= Tropical Storm Nicole (2010) =

Tropical Storm Nicole was a short @-@ lived and unusually asymmetric tropical cyclone that caused extensive rainfall and flooding in Jamaica during the 2010 Atlantic hurricane season . It was the sixteenth tropical cyclone and the fourteenth named storm of the season , as well as the last of a record eight tropical storms to form in September . Originating from a broad monsoonal low , Nicole became a tropical depression over the northwestern Caribbean Sea on September 28 . It maintained an unusual structure as it tracked northeastward , with a poorly defined wind circulation and few thunderstorms near its center . Nicole approached the coast of Cuba as a weak tropical storm , losing its status as a tropical cyclone over the territory on September 29 . The remnants emerged over the Bahamas and eventually became absorbed by a separate extratropical system .

Due to Nicole 's atypical structure , the strongest thundershowers were well removed from the center ; most of the weather activity occurred over the north @-@ central Caribbean . In Jamaica , the storm triggered widespread power outages across more than 288 @,@ 000 residences . Extreme precipitation of up to 37 @.@ 42 inches (940 mm) caused disastrous flooding in several parishes , severely damaging or destroying 528 houses . The devastation extended to the island 's farmland and environment , which suffered from expansive water pollution . In all , Nicole wrought an estimated $ 240 million (2010 USD) in damage throughout Jamaica , and there were sixteen fatalities . Elsewhere , minor flooding occurred in Cuba , Florida , and the Cayman Islands . The remnants of the storm contributed to a large disturbance along the East Coast of the United States , causing additional damage and deaths .

= = Meteorological history = =

In late September 2010 , a wide band of disturbed weather and low pressure associated with the monsoon trough and remnant tropical moisture from Tropical Storm Matthew meandered over the northwestern Caribbean Sea . With a broad upper ridge anchored along the Yucatán coast , diffluence aloft in the vicinity of the disturbance provided focus for the development of scattered convection . The National Hurricane Center (NHC) noted an environment supportive of tropical development , and by September 27 a broad surface low formed amid the convection . The next day , surface pressures steadily dropped as sustained winds around the low increased to near tropical storm force . Throughout the development process , moderate westerly wind shear over the region caused the disturbance to exhibit a rather asymmetric structure ; it developed an elongated low @-@ pressure center by September 28 , well to the northwest of its strongest wind field . Despite the asymmetry , the NHC initiated advisories on a tropical depression around 15 : 00 UTC that day , after surface and satellite observations revealed a sufficiently defined circulation center west of the deep convection . Post @-@ season reassessments , however , indicated that a tropical storm had in fact formed three hours earlier , about 75 miles (120 km) south of Cuba 's Isle of Youth .

For most of its duration , Nicole maintained a generally northeastward motion , caught in the steering flow between a large mid- to upper @-@ level trough and an anticyclone to the west . Within hours of the storm 's formation , observations from a Hurricane Hunters flight confirmed a composition similar to the one initially discerned , with the strongest gusts and thunderstorms dislocated 250 mi (400 km) east from the ill @-@ defined center . In comparison , the core consisted of light winds and sporadic convection ? a structure rather characteristic of a North Indian Ocean monsoon depression . The system 's ambiguous nature led to disagreement among weather specialist over its classification : while the NHC maintained its tropical cyclone status , Cuban meteorologist José Rubiera stated that " no tropical storm exists over [Cuba] , or near it , " noting a lack of significant winds in the country 's vicinity .

Over the course of September 29 , radar data showed the convection increasing over the northern half of the storm ; bands of intense thunderstorms in the southeastern periphery also formed closer to the center , and weather buoys and ships in that region observed sustained tropical @-@ storm @-@ force winds . Around 12 : 00 UTC , Nicole attained an estimated peak intensity of 45 mph (75 km / h) winds and a minimum pressure of 995 mbar (hPa ; 29 @.@ 38 inHg) , just south of Cuba .

Despite the increase in strength , Nicole 's circulation soon became exceedingly elongated and untrackable over central Cuba , prompting the NHC to declassify it as a tropical cyclone by 15 : 00 UTC . The remnant low began interacting with the neighboring trough that had steered Nicole in its tropical stages , resulting in significant amounts of precipitation along the southeastern coastlines of the United States . Accelerating toward the northeast , the system acquired frontal characteristics and became extratropical over the Bahamas by 0600 UTC , September 30 , twelve hours before merging with a developing system over eastern North Carolina . Lingering low pressure and broad cyclonic flow over the north @-@ central Caribbean in Nicole 's wake contributed to the development of Hurricane Paula in the first weeks of October .

= = Preparations = =

= = = Caribbean = = =

In anticipation of a tropical storm , warnings were issued for the Cayman Islands , the northwestern and central Bahamas , and the Cuban provinces of Matanzas , Cienfuegos , Villa Clara , Sancti Spíritus , and Ciego de Ávila on September 28 . However , the warnings were discontinued the following day after reports of the storm 's prompt dissipation . After forecasters warned of severe weather across the Cayman Islands , schools and government offices closed in low @-@ lying areas , and emergency teams cleaned out storm drains and readied shelters . Thunderstorms in Grand Cayman forced Cayman Airways to cancel all express flights to Cayman Brac and Little Cayman on October 29 ; weather @-@ resistant jet service was provided to stranded passengers . A marine warning was required for all three islands due to rough sea conditions .

In Jamaica , a flash flood warning remained in effect for flood @-@ prone regions for four days , ultimately discontinued on October 3 . Schools and several businesses , including the US Embassy in Kingston , closed on September 29 ? 30 as the island braced for heavy rains . Public transit was suspended islandwide on the evening of September 29 , and shipping interests were cautioned to secure their vessels . At the height of the storm , army and police officials patrolled the island in case of emergencies .

= = = United States = = =

Tropical storm warnings were issued for the Florida Keys , the Florida Bay , and from the Jupiter Inlet coast southward to Cape Sable on September 28 . A tropical storm watch was in place for the mainland north from the Jupiter Inlet to the Sebastian Inlet and north of East Cape Sable to Chokoloskee . The warnings and watch were discontinued the next day , after a direct impact was no longer expected . At the time , a flood watch remained in effect for Palm Beach , Broward , Miami @-@ Dade , Collier , and Monroe counties into September 30 . An airport weather warning was issued for Orlando International Airport and Executive Airport on September 28 ; arriving flights were put on hold , and pilots rerouted to other airports if possible . Eight Southwest Airlines flights were diverted to the airports of Tampa and Jacksonville , and one JetBlue flight to West Palm Beach . Though airport officials later reported normalized conditions , an additional 26 flights were canceled at Miami International Airport the next day .

In Brunswick and New Hanover counties , North Carolina , officials readied shelters on September 29 to accommodate stranded residents unable to access their homes . Multiple schools in New Hanover and Pender County remained closed the next morning due to worsening storm conditions from the disturbance succeeding Nicole . At the threat of prolonged rainfall , a flood watch was issued for Kent County , Maryland , from September 30 to October 1 . Also in the area , the National Weather Service declared both a coastal flood advisory and wind advisory for September 30 .

= = Impact = =

= = = Jamaica = = =

For several days , Nicole and its precursor disturbance brought great amounts of rainfall to much of Jamaica . A maximum total of 37 @.@ 42 inches (940 mm) was recorded in Belleisle , Westmoreland Parish , from September 26 to 30 ; most other parishes received over 12 in (300 mm) during this time . With a return period of 30 years , these quantities tripled the monthly rainfall average for September at several locations . Though the broad @-@ scale wind regime over the island remained gentle , the storm 's intense convective bands produced three microbursts ? small downdrafts of intense winds . Following the degradation of river banks and waterways , the heaviest impact was due to landslides and particularly severe flooding across numerous communities , primarily in the southern parishes .

The disaster affected a total of 507 @,@ 831 people ; it resulted in 16 deaths ? 14 of which confirmed ? and 42 injuries . In Saint Andrew Parish 's Sandy Park , a house next to a street gully succumbed to the effects of the storm ; five bodies were recovered near the site , while the remaining missing inhabitant was later presumed dead . Elsewhere in Saint Andrew , three construction workers were killed when the shed in which they were sleeping caved in . A girl was crushed to death under the weight of a collapsed board house in Saint Catherine Parish . Rushing waters in different parts of the island swept away three people , all of whom drowned . A waterspout hit Westmoreland Parish 's capital of Savanna @-@ la @-@ Mar amid a microburst , tearing the roofs off buildings and hospitalizing five residents . In the wake of the storm , a body was recovered from debris along a road in Saint Catherine . Nationwide , floods trapped hundreds of residents in their homes . The obstruction of roads and bridges isolated various communities across seven of the island 's parishes .

Jamaica 's infrastructure was devastated in the deluge , accounting for most of the material damage on the island . At the height of the storm , more than 288 @,@ 000 residences lost power due to downed electricity lines and poles , and over 40 percent of the island 's water supply was disrupted . Dozens of bridges collapsed under the force of swollen rivers and creeks . In Kingston , underpasses suffered severe flooding as prolonged rainfall overwhelmed storm drains ; subsequent surface inundations left several of the city 's roads impassable . Destruction to the transport infrastructure was especially extensive in Westmoreland , Saint Elizabeth , and Hanover parishes , though overall 543 of the island 's principle roads sustained some degree of damage . The value of costs linked to the infrastructure neared J $ 20 billion (US $ 235 @.@ 4 million) .

Nicole wreaked widespread property damage , encompassing 2 @,@ 169 houses : 474 sustained severe damage , while 54 were beyond repair . The losses totaled J $ 274 @.@ 3 million (US $ 3 @.@ 2 million) , J $ 75 @.@ 6 million (US $ 890 @,@ 000) hereof required to replace destroyed housing units . With much of its crops and livestock washed away , the island 's agricultural sector suffered about J $ 576 @.@ 5 million (US $ 6 @.@ 8 million) in losses , including 40 percent of the season 's banana produce . The storm had a discernible impact on the environment , which plays a crucial role in the Jamaica 's economy and tourism . Surface runoffs and spills along industrial zones and sewage systems infiltrated wide stretches of land , leading to scattered pollution , coastal erosion , and deterioration in the ecosystems of the affect regions . In addition , light damage occurred to vegetation as evidenced by uprooted trees .

= = = Elsewhere = = =

While intensifying offshore , Nicole 's outer bands produced heavy downpours over drought @-@ stricken Cuba . Locally , rain along the southeastern coast was particularly high ; a 48 @-@ hour total of 9 @.@ 22 inches (235 mm) fell at Cape Cruz , in the mountainous Granma Province . The region briefly observed gale @-@ force winds , gusting to 53 mph (85 km / h) at Guantánamo Bay . Throughout eastern Cuba , 300 people sought refuge during the storm . As rivers overflowed in Granma , eight houses collapsed and more than 300 others endured flooding in the coastal town of Pilón . Several roads were obstructed , with part of the highway between Granma and Santiago de

Cuba destroyed . The floods resulted in 5 @,@ 000 lbs (2 @.@ 5 tons) of losses in crops and livestock . These effects were nevertheless considered minor , and the rains helped alleviate a persistent dry spell in the country .

In the Cayman Islands , gusts to 51 mph (82 km / h) stirred up a rough sea with 8 ? 10 ft (2 @.@ 5 ? 3 m) high waves , causing light erosion along south and western shores . Though heavy rainfall over the region was widespread , the greatest quantities fell on Grand Cayman , where the Owen Roberts International Airport recorded 9 @.@ 02 in (229 mm) of rain over a period of two days . The storm flooded low @-@ lying areas , caused roof leaks , and knocked out the power in parts of eastern Grand Cayman , but overall damage across the islands was limited .

Despite initial threats of heavy thunderstorms and strong gusts , Florida was spared a direct impact from Nicole . The storm only skirted the state with showers ; a rainfall total of 12 @.@ 71 inches (323 mm) was recorded at North Key Largo , though the mainland received considerably less . Street flooding occurred in Miami Beach and the northern Florida Keys , but only one residence sustained damage . Similarly , inclement weather spread over parts of the Bahamas without significant consequences .

= = = Post @-@ tropical system = = =

The extratropical remnants of Nicole retained plenty of moisture and ultimately combined with a large low @-@ pressure system slowly tracking up the US East Coast . The resultant disturbance produced torrential thunderstorms over entire coastlines and inland as far north as Canada , resulting in widespread power outages and shattering numerous precipitation records throughout the region . The most extreme weather was concentrated over Eastern North Carolina ; in the week of September 24 ? October 1 , most communities recorded rainfall totals of 8 ? 10 in (200 ? 250 mm) . Wilmington measured 22 @.@ 54 inches (573 mm) of rain , the most it had received over a five @-@ day period since 1871 , while Kinston recorded 15 in (380 mm) during that time . The rains caused widespread flooding exacerbated by overflowing creeks and rivers , surrounding and isolating several homes . About 150 roads were closed due to the hazardous conditions ; traffic accidents across the state nonetheless resulted in seven deaths .

In the Mid @-@ Atlantic , the event broke daily rainfall records for September 30 at several locations including the Norfolk , Baltimore ? Washington , and Ronald Reagan Washington airports , which recorded 7 @.@ 85 in (199 mm) , 6 @.@ 02 in (153 mm) , and 4 @.@ 66 in (118 mm) respectively . In Maryland , two buses collided amid the stormy weather , injuring 26 passengers . With localized estimates of up to 8 in (200 mm) , the state of New York experienced some of its most historic rainfall ; an official 4 @.@ 24 in (108 mm) shattered the 24 @-@ hour record for any calendar day in Binghamtom . Flash floods throughout the state led to one drowning and about US $ 10 @,@ 000 in damage . Considerable flooding also occurred in Vermont and Pennsylvania , with a 24 @-@ hour rainfall maximum of 10 @.@ 5 in (265 mm) observed in Moscow . Farther north , the remnant low enhanced a pressure gradient over southern New England , generating strong winds that knocked out power in Litchfield County . Rainfall there additionally caused minor flooding . In Quebec , torrents following 3 @.@ 5 in (90 mm) of rainfall inundated basements and caused two drownings . Despite the deaths and damage , the rains alleviated prolonged drought conditions in those regions .

= = Aftermath = =

On October 5 , a national disaster was declared for Jamaica due to the effects of Nicole . In response , the USAID 's Office of Foreign Disaster Assistance provided US $ 50 @,@ 000 for the purchase and delivery of relief supplies and fuel for emergency vehicles . About J $ 4 million (US $ 46 @,@ 800) was donated by the Ministry of Agriculture and Fisheries to the Greenhouse Growers Association for the repair of greenhouses . In conjunction with the Food and Agriculture Organization , an estimated J $ 12 million (US $ 140 @,@ 400) was made available to initiate the planting of about 50 @,@ 000 crop seedlings . The Veterinary Division provided financial assistance

to livestock farmers and dispatched animal technicians providing prophylactic medication and vitamins to avert foot rot disease in small ruminants , including goats and sheep . The cost of the medication was estimated at J $ 2 million (US $ 23 @,@ 400) . The Banana Board 's Catastrophe Fund , which at the time comprised J $ 50 million (US $ 585 @,@ 000) , delivered both monetary support and human resources to local banana and plantain farmers .

Eleven days after the storm , the International Federation of Red Cross and Red Crescent Societies allocated CHF150,644 (US $ 156 @,@ 221) to sustain the Jamaica Red Cross in distributing aid to about 500 families ? or 2 @,@ 500 beneficiaries ? in need of life supplies . In late December 2010 , the Jamaica ? Canadian Association in Toronto , Canada raised a total of CDN $ 10 @,@ 153 @.@ 87 (US $ 10 @,@ 221 @.@ 33) in relief funds to assist flood victims . The Hanover Parish Council requested J $ 30 million (US $ 351 @,@ 000) to assist the Saint James Parish Council and other municipal authorities across the country in post @-@ storm clean @-@ up and beautification work . A grant of J $ 279 million (US $ 3 @.@ 26 million) was approved for the reconstruction of a major roadway section in Westmoreland Parish .

In spite of the timely relief efforts , Nicole 's effects were still felt for months in its wake . The gross domestic product for Jamaica , which had been suffering from a substantially slow economic growth rate , further declined following the extensive storm damage . The agriculture sector sustained slight losses from reduced egg production due to the traumatizing effects on farm chickens , and the storm 's impact contributed to below @-@ standard levels of holiday season consumption .