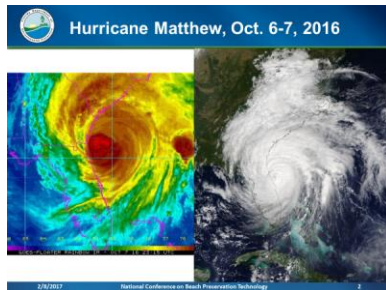


Impact of Hurricane Matthew on the Atlantic Coast of Florida



A coastal engineer was driving across country and his jeep broke down in front of a monastery. It was late in the day and the monks invited him in for the evening and treated him to a hot meal of fish and chips. He was so impressed by the dinner that upon finishing his meal he went into the kitchen to praise the cook. He sees a man wearing an apron and asks if he's the fish friar. The man replies no, I'm the chip monk.

Okay, a few of you are awake.



Between October 6 and 7, 2016, Hurricane Matthew, a major category three hurricane, tracked northward along and just offshore from the Florida east coast.



This is the hurricane center's track showing where Matthew skirted close to the NE FL coast.



Immediately following the impact of Hurricane Matthew, two post-storm damage assessment teams from the Florida Department of Environmental Protection (FDEP) and the U. S. Army Corps of Engineers, Jacksonville District, conducted detailed inspections and assessments of the beach and dune erosion conditions and coastal structural damages.

Winds, Waves, & Tides

Winds

- 85 mph – Kennedy Space Center
- 91 mph – Daytona Beach Airport

Waves (NOAA data buoys)

- 23.6 ft – offshore of Ft. Pierce
- 19.7 ft – offshore of Fernandina Beach

Storm Tide

- +7 ft (NAVD) at Flagler Beach Pier, Flagler County
- +8.4 ft (NAVD) at Mickler Landing, St. Johns County
- Equivalent to a 30-Year return interval

Damage along the Florida coast was attributable to high winds, high energy wave conditions, and storm surge flooding. Hurricane Matthew was largely a severe wave event for the Florida east coast. Although maximum sustained winds were in excess of 110 mph offshore, maximum wind gusts over the coast of Florida only ranged from a measured 55 mph at the Lake Worth Pier in Palm Beach County up to 85 mph at Kennedy Space Center and 91 mph at the Daytona Beach Airport.

Waves were in the 20-ft range offshore, and storm tides reached 7 ft in Flagler and 8.4 ft in St. Johns Counties. These storm tide levels were equivalent to a 30-year return interval.

Impacts to Beaches and Dunes - Overview

- Major beach and dune erosion sustained for 212 miles of coast along six counties between St. Johns River and Vero Beach.
- All 363 miles of Florida east coast beaches sustained erosion of varying degree.
- Upland development and property landward of restored beaches fared much better than where beaches were narrow or eroded.

Nearly all of the state's sandy beach shoreline fronting on the Atlantic Ocean and Straits of Florida was affected. Approximately 212 miles of these beaches sustained major beach and dune erosion (from the St. Johns River at Jacksonville southward through Vero Beach).

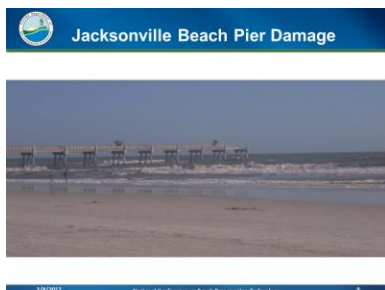
Property and upland development located landward of beaches that had been restored fared much better than areas where the beaches were eroded and narrow.



I'll share a few of the damage highlights. Matthew created a breach in the barrier island at Summer Haven in southern St. Johns County. The barrier breach has been closed on an emergency basis with material excavated from a river restoration project currently taking place.



A major dune breach occurred at Washington Oaks State Park in Flagler County. Storm surge and wave overtopping of the dunes caused inland flooding along most of northern Flagler County. This breach actually caused flooding to a residential community south of the state park. The dune breach has subsequently been closed by emergency dune construction; however, the threat exists for future breaches in the area that could bring significant coastal flooding to adjacent developments.



Over 300 feet was lost from the end of the Jacksonville Beach Pier, which was designed for a 20-year storm event in accordance with Florida Administrative Code. But Hurricane Matthew represented a 30-year storm, which exceeded the design for the pier.

Jacksonville Beach Deflation and Dune Erosion



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Running down the coast, starting in Duval County, I'll mention the Jacksonville Beach SPP met its design objectives of protecting the coast. But I don't wish to steal Kevin's thunder in the next presentation, so I'll move on...

**Single-family Dwellings Damaged
South Ponte Vedra, St. Johns County**



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Moving to northern St. Johns County, one of the worst damage areas from Matthew's impact was the South Ponte Vedra – Vilano Beach area. There were 19 dwellings essentially destroyed in SPV and another 5 in VB.

**South Ponte Vedra
Threatened Structures**



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Overall, I believe there were 49 SFD's with major damage in this area. Another 118 dwellings had understructure damage.

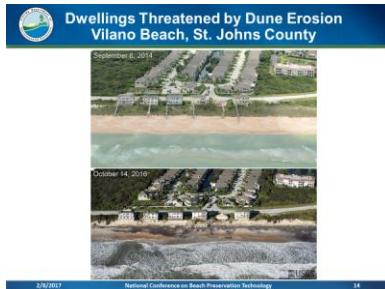
**South Ponte Vedra
Threatened Structures**



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In SPV and VB there were approximately 265 homes or properties with nonstructural damages (including damage to breakaway expendable understructure elements and septic systems) and/or damage to minor structures

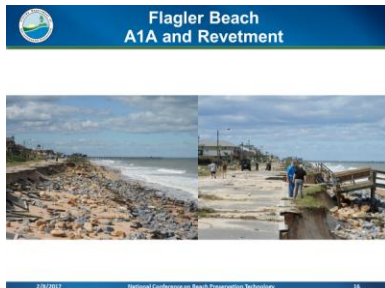
(including dune walkovers, patios and decks). Also numerous timber seawalls were destroyed and many vinyl composite seawalls were damaged.



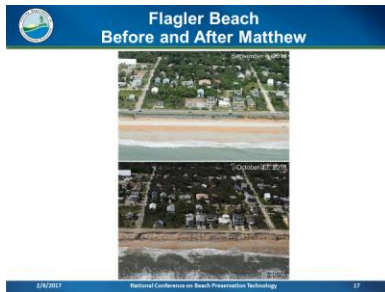
We've identified a roughly 9.5-mile segment along SPV and VB that needs dune restoration as an interim measure of protection. And we recommend the completion of the federal feasibility study for potential beach restoration along this segment. The next maintenance dredging of the federal navigation project in St. Augustine Inlet proposes the placement of 178 kcy along VB.



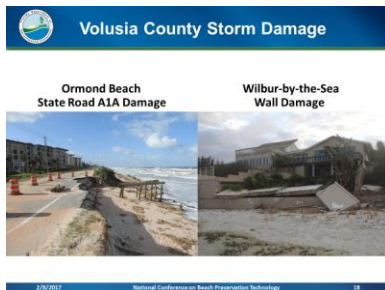
In southern St. Johns County along northern Summerhaven, the rock revetment that was constructed in the 1960's, was substantially damaged along with Old A1A. Also in south Summerhaven, Old A1A was substantially destroyed.



Moving down to Flagler County, State Road A1A was damaged where it was in close proximity to the beach. In northern Flagler Beach, there were segments of road damage between 21st Street North and 23rd Street North.



The road damage was more severe in southern Flagler Beach where the road was damaged between 11th Street South and 21st Street South. This area of southern Flagler Beach also saw a mile and a half of rock revetment destroyed.



There was additional damage to State Road A1A in northern Volusia County north of Ormond Beach. Throughout Volusia County, 0.7 mile of revetments and walls were damaged or destroyed.



Now going south of the cape, major beach and dune erosion took place in south Brevard County threatening structures and undermining a swimming pool.



Numerous homes and several commercial buildings remain threatened by Matthew's beach and dune erosion. Assessing the damage can be overwhelming, as Mike McGarrity caught me taking a break.



In Vero Beach, Indian River County, major beach and dune erosion undermined the parking area along Ocean Drive at Conn Park.

Summary of Structural Damages				
County	# Single-Family Dwellings Damaged	# Multifamily Dwellings Damaged	# Other Major Structures Damaged	Total # Damaged
Duval	0	0	1	1
St. Johns	85	1	0	86
Flagler	11	6	4	21
Volusia	30	35	10	75
Brevard	0	1	2	3
Indian River	0	0	1	1
TOTAL	126	43	18	187

Here is a table summarizing the *major* structural damages observed from Duval through Indian River Counties.

Multifamily Dwellings include condominiums, townhouses, apartments, hotels and motels.

Other Major Structures include commercial buildings (restaurants, stores, beach bars, etc.), recreational buildings and non-habitable Major Structures (i.e., piers, pools, pavilions and parking lots).

Not included in this summary are Minor Structures (i.e., walkways, decks, driveways, patios, etc.), coastal and shore protection structures (i.e., seawalls, revetments, sills, groins, jetties), minor damage to Major Structures or structures located inland of the coastal building zone.

Armoring and Road Damage		
County	Armoring Damage In Feet	Road Damage In Feet
Duval	0	0
St. Johns	7,690	5,170
Flagler	7,860	3,350
Volusia	3,820	195
Brevard	0	0
Indian River	0	550
TOTAL	19,370	9,265

This table summarizes the armoring and road damage. This amounted to over 3 and 2/3's miles of damage to seawalls and revetments, and 1 and 3/4 miles of road damage.

Given the landward relocation of the road along Flagler Beach, a substantially greater length of State Highway A1A will have to be reconstructed. These figures represent the length of pavement damage, whereas DOT will have figures that reflect the total length of highway to be replaced.

Beach Restoration Projects Sustained Minimal Damage				
Beach Restoration Projects	Project Length (Feet)	# of Major Structures with Damage	Armoring Damage (Feet)	Road Damage (Feet)
Duval County Shore Protection Project	53,328	1	0	0
St. Johns County Shore Protection Project	20,064	0	290	0
Brevard County Shore Protection Project – North Beach	49,632	0	0	0
Patrick Air Force Base Beach Project	21,120	0	0	0
Brevard County Shore Protection Project – South Beach	20,064	0	0	0
Indian River County – Ambersand Nourishment	14,256	0	0	0
Indian River County – Wabasso Beach Nourishment	34,848	0	0	0
Indian River County Sector 7 Beach Nourishment	10,735	0	0	0
TOTAL	224,047	1	290	0

This was my favorite damage table. On its face, its rather stupid – a whole bunch of zeros. But what does it tell us? It shows indisputable evidence, that where the coast was protected by a beach restoration project, there was essentially no significant damage. The one structure damaged at a project, was the Jacksonville Beach pier, which was seaward of the project. And the armoring damage was some relatively minor damage to a very old wall at St. Augustine Beach.

So, where a beach restoration project existed, upland damages to buildings, armoring and infrastructure was minimal.



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Thank you!