

3-year PEM installation at Hillsboro Beach, FL.

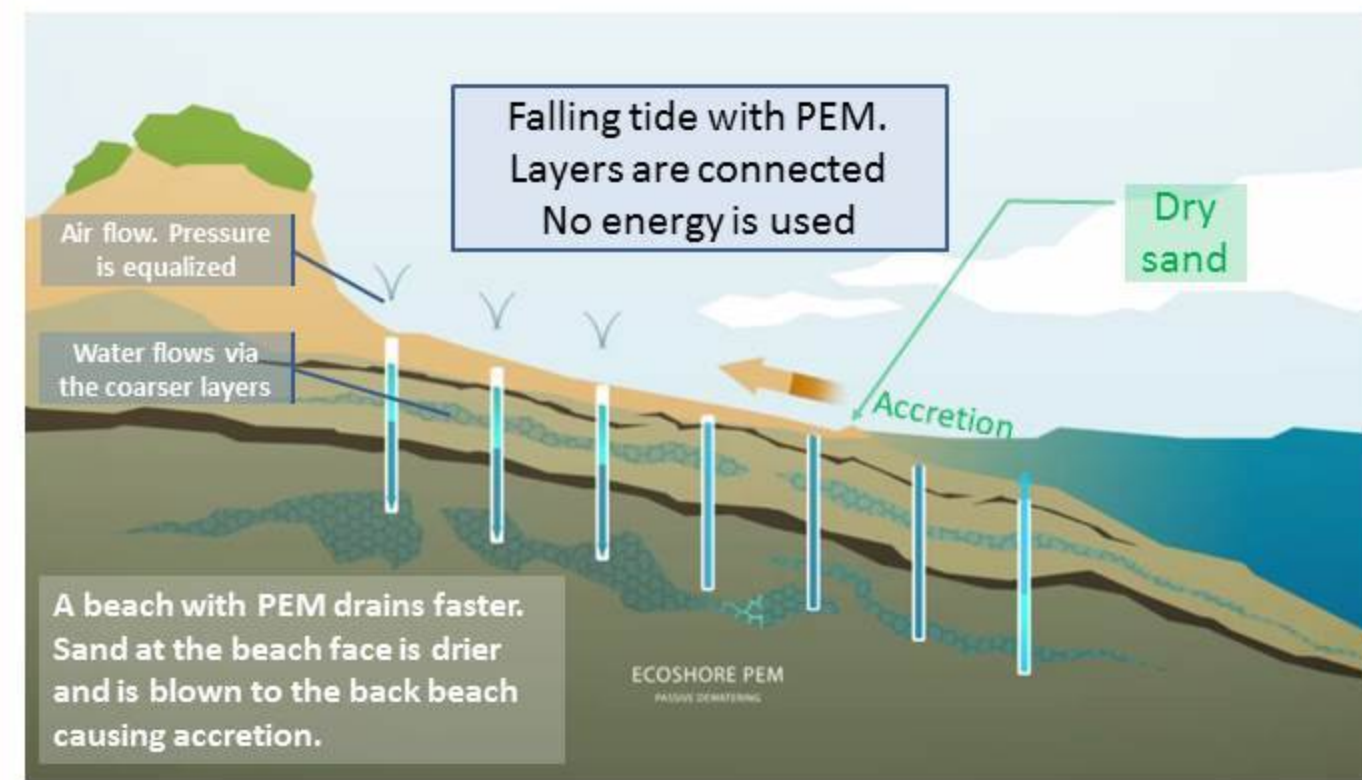
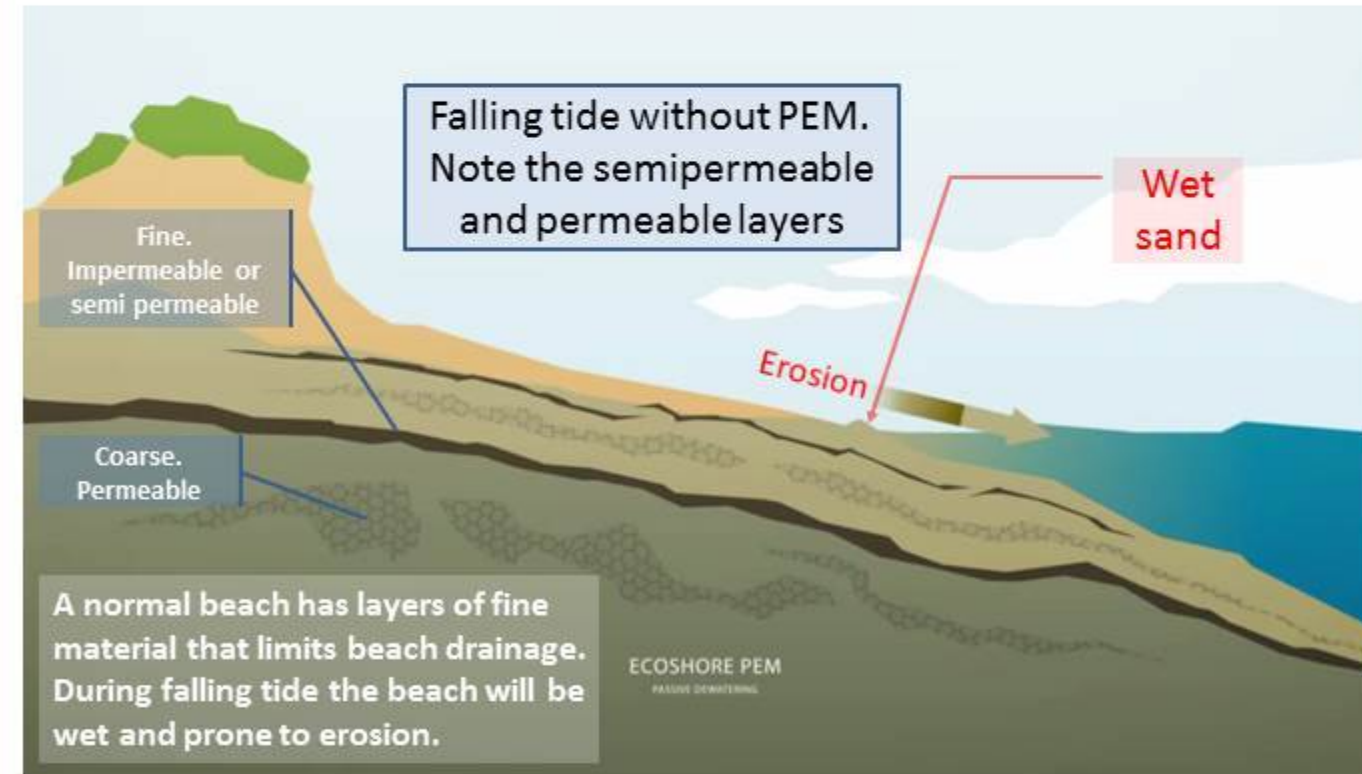
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Introduction

Pressure Equalizing Modules (PEM) are passive drain tubes installed vertically in a beach to mitigate beach erosion. A PEM system was installed at the chronically eroding Hillsboro Beach for 3 years from Feb 2008 to Jan 2011. The purpose of this study is to compare test data with historic data (2001-2007).

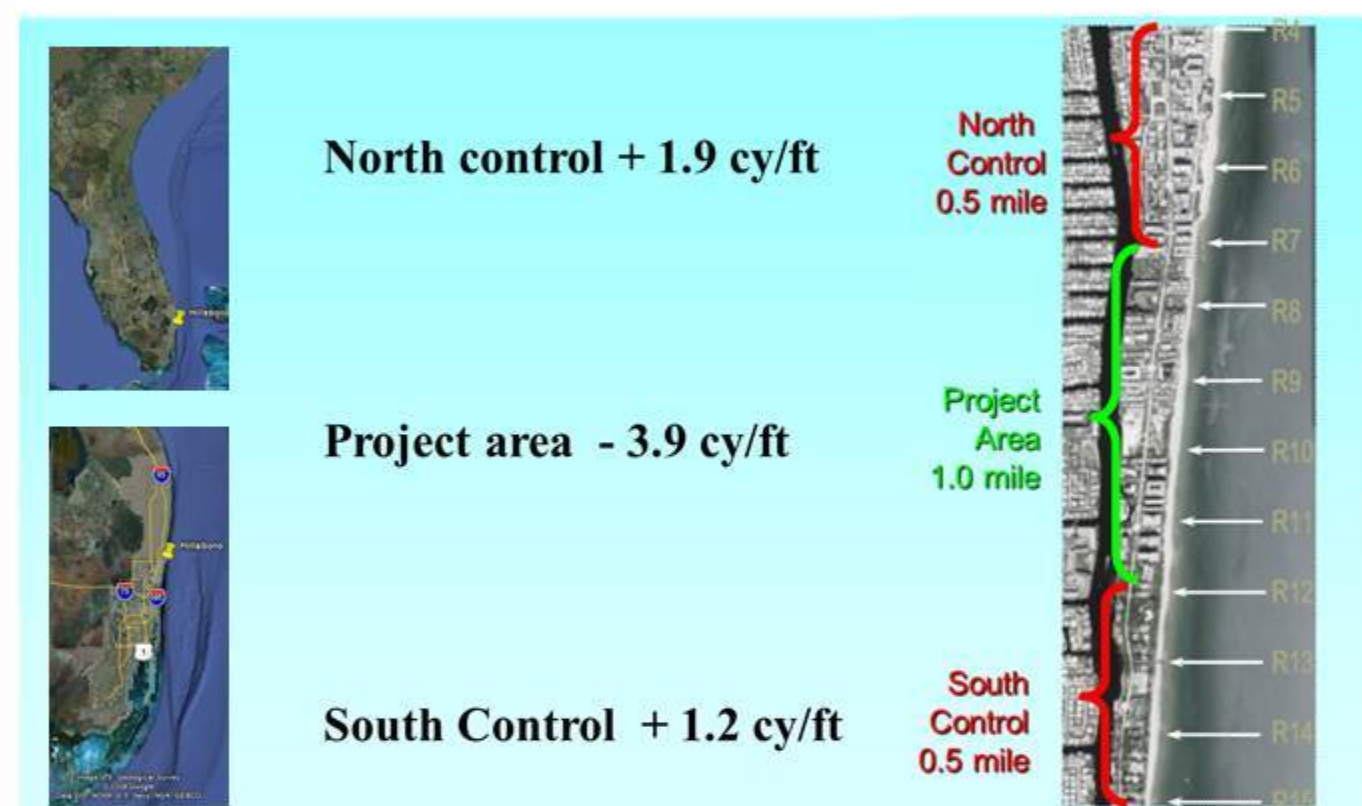
PEM Technology

Pressure Equalizing Modules (PEM) are passive drains installed vertically in a beach below the surface. PEM enhances the beach's ability to drain. More water percolates through the top layer of the beach causing extra sand grains to be deposited on the beach rather than pulled away by the swash. The wind will blow the dry sand further onto the beach and the dunes.



Test site Hillsboro Beach, FL

The test site is located 25 miles North of Miami, FL on the Atlantic coast. The project area R7-12 had been eroding for decades partly due to groins at R6. Predominant winds are from Northeast. Littoral drift is from North to South. Annual erosion rates from R-monument line to Depth Of Closure in cubic yards per shore foot from 2001-2007: (Olsen and Associates, FL)



- Pre-PEM installation February 2008**
- Validate physics: Installed water wells/PEMs - Very high groundwater level
- PEM Installation in February 2008**
- Installation completed in 2 weeks
 - 90 PEMs installed with drill
 - Very poor beach condition
 - >50% of PEMs were reduced in size



PEMs were installed in Feb 2008 and removed in Jan 2011, prior to a beach nourishment project (340,000 cy) at R7-12.

Surveys were conducted according to FDEP guidelines by SEA Diversified after 6, 12, 24, and 36 months. Beach elevation was recorded at each PEM location at installation and removal.

Due to severe erosion prior to project start two nourishments, 8,500 cubic yards, were placed near R 7 during the first year. This amount has been deducted from all volumetric data.

Results

The overall result of the test was that the previously chronically eroding part of Hillsboro Beach, R7-12, after 3 years with PEM was no longer eroding. As can be seen from the table below "Beach elevation at removed PEMs" the beach was approximately one foot higher at the time of removal than at installation 3 years prior.

Surveys of volumetric change (DOC, MHW, -5ft) and shoreline change were conducted one month after removal of PEM, at which time the sand had started to wash away. Still the data show that sand volume had grown and shoreline advanced as can be seen below.

Beach Elevation At Removed PEMs (ft)			
	Installation	Removal	Change
Row A (MLW)	-2.26	-0.08	2.18
Row B	0.21	1.83	1.62
Row C	4.46	4.25	-0.21
Row D (Dune)	4.80	5.45	0.65

(Avg. +1 ft)

Volume data in PEM area to DOC (surveyed 1 month after removal)

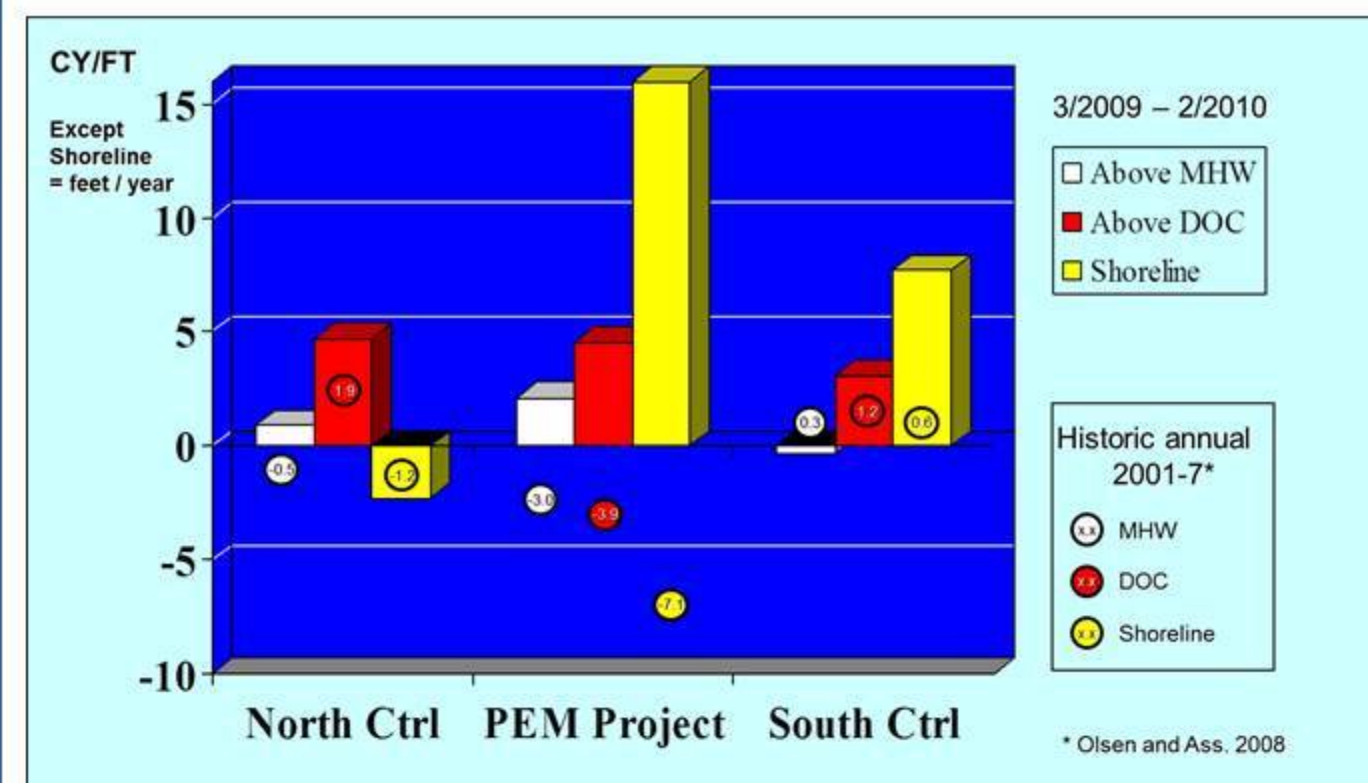
- Accumulated sand to depth of closure (DOC): 47,000 cy
- Sand placed in test area during 2008 / 2009 (truck hauls): 8,500 cy
- In total, the test area added (47,000 - 8,500) = 38,500 cy in 3 years
- The same area historically lost an average 21,000 cy annually = -63,000 cy in 3 years

Shoreline data in PEM area (surveyed 1 month after removal)

- Shoreline advanced an average 26.9 ft
- Shoreline was expected to retreat by 25.2 ft

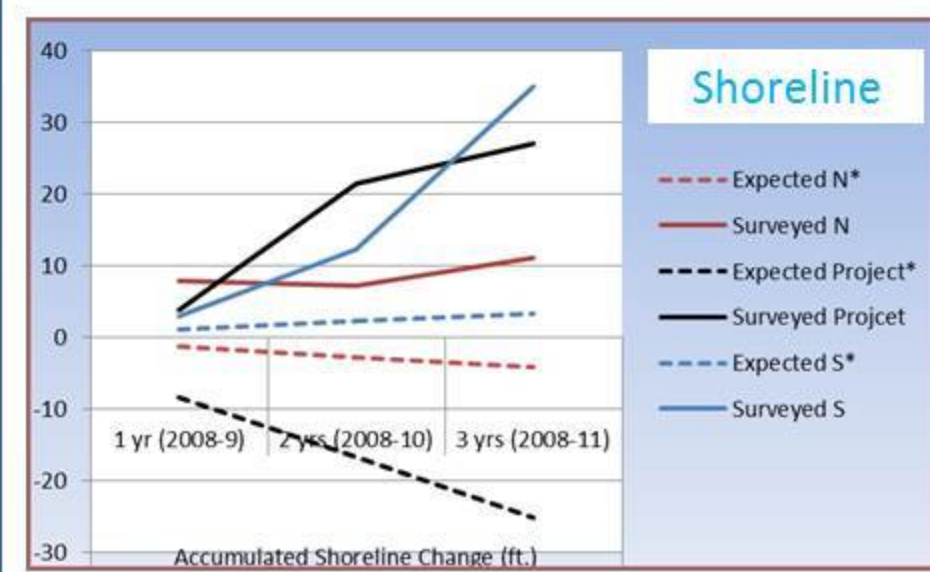
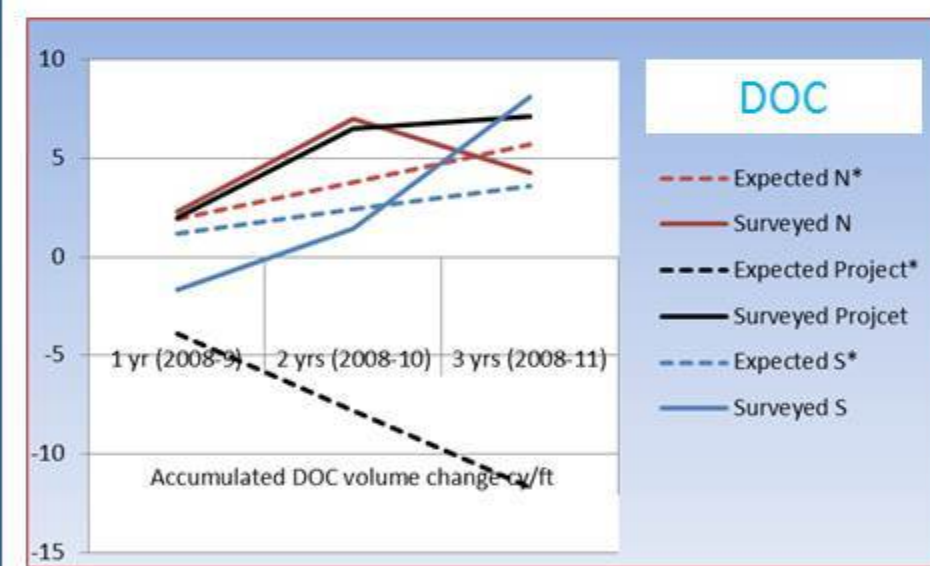
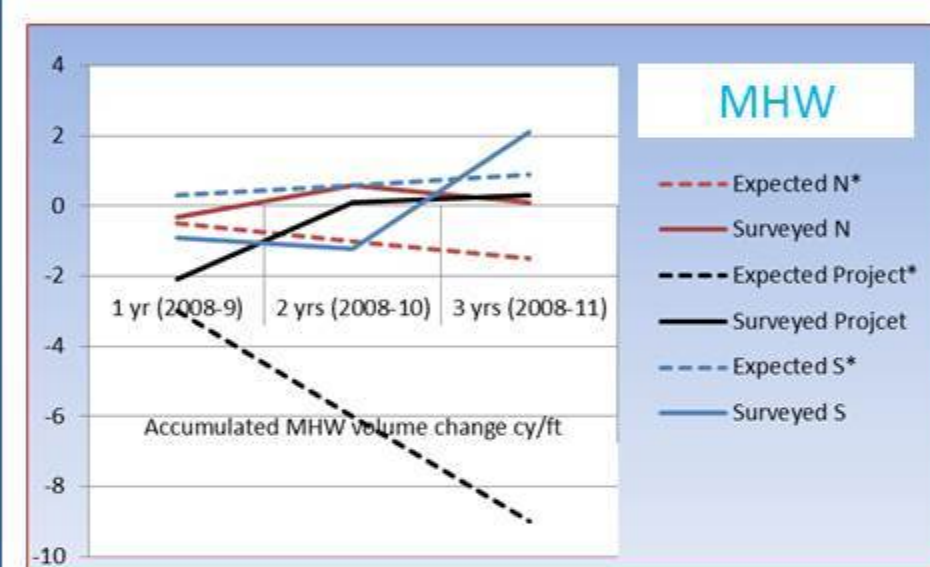
2nd full year - 12 months results

Projects are often influenced by weather events distorting data. During the second year the weather was stable and no nourishments took place, making it an ideal observation period. Below are the data from the 2nd full year 3/2009 - 2/2010. The historic values (2001-7) are in circles. As can be seen the North and South control fall within the norm. Only the PEM project area is performing different from historic. The PEM project area was supposed to lose sand but gained sand.



3-year results compared to historic/expected

Below the 3-year historic/expected performance is compared to the actual performance in the North and South controls and PEM project area. Of special interest is if the South control is performing worse than expected as this may be an indication of downdrift erosion (robbing Peter to pay Paul).



In all of the graphs the South control area (solid blue line) are doing better than historic data (dotted blue line). This indicates no downdrift erosion. Instead downdrift accretion is observed, which is a typical effect of PEM

Results

The photos below are shot at low tide and show the beach from R6.5 looking South.



The two photos above from project start and project end indicates a successful project, a conclusion which is also supported by the survey data. However; the Town decided to end the PEM project and have a traditional nourishment. As a result the PEMs were removed and 340,000 cubic yards of sand were placed from R7-12 in April 2011 at a cost of \$5.6 M. How the beach performed can be seen from the photo below.



Discussion

The PEMs took longer than normal to show effect, which may be due to shortened PEMs to accommodate for a thin sand layer. The towns consultant documented that the project fulfilled the success criteria, and the town paid EcoShore. Commonly asked questions: If the project was a success why stop? Why did the nourishment backup plan require PEMs to be removed?

Conclusion

The previously critically eroding Hillsboro Beach from R7-12 had PEMs installed from 2008 to 2011. At the end of the 3-year period erosion had stopped and the beach was higher and wider than before. The North and South control areas were not negatively affected.