Shoreline
FLORIDA SHORE & BEACH
PRESERVATION ASSOCIATION

news from the Florida Shore and Beach Preservation Association **May 2018**

Repetitive Renourishments - Do Subsequent Renourishment Projects Last Longer?

By Peter Seidle, P.E., Applied Technology & Management, Inc.

Does your beach program have to have a fixed, constant design renourishment interval or can your renourishment design interval become increasingly longer? Analytical analyses have shown that as a project area is renourished, each subsequent renourishment event should retain sand longer than the prior event. Is this effect observed in real-life projects? Click to read more.

2018 FSBPA Annual Conference
September 19-21
Hyatt Clearwater Beach

The 2018 FSBPA Annual Conference is coming to Pinellas County September 19-21, and we couldn't be more excited about returning to Hyatt on Clearwater Beach. To set the stage, the next few editions of Shoreline will have articles about the area and the County's beaches just to give you a preview about what you can see while you are there. This month's Pinellas County article is on the history of John's Pass, recent studies and the adoption of a new inlet management plan. After you read Guy Weeks' article, I hope you will take a few minutes to register for the conference and reserve your hotel room. Start by clicking on the conference logo!
Jackie Larson, FSBPA Executive Director

John's Pass - Inlet Management Plan

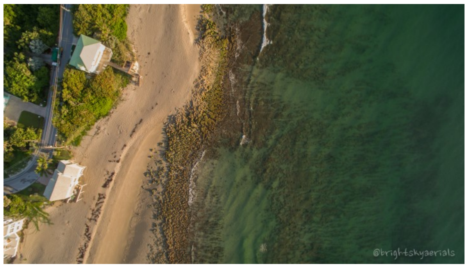
By William "Guy" Weeks, Planning Manager, FDEP

On January 31, 2018, (FDEP) adopted a new inlet management plan for John's Pass of Pinellas County. The plan establishes a new sediment budget and management strategies that are consistent with current statutes and observed erosion conditions. Continued on page 12

Using Drones for Aerial Mapping of Nearshore Habitats and Comparison with Current Methods

By Rex "Chip" Baumberger, Brent Gore, Dustin Myers, CSA Ocean Sciences Inc.
Corresponding Author: Chip Baumberger

The rapidly improving technology of drones with integrated cameras and global positioning systems (GPS), as well as software capable of compositing orthomosaics from drone imagery, have the potential to supplant or at least augment full-scale manned aircraft for aerial imagery collection at a fraction of the cost. Aerial imagery of beaches, nearshore hardbottom, and seagrass habitats is used for a variety of applications. To determine the efficacy of drones in these applications, CSA conducted a pilot study that compared GIS-based nearshore hardbottom assessments using imagery collected with a drone versus manned aircraft. Link to full article



About Shoreline

Repetitive Renourishments – Do Subsequent Renourishment Projects Last Longer?

By Peter Seidle, P.E., Applied Technology & Management, Inc.

Does your beach program have to have a fixed, constant design renourishment interval or can your renourishment design interval become increasingly longer? Beaches are rarely renourished at the given design interval, largely due to regulatory process, funding mechanisms, or storm damage recovery response. The concept of an expanding renourishment interval has been studied primarily by Dette, Führböter and Raudkivi (1994) and Dean (2003). Analytical analyses have shown that as a project area is renourished, each subsequent renourishment event should retain sand longer than the prior event. Is this effect observed in real-life projects? These analyses can be used for better mid- to long-term renourishment budget and program planning.

Three case studies provided here were analyzed for long-term performance of multiple project – Sandbridge, VA, Boca Raton, FL, and Brevard County, FL. In each of these case studies, project performance data were assessed relative to project conditions prior to the initial sand placement (pre-initial project). The observed performance was compared to the analytically predicted performance, which is based on the Pelnard-Considere solutions. Overall, each of the case studies showed evidence that subsequent renourishments lasted longer and observed performance was in good agreement with the predicted performance. Deviations occurred only following direct hurricane impacts.

In the Sandbridge, VA project, the initial 1998 project placed 1.5 MCY of sand, followed by three subsequent renourishments. Hurricanes Isabel in 2003 and Sandy in 2012 significantly impacted the area. The performance data show that the renourishment interval is generally increasing (Figure 1). The performance data for the most recent 2013 placement event are reflective of the anticipated performance.

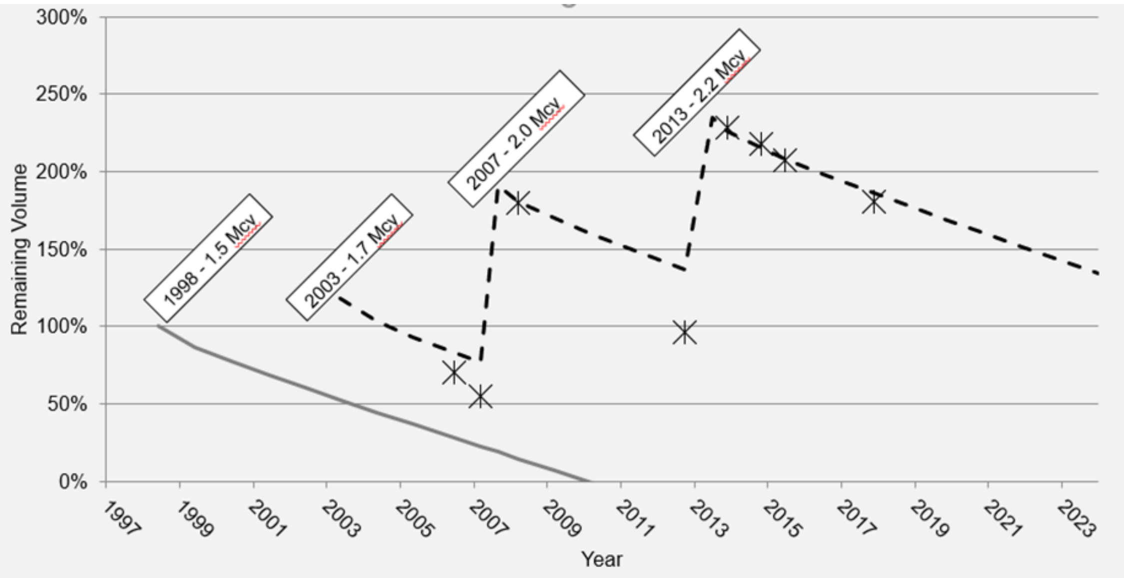


Figure 1. Sandbridge, VA, Project Performance Data.

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The Boca Raton, FL project (specifically the North Boca Raton segment) was initially nourished in 1988 with approximately 1.1 MCY. The project area has been renourished three times, most recently in 2014 (Figure 2). While the project cycle increased from 10 years to 12 years from the 1998 renourishment to the 2010 renourishment, the offshore passing of Hurricane Sandy in 2012 shortened the performance of the renourishment. The 2010 project was performing better than the analytical prediction until the significant impact of Hurricane Sandy. The observed performance of the 2014 project was better than predicted. Note the that the curve for the anticipated performance of the 2014 project is flatter than it was for the previous renourishment events. This indicates that the 2014 project is anticipated to have life span longer than previous projects unless the area is directly impacted by a hurricane.

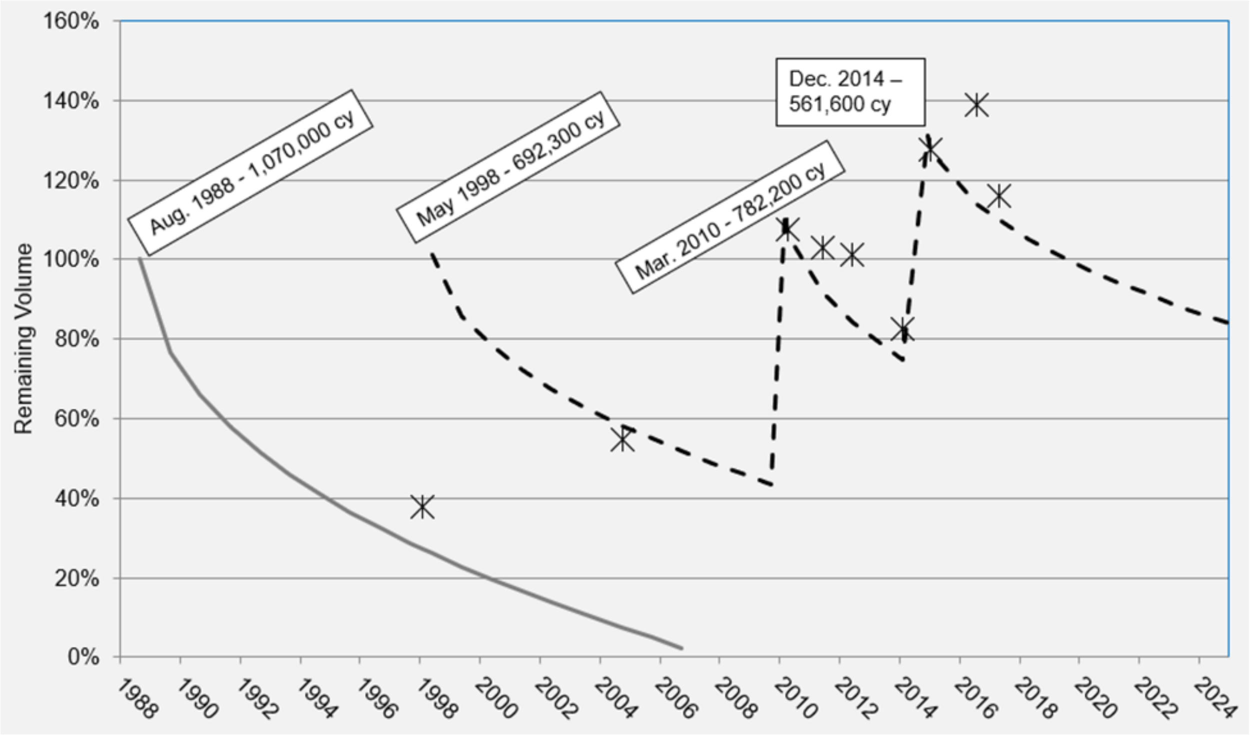

Figure 2. Boca Raton, FL, Project Performance Data.

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The third case studied is South Reach Project in Brevard County, FL. This project was initially constructed in 2003 and has been renourished three times since 2003 (Figure 3). Hurricanes Frances and Jeanne in 2004 and Hurricane Sandy in 2012 impacted this area, as seen in the date points for 2004, 2012 and 2013. Overall, the observed performance of the project is consistent with the analytical prediction curve. Taking into account storm-response projects, this project is generally showing increased performance with each renourishment.

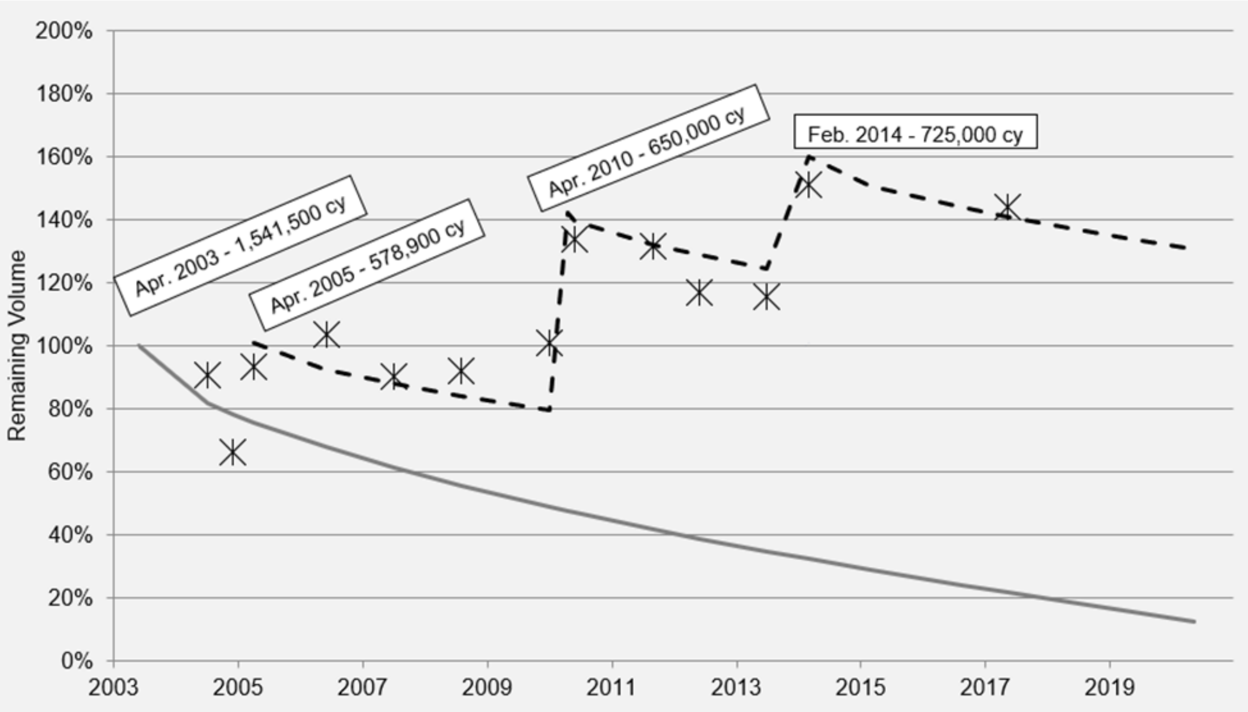

Figure 3. South Reach Project, Brevard County, FL Project Performance Data.

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One of the of the commonalities seen in assessing the performance of the each of the study areas is that significantly more sand is within the project area after multiple renourishments than the initial project placed. While the renourishments are triggered and necessary based on the loss of sand from the project area, the coastal system naturally becomes more robust and resilient with each renourishment event. Most often, the initial project intent is to provide public beach to communities that have minimal recreational beach or no beach at all. These case studies demonstrate that following the initial project, beach dunes develop or become more robust and the offshore sandbar becomes more developed (Figure 4).

Overall, assessing project performance using mid- and long-term analytical predictions shows good agreement to observed performance and can be used for a programmatic planning tool for project and budget planning.

Figure 4. Multiple renourishments developed robust dunes and sandbars in areas that were historically fronted by seawalls.

Acknowledgements: Data were provided and made available by City of Boca Raton, Brevard County, City of Virginia Beach and Olsen and Assoc., Inc.

Find Peter's presentation from the 2018 Tech Conference about this project on our website at: https://www.fsbpa.com/2018TechPresentations/SeidleP_2.pdf

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Using Drones for Aerial Mapping of Nearshore Habitats and Comparison with Current Methods

By Rex “Chip” Baumberger, Brent Gore, Dustin Myers, CSA Ocean Sciences Inc.
Corresponding Author: Chip Baumberger

INTRODUCTION

The rapidly improving technology of drones with integrated cameras and global positioning systems (GPS), as well as software capable of compositing orthomosaics from drone imagery, have the potential to supplant or at least augment full-scale manned aircraft for aerial imagery collection at a fraction of the cost. Aerial imagery of beaches, nearshore hardbottom, and seagrass habitats is used for a variety of applications, including mapping, estimation of areal extent, habitat characterization, resource utilization, and observation of change in dynamic coastal environments.

Typically, full-scale manned aircraft, equipped with geo-referenced digital and/or film cameras, fly at altitudes of 10,000 ft and coordinate with fixed ground stations to collect geo-rectified photographic imagery of coastal areas. This process has provided orthomosaics meeting aerial cartography standards for coastal areas for many decades, but it is logistically intensive and costly.

The actual collection of aerial imagery is fast; however, setup of fixed ground stations, flight planning, and other logistics can be time consuming. The time from initial field reports of adequate visibility to the collection of aerial imagery can range from 1 to 7 days. In the dynamically changing nearshore environment, responsive aerial imagery collection is an extremely important factor, as many weather and visibility windows last hours to days.

In Florida (in association with nearshore hardbottom monitoring), the Florida Department of Environmental Protection (FDEP) dictates the standards for aerial photography acquisition (FDEP, 2012). The main criteria are ground sampling distance (GSD) of ≤15 cm (6 in.)/pixel, horizontal accuracy of 1 in. = 500 ft, ground control points (GCPs; 2-cm accuracy) every 7 to 12 mi, a sun angle of ≤30°, and no cloud cover over the target area. GSD represents the aerial cartography equivalent to camera resolution, defining the size of each image pixel. Horizontal accuracy and many other required technical specifications for aerial collection are based on the American Society

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[1] Florida Department of Environmental Protection. 2014. Monitoring Standards for Beach Erosion Control Projects, May 2014 (edited: October 2014). Division of Water Resource Management. 40 pgs. https://floridadep.gov/sites/default/files/PhysicalMonitoringStandards.pdf

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for Photogrammetry and Remote Sensing Accuracy Standards for Digital Geospatial Data (March 2014).

Drones represent GPS-enabled aerial imaging platforms that can provide similar services with faster response times, streamlined logistics, and lower costs of operation. In order to determine the efficacy of drones in these applications, CSA conducted a pilot study that compared GIS-based nearshore hardbottom assessments using imagery collected with a drone versus manned aircraft.

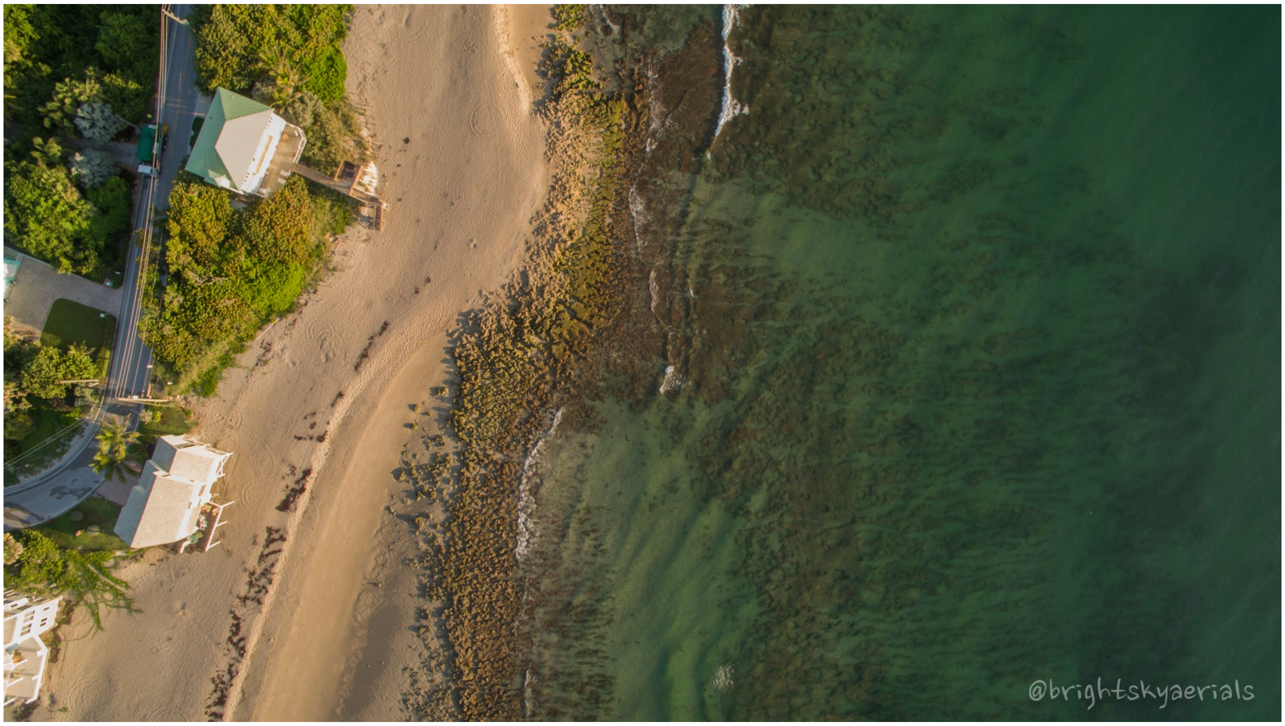

Photo 1. DJI Inspire 1 drone image of a beach in Martin County, and associated nearshore hardbottom resources.

METHODS

Drone

CSA utilized a DJI Inspire 1 quadcopter equipped with a 12-MP camera and commercial drone software to collect imagery (**Photo 1**). Drone flights were conducted at 250 ft (76 m) height with auto white balance settings and *.jpg output. Drone imagery was collected 1 month after manned-aircraft imagery along the same areas of shoreline and nearshore hardbottom in July 2017. The drone flight was conducted at similar time of day and tide cycle as those of the manned-aircraft aerial collection.

Imagery Processing and Hardbottom Classification

Drone imagery was processed with commercially available mosaicking software which produced orthomosaics in GeoTIFF format; manned-aircraft imagery was also in GeoTIFF format. A combination of supervised and unsupervised classification were performed on each area of interest (AOI) using Esri ArcGIS and ERDAS Imagine software. Separate classification of each AOI helped

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[2] American Society for Photogrammetry and Remote Sensing. 2014. ASPRS Positional Accuracy Standards for Digital Geospatial Data. Photogrammetric Engineering & Remote Sensing Vol. 81, No. 3. 53pp. https://www.asprs.org/wp-content/uploads/2015/01/PERS_March2015_Highlight.pdf

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to eliminate variations in reflectance and environmental conditions across the entire project area. After running the combination of supervised and unsupervised classifications, each AOI was manually interpreted by denoting classes of hardbottom and non-hardbottom.

Using a combination of tools in Esri ArcGIS and ERDAS Imagine, spectral noise and holes were removed as a correction to classification results. A manual technique was then applied to the classification by an in-house subject expert, which consisted of removing areas of over-classification and adding areas (digitizing) where under-classification was evident in the unsupervised classifications.

Lastly, an accuracy assessment was performed using field verification points (bounce dives). Three approaches were used to evaluate the accuracy of hardbottom features for the study: 1) accuracy assessment using only diver-collected data; 2) accuracy assessment of non-hardbottom environments using randomly generated points; and 3) accuracy assessment using combined dive data and randomly generated points. For each approach to classifying the seafloor, four standard geographic analysis metrics were computed. First, Total Classification Accuracy, which is the overall measure of discrepancy in predicted vs. observed values, was calculated. Next, Producer's Accuracy or error of omission (erroneously omitting actual hard bottom from the hard bottom classification) was calculated along with User's accuracy or error of commission (erroneous assignment of hard bottom to a sand or other classification). Finally, the Kappa Coefficient was calculated. The Kappa Coefficient is a statistical test that compares the assignment of classes (hardbottom or sand) by the software and GIS analyst with the probability of random chance assignment. The greater the Kappa Coefficient, the less likely assignment of classes by random chance.

RESULTS

Drone Orthophotography

Drone imagery was collected over a 77-acre area of seafloor offshore Martin County, Florida 33 days after the manned aerials. One 24-min flight with the drone was sufficient for image acquisition. The drone imagery achieved a GSD of 4 in./pixel resolution (**Figure 1a**), while manned was 6 in./pixel (**Figure 1b**). Horizontal accuracy for the drone was ±3 ft. As GCPs were not deployed, embedded GPS coordinates were used for orthorectification.

1a

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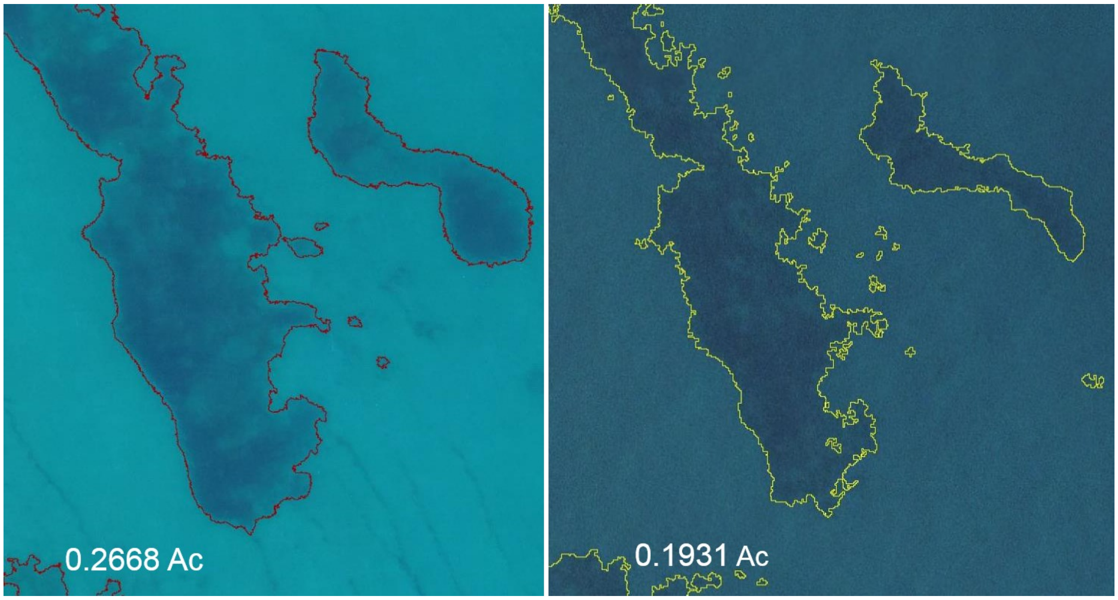
1b

Figure 1. Portion of artificial reef overlaying a natural reef offshore Martin County, Florida: a) DJI inspire drone image (4 in./pixel); b) manned aircraft image (6 in./pixel).

Hardbottom Classification

Based on the drone imagery collection data, the GIS analyst selected the identical 77 acres of area from the manned aerial imagery for comparison. Each unguided classification was run with the same parameters to provide relatable data between the two methods. The software calculated 4.676 acres of hardbottom from the drone imagery, and 3.874 acres from the manned aircraft (**Figure 2**). Total accuracy of the drone classification was 96.7%, while from the manned aircraft was 95.8%. Calculated Kappa Coefficient was 0.880 for the drone imagery and 0.847 for the manned aircraft, both more accurate than random chance.



a. b.

Figure 2. Martin County reef areas from classification from (a) drone and (b) manned aircraft imagery of the same reef area. Acreage calculations from hardbottom classification.

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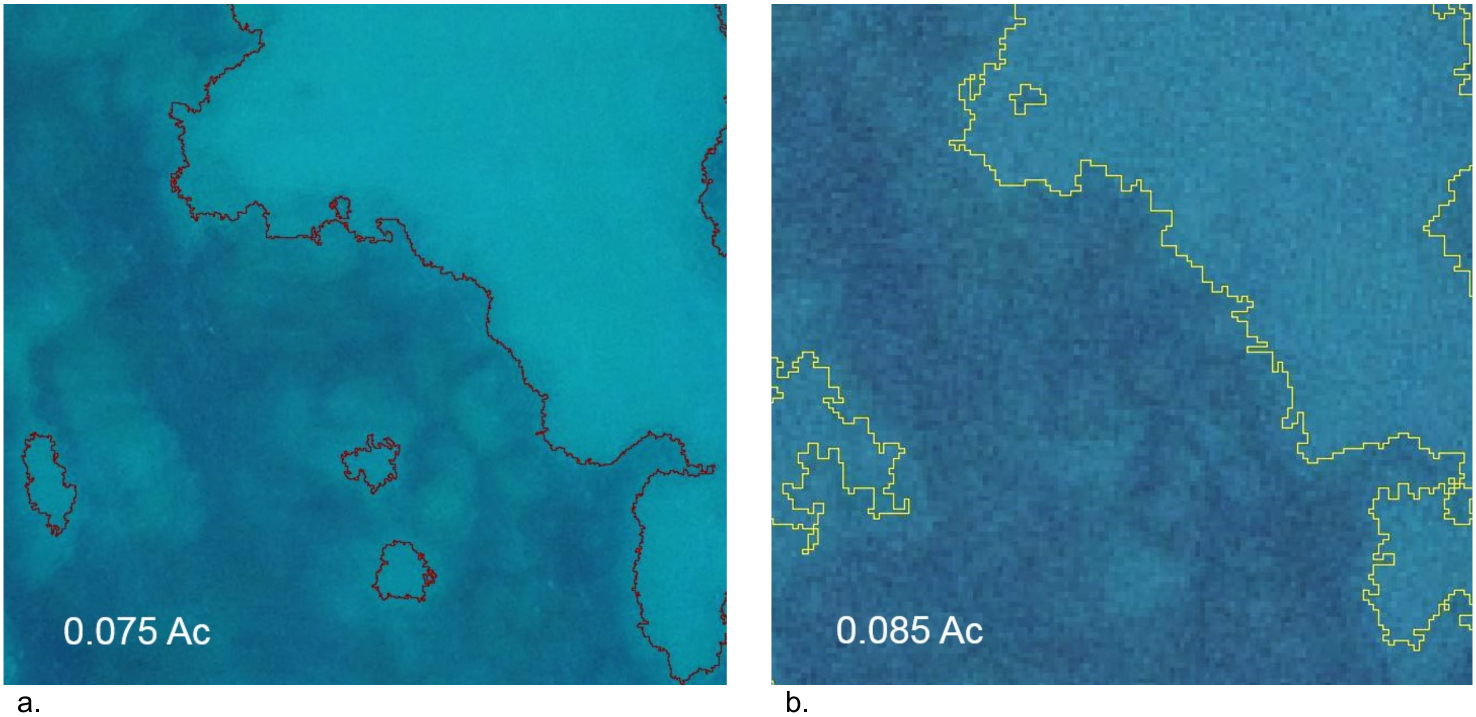
CONCLUSIONS

Drone collected aerials were superior in resolution and classification accuracy and had lower percentage error in the classification. The added ability to respond immediately to field reports enabled collection during ideal conditions, and the greater resolution of the drone imagery, compared to the fixed-wing manned aircraft (**Figure 3**), resulted in superior imaging of the seafloor. Notably, these results were acquired at less than 25% of the cost of the manned aircraft aerials. Background imagery for use in cartography was also improved when the high-resolution drone images were compared with manned-aircraft aerial imagery.



a. b.

Figure 3. Martin County reef areas from classification from (a) drone and (b) manned aircraft imagery of the same reef area. The difference in Ground Sampling Distance is evident in the "blocky" classification line and lower contrast between sand and rock of the manned aircraft image compared to the drone image.

Drones are not without fault, as long collection times due to the lower flight altitude, slower speeds, and relatively short battery life could be logistically challenging, especially over large project areas. However, the ability to provide a more rapid response to optimal field conditions versus the manned aircraft likely offsets increased collection times associated with drone imagery. The addition of GCPs would enhance the precision of orthomosaics from the drone and provide location accuracy similar to the fixed-wing aircraft.

Future goals for use of drones in acquiring nearshore imagery should focus on improving camera function (exposure and white balance) and using higher-resolution cameras. Standards for drone aerial imagery collection should be developed to meet agency requirements, similar to those from the FDEP (2012) guidelines. Habitat classification within hardbottom and seagrass areas may be possible with the refinement of techniques and ground-truthing. Drones have utility for numerous

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nearshore and offshore applications, including aerial surveys such as seagrass habitat mapping (**Photo 2**), marine mammal tracking, and recreational use data collection.

The 12-hr or less response time, ease of launch and recovery, lower operational and logistical costs, superior imagery resolution, and reduced error in hardbottom classification underscore the enhanced capabilities of drones for aerial imagery collection compared to the previous best practices with manned, fixed-wing aircraft.

Find Chip's presentation from the 2018 Tech Conference about this project on our website at: https://www.fsbpa.com/2018TechPresentations/BaumbergerChip.pdf

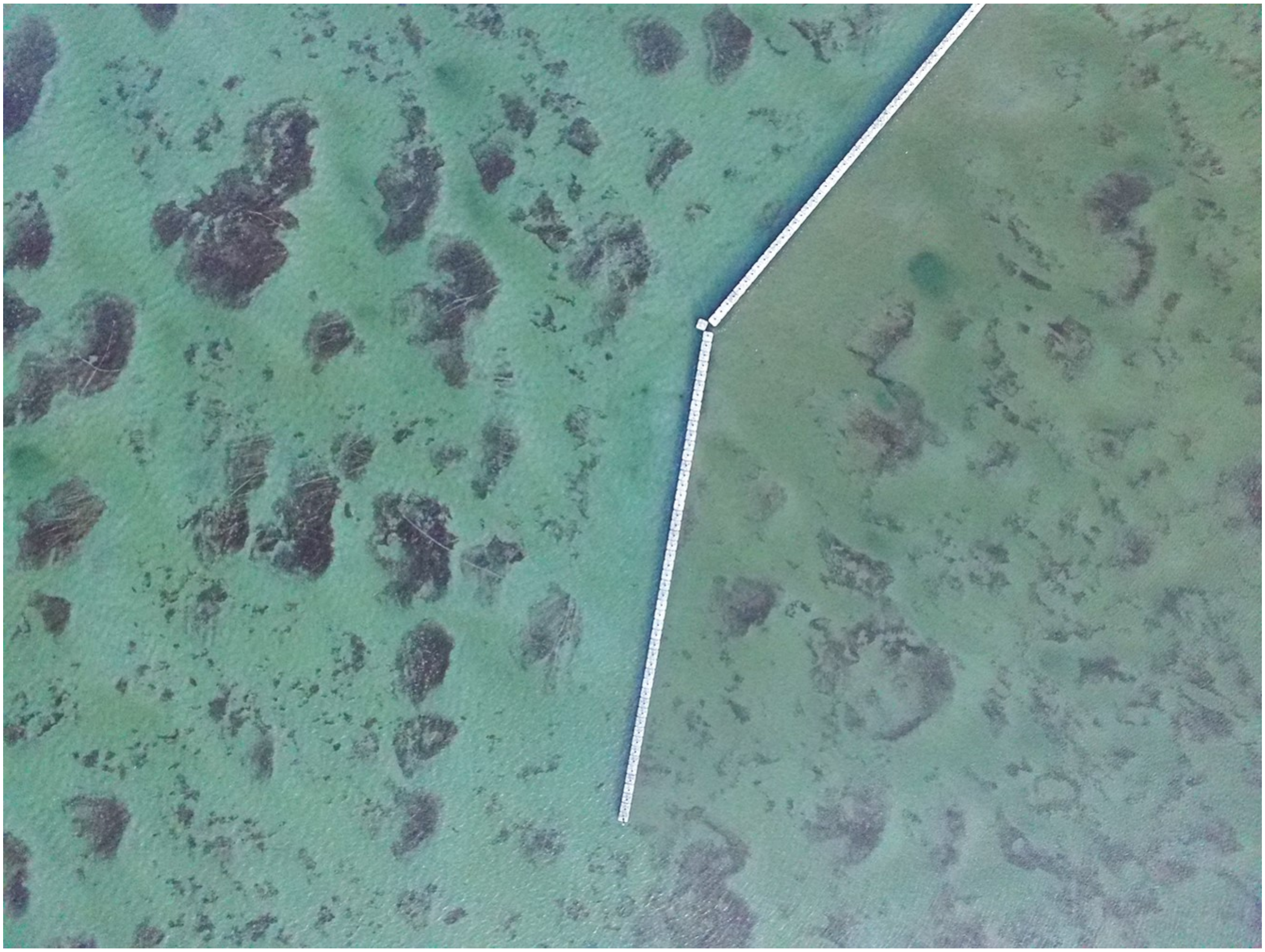

Photo 2. Drone image from seagrass habitat mapping project in Pamlico Sound, North Carolina.

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John's Pass - Inlet Management Plan

By William "Guy" Weeks, Planning Manager, FDEP

On January 31, 2018, the Florida Department of Environmental Protection (FDEP) adopted a new inlet management plan for John's Pass of Pinellas County. The plan establishes a new sediment budget and management strategies that are consistent with current statutes and observed erosion conditions.

In 2008, the Florida Legislature amended Chapter 161.142, Florida Statutes, to improve the management activities for inlets and the adjacent eroding beaches by requiring a balanced sediment budget for each managed inlet.

> *"It is in the public interest to replicate the natural drift of sand which is interrupted or altered by inlets to be replaced and for each level of government to undertake all reasonable efforts to maximize inlet sand bypassing to ensure that beach-quality sand is placed on adjacent eroding beaches. Such activities cannot make up for the historical sand deficits caused by inlets but shall be designed to balance the sediment budget of the inlet and adjacent beaches and extend the life of proximate beach-restoration projects so that periodic nourishment is needed less frequently."*

Consistent with statute, FDEP and the University of South Florida (USF) developed a scope of work in late 2013 to conduct an inlet management study for both Blind Pass and John's Pass in Pinellas County. The study was designed to incorporate both passes into one study due to their proximity (3.5 miles) and the interconnected tidal prisms with the Gulf of Mexico and Boca Ciega Bay (Figure 1). The purpose of the study was to examine the hydrodynamic, sediment transport, and morphodynamical processes at Blind Pass and John's Pass and their adjacent beaches, based on field measurements and numerical modeling.

To gain perspective on the inlet's dynamics, and the necessity of updating the management strategies, it is important to understand the history of John's Pass, its geomorphological evolution, prior inlet management, and beach erosion control activities conducted along the adjacent beaches.

In 1848, a severe hurricane opened and created John's Pass, which was named for a local fisherman and citrus grower, John Levique. For the two-inlet system (John's Pass and Blind Pass) connecting Boca Ciega Bay to the Gulf of Mexico, John's Pass has been the hydraulically dominant inlet, transporting between 70 and 80 percent of the tidal prism that flows into and out of Boca Ciega Bay. This tidal dominance has likely resulted in the hydraulic stability and geomorphological stability of the inlet, as John's Pass has not experienced any significant migration in its location since opening. Natural fluctuations in shoreline position along southern Sand Key and northern Treasure Island have been observed in the historical record of aerial photography, beach profiles, and shoreline surveys (Figure 2).

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Figure 1. *John's Pass in Pinellas County, Fl. (2011 aerial photo by Southwest Florida Water Management District [SWFWMD])*

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Figure 2. *Historical aerial photos of John's Pass from 1926 to 2010. (Wang 2016).*

At present, John's Pass is stabilized on the north side by a 460-foot curved jetty that was constructed in 1961, and on the south side of the inlet by a 920-foot long revetment that was constructed in 1966. The northern jetty was reconstructed in 1987 due to impacts occurring from Hurricane Elena (1985). Due to chronic erosion occurring at Sunshine Beach, a southern jetty was constructed in 2000.

The modeling analysis for the John's Pass study included seven design alternatives, including baseline conditions, dredging of the northern portion of the ebb shoal, dredging the south bypass bars, re-dredging of 198,000 cubic yards from the navigation channel and side borrow area, extending the southern jetty or extending both jetties, and finally dredging the main channel. Both the field data and modeling work of these alternatives contributed to the development of the sediment budgets for both passes. The inlet management study for John's Pass conducted an updated hydrographic survey of the inlet system in 2014 (Figure 3) to compare with a prior survey from 2010, and developed a sediment budget using the methodology described by Rosati (2005). The sediment budget established bypass objectives for the southern shoreline (Figure 4). The northern shoreline adjacent to the pass is accreting and is not designated critically eroded.

While the study was conducted, a total of three technical advisory committee (TAC) meetings were held in 2014 and 2016. Participants of the TAC meetings included FDEP, USF, Pinellas County, APTIM, Inc and the U.S. Army Corps of Engineers (USACE). The two-inlet study was finalized by USF in March of 2016 and later revised in August of 2016.

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The study resulted in four recommended strategies for the inlet. The study recommends the continuation of a comprehensive beach and inlet monitoring program to monitor the inlet dynamics and to facilitate important planning decisions regarding future sediment budgets. This monitoring effort will ensure that current strategies are effective, and that the plan is updated as necessary, based upon the monitoring data. Additionally, sand from the inlet will be bypassed south of the inlet onto adjacent eroding beaches within designated critically eroded areas between R126 and R130, with target bypassing quantities of an average annual placement of 21,000 cubic yards to the south. A second priority area for bypass material is at southern Treasure Island beaches between R135 and R143. The source of the bypass material will be sand from the John's Pass navigation channel, channel side borrow area, and ebb shoal borrow area.

The new strategies in the 2018 inlet management plan will provide more efficient bypass objectives to replicate the natural flow of sand and implement best management practices that will benefit the adjacent beaches and local communities adjacent to John's Pass. With the adoption of this new inlet management plan, all future inlet management activities shall be consistent with the four strategies located in the plan found at the following link below:

https://floridadep.gov/water/beaches-inlets-ports/documents/john%E2%80%99s-pass-inlet-management-plan

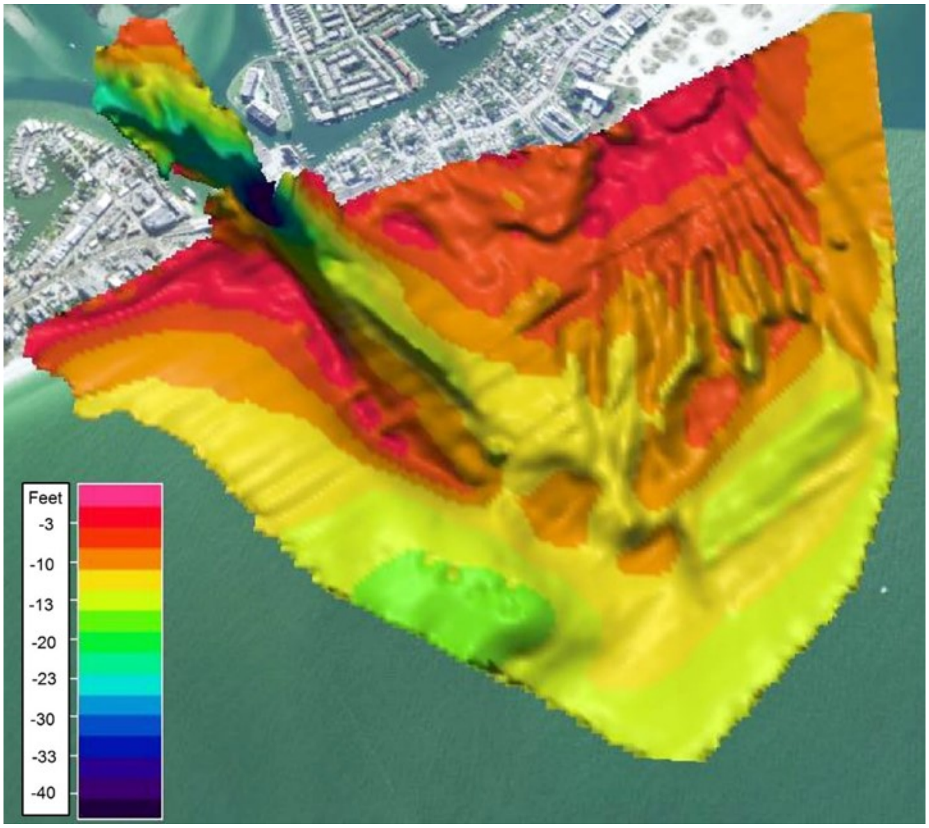

***Figure 3**. John's Pass channel and ebb shoal surveyed in 2014 using a multi-beam hydrographic surveys (Wang et al., 2016).*

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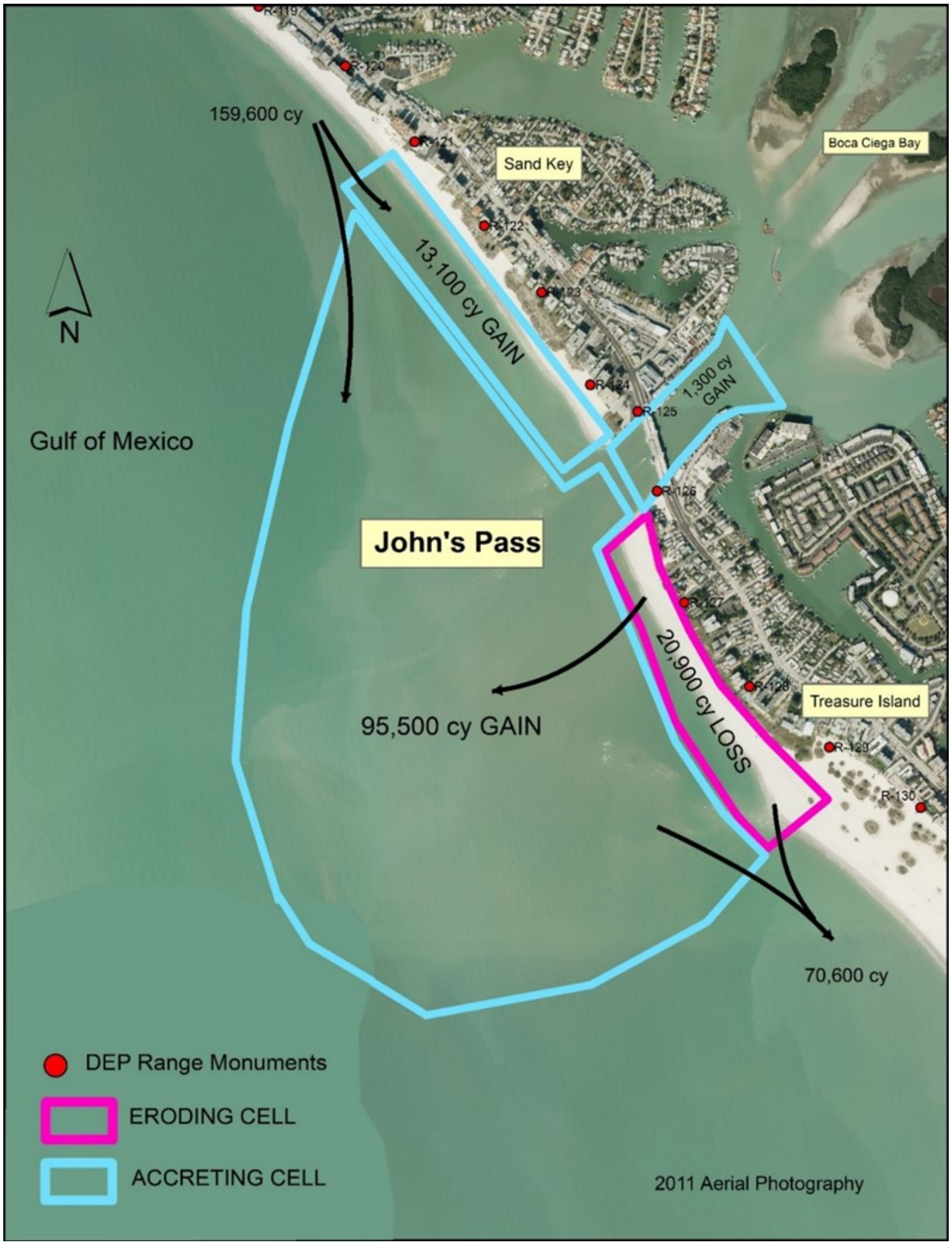

***Figure 4**. Annualized sediment budget at John's Pass based on field data collected from October 2010 to June 2014 (Wang et al., 2016). The 2011 aerial photo is courtesy of SWFWMD.*

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Rosati, J.D., 2005. *Concepts in Sediment Budgets*, Journal of Coastal Research, v. 21, pp. 307-322.

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Florida Shore & Beach Preservation Association
PO Box 13146, Tallahassee FL 32317
Phone: (850) 906-9227 • **Fax:** (850) 462-3575

CALENDAR OF EVENTS

FSBPA Conferences

September 19-21, 2018
61st Annual Conference
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