2024 Hurricane Season – Florida's Big Bend Coast Hurricanes Debby and Helene Post-Storm Beach Conditions and Coastal Impact Report Fiscal Year 2024-25

Office of Resilience and Coastal Protection
Florida Department of Environmental Protection
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2024 Hurricane Season – Florida Big Bend Coast Hurricanes Debby and Helene

TABLE OF CONTENTS

Introduction

The Big Bend coast of Florida experienced two hurricane landfalls during the 2024 tropical storm season. Hurricane Debby made landfall on August 5, 2024, at approximately 7:00 a.m. Eastern Daylight Time (EDT), near Steinhatchee, Florida in Taylor County as a Category 1 hurricane on the Saffir-Simpson hurricane intensity scale. Data from the U.S. Air Force Hurricane Hunters aircraft indicated the central pressure at landfall was about 979 millibars (28.91 inches of mercury) and the maximum winds were estimated to be around 80 miles per hour (mph). Nearly two months later, Hurricane Helene made landfall on September 26, 2024, at approximately 11:10 p.m. EDT, just east of the mouth of the Aucilla River in Taylor County as a Category 4 major hurricane. Data from the Air Force aircraft indicated a minimum central pressure of 938 millibars (27.70 inches) and maximum sustained winds of 140 mph. This location was only 45 miles east-southeast of Tallahassee, Florida, and resulted in the Big Bend receiving three hurricanes in 13 months including Hurricane Idalia on August 30, 2023. **Figure 1** illustrates the landfalling tracks of Hurricanes Idalia, Debby and Helene on the Big Bend coast of Florida and their proximity to the worst impacted areas of Taylor, Dixie, and Levy Counties, which were to the right of the hurricanes' eyes. The various coastal communities and island beaches discussed in more detail can be found in the damage assessment by county section of the report.

When Category 3 Hurricane Idalia came ashore a year earlier with maximum sustained winds of nearly 125 mph, it devastated several small Gulf-front communities in the Big Bend with strong winds and high storm tides estimated between seven and twelve feet. Hurricane Debby's impact was substantially less than from Idalia as Debby's storm tides only ranged from two to six feet. However, Hurricane Helene brought catastrophic impacts to the Florida Big Bend with storm tides ranging from ten to fifteen feet.

The Big Bend is sparsely populated with widely scattered small coastal communities surrounded by major wildlife refuges – St. Marks National Wildlife Refuge, Lower Suwanee National Wildlife Refuge, and Cedar Keys National Wildlife Refuge, as well as the Big Bend Seagrasses Aquatic Preserve. There are a limited number of small natural sandy beaches along with a few man-made beaches in the Big Bend region, which is dominated by vegetated wetland shorelines. Observations following Hurricanes Debby and Helene noted little erosion or damage to the densely vegetated wetland shorelines, but generally major erosion to natural sandy beaches between Horseshoe Beach in Dixie County and Cedar Key in Levy County.

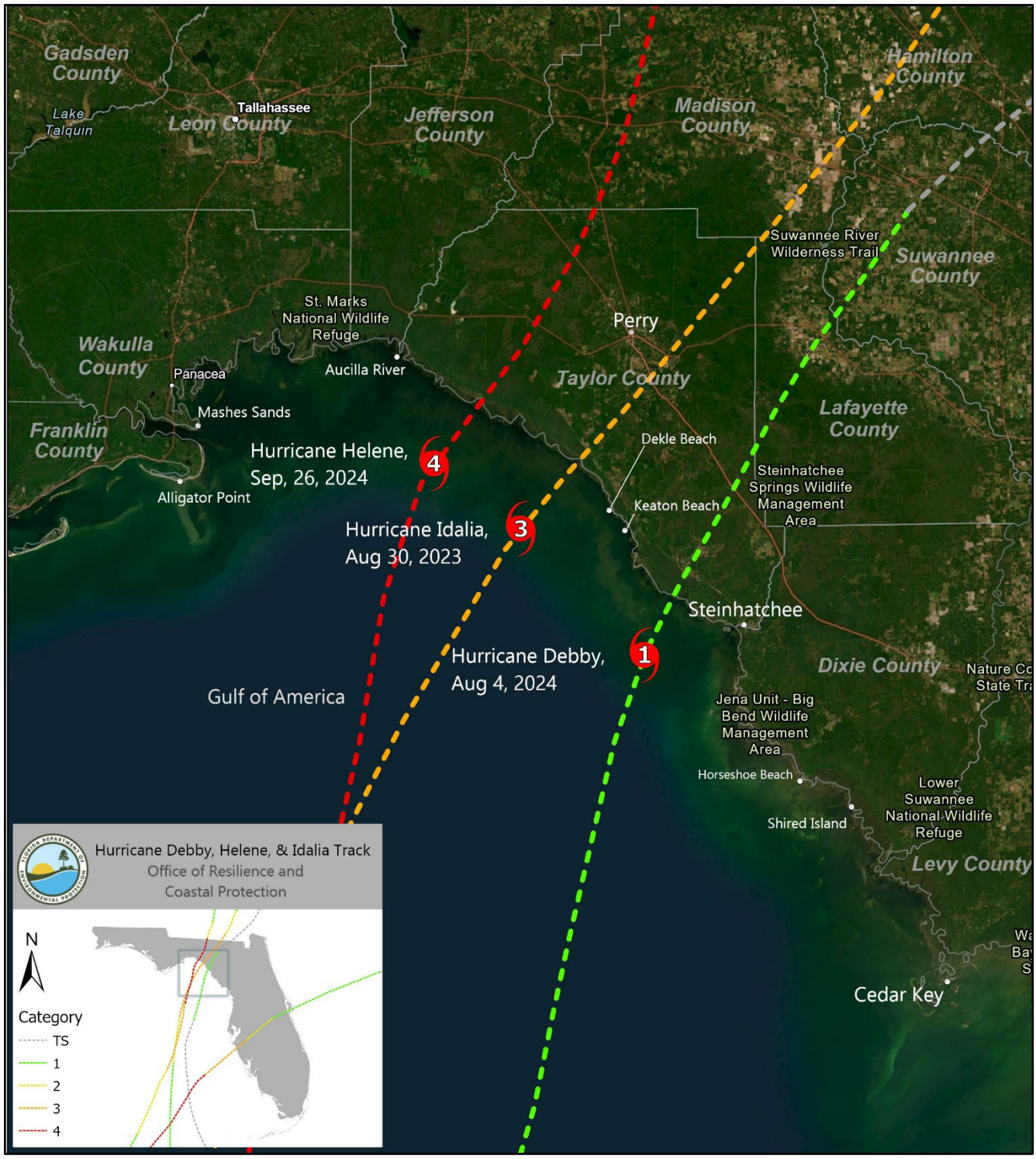

Figure 1. The tracks Hurricanes Idalia, Debby and Helene making landfall in Florida's Big Bend.

West of the Big Bend, Hurricane Debby had no significant impact and Hurricane Helene caused mostly minor beach erosion in Wakulla and Franklin Counties. Along the south end of St. Joseph Peninsula and Cape San Blas in Gulf County moderate to major beach and dune erosion (condition III and IV) was sustained during Helene. No major damage to any major structures was observed in Gulf, Franklin or Wakulla Counties.

This report documents the post-storm beach conditions and coastal impact of Hurricanes Debby and Helene in the Florida Big Bend. It will assist the Florida Department of Environmental Protection (Department) and local governments to identify areas where storm erosion has left upland development and infrastructure vulnerable to imminent damage from future storms, where sand berms could be placed to fortify and assist in the recovery of the beach and dunes, and where expedited permitting procedures are needed to assist homeowners in repairs and reconstruction.

The Department developed this Post-Storm Beach Conditions and Coastal Impact Report to quantify the coastal damage caused by Hurricanes Debby and Helene. This report provides a mostly qualitative assessment of storm impact, beach and dune erosion, and structural damages to the Big Bend coast of Florida fronting the Gulf of America. Although extensive structural damage occurred well inland of the coast, the damage assessment in this report specifically focuses on damage within the Coastal Building Zone as defined in Section 161.54, Florida Statutes.

Procedures Employed for Evaluating Coastal Impacts of Hurricanes Debby and Helene

Immediately following the impacts of Hurricanes Debby and Helene, a damage assessment team was dispatched to the Big Bend coast. The damage assessment team from the Department included Ralph Clark, P.E., Sarah Lindeman, Coastal Geologist, Ahsan Habib, Coastal Engineer, and Allix North, UAS Program Coordinator/Spatial Ecologist. Office support was provided by Bud Bostick, GIS Manager, Ted Kiper, GIS Specialist, Kevin Copland, Engineer, and Shamim Murshid, PhD, Program Manager.

The post-storm damage assessment team conducted detailed field inspections and assessments of the beach and dune erosion conditions and coastal structural damages within the Coastal Building Zone using criteria consistently employed by Department staff over the past 40 years. The damage assessment team evaluated major damages to buildings including roof damage, siding damage, foundation damage and other structural damage on residential and commercial buildings, including single-family dwellings, multifamily dwellings including motels, and other major structures such as swimming pools, fishing piers, parking lots, roads, and restaurants. Damages were also assessed for rigid coastal and shore protection structures including seawalls, revetments, groins, and jetties. The damage assessment team logged observations into computer tablets and field books while inspecting the beach and dune erosion conditions and structures. The hurricane damage assessment team conducted detailed damage assessments in the following counties: eastern Franklin, Wakulla, Taylor, Dixie, and Levy. Additional data, information, and assistance

was provided to the Department staff by various state parks and aquatic preserve staffs.

Figure 2 reflects a segment of coast at Horseshoe Beach in Dixie County showing the Coastal Building Zone. The colored dots in **Figure 2** are the data points that were collected in the field and posted on a geographic information system (GIS) map layer.

Figure 2. A snapshot of data points representing structural damages collected by DEP damage assessment team at Horseshoe Beach within Dixie County following Hurricane Debby (left) and Hurricane Helene (right).

Post-storm reports have been prepared by the Department staff since 1979 and are available on the Department's website. The post-storm reports and the recovery plans are shared with coastal stakeholders and local governments, the Florida Legislature, and the Federal Emergency Management Agency (FEMA).

The summary of post-hurricane field data collected after Hurricanes Debby and Helene can be viewed in the hurricane impact summary section/overview and in each coastal county section of this report.

Hurricane Debby: August 2-10, 2024

Hurricane Debby spawned from a tropical wave that crossed Cuba on Friday, August 2. By 11:00 p.m. Friday, the season's fourth tropical depression formed off the south coast of Cuba with maximum sustained winds of 30 mph. The depression tracked slowly northwest across Cuba into the Gulf of America and its intensity increased so that by 5:00 p.m. EDT, Saturday, August 3, the depression was upgraded to Tropical Storm Debby with maximum winds of 40 mph.

Throughout Saturday night and Sunday morning, Tropical Storm Debby tracked slowly northward across the Gulf and intensified with maximum sustained winds of 65 mph. Debby's structure continued to improve and by 11:00 p.m. EDT Sunday, August 4, Debby was upgraded to a hurricane with 75 mph winds. Hurricane warnings were issued for the Big Bend region of Florida.

Wave heights off Naples measured from a NOAA weather buoy at Pulley Ridge peaked at 11.2 feet. At the entrance to Tampa Bay at Egmont Channel, waves peaked at 13.1 feet. A peak wind gust of 95 mph was measured Monday morning at Horseshoe Beach. At 7:00 a.m. EDT Monday, August 5, Hurricane Debby made landfall near Steinhatchee, Florida, with maximum sustained winds of 80 mph and a minimum central pressure of 979 millibars (28.91 inches). **Figure 3** illustrates the track history of Hurricane Debby overlayed on satellite imagery.

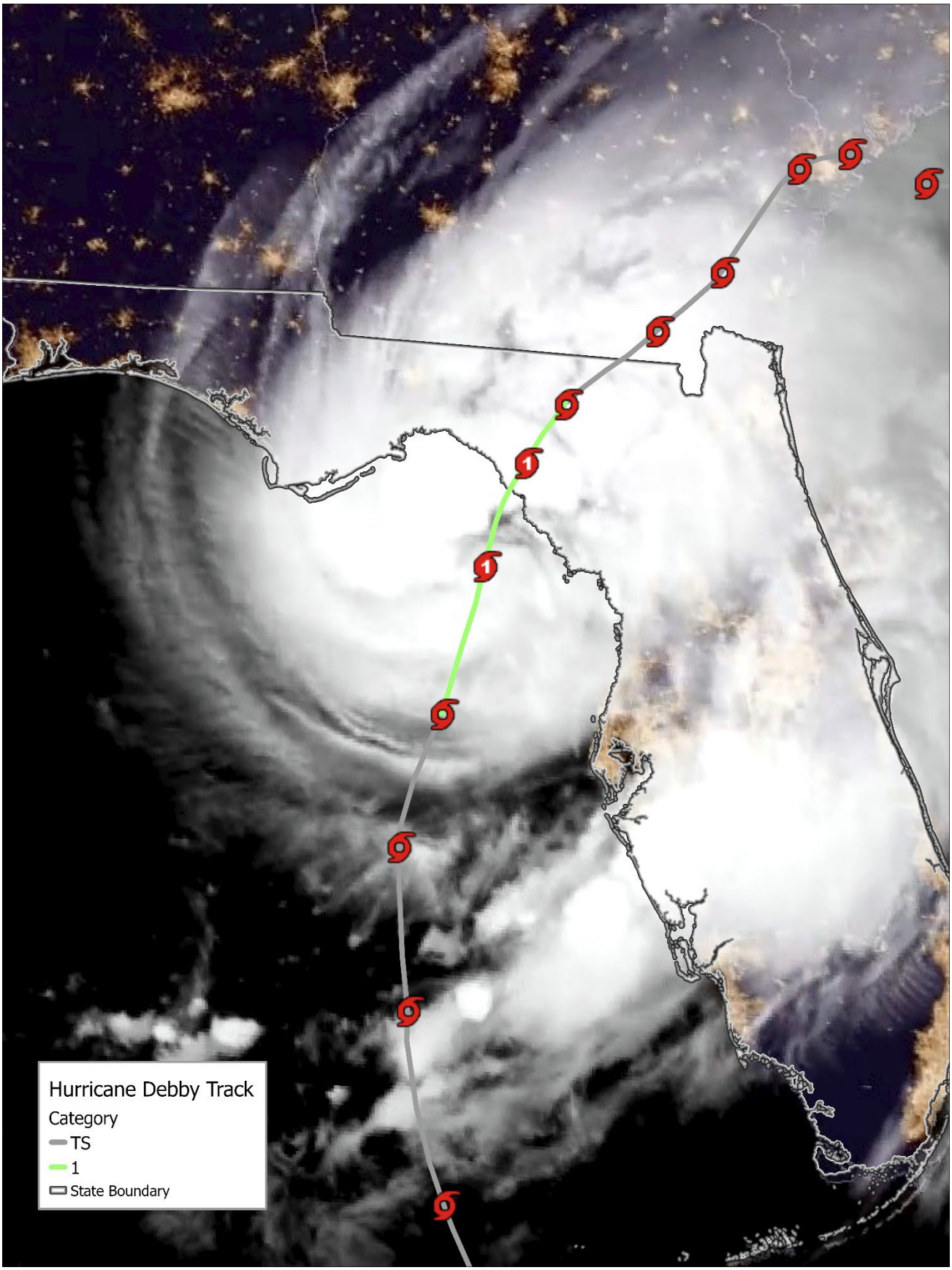

Figure 3. Hurricane Debby track overlayed on satellite imagery.

Hurricane Helene: September 23-28, 2024

Throughout Monday, September 23, the National Hurricane Center (NHC) tracked a broad area of low pressure in the northwestern Caribbean Sea. At 11:00 a.m. Tuesday, September 24, the system was designated Tropical Storm Helene with maximum sustained winds of 45 mph. By Tuesday evening, Helene had become better organized with 60 mph winds while drifting west-northwestward. At 11:00 a.m. EDT, Wednesday, September 25, the NHC upgraded Helene to a hurricane with maximum sustained winds of 80 mph with a turn north-northwestward as it moved through the Yucatan Straits between Cuba and Yucatan.

Wednesday afternoon, as Helene moved northward into the southeastern Gulf of America, hurricane warnings were issued for the Big Bend region of Florida. Throughout Wednesday evening and Thursday morning, Helene tracked northward and then north-northeastward. Wave heights off Naples measured from a NOAA weather buoy at Pulley Ridge peaked at 29.9 feet. Offshore from Tampa Bay, waves peaked at 24.9 feet. Thursday morning, with the 8:00 a.m. EDT advisory, the NHC upgraded Helene to a Category 2 hurricane on the Saffir Simpson hurricane intensity scale citing maximum sustained winds of 100 mph.

Thursday afternoon, the NHC issued an intermediate advisory at 2:25 p.m. EDT noting that Air Force Hurricane Hunter aircraft had found maximum sustained winds had increased to 120 mph making Helene a Category 3 major hurricane. Helene was also expanding in size and had become a very large hurricane with wind, wave and storm surge impacts spreading along the entire southwest coast of Florida.

At 6:20 p.m. EDT, Thursday, September 26, the NHC issued an intermediate advisory that NOAA aircraft had found maximum sustained winds of 130 mph making Helene an extremely dangerous Category 4 hurricane moving into the Big Bend of Florida. Thursday evening, Helene made landfall at about 11:10 p.m. just east of the mouth of the Aucilla River in Taylor County with maximum sustained winds of 140 mph and a central pressure of 938 millibars (27.70 inches). **Figure 4** illustrates the track history of Hurricane Helene overlayed on satellite imagery.

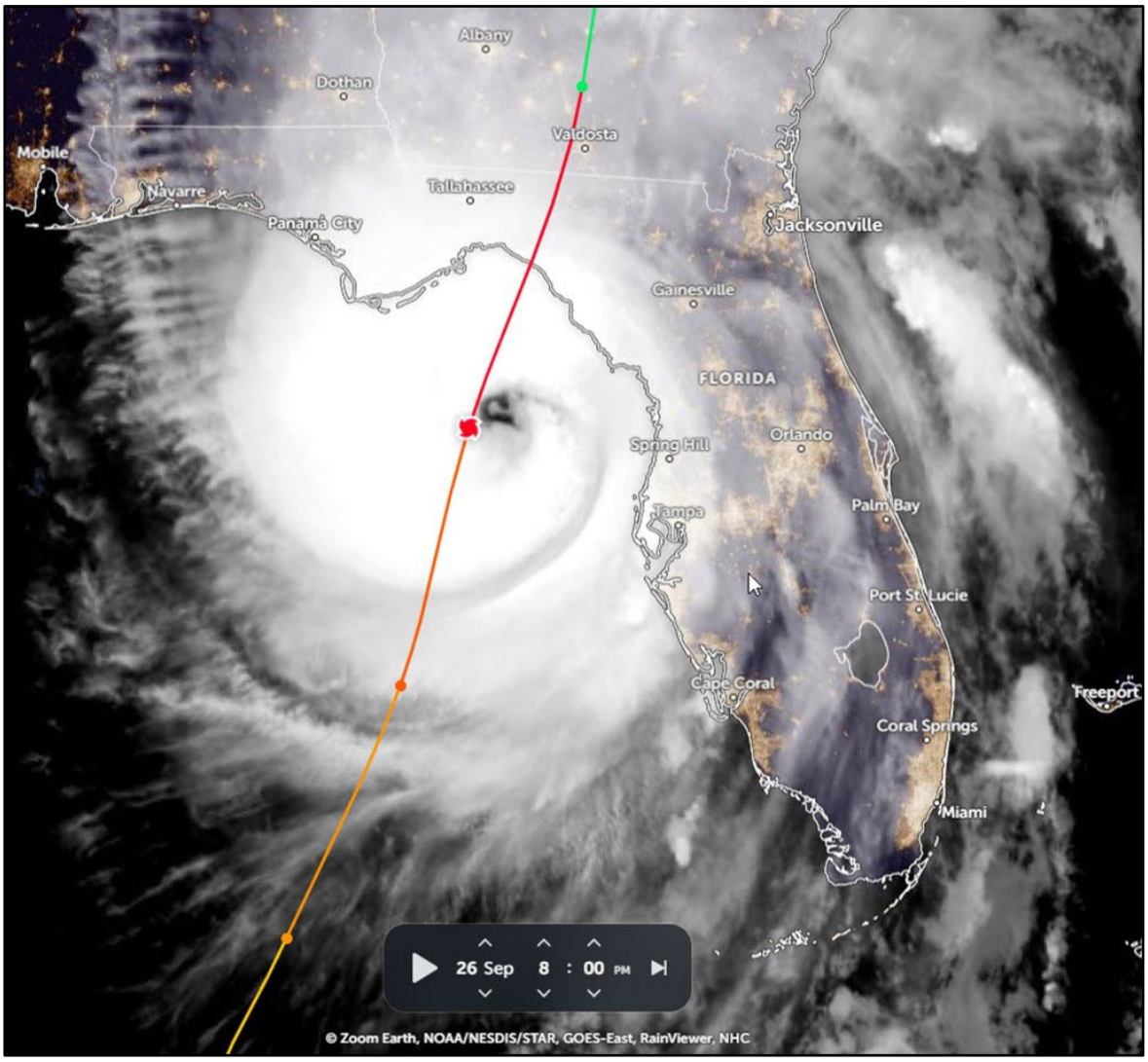

Figure 4. Hurricane Helene track overlayed on satellite imagery (source: Zoom Earth).

The distribution of Hurricane Helene's spatial wind field at landfall on Florida's Big Bend Coast is illustrated in the Synthetic Aperture Radar (SAR) imagery by NOAA in **Figure 5**.

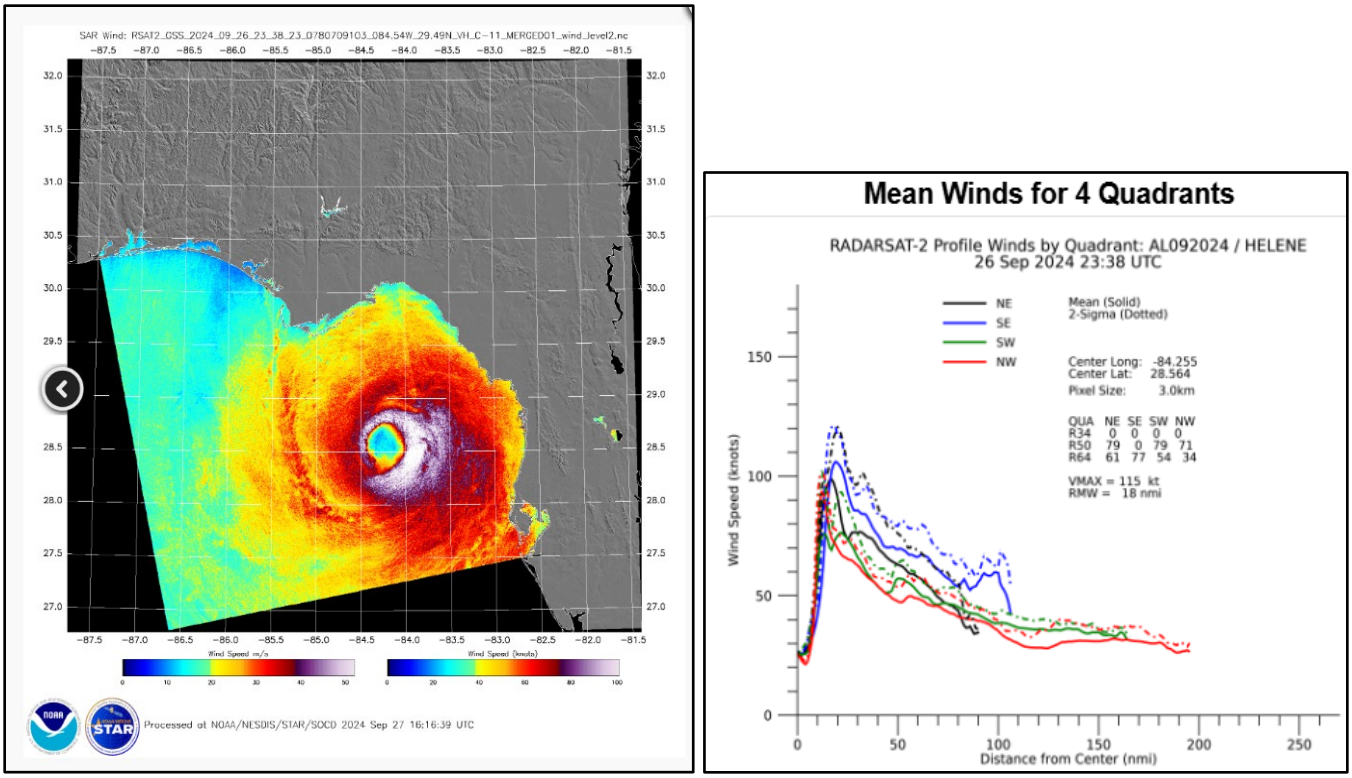

Figure 5. Synthetic Aperture Radar (SAR) imagery showing the spatial distribution of Hurricane Helene's wind field impacting Florida's Big Bend Coast (NOAA).

Prior to the arrival of Hurricane Helene, the University of Florida installed two state-of the-art monitoring stations (called "Sentinels") engineered to operate in and measure extreme wind, storm surge, wave, and hazardous water quality conditions. These Sentinels were deployed at Cedar Key (Levy County) and Mashes Sands (Wakulla County) a day in advance of Helene's landfall (**Figure 6**). During the offshore passage of the eye of Helene, the Cedar Key Sentinel measured a peak 3-second wind gust of 86.5 mph and a sustained 1-minute wind of 72.0 mph (**Figure 7**). A maximum surge was measured at +10.8 feet NAVD, which was consistent with the storm tide measured by the NOAA tide gage at Cedar Key.

Figure 6. The Sentinel deployed at Mashes Sands.

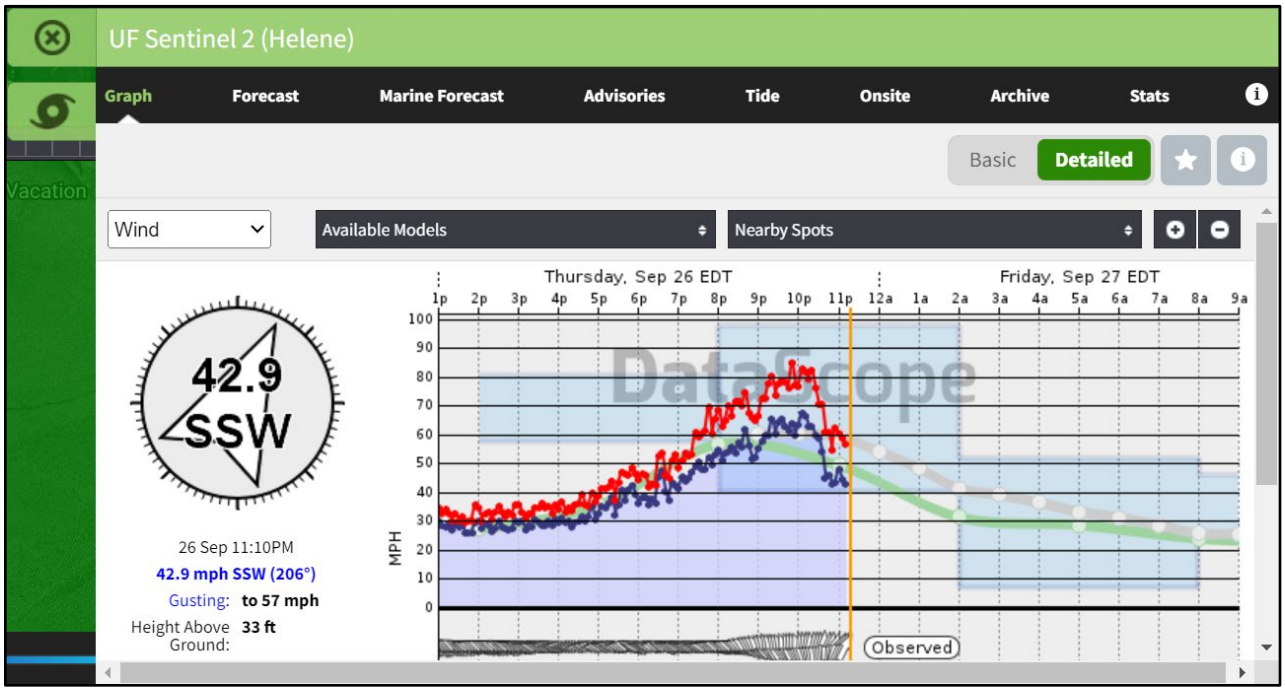

Figure 7. Example of Sentinel live streaming wind data during Hurricane Helene at Cedar Key (University of Florida).

As Helene passed offshore from Horseshoe Beach, a WeatherSTEM station measured barometric pressure and winds reaching 78 mph (**Figure 8**).

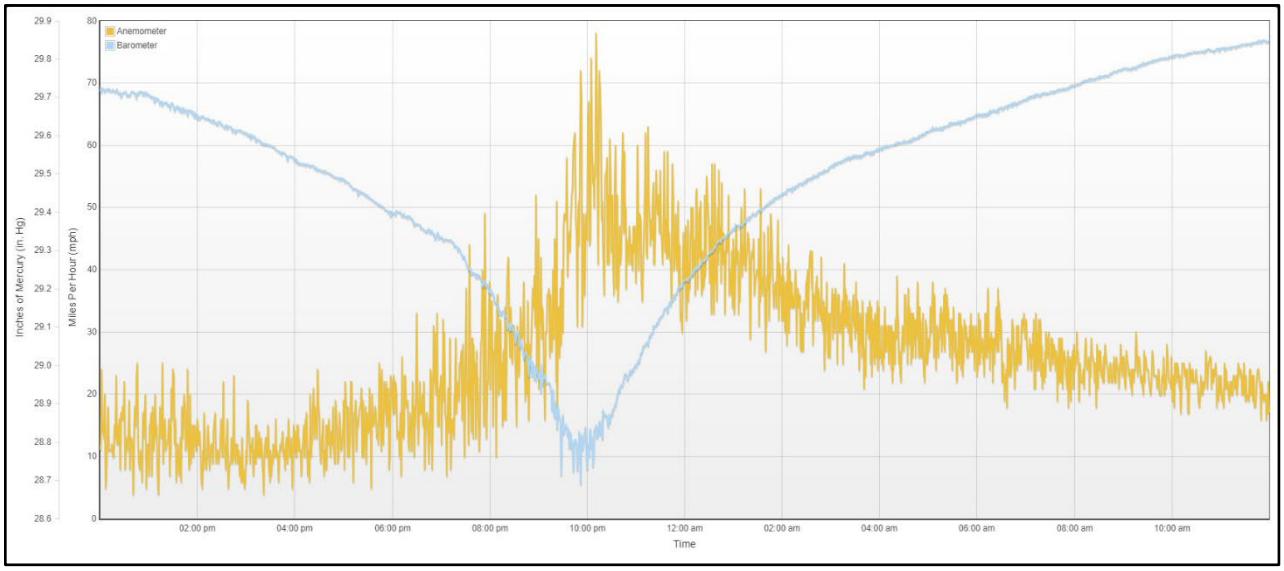

Figure 8. WeatherSTEM data at Horseshoe Beach during Hurricane Helene.

Helene caused severe flooding in the Big Bend region. Storm tide data in the worst flooded area is scarce; however, some data is available from several of NOAA's recording tide gauges. A NOAA tide gauge at Cedar Key recorded a maximum water level of +10.84 feet NAVD (**Figure 9**). Another NOAA tide gauge at Apalachicola recorded a maximum water level of +5.18 feet NAVD (**Figure 10**). Staff observations and local reports in the severely impacted areas of Taylor and Dixie Counties suggested approximate storm tide levels as high as +15 feet NAVD, however, such estimates likely included some wave runup effects.

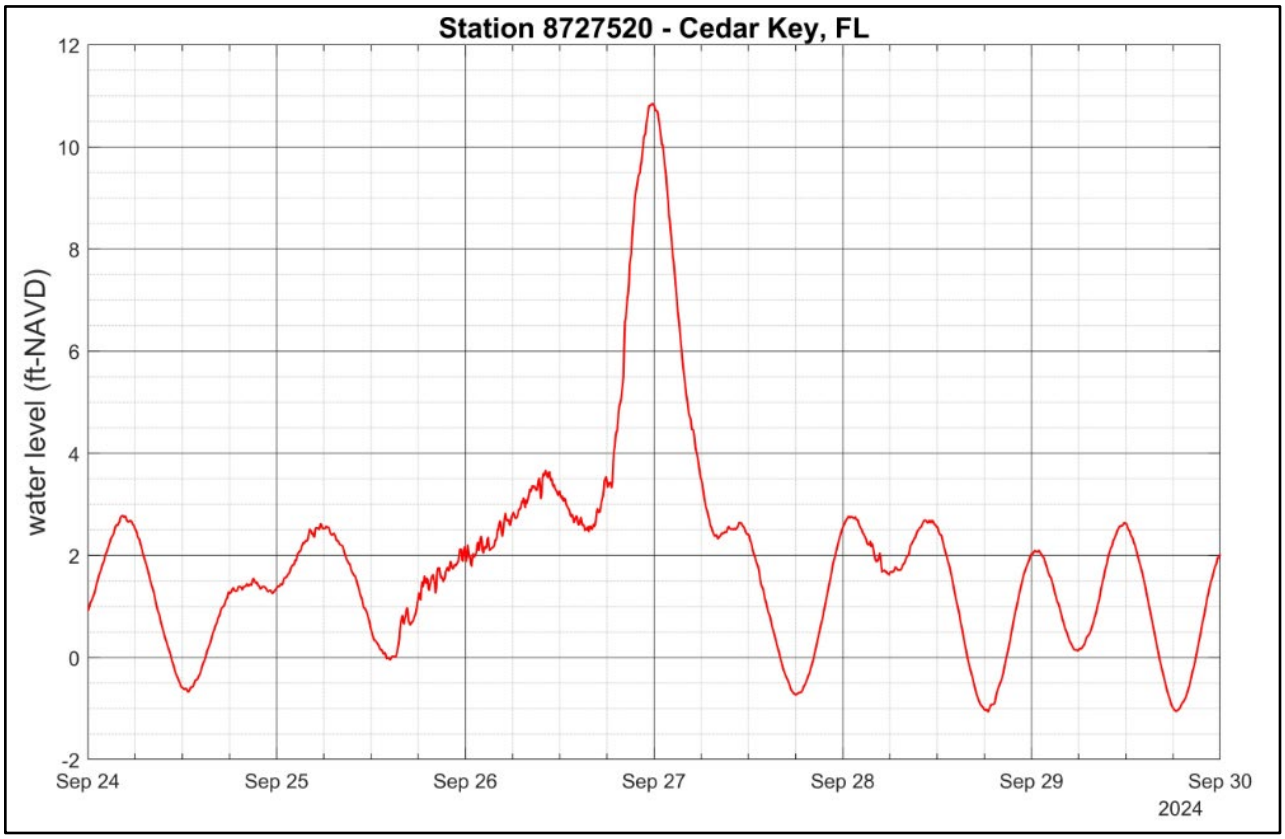

Figure 9. Water level elevations at Cedar Key, FL (NOAA).

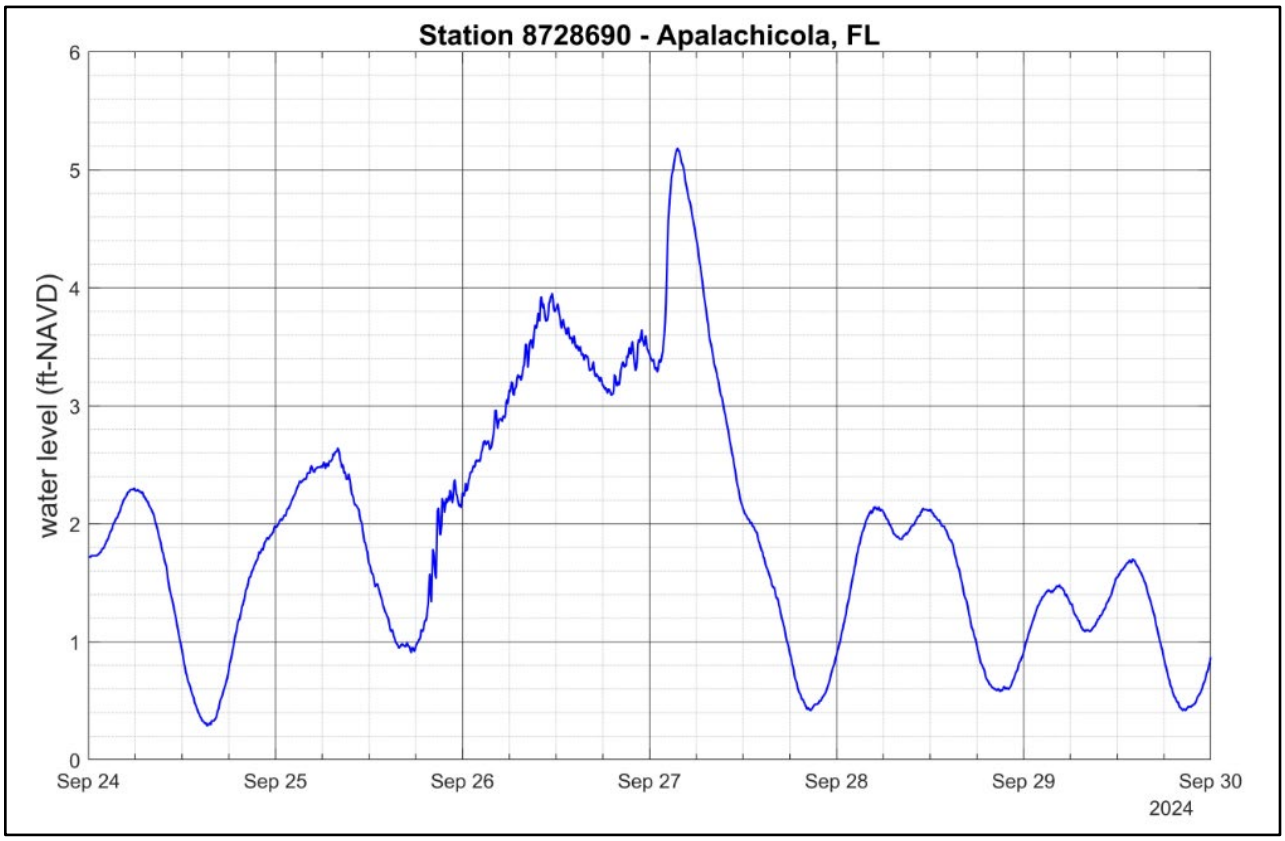

Figure 10. Water level elevations at Apalachicola, FL (NOAA).

Hurricane Impact Summary and Overview

This section provides a summary of the beach and dune erosion and structural damage that occurred in the more substantially affected Big Bend coastal counties. **Table 1** lists beach and dune erosion conditions starting with Franklin County on the lee of Hurricane Helene in northwest Florida and continuing southward through Levy County. Reference or Range ("R") monuments are survey markers established and maintained since 1972 by the Department that are spaced approximately every 1000 feet to measure beach and dune conditions in counties that have established Coastal Construction Control Lines (CCCL). The Big Bend counties do not have CCCL's and therefore do not have R-monuments, so the maps preceding the discussion of each of those counties are the best means of determining the location of those specific erosion areas. A graphic depiction of the classification of beach erosion conditions is provided in **Figure 11**.

Table 1. Beach and Dune Erosion Summary after Helene.

Franklin County

Locations	Range Monuments	Erosion Condition
Alligator Point	R196 – R210	I
Southwest Cape to Lighthouse Point	R210 – R220	I
Lighthouse Point	R220 – R222	II
Lighthouse Point to Bald Point	R222 – R230	I
Bald Point	R230 – R232	II

Wakulla County

Locations	Range Monuments	Erosion Condition
Mashes Sands	N/A	II
Shell Point	N/A	I

Taylor County

Locations	Range Monuments	Erosion Condition
Keaton Beach	N/A	II
Dekle Beach	N/A	I
Dark Island	N/A	I

Dixie County

Locations	Range Monuments	Erosion Condition
Cotton Island	N/A	IV
Bird Island	N/A	IV
Butler Island	N/A	IV
Shired Island	N/A	IV
Big Pine Island	N/A	IV
Little Pine Island	N/A	IV

Levy County

Deer Island	N/A	IV
Cedar Key – Piney Point	N/A	IV
Cedar Key – Airport Road Beach	N/A	I
Cedar Key – G Street	V302 – V312	I
Cedar Key – 1st Street	V312 – V318	I
Cedar Park – Lil Shark Park	N/A	I
Cedar Key – Fenimore Mill Condos	N/A	I
Gomez Key	N/A	IV
Atsena Otie Key	N/A	IV
Seahorse Key	N/A	IV

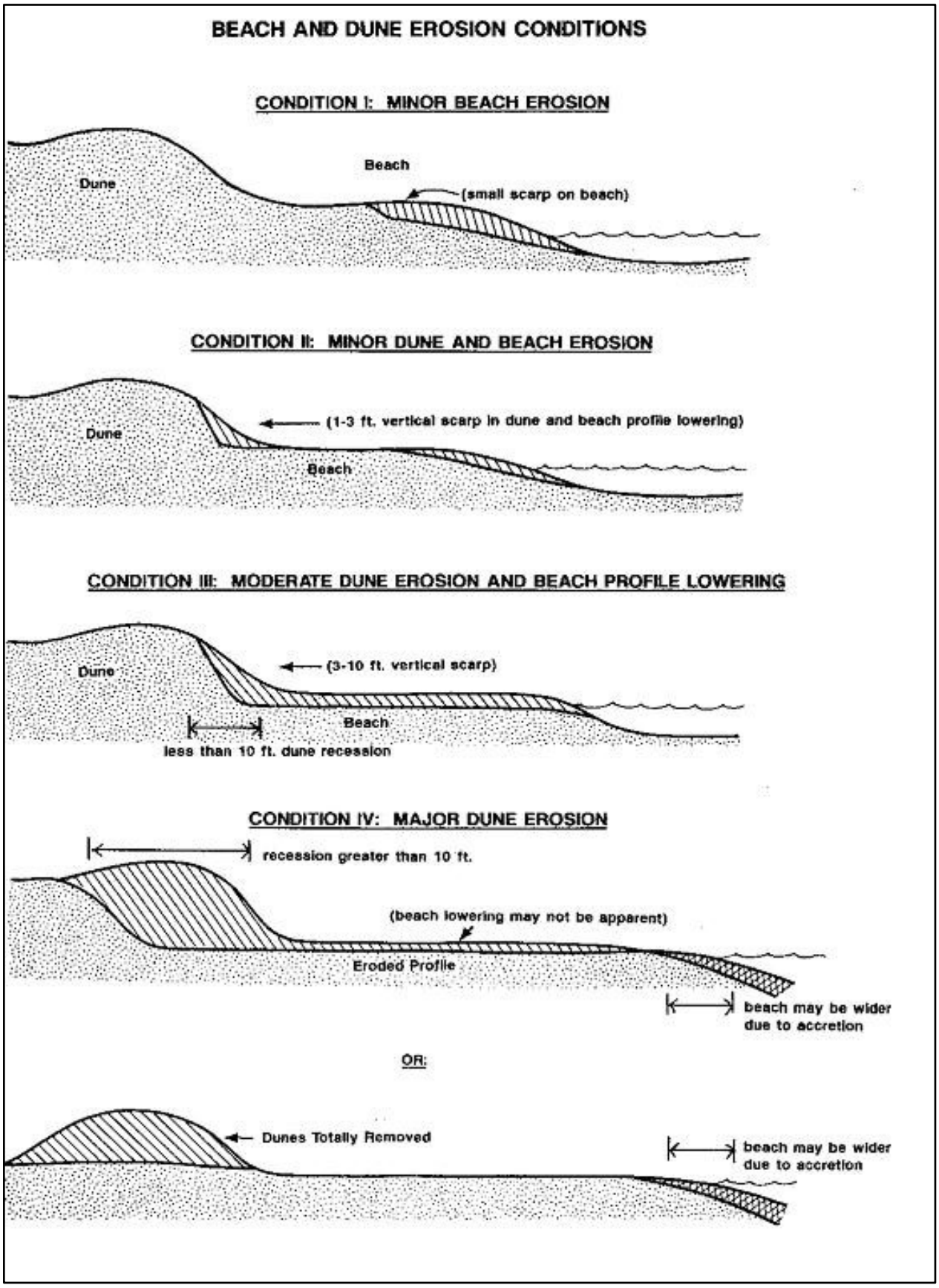

Figure 11. Beach Erosion Conditions I to IV.

Major Structural Damage

Hurricane Debby caused major damage to 18 major structures and Hurricane Helene caused major damage to 626 major structures in the Coastal Building Zone of the Florida Big Bend in Taylor, Dixie, and Levy Counties. An overall summary of structural damage to major structures is given in **Table 2.** A more detailed description of these impacts by each county is provided in the damage assessment by county section of this report.

Table 2. Summary of Major Structural Damage to Major Structures by Hurricane Debby and Hurricane Helene along the Big Bend Coast of Florida.

Hurricane Debby – Major Structural Damages				
County	**# Single-Family Dwellings Damaged**	**# Multifamily Dwellings[1] Damaged**	**# Other Major Structures[2] Damaged**	**Total # Damaged[3]**
Taylor	0	0	0	0
Dixie	10	2	1	13
Levy	1	3	1	5
TOTAL	**11**	**5**	**2**	**18**
Hurricane Helene – Major Structural Damages				
County	**# Single-Family Dwellings Damaged**	**# Multifamily Dwellings[1] Damaged**	**# Other Major Structures[2] Damaged**	**Total # Damaged[3]**
Taylor	265	2	96	363
Dixie	123	4	58	185
Levy	55	18	13	86
TOTAL	**443**	**24**	**167**	**634**

1) Multifamily dwellings include condominiums, townhouses, apartments, hotels, and motels.

2) 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).

3) 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, structures located inland of the Coastal Building Zone, or structures with hydrostatic flooding damage caused by the storm surge or storm water runoff.

A summary of damage to coastal armoring, including seawalls, bulkheads, revetments, or other rigid coastal protection structures fronting on the Gulf of America, is provided in **Table 3** for Hurricanes Debby and Helene. Not included in these tables are damage to retaining walls, concrete block walls, or concrete gravity walls that do not provide protection from erosion or storm tides and waves. Also not included are armoring on interior tidal waters.

Table 3. Summary of Coastal Armoring Damage Caused by Hurricanes Debby and Helene.

Hurricane Debby – Armoring Damage		
County	**Major Damage (Feet)**	**Minor Damage (Feet)**
Taylor	0	0
Dixie	85	525
Levy	0	0
TOTAL	**85**	**525**
Hurricane Helene – Armoring Damage		
County	**Major Damage (Feet)**	**Minor Damage (Feet)**
Taylor	0	0
Dixie	210	175
Levy	150	0
TOTAL	**360**	**175**

Detailed Damage Assessment by County

Taylor, Dixie and Levy Counties are discussed individually in this section. Each detailed county summary is preceded by a county map showing the qualitative beach and dune erosion conditions after Hurricane Helene graphically displayed. Each detailed county summary also includes photographic examples of the type of damage sustained.

Taylor County

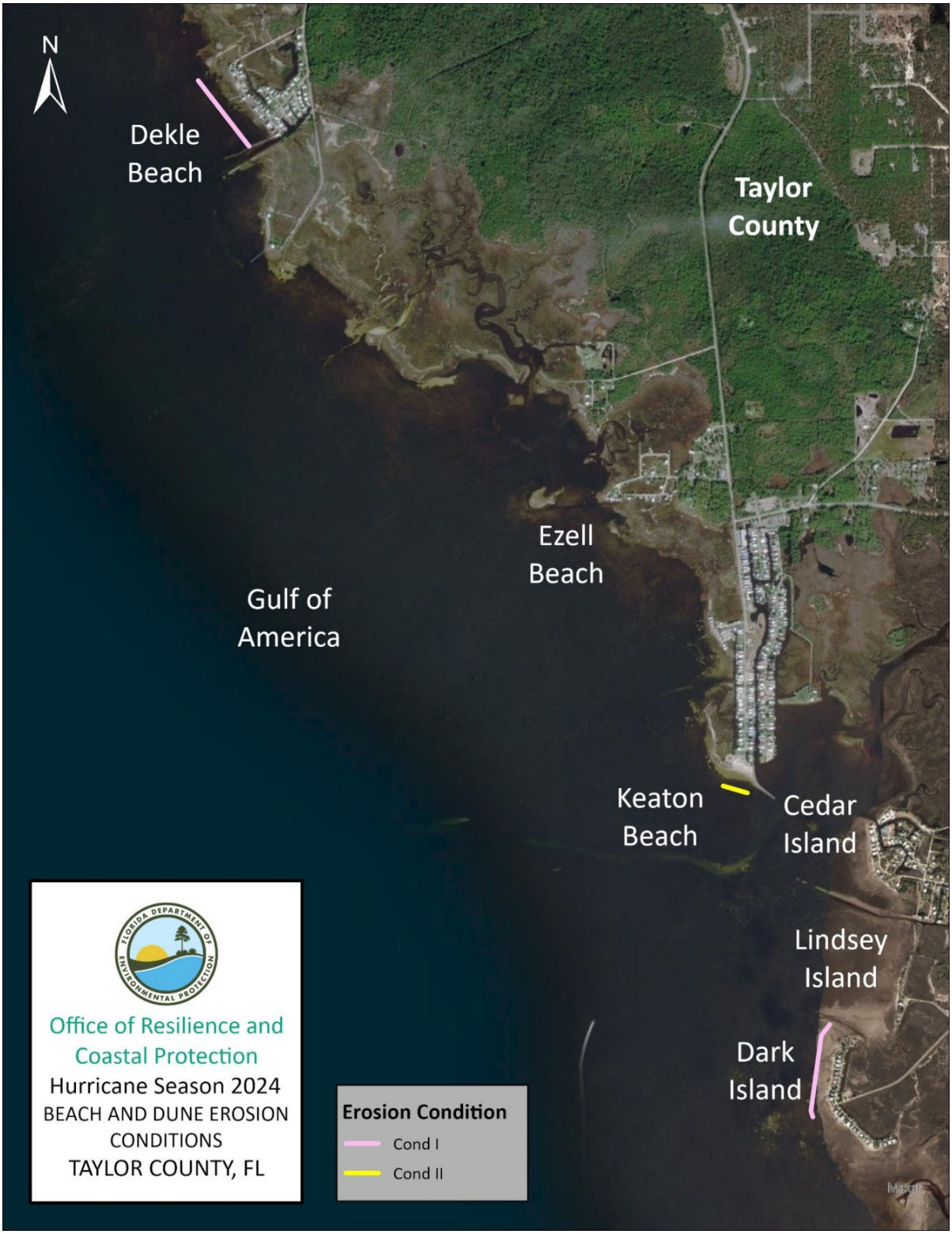

Figure 12. Taylor County beach and dune erosion conditions from Hurricane Helene.

Taylor County

Taylor County, lying between Jefferson and Dixie counties, is one of eight counties within the Big Bend Gulf Coast Region as set forth in the Department's *Strategic Beach Management Plan* (FDEP, 2023). Taylor County has a predominately marsh/wetland coast and includes the Big Bend Seagrasses Aquatic Preserve (**Figure 12**). Taylor County includes the following beach and coastal communities: Adams Beach, Dekle Beach, Ezell Beach, Keaton Beach, Cedar Island, Lindsey Island, Dark Island, Bird Island, and Fish Creek.

Storm Effects and Erosion Conditions

Hurricane Debby made landfall near Steinhatchee on the Taylor County and Dixie County line. North of Steinhatchee, the Taylor County shorelines sustained no visible impact, and the storm tides appeared to range from 2 to 3 feet. In contrast, Hurricane Helene made landfall near the mouth of the Aucilla River subjecting all of Taylor County to the severe flooding of Helene's storm surge which was estimated to have ranged between 13 and 15 feet.

Taylor County has a 0.2-mile segment of critical erosion threatening private development at Dekle Beach. The erosion from Helene on the small intermittent beaches and sandy shorelines of Taylor County was generally minor beach erosion (condition I). At the public beach at Keaton Beach, given the scour to the upland area landward of the beach, minor beach and dune erosion was sustained (condition II). Overwash of sand and shell was experienced in the wetlands along much of this coast. However, there did not appear to be any significant loss of wetland shorelines due to erosion.

Storm Damage

When the eye of Hurricane Debby was located about 6 miles off the coast and tracking generally north-northeastward, it made a hard right turn to the east making landfall near Steinhatchee. This storm track realignment placed the Taylor County coast on the weaker leeside of Hurricane Debby subjecting the area to offshore and alongshore winds. The result was a very minimal storm tide and substantially weaker winds and wave energy impacting the Taylor County coast. No major structural damage was observed at any of the communities inspected, and only the

most minor of wind effects were observed. In addition, no flooding damage was observed to any major structures.

In contrast, Hurricane Helene caused the most severe damage to the coast of Taylor County in recorded history. Helene caused major structural damage to 363 major structures within the Coastal Building Zone of Taylor County (determined by the FEMA V-Zone). Nearly three fourths (269) of these damaged structures were destroyed. Most of the coastal building damage in Taylor County was due to the storm surge and waves of Hurricane Helene. In addition, most of the surviving buildings (approximately 125) had understructure damage, which included damaged utilities, breakaway walls, lost storage rooms and access stairways.

North of Dekle Beach near Adams Beach, 2 single-family dwellings were destroyed with 2 others having understructure damage. Dekle Beach is the northernmost community on the coast of Taylor County. At Dekle Beach 24 single-family dwellings were destroyed and 2 others sustained major damage from the storm surge (**Figure 13** and **Figure 14**). Another 14 dwellings sustained major wind damage, and 31 others sustained understructure damage. In addition, 14 other major structures were destroyed and another sustained major damage. One of these other major structures was a small bridge. A total of 55 major structures sustained major structural damage at Dekle Beach.

Figure 13. Catastrophic damage in Dekle Beach.

Figure 14. Dekle Beach dwelling destroyed.

South of Dekle Beach, 6 single-family dwellings and 2 other major structures were destroyed at the gulfward end of J.L. Gibson Road. To the south at the small community of Ezell Beach 20 single-family dwellings, one commercial building and 5 other major structures were destroyed. Two other dwellings sustained wind damage, and another 4 dwellings sustained understructure damage. A total of 28 major structures sustained major structural damage at Ezell Beach.

Keaton Beach is the largest coastal community in Taylor County. At Keaton Beach 86 single-family dwellings were destroyed and 15 other dwellings were substantially damaged by the storm surge (**Figure 15**). Another 13 dwellings sustained major wind damage, and 48 others sustained understructure damage. One multifamily building was destroyed, and another was wind damaged, and 22 other major structures were destroyed with another 7 sustaining major damage. Only a few structures escaped the wrath of Helene's catastrophic storm surge as many buildings were transported up to a half mile away into the adjoining marsh (**Figure 16**). The storm surge also left dwellings in canals (**Figure 17**), on roads (**Figure 18**) and on other

properties (**Figure 19**). A total of 145 major structures sustained major structural damage at Keaton Beach.

Figure 15. Catastrophic damage in Keaton Beach.

Figure 16. Keaton Beach dwellings carried into the marsh by the storm surge (NOAA photo).

Figure 17. Keaton Beach dwelling in a canal.

Figure 18. Keaton Beach dwelling on a road blocking access.

Figure 19. Keaton Beach dwelling carried across a canal and deposited on a neighbor's driveway.

On Cedar Island south of Keaton Beach, 48 single-family dwellings were destroyed and five others sustained major structural damage by the storm surge (**Figure 20** through **Figure 22**). Another 8 single-family dwellings sustained major wind damage, and 27 other dwellings sustained understructure damage. In addition, 23 other major structures were destroyed and 14 others sustained major structural damage. Most of these other major structures were designed to shelter recreation vehicles (**Figure 23**). Although not considered major structures, a number of recreation vehicles that were not evacuated were destroyed or substantially damaged by the storm surge (**Figure 24**). A total of 90 major structures sustained major structural damage at Cedar Island.

Immediately south of Cedar Island and north of Dark Island is Lindsey Island, which is a very small island with two single-family dwellings. Both homes were destroyed by the storm surge and waves of Helene.

Figure 20. Catastrophic damage on Cedar Island.

Figure 21. Catastrophic damage on Cedar Island.

Figure 22. Cedar Island dwelling destroyed.

Figure 23. Recreation vehicle shelter destroyed on Cedar Island.

Figure 24. Damaged recreation vehicles on Cedar Island.

South of Cedar Island is the community of Dark Island where 10 single-family dwellings were destroyed and another one sustained major structural damage from Helene's storm surge. Another 5 single-family dwellings sustained major wind damage, and 12 dwellings sustained understructure damage. In addition, 3 other major structures were destroyed and 3 others sustained major structural damage. A total of 22 major structures sustained major structural damage at Dark Island.

Figure 25. Six single-family dwellings in a row destroyed on Dark Island.

Figure 26. Three fourths of the houses on Dark Island were destroyed or sustained major structural damage.

South of Dark Island a single-family dwelling sustained major structural damage on Bird Island. Nearby, a single-family dwelling was destroyed, and a storage building was damaged at Fish Creek.

Figure 27. Damaged house on Bird Island.

Dixie County

Figure 28. Northern Dixie County beach and dune erosion conditions from Hurricane Helene.

Figure 29. Southern Dixie County beach and dune erosion conditions from Hurricane Helene.

Dixie County

Dixie County, lying between Taylor and Levy counties, is one of eight counties within the Big Bend Gulf Coast Region as set forth in the Department's *Strategic Beach Management Plan* (FDEP, 2023). Dixie County has a predominately wetland coast with the Lower Suwannee River National Wildlife Refuge and the Big Bend Seagrasses Aquatic Preserve (**Figures 28** and **29**). The small fishing and residential community of Horseshoe Beach provides the only significant development along this mostly natural coastline. Offshore from Horseshoe Beach, Bird Island and Cotton Island are also developed with single-family residences.

Storm Effects and Erosion Conditions

The shorelines of Horseshoe Beach are substantially armored with vertical seawalls and sloping rock revetments. A minimal sandy beach exists only along the toe of some of the armoring, so beach erosion conditions are generable not describable for this area. The southern shorelines of Horseshoe Beach west and east of the Main Canal entrance were subject to the waves and storm tides of Hurricanes Debby and Helene. The storm tide during Hurricane Debby appeared to reach 6 feet above sea level (+6 feet NAVD) as estimated by observing water marks on structures and wrack lines of seagrass on upland properties. **Figure 30** is an example of a tide mark on a structure. The storm tides of Hurricane Helene in Dixie County appeared to have generally ranged between 13 and 15 feet above sea level. Helene's eastern eye wall appeared to have impacted both Dixie and Taylor Counties and brought what was likely the highest storm tides from this event.

Figure 30. High water indicators for Debby on the left and Helene to the right.

Dixie County has critically eroded beaches on three small islands – Bird Island, Cotton Island and Shired Island. The hurricanes' impact to these islands offshore and south of Horseshoe Beach were assessed from aerial photography obtained by the National Oceanic and Atmospheric Administration (NOAA) and from airboat inspections by the staff of the Big Bend Seagrasses Aquatic Preserve (BBSAP). The erosion from Debby and Helene on these islands varied depending on the existence of shell mounds. For example, along much of Shired Island, minor beach erosion (condition I) was sustained from Hurricane Debby as the storm surge rose above the beach berm and inundated the coastal barrier (**Figure 31**). However, the ancient shell mound at the north end of the island presented major dune erosion (condition IV) due to the severe deflation and loss of mound material (**Figure 32**). Hurricane Helene caused severe erosion throughout Shired Island and also caused a breach that truncated the shell mound from the rest of the island (**Figure 33**). A substantial overwash of sand and shell was experienced into the wetlands behind the low narrow beach ridges of this coast. Throughout most of the county, the natural shoreline conditions are anchored by oyster growth and wetland vegetation (*Spartina alterniflora, Spartina patens, Juncus roemerianus*, etc.) and experienced little if any shoreline retreat.

Figure 31. Shired Island beach erosion after Hurricane Debby.

Bird Island and Cotton Island, which are designated critically eroded, are located just offshore and south of Horseshoe Beach. The south shoreline of critically eroded Bird Island is substantially armored with a rock revetment. The northwest and east shorelines of Bird Island sustained minor to moderate beach erosion (condition I to III) from Debby and major beach and dune erosion (condition IV) from Helene.

To the east of Bird Island, critically eroded Cotton Island sustained major beach and dune erosion (condition IV) from both Debby and Helene. Last year during Hurricane Idalia, Cotton Island sustained major beach and dune erosion at its southwest point behind a recently constructed oyster bag breakwater. NOAA aerials from before Idalia, after Idalia, and after Debby and Helene reveal the progression of cumulative severe erosion to Cotton Island in a little over 13 months (**Figure 34**).

Figure 32. Severely eroded shell mound on Shired Island after Debby (NOAA).

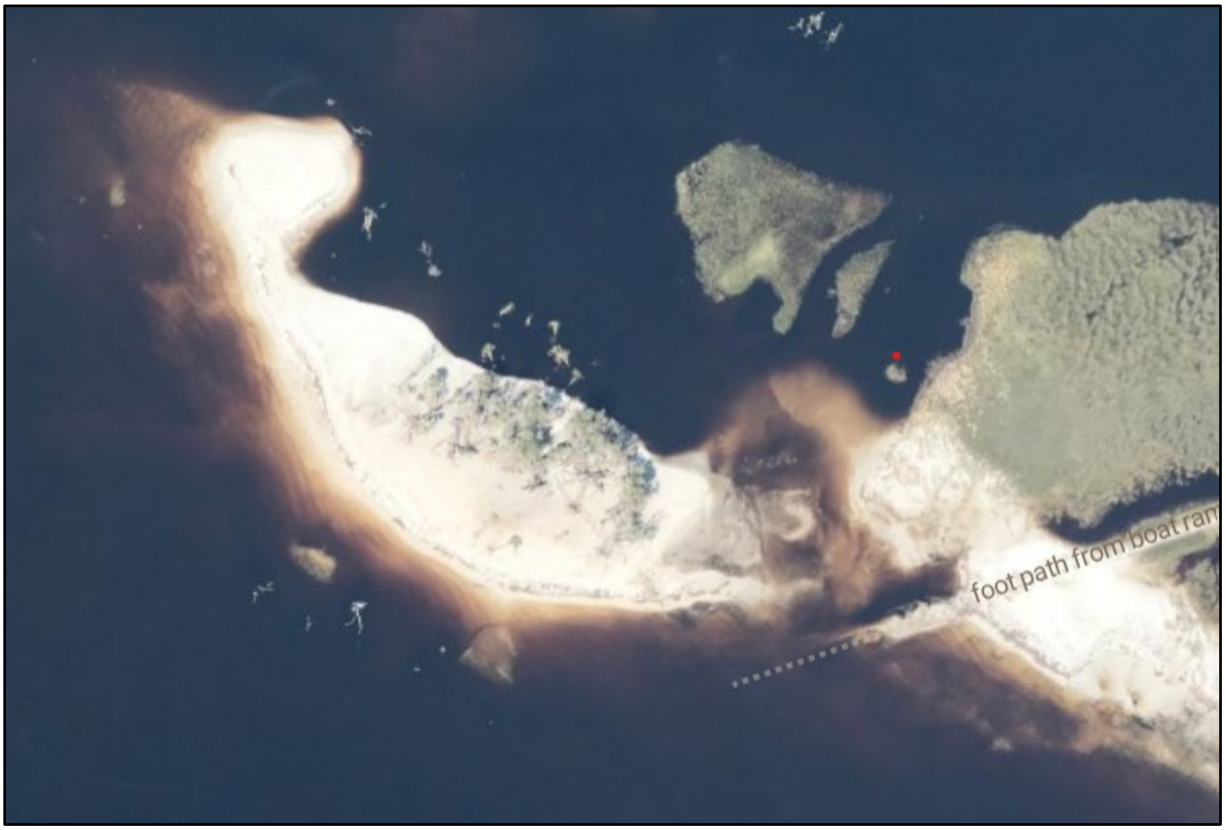

Figure 33. Severely eroded shell mound on Shired Island after Helene (NOAA).

Before Hurricane Idalia.

After Hurricane Idalia.

After Hurricanes Debby and Helene.

Figure 34. Three NOAA aerial photos of the progressive erosion to Cotton Island.

Immediately east of Cotton Island, Butler Island sustained moderate to major beach and dune erosion (condition III to IV) from both Debby and Helene. The impact to the islands south of Shired Island were assessed from aerial photography obtained by NOAA. Both Big Pine Island and Little Pine Island appeared to have sustained minor to moderate beach and dune erosion (condition II to III) from Debby and major beach and dune erosion (condition IV) from Helene.

Storm Damage

The gulf front community of Horseshoe Beach sustained the worst Florida coastal impact from Hurricane Idalia in August 2023. With substantially lower storm tide levels during Hurricane Debby in August 2024, the impacts to the community were substantially less. On most properties, water levels were measured in inches above ground level where the storm tide rose only slightly above the canal banks. Most of the prior coastal storm damage from Hurricane Idalia was due to the storm surge and waves. None of the damage to major structures from Debby was due to the storm surge as all the major damage was due to the winds of Debby. The eye of Debby was much closer to Horseshoe Beach than Idalia, which subjected the community to hurricane force winds that caused most of the building damages. As Debby was passing offshore from Horseshoe Beach, the National Hurricane Center posted a 95 mile per hour wind gust in Horseshoe Beach. Throughout the community 13 major structures (12 single-family dwellings and 1 commercial building) sustained major damage from the wind.

West of the Main Canal entrance, the armoring protecting the road did not appear significantly impacted from Debby. However, the road shoulder comprising interlocking paver blocks was substantially damaged along a roughly 1,000-foot length. East of the Main Canal, about 500 feet of walls sustained Level 2 minor damage and another 35 feet of walls sustained Level 4 major damage. **Figure 35** provides an example of a segment of major wall damage. In addition, 100 feet of sloping concrete revetment sustained Level 2 minor damage, and another 35 feet sustained Level 3 major damage. Upland of the damaged sloping concrete revetment, an asphalt paved road recently repaired from the damage caused by Hurricane Idalia in 2023, sustained 50 feet of new damage by Hurricane Debby (**Figure 36**).

Figure 35. Damage to a timber wall at Horseshoe Beach by Debby.

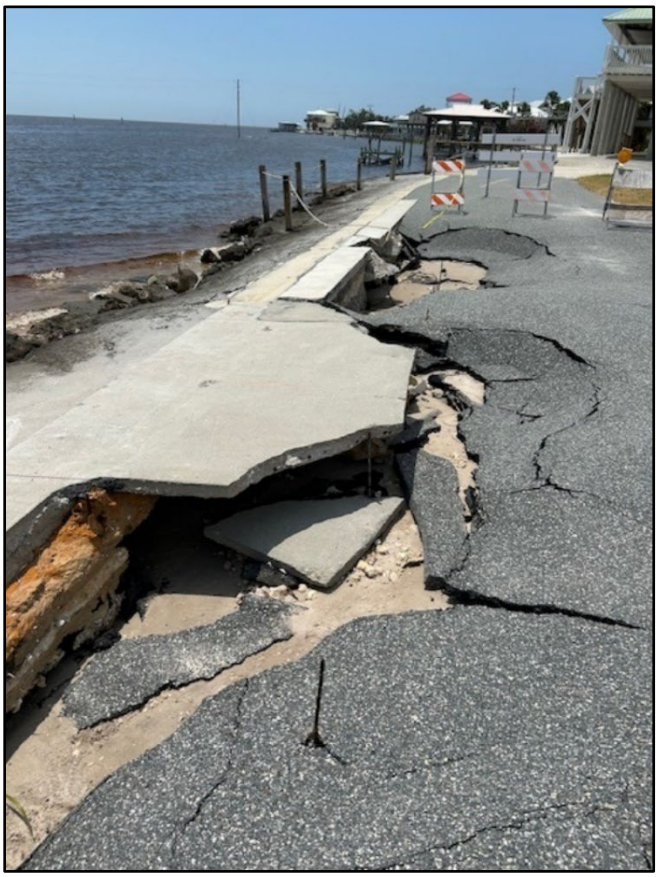

Figure 36. Road damage in Horseshoe Beach from Debby.

When Hurricane Helene passed offshore in September 2024, the eye was a little further from Horseshoe Beach than the eye of Idalia. But Helene was a stronger and larger hurricane and caused a greater storm surge. Hurricane Idalia had caused the most building damage along the coast of Dixie County than any storm since the March 1993 storm. Idalia caused major structural damage to 165 major structures within the Coastal Building Zone of Dixie County (determined by the FEMA V-Zone). Of these damaged structures, 92 major structures were destroyed in Horseshoe Beach and four were destroyed on Shired Island. Most of the coastal building damage was due to the storm surge and waves of Idalia, which destroyed most all the grade level structures in the community. These structures were no longer present when Helene impacted the community.

Hurricane Helene caused major structural damage to 184 major structures in Horseshoe Beach. Of these, 74 single-family dwellings, 2 churches, 3 commercial buildings, and 32 other major structures were destroyed, and 20 single-family dwellings, 1 church, 18 other major structures sustained major structural damage from the storm surge and waves. In addition, 28 single-family dwellings, 4 multifamily dwellings, and 2 commercial buildings sustained major damage from the wind, and 93 single-family dwellings and 4 multifamily dwellings sustained understructure damage, which included damaged utilities, breakaway walls, lost storage rooms and access stairways.

As a small gulf fishing and residential community lined with canals, Horseshoe Beach sustained damage to most of its docks, wharves, and boat mooring facilities. The marina buildings were destroyed by Helene, and the Main Canal was clogged with extensive debris from the damaged docks and sunken vessels as well as upland sheds, garages, and houses. In addition, 265 feet of road west of the Main Canal was damaged. East of the Main Canal another 78 feet of road was damaged, and 110 feet of wood seawall and 100 feet of rock revetment sustained major damage.

Many grade level residences were destroyed in the March 1993 storm and most of the reconstruction and new structures since then were elevated above the predicted 100-year storm surge elevation. During Idalia, the newer structures generally fared well with mostly grade level buildings being destroyed or substantially damaged. Helene destroyed most of the remaining grade level structures and many of the pile supported structures where buildings were only

elevated 8 to 10 feet above grade. The newer buildings constructed on massive concrete piles and elevated to +16 feet NAVD and higher were relatively unscathed by the storm surge and waves of Helene. **Figure 37** through **Figure 48** show examples of the damage that was sustained in Horseshoe Beach by Helene.

Figure 37. Catastrophic damage in Horseshoe Beach from Helene.

Figure 38. Catastrophic damage in Horseshoe Beach.

Figure 39. Grade level dwelling destroyed in Horseshoe Beach.

Figure 40. Grade level of a dwelling destroyed in Horseshoe Beach.

Figure 41. Grade level of a church building destroyed in Horseshoe Beach.

Figure 42. Grade level of a dwelling destroyed in Horseshoe Beach.

Figure 43. Grade level of a church destroyed in Horseshoe Beach.

Figure 44. Three pile supported dwellings in Horseshoe Beach destroyed due to insufficient elevation for Helene's storm surge and waves.

Figure 45. Pile supported dwelling damaged due to insufficient elevation.

Figure 46. Buildings destroyed with insufficient elevations.

Figure 47. Horseshoe Beach dwelling transported into the adjacent wetlands.

Figure 48. The Horseshoe Beach Marina survived Idalia but was destroyed by Helene.

Levy County

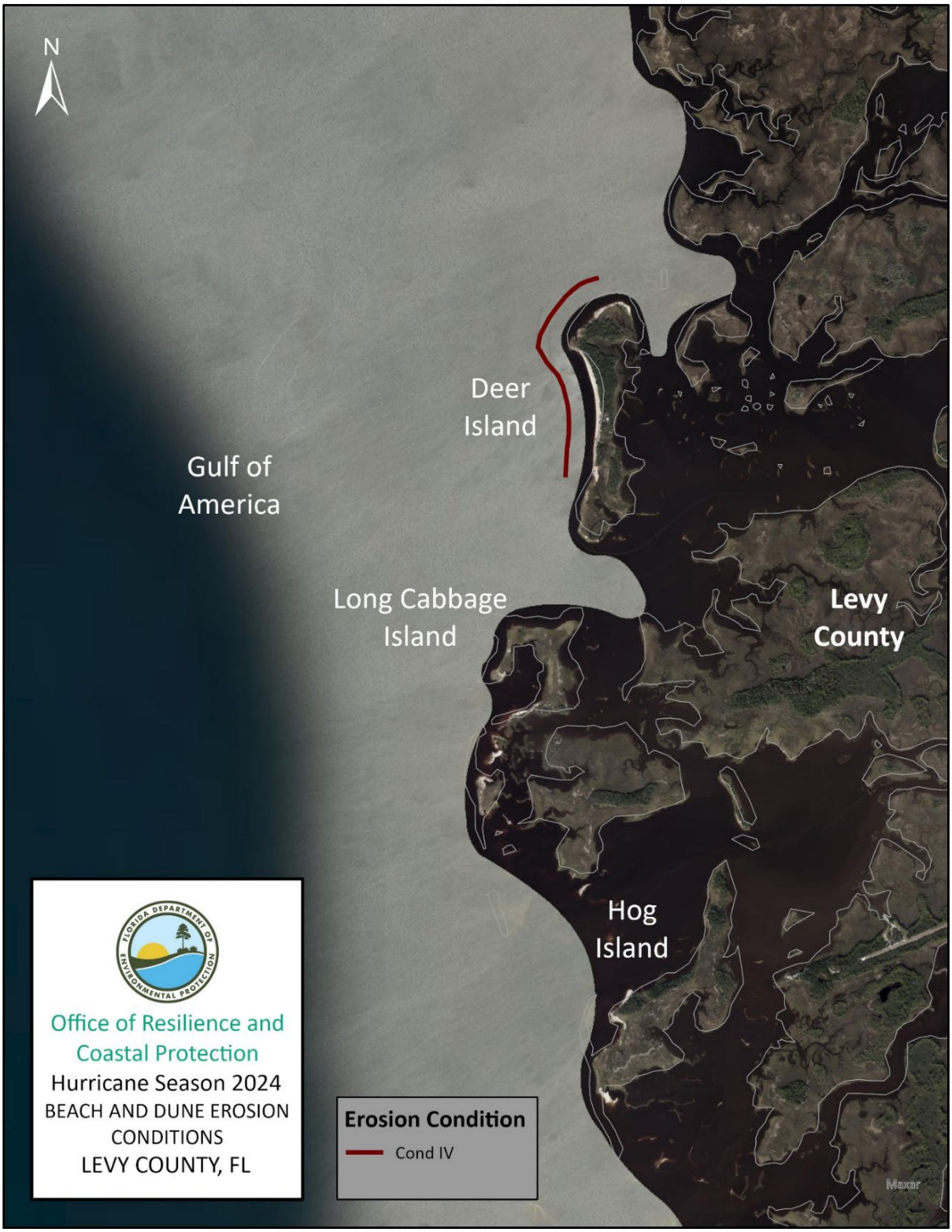

Figure 49. Northern Levy County beach and dune erosion conditions from Hurricane Helene.

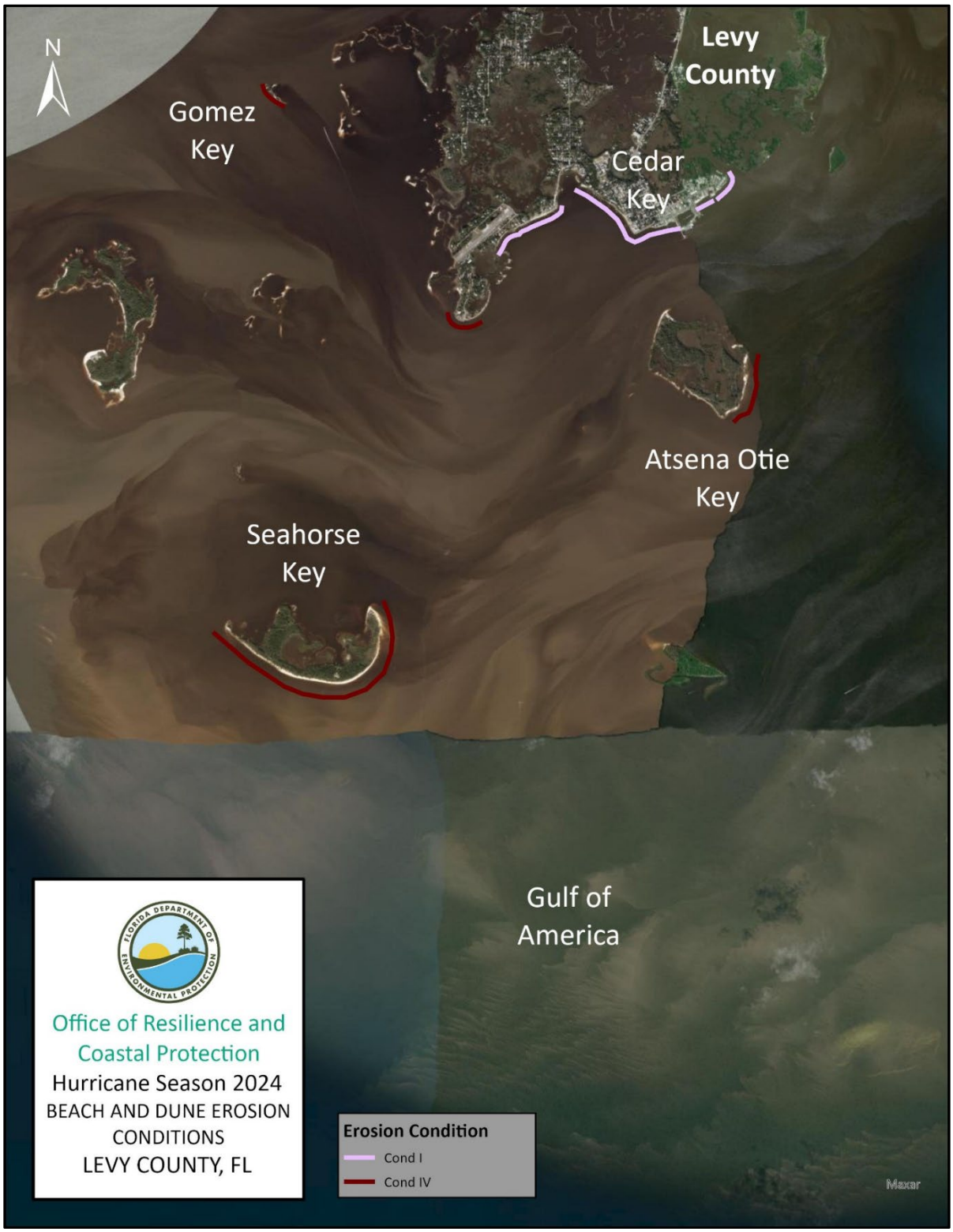

Figure 50. Southern Levy County beach and dune erosion conditions from Hurricane Helene.

Levy County

Levy County, lying between Dixie and Citrus counties, is one of eight counties within the Big Bend Gulf Coast Region as set forth in the Department's *Strategic Beach Management Plan* (FDEP, 2023). Levy County has a predominately wetland coast and includes the Lower Suwanee National Wildlife Refuge, the Cedar Keys National Wildlife Refuge, and the Big Bend Seagrasses Aquatic Preserve (**Figures 49** and **50**). The small fishing, residential, and tourist community of Cedar Key provides the only significant development along this mostly natural coastline.

Storm Effects and Erosion Conditions

The eyes of both Debby and Helene passed offshore from Levy County. Because the county was on the windward side of the eye, very high storm tides were experienced. The storm tide during Hurricane Debby exceeded +6 feet NAVD as measured by the NOAA tide station at Cedar Key. This was nearly two and a half feet lower than the peak storm tide of +8.4 feet NAVD measured during Hurricane Idalia. In contrast, the NOAA tide gage measured a peak storm tide of +10.8 feet during Hurricane Helene. This was nearly two and a half feet higher than during Idalia. The University of Florida's Sentinel at Cedar Key likewise measured a peak storm tide of +10.8 feet NAVD during Helene.

Levy County has three designated critical erosion areas. The northern end of Deer Island is critically eroded affecting an ancient shell mound. Both hurricanes' impact to Deer Island was assessed from aerial photography obtained by NOAA and from airboat inspections by the staff of the Big Bend Seagrasses Aquatic Preserve (BBSAP). The north end of Deer Island around the ancient shell mound sustained major beach and dune erosion (condition IV) from both Debby and Helene (**Figure 51**). The remainder of Deer Island and Hog Island further south appeared to have sustained minor to moderate beach and dune erosion (condition II to III) from Debby and major beach and dune erosion (condition IV) from Helene.

Northwest of Cedar Key is the small island of Gomez Key, which has critical erosion threatening an important nesting site for the threatened American Oystercatcher. Staff of the Big Bend Seagrasses Aquatic Preserve (BBSAP) visited Gomez Key by airboat on August 12 after Debby

and observed substantial erosion to the already severely eroded island. Major beach and dune erosion (condition IV) was observed as substantial scour occurred within the black mangroves (**Figure 52**). NOAA aerials show severe erosion after both Debby and Helene (**Figure 53**).

Figure 51. North end of Deer Island at ancient shell mound after Debby, left, and Helene, right, (NOAA).

Figure 52. Exposed pneumatophores (peg roots) of the black mangroves reveal erosion and scour across Gomez Key after Debby (Trisha Green, BBSAP).

Figure 53. Critically eroded Gomez Key after Debby, left, and after Helene, right, (NOAA).

Hurricane Debby's impact on the offshore islands of the Cedar Keys were assessed where coverage was available from aerial photography obtained by NOAA. Both North Key and Seahorse Key appeared to have sustained moderate to major beach and dune erosion (condition III to IV) from both Debby and Helene. Aerial photo coverage was not available for Atsena Otie Key so erosion conditions could not be assessed.

The town of Cedar Key has 0.5 mile of critical erosion along G Street and 1st Avenue. These segments are substantially armored now with seawalls and revetments. Along the northern reach of G Street and Joe Rains Beach, living shoreline projects successfully mitigated erosion from both Debby and Helene (**Figures 54** and **55**).

Beach erosion conditions due to Debby were generally minor around Cedar Key, in part due to the lower storm surge and in part due to the lack of beach sediment waterward of existing structures. At the public beach, minor beach and dune erosion (condition II) was sustained. The storm tide and wave uprush scoured the park's upland causing damage to a sidewalk and grassed area (**Figure 56**). On Airport Key, the western island segment of the Cedar Key shoreline fronting Airport Road was protected by a living shoreline project that included submerged Reef Ball breakwaters. This segment sustained only minor beach erosion (condition I) from Debby and Helene (**Figure 57**).

Figure 54. Living shoreline project at G Street after Debby.

Figure 55. Living shoreline project at Joe Raines Beach after Debby.

Figure 56. Scoured upland and damaged sidewalk at public beach, Cedar Key.

Figure 57. Airport Road eroded beach after Helene.

Storm Damage

Cedar Key has been impacted by many storms in the past, including a 19th century hurricane that destroyed the original town on Atsena Otie Key. The most recent storms to have significant impacts were Hurricane Elena (1985), the Storm of the Century (1993), Hurricane Gordon (2000), Hurricane Hermine (2016), Tropical Storm Eta (2020), and Hurricane Idalia (2023).

Last year's Hurricane Idalia caused major structural damage to 24 major structures within the Coastal Building Zone of Cedar Key. In comparison, Hurricane Debby caused major damage to only 5 major structures as the storm tide from Debby was nearly two and a half feet lower and caused considerably less damage than occurred during Idalia. Debby destroyed no major structures, while Idalia destroyed 3 major structures in Cedar Key. Most of the coastal storm damage from Hurricane Idalia was due to the storm surge and waves. None of the damage to major structures from Debby was due to the storm surge as all the major damage to major structures was due to the winds of Debby, which was substantially closer to Cedar Key.

In contrast, Hurricane Helene caused major structural damage to 86 major structures in Cedar Key, resulting in the worst storm damage in modern history. Of these, 23 single-family dwellings, 5 motel buildings, 2 commercial buildings, and 2 other major structures were destroyed, and 17 single-family dwellings, 9 multifamily dwellings, 3 motel buildings, 7 commercial buildings, and the University of Florida's research building sustained major structural damage from the storm surge and waves. In addition, 15 single-family dwellings, 1 multifamily dwelling, and 1 commercial building sustained major damage from the wind. Wind damage was also sustained to signs and other minor structures around Cedar Key.

The five motel buildings destroyed by the storm surge were located adjacent to G Street on one property (**Figure 58**). Damage on 1st Street was particularly severe where 8 single-family dwellings were destroyed and 3 others had major structural damage (**Figures 59 through 61**). On the exposed Water Street, one commercial building was destroyed and 5 others sustained major damage (**Figure 62**).

Debby caused no major damage to shoreline armoring in Cedar Key. Debby caused about 100 feet of minor damage (Level 2) to a newly constructed rock revetment at Piney Point on the

south tip of Airport Key. This revetment replaced a seawall that was destroyed in Hurricane Idalia. Helene caused major damage (Level 3) to about 125 feet of timber seawall and damaged about 60 feet of Airport Road.

Figure 58. One of five destroyed motel buildings on G Street, Cedar Key.

Figure 59. Single-family dwelling destroyed on 1st Street, Cedar Key.

Figure 60. Single-family dwelling destroyed on 1st Street, Cedar Key.

Figure 61. Three single-family dwellings destroyed on 1st Street, Cedar Key.

Figure 62. Commercial building damaged on Water Street, Cedar Key.