

Place logs

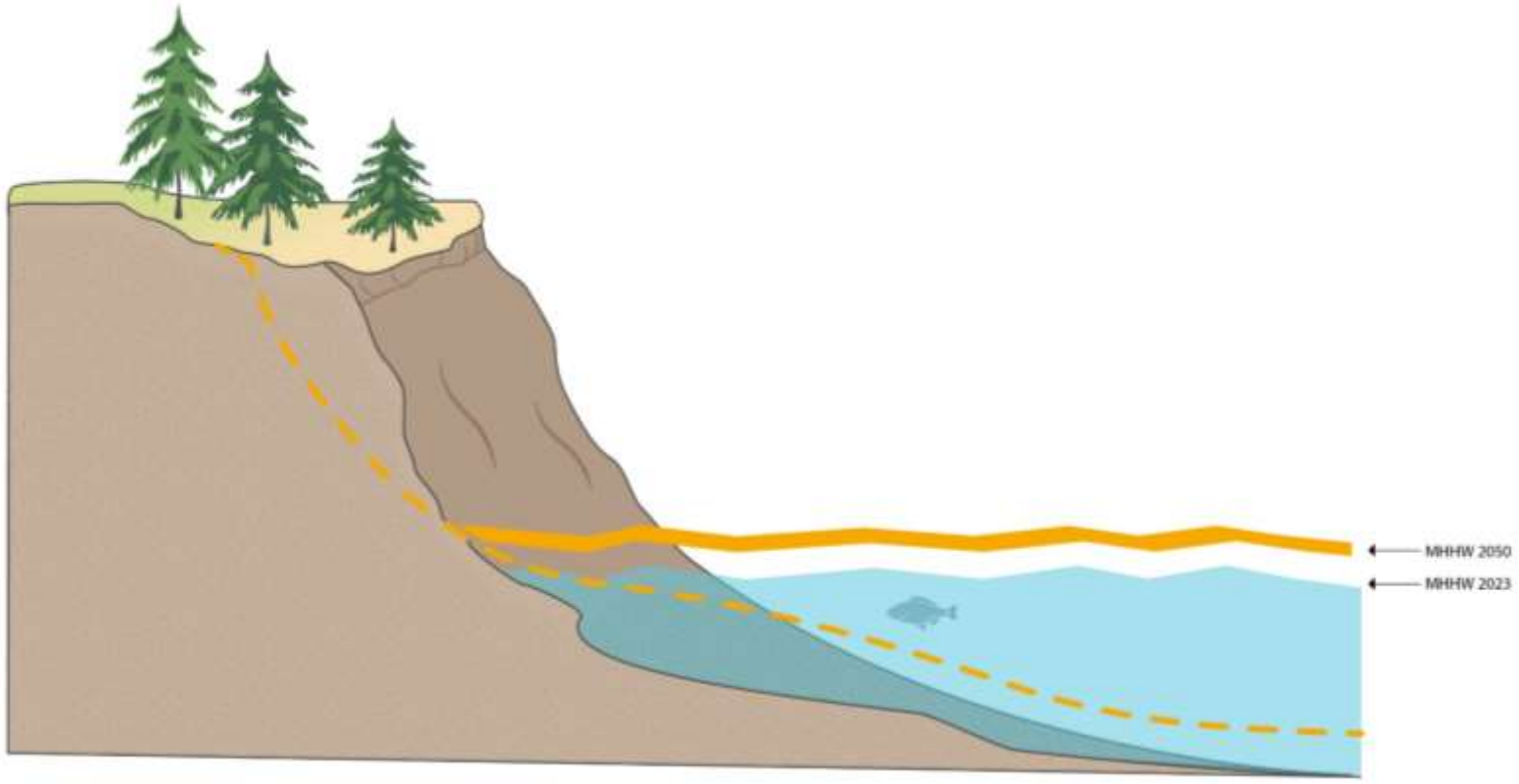
Fortify

ROCKY SHORE RESPONSE



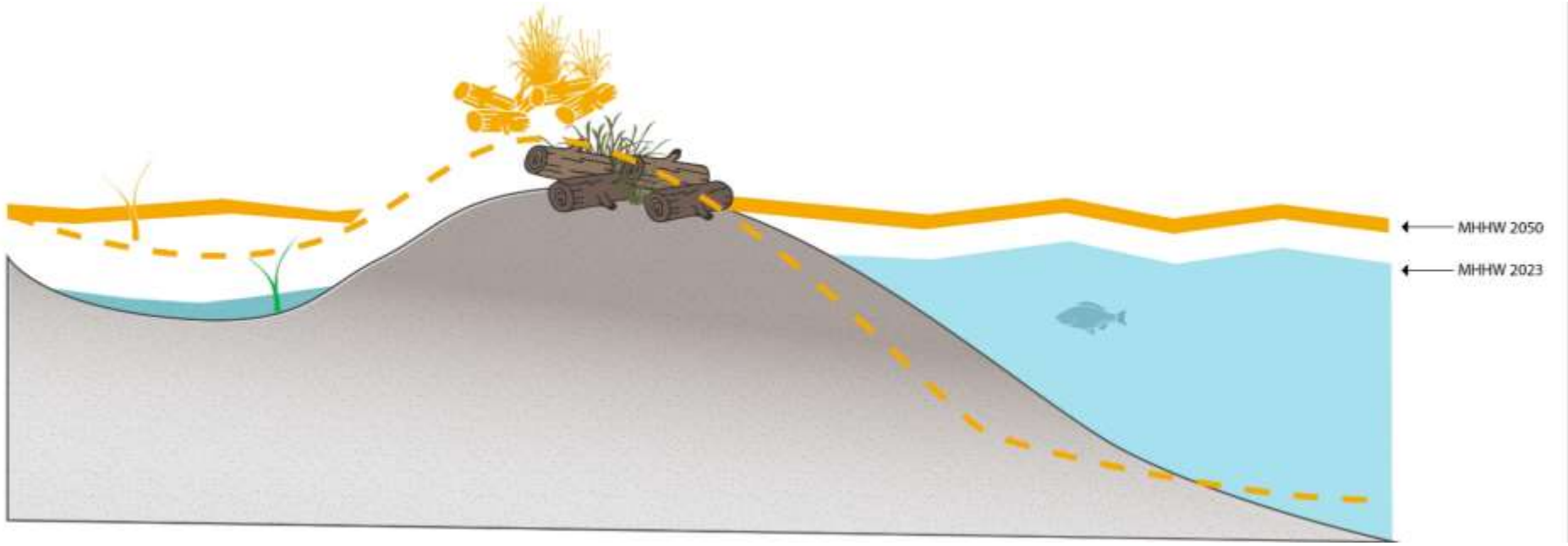
- Vertical shift upwards/landward shift in tidal elevation
- Similar shift in intertidal habitats

COASTAL BLUFF RESPONSE



- Higher water level at bluff toe = accelerated bluff recession
- Increased landslide frequency with heavier rainfall
- Landward shift of entire beach profile
- Bluff erosion enables local and down-drift beaches to adjust

BARRIER BEACH RESPONSE



- Crest of berm will build higher and shift landward via overwash
- Landward shift in habitats, dune grass, driftwood, intertidal spawners
- Habitat/beach loss can occur where landward constrains limits natural migration of beach features

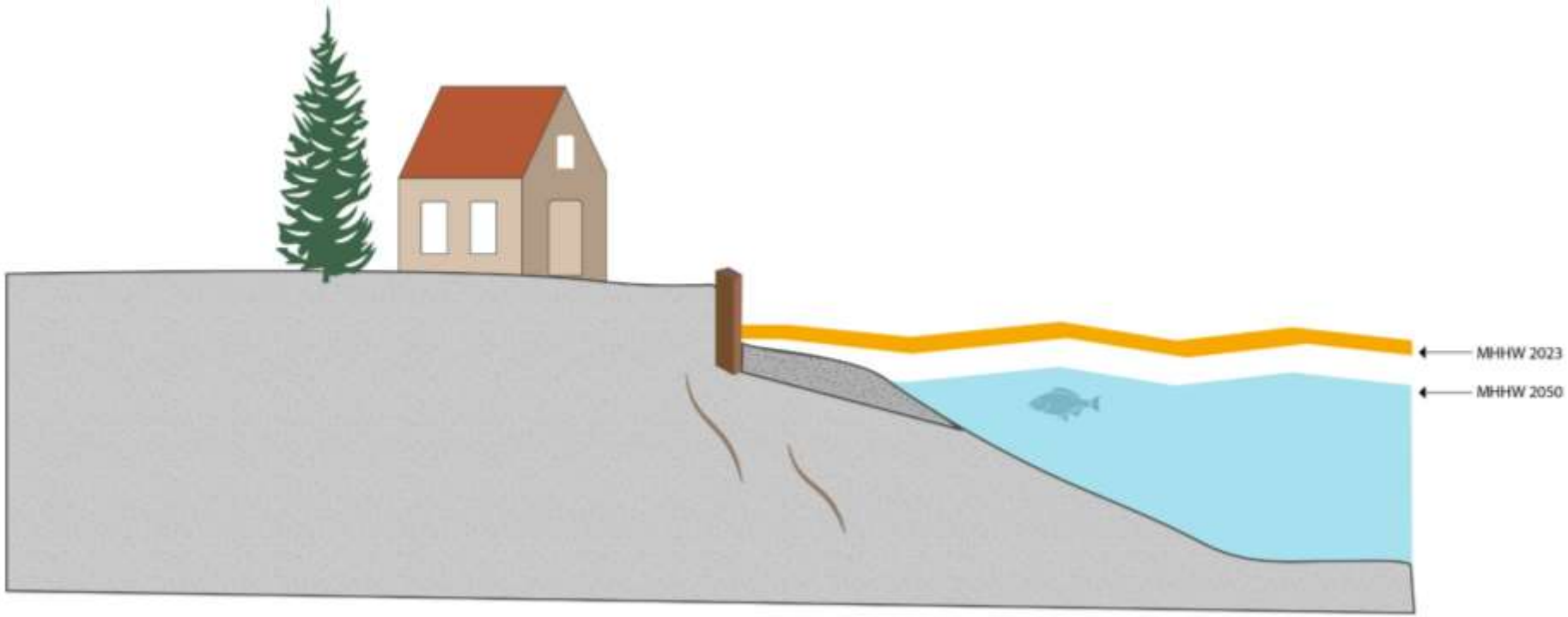
SEA LEVEL RISE RESILIENCE & SHORELINE ARMOR

Why NOT Armor?

- Does not mitigate hazard
  - Flood water can go around
  - Bluff erosion continues landward

- Impacts of Armor on Resilience
  - Loss of sediment input from bluffs
  - Coastal Squeeze

SEA LEVEL RISE RESILIENCE & SHORELINE ARMOR



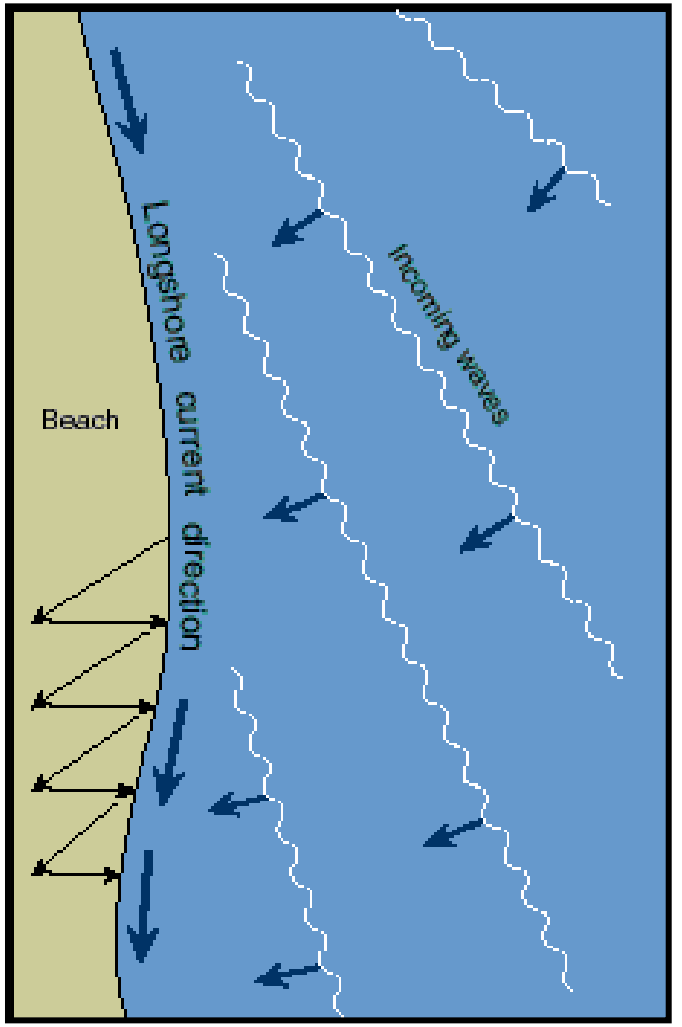
- Static shoreline armor prevents landward migration of shoreline and habitats resulting in habitat and beach loss
- Increase in water level can overtop and compromise armor

COASTAL PROCESSES IN SALISH SEA

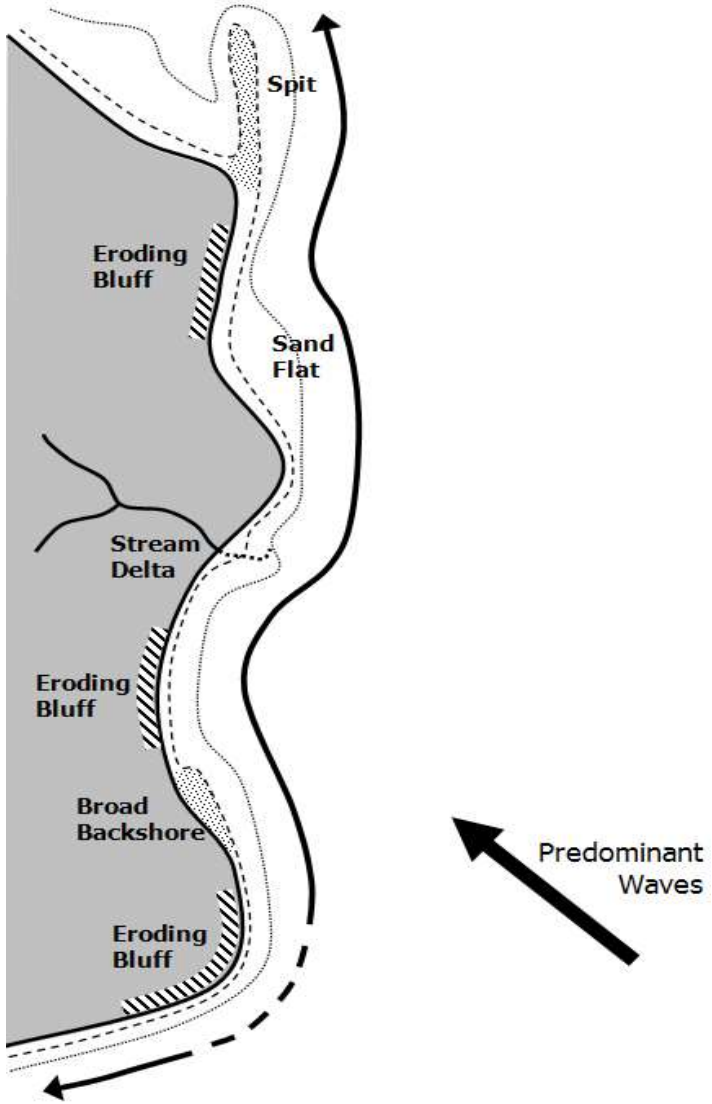
- Oblique wave approach produces longshore currents

- **Upswash** flows up the beach at an angle, **Backswash** flows perpendicular to the beach face ~ creating longshore or littoral transport

- Transport movement can shift or increase with tides, storms and seasons



NET SHORE-DRIFT CELLS



- Sediment system with predominant direction of littoral drift
  - Orientation, predominant winds
- Landforms evolve over time in interdependent system
- Divergence zones, NAD shores
- Indicators of drift direction: spit development, stream mouth deflection, groins/obstructions
- Each cell has a sediment budget that reflects the system's health and resilience

SHORETYPE + HAZARD EXPOSURE + LOCAL CONDITIONS

- Up-drift sediment supply
- Setback distance (horizontal)
  - Bluff crest or log line
  - Nearest constraint (septic tank or drain field)
  - Parcel geometry, space to relocate
- Elevations (how long?)
- Constraints – cultural resources, utilities
- Shoreline length
- Adjacent shorelines
  - armored? end-effects?
- Upland land use

ADAPTATION TOOLBOX

Tools used depend on shoretype, hazard exposure, and local conditions and will change over time

Reslope and revegetate

Relocate and elevate

Nourish the beach

Manage drainage

Place logs

Enhance native vegetation

Fortify

ENHANCE NATIVE VEGETATION

Benefits

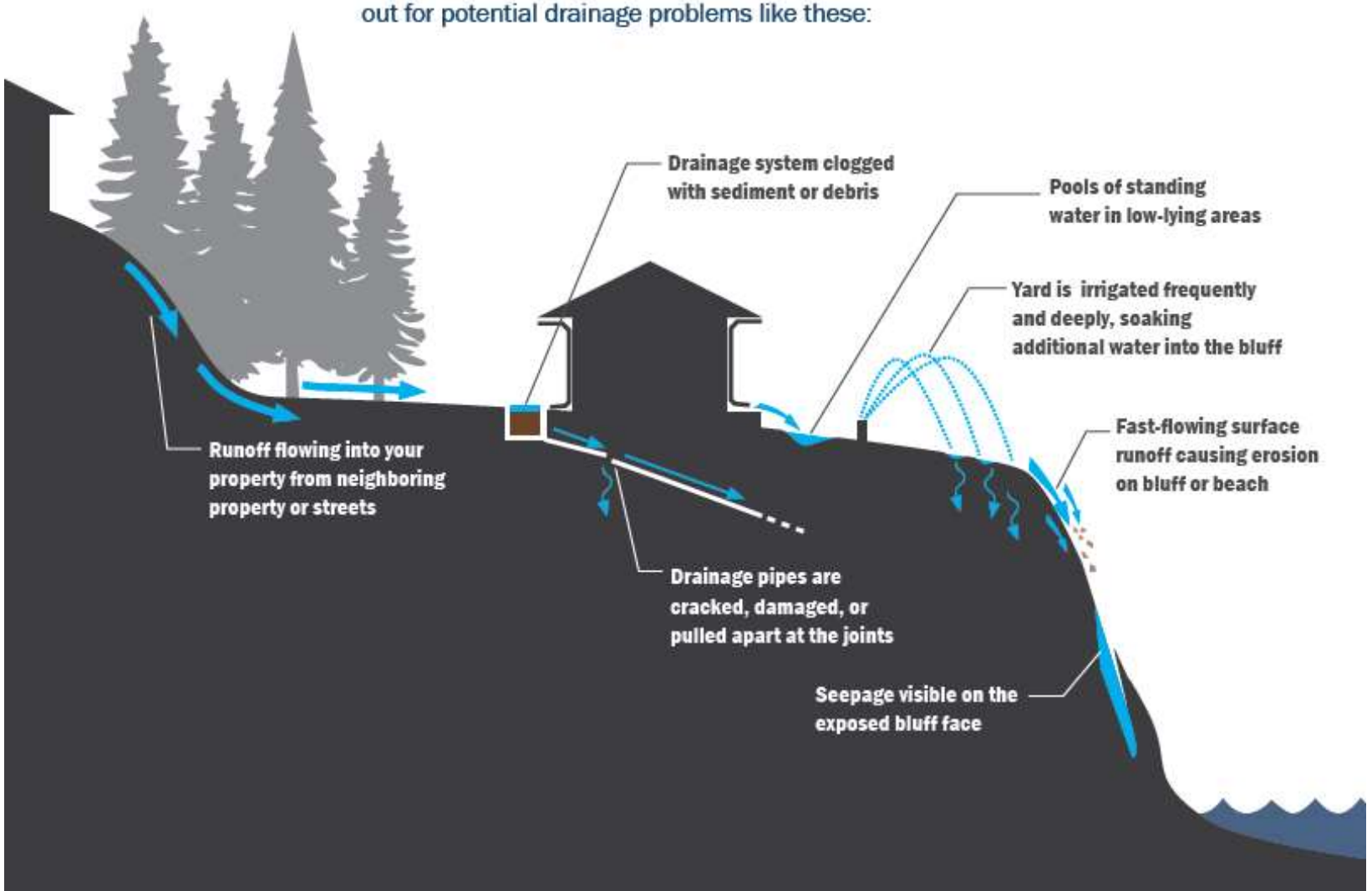
- Reduce sheet flow
- Resist landslides
- Slope stability
- Provide habitat
- Absorb and filter rainfall

Limitations

- May not work with higher sea levels

What to Look For

As you get to know your drainage system, keep an eye out for potential drainage problems like these:

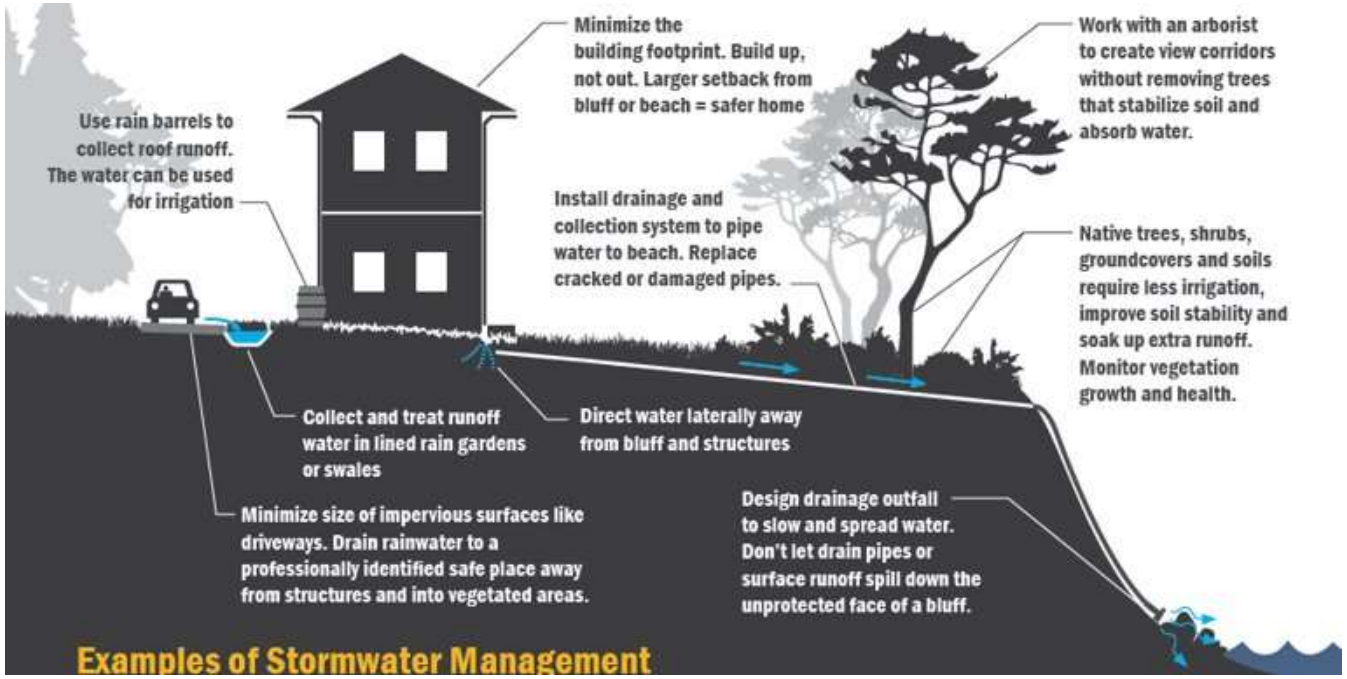


Benefits

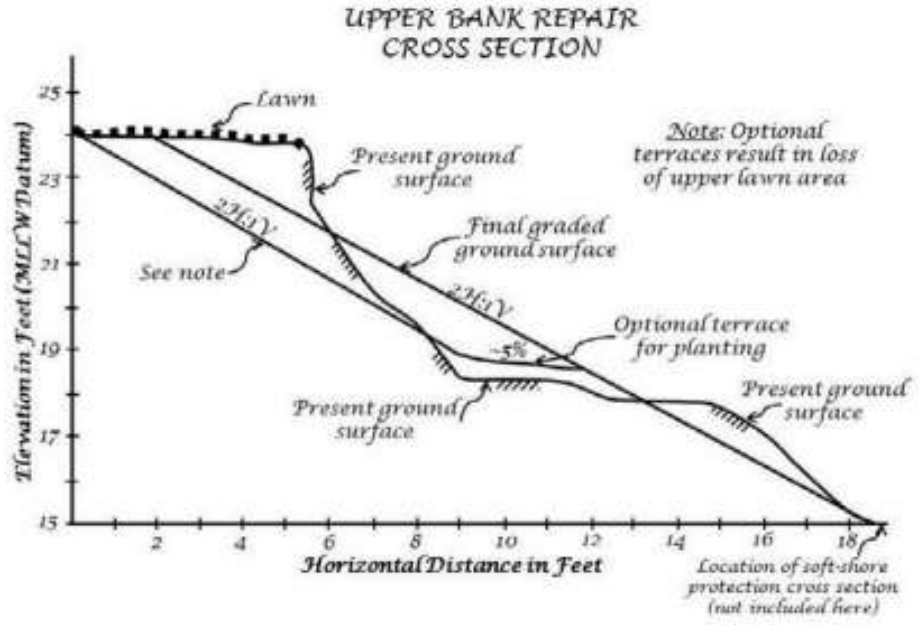
- Reduce seepage, pooling
- Reduce erosion on beach and bluff

Limitations

- Addresses only one cause of erosion issues
- Does not address natural bluff stratigraphy's influence on groundwater regime



RESLOPE AND REVEGETATE



Benefits

- Protect from erosion
- Enhance aesthetics
- Wildlife habitat

Limitations

- Not appropriate for high bluffs
- Requires space for regrading

RESLOPE AND REVEGETATE

Step 1 – secure drainage issues & remove invasive species in phases

Step 2 – secure erosion control blankets

Final steps – place mulch (hog fuel) on slope and plant native vegetation densely.

*Plan for 5 or so yrs of maintenance depending on site or slope conditions.

RESLOPE REVEGETATE

Filucy Bay Shore Friendly Restoration
Illustrative Rendering | NTS

NOURISH THE BEACH

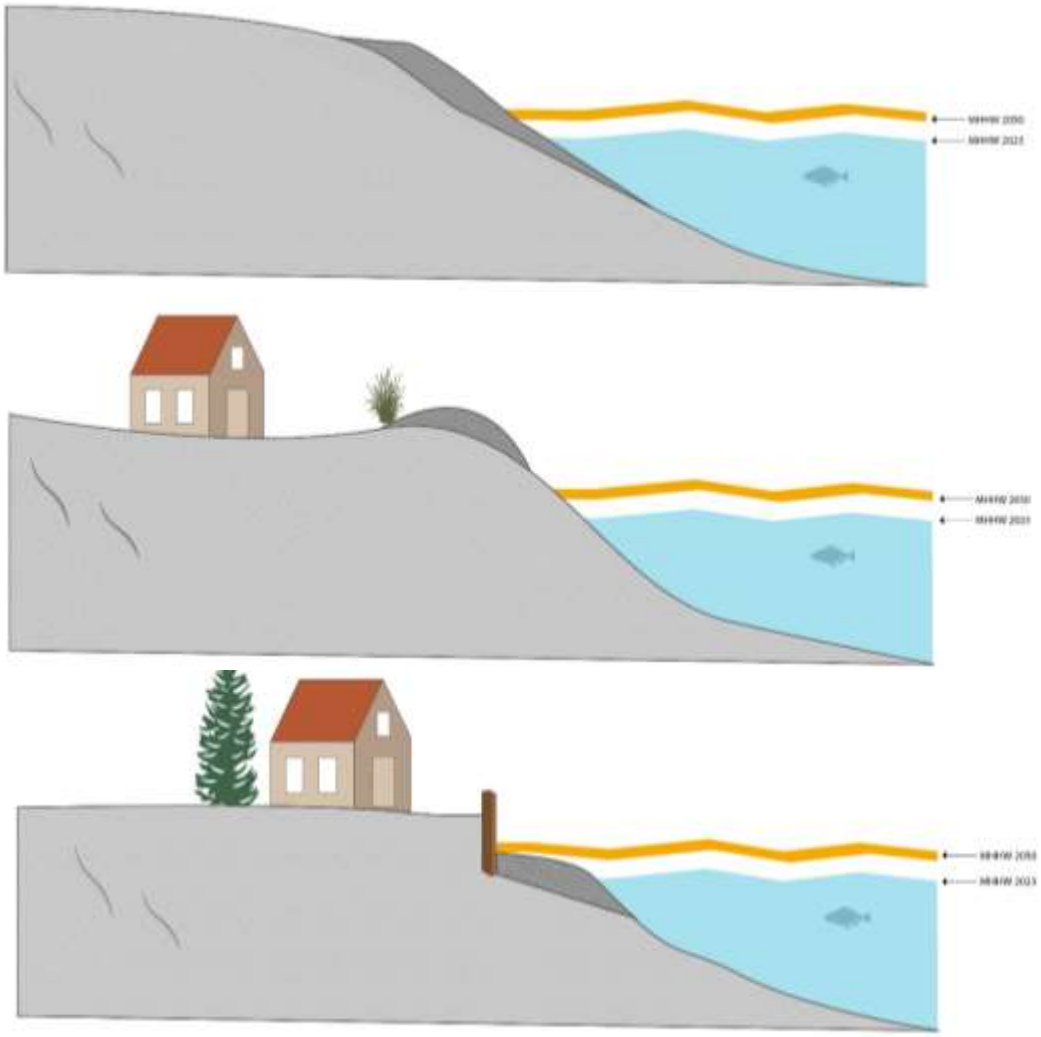
Benefits

- Build a berm to absorb wave energy
- Rebuild beach area
- Recreation area

Limitations

- Not adequate for long-term
- Must be renourished over time (decades)

NOURISH THE BEACH

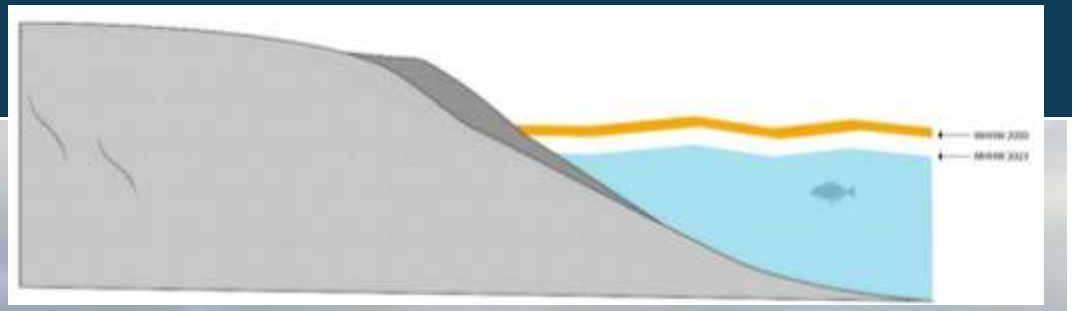


Nourish the entire beach profile (foreshore)

Build a storm berm to absorb wave energy and curb flooding

Compensate (short-term) for lost sediment supply or habitat loss

NOURISH THE BEACH



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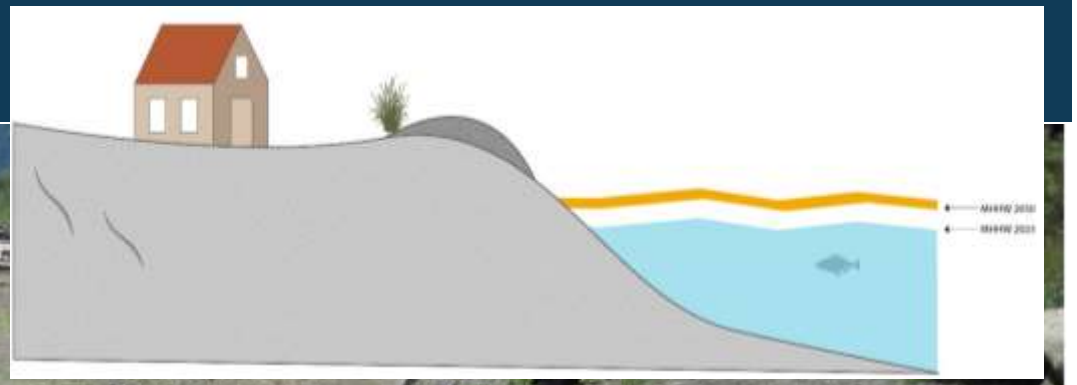

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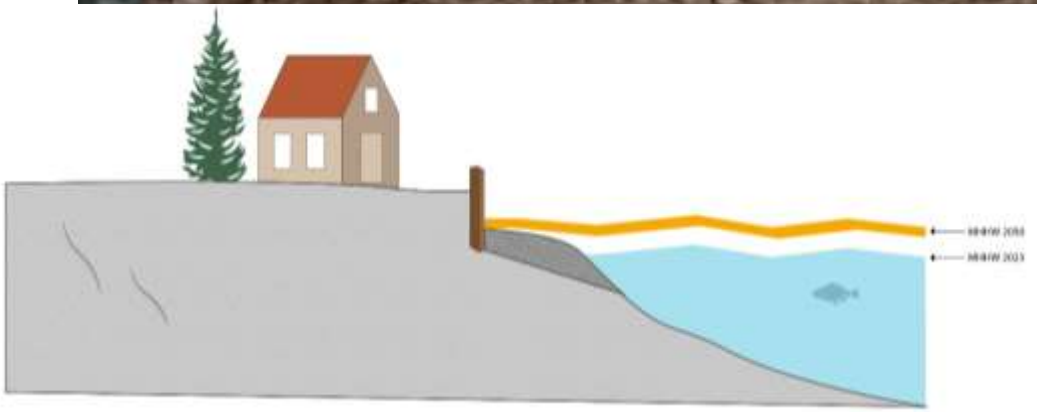
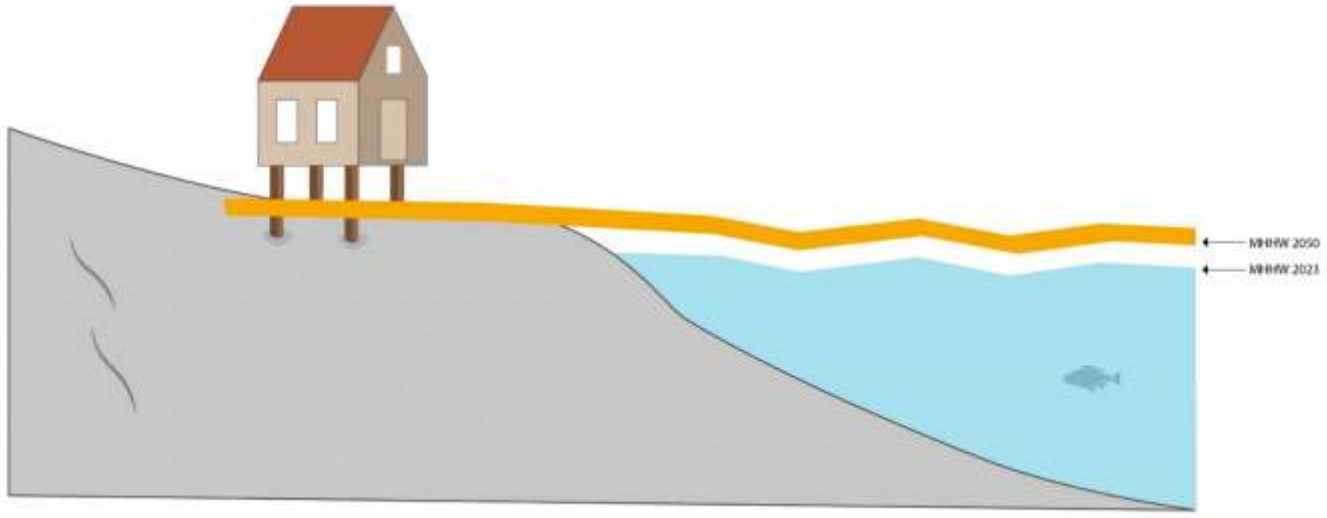
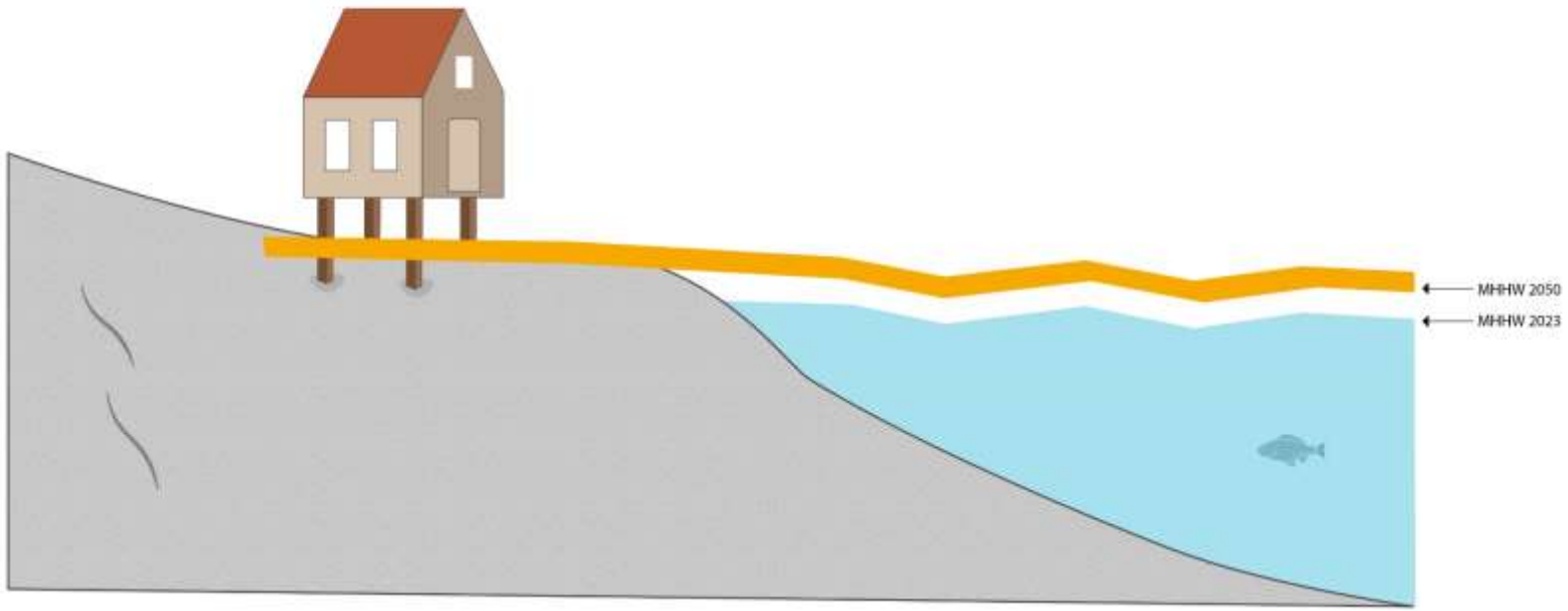


Compensate (short-term) for lost sediment supply or habitat loss

ELEVATE



ELEVATE



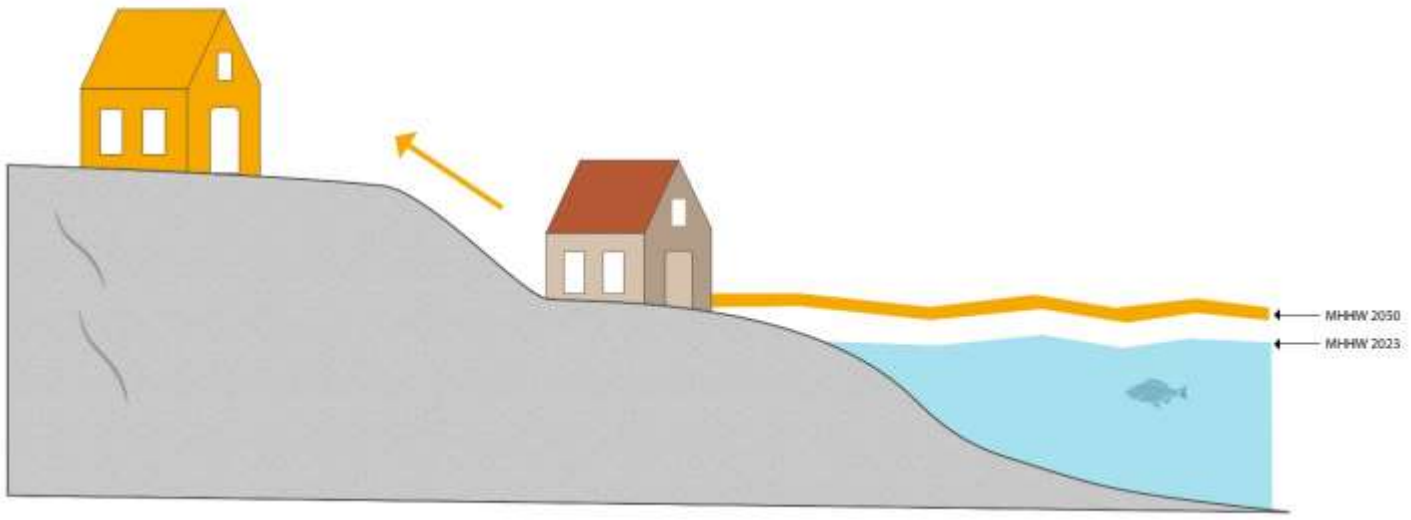
Benefits

- Reduces flood risk

Limitations

- Will not stop erosion
- Driftwood damage
- Septic, drainfields
- Short-term solution

REPLACE SEPTIC WITH UPLAND COMMUNITY SEPTIC



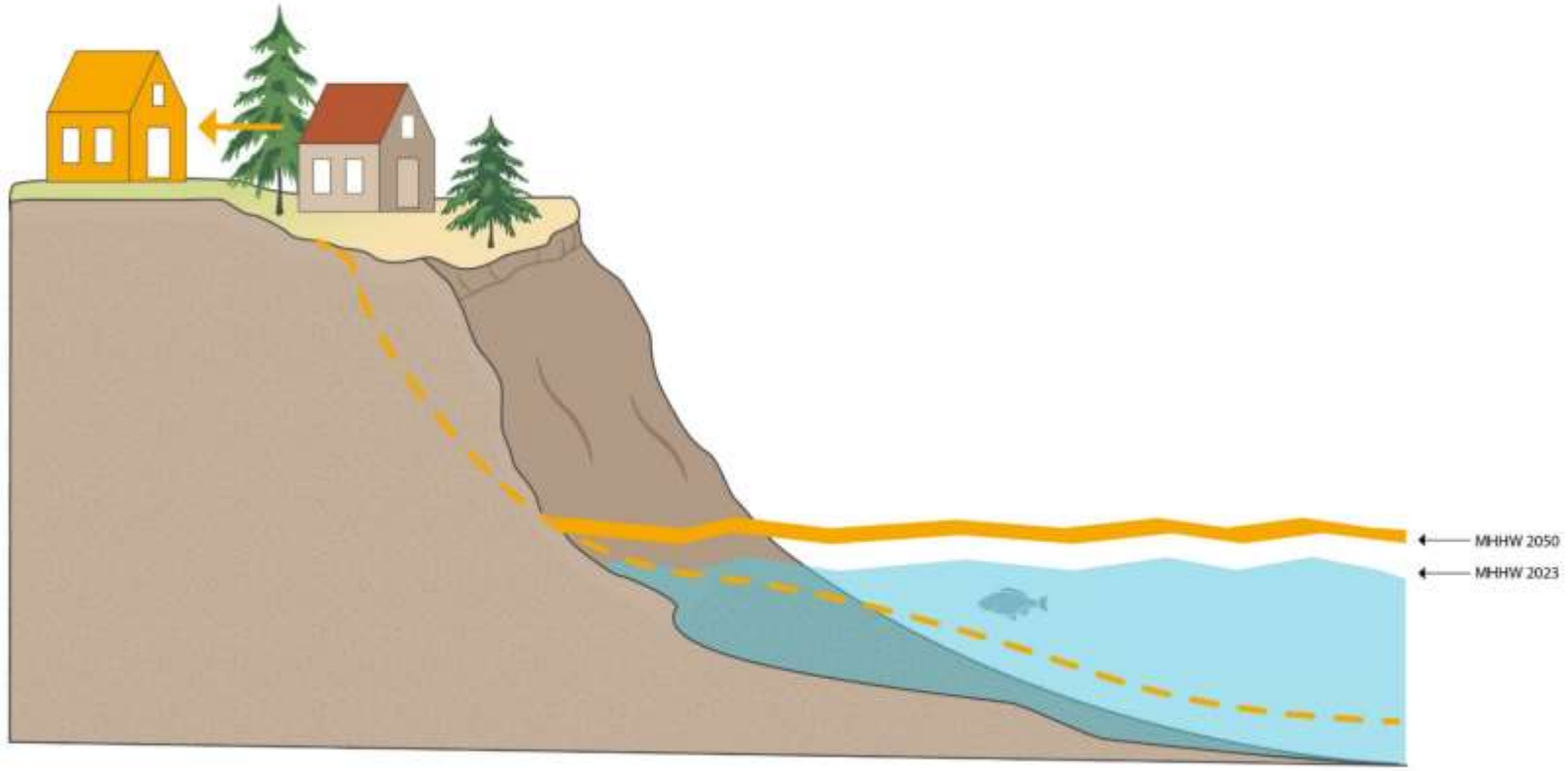
Benefits

- Benefits at community-scale
- Shared costs across community
- Supporting load programs
- Mitigates water quality impacts

Limitations

- Requires adequate upland area for relocation

RELOCATE



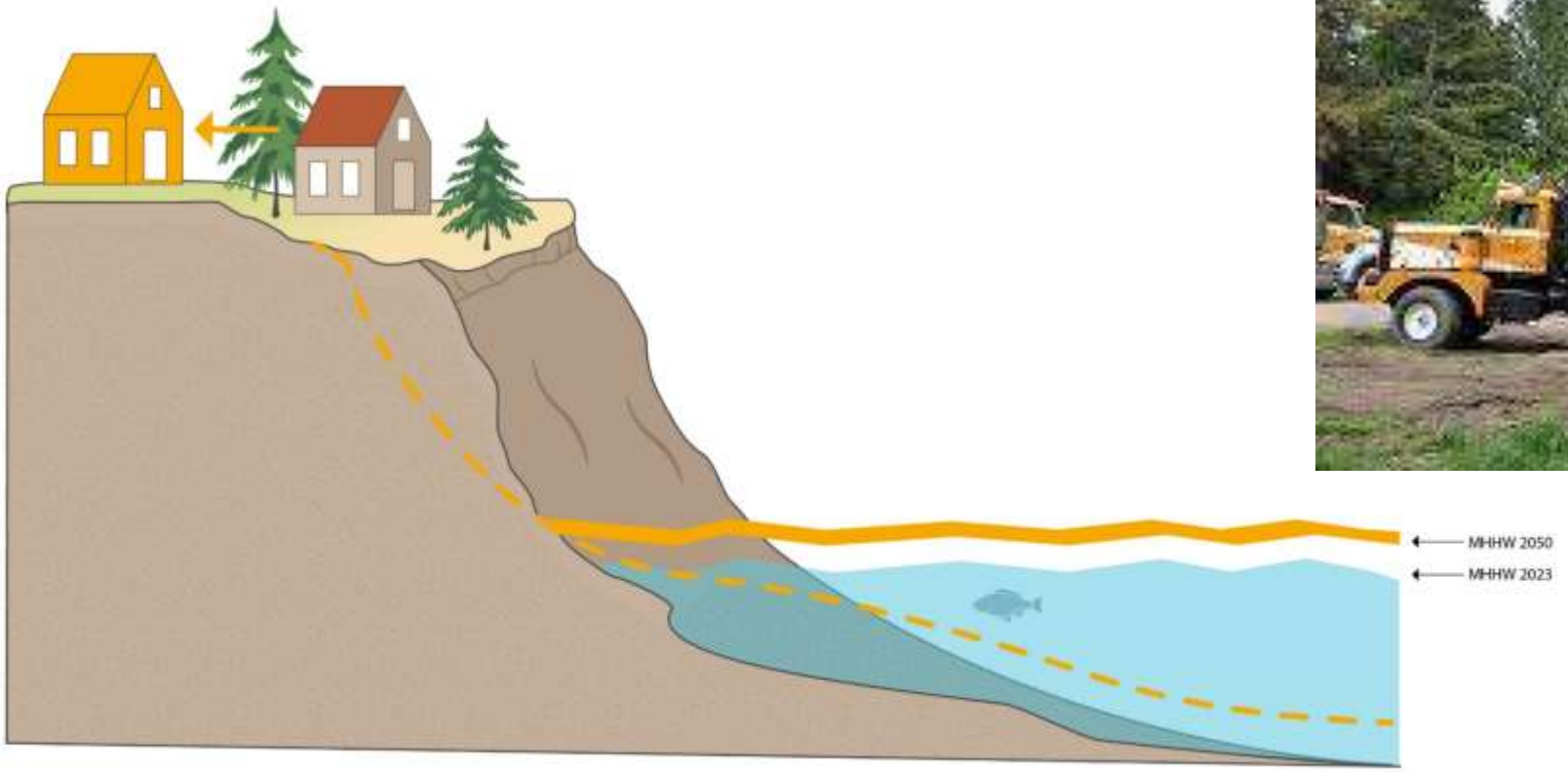
Benefits

- Mitigates risk of erosion and flooding
- Long-term solution
- Cheaper than engineered approaches
- Most effective for highly vulnerable structures

Limitations

- Requires adequate upland area for relocation

RELOCATE



QUESTIONS & ANSWERS