

**Gulf County
Cape San Blas / White Sands Project
Post-Storm Evaluation**

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1 INTRODUCTION / PURPOSE

Florida Department of Environmental Protection (FDEP) Bureau of Beaches and Coastal Systems (BBCS) contracted Post, Buckley, Schuh and Jernigan, Inc. (PBS&J) for professional coastal engineering services to support the Coastal Construction Control Line Program (CCCL), Contract No. BS013, Task 25. Services to be performed under this task include post-04' hurricane assistance, emergency armoring assessments, public communications, permitting, engineering analysis, and general support for program matters.

In April of 2003 a sand-filled container system was installed in front of five (5) beachfront homes located on White Sands Drive, Cape San Blas, Gulf County, Florida. This geotextile tube system, known as the *ProTecTube III* dune stabilization system, was placed along the shoreline and subsequently hit by Hurricane Ivan approximately 17 months after installation in September 2004. Hurricane Ivan made landfall in the vicinity of Mobile, Alabama in the early morning of September 16, 2004. Ivan was a category four hurricane for the majority of its time spent in the Gulf of Mexico. Ivan was strongest in the northeast quadrant of the storm, causing damage eastward of the storm's landfall position. Estimates of storm surge with respective wave height along the Florida Panhandle counties exceeded 15 feet. Gulf County was among the counties in Florida impacted by Ivan (FDEP, 2004).

The FDEP was asked by the Gulf County Board of County Commissioners to perform a post-storm evaluation of the *ProTecTube III* system to determine its viability. This task assignment is in response to this request and was performed using several sources of information. Our research revealed a lack of quantitative data regarding this product and project. In addition, there was no requirement for monitoring of the project to document changes in the shoreline as a result of the presence of the *ProTecTube III* system. As such, the majority of the data available to conduct our evaluation was qualitative.

The data used for this evaluation came from three sources. The designer of the *ProTecTube III* system, Jay W. Sample, Advanced Coastal Technology, Inc., has

provided background information on the design of the system as well as photographs of other ProTecTube projects. Secondly, the FDEP conducted an onsite inspection of the damage caused by Hurricane Ivan noting damage and beach response in the project area. Included in this evaluation are photographs and videos of the project site before and after the hurricane as well as during construction. The FDEP also provided background shoreline information including aerial photographs, aerial fly-overs, and a beach profile history of the area in order to better determine erosional and accretional trends of the site. Jeffrey R. Tabar, P.E. of PBS&J also conducted a post-storm onsite inspection collecting additional photographs and qualitative evidence.

2 SYSTEM DESCRIPTION

The location of the project site is along the beach fronting five (5) properties located on White Sands Drive, approximately 400 feet south of FDEP reference monument R-83 [Appendix A, William Fokes FDEP construction video]. The site is located along an eroding headland of St. Joseph Peninsula on the Cape San Blas spit. The five homes along the project site are situated on the dune crest seaward of the Coastal Construction Control Line (CCCL). Prior to the installation of the *ProTecTube III* system the site was experiencing erosion that resulted in the undermining of the structures (homes) [Figure 1].



Figure 1. Pre-project condition of beachface along the five (5) properties on White Sands Drive. Note the homes (289 White Sands Drive in forefront) are beginning to be undermined by the scalloping of the dunes, Jay Sample, ACT Inc.

The St. Joseph Peninsula has experienced high erosion rates near Stump Hole and Cape San Blas ranging from 10 feet per year to 43 feet per year, respectively. The project site has experienced more moderate erosion rates over the last 30 years, as shown in Appendix B. The two nearest FDEP monuments to the project site, R-83 and R-84 experienced erosional rates of 1.5 feet per year and 2.0 feet per year, respectively (FDEP, 2001). The site experienced eight (8) tropical storms and/or hurricanes in the last ten years, most notably Tropical Storm Isadore (2002) and Hurricanes Opal (1995), Ivan (2004).

The beaches adjacent to the project site exhibit similar erosional trends, although it is less noticeable as less structures exist on the neighboring shoreline, particularly to the south of the project area. Prior to the installation of the *ProTecTube III* system there was a noticeable dune offset between the project site and adjacent beaches both north and south [Appendix A, aerial fly-over]. This was likely due to the presence of the homes and attempts to maintain the dune fronting these structures.

3 PROJECT CONSTRUCTION

3.1 – Design specifications of ProTecTube III

The *ProTecTube III* is made up of an improved geosynthetic material that has been structurally enhanced from its predecessors. The *ProTecTube III* itself is designed on an angle to mimic the slope of the beach face at the installation site [Appendix E]. The *ProTecTube III* is installed at a specified depth for the project area and then covered with sand to return the beach to ideal conditions (i.e. similar berm width and dune height to adjacent beaches).

The *ProTecTube III* system is a sloping, multi-celled, sand-filler container system designed to provide long-term protection to upland properties along a beach while minimizing beach scour seaward of the system, a common problem among other products. Literature provided by Mr. Sample states the welded polymer design of the *ProTecTube III* is capable of surviving hurricanes without damage though not intended to

protect the shoreline against these severe storms. The design limits of the *ProTecTube III* system is estimated to be for a 5 to 10 year storm tide event. However, our research has concluded that no long-term studies specific to the *ProTecTube III* system have been conducted to accurately define the performance of the system under these conditions.

3.2 – Site-specific installation

In response to Tropical Storm Isadore during the 2002 hurricane season, an emergency permit was granted in February of 2003 to install the *ProTecTube III* system along the beach frontage of White Sands Drive. In April of 2003 the project was constructed and the installation documented by FDEP representative William Fokes [Appendix A, video]. The *ProTecTube III* was installed at the base of the dunes and placed parallel to the homes. The *ProTecTube III* was subsequently covered with sand and re-vegetated [Figure 2 and 3]. Initially six (6) homes were to be included in the project. However, leading into construction only four homeowners were involved. From North to South those homeowners were Adams, Blake, Fenlon, and Pierce homes. During the construction phase a fifth home at the north end of the site (Golz home) was added [Appendix C]. Permission from the sixth homeowner was never secured.



Figure 2. Installation of ProTecTube system showing the ProTecTube III's landward edge is flush with base of dune and the immediate vicinity of homes to be protected. Jay Sample, ACT Inc. (April, 2003)



Figure 3. ProTecTube site showing dune rebuilding and re-vegetation upon completion of installation and prior to storm events. 289 White Sands Drive is first house on right. Jay Sample, ACT Inc.

During the installation, the dune immediately south of the southernmost home was partially excavated in order to place the terminus (return) of the *ProTecTube III* [Appendix A, C, & D]. The terminus of the *ProTecTube III* on the north end of the project site was installed parallel to the dune, in expectation of the sixth homeowner being added at a later date. The final layout of the *ProTecTube III* system is outlined in the emergency permit documents found in Appendix C.

4 SITE EVALUATION

During the 2004 hurricane season Tropical Storm Bonnie and Hurricanes Frances and Ivan impacted the shoreline of the White Sands Drive area. Hurricane Ivan, the strongest of the three storms, was the impetus for the following evaluation outlined below.

4.1 – *ProTecTube III* System Analysis

- 1) There was a lack of quantitative data to assist in determining whether the *ProTecTube III* successfully provided its intended long-term protection of upland properties because the system had only been installed for 17 months before the hurricane and no monitoring requires were in place to document beach changes over time. In addition, during this 17 month period the *ProTecTube III* system

did not encounter the storm conditions for which it was designed. However, the performance of the *ProTecTube III* system can be recognized for storm events encountered during the 2004 hurricane season, as presented herein.

- 2) After initial impact of the storm, the re-vegetated dunes and upland areas were eroded away exposing the *ProTecTube III*. Upon impact of storm waves and surge from Hurricane Ivan, the *ProTecTube III* acted to create wave uprush ramping. Compounded with the various angles of wave approach, the *ProTecTube III* caused the formation of a ridge and runnel system between the sand-filled containers and the homes [Figure 4]. This resulted in a greater change in the vertical profile and likely caused increased erosion damage in the lee of the *ProTecTube III*.



Figure 4. View of waves during Hurricane Ivan overtopping geotube system and trapped water running between geotubes and project site homes. Jay Sample, ACT Inc. (September, 2004)

- 3) Resulting from Hurricane Ivan approximately 35-45 ft. of sand landward of the *ProTecTube III* scoured out undermining the homes [Appendix A, William Fokes post-storm erosion video, FDEP] [Figure 5]. Similar losses were observed along the adjacent beaches.



Figure 5. Post-storm damage showing scouring of dunes beneath structures as a direct result of wave action evidenced by Figure 4. Jeffrey R. Tabar, PBS&J (November, 2004)

- 4) Qualitative evidence confirms the company/product claim that the *ProTecTube III* system is not designed to protect against hurricanes and did not abate erosion caused by Hurricane Ivan. An aerial photograph from the FDEP shows a similar erosional pattern of the adjacent, un-protected beaches [Figure 6].
- 5) Both ends of the *ProTecTube III* were flanked as a result of Hurricane Ivan. In the immediate vicinity of the north and south ends erosion was exacerbated by the end effects of the *ProTecTube III* [Appendix A & D] [Figure 7 & 8]. There were no differences observed regarding the north (parallel terminus) and south (curved

terminus) ends of the *ProTecTube III*, as both ends displayed similar scalloping. Outside the vicinity of these flanked zones, the dunes return to a position consistent with that of the adjacent shoreline.



Figure 6. Aerial photograph looking northward showing similar erosional trends on both project, and non-project beaches. The dunes directly behind the geotubes show a state of erosion that is more advanced than pre-project conditions and exhibits an erosional rate similar to adjacent beaches. Florida Dept. of Environmental Protection (September 17, 2004)

- 6) Based on available data, the beach and dune in the project area did not fair any better as compared to properties adjacent to the project site. Moreover, the *ProTecTube III* caused an abnormal swash pattern by trapping water in the structures lee creating a shoreline parallel scour trench.

- 7) The *ProTecTube III* system did not sustain any damage from Tropical Storm Bonnie and Hurricanes Frances and Ivan. Moreover, the system did not appear to be twisted, ripped or deformed in any way following these storm events. Observations made of other coastal armoring structures along this region of shoreline revealed damage. The rock revetment located at Stump Hole sustained damage and required reconfiguration of approximately 20% of the structure. In addition, a vinyl sheet pile seawall in the area sustained severe damage and required extensive repairs following Hurricane Ivan.



Figure 7. Aerial photograph showing increased dune scalloping around southern terminus of geotubes caused when the geotube return was flanked (289 White Sands Drive visible on the left. *Florida Department of Environmental Protection (September 17, 2004)*



Figure 8. Aerial photograph showing increased dune scalloping around northern terminus of geotubes caused when the geotube return was flanked. *Florida Department of Environmental Protection (September 17, 2004)*

4.2 – Summary

In April of 2003 a *ProTecTube III* dune stabilization system was installed in front of five (5) beachfront homes located on White Sands Drive, Cape San Blas, Gulf County, Florida. This system was placed along the shoreline and subsequently hit by Hurricane Ivan approximately 17 months after installation in September 2004. Consequently, the FDEP was asked to make a determination of the viability of the *ProTecTube III* system. Research efforts revealed a lack of quantitative data available for the evaluation. As a result, the majority of the data available to conduct this evaluation was qualitative.

During this 17 month period the *ProTecTube III* system did not encounter storm conditions from a 5 to 10 year storm tide event for which it was designed. As such, the system has not been tested against design conditions. Notwithstanding, the performance of the *ProTecTube III* system can be evaluated for storm events encountered during the 2004 hurricane season, Tropical Storm Bonnie, and Hurricanes Frances and Ivan.

Following Hurricane Ivan, the *ProTecTube III* caused the formation of a ridge and runnel system between the sand-filled containers and homes. This feature caused an abnormal swash pattern by trapping water in the structures lee creating a shoreline parallel scour trench. This resulted in increased vertical profile change and greater erosion damage in the lee of the *ProTecTube III*. Overall approximately 35-45 ft. of shoreline retreat resulted from the impact of Hurricane Ivan, with similar losses were observed along the adjacent beaches. The *ProTecTube III* system is not designed to protect against hurricanes and did not prevent erosion losses during Hurricane Ivan.

Both ends of the *ProTecTube III* were flanked resulting in increased erosion and scalloping as a result of Hurricane Ivan. Outside the vicinity of these flanked zones, the dunes returned to a position consistent with that of the adjacent shoreline. Based on available data for the study, the beach in the area of the *ProTecTube III* system did not fair any better than properties adjacent to the project site.

The *ProTecTube III* system did not sustain any physical damage resulting from Tropical Storm Bonnie and Hurricanes Frances and Ivan. The system did not appear to be twisted, ripped or deformed in any way following the storm events. Evidence of damage to other coastal armoring structures in the project region was observed, while the *ProTecTube III* system remained intact and undamaged.

5 REFERENCES

Florida Department of Environmental Protection, Bureau of Beaches and Coastal Systems. (2004). Hurricane Ivan: Beach and Dune Erosion and Structural Assessment and Post-Storm Recovery Plan for the Panhandle Coast of Florida. Tallahassee, FL: Leadon, M.E.

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