From: Catherine Young
Sent: Wednesday, November 13, 2024 4:59 PM
To: Rob Pingle; SSIInfo
Subject: Trustees and Planners: Baker Road Beach correspondence
Attachments: Beach Nourishment.pdf; Groundwater and Erosion Hazard.pdf; Log ProtectionLarge Wood.pdf; Predicted Ocean Sea Level Rise and GHG emissions 3.pdf; Wave Energy.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

Just got this posted on the BC Govt. Applications Comment site (Crown Land File: #1415573) hope you can add it for tomorrow's meeting!

Thank you,
Cathy Young

As one of a large group of concerned citizens on the proposed "erosion mitigation" project on Baker Beach, I have studied the original Geohazard Assessment and can suggest a compromise that could be good for all.
This is not an official Green Shores project, and the engineer is not one of their qualified engineer, though it appears to me he has done his best to implement green shore practices but with critical oversights and errors. Particularly an over-calculation about Climate Change as it will impact Sea Level Rise, while no Climate Change consideration of rainfall, especially atmospheric rivers. Also an over-estimation of Wave Energy, and an emphasis on restoring loose materials on the beach ('beach nourishment') when Baker Beach is probably 80%+ bedrock - friable shale.
The oversight is the possibility in "Your Marine Waterfront" (Islands Trust recommended document) that Log Placement, with driftwood logs anchored in place, is quick, very cheap and even beneficial (photos show a great number already there, and toppled trees can be added).
As such a lovely much-visited walkers' beach we sincerely hope this can be resolved.

Beach Nourishment

(Noe: Beach Nourishment applies to only the loose portions of a beach (sand, gravel, cobbles, etc.), not the entire foreshore, bedrock and all, as in "Baker Beach"

https://climate-adapt.eea.europa.eu/en/metadata/adaptation-options/beach-and-shoreface-nourishment
Beach nourishment does not halt erosion. It rather addresses sediment deficit by providing additional sediment from external sources, often requiring repeated interventions. The process involves dredging material (sand, gravel, small pebbles) from a source area (offshore, near-land or inland) to feed the beach where erosion is occurring.

https://www2.gov.bc.ca/assets/gov/environment/climate-change/adaptation/resources/slr-primer.pdf (2013)

-- p. 79-80: **Beach nourishment** reduces the detrimental effects of coastal erosion by providing additional sediment to satisfy the natural forces of erosion. Beach nourishment will not stop erosion; however, it will provide a sacrificial element against coastal erosion, rather than a hard barrier. Beach nourishment will likely be required on an ongoing basis as long as the forces of erosion are present.

Environmental – Beach nourishment may enhance intertidal areas. However, negative effects could occur if the material deposited does not match the size and composition of native beach material, if the deposited material provides excessive turbidity or if the depth of material deposited buries existing marine organisms.

Disadvantages:
The use of beach nourishment is subject to a number of widespread limitations, including a consistent supply of correctly sized sediment for the long-term and a suitable foreshore profile. Beach nourishment can become prohibitively expensive if a supply of sediment is not readily available. The value of aggregate resources including sand is highly dependent on the proximity of supply sources to the locations in which they are needed. Beach nourishment is not a permanent solution to shoreline erosion. It will require regular monitoring and periodic re-nourishment depending on the rate of erosion that takes place. Beach nourishment may affect the productivity of intertidal areas.

Green Shore Beach Protection

https://stewardshipcentrebc.ca/PDF_docs/greenshores/reports/GSPolicyandRegulatoryToolsLocalGovtsReport2016.pdf

- Shoreline stabilization should be limited to that necessary a) to prevent damage to existing structures or established uses on adjacent upland;…
- Apply the 'softest' possible stabilization measure that will still provide satisfactory protection.
- Limit the size of necessary stabilization measures to the minimum necessary.

https://stewardshipcentrebc.ca/PDF_docs/greenshores/Resources/GSHCreditsandRatingsGuide.pdf

(p. 37): …rocky shores are more resistant to erosion and typically do not need protective structures.

(p. 54): **Credit 1.5: Nature-Based Erosion & Flood Management:**
This credit applies to marine and freshwater shores with sediment-based shorelines. **Adding soft or hybrid protection to a naturally rocky shore does not qualify for this credit.**

Groundwater and Erosion Hazard

https://comment.nrs.gov.bc.ca/api/public/document/6720089410f6e90022aeff7e/download

(p. 9)
There exists a transient erosion hazard consequent to high pore water pressure conditions within the veneer of surficial Galiano soils at base of the slope on Site, as a component of the failing coastal bluff. Under adverse climatic conditions, this hazard would result in a limited mass wasting failure which would mobilize and entrain the full depth of surficial material. With standard climatic conditions, this mechanism is not as likely to result in such mass failure..

(p. 97)
Of the erosion mechanisms identified on Site from previous geohazard reports, the following are of note:
- Pore pressure/Groundwater Seepage from surficial soils, reducing cohesion and resulting in landward progression of the crest through continuous or punctuated mobilization of sediment.
- Toe-erosion of bedrock, or undercutting of shoreline sediment, which decreases stability of all materials above, often resulting in narrow failures from crest to base of coastal bluff.
- Landslip/Tree-topple is occurring on Site wherein trees near, or overhanging, the coastal bluff mobilize consequent to soil creep, pore pressure or toe-erosion. These failures result in a larger volume of surficial sediment during failure than toe-erosion instability reaching the crest. Consequent to root reinforcement or friability of bedrock, landslip is likely to mobilize underlying shale and siltstone.
- Landslide is a moderate to large scale failure event which can mobilize bedrock and overlying surficial sediment. Coastal landslide are often consequent to a history of toe-erosion, bedrock fracture and an increase in pore pressure (i.e. saturated soils & rock-fractures during a storm event) which has destabilized the coastal bluff in that area.

Geohazard Assessment of Surface and Groundwater Hazards:
Mitigation measures
pp. 11-12, 35-36, 58-59, and 81-82

Mitigation options include, but are not limited to:
o Annual monitoring of erosional regression of surficial materials at the coastal bluff;
o Groundwater intercept and redirection to non-erosive receiving environment;
o Bioengineering and selective planting of native species toward increasing shear strength of surficial materials;
o Re-contour of the surficial materials to allow for emergence of groundwater without erosion;
o Selective removal of shoreline trees deemed hazardous due to undercutting erosion.

Climate change is already increasing the intensity, frequency and spread of Atmospheric Rivers – why was this not taken into account?

Climate Change Variables: Atmospheric Rivers

https://www.climatehubs.usda.gov/hubs/northwest/topic/atmospheric-rivers-northwest-0

As human-caused climate change continues to warm the planet, the number of days that the western U.S. will experience atmospheric rivers is projected to increase. Atmospheric rivers are also expected to be bigger and more hazardous on average. As climate change warms the air and oceans, these storms will have more fuel to become larger and stronger because a warmer atmosphere can hold more moisture. Some research shows that they are expected to be 25 percent longer and wider, meaning more rain over more area for longer. Therefore, heavy rainfall and extreme winds caused by these rivers will increase.

https://theconversation.com/atmospheric-rivers-are-shifting-poleward-reshaping-global-weather-patterns-240673

Atmospheric rivers – those long, narrow bands of water vapor in the sky that bring heavy rain and storms to the U.S. West Coast and many other regions – are shifting toward higher latitudes… new studies show that atmospheric rivers have shifted about 6 to 10 degrees toward the two poles over the past four decades… In higher latitudes, atmospheric rivers moving poleward could lead to more extreme rainfall, flooding and landslides in places such as the Pacific Northwest.

Surface and Groundwater Management

(from Marine Shoreline Design Guidelines):

https://stewardshipcentrebc.ca/PDF_docs/GS_LocGov/GuidesTemplates/wdfw01583.pdf

p. 113: In the undeveloped, forested condition, up to 40% of rainwater is intercepted by the canopy where it accumulates on the foliage and is transpired or evaporated. Compared to the forested condition, relatively little reaches the ground, and what does is absorbed by the thick layer of leaf litter and humus. When the forest is cleared for development more water is able to reach the ground. Additional infrastructure to support human uses such as septic drainfields and irrigation systems are also sources of water input. Water management and drainage systems that route runoff into the ground without adequate consideration of soil characteristics may result in slope instability. Figure 6-1 schematically shows these changes to groundwater and the potential increase in bluff slope instability.

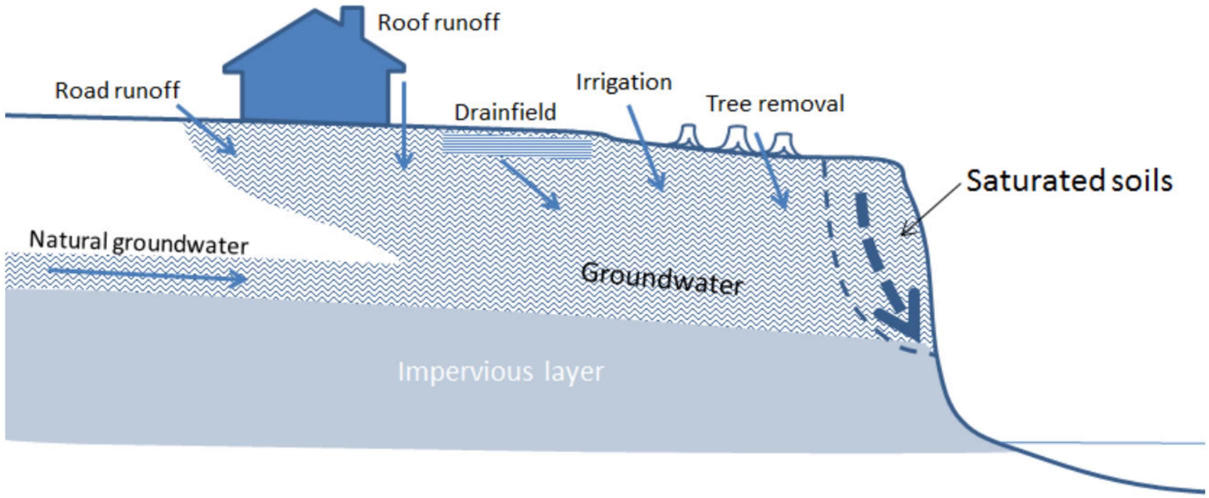


Figure 6-1. Development practices can increase groundwater and saturate bluff soils, increasing the likelihood of slope failure (Redrawn from Marsh 2005).

Water that is allowed to seep into the ground near the crest of the bluff helps saturate the soil, increasing pore water pressure and decreasing the strength of the soil structure.

Log Protection/Large Wood

Geohazard Assessment of Baker Beach

https://comment.nrs.gov.bc.ca/api/public/document/6720089410f6e90022aeff7e/download

(p. 128)

"Presence of large woody debris is a benefit, but transient." **(…when unanchored…)**

https://www.qathet.ca/wp-content/uploads/2019/12/Your-Marine-Waterfront.pdf

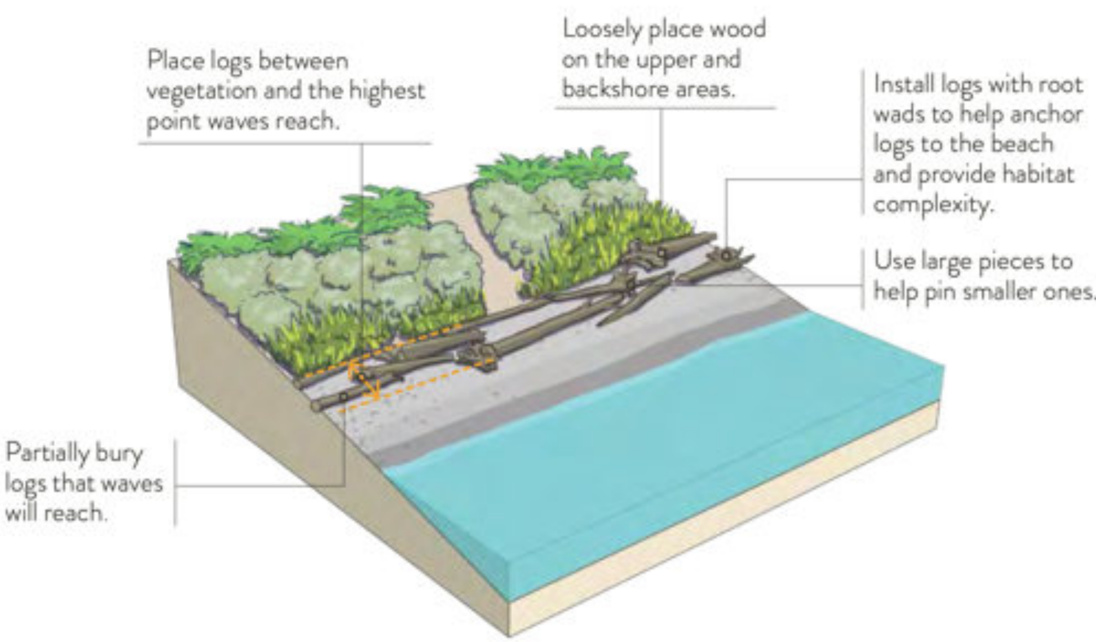
(p. 23) One solution, not likely to be of interest, is moving the buildings!

FEEDER BLUFF

Relocation in lieu of a seawall is especially beneficial on feeder bluffs. It is safer for your home, allows for natural erosion of the bluff, and promotes a healthier ecosystem.

This bluff supplies sediment to nearby beaches and maintains habitat used by spawning forage fish, which salmon eat.

(p. 25)



(p. 26) "This technique places large logs and root wads (also known as large woody debris) along the upper beach to mimic natural driftwood accumulation. Logs disperse wave energy, trap and build up sand (which can provide additional erosion protection), and improve habitat. "

ANCHORING

Anchoring logs may be appropriate depending on site conditions. Use durable materials appropriate for the marine environment to reduce the likelihood of failure and beach debris. …and revegetation. …Selective use of larger logs or boulders can help pin logs in place.

(p. 29)

PLANT FOR LONG-TERM SUCCESS Revegetating provides soil strength through root systems. Plants and grasses with shallow root systems will not adequately strengthen steeper slopes. It may take time for deep-rooted plants and trees to establish, so temporary erosion control features like geofabric and wood stakes may be necessary. Always try to use native plants in designs (see page 37)

Logs are used as a natural approach to slow tidal flows and to prevent erosion.

https://www.stewardshipcentrebc.ca/PDF_docs/GSH_pilot/Guides%20and%20Templates/FirstDraftShorelineGuideJune13.pdf (2013)

Some engineered shore protection techniques are as follows:

- **Beach nourishment**; the addition of sand or gravel to a beach can be used as a protection or restoration technique where feasible. When designed to function with natural coastal processes this technique has low to moderate impacts and requires relatively little mitigation.
- **Large wood; strategic placement of logs** and root wads that maintains/enhances natural processes, such as recruitment of drift logs, in order to build up the backshore while maintaining dynamic near shore processes. If appropriately designed and installed there are few impacts from the technique.
- **Reslope/revegetation**; creating or maintaining a stable bank slope and using vegetation to stabilize it. Generally, there are few impacts from this technique.

Marine Shoreline Development Guidelines (2014)

https://wdfw.wa.gov/sites/default/files/publications/01583/wdfw01583.pdf

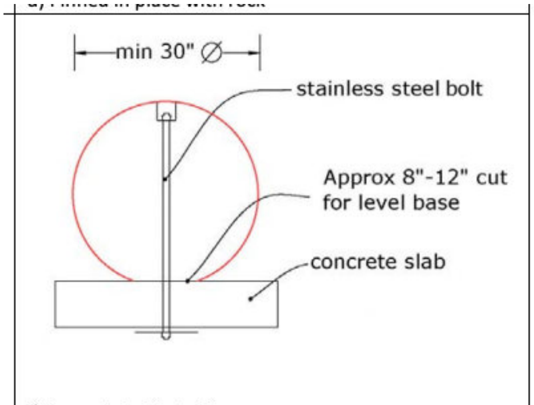
(p. 152 - 168) Chapter 7.2: **Large Wood**

Large wood placement designs typically consist of large tree trunks with and without rootwads… Logs of all sizes, typically with rootwads, were more prevalent Puget Sound wide historically… The strategic placement of large wood can be designed to achieve the following objectives: enhance shore form structure, reduce shoreline erosion rates, and enhance marine riparian ecotone, aquatic productivity, and/or habitat complexity…. it can mimic the natural process of wood recruitment to the beach or salt marsh that might otherwise take many years to occur naturally in a restoring system … Large wood placement designs can be tailored to trap additional large wood and sediment, resulting in increased habitat complexity and biological processes like the germination of certain plants, microclimates for beach fauna, and attachment substrate for sessile invertebrates and boring organisms. Large wood placement can also be used to reduce shoreline erosion and replicate historical processes beneficial to many organisms, including salmonids….

(p. 22)
Substrate density: The density and composition of the sub-surface sediment/geology, which will inform that appropriate selection of LWD anchoring mechanism. …for sites with higher density or lithified subsurface geology (e.g. bedrock), ballasted Large Wood Debris would represent the best LWD anchoring mechanism.

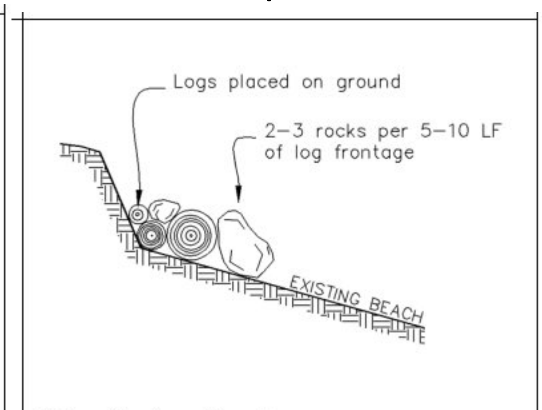
(p. 163-165) **Log anchoring:**

Ballasted:



f) Concrete ballasted log

Held in place:



d) Pinned in place with rock

(Others suggest pinning log-to-log, piling up etc.)

Geohazard Assessment Rationale for Design Sea Level
2024-03-08 Coastal Rpts 1415573.pdf

(p. 150) The project DSL is calculated to match the lifespan of existing structures, which is 75 years for single family dwellings in British Columbia. As such, predictions of sea level change for the year 2100 are considered for this rationale.

(p. 152) The estimated rate of additional sea level rise contributed by melt of Antarctica ice sheets is shown in Figure 3

(p. 154) The year 2100 prediction of sea level rise is 0.40m under median (RCP4.5) conditions….Using a precautionary approach, the addition of meltwater from the Anatarctica ice sheet was considered to be contributory – resulting in an additional 0.47m of sea level rise by year 2100. Therefore the DSL is 0.87m above current relative sea level along the west coast of Salt Spring Island.

Green Shoring details (Aurora plan)
2024-08-04 Ref Pkg 1415573.pdf

(Green Shores: The Ordinary High Water Mark (OHWM) is "the highest level reached by a body of water that has been maintained for a sufficient period of time to leave evidence on the landscape", (and is) interchangeable with the term Natural Boundary.")

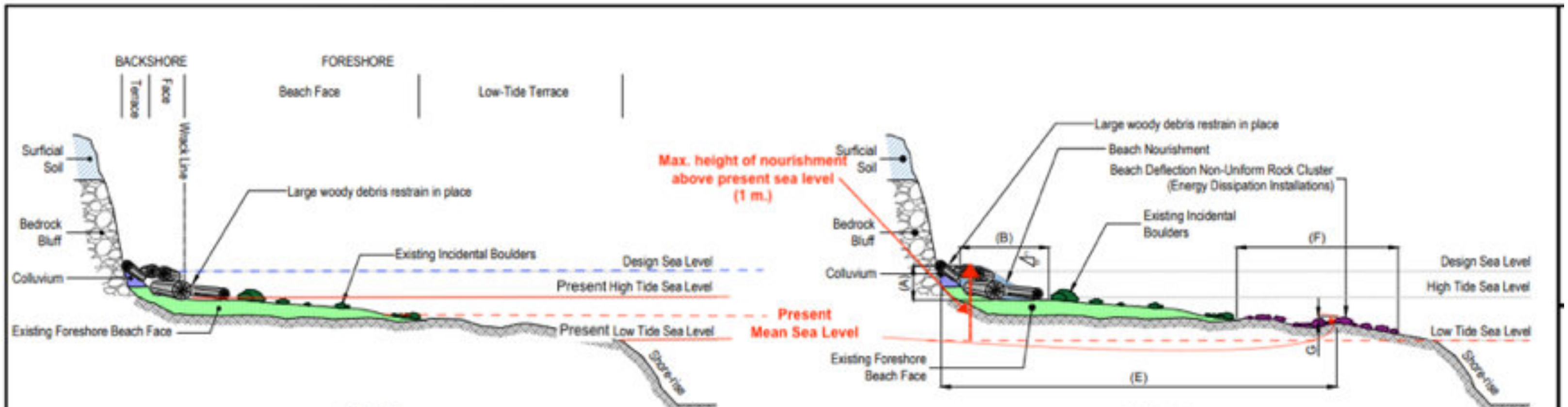


FIGURE 6:
NOMINAL CROSS-SECTION OF A PROJECT AREA
CURRENT CONDITION

FIGURE 7:
NEAR-TERM CROSS-SECTION

Alternative rationale:
Predicted Ocean Sea Level Rise

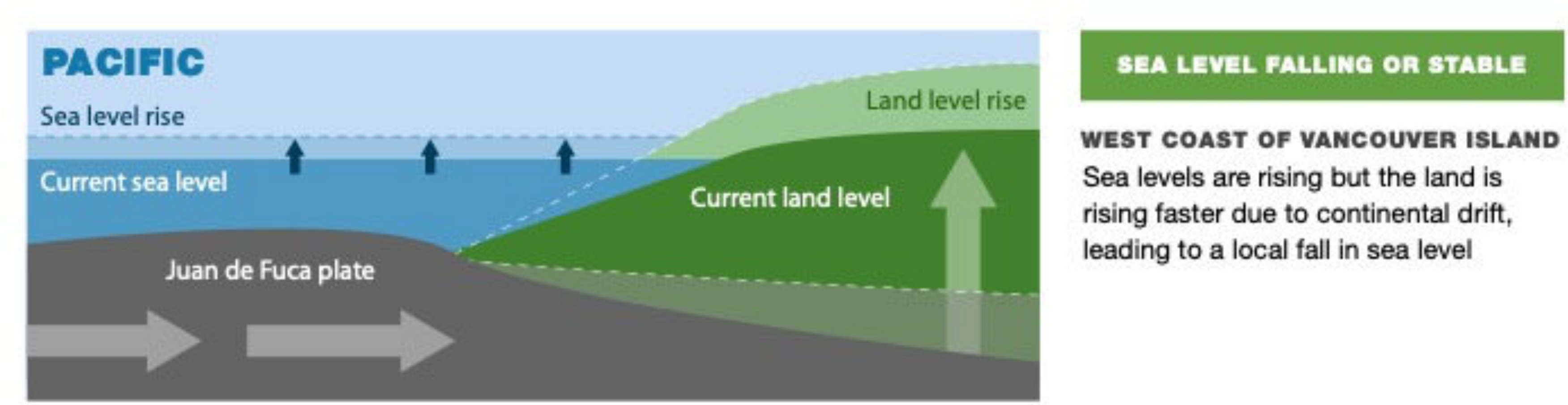
Research	**Greenhouse gas emissions: RCP 4.5 (Representative Concentration Pathways median projections) (in cm)**	
	RCP4.5	
	2050	**2100**
Nasa IPCC: Fulford Harbour https://sealevel.nasa.gov/ipcc-ar6-sea-level-projection-tool (**IPCC:** The Intergovernmental Panel on Climate Change: the United Nations body for assessing the science related to climate change: AP6 (2022)	10 cm	35 cm
NOAA (GLOBAL): Northwest Pacific https://sealevel.globalchange.gov/national-sea-level-explorer/?type=regional&region=NWC&scope=section_1	0.5ft. = 6 in., or 15 cm	
Canadian Extreme Water Level Adaption Tool https://gisp.dfo-mpo.gc.ca/portal/apps/experiencebuilder/experience/?id=760c4e0033ef4023ba395127a406d3a7&locale=en	12 cm	41 cm

https://www.env.gov.bc.ca/soe/indicators/climate-change/sea-level.html#:~:text=Average%20sea%20level%20has%20risen,centimetres%20per%20century%20at%20Vancouver.

- **Sea level trends identified for coastal B.C. reflect the combined impacts of climate change and vertical land movements.** The coast of B.C. is still rising from a geological process called post-glacial rebound—the rising of land due to past thinning and retreat of the massive ice sheet that once covered much of the province. In addition, the shifting of the tectonic plates generates vertical land motion in coastal B.C. causing parts of Vancouver Island to rise.

- Land along the southwest coast of Vancouver Island is rising at about 25 centimetres per century.
- Climate models project a further rise in global mean sea level of 26 to 98 centimetres by 2100. The rate and magnitude of this rise in sea level will not be uniform over the globe. It will vary from one basin to another, reflecting variations in the amount of ocean warming and the way in which ocean currents redistribute heat and mass.

https://www.dfo-mpo.gc.ca/about-notre-sujet/publications/infographics-infographies/soto-rceo-national/2020/figure-3-sea-levels-niveau-mer-eng.html



Criticisms

1) Design Sea Level uses the year 2100 because of 75 years for building life when beach nourishment monitoring and maintenance will only take place for 30 years. (Application document p. 3)

2) Design Sea Level estimation of Antarctic melting uses the maximum value … to demonstrate a precautionary principle when determining DSL.

-- 0.47m is the most extreme possible by 2100, while the **median** value for 2100 is 0.15m, and 2050 about 0.04m.

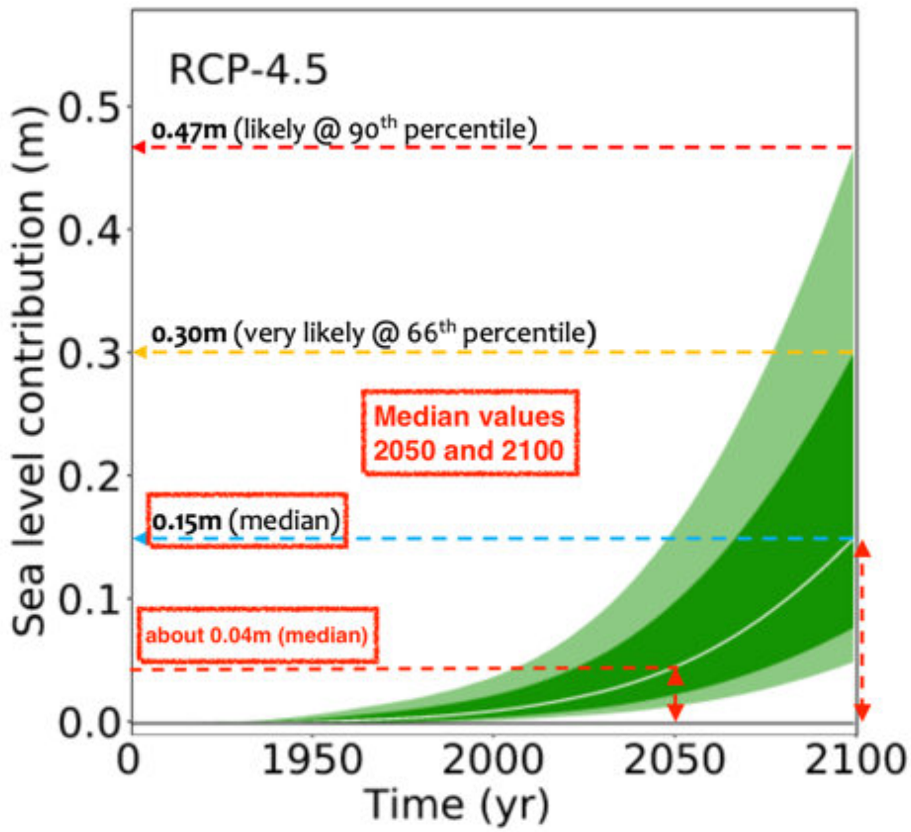


Figure 3. Contribution to sea level by meltwater from the Antarctica ice sheet, as determined in LARMIP-2 modeling[2].

3) Calculation of Antarctic melting of sea level rise is not yet feasible:

https://sealevel.globalchange.gov/resources/2022-sea-level-rise-technical-report/#slr

"Above 5.5°F of global warming, much greater sea level rise becomes possible for the U.S. and globally because of the potential for rapid melting of ice sheets in Greenland and Antarctica. The amount of additional warming required to trigger this is unknown because ice sheet instability is difficult to model and there is great variability in current modeling approaches."

4) this amount of "Beach Nourishment" would have a great cost in GHG emissions – as if sea level rise would be the only consequence of unchecked global warming – sounds like fiddling (playing) while Rome (the world) burns!

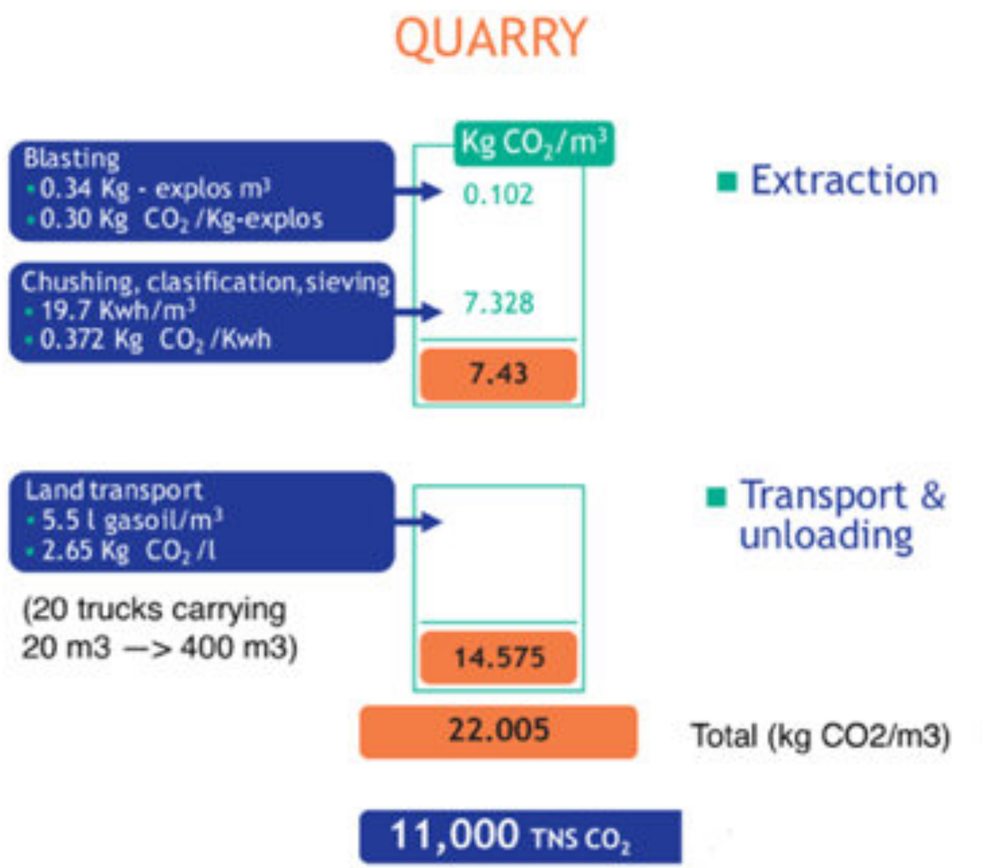
ENVIRONMENTAL IMPACTS IN BEACH NOURISHMENT: A COMPARISON

International Association of Dredging Companies (2010)

https://www.iadc-dredging.com/wp-content/uploads/2017/02/article-enviromental-impacts-in-beach-nourshiment-a-comparison-of-options-119-2.pdf

(this estimate is based on a quarry 30 km (18 miles) from the beach, and total volume of 400 m3: about 55% of the calculated volume for Baker Beach materials, and coming from Sechelt, at least 72 km. by barge)

GHG Emissions of Beach Nourishment from Quarries

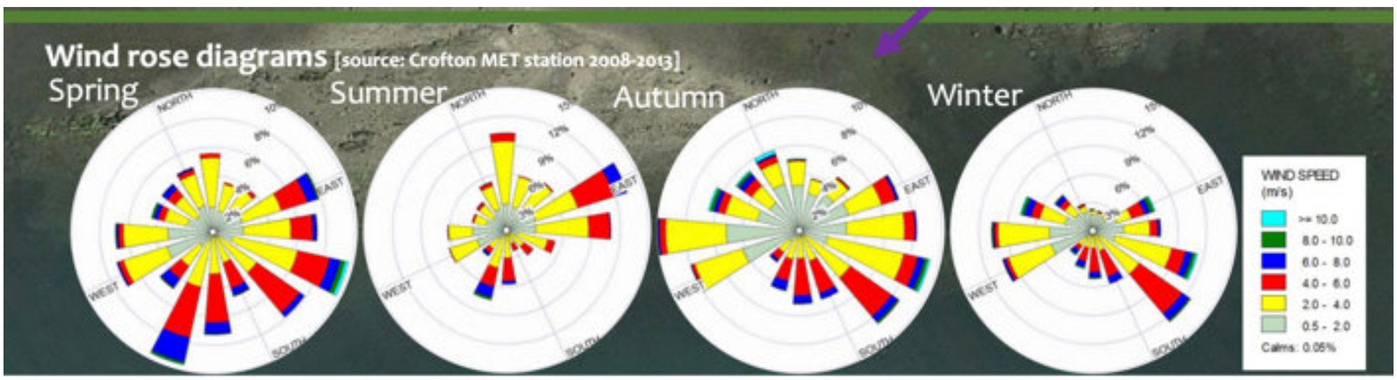


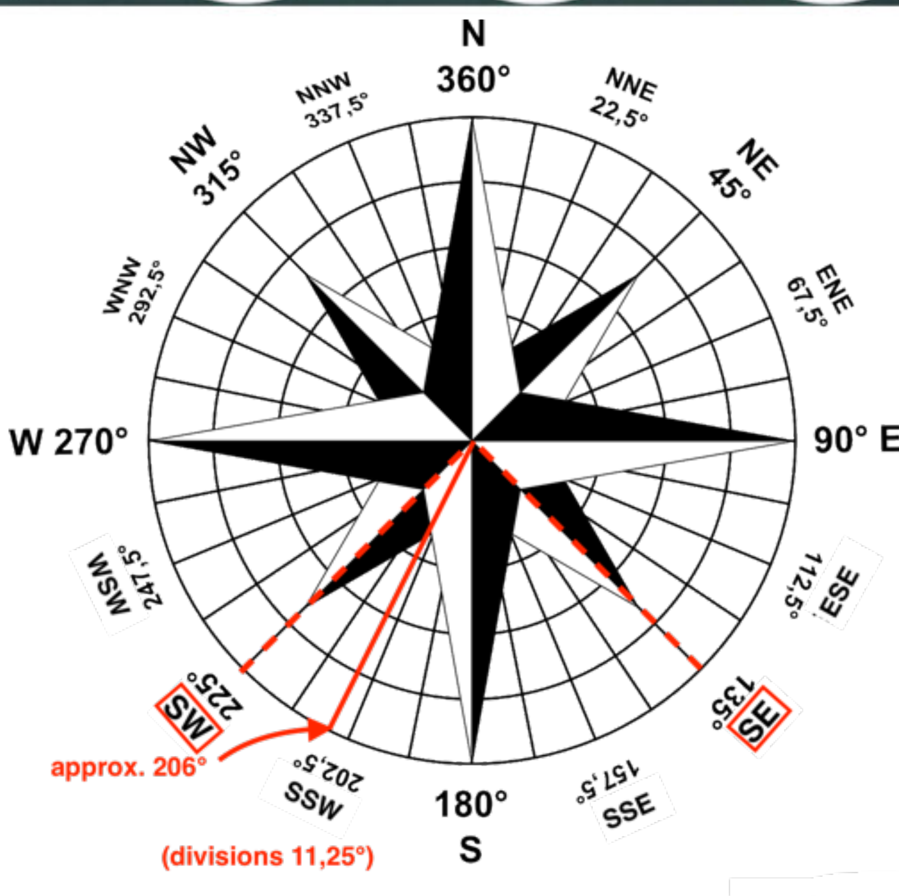
5) if this amount were to be used, and be ‘worth’ the great cost in GHG, 500 m (even 300 m) would be enough to protect most of Ganges.

Wave Energy
(from Geohazards Assessment pp. 100 – 101)

6.4. Wave dynamics
Wind-driven wave generation is largest in the west to northwest direction, creating acute incidence of approach. However, wind rose diagrams (Figure 4) demonstrate a predominantly southwest to southeast winds that reach moderate velocity (≥6.0m/s) (= 13 mph, or 12 knots). These predominant winds would form waves over a maximum 4.6km fetch. There are rarely occurring strong northerly to northwesterly winds recorded for the autumn period which would incur the maximum possible 13.5km fetch for the Site. The reference marine shoreline development guidelines recommend differentiating between Low, Moderate and High energy waves when fetch exceeds 1.6km & 8.0km (respectively) – therefore wind-driven wave energy on Site is determined to be Moderate.

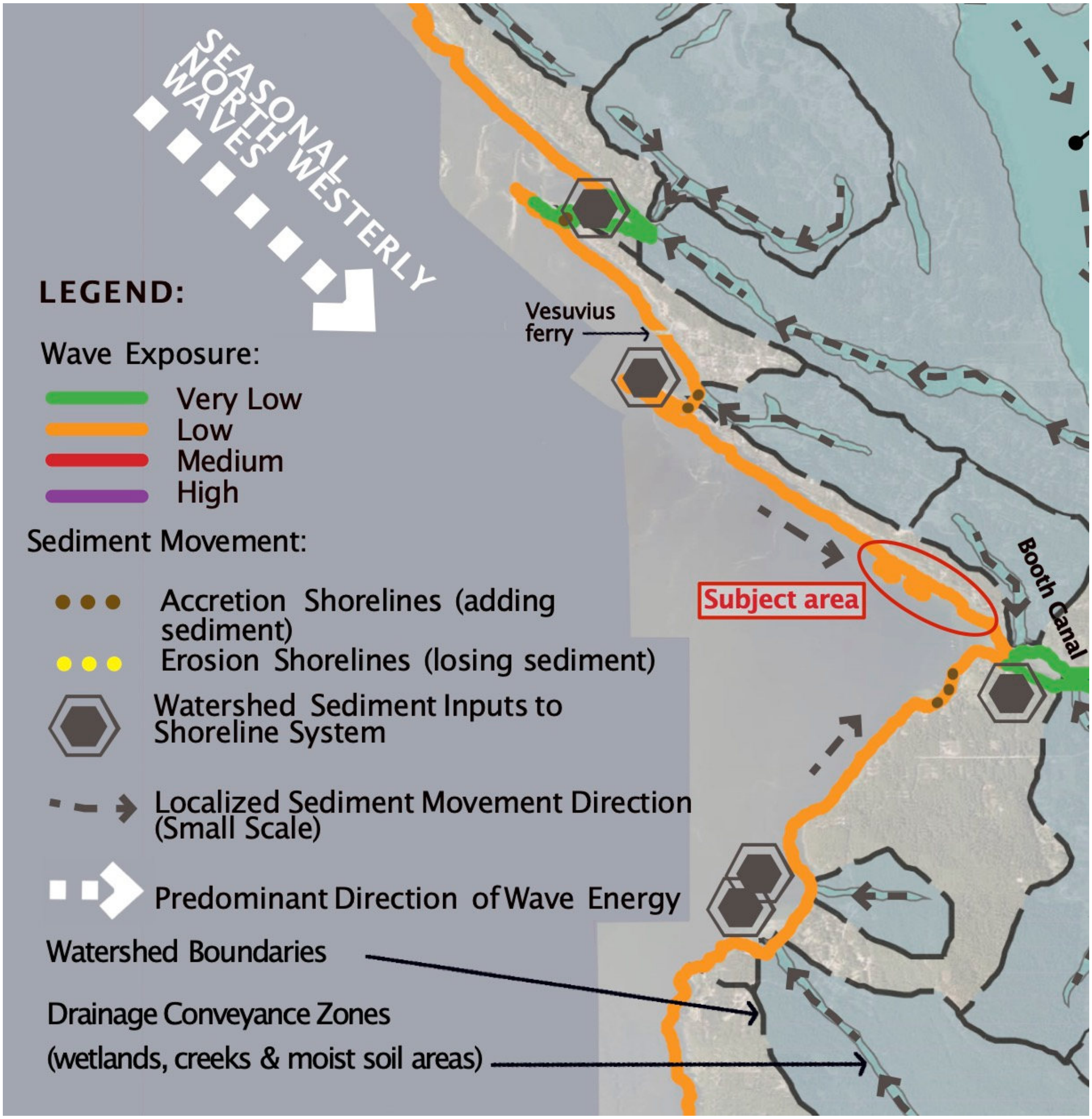
Wind rose diagrams from **Crofton**





Rebuttal:

Islands Trust Erosion Hazard from **Shoreline Mapping**
https://islandstrust.bc.ca/wp-content/uploads/2011/10/11.10.25-IT-Saltspring-shoreline-mapping.pdf



Marine Shoreline Guidelines
https://wdfw.wa.gov/sites/default/files/publications/01583/wdfw01583.pdf

(p. 60) defines Fetch as

Fetch		Relative Wave Energy
0–1 mile	1.6 km	Low
1–5 miles	1.6 – 8 km	Moderate
5–15 miles	8 - 24	High
15+ miles	Over 24	Very High