Executive Summary of "Neskowin Shoreline Assessment, Coastal Engineering Analysis of Existing and Proposed Shoreline Protective Structures"[1]

Preface[2]

The Neskowin Coastal Hazards Committee determined that a coastal engineering perspective was needed to evaluate thoroughly the erosion problem that Neskowin faces. In the summer of 2011, the Committee asked six coastal engineering firms to submit proposals for the evaluation. The proposed work included: (1) a science/literature review; (2) an analysis of existing and potential shoreline protective structures and other options for Neskowin; and (3) a Final Report containing key concepts, recommendations, and preliminary costs. The engineering firm ESA PWA, San Francisco, CA received the contract to carry out the study. The work was funded by generous contributions from the Neskowin Community Association, Proposal Rock Homeowners Association, South Beach Road Association, individuals from the Neskowin community, and the Oregon Department of Land Conservation and Development.

Background

The erosion problem at Neskowin has a variety causes: (1) high total water level (TWL), (2) reorientation of sediment movement between Neskowin and Pacific City (the Neskowin Littoral Cell), (3) rip currents, and (4) structural effects.

(1) Total water level is a composite measure of the tides, storm surge, seasonal variation, dynamic wave setup, wave run-up, and sea level rise. Future total water levels may be higher as a result of increased storm wave heights and El Niño activity, potentially leading to more frequent overtopping of the riprap revetment and flooding of the community (upland).
(2) The Neskowin beach currently is sediment starved because of the net northward transport of sand in the Neskowin Littoral Cell, a likely El Niño-induced pattern. Typically, this pattern would be expected to reverse (counter rotate) and bring sediment back to Neskowin. Although it is uncertain whether the counter rotation will occur, proposed erosion mitigation strategies should not block the potential future southward migration of sand.
(3) Rip current embayments are a common feature of the Neskowin shoreline. The complex interaction between incoming waves, Proposal Rock, Neskowin Creek, and the riprap produce a persistent, erosive rip current north of Proposal Rock.
(4) The influence of structural effects on beach erosion refers to the consequence of constructing the riprap revetment on a sand base. In the Neskowin area, bedrock is buried too deeply to base the riprap on solid rock and, as a result, settlement, erosive undercutting, and structural damage of the revetment are common.

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[1] This is a summary of a report prepared by ESA PWA, David Revell, Ph.D., Project Manager, dated March 12, 2013, under contract to Tillamook County at the request of the Neskowin Coastal Hazards Committee (NCHC). The aforementioned committee prepared this summary, but it does not necessarily represent the views of the NCHC.

[2] Comments by the NCHC itself are in italics.

The effects of all of these causative factors are amplified by increased wave exposure resulting from the narrowing of the beach and the decreased ability of the beach to dissipate incoming waves.

Methods

Multiple approaches were used in the Neskowin shoreline assessment.

(1) The total water level was calculated using a composite slope run-up method that factors in the slope of the beach and the slope of the revetment. Two cross-shore profiles were used for these calculations; one profile was south of Proposal Rock, the second was north of the Rock.
(2) Future changes in the widths of the beach and the upland were estimated using a proprietary computer model for predicting changes in beach profiles (BEACH10). Beach width and erosion rate were varied in the computer simulations: beach widths were either wide (250 ft) or narrow (100 ft) and erosion rates, based on historical changes, were either low (1.99 ft/yr) or high (6.43 ft/yr).
(3) Cost estimates for existing structures and alternative erosion mitigation strategies were determined based on the experience of ESA PWA with similar projects. Life cycle costs for the existing riprap revetment were estimated from the maintenance history of the structure.
(4) Innovative options for shoreline protection were reviewed.

Results

<u>Composite slope analysis</u>

The composite slope run-up calculations were verified by TWL observations provided by the Oregon Department of Geology and Mineral Industries and by anecdotal observations of wave overtopping from several events. The 100-year TWL computed with the composite slope method is higher than that previously calculated by other analytical methods, and, as a result, ESA PWA recommends that the top of the riprap revetment should be raised by 8 ft (*on average*).

<u>BEACH10 modeling</u>

Five erosion mitigation strategies were tested with the BEACH10 model: (1) managed retreat (*no riprap present*); (2) riprap revetment; (3) seawall; (4) nourishment (the addition of sand to the beach); and (5) a segmented, shore-parallel breakwater plus nourishment. The program determined the resulting width of the beach and upland when using each of these mitigation strategies projected from the present to 2050. *The starting condition for all model runs is that the current riprap is not present.*

The managed retreat model run starts with an initial 40-foot increase in beach width (*to take the width of the current riprap into account*). After this increase, the beach width remains unchanged in the model runs, and the width of the upland decreases steadily. This decrease in upland width is equivalent to landward migration of the shoreline. In the low erosion model, the shoreline moves 80 ft landward by 2050. In the high erosion models, the shoreline moves 250 ft landward.

The upland width does not change for the other four mitigation strategies. By 2050, changes in beach width for the revetment and seawall options are: (1) a loss of 90 ft of beach for the low erosion, wide beach model; (2) a loss of the entire beach for the high erosion, wide beach model; and (3) a loss of the entire beach by 2025 for the high erosion, narrow beach model. It is important to note that because the models assume the current riprap is not present, construction of a revetment immediately subtracts 40 ft from the beach width and construction of a seawall subtracts 10 ft.

The beach nourishment and breakwater options start with an initial 100-foot increase in beach width because of the added sand. The nourishment model runs predict that the width of the beach in year 2050 will be reduced to 242 ft for the low erosion, wide beach; 94 ft for the high erosion, wide beach; and 0 for the high erosion, narrow beach. Construction of a breakwater plus nourishment is projected to lead to year 2050 beach widths of 262 ft for the low erosion and high erosion, wide beaches and 112 ft for the high erosion, narrow beach.

Cost estimates

Construction costs for five shoreline protection alternatives for Neskowin were estimated assuming a total shore length of 7,000 linear feet (1.3 miles). The proposed alternatives and their roughly-estimated, initial costs are: (1) altered riprap revetment, height increased with a rock cap, $7 million; (2) altered riprap revetment, height increased with a concrete wall, $14 million; (3) structural modifications to buildings, $14 to $27 million; (4) beach nourishment, $18 million; and (5) nearshore breakwater, $38 to $58 million. The estimates do not include costs for permitting, design, monitoring, and maintenance of these alternatives.

Life cycle costs for the current riprap revetment were estimated from the cost of repairs to the riprap between 1999 and 2008. Over this period, repair costs were approximately $73,000/yr, yielding an estimated expense of $3 million (present day dollars) for repairs to the riprap revetment between now and 2050.

Innovative options

The advantages and disadvantages of six innovative erosion mitigation options were reviewed. The options include: breakwaters, wave tripping structures, pile baffle walls, T-head groins, pile groins, and dynamic revetments. From this list, only breakwaters are viewed as being a viable alternative for Neskowin. Rejection of the other options is based on their being: (1) unable to withstand the waves in Neskowin (wave tripping structures); (2) traps for debris that could lead the structures failing under the force of the waves, in addition to being unsightly (pile baffle walls and pile groins); (3) potential barriers to the return of sand if counter rotation occurs in the littoral cell (T-head and pile groins); (4) structures that might cause rip currents (T-head groins); and (5) sources of cobble projectiles and barriers to beach access (dynamic revetments).

Findings and Recommendations

The ESA PWA report ends with a list of 14 findings and recommendations. These items include: (1) recommendations based on the results of their analyses (beach nourishment and breakwaters offer protection for the beach and community, managed retreat will maintain the beach); (2) suggestions for protecting structures (elevating houses, dynamic revetment and gabion matting to protect the Hawk Creek bridge; (3) descriptions of alterations that might improve the performance of the existing riprap revetment (increasing the surface roughness, overlaying additional rocks, deepening the foundation, creating a sacrificial toe by adding additional rocks on the beach in front of the riprap, limiting the ponding of water behind the revetment); (4) speculative proposals for reducing erosion (stabilizing the location of rip embayments, transferring sand from the dunes to the beach); (5) a review of life cycle costs for the present riprap revetment; and (6) a suggested mechanism to fund erosion mitigation options (formation of a geological hazard abatement district).