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COASTAL GEOLOGIC HAZARDS AND CLIMATE CHANGE

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When contemplating Rhode Island coastal geologic hazards, one must consider: 1) hurricanes (tropical cyclones), 2) extratropical cyclones ("Nor'easters"), and 3) sea-level rise. The hazards give rise to these geologic processes: 1) frontal erosion from breaking waves and swash run up, 2) storm-surge overwash, and 3) an elevated level of mean-higher high water into the future. Scale of these processes is: 1) breaking waves: 1 to 3+ meters at the shoreline, 2) storm-surge overwash: 0.5 to 4 m water depth across the shore zone, and 3) sea-level rise: 3 mm per year at present.

The south shore of Rhode Island is a microtidal (1.05 m mean, 1.17 m spring range) mixed wave/tide dominated shore; Narragansett Bay also is microtidal (1.05 m mean Newport, 1.34 m Providence; spring range- 1.17 m, 1.47 m respectively). Geologic shore zone types and percentages are:

1) beach plain/barrier spit – 25%,
2) glacial stratified material bluff – 8
3) till bluff – 23%
4) Meta-sedimentary bedrock – 8%,
5) Igneous/other meta bedrock – 5
6) Discontinuous bedrock – 1
7) Shore protection structure – 28%

Frontal erosion rates range from 120 meters over 70 year time span to undetectable. Erosion rate is of course controlled by shoreline type, but glacial stratified material headlands erode at the same rate as beach plains and barrier spits. Shoreline protection structures (revetments, bulkheads and seawalls) are considered a viable geologic shore-zone type if they co-opt the naturally occurring shore at that location.

Storm surges range from 2.9 m above MHHW (1938 category 3 hurricane) to 0.9 m (Patriots Day 2007 extratropical cyclone). Sustained southeast winds may cause extratropical surges to extend over 5-9 tidal cycles. Relative sea-level rise of 25.8 cm per 100 yr has resulted in a 22 cm rise since 1930 and 17 cm since 1938.

Continuing frontal erosion combined with a possible accelerated sea-level rise of 1-1.5 m by 2100, and perhaps by 2050, will allow storm surges from major extratropical and tropical events to penetrate further inland and result in deeper water depths than present obsolete maps suggest.

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