COCOPLUM DEVELOPMENTS LIMITED, NEGRIL JAMAICA

FINAL MONITORING REPORT OF COASTAL EROSION PREVENTION
AND SAND ACCRETION
Design and Modeled Solution for Coastal Erosion

In December 2007, Artificial Reefs Inc. / Coastal Restoration Inc. was contacted to perform a site survey for a potential beach restoration project at a private vacation villa on the North side of Long Bay Negril, Jamaica, W.I. An extensive survey was performed on over 400 feet of severely eroded coastline at the site with the area evaluated for:

- Protecting beach and infrastructure from further erosion.
- The potential of a sand source and the potential for natural rebuilding of the beach through wave energy attenuation.
- Provide an estimate of costs for design-modeling, manufacture and installation of a barrier reef system to protect coastal area.

As can be seen from the pictures taken on the site, the foundation of the infrastructure was in danger of being totally undermined. Here, the low tide line is just four feet from the foundation with a rise of only 3 inches. Water was at and over the porch foundation at high tide. On the north side of the property the erosion was so severe that it was undermining root structures of the trees, lawn and the lawn lighting system that had been in place for decades. Here at low tide you can view the BENCHMARK tree that is at the waters edge during very calm weather conditions in the early morning hours of the survey. Observe the erosion and tide line that extends to the right up over the step and across to the white light where the grass begins.

In the picture left, again at low tide, observe the surveyor on the south side of the BENCHMARK tree that is in most of the photos. At higher tides, the grass boundary is the only impediment to faster erosion of this northern side.
At Low Tide, extensive erosion and undermining of tree line.
Following an extensive survey, ARI/CRI performed its’ modeling effort to design a site specific barrier reef system that would meet all objectives of the project. It was determined that a Wave Attenuation Device (WAD) would be built with a 10 foot base on each of three sides, standing 4.5 feet tall. Units would be placed as a barrier reef system centered on the -3.5 feet contour line at 145 feet from the middle of the property. At low tide, units would be exposed by 1 foot and covered at high tide.
During the winter and spring months of 2009, the WADs were manufactured 4 miles from the deployment site and successfully deployed on 22 May 2009 all from land and without any disturbance to the fragile marine life ecosystem. In fact, within hours of placing the WAD units, marine life was observed in, on and around the barrier reef system. The 160 WAD units provide 3,840 square meters of productive substrate, contributing to a measureable, estimated 1,857 metric tons of additional marine life biomass on an annual basis, after the first year.

The accretion of sand at the subject site has been observed on a daily basis by the local villa staff and periodically by an independent source from **Sea Control Inc.**, a local engineering firm. Twenty-one weeks following deployment, a survey was performed and compared to the baseline performed on the day of deployment. A Second survey was completed in March 2010 and the FINAL Survey completed 17 December 2010. The results are clearly indicated below on the beach profile graphics with the dark blue reference line as the benchmark of the beach profile days before the WADs were placed on the project site. Please reference the below overhead showing the WAD configuration and the profile lines in subsequent survey profiles with the latest profile at the bottom of each page. Observe the dramatic changes in beach profiles and the tremendous amount of sand accretion and the stabilization of the beach to its original profile. The WADs performed as advertised and performed best in severe weather with protection during tropical storms and hurricanes, while the rest of Negril’s Beaches suffered severe
erosion.
Notice on inset picture taken before deployment, picture was taken at low tide with high water line up to base of living tree (see white arrow) Now, 18 months later, picture shows new property line wall and behind it reference tree. This picture was taken just after recent storm and you will notice the significant amount of seagrass that has washed up on shore, including a dead tree that washed up in front of benchmark tree.
In Profile B/B, the inset picture depicts the corner of the pool deck. The high tide water line was at the base of this concrete foundation. You will also notice the ground light to the left of the white arrow that has had its foundation severely eroded away as well. The larger picture is a reverse angle from the previous picture (Profile A/A) and shows significant accretion and the start of vegetative growth from the pool deck seaward. In the distance, close to the waterline, you may observe the Northern tip of the WADs that arc in towards the property line.
PROFILE C/C

Negril, Jamaica Beach Profile at
12 week point post installation
WADs.
- Baseline Elevation - 5/22/2009
- December Elevation - 12/17/2010

GAIN 13.7 METERS

Negril, Jamaica Beach Profile at
44 week point post installation
WADs.
- Baseline Elevation - 5/22/2009
- March Elevation - 03/26/2010

GAIN 23 METERS

Negril, Jamaica Beach Profile at
82 week point post installation
WADs.
- Baseline Elevation - 5/22/2009

GAIN 19.2 METERS
In Profile C/C, the benchmark is the base of the porch where in the inset picture to the right you can observe the high water mark at the base of the porch foundation. In the larger picture, you can now observe the stabilized beach after shortly accreting its present, stable profile. The picture at the end of this report has a nice panoramic with a close up of the porch area and the substantial rebuild of the original beach profile prior to erosion.
In Profile D/D inset picture to the left here, you are looking at the Sea grape tree benchmark, looking North. You will notice the severe erosion at its base, exposing the roots and eroding the property on either side shoreward behind the tree. In the larger picture, you are now looking South towards the residence. You will notice how much sand has built up and above the former land/beach profile. Notice the pile of sand to the right: workers are digging holes to fill with all the dead sea grass that has washed up over recent storms.
In Profile E/E both inset pictures provide a snapshot of the severe erosion that has taken place along the Northern side of the property. In the larger more recent picture, it is evident just how much accretion has occurred in the past 18 months, rebuilding and stabilizing the root structure of the tree and the post at the edge of the property.
This shot is a nice overview standing at the water’s edge looking North from benchmark profile B/B, 
Looking- North through profiles C/C, D/D, E/E and farther up 200 meters F/F.