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## Engineering sustainable shorelines: an evaluation framework

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# Engineering Sustainable Shorelines:

## An Evaluation Framework

April 4<sup>th</sup>, 2018



# Engineering Sustainable Shorelines: An Evaluation Framework

April 4, 2018

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# Outline

- › Background
- › Evaluation Framework
- › Project Example
- › Take Aways







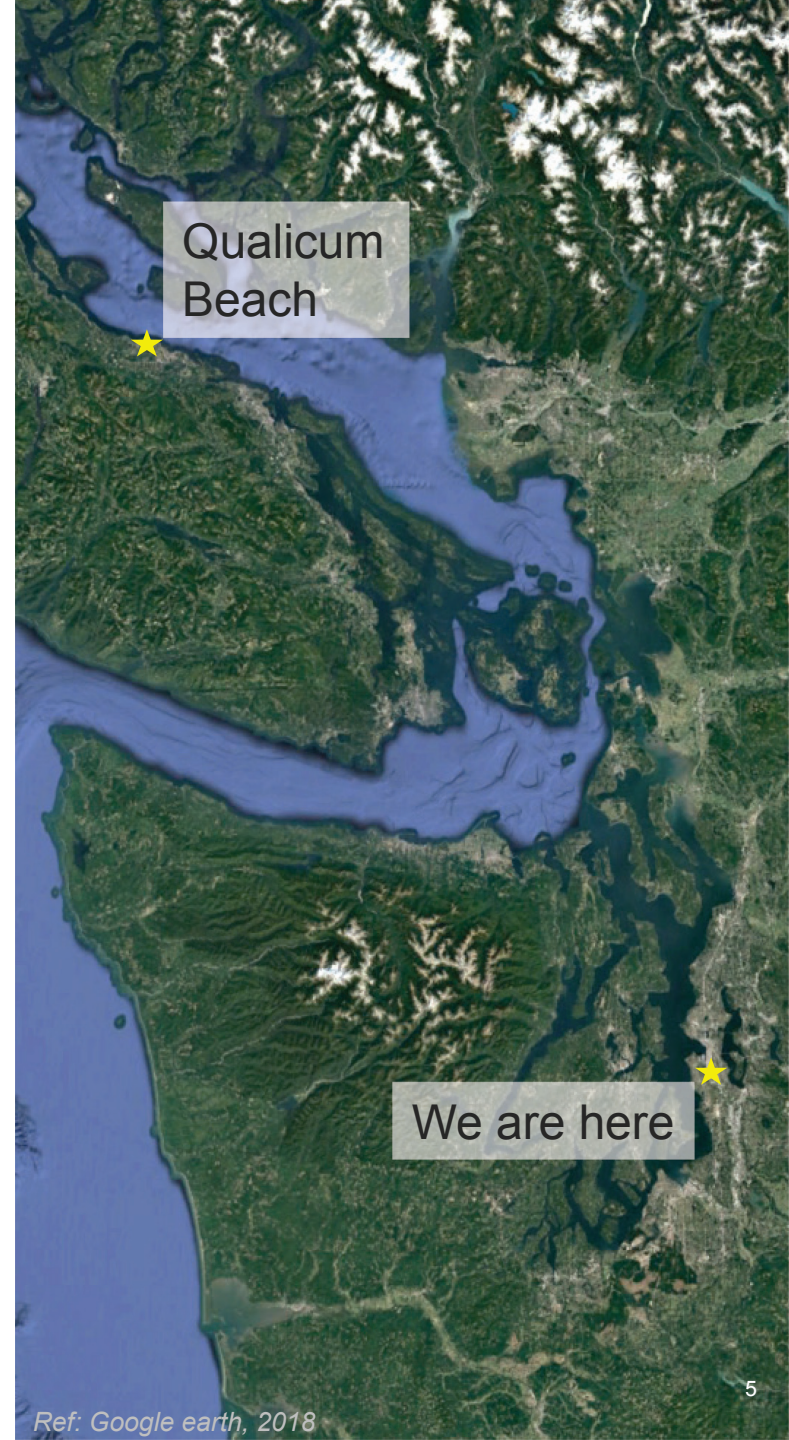
# Background



# Background

## The Qualicum Beach Waterfront Master Plan

- › The Town is developing a comprehensive Waterfront Master Plan.
- › The Plan involves a consultation process, which is expected to result in a variety of waterfront development concepts.
- › A method was needed to evaluate the engineering feasibility and environmental effects of proposed concepts.





A wide-angle photograph of a coastal scene. In the foreground, gentle waves with white foam wash onto a sandy beach. The water is a deep blue, transitioning to a lighter turquoise near the shore. In the middle ground, a line of buildings, including a prominent yellow house and several blue-roofed structures, sits on a slight rise. Behind the buildings is a dense forest of trees, some with bare branches and others with green foliage. The background shows a clear, bright blue sky and distant, hazy mountains on the horizon. The overall atmosphere is peaceful and scenic.

# Evaluation Framework



# Evaluation Framework

- › The Evaluation Framework is based on the idea that a one-size-fits-all solution is insufficient.



# Evaluation Framework

## Principles

- › Based on three general principles:
  - 1) Demonstrate compatibility with the expected coastal/marine conditions,
  - 2) Maintain or enhance foreshore ecological services, and
  - 3) Optimize community investment in waterfront areas.
- › The framework uses 11 criteria to evaluate and compare alternative waterfront concepts for the same shoreline.





# Evaluation Framework

Principle 1: Compatibility with the Expected Coastal/Marine Conditions

No.	Criteria Name	Weight (%)
1a	Compatibility with Expected Sea Level Rise	10
1b	Flood Adaptation Effectiveness	12
1c	Compatibility with Coastal Processes	12
Sub-Total		34





# Evaluation Framework

## Principle 1, Criteria 1c: Evaluation Guidance

No.	Criteria Name	Weight (%)
1a	Compatibility with Expected Sea Level Rise	10
1b	Flood Adaptation Effectiveness	12
1c	Compatibility with Coastal Processes	12
Sub-Total		34

Rating	Guidance
+2	The <i>Option</i> results in <b>no hard structures</b> along the shoreline, only natural shoreline and soft structures.
+1	The <i>Option</i> results in greater than 50% of the shoreline with natural shoreline and soft structures. Any hard structures, including berms, are <b>not likely to modify alongshore or cross-shore processes</b> .
0	In light of the site history, the <i>Option</i> <b>does not result in changes to the shoreline or modify alongshore and/or cross-shore processes</b> .
-1	The <i>Option</i> results in the placement of hard structures, including groins, along more than 50% of the shoreline. Hard structures <b>likely modify alongshore and/or cross-shore processes</b> .
-2	The <i>Option</i> results in <b>hard structures along the entire shoreline</b> length and likely modify cross-shore and/or alongshore processes.





# Evaluation Framework

Principle 2: Maintain or enhance foreshore ecological services

No.	Criteria Name	Weight (%)
2a	Effect on Marine Riparian Vegetation	8
2b	Foreshore Habitat Supply	8
2c	Foreshore Habitat Diversity	8
2d	Marine Pollutants	5
2e	Cumulative Effects to the Foreshore Environment	5
Sub-Total		34

# Evaluation Framework

## Principle 2, Criteria 2b: Evaluation Guidance



No.	Criteria Name	Weight (%)
2a	Effect on Marine Riparian Vegetation	8
2b	Foreshore Habitat Supply	8
2c	Foreshore Habitat Diversity	8
2d	Marine Pollutants	5
2e	Cumulative Effects to the Foreshore Environment	5
Sub-Total		34

Rating	Guidance
+2	The <i>Option</i> restores or enhances naturally occurring foreshore habitat along the entire project shoreline (e.g. gravel beach).
+1	The <i>Option</i> restores or enhances at least 50% of the linear (m) or surface area (m <sup>2</sup> ) of naturally occurring foreshore habitats.
0	The <i>Option</i> does not reduce or enhance the linear (m) or surface area (m <sup>2</sup> ) of naturally occurring foreshore habitats.
-1	The <i>Option</i> reduces at least 50% of the linear (m) or surface area (m <sup>2</sup> ) of naturally occurring foreshore habitat.
-2	The <i>Option</i> reduces or eliminates naturally occurring foreshore habitat along the entire project shoreline.





# Evaluation Framework

Principle 3: Optimize community investment in waterfront areas

No.	Criteria Name	Weight (%)
3a	Compatibility with Existing Infrastructure and Adjacent Properties	11
3b	Stability and Maintenance	10
3c	Technical Feasibility and Innovation	11
Sub-Total		32
Total		100





# Evaluation Framework

## Principle 3, Criteria 3b: Evaluation Guidance

No.	Criteria Name	Weight (%)
3a	Compatibility with Existing Infrastructure and Adjacent Properties	11
3b	Stability and Maintenance	10
3c	Technical Feasibility and Innovation	11
Sub-Total		32
Total		100

Rating	Guidance
+2	The <i>Option</i> results in a natural shoreline that <b>requires no maintenance or modifications</b> , and can change dynamically to adapt to the marine environment.
+1	The <i>Option</i> results in structures that will <b>likely not require frequent maintenance</b> and <b>can be easily modified and maintained</b> .
0	The <i>Option</i> results in structures that will <b>likely not require frequent maintenance</b> and <b>cannot be easily modified and maintained</b> .
-1	The <i>Option</i> results in structures that will <b>likely require frequent maintenance</b> and <b>can be easily modified or maintained</b> .
-2	The <i>Option</i> results in structures that will <b>likely require frequent maintenance</b> and <b>cannot be easily modified or maintained</b> .



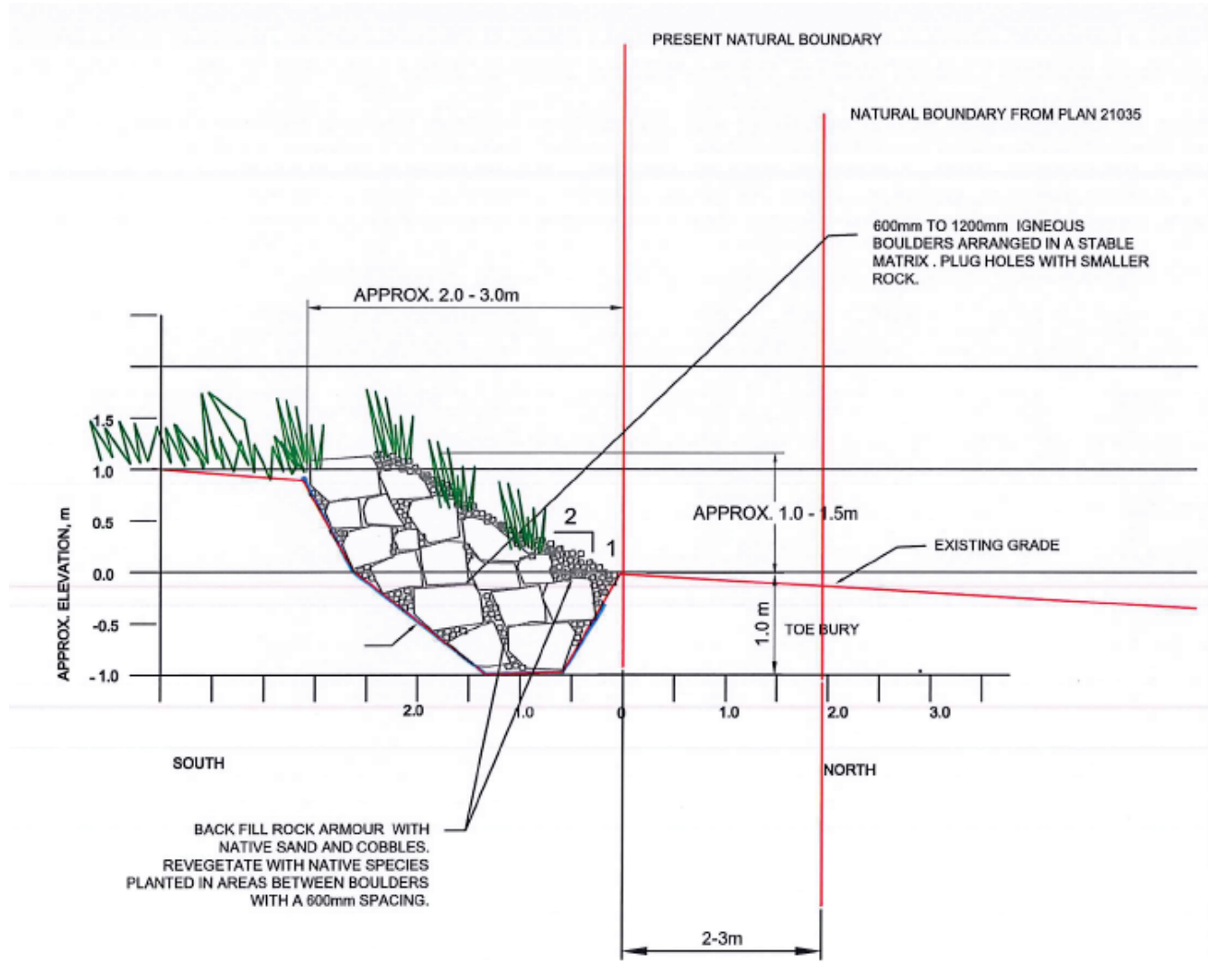




# Project Example: Private Property, Eroding Shoreline



# Project Example: Proposed Design





# Project Example: Evaluation

No.	Criteria Name	Score		Weighted Score	
		Armour Rock Revetment	'Do Nothing'	Armour Rock Revetment	'Do Nothing'
1a	Compatibility with Expected Sea Level Rise	-2	-2	-20	-20
1b	Flood Adaptation Effectiveness	-2	-2	-24	-24
1c	Compatibility with Coastal Processes	-1	+2	-12	+24
Sub-Total				-36	-20
2a	Effect on Marine Riparian Vegetation	-1	0	-8	0
2b	Foreshore Habitat Supply	-1	0	-8	0
2c	Foreshore Habitat Diversity	-1	0	-8	0
2d	Marine Pollutants	0	0	0	0
2e	Cumulative Effects to the Foreshore Environment	-1	0	-5	0
Sub-Total				-29	0
3a	Compatibility with Existing Infrastructure and Adjacent Properties	+1	-1	+11	-11
3b	Stability and Maintenance	+1	-1	+10	-10
3c	Technical Feasibility and Innovation	-1	0	-11	0
Sub-Total				+10	-21
<b>Total</b>				<b>-55</b>	<b>-41</b>







## Amended Design:

- › Mild slope
- › Gravel Fill
- › Rip-rap fully buried
- › Woody Debris
- › Native vegetation planted
- › Reduced coastal squeeze





# Take Aways

- › Shoreline works need to account for site-specific requirements, such as wave exposure, space restrictions, maintenance, community needs, etc.
- › A ‘soft’ solution might not be best approach! A ‘hybrid’ or ‘hard’ solution might have better long-term results.
- › The Framework provides a systematic method to evaluate proposed shoreline options.
- › No framework is perfect!
  - › Community specific.
  - › Some Criteria are difficult to evaluate.







Questions?