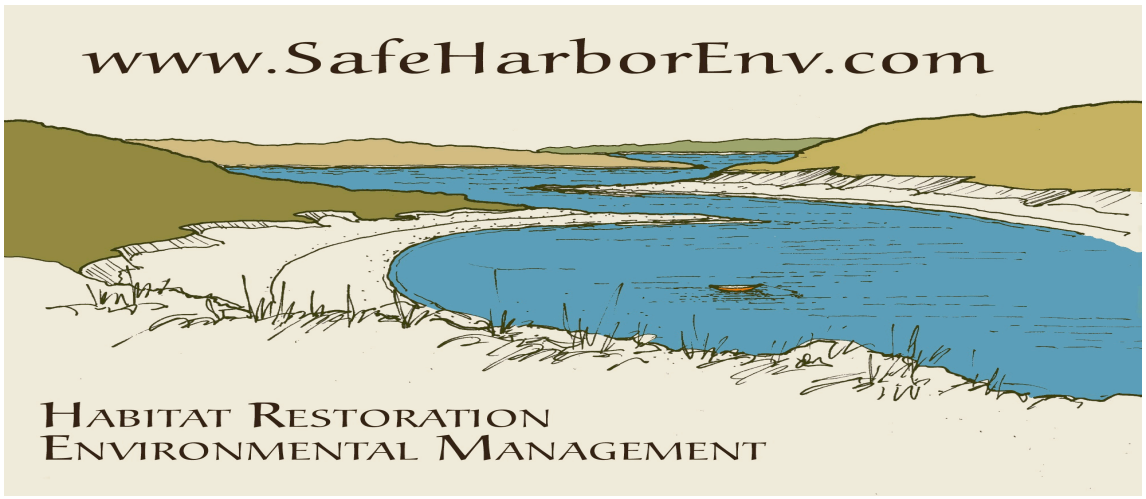
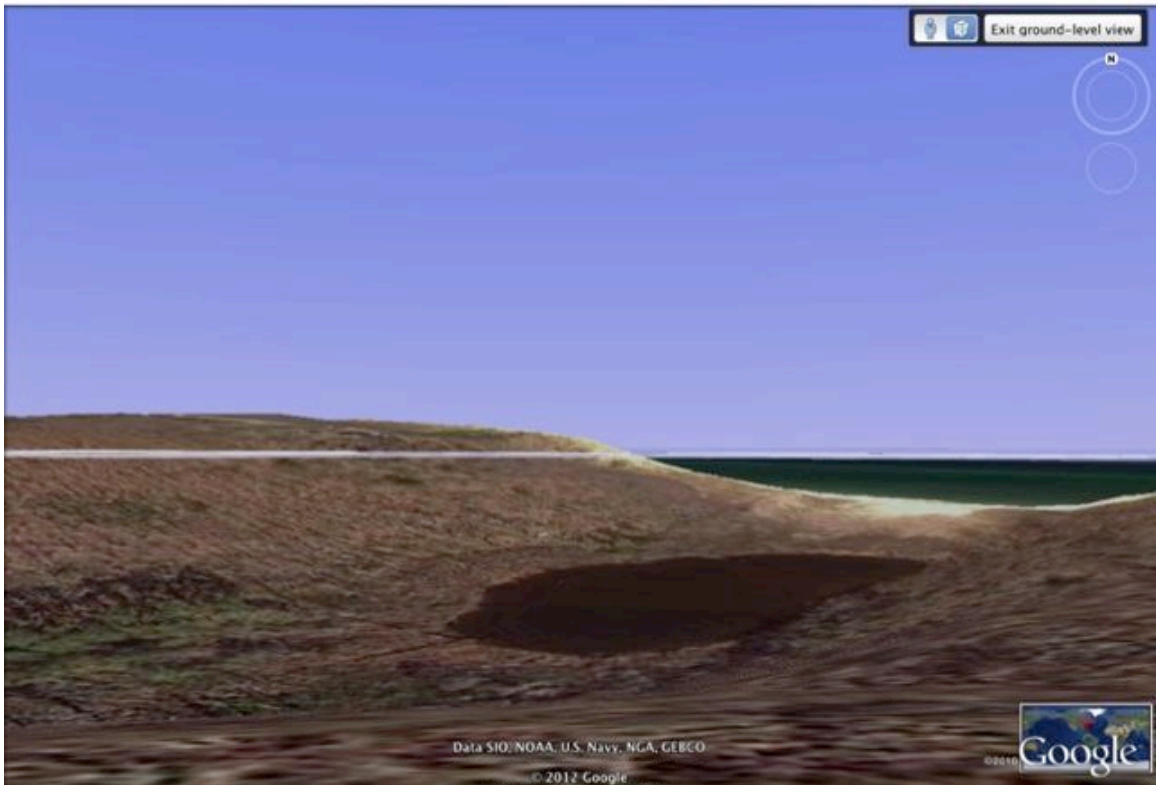


BREACHED COASTAL PONDS Geomorphology & Climate Change

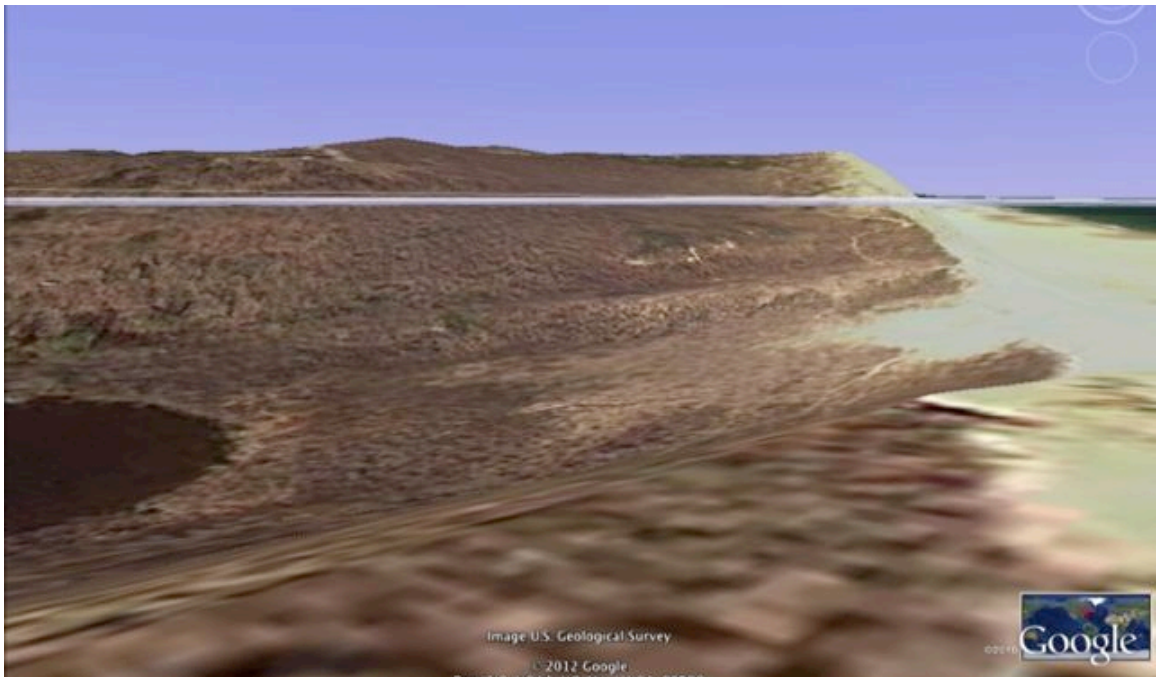
Gordon Peabody, Safe Harbor, 2016, gordonpebody@gmail.com



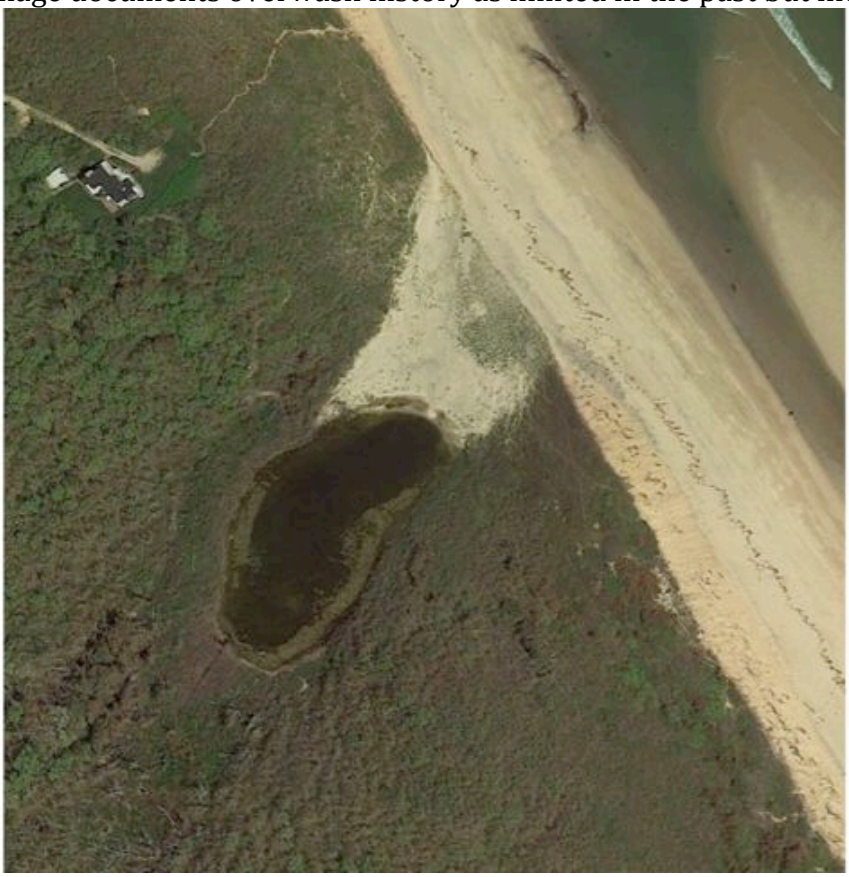
Extraordinary cross section illustrating geomorphological transition from a full size fresh water pond to a minimal, breached coastal pond. When coastal erosion removed the bank protecting the pond, volume was significantly reduced. Adjacent erosion provided a sand source for a barrier dune to form on the seaward margin. This low, saddle shape, directed onshore winds between the higher elevation coastal banks, enhancing additional, aeolian deposition of unconsolidated sediment. Recent, high energy, mega storm pulses, have contributed to overwash events at this pond.

Above and below: Two perspectives of a breached pond under study. Bowl shaped depression of original pond is clearly visible. Images are before recent mega storms.

Ocean shoreline diversity is characteristic of high stress. This is in contrast to pond margins with significantly higher diversity that might not be possible without the stabilizing presence of the wetland resource. Reports of salamanders populating this habitat pond may suggest a low population of fish, which would consume salamander eggs. We have been synoptically studying pulse event impacts to profile, margin recovery and periodically observing aquatic plant diversity as a function of fresh water restabilization, following multiple pulse events including overwash.



Above image documents overwash history as limited in the past but increasing.


Overview following multi year, periodic, pulse events from mega storms. Overwash energy reduced margin elevations by transporting sand to lower elevations. Overwash events created multiple, chemical and physical intrusions into this pond.

Above image shows nearshore rip channel and sandbar adjacent to this coastal pond. Sand bars are components of linked, coastal resource systems. One way they perform is by creating benthic friction, reducing storm wave heights. When onshore, storm wave loading piles water inside sand bars after the tide has turned; rip channels develop, providing equalization of SSH. During long duration storm events, wind directions may remain unchanged through multiple tide cycles. On the incoming tide, full height waves can access limited sections of coastline. We believe that many anomalous erosion events may be linked to the existence of rip channels.

Safe Harbor image: Studying the results of a previous overwash. Note the pond in background. Note also the drop in elevations leading down to the pond. Anthropogenic impacts from hikers has contributed to overwash vulnerability.

Image by G. Peabody: Barrier dune and pond margin, after several overwash events.

Above image details geomorphological transitioning of pond margin, barrier dune habitat. Limited area of transported sand benefitted the barrier dune elevation but the preponderance of ovrwash transport activity, characteristicly moved sand to lower elevations. Some of this transported sand volume was added to the pond edge. Vegetation in both the low and high diversity habitats was impacted by the physical stress of deposition and chemical stress of salt water during overwash.

Image by G. Peabody: Approximately 18,000 sq ft, 6-800 cubic yards of overwash fan, covered the entire pond margin, from the barrier dune to the pond itself.

Image by G. Peabody: Documentation of overwash fan into a breached coastal pond. While this may be considered detrimental on a short time scale, the additional sand elevations may contribute to enhanced protection of the pond on a longer time scale. Because the pond margin vegatation evolved within a lower stress, exposure to salt stress resulted in 100% mortality for exposed, pond margin vegetation.

Image G. Peabody: Approximately 35 feet of the pond's seaward edge received sand.

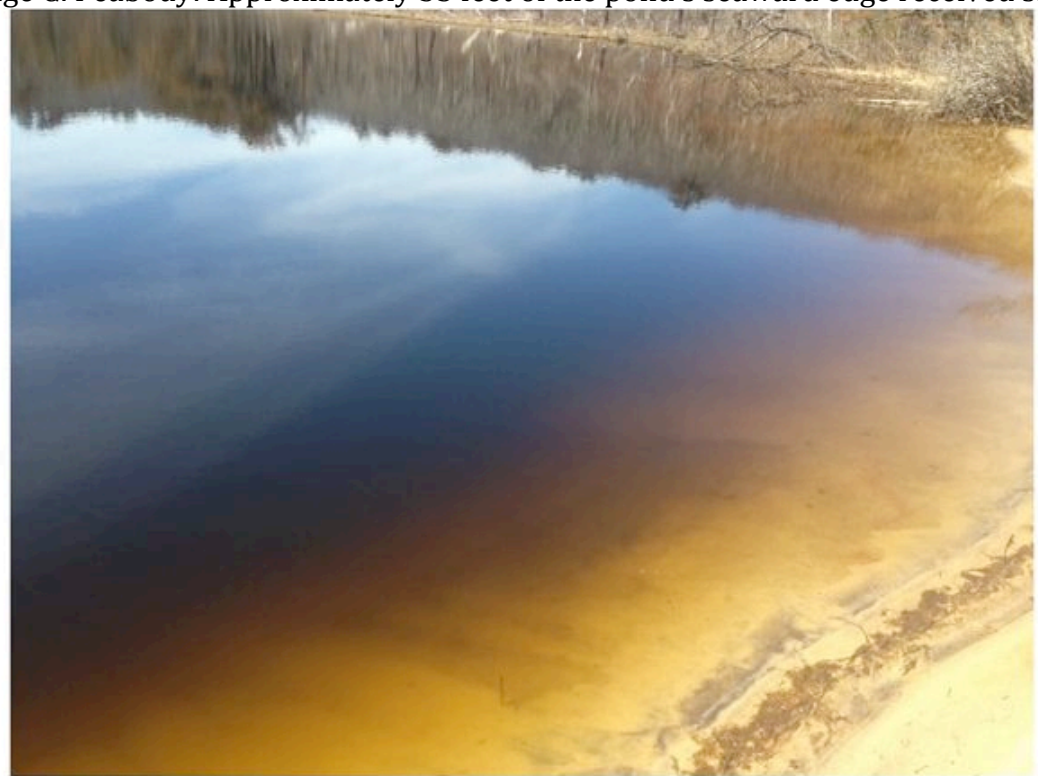


Image by G. Peabody. Benthic cores should confirm annual, windblown sand layers from winter stoirms and more recent, heavy layers representing overwash. We are monitoring this area to record diversity and abundance of recovery species as a way of studying some of the synergistic parameters of transitional, habitat stress.

Above image shows active recovery in the low diversity, higher stress, barrier dune overwash habitat. The lower stress, higher diversity area of pond margin impacted by overwash is much slower to respond and so far has shown no recovery.

Above image by G. Peabody (taken from above overwash area) ilustrates active rate of habitat recovery in high stress, low diversity, barrier dune habitat. American Beach Grass dominates. Very limited, additional diversity includes Rugosa rose, Beach Pea and Seaside Goldenrod. Native vegetation growing in high stress barrier dune habitat shows extraordinary stress tolerance and resilient recovery to overwash overwash events. This performance enhances habitat sustainability.

Another ocean side, breached coastal pond, including the signature barrier dune and change in patterned vegetation. This site still exhibits diversity but is geomorphologically advanced, with grown trees and only a small wetland area remaining at the center of the old pond. Hydric soils are widespread, as expected.

Image by G. Peabody. A lateral perspective of the breached pond basin. Intermediate stress levels have re-established in some areas, as indicated by lower plant diversity. The remaining, lower stress, high diversity, vestigal wetland area can be seen in the center of the image. The tree elevations remain below dune crest levels.

Image by G. Peabody. Barrier dune, bracketed between coastal banks, provides classical confirmation of breached pond geomorphology. This particular dune exhibits good stability, in part because of reduced anthropogenic impacts.

Image by G. Peabody: Characteristic breached coastal pond beachface, showing margin between coastal bank and coastal dune. Note differential sediments: Unconsolidated aeolian sediments on left; consolidated glacial sediments on right. Multiple breached ponds exist on both the ocean and bayside of Cape Cod.