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Engineering sustainable shorelines: an evaluation framework

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Engineering Sustainable Shorelines:

An Evaluation Framework

April 4th, 2018

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Outline

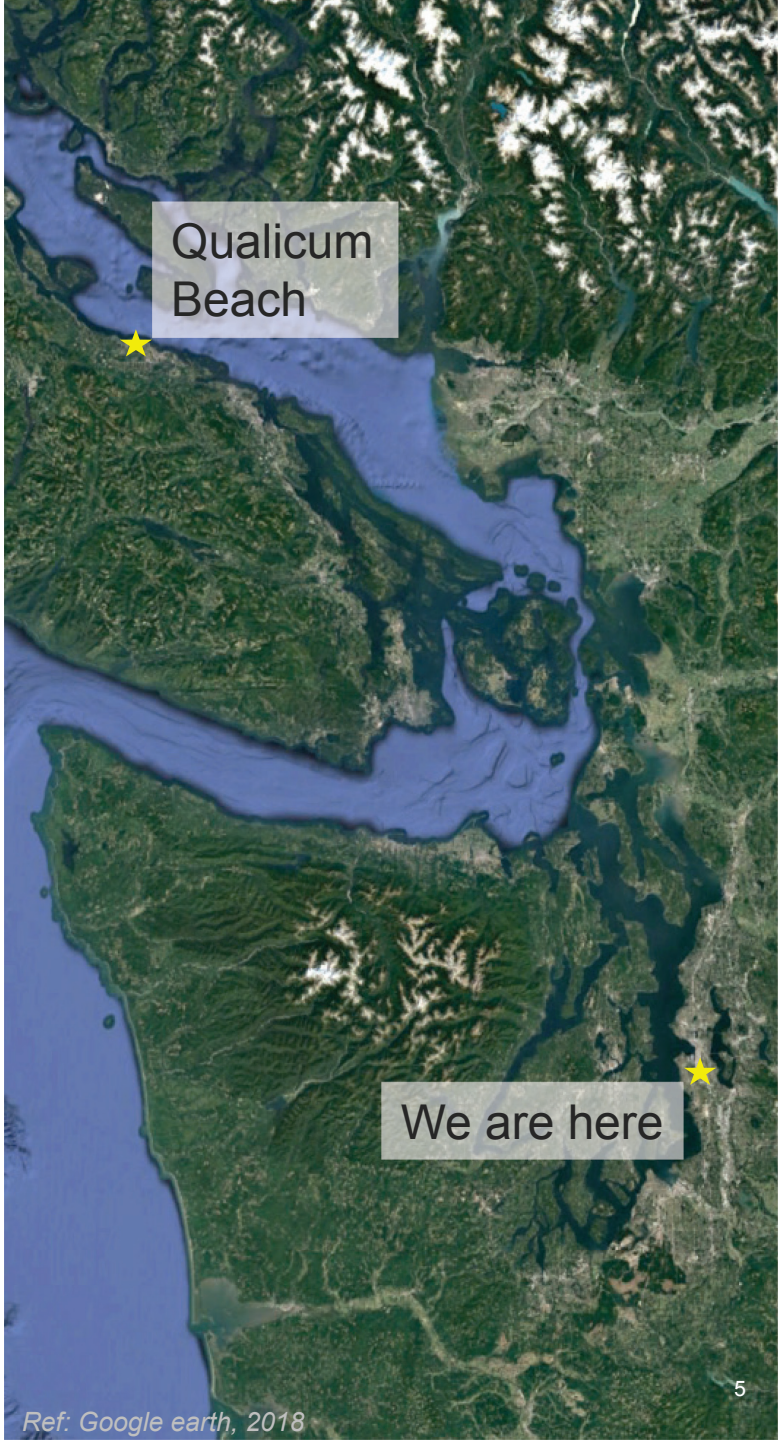
- Background
- Evaluation Framework
- Project Example
- Take Aways

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.



Ref: Google earth, 2018

Evaluation Framework

Photo Credit: John Readshaw, SNC-Lavalin

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 *Option* results in no hard structures along the shoreline, only natural shoreline and soft structures.
+1	The *Option* results in greater than 50% of the shoreline with natural shoreline and soft structures. Any hard structures, including berms, are not likely to modify alongshore or cross-shore processes.
0	In light of the site history, the *Option* does not result in changes to the shoreline or modify alongshore and/or cross-shore processes.
-1	The *Option* results in the placement of hard structures, including groins, along more than 50% of the shoreline. Hard structures likely modify alongshore and/or cross-shore processes.
-2	The *Option* results in hard structures along the entire shoreline 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 *Option* restores or enhances naturally occurring foreshore habitat along the entire project shoreline (e.g. gravel beach).
+1	The *Option* restores or enhances at least 50% of the linear (m) or surface area (m^2) of naturally occurring foreshore habitats.
0	The *Option* does not reduce or enhance the linear (m) or surface area (m^2) of naturally occurring foreshore habitats.
-1	The *Option* reduces at least 50% of the linear (m) or surface area (m^2) of naturally occurring foreshore habitat.
-2	The *Option* 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

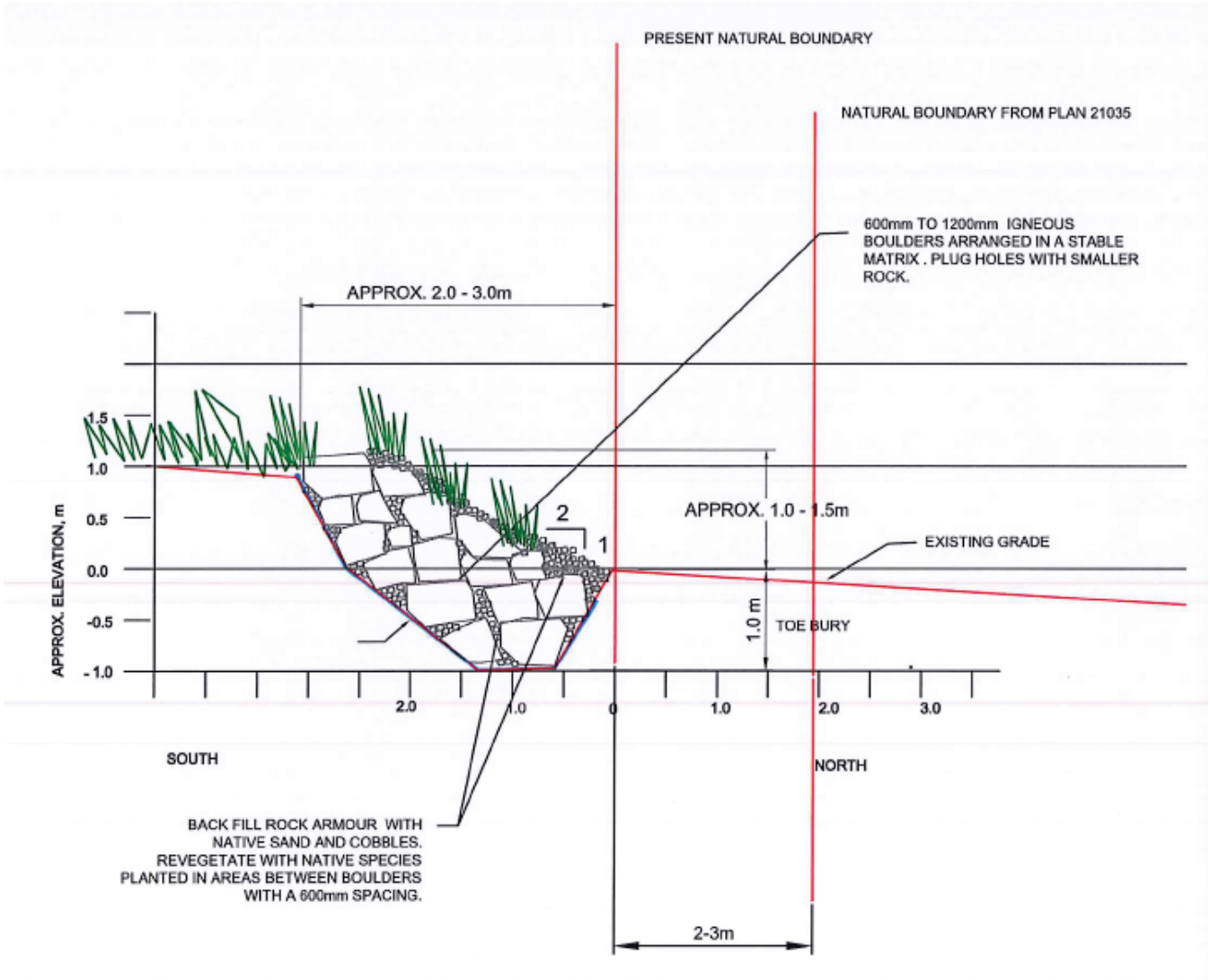
No.	Criteria Name	Weight (%)
3a	Compatibility with Existing Infrastructure and Adjacent Properties	11
3b	Stability and Maintenance	10
3c	Technical Feasibility and Innovation	11
	Sub-Total	32
	Total	100

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

Project Example:
Private Property, Eroding Shoreline

Photo Credit: Luke Sales, Town of Qualicum Beach

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
			Total	**-55**	**-41**

Photo Credit: John Readshaw, SNC-Lavalin

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.

Photo Credit: John Readshaw, SNC-Lavalin

Questions?