Baker Rd Properties Project, Beach Observations, 27 March 2023

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This report provides a short review of a site visit to the *Baker Road Properties* (235,237, 239 Quarry Rd; 431, 434 Baker Rd) on northwest Salt Spring Island. The purpose of the visit was to examine the shoreline and immediate backshore of five waterfront properties near the west end of Baker Rd. Of particular interest was the condition of the cliff or bank along the shore, the morphology of the foreshore and the composition of beach sediments. The shoreline was walked from the Quarry Drive Park beach access (~235 Quarry Rd) to approximately 120 m east of the Baker Road beach access (431 Baker Rd) – a 500m distance. The survey was near low tide (0.96m at 16:010) so most of the intertidal zone was exposed (Fig. 1).

Figure 1. A 2021 aerial photo of the Baker Rd Properties showing property boundaries and general intertidal morphology. (source: *CRD Natural Areas Atlas*)

General Shoreline Description

The shoreline orientation is controlled by the bedrock structure and is exposed to the west and northwest. Wave fetches to the northwest are in the order of 20 km (10 n mi) making this a *semi-protected* shoreline. The shoreline is a combination of rock and sediment (Fig 2). The bedrock is shale and siltstone (Nanaimo Group; Muller 1980). A wave-cut rock platform has been cut into the bedrock leaving a relatively gradual foreshore slope and a steep bedrock cliff in the backshore. The bedrock platform has a discontinuous veneer of pebbles, cobbles, and boulders (Fig 3). There is a continuous beach (~5 m in width) in the upper intertidal at the base of the cliff; sediments on the beach are pebble to sand-sized, shale fragments that have weathered off the cliff face (Fig. 4). The are two large intertidal siltstone reefs offshore that provide shelter so that muddy sand has accumulated in the wave shadow of the lower intertidal zone landward of these reefs (Fig. 1, 2).

Figure 2. Drone photo of the Baker Road Properties foreshore looking to the southeast. From left to right, there is (a) a cliff in the supratidal zone, (b) a narrow sand beach with logs, (c) a rock platform with a discontinuous cover of pebbles, cobbles and boulders, and (d) a sand flat inside of (d) the two offshore reefs.

Figure 3. Ground photo of the Baker Road Properties foreshore looking to the southeast. The siltstone bedrock is very prominent.

Erosion on the cliff varies along the shore with some segments showing more stability due to resistant bedrock and some segments showing less stability where the siltstone is *friable*[1]. On friable sections, one can scrape off sediment by hand (Fig. 5). Stability is indirectly indicated by growth of vegetation on the cliff face. For example, the cliff at 431 Baker Rd is almost completely vegetation covered (Fig. 6), indicating greater stability. The rate of cliff erosion has not been documented.

[1] **Friable:** *easily crumbled as would be the case for rock that is poorly cemented*. (American Geological Institute 1976)

Figure 4. A narrow (~5m-wide) pebbly sand beach just below the high-water line and seaward of the cliffs (looking NW). Much of this beach is comprised of *plate-like* shale fragments eroded from the cliff face.

Figure 5. The cliff at the 235 Quarry Rd property is mostly bare of vegetation and material can easily be scrapped off the cliff face.

Sediment Dispersal System

The primary source of sediment to the shore system is from cliff erosion. Most of the material presently being eroded is fine and is carried alongshore to the southeast by wave-driven alongshore currents. Some of the coarser sediment, boulders and cobbles, may be derived from erosion of glacial till layers, where the fine sediments of the till are swept away by waves and tidal currents, and the coarser components (pebbles, cobbles and Boulders) remain as a surface lag on the bedrock. While no direct indicators of longshore transport were noted during the survey or on aerial photos, the dominant fetches from the west and northwest will drive a southeast-directed longshore transport. Sediments to the southeast are finer and there is a very large ebb-tidal delta at the western entrance of Booth Inlet. These sediment trends support the assumption that sediment transport is from northwest to southeast.

Figure 6. The cliff at the 431 Baker Rd property is almost totally vegetated, suggesting greater stability than sections further to the northwest.

Existing Anthropogenic Modifications

The Baker Rd of section of properties are in a near natural state. But to the north, a bulldozer has scraped boulders into linear, groyne-like features in the intertidal zone at the 183 to 205 Quarry Rd properties; these features have <u>not</u> been effective at catching sediment. Between the 234 Quarry Rd and 431 Baker Rd properties, there are three sections of rip-rap (large boulders) placed in the upper intertidal zone at (a) the NW CRD access stairs (10m alongshore length), (b) a private residence at 241 Quarry Rd (30m of along length) and (c) the SE CRD beach access stairs (30m of alongshore length). A total of 70m of rip-rap presently exist along 500m of shoreline (14%).

Figure 7. Aerial photo of the shoreline near 201 Quarry Rd showing groynes created from beach boulders. There is no strong indication of sediment accumulation within these groynes or longshore transport direction. (August 2021 *ShoreZone* photo)

Recommendations

Property owners are concerned about erosion along their seaward property boundary. The cliff extends along the entire 500m section of shoreline. The toe erosion at the cliff base has created this cliff morphology. Some sections are more actively eroding than others as evidenced by the degree of vegetation growth on the cliff face. In view of projected sea level rise of 1m or more by 2100 (IPCC 2019) this trend is likely to continue.

Potential anthropogenic responses to sea level rise are summarized in Figure 8. A combination of ***protection strategies*** and ***eco-system-based adaptation*** are considered for this site.

1. Reducing toe erosion at the base of the cliffs will contribute to reducing the retreat rate of cliffs. This may be achieved by a combination of a *protection strategy* (using rip rap) and *ecosystem adaptation strategy* (using placement of a beach berm against the base of the cliff).
2. Another *ecosystem adaptation strategy* would be to pull back the upper portion of the cliff, where possible, to reduce the cliff-face slope. A lower gradient slope would provide for a better riparian habitat to establish vegetation on the cliff face. Implementation of a *riparian planting strategy* with drought-resistant vegetation (a mix of understory plants and trees) would also contribute to cliff stability.

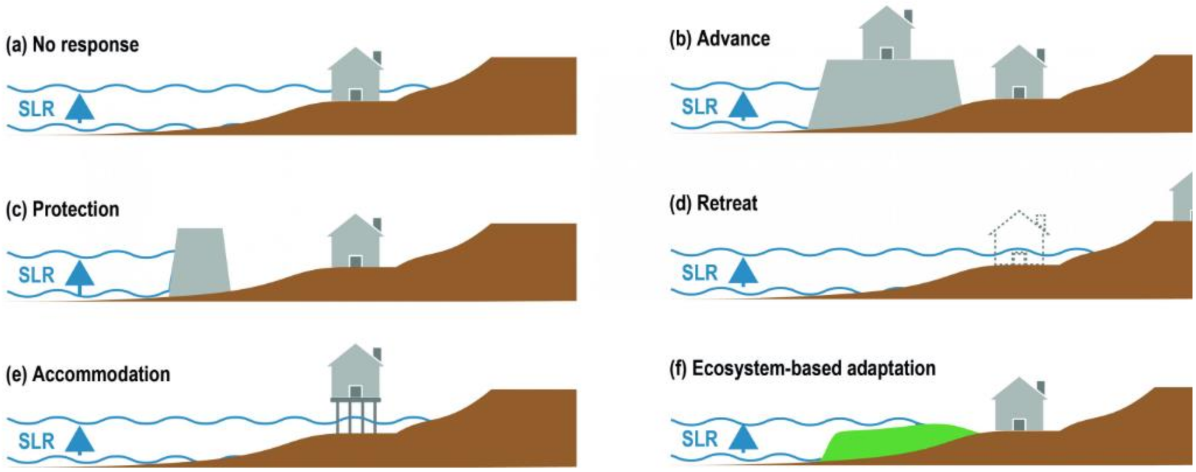

Figure 8. Potential anthropogenic responses to sea level rise (from Oppenheimer et al 2019).

3. While these strategies will likely provide a reduction in cliff erosion over a decade or two, the accelerating rise in sea level will eventually re-activate the cliff erosion without ongoing mitigation. Longer term strategies should also consider *retreat of infrastructure* from the cliff edge.
4. As part of any foreshore works, property owners should consider a cliff edge monitoring program to document the rate of retreat and to provide a better planning metric

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