# Planning for Sea Level Rise (SLR)

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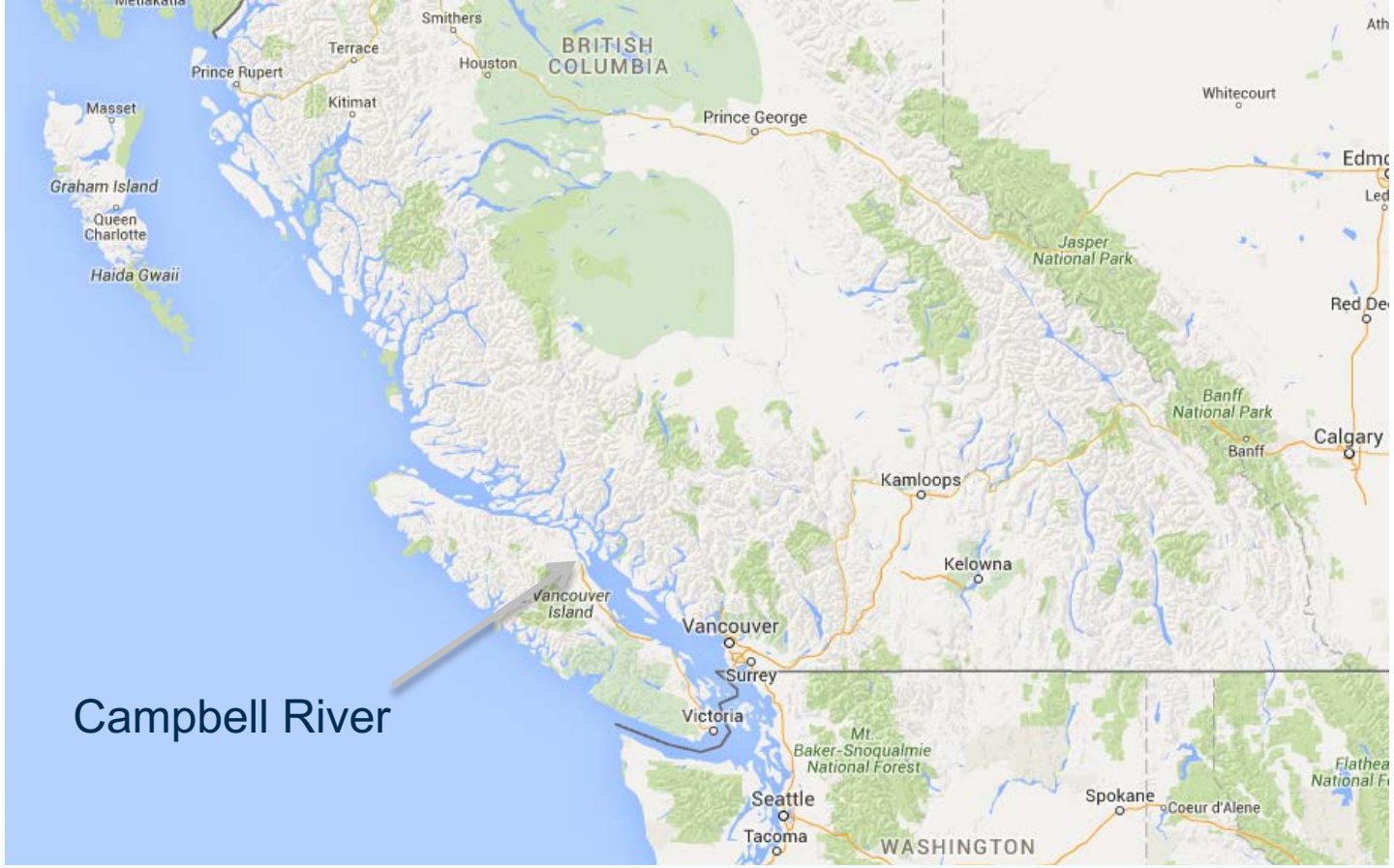
*Acting Manager, Long Range Planning*
*City of Campbell River*

*Adaptation Canada, Vancouver, 19 February 2020*

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# Where it began:


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# Where it began:


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King Tide,

calm conditions

1’ lower than King Tide,

storm conditions

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# Sea Level Rise (SLR) and Campbell River

This part of the presentation will provide a review of

1. SLR planning guidance, and
2. Review the coastal engineering assessment and mitigation options at Campbell River

Grant Lamont, P.Eng. Principal, NHC

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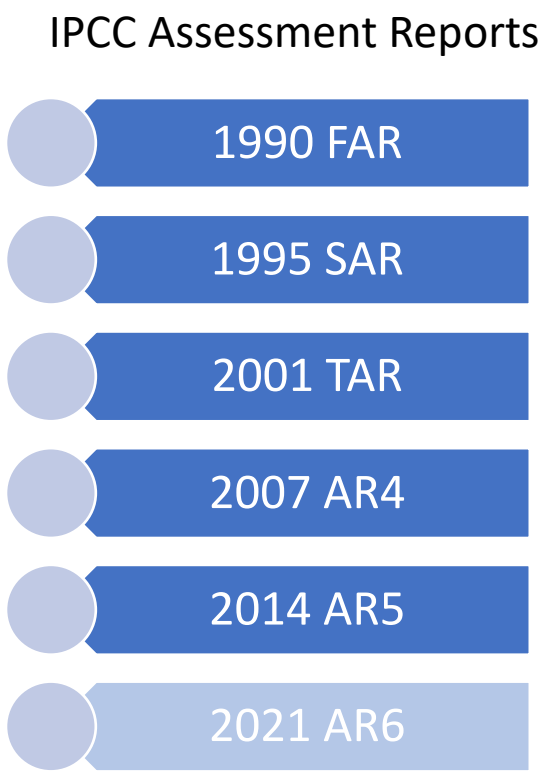
Ken Forde Boat Ramp, Campbell River
Photo Credit: C. Osborne (Dec 20, 2018)

# Sea Level Rise (SLR) Guidance

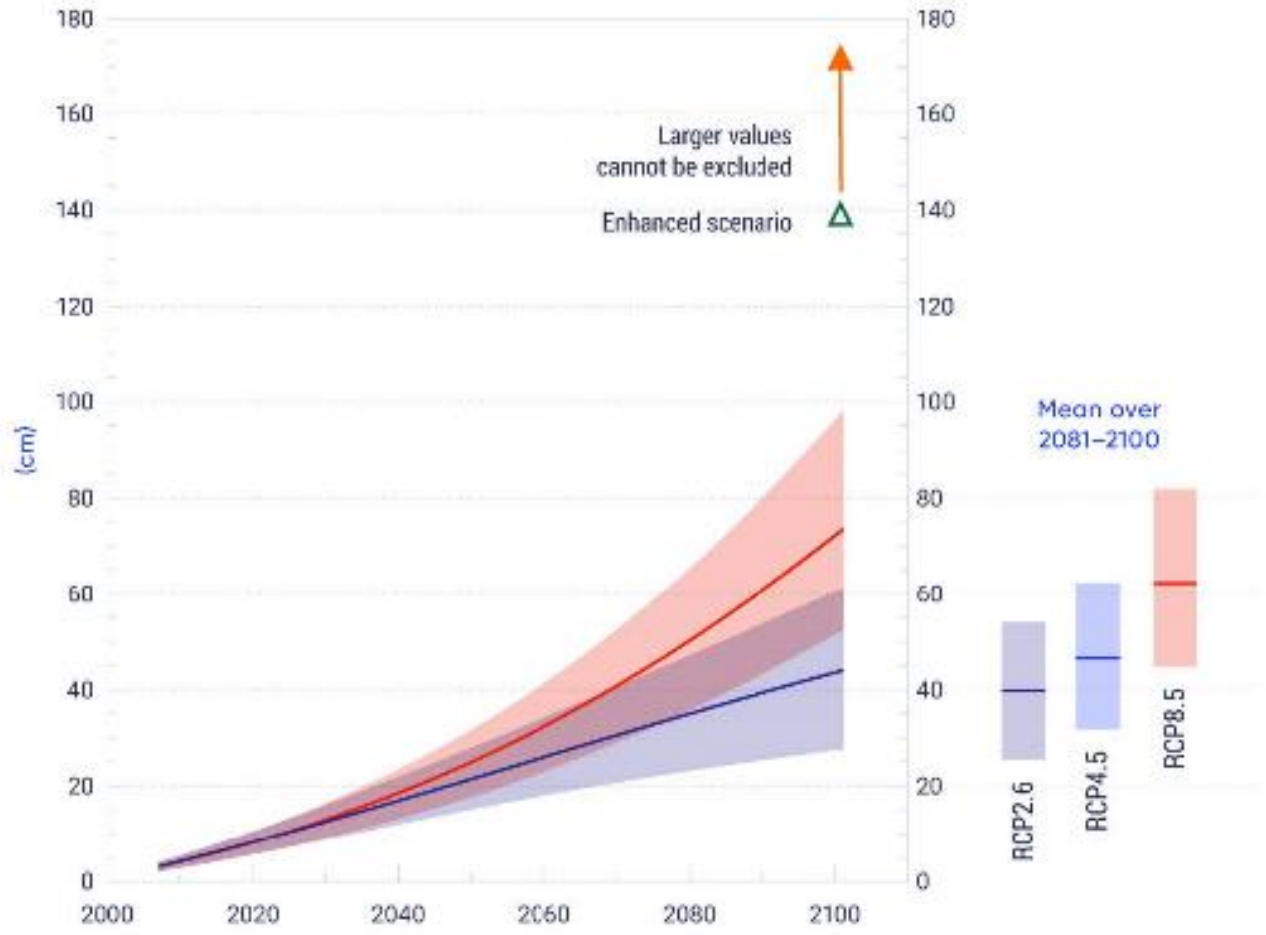
Guidance available from scientific journals and also International Panel on Climate Change (IPCC) reports.

- The Intergovernmental Panel on Climate Change (IPCC) is the United Nations body for assessing the science related to climate change.
- Most recent report was Fifth Assessment Report (AR5) finalized in 2013-2014.
- The sixth Assessment Report (AR6) Physical Science Basis is expected in 2021.



# Sea Level Rise – Recent Studies relevant to BC

- 1.63 m of SLR at Pt. Atkinson for year 2100 estimated for a “high emissions scenario with rapid Antarctic ice sheet loss” (Han et. al., 2016).
- 1.39 m of SLR for year 2100 (enhanced scenario). Canadian Climate Change Report (CCCR 2019)
- SLR values above 1.39 m for year 2100 cannot be excluded (CCCR, 2019)




Credit: CCCR2019, Chapter 7, Changes in Oceans Surrounding Canada, Figure 7.15.
Reference: Government of Canada (2019). Canada’s Changing Climate. Bush, E. and Lemmen, D.S. (Editors). Government of Canada, Ottawa, ON. 444 pp.

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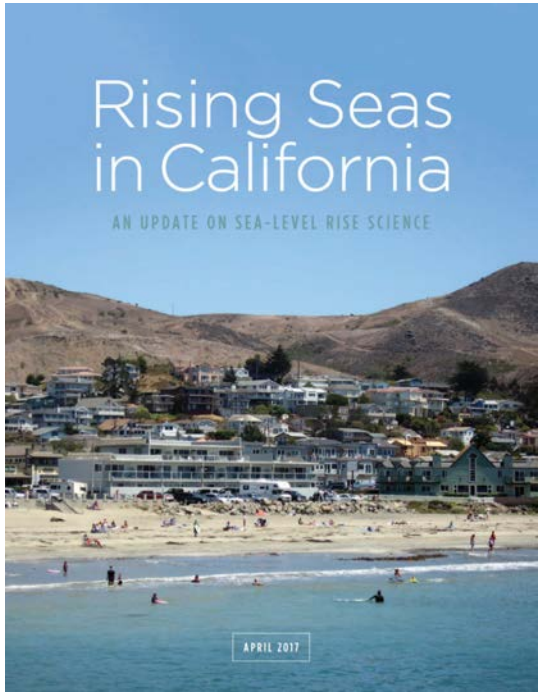
# Range of SLR Values for Planning

Example from recent planning guidance for State of California.

Note range of guidance reflecting uncertainty and risk tolerance.

**SLR estimates (in metres) for San Francisco, Golden Gate Bridge, from Griggs et al., 2017**

| Year (Scenario) | Likely Range - 67% probability SLR is between... | 1 in 20 Chance - 5% probability SLR meets or exceeds... | 1 in 200 Chance - 0.5% probability SLR meets or exceeds... | Extreme |
|---|---|---|---|---|
| 2100 (RCP 2.6) | 0.30 – 0.73 | 0.98 | 1.74 | - |
| 2100 (RCP 4.5) | 0.37 – 0.82 | 1.07 | 1.80 | - |
| 2100 (RCP 8.5) | 0.49 – 1.04 | 1.34 | 2.10 | - |
| 2100 (H++) | - | - | - | 3.05 |




Reference: Griggs, G, Arvai, J, Cayan, D, DeConto, R, Fox, J, Fricker, HA, Kopp, RE, Tebaldi, C, Whiteman, EA; California ocean Protection Council Science Advisory Team Working Group. *Rising Seas in California: An Update on Sea-Level Rise Science.* California Ocean Trust (2017)

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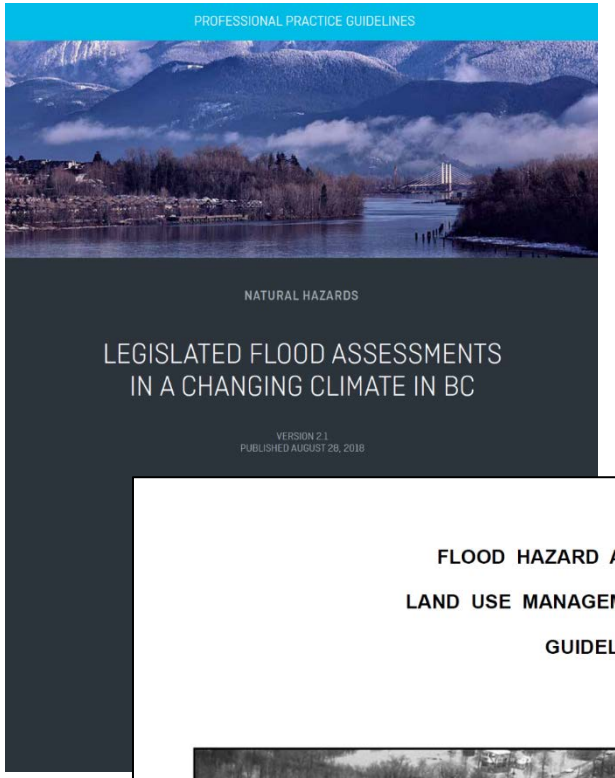
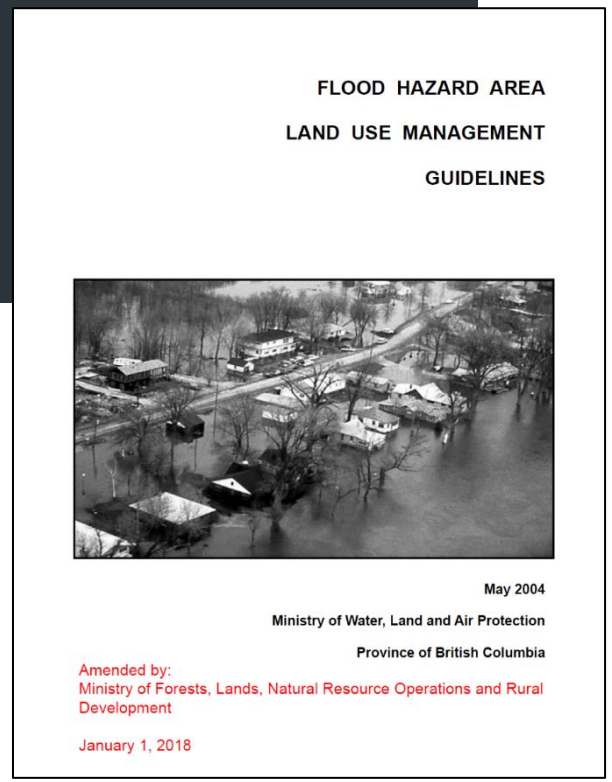
# Governing Practice Guidelines - BC

The following guidelines and regulations exist in BC:

- Professional Practice Guidelines – Legislated Flood Assessments in a Changing Climate in BC (EGBC, 2018)
- Flood Hazard Area Land Use Management Guidelines (BCMFLNRD, 2018)
  - Climate Change Adaptation Guidelines for Sea Dikes and Coastal Flood Hazard Land Use – Policy Discussion Paper (BC Ministry of Environment, 2011a)
  - Coastal Floodplain Mapping – Guidelines and Specifications (BC Ministry of Environment, 2011b)
  - Climate Change Adaptation Guidelines for Sea Dikes and Coastal Flood Hazard Land Use – Guidelines for Management of Coastal Flood Hazard Land Use (BC Ministry of Environment, 2011c)

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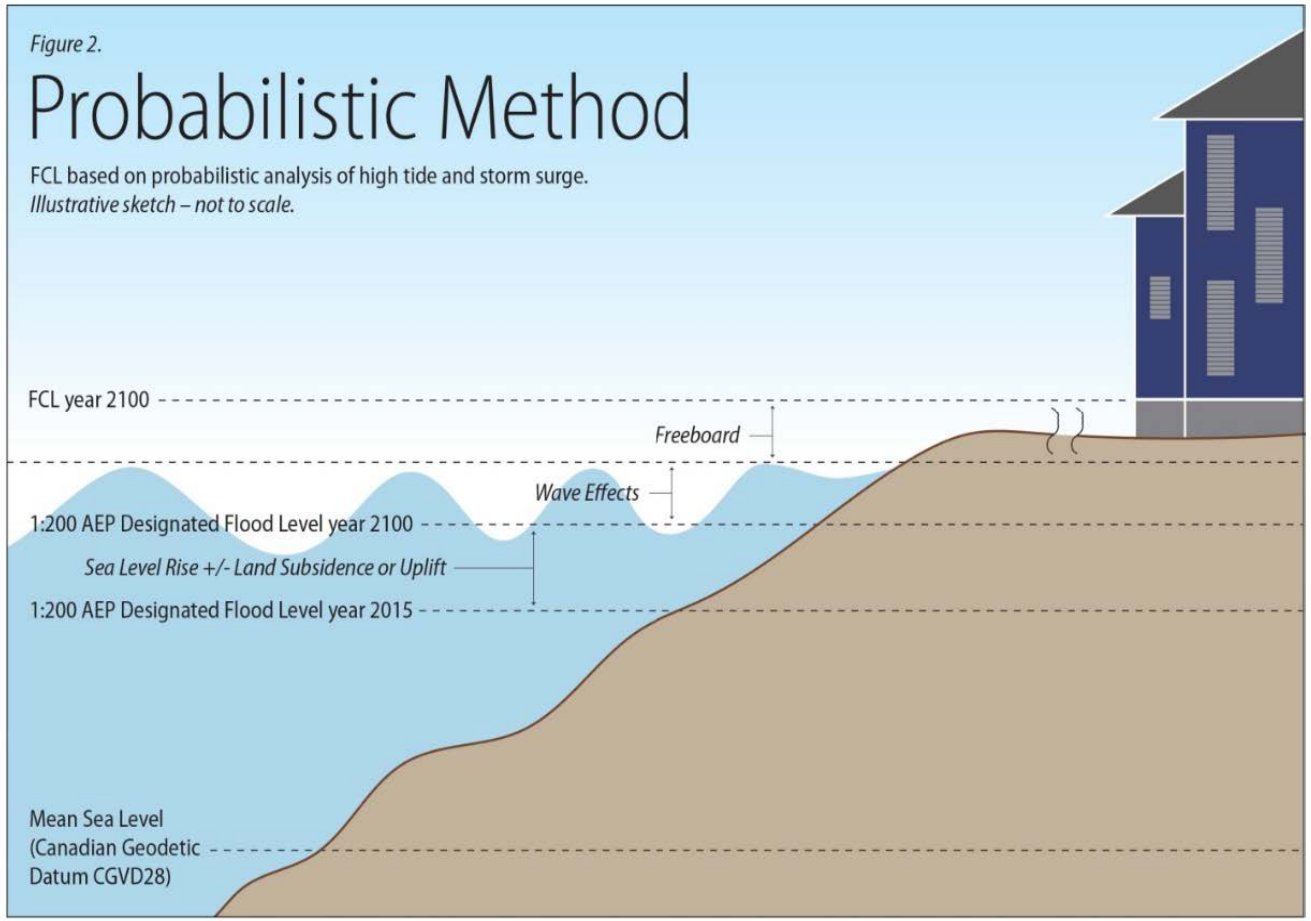
# Governing Practice Guidelines

There are two approaches for determining the 200-year FCL as per BC Guidance:




Joint Probability Method

- NHC pioneered this approach in BC
- Considers the probability of severe events occurring simultaneously
- More extensive analysis required to complete than additive approach

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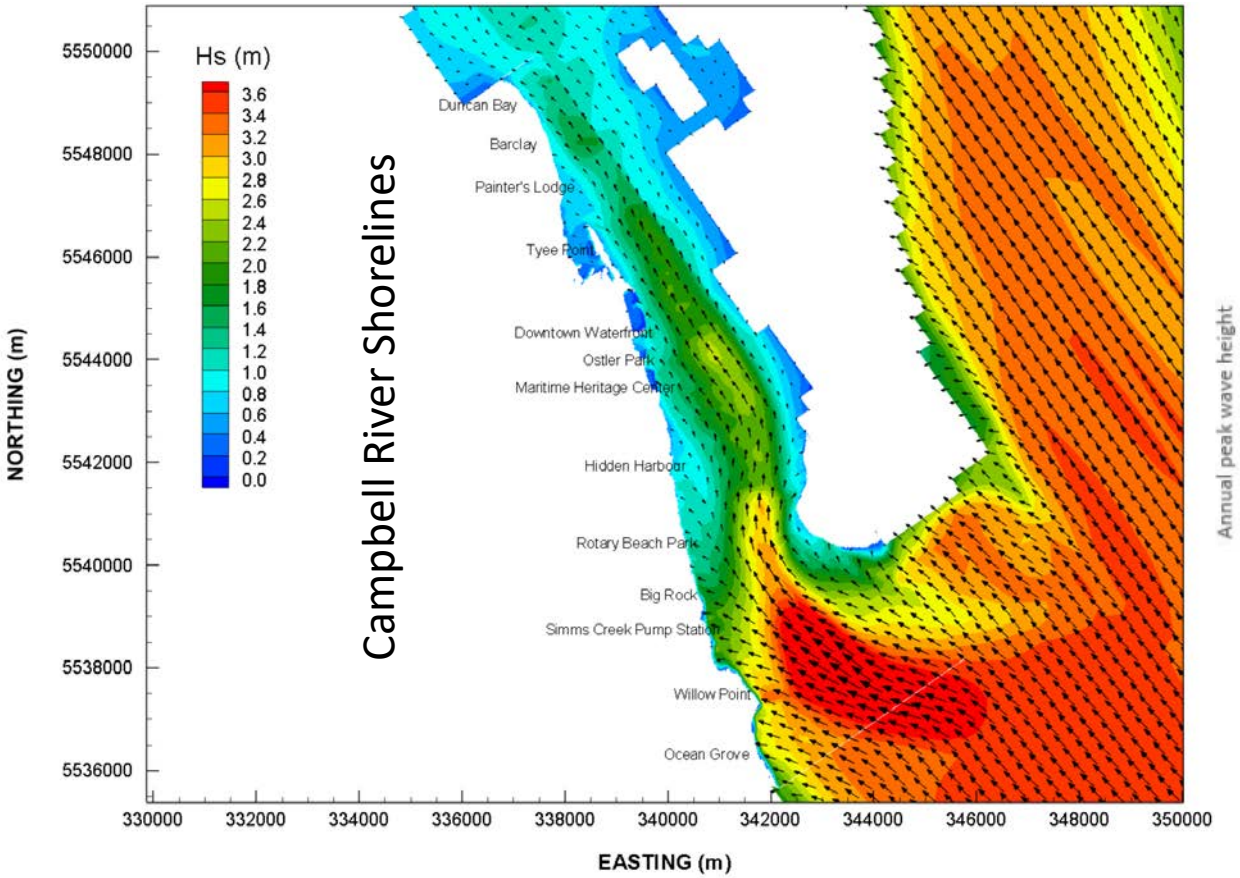
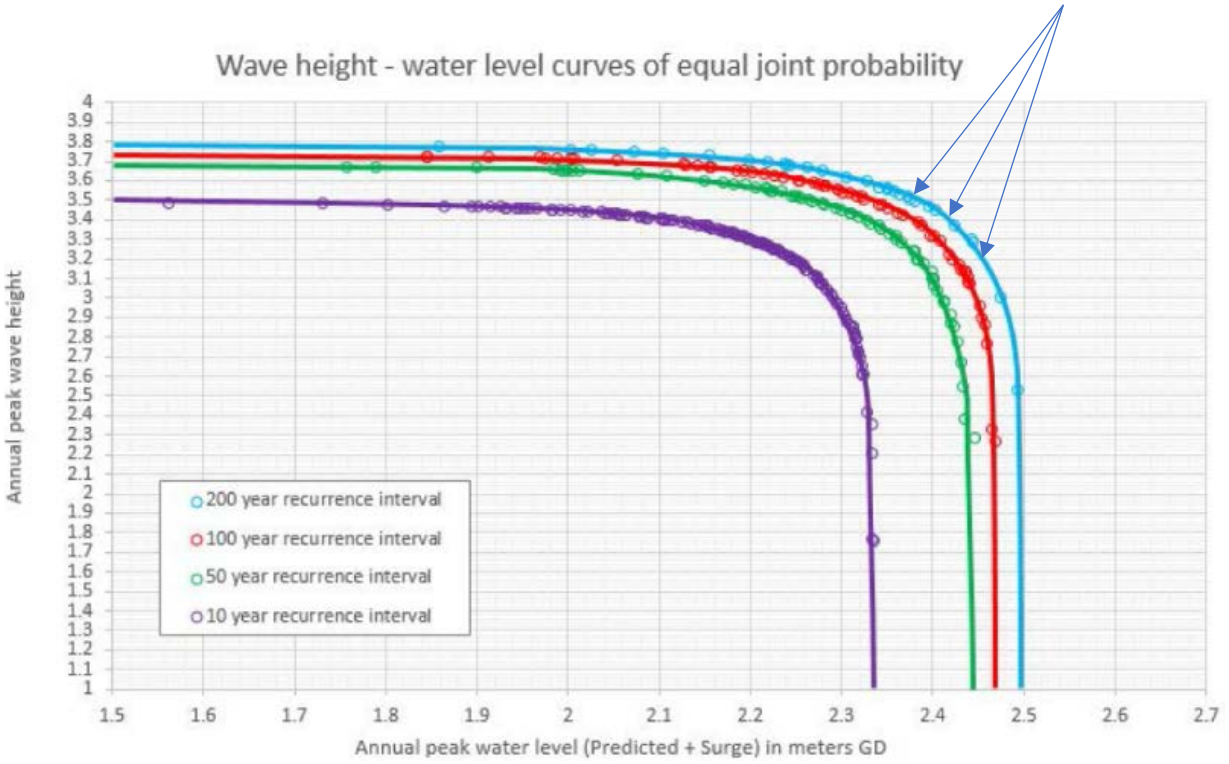
# Joint Probability Method




NHC wave model (SWAN) output of wave height at Campbell River

Concern is both large waves coinciding with high water levels




Based upon statistical analysis of measured water levels (Campbell River) and Sentry Shoal wave data

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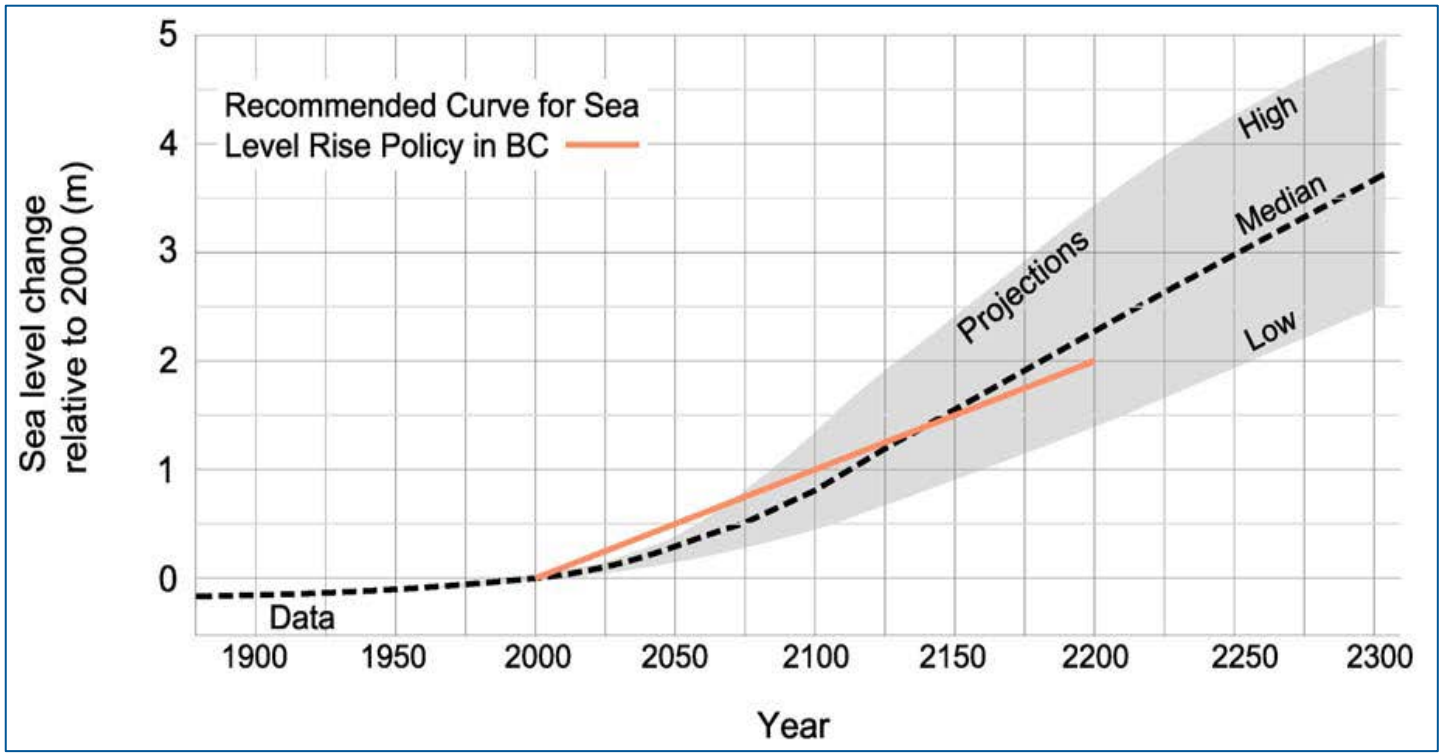
# Sea Level Rise (SLR) – BC planning




- BC Guidance is for 1 m for year 2100, and 2 m for year 2200 (Credit: Ausenco Sandwell - BCMOE 2011)

- Single value for planning purposes. Estimate developed using IPCC AR4 (2007) and additional information available in 2008-2010 period.

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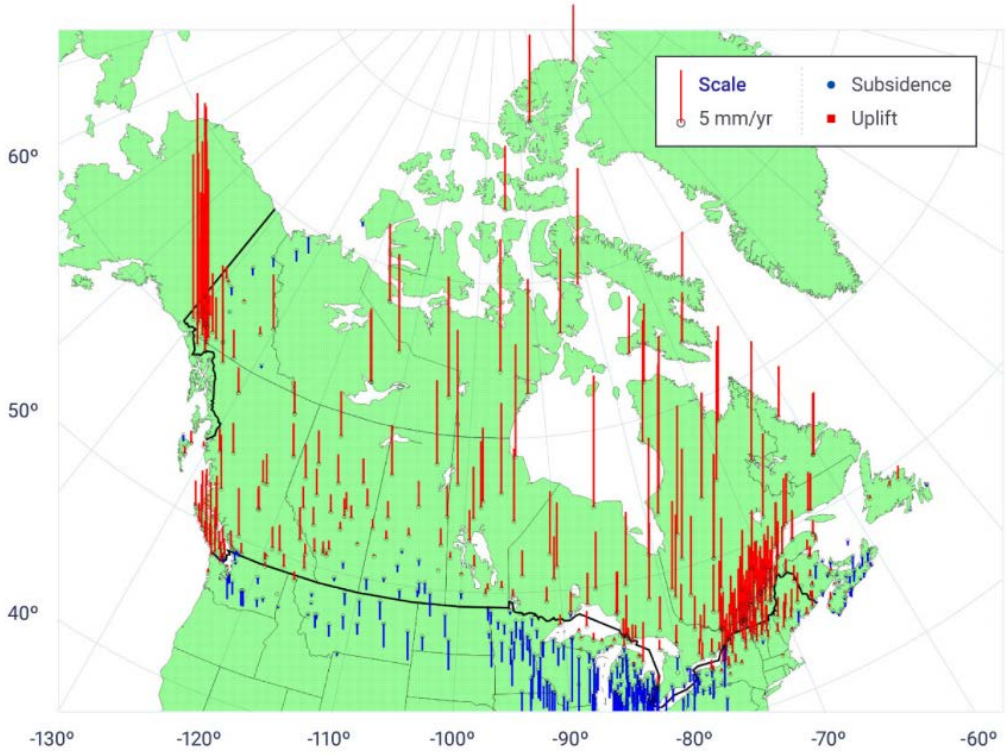
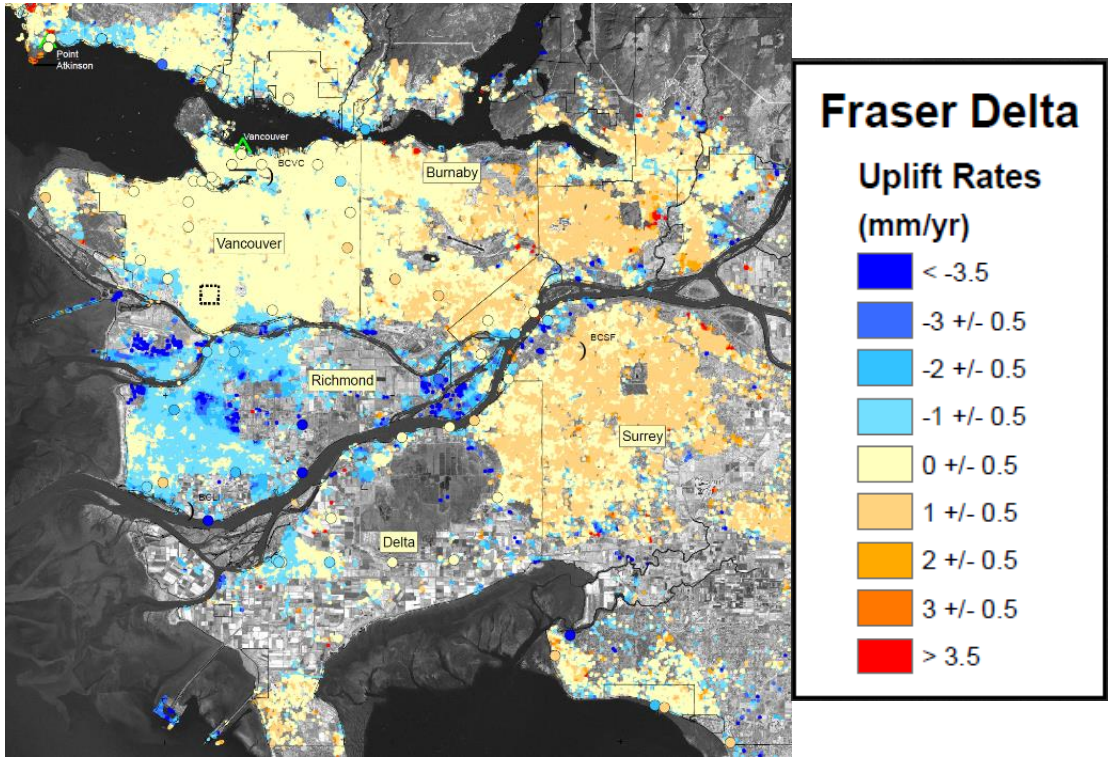
# Regional Sea Level Rise relative to local land

Much of Canada is presently experiencing iso-static rebound from previous ice age.




Credit: CCCR 2019, Chapter 7, Figure 7.13 – Crustal uplift and subsidence rates for the Canadian landmass




Credit: Subsidence and uplift in the Fraser River Delta; Lambert, A.S., Mazzotti, M., van der Kooij, A. Mainville, Geological Survey of Canada Open file 5698, p44.

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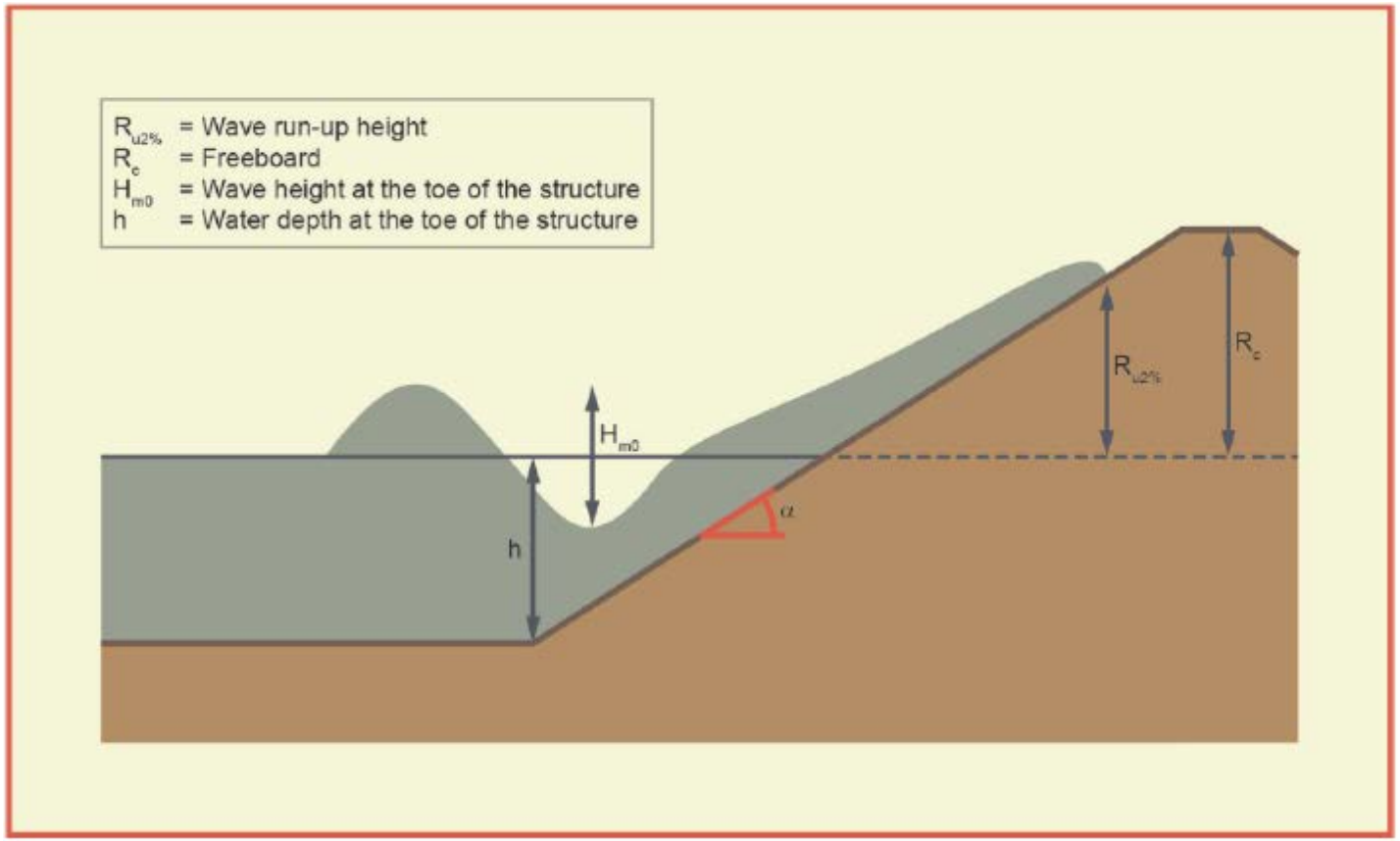
# Wave Effects (Wave Runup)

Note: Empirical wave runup assumes a continuous slope upwards.




*Ref: EurOtop Manual (2018): Manual on wave overtopping of sea defences and related structures. (Second Edition)*

*Photo: NHC – West Vancouver, December 20, 2018*

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# Wave Effects (Overtopping)

A mean overtopping discharge is commonly used in design guidance.

- q < 0.1 liters /s /m: Insignificant with respect to strength of crest and structure
- q = 1 liters /s /m: On crest and landward slopes grass covers or clay may erode.
- q = 10 liters /s /m: Significant overtopping for dikes, embankments.

Noted that individual wave overtopping can be much higher than mean values. (Order of magnitude higher)

Major damage is often the result of a small number of the highest waves in a given storm.

*Ref: EurOtop Manual (2018): Manual on wave overtopping of sea defences and related structures. (Second Edition)*
*Photo Left: C Osborne (City of Campbell River) – Photo of Ostler Park following a storm event, December 20, 2018*
*Photo Right: NHC – Photo of West Vancouver Seawalk west of Ambleside, December 20, 2018*

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# Campbell River

Located 175 km NW of Vancouver, on Vancouver Island

Exposed wave fetch to SE in Strait of Georgia

Variety of shorelines


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*Photos: NHC - G Lamont (2018)*

*Map produced using m_map software (Pawlowicz, R., 2020. "M_Map: A mapping package for MATLAB"*

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# Campbell River


Key areas along the Campbell River waterfront

*Campbell River – Coastal Assessment Study Area; Aerial Photo – Google Earth*

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# Campbell River

*Hwy 19A and bike path*

*Painter Barkley Area*

*Ocean Grove*

*Near Rotary Beach Park*

*Sequoia Park Area – Near Anchor Inn*

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*Photos of the shoreline variety: NHC (2017-2018)*

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# Historical Setting of Downtown Campbell River

Downtown area is primary built on reclaimed land.

Was previously estuary marsh, beach, and lower river flood plain


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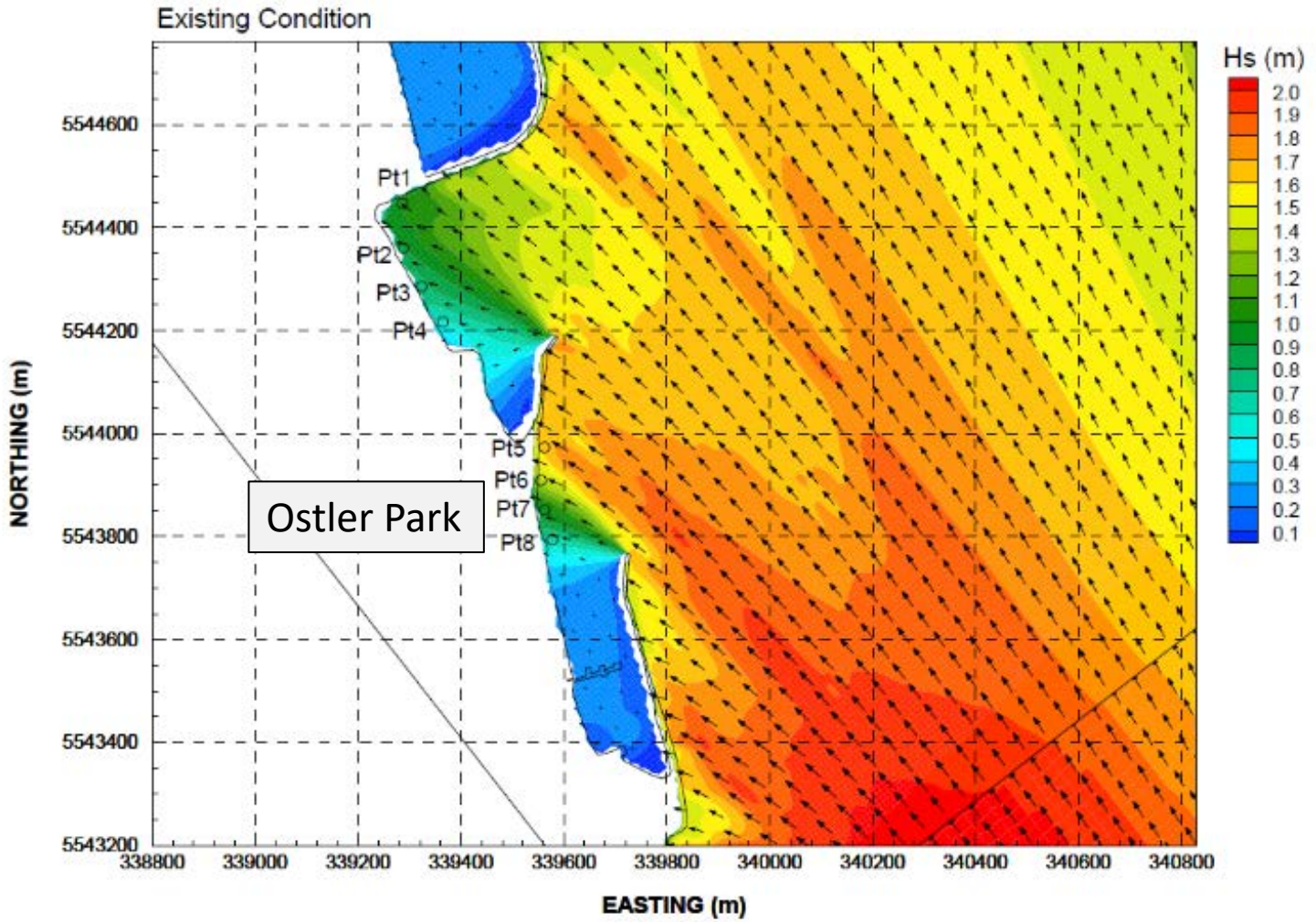
# Downtown Shoreline




*Photos: NHC (2018)*

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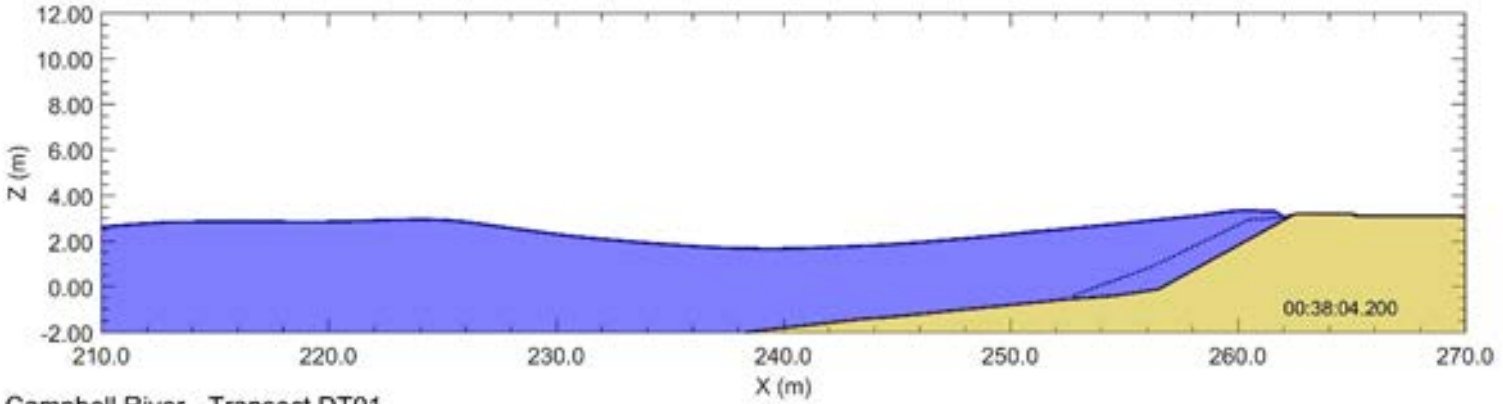
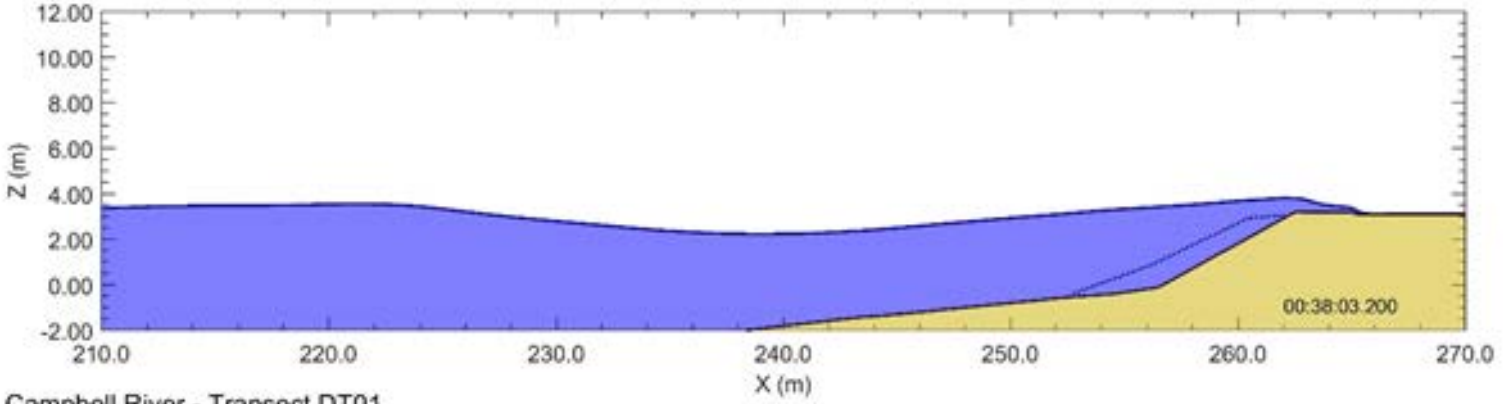
# Downtown Shoreline – Effect of SLR




Campbell River - Transect DT01
Incident Seastate: 1.0 m / 7.5 s
Still water level: 2.45 m GD
SLR Allowance: 0 m

Simulation duration: 40 min
Average over-topping: 14 litres/m/s
Maximum over-topping: 258 litres/m/s




Campbell River - Transect DT01
Incident Seastate: 1.0 m / 7.5 s
Still water level: 3.04 m GD
SLR Allowance: 1 m

Simulation duration: 40 min
Average over-topping: 134 litres/m/s
Maximum over-topping: 535 litres/m/s

*Ostler Park, Dec 20, 2018 (C. Osborne)*

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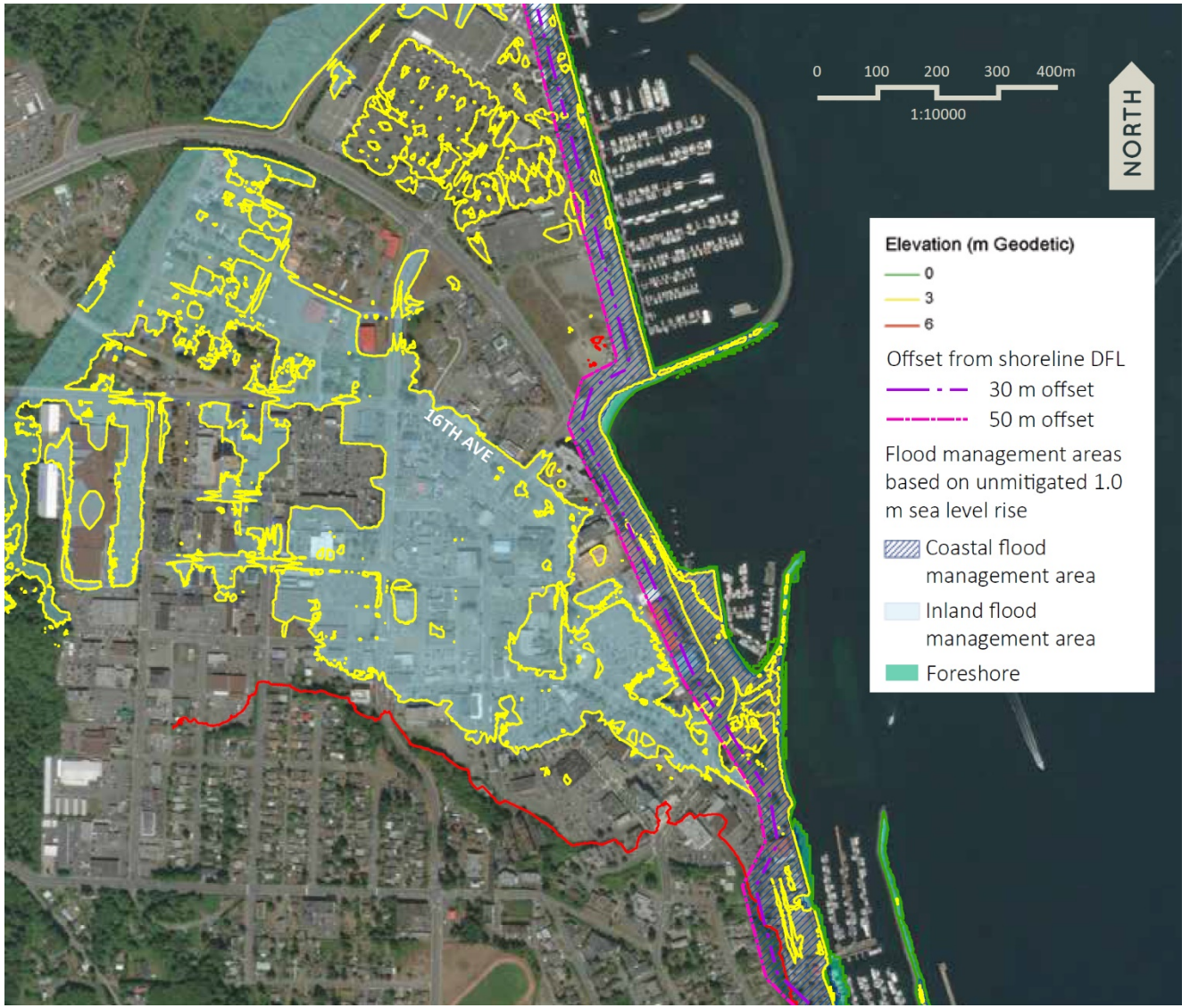
# Downtown Flood Risks




- Coastal Flood Hazard due to low shorelines (wave overtopping)
- Inland Flood Hazard due to river flooding
- Raising the coastal shoreline creates “bathtub” problem for downtown area
- Passive stormwater drainage will not work during high ocean waterlevels

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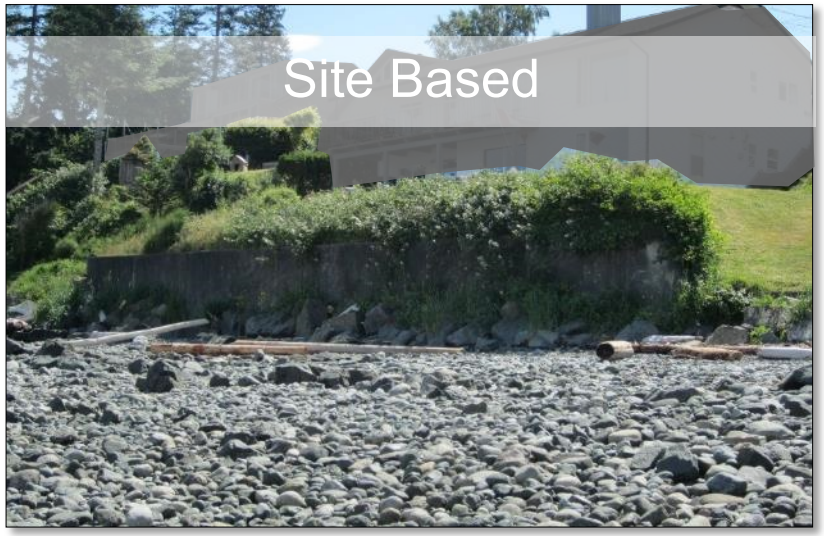
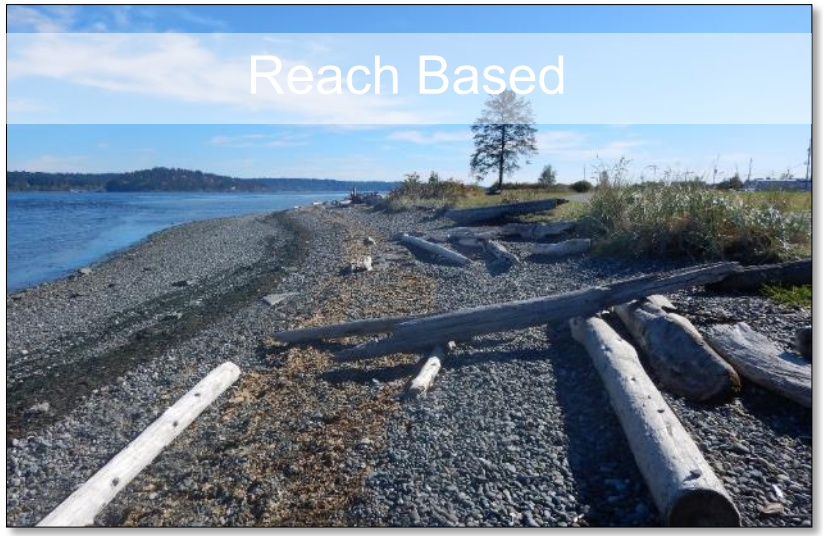
# Protect & Accommodate Approaches




- Floodproofing
- Wetproofing
- Elevate on piles or fill
- Floating Structures
- Shoreline protection structures
- Etc.




- Flood protection works
- Shoreline protection structures
- Offshore structures
- Etc.

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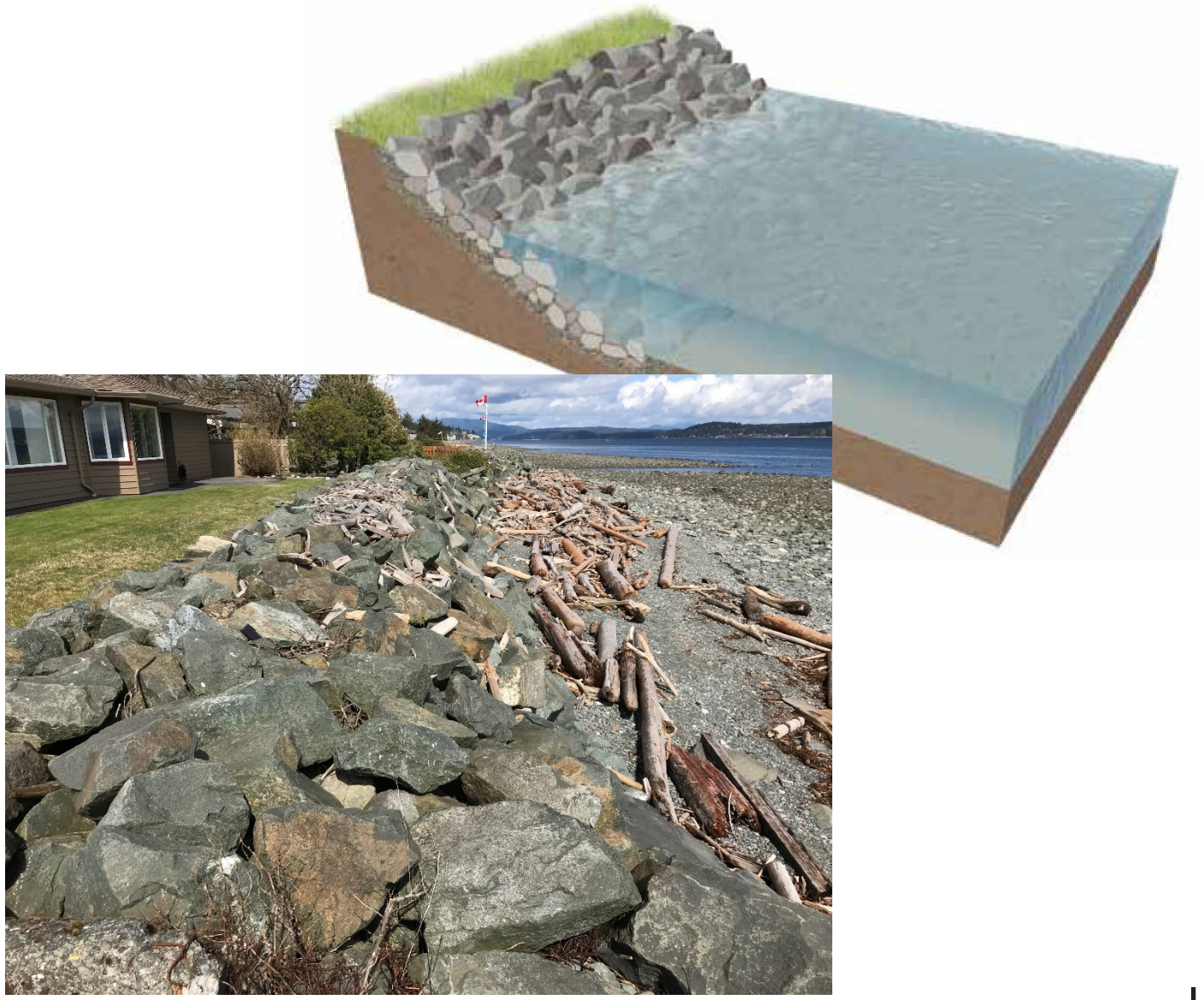
# Revetment





**Ability to Address Coastal Hazards**

| | | |
|---|---|---|
| Event Based | Storm Surge (High) | ○ |
| | Storm Surge (Low) | ◐ |
| | Wave Force | ● |
| | Sudden Erosion | ● |
| Gradual | Flooding Due to Sea Level Rise | ● |
| | Gradual Erosion | ● |

**Applicability to Landscape Type**

| | |
|---|---|
| Oceanfront Beaches | ○ |
| Coastal Marshes | ○ |
| Oceanfront Slopes | ◐ |
| Sheltered Bay Slopes | ● |
| Hardened Sheltered Bay Slopes | ● |
| Sheltered Bluffs | ○ |
| Hardened Sheltered Bluffs | ● |

● HIGH ◐ MEDIUM ○ LOW

*Photo: NHC (2018)*

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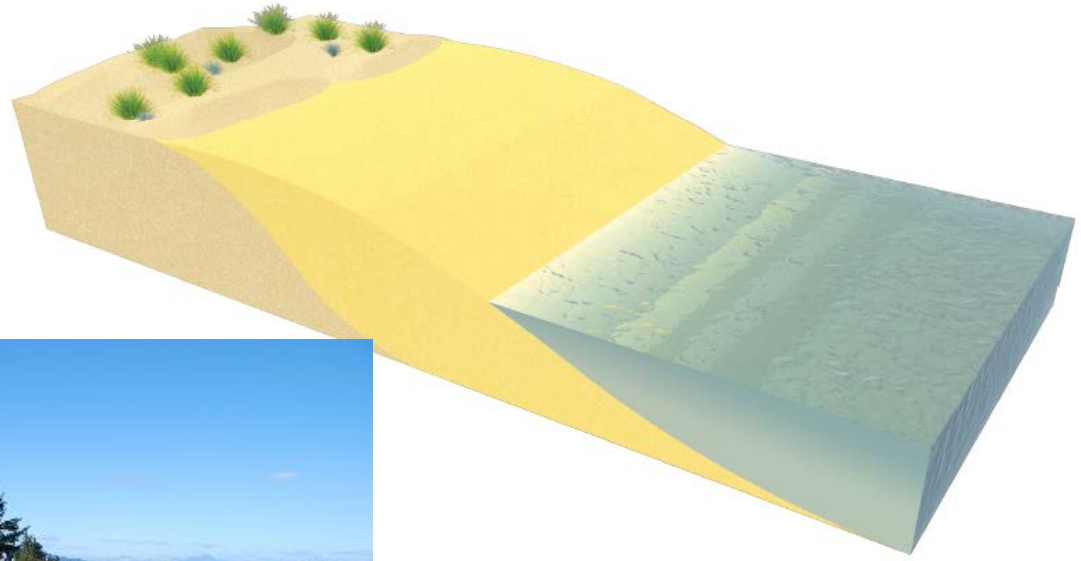
# Beach nourishment



**Ability to Address Coastal Hazards**

| | | |
|---|---|---|
| Event Based | Storm Surge (High) | ● |
| | Storm Surge (Low) | ● |
| | Wave Force | ● |
| | Sudden Erosion | ◐ |
| Gradual | Flooding Due to Sea Level Rise | ● |
| | Gradual Erosion | ◐ |

**Applicability to Landscape Type**

| | |
|---|---|
| Oceanfront Beaches | ● |
| Coastal Marshes | ○ |
| Oceanfront Slopes | ◐ |
| Sheltered Bay Slopes | ○ |
| Hardened Sheltered Bay Slopes | ○ |
| Sheltered Bluffs | ○ |
| Hardened Sheltered Bluffs | ○ |

● HIGH ◐ MEDIUM ○ LOW

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*Photos: D. Reid*

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# Beach nourishment – Won’t work everywhere

What are these shorelines telling us?

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*Photos: NHC (2018)*

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# Pocket beach/ headland

**Ability to Address Coastal Hazards**

| | | |
|---|---|---|
| Event Based | Storm Surge (High) | ○ |
| | Storm Surge (Low) | ◐ |
| | Wave Force | ● |
| | Sudden Erosion | ● |
| Gradual | Flooding Due to Sea Level Rise | ○ |
| | Gradual Erosion | ● |

**Applicability to Landscape Type**

| | |
|---|---|
| Oceanfront Beaches | ● |
| Coastal Marshes | ◐ |
| Oceanfront Slopes | ● |
| Sheltered Bay Slopes | ◐ |
| Hardened Sheltered Bay Slopes | ◐ |
| Sheltered Bluffs | ○ |
| Hardened Sheltered Bluffs | ○ |

● HIGH ◐ MEDIUM ○ LOW

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*Photos: NHC (left) and D. Reid (right)*

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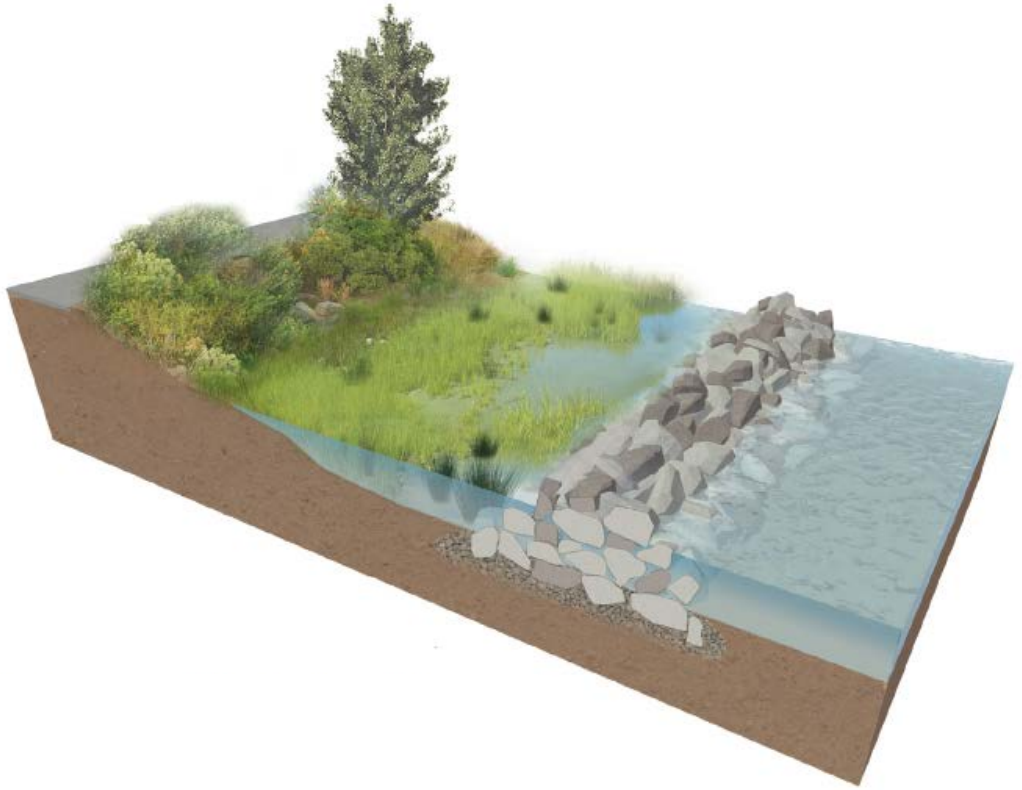
# Living shorelines



*Photos: D. Reid*

**Ability to Address Coastal Hazards**

| | | |
|---|---|---|
| Event Based | Storm Surge (High) | ○ |
| | Storm Surge (Low) | ◑ |
| | Wave Force | ◑ |
| | Sudden Erosion | ● |
| Gradual | Flooding Due to Sea Level Rise | ● |
| | Gradual Erosion | ● |

**Applicability to Landscape Type**

| | |
|---|---|
| Oceanfront Beaches | ○ |
| Coastal Marshes | ● |
| Oceanfront Slopes | ○ |
| Sheltered Bay Slopes | ● |
| Hardened Sheltered Bay Slopes | ● |
| Sheltered Bluffs | ● |
| Hardened Sheltered Bluffs | ● |

● HIGH ◑ MEDIUM ○ LOW

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# Summary

- 1.0 m of SLR for year ~ year 2100 but, SLR won't stop at 1.0 m!
- Wave effects are shoreline specific, and will change with SLR
- Adaptations must consider physical setting (Work with nature, not against it.)

The ocean will always win… eventually.

Thank you.

Grant Lamont, P.Eng. Principal, NHC

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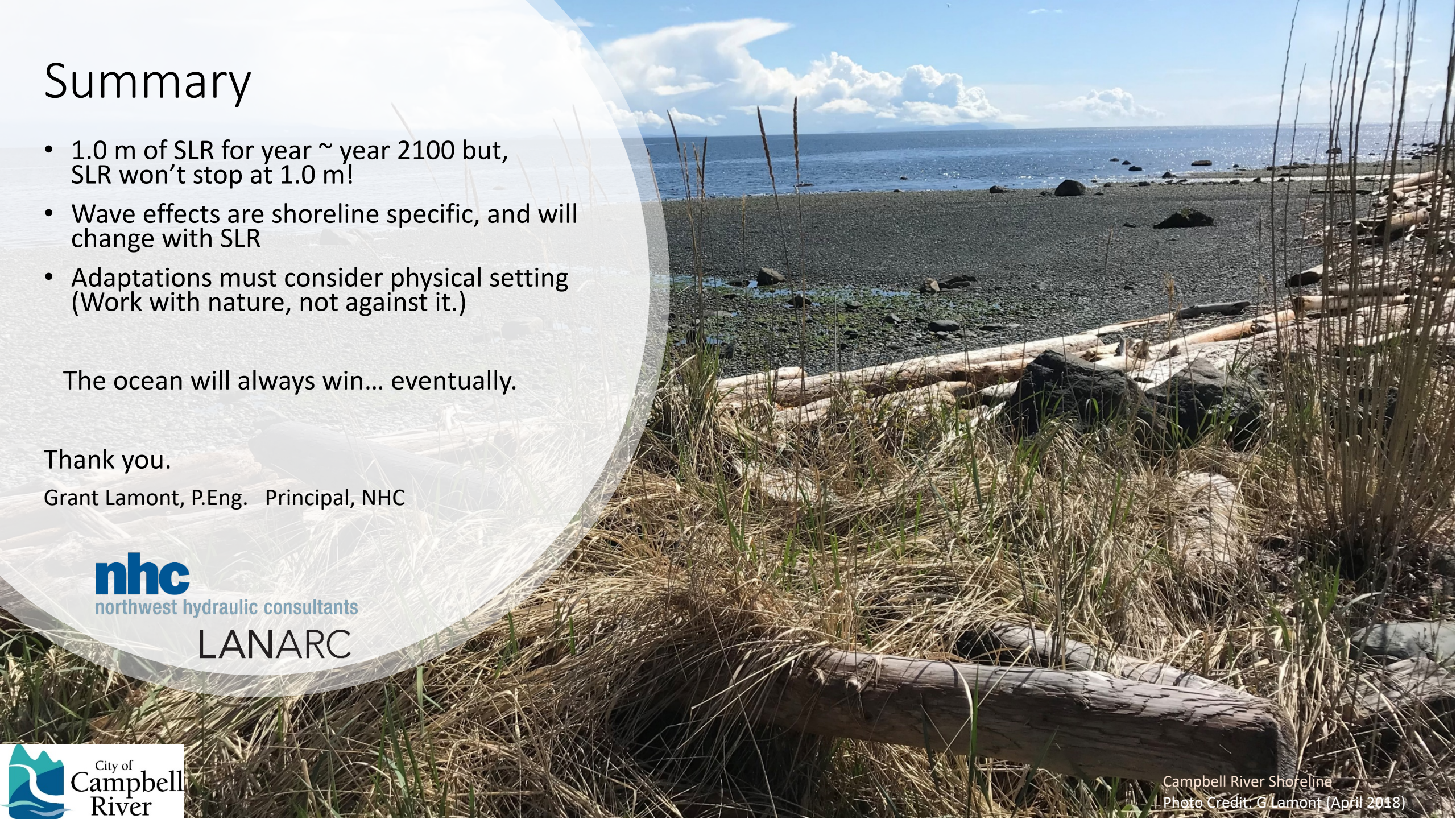
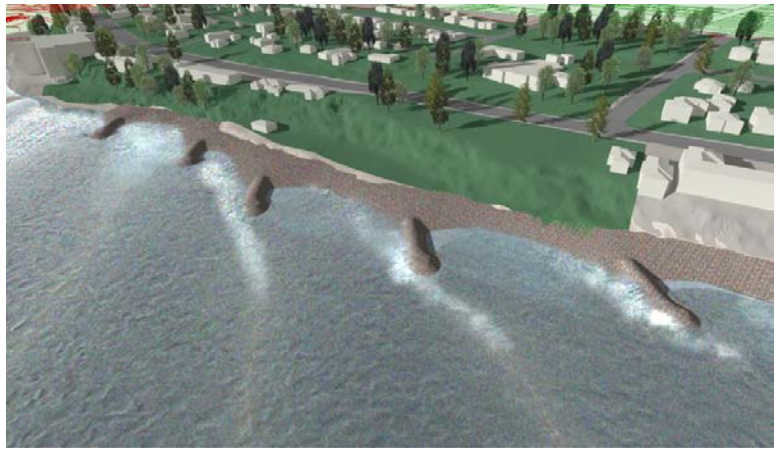


Campbell River Shoreline
Photo Credit: G Lamont (April 2018)



# Sea Level Rise COMMUNICATIONS AND VISUALIZATIONS

Don Crockett, MLA, BES, BCSLA

Principal, Landscape Architect

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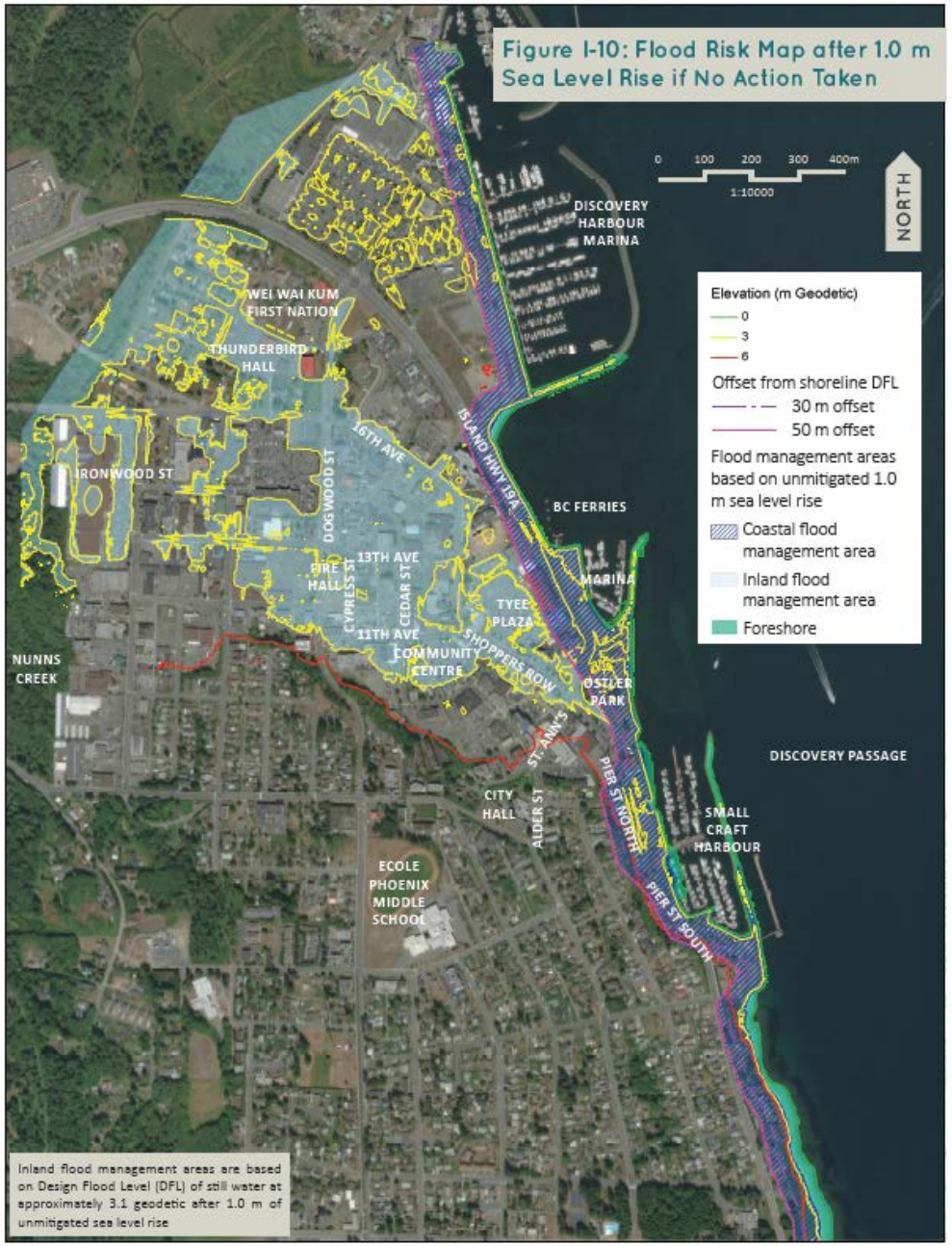
# Downtown

## Mapping of Coastal and Inland Flood Management Areas

- Based on detailed flood projections, mathematical modelling, and terrain modelling

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# Coastal Flood Management Areas


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# Inland Flood Management Areas


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# Why Visualizations?

Sea shores are dynamic places, with wind, waves, tides, storm surges, sea level rise, local topography and geomorphology at play.

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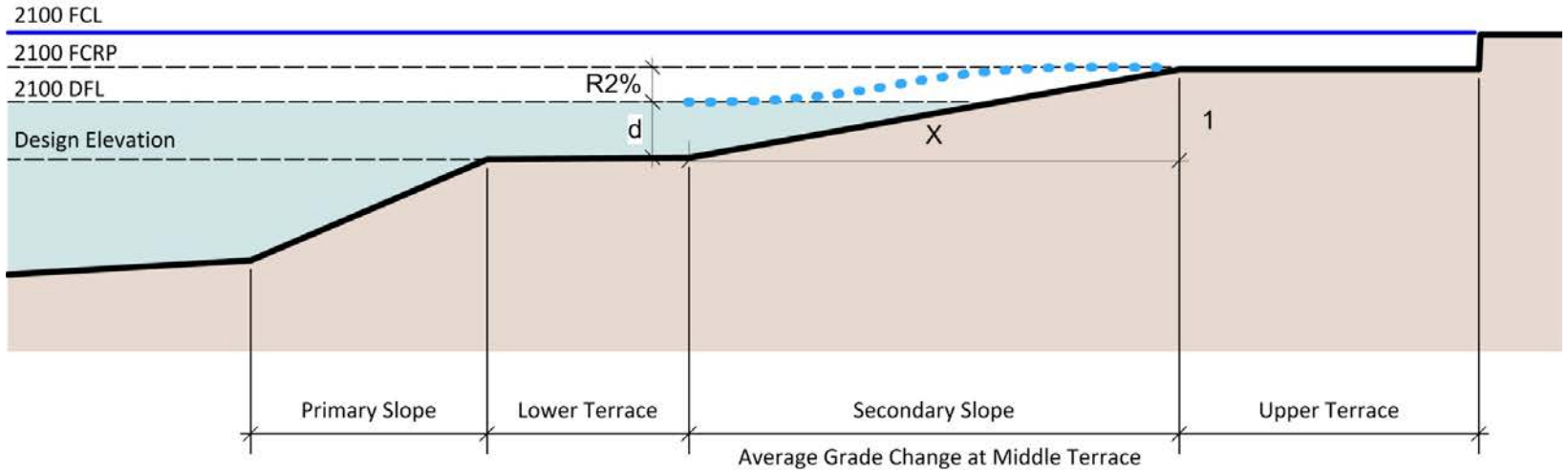
# Why Visualizations?

Engineering modelling as a predictive tool is complex and difficult to communicate to non-technical audiences.




| Scenario | Wave Hindcast | | at Water Depth of 0.8 m ( Elevation of Perched Beach at +3.24 m CGD) | | | at Water Depth of 1.6 m ( Elevation of Salt Marsh at +2.44 m CGD) | | |
|---|---|---|---|---|---|---|---|---|
| | Sign. Wave Height | Peak Wave Period | 1/4.0 Slope | 1/4.3 Slope | 1/5.0 Slope | 1/4.0 Slope | 1/4.6 Slope | 1/5.0 Slope |
| | (m) | (sec) | (m) | (m) | (m) | (m) | (m) | (m) |
| **200-Year Wind form Vancouver Harbour (VH)** | 0.42 | 2.33 | 0.46 | 0.42 | 0.39 | 0.47 | 0.43 | 0.40 |
| **200-Year Wind from Vancouver International Airport (YVR)** | 0.6 | 2.7 | 0.63 | **0.6** | 0.54 | 0.66 | **0.6** | 0.56 |

1. Steven A. Hughes: Estunatubg Irregular Wave Runup on Rough, Impermeable Slopes, US Army Corps of Engineers, ERDC/CHL CHETN-III-70, July 2005

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# Why Visualizations?

- Visualizations are useful to inform design and policy decisions
- Visualizations can be powerful tools to communicate potential impacts, scenario options, and spatial relationships


*Without mitigation*

*With mitigation*

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# Visualizations Defined

- Visualizations in this presentation are defined as images or animations that represent a three (or four) dimensional construct
- They are typically generated from a set of 3D data using specialized computer modelling software
- Images can be enhanced using a variety of methods including post-production software and hand drawing

# Visualizations Defined

- **What is the Point?** Similar to written text, visualizations should be carefully prepared to deliver a particular message or narrative.

# Visualizing Potential Threats

- Illustrating various sea level conditions and flooding impacts


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# Visualizing Potential Threats

- Illustrating various sea level conditions and flooding impacts


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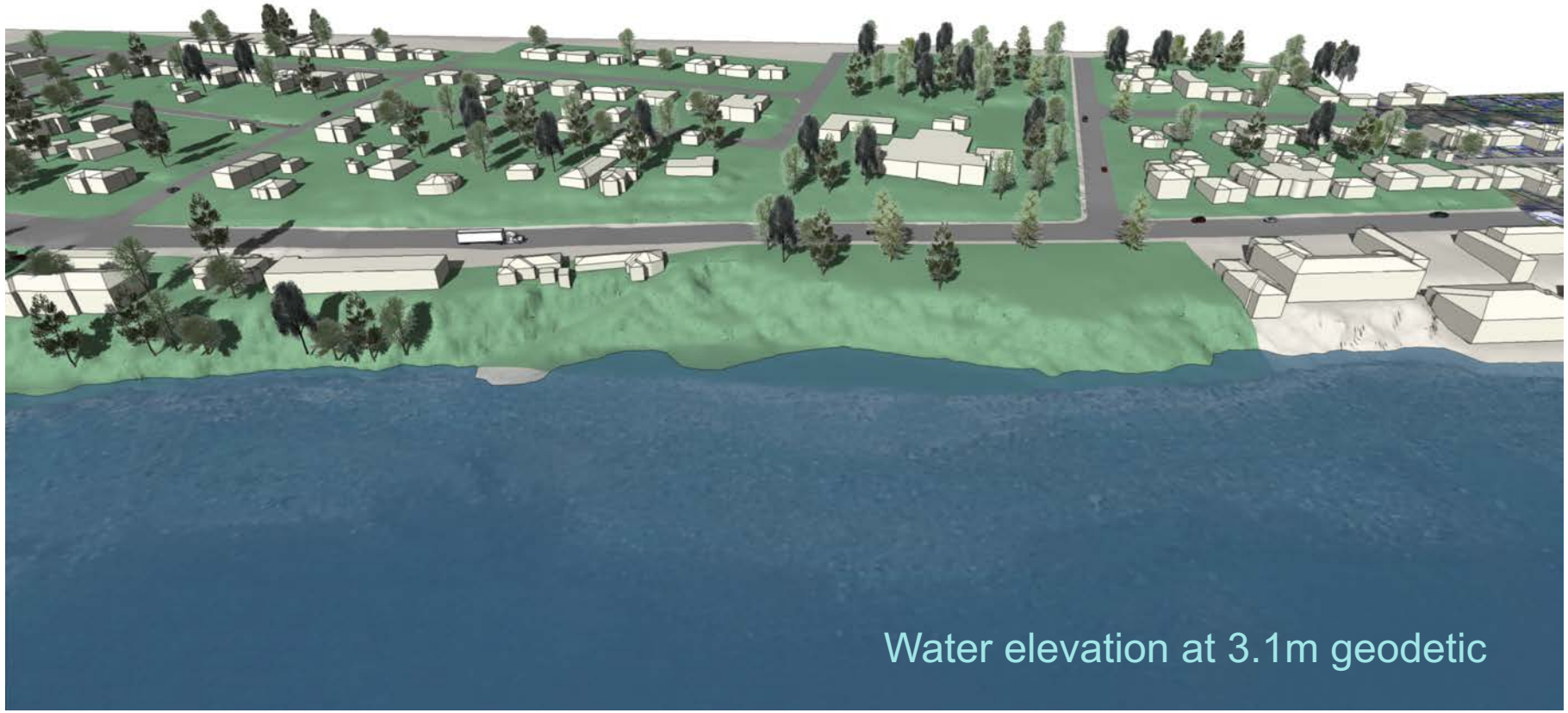
# Visualizing Potential Threats

- Illustrating various sea level conditions and flooding impacts

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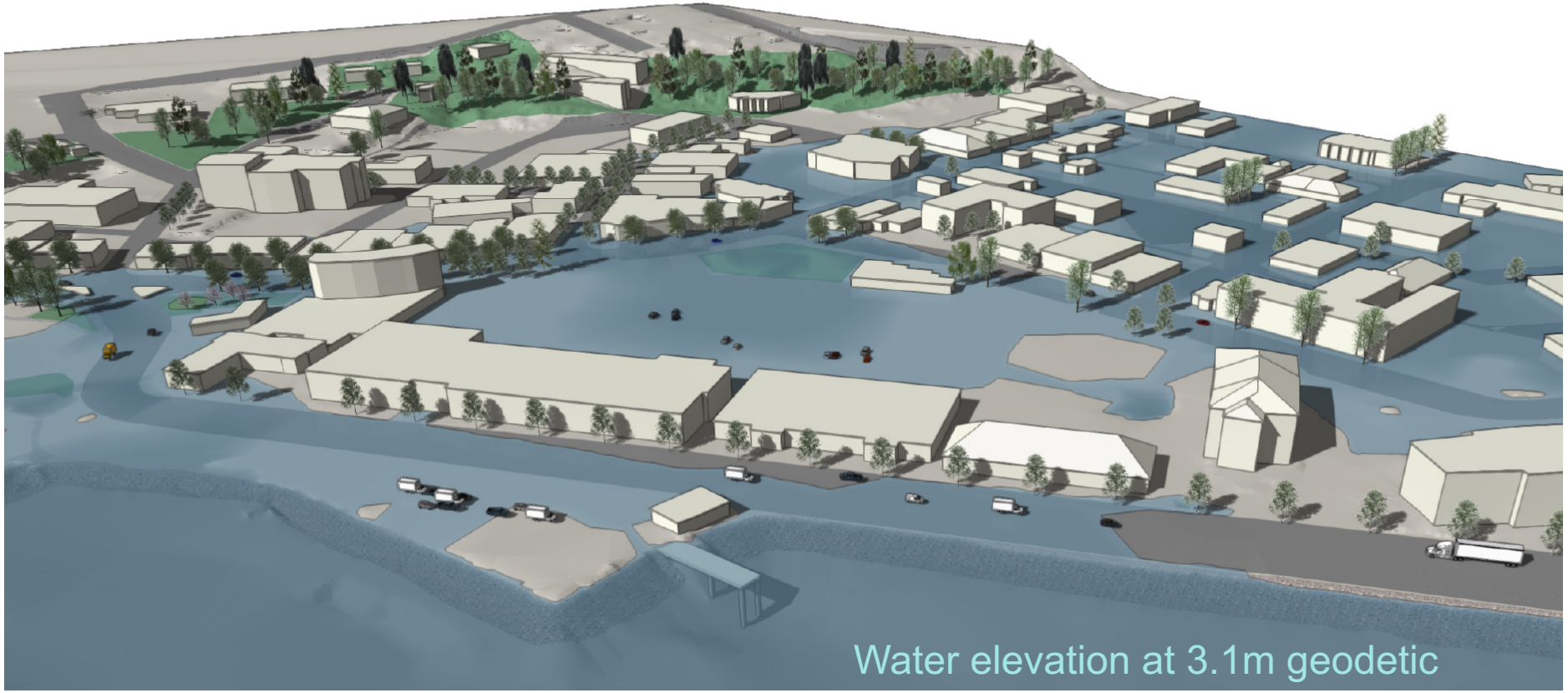
# Visualizing Threats and Solutions

- Potential impacts to urban areas need to be understood in order to design adaptive management structures and policies.

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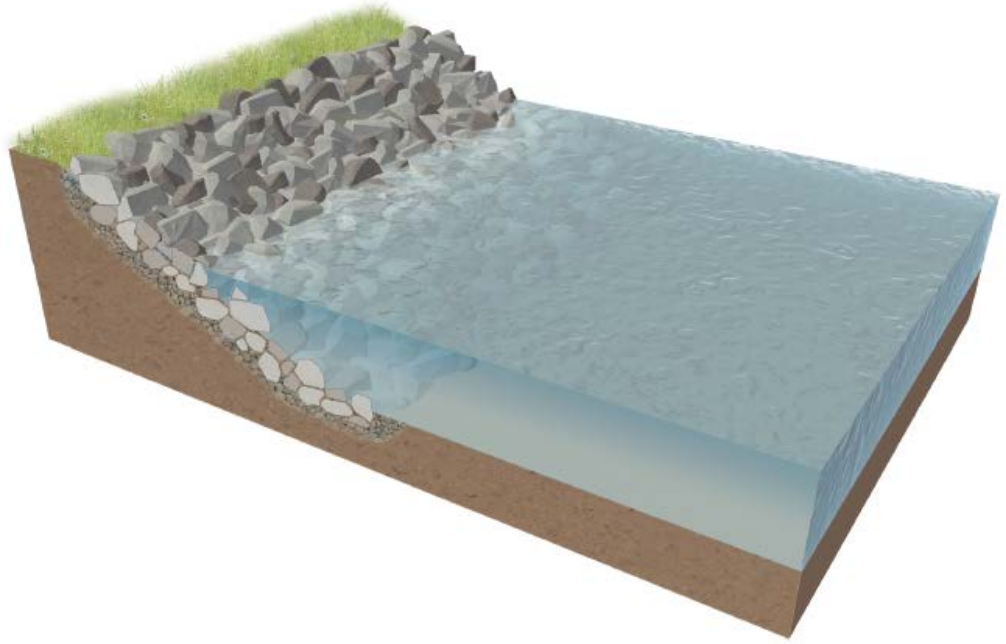
# Visualizing Adaptive Strategies

## Rock armouring



**Ability to Address Coastal Hazards**

| | | |
|---|---|---|
| Event Based | Storm Surge (High) | ● |
| | Storm Surge (Low) | ● |
| | Wave Force | ◐ |
| | Sudden Erosion | ◐ |
| Gradual | Flooding Due to Sea Level Rise | ● |
| | Gradual Erosion | ◐ |

**Applicability to Landscape Type**

| | |
|---|---|
| Oceanfront Beaches | ○ |
| Coastal Marshes | ● |
| Oceanfront Slopes | ○ |
| Sheltered Bay Slopes | ◐ |
| Hardened Sheltered Bay Slopes | ◐ |
| Sheltered Bluffs | ○ |
| Hardened Sheltered Bluffs | ○ |

● HIGH ◐ MEDIUM ○ LOW

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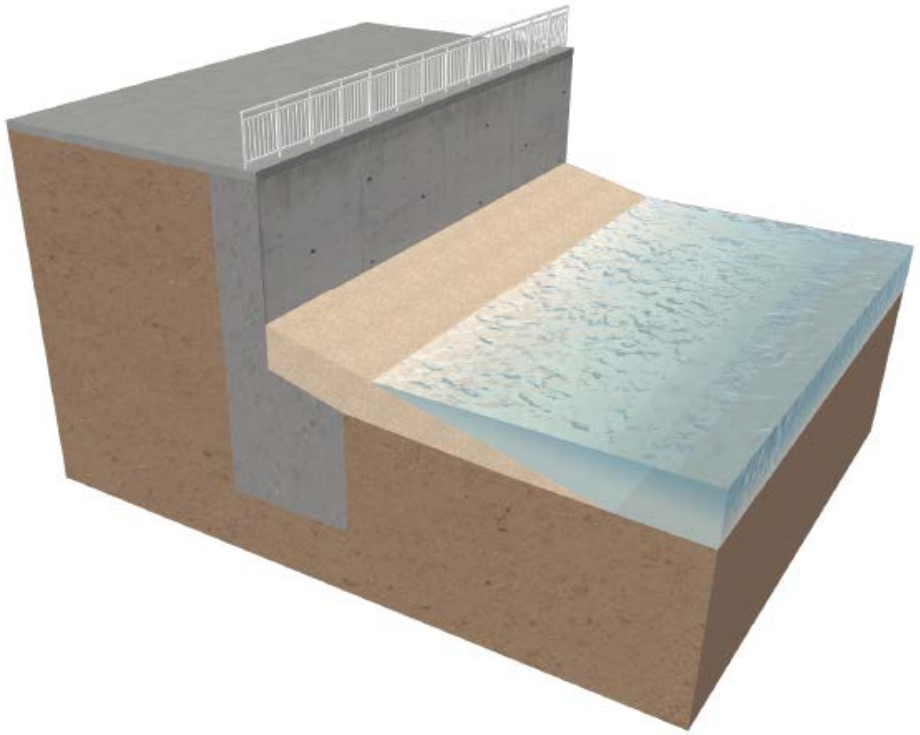
# Visualizing Adaptive Strategies

## Seawalls

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| Sheltered Bluffs | ○ |
| Hardened Sheltered Bluffs | ○ |

● HIGH ◐ MEDIUM ○ LOW

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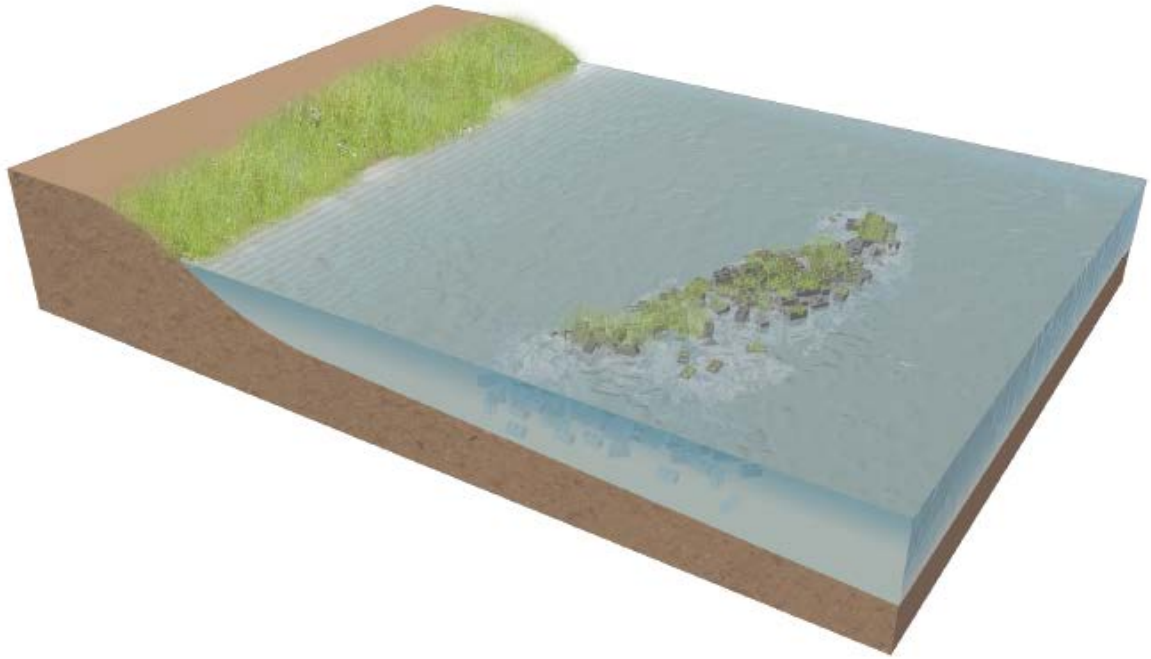
# Visualizing Adaptive Strategies

## Offshore reefs / breakwaters



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| | | |
|---|---|---|
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| | Storm Surge (Low) | ● |
| | Wave Force | ◐ |
| | Sudden Erosion | ◐ |
| Gradual | Flooding Due to Sea Level Rise | ● |
| | Gradual Erosion | ◐ |

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| | |
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| Sheltered Bluffs | ○ |
| Hardened Sheltered Bluffs | ○ |

● HIGH ◐ MEDIUM ○ LOW

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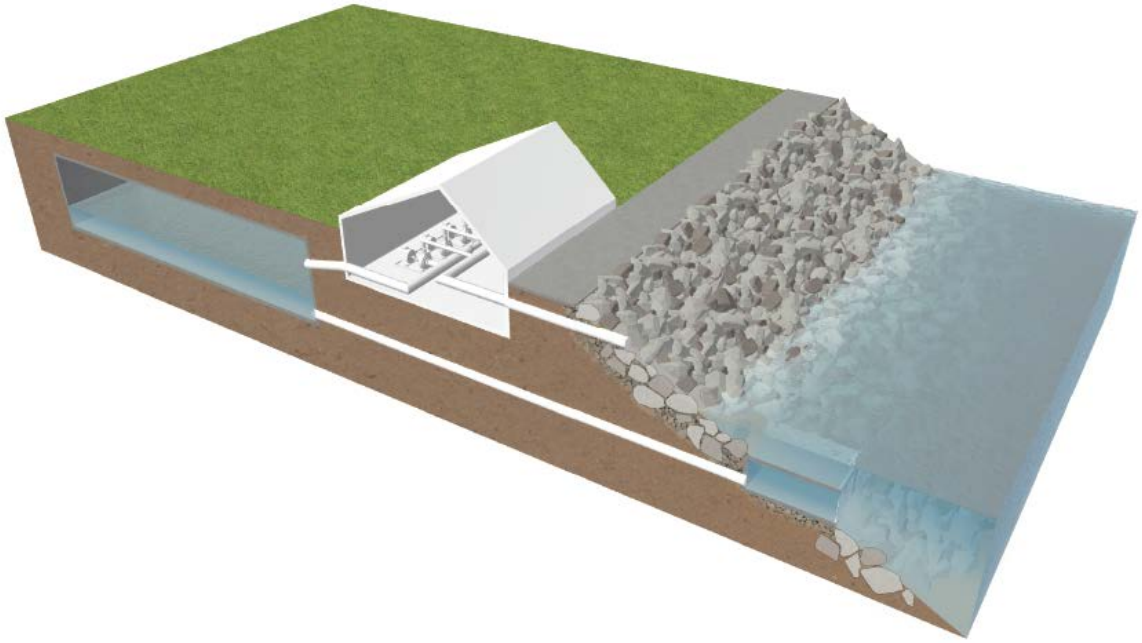
# Visualizing Adaptive Strategies

## Floodbox / pump station



**Ability to Address Coastal Hazards**

| | | |
|---|---|---|
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| | Storm Surge (Low) | ● |
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| Hardened Sheltered Bluffs | ○ |

● HIGH ◐ MEDIUM ○ LOW

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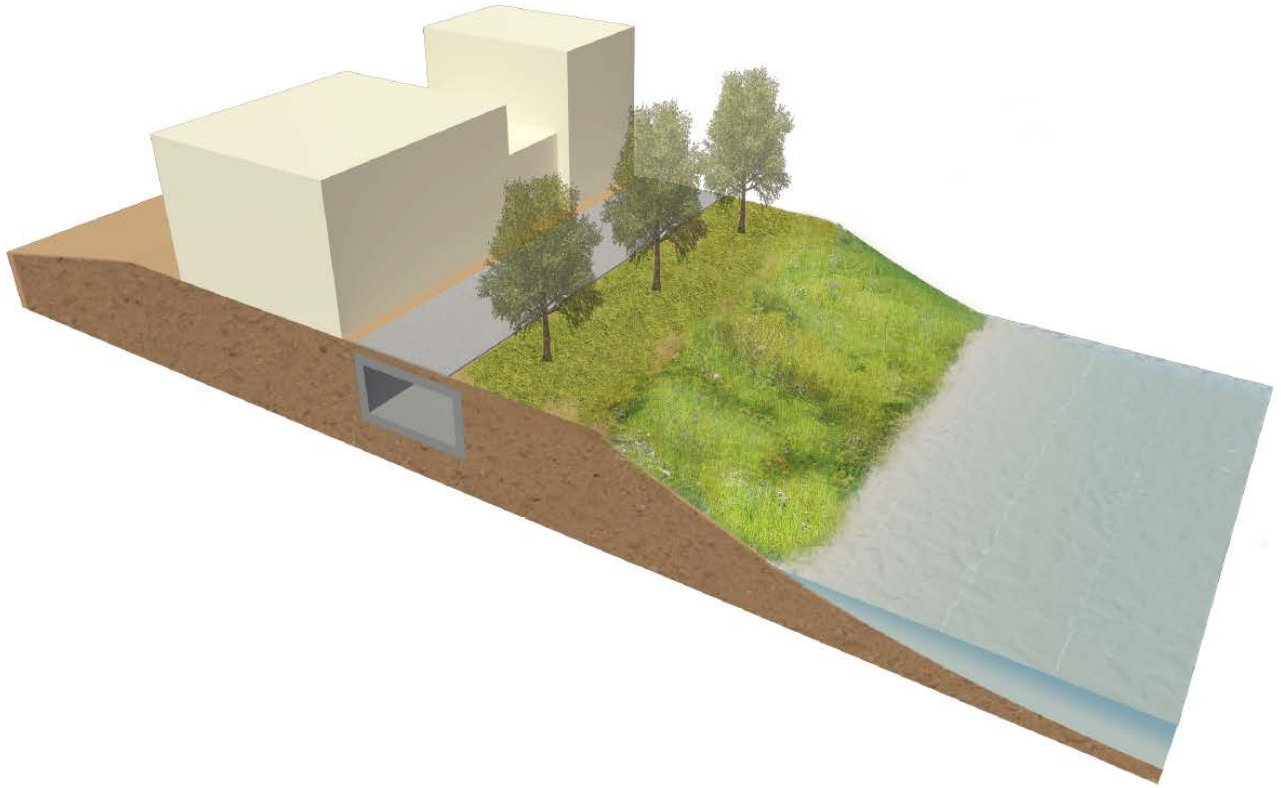
# Visualizing Adaptive Strategies

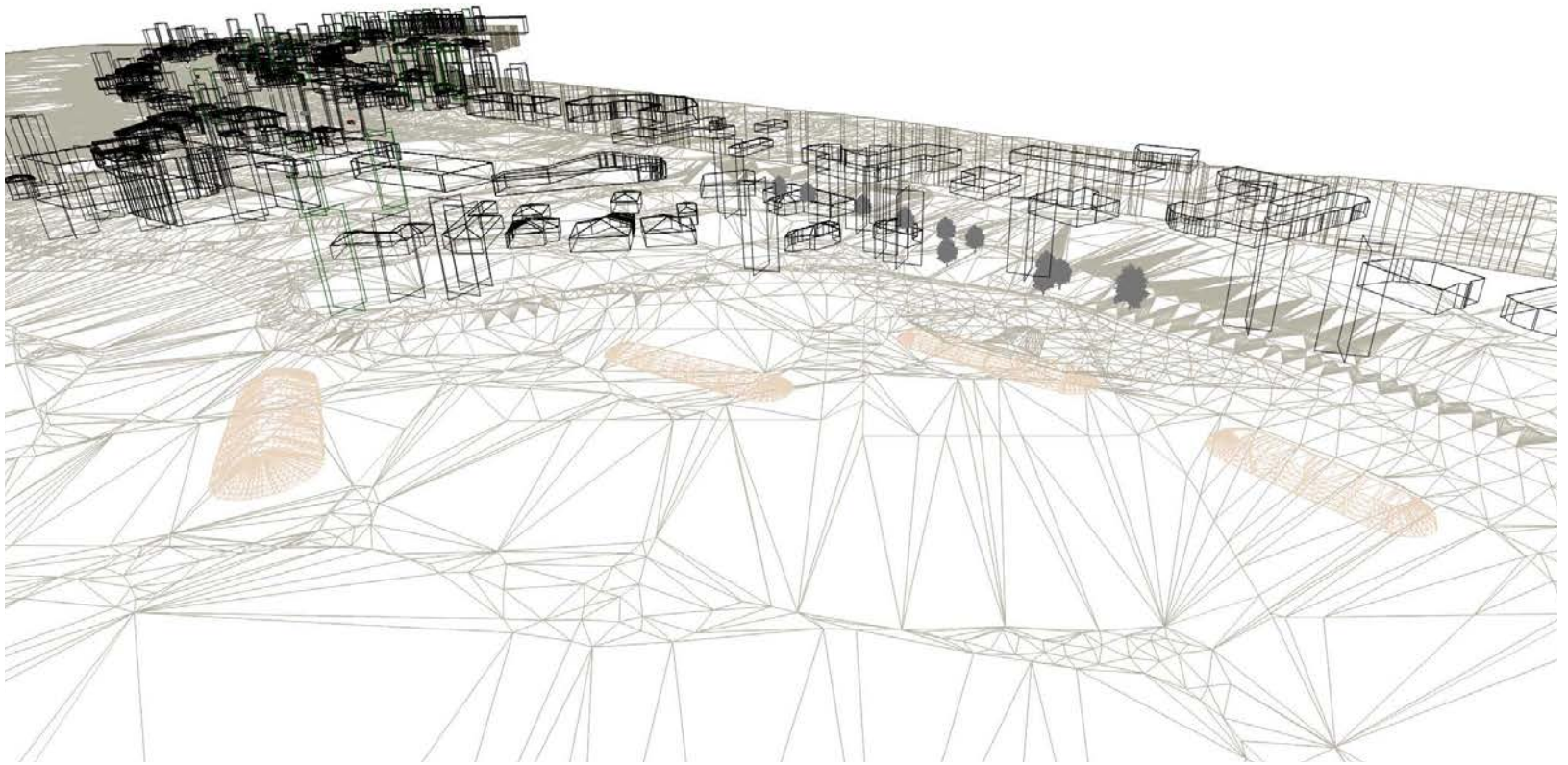
- Incorporating structures, public open space systems, and future development



# Visualizations Methodology

- Terrain modelling, bathymetry and urban form

WIREFRAME TERRAIN MODEL



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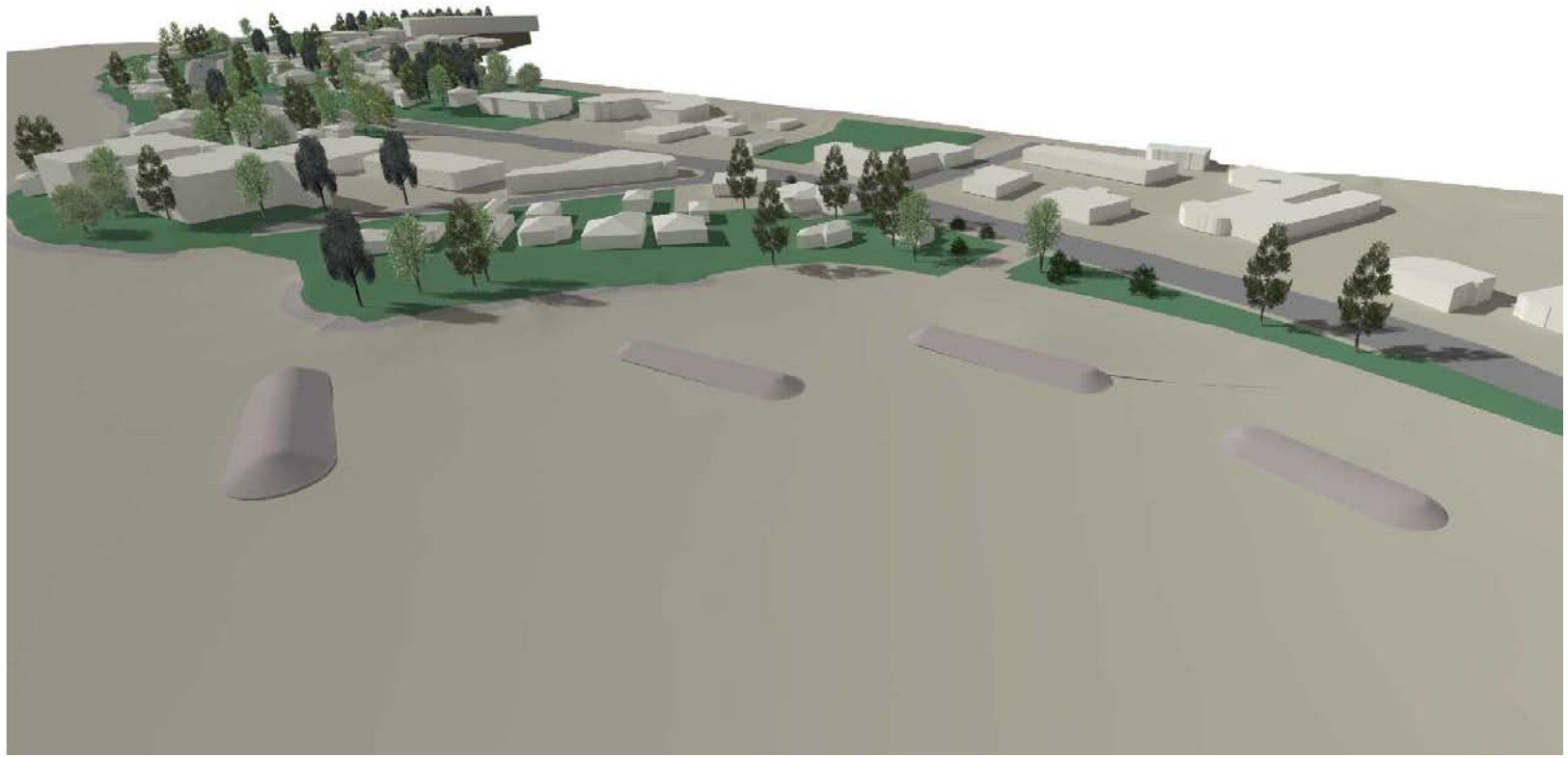
# Visualizations Methodology

- Terrain modelling, bathymetry and urban form

MODEL WITH SURFACE AND SUBSURFACE TOPOGRAPHY, URBAN CONTEXT



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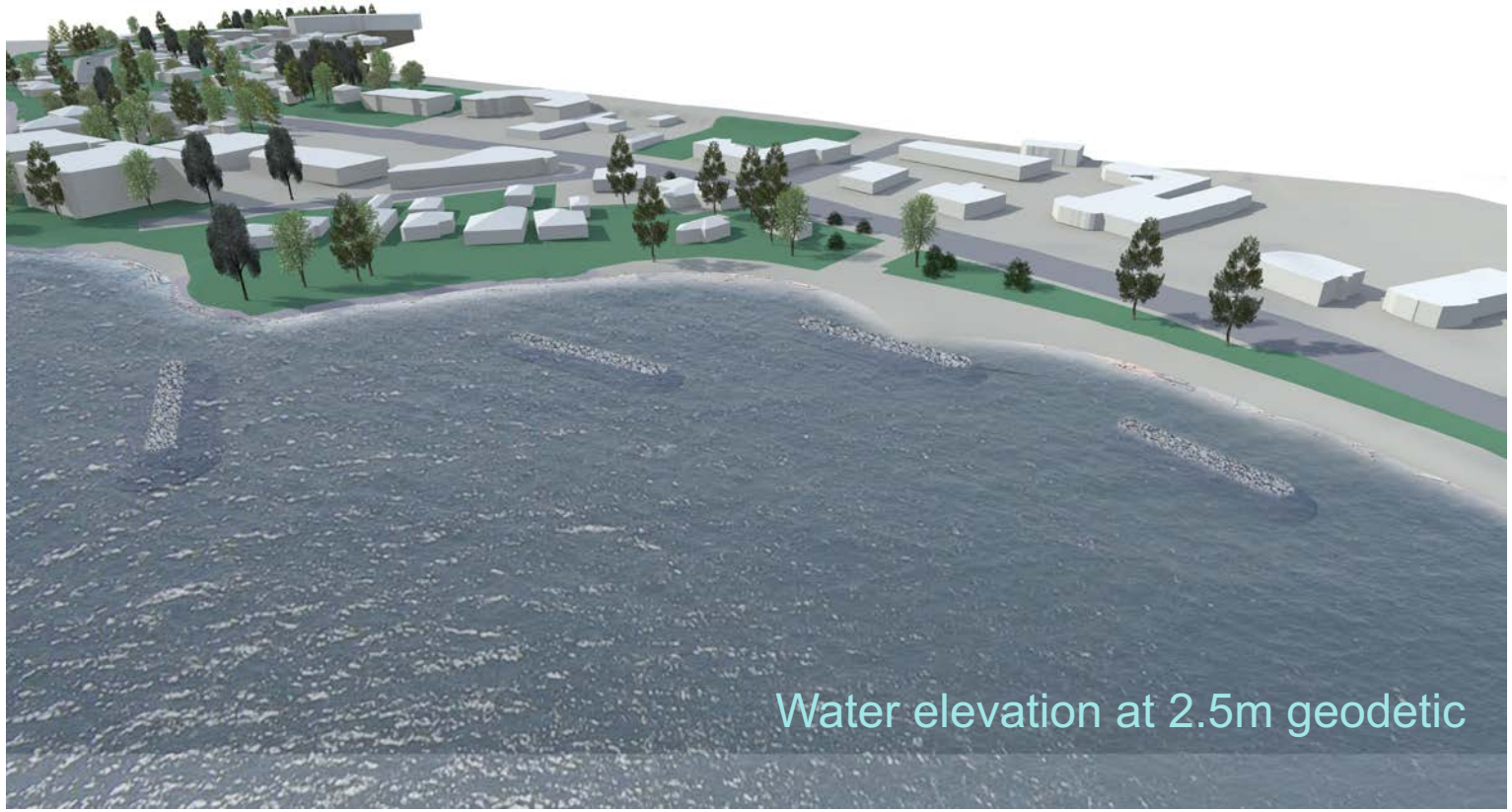
# Visualizations Methodology

- Terrain modelling, bathymetry and urban form

MODEL WITH WATER AT PRESCRIBED ELEVATION

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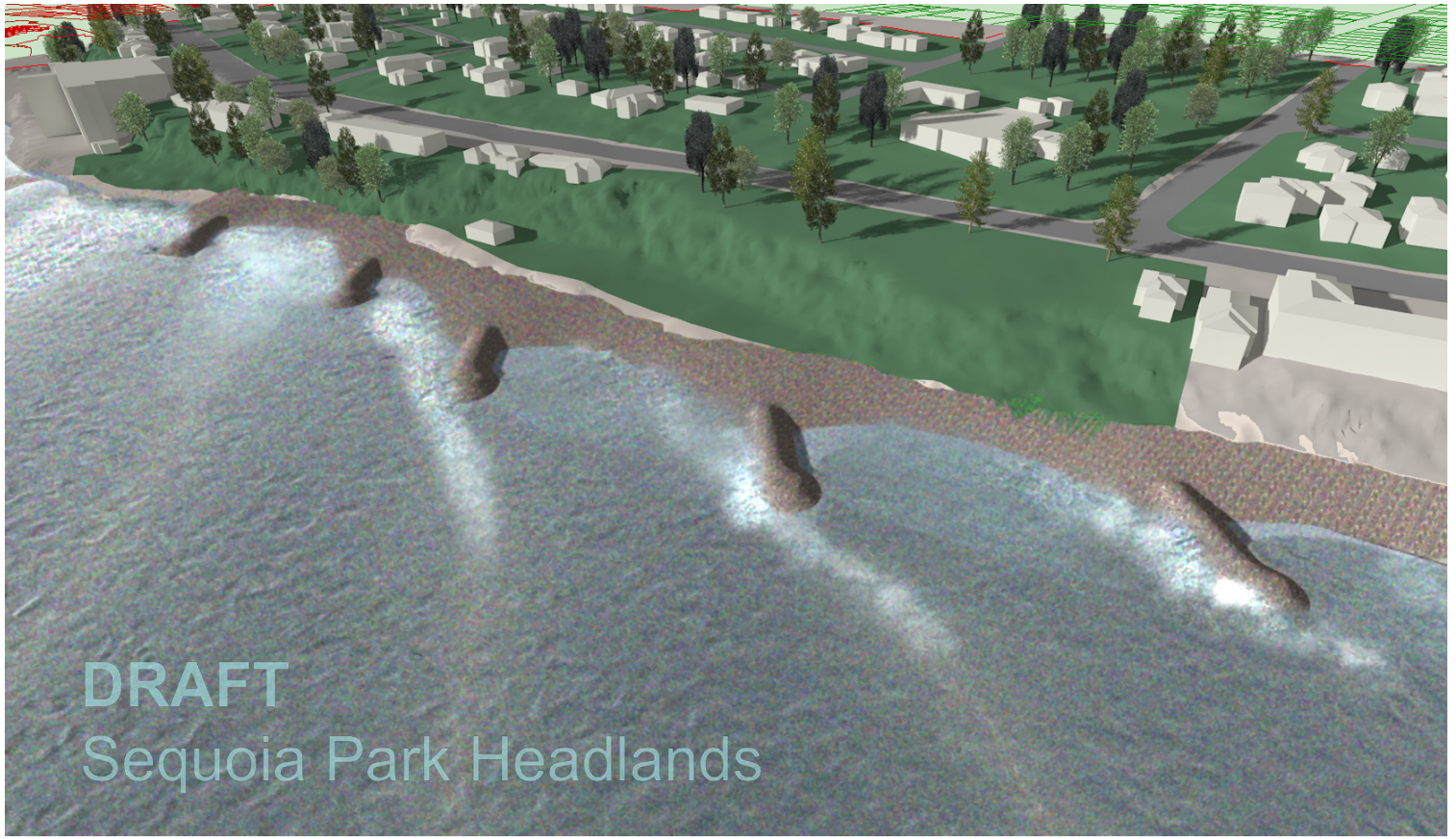
# Visualizations Methodology

- Incorporating engineering off shore and on shore mitigation options

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# Visualizations Methodology

- Incorporating structures, public open space systems, and future development


WATER AT 3.1M ELEVATION, DRAFT FUTURE MITIGATIONS

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# Visualizations- Challenges

Still images represent only a static condition, or snapshot. They do not communicate motion or processes well.

ANIMATION would be useful to:

- Communicate that flooding is an ephemeral event that can last for a short duration but with significant consequences.
- Communicate scale – bird's eye view does not communicate power of waves and wave effects very well. Fly-throughs into model details would be effective.

# Visualizations- Challenges

ANIMATION is useful but:

- Storm and wave animations require sophisticated software and significant rendering times to be convincing.  The effects may be less scientific, requiring engineering input for validation.
- Significant expense: there are trade-offs between effective delivery of the visual message and costs to produce.

# Visualizations - Challenges

- Still images are generally more cost effective so a combination of select still images supplemented with photo precedent images, real time video, and engineering modelling can deliver the message effectively.
- Need to be selective as to what tools best deliver the message most effectively.

# Visualizations
## Summary

- 3D Visualizations are useful as an exploratory design tool as well as a communications tool
- Need to be selective as to what is the purpose and message of the image(s)
- Consider the audience and how the images might be interpreted (e.g. when illustrating impacts and mitigations to private property)
- Be clear about assumptions and the limitations of the images.

# City of CR Sea Level Rise Planning Program

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# Overview

**2017 – 2019**

**Phase 1: Gather data, preliminary mapping**

**Phase 2: Technical studies**

**Phase 3: Public input to choose responses, write long term strategy**

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# Funding:

City of Campbell River — $205k

FCM Federation of Canadian Municipalities / Fédération canadienne des municipalités — $175k

UBCM Union of BC Municipalities — $150k

Pacific Institute for Climate Solutions — Knowledge. Insight. Action. — $20k

$175k + $150k + $20k = $345k

- ***TOTAL:*** ***$550k***

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# 1: Data Gathering & Engineering

- What's at risk?
- How bad is the risk?

  (*Risk = likelihood x consequence*)

- What are the reasonable mitigation options available?

→ What CAN we do?

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# 2: Community Preferences

- What values should be protected?
- How much risk can we tolerate?
- What are we willing to spend?
- Who should pay?

→ What SHOULD we do?

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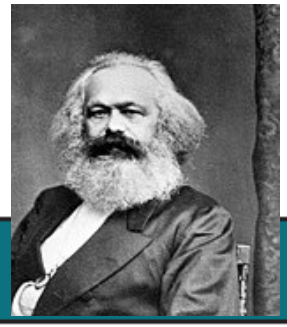
# "Political" Options:



| Option A | Option B | Option C |
|---|---|---|
| Minimum Community Intervention | Extensive Community Intervention | Balanced Intervention by Priority |
| Adaptation at Property Scale | Adaptation at Neighbourhood Scale | Mixed Property/Neighbourhood Scale |
| City addresses adaptation in public streets and street ends, parks, infrastructure only | City pursues on-foreshore adaptation fronting private waterfront wherever possible, in addition to adaptation for public infrastructure | City pursues on-foreshore adaptation fronting private waterfront only where there is a cummunity-wide benefit, in addition to adapting public infrastructure |
| Private waterfront owners protect shoreline independently and raise buildings/lots at time of reconstruction at their own expense | Private waterfront owners face reduced costs for shoreline protection. Owners raise buildings/lots at time of reconstruction at their own expense | Private waterfront owners and City share costs in proportion to benefits for neighbourhood shoreline protection where feasible. Private waterfront owners raise buildings/ lots at time of reconstruction at their own expense |

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# Healthy Built Environment

Improved foreshore access

Encourage physical activity and interaction with environment

Protect and enhance foreshore ecology

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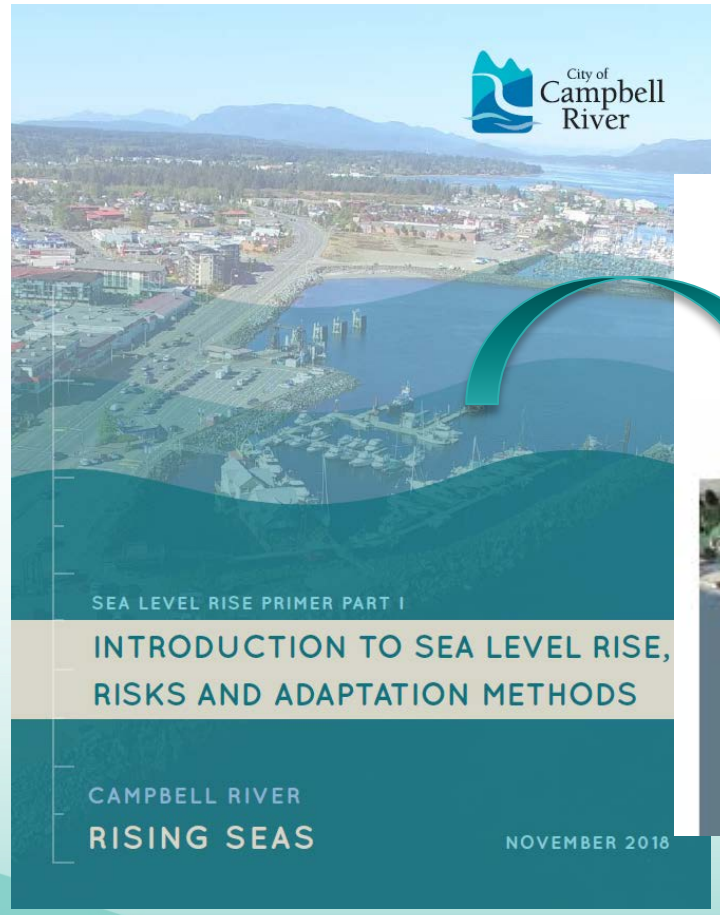
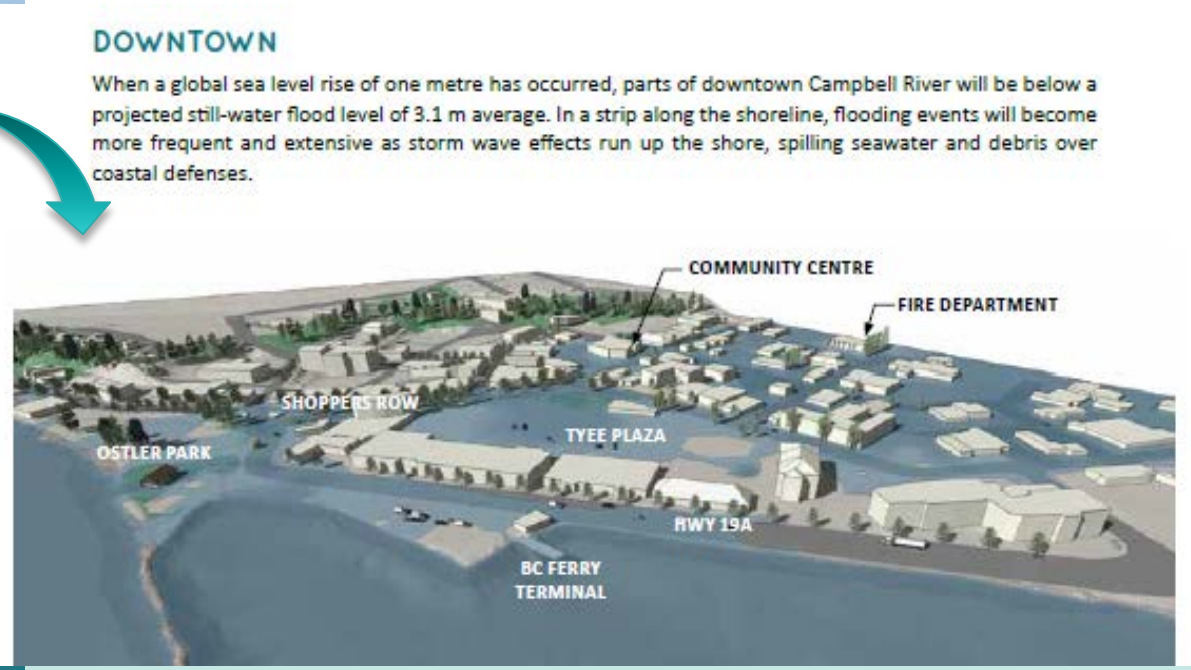
# Public Engagement: Events & Primers

- November 2018: Introduction to SLR (Primers I & II)

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# Public Engagement: Events & Primers

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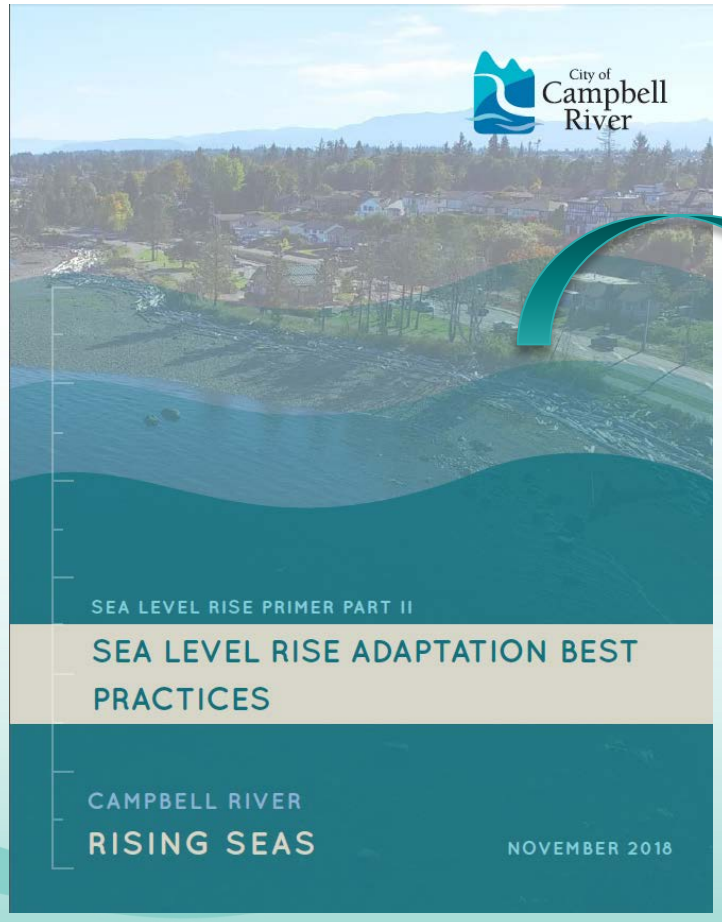


| ADAPTIVE STRATEGY | SCALE | BENEFITS/LIMITS |
|---|---|---|
| Beach Nourishment | Neighbourhood / reach | • Expands the usable beach area, allowing for increased public access and use<br>• Reduces wave runup and wave effect elevations at natural boundary |
| Living Shorelines | Neighbourhood / reach | • Provides increased complexity of intertidal habitat and coastal vegetation<br>• May help improve water quality<br>• Provides educational opportunities<br>• Must be sheltered from erosion |
| Dikes | Neighbourhood / reach | • Will resist storm waves when surface is properly armoured<br>• Land on top of dikes can be used for paths or roads<br>• May block views of the sea |
| Groynes | Neighbourhood / reach | • Can extend lifespan of beach nourishment projects<br>• Wide range of construction methods and materials<br>• Inconvenience to walking along the shore<br>• Can increase beach erosion |
| | | • Can create marine habitat<br>• Provide recreational opportunities |

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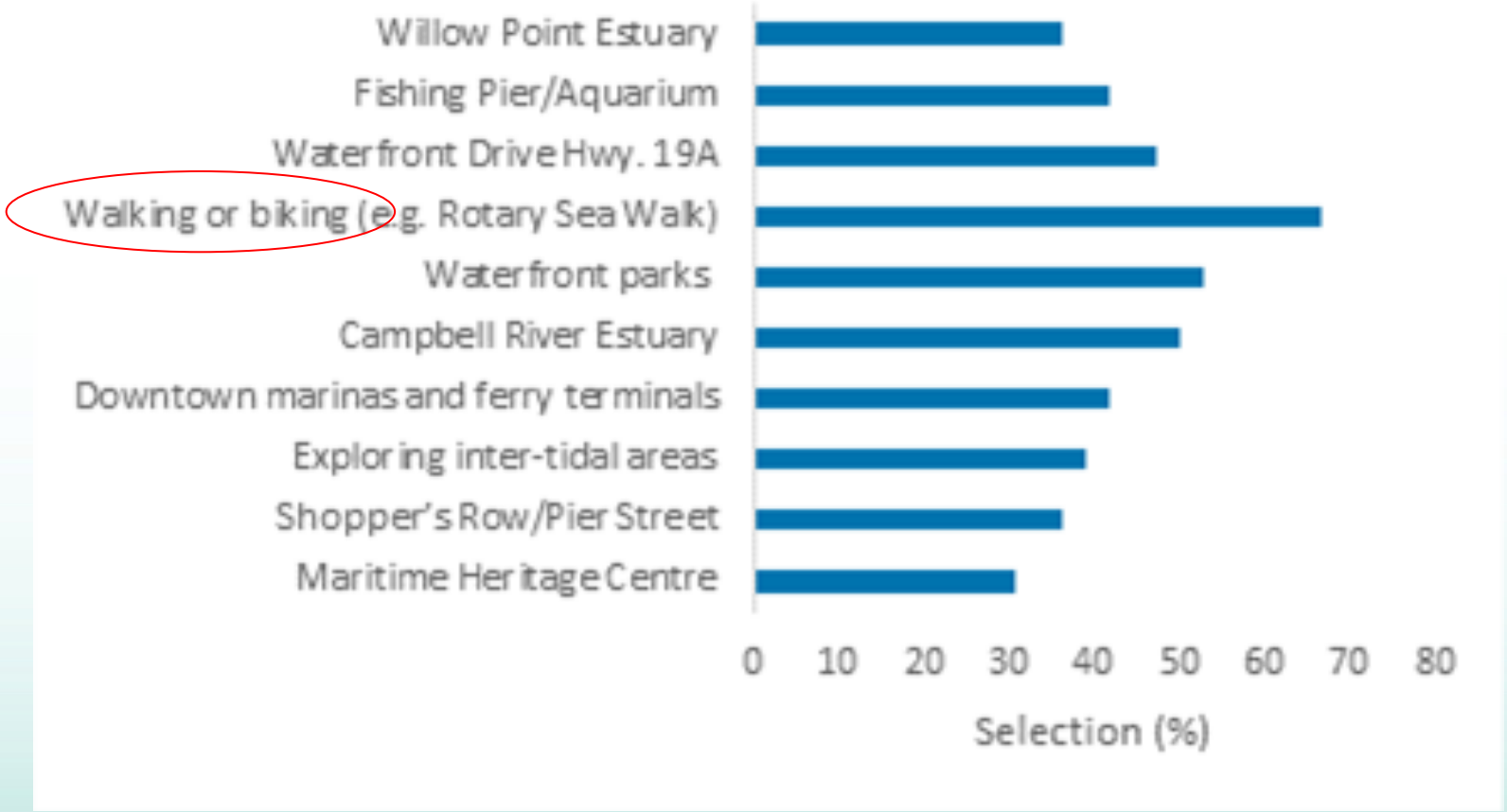
# Waterfront Values

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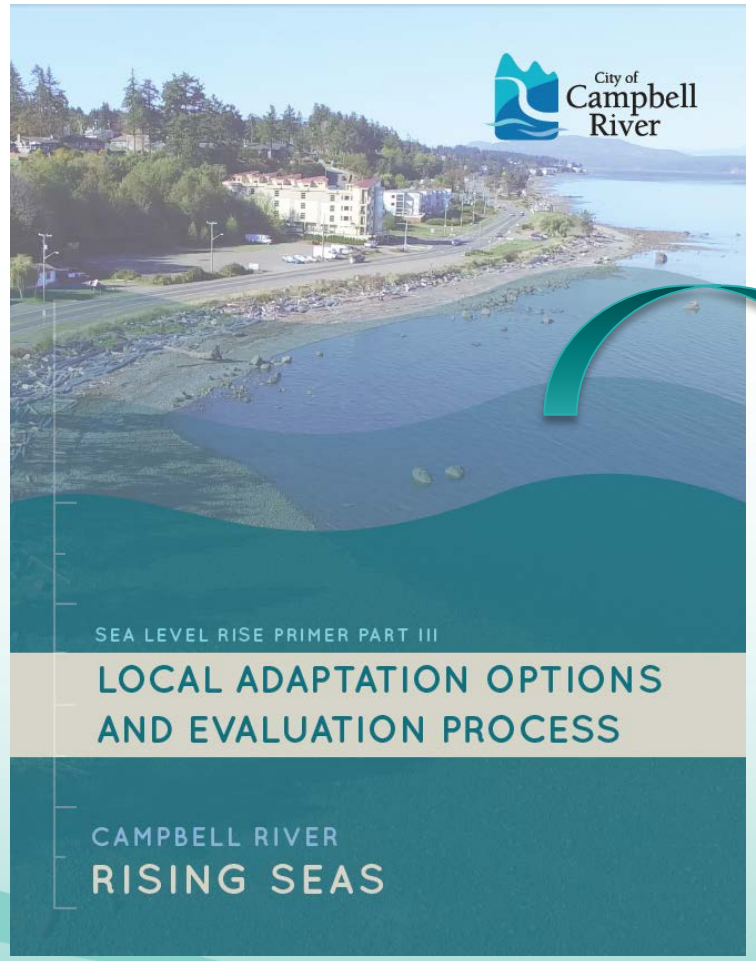
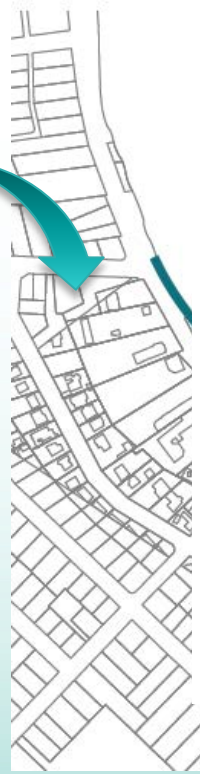
# Public Engagement: Events & Primers

- March 2019: Potential Approaches (Primer III)



OPTIONS EVALUATION

| | Baseline<br>No Adaptation | Option A<br>Parcel Scale Minimum Intervention | Option B<br>Neighbourhood Scale Extensive Intervention | Option C<br>Balanced Intervention / Neighbourhood Priorities |
|---|---|---|---|---|
| **VALUES CRITERIA** | | | | |
| **People**<br>Highest # Protected | Far Worse | Slightly Better | Far Better | Far Better |
| **Economy**<br>Sustained jobs and tax base | Far Worse | No Change | Slightly Better | Slightly Better |
| **Environment**<br>Sustained/improved long term | Far Worse | Moderately Worse | Moderately Better | Moderately Better |
| **Recreation/Culture**<br>Views / access / shoreline | Far Worse | Moderately Worse | Moderately Better | Slightly Better |
| **Infrastructure**<br>Road / emergency / utility function | Far Worse | No Change | No Change | No Change |
| **IMPACT AND RISK OF FAILURE** | | | | |
| **Overall Risk** | Very High | Moderate | Low | Moderate |
| **COST CRITERIA** | | | | |
| **Capital Cost to Taxpayers** | N/A | $ | $$$$ | $$$ |
| **CR Operations and Maintenance Effort** | N/A | $$$ | $$$$ | $$$$ |

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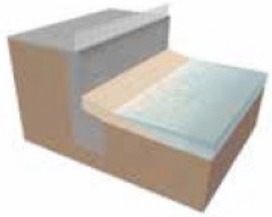
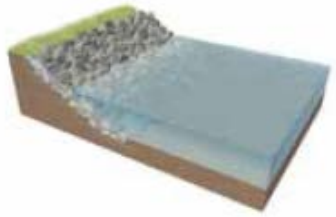
# Nature Based Infrastructure

Seawalls

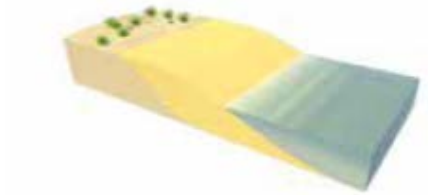


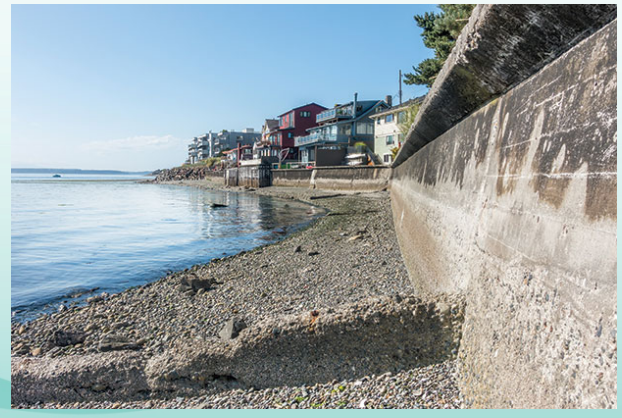
Living Shorelines

Rock armouring



Beach Nourishment





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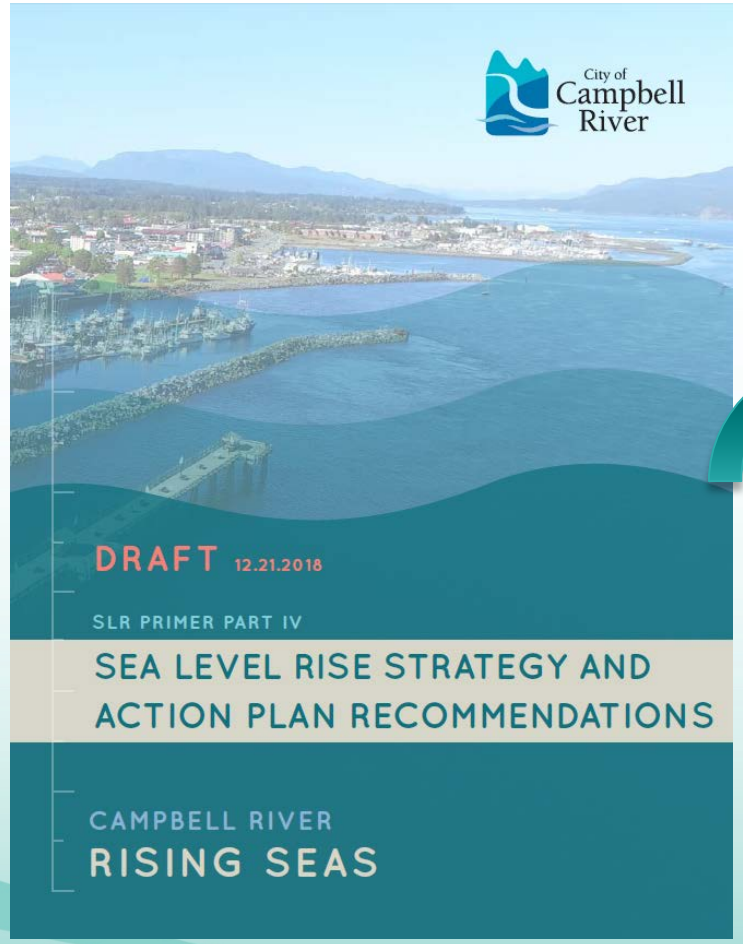
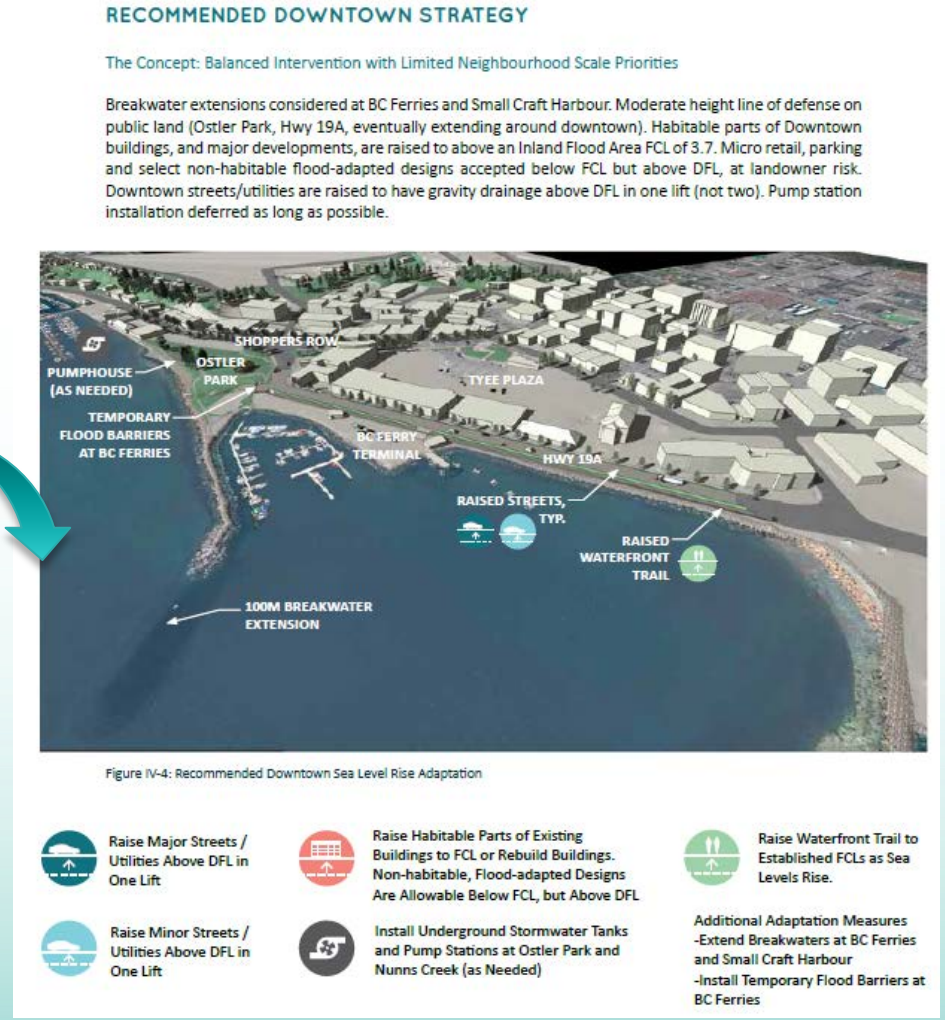
# Public Engagement: Events & Primers

- May 2019: Potential Approaches (Primer IV)

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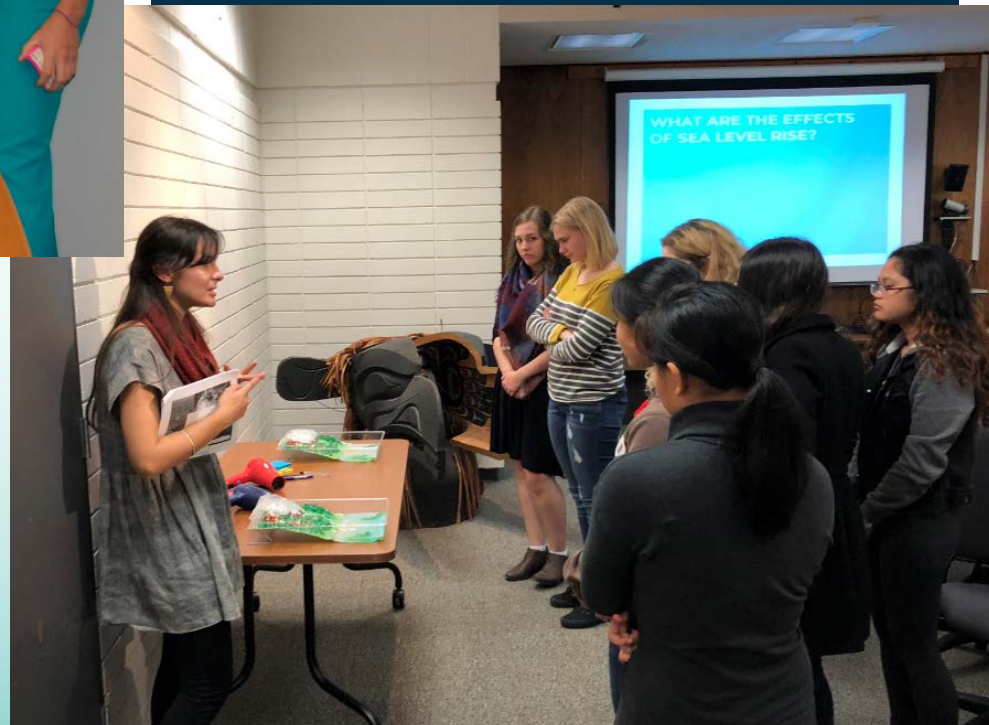
# Outreach – Prioritize Youth


**Grade School Presentations**

**City's Youth Action Committee**

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# Outreach – Education


Vancouver Island University
Master in Community Planning program

Vancouver Island University
Public Info Session: Climate Change

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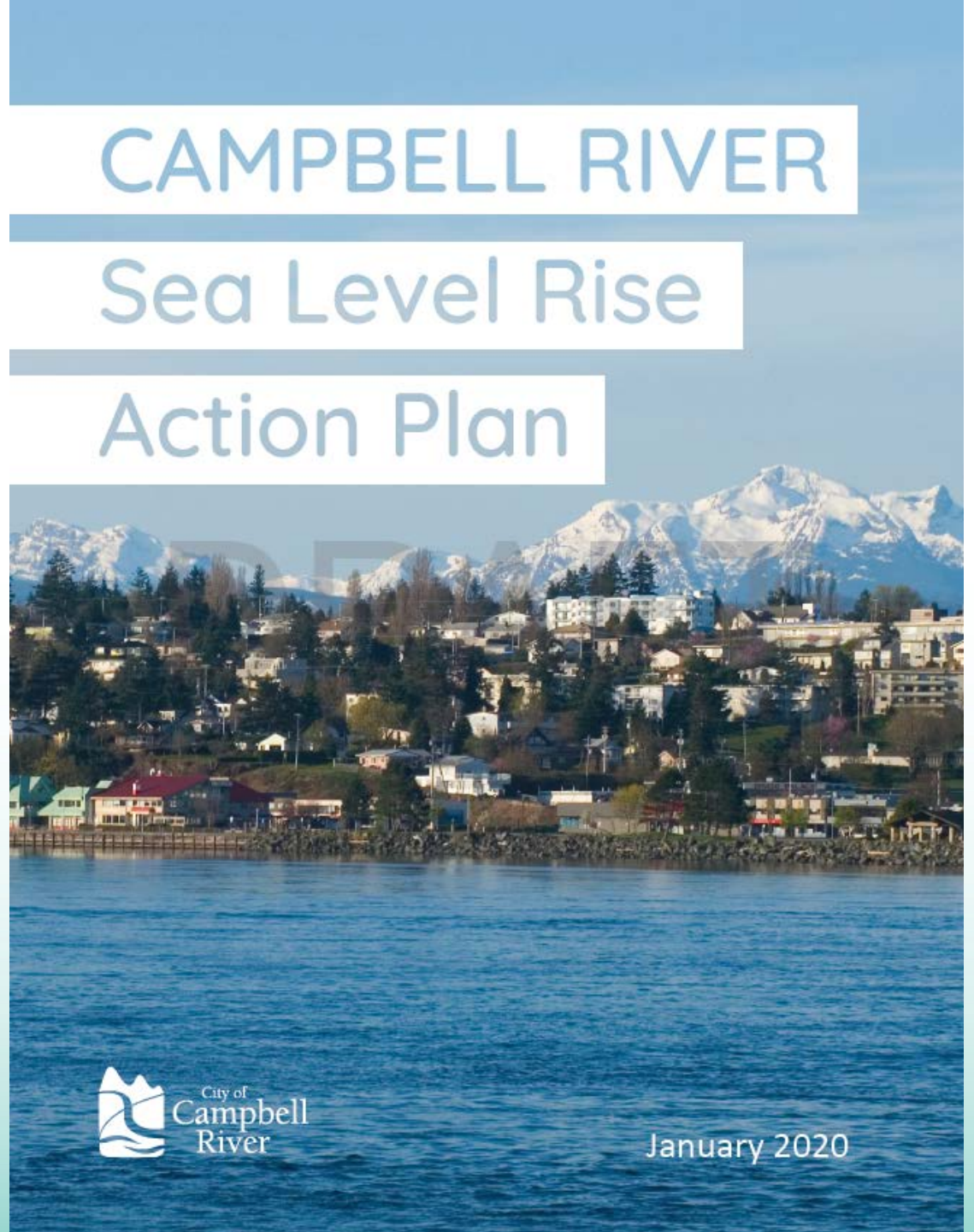
# Implementation

**Adopted by Council**
**Feb 2020**

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# What's in the City SLR Strategy?

- Recommended approaches by geog. area
- Adopt Flood Management Bylaw
- Adopt Marine Flooding DP Area
- Property Acquisition, Asset Management
- Capital Works & Financing
- Parks Plans, MTP, etc.
- Monitoring & Review

→ What we WILL do

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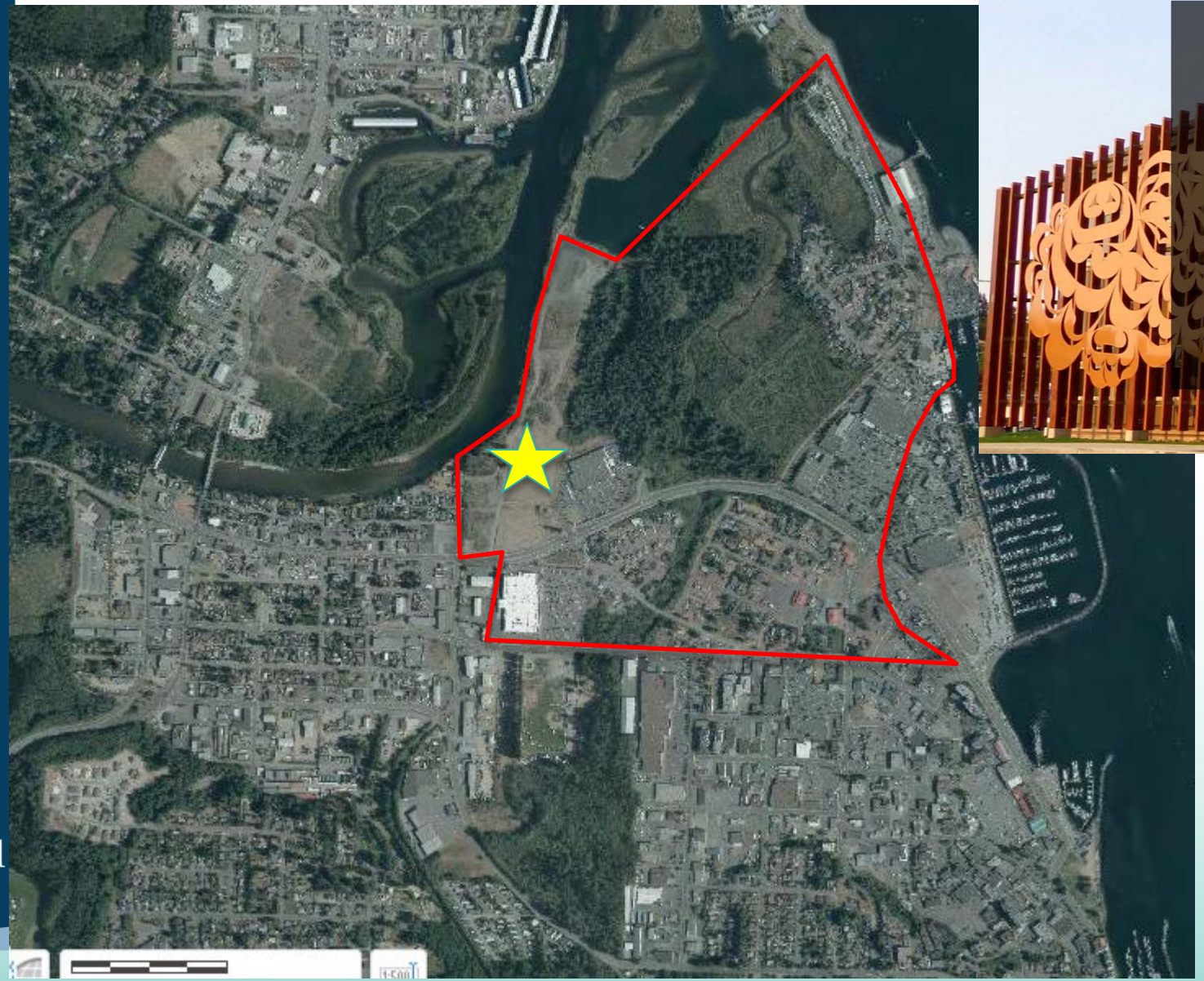
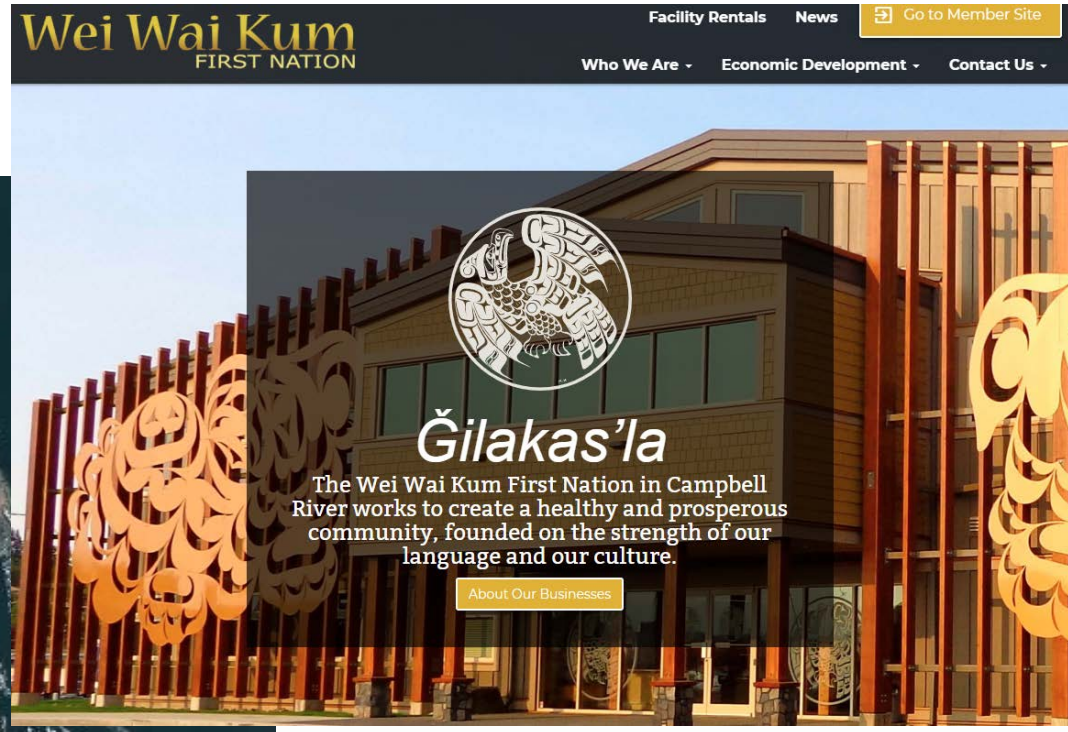
# Rollout 2020:



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# Rollout 2020:

*Regulation!*

*…coming soon!...*

*…to a bureaucracy near you*

*Flood bylaw: sets minimum elevations*

*Development permit area: horizontal setbacks and site design*

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# Sea Level Rise
# ROLE OF MULTIMEDIA
# in
# ENGAGEMENT

---


David Reid, BLA, BCSLA, FCSLA

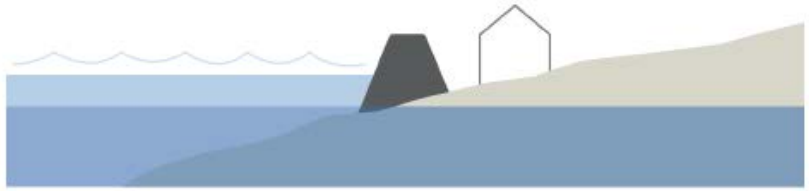
Principal, Landscape Architect

Lanarc 2015 Consultants Ltd.


City of Campbell River

nhc LANARC

# TYPICAL APPROACHES TO ADAPTATION

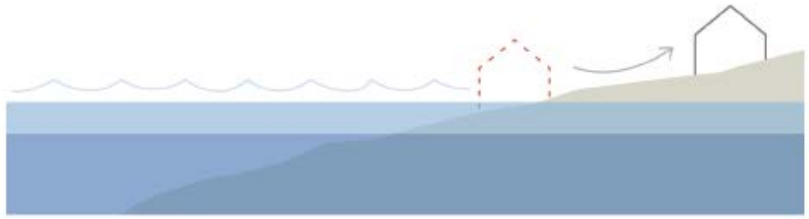


**PROTECT**

Construct barriers against flood waters.

**ACCOMMODATE**

Modify human activities, buildings, and infrastructure to accommodate increased flooding.



**RETREAT / RE-ALIGN**

Relocate people and infrastructure within the floodplain over time.

**AVOID**

Limit development within the floodplain through planning.

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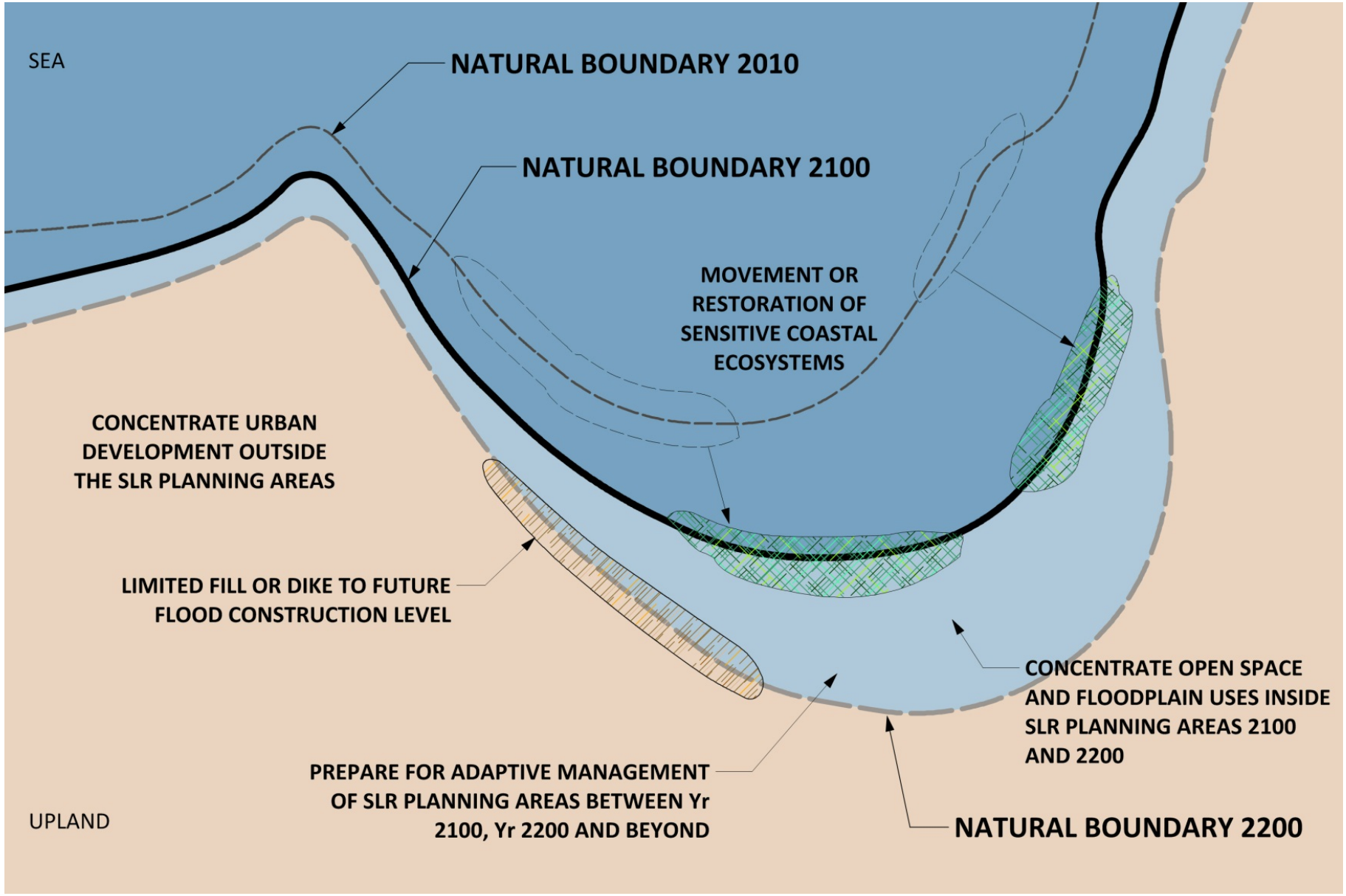
# WHEREVER POSSIBLE, AVOID




Conceptual Site Diagrams to Communicate Principles

# MULTIPLE MULTIMEDIA TECHNIQUES FOR ENGAGEMENT:

## INTERNAL WORKSHOPS; EXTERNAL SMALL GROUP WORKSHOPS; COMMUNITY VALUES TO CHOOSE OPTIONS AND PRIORITIES

STEP 1: Please sit at a table together in groups of 5-8 participants

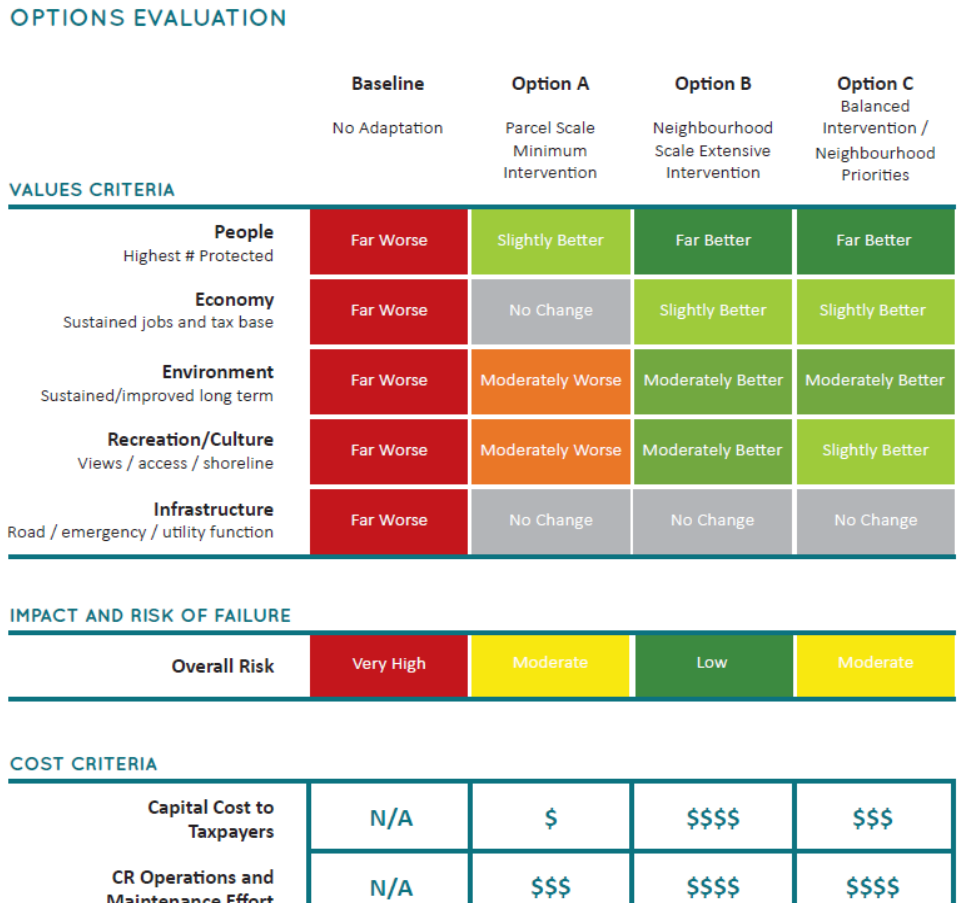
STEP 2: Choose one individual as a facilitator for the group.

STEP 3: Choose a second individual to be the group reporter.

STEP 4: Using the feedback form, complete Sections 3 & 4 as a group.

STEP 5: At the end, your reporter will share with the larger group:

- TOP 3 things group members strongly agreed upon.
- TOP 3 things group members had a lack of agreement.



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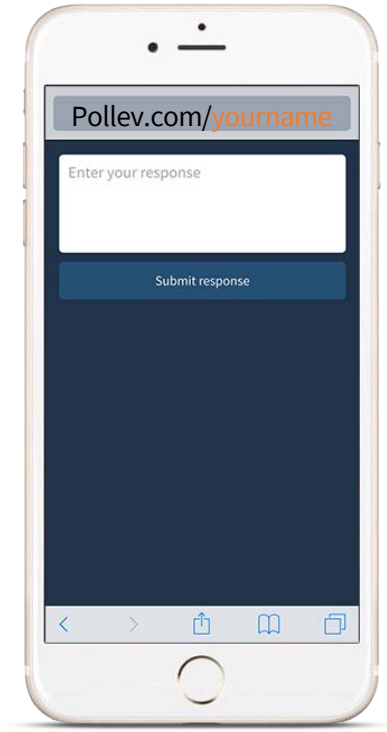
|---|---|---|---|---|
| **VALUES CRITERIA** | | | | |
| **People**<br>Highest # Protected | Far Worse | Slightly Better | Far Better | Far Better |
| **Economy**<br>Sustained jobs and tax base | Far Worse | No Change | Slightly Better | Slightly Better |
| **Environment**<br>Sustained/improved long term | Far Worse | Moderately Worse | Moderately Better | Moderately Better |
| **Recreation/Culture**<br>Views / access / shoreline | Far Worse | Moderately Worse | Moderately Better | Slightly Better |
| **Infrastructure**<br>Road / emergency / utility function | Far Worse | No Change | No Change | No Change |
| **IMPACT AND RISK OF FAILURE** | | | | |
| **Overall Risk** | Very High | Moderate | Low | Moderate |
| **COST CRITERIA** | | | | |
| **Capital Cost to Taxpayers** | N/A | $ | $$$$ | $$$ |
| **CR Operations and Maintenance Effort** | N/A | $$$ | $$$$ | $$$$ |

City of Campbell River

nhc LANARC

# Responding with Poll Everywhere




Web voting

City of Campbell River

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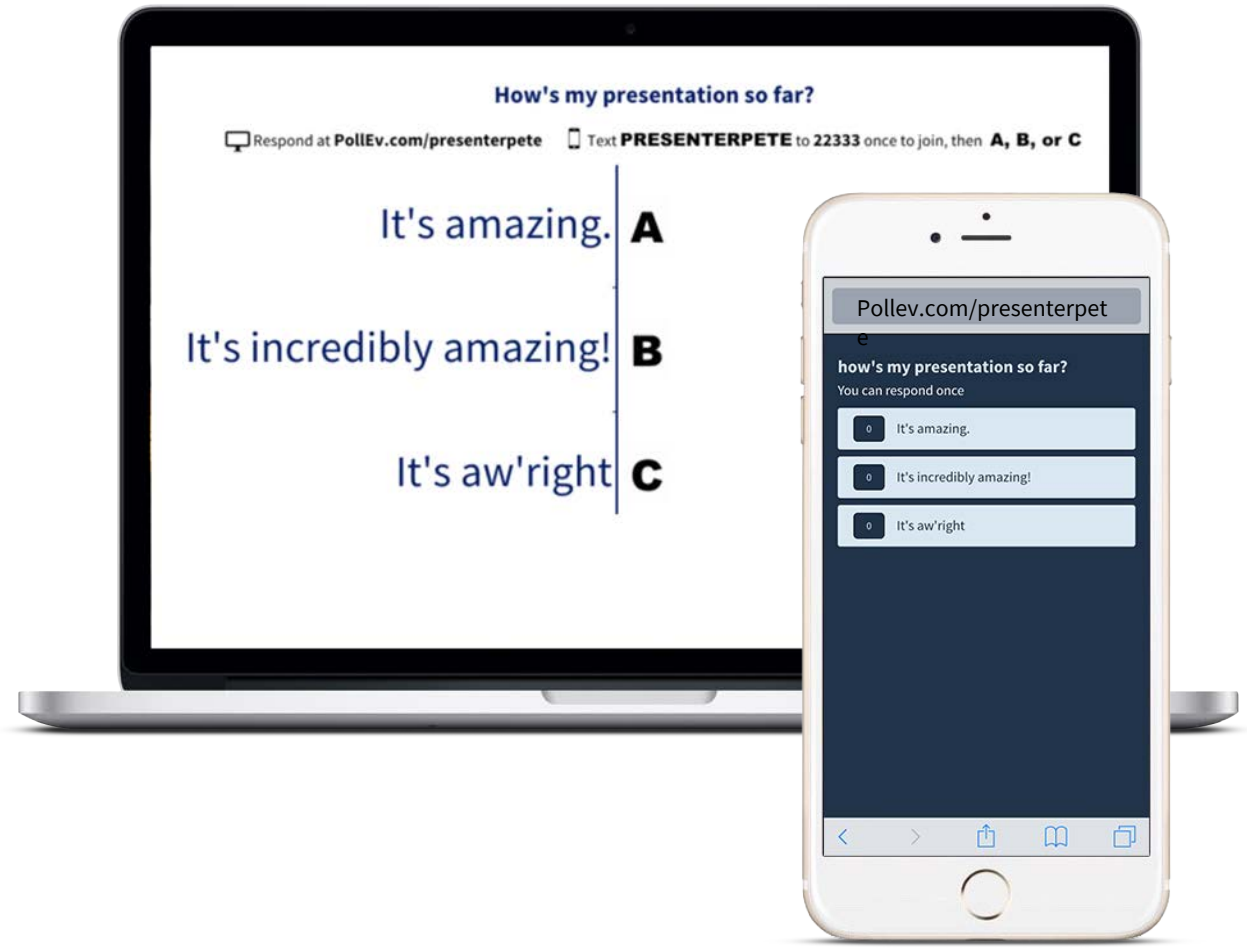


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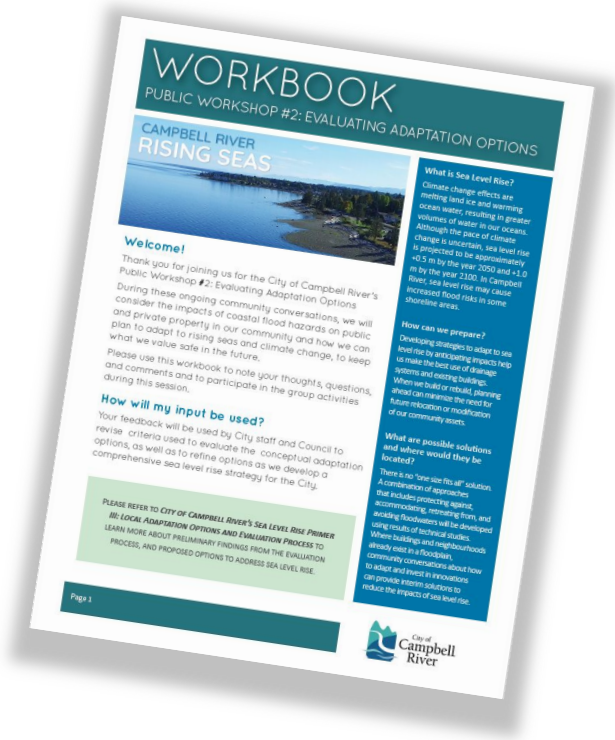
# PRINT STILL HAS A ROLE: PRIMER & WORKBOOK EXAMPLES

**Please complete the individual sections of your workbook and hand it in to the Planning Team at the end of this session.**

**If you need more time, you can provide your responses online by date:**

**www.campbellriver.ca/rising-seas**

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# WHY USE VIDEO?

Still images represent only a static condition, or snapshot.  They do not communicate motion or processes well.

ANIMATION would be useful to:

- Communicate that flooding is an ephemeral event that can last for a short duration but with significant consequences.


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FLOOD SEQUENCE TO 3.1M ELEVATION (UNMITIGATED)


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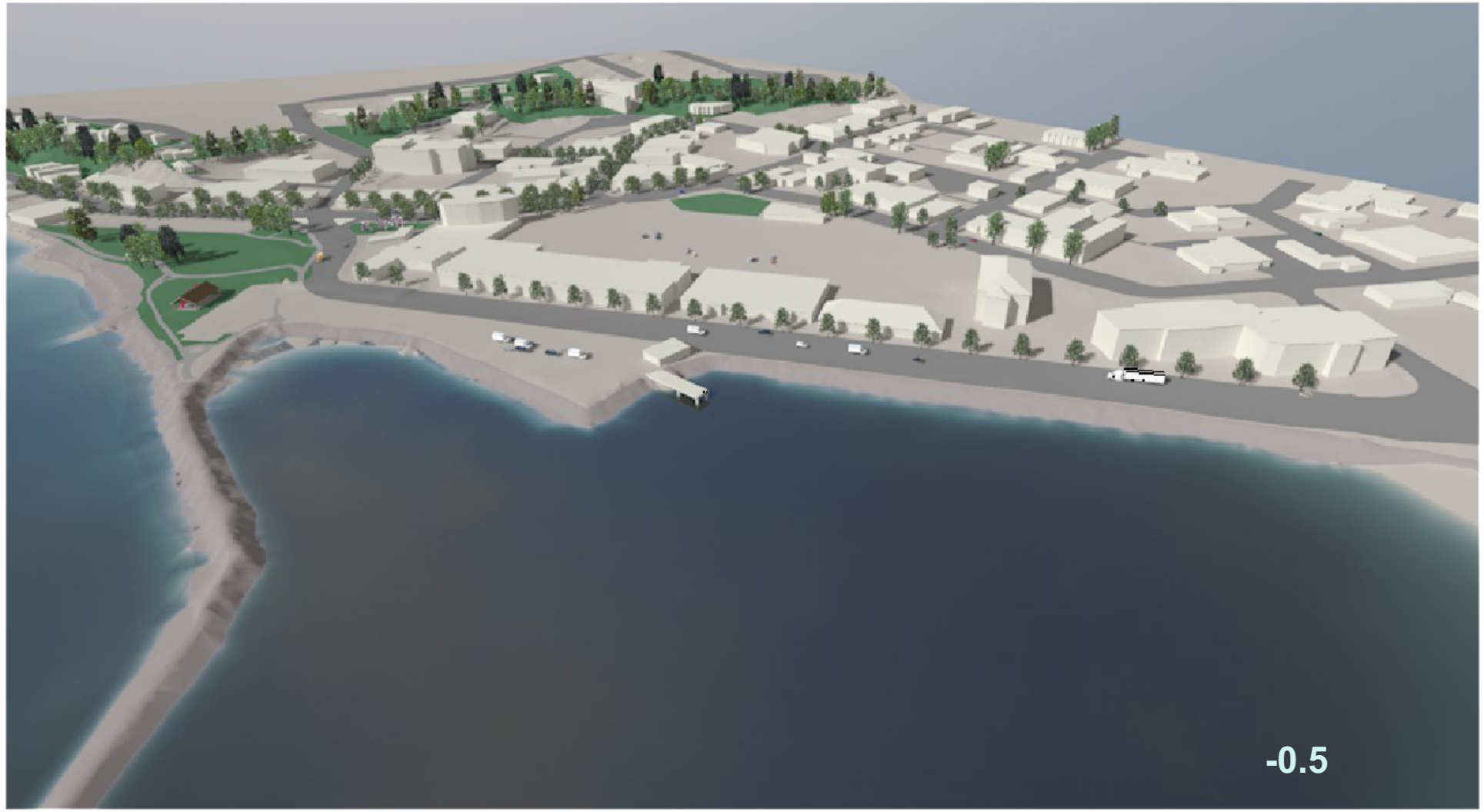


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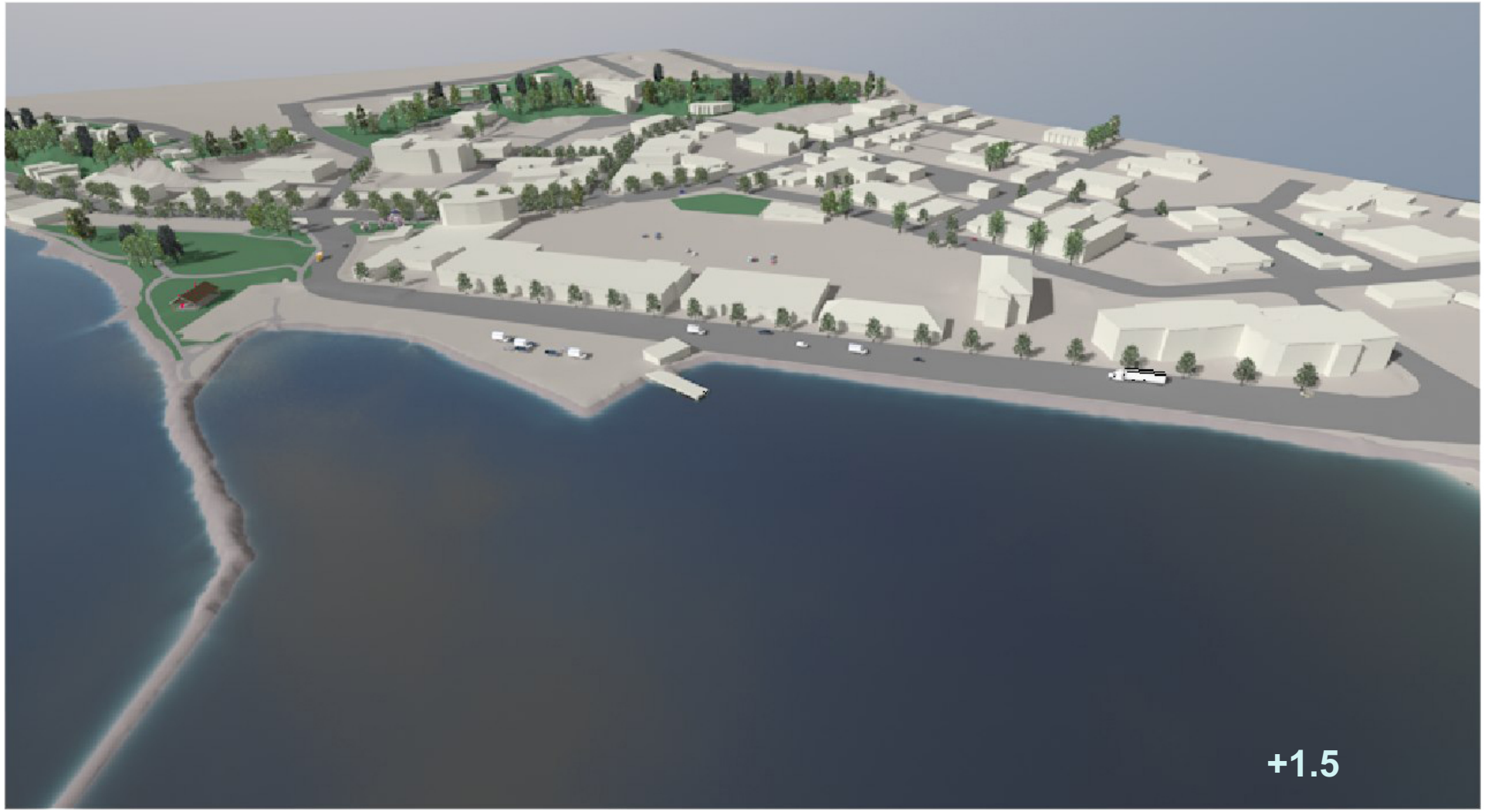


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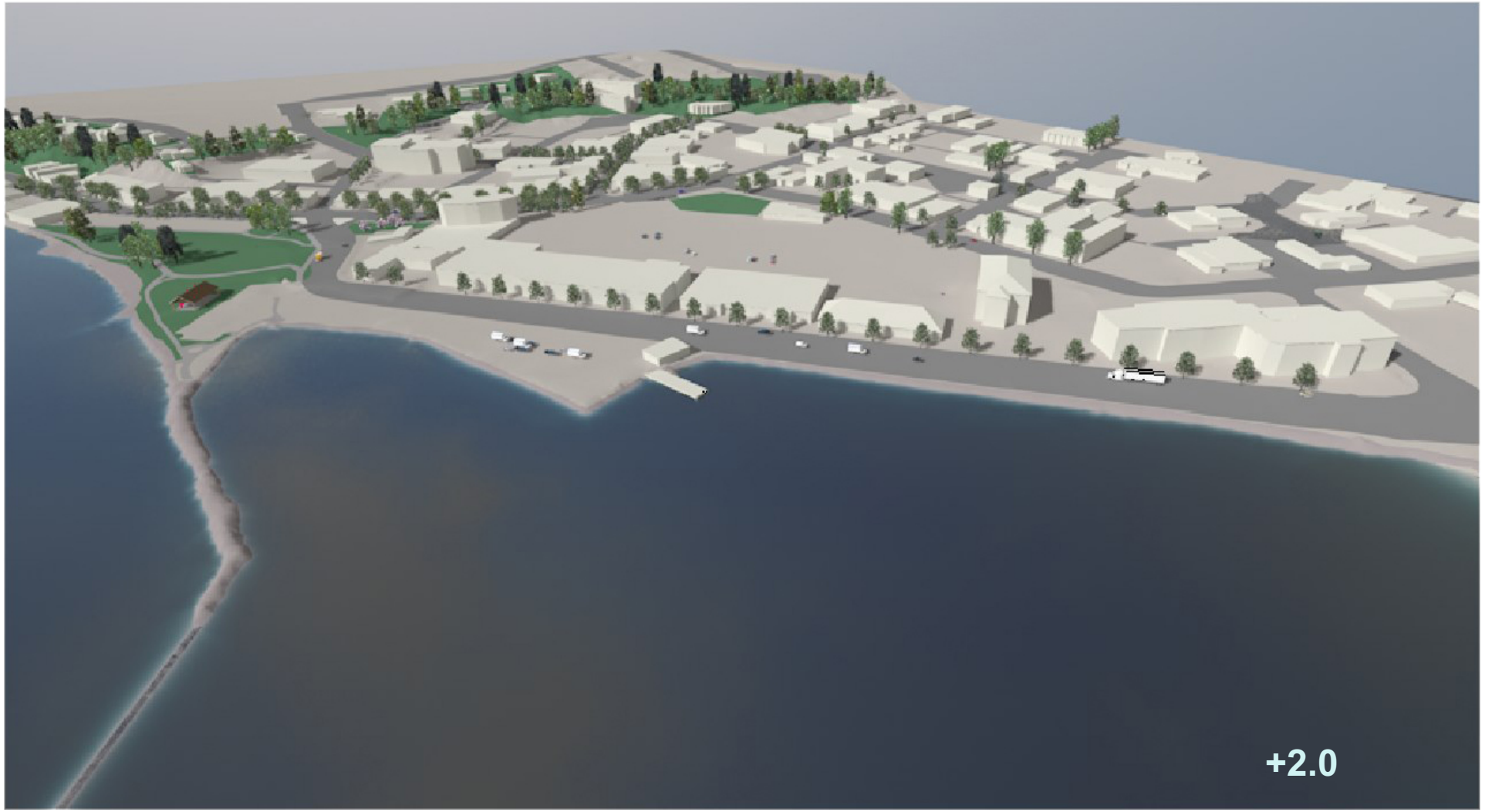


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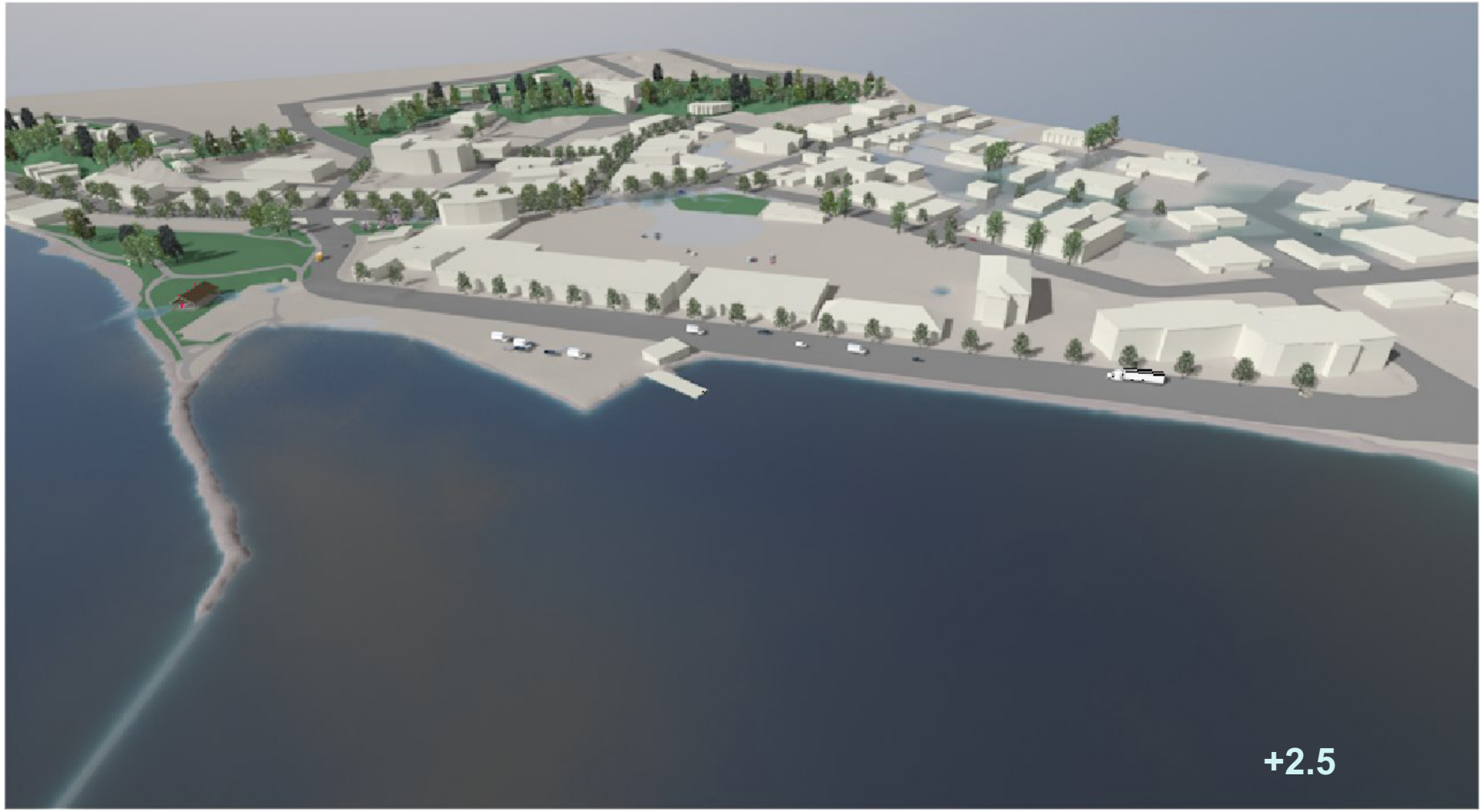


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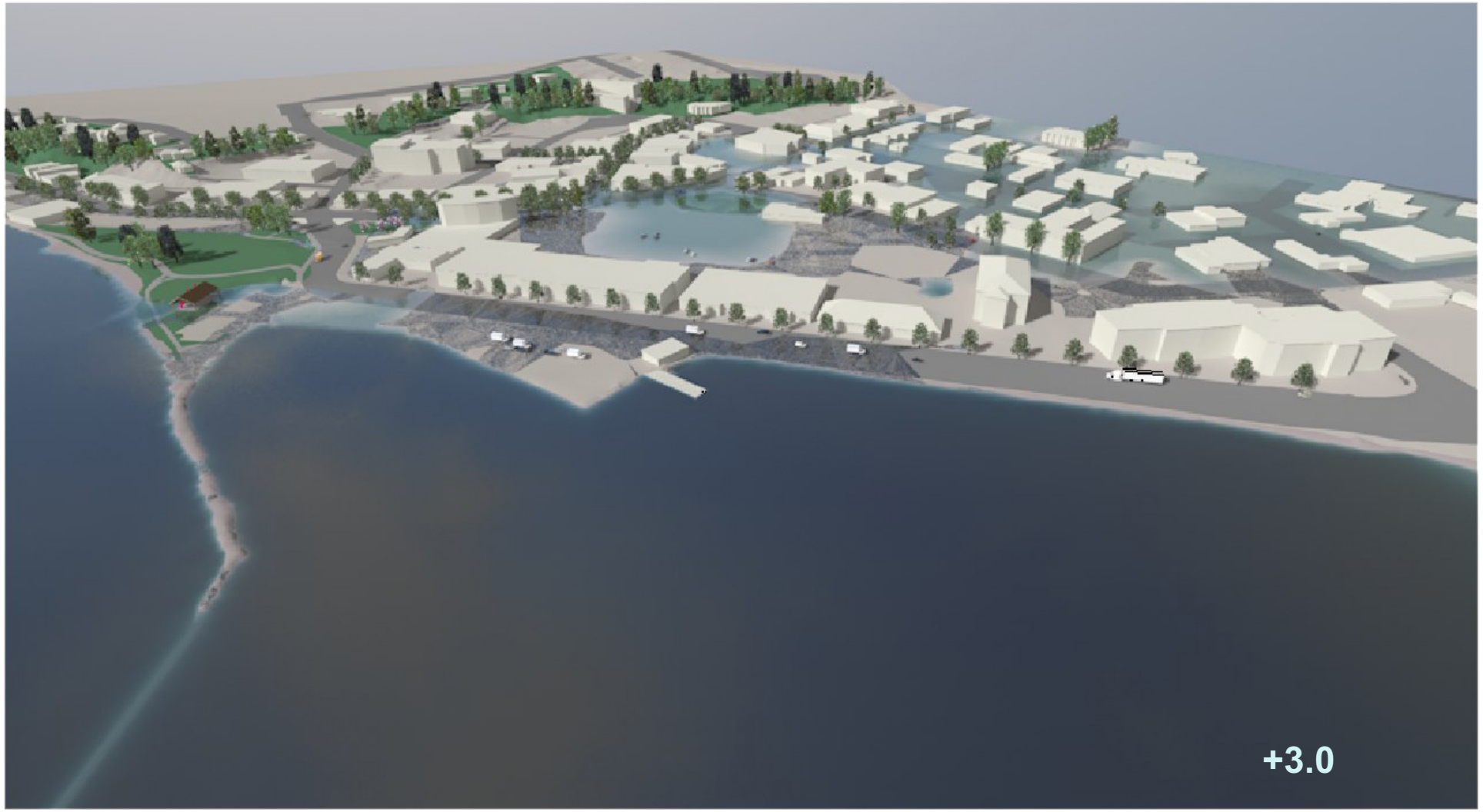


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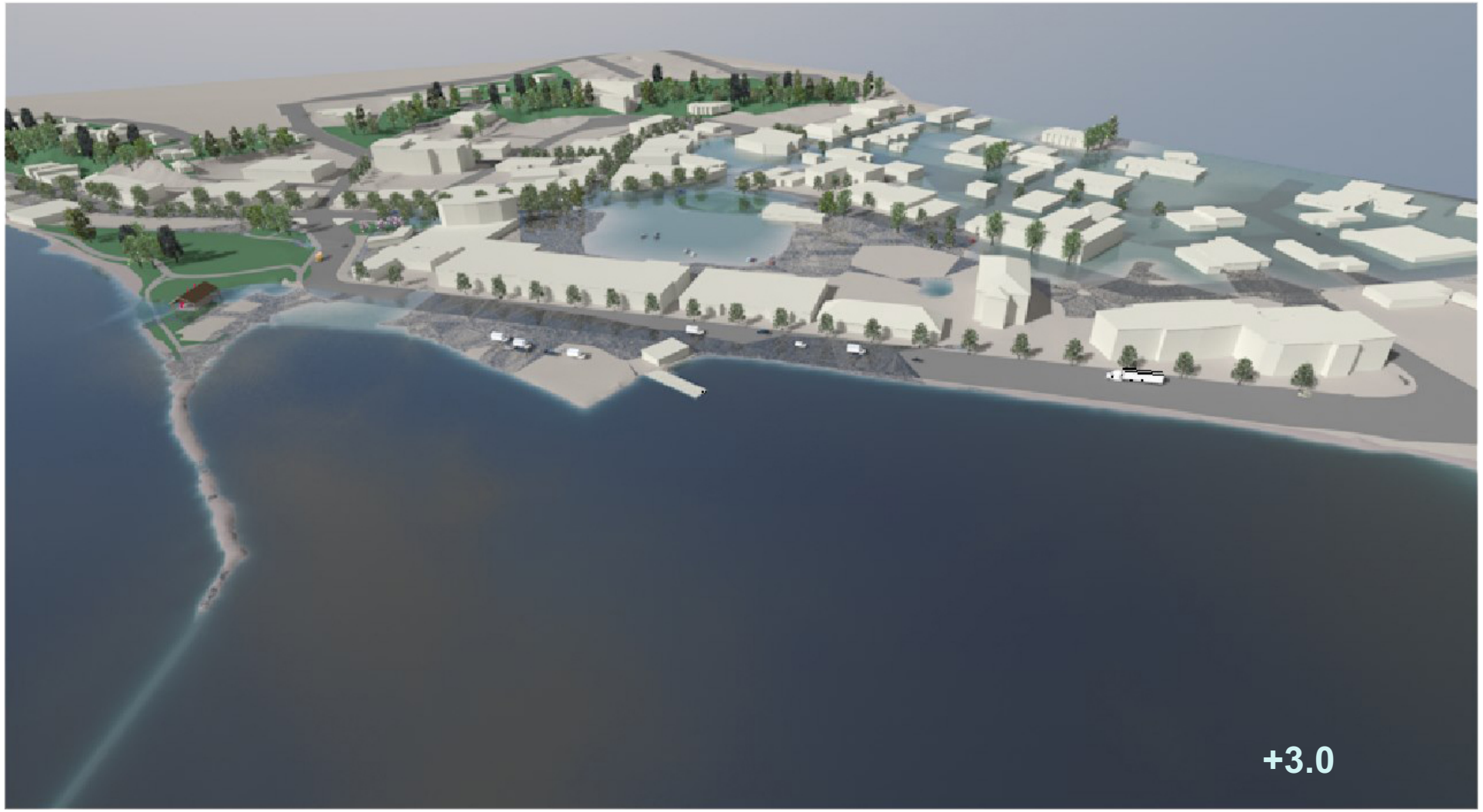


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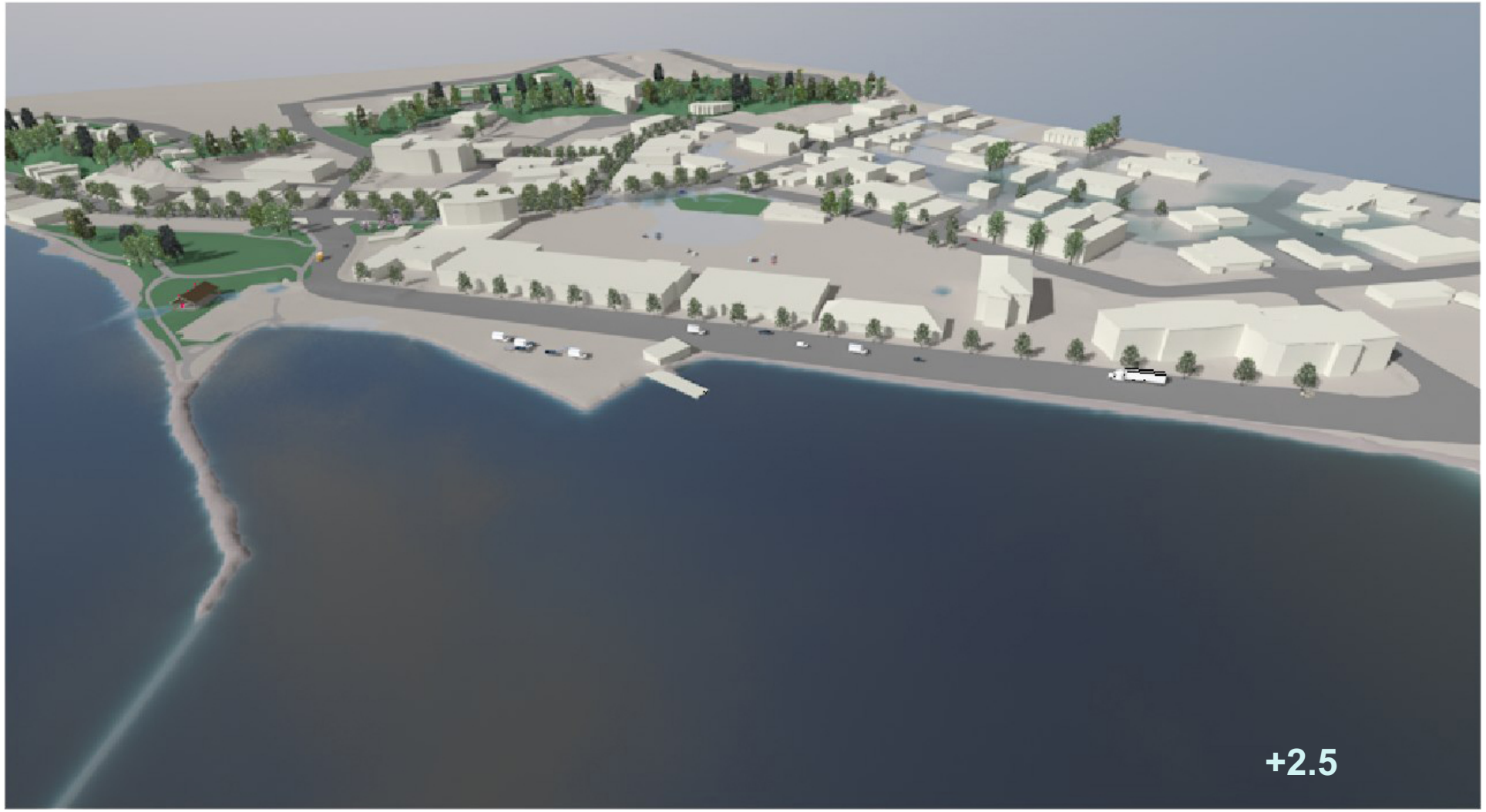


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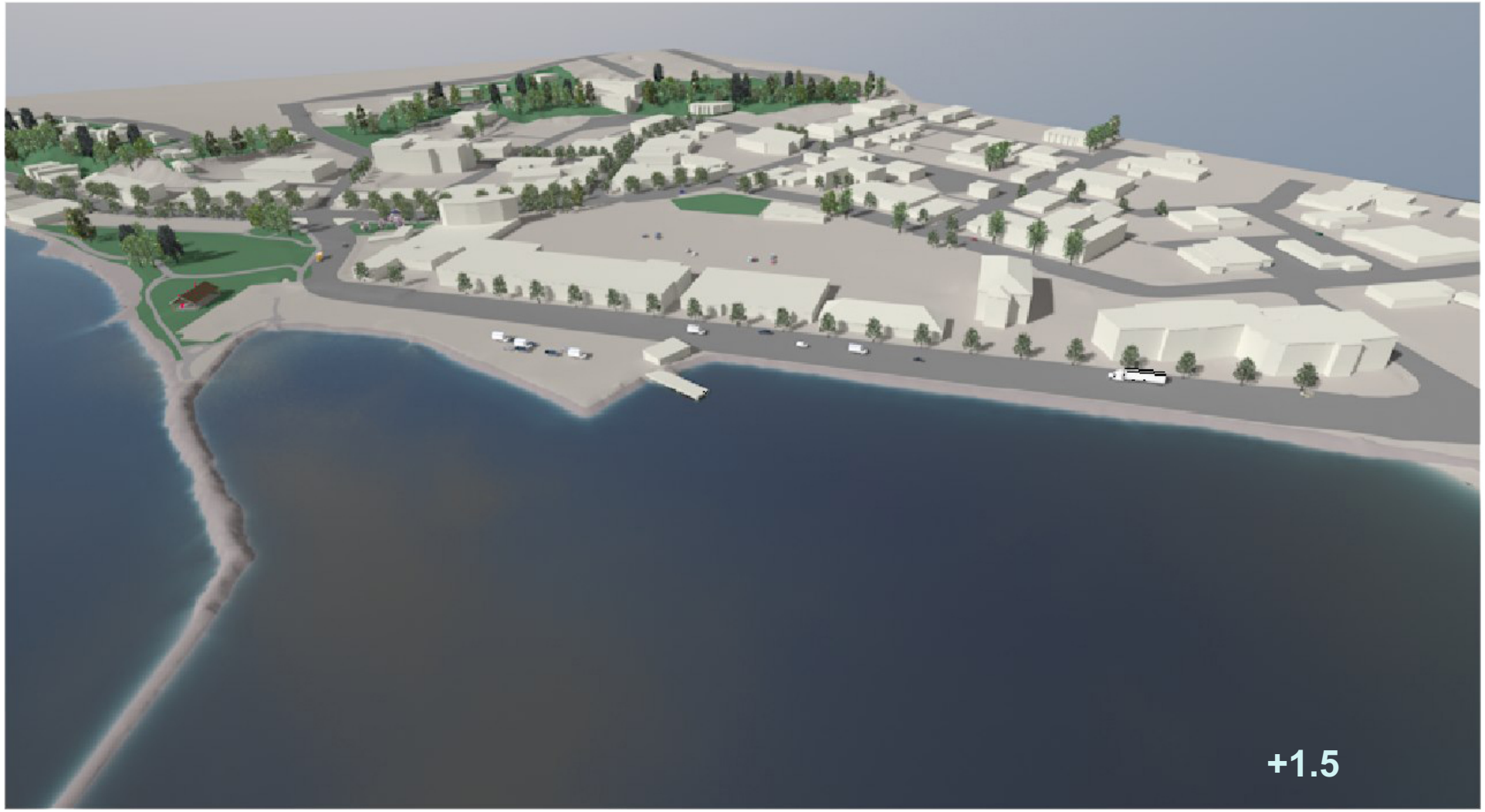


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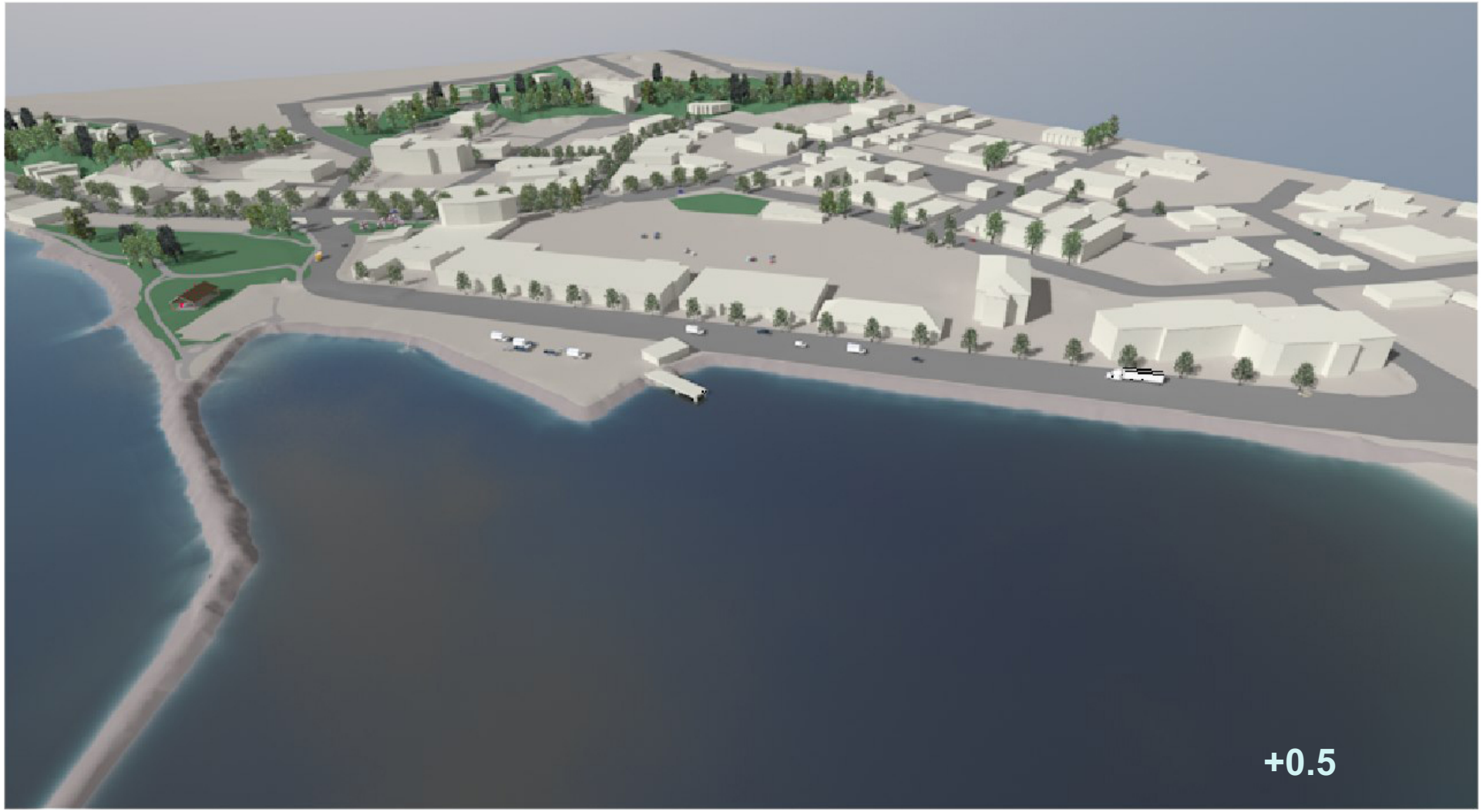


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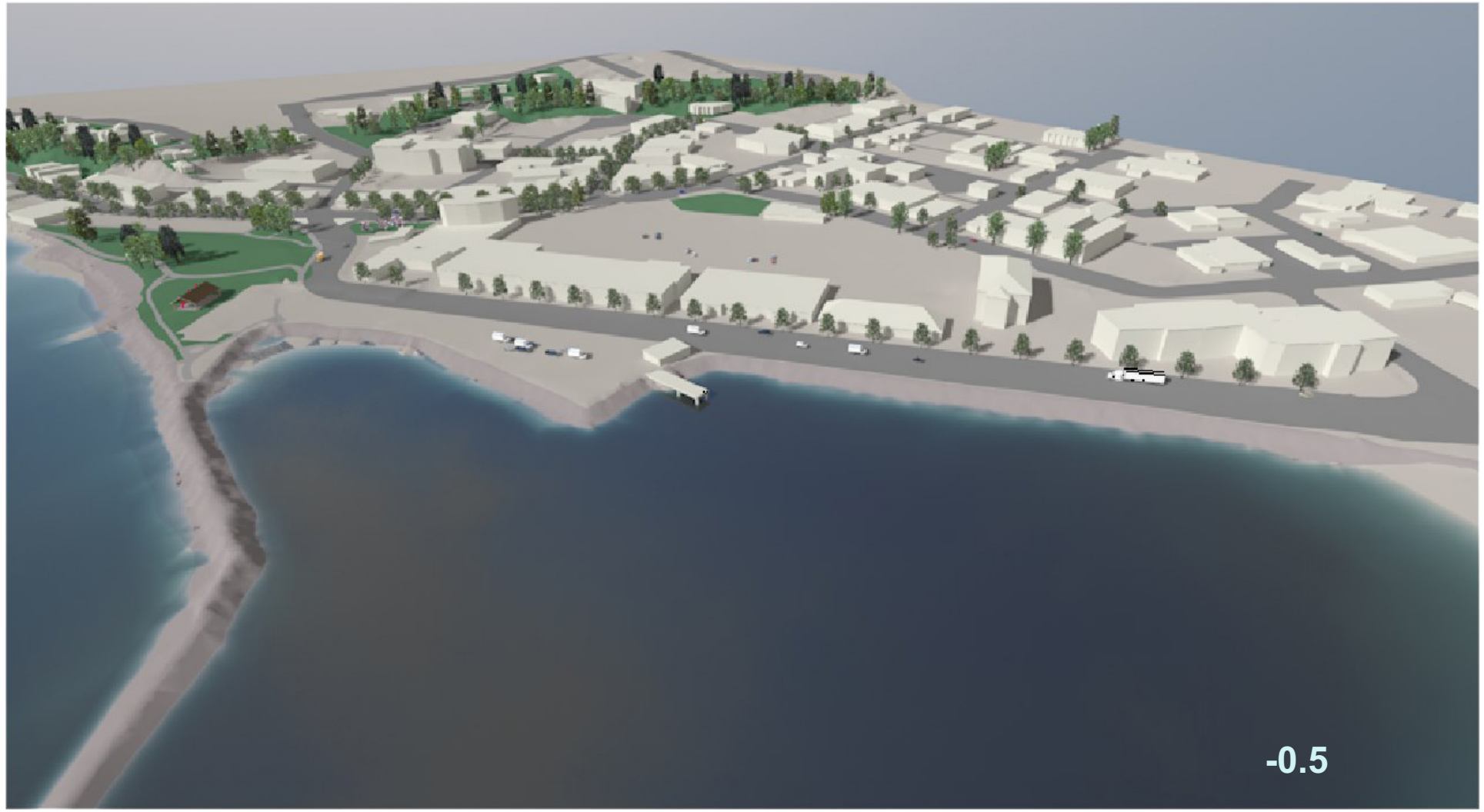


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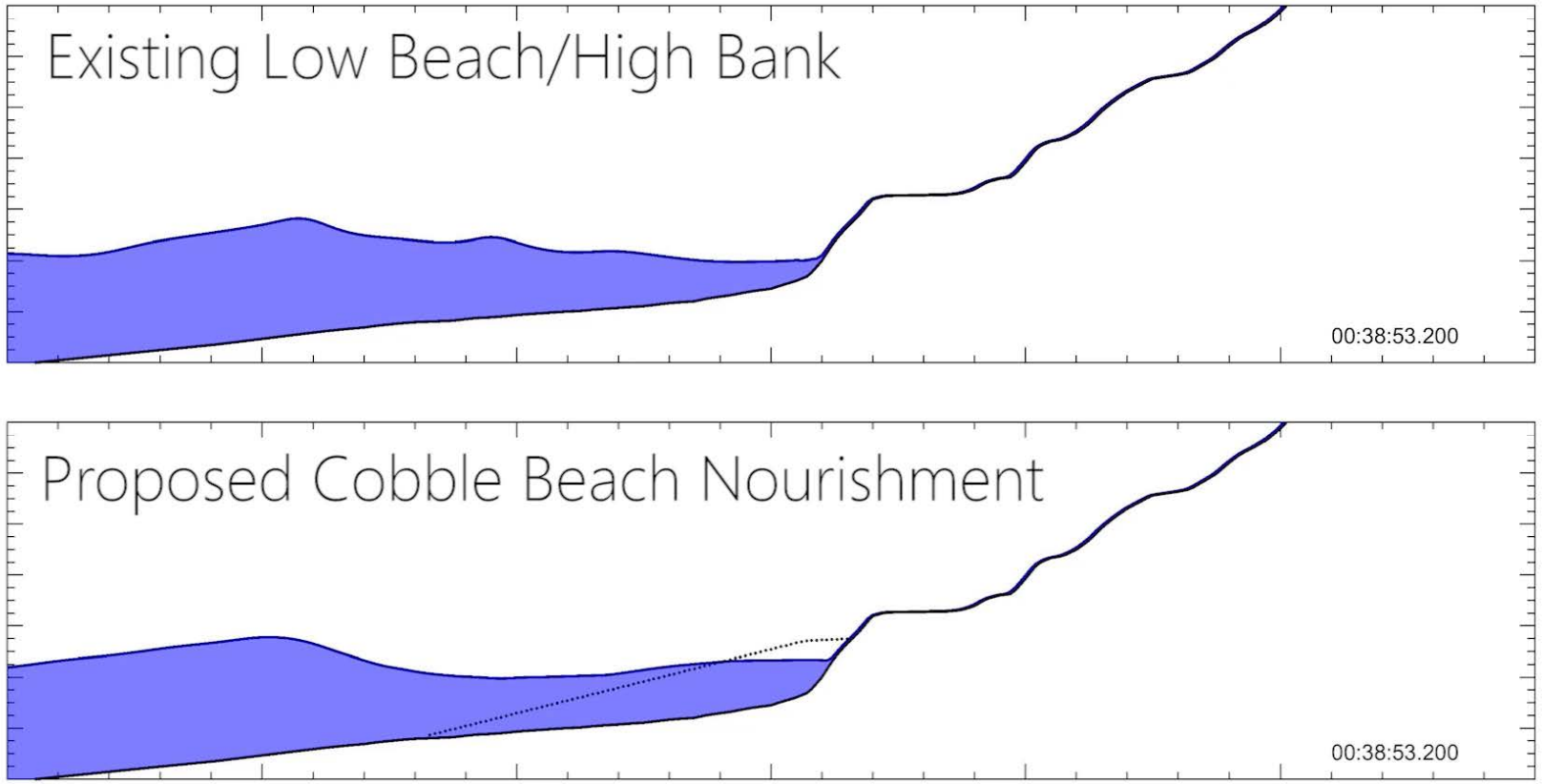
# WHY USE VIDEO?




## PAINTER BARCLAY GROYNE / BEACH NOURISHMENT ANIMATION EXAMPLES

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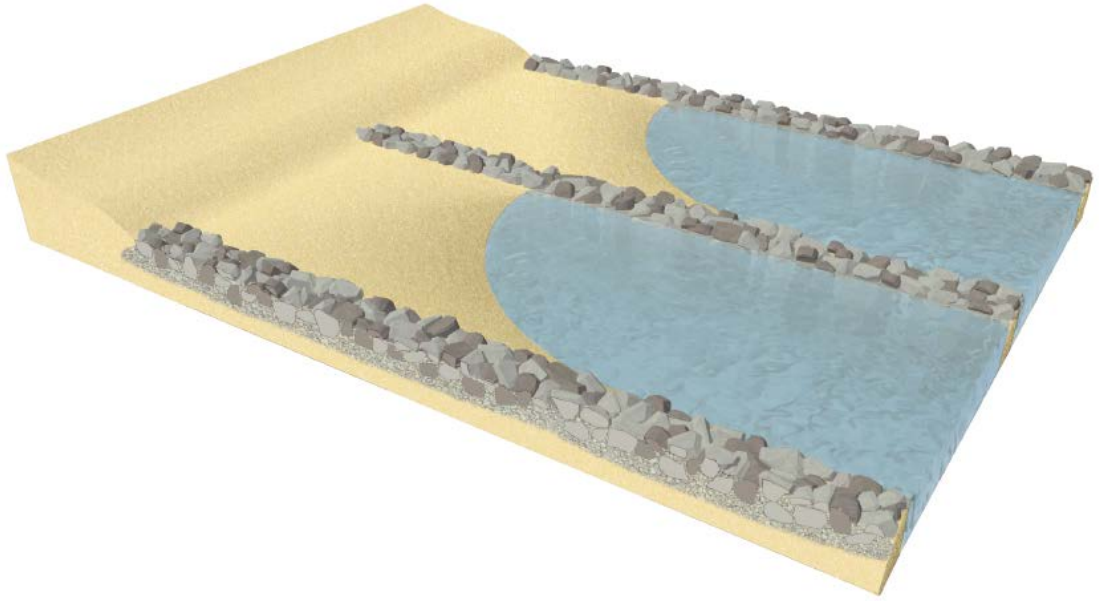
nhc LANARC

# WHY USE VIDEO?

Pictures communicate – but without interaction of waves and shore design



**Ability to Address Coastal Hazards**

| | | |
|---|---|---|
| Event Based | Storm Surge (High) | ○ |
| | Storm Surge (Low) | ○ |
| | Wave Force | ◐ |
| | Sudden Erosion | ◐ |
| Gradual | Flooding Due to Sea Level Rise | ○ |
| | Gradual Erosion | ● |

**Applicability to Landscape Type**

| | |
|---|---|
| Oceanfront Beaches | ● |
| Coastal Marshes | ○ |
| Oceanfront Slopes | ○ |
| Sheltered Bay Slopes | ○ |
| Hardened Sheltered Bay Slopes | ○ |
| Sheltered Bluffs | ◐ |
| Hardened Sheltered Bluffs | ○ |

● HIGH ◐ MEDIUM ○ LOW

# REACH-BASED ADAPTATIONS: GROYNES

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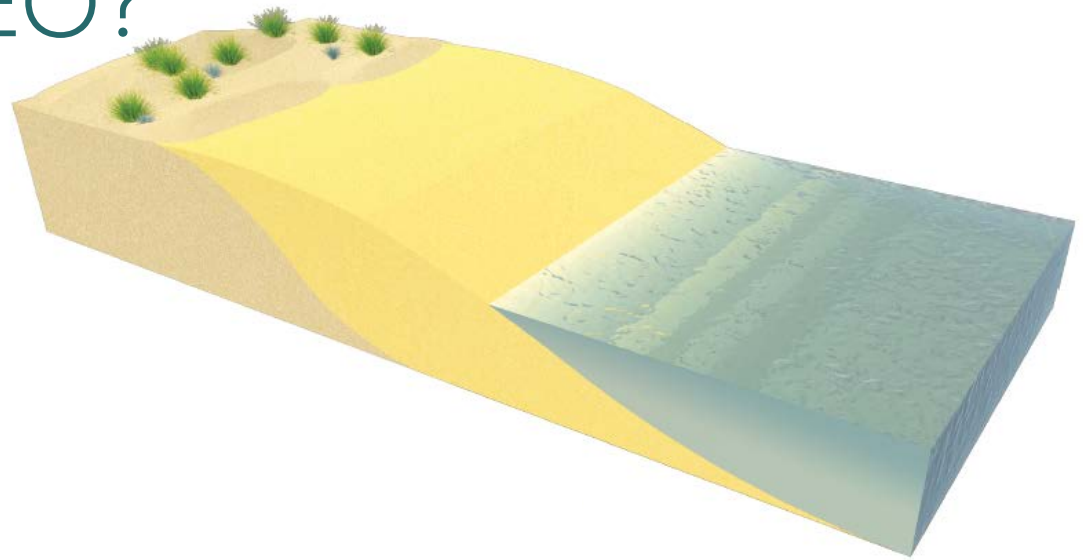
# WHY USE VIDEO?

Pictures communicate – but without showing how waves dissipate on shallow slopes



**Ability to Address Coastal Hazards**

| | | |
|---|---|---|
| Event Based | Storm Surge (High) | ● |
| | Storm Surge (Low) | ● |
| | Wave Force | ● |
| | Sudden Erosion | ◐ |
| Gradual | Flooding Due to Sea Level Rise | ● |
| | Gradual Erosion | ◐ |

**Applicability to Landscape Type**

| | |
|---|---|
| Oceanfront Beaches | ● |
| Coastal Marshes | ○ |
| Oceanfront Slopes | ◐ |
| Sheltered Bay Slopes | ○ |
| Hardened Sheltered Bay Slopes | ○ |
| Sheltered Bluffs | ○ |
| Hardened Sheltered Bluffs | ○ |

● HIGH ◐ MEDIUM ○ LOW

## BEACH NOURISHMENT

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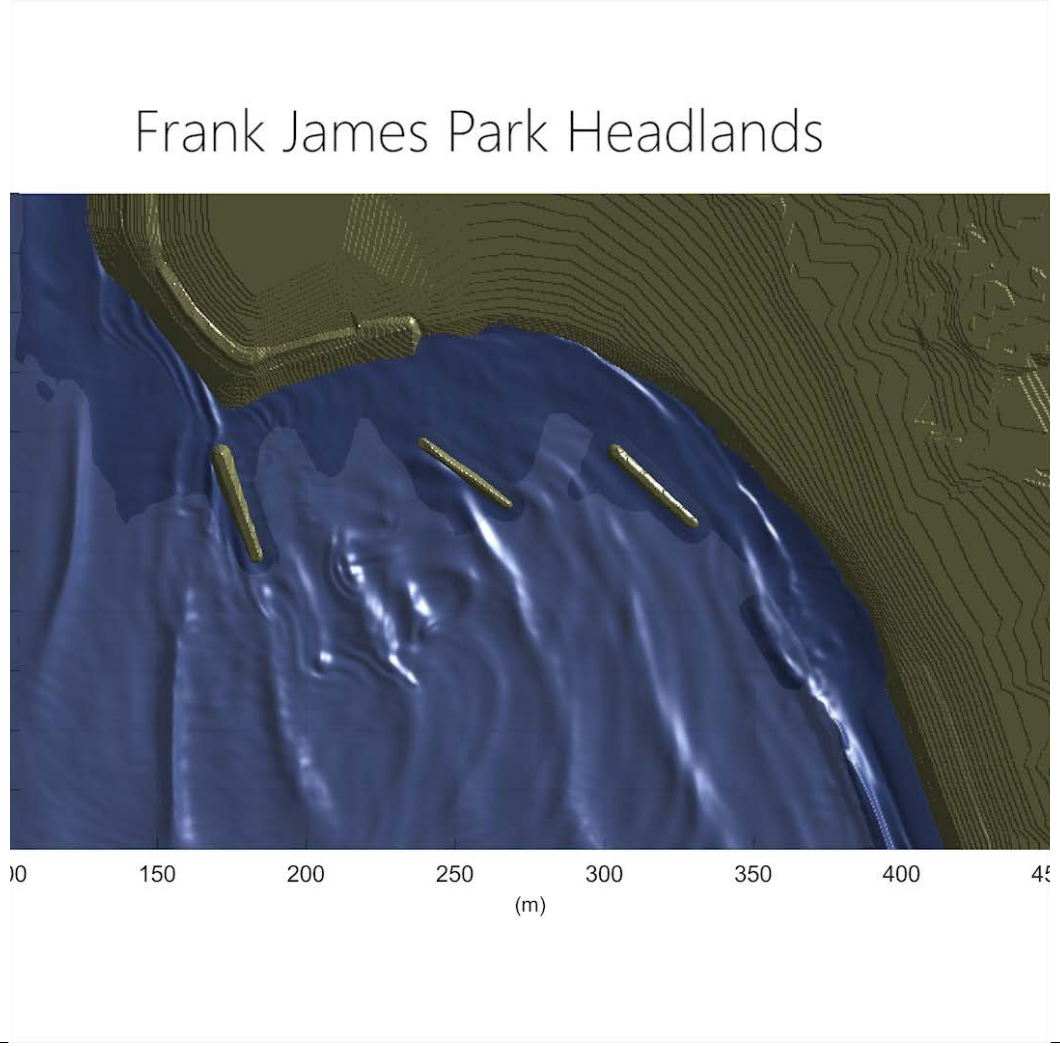
# HEADLANDS/BEACH NOURISHMENT ANIMATION EXAMPLES

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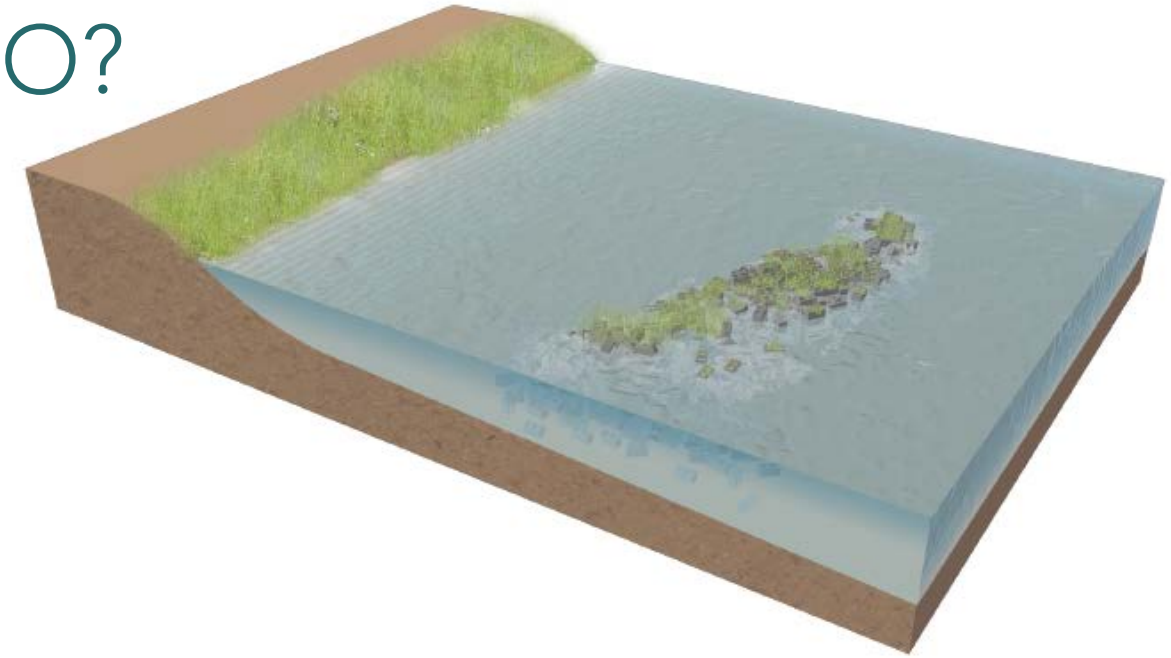
# WHY USE VIDEO?

Pictures communicate – but don't show how tidal features expose and hide themselves over time



**Ability to Address Coastal Hazards**

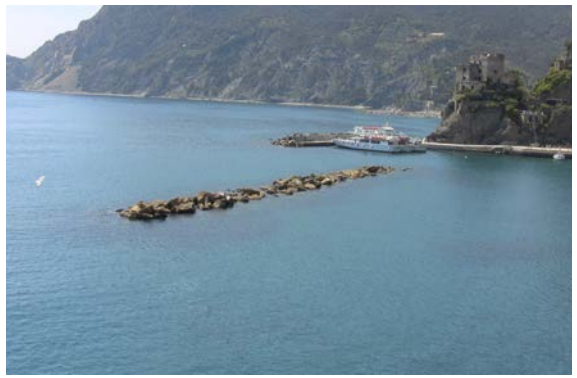
| | | |
|---|---|---|
| Event Based | Storm Surge (High) | ○ |
| | Storm Surge (Low) | ◐ |
| | Wave Force | ● |
| | Sudden Erosion | ● |
| Gradual | Flooding Due to Sea Level Rise | ○ |
| | Gradual Erosion | ● |

**Applicability to Landscape Type**

| | |
|---|---|
| Oceanfront Beaches | ● |
| Coastal Marshes | ◐ |
| Oceanfront Slopes | ● |
| Sheltered Bay Slopes | ◐ |
| Hardened Sheltered Bay Slopes | ◐ |
| Sheltered Bluffs | ○ |
| Hardened Sheltered Bluffs | ○ |

● HIGH ◐ MEDIUM ○ LOW

## OFFSHORE REEFS / BREAKWATERS



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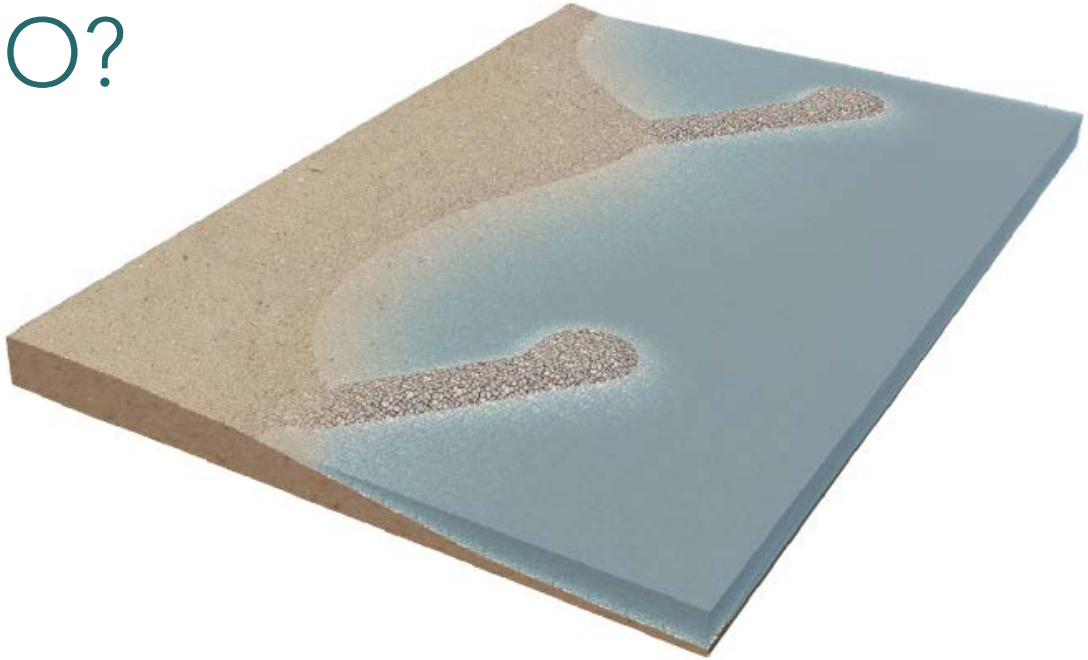
# WHY USE VIDEO?

Pictures communicate – but without showing how people and wildlife use the shore



**Ability to Address Coastal Hazards**

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| Event Based | Storm Surge (High) | ○ |
| | Storm Surge (Low) | ◐ |
| | Wave Force | ● |
| | Sudden Erosion | ● |
| Gradual | Flooding Due to Sea Level Rise | ○ |
| | Gradual Erosion | ● |

**Applicability to Landscape Type**

| | |
|---|---|
| Oceanfront Beaches | ● |
| Coastal Marshes | ◐ |
| Oceanfront Slopes | ● |
| Sheltered Bay Slopes | ◐ |
| Hardened Sheltered Bay Slopes | ◐ |
| Sheltered Bluffs | ○ |
| Hardened Sheltered Bluffs | ○ |

● HIGH ◐ MEDIUM ○ LOW

## POCKET BEACH/ HEADLAND

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# WATERFRONT RESIDENCES

## DEVELOPMENT PERMIT GUIDELINES FOR ADAPTATION GRAPHIC AND ANIMATION EXAMPLES

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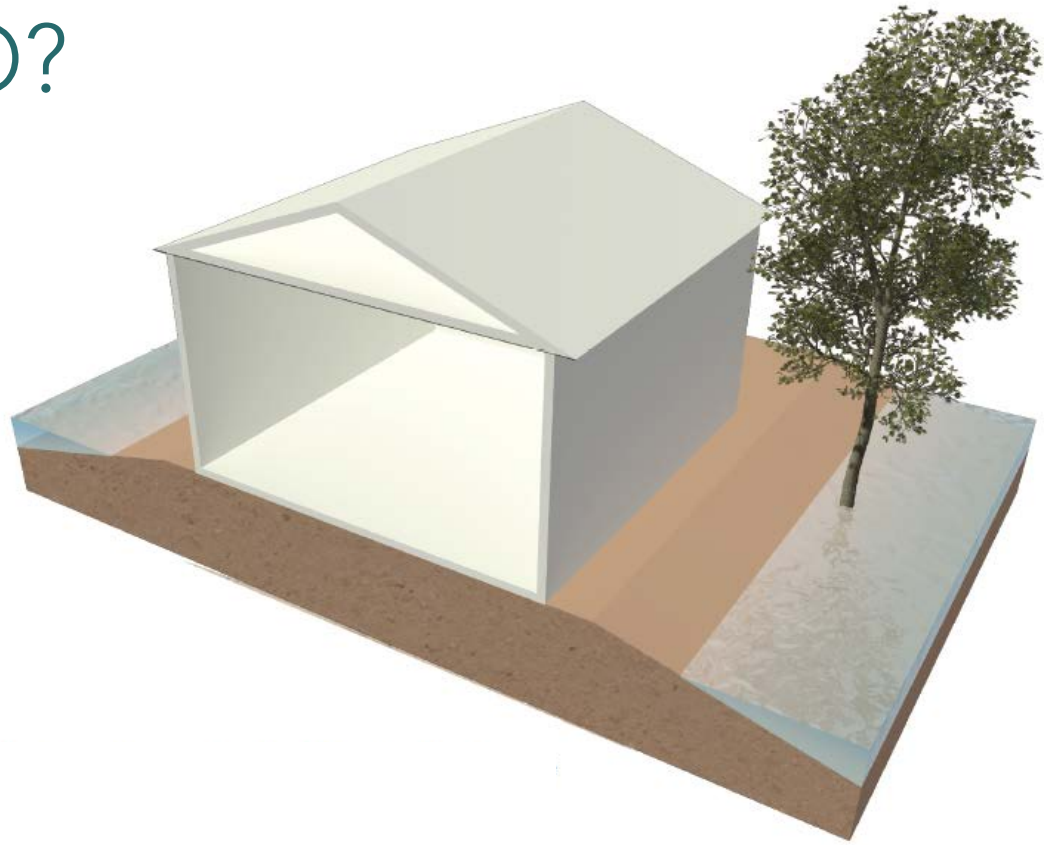
# WHY USE VIDEO?

Pictures communicate – but video of precedents makes it clear 'it's been done – it's achievable'



**Ability to Address Coastal Hazards**

| | |
|---|---|
| Storm Surge (High) | ● |
| Storm Surge (Low) | ● |
| Wave Force | ● |

**Applicability to Building Type**

| | |
|---|---|
| 1-2 Family Detached | ◐ |
| 1-2 Family Attached | ◐ |
| Low-Mid Rise Residential, Commercial, Mixed | ◐ |
| Industrial | ◐ |

● HIGH ◐ MEDIUM ○ LOW

# SITE ADAPTATION - ELEVATE ON FILL

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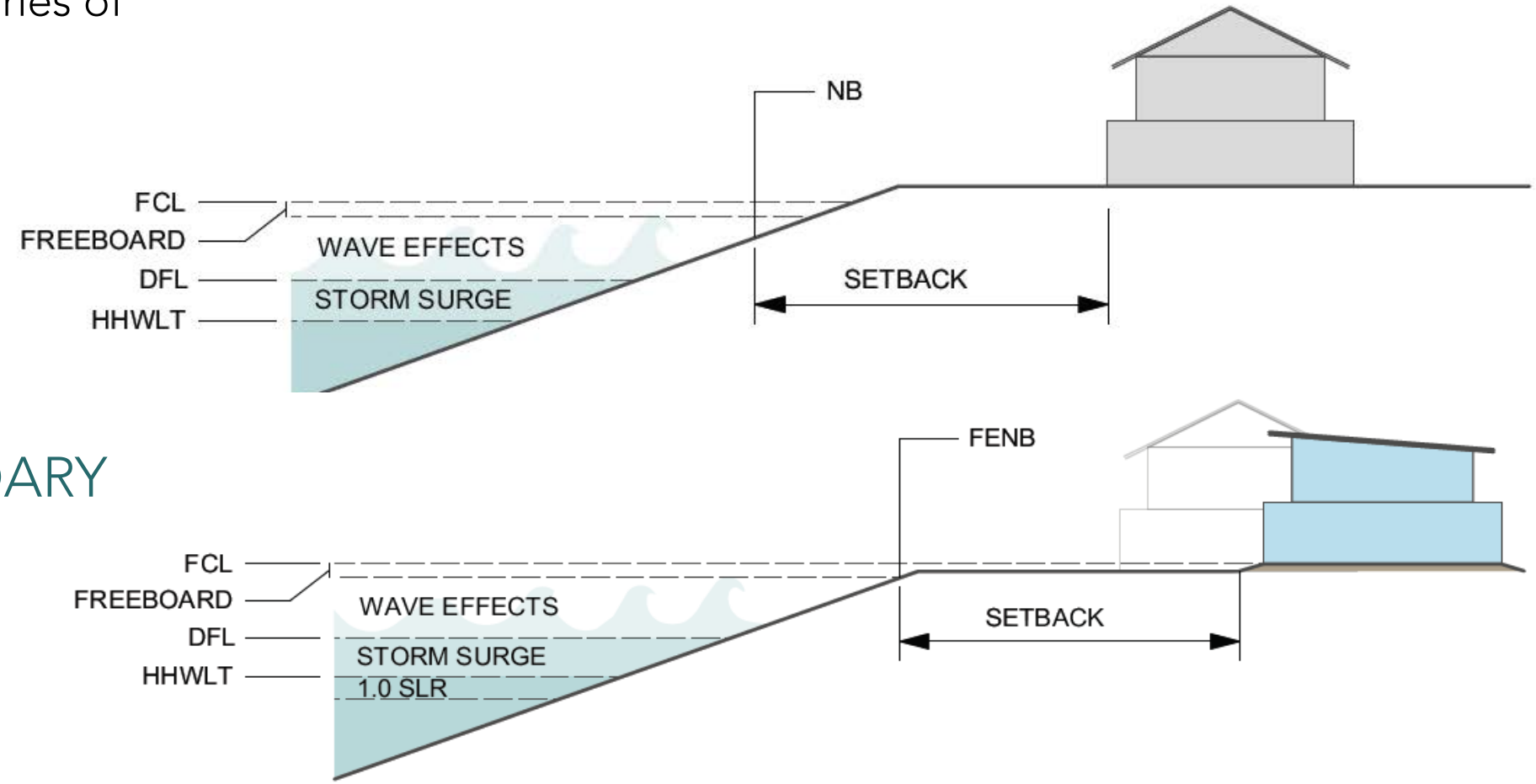
# WHY USE VIDEO?

Pictures communicate –
more effectively in a series of
images with narrative

## SEA LEVEL RISE NATURAL BOUNDARY AND SETBACK

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# WHY USE VIDEO?

Pictures communicate –
but this presentation is
taking too long!

## WILLOW POINT
ADAPTING
WATERFRONT HOMES &
PARKS


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Campbell
River

nhc LANARC

# CAMPBELL RIVER SEA LEVEL RISE ADAPTATION

## VIDEO SHORT

## WHY USE VIDEO?

When 5 minutes is all you have!

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B.C. ADAPTS VIDEO SERIES

14 VIDEO SHORTS FOR PROVINCE OF BC AND PARTNERS

- ✓ Coastal Flood Management
- ✓ Rainwater Management
- ✓ Water Conservation

# gov.bc.ca/BC-Adapts

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# MULTIDISCIPLINARY TEAMWORK

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# QUESTIONS TO THE ROOM

1. What take-aways & techniques from the presentation are relevant to your community or practice?

2. Are you facing decision-making barriers on risk & adaptation – lets discuss how to overcome them?

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