

HURRICANE CHARLEY

**Post-storm Beach Conditions and Coastal Impact Report
with
Recommendations for Recovery and Modifications of Beach
Management Strategies**

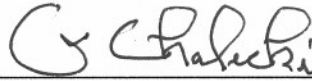


**Florida Department of Environmental Protection
Division of Water Resource Management
Bureau of Beaches and Coastal Systems
August 2004**

Foreword

The Bureau of Beaches and Coastal Systems is responsible for planning and management of sandy beaches fronting the Gulf of Mexico, the Atlantic Ocean and the Straits of Florida. Tropical storms and hurricanes can cause significant shoreline change, necessitating adoption of new or even emergency management strategies. This report documents immediate post storm assessments conducted by Ralph R. Clark, P.E., James LaGrone, Steve West, and Jennifer Cowart, and recommendations for actions to address the changes from the professional staff of the Bureau.

STATE OF FLORIDA, DEPARTMENT
OF ENVIRONMENTAL PROTECTION



for

Michael R. Barnett, P.E., Chief
Bureau of Beaches and Coastal Systems

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Post-storm Beach Conditions and Coastal Impact

Friday, August 13, 2004, Hurricane Charley made landfall on the Southwest Coast of Florida as a category four hurricane on the Saffir-Simpson hurricane scale (see Figure 1). The eye of Hurricane Charley made landfall on the Lee County coast at Charlotte Harbor and traversed the axis of the estuary on a south-southwest to north-northeast alignment and continued across the Florida peninsula. The hurricane impacted the inland region of Charlotte County, and the inland counties of DeSoto, Hardee, Polk, Osceola, and Orange, before exiting the Atlantic coast at Volusia County near Daytona Beach.

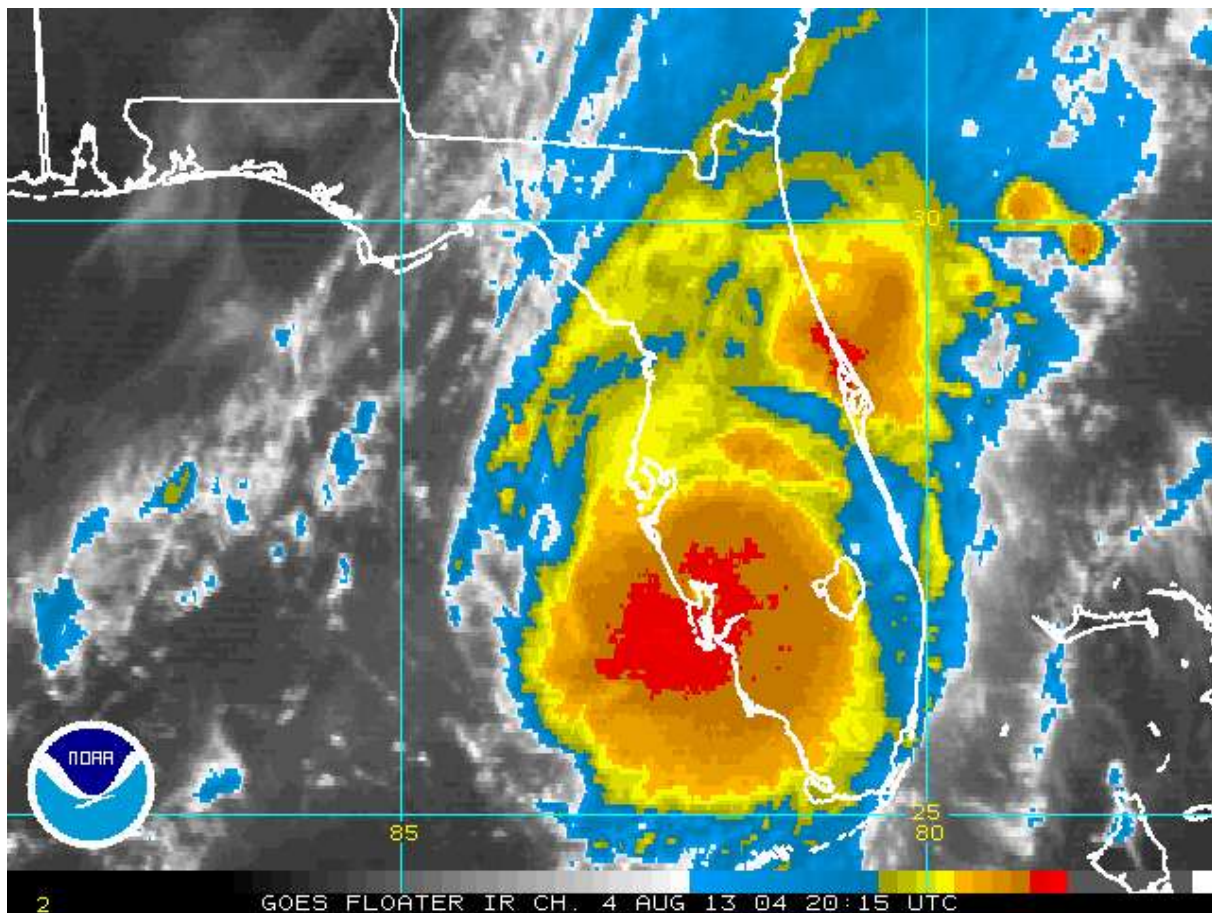


Figure 1. Infrared Satellite Image of Hurricane Charley at 4:20 PM, August 13, 2004

The nine Lee County coastal barriers, including Gasparilla Island, Cayo Costa, North Captiva Island, Captiva Island, Sanibel Island, Estero Island, Lovers Key, Big Hickory Island, and Little hickory Island, all sustained the predominant erosion (See Appendix A) and flooding impact of Hurricane Charley (See Figure 2). Charlotte County to the north and Collier County to the south sustained only a “fringe” impact from the storm surge and waves. Generally minor beach and dune erosion was sustained in these fringe impact areas, with the exception of a few localized erosion hot spots due predominantly to littoral obstructions.

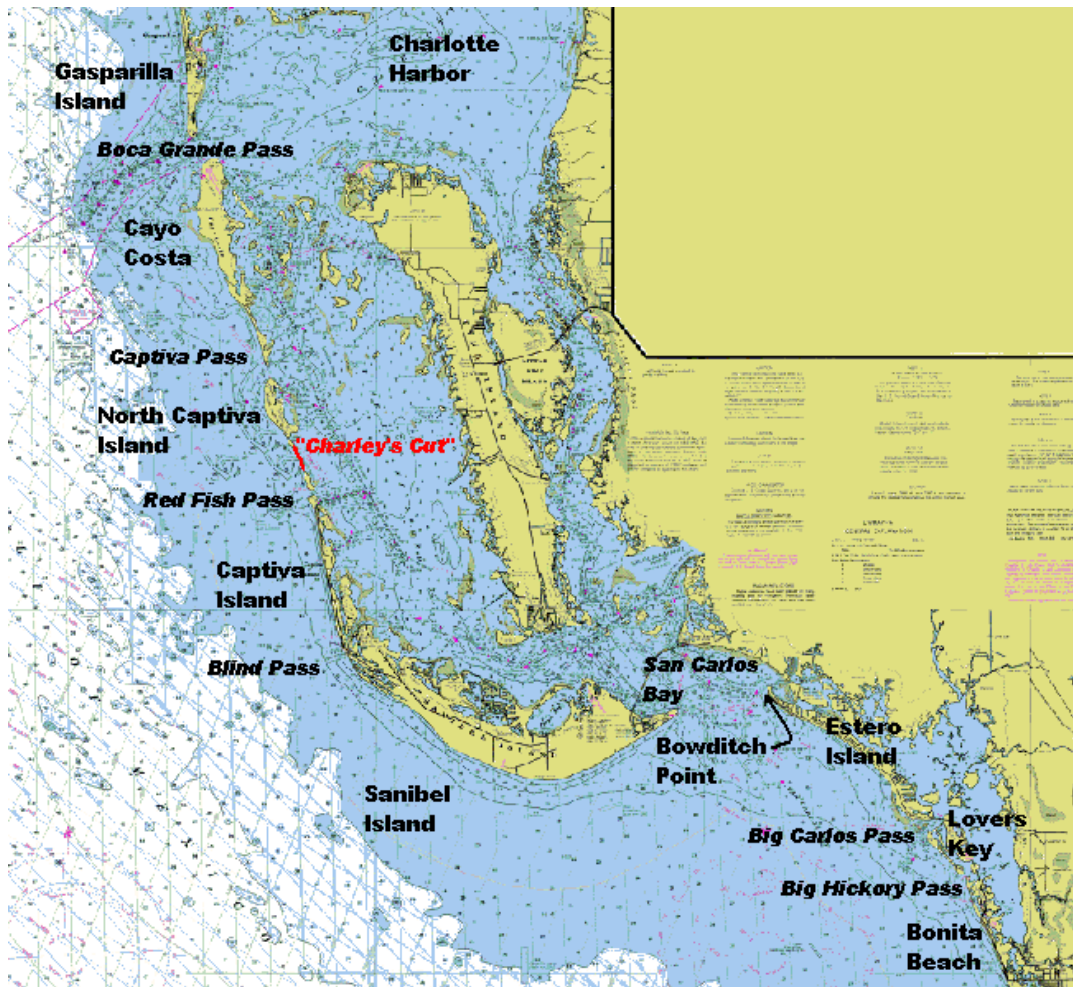


Figure 2. Nautical Chart of Impacted Coastal Areas

Hurricane Charley inflicted severe wind damage along the path of its highest wind, which was located on the southeast side of its eye. The residential communities of Port Charlotte and Punta Gorda at the north end of Charlotte Harbor and 18 miles from the coast sustained severe wind damage to residential and commercial development. The nearby communities of Fort Myers, Cape Coral, and North Fort Myers, also sustained

major wind damage to residential and commercial buildings. Pine Island and Little Pine Island, which lie inland of Sanibel and Captiva Islands and seaward of the mainland at Cape Coral sustained severe wind damage to residential and commercial development, particularly to the marina facilities. The DeSoto County seat of Arcadia and nearby rural communities also sustained severe wind impact to residential, commercial, and agricultural development. Major wind damage was inflicted on both urban and rural development as well as agricultural interests throughout the narrow path of the eye across the Florida peninsula. The Red Cross reported over 70,000 dwellings being impacted by Charley, including over 10,000 dwellings destroyed and another 16,000 dwellings with major structural damage rendering them uninhabitable. Another 46,000 dwellings had minor damages yet were habitable. At the end of August, the insurance industry reported that Hurricane Charley caused an estimated \$7.4 billion in insured damage to residential property, businesses, and personal possessions, making it the most costly hurricane in Florida since Hurricane Andrew in 1992.

Gasparilla Island

Gasparilla Island is the northernmost coastal barrier island of the Charlotte Harbor complex. The island is 6.8 miles long between Gasparilla Pass to the north and Boca Grande Pass to the south at the entrance to Charlotte Harbor. Boca Grande Pass has an inactive federal navigation channel that likely experienced significant storm tide induced shoaling due to Hurricane Charley.

Throughout the length of Gasparilla Island only minor beach erosion (Condition I) prevailed (Photo 1). Gasparilla Island was on the lee side of Charley's eye and a storm surge was estimated to be between +4 and +5 feet in this area. The southern 4.1 miles of Gasparilla Island between Lee County DEP Reference Monuments R7 and R26 is designated as critically eroded. Much of the area is armored with seawalls and revetments. No significant damage was observed to these coastal protection structures; however, some scouring of the beach and nearshore was observed.



Photo 1. Minor beach erosion at Gasparilla State Park
(Lee County DEP Reference Monument R17)

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Wind damage was minor to moderate (Condition II to III) throughout the island with much of the impact being experienced in the town of Boca Grande at the south tip of the island. At least five Gulf-front buildings sustained major roof damage. Extensive light wind damage was experienced throughout Boca Grande.

The island's leeward position to the hurricane's eye is evident in the southward fallen trees (Photo 2). A duplex at R25 was highly exposed to the north wind and its roof blew off to the south (Photo 3).



Photo 2. Downed tree.



Photo 3. Belcher Road dwelling with roof damage (R25)

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At the Gasparilla Island State Park between R16 and R17, the roofs of seven out of eight gazebos blew off (Photo 4).



Photo 4. Gasparilla State Park shelters had roofs blown off.

Cayo Costa

To the south of Boca Grande Pass and extending for 7.1 miles to Captiva Pass is the generally undeveloped barrier island of Cayo Costa (Photo 5). Three areas on Cayo Costa have been designated as noncritically eroded. The northern segment (R27-R33) extends for 1.1 miles, the central segment (R46-R52) extends for 1.2 miles, and the southern segment (R60-R65) extends for 1.0 mile.

The Department's Division of Recreation and Park's staff reports that state lands and structures were damaged. Cayo Costa is accessible only by boat, and the impact of Hurricane Charley on the shoreline has yet to be assessed pending access to aerial videography.



Photo 5. View of Cayo Costa looking across Boca Grande Pass

North Captiva Island

South of Cayo Costa fronting on Pine Island Sound is North Captiva Island, which extends four miles between Captiva Pass and Redfish Pass. At the north end of North Captiva Island is a 1.2-mile segment of shoreline (R66-R71) that is designated as critically eroded. From aerial videography and visual survey by boat, the shoreline extending between R66 and R68 sustained major beach and dune erosion (Condition IV) from Hurricane Charley. This area was within the path of maximum winds at landfall, and severe wind damage was sustained throughout the residential development. At least ten single-family dwellings were totally destroyed by the wind and numerous others were substantially damaged (Photos 6-9). The North Captiva Fire Department reported that at least half of the approximately 300 homes were substantially damaged.

The undeveloped stretch of the island between R71 and R75 will be assessed in more detail pending access to aerial videography.

The narrow southern 2.1 miles of North Captiva Island experienced severe flooding, erosion, and wind damage from the eye of Hurricane Charley. Major beach and dune erosion (Condition IV) was inflicted on this entire stretch of shoreline between R75 and R82 (Photo 10). Along a 0.3-mile segment in the vicinity of R78 and R79 the island completely disintegrated forming a new tidal pass (Photo 11) and truncating a 0.8-mile segment of island north of Redfish Pass. This pass is through state owned lands managed by the Division of Recreation and Parks, and is locally known as “Charley’s Cut.” With Condition IV erosion, very little beach remains along this island (R79-R82). At the south end of the island eight single-family dwellings sustained major roof damage and three single-family dwellings sustained major damage (Photo 12). Severe wind damage to shrubs and trees (including mangrove and Australian pines) and minor structures (decks, walkways, understructures, docks, etc.) was sustained throughout this area.

From a water line apparent on an enclosed understructure storage room of one of the dwellings, a storm surge of +9 feet was estimated (Photo 13).

Three T-groins at the south end of North Captiva Island at Redfish Pass appear to have sustained no significant damage and are functioning to hold small pockets of sand in their lee; however, most of the beach was lost.

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Photo 6. North Captiva Island dwelling destroyed.



Photo 7. Typical structure damage to dwellings on North Captiva Island.

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Photo 8. North Captiva Island dwelling destroyed.



Photo 9. North Captiva Island dwelling destroyed

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Photo 10. Major beach erosion, North Captiva Island

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Photo 11. "Charley's Cut" across North Captiva Island (R78-R79)



Photo 12. Typical damage at south end of North Captiva Island (R81)

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Photo 13. Storm surge elevation of approximately +9 feet on North Captiva Island

Captiva Island

South of North Captiva Island and fronting Pine Island Sound is Captiva Island, which extends for five miles between Redfish Pass on the north and Blind Pass connecting Sanibel Island to the south. All of the Gulf-front shoreline of Captiva Island (R84-R109) is designated critically eroded, however, this critical erosion area is currently managed with a beach restoration project. A 0.2-mile segment of shoreline (R83-R84) at Redfish Pass is also designated as critically eroded and is armored with a rock revetment.

The South Seas Resort at the north end of Captiva Island sustained severe wind damage and significant flooding throughout the development. A storm surge was estimated to have reached between +7 and +8 feet. The northern area of the Resort fronting on the golf course sustained major beach and dune erosion (Condition IV) between R84 and R86 (Photos 14 and 15). A seaward segment of Redfish Pass shoreline revetment sustained damage from the storm surge and storm waves, and the terminal groin at R84 appears to have been completely destroyed. Between R83 and R84 at least 14 out of 17 multifamily dwelling structures sustained major damage primarily to roofs. At least five other buildings near R85 between the golf course and the marina sustained major roof damage. Overall within the Resort extensive wind and flooding damage was sustained by shrubs and trees, utility lines and poles, signs, minor structures (fences, walkways, restrooms, etc.), marina facilities, and recreation structures (tennis court facilities, club houses, golf cart paths, fairways, etc.)(Photo 16).

Along the remainder of Captiva Island (R86-R109) minor beach and dune erosion (Condition II) prevailed (Photo 17). The beach restoration project functioned well to mitigate any major storm surge or wave damage. Had the beach restoration project not existed it is highly probable that Captiva Drive between R96 and R101 would have been substantially damaged.

Between R86 and R93 at least seven Gulf-front multifamily dwellings sustained major roof damage. A tennis shop building was also destroyed. Extensive wind damage was sustained along this entire reach to shrubs and trees, minor structures, utilities, and roofing. Many wood power poles were snapped at different elevations.

Between R94 and R101 at least one single-family dwelling and one hotel received major roof damage. Extensive wind damage was also sustained to shrubs and trees, minor structures, utilities, and roofing.

Between R101 and R109 along the southern third of the island, extensive wind damage was sustained to shrubs and trees, minor structures and roofing. The terminal groin at R109 did not appear to sustain significant damage.

Between Captiva and Sanibel Island, Blind Pass was flowing during the storm surge. The pass is currently closed at low tide, but is breached at high tide near the north bridge abutment. Additional sand from off the northern Sanibel Island beach was lost into the pass east of the bridge during the storm surge of Hurricane Charley.

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Photo 14. Condition IV erosion, Captiva Island (R84)



Photo 15. Major beach and dune erosion, South Seas Plantation (R85)

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Photo 16. Typical flood damage, Captiva Island (R86)



Photo 17. Minor beach and dune erosion, Captiva Island (R97)

Sanibel Island

South of Blind Pass and Captiva Island is the wide coastal barrier of Sanibel Island. Arcuate-shaped, Sanibel Island is the largest and longest barrier island of the Lee County coast having 12.4 miles of Gulf-fronting beaches. Except for the island's north end, most of Sanibel Island is stable or accretional.

The northern 1.7 miles south of Blind Pass (R109-R118) is designated as critically eroded. This area is managed as a beach restoration project. Were it not for the nourishment in this area, Hurricane Charley would have inflicted severe flooding and wave damage to the road and single-family dwellings seaward of the road immediately south of Blind Pass. As it was, only minor beach and dune erosion (Condition II) was sustained between R110 and R112. However, at least four Gulf-fronting single-family dwellings sustained major roof damage and one dwelling received major side damage. At least eight single-family dwellings seaward of Sanibel-Captiva Drive were flooded but not gutted on their interior.

Between R112 and R113, Clam Bayou remained closed due to the past beach nourishment. Between R114 and R115, Old Blind Pass was also closed. However, between R114 and R119 major beach and dune erosion (Condition IV) was sustained. At R123, the Bowman Beach pedestrian bridge was destroyed.

Throughout the remainder of Sanibel Island (R119-R174) minor beach and dune erosion (Condition II) was generally observed (Photo 18). Extensive wind damage was sustained throughout Sanibel Island to shrubs and trees, minor structures, signs, utility lines and poles, and roofing.

East of Sanibel Island, the causeway to the mainland was flooded and sustained wave induced erosion. Inside San Carlos Bay entrance, Punta Rassa and the mangrove lined mainland shoreline to the east received extensive wind damage to vegetation, signs, and utilities.

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Photo 18. Minor beach and dune erosion, Sanibel Island (R165)

Estero Island

To the east of San Carlos Bay and south of Matanzas Pass lies Estero Island (Fort Myers Beach) extending for 6.9 miles between Estero Pass on the north to Big Carlos Pass on the south. From R176 to R200, 4.8 miles of Estero Island are designated as critically eroded. A federal navigation channel passes through Estero Pass around the north end of Estero Island. The channel likely experienced significant shoaling from the transport of sand off Bowditch Point (R175) at the north end of the island.

Major beach and dune erosion (Condition IV) was sustained along the north end of Estero Island (R175-R177). At Bowditch Point Park the shoreline receded an estimated 50 to 75 feet (Photo 19). No beach exists at high tide between R175 and R176. Between R176 and R180, grade level commercial and residential development was flooded by a storm surge estimated at +6 to +7 feet. The public beach at Times Square north of the fishing pier also experienced dramatic recession.

The shoreline receded between 150 and 200 feet at and immediately south of the Ft. Myers Beach Pier (R181). No beach exists at the pier; however, the pier did not appear to sustain any significant damage (Photo 20). Three Gulf-front commercial buildings at R181 sustained major roof damage and two other commercial buildings sustained major side damage. A pool house was also destroyed.

Between R182 and R184 a wide beach remains that saw an estimated two feet of vertical scour. One single-family dwelling located 300 feet north of R183 (Photo 21) was totally destroyed. A large commercial building (hotel and restaurant) sustained major first floor damage and was gutted by flooding on the interior. In addition, four single-family dwellings and three multifamily dwellings sustained major roof damage. Numerous structures in this area (R182-R184) sustained flooding damage as well as roofing and siding damage.

Between R184 and R187, a narrow beach remains with at least two feet of vertical scour. Two commercial buildings sustained major structural damage. Several condominium carports ranging in lengths between 50 and 100 feet were destroyed. At R187, a trailer on the coastal construction control line was destroyed. Extensive wind damage was sustained throughout the trailer park landward of the coastal construction control line.

Between R187 and R192, major beach and dune erosion (Condition IV) was observed. Along this hard hit segment of Estero Island, eleven single-family dwellings had major first floor damage (Photo 22), sixteen single-family dwellings had understructure damage, and three single-family dwellings had major roof damage. About 450 feet north of R190 a 100-foot long wood retaining wall with a 20-foot return and a concrete cap was damaged.

Between R192 and R196 is a segment of shoreline that is armored with concrete seawalls and rock revetments. This armored stretch of shoreline sustained major beach erosion (Condition IV). No beach remains along this stretch as the shoreline receded between 50

and 100 feet (Photo 23). The beach scoured a maximum of about 4 to 5 feet vertically immediately seaward of the armoring leaving a pronounced scour trough aligned parallel with the seawalls (Photo 24). Conditions appeared similar to the scour trough left by Hurricane Elena in 1985 along the Sand Key seawalls in Pinellas County, except no major damage was apparent to these Estero Island walls.

Within this segment (R192-R196), one single-family dwelling had major first floor damage, one commercial building had major roof damage, and four single-family dwellings had understructure damage. In the segment between R196 and R197, one single-family dwelling had major roof damage and four single-family dwellings had understructure damage. Between R201 and R203, at least ten canopied parking structures were destroyed or substantially damaged (Photo 25). These condominium-parking structures varied between 100 and 200 feet in length.

South of R197, the beach begins to widen to the north attachment area (about R200 to R202) of the former emerged shoal, known locally as Little Estero Island. The entrapped lagoon extends for about a mile between R202 and R207. This narrow emerged bar has now been breached, creating an inlet connection to the entrapped lagoon (Photo 26). Dramatic morphological changes are now to be expected with continued disintegration of this truncated coastal barrier.

Given the low island elevations (averaging +5 ft. NAVD) and a storm surge of approximately +7 feet, significant flooding of this area occurred. Estero Boulevard between R207 and R209 was overtopped by the storm surge, leaving a wrack line along properties north of the roadway at an approximate elevation of +7 ft. NAVD. There appeared to be significant accretion of the beach between R207 and R210. Concrete seawalls along the Big Carlos Pass shoreline near R209 had no beach in front of them as recently as June 2001 (reference – DEP Coastal Construction Control Line Aerial Photomaps, Lee County, sheet 68 of 78). At present there appears to be as much as 200 feet of beach width seaward of these walls.

Throughout Estero Island, extensive wind damage was sustained to trees and shrubs, minor structures, signs, carports, roofing and siding. Minor to moderate structural damage was also inflicted on manufactured housing in neighborhoods inland of the coastal construction control line.

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Photo 19. Major beach erosion, Bowditch Point (R176)



Photo 20. Major beach loss adjacent Ft. Myers Beach Pier (R181)

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Photo 21. Estero Island dwelling destroyed (R183)



Photo 22. Estero Island dwelling with typical flood damage (R191)

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Photo 23. Beach lost seaward of armoring (R192)



Photo 24. Scour trough with sandbar formation seaward of armoring (R195)

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Photo 25. Typical canopied parking structure destroyed (R202)



Photo 26. Barrier breach on south Estero Island in the vicinity of R206
(Photo by Robert Neal, Lee County Department of Natural Resources)

Lovers Key – Black Island

South of Estero Island and Big Carlos Pass is the natural barrier island complex of Lovers Key and Black Island, which is managed as Lovers Key State Park. The Gulf beach on Lovers Key extends for 1.7 miles. Most of this beach is erosional and the 1.1-mile segment between R215 and R221 is designated as critically eroded. A beach restoration project had just commenced and placed beach fill between R217 and R219 when Hurricane Charley arrived. The Gulf shoreline of Lovers Key north and south of the fill area sustained major erosion (Condition IV). Surveys are being conducted by the contractor within the fill area to determine fill placement losses.

It is likely that damage to park facilities would have been greater on the beachfront had the new fill not been placed. As it was, the contractor's dredge pipe was transported by the storm surge into the beach pavilion 450 feet north of R219. The dredge pipe caused battering load damage to three of the pavilion's foundation piles. North of the new fill area, the seaward approximately 60 feet of the pedestrian bridge broke away and was transported about 250 feet inland across the lagoon and deposited in the mangrove (Photo 27). Over 100 additional feet of this bridge located 350 feet north of R217 was substantially damaged. Extensive damage to trees and shrubs occurred throughout the park. The worst tree damage was observed along the seaward barrier due to the forces of flooding in combination with the wind loads.



Photo 27. Pedestrian bridge destroyed at Lovers Key State Park (R217)

Big Hickory Island

To the south of Lovers Key and separated from Lovers Key by New Pass on its north end is Big Hickory Island, which extends one mile south to Big Hickory Pass. The north end of Big Hickory Island between R222 and R223 is accretional; however, the 0.7-mile segment between R223 and R226 is designated as noncritically eroded.

This erosional beach segment between R223 and R226 sustained major beach and dune erosion (Condition IV) during Hurricane Charley. Very little beach remains along this undeveloped island. As on Lovers Key extensive tree and shrub damage was sustained particularly along the Gulf-front where the storm tide flooding was acting in combination with the high winds off the Gulf.

At the south end of the island, Big Hickory Pass remains open, but additional sand was transported into the pass off Bonita Beach. Three dominant sandbars are exposed at low tide representing the bypassing bars of the inlet (Photo 28).



Photo 28. Scour hole and bypassing bars, Big Hickory Pass (R226)

Bonita Beach (Little Hickory Island)

At the south end of Lee County and extending into Collier County is Little Hickory Island. Bonita Beach at the north end extends 2.6 miles south from Big Hickory Pass to the Collier County line (R226-R239). This narrow, low-lying, and highly developed coastal barrier experienced a predominantly fringe impact from Hurricane Charley.

The northern 0.8 mile (R226-R230) is designated as critically eroded and has a beach restoration project fronting a continuous line of concrete bulkheads and revetments. This shoreline benefited from the completion of a maintenance nourishment project immediately prior to the hurricane. The two terminal rock groins constructed with the project at R226 appeared to have no significant damage, although scour holes were created around their ends. The new fill project between R226 and R230 is being surveyed by the project engineer to determine the quantity of material displaced by the storm. Much of the material scoured from the new beach berm appears to be deposited into a storm-built bar at the low tide line (Photo 29). A significant quantity of the new fill was also transported northward into Big Hickory Pass. Additional material was also deposited in condominium parking lots as washover deposits. This material was being scraped and returned to the beach.

South of the beach project, the segment between R230 and R239 sustained only minor beach and dune erosion (Condition II). Bonita Beach also sustained minor wind damage throughout the community.



Photo 29. Minor erosion of Bonita Beach (R227)

Recommendations for Recovery and Modifications of Beach Management Strategies

Areawide (Sarasota, Charlotte, Lee and Collier Counties)

- Encourage expedited federal funding from the United States Army Corps of Engineers for the Federal beach projects.
- Seek Federal Emergency Management Agency assistance to repair non-federal engineered beach projects.
- Conduct supplemental dune restoration and vegetation activities as needed.

Lee County, countywide

- Topographical and bathymetric surveys should be conducted for the entire Gulf coast shoreline and inlet areas.

Gasparilla Island

- Implementation of the existing beach management strategy that includes beach restoration is recommended.

Cayo Costa

- Additional shoreline assessment should be conducted when aerial videography is available.
- Natural recovery is recommended.

North Captiva Island

- Additional shoreline assessment should be conducted when aerial videography is available.
- The new “Charley’s Cut” should be evaluated for its long-term stability and impact on adjoining beaches and Redfish Pass.
- The entire truncated southern portion of the island (R79-R82) should be designated as critically eroded.
- A new management strategy should be developed for the southern 0.8 mile of shoreline (R79-R82).

- Natural recovery is recommended, along with continued implementation of the existing monitoring strategies, unless the Department finds that wildlife impacts are severe.

Captiva Island

- The scheduled maintenance nourishment project should proceed forward following a recalculation of fill quantities.
- Major reconstruction of the terminal groin at Redfish Pass is recommended.
- Additional dune restoration and revegetation should be conducted where needed.

Sanibel Island

- The scheduled nourishment project on the northern beaches should proceed forward.
- An evaluation of the need and feasibility of dune restoration and revegetation along the island's beaches is recommended.

Estero Island

- Expedited implementation of the existing beach management strategy that includes the authorized beach restoration project is recommended.
- An evaluation of the need and feasibility of dune restoration and revegetation along the island's beaches is recommended.

Lovers Key

- The ongoing beach restoration project should be reevaluated for additional fill volume and completed as planned.
- Dune revegetation should be conducted following completion of the project.

Big Hickory Island

- Continued monitoring of the beach and Big Hickory Pass is recommended.

Bonita Beach (Little Hickory Island)

- The nourishment project's erosion losses should be evaluated and the feasibility of fill replacement should be considered while the dredge equipment conducting the Lover's Key beach restoration project remains in the vicinity.

- Pending more extensive engineering evaluation, make needed repairs to the terminal rock groins.
- An evaluation of the need and feasibility of dune restoration and revegetation along the island's beaches is recommended.

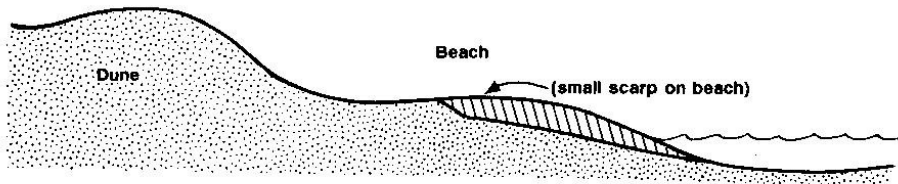
Appendix A

Beach and Dune Erosion Conditions

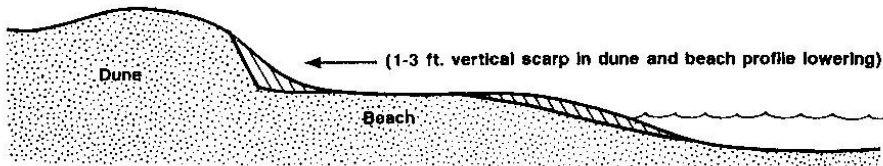
Illustrates a means to qualitatively describe erosion after a storm event.

BEACH AND DUNE EROSION CONDITIONS

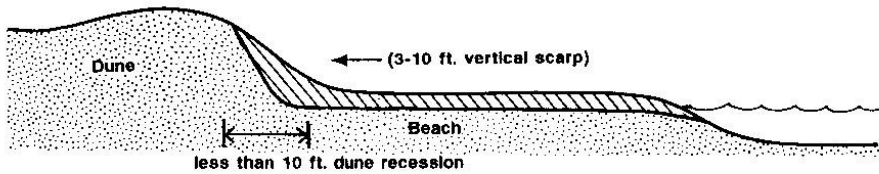
CONDITION I: MINOR BEACH EROSION



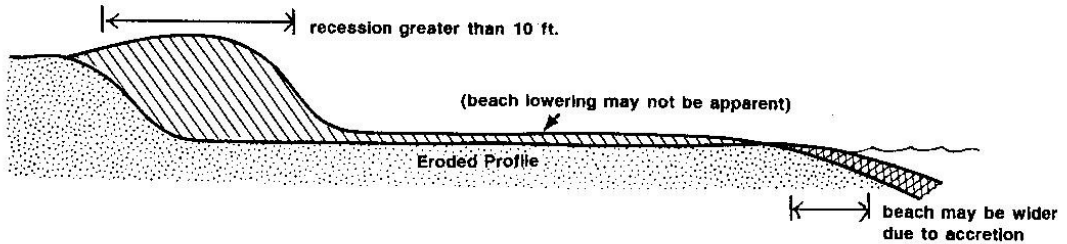
CONDITION II: MINOR DUNE AND BEACH EROSION



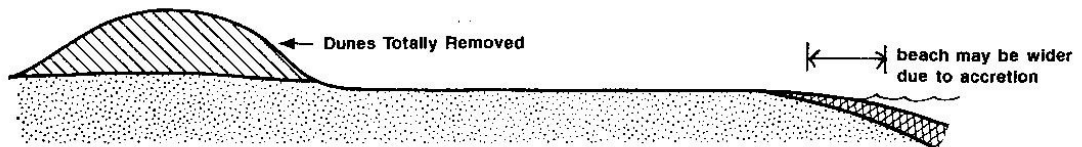
CONDITION III: MODERATE DUNE EROSION AND BEACH PROFILE LOWERING



CONDITION IV: MAJOR DUNE EROSION



OR:



R. R. CLARK 8/27/81