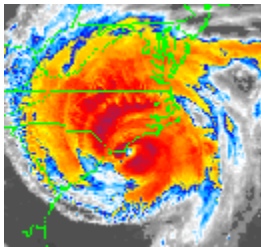


Virginia HURRICANES

By Barbara McNaught Watson

A hurricane is a large tropical complex of thunderstorms forming spiral bands around an intense low pressure center (the eye). Sustained winds must be at least 75 mph, but may reach over 200 mph in the strongest of these storms. The strong winds drive the ocean's surface, building waves 40 feet high on the open water. As the storm moves into shallower waters, the waves lessen, but water levels rise, bulging up on the storm's front right quadrant in what is called the "storm surge." This is the deadliest part of a hurricane. The storm surge and wind driven waves can devastate a coastline and bring ocean water miles inland. Inland, the hurricane's band of thunderstorms produce torrential rains and sometimes tornadoes. A foot or more of rain may fall in less than a day causing flash floods and mudslides. The rain eventually drains into the large rivers which may still be flooding for days after the storm has passed. The storm's driving winds can topple trees, utility poles, and damage buildings. Communication and electricity is lost for days and roads are impassable due to fallen trees and debris.



A tropical storm has winds of 39 to 74 mph. It may or may not develop into a hurricane, or may be a hurricane in its dissipating stage. While a tropical storm does not produce a high storm surge, its thunderstorms can still pack a dangerous and deadly punch. **Agnes** was only a tropical storm when it dropped torrential rains that lead to devastating floods in Pennsylvania, Maryland, and Virginia. Sixteen people died in Virginia and damage was estimated at 222 million dollars (1972 dollars).

A tropical depression is a less organized system that has winds up to 38 mph. It may organize into a tropical storm and a hurricane or it may be a hurricane in its dissipating stages. The whole group of systems (tropical depressions, tropical storms, and hurricanes) are called tropical cyclones. The National Weather Service's National Hurricane Center tracks all these storms. Depressions are numbered in sequential order through the season. Once they reach tropical storm strength, they are given a name in alphabetical order for the season. Go to <http://www.nhc.noaa.gov/aboutnames.html> for the list of hurricane names for the upcoming season. Names of disastrous hurricanes like Andrew, Hugo, and Fran, are retired and their names are replaced on the six year list by an international committee.

Deadly hurricanes and their remnants have affected Virginia in many different forms. In August 1969, a hurricane that hit the Gulf Coast caused surprising devastation to Virginia. **Hurricane Camille** was an extremely dangerous Category 5 storm when it made landfall, smashing the Louisiana coast with winds over 200 mph. She was the strongest hurricane to ever make landfall on the U.S. mainland this century. She maintained hurricane force for 10 hours while moving inland 150 miles. However, when Camille turned east, her position became uncertain and her strength was that of a depression. Upon picking up new moisture from the Gulf Stream off the Carolinas, Camille produced torrential rains in the remote mountains of Virginia. In just 12 hours, the mountain slopes between Charlottesville and Lynchburg received over 10 inches of rain. Nelson County recorded 27 inches! The flooding was so catastrophic that all communications were cut off. Over 150 people died and another 100 were injured. Damage was estimated at \$113 million (1969 dollars).

Since 1871, 123 (update) hurricanes and tropical storms have affected Virginia taking 228 lives and costing the commonwealth over a billion dollars in damages. The eye or center of 69 tropical cyclones has tracked directly across Virginia. Eleven have made landfall on or close (within 60 miles) to the Virginia Coast. Virginia averages one storm a year. However, as recent history has demonstrated, some years go by with no storms while others years threaten the Commonwealth with multiple storms sometimes, just days or weeks apart.

The Saffir-Simpson Hurricane Damage Scale is used to classify hurricanes into five categories from a weak hurricane, category 1 to a catastrophic hurricane, category 5. It is believed that scientifically, the strongest possible hurricane that could hit the Virginia Coast is a category 4 storm. It is believed that the water temperatures off the coast are too cool to support a category five storm. Looking at the Virginia history, a category 3 storm is without question a strong possibility.

Saffir-Simpson Hurricane Damage Scale

Hurricane Category	Sustained Winds (mph)	Damage Potential
1	74 - 95	Minimal
2	96 - 110	Moderate
3	111 - 130	Extensive
4	131 - 155	Extreme
5	> 155	Catastrophic

The longest period of hurricane inactivity was four years (1919 through 1922) when not a single hurricane or tropical storm came anywhere near Virginia. Certain global climate patterns contribute to this. One such example is El Nino, the warm waters over the tropical equatorial region of the Pacific Ocean. El Nino has a rippling effect into the Atlantic Ocean. One such effect from El Nino is that it causes stronger westerly winds in the upper atmosphere over the lower latitudes of the United States. These winds tend to shear hurricanes apart and help steer the storms away from the mainland. For more information on El Nino, go to <http://www.pmel.noaa.gov/toga-tao/enso.html>. Another indicator that few storms will develop is a drought over the Sahel portion of Africa. Hurricanes usually develop off of atmospheric waves or weather disturbances that move westward off the West Coast of Africa, but when there is drought conditions, it is an indicator that few of these waves will develop. Dr. William Gray of the University of Colorado has done extensive studies on this and other factors that contribute to active and inactive hurricane seasons, you can find out more about it and his season forecast, go to <http://typhoon.atmos.colostate.edu/>.

These non-active periods are balanced out by years when more than one storm impacts. When the opposite phase of El Nino, La Nina, cold waters over the equatorial Pacific, occur, there tends to be a dramatic increase in hurricane activity. Go to <http://www.pmel.noaa.gov/toga-tao/la-nina-story.html>. During the La Nina phase from the 1954 to 1956, the Eastern Seaboard was pounded by storms including Hazel, Connie, Diane, and Flossy. Between 1951 and 1960, Virginia was effected by 16 storms. On August 13, 1955, **Hurricane Connie** moved up the Chesapeake Bay and across Baltimore and only five days later, **Hurricane Diane** moved across central Virginia, Richmond and Washington, D.C. Rain from the two storms set records for the month of August over central and northern Virginia and caused flooding from Virginia through Pennsylvania.

Considering the damage one hurricane or tropical storm can produce, imagine a year with seven storms as occurred in **1893**! One of these storms was the last major hurricane to

strike Charleston, South Carolina prior to Hugo. Its storm surge drowned between 1000 and 2000 people. Later that year, another storm killed near 2000 people on the Louisiana Coast. For Virginia, the 1893 season began early with a hurricane moving across the state on June 17. Two months later, August 23, a hurricane passed just off the coast, making landfall in New York. Winds gusted to 88 mph at Cape Henry. Just five days later, a second hurricane crossed the state. On October 4, a hurricane veered off the North Carolina coast after passing Cape Hatteras. Nine days passed and then, for the third time, a hurricane passed over Virginia producing a 4 to 5 foot tidal surge up the Potomac River. Ten days later, a tropical storm made landfall on the Delmarva Peninsula; and last, on November 8, a tropical storm passed Cape Hatteras and veered out to sea. It was a long and active season and were it to happen again, it might mean seven different coastal evacuations for the Virginia Tidewater in just one season!

The majority of hurricanes (61 percent) and tropical storms that have affected Virginia have originated in the Atlantic Ocean. The storm begins as a disturbance moving off the west coast of Africa near the Cape Verde Islands. It gains strength over the very warm equatorial waters. The easterly winds (called Trade Winds) which prevail in the tropics carry the storm toward North America. If a trough of low pressure exists over the United States with high pressure over the central North Atlantic Ocean, the storm curves to the north and gets caught in the "Prevailing Southwesterlies". The position of the Ocean high pressure center and the position of the US trough will play a big role on whether the storm curve out over the ocean missing the coast or it comes in and hits the mainland.

Twenty-six percent of the tropical cyclones that affect Virginia originate in the Caribbean waters and eight percent in the Gulf of Mexico. Three storms (2.5%) originated in the eastern Pacific. They traversed Central America into the Gulf of Mexico before moving northeast toward Virginia.

Hurricanes often spawn tornadoes across Mid-Atlantic region that have, at times, been strong and deadly. This century, 15 hurricanes, tropical storms or their remnants have spawned tornadoes in Virginia. **Hurricane David** in 1979 spawned 34 tornadoes, of which, eight were in Virginia. Tornadoes struck five counties and three cities from Norfolk in the southeast to near Leesburg in the far north. One person was killed, 25 were injured and damages were close to \$14 million.

Hurricanes Spawning Tornadoes (data through 1999):

September 4, 1915	1 small tornado
October 29, 1917	2 small tornadoes
September 5, 1935	5-7 tornadoes; 3 dead, 21 injured
August 31, 1952 "Able"	1 strong tornado
July 10, 1959 "Cindy"	3 small tornadoes
September 29, 1959 "Gracie"	3 strong tornadoes; 12 dead, 13 injured
September 10, 1960 "Donna"	1 strong tornado
September 5, 1979 "David"	8 tornadoes, 6 strong ones; 1 dead and 19 injured
July 25, 1985 "Bob"	2 small tornadoes and 1 strong one
August 17, 1994 "Beryl"	1 strong tornado injuring 10 people

October 5, 1995 "Opal"	3 small tornadoes
July 12, 1996 "Bertha"	5 small tornadoes injuring 9 people
September 6, 1996 "Fran"	2 small tornadoes
July 24, 1997 "Danny"	3 small tornadoes
September 4, 1999 "Dennis"	1 strong tornado injuring 6 people

Hurricanes need not make landfall or move directly across the commonwealth to cause damage. The eye of Hurricane Gloria in September 1985 passed 45 miles east of Cape Henry. She was a category 3 hurricane. South Island had a wind gust to 104 mph. Damage to the eastern Virginia coastal area was 5.5 million dollars. The fastest one-minute wind ever recorded in Virginia was 134 mph with a hurricane in **September 1944** at Cape Henry. Winds gusted up to 150 mph! Like Gloria, it stayed just offshore of the coast.

On the other hand, fast moving inland storms like **Hurricane Hazel** in October 1954 can also be devastating. Hazel maintained hurricane force winds after making landfall near Wilmington, NC and produced record wind gusts over the eastern portion of Virginia and Maryland. In Hampton, winds gusted to 130 mph and gusts to around 100 mph were common east of Richmond and Fairfax, Va. Virginia lost 13 people and statewide damage was conservatively estimated at \$15 million.

Virginia has a long history of tropical cyclones mentioned in writings of the early Virginia colonists. Official weather records began in Norfolk in 1871. Prior to this, some tremendous hurricanes were noted, the force of which Virginia has not been seen, fortunately, in the 20th century. In **September 1667**, the Chesapeake Bay was said to have risen 12 feet and in **October 1749**, it rose 15 feet! The 1749 hurricane washed up an 800 acre sand spit and with the help of a hurricane in **1806**, it became Willoughby Spit. This narrow slice of land is now dotted with hundreds of homes and supports a section of Interstate-64 just east of Hampton Roads Tunnel Bridge. Those storm surges today would cause major devastation to property along the heavily populated bay and coast and without evacuations, a loss of life.

Virginia Hurricane Chronology:

17th and 18th Century Hurricanes

September 6, 1667: The Chesapeake Bay was said to have risen 12 feet. It is likely that this storm caused the widening of the Lynnhaven River. In writing from *Norfolk in By-Gone Days* by Rev. W. H. T. Squires, it said that Jamestown saw 10,000 houses blown down. "The hurricane blew for 24 hours with unexpected fury, first from the northeast, then due north, thence to the west, and then southeast.... It is said that planters who did not live in sight of the rivers found their farms flooded, and many were forced to seek protection on the roofs of their homes until the storm was over." The storm washed away the foundation of Fort George at Old Point Comfort. Twelve days of rain was said to have followed this storm.

October 19, 1749: This tremendous hurricane washed up 800 acres of sand that now forms Willoughby Spit. The Chesapeake Bay was said to have risen an amazing 15 feet. Again from *Norfolk in By-Gone Days* by Rev. W. H. T. Squires, indicated that the storm

destroyed Fort George at Old Point Comfort, "washing it almost entirely away". The Virginia General Assembly had tried in 1727 to strengthen it after the damage done by the 1667 hurricane.

September 4, 1775: On September 9, 1775, a Williamsburg correspondent of the *Virginia Gazette* wrote "The shocking accounts of damage done by the rains last week are numerous; most of the mill-dams are broke, the corn laid almost level with the ground, and fodder destroyed; many ships and other vessels drove ashore and damaged at Norfolk, Hampton, and York. The death toll in Virginia and North Carolina was 163 lives.

September 8, 1769: From the *Virginia Gazette* on September 14, 1769, it indicated that torrential rains had struck around 1 am and that violent winds blew until 10 or 11 o'clock that morning, when they shifted. The winds increased and continued until after dinner. Damage was "inconceivable" and crops were destroyed. "There was not a dry house in town that day..." "Many old houses were blown down and a number of trees..." "All the shipping and small vessels at Norfolk are aground, many of them dismantled; some of the wharves are gone, and others damaged. A vessel from Norfolk, laden with coal for the city, was driven up to Jamestown and stove to pieces..."

September 22-24, 1785: From *Historical and Descriptive Sketches of Norfolk and Vicinity* by William S. Forrest written in 1853, "This year (1785) was noted for the highest tide ever before known to the borough (Norfolk) completely deluging a large portion of its site on the water side." 181 lives were lost off on the Delaware Coast.

19th Century Hurricanes

September 8, 1804: Did much damage in Norfolk. Storm track took the eye just west of Norfolk as it veered to the northeast. The hurricane's storm surge killed 500 people when it made landfall in the Charleston, South Carolina area.

August 23, 1806: The "Great Coastal Hurricane of 1806" helped form Willoughby Spit.

September 3, 1821: One of the most violent hurricanes on record. Eye passed over the City of Norfolk then the storm moved northeast along the New Jersey coast onto Long Island. From *Historical and Descriptive Sketches of Norfolk and Vicinity* by William S. Forrest in 1853, " Many houses in Norfolk and Portsmouth were damaged - some unroofed and others entirely demolished. Chimneys, trees and fences were blown down and several lives were lost. The tide rose to a great height; the Norfolk drawbridge was swept away, and the damage to the shipping was immense." A correspondent at Old Point Comfort wrote " When the wind changed, the water broke in on the island and almost covered it. By its force a number of buildings were destroyed...prostrated fences, and entered every building..." From the American Beacon on Tuesday, September 4, 1821, talking about the Norfolk area, "So general and widespread is the devastation, that it would be impossible...to give...a detail of its awful consequences. "...very few house-keepers have escaped injury, either in their enclosures or houses and nearly all of the most highly improved lots in the borough have been despoiled of their attractions, by the prostration of their walls or fences, the uprooting of trees.... The ground stories of all warehouses on the wharves and as high up as Wide Water Street, were entirely overflowed..."

June 4, 1825: From *Historical and Descriptive Sketches of Norfolk and Vicinity* by William S. Forrest in 1853, "In 1825, there was a violent storm was accompanied by astronomically high tides which almost entirely inundated the lower portion of town, materially damaging many articles of merchandise, such as sugar, salt, tobacco, etc., and floating away quantities of lumber and firewood."

August 24-25, 1827: Hurricane was severe on the coast and inland to the mountains and caused damage from Charleston to Baltimore.

September 8, 1846: A slow moving hurricane piled water into the Pamlico and Albemarle Sounds. When the winds shifted, the water washed back over the barrier islands from the sound and Hatteras and Oregon Inlets were formed.

August 25, 1851: Hurricane did considerable damage to Norfolk area. Storm had made landfall on the Florida coast and moved northeast emerging off the mainland just north and east of Norfolk.

September 17, 1876: Average 5 minute wind speed at Cape Henry was 78 mph. 8.32 inches of rain fell.

October 4, 1877: The hurricane made landfall near New Orleans and moved northeast over the Carolinas and Virginia. From *The Norfolk Landmark* on August 19, 1879, "...the gale was terrific and many buildings were blown down and unroofed, trees uprooted, and numerous marine disasters...." It was said to be "a terrific storm" in the vicinity of Albemarle Sound and bridges and wharves were washed away. Ships were lost all along the Atlantic Coast into New England.

September 12, 1878: Hurricane spawned several tornadoes in Virginia between 1 and 4 pm. At least one person was killed and seven injured. One hit Dinwiddie southeast of Petersburg, another moved northwest through Ford's Depot. Another hit Nottoway near Burkeville. A fourth hit in Henrico where the death and injuries occurred. and last one was documented hitting Goochland near Dover Mills and was on the ground for 28 miles.

October 22-23, 1878: The hurricane's eye made landfall at Cape Fear and moved north across Richmond and Washington, DC and seemed to loose little strength. When the eye passes over DC, a calm was reported and the pressure dropped to 975 mb. The storm was thought to resemble that of Hurricane Hazel in 1954. Winds downed trees and fences and unroofed homes. Very high tides occurred on the coast. Cobb and Smith Islands on the Eastern Shore (Northampton County) were completely submerged and all livestock were swept away. Average 5 minute wind at Cape Henry was 84 mph. Eighteen died when the A.S. Davis went ashore near Virginia Beach.

August 18, 1879, "The Great Tempest": A gale was said to have blown from the northeast for 24 hours before the winds shifted northwest and increased to 70 mph. The eye passed about 50 miles west of Norfolk. Tide in Norfolk 7.77 feet above Mean Low Low Water. Average 5-minute wind speed at Cape Henry was 76 mph with estimated gusts to 100 mph. Fastest 1 minute at Norfolk was 72 mph and the pressure reached 29.26 inches. From *The Norfolk Landmark* on August 19, 1879, "The tide swept up over Bank street, invaded the City Hall grounds and went surging and breaking up Cove Street beyond the Station House, so that the oldest inhabitant saw the like in the history of Norfolk." More than 46 people were lost in Virginia and North Carolina, many on ships.

October 31, 1887: Average 5 minute wind speed at Cape Henry 78 mph. The storm caused a record number of marine disasters.

November 25, 1888: This hurricane over 100 to 200 miles off the coast and yet was reported to have caused damage in the Tidewater area. High tides flooded the lower part of Norfolk and strong winds blew down telegraph lines and blew vessels from their moorings.

September 10-12, 1889: The hurricane moved north from Puerto Rico and stalled off the Virginia Capes for several days. The force of the storm was felt along the coast from North Carolina to New York with high tides and heavy swells.

August 23, 1893: Average 5 minute wind speed at Cape Henry was 88 mph.

October 12, 1893: Tidal surge up the Potomac into Washington recorded a tide of 8.2 ft above MSL at the Navy Yards which is across the river from Alexandria, VA.

September 29, 1894: Average 5 minute wind speed at Cape Henry was 80 mph with gusts to 90 mph. Storm made landfall between Savannah and Charleston and then moved northeast just inland from the coast and emerged again out over the Outer Banks north of Hatteras.

July 8, 1896: A hurricane spawned at least seven tornadoes in Virginia on this day. One struck Dinwiddie and Prince George about 10 miles southeast of Petersburg and another tracked 17 miles moving northwest across the James River near Williamsburg. Eleven people were injured.

September 29, 1896: From *Hurricanes* by Ivan Ray Tannehill (page 262) "...increased in intensity as it reached Florida and moved through the Atlantic state, inside the coastline. Center passed over District of Columbia...". Storm killed 16 people and did almost \$4 million in damages up the Eastern Seaboard. The Richmond News Leader on June 14, 1951 after a tornado had struck the city wrote "Tornado recalls windstorm of 1896 to older residents..." Speaking of September 29, "torrential rain and very high wind for several hours in the evening. Wind estimated at 80 mph...caused a steeple to fall."

October 24-26, 1897: Storm passed off the coast on October 20 producing a 60 mph wind at Cape Henry. Another storm moved northwest to Hatteras and then to the Virginia Capes, it then looped off the coast on the 25 and moved west onto the Outer Banks north of Hatteras on the morning of the 26th. The storm lasted 60 hours in the Norfolk area and tides reached 8.1 feet above mean low low water.

August 17, 1899: One of the most severe storms to hit the Outer Banks. Hatteras experienced 93 mph winds with gusts of 120 to 140 mph before the anemometer blew away. The island was covered by 4 to 10 feet of water. Strong winds and heavy rains reached as far inland as Raleigh and did extensive damage to crops. Hurricane moved just east of Norfolk. No information on the impact in Virginia was found.

October 31, 1899: Average 5 minute wind speed at Cape Henry was 72 mph. Tide at Norfolk reached 8.9 feet above mean low low water. Storm followed a track similar to Hazel.

20th Century Hurricanes

October 10, 1903: Average 5 minute wind speed at Cape Henry was 74 mph. Tide in Norfolk reached 9 feet above Mean Low Low Water.

September 15, 1904: From *Hurricanes* by Ivan Ray Tannehill (page 164), "It moved to the south Atlantic Coast where it recurved to the northeast and progressed rapidly to New England. A number of lives were lost and there was much damage to seaside property and many vessels were wrecked." It moved back out over the ocean near Norfolk. Two other hurricanes would past over Virginia this season (October and November) bringing heavy rains and gales.

August 26, 1924: Average 1 minute wind speed at Cape Henry was 72 mph. Damage was slight.

September 30, 1924: Fastest 1 minute wind speed at Norfolk was 76 mph. Heavy rains in Central Virginia brought moderate flooding to Fredericksburg on October 1. The river crested at 22.8 feet (about 5 ft over flood stage).

December 2, 1925: A rare late season storm. Moved just inland of the Coast in North Carolina and back out to sea near Cape Henry. Damage was slight.

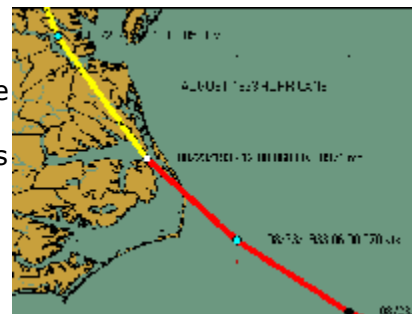
August 22, 1926: Fastest 1 minute wind speed at Cape Henry was 74 mph.

August 12-16, 1928: Two tropical storms moved across the Florida panhandle and then turned northeast and moved up the Appalachians weakening into depressions. The depressions passed over Virginia just 4 days apart bringing heavy rains, flash flooding and significant rises on the larger rivers. Major flooding occurred on the Roanoke River through Roanoke and Brookneal. The river crested on the 16th at 18.1 ft (8 ft above flood stage) in Roanoke. It was the fourth highest crest to date on the Roanoke River at Brookneal with 37.2 ft (about 14 ft over flood stage) occurring on the August 12.

September 19, 1928: Fastest 1 minute wind speed at Cape Henry was 72 mph. The tide reached 7.16 feet above Mean Low Low Water (5.8 ft MSL) at Norfolk. Storm caused heavy rains and flooding over North Carolina.

October 18, 1932: Tropical storm made landfall on the Gulf Coast moved northeast weakening to a depression. The center passed over the Virginia-Kentucky border into West Virginia. Heavy rains to the east of the storm impacted the Appalachians. It caused major flooding on the Roanoke River through Alta Vista where it crested at 29 ft (11 feet over flood stage) and moderate flooding in South Boston on the Dan River.

August 23, 1933: The hurricane was born off the Cape Verde Islands. It reached Category 4 strength, but weakened to a Category two and grew in size before making landfall. The storm approached the coast with its area of maximum winds pushing water into the mouth of Chesapeake Bay. North winds down the bay formed a bulge of water in the Tidewater area that moved north up the Bay and its tributaries as the storm did. This storm caused record high tides up the entire west



side of the Chesapeake Bay with damages the highest ever recorded from a storm surge. The hurricane caused a total of 18 deaths and 79 million dollars (adjusted to 1969) in damages in Virginia. 15 lives were lost in the Tidewater area. Huge plate glass windows in downtown Norfolk crashed under the pressure of the wind showering the walks and streets with glass; awnings and signs were ripped and large shade tree (easy prey after the record-breaking rain of 6.5 inches the Sunday before) blew over, in many cases carrying electrical and telephone wires with them. Virtually the entire tidewater area including Virginia Beach was paralyzed by the storm in the way of communication, electricity, water service, and traffic. 79,000 telephones were put out of commission and over 600 trees, many of them a century old, were uprooted in the city, while shrubs, gardens, lawns, and parks suffered severely. Highest 1-minute wind speed was 70 mph at Norfolk, 82 mph at Cape Henry, and 88 mph at NAS, Norfolk. As the storm moved north out of the densely populated tidewater area, damages in the commonwealth were largely to crops: \$2 million (1933 dollars) in corn, \$2 million in tobacco, \$750,000 in apples and half a million in other crops.

Record Tidal Surge: Established the record high tide of 9.8 feet above Mean Low Water (8.0 ft MSL) at Sewells Point with 9.0 ft in Norfolk and 9.3 ft at Portsmouth gages. The downtown business area was flooded as never seen before. Stores on Granby Street were flooded, on the west side, from Atlantic Hotel to Tazewell Street (about 4 blocks) and for nearly the same distance on the east side, the water being 4 feet deep on the street floor of many businesses, damaging stocks of goods and fixtures, as well as the structures. Damage to merchandise, stored in the warehouses and piers also suffered heavy damage. On Willoughby Spit, water reached the ceiling of many homes and 141 were destroyed. Water at Virginia Beach reached 8.6 ft MSL on the Atlantic side (the tide reached two blocks in from the beach), 8.6 ft MSL at Lynnhaven Inlet, 8 ft at Lynnhaven Bay and at East Bridge on the Elizabeth River and only 3.8 ft MSL at Back Bay. Extensive damage to water front property occurred. At Buckroe Beach and Old Point, 60 homes and stores were demolished in addition to concession stands, fishing camps and seine houses. West Point on the York River had its highest tide of 10 feet Mean Low Water (8.5 ft MSL) which is 5 feet above flood level where minimum damage begins. About 5% of the residential area was flooded and a paper mill had about 5 feet of water. Yorktown also had considerable flooding. It reached an estimated 9.7 feet above Mean Low Water which is about over 5 feet above where damage from flooding begins. Gwynn Island in Mathews County estimated a tide of 8 feet Mean Low Water for New Point Comfort (6.9 ft MSL in Matthews). Roads begin to flood at about 5 ft Mean Low Water. Homes, an oyster plant and a store were flooded. Urbanna in Middlesex County on the Rappahannock River estimated their highest tide at 5.7 ft Mean Low Water (7 ft MSL). Some summer cottages and an oyster plant had about 4 feet of water. Higher up river, Tappahannock had a tide estimated at 8 ft Mean Low Water which is about 4 ft above flood. Lower on the River, Morattico in Lancaster County reached an estimated tide of 7 ft above Mean Low Water and the entire town floods at 6 feet with roads flooding at 4.5 ft. At Dahlgren on the Potomac River, tides were estimated to have reached 8.5 ft above Mean Low Water (close to 8 ft MSL) by the Dock Supervisor.

September 16, 1933: The hurricane developed east of the Bahamas and strengthened to a Category 3 storm and made landfall near Cape Lookout. The tide reached 8.3 feet above Mean Low Water (6.5 ft MSL) at Sewells Point again causing flooding in the Tidewater area less than one month after the August 23 storm. The peak surge, however, occurred around the time of low tide and hence could have been even higher. Regardless, the storm caused far less damage than the August storm because of extensive preparations made to combat the gales and high tides. Losses were expected to reach a quarter of a million dollars in the Tidewater area in comparison to the \$5 million (1933 dollars) caused by the previous storm and no lives were lost. However, hundreds more trees uprooted and large plate glass windows were blown in all over the business section. Damage to roofs was extensive, due to the strong wind gusts which exceeded those in the storm of last month.

Falling trees carried away telephone and power lines in some instances, and a large number of households were without power for some time. Over 2000 telephones were out of service. The storm tide flooded the business section centering at City Hall Avenue and Granby Street. Traffic was tied up in the downtown area all day and shipping was at a standstill. The fastest 1 minute wind speed at NAS, Norfolk was 88 mph with 75 mph at the NWS Office in Norfolk and 87 mph at Cape Henry. Two people were killed in Virginia. High winds and waves in Pamlico and Albemarle Sounds left hundreds without food and shelter and contributed to the 21 lives lost in North Carolina.

September 5, 1935 "The Great Labor Day Hurricane": While this storm is known for its destruction of the Florida Keys, it eventually moved north over the central portions of the Carolinas and then back out to sea near the Virginia Capes. While passing, it spawned several tornadoes in Virginia and caused flooding. A killer tornado (probably an F3) in Prince Edward tracked 10 miles and took 2 lives and injured 12 more. A third tornado struck Southampton County near Courtland killing one person. Another tornado tracked from Portsmouth across Craney Island to the western portions of the city of Norfolk and Willoughby Spit and became a waterspout. One tornado struck Pittsylvania County injuring 3 people and another tornado struck Gloucester. It was on the ground for 8 miles and injured another 6 people. Two small tornadoes may have touched down in Middlesex. Heavy rains fell over central Virginia from the storm and a major flood resulted on the James River in Richmond. Water level at the Richmond locks reached 23.7 ft which is over 15 feet above flood stage. Moderate flooding occurred upstream on the James and at Culpeper on the Rapidan River.

September 18, 1936: This storm developed near the windward Islands and intensified to a Category 3 off the Carolina coast. It passed within 25 miles of Virginia Beach. The fastest 1 minute mile was 84 mph at Cape Henry and 68 mph the NWS Office in Norfolk. In the lower section of Norfolk, high winds demolished windows, roofs, and buildings with damages equaling around a half a million in that area. Power and telephone lines were down along with trees. Shipping was suspended, train service canceled, and traffic was stalled. Yachts were driven ashore and many were broken, and some damage was sustained by larger craft. The road from Currituck to Norfolk was washed out. The tide reached 9.3 feet above Mean Low Low Water (7.4 ft MSL) at Sewells Point and is the second highest tide of record. The storm's surge was 5.6 ft on top of the tide into Norfolk Harbor. From *Hurricanes* by Ivan Ray Tannehill, "It moved northward gaining in intensity. By the morning of the 15th this hurricane was of wide extent and marked intensity. On the 16th, the area of winds of force 6 and higher (Beaufort scale) was about one thousand miles in diameter. By that criterion it was one of the largest tropical cyclones of record. ...At Norfolk, it was considered the worst storm that ever visited that section..." Due largely to extensive preparations that had been made on Weather Bureau warnings, the property loss was much reduced over the damage sustained in the August 1933 and loss of life was limited to one.

August 19, 1939: Hurricane made landfall on the Florida coast and then again on the Gulf Coast. The storm turned northeast and moved up across Virginia as a tropical depression on the 19th. The storm produced heavy rains and flash flooding particularly along the eastern slopes of the southern Blue Ridge. Major flooding occurred on the Roanoke River through Alta Vista (11.5 feet over flood stage).

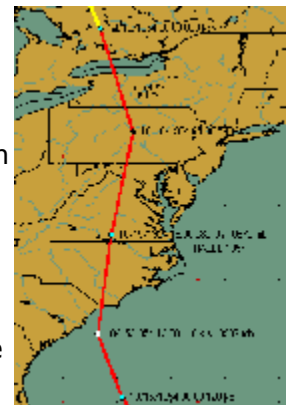
September 14, 1944, the "Great Hurricane": Heavy rain and high winds lashed the Virginia Beach area. The storm moved about 50 miles east of the shore. Fastest 1 minute mile wind speed was 134 mph at Cape Henry which is the highest speed of record in this area. Gusts were estimated to 150 mph. The NWS Office in Norfolk recorded 73 mph with

gusts to 90 mph. Tides reached 5.2 feet above normal. Extensive property damage occurred along the coast with 41,000 buildings damaged from the Carolinas to New England. 390 lives were lost, of which 344 were World War II servicemen at sea who lost their lives when a destroyer, two Coast Guard cutters, and a minesweeper sunk.

August 31, 1952, Hurricane Able: The first hurricane of the season made landfall between Charleston and Savannah and moved north across Virginia and Washington, DC in a very weakened form. Rainfall was around 2 to 3 inches. It produced winds of 30 to 40 mph with a peak gusts to 60 mph. Its greatest impact on Virginia was a small tornado (F2) that struck Franconia in Fairfax County. It traveled 2 miles and was around 100 yards wide. Property damage in the area was \$500,000 caused by flooding, the tornado, and falling trees and branches that disrupted power and telephone facilities.

August 14, 1953, Hurricane Barbara: The fastest 1 minute wind speed was 72 mph at Cape Henry with 63 mph gusting to 76 mph at the Norfolk Airport. Tides reached 6.0 ft above Mean Low Water. Heavy rains accompanied the storm. The hurricane struck the North Carolina coast near Ocracoke as a Category 1 storm and moved north along the Outer Banks to the Virginia line, and then out to sea. Five to 8 inches of rain fell over Southeast Virginia with 9.3 inches in Portsmouth.

October 15, 1954, Hurricane Hazel: Hazel maintained hurricane force winds up the East Coast and produced a number of record wind gusts. In Hampton, winds gusted to 130 mph; Norfolk had 78 mph sustained hurricane force winds with gusts to 100 mph. Blackstone, VA had 63 mph winds with a gust to 92 mph; Richmond 68 mph winds with a maximum gust to 79 mph; Washington National Airport in Arlington, VA had sustain winds reach 78 mph with a gust of 98 mph; Salisbury had 52 mph with a gust to 101 and Philadelphia gusted to 100 mph. Several planes were damaged at Patrick Henry Airport and installations at Washington National Airport were damaged. Damages in Norfolk alone reached 3.5 million dollars with 1800 homes and businesses were damaged. Hundreds of thousands of trees were destroyed. Half of the phone and electric lines in the state were knocked out equaling 2 million dollars in damages. A 150 foot microwave telephone tower was toppled near Warsaw. 200 plate glass store fronts in Richmond were broken. In the Shenandoah Valley, Turkey Growers lost between 150,000 and 250,000 turkeys when poultry sheds were wrecked. Small crafts were driven ashore or sank. Four people died when a tug capsized on the James River about 25 miles from Richmond. Piers were demolished and private docks swept away in the Tidewater rivers. The Potomac rose to 5.4 feet above MSL at Dahlgren, Va and Colonial Beach. Damage from flooding begins between 3 and 5 feet. However, add on waves from strong winds and considerable damage was reported along with much erosion of the beach and banks. West Point on the York River rose to 7.5 feet Mean Low Water (6 ft MSL) which is 2.5 feet above flood level where minimum damage begins. The Potomac at Alexandria rose to around 7.5 feet. Back Bay and North Landing River of Virginia Beach also experienced flooding as strong south winds pushed water northward from Currituck Sound. Lynchburg, Roanoke, and Danville recorded 5 to 6 inches of rain causing flooding of small streams. Lesser rainfall amounts fell to the east. Virginia lost 13 people and damaged conservatively were estimated at \$15 million.



August 12-13, 1955, Hurricane Connie: After slowing and moving erratically off the Carolina coast for a couple days, Connie finally made landfall near Cape Lookout, NC on August 12. She moved north and came right up the Chesapeake Bay on the 13th. On the

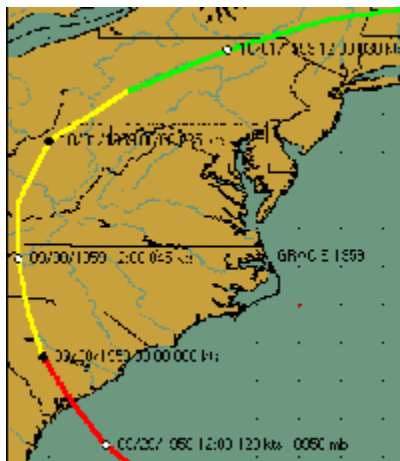
Chesapeake Bay, 16 people died in the capsizing of a small boat. Connie had weakened and winds only reached 47 mph with gusts to 52 mph at Norfolk and the fastest 1 minute wind speed was 65 mph at Cape Henry. Richmond 8.85 inches of rain, Washington, DC 6.59 inches and Norfolk 4.62 inches. The storm hit the Tidewater area at low tide and so water levels only reached 4.8 feet above normal at Norfolk and 4 feet above normal at Cape Henry. Minor flooding was reported at Virginia Beach and Willoughby Spit areas. Atlanta Beach in Oceana reported \$200,000 in damages. Total damages were \$1 million.

August 17, 1955, Hurricane Diane: Just 5 days after Connie, along came Diane. Diane made landfall near Wilmington, NC as a Category 1 storm on August 17 and moved north across central Virginia. As she did so, rain spread north up to 250 miles ahead of the storm's eye. On the evening of the 17th, the Blue Ridge saw rainfall amounts of 5 to 10 inches along the southern and eastern slopes. The Skyline Drive area was hardest hit. The combination of rain from Connie and Diane brought record total rainfall for the month of August. Severe flooding followed on the Rappahannock River with some flooding also on the James, Potomac and Shenandoah Rivers. Norfolk winds gusted to 53 mph from the east, Cape Henry had 43 mph winds with gusts to 49 mph. Roanoke saw winds gusts to 62 mph and Lynchburg 56 mph out of the north. While only minor tides occurred, Atlantic Beach, Oceana, again had another \$200,000 in damages that included sewer and water lines. Statewide damages equaled \$1.5 million.

September 19-20, 1955 Hurricane Ione: Storm moved off the shore over Virginia Beach. Tides at Norfolk reached 5.8 feet Mean Low Water and winds reached 47 sustained with gusts to 58 mph. Cape Henry's fastest 1 minute wind was 56 mph from the east. Roanoke gusted to 48 mph from the north and Richmond 42 mph. Richmond and southeast Virginia had another 3 to 4 inches of rain.

September 27, 1956, Hurricane Flossy: Tides at Norfolk reached 7.2 feet Mean Low Water (5.9 ft MSL) or about 4.5 feet above normal. Winds reached 56 mph from the northeast in Norfolk.

July 10, 1959, Hurricane Cindy: Spawned 8 tornadoes in Georgia, North Carolina and Virginia.

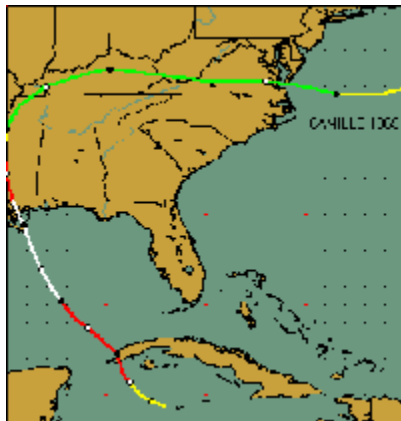


September 30, 1959, Hurricane Gracie: The storm moved just west of Charlotte, NC and then into extreme southwest Virginia, but had weakened considerably. Two to 4 inches of rain fell from the storm with local amounts of 8 to 10 inches. Norfolk recorded 6.79 inches in 24 hours. An intense squall line developed over southwest Virginia in the afternoon that progressed east with tragic results near Charlottesville. Gracie spawned tornadoes in North and South Carolina, Virginia and Pennsylvania. In Virginia, three strong F3 tornadoes were spawned striking Albemarle, Greene and Fluvanna Counties and killing 11 people. For more details, see the Virginia Storms chapter on Tornadoes.

September 12, 1960, Hurricane Donna: Donna produced rainfall of up to 3 inches over Richmond and up to Washington, DC. The west edge of the eye brushed along the Delmarva Coast but the storm had weakened before reaching Virginia. Fastest 1 minute wind speed was 73 mph at Norfolk Airport, 80 mph at Cape Henry and estimated at 138 mph at Chesapeake Light Ship. Norfolk FWF reported gusts to 89

mph. Ocean City, MD recorded 83 mph winds before the sensor failed. Salisbury Airport recorded 58 mph winds with gusts to 83 mph. Some structural damage was reported in southeast Virginia. Donna produced 5 tornadoes in North and South Carolina and Virginia. The tornado in Virginia hit around 6 pm in Buckingham County. The F2 tornado was on the ground for about a half mile. Rainfall of 4 to 8 inches occurred and some streams/ivers on the Delmarva reached record or near record overflow. Lowest pressure was 28.65 inches holds the record. Water reached 7 ft above normal (6.3 ft MSL) in Norfolk Harbor. Serious flooding was reported. There were 3 deaths.

September 1, 1964, Hurricane Cleo: Record rains fell over much of the Hampton Roads area on August 31 into September 1. The Back Bay Wildlife Refuge recorded 14.09 inches, Diamond Springs and Oceana NAS 13.70 inches, Navy Norfolk 13.32 inches, Norfolk Weather Office 11.40 inches, Cape Henry 10.41 inches and Langley Field 6.59 inches. Winds in the Norfolk to Virginia Beach area were 28 to 31 mph with gusts 40 to 42 mph. Cleo spawned 17 tornadoes across Florida, South and North Carolina and Virginia.

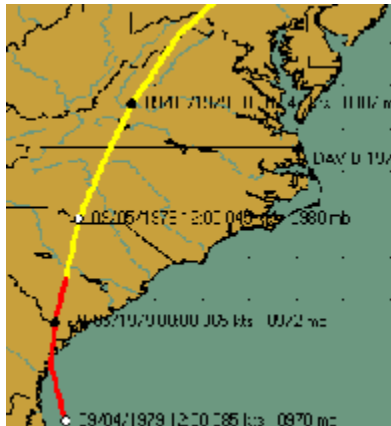


August 20, 1969, Hurricane Camille: Camille made landfall as a Category 5 hurricane smashing the Mississippi Coast with 200 mph winds on August 17. She was the strongest hurricane to make landfall on the U.S. this century. She maintained hurricane force for 10 hours as it moved 150 miles inland. The storm tracked northward weakening and becoming less defined. When Camille turned east, her position and strength became uncertain. It moved toward Virginia on the 19th and was only a tropical depression. Moisture from the warm Gulf Stream waters moved northwest toward the storm and new feeder bands formed. These thunderstorms "trained" (one followed the other), into the Blue Ridge south of Charlottesville. In just 12 hours, up to 31 inches of rain fell with devastating results. The ensuing flash flood and mudslide is estimated to have killed 153 people (not all the bodies were found). Most died in Nelson County. The County also saw 113 bridges washed out. All communications were cut off. Major flooding followed as the bulge of water moved down the James River into Richmond. Waynesboro on the South River saw 8 feet of water in its downtown and Buena Vista had 5 ½ feet in its business section. Damage was estimated at 113 million dollars (1969 dollars). See Virginia Storm's Chapter on Floods for a more detailed and amazing chronicle of Virginia's worst disaster.

August 27, 1971, Tropical Storm Doria: Fastest 1 minute wind speed 52 mph at Norfolk Airport and 71 mph at NAS, Norfolk. Doria made landfall in North Carolina near Atlanta Beach and moved up the Delmarva coast. Tide was 3.6 feet above normal and 3 inches of rain fell in Norfolk. A tornado touched down 10 miles west-southwest of the Norfolk Airport and caused \$250,000 in damages. Flooding and fallen tree limbs, etc. amounted to another \$125,000 from the tropical storm. One person drowned in Virginia.

June 21, 1972, Tropical Storm Agnes: Agnes was only a weak hurricane when it developed over the Gulf of Mexico and struck the Florida panhandle. It across Georgia, the Carolinas, and the southeast tip of Virginia, as a depression. Back out over the warm Gulf Stream waters, the storm regained some of its strength but was still just a tropical storm when making landfall into New York. Agnes produced devastating floods in Pennsylvania, Maryland, and Virginia. Sixteen inches of rain was recorded in Chantilly (Fairfax County) and both the Potomac and James Rivers experienced major flooding. Richmond was hard hit. The water supply and sewage treatment plants were inundated. Electric and gas plants were

flooded. Only one of the five bridges crossing the James was usable and the downtown section was closed for several days. Industry and businesses suffered immense damage. Sixteen people died in Virginia and damage was estimated at \$222 million (1972 dollars). Sixty-three counties and 23 cities in the commonwealth qualified for disaster relief. For more details on the extensive flooding throughout the commonwealth, see the chapter in Virginia Storms on Floods.



September 5, 1979, Hurricane David: Spawned eight tornadoes across Virginia. Two cities and five counties were hit from Norfolk in the southeast to Leesburg in the north. Because the tornadoes were associated with the spiral bands of a hurricane, they moved from the southeast to the northwest. There was a total of one death and 19 injuries. Damage to Newport News was \$2 million with another half million to Hampton; Fairfax County had \$2.5 million in damages. (See Virginia Tornadoes for more details).

July 25, 1985, Hurricane Bob: Hurricane Bob moved north from the Carolinas into central Virginia. A large band of thunderstorms intensified over central Virginia and moved rapidly north. The storms produced strong winds and three tornadoes. Near Manikin in Goochland County at 12:30 pm EDT, a F0 tornado was witnessed. It briefly touched down falling a large oak tree. At 1:18 pm, a second short-lived F0 tornado was reported in Hanover County near Holly Hills. At 2:14 pm, a funnel was sighted moving northwest in Albemarle County near the Greene County line and U.S. Route 29. It became a strong F3 tornado touching down and tearing off the roof and blowing out windows of the County Line Grocery Store. The tornado then struck the West Lee Subdivision in Greene County uprooting trees, totally destroying two houses by blowing off the roofs and caving in the sides. Several other houses were struck and damaged by flying debris.

September 27, 1985, Hurricane Gloria: Pasted 45 miles east of Cape Henry. Fastest 1 minute wind speed was 46 with gusts to 67 mph at Norfolk International Airport, a gust to 94 mph at Norfolk NAS, 94 mph with gust to 104 mph at the South Island Chesapeake Bay Bridge Tunnel. Wallops Island (South of Chincoteague) had a fastest 1 minute wind speed of 72 mph. Highest tide at Norfolk was 5.3 feet above Mean Low Low Water. The storm's rainfall was 5.65 inches at Norfolk with 5 to 6 inches common across the Eastern Shore causing minor flooding along with the tide. A fishing pier at Virginia Beach was heavily damaged. Numerous branches and trees blew down with some damage to roofs, signs, and trim on buildings. Total damages in Virginia was \$5.5 million.

August 17, 1986, Hurricane Charley: The weak center passed over southeast Virginia Beach. Fastest 1 minute wind speed was from the west-north-west at 46 mph with gusts to 67 mph at the Norfolk Airport, gusts to 81 mph at the Norfolk Coal Pier, and gusts to 82 mph at Cape Henry. At 10 pm EDT, the wind blew from the northeast at 94 mph with gusts to 104 mph at South Island of the Chesapeake Bay Bridge Tunnel (anemometer is elevated). Many trees were blown down, including 250 in Hampton Roads. High tides were 2.3 feet above normal, causing flooding of low-lying areas in Fort Monroe. Over 110,000 homes were without power in the Tidewater area. Six foot waves destroyed 70 feet of the fishing pier in Norfolk. Total damages were less than \$1 million.

July 12-13, 1996, Hurricane Bertha: Made landfall near Cape Fear and moved north passing over Suffolk and Newport News then northeast toward Atlantic City, NJ. The fastest

1 minute wind speed was 35 mph with gusts to 48 mph at the Norfolk International Airport. The storm knocked out power as many as 115,000 customers in the eastern part of the state. Bertha spawned four tornadoes in east central Virginia. The strongest was an F1 that moved over Northumberland County injuring 9 people and causing several million dollars in damages. Other tornadoes moved over Smithfield, Gloucester and Hampton.

September 5-6, 1996, Hurricane Fran: Fran made landfall at Cape Fear on the NC coast and moved north entering Virginia near Danville. Rainfall of 8 to 15 inches fell over the mountains and the Shenandoah Valley. Rainfall for the week totaled 20 inches at Big Meadows in Page County. In just one hour, some areas saw 3.5 inches of rain. Six people died and damages totaled near \$350 million. Agricultural damages appear to be severe and extensive to what would have been a bunker crop from the cooler, wetter than normal summer. Agricultural damage were estimated in excess of \$50 million. All rivers in the central part of the state experienced major flooding. Record-level flooding occurred on the Dan River at South Boston and on the North and South Forks of the Shenandoah River. 100 people were rescued from the flood waters caused by Fran's excessive rains. A record number of people (560,000) in Virginia experienced power outages with about 2,000 still without power a week later. Rain bands produced tropical storm force winds with gusts as high as 79 mph (Big Meadows) with measured gusts to 60 mph at lower elevation areas. Scattered tree damage occurred throughout much of the state with many trees uprooting from the combination of strong winds and saturated ground. One small tornado touched down in Madison County and one in Fauquier County. Damage was mainly to trees and corn.

During the height of the storm, 78 primary roads and 853 secondary roads were closed due to flooding and down trees. Estimated damages to state roads was \$37 million. Access to and from isolated communities, mostly in Page county, continued to be a problem for a couple weeks due to washed out bridges and roads. (10 to 15 inches of rain fell over this area). County and State agencies helped get food and water into these areas. Hundreds of people were initially reported stranded and 75 homes reported sustaining major damage in Page County. Shenandoah National Park remained closed for two weeks due to wind and flash flood damage with the southern portion of the park not opening to vehicle traffic until near the end of the month. Rockingham County reported 40 homes destroyed and 105 homes with major damage. In Warren County, 250 homes were flooded with 50 sustaining major damage. Waynesboro saw major damage to its downtown area.

Tidal flooding was also a problem on the western tributaries to the Chesapeake Bay particularly areas where the south to southeast wind could funnel the water. Tappahannock on the Rappahannock River reported tides up to 5.5 feet above normal. The Old Town section of the City of Alexandria also saw extensive tidal flooding from the Potomac River. Water was 5 feet deep in the lower portion of the city and many shops were flooded, some losing merchandise. Heavy rains and wind driven water exacerbated the tidal flooding problem. The wind driven storm surge reached over 5 feet above normal and came at about the same time as high tide which was 4:11 pm at the Wisconsin Avenue gage in DC. Because of Alexandria VA's orientation to the wind, water levels were likely a little higher. Washington National Airport in southern Arlington County also had damage with the river crest late Sunday into Monday morning. Flooding tore out their security fence and flooded their boat houses where their rescue equipment is kept. Mud and debris had to be removed from the grounds.

July 24, 1997, Hurricane Danny: Langley Air Force Base in Hampton recorded a wind gust of 61 mph as did Cape Henry and South Island on the Chesapeake Bay Tunnel Bridge. Scattered trees and power lines were blown down in the Tidewater area. Tropical moisture

from Danny interacted with a stationary front across the central Shenandoah Valley and central Piedmont. Over 6 inches of rain fell in some locations causing flash flooding of creeks and streams. Orange County received the most rain and 10 roads were closed from high water. Danny spawned three small tornadoes in the Norfolk-Chesapeake area. Each tornado was on the ground for about a mile. One moved through south Norfolk, damaging a business, destroying a car wash, causing major damage to a dozen structures.

August 27, 1998, Hurricane Bonnie: Bonnie made landfall near Wilmington, NC and then moved back out to sea over the northern Outer Banks as a tropical storm and then strengthened again over the open waters. Fastest 1 minute wind speed was northeast at 46 mph with gusts to 64 mph at Norfolk International Airport. Langley Air Base recorded a sustained wind of 53 mph with gusts to 67 mph. Cape Henry recorded a sustained wind (fastest 1 minute) of 81 mph (anemometer is at 90 feet) and a gust of 104 mph. Power was knocked out to 320,000 customers in the Norfolk-Virginia Beach area. Numerous trees were down, some on homes and cars. Some structural damage to buildings occurred from winds especially in the Virginia Beach area. Windows were blown out of high rise hotels and there was some roof damage. Rainfall amounts were 1 to 3 inches with some local amounts of 4 to 7 inches. The highest tide was 6.0 feet above Mean Low Water (3.5 feet above normal tide). The heavy rain and a two to four foot storm surge combined to produce street flooding in Norfolk, Virginia Beach and Portsmouth. Total storm damages in Virginia reached \$24 million.

September 4-5, 1999, Hurricane Dennis: Hurricane Dennis loomed off of Cape Hatteras for several days and weakened to a tropical storm. It then moved west making landfall on the Outer Banks of North Carolina and spreading rains and wind across Virginia. Tropical cyclone conditions were felt over eastern Virginia from August 30th through September 5th. The peak of the storm came on the 4th and 5th. A sustained wind of 52 mph was recorded at Langley Air Force Base with a peak gust of 76 mph. A F2 tornado (winds 113 to 157) touched down in the city of Hampton causing significant damage to a three block area and injuring six people. Six apartment complexes, an assisted living complex, and a nursing home were damaged causing 460 people to be evacuated. Four of those buildings were condemned. An estimated 800 vehicles were damaged. Tidal departures with the storm were about 3 feet above normal resulting in moderate coastal flooding at high tide. About 2 to 5 inches of rain fell resulting in some street flooding in southeast Virginia. Across the southern and central Piedmont into the mountains of Virginia about 4 to 7 inches of rain fell with as much as 9.5 inches at Montebello in Nelson County and Mill Creek Dam in Augusta County and 8.5 inches at Monterey in Highland County. Much of Virginia had been experiencing drought conditions prior to Dennis. Total damages from Dennis was estimated at \$8 million, mostly from the Hampton tornado.

September 15-16, 1999, Hurricane Floyd: Hurricane Floyd, at one time a large Category 4 storm, had weakened to a minimal hurricane as it reached Virginia. However, rain associated with Floyd began well in advance of the storm and intensified as the storm neared and crossed Virginia Beach on the 16th. Rainfall amounts averaged 10 to 20 inches across a 50 to 75 mile swath centered over interior southeast Virginia. Over 300 roads were closed in the peak of the storm from flooding and downed trees. Towns were completely isolated at times. The flooding caused damages to roads estimated at 30 to 40 million dollars. The hardest hit counties were Southampton, Sussex, Isle of Wight, and Surry. The city of Franklin experienced a record flood with 206 businesses impacted and numerous homes. Two people died in flooding in the state. The highest sustained wind recorded over land was only 46 mph at Langley Air Force Base with a gust to 63 mph. The James River Bridge recorded a wind gust of 100 mph. The saturated ground from Dennis and Floyd

combined with the wind and lead to trees uprooting and widespread power outages. Two people were killed by falling trees. One person in a car in Fairfax County and another in a mobile home in Paces, Virginia and a baby was injured. Tides reached almost 4 feet above normal in the Hampton Roads area. The greatest storm surge occurred on the back side of the storm as the wind shifted blowing out of the west across the Chesapeake Bay. Accomack County saw a surge of 5 to 7 feet flooding some homes with up to 6 feet of water. Total storm damage in Virginia reached \$255 million with 64 jurisdictions affected. Four people lost their lives directly related to the storm.

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